Hawaii State Department of Health

5-Year Regional Haze Progress Report For Federal Implementation Plan

Draft Report
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Halema'uma'u Crater, from Crater Rim Trail, Hawaii Volcanoes National Park, 5/2/2015, 2:15 PM

Volcanic Landscape, from Visitor Center (House of the Sun), Haleakala National Park, 7/1/2016, 2:32 PM

Executive Summary

In 1977, Congress amended the Clean Air Act (CAA) to include provisions of a national visibility goal to protect the scenic vistas of the nation's national parks and wilderness areas. In Section 169A of the CAA, Congress established the following national visibility goal:

> "The prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution."

On July 1, 1999, the Environmental Protection Agency (EPA) issued the Regional Haze Rule (RHR) to establish goals and emission control strategies that make reasonable progress towards improving visibility in Mandatory Federal Class I Areas. The goal of the RHR is to restore natural visibility conditions at all 156 Mandatory Federal Class I Areas by 2064. States are required to prepare Regional Haze State Implementation Plans (RH-SIPs) that provide long-term strategies for complying with the RHR. Hawaii's Mandatory Federal Class I Areas are Haleakala National Park on Maui Island and Hawaii Volcanoes National Park on the Big Island (Hawaii Island).

Since Hawaii was unable to submit the initial RH-SIP, the EPA developed a Regional Haze Federal Implementation plan (RH-FIP) that was promulgated on October 9, 2012. The RH-FIP established a total combined SO_2 emissions cap of 3,550 tons per year for three electric power plants in Hilo on the Big Island by December 31, 2018. Since one of these power plants shut down, only two plants are subject to the SO_2 emissions cap. The RH-FIP is for the first 2001-2018 regional haze planning period.

In accordance with 40 CFR §51.308(g), Hawaii must submit a progress report within five (5) years from submittal of the initial implementation plan. This report evaluates progress towards achieving the reasonable progress goal (RPG) for each National Park and is due by October 2017.

Significant reductions in sulfur dioxide (SO_2) and nitrogen oxide (NO_X) emissions have occurred during the first planning period. Point source emissions on Maui and Hawaii Islands, where the National Parks are located, have reduced significantly as a result of clean energy programs implemented by the state to mitigate greenhouse gas emissions.

Visibility has improved on the best and worst days at Haleakala National Park and Hawaii Volcanoes National Park. The five-year rolling average plot of haze index over this first planning period for Haleakala National Park reaches natural visibility conditions for the 20% best visibility days. A majority of the visibility degradation is due to the ongoing release of SO_2 from Kilauea volcano with emissions that vary by hundreds of thousands of tons from one year to another. Visibility improvement from significant reductions in Maui and Hawaii Island point source SO_2 is obscured by sulfate from natural volcanic SO_2 that overwhelms sulfate from anthropogenic SO_2 sources.

The estimated visibility impairment at Haleakala National Park and Hawaii Volcanoes National Park from anthropogenic sources was shown to be generally among the very lowest in the nation. Since the IMPROVE program has not yet developed calculation procedures for uncertainties associated with the Visibility Impacting Parameter values, it is unclear if or to what extent visibility impairment due to anthropogenic sources exceeds the uncertainty. In addition to uncertainties due to measurement, those resulting from data replacement should be included. Validated uncertainty estimation protocols are needed for the Hawaii IMPROVE monitoring Visibility Impacting Parameter values to ensure that future compliance approaches are needed and justifiable.

The Hawaii Department of Health Clean Air Branch (DOH-CAB) has determined that control strategies in the existing Regional Haze Plan are adequate for Hawaii to meet the 2018 reasonable progress goals. The DOH-CAB is also providing to EPA a negative declaration that further revision of the existing implementation plan is not needed at this time.

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List of Acronyms and Definitions	
Aerosols	Suspensions of tiny liquid and/or solid particles in the air
AirSHED	Emissions Inventory System Software from Lakes Environmental
Asian Dust	A meteorological phenomenon which affects must of East Asia. The dust originates in the deserts of Mongolia, northern China and Kazakhstan where high winds and intense dust storms kick up dense clouds of fine dry soil particles. The clouds are then carried eastward by prevailing winds.
BART	Best Available Retrofit Technology
b_{ext}	Reconstructed Light Extinction
CAA	Clean Air Act
CALPUFF	Transport and Dispersion Model
CFR	Code of Federal Regulations
CM	Coarse Mass
CT	Combustion Turbine
CY	Cubic Yard
DEG	Diesel Engine Generator
DOH-CAB	Department of Health Clean Air Branch (State of Hawaii)
dv	Deciview, a measurement of visibility impairment
EC	Elemental Carbon
EEPS	Energy Efficiency Portfolio Standard
EGUs	Electric Generating Units
EIS	EPA's Emissions Inventory System
EPA	US Environmental Protection Agency
ESP	Electrostatic Precipitator for particulate control
FIP	Federal Implementation Plan
FITR	Fuel Injection Timing Retard for NO_X control
FLM	Federal Land Manager
ft	Feet
gal	gallon
GHG	Greenhouse Gas
Glidepath	The linear rate of improvement sufficient to attain natural conditions by 2064.
GWh	Gigawatt Hour (unit of electrical energy)
HACR1	Haleakala Crater Visibility Monitoring Site
HALE1	Haleakala Visibility Monitoring Site Outside Haleakala National Park
HAVO1	Hawaii Volcanoes National Park Visibility Monitoring Site
HELCO	Hawaiian Electric Light Company
HI	Haze Index
hr	Hour
IMPROVE	Interagency Monitoring of Protected Visual Environments
kW	Kilowatt
m	meter
MECO	Maui Electric Company

List of Acronyms and Definitions	
MVA	Megavolt Amp
MW	Megawatt
NA ECA	North American Emissions Control Area
NH_3	Ammonia
NO_X	Nitrogen oxides
NP	National Park
NPS	National Park Service
OC	Organic Carbon
$PM_{2.5}$	Particulate matter less than or equal to 2.5 micrometers in diameter
PMF	Positive Matrix Factorization
POM	Particulate Organic Mass
PSIP	Power Supply Improvement Plan
RH	Regional Haze
RHR	Regional Haze Rule
RPG	Reasonable Progress Goal
RPS	Renewable Portfolio Standard
SCR	Selective Catalytic Reduction for NO_X control
SIP	State Implementation Plan
SLEIS	State and Local Emissions Inventory System Software from Windsor Solutions.
SO_2	Sulfur dioxide Gas
SNCR	Selective Non-catalytic Reduction for NO_X control
SUV	Sport Utility Vehicle
TPY	Tons per year
ULSD	Ultra Low Sulfur Diesel
USDI	US Department of Interior
USDI-NSP	US Department of Interior – National Park Service
USGS-HAVO	United States Geological Survey Hawaii Volcano Observatory
VOC	Volatile organic compound
Vog	This is a local term that refers to “volcanic smog” or a hazy air pollution condition attributed to the active volcano.
Water Injection System	A system that injects demineralized water into the turbine generator’s combustion chamber to reduce the formation of thermal NO_X.
WESTAR	Western States Air Resources Council
WRAP	Western Regional Air Partnership
yr	Year

1.0 Introduction

Regional haze causes visibility impairment over a large region primarily from sources that emit fine particulate ($PM_{2.5}$) and its precursors into the air. Fine particulate that absorb and scatter light to cause the haze include sulfates, nitrates, organic carbon, elemental carbon, soil dust, and sea salt. Sources of particulate can be man-made (anthropogenic) or from natural events. Anthropogenic emissions from Hawaii sources include primary (directly emitted) $PM_{2.5}$ such as fugitive dust from aggregate processing or road dust from vehicle travel on unpaved roads. Natural emissions of primary $PM_{2.5}$ include aerosolized salts from sea spray. Precursors of $PM_{2.5}$, such as SO_2, NO_X, NH_3, and VOCs, can also react in the atmosphere to form secondary $PM_{2.5}$. For example, Kilauea volcano on the Big Island (Hawaii) emits extremely large quantities of natural SO_2 as a secondary $PM_{2.5}$ source. Volcanic SO_2 emissions create vog when SO_2 reacts with sunlight and constituents in the air to form secondary sulfate aerosols (fine particulates) that cause haze on the Big Island and on other islands hundreds of miles away. Other sources of visibility impairing pollutants include primary and secondary particulate from combustion (e.g., electric and industrial plants, motor vehicles, agricultural burning, wildfires, etc.).

Pursuant to Section 169A of the 1977 CAA amendments for addressing Regional Haze, goals were established to protect visibility in 156 National Parks and wilderness areas designated by Congress as Mandatory Federal Class I Areas (see Figure 1.1-1).[1] To meet these goals, the Regional Haze Rule (RHR) was established that requires State Implementation Plans (SIPs) to address visibility in Mandatory Federal Class I Areas.

1.1 Regional Haze Rule

The primary purpose of the RHR is to assure reasonable progress toward meeting the national goal of preventing any future, and remedying any existing, impairment of visibility in Mandatory Federal Class I Areas from manmade air pollution.[2] Under the RHR, states develop implementation plans with long-term strategies for protecting visibility in Class I Areas. Requirements from the RHR are specified in 40 CFR Part 51, Subpart P, Protection of Visibility.[2] The objective of the rule is to improve the visibility on the 20% most impaired (haziest or worst) days at each Class I Area, and protect the visibility in these areas on the 20% least impaired (best) days. The ultimate goal from implementing the RHR is to achieve natural visibility conditions in Class I Areas by 2064. In accordance with 40 CFR §51.308(f), Hawaii must submit its comprehensive Regional Haze implementation plan revision by July 31, 2018 and every ten (10) years thereafter.

On January 10, 2017, the EPA finalized amendments to the RHR, which specify actions that states must take when submitting regional haze SIPs and progress reports.[3] Included in the revisions is an adjustment to the due date for the next SIP revisions from 2018 to 2021.[3] Another change is that subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter.[3]

[1] See https://www.epa.gov/visibility/visibility-regional-haze-program.

[2] 40 CFR, Part 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans, Subpart P, Protection of Visibility.

[3] Federal Register, Vol. 82, No. 6, January 10, 2017, 40 CFR Parts 51 and 52, Protection of Visibility: Amendments to Requirements for State Plans; Final Rule.

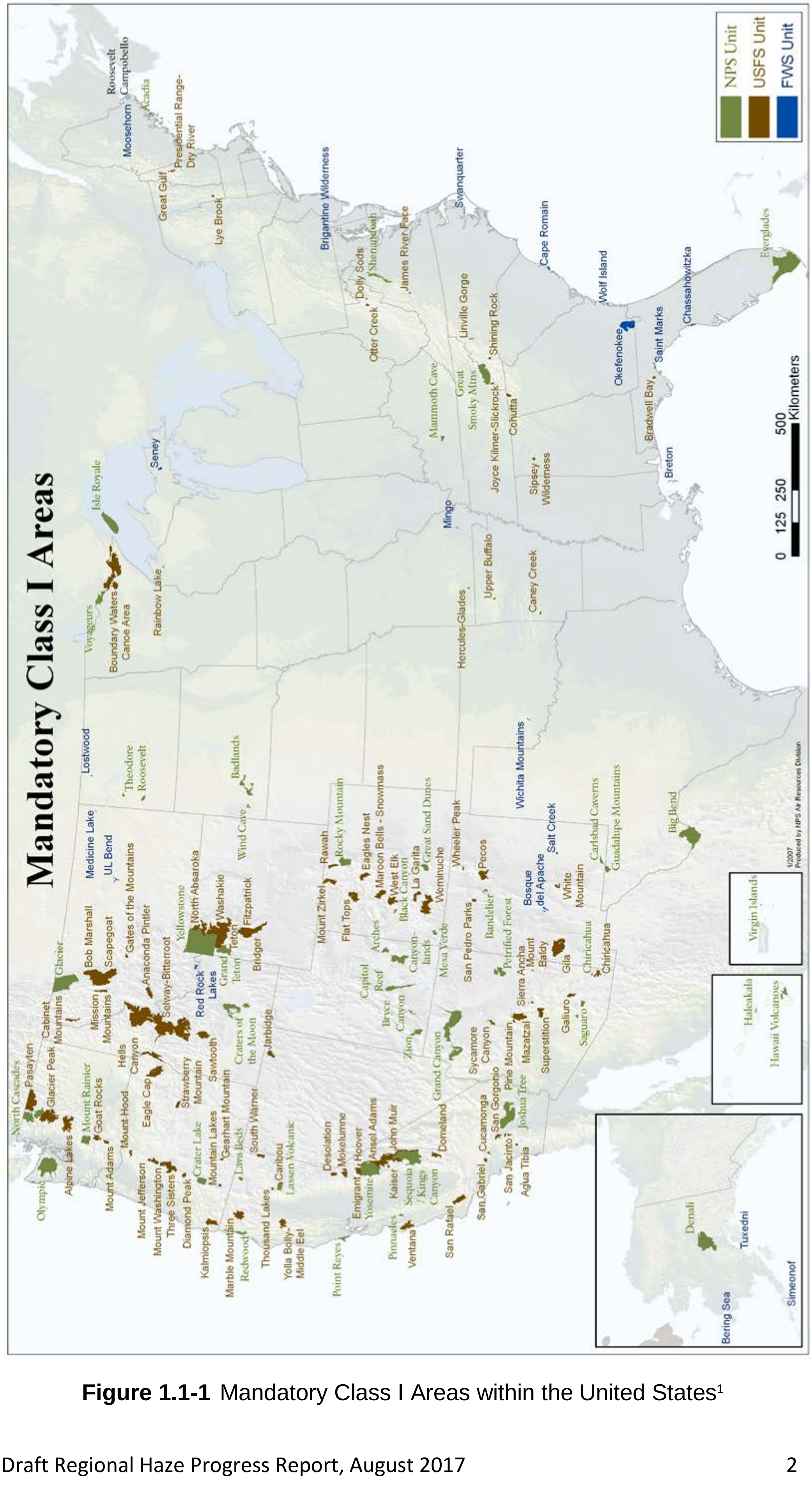

Figure 1.1-1 Mandatory Class I Areas within the United States[1]

1.2 Hawaii's Class I Areas

Hawaii's two Mandatory Federal Class I Areas are Haleakala National Park on Maui and Hawaii Volcanoes National Park on the Big Island (Hawaii). As indicated in Note 3 on Page 1-3 of Reference 4 below, Class I areas include certain National Parks (over 6,000 acres), wilderness areas and national memorial parks (over 5,000 acres), and international parks which existed as of August 1977.[4] Table 1.2-1 below provides information on the acreage of Hawaii's two National Parks (one on Maui and the other on the Big Island). The National Parks are shaded in green in Figures 1.3-1 and 1.3-2.

Table 1.2-1 Hawaii's Class I Areas

Class I Area	Island	Federal Land Manager[5]	Acreage[5]
Haleakala National Park	Maui	NPS	33,265
Volcanoes National Park	Hawaii	NPS	229,616

1.3 Hawaii's IMPROVE Monitoring Sites

Visibility is measured at Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites to track Regional Haze progress. The HALE1 IMPROVE monitor, identified with blue dot in Figure 1.3-1, began operation on Maui in 1990 at a site approximately 3.5 miles outside of Haleakala National Park.[5,6] In 2007 a second IMPROVE monitor (HACR1 identified with pink dot in Figure 1.3-1) was installed at a higher elevation within Haleakala National Park.[6] The HACR1 IMPROVE site was considered more representative of visibility conditions within Haleakala National Park and replaced the HALE1 monitoring station in 2012.[6] The HAVO1 Hawaii Volcanoes National Park IMPROVE monitor started operation on the Big Island in 1988 and is identified with yellow dot in Figure 1.3-2. Topographical maps with IMPROVE monitoring sites, MesoWest weather observation locations, elevations, and mountain peaks for Maui and Hawaii Island are provided in Appendix B. Table 1.3-1 below provides additional information on the IMPROVE monitoring sites.

Table 1.3-1 Hawaii's IMPROVE Monitoring Stations

Class I Area	IMPROVE Site	Island	Location[6]		Elevation[6]	
			Latitude	Longitude	m	ft
Haleakala NP	HACR1*	Maui	20.7585	-156.2479	2,158	7,080
	HALE1**	Maui	20.8086	-156.2823	1,153	3,783
Hawaii Volcanoes NP	HAVO1	Hawaii	19.40309	-155.2579	1,259	4,130

* Monitoring at HACR1 began in 2007.
**Monitoring at HALE1 site was discontinued in 2012.

[4] Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule, U.S. EPA, September 2003.
[5] Federal Land Manager Environmental Database http://views.cira.colostate.edu/fed/DataWizard/Default.aspx.
[6] WRAP Regional Haze Rule Reasonable Progress Summary Report, June 28, 2013; Appendix A.

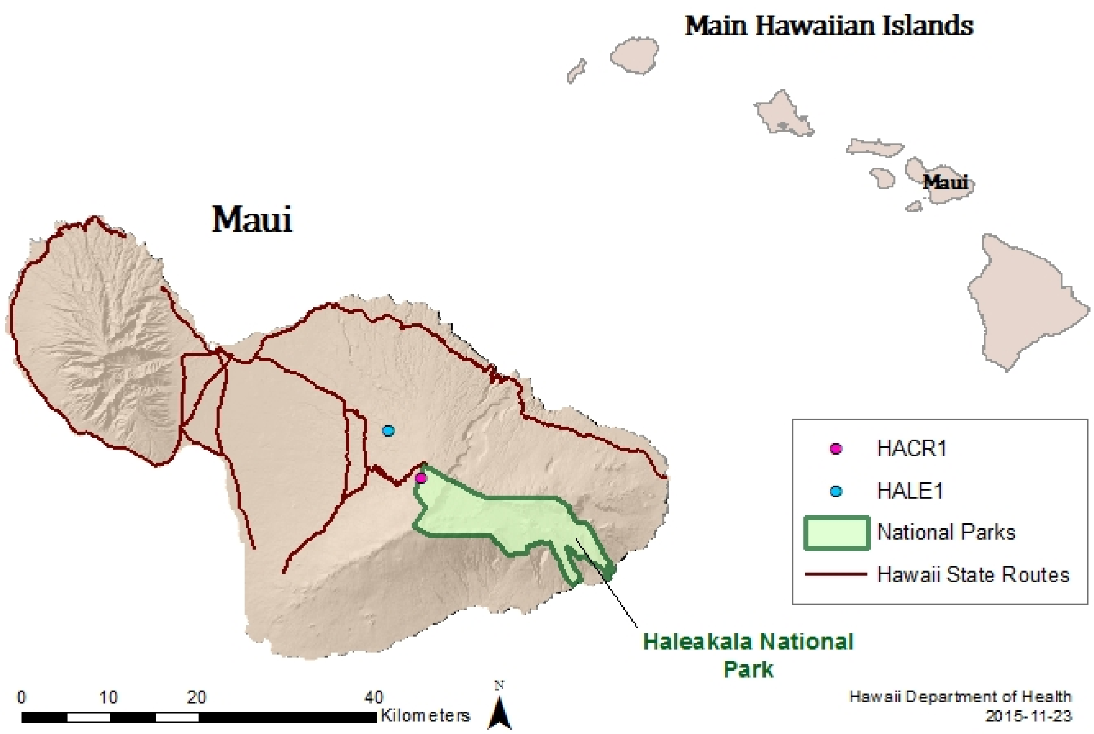

Figure 1.3-1 Haleakala National Park Visibility Monitoring Sites
(IMPROVE Sites HALE1 and HACR1)

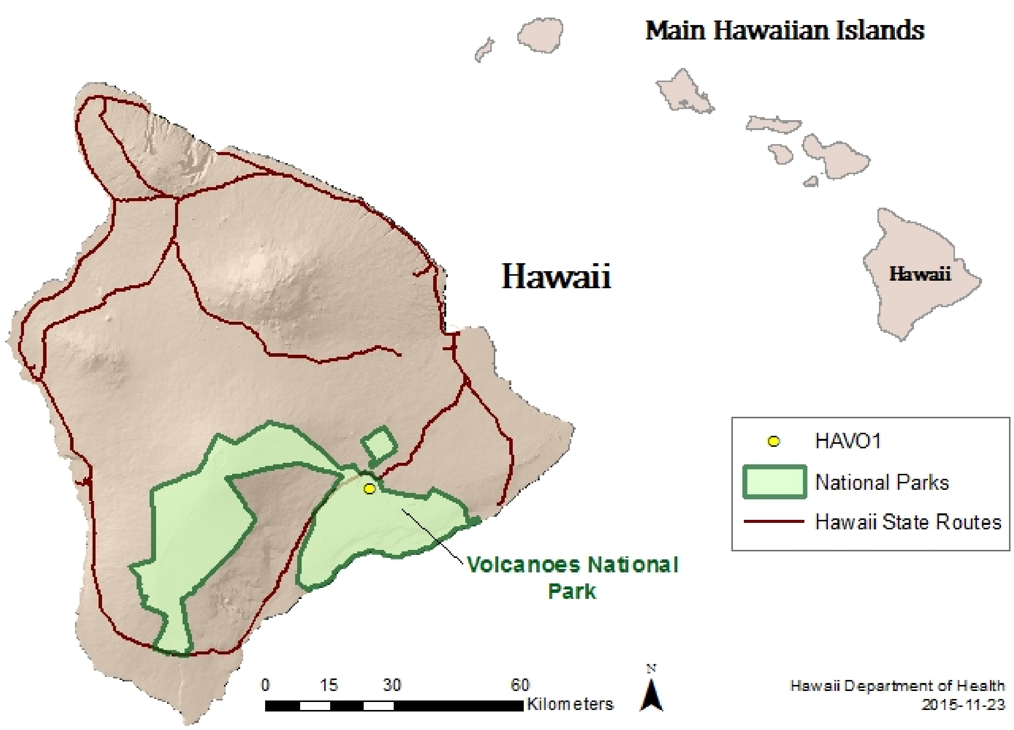

Figure 1.3-2 Volcanoes National Park Visibility Monitoring Sites
(IMPROVE Site HAVO1)

1.4 Estimating Visibility Impairment

Particles and gases in the atmosphere can both absorb and scatter light. The absorption and scattering of light result in light extinction (visibility impairment between the viewer and the light source) creating haze.

To determine compliance under the RHR, each IMPROVE monitor collects 24 hour particulate samples every three (3) days on a set of particulate filters to identify the chemical constituents causing visibility impairment at the site.[7] The particulate concentration data is converted into reconstructed light extinction ("b_{ext}") in units of inverse mega meters (Mm^{-1}) with the IMPROVE equation.[8] The IMPROVE equation is used to convert the measured or modeled concentrations into extinction for each pollutant chemical species and totals the extinction values accounting for the effect of relative humidity.[8] The equation also accounts for the Rayleigh scattering that occurs in pure air.[8] The IMPROVE equation, that was revised in December 2005, is listed below in Figure 1.4-1.

$$
\begin{aligned}
b_{ext} = \;& 2.2 \times f_s(RH) \times [\text{small sulfate}] + 4.8 \times f_L(RH) \times [\text{large sulfate}] \\
& + 2.4 \times f_s(RH) \times [\text{small nitrate}] + 5.1 \times f_L(RH) \times [\text{large nitrate}] \\
& + 2.8 \times [\text{small organic mass}] + 6.1 \times [\text{large organic mass}] \\
& + 10 \times [\textit{elemental carbon}] \\
& + 1 \times [\textit{fine soil}] \\
& + 1.7 \times f_{ss}(RH) \times [\text{sea salt}] \\
& + 0.6 \times [\textit{coarse mass}] \\
& + \text{Rayleigh scattering (site specific)} \\
& + 0.33 \times [NO_2 \text{ (pbb)}]
\end{aligned}
$$

Figure 1.4-1 Revised IMPROVE Equation[8]

Bracketed items in the IMPROVE equation are the measured concentrations in ug/m^3 of the particulate constituents collected by the IMPROVE monitoring station.[8] The f(RH) is a water growth factor for sulfate and nitrate, that are hygroscopic (these particles tend to attract water).[8] The f_s, f_L, and f_{ss} parameters are water growth factors for small ("s") and large ("L") fractions of sulfate and nitrate, and for sea salt ("ss").[8]

1.5 Measures of Visibility

Parameters for evaluating visibility include light extinction - b_{ext}, haze index (HI) in units of dv, and visual range in units of kilometers or miles. Reference 8 disclosed the following information for these parameters:

Light Extinction (b_{ext}) – This parameter is the attenuation of light due to scattering and absorption as it passes through a medium. Light extinction is the most useful parameter for evaluating the relative contributions of pollutants to visibility impairment. Light extinction affects the clarity and color of the object being viewed.

Haze Index (deciview) – This parameter is required by the RHR for tracking visibility conditions. Generally, a one deciview change in the haze index is likely humanly perceptible under ideal conditions. The deciview is a useful measure for tracking

[7] Guidance for Tracking Progress Under the Regional Haze Rule, U.S. EPA, September 2003.

[8] Technical Support Document for the Proposed Action on the Federal Implementation Plan for the Regional Haze Program in the State of Hawaii, U.S. EPA Region 9, May 14, 2012.

progress in improving visibility because each deciview change is an equal incremental change in visibility perceived by the human eye from pristine to highly impaired.

Visual Range – This parameter is the greatest distance, in kilometers or miles, at which a dark object can be viewed against the sky.

Relationships between extinction (Mm^{-1}) or ($10^{-6}m^{-1}$), haze index (dv), and visual range (km or mi) are as follows:

1. There is a logarithmic range between the haze index (dv) and reconstructed light extinction (Mm^{-1}) expressed by the following equation:

   $HI = 10\ \ln(b_{ext}/10)$

2. The relationship between extinction (Mm^{-1}), haze index (dv), and visual range (km) is provided in Figure 1.5-1.

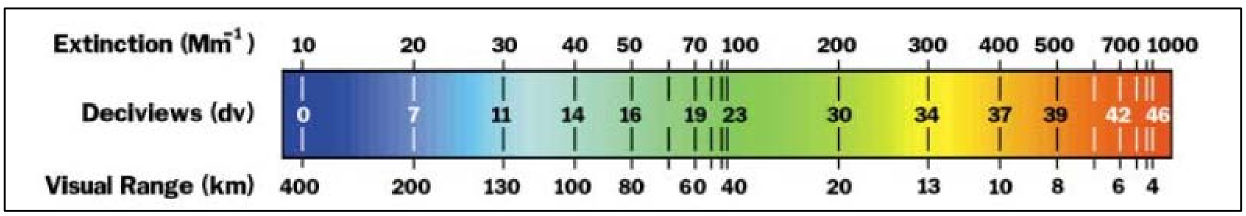

Figure 1.5-1 Comparison of Extinction, Deciview, and Visual Range[9]

1.6 Natural, Baseline, and Current Visibility Conditions

For each Class I Area, the following three (3) visibility conditions are part of the determination of reasonable progress:

Natural Visibility – As defined in Reference 3, natural visibility conditions mean visibility (contrast, coloration, and texture) that would have existed under natural conditions. Natural visibility conditions vary with time and location, and are estimated or inferred rather than directly measured. For Hawaii, natural visibility value estimations for 2064 do not include an estimate of the visibility impairment from Kilauea volcano emissions.[8]

Baseline Visibility – Baseline visibility is the starting point for the improvement of visibility conditions. Pursuant to 40 CFR 51.308(d)(2)(i), the period for establishing baseline visibility conditions is 2000 to 2004. Also, baseline visibility conditions must be calculated, using available monitoring data, by establishing the average degree of visibility impairment for the most and least impaired days for each calendar year from 2000-2004.

Current Visibility – Current visibility conditions are assessed every five (5) years as part of the SIP review where actual progress in reducing visibility impairment is compared to the reductions committed to in the SIP.[3] According to what is proposed for 40 CFR §51.308(f)(1)(iii) in Reference 3, current visibility conditions must be calculated based on the annual average level of visibility impairment for the most impaired and clearest days for each of these five (5) years.

[9] William C. Malm, Introduction to Visibility, May 1999.

1.7 Uniform Rate of Progress

Pursuant to Reference 10, the Uniform Rate of Progress (URP) is the calculation of the uniform slope, or glide path, of the line between the baseline visibility conditions over the 60-year period.[10] By comparing baseline conditions with natural conditions, the uniform rate of visibility improvement, or progress, needed to reach natural conditions by 2064 can be determined for each Class I area.[10] For example, in Figure 1.7-1 below, the 20% worst visibility baseline condition is 29 dv and the natural visibility condition is 11dv. Therefore, the URP is 4.2 dv over the first planning period. This is equivalent to 0.3 dv per year over a 14 year time frame. The 4.2 dv value is determined as follows: 18 dv/60 yr = 14yr/ x dv, x = 18 dv/60 yr x 14 yr = 4.2 dv.

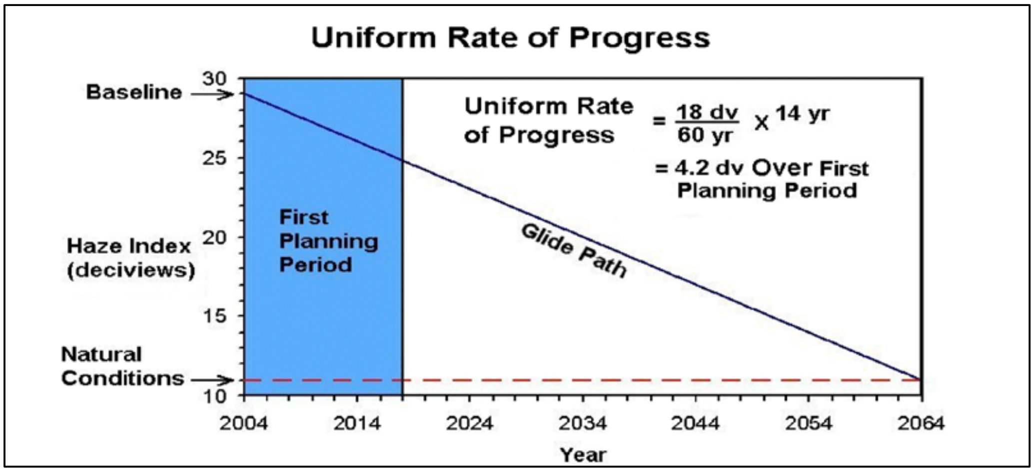

Figure 1.7-1 Uniform Rate of Progress Example[10]

1.8 Regional Haze Rule Progress Report

Hawaii's requirements for 5-year reports describing progress towards the reasonable progress goals (RPGs) for each of its two Class I Areas are specified in 40 CFR §51.308(g). The first progress report for Regional Haze is due on October 12, 2017 which is five (5) years from EPA's issuance of Hawaii's Regional Haze FIP in October of 2012. Pursuant to Reference 2, the progress report must contain, at a minimum, the following elements:

(1) A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal Areas both within and outside the state.
(2) A summary of the emissions reductions achieved throughout the State through implementation of the measures described in Paragraph 40 CFR §51.308(g)(1).
(3) Address the following visibility conditions and changes, with values for most impaired and least impaired days expressed in terms of 5-year averages of these annual values for each mandatory Class I Federal area:

i. The current visibility conditions for the most impaired and least impaired days;
ii. The difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions; and

[10] Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program, U.S. EPA, June 1, 2007.

iii. The change in visibility impairment for the most impaired and least impaired days over the past five (5) years.

(4) An analysis tracking the change over the past five (5) years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State.
(5) An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred over the past five (5) years that have limited or impeded progress in reducing pollutant emissions and improving visibility.
(6) An assessment of whether the current implementation plan elements and strategies are sufficient to enable the State to meet all established reasonable progress goals.
(7) A review of the State's visibility monitoring strategy and any modifications to the strategy as necessary.

At the same time the 5-year progress report is submitted to EPA, the state must review the adequacy of the existing implementation plan in accordance with 40 CFR §51.308(h) and revise if necessary. If there are no revisions, the state must include a negative declaration that no further revisions of the implementation plan are needed.

2.0 Status of Implementing Control Measures - 40 CFR §51.308(g)(1)

Section 2 of this report provides the status of control measures in the RH-FIP to achieve reasonable progress goals (RPGs) during the first planning period and provides a list of source shutdowns. Since sulfate was the primary cause of visibility impairment in Hawaii's two Class I Areas, EPA focused on significant point sources of SO_2 from Maui and the Big Island where the Class I Areas are located. Emissions of NO_X as a nitrate precursor were a secondary concern. Please refer to Figures 2.0-1 and 2.0-2 showing the location of point sources on Maui and the Big Island, respectively, in relation to monitoring stations, airports, and roads. A description of these sources is provided in Tables 2.0-1 and 2.0-2.

Modeling found that sources on the Island of Oahu, where economic activity and anthropogenic emissions are concentrated, did not significantly impair visibility in the Class I Areas. For example, Kahe Generating Station on Oahu, one of the largest emitters in the state with total combined SO_2 and NO_X emissions exceeding 11,500 TPY at the time of the modeling assessment, had relatively small visibility impact (0.221 deciview change on the Haleakala HALE1 visibility monitor).[8] Kahe Generating Station is approximately 122 miles and 128 miles from the HALE1 and HARC1 monitors, respectively, and about 230 miles from the HAVO1 monitor. Significant factors limiting visibility impact from the Oahu sources are the distance of these sources from the visibility monitors, location of visibility monitors that are southeast of Oahu, and prevailing trade winds from the northeast that transport pollutants from Oahu to the southwest away from the Class I Areas a majority of the time. Therefore, EPA focused its reasonable progress analysis on the islands of Maui and Hawaii where the Class I Areas are located. Please refer to Figure 2.0-3 with wind data from Honolulu International Airport, Molokai Airport, and Kahului International Airport showing predominate northeast trade winds for these islands between 2013 and 2015. This arbitrarily selected wind data is provided in Appendix C.

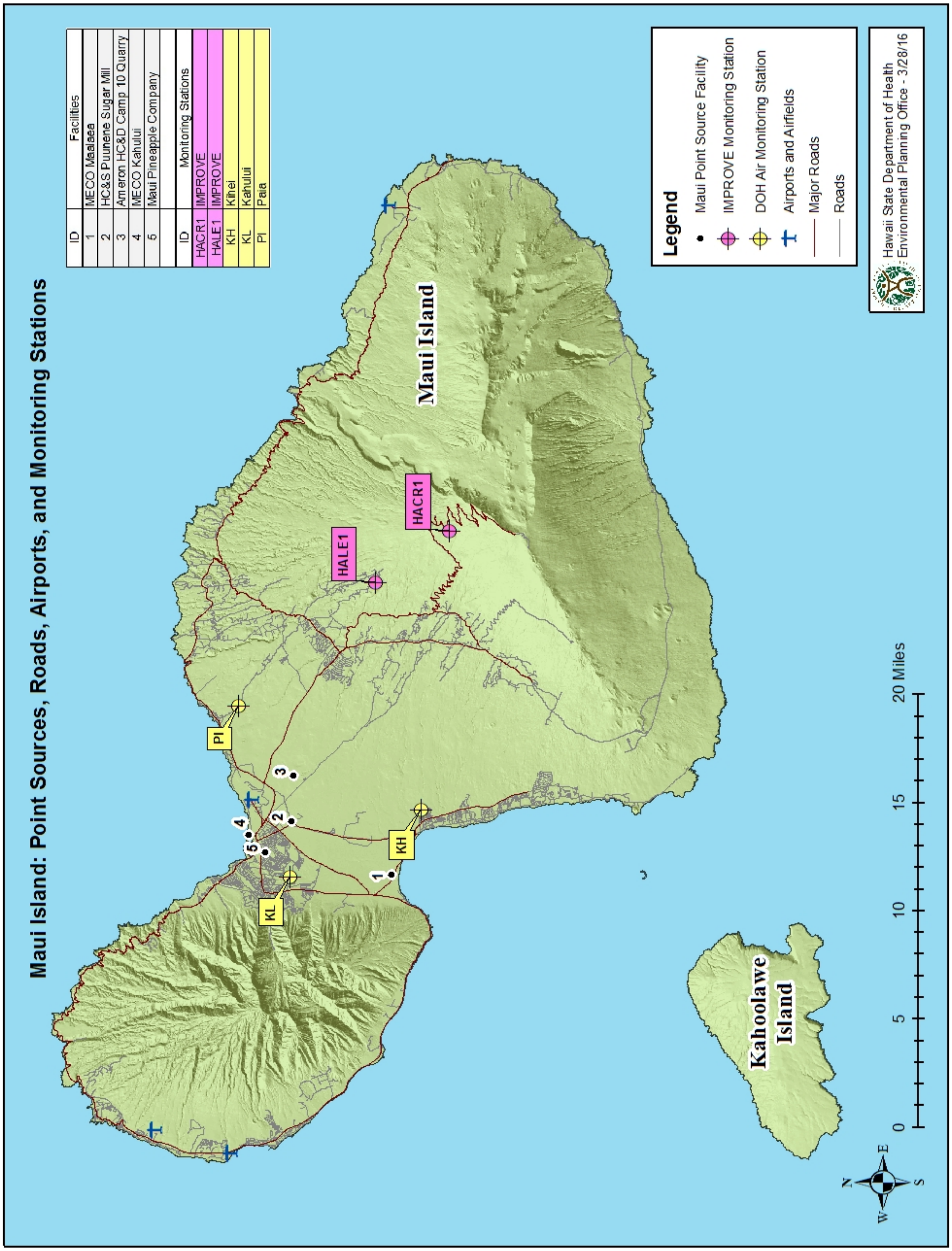

Figure 2.0-1 Point Sources on Maui Island

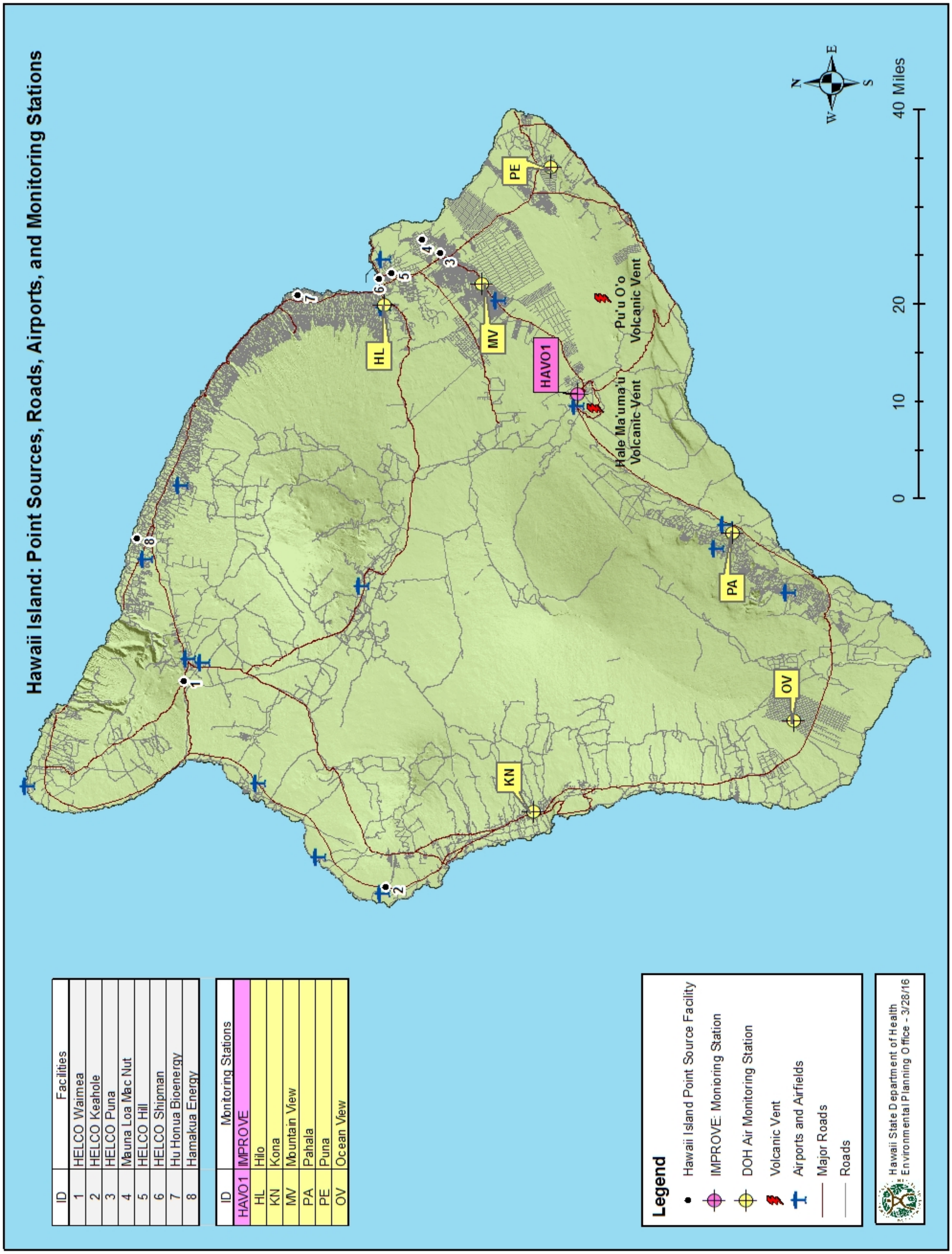

Figure 2.0-2 Point Sources on Big Island

Table 2.0-1 Point Sources on Maui Island						
No.	Facility	Type	Equipment	Distance From Station (miles)		
				HACR1	HALE1	HAVO1
1	MECO Maalaea Plant	Electric Generation	Two 20 MW CTs with Water Injection and Two 5.6 MW DEGs with Oxidation Catalyst Under CSP No. 0067-01-C. Three 2.5 MW DEGs with Oxidation Catalyst, Two 2.5 MW DEGs with FITR and Oxidation Catalyst, Two 12.5 MW DEGs with Oxidation Catalyst, Two 12.5 MW DEGs with FITR and Oxidation Catalyst, Four 5.6 MW DEGs with Oxidation Catalyst, One 600 kW Black Start DEG, and Two 20 MW CTs with Water Injection Under CSP No. 0067-02-C.	16.1	13.6	124.9
2	HC & S Puunene Sugar Mill	Sugar Cane Cleaning & Processing	Two (2) 212 MMBtu/hr Biomass/Oil/Coal Boilers with Multicyclone and Venturi Scrubber and One 568 MMBtu/hr Biomass/Oil/Coal Boiler with Multicyclone.	15.3	11.8	126.4
3	Ameron HC& D Camp 10 Quarry	Aggregate & Concrete Processing	600 TPH Stone Processing Plant and 120 CY/hr Concrete Batch Plant with Water Sprays and Cement Silo Baghouses.	13.2	9.6	125.1
4	MECO Kahului	Electric Generation	Two 5.0 MW Boilers, One 11.5 MW Boiler, and One 12.5 MW Boiler.	16.7	13.1	128.9
5	Maui Pineapple Company	Canned Fruit and Selling Power	Two 1,305 kW DEGs, Two 1,970 kW DEGs, Two 36.7 MMBtu/hr Boilers, and Three 47.5 MMBtu/hr Boilers.	17.0	13.2	128.7

Table 2.0-2 Point Sources on Big Island						
No.	Facility	Type	Equipment	Distance From Station (miles)		
				HACR1	HALE1	HAVO1
1	HELCO Waimea	Electric Generation	Three 2.5 MW DEGs with Oxidation Catalyst.	61.3	65.5	51.4
2	HELCO Keahole Plant	Electric Generation	Two 20 MW CTs with water injection and SCR, One 18 MW CT with FITR, Three 2.5 MW DEGs with FITR and Oxidation Catalyst, and 500 kW Black Start DEG.	72.2	76.0	54.8
3	HELCO Puna Plant	Electric Generation	20 MW CT with Water Injection, 600 kW DEG, and 15 MW Boiler.	110.8	114.9	21.3
4	Mauna Loa Macadamia Nut	Macadamia Nuts and Chocolates	35.7 MMBtu/hr Oil/Biomass fired Boiler with ESP, 350 hp Boiler, and Two 460 hp DEGS.	110.6	114.6	23.8
5	HELCO Kanoelehua Hill Plant	Electric Generation	11.6 MW CT, 14.1 MW Boiler, 23 MW Boiler, 2.0 MW DEG with Oxidation Catalyst, and Three 2.75 MW DEGs with Oxidation Catalyst.	105.8	110.0	24.3
6	HELCO Shipman Plant	Electric Generation	7.5 MW Boiler and 7.7 MW Boiler.	104.3	108.7	25.2
7	Hu Honua BioEnergy	Electric Generation	407 MMBtu/hr Boiler with Lime Injection, SNCR, and ESP.	98.0	101.9	32.5
8	Hamakua Energy	Electric Generation	Two 20 MW CTs with Water Injection and SCR and 1,250 hp Black Start DEG.	68.2	72.2	49.3

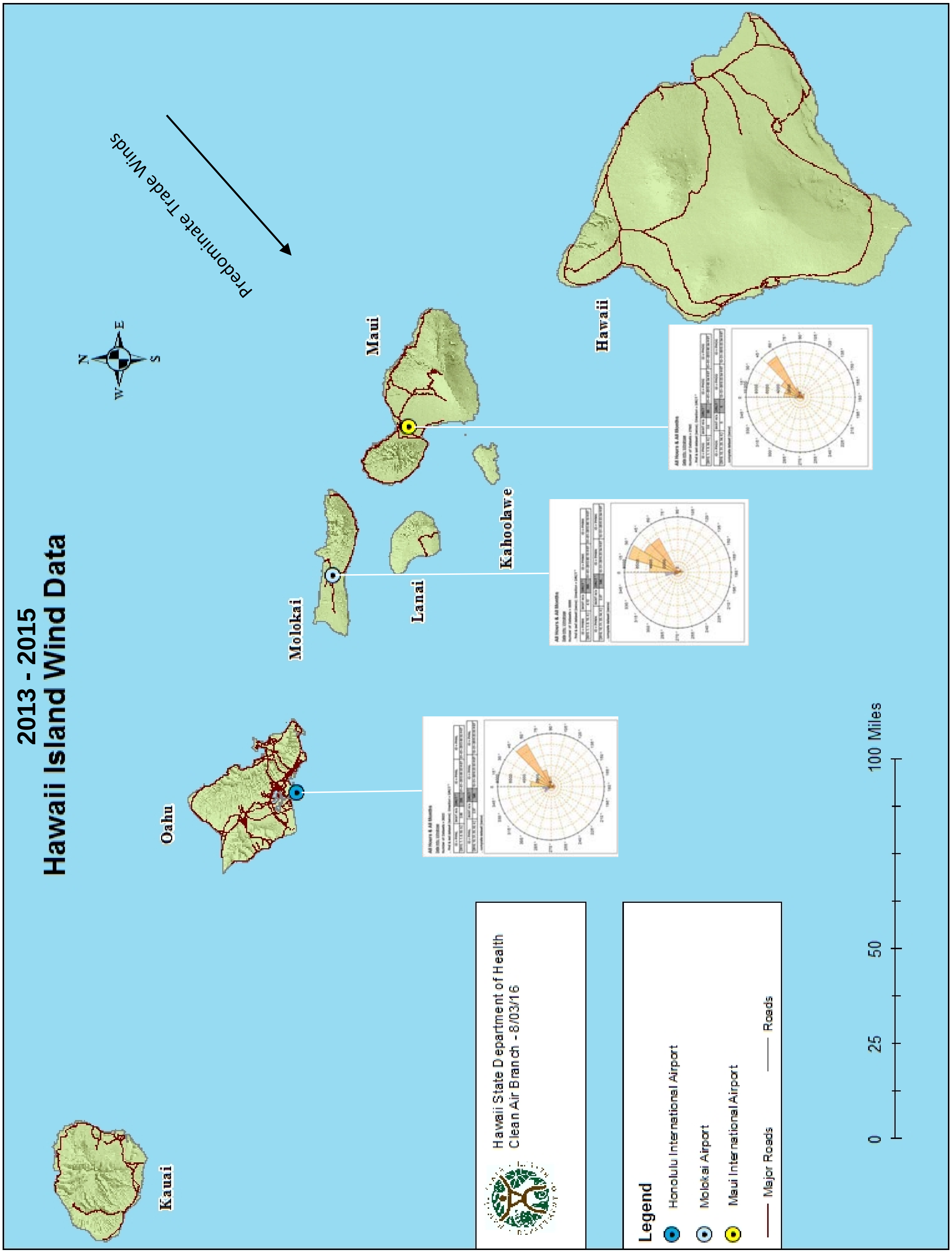

Figure 2.0-3 2013 -2015 Wind Data for Oahu, Molokai, and Maui Islands

2.1 Major Control Measures in RH-FIP

Various control measures were addressed in the TSD for Hawaii's Regional Haze FIP. Table 2.1-1 below lists the control measures for achieving the reasonable progress goals during the first Regional Haze planning period (2001-2018).

Table 2.1-1 Major Control Measures in Hawaii RH-FIP

Control Measure	Description of Control Measure	Effective Date of Measure(s)
SO_2 Emissions Cap Specified by RH FIP	The Regional Haze FIP specifies an SO_2 emissions cap for three generating stations on the Hilo side of the Big Island not to exceed 3,550 tons of SO_2 per year as the sum of the total of five affected units for these plants over a rolling twelve (12) month period.	On and After December 31, 2018
Hawaii's Renewable Portfolio Standard (RPS)*	Replace electric generated from burning fossil fuel with renewable energy.	10% RPS by December 31, 2010 15% RPS by December 31, 2015 25% RPS by December 31, 2030 100% RPS by December 31, 2045
Hawaii's Energy Efficiency Portfolio Standard (EEPS)*	Increasing demand side energy efficiency to reduce electric generation from fuel oil combustion.	4,300 GWh electricity savings by December 31, 2030
NA ECA	The United States together with Canada and France established the NA ECA under the auspices of Annex VI of the International Convention for the Prevention of Pollution from Ships; a treaty developed by the International Maritime Organization. This NA ECA applies to ships operating 200 nautical miles of the majority of the U.S. and Canadian coastline, including the U.S. Gulf Coast and Hawaii.	August 2012
Federal Mobile Source Regulations	Non-road Mobile Diesel Emissions Program. Tier 2 Vehicle and Gasoline Program. 2007 Heavy-Duty Highway Rule. Tier 3 Vehicle and Gasoline Program.	2004 2004 2007-2010 2017
Hawaii's Agricultural Open Burning Regulations	HAR, Section 11-60.1 Subchapter 3. Open Burning includes agricultural, residential, and prescribed burning.	Existing
BART	Applicable to certain large stationary sources that have been in operation between 1962 and 1977. A stationary source is BART eligible if 1) it belongs to one of 26 BART source categories; 2) has emission units which were in existence on August 7, 1977, but not in operation before 1962; and 3) has total combined emission units with the potential to emit more than 250 tons per year of any single visibility-impairing pollutant (SO_2, NO_X, and PM).	No Additional Controls Required.

* State implements requirements as a matter of State Law. Noncompliance penalty is at the discretion of the Hawaii PUC which can assess penalties.

2.2 Major Control Measure Status

The status of control measures listed in Table 2.1-1 are provided below.

SO_2 Emissions Cap (RH-FIP)

Based on the reasonable progress analysis in Reference 8, an SO_2 emissions cap is being incorporated into air permits for Hilo power plants on the Big Island under permit renewal applications for these facilities in accordance with 40 CFR Part 52, Subpart M. In Subpart M, the affected EGUs shall not emit or cause to be emitted SO_2 in excess of a total of 3,550 tons per year, calculated as the sum of the total for five (5) units over a rolling twelve (12) month period. Affected units are Kanoelehua Hill Generating Station, Boilers Hill 5 and Hill 6; Puna Power Plant, Boiler 1; and Shipman Power Plant, Boilers S-3 and S-4. These plants are #3, #5, and #6 in Figure 2.0-2 and Table 2.0-2 for the Puna, Hill, and Shipman plants, respectively. The primary fuel for these plants is fuel oil No. 6 fired by large boilers. Since the Shipman Power Plant permanently discontinued operations on December 31, 2015, the SO_2 emissions cap only applies to the Puna and Kanoelehua Hill Generating Stations.

Hawaii's RPS & EEPS

Hawaii has aggressive renewable energy and energy efficiency programs for mitigating greenhouse gas (GHG) emissions that have reduced the need to generate power from Hawaiian Electric's steam units including those on the Big Island and Maui where the Federal Class I Areas are located. Measures to control GHGs also reduce other pollutants such as SO_2 and NO_x by reducing the need to burn fossil fuel for generating power. The SO_2 and NO_X emitted by power plants react to form fine particulate (sulfates and nitrates) that cause haze and were pollutants of concern in Hawaii's RH-FIP.

As indicated by HECO at a May 2, 2017 meeting, an E3 plan in the PSIP will be used as the preferred plan for MECO to achieve 100% renewable energy for Maui Island by 2045. This plan includes battery storage for firm capacity needs, high amounts of renewable resources including grid-scale PV and grid-scale wind, a new 30 MVA synchronous condenser in 2019 to provide reactive power/voltage support and fault current, and a new 16 MVA synchronous condenser in 2022, before Kahului Power Plant is retired in 2024.[11]

As indicated in a May 2, 2017 meeting with HECO, an E3 plan in the PSIP will be used as the preferred plan for HELCO to achieve 100% renewable energy for Hawaii Island by 2045. The plan includes a fast frequency reserve-1 of 9 MW in 2019, a new 25 MVA synchronous condenser, and 59 MW of distributed grid-scale renewable energy capacity (e.g., grid scale wind and solar), increasing the total renewable energy capacity to 235 MW.[11]

[11] Hawaiian Electric Companies' PSIPs Update Report, Filed December 23, 2016.

North American Emissions Control Area (NA ECA)

The NA ECA, which became enforceable in August 2012, regulates NO_X, SO_2, and $PM_{2.5}$ emissions from ships. The NA ECA includes waters adjacent to the Pacific coast, the Atlantic/Gulf coast, and the eight main Hawaiian Islands.[12] Emissions control area standards involve reductions in fuel sulfur content from 15,000 ppm (1.5%) to 10,000 ppm (1.0%) in 2010 to 1,000 ppm (0.1%) in 2015 and a Tier III NO_X standards in 2016.[12] As indicated in Reference 12, the Tier I NO_X standards range from 9.8 to 17 g/kW-hr, depending on engine size.[12] The Tier III standards will be an 80 percent NO_X reduction below the Tier I standard.[12] Ship operators may also use air pollution control devices for the exhaust gas as an option to the lower sulfur fuel standards for complying with the NA ECA.[12]

Federal Mobile Source Regulations

The Federal Clean Air Nonroad Diesel Rule was announced in 2004 to reduce emissions from nonroad diesel engines by more than 90 percent.[13] The rule integrates engine and fuel controls as a system to gain emission reductions and covers new fuel requirements for decreasing sulfur levels in fuel used for nonroad diesel engines, locomotives, and marine vessels by more than 99 percent.[13] The new emissions standards from this rule apply to diesel engines in most construction, agricultural, industrial, and airport equipment.[13] The emission standards, however, do not apply to diesel engines used in locomotives and marine vessels.[13] The emission standards took effect for new engines beginning in 2008 and were fully phased in by 2014.[13]

Federal control measures for Heavy-Duty Highway Vehicles are specified in 40 CFR, Part 86, Subpart P. The current mandatory emission standards for heavy-duty engines were phased-in from 2007-2010 and included a NO_X emission standard of 0.20 g/bhp-hr.[14] The regulation also reduced sulfur content for on-highway diesel fuel from 500 ppm to 15 ppm.[14] Refineries were required to produce 15 ppm ULSD fuel beginning in June 2006 to enable the use of control technologies such as catalytic diesel particulate filters and NO_X catalysts for compliance with the 2007/2010 emission limits.[14]

The Federal Tier II Vehicle and Gasoline Sulfur Program has reduced the sulfur content of gasoline by up to 90 percent.[14] Low sulfur gasoline requirements have enabled the use of advanced emission control systems in cars, pickups, SUVs, and vans beginning in model year 2004.[14] The new regulations have set an average standard of 0.07 grams per mile for NO_X emissions for all classes of passenger vehicles beginning in 2004.[15]

The Federal Tier III gasoline sulfur regulations are in 40 CFR Part 80, Subparts D, E, H, and O. These regulations set new vehicle emission standards and lower the sulfur content in gasoline to a maximum level of 10 ppm by 2017.[14] The gasoline sulfur standard will enable more stringent vehicle emission control measures and increase the effectiveness of air pollution control systems.[14]

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[12] United States Environmental Protection Agency, Regulatory Announcement, Designation of North American Emission Control Area to Reduce Emissions from Ships, Office of Transportation and Air Quality, EPA-420-F-10-015, March 2010.

[13] United States Environmental Protection Agency, Regulatory Announcement, Clean Air Nonroad Diesel Rule, EPA420-F-04-032, May 2004.

[14] See https://www.epa.gov/gasoline-standards/gasoline-sulfur.

[15] EPA Regulatory Announcement, EPA's Program for Cleaner Vehicles and Cleaner Gasoline, December 1999.

Hawaii's Open Burning Regulations

The DOH-CAB continues to regulate open burning activities for all the islands. Open burning includes agricultural, residential, and prescribed burning and is generally prohibited except for activities such as cooking, fire training, and agricultural burning activities. For agricultural burning, the DOH-CAB established a permit program for burning green waste at agricultural operations. Agricultural burning may be further restricted in times of drought, fire hazards or "No-Burn" periods. On the island of Maui, Hawaiian Commercial and Sugar Company (HC&S) is the last sugar cane plantation in the state and has agricultural burn permits to burn cane. The transitioning of HC&S out of farming sugar and the shutdown of this plant in 2016 will alleviate emissions from agricultural burning on Maui.

Best Available Retrofit Technology (BART) Determinations

For the RH-FIP, visibility modeling with CALPUFF was conducted by Alpine Geophysics on behalf of the DOH-CAB to determine which BART eligible sources were reasonably anticipated to cause or contribute to visibility impairment at any Class I Area. Modeling determined that the Hu Honua Bioenergy plant (source #7 in Figure 2.0-2 and Table 2.0-2) and HELCO Kanoelehua Hill facility (source #5 in Figure 2.0-2 and Table 2.0-2) on the Big Island were subject to BART review since the visibility impacts from these sources were greater than the 0.5 deciview BART applicability threshold.[8]

The Hu Honua Bioenergy facility was originally constructed in 1971 and operated by Hilo Coast Processing Company starting in 1974 under CSP No. 0229-02-C. Since 2004, ownership of the facility has been held by several companies. Covered Source Permit No. 0229-02-C that was transferred to Hu Honua Bioenergy, was replaced by CSP No. 0724-01-C for a 407 MMBtu/hr biomass boiler. Controls for the boiler include lime injection to reduce SO_2, an SNCR system for NO_X control, and an electrostatic precipitator and baghouse to remove particulate. As a result of the change to construct the new facility, which includes application of Best Available Control Technology (BACT), the Hu Honua Bioenergy is no longer BART eligible.

The Kanoelehua Hill Generating Station operates two boilers, Hill 5 and Hill 6, fired on fuel oil No. 6 that were found to be BART eligible. Although BART guidelines were not mandatory because this plant's total generating capacity is less than 750 MW, the EPA conservatively evaluated this source for BART applicability anyway to address visibility. Various measures for reducing visibility impairing pollutants of SO_2, NO_X, and PM were considered including scrubbers, flue gas desulfurization, fuel switching, low NO_X burners, and SCR. However, based on consideration of the five BART factors, and given the unique conditions in Hawaii, the EPA determined that no control for NO_X and PM at the Hill plant was consistent with BART. For SO_2, it was estimated that lowering the allowable fuel sulfur content from 2% to 1% for the boilers would result in an improvement in visibility of 0.5 dv. Taking into consideration Hawaii's renewable energy programs and the costs involved with using a lower sulfur fuel, the EPA ultimately determined that BART for the Kanoelehua Hill Generating Station is no controls.

Plant Shutdowns

Table 2.2-1 below shows point sources which have shutdown.

Table 2.2-1 Point Source Shutdowns				
Source	Figure	Source Name	Island	Date Permit File Closed
2	2.0-1	HC&S Puunene Sugar Mill	Maui	12-16-2016
5	2.0-1	Maui Pineapple Company	Maui	6-1-2010
7	2.0-2	HELCO Shipman	Hawaii	12-31-2015

3.0 Summary of Emission Reductions Achieved - 40 CFR §51.308(g)(2)

Section 3 provides emission reductions from implementing the control measures described in Section 2.0. As indicated in Section 2.0, sulfate is the primary cause of visibility impairment in Hawaii's two (2) Mandatory Class I Federal Areas based on an evaluation of the seven particulate pollutants (ammonium sulfate, ammonium nitrate, OC, EC, CM, soil, and sea salt). Therefore, EPA focused primarily on reducing emissions from anthropogenic sources of SO_2 as a sulfate precursor. Note, however, that Kilauea volcano is an extremely large natural source of SO_2 that is not controllable or preventable and affects visibility on the Big Island and other Islands hundreds of miles away. Source apportionment assessments in the TSD for Hawaii's Regional Haze FIP estimated that sulfates from SO_2 emitted by the Kilauea volcano caused approximately 90% of the visibility impairment at Hawaii Volcanoes National Park and approximately 60% of the visibility impairment at Haleakala Nation Park on the 20% worst days.[8] Sulfate was also the largest cause of visibility degradation on the 20% best days, contributing to 42% of the visibility degradation at Hawaii Volcanoes National Park and 37% of the visibility degradation at Haleakala National Park.[8] The secondary concern was anthropogenic emissions of NO_X as a nitrate precursor. As indicated in the TSD for Hawaii's Regional Haze FIP, nitrate contributed to 9% of the visibility degradation on the 20% worst days at Haleakala National Park and 1% of the visibility degradation on the 20% worst days at Hawaii Volcanoes National Park.

SO_2 Emissions Cap (RH-FIP)

Maximum potential emissions from Hawaiian Electric Light units subject to the SO_2 emissions cap for affected units on the Hilo side of the Big Island were compared to potential emissions after the limit. Maximum potential emissions for the comparison were based on information from permit application reviews. Table 3.0-1 below compares maximum potential SO_2 emissions before and after the SO_2 emissions cap.

Table 3.0-1 Potential SO_2 Emissions Before and After Cap				
Facility	Covered Source Permit	Boiler Units	Potential SO_2 Emissions (TPY)	
			Before Cap	After Cap
Kanoelehua Hill Power Plant	0234-01-C	Hill 5 & 6	4,297	3,550
Puna Power Plant	0235-01-C	Boiler 1	2,399	
Shipman Power Plant*	0236-01-C	S3 & S4	2,252	
		Total→	8,948	

* Plant permanently shut down operations on December 31, 2015.

Hawaii's RPS & EEPS (MECO Point Sources)

There have been significant reductions in emissions and fuel consumption for the MECO Kahului Generating Station (source #4 in Figure 2.0-1 and Table 2.0-1) as indicated in Figures 3.0-1 and 3.0-2. This plant fires fuel oil No. 6 as the primary fuel with maximum 2.0% sulfur content. Emissions and fuel data were obtained from AIRSHED and SLEIS electronic receiving systems for reporting to EPA's EIS. Figure 3.0-1 shows mostly SO_2 emissions among NO_X and SO_2 which would be expected from a facility that burns residual fuel oil No. 6 as the primary fuel which generally contains significant quantities of sulfur. Between 2006 and 2015 there is a 56% reduction in SO_2 emissions from 2,990 TPY to 1,311 TPY and a 32% reduction in NO_X emissions from 535 TPY to 361 TPY. In Figure 3.0-2, fuel oil No. 6 consumption for the Kahului Power Plant has significantly decreased (54% from 21,680,607 gal/yr in 2006 to 9,975,351 gal/yr in 2015) as a result of clean energy projects that have reduced the need to generate power from this plant's steam units (Boilers K-1 through K-4). Figure 3.0-2 shows that NO_X emissions are influenced by the lb/MMBtu emission factor for firing the boilers on fuel oil No. 6 that is based on stack testing. Figure 3.0-1 discloses an increase in NO_X emissions for 2010 that is associated with an increase in the average NO_X emission factor as shown in Figure 3.0-2 for firing fuel oil No. 6. Boiler utilization influences emissions since NO_X emission factors vary from one unit and stack test to another. The fuel sulfur content is another factor influencing emissions as shown in Figures 3.0-6 and 3.0-7 for SO_2 emitted by the Hilo power plants.

There have been significant reductions in emissions and fuel consumption from the MECO Maalaea Generating Station (source #1 in Figure 2.0-1 and Table 2.0-1) as indicated in Figures 3.0-3 and Figure 3.0-4. This plant fires fuel oil No. 2 as the primary fuel with maximum 0.4% sulfur content. Emissions and fuel data were obtained from AIRSHED and SLEIS electronic receiving systems. This plant operates large DEGS and CTs to generate electricity. Figure 3.0-3 shows that emissions are primarily NO_X among NO_X and SO_2 emissions which would be expected from this facility. The Maalaea plant burns distillate fuel which typically has a much lower sulfur content than residual oil and operates internal combustion units (DEGs and CTs) that form NO_X from high pressures and temperatures during the combustion process.[16,17] Figure 3.0-3 shows a 46% reduction in NO_X emissions from 4,454 TPY to 2,409 TPY and a 14% reduction in SO_2 emissions from 697 TPY to 600 TPY between 2006 and 2015. Figure 3.0-4 shows that fuel oil No. 2 consumption for the Maalaea has decreased significantly (23% from 61,674,930 gal/yr in 2006 to 47,432,666 gal/yr in 2015) as a result of clean energy programs implemented by the State to reduce GHG emissions. As noted for the MECO Kahului Generating Station, variables influencing emissions are the lb/MMBtu NO_X emission factor, the generating unit's utilization, and fuel sulfur content.

[16] AP-42, Chapter 3.1, Stationary Gas Turbines, April 2000

[17] AP-42, Chapter 3.4, Large Stationary Diesel and All Stationary Dual-Fuel Engines, October 1996.

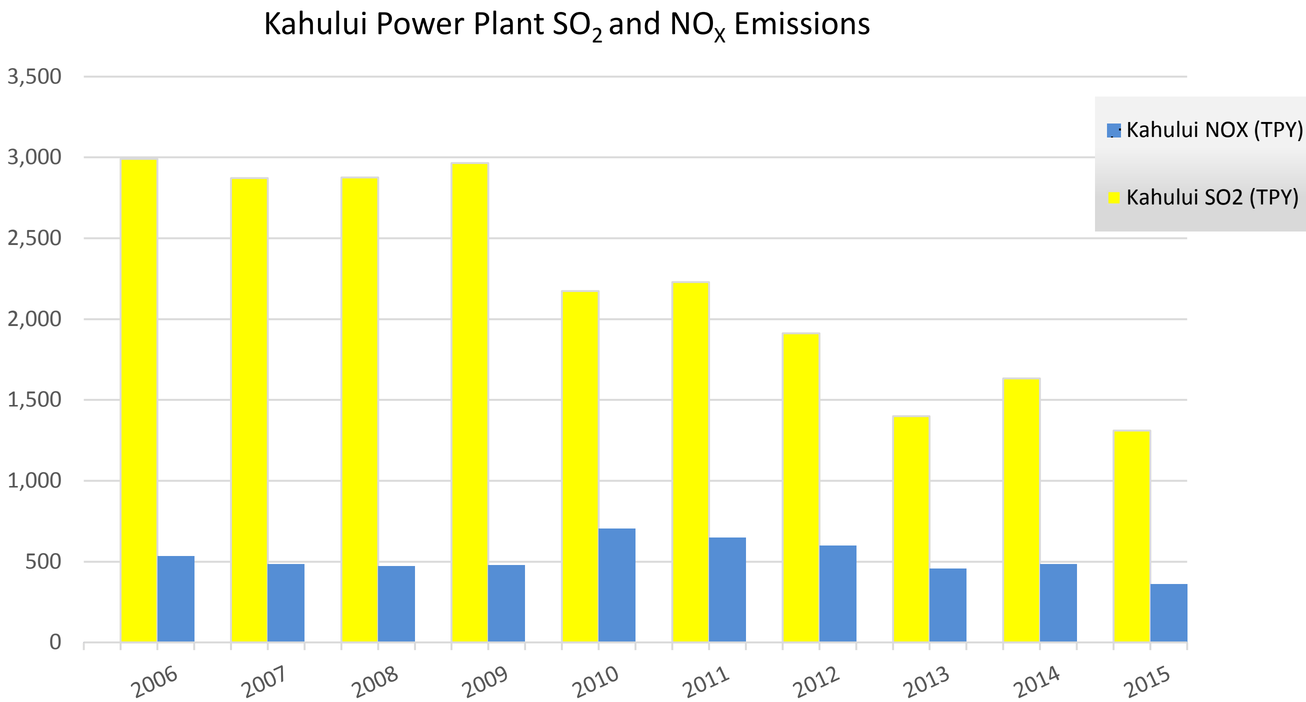

Figure 3.0-1 SO_2 and NO_X Emissions from Kahului Power Plant

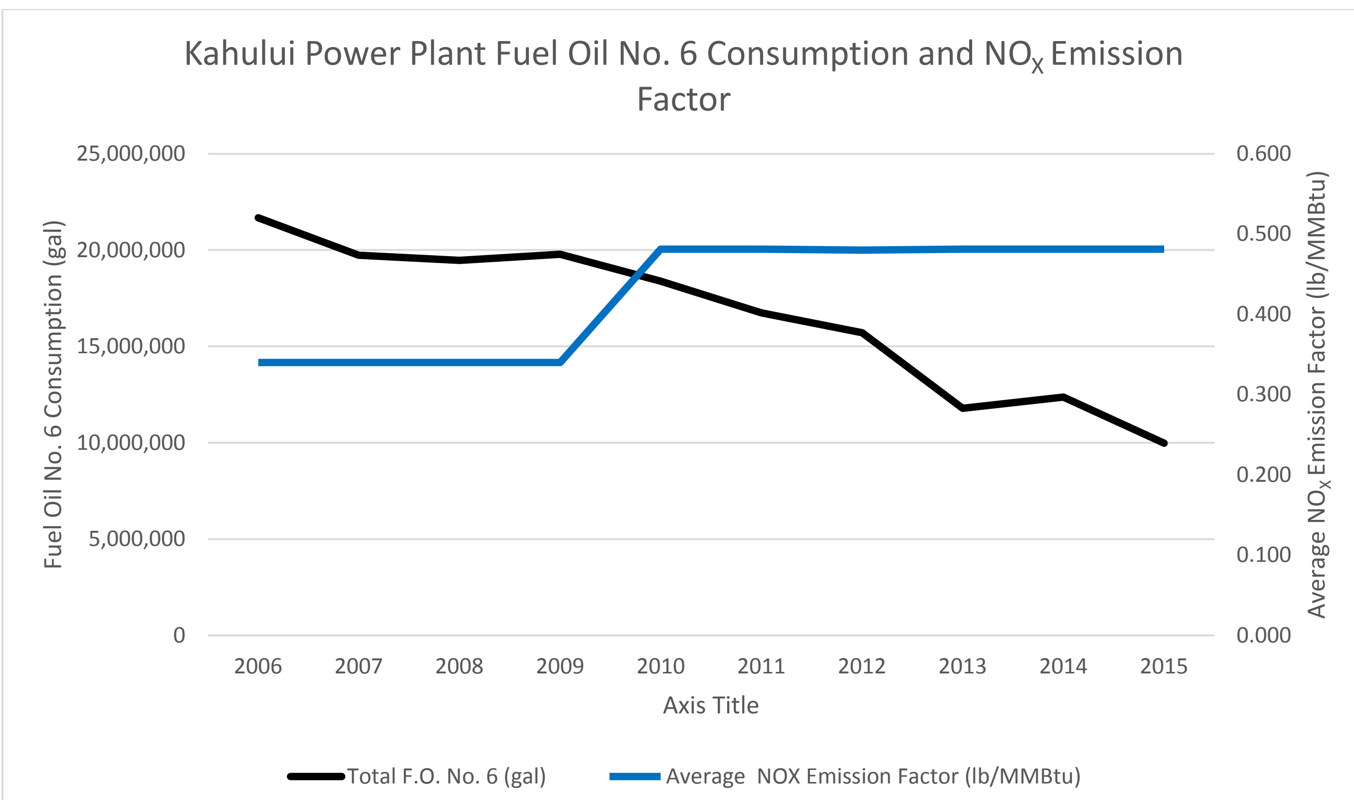

Figure 3.0-2 Fuel Oil No. 6 Use and NO_X Emissions Factor for Kahului Power Plant

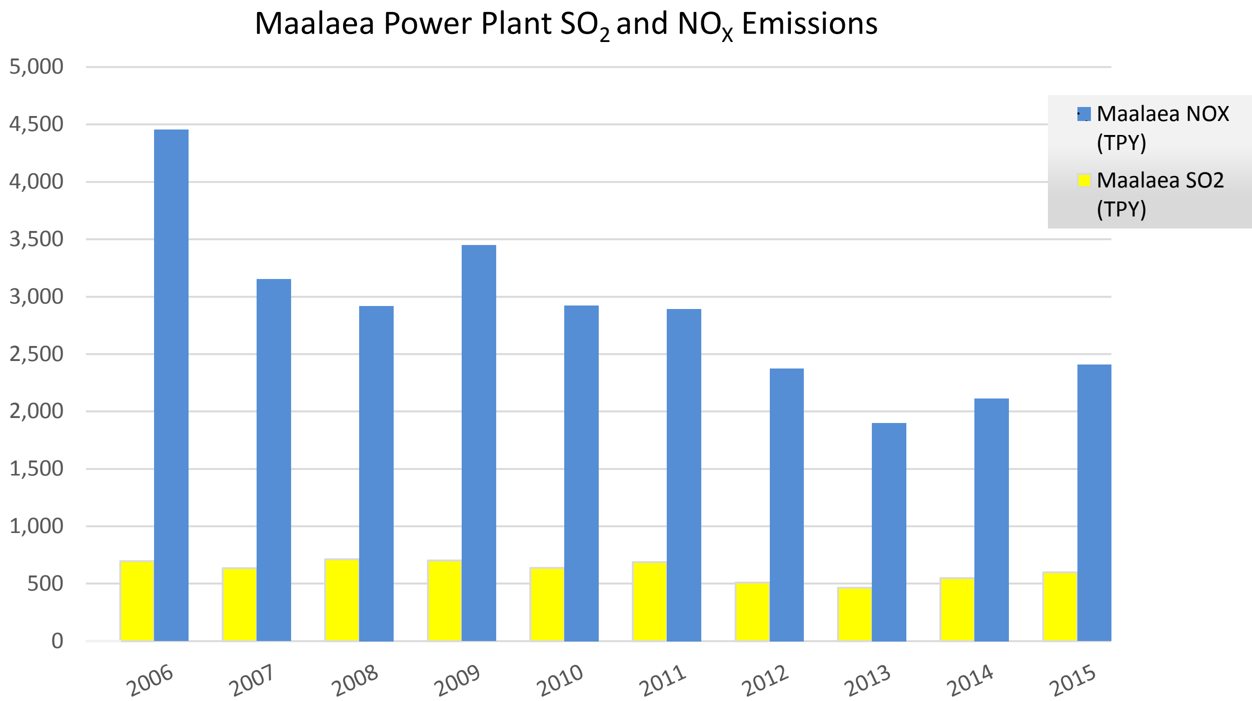

Figure 3.0-3 SO_2 and NO_X Emissions from Maalaea Power Plant

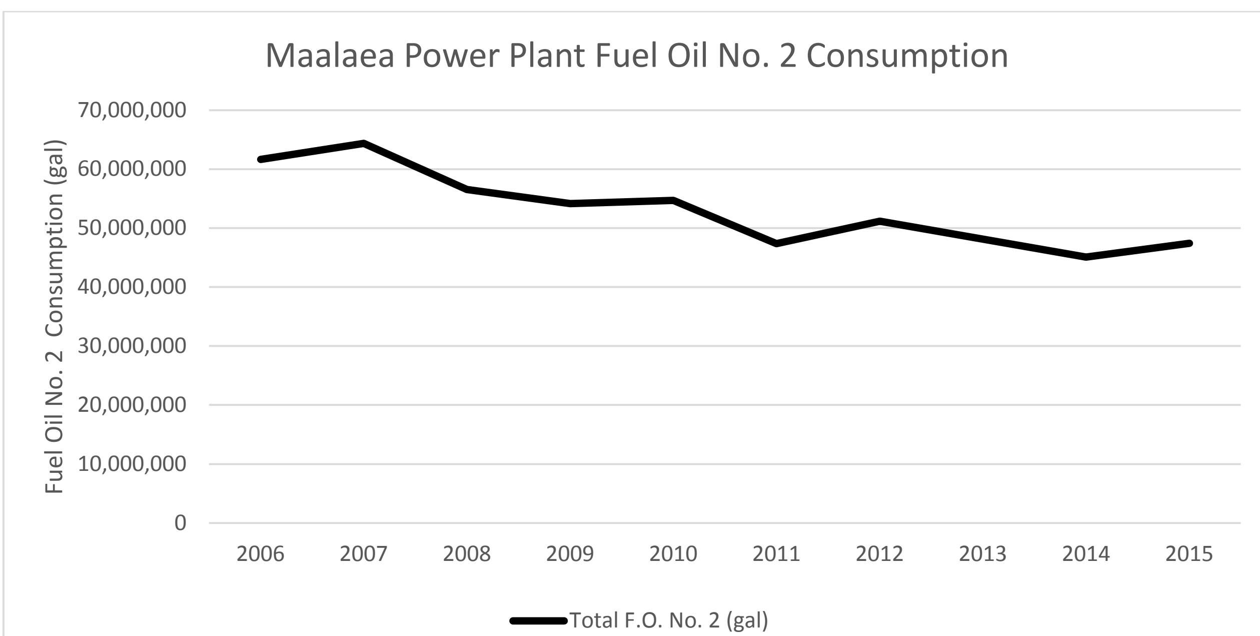

Figure 3.0-4 Fuel Oil No. 2 Use for Maalaea Power Plant

Figure 3.0-5 shows a rough projection of SO_2 and NO_X emissions from MECO power plants based on information in Reference 11 indicating the generating units that will be retired from service.[11] The 2014 baseline actual emissions for the projection were obtained from the DOH-CAB's SLEIS electronic receiving application. The event timeline, based on MECO's E3 Plan in the PSIP, includes the retirement of Kahului Generating Station (Units K-1, K-2, K-3, and K-4) in 2024.[11] As indicated in the PSIP, emissions will continue to decrease over time as more renewables are added to the system to reach 100% renewable energy by 2045.[11]

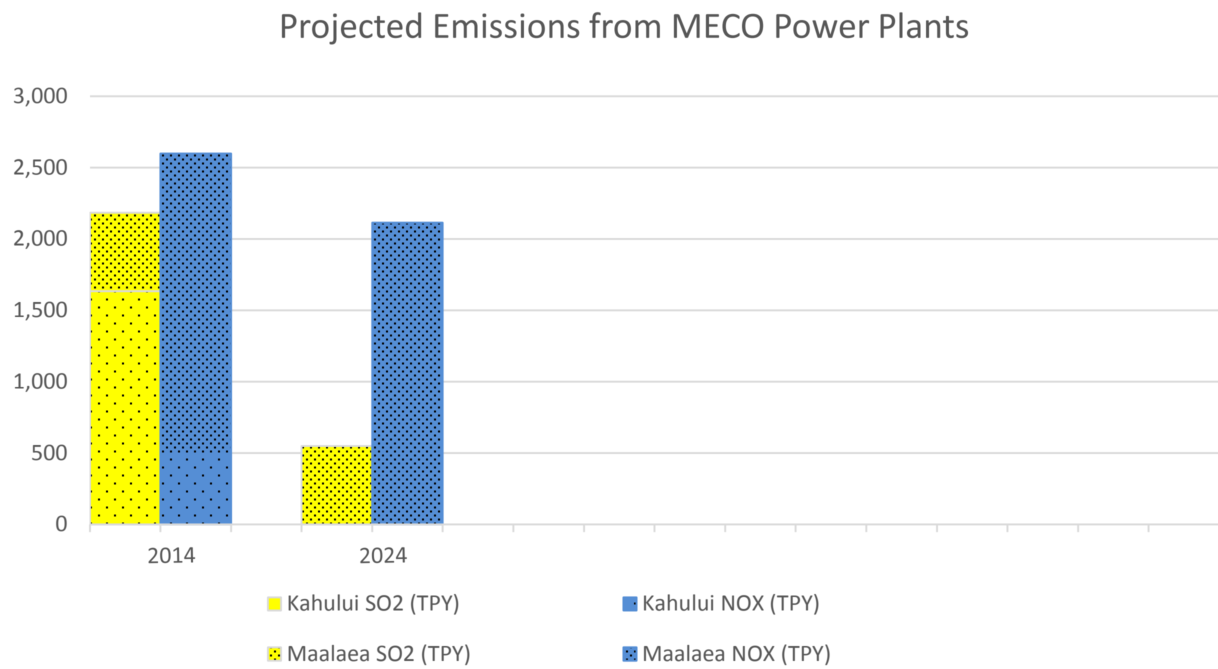

Figure 3.0-5 MECO Power Plant Projected Emissions

<u>Hawaii's RPS & EEPS (HELCO Point Sources)</u>

There has been a significant reduction in emissions and fuel consumption at the Kanoelehua Hill, Puna, and Shipman Generating Stations on the Hilo side of the Big Island as shown in Figures 3.0-6 and 3.0-7. In Figure 2.0-2 and Table 2.0-2, these are sources #3, #5, and #6 for the Puna, Hill, and Shipman plants, respectively. Emissions and fuel data were obtained from AIRSHED and SLEIS reporting. The decrease in emissions and fuel consumption is a result of clean energy programs that reduce the need to generate power from Hawaiian Electric Light's steam units. From 2006 to 2015 there is a 59% reduction in SO_2 emissions from 5,228 TPY to 2,142 TPY and a 25% reduction in NO_X emissions from 886 TPY to 660 TPY. For 2014, there are no emissions from the Shipman Generating Station because it was deactivated (not operating, but could restart if necessary). There are also no emissions from the Shipman Generating Station in 2015 and no further emissions thereafter since this plant was permanently shut down in 2015. Figure 3.0-7 shows plots of the fuel oil No. 6 consumption and this fuel's sulfur content between years 2006 and 2015. Figure 3.0-7 shows that total combined fuel oil No. 6 consumption as the primary fuel for the Hilo power plants has significantly decreased. In Figure 3.0-7 it is apparent that a contributing factor to SO_2 reductions is use of fuel oil No. 6 between 2010 and 2015 with lower sulfur content than that from 2006 to 2009.

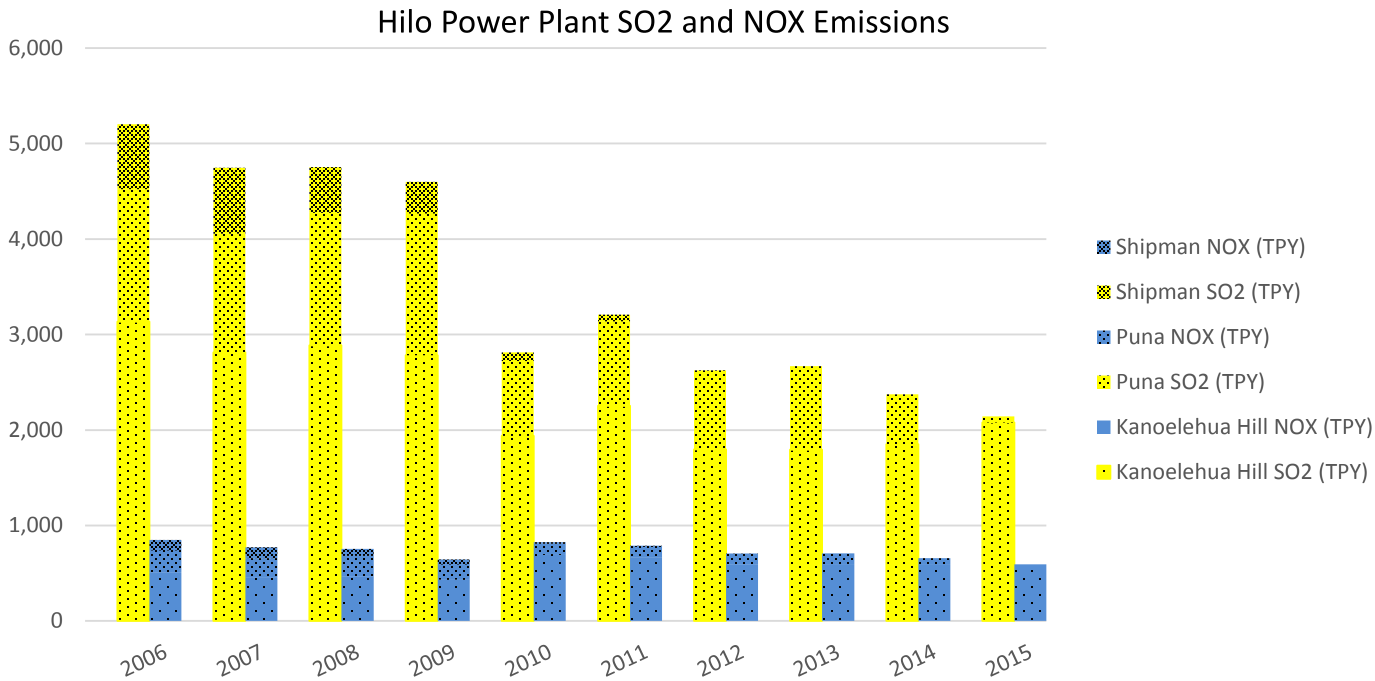

Figure 3.0-6 SO_2 and NO_X Emissions from Hilo Power Plants

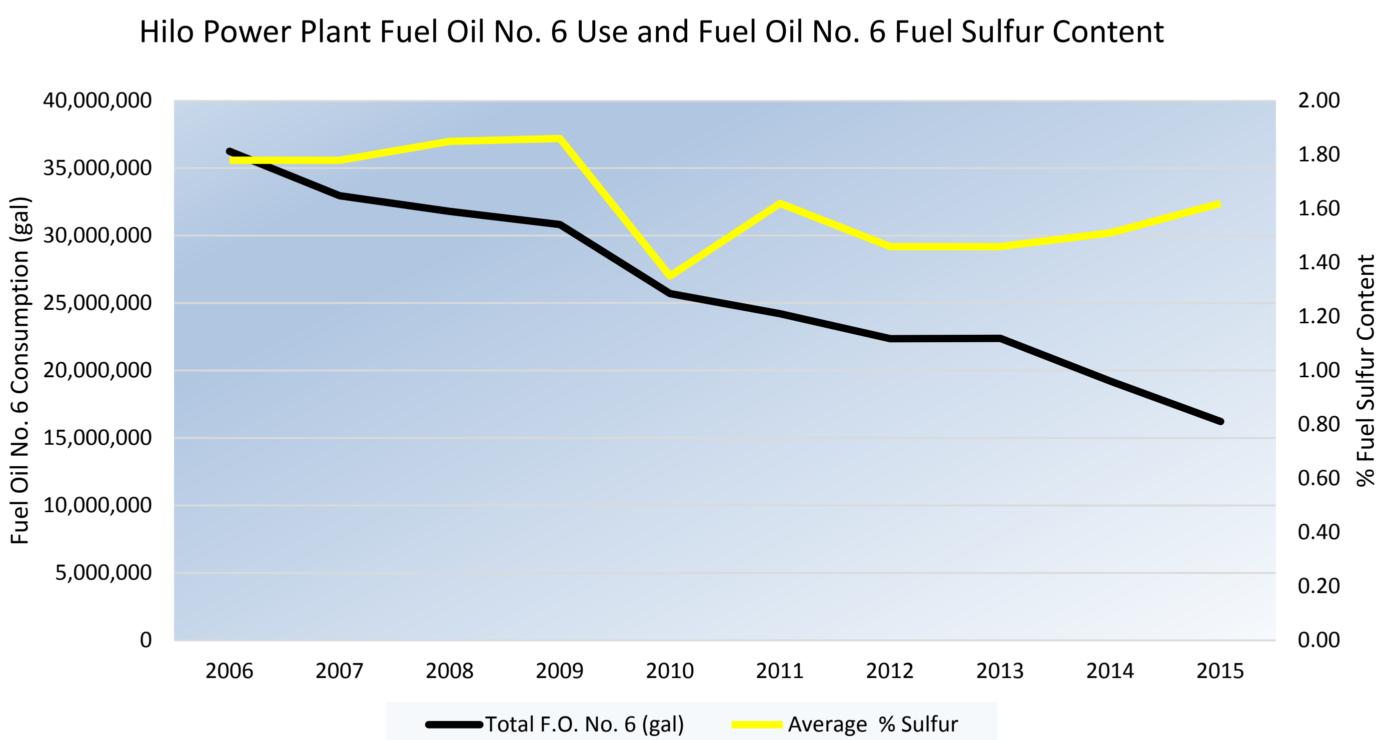

Figure 3.0-7 Fuel Oil No. 6 Consumption and Sulfur Content for Hilo Power Plants

Figure 3.0-8 shows a rough projection of SO_2 and NO_X emissions from HELCO power plants on the Hilo side of the island based on information in Reference 11.[11] The 2014 baseline emissions for the projection were obtained from the DOH-CAB's SLEIS application. The timeline of events for the projection includes the decommissioning (complete removal) of the Shipman facility which permanently shut down in 2015.[11] Also, according to the Hawaii Island E3 Plan in the PSIP, in 2020 steam Boiler 1 will be removed from service at the Puna Generating Station and Hill Boilers 5 and 6 will be removed from service from the Kanoelehua Hill Plant.

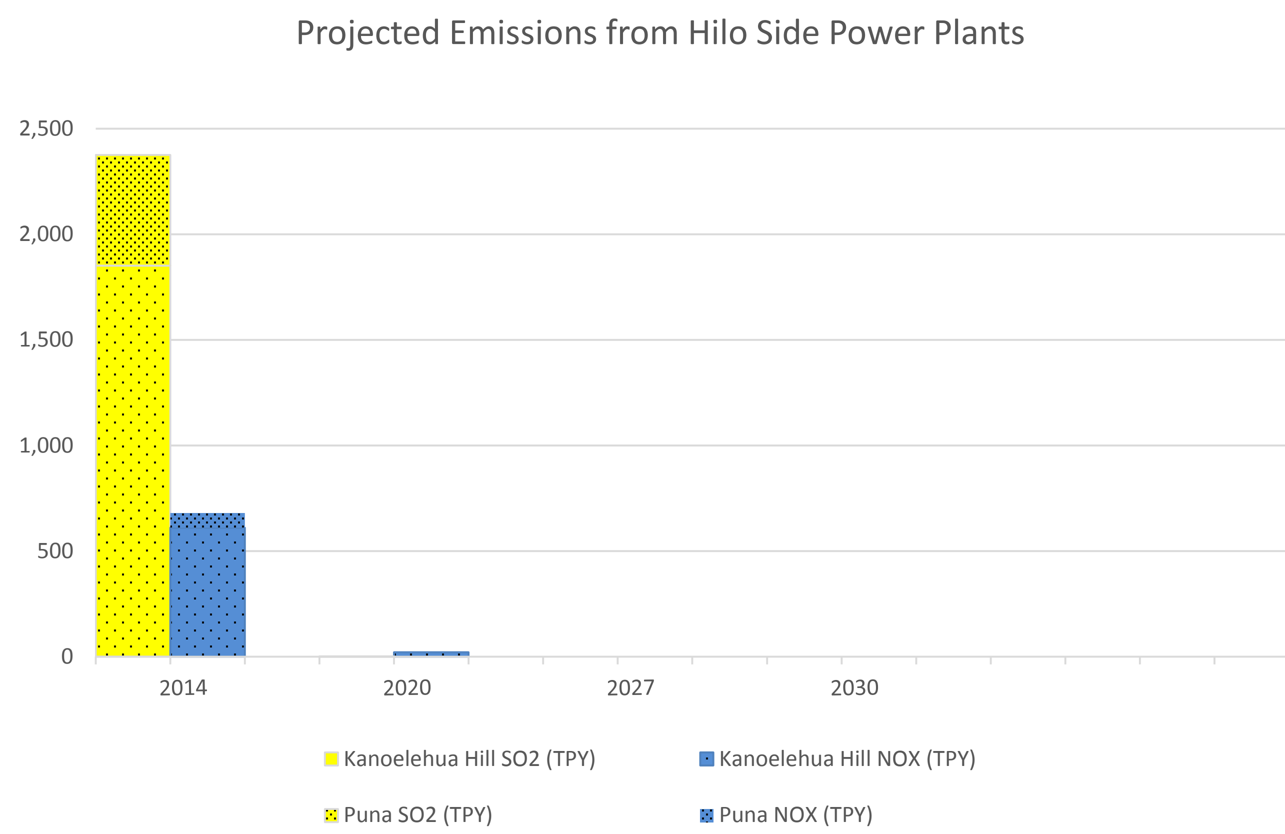

Figure 3.0-8 Hilo Side Power Plant Projected Emissions

<u>NA ECA and Federal Mobile Source Regulations</u>

Tables 3.0-2 and 3.0-3 below provide mobile source emissions for the islands of Maui and Hawaii, respectively. Emissions were based on NEI data for years 2008 and 2011 and emissions inventory data from Reference 8 for year 2005.[8] The NEI is prepared every three years and emissions inventory data for 2014 is not available yet.

Table 3.0-2 Mobile Source Emissions for Maui Island (see note 1)									
Source	Sector	2005 Emissions (TPY)		2008 Emissions (TPY)			2011 Emissions (TPY)		
		SO_2	NO_X	SO_2	NO_X	PM_{10}	SO_2	NO_X	PM_{10}
On-road Mobile	Diesel Heavy Duty Vehicles	47	2,957	22	646	79	1	399	24
	Diesel Light Duty Vehicles			2	46	6	------	67	4
	Non-Diesel Heavy Duty Vehicles			1	109	3	------	20	------
	Non-Diesel Heavy Light Duty Vehicles			13	1,968	68	12	1,669	15
Nonroad Mobile	Aircraft	57	496	44	410	23	55	465	21
	Commercial Marine Vessel			580	1,158	81	734	1,465	104
	Equipment Diesel			9	416	33	1	367	29
	Equipment Gasoline			1	114	23	1	108	23
	Other			1	31	2	1	23	2
	Total →	104	3,453	673	4,898	318	805	4,583	222

1. Nonroad Mobile totals include aircraft emissions.

Table 3.0-3 Mobile Source Emissions for Big Island (see note 1)									
Source	Sector	2005 Emissions (TPY)		2008 Emissions (TPY)			2011 Emissions (TPY)		
		SO_2	NO_X	SO_2	NO_X	PM_{10}	SO_2	NO_X	PM_{10}
On-road Mobile	Diesel Heavy Duty Vehicles	53	3,217	24	760	88	1	969	56
	Diesel Light Duty Vehicles			2	48	7	------	115	7
	Non-Diesel Heavy Duty Vehicles			1	124	4	------	48	------
	Non-Diesel Heavy Light Duty Vehicles			15	2,225	77	20	2,891	28
Nonroad Mobile	Aircraft	95	784	40	335	27	43	324	24
	Commercial Marine Vessel			737	1,105	89	80	128	11
	Equipment Diesel			14	669	54	1	588	48
	Equipment Gasoline			1	103	18	1	100	18
	Other			1	32	2	1	22	2
	Total →	148	4,001	835	5,401	366	147	5,185	194

1. Nonroad Mobile totals include aircraft emissions.

Hawaii's Agricultural and Open Burning Regulations

Tables 3.0-4 and 3.0-5 below provide fire emissions for the islands of Maui and Hawaii, respectively. Emissions were based on NEI data for years 2008 and 2011 and emissions inventory data from Reference 8 for year 2005.[8] As indicated for mobile source emissions, the NEI is prepared every three years and emissions inventory data for 2014 is not available yet.

Table 3.0-4 Fire Emissions for Maui Island

Source	2005 Emissions (TPY)		2008 Emissions (TPY)			2011 Emissions (TPY)		
	SO_2	NO_X	SO_2	NO_X	PM_{10}	SO_2	NO_X	PM_{10}
Agricultural Burning	132	298	132	298	1,154	132	298	1,154
Prescribed Burning	-----	-----	-----	------	-----	10	88	219
Wildfires	14	52	-----	------	-----	-----	-----	-----
Total →	146	350	132	298	1,154	142	386	1,373

Table 3.0-5 Fire Emissions for Big Island

Source	2005 Emissions (TPY)		2008 Emissions (TPY)			2011 Emissions (TPY)		
	SO_2	NO_X	SO_2	NO_X	PM_{10}	SO_2	NO_X	PM_{10}
Agricultural Burning	0	2	-----	2	3	-----	2	3
Prescribed Burning	-----	-----	-----	-----	-----	26	297	630
Wildfires	469	1,712	-----	-----	-----	9	99	162
Total →	468	1,714	-----	2	3	35	398	795

4.0 Visibility Progress – 40 CFR 51.308(g)(3)

Section 4.0 describes the progress towards the reasonable progress goals for Haleakala National Park on Maui and Hawaii Volcanoes National Park on the Big Island based on IMPROVE data. Reference 18 requires this section to include deciview values for "current visibility conditions", "baseline visibility conditions", and "the past five years".[18]

For the "baseline visibility conditions" during the 2000-2004 baseline period, there is no visibility monitoring data for the HACR1 visibility monitoring site at Haleakala National Park. The HACR1 monitoring station began operation in 2007 and replaced the HALE1 monitoring station for Haleakala National Park in 2012. Figure 4.0-1 is a map showing the locations of the HALE1 and HARC1 visibility monitoring sites for Haleakala National Park.[6]

[18] United States Environmental Protection Agency, General Principles for the 5-Year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans, April 2013

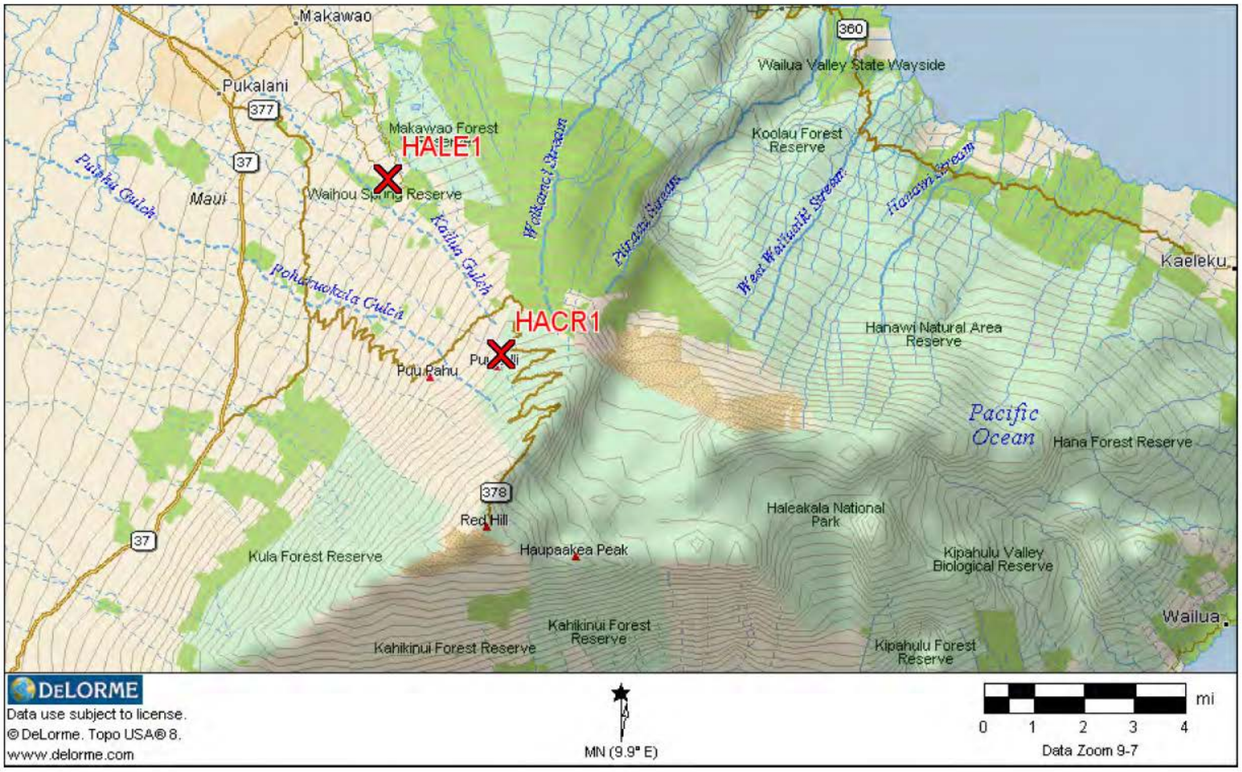

Figure 4.0-1 Map of HALE1 and HACR1 Sites for Haleakala National Park[6]

Pursuant to 40 CFR §308(d)(2)(i), the WRAP established baseline visibility conditions for HACR1 at Haleakala National Park on Maui using a methodology developed in consultation with DOH-CAB, NPS, and EPA Region 9.[6] Visibility data for establishing baseline conditions was obtained from the Federal Land Manager Environmental Database (Reference 5). The 2000-2004 baseline data and 2005-2009 data over the first progress period was available for the HALE1 monitor; however, visibility data for the HARC1 monitor was only available in the first progress period (2005-2009), since it started operation in 2007.[6] Therefore, ratios between the 2005-2009 progress period and the 2000-2004 baseline period for each aerosol species at the HALE1 were used to estimate visibility conditions for the HACR1 site.[6] For the 2000-2004 baseline period, 2000 data at the HALE1 monitor was not representative and unavailable for use in the 2000-2004 baseline period average. Averages for the 2000-2004 baseline were determined from visibility data between 2001 and 2004 for the HALE1 monitor. Progress period (2005-2009) to baseline (2000-2004) ratios for each species and haze index (HI) were determined as follows[6]:

$$\frac{\text{HACR1 Progress Period}}{\text{HALE } \frac{\text{Progress}}{\text{Baseline}} \text{ Average}} = \text{HACR1 Baseline Period Estimate}$$

Table 4.0-1 below shows light extinction averages from the progress to baseline ratios determined from data collected at the HALE1 station.

Table 4.0-1 HALE1 Averages and Ratios				
Species	Group	HALE1 2000-2004 Baseline Period b_{ext} (Mm^{-1})	HALE1 2005-2009 Progress Period b_{ext} (Mm^{-1})	HALE1 Progress/Baseline Ratio
Ammonium Sulfate	Best 20% Days	2.1654	2.0871	0.9638
	Worst 20% Days	17.5321	26.4691	1.5098
Ammonium Nitrate	Best 20% Days	0.5570	0.4258	0.7645
	Worst 20% Days	2.6633	2.1082	0.7916
Particulate Organic Mass	Best 20% Days	0.6716	0.5107	0.7604
	Worst 20% Days	2.8905	2.2196	0.7679
Elemental Carbon	Best 20% Days	0.2041	0.1606	0.7869
	Worst 20% Days	1.3953	1.1657	0.8354
Soil	Best 20% Days	0.1000	0.0892	0.8920
	Worst 20% Days	0.3490	0.3781	1.0834
Coarse Mass	Best 20% Days	1.0436	0.8525	0.8169
	Worst 20% Days	2.6279	1.9207	0.7309
Sea Salt	Best 20% Days	1.0870	1.4916	1.3722
	Worst 20% Days	1.2877	1.9774	1.5356

Table 4.0-2 below shows the baseline estimates for HACR1 determined from the 2005-2009 HACR1 progress period and the progress period/baseline ratios for the HALE1 IMPROVE monitor. For the HACR1 monitor, data for the 2005-2009 progress period was from 2007 through 2009 because this visibility monitor was installed in 2007.

Table 4.0-2 HACR1 Baseline b_{ext} Estimates				
Species	Group	HACR1 2005-2009 Progress Period b_{ext} (Mm^{-1})	HALE1 Progress/Baseline Ratio	HACR1 2000-2004 Baseline Period b_{ext} (Mm^{-1}) Estimate
Ammonium Sulfate	Best 20% Days	1.0318	0.9638	1.0706
	Worst 20% Days	16.5051	1.5098	10.9320
Ammonium Nitrate	Best 20% Days	0.1406	0.7645	0.1839
	Worst 20% Days	1.1013	0.7916	1.3912
Particulate Organic Mass	Best 20% Days	0.0694	0.7604	0.0913
	Worst 20% Days	1.8325	0.7679	2.3864
Elemental Carbon	Best 20% Days	0.0411	0.7869	0.0522
	Worst 20% Days	0.6385	0.8354	0.7643
Soil	Best 20% Days	0.0722	0.8920	0.0809
	Worst 20% Days	0.4406	1.0834	0.4067
Coarse Mass	Best 20% Days	0.3125	0.8169	0.3825
	Worst 20% Days	1.6976	0.7309	2.3226
Sea Salt	Best 20% Days	0.3034	1.3722	0.2211
	Worst 20% Days	0.7422	1.5356	0.4833

Table 4.0-3 below provides baseline haze index (HI) estimates for the HACR1 monitor. The baseline HI was determined by scaling each HACR1 species for each of the worst 20% and best 20% days by the HALE1 scaling ratio, summing the scaled b_{ext} for each species for each day, calculating the HI from summed b_{ext} values with the deciview equation (i.e., dv = 10

ln(b_{ex}/10)), averaging the deciview values for each year, and averaging the yearly deciview values over the years representing the baseline period.

Table 4.0-3 HACR1 Baseline HI (dv) Estimates		
HI (dv)	Group	HACR1 2000-2004 Baseline HI (dv) Estimate
Deciviews	Best 20% Days	1.00430
	Worst 20% Days	9.47734

4.1 Current Visibility Conditions – 40 CFR 51.308(g)(3)(i)

Section 4.1 provides current visibility conditions for the most impaired and least impaired days. As indicated in Reference 19, current visibility conditions should include the 5-year average with the most recent data at the time the state submits its 5-year progress report. At this time the most recent five years of visibility data is from 2011 to 2015. Please note that visibility conditions for Hawaii's IMPROVE monitors were also addressed in Reference 6 for the 2005 to 2009 period.

Tables 4.1-1 and 4.1-2 provide the annual visibility conditions from years 2011 to 2015 for the HACR1 IMPROVE monitor representing current visibility conditions at Haleakala National Park for the 20% most impaired (worst) days and 20% least impaired (best) days, respectively.

Table 4.1-1 Current Annual Average Visibility Conditions (2011-2015) at HACR1 from Haleakala National Park for 20% Most Impaired Days

Year	HI (dv)	Aerosol Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2011	9.4	13.7	1.0	0.7	0.4	0.3	0.8	1.1
2012	9.9	13.5	1.1	0.6	0.3	0.5	1.4	1.1
2013 see note 1	11.4	19.1	0.9	0.9	0.5	0.4	0.9	0.8
2014	8.9	10.8	1.1	0.8	0.2	0.4	1.0	1.4
2015	8.7	10.1	1.2	0.8	0.2	0.2	1.3	1.4
Average	**9.7**	**13.4**	**1.1**	**0.8**	**0.3**	**0.4**	**1.1**	**1.2**

1. No statistical groupings (i.e., Best 20% Days, Worst 20% Days, etc.) provided since 2013 data is below data collection standard. DOH-CAB determined statistical groupings based on available data (about 72% collection) by using days with a dv value.

Table 4.1-2 Current Annual Average Visibility Conditions (2011-2015) at HACR1 from Haleakala National Park for 20% Least Impaired Days

Year	HI (dv)	Aerosol Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2011	0.7	1.0	0.1	0.05	0.03	0.03	0.2	0.3
2012	0.8	1.0	0.1	0.1	0.07	0.04	0.3	0.3
2013 see note 1	0.6	0.7	0.1	0.2	0.06	0.04	0.2	0.3
2014	0.6	0.9	0.1	0.1	0.04	0.06	0.6	0.2
2015	0.3	0.7	0.1	0.1	0.01	0.01	0.2	0.2
Average	**0.6**	**0.9**	**0.1**	**0.1**	**0.04**	**0.04**	**0.3**	**0.3**

1. No statistical groupings (i.e., Best 20% Days, Worst 20% Days, etc.) provided since 2013 data is below data collection standard. DOH-CAB determined statistical groupings based on available data (about 72% collection) by using days with a dv value.

Tables 4.1-3 and 4.1-4 provide the annual visibility conditions between years 2011 and 2015 at the HAVO1 IMPROVE monitor representing current visibility conditions at Hawaii Volcanoes National Park for the 20% most impaired (worst) days and 20% least impaired (best) days, respectively.

Table 4.1-3 Current Annual Average Visibility Conditions (2011-2015) At HAVO1 from Hawaii Volcanoes National Park For 20% Most Impaired (Worst) Days

Year	HI	Aerosol Extinction by Species (Mm^{-1})						
	(dv)	Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2011	15.1	34.2	0.6	0.6	0.4	0.2	0.7	2.5
2012	16.4	43.2	0.6	0.6	0.4	0.2	0.9	1.9
2013	19.7	61.4	0.6	1.0	0.5	0.2	0.7	1.6
2014	19.3	55.2	0.6	1.8	0.7	0.2	0.7	2.2
2015	19.3	56.8	0.6	1.5	0.5	0.2	0.7	1.5
Average	**18.0**	**50.2**	**0.6**	**1.1**	**0.5**	**0.2**	**0.7**	**1.9**

Table 4.1-4 Current Annual Average Visibility Conditions (2011-2015) at HAVO1 from Hawaii Volcanoes National Park for 20% Least Impaired (Best) Days

Year	HI	Aerosol Extinction by Species (Mm^{-1})						
	(dv)	Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2011	3.1	1.5	0.2	0.2	0.1	0.02	0.5	1.1
2012	2.9	1.5	0.2	0.2	0.07	0.03	0.4	1.1
2013	3.9	2.1	0.4	0.2	0.07	0.03	0.6	1.4
2014	3.2	1.8	0.2	0.2	0.04	0.04	0.7	1.1
2015	4.0	2.0	0.4	0.4	0.07	0.06	0.7	1.4
Average	**3.4**	**1.8**	**0.3**	**0.2**	**0.07**	**0.04**	**0.6**	**1.2**

4.2 Difference Between Current and Baseline Visibility Conditions – 40 CFR 51.308(g)(3)(ii)

Section 4.2 provides the difference between current and baseline visibility conditions for the most and least impaired days. Visibility displays for this section include rolling five-year average plots for the worst and best days from the baseline period to the year with the most recent data based on guidance from Reference 18.

Tables 4.2-1 and 4.2-2 below provide the haze index and extinction values by species for the 20% worst and 20% best visibility days at Haleakala National Park, respectively. The haze index and light extinction values are five-year averages based on annual average visibility data from the baseline period (2000-2004) to the five-year period with most recent data (2011-2015). The tables also show the difference between the baseline and current visibility conditions at Haleakala National Park. Red values, representing an increase, indicate more haze (impairment). Negative values in blue indicate less haze (improvement).

Table 4.2-1 Difference in Aerosol Extinction by Species and Haze Index 2000-2004 Baseline to 2011-2015 Current Period Haleakala National Park HACR1 Monitor 20% Most Impaired (Worst) Days								
Progress Period	HI (dv)	Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2000-2004 (See note 1)	**9.5**	**10.9**	**1.4**	**2.4**	**0.8**	**0.4**	**2.3**	**0.5**
2005-2009 (See note 2)	----	-----	----	----	----	----	----	----
2006-2010 (See note 2)	----	-----	----	----	----	----	----	----
2007-2011	10.4	15.5	1.1	1.4	0.5	0.5	1.4	0.8
2008-2012	10.5	16.4	1.0	0.7	0.4	0.5	1.4	0.8
2009-2013	10.3	15.7	1.0	0.7	0.4	0.5	1.4	0.9
2010-2014	9.9	14.3	1.0	0.8	0.4	0.5	1.1	1.0
2011-2015	**9.7**	**13.4**	**1.1**	**0.8**	**0.3**	**0.4**	**1.1**	**1.1**
Difference (see note 3)	**+0.2**	**+2.5**	**-0.3**	**-1.6**	**-0.5**	**0**	**-1.2**	**+0.6**

1. Baseline values are from Tables 4.0-2 and 4.0-3 on Pages 26 and 27, respectively.
2. Rolling 5-year visibility data is not available since HACR1 monitor began operating in 2007
3. Difference is current five year period (2011-2015) value minus baseline (2000-2004) value.

Table 4.2-2 Difference in Aerosol Extinction by Species and Haze Index 2000-2004 Baseline to 2011-2015 Current Period Haleakala National Park HACR1 Monitor 20% Least Impaired (Best) Days								
Progress Period	HI (dv)	Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2000-2004 (See note 1)	**1.0**	**1.1**	**0.2**	**0.1**	**0.1**	**0.1**	**0.4**	**0.2**
2005-2009 (See note 2)	----	-----	----	----	----	----	----	----
2006-2010 (See note 2)	----	-----	----	----	----	----	----	----
2007-2011	0.8	1.0	0.1	0.3	0.04	0.06	0.3	0.3
2008-2012	0.8	1.0	0.1	0.06	0.05	0.06	0.3	0.3
2009-2013	0.8	0.9	0.1	0.08	0.05	0.05	0.3	0.3
2010-2014	0.6	0.9	0.1	0.1	0.05	0.04	0.2	0.3
2011-2015	**0.6**	**0.9**	**0.1**	**0.1**	**0.04**	**0.04**	**0.2**	**0.2**
Difference (see note 3)	**-0.4**	**-0.20**	**-0.10**	**0**	**-0.06**	**-0.06**	**-0.20**	**0**

1. Baseline values are from Tables 4.0-2 and 4.0-3 on Pages 26 and 27, respectively.
2. Rolling 5-year visibility data is not available since HACR1 monitor began operating in 2007.
3. Difference is current five year period (2011-2015) value minus baseline (2000-2004) value.

Tables 4.2-3 and 4.2-4 below provide the haze index and light extinction by species for the 20% best and 20% worst visibility days at Hawaii Volcanoes National Park, respectively. The haze index and light extinction values are five year rolling annual averages from the baseline period (2000-2004) to the five-year period with most recent data (2011-2015). The tables also show the difference between the baseline and current visibility conditions for Hawaii Volcanoes National Park. Red values, representing an increase, indicate more haze (impairment). Negative values in blue indicate less haze (improvement).

Table 4.2-3 Difference in Aerosol Extinction by Species and Haze Index 2000-2004 Baseline to 2011-2015 Current Period Hawaii Volcanoes National Park HAVO1 Monitor 20% Most Impaired (Worst) Days								
Progress Period	HI (dv)	Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2000-2004 (See note1)	**18.9**	**60.0**	**0.9**	**2.5**	**1.0**	**0.9**	**0.7**	**1.1**
2005-2009	24.9	132.1	0.6	1.3	0.8	0.5	1.1	1.3
2006-2010	25.4	141.4	0.5	1.2	0.8	0.6	1.0	1.2
2007-2011	24.3	134.4	0.6	1.1	0.7	0.6	1.1	1.4
2008-2012	22.8	121.3	0.5	1.0	0.6	0.6	1.1	1.5
2009-2013	21.2	97.7	0.5	0.8	0.5	0.5	0.8	1.5
2010-2014	19.0	65.1	0.9	1.0	0.5	0.3	0.7	1.8
2011-2015	**18.0**	**50.2**	**0.6**	**1.1**	**0.5**	**0.2**	**0.7**	**2.0**
Difference (see note 2)	**-0.9**	**-9.8**	**-0.3**	**-1.4**	**-0.5**	**-0.7**	**0**	**+0.9**

1. Baseline values are four year average from years 2001 through 2004, since 2000 data is invalid.
2. Difference is current five year period (2011-2015) value minus baseline (2000-2004) value.

Table 4.2-4 Difference in Aerosol Extinction by Species and Haze Index 2000-2004 Baseline to 2011-2015 Current Period Hawaii Volcanoes National Park HAVO1 Monitor 20% Least Impaired (Best) Days								
Progress Period	HI (dv)	Extinction by Species (Mm^{-1})						
		Sulfate	Nitrate	POM	EC	Soil	CM	Sea Salt
2000-2004 (See note1)	**4.1**	**2.1**	**0.3**	**1.5**	**0.2**	**0.1**	**0.4**	**0.9**
2005-2009	3.8	2.2	0.3	0.1	0.1	0.03	0.4	1.6
2006-2010	3.8	2.2	0.3	0.1	0.1	0.04	0.4	1.5
2007-2011	3.8	2.1	0.3	0.2	0.1	0.04	0.4	1.5
2008-2012	3.5	2.0	0.3	0.1	0.1	0.04	0.4	1.4
2009-2013	3.5	2.0	0.3	0.2	0.1	0.04	0.5	1.3
2010-2014	3.4	1.8	0.3	0.2	0.1	0.04	0.5	1.2
2011-2015	**3.4**	**1.8**	**0.3**	**0.2**	**0.1**	**0.04**	**0.5**	**1.2**
Difference (see note 2)	**-0.7**	**-0.3**	**0**	**-1.3**	**-0.1**	**-0.06**	**+0.1**	**+0.3**

1. Baseline values are four year average from years 2001 through 2004, since 2000 data is invalid.
2. Difference is current five year period (2011-2015) value minus baseline (2000-2004) value.

Visibility conditions are shown in Figures 4.2-1 and 4.2-2 for Haleakala National Park and in Figures 4.2.3 and 4.2-4 for Hawaii Volcanoes National Park. Dashed green curves are plots of the average annual average haze index. Solid green curves show five-year rolling average haze index. For HACR1, the five-year rolling average haze index starts from a 2009 center point (i.e., 2007-2011 for 2009, 2008-2012 for 2008, etc.) since data is available for this monitor from 2004 to 2007. Baseline visibility conditions are represented by solid green line from 2000 to 2004. Solid orange lines are natural visibility conditions. Since no natural visibility conditions were established for HACR1, natural visibility was roughly estimated with the following relation: $HACR1_{Natural} = (HACR1_{Baseline}/HALE1_{Baseline}) \times (HALE1_{Natural})$; $HACR1_{Natural\ for\ 20\%\ worst\ days} = [9.48\ dv/13.3\ dv](7.4dv) = 5.3\ dv$; $HACR1_{Natural\ for\ 20\%\ best\ days} = [1.0\ dv/4.6dv](2.7) = 0.6\ dv$. Five year rolling averages of haze index show slight visibility improvements at both national parks for the 20% worst days and more significant visibility improvements for the 20% best days. For HACR1, the haze index reaches natural visibility conditions for the 20% best visibility days.

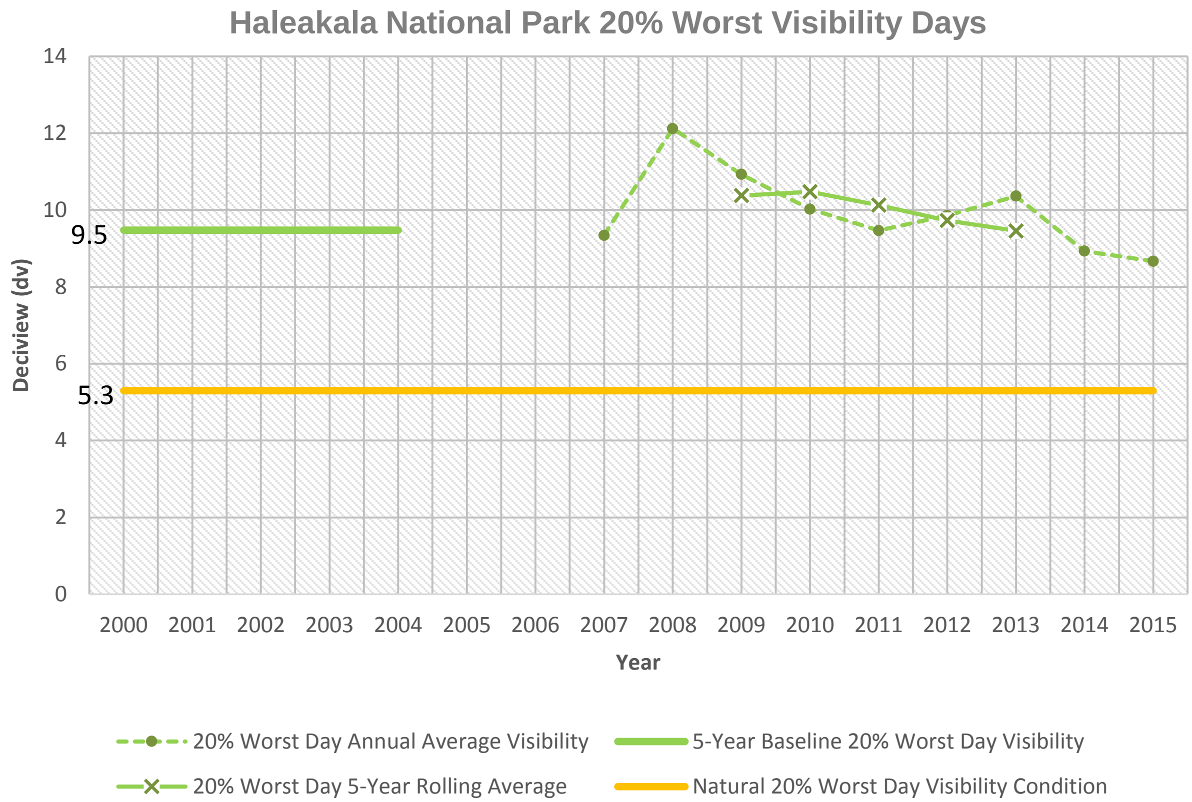

Figure 4.2-1 Haleakala National Park 20% Worst Day Visibility

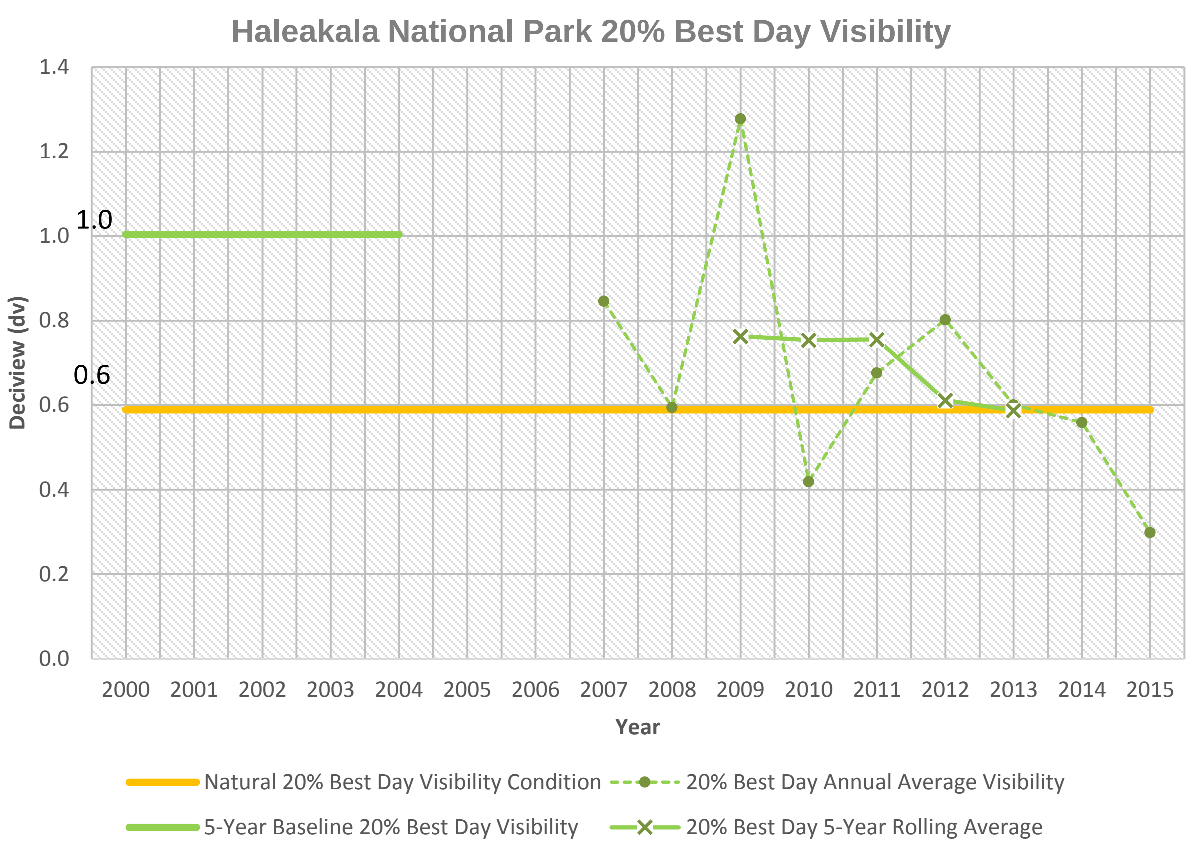

Figure 4.2-2 Haleakala National Park 20% Best Day Visibility

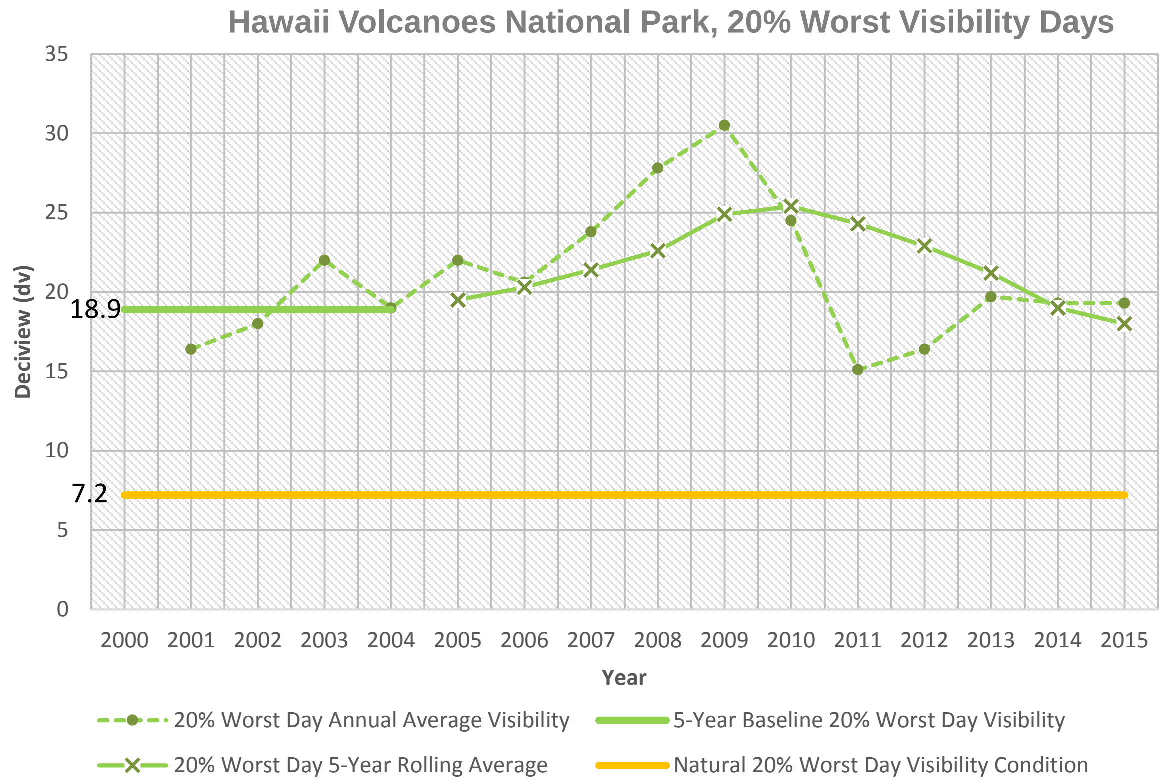

Figure 4.2-3 Hawaii Volcanoes National Park, 20% Worst Day Visibility

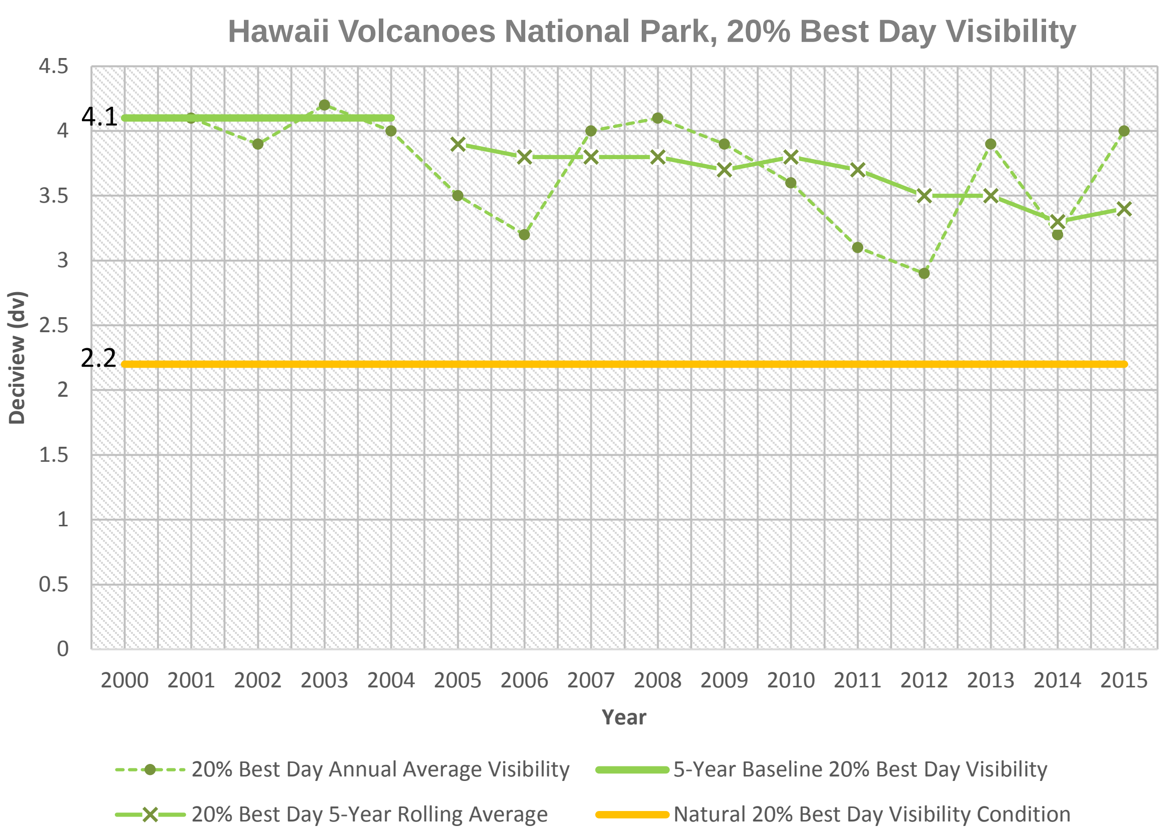

Figure 4.2-4 Hawaii Volcanoes National Park, 20% Best Day Visibility

Figures 4.2-5 to 4.2-6 and 4.2-7 to 4.2-9 present 5-year average light extinction between 2000 and 2015 for Haleakala National Park and Volcanoes National Park, respectively. Figures 4.2-5 to 4.2-7 and 4.2-9 include all aerosol species in the extinction. Figure 4.2-8 excludes sulfate to magnify contributions to light extinction from other aerosol species on the worst visibility days at Hawaii Volcanoes National Park.

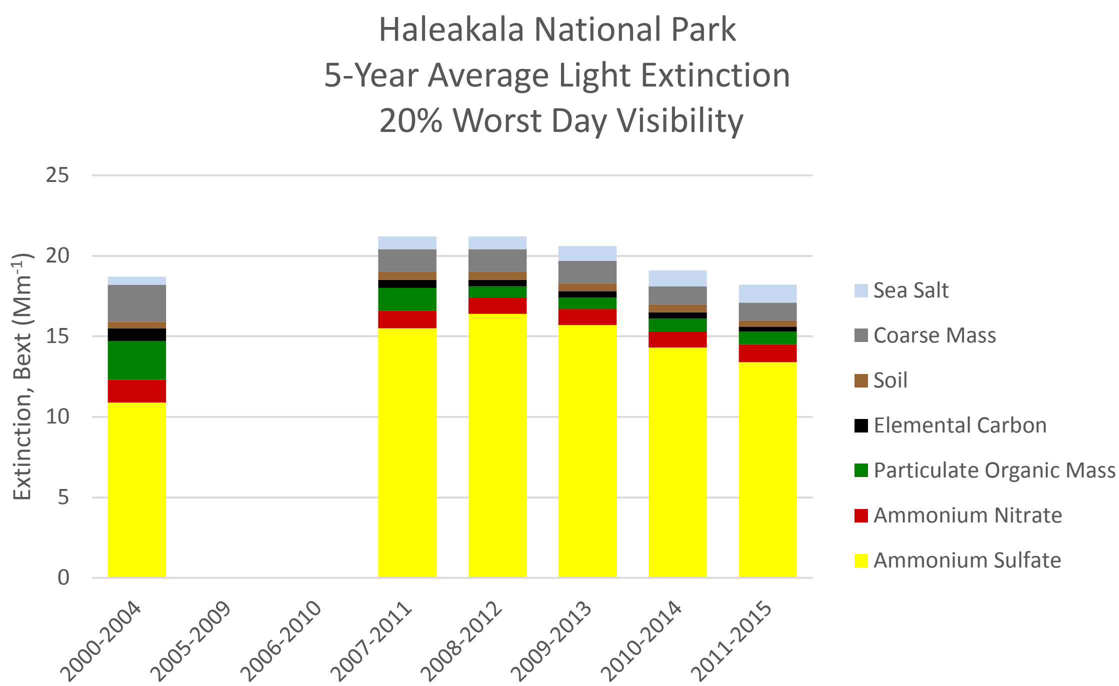

Figure 4.2-5 Haleakala National Park Light Extinction, 20% Worst Visibility Days

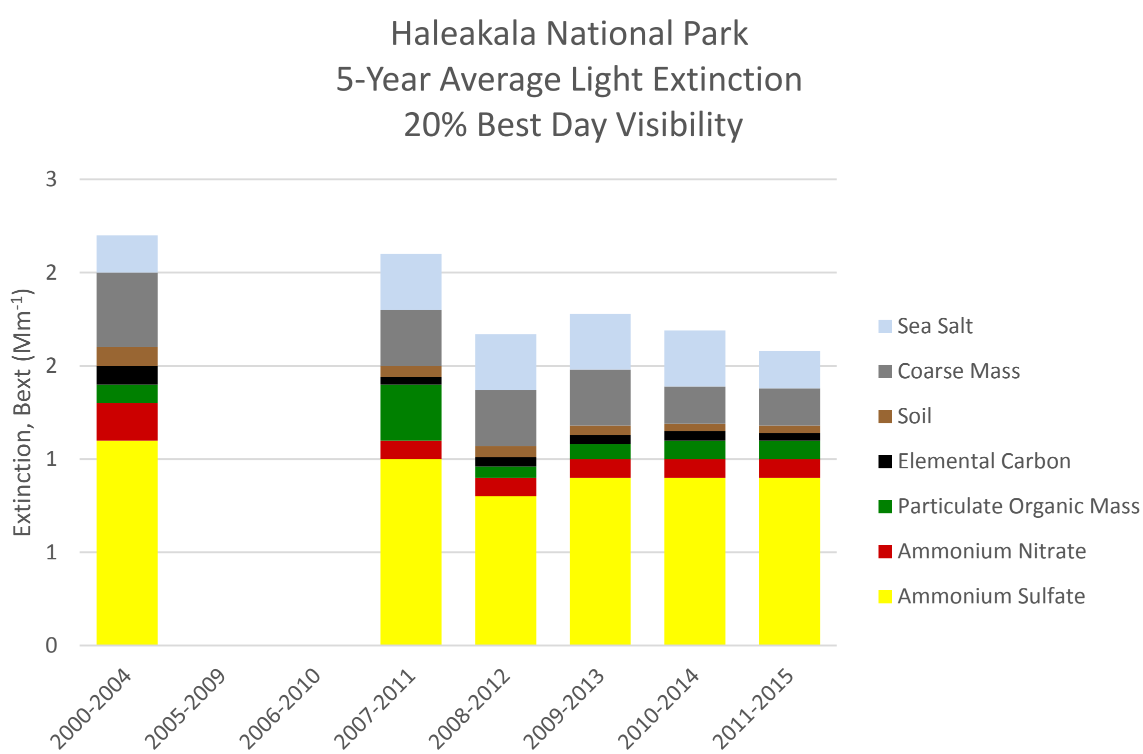

Figure 4.2-6 Haleakala National Park Light Extinction, 20% Best Visibility Days

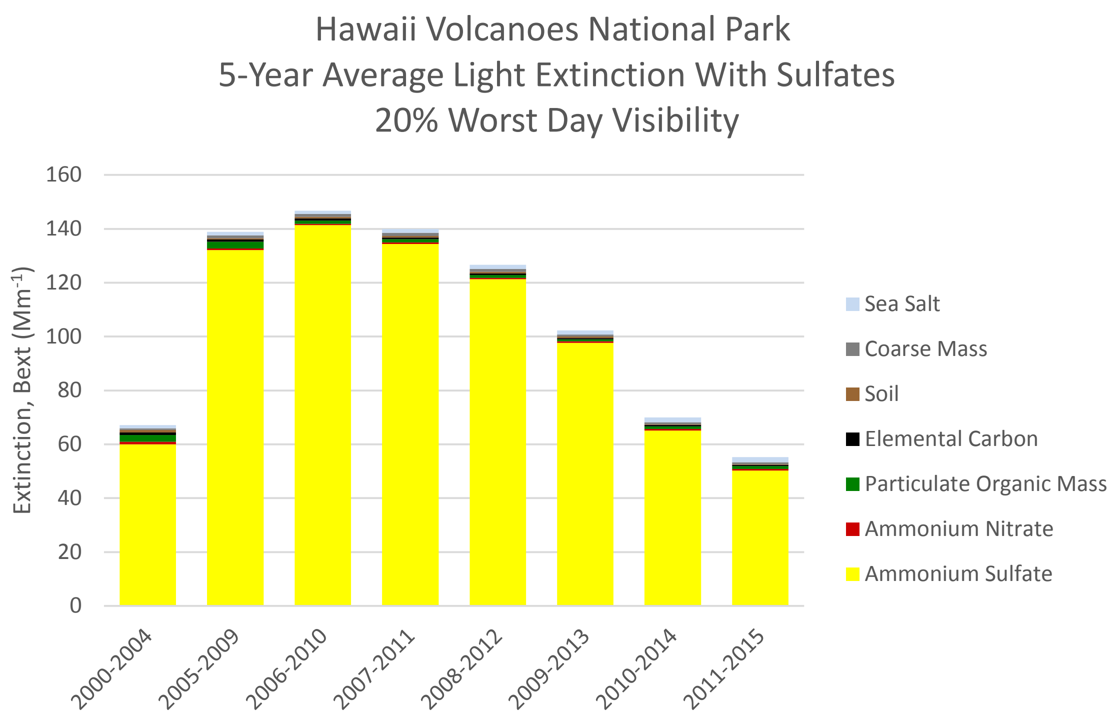

Figure 4.2-7 Hawaii Volcanoes National Park Light Extinction Including Sulfates, 20% Worst Visibility Days

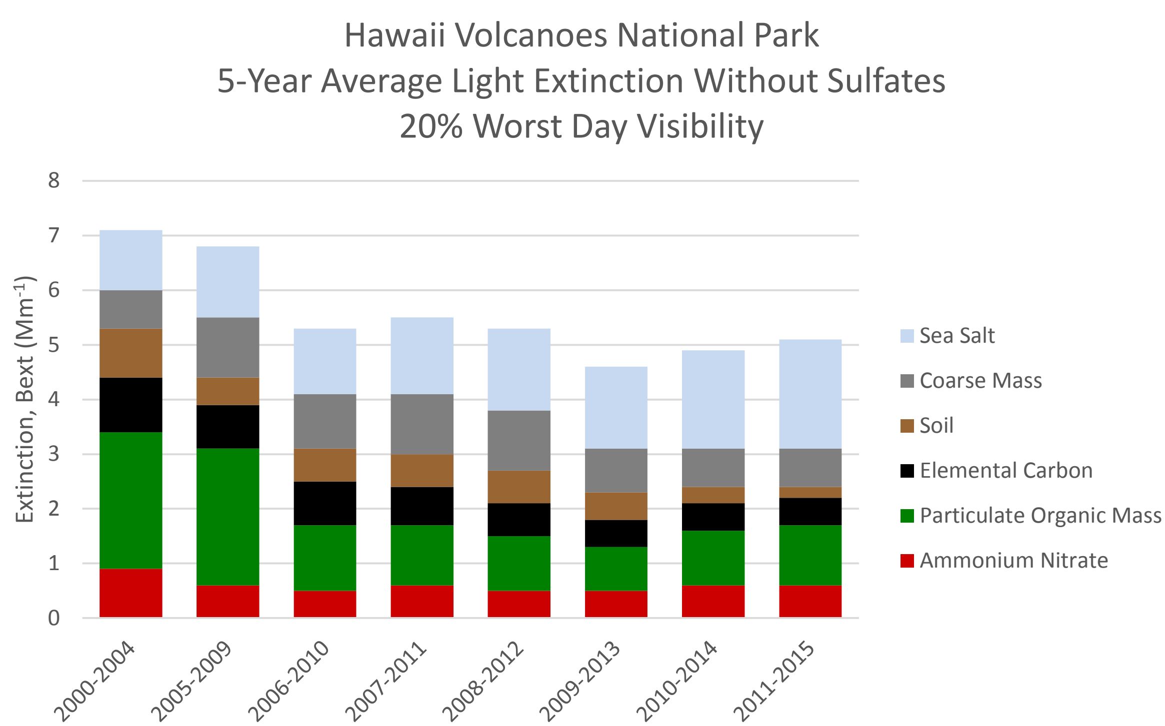

Figure 4.2-8 Hawaii Volcanoes National Park Light Extinction Excluding Sulfates, 20% Worst Visibility Days

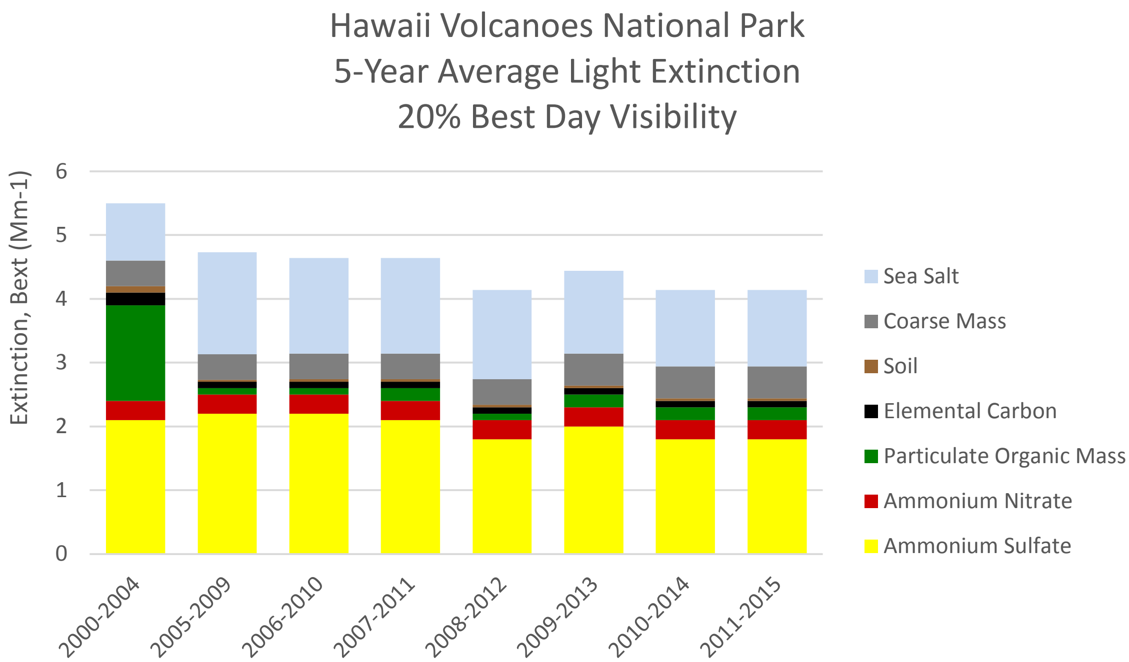

Figure 4.2-9 Hawaii Volcanoes National Park Light Extinction, 20% Best Visibility Days

Figures 4.2-10 and 4.2-11 show changes in speciated light extinction between the five-year baseline period (2000-2004) and current 5-Year progress period (2011-2015) for Haleakala National Park (HACR1) and Hawaii Volcanoes National Park (HAVO1), for the worst and best visibility days, respectively.

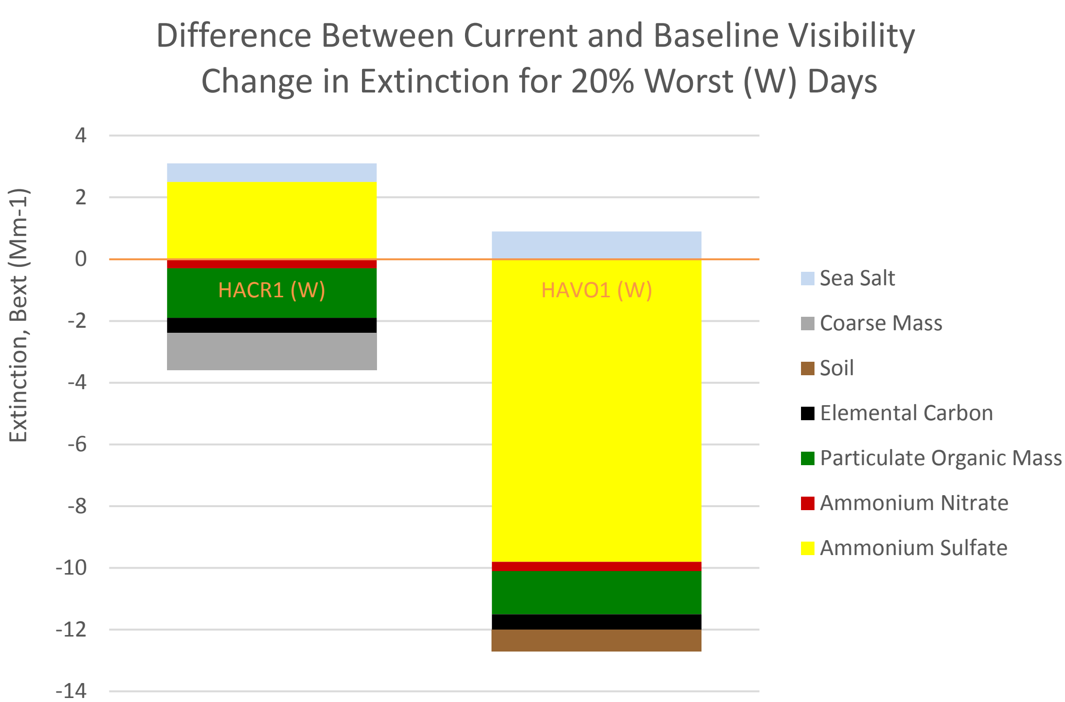

Figure 4.2-10 Change in Extinction for Worst Days at HACR1 and HAVO1

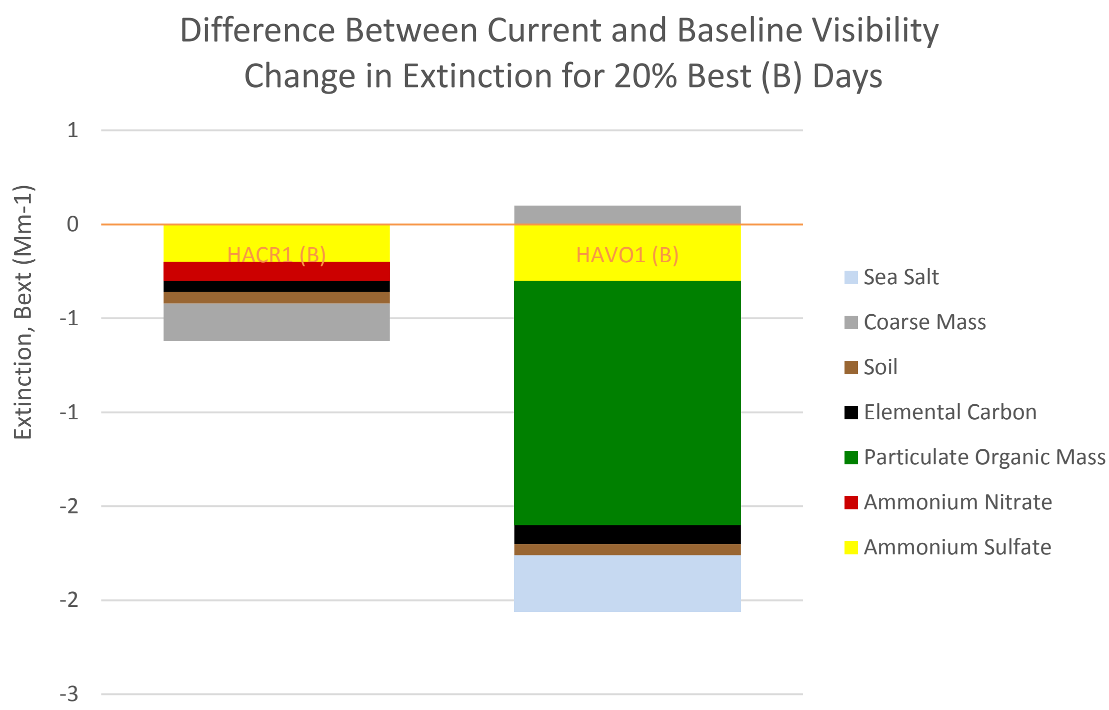

Figure 4.2-11 Change in Extinction for Best Days at HACR1 and HAVO1

4.3 Change in Visibility for Most and Least Impaired Days – 40 CFR 51.308(g)(3)(iii)

This section addresses the change in visibility impairment characterized by annual average trend statistics for HACR1 and HAVO1. Although 40 CFR §51.308(g)(3)(iii) specifies an evaluation of changes over the most current 5-Year progress period, as indicated in Reference 6, trend analysis is better suited to longer periods of time. Therefore DOH-CAB evaluated trends over the entire time of monitor operation. Data for the HACR1 was available from 2007 to 2015. For HAVO1, data was available from 2001 to 2015. Additional analysis is provided in Reference 6.

Tables 4.3-1 and 4.3-2 on Page 39 provide trend statistics for light extinction (b_{ext}) and haze index (dv) for HACR1 and HAVO1 at Haleakala and Volcanoes National Parks, respectively. Light extinction was evaluated for each species and trends in b_{ext} and haze index were determined with Linear Theil Regression. Individual site trends (%/yr) from the Theil Regression were computed using guidance in Reference 19 by dividing the slope from the regression of b_{ext} by the median of b_{ext} over the time period of the trend and multiplying by 100%.[19] Only trends for aerosol species and haze index with p-value statistics less than 0.15 (85% confidence level) are provided, with increasing slopes in red and decreasing slopes in blue.

[19] Widespread reductions in haze across the United States from the early 1990s through 2011, Atmospheric Environment, journal homepage: www.elsevier.com/locate/atmosenv.

A more comprehensive list of trends for all species, including the associated p-values, are provided in Appendix D. The following are some observations regarding changes in visibility impairment at HACR1 and HAVO1:

- Ammonium sulfate, associated primarily with volcanic activity, is the dominate aerosol extinction species at both Haleakala and Hawaii Volcanoes National Park. Please refer to Page 6 of Appendix D and yellow bars designating sulfate species in Figures 4.2-5 to 4.2-7 from Pages 34 to 35 and Figure 4.2-9 on Page 36.
- Charts on Page 6 of Appendix D show spikes in b_{ext} from sulfates at HACR1 and HAVO1 on the 20% worst visibility days. For HACR1, spikes from sulfates occur in 2008 (22.9 Mm^{-1}), 2009 (17.6 Mm^{-1}) and 2013 (19.2 Mm^{-1}). Spikes from sulfates occur in 2008 (179.5 Mm^{-1}) and 2009 (218.1 Mm^{-1}) at HAVO1.
- Charts on Page 14 of Appendix D for the 20% best days at the HACR1 and HAVO1 monitors also show spikes in b_{ext} from sulfates. For HACR1, an increase in b_{ext} from sulfate occurs in 2009 (1.2 Mm^{-1}). Spikes from sulfate also occur in 2003 (2.9 Mm^{-1}) and 2009 (2.7 Mm^{-1}) for the HAVO1 monitor.
- Light extinction spikes due to sulfates from 2008 to 2009 to 2013 at HACR1 and HAVO1 appear to be associated with increased SO_2 at the Kilauea volcano's summit after the new Halemua'uma'u vent opened in 2008. As indicated on Page 18 of Reference 20, SO_2 emissions began to increase at the Halemua'uma'u crater prior to December 2007; and on March 13, 2008, a new gas vent at Halema'uma'u increased the amount of SO_2 from this location ten-fold, from an estimated 200 to 2,000 tons per day.[20] See Figure 2-16 on Page 18 of Reference 20.[20]
- HACR1 shows the following statistically decreasing annual trends in b_{ext} (visibility improvement) over the past nine years (2007-2015):

  1) 56.7% (6.3%/yr, p = 0.13, Pages 6 and 30 of Appendix D) from sulfates for the 20% worst visibility days;
  2) 34.2% (3.8%/yr, p = 0.02, Pages 14 and 30 of Appendix D) from sulfates for the 20% best visibility days;
  3) 111.7% (12.4%/yr, p = 0.001, Pages 9 and 31 of Appendix D) from EC for the 20% worst visibility days;
  4) 42.3 % (4.7%/yr, p = 0.13, Pages 10 and 32 of Appendix D) from soil for the 20% worst visibility days;
  5) 101.7% (11.3%/yr, p = 0.09, Pages 18 and 32 of Appendix D) from soil for the 20% best visibility days; and
  6) 48.6% (5.4%/yr, p = 0.038, Pages 20 and 34 of Appendix D) from sea salt for the 20% best visibility days.

- As indicated above, light extinction from sulfates appears to be associated with volcanic activity for both HAVO1 and HACR1. For HACR1, a decreasing trend in b_{ext} is observed for sulfates over a nine year period (2007-2015); however, data over a longer fifteen year period from 2001 to 2015 for HAVO1, situated about 1.6 miles from Kilauea volcano's Halema'uma'u vent, indicates the trend from sulfates is insignificant.

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[20] Documentation for Natural Events Excluded Data Hilo Air Monitoring Station, AQS ID 15-001-2023; Ocean View Air Monitoring Station, AQS ID 15-001-2020; Pahala Air Monitoring Station, AQS ID 15-001-2016; 2012-2014 Sulfur Dioxide (SO_2) Exceedances; Final Report; January 2016 (Document Control Number HDOH-NEED-2015v01); State of Hawaii; Department of Health; Clean Air Branch

- HACR1 shows the following statistically decreasing annual trends in haze index (visibility improvement) over the past nine years (2007-2015):

  1) 24.2% (2.7%/yr, $p = 0.09$, Pages 13 and 35 of Appendix D) for the 20% worst visibility days; and
  2) 63.0% (7.0%/yr, $p = 0.06$, Pages 21 and 35 of Appendix D) for the 20% best visibility days.

- The b_{ext} from POM over the last nine years (2007-2015) has increased at HACR1 by 92.7% (10.3%/yr, $p = 0.09$, Pages 16, and 31 of Appendix D) for the 20% best visibility days.
- The b_{ext} from sea salt over the last nine years (2007-2015) has increased at HACR1 by 81.9% (9.1%/yr, $p = 0.01$, Pages 12 and 34 of Appendix D) for the 20% worst visibility days.
- The b_{ext} from sea salt over the last fifteen years (2001 – 2015) at HAVO1 has increased by 52.5% (3.5%/yr, $p=0.08$, Pages 12 and 33 of Appendix D) for the 20% worst visibility days.
- Over the last fifteen years (2001 -2015) b_{ext} due to CM has increased by 61.5% (4.1%/yr, $p = 0.02$, Pages 19 and 33 of Appendix D) for the 20% best visibility days at HAVO1.
- Reference 6 identified an anomalously high particulate organic event on the first sampling day in 2007 at HACR1 corresponding to a 2291 acre forest fire south-west of HACR1.

Table 4.3-1 2007-2015 Annual Average Trends in Aerosol Extinction by Species (HACR1)

Group	dv	Slope for Trend (Mm^{-1}/yr)						
		Ammonium Sulfate	Ammonium Nitrate	POM	EC	Soil	CM	Sea Salt
20% Best	**-0.04**	**-0.04**	------	**+0.01**	------	**-0.005**	------	**-0.01**
20% Worst	**-0.26**	**-0.86**	------	------	**-0.05**	**-0.02**	------	**+0.09**
All Days	**-0.12**	------	**-0.008**	------	**-0.02**	**-0.009**	**-0.03**	------

Table 4.3-2 2001-2015 Annual Average Trends in Aerosol Extinction by Species (HAVO1)

Group	dv	Slope for Trend (Mm^{-1}/yr)						
		Ammonium Sulfate	Ammonium Nitrate	POM	EC	Soil	CM	Sea Salt
20% Best	------	------	------	------	------	------	**+0.01**	------
20% Worst	------	------	------	------	------	------	------	**+0.05**
All Days	------	------	------	------	------	------	------	**+0.05**

5.0 Statewide Emissions Inventory Changes – 40 CFR 51.308(g)(4)

Section 5 provides statewide emissions inventory data for tracking the change over the past five (5) years in emissions of pollutants contributing to visibility impairment from all sources and activities within the state. For Hawaii, year 2005 was selected as the baseline emissions inventory because it was the most complete inventory available at the time technical work commenced for the RH-FIP. The most recent statewide emissions inventory data for tracking the changes in emissions was obtained from EPA's 2011 NEI. Table 5.0-1 lists the major emitted pollutants inventoried, the related aerosol species, and some of the major sources for each pollutant.[6] Statewide emissions inventories for SO_2, NO_X, NH_3, VOC, and PM_{10} are provided in Tables 5.0-2 and 5.0-3 for the 2005 baseline and 2011 inventory years. The 2005 emissions inventory, based on data in Reference 8, was derived from a 2010 study conducted by the consulting firm Environ on behalf of the Hawaii DOH-CAB that provided Hawaii's statewide emissions for 2002, 2005, and 2018.[8,21] The emission inventory numbers developed by Environ Corporation were refined, as applicable, by the Hawaii DOH-CAB.[8] The EPA also worked with the University of North Carolina and consulting firm ICF International to develop new emission inventories for on-road vehicles after finalizing a new model MOVES for estimating emissions from on-road vehicles.[8] The Hawaii emission inventories provided by Environ were updated with estimations using the MOVES model. Reference 6 also provides statewide emission changes between the 2005 and 2008 emission inventory years.

[21] Final Emission Inventory Report: Data Population of Air System For Hawaii's Emissions Data (AirSHED), Prepared for Hawaii Department of Health by ENVIRON International Corporation.

Table 5.0-1 Hawaii Pollutants, Aerosol Species, and Major Sources[1]			
Emitted Pollutant	Related Aerosol	Major Sources	Notes
SO_2	Ammonium Sulfate	Point Sources; On- and Off-Road Mobile Sources; Volcanic Emissions	SO_2 emissions are generally associated with anthropogenic sources such as fuel oil fired power plants, large commercial operations such aggregate processing or sugar cane processing, and both on- and off-road diesel engines. Also, in Hawaii, volcanic activity contributes significantly to natural emissions of SO_2, and it is possible that some of these emissions are transported to the contiguous states.
NO_X	Ammonium Nitrate	On- and Off-Road Mobile Sources; Point Sources; Area Sources	NO_X emissions are generally associated with anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.
NH_3	Ammonium Sulfate & Ammonium Nitrate	Area Sources; On-Road Mobile Sources	Gaseous NH_3 has implications in particulate formation because it can form particulate ammonium. Ammonium is not directly measured by the IMPROVE program, but affects formation potential of ammonium sulfate and ammonium nitrate. All measured nitrate and sulfate is assumed to be associated with ammonium for IMPROVE reporting purposes.
VOCs	Particulate Organic Mass (POM)	Biogenic Emissions; Vehicle Emissions; Area Sources	VOCs are gaseous emissions of carbon compounds, which are often converted to POM through chemical reactions in the atmosphere. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions (see Section 3.2.1 of Reference 6).
Fine Soil	Soil	Windblown Dust; Fugitive Dust; Road Dust; Area Sources	Fine soil is reported here as the crustal or soil components of $PM_{2.5}$.
Coarse Mass (PMC)	Coarse Mass	Windblown Dust; Fugitive Dust	Coarse mass is reported by the IMPROVE Network as the difference between PM_{10} and $PM_{2.5}$ mass measurements. Coarse mass is not separated by species in the same way that $PM_{2.5}$ is speciated, but these measurements are generally associated with crustal components. Similar to crustal $PM_{2.5}$, natural windblown dust is often the largest contributor to PMC.

1. From Table 6.5-7 on Page 6-131 of Reference 6.

Table 5.0-2 Statewide Emissions Inventory 2005 (see note 1)					
Source Category	SO_2	NO_X	VOC	PM_{10}	NH_3
Anthropogenic Sources (TPY)					
Point Sources	27,072	22,745	2,695	3,536	12
Area Sources	3,716	1,509	16,920	33,408	11,136
Agricultural Burning	178	406	535	1,567	60
Other Fire	0	1	7	7	0
On-Road Mobile Sources	321	20,642	12,066	638	1,085
Non-Road Mobile Sources[2]	669	6,296	6,383	649	0
Marine[3]	3,619	5,624	209	398	0
Total Anthropogenic	**35,575**	**57,223**	**38,815**	**40,203**	**12,298**
Natural Sources (TPY)					
Volcano	961,366	0	0	0	0
Sea Spray	0	0	0	382,637	0
Windblown Dust	0	0	0	46,808	0
Wildfire	591	2,156	4,729	9,771	540
Biogenic	0	4,617	130,153	0	0
Total Natural	**961,957**	**6,773**	**134,882**	**439,216**	**540**
All Sources (TPY)					
Total Overall Emissions	**997,532**	**63,996**	**173,697**	**479,419**	**12,838**

1. Based on emission inventory work from ENVIRON International Corporation (Reference 21)
2. Non-Road Mobile totals include aircraft and locomotive emissions.
3. Marine totals include in/near/underway emissions.

Table 5.0-3 Statewide Emissions Inventory 2011 (see note 1)					
Source Category	SO_2	NO_X	VOC	PM_{10}	NH_3
Anthropogenic Sources (TPY)					
Point Sources	22,047	28,982	3,059	2,813	1,031
Area Sources[2]	3,331	1,176	18,425	34,803	7,547
Agricultural Burning	178	405	535	1,567	148
Prescribed Burning	36	389	1,672	853	59
On-Road Mobile Sources	102	15,503	11,180	305	412
Non-Road Mobile Sources	7	3,842	5,428	403	6
Marine[3]	2,037	4,895	154	338	3
Total Anthropogenic	**27,738**	**55,192**	**40,453**	**41,420**	**9,749**
Natural Sources (TPY)					
Volcano[4]	406,030	0	0	0	0
Sea Spray[5]	0	0	0	382,637	0
Windblown Dust[5]	0	0	0	46,808	0
Wildfire	9	99	390	162	12
Biogenic[5]	0	4,617	130,153	0	0
Total Natural	**406,030**	**4,716**	**130,543**	**429,607**	**12**
All Sources (TPY)					
Total Overall Emissions	**433,768**	**59,808**	**170,996**	**471,027**	**9,761**

1. Based on 2011 NEI at: https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data.
2. Area source emissions exclude agricultural burning and marine.
3. Marine totals include diesel port diesel underway, residual port and residual underway.
4. Based on SO_2 emission rates reported by USGS for Kilauea volcano that was reported in Ref. 22.[22]
5. Based on emission inventory work from ENVIRON International Corporation for 2005 and 2008 (Ref. 21).[21]

[22] State of Hawaii Department of Health Clean Air Branch, Documentation for Natural Excluded Data Kona Air Monitoring Station, AQS ID 15-001-1012, 2011-2012 $PM_{2.5}$ Exceedances, Final Report, December 2013.

Figures 5.0-1 through 5.0-3, based on emissions inventory data from Tables 5.0-2 and 5.0-3, show that nonanthropogenic (natural) emissions are significant for SO_2, PM_{10}, and VOCs. As shown in Figure 5.0-1, SO_2 from the volcano overwhelms statewide anthropogenic sources of SO_2. Volcanic SO_2 emissions are 96% of total SO_2 emissions (statewide anthropogenic SO_2 + volcanic SO_2). Also, SO_2 emissions would have been higher for 2005 and 2011 if updated methods were used to measure emissions. In 2014 USGS-HAVO began using more accurate techniques to measure emissions rates at the Halema'uma'u summit vent using a fixed array of ten (10) upward-facing ultraviolet spectrometers that replaced measurement of SO_2 with vehicle-based ultraviolet light spectrometer for the Halema'uma'u vent. According to USGS-HAVO, the numbers increased from the vehicle based measuring method by a factor of two (2) to four (4). In Figure 5.0-2 statewide PM_{10} emissions from sea spray, accounting for 90% of the total statewide emissions, dominate anthropogenic PM_{10}. Figure 5.0-3 shows that natural emissions from plants and soils are a dominate source of VOC, accounting for 77% of the total statewide VOC emissions.

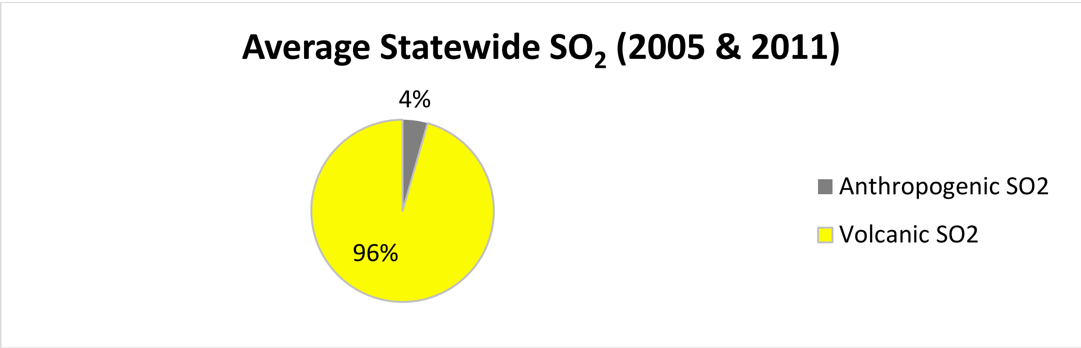

Figure 5.0-1 Average Statewide Anthropogenic and Volcanic SO_2

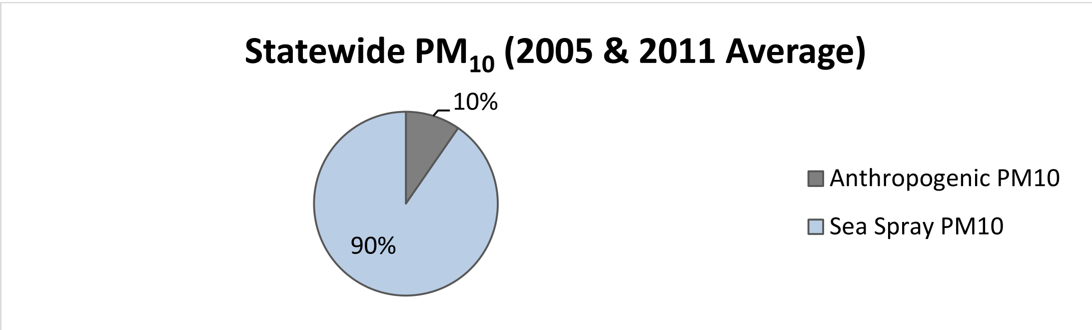

Figure 5.0-2 Average Statewide Anthropogenic and Sea Spray PM_{10}

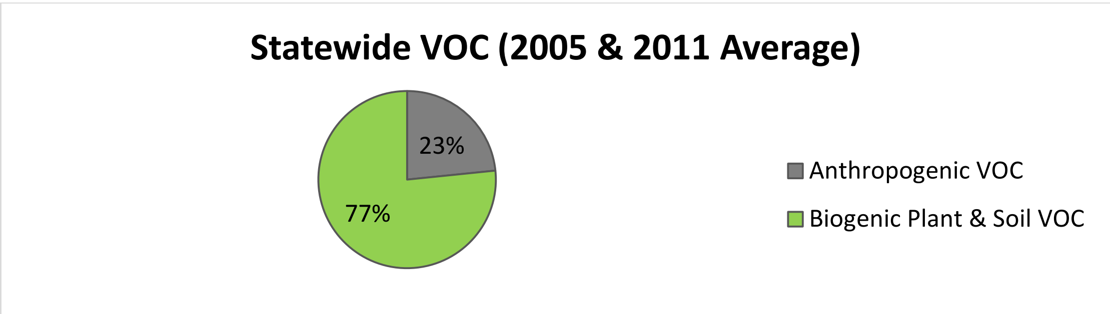

Figure 5.0-3 Average Statewide Anthropogenic and Biogenic Plant & Soil VOC

6.0 Changes in Emissions – 40 CFR 51.308(g)(5)

Section 6 provides an assessment for any significant changes in anthropogenic emissions within or outside the state that have occurred over the past five years that have limited or impeded progress in reducing pollutant emissions and improving visibility. Anthropogenic emissions from Tables 5.0-2 and 5.0-3 were used for the assessment.

The difference in statewide SO_2 emission inventory totals for the 2005 baseline and 2011 progress period in Table 6.0-1 and Figure 6.0-1 show an overall decrease in SO_2 emissions. The only increases in SO_2 emissions is from the other fire/prescribed burning source category. The increase is less than 1% of total SO_2 emitted by all sources statewide for both the 2005 and 2011 emission years.

Table 6.0-1 Difference in Statewide Anthropogenic Sulfur Dioxide Emissions

Source Category	Statewide Sulfur Dioxide (TPY)			
	2005	2011	Difference	Percent Change
Point Sources	27,072	22,047	-5,025	-19%
Area Sources	3,716	3,331	-385	-10%
Agricultural Burning	178	178	0	0%
Other Fire/Prescribed Burning	0	36	36	>100%
On-Road Mobile Sources	321	102	-219	-68%
Non-Road Mobile Sources	669	7	-662	-99%
Marine	3,619	2,037	-1,582	-44%
Total Anthropogenic	**35,575**	**27,775**	**-7,837**	**-22%**

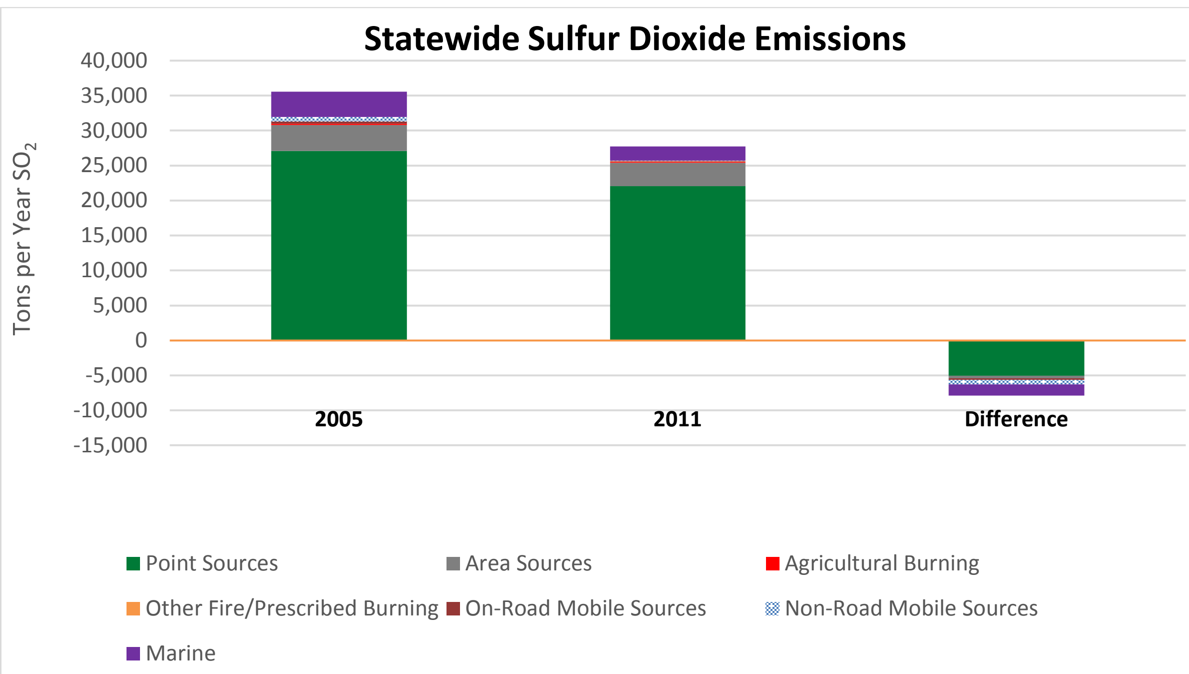

Figure 6.0-1 2005 and 2011 Emissions and Difference in Emission Inventory Totals for Sulfur Dioxide by Source Category for Hawaii

The difference in NO_X emission inventory totals from the 2005 baseline and 2011 progress period in Table 6.0-2 and Figure 6.0-2 show an overall decrease in NO_X emissions. The only increases in NO_X are from the point and other fire/prescribed burning source categories. For point sources, the change is consistent with Reference 8 that projected an increase in NO_X emissions from point sources from 2005 to 2018. A majority of point source emissions are on the Island of Oahu where prevailing trade winds would blow pollutants away from the Class I Areas a majority of the time. Figures 6.0-5 and 6.0-6 also show that NO_X emissions from point sources between 2011 and 2015 are lower than the 2018 projected emissions for the Islands of Maui and Hawaii where the Class I areas are located. The increase in NO_X emissions from 2005 to 2011 for the other fire/prescribed burning source category is less significant, accounting for about 1% of the total NO_X emitted by all sources statewide for both the 2005 and 2011 emission years.

Table 6.0-2 Difference in Statewide Anthropogenic Nitrogen Oxide Emissions

Source Category	Statewide Nitrogen Oxide (TPY)			
	2005	2011	Difference	Percent Change
Point Sources	22,745	28,982	6,237	27%
Area Sources	1,509	1,176	-333	-22%
Agricultural Burning	406	405	-1	-0.2%
Other Fire/Prescribed Burning	1	389	388	>100%
On-Road Mobile Sources	20,642	15,503	-5,139	-25%
Non-Road Mobile Sources	6,296	3,842	-2,454	-39%
Marine	5,624	4,895	-729	-13%
Total Anthropogenic	**57,223**	**55,192**	**-2,031**	**-4%**

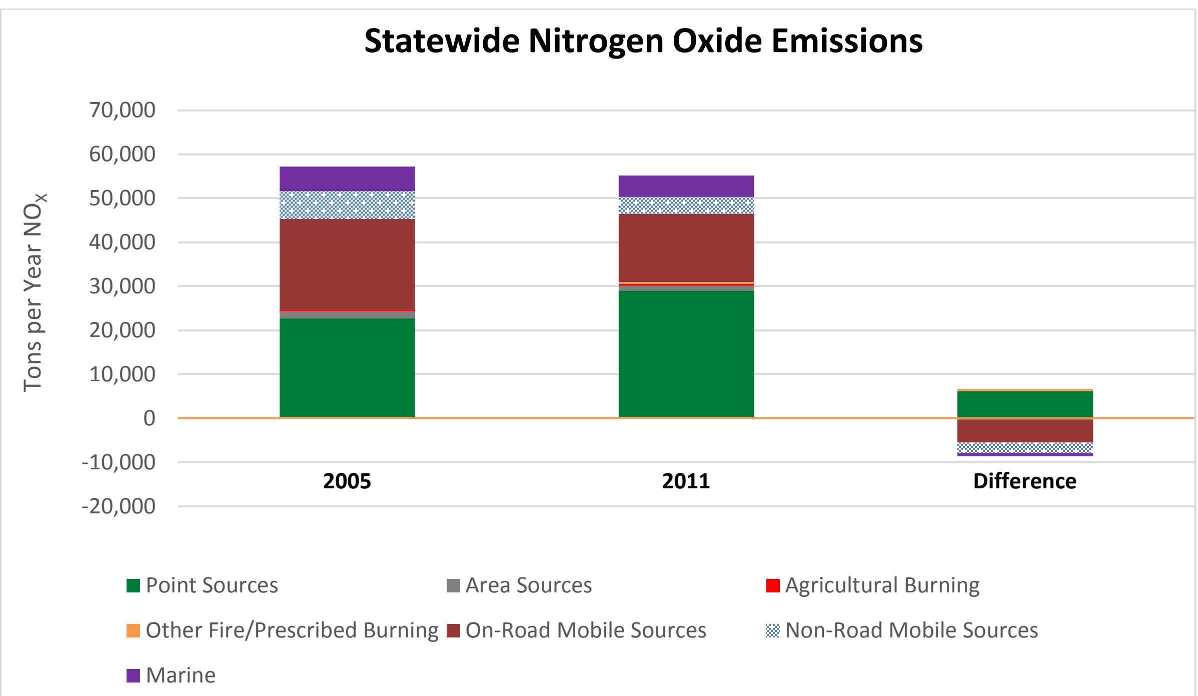

Figure 6.0-2 2005 and 2011 Emissions and Difference in Emission Inventory Totals for Nitrogen Oxide by Source Category for Hawaii

The difference in VOC emission inventory totals for the 2005 baseline and 2011 progress period in Table 6.0-3 and Figure 6.0-3 show an overall increase in statewide VOC emissions. Increases in VOC emissions from 2005 to 2011 are shown for point, area, and other fire/prescribed fire source categories. For point and area sources, the change is consistent with Reference 8 that projected an increase in VOCs from these sources from 2005 to 2018. A majority of these point and area source emissions are on the Island of Oahu based on 2011 NEI data. As indicated in Figure 2.0-3, prevailing trade winds would blow pollutants emitted by sources on Oahu away from the Class I Areas a majority of the time. A large increase in VOC emissions from 2005 to 2011 is attributed to the other fire/prescribed burning source category which is about 4% of the total VOCs emitted by all sources statewide for both the 2005 and 2011 emission years.

Table 6.0-3 Difference in Statewide Anthropogenic Volatile Organic Compound Emissions

Source Category	Statewide Volatile Organic Compound (TPY)			
	2005	2011	Difference	Percent Change
Point Sources	2,695	3,059	364	14%
Area Sources	16,920	18,425	1,505	9%
Agricultural Burning	535	535	0	0%
Other Fire/Prescribed Burning	7	1,672	1,665	>100%
On-Road Mobile Sources	12,066	11,180	-886	-25%
Non-Road Mobile Sources	6,383	5,428	-955	-15%
Marine	209	154	-55	-26%
Total Anthropogenic	**38,815**	**40,453**	**1,638**	**4%**

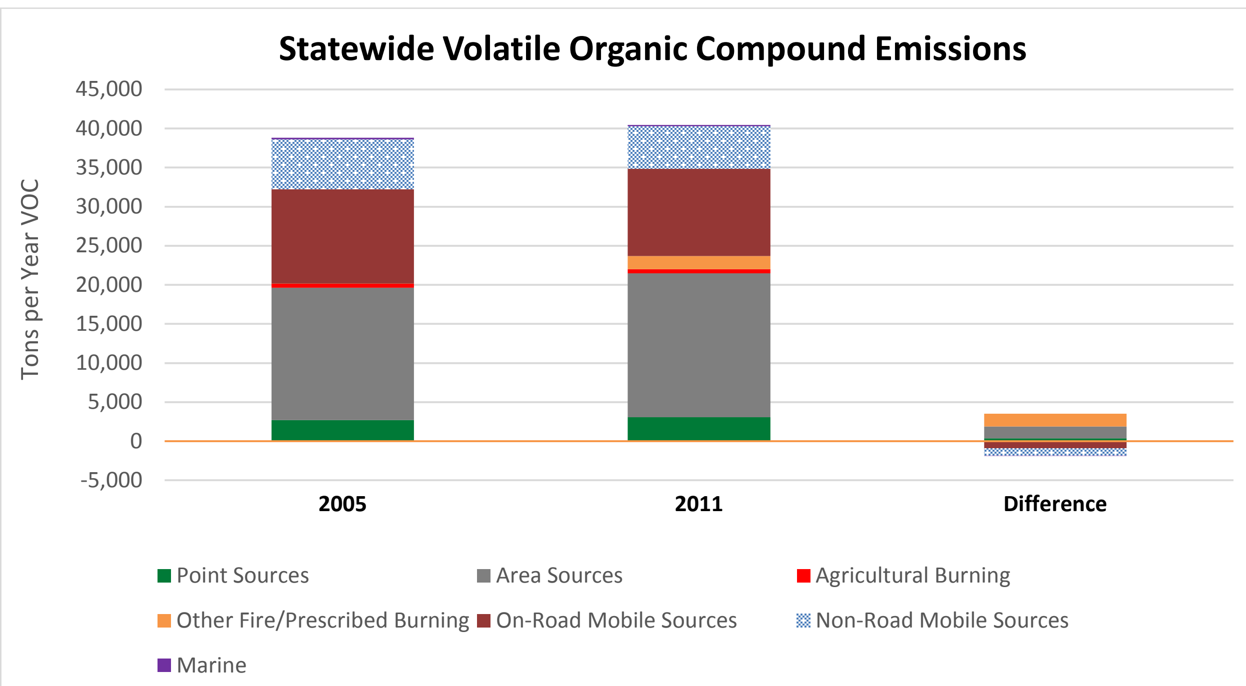

Figure 6.0-3 2005 and 2011 Emissions and Difference in Emission Inventory Totals for Volatile Organic Compound by Source Category for Hawaii

The difference in NH_3 emissions inventory totals for the 2005 baseline and 2011 progress period in Table 6.0-4 and Figure 6.0-4 show an overall decrease in statewide NH_3 emissions. Increases in NH_3 emissions are shown for point, agricultural burning, other fire/prescribed burning, non-road mobile, and marine source categories. For point sources, a majority of the NH_3 emissions are from sources on Oahu where prevailing trade winds would blow pollutants away from the Class I areas a majority of the time. The total combined increase in NH_3 emissions from agricultural burning, other fire/prescribed burning, non-road mobile, and marine source categories is less than 2% of the total NH_3 emitted by all sources statewide for both the 2005 and 2011 emission years.

Table 6.0-4 Difference in Statewide Anthropogenic Ammonia Emissions

Source Category	Statewide Ammonia (TPY)			
	2005	2011	Difference	Percent Change
Point Sources	12	1,031	1,019	>100%
Area Sources	11,136	7,547	-3,589	-32%
Agricultural Burning	60	148	88	>100%
Other Fire/Prescribed Burning	0	59	59	>100%
On-Road Mobile Sources	1,085	412	-673	-62%
Non-Road Mobile Sources	0	6	6	>100%
Marine	0	3	3	>100%
Total Anthropogenic	**12,293**	**9,206**	**-3,087**	**-25%**

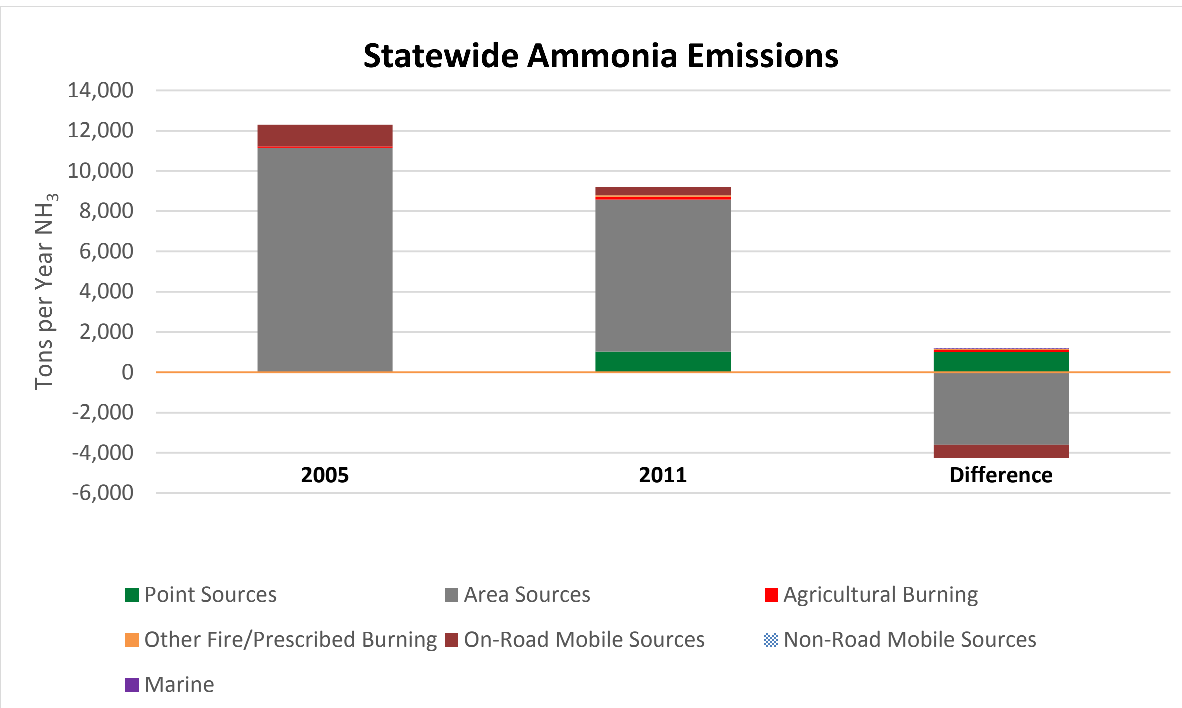

Figure 6.0-4 2005 and 2011 Emissions and Difference in Emission Inventory Totals for Ammonia by Source Category for Hawaii

Tables 6.0-5 and 6.0.6 compare SO_2 and NO_X emissions between 2011 and 2015 to the 2005 baseline and 2018 projected emissions provided in Reference 8 for Maui point sources. Point source emissions are also shown in Figure 6.0-5. The location of Maui point sources are shown on map in Figure 2.0-1. There has been about a 54% reduction in SO_2 and 73% reduction in NO_X emissions from Maui point sources from 2005 to 2015. The SO_2 and NO_X emissions from Maui point sources for the 2015 are also lower than 2018 projected emissions.

Table 6.0-5 Maui Island Point Source SO_2 Emissions

Source		SO_2 (TPY)						
		2005	2011	2012	2013	2014	2015	2018
1	MECO Maalaea	913	688	509	465	549	600	923
2	HC& S	424	302	241	217	219	206	469
3	Ameron Camp 10	0	1	0	0	1	1	0
4	MECO Kahului	3,198	2,230	1,912	1,400	1,634	1,311	3,233
5	Maui Pineapple	24	0	0	0	0	0	0
	Total SO_2 →	**4,559**	**3,221**	**2,662**	**2,082**	**2,403**	**2,118**	**4,625**

Table 6.0-6 Maui Island Point Source NO_X Emissions

Source		NO_X (TPY)						
		2005	2011	2012	2013	2014	2015	2018
1	MECO Maalaea	3,255	2,894	2,375	1,899	2,114	241	3,291
2	HC& S	617	714	651	764	692	613	760
3	Ameron Camp 10	4	4	2	4	8	5	4
4	MECO Kahului	536	648	600	457	483	361	542
5	Maui Pineapple	80	0	0	0	0	0	0
	Total NO_X →	**4,492**	**4,260**	**3,628**	**3,124**	**3,297**	**1,220**	**4,597**

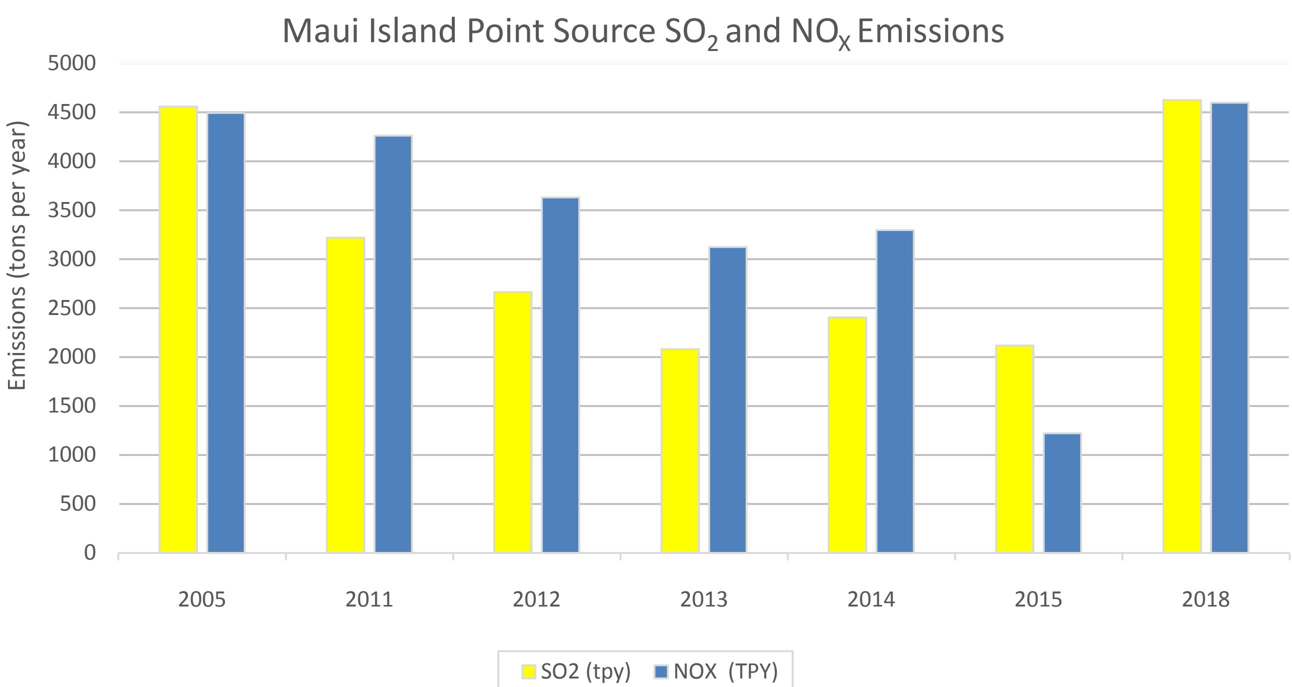

Figure 6.0-5 2011 to 2015 SO_2 and NO_X Emissions Compared to 2005 Baseline and 2018 Projected Emissions for Maui Island Point Sources

Tables 6.0-7 and 6.0.8 compare SO_2 and NO_X emissions between 2011 and 2015 to the 2005 baseline and 2018 projected emissions provided in Reference 8 for Hawaii Island point sources. Point source emissions are also provided in Figure 6.0-6 and these sources are shown on Map in Figure 2.0-1. From 2005 to 2015 there has been about a 16% reduction in NO_X emissions and a 51% reduction in SO_2 emissions from Hawaii point sources. The respective NO_X and SO_2 emissions from Hawaii point sources for the 2015 operating year are also 47% and 57% lower than 2018 projected emissions.

Table 6.0-7 Hawaii Island Point Source SO_2 Emissions

Source		SO_2 (TPY)						
		2005 Baseline	2011	2012	2013	2014	2015	2018 Projected
1	HELCO Waimea	5	1	0	0	0	0	5
2	HELCO Keahole	157	71	70	70	100	93	182
3	HELCO Puna	1,345	890	822	876	524	70	1,556
4	Mauna Loa Mac Nut[1]	0	4	6	9	6	5	0
5	HELCO Hill	2,822	2,252	1,798	1,795	1,852	2,079	3,264
6	HELCO Shipman	222	72	1	1	0	0	166
7	Hu Honua Bioenergy	0	0	0	0	0	0	78
8	Hamakua Energy	30	17	16	2	1	3	0
--	Tradewinds Forest[2]	Changed to Nonpoint Source					133	15
Total SO_2 →		**4,581**	**3,303**	**2,713**	**2,753**	**2,483**	**2,250**	**5,266**

1. After further evaluation of the emissions for burning Macadamia nut shells, this facility was determined to be a point source after the 2005 operating year. The 2005 baseline and 2018 projected emissions were not determined for this facility in RH-FIP technical support document.
2. The 2005 baseline and 2018 projected emissions were not determined for this facility in technical support document for the RH-FIP.

Table 6.0-8 Hawaii Island Point Source NO_X Emissions

Source		NO_X (TPY)						
		2005 Baseline	2011	2012	2013	2014	2015	2018 Projected
1	HELCO Waimea	89	40	19	108	54	51	103
2	HELCO Keahole	154	104	94	93	118	114	178
3	HELCO Puna	241	116	114	123	70	21	279
4	Mauna Loa Mac Nut[1]	See Note 1	75	111	75	70	63	0
5	HELCO Hill	514	669	602	626	611	639	595
6	HELCO Shipman	38	13	8	1	0	0	28
7	Hu Honua Bioenergy	0	0	0	0	0	0	420
8	Hamakua Energy[2]	74	41	43	29	32	40	0
---	Tradewinds Forest	Changed to Nonpoint Source						133
Total NO_X →		**1,110**	**1,058**	**991**	**1,055**	**955**	**928**	**1,736**

1. After further evaluation of the emissions for burning Macadamia nut shells, this facility was determined to be a point source after the 2005 operating year. The 2005 baseline and 2018 projected emissions were not determined for this facility in the RH-FIP.
2. The 2005 baseline and 2018 projected emissions were not determined for this facility in technical support document for the RH-FIP.

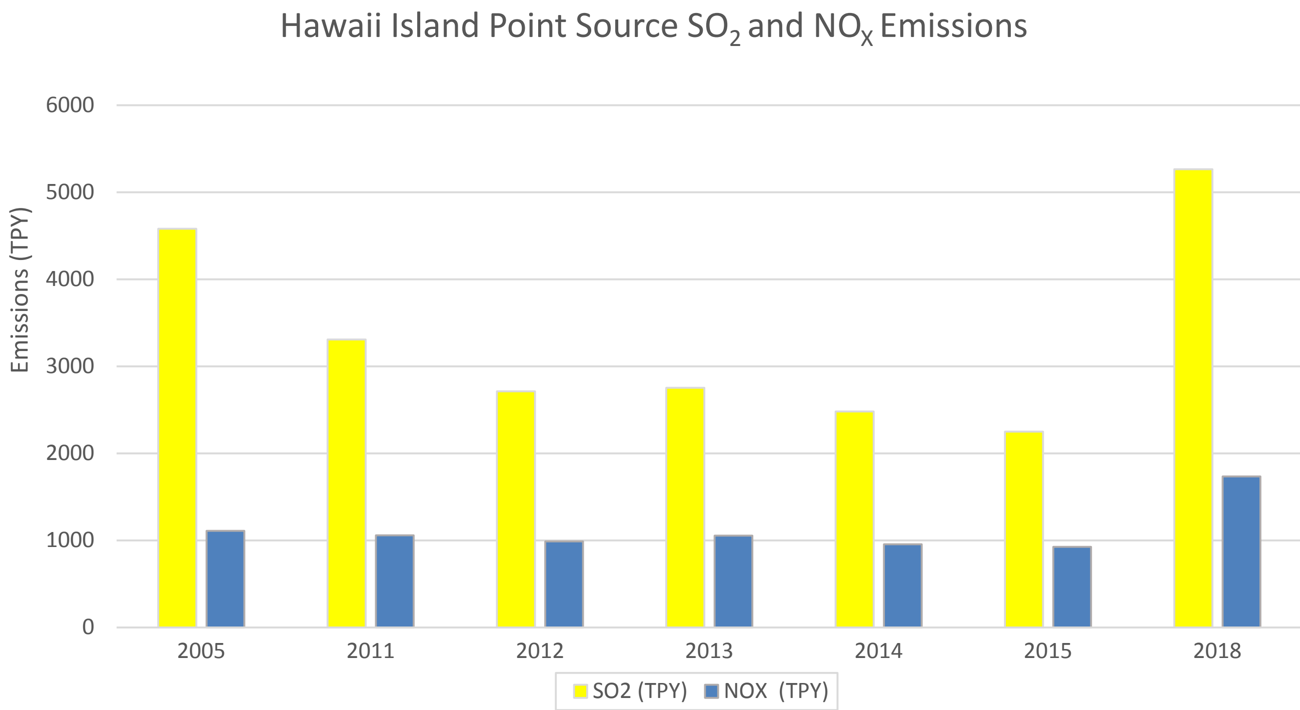

Figure 6.0-6 2011 to 2015 SO_2 and NO_X Emissions Compared to 2005 Baseline and 2018 Projected Emissions for Hawaii Island Point Sources

Anthropogenic emissions outside Hawaii that are beyond State control include global emissions from Asian Dust. Source apportionment analysis with IMPROVE data and Positive Matrix Factorization (PMF) found that Asian Dust contributed to 10% and 2% of the light extinction for the HALE1 monitor at Haleakala National Park for 2005 and 2003-2008 data sets, respectively.[23] Analysis of the IMPROVE data with PMF for the HAVO1 monitor found that Asian Dust contributed to 1.3% and 0.4% of the light extinction at Hawaii Volcanoes National Park for 2005 and 2003-2008 data sets, respectively.[23]

International shipping is another source of emissions outside the State that can affect visibility in Hawaii's National Parks. Source apportionment analysis with IMPROVE data and PMF found that shipping contributed to 2% and 3% of the light extinction for the HALE1 monitor at Haleakala National Park for 2005 and 2003-2008 data sets, respectively.[23] Analysis of the IMPROVE data with PMF for the HAVO1 monitor found that shipping contributed to 1.1% and 1.5% of the light extinction at Hawaii Volcanoes National Park for 2005 and 2003-2008 data sets, respectively.[23] As with Asian Dust, Hawaii is not able to control these sources of international emissions that can contribute to visibility impairment.

[23] State of Hawaii, Department of Health, Clean Air Branch, C. 2 Documents Related to Causes of Haze for Haleakala and Hawaii Volcanoes National Parks, C.2.a, C.2.b, C.2.c, C.2.e, C.2.f; https://www.regulations.gov/document?D=EPA-R09-OAR-2012-0345-0005.

7.0 Assessment of Current Strategy – 40 CFR 51.308(g)(6)

Section 7 provides an assessment of whether the current implementation plan elements and strategies are sufficient to enable the State to meet all established reasonable progress goals.

Since no modeling was available for the first 2008-2018 planning period, EPA used projections based on island-specific emission inventories as a surrogate for judging whether reasonable progress is being made. For this Section 7 assessment, the most current visibility conditions in 2015 where compared to the 2005 baseline and 2018 projected visibility conditions from Reference 8. Visibility conditions for 2005, 2015, and 2018 were evaluated using island specified emission inventories for NO_X and SO_2 and the following assumptions for establishing the 2005 baseline and 2018 projected visibility conditions in Reference 8:

1. Sea salt, soil, coarse mass, organic carbon, and elemental carbon were assumed to be constant for the 20% best days and 20% worst days for Haleakala National Park and Hawaii Volcanoes National Park.

2. The visibility impact from nitrate was projected for Haleakala National Park and Hawaii Volcanoes National Park based on the percentage change in NO_X emissions between the baseline emissions in 2005 and projected anthropogenic NO_X for 2018. This indicated a 20% and 21% decrease in anthropogenic NO_X from 2005 to 2018 for Maui and Hawaii Islands, respectively. EPA assumed that nonanthropogenic emissions were unchanged from the 2005 baseline emissions inventory. Benefits from the ECA in transit shipping emissions were not considered in the projections.

3. The visibility impact from sulfate was projected for Haleakala National Park based on the change in SO_2 emissions between the 2005 and 2018 anthropogenic emission inventories. This indicated a 7.9% decrease in anthropogenic SO_2 from 2005 to 2018 for Maui Island. EPA also assumed that the anthropogenic visibility impact was 33% of the total for Maui Island on the 20% worst days and 70% of the total for the 20% best days. Although a 3,550 TPY SO_2 emissions cap for power plants on Hawaii Island would likely reduce sulfate at Haleakala National Park to some extent, this reduction was not accounted for in the 2018 projections for Maui Island. Therefore, 2018 projections with and without the FIP are the same.

4. Light extinction values for 2015 from the HACR1 were multiplied by the ratio [HACR1 b_{ext} x (HALE1 Baseline b_{ext}/HACR1 Baseline b_{ext})] for each aerosol species to estimate current visibility conditions at HALE1. The ratio was used because IMPROVE data for 2015 at Haleakala National Park is from the HACR1 monitor and the 2005 baseline and 2018 projected visibility conditions are based on data from the HALE1 monitor that was replaced by HACR1 in 2012.

5. The visibility impact from sulfate was projected for Hawaii Volcanoes National Park based on the change in SO_2 between the 2005 and 2018 anthropogenic emission inventories. This indicated a 3.9% increase in anthropogenic SO_2 from 2005 to 2018 for Hawaii Island. EPA also assumed that the anthropogenic visibility impact was 10% of the total for Hawaii Island on the 20% worst days and 70% of the total on the 20% best days. The 2018 impact with FIP accounted for the 3,550 ton per year SO_2 emissions cap on oil-fired boilers at the Hill, Shipman, and Puna power plants beginning January 1, 2018. According to Reference 8, the emission cap is a 1,400 ton per year reduction in SO_2 from the 2018 anthropogenic emission estimate without FIP.

Tables and Figures 7.0-1 through 7.0-5 show the most current 2015 visibility conditions in comparison to 2005 baseline and 2018 projected visibility conditions.

Table 7.0-1 Haleakala National Park RPG (20% Worst Days)				
Species	B_{ext} (Mm^{-1})			
	2005	2015	2018	2018 With FIP
Sea Salt	2.14	3.73	2.14	2.14
Coarse Mass	1.86	1.47	1.86	1.86
Soil	0.34	0.17	0.34	0.34
Elemental Carbon	1.28	0.37	1.28	1.28
Particulate Organic Mass	2.33	0.97	2.33	2.33
Ammonium Nitrate	2.24	2.30	1.79	1.79
Ammonium Sulfate	18.8	16.2	18.3	18.3

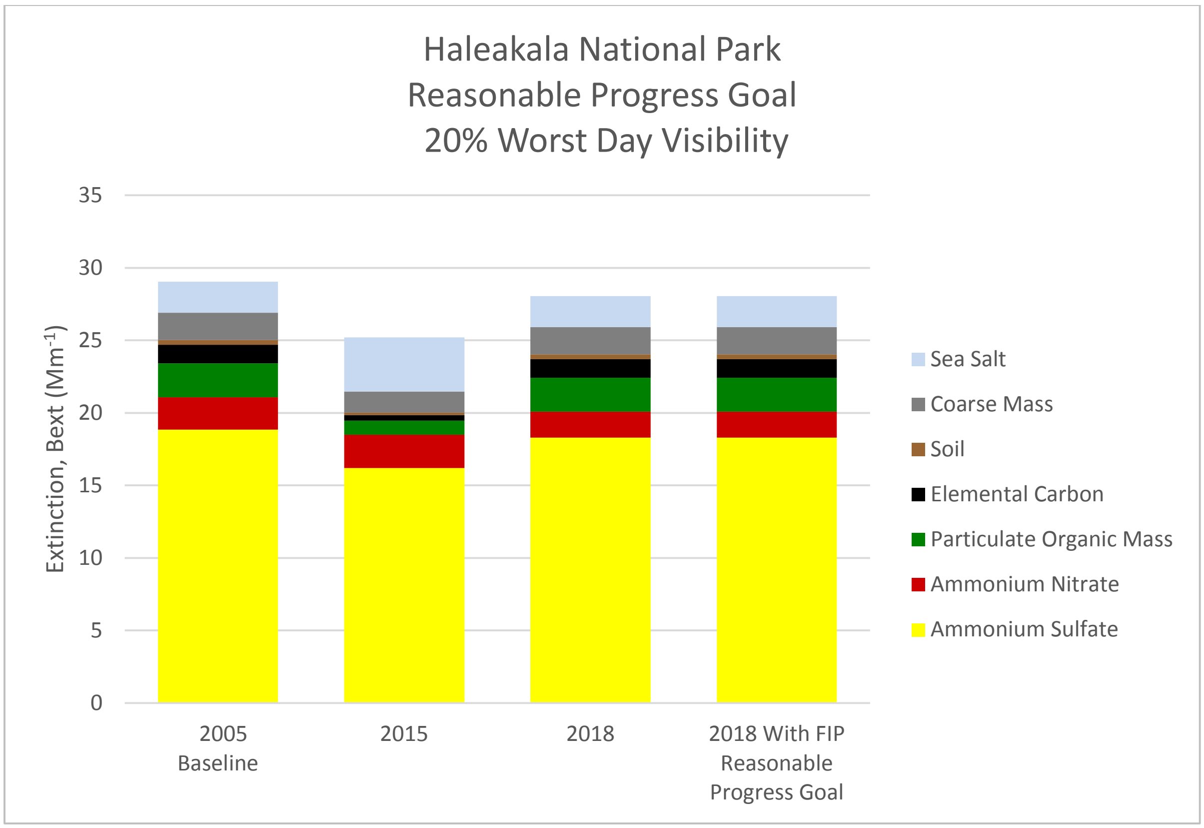

Figure 7.0-1 Haleakala National Park
Reasonable Progress Goal for
20% Worst Day Visibility

Table 7.0-2 Haleakala National Park RPG (20% Best Days)				
Species	B_{ext} (Mm^{-1})			
	2005	2015	2018	2018 With FIP
Sea Salt	1.06	0.98	1.06	1.06
Coarse Mass	0.76	0.55	0.76	0.76
Soil	0.05	0.01	0.05	0.05
Elemental Carbon	0.20	0.04	0.20	0.20
Particulate Organic Mass	0.55	0.74	0.55	0.55
Ammonium Nitrate	0.28	0.30	0.22	0.22
Ammonium Sulfate	1.71	1.42	1.62	1.62

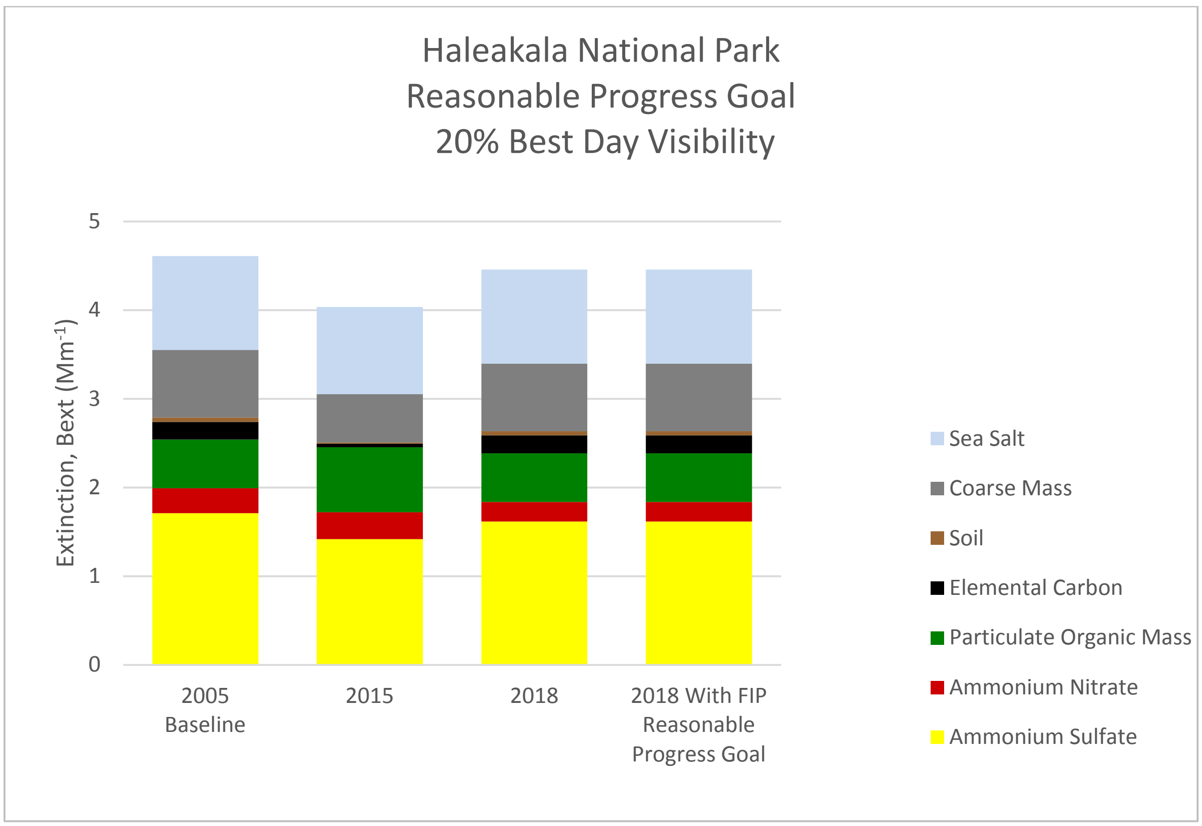

Figure 7.0-2 Haleakala National Park
Reasonable Progress Goal for
20% Best Day Visibility

Table 7.0-3 Hawaii Volcanoes National Park RPG (20% Worst Days)				
Species	B_{ext} (Mm^{-1})			
	2005	2015	2018	2018 With FIP
Sea Salt	1.51	1.53	1.51	1.51
Coarse Mass	0.95	0.70	0.95	0.95
Soil	0.26	0.17	0.26	0.26
Elemental Carbon	0.93	0.52	0.93	0.93
Particulate Organic Mass	1.38	1.50	1.38	1.38
Ammonium Nitrate	0.59	0.60	0.47	0.47
Ammonium Sulfate	85.3	56.8	85.6	83.8

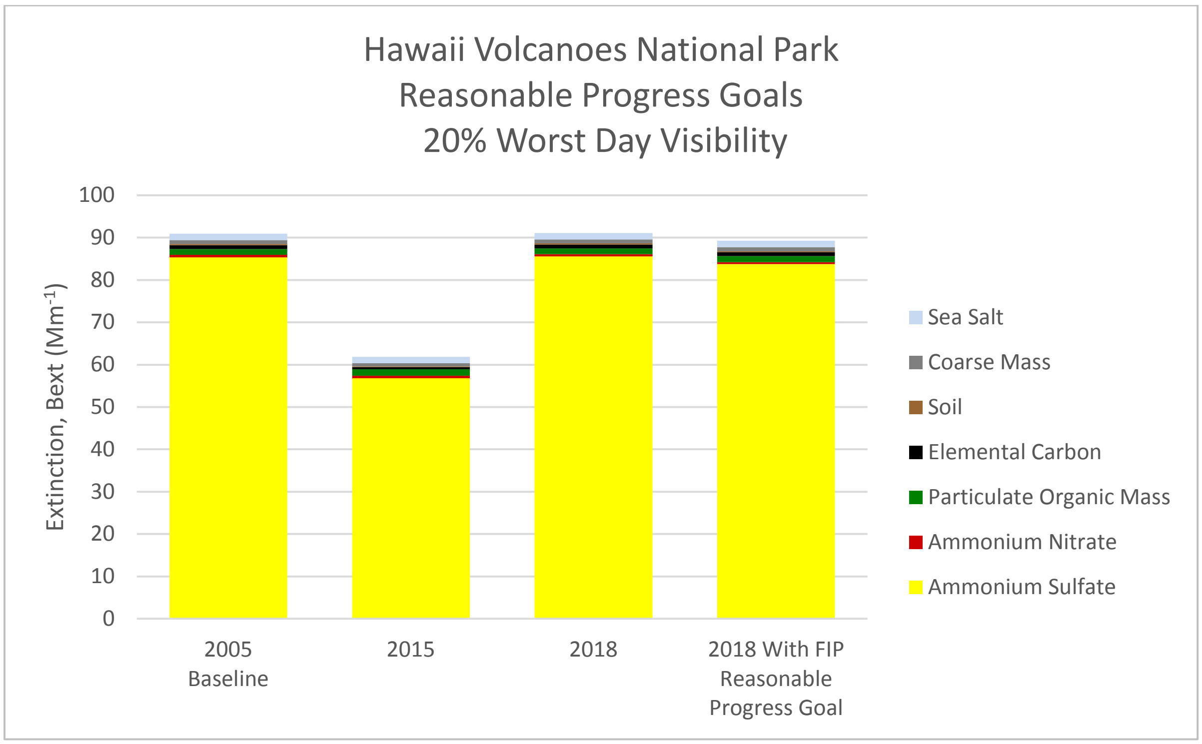

Figure 7.0-3 Hawaii Volcanoes National Park
Reasonable Progress Goal for
20% Worst Day Visibility

Table 7.0-4 Hawaii Volcanoes National Park RPG (20% Best Days)				
Species	B_{ext} (Mm^{-1})			
	2005	2015	2018	2018 With FIP
Sea Salt	1.42	1.36	1.42	1.42
Coarse Mass	0.39	0.73	0.39	0.39
Soil	0.02	0.06	0.02	0.02
Elemental Carbon	0.06	0.08	0.06	0.06
Particulate Organic Mass	0.09	0.39	0.09	0.09
Ammonium Nitrate	0.21	0.35	0.17	0.17
Ammonium Sulfate	2.07	2.00	2.13	1.81

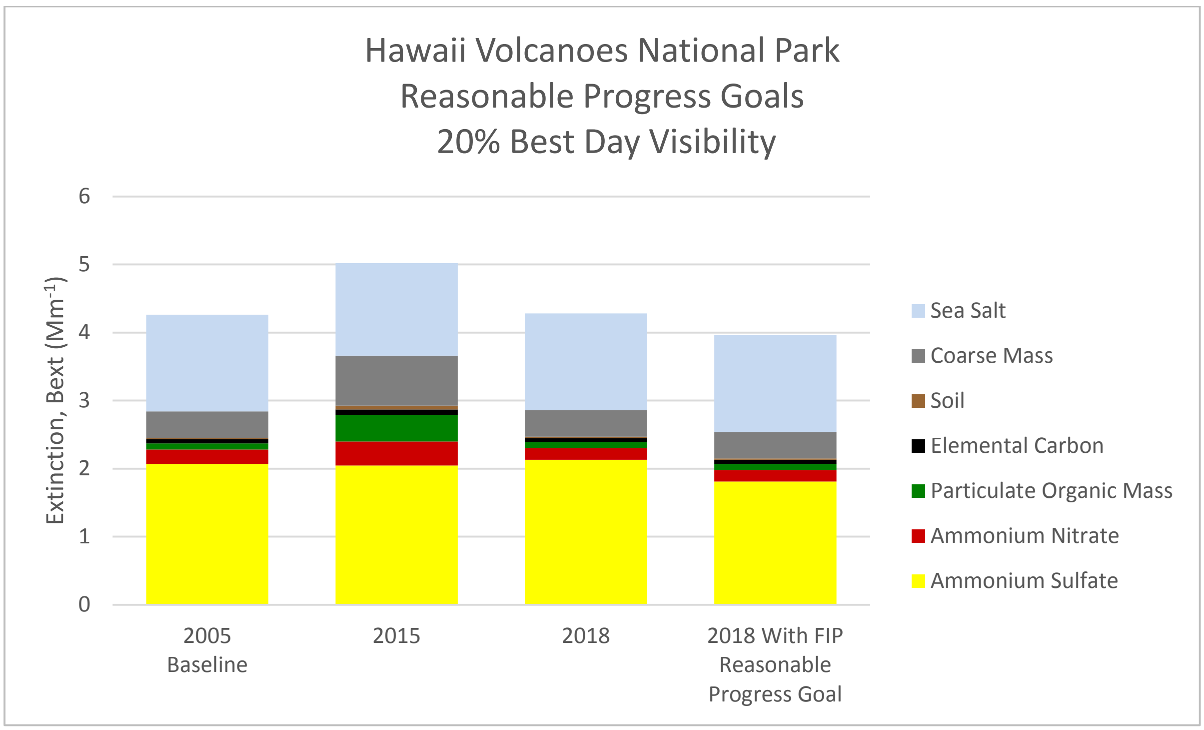

Figure 7.0-4 Hawaii Volcanoes National Park
Reasonable Progress Goal for
20% Best Day Visibility

Maui Island MECO Point Sources

There are significant reductions in SO_2 and NO_X from MECO power plants as a result of clean energy projects which have reduced the need to generate power from burning fossil fuels. Figure 3.0-1 on Page 19 shows that from 2006 to 2015, emissions from the Kahului Generating Station have decreased from 2,990 TPY to 1,311 TPY for SO_2 and from 535 TPY to 361 TPY for NO_X. Figure 3.0-3 on Page 20 shows that from 2006 to 2015 emissions from the Maalaea Generating Station have decreased from 697 TPY to 600 TPY for SO_2 and from 4,454 TPY to 2,409 TPY for NO_X. A rough projection in Figure 3.0-5 on Page 21 shows that from 2014 to 2024 total combined emissions from these MECO power plants to decrease from 2,184 TPY to 549 TPY for SO_2 and from 2,597 TPY to 2,114 TPY for NO_x.

Figure 6.0-5 on Page 48 shows substantial reductions in SO_2 and NO_X for Maui Island point sources. From 2005 to 2015, these emissions have decreased from 4,559 TPY to 2,118 TPY for SO_2 and from 4,492 TPY to 1,220 TPY for NO_X. The total combined 2,118 TPY of SO_2 emitted by point sources in 2015 is 54% below the 4,625 TPY of SO_2 projected for point sources in 2018. The total combined 1,220 TPY of NO_X emitted by point sources in 2015 is 73% below the 4,597 TPY of NO_X projected for point sources in 2018.

Hawaii Island HELCO Point Sources

From 2006 to 2015 there are significant reductions in SO_2 and NO_X from HELCO power plants due to clean energy projects implemented by the state to mitigate GHG emissions. Figure 3.0-6 on Page 22 shows that from 2006 to 2015 total combined emissions from Hilo power plants have decreased from 5,228 TPY to 2,149 TPY for SO_2 and from 886 TPY to 660 TPY for NO_X. A rough projection in Figure 3.0-8 on Page 23 shows that emissions from Hilo power plants will be virtually eliminated by 2020 due to the retirement of equipment.

Figure 6.0-6 on Page 50 shows substantial reductions in SO_2 and NO_X for Hawaii Island point sources. From 2005 to 2015 these emissions have decreased from 4,581 TPY to 2,250 TPY for SO_2 and from 1,110 TPY to 928 TPY for NO_X. The total combined 2,250 TPY of SO_2 emitted by Hawaii Island point sources in 2015 is 57% below the 5,266 TPY of SO_2 emissions projected from these sources for 2018. The total combined 928 TPY of NO_X emitted by Hawaii Island point sources in 2015 is 47% below the 1,736 TPY of NO_X projected for these sources in 2018.

RPG for HACR1 (Worst and Best Visibility Days)

Figures 7.0-1 on Page 52 and 7.0-2 on Page 53 show that 2015 visibility conditions are below the RPG at the Haleakala National Park HACR1 monitor for 2018 on the worst and best visibility days. Primary contributors to the light extinction on Maui are sulfates from the volcano and sea salts. Our analysis of visibility trends at HACR1 in Section 4.3 on Page 37 indicates statistically decreasing annual trends in b_{ext} (visibility improvement) from 2007 to 2015 for sulfates on the 20% worst and best visibility days.

RPG for HAVO1 (Worst Visibility Days)

Figure 7.0-3 on Page 54 shows that visibility conditions are below the RPG for the HAVO1 monitor in Hawaii Volcanoes National Park on the worst visibility days for 2018. The primary contributor to light extinction for worst visibility days are sulfates from the Kilauea volcano. Our analysis from 2001 to 2015 of visibility trends indicated that the trend in b_{ext} from sulfates at HAVO1 is insignificant.

RPG for HAVO1 (Best Visibility Days)

Despite significant reductions in SO_2 and NO_X emissions from Hawaii Island point sources, Figure 7.0-4 shows that 2015 visibility conditions are above the RPG for the HAVO1 monitor on the best visibility days anticipated for 2018. It also shows no significant reductions in light extinction from sulfates and an increase in light extinction from nitrates, particulate organic mass, and course mass. For coarse mass, the increase in light extinction in 2015 appears to be attributed to data substitution involving repeated use of the same number from one day to another. The sets of repeated b_{ext} values for course mass were relatively large ranging from 0.65328 Mm^{-1} to 1.01002 Mm^{-1} to 0.82943 Mm^{-1}. Please refer to Page 75 in Section 8 of this progress report for evaluation of the IMPROVE monitoring data.

Natural Sources of Visibility Impairing Pollutants

Figures 5.0.1 through 5.0-3 on Page 43 show that natural sources of visibility impairing pollutants overwhelm those emitted by anthropogenic sources. The primary natural source is Kilauea volcano that emits extremely large quantities of SO_2 causing haze on the Big Island and on other Islands hundreds of miles away. Visibility improvement due to reductions in anthropogenic SO_2 is masked by volcanic sulfates that overwhelms sulfate from anthropogenic sources. The SO_2 emissions from Kilauea volcano were quantified based on information from the USGS-HAVO. Table 7.0-5 shows SO_2 emissions from the volcano in comparison to the total combined SO_2 emitted by point sources on Maui and the Big Island. As shown in Figure 7.0-5, anthropogenic SO_2 emissions from Maui and Hawaii Island point sources are less than 1% of the total emissions (Maui and Hawaii Island point source SO_2 + volcanic SO_2).

Table 7.0-5 Kilauea Volcano Emissions

Source	SO_2 (TPY)		
	2014	2015	2014-2015 Average
Volcano[1]	2,140,187	1,717,075	1,928,631
Maui and Hawaii Point Sources[2]	4,886	4,368	4,627

1: Emissions are based on measurement with vehicle mounted spectrometer at Pu'u O'o Vent and fixed spectrometers at Halema'uma'u Vent.

2: Total combined SO_2 emissions from Maui and Hawaii Island point sources.

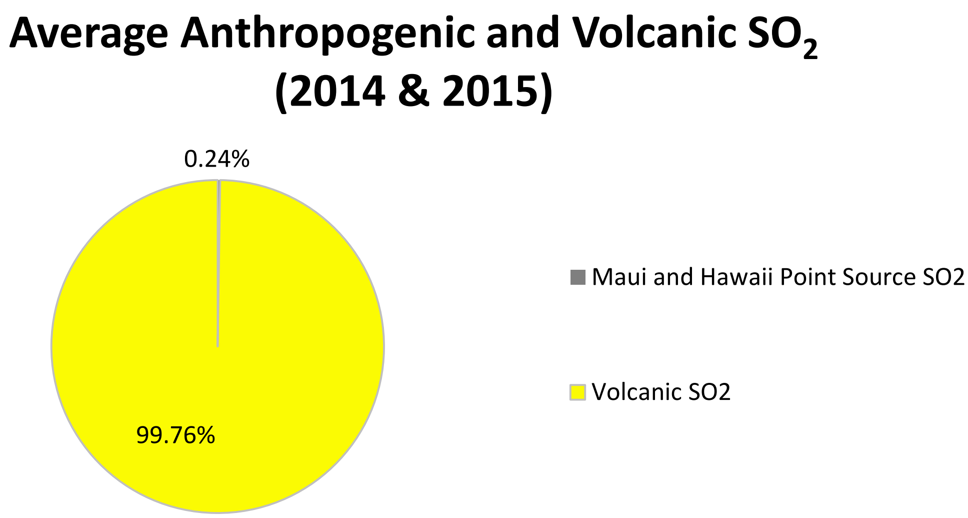

Figure 7.0-5 Average Point Source and Volcanic SO_2

Considering the significant reductions in SO_2 and NO_X point source emissions on islands where the Class I Areas are located, future emissions reductions projected for EGUs on these islands, visibility conditions that are below the RPGs except for the best visibility days at HAVO1, and extremely large contributions to light extinction from natural volcanic SO_2 emissions which overwhelm anthropogenic emissions, Hawaii believes that control strategies from the existing Regional Haze Plan are sufficient at this time.

8.0 Visibility Monitoring Strategy – 40 CFR § 51.308(g)(7)

Section 8 provides a review and assessment of Visibility Monitoring Strategy, identifies any planned changes, and provides associated recommendations.

<u>2012 Hawaii Regional Haze – Federal Implementation Plan Background</u>

The 2012 Hawaii Regional Haze - Federal Implementation Plan[24] (Hawaii RHR FIP) established an emissions cap of 3,550 tons of sulfur dioxide (SO_2) per year from specific fuel oil fired boilers at three electric utility plants on Hawaii Island. EPA Responses to Comments on the RH-FIP addressed several issues relevant to visibility monitoring that included:

1. *Baseline Visibility, Natural Visibility and Uniform Rate of Progress* - "However, given the dominance of volcanic emissions on the worst 20 percent days in Hawaii, it may be appropriate for future plans to focus on other days when the proportion of anthropogenic contribution to visibility impairment is larger."
2. *Estimating Natural Visibility Conditions* - "We would consider a refined estimate of natural conditions at these Class I areas if the State of Hawaii were to propose such a

[24] US Environmental Protection Agency, Approval and Promulgation of Implementation Plans; State of Hawaii; Regional Haze Federal Implementation Plan; Final Rule, October 9, 2012; https://www.regulations.gov/document?D=EPA-R09-OAR-2012-0345-0067.

change as part of the next Regional Haze plan for Hawaii. Any such estimate would need to be consistent with our guidance on this subject [Doc. Ref. 7].” [25]

3. *Comments on the Monitoring Strategy* - “EPA appreciates NPS’s evaluation of the IMPROVE data for both the HALE and HACR monitors for the period 2007 through 2010, and agrees with their recommendation to use Haleakala Crater (HACR) for future regional haze planning efforts.”
4. *Other Comments, Comment 7: Monitoring Concerns* - “Hawaii DOH, NPS and EPA are reviewing HALE and HACR data to develop methodologies to establish a 2000–2004 baseline estimate, which can be used to track continued progress at the site in a manner consistent with RHR requirements. Therefore, it is not necessary to continue operation of HALE to provide continuity with the baseline. In addition, since HACR is more representative of conditions in the park, and HALE is nearby, it is not a good use of resources to continue operation of HALE. EPA is working with Hawaii DOH to move the Federal funding currently used to support HALE to instead support the operation of a new PM2.5 monitor to be sited in a populated area of the isthmus near sugar cane fields.

EPA is not selectively using data to justify a particular policy outcome. Data from both HALE and HACR were considered when determining if there was any evidence that smoke from agricultural operations was impacting visibility at Haleakala NP. This is explained in more detail in our discussion on agricultural burning in Section II.A.11 of this notice.

The tables in the proposal and the TSD referenced by the commenters indicate possible smoke impacts at the HALE monitor. As we discussed previously, there is no evidence that this smoke is from agricultural burning. Nor is there any evidence that the smoke measured at HALE (which is outside the park and at a significantly lower elevation) is impacting the park itself,

EPA believes the current filter-based monitoring instrumentation, based on the IMPROVE Program, is the appropriate approach to determine the visibility levels at Hawaii’s National Parks. The IMPROVE Program is discussed in greater detail in the response to Comment 3: Chemtrails, above. Visibility levels can be estimated from aerosol monitoring filters. Understanding the characteristics of the aerosols in a haze can also help identify the type of sources that contributed to the haze. It is possible to statistically estimate what portion of haze is caused by each aerosol type. This approach, known as an extinction budget analysis, can narrow the list of possible sources responsible for visibility impacts [Doc. Ref. 67].[26] Therefore, in addition to establishing visibility levels, the filter-based monitoring approach, which measures the characteristics of the aerosols in haze, can help identify the type of sources that contributed to the haze.”

[25] [Document reference 7] See ‘‘Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule’’ Document No. EPA–R09–OAR–2012–0345–0003–B9. (note that this is a September 2003 EPA publication, EPA-454/B-03-005 available at https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0531-0005).

[26] [Document reference 67] See Section 2–15 of ‘‘Visibility Monitoring Guidance’’, June 1999 Document No. EPA–R09-OAR–2012–0345–0003–B5. (note that this is a June 1999 EPA publication, EPA-454/R-99-003 available at http://vista.cira.colostate.edu/Improve/wp-content/uploads/2016/03/VisibilityMonitoringGuidance.pdf).

5. *Other Comments, Comment 21: Lack of concern for public* – "EPA is very concerned about public health. EPA and the State of Hawaii protect public health through implementation of the NAAQS. In fact, EPA recently revised the NAAQS for SO_2 to be more stringent and more protective of public health. We are currently evaluating whether Hawaii and other areas of the country are in compliance with this new standard. In addition, EPA has been working with Hawaii DOH on using real-time data from the extensive SO_2 monitoring network on the Big Island to monitor the impacts of the volcano and to protect public health."

IMPROVE Monitoring Background

For the Hawaii RH-FIP, DOH-CAB examined the IMPROVE monitoring network[27] information and IMPROVE data for calendar years 2001 – 2008, and identified emissions from the Kilauea volcano as a large source of visibility impairment for Hawaii's Class I National Parks. These analyses were recorded in technical support documents in the EPA FIP Docket EPA-R09-OAR-2012-0345-0005.[23]

For this 2017 progress report, IMPROVE monitoring network data from the Federal Land Manager Environmental Database DataWizard (DataWizard)[28] were examined for calendar years 2001 through 2015. The IMPROVE monitoring network in Hawaii currently consists of the HACR1 monitor within Haleakala National Park on Maui Island, and the HAVO1 monitor within Volcanoes National Park on Hawaii Island. While monitoring data for the HACR1 site has only been available since 2007, data from the HALE1 monitor outside but near the boundary of Haleakala National Park was available from 2001 through 2011. Monitoring data for the HAVO1 site was available throughout the period of interest.

In July of 2016, EPA invited public comments on the RHR draft guidance on "Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period".[29] In August of 2016, the DOH-CAB commented on the RHR draft guidance[30] regarding Hawaii's IMPROVE monitoring datasets.

DOH-CAB recommended that the EPA examine Hawaii's "arguably unique" IMPROVE datasets and provide guidance "to estimate natural and anthropogenic light extinction". DOH-CAB recommended "that this guidance should, at a minimum, include the estimation of volcanic sulfate fractions of total light extinction associated with the HACR1 and HAVO1 IMPROVE monitors and dust from outside the state of Hawaii." DOH-CAB agreed that the "visibility impact associated with sea salt be considered natural." DOH-CAB recommended that "EPA consider other possible non-trivial sources of visibility impairment that are beyond the ability of the state of Hawaii to control (e.g., shipping in international waters) for inclusion in the guidance."[30]

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[27] Colorado State University, Cooperative Institute for Research in the Atmosphere (CIRA), Interagency Monitoring of Protected Visual Environments (IMPROVE); http://vista.cira.colostate.edu/Improve/.

[28] Colorado State University, Cooperative Institute for Research in the Atmosphere (CIRA), Federal Land Manager Environmental Database; http://views.cira.colostate.edu/fed/DataWizard/Default.aspx.

[29] US Environmental Protection Agency, Draft Guidance: Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period; https://www.regulations.gov/document?D=EPA-HQ-OAR-2016-0289-0001.

[30] State of Hawaii, Department of Health, Clean Air Branch, Comment on the Environmental Protection Agency (EPA) Notice: Draft Guidance: Progress Tracking Metrics, Long-term Strategies, Reasonable Progress Goals and Other Requirements for Regional Haze State Implementation Plans for the Second Implementation Period, available at regulations.gov; https://www.regulations.gov/document?D=EPA-HQ-OAR-2016-0289-0053.

Regarding the “draft Supplemental Information” document provided with the draft guidance, DOH-CAB noted that the data included in the document appeared to include information associated with the HALE1 monitor on Maui that was shut down in 2012, and failed to include information associated with the HACR1 monitor on Maui that replaced the HALE1 monitor. DOH-CAB noted that the document associates monitoring data with the respective National Park, but does not note the specific monitor, and the monitor retirement and replacement could not be identified using the current format. DOH-CAB recommended that “the IMPROVE monitor site code be added so the monitoring site and associated data will be unambiguous.”[30]

Regarding the “draft Technical Support” document provided with the draft guidance, DOH-CAB noted that footnote 16 stated: "Graphics for all of the sites including those in Hawaii, Alaska, and the U.S. Virgin Islands can be found in Appendices G-J.", and recommended that EPA review and confirm that “monitoring data from the HACR1 site is used as appropriate and that monitoring sites are unambiguously identified.”[30]

Recent Regional Haze Rule revisions[3, 31] were examined for relevance with respect to DOH-CAB comments. The Final Rule includes several discussions and clarifications that pertain to the need to quantify and correct for the influence of visibility impacting emissions from the Kilauea volcano.

The final rule document notes that the EPA and IMPROVE program will work with states to analyze the data to identify and quantify the visibility impact from anthropogenic sources versus natural sources.

“The EPA and IMPROVE program will work together to provide datasets that identify the most anthropogenically impaired days in each year of IMPROVE data and that contain the statistical summaries of these days need as part of a SIP revision or progress report. These datasets will be based on a specific method the EPA intends to recommend in a future guidance document. We expect that these datasets will avoid any increase in the workload and resources required of states relative to continued use of the haziest days. We will also work with any state or states interested in a different specific method for identifying the most impaired days than the one we will recommend, to avoid an increase in workload that would interfere with other aspects of SIP development.”[3, 31]

“The EPA agrees that some of the suggestions provided by commenters further clarify that visibility impairment is due to anthropogenic sources and does not include emissions from natural sources. Therefore, in response to these comments, we have finalized additional changes to the definitions of most impaired days, regional haze, and visibility impairment to also include the concept that impairment is anthropogenic.”[3, 31]

“The EPA is finalizing the requirement that all states select the 20 percent most impaired days, i.e., the days with the most impairment from anthropogenic sources, as the ‘‘worst’’ days for purposes of calculating baseline visibility conditions, current visibility conditions, natural visibility conditions and the URP in SIPs and, as applicable, in progress reports.”[3, 31]

[31] US Environmental Protection Agency, Visibility and Haze, Public Informational Webinar: Final Regional Haze Rule Revisions; https://www.epa.gov/visibility/public-informational-webinar-final-regional-haze-rule-revisions;
“Protection of Visibility: Amendments to Requirements for State Plans” presentation at https://www.epa.gov/sites/production/files/2017-01/documents/2017_01_26_final_rhr_revisions_webinar_for_public_final_to_post.pdf.

The Final Rule document clarifies that EPA will provide states the opportunity to develop and justify site specific approaches to calculating visibility impairment (e.g., anthropogenic visibility impacts).

“The EPA did not propose to require any particular method for determining the natural versus anthropogenic contributions to daily haze and thus the degree of visibility impairment for each monitored day.”[3, 31]

“No particular method is being prescribed by the final rule nor will the final version of the guidance contain any binding requirements; states can therefore develop, justify and use another method of discerning natural and anthropogenic contributions to visibility impairment in their SIPs. The EPA intends to include more information on this subject in the final guidance.”[3, 31]

The Final Rule document defines natural conditions as including the effects from volcanic activity.

“Natural conditions reflect naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration, and may refer to the conditions on a single day or a set of days. These phenomena include, but are not limited to, humidity, fire events, dust storms, volcanic activity, and biogenic emissions from soils and trees. These phenomena may be near or far from a Class I area and may be outside the United States.”[3, 31]

The Final Rule document also explicitly addresses the issue of visibility impacts associated with international anthropogenic sources. In the process, it raises the very important consideration of estimate and model accuracy. The DOH-CAB will discuss this issue in broader context in subsequent parts of this section.

“Although we do not believe such estimates and models are currently able to adequately represent the impacts of international anthropogenic sources on visibility, we acknowledge that this is an area of active research and development that may lead to adequate estimates in time for the development of SIPs for the second implementation period.”[3, 31]

While the Final Rule document does not appear to explicitly address the DOH-CAB comments regarding the “draft Supplemental Information” and “draft Technical Support”[30], it makes a clear commitment to working with states to ensure data quality. In the Final Rule, “§ 52.633 Visibility protection”[3, 31] explicitly notes changes to the “applicable plan for the State of Hawaii”[3, 31], and there is no indication that HACR1 is not still considered to be the appropriate IMPROVE monitor for Haleakala National Park.

<u>Examination of Hawaii IMPROVE monitoring data for 2001 – 2015</u>

Hawaii IMPROVE monitoring data from the HACR1, HALE1, and HAVO1 monitoring sites for calendar years 2001 through 2015 was reviewed to help evaluate the need for modifications to the current visibility monitoring strategy. The IMPROVE aggregations (e.g., Worst 20% days and Best 20% days) associated with visibility degradation (e.g., ammonium nitrate visibility extinction and ammonium sulfate visibility extinction) as reported in the DataWizard[28] were used for this portion of the review. The DataWizard identifies the Worst 20% days using “G90” in the aggregation code, and the Best 20% days using “G10”. The remaining quintile groupings in descending magnitude are identified by “G70”, “G50”, and “G30”. The DataWizard codes for visibility impacting parameters (e.g., ammonium nitrate extinction) are listed in Table 8.0-1.

Table 8.0-1 Visibility Impacting Parameter From the IMPROVE DataWizard

Visibility Impacting Parameter	Unit	IMPROVE DataWizard Code
Ammonium Nitrate Extinction	1/Mm	ammNO3f_bext
Ammonium Sulfate Extinction	1/Mm	ammSO4f_bext
Elemental Carbon Extinction	1/Mm	ECf_bext
Coarse Mass Extinction	1/Mm	CM_bext
Organic (Carbon) Mass Extinction	1/Mm	OMCf_bext
Sea Salt Extinction	1/Mm	SeaSaltf_bext
Soil Extinction	1/Mm	SOILf_bext
Total Aerosol Extinction	1/Mm	aerosol_bext
Standard Visibility Range	km	SVR
Haze Index	1	dv
Total Extinction	1/Mm	total_bext

The DOH-CAB calculated the visibility impacts at the HACR1, HALE1, and HAVO1 monitors associated with anthropogenic sources by removing estimated impacts due to the Kilauea volcano and sea salt. While an updated Positive Matrix Factorization (PMF) analysis of the available IMPROVE data from 2001 through 2015 could be performed to estimate the visibility impact from the Kilauea volcano, it was deemed premature for this progress report. IMPROVE data from 2009 through 2015 is now available and should be examined before new PMF analyses are made. A new version of EPA’s PMF code[32] (PMF 5.0) was released in 2014 and needs to be evaluated for use with the new Hawaii data. Instead of performing a new PMF analysis with the 2001 – 2015 IMPROVE data, this update uses the PMF results reported in the DOH-CAB’s “Documents Related to Causes of Haze for Haleakala and Hawaii Volcanoes National Parks”[23] and applies them to the 2001 – 2015 IMPROVE data. The fraction of visibility impairment due to volcanic sulfate is taken to be a constant in time for each of the Hawaii monitors. To examine the suitability of the new Hawaii IMPROVE data for a PMF analysis, this update examines the 2001 – 2015 IMPROVE data for the Hawaii sites with respect to the nationwide data. Hawaii signal to noise, data completeness, and data values (e.g., concentrations, extinction coefficients, and haze indices) are contrasted to the distribution of values from the sites nationwide. This provides a means of identifying the extent to which Hawaii IMPROVE data appears to be outliers or not with respect to the national dataset.

The estimated impact associated with Kilauea volcano for evaluating visibility in Haleakala National Park is 67% ammonium sulfate extinction based on data from the HACR1 and HALE1 monitors. Estimated impacts for the worst 20% days at the HALE1 monitor are provided in the DOH-CAB’s technical support document “Haleakala National Park Visibility Assessment”[23], C.2.a (Section 2.4.2 Observations of HALE1 PMF Factors for Worst 20% Days). The PMF analysis of 2005 IMPROVE data from the HALE1 monitor for the worst 20% days indicated that 67% of the sulfate was associated with volcanic emissions (Reference 23, C.2.a, Table 6.1-4). The PMF analysis of the 2003-2008 IMPROVE dataset for HALE1 indicated that 77% of the sulfate was associated with volcanic emissions (Reference 23, C.2.a, Table 6.1-5). A comparison of HACR1 and HALE1 datasets for 2007 – 2008 was presented in DOH-CAB’s technical support document “Comparison of

[32] US Environmental Protection Agency, Positive Matrix Factorization Model for environmental data analyses, PMF 5.0, April 2014; https://www.epa.gov/air-research/positive-matrix-factorization-model-environmental-data-analyses.

Haleakala National Park HALE1 and HACR1 IMPROVE Monitoring Site 2007-2008 Data Sets" (Reference 23, C.2.f). In Table 1, the square of the Pearson correlation coefficient (e.g., "r^2 value") for ammonium sulfate at the two sites was shown to be 0.81. In Table 2, the r^2 value for the volcano emissions (e.g., "F#4: Volcano#1 (Metals w/high Se)") at HALE1 and HACR1 was shown to be 0.79. Because the percentage of ammonium sulfate extinction due to the volcano is taken to be a constant for 2001 – 2015, it seems appropriate to use the lower 67% of the two values. And because the correlation of sulfate and volcanic emissions for HACR1 and HALE1 are relatively large, it seems appropriate to use the HALE1 volcanic sulfate percentage for HACR1 as well.

The estimated impact associated with Kilauea volcano for evaluating visibility in Hawaii Volcanoes National Park is 95% ammonium sulfate extinction based on the data from the HAVO1 monitor. This estimate is provided in DOH-CAB's technical support document "Hawai'i Volcanoes National Park Visibility Assessment" (Reference 23, C.2.b, Section 2.4.2 Observations of HAVO1 PMF Factors for Worst 20% Days). This value is based on the PMF analysis of 2005 IMPROVE data from the HAVO1 monitor for the worst 20% days. It indicated that 50% of the sulfate was associated with volcanic emissions from PMF factor 1 and 45% of the sulfate was associated with PMF factor 5 (Reference 23, C.2.b, Table 6.1-4). These two PMF factors associated with the volcano account for 95% of the sulfate for the worst 20% days. In addition, PMF factor 6 is also believed to be associated with volcanic emissions. Since it contributes only about 1.5% of total sulfate for the Worst 20% days, to make a more conservative (e.g., large) estimate of anthropogenic sulfate emissions, the sulfate contribution from PMF factor 6 was not included in this report estimate of sulfate visibility impacts from the Kilauea Volcano. The 2003-2008 IMPROVE dataset for HAVO1 was analyzed and indicated that 98% of the sulfate was associated with volcanic emissions. This value resulted from the PMF analysis of 2003 through 2008 IMPROVE data from the HAVO1 monitor applied to the Worst 20% days. It indicated that about 14% of the sulfate was associated with volcanic emissions from PMF factor 1, about 7% with PMF factor 3, and about 77% with PMF factor 7 (Reference 23, C.2.b, Table 6.1-5). Since these three PMF factors also exceeded the 95% value for sulfate attributed to the Kilauea volcano, this added additional confidence that the 95% value should provide conservative (e.g., large) estimate of anthropogenic sulfate emissions. Note that the DOH-CAB's technical support document "IMPROVE PMF Factor Identification notes Positive Matrix Factorization Analysis of HALE1 & HAVO1 IMPROVE data sets" (Ref. 23, C.2.c) presents supporting information regarding the attribution of PMF factors to various sources (e.g., Kilauea volcano, Dust (Asian), Nitrate/Sulfate-Rich Secondary (Iron), and Smoke (Bromine)). Table 8.0-2 provides DOH-CAB defined parameters related to the visibility impacts associated with sulfate attributed to the Kilauea volcano and are used in subsequent tables.

Table 8.0-2 Visibility Impacting Parameters Used by DOH-CAB

Visibility Impacting Parameter	Unit	DOH-CAB Code
Aerosol Extinction without Ammonium Sulfate and Sea Salt	1/Mm	aerosol_bext w/o SO4f and SeaSaltf
Fraction of Ammonium Sulfate Attributed to the Kilauea Volcano	1	volcano fract SO4f
Aerosol Extinction without Ammonium Sulfate Attributed to the Kilauea Volcano and Sea Salt	1/Mm	aerosol_bext w/o volcano fract SO4f and SeaSaltf

Tables 8.0-3 and 8.0-4 present Hawaii IMPROVE site (e.g., HACR1, HALE1, HAVO1) visibility impacts for the worst 20% days compared to all available national IMPROVE sites. All available annual IMPROVE values for 2001 through 2015 for the Hawaii IMPROVE sites were averaged and compared against the average values for those same years for all national sites. Note that Appendix E contains tables with the annual values that were averaged and reported in Tables 8.0-3 and 8.0-4. Results presented in Table 8.0-3 show that Hawaii IMPROVE site visibility impacts for ammonium nitrate, elemental carbon, coarse mass, organic (carbon) mass, and soil are all very low compared to national levels. For example, the average HACR1 ammonium nitrate visibility impact (ammNO3d_bext) for the worst 20% days is about 1.1 inverse mega-meters (Mm^{-1}). Over the years where IMPROVE statistical data was available for HACR1 (e.g., 2007-2012 & 2014-2015), this average HACR1 value ranked about 140 among 155 sites, and is about one fourth the median value for all sites of 4.2 Mm^{-1}. Note that a ranking of one (1) indicates the largest value among those ranked. Also, a haze index for example, with a ranking of one (1), would indicate a most visibly impaired condition. These average values with respect to HACR1, HALE1, and HAVO1 site ammonium nitrate are averages of data in Appendix E, Table E-15. The average values with respect to all visibility impacting parameters in Tables 8.0-3 and 8.0-4 are averages of data in Appendix E, Tables E-15 through E-28. Average values for all parameters and aggregations are presented in Appendix E, Tables E-1 through E-14. Note that the IMPROVE "IMPRHR2" dataset was the source of this data.

In Table 8.0-3, only visibility impacts due to sulfate and sea salt exceed the median values for all national sites. Since sulfate is primarily due to the volcano at all sites, and sea salt is not anthropogenic, it is clear that Hawaii IMPROVE sites should have relatively low impacts due to anthropogenic sources. In Table 8.0-4, the visibility impacts from aerosols without ammonium sulfate and sea salt (aerosol_bext w/o SO4f and SeaSaltf) are quantified and compared to all national sites for the worst 20% days. Over the years where IMPROVE statistical data was available for HACR1 (e.g., 2007-2012 & 2014-2015), the average HACR1 value, about 4.5 Mm^{-1}, ranked about 154 of about 155 sites (154/155), and is about one sixth the median value for all sites of about 27.3 Mm^{-1}, and only marginally larger than the national minimum of about 3.5 Mm^{-1}. As expected, the average HALE1 value, about 8.5 Mm^{-1}, is larger than for the more representative HACR1 site, but it is still ranked about 143/145. The average HAVO1 value, about 4.2 Mm^{-1}, ranked about 148/148, and is about one seventh the median value for all sites of about 27.8 Mm^{-1}, and barely larger than the national minimum of about 4.0 Mm^{-1}.

Table 8.0-3 Hawaii IMPROVE Site Visibility Impacts and Average Annual Rankings for Worst 20% Days (G90 Grouping) – Part 1 of 2

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.101	140.125	154.750	183.077	4.158	0.533
HALE1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.259	104.909	145.364	135.757	4.689	0.526
HAVO1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.637	146.133	147.733	151.445	4.542	0.523
HACR1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	13.995	77.500	154.750	125.983	13.621	3.047
HALE1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	23.283	60.182	145.364	185.619	15.267	3.230
HAVO1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	85.548	19.200	147.733	152.188	13.984	3.116
HACR1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.430	153.375	154.750	21.441	2.672	0.337
HALE1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.208	134.818	145.364	23.631	3.127	0.627
HAVO1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.750	145.200	147.733	22.127	2.953	0.535
HACR1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.352	146.500	154.750	21.743	3.865	0.808
HALE1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.148	120.364	145.364	21.339	3.564	0.761
HAVO1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.872	145.467	147.733	21.634	3.682	0.764
HACR1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.164	153.250	154.750	94.733	10.782	0.703
HALE1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.509	142.364	145.364	80.540	11.988	1.131
HAVO1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.533	146.467	147.733	82.670	11.483	1.032
HACR1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.981	36.625	154.750	27.629	0.294	0.016
HALE1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.787	16.000	145.364	25.404	0.216	0.008
HAVO1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.431	26.333	147.733	26.108	0.242	0.012
HACR1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.444	129.125	154.750	8.722	0.879	0.146
HALE1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.343	136.000	145.364	8.512	0.883	0.159
HAVO1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.376	129.267	147.733	8.313	0.895	0.146
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	19.466	141.875	154.750	283.743	49.028	13.752
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	33.537	103.091	145.364	264.526	52.311	15.173
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	91.148	46.200	147.733	271.275	50.315	14.683
HACR1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	28.466	143.625	154.750	294.743	59.962	23.184
HALE1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	43.537	102.818	145.364	275.526	62.949	24.313
HAVO1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	101.148	46.933	147.733	282.275	61.052	23.844

When the estimated visibility impacts from volcanic sulfate are removed as opposed to removing all sulfate from the Hawaii datasets for the worst 20% days, the average haze index (aerosol_bext w/o volcano fract SO4f and SeaSalt) increases from approximately 4.5 Mm^{-1} to 9.1 Mm^{-1} for HACR1, from about 8.5 Mm^{-1} to 16.2 Mm^{-1} for HALE1, and from about 4.2 Mm^{-1} to 8.4 Mm^{-1} for HAVO1. These large increases in haze index show that volcanic sulfate contributions to visibility impairment are significant. The rankings for HACR1, HALE1, and HAVO1, however, remain relatively unchanged at about 154/155, 140/145, and 147/147, respectively. And for HACR1 and HAVO1, the two monitors providing the most representative data for Hawaii's two Class I areas, the monitored values are barely above the national minimum values of 7.9 Mm^{-1} for both sites. The annual values averaged in Table 8.0-4 are presented in Appendix E, Table E-28. These results show that the annual values and rankings are consistent with the averaged values. HACR1 and HAVO1 are consistently the two least visibility impaired monitoring sites when the estimated volcanic sulfate and actual sea salt visibility impacts are removed.

Table 8.0-4 Hawaii IMPROVE Site Visibility Examination and Average Annual Rankings for Worst 20% days (G90 Grouping) – Part 2 of 2										
Site	**Year**	**Aggregation**	**Value Type**	**Value Unit**	**Site Value**	**Site Rank (High)**	**Number of Sites**	**Max Value (All Sites)**	**Median Value (All Sites)**	**Min Value (All Sites)**
HACR1	Average	ANN_1YR_G90_902_#	dv	1	9.915	144.875	154.750	32.898	17.236	8.207
HALE1	Average	ANN_1YR_G90_902_#	dv	1	14.207	101.727	145.364	32.527	17.849	8.689
HAVO1	Average	ANN_1YR_G90_902_#	dv	1	20.943	49.267	147.733	32.628	17.473	8.481
HACR1	Average	ANN_1YR_G90_902_#	SVR	km	144.905	11.125	154.750	169.749	74.196	15.880
HALE1	Average	ANN_1YR_G90_902_#	SVR	km	97.957	45.818	145.364	163.546	69.592	16.015
HAVO1	Average	ANN_1YR_G90_902_#	SVR	km	56.782	97.600	147.733	165.844	72.500	16.045
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.491	153.500	154.750	262.674	27.275	3.479
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.467	142.636	145.364	206.671	28.283	4.219
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.169	147.533	147.733	224.102	27.839	3.950
HACR1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.109	154.125	154.750	280.507	46.621	7.908
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	16.150	140.455	145.364	262.285	49.664	8.471
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.446	147.400	147.733	268.791	47.791	7.832

Appendix E, Table E-28 includes haze index estimates for all five aggregation groupings (e.g., G90, G70, G50, G30, G10) that are based on removing the same volcano sulfate fractions as those removed when estimating haze index for the G90 (worst 20% days) aggregation groupings. While more accurate volcano sulfate fractions for these aggregations could potentially be achieved with an updated PMF analysis, it is import to first assess if the quality of the monitoring data is sufficient to provide good results.

Appendix F, Figures F-1, F-2, and F-3 show the trends in aerosol extinction (Aerosol B_{ext}) for all five aggregation groupings without the inclusion of impacts from sulfate and sea salt for the HACR1, HALE1, and HAVO1 monitors, respectively. These figures show that generally, these aggregated grouping have extinction values where G90 > G70 > G50 > G30 > G10. Had this not been the case, it would indicate that new aggregations should definitely be performed after the estimated volcano sulfate and sea salt are removed. However, for future SIP efforts, DOH-CAB will likely perform aggregations after corrections removing volcano sulfate and sea salt. Figure F-4 in Appendix F presents the IMPROVE aerosol extinction without volcanic sulfate and sea salt for the G90 aggregation for Hawaii sites with respect to the national distribution. Figures F-5 through F-19 in Appendix F present the 2001 to 2015 (in reverse order) IMPROVE visibility extinction contributions for all aerosols (ammonium nitrate, ammonium sulfate, elemental carbon, coarse mass, organic (carbon) mass, sea salt, and soil) for the Hawaii sites with respect to the national distribution.

Appendix E, Tables E-29 and E-30 examine IMPROVE measurement data quality associated with the Hawaii IMPROVE sites from the standpoint of the number of “positive measurement datasets” per year and measurement of signal to noise, respectively. The DOH-CAB uses the term “positive measurement dataset” to mean a measurement where the IMPROVE measured value, the associated uncertainty (Unc), and the associated minimum detectable limit (MDL) are all greater than zero. As an example, Table E-29 shows that the aluminum (Alf) dataset for HACR1 in 2015 had 88 measurements where the measured value, Unc, and MDL, were all greater than zero, and that value is ranked 88th out of the 165 IMPROVE monitoring sites that reported Alf data for 2015. Note that the site with the most measurements would be ranked 1. A list of the IMPROVE pollutants that are monitored is presented in Table 8.0-5. The DOH-CAB uses the term "signal to noise" to mean a calculated ratio of measured values and their associated uncertainties. In Table 8.0-6, the "signal to noise" ($\frac{S}{N}$) value for each pollutant is calculated using Equations 5-3 & 5-4 in the "EPA PMF 5.0 User Guide"[33]. The summation of annual dataset values (d) and uncertainties (s) is performed separately for each pollutant (indicated by the index j) over all positive measurement datasets for that pollutant (indicated by the index i). For the signal to noise values presented in Table E-30 of Appendix E. Note that the DOH-CAB implementation of this equation applied the summation over positive measurement datasets, so the DOH-CAB summation is over n_j values for the j^{th} pollutant. As an Example, Table E-30 in Appendix E shows that the aluminum (Alf) dataset for HACR1 in 2015 had a signal to noise value of about 5.0, and that value is ranked 161st out of the 165 IMPROVE monitoring sites that reported Alf data for 2015. The Alf dataset for HAVO1 in 2015 had a signal to noise value of about 6.1, which ranked 144th out of 165. A survey of the signal to noise values shows that, frequently, Hawaii IMPROVE site ranks have large values, meaning small signal to noise values, compared to all national sites. Some notable exceptions include HACR1 and HAVO1 chlorine (CLf), chloride (CHLf), and sodium (Naf), and HAVO1 magnesium (MGf) and selenium (Sef). Chlorine, chloride, and sodium are associated with sea salt, and selenium and magnesium were identified in the DOH-CAB Hawaii RH-FIP supporting documents (e.g., Hawai'i Volcanoes National Park Visibility Assessment Regional Haze Program Visibility Assessment) as being associated with emissions from the Kilauea volcano (e.g., Volcano#3 PMF factor for magnesium and Volcano#1 PMF factor for selenium).

[33] US Environmental Protection Agency, EPA Positive Matrix Factorization (PMF) 5.0 Fundamentals and User Guide, EPA/600/R-14/109, April 2014, www.epa.gov; https://www.epa.gov/sites/production/files/2015-02/documents/pmf_5.0_user_guide.pdf.

Table 8.0-5 IMPROVE "IMPFSPED" Dataset Measured Pollutants, Codes, and Measurement Units							
Parameter	**Code**	**AQSCode**	**Units**	**Parameter**	**Code**	**AQSCode**	**Units**
Aluminum (Fine)	ALf	88104	ug/m^3	Lead (Fine)	PBf	88128	ug/m^3
Ammonium Ion (Fine)	NH4f	88301	ug/m^3	Magnesium (Fine)	MGf	88140	ug/m^3
Arsenic (Fine)	ASf	88103	ug/m^3	Manganese (Fine)	MNf	88132	ug/m^3
Bromine (Fine)	BRf	88109	ug/m^3	Mass, PM10 (Total)	MT	85101	ug/m^3
Calcium (Fine)	CAf	88111	ug/m^3	Mass, PM2.5 (Fine)	MF	88101	ug/m^3
Carbon, Elemental Fraction 1 (Fine)	EC1f	88329	ug/m^3	Nickel (Fine)	NIf	88136	ug/m^3
Carbon, Elemental Fraction 2 (Fine)	EC2f	88330	ug/m^3	Nitrate (Fine)	NO3f	88306	ug/m^3
Carbon, Elemental Fraction 3 (Fine)	EC3f	88331	ug/m^3	Nitrite (Fine)	N2f	88338	ug/m^3
Carbon, Organic Fraction 1 (Fine)	OC1f	88332	ug/m^3	Phosphorus (Fine)	Pf	88152	ug/m^3
Carbon, Organic Fraction 2 (Fine)	OC2f	88333	ug/m^3	Potassium (Fine)	Kf	88180	ug/m^3
Carbon, Organic Fraction 3 (Fine)	OC3f	88334	ug/m^3	Rubidium (Fine)	RBf	88176	ug/m^3
Carbon, Organic Fraction 4 (Fine)	OC4f	88335	ug/m^3	Selenium (Fine)	SEf	88154	ug/m^3
Carbon, Organic Pyrolized (Fine)	OPf	88336	ug/m^3	Silicon (Fine)	SIf	88165	ug/m^3
Chloride (Fine)	CHLf	88203	ug/m^3	Sodium (Fine)	NAf	88184	ug/m^3
Chlorine (Fine)	CLf	88115	ug/m^3	Strontium (Fine)	SRf	88168	ug/m^3
Chromium (Fine)	CRf	88112	ug/m^3	Sulfate (Fine)	SO4f	88403	ug/m^3
Copper (Fine)	CUf	88114	ug/m^3	Sulfur (Fine)	Sf	88169	ug/m^3
Filter Absorption Coefficient	fAbs	63102	Mm-1	Titanium (Fine)	TIf	88161	ug/m^3
Filter Absorption Coefficient (uncalibrated)	fAbs_HIPS	-999	10^-8/m	Vanadium (Fine)	Vf	88164	ug/m^3
Hydrogen (Fine)	Hf	88337	ug/m^3	Zinc (Fine)	ZNf	88167	ug/m^3
Iron (Fine)	FEf	88126	ug/m^3	Zirconium (Fine)	ZRf	88185	ug/m^3

Table 8.0-6 EPA PMF 5.0 Equations to Calculate Signal to Noise Ratio	
$d_{ij} = \left(\frac{x_{ij} - s_{ij}}{s_{ij}}\right) \; if \; x_{ij} > s_{ij}$	Reference 33, Equation 5-3
$d_{ij} = 0 \; if \; x_{ij} \leq s_{ij}$	Reference 33, Equation 5-3
$\left(\frac{S}{N}\right)_j = {}^1\!/_n \sum_{i=1}^{n} d_{ij}$	Reference 33, Equation 5-4; note that the DOH-CAB implementation of this equation applied the summation over positive measurement datasets, so the DOH-CAB summation is over n_j values for the j^{th} pollutant.

The pollutant measurements associated with Hawaii IMPROVE sites are likewise seen to be generally low compared to those across all national sites. Table 8.0-7 provides the average annual 90th percentile measurement values and rankings for Hawaii IMPROVE sites. For example, the HACR1 results for aluminum (ALf) show that the average measured concentration is 0.0552 ug/m^3. The "Average Site Rank (High)" is about 129 out of about 169 sites ("Average Number of Sites"), equivalent to an "Average Ranking Percentile" of 24%. The "Average Ranking Percentile" values presented in the table are calculated by taking the ratio of the "Average Site Rank (High)" and "Average Number of Sites", subtracting that from one, and representing the result as a percentage. The highlighted rows show those cases where Hawaii "Average Ranking Percentiles" are greater than or equal to 50%. Green highlights indicate rankings between 50% and less than 60%. Blue highlights indicate rankings between 60% and less than 70%. Yellow highlight indicate rankings between 70% and less than 80%. An orange highlight indicates rankings of 80% and above. Table E-31 in Appendix E presents the annual 90th percentile measurement values and rankings for Hawaii IMPROVE sites that were averaged for the data reported in Table 8.0-7.

Table 8.0-8 consists of the cases where Hawaii sites were nationally ranked about 40% or higher in Table 8.0-7. Table 8.0-9 documents the national IMPROVE monitoring sites used for this assessment. The pollutants were matched with associated PMF factors determined from the DOH-CAB analyses for the 2012 RH-FIP, with relevant PMF factors indicated on the right side of the table. With the exception of nickel (NIf), vanadium (Vf), and nitrite (N2f) concentrations for HALE1, the nitrite concentration at HACR1 and the nitrite, nickel and phosphorus (Pf) concentrations for HAVO1, all "Average Ranking Percentile" values above 40% appear to result from primarily natural (e.g., biogenic, geogenic, non-anthropogenic) sources. Since the HALE1 monitoring site is outside of the national park and has been replaced by the HACR1 site, the rankings seem insignificant. The relatively high nitrite rankings associated with all three Hawaii monitoring sites appears consistent with the nitrite resulting from a volcanic source. Mather et al. noted: "Hot volcanic vents promote the thermal fixation of atmospheric N_2 into biologically available forms. The importance of this process for the global nitrogen cycle is poorly understood. At Masaya volcano, Nicaragua, NO and NO_2 are intimately associated with volcanic aerosol, such that NOx levels reach as much as an order of magnitude above local background." and "NO has been observed above Hawaiian lava flows (Huebert et al., 1999)".[34] Note also that Table E-29 in Appendix E shows that the number of annual positive measurement datasets (value, uncertainty, minimum detectable limit) for nitrite (N2f) at the HACR1, HALE1, and HAVO1 sites are generally low compared to both other national sites and other pollutants at the Hawaii sites. For example, the HAVO1 site in 2014 had 51 positive datasets. That was the largest number of positive datasets for any Hawaii site during the 2001 to 2015 time period. That HAVO1 case ranks 156th out of 164 sites for that year, meaning that 155 monitoring sites had more positive measurement datasets than HAVO1. For comparison, the HACR1 site had 37 positive measurement datasets, which ranked 163rd out of 164 sites. So while elevated levels of nitrite at all three Hawaii sites, with the maximum value at the HAVO1 site seems consistent with a Kilauea volcano origin, it is not clear that the data quality for nitrite is sufficient to generate much confidence in that assessment.

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[34] T.A. Mather, D.M. Pyle, A.G. Allen, Volcanic source for fixed nitrogen in the early Earth's atmosphere, Geology; October 2004; v. 32; no. 10; p. 905–908; http://www.geo.mtu.edu/~raman/papers2/MatheretalGEO.pdf

Table 8.0-7 Hawaii IMPROVE Site Average of Annual 90th Percentile Measurement Values and Rankings*

		Highlighted Hawaii site Average Ranking Percentiles equal or exceed the values below			
90th percentile measurement	Highlighting	50%	60%	70%	80%
	Data Type	Average Site Value	Average Rankings Percentile	Average Site Rank (High)	Average Number of Sites
Site	Units -> Pollutant	(ug/m^3*)	(%)	(1)	(1)
HACR1	ALf	0.0552	24%	128.67	168.56
HALE1	ALf	0.0587	13%	146.17	167.33
HAVO1	ALf	0.0476	12%	146.33	167.00
HACR1	NH4f	NA	NA	NA	NA
HALE1	NH4f	NA	NA	NA	NA
HAVO1	NH4f	NA	NA	NA	NA
HACR1	ASf	0.0002	3%	163.89	168.56
HALE1	ASf	0.0003	11%	148.42	167.58
HAVO1	ASf	0.0006	35%	109.27	167.20
HACR1	BRf	0.0009	0%	168.00	168.56
HALE1	BRf	0.0017	11%	148.33	167.58
HAVO1	BRf	0.0010	1%	165.93	167.20
HACR1	CAf	0.0364	19%	136.67	168.56
HALE1	CAf	0.0399	19%	136.08	167.58
HAVO1	CAf	0.0274	9%	151.87	167.20
HACR1	EC1f	0.0990	0%	170.44	170.89
HALE1	EC1f	0.2132	4%	162.92	169.17
HAVO1	EC1f	0.1358	1%	167.20	168.73
HACR1	EC2f	0.0229	0%	170.56	170.89
HALE1	EC2f	0.0415	2%	165.83	169.17
HAVO1	EC2f	0.0373	1%	166.33	168.73
HACR1	EC3f	0.0039	18%	140.00	170.56
HALE1	EC3f	0.0093	25%	126.58	168.67
HAVO1	EC3f	0.0135	25%	126.79	168.14
HACR1	OC1f	0.0252	2%	167.44	170.89
HALE1	OC1f	0.0413	6%	158.75	169.17
HAVO1	OC1f	0.0533	11%	150.20	168.73
HACR1	OC2f	0.0528	1%	170.00	170.89
HALE1	OC2f	0.1026	2%	166.25	169.17
HAVO1	OC2f	0.0963	6%	158.20	168.73
HACR1	OC3f	0.0820	0%	170.33	170.89
HALE1	OC3f	0.2009	3%	164.92	169.17
HAVO1	OC3f	0.1077	0%	167.93	168.73
HACR1	OC4f	0.0608	0%	170.78	170.89
HALE1	OC4f	0.1552	4%	162.42	169.17
HAVO1	OC4f	0.0963	1%	167.53	168.73
HACR1	OPf	0.0718	0%	170.11	170.89
HALE1	OPf	0.1307	3%	163.67	169.17
HAVO1	OPf	0.0985	2%	166.00	168.73
HACR1	CHLf	0.1510	75%	41.56	167.89
HALE1	CHLf	0.4251	87%	22.00	167.67
HAVO1	CHLf	0.4447	88%	20.13	166.93
HACR1	CLf	0.0993	75%	42.00	165.33
HALE1	CLf	0.2863	85%	24.50	159.00
HAVO1	CLf	0.3042	87%	21.33	160.33
HACR1	CRf	0.0002	17%	140.33	168.11
HALE1	CRf	0.0002	5%	158.42	167.25
HAVO1	CRf	0.0002	11%	148.33	166.93
HACR1	CUf	0.0003	2%	165.11	168.56
HALE1	CUf	0.0003	5%	159.08	167.58
HAVO1	CUf	0.0014	69%	51.67	167.20
HACR1	fAbs*	0.9422	1%	166.11	168.56
HALE1	fAbs*	1.7923	12%	149.90	171.10
HAVO1	fAbs*	0.7236	0%	169.46	169.85
HACR1	fAbs_HIPS*	183.2600	2%	167.33	171.00
HALE1	fAbs_HIPS*	224.6889	10%	150.67	166.56
HAVO1	fAbs_HIPS*	133.7622	0%	166.11	166.56
HACR1	Hf	0.1553	3%	166.50	171.25
HALE1	Hf	0.2105	17%	139.80	167.60
HAVO1	Hf	0.4222	57%	71.70	167.60
HACR1	FEf	0.0337	13%	146.33	168.56
HALE1	FEf	0.0362	13%	146.08	167.58
HAVO1	FEf	0.0196	3%	161.53	167.20

		Highlighted Hawaii site Average Ranking Percentiles equal or exceed the values below			
90th percentile measurement	Highlighting	50%	60%	70%	80%
	Data Type	Average Site Value	Average Rankings Percentile	Average Site Rank (High)	Average Number of Sites
Site	Units -> Pollutant	(ug/m^3*)	(%)	(1)	(1)
HACR1	PBf	0.0008	7%	156.8889	168.5556
HALE1	PBf	0.0007	3%	161.7500	167.5833
HAVO1	PBf	0.0020	49%	84.6667	167.2000
HACR1	MGf	0.0311	33%	112.4444	168.5556
HALE1	MGf	0.0442	39%	101.0833	166.5000
HAVO1	MGf	0.0583	60%	66.1333	166.3333
HACR1	MNf	0.0008	8%	155.8889	168.5556
HALE1	MNf	0.0010	7%	155.1667	167.5833
HAVO1	MNf	0.0006	1%	165.0000	167.2000
HACR1	MT	5.4463	1%	165.7778	167.8889
HALE1	MT	9.0510	11%	149.0833	167.4167
HAVO1	MT	13.2073	34%	110.2000	166.7333
HACR1	MF	3.2143	3%	163.5556	168.5556
HALE1	MF	4.7485	12%	146.8333	167.5000
HAVO1	MF	11.9304	69%	52.2667	167.1333
HACR1	NIf	0.0002	25%	125.7778	168.1111
HALE1	NIf	0.0004	63%	62.1667	167.2500
HAVO1	NIf	0.0004	54%	76.2000	166.9333
HACR1	NO3f	0.1602	7%	156.6667	167.8889
HALE1	NO3f	0.3343	26%	124.0000	167.6667
HAVO1	NO3f	0.1356	3%	162.2000	166.9333
HACR1	N2f	0.0354	64%	60.3333	167.8889
HALE1	N2f	0.0365	62%	64.3333	167.6667
HAVO1	N2f	0.0400	70%	49.7333	166.9333
HACR1	Pf	0.0039	29%	99.3333	139.8889
HALE1	Pf	0.0159	53%	52.5833	111.9167
HAVO1	Pf	0.0061	47%	65.1333	122.6667
HACR1	Kf	0.0333	7%	157.1111	168.5556
HALE1	Kf	0.0561	29%	119.0833	167.5833
HAVO1	Kf	0.0304	5%	159.5333	167.2000
HACR1	RBf	0.0003	19%	135.7778	168.5556
HALE1	RBf	0.0002	11%	149.8333	167.5000
HAVO1	RBf	0.0002	8%	153.0000	167.1333
HACR1	SEf	0.0002	18%	138.1111	168.5556
HALE1	SEf	0.0003	26%	123.8333	167.5833
HAVO1	SEf	0.0069	99%	1.4000	167.2000
HACR1	SIf	0.1215	20%	135.0000	168.5556
HALE1	SIf	0.1069	10%	150.5833	167.5833
HAVO1	SIf	0.1459	21%	132.6000	167.2000
HACR1	NAf	0.1426	50%	85.0000	168.5556
HALE1	NAf	0.3320	68%	52.7500	167.4167
HAVO1	NAf	0.4698	84%	26.2000	167.0667
HACR1	SRf	0.0006	21%	133.3333	168.5556
HALE1	SRf	0.0006	26%	124.5000	167.5833
HAVO1	SRf	0.0005	16%	140.2000	167.2000
HACR1	SO4f	1.3452	45%	92.3333	167.8889
HALE1	SO4f	2.1815	59%	69.1667	167.6667
HAVO1	SO4f	6.3915	89%	18.0000	166.9333
HACR1	Sf	0.4371	41%	99.5556	168.5556
HALE1	Sf	0.7310	57%	72.6667	167.5833
HAVO1	Sf	1.7852	84%	27.4667	167.2000
HACR1	TIf	0.0037	24%	128.1111	168.5556
HALE1	TIf	0.0050	29%	118.5000	167.5833
HAVO1	TIf	0.0025	6%	156.6667	167.2000
HACR1	Vf	0.0003	21%	133.1111	168.5556
HALE1	Vf	0.0009	47%	89.5833	167.5833
HAVO1	Vf	0.0008	36%	106.4000	167.2000
HACR1	ZNf	0.0011	0%	168.0000	168.5556
HALE1	ZNf	0.0018	6%	158.1667	167.5833
HAVO1	ZNf	0.0023	17%	139.2667	167.2000
HACR1	ZRf	0.0009	23%	130.3333	168.5556
HALE1	ZRf	0.0005	25%	126.1667	167.4167
HAVO1	ZRf	0.0006	16%	139.5333	167.0667

*note the units for fAbs and fAbs_HIPS are 1/Mm and 10^-8/m, respectively.

Table 8.0-8 Review of PMF Results Associated with Hawaii IMPROVE Site Average of Annual 90th Percentile Measurement Values and Rankings with "Average Rankings Percentile" Values Greater Than or Equal to 40%

		Highlighted Hawaii site Average Ranking Percentiles equal or exceed the values below				Key results from HIDOH-CAB PMF for the 2012 RHR FIP using 2005 IMPROVE data for HAVO1 and HALE1 (see State of Hawaii, Department of Health, Clean Air Branch, C. 2 Documents Related to Causes of Haze for Haleakala and Hawaii Volcanoes National Parks, C.2.a, C.2.b). N2f comment from Mather et al.,"Volcano source for fixed Nitrogen in the early Earth's atmosphere", Geology; October 2004; v. 32; no. 10; p. 905–908.**				
90th percentile measurement	Highlighting	50%	60%	70%	80%					
	Data Type	Average Site Value	Average Rankings Percentile	Average Site Rank (High)	Average Number of Sites					
Site	Units -> Pollutant	(ug/m^3*)	(%)	(1)	(1)	Factor Name	Factor %	Factor Name	Factor %	r^2
HACR1	CHLf	0.1510	75%	41.56	167.89	Sea Salt / NRS	33.20%	Oil Combust.	24.90%	0.98
HALE1	CHLf	0.4251	87%	22.00	167.67					
HAVO1	CHLf	0.4447	88%	20.13	166.93	Sea Salt / NRS	34.5%	Smoke (Br)	28.1%	0.808
HACR1	CLf	0.0993	75%	42.00	165.33	Sea Salt / NRS	100%	NA	NA	0.913
HALE1	CLf	0.2863	85%	24.50	159.00					
HAVO1	CLf	0.3042	87%	21.33	160.33	Sea Salt / NRS	93.2%	NA	NA	0.294
HAVO1	CUf	0.0014	69%	51.67	167.20	Volcano #1	67.9%	Volcano #3	24.1%	0.804
HAVO1	Hf	0.4222	57%	71.70	167.60	Volcano #2	41.4%	Volcano #1	29.3%	0.833
HAVO1	PBf	0.0020	49%	84.6667	167.2000	Volcano #1	74.8%	Volcano #3	16.3%	0.973
HAVO1	MGf	0.0583	60%	66.1333	166.3333	Volcano #3	67.3%	Sea Salt / NRS	11.2%	0.343
HAVO1	MF	11.9304	69%	52.2667	167.1333	Volcano #1	47.4%	Volcano #2	42.2%	0.985
HALE1	NIf	0.0004	63%	62.1667	167.2500	Oil Combust.	59.4%	Volcano #1	25.2%	0.421
HAVO1	NIf	0.0004	54%	76.2000	166.9333	Oil Combust.	51.1%	Shipping	30.8%	0.645
HACR1	N2f	0.0354	64%	60.3333	167.8889	**Not included in HIDOH-CAB PMF for the 2012 RHR FIP. Note: "Hot volcanic vents promote the thermal fixation of atmospheric N2 into biologically available forms. The importance of this process for the global nitrogen cycle is poorly understood. At Masaya volcano, Nicaragua, NO and NO2 are intimately associated with volcanic aerosol, such that NOx levels reach as much as an order of magnitude above local background."				
HALE1	N2f	0.0365	62%	64.3333	167.6667					
HAVO1	N2f	0.0400	70%	49.7333	166.9333					
HALE1	Pf	0.0159	53%	52.5833	111.9167	Brush Fire	67.2%	Shipping	29.3%	0
HAVO1	Pf	0.0061	47%	65.1333	122.6667	Shipping	98.5%	NA	NA	0
HAVO1	SEf	0.0069	99%	1.4000	167.2000	Volcano #1	93.1%	NA	NA	0.996
HACR1	NAf	0.1426	50%	85.0000	168.5556	Oil Combust.	23.40%	Volcano #1	20.80%	0.857
HALE1	NAf	0.3320	68%	52.7500	167.4167					
HAVO1	NAf	0.4698	84%	26.2000	167.0667	Volcano #3	62.2%	Volcano #2	15.4%	0.688
HACR1	SO4f	1.3452	45%	92.3333	167.8889	In an attempt to avoid biasing the PMF calculations through near duplicate species, DOH-CAB did not include SO4 pollutant since measured sulfur was included.				
HALE1	SO4f	2.1815	59%	69.1667	167.6667					
HAVO1	SO4f	6.3915	89%	18.0000	166.9333					
HACR1	Sf	0.4371	41%	99.5556	168.5556	Volcano #1	67.20%	Smoke (Br)	9.70%	0.962
HALE1	Sf	0.7310	57%	72.6667	167.5833					
HAVO1	Sf	1.7852	84%	27.4667	167.2000	Volcano #1	49.9%	Volcano #2	45.3%	0.973
HALE1	Vf	0.0009	47%	89.5833	167.5833	Oil Combust.	46.00%	Volcano #1	17.1%	0.409

*note the units for fAbs and fAbs_HIPS are 1/Mm and 10^-8/m, respectively.

Table 8.0-9 IMPROVE IMPRHR2 dataset list of Monitoring Sites, Codes, and States

Site	Code	State
Barrier Lake	BALA1	AB
Simeonof	SIME1	AK
Denali NP	DENA1	AK
Tuxedni	TUXE1	AK
Kenai Peninsula Borough	KPBO1	AK
Trapper Creek	TRCR1	AK
Ambler	AMBL1	AK
Gates of the Arctic NP	GAAR1	AK
Petersburg	PETE1	AK
North Birmingham	BIRM1	AL
Sipsey Wilderness	SIPS1	AL
Upper Buffalo Wilderness	UPBU1	AR
Caney Creek	CACR1	AR
Petrified Forest NP	PEFO1	AZ
Mount Baldy	BALD1	AZ
Chiricahua NM	CHIR1	AZ
Douglas	DOUG1	AZ
Sycamore Canyon	SYCA1	AZ
Hance Camp at Grand Canyon NP	GRCA2	AZ
Indian Gardens	INGA1	AZ
Hopi Point #1	GRCA1	AZ
Tonto NM	TONT1	AZ
Sierra Ancha	SIAN1	AZ
Phoenix	PHOE1	AZ
Meadview	MEAD1	AZ
Saguaro NM	SAGU1	AZ
Saguaro West	SAWE1	AZ
Organ Pipe	ORPI1	AZ
Queen Valley	QUVA1	AZ
Ike's Backbone	IKBA1	AZ
Hillside	HILL1	AZ
Redwood NP	REDW1	CA
Bliss SP (TRPA)	BLIS1	CA
South Lake Tahoe	SOLA1	CA
Lake Tahoe Community College	LTCC1	CA
Fresno	FRES1	CA
Death Valley NP	DEVA1	CA
Owens Valley	OWVL1	CA
Dome Lands Wilderness	DOLA1	CA
Dome Lands Wilderness	DOME1	CA
San Gabriel	SAGA1	CA
Point Reyes National Seashore	PORE1	CA
Yosemite NP	YOSE1	CA
Hoover	HOOV1	CA
Rubidoux	RUBI1	CA
Pinnacles NM	PINN1	CA
San Gorgonio Wilderness	SAGO1	CA
Joshua Tree NP	JOSH1	CA
Kaiser	KAIS1	CA
Joshua Tree NP	JOTR1	CA
Wrightwood	WRIG1	CA
Agua Tibia	AGTI1	CA
San Rafael	RAFA1	CA
Lassen Volcanic NP	LAVO1	CA
Lava Beds NM	LABE1	CA
Trinity	TRIN1	CA
Sequoia NP	SEQU1	CA
White River NF	WHRI1	CO
Weminuche Wilderness	WEMI1	CO
Shamrock Mine	SHMI1	CO
Rocky Mountain NP	ROMO1	CO
Rocky Mountain NP HQ	RMHQ1	CO
Mesa Verde NP	MEVE1	CO
Ripple Creek	RICR1	CO
Flat Tops	FLTO1	CO
Mount Zirkel Wilderness	MOZI1	CO
Storm Peak	STPE1	CO
Great Sand Dunes NM	GRSA1	CO
Mohawk Mt.	MOMO1	CT
Washington D.C.	WASH1	DC
Chassahowitzka NWR	CHAS1	FL
Everglades NP	EVER1	FL
St. Marks	SAMA1	FL
Okefenokee NWR	OKEF1	GA
South Dekalb	ATLA1	GA
Cohutta	COHU1	GA
Hawaii Volcanoes NP	HAVO1	HI
Haleakala NP	HALE1	HI
Haleakala Crater	HACR1	HI
Lake Sugema	LASU2	IA
Viking Lake	VILA1	IA
Lake Sugema	LASU1	IA
Craters of the Moon NM	CRMO1	ID
Scoville	SCOV1	ID
Sawtooth NF	SAWT1	ID
Salmon NF	SALM1	ID
Bondville	BOND1	IL
Chicago	CHIC1	IL
Livonia	LIVO1	IN
Sac and Fox	SAFO1	KS
Tallgrass	TALL1	KS
Cedar Bluff	CEBL1	KS
Mammoth Cave NP	MACA1	KY
Cadiz	CADI1	KY
Breton	BRET1	LA
Breton Island	BRIS1	LA
Sikes	SIKE1	LA
Cape Cod	CACO1	MA
Martha's Vineyard	MAVI1	MA
Quabbin Summit	QURE1	MA
Baltimore	BALT1	MD
Frostberg Reservoir (Big Piney Run)	FRRE1	MD
Presque Isle	PRIS1	ME
Casco Bay	CABA1	ME
Bridgton	BRMA1	ME
Acadia NP	ACAD1	ME
Old Town	OLTO1	ME
Penobscot	PENO1	ME
Moosehorn NWR	MOOS1	ME
Isle Royale NP	ISLE1	MI
Isle Royale NP	ISRO1	MI
Seney	SENE1	MI
Detroit	DETR1	MI
Boundary Waters Canoe Area	BOWA1	MN
Blue Mounds	BLMO1	MN
Voyageurs NP #1	VOYA1	MN
Voyageurs NP #2	VOYA2	MN
Great River Bluffs	GRRI1	MN
El Dorado Springs	ELDO1	MO
Mingo	MING1	MO
Hercules-Glades	HEGL1	MO
Glacier NP	GLAC1	MT
Flathead	FLAT1	MT
Gates of the Mountains	GAMO1	MT
Cabinet Mountains	CABI1	MT
UL Bend	ULBE1	MT
Monture	MONT1	MT
Sula Peak	SULA1	MT
Fort Peck	FOPE1	MT
Northern Cheyenne	NOCH1	MT
Medicine Lake	MELA1	MT
Linville Gorge	LIGO1	NC
Shining Rock Wilderness	SHRO1	NC
Swanquarter	SWAN1	NC
Theodore Roosevelt	THRO1	ND
Lostwood	LOST1	ND
Crescent Lake	CRES1	NE
Nebraska NF	NEBR1	NE
Omaha	OMAH1	NE
Great Gulf Wilderness	GRGU1	NH
Pack Monadnock Summit	PACK1	NH
Londonderry	LOND1	NH
Brigantine NWR	BRIG1	NJ
Gila Wilderness	GICL1	NM
San Andres	SAAN1	NM
Salt Creek	SACR1	NM
White Mountain	WHIT1	NM
Bandelier NM	BAND1	NM
San Pedro Parks	SAPE1	NM
Bosque del Apache	BOAP1	NM
Wheeler Peak	WHPE1	NM
Jarbidge Wilderness	JARB1	NV
Walker River Paiute Tribe	WARI1	NV
Great Basin NP	GRBA1	NV
Is 52	NEYO1	NY
Addison Pinnacle	ADPI1	NY
Connecticut Hill	COHI1	NY
Quaker City	QUCI1	OH
Wichita Mountains	WIMO1	OK
Ellis	ELLI1	OK
Cherokee Nation	CHER1	OK
Stilwell	STIL1	OK
Egbert	EGBE1	ON
Mount Hood	MOHO1	OR
Kalmiopsis	KALM1	OR
Crater Lake NP	CRLA1	OR
Three Sisters Wilderness	THSI1	OR
Starkey	STAR1	OR
Hells Canyon	HECA1	OR
Arendtsville	AREN1	PA
Lawrenceville	PITT1	PA
M.K. Goddard	MKGO1	PA
Cape Romain NWR	ROMA1	SC
Wind Cave	WICA1	SD
Badlands NP	BADL1	SD
Great Smoky Mountains NP	GRSM1	TN
Big Bend NP	BIBE1	TX
Guadalupe Mountains NP	GUMO1	TX
Houston Deer Park #2	HOUS1	TX
Bryce Canyon NP	BRCA1	UT
Arches NP	ARCH1	UT
Canyonlands NP	CANY1	UT
Lone Peak Wilderness	LOPE1	UT
Zion	ZION1	UT
Zion Canyon	ZICA1	UT
Capitol Reef NP	CAPI1	UT
James River Face Wilderness	JARI1	VA
Jefferson NF	JEFF1	VA
Shenandoah NP	SHEN1	VA
Virgin Islands NP	VIIS1	VI
Lye Brook Wilderness	LYBR1	VT
Proctor Maple R. F.	PMRF1	VT
Lye Brook Wilderness	LYEB1	VT
Olympic	OLYM1	WA
Puget Sound	PUSO1	WA
Snoqualmie Pass	SNPA1	WA
Columbia River Gorge	CORI1	WA
Columbia Gorge #1	COGO1	WA
White Pass	WHPA1	WA
Pasayten	PASA1	WA
Mount Rainier NP	MORA1	WA
Spokane Res.	SPOK1	WA
North Cascades	NOCA1	WA
Lynden	LYND1	WA
Makah Tribe	MAKA1	WA
Makah Tribe Site #2	MAKA2	WA
Dolly Sods Wilderness	DOSO1	WV
Brooklyn Lake	BRLA1	WY
Thunder Basin	THBA1	WY
Cloud Peak	CLPE1	WY
North Absaroka	NOAB1	WY
Yellowstone NP 2	YELL2	WY
Bridger Wilderness	BRID1	WY
Boulder Lake	BOLA1	WY

While the number of positive measurement datasets appears to be a useful metric for assessing pollutant specific data completeness, it is not applicable for examining the calculated visibility impacting parameters identified in Table 8.0-1. Because the IMPROVE program has not yet developed calculation procedures, the uncertainties associated with the visibility impacting parameter values are not currently included in the DataWizard datasets. As detailed in "Guidance for Tracking Progress Under the Regional Haze Rule"[35], missing data values are replaced with quarterly median values based on the "current year and each of the previous four years of data." For the Hawaii sites, the IMPRHR2 datasets available from the DataWizard use a Flag4 value of "1" to indicate when values result from data replacement. However, Instead of examining the Flag4 values to assess data replacement, we identified duplicate reported values in the annual site specific datasets, and based our calculations on those values. The available IMPROVE 2001-2015 IMPRHR2 datasets for HACR1, HALE1, and HAVO1 were examined for duplicate values, zero values, and error values (invalid values indicated by a -999).

Key results of this examination are presented in Table 8.0-10. For each site, year, and pollutant, two metrics were used to identify areas of potential concerns. The first, "Sum Duplicate Total Value Fraction" represents the ratio of duplicate values to the total of all valid values. This metric weights larger duplicate values more than smaller ones, and provides zero weighting for zero and error values. The left half of Table 8.0-10 shows the thirty largest values associated with this metric. The top four values are associated with HAVO1 coarse mass for 2015 and 2014. The results show that approximately 74% of the summed coarse mass concentrations and b_{ext} values for HAVO1 in 2015 are associated with duplicate values. For 2014, about 42% of the summed values for coarse mass are associated with duplicate values. The remaining rankings values for the other aerosol species are much smaller in magnitude. For the other aerosol species, about 11% to 22% of the summed values for the various species are associated with duplicate values. They are frequently associated with elemental carbon (ECf). The second metric, "Sum Duplicate / Zero / Error Count Fraction" represents the ration of the number of values associated with duplicates, zero values, or error values (invalid values indicated by a -999). This metric equally weights duplicate, zero, and error values. The right half of Table 8.0-10 shows the 30 largest values associated with this metric. The top four values for this metric are also associated with HAVO1 coarse mass for 2015 and 2014, and have values of about 79% for 2015 and 54% for 2014. Subsequent values for this metric range from about 53% for 2014 HACR1 elemental carbon to about 38% for 2007 HACR1 elemental carbon. The ranked values are generally associated with HACR1 and HAVO1 elemental carbon and organic carbon mass.

Coarse mass related data associated with the HAVO1 site for 2015 was examined in more detail. Total mass (MT), fine mass (MF), and calculated coarse mass (CM_calculated) information from the IMPFSPED dataset and coarse mass b-extinction (CM_bext) information from the IMPRHR2 dataset were used to confirm data replacement estimates for this seemingly extreme case. The coarse mass b-extinction calculation was validated using the 2nd (e.g., revised) IMPROVE equation as presented in "An Examination of the Current IMPROVE Algorithm"[36]. The results confirmed that coarse mass visibility extinction values for all 27 of the first quarter, all 29 of the second quarter, all 26 of the third quarter,

[35] US Environmental Protection Agency, Guidance for Tracking Progress Under the Regional Haze Rule, EPA-454/B-03-004, September 2003; https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0531-0006.
[36] T. Prenni (National Park Service), J.L. Hand, W.C. Malm, B.A Schichtel (Colorado State University), "An Examination of the Current IMPROVE Algorithm", 2016 IMPROVE Meeting, 11/01/2016.; http://vista.cira.colostate.edu/improve/wp-content/uploads/2016/12/15_Prenni_IMPROVENeph_2016.pdf.

and 1 in the fourth quarter were replaced. Please refer to Page 57 in Section 7 of the progress report.

Table 8.0-10 IMPROVE 2001-2015 IMPRHR2 datasets for HACR1, HALE1, and HAVO1, Largest 30 Sum of Duplicate Total Value Fraction and Sum of Duplicate / Zero / Error (-999) Count Fraction

Site	Year	Pollut.	Sum Duplicate Total Value Fract. (1)	Sum Duplicate / Zero / Error Count Fract. (1)	Site	Year	Pollut.	Sum Duplicate Total Value Fract. (1)	Sum Duplicate / Zero / Error Count Fract. (1)
HAVO1	2015	CM_calculated:Value2	0.740	0.785	HAVO1	2015	CM_calculated:Value2	0.740	0.785
HAVO1	2015	CM_bext:Value2	0.740	0.785	HAVO1	2015	CM_bext:Value2	0.740	0.785
HAVO1	2014	CM_calculated:Value2	0.423	0.541	HAVO1	2014	CM_calculated:Value2	0.423	0.541
HAVO1	2014	CM_bext:Value2	0.423	0.541	HAVO1	2014	CM_bext:Value2	0.423	0.541
HACR1	2012	ECf:Value2	0.216	0.434	HACR1	2014	ECf:Value2	0.148	0.525
HACR1	2012	ECf_bext:Value2	0.216	0.434	HACR1	2014	ECf_bext:Value2	0.148	0.525
HALE1	2003	MT:Value2	0.206	0.240	HACR1	2015	ECf:Value2	0.102	0.512
HAVO1	2002	ECf:Value2	0.170	0.418	HACR1	2015	ECf_bext:Value2	0.102	0.512
HAVO1	2002	ECf_bext:Value2	0.170	0.418	HACR1	2009	OMCf:Value2	0.004	0.508
HAVO1	2008	ECf:Value2	0.162	0.426	HACR1	2009	OMCf_bext:Value2	0.004	0.508
HAVO1	2008	ECf_bext:Value2	0.162	0.426	HACR1	2012	ECf:Value2	0.216	0.434
HACR1	2014	ECf:Value2	0.148	0.525	HACR1	2012	ECf_bext:Value2	0.216	0.434
HACR1	2014	ECf_bext:Value2	0.148	0.525	HAVO1	2008	ECf:Value2	0.162	0.426
HACR1	2011	ECf:Value2	0.147	0.372	HAVO1	2008	ECf_bext:Value2	0.162	0.426
HACR1	2011	ECf_bext:Value2	0.147	0.372	HAVO1	2005	OMCf:Value2	0.021	0.418
HALE1	2002	MT:Value2	0.144	0.279	HAVO1	2005	OMCf_bext:Value2	0.021	0.418
HAVO1	2011	ECf:Value2	0.141	0.240	HAVO1	2002	ECf:Value2	0.170	0.418
HAVO1	2011	ECf_bext:Value2	0.141	0.240	HAVO1	2002	ECf_bext:Value2	0.170	0.418
HALE1	2004	MT:Value2	0.138	0.213	HACR1	2012	OMCf:Value2	0.035	0.410
HALE1	2002	ECf:Value2	0.133	0.328	HACR1	2012	OMCf_bext:Value2	0.035	0.410
HALE1	2002	ECf_bext:Value2	0.133	0.328	HACR1	2008	ECf:Value2	0.083	0.410
HAVO1	2004	ammNO3f:Value2	0.118	0.189	HACR1	2008	ECf_bext:Value2	0.083	0.410
HAVO1	2014	ECf:Value2	0.118	0.344	HACR1	2013	OMCf:Value2	0.030	0.393
HAVO1	2014	ECf_bext:Value2	0.118	0.344	HACR1	2013	OMCf_bext:Value2	0.030	0.393
HAVO1	2010	ECf:Value2	0.114	0.270	HACR1	2008	OMCf:Value2	0.003	0.393
HAVO1	2010	ECf_bext:Value2	0.114	0.270	HACR1	2008	OMCf_bext:Value2	0.003	0.393
HALE1	2001	MT:Value2	0.111	0.238	HACR1	2015	OMCf:Value2	0.049	0.388
HAVO1	2008	ammNO3f:Value2	0.109	0.156	HACR1	2015	OMCf_bext:Value2	0.048	0.388
HALE1	2001	ECf:Value2	0.108	0.238	HACR1	2007	ECf:Value2	0.055	0.377
HALE1	2001	ECf_bext:Value2	0.108	0.238	HACR1	2007	ECf_bext:Value2	0.055	0.377

IMPROVE Data Distribution Observations

Appendix F, Figures F-20 to F-61 present the IMPROVE distributions across all national sites of the 90th percentile values (top chart) and signal to noise values (bottom chart) for the 42 individual monitored pollutants (aluminum through zirconium). Figures F-62 to F-103 present the IMPROVE distribution across all national sites of the signal to noise values (top chart) and number of positive annual datasets (measurement days with a positive measured value, positive uncertainty, and positive minimum detectable limit; bottom chart). The charts show the annual distributions for 2001 – 2015. In addition to graphically indicating the great extent that Hawaii monitoring data are outliers when compared to the national distribution, these figures show national trends in measured value, signal to noise, and positive annual datasets.

There are a number of examples where there are seemingly large jumps in the national signal to noise values over the span of one year. For example, Figure F-20 shows relatively large reduction in the aluminum (ALf) signal to noise distribution between 2010 and 2011-2015, from about 11 to about 7. The median national signal to noise values were generally increasing from 2005 to 2010, and then they decreased to somewhat below the 2001 – 2004 levels. These are all still relatively high signal to noise levels for the purpose of PMF analyses for source apportionment associated with soil extinction, but an up to date and comprehensive assessment of trends across all pollutants would be a helpful reference for future SIPs. Figure F-21 shows a similar jump for arsenic (ASf) signal to noise between 2010 and 2011. In this case, though, there is a drop from a 2001 – 2010 median value of about 3 to a 2011 – 2015 median value less than 1. Bromine (BRf), calcium (CAf), chlorine (CLf), chromium (CRf), copper (CUf), iron (FEf), magnesium (MGf), manganese (MNf), sodium (NAf), nickel (NIf), lead (PBf), phosphorus (Pf), rubidium (RBf), selenium (SEf), silicon (SIf), strontium (SRf), titanium (TIf), vanadium (Vf), zinc (ZNf), and zirconium (ZRf) also showed noticeable signal to noise decreases between 2010 and 2011. From the standpoint of possible future PMF evaluations, the cases where the signal to noise decreased from values well in excess of one to one or less would seem to be among the most problematic. That is the case for the median national signal to noise values for arsenic (Figure F-21), chromium (Figure F-26), copper (Figure F-27), nickel (Figure 8.0-1, Figure F-43), lead (Figure F-50), phosphorus (Figure F-51), rubidium (Figure F-52), selenium (Figure F-53), strontium (Figure F-57), and zirconium (Figure F-61). The distribution for nickel is presented in Figure 8.0-1 as a representative example.

The national median value for the number of positive chlorine (Figure F-67), magnesium (Figure F-79), sodium (Figure F-83), nickel (F-85), phosphorus (F-93), and zirconium (Figure F-103) datasets increased noticeably between 2010 and 2011.

Because the data associated with the Hawaii IMPROVE monitoring sites are frequently outliers compared to the national median, future PMF analyses of Hawaii data would be expected to have challenges that go beyond those associated with the data from most national sites.

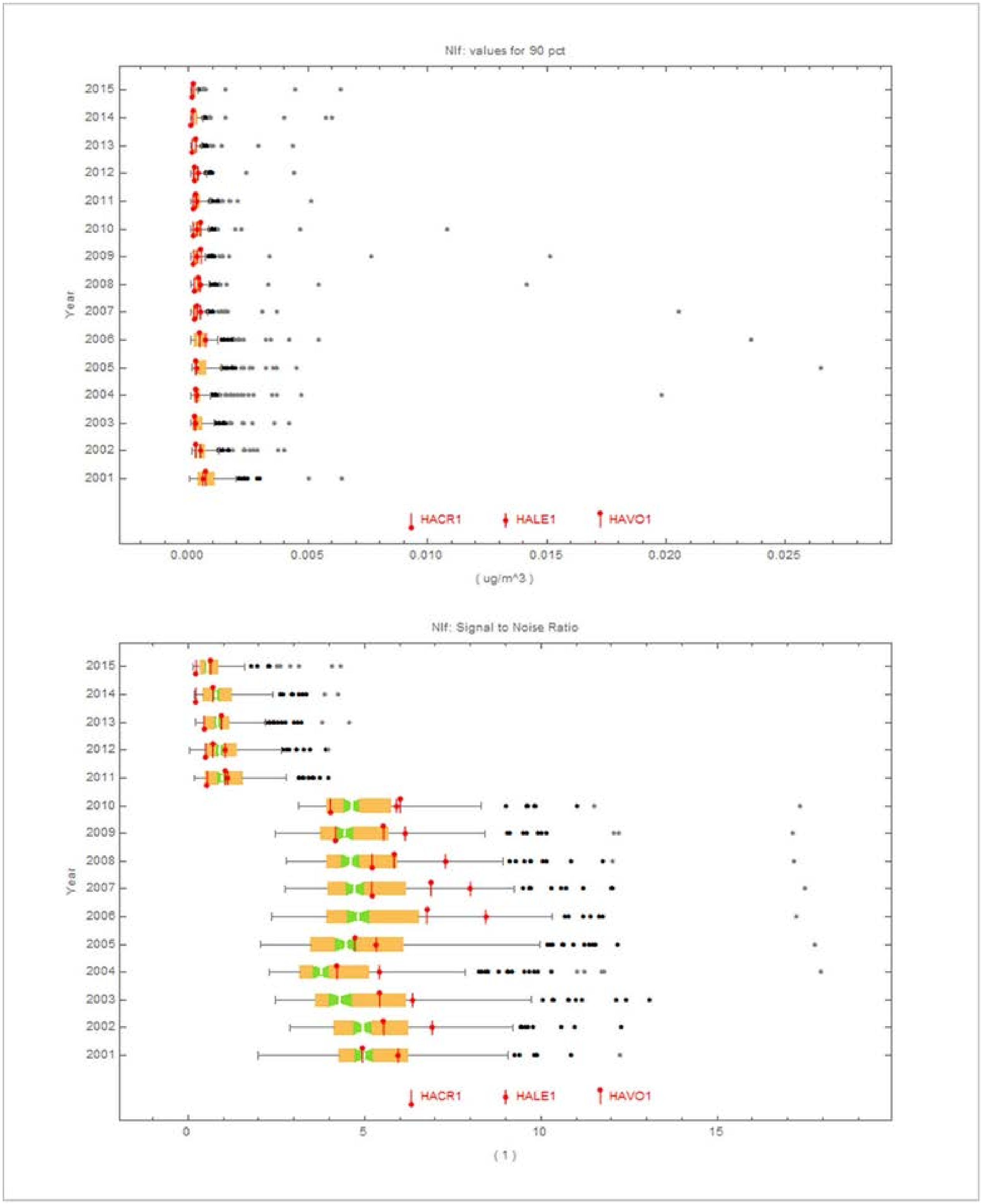

Figure 8.0-1 IMPROVE NIf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

IMPROVE Aggregation Observations

Because the 2013 HACR1 dataset failed to meet the IMPROVE 75% data completeness requirement, the data was not aggregated into groups (e.g., Best 20% Days and Worst 20% Days). However, since the 2013 HACR1 data completeness was about 72%, and very close to that requirement, DOH-CAB decided to aggregate this data to support trend analyses for HACR1. In reviewing the IMPROVE aggregation results, we noted that the algorithm used by IMPROVE does not appear to generate standard aggregations for the three middle groups (e.g., G70, G50, G30). Since this does not adversely impact the worst 20% days (G90) or the best 20% days (G10) that are currently used for regional haze assessments, this is currently not an issue. However, this does explain why the IMPROVE aggregation groups have seemingly anomalous differences in size. For example, the 122 values associated with the 2010 HAVO1 dataset is aggregated in 25 values for G90, 23 for G70, 27 for G50, 23 for G30, and 24 for G10. This aggregation results in a difference of four elements between the G50 (with 27 elements) and G70 and G30 (with 23 elements) aggregations. An alternate aggregation could result in subsets that differ by no more than one element. Such an aggregation could be achieved with the candidate alternative aggregation algorithm given in Table 8.0-11 below. We confirmed that this algorithm would also match the G10 and G90 aggregations in the current IMPROVE algorithm for the 2001 – 2015 Hawaii IMPROVE datasets. The Integer ("INT") function shown in the table returns the integer part of the value within the square brackets.

Table 8.0-11 Candidate Alternative Aggregation Algorithm

Item	Description	Example Calculations				
ntotal	**total number of values in set**	122	121	120	119	118
f90	**fraction for top of G90**	1.0	1.0	1.0	1.0	1.0
f70	**fraction for top of G70**	0.8	0.8	0.8	0.8	0.8
f50	**fraction for top of G50**	0.6	0.6	0.6	0.6	0.6
f30	**fraction for top of G30**	0.4	0.4	0.4	0.4	0.4
f10	**fraction for top of G10**	0.2	0.2	0.2	0.2	0.2
n90	**INT[f90*ntotal]-INT[f70*ntotal]**	25	25	24	24	24
n70	**INT[f70*ntotal]-INT[f50*ntotal]**	24	24	24	24	24
n50	**INT[f50*ntotal]-INT[f30*ntotal]**	25	24	24	24	23
n30	**INT[f30*ntotal]-INT[f10*ntotal]**	24	24	24	24	24
n10	**INT[f10*ntotal]**	24	24	24	23	23

For the 2009 HAVO1 ammonium sulfate extinction, use of the IMPROVE aggregation results in a G70 value of 41.698 Mm^{-1} compared to 40.602 Mm^{-1}, a difference of about 1.1 Mm^{-1}, when the candidate alternate algorithm is used. For the 2012 HACR1 ammonium sulfate extinction, the IMPROVE aggregation has a G70 value of 6.022 compared to 5.848, a difference of about 0.17, when the candidate alternate algorithm is used. A comparison of aggregation results for the 2001 – 2015 years for HACR1 and HAVO1 is presented in Appendix D, Tables D-1 and D-2.

Discussion

The EPA's "Protection of Visibility: Amendments to Requirements for State Plans" Final Rule includes findings that appear consistent with the statements in the Hawaii RH-FIP regarding visibility monitoring. The Hawaii RH-FIP's statement regarding the "dominance of volcanic emissions on the Worst 20% Days" and the possible use of days "when the proportion of anthropogenic contribution to visibility impairment is larger" is consistent with the Final Rule's specification that "anthropogenic impaired days" should be used instead of the "20% haziest days". The Hawaii RH-FIP indicated that IMPROVE monitoring data could "help identify the type of sources that contributed to the haze", which is consistent with the Final Rule's non-site specific statement that "The EPA and IMPROVE program will work together to provide datasets that identify the most anthropogenically impaired days". However, while the Final Rule explicitly addresses the need for accuracy with respect to the quantification of the "impacts of anthropogenic sources on visibility", it does not appear to do so with respect to the Visibility Impacting Parameters (e.g., Ammonium Nitrate Extinction). Since the analysis results associated with this DOH-CAB review clearly show that datasets for many pollutants and Visibility Impacting Parameters have characteristics that show them to be outliers to the national set of monitoring data, it is very appropriate that the Final Rule noted that site specific methods of "discerning natural and anthropogenic contributions to visibility impairment in their SIPs" can be developed.

This DOH-CAB review only attempted to estimate and adjust for the visibility impact of volcanic emissions and sea salt. Based on prior analysis results associated with the Hawaii RH-FIP and the results of this review, it is expected that the visibility impact of dust from international sources will be able to be estimated with sufficient accuracy to be considered in future SIPs. However, for all types of non-local anthropogenic sources (e.g., international dust and international shipping), accurate quantification of visibility impact uncertainties is expected to be a non-trivial effort. Because of the dominance of visibility impacts from the Kilauea volcano, even small percentage uncertainties are expected to be relatively large in magnitude and important to consider. The DOH-CAB review also presented IMPROVE data distribution information and IMPROVE aggregation observations that came up during this review of the visibility monitoring strategy. For the Hawaii specific data, the primary concern was with respect to recent data replacement trends associated with coarse mass values. However, the results indicated that data replacement, zero values, and invalid values are quite common for many Visibility Impacting Parameters. It seems clear that developing a comprehensive protocol to estimate the uncertainties associated with daily, site specific, IMPROVE Visibility Impacting Parameters are needed to develop analysis priorities, provide accurate results, and enable rational conclusions to be drawn.

Conclusions

Using prior PMF analysis results, the IMPROVE monitoring data indicates that Hawaii's two Class I areas are consistently about the least impacted in the nation relative to visibility impairment due to anthropogenic sources. Figure 8.0-2 (also Appendix F, Figure F-5) shows that the HACR1 and HAVO1 aerosol extinctions without the impact of volcanic sulfate and all sea salt for the Worst 20% Days are both ranked at or very near the bottom of all national IMPROVE monitoring sites. HACR1, HALE1, and HAVO1 annual values are represented on the left side of the figure by vertical red lines with solid dots at the bottom, center, and top, respectively. The annual site rankings for the Hawaii sites are noted on the right side of the figure. While update PMF analyses might be helpful in obtaining a more accurate assessment of the visibility impacts of local anthropogenic sources, this review shows that the Hawaii IMPROVE monitored pollutants tend to have many low signal to noise values and low data completeness compared to other national sites. While the EPA PMF code systematically addresses signal to noise, it seems reasonable to question the utility of a future effort for cases with so many pollutant datasets that are clear statistical outliers compared to the rest of the nation. At this point, it seems likely to be useful for refining estimates for the volcanic sulfate and international dust, but additional guidance from EPA would be desired before attempting to source apportionment analyses for other anthropogenic sources.

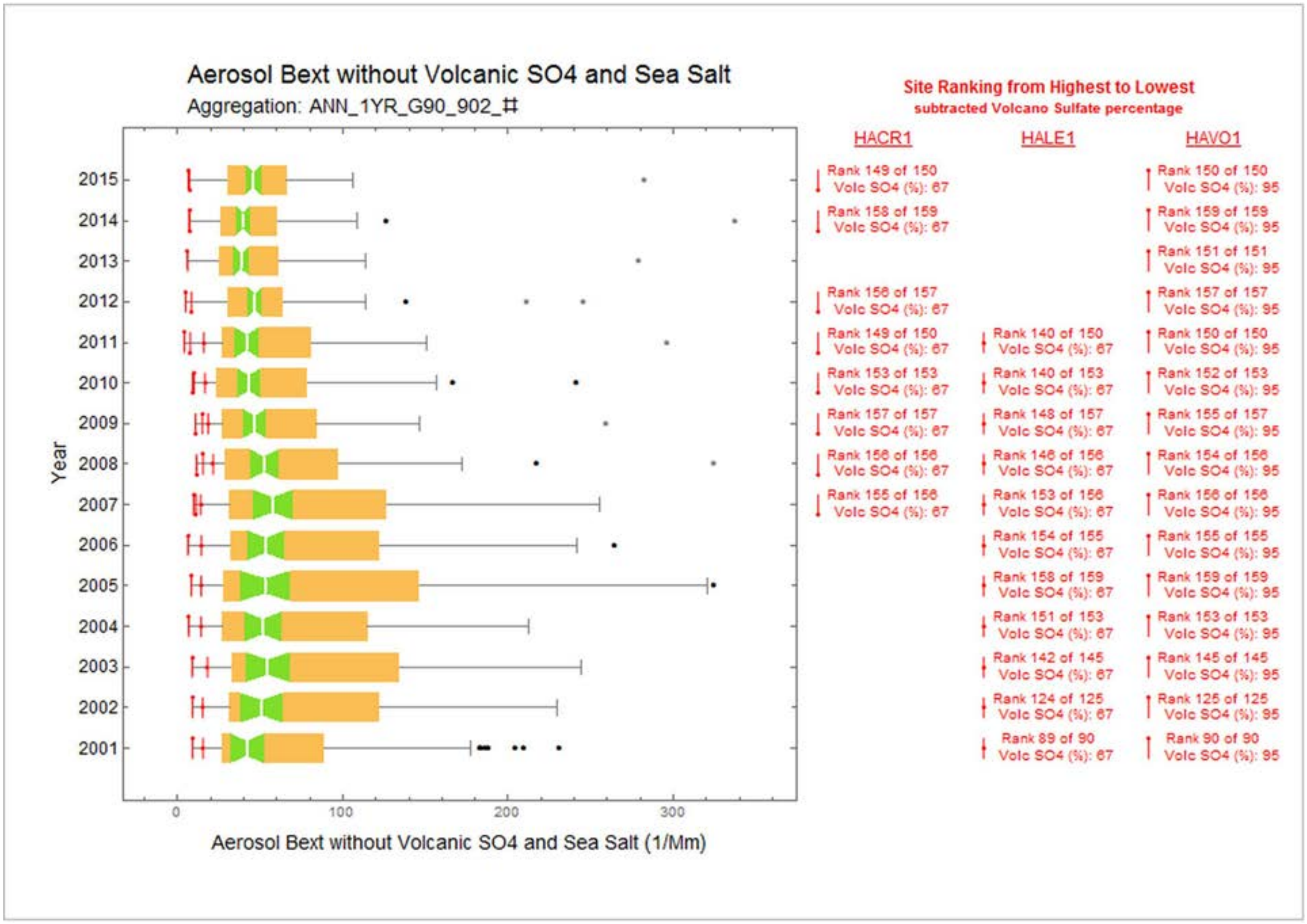

Figure 8.0-2 IMPROVE Aerosol Bext without Volcanic Sulfate Bext and Sea Salt Bext and Hawaii annual rankings for the Worst 20% Days

The current Regional Haze rule establishes site specific visibility goals. Sites that have less visibly impaired baselines have visibility impairment goals that are more stringent than sites that have more visibly impaired baselines. The IMPROVE program has not yet developed calculation procedures for uncertainties associated with the Visibility Impacting Parameter values. Since the anthropogenic pollutant levels at the Hawaii monitoring sites are very low, and the annual averaged visibility impairment values appear to be generally among the very lowest in the nation, good estimates of these uncertainties seem critical to developing and justifying effective and rational means of improving visibility in compliance of the current Regional Haze Rule. Without eruptions from the Kilauea volcano, existing analyses show that visibility impairment measured at both of Hawaii's current monitoring sites would be among the very lowest in the nation. The development and validation of comprehensive uncertainty estimation protocols for Visibility Impacting Parameters is critical to assessing and justifying compliance approaches to reach the visibility impairment goals. Additional guidance from EPA is recommended.

Extensive data replacement is a concern with respect to estimating the visibility impacts of coarse mass at the HAVO1 site for 2014 and 2015. High fractions of replaced, invalid, or zero value measurements for coarse mass, elemental carbon, and organic carbon (mass) appear to be an issue for both HAVO1 and HACR1 for many years. A comprehensive protocol to estimate the uncertainties associated with daily, site specific, IMPROVE Visibility Impacting Parameters could address both these items with respect to visibility impacts and support possible future source apportionment attempts. In addition though, site monitoring system problems should be looked for when seemingly anomalous situations are observed. The DOH-CAB will also work with the IMPROVE program to understand the root cause HAVO1 coarse mass data replacement.

The distribution of IMPROVE data for all national sites had many changes between the period prior to and subsequent to 2011. Aluminum, arsenic, bromine, calcium, chlorine, chromium, copper, iron, magnesium, manganese, sodium, nickel, lead, phosphorus, rubidium, selenium, silicon, strontium, titanium, vanadium, zinc, and zirconium showed noticeable stepwise signal to noise decreases between 2010 and 2011. From the standpoint of possible future PMF evaluations, the cases where the signal to noise decreased from values well in excess of one to one or less would seem to be among the most problematic. That is the case for the median national signal to noise values for arsenic, chromium, copper, nickel, lead, phosphorus, rubidium, selenium, strontium, and zirconium. The DOH-CAB will consult with the IMPROVE program to document the cause for these changes. The DOH-CAB will work with the EPA regarding the challenges and potential benefits associated performing PMF analyses on data from the HACR1 and HAVO1 IMPROVE monitors.

The IMPROVE method for aggregating data appears to use a non-standard algorithm which can result in a relatively large difference in the number of elements in the five aggregations (e.g., G90, G70, G50, G30, G10). The IMPROVE aggregation algorithm produces a standard aggregation for G90 and G10, but not for G70, G50, and G10. The G70, G50, and G30 data subsets are not associated with Regional Haze visibility goals, but when, for example, a group of 122 elements is divided into five seemingly equal sized subgroups, it seems worth noting that the number of elements in the subgroups can differ by four when a difference of one would typically be expected.

9.0 Determination of Adequacy – 40 CFR 51.308(h)(1)

The DOH-CAB believes that control strategies in the existing Regional Haze Plan are adequate for Hawaii to meet the 2018 reasonable progress goals and has determined that no substantive revision of the Regional Haze Plan is needed at this time based on the following:

- There have been significant reductions in SO_2 and NO_X emissions from Maui and Hawaii Island point sources during the first planning period as a result of:

  1. Clean energy projects that have replaced the need to generate power from burning fossil fuels;
  2. The retirement of steam boiler EGUs; and
  3. Plant shutdowns.

- Projections indicate SO_2 and NO_X emissions will continue to decease over time for HELCO and MECO EGUs as more renewables are added to the system to reach 100% renewable energy by 2045.
- The DOH-CAB is incorporating a 3,550 ton per year SO_2 emissions cap into permits for the HELCO Puna and Hill Generating Plants. The actual total combined SO_2 emitted by these plants was 2,376 TPY and 2,149 TPY for 2014 and 2015, respectively.
- Plots of the five-year rolling average haze index over this first planning period show slight improvements in visibility for the 20% worst visibility days and more significant visibility improvement for the 20% best visibility days for both National Parks (Figures 4.2-1 through 4.2-4, Pages 32 and 33). For Haleakala National Park, the five year rolling average haze index reaches natural visibility conditions for the 20% best visibility days.
- Despite improvements in visibility, the main factor contributing to visibility impairment is the ongoing release of SO_2 from the Kilauea volcano with emissions that vary by hundreds of thousands of tons from one year to the other. Visibility improvement due to Maui and Hawaii Island point source SO_2 reductions is masked by natural sulfate from volcanic SO_2 that overwhelms sulfate from anthropogenic SO_2 sources.
- The estimated visibility impairment at HACR1 and HAVO1 due to anthropogenic sources was shown to be generally among the very lowest in the nation. Since the IMPROVE program has not yet developed calculation procedures for uncertainties associated with the Visibility Impacting Parameter values, it is unclear if or to what extent visibility impairment due to anthropogenic sources exceeds the uncertainty. Validated uncertainty estimation protocols are needed for the Hawaii IMPROVE monitoring Visibility Impacting Parameter values to ensure that future compliance approaches are needed and justifiable.
- The second planning period from 2018 to 2028 will begin soon with new EPA guidance for developing RH-SIPs.

10.0 Consultation With Federal Land Managers – 40 CFR 51.308(h)(2)

Hawaii provided an opportunity for consultation with the Federal Land Managers (FLMs) at least sixty (60) days prior to initiating the public comment period and providing the public the opportunity to request a public hearing on the Regional Haze Progress Report. The Regional Haze Progress Report was submitted to the FLMs on May 12, 2017 for review and comments. The FLMs provided comments on July 6, 2017. In accordance with 40 CFR §51.308(i)(3), comments from the FLMs are provided in Appendix G.

11.0 Procedural Requirements – 40 CFR 51.102

The public notice for the Regional Haze Progress Report was published on August 1, 2017 with the public comment period commencing on August 1, 2017 and ending on August 31, 2017. The public notice provided the opportunity for the public to request a public hearing by August 15, 2017. If requested, a notice for the hearing will be published at least thirty days in advance of the hearing.

Appendix A: WRAP Reasonable Progress Summary Report

WESTERN REGIONAL AIR PARTERNERSHIP
REGIONAL HAZE RULE
REASONABLE PROGRESS SUMMARY REPORT

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GLOSSARY OF TERMS

Aerosols: Suspensions of tiny liquid and/or solid particles in the air.

Ammonium nitrate (NH_4NO_3): Ammonium nitrate is formed in the atmosphere from reactions involving nitrogen dioxide (NO_2) emissions, which are dominated by anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.

Ammonium sulfate ($(NH_4)_2SO_4$): Ammonium sulfate is formed in the atmosphere from reactions involving sulfur dioxide (SO_2) emissions. Anthropogenic sources include coal-burning power plants and other industrial sources, such as smelters, industrial boilers, and oil refineries, and to a lesser extent, gasoline and diesel combustion.

Anthropogenic: Produced by human activities.

Area sources: Sources that are treated as being spread over a spatial extent (usually a county or air district) and that are not movable (as compared to non-road mobile and on-road mobile sources). Because it is not possible to collect the emissions at each point of emission, they are estimated over larger regions. Examples of stationary area sources are residential heating and architectural coatings. Numerous sources, such as dry cleaning facilities, may be treated either as stationary area sources or as point sources.

BART: Best Available Retrofit Technology, a process under the CAA to evaluate the need and, if warranted, install the most effective pollution controls on an already existing air pollution source.

Baseline period: The baseline period, or baseline conditions, are the basis against which improvements in worst day visibility, and lack of degradation for the best day visibility, are judged. For initial RHR implementation plan purposes, the baseline is the average visibility impairment as measured by IMPROVE monitors during the 2000-2004 5-year period.

Biogenic emissions: Biogenic emissions are based on the activity fluxes modeled from biogenic land use data, which characterizes the types of vegetation that exist in particular areas. Emissions are generally derived using modeled estimates of biogenic gas-phase pollutants from land use information, emissions factors for different plant species, and meteorology data.

Class I area (CIA): As defined in the Clean Air Act, areas that were in existence as of August 7, 1977: national parks over 6,000 acres, national wilderness areas and national memorial parks over 5,000 acres, and international parks.

Clean Air Act (CAA): The basic framework for controlling air pollutants in the United States, originally adopted in 1963, and amended in 1970, 1977, and 1990. The CAA was designed to "protect and enhance" air quality. Section 169A of the Clean Air Act (CAA), established in the 1977 Amendments, set forth a national goal for visibility which is the ‘‘prevention of any future, and the remedying of any existing, impairment of visibility in Federal Class I areas (CIAs) which impairment results from manmade air pollution.’’

Coarse mass (CM): Coarse mass refers to the mass of large particles greater than 2.5 and smaller than 10 µm in diameter.

Colorado Plateau: A high, semi-arid tableland in southeast Utah, northern Arizona, northwest New Mexico, and western Colorado.

Current conditions: For purposes of this report, current conditions represent the most recent successive 5-year average after the 2000-2004 baseline conditions, or the 2005-2009 period.

Current progress period: For purposes of this report, the current progress period, also referred to as the first progress period, represents the most recent successive 5-year average after the 2000-2004 baseline conditions, or the 2005-2009 period.

Deciview (dv): The deciview metric is used to track regional haze in the RHR. The Haze Index (measured in deciviews) was designed to be linear with respect to human perception of visibility. A one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect.

Dust: Dust emissions may have a variety of sources that could include anthropogenic sources, natural sources, and natural sources that may be influenced by anthropogenic activity. Fugitive dust includes sources such as road dust, agricultural operations, construction and mining operations and windblown dust from vacant lands. Windblown dust includes more of the natural influences such as wind erosion on natural lands.

Elemental carbon (EC): Elemental carbon, also known as light absorbing carbon (LAC), is the primary light absorbing compound in the atmosphere. These particles are emitted directly into the air from virtually all combustion activities, but are especially prevalent in diesel exhaust and smoke from wild and prescribed fires.

Environmental Protection Agency (EPA): The EPA is an agency of the U.S. federal government which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.

Extinction (b_{ext}): Extinction is a measure of the fraction of light lost per unit length along a sight path due to scattering and absorption by gases and particles, expressed in inverse Megameters (Mm^{-1}).

Fine soil: Particulate matter composed of pollutants from the Earth’s soil that enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface mechanical disturbance activities. Fine soil includes soil particles with an aerodynamic diameter less than 2.5 microns.

Fire: Fire sources may have a mix of natural and anthropogenic influences. Natural sources include wildland fires, while anthropogenic sources can include agricultural and prescribed fires.

First progress period: For purposes of this report, the first progress period, also referred to as the current progress period, represents the most recent successive 5-year average after the 2000-2004 baseline conditions, or the 2005-2009 period.

Grand Canyon Visibility Transport Commission (GCVTC): In 1990, amendments to the Clean Air Act established the Commission to advise the EPA on strategies for protecting visual air quality on the Colorado Plateau.

Haze Index (HI): The Haze Index (measured in deciviews) is used to track regional haze in the RHR. It was designed to be linear with respect to human perception of visibility, where a one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect.

Interagency Monitoring of Protected Visual Environment (IMPROVE): A collaborative monitoring program governed by a steering committee composed of representatives from Federal and regional-state organizations to establish present visibility levels and trends, and to identify sources of man-made impairment

Inverse megameters (Mm^{-1}): A measurement unit used for light extinction, the higher the value, the hazier the air is.

Least impaired days: The least impaired, or best, days refers to the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the lowest amount of visibility impairment.

Light extinction: A measure of how much light is absorbed or scattered as it passes through a medium, such as the atmosphere. Aerosol light extinction refers to the absorption and scattering by aerosols. Total light extinction refers to the sum of aerosol light extinction, the absorption by gases (such as NO_2), and the atmospheric light extinction (Rayleigh scattering). Extinction is often expressed as a measure of the fraction of light lost per unit length in units of inverse Megameters (Mm^{-1}).

Mandatory Federal Class I areas: Certain national parks (over 6,000 acres), wilderness areas (over 5,000 acres), national memorial parks (over 5,000 acres), and international parks that were in existence as of August 1977.

Most impaired days: The most impaired, or worst, days refers to the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the highest amount of visibility impairment.

Natural background condition: Naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Natural conditions: Natural conditions include any naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Off-road mobile sources: Off-road mobile sources are vehicles and engines that encompass a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. Examples include agricultural equipment such as tractors or combines, aircraft, locomotives and oil field equipment such as mechanical drilling engines.

Off-shore: Commercial marine emissions comprise a wide variety of vessel types and uses. Emissions can be include deep draft vessels within shore and near port using port call data, and offshore emissions generated from ship location data.

Oil and gas sources: Oil and gas sources consist of a number of different types of activities from engine sources for drill rigs and compressor engines, to sources such as condensate tanks and fugitive gas emissions. The variety of emissions types for sources specific to oil and gas activity can, in some cases, overlap with mobile, area or point sources, but these can also be extracted and treated separately.

On-road mobile sources: Vehicular sources that travel on roadways. Emissions from these sources can be computed either as being spread over a spatial extent or as being assigned to a line location (called a link). Emissions are estimated as the product of emissions factors and activity data (vehicle miles traveled (VMT). Examples of on-road mobile sources include light-duty gasoline vehicles and heavy-duty diesel vehicles.

Oxides of nitrogen (NO_X): A mixture of nitrogen dioxide and other nitrogen oxide gases. Nitrogen is the most common gas in the atmosphere. In high temperature and/or high pressure burning (as in an engine), the air's nitrogen is broken down and combined with oxygen, forming unstable or reactive NO_X gases. Nitrogen dioxide (NO_2) is yellowish brown, and thus contributes directly to haze. All the NO_X gases react in the air to form haze-causing aerosols and smog.

Particulate organic aerosol (POA): Particulate organic aerosol represents organic aerosols that are emitted directly as particles, as opposed to gases.

Particulate organic mass (POM): Particulate Organic Mass is also referred to as Particulate Organic Carbon and Organic Mass Carbon (OMC). Particulate organic mass can be emitted directly as particles, or formed through reactions involving gaseous emissions. Natural sources of organic carbon include wildfires and biogenic emissions. Man-made sources can include prescribed forest and agricultural burning, vehicle exhaust, vehicle refueling, solvent evaporation (e.g., paints), food cooking, and various commercial and industrial sources.

Point sources: These are sources that are identified by point locations, typically because they are regulated and their locations are available in regulatory reports. In addition, elevated point sources will have their emissions allocated vertically through the model layers, as opposed to being emitted into only the first model layer. Point sources can be further subdivided into electric generating unit (EGU) sources and non-EGU sources, particularly in criteria inventories in which EGUs are a primary source of NO_X and SO_2. Examples of non-EGU point sources include chemical manufacturers and furniture refinishers.

Prevention of significant deterioration (PSD): A program established by the Clean Air Act Amendments of 1977 that limits the amount of additional air pollution that is allowed in Class I and Class II areas.

Rayleigh: Light scattering of the natural gases in the atmosphere. At an elevation of 1.8 kilometers, the light extinction from Rayleigh scattering is approximately 10 inverse megameters (Mm-1).

Reasonable progress: Reasonable progress refers to progress in reducing human-caused haze in Class I areas under the national visibility goal. The Clean Air Act indicates that "reasonable" should consider the cost of reducing air pollution emissions, the time necessary, and the energy and non-air quality environmental impacts of reducing.

Reconstructed aerosol extinction: The percent of total atmospheric extinction attributed to each aerosol and gaseous component of the atmosphere.

Regional haze: Regional haze refers to visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area.

Regional Haze Rule (RHR): Federal rule that requires states to develop programs to assure reasonable progress toward meeting the national goal of preventing any future, and remedying any existing, impairment of visibility in mandatory Class I Federal areas.

Relative humidity: Partial pressure of water vapor at the atmospheric temperature divided by the vapor pressure of water at that temperature, expressed as a percentage.

Scattering efficiency: The amount of light scattered relative to the particle's size.

Sea salt: Sea salt is a natural aerosol emitted in coastal areas. In practice, chloride ion measurements are used to represent sea salt in IMPROVE measurements, and measurements may sometimes show anthropogenic or crustal influences at inland monitors.

Sulfur dioxide (SO_2): SO_2 gas is associated with emissions from processes such as burning fuels, manufacturing paper, or smelting rock. SO_2 is converted in the air to other sulfur oxides (SO_X) or haze-causing aerosols (sulfates).

State Implementation Plans (SIPs): A detailed description of the programs a state will use to carry out its responsibilities under the Clean Air Act. State implementation plans are collections of the regulations used by a state to reduce air pollution. Plans devised by states and tribes to carry out their responsibilities under the Clean Air Act. SIPs and TIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Visibility impairment: Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

Visibility: Refers to the visual quality of the view, or scene, in daylight with respect to color rendition and contrast definition.

Visual range (VR): Visual range is the greatest distance a large black object can be seen on the horizon, expressed in kilometers (km) or miles (mi).

Volatile organic compound (VOC): A carbon-containing material that evaporates, such as gasoline, some paints, solvents, dry cleaning fluids, and the like. VOCs contribute to the formation of particulate organic mass.

Western Regional Air Partnership (WRAP): A partnership of state, tribal and federal land management agencies to help coordinate implementation of the GCTVC's recommendation.

EXECUTIVE SUMMARY

The United States Environmental Protection Agency's (EPA's) 1999 Regional Haze Rule (RHR)[1] was designed to improve visibility conditions in the nation's largest National Parks and Wilderness Areas. The goal of the RHR, as stated in the Clean Air Act (CAA) 1977 Amendments, is the "prevention of any future, and the remedying of any existing, impairment of visibility."[2] The RHR mandates that states identify and implement pollution control strategies to progress towards a "natural conditions" goal, or conditions without any manmade impairment, by the year 2064. States were required to submit initial RHR implementation plans in 2007 which identified goals and strategies for visibility improvement. States are then required to revise implementation plan every 10-years, and submit progress reports at interim points between implementation plan submittals. This support document has been prepared for the Western Regional Air Partnership (WRAP), on behalf of the 15 western state members in the WRAP region, to provide technical basis for use by the western states to develop the first of their RHR progress reports, assessing progress towards goals as defined in their initial SIPs.

The visibility improvement goal, as stated in the RHR, is to ensure that visibility on the worst days improves towards a natural conditions goal, and that visibility on the best days does not get worse. To measure progress towards natural conditions, the EPA provided the concept of a linear, or uniform, rate of reasonable progress between the 2000-2004 baseline period and a default natural conditions goal year of 2064.[3] The RHR specifies that progress is determined for "current conditions", and RHR guidance released in 2003 specifies that progress be tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods (i.e. 2005-2009, 2010-2014, etc.).[4] More recent guidance, released in April, 2013, indicates that progress reports "should include the 5-year average that includes the most recent quality assured public data available at the time the state submits its 5-year progress report for public review,"[5] and suggests assessing changes using a rolling 5-year period average. Per original 2003 guidance, progress for this support document is reported as changes in monitored between baseline conditions and the first successive 5-year progress period (2005-2009) data. Additionally, for summaries here, annual average trend statistics as measured for each aerosol species during the 2000-2009 10-year period are reported to support assessments of changing conditions.

This report includes regional, state, and CIA specific summaries that characterize the difference between the baseline conditions and first successive progress period. Assessments include changes in visibility impairment as measured using aerosol data collected by the

[1] See CFR 40 Part 51 Regional Haze Regulations; Final Rule, July 1, 1999, available online at http://www.epa.gov/airquality/visibility/actions.html.
[2] See Section 169a of the 1977 CAA Amendments.
[3] Note that "default" natural conditions as defined by the EPA are subject to revisions, and that States can extend the period of time needed to achieve natural conditions, beyond the nominal 2064 in the RHR, defining and defending new interim reasonable progress rates, and adjusting the 2064 end year as needed (see CFR Section 51.308).
[4] See page 4-2 in EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.*
[5] See page 9 in EPA's April 2013 *General Principals for the 5-Year Regional Haze Progress reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports).*

Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and assessments of progress also include the differences between emissions inventories for years that represent both the baseline and progress periods. Specific regulatory questions addressed in this report include:

- What are the current visibility conditions for the most impaired (worst) and least impaired (best) days?
- What is the difference between current visibility conditions and baseline conditions for the most impaired and least impaired days?
- What is the change in emissions that occurred between the baseline period and the progress period?

The RHR also requires states to evaluate the sufficiency of current implementation plan elements and strategies to meet reasonable progress goals. Determining the status of emissions reductions and evaluation of state-selected goals are beyond the scope of this report, and will be addressed separately by individual states. Specific regulatory questions that address evaluation requirements include:

- What is the status of implementation of all measures included in the implementation plan?
- What emissions reductions have been achieved through implementation of these measures?
- What emissions from within or outside of the state have limited or impeded progress in reducing pollutant emission and improving visibility?
- Are current implementation plan elements and strategies sufficient to enable the state or other states with mandatory federal CIAs affected by the state, to meet all established reasonable progress goals?

Visibility impairment is tracked using a Haze Index (HI) in units of deciviews (dv), which is related to the cumulative sum of visibility impairment from individual aerosol species as measured by monitors in the IMPROVE Network. Emissions which affect regional haze include a wide variety of natural (e.g., wildland fires) and anthropogenic, or man-made, sources (e.g., industry sources and vehicles). Per regulatory requirements, differences between emissions inventories representing both the baseline and progress periods are presented here. Baseline emissions in most cases are represented using the 2002 inventory that was originally developed, with support from the WRAP, to represent emissions for the initial implementation plans. Current emissions are represented here by leveraging recent work by the WRAP to develop an updated and comprehensive inventory for the year 2008 for use in modeling projects. Emissions inventory comparisons in this report were complicated by the fact that a number of changes and enhancements have occurred between development of the baseline and current period inventories, such that some of the differences between inventories are more reflective of changes in inventory methodology, rather than changes in actual emissions. Characterizations here focus more on differences in the actual monitored data, which are thought to be more reflective of progress than differences between the emission inventories. Some notable results were as follows:

- Analysis of monitored data, in terms of comparisons between the 5-year average deciview metrics, showed improved visibility conditions on the best days at nearly all of the WRAP CIAs. Most sites showed improved conditions on the worst days, but some sites showed a decline in visibility conditions for the worst days.
- Looking at differences between 5-year averages for individual measured species, most sites that did not show improved deciview conditions on the worst days were affected by large particulate organic matter measurements related to wildland fire.
- Ammonium nitrate, in most cases, showed the largest decreases in 5-year averages and the largest decreasing annual trends. This was consistent with mobile source inventory comparisons which showed large decreases in oxides of nitrogen (NO_X), which are among the precursors for ammonium nitrate particulate formation. Decreasing emissions were due in large part to federal and state emissions standards that have already been implemented for mobile sources.
- In many of the plains states, the 5-year average of ammonium sulfate increased, but annual averages showed decreasing trends. Sulfur dioxide (SO_2) emissions, which are precursors for ammonium sulfate particle formation, showed decreases in most cases, especially from EGUs and other point sources. Many of the highest ammonium sulfate measurements spanned large regions. Possible contributions to measured visibility impairment from international sources were not quantified here.
- In southern Oregon and northern California, increasing ammonium sulfate trends were evident at several coastal sites. State emissions inventory comparisons did not reflect these increases, but marine vessel emissions were not quantified for summaries here.
- Also, in northeastern Montana and northwestern North Dakota, increasing ammonium sulfate trends were evident at several sites. State emissions inventory comparisons did not reflect these increases, but these sites are along the Canadian border, and possible influences from nearby international sources were not quantified here.
- In Hawaii, dramatic increases in ammonium sulfate were related to natural emissions, with increased volcanic emissions accounting for most of the SO_2 emissions inventoried.
- Coarse mass extinction trends were variable and not statistically significant in most cases, but an area represented by several IMPROVE sites in eastern Arizona and western New Mexico did show increasing coarse mass trends. Emission inventories indicated that natural windblown dust is the largest contributor to coarse mass measurements in this area, but significant changes in the development of the windblown dust inventories did not allow for definitive comparisons between 2002 and 2008 inventories for these emissions.

More detailed summaries are provided in this report on a regional, state and CIA specific basis. These summaries are also supported by interactive tools available from the online WRAP

Technical Support System (TSS).[6] Summaries presented here were developed cooperatively with representatives from each state in the WRAP region. This report and accompanying data analysis results were developed to support state development of RHR progress reports, the first of which are due in 2013, but should also serve as an important interim step informing the next round of full implementation plan revisions which come due in 2018.

[6] The WRAP TSS, available at http://vista.cira.colostate.edu/tss/, is an online tool developed to support the air quality planning needs of western state and tribes, which has been recently updated with summaries of current IMPROVE monitoring data, and recent emissions to support development of RHR progress reports.

1.0 INTRODUCTION

The United States Environmental Protection Agency's (EPA's) 1999 Regional Haze Rule (RHR)[7] was designed to address visibility impairment in Class I areas (CIAs), where CIAs include many of the nation's largest National Parks and Wilderness Areas. The RHR mandates that each CIA progress towards a natural conditions goal, or conditions without any man-made influences, by the year 2064. Each state is required to periodically assess the rate of progress towards visibility improvement goals for each CIA in that state, and for CIAs affected by transport from that state.

The RHR requires states to develop state implementation plans (SIPs) every 10 years which identify strategies designed to meet a series of interim goals over the long term regional haze planning period. The first of these SIPs were due in 2007 and were required to identify a baseline starting point using the average of monitoring data for the 2000-2004 5-year period, and demonstrate progress towards visibility improvement that is expected to occur by the first interim goal in 2018. In addition to SIPs, the RHR requires each state to assess progress towards interim visibility improvement goals between each 10-year SIP submittal, where the first progress report addressing changes between the 2000-2004 baseline conditions and current conditions. The individual, state-submitted, progress reports for the western states are due at various times between 2013 and 2017, depending on respective approval dates for each state's initial implementation plan.

This progress report support document has been prepared by the Western Regional Air Partnership (WRAP)[8], on behalf of the 15 western state members in the WRAP region, to provide the technical basis for use by States to develop the first of their individual reasonable progress reports for the 116 Federal CIAs located in the western states. Data are presented in this report on a regional, state, and CIA specific basis that characterize the difference between 2000-2004 baseline conditions and current conditions, represented here by the most recent successive 5-year average, or the 2005-2009 period. Changes in visibility impairment are characterized using aerosol measurements from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and the differences between emissions inventory years representing both the baseline and current progress period.

Analysis and summaries provided in this report were developed cooperatively with representatives from each state in the WRAP region, and were designed to provide western states with the technical basis necessary to support their evaluation of the current or proposed elements and strategies as outlined in their initial RHR implementation plans. Summaries here are also

[7] See CFR 40 Part 51 Regional Haze Regulations; Final Rule, July 1, 1999, available online at http://www.epa.gov/airquality/visibility/actions.html.

[8] The WRAP is a collaborative effort of tribal governments, state governments and various federal agencies representing the western states that provides technical and policy tools for the western states and tribes to comply with the EPA's RHR regulations. Detailed information regarding WRAP support of air quality management issues for western states is provided on the WRAP website (www.wrapair2.org) and data summary descriptions and tools specific to RHR support are available on the WRAP Technical Support System website (http://vista.cira.colostate.edu/tss/).

supported by interactive tools available from the online WRAP Technical Support System (TSS).[9] Any questions regarding the content of this report should be addressed to:

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[9] The WRAP TSS, available at http://vista.cira.colostate.edu/tss/, is an online tool developed to support the air quality planning needs of western states and tribes; it has been recently updated with summaries of current IMPROVE monitoring data, and recent emissions to support development of RHR progress reports.

2.0 REGULATORY REQUIREMENTS

In regulatory context, Section 169A of the Clean Air Act (CAA), established in the 1977 Amendments, set forth a national goal for visibility which is the ‘‘prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas which impairment results from manmade air pollution.”[10] In 1999, the Environmental Protection Agency’s (EPA) promulgated regulations that provided the requirements for states to develop and submit state implementation plans (SIPs) to address regional haze in Federal CIAs (40 CFR 51.308 and 51.309), where SIPs address each state’s strategy to progress towards meeting the long term natural condition visibility impairment goal by the year 2064.

The first of these SIPs were due by December 17, 2007, and were required to address a uniform rate of reasonable progress towards an interim 2018 goal. Each state is required to submit a revised implementation plan by July 31, 2018 and every 10 years thereafter (51.308(f)). Additionally, at 5-year intervals between SIP revisions, states are required to submit periodic progress reports evaluating progress towards the reasonable progress goals defined the SIPs. The first progress report is due 5 years from the approval of the initial implementation plan (51.308(g)), or, for states who submitted a SIP under 40 CFR 51.309, by December 31, 2013. To support development of Regional Haze Rule (RHR) SIPs, the EPA has released several guidance documents, including:

- EPA’s September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule*
- EPA’s September 2003 *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule*
- EPA’s April 2013 *General Principals for the 5-Year Regional Haze Progress reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports)*

EPA’s September 2003 guidance specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc.[11] EPA’s more recent guidance, released in April 2013, indicates that progress reports “should include the 5-year average that includes the most recent quality assured public data available at the time the state submits its 5-year progress report for public review,”[12] and suggests assessing changes using a rolling 5-year period average. The new EPA guidance was released as this report and analysis were finalized and, per the original 2003 guidance, progress for this support document is reported as changes in monitored between baseline conditions and the most recent successive 5-year progress period, or the 2005-2009 period. Figure 2.0-1 below presents an idealized glide slope indicating linear progress in successive 5-year increments for

[10] See section 169A of the Clean Air Act (CAA) 1977 Amendments.
[11] See page 4-2 in EPA’s September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.*
[12] See page 9 in EPA’s April 2013 *General Principals for the 5-Year Regional Haze Progress reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports)*

improvement on the worst days towards a 2064 natural conditions goal. Specific references for RHR Section 308 and 309 regulatory requirements are provided in this section.

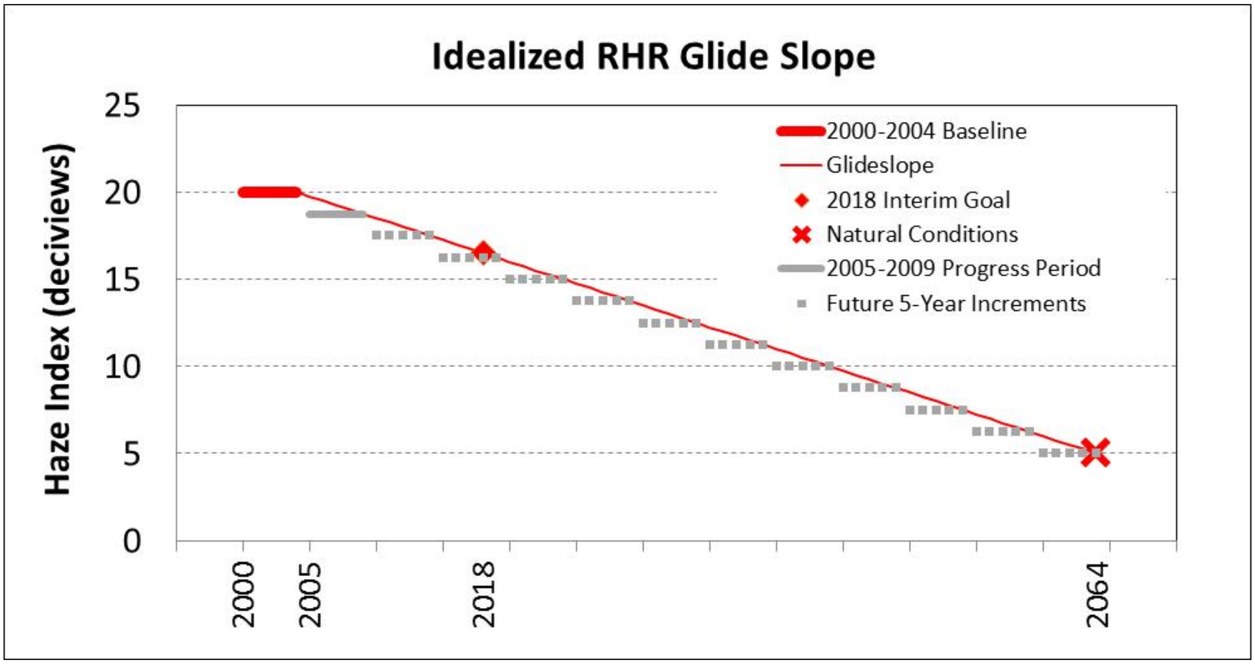


Figure 2.0-1. Idealized RHR Glide Slope Representing Linear Progress from a 2000-2004 Baseline Average to a 2064 Natural Conditions End Goal. Also Represented Are the 2018 Interim Goal and Successive 5-Year Progress Periods.

2.1 SECTION 308

Section 51.308(g) of the RHR contains the requirements for periodic progress reports. Each state is required to submit a report evaluating progress towards the reasonable progress goals outlined in its regional haze state, or in some cases federal, implementation plan (SIP or FIP).[13] These state progress reports are required to summarize recent changes in monitoring and emissions data, and evaluate the adequacy of the current SIP to meet interim progress goals. Specific regulatory text related to Section 308 progress report requirements is summarized here.

2.1.1 Monitoring and Emissions Data Summary Requirements

Sections 51.308(g)(3) and 51.308(g)(4) of the RHR contain the monitoring and emissions data summary requirements for RHR progress reports. These requirements are addressed in this report on a regional, state and Class I Area specific basis. Monitoring and emissions summary requirements for progress reports include the following:

- How has visibility changed at the CIAs in the state in the last 5 years (51.308(g)(3))? Specifically listed under this requirement are the following elements:

[13] Note that implementation plan references to SIPs in this report are also intended to include any full or partial FIPs.

- What are the current visibility conditions for the most impaired and least impaired days (51.308(g)(3)(i))?
- What is the difference between baseline visibility conditions and current visibility conditions for the most impaired and least impaired days (51.308(g)(3)(ii))?
- What is the change in visibility impairment for the most impaired and least impaired days over the past 5 years (51.308(g)(3)(iii))?

- For pollutants that affect visibility at CIAs, how have total emissions in the state changed over the past 5 years (51.308(g)(4))?

Monitoring data summaries presented in this report include data collected by the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network.[14] For monitoring data summaries, baseline visibility conditions are defined as the average deciview values for the 20% most impaired, or worst, and 20% least impaired, or best, days averaged over the 2000-2004 5-year period. Current visibility conditions are represented here per EPA's 2003 guidance as the most recent successive 5-year average period available, or the 2005-2009 period.[15]

Per regulatory requirements, differences between emissions inventories representing both the baseline and progress are presented here. Baseline emissions in most cases are represented using a 2002 inventory that was originally developed, with support from the WRAP, to represent emissions for the initial implementation plans. Changes in emissions are represented using differences between the baseline inventory, and more recent inventory development work sponsored by the WRAP for the year 2008.[16]

2.1.2 SIP Evaluation Requirements

The RHR progress report stipulations require individual states to determine if the current visibility monitoring strategy and existing implementation plans are sufficient, or if modifications are necessary. Evaluation of current SIPs is not within the scope of this support document, but monitoring and emissions data summaries presented here have been designed to provide the western states with the technical basis to assist with their evaluation of current or proposed implementation plan elements and strategies. Specific regulatory questions relating to SIP evaluations are listed below.

- What is the status of implementation of all measures included in each state's regional haze SIP (51.308(g)(1))?
  - Note that, for most states, 2018 projections provided by the WRAP for use in the initial SIPs were conservative estimates that did not include best available retrofit technology (BART) controls.

[14] Descriptions of IMPROVE Network monitoring data and visibility calculations are provided in Section 3.1 of this report.
[15] See page 4-2 in EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.*
[16] See emission inventory descriptions in Section 3.2 of this report.

- What emission reductions have been achieved through implementation of regional haze SIP measurers (51.308(g)(2))?
  - Note that emissions data summaries presented in this report include a comparison of emission inventories representing both the baseline and current period, but a determination of what reductions may be related to implementation of SIP measures will be made by individual states.
- Have there been significant changes in emissions over the past 5 years from within or outside the state that have impeded progress in improving visibility at each state's Federal CIAs (51.308(g)(5))?
  - As noted previously, emissions data summaries presented in this report include a comparison of emission inventories representing both the baseline and current period, but a determination of whether specific emissions have limited or impeded progress will be made by individual states.
- Is the state's SIP sufficient to enable the state, and other states with CIAs affected by emissions from your state, to meet their reasonable progress goals (51.308(g)(6))?
- Based on these assessments, are any changes in the state's visibility monitoring plan necessary (51.308(g)(7))?
- Based on the state's assessment of the adequacy of the existing monitoring plan, the State is also required to take one of the following actions (51.308(h)):
  - Submit a declaration that the plan is adequate and further revisions are not necessary ((51.308(h)(1)); or
  - If the implementation plan is determined to be inadequate, the state must take steps to develop additional strategies to address the plans deficiencies ((51.308(h)(2), (3) and (4)).

The Regional Haze Rule also includes requirements for each state to coordinate and consult with federal land managers (FLMs) when assessing progress for current visibility conditions and SIP strategies. Specific requirements related to consultation with FLMs include:

- Has the state provided FLMs an opportunity for consultation in person 60 days prior to holding any public hearing on a regional haze SIP revision? (51.308(i)(2))
- Has the state included a description in your SIP revision on how the state addressed FLM comments? (51.308(i)(3))
- Has the state provided procedures for continuing consultation with FLMs in the regional haze SIP revisions and 5-year progress reports? (51.308(i)(4))

Development of this progress report has included regional coordination, offering opportunities for consultation with surrounding states. Also, this project has facilitated some opportunities for feedback from FLMs through summary calls and meetings.

2.2 SECTION 309

Under Section 309 of the RHR, 9 western states and tribes within those states had the option of submitting plans to reduce regional haze emissions that impair visibility at 16 CIAs on the Colorado Plateau. Five states, including Arizona, New Mexico, Oregon, Utah, and Wyoming, initially exercised this option by submitting plans to the EPA by December 31, 2003. Oregon elected to cease participation in the program in 2006 and Arizona elected to cease participation in 2010. As used in this document, Section 309 states refer to the states of New Mexico, Utah, and Wyoming and the city of Albuquerque/Bernalillo County.

Section 309 of the RHR specifically requires participating states to submit progress evaluations in 2013 (51.309(d)(10)), as opposed to the more general requirement of 5-years from initial SIP approvals, as referenced in Section 308. Specific regulatory text related to Section 309 progress report requirements is summarized here.

2.2.1 Monitoring and Emissions Data Summary Requirements

Section 51.309(d)(10) contains the monitoring and emissions data summary requirements for progress reports for Section 309 states. These requirements address the 16 CIAs on the Colorado Plateau (Grand Canyon National Park, Sycamore Canyon Wilderness, Petrified Forest National Park, Mount Baldy Wilderness, San Pedro Parks Wilderness, Mesa Verde National Park, Weminuche Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Maroon Bells Wilderness, Flat Tops Wilderness, Arches National Park, Canyonlands National Park, Capital Reef National Park, Bryce Canyon National Park, and Zion National Park). Specific monitoring and emissions summary requirements are listed below, and are addressed in this progress report support document on a regional, state, and CIA basis.

- How has visibility changed at the CIAs in the state in the last 5 years (51.309(d)(3))? Specifically listed under this requirement are the following elements:
  - What are the current visibility conditions for the most impaired and least impaired days (51.309(d)(10)(i)(C))?
  - What is the difference between baseline visibility conditions and current visibility conditions for the most impaired and least impaired days (51.309(d)(10)(i)(C))?
  - What is the change in visibility impairment for the most impaired and least impaired days over the past 5 years (51.309(d)(10)(i)(C))?
- For pollutants that affect visibility at CIAs, how have total emissions in the state changed over the past 5 years (51.309(d)(10)(i)(D))?

2.2.2 SIP Evaluation Requirements

Section 309 of the RHR requires that progress reports include a determination of whether the current visibility monitoring strategy and existing implementation plans are sufficient, or if modifications are necessary. Evaluation of current SIPs is not within the scope of this support document, but monitoring and emissions data summaries presented here have been designed to help states with their evaluation of current or proposed implementation plan elements and strategies. Specific regulatory requirements relating to Section 309 SIP evaluations are listed below.

- What is the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals (51.309(d)(10)(i)(A))? Note that there are also some specific interim report requirements referenced separately in the RHR:
  - What is the status of mobile source emissions (51.309(d)(5)(ii))?
  - What is the status of progress towards renewable energy goals (51.309(d)(8)(vi))?
- What emission reductions have been achieved through implementation of regional haze SIP measures (51.309(d)(10)(i)(B))?
  - Note that emissions data summaries presented in this report include a comparison of emission inventories representing both the baseline and current period, but a determination of what reductions may be related to implementation of SIP measures will be made by individual states.
- Have there been significant changes in emissions over the past 5 years from within or outside the state that have impeded progress in improving visibility at your states Federal CIAs (51.309(d)(10)(i)(E))?
  - As noted previously, emissions data summaries presented in this report include a comparison of emission inventories representing both the baseline and current periods, but a determination of whether specific emissions have limited or impeded progress will be made by individual states.
- Is your state's SIP sufficient to enable your state, and other states with CIAs affected by emissions from your state, to meet their reasonable progress goals (51.309(d)(10)(i)(F)?
  - Specifically noted is a requirement to assess whether annual SO_2 emissions milestones have been met (51.309(d)(4)(i)). Note that the WRAP has supported work addressing the SO_2 milestone requirements for 309 states. These annual regional SO_2 emissions and milestone reports are located on the WRAP website at http://www.wrapair2.org/reghaze.aspx.
- Based on the state's assessment of the adequacy of the existing monitoring plan, the state is also required to take one of the following actions (51.309(d)(10)(ii)):
  - Submit a declaration that the plan is adequate and further revisions are not necessary (51.309(d)(10)(ii)(A)); or
  - If the implementation plan is determined to be inadequate, the state must take steps to develop additional strategies to address the plans deficiencies ((51.309(d)(10)(ii)(B), (C) and (D)).

2.3 2064 NATURAL CONDITIONS

The concept of "natural conditions" in regional haze represents the long term goal of improving visual conditions in our national parks and wilderness areas. EPA provided the concept of a linear, or uniform, rate of reasonable progress between the 2000-2004 baseline period and the nominal natural conditions goal year in 2064.[17] With each 10-year SIP revision The States have the opportunity to further refine natural conditions estimates. Separate from this report, the WRAP has prepared summaries of the progression and current status of natural condition estimates, including the original EPA default estimates[18] and the revised natural conditions II estimates.[19] Also included in the WRAP report are considerations and recommendations for future natural condition refinements, and some recommended adjustments to regional haze management strategies.[20]

As of 2013, the initial SIPs/FIPs have not been approved for all WRAP states, and as such, not all reasonable progress goals have been defined and/or approved at the time this support document was prepared. Through consultation with state representatives, it was determined that this progress report support document would not address state specific reasonable progress goals or natural conditions. Only summaries of the differences between baseline and current progress period aerosol measurements and emissions inventories are provided here as the technical basis for use by states to determine if they are on track to meet or exceed their individual reasonable progress goals towards natural conditions.

2.4 TRIBAL CONSIDERATIONS

Under the Tribal Air Rule, Tribal governments may elect to implement air programs in much the same way as States, including development of Tribal implementation plans (TIPs). Also, as sovereign nations, Indian tribes have the right under the Clean Air Act to have the EPA classify their lands as CIAs, but this does not provide for the inclusion of the Tribal CIAs as Federal CIAs mandated for protection under the RHR.

Even if a Tribe does not seek authority to implement an RHR TIP, it may be desirable for a Tribe to participate in the regional planning efforts to address visibility and to consult with neighboring states as they develop their regional haze SIPs. Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Several Tribal nations in the United States have been classified as CIAs, and IMPROVE visibility monitors are located in 4 tribal CIAs in the WRAP. Because these IMPROVE monitors do not represent federally mandated CIAs, summaries for these monitors are not included in this progress report support document.

[17] Note that states can extend the period of time needed to achieve natural conditions, beyond the nominal 2064 in the RHR, defining and defending new interim amounts of reasonable progress, and adjusting the 2064 end year as needed (see Section 51.308(d)(1)(i)(B) and 501.308(d)(1)(B)(ii) of the RHR).

[18] Default natural conditions estimates are described in EPA's September 2003 *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule.*

[19] See Copeland's 2008 *Regional Haze Rule Natural Level Estimates Using the Revised IMPROVE Aerosol Reconstructed Light Extinction Algorithm*, available at http://vista.cira.colostate.edu/improve/publications/graylit/032_NaturalCondIIpaper/Copeland_etal_NaturalConditionsII_Description.pdf.

[20] WRAP's archived repository of natural conditions information, projects and references is available at http://www.wrapair.org/forums/aamrf/projects/NCB/index.html.

3.0 DATA SOURCES

This report includes summaries of monitoring and emissions data designed to support the first regional haze progress reports for the Western Regional Air Partnership (WRAP) member states. Monitoring data described here includes data collected by the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, with the addition of some data substitution and baseline estimates. Emissions data summaries use inventories previously developed by the WRAP to represent baseline conditions for the initial Regional Haze Rule (RHR) implementation plans, and a more current inventory that leverages emissions estimates that have been recently collected and enhanced to support modeling work currently in progress by the WRAP. Detailed descriptions and references for these data sources as used in this report are described in this section. Also described here are recent changes to dynamic data summary tools available from the WRAP Technical Support System (TSS) website (www.vista.cira.colostate.edu/tss/), which has been updated to support development of RHR progress reports.

3.1 IMPROVE MONITORING DATA

Visibility is reduced by the absorption and scattering of light by particles and gases in the atmosphere. Light extinction, or the fraction of light lost due to scattering and absorption by gases and particles, can be estimated from measurements of speciated aerosol mass. The IMPROVE Network is a multi-agency, nation-wide visibility monitoring network which began in 1988, and expanded significantly in 2000 in support of the EPA's RHR. Each Federal Class I area (CIA) is represented by at least one IMPROVE monitor, as depicted for the WRAP region in Figure 3.1-1.

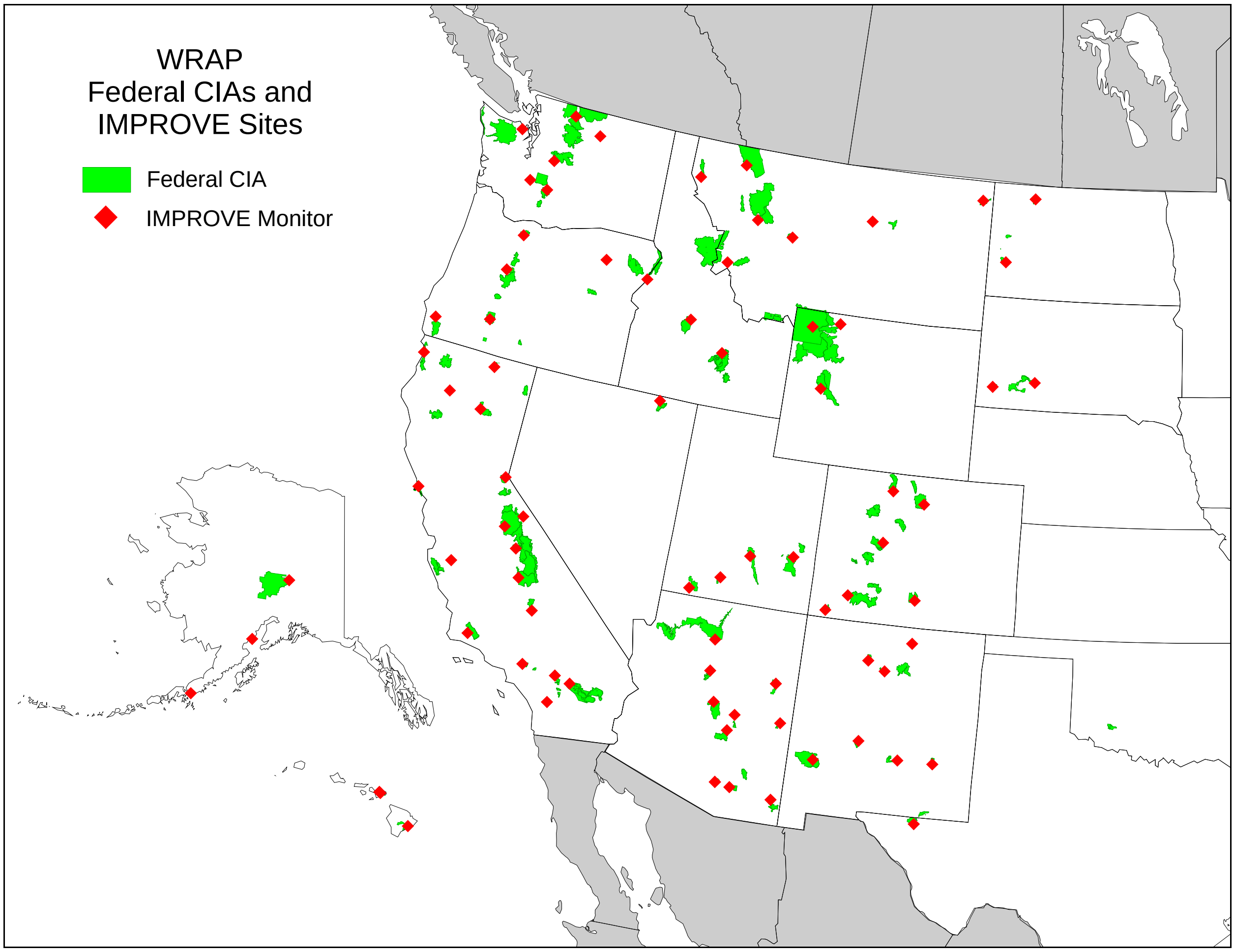


Figure 3.1-1. Map of Federal CIA IMPROVE Monitors in the WRAP Region.

IMPROVE aerosol samplers collect 24-hour integrated filter samples every third day. Each monitoring location operates four samplers (designated Module A through D) designed to quantify aerosol species that are related to visibility impairment. The aerosol species collected for regional haze purposes include:

- Ammonium Sulfate: Ammonium sulfate is formed in the atmosphere from reactions involving sulfur dioxide (SO_2) emissions. Anthropogenic sources include coal-burning power plants and other industrial sources, such as smelters, industrial boilers, and oil refineries, and to a lesser extent, gasoline and diesel combustion.
- Ammonium Nitrate: Ammonium nitrate is formed in the atmosphere from reactions involving nitrogen dioxide (NO_2) emissions, which are dominated by anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.
- Particulate Organic Mass (POM): Particulate organic mass can be emitted directly as particles, or formed through reactions involving gaseous emissions. Natural sources of organic carbon include wildfires and biogenic emissions. Man-made sources can

include prescribed forest and agricultural burning, vehicle exhaust, vehicle refueling, solvent evaporation (e.g., paints), food cooking, and various commercial and industrial sources.

- Elemental Carbon (EC): Elemental carbon is the primary light absorbing compound in the atmosphere. These particles are emitted directly into the air from virtually all combustion activities, but are especially prevalent in diesel exhaust and smoke from wild and prescribed fires.
- Fine Soil: Soil, as reported by the IMPROVE Network, refers to fine soil (less than 2.5 µm in diameter) that enters the air from dirt roads, fields, and other open spaces as a result of wind, traffic, and other surface mechanical disturbance activities.
- Coarse Mass (CM): Coarse mass refers to large particles (larger than 2.5 and smaller than 10 µm in diameter), and generally includes similar sources as fine soil, but can also include coarse fraction ammonium nitrate and ammonium sulfate at some sites. Speciated coarse mass is not routinely analyzed by the IMPROVE Network.
- Sea Salt: Sea salt is a natural aerosol emitted in coastal areas. In practice, chloride ion measurements are used to represent sea salt in IMPROVE measurements, and measurements may sometimes show anthropogenic or crustal influences at inland monitors.

These different particle species scatter and absorb light in the atmosphere with different efficiencies. For example, the elemental carbon fraction of particle pollution is about ten times more efficient at absorbing light than the soil fraction is at scattering light. Some particle species, including ammonium sulfate and ammonium nitrate, will absorb water as relative humidity increases, which effectively increases the size and the light scattering efficiencies of these particles. In addition to aerosol scattering, light extinction due to natural background gases in a clean atmosphere, or Rayleigh scattering, will contribute to total light extinction. Aerosol extinction from each of these species is additive, so the sum of the individual aerosol extinction species, plus Rayleigh scattering, represents total extinction.

The IMPROVE program has developed an algorithm for estimating light extinction from speciated aerosol and relative humidity data. The original algorithm, as cited in RHR guidance, was revised in 2005.[21] IMPROVE data are available from the IMPROVE Network through the Federal Land Manager Database online repository (http://views.cira.colostate.edu/fed/) and are also reported along with data summary charts and tables specifically designed to address RHR planning efforts on the WRAP TSS (www.vista.cira.colostate.edu/tss/).

Once extinction has been calculated from speciated aerosol mass, it can be converted to other metrics that describe visibility impairment. Figure 3.1-2 presents a comparison of the most commonly used metrics, which are described below:

[21] The revised IMPROVE algorithm is described in detail in Hand's 2006 *Review of the IMPROVE Equation for Estimating Ambient Light Extinction Coefficients - Final Report* available at http://vista.cira.colostate.edu/improve/Publications/GrayLit/016_IMPROVEeqReview/IMPROVEeqReview.htm.

- Extinction (b_{ext}) – Extinction is a measure of the fraction of light lost per unit length along a sight path due to scattering and absorption by gases and particles, expressed in inverse Megameters (Mm^{-1}).
- Deciview (dv) – This is the metric used for tracking regional haze in the RHR. The Haze Index (measured in deciviews) was designed to be linear with respect to human perception of visibility. A one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect.
- Visual Range (VR) – Visual range is the greatest distance a large black object can be seen on the horizon, expressed in kilometers (km) or miles (mi).

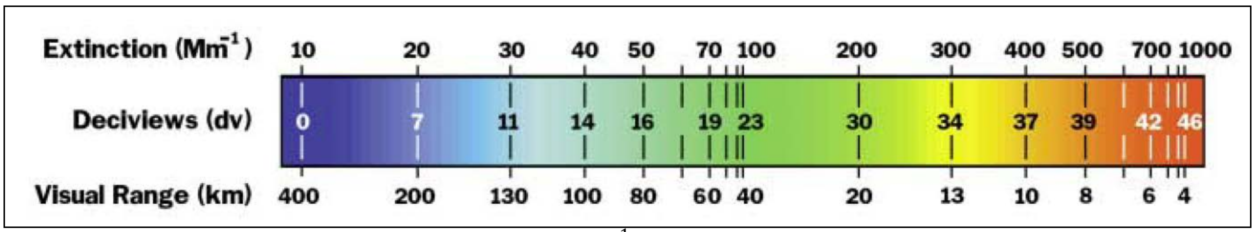


Figure 3.1-2. Comparison of Extinction (Mm^{-1}), Deciview (dv) and Visual Range (km) units.

3.1.1 Data Completeness Requirements

As described in Section 2.0, progress for the RHR is determined using 5-year average visibility conditions. EPA's 2003 *Guidance for Tracking Progress Under the Regional Haze Rule*[22] includes data completeness requirements designed to ensure that calculated averages include sufficient data to represent each daily, annual and 5-year period. EPA's 2003 Guidance specifies that the 2000-2004 baseline period, and each subsequent 5-year average progress period, meet the following conditions:

- Individual samples must contain all species required for the calculation of light extinction (ammonium sulfate, ammonium nitrate, POM, EC, soil, coarse mass, and sea salt)
- Calendar seasons must contain at least 50% of all possible daily samples
- Calendar years must contain at least 75% of all possible daily samples
- Calendar years must not contain more than 10 consecutive missing daily samples
- The 5-year baseline and each 5-year progress period averages must contain at least 3 complete years of data

[22] Data completeness requirements are listed in Section 2.2 (step 7) of EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule*.

RHR guidance specifies that if a 5-year period has less than three complete years of data, then estimates should be prepared for the missing data.[23] In the WRAP states, two data completeness issues were addressed to support progress summaries in document:

- **Incomplete Progress Period Data**: The 2005-2009 progress period did not have complete data available for one site in the WRAP. The SIAN1 site, representing the Sierra Ancha Wilderness Area in Arizona, did not meet RHR data completeness criteria for the years 2006, 2007, and 2008, which did not leave the 3 complete years required for a 5-year average. Data substitutions for these years were performed in a manner similar to that previously performed by the WRAP for incomplete 2000-2004 baseline years at 10 IMPROVE sites in the WRAP. Detailed methods are summarized in the Arizona state monitoring section (Section 6.2.1).
- **Monitor Relocation**: For two CIAs, Zion National Park in Utah and Haleakala National Park in Hawaii, it was determined that the original IMPROVE monitors sited to represent the parks did not adequately represent the CIAs. New sites were installed to better represent the parks, but because these sites were installed later, 2000-2004 baseline data averages are not available for the new locations. The RHR requires that the state establish baseline values using the most representative monitoring data for 2000-2004.[24] Detailed methodologies used to approximate baseline averages for these sites are summarized in the Hawaii and Utah monitoring sections (Sections 6.5 and 6.12, respectively).

All regional and state summaries presented in this report include the SIAN1 substituted data, and baseline estimates calculated for the ZICA1 and HACR1 sites.

3.1.2 RHR Progress Period Calculation Considerations

The goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve, and that visibility on the 20% least impaired, or best, days does not get worse, as measured in units of deciviews, calculated using data measured at IMPROVE monitoring sites. As described previously, progress for this report is measured for discreet 5-year average increments, beginning with the 2000-2004 baseline average, and proceeding with the most recently available subsequent 5-year average (2005-2009).[25] Some of the more subtle, but important, considerations for RHR calculations using IMPROVE data measurements are described below.

[23] Section 2.2 (step 7) of the September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* states "If 3 years with complete data are not available, estimates for baseline of current conditions should be prepared in consultation with the Environmental Protection Agency's Office of Air Quality and Planning Standards (EPA/OAQPS)."

[24] Section 308(d)(2)(i) of the RHR states, "For mandatory Class I Federal areas without onsite monitoring data for 2000-2004, the State must establish baseline values using the most representative available monitoring data for 2000-2004, in consultation with the Administrator or his or her designee."

[25] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (see page 4-2 in the Guidance document).

3.1.2.1 Identification of 20% Worst Days

As described in Section 3.1, visibility impairment is the result of the cumulative effect of several different particle pollutant types. Many of these pollutants have individually consistent seasonal patterns. For example, ammonium nitrate is temperature sensitive, and formation often favored during colder winter months, while ammonium sulfate formation may be favored during warmer summer months. Other pollutants, such as particulate organic mass, may be impacted by large and variable episodic events such as wildland fires, which generally occur during the summer.

To determine the 5-year average of the 20% best and worst days, the highest and lowest 20% of days for each complete year are first selected and averaged on an annual basis, with a 5-year average calculated from these annual averages. The timing for identification of the 20% best and worst days may be significantly influenced by large episodic events (e.g., wildland fires) which may occur at different time during different years. As a result, the identification of more best or worst days during different seasons of different years may affect the averages for individual species in ways that are independent from actual increases or decreases of individual pollutants from one 5-year period to the next.

As an illustration of the effect of large episodic events on worst day averages, consider daily average aerosol extinction calculated from IMPROVE data at the CHIR1 site in Arizona. Figures 3.1-3 and 3.1-4 present daily aerosol extinction measurements for 2002 and 2008 at CHIR1, with the 20% worst days represented by an orange box with an "x" below the day. Similar daily aerosol charts depicting the 20% worst days are included for each Class I area in state specific Appendices. For 2002, large wildfire events in June and July contributed to high particulate organic mass (POM) measurements, resulting in more worst days selected during this period. In 2008, more of the worst days were selected in August and October.

As an illustration of the seasonal patterns of individual compounds, consider the monthly averages of aerosol extinction calculated from IMPROVE data at the CHIR1 site. Figure 3.1-5 presents monthly average aerosol pollution for CHIR1 measured during 2002, and Figure 3.1-6 presents monthly averages in 2008. State specific appendices included with this document present similar monthly average plots for each year at each site. The seasonal patterns for both years indicated that ammonium sulfate was generally higher between May and July than in October.

Because of the seasonal ammonium sulfate patterns, the identification of more worst days between May and July (e.g., 2002 at CHIR1) will show a higher ammonium sulfate average than a year with more worst days in October (e.g., 2008 at CHIR1), even though annual ammonium sulfate levels may not have increased. For this case, Table 3.1-1 presents the annual averages of ammonium sulfate for both the 20% worst days and all measured days. For these years, the annual average of ammonium sulfate extinction for all measured days decreases, while the 20% worst day average actually increased.

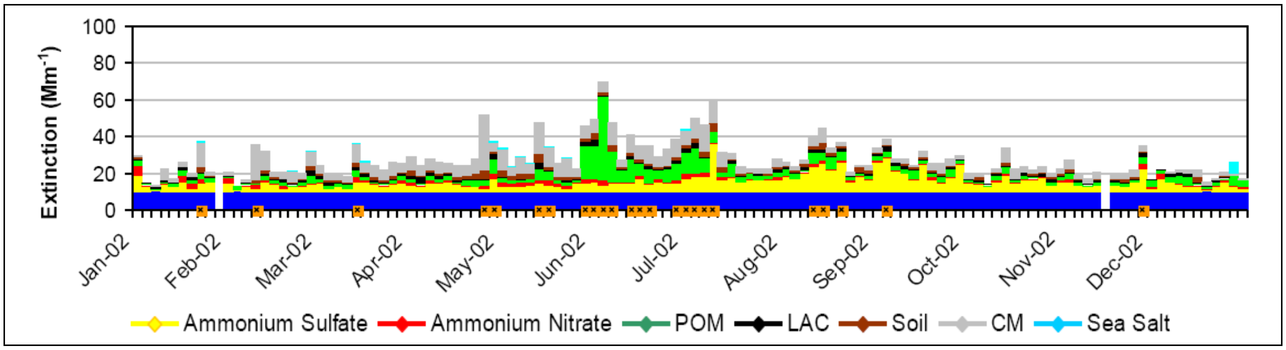


Figure 3.1-3. Daily Aerosol Extinction measured by the Chiricahua CHIR1 IMPROVE monitor during 2002.

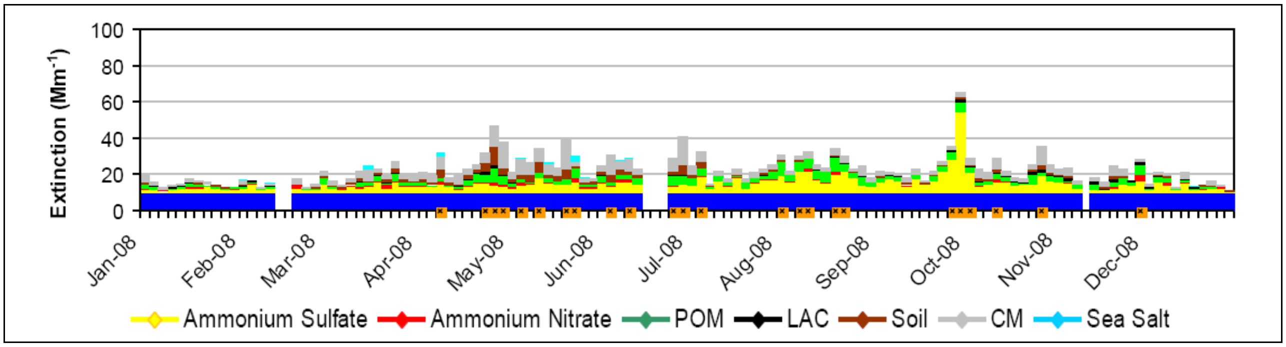


Figure 3.1-4. Daily Aerosol Extinction measured by the Chiricahua CHIR1 IMPROVE monitor during 2008.

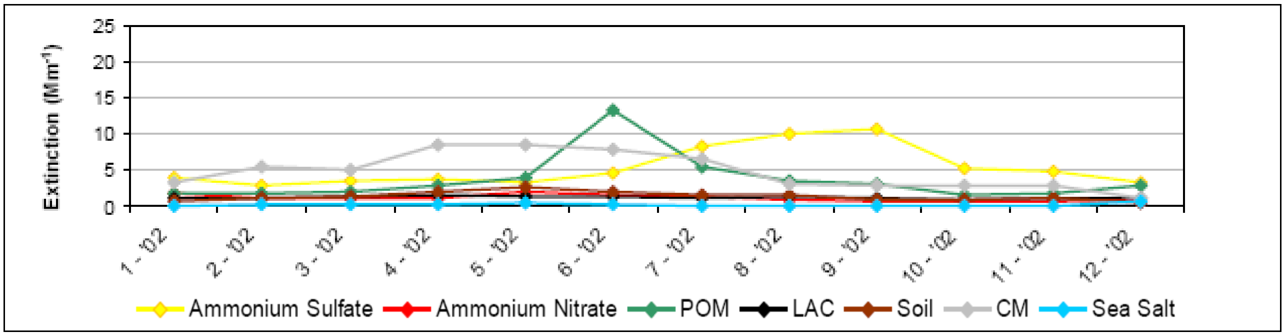


Figure 3.1-5. Monthly Average Aerosol Extinction measured by the CHIR1 IMPROVE monitor in 2002.

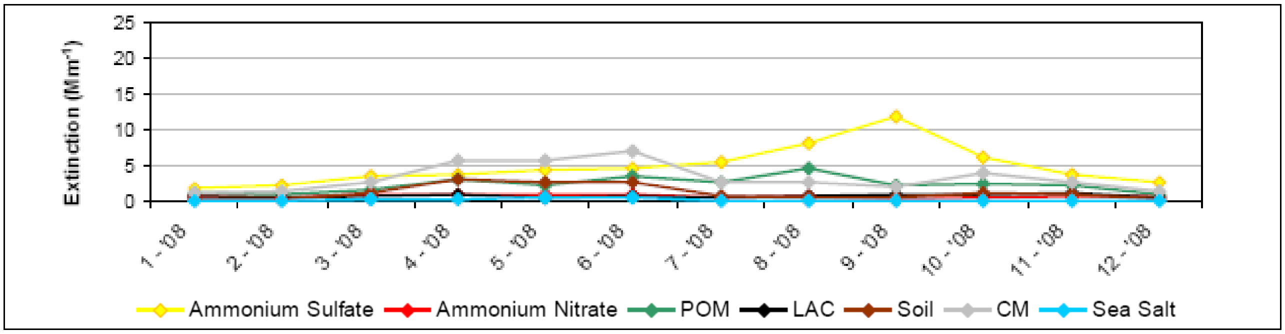


Figure 3.1-6. Monthly Average Aerosol Extinction measured by the CHIR1 IMPROVE monitor in 2008.

Table 3.1-1
CHIR IMPROVE Site
Comparison of Ammonium Sulfate Average
All Days and 20% Worst Days

Year	All Days Amm. Sulfate Average (Mm^{-1})	20% Worst Days Amm. Sulfate Average (Mm^{-1})
2002	5.3	7.8
2008	4.9	9.0
Difference	**-0.4 Mm^{-1}**	**+2.2 Mm^{-1}**

3.1.2.2 Discreet 5-Year Averages vs. Trends

The 2003 RHR Guidance prescribes that progress be measured using discreet 5-year average increments,[26] but states that determining trends for all the individual species that contribute to haze is especially helpful in tracking progress. Individual high or low years can affect the 5-year averages, while trend statistics are more resistant to extreme events and may better represent the effects of emissions controls.[27] For this reason, looking at annual trends in addition to the differences between 5-year averages can also be instructive in determining the long term behavior of pollutant measurements.

Generally, the 10-year trends are consistent with the 5-year average differences, but in some cases annual trends and differences between 5-year averages may show different characteristics. Trends for annual averages of each species at each site are presented in this report as calculated using Kendall-Theil statistics, which are often used in environmental applications because these statistics are resistant to outliers.[28] Figure 3.1-7 shows an example of an increase in the 5-year average deciview metric for ammonium sulfate measured on the 20% most impaired days at the Salt Creek Wilderness Area (SACR1) IMPROVE site (16.7 Mm^{-1} to 18.9 Mm^{-1}), but a decreasing annual deciview trend (-0.5 Mm^{-1}/year). The increase in the 5-year average was driven by uncharacteristically high average ammonium sulfate measured in 2005. For all sites included in this report, both 5-year average differences and trends is reported, and any differing characteristics are noted and described.

[26] As noted previously, EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (see page 4-2 in the Guidance document).
[27] Section 4.7 of EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* states that "In the long-term, tracking trends of species contributions to haze provides information that can be useful in determining whether implemented emissions controls are having the expected effects."
[28] Trend statistics used in this report are also used in EPA's National Air EPA's National Air Quality Trends Reports (http://www.epa.gov/airtrends/) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)

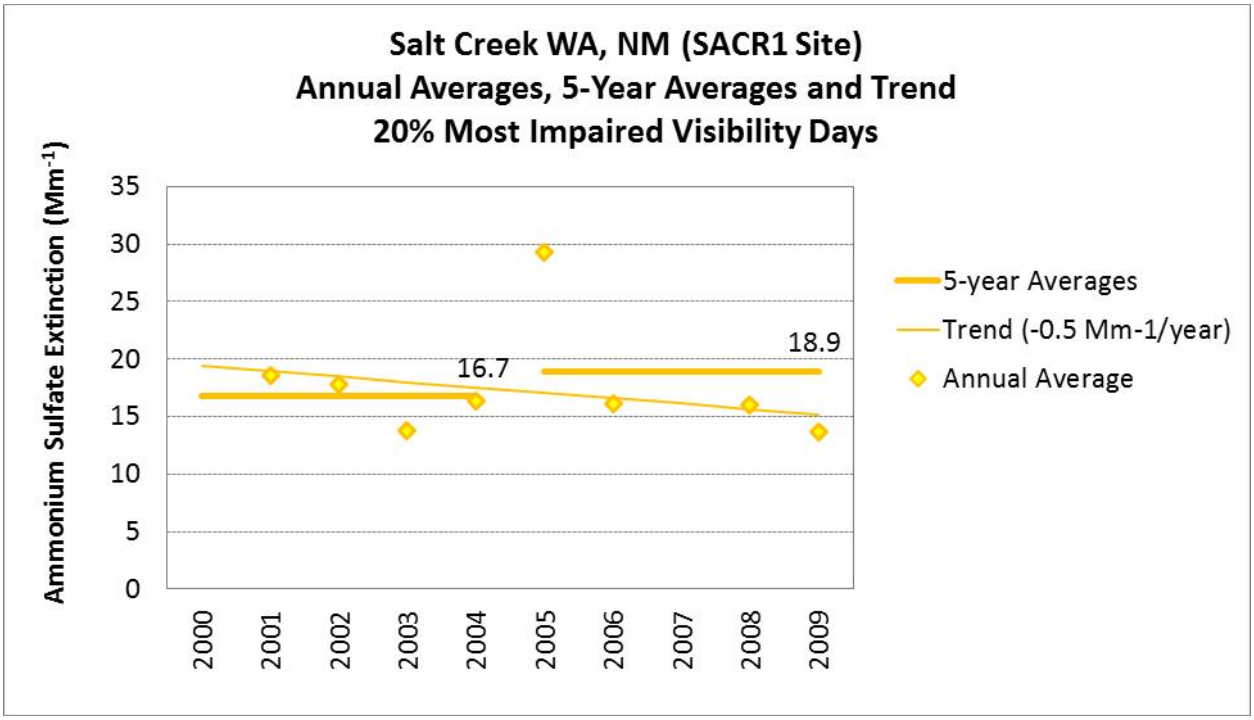


Figure 3.1-7. Annual Averages, Period Averages and Trend Statistics for Ammonium Sulfate Measured at the SACR1 IMPROVE Site in New Mexico.

3.1.2.3 Averaging Considerations for Deciview Calculations

The RHR haze index, as defined using deciviews (dv), does not provide information regarding the relative contributions of individual species to overall visibility. The deciview metric for extinction is logarithmically related to total extinction (b_{ext}), e.g. dv=10ln(b_{ext}/10), where b_{ext} is the sum of extinction as calculated from individual species mass measurements. Looking at individual species extinction is necessary for RHR considerations because each species that contributes to regional haze can have different sources and control options. For example, some species (e.g. sulfate and nitrate species) originate from largely anthropogenic sources, while others (e.g. organic species) from a mixture of both anthropogenic and natural sources. Because of the logarithmic nature of deciviews, it is not possible to separate this metric into individual species, so a representation of total extinction in units of inverse megameters (Mm^{-1}) is useful.

EPA's *Guidance for Tracking Progress Under the Regional Haze Rule* (EPA 2003) specifies that the 5-year average deciview value is calculated as an average of annual values, which are in turn calculated as averages of daily values.[29] In most cases, an increase/decrease in the deciview metric corresponds to an increase/decrease in total extinction. In some cases, because the 5-year deciview value is effectively the average of logarithmic values, the average deciviews may change in a different direction than the average of total extinction. As an

[29] Calculation of the 5-year average deciview metric is described in Section 4.3 of EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.*

example, consider the following extinction measurements presented in Table 3.1-1 for a contrived dataset of 2 days for each of 2 periods. The table shows both daily and period average extinction, and corresponding deciview calculations. Note that the average total extinction decreases (70 to 55 Mm^{-1}), while the average deciview value increases (15.9 to 17.0 dv).

Table 3.1-1
Example Calculation
Decreasing b_{ext} Averages With Increasing deciview Averages

Averaging Periods		Extinction (Mm^{-1})	Deciviews (dv) $10\times\ln(b_{ext}/10)$
Period 1	Day 1	20	6.9
	Day 2	120	24.8
	Period 1 Average	**70**	**15.9**
Period 2	Day 1	50	16.1
	Day 2	60	17.9
	Period 2 Average	**55**	**17.0**
	Difference	**-15 Mm^{-1}**	**+1.1 dv**

For comparisons between the 2000-2004 baseline period and the 2005-2009 progress period, decreasing 5-year average deciview metrics, but increasing extinction for the 20% most impaired, or worst, days was observed at 9 WRAP Federal CIA sites, and slightly increasing deciview associated with decreasing average extinction was observed at 1 site, as listed in Table 3.1-2.

Table 3.1-2
20% Most Impaired Visibility Days
Total Extinction and Deciview Average Differences

State	Site	Extinction (Mm^{-1})			Deciviews (dv)		
		Baseline Period (2000-2004)	Progress Period (2005-2009)	Difference	Baseline Period (2000-2004)	Progress Period (2005-2009)	Difference
AZ	SYCA1	47.2	47.4	**+0.2**	15.3	15.2	**-0.1**
CA	DOME1	71.7	76.7	**+5.0**	19.4	19.2	**-0.2**
	PINN1	65.1	65.7	**+0.6**	18.5	18.4	**-0.1**
	TRIN1	68.0	91.8	**+23.8**	17.3	17.3	0.0
OR	CRLA1	47.9	47.7	**-0.2**	13.7	13.8	**+0.1**
	HECA1	69.1	71.9	**+2.8**	18.6	18.1	**-0.5**
MT	GAMO1	31.8	32.9	**+1.1**	11.3	11.2	**-0.1**
WA	WHPA1	37.1	37.9	**+0.8**	12.8	12.7	**-0.1**
WY	BRID1	31.6	31.7	**+0.1**	11.1	10.7	**-0.4**
	YELL2	34.5	36.1	**+1.6**	11.8	11.5	**-0.3**

3.2 EMISSIONS INVENTORIES

To demonstrate RHR progress, states are required to report how total emissions in the state have changed over the past 5 years (51.308(g)(4)), and to determine if there have been significant changes in emissions from the state or from other states affecting visibility at each Federal CIA which has impeded progress in improving visibility (51.308(g)(5)). Comparisons between emissions inventories in this report use the inventories that represent both baseline and current conditions. Baseline emissions in most cases are represented using the 2002 inventory that was originally developed, with support from the WRAP, to represent emissions for the initial implementation plans. Current emissions are represented here by leveraging recent work by the WRAP to develop an updated and comprehensive inventory for the year 2008 for use in modeling projects. For non-contiguous states (Alaska and Hawaii), alternate inventories representing the progress periods were obtained in consultation with the states.

Emissions inventories in this report were complicated by the fact that a number of changes and enhancements have occurred between development of the baseline and current period inventories, such that many of the differences between inventories are more reflective of changes in inventory methodology, rather that changes in actual emissions. Differences in emissions are presented for all categories in this report, but summaries focus on aspects of source categories that have been more consistently inventoried over time, while noting any changes in methodologies that may affect differences in other categories. Detailed references regarding emissions inventories are presented in this section.

3.2.1 Inventory Descriptions

Emissions related to the different particle species that affect regional haze are varied and complex, including a number of both anthropogenic and natural source possibilities. Emissions estimates vary by source category according to the different characteristics and attributes of each category, and how the emissions are modeled. A number of anthropogenic, or man-made, sources such as motor vehicles and electric generating units (EGUs) are reported by states and may be subject to controls. Natural emissions, such as fires, biogenic emissions and some categories of dust can have large regional haze impacts, but are not subject to control strategies. Source categories for both anthropogenic and natural sources are listed and described briefly below, followed by information related to inventory development and comparisons for the contiguous states, Alaska, and Hawaii.

- *Point Sources:* These are sources that are identified by point locations, typically because they are regulated and their locations are available in regulatory reports. In addition, elevated point sources will have their emissions allocated vertically through the model layers, as opposed to being emitted into only the first model layer. Point sources can be further subdivided into EGU sources and non-EGU sources, particularly in criteria inventories in which EGUs are a primary source of NO_X and SO_2. Examples of non-EGU point sources include chemical manufacturers and furniture refinishers.
- *Area Sources:* Sources that are treated as being spread over a spatial extent (usually a county or air district) and that are not movable (as compared to non-road mobile and

on-road mobile sources). Because it is not possible to collect the emissions at each point of emission, they are estimated over larger regions. Examples of stationary area sources are residential heating and architectural coatings. Numerous sources, such as dry cleaning facilities, may be treated either as stationary area sources or as point sources.

- *On-Road Mobile Sources:* These include vehicular sources that travel on roadways. Emissions from these sources can be computed either as being spread over a spatial extent or as being assigned to a line location (called a link). Emissions are estimated as the product of emissions factors and activity data, such as vehicle miles traveled (VMT). Examples of on-road mobile sources include light-duty gasoline vehicles and heavy-duty diesel vehicles.
- *Off-Road Mobile Sources:* Off-road mobile sources are vehicles and engines that encompass a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. Examples include agricultural equipment such as tractors or combines, aircraft, locomotives and oil field equipment such as mechanical drilling engines. Emissions from marine vessels are included here separately as offshore emissions.
- *Off-shore:* Commercial marine emissions comprise a wide variety of vessel types and uses. Emissions can be estimated for deep draft vessels within shore and near port using port call data, and offshore emissions generated from ship location data.
- *Oil and Gas Sources:* Oil and gas sources consist of a number of different types of activities from engine sources for drill rigs and compressor engines, to sources such as condensate tanks and fugitive gas emissions. The variety of emissions types for sources specific to oil and gas activity can, in some cases, overlap with mobile, area or point sources, but these can also be extracted and treated separately.
- *Biogenic Emissions:* Biogenic emissions are based on the activity fluxes modeled from biogenic land use data, which characterizes the types of vegetation that exist in particular areas. Emissions are generally derived using modeled estimates of biogenic gas-phase pollutants from land use information, emissions factors for different plant species, and meteorology data.
- *Dust:* Dust emissions may have a variety of sources that could include anthropogenic sources, natural sources, and natural sources that may be influenced by anthropogenic activity. In order to better distinguish between the natural and anthropogenic sources, the WRAP undertook a Definitions of Dust project, with a final report available here: http://www.wrapair.org/forums/dejf/documents/defdust/index.html. For emissions summary purposes, dust is classified here as fugitive dust and windblown dust. Fugitive dust includes sources such as road dust, agricultural operations, construction and mining operations and windblown dust from vacant lands. The windblown dust category includes more of the natural influences such as wind erosion on natural lands.
- *Fire:* Fire sources are difficult to predict and control, and may have a mix of natural and anthropogenic influences. Natural sources include wildland fires, while anthropogenic sources can include agricultural and prescribed fires. In order to better

distinguish between natural and anthropogenic fires, the WRAP has created an operational policy level definition of fire activity as discretely natural or anthropogenic, which included allowing certain types of prescribed fires to be treated as natural.[30]

3.2.1.1 Contiguous WRAP States

As noted previously, baseline and current period emissions are summarized here using two discreet years, where one year is used to represent baseline emissions, and other is used to represent the current progress period. For contiguous states, the baseline period inventories summarized here for comparison to current conditions is the 2002 inventory that was developed for WRAP states in support of the original SIPs, termed "plan02d" (or "plan02c" in California). Development of the plan02 inventories were a cooperative effort sponsored by the WRAP in cooperation with WRAP states. This effort built upon 2002 emissions reported by states, and included work with contractors and WRAP workgroups, in consultation with states, to enhance specific categories (e.g., point, area, on- and off-road mobile, oil and gas, fire, and dust) to better characterize regional haze implications. Detailed descriptions of inventory development are available from the WRAP Technical Support System website (http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx).

The WRAP has continued to support emissions data tracking and related technical analyses focused on understanding current and evolving regional air quality issues in the western states. Methods for estimating emissions of many of the source categories that affect regional haze have continued to evolve and be refined over time. This is especially true for inventories of natural emissions categories including windblown dust and biogenic emissions, and also for rapidly evolving industries such as oil and gas exploration. To represent current conditions, this progress report support document leverages 2008 emissions data inventories which have been recently developed as part of the WRAP's West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS) and Deterministic and Empirical Assessment of Smoke's Contribution to Ozone (DEASCO$_3$) study, which are described briefly below:

- The WestJumpAQMS project (http://wrapair2.org/WestJumpAQMS.aspx) sponsored by the WRAP includes coordination and harmonization with the EPA 2008 National Emissions Inventory (2008 NEI v2). Among other goals, this project is intended to provide technical updates and improvements for multiple air quality issues, including regional haze, ozone, particulate pollution and nitrogen deposition.
- The DEASCO$_3$ study (http://www.wrapfets.org/deasco3.cfm) is a project sponsored by the Joint Fire Sciences Program (JFSP) that looks at impact of weather and fires on ozone formation. This project has included the development of a detailed and comprehensive 2008 fire emissions inventory, which will eventually be incorporated into the WestJumpAQMS project.

[30] The WRAP Policy for characterizing fire emissions is available at http://www.wrapair.org/forums/fejf/documents/nbtt/firepolicy.pdf.

Because these inventories have been refined over time, there is not necessarily continuity between the 2002 and 2008 inventories, which affects data comparisons for particular source categories. Detailed references and major methodology differences for the emissions inventories compared here are summarized in Table 3.2-1. In addition to comparing baseline and progress period inventories, regional and state summary sections in this report include annual averages tracking changes in regional and state totals for SO_2 and NO_X emissions for EGU as tracked in the EPA's Air Markets Program Database for permitted Title V facilities in the state (http://ampd.epa.gov/ampd/).

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Point Sources	Most WRAP states used the Plan02d point source inventories, while California used the Plan02c inventory for their initial SIP. These inventories were generated using hourly EPA CAMD CEM data for EGUs. Other point were developed in consultation with states by the ERG contractor. Note that the WRAP also generated point source inventories for both actual reported 2002 (Base02b) EGU and all other point source data, and for a 2000-2004 average of EGU point sources (Plan02c and Plan02d). Plan02 emissions are summarized in this report because they are consistent with what was reported as baseline conditions for most initial WRAP region SIPs.	The WRAP WestJump 2008 inventories were generated using hourly EPA CAMD CEM data for EGUs. Other point sources are from the 2008 NEI v2. Note that point source oil and gas inventories were inventoried separately for WestJump08, but included in the point source totals here for comparisons with 2002 inventories.	Because point source definitions vary by state, any changes or additions for an individual state will affect comparisons of 2002 and 2008. Note that baseline conditions presented here represent a 5-year average for EGUs, while progress period conditions are represented with 2008 data. In addition to inventory changes for these two years, year-to-year variations are also presented separately for Title V Major Sources on a regional and state basis.[33]

[31] Detailed inventory descriptions for development of the WRAP Base02b, plan02c and plan02d inventories are available on the WRAP TSS website http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx and archived on the original WRAP website http://www.wrapair.org/forums/ssjf/pivot.html.
[32] Detailed inventory descriptions for development of the WRAP WestJump08 inventory are available on the WRAP project page http://wrapair2.org/WestJumpAQMS.aspx.
[33] Annual EGU emissions for each state were obtained from EPA's Air Markets Program Database for permitted Title V facilities (http://ampd.epa.gov/ampd/).

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Area Sources	Most WRAP states used the Plan02d point source inventories, while California used the Plan02c inventory for their initial SIP. These inventories were developed by the ERG contractor in consultation with states.	The WRAP WestJump 2008 used state reported area source inventories from the 2008 NEI v2.[34] Note that, beginning in 2008, some source categories such as Class I and II commercial marine vessels, Class III vessels on in-land waterways and in-transit locomotive emissions, were defined as area sources (moved from off-road inventory). To reflect these changes, EPA now refers to the area source category as the "non-point" emissions.	Note that area oil and gas sources are reported separately in this report. Area source estimates represent broad areas, and include calculations which are, in part, based on population estimates and activity data. Because of this, changes in are source definitions and changes in calculation methods (which can be different from state to state and year to year), as well as changes in inputs such as population can affect differences between these inventories. One important example of methodology differences is the addition of some sources previously considered "off-road" into the area (also referenced as non-point) source category.

[34] EPA's 2008 NEI inventory estimates are available at http://www.epa.gov/ttn/chief/net/2008inventory.html.

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Area Oil and Gas	These inventories were developed for specific oil and gas basins using WRAP Phase II emissions methodologies.[35] Where WRAP Phase II emissions were not available, area source oil and gas emissions as reported by the state were used. Phase II emissions process estimated for 2002 included: • Drill Rigs • Wellhead Compressor Engines • CBM Pump Engines • Heaters • Pneumatic Devices • Condensate and oil tanks • Dehydrators • Completion Venting	These inventories were developed for specific oil and gas basins using WRAP Phase III emissions methodologies. Where WRAP Phase III emissions were not available, area source oil and gas emissions as reported by the state were used. Phase III emissions process estimated for 2008 included: These inventories used 2008 production data, which was updated with State-reported data in some cases. The following additional categories were included in addition to those listed for 2002: • Lateral compressor engines • Workover rigs • Salt-water disposal engines • Artificial lift engines • Vapor recovery units (VRUs) • Miscellaneous or exempt engines • Flaring • Fugitive emissions • Well blowdowns • Truck loading • Amine units (and gas removal) • Water tanks	Oil and gas development is a rapidly evolving industry, and significant efforts to better characterize emissions have occurred between development of the 2002 and 2008 inventories. In addition to expanded development, some notable emission inventory difference include: • Regulatory changes specific to each state may have required more sources to be reported in 2008 than were reported in 2002. • New and/or revised estimation methodologies, especially for VOC emissions rates, were used for more source categories in Phase III. • Phase III estimates included surveys which provided detailed information about specific sources (e.g. counts by device type such as low-bleed vs. high-bleed) among other improvements to activity data. These sources included small area source equipment typically not inventories by the states. Phase II did not have that information available, since no surveys were made in Phase II. • Phase III used the high-quality and complete IHS commercial database of O&G production data by well by basin. For Phase II, the state O&G Commission databases, which have been improved quite a bit over time, were used.

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
On-Road Mobile	The 2002 inventory for most WRAP states used the EPA MOBILE6 model as applied by ENVIRON using inputs from states. California provided emissions separately using their EMFAC2002 model.	The 2008 on-road mobile inventory used the EPA MOVES2010 model applied to state inputs in inventory mode. The California EMFAC2011 data were downloaded in 2012 from the California ARB website.	Differences in models contribute to some differences in emissions reported, but other differences are due to a combination of VMT differences and new controls on vehicles.
Off-Road Mobile	The 2002 inventory for most WRAP states used the draft NONROAD2004 model as applied by ENVIRON using inputs from states. California provided emissions separately.	The 2008 off-road mobile inventory was obtained from the NEIv2.0 using the NONROAD model estimates within the National Mobile Inventory Model (NMIM). Note that, beginning in 2008, some source categories were removed from the off-road mobile category to the area/non-point category. These emissions included Class I and II commercial marine vessels, Class III vessels on in-land waterways and in-transit locomotive emissions. California supplied non-road emissions calculations using a California state-specific off-road model.	The off-road models include both emission factors and default county-level population and activity data. One important methodology change was the re-classification of some sources previously labeled off-road as non-point (area) sources in 2008.

[35]Additional Phase II oil and gas inventory descriptions are archived on the original WRAP website http://www.wrapair.org/forums/ogwg/documents/2007-10_Phase_II_O&G_Final)Report(v10-07%20rev.s).pdf.

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Offshore	For the baseline inventories, off-Shore emissions were treated as a region rather than a source category.	For the 2008 inventories, specific SCCs do not distinguish between regions (e.g. Atlantic, Pacific and Gulf), so these are presented as a sum of all offshore emissions.	Note that while offshore emissions are available from both datasets, comparisons are not presented in this report. These emissions were not comparable, as baseline emissions were presented as a region, and not explicitly associated with any of the coastal states for summaries here, and progress period summaries totaled all offshore emissions for the US (e.g. Atlantic, Pacific and Gulf)
Fugitive Dust and Road Dust	The WRAP 2002 inventory by ENVIRON began with inputs from states. For 2002, note that vegetative scavenging factors were applied pre-processing at the county level, as opposed to grid-level for 2008 data.	These emissions were extracted from state reported area source emissions for 2008 (NEI08v2). For the NEI08v2 inventories, the State of California notes that they have changed the way they calculate and report paved road dust. For 2008, note that vegetative scavenging factors were applied post-processing at a higher resolution grid cell level, as compared to 2002 data.	Note that fugitive dust and road dust categories were available separately in the WRAP Plan02d inventories, but are combined for summary purposes here. For the 2008 inventory, vegetative scavenging factors were applied to the combined sources; thus these source categories were not easily separated.

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Windblown Dust	Generated using WRAP Windblown Dust Model and 2002 MM5 meteorology, at 36km grid cell resolution. Vegetative scavenging factors were applied pre-processing at the county level.	Generated using WRAP Windblown Dust Model and 2008WRF meteorology, at 4km and 12km grid cell resolution for the WRAP region. Vegetative scavenging factors applied post-processing at the grid cell level.	Significant updates to enhance the accuracy of the WRAP Windblown Dust Model will affect comparisons between the 2002 and 2008 inventories. Specific differences between the inventories include: • Different meteorological models; MM5 (2002) vs. WRF (2008) met models • Higher resolution of grid cells in 2008, which led to higher average wind speeds in individual cells, and increased windblown dust emissions aggregated at the county level. • MM5 Layer 1 used 36 meter height winds vs. WRF average winds across lowest 3 layers spanning ~40 meter height. • An error in 2002 WBD model was corrected where rainfall in centimeters was treated as inches.
Biogenic	The 2002 biogenic inventory used the BEIS3.12 model with BELD3 landuse and 2002 MM5 meteorology data, at 36km grid cell resolution.	The 2008 biogenic inventory used the MEGAN2.10 with 2008 WRF meteorology data, at 4 and 12 km grid cell resolution.	Significant model changes designed to enhance the accuracy of the biogenic emissions estimates will affect comparisons between the 2002 and 2008 inventories. Specific differences between the BEIS3.12 and MEGAN2.10 model outputs include: • Different meteorological years and models (2002 MM5 vs. 2008 WRF). • Higher temporal and spatial variability of land cover and other environmental input factors. • Improved emissions factors based on better sources of data (e.g., satellites and field studies).

Table 3.2-1
Emissions Inventory Descriptions
Contiguous WRAP States

Inventory Sector	2002 Baseline Inventory (Plan02c/Plan02d) [31]	2008 Progress Period Inventory (WRAP WestJump08) [32]	Comments
Fires (Natural and Anthro-pogenic)	Baseline estimates used the WRAP Phase III fire inventory, which represent a 2000-2004 5-year average of fire activity. Inventories included both anthropogenic and natural emissions.	2008 estimates use DEASCO$_3$ fire summaries, which account for fires in 2008, and include separate reporting of anthropogenic and natural fires. [36]	Baseline conditions are represented with a 5-year average of fire, while progress period conditions are represented with 2008 data. Comparisons between these inventories are complicated by the variable and sporadic nature of wildfires. Also, differences between methodologies will affect comparisons of inventories used for 2002 and 2008 estimates.

[36] Additional details regarding fire inventory descriptions for development of the DEASCO$_3$ inventory are available on the WRAP project page at http://www.wrapfets.org/deasco3.cfm.

3.2.1.2 Alaska

Current emissions summaries for the contiguous states use inventories developed for modeling purposes, but the States of Alaska (and Hawaii) were not included in the modeling effort, so these current year inventories were not available. Baseline conditions were represented with data originally used to represent baseline emissions in the initial Alaska implementation plan. For current progress period summaries, inventories were assembled through consultation with the Alaska Department of Environmental Control (DEC). Table 3.2-2 presents data references for source categories used to represent emissions in Alaska.

Table 3.2-2
Emissions Inventory Descriptions
Alaska

<table>
<tr><th>Source Categories</th><th>2002 Inventory</th><th>2008 Inventory</th></tr>
<tr><td>Point</td><td>WRAP 2002 point source inventory[37]</td><td>Provided by Alaska DEC</td></tr>
<tr><td>Area</td><td rowspan="2">2002 emissions from the Alaska DEC “Big 3” [38] Criteria Inventories and
2005 emission from the Alaska DEC Rural Inventory[39]</td><td>2008 WestJump[40]</td></tr>
<tr><td>On-Road and Off-Road Mobile</td><td rowspan="3">NEI2008v3[41]</td></tr>
<tr><td>Aviation</td><td>WRAP 2002 Aviation Report[42]</td></tr>
<tr><td>Commercial Marine</td><td>Pechan Report[43]</td></tr>
<tr><td>Fire</td><td>WRAP 2003 Phase III Inventory[44]</td><td>Alaska Interagency Coordination Center (AICC) Incident Support Website[45]</td></tr>
</table>

3.2.1.3 Hawaii

Current emissions summaries for the contiguous states use inventories developed for modeling purposes, but the States of Hawaii (and Alaska) were not included in the modeling

[37] The WRAP 2002 point source inventory is available from http://www.wrapair.org/forums/ssjf/pivot.html.
[38] Alaska “Big 3” inventories include Anchorage, Juneau and Fairbanks.
[39] Alaska “rural” inventories refers to remaining boroughs and census areas outside of Anchorage, Juneau and Fairbanks. The 2005 Alaska rural inventory is available at http://www.epa.gov/region10/pdf/tribal/wrap_alaska_communities_final_report.pdf.
[40] WRAP 2008 WestJump inventories are available on the WRAP project page http://www.wrapfets.org/deasco3.cfm
[41] EPA’s 2008 NEI inventory estimates are available at http://www.epa.gov/ttn/chief/net/2008inventory.html. Note that only lead (Pb) emissions totals were available from the NEI2008v3 data set, so 2008 emissions are not included from this source for comparison purposes.
[42] Aviation inventories are available from the 2005 WRAP report, *Alaska Aviation Emissions Inventory Report*, developed by Sierra Research, available at http://www.wrapair.org/forums/ef/inventories/akai/.
[43] Commercial marine inventories are available from the 2005 Pechan report, *Commercial marine inventories for select Alaskan ports : final report*.
[44] The WRAP Phase III fire inventory is available at http://wrapair.org/forums/fejf/tasks/FEJFtask7Phase3-4.html.
[45] Alaska wildland fire data are available from the Alaska Interagency Coordination Center (AICC) Incident support website at http://fire.ak.blm.gov/administration/awfcg_committees.php.

effort, so these current year inventories were not available. Baseline conditions were represented the data that were used to represent baseline emissions in the initial Hawaii implementation plan. For current progress period summaries, alternate inventories were obtained through consultation with Hawaii Department of Health (DOH).

For Hawaii, summaries for the baseline period are represented with a 2005 inventory, and the current progress period is represented with a 2008 inventory. The year 2005 was selected, with EPA approval, as the baseline inventory because it was the most complete inventory available at the time technical work commenced. Categories summarized for Hawaii are listed below:

- Point
- Area
- On-road Mobile
- Off-road Mobile
- Marine
- Fire
- Biogenic
- Volcano
- Sea Spray
- Wind Blown Dust

Data summaries for both 2005 and 2008 presented in this report were obtained from the *Technical Support Document for the Proposed Action on the Federal Implementation Plan for the Regional Haze Program in the State of Hawaii*, developed by EPA Region 9,[46] except for area source SO_2 inventories, which were provided separately by the Hawaii Department of Health, Clean Air Branch (HIDOCAB). The EPA inventories were largely compiled by ENVIRON under direction from DOH. Hawaii DOH further refined the mobile inventories in conjunction with ICF International to incorporate the latest release of the MOVES model.

[46] The May 2012 *Technical Support Document for the Proposed Action on the Federal Implementation Plan for the Regional Haze Program in the State of Hawaii* developed by the EPA Region 9 Air Quality Division is available at www.epa.gov/region9/air/actions/pdf/hi/hi-haze-tsd.pdf.

3.3 THE WRAP TSS

The WRAP Technical Support System (TSS) (http://vista.cira.colostate.edu/tss/) is an online, dynamic tool designed to provide a single portal to technical data and analytical results coordinated by the WRAP. The data, results, and methods displayed on the TSS are intended to support the air quality planning needs of western state and tribes, and were designed to be maintained and updated to support the development of RHR SIPs, progress reports, and other western air quality analysis and management needs. The TSS has recently been updated to support the first RHR progress reports, providing access, visualization, analysis, and retrieval of technical data and regional analytical results that complement the RHR progress analysis provided in this report.

The TSS integrates a number of different information resources and incorporates applicable data sets, analysis results, and documentation under one web-based umbrella. Full documentation, including tutorials and detailed descriptions of TSS tools are available directly from the website. Figure 3.3-1 shows the interactive menu options available from the "Haze Planning" section on the TSS, where each of these selection option interfaces with a variety of summary options. This section briefly describes some of these summary options that have been updated to support the development of RHR progress reports for western states.

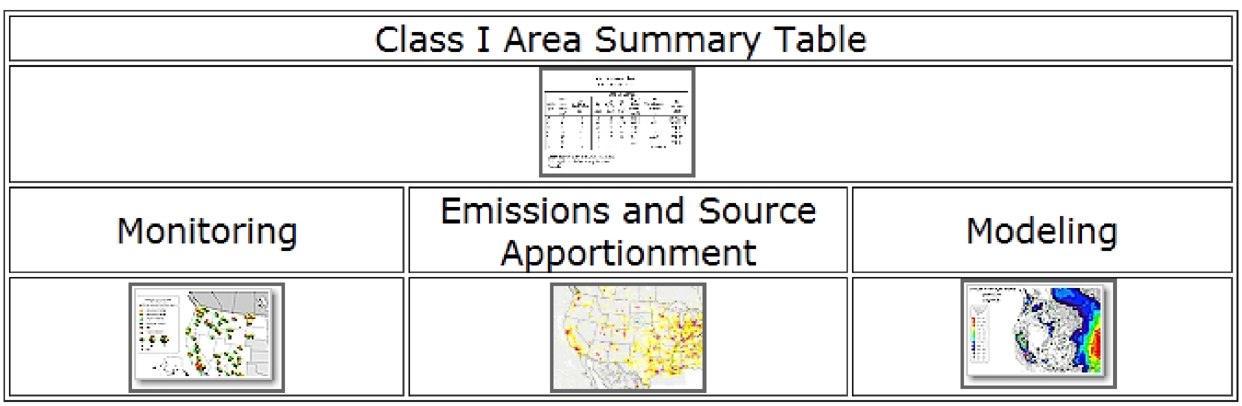


Figure 3.3-1. The WRAP TSS Summary Tools Interface.

3.3.1 Data Updates

IMPROVE data were updated through 2011, using IMPROVE data downloaded from the FED[47] database, and emissions data were updated with county and state level emission from the WestJumpAQMS 2008 inventory.[48] In addition to data updates, some of the averaging conventions were changed on the TSS, which affected some of the data summaries that may have previously been obtained from the TSS for initial SIP development. Specifically, the TSS originally reported data first rounded to 2 decimals, which were then rounded to 1 decimal. In this update, changes were made to round directly from full decimal resolution to 1 decimal.

[47] IMPROVE data are available from the IMPROVE Network through the Federal Land Manager Database online repository (http://views.cira.colostate.edu/fed/)

[48] See Emissions Inventory descriptions in Section 3.2.

While this was a small change, it did have the effect of changing the reported deciview average for the 2000-2004 progress period at a few sites by no more than 0.1 dv, which is much less than the 1 deciview change which is considered perceptible to the human eye. Figure 3.3-1 below presents a list of sites where the 5-year 2000-2004 deciview average has changed since originally published for use in initial SIPs, as reported by the TSS.

Table 3.3-1
Changes in TSS Reported Deciview Averages
2000-2004 Baseline Period

State	Class I area(s)	Site	Group	Deciview Average 2000-2004 Baseline Period		
				Extended Decimal Resolution	Previous Rounding Convention	Current Rounding Convention
AZ	Mount Baldy WA	BALD1	Worst	11.847	11.85→11.9	11.8
	Mazatzal WA Pine Mountain WA	IKBA1	Worst	13.345	13.35→12.5	12.4
CA	Lassen Volcanic NP Thousand Lakes WA Caribou WA	LAVO1	Worst	14.146	14.15→14.2	14.1
	Marble Mountain WA Yolla-Bolly-Middle-Eel WA	TRIN1	Worst	17.349	17.35→17.4	17.3
HI	Haleakala NP	HALE1	Best	4.547	4.55→4.6	4.5
MT	U L Bend WA	ULBE1	Best	4.749	4.75→4.8	4.7
NM	Guadalupe Mountains NP Carlsbad Caverns NP	GUMO1	Best	5.945	5.95→6.0	5.9
UT	Bryce Canyon NP	BRCA1	Worst	11.649	11.65→11.7	11.6
	Arches NP Canyonlands NP	CANY1	Best	3.746	3.75→3.8	3.7

3.3.2 Class I Area Summary Table

The Class I Area Summary Table calculates metrics to support regional haze analysis by species, total light extinction, and deciview, and presents a tabular display of associated values. To support progress reports, a new selection option, "Table Type: Reasonable Progress", was added as the default summary option. Original table summary options developed to support the initial RHR SIPS are available under "Table Type: Baseline to 2018 Projections".

The new Reasonable Progress Table presents monitoring data averages for each measured species extinction value, for total extinction and for deciview extinction. Periods represented include the 2000-2004 baseline period, the 2005-2009 next successive 5-year period, and the 2006-2010 and 2007-2011 rolling period averages. Table 3.2-2 presents an example Table for Rocky Mountain National Park (the ROMO1 IMPROVE monitor) in Colorado.

Table 3.3-1
WRAP Technical Support System Product
Example of a Class I Area Summary Table

Class I Area Summary Table

	Class I Area Visibility Summary: Rocky Mountain NP, CO Class I area **Visibility Conditions:** Worst 20% Days **Reasonable Progress Summary**			
	2000-04 Baseline Conditions (Mm-1)	2005-09 Progress Period (Mm-1)	2006-10 Progress Period (Mm-1)	2007-11 Progress Period (Mm-1)
Sulfate	7.9	7.2	6.4	6.3
Nitrate	5.3	4.0	3.7	3.4
Organic Carbon	10.5	8.9	8.4	8.0
Elemental Carbon	2.6	2.2	2.0	1.8
Fine Soil	1.4	1.5	1.5	1.5
Coarse Material	4.9	3.9	3.8	3.9
Sea Salt	0.0	0.1	0.1	0.1
Total Light Extinction	41.5	36.7	34.8	34.1
Deciview	13.8	12.6	12.0	11.8

3.3.3 Monitoring

For the “Monitoring” summary option, IMPROVE data were updated through 2011, and options were added to represent current 5-year averages. From the “Monitoring” options, two types of plots are available; “Time Series” plots and “Glide Slope” plots. For the “Time Series” plots, 5-year periods were added to the “averaging” option. The tool enables a comparison of either the 2000-2004 baseline period and the 2005-2009 most recent successive 5-year period, or the 2000-2004 period and the most recently available 2007-2011 5-year period. Options are available to display deciview averages, or any combination of species extinction and mass. Figure 3.3-2 presents an example display of 5-year period averages for the Rocky Mountain National Park ROMO1 site. The “Show Data” link below the display provides the data shown in the display in a table (this functionality is available on all TSS tools).

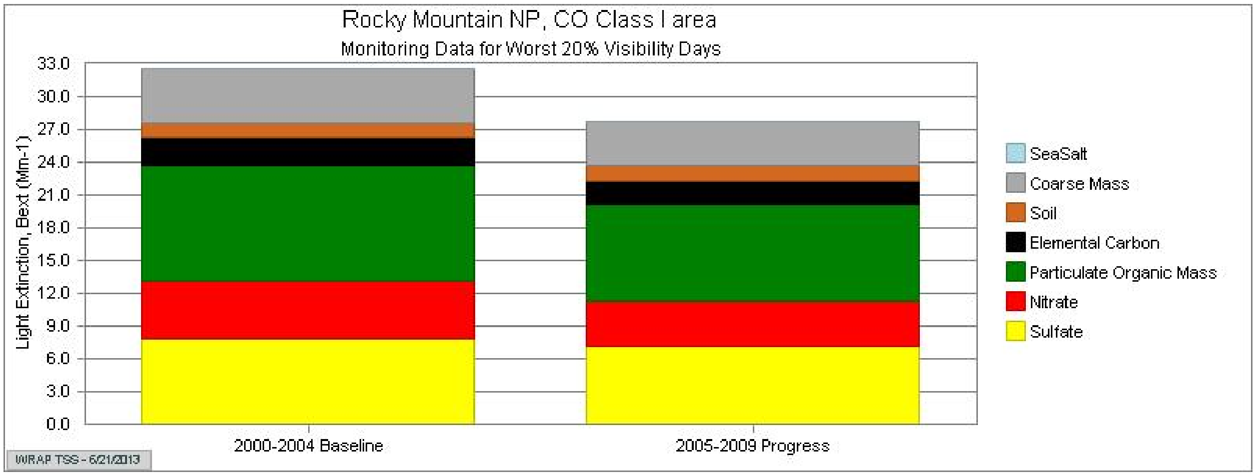


Figure 3.3-2. Example TSS Comparison of 2000-2004 and 2005-2009 period averages for Rocky Mountain National Park in CO.

For the "Glide Slope" plots, options were added to display 5-year period averages for both "successive" and "rolling" period average. As noted in Section 2.0, EPA's September 2003 guidance specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, et cetera,[49] but EPA's more recent guidance principals, released in April 2013, suggest that progress be tracked using rolling 5-year period averages. This support document assessed change using the successive periods, but rolling period averages have been made available through the TSS. Options are available to display either successive or rolling averages, with or without 2064 Natural Conditions estimates, for deciview averages and any combination of species extinction. Figure 3.3-3 presents an example of successive 5-year period averages, plotted along with annual averages, for the Rocky Mountain National Park ROMO1 site, and Figure 3.3-4 presents an example of rolling period averages.

[49] See page 4-2 in EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.* (http://www.epa.gov/ttnamti1/files/ambient/visible/tracking.pdf)

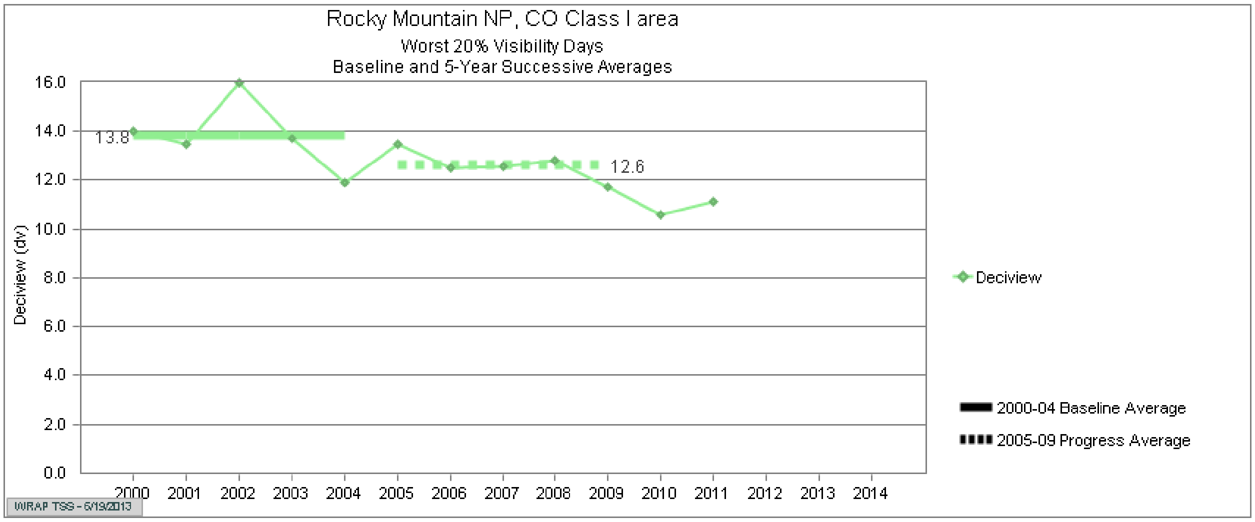


Figure 3.3-3. Example TSS Plot of 5-Year Successive Averages, Showing the 2000-2004 Baseline Average and 2005-2009 Period Averages for Rocky Mountain National Park in CO.

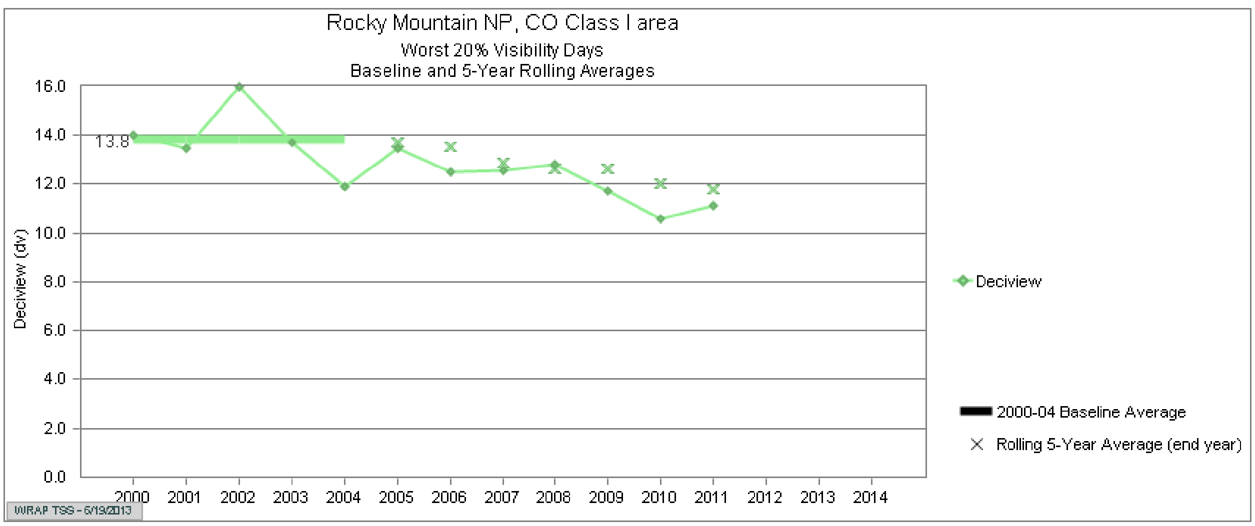


Figure 3.3-4. Example TSS Plot of 5-Year Rolling Averages, Showing the 2000-2004 Baseline Average and Rolling Averages Beginning With 2001-2005 through 2007-2011, for Rocky Mountain National Park in CO.

3.3.4 Emissions Summary Tools

For the "Emissions" summary option, the WestJumpAQMS 2008 emissions dataset was added. For display purposes, source categories were aligned with those used in the baseline planning period and display options were added for the 2008 data, including side-by-side comparisons of 2008 and 2002 data under the "Emissions Review Tool" link. Only state level summaries have been presented in this report, but county level summaries are available through the TSS. Figure 3.3-5 presents an example of a side-by-side comparison of 2002 and 2008 emissions for counties in Arizona. Note that these summaries are not available from the TSS for Alaska and Hawaii.

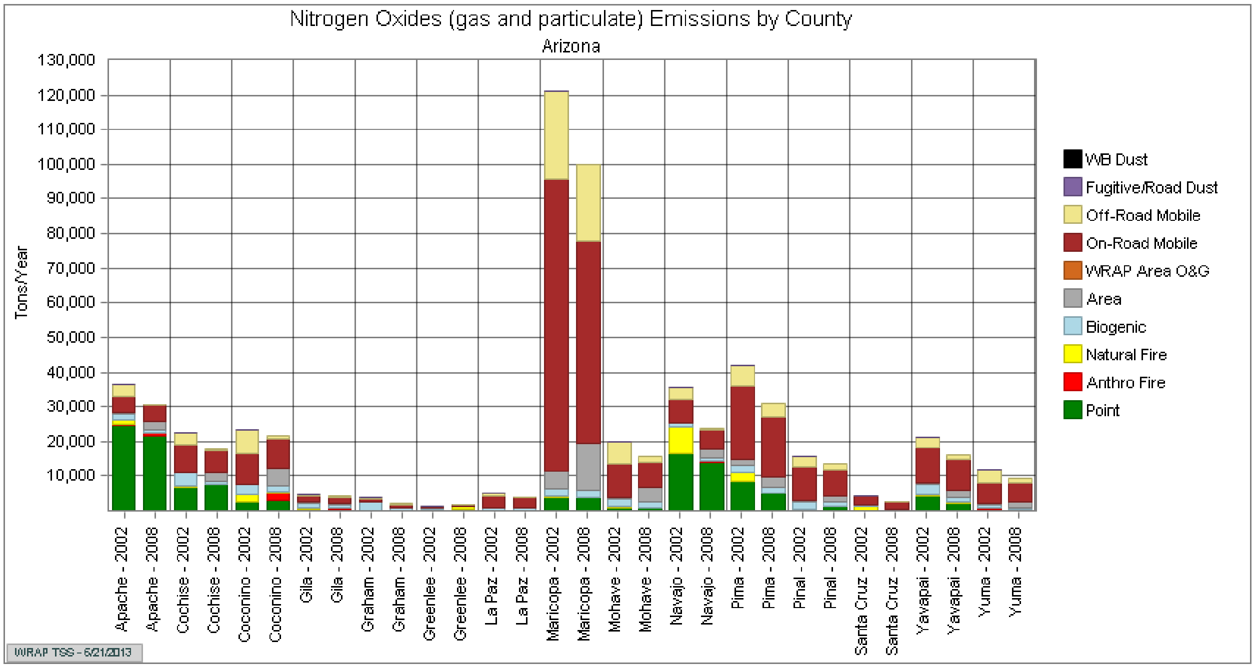


Figure 3.3-4. Example TSS Plot Showing Side-by-Side Comparisons of 2002 and 2008 Emission Inventories for Counties in Arizona.

4.0 WRAP REGIONAL SUMMARIES

As described in Section 2.0, each state is required to submit a report evaluating progress toward the reasonable progress goal, pursuant to Regional Haze Rule (RHR) 40 CFR 51.308(g). Because haze is a regional issue, summaries of monitoring and emissions data are presented here on a regional scale. These summaries are intended to support the individual State and Class I area data summaries which are presented in Section 6.0. Some general observations from these regional summaries are listed below, and described in more detail in the following sections.

- The 5-year deciview metric for the worst days decreased between the 2000-2004 baseline period and the 2005-2009 progress period at most sites, but increased at several sites. Particulate organic mass concentration was the largest contributing factor to increases in the 5-year deciview metric. The increases in particulate organic mass measurements were correlated with regions where large wildfire events occurred during the 2005-2009 progress period.
- The 5-year deciview metric for the best days decreased between the 2000-2004 baseline period and the 2005-2009 progress period did not get worse, and actually improved, at all but a few sites in Washington, Oregon, and Alaska, where small increases were measured.
- For ammonium nitrate, decreases in the 5-year average for the worst days, and decreasing annual trends, were measured at nearly all sites, with the largest decreases in northern Oregon and southern California. Emissions inventories indicate that oxides of nitrogen (NO_X) are mostly due to on-road mobile, off-road mobile, and point source emissions. Decreasing ammonium nitrate measurements were consistent with comparisons between baseline and progress period inventories, and tracking of annual averages electric generating units (EGU) emissions, which showed decreasing inventory totals for NO_X in most Western Regional Air Partnership (WRAP) states.
- A number of sites measured increases in 5-year average ammonium sulfate for the worst days, but most sites showed decreasing ammonium sulfate trends. For the 5-year average, most sites, including all sites in Utah, Colorado, Arizona, and New Mexico, were affected by anomalously high ammonium sulfate annual averages in 2005. Emissions inventories indicate that sulfur dioxide (SO_2) emissions in the western states are dominated by point sources, and comparisons between baseline and progress period inventories, and tracking of annual averages EGU emissions, show decreasing SO_2 emissions for most WRAP states.
- While most sites measured decreasing ammonium sulfate trends, increasing trends were measured in Alaska and Hawaii, at a few coastal sites in northwestern California and southwestern Oregon, and at a few sites along the Canadian border in northeastern Montana and northwestern North Dakota. Emissions inventories show that increases in Hawaii are largely due to volcanic emissions of SO_2. Increases at other WRAP sites do not appear to be reflected in the emissions inventory totals. The increases at the coastal sites may be affected by offshore emissions, which are not presented here on a state level. Increases along the Canadian border may be due to international emissions.

- For fine soil and coarse mass, measured concentrations were highest in the southern WRAP region. Soil and coarse mass extinction trends were variable and not statistically significant in most cases, but an area represented by several Interagency Monitoring of Protected Visual Environments (IMPROVE) sites in eastern Arizona and western New Mexico did show increasing coarse mass trends. Emission inventories indicated that natural windblown dust is the largest contributor to coarse mass measurements in this area, but significant changes in the development of the windblown dust inventories did not allow for definitive comparisons between 2002 and 2008 inventories for these emissions.

4.1 MONITORING DATA

The goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve, and that visibility on the 20% least impaired, or best, days does not get worse, as measured in units of deciviews (dv) calculated from data measured at IMPROVE monitoring sites. For purposes here, progress is measured in 5-year average increments beginning with the 2000-2004 baseline average, and proceeding with each subsequent 5-year average (e.g. 2005-2009, 2010-2014, etc.).[50] This section addresses changes as measured between the baseline period and the most recent successive progress period available, or the 2005-2009 first progress period.

Figures 4.1-1 and 4.1-2 present the difference between the 2000-2004 average baseline period and the 2005-2009 first progress period in deciviews for the 20% worst and 20% best days, respectively, for Federal Class I area (CIA) IMPROVE sites in the WRAP region. The maps indicate that 5-year average extinction on the 20% worst days decreased at most sites, but showed some increases at several sites. The map for the 20% best days indicates that best days did not get worse, and actually improved, at all but a few sites in Washington, Oregon, and Alaska, where increases were small (~0.1 dv).

[50] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (see page 4-2 in the Guidance document).

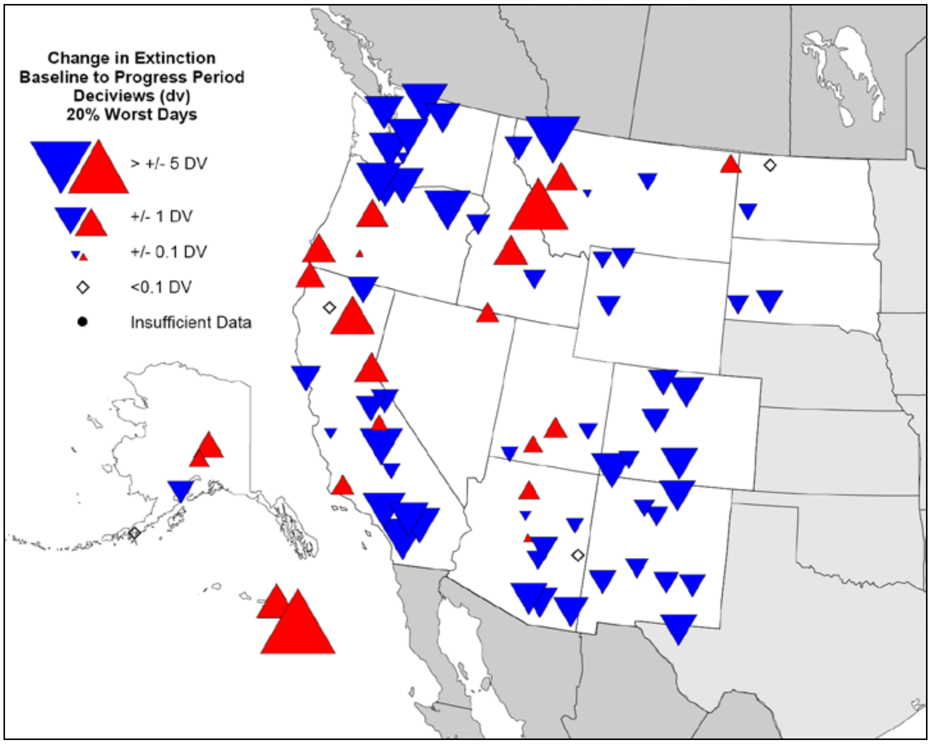


Figure 4.1-1. Change in Deciview Extinction between Baseline Period Average (2000-2004) and the First Progress Period Average (2005-2009) for the 20% Worst Visibility Days.

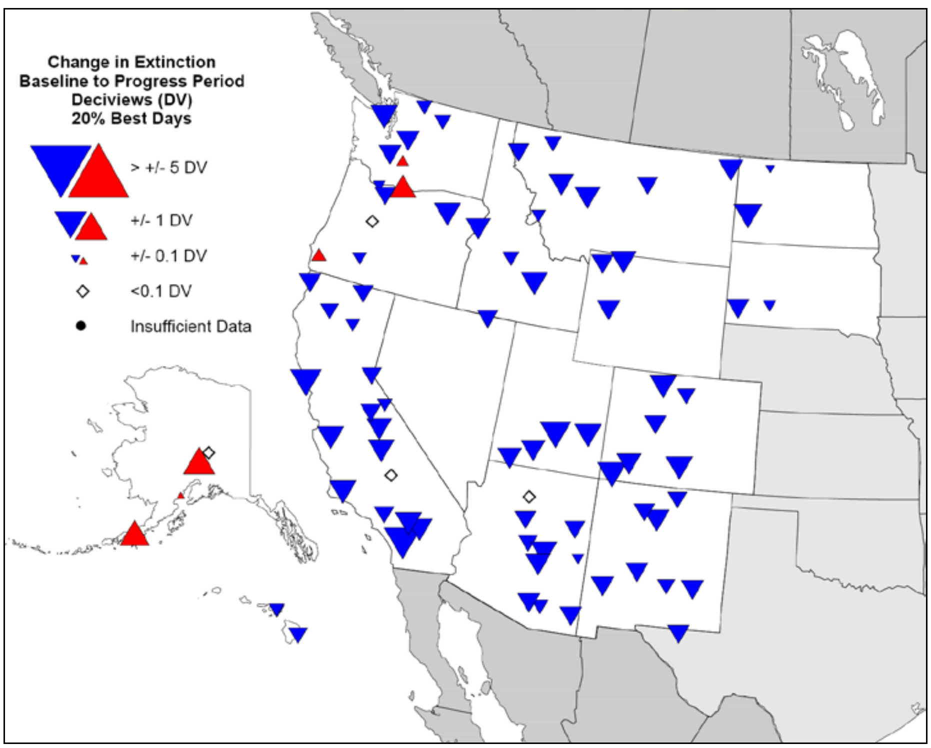


Figure 4.1-2. Change in Deciview Extinction between Baseline Period Average (2000-2004) and the First Progress Period Average (2005-2009) for the 20% Best Visibility Days.

The RHR haze index, as defined using deciview units, does not provide information regarding the relative contributions of specific pollutants to overall visibility impairment. As described in Section 3.1, calculation of visibility impairment is based on the cumulative impacts of several different species measured as measured at IMPROVE Network sites. Analyzing the behavior of each individual species has important implications for control measures, as some species originate from largely anthropogenic sources, while others may originate from a mixture of both anthropogenic and natural sources.

Figures 4.1-3 and 4.1-4 present regional maps of average aerosol extinction for the most impaired days during baseline period (2000-2004), and the first progress period average (2005-2009), respectively, for the IMPROVE monitors representing Federal CIAs in the WRAP region. The size of the pie chart is related to the magnitude of visibility impairment, and colors represent the relative contribution of the pollutants measured by the IMPROVE Network.

The maps indicate that particulate organic matter, which is often related to wildfire activity, is a large factor in visibility reduction in the west. Visibility impairment in western CIAs that are directly adjacent to more populated areas in the West is influenced more by ammonium nitrate, which is commonly associated with combustion activities, especially vehicles and industrial activities. Ammonium sulfate represents most of the visibility impairment at the Hawaii sites, and up to one third of the impairment in the contiguous United States. The largest contributor to ammonium sulfate concentrations in the contiguous United States and Alaska is generally industrial activities such as coal burning power plants, while natural volcanic activity contributes to the high measured ammonium sulfate at Hawaii sites.

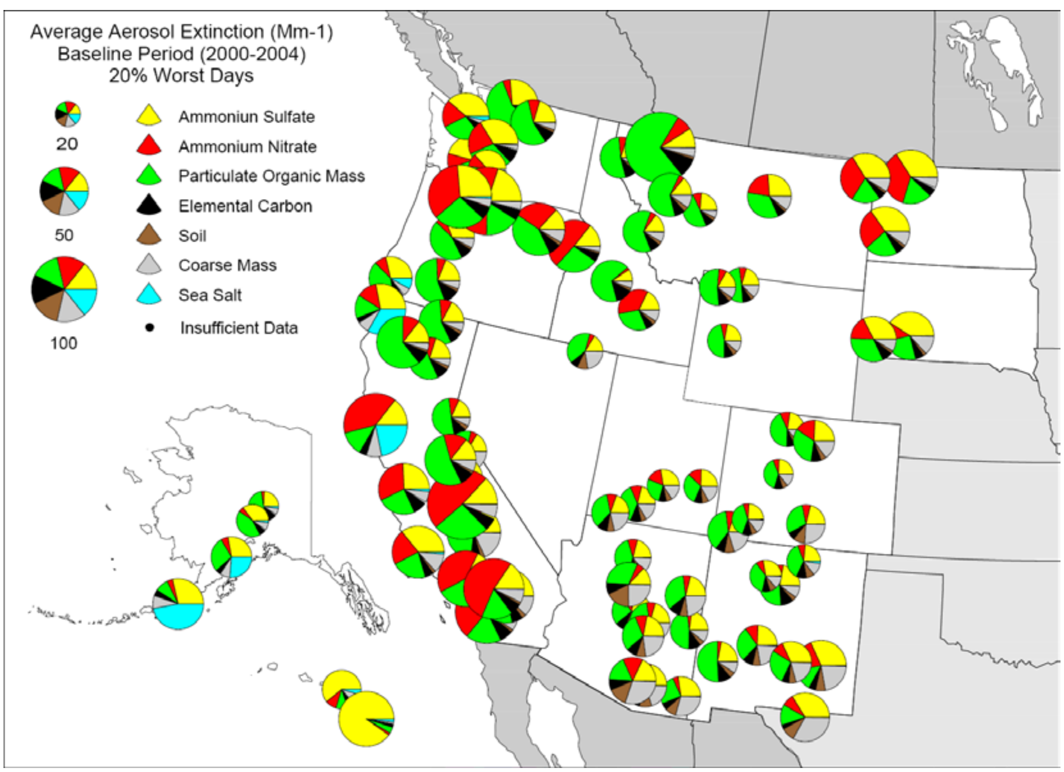


Figure 4.1-3. Regional Average of Aerosol Extinction by Pollutant for Baseline Period Average (2000-2004) for 20% Worst Days.

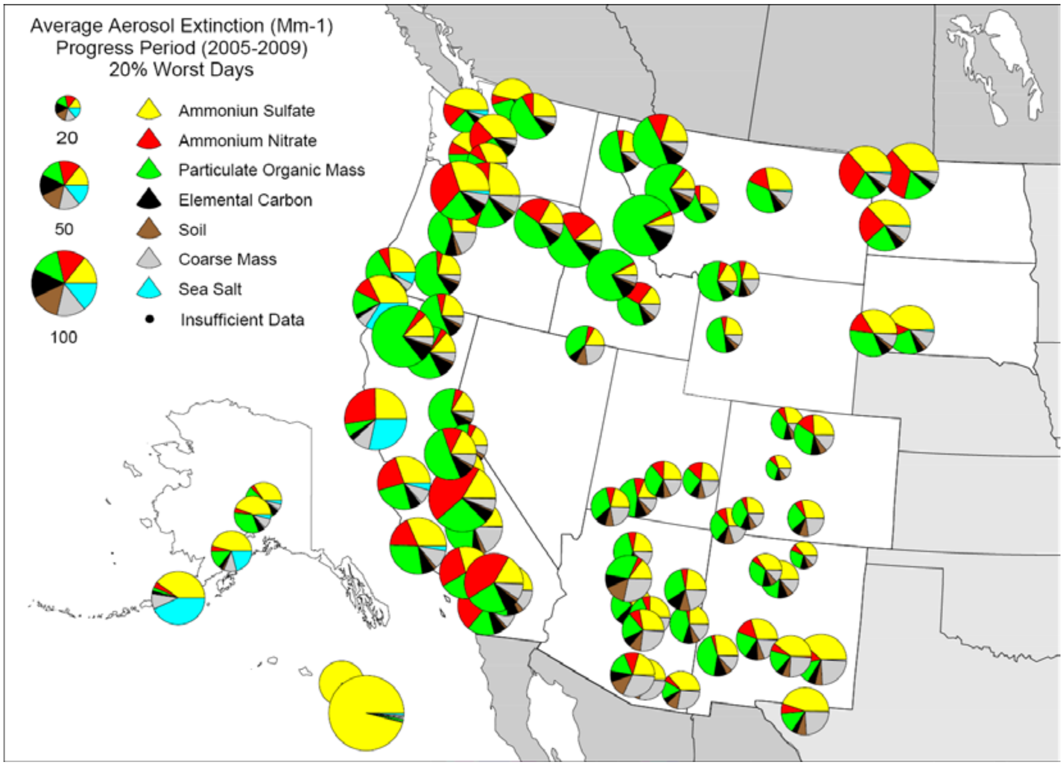


Figure 4.1-4. Regional Average of Aerosol Extinction by Pollutant for the First Progress Period Average (2005-2009) for 20% Worst Days.

The changes in deciview between the 2000-2004 baseline and 2005-2009 progress period averages, as depicted in Figure 4.1-1, is the combined effect of increases in some species and decreases in other species. To identify individual species behavior, the increasing and decreasing species are presented separately in Figures 4.1-5 and 4.1-6. Figure 4.1-5 presents the individual species of haze that have decreased between the 2000-2004 baseline period and the 2005-2009 progress period, where sites with corresponding decreases in deciview measurements are highlighted with blue circles. Figure 4.1-6 presents the individual species of haze that have increased, with corresponding deciview increases highlighted with purple circles.

As depicted in Figure 4.1-5, most of the decreases in deciviews averages values were associated with decreasing ammonium nitrate and particulate organic mass. Decreases in California, eastern Oregon, and Idaho were largely due to ammonium nitrate reductions, while decreases in northern Washington and Montana, Colorado, New Mexico, and Arizona were largely due to decreasing particulate organic mass. Some ammonium sulfate reductions were also measured in western Washington and northwestern Oregon. As depicted in Figure 4.1-6, most of the increases in deciview values were associated with increasing particulate organic mass in California, Idaho, Montana, and Utah. Ammonium sulfate increases also occurred in Alaska, Hawaii, and at a few of the sites in the contiguous states.

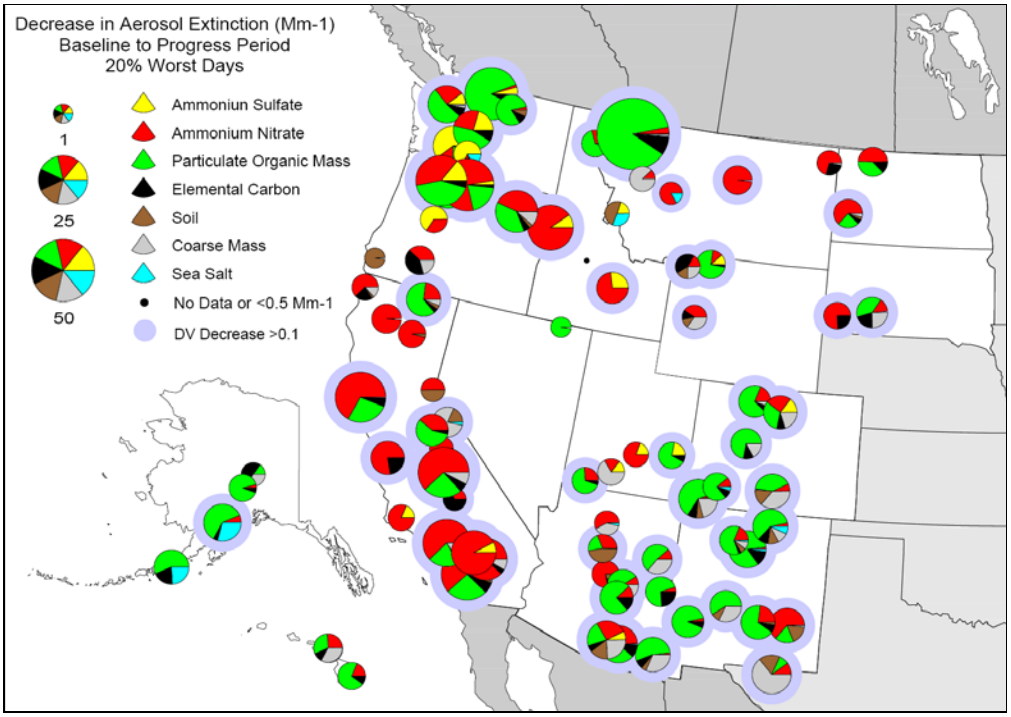


Figure 4.1-5. Magnitude of Aerosol Extinction Species That Have Decreased Between the Baseline Average (2000-2004) and the First Progress Period Average (2005-2009) for the 20% Worst Days.

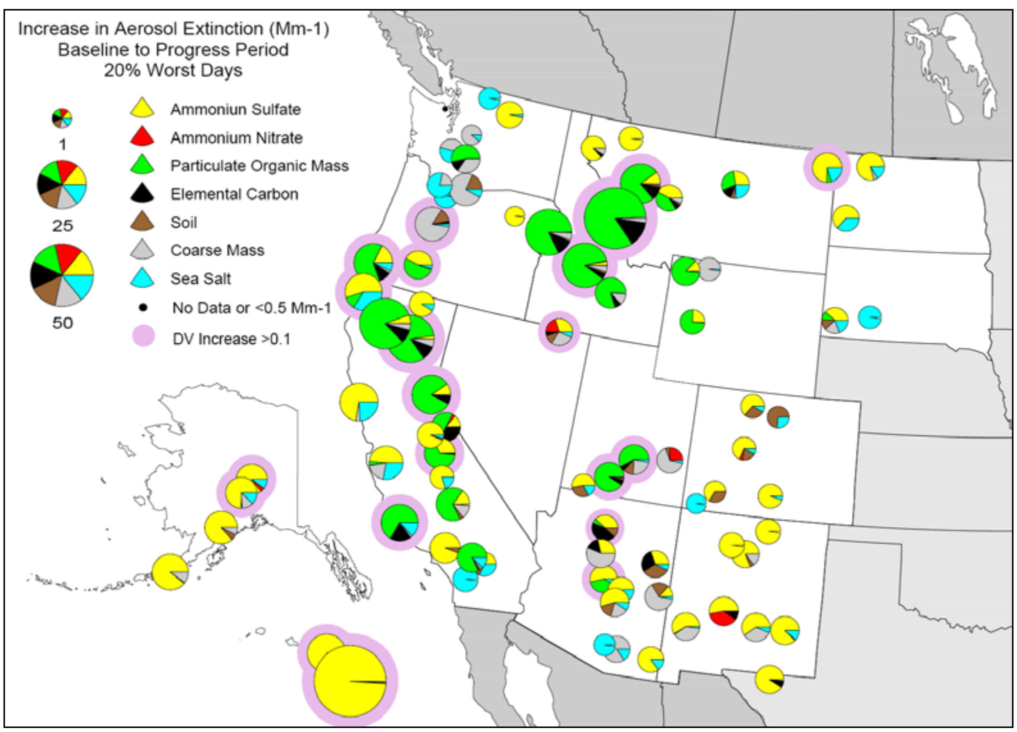


Figure 4.1-6. Magnitude of Aerosol Extinction Species That Have Increased Between the Baseline Average (2000-2004) and the First Progress Period Average (2005-2009) for the 20% Worst Days.

4.1.1 Annual Trends

In addition to looking at the 5-year averages deciview metric that is specified in regulatory text, it is useful to examine annual trends for each particle species. In the long term, annual trend statistics are useful in analyzing changes in air quality data because these statistics can show the overall tendency of measurements over long periods of time, while minimizing the effects of year-to-year fluctuations which are common in air quality data.

Annual trends were calculated for the years 2000-2009, with a trend defined as the slope derived using Theil statistics, which is a nonparametric regression technique that is commonly applied to environmental data to determine statistically significant trends.[51] The significance of the trend is represented with p-values calculated using Mann-Kendall trend statistics. Determining a significance level helps to distinguish random variability in data from a real tendency to increase or decrease over time, where lower p-values indicate higher confidence levels in the computed slopes. Regional trends are presented here for aerosol species trends with p-value statistics less than 0.15 (85% confidence level). Trends for all significance levels at all sites are also included in state specific appendices provided with this report.

Figures 4.1-7 presents trends in ammonium sulfate measurements for the period 2000-2009 for the 20% most impaired or worst days at each IMPROVE Federal CIA site that had at least five years of complete data, and Figure 4.1-7 presents trends for all sampled days. Figures 4.1-9 through 4.1-20 present similar maps of ammonium nitrate, particulate organic mass, elemental carbon, soil, coarse mass, and sea salt trends. At the time this report was prepared, data were available through 2010,[52] but trends presented here include only data collected between 2000-2009 to better reflect the changes between the 2000-2004 baseline and 2005-2009 progress periods.

The RHR haze index specifically refers to the 20% most impaired and least impaired days, but trends are also presented here for the annual average of all sampled days. The 20% most impaired and least impaired days can represent different times of the year, especially when large events such as wildfires influence the worst day identification.[53] Because the annual average represents the entire year, these averages may better represent overall aerosol species trends than trends for just the 20% worst days. Consistency between worst day and all day trends adds confidence to the characterization of the trend, and differences may suggest a seasonality affect. Specific trend observations by species are listed below:

- Figures 4.1-7 and 4.1-8 indicate decreasing ammonium sulfate trends for most sites, but increasing trends were measured in Alaska and Hawaii, at a few coastal sites in northwestern California and southwestern Oregon, and at a few sites along the Canadian border in northeastern Montana and northwestern North Dakota.

[51]Theil statistics are also used in EPA's National Air EPA's National Air Quality Trends Reports (http://www.epa.gov/airtrends/) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)
[52] The 2010 IMPROVE data were not included in trend analysis, but 2010 annual averages are included for reference in states specific appendices.
[53] Seasonality effects of the identification of worst days are discussed further in Section 3.1.2.1.

- Figures 4.1-9 and 4.1-10 indicate decreasing ammonium nitrate trends at nearly all sites. Slightly increasing trends were measured at the DENA1 site in Alaska.
- Figures 4.1-11 and 4.1-12 indicate that most particulate organic mass trends are either decreasing or insignificant.
- Figures 4.1-13 and 4.1-14 indicate that elemental carbon is also generally trending down.
- Figures 4.1-15 and 4.1-16 indicate that trends in soil are mostly insignificant.
- Figures 4.1-17 and 4.1-18 indicate that trends for coarse mass were mostly decreasing, but increasing trends were apparent for a region in eastern Arizona and western New Mexico.
- Figures 4.1-19 and 4.1-20 indicate that sea salt trends are mostly insignificant, with the largest significantly increasing trends measured on the pacific coast for the worst days.

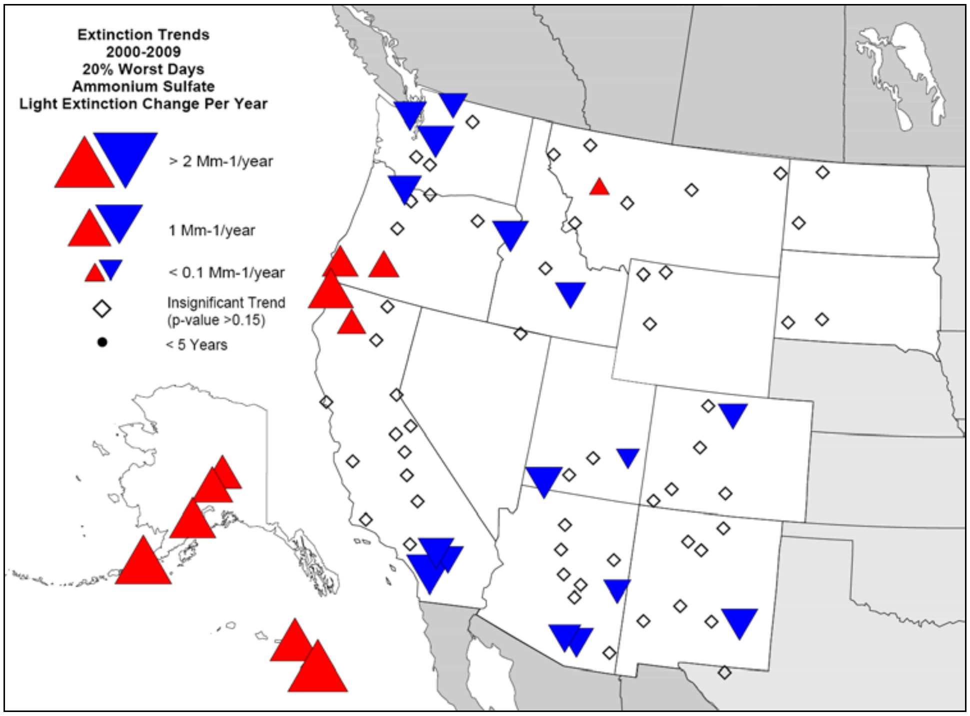


Figure 4.1-7. 10-Year Annual Average Ammonium Sulfate Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

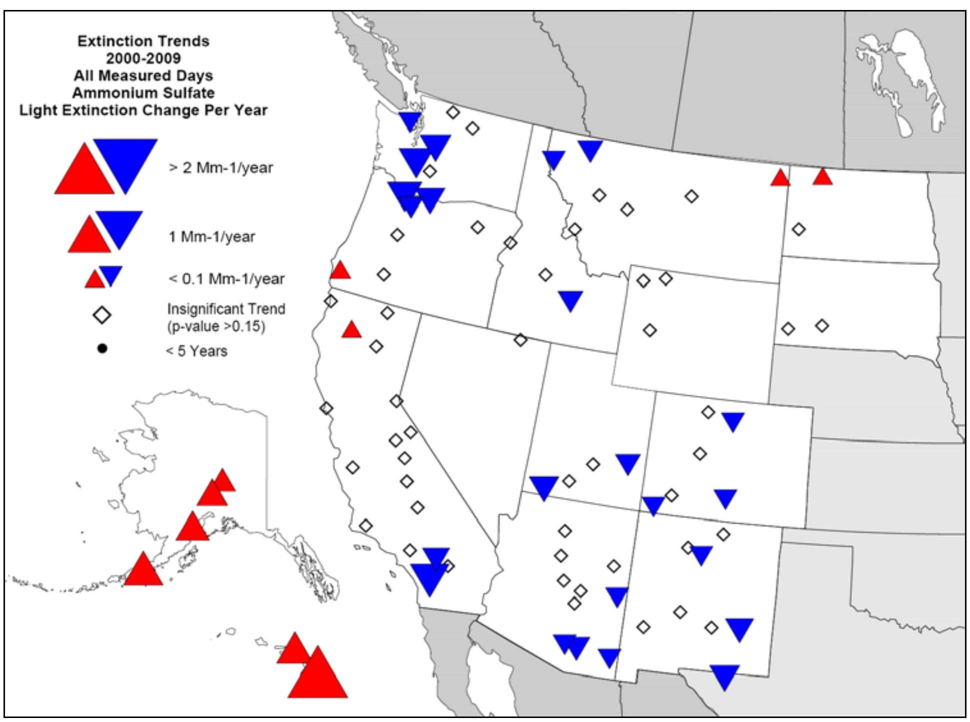


Figure 4.1-8. 10-Year Annual Average Ammonium Sulfate Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

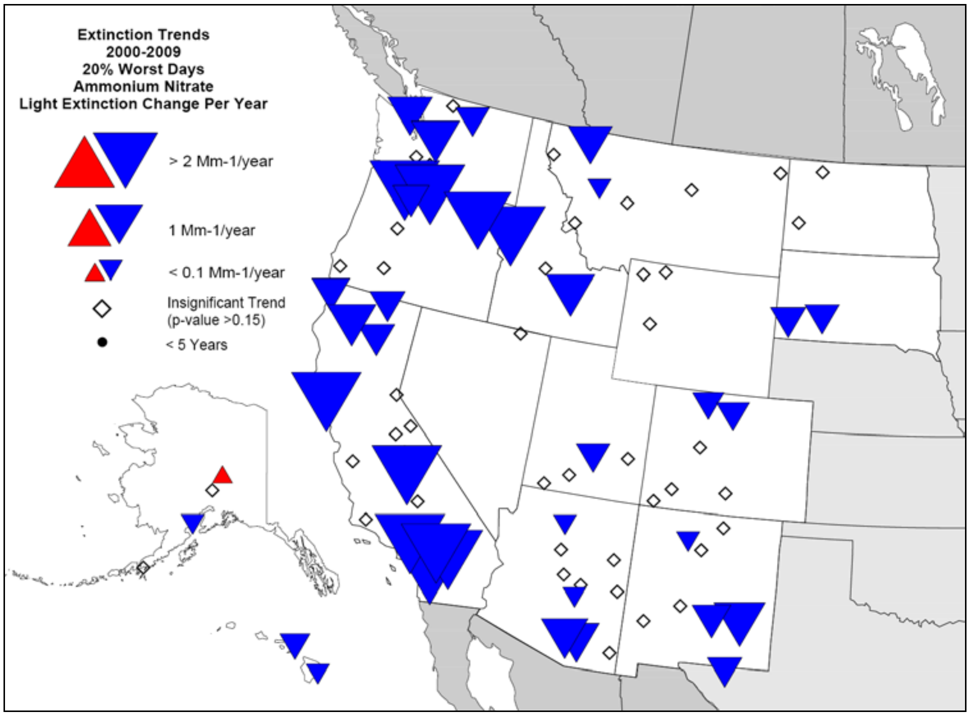


Figure 4.1-9. 10-Year Annual Average Ammonium Nitrate Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

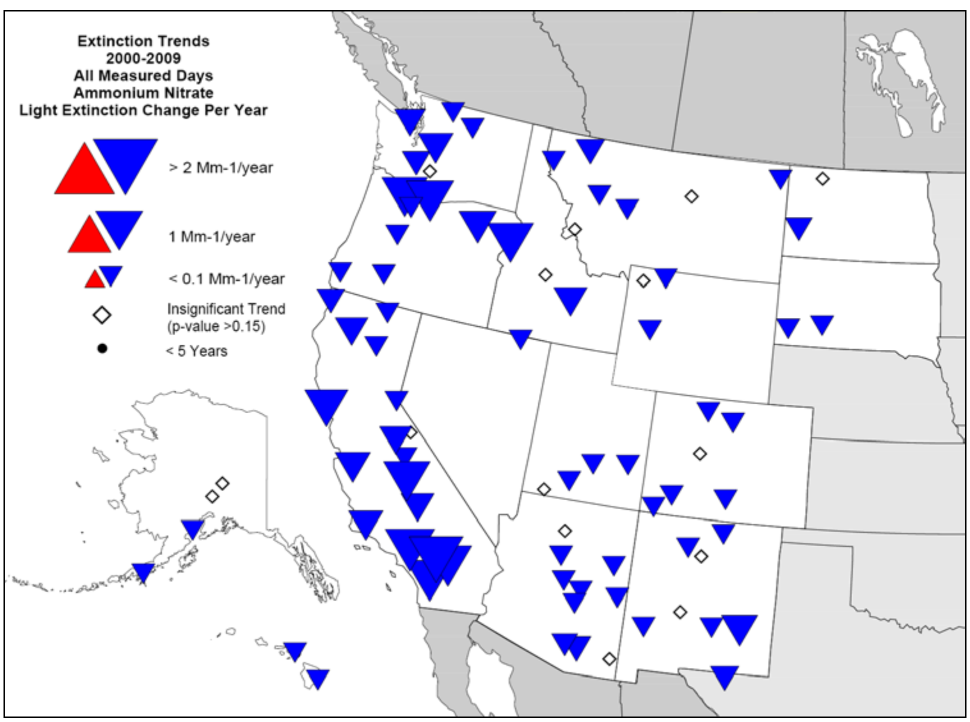


Figure 4.1-10. 10-Year Annual Average Ammonium Nitrate Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

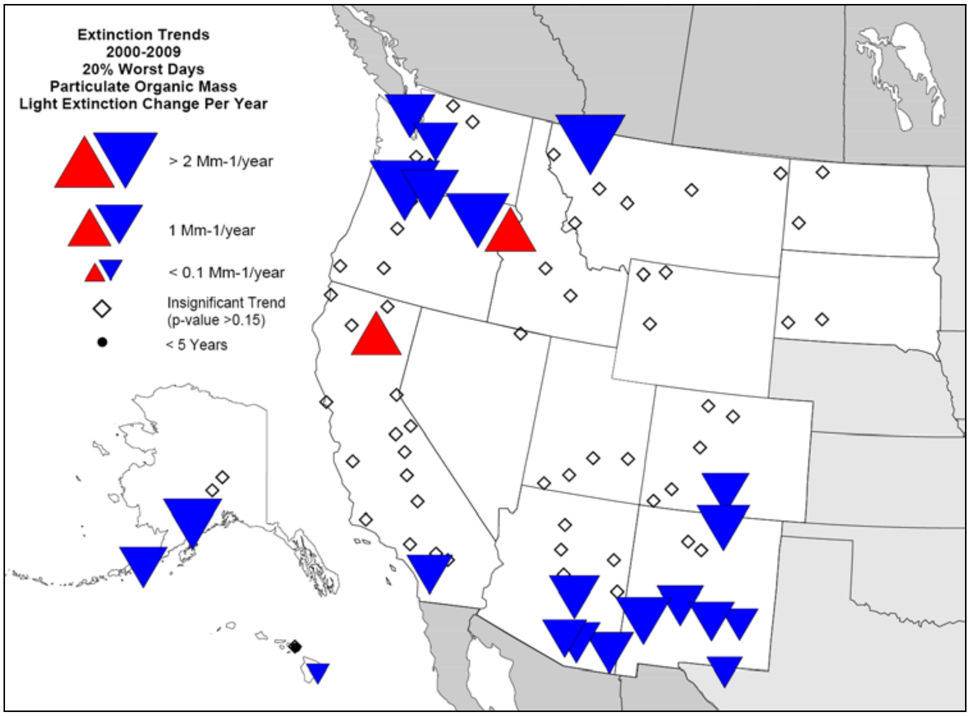


Figure 4.1-11. 10-Year Annual Average Particulate Organic Matter Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

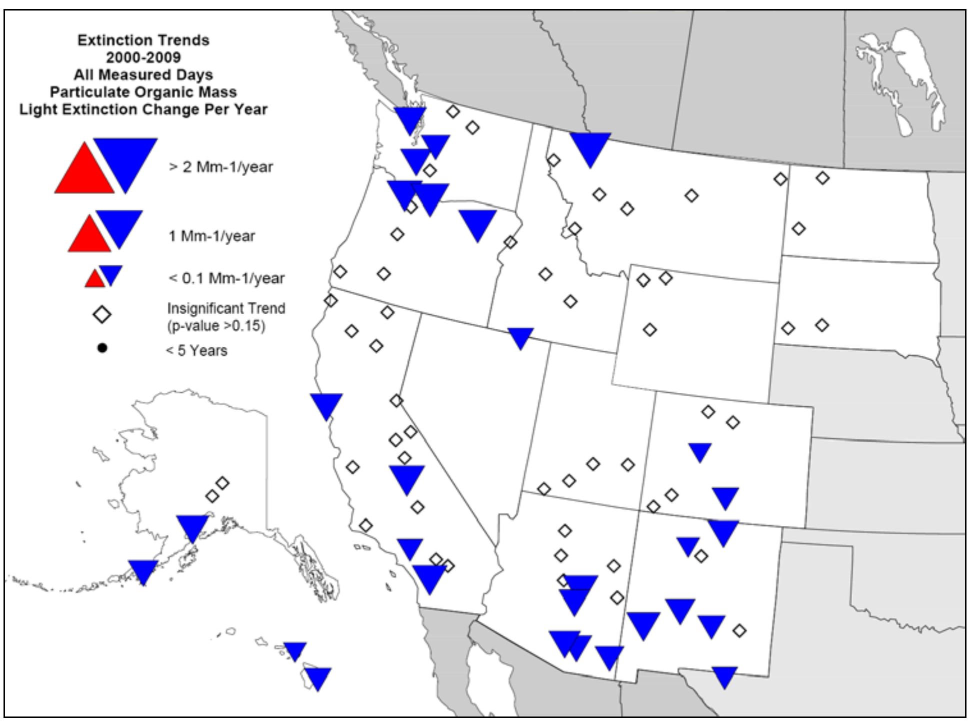


Figure 4.1-12. 10-Year Annual Average Particulate Organic Matter Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

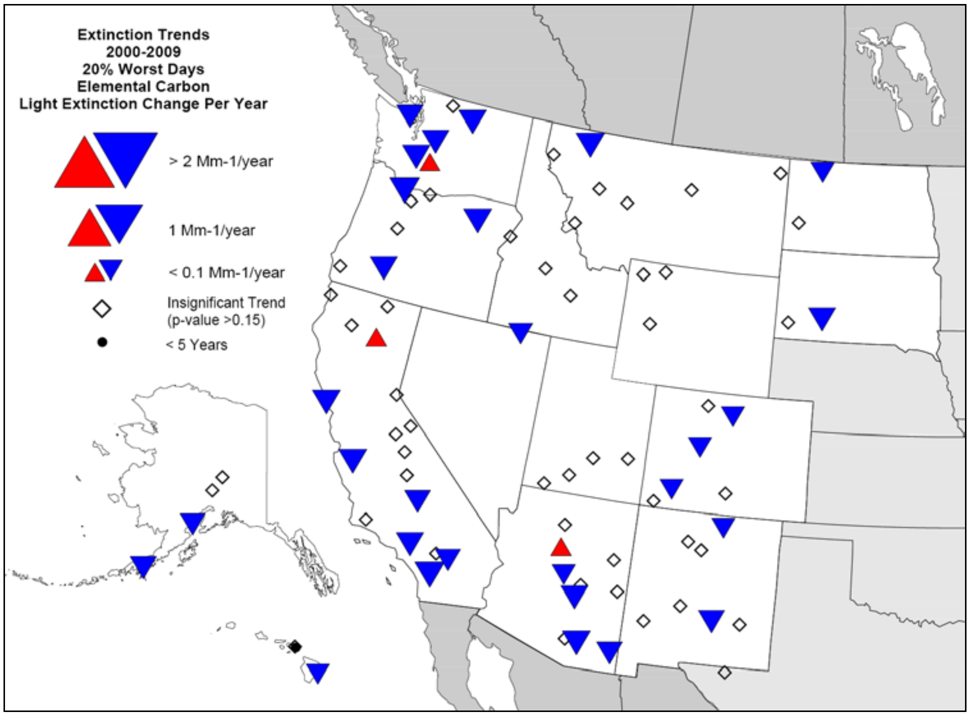


Figure 4.1-13. 10-Year Annual Average Light Absorbing Carbon Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

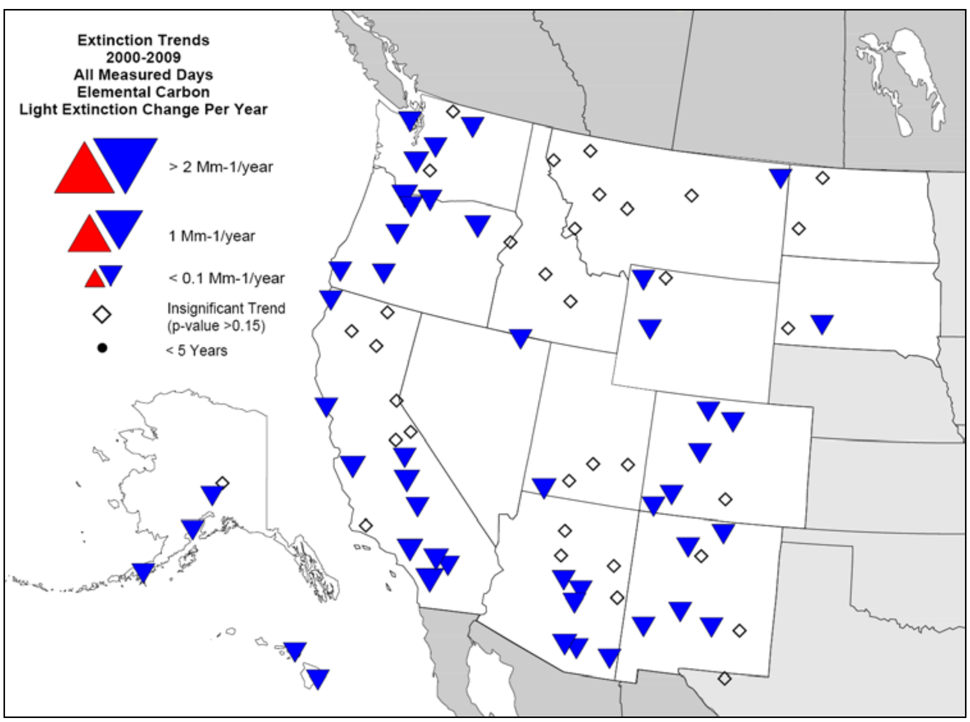


Figure 4.1-14. 10-Year Annual Average Light Absorbing Carbon Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

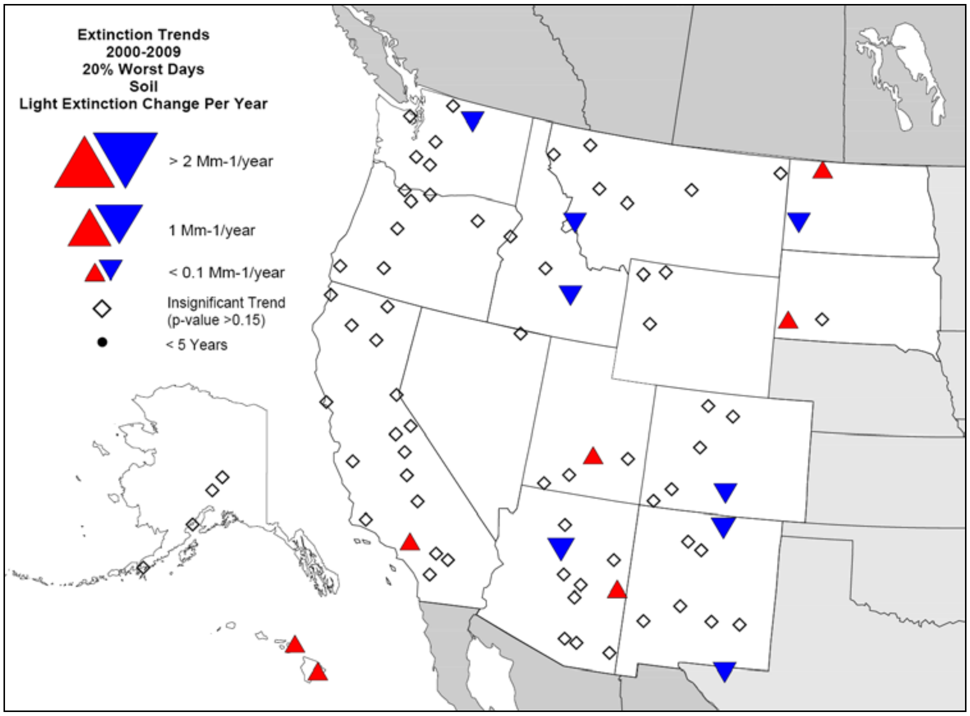


Figure 4.1-15. 10-Year Annual Average Soil Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

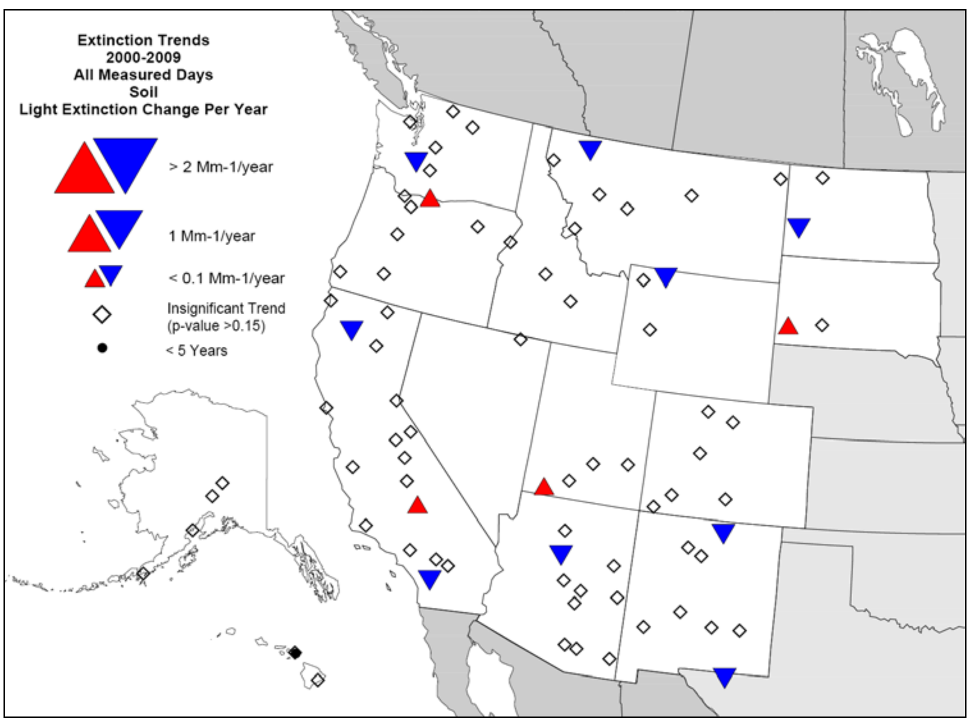


Figure 4.1-16. 10-Year Annual Average Soil Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

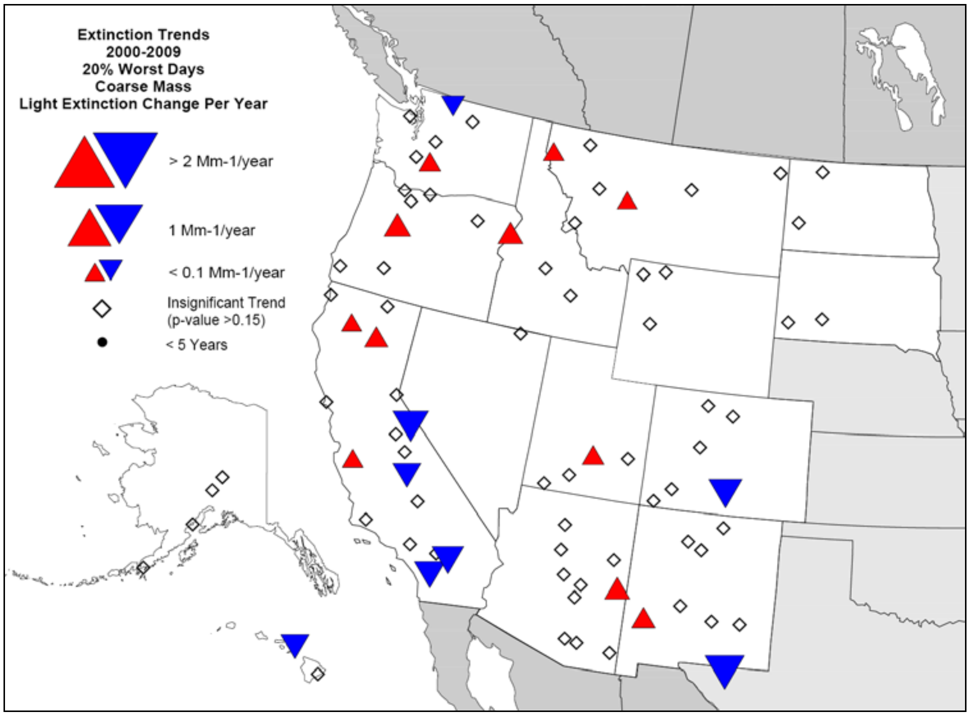


Figure 4.1-17. 10-Year Annual Average Coarse Mass Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

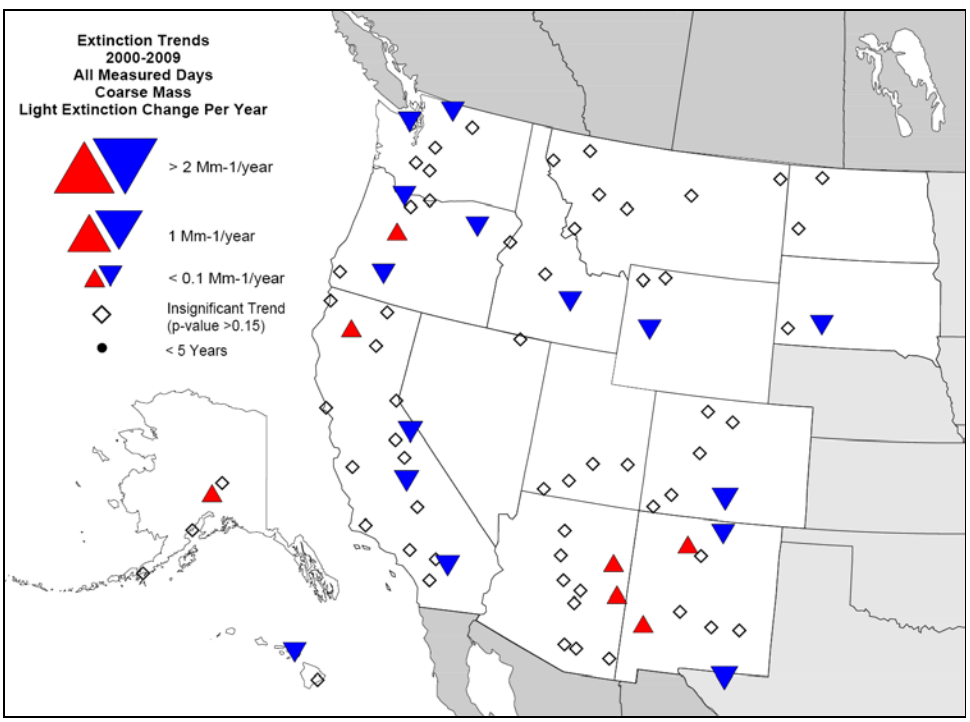


Figure 4.1-18. 10-Year Annual Average Coarse Mass Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

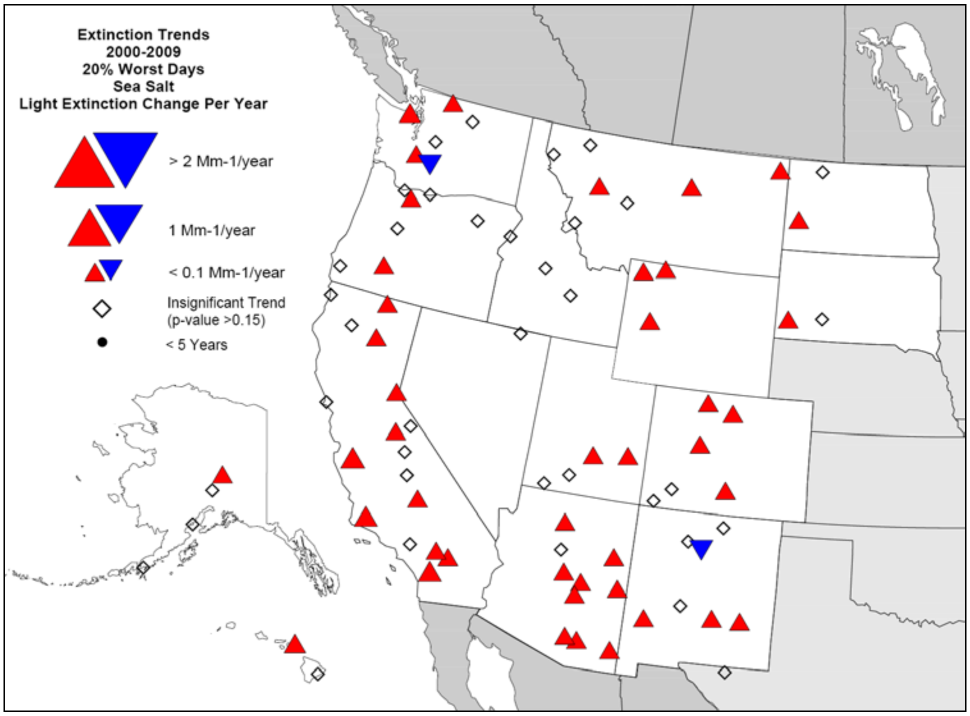


Figure 4.1-19. 10-Year Annual Average Sea Salt Extinction Trends for 20% Worst Days at CIA IMPROVE Sites in the WRAP Region.

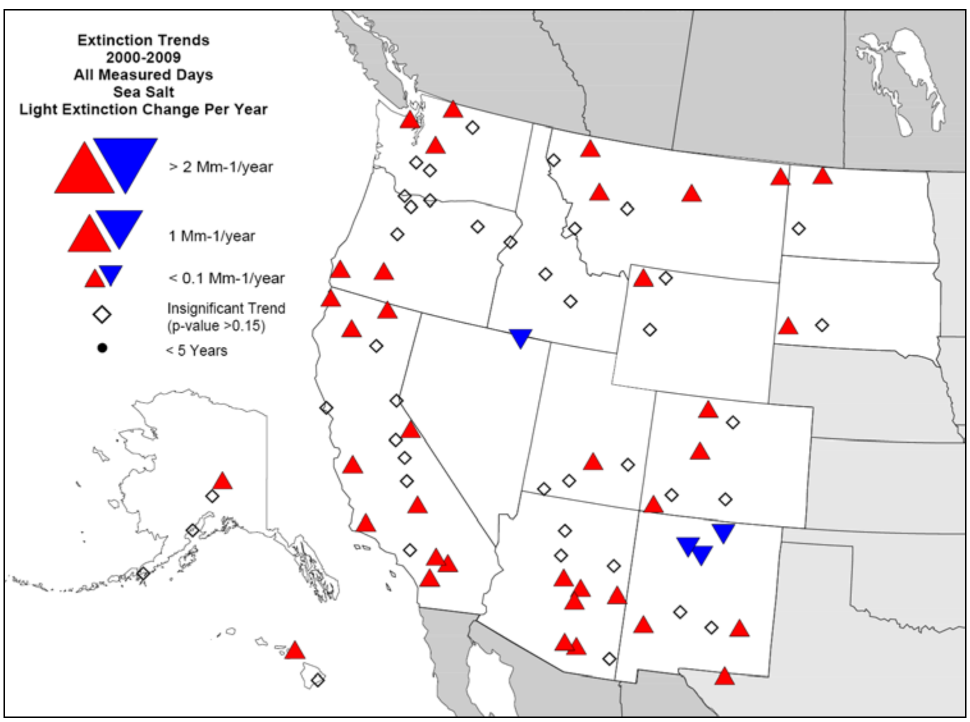


Figure 4.1-20. 10-Year Annual Average Sea Salt Extinction Trends for All Measured Days at CIA IMPROVE Sites in the WRAP Region.

4.1.2 Regional Events

The previous section presented aerosol trends, which are useful in analyzing changes in air quality data over long periods of time, but minimize the effects of large events that can affect the 5-year average metrics. Large regional episodic events can include windstorms which can transport dust from some of the desert regions in the WRAP, and even from intercontinental dust sources, as documented for several cases of Asian and African dust impacts on the United States. Other examples of large episodic regional events can include wildfires, which impact most of the western states, and volcanic emissions, which have large impacts in Hawaii. This section includes some examples showing the impact of large regional events on specific aerosol species as measured during the 2005-2009 progress period. Some effects of large events on the 5-year RHR haze indexes are discussed in for each WRAP state in Section 6.0.

Figure 4.1-21 presents an example of particulate organic mass measurements on August 4, 2007. High measurements spanned most of the state of Montana, and also some sites in Idaho, North Dakota, and Wyoming. Figure 4.1-22 presents a map from the WRAP Fire Emissions Tracking System (FETS) online tool,[54] showing fire detections between August 2 and 4, which indicates that there were a number of detections western Montana and Idaho. Largest fires in the area at the time included a fire in the Salish Mountains north of Hot Springs in Montana that began on July 31, and the Chippy Creek Fire which burned almost 100,000 acres in northwest Montana.

Figure 4.1-23 presents an example of particulate organic mass measurements on June 26, 2008, where high measurements spanned most of the state of California. Figure 4.1-24 presents a map from the WRAP FETS online tool showing fire detections on June 26, with numerous detections all along the Cascades, many of which were attributed to lightning strikes in the region.

Figures 4.1-25 and 4.1-26 present fine soil and coarse mass, respectively, as measured on May 15, 2005. For this event, high measurements spanned most of the west coast, which is consistent with what might be expected for international transport of dust from Asia. Further analysis of the chemical composition of the measured fine soil, including correlation with manganese (Mg) levels, would help elucidate whether this was an actual Asian Dust event. Figures 4.1-27 and 4.1-28 present fine soil and coarse mass as measured on June 29, 2008, representing a more typical dust event in the west, with high measurements spanning most of Arizona.

Figure 4.1-29 presents an abnormally high sea salt event that was measured on December 14, 2008 at several sites across the northern Great Plains, including sites in Montana, Wyoming, the Dakotas, and neighboring states as far south as Kansas. This event was discussed at the 2009 IMPROVE Steering Committee meeting, where it was noted that airmass characteristics and back-trajectories pointed to the Canadian arctic as the likely source of the material observed.[55]

[54] The WRAP FETS is available online at http://www.wrapfets.org/.
[55] IMPROVE Steering committee meeting minutes are available at http://vista.cira.colostate.edu/improve/Activities/activities.htm.

Note that sea salt measurements are based on IMPROVE chloride measurements, which can also be associated with compounds not found in seawater. Figure 4.1-30 presents a more typical sea salt event, with higher measurements spanning the western coast.

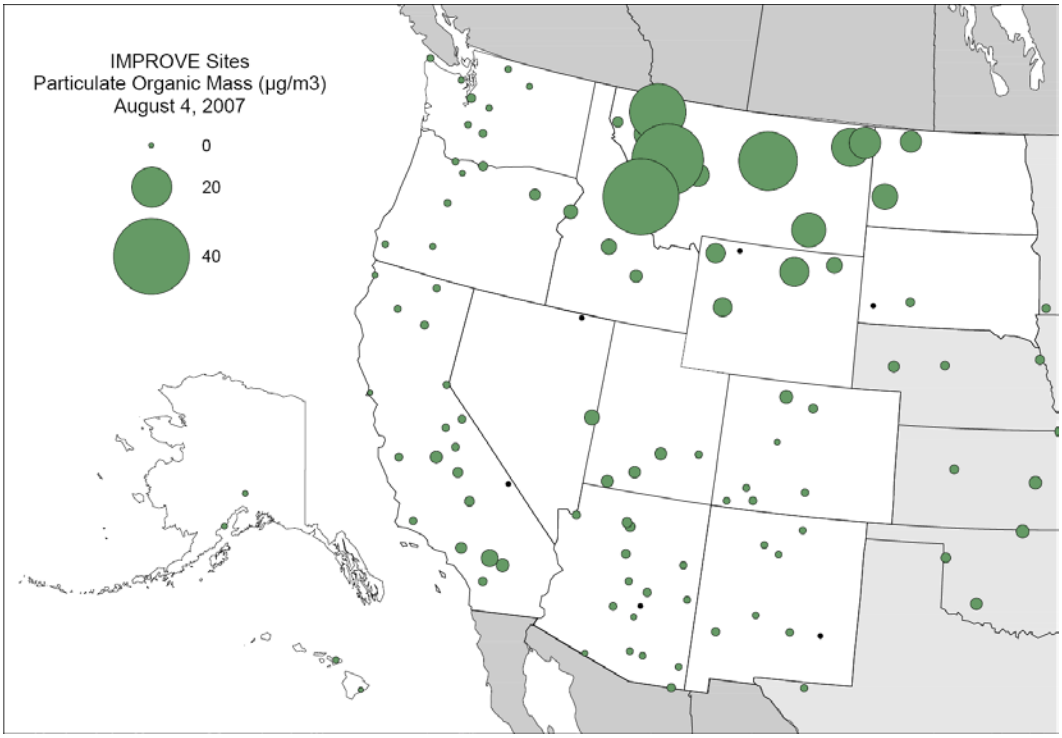


Figure 4.1-21. Particulate Organic Mass Event Measured on August 4, 2007, Affecting Most Montana IMPROVE Sites.

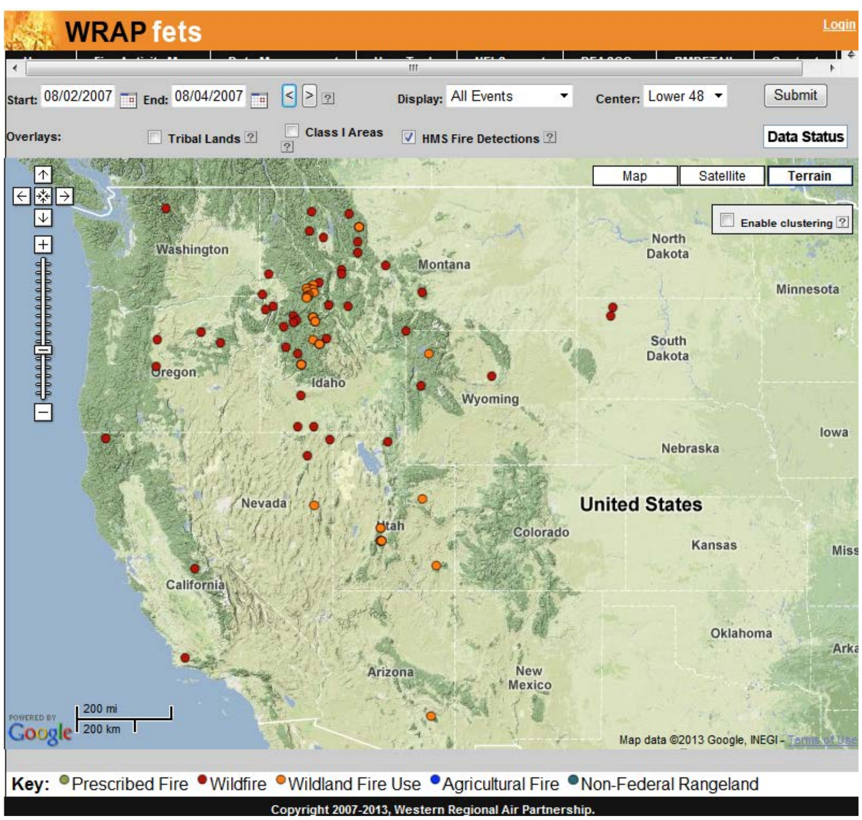


Figure 4.1-22. Map From the WRAP FETS Showing Fire Detections for the Period August 2 through August 4, 2007.

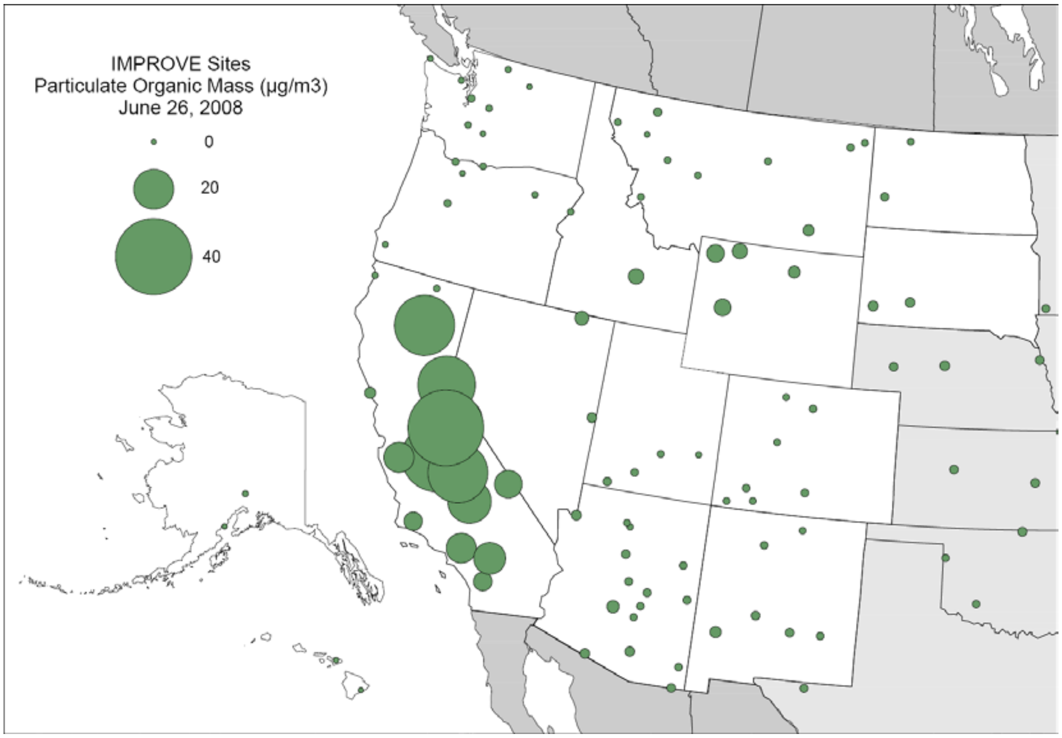


Figure 4.1-23. Particulate Organic Mass Event Measured on June 26, 2008, Affecting Most California IMPROVE Sites.

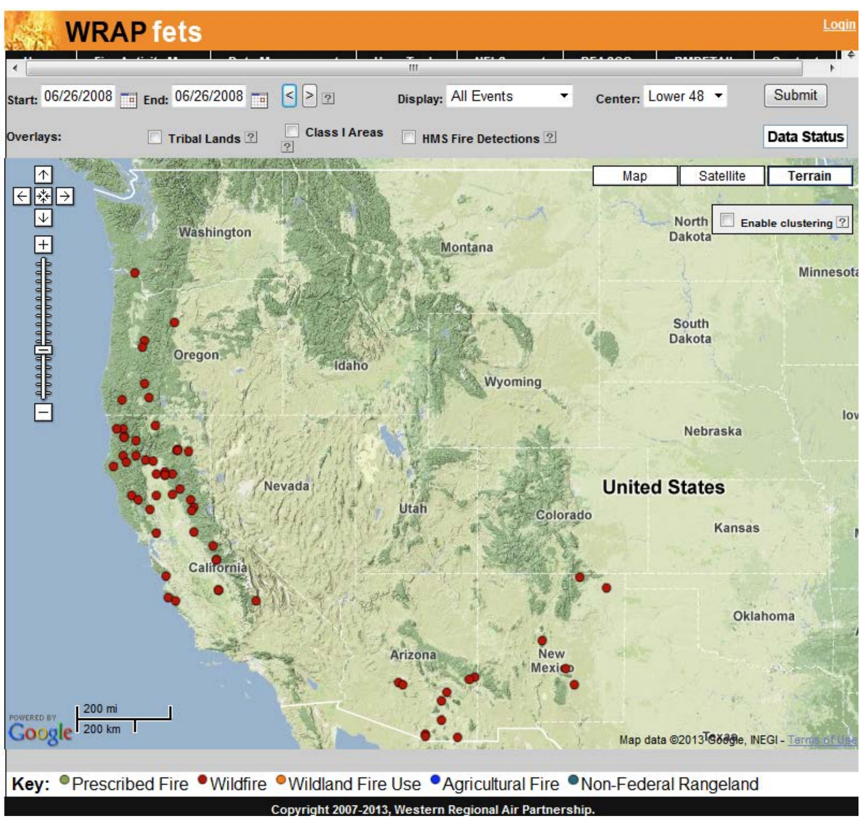


Figure 4.1-24. Map From the WRAP FETS Showing Fire Detections on June 26, 2007.

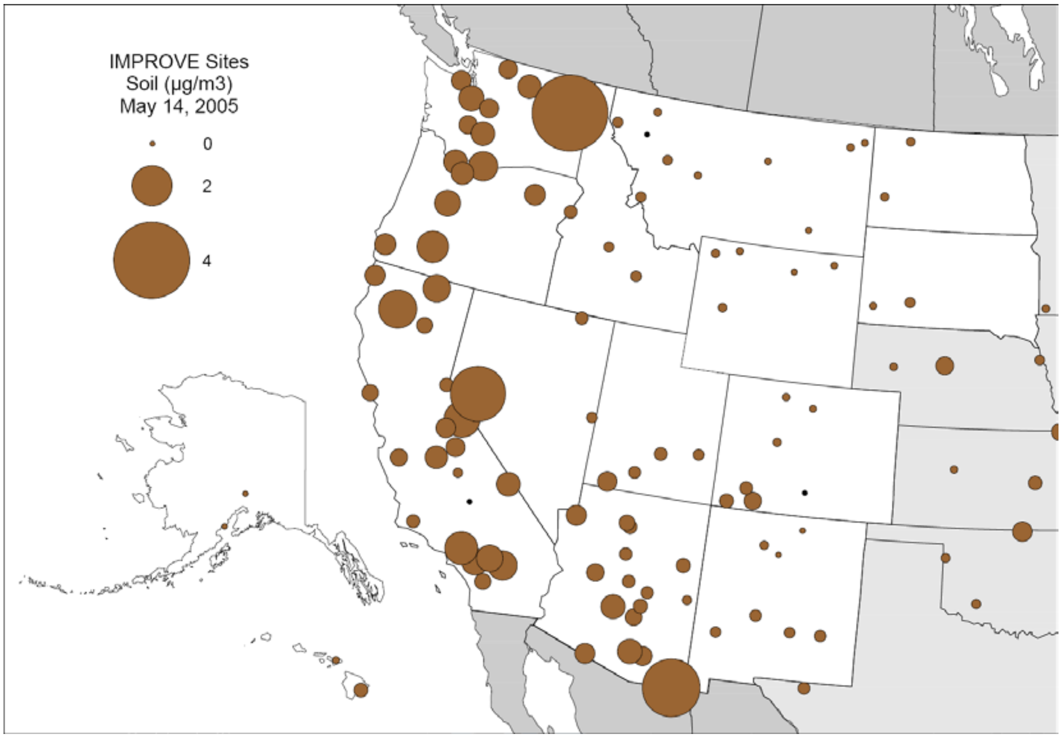


Figure 4.1-25. Soil Event Measured on March 14, 2005, Affecting Coastal IMPROVE Sites.

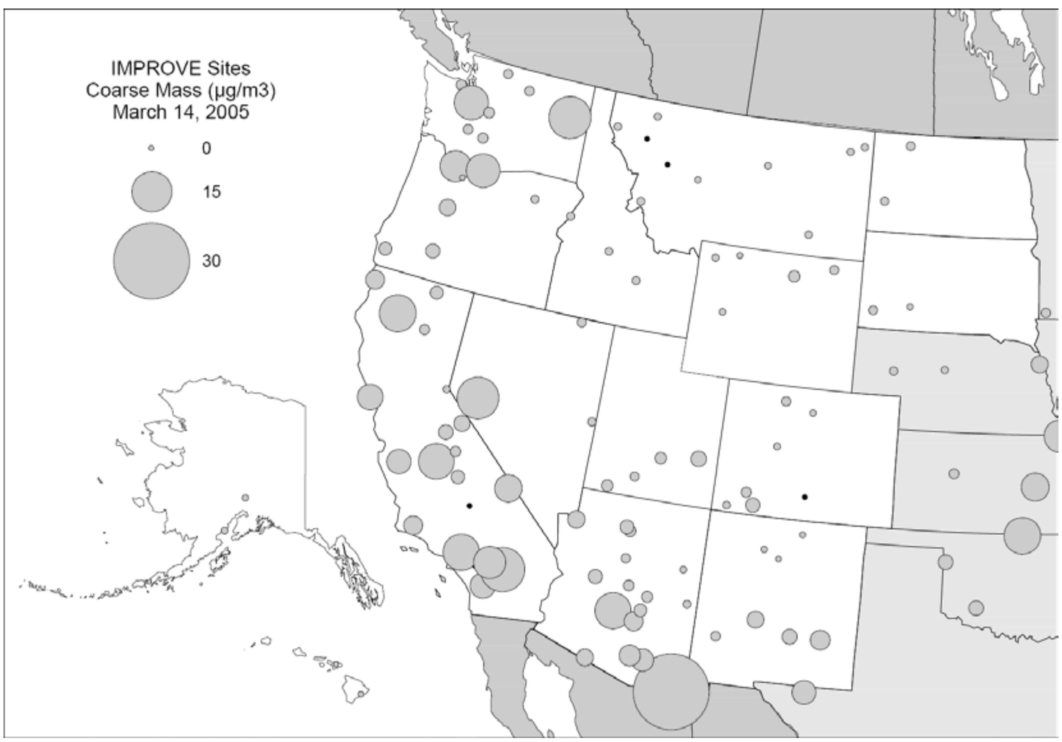


Figure 4.1-26. Coarse Mass Event Measured on March 14, 2005, Affecting Coastal IMPROVE Sites.

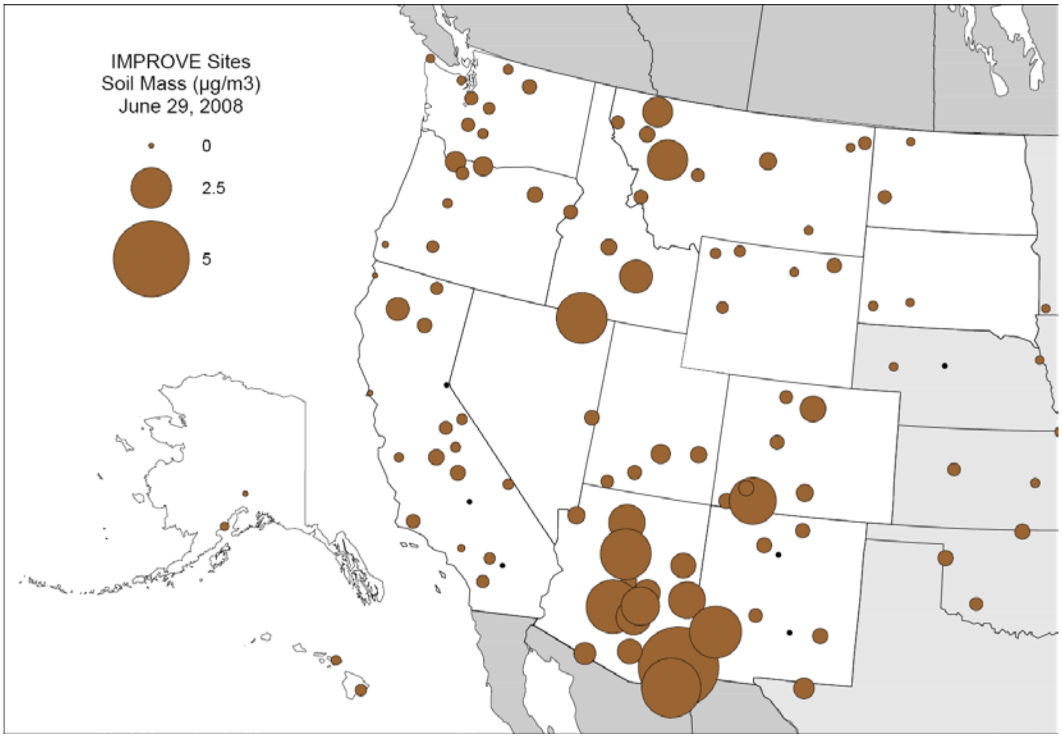


Figure 4.1-27. Soil Event Measured on June 29, 2008, Affecting Most Arizona IMPROVE Sites.

Figure 4.1-28. Coarse Mass Event Measured on June 29, 2008, Affecting Most Arizona IMPROVE Sites.

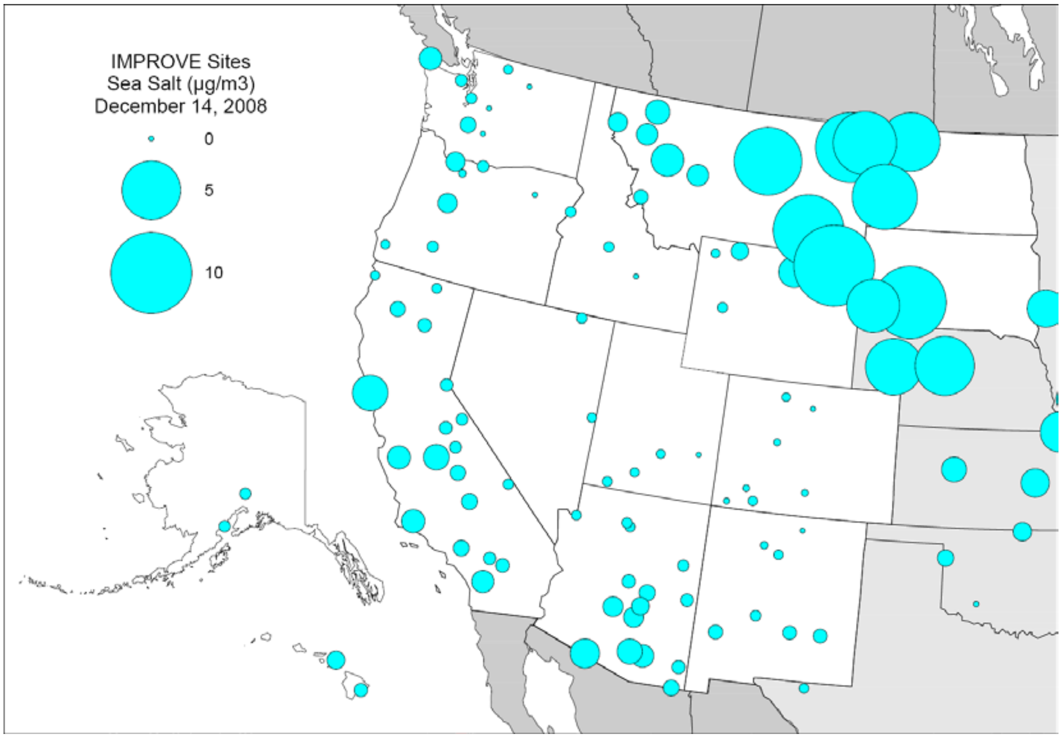


Figure 4.1-29 Sea Salt Event Measured on December 14, 2008, Affecting Inland IMPROVE Sites.

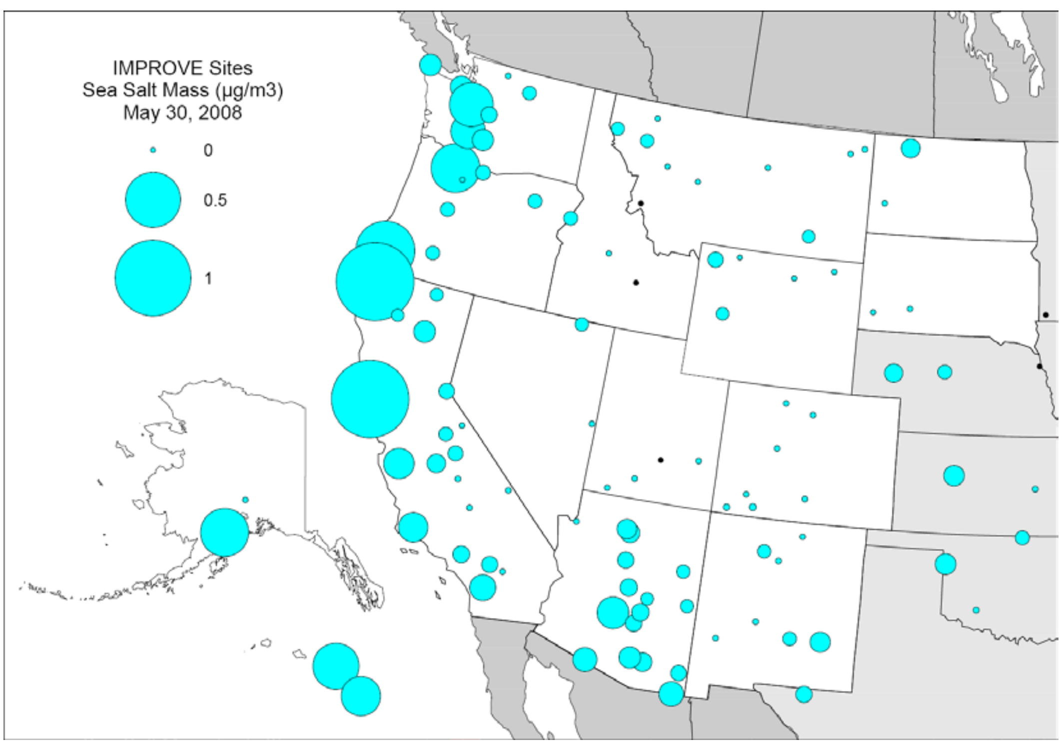


Figure 4.1-30. Sea Salt Event Measured on May 30, 2008, Affecting Coastal IMPROVE Sites.

4.2 EMISSIONS DATA

Included here are summaries depicting differences between an annual emission inventory representing the baseline period and an annual inventory representing the current progress period for the contiguous WRAP states.[56] For these summaries, emissions during the baseline years are represented using a 2002 inventory (termed plan02) which was developed with support from the WRAP for use in the original RHR SIP strategy development. Differences between inventories are represented as the difference between the 2002 inventory, and a 2008 inventory which leverages more recent inventory development work performed by the WRAP for the WestJumpAQMS and Deterministic and Empirical Assessment of Smoke's Contribution to Ozone (DEASCO$_3$) modeling projects (termed WestJump2008). Note that the comparisons of differences between inventories does not necessarily reflect a change in emissions, as a number of methodology changes and enhancements have occurred between development of the individual inventories, as referenced in Section 3.2.1.

Growth in population has implications for the planning needs of states. Population does not directly translate into increased emissions, but population growth can affect energy use, vehicle miles traveled (VMT), and other factors that affect the emissions of visibility related species. Figure 4.2-1 presents a map comparing 2002 and 2010 census populations by county for the WRAP states.[57] Population differences are not directly related to regulatory requirements, but are provided here as reference for state planning purposes. Note that the largest population increases were observed in southern California and southern Arizona, and the largest decreases were reported for Montana, North Dakota and South Dakota.

[56] Emissions inventories used to represent Alaska and Hawaii were developed differently, so discussions for these states are not included here but are included in state specific summaries in Section 6.0.
[57] The US census is conducted every 10-years. Population data for the years 2000 and 2010 were obtained from http://www.census.gov/main/www/access.html.

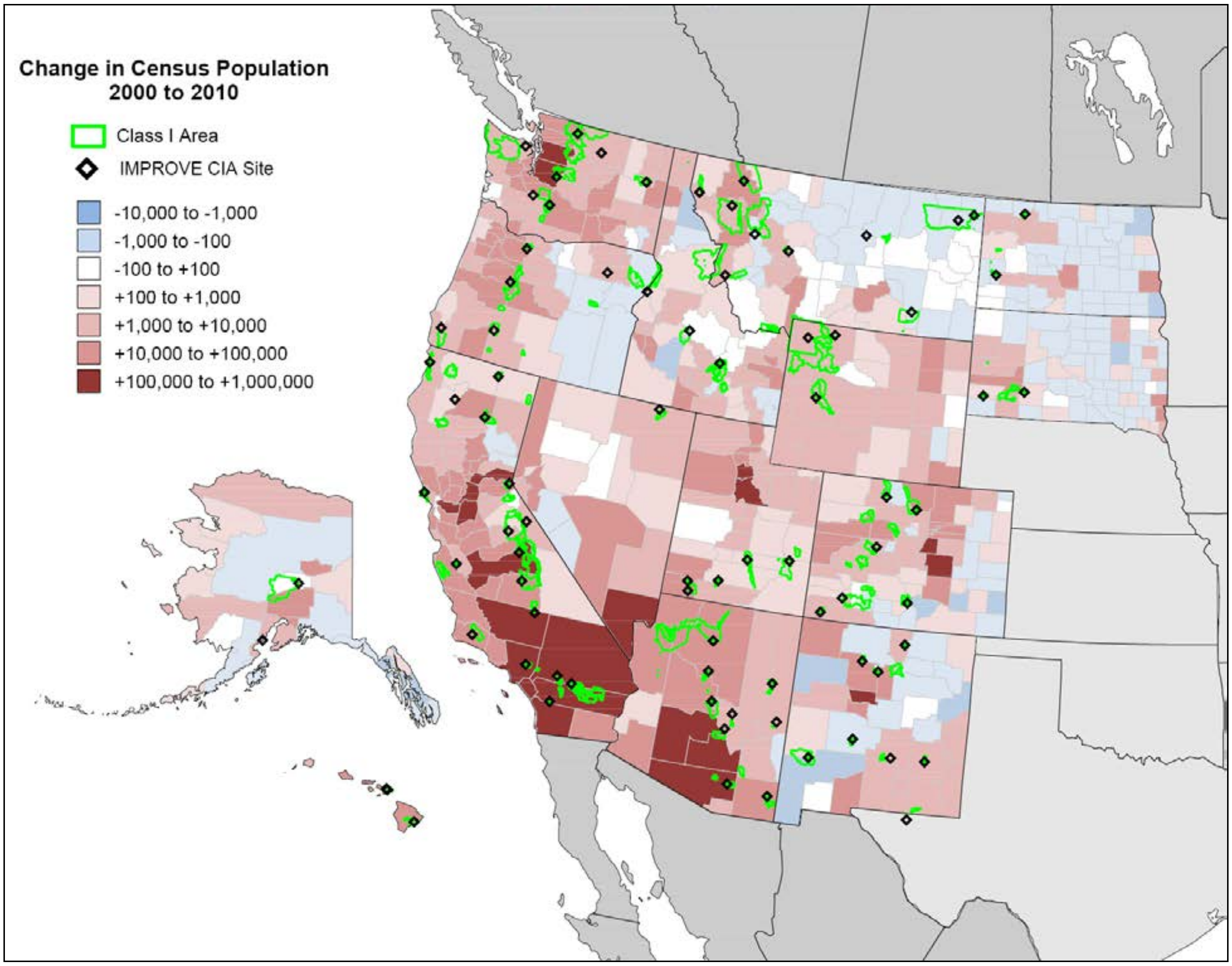


Figure 4.2-1. Difference Between 2000 and 2010 Census Population for the WRAP Region.

For regulatory purposes, State-wide inventories totals and differences for all major visibility impairing pollutants from both natural and anthropogenic source categories are presented here, and inventory totals from a county level basis are available on the WRAP Technical Support System website (http://vista.cira.colostate.edu/tss/).[58] Figure 4.2-2 presents both the 2002 and 2008 sulfur dioxide (SO_2) emission totals by source category for the contiguous and Figure 4.2-3 presents the differences for SO_2 for each category by state. Figures 4.2-4 and 4.2-5 present similar charts for oxides of nitrogen (NO_X), and subsequent figures (Figures 4.2-6 through 4.2-17) present ammonia, volatile organic compounds (VOCs), primary organic aerosol (POA), elemental carbon (EC), fine soil, and coarse particulate matter. These emissions inventory totals, including differences between inventories, are discussed for each State individually in Section 6.0. Some general regional observations are listed below.

- Inventories show that SO_2 emissions are largely due to point sources. These emissions saw decreases in most source categories for most states, with the largest decreases reported for point sources. Reductions are likely due to the implementation

[58] The WRAP TSS is described in Section 3.3.

of control strategies such as SO_2 scrubbers installed at point sources and required use of low sulfur diesel fuel.

- Inventories show that NO_X emissions are mainly due to on-road mobile, off-road mobile, and point sources. Inventories showed decreases in these categories for most states. Reductions may be to implementation of stricter emissions limits for NO_X related to combustion sources such as utility boilers and automobile engines.
- Inventories show that concentrations of VOCs are mainly due to biogenic emissions. Inventory totals comparing 2002 and 2008 emissions show large decreases in 2008, but this is likely due to enhancements in biogenic inventory methodology, as referenced in Section 3.2.1, rather than decreases of this magnitude in actual emissions.
- Inventories show that VOC, POA and EC emissions include large contributions from fire sources. Comparisons between fire inventories is not definitive as the current year inventory represent only the year 2008, as opposed to the entire 2005-2009 progress period represented in monitored data. In 2008, large fire events occurred in California, so fire emissions inventory totals increased in California, but decreased for other WRAP states.
- For fine soil and coarse mass, emissions inventories indicate that windblown and fugitive dust are the largest contributors to these haze species, with some contribution to fine soil from area and fire sources. Changes in fugitive dust and area source inventories were variable between states, and may be related to changes in population. Estimates for windblown dust inventory totals for most states in 2008 were lower than the baseline inventories, but significant methodology changes occurred with the development of the new WRAP windblown dust model, as referenced in Section 3.2.1, so differences reported here are not necessarily indicative of changes in actual source emissions between 2002 and 2008.

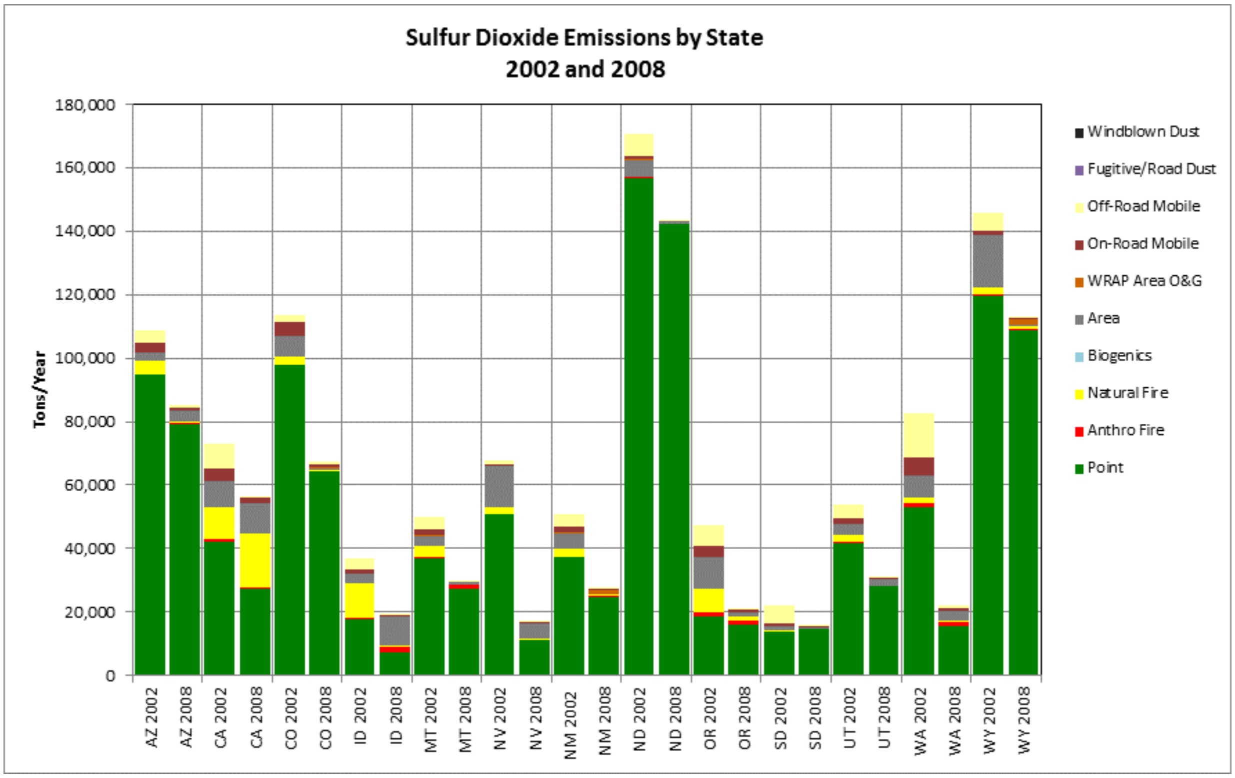


Figure 4.2-2. Comparison for 2002 and 2008 Sulfur Dioxide Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

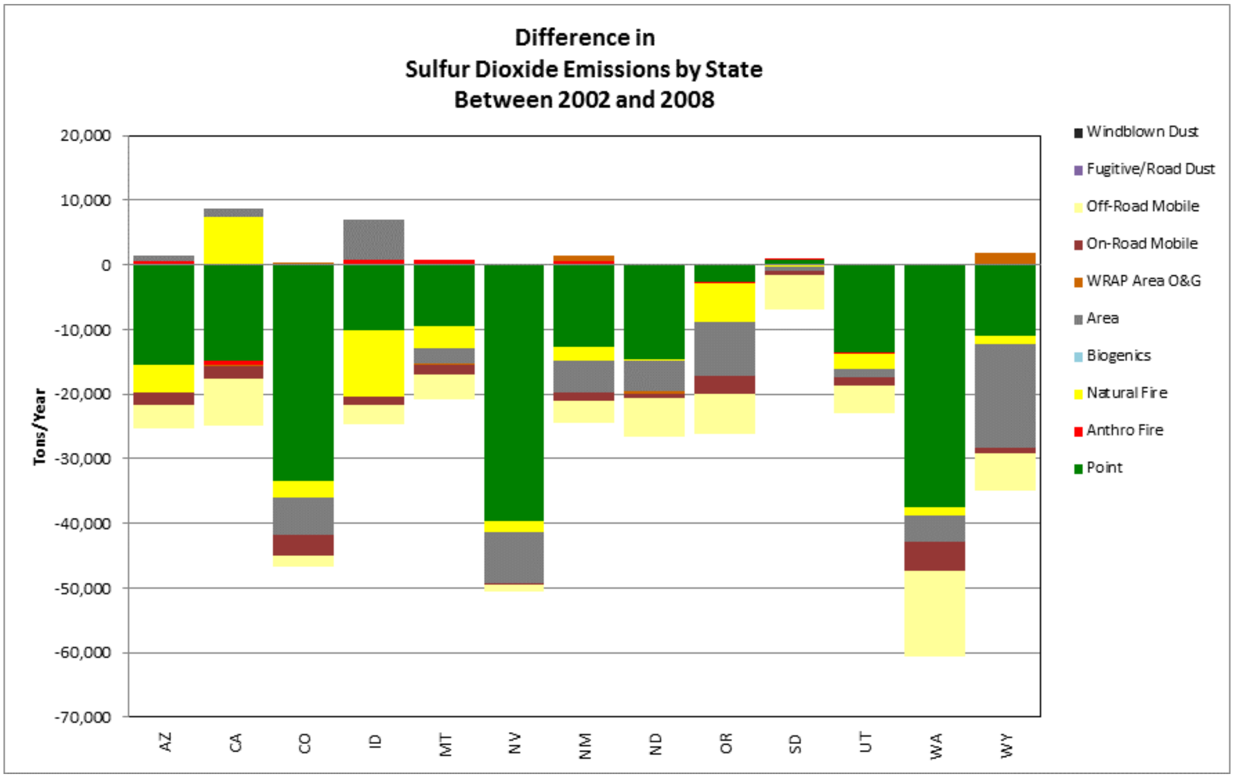


Figure 4.2-3. Differences between 2008 and 2002 Sulfur Dioxide Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

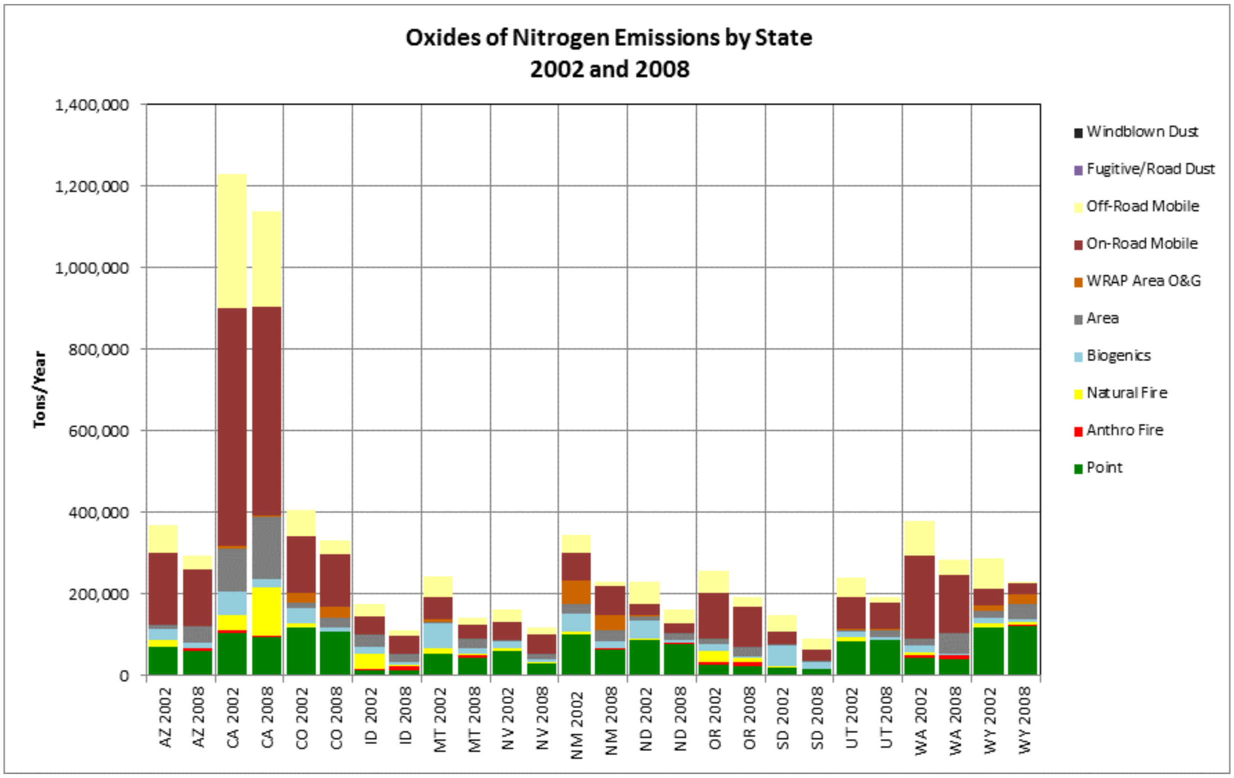


Figure 4.2-4. Comparison for 2002 and 2008 Oxides of Nitrogen Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

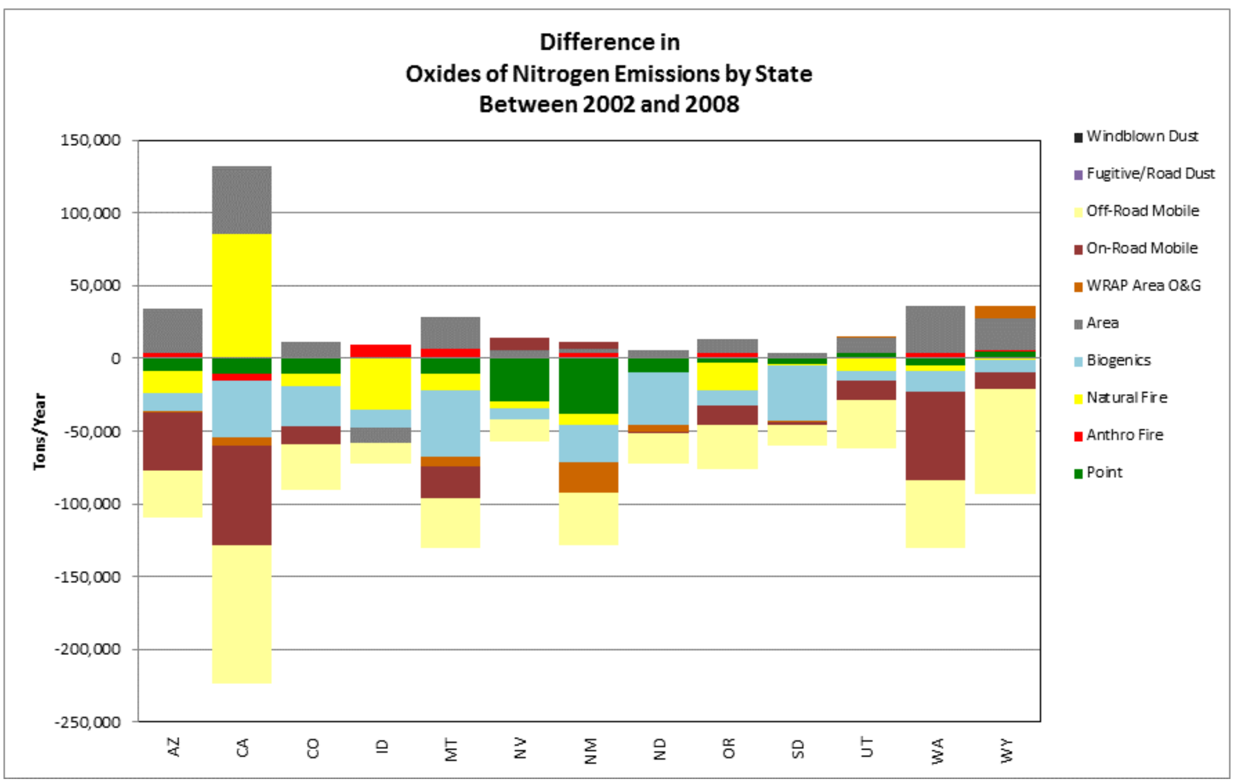


Figure 4.2-5. Differences between 2008 and 2002 Oxides of Nitrogen Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

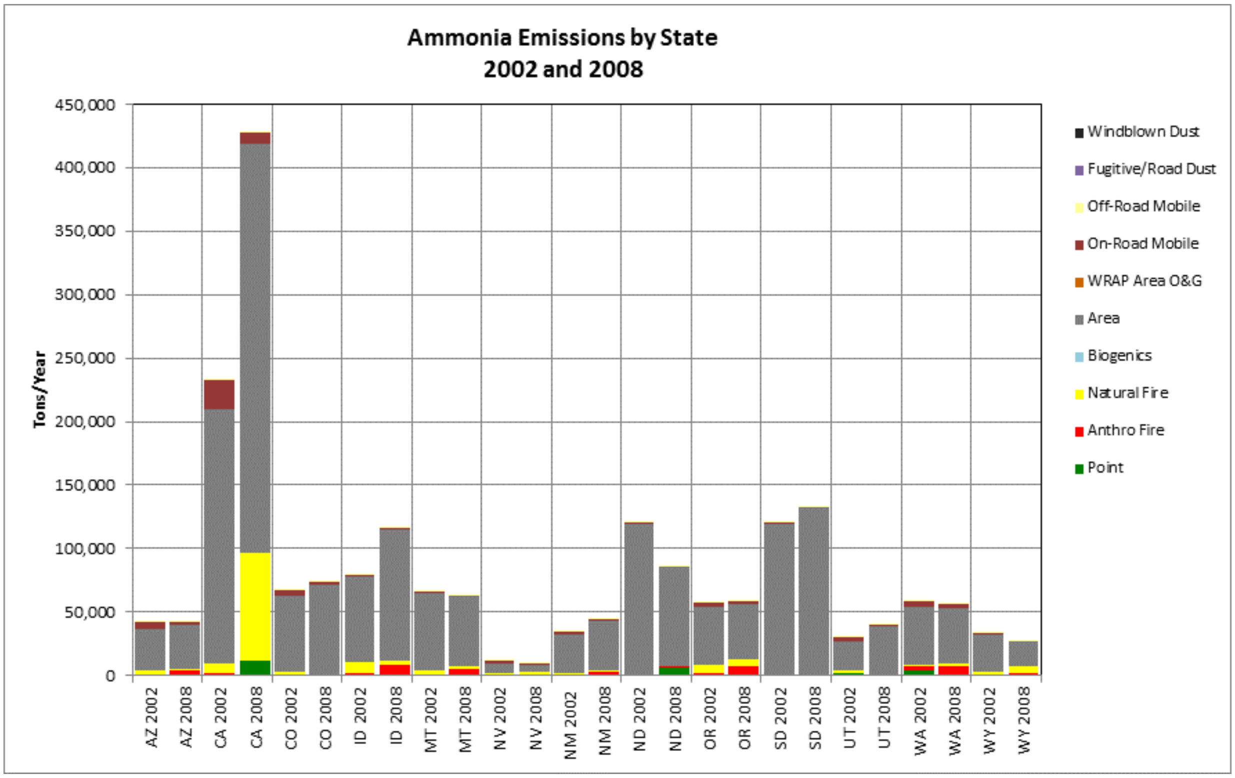


Figure 4.2-6. Comparison for 2002 and 2008 Ammonia Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

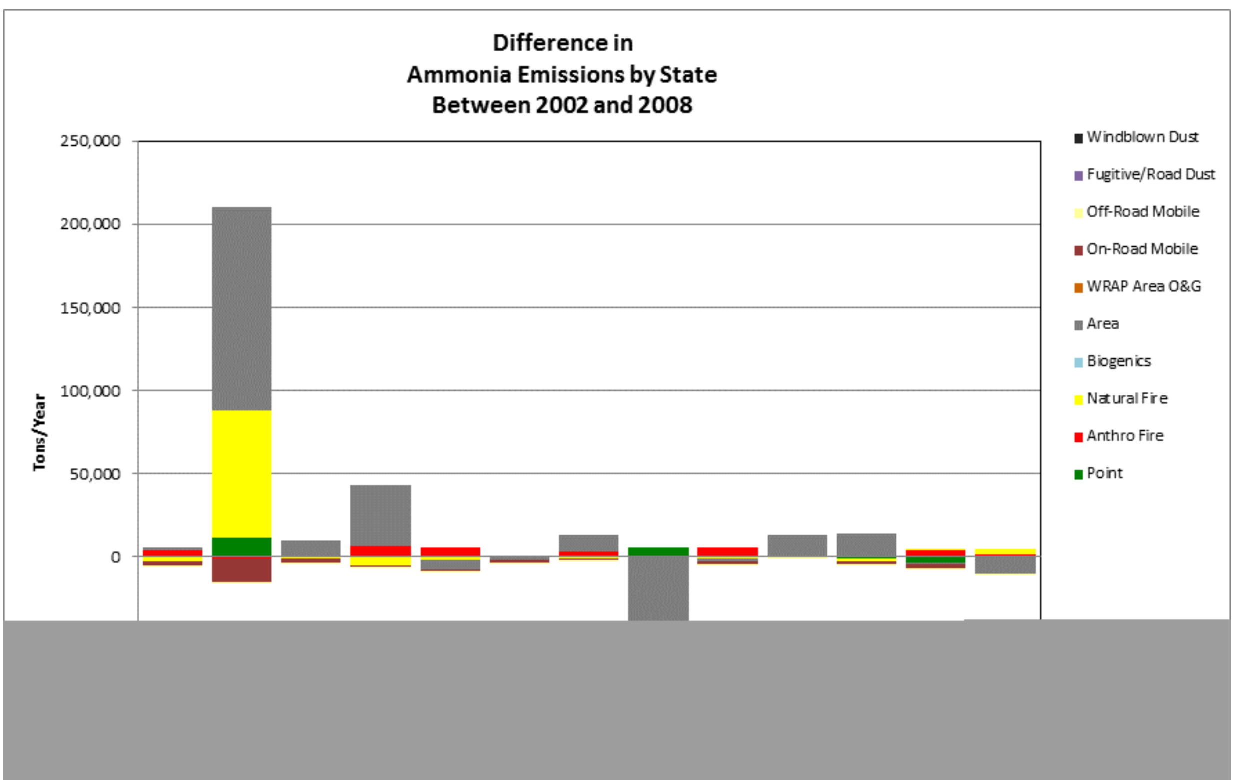


Figure 4.2-7. Differences between 2008 and 2002 Ammonia Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

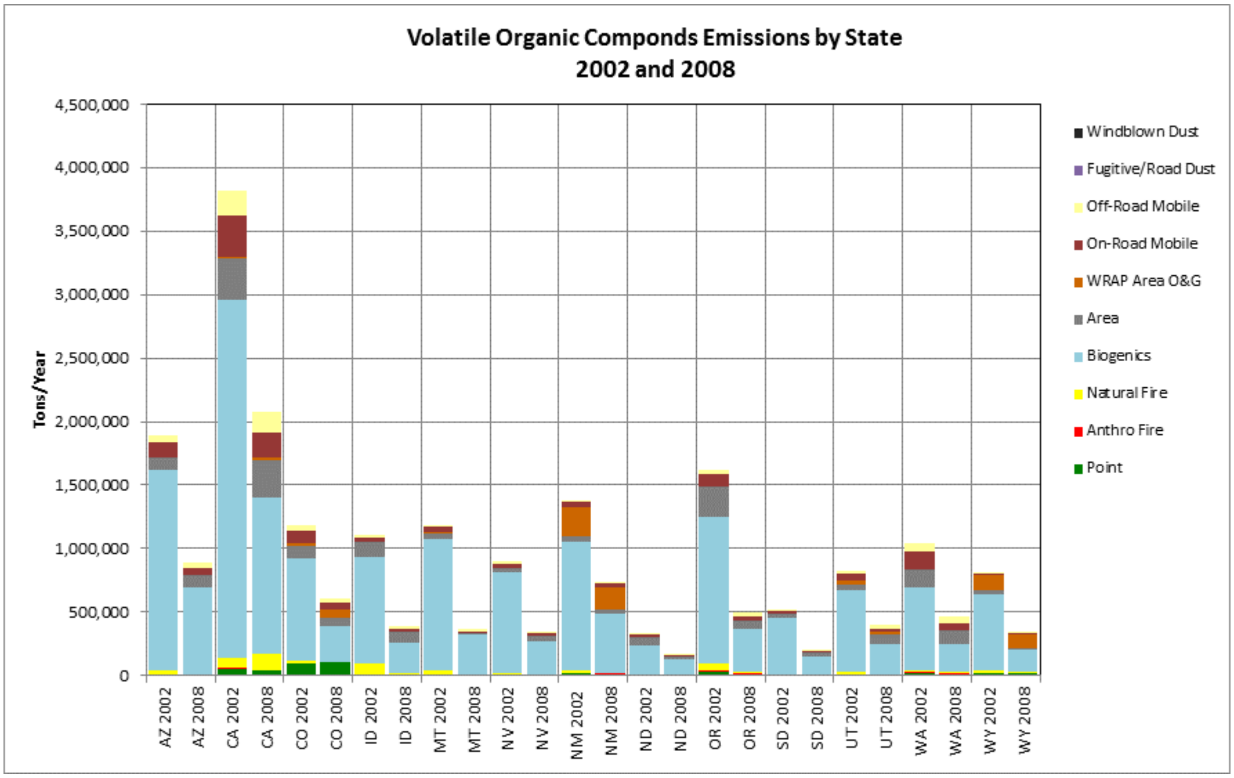


Figure 4.2-8. Comparison for 2002 and 2008 Volatile Organic Compound Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

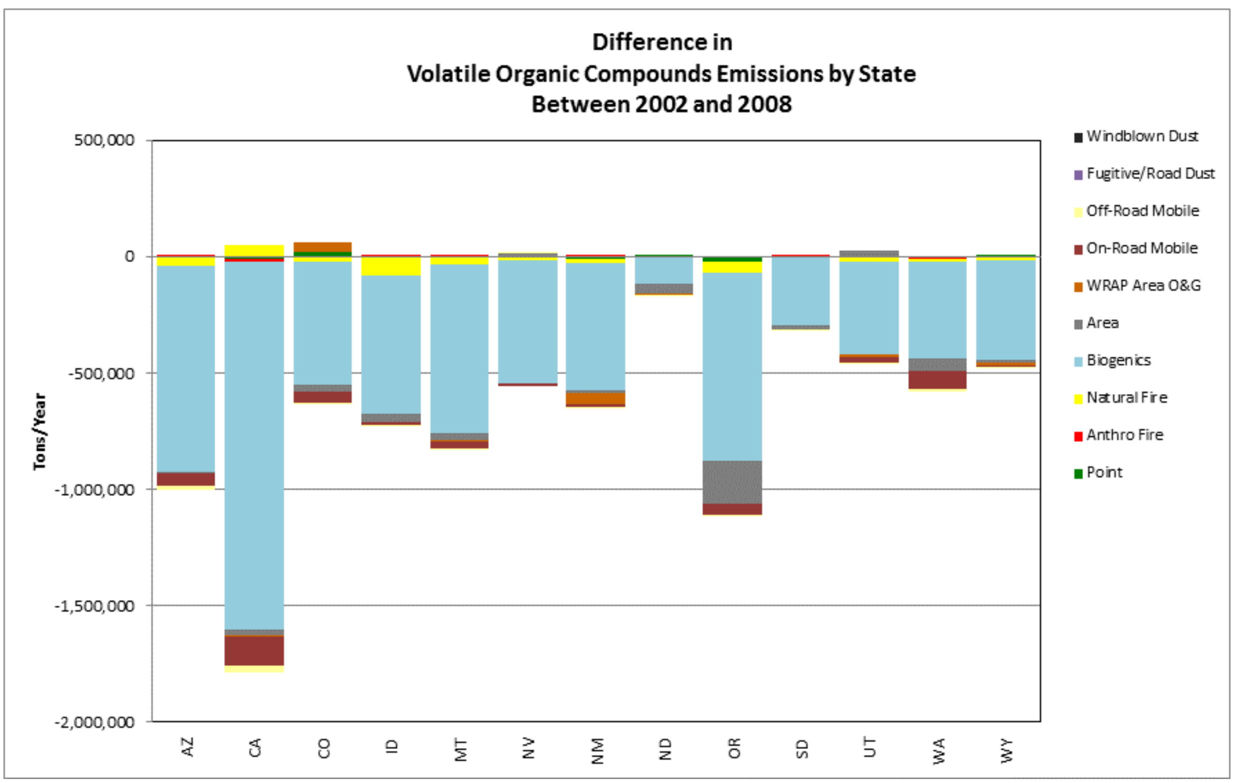


Figure 4.2-9. Differences between 2008 and 2002 Volatile Organic Compound Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

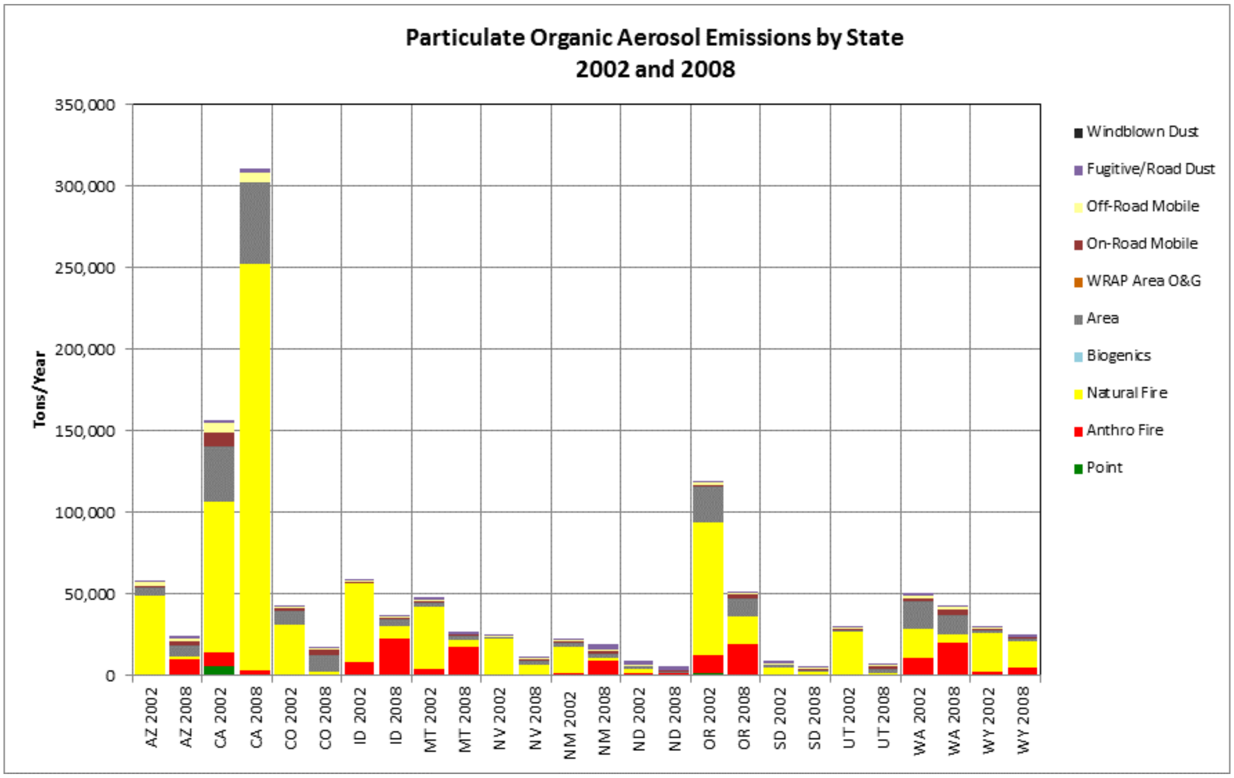


Figure 4.2-10. Comparison for 2002 and 2008 Particulate Organic Aerosol Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

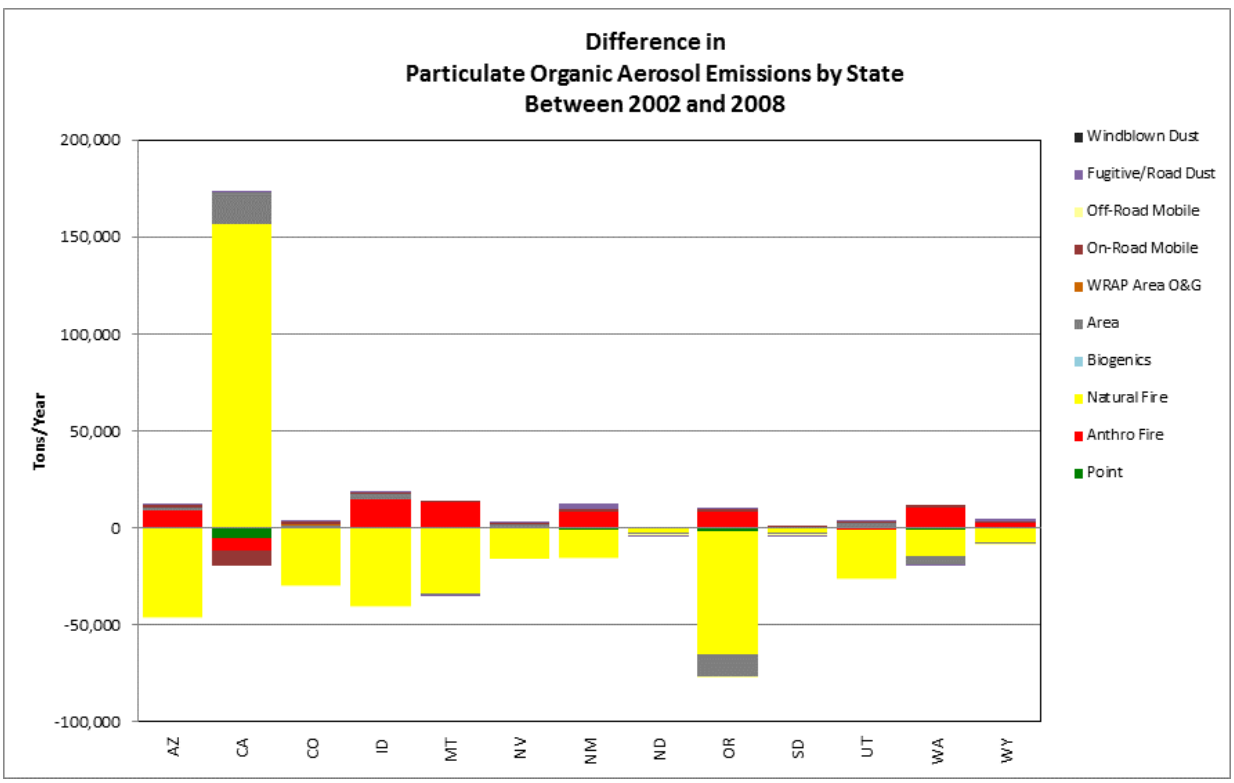


Figure 4.2-11. Differences between 2008 and 2002 Particulate Organic Aerosol Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

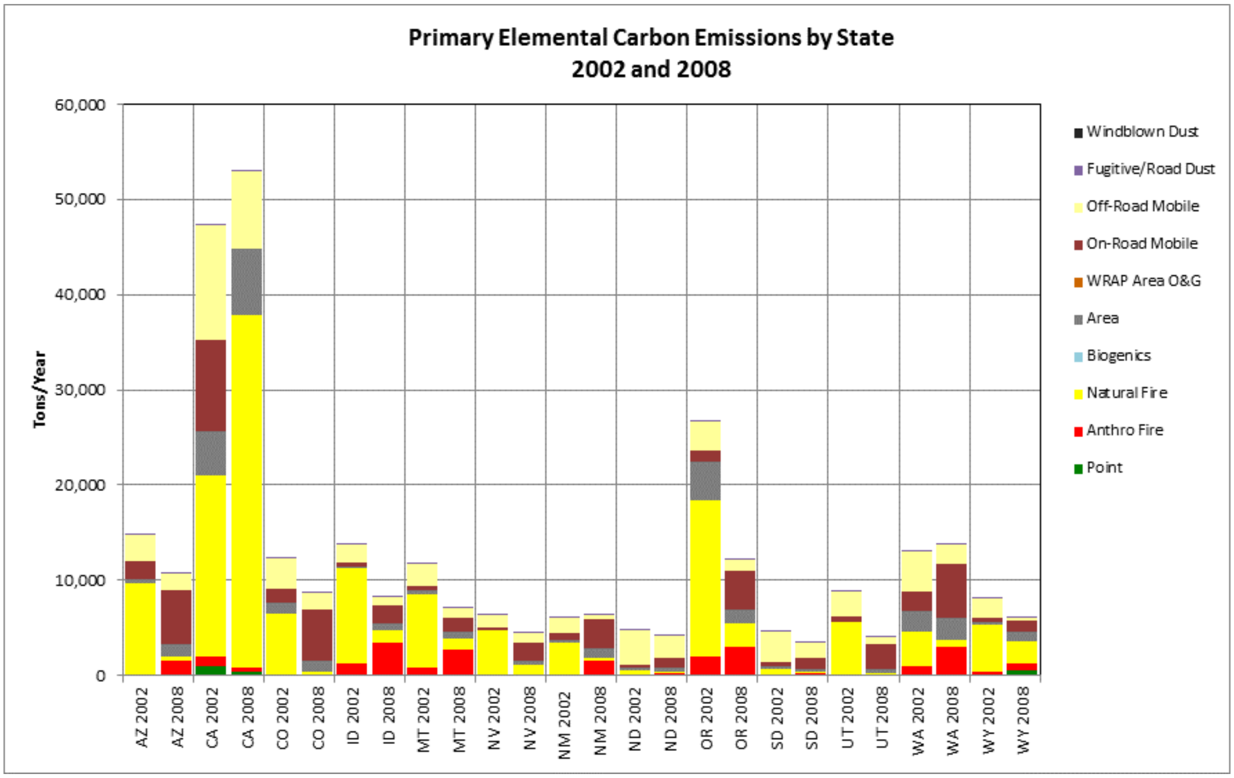


Figure 4.2-12. Comparison for 2002 and 2008 Elemental Carbon Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

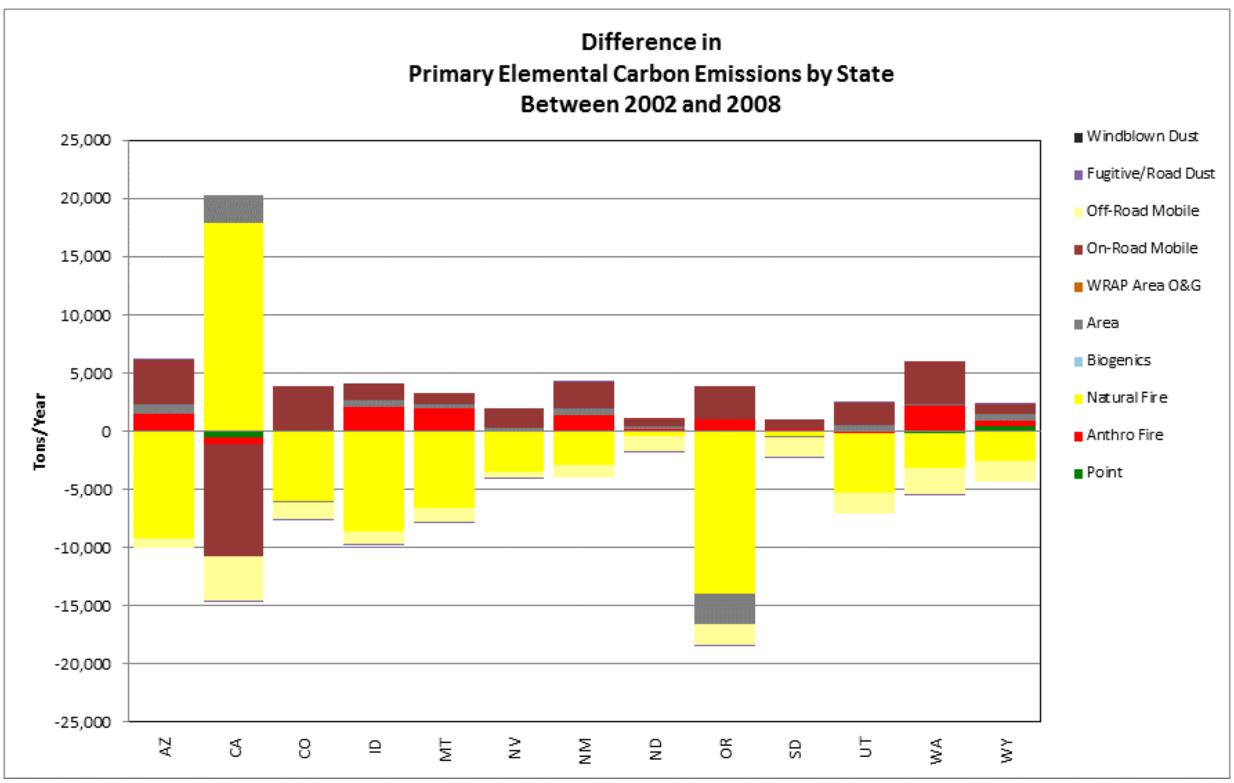


Figure 4.2-13. Differences between 2008 and 2002 Elemental Carbon Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

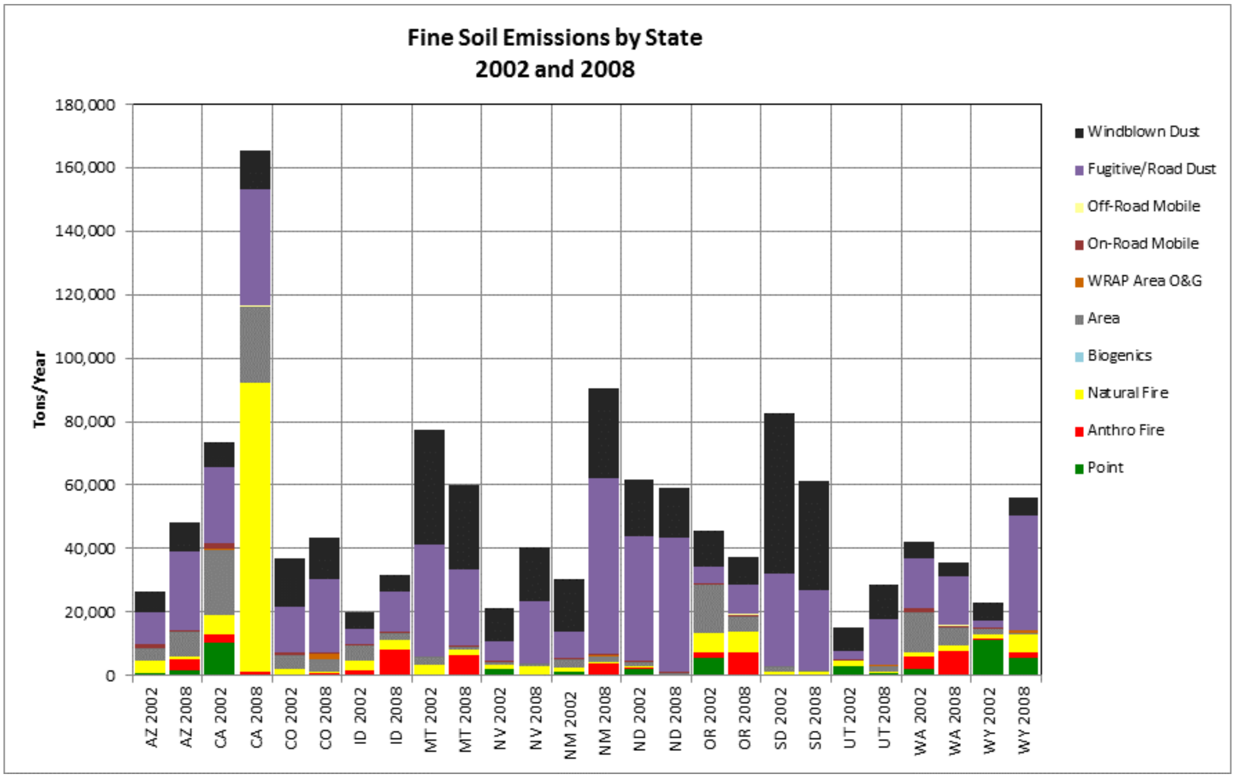


Figure 4.2-14. Comparison for 2002 and 2008 Fine Soil Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

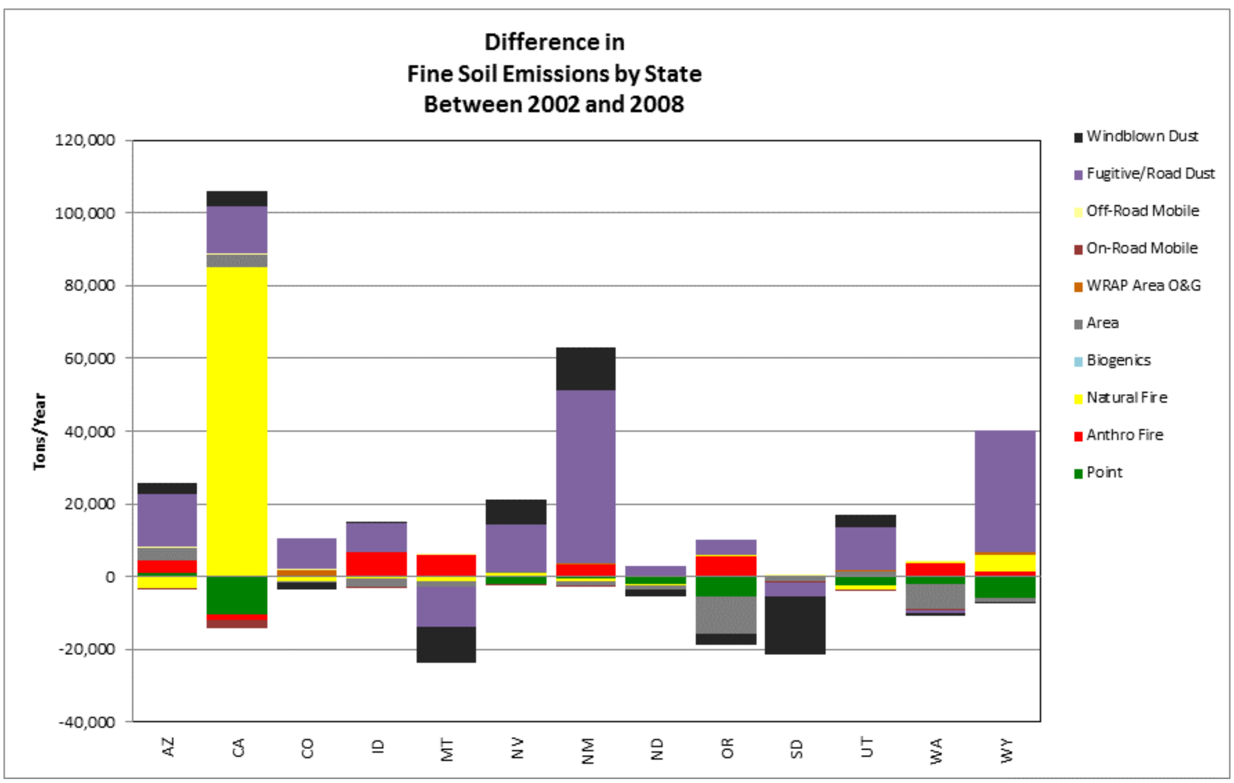


Figure 4.2-15. Differences between 2008 and 2002 Fine Soil Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

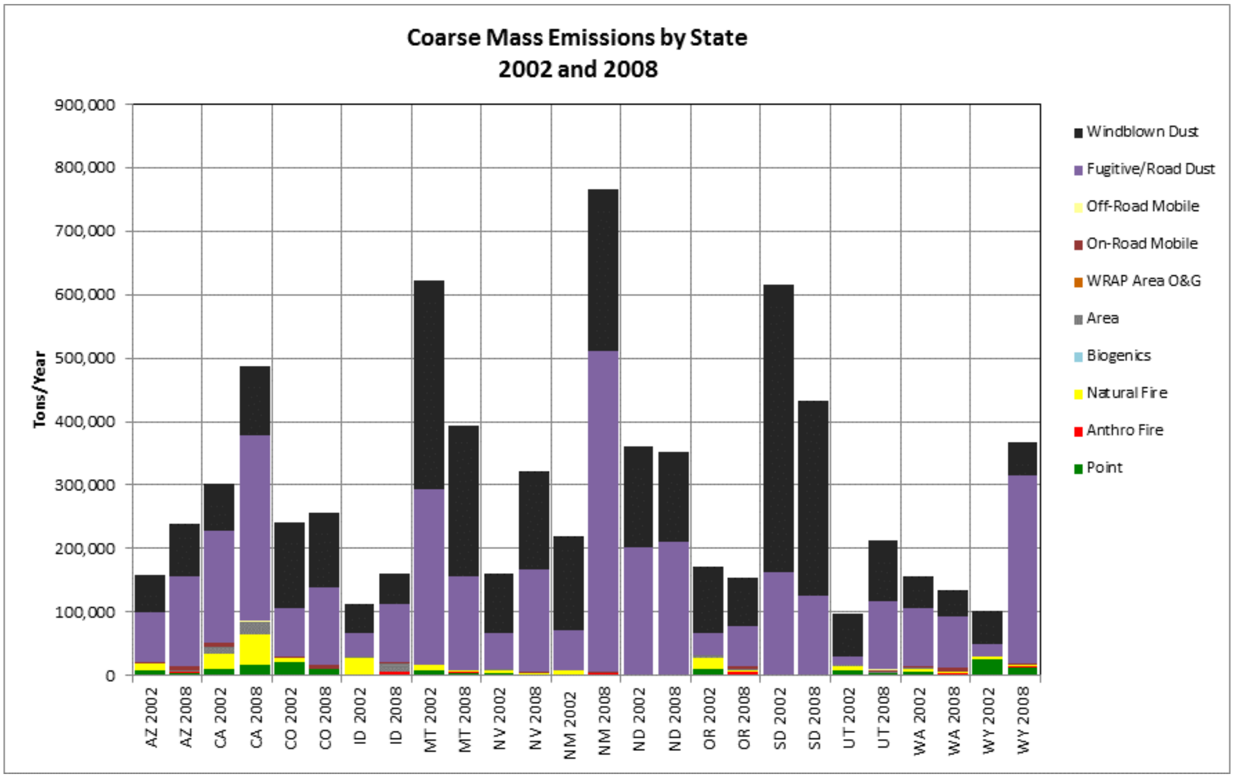


Figure 4.2-16. Comparison for 2002 and 2008 Coarse Mass Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

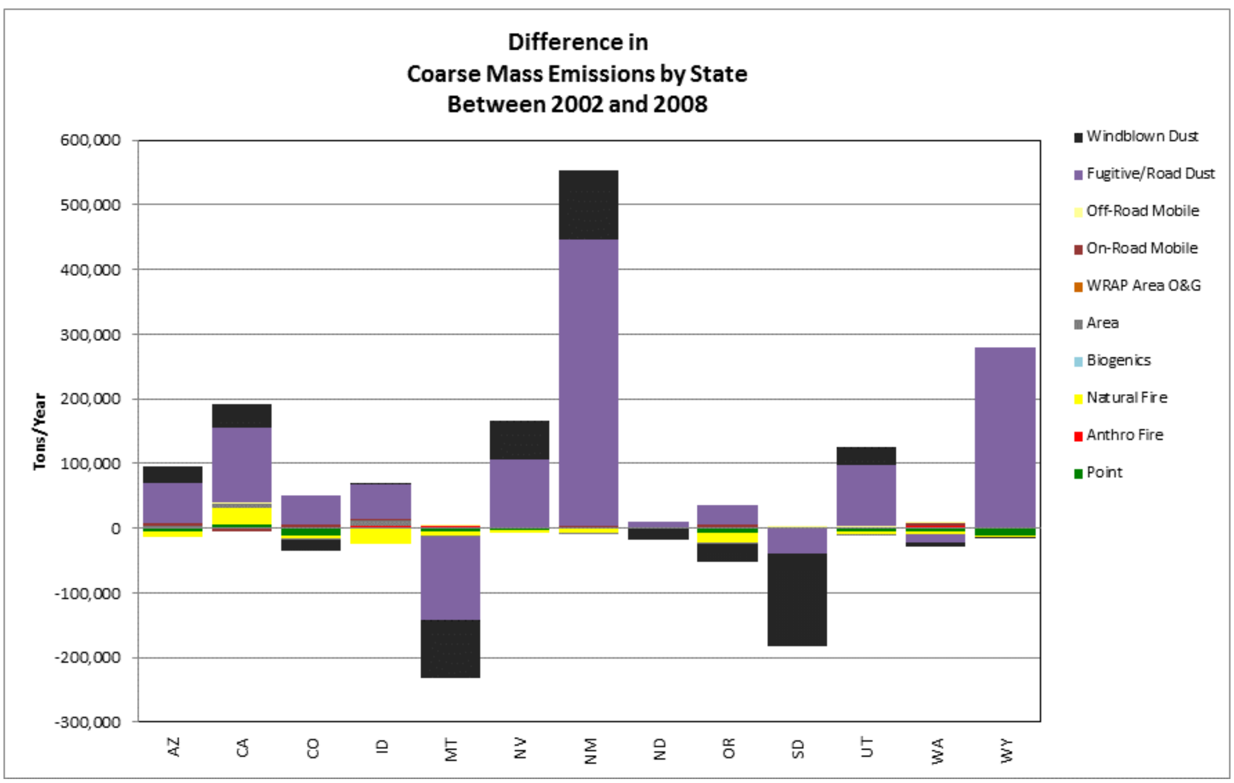


Figure 4.2-17. Differences between 2008 and 2002 Coarse Mass Emission Inventory Totals for the Contiguous WRAP States (2008 minus 2002).

4.2.1 EGU Summary

As described in previous sections, differences between the baseline and progress period inventories presented here do not necessarily represent changes in actual emissions as numerous updates in inventory methodologies have occurred between the development of the separate inventories. Also, the 2002 baseline and 2008 progress period inventories represent only annual snapshots of emissions estimates, which may not be representative of entire 5-year monitoring periods compared. To better account for year-to-year changes in emissions, annual emission totals for electrical generating units (EGU) are presented here for the contiguous states, and for each state individually in Section 6.0. EGU emissions are some of the more consistently reported emissions, as tracked in EPA's Air Markets Program Database for permitted Title V facilities in the state (http://ampd.epa.gov/ampd/). RHR implementation plans are required to pay specific attention to certain major stationary sources, including EGUs, built between 1962 and 1977.

Figure 4.2-18 presents a sum of annual NO_X and SO_2 emissions as reported for all EGU sources in the contiguous WRAP states between 1996 and 2010. While these types of facilities are targeted for controls in state regional haze SIPs, it should be noted that many of the controls planned for EGUs in the WRAP states had not taken place yet in 2010, while other controls separate from the RHR may have been implemented. The chart shows steady declines for both SO_2 and NO_X.

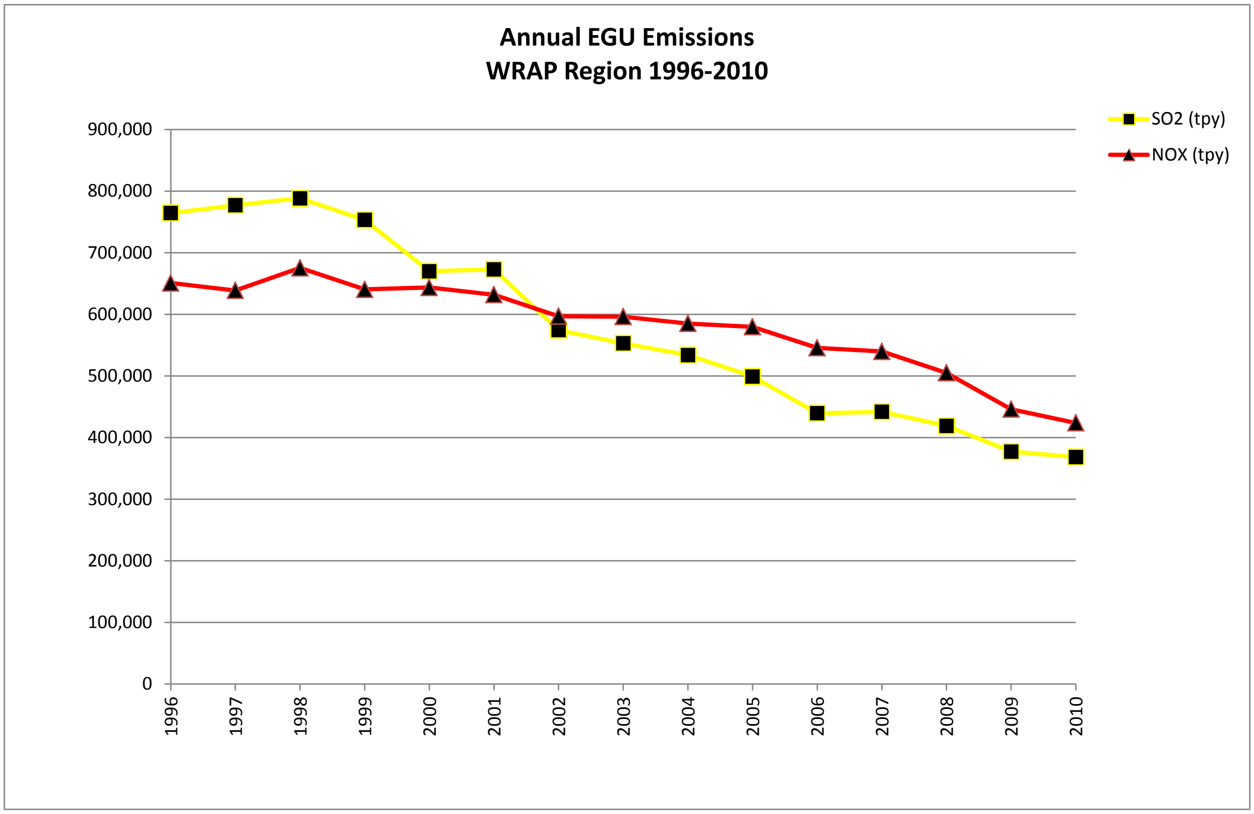


Figure 6.2-18. Sum of EGU Emissions of SO_2 and NOx Reported between 1996 and 2010 for the WRAP Region.

5.0 SECTION 309 REGIONAL SUMMARIES

As described in Section 2.2, some states in the Western Regional Air Partnership (WRAP) qualify for Section 309 requirements for submittal of Regional Haze Rule (RHR) progress reports, but have the option of compliance with Section 308 regulations. Section 309 rules were based on recommendations from the Grand Canyon Visibility Transport Commission (GCVTC) Recommendations report,[59] specific to visibility impacts at the 16 Class I areas (CIAs) on the Colorado Plateau. Of the nine western states originally eligible for Section 309 RHR implementation, only the states of New Mexico, Utah, and Wyoming and the city of Albuquerque/Bernalillo County currently exercise this option.

The 16 CIAs on the Colorado Plateau are depicted in Figure 5.0-1 and listed in Table 5.0-1. Note that the ZION1 site, which originally represented Zion Canyon National Park, has since been replaced with the ZICA1 site, as described in Section 6.13.1.1. This section presents regional progress summaries specific to monitoring and emissions data at these Colorado Plateau sites. Additionally, regional summaries for the entire WRAP region are presented in Section 4.0, and state and site specific summaries are presented in Section 6.0.

[59] The Grand Canyon Visibility Transport Commission Recommendations for Improving Western Vistas Report is archived on the WRAP website at www.wrapair.org/WRAP/reports/GCVTCFinal.PDF.

Table 5.0-1
Colorado Plateau CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Arizona				
Grand Canyon NP	GRCA2	35.97	-111.98	2267
Mount Baldy WA	BALD1	34.06	-109.44	2508
Petrified Forest NP	PEFO1	35.08	-109.77	1766
Sycamore Canyon WA	SYCA1	35.14	-111.97	2046
Colorado				
Black Canyon of the Gunnison NP Weminuche WA	WEMI1	37.66	-107.80	2750
Flat Tops WA Maroon Bells-Snowmass WA West Elk WA	WHRI1	39.15	-106.82	3413
Mesa Verde NP	MEVE1	37.20	-108.49	2172
New Mexico				
San Pedro Parks WA	SAPE1	36.01	-106.84	2935
Utah				
Bryce Canyon NP	BRCA1	37.62	-112.17	2481
Canyonlands NP Arches NP	CANY1	38.46	-109.82	1798
Capitol Reef NP	CAPI1	38.30	-111.29	1896
Zion NP	ZICA1*	37.20	-113.15	1215

*Replaced the ZION1 monitoring site in 2003.

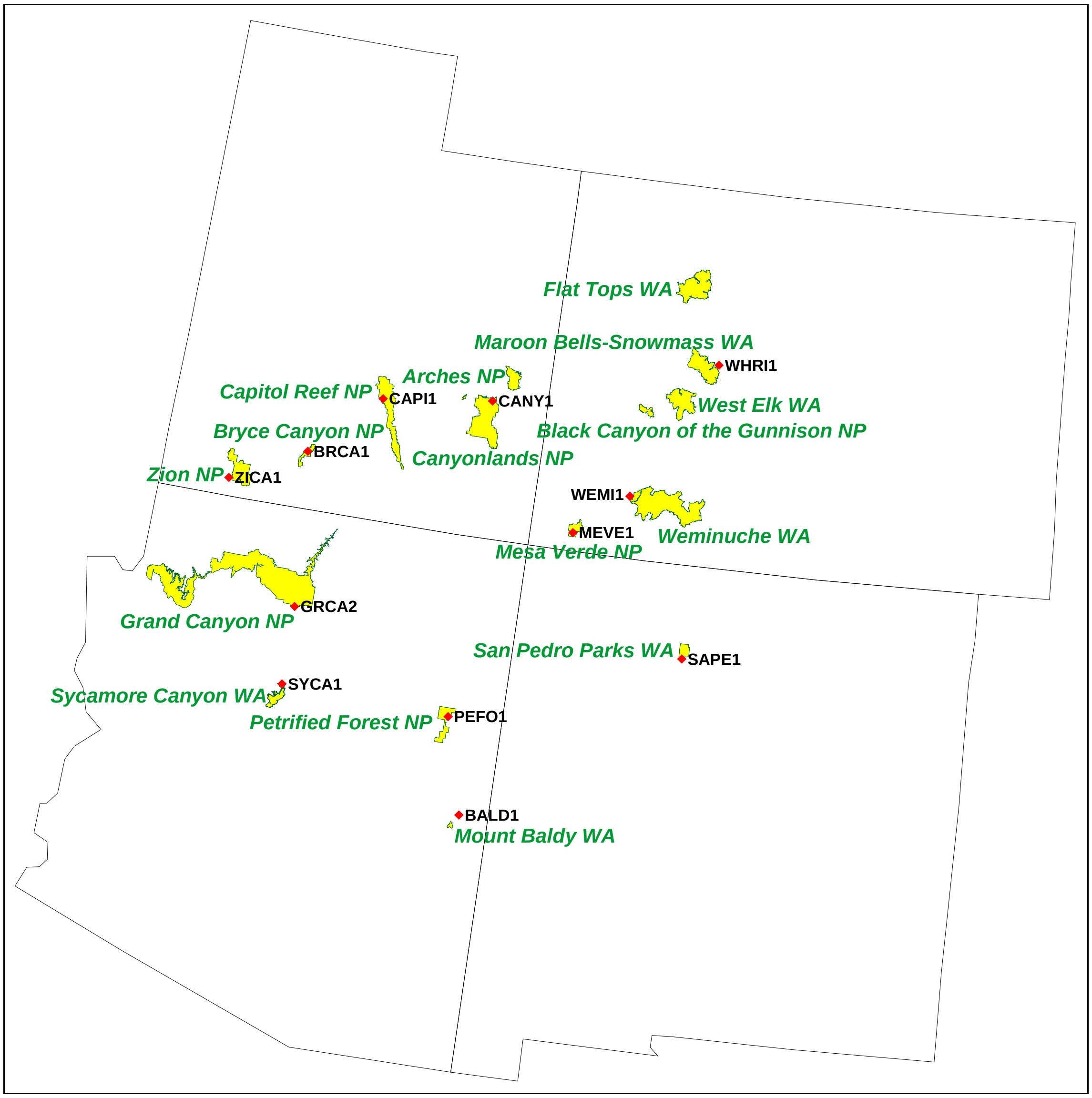


Figure 5.0-1. Map Depicting Colorado Plateau CIAs and Representative IMPROVE Monitors in Arizona, Colorado, New Mexico, and Utah.

5.1 MONITORING DATA

As described previously, the goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve at each Federal CIA, and that visibility on the 20% least impaired, or best, days does not get worse. Progress is determined by comparing current monitored conditions to the baseline average, beginning with the 2000-2004 baseline, and proceeding with each subsequent 5-year average (e.g. 2005-2009, 2010-2014, etc.) [60], as measured at representative IMPROVE monitoring sites.

[60] See page 4-2 in EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule.*

Figures 5.1-1 and 5.1-2 present the 2005-2009 visibility averages for the most impaired (20% worst) and least impaired (20% best) days, respectively, for the IMPROVE sites representing CIAs on the Colorado Plateau. The size of the pie chart is related to the magnitude of visibility impairment, and colors represent the relative contribution of the pollutants which are measured by the IMPROVE Network.

Tables 5.1-1 and 5.1-2 present the calculated deciview values for current conditions at each site, along with the percent contribution to extinction from each aerosol species for the worst and best days, respectively, for each site. Tables 5.1-3 and 5.1-4 present the difference between the 2000-2004 baseline period average and the 2005-2009 first progress period average for the 20% worst and 20% best days, respectively, for the CIA sites in the Colorado Plateau region. Also, trend statistics for the years 2000-2009 for each species at each site are summarized in Table 5.1-5.[61] Only trends for aerosol species trends with p-value statistics less than 0.15 (85% confidence level) are presented in the table here, with increasing slopes in red and decreasing slopes in blue.[62] Some general observations for the current visibility conditions, and the difference between current and baseline conditions listed below:

- The largest contributors to aerosol extinction at the Colorado Plateau sites were particulate organic mass, ammonium sulfate, and coarse mass.
- For all sites, the 5-year average as measured in deciview metric decreased for the best days decreased between the baseline and first progress period.
- For most sites, the 5-year average as measured in deciview metric decreased for the worst days between the baseline and first progress period. Exceptions included GRCA2 and BALD1 in Arizona and BRCA1 and CAPI1 in Utah. Some contributing factors for aerosol measurements that affected increased in 5-year average deciviews are listed below.
    - The increase at GRCA2 was due to increases in ammonium sulfate, elemental carbon, particulate organic mass and soil, partially offset by decreases in ammonium nitrate and coarse mass. The particulate organic carbon increase was associated with high measurements due to fire events in June and August of 2009. No statistically significant increasing annual trends were measured for any of the species at the GRCA2 site.
    - Extinction remained relatively unchanged in terms of deciviews for the worst days measured at the BALD1 site. Increases in coarse mass, soil, and ammonium sulfate were offset by decreases in particulate organic mass, elemental carbon,

[61] Annual trends were calculated for the years 2000-2009, with a trend defined as the slope derived using Theil statistics. Trends derived from Theil statistics are useful in analyzing changes in air quality data because these statistics can show the overall tendency of measurements over long periods of time, while minimizing the effects of year-to-year fluctuations which are common in air quality data. Theil statistics are also used in EPA's National Air EPA's National Air Quality Trends Reports (http://www.epa.gov/airtrends/) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)

[62] The significance of the trend is represented with p-values calculated using Mann-Kendall trend statistics. Determining a significance level helps to distinguish random variability in data from a real tendency to increase or decrease over time, where lower p-values indicate higher confidence levels in the computed slopes.

and ammonium nitrate. Trend statistics showed an increasing coarse mass trend at the BALD1 and PEFO1 sites in eastern Arizona.

- At the BRCA1 and CAPI1 sites, the largest contributor to increases was particulate organic mass which, similar to GRCA2, was associated with large fires events in July and August 2009. These increases were offset by decreases in ammonium nitrate and ammonium sulfate. An increasing soil trend was measured for the worst days at the CAPI1 site.

- Increases in 5-year average ammonium sulfate were measured at many regional sites, although most sites showed decreasing annual average ammonium sulfate trends. The 5-year average was influenced by relatively high regional measurements of ammonium sulfate in 2005. Figure 5.1.3 presents a plot of the annual averages for all Colorado Plateau sites, showing the high values measured in 2005, followed by generally decreasing trends.

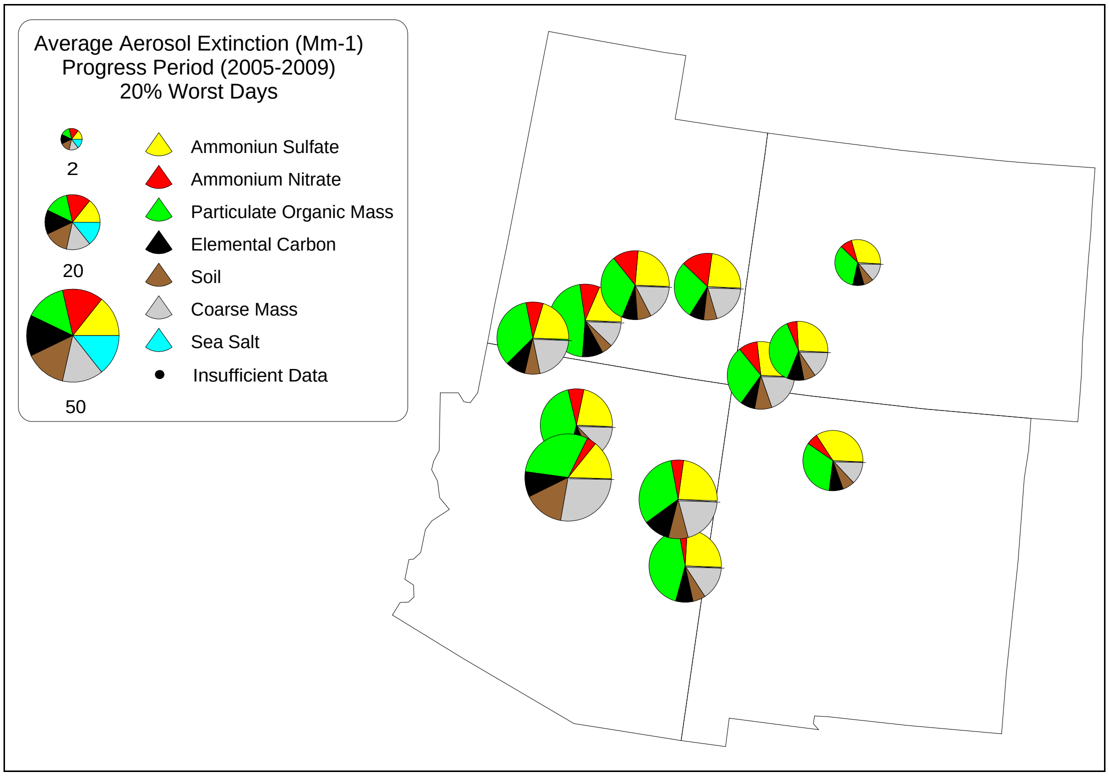


Figure 5.1-1. Regional Average of Aerosol Extinction by Pollutant for the First Progress Period Average (2005-2009) for 20% Worst Days.

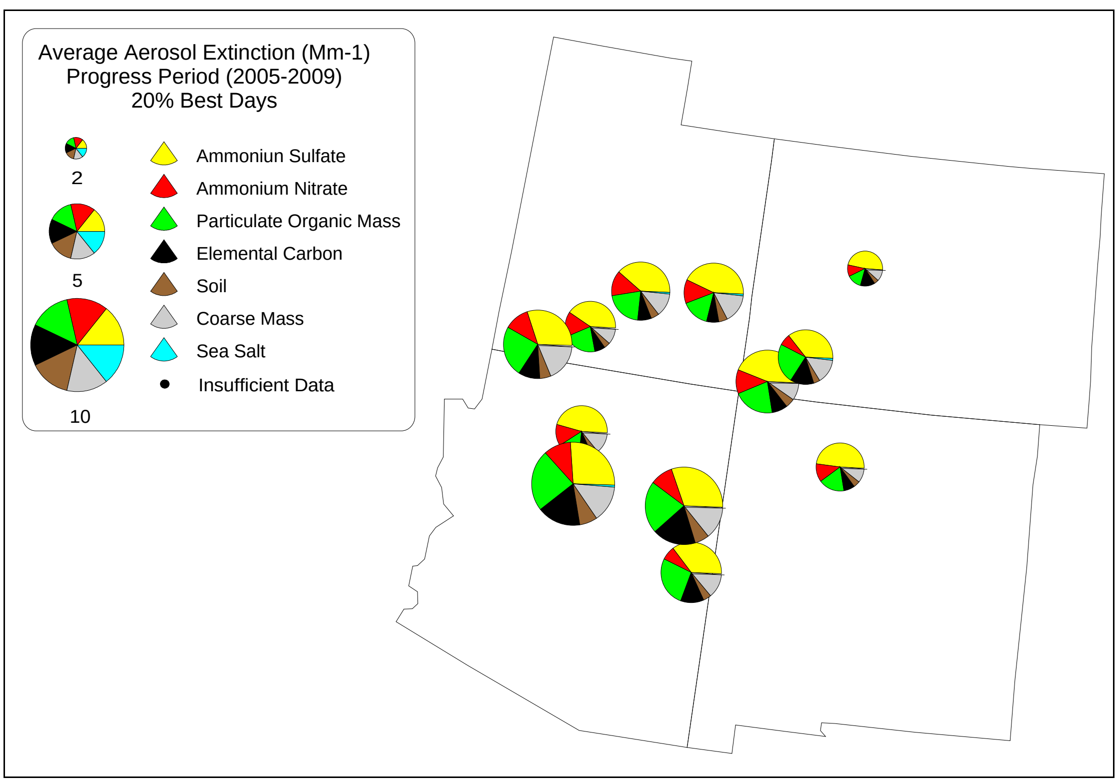


Figure 5.1-2. Regional Average of Aerosol Extinction by Pollutant for First Progress Period Average (2005-2009) for 20% Best Days.

Table 5.1-1
Colorado Plateau Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Most Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank*						
		Ammonium Sulfate	Ammonium Nitrate	Particulate Organic Mass	Elemental Carbon	Soil	Coarse Mass	Sea Salt
Arizona								
GRCA2	12.0	22% (2)	7% (5)	**41% (1)**	11% (4)	6% (6)	12% (3)	0% (7)
BALD1	11.8	25% (2)	4% (6)	**42% (1)**	8% (4)	6% (5)	16% (3)	0% (7)
PEFO1	13.0	23% (2)	5% (6)	**31% (1)**	11% (4)	8% (5)	21% (3)	1% (7)
SYCA1	15.2	15% (4)	4% (6)	**29% (1)**	9% (5)	15% (3)	28% (2)	0% (7)
Colorado								
WEMI1	10.0	27% (2)	5% (6)	**36% (1)**	10% (4)	7% (5)	15% (3)	0% (7)
WHRI1	8.9	30% (2)	8% (5)	**33% (1)**	8% (4)	7% (6)	13% (3)	0% (7)
MEVE1	11.3	27% (2)	9% (4)	**28% (1)**	7% (6)	9% (5)	20% (3)	0% (7)
New Mexico								
SAPE1	9.9	**34% (1)**	6% (6)	32% (2)	8% (4)	7% (5)	13% (3)	0% (7)
Utah								
BRCA1	11.9	19% (2)	9% (5)	**45% (1)**	10% (4)	5% (6)	12% (3)	0% (7)
CANY1	11.0	23% (2)	14% (4)	**27% (1)**	7% (5)	7% (6)	20% (3)	0% (7)
CAPI1	11.3	24% (2)	12% (4)	**32% (1)**	8% (5)	7% (6)	17% (3)	0% (7)
ZICA1	12.3	21% (3)	7% (5)	**33% (1)**	9% (4)	7% (6)	22% (2)	0% (7)

*Highest aerosol species contribution per site is highlighted in bold.

Table 5.1-2
Colorado Plateau Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Least Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank*						
		Ammonium Sulfate	Ammonium Nitrate	Particulate Organic Mass	Elemental Carbon	Soil	Coarse Mass	Sea Salt
Arizona								
GRCA2	2.2	**45% (1)**	13% (4)	15% (2)	9% (5)	4% (6)	14% (3)	1% (7)
BALD1	2.9	**35% (1)**	7% (5)	26% (2)	13% (4)	5% (6)	13% (3)	1% (7)
PEFO1	4.6	**31% (1)**	9% (5)	21% (2)	19% (3)	6% (6)	14% (4)	0% (7)
SYCA1	5.1	**27% (1)**	10% (5)	23% (2)	17% (3)	7% (6)	15% (4)	1% (7)
Colorado								
WEMI1	2.4	**36% (1)**	6% (5)	23% (2)	15% (4)	4% (6)	15% (3)	1% (7)
WHRI1	0.2	**46% (1)**	10% (5)	14% (3)	15% (2)	5% (6)	11% (4)	0% (7)
MEVE1	3.1	**44% (1)**	12% (3)	21% (2)	9% (5)	5% (6)	9% (4)	0% (7)
New Mexico								
SAPE1	1.0	**47% (1)**	12% (3)	18% (2)	8% (5)	5% (6)	10% (4)	1% (7)
Utah								
BRCA1	11.9	19% (2)	9% (5)	**45% (1)**	10% (4)	5% (6)	12% (3)	0% (7)
CANY1	11.0	23% (2)	14% (4)	**27% (1)**	7% (5)	7% (6)	20% (3)	0% (7)
CAPI1	11.3	24% (2)	12% (4)	**32% (1)**	8% (5)	7% (6)	17% (3)	0% (7)
ZICA1	12.3	21% (3)	7% (5)	**33% (1)**	9% (4)	7% (6)	22% (2)	0% (7)

*Highest aerosol species contribution per site is highlighted in bold.

Table 5.1-3
Colorado Plateau Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Most Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona										
GRCA2	11.7	12.0	+0.3	+0.5	-0.4	+0.1	+0.5	+0.1	-0.3	0.0
BALD1	11.8	11.8	0.0	+0.3	-0.1	-2.1	-0.7	+0.4	+1.3	+0.1
PEFO1	13.2	13.0	-0.2	+0.5	-0.3	-1.4	+0.5	+0.6	-1.0	+0.1
SYCA1	15.3	15.2	-0.1	+0.7	-0.7	-0.5	+0.4	-1.0	+1.4	0.0
Colorado										
WEMI1	10.3	10.0	-0.3	+0.1	-0.2	-1.4	-0.2	+0.1	0.0	-0.1
WHRI1	9.6	8.9	-0.7	+0.3	0.0	-2.3	-0.3	+0.1	-0.5	0.0
MEVE1	13.0	11.3	-1.7	-0.2	-0.3	-5.8	-0.7	-0.5	-2.0	0.0
New Mexico										
SAPE1	10.2	9.9	-0.3	+1.0	-0.4	-1.4	-0.1	-0.1	-0.2	0.0
Utah										
BRCA1	11.6	11.9	+0.3	-0.2	-0.3	+2.5	+0.2	+0.1	-0.9	0.0
CANY1	11.2	11.0	-0.2	-0.3	+0.3	-0.9	-0.1	+0.1	+0.8	0.0
CAPI1	10.9	11.3	+0.4	-0.2	-0.7	+1.8	+0.2	+0.3	+0.7	+0.1
ZICA1	12.5	12.3	-0.2	+0.2	-0.3	-0.8	-0.1	+0.1	0.0	+0.1

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 5.1-4
Colorado Plateau Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Least Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona										
GRCA2	2.2	2.2	0.0	+0.1	0.0	-0.1	0.0	0.0	0.0	0.0
BALD1	3.0	2.9	-0.1	-0.1	-0.1	-0.1	0.0	0.0	+0.1	0.0
PEFO1	5.0	4.6	-0.4	-0.1	-0.2	-0.4	0.0	+0.1	0.0	0.0
SYCA1	5.6	5.1	-0.5	+0.1	-0.1	-0.6	-0.2	-0.1	+0.1	0.0
Colorado										
WEMI1	3.1	2.4	-0.7	-0.1	-0.1	-0.4	-0.2	0.0	-0.1	0.0
WHRI1	0.7	0.2	-0.5	0.0	-0.1	-0.3	-0.1	0.0	0.0	0.0
MEVE1	4.3	3.1	-1.2	-0.3	-0.3	-0.5	-0.2	-0.2	-0.3	0.0
New Mexico										
SAPE1	1.5	1.0	-0.5	-0.1	-0.1	-0.2	-0.1	0.0	0.0	0.0
Utah										
BRCA1	2.8	2.1	-0.7	-0.1	-0.2	-0.3	-0.2	0.0	-0.1	0.0
CANY1	3.7	2.8	-0.9	-0.3	-0.1	-0.5	-0.1	-0.1	-0.2	0.0
CAPI1	4.1	2.7	-1.4	-0.3	-0.4	-0.5	-0.2	-0.1	-0.4	0.0
ZICA1	5.0	4.3	-0.7	-0.1	-0.2	-0.5	-0.2	0.0	-0.1	0.0

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 5.1-5
Colorado Plateau Class I Area IMPROVE Sites
Change in Aerosol Extinction by Species
2000-2009 Annual Average Trends

Site	Group	Annual Trend* (Mm^{-1}/year)						
		Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona								
GRCA2	20% Best	--	--	--	0.0	--	--	0.0
	20% Worst	--	**-0.1**	--	--	--	--	--
	All Days	--	0.0	--	--	--	--	--
BALD1	20% Best	--	0.0	--	0.0	--	0.0	0.0
	20% Worst	**-0.2**	--	--	--	**0.1**	**0.3**	0.0
	All Days	**-0.1**	0.0	--	--	--	**0.1**	0.0
PEFO1	20% Best	--	0.0	**-0.1**	--	--	--	0.0
	20% Worst	--	--	--	--	**0.1**	--	0.0
	All Days	--	0.0	--	--	0.0	**0.1**	0.0
SYCA1	20% Best	--	--	**-0.1**	--	--	--	0.0
	20% Worst	--	--	--	0.1	**-0.3**	--	--
	All Days	--	0.0	--	--	**-0.1**	--	--
Colorado								
WEMI1	20% Best	**-0.1**	0.0	**-0.1**	**-0.1**	--	--	--
	20% Worst	--	--	--	0.0	--	--	--
	All Days	--	0.0	--	**-0.1**	--	--	--
WHRI1	20% Best	--	0.0	**-0.1**	0.0	--	--	--
	20% Worst	--	--	--	**-0.1**	--	--	0.0
	All Days	--	--	**-0.1**	0.0	--	--	0.0
MEVE1	20% Best	**-0.1**	0.0	**-0.1**	0.0	0.0	0.0	--
	20% Worst	--	--	--	**-0.2**	--	--	0.0
	All Days	**-0.1**	--	**-0.3**	**-0.1**	--	--	0.0
New Mexico								
SAPE1	20% Best	--	0.0	0.0	0.0	--	--	--
	20% Worst	--	**-0.1**	--	--	--	--	--
	All Days	--	0.0	**-0.1**	0.0	--	0.0	0.0
Utah								
BRCA1	20% Best	--	0.0	**-0.1**	0.0	--	0.0	0.0
	20% Worst	**-0.2**	--	**0.5**	**0.1**	--	--	0.0
	All Days	**-0.1**	0.0	--	--	--	--	--
CANY1	20% Best	**-0.1**	--	**-0.1**	0.0	--	**-0.1**	0.0
	20% Worst	**-0.1**	--	--	--	--	--	0.0
	All Days	**-0.1**	0.0	--	0.0	0.0	--	0.0
CAPI1	20% Best	**-0.1**	**-0.1**	**-0.1**	0.0	--	**-0.1**	--
	20% Worst	--	**-0.2**	--	--	**0.1**	--	0.0
	All Days	**-0.1**	**-0.1**	--	0.0	--	--	0.0
ZICA1	20% Best	0.0	--	--	0.0	0.0	--	0.0
	20% Worst	**-0.5**	--	--	--	--	--	--
	All Days	**-0.2**	--	--	**-0.1**	**0.1**	--	--

*(--) Indicates statistically insignificant trend (<85% confidence level). Annual averages and complete trend statistics for all significance levels are included for each site in state specific appendices.

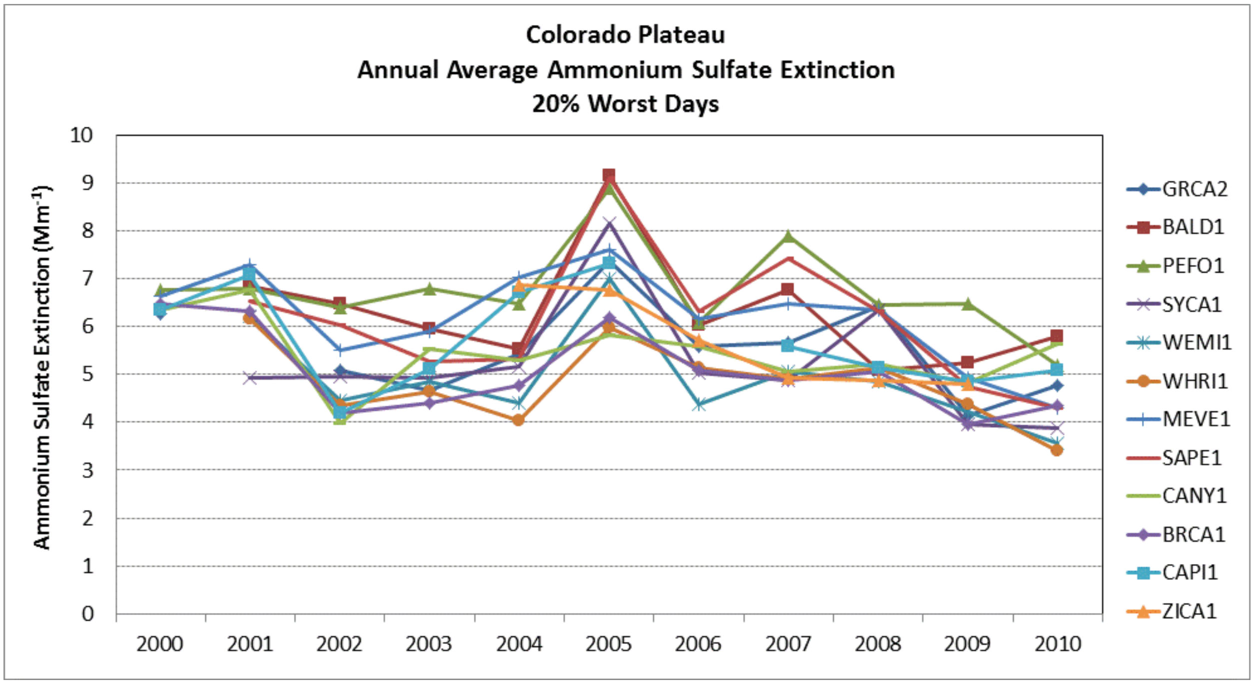


Figure 5.1-3. Chart Depicting Annual Average Ammonium Sulfate Concentrations for the 20% Worst Days as Measured at the Colorado Plateau CIA IMPROVE Sites.

5.2 EMISSIONS DATA

Similar to Section 308 requirements, Section 309 states are required to address how total emissions state have changes over the past 5 years (51.309(d)(10)(i)(D)). Summaries depicting differences between emission inventories are included for all WRAP states in Section 3, and for each state individually in Section 6.0, using 2002 and 2008 inventories to represent changes between the baseline and progress periods. These inventories are described in detail in Section 3.2.

In addition to tracking these differences in inventories, for the initial SIPS, Section 309 states were required to identify "clean air corridors" and track emissions inside and outside of these corridors that may affect impairment on the cleanest days.[63] In these initial 309 SIPs, an area covering major portions of Nevada, southern Utah, eastern Oregon and southwestern Idaho was defined as a "clean air corridor," which was intended to represent a region from which clean air transport influences many of the clean air days at Grand Canyon National Park. As noted in Section 5.1, visibility has improved for the best days at all of the CIA sites on the Colorado Plateau, so emissions specific to the "clean air corridor" counties are not presented separately here.

[63] Section 51.309(d)(3) states, for treatment of clean-air corridors, "the plan must describe and provide for implementation of comprehensive emission tracking strategies for clean-air corridors to ensure that the visibility does not degrade on the least-impaired days at any of the 16 Class I areas."

Also, under Section 309 of the RHR, the participating states (and county) are required to identify sulfur dioxide (SO_2) emissions milestones, where a milestone is a maximum level of annual emissions for a given year (51.309(d)(4)(i)). In general, SO_2 emissions are specified in Section 309 because they are more instructive to track than most other pollutants, as they are generally associated with a small number of large sources, and can be measured and tracked with more certainty than some of the other pollutants that impact visibility. Separate work by the WRAP supports the submittal of annual regional SO_2 and emission milestone reports for the 309 states which compare actual emissions estimates to the pre-defined milestones.[64] Figure 5.1-4 presents a plot from the most recent WRAP SO_2 milestone report, showing the 3-year average of current emissions through 2010, which indicated that actual emissions were below SO_2 milestone. Additionally, SO_2 emissions specific to EGU sources are presented in Section 6.0 on an annual basis showing changes in these sources between 1996 and 2010 for each WRAP state.

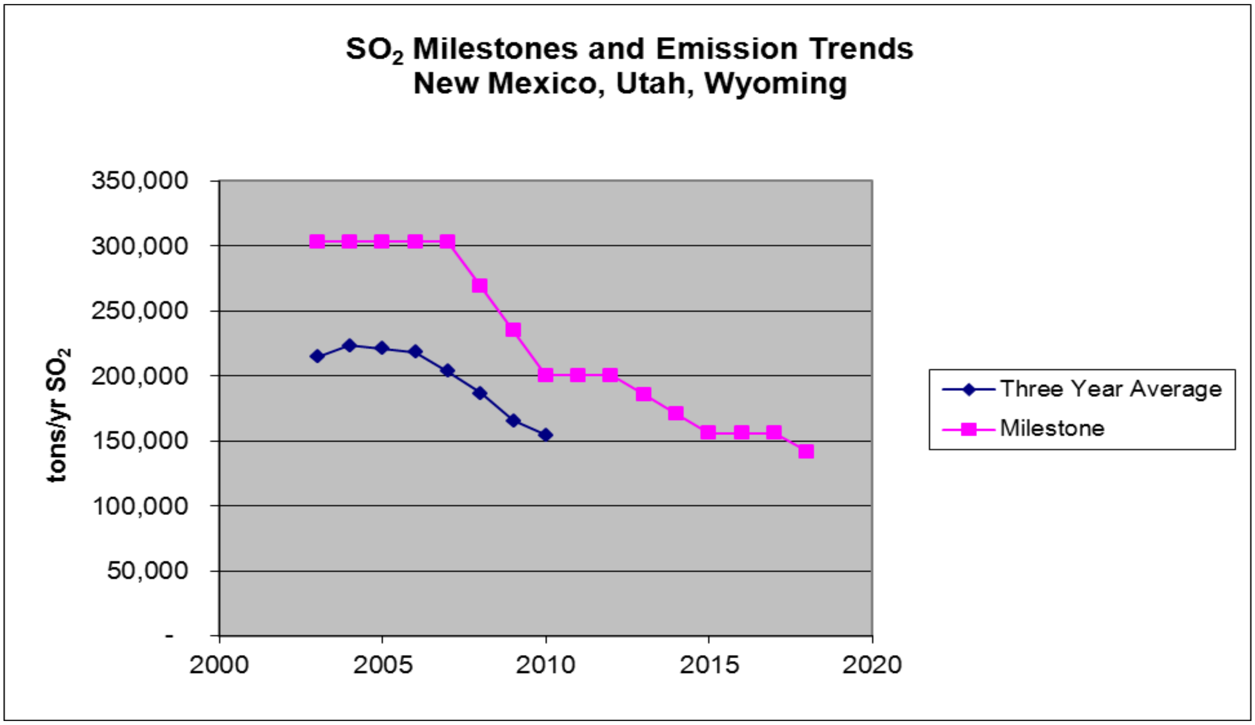


Figure 5.1-4. Chart Depicting 3-Year Average Sum of SO_2 emissions for New Mexico, Utah, and Wyoming and the city of Albuquerque/Bernalillo County as compared to the 309 SIP SO_2 Milestones.

[64] Annual regional SO_2 emissions and milestone reports are located on the WRAP website at http://www.wrapair2.org/reghaze.aspx.

6.0 STATE AND CLASS I AREA SUMMARIES

As described in Section 2.0, each state is required to submit progress reports at interim points between submittals of Regional Haze Rule (RHR) State Implementation Plans (SIPs), which assess progress towards visibility improvement goals in each state's mandatory Federal Class I areas (CIAs). Data summaries for each CIA in each Western Regional Air Partnership (WRAP) state, which address Regional Haze Rule (RHR) requirements for visibility measurements and emissions inventories are provided in this section. These summaries are intended to provide individual states with the technical information they need to determine if current RHR implementation plan elements and strategies are sufficient to meet all established reasonable progress goals, as defined in their respective initial RHR implementation plans.

6.5 HAWAII

The goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve at each Federal Class I area (CIA), and that visibility on the 20% least impaired, or best, days does not get worse, as measured at representative Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites. Hawaii has 2 mandatory Federal CIAs, which are depicted in Figure 6.5-1 and listed in Table 6.5-1, along with the associated IMPROVE monitor locations. Note that two sites are listed to represent the Haleakala CIA, but one site (HALE1) was discontinued in 2012, and the other site (HACR1) began operation in 2007. Data collected from both sites are summarized in this report, but future regional haze progress will be determined using only the HACR1 site.

This section addresses differences between the 2000-2004 baseline and 2005-2009 period, for both monitored data and emission inventory estimates. Monitored data are presented for the 20% most impaired, or worst, days and for the 20% least impaired, or best, days, as per Regional Haze Rule (RHR) requirements. Annual average trend statistics for the 2000-2009 10-year period are also presented here to support assessments of changes in each monitored species that contributes to visibility impairment. Some of the highlights regarding these comparisons are listed below, and more detailed state specific information is provided in monitoring and emissions sub-sections that follow.

- The 5-year average deciview metric decreased between the baseline and progress period at all 3 sites on best days, and increased on the worst days.
- The largest aerosol contributor to increases on the worst days was ammonium sulfate. The major source of ammonium sulfate for the State of Hawaii is SO_2 emissions from volcanic sources.
- Increases in ammonium sulfate were partially offset by decreases in ammonium nitrate, particulate organic mass and elemental carbon at all sites. Decreases in emissions inventories oxides of nitrogen (NO_X) were shown for mobile and point sources, but these were offset by increases in marine emissions.
- Slight increases for the worst days were observed in soil and coarse mass at the HAVO1 site, but these soil and coarse mass components combined comprised less than 2% of the total measured extinction.

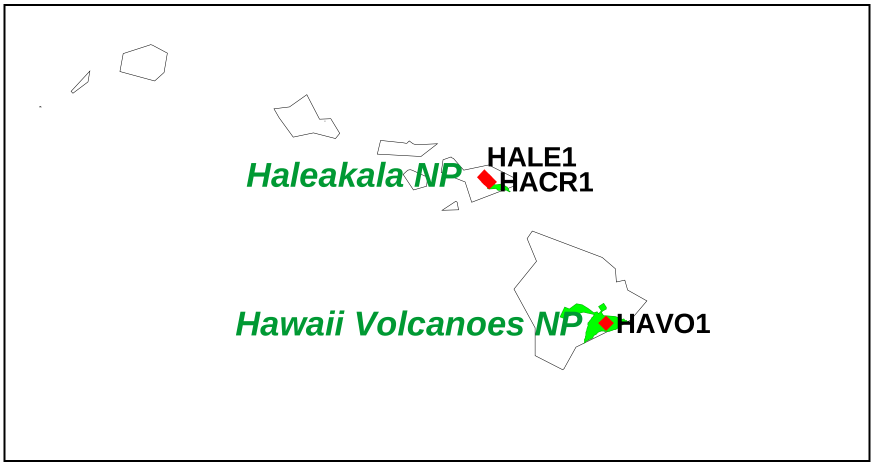


Figure 6.5-1. Map Depicting Federal CIAs and Representative IMPROVE Monitors in Hawaii.

Table 6.5-1
Hawaii CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Haleakala NP	HACR1*	20.76	-156.25	2158
	HALE1*	20.81	-156.28	1153
Hawaii Volcanoes NP	HAVO1	19.43	-155.26	1258

*Monitoring at the HACR1 site began in 2007 and monitoring at the HALE1 site was discontinued in 2012.

6.5.1 Monitoring Data

This section addresses RHR regulatory requirements for monitored data as measured by IMPROVE monitors representing Federal CIAs in Hawaii, including estimates of baseline concentrations for the Haleakala HACR1 site. These summaries are supported by regional data presented in Section 4.0 and by more detailed site specific tables and charts in Appendix E.

As described in Section 3.1, regional haze progress in Federal CIAs is tracked using calculations based on speciated aerosol mass as collected by IMPROVE monitors. The RHR calls for tracking haze in units of deciviews (dv), where the deciview metric was designed to be linearly associated with human perception of visibility. In a pristine atmosphere, the deciview metric is near zero, and a one deciview change is approximately equivalent to a 10% change in cumulative species extinction. To better understand visibility conditions, summaries here include both the deciview metric, and the apportionment of haze into extinction due to the various measured species in units of inverse megameters (Mm^{-1}).

6.5.1.1 Haleakala Baseline Estimate

In Hawaii, the HALE1 IMPROVE monitor began operation in 2000 at a site approximately 3.5 miles outside of Haleakala National Park boundaries. In 2007 a second IMPROVE monitor, HACR1, was installed at a higher elevation within park boundaries. The intention of the HACR1 site was to replace the HALE1 site, as the new HACR1 site was determined to be more representative of conditions in the park. A map depicting both Haleakala sites is presented in Figure 6.5-2. Data from the HALE1 site were used to represent Haleakala in the Hawaii RHR Federal Implementation Plan (FIP), but progress for both the HALE1 and HACR1 sites will be presented in Hawaii's first RHR progress report. Future RHR SIPs and progress updates will use only HACR1 data, as monitoring at the HALE1 site was discontinued in 2012.

RHR guidelines require that progress be measured again the 2000-2004 baseline period[81], but baseline data were not measured at the HACR1 location. The RHR also states that approximations should be made for baseline conditions if these monitoring data are not available.[82] A methodology to estimate baseline conditions for the HACR1 site was developed in consultation with staff from the State of Hawaii Department of Health – Clean Air Branch, the National Park Service, and U.S. EPA Region 9. This methodology and baseline results are presented in this section.

[81] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (see page 4-2 in the Guidance document).
[82] Section 308(d)(2)(i) of the RHR states, "For mandatory Class I Federal areas without onsite monitoring data for 2000-2004, the State must establish baseline values using the most representative available monitoring data for 2000-2004, in consultation with the Administrator or his or her designee."

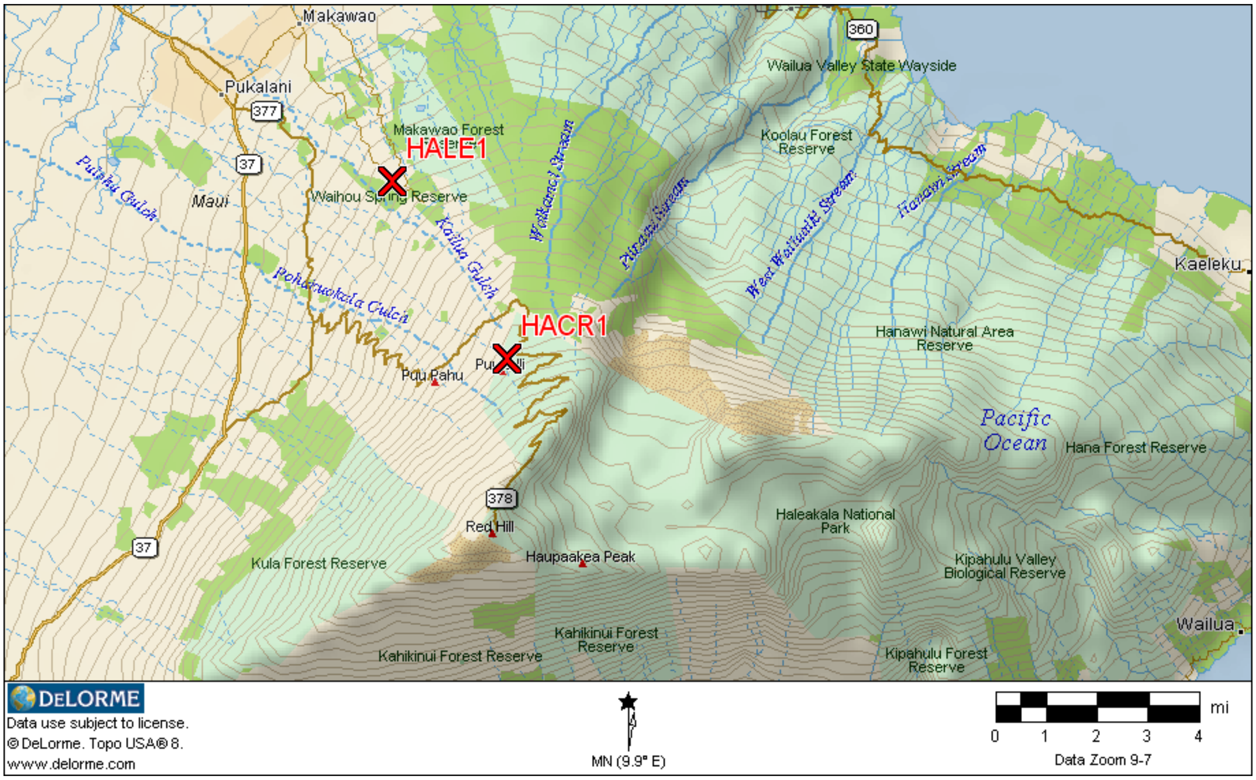


Figure 6.5-2. Map of HALE1 and HACR1 Sites Representing Haleakala National Park.

Both baseline (2000-2004) and first progress period (2004-2009) average data were available for the HALE1 site, but only the progress period average was available for the HACR1 site. To estimate baseline conditions at the HACR1 site, ratios between the 2005-2009 progress period and the 2000-2004 baseline period were determined for each aerosol species at the HALE1 site, for both the 20% most impaired and 20% least impaired days. These ratios were then applied to the HACR1 progress period to estimate a 5-year average baseline for each species. Table 6.5-2 lists the average progress to baseline period ratios for the HALE1 for the 20% most impaired days and least impaired days. These average ratios were applied to the 2005-2009 progress period for HACR1 site to obtain species and group specific estimates, such that, for each species:

$$\frac{\text{HACR1 Progress Period}}{\text{HALE } \frac{\text{Progress}}{\text{Baseline}} \text{ Average}} = \text{HACR1 Baseline Period Estimate}$$

Table 6.5-2
HALE1 Averages and Ratios

Species	Group	2000-2004 Baseline Period	2005-2009 Progress Period	HALE1 Progress/ Baseline Ratio
Ammonium Sulfate (Mm^{-1})	Best 20% Days	2.2	2.1	0.96
	Worst 20% Days	17.5	26.5	1.51
Ammonium Nitrate (Mm^{-1})	Best 20% Days	0.6	0.4	0.76
	Worst 20% Days	2.7	2.1	0.79
Particulate Organic Mass (Mm^{-1})	Best 20% Days	0.7	0.5	0.76
	Worst 20% Days	2.9	2.2	0.77
Elemental Carbon (Mm^{-1})	Best 20% Days	0.2	0.2	0.79
	Worst 20% Days	1.4	1.2	0.84
Soil (Mm^{-1})	Best 20% Days	0.1	0.1	0.89
	Worst 20% Days	0.4	0.4	1.08
Coarse Mass (Mm^{-1})	Best 20% Days	1.0	0.9	0.82
	Worst 20% Days	2.6	1.9	0.73
Sea Salt (Mm^{-1})	Best 20% Days	1.1	1.5	1.37
	Worst 20% Days	1.3	2.0	1.54

Because of the logarithmic nature of the deciview calculation (i.e., $dv = 10\ln(b_{ext}/10)$), average deciview ratios were not applied. Instead, in a manner consistent with RHR calculations, ratios were applied to individual species and individual days, and 5-year average deciview value was calculated from annual average deciviews, which was in turn calculated from daily average deciview values. Table 6.5-3 lists results for the HACR1 site, showing deciview values for the baseline period approximated as being slightly higher than the measured progress period for both the 20% most impaired and least impaired days. These estimated baseline averages are used to represent the HACR1 for all summaries presented in this report. Note that similar baseline estimates have also been applied to estimate baseline conditions for the ZICA1 site in Utah, as described in Section 6.13.1.1.

Table 6.5-3
HACR1 Baseline Estimates

Species	Group	HACR1 2005-2009 Progress Period	HALE1 Progress/ Baseline Ratio	HACR1 2000-2004 Baseline Estimate
Ammonium Sulfate (Mm^{-1})	Best 20% Days	1.0	1.0	1.07
	Worst 20% Days	16.5	1.5	10.93
Ammonium Nitrate (Mm^{-1})	Best 20% Days	0.1	0.8	0.18
	Worst 20% Days	1.1	0.8	1.39
Particulate Organic Mass (Mm^{-1})	Best 20% Days	0.1	0.8	0.09
	Worst 20% Days	1.8	0.8	2.39
Elemental Carbon (Mm^{-1})	Best 20% Days	0.0	0.8	0.05
	Worst 20% Days	0.6	0.8	0.76
Soil (Mm^{-1})	Best 20% Days	0.1	0.9	0.08
	Worst 20% Days	0.4	1.1	0.41
Coarse Mass (Mm^{-1})	Best 20% Days	0.3	0.8	0.38
	Worst 20% Days	1.7	0.7	2.32
Sea Salt (Mm^{-1})	Best 20% Days	0.3	1.4	0.22
	Worst 20% Days	0.7	1.5	0.48
Deciviews (dv)	Best 20% Days	0.9	N/A	**1.00***
	Worst 20% Days	10.8	N/A	**9.48***

*Calculated from daily average b_{ext} determined using species specific average ratios from HALE1 site

6.5.1.2 Current Conditions

This section addresses the regulatory question, ***what are the current visibility conditions for the most impaired and least impaired days (40 CFR 51.308 (g)(3)(i))?*** RHR guidance specifies that 5-year averages be calculated over successive 5-year periods, i.e. 2000-2004, 2005-2009, 2010-2014, etc.[83] Current visibility conditions are represented here as the most recent successive 5-year average period available, or the 2005-2009 period average, although the most recent IMPROVE monitoring data currently available includes 2010 data.

Tables 6.5-2 and 6.5-3 present the calculated deciview values for current conditions at each site, along with the percent contribution to extinction from each aerosol species for the 20% most impaired, or worst, and 20% least impaired, or best, days for each of the Federal CIA IMPROVE monitors in Hawaii. Figure 6.5-2 presents 5-year average extinction for the current progress period for both the 20% most impaired and 20% least impaired days. Note that the

[83] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (See page 4-2 in the Guidance document.)

percentages in the tables consider only the aerosol species which contribute to extinction, while the charts also show Rayleigh, or scattering due to background gases in the atmosphere.

Specific observations for the current visibility conditions on the 20% most impaired days are as follows:

- The highest aerosol extinction (24.9 dv) was measured at the HAVO1 site, and the lowest aerosol extinction (10.8 dv) was measured at the HACR1 site.
- The largest contributors to aerosol extinction at Hawaii sites was ammonium sulfate (72-96% of aerosol extinction).

Specific observations for the current visibility conditions on the 20% least impaired days are as follows:

- The aerosol contribution to total extinction on the best days was less than Rayleigh, or the background scattering that would occur in clear air. Average extinction (including Rayleigh) ranged from 0.9 dv (HACR1) to 4.4 dv (HALE1).

Table 6.5-2
Hawaii Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Most Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
HACR1	10.8	**72% (1)**	5% (4)	8% (2)	3% (6)	2% (7)	7% (3)	3% (5)
HALE1	14.8	**73% (1)**	6% (3)	6% (2)	3% (6)	1% (7)	5% (5)	5% (4)
HAVO1	24.9	**96% (1)**	0% (6)	1% (2)	1% (5)	0% (7)	1% (4)	1% (3)

*Highest aerosol species contribution per site is highlighted in bold.

Table 6.5-3
Hawaii Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Least Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
HACR1	0.9	**52% (1)**	7% (4)	4% (6)	2% (7)	4% (5)	16% (2)	15% (3)
HALE1	4.4	**37% (1)**	8% (5)	9% (4)	3% (6)	2% (7)	15% (3)	27% (2)
HAVO1	3.8	**47% (1)**	6% (4)	3% (5)	1% (6)	1% (7)	8% (3)	34% (2)

*Highest aerosol species contribution per site is highlighted in bold.

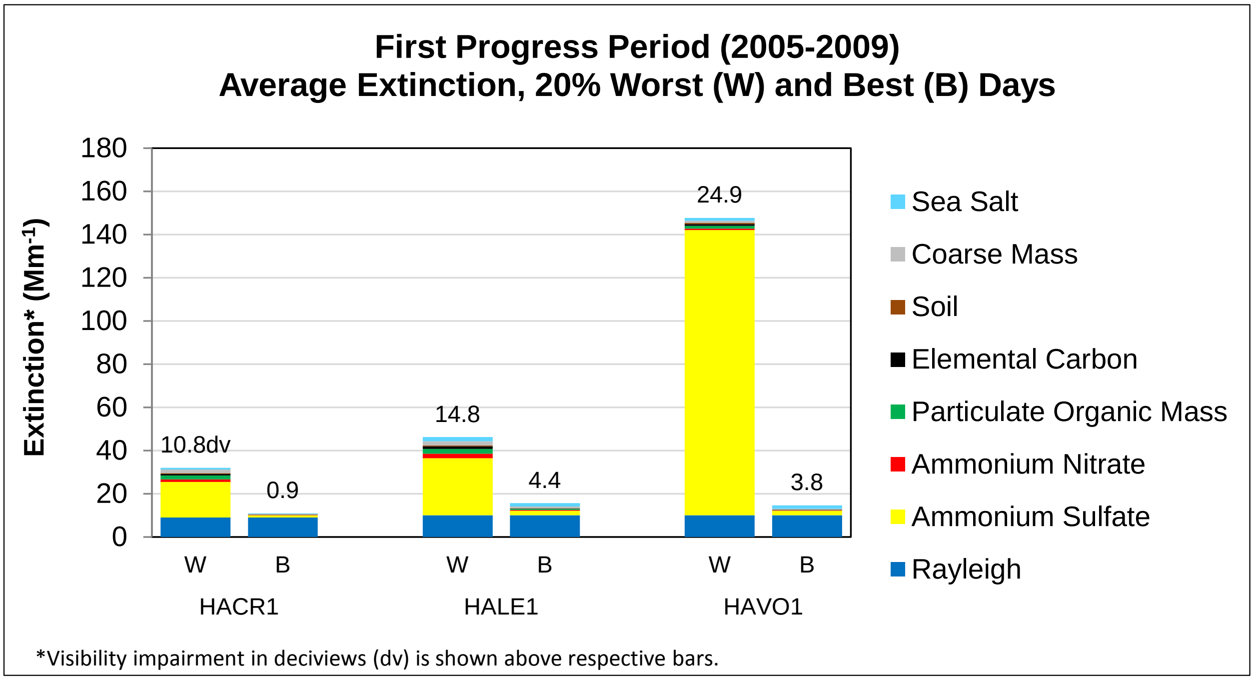


Figure 6.5-2. Average Extinction for Current Progress Period (2005-2009) for the Worst (Most Impaired) and Best (Least Impaired) Days Measured at Hawaii Class I Area IMPROVE Sites.

6.5.1.3 Differences between Current and Baseline Conditions

This section addresses the regulatory question, ***what is the difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions (40 CFR 51.308 (g)(3)(ii))?*** Included here are comparisons between the 5-year average baseline conditions (2000-2004) and current progress period extinction (2005-2009).

Table 6.5-4 presents the differences between the 2000-2004 baseline period average extinction and the 2005-2009 progress period average for each site in Hawaii for the 20% most impaired days, and Table 6.5-5 presents similar data for the least impaired days. Averages that increased are depicted in red text and averages that decreased in blue.

Figure 6.5-3 presents the 5-year average extinction for the baseline and current progress period averages for the worst days and Figure 6.5-4 presents the differences in averages by aerosol species, with increases represented above the zero line and decreases below the zero line. Figures 6.5-5 and 6.5-6 present similar plots for the best days.

For the 20% most impaired days, the 5-year average RHR deciview metric increased between the 2000-2004 and 2005-2009 periods at all three Hawaii sites. Notable differences for individual species averages were as follows:

- At all three sites, increases in deciview were mostly due to increases in ammonium sulfate. These increases were partially offset by decreases in particulate organic mass, ammonium nitrate and elemental carbon.

- The HAVO1 site showed slight increases in soil and coarse mass.

For the 20% least impaired days, the 5-year average deciview metric decreased at all three Hawaii sites. Notable differences for individual species averages on the 20% least impaired days were as follows:

- The largest increases were measured in sea salt, but these increases were offset by decreases in most other species.

Table 6.5-4
Hawaii Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Most Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-2004 Baseline Period	2005-2009 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
HACR1	9.5	10.8	+1.3	+5.6	-0.3	-0.6	-0.1	0.0	-0.6	+0.3
HALE1	13.3	14.8	+1.5	+8.9	-0.6	-0.7	-0.2	0.0	-0.7	+0.7
HAVO1	18.9	24.9	+6.0	+72.2	-0.3	-1.2	-0.2	+0.2	+0.3	+0.1

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 6.5-5
Hawaii Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Least Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-2004 Baseline Period	2005-2009 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
HACR1	1.0	0.9	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	+0.1
HALE1	4.5	4.4	-0.1	-0.1	-0.1	-0.2	0.0	0.0	-0.2	+0.4
HAVO1	4.1	3.8	-0.3	0.0	0.0	-1.0	-0.1	0.0	0.0	+0.7

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

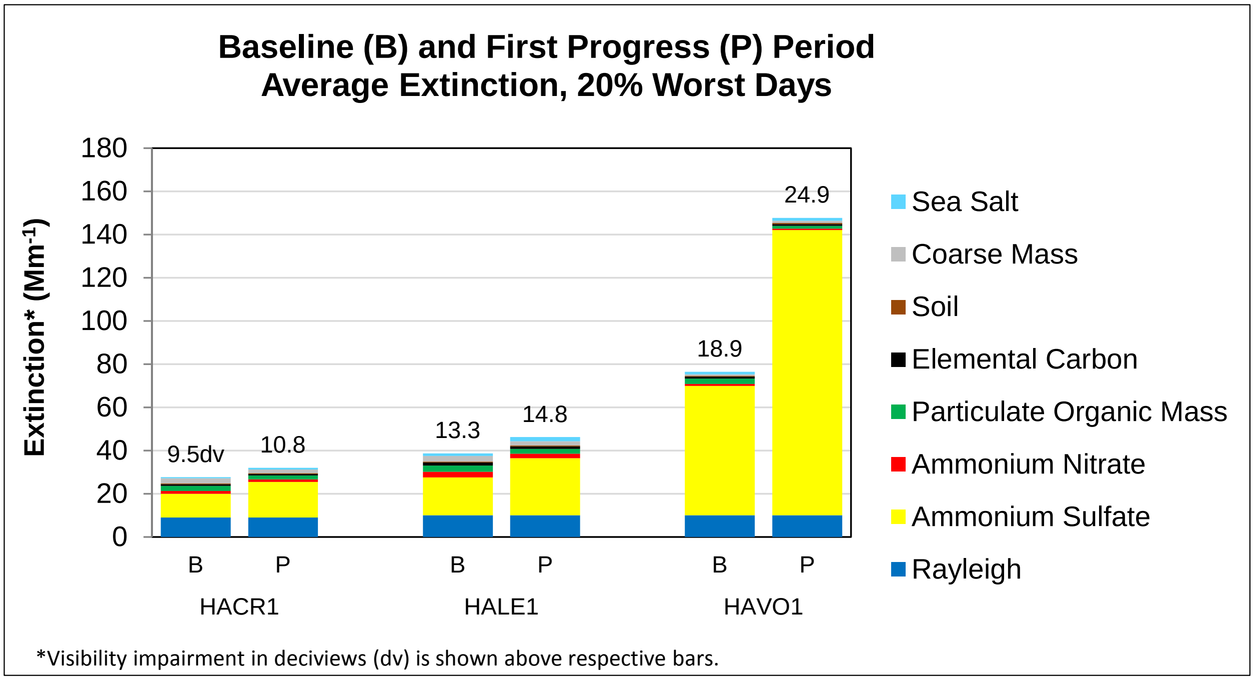


Figure 6.5-3. Average Extinction for Baseline and Progress Period Extinction for Worst (Most Impaired) Days Measured at Hawaii Class I Area IMPROVE Sites.

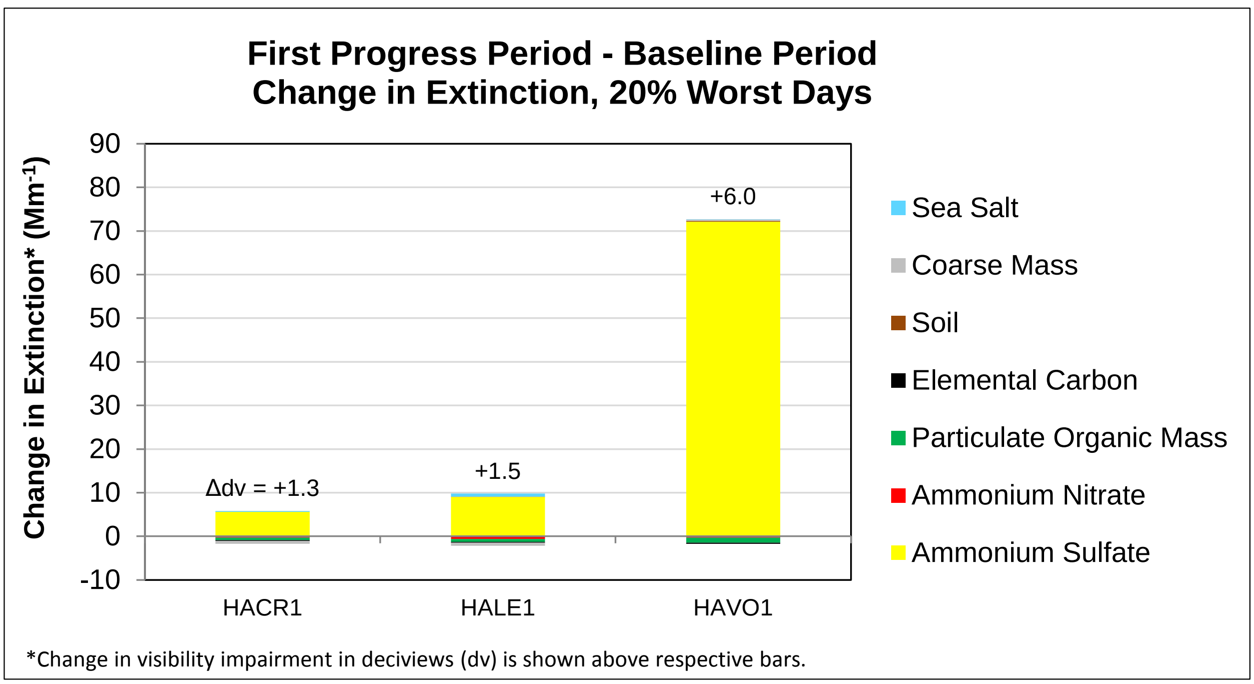


Figure 6.5-4. Difference between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Worst (Most Impaired) Days Measured at Hawaii Class I Area IMPROVE Sites.

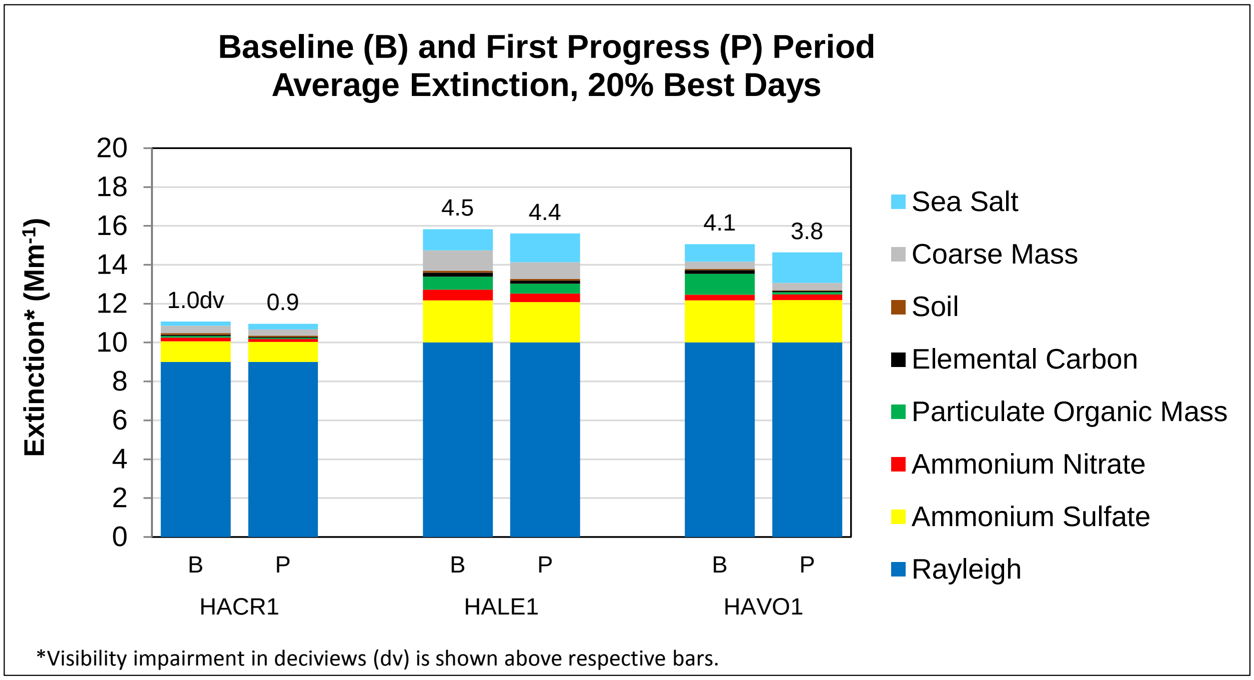


Figure 6.5-5. Average Extinction for Baseline and Progress Period Extinction for Best (Least Impaired) Days Measured at Hawaii Class I Area IMPROVE Sites.

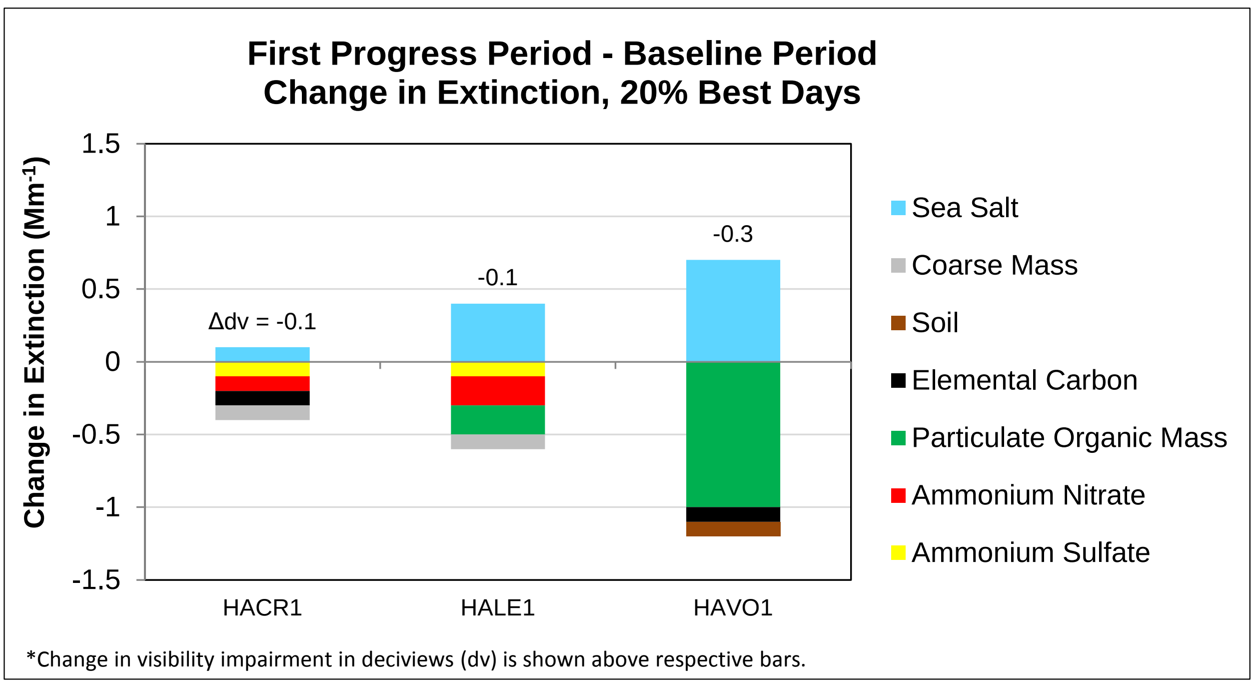


Figure 6.5-6. Difference Between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Best (Least Impaired) Days Measured at Hawaii Class I Area IMPROVE Sites.

6.5.1.4 Changes in Visibility Impairment

This section addresses the regulatory question, ***what is the change in visibility impairment for the most impaired and least impaired days over the past 5 years (40 CFR 51.308 (g)(3)(iii))?*** Included here are changes in visibility impairment as characterized by annual average trend statistics, and some general observations regarding local and regional events and outliers on a daily and annual basis that affected the current 5-year progress period. The regulatory requirement asks for a description of changes over the past 5-year period, but trend analysis is better suited to longer periods of time, so trends for the entire 10-year planning period are presented here.

Trend statistics for the years 2000-2009 for each species at each site in Hawaii are summarized in Table 6.5-6, and regional trends were presented earlier in Section 4.1.1.[84] Only trends for aerosol species trends with p-value statistics less than 0.15 (85% confidence level) are presented in the table here, with increasing slopes in red and decreasing slopes in blue.[85] In some cases, trends may show decreasing tendencies while the difference between the 5-year averages do not (or vice versa), as discussed in Section 3.1.2.2. In these cases, the 5-year average for the best and worst days is the important metric for RHR regulatory purposes, but trend statistics may be of value to understand and address visibility impairment issues for planning purposes.

For each site, a more comprehensive list of all trends for all species, including the associated p-values, is provided in Appendix E. Additionally, this appendix includes plots depicting 5-year, annual, monthly, and daily average extinction for each site. These plots are intended to provide a fairly comprehensive compilation of reference information for individual states to investigate local and regional events and outliers that may have influenced changes in visibility impairment as tracked using the 5-year deciview metrics. Note that similar summary products are also available from the WRAP TSS website (http://vista.cira.colostate.edu/tss/). Some general observations regarding changes in visibility impairment at sites in Hawaii are as follows:

- Ammonium sulfate, which is associated with volcanic activity in Hawaii, dominated aerosol extinction. The 5-year averages were higher during the progress period, and trend statistics showed increasing annual averages. Ammonium sulfate extinction at the HAVO1 site began climbing in 2007, with highs in 2008 and 2009. Ammonium sulfate extinction at the HACR1 and HALE1 site measured highest in 2008, with the largest events generally occurring in the spring.

[84] Annual trends were calculated for the years 2000-2009, with a trend defined as the slope derived using Theil statistics. Trends derived from Theil statistics are useful in analyzing changes in air quality data because these statistics can show the overall tendency of measurements over long periods of time, while minimizing the effects of year-to-year fluctuations which are common in air quality data. Theil statistics are also used in EPA's National Air EPA's National Air Quality Trends Reports (http://www.epa.gov/airtrends/) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)
[85] The significance of the trend is represented with p-values calculated using Mann-Kendall trend statistics. Determining a significance level helps to distinguish random variability in data from a real tendency to increase or decrease over time, where lower p-values indicate higher confidence levels in the computed slopes.

- Daily plots in Appendix E indicate an anomalously high particulate organic event on the first sampling day in 2007 at the HACR1 site. This sample day corresponded to a 2291 acre forest fire south-west of the HACR1 and HALE1 sites.[86]
- In general, particulate organic mass concentrations were lower at the HACR1 site than the HALE1 site. Proximity of the HALE1 site to sugar cane burning was part of the justification for a new location to represent the Haleakala NP.
- Note that the State of Hawaii is investigating potential anomalies in particulate organic mass and select metal measurements for source apportionment calculations.[87] For purposes of progress determination, particulate organic mass decreases at all of the Hawaii sites, but soil and coarse mass increased slightly at the HAVO1 site. Because of the large ammonium sulfate contribution to visibility impairment, the combined contribution of coarse mass and soil was less than 1% of the overall increase in extinction between the baseline and progress periods.

[86] This event, and other events at the HALE1 and HACR1 sites in 2007 and 2008, have been characterized in a report by the State of Hawaii, Clean Air Branch (HIDOHCAB) which is available at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-0345-0005.
[87] Details of HIDOHCABs efforts to characterize potential sources of error in source apportionment calculations are available at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-0345-0005.

Table 6.5-6
Hawaii Class I Area IMPROVE Sites
Change in Aerosol Extinction by Species
2000-2009 Annual Average Trends

Site	Group	Annual Trend* (Mm^{-1}/year)						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
HACR1	20% Best	**	**	**	**	**	**	**
	20% Worst	**	**	**	**	**	**	**
	All Days	**	**	**	**	**	**	**
HALE1	20% Best	--	0.0	--	0.0	--	0.0	**0.1**
	20% Worst	**1.2**	**-0.1**	--	--	0.0	**-0.2**	**0.1**
	All Days	**0.4**	**-0.1**	0.0	0.0	--	**-0.1**	**0.1**
HAVO1	20% Best	**0.1**	--	**-0.1**	0.0	--	--	**0.1**
	20% Worst	**18.9**	**-0.1**	**-0.1**	0.0	**0.1**	--	--
	All Days	**3.9**	0.0	**-0.1**	0.0	--	--	--

*(--) Indicates statistically insignificant trend (<85% confidence level). Annual averages and complete trend statistics for all significance levels are included for each site in Appendix E.
**Less than 5 years of monitoring were available for the HACR1 site, so trend statistics for this site were not calculated.

6.5.2 Emissions Data

Included here are summaries depicting differences between emission inventories representing the baseline period (2005) and the current progress period (2008). The year 2005 was selected, with EPA approval, as the baseline inventory for Hawaii's initial RHR implementation plan because it was the most complete inventory available at the time technical work commenced[88]. The same technical work also included the development of a 2008 inventory, which is summarized here. These inventories are described in more detail in Section 3.2.1. For reference, Table 6.5-7 lists the major emitted pollutants inventoried, the related aerosol species, some of the major sources for each pollutant, and some notes regarding implications of these pollutants. Differences between these baseline and progress period inventories are presented in this section.

[88] See the *Technical Support Document for the Proposed Action on the Federal Implementation Plan for the Regional Haze Program in the State of Hawaii*, developed by EPA Region 9

Table 6.5-7
Hawaii
Pollutants, Aerosol Species, and Major Sources

Emitted Pollutant	Related Aerosol	Major Sources	Notes
Sulfur Dioxide (SO_2)	Ammonium Sulfate	Point Sources; On- And Off-Road Mobile Sources; Volcanic Emissions	SO_2 emissions are generally associated with anthropogenic sources such as coal-burning power plants, other industrial sources such and refineries and cement plants, and both on- and off-road diesel engines. Also, in Hawaii, volcanic activity contributes significantly to natural emissions of SO_2, and it is possible that some of these emissions are transported to the contiguous states.
Oxides of Nitrogen (NO_X)	Ammonium Nitrate	On- and Off-Road Mobile Sources; Point Sources; Area Sources	NO_X emissions are generally associated with anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.
Ammonia (NH_3)	Ammonium Sulfate and Ammonium Nitrate	Area Sources; On-Road Mobile Sources	Gaseous NH_3 has implications in particle formation because it can form particulate ammonium. Ammonium is not directly measured by the IMPROVE program, but affects formation potential of ammonium sulfate and ammonium nitrate. All measured nitrate and sulfate is assumed to be associated with ammonium for IMPROVE reporting purposes.
Volatile Organic Compounds (VOCs)	Particulate Organic Mass (POM)	Biogenic Emissions; Vehicle Emissions; Area Sources	VOCs are gaseous emissions of carbon compounds, which are often converted to POM through chemical reactions in the atmosphere. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions (see Section 3.2.1).
Fine soil	Soil	Windblown Dust; Fugitive Dust; Road Dust; Area Sources	Fine soil is reported here as the crustal or soil components of $PM_{2.5}$.
Coarse Mass (PMC)	Coarse Mass	Windblown Dust; Fugitive Dust	Coarse mass is reported by the IMPROVE Network as the difference between PM_{10} and $PM_{2.5}$ mass measurements. Coarse mass is not separated by species in the same way that $PM_{2.5}$ is speciated, but these measurements are generally associated with crustal components. Similar to crustal $PM_{2.5}$, natural windblown dust is often the largest contributor to PMC.

6.5.2.1 Changes in Emissions

This section addresses the regulatory question, ***what is the change over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State (40 CFR 51.308 (g)(4))?*** For these summaries, emissions during the baseline and progress years are represented using 2005 and 2008 inventories, which were both available from technical support work used in the original RHR SIP strategy development, as referenced in Section 3.2.1. The differences between inventories are presented here for all major visibility impairing pollutants, and categorized by source for both anthropogenic and natural emissions.

Table 6.5-8 and Figure 6.5-7 present differences between the 2005 and 2008 Sulfur dioxide (SO_2) inventories by source category. Tables 6.5-9 and Figure 6.5-8 present data for oxides of nitrogen (NO_X), and subsequent tables and figures (Tables 6.5-10 through 6.5-12 and Figures 6.5-9 through 6.5-11 present data for ammonia (NH_3), volatile organic carbon (VOC), and total particulate matter (PM). General observations regarding emissions inventory comparisons are listed below.

- Natural emissions are significant for SO_2, VOC, and PM due to natural volcanic (SO_2) and sea spray (PM) emissions.
- Volcanic emissions account for the majority of SO_2 emissions for the state. The State of Hawaii, Clean Air Branch (HIDOHCAB) has analyzed the time variability of volcano impacts by applying the EPA Positive Matrix Factorization (PMF) model for the years 2003 through 2008 at both the HALE1 and HAVO1 sites, and estimated that on average, approximately 55% of the total extinction at the HALE1 site, and 94% of the extinction at the HAVO1 site was due to emissions from the Kilauea volcano.[89]
- Inventory comparisons show decreases in mobile NO_X emissions, which are likely due to tighter EPA regulations for on-road vehicles.
- Inventory comparisons show decreases in SO_2 emissions from marine sources, which may be partially attributable to decreased marine activity during the economic recession, especially cruise ship activity. EPA mandates requiring the use of lower sulfur fuels in ships operating within 200 miles of the United States, effective August 2012, are expected to further decrease SO_2 marine emissions.

[89] PMF results are detailed in the Hawaii Department of Health, Clean Air Branch *Heleakala National Park Visibility Assessment: Regional Haze Program Visibility Assessment* report dated 4/20/2012, available at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-2012-0345-0005.

Table 6.5-8
Hawaii
Sulfur Dioxide Emissions by Category

Source Category	Sulfur Dioxide Emissions (tons/year)		
	2005 (State Inventory)	2008 (State Inventory)	Difference (Percent Change)
Anthropogenic Sources			
Point	27,072	25,849	-1,223
Area	3,716	3,512	-204
On-Road Mobile	321	97	-224
Off-Road Mobile[1]	669	338	-331
Marine[2]	3,619	2,920	-699
Anthropogenic Fire	178	178	0
Total Anthropogenic	**35,575**	**32,894**	**-2,681 (-8%)**
Natural Sources			
Natural Fire	591	591	0
Biogenic	0	0	0
Volcano	961,366	1,195,314	233,948
Sea Spray	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**961,957**	**1,195,905**	**233,948 (24%)**
All Sources			
Total Emissions	**997,532**	**1,228,799**	**231,267 (23%)**

[1] Off-Road Mobile totals include aircraft and locomotive emissions
[2] Marine totals include in/near/underway emissions

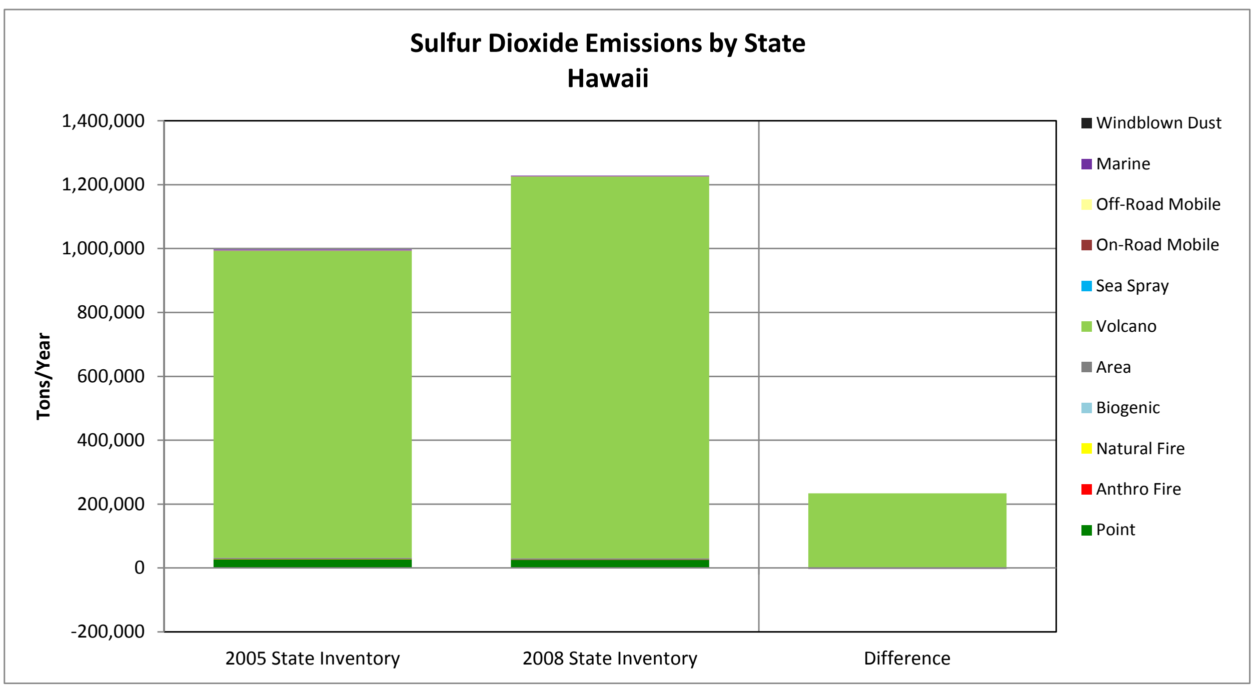


Figure 6.5-7. 2005 and 2008 Emissions, and Difference between Emissions Inventory Totals, for Sulfur Dioxide by Source Category for Hawaii.

Table 6.5-9
Hawaii
Oxides of Nitrogen Emissions by Category

Source Category	Oxides of Nitrogen Emissions (tons/year)		
	2005 (State Inventory)	2008 (State Inventory)	Difference (Percent Change)
Anthropogenic Sources			
Point	22,745	20,246	-2,499
Area	1,509	1,166	-343
On-Road Mobile	20,642	14,239	-6,403
Off-Road Mobile[1]	6,296	7,146	850
Marine[2]	5,624	12,994	7,370
Anthropogenic Fire	407	407	0
Total Anthropogenic	**57,223**	**56,198**	**-1,025 (-2%)**
Natural Sources			
Natural Fire	2,156	2,156	0
Biogenic	4,617	4,617	0
Volcano	0	0	0
Sea Spray	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**6,773**	**6,773**	**0 (0%)**
All Sources			
Total Emissions	**63,996**	**62,971**	**-1,025 (-2%)**

[1] Off-Road Mobile totals include aircraft and locomotive emissions
[2] Marine totals include in/near/underway emissions

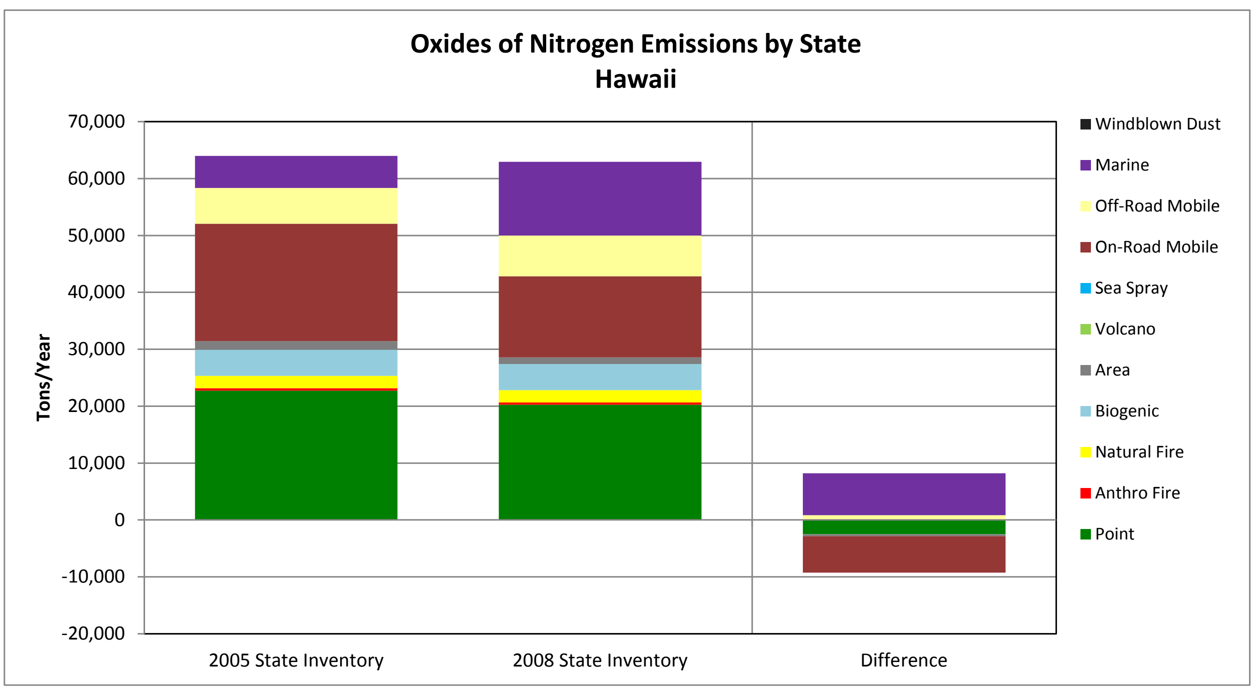


Figure 6.5-8. 2005 and 2008 Emissions, and Difference between Emissions Inventory Totals, for Oxides of Nitrogen by Source Category for Hawaii.

Table 6.5-10
Hawaii
Ammonia Emissions by Category

Source Category	Ammonia Emissions (tons/year)		
	2005 (State Inventory)	2008 (State Inventory)	Difference (Percent Change)
Anthropogenic Sources			
Point	12	12	0
Area	11,136	11,275	139
On-Road Mobile	1,085	1,124	39
Off-Road Mobile[1]	5	5	0
Marine[2]	0	0	0
Anthropogenic Fire	60	60	0
Total Anthropogenic	**12,298**	**12,476**	**178 (1%)**
Natural Sources			
Natural Fire	540	540	0
Biogenic	0	0	0
Volcano	0	0	0
Sea Spray	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**540**	**540**	**0 (0%)**
All Sources			
Total Emissions	**12,838**	**13,016**	**178 (1%)**

[1] Off-Road Mobile totals include aircraft and locomotive emissions
[2] Marine totals include in/near/underway emissions

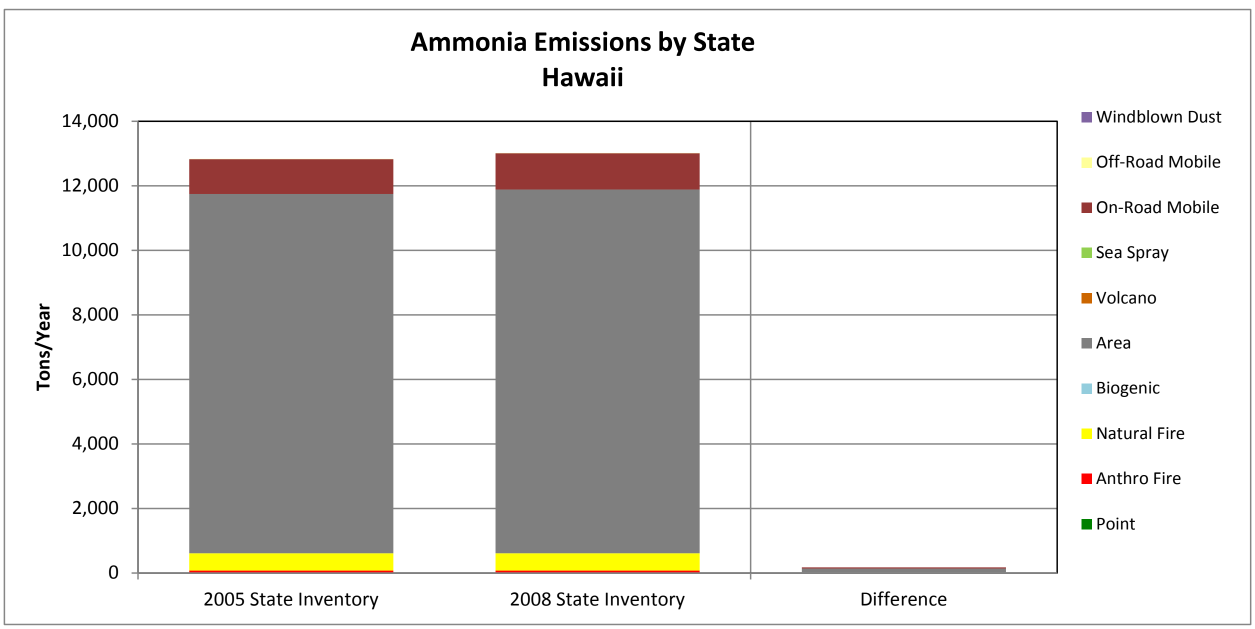


Figure 6.5-9. 2005 and 2008 Emissions, and Difference between Emissions Inventory Totals, for Ammonia by Source Category for Hawaii.

Table 6.5-11
Hawaii
Volatile Organic Compound Emissions by Category

Source Category	**Volatile Organic Compound Emissions (tons/year)**		
	2005 (State Inventory)	**2008 (State Inventory)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	2,695	2,544	-151
Area	16,920	18,025	1,105
On-Road Mobile	12,066	8,526	-3,540
Off-Road Mobile[1]	6,383	5,540	-843
Marine[2]	209	326	117
Anthropogenic Fire	542	542	0
Total Anthropogenic	**38,815**	**35,503**	**-3,312 (-9%)**
Natural Sources			
Natural Fire	4,729	4,729	0
Biogenic	130,153	130,153	0
Volcano	0	0	0
Sea Spray	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**134,882**	**134,882**	**0 (0%)**
All Sources			
Total Emissions	**173,697**	**170,385**	**-3,312 (-2%)**

[1] Off-Road Mobile totals include aircraft and locomotive emissions
[2] Marine totals include in/near/underway emissions

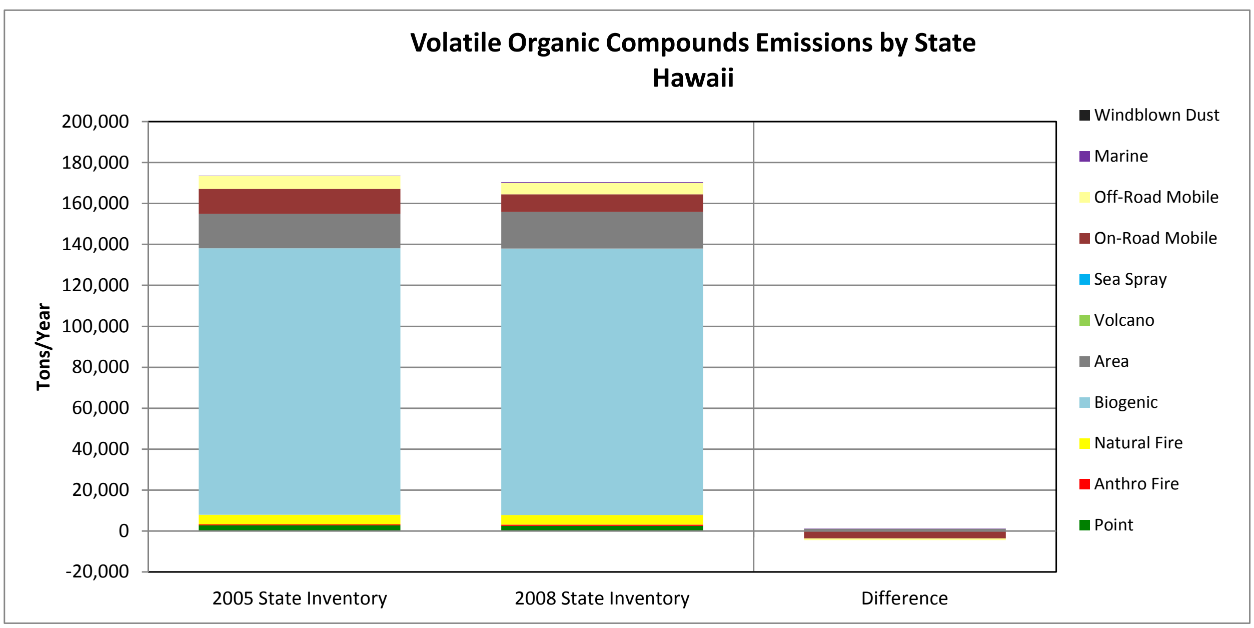


Figure 6.5-10. 2005 and 2008 Emissions, and Difference between Emissions Inventory Totals, for Volatile Organic Compounds by Source Category for Hawaii.

Table 6.5-12
Hawaii
Particulate Matter Emissions by Category

Source Category	Particulate Matter Emissions (tons/year)		
	2005 (State Inventory)	**2008 (State Inventory)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	3,536	3,389	-147
Area	33,408	34,917	1,509
On-Road Mobile	638	547	-91
Off-Road Mobile[1]	649	545	-104
Marine[2]	398	647	249
Anthropogenic Fire*	1,574	1,574	0
Total Anthropogenic	**40,203**	**41,619**	**1,416 (4%)**
Natural Sources			
Natural Fire*	9,771	9,771	0
Biogenic	0	0	0
Volcano	0	0	0
Sea Spray	382,637	382,637	0
Wind Blown Dust	46,808	46,808	0
Total Natural	**439,216**	**439,216**	**0 (0%)**
All Sources			
Total Emissions	**479,419**	**480,835**	**1,416 (0%)**

[1] Off-Road Mobile totals include aircraft and locomotive emissions
[2] Marine totals include in/near/underway emissions

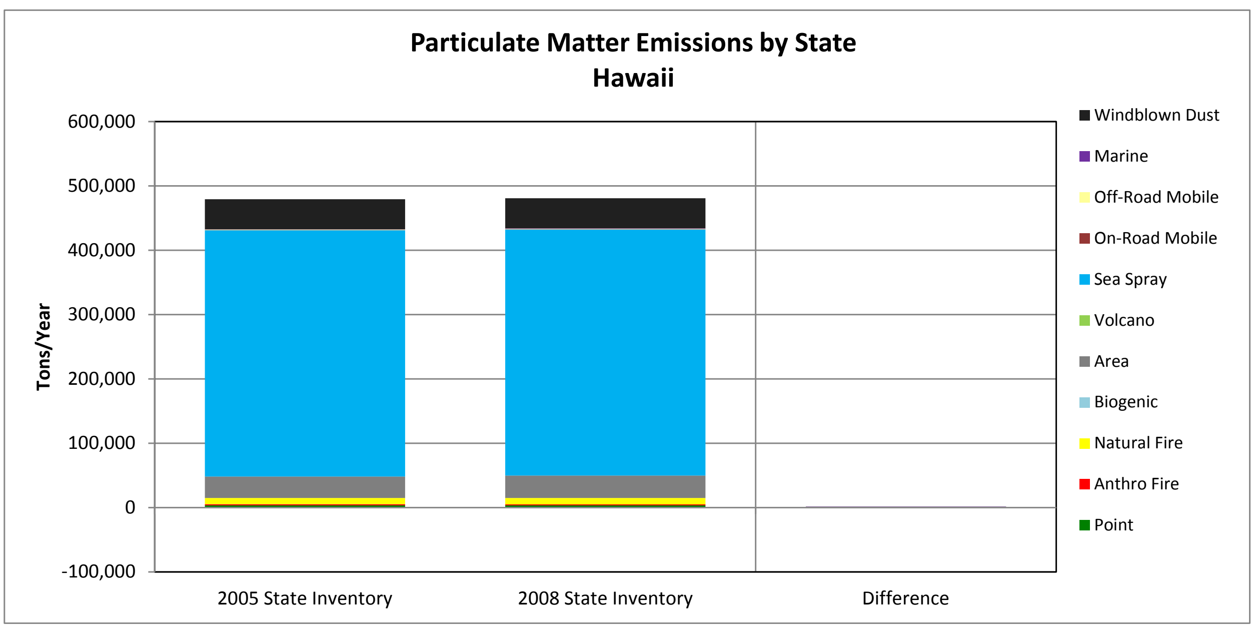


Figure 6.5-11. 2005 and 2008 Emissions, and Difference between Emissions Inventory Totals, for Particulate Matter by Source Category for Hawaii.

6.11.2.2 EGU Summary

As described in previous sections, differences between the baseline and progress period inventories presented here do not necessarily represent changes in actual emissions because numerous updates in inventory methodologies have occurred between the development of the separate inventories. Also, the 2002 baseline and 2008 progress period inventories represent only annual snapshots of emissions estimates, which may not be representative of entire 5-year monitoring periods compared. To better account for year-to-year changes in emissions, annual emission totals for Oregon electrical generating units (EGU) are presented here. EGU emissions are some of the more consistently reported emissions, as tracked in EPA's Air Markets Program Database for permitted Title V facilities in the state (http://ampd.epa.gov/ampd/). RHR implementation plans are required to pay specific attention to certain major stationary sources, including EGUs, built between 1962 and 1977.

Figure 6.11-17 presents a sum of annual NO_X and SO_2 emissions as reported for Oregon EGU sources between 1996 and 2010. While these types of facilities are targeted for controls in state regional haze SIPs, it should be noted that many of the controls planned for EGUs in the WRAP states had not taken place yet in 2010, while other controls separate from the RHR may have been implemented. The chart shows several periods of increases and decreases for both SO_2 and NO_X.

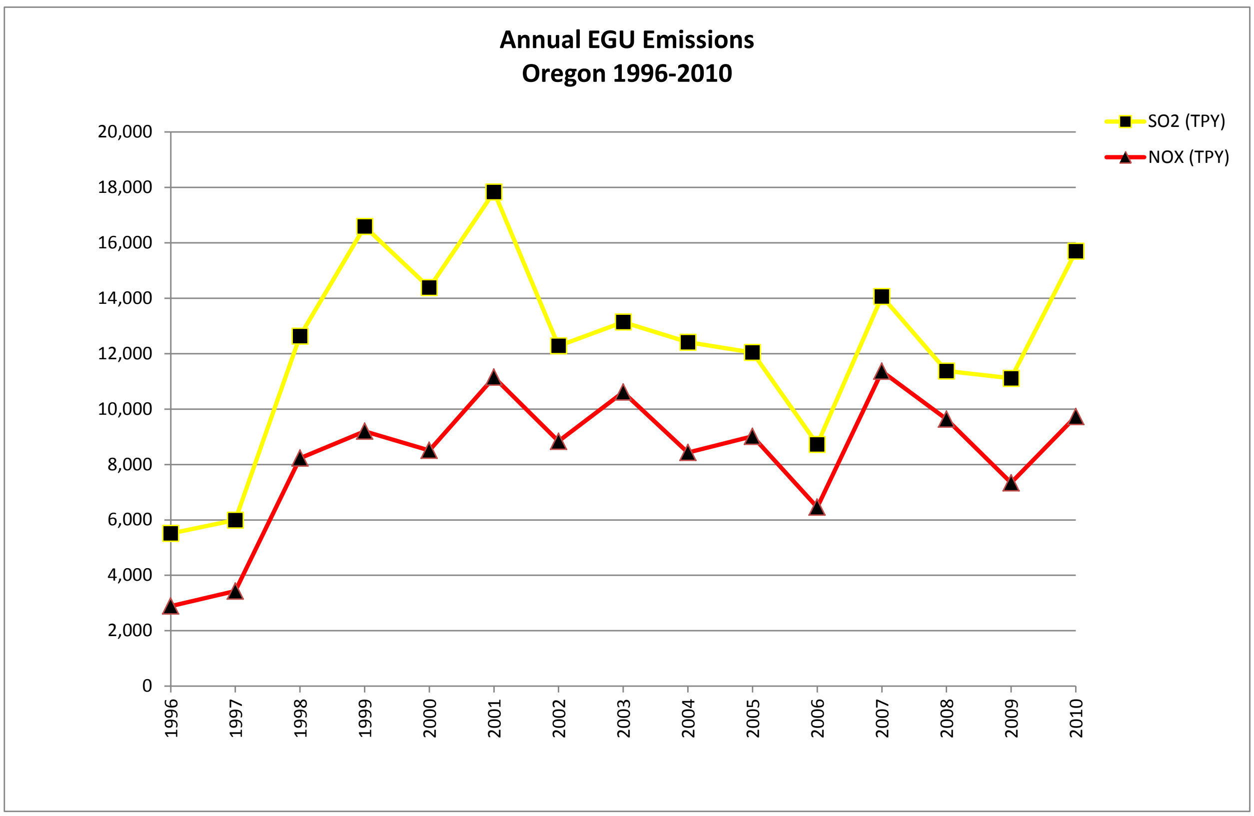


Figure 6.11-8. Sum of EGU Emissions of SO_2 and NO_X reported between 1996 and 2010 for Oregon.

7.0 REFERENCES

Alaska Interagency Coordination Center (AICC). *Alaska Wildland Fire Coordinating Group Committees: Air Quality and Smoke Management*. Available online at http://fire.ak.blm.gov/administration/awfcg_committees.php.

Cooperative Institute for Research in the Atmosphere (CIRA). *Federal Landmanager Database (FED)*. Available online at http://views.cira.colostate.edu/fed/Default.aspx.

Cooperative Institute for Research in the Atmosphere (CIRA). *IMPROVE Reports*. Available online at http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm.

Cooperative Institute for Research in the Atmosphere (CIRA). *Interagency Monitoring of Protected Visual Environments (IMPROVE) Steering Committee Activities*. Available online at http://vista.cira.colostate.edu/improve/Activities/activities.htm.

Copeland, S.A., Pitchford M., and Ames, R. 2008. *Regional Haze Rule Natural Level Estimates Using the Revised IMPROVE Aerosol Reconstructed Light Extinction Algorithm.* Available online at http://vista.cira.colostate.edu/improve/publications/graylit/032_NaturalCondIIpaper/Copeland_etal_NaturalConditionsII_Description.pdf.

E.H. Pechan & Associates. 2005. *Commercial Marine Inventories for Select Alaskan Ports, Final Report, Prepared for the Alaska Department of Conservation, Docket ID EPA-HQ-OAR-2007-0121-0165*.

Environ International Corporation. 2007. *WRAP Area Source Emissions Inventory Projections and Control Strategy Evaluation Phase II.* Available online at http://www.wrapair.org/forums/ogwg/documents/2007-10_Phase_II_O&G_Final)Report(v10-07%20rev.s).pdf.

Grand Canyon Visibility Transport Commission. 1996. *Recommendations for Improving Western Vistas*. Available online at http://www.wrapair.org/WRAP/reports/GCVTCFinal.PDF.

Hand, J.A., & Malm, W.C. 2006. *Review of the IMPROVE Equation for Estimating Ambient Light Extinction Coefficients - Final Report.* Available online at http://vista.cira.colostate.edu/improve/Publications/GrayLit/016_IMPROVEeqReview/IMPROVEeqReview.htm.

National Park Service, Air Resource Division. Mandatory Class I Areas. Available online at http://www.epa.gov/ttn/oarpg/t1/fr_notices/classimp.gif.

Sierra Research, Inc. 2005. *Alaska Aviation Emission Inventory. Report No. SR2005-06-02*. Available online at http://www.wrapair.org/forums/ef/inventories/akai/.

Sierra Research, Inc.. 2007. *Alaska Rural Communities Emission Inventory. Report No. SR2007-02-01*. Available online at http://www.epa.gov/region10/pdf/tribal/wrap_alaska_communities_final_report.pdf.

State of Hawaii, Department of Health, Clean Air Branch. 2012a. *Comparison of Haleakala National Park HALE1 and HACR1 IMPROVE Monitoring Site 2007-2008 Data Sets*. Available online at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-0345-0005.

State of Hawaii, Department of Health, Clean Air Branch. 2012b. *Hawaii Volcanoes National Park Visibility Assessment, Regional Haze Program Visibility Assessment*. Available online at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-0345-0005.

State of Hawaii, Department of Health, Clean Air Branch. 2012c. *IMPROVE PMF Factor Identification Notes Positive Matrix Factorization Analysis of HALE1 and HAVO1 IMPROVE Data Sets*. Available online at http://www.regulations.gov/#!documentDetail;D=EPA-R09-OAR-2012-0345-0005.

U.S. Census Bureau. Data Access Tools. Available online at http://www.census.gov/main/www/access.html.

U.S. Environmental Protection Agency. 1977. *Clean Air Act, Title I, Part C, Subpart 2, Section 169a: Visibility Protection for Federal Class I Areas*. (Also refered to as 42 USC §7491.) Available online at http://www.law.cornell.edu/uscode/text/42/7491.

U.S. Environmental Protection Agency. 1999. *CFR 40 Part 51 Regional Haze Regulations; Final Rule, July 1, 1999*. Available online at http://www.epa.gov/ttn/oarpg/t1/fr_notices/rhfedreg.pdf.

U.S. Environmental Protection Agency. 2003a. *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*. EPA-454/B-03-005. Available online at http://www.epa.gov/ttnamti1/files/ambient/visible/natural.pdf.

U.S. Environmental Protection Agency. 2003b. *Guidance for Tracking Progress Under the Regional Haze Rule*. EPA-454/B- 03-004. Available online at http://www.epa.gov/ttnamti1/files/ambient/visible/tracking.pdf.

U.S. Environmental Protection Agency. 2012. *Technical Support Document for the Proposed Action on the Federal Implementation Plan for the Regional Haze Program in the State of Hawaii.* Air Division, U.S. EPA Region 9. Available online at: http://www.epa.gov/region9/air/actions/pdf/hi/hi-haze-tsd.pdf.

U.S. Environmental Protection Agency. 2013. *General Principals for the 5-Year Regional Haze Progress reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports).* Available online at http://www.4cleanair.org/Documents/haze_5year_4-10-13.pdf.

U.S. Environmental Protection Agency. *Air Markets Program Data*. Available online at http://ampd.epa.gov/ampd/.

U.S. Environmental Protection Agency. *Air Trends*. Available online at http://www.epa.gov/airtrends/.

U.S. Environmental Protection Agency. *The National Emissions Inventory*. Available online at http://www.epa.gov/ttn/chief/net/2008inventory.html.

Western Regional Air Partnership. 2001. *Policy for Categorizing Fire Emissions*. Available online at http://www.wrapair.org/forums/fejf/documents/nbtt/firepolicy.pdf.

Western Regional Air Partnership. 2007. WRAP IMPROVE Data Substitutions. Available online at http://vista.cira.colostate.edu/docs/wrap/Monitoring/WRAP_Data_Substitution_Methods_April_2007.doc.

Western Regional Air Partnership. *Air Monitoring and Reporting Forum: Natural Conditions Background Info.* Archive available online at http://www.wrapair.org/forums/aamrf/projects/NCB/index.html.

Western Regional Air Partnership. *Deterministic & Empirical Assessment of Smoke's Contribution to Ozone (DEASCO$_3$) Project*. Available online at http://www.wrapfets.org/deasco3.cfm.

Western Regional Air Partnership. *Fire Emissions Joint Forum: WRAP Phase III & IV Fire Emission Inventories for the 2000-04 Baseline Period and 2018 Projection Year*. Available online at http://wrapair.org/forums/fejf/tasks/FEJFtask7Phase3-4.html.

Western Regional Air Partnership. *Regional Haze Analyses*. Available online at http://www.wrapair2.org/reghaze.aspx.

Western Regional Air Partnership. *Stationary Sources Joint Forum: Point and Area Source Pivot Tables for Regional Haze Planning Emissions Scenarios*. Available online at http://www.wrapair.org/forums/ssjf/pivot.html.

Western Regional Air Partnership. *Western Regional Air Partnership Technical Support System Database (WRAP TSS).* Available online at: http://vista.cira.colostate.edu/tss/.

Western Regional Air Partnership. *WRAP Fire Emissions Tracking Systems (FETS).* Available online at http://www.wrapfets.org/.

APPENDIX E:

Hawaii Class I Area Monitoring Data Summary Tables and Charts

Includes the following subsections:

Subsection	IMPROVE Monitor	Class I Area(s) Represented
E.1	HACR1	Haleakala NP
E.2	HALE1	Haleakala NP
E.3	HAVO1	Hawaii Volcanoes NP

E.1. HALEAKALA NP (HACR1)

The following tables and figures are presented in this section for the Haleakala NP represented by the HACR1 IMPROVE Monitor:

- **Table E.1-1: Annual Averages, 5-Year Period Averages, and Trends:** Table of averages and other metrics for the 20% least impaired days, the 20% most impaired days, and all sampled days is presented.

- **Figure E.1-1: Annual and 5-Year Period Averages for the 20% Most Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.

- **Figure E.1-2: Annual and 5-Year Period Averages for the 20% Least Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.

- **Figure E.1-3: 20% Most Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component for the 20% most impaired days are presented.

- **Figure E.1-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.

- **Figure E.1-5: 2000-2004 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the baseline period are presented.

- **Figure E.1-6: 2005-2009 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the progress period are presented.

- **Figure E.1-7: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the baseline period are presented.

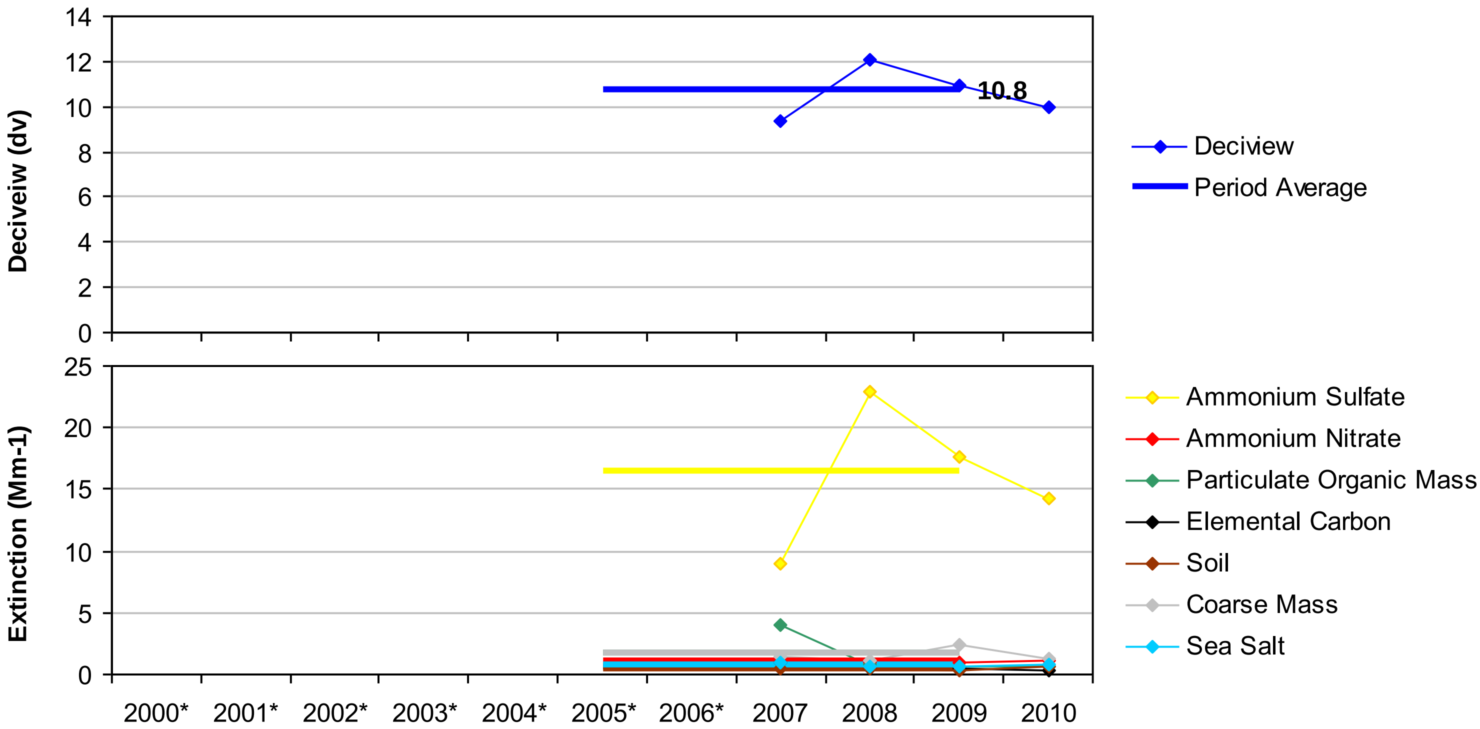
- **Figure E.1-8: 2000-2004 Progress Period Extinction, All Sampled Days**: Stacked bar charts depicting daily averages by year and component for the progress period are presented.

Table E.1-1
Haleakala NP, HI (HACR1 Site)
Annual Averages, 5-Year Period Averages and Trends

Group	Baseline Period					Progress Period						2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P -B)	Percent Change
Deciview (dv)																	
Best 20% Days	---	---	---	---	---	---	---	0.8	0.6	1.3	0.4	N/A	N/A	1.0	0.9	-0.1	-10%
Worst 20% Days	---	---	---	---	---	---	---	9.3	12.1	10.9	9.9	N/A	N/A	9.5	10.8	1.3	14%
All Days	---	---	---	---	---	---	---	4.4	5.3	5.2	4.5	N/A	N/A	4.6	5.0	0.4	9%
Total Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	10.9	10.6	11.4	10.4	N/A	N/A	11.1	11.0	-0.1	-1%
Worst 20% Days	---	---	---	---	---	---	---	27.3	36.3	32.3	28.1	N/A	N/A	27.7	32.0	4.3	16%
All Days	---	---	---	---	---	---	---	16.6	19.1	18.4	16.8	N/A	N/A	17.2	18.0	0.8	5%
Ammonium Sulfate Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	1.0	1.0	1.2	0.8	N/A	N/A	1.1	1.0	-0.1	-9%
Worst 20% Days	---	---	---	---	---	---	---	9.0	22.9	17.6	14.3	N/A	N/A	10.9	16.5	5.6	51%
All Days	---	---	---	---	---	---	---	3.7	7.3	6.2	5.1	N/A	N/A	4.5	5.7	1.2	27%
Ammonium Nitrate Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.2	0.1	0.2	0.1	N/A	N/A	0.2	0.1	-0.1	-50%
Worst 20% Days	---	---	---	---	---	---	---	1.3	1.0	1.0	1.1	N/A	N/A	1.4	1.1	-0.3	-21%
All Days	---	---	---	---	---	---	---	0.7	0.6	0.6	0.6	N/A	N/A	0.7	0.6	-0.1	-14%
Particulate Organic Mass Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.1	0.0	0.1	0.0	N/A	N/A	0.1	0.1	0.0	0%
Worst 20% Days	---	---	---	---	---	---	---	4.1	0.7	0.7	0.7	N/A	N/A	2.4	1.8	-0.6	-25%
All Days	---	---	---	---	---	---	---	1.2	0.4	0.3	0.3	N/A	N/A	0.8	0.6	-0.2	-25%
Elemental Carbon Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.0	0.0	0.1	0.0	N/A	N/A	0.1	0.0	-0.1	-100%
Worst 20% Days	---	---	---	---	---	---	---	0.9	0.5	0.5	0.4	N/A	N/A	0.8	0.6	-0.2	-25%
All Days	---	---	---	---	---	---	---	0.3	0.2	0.2	0.2	N/A	N/A	0.3	0.2	-0.1	-33%
Soil Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.0	0.1	0.1	0.1	N/A	N/A	0.1	0.1	0.0	0%
Worst 20% Days	---	---	---	---	---	---	---	0.5	0.4	0.4	0.7	N/A	N/A	0.4	0.4	0.0	0%
All Days	---	---	---	---	---	---	---	0.2	0.2	0.2	0.3	N/A	N/A	0.2	0.2	0.0	0%
Coarse Mass Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.2	0.2	0.5	0.2	N/A	N/A	0.4	0.3	-0.1	-25%
Worst 20% Days	---	---	---	---	---	---	---	1.4	1.2	2.5	1.2	N/A	N/A	2.3	1.7	-0.6	-26%
All Days	---	---	---	---	---	---	---	0.8	0.7	1.3	0.8	N/A	N/A	1.2	0.9	-0.3	-25%
Sea Salt Extinction (Mm-1)																	
Best 20% Days	---	---	---	---	---	---	---	0.3	0.3	0.3	0.2	N/A	N/A	0.2	0.3	0.1	50%
Worst 20% Days	---	---	---	---	---	---	---	1.0	0.6	0.6	0.7	N/A	N/A	0.5	0.7	0.2	40%
All Days	---	---	---	---	---	---	---	0.7	0.6	0.6	0.6	N/A	N/A	0.4	0.6	0.2	50%

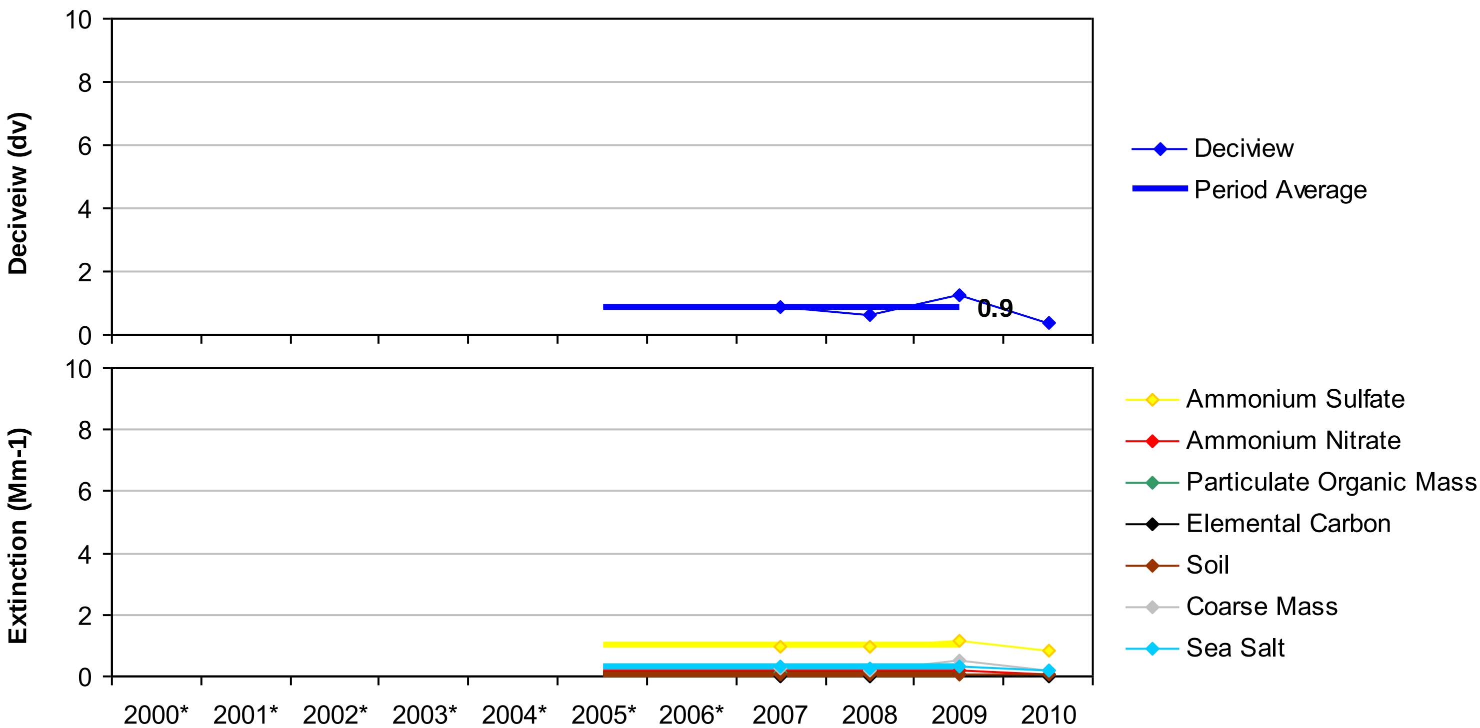
*Values highlighted in blue (red) indicate statistically significant decreasing (increasing) annual trend. Significance is measured at the 85% confidence level (p-value ≤0.15).
**Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.
"---" Indicates a missing year that did not meet RHR data completeness criteria.

Figure E.1-1
Haleakala NP, HI (HACR1 Site)
Annual and 5-Year Period Averages
20% Most Impaired Visibility Days



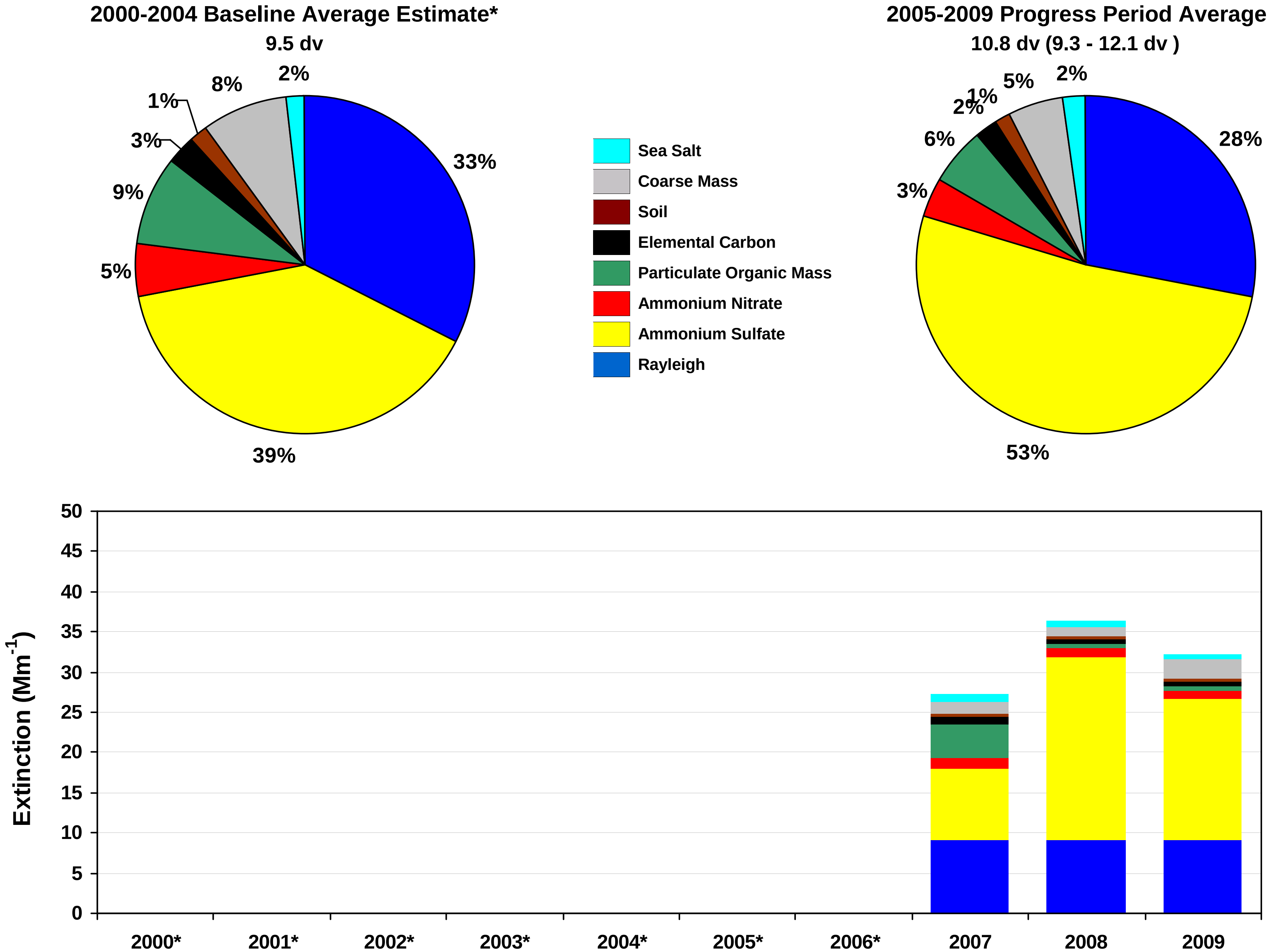
*Missing years did not meet RHR data completeness criteria.

Figure E.1-2
Haleakala NP, HI (HACR1 Site)
Annual and 5-Year Period Averages
20% Least Impaired Visibility Days



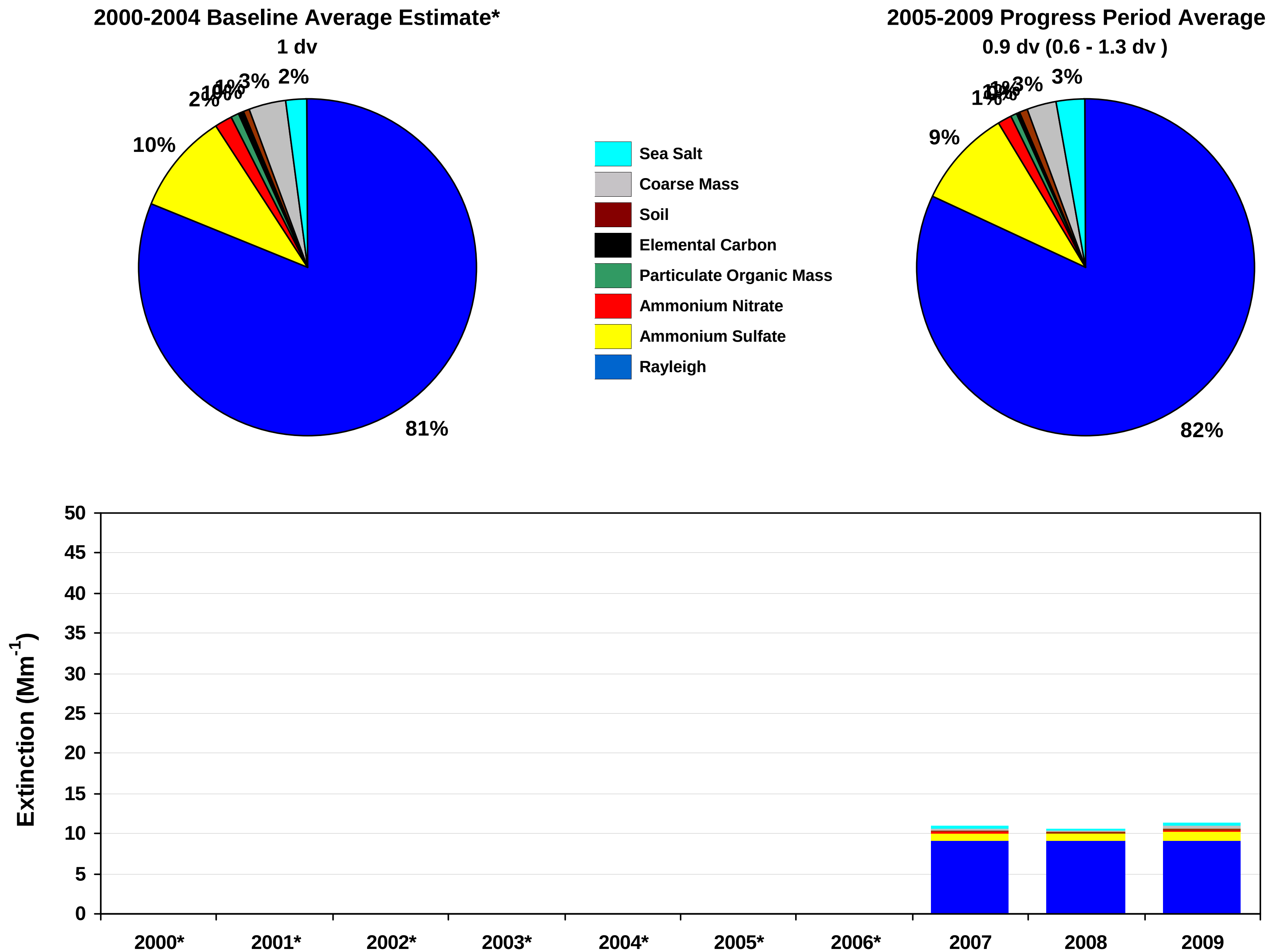
*Missing years did not meet RHR data completeness criteria.

Figure E.1-3
Haleakala NP, HI (HACR1 Site)
20% Most Impaired Visibility Days



*Baseline years did not meet RHR data completeness criteria. The 5-year baseline average represents an approximation based on methods described in text.

Figure E.1-4
Haleakala NP, HI (HACR1 Site)
20% Least Impaired Visibility Days



*Baseline years did not meet RHR data completeness criteria. The 5-year baseline average represents an approximation based on methods described in text.

Figure E.1-5
Haleakala NP, HI (HACR1 Site)
2000-2004 Monthly Average Aerosol Extinction, All Monitored Days

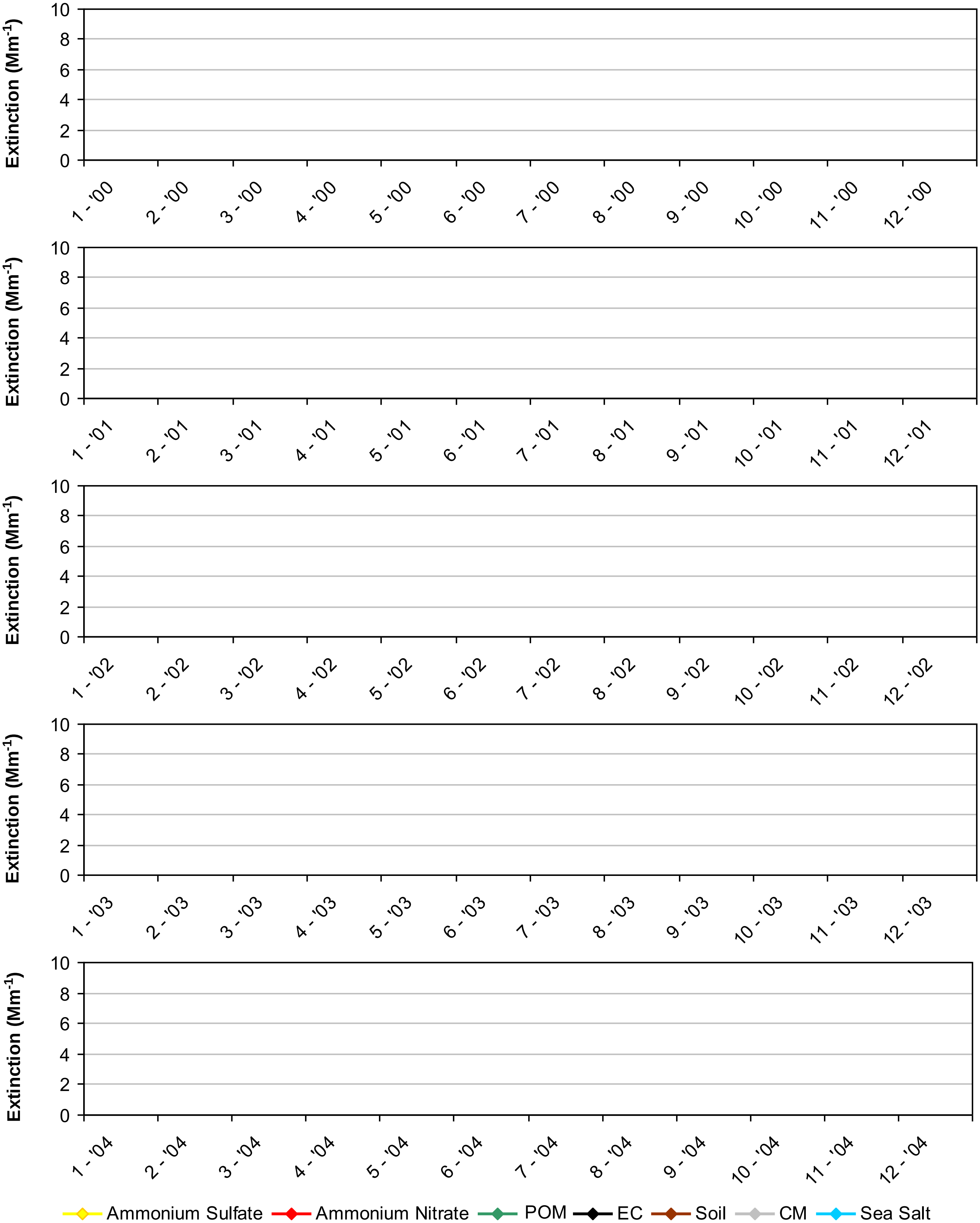
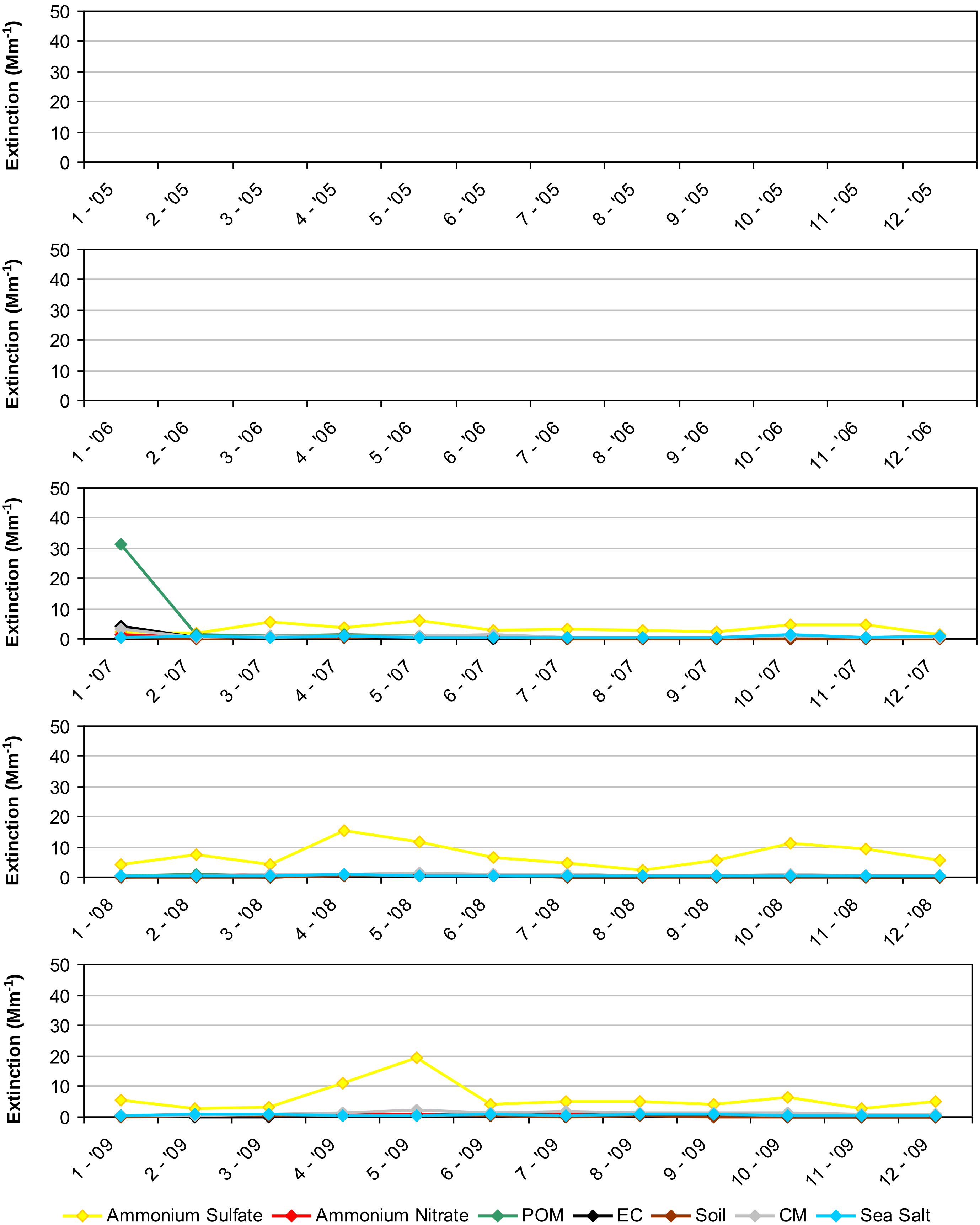
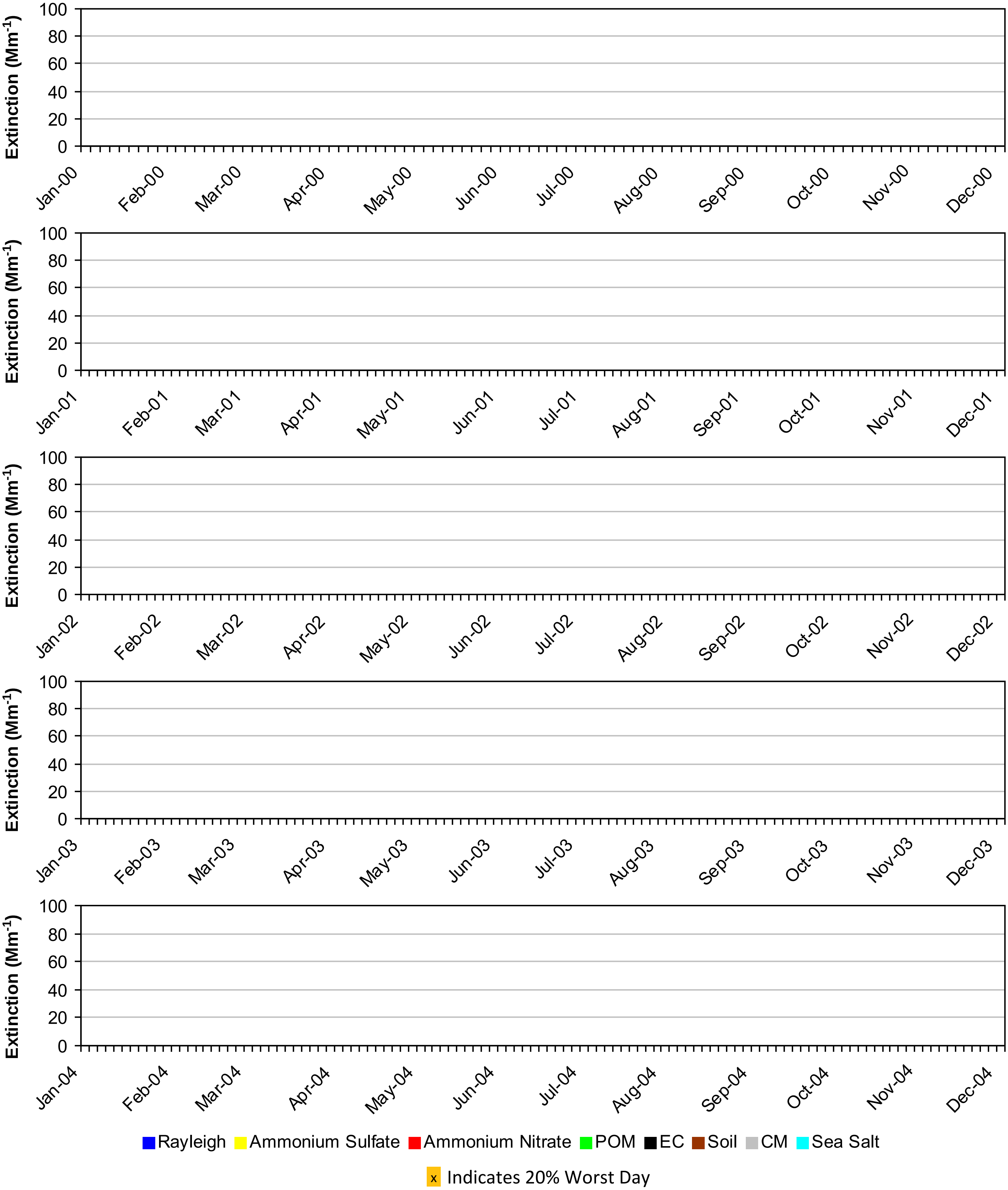


Figure E.1-6
Haleakala NP, HI (HACR1 Site)
2005-2009 Monthly Average Aerosol Extinction, All Monitored Days



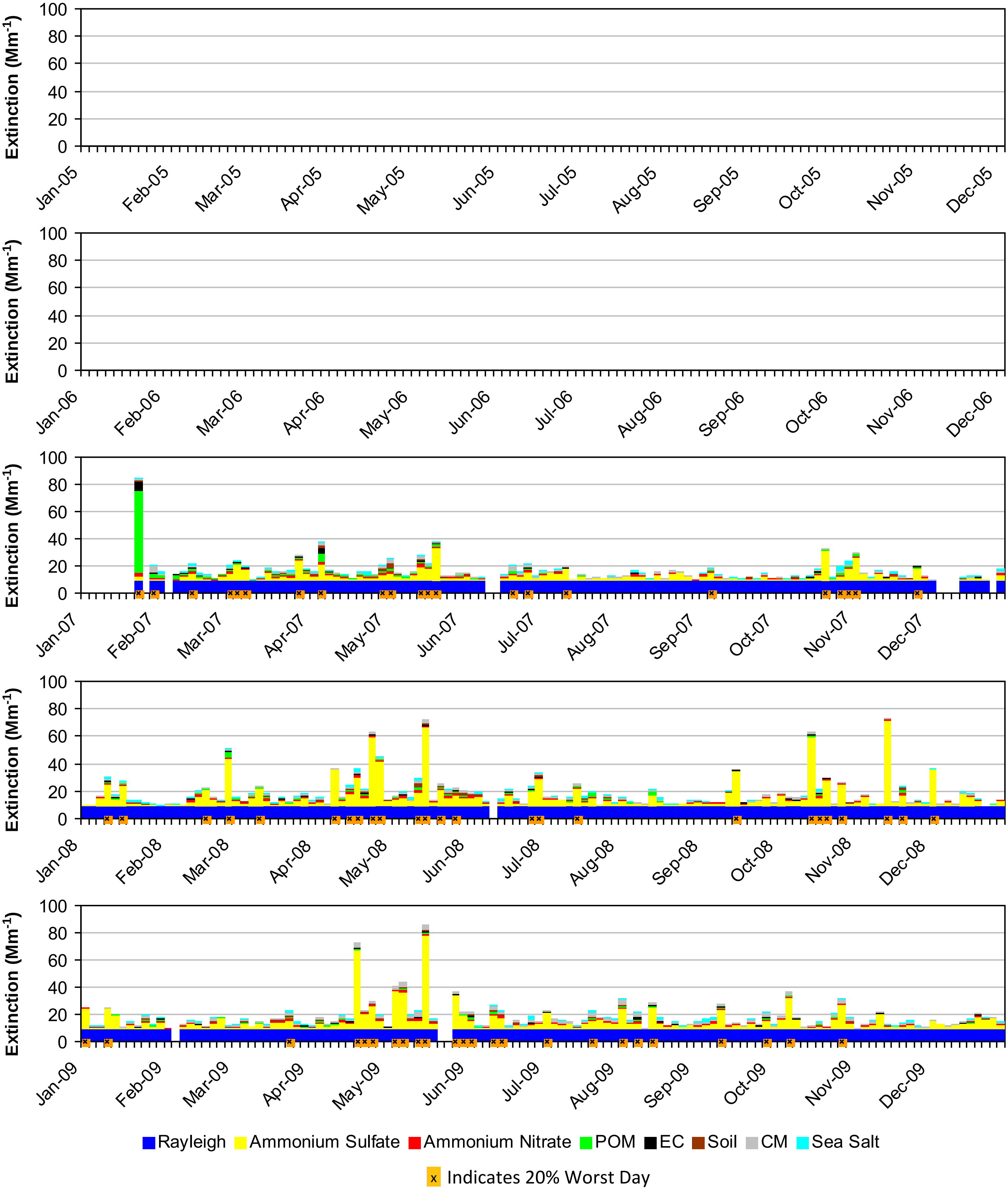
*Note that monthly averages for the years 2005 and 2006 are shown here, but these years did not meet RHR data completeness criteria.

Figure E.1-7
Haleakala NP, HI (HACR1 Site)
2000-2004 Progress Period Extinction, All Sampled Days



*Note that daily averages for the years 2000, 2001, 2002, 2003 and 2004 are shown here, but these years did not meet RHR data completeness criteria.

Figure E.1-8
Haleakala NP, HI (HACR1 Site)
2005-2009 Progress Period Extinction, All Sampled Days



*Note that daily averages for the years 2005 and 2006 are shown here, but these years did not meet RHR data completeness criteria.

E.2. HALEAKALA NP (HALE1)

The following tables and figures are presented in this section for the Haleakala NP represented by the HALE1 IMPROVE Monitor:

- **Table E.2-1: Annual Averages, 5-Year Period Averages, and Trends:** Table of averages and other metrics for the 20% least impaired days, the 20% most impaired days, and all sampled days is presented.

- **Figure E.2-1: Annual and 5-Year Period Averages for the 20% Most Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.

- **Figure E.2-2: Annual and 5-Year Period Averages for the 20% Least Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.

- **Figure E.2-3: 20% Most Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component for the 20% most impaired days are presented.

- **Figure E.2-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.

- **Figure E.2-5: 2000-2004 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the baseline period are presented.

- **Figure E.2-6: 2005-2009 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the progress period are presented.

- **Figure E.2-7: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the baseline period are presented.

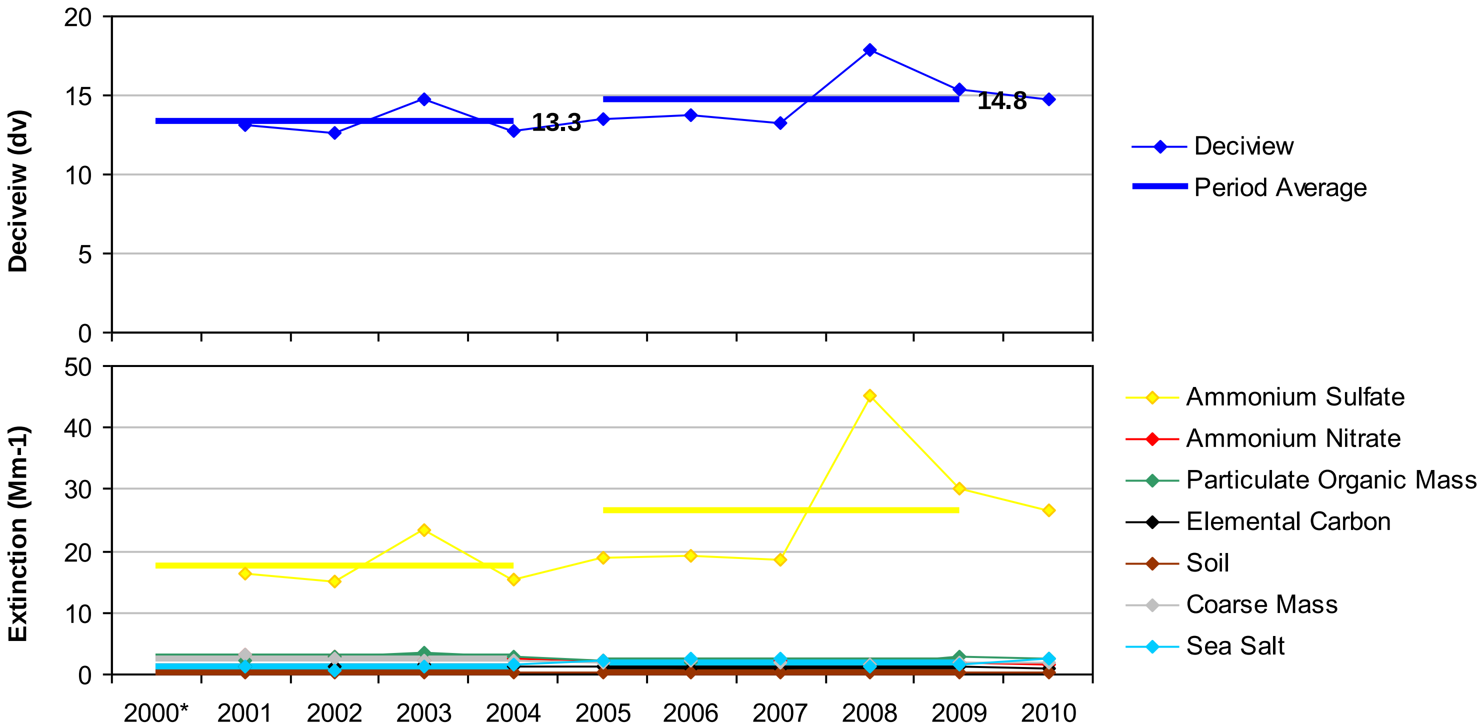
- **Figure E.2-8: 2000-2004 Progress Period Extinction, All Sampled Days**: Stacked bar charts depicting daily averages by year and component for the progress period are presented.

Table E.2-1
Haleakala NP, HI (HALE1 Site)
Annual Averages, 5-Year Period Averages and Trends

Group	Baseline Period					Progress Period						2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P -B)	Percent Change
Deciview (dv)																	
Best 20% Days	---	4.6	4.8	4.3	4.5	3.7	4.5	4.6	4.6	4.6	4.2	0.0	0.5	4.5	4.4	-0.1	-2%
Worst 20% Days	---	13.1	12.6	14.8	12.8	13.5	13.7	13.3	17.9	15.4	14.8	0.3	0.0	13.3	14.8	1.5	11%
All Days	---	8.5	8.7	9.1	8.6	8.5	8.8	8.5	9.9	9.3	8.6	0.1	0.2	8.7	9.0	0.3	3%
Total Extinction (Mm-1)																	
Best 20% Days	---	15.9	16.2	15.5	15.8	14.6	15.8	15.9	15.8	16.0	15.2	0.0	0.5	15.8	15.6	-0.2	-1%
Worst 20% Days	---	37.7	36.1	45.1	36.1	39.0	39.9	38.9	63.2	50.2	46.5	1.0	0.0	38.7	46.2	7.5	19%
All Days	---	24.7	25.0	26.9	24.6	24.9	25.6	24.8	30.9	28.1	26.0	0.3	0.1	25.3	26.8	1.5	6%
Ammonium Sulfate Extinction (Mm-1)																	
Best 20% Days	---	2.3	2.4	2.1	2.0	1.7	2.3	2.2	2.2	2.1	1.8	0.0	0.3	2.2	2.1	-0.1	-5%
Worst 20% Days	---	16.2	15.2	23.5	15.3	18.8	19.4	18.6	45.3	30.3	26.8	1.2	0.0	17.5	26.5	9.0	51%
All Days	---	7.0	7.2	8.7	6.9	7.6	8.1	7.1	14.0	10.8	9.3	0.4	0.1	7.4	9.5	2.1	28%
Ammonium Nitrate Extinction (Mm-1)																	
Best 20% Days	---	0.5	0.7	0.5	0.5	0.3	0.4	0.5	0.4	0.5	0.4	0.0	0.1	0.6	0.4	-0.2	-33%
Worst 20% Days	---	3.1	2.8	2.4	2.4	2.3	2.4	2.4	1.7	1.8	1.7	-0.1	0.0	2.7	2.1	-0.6	-22%
All Days	---	1.7	1.8	1.6	1.5	1.4	1.6	1.5	1.4	1.3	1.1	-0.1	0.0	1.6	1.4	-0.2	-13%
Particulate Organic Mass Extinction (Mm-1)																	
Best 20% Days	---	0.4	0.7	0.7	0.9	0.6	0.4	0.6	0.5	0.5	0.4	0.0	0.3	0.7	0.5	-0.2	-29%
Worst 20% Days	---	2.2	3.0	3.6	2.8	2.3	2.0	2.0	1.7	3.0	2.5	-0.1	0.2	2.9	2.2	-0.7	-24%
All Days	---	1.4	1.8	2.0	1.9	1.4	1.4	1.3	1.2	1.4	1.2	0.0	0.0	1.8	1.3	-0.5	-28%
Elemental Carbon Extinction (Mm-1)																	
Best 20% Days	---	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.0	0.0	0.2	0.2	0.0	0%
Worst 20% Days	---	1.2	1.3	1.7	1.3	1.3	1.0	1.0	1.1	1.3	1.0	0.0	0.3	1.4	1.2	-0.2	-14%
All Days	---	0.7	0.8	0.9	0.8	0.6	0.7	0.6	0.6	0.6	0.5	0.0	0.1	0.8	0.6	-0.2	-25%
Soil Extinction (Mm-1)																	
Best 20% Days	---	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.4	0.1	0.1	0.0	0%
Worst 20% Days	---	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.0	0.1	0.3	0.4	0.1	33%
All Days	---	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.5	0.2	0.2	0.0	0%
Coarse Mass Extinction (Mm-1)																	
Best 20% Days	---	1.2	1.1	1.0	0.9	0.8	0.8	0.9	0.9	1.0	0.9	0.0	0.1	1.0	0.9	-0.1	-10%
Worst 20% Days	---	3.2	2.7	2.4	2.2	1.9	2.3	2.0	1.6	1.9	1.9	-0.2	0.0	2.6	1.9	-0.7	-27%
All Days	---	2.2	2.0	1.9	1.6	1.5	1.6	1.6	1.5	1.6	1.5	-0.1	0.0	1.9	1.6	-0.3	-16%
Sea Salt Extinction (Mm-1)																	
Best 20% Days	---	1.1	1.0	0.9	1.3	1.1	1.4	1.6	1.7	1.7	1.5	0.1	0.0	1.1	1.5	0.4	36%
Worst 20% Days	---	1.4	0.7	1.3	1.7	2.1	2.5	2.5	1.3	1.5	2.4	0.1	0.1	1.3	2.0	0.7	54%
All Days	---	1.4	1.1	1.6	1.7	2.3	2.1	2.5	1.9	2.1	2.2	0.1	0.0	1.4	2.2	0.8	57%

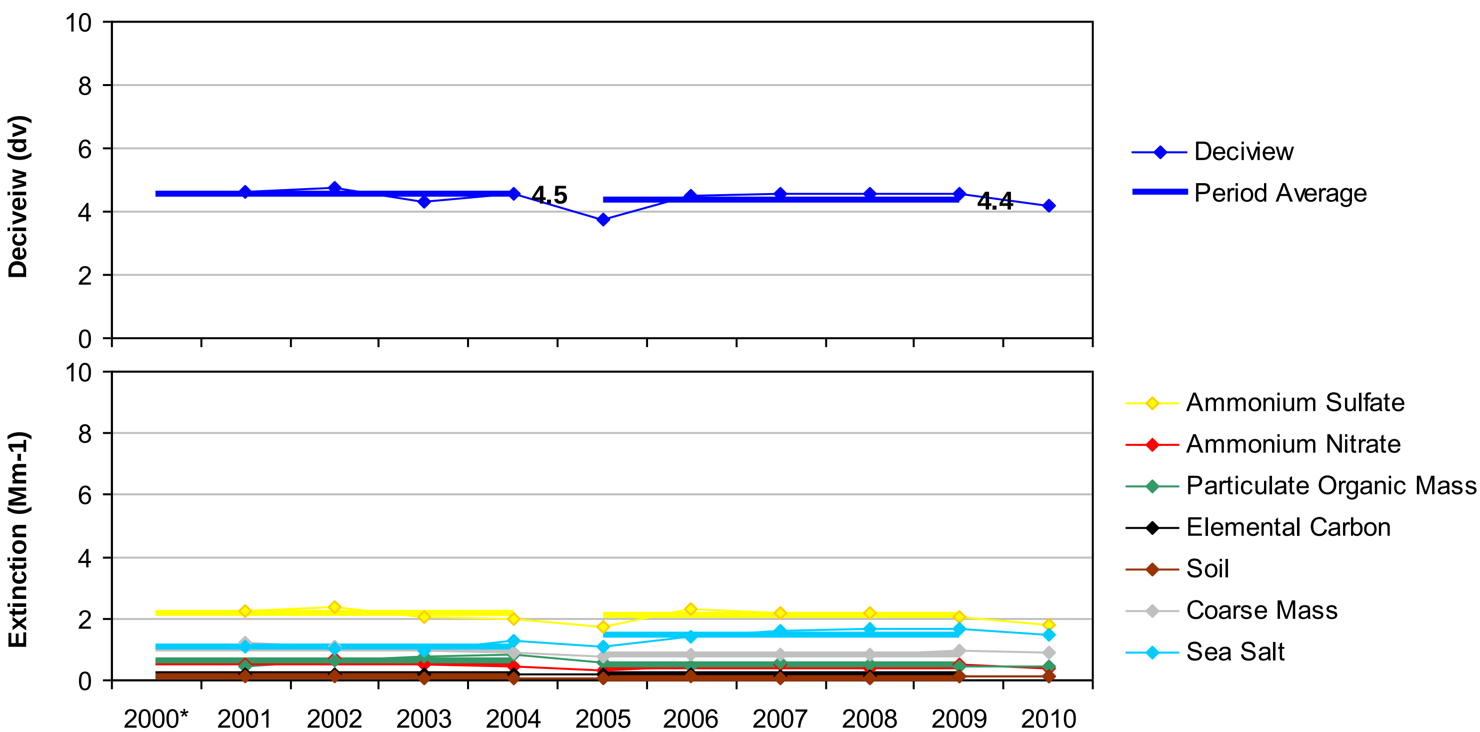
*Values highlighted in blue (red) indicate statistically significant decreasing (increasing) annual trend. Significance is measured at the 85% confidence level (p-value ≤0.15).
**Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.
"---" Indicates a missing year that did not meet RHR data completeness criteria.

Figure E.2-1
Haleakala NP, HI (HALE1 Site)
Annual and 5-Year Period Averages
20% Most Impaired Visibility Days



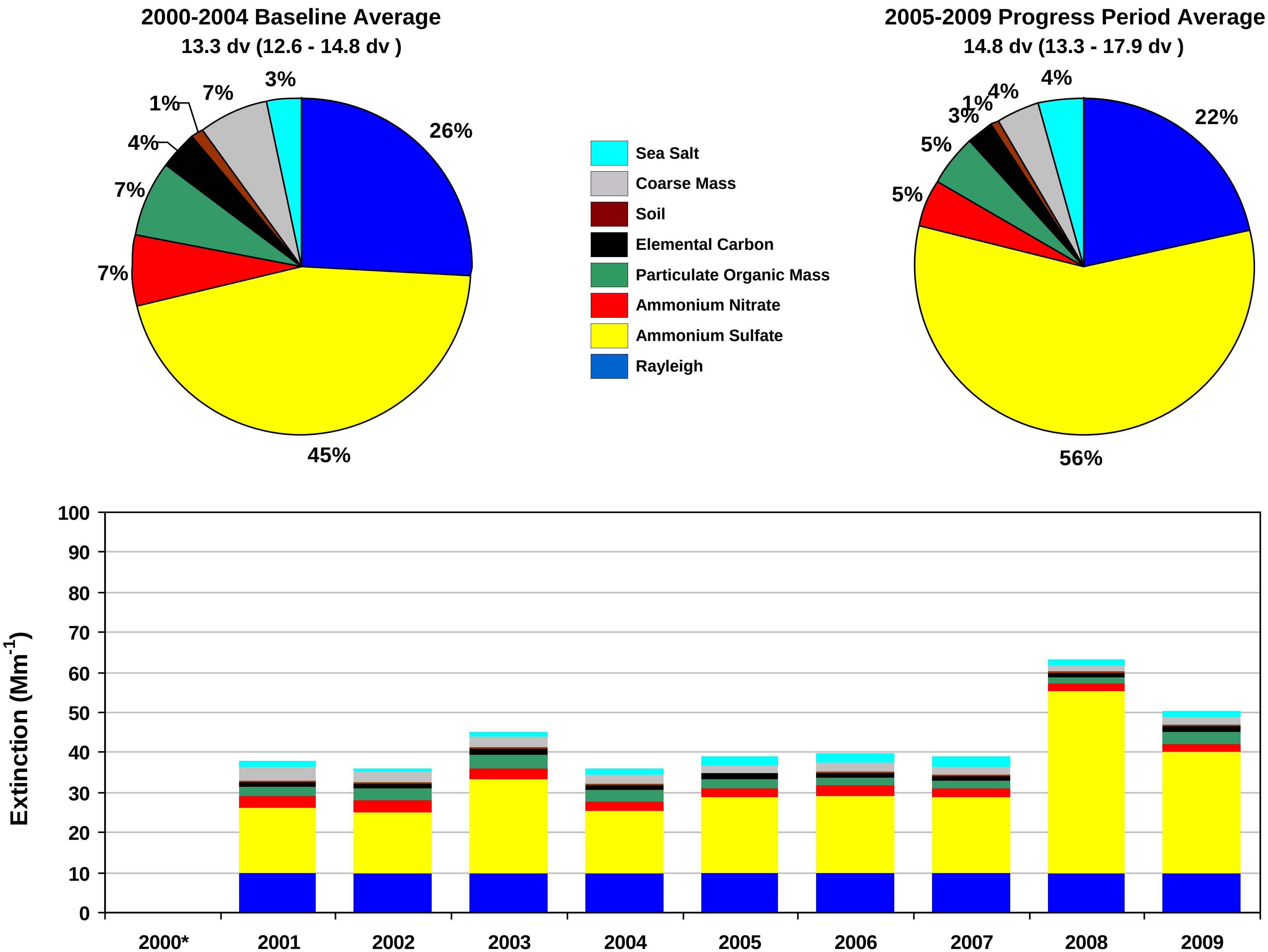
*Missing years did not meet RHR data completeness criteria.

Figure E.2-2
Haleakala NP, HI (HALE1 Site)
Annual and 5-Year Period Averages
20% Least Impaired Visibility Days



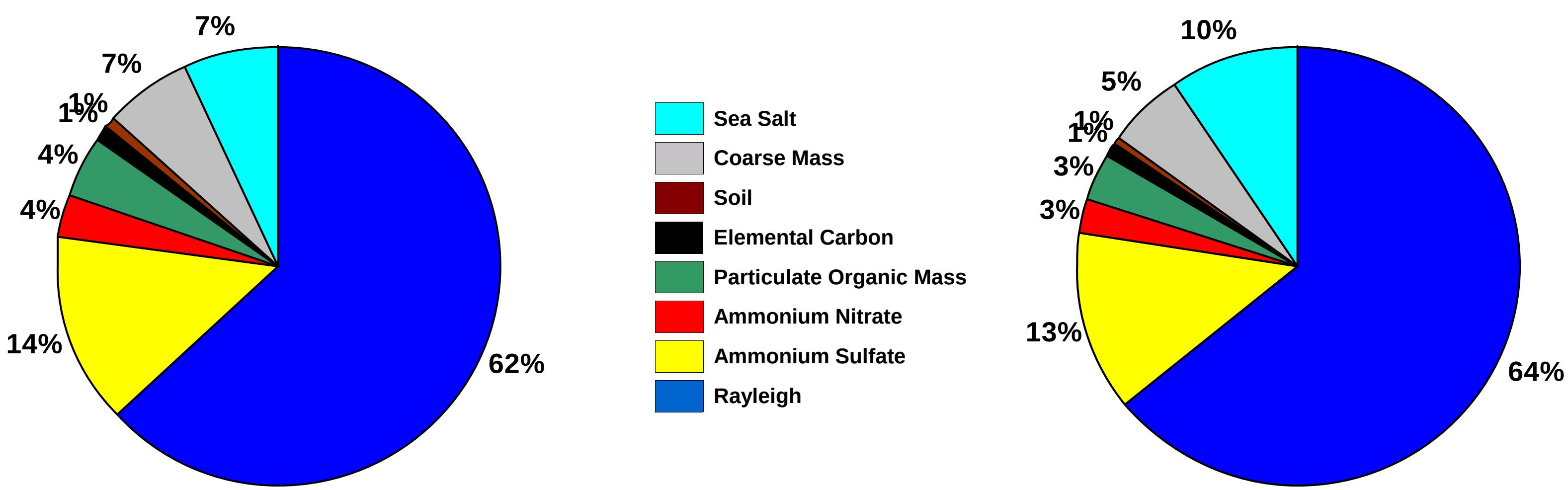
*Missing years did not meet RHR data completeness criteria.

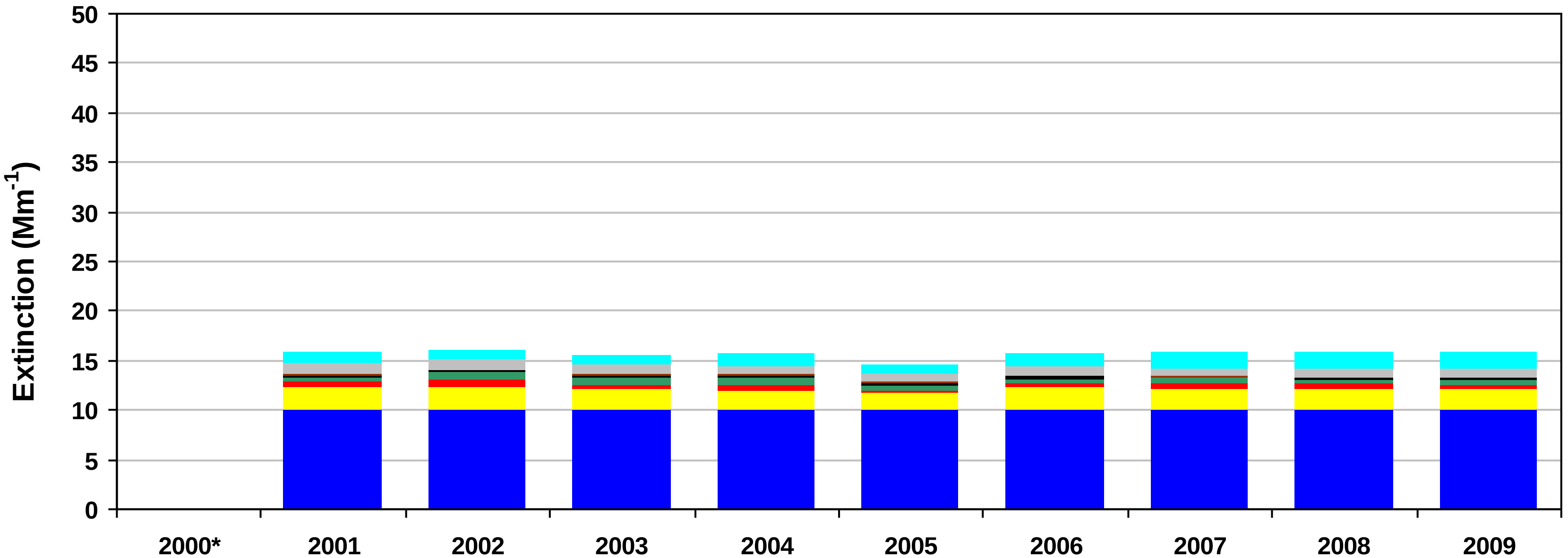
Figure E.2-3
Haleakala NP, HI (HALE1 Site)
20% Most Impaired Visibility Days



*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

Figure E.2-4
Haleakala NP, HI (HALE1 Site)
20% Least Impaired Visibility Days

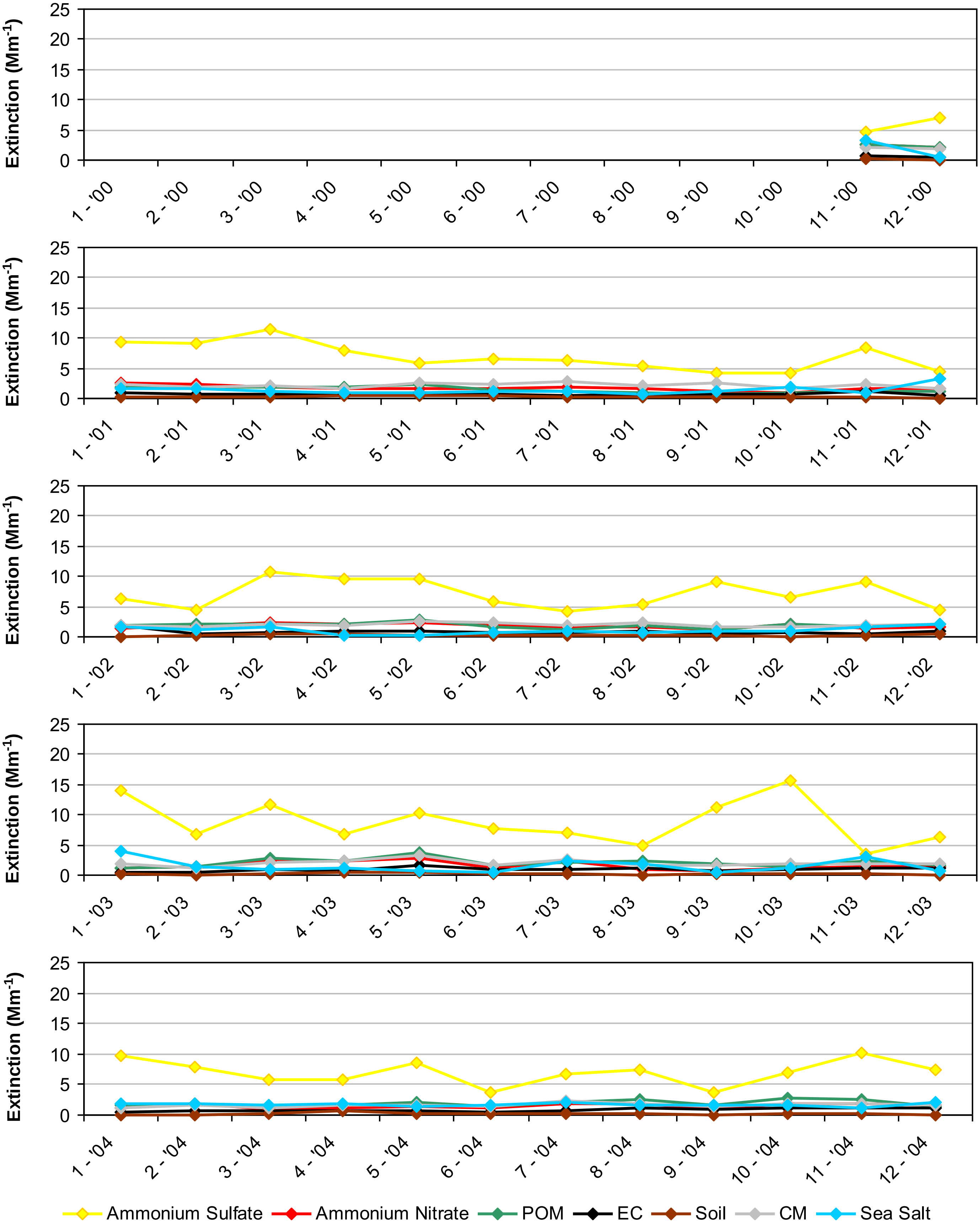




*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

Appendix A

Figure E.2-5
Haleakala NP, HI (HALE1 Site)
2000-2004 Monthly Average Aerosol Extinction, All Monitored Days



*Note that monthly averages for the year 2000 are shown here, but this year did not meet RHR data completeness criteria.

Figure E.2-6
Haleakala NP, HI (HALE1 Site)
2005-2009 Monthly Average Aerosol Extinction, All Monitored Days

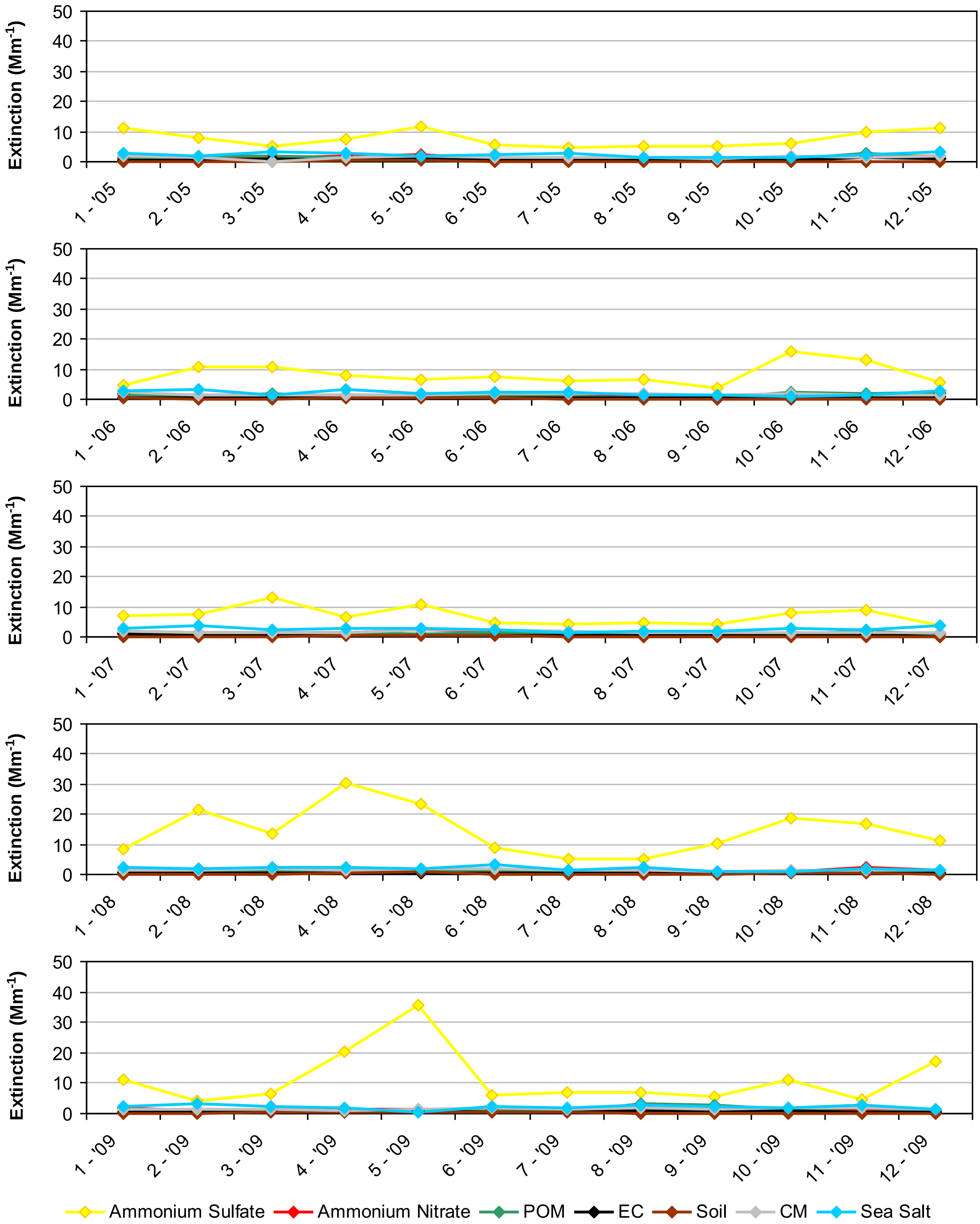
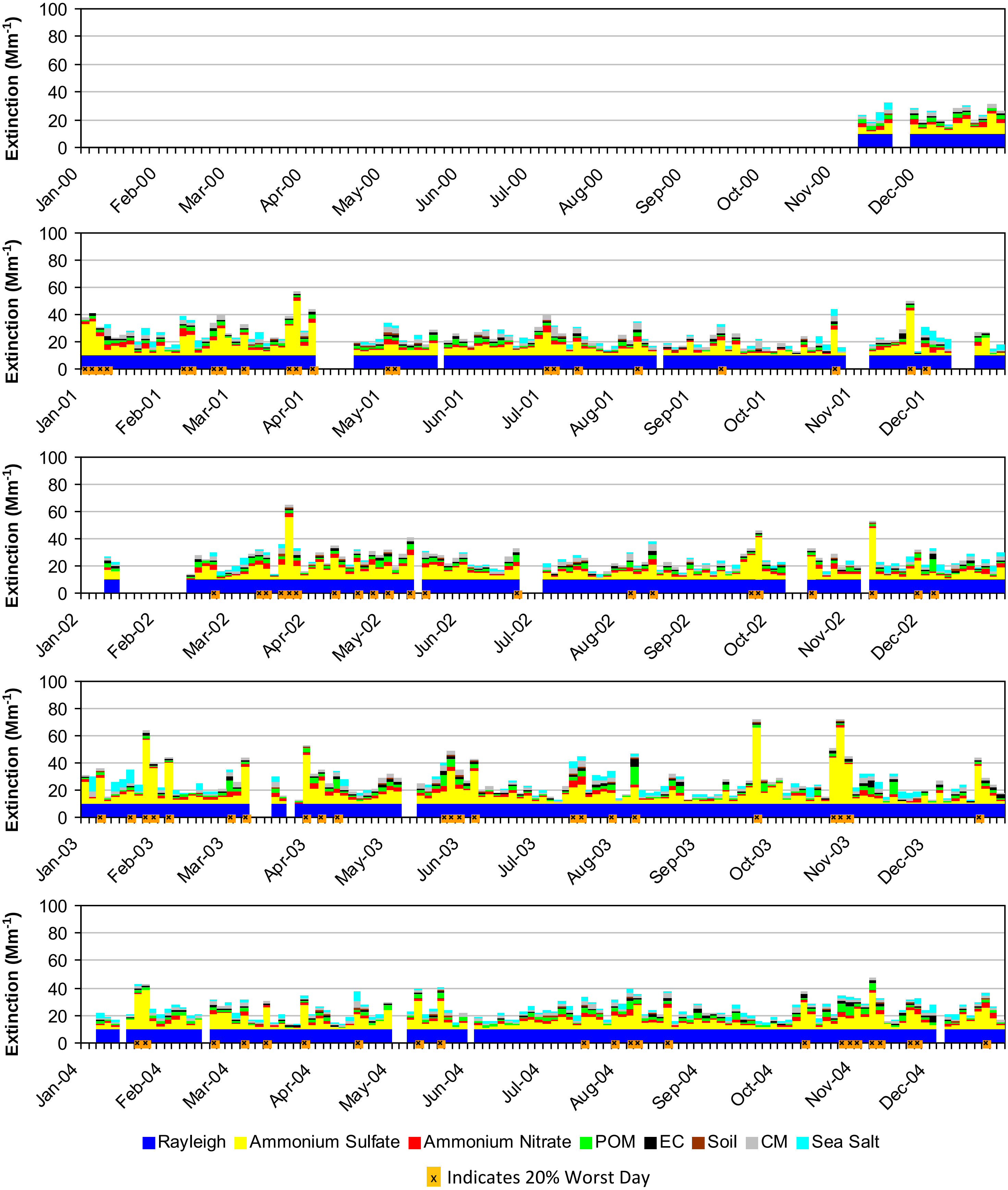
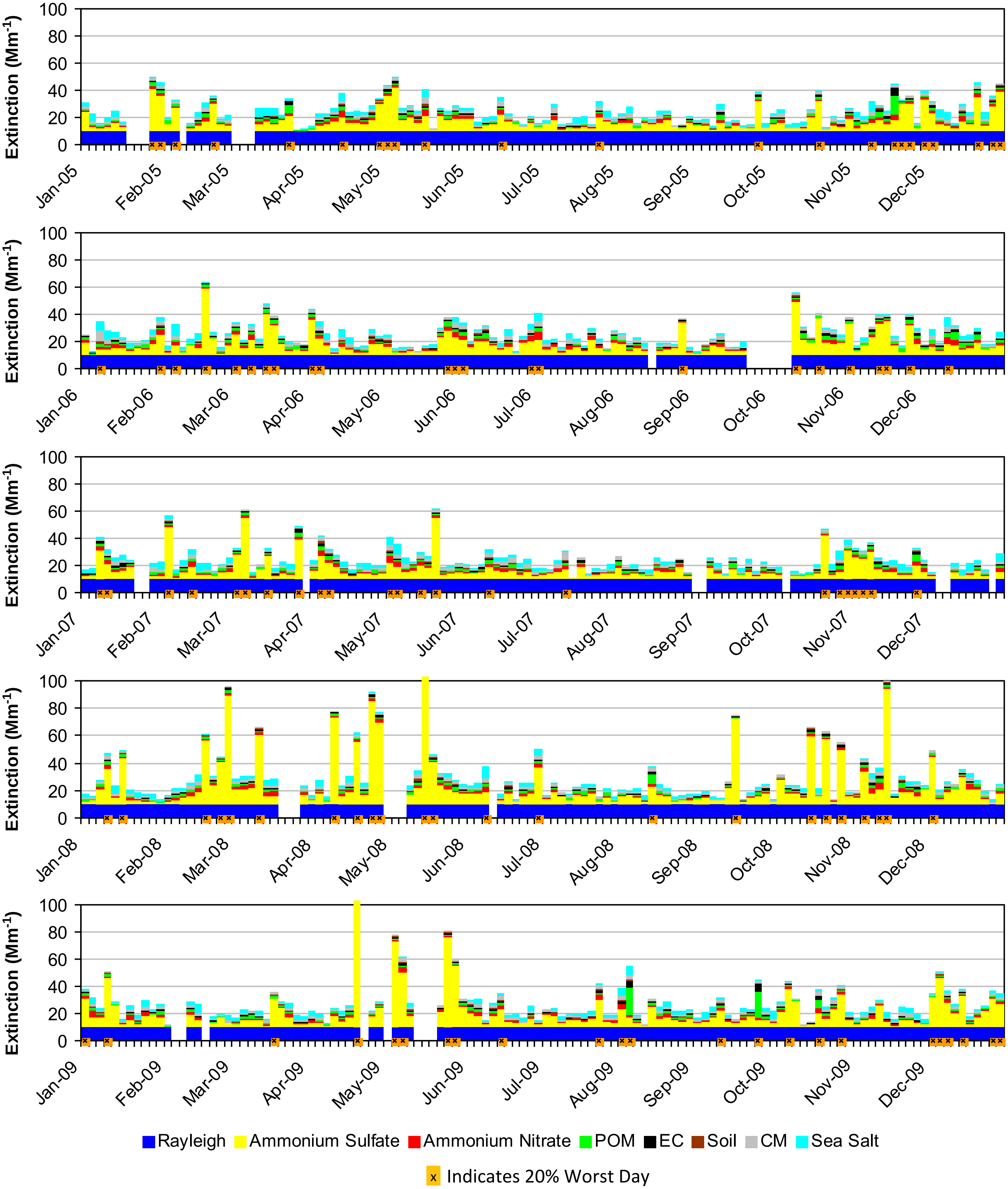


Figure E.2-7
Haleakala NP, HI (HALE1 Site)
2000-2004 Progress Period Extinction, All Sampled Days



*Note that daily averages for the year 2000 are shown here, but this year did not meet RHR data completeness criteria.

Figure E.2-8
Haleakala NP, HI (HALE1 Site)
2005-2009 Progress Period Extinction, All Sampled Days



E.3. HAWAII VOLCANOES NP (HAVO1)

The following tables and figures are presented in this section for the Hawaii Volcanoes NP represented by the HAVO1 IMPROVE Monitor:

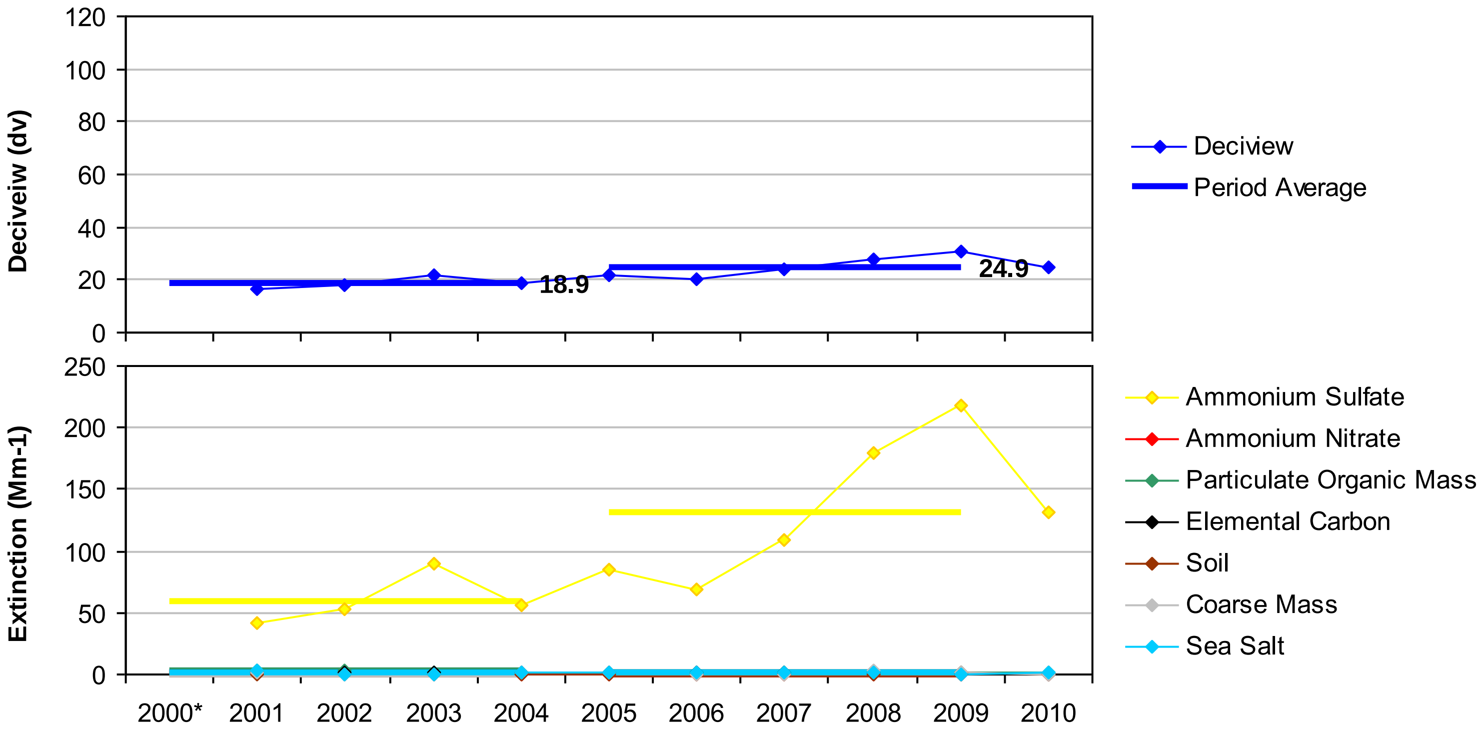
- **Table E.3-1: Annual Averages, 5-Year Period Averages, and Trends:** Table of averages and other metrics for the 20% least impaired days, the 20% most impaired days, and all sampled days is presented.
- **Figure E.3-1: Annual and 5-Year Period Averages for the 20% Most Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure E.3-2: Annual and 5-Year Period Averages for the 20% Least Impaired Visibility Days:** Line graphs depicting annual and period averages by component are presented.
- **Figure E.3-3: 20% Most Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component for the 20% most impaired days are presented.
- **Figure E.3-4: 20% Least Impaired Visibility Days:** Pie charts depicting period averages and stacked bar charts depicting annual averages by component are presented.
- **Figure E.3-5: 2000-2004 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the baseline period are presented.
- **Figure E.3-6: 2005-2009 Monthly Average Aerosol Extinction, All Monitored Days:** Line graphs depicting monthly averages by year and component for the progress period are presented.
- **Figure E.3-7: 2000-2004 Progress Period Extinction, All Sampled Days:** Stacked bar charts depicting daily averages by year and component for the baseline period are presented.
- **Figure E.3-8: 2000-2004 Progress Period Extinction, All Sampled Days**: Stacked bar charts depicting daily averages by year and component for the progress period are presented.

Table E.3-1
Hawaii Volcanoes NP, HI (HAVO1 Site)
Annual Averages, 5-Year Period Averages and Trends

Group	Baseline Period					Progress Period						2000-2009 Trend Statistics*		Period Averages**			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Slope (change/yr.)	p-value	Baseline (B)	Progress (P)	Difference (P -B)	Percent Change
Deciview (dv)																	
Best 20% Days	---	4.1	3.9	4.2	4.0	3.5	3.2	4.0	4.1	3.9	3.5	0.0	0.2	4.1	3.8	-0.3	-7%
Worst 20% Days	---	16.4	18.0	22.0	19.0	22.1	20.6	23.8	27.5	30.5	24.4	1.6	0.0	18.9	24.9	6.0	32%
All Days	---	8.8	9.2	10.6	9.7	10.2	10.0	10.3	11.5	13.2	10.5	0.4	0.0	9.6	11.1	1.5	16%
Total Extinction (Mm-1)																	
Best 20% Days	---	15.2	14.9	15.3	15.0	14.3	13.9	15.1	15.1	14.9	14.2	0.0	0.3	15.1	14.6	-0.5	-3%
Worst 20% Days	---	60.9	69.7	103.7	71.6	100.8	83.5	124.1	197.5	232.9	145.3	19.1	0.0	76.5	147.7	71.2	93%
All Days	---	28.6	30.5	39.3	31.8	37.7	34.5	41.4	57.4	69.4	46.4	3.9	0.0	32.5	48.1	15.6	48%
Ammonium Sulfate Extinction (Mm-1)																	
Best 20% Days	---	1.9	1.7	2.9	2.1	2.1	1.8	2.2	2.3	2.7	2.0	0.1	0.1	2.2	2.2	0.0	0%
Worst 20% Days	---	41.4	53.0	89.3	56.2	85.2	69.2	108.6	179.5	218.1	131.2	18.9	0.0	60.0	132.1	72.1	>100%
All Days	---	12.0	14.6	24.3	15.8	22.6	20.0	26.1	41.8	55.1	31.8	3.9	0.0	16.7	33.1	16.4	98%
Ammonium Nitrate Extinction (Mm-1)																	
Best 20% Days	---	0.3	0.2	0.4	0.3	0.2	0.2	0.4	0.3	0.3	0.3	0.0	0.4	0.3	0.3	0.0	0%
Worst 20% Days	---	1.1	1.0	0.8	0.6	0.6	0.3	0.7	0.7	0.5	0.4	-0.1	0.0	0.9	0.6	-0.3	-33%
All Days	---	0.9	0.9	0.8	0.8	0.7	0.6	0.8	0.7	0.5	0.6	0.0	0.0	0.8	0.7	-0.1	-13%
Particulate Organic Mass Extinction (Mm-1)																	
Best 20% Days	---	1.7	1.9	0.3	0.5	0.1	0.1	0.2	0.1	0.1	0.0	-0.1	0.0	1.1	0.1	-1.0	-91%
Worst 20% Days	---	3.6	3.9	1.3	1.2	1.4	1.0	1.5	1.7	0.9	0.8	-0.1	0.1	2.5	1.3	-1.2	-48%
All Days	---	2.4	2.7	0.8	0.9	0.6	0.5	0.7	0.6	0.4	0.3	-0.1	0.0	1.7	0.6	-1.1	-65%
Elemental Carbon Extinction (Mm-1)																	
Best 20% Days	---	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.2	0.1	-0.1	-50%
Worst 20% Days	---	0.9	0.9	1.2	1.0	0.9	0.8	0.9	0.9	0.6	0.6	0.0	0.1	1.0	0.8	-0.2	-20%
All Days	---	0.4	0.4	0.5	0.5	0.3	0.3	0.3	0.3	0.3	0.2	0.0	0.0	0.4	0.3	-0.1	-25%
Soil Extinction (Mm-1)																	
Best 20% Days	---	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	-0.1	-100%
Worst 20% Days	---	0.2	0.2	0.4	0.3	0.3	0.2	0.3	0.7	1.2	0.8	0.1	0.0	0.3	0.5	0.2	67%
All Days	---	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.4	0.3	0.0	0.2	0.2	0.2	0.0	0%
Coarse Mass Extinction (Mm-1)																	
Best 20% Days	---	0.4	0.2	0.5	0.5	0.4	0.3	0.5	0.4	0.3	0.5	0.0	0.5	0.4	0.4	0.0	0%
Worst 20% Days	---	1.1	0.4	0.7	0.9	1.0	0.4	0.8	2.5	0.8	0.7	0.0	0.3	0.8	1.1	0.3	38%
All Days	---	0.8	0.6	1.1	0.9	0.9	0.6	0.9	1.3	0.7	0.9	0.0	0.5	0.9	0.9	0.0	0%
Sea Salt Extinction (Mm-1)																	
Best 20% Days	---	0.7	0.7	1.0	1.3	1.4	1.4	1.7	1.8	1.4	1.3	0.1	0.0	0.9	1.6	0.7	78%
Worst 20% Days	---	2.7	0.4	0.1	1.4	1.5	1.5	1.2	1.5	0.8	0.8	0.0	0.4	1.2	1.3	0.1	8%
All Days	---	1.9	1.2	1.6	2.7	2.4	2.3	2.5	2.4	2.0	2.3	0.1	0.2	1.8	2.3	0.5	28%

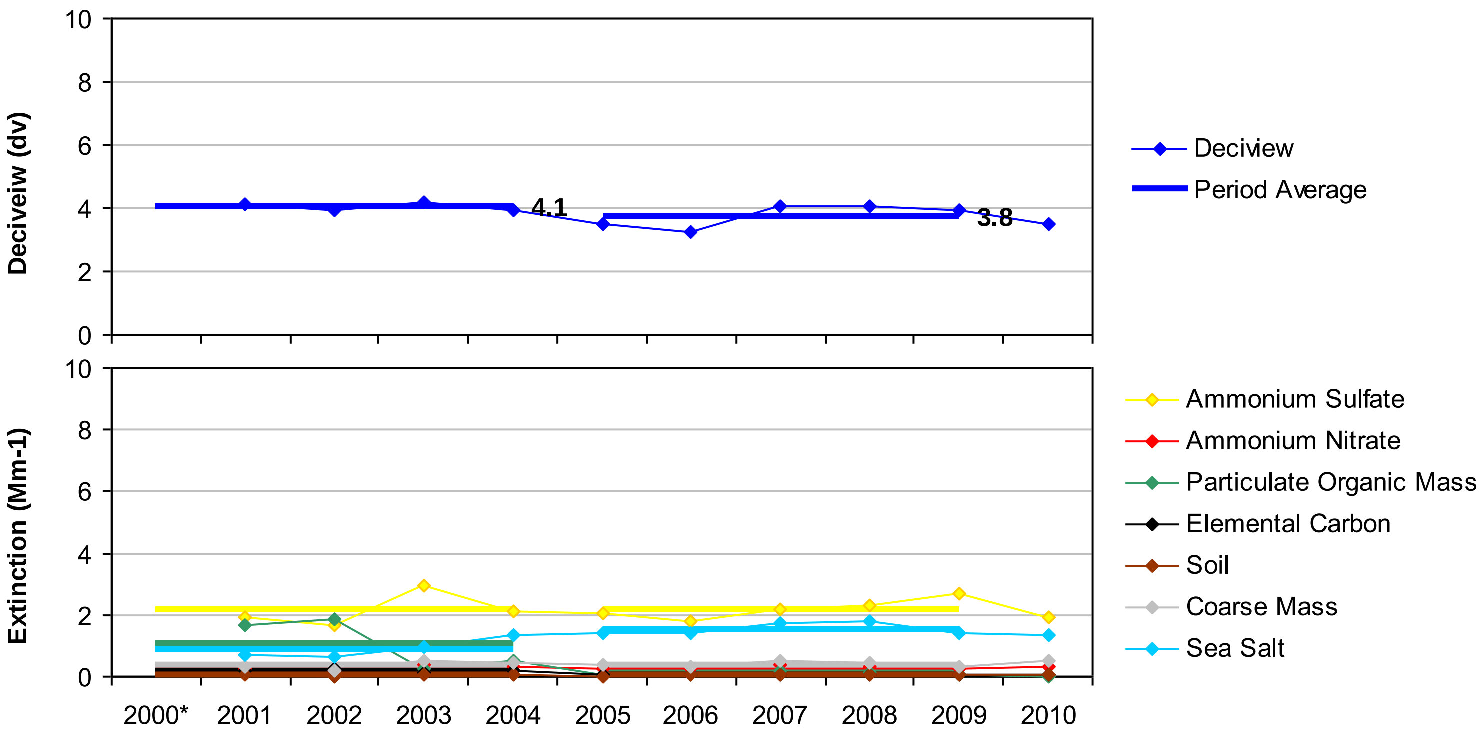
*Values highlighted in blue (red) indicate statistically significant decreasing (increasing) annual trend. Significance is measured at the 85% confidence level (p-value ≤0.15).
**Values highlighted in blue indicate a decrease in the 5-year average, values highlighted in red indicate an increase.
"---" Indicates a missing year that did not meet RHR data completeness criteria.

Figure E.3-1
Hawaii Volcanoes NP, HI (HAVO1 Site)
Annual and 5-Year Period Averages
20% Most Impaired Visibility Days



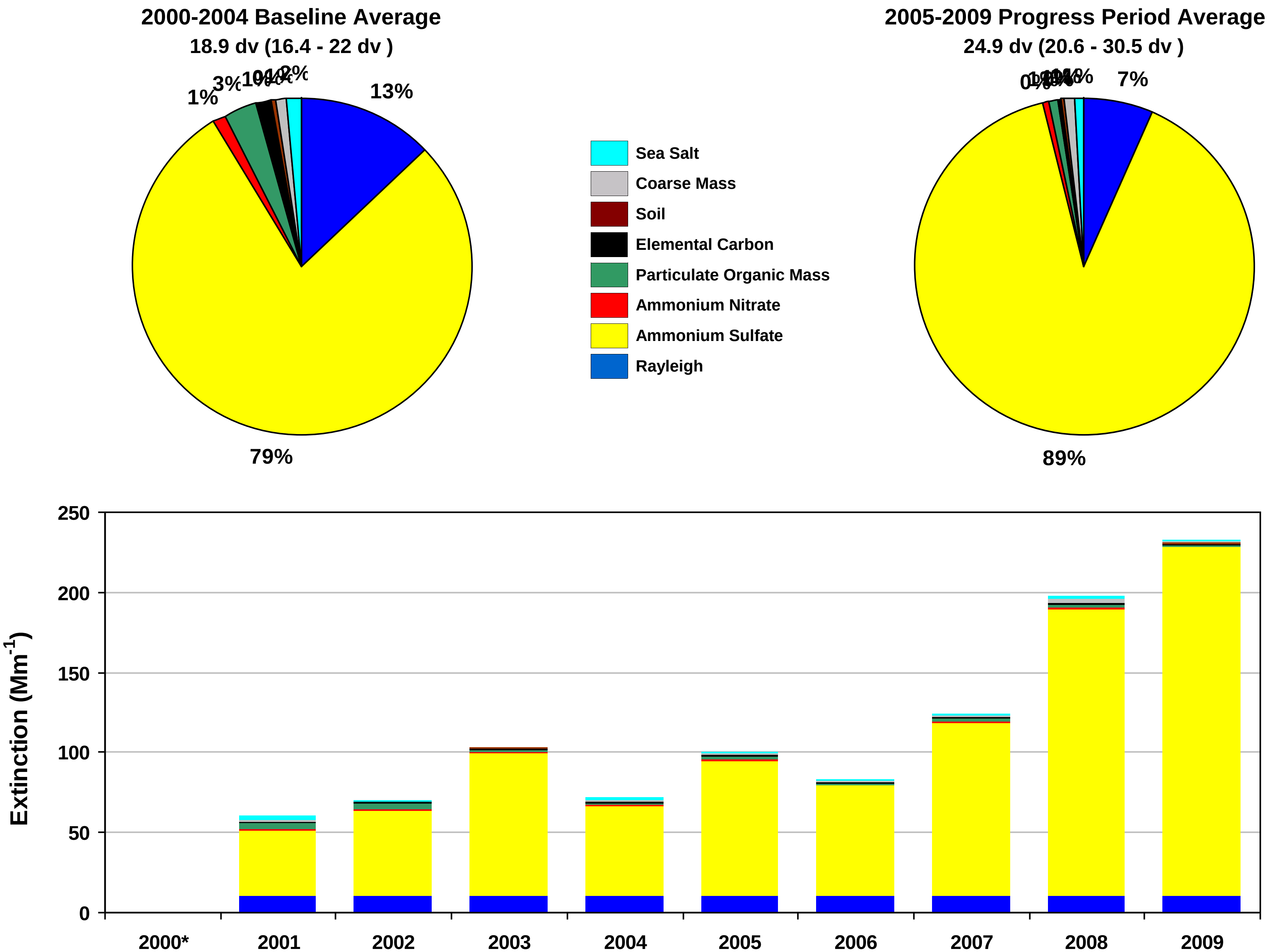
*Missing years did not meet RHR data completeness criteria.

Figure E.3-2
Hawaii Volcanoes NP, HI (HAVO1 Site)
Annual and 5-Year Period Averages
20% Least Impaired Visibility Days



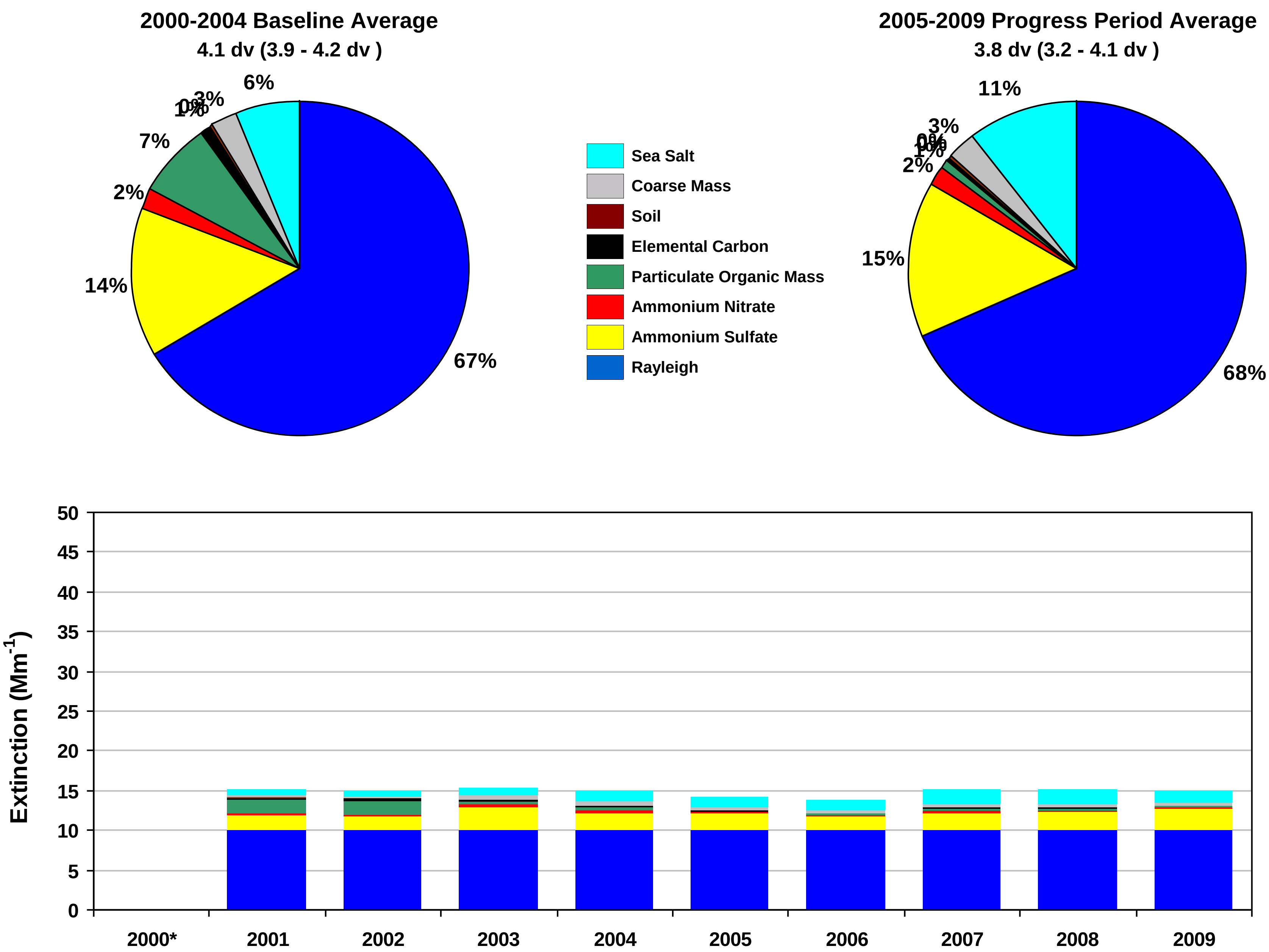
*Missing years did not meet RHR data completeness criteria.

Figure E.3-3
Hawaii Volcanoes NP, HI (HAVO1 Site)
20% Most Impaired Visibility Days



*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

Figure E.3-4
Hawaii Volcanoes NP, HI (HAVO1 Site)
20% Least Impaired Visibility Days



*Missing years did not meet RHR data completeness criteria. Only complete years are included in 5-year average pie charts.

Figure E.3-5
Hawaii Volcanoes NP, HI (HAVO1 Site)
2000-2004 Monthly Average Aerosol Extinction, All Monitored Days

*Note that monthly averages for the year 2000 are shown here, but this year did not meet RHR data completeness criteria.

Figure E.3-6
Hawaii Volcanoes NP, HI (HAVO1 Site)
2005-2009 Monthly Average Aerosol Extinction, All Monitored Days

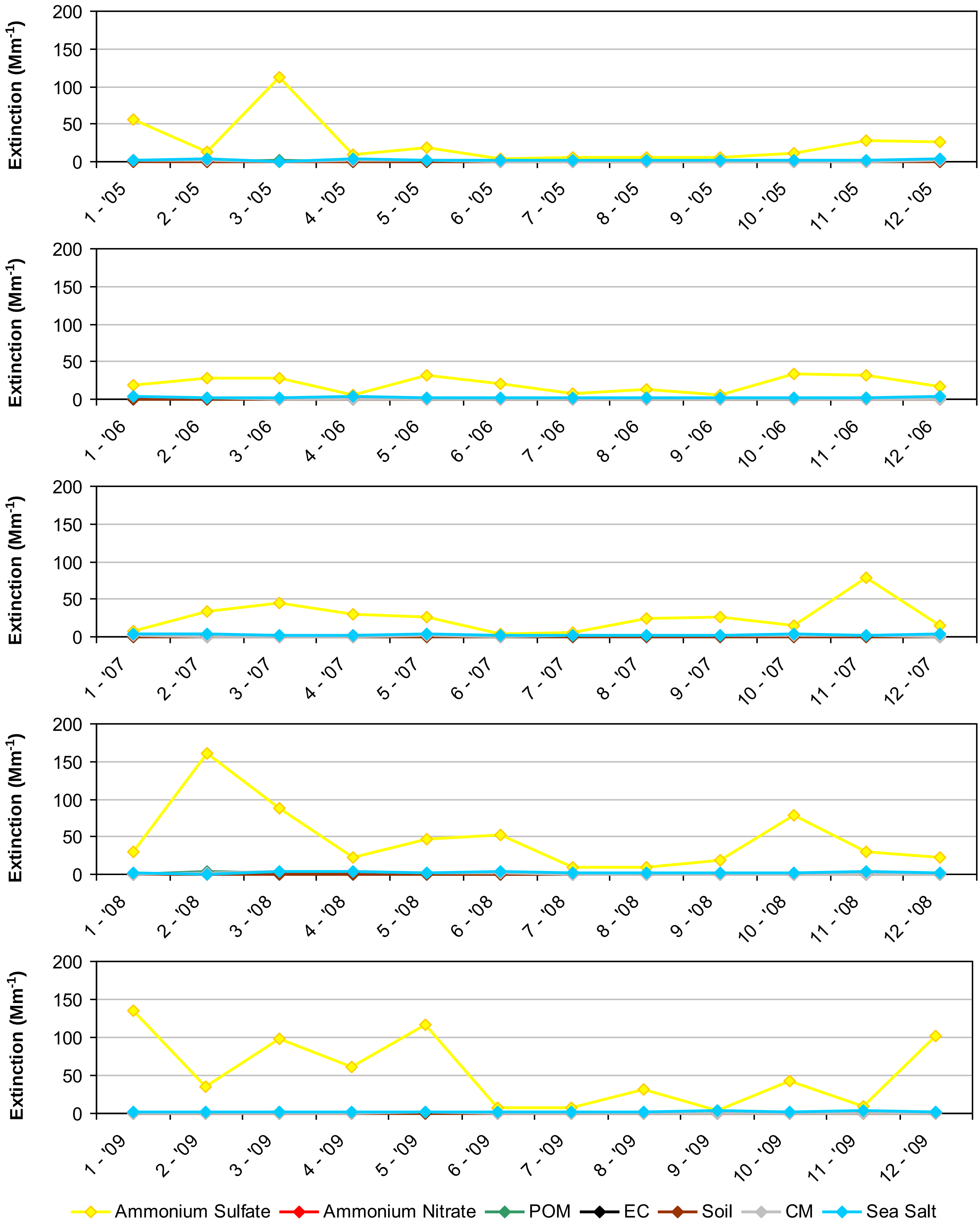
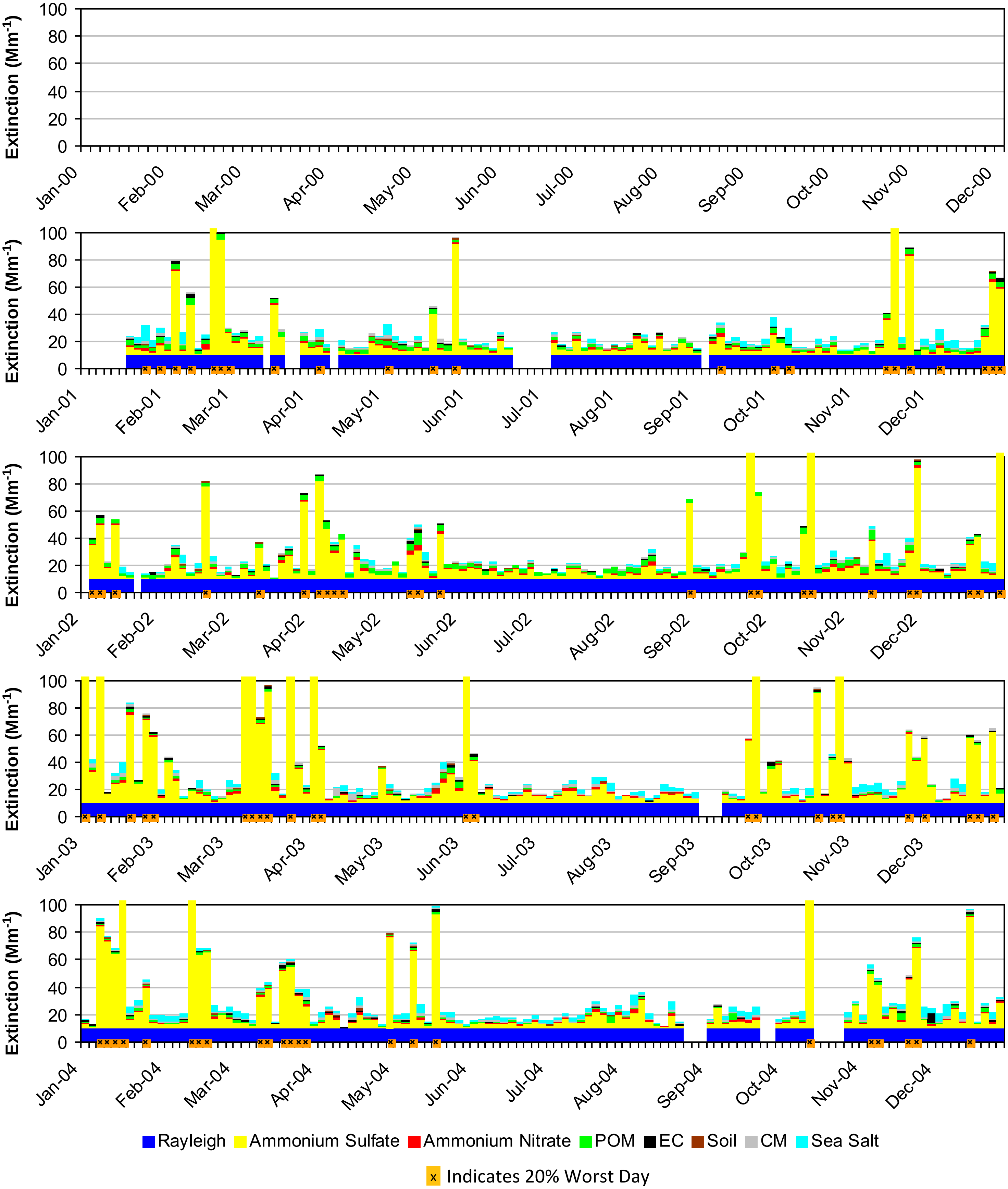
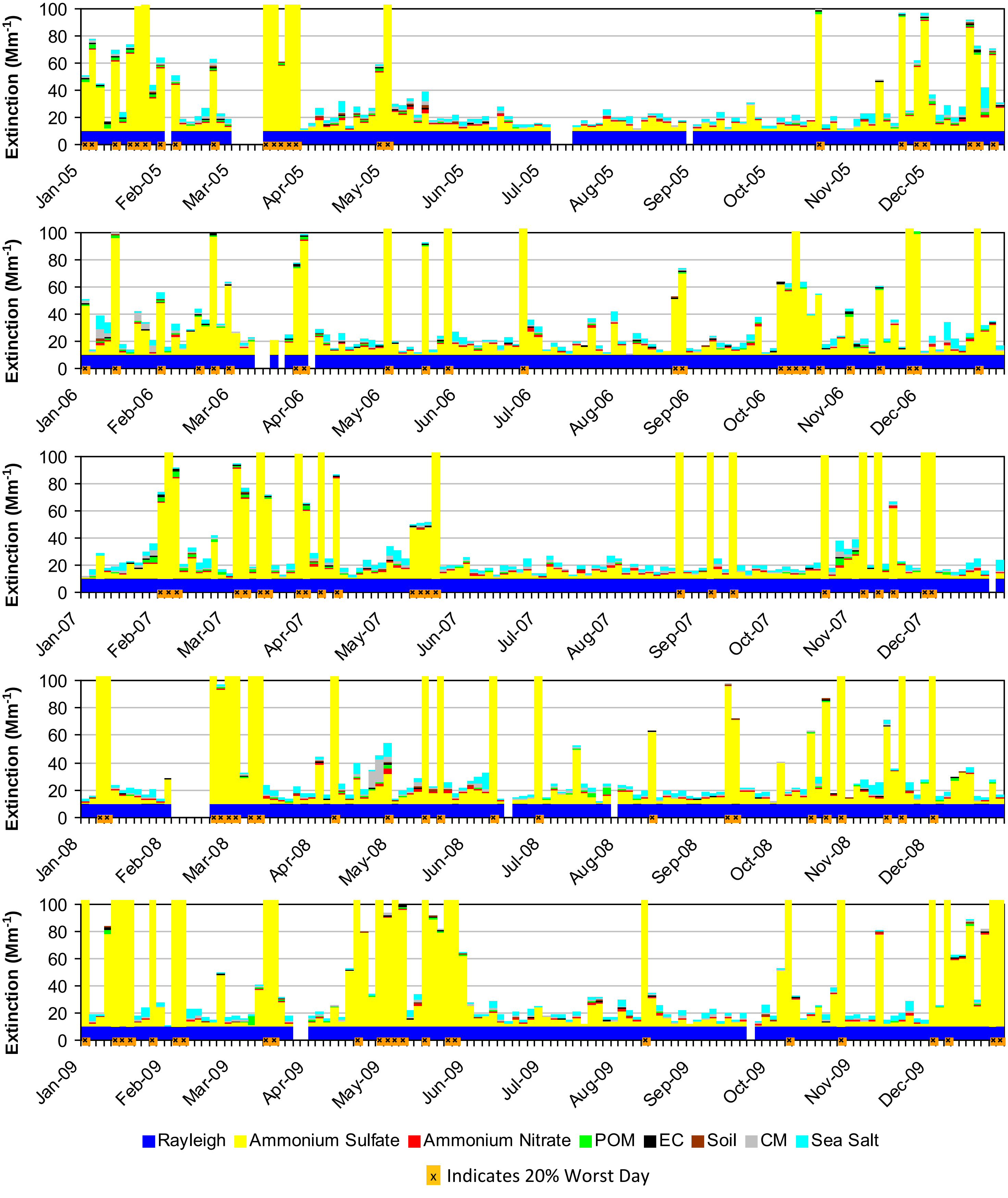


Figure E.3-7
Hawaii Volcanoes NP, HI (HAVO1 Site)
2000-2004 Progress Period Extinction, All Sampled Days

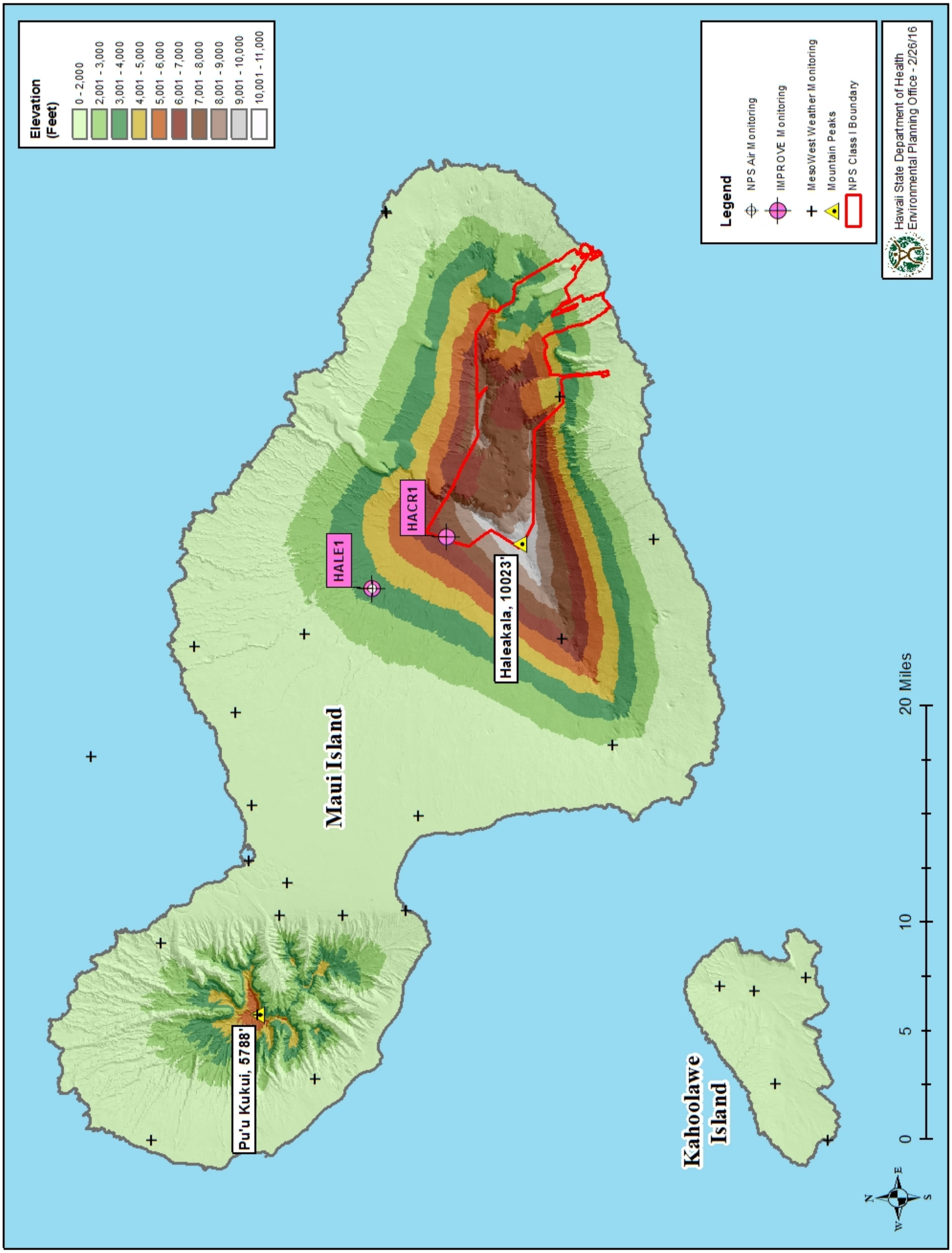


*Note that daily averages for the year 2000 are shown here, but this year did not meet RHR data completeness criteria.

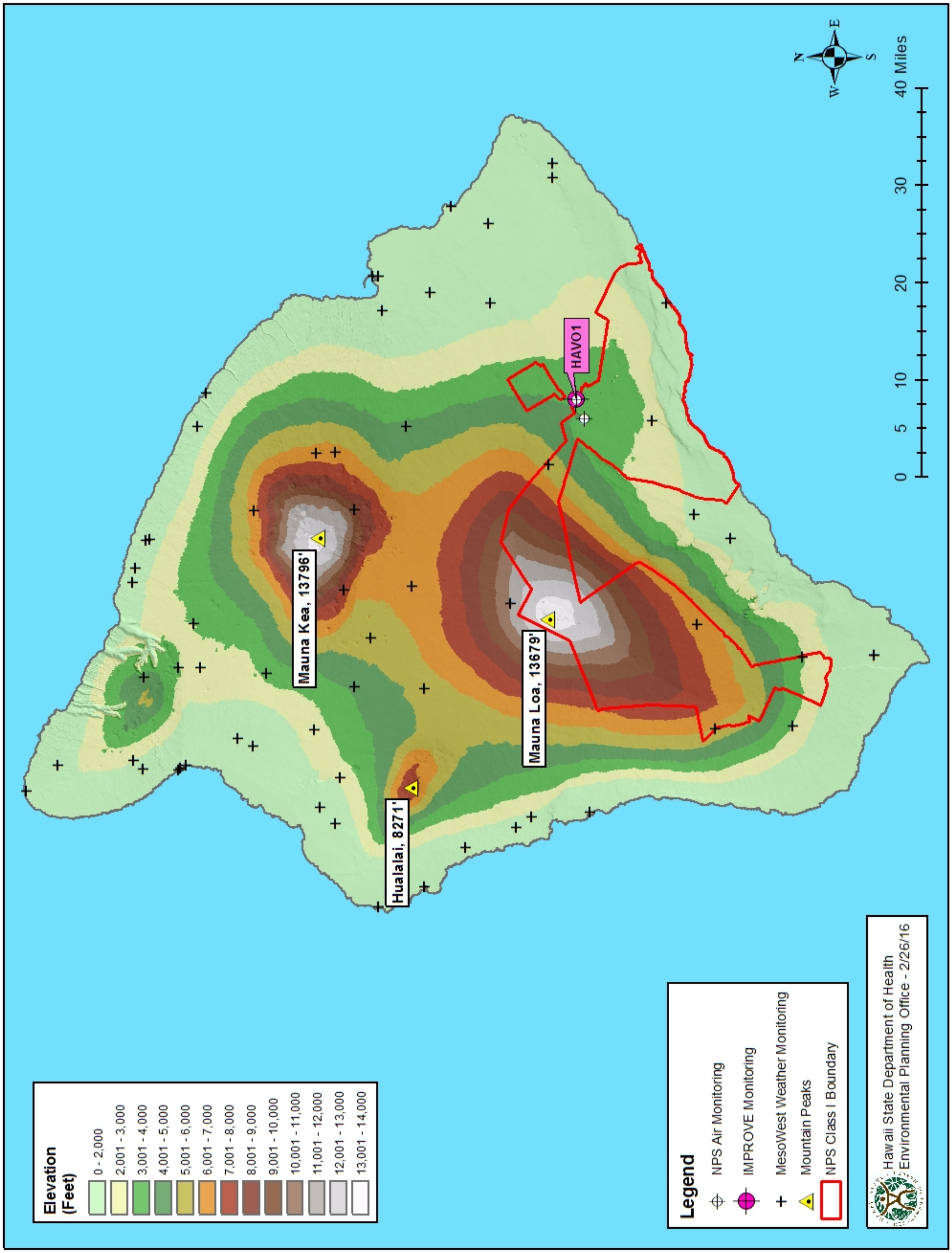
Figure E.3-8
Hawaii Volcanoes NP, HI (HAVO1 Site)
2005-2009 Progress Period Extinction, All Sampled Days



Appendix B: Topographical Maps of Maui and Hawaii Islands



Elevation
(Feet)
0 - 2,000
2,001 - 3,000
3,001 - 4,000
4,001 - 5,000
5,001 - 6,000
6,001 - 7,000
7,001 - 8,000
8,001 - 9,000
9,001 - 10,000
10,001 - 11,000
Legend
NPS Air Monitoring
IMPROVE Monitoring
MesoWest Weather Monitoring
Mountain Peaks
NPS Class I Boundary
Hawaii State Department of Health
Environmental Planning Office - 2/26/16
HACR1
HALE1
Haleakala, 10023'
Maui Island
Pu'u Kukui, 5788'
Kahoolawe
Island
0
5
10
20 Miles



Elevation (Feet)
0 - 2,000
2,001 - 3,000
3,001 - 4,000
4,001 - 5,000
5,001 - 6,000
6,001 - 7,000
7,001 - 8,000
8,001 - 9,000
9,001 - 10,000
10,001 - 11,000
11,001 - 12,000
12,001 - 13,000
13,001 - 14,000
Legend
NPS Air Monitoring
IMPROVE Monitoring
MesoWest Weather Monitoring
Mountain Peaks
NPS Class I Boundary
Hawaii State Department of Health
Environmental Planning Office - 2/26/16
Mauna Kea, 13796'
Mauna Loa, 13679'
Hualalai, 8271'
HAVO1
0 5 10 20 30 40 Miles
N
E
S
W

Appendix C: 2013-2015 Wind Rose Plots from Oahu, Molokai, and Maui Islands

Whether Monitoring Stations

STID	NAME	LATITUDE	LONGITUDE
KRCH1	KAHUKU	19.232222	155.78
P1Z6	FRENCH FRIGATE SHLS	23.87	166.28
PHBK	Kekaha, Pacific Missile Test Facility Barking Sands	22.03639	-159.78639
KHKP	KAANAPALI/MAUI ISL	20.92	-156.68
PHNL	Honolulu, Honolulu International Airport	21.32750	-157.94306
PHNM	HANA ARPT/MAUI	20.8	-156.02
PHTO	Hilo, Hilo International Airport	19.72222	-155.05583
PHKO	Kailua / Kona, Keahole Airport	19.74083	-156.05056
PHLI	Lihue, Lihue Airport	21.98389	-159.34111
PHNY	Lanai City, Lanai Airport	20.78556	-156.95139
PHMK	Kaunakakai, Molokai Airport	21.15	-157.1
PMUE	WAIMEA-KOHALA ARPT	20	-155.67
PHOG	Kahului, Kahului Airport	20.89250	-156.43694

All Hours & All Months

Data Info: Windrose

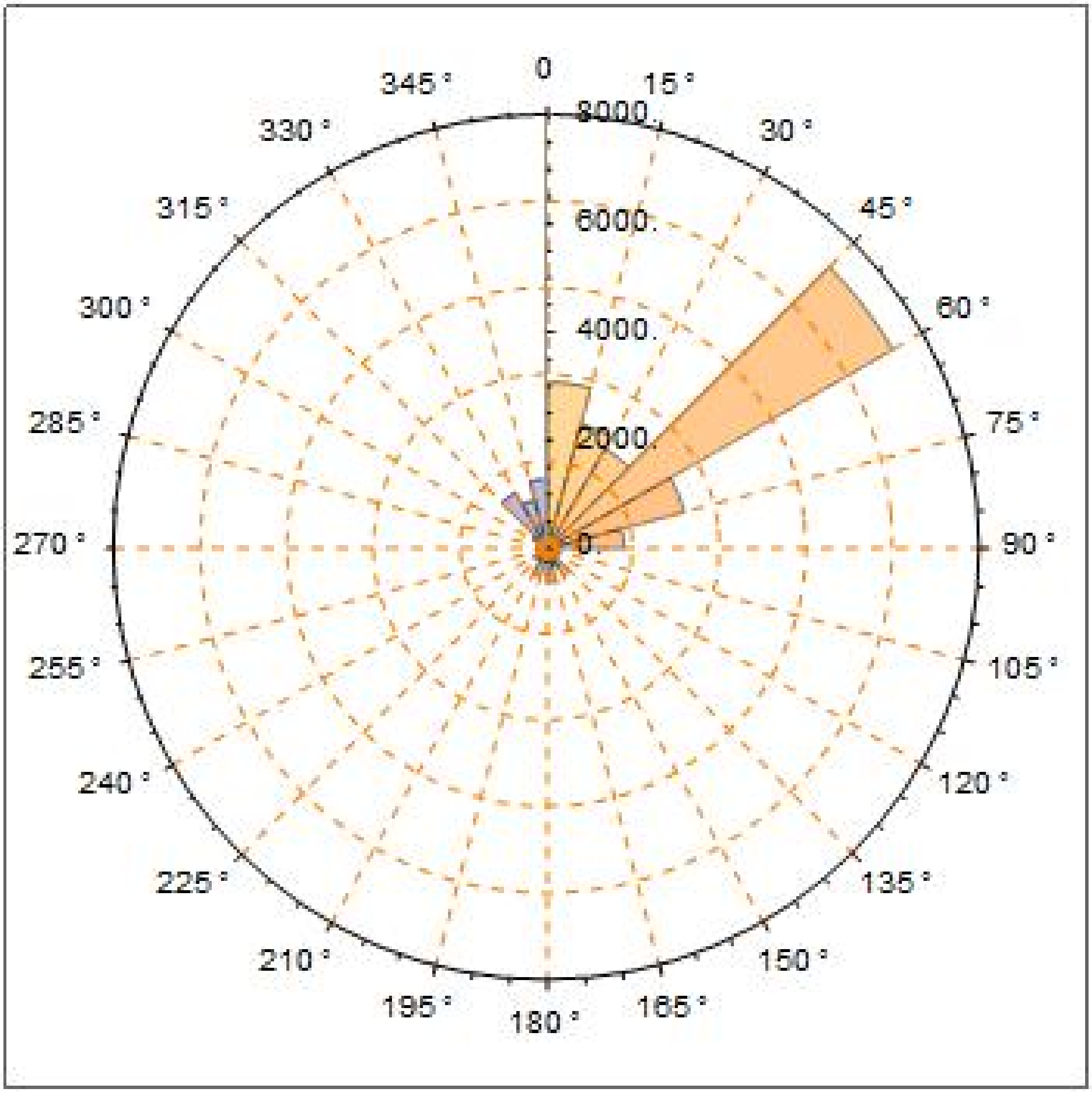
Number of Datasets = 26823

... first & last dataset (below); Direction = DRCT °

ID = PHNL	SKNT m/s	DRCT °	ID = PHNL	ID = PHNL
{2013, 1, 1, 0, 53, 0.}	2.06	330.	01–01–2013 00:53 HST	01–01–2013 00:53 HST

ID = PHNL	SKNT m/s	DRCT °	ID = PHNL	ID = PHNL
{2015, 12, 31, 23, 53, 0.}	2.57	340.	12–31–2015 23:53 HST	12–31–2015 23:53 HST

... complete dataset (below)



All Hours & All Months

Data Info: Windrose

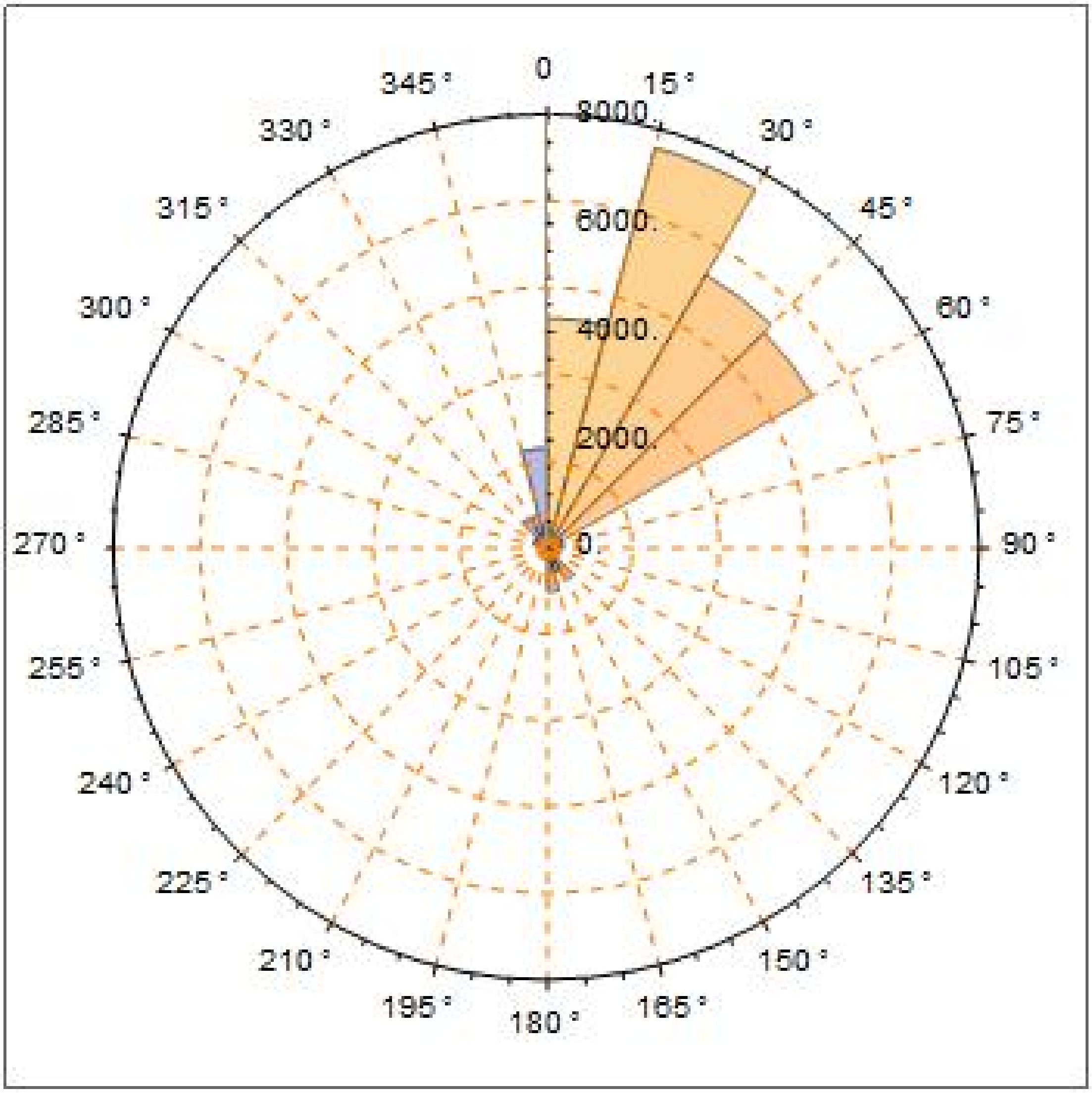
Number of Datasets = 30889

... first & last dataset (below); Direction = DRCT °

ID = PHMK	SKNT m/s	DRCT °	ID = PHMK	ID = PHMK
{2013, 1, 1, 0, 15, 0.}	4.12	360.	01-01-2013 00:15 HST	01-01-2013 00:15 HST

ID = PHMK	SKNT m/s	DRCT °	ID = PHMK	ID = PHMK
{2015, 12, 31, 23, 54, 0.}	2.57	340.	12-31-2015 23:54 HST	12-31-2015 23:54 HST

... complete dataset (below)



All Hours & All Months

Data Info: Windrose

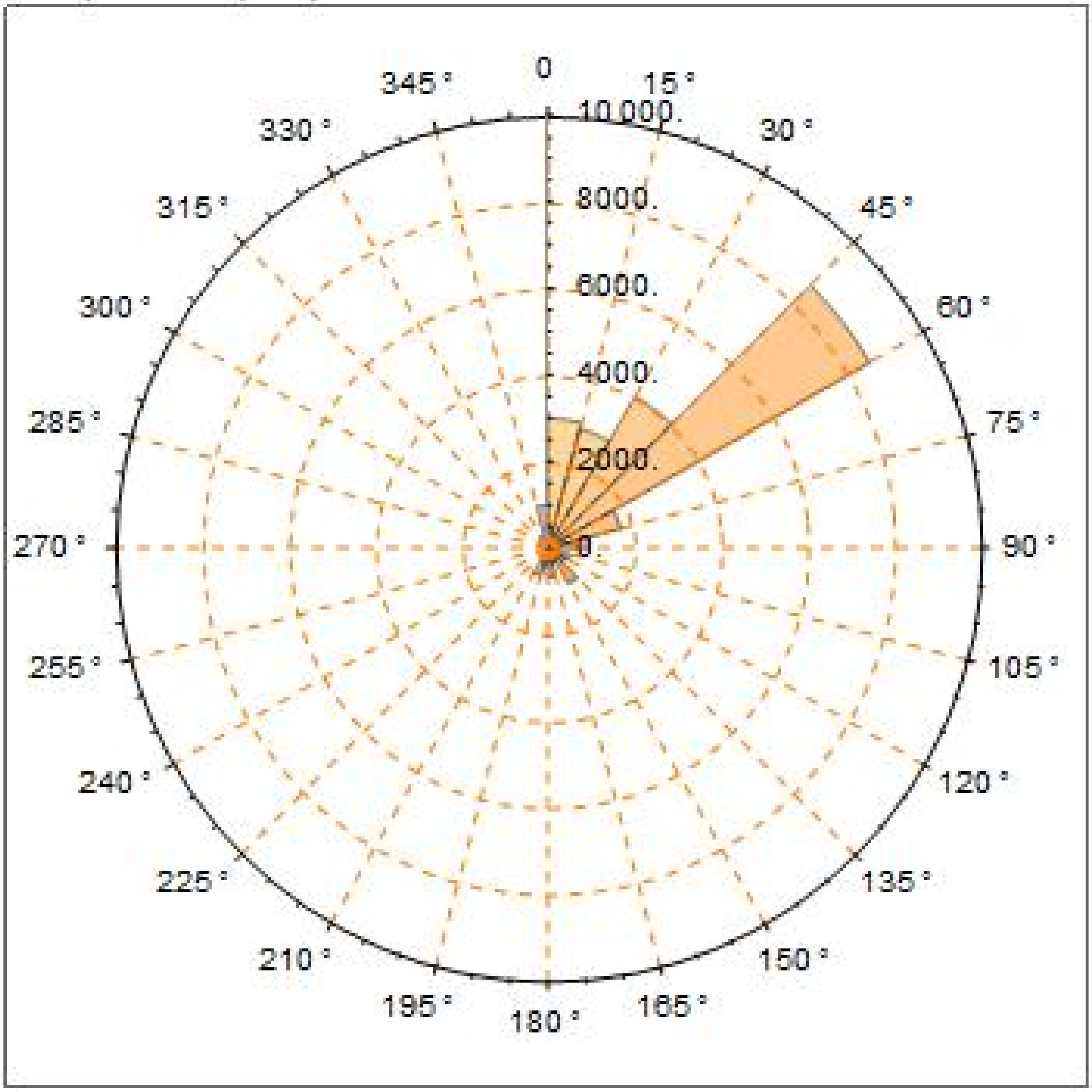
Number of Datasets = 27603

... first & last dataset (below); Direction = DRCT °

ID = PHOG	SKNT m/s	DRCT °	ID = PHOG	ID = PHOG
{2013, 1, 1, 0, 54, 0.}	3.6	60.	01-01-2013 00:54 HST	01-01-2013 00:54 HST

ID = PHOG	SKNT m/s	DRCT °	ID = PHOG	ID = PHOG
{2015, 12, 31, 23, 54, 0.}	0.	0.	12-31-2015 23:54 HST	12-31-2015 23:54 HST

... complete dataset (below)



Appendix D: HACR1 and HAVO1 Trend Statistics

					Annual Average Values												
Site	Year	Quantile & Method		No.	dv	S_Rayleigh:Value	ammNO3f_bext:Value	ammSO4f_bext:Value	ECf_bext:Value	CM_bext:Value	OMCf_bext:Value	SeaSaltf_bext:Value	SOILf_bext:Value	Aerosol Bext Calc	aerosol_bext:Value	Total Bext Calc	total_bext:Value
HACR1	2007	90	"IMPROVE"	22	9.340	9.000	1.303	9.039	0.931	1.443	4.067	1.011	0.536	18.331	18.331	27.331	27.331
HACR1	2007	90	"RHR BY HIDOH"	22	9.340	9.000	1.303	9.039	0.931	1.443	4.067	1.011	0.536	18.331	18.331	27.331	27.331
HACR1	2007	90	"HIDOH"	22	9.340	9.000	1.303	9.039	0.931	1.443	4.067	1.011	0.536	18.331	18.331	27.331	27.331
HACR1	2007	70	"IMPROVE"	20	5.214	9.000	1.000	3.873	0.238	0.993	0.631	0.892	0.239	7.866	7.866	16.866	16.866
HACR1	2007	70	"RHR BY HIDOH"	20	5.214	9.000	1.000	3.873	0.238	0.993	0.631	0.892	0.239	7.866	7.866	16.866	16.866
HACR1	2007	70	"HIDOH"	21	5.185	9.000	0.979	3.743	0.239	0.977	0.709	0.938	0.231	7.817	7.817	16.817	16.817
HACR1	2007	50	"IMPROVE"	23	3.885	9.000	0.652	2.518	0.175	0.685	0.678	0.811	0.249	5.767	5.767	14.767	14.767
HACR1	2007	50	"RHR BY HIDOH"	23	3.885	9.000	0.652	2.518	0.175	0.685	0.678	0.811	0.249	5.767	5.767	14.767	14.767
HACR1	2007	50	"HIDOH"	21	3.896	9.000	0.660	2.627	0.179	0.677	0.634	0.788	0.215	5.780	5.780	14.780	14.780
HACR1	2007	30	"IMPROVE"	20	2.250	9.000	0.420	1.748	0.071	0.471	0.137	0.541	0.146	3.534	3.534	12.534	12.534
HACR1	2007	30	"RHR BY HIDOH"	20	2.250	9.000	0.420	1.748	0.071	0.471	0.137	0.541	0.146	3.534	3.534	12.534	12.534
HACR1	2007	30	"HIDOH"	21	2.283	9.000	0.427	1.741	0.068	0.490	0.130	0.527	0.194	3.576	3.576	12.576	12.576
HACR1	2007	10	"IMPROVE"	21	0.846	9.000	0.172	0.971	0.029	0.233	0.130	0.314	0.047	1.896	1.896	10.896	10.896
HACR1	2007	10	"RHR BY HIDOH"	21	0.846	9.000	0.172	0.971	0.029	0.233	0.130	0.314	0.047	1.896	1.896	10.896	10.896
HACR1	2007	10	"HIDOH"	21	0.846	9.000	0.172	0.971	0.029	0.233	0.130	0.314	0.047	1.896	1.896	10.896	10.896
HACR1	2008	90	"IMPROVE"	25	12.118	9.000	0.995	22.865	0.481	1.182	0.736	0.599	0.427	27.286	27.286	36.286	36.286
HACR1	2008	90	"RHR BY HIDOH"	25	12.118	9.000	0.995	22.865	0.481	1.182	0.736	0.599	0.427	27.286	27.286	36.286	36.286
HACR1	2008	90	"HIDOH"	25	12.118	9.000	0.995	22.865	0.481	1.182	0.736	0.599	0.427	27.286	27.286	36.286	36.286
HACR1	2008	70	"IMPROVE"	23	6.595	9.000	0.980	6.266	0.316	1.048	0.796	0.711	0.276	10.394	10.394	19.394	19.394
HACR1	2008	70	"RHR BY HIDOH"	23	6.595	9.000	0.980	6.266	0.316	1.048	0.796	0.711	0.276	10.394	10.394	19.394	19.394
HACR1	2008	70	"HIDOH"	24	6.544	9.000	0.970	6.250	0.305	1.030	0.776	0.700	0.269	10.299	10.299	19.299	19.299
HACR1	2008	50	"IMPROVE"	26	4.313	9.000	0.656	3.599	0.114	0.838	0.361	0.708	0.143	6.420	6.420	15.420	15.420
HACR1	2008	50	"RHR BY HIDOH"	26	4.313	9.000	0.656	3.599	0.114	0.838	0.361	0.708	0.143	6.420	6.420	15.420	15.420
HACR1	2008	50	"HIDOH"	24	4.307	9.000	0.661	3.523	0.119	0.862	0.378	0.715	0.148	6.407	6.407	15.407	15.407
HACR1	2008	30	"IMPROVE"	23	2.510	9.000	0.302	2.343	0.130	0.392	0.119	0.495	0.090	3.871	3.871	12.871	12.871
HACR1	2008	30	"RHR BY HIDOH"	23	2.510	9.000	0.302	2.343	0.130	0.392	0.119	0.495	0.090	3.871	3.871	12.871	12.871
HACR1	2008	30	"HIDOH"	24	2.546	9.000	0.309	2.377	0.128	0.396	0.114	0.507	0.088	3.919	3.919	12.919	12.919
HACR1	2008	10	"IMPROVE"	24	0.595	9.000	0.072	0.964	0.020	0.206	0.026	0.265	0.076	1.630	1.630	10.630	10.630
HACR1	2008	10	"RHR BY HIDOH"	24	0.595	9.000	0.072	0.964	0.020	0.206	0.026	0.265	0.076	1.630	1.630	10.630	10.630
HACR1	2008	10	"HIDOH"	24	0.595	9.000	0.072	0.964	0.020	0.206	0.026	0.265	0.076	1.630	1.630	10.630	10.630
HACR1	2009	90	"IMPROVE"	24	10.926	9.000	1.006	17.611	0.503	2.467	0.694	0.617	0.359	23.257	23.257	32.257	32.257
HACR1	2009	90	"RHR BY HIDOH"	24	10.926	9.000	1.006	17.611	0.503	2.467	0.694	0.617	0.359	23.257	23.257	32.257	32.257
HACR1	2009	90	"HIDOH"	24	10.926	9.000	1.006	17.611	0.503	2.467	0.694	0.617	0.359	23.257	23.257	32.257	32.257
HACR1	2009	70	"IMPROVE"	23	6.380	9.000	0.789	6.173	0.245	1.405	0.292	0.769	0.295	9.966	9.966	18.966	18.966
HACR1	2009	70	"RHR BY HIDOH"	23	6.380	9.000	0.789	6.173	0.245	1.405	0.292	0.769	0.295	9.966	9.966	18.966	18.966
HACR1	2009	70	"HIDOH"	24	6.338	9.000	0.799	6.089	0.234	1.433	0.279	0.760	0.293	9.888	9.888	18.888	18.888
HACR1	2009	50	"IMPROVE"	26	4.643	9.000	0.649	3.584	0.194	1.284	0.191	0.810	0.213	6.926	6.926	15.926	15.926
HACR1	2009	50	"RHR BY HIDOH"	26	4.643	9.000	0.649	3.584	0.194	1.284	0.191	0.810	0.213	6.926	6.926	15.926	15.926
HACR1	2009	50	"HIDOH"	24	4.640	9.000	0.640	3.604	0.200	1.276	0.194	0.799	0.208	6.920	6.920	15.920	15.920
HACR1	2009	30	"IMPROVE"	23	2.835	9.000	0.347	2.176	0.169	0.775	0.137	0.563	0.130	4.296	4.296	13.296	13.296
HACR1	2009	30	"RHR BY HIDOH"	23	2.835	9.000	0.347	2.176	0.169	0.775	0.137	0.563	0.130	4.296	4.296	13.296	13.296
HACR1	2009	30	"HIDOH"	24	2.883	9.000	0.353	2.190	0.172	0.772	0.145	0.594	0.137	4.363	4.363	13.363	13.363
HACR1	2009	10	"IMPROVE"	23	1.278	9.000	0.178	1.160	0.074	0.498	0.052	0.331	0.094	2.387	2.387	11.387	11.387
HACR1	2009	10	"RHR BY HIDOH"	23	1.278	9.000	0.178	1.160	0.074	0.498	0.052	0.331	0.094	2.387	2.387	11.387	11.387
HACR1	2009	10	"HIDOH"	23	1.278	9.000	0.178	1.160	0.074	0.498	0.052	0.331	0.094	2.387	2.387	11.387	11.387
HACR1	2010	90	"IMPROVE"	24	10.021	9.000	1.116	14.317	0.389	1.235	0.843	0.745	0.703	19.348	19.348	28.348	28.348
HACR1	2010	90	"RHR BY HIDOH"	24	10.021	9.000	1.116	14.317	0.389	1.235	0.843	0.745	0.703	19.348	19.348	28.348	28.348
HACR1	2010	90	"HIDOH"	24	10.021	9.000	1.116	14.317	0.389	1.235	0.843	0.745	0.703	19.348	19.348	28.348	28.348
HACR1	2010	70	"IMPROVE"	22	5.864	9.000	0.879	4.843	0.285	1.046	0.614	0.890	0.438	8.995	8.995	17.995	17.995
HACR1	2010	70	"RHR BY HIDOH"	22	5.864	9.000	0.879	4.843	0.285	1.046	0.614	0.890	0.438	8.995	8.995	17.995	17.995
HACR1	2010	70	"HIDOH"	23	5.822	9.000	0.874	4.818	0.276	1.021	0.587	0.916	0.430	8.922	8.922	17.922	17.922
HACR1	2010	50	"IMPROVE"	25	4.145	9.000	0.594	3.116	0.203	1.012	0.261	0.680	0.295	6.160	6.160	15.160	15.160
HACR1	2010	50	"RHR BY HIDOH"	25	4.145	9.000	0.594	3.116	0.203	1.012	0.261	0.680	0.295	6.160	6.160	15.160	15.160
HACR1	2010	50	"HIDOH"	23	4.157	9.000	0.598	3.093	0.208	1.032	0.283	0.656	0.304	6.175	6.175	15.175	15.175
HACR1	2010	30	"IMPROVE"	22	2.188	9.000	0.280	1.947	0.090	0.467	0.178	0.395	0.121	3.478	3.478	12.478	12.478
HACR1	2010	30	"RHR BY HIDOH"	22	2.188	9.000	0.280	1.947	0.090	0.467	0.178	0.395	0.121	3.478	3.478	12.478	12.478
HACR1	2010	30	"HIDOH"	23	2.228	9.000	0.282	1.970	0.094	0.495	0.170	0.396	0.122	3.529	3.529	12.529	12.529
HACR1	2010	10	"IMPROVE"	23	0.419	9.000	0.084	0.804	0.036	0.223	0.046	0.198	0.051	1.441	1.441	10.441	10.441
HACR1	2010	10	"RHR BY HIDOH"	23	0.419	9.000	0.084	0.804	0.036	0.223	0.046	0.198	0.051	1.441	1.441	10.441	10.441
HACR1	2010	10	"HIDOH"	23	0.419	9.000	0.084	0.804	0.036	0.223	0.046	0.198	0.051	1.441	1.441	10.441	10.441
HACR1	2011	90	"IMPROVE"	23	9.464	9.000	0.956	13.687	0.380	0.770	0.747	1.061	0.319	17.919	17.919	26.919	26.919
HACR1	2011	90	"RHR BY HIDOH"	23	9.464	9.000	0.956	13.687	0.380	0.770	0.747	1.061	0.319	17.919	17.919	26.919	26.919
HACR1	2011	90	"HIDOH"	23	9.464	9.000	0.956	13.687	0.380	0.770	0.747	1.061	0.319	17.919	17.919	26.919	26.919
HACR1	2011	70	"IMPROVE"	21	5.631	9.000	0.939	4.591	0.197	0.999	0.616	1.040	0.199	8.581	8.581	17.581	17.581
HACR1	2011	70	"RHR BY HIDOH"	21	5.631	9.000	0.939	4.591	0.197	0.999	0.616	1.040	0.199	8.581	8.581	17.581	17.581
HACR1	2011	70	"HIDOH"	22	5.597	9.000	0.930	4.562	0.207	0.972	0.629	1.019	0.203	8.523	8.523	17.523	17.523
HACR1	2011	50	"IMPROVE"	25	3.885	9.000	0.585	2.932	0.187	0.684	0.335	0.911	0.141	5.776	5.776	14.776	14.776
HACR1	2011	50	"RHR BY HIDOH"	25	3.885	9.000	0.585	2.932	0.187	0.684	0.335	0.911	0.141	5.776	5.776	14.776	14.776
HACR1	2011	50	"HIDOH"	23	3.880	9.000	0.593	2.933	0.183	0.703	0.310	0.903	0.140	5.765	5.765	14.765	14.765
HACR1	2011	30	"IMPROVE"	21	2.236	9.000	0.340	1.894	0.086	0.401	0.072	0.630	0.093	3.516	3.516	12.516	12.516
HACR1	2011	30	"RHR BY HIDOH"	21	2.236	9.000	0.340	1.894	0.086	0.401	0.072	0.630	0.093	3.516	3.516	12.516	12.516
HACR1	2011	30	"HIDOH"	22	2.272	9.000	0.335	1.894	0.084	0.406	0.085	0.668	0.090	3.561	3.561	12.561	12.561
HACR1	2011	10	"IMPROVE"	22	0.677	9.000	0.078	1.010	0.027	0.194	0.048	0.325	0.033	1.716	1.716	10.716	10.716
HACR1	2011	10	"RHR BY HIDOH"	22	0.677	9.000	0.078	1.010	0.027	0.194	0.048	0.325	0.033	1.716	1.716	10.716	10.716
HACR1	2011	10	"HIDOH"	22	0.677	9.000	0.078	1.010	0.027	0.194	0.048	0.325	0.033	1.716	1.716	10.716	10.716
HACR1	2012	90	"IMPROVE"	20	9.855	9.000	1.061	13.540	0.336	1.381	0.625	1.054	0.541	18.539	18.539	27.539	27.539
HACR1	2012	90	"RHR BY HIDOH"	20	9.855	9.000	1.061	13.540	0.336	1.381	0.625	1.054	0.541	18.539	18.539	27.539	27.539

					Annual Average Values												
Site	Year	Quantile & Method		No.	dv	S_Rayleigh:Value	ammNO3f_bext:Value	ammSO4f_bext:Value	ECf_bext:Value	CM_bext:Value	OMCf_bext:Value	SeaSaltf_bext:Value	SOILf_bext:Value	Aerosol Bext Calc	aerosol_bext:Value	Total Bext Calc	total_bext:Value
HACR1	2012	90	"HIDOH"	20	9.855	9.000	1.061	13.540	0.336	1.381	0.625	1.054	0.541	18.539	18.539	27.539	27.539
HACR1	2012	70	"IMPROVE"	18	6.370	9.000	1.000	6.022	0.247	0.989	0.457	0.983	0.289	9.987	9.987	18.987	18.987
HACR1	2012	70	"RHR BY HIDOH"	18	6.370	9.000	1.000	6.022	0.247	0.989	0.457	0.983	0.289	9.987	9.987	18.987	18.987
HACR1	2012	70	"HIDOH"	19	6.308	9.000	0.997	5.848	0.241	1.011	0.437	0.983	0.353	9.871	9.871	18.871	18.871
HACR1	2012	50	"IMPROVE"	21	4.328	9.000	0.566	3.731	0.168	0.739	0.262	0.795	0.184	6.447	6.447	15.447	15.447
HACR1	2012	50	"RHR BY HIDOH"	21	4.328	9.000	0.566	3.731	0.168	0.739	0.262	0.795	0.184	6.447	6.447	15.447	15.447
HACR1	2012	50	"HIDOH"	19	4.340	9.000	0.560	3.810	0.172	0.714	0.264	0.817	0.123	6.461	6.461	15.461	15.461
HACR1	2012	30	"IMPROVE"	18	2.438	9.000	0.285	2.159	0.119	0.429	0.204	0.502	0.075	3.773	3.773	12.773	12.773
HACR1	2012	30	"RHR BY HIDOH"	18	2.438	9.000	0.285	2.159	0.119	0.429	0.204	0.502	0.075	3.773	3.773	12.773	12.773
HACR1	2012	30	"HIDOH"	19	2.481	9.000	0.286	2.216	0.120	0.435	0.215	0.485	0.073	3.829	3.829	12.829	12.829
HACR1	2012	10	"IMPROVE"	19	0.802	9.000	0.127	0.964	0.068	0.262	0.108	0.286	0.043	1.857	1.857	10.857	10.857
HACR1	2012	10	"RHR BY HIDOH"	19	0.802	9.000	0.127	0.964	0.068	0.262	0.108	0.286	0.043	1.857	1.857	10.857	10.857
HACR1	2012	10	"HIDOH"	19	0.802	9.000	0.127	0.964	0.068	0.262	0.108	0.286	0.043	1.857	1.857	10.857	10.857
HACR1	2013	90	"IMPROVE"	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
HACR1	2013	90	"RHR BY HIDOH"	18	11.360	9.000	0.900	19.154	0.472	0.948	0.836	0.819	0.417	23.545	23.545	32.545	32.545
HACR1	2013	90	"HIDOH"	18	11.360	9.000	0.900	19.154	0.472	0.948	0.836	0.819	0.417	23.545	23.545	32.545	32.545
HACR1	2013	70	"IMPROVE"	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
HACR1	2013	70	"RHR BY HIDOH"	17	6.695	9.000	1.105	5.501	0.295	1.065	0.883	1.377	0.351	10.576	10.576	19.576	19.576
HACR1	2013	70	"HIDOH"	18	6.618	9.000	1.115	5.369	0.279	1.089	0.848	1.391	0.343	10.434	10.434	19.434	19.434
HACR1	2013	50	"IMPROVE"	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
HACR1	2013	50	"RHR BY HIDOH"	19	4.113	9.000	0.668	3.388	0.170	0.620	0.470	0.719	0.089	6.125	6.125	15.125	15.125
HACR1	2013	50	"HIDOH"	17	4.096	9.000	0.664	3.403	0.169	0.589	0.485	0.698	0.084	6.093	6.093	15.093	15.093
HACR1	2013	30	"IMPROVE"	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
HACR1	2013	30	"RHR BY HIDOH"	17	2.461	9.000	0.392	1.700	0.159	0.404	0.290	0.796	0.063	3.804	3.804	12.804	12.804
HACR1	2013	30	"HIDOH"	18	2.502	9.000	0.377	1.794	0.170	0.395	0.297	0.761	0.063	3.858	3.858	12.858	12.858
HACR1	2013	10	"IMPROVE"	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
HACR1	2013	10	"RHR BY HIDOH"	17	0.601	9.000	0.134	0.745	0.057	0.208	0.168	0.285	0.035	1.632	1.632	10.632	10.632
HACR1	2013	10	"HIDOH"	17	0.601	9.000	0.134	0.745	0.057	0.208	0.168	0.285	0.035	1.632	1.632	10.632	10.632
HACR1	2014	90	"IMPROVE"	21	8.926	9.000	1.148	10.790	0.229	1.027	0.799	1.367	0.422	15.782	15.782	24.782	24.782
HACR1	2014	90	"RHR BY HIDOH"	21	8.926	9.000	1.148	10.790	0.229	1.027	0.799	1.367	0.422	15.782	15.782	24.782	24.782
HACR1	2014	90	"HIDOH"	21	8.926	9.000	1.148	10.790	0.229	1.027	0.799	1.367	0.422	15.782	15.782	24.782	24.782
HACR1	2014	70	"IMPROVE"	19	5.314	9.000	0.643	5.264	0.109	0.662	0.363	0.837	0.181	8.058	8.058	17.058	17.058
HACR1	2014	70	"RHR BY HIDOH"	19	5.314	9.000	0.643	5.264	0.109	0.662	0.363	0.837	0.181	8.058	8.058	17.058	17.058
HACR1	2014	70	"HIDOH"	20	5.263	9.000	0.653	5.129	0.120	0.651	0.377	0.856	0.188	7.974	7.974	16.974	16.974
HACR1	2014	50	"IMPROVE"	23	3.520	9.000	0.548	2.986	0.135	0.493	0.375	0.554	0.143	5.234	5.234	14.234	14.234
HACR1	2014	50	"RHR BY HIDOH"	23	3.520	9.000	0.548	2.986	0.135	0.493	0.375	0.554	0.143	5.234	5.234	14.234	14.234
HACR1	2014	50	"HIDOH"	21	3.521	9.000	0.541	3.072	0.132	0.498	0.351	0.515	0.124	5.233	5.233	14.233	14.233
HACR1	2014	30	"IMPROVE"	19	1.874	9.000	0.244	1.691	0.051	0.429	0.237	0.323	0.097	3.074	3.074	12.074	12.074
HACR1	2014	30	"RHR BY HIDOH"	19	1.874	9.000	0.244	1.691	0.051	0.429	0.237	0.323	0.097	3.074	3.074	12.074	12.074
HACR1	2014	30	"HIDOH"	20	1.915	9.000	0.252	1.687	0.049	0.429	0.256	0.342	0.110	3.125	3.125	12.125	12.125
HACR1	2014	10	"IMPROVE"	20	0.559	9.000	0.093	0.907	0.037	0.195	0.134	0.161	0.059	1.587	1.587	10.587	10.587
HACR1	2014	10	"RHR BY HIDOH"	20	0.559	9.000	0.093	0.907	0.037	0.195	0.134	0.161	0.059	1.587	1.587	10.587	10.587
HACR1	2014	10	"HIDOH"	20	0.559	9.000	0.093	0.907	0.037	0.195	0.134	0.161	0.059	1.587	1.587	10.587	10.587
HACR1	2015	90	"IMPROVE"	20	8.667	9.000	1.222	10.112	0.189	1.310	0.798	1.391	0.247	15.269	15.269	24.269	24.269
HACR1	2015	90	"RHR BY HIDOH"	20	8.667	9.000	1.222	10.112	0.189	1.310	0.798	1.391	0.247	15.269	15.269	24.269	24.269
HACR1	2015	90	"HIDOH"	20	8.667	9.000	1.222	10.112	0.189	1.310	0.798	1.391	0.247	15.269	15.269	24.269	24.269
HACR1	2015	70	"IMPROVE"	19	5.149	9.000	0.781	4.123	0.138	0.876	0.646	0.936	0.271	7.771	7.771	16.771	16.771
HACR1	2015	70	"RHR BY HIDOH"	19	5.149	9.000	0.781	4.123	0.138	0.876	0.646	0.936	0.271	7.771	7.771	16.771	16.771
HACR1	2015	70	"HIDOH"	20	5.091	9.000	0.762	4.131	0.141	0.863	0.631	0.889	0.260	7.677	7.677	16.677	16.677
HACR1	2015	50	"IMPROVE"	21	2.989	9.000	0.483	2.324	0.097	0.510	0.319	0.656	0.112	4.501	4.501	13.501	13.501
HACR1	2015	50	"RHR BY HIDOH"	21	2.989	9.000	0.483	2.324	0.097	0.510	0.319	0.656	0.112	4.501	4.501	13.501	13.501
HACR1	2015	50	"HIDOH"	19	2.972	9.000	0.489	2.287	0.093	0.510	0.335	0.643	0.118	4.475	4.475	13.475	13.475
HACR1	2015	30	"IMPROVE"	19	1.859	9.000	0.273	1.430	0.038	0.468	0.326	0.435	0.081	3.051	3.051	12.051	12.051
HACR1	2015	30	"RHR BY HIDOH"	19	1.859	9.000	0.273	1.430	0.038	0.468	0.326	0.435	0.081	3.051	3.051	12.051	12.051
HACR1	2015	30	"HIDOH"	20	1.882	9.000	0.282	1.412	0.041	0.465	0.309	0.491	0.079	3.079	3.079	12.079	12.079
HACR1	2015	10	"IMPROVE"	19	0.299	9.000	0.116	0.671	0.014	0.238	0.110	0.155	0.012	1.317	1.317	10.317	10.317
HACR1	2015	10	"RHR BY HIDOH"	19	0.299	9.000	0.116	0.671	0.014	0.238	0.110	0.155	0.012	1.317	1.317	10.317	10.317
HACR1	2015	10	"HIDOH"	19	0.299	9.000	0.116	0.671	0.014	0.238	0.110	0.155	0.012	1.317	1.317	10.317	10.317

Table D-1: HACR1 Visibility Impact for 2007 - 2015 with an Examination of Quantile Grouping Methods

					Annual Average Values											
Site	Year	Quantile & Method		No.	dv	S_Rayleigh:Value	ammNO3f_bext:Value	ammSO4f_bext:Value	ECf_bext:Value	CM_bext:Value	OMCf_bext:Value	SeaSaltf_bext:Value	SOILf_bext:Value	Aerosol Bext Calc	aerosol_bext:Value	Total Bext Calc	total_bext:Value
HAVO1	2001	90	"IMPROVE"	22	16.382	10.000	1.000	41.741	0.929	1.061	3.629	2.332	0.225	50.917	50.917	60.917	60.917
HAVO1	2001	90	"RHR BY HIDOH"	22	16.382	10.000	1.000	41.741	0.929	1.061	3.629	2.332	0.225	50.917	50.917	60.917	60.917
HAVO1	2001	90	"HIDOH"	22	16.382	10.000	1.000	41.741	0.929	1.061	3.629	2.332	0.225	50.917	50.917	60.917	60.917
HAVO1	2001	70	"IMPROVE"	20	9.484	10.000	1.537	7.605	0.394	1.166	2.604	2.316	0.237	15.859	15.859	25.859	25.859
HAVO1	2001	70	"RHR BY HIDOH"	20	9.484	10.000	1.537	7.605	0.394	1.166	2.604	2.316	0.237	15.859	15.859	25.859	25.859
HAVO1	2001	70	"HIDOH"	21	9.437	10.000	1.479	7.671	0.403	1.138	2.619	2.206	0.226	15.742	15.742	25.742	25.742
HAVO1	2001	50	"IMPROVE"	23	7.677	10.000	0.857	4.367	0.293	0.952	2.296	2.695	0.113	11.572	11.572	21.572	21.572
HAVO1	2001	50	"RHR BY HIDOH"	23	7.677	10.000	0.857	4.367	0.293	0.952	2.296	2.695	0.113	11.572	11.572	21.572	21.572
HAVO1	2001	50	"HIDOH"	21	7.678	10.000	0.893	4.247	0.284	0.996	2.298	2.731	0.122	11.570	11.570	21.570	21.570
HAVO1	2001	30	"IMPROVE"	20	5.851	10.000	0.609	3.250	0.206	0.622	1.841	1.284	0.159	7.972	7.972	17.972	17.972
HAVO1	2001	30	"RHR BY HIDOH"	20	5.851	10.000	0.609	3.250	0.206	0.622	1.841	1.284	0.159	7.972	7.972	17.972	17.972
HAVO1	2001	30	"HIDOH"	21	5.897	10.000	0.611	3.203	0.205	0.611	1.832	1.443	0.153	8.059	8.059	18.059	18.059
HAVO1	2001	10	"IMPROVE"	21	4.145	10.000	0.276	1.934	0.162	0.350	1.669	0.680	0.087	5.158	5.158	15.158	15.158
HAVO1	2001	10	"RHR BY HIDOH"	21	4.145	10.000	0.276	1.934	0.162	0.350	1.669	0.680	0.087	5.158	5.158	15.158	15.158
HAVO1	2001	10	"HIDOH"	21	4.145	10.000	0.276	1.934	0.162	0.350	1.669	0.680	0.087	5.158	5.158	15.158	15.158
HAVO1	2002	90	"IMPROVE"	24	18.049	10.000	1.019	52.983	0.874	0.377	3.864	0.427	0.198	59.743	59.743	69.743	69.743
HAVO1	2002	90	"RHR BY HIDOH"	24	18.049	10.000	1.019	52.983	0.874	0.377	3.864	0.427	0.198	59.743	59.743	69.743	69.743
HAVO1	2002	90	"HIDOH"	24	18.049	10.000	1.019	52.983	0.874	0.377	3.864	0.427	0.198	59.743	59.743	69.743	69.743
HAVO1	2002	70	"IMPROVE"	23	10.125	10.000	1.374	9.298	0.332	1.104	3.125	2.336	0.193	17.762	17.762	27.762	27.762
HAVO1	2002	70	"RHR BY HIDOH"	23	10.125	10.000	1.374	9.298	0.332	1.104	3.125	2.336	0.193	17.762	17.762	27.762	27.762
HAVO1	2002	70	"HIDOH"	24	10.054	10.000	1.385	9.168	0.322	1.109	3.074	2.324	0.190	17.572	17.572	27.572	27.572
HAVO1	2002	50	"IMPROVE"	26	7.795	10.000	1.050	5.804	0.232	0.838	2.173	1.578	0.149	11.824	11.824	21.824	21.824
HAVO1	2002	50	"RHR BY HIDOH"	26	7.795	10.000	1.050	5.804	0.232	0.838	2.173	1.578	0.149	11.824	11.824	21.824	21.824
HAVO1	2002	50	"HIDOH"	24	7.800	10.000	1.025	5.752	0.243	0.843	2.197	1.615	0.155	11.831	11.831	21.831	21.831
HAVO1	2002	30	"IMPROVE"	23	6.072	10.000	0.654	3.370	0.224	0.506	2.353	1.215	0.054	8.376	8.376	18.376	18.376
HAVO1	2002	30	"RHR BY HIDOH"	23	6.072	10.000	0.654	3.370	0.224	0.506	2.353	1.215	0.054	8.376	8.376	18.376	18.376
HAVO1	2002	30	"HIDOH"	24	6.113	10.000	0.671	3.508	0.218	0.499	2.332	1.173	0.053	8.455	8.455	18.455	18.455
HAVO1	2002	10	"IMPROVE"	24	3.936	10.000	0.202	1.669	0.250	0.206	1.854	0.664	0.031	4.877	4.877	14.877	14.877
HAVO1	2002	10	"RHR BY HIDOH"	24	3.936	10.000	0.202	1.669	0.250	0.206	1.854	0.664	0.031	4.877	4.877	14.877	14.877
HAVO1	2002	10	"HIDOH"	24	3.936	10.000	0.202	1.669	0.250	0.206	1.854	0.664	0.031	4.877	4.877	14.877	14.877
HAVO1	2003	90	"IMPROVE"	24	22.001	10.000	0.763	89.276	1.188	0.666	1.284	0.065	0.446	93.687	93.687	103.687	103.687
HAVO1	2003	90	"RHR BY HIDOH"	24	22.001	10.000	0.763	89.276	1.188	0.666	1.284	0.065	0.446	93.687	93.687	103.687	103.687
HAVO1	2003	90	"HIDOH"	24	22.001	10.000	0.763	89.276	1.188	0.666	1.284	0.065	0.446	93.687	93.687	103.687	103.687
HAVO1	2003	70	"IMPROVE"	23	12.309	10.000	1.258	17.016	0.685	1.602	1.530	2.610	0.174	24.875	24.875	34.875	34.875
HAVO1	2003	70	"RHR BY HIDOH"	23	12.309	10.000	1.258	17.016	0.685	1.602	1.530	2.610	0.174	24.875	24.875	34.875	34.875
HAVO1	2003	70	"HIDOH"	24	12.184	10.000	1.307	16.604	0.669	1.628	1.489	2.602	0.178	24.477	24.477	34.477	34.477
HAVO1	2003	50	"IMPROVE"	25	8.253	10.000	1.056	6.343	0.307	1.462	0.723	2.835	0.147	12.873	12.873	22.873	22.873
HAVO1	2003	50	"RHR BY HIDOH"	25	8.253	10.000	1.056	6.343	0.307	1.462	0.723	2.835	0.147	12.873	12.873	22.873	22.873
HAVO1	2003	50	"HIDOH"	23	8.254	10.000	0.988	6.446	0.317	1.414	0.718	2.856	0.129	12.867	12.867	22.867	22.867
HAVO1	2003	30	"IMPROVE"	23	6.186	10.000	0.637	4.586	0.192	1.074	0.412	1.617	0.065	8.583	8.583	18.583	18.583
HAVO1	2003	30	"RHR BY HIDOH"	23	6.186	10.000	0.637	4.586	0.192	1.074	0.412	1.617	0.065	8.583	8.583	18.583	18.583
HAVO1	2003	30	"HIDOH"	24	6.228	10.000	0.662	4.527	0.188	1.104	0.437	1.665	0.081	8.665	8.665	18.665	18.665
HAVO1	2003	10	"IMPROVE"	23	4.206	10.000	0.406	2.931	0.145	0.504	0.279	0.960	0.052	5.277	5.277	15.277	15.277
HAVO1	2003	10	"RHR BY HIDOH"	23	4.206	10.000	0.406	2.931	0.145	0.504	0.279	0.960	0.052	5.277	5.277	15.277	15.277
HAVO1	2003	10	"HIDOH"	23	4.206	10.000	0.406	2.931	0.145	0.504	0.279	0.960	0.052	5.277	5.277	15.277	15.277
HAVO1	2004	90	"IMPROVE"	23	18.992	10.000	0.645	56.162	1.012	0.888	1.185	1.437	0.311	61.640	61.640	71.640	71.640
HAVO1	2004	90	"RHR BY HIDOH"	23	18.992	10.000	0.645	56.162	1.012	0.888	1.185	1.437	0.311	61.640	61.640	71.640	71.640
HAVO1	2004	90	"HIDOH"	23	18.992	10.000	0.645	56.162	1.012	0.888	1.185	1.437	0.311	61.640	61.640	71.640	71.640
HAVO1	2004	70	"IMPROVE"	21	10.598	10.000	1.267	10.470	0.607	1.300	1.419	3.751	0.174	18.988	18.988	28.988	28.988
HAVO1	2004	70	"RHR BY HIDOH"	21	10.598	10.000	1.267	10.470	0.607	1.300	1.419	3.751	0.174	18.988	18.988	28.988	28.988
HAVO1	2004	70	"HIDOH"	22	10.540	10.000	1.289	10.323	0.581	1.305	1.386	3.774	0.167	18.825	18.825	28.825	28.825
HAVO1	2004	50	"IMPROVE"	25	8.165	10.000	1.020	5.455	0.515	1.132	0.888	3.523	0.140	12.674	12.674	22.674	22.674
HAVO1	2004	50	"RHR BY HIDOH"	25	8.165	10.000	1.020	5.455	0.515	1.132	0.888	3.523	0.140	12.674	12.674	22.674	22.674
HAVO1	2004	50	"HIDOH"	23	8.150	10.000	1.010	5.317	0.554	1.117	0.914	3.576	0.147	12.634	12.634	22.634	22.634
HAVO1	2004	30	"IMPROVE"	21	6.549	10.000	0.744	3.626	0.141	0.844	0.604	3.235	0.085	9.279	9.279	19.279	19.279
HAVO1	2004	30	"RHR BY HIDOH"	21	6.549	10.000	0.744	3.626	0.141	0.844	0.604	3.235	0.085	9.279	9.279	19.279	19.279
HAVO1	2004	30	"HIDOH"	22	6.586	10.000	0.735	3.773	0.140	0.860	0.599	3.159	0.085	9.351	9.351	19.351	19.351
HAVO1	2004	10	"IMPROVE"	22	3.962	10.000	0.296	2.136	0.176	0.473	0.504	1.323	0.046	4.955	4.955	14.955	14.955
HAVO1	2004	10	"RHR BY HIDOH"	22	3.962	10.000	0.296	2.136	0.176	0.473	0.504	1.323	0.046	4.955	4.955	14.955	14.955
HAVO1	2004	10	"HIDOH"	22	3.962	10.000	0.296	2.136	0.176	0.473	0.504	1.323	0.046	4.955	4.955	14.955	14.955
HAVO1	2005	90	"IMPROVE"	23	22.058	10.000	0.612	85.153	0.929	0.956	1.379	1.517	0.256	90.801	90.801	100.801	100.801
HAVO1	2005	90	"RHR BY HIDOH"	23	22.058	10.000	0.612	85.153	0.929	0.956	1.379	1.517	0.256	90.801	90.801	100.801	100.801
HAVO1	2005	90	"HIDOH"	23	22.058	10.000	0.612	85.153	0.929	0.956	1.379	1.517	0.256	90.801	90.801	100.801	100.801
HAVO1	2005	70	"IMPROVE"	22	11.535	10.000	1.231	14.034	0.421	1.446	0.757	4.130	0.329	22.347	22.347	32.347	32.347
HAVO1	2005	70	"RHR BY HIDOH"	22	11.535	10.000	1.231	14.034	0.421	1.446	0.757	4.130	0.329	22.347	22.347	32.347	32.347
HAVO1	2005	70	"HIDOH"	23	11.416	10.000	1.213	13.704	0.430	1.421	0.796	4.111	0.316	21.989	21.989	31.989	31.989
HAVO1	2005	50	"IMPROVE"	24	7.663	10.000	0.934	6.037	0.124	1.019	0.386	2.969	0.088	11.557	11.557	21.557	21.557
HAVO1	2005	50	"RHR BY HIDOH"	24	7.663	10.000	0.934	6.037	0.124	1.019	0.386	2.969	0.088	11.557	11.557	21.557	21.557
HAVO1	2005	50	"HIDOH"	22	7.651	10.000	0.949	6.073	0.101	1.040	0.335	2.933	0.094	11.525	11.525	21.525	21.525
HAVO1	2005	30	"IMPROVE"	22	6.041	10.000	0.648	4.303	0.176	0.767	0.275	2.087	0.063	8.319	8.319	18.319	18.319
HAVO1	2005	30	"RHR BY HIDOH"	22	6.041	10.000	0.648	4.303	0.176	0.767	0.275	2.087	0.063	8.319	8.319	18.319	18.319
HAVO1	2005	30	"HIDOH"	23	6.073	10.000	0.651	4.326	0.173	0.765	0.273	2.129	0.062	8.380	8.380	18.380	18.380
HAVO1	2005	10	"IMPROVE"	22	3.506	10.000	0.226	2.061	0.057	0.390	0.091	1.425	0.016	4.265	4.265	14.265	14.265
HAVO1	2005	10	"RHR BY HIDOH"	22	3.506	10.000	0.226	2.061	0.057	0.390	0.091	1.425	0.016	4.265	4.265	14.265	14.265
HAVO1	2005	10	"HIDOH"	22	3.506	10.000	0.226	2.061	0.057	0.390	0.091	1.425	0.016	4.265	4.265	14.265	14.265
HAVO1	2006	90	"IMPROVE"	24	20.598	10.000	0.305	69.231	0.820	0.408	0.996	1.472	0.230	73.463	73.463	83.463	83.463
HAVO1	2006	90	"RHR BY HIDOH"	24	20.598	10.000	0.305	69.231	0.820	0.408	0.996	1.472	0.230	73.463	73.463	83.463	83.463
HAVO1	2006	90	"HIDOH"	24	20.598	10.000	0.305	69.231	0.820	0.408	0.996	1.472	0.230	73.463	73.463	83.463	83.463
HAVO1	2006	70	"IMPROVE"	23	12.059	10.000	1.115	16.340	0.315	1.409	0.505	3.835	0.204	23.723	23.723	33.723	33.723

					Annual Average Values												
Site	Year	Quantile & Method		No.	dv	S_Rayleigh:Value	ammNO3f_bext:Value	ammSO4f_bext:Value	ECf_bext:Value	CM_bext:Value	OMCf_bext:Value	SeaSaltf_bext:Value	SOILf_bext:Value	Aerosol Bext Calc	aerosol_bext:Value	Total Bext Calc	total_bext:Value
HAVO1	2006	70	"RHR BY HIDOH"	23	12.059	10.000	1.115	16.340	0.315	1.409	0.505	3.835	0.204	23.723	23.723	33.723	33.723
HAVO1	2006	70	"HIDOH"	24	11.948	10.000	1.134	15.981	0.310	1.393	0.529	3.839	0.198	23.384	23.384	33.384	33.384
HAVO1	2006	50	"IMPROVE"	25	8.081	10.000	0.897	7.167	0.206	0.735	0.406	2.934	0.151	12.497	12.497	22.497	22.497
HAVO1	2006	50	"RHR BY HIDOH"	25	8.081	10.000	0.897	7.167	0.206	0.735	0.406	2.934	0.151	12.497	12.497	22.497	22.497
HAVO1	2006	50	"HIDOH"	23	8.072	10.000	0.864	7.147	0.214	0.731	0.395	2.959	0.161	12.469	12.469	22.469	22.469
HAVO1	2006	30	"IMPROVE"	23	5.795	10.000	0.498	4.339	0.187	0.388	0.314	2.087	0.065	7.879	7.879	17.879	17.879
HAVO1	2006	30	"RHR BY HIDOH"	23	5.795	10.000	0.498	4.339	0.187	0.388	0.314	2.087	0.065	7.879	7.879	17.879	17.879
HAVO1	2006	30	"HIDOH"	24	5.844	10.000	0.520	4.452	0.181	0.395	0.301	2.056	0.064	7.969	7.969	17.969	17.969
HAVO1	2006	10	"IMPROVE"	23	3.227	10.000	0.238	1.769	0.069	0.292	0.078	1.396	0.034	3.876	3.876	13.876	13.876
HAVO1	2006	10	"RHR BY HIDOH"	23	3.227	10.000	0.238	1.769	0.069	0.292	0.078	1.396	0.034	3.876	3.876	13.876	13.876
HAVO1	2006	10	"HIDOH"	23	3.227	10.000	0.238	1.769	0.069	0.292	0.078	1.396	0.034	3.876	3.876	13.876	13.876
HAVO1	2007	90	"IMPROVE"	24	23.811	10.000	0.716	108.613	0.864	0.795	1.544	1.238	0.284	114.053	114.053	124.053	124.053
HAVO1	2007	90	"RHR BY HIDOH"	24	23.811	10.000	0.716	108.613	0.864	0.795	1.544	1.238	0.284	114.053	114.053	124.053	124.053
HAVO1	2007	90	"HIDOH"	24	23.811	10.000	0.716	108.613	0.864	0.795	1.544	1.238	0.284	114.053	114.053	124.053	124.053
HAVO1	2007	70	"IMPROVE"	23	10.592	10.000	1.325	10.145	0.323	1.615	1.004	4.645	0.220	19.278	19.278	29.278	29.278
HAVO1	2007	70	"RHR BY HIDOH"	23	10.592	10.000	1.325	10.145	0.323	1.615	1.004	4.645	0.220	19.278	19.278	29.278	29.278
HAVO1	2007	70	"HIDOH"	24	10.500	10.000	1.273	10.181	0.327	1.556	0.963	4.507	0.213	19.020	19.020	29.020	29.020
HAVO1	2007	50	"IMPROVE"	26	7.342	10.000	0.854	5.637	0.120	0.889	0.408	2.854	0.100	10.863	10.863	20.863	20.863
HAVO1	2007	50	"RHR BY HIDOH"	26	7.342	10.000	0.854	5.637	0.120	0.889	0.408	2.854	0.100	10.863	10.863	20.863	20.863
HAVO1	2007	50	"HIDOH"	24	7.326	10.000	0.889	5.503	0.109	0.920	0.418	2.883	0.102	10.826	10.826	20.826	20.826
HAVO1	2007	30	"IMPROVE"	23	5.952	10.000	0.577	3.854	0.108	0.765	0.440	2.343	0.066	8.152	8.152	18.152	18.152
HAVO1	2007	30	"RHR BY HIDOH"	23	5.952	10.000	0.577	3.854	0.108	0.765	0.440	2.343	0.066	8.152	8.152	18.152	18.152
HAVO1	2007	30	"HIDOH"	24	5.983	10.000	0.585	3.838	0.107	0.769	0.445	2.398	0.066	8.210	8.210	18.210	18.210
HAVO1	2007	10	"IMPROVE"	24	4.044	10.000	0.367	2.165	0.066	0.499	0.210	1.711	0.041	5.058	5.058	15.058	15.058
HAVO1	2007	10	"RHR BY HIDOH"	24	4.044	10.000	0.367	2.165	0.066	0.499	0.210	1.711	0.041	5.058	5.058	15.058	15.058
HAVO1	2007	10	"HIDOH"	24	4.044	10.000	0.367	2.165	0.066	0.499	0.210	1.711	0.041	5.058	5.058	15.058	15.058
HAVO1	2008	90	"IMPROVE"	23	27.471	10.000	0.698	179.540	0.902	2.465	1.658	1.455	0.749	187.467	187.467	197.467	197.467
HAVO1	2008	90	"RHR BY HIDOH"	23	27.471	10.000	0.698	179.540	0.902	2.465	1.658	1.455	0.749	187.467	187.467	197.467	197.467
HAVO1	2008	90	"HIDOH"	23	27.471	10.000	0.698	179.540	0.902	2.465	1.658	1.455	0.749	187.467	187.467	197.467	197.467
HAVO1	2008	70	"IMPROVE"	22	11.871	10.000	0.841	16.126	0.296	2.122	0.548	3.291	0.212	23.435	23.435	33.435	33.435
HAVO1	2008	70	"RHR BY HIDOH"	22	11.871	10.000	0.841	16.126	0.296	2.122	0.548	3.291	0.212	23.435	23.435	33.435	33.435
HAVO1	2008	70	"HIDOH"	23	11.769	10.000	0.891	15.778	0.283	2.106	0.524	3.307	0.218	23.107	23.107	33.107	33.107
HAVO1	2008	50	"IMPROVE"	25	8.236	10.000	0.909	7.043	0.113	0.965	0.601	3.059	0.152	12.841	12.841	22.841	22.841
HAVO1	2008	50	"RHR BY HIDOH"	25	8.236	10.000	0.909	7.043	0.113	0.965	0.601	3.059	0.152	12.841	12.841	22.841	22.841
HAVO1	2008	50	"HIDOH"	23	8.227	10.000	0.866	7.186	0.118	0.924	0.644	2.930	0.145	12.813	12.813	22.813	22.813
HAVO1	2008	30	"IMPROVE"	22	6.149	10.000	0.623	4.219	0.118	0.713	0.274	2.502	0.073	8.522	8.522	18.522	18.522
HAVO1	2008	30	"RHR BY HIDOH"	22	6.149	10.000	0.623	4.219	0.118	0.713	0.274	2.502	0.073	8.522	8.522	18.522	18.522
HAVO1	2008	30	"HIDOH"	23	6.193	10.000	0.630	4.151	0.118	0.731	0.271	2.628	0.075	8.605	8.605	18.605	18.605
HAVO1	2008	10	"IMPROVE"	23	4.071	10.000	0.300	2.286	0.057	0.427	0.145	1.813	0.049	5.077	5.077	15.077	15.077
HAVO1	2008	10	"RHR BY HIDOH"	23	4.071	10.000	0.300	2.286	0.057	0.427	0.145	1.813	0.049	5.077	5.077	15.077	15.077
HAVO1	2008	10	"HIDOH"	23	4.071	10.000	0.300	2.286	0.057	0.427	0.145	1.813	0.049	5.077	5.077	15.077	15.077
HAVO1	2009	90	"IMPROVE"	24	30.513	10.000	0.469	218.113	0.620	0.837	0.902	0.772	1.179	222.892	222.892	232.892	232.892
HAVO1	2009	90	"RHR BY HIDOH"	24	30.513	10.000	0.469	218.113	0.620	0.837	0.902	0.772	1.179	222.892	222.892	232.892	232.892
HAVO1	2009	90	"HIDOH"	24	30.513	10.000	0.469	218.113	0.620	0.837	0.902	0.772	1.179	222.892	222.892	232.892	232.892
HAVO1	2009	70	"IMPROVE"	23	16.385	10.000	0.622	41.698	0.480	0.594	0.598	1.272	0.361	45.624	45.624	55.624	55.624
HAVO1	2009	70	"RHR BY HIDOH"	23	16.385	10.000	0.622	41.698	0.480	0.594	0.598	1.272	0.361	45.624	45.624	55.624	55.624
HAVO1	2009	70	"HIDOH"	24	16.154	10.000	0.634	40.602	0.469	0.601	0.596	1.288	0.347	44.537	44.537	54.537	54.537
HAVO1	2009	50	"IMPROVE"	26	8.648	10.000	0.835	8.161	0.152	0.976	0.208	3.477	0.121	13.929	13.929	23.929	23.929
HAVO1	2009	50	"RHR BY HIDOH"	26	8.648	10.000	0.835	8.161	0.152	0.976	0.208	3.477	0.121	13.929	13.929	23.929	23.929
HAVO1	2009	50	"HIDOH"	24	8.630	10.000	0.849	7.858	0.152	1.005	0.203	3.668	0.127	13.862	13.862	23.862	23.862
HAVO1	2009	30	"IMPROVE"	23	6.188	10.000	0.489	4.044	0.134	0.630	0.416	2.767	0.101	8.581	8.581	18.581	18.581
HAVO1	2009	30	"RHR BY HIDOH"	23	6.188	10.000	0.489	4.044	0.134	0.630	0.416	2.767	0.101	8.581	8.581	18.581	18.581
HAVO1	2009	30	"HIDOH"	24	6.218	10.000	0.487	4.216	0.131	0.624	0.398	2.681	0.099	8.637	8.637	18.637	18.637
HAVO1	2009	10	"IMPROVE"	23	3.915	10.000	0.269	2.665	0.086	0.293	0.081	1.441	0.048	4.884	4.884	14.884	14.884
HAVO1	2009	10	"RHR BY HIDOH"	23	3.915	10.000	0.269	2.665	0.086	0.293	0.081	1.441	0.048	4.884	4.884	14.884	14.884
HAVO1	2009	10	"HIDOH"	23	3.915	10.000	0.269	2.665	0.086	0.293	0.081	1.441	0.048	4.884	4.884	14.884	14.884
HAVO1	2010	90	"IMPROVE"	25	24.464	10.000	0.389	131.631	0.614	0.694	1.019	0.824	0.768	135.940	135.940	145.940	145.940
HAVO1	2010	90	"RHR BY HIDOH"	25	24.464	10.000	0.389	131.631	0.614	0.694	1.019	0.824	0.768	135.940	135.940	145.940	145.940
HAVO1	2010	90	"HIDOH"	25	24.464	10.000	0.389	131.631	0.614	0.694	1.019	0.824	0.768	135.940	135.940	145.940	145.940
HAVO1	2010	70	"IMPROVE"	23	10.987	10.000	0.896	13.403	0.204	1.146	0.429	3.843	0.286	20.208	20.208	30.208	30.208
HAVO1	2010	70	"RHR BY HIDOH"	23	10.987	10.000	0.896	13.403	0.204	1.146	0.429	3.843	0.286	20.208	20.208	30.208	30.208
HAVO1	2010	70	"HIDOH"	24	10.912	10.000	0.914	13.011	0.205	1.178	0.426	3.981	0.277	19.992	19.992	29.992	29.992
HAVO1	2010	50	"IMPROVE"	27	7.975	10.000	0.887	6.234	0.175	1.240	0.406	3.197	0.169	12.308	12.308	22.308	22.308
HAVO1	2010	50	"RHR BY HIDOH"	27	7.975	10.000	0.887	6.234	0.175	1.240	0.406	3.197	0.169	12.308	12.308	22.308	22.308
HAVO1	2010	50	"HIDOH"	25	7.987	10.000	0.885	6.330	0.176	1.224	0.419	3.115	0.179	12.327	12.327	22.327	22.327
HAVO1	2010	30	"IMPROVE"	23	5.475	10.000	0.545	3.420	0.096	0.888	0.155	2.137	0.069	7.310	7.310	17.310	17.310
HAVO1	2010	30	"RHR BY HIDOH"	23	5.475	10.000	0.545	3.420	0.096	0.888	0.155	2.137	0.069	7.310	7.310	17.310	17.310
HAVO1	2010	30	"HIDOH"	24	5.516	10.000	0.541	3.531	0.096	0.892	0.155	2.102	0.067	7.384	7.384	17.384	17.384
HAVO1	2010	10	"IMPROVE"	24	3.593	10.000	0.309	1.958	0.097	0.487	0.147	1.323	0.048	4.369	4.369	14.369	14.369
HAVO1	2010	10	"RHR BY HIDOH"	24	3.593	10.000	0.309	1.958	0.097	0.487	0.147	1.323	0.048	4.369	4.369	14.369	14.369
HAVO1	2010	10	"HIDOH"	24	3.593	10.000	0.309	1.958	0.097	0.487	0.147	1.323	0.048	4.369	4.369	14.369	14.369
HAVO1	2011	90	"IMPROVE"	24	15.080	10.000	0.616	34.216	0.373	0.679	0.593	2.525	0.175	39.178	39.178	49.178	49.178
HAVO1	2011	90	"RHR BY HIDOH"	24	15.080	10.000	0.616	34.216	0.373	0.679	0.593	2.525	0.175	39.178	39.178	49.178	49.178
HAVO1	2011	90	"HIDOH"	24	15.080	10.000	0.616	34.216	0.373	0.679	0.593	2.525	0.175	39.178	39.178	49.178	49.178
HAVO1	2011	70	"IMPROVE"	23	8.873	10.000	0.755	7.752	0.139	1.302	0.322	3.965	0.140	14.375	14.375	24.375	24.375
HAVO1	2011	70	"RHR BY HIDOH"	23	8.873	10.000	0.755	7.752	0.139	1.302	0.322	3.965	0.140	14.375	14.375	24.375	24.375
HAVO1	2011	70	"HIDOH"	24	8.811	10.000	0.736	7.775	0.133	1.268	0.314	3.868	0.138	14.231	14.231	24.231	24.231
HAVO1	2011	50	"IMPROVE"	26	6.528	10.000	0.586	4.666	0.149	0.936	0.330	2.497	0.063	9.228	9.228	19.228	19.228
HAVO1	2011	50	"RHR BY HIDOH"	26	6.528	10.000	0.586	4.666	0.149	0.936	0.330	2.497	0.063	9.228	9.228	19.228	19.228

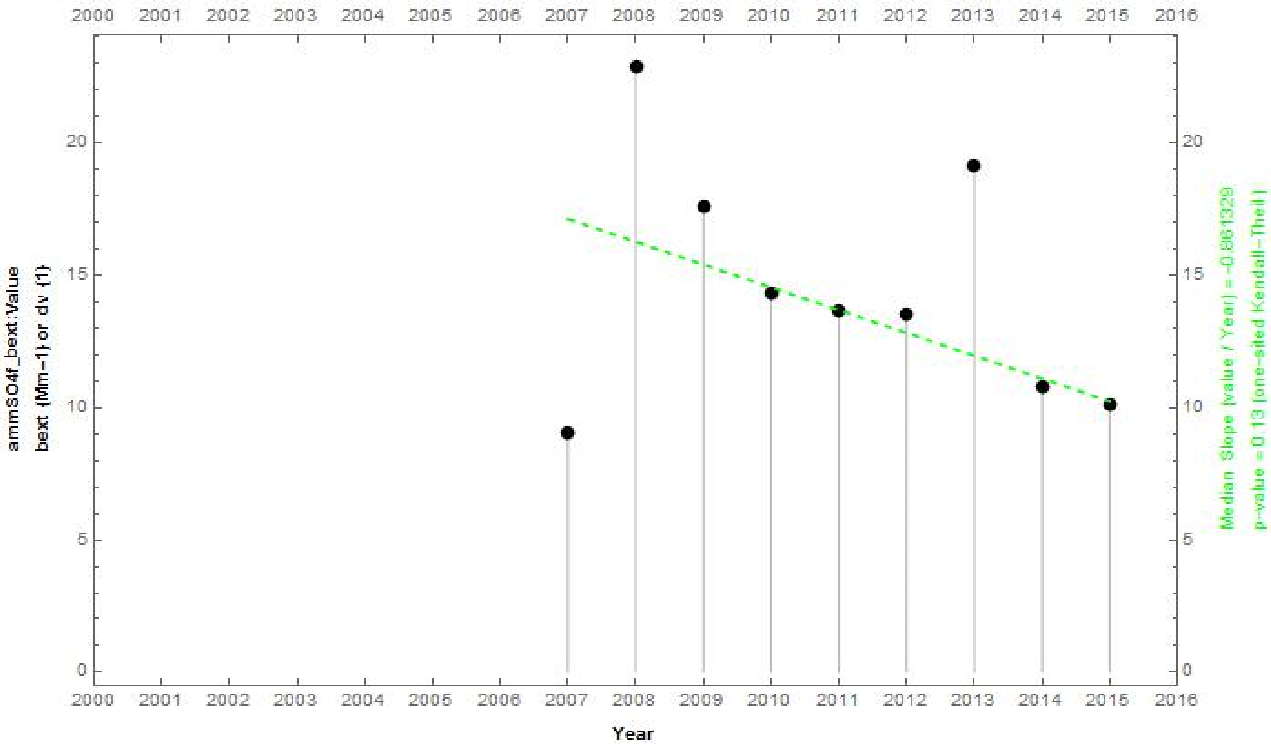
					Annual Average Values												
Site	Year	Quantile & Method		No.	dv	S_Rayleigh:Value	ammNO3f_bext:Value	ammSO4f_bext:Value	ECf_bext:Value	CM_bext:Value	OMCf_bext:Value	SeaSaltf_bext:Value	SOILf_bext:Value	Aerosol Bext Calc	aerosol_bext:Value	Total Bext Calc	total_bext:Value
HAVO1	2011	50	"HIDOH"	24	6.521	10.000	0.604	4.580	0.156	0.935	0.346	2.525	0.064	9.211	9.211	19.211	19.211
HAVO1	2011	30	"IMPROVE"	23	5.187	10.000	0.470	3.007	0.078	0.824	0.162	2.227	0.049	6.817	6.817	16.817	16.817
HAVO1	2011	30	"RHR BY HIDOH"	23	5.187	10.000	0.470	3.007	0.078	0.824	0.162	2.227	0.049	6.817	6.817	16.817	16.817
HAVO1	2011	30	"HIDOH"	24	5.214	10.000	0.469	3.011	0.080	0.849	0.162	2.246	0.047	6.864	6.864	16.864	16.864
HAVO1	2011	10	"IMPROVE"	23	3.138	10.000	0.210	1.504	0.141	0.531	0.199	1.139	0.019	3.743	3.743	13.743	13.743
HAVO1	2011	10	"RHR BY HIDOH"	23	3.138	10.000	0.210	1.504	0.141	0.531	0.199	1.139	0.019	3.743	3.743	13.743	13.743
HAVO1	2011	10	"HIDOH"	23	3.138	10.000	0.210	1.504	0.141	0.531	0.199	1.139	0.019	3.743	3.743	13.743	13.743
HAVO1	2012	90	"IMPROVE"	25	16.459	10.000	0.552	43.235	0.444	0.920	0.619	1.970	0.201	47.942	47.942	57.942	57.942
HAVO1	2012	90	"RHR BY HIDOH"	25	16.459	10.000	0.552	43.235	0.444	0.920	0.619	1.970	0.201	47.942	47.942	57.942	57.942
HAVO1	2012	90	"HIDOH"	25	16.459	10.000	0.552	43.235	0.444	0.920	0.619	1.970	0.201	47.942	47.942	57.942	57.942
HAVO1	2012	70	"IMPROVE"	23	9.832	10.000	0.894	10.199	0.218	1.258	0.672	3.324	0.269	16.833	16.833	26.833	26.833
HAVO1	2012	70	"RHR BY HIDOH"	23	9.832	10.000	0.894	10.199	0.218	1.258	0.672	3.324	0.269	16.833	16.833	26.833	26.833
HAVO1	2012	70	"HIDOH"	24	9.761	10.000	0.897	10.002	0.214	1.275	0.655	3.311	0.301	16.654	16.654	26.654	26.654
HAVO1	2012	50	"IMPROVE"	27	7.026	10.000	0.629	4.887	0.162	0.966	0.365	3.084	0.149	10.244	10.244	20.244	20.244
HAVO1	2012	50	"RHR BY HIDOH"	27	7.026	10.000	0.629	4.887	0.162	0.966	0.365	3.084	0.149	10.244	10.244	20.244	20.244
HAVO1	2012	50	"HIDOH"	25	7.037	10.000	0.624	4.899	0.161	0.958	0.363	3.138	0.116	10.259	10.259	20.259	20.259
HAVO1	2012	30	"IMPROVE"	23	4.661	10.000	0.365	2.645	0.098	0.630	0.226	1.940	0.052	5.956	5.956	15.956	15.956
HAVO1	2012	30	"RHR BY HIDOH"	23	4.661	10.000	0.365	2.645	0.098	0.630	0.226	1.940	0.052	5.956	5.956	15.956	15.956
HAVO1	2012	30	"HIDOH"	24	4.702	10.000	0.367	2.703	0.103	0.624	0.238	1.935	0.054	6.024	6.024	16.024	16.024
HAVO1	2012	10	"IMPROVE"	24	2.915	10.000	0.219	1.507	0.067	0.393	0.151	1.073	0.034	3.444	3.444	13.444	13.444
HAVO1	2012	10	"RHR BY HIDOH"	24	2.915	10.000	0.219	1.507	0.067	0.393	0.151	1.073	0.034	3.444	3.444	13.444	13.444
HAVO1	2012	10	"HIDOH"	24	2.915	10.000	0.219	1.507	0.067	0.393	0.151	1.073	0.034	3.444	3.444	13.444	13.444
HAVO1	2013	90	"IMPROVE"	25	19.693	10.000	0.582	61.404	0.493	0.699	0.996	1.646	0.195	66.016	66.016	76.016	76.016
HAVO1	2013	90	"RHR BY HIDOH"	25	19.693	10.000	0.582	61.404	0.493	0.699	0.996	1.646	0.195	66.016	66.016	76.016	76.016
HAVO1	2013	90	"HIDOH"	25	19.693	10.000	0.582	61.404	0.493	0.699	0.996	1.646	0.195	66.016	66.016	76.016	76.016
HAVO1	2013	70	"IMPROVE"	23	11.118	10.000	0.982	12.946	0.177	1.275	0.638	4.473	0.127	20.618	20.618	30.618	30.618
HAVO1	2013	70	"RHR BY HIDOH"	23	11.118	10.000	0.982	12.946	0.177	1.275	0.638	4.473	0.127	20.618	20.618	30.618	30.618
HAVO1	2013	70	"HIDOH"	24	11.055	10.000	0.981	12.655	0.179	1.331	0.617	4.544	0.125	20.431	20.431	30.431	30.431
HAVO1	2013	50	"IMPROVE"	26	8.237	10.000	0.840	6.542	0.136	1.308	0.397	3.526	0.099	12.847	12.847	22.847	22.847
HAVO1	2013	50	"RHR BY HIDOH"	26	8.237	10.000	0.840	6.542	0.136	1.308	0.397	3.526	0.099	12.847	12.847	22.847	22.847
HAVO1	2013	50	"HIDOH"	24	8.216	10.000	0.849	6.521	0.136	1.264	0.424	3.495	0.103	12.792	12.792	22.792	22.792
HAVO1	2013	30	"IMPROVE"	23	6.411	10.000	0.586	4.524	0.128	0.893	0.286	2.549	0.054	9.020	9.020	19.020	19.020
HAVO1	2013	30	"RHR BY HIDOH"	23	6.411	10.000	0.586	4.524	0.128	0.893	0.286	2.549	0.054	9.020	9.020	19.020	19.020
HAVO1	2013	30	"HIDOH"	24	6.450	10.000	0.583	4.653	0.125	0.900	0.274	2.510	0.053	9.097	9.097	19.097	19.097
HAVO1	2013	10	"IMPROVE"	24	3.920	10.000	0.361	2.188	0.077	0.590	0.210	1.431	0.032	4.890	4.890	14.890	14.890
HAVO1	2013	10	"RHR BY HIDOH"	24	3.920	10.000	0.361	2.188	0.077	0.590	0.210	1.431	0.032	4.890	4.890	14.890	14.890
HAVO1	2013	10	"HIDOH"	24	3.920	10.000	0.361	2.188	0.077	0.590	0.210	1.431	0.032	4.890	4.890	14.890	14.890
HAVO1	2014	90	"IMPROVE"	24	19.269	10.000	0.583	55.206	0.668	0.702	1.810	2.168	0.244	61.379	61.379	71.379	71.379
HAVO1	2014	90	"RHR BY HIDOH"	24	19.269	10.000	0.583	55.206	0.668	0.702	1.810	2.168	0.244	61.379	61.379	71.379	71.379
HAVO1	2014	90	"HIDOH"	24	19.269	10.000	0.583	55.206	0.668	0.702	1.810	2.168	0.244	61.379	61.379	71.379	71.379
HAVO1	2014	70	"IMPROVE"	22	12.618	10.000	1.031	17.526	0.372	1.305	1.309	3.835	0.228	25.606	25.606	35.606	35.606
HAVO1	2014	70	"RHR BY HIDOH"	22	12.618	10.000	1.031	17.526	0.372	1.305	1.309	3.835	0.228	25.606	25.606	35.606	35.606
HAVO1	2014	70	"HIDOH"	23	12.535	10.000	1.071	17.136	0.367	1.346	1.258	3.928	0.221	25.327	25.327	35.327	35.327
HAVO1	2014	50	"IMPROVE"	25	8.465	10.000	0.827	7.306	0.169	1.206	0.573	3.270	0.137	13.488	13.488	23.488	23.488
HAVO1	2014	50	"RHR BY HIDOH"	25	8.465	10.000	0.827	7.306	0.169	1.206	0.573	3.270	0.137	13.488	13.488	23.488	23.488
HAVO1	2014	50	"HIDOH"	23	8.425	10.000	0.770	7.461	0.168	1.147	0.616	3.075	0.137	13.373	13.373	23.373	23.373
HAVO1	2014	30	"IMPROVE"	22	5.956	10.000	0.529	4.093	0.109	0.816	0.386	2.141	0.110	8.184	8.184	18.184	18.184
HAVO1	2014	30	"RHR BY HIDOH"	22	5.956	10.000	0.529	4.093	0.109	0.816	0.386	2.141	0.110	8.184	8.184	18.184	18.184
HAVO1	2014	30	"HIDOH"	23	6.008	10.000	0.548	4.024	0.109	0.848	0.372	2.268	0.113	8.282	8.282	18.282	18.282
HAVO1	2014	10	"IMPROVE"	23	3.248	10.000	0.233	1.795	0.048	0.435	0.226	1.125	0.049	3.912	3.912	13.912	13.912
HAVO1	2014	10	"RHR BY HIDOH"	23	3.248	10.000	0.233	1.795	0.048	0.435	0.226	1.125	0.049	3.912	3.912	13.912	13.912
HAVO1	2014	10	"HIDOH"	23	3.248	10.000	0.233	1.795	0.048	0.435	0.226	1.125	0.049	3.912	3.912	13.912	13.912
HAVO1	2015	90	"IMPROVE"	22	19.290	10.000	0.602	56.799	0.519	0.734	1.495	1.528	0.173	61.850	61.850	71.850	71.850
HAVO1	2015	90	"RHR BY HIDOH"	22	19.290	10.000	0.602	56.799	0.519	0.734	1.495	1.528	0.173	61.850	61.850	71.850	71.850
HAVO1	2015	90	"HIDOH"	22	19.290	10.000	0.602	56.799	0.519	0.734	1.495	1.528	0.173	61.850	61.850	71.850	71.850
HAVO1	2015	70	"IMPROVE"	20	13.423	10.000	0.826	21.908	0.444	0.848	1.319	3.138	0.154	28.638	28.638	38.638	38.638
HAVO1	2015	70	"RHR BY HIDOH"	20	13.423	10.000	0.826	21.908	0.444	0.848	1.319	3.138	0.154	28.638	28.638	38.638	38.638
HAVO1	2015	70	"HIDOH"	21	13.320	10.000	0.833	21.614	0.438	0.848	1.268	3.110	0.157	28.268	28.268	38.268	38.268
HAVO1	2015	50	"IMPROVE"	24	9.183	10.000	0.799	7.993	0.467	1.011	0.623	4.140	0.176	15.208	15.208	25.208	25.208
HAVO1	2015	50	"RHR BY HIDOH"	24	9.183	10.000	0.799	7.993	0.467	1.011	0.623	4.140	0.176	15.208	15.208	25.208	25.208
HAVO1	2015	50	"HIDOH"	22	9.163	10.000	0.789	7.875	0.482	1.024	0.645	4.136	0.180	15.133	15.133	25.133	25.133
HAVO1	2015	30	"IMPROVE"	20	6.748	10.000	0.676	4.100	0.314	0.951	0.509	2.913	0.206	9.668	9.668	19.668	19.668
HAVO1	2015	30	"RHR BY HIDOH"	20	6.748	10.000	0.676	4.100	0.314	0.951	0.509	2.913	0.206	9.668	9.668	19.668	19.668
HAVO1	2015	30	"HIDOH"	21	6.785	10.000	0.683	4.041	0.313	0.949	0.508	3.051	0.198	9.743	9.743	19.743	19.743
HAVO1	2015	10	"IMPROVE"	21	3.999	10.000	0.353	2.048	0.079	0.734	0.389	1.358	0.058	5.019	5.019	15.019	15.019
HAVO1	2015	10	"RHR BY HIDOH"	21	3.999	10.000	0.353	2.048	0.079	0.734	0.389	1.358	0.058	5.019	5.019	15.019	15.019
HAVO1	2015	10	"HIDOH"	21	3.999	10.000	0.353	2.048	0.079	0.734	0.389	1.358	0.058	5.019	5.019	15.019	15.019

Table D-2: HAVO1 Visibility Impact for 2001 - 2015 with an Examination of Quantile Grouping Methods

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

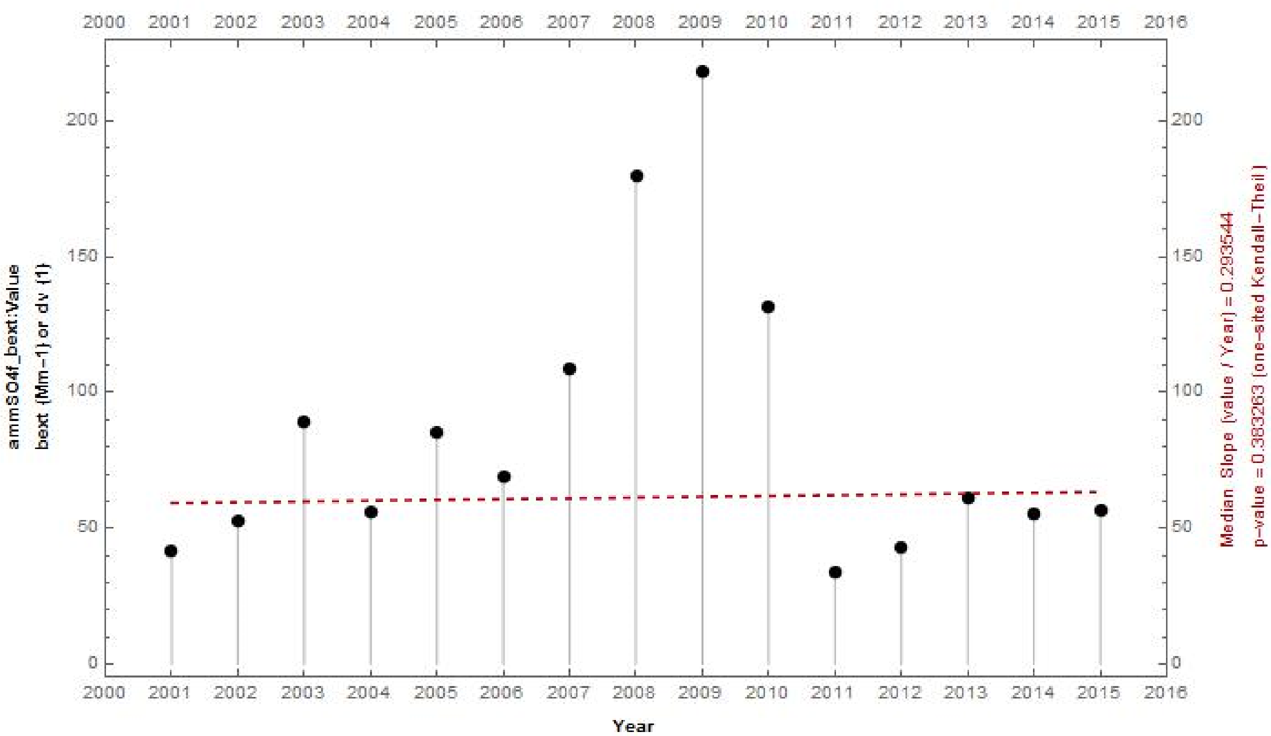
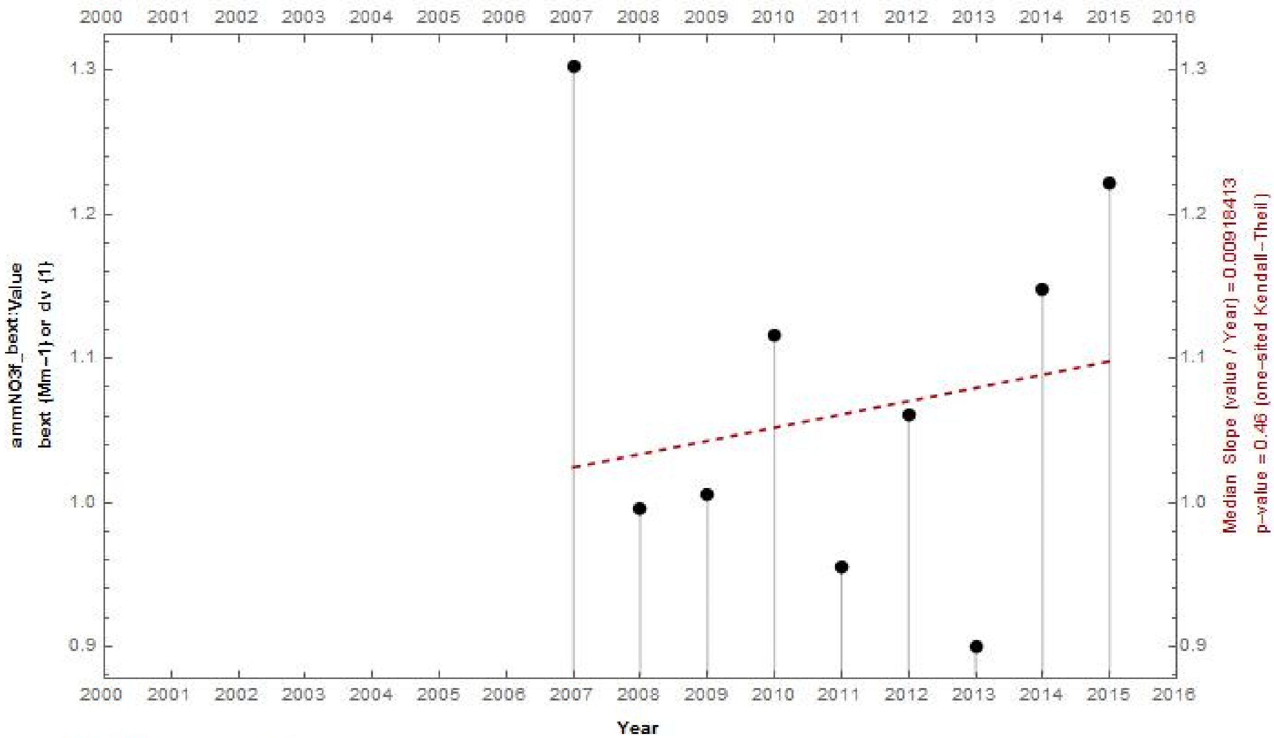


Figure D-1: HACR1 & HAVO1 Bext for Sulfates; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

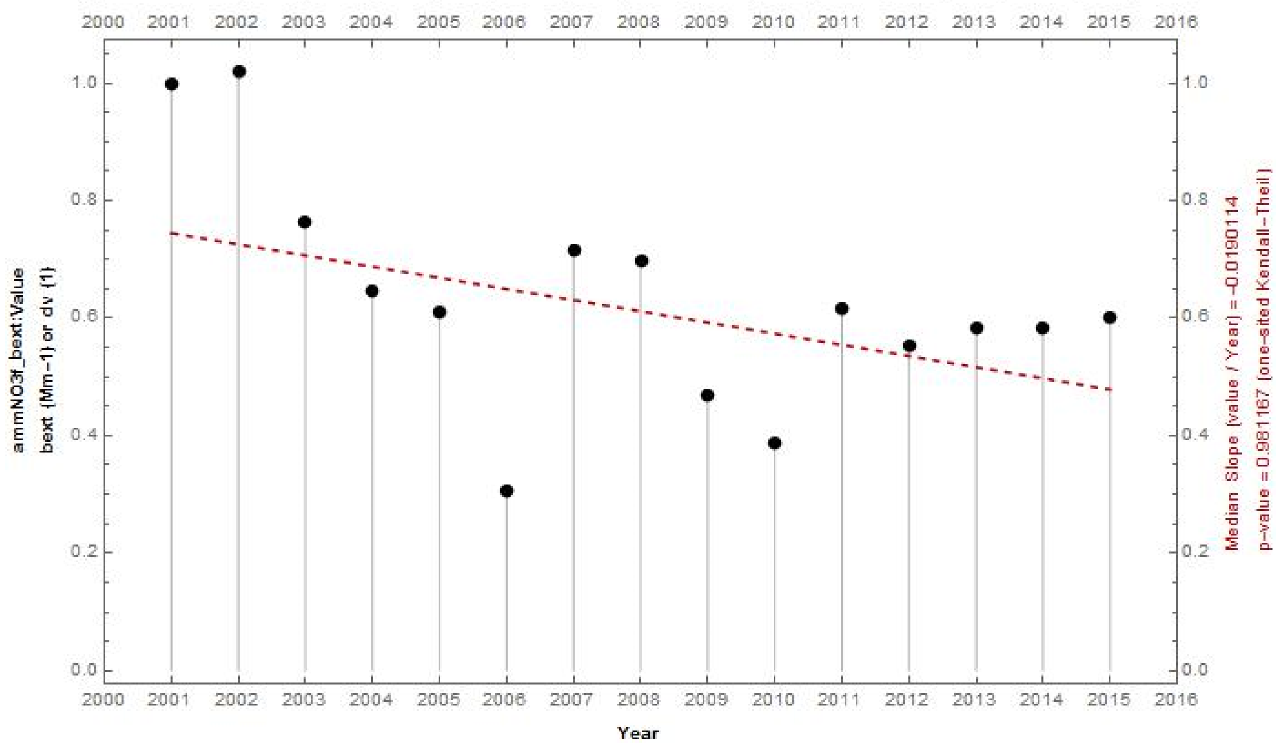
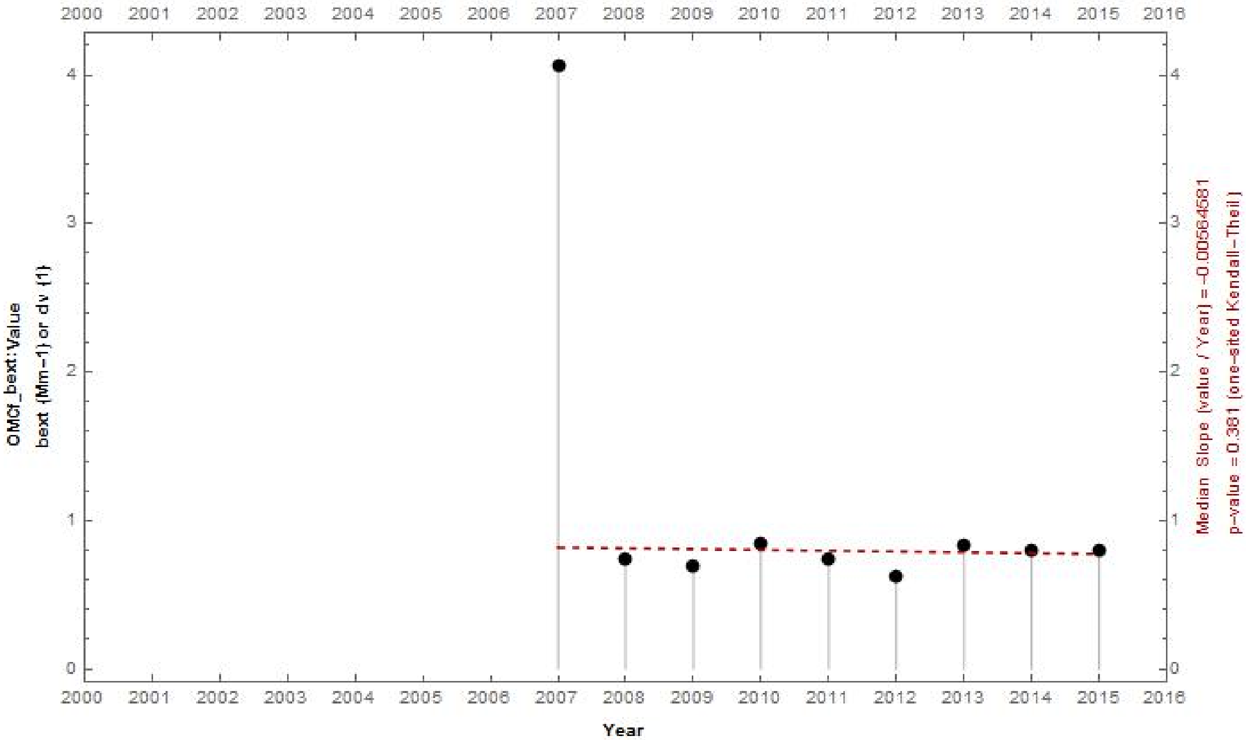


Figure D-2: HACR1 & HAVO1 Bext for Nitrates; 20% Worst Visibility Days

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

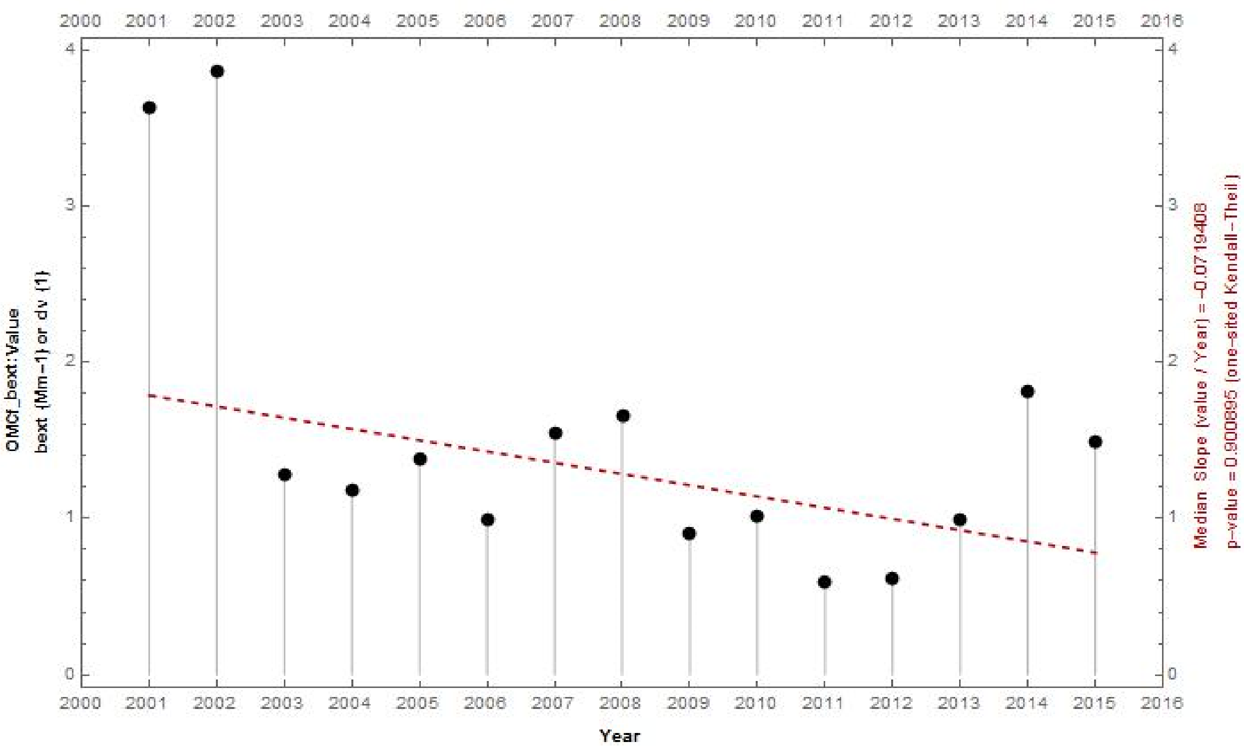
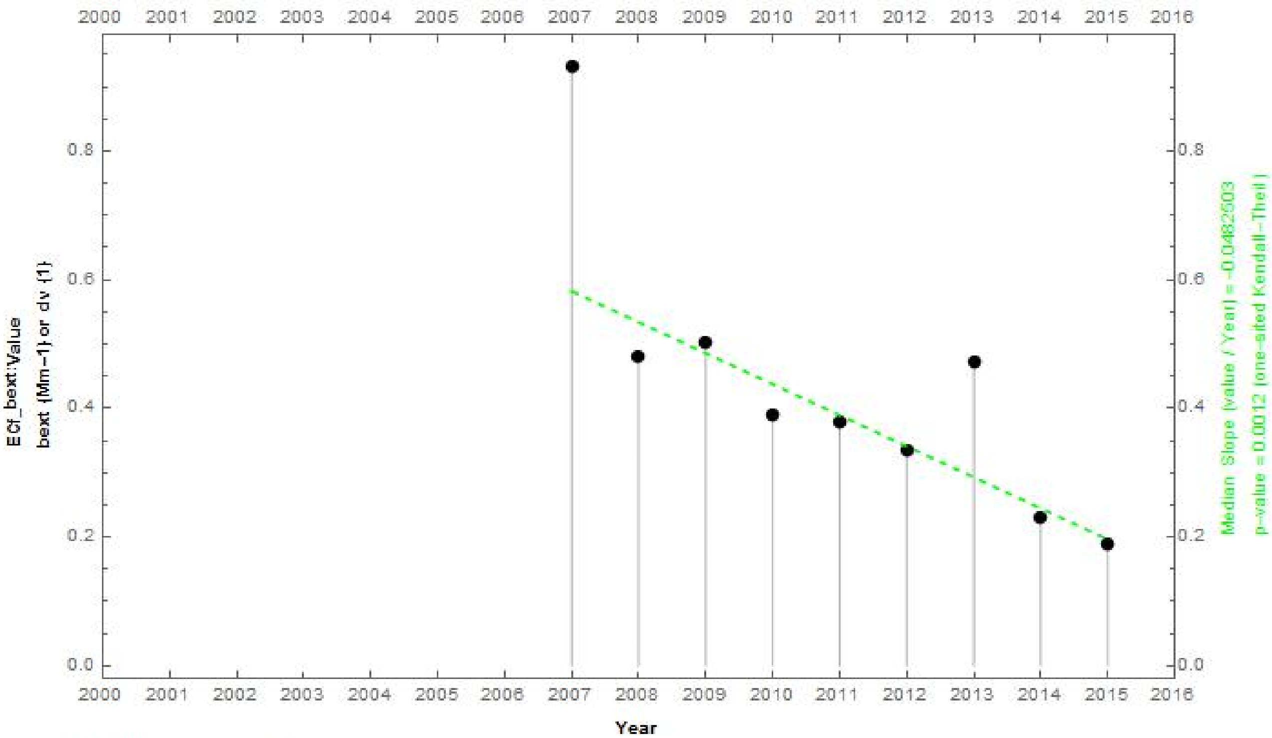


Figure D-3: HACR1 & HAVO1 Bext for POM; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

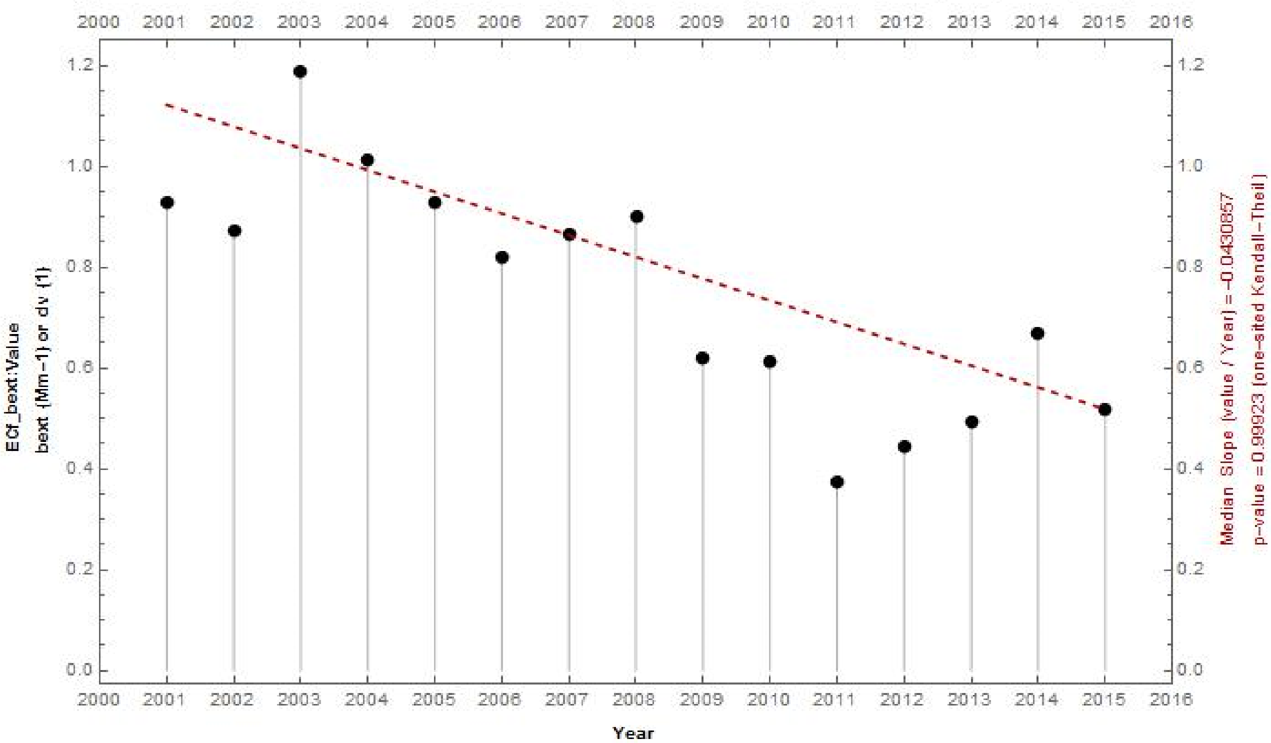
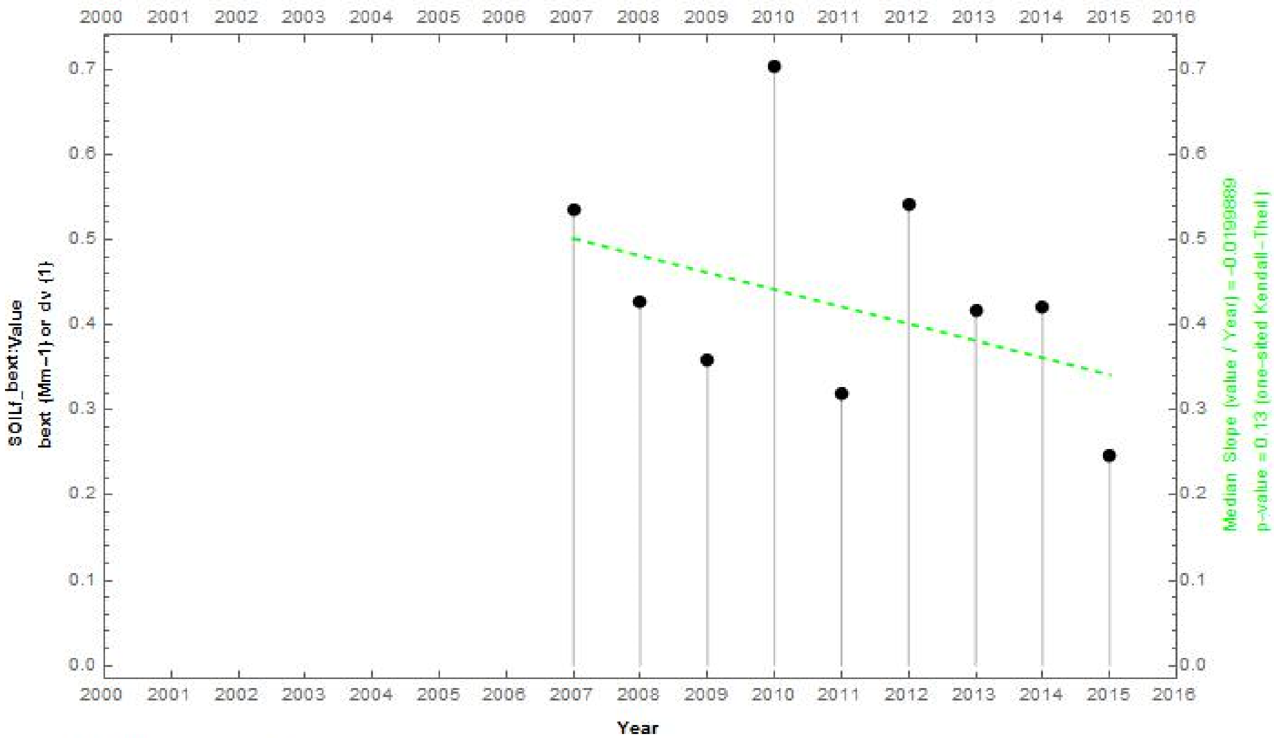


Figure D-4: HACR1 & HAVO1 Bext for EC; 20% Worst Visibility Days

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

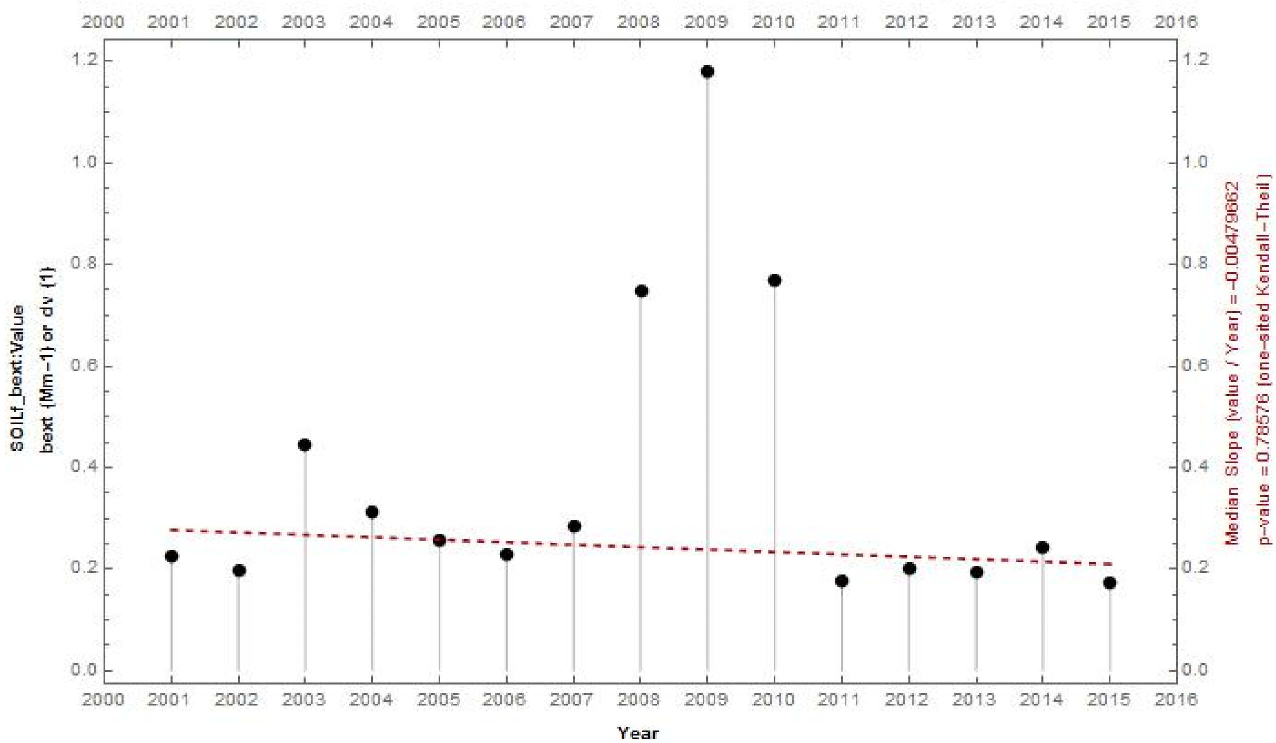
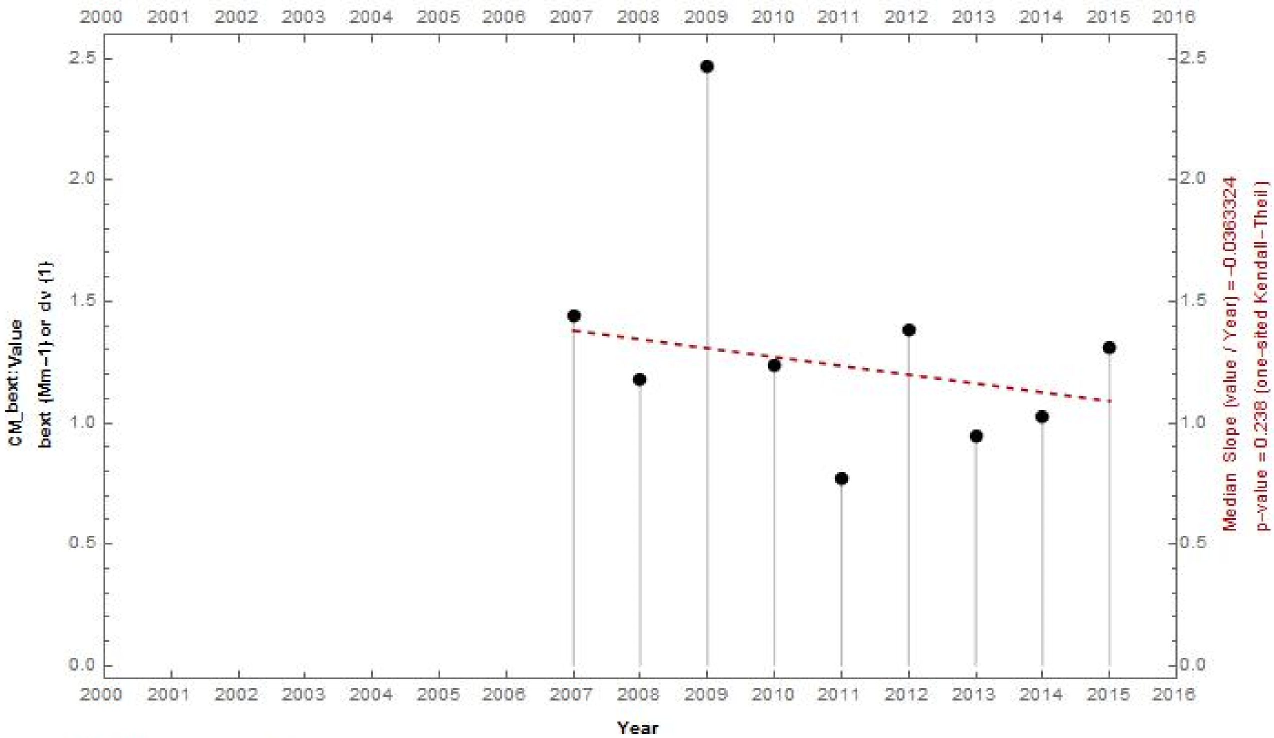


Figure D-5: HACR1 & HAVO1 Bext for Soil; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

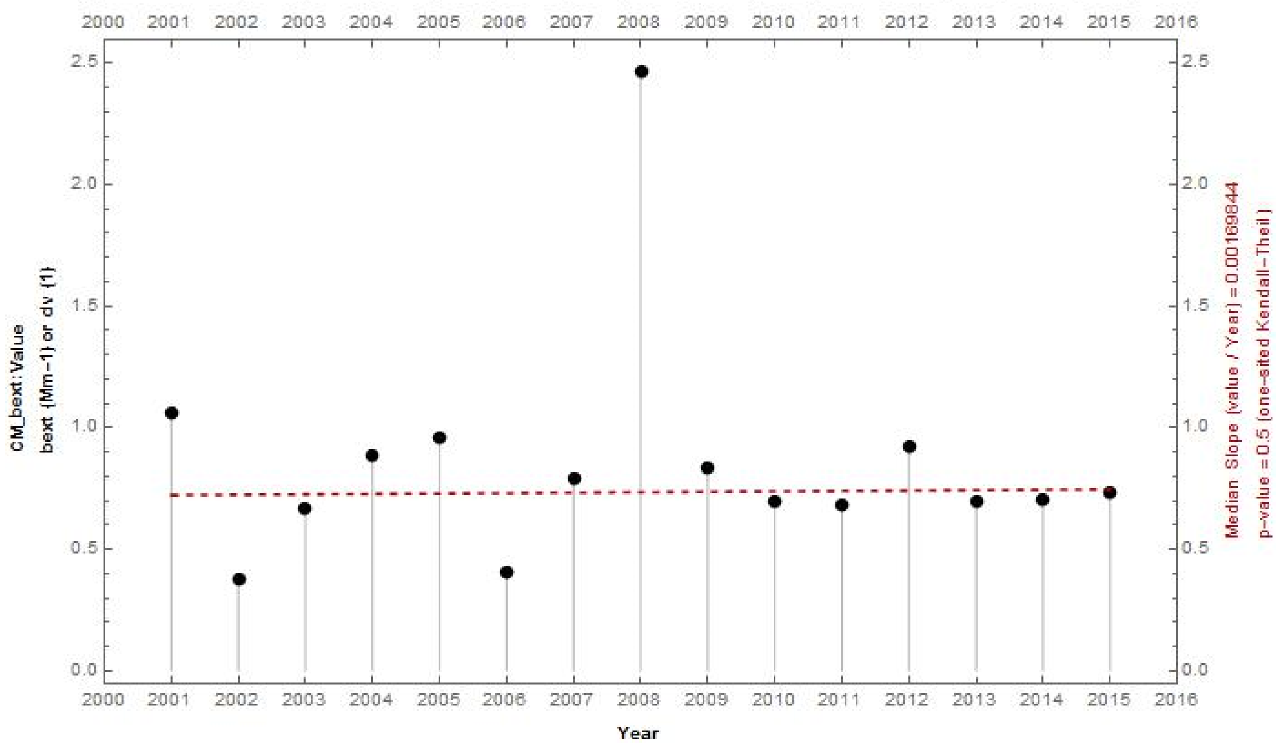
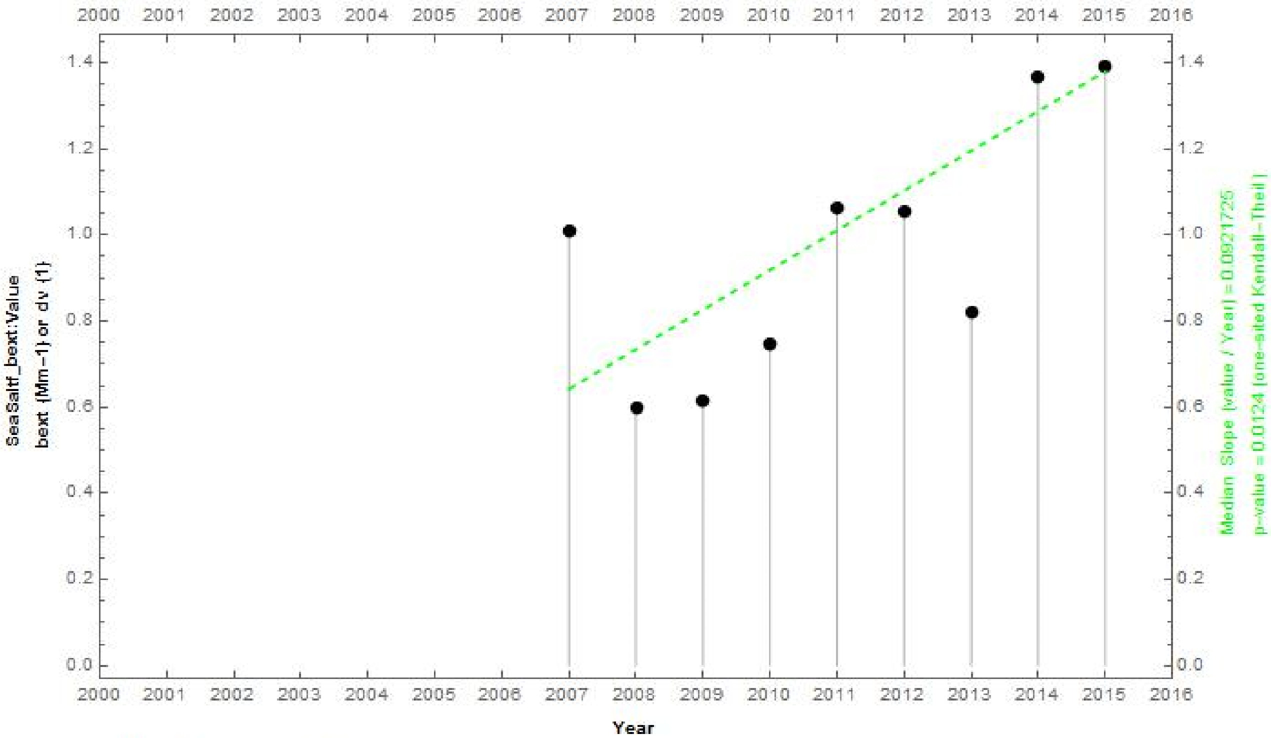


Figure D-6: HACR1 & HAVO1 Bext for CM; 20% Worst Visibility Days

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

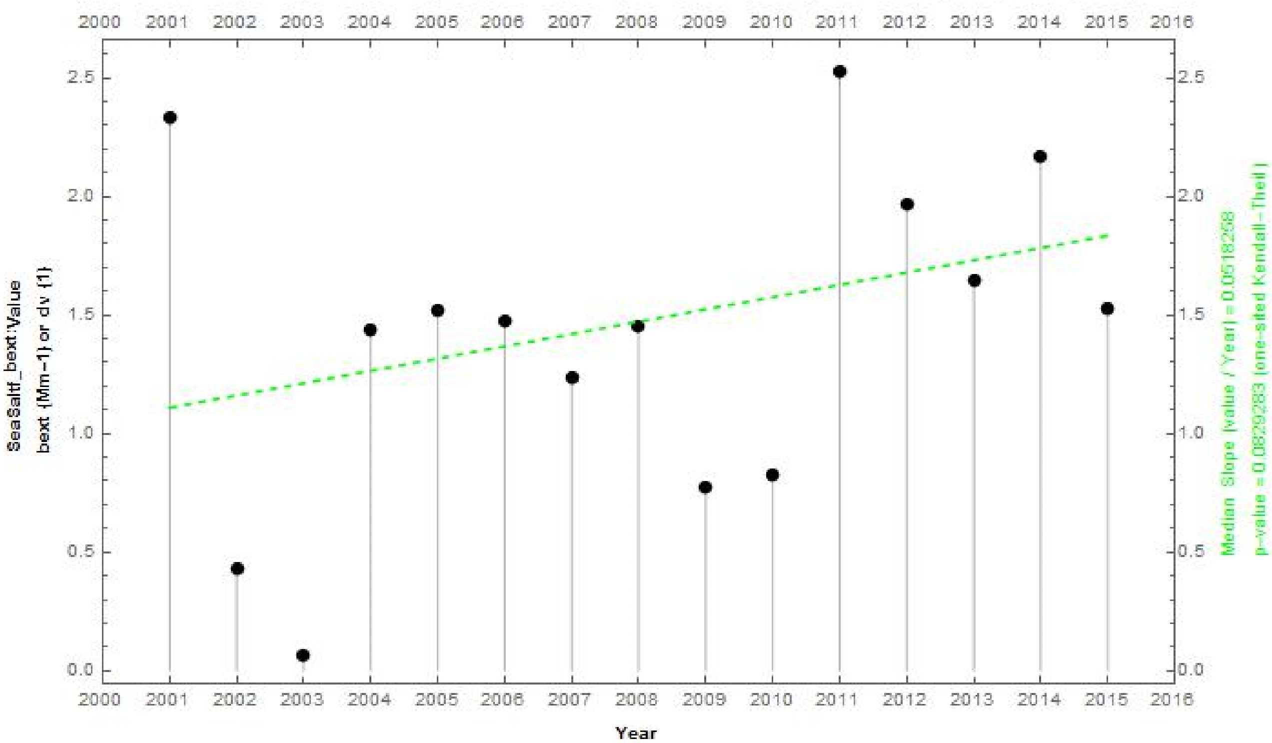
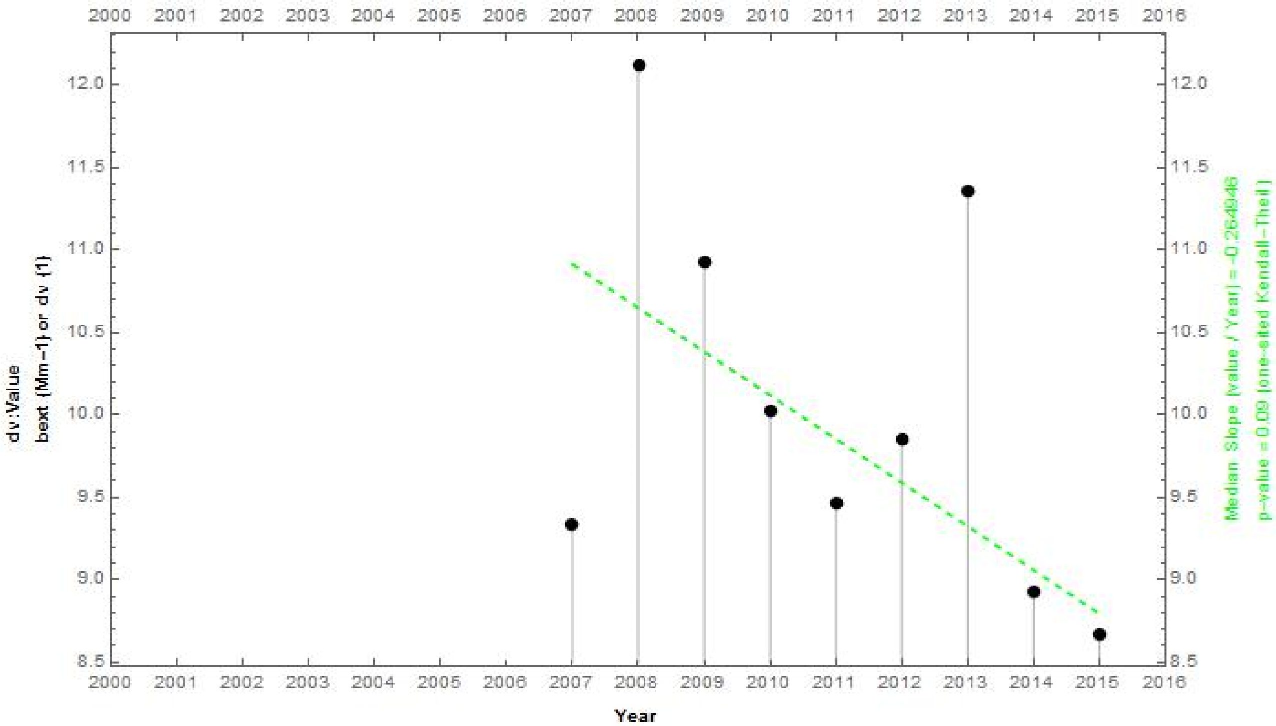


Figure D-7: HACR1 & HAVO1 Bext for Sea Salt; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	25	24	24	23	20	18	21	20
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.193	0.205	0.197	0.197	0.190	0.164	0.148	0.172	0.165



Site: HAVO1, Quantile : {90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	22	24	24	23	23	24	24	23	24	25	24	25	25	24	22
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.180	0.197	0.198	0.189	0.189	0.197	0.198	0.189	0.197	0.205	0.198	0.205	0.205	0.197	0.182

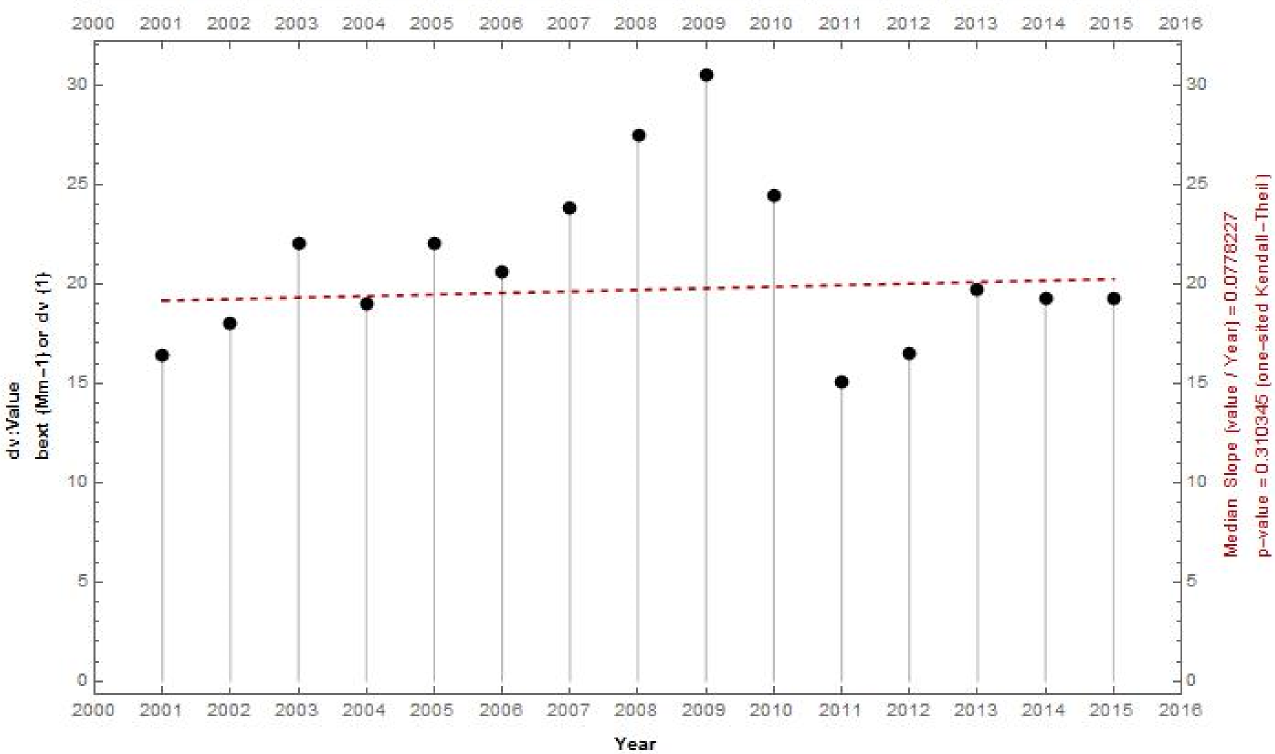
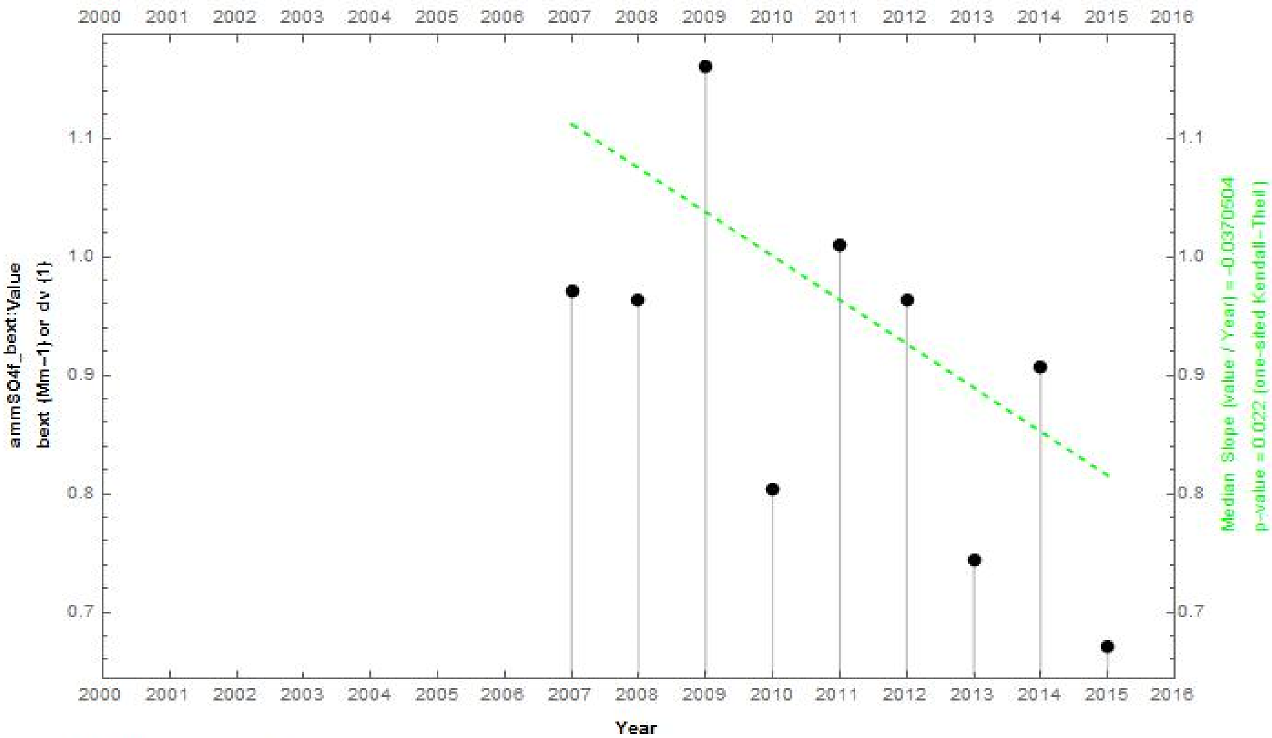


Figure D-8: HACR1 & HAVO1 Haze Index (dv); 20% Worst Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N–quant	21	24	23	23	22	19	17	20	19
N–All	114	122	122	122	121	122	122	122	121
quantile–fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N–quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N–All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile–fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

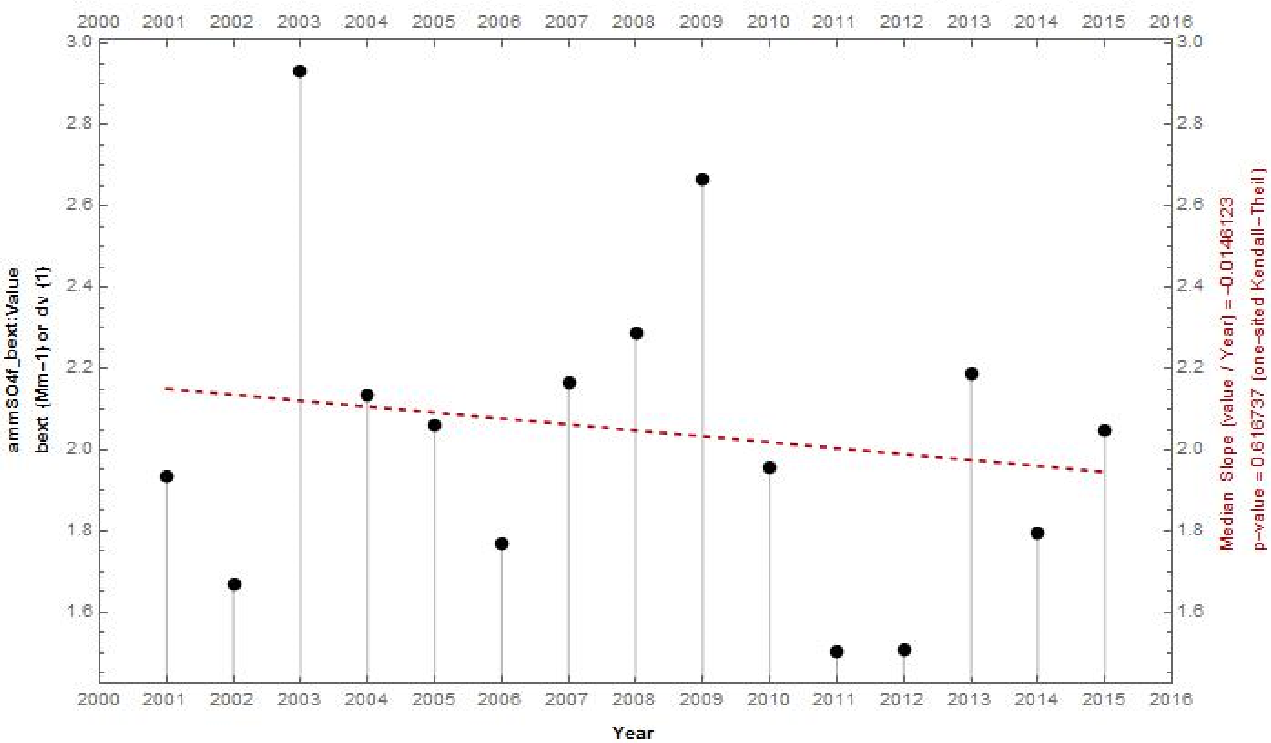
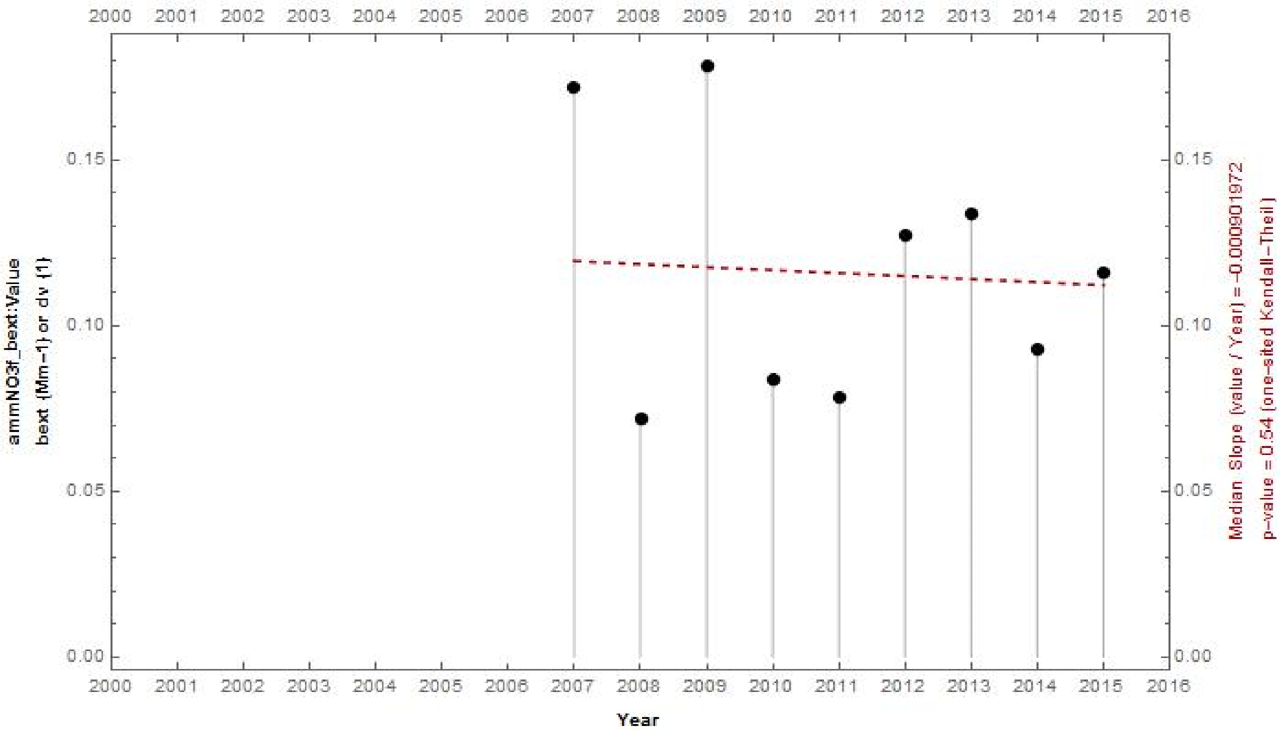


Figure D-9: HACR1 & HAVO1 Bext for Sulfates; 20% Best Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

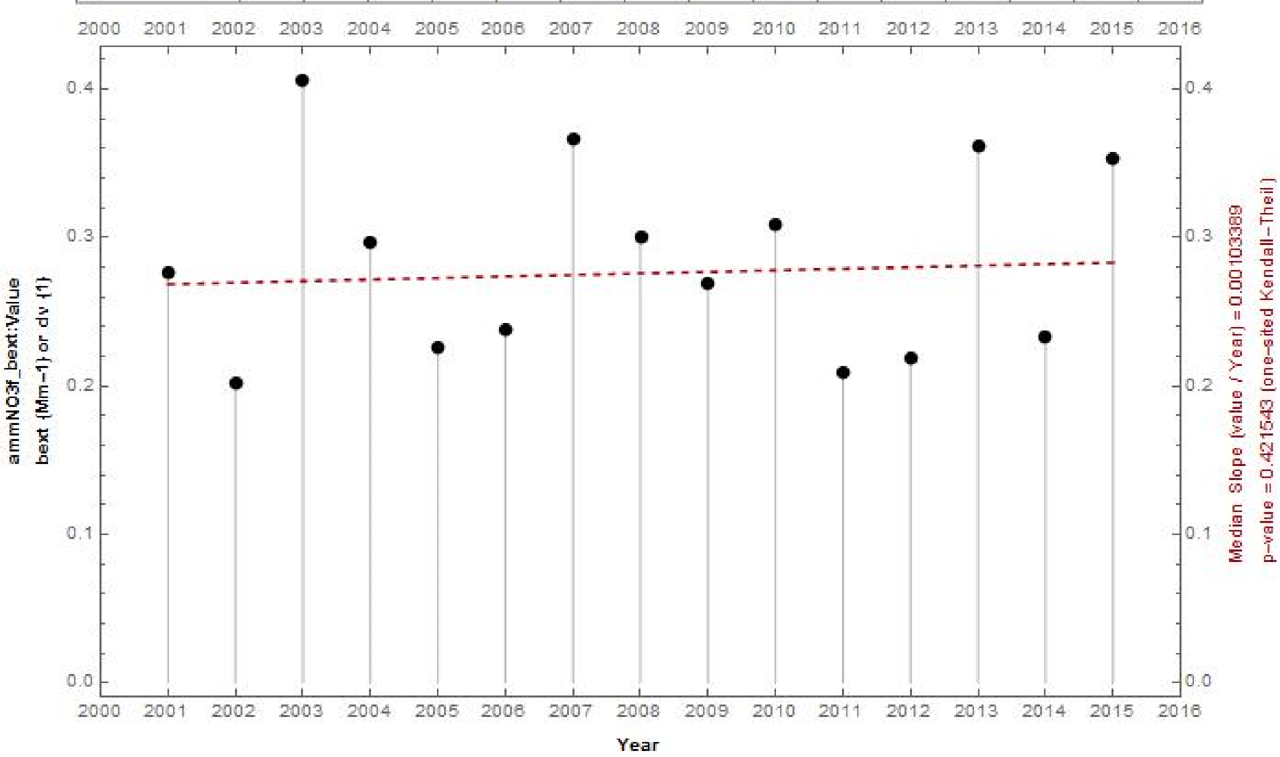
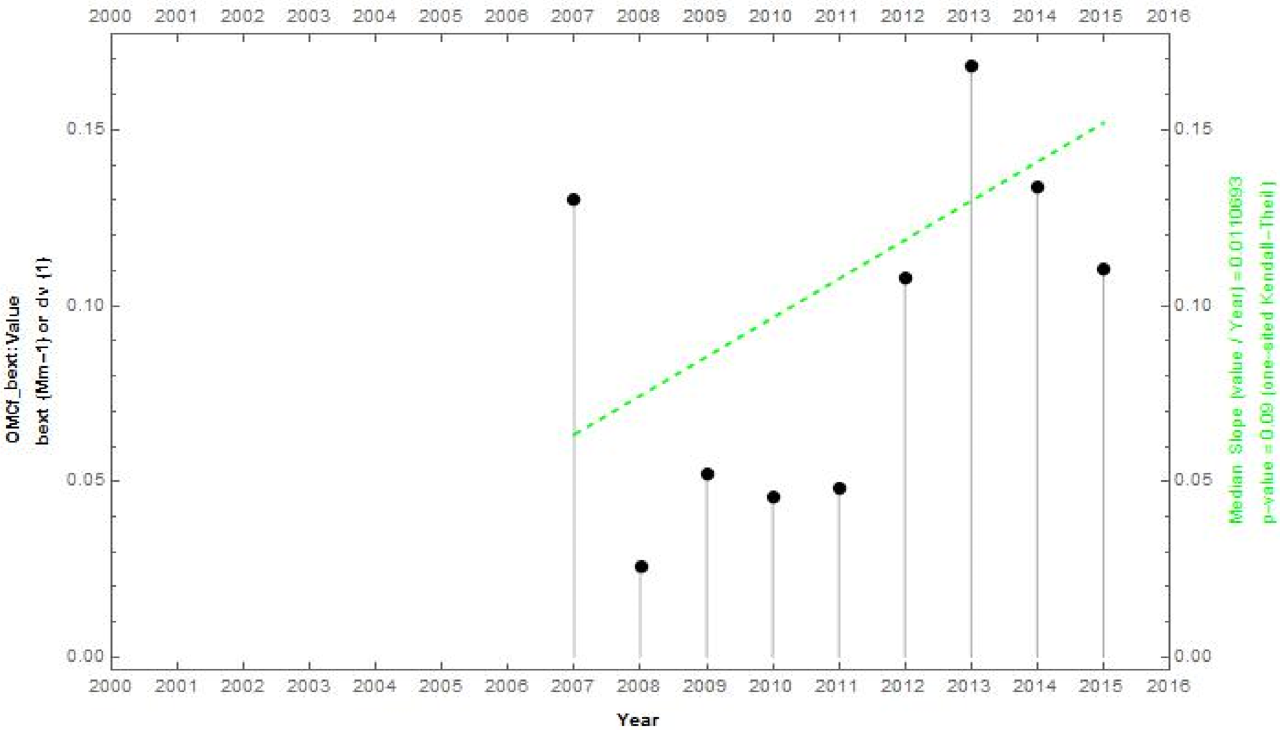


Figure D-10: HACR1 & HAVO1 Bext for Nitrates; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

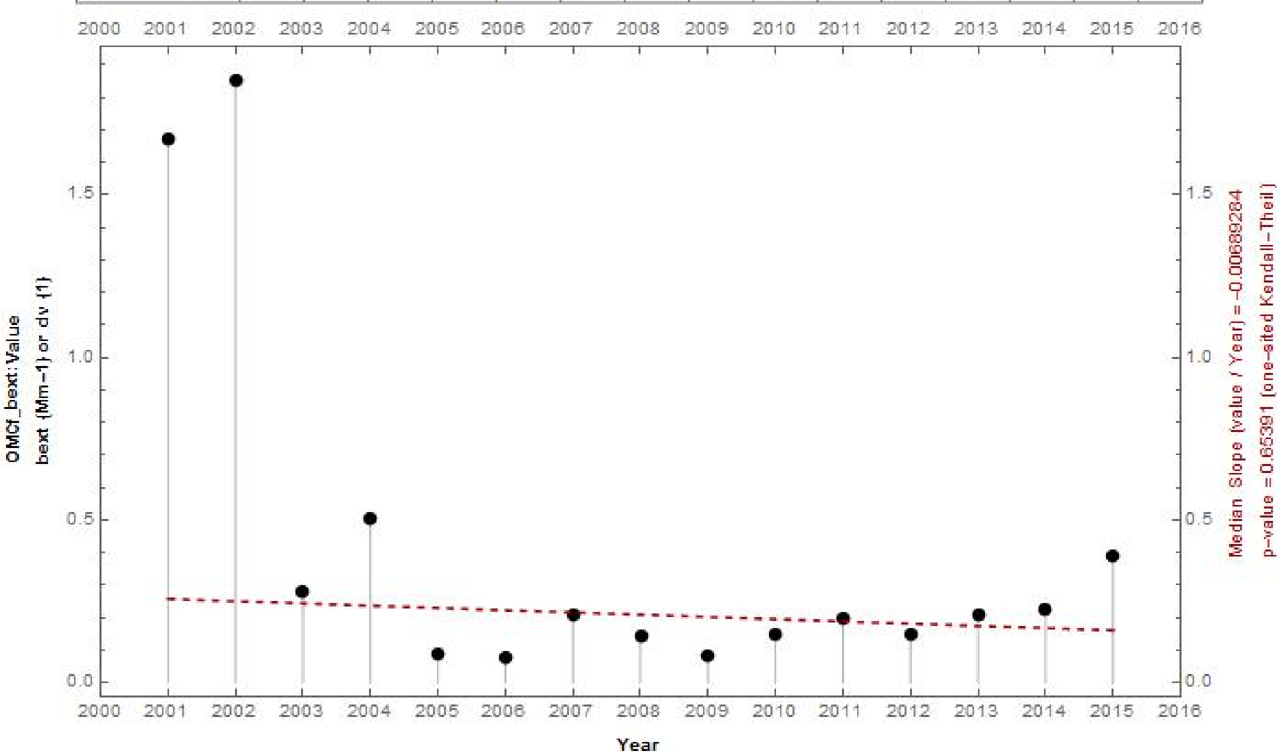
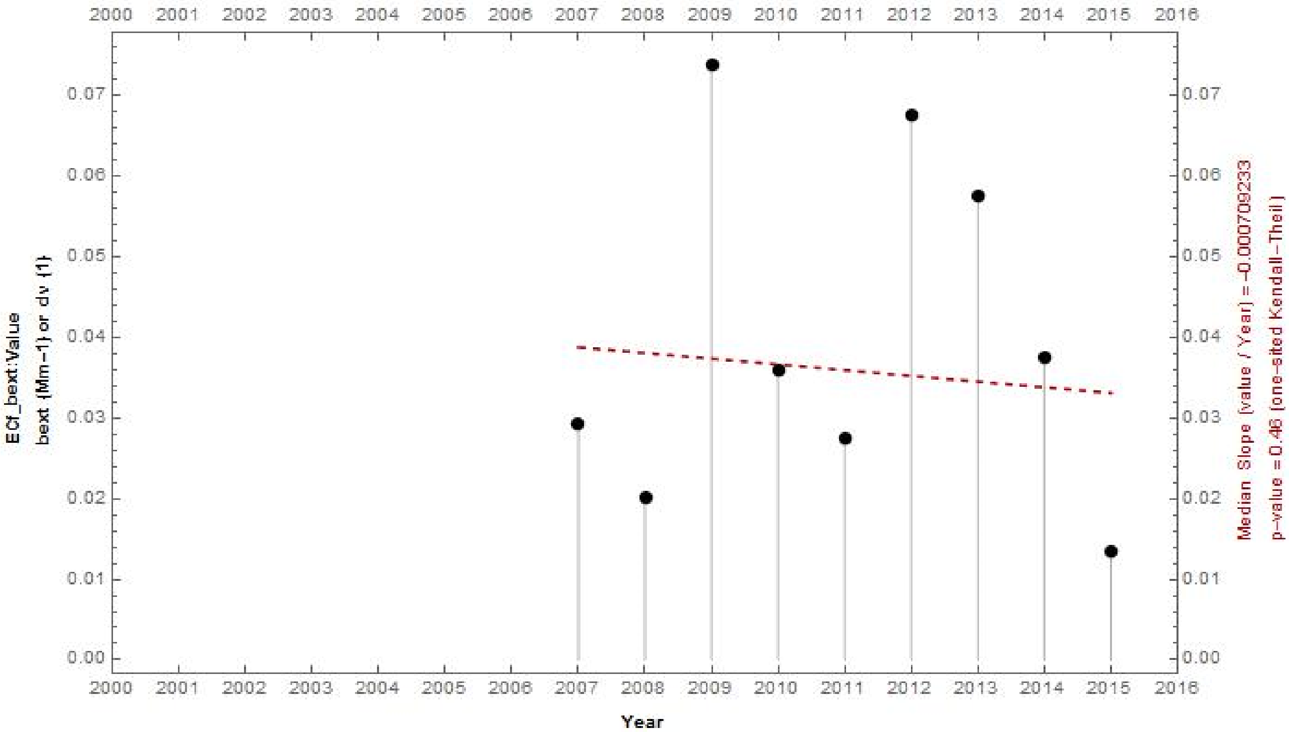


Figure D-11: HACR1 & HAVO1 Bext for POM; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

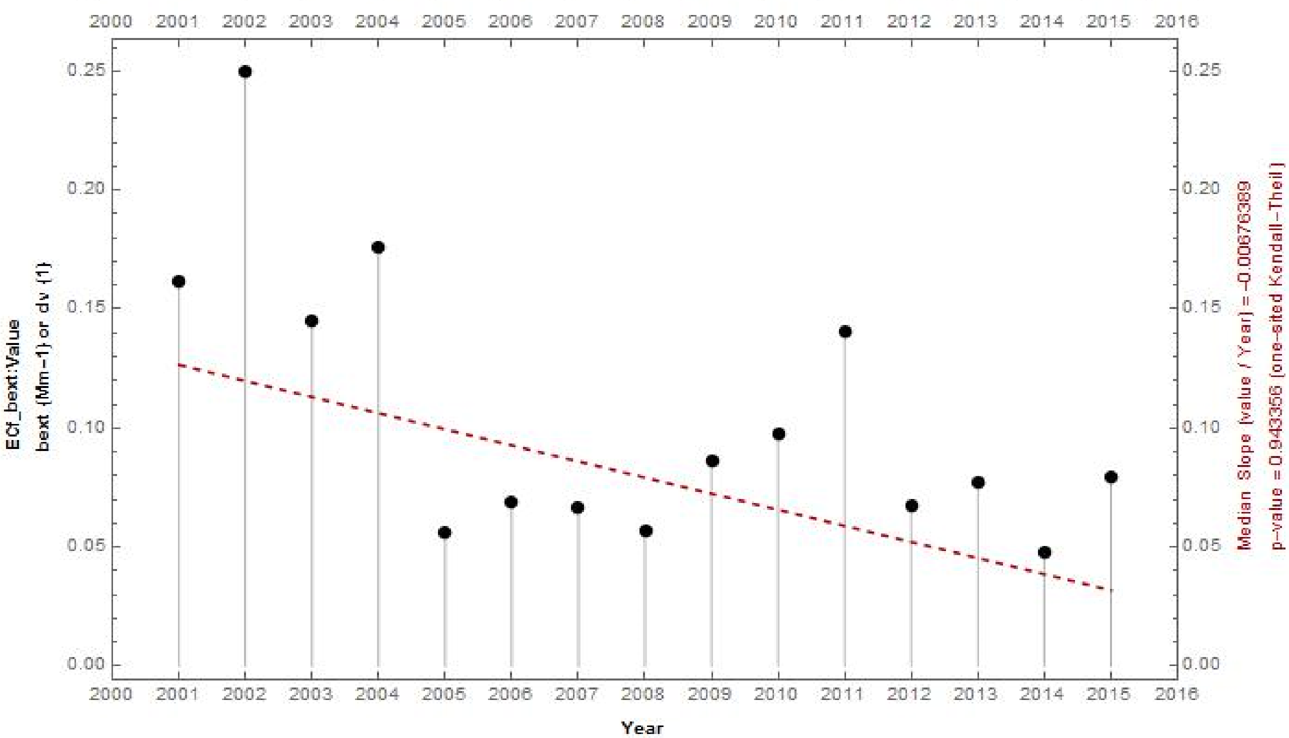
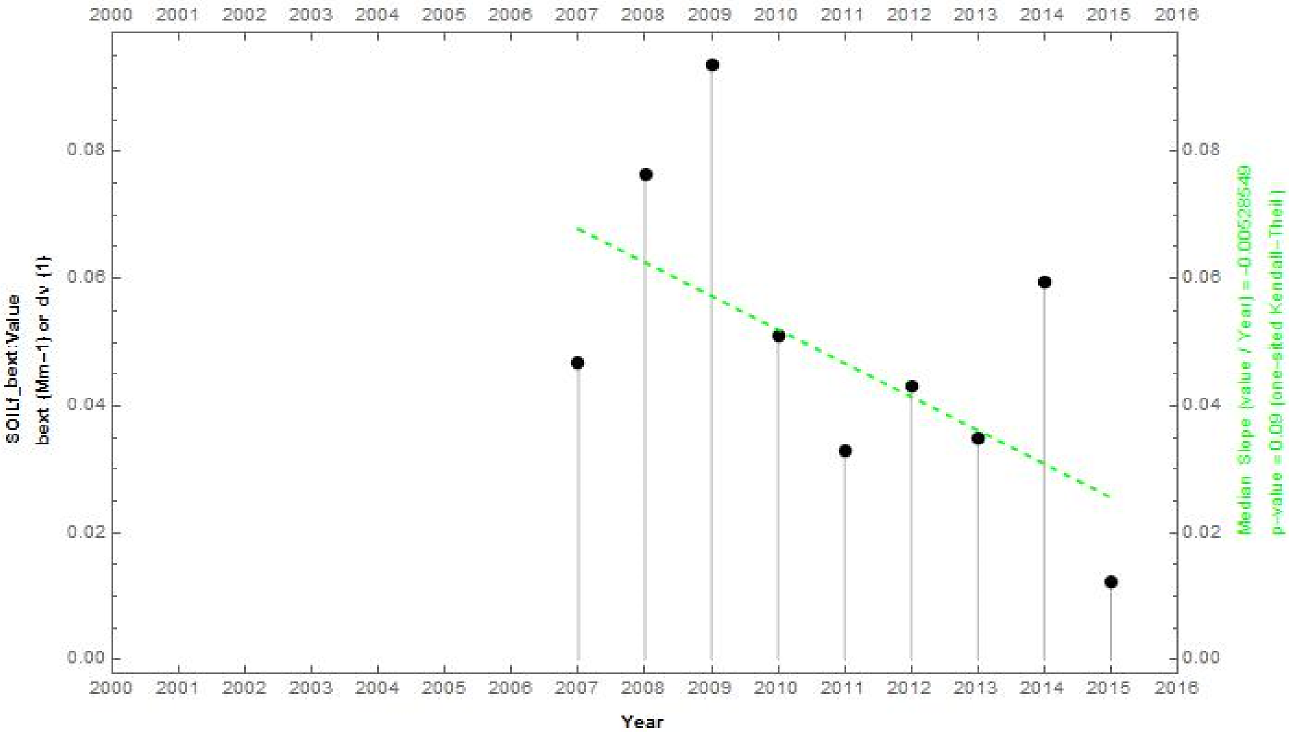


Figure D-12: HACR1 & HAVO1 Bext for EC; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

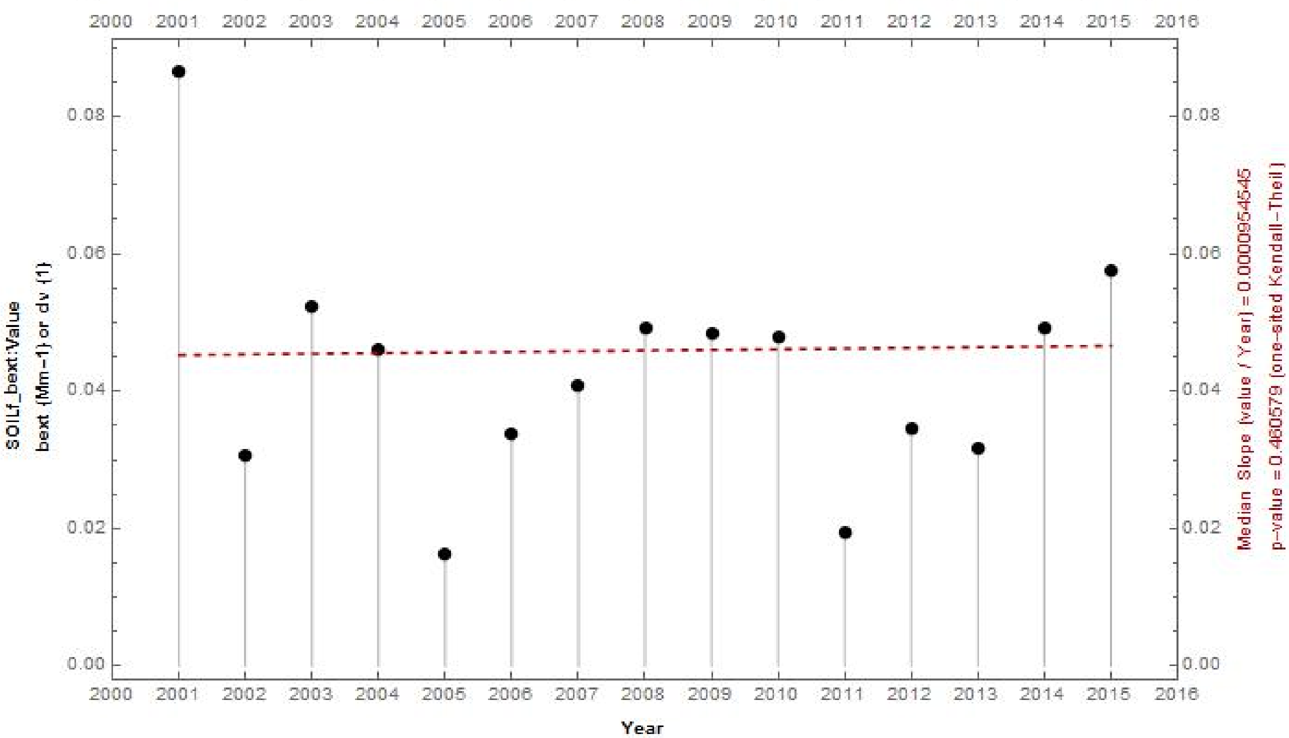
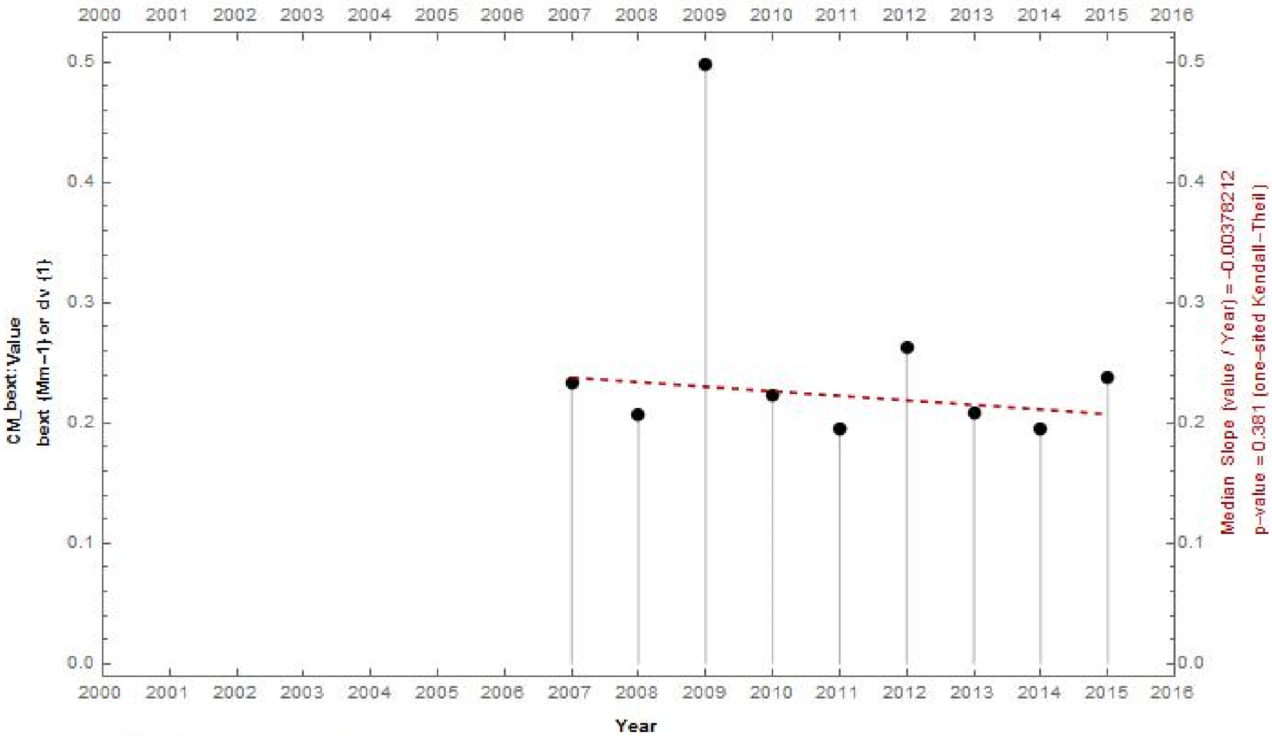


Figure D-13: HACR1 & HAVO1 Bext for Soil; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

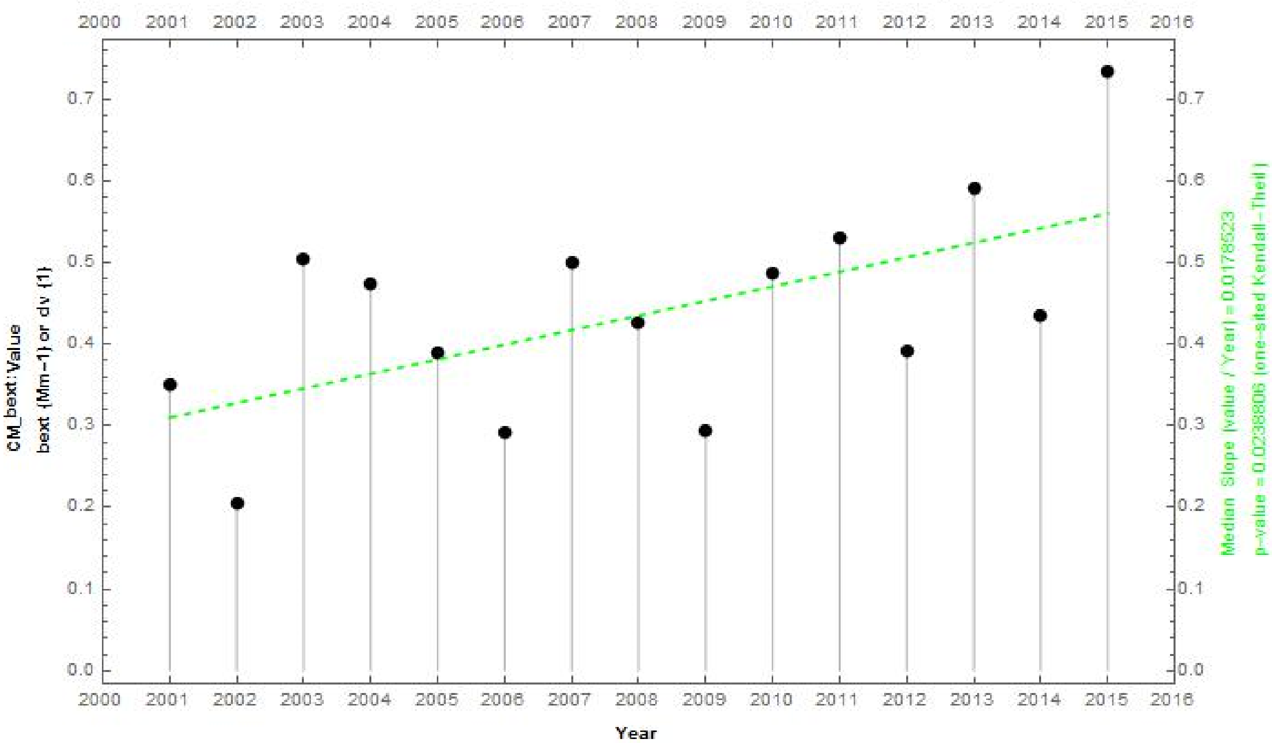
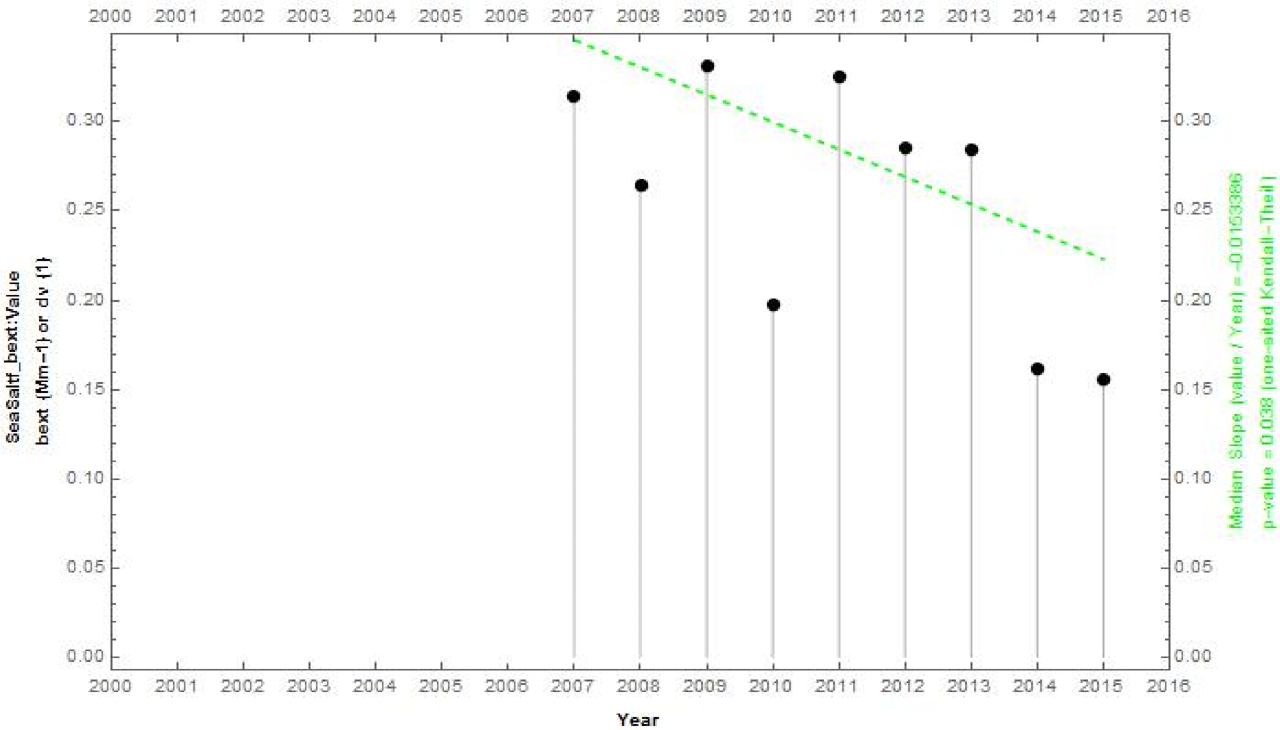


Figure D-14: HACR1 & HAVO1 Bext for CM; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

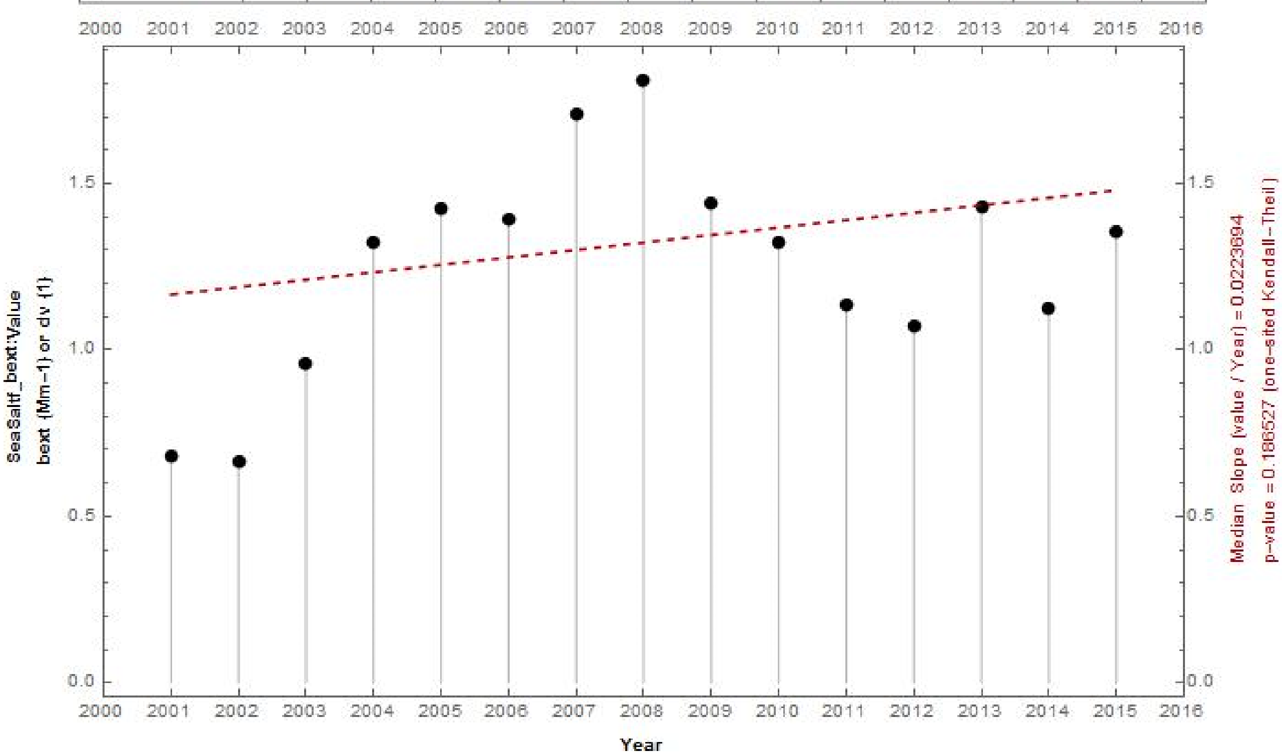
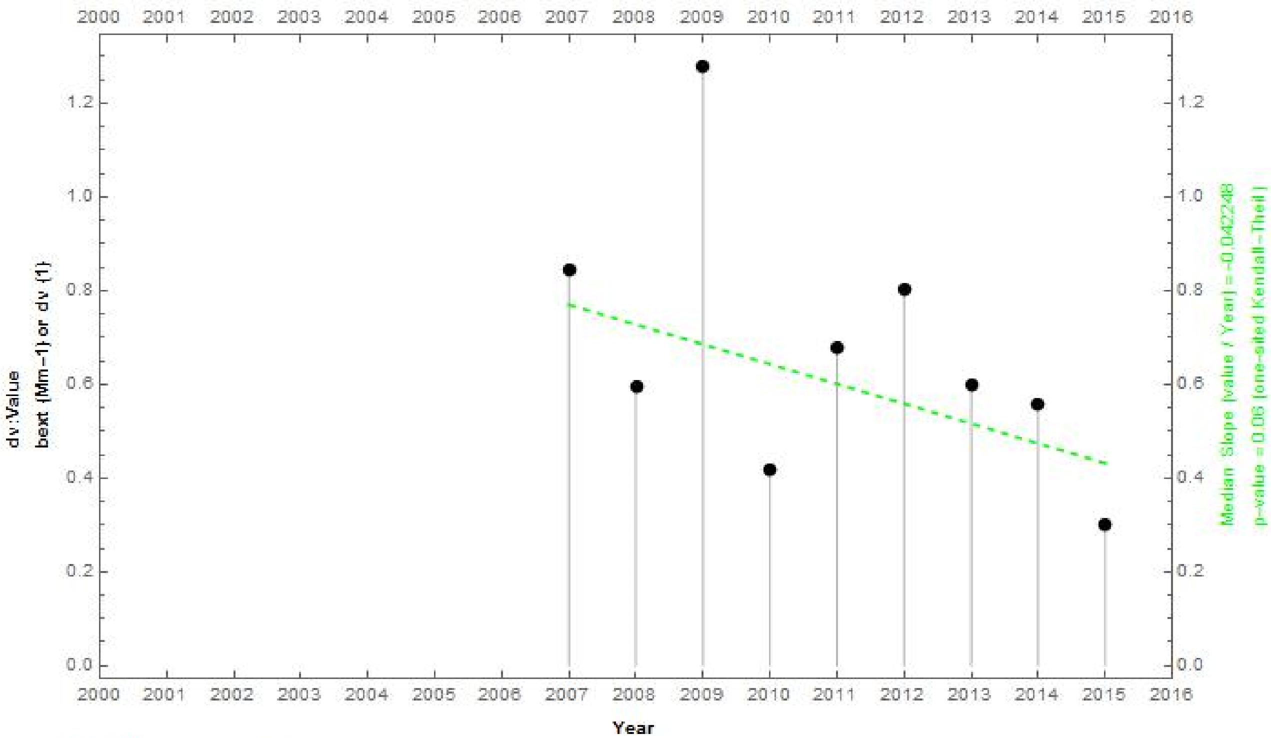


Figure D-15: HACR1 & HAVO1 Bext for Sea Salt; 20% Best Visibility Days

Site: HACR1, Quantile : {10.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	23	22	19	17	20	19
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.184	0.197	0.189	0.189	0.182	0.156	0.139	0.164	0.157



Site: HAVO1, Quantile : {10.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	21	24	23	22	22	23	24	23	23	24	23	24	24	23	21
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.172	0.197	0.190	0.180	0.180	0.189	0.198	0.189	0.189	0.197	0.190	0.197	0.197	0.189	0.174

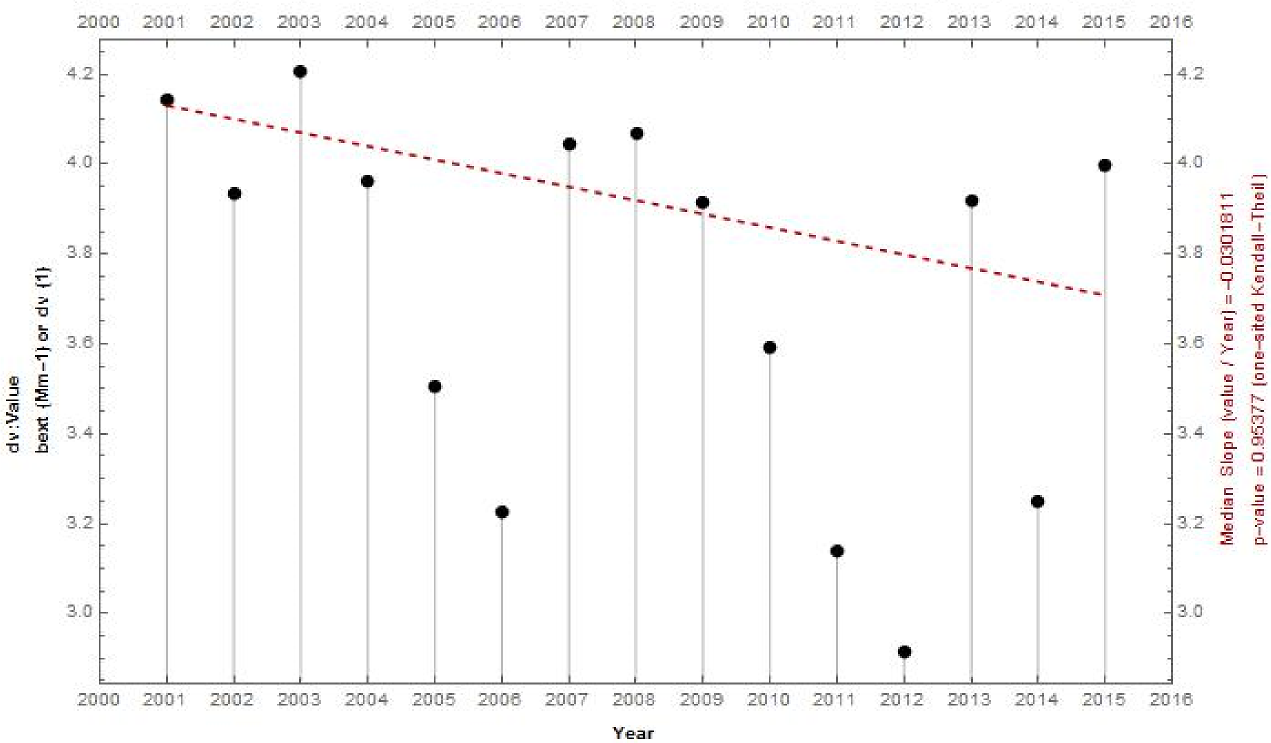
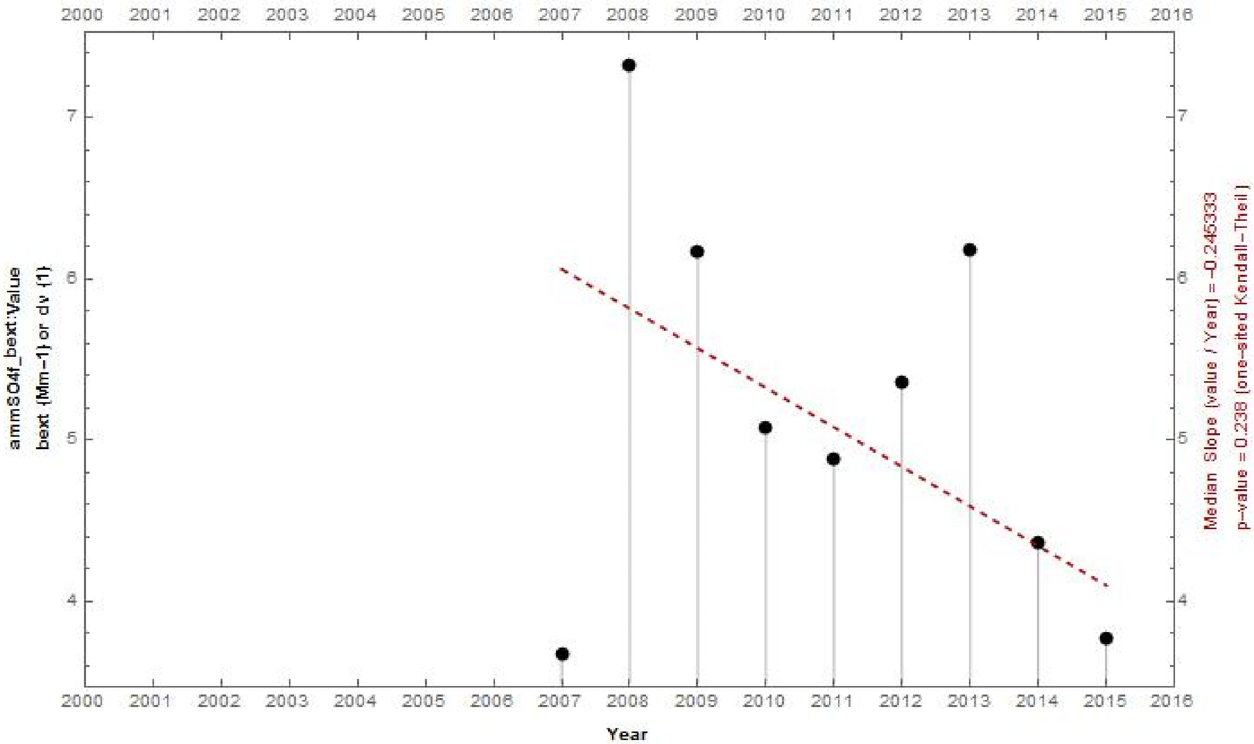


Figure D-16: HACR1 & HAVO1 Haze Index (dv); 20% Best Visibility Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

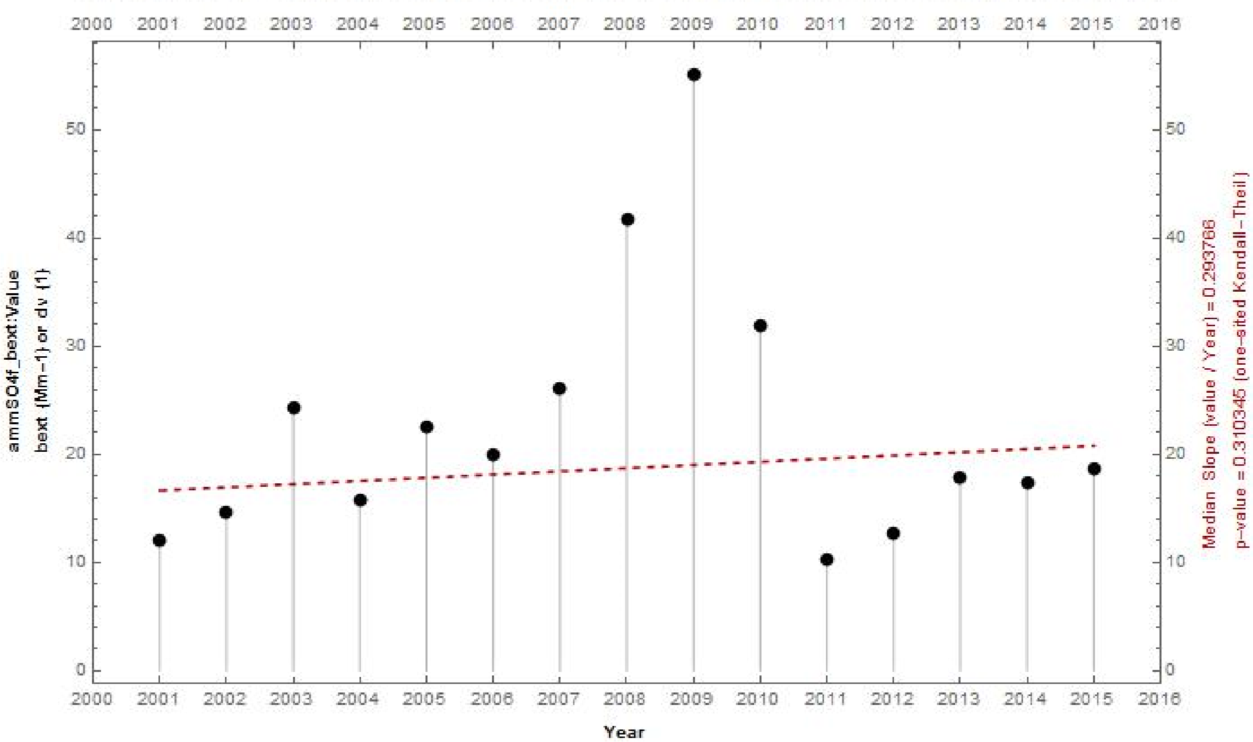
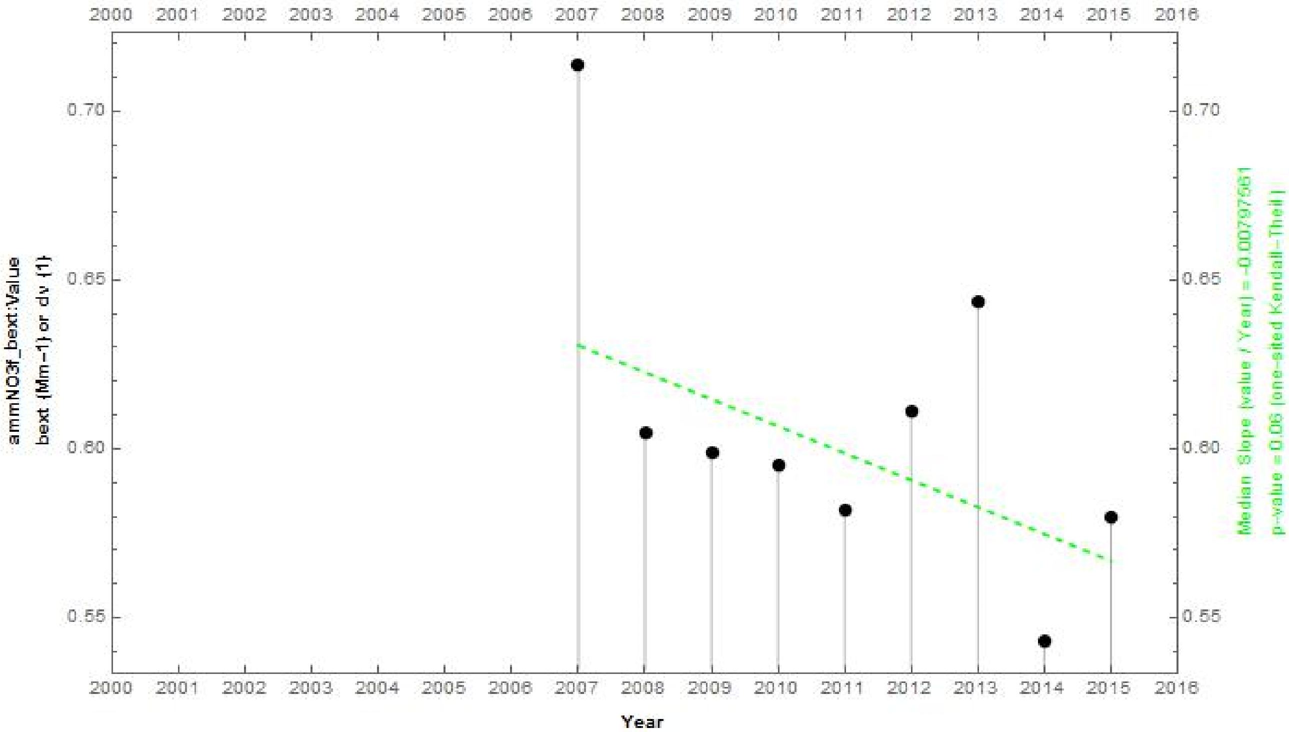


Figure D-17: HACR1 & HAVO1 Bext for Sulfates; All Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

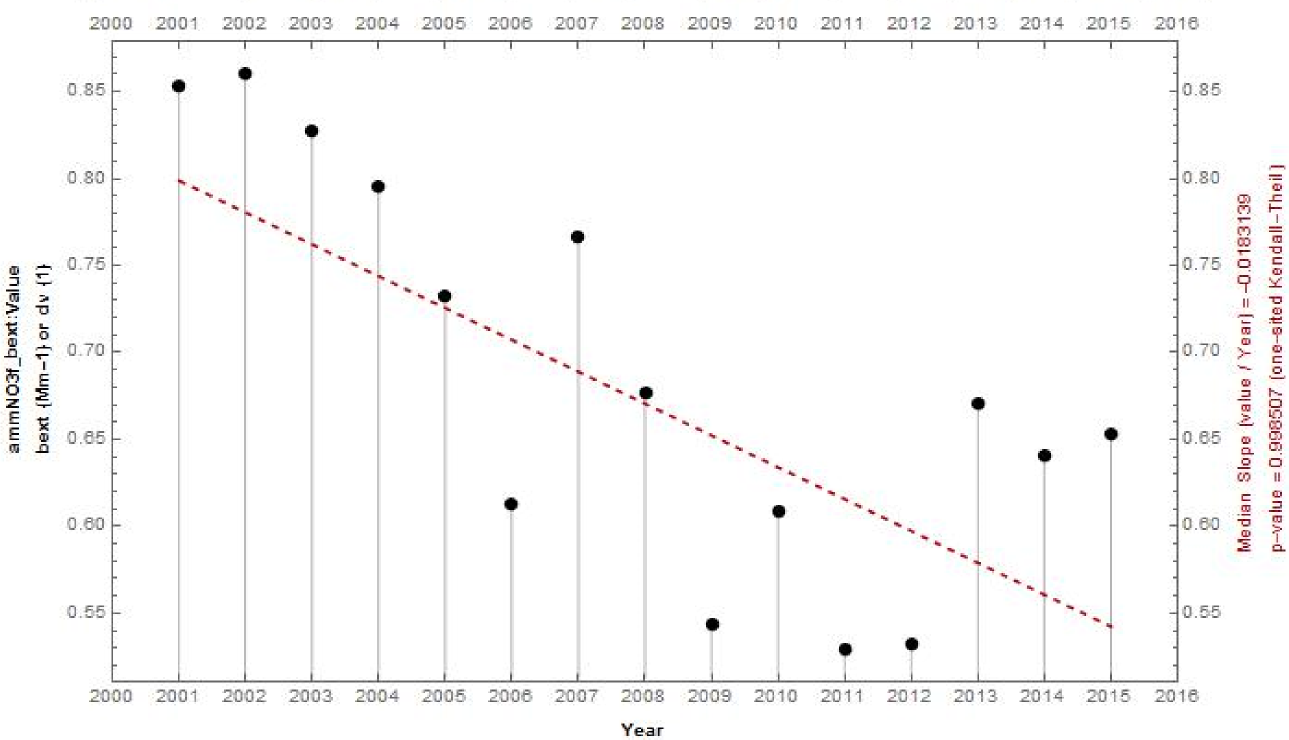
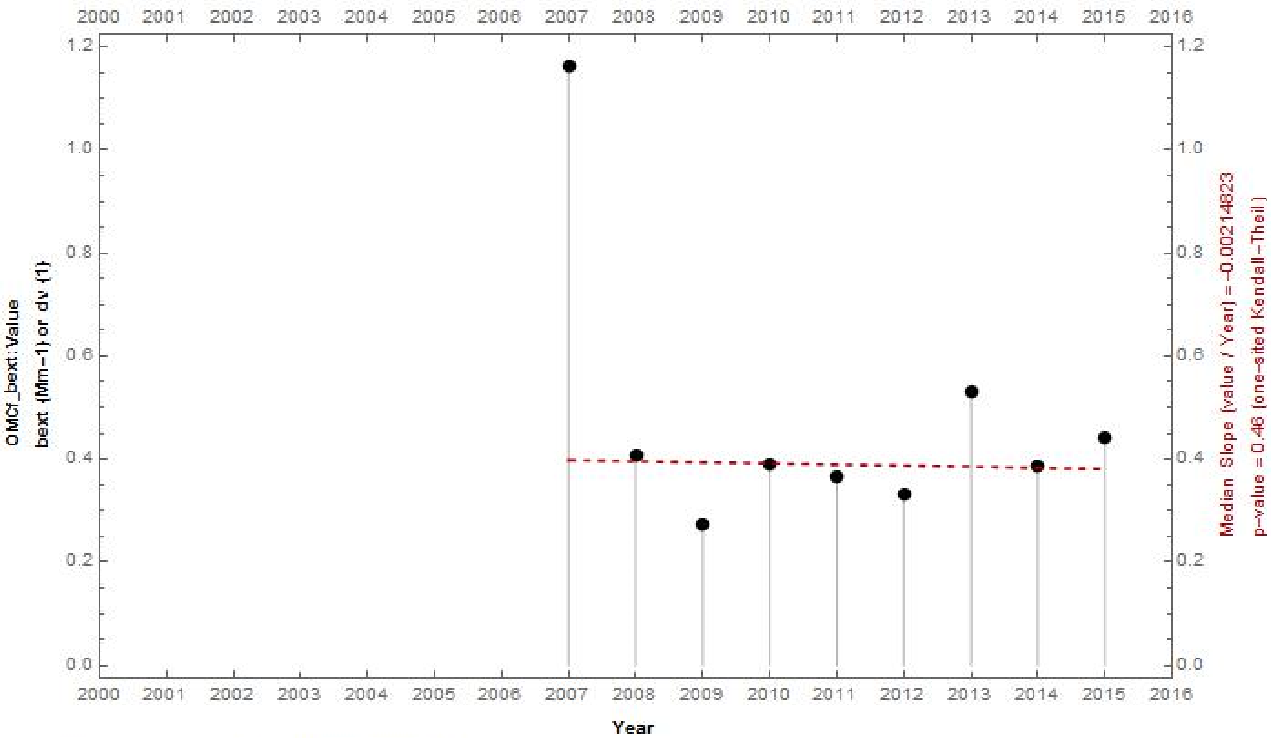


Figure D-18: HACR1 & HAVO1 Bext for Nitrates; All Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

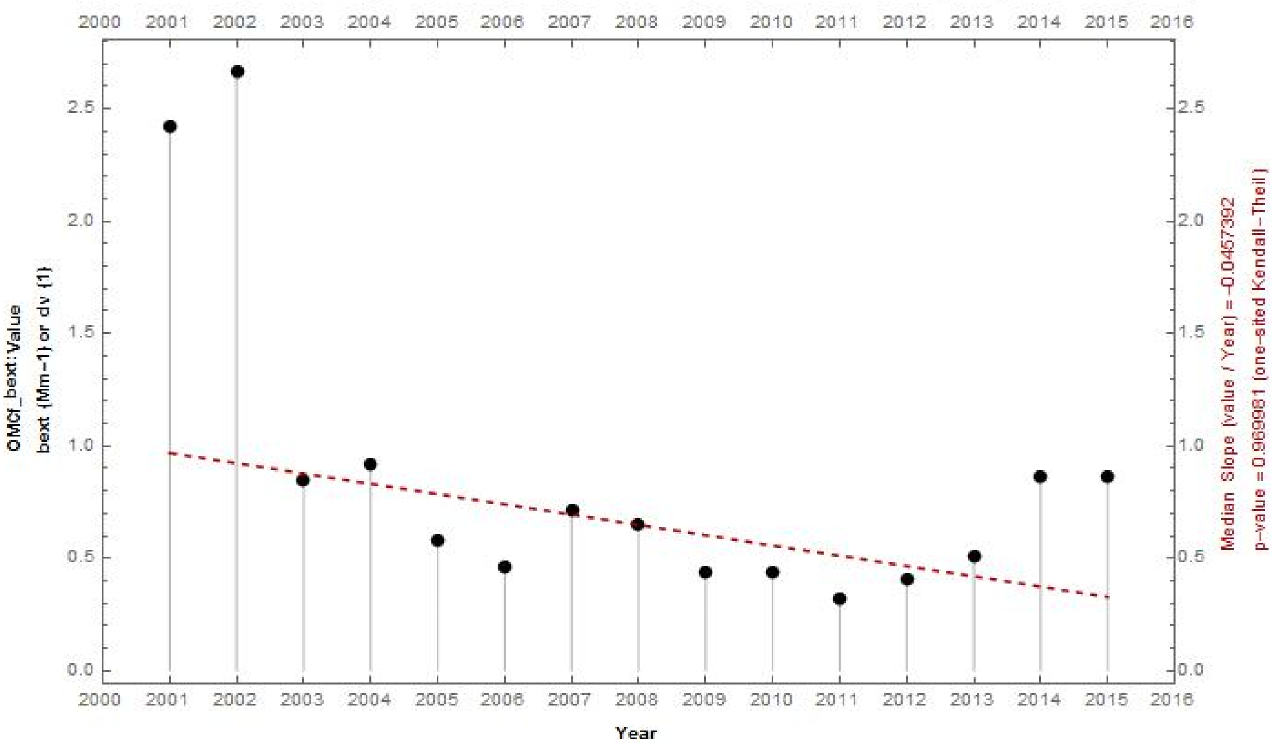
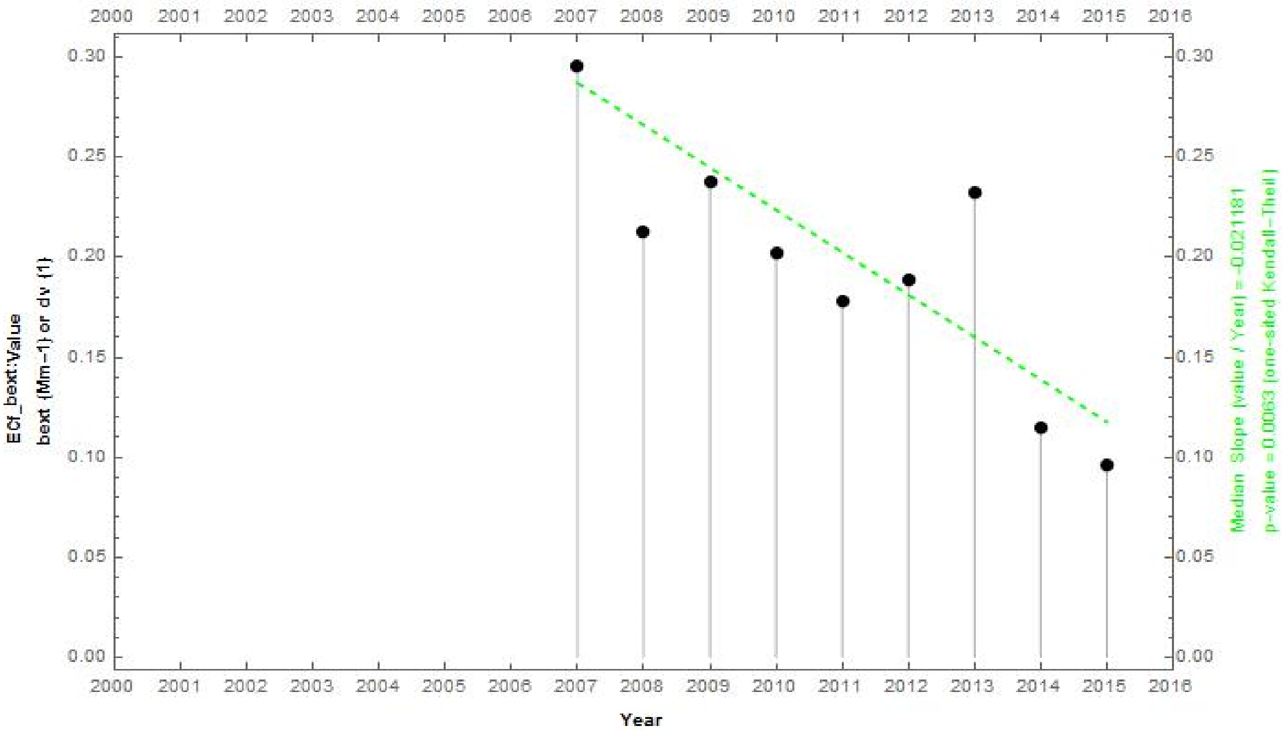


Figure D-17: HACR1 & HAVO1 Bext for POM; All Days

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

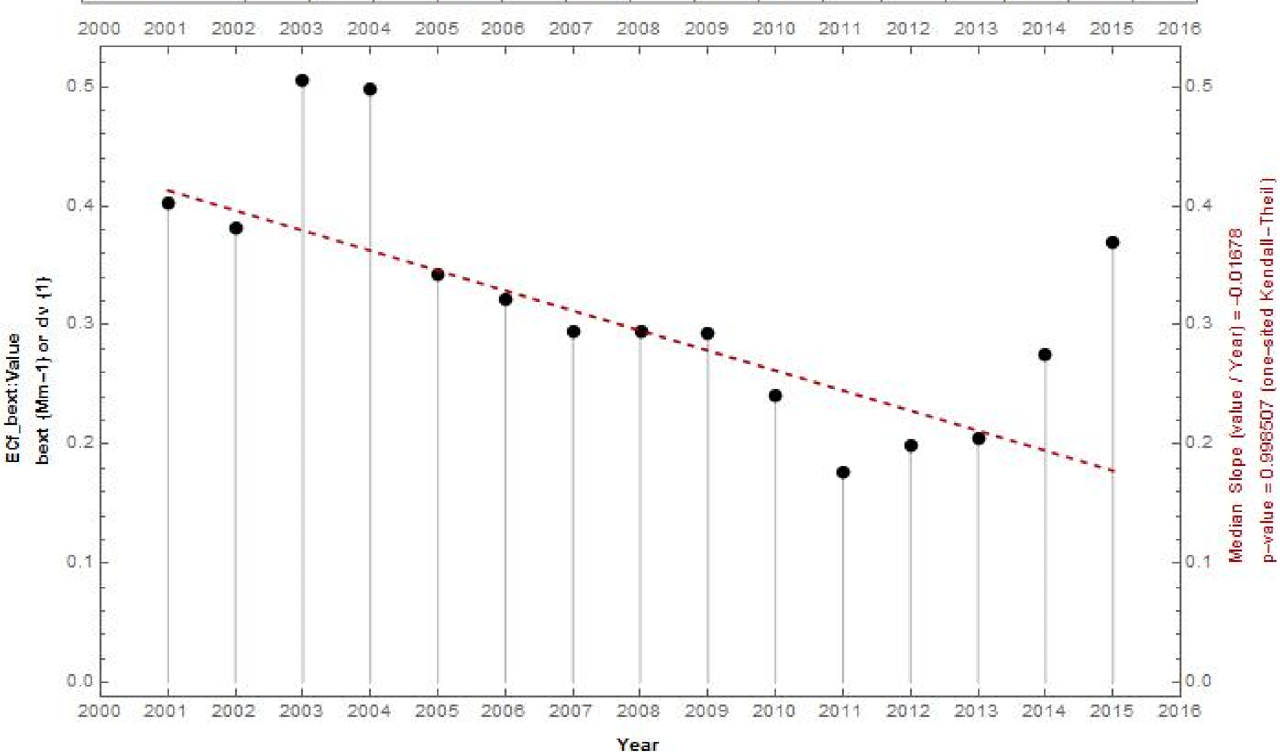
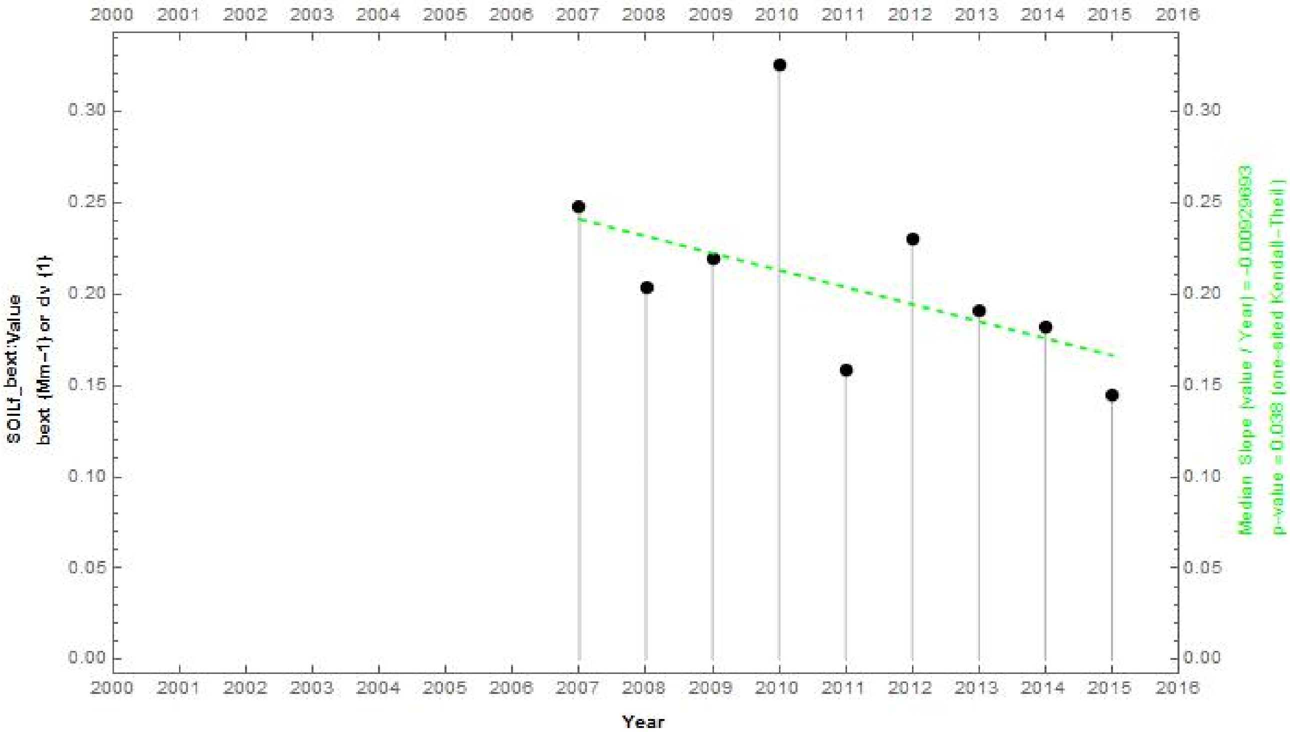


Figure D-17: HACR1 & HAVO1 Bext for EC; All Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

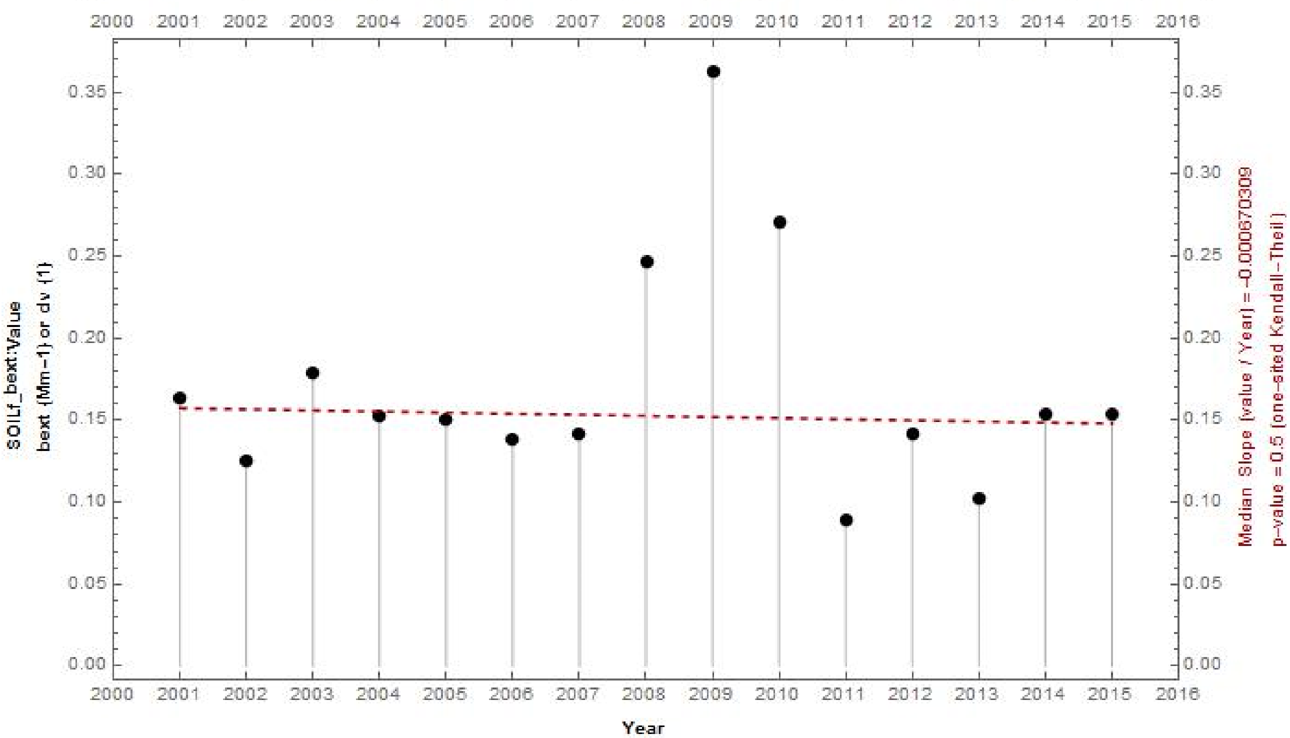
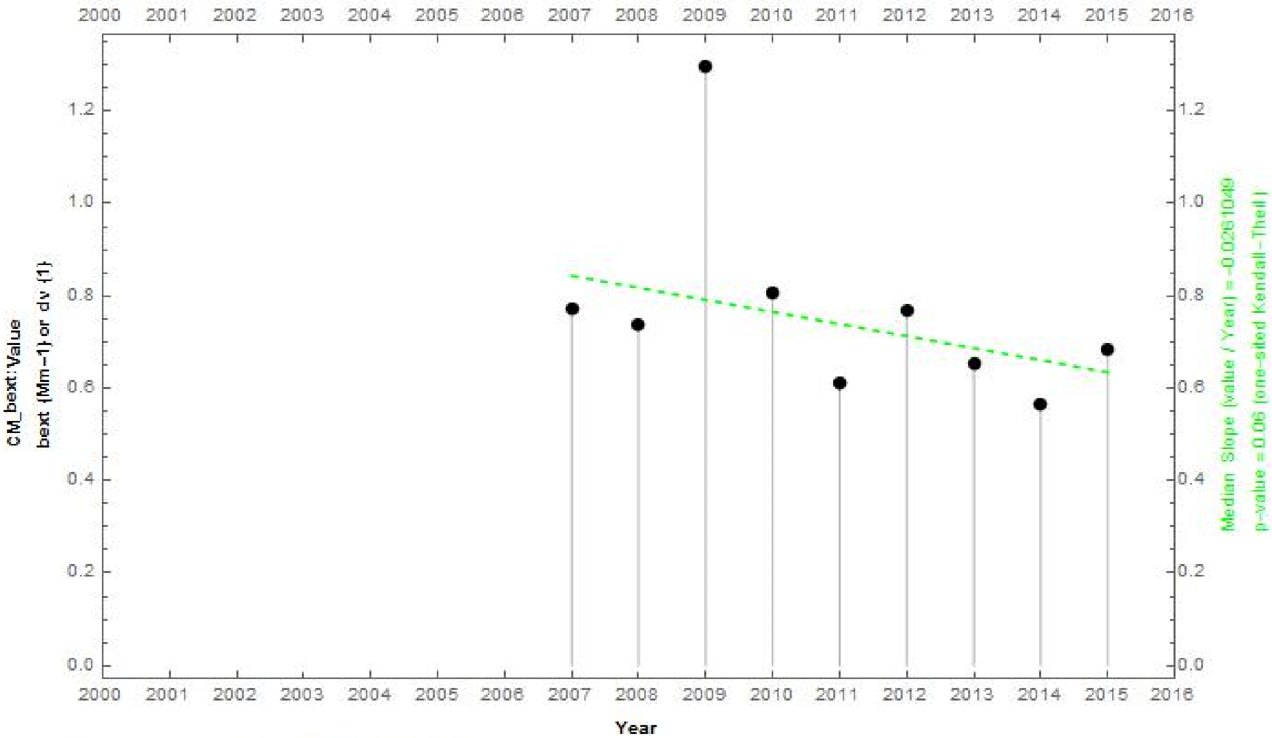


Figure D-17: HACR1 & HAVO1 Bext for Soil; All Days

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

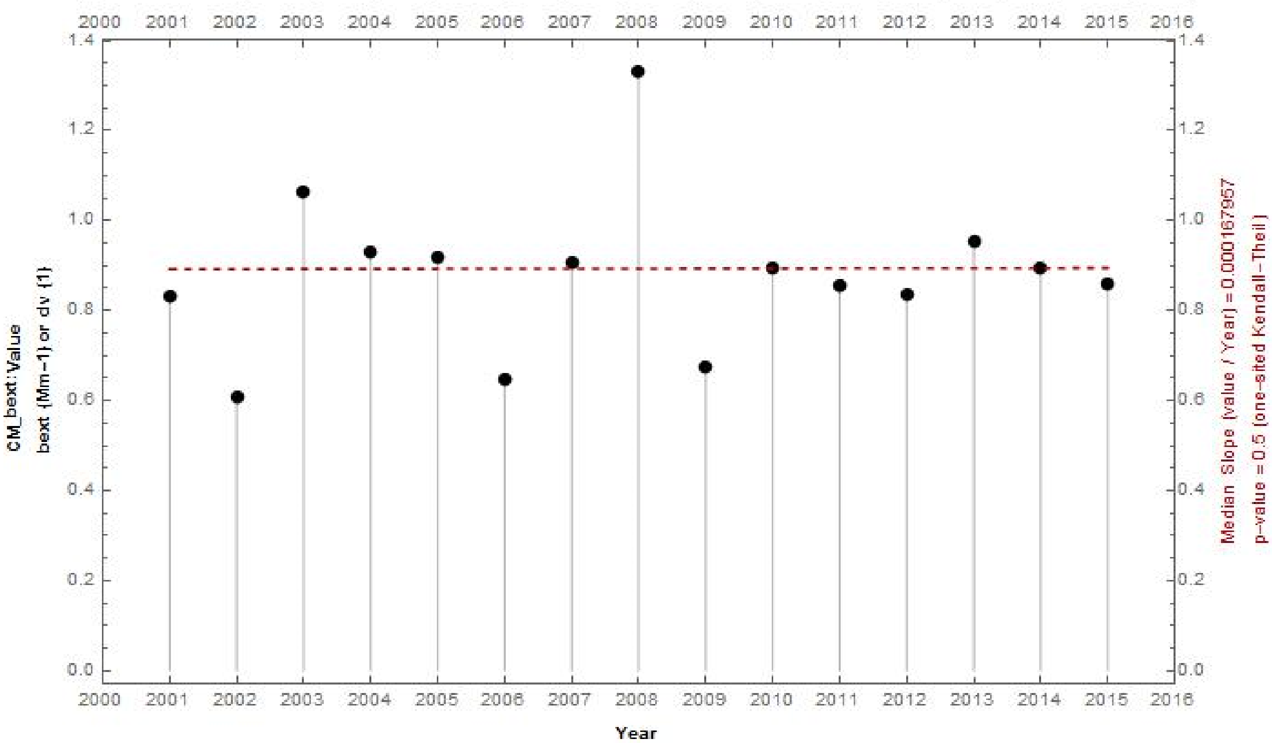
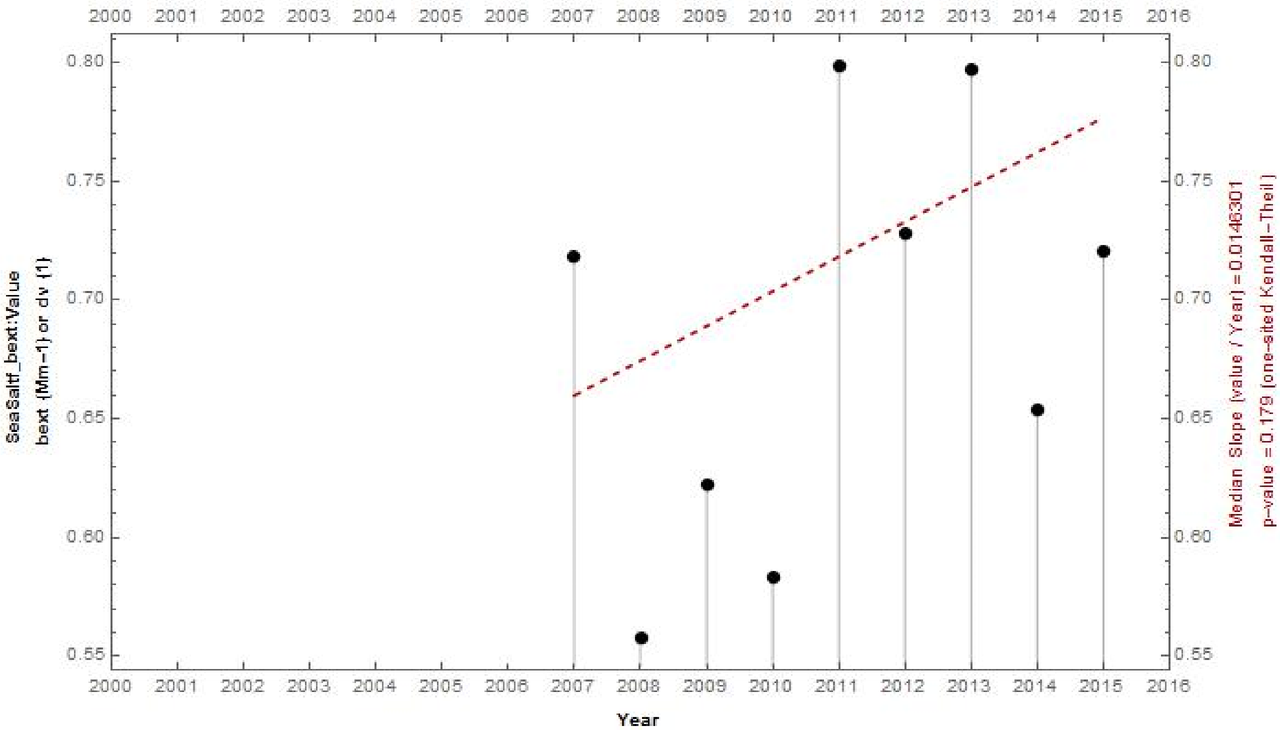


Figure D-17: HACR1 & HAVO1 Bext for CM; All Days

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

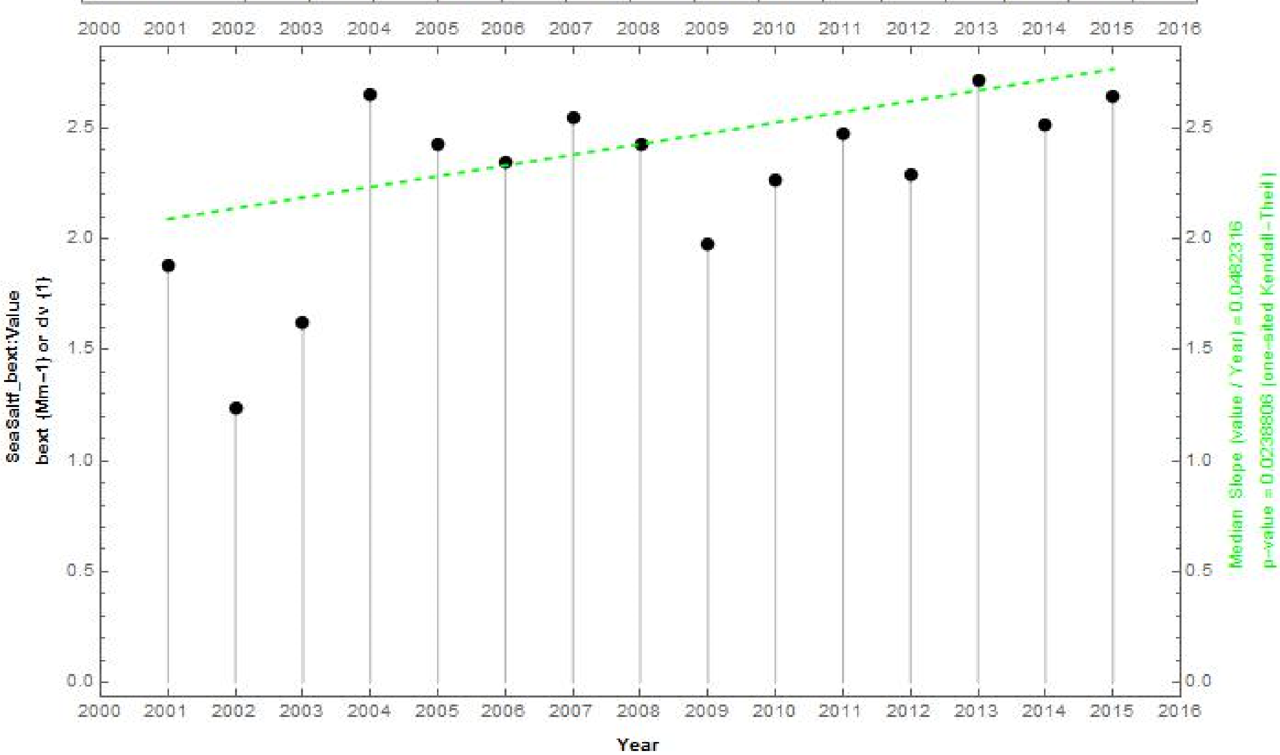
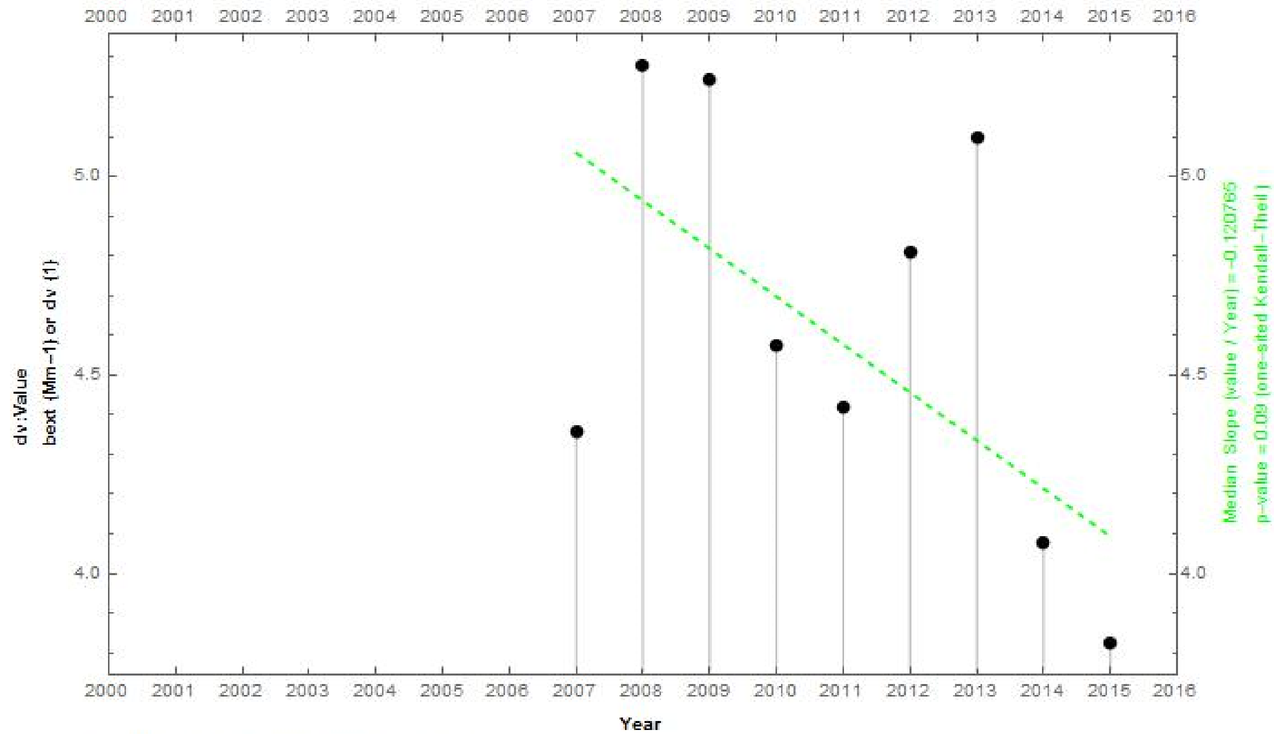


Figure D-17: HACR1 & HAVO1 Bext for Sea Salt; All Days

Data and Trends (HACR1 & HAVO1)

Site: HACR1, Quantile : {10., 30., 50., 70., 90.}

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	121	119	116	112	96	88	102	98
N-All	114	122	122	122	121	122	122	122	121
quantile-fraction	0.930	0.992	0.975	0.951	0.926	0.787	0.721	0.836	0.810



Site: HAVO1, Quantile : {10., 30., 50., 70., 90.}

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N-quant	106	120	118	112	113	118	120	115	119	122	119	122	121	116	107
N-All	122	122	121	122	122	122	121	122	122	122	121	122	122	122	121
quantile-fraction	0.869	0.984	0.975	0.918	0.926	0.967	0.992	0.943	0.975	1.00	0.983	1.00	0.992	0.951	0.884

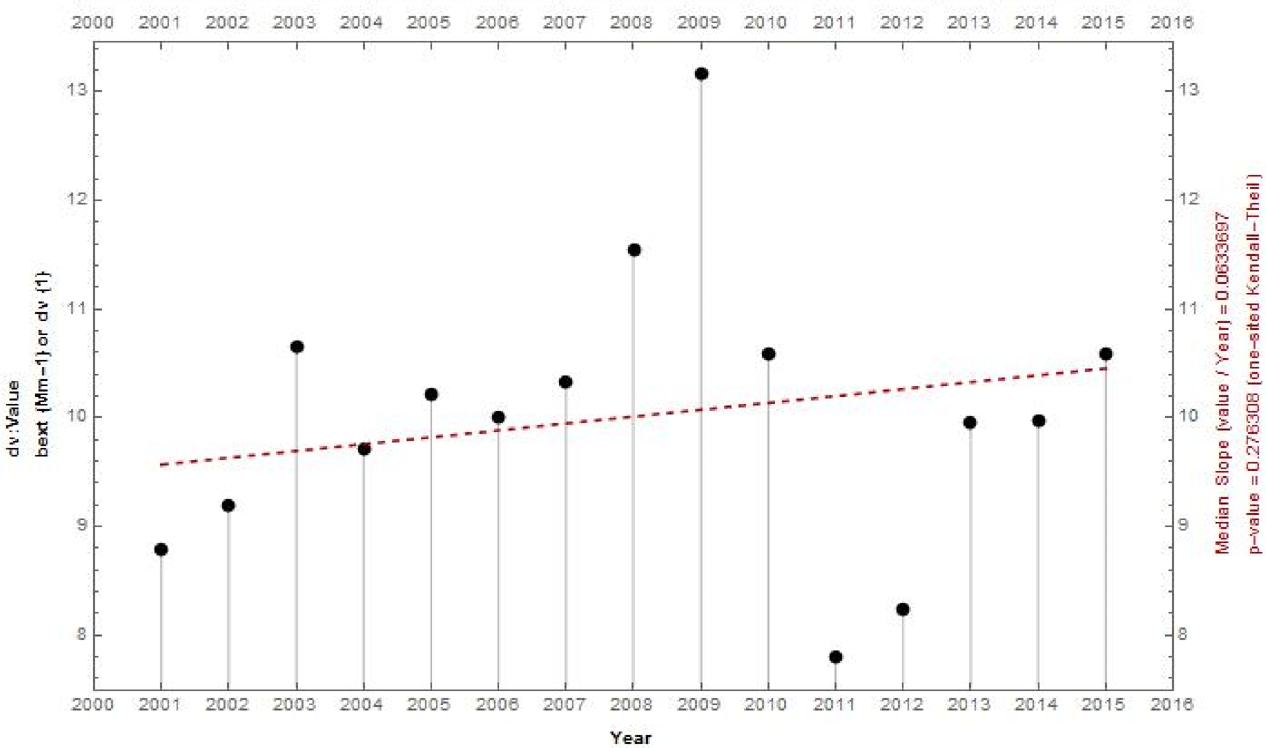


Figure D-17: HACR1 & HAVO1 Haze Index (dv); All Days

Data and Trends (HACR1 & HAVO1)

HACR1 (Median bext)		
Year	Bext for Sulfates; 20% Best Visibility Days (Mm-1)	
2007	0.971	
2008	**0.964**	*
2009	1.160	
2010	0.804	
2011	1.010	
2012	**0.964**	*
2013	0.745	
2014	0.907	
2015	0.671	
* Median bext (Mm-1)	0.964	
Theil Slope (Mm-1/yr)	-0.037	
Percent Change / yr	-3.8%	

Table D-3: HACR1 Bext for Sulfates; 20% Best Visibility Days

HACR1 (Median bext)		
Year	Bext for Sulfates; 20% Worst Visibility Days (Mm-1)	
2007	9.039	
2008	22.865	
2009	17.611	
2010	14.317	
2011	**13.687**	*
2012	13.540	
2013	19.154	
2014	10.790	
2015	10.112	
* Median bext (Mm-1)	13.687	
Theil Slope (Mm-1/yr)	-0.861	
Percent Change / yr	-6.3%	

Table D-4: HACR1 Bext for Sulfates; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

HACR1 (Median bext)		
Year	Bext for POM; 20% Best Visibility Days (Mm-1)	
2007	0.130	
2008	0.026	
2009	0.052	
2010	0.046	
2011	0.048	
2012	**0.108**	*
2013	0.168	
2014	0.134	
2015	0.110	
* Median bext (Mm-1)	0.108	
Theil Slope (Mm-1/yr)	0.011	
Percent Change / yr	10.3%	

Table D-5: HACR1 Bext for POM; 20% Best Visibility Days

HACR1 (Median bext)		
Year	Bext for EC; 20% Worst Visibility Days (Mm-1)	
2007	0.931	
2008	0.481	
2009	0.503	
2010	**0.389**	*
2011	0.380	
2012	0.336	
2013	0.472	
2014	0.229	
2015	0.189	
* Median bext (Mm-1)	0.389	
Theil Slope (Mm-1/yr)	-0.048	
Percent Change / yr	-12.4%	

Table D-6: HACR1 Bext for EC; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

HACR1 (Median bext)		
Year	Bext for Soil; 20% Best Visibility Days (Mm-1)	
2007	0.047	*
2008	0.076	
2009	0.094	
2010	0.051	
2011	0.033	
2012	0.043	
2013	0.035	
2014	0.059	
2015	0.012	
* Median bext (Mm-1)	0.047	
Theil Slope (Mm-1/yr)	-0.005	
Percent Change / yr	-11.3%	

Table D-7: HACR1 Bext for Soil; 20% Best Visibility Days

HACR1 (Median bext)		
Year	Bext for Soil; 20% Worst Visibility Days (Mm-1)	
2007	0.536	
2008	0.427	
2009	0.359	
2010	0.703	
2011	0.319	
2012	0.541	
2013	0.417	
2014	0.422	*
2015	0.247	
* Median bext (Mm-1)	0.422	
Theil Slope (Mm-1/yr)	-0.020	
Percent Change / yr	-4.7%	

Table D-8: HACR1 Bext for Soil; 20% Worst Visibility Days

HAVO1 (Median bext)		
Year	Bext for CM; 20% Best Visibility Days (Mm-1)	
2001	0.350	
2002	0.206	
2003	0.504	
2004	0.473	
2005	0.390	
2006	0.292	
2007	0.499	
2008	0.427	
2009	0.293	
2010	0.487	
2011	0.531	
2012	0.393	
2013	0.590	
2014	**0.435**	*
2015	0.734	
* Median bext (Mm-1)	0.435	
Theil Slope (Mm-1/yr)	0.018	
Percent Change / yr	4.1%	

Table D-9: HAVO1 Bext for CM; 20% Best Visibility Days

HAVO1 (Median bext)		
Year	Bext for Sea Salt; 20% Worst Visibility Days (Mm-1)	
2001	2.332	
2002	0.427	
2003	0.065	
2004	1.437	
2005	1.517	
2006	**1.472**	*
2007	1.238	
2008	1.455	
2009	0.772	
2010	0.824	
2011	2.525	
2012	1.970	
2013	1.646	
2014	2.168	
2015	1.528	
* Median bext (Mm-1)	1.472	
Theil Slope (Mm-1/yr)	0.052	
Percent Change / yr	3.5%	

Table D-10: HAVO1 Bext for Sea Salt; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

HACR1 (Median bext)		
Year	Bext for Sea Salt; 20% Best Visibility Days (Mm-1)	
2007	0.314	
2008	0.265	
2009	0.331	
2010	0.198	
2011	0.325	
2012	0.286	
2013	**0.285**	*
2014	0.161	
2015	0.155	
* Median bext (Mm-1)	0.285	
Theil Slope (Mm-1/yr)	-0.015	
Percent Change / yr	-5.4%	

Table D-11: HACR1 Bext for Sea Salt; 20% Best Visibility Days

HACR1 (Median bext)		
Year	Bext for Sea Salt; 20% Worst Visibility Days (Mm-1)	
2007	**1.011**	*
2008	0.599	
2009	0.617	
2010	0.745	
2011	1.061	
2012	1.054	
2013	0.819	
2014	1.367	
2015	1.391	
* Median bext (Mm-1)	1.011	
Theil Slope (Mm-1/yr)	0.092	
Percent Change / yr	9.1%	

Table D-12: HACR1 Bext for Sea Salt; 20% Worst Visibility Days

Data and Trends (HACR1 & HAVO1)

HACR1 (Median bext)		
Year	Haze Index (dv); 20% Best Visibility Days (1)	
2007	0.846	
2008	0.595	
2009	1.278	
2010	0.419	
2011	0.677	
2012	0.802	
2013	**0.601**	*
2014	0.559	
2015	0.299	
* Median dv (1)	0.601	
Theil Slope (1/yr)	-0.042	
Percent Change / yr	-7.0%	

Table D-13: Haze Index (dv); 20% Best Visibility Days

HACR1 (Median bext)		
Year	Haze Index (dv); 20% Worst Visibility Days (1)	
2007	9.340	
2008	12.118	
2009	10.926	
2010	10.021	
2011	9.464	
2012	**9.855**	*
2013	11.360	
2014	8.926	
2015	8.667	
* Median dv (1)	9.855	
Theil Slope (1/yr)	-0.265	
Percent Change / yr	-2.7%	

Table D-14: Haze Index (dv); 20% Worst Visibility Days

Appendix E: IMPROVE Data Review

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.101	140.125	154.750	183.077	4.158	0.533
HALE1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.259	104.909	145.364	135.757	4.689	0.526
HAVO1	Average	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.637	146.133	147.733	151.445	4.542	0.523
HACR1	Average	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.876	136.250	154.750	34.798	2.665	0.378
HALE1	Average	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.168	86.727	145.364	38.098	3.077	0.377
HAVO1	Average	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.062	126.600	147.733	36.537	2.909	0.380
HACR1	Average	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.592	144.375	154.750	16.603	1.749	0.242
HALE1	Average	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.470	88.455	145.364	22.803	2.010	0.293
HAVO1	Average	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.867	122.667	147.733	20.204	1.907	0.278
HACR1	Average	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.311	151.000	154.750	10.820	1.170	0.163
HALE1	Average	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.935	95.091	145.364	15.571	1.352	0.196
HAVO1	Average	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.576	127.733	147.733	13.872	1.287	0.183
HACR1	Average	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.115	152.625	154.750	6.084	0.655	0.073
HALE1	Average	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.472	104.000	145.364	8.364	0.786	0.087
HAVO1	Average	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.284	126.267	147.733	7.545	0.743	0.084

Table E-1: Hawaii IMPROVE site Nitrate Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	13.995	77.500	154.750	125.983	13.621	3.047
HALE1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	23.283	60.182	145.364	185.619	15.267	3.230
HAVO1	Average	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	85.548	19.200	147.733	152.188	13.984	3.116
HACR1	Average	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	5.144	113.375	154.750	53.857	8.995	2.807
HALE1	Average	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	8.366	81.818	145.364	74.585	10.163	2.826
HAVO1	Average	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	15.107	53.467	147.733	64.642	9.427	2.829
HACR1	Average	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	3.099	133.500	154.750	37.417	6.548	2.192
HALE1	Average	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.776	85.182	145.364	49.937	7.249	2.174
HAVO1	Average	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.235	78.333	147.733	44.303	6.845	2.125
HACR1	Average	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.923	141.625	154.750	27.899	4.363	1.365
HALE1	Average	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.841	87.091	145.364	34.492	4.909	1.425
HAVO1	Average	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.829	86.133	147.733	31.134	4.603	1.383
HACR1	Average	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.932	145.750	154.750	17.110	2.462	0.612
HALE1	Average	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.089	90.364	145.364	21.585	2.794	0.697
HAVO1	Average	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.037	88.733	147.733	19.377	2.628	0.635

Table E-2: Hawaii IMPROVE site Sulfate Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.430	153.375	154.750	21.441	2.672	0.337
HALE1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.208	134.818	145.364	23.631	3.127	0.627
HAVO1	Average	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.750	145.200	147.733	22.127	2.953	0.535
HACR1	Average	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.222	154.000	154.750	13.191	1.464	0.192
HALE1	Average	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.927	127.727	145.364	14.583	1.819	0.341
HAVO1	Average	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.360	146.333	147.733	13.380	1.674	0.293
HACR1	Average	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.159	153.875	154.750	10.450	1.095	0.136
HALE1	Average	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.612	130.818	145.364	11.382	1.365	0.193
HAVO1	Average	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.221	145.533	147.733	10.175	1.257	0.177
HACR1	Average	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.094	153.875	154.750	7.807	0.823	0.084
HALE1	Average	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.377	131.909	145.364	9.298	1.031	0.142
HAVO1	Average	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.154	145.467	147.733	8.151	0.941	0.123
HACR1	Average	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.038	154.125	154.750	5.429	0.508	0.032
HALE1	Average	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.180	133.273	145.364	6.528	0.683	0.066
HAVO1	Average	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.105	142.200	147.733	5.704	0.610	0.056

Table E-3: Hawaii IMPROVE site EC Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.352	146.500	154.750	21.743	3.865	0.808
HALE1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.148	120.364	145.364	21.339	3.564	0.761
HAVO1	Average	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.872	145.467	147.733	21.634	3.682	0.764
HACR1	Average	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.002	148.250	154.750	16.066	2.844	0.650
HALE1	Average	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.194	95.273	145.364	15.161	2.758	0.659
HAVO1	Average	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.288	132.800	147.733	15.817	2.806	0.675
HACR1	Average	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.781	142.000	154.750	15.711	2.234	0.430
HALE1	Average	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.806	87.727	145.364	14.290	2.164	0.439
HAVO1	Average	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.033	125.867	147.733	15.084	2.165	0.440
HACR1	Average	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.479	140.625	154.750	11.871	1.613	0.232
HALE1	Average	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.412	79.455	145.364	10.783	1.610	0.204
HAVO1	Average	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.753	116.867	147.733	11.532	1.585	0.208
HACR1	Average	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.256	138.875	154.750	8.142	0.939	0.098
HALE1	Average	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.936	76.000	145.364	7.555	0.974	0.089
HAVO1	Average	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.461	110.867	147.733	7.923	0.949	0.090

Table E-4: Hawaii IMPROVE site CM Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.164	153.250	154.750	94.733	10.782	0.703
HALE1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.509	142.364	145.364	80.540	11.988	1.131
HAVO1	Average	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.533	146.467	147.733	82.670	11.483	1.032
HACR1	Average	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.552	154.375	154.750	25.868	5.090	0.462
HALE1	Average	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	2.028	140.000	145.364	27.633	5.773	0.673
HAVO1	Average	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.119	145.867	147.733	26.585	5.520	0.634
HACR1	Average	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.348	154.500	154.750	17.165	3.437	0.313
HALE1	Average	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.413	139.000	145.364	19.044	3.872	0.499
HAVO1	Average	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.717	145.467	147.733	17.638	3.699	0.456
HACR1	Average	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.176	154.625	154.750	11.599	2.441	0.173
HALE1	Average	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.042	131.727	145.364	13.220	2.740	0.294
HAVO1	Average	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.578	142.333	147.733	12.191	2.613	0.281
HACR1	Average	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.082	154.500	154.750	7.532	1.439	0.073
HALE1	Average	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.604	125.000	145.364	8.531	1.630	0.114
HAVO1	Average	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.416	137.533	147.733	8.034	1.548	0.110

Table E-5: Hawaii IMPROVE site POM Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.981	36.625	154.750	27.629	0.294	0.016
HALE1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.787	16.000	145.364	25.404	0.216	0.008
HAVO1	Average	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.431	26.333	147.733	26.108	0.242	0.012
HACR1	Average	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.882	34.625	154.750	17.142	0.240	0.009
HALE1	Average	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.423	12.455	145.364	15.813	0.189	0.004
HAVO1	Average	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.379	9.667	147.733	16.542	0.209	0.006
HACR1	Average	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.740	34.500	154.750	11.444	0.235	0.008
HALE1	Average	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.179	12.182	145.364	10.651	0.206	0.005
HAVO1	Average	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.048	9.067	147.733	10.882	0.208	0.005
HACR1	Average	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.486	40.125	154.750	7.693	0.199	0.005
HALE1	Average	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.892	12.818	145.364	6.786	0.177	0.003
HAVO1	Average	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.199	11.333	147.733	7.082	0.179	0.003
HACR1	Average	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.254	52.375	154.750	4.298	0.143	0.004
HALE1	Average	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.362	13.182	145.364	3.892	0.130	0.003
HAVO1	Average	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.261	14.000	147.733	4.167	0.127	0.003

Table E-6: Hawaii IMPROVE site Sea Salt Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.444	129.125	154.750	8.722	0.879	0.146
HALE1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.343	136.000	145.364	8.512	0.883	0.159
HAVO1	Average	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.376	129.267	147.733	8.313	0.895	0.146
HACR1	Average	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.273	131.375	154.750	4.849	0.682	0.093
HALE1	Average	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.293	125.818	145.364	4.568	0.676	0.110
HAVO1	Average	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.221	135.267	147.733	4.557	0.678	0.105
HACR1	Average	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.185	134.625	154.750	3.575	0.484	0.058
HALE1	Average	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.204	123.818	145.364	3.548	0.502	0.072
HAVO1	Average	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.130	138.600	147.733	3.536	0.489	0.068
HACR1	Average	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.104	137.000	154.750	2.857	0.322	0.037
HALE1	Average	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.151	120.636	145.364	2.715	0.336	0.046
HAVO1	Average	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.083	137.133	147.733	2.685	0.322	0.041
HACR1	Average	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.051	135.875	154.750	1.595	0.170	0.014
HALE1	Average	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.094	111.273	145.364	1.627	0.184	0.020
HAVO1	Average	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.040	137.933	147.733	1.627	0.175	0.017

Table E-7: Hawaii IMPROVE site Soil Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	19.466	141.875	154.750	283.743	49.028	13.752
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	33.537	103.091	145.364	264.526	52.311	15.173
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	91.148	46.200	147.733	271.275	50.315	14.683
HACR1	Average	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	8.952	152.875	154.750	108.445	25.162	7.716
HALE1	Average	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	18.399	98.909	145.364	131.582	27.456	7.863
HAVO1	Average	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	22.536	86.467	147.733	121.918	26.206	7.768
HACR1	Average	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	5.904	152.750	154.750	78.888	17.673	5.397
HALE1	Average	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.461	96.182	145.364	95.413	19.456	5.323
HAVO1	Average	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.251	103.733	147.733	86.429	18.551	5.173
HACR1	Average	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.574	153.000	154.750	58.705	12.139	3.086
HALE1	Average	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.650	95.364	145.364	69.574	13.517	3.256
HAVO1	Average	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.172	104.467	147.733	63.530	12.908	3.108
HACR1	Average	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.728	151.875	154.750	38.616	7.024	1.310
HALE1	Average	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.738	93.273	145.364	45.508	7.962	1.501
HAVO1	Average	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.604	103.067	147.733	41.929	7.541	1.374

Table E-8: Hawaii IMPROVE site Aerosol Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	28.466	143.625	154.750	294.743	59.962	23.184
HALE1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	43.537	102.818	145.364	275.526	62.949	24.313
HAVO1	Average	ANN_1YR_G90_902_#	total_bext	1/Mm	101.148	46.933	147.733	282.275	61.052	23.844
HACR1	Average	ANN_1YR_G70_902_#	total_bext	1/Mm	17.952	152.750	154.750	119.445	35.827	17.149
HALE1	Average	ANN_1YR_G70_902_#	total_bext	1/Mm	28.399	98.818	145.364	142.744	38.430	17.984
HAVO1	Average	ANN_1YR_G70_902_#	total_bext	1/Mm	32.536	87.267	147.733	133.037	37.088	17.664
HACR1	Average	ANN_1YR_G50_902_#	total_bext	1/Mm	14.904	153.625	154.750	89.888	28.433	14.592
HALE1	Average	ANN_1YR_G50_902_#	total_bext	1/Mm	23.461	96.273	145.364	106.595	30.211	15.142
HAVO1	Average	ANN_1YR_G50_902_#	total_bext	1/Mm	22.251	103.400	147.733	97.563	29.319	14.891
HACR1	Average	ANN_1YR_G30_902_#	total_bext	1/Mm	12.574	153.375	154.750	69.705	22.910	12.088
HALE1	Average	ANN_1YR_G30_902_#	total_bext	1/Mm	19.650	95.182	145.364	80.763	24.179	12.676
HAVO1	Average	ANN_1YR_G30_902_#	total_bext	1/Mm	18.172	104.000	147.733	74.669	23.591	12.411
HACR1	Average	ANN_1YR_G10_902_#	total_bext	1/Mm	10.728	151.875	154.750	49.616	17.723	10.031
HALE1	Average	ANN_1YR_G10_902_#	total_bext	1/Mm	15.738	94.182	145.364	56.804	18.637	10.319
HAVO1	Average	ANN_1YR_G10_902_#	total_bext	1/Mm	14.604	103.000	147.733	53.146	18.191	10.163

Table E-9: Hawaii IMPROVE site Total Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	dv	1	9.915	144.875	154.750	32.898	17.236	8.207
HALE1	Average	ANN_1YR_G90_902_#	dv	1	14.207	101.727	145.364	32.527	17.849	8.689
HAVO1	Average	ANN_1YR_G90_902_#	dv	1	20.943	49.267	147.733	32.628	17.473	8.481
HACR1	Average	ANN_1YR_G70_902_#	dv	1	5.815	152.750	154.750	24.587	12.706	5.365
HALE1	Average	ANN_1YR_G70_902_#	dv	1	10.414	98.727	145.364	26.373	13.414	5.844
HAVO1	Average	ANN_1YR_G70_902_#	dv	1	11.452	88.467	147.733	25.598	13.045	5.660
HACR1	Average	ANN_1YR_G50_902_#	dv	1	3.963	153.625	154.750	21.729	10.416	3.752
HALE1	Average	ANN_1YR_G50_902_#	dv	1	8.508	96.273	145.364	23.486	11.011	4.129
HAVO1	Average	ANN_1YR_G50_902_#	dv	1	7.946	103.533	147.733	22.498	10.703	3.955
HACR1	Average	ANN_1YR_G30_902_#	dv	1	2.273	153.375	154.750	19.251	8.265	1.875
HALE1	Average	ANN_1YR_G30_902_#	dv	1	6.736	95.091	145.364	20.756	8.799	2.347
HAVO1	Average	ANN_1YR_G30_902_#	dv	1	5.947	103.867	147.733	19.894	8.549	2.129
HACR1	Average	ANN_1YR_G10_902_#	dv	1	0.684	151.875	154.750	15.788	5.620	0.008
HALE1	Average	ANN_1YR_G10_902_#	dv	1	4.481	94.000	145.364	17.122	6.129	0.278
HAVO1	Average	ANN_1YR_G10_902_#	dv	1	3.734	103.067	147.733	16.421	5.885	0.127

Table E-10: Hawaii IMPROVE site Haze Index (dv) average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	SVR	km	144.905	11.125	154.750	169.749	74.196	15.880
HALE1	Average	ANN_1YR_G90_902_#	SVR	km	97.957	45.818	145.364	163.546	69.592	16.015
HAVO1	Average	ANN_1YR_G90_902_#	SVR	km	56.782	97.600	147.733	165.844	72.500	16.045
HACR1	Average	ANN_1YR_G70_902_#	SVR	km	207.653	2.875	154.750	221.695	112.515	34.458
HALE1	Average	ANN_1YR_G70_902_#	SVR	km	138.339	47.636	145.364	219.867	105.606	28.798
HAVO1	Average	ANN_1YR_G70_902_#	SVR	km	127.748	60.067	147.733	221.079	109.410	31.356
HACR1	Average	ANN_1YR_G50_902_#	SVR	km	247.019	3.000	154.750	255.144	142.695	46.051
HALE1	Average	ANN_1YR_G50_902_#	SVR	km	167.294	50.182	145.364	256.187	134.158	38.447
HAVO1	Average	ANN_1YR_G50_902_#	SVR	km	177.517	44.600	147.733	258.718	138.523	42.919
HACR1	Average	ANN_1YR_G30_902_#	SVR	km	288.885	2.750	154.750	299.878	177.712	58.850
HALE1	Average	ANN_1YR_G30_902_#	SVR	km	199.730	51.000	145.364	295.812	167.537	50.477
HAVO1	Average	ANN_1YR_G30_902_#	SVR	km	216.309	44.467	147.733	299.306	172.149	55.488
HACR1	Average	ANN_1YR_G10_902_#	SVR	km	334.468	4.000	154.750	347.064	233.737	84.450
HALE1	Average	ANN_1YR_G10_902_#	SVR	km	251.198	53.364	145.364	341.217	221.895	74.218
HAVO1	Average	ANN_1YR_G10_902_#	SVR	km	270.639	45.667	147.733	345.042	227.226	79.812

Table E-11: Hawaii IMPROVE site Standard Visual Range (SVR) average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.491	153.500	154.750	262.674	27.275	3.479
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.467	142.636	145.364	206.671	28.283	4.219
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.169	147.533	147.733	224.102	27.839	3.950
HACR1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.926	154.125	154.750	83.194	13.769	2.727
HALE1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.610	131.818	145.364	80.629	15.422	3.298
HAVO1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.050	146.267	147.733	81.192	14.769	3.142
HACR1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.065	154.250	154.750	52.542	9.749	2.003
HALE1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.505	127.182	145.364	54.032	10.748	2.319
HAVO1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.968	145.733	147.733	52.504	10.338	2.207
HACR1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.165	154.500	154.750	35.733	7.034	1.135
HALE1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.918	119.364	145.364	38.575	7.728	1.357
HAVO1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.144	142.133	147.733	37.335	7.423	1.279
HACR1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.542	153.750	154.750	22.756	4.133	0.472
HALE1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.287	112.455	145.364	25.274	4.664	0.596
HAVO1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.306	135.933	147.733	24.595	4.407	0.550

Table E-12: Hawaii IMPROVE site Aerosol Bext without Sulfate Bext and Sea Salt Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000
HACR1	Average	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000
HACR1	Average	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000
HACR1	Average	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000
HACR1	Average	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2.625	154.750	0.950	0.000	0.000
HALE1	Average	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2.455	145.364	0.950	0.000	0.000
HAVO1	Average	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1.000	147.733	0.950	0.000	0.000

Table E-13: Hawaii IMPROVE site Volcano fraction of Sulfate Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.109	154.125	154.750	280.507	46.621	7.908
HALE1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	16.150	140.455	145.364	262.285	49.664	8.471
HAVO1	Average	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.446	147.400	147.733	268.791	47.791	7.832
HACR1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.623	154.125	154.750	107.030	23.837	4.019
HALE1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.371	140.182	145.364	130.392	26.274	4.920
HAVO1	Average	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.806	147.533	147.733	120.698	24.910	4.637
HACR1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.087	154.000	154.750	77.614	16.869	2.682
HALE1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.411	138.545	145.364	94.250	18.672	3.342
HAVO1	Average	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.280	147.533	147.733	85.346	17.788	3.156
HACR1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.799	154.500	154.750	57.531	11.763	1.720
HALE1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.185	133.000	145.364	68.634	12.960	2.195
HAVO1	Average	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.336	147.000	147.733	62.544	12.401	2.066
HACR1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.850	154.500	154.750	37.834	6.755	0.801
HALE1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.976	125.364	145.364	44.809	7.721	1.038
HAVO1	Average	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.408	145.333	147.733	41.215	7.293	0.965

Table E-14: Hawaii IMPROVE site Aerosol Bext without Volcano fraction of Sulfate Bext and Sea Salt Bext average annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	90	78.580	4.626	0.596
HALE1	2001	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	3.076	55	90	78.580	4.626	0.596
HAVO1	2001	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.000	84	90	78.580	4.626	0.596
HACR1	2002	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	125	60.029	5.319	0.441
HALE1	2002	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.800	84	125	60.029	5.319	0.441
HAVO1	2002	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.019	122	125	60.029	5.319	0.441
HACR1	2003	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	145	74.454	5.641	0.490
HALE1	2003	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.367	106	145	74.454	5.641	0.490
HAVO1	2003	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.763	142	145	74.454	5.641	0.490
HACR1	2004	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	153	77.841	6.127	0.619
HALE1	2004	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.411	114	153	77.841	6.127	0.619
HAVO1	2004	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.645	152	153	77.841	6.127	0.619
HACR1	2005	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	159	215.755	4.337	0.582
HALE1	2005	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.256	108	159	215.755	4.337	0.582
HAVO1	2005	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.612	157	159	215.755	4.337	0.582
HACR1	2006	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	155	125.914	4.477	0.305
HALE1	2006	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.380	107	155	125.914	4.477	0.305
HAVO1	2006	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.305	155	155	125.914	4.477	0.305
HACR1	2007	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.303	143	156	166.484	4.526	0.716
HALE1	2007	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	2.390	113	156	166.484	4.526	0.716
HAVO1	2007	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.716	156	156	166.484	4.526	0.716
HACR1	2008	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.995	148	156	200.881	4.299	0.698
HALE1	2008	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.718	121	156	200.881	4.299	0.698
HAVO1	2008	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.698	156	156	200.881	4.299	0.698
HACR1	2009	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.006	146	157	151.371	4.589	0.394
HALE1	2009	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.797	118	157	151.371	4.589	0.394
HAVO1	2009	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.469	156	157	151.371	4.589	0.394
HACR1	2010	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.116	137	153	153.422	3.863	0.389
HALE1	2010	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.671	116	153	153.422	3.863	0.389
HAVO1	2010	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.389	153	153	153.422	3.863	0.389
HACR1	2011	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.956	139	150	188.592	3.772	0.555
HALE1	2011	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.983	112	150	188.592	3.772	0.555
HAVO1	2011	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.616	148	150	188.592	3.772	0.555
HACR1	2012	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.061	145	157	164.441	3.729	0.490
HALE1	2012	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	157	164.441	3.729	0.490
HAVO1	2012	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.552	156	157	164.441	3.729	0.490

Table E-15

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	151	174.488	4.348	0.553
HALE1	2013	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	151	174.488	4.348	0.553
HAVO1	2013	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.582	150	151	174.488	4.348	0.553
HACR1	2014	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.148	137	159	244.390	4.244	0.425
HALE1	2014	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	159	244.390	4.244	0.425
HAVO1	2014	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.593	156	159	244.390	4.244	0.425
HACR1	2015	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	1.222	126	150	195.034	4.238	0.597
HALE1	2015	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	NA	NA	150	195.034	4.238	0.597
HAVO1	2015	ANN_1YR_G90_902_#	ammNO3f_bext	1/Mm	0.602	149	150	195.034	4.238	0.597
HACR1	2001	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	90	31.045	2.737	0.356
HALE1	2001	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.300	50	90	31.045	2.737	0.356
HAVO1	2001	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.537	68	90	31.045	2.737	0.356
HACR1	2002	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	125	39.353	4.154	0.346
HALE1	2002	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.552	72	125	39.353	4.154	0.346
HAVO1	2002	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.374	108	125	39.353	4.154	0.346
HACR1	2003	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	145	36.816	3.598	0.441
HALE1	2003	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.239	89	145	36.816	3.598	0.441
HAVO1	2003	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.258	120	145	36.816	3.598	0.441
HACR1	2004	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	153	33.013	3.159	0.409
HALE1	2004	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.910	106	153	33.013	3.159	0.409
HAVO1	2004	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.267	131	153	33.013	3.159	0.409
HACR1	2005	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	159	54.308	2.943	0.411
HALE1	2005	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.176	95	159	54.308	2.943	0.411
HAVO1	2005	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.231	128	159	54.308	2.943	0.411
HACR1	2006	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	155	35.079	3.263	0.311
HALE1	2006	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.490	87	155	35.079	3.263	0.311
HAVO1	2006	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.115	130	155	35.079	3.263	0.311
HACR1	2007	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.000	143	156	41.272	3.406	0.283
HALE1	2007	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.110	99	156	41.272	3.406	0.283
HAVO1	2007	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.325	128	156	41.272	3.406	0.283
HACR1	2008	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.980	136	156	44.460	3.003	0.367
HALE1	2008	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.325	90	156	44.460	3.003	0.367
HAVO1	2008	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.841	146	156	44.460	3.003	0.367
HACR1	2009	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.789	140	157	33.580	2.842	0.504
HALE1	2009	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.897	96	157	33.580	2.842	0.504
HAVO1	2009	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.622	154	157	33.580	2.842	0.504

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.879	131	153	33.702	2.145	0.319
HALE1	2010	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.838	86	153	33.702	2.145	0.319
HAVO1	2010	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.896	128	153	33.702	2.145	0.319
HACR1	2011	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.939	124	150	36.445	2.595	0.400
HALE1	2011	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	2.009	84	150	36.445	2.595	0.400
HAVO1	2011	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.735	138	150	36.445	2.595	0.400
HACR1	2012	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.000	132	157	18.475	2.255	0.467
HALE1	2012	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	157	18.475	2.255	0.467
HAVO1	2012	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.894	139	157	18.475	2.255	0.467
HACR1	2013	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	151	40.061	2.456	0.402
HALE1	2013	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	151	40.061	2.456	0.402
HAVO1	2013	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.982	133	151	40.061	2.456	0.402
HACR1	2014	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.643	151	159	28.109	2.516	0.350
HALE1	2014	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	159	28.109	2.516	0.350
HAVO1	2014	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	1.031	120	159	28.109	2.516	0.350
HACR1	2015	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.781	133	150	42.339	2.555	0.332
HALE1	2015	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	NA	NA	150	42.339	2.555	0.332
HAVO1	2015	ANN_1YR_G70_902_#	ammNO3f_bext	1/Mm	0.826	128	150	42.339	2.555	0.332
HACR1	2001	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	90	18.065	1.636	0.375
HALE1	2001	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.600	48	90	18.065	1.636	0.375
HAVO1	2001	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.857	83	90	18.065	1.636	0.375
HACR1	2002	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	125	31.517	2.305	0.331
HALE1	2002	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.783	74	125	31.517	2.305	0.331
HAVO1	2002	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.050	110	125	31.517	2.305	0.331
HACR1	2003	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	145	33.297	2.666	0.359
HALE1	2003	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.624	90	145	33.297	2.666	0.359
HAVO1	2003	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.056	121	145	33.297	2.666	0.359
HACR1	2004	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	153	19.540	2.246	0.308
HALE1	2004	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.514	96	153	19.540	2.246	0.308
HAVO1	2004	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.020	130	153	19.540	2.246	0.308
HACR1	2005	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	159	29.376	2.116	0.304
HALE1	2005	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.434	97	159	29.376	2.116	0.304
HAVO1	2005	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.934	127	159	29.376	2.116	0.304
HACR1	2006	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	155	21.566	1.947	0.227
HALE1	2006	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.560	89	155	21.566	1.947	0.227
HAVO1	2006	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.897	125	155	21.566	1.947	0.227

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.652	147	156	21.114	2.318	0.255
HALE1	2007	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.412	107	156	21.114	2.318	0.255
HAVO1	2007	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.854	138	156	21.114	2.318	0.255
HACR1	2008	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.656	143	156	19.882	1.989	0.268
HALE1	2008	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.440	98	156	19.882	1.989	0.268
HAVO1	2008	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.909	130	156	19.882	1.989	0.268
HACR1	2009	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.649	144	157	21.889	1.827	0.295
HALE1	2009	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.455	91	157	21.889	1.827	0.295
HAVO1	2009	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.835	128	157	21.889	1.827	0.295
HACR1	2010	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.594	140	153	19.900	1.455	0.239
HALE1	2010	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.035	95	153	19.900	1.455	0.239
HAVO1	2010	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.887	110	153	19.900	1.455	0.239
HACR1	2011	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.585	138	150	14.692	1.609	0.260
HALE1	2011	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	1.313	88	150	14.692	1.609	0.260
HAVO1	2011	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.604	136	150	14.692	1.609	0.260
HACR1	2012	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.566	150	157	10.816	1.526	0.229
HALE1	2012	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	157	10.816	1.526	0.229
HAVO1	2012	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.629	144	157	10.816	1.526	0.229
HACR1	2013	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	151	16.876	1.694	0.331
HALE1	2013	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	151	16.876	1.694	0.331
HAVO1	2013	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.840	124	151	16.876	1.694	0.331
HACR1	2014	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.548	150	159	12.688	1.590	0.148
HALE1	2014	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	159	12.688	1.590	0.148
HAVO1	2014	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.838	121	159	12.688	1.590	0.148
HACR1	2015	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.483	143	150	11.846	1.680	0.239
HALE1	2015	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	NA	NA	150	11.846	1.680	0.239
HAVO1	2015	ANN_1YR_G50_902_#	ammNO3f_bext	1/Mm	0.799	113	150	11.846	1.680	0.239
HACR1	2001	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	90	13.317	1.276	0.296
HALE1	2001	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.980	59	90	13.317	1.276	0.296
HAVO1	2001	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.609	84	90	13.317	1.276	0.296
HACR1	2002	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	125	23.601	1.506	0.254
HALE1	2002	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	1.114	85	125	23.601	1.506	0.254
HAVO1	2002	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.654	116	125	23.601	1.506	0.254
HACR1	2003	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	145	18.353	1.543	0.178
HALE1	2003	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	1.115	94	145	18.353	1.543	0.178
HAVO1	2003	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.637	131	145	18.353	1.543	0.178

Table E-15

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	153	16.101	1.636	0.224
HALE1	2004	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.922	111	153	16.101	1.636	0.224
HAVO1	2004	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.744	127	153	16.101	1.636	0.224
HACR1	2005	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	159	20.426	1.439	0.173
HALE1	2005	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.838	108	159	20.426	1.439	0.173
HAVO1	2005	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.648	131	159	20.426	1.439	0.173
HACR1	2006	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	155	17.587	1.347	0.178
HALE1	2006	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.893	104	155	17.587	1.347	0.178
HAVO1	2006	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.498	139	155	17.587	1.347	0.178
HACR1	2007	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.420	151	156	17.856	1.421	0.158
HALE1	2007	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.932	108	156	17.856	1.421	0.158
HAVO1	2007	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.577	141	156	17.856	1.421	0.158
HACR1	2008	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.302	153	156	11.289	1.316	0.140
HALE1	2008	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.939	98	156	11.289	1.316	0.140
HAVO1	2008	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.623	132	156	11.289	1.316	0.140
HACR1	2009	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.347	154	157	11.697	1.292	0.205
HALE1	2009	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.914	97	157	11.697	1.292	0.205
HAVO1	2009	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.489	145	157	11.697	1.292	0.205
HACR1	2010	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.280	150	153	10.508	0.975	0.180
HALE1	2010	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.809	91	153	10.508	0.975	0.180
HAVO1	2010	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.545	123	153	10.508	0.975	0.180
HACR1	2011	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.340	144	150	10.540	1.123	0.165
HALE1	2011	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.830	91	150	10.540	1.123	0.165
HAVO1	2011	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.470	133	150	10.540	1.123	0.165
HACR1	2012	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.285	153	157	8.200	1.137	0.142
HALE1	2012	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	157	8.200	1.137	0.142
HAVO1	2012	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.365	149	157	8.200	1.137	0.142
HACR1	2013	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	151	12.128	1.194	0.146
HALE1	2013	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	151	12.128	1.194	0.146
HAVO1	2013	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.586	130	151	12.128	1.194	0.146
HACR1	2014	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.244	155	159	9.056	1.054	0.155
HALE1	2014	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	159	9.056	1.054	0.155
HAVO1	2014	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.524	129	159	9.056	1.054	0.155
HACR1	2015	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.273	148	150	7.413	1.045	0.155
HALE1	2015	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	NA	NA	150	7.413	1.045	0.155
HAVO1	2015	ANN_1YR_G30_902_#	ammNO3f_bext	1/Mm	0.676	106	150	7.413	1.045	0.155

Table E-15

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	90	8.635	0.816	0.122
HALE1	2001	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.540	71	90	8.635	0.816	0.122
HAVO1	2001	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.276	89	90	8.635	0.816	0.122
HACR1	2002	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	125	12.120	0.843	0.104
HALE1	2002	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.735	78	125	12.120	0.843	0.104
HAVO1	2002	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.202	123	125	12.120	0.843	0.104
HACR1	2003	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	145	10.066	0.941	0.089
HALE1	2003	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.499	104	145	10.066	0.941	0.089
HAVO1	2003	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.406	113	145	10.066	0.941	0.089
HACR1	2004	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	153	9.643	0.956	0.165
HALE1	2004	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.454	119	153	9.643	0.956	0.165
HAVO1	2004	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.296	143	153	9.643	0.956	0.165
HACR1	2005	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	159	9.456	0.861	0.099
HALE1	2005	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.300	135	159	9.456	0.861	0.099
HAVO1	2005	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.226	150	159	9.456	0.861	0.099
HACR1	2006	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	155	9.300	0.812	0.061
HALE1	2006	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.443	106	155	9.300	0.812	0.061
HAVO1	2006	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.238	139	155	9.300	0.812	0.061
HACR1	2007	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.172	154	156	8.899	0.822	0.080
HALE1	2007	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.493	113	156	8.899	0.822	0.080
HAVO1	2007	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.367	130	156	8.899	0.822	0.080
HACR1	2008	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.072	154	156	6.651	0.746	0.029
HALE1	2008	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.405	115	156	6.651	0.746	0.029
HAVO1	2008	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.300	130	156	6.651	0.746	0.029
HACR1	2009	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.178	152	157	5.200	0.679	0.088
HALE1	2009	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.488	105	157	5.200	0.679	0.088
HAVO1	2009	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.269	129	157	5.200	0.679	0.088
HACR1	2010	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.084	152	153	6.096	0.593	0.066
HALE1	2010	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.380	103	153	6.096	0.593	0.066
HAVO1	2010	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.309	115	153	6.096	0.593	0.066
HACR1	2011	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.078	149	150	5.934	0.581	0.051
HALE1	2011	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.452	95	150	5.934	0.581	0.051
HAVO1	2011	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.210	136	150	5.934	0.581	0.051
HACR1	2012	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.127	153	157	5.691	0.643	0.087
HALE1	2012	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	157	5.691	0.643	0.087
HAVO1	2012	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.219	135	157	5.691	0.643	0.087

Table E-15

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	151	5.281	0.676	0.036
HALE1	2013	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	151	5.281	0.676	0.036
HAVO1	2013	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.361	113	151	5.281	0.676	0.036
HACR1	2014	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.093	157	159	4.698	0.587	0.067
HALE1	2014	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	159	4.698	0.587	0.067
HAVO1	2014	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.226	137	159	4.698	0.587	0.067
HACR1	2015	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.116	150	150	5.504	0.586	0.116
HALE1	2015	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	NA	NA	150	5.504	0.586	0.116
HAVO1	2015	ANN_1YR_G10_902_#	ammNO3f_bext	1/Mm	0.353	112	150	5.504	0.586	0.116

Table E-15: Hawaii IMPROVE site Nitrate Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	90	191.305	11.680	3.473
HALE1	2001	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	16.202	37	90	191.305	11.680	3.473
HAVO1	2001	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	41.741	22	90	191.305	11.680	3.473
HACR1	2002	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	125	184.557	14.664	2.132
HALE1	2002	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	15.174	61	125	184.557	14.664	2.132
HAVO1	2002	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	52.983	40	125	184.557	14.664	2.132
HACR1	2003	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	145	205.610	14.091	2.597
HALE1	2003	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	23.472	60	145	205.610	14.091	2.597
HAVO1	2003	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	89.276	25	145	205.610	14.091	2.597
HACR1	2004	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	153	179.613	14.416	3.649
HALE1	2004	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	15.281	74	153	179.613	14.416	3.649
HAVO1	2004	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	56.162	40	153	179.613	14.416	3.649
HACR1	2005	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	159	252.732	18.222	3.818
HALE1	2005	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	18.819	79	159	252.732	18.222	3.818
HAVO1	2005	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	85.153	44	159	252.732	18.222	3.818
HACR1	2006	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	155	199.730	17.348	3.646
HALE1	2006	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	19.354	75	155	199.730	17.348	3.646
HAVO1	2006	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	69.231	37	155	199.730	17.348	3.646
HACR1	2007	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	9.039	105	156	205.118	16.863	3.817
HALE1	2007	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	18.600	74	156	205.118	16.863	3.817
HAVO1	2007	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	108.613	22	156	205.118	16.863	3.817
HACR1	2008	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	22.865	62	156	179.540	15.042	3.723
HALE1	2008	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	45.311	40	156	179.540	15.042	3.723
HAVO1	2008	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	179.540	1	156	179.540	15.042	3.723
HACR1	2009	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	17.611	79	157	218.113	17.611	2.464
HALE1	2009	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	30.261	59	157	218.113	17.611	2.464
HAVO1	2009	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	218.113	1	157	218.113	17.611	2.464
HACR1	2010	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	14.317	76	153	131.631	14.287	2.695
HALE1	2010	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	26.855	53	153	131.631	14.287	2.695
HAVO1	2010	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	131.631	1	153	131.631	14.287	2.695
HACR1	2011	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	13.687	76	150	93.859	13.715	3.511
HALE1	2011	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	26.786	50	150	93.859	13.715	3.511
HAVO1	2011	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	34.216	42	150	93.859	13.715	3.511
HACR1	2012	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	13.540	67	157	61.099	11.019	2.650
HALE1	2012	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	157	61.099	11.019	2.650
HAVO1	2012	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	43.235	9	157	61.099	11.019	2.650

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	151	61.404	10.372	3.056
HALE1	2013	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	151	61.404	10.372	3.056
HAVO1	2013	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	61.404	1	151	61.404	10.372	3.056
HACR1	2014	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	10.790	81	159	61.705	10.808	3.063
HALE1	2014	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	159	61.705	10.808	3.063
HAVO1	2014	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	55.122	2	159	61.705	10.808	3.063
HACR1	2015	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	10.112	74	150	56.799	9.622	2.451
HALE1	2015	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	NA	NA	150	56.799	9.622	2.451
HAVO1	2015	ANN_1YR_G90_902_#	ammSO4f_bext	1/Mm	56.799	1	150	56.799	9.622	2.451
HACR1	2001	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	90	74.655	8.250	2.940
HALE1	2001	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.535	50	90	74.655	8.250	2.940
HAVO1	2001	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.605	49	90	74.655	8.250	2.940
HACR1	2002	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	125	79.845	9.023	2.385
HALE1	2002	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	8.794	64	125	79.845	9.023	2.385
HAVO1	2002	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	9.298	62	125	79.845	9.023	2.385
HACR1	2003	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	145	78.341	10.211	2.594
HALE1	2003	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	8.304	81	145	78.341	10.211	2.594
HAVO1	2003	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	17.016	53	145	78.341	10.211	2.594
HACR1	2004	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	153	72.250	10.135	2.753
HALE1	2004	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	8.431	84	153	72.250	10.135	2.753
HAVO1	2004	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	10.470	75	153	72.250	10.135	2.753
HACR1	2005	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	159	108.444	11.770	2.915
HALE1	2005	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.880	97	159	108.444	11.770	2.915
HAVO1	2005	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	14.034	70	159	108.444	11.770	2.915
HACR1	2006	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	155	91.936	12.581	3.383
HALE1	2006	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	8.477	94	155	91.936	12.581	3.383
HAVO1	2006	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	16.340	62	155	91.936	12.581	3.383
HACR1	2007	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	3.873	152	156	91.932	10.620	3.238
HALE1	2007	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	6.446	103	156	91.932	10.620	3.238
HAVO1	2007	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	10.145	81	156	91.932	10.620	3.238
HACR1	2008	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	6.266	107	156	62.226	10.792	3.090
HALE1	2008	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	10.555	81	156	62.226	10.792	3.090
HAVO1	2008	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	16.126	57	156	62.226	10.792	3.090
HACR1	2009	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	6.173	104	157	53.208	10.723	2.892
HALE1	2009	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	10.635	82	157	53.208	10.723	2.892
HAVO1	2009	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	41.698	9	157	53.208	10.723	2.892

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	4.843	108	153	54.354	8.853	2.304
HALE1	2010	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.966	79	153	54.354	8.853	2.304
HAVO1	2010	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	13.403	51	153	54.354	8.853	2.304
HACR1	2011	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	4.591	124	150	53.250	8.840	2.586
HALE1	2011	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.008	85	150	53.250	8.840	2.586
HAVO1	2011	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	7.892	82	150	53.250	8.840	2.586
HACR1	2012	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	6.022	98	157	44.401	7.418	3.125
HALE1	2012	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	157	44.401	7.418	3.125
HAVO1	2012	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	10.199	63	157	44.401	7.418	3.125
HACR1	2013	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	151	33.295	7.477	3.014
HALE1	2013	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	151	33.295	7.477	3.014
HAVO1	2013	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	12.946	41	151	33.295	7.477	3.014
HACR1	2014	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	5.264	103	159	40.143	7.656	2.783
HALE1	2014	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	159	40.143	7.656	2.783
HAVO1	2014	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	17.526	33	159	40.143	7.656	2.783
HACR1	2015	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	4.123	111	150	31.344	7.060	2.439
HALE1	2015	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	NA	NA	150	31.344	7.060	2.439
HAVO1	2015	ANN_1YR_G70_902_#	ammSO4f_bext	1/Mm	21.908	14	150	31.344	7.060	2.439
HACR1	2001	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	90	53.088	6.489	2.242
HALE1	2001	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.249	48	90	53.088	6.489	2.242
HAVO1	2001	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	4.367	68	90	53.088	6.489	2.242
HACR1	2002	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	125	54.536	6.876	1.963
HALE1	2002	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.681	73	125	54.536	6.876	1.963
HAVO1	2002	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.804	72	125	54.536	6.876	1.963
HACR1	2003	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	145	49.827	6.842	1.601
HALE1	2003	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.914	83	145	49.827	6.842	1.601
HAVO1	2003	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.343	79	145	49.827	6.842	1.601
HACR1	2004	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	153	49.464	6.916	1.871
HALE1	2004	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	4.913	95	153	49.464	6.916	1.871
HAVO1	2004	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.455	87	153	49.464	6.916	1.871
HACR1	2005	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	159	72.307	8.763	2.203
HALE1	2005	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.402	107	159	72.307	8.763	2.203
HAVO1	2005	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.037	95	159	72.307	8.763	2.203
HACR1	2006	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	155	59.100	8.445	2.455
HALE1	2006	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.382	89	155	59.100	8.445	2.455
HAVO1	2006	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	7.167	83	155	59.100	8.445	2.455

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	2.518	154	156	51.834	7.452	2.130
HALE1	2007	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	4.342	111	156	51.834	7.452	2.130
HAVO1	2007	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.637	92	156	51.834	7.452	2.130
HACR1	2008	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	3.599	138	156	44.338	7.646	2.810
HALE1	2008	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	7.530	80	156	44.338	7.646	2.810
HAVO1	2008	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	7.043	84	156	44.338	7.646	2.810
HACR1	2009	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	3.584	131	157	39.557	7.854	2.477
HALE1	2009	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.561	87	157	39.557	7.854	2.477
HAVO1	2009	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	8.161	75	157	39.557	7.854	2.477
HACR1	2010	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	3.116	130	153	40.955	6.234	2.235
HALE1	2010	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.230	78	153	40.955	6.234	2.235
HAVO1	2010	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.234	77	153	40.955	6.234	2.235
HACR1	2011	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	2.932	137	150	34.305	6.226	1.926
HALE1	2011	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	5.335	86	150	34.305	6.226	1.926
HAVO1	2011	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	4.542	91	150	34.305	6.226	1.926
HACR1	2012	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	3.731	117	157	33.276	5.550	2.254
HALE1	2012	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	157	33.276	5.550	2.254
HAVO1	2012	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	4.887	87	157	33.276	5.550	2.254
HACR1	2013	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	151	26.889	5.963	2.001
HALE1	2013	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	151	26.889	5.963	2.001
HAVO1	2013	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	6.542	69	151	26.889	5.963	2.001
HACR1	2014	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	2.986	125	159	29.700	5.998	1.889
HALE1	2014	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	159	29.700	5.998	1.889
HAVO1	2014	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	7.310	61	159	29.700	5.998	1.889
HACR1	2015	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	2.324	136	150	25.370	5.424	1.818
HALE1	2015	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	NA	NA	150	25.370	5.424	1.818
HAVO1	2015	ANN_1YR_G50_902_#	ammSO4f_bext	1/Mm	7.993	55	150	25.370	5.424	1.818
HACR1	2001	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	90	34.564	4.236	1.571
HALE1	2001	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.361	64	90	34.564	4.236	1.571
HAVO1	2001	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.250	67	90	34.564	4.236	1.571
HACR1	2002	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	125	35.338	4.732	1.422
HALE1	2002	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.943	71	125	35.338	4.732	1.422
HAVO1	2002	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.370	80	125	35.338	4.732	1.422
HACR1	2003	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	145	34.853	4.586	1.072
HALE1	2003	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.646	87	145	34.853	4.586	1.072
HAVO1	2003	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.586	73	145	34.853	4.586	1.072

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	153	34.650	4.944	1.285
HALE1	2004	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.740	91	153	34.650	4.944	1.285
HAVO1	2004	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.626	95	153	34.650	4.944	1.285
HACR1	2005	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	159	44.146	6.063	1.461
HALE1	2005	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.038	103	159	44.146	6.063	1.461
HAVO1	2005	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.303	96	159	44.146	6.063	1.461
HACR1	2006	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	155	39.518	5.808	1.856
HALE1	2006	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.971	98	155	39.518	5.808	1.856
HAVO1	2006	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.339	94	155	39.518	5.808	1.856
HACR1	2007	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.748	152	156	38.671	5.337	1.388
HALE1	2007	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.621	100	156	38.671	5.337	1.388
HAVO1	2007	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.854	96	156	38.671	5.337	1.388
HACR1	2008	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	2.343	141	156	33.733	5.245	1.511
HALE1	2008	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.603	86	156	33.733	5.245	1.511
HAVO1	2008	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.219	89	156	33.733	5.245	1.511
HACR1	2009	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	2.176	145	157	27.238	4.880	1.637
HALE1	2009	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.288	87	157	27.238	4.880	1.637
HAVO1	2009	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.044	93	157	27.238	4.880	1.637
HACR1	2010	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.947	135	153	29.936	3.891	1.110
HALE1	2010	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.460	85	153	29.936	3.891	1.110
HAVO1	2010	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.420	87	153	29.936	3.891	1.110
HACR1	2011	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.894	143	150	26.765	4.274	1.363
HALE1	2011	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.573	86	150	26.765	4.274	1.363
HAVO1	2011	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	3.007	97	150	26.765	4.274	1.363
HACR1	2012	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	2.159	127	157	23.832	3.637	1.476
HALE1	2012	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	157	23.832	3.637	1.476
HAVO1	2012	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	2.645	108	157	23.832	3.637	1.476
HACR1	2013	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	151	20.742	3.777	1.168
HALE1	2013	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	151	20.742	3.777	1.168
HAVO1	2013	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.525	70	151	20.742	3.777	1.168
HACR1	2014	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.691	145	159	23.753	3.966	1.212
HALE1	2014	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	159	23.753	3.966	1.212
HAVO1	2014	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.148	76	159	23.753	3.966	1.212
HACR1	2015	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	1.430	145	150	19.268	3.670	1.220
HALE1	2015	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	NA	NA	150	19.268	3.670	1.220
HAVO1	2015	ANN_1YR_G30_902_#	ammSO4f_bext	1/Mm	4.100	71	150	19.268	3.670	1.220

Table E-16

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	90	21.886	2.429	0.962
HALE1	2001	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.266	52	90	21.886	2.429	0.962
HAVO1	2001	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.934	62	90	21.886	2.429	0.962
HACR1	2002	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	125	25.571	2.691	0.787
HALE1	2002	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.357	73	125	25.571	2.691	0.787
HAVO1	2002	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.669	88	125	25.571	2.691	0.787
HACR1	2003	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	145	20.423	2.894	0.548
HALE1	2003	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.083	87	145	20.423	2.894	0.548
HAVO1	2003	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.931	71	145	20.423	2.894	0.548
HACR1	2004	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	153	21.764	2.834	0.637
HALE1	2004	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.955	104	153	21.764	2.834	0.637
HAVO1	2004	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.136	95	153	21.764	2.834	0.637
HACR1	2005	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	159	25.525	3.531	0.548
HALE1	2005	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.702	123	159	25.525	3.531	0.548
HAVO1	2005	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.061	105	159	25.525	3.531	0.548
HACR1	2006	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	155	25.356	3.152	0.839
HALE1	2006	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.282	98	155	25.356	3.152	0.839
HAVO1	2006	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.769	115	155	25.356	3.152	0.839
HACR1	2007	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.971	152	156	19.789	3.085	0.774
HALE1	2007	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.164	96	156	19.789	3.085	0.774
HAVO1	2007	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.165	95	156	19.789	3.085	0.774
HACR1	2008	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.964	152	156	19.349	2.949	0.840
HALE1	2008	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.204	91	156	19.349	2.949	0.840
HAVO1	2008	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.286	88	156	19.349	2.949	0.840
HACR1	2009	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.160	144	157	17.601	2.599	0.846
HALE1	2009	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.083	98	157	17.601	2.599	0.846
HAVO1	2009	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.665	77	157	17.601	2.599	0.846
HACR1	2010	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.804	149	153	20.979	2.174	0.472
HALE1	2010	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.859	90	153	20.979	2.174	0.472
HAVO1	2010	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.958	84	153	20.979	2.174	0.472
HACR1	2011	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.010	141	150	19.188	2.391	0.411
HALE1	2011	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.028	82	150	19.188	2.391	0.411
HAVO1	2011	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.504	108	150	19.188	2.391	0.411
HACR1	2012	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.964	139	157	15.552	2.281	0.708
HALE1	2012	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	157	15.552	2.281	0.708
HAVO1	2012	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.507	103	157	15.552	2.281	0.708

Table E-16

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	151	13.251	2.188	0.311
HALE1	2013	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	151	13.251	2.188	0.311
HAVO1	2013	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.188	76	151	13.251	2.188	0.311
HACR1	2014	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.907	143	159	13.705	2.136	0.364
HALE1	2014	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	159	13.705	2.136	0.364
HAVO1	2014	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	1.738	87	159	13.705	2.136	0.364
HACR1	2015	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	0.671	146	150	10.720	2.084	0.478
HALE1	2015	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	NA	NA	150	10.720	2.084	0.478
HAVO1	2015	ANN_1YR_G10_902_#	ammSO4f_bext	1/Mm	2.048	77	150	10.720	2.084	0.478

Table E-16: Hawaii IMPROVE site Sulfate Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	90	13.304	2.728	0.929
HALE1	2001	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.232	85	90	13.304	2.728	0.929
HAVO1	2001	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.929	90	90	13.304	2.728	0.929
HACR1	2002	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	125	21.028	3.510	0.874
HALE1	2002	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.314	119	125	21.028	3.510	0.874
HAVO1	2002	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.874	125	125	21.028	3.510	0.874
HACR1	2003	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	145	18.225	3.606	0.749
HALE1	2003	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.707	133	145	18.225	3.606	0.749
HAVO1	2003	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.188	141	145	18.225	3.606	0.749
HACR1	2004	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	153	17.884	3.133	0.985
HALE1	2004	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.328	140	153	17.884	3.133	0.985
HAVO1	2004	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.012	152	153	17.884	3.133	0.985
HACR1	2005	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	159	37.069	3.852	0.851
HALE1	2005	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.282	153	159	37.069	3.852	0.851
HAVO1	2005	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.929	156	159	37.069	3.852	0.851
HACR1	2006	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	155	31.513	3.842	0.566
HALE1	2006	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.046	150	155	31.513	3.842	0.566
HAVO1	2006	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.820	154	155	31.513	3.842	0.566
HACR1	2007	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.931	149	156	27.702	3.550	0.424
HALE1	2007	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.018	148	156	27.702	3.550	0.424
HAVO1	2007	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.864	151	156	27.702	3.550	0.424
HACR1	2008	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.481	154	156	24.954	2.703	0.321
HALE1	2008	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.147	141	156	24.954	2.703	0.321
HAVO1	2008	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.902	148	156	24.954	2.703	0.321
HACR1	2009	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.503	157	157	20.621	2.481	0.503
HALE1	2009	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.336	134	157	20.621	2.481	0.503
HAVO1	2009	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.620	155	157	20.621	2.481	0.503
HACR1	2010	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.389	152	153	27.080	2.303	0.318
HALE1	2010	ANN_1YR_G90_902_#	ECf_bext	1/Mm	1.052	139	153	27.080	2.303	0.318
HAVO1	2010	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.614	150	153	27.080	2.303	0.318
HACR1	2011	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.380	149	150	20.561	2.695	0.373
HALE1	2011	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.826	141	150	20.561	2.695	0.373
HAVO1	2011	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.373	150	150	20.561	2.695	0.373
HACR1	2012	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.336	157	157	18.025	2.889	0.336
HALE1	2012	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	157	18.025	2.889	0.336
HAVO1	2012	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.444	155	157	18.025	2.889	0.336

Table E-17

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	151	21.358	2.253	0.380
HALE1	2013	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	151	21.358	2.253	0.380
HAVO1	2013	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.493	149	151	21.358	2.253	0.380
HACR1	2014	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.229	159	159	16.767	2.249	0.229
HALE1	2014	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	159	16.767	2.249	0.229
HAVO1	2014	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.675	154	159	16.767	2.249	0.229
HACR1	2015	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.189	150	150	15.813	2.504	0.189
HALE1	2015	ANN_1YR_G90_902_#	ECf_bext	1/Mm	NA	NA	150	15.813	2.504	0.189
HAVO1	2015	ANN_1YR_G90_902_#	ECf_bext	1/Mm	0.519	148	150	15.813	2.504	0.189
HACR1	2001	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	90	10.478	1.777	0.394
HALE1	2001	ANN_1YR_G70_902_#	ECf_bext	1/Mm	1.190	71	90	10.478	1.777	0.394
HAVO1	2001	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.394	90	90	10.478	1.777	0.394
HACR1	2002	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	125	11.387	1.955	0.332
HALE1	2002	ANN_1YR_G70_902_#	ECf_bext	1/Mm	1.028	112	125	11.387	1.955	0.332
HAVO1	2002	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.332	125	125	11.387	1.955	0.332
HACR1	2003	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	145	12.122	2.137	0.685
HALE1	2003	ANN_1YR_G70_902_#	ECf_bext	1/Mm	1.503	106	145	12.122	2.137	0.685
HAVO1	2003	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.685	145	145	12.122	2.137	0.685
HACR1	2004	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	153	9.210	1.829	0.535
HALE1	2004	ANN_1YR_G70_902_#	ECf_bext	1/Mm	1.193	117	153	9.210	1.829	0.535
HAVO1	2004	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.607	151	153	9.210	1.829	0.535
HACR1	2005	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	159	22.196	2.327	0.416
HALE1	2005	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.786	153	159	22.196	2.327	0.416
HAVO1	2005	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.421	158	159	22.196	2.327	0.416
HACR1	2006	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	155	19.921	2.145	0.315
HALE1	2006	ANN_1YR_G70_902_#	ECf_bext	1/Mm	1.035	142	155	19.921	2.145	0.315
HAVO1	2006	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.315	155	155	19.921	2.145	0.315
HACR1	2007	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.238	156	156	17.891	1.904	0.238
HALE1	2007	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.872	143	156	17.891	1.904	0.238
HAVO1	2007	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.323	154	156	17.891	1.904	0.238
HACR1	2008	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.316	154	156	16.362	1.559	0.252
HALE1	2008	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.707	141	156	16.362	1.559	0.252
HAVO1	2008	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.296	155	156	16.362	1.559	0.252
HACR1	2009	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.245	156	157	13.479	1.471	0.240
HALE1	2009	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.732	140	157	13.479	1.471	0.240
HAVO1	2009	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.480	154	157	13.479	1.471	0.240

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.285	152	153	14.983	1.439	0.204
HALE1	2010	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.601	142	153	14.983	1.439	0.204
HAVO1	2010	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.204	153	153	14.983	1.439	0.204
HACR1	2011	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.197	149	150	12.383	1.470	0.137
HALE1	2011	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.554	138	150	12.383	1.470	0.137
HAVO1	2011	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.137	150	150	12.383	1.470	0.137
HACR1	2012	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.247	156	157	12.692	1.466	0.218
HALE1	2012	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	157	12.692	1.466	0.218
HAVO1	2012	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.218	157	157	12.692	1.466	0.218
HACR1	2013	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	151	9.856	1.227	0.177
HALE1	2013	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	151	9.856	1.227	0.177
HAVO1	2013	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.177	151	151	9.856	1.227	0.177
HACR1	2014	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.109	159	159	9.454	1.220	0.109
HALE1	2014	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	159	9.454	1.220	0.109
HAVO1	2014	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.372	154	159	9.454	1.220	0.109
HACR1	2015	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.138	150	150	8.288	1.185	0.138
HALE1	2015	ANN_1YR_G70_902_#	ECf_bext	1/Mm	NA	NA	150	8.288	1.185	0.138
HAVO1	2015	ANN_1YR_G70_902_#	ECf_bext	1/Mm	0.444	143	150	8.288	1.185	0.138
HACR1	2001	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	90	7.675	1.363	0.293
HALE1	2001	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.640	84	90	7.675	1.363	0.293
HAVO1	2001	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.293	90	90	7.675	1.363	0.293
HACR1	2002	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	125	7.649	1.496	0.232
HALE1	2002	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.813	107	125	7.649	1.496	0.232
HAVO1	2002	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.232	125	125	7.649	1.496	0.232
HACR1	2003	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	145	8.488	1.616	0.262
HALE1	2003	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.766	131	145	8.488	1.616	0.262
HAVO1	2003	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.307	144	145	8.488	1.616	0.262
HACR1	2004	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	153	7.908	1.422	0.321
HALE1	2004	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.907	118	153	7.908	1.422	0.321
HAVO1	2004	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.515	151	153	7.908	1.422	0.321
HACR1	2005	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	159	16.710	1.713	0.124
HALE1	2005	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.523	154	159	16.710	1.713	0.124
HAVO1	2005	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.124	159	159	16.710	1.713	0.124
HACR1	2006	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	155	14.184	1.532	0.206
HALE1	2006	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.611	148	155	14.184	1.532	0.206
HAVO1	2006	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.206	155	155	14.184	1.532	0.206

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.175	155	156	14.750	1.352	0.120
HALE1	2007	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.433	150	156	14.750	1.352	0.120
HAVO1	2007	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.120	156	156	14.750	1.352	0.120
HACR1	2008	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.114	155	156	13.234	1.205	0.113
HALE1	2008	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.667	126	156	13.234	1.205	0.113
HAVO1	2008	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.113	156	156	13.234	1.205	0.113
HACR1	2009	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.194	156	157	13.309	1.146	0.152
HALE1	2009	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.472	143	157	13.309	1.146	0.152
HAVO1	2009	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.152	157	157	13.309	1.146	0.152
HACR1	2010	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.203	151	153	9.937	1.061	0.155
HALE1	2010	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.404	146	153	9.937	1.061	0.155
HAVO1	2010	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.175	152	153	9.937	1.061	0.155
HACR1	2011	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.187	149	150	11.363	1.108	0.151
HALE1	2011	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.497	132	150	11.363	1.108	0.151
HAVO1	2011	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.151	150	150	11.363	1.108	0.151
HACR1	2012	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.168	156	157	9.176	1.020	0.162
HALE1	2012	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	157	9.176	1.020	0.162
HAVO1	2012	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.162	157	157	9.176	1.020	0.162
HACR1	2013	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	151	6.404	0.954	0.136
HALE1	2013	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	151	6.404	0.954	0.136
HAVO1	2013	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.136	151	151	6.404	0.954	0.136
HACR1	2014	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.135	159	159	6.229	0.977	0.135
HALE1	2014	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	159	6.229	0.977	0.135
HAVO1	2014	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.165	158	159	6.229	0.977	0.135
HACR1	2015	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.097	150	150	5.603	0.891	0.097
HALE1	2015	ANN_1YR_G50_902_#	ECf_bext	1/Mm	NA	NA	150	5.603	0.891	0.097
HAVO1	2015	ANN_1YR_G50_902_#	ECf_bext	1/Mm	0.467	122	150	5.603	0.891	0.097
HACR1	2001	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	90	7.310	0.986	0.206
HALE1	2001	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.376	86	90	7.310	0.986	0.206
HAVO1	2001	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.206	90	90	7.310	0.986	0.206
HACR1	2002	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	125	7.755	1.068	0.224
HALE1	2002	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.535	112	125	7.755	1.068	0.224
HAVO1	2002	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.224	125	125	7.755	1.068	0.224
HACR1	2003	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	145	6.905	1.293	0.150
HALE1	2003	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.430	128	145	6.905	1.293	0.150
HAVO1	2003	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.192	144	145	6.905	1.293	0.150

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	153	6.210	1.097	0.141
HALE1	2004	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.462	138	153	6.210	1.097	0.141
HAVO1	2004	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.141	153	153	6.210	1.097	0.141
HACR1	2005	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	159	13.704	1.187	0.176
HALE1	2005	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.243	156	159	13.704	1.187	0.176
HAVO1	2005	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.176	159	159	13.704	1.187	0.176
HACR1	2006	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	155	13.116	1.182	0.187
HALE1	2006	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.447	141	155	13.116	1.182	0.187
HAVO1	2006	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.187	155	155	13.116	1.182	0.187
HACR1	2007	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.071	156	156	10.497	1.015	0.071
HALE1	2007	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.321	147	156	10.497	1.015	0.071
HAVO1	2007	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.108	155	156	10.497	1.015	0.071
HACR1	2008	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.130	154	156	10.776	0.919	0.109
HALE1	2008	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.357	138	156	10.776	0.919	0.109
HAVO1	2008	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.118	155	156	10.776	0.919	0.109
HACR1	2009	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.169	155	157	10.924	0.901	0.134
HALE1	2009	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.338	140	157	10.924	0.901	0.134
HAVO1	2009	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.134	157	157	10.924	0.901	0.134
HACR1	2010	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.090	153	153	7.294	0.838	0.090
HALE1	2010	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.308	136	153	7.294	0.838	0.090
HAVO1	2010	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.096	152	153	7.294	0.838	0.090
HACR1	2011	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.086	149	150	7.788	0.850	0.078
HALE1	2011	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.331	129	150	7.788	0.850	0.078
HAVO1	2011	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.078	150	150	7.788	0.850	0.078
HACR1	2012	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.119	155	157	6.749	0.732	0.098
HALE1	2012	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	157	6.749	0.732	0.098
HAVO1	2012	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.098	157	157	6.749	0.732	0.098
HACR1	2013	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	151	4.813	0.714	0.098
HALE1	2013	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	151	4.813	0.714	0.098
HAVO1	2013	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.128	148	151	4.813	0.714	0.098
HACR1	2014	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.051	159	159	4.390	0.728	0.051
HALE1	2014	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	159	4.390	0.728	0.051
HAVO1	2014	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.114	157	159	4.390	0.728	0.051
HACR1	2015	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.038	150	150	4.037	0.600	0.038
HALE1	2015	ANN_1YR_G30_902_#	ECf_bext	1/Mm	NA	NA	150	4.037	0.600	0.038
HAVO1	2015	ANN_1YR_G30_902_#	ECf_bext	1/Mm	0.314	125	150	4.037	0.600	0.038

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	90	5.268	0.720	0.078
HALE1	2001	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.224	85	90	5.268	0.720	0.078
HAVO1	2001	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.162	89	90	5.268	0.720	0.078
HACR1	2002	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	125	5.398	0.784	0.118
HALE1	2002	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.199	119	125	5.398	0.784	0.118
HAVO1	2002	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.250	114	125	5.398	0.784	0.118
HACR1	2003	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	145	5.214	0.783	0.104
HALE1	2003	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.171	135	145	5.214	0.783	0.104
HAVO1	2003	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.145	139	145	5.214	0.783	0.104
HACR1	2004	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	153	5.171	0.778	0.123
HALE1	2004	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.222	146	153	5.171	0.778	0.123
HAVO1	2004	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.176	147	153	5.171	0.778	0.123
HACR1	2005	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	159	9.041	0.772	0.057
HALE1	2005	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.198	149	159	9.041	0.772	0.057
HAVO1	2005	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.057	159	159	9.041	0.772	0.057
HACR1	2006	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	155	9.031	0.822	0.069
HALE1	2006	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.218	140	155	9.031	0.822	0.069
HAVO1	2006	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.069	155	155	9.031	0.822	0.069
HACR1	2007	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.029	156	156	7.612	0.694	0.029
HALE1	2007	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.120	149	156	7.612	0.694	0.029
HAVO1	2007	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.066	154	156	7.612	0.694	0.029
HACR1	2008	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.020	156	156	8.516	0.582	0.020
HALE1	2008	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.108	145	156	8.516	0.582	0.020
HAVO1	2008	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.057	155	156	8.516	0.582	0.020
HACR1	2009	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.074	156	157	6.886	0.568	0.064
HALE1	2009	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.159	143	157	6.886	0.568	0.064
HAVO1	2009	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.086	153	157	6.886	0.568	0.064
HACR1	2010	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.036	153	153	4.575	0.495	0.036
HALE1	2010	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.180	131	153	4.575	0.495	0.036
HAVO1	2010	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.097	146	153	4.575	0.495	0.036
HACR1	2011	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.027	150	150	5.091	0.514	0.027
HALE1	2011	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.182	124	150	5.091	0.514	0.027
HAVO1	2011	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.141	138	150	5.091	0.514	0.027
HACR1	2012	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.068	153	157	4.449	0.467	0.026
HALE1	2012	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	157	4.449	0.467	0.026
HAVO1	2012	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.067	154	157	4.449	0.467	0.026

Table E-17

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	151	3.002	0.428	0.037
HALE1	2013	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	151	3.002	0.428	0.037
HAVO1	2013	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.077	139	151	3.002	0.428	0.037
HACR1	2014	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.037	159	159	3.501	0.393	0.037
HALE1	2014	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	159	3.501	0.393	0.037
HAVO1	2014	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.046	158	159	3.501	0.393	0.037
HACR1	2015	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.014	150	150	2.799	0.352	0.014
HALE1	2015	ANN_1YR_G10_902_#	ECf_bext	1/Mm	NA	NA	150	2.799	0.352	0.014
HAVO1	2015	ANN_1YR_G10_902_#	ECf_bext	1/Mm	0.079	133	150	2.799	0.352	0.014

Table E-17: Hawaii IMPROVE site EC Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	90	15.133	3.181	1.061
HALE1	2001	ANN_1YR_G90_902_#	CM_bext	1/Mm	3.200	45	90	15.133	3.181	1.061
HAVO1	2001	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.061	90	90	15.133	3.181	1.061
HACR1	2002	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	125	19.814	3.454	0.377
HALE1	2002	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.695	84	125	19.814	3.454	0.377
HAVO1	2002	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.377	125	125	19.814	3.454	0.377
HACR1	2003	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	145	28.092	3.458	0.606
HALE1	2003	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.404	108	145	28.092	3.458	0.606
HAVO1	2003	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.666	144	145	28.092	3.458	0.606
HACR1	2004	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	153	17.594	2.940	0.888
HALE1	2004	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.213	111	153	17.594	2.940	0.888
HAVO1	2004	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.888	153	153	17.594	2.940	0.888
HACR1	2005	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	159	21.834	3.537	0.956
HALE1	2005	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.860	138	159	21.834	3.537	0.956
HAVO1	2005	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.956	159	159	21.834	3.537	0.956
HACR1	2006	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	155	22.952	3.810	0.408
HALE1	2006	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.292	138	155	22.952	3.810	0.408
HAVO1	2006	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.408	155	155	22.952	3.810	0.408
HACR1	2007	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.443	149	156	16.064	3.828	0.795
HALE1	2007	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.006	137	156	16.064	3.828	0.795
HAVO1	2007	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.795	156	156	16.064	3.828	0.795
HACR1	2008	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.182	155	156	27.408	3.912	1.069
HALE1	2008	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.558	151	156	27.408	3.912	1.069
HAVO1	2008	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.465	125	156	27.408	3.912	1.069
HACR1	2009	ANN_1YR_G90_902_#	CM_bext	1/Mm	2.467	113	157	21.593	3.497	0.837
HALE1	2009	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.887	142	157	21.593	3.497	0.837
HAVO1	2009	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.837	157	157	21.593	3.497	0.837
HACR1	2010	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.235	149	153	18.200	3.732	0.694
HALE1	2010	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.924	130	153	18.200	3.732	0.694
HAVO1	2010	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.694	153	153	18.200	3.732	0.694
HACR1	2011	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.770	149	150	26.045	3.859	0.679
HALE1	2011	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.586	140	150	26.045	3.859	0.679
HAVO1	2011	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.679	150	150	26.045	3.859	0.679
HACR1	2012	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.381	152	157	21.071	4.214	0.844
HALE1	2012	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	157	21.071	4.214	0.844
HAVO1	2012	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.920	156	157	21.071	4.214	0.844

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	151	25.149	3.925	0.699
HALE1	2013	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	151	25.149	3.925	0.699
HAVO1	2013	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.699	151	151	25.149	3.925	0.699
HACR1	2014	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.027	156	159	22.983	4.087	0.809
HALE1	2014	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	159	22.983	4.087	0.809
HAVO1	2014	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.902	158	159	22.983	4.087	0.809
HACR1	2015	ANN_1YR_G90_902_#	CM_bext	1/Mm	1.310	149	150	20.579	3.793	0.734
HALE1	2015	ANN_1YR_G90_902_#	CM_bext	1/Mm	NA	NA	150	20.579	3.793	0.734
HAVO1	2015	ANN_1YR_G90_902_#	CM_bext	1/Mm	0.734	150	150	20.579	3.793	0.734
HACR1	2001	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	90	10.159	2.608	0.639
HALE1	2001	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.595	46	90	10.159	2.608	0.639
HAVO1	2001	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.166	85	90	10.159	2.608	0.639
HACR1	2002	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	125	19.854	2.542	0.723
HALE1	2002	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.557	62	125	19.854	2.542	0.723
HAVO1	2002	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.104	119	125	19.854	2.542	0.723
HACR1	2003	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	145	16.478	2.730	0.803
HALE1	2003	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.533	81	145	16.478	2.730	0.803
HAVO1	2003	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.602	119	145	16.478	2.730	0.803
HACR1	2004	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	153	11.284	2.709	0.629
HALE1	2004	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.033	100	153	11.284	2.709	0.629
HAVO1	2004	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.300	137	153	11.284	2.709	0.629
HACR1	2005	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	159	14.707	2.868	0.669
HALE1	2005	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.844	113	159	14.707	2.868	0.669
HAVO1	2005	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.446	137	159	14.707	2.868	0.669
HACR1	2006	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	155	18.704	2.901	0.698
HALE1	2006	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.059	111	155	18.704	2.901	0.698
HAVO1	2006	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.409	141	155	18.704	2.901	0.698
HACR1	2007	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.993	148	156	13.577	2.969	0.654
HALE1	2007	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.207	109	156	13.577	2.969	0.654
HAVO1	2007	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.615	132	156	13.577	2.969	0.654
HACR1	2008	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.048	150	156	16.035	2.738	0.641
HALE1	2008	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.023	112	156	16.035	2.738	0.641
HAVO1	2008	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.122	104	156	16.035	2.738	0.641
HACR1	2009	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.405	141	157	15.762	2.669	0.594
HALE1	2009	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.923	121	157	15.762	2.669	0.594
HAVO1	2009	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.594	157	157	15.762	2.669	0.594

Table E-18

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.046	146	153	13.396	2.722	0.697
HALE1	2010	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.221	95	153	13.396	2.722	0.697
HAVO1	2010	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.146	143	153	13.396	2.722	0.697
HACR1	2011	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.999	138	150	16.811	2.887	0.502
HALE1	2011	ANN_1YR_G70_902_#	CM_bext	1/Mm	2.136	98	150	16.811	2.887	0.502
HAVO1	2011	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.256	133	150	16.811	2.887	0.502
HACR1	2012	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.989	155	157	16.896	2.967	0.602
HALE1	2012	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	157	16.896	2.967	0.602
HAVO1	2012	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.258	146	157	16.896	2.967	0.602
HACR1	2013	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	151	17.544	2.987	0.763
HALE1	2013	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	151	17.544	2.987	0.763
HAVO1	2013	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.275	140	151	17.544	2.987	0.763
HACR1	2014	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.662	159	159	19.313	2.915	0.662
HALE1	2014	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	159	19.313	2.915	0.662
HAVO1	2014	ANN_1YR_G70_902_#	CM_bext	1/Mm	1.183	149	159	19.313	2.915	0.662
HACR1	2015	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.876	149	150	16.739	2.886	0.848
HALE1	2015	ANN_1YR_G70_902_#	CM_bext	1/Mm	NA	NA	150	16.739	2.886	0.848
HAVO1	2015	ANN_1YR_G70_902_#	CM_bext	1/Mm	0.848	150	150	16.739	2.886	0.848
HACR1	2001	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	90	8.119	1.842	0.571
HALE1	2001	ANN_1YR_G50_902_#	CM_bext	1/Mm	2.281	36	90	8.119	1.842	0.571
HAVO1	2001	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.952	79	90	8.119	1.842	0.571
HACR1	2002	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	125	19.692	2.114	0.435
HALE1	2002	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.988	68	125	19.692	2.114	0.435
HAVO1	2002	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.838	118	125	19.692	2.114	0.435
HACR1	2003	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	145	12.227	2.257	0.415
HALE1	2003	ANN_1YR_G50_902_#	CM_bext	1/Mm	2.271	72	145	12.227	2.257	0.415
HAVO1	2003	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.462	108	145	12.227	2.257	0.415
HACR1	2004	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	153	10.194	2.054	0.384
HALE1	2004	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.697	93	153	10.194	2.054	0.384
HAVO1	2004	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.132	127	153	10.194	2.054	0.384
HACR1	2005	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	159	14.521	2.128	0.448
HALE1	2005	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.743	90	159	14.521	2.128	0.448
HAVO1	2005	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.019	133	159	14.521	2.128	0.448
HACR1	2006	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	155	16.064	2.218	0.442
HALE1	2006	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.726	102	155	16.064	2.218	0.442
HAVO1	2006	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.735	146	155	16.064	2.218	0.442

Table E-18

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.685	147	156	16.287	2.420	0.412
HALE1	2007	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.718	101	156	16.287	2.420	0.412
HAVO1	2007	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.889	141	156	16.287	2.420	0.412
HACR1	2008	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.838	142	156	20.167	2.226	0.500
HALE1	2008	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.553	105	156	20.167	2.226	0.500
HAVO1	2008	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.965	138	156	20.167	2.226	0.500
HACR1	2009	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.284	120	157	13.964	2.261	0.451
HALE1	2009	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.703	99	157	13.964	2.261	0.451
HAVO1	2009	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.976	139	157	13.964	2.261	0.451
HACR1	2010	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.012	128	153	11.660	2.154	0.386
HALE1	2010	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.406	107	153	11.660	2.154	0.386
HAVO1	2010	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.240	115	153	11.660	2.154	0.386
HACR1	2011	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.684	141	150	14.294	2.126	0.388
HALE1	2011	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.783	92	150	14.294	2.126	0.388
HAVO1	2011	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.977	131	150	14.294	2.126	0.388
HACR1	2012	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.739	150	157	14.453	2.277	0.346
HALE1	2012	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	157	14.453	2.277	0.346
HAVO1	2012	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.966	137	157	14.453	2.277	0.346
HACR1	2013	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	151	19.752	1.992	0.465
HALE1	2013	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	151	19.752	1.992	0.465
HAVO1	2013	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.308	110	151	19.752	1.992	0.465
HACR1	2014	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.493	158	159	16.892	2.216	0.448
HALE1	2014	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	159	16.892	2.216	0.448
HAVO1	2014	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.018	138	159	16.892	2.216	0.448
HACR1	2015	ANN_1YR_G50_902_#	CM_bext	1/Mm	0.510	150	150	17.969	2.194	0.510
HALE1	2015	ANN_1YR_G50_902_#	CM_bext	1/Mm	NA	NA	150	17.969	2.194	0.510
HAVO1	2015	ANN_1YR_G50_902_#	CM_bext	1/Mm	1.011	128	150	17.969	2.194	0.510
HACR1	2001	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	90	5.381	1.441	0.204
HALE1	2001	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.691	36	90	5.381	1.441	0.204
HAVO1	2001	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.622	75	90	5.381	1.441	0.204
HACR1	2002	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	125	15.446	1.613	0.235
HALE1	2002	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.639	60	125	15.446	1.613	0.235
HAVO1	2002	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.506	113	125	15.446	1.613	0.235
HACR1	2003	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	145	11.146	1.741	0.173
HALE1	2003	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.426	81	145	11.146	1.741	0.173
HAVO1	2003	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.074	99	145	11.146	1.741	0.173

Table E-18

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	153	8.622	1.411	0.144
HALE1	2004	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.307	82	153	8.622	1.411	0.144
HAVO1	2004	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.844	115	153	8.622	1.411	0.144
HACR1	2005	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	159	10.568	1.582	0.154
HALE1	2005	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.165	91	159	10.568	1.582	0.154
HAVO1	2005	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.767	126	159	10.568	1.582	0.154
HACR1	2006	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	155	11.725	1.707	0.200
HALE1	2006	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.268	91	155	11.725	1.707	0.200
HAVO1	2006	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.388	145	155	11.725	1.707	0.200
HACR1	2007	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.471	144	156	10.620	1.661	0.227
HALE1	2007	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.407	90	156	10.620	1.661	0.227
HAVO1	2007	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.765	127	156	10.620	1.661	0.227
HACR1	2008	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.392	146	156	12.447	1.670	0.254
HALE1	2008	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.322	90	156	12.447	1.670	0.254
HAVO1	2008	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.713	131	156	12.447	1.670	0.254
HACR1	2009	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.775	123	157	11.217	1.641	0.237
HALE1	2009	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.426	87	157	11.217	1.641	0.237
HAVO1	2009	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.630	136	157	11.217	1.641	0.237
HACR1	2010	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.467	138	153	10.082	1.544	0.206
HALE1	2010	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.375	85	153	10.082	1.544	0.206
HAVO1	2010	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.888	110	153	10.082	1.544	0.206
HACR1	2011	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.401	142	150	11.357	1.699	0.206
HALE1	2011	ANN_1YR_G30_902_#	CM_bext	1/Mm	1.509	81	150	11.357	1.699	0.206
HAVO1	2011	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.824	115	150	11.357	1.699	0.206
HACR1	2012	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.429	146	157	11.500	1.557	0.203
HALE1	2012	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	157	11.500	1.557	0.203
HAVO1	2012	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.630	133	157	11.500	1.557	0.203
HACR1	2013	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	151	15.130	1.374	0.147
HALE1	2013	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	151	15.130	1.374	0.147
HAVO1	2013	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.893	104	151	15.130	1.374	0.147
HACR1	2014	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.429	150	159	13.797	1.677	0.290
HALE1	2014	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	159	13.797	1.677	0.290
HAVO1	2014	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.792	123	159	13.797	1.677	0.290
HACR1	2015	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.468	136	150	13.947	1.455	0.237
HALE1	2015	ANN_1YR_G30_902_#	CM_bext	1/Mm	NA	NA	150	13.947	1.455	0.237
HAVO1	2015	ANN_1YR_G30_902_#	CM_bext	1/Mm	0.951	101	150	13.947	1.455	0.237

Table E-18

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	90	4.273	0.844	0.099
HALE1	2001	ANN_1YR_G10_902_#	CM_bext	1/Mm	1.194	31	90	4.273	0.844	0.099
HAVO1	2001	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.350	72	90	4.273	0.844	0.099
HACR1	2002	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	125	11.740	1.042	0.137
HALE1	2002	ANN_1YR_G10_902_#	CM_bext	1/Mm	1.102	57	125	11.740	1.042	0.137
HAVO1	2002	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.206	118	125	11.740	1.042	0.137
HACR1	2003	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	145	7.674	1.040	0.060
HALE1	2003	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.972	76	145	7.674	1.040	0.060
HAVO1	2003	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.504	110	145	7.674	1.040	0.060
HACR1	2004	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	153	6.152	0.877	0.045
HALE1	2004	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.906	74	153	6.152	0.877	0.045
HAVO1	2004	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.473	115	153	6.152	0.877	0.045
HACR1	2005	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	159	7.340	0.923	0.056
HALE1	2005	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.759	92	159	7.340	0.923	0.056
HAVO1	2005	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.390	121	159	7.340	0.923	0.056
HACR1	2006	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	155	6.871	1.111	0.095
HALE1	2006	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.833	93	155	6.871	1.111	0.095
HAVO1	2006	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.292	134	155	6.871	1.111	0.095
HACR1	2007	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.233	144	156	9.672	1.042	0.114
HALE1	2007	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.865	87	156	9.672	1.042	0.114
HAVO1	2007	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.499	117	156	9.672	1.042	0.114
HACR1	2008	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.206	146	156	9.490	0.956	0.069
HALE1	2008	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.853	86	156	9.490	0.956	0.069
HAVO1	2008	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.427	123	156	9.490	0.956	0.069
HACR1	2009	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.498	116	157	6.818	1.016	0.135
HALE1	2009	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.953	88	157	6.818	1.016	0.135
HAVO1	2009	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.293	139	157	6.818	1.016	0.135
HACR1	2010	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.223	136	153	5.645	0.847	0.062
HALE1	2010	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.855	76	153	5.645	0.847	0.062
HAVO1	2010	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.487	103	153	5.645	0.847	0.062
HACR1	2011	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.194	143	150	7.431	1.021	0.110
HALE1	2011	ANN_1YR_G10_902_#	CM_bext	1/Mm	1.007	76	150	7.431	1.021	0.110
HAVO1	2011	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.531	108	150	7.431	1.021	0.110
HACR1	2012	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.262	142	157	6.673	0.944	0.117
HALE1	2012	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	157	6.673	0.944	0.117
HAVO1	2012	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.393	129	157	6.673	0.944	0.117

Table E-18

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	151	9.669	0.882	0.073
HALE1	2013	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	151	9.669	0.882	0.073
HAVO1	2013	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.591	99	151	9.669	0.882	0.073
HACR1	2014	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.195	152	159	9.552	0.899	0.077
HALE1	2014	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	159	9.552	0.899	0.077
HAVO1	2014	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.745	90	159	9.552	0.899	0.077
HACR1	2015	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.238	132	150	9.853	0.787	0.097
HALE1	2015	ANN_1YR_G10_902_#	CM_bext	1/Mm	NA	NA	150	9.853	0.787	0.097
HAVO1	2015	ANN_1YR_G10_902_#	CM_bext	1/Mm	0.734	85	150	9.853	0.787	0.097

Table E-18: Hawaii IMPROVE site CM Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	90	46.897	10.642	2.129
HALE1	2001	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.205	89	90	46.897	10.642	2.129
HAVO1	2001	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	3.629	88	90	46.897	10.642	2.129
HACR1	2002	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	125	70.435	15.632	2.966
HALE1	2002	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.966	125	125	70.435	15.632	2.966
HAVO1	2002	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	3.864	123	125	70.435	15.632	2.966
HACR1	2003	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	145	113.069	15.052	1.284
HALE1	2003	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	3.551	143	145	113.069	15.052	1.284
HAVO1	2003	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.284	145	145	113.069	15.052	1.284
HACR1	2004	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	153	52.180	11.970	0.869
HALE1	2004	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.840	150	153	52.180	11.970	0.869
HAVO1	2004	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.185	152	153	52.180	11.970	0.869
HACR1	2005	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	159	64.992	11.358	0.908
HALE1	2005	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.327	156	159	64.992	11.358	0.908
HAVO1	2005	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.379	158	159	64.992	11.358	0.908
HACR1	2006	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	155	73.803	12.693	0.873
HALE1	2006	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.985	152	155	73.803	12.693	0.873
HAVO1	2006	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.996	154	155	73.803	12.693	0.873
HACR1	2007	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	4.067	146	156	136.545	12.591	0.542
HALE1	2007	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.007	154	156	136.545	12.591	0.542
HAVO1	2007	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.544	155	156	136.545	12.591	0.542
HACR1	2008	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.736	156	156	138.959	12.054	0.736
HALE1	2008	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.745	152	156	138.959	12.054	0.736
HAVO1	2008	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.658	153	156	138.959	12.054	0.736
HACR1	2009	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.694	157	157	58.649	9.365	0.694
HALE1	2009	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	3.034	150	157	58.649	9.365	0.694
HAVO1	2009	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.902	156	157	58.649	9.365	0.694
HACR1	2010	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.843	153	153	46.757	9.150	0.843
HALE1	2010	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.646	150	153	46.757	9.150	0.843
HAVO1	2010	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.019	152	153	46.757	9.150	0.843
HACR1	2011	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.747	149	150	83.656	11.362	0.593
HALE1	2011	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	2.297	145	150	83.656	11.362	0.593
HAVO1	2011	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.593	150	150	83.656	11.362	0.593
HACR1	2012	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.625	156	157	181.426	10.242	0.619
HALE1	2012	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	157	181.426	10.242	0.619
HAVO1	2012	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.619	157	157	181.426	10.242	0.619

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	151	60.809	8.638	0.820
HALE1	2013	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	151	60.809	8.638	0.820
HAVO1	2013	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.996	150	151	60.809	8.638	0.820
HACR1	2014	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.799	159	159	42.827	8.606	0.799
HALE1	2014	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	159	42.827	8.606	0.799
HAVO1	2014	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.833	156	159	42.827	8.606	0.799
HACR1	2015	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	0.798	150	150	69.047	12.889	0.798
HALE1	2015	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	NA	NA	150	69.047	12.889	0.798
HAVO1	2015	ANN_1YR_G90_902_#	OMCf_bext	1/Mm	1.495	148	150	69.047	12.889	0.798
HACR1	2001	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	90	21.171	5.665	1.512
HALE1	2001	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.993	88	90	21.171	5.665	1.512
HAVO1	2001	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	2.604	85	90	21.171	5.665	1.512
HACR1	2002	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	125	23.874	6.605	0.886
HALE1	2002	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	2.345	122	125	23.874	6.605	0.886
HAVO1	2002	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	3.125	117	125	23.874	6.605	0.886
HACR1	2003	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	145	27.557	7.304	0.701
HALE1	2003	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	3.031	137	145	27.557	7.304	0.701
HAVO1	2003	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.530	144	145	27.557	7.304	0.701
HACR1	2004	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	153	24.120	6.307	0.872
HALE1	2004	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	2.564	148	153	24.120	6.307	0.872
HAVO1	2004	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.419	151	153	24.120	6.307	0.872
HACR1	2005	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	159	36.677	5.844	0.701
HALE1	2005	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.928	155	159	36.677	5.844	0.701
HAVO1	2005	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.757	158	159	36.677	5.844	0.701
HACR1	2006	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	155	30.207	5.899	0.505
HALE1	2006	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	2.197	148	155	30.207	5.899	0.505
HAVO1	2006	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.505	155	155	30.207	5.899	0.505
HACR1	2007	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.631	156	156	28.935	5.864	0.631
HALE1	2007	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.626	151	156	28.935	5.864	0.631
HAVO1	2007	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.004	154	156	28.935	5.864	0.631
HACR1	2008	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.796	155	156	39.238	5.362	0.548
HALE1	2008	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.686	149	156	39.238	5.362	0.548
HAVO1	2008	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.548	156	156	39.238	5.362	0.548
HACR1	2009	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.292	157	157	22.633	4.898	0.292
HALE1	2009	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.426	152	157	22.633	4.898	0.292
HAVO1	2009	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.598	156	157	22.633	4.898	0.292

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.614	152	153	25.166	4.728	0.429
HALE1	2010	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.705	148	153	25.166	4.728	0.429
HAVO1	2010	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.429	153	153	25.166	4.728	0.429
HACR1	2011	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.616	149	150	24.379	5.030	0.328
HALE1	2011	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.812	142	150	24.379	5.030	0.328
HAVO1	2011	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.328	150	150	24.379	5.030	0.328
HACR1	2012	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.457	157	157	23.740	5.209	0.457
HALE1	2012	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	157	23.740	5.209	0.457
HAVO1	2012	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.672	156	157	23.740	5.209	0.457
HACR1	2013	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	151	28.223	4.456	0.638
HALE1	2013	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	151	28.223	4.456	0.638
HAVO1	2013	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.638	151	151	28.223	4.456	0.638
HACR1	2014	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.363	159	159	18.480	4.498	0.363
HALE1	2014	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	159	18.480	4.498	0.363
HAVO1	2014	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.309	155	159	18.480	4.498	0.363
HACR1	2015	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	0.646	150	150	24.371	5.130	0.646
HALE1	2015	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	NA	NA	150	24.371	5.130	0.646
HAVO1	2015	ANN_1YR_G70_902_#	OMCf_bext	1/Mm	1.319	147	150	24.371	5.130	0.646
HACR1	2001	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	90	13.925	3.598	0.976
HALE1	2001	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.381	88	90	13.925	3.598	0.976
HAVO1	2001	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	2.296	80	90	13.925	3.598	0.976
HACR1	2002	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	125	15.861	4.089	0.806
HALE1	2002	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.834	119	125	15.861	4.089	0.806
HAVO1	2002	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	2.173	110	125	15.861	4.089	0.806
HACR1	2003	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	145	19.227	4.976	0.681
HALE1	2003	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.564	141	145	19.227	4.976	0.681
HAVO1	2003	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.723	144	145	19.227	4.976	0.681
HACR1	2004	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	153	17.321	4.357	0.690
HALE1	2004	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.900	144	153	17.321	4.357	0.690
HAVO1	2004	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.888	152	153	17.321	4.357	0.690
HACR1	2005	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	159	24.928	4.148	0.386
HALE1	2005	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.357	151	159	24.928	4.148	0.386
HAVO1	2005	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.386	159	159	24.928	4.148	0.386
HACR1	2006	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	155	22.815	3.804	0.406
HALE1	2006	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.195	149	155	22.815	3.804	0.406
HAVO1	2006	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.406	155	155	22.815	3.804	0.406

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.678	155	156	22.424	3.805	0.408
HALE1	2007	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.277	149	156	22.424	3.805	0.408
HAVO1	2007	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.408	156	156	22.424	3.805	0.408
HACR1	2008	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.361	156	156	23.116	3.879	0.361
HALE1	2008	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.386	150	156	23.116	3.879	0.361
HAVO1	2008	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.601	154	156	23.116	3.879	0.361
HACR1	2009	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.191	157	157	14.926	3.364	0.191
HALE1	2009	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.135	152	157	14.926	3.364	0.191
HAVO1	2009	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.208	156	157	14.926	3.364	0.191
HACR1	2010	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.261	153	153	16.123	3.384	0.261
HALE1	2010	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.137	147	153	16.123	3.384	0.261
HAVO1	2010	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.406	152	153	16.123	3.384	0.261
HACR1	2011	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.335	149	150	18.818	3.185	0.325
HALE1	2011	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	1.381	139	150	18.818	3.185	0.325
HAVO1	2011	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.325	150	150	18.818	3.185	0.325
HACR1	2012	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.262	157	157	13.728	3.421	0.262
HALE1	2012	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	157	13.728	3.421	0.262
HAVO1	2012	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.365	156	157	13.728	3.421	0.262
HACR1	2013	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	151	13.171	3.019	0.397
HALE1	2013	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	151	13.171	3.019	0.397
HAVO1	2013	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.397	151	151	13.171	3.019	0.397
HACR1	2014	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.375	159	159	14.670	3.103	0.375
HALE1	2014	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	159	14.670	3.103	0.375
HAVO1	2014	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.555	158	159	14.670	3.103	0.375
HACR1	2015	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.319	150	150	13.514	3.357	0.319
HALE1	2015	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	NA	NA	150	13.514	3.357	0.319
HAVO1	2015	ANN_1YR_G50_902_#	OMCf_bext	1/Mm	0.623	149	150	13.514	3.357	0.319
HACR1	2001	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	90	11.598	2.575	0.588
HALE1	2001	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.022	87	90	11.598	2.575	0.588
HAVO1	2001	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.841	69	90	11.598	2.575	0.588
HACR1	2002	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	125	11.872	2.949	0.526
HALE1	2002	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.315	118	125	11.872	2.949	0.526
HAVO1	2002	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	2.353	80	125	11.872	2.949	0.526
HACR1	2003	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	145	12.612	3.394	0.313
HALE1	2003	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.191	132	145	12.612	3.394	0.313
HAVO1	2003	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.412	144	145	12.612	3.394	0.313

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	153	10.361	3.158	0.597
HALE1	2004	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.245	140	153	10.361	3.158	0.597
HAVO1	2004	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.604	152	153	10.361	3.158	0.597
HACR1	2005	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	159	18.461	2.765	0.275
HALE1	2005	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.642	153	159	18.461	2.765	0.275
HAVO1	2005	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.275	159	159	18.461	2.765	0.275
HACR1	2006	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	155	16.303	2.676	0.309
HALE1	2006	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.027	138	155	16.303	2.676	0.309
HAVO1	2006	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.314	154	155	16.303	2.676	0.309
HACR1	2007	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.137	156	156	15.166	2.695	0.137
HALE1	2007	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.118	139	156	15.166	2.695	0.137
HAVO1	2007	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.440	155	156	15.166	2.695	0.137
HACR1	2008	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.119	156	156	14.516	2.721	0.119
HALE1	2008	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.901	144	156	14.516	2.721	0.119
HAVO1	2008	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.274	155	156	14.516	2.721	0.119
HACR1	2009	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.137	157	157	9.224	2.368	0.137
HALE1	2009	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.693	147	157	9.224	2.368	0.137
HAVO1	2009	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.416	155	157	9.224	2.368	0.137
HACR1	2010	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.178	152	153	12.376	2.483	0.155
HALE1	2010	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.075	132	153	12.376	2.483	0.155
HAVO1	2010	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.155	153	153	12.376	2.483	0.155
HACR1	2011	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.072	150	150	12.930	2.352	0.072
HALE1	2011	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	1.236	119	150	12.930	2.352	0.072
HAVO1	2011	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.162	149	150	12.930	2.352	0.072
HACR1	2012	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.204	157	157	10.260	2.138	0.204
HALE1	2012	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	157	10.260	2.138	0.204
HAVO1	2012	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.226	156	157	10.260	2.138	0.204
HACR1	2013	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	151	8.873	2.156	0.216
HALE1	2013	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	151	8.873	2.156	0.216
HAVO1	2013	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.286	150	151	8.873	2.156	0.216
HACR1	2014	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.237	159	159	9.172	2.207	0.237
HALE1	2014	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	159	9.172	2.207	0.237
HAVO1	2014	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.407	156	159	9.172	2.207	0.237
HACR1	2015	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.326	150	150	9.148	2.563	0.326
HALE1	2015	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	NA	NA	150	9.148	2.563	0.326
HAVO1	2015	ANN_1YR_G30_902_#	OMCf_bext	1/Mm	0.509	148	150	9.148	2.563	0.326

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	90	7.185	1.555	0.189
HALE1	2001	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.431	87	90	7.185	1.555	0.189
HAVO1	2001	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	1.669	43	90	7.185	1.555	0.189
HACR1	2002	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	125	7.658	1.833	0.221
HALE1	2002	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.653	111	125	7.658	1.833	0.221
HAVO1	2002	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	1.854	62	125	7.658	1.833	0.221
HACR1	2003	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	145	9.679	1.889	0.180
HALE1	2003	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.744	126	145	9.679	1.889	0.180
HAVO1	2003	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.279	143	145	9.679	1.889	0.180
HACR1	2004	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	153	7.467	1.933	0.190
HALE1	2004	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.858	130	153	7.467	1.933	0.190
HAVO1	2004	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.504	145	153	7.467	1.933	0.190
HACR1	2005	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	159	12.521	1.664	0.091
HALE1	2005	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.553	138	159	12.521	1.664	0.091
HAVO1	2005	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.091	159	159	12.521	1.664	0.091
HACR1	2006	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	155	9.919	1.597	0.078
HALE1	2006	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.433	139	155	9.919	1.597	0.078
HAVO1	2006	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.078	155	155	9.919	1.597	0.078
HACR1	2007	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.130	156	156	9.550	1.681	0.130
HALE1	2007	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.570	140	156	9.550	1.681	0.130
HAVO1	2007	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.210	153	156	9.550	1.681	0.130
HACR1	2008	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.026	156	156	9.182	1.523	0.026
HALE1	2008	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.518	135	156	9.182	1.523	0.026
HAVO1	2008	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.145	155	156	9.182	1.523	0.026
HACR1	2009	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.052	157	157	6.514	1.456	0.052
HALE1	2009	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.479	136	157	6.514	1.456	0.052
HAVO1	2009	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.081	156	157	6.514	1.456	0.052
HACR1	2010	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.046	153	153	7.318	1.416	0.046
HALE1	2010	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.672	124	153	7.318	1.416	0.046
HAVO1	2010	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.147	151	153	7.318	1.416	0.046
HACR1	2011	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.048	150	150	6.850	1.386	0.048
HALE1	2011	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.732	109	150	6.850	1.386	0.048
HAVO1	2011	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.199	146	150	6.850	1.386	0.048
HACR1	2012	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.108	156	157	7.827	1.341	0.068
HALE1	2012	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	157	7.827	1.341	0.068
HAVO1	2012	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.151	154	157	7.827	1.341	0.068

Table E-19

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	151	5.827	1.234	0.119
HALE1	2013	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	151	5.827	1.234	0.119
HAVO1	2013	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.210	145	151	5.827	1.234	0.119
HACR1	2014	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.134	158	159	6.404	1.240	0.106
HALE1	2014	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	159	6.404	1.240	0.106
HAVO1	2014	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.227	154	159	6.404	1.240	0.106
HACR1	2015	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.110	150	150	6.609	1.473	0.110
HALE1	2015	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	NA	NA	150	6.609	1.473	0.110
HAVO1	2015	ANN_1YR_G10_902_#	OMCf_bext	1/Mm	0.389	142	150	6.609	1.473	0.110

Table E-19: Hawaii IMPROVE site POM Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	90	19.465	0.032	0.007
HALE1	2001	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.420	6	90	19.465	0.032	0.007
HAVO1	2001	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.332	4	90	19.465	0.032	0.007
HACR1	2002	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	125	23.151	0.058	0.002
HALE1	2002	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.741	14	125	23.151	0.058	0.002
HAVO1	2002	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.427	24	125	23.151	0.058	0.002
HACR1	2003	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	145	24.120	0.076	0.001
HALE1	2003	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.258	12	145	24.120	0.076	0.001
HAVO1	2003	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.065	77	145	24.120	0.076	0.001
HACR1	2004	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	153	29.031	0.318	0.008
HALE1	2004	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.732	16	153	29.031	0.318	0.008
HAVO1	2004	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.437	20	153	29.031	0.318	0.008
HACR1	2005	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	20.296	0.219	0.005
HALE1	2005	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.128	13	159	20.296	0.219	0.005
HAVO1	2005	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.517	15	159	20.296	0.219	0.005
HACR1	2006	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	155	27.631	0.260	0.004
HALE1	2006	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.474	12	155	27.631	0.260	0.004
HAVO1	2006	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.472	21	155	27.631	0.260	0.004
HACR1	2007	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.011	27	156	31.635	0.258	0.014
HALE1	2007	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.458	11	156	31.635	0.258	0.014
HAVO1	2007	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.238	22	156	31.635	0.258	0.014
HACR1	2008	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.599	61	156	27.556	0.316	0.006
HALE1	2008	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.322	33	156	27.556	0.316	0.006
HAVO1	2008	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.455	30	156	27.556	0.316	0.006
HACR1	2009	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.617	44	157	23.861	0.275	0.003
HALE1	2009	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.506	24	157	23.861	0.275	0.003
HAVO1	2009	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.772	37	157	23.861	0.275	0.003
HACR1	2010	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.745	31	153	26.515	0.168	0.002
HALE1	2010	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.414	13	153	26.515	0.168	0.002
HAVO1	2010	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	0.824	29	153	26.515	0.168	0.002
HACR1	2011	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.061	37	150	26.189	0.401	0.036
HALE1	2011	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.208	22	150	26.189	0.401	0.036
HAVO1	2011	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.525	17	150	26.189	0.401	0.036
HACR1	2012	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.054	37	157	33.520	0.338	0.034
HALE1	2012	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	157	33.520	0.338	0.034
HAVO1	2012	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.970	24	157	33.520	0.338	0.034

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	26.891	0.317	0.017
HALE1	2013	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	26.891	0.317	0.017
HAVO1	2013	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.646	27	151	26.891	0.317	0.017
HACR1	2014	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.367	28	159	27.870	0.343	0.022
HALE1	2014	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	27.870	0.343	0.022
HAVO1	2014	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	2.261	22	159	27.870	0.343	0.022
HACR1	2015	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.391	28	150	23.887	0.253	0.014
HALE1	2015	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	NA	NA	150	23.887	0.253	0.014
HAVO1	2015	ANN_1YR_G90_902_#	SeaSaltf_bext	1/Mm	1.528	26	150	23.887	0.253	0.014
HACR1	2001	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	90	10.339	0.023	0.006
HALE1	2001	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	1.456	5	90	10.339	0.023	0.006
HAVO1	2001	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.316	4	90	10.339	0.023	0.006
HACR1	2002	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	125	21.817	0.063	0.002
HALE1	2002	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.637	20	125	21.817	0.063	0.002
HAVO1	2002	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.336	5	125	21.817	0.063	0.002
HACR1	2003	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	145	8.872	0.076	0.001
HALE1	2003	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.050	11	145	8.872	0.076	0.001
HAVO1	2003	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.610	9	145	8.872	0.076	0.001
HACR1	2004	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	153	16.576	0.265	0.003
HALE1	2004	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	1.814	15	153	16.576	0.265	0.003
HAVO1	2004	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.751	7	153	16.576	0.265	0.003
HACR1	2005	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	17.304	0.235	0.001
HALE1	2005	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.229	9	159	17.304	0.235	0.001
HAVO1	2005	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	4.130	8	159	17.304	0.235	0.001
HACR1	2006	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	155	13.760	0.253	0.002
HALE1	2006	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.652	15	155	13.760	0.253	0.002
HAVO1	2006	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.835	8	155	13.760	0.253	0.002
HACR1	2007	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.892	34	156	19.755	0.307	0.008
HALE1	2007	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.778	15	156	19.755	0.307	0.008
HAVO1	2007	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	4.645	7	156	19.755	0.307	0.008
HACR1	2008	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.711	40	156	17.594	0.193	0.004
HALE1	2008	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.649	13	156	17.594	0.193	0.004
HAVO1	2008	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.291	10	156	17.594	0.193	0.004
HACR1	2009	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.769	39	157	12.661	0.216	0.001
HALE1	2009	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	2.326	15	157	12.661	0.216	0.001
HAVO1	2009	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	1.272	31	157	12.661	0.216	0.001

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.890	27	153	18.352	0.131	0.002
HALE1	2010	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.244	10	153	18.352	0.131	0.002
HAVO1	2010	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.843	8	153	18.352	0.131	0.002
HACR1	2011	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	1.040	35	150	16.915	0.322	0.009
HALE1	2011	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.817	9	150	16.915	0.322	0.009
HAVO1	2011	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.886	8	150	16.915	0.322	0.009
HACR1	2012	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.983	32	157	18.390	0.241	0.024
HALE1	2012	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	157	18.390	0.241	0.024
HAVO1	2012	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.324	12	157	18.390	0.241	0.024
HACR1	2013	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	22.334	0.292	0.007
HALE1	2013	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	22.334	0.292	0.007
HAVO1	2013	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	4.473	9	151	22.334	0.292	0.007
HACR1	2014	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.837	37	159	16.348	0.267	0.013
HALE1	2014	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	16.348	0.267	0.013
HAVO1	2014	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.835	9	159	16.348	0.267	0.013
HACR1	2015	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	0.936	33	150	17.117	0.248	0.010
HALE1	2015	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	NA	NA	150	17.117	0.248	0.010
HAVO1	2015	ANN_1YR_G70_902_#	SeaSaltf_bext	1/Mm	3.138	10	150	17.117	0.248	0.010
HACR1	2001	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	90	4.731	0.036	0.005
HALE1	2001	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.404	7	90	4.731	0.036	0.005
HAVO1	2001	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.695	3	90	4.731	0.036	0.005
HACR1	2002	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	125	14.431	0.112	0.001
HALE1	2002	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.313	10	125	14.431	0.112	0.001
HAVO1	2002	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.578	8	125	14.431	0.112	0.001
HACR1	2003	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	145	5.474	0.101	0.002
HALE1	2003	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.991	9	145	5.474	0.101	0.002
HAVO1	2003	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.835	6	145	5.474	0.101	0.002
HACR1	2004	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	153	12.620	0.278	0.002
HALE1	2004	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.614	15	153	12.620	0.278	0.002
HAVO1	2004	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.523	7	153	12.620	0.278	0.002
HACR1	2005	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	9.516	0.229	0.001
HALE1	2005	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.114	8	159	9.516	0.229	0.001
HAVO1	2005	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.969	9	159	9.516	0.229	0.001
HACR1	2006	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	155	10.334	0.257	0.001
HALE1	2006	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.263	16	155	10.334	0.257	0.001
HAVO1	2006	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.934	12	155	10.334	0.257	0.001

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.811	38	156	13.662	0.294	0.012
HALE1	2007	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.331	9	156	13.662	0.294	0.012
HAVO1	2007	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.854	12	156	13.662	0.294	0.012
HACR1	2008	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.708	32	156	12.790	0.200	0.002
HALE1	2008	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.074	15	156	12.790	0.200	0.002
HAVO1	2008	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.059	12	156	12.790	0.200	0.002
HACR1	2009	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.810	31	157	11.652	0.252	0.002
HALE1	2009	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.570	13	157	11.652	0.252	0.002
HAVO1	2009	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.477	10	157	11.652	0.252	0.002
HACR1	2010	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.680	30	153	10.561	0.143	0.001
HALE1	2010	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	1.963	15	153	10.561	0.143	0.001
HAVO1	2010	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.197	8	153	10.561	0.143	0.001
HACR1	2011	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.911	35	150	11.388	0.359	0.021
HALE1	2011	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.334	17	150	11.388	0.359	0.021
HAVO1	2011	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	2.568	15	150	11.388	0.359	0.021
HACR1	2012	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.795	32	157	10.269	0.217	0.007
HALE1	2012	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	157	10.269	0.217	0.007
HAVO1	2012	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.084	10	157	10.269	0.217	0.007
HACR1	2013	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	14.568	0.226	0.005
HALE1	2013	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	14.568	0.226	0.005
HAVO1	2013	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.526	10	151	14.568	0.226	0.005
HACR1	2014	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.554	44	159	10.214	0.220	0.011
HALE1	2014	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	10.214	0.220	0.011
HAVO1	2014	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	3.279	7	159	10.214	0.220	0.011
HACR1	2015	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	0.656	34	150	11.015	0.192	0.005
HALE1	2015	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	NA	NA	150	11.015	0.192	0.005
HAVO1	2015	ANN_1YR_G50_902_#	SeaSaltf_bext	1/Mm	4.140	7	150	11.015	0.192	0.005
HACR1	2001	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	90	2.955	0.060	0.005
HALE1	2001	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.503	4	90	2.955	0.060	0.005
HAVO1	2001	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.284	5	90	2.955	0.060	0.005
HACR1	2002	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	125	6.599	0.090	0.001
HALE1	2002	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.564	8	125	6.599	0.090	0.001
HAVO1	2002	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.215	12	125	6.599	0.090	0.001
HACR1	2003	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	145	5.402	0.090	0.001
HALE1	2003	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.560	8	145	5.402	0.090	0.001
HAVO1	2003	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.617	7	145	5.402	0.090	0.001

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	153	8.305	0.247	0.002
HALE1	2004	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.019	13	153	8.305	0.247	0.002
HAVO1	2004	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	3.235	9	153	8.305	0.247	0.002
HACR1	2005	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	6.407	0.198	0.001
HALE1	2005	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.931	13	159	6.407	0.198	0.001
HAVO1	2005	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.087	11	159	6.407	0.198	0.001
HACR1	2006	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	155	7.331	0.209	0.001
HALE1	2006	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.637	16	155	7.331	0.209	0.001
HAVO1	2006	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.087	14	155	7.331	0.209	0.001
HACR1	2007	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.541	45	156	7.754	0.249	0.005
HALE1	2007	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.077	16	156	7.754	0.249	0.005
HAVO1	2007	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.343	13	156	7.754	0.249	0.005
HACR1	2008	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.495	43	156	7.483	0.196	0.006
HALE1	2008	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.031	17	156	7.483	0.196	0.006
HAVO1	2008	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.502	13	156	7.483	0.196	0.006
HACR1	2009	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.563	36	157	7.763	0.173	0.001
HALE1	2009	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.511	13	157	7.763	0.173	0.001
HAVO1	2009	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.767	10	157	7.763	0.173	0.001
HACR1	2010	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.395	37	153	7.367	0.133	0.001
HALE1	2010	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.772	15	153	7.367	0.133	0.001
HAVO1	2010	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.137	13	153	7.367	0.133	0.001
HACR1	2011	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.630	40	150	7.280	0.296	0.003
HALE1	2011	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.207	18	150	7.280	0.296	0.003
HAVO1	2011	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.227	17	150	7.280	0.296	0.003
HACR1	2012	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.502	34	157	7.840	0.192	0.008
HALE1	2012	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	157	7.840	0.192	0.008
HAVO1	2012	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	1.940	14	157	7.840	0.192	0.008
HACR1	2013	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	7.688	0.202	0.002
HALE1	2013	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	7.688	0.202	0.002
HAVO1	2013	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.549	10	151	7.688	0.202	0.002
HACR1	2014	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.323	51	159	8.707	0.191	0.010
HALE1	2014	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	8.707	0.191	0.010
HAVO1	2014	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.082	14	159	8.707	0.191	0.010
HACR1	2015	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	0.435	35	150	7.353	0.158	0.003
HALE1	2015	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	NA	NA	150	7.353	0.158	0.003
HAVO1	2015	ANN_1YR_G30_902_#	SeaSaltf_bext	1/Mm	2.913	8	150	7.353	0.158	0.003

Table E-20

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	90	2.746	0.054	0.004
HALE1	2001	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.105	8	90	2.746	0.054	0.004
HAVO1	2001	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.680	11	90	2.746	0.054	0.004
HACR1	2002	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	125	3.704	0.068	0.001
HALE1	2002	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.015	12	125	3.704	0.068	0.001
HAVO1	2002	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.664	16	125	3.704	0.068	0.001
HACR1	2003	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	145	2.904	0.052	0.001
HALE1	2003	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.933	12	145	2.904	0.052	0.001
HAVO1	2003	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.960	10	145	2.904	0.052	0.001
HACR1	2004	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	153	3.837	0.164	0.002
HALE1	2004	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.295	14	153	3.837	0.164	0.002
HAVO1	2004	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.323	13	153	3.837	0.164	0.002
HACR1	2005	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	4.318	0.140	0.001
HALE1	2005	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.064	16	159	4.318	0.140	0.001
HAVO1	2005	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.425	10	159	4.318	0.140	0.001
HACR1	2006	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	155	4.615	0.169	0.001
HALE1	2006	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.415	17	155	4.615	0.169	0.001
HAVO1	2006	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.396	18	155	4.615	0.169	0.001
HACR1	2007	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.314	59	156	3.999	0.207	0.004
HALE1	2007	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.632	14	156	3.999	0.207	0.004
HAVO1	2007	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.711	12	156	3.999	0.207	0.004
HACR1	2008	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.265	53	156	3.506	0.123	0.007
HALE1	2008	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.681	14	156	3.506	0.123	0.007
HAVO1	2008	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.813	12	156	3.506	0.123	0.007
HACR1	2009	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.331	38	157	4.532	0.130	0.001
HALE1	2009	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.667	14	157	4.532	0.130	0.001
HAVO1	2009	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.441	16	157	4.532	0.130	0.001
HACR1	2010	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.198	47	153	4.110	0.091	0.001
HALE1	2010	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.474	10	153	4.110	0.091	0.001
HAVO1	2010	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.323	12	153	4.110	0.091	0.001
HACR1	2011	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.325	52	150	4.539	0.237	0.006
HALE1	2011	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.697	14	150	4.539	0.237	0.006
HAVO1	2011	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.139	19	150	4.539	0.237	0.006
HACR1	2012	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.286	43	157	4.981	0.128	0.005
HALE1	2012	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	157	4.981	0.128	0.005
HAVO1	2012	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.073	16	157	4.981	0.128	0.005

Table E-20

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	6.004	0.110	0.002
HALE1	2013	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	151	6.004	0.110	0.002
HAVO1	2013	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.431	15	151	6.004	0.110	0.002
HACR1	2014	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.161	76	159	4.557	0.144	0.005
HALE1	2014	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	159	4.557	0.144	0.005
HAVO1	2014	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.172	16	159	4.557	0.144	0.005
HACR1	2015	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	0.155	51	150	4.158	0.086	0.001
HALE1	2015	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	NA	NA	150	4.158	0.086	0.001
HAVO1	2015	ANN_1YR_G10_902_#	SeaSaltf_bext	1/Mm	1.358	14	150	4.158	0.086	0.001

Table E-20: Hawaii IMPROVE site Sea Salt Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	90	7.123	1.152	0.225
HALE1	2001	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.362	86	90	7.123	1.152	0.225
HAVO1	2001	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.225	90	90	7.123	1.152	0.225
HACR1	2002	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	125	9.272	1.050	0.171
HALE1	2002	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.391	120	125	9.272	1.050	0.171
HAVO1	2002	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.198	123	125	9.272	1.050	0.171
HACR1	2003	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	145	7.785	0.771	0.147
HALE1	2003	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.324	138	145	7.785	0.771	0.147
HAVO1	2003	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.446	129	145	7.785	0.771	0.147
HACR1	2004	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	153	6.731	0.871	0.128
HALE1	2004	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.319	145	153	6.731	0.871	0.128
HAVO1	2004	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.311	147	153	6.731	0.871	0.128
HACR1	2005	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	159	7.841	0.709	0.091
HALE1	2005	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.336	142	159	7.841	0.709	0.091
HAVO1	2005	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.256	149	159	7.841	0.709	0.091
HACR1	2006	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	155	9.345	0.975	0.166
HALE1	2006	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.326	150	155	9.345	0.975	0.166
HAVO1	2006	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.230	154	155	9.345	0.975	0.166
HACR1	2007	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.536	132	156	8.065	0.861	0.166
HALE1	2007	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.394	141	156	8.065	0.861	0.166
HAVO1	2007	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.284	147	156	8.065	0.861	0.166
HACR1	2008	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.427	139	156	10.583	0.962	0.148
HALE1	2008	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.421	141	156	10.583	0.962	0.148
HAVO1	2008	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.749	108	156	10.583	0.962	0.148
HACR1	2009	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.359	151	157	8.543	0.810	0.234
HALE1	2009	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.413	143	157	8.543	0.810	0.234
HAVO1	2009	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	1.179	52	157	8.543	0.810	0.234
HACR1	2010	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.703	109	153	12.413	0.913	0.162
HALE1	2010	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.306	146	153	12.413	0.913	0.162
HAVO1	2010	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.768	100	153	12.413	0.913	0.162
HACR1	2011	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.319	118	150	5.930	0.635	0.112
HALE1	2011	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.180	144	150	5.930	0.635	0.112
HAVO1	2011	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.175	147	150	5.930	0.635	0.112
HACR1	2012	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.541	119	157	8.956	1.119	0.070
HALE1	2012	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	157	8.956	1.119	0.070
HAVO1	2012	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.199	153	157	8.956	1.119	0.070

Table E-21

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	151	6.819	0.868	0.090
HALE1	2013	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	151	6.819	0.868	0.090
HAVO1	2013	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.192	147	151	6.819	0.868	0.090
HACR1	2014	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.422	124	159	7.359	0.883	0.135
HALE1	2014	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	159	7.359	0.883	0.135
HAVO1	2014	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.251	146	159	7.359	0.883	0.135
HACR1	2015	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.247	141	150	7.928	0.845	0.144
HALE1	2015	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	NA	NA	150	7.928	0.845	0.144
HAVO1	2015	ANN_1YR_G90_902_#	SOILf_bext	1/Mm	0.173	147	150	7.928	0.845	0.144
HACR1	2001	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	90	3.869	0.773	0.206
HALE1	2001	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.318	85	90	3.869	0.773	0.206
HAVO1	2001	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.237	88	90	3.869	0.773	0.206
HACR1	2002	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	125	4.228	0.677	0.130
HALE1	2002	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.282	114	125	4.228	0.677	0.130
HAVO1	2002	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.193	123	125	4.228	0.677	0.130
HACR1	2003	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	145	3.488	0.606	0.120
HALE1	2003	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.296	126	145	3.488	0.606	0.120
HAVO1	2003	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.174	142	145	3.488	0.606	0.120
HACR1	2004	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	153	2.999	0.729	0.107
HALE1	2004	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.240	144	153	2.999	0.729	0.107
HAVO1	2004	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.174	150	153	2.999	0.729	0.107
HACR1	2005	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	159	5.245	0.567	0.098
HALE1	2005	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.243	140	159	5.245	0.567	0.098
HAVO1	2005	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.329	131	159	5.245	0.567	0.098
HACR1	2006	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	155	5.493	0.734	0.057
HALE1	2006	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.271	133	155	5.493	0.734	0.057
HAVO1	2006	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.204	146	155	5.493	0.734	0.057
HACR1	2007	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.239	137	156	3.558	0.698	0.077
HALE1	2007	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.237	138	156	3.558	0.698	0.077
HAVO1	2007	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.220	141	156	3.558	0.698	0.077
HACR1	2008	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.276	138	156	5.859	0.745	0.107
HALE1	2008	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.394	125	156	5.859	0.745	0.107
HAVO1	2008	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.212	146	156	5.859	0.745	0.107
HACR1	2009	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.295	142	157	5.740	0.674	0.148
HALE1	2009	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.264	146	157	5.740	0.674	0.148
HAVO1	2009	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.361	132	157	5.740	0.674	0.148

Table E-21

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.438	120	153	5.288	0.754	0.084
HALE1	2010	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.383	124	153	5.288	0.754	0.084
HAVO1	2010	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.286	137	153	5.288	0.754	0.084
HACR1	2011	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.198	121	150	4.484	0.482	0.072
HALE1	2011	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.291	109	150	4.484	0.482	0.072
HAVO1	2011	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.141	138	150	4.484	0.482	0.072
HACR1	2012	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.290	126	157	4.751	0.794	0.080
HALE1	2012	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	157	4.751	0.794	0.080
HAVO1	2012	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.269	130	157	4.751	0.794	0.080
HACR1	2013	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	151	4.240	0.633	0.114
HALE1	2013	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	151	4.240	0.633	0.114
HAVO1	2013	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.127	149	151	4.240	0.633	0.114
HACR1	2014	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.180	143	159	5.040	0.692	0.073
HALE1	2014	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	159	5.040	0.692	0.073
HAVO1	2014	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.227	133	159	5.040	0.692	0.073
HACR1	2015	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.271	124	150	4.076	0.618	0.104
HALE1	2015	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	NA	NA	150	4.076	0.618	0.104
HAVO1	2015	ANN_1YR_G70_902_#	SOILf_bext	1/Mm	0.154	143	150	4.076	0.618	0.104
HACR1	2001	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	90	1.956	0.570	0.109
HALE1	2001	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.257	75	90	1.956	0.570	0.109
HAVO1	2001	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.113	89	90	1.956	0.570	0.109
HACR1	2002	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	125	4.139	0.528	0.074
HALE1	2002	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.266	103	125	4.139	0.528	0.074
HAVO1	2002	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.149	119	125	4.139	0.528	0.074
HACR1	2003	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	145	3.014	0.471	0.079
HALE1	2003	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.175	130	145	3.014	0.471	0.079
HAVO1	2003	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.147	134	145	3.014	0.471	0.079
HACR1	2004	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	153	3.034	0.529	0.076
HALE1	2004	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.208	131	153	3.034	0.529	0.076
HAVO1	2004	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.140	143	153	3.034	0.529	0.076
HACR1	2005	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	159	4.778	0.417	0.069
HALE1	2005	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.210	127	159	4.778	0.417	0.069
HAVO1	2005	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.088	155	159	4.778	0.417	0.069
HACR1	2006	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	155	4.124	0.521	0.085
HALE1	2006	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.227	125	155	4.124	0.521	0.085
HAVO1	2006	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.151	144	155	4.124	0.521	0.085

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.249	121	156	2.657	0.490	0.039
HALE1	2007	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.193	131	156	2.657	0.490	0.039
HAVO1	2007	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.100	148	156	2.657	0.490	0.039
HACR1	2008	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.143	151	156	4.319	0.574	0.050
HALE1	2008	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.197	135	156	4.319	0.574	0.050
HAVO1	2008	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.152	147	156	4.319	0.574	0.050
HACR1	2009	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.213	139	157	3.932	0.521	0.085
HALE1	2009	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.157	151	157	3.932	0.521	0.085
HAVO1	2009	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.121	155	157	3.932	0.521	0.085
HACR1	2010	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.295	126	153	3.213	0.560	0.073
HALE1	2010	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.181	138	153	3.213	0.560	0.073
HAVO1	2010	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.169	140	153	3.213	0.560	0.073
HACR1	2011	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.141	124	150	3.858	0.341	0.052
HALE1	2011	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.169	116	150	3.858	0.341	0.052
HAVO1	2011	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.058	148	150	3.858	0.341	0.052
HACR1	2012	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.186	129	157	4.466	0.537	0.042
HALE1	2012	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	157	4.466	0.537	0.042
HAVO1	2012	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.148	138	157	4.466	0.537	0.042
HACR1	2013	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	151	3.393	0.421	0.064
HALE1	2013	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	151	3.393	0.421	0.064
HAVO1	2013	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.094	146	151	3.393	0.421	0.064
HACR1	2014	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.142	142	159	3.807	0.452	0.060
HALE1	2014	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	159	3.807	0.452	0.060
HAVO1	2014	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.140	143	159	3.807	0.452	0.060
HACR1	2015	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.112	145	150	2.347	0.399	0.061
HALE1	2015	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	NA	NA	150	2.347	0.399	0.061
HAVO1	2015	ANN_1YR_G50_902_#	SOILf_bext	1/Mm	0.176	130	150	2.347	0.399	0.061
HACR1	2001	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	90	1.175	0.380	0.078
HALE1	2001	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.239	64	90	1.175	0.380	0.078
HAVO1	2001	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.159	79	90	1.175	0.380	0.078
HACR1	2002	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	125	3.299	0.336	0.054
HALE1	2002	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.233	91	125	3.299	0.336	0.054
HAVO1	2002	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.054	124	125	3.299	0.336	0.054
HACR1	2003	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	145	2.829	0.322	0.056
HALE1	2003	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.156	122	145	2.829	0.322	0.056
HAVO1	2003	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.065	140	145	2.829	0.322	0.056

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	153	2.330	0.346	0.045
HALE1	2004	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.107	137	153	2.330	0.346	0.045
HAVO1	2004	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.085	144	153	2.330	0.346	0.045
HACR1	2005	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	159	2.649	0.287	0.042
HALE1	2005	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.081	147	159	2.649	0.287	0.042
HAVO1	2005	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.063	153	159	2.649	0.287	0.042
HACR1	2006	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	155	2.965	0.318	0.029
HALE1	2006	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.096	144	155	2.965	0.318	0.029
HAVO1	2006	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.065	152	155	2.965	0.318	0.029
HACR1	2007	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.146	129	156	2.435	0.339	0.047
HALE1	2007	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.189	116	156	2.435	0.339	0.047
HAVO1	2007	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.066	150	156	2.435	0.339	0.047
HACR1	2008	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.090	146	156	2.477	0.375	0.034
HALE1	2008	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.114	141	156	2.477	0.375	0.034
HAVO1	2008	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.073	151	156	2.477	0.375	0.034
HACR1	2009	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.130	136	157	3.276	0.363	0.059
HALE1	2009	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.168	127	157	3.276	0.363	0.059
HAVO1	2009	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.101	149	157	3.276	0.363	0.059
HACR1	2010	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.121	134	153	4.119	0.382	0.038
HALE1	2010	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.172	119	153	4.119	0.382	0.038
HAVO1	2010	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.069	145	153	4.119	0.382	0.038
HACR1	2011	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.093	130	150	2.311	0.253	0.020
HALE1	2011	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.108	119	150	2.311	0.253	0.020
HAVO1	2011	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.046	143	150	2.311	0.253	0.020
HACR1	2012	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.076	141	157	3.632	0.324	0.029
HALE1	2012	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	157	3.632	0.324	0.029
HAVO1	2012	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.045	151	157	3.632	0.324	0.029
HACR1	2013	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	151	2.165	0.270	0.016
HALE1	2013	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	151	2.165	0.270	0.016
HAVO1	2013	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.048	145	151	2.165	0.270	0.016
HACR1	2014	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.096	141	159	3.013	0.283	0.035
HALE1	2014	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	159	3.013	0.283	0.035
HAVO1	2014	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.098	140	159	3.013	0.283	0.035
HACR1	2015	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.081	139	150	1.598	0.256	0.036
HALE1	2015	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	NA	NA	150	1.598	0.256	0.036
HAVO1	2015	ANN_1YR_G30_902_#	SOILf_bext	1/Mm	0.206	91	150	1.598	0.256	0.036

Table E-21

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	90	0.946	0.194	0.040
HALE1	2001	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.149	58	90	0.946	0.194	0.040
HAVO1	2001	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.087	80	90	0.946	0.194	0.040
HACR1	2002	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	125	2.275	0.182	0.020
HALE1	2002	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.111	89	125	2.275	0.182	0.020
HAVO1	2002	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.031	120	125	2.275	0.182	0.020
HACR1	2003	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	145	1.819	0.183	0.012
HALE1	2003	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.055	130	145	1.819	0.183	0.012
HAVO1	2003	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.052	133	145	1.819	0.183	0.012
HACR1	2004	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	153	1.421	0.184	0.024
HALE1	2004	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.084	124	153	1.421	0.184	0.024
HAVO1	2004	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.046	143	153	1.421	0.184	0.024
HACR1	2005	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	159	1.686	0.166	0.014
HALE1	2005	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.045	143	159	1.686	0.166	0.014
HAVO1	2005	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.016	157	159	1.686	0.166	0.014
HACR1	2006	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	155	1.914	0.205	0.020
HALE1	2006	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.135	96	155	1.914	0.205	0.020
HAVO1	2006	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.034	147	155	1.914	0.205	0.020
HACR1	2007	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.047	143	156	1.315	0.201	0.015
HALE1	2007	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.060	140	156	1.315	0.201	0.015
HAVO1	2007	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.041	147	156	1.315	0.201	0.015
HACR1	2008	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.076	129	156	1.612	0.182	0.020
HALE1	2008	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.072	132	156	1.612	0.182	0.020
HAVO1	2008	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.049	147	156	1.612	0.182	0.020
HACR1	2009	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.094	122	157	1.813	0.205	0.030
HALE1	2009	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.134	104	157	1.813	0.205	0.030
HAVO1	2009	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.048	151	157	1.813	0.205	0.030
HACR1	2010	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.051	139	153	1.488	0.191	0.019
HALE1	2010	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.113	104	153	1.488	0.191	0.019
HAVO1	2010	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.048	141	153	1.488	0.191	0.019
HACR1	2011	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.032	138	150	1.610	0.137	0.007
HALE1	2011	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.079	104	150	1.610	0.137	0.007
HAVO1	2011	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.012	148	150	1.610	0.137	0.007
HACR1	2012	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.041	138	157	2.156	0.171	0.006
HALE1	2012	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	157	2.156	0.171	0.006
HAVO1	2012	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.026	148	157	2.156	0.171	0.006

Table E-21

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	151	1.583	0.145	0.003
HALE1	2013	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	151	1.583	0.145	0.003
HAVO1	2013	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.023	143	151	1.583	0.145	0.003
HACR1	2014	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.058	128	159	1.644	0.152	0.006
HALE1	2014	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	159	1.644	0.152	0.006
HAVO1	2014	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.031	148	159	1.644	0.152	0.006
HACR1	2015	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.012	150	150	1.123	0.121	0.012
HALE1	2015	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	NA	NA	150	1.123	0.121	0.012
HAVO1	2015	ANN_1YR_G10_902_#	SOILf_bext	1/Mm	0.058	116	150	1.123	0.121	0.012

Table E-21: Hawaii IMPROVE site Soil Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	90	231.787	45.237	16.081
HALE1	2001	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	27.697	68	90	231.787	45.237	16.081
HAVO1	2001	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	50.917	41	90	231.787	45.237	16.081
HACR1	2002	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	125	230.256	53.535	18.665
HALE1	2002	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	26.081	112	125	230.256	53.535	18.665
HAVO1	2002	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	59.743	55	125	230.256	53.535	18.665
HACR1	2003	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	145	244.413	55.688	16.257
HALE1	2003	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	35.082	105	145	244.413	55.688	16.257
HAVO1	2003	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	93.687	54	145	244.413	55.688	16.257
HACR1	2004	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	153	212.785	53.902	13.679
HALE1	2004	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	26.124	122	153	212.785	53.902	13.679
HAVO1	2004	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	61.640	68	153	212.785	53.902	13.679
HACR1	2005	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	159	328.779	55.507	16.312
HALE1	2005	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	29.007	122	159	328.779	55.507	16.312
HAVO1	2005	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	90.801	58	159	328.779	55.507	16.312
HACR1	2006	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	155	267.763	57.527	16.083
HALE1	2006	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	29.858	126	155	267.763	57.527	16.083
HAVO1	2006	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	73.463	67	155	267.763	57.527	16.083
HACR1	2007	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	18.331	151	156	257.992	59.978	13.359
HALE1	2007	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	28.874	125	156	257.992	59.978	13.359
HAVO1	2007	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	114.053	49	156	257.992	59.978	13.359
HACR1	2008	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	27.286	126	156	327.406	55.146	15.193
HALE1	2008	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	53.221	81	156	327.406	55.146	15.193
HAVO1	2008	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	187.467	3	156	327.406	55.146	15.193
HACR1	2009	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	23.257	136	157	262.314	50.739	14.910
HALE1	2009	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	40.234	91	157	262.314	50.739	14.910
HAVO1	2009	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	222.892	2	157	262.314	50.739	14.910
HACR1	2010	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	19.348	130	153	245.924	43.644	13.213
HALE1	2010	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	36.867	86	153	245.924	43.644	13.213
HAVO1	2010	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	135.940	6	153	245.924	43.644	13.213
HACR1	2011	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	17.920	140	150	300.369	44.512	13.153
HALE1	2011	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	35.866	96	150	300.369	44.512	13.153
HAVO1	2011	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	39.177	87	150	300.369	44.512	13.153
HACR1	2012	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	18.539	151	157	249.166	48.055	13.145
HALE1	2012	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	157	249.166	48.055	13.145
HAVO1	2012	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	47.939	80	157	249.166	48.055	13.145

Table E-22

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	151	283.402	41.099	13.157
HALE1	2013	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	151	283.402	41.099	13.157
HAVO1	2013	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	66.013	36	151	283.402	41.099	13.157
HACR1	2014	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	15.782	151	159	340.228	41.728	11.770
HALE1	2014	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	159	340.228	41.728	11.770
HAVO1	2014	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	61.636	42	159	340.228	41.728	11.770
HACR1	2015	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	15.269	150	150	286.543	48.422	15.269
HALE1	2015	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	NA	NA	150	286.543	48.422	15.269
HAVO1	2015	ANN_1YR_G90_902_#	aerosol_bext	1/Mm	61.850	45	150	286.543	48.422	15.269
HACR1	2001	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	90	130.908	23.369	7.057
HALE1	2001	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	17.386	61	90	130.908	23.369	7.057
HAVO1	2001	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	15.859	70	90	130.908	23.369	7.057
HACR1	2002	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	125	124.095	29.048	7.904
HALE1	2002	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	18.194	88	125	124.095	29.048	7.904
HAVO1	2002	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	17.762	90	125	124.095	29.048	7.904
HACR1	2003	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	145	122.600	29.882	8.748
HALE1	2003	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	19.956	102	145	122.600	29.882	8.748
HAVO1	2003	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	24.875	86	145	122.600	29.882	8.748
HACR1	2004	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	153	118.970	27.987	7.136
HALE1	2004	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	18.184	105	153	118.970	27.987	7.136
HAVO1	2004	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	18.988	100	153	118.970	27.987	7.136
HACR1	2005	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	159	189.739	29.400	7.023
HALE1	2005	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	18.086	113	159	189.739	29.400	7.023
HAVO1	2005	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	22.347	99	159	189.739	29.400	7.023
HACR1	2006	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	155	165.533	29.889	8.000
HALE1	2006	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	19.180	108	155	165.533	29.889	8.000
HAVO1	2006	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	23.723	94	155	165.533	29.889	8.000
HACR1	2007	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	7.866	155	156	153.377	30.243	7.340
HALE1	2007	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	16.277	120	156	153.377	30.243	7.340
HAVO1	2007	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	19.278	105	156	153.377	30.243	7.340
HACR1	2008	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	10.394	153	156	132.601	28.103	8.200
HALE1	2008	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	20.338	102	156	132.601	28.103	8.200
HAVO1	2008	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	23.435	91	156	132.601	28.103	8.200
HACR1	2009	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	9.966	155	157	94.453	26.311	9.673
HALE1	2009	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	19.203	101	157	94.453	26.311	9.673
HAVO1	2009	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	45.624	45	157	94.453	26.311	9.673

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	8.995	151	153	108.734	22.960	7.375
HALE1	2010	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	17.958	93	153	108.734	22.960	7.375
HAVO1	2010	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	20.208	83	153	108.734	22.960	7.375
HACR1	2011	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	8.580	149	150	106.395	24.824	8.038
HALE1	2011	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	17.628	95	150	106.395	24.824	8.038
HAVO1	2011	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	14.374	116	150	106.395	24.824	8.038
HACR1	2012	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	9.988	154	157	85.041	23.460	7.100
HALE1	2012	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	157	85.041	23.460	7.100
HAVO1	2012	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	16.834	110	157	85.041	23.460	7.100
HACR1	2013	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	151	109.371	22.218	8.926
HALE1	2013	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	151	109.371	22.218	8.926
HAVO1	2013	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	20.618	82	151	109.371	22.218	8.926
HACR1	2014	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	8.057	158	159	84.967	22.870	6.767
HALE1	2014	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	159	84.967	22.870	6.767
HAVO1	2014	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	25.483	71	159	84.967	22.870	6.767
HACR1	2015	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	7.771	148	150	101.994	22.529	7.235
HALE1	2015	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	NA	NA	150	101.994	22.529	7.235
HAVO1	2015	ANN_1YR_G70_902_#	aerosol_bext	1/Mm	28.638	55	150	101.994	22.529	7.235
HACR1	2001	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	90	86.910	16.475	4.921
HALE1	2001	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.811	58	90	86.910	16.475	4.921
HAVO1	2001	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	11.572	70	90	86.910	16.475	4.921
HACR1	2002	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	125	91.825	20.858	4.657
HALE1	2002	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.677	88	125	91.825	20.858	4.657
HAVO1	2002	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	11.824	99	125	91.825	20.858	4.657
HACR1	2003	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	145	88.441	21.490	5.264
HALE1	2003	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	14.304	96	145	88.441	21.490	5.264
HAVO1	2003	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.873	103	145	88.441	21.490	5.264
HACR1	2004	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	153	87.570	20.091	4.521
HALE1	2004	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.753	106	153	87.570	20.091	4.521
HAVO1	2004	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.674	109	153	87.570	20.091	4.521
HACR1	2005	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	159	132.184	21.390	4.715
HALE1	2005	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.783	108	159	132.184	21.390	4.715
HAVO1	2005	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	11.557	122	159	132.184	21.390	4.715
HACR1	2006	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	155	118.423	20.855	5.743
HALE1	2006	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.964	103	155	118.423	20.855	5.743
HAVO1	2006	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.497	111	155	118.423	20.855	5.743

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	5.767	155	156	114.568	20.962	5.084
HALE1	2007	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.706	110	156	114.568	20.962	5.084
HAVO1	2007	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	10.863	123	156	114.568	20.962	5.084
HACR1	2008	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	6.420	155	156	100.717	20.430	6.138
HALE1	2008	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	14.846	99	156	100.717	20.430	6.138
HAVO1	2008	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.841	109	156	100.717	20.430	6.138
HACR1	2009	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	6.926	154	157	68.324	18.190	6.446
HALE1	2009	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	14.054	101	157	68.324	18.190	6.446
HAVO1	2009	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.929	103	157	68.324	18.190	6.446
HACR1	2010	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	6.160	150	153	82.150	16.208	5.637
HALE1	2010	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.355	94	153	82.150	16.208	5.637
HAVO1	2010	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.308	95	153	82.150	16.208	5.637
HACR1	2011	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	5.776	148	150	78.430	17.063	5.428
HALE1	2011	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.812	95	150	78.430	17.063	5.428
HAVO1	2011	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	9.225	120	150	78.430	17.063	5.428
HACR1	2012	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	6.449	153	157	68.252	16.261	5.410
HALE1	2012	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	157	68.252	16.261	5.410
HAVO1	2012	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	10.242	118	157	68.252	16.261	5.410
HACR1	2013	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	151	59.981	15.729	4.600
HALE1	2013	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	151	59.981	15.729	4.600
HAVO1	2013	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	12.842	94	151	59.981	15.729	4.600
HACR1	2014	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	5.233	158	159	60.602	16.506	4.775
HALE1	2014	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	159	60.602	16.506	4.775
HAVO1	2014	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	13.304	98	159	60.602	16.506	4.775
HACR1	2015	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	4.501	149	150	58.064	15.766	4.255
HALE1	2015	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	NA	NA	150	58.064	15.766	4.255
HAVO1	2015	ANN_1YR_G50_902_#	aerosol_bext	1/Mm	15.208	82	150	58.064	15.766	4.255
HACR1	2001	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	90	62.657	12.778	3.442
HALE1	2001	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.172	63	90	62.657	12.778	3.442
HAVO1	2001	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	7.972	72	90	62.657	12.778	3.442
HACR1	2002	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	125	69.116	14.439	3.064
HALE1	2002	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	10.344	85	125	69.116	14.439	3.064
HAVO1	2002	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.376	96	125	69.116	14.439	3.064
HACR1	2003	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	145	63.105	15.228	3.099
HALE1	2003	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.524	99	145	63.105	15.228	3.099
HAVO1	2003	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.583	105	145	63.105	15.228	3.099

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	153	61.036	14.037	3.080
HALE1	2004	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.802	101	153	61.036	14.037	3.080
HAVO1	2004	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.279	106	153	61.036	14.037	3.080
HACR1	2005	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	159	97.768	14.533	2.941
HALE1	2005	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.938	110	159	97.768	14.533	2.941
HAVO1	2005	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.319	118	159	97.768	14.533	2.941
HACR1	2006	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	155	83.817	14.193	4.124
HALE1	2006	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.340	107	155	83.817	14.193	4.124
HAVO1	2006	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	7.879	118	155	83.817	14.193	4.124
HACR1	2007	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.534	155	156	81.059	14.351	3.420
HALE1	2007	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.665	105	156	81.059	14.351	3.420
HAVO1	2007	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.152	119	156	81.059	14.351	3.420
HACR1	2008	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.871	155	156	68.713	13.621	3.793
HALE1	2008	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	10.267	98	156	68.713	13.621	3.793
HAVO1	2008	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.522	110	156	68.713	13.621	3.793
HACR1	2009	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	4.296	153	157	54.342	12.602	3.874
HALE1	2009	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	10.337	95	157	54.342	12.602	3.874
HAVO1	2009	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.581	108	157	54.342	12.602	3.874
HACR1	2010	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.478	151	153	63.806	10.910	2.409
HALE1	2010	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.972	95	153	63.806	10.910	2.409
HAVO1	2010	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	7.310	108	153	63.806	10.910	2.409
HACR1	2011	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.515	149	150	59.893	12.000	2.571
HALE1	2011	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.794	91	150	59.893	12.000	2.571
HAVO1	2011	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	6.814	111	150	59.893	12.000	2.571
HACR1	2012	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.773	154	157	52.133	11.238	3.341
HALE1	2012	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	157	52.133	11.238	3.341
HAVO1	2012	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	5.949	122	157	52.133	11.238	3.341
HACR1	2013	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	151	45.808	11.308	2.176
HALE1	2013	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	151	45.808	11.308	2.176
HAVO1	2013	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.015	89	151	45.808	11.308	2.176
HACR1	2014	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.072	158	159	46.912	11.437	2.651
HALE1	2014	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	159	46.912	11.437	2.651
HAVO1	2014	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	8.164	97	159	46.912	11.437	2.651
HACR1	2015	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	3.051	149	150	42.780	10.948	2.629
HALE1	2015	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	NA	NA	150	42.780	10.948	2.629
HAVO1	2015	ANN_1YR_G30_902_#	aerosol_bext	1/Mm	9.668	88	150	42.780	10.948	2.629

Table E-22

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	90	43.987	7.479	1.870
HALE1	2001	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.909	62	90	43.987	7.479	1.870
HAVO1	2001	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.158	67	90	43.987	7.479	1.870
HACR1	2002	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	125	48.505	8.776	1.645
HALE1	2002	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	6.173	84	125	48.505	8.776	1.645
HAVO1	2002	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.877	93	125	48.505	8.776	1.645
HACR1	2003	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	145	42.536	8.826	1.183
HALE1	2003	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.458	97	145	42.536	8.826	1.183
HAVO1	2003	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.277	99	145	42.536	8.826	1.183
HACR1	2004	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	153	40.292	8.441	1.579
HALE1	2004	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.774	102	153	40.292	8.441	1.579
HAVO1	2004	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.955	115	153	40.292	8.441	1.579
HACR1	2005	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	159	61.991	8.865	1.289
HALE1	2005	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.622	120	159	61.991	8.865	1.289
HAVO1	2005	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.265	125	159	61.991	8.865	1.289
HACR1	2006	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	155	53.365	8.274	1.909
HALE1	2006	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.759	105	155	53.365	8.274	1.909
HAVO1	2006	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	3.876	122	155	53.365	8.274	1.909
HACR1	2007	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.896	156	156	49.239	8.155	1.896
HALE1	2007	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.903	101	156	49.239	8.155	1.896
HAVO1	2007	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.058	110	156	49.239	8.155	1.896
HACR1	2008	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.630	155	156	42.919	8.146	1.623
HALE1	2008	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.841	94	156	42.919	8.146	1.623
HAVO1	2008	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.077	103	156	42.919	8.146	1.623
HACR1	2009	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	2.387	149	157	35.438	7.511	1.600
HALE1	2009	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.963	89	157	35.438	7.511	1.600
HAVO1	2009	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.884	107	157	35.438	7.511	1.600
HACR1	2010	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.441	151	153	42.065	6.218	1.026
HALE1	2010	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.533	88	153	42.065	6.218	1.026
HAVO1	2010	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.369	103	153	42.065	6.218	1.026
HACR1	2011	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.715	148	150	40.251	6.887	0.891
HALE1	2011	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	6.177	84	150	40.251	6.887	0.891
HAVO1	2011	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	3.736	107	150	40.251	6.887	0.891
HACR1	2012	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.855	152	157	36.219	6.492	1.368
HALE1	2012	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	157	36.219	6.492	1.368
HAVO1	2012	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	3.435	113	157	36.219	6.492	1.368

Table E-22

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	151	29.330	6.267	0.661
HALE1	2013	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	151	29.330	6.267	0.661
HAVO1	2013	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.881	92	151	29.330	6.267	0.661
HACR1	2014	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.586	155	159	31.482	6.614	0.876
HALE1	2014	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	159	31.482	6.614	0.876
HAVO1	2014	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	4.187	102	159	31.482	6.614	0.876
HACR1	2015	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	1.317	149	150	31.312	6.170	1.203
HALE1	2015	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	NA	NA	150	31.312	6.170	1.203
HAVO1	2015	ANN_1YR_G10_902_#	aerosol_bext	1/Mm	5.019	88	150	31.312	6.170	1.203

Table E-22: Hawaii IMPROVE site Aerosol Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	90	242.787	54.990	25.576
HALE1	2001	ANN_1YR_G90_902_#	total_bext	1/Mm	37.697	68	90	242.787	54.990	25.576
HAVO1	2001	ANN_1YR_G90_902_#	total_bext	1/Mm	60.917	41	90	242.787	54.990	25.576
HACR1	2002	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	125	241.256	64.519	28.725
HALE1	2002	ANN_1YR_G90_902_#	total_bext	1/Mm	36.081	110	125	241.256	64.519	28.725
HAVO1	2002	ANN_1YR_G90_902_#	total_bext	1/Mm	69.743	55	125	241.256	64.519	28.725
HACR1	2003	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	145	255.413	66.298	25.719
HALE1	2003	ANN_1YR_G90_902_#	total_bext	1/Mm	45.082	105	145	255.413	66.298	25.719
HAVO1	2003	ANN_1YR_G90_902_#	total_bext	1/Mm	103.687	54	145	255.413	66.298	25.719
HACR1	2004	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	153	223.785	64.797	21.679
HALE1	2004	ANN_1YR_G90_902_#	total_bext	1/Mm	36.124	122	153	223.785	64.797	21.679
HAVO1	2004	ANN_1YR_G90_902_#	total_bext	1/Mm	71.640	69	153	223.785	64.797	21.679
HACR1	2005	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	159	339.779	65.507	25.056
HALE1	2005	ANN_1YR_G90_902_#	total_bext	1/Mm	39.007	121	159	339.779	65.507	25.056
HAVO1	2005	ANN_1YR_G90_902_#	total_bext	1/Mm	100.801	58	159	339.779	65.507	25.056
HACR1	2006	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	155	278.763	68.225	24.277
HALE1	2006	ANN_1YR_G90_902_#	total_bext	1/Mm	39.858	125	155	278.763	68.225	24.277
HAVO1	2006	ANN_1YR_G90_902_#	total_bext	1/Mm	83.463	70	155	278.763	68.225	24.277
HACR1	2007	ANN_1YR_G90_902_#	total_bext	1/Mm	27.331	152	156	268.992	71.978	23.919
HALE1	2007	ANN_1YR_G90_902_#	total_bext	1/Mm	38.874	124	156	268.992	71.978	23.919
HAVO1	2007	ANN_1YR_G90_902_#	total_bext	1/Mm	124.053	49	156	268.992	71.978	23.919
HACR1	2008	ANN_1YR_G90_902_#	total_bext	1/Mm	36.286	131	156	338.406	65.613	26.193
HALE1	2008	ANN_1YR_G90_902_#	total_bext	1/Mm	63.221	82	156	338.406	65.613	26.193
HAVO1	2008	ANN_1YR_G90_902_#	total_bext	1/Mm	197.467	3	156	338.406	65.613	26.193
HACR1	2009	ANN_1YR_G90_902_#	total_bext	1/Mm	32.257	139	157	273.314	61.739	22.910
HALE1	2009	ANN_1YR_G90_902_#	total_bext	1/Mm	50.234	92	157	273.314	61.739	22.910
HAVO1	2009	ANN_1YR_G90_902_#	total_bext	1/Mm	232.892	2	157	273.314	61.739	22.910
HACR1	2010	ANN_1YR_G90_902_#	total_bext	1/Mm	28.348	134	153	256.924	54.143	22.240
HALE1	2010	ANN_1YR_G90_902_#	total_bext	1/Mm	46.867	85	153	256.924	54.143	22.240
HAVO1	2010	ANN_1YR_G90_902_#	total_bext	1/Mm	145.940	6	153	256.924	54.143	22.240
HACR1	2011	ANN_1YR_G90_902_#	total_bext	1/Mm	26.920	141	150	311.369	54.632	21.153
HALE1	2011	ANN_1YR_G90_902_#	total_bext	1/Mm	45.866	97	150	311.369	54.632	21.153
HAVO1	2011	ANN_1YR_G90_902_#	total_bext	1/Mm	49.177	90	150	311.369	54.632	21.153
HACR1	2012	ANN_1YR_G90_902_#	total_bext	1/Mm	27.539	151	157	260.166	59.101	24.145
HALE1	2012	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	157	260.166	59.101	24.145
HAVO1	2012	ANN_1YR_G90_902_#	total_bext	1/Mm	57.939	82	157	260.166	59.101	24.145

Table E-23

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	151	294.402	51.742	21.157
HALE1	2013	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	151	294.402	51.742	21.157
HAVO1	2013	ANN_1YR_G90_902_#	total_bext	1/Mm	76.013	36	151	294.402	51.742	21.157
HACR1	2014	ANN_1YR_G90_902_#	total_bext	1/Mm	24.782	152	159	351.228	53.068	20.957
HALE1	2014	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	159	351.228	53.068	20.957
HAVO1	2014	ANN_1YR_G90_902_#	total_bext	1/Mm	71.636	43	159	351.228	53.068	20.957
HACR1	2015	ANN_1YR_G90_902_#	total_bext	1/Mm	24.269	149	150	297.543	59.422	23.958
HALE1	2015	ANN_1YR_G90_902_#	total_bext	1/Mm	NA	NA	150	297.543	59.422	23.958
HAVO1	2015	ANN_1YR_G90_902_#	total_bext	1/Mm	71.850	46	150	297.543	59.422	23.958
HACR1	2001	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	90	142.682	34.332	18.057
HALE1	2001	ANN_1YR_G70_902_#	total_bext	1/Mm	27.386	61	90	142.682	34.332	18.057
HAVO1	2001	ANN_1YR_G70_902_#	total_bext	1/Mm	25.859	68	90	142.682	34.332	18.057
HACR1	2002	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	125	135.095	40.048	18.904
HALE1	2002	ANN_1YR_G70_902_#	total_bext	1/Mm	28.194	88	125	135.095	40.048	18.904
HAVO1	2002	ANN_1YR_G70_902_#	total_bext	1/Mm	27.762	91	125	135.095	40.048	18.904
HACR1	2003	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	145	133.600	41.121	19.102
HALE1	2003	ANN_1YR_G70_902_#	total_bext	1/Mm	29.956	100	145	133.600	41.121	19.102
HAVO1	2003	ANN_1YR_G70_902_#	total_bext	1/Mm	34.875	86	145	133.600	41.121	19.102
HACR1	2004	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	153	130.970	38.987	17.639
HALE1	2004	ANN_1YR_G70_902_#	total_bext	1/Mm	28.184	105	153	130.970	38.987	17.639
HAVO1	2004	ANN_1YR_G70_902_#	total_bext	1/Mm	28.988	101	153	130.970	38.987	17.639
HACR1	2005	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	159	200.739	41.389	18.023
HALE1	2005	ANN_1YR_G70_902_#	total_bext	1/Mm	28.086	112	159	200.739	41.389	18.023
HAVO1	2005	ANN_1YR_G70_902_#	total_bext	1/Mm	32.347	100	159	200.739	41.389	18.023
HACR1	2006	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	155	176.533	40.650	19.000
HALE1	2006	ANN_1YR_G70_902_#	total_bext	1/Mm	29.180	110	155	176.533	40.650	19.000
HAVO1	2006	ANN_1YR_G70_902_#	total_bext	1/Mm	33.723	93	155	176.533	40.650	19.000
HACR1	2007	ANN_1YR_G70_902_#	total_bext	1/Mm	16.866	156	156	164.377	40.495	16.866
HALE1	2007	ANN_1YR_G70_902_#	total_bext	1/Mm	26.277	117	156	164.377	40.495	16.866
HAVO1	2007	ANN_1YR_G70_902_#	total_bext	1/Mm	29.278	106	156	164.377	40.495	16.866
HACR1	2008	ANN_1YR_G70_902_#	total_bext	1/Mm	19.394	154	156	143.601	39.265	18.703
HALE1	2008	ANN_1YR_G70_902_#	total_bext	1/Mm	30.338	104	156	143.601	39.265	18.703
HAVO1	2008	ANN_1YR_G70_902_#	total_bext	1/Mm	33.435	90	156	143.601	39.265	18.703
HACR1	2009	ANN_1YR_G70_902_#	total_bext	1/Mm	18.966	152	157	105.453	37.734	17.673
HALE1	2009	ANN_1YR_G70_902_#	total_bext	1/Mm	29.203	101	157	105.453	37.734	17.673
HAVO1	2009	ANN_1YR_G70_902_#	total_bext	1/Mm	55.624	47	157	105.453	37.734	17.673

Table E-23

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	total_bext	1/Mm	17.995	151	153	119.734	33.853	16.921
HALE1	2010	ANN_1YR_G70_902_#	total_bext	1/Mm	27.958	93	153	119.734	33.853	16.921
HAVO1	2010	ANN_1YR_G70_902_#	total_bext	1/Mm	30.208	84	153	119.734	33.853	16.921
HACR1	2011	ANN_1YR_G70_902_#	total_bext	1/Mm	17.580	148	150	117.395	34.858	16.935
HALE1	2011	ANN_1YR_G70_902_#	total_bext	1/Mm	27.628	96	150	117.395	34.858	16.935
HAVO1	2011	ANN_1YR_G70_902_#	total_bext	1/Mm	24.374	115	150	117.395	34.858	16.935
HACR1	2012	ANN_1YR_G70_902_#	total_bext	1/Mm	18.988	156	157	96.041	33.508	18.100
HALE1	2012	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	157	96.041	33.508	18.100
HAVO1	2012	ANN_1YR_G70_902_#	total_bext	1/Mm	26.834	109	157	96.041	33.508	18.100
HACR1	2013	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	151	120.371	33.184	17.040
HALE1	2013	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	151	120.371	33.184	17.040
HAVO1	2013	ANN_1YR_G70_902_#	total_bext	1/Mm	30.618	86	151	120.371	33.184	17.040
HACR1	2014	ANN_1YR_G70_902_#	total_bext	1/Mm	17.057	158	159	95.967	33.248	16.743
HALE1	2014	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	159	95.967	33.248	16.743
HAVO1	2014	ANN_1YR_G70_902_#	total_bext	1/Mm	35.483	75	159	95.967	33.248	16.743
HACR1	2015	ANN_1YR_G70_902_#	total_bext	1/Mm	16.771	147	150	112.994	33.653	15.248
HALE1	2015	ANN_1YR_G70_902_#	total_bext	1/Mm	NA	NA	150	112.994	33.653	15.248
HAVO1	2015	ANN_1YR_G70_902_#	total_bext	1/Mm	38.638	58	150	112.994	33.653	15.248
HACR1	2001	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	90	97.910	26.753	15.921
HALE1	2001	ANN_1YR_G50_902_#	total_bext	1/Mm	22.811	58	90	97.910	26.753	15.921
HAVO1	2001	ANN_1YR_G50_902_#	total_bext	1/Mm	21.572	67	90	97.910	26.753	15.921
HACR1	2002	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	125	103.825	31.858	15.657
HALE1	2002	ANN_1YR_G50_902_#	total_bext	1/Mm	23.677	85	125	103.825	31.858	15.657
HAVO1	2002	ANN_1YR_G50_902_#	total_bext	1/Mm	21.824	98	125	103.825	31.858	15.657
HACR1	2003	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	145	99.441	32.382	15.447
HALE1	2003	ANN_1YR_G50_902_#	total_bext	1/Mm	24.304	95	145	99.441	32.382	15.447
HAVO1	2003	ANN_1YR_G50_902_#	total_bext	1/Mm	22.873	102	145	99.441	32.382	15.447
HACR1	2004	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	153	99.570	30.452	15.137
HALE1	2004	ANN_1YR_G50_902_#	total_bext	1/Mm	22.753	107	153	99.570	30.452	15.137
HAVO1	2004	ANN_1YR_G50_902_#	total_bext	1/Mm	22.674	110	153	99.570	30.452	15.137
HACR1	2005	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	159	143.184	32.320	14.753
HALE1	2005	ANN_1YR_G50_902_#	total_bext	1/Mm	23.783	108	159	143.184	32.320	14.753
HAVO1	2005	ANN_1YR_G50_902_#	total_bext	1/Mm	21.557	120	159	143.184	32.320	14.753
HACR1	2006	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	155	129.423	32.138	15.682
HALE1	2006	ANN_1YR_G50_902_#	total_bext	1/Mm	23.964	104	155	129.423	32.138	15.682
HAVO1	2006	ANN_1YR_G50_902_#	total_bext	1/Mm	22.497	112	155	129.423	32.138	15.682

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	total_bext	1/Mm	14.767	156	156	125.568	31.254	14.767
HALE1	2007	ANN_1YR_G50_902_#	total_bext	1/Mm	22.706	108	156	125.568	31.254	14.767
HAVO1	2007	ANN_1YR_G50_902_#	total_bext	1/Mm	20.863	121	156	125.568	31.254	14.767
HACR1	2008	ANN_1YR_G50_902_#	total_bext	1/Mm	15.420	156	156	111.717	30.990	15.420
HALE1	2008	ANN_1YR_G50_902_#	total_bext	1/Mm	24.846	99	156	111.717	30.990	15.420
HAVO1	2008	ANN_1YR_G50_902_#	total_bext	1/Mm	22.841	108	156	111.717	30.990	15.420
HACR1	2009	ANN_1YR_G50_902_#	total_bext	1/Mm	15.926	153	157	79.324	29.131	14.809
HALE1	2009	ANN_1YR_G50_902_#	total_bext	1/Mm	24.054	101	157	79.324	29.131	14.809
HAVO1	2009	ANN_1YR_G50_902_#	total_bext	1/Mm	23.929	103	157	79.324	29.131	14.809
HACR1	2010	ANN_1YR_G50_902_#	total_bext	1/Mm	15.160	152	153	93.150	27.074	14.697
HALE1	2010	ANN_1YR_G50_902_#	total_bext	1/Mm	22.355	97	153	93.150	27.074	14.697
HAVO1	2010	ANN_1YR_G50_902_#	total_bext	1/Mm	22.308	98	153	93.150	27.074	14.697
HACR1	2011	ANN_1YR_G50_902_#	total_bext	1/Mm	14.776	148	150	89.430	27.972	14.271
HALE1	2011	ANN_1YR_G50_902_#	total_bext	1/Mm	22.812	97	150	89.430	27.972	14.271
HAVO1	2011	ANN_1YR_G50_902_#	total_bext	1/Mm	19.225	119	150	89.430	27.972	14.271
HACR1	2012	ANN_1YR_G50_902_#	total_bext	1/Mm	15.449	157	157	79.252	27.222	15.449
HALE1	2012	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	157	79.252	27.222	15.449
HAVO1	2012	ANN_1YR_G50_902_#	total_bext	1/Mm	20.242	115	157	79.252	27.222	15.449
HACR1	2013	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	151	70.981	26.420	14.035
HALE1	2013	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	151	70.981	26.420	14.035
HAVO1	2013	ANN_1YR_G50_902_#	total_bext	1/Mm	22.842	96	151	70.981	26.420	14.035
HACR1	2014	ANN_1YR_G50_902_#	total_bext	1/Mm	14.233	158	159	71.602	27.095	14.190
HALE1	2014	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	159	71.602	27.095	14.190
HAVO1	2014	ANN_1YR_G50_902_#	total_bext	1/Mm	23.304	99	159	71.602	27.095	14.190
HACR1	2015	ANN_1YR_G50_902_#	total_bext	1/Mm	13.501	149	150	69.064	26.729	13.137
HALE1	2015	ANN_1YR_G50_902_#	total_bext	1/Mm	NA	NA	150	69.064	26.729	13.137
HAVO1	2015	ANN_1YR_G50_902_#	total_bext	1/Mm	25.208	83	150	69.064	26.729	13.137
HACR1	2001	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	90	73.740	22.828	13.621
HALE1	2001	ANN_1YR_G30_902_#	total_bext	1/Mm	19.172	62	90	73.740	22.828	13.621
HAVO1	2001	ANN_1YR_G30_902_#	total_bext	1/Mm	17.972	68	90	73.740	22.828	13.621
HACR1	2002	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	125	81.116	25.439	13.561
HALE1	2002	ANN_1YR_G30_902_#	total_bext	1/Mm	20.344	81	125	81.116	25.439	13.561
HAVO1	2002	ANN_1YR_G30_902_#	total_bext	1/Mm	18.376	95	125	81.116	25.439	13.561
HACR1	2003	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	145	75.105	25.614	12.713
HALE1	2003	ANN_1YR_G30_902_#	total_bext	1/Mm	19.524	98	145	75.105	25.614	12.713
HAVO1	2003	ANN_1YR_G30_902_#	total_bext	1/Mm	18.583	104	145	75.105	25.614	12.713

Table E-23

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	153	72.036	24.685	12.888
HALE1	2004	ANN_1YR_G30_902_#	total_bext	1/Mm	19.802	100	153	72.036	24.685	12.888
HAVO1	2004	ANN_1YR_G30_902_#	total_bext	1/Mm	19.279	107	153	72.036	24.685	12.888
HACR1	2005	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	159	108.768	25.440	11.957
HALE1	2005	ANN_1YR_G30_902_#	total_bext	1/Mm	18.938	111	159	108.768	25.440	11.957
HAVO1	2005	ANN_1YR_G30_902_#	total_bext	1/Mm	18.319	118	159	108.768	25.440	11.957
HACR1	2006	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	155	94.817	24.985	13.153
HALE1	2006	ANN_1YR_G30_902_#	total_bext	1/Mm	19.340	105	155	94.817	24.985	13.153
HAVO1	2006	ANN_1YR_G30_902_#	total_bext	1/Mm	17.879	117	155	94.817	24.985	13.153
HACR1	2007	ANN_1YR_G30_902_#	total_bext	1/Mm	12.534	156	156	92.059	24.772	12.534
HALE1	2007	ANN_1YR_G30_902_#	total_bext	1/Mm	19.665	104	156	92.059	24.772	12.534
HAVO1	2007	ANN_1YR_G30_902_#	total_bext	1/Mm	18.152	115	156	92.059	24.772	12.534
HACR1	2008	ANN_1YR_G30_902_#	total_bext	1/Mm	12.871	155	156	79.713	24.447	12.388
HALE1	2008	ANN_1YR_G30_902_#	total_bext	1/Mm	20.267	99	156	79.713	24.447	12.388
HAVO1	2008	ANN_1YR_G30_902_#	total_bext	1/Mm	18.522	107	156	79.713	24.447	12.388
HACR1	2009	ANN_1YR_G30_902_#	total_bext	1/Mm	13.296	154	157	65.342	22.979	12.466
HALE1	2009	ANN_1YR_G30_902_#	total_bext	1/Mm	20.337	99	157	65.342	22.979	12.466
HAVO1	2009	ANN_1YR_G30_902_#	total_bext	1/Mm	18.581	107	157	65.342	22.979	12.466
HACR1	2010	ANN_1YR_G30_902_#	total_bext	1/Mm	12.478	151	153	74.806	21.881	12.409
HALE1	2010	ANN_1YR_G30_902_#	total_bext	1/Mm	18.972	97	153	74.806	21.881	12.409
HAVO1	2010	ANN_1YR_G30_902_#	total_bext	1/Mm	17.310	108	153	74.806	21.881	12.409
HACR1	2011	ANN_1YR_G30_902_#	total_bext	1/Mm	12.515	149	150	70.893	22.899	11.742
HALE1	2011	ANN_1YR_G30_902_#	total_bext	1/Mm	19.794	91	150	70.893	22.899	11.742
HAVO1	2011	ANN_1YR_G30_902_#	total_bext	1/Mm	16.814	113	150	70.893	22.899	11.742
HACR1	2012	ANN_1YR_G30_902_#	total_bext	1/Mm	12.773	156	157	63.133	22.001	12.387
HALE1	2012	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	157	63.133	22.001	12.387
HAVO1	2012	ANN_1YR_G30_902_#	total_bext	1/Mm	15.949	121	157	63.133	22.001	12.387
HACR1	2013	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	151	56.808	21.595	11.560
HALE1	2013	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	151	56.808	21.595	11.560
HAVO1	2013	ANN_1YR_G30_902_#	total_bext	1/Mm	19.015	93	151	56.808	21.595	11.560
HACR1	2014	ANN_1YR_G30_902_#	total_bext	1/Mm	12.072	158	159	57.912	22.468	11.593
HALE1	2014	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	159	57.912	22.468	11.593
HAVO1	2014	ANN_1YR_G30_902_#	total_bext	1/Mm	18.164	100	159	57.912	22.468	11.593
HACR1	2015	ANN_1YR_G30_902_#	total_bext	1/Mm	12.051	148	150	53.780	21.837	11.188
HALE1	2015	ANN_1YR_G30_902_#	total_bext	1/Mm	NA	NA	150	53.780	21.837	11.188
HAVO1	2015	ANN_1YR_G30_902_#	total_bext	1/Mm	19.668	87	150	53.780	21.837	11.188

Table E-23

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	90	55.987	17.562	11.186
HALE1	2001	ANN_1YR_G10_902_#	total_bext	1/Mm	15.909	60	90	55.987	17.562	11.186
HAVO1	2001	ANN_1YR_G10_902_#	total_bext	1/Mm	15.158	63	90	55.987	17.562	11.186
HACR1	2002	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	125	60.505	19.239	10.249
HALE1	2002	ANN_1YR_G10_902_#	total_bext	1/Mm	16.173	84	125	60.505	19.239	10.249
HAVO1	2002	ANN_1YR_G10_902_#	total_bext	1/Mm	14.877	92	125	60.505	19.239	10.249
HACR1	2003	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	145	54.496	19.183	10.161
HALE1	2003	ANN_1YR_G10_902_#	total_bext	1/Mm	15.458	99	145	54.496	19.183	10.161
HAVO1	2003	ANN_1YR_G10_902_#	total_bext	1/Mm	15.277	100	145	54.496	19.183	10.161
HACR1	2004	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	153	51.594	19.406	10.622
HALE1	2004	ANN_1YR_G10_902_#	total_bext	1/Mm	15.774	102	153	51.594	19.406	10.622
HAVO1	2004	ANN_1YR_G10_902_#	total_bext	1/Mm	14.955	112	153	51.594	19.406	10.622
HACR1	2005	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	159	72.991	19.874	9.970
HALE1	2005	ANN_1YR_G10_902_#	total_bext	1/Mm	14.622	117	159	72.991	19.874	9.970
HAVO1	2005	ANN_1YR_G10_902_#	total_bext	1/Mm	14.265	120	159	72.991	19.874	9.970
HACR1	2006	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	155	64.365	18.931	10.562
HALE1	2006	ANN_1YR_G10_902_#	total_bext	1/Mm	15.759	107	155	64.365	18.931	10.562
HAVO1	2006	ANN_1YR_G10_902_#	total_bext	1/Mm	13.876	122	155	64.365	18.931	10.562
HACR1	2007	ANN_1YR_G10_902_#	total_bext	1/Mm	10.896	154	156	60.239	19.236	10.378
HALE1	2007	ANN_1YR_G10_902_#	total_bext	1/Mm	15.903	103	156	60.239	19.236	10.378
HAVO1	2007	ANN_1YR_G10_902_#	total_bext	1/Mm	15.058	109	156	60.239	19.236	10.378
HACR1	2008	ANN_1YR_G10_902_#	total_bext	1/Mm	10.630	154	156	53.919	18.537	10.101
HALE1	2008	ANN_1YR_G10_902_#	total_bext	1/Mm	15.841	96	156	53.919	18.537	10.101
HAVO1	2008	ANN_1YR_G10_902_#	total_bext	1/Mm	15.077	105	156	53.919	18.537	10.101
HACR1	2009	ANN_1YR_G10_902_#	total_bext	1/Mm	11.387	150	157	46.438	18.266	10.162
HALE1	2009	ANN_1YR_G10_902_#	total_bext	1/Mm	15.963	95	157	46.438	18.266	10.162
HAVO1	2009	ANN_1YR_G10_902_#	total_bext	1/Mm	14.884	109	157	46.438	18.266	10.162
HACR1	2010	ANN_1YR_G10_902_#	total_bext	1/Mm	10.441	151	153	53.065	17.147	10.133
HALE1	2010	ANN_1YR_G10_902_#	total_bext	1/Mm	15.533	89	153	53.065	17.147	10.133
HAVO1	2010	ANN_1YR_G10_902_#	total_bext	1/Mm	14.369	103	153	53.065	17.147	10.133
HACR1	2011	ANN_1YR_G10_902_#	total_bext	1/Mm	10.715	148	150	51.251	17.622	9.984
HALE1	2011	ANN_1YR_G10_902_#	total_bext	1/Mm	16.177	84	150	51.251	17.622	9.984
HAVO1	2011	ANN_1YR_G10_902_#	total_bext	1/Mm	13.736	111	150	51.251	17.622	9.984
HACR1	2012	ANN_1YR_G10_902_#	total_bext	1/Mm	10.855	155	157	47.219	17.392	9.944
HALE1	2012	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	157	47.219	17.392	9.944
HAVO1	2012	ANN_1YR_G10_902_#	total_bext	1/Mm	13.435	111	157	47.219	17.392	9.944

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	151	40.330	16.892	9.440
HALE1	2013	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	151	40.330	16.892	9.440
HAVO1	2013	ANN_1YR_G10_902_#	total_bext	1/Mm	14.881	94	151	40.330	16.892	9.440
HACR1	2014	ANN_1YR_G10_902_#	total_bext	1/Mm	10.586	155	159	42.482	16.883	9.883
HALE1	2014	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	159	42.482	16.883	9.883
HAVO1	2014	ANN_1YR_G10_902_#	total_bext	1/Mm	14.187	104	159	42.482	16.883	9.883
HACR1	2015	ANN_1YR_G10_902_#	total_bext	1/Mm	10.317	148	150	42.312	16.700	9.663
HALE1	2015	ANN_1YR_G10_902_#	total_bext	1/Mm	NA	NA	150	42.312	16.700	9.663
HAVO1	2015	ANN_1YR_G10_902_#	total_bext	1/Mm	15.019	90	150	42.312	16.700	9.663

Table E-23: Hawaii IMPROVE site Total Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	dv	1	NA	NA	90	31.543	16.499	9.093
HALE1	2001	ANN_1YR_G90_902_#	dv	1	13.141	67	90	31.543	16.499	9.093
HAVO1	2001	ANN_1YR_G90_902_#	dv	1	16.382	46	90	31.543	16.499	9.093
HACR1	2002	ANN_1YR_G90_902_#	dv	1	NA	NA	125	31.323	17.988	10.216
HALE1	2002	ANN_1YR_G90_902_#	dv	1	12.611	108	125	31.323	17.988	10.216
HAVO1	2002	ANN_1YR_G90_902_#	dv	1	18.049	62	125	31.323	17.988	10.216
HACR1	2003	ANN_1YR_G90_902_#	dv	1	NA	NA	145	31.819	18.444	9.378
HALE1	2003	ANN_1YR_G90_902_#	dv	1	14.804	106	145	31.819	18.444	9.378
HAVO1	2003	ANN_1YR_G90_902_#	dv	1	22.001	57	145	31.819	18.444	9.378
HACR1	2004	ANN_1YR_G90_902_#	dv	1	NA	NA	153	30.593	18.403	7.643
HALE1	2004	ANN_1YR_G90_902_#	dv	1	12.778	118	153	30.593	18.403	7.643
HAVO1	2004	ANN_1YR_G90_902_#	dv	1	18.992	71	153	30.593	18.403	7.643
HACR1	2005	ANN_1YR_G90_902_#	dv	1	NA	NA	159	34.721	18.270	9.058
HALE1	2005	ANN_1YR_G90_902_#	dv	1	13.507	119	159	34.721	18.270	9.058
HAVO1	2005	ANN_1YR_G90_902_#	dv	1	22.058	61	159	34.721	18.270	9.058
HACR1	2006	ANN_1YR_G90_902_#	dv	1	NA	NA	155	33.053	18.691	8.805
HALE1	2006	ANN_1YR_G90_902_#	dv	1	13.689	122	155	33.053	18.691	8.805
HAVO1	2006	ANN_1YR_G90_902_#	dv	1	20.598	64	155	33.053	18.691	8.805
HACR1	2007	ANN_1YR_G90_902_#	dv	1	9.340	153	156	32.610	19.126	8.622
HALE1	2007	ANN_1YR_G90_902_#	dv	1	13.312	121	156	32.610	19.126	8.622
HAVO1	2007	ANN_1YR_G90_902_#	dv	1	23.811	52	156	32.610	19.126	8.622
HACR1	2008	ANN_1YR_G90_902_#	dv	1	12.118	137	156	34.641	18.135	9.329
HALE1	2008	ANN_1YR_G90_902_#	dv	1	17.908	81	156	34.641	18.135	9.329
HAVO1	2008	ANN_1YR_G90_902_#	dv	1	27.471	8	156	34.641	18.135	9.329
HACR1	2009	ANN_1YR_G90_902_#	dv	1	10.926	142	157	32.585	17.715	8.214
HALE1	2009	ANN_1YR_G90_902_#	dv	1	15.389	96	157	32.585	17.715	8.214
HAVO1	2009	ANN_1YR_G90_902_#	dv	1	30.513	2	157	32.585	17.715	8.214
HACR1	2010	ANN_1YR_G90_902_#	dv	1	10.021	136	153	31.778	16.663	7.861
HALE1	2010	ANN_1YR_G90_902_#	dv	1	14.821	83	153	31.778	16.663	7.861
HAVO1	2010	ANN_1YR_G90_902_#	dv	1	24.464	20	153	31.778	16.663	7.861
HACR1	2011	ANN_1YR_G90_902_#	dv	1	9.464	141	150	33.131	16.409	7.360
HALE1	2011	ANN_1YR_G90_902_#	dv	1	14.321	98	150	33.131	16.409	7.360
HAVO1	2011	ANN_1YR_G90_902_#	dv	1	15.080	88	150	33.131	16.409	7.360
HACR1	2012	ANN_1YR_G90_902_#	dv	1	9.854	152	157	31.572	16.943	8.718
HALE1	2012	ANN_1YR_G90_902_#	dv	1	NA	NA	157	31.572	16.943	8.718
HAVO1	2012	ANN_1YR_G90_902_#	dv	1	16.458	84	157	31.572	16.943	8.718

Table E-24

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	dv	1	NA	NA	151	33.180	15.911	7.367
HALE1	2013	ANN_1YR_G90_902_#	dv	1	NA	NA	151	33.180	15.911	7.367
HAVO1	2013	ANN_1YR_G90_902_#	dv	1	19.692	39	151	33.180	15.911	7.367
HACR1	2014	ANN_1YR_G90_902_#	dv	1	8.926	150	159	33.983	16.088	7.255
HALE1	2014	ANN_1YR_G90_902_#	dv	1	NA	NA	159	33.983	16.088	7.255
HAVO1	2014	ANN_1YR_G90_902_#	dv	1	19.284	43	159	33.983	16.088	7.255
HACR1	2015	ANN_1YR_G90_902_#	dv	1	8.667	148	150	32.885	16.807	8.297
HALE1	2015	ANN_1YR_G90_902_#	dv	1	NA	NA	150	32.885	16.807	8.297
HAVO1	2015	ANN_1YR_G90_902_#	dv	1	19.290	42	150	32.885	16.807	8.297
HACR1	2001	ANN_1YR_G70_902_#	dv	1	NA	NA	90	26.526	12.292	5.897
HALE1	2001	ANN_1YR_G70_902_#	dv	1	10.058	61	90	26.526	12.292	5.897
HAVO1	2001	ANN_1YR_G70_902_#	dv	1	9.484	68	90	26.526	12.292	5.897
HACR1	2002	ANN_1YR_G70_902_#	dv	1	NA	NA	125	25.983	13.860	6.350
HALE1	2002	ANN_1YR_G70_902_#	dv	1	10.357	88	125	25.983	13.860	6.350
HAVO1	2002	ANN_1YR_G70_902_#	dv	1	10.125	93	125	25.983	13.860	6.350
HACR1	2003	ANN_1YR_G70_902_#	dv	1	NA	NA	145	25.840	14.118	6.452
HALE1	2003	ANN_1YR_G70_902_#	dv	1	10.958	100	145	25.840	14.118	6.452
HAVO1	2003	ANN_1YR_G70_902_#	dv	1	12.309	89	145	25.840	14.118	6.452
HACR1	2004	ANN_1YR_G70_902_#	dv	1	NA	NA	153	25.683	13.597	5.665
HALE1	2004	ANN_1YR_G70_902_#	dv	1	10.352	105	153	25.683	13.597	5.665
HAVO1	2004	ANN_1YR_G70_902_#	dv	1	10.598	102	153	25.683	13.597	5.665
HACR1	2005	ANN_1YR_G70_902_#	dv	1	NA	NA	159	29.942	14.186	5.878
HALE1	2005	ANN_1YR_G70_902_#	dv	1	10.310	112	159	29.942	14.186	5.878
HAVO1	2005	ANN_1YR_G70_902_#	dv	1	11.535	102	159	29.942	14.186	5.878
HACR1	2006	ANN_1YR_G70_902_#	dv	1	NA	NA	155	28.673	14.005	6.409
HALE1	2006	ANN_1YR_G70_902_#	dv	1	10.693	110	155	28.673	14.005	6.409
HAVO1	2006	ANN_1YR_G70_902_#	dv	1	12.059	95	155	28.673	14.005	6.409
HACR1	2007	ANN_1YR_G70_902_#	dv	1	5.214	156	156	27.955	13.943	5.214
HALE1	2007	ANN_1YR_G70_902_#	dv	1	9.650	117	156	27.955	13.943	5.214
HAVO1	2007	ANN_1YR_G70_902_#	dv	1	10.592	106	156	27.955	13.943	5.214
HACR1	2008	ANN_1YR_G70_902_#	dv	1	6.595	154	156	26.598	13.630	6.241
HALE1	2008	ANN_1YR_G70_902_#	dv	1	11.065	103	156	26.598	13.630	6.241
HAVO1	2008	ANN_1YR_G70_902_#	dv	1	11.871	93	156	26.598	13.630	6.241
HACR1	2009	ANN_1YR_G70_902_#	dv	1	6.380	152	157	23.502	13.269	5.681
HALE1	2009	ANN_1YR_G70_902_#	dv	1	10.701	101	157	23.502	13.269	5.681
HAVO1	2009	ANN_1YR_G70_902_#	dv	1	16.385	52	157	23.502	13.269	5.681

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	dv	1	5.864	151	153	24.795	12.186	5.247
HALE1	2010	ANN_1YR_G70_902_#	dv	1	10.255	93	153	24.795	12.186	5.247
HAVO1	2010	ANN_1YR_G70_902_#	dv	1	10.987	84	153	24.795	12.186	5.247
HACR1	2011	ANN_1YR_G70_902_#	dv	1	5.630	148	150	24.604	12.462	5.254
HALE1	2011	ANN_1YR_G70_902_#	dv	1	10.152	96	150	24.604	12.462	5.254
HAVO1	2011	ANN_1YR_G70_902_#	dv	1	8.873	115	150	24.604	12.462	5.254
HACR1	2012	ANN_1YR_G70_902_#	dv	1	6.371	156	157	22.598	12.064	5.925
HALE1	2012	ANN_1YR_G70_902_#	dv	1	NA	NA	157	22.598	12.064	5.925
HAVO1	2012	ANN_1YR_G70_902_#	dv	1	9.832	109	157	22.598	12.064	5.925
HACR1	2013	ANN_1YR_G70_902_#	dv	1	NA	NA	151	24.631	11.965	5.320
HALE1	2013	ANN_1YR_G70_902_#	dv	1	NA	NA	151	24.631	11.965	5.320
HAVO1	2013	ANN_1YR_G70_902_#	dv	1	11.118	86	151	24.631	11.965	5.320
HACR1	2014	ANN_1YR_G70_902_#	dv	1	5.314	158	159	22.528	11.978	5.147
HALE1	2014	ANN_1YR_G70_902_#	dv	1	NA	NA	159	22.528	11.978	5.147
HAVO1	2014	ANN_1YR_G70_902_#	dv	1	12.587	75	159	22.528	11.978	5.147
HACR1	2015	ANN_1YR_G70_902_#	dv	1	5.149	147	150	24.117	12.112	4.212
HALE1	2015	ANN_1YR_G70_902_#	dv	1	NA	NA	150	24.117	12.112	4.212
HAVO1	2015	ANN_1YR_G70_902_#	dv	1	13.423	58	150	24.117	12.112	4.212
HACR1	2001	ANN_1YR_G50_902_#	dv	1	NA	NA	90	22.745	9.803	4.647
HALE1	2001	ANN_1YR_G50_902_#	dv	1	8.237	58	90	22.745	9.803	4.647
HAVO1	2001	ANN_1YR_G50_902_#	dv	1	7.677	68	90	22.745	9.803	4.647
HACR1	2002	ANN_1YR_G50_902_#	dv	1	NA	NA	125	23.378	11.554	4.478
HALE1	2002	ANN_1YR_G50_902_#	dv	1	8.605	85	125	23.378	11.554	4.478
HAVO1	2002	ANN_1YR_G50_902_#	dv	1	7.795	98	125	23.378	11.554	4.478
HACR1	2003	ANN_1YR_G50_902_#	dv	1	NA	NA	145	22.940	11.733	4.331
HALE1	2003	ANN_1YR_G50_902_#	dv	1	8.860	95	145	22.940	11.733	4.331
HAVO1	2003	ANN_1YR_G50_902_#	dv	1	8.253	102	145	22.940	11.733	4.331
HACR1	2004	ANN_1YR_G50_902_#	dv	1	NA	NA	153	22.928	11.112	4.134
HALE1	2004	ANN_1YR_G50_902_#	dv	1	8.208	107	153	22.928	11.112	4.134
HAVO1	2004	ANN_1YR_G50_902_#	dv	1	8.165	110	153	22.928	11.112	4.134
HACR1	2005	ANN_1YR_G50_902_#	dv	1	NA	NA	159	26.571	11.686	3.866
HALE1	2005	ANN_1YR_G50_902_#	dv	1	8.651	108	159	26.571	11.686	3.866
HAVO1	2005	ANN_1YR_G50_902_#	dv	1	7.663	119	159	26.571	11.686	3.866
HACR1	2006	ANN_1YR_G50_902_#	dv	1	NA	NA	155	25.563	11.654	4.484
HALE1	2006	ANN_1YR_G50_902_#	dv	1	8.722	104	155	25.563	11.654	4.484
HAVO1	2006	ANN_1YR_G50_902_#	dv	1	8.081	112	155	25.563	11.654	4.484

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	dv	1	3.885	156	156	25.269	11.374	3.885
HALE1	2007	ANN_1YR_G50_902_#	dv	1	8.193	108	156	25.269	11.374	3.885
HAVO1	2007	ANN_1YR_G50_902_#	dv	1	7.342	121	156	25.269	11.374	3.885
HACR1	2008	ANN_1YR_G50_902_#	dv	1	4.313	156	156	24.095	11.298	4.313
HALE1	2008	ANN_1YR_G50_902_#	dv	1	9.091	99	156	24.095	11.298	4.313
HAVO1	2008	ANN_1YR_G50_902_#	dv	1	8.236	108	156	24.095	11.298	4.313
HACR1	2009	ANN_1YR_G50_902_#	dv	1	4.643	153	157	20.693	10.676	3.904
HALE1	2009	ANN_1YR_G50_902_#	dv	1	8.763	101	157	20.693	10.676	3.904
HAVO1	2009	ANN_1YR_G50_902_#	dv	1	8.648	103	157	20.693	10.676	3.904
HACR1	2010	ANN_1YR_G50_902_#	dv	1	4.145	152	153	22.286	9.956	3.845
HALE1	2010	ANN_1YR_G50_902_#	dv	1	8.031	97	153	22.286	9.956	3.845
HAVO1	2010	ANN_1YR_G50_902_#	dv	1	7.975	99	153	22.286	9.956	3.845
HACR1	2011	ANN_1YR_G50_902_#	dv	1	3.885	148	150	21.881	10.273	3.534
HALE1	2011	ANN_1YR_G50_902_#	dv	1	8.232	97	150	21.881	10.273	3.534
HAVO1	2011	ANN_1YR_G50_902_#	dv	1	6.527	119	150	21.881	10.273	3.534
HACR1	2012	ANN_1YR_G50_902_#	dv	1	4.329	157	157	20.686	9.994	4.329
HALE1	2012	ANN_1YR_G50_902_#	dv	1	NA	NA	157	20.686	9.994	4.329
HAVO1	2012	ANN_1YR_G50_902_#	dv	1	7.025	115	157	20.686	9.994	4.329
HACR1	2013	ANN_1YR_G50_902_#	dv	1	NA	NA	151	19.508	9.679	3.375
HALE1	2013	ANN_1YR_G50_902_#	dv	1	NA	NA	151	19.508	9.679	3.375
HAVO1	2013	ANN_1YR_G50_902_#	dv	1	8.235	96	151	19.508	9.679	3.375
HACR1	2014	ANN_1YR_G50_902_#	dv	1	3.519	158	159	19.659	9.944	3.485
HALE1	2014	ANN_1YR_G50_902_#	dv	1	NA	NA	159	19.659	9.944	3.485
HAVO1	2014	ANN_1YR_G50_902_#	dv	1	8.389	99	159	19.659	9.944	3.485
HACR1	2015	ANN_1YR_G50_902_#	dv	1	2.989	149	150	19.264	9.816	2.717
HALE1	2015	ANN_1YR_G50_902_#	dv	1	NA	NA	150	19.264	9.816	2.717
HAVO1	2015	ANN_1YR_G50_902_#	dv	1	9.183	84	150	19.264	9.816	2.717
HACR1	2001	ANN_1YR_G30_902_#	dv	1	NA	NA	90	19.963	8.241	3.081
HALE1	2001	ANN_1YR_G30_902_#	dv	1	6.492	62	90	19.963	8.241	3.081
HAVO1	2001	ANN_1YR_G30_902_#	dv	1	5.851	68	90	19.963	8.241	3.081
HACR1	2002	ANN_1YR_G30_902_#	dv	1	NA	NA	125	20.918	9.314	3.010
HALE1	2002	ANN_1YR_G30_902_#	dv	1	7.094	81	125	20.918	9.314	3.010
HAVO1	2002	ANN_1YR_G30_902_#	dv	1	6.072	95	125	20.918	9.314	3.010
HACR1	2003	ANN_1YR_G30_902_#	dv	1	NA	NA	145	20.141	9.394	2.390
HALE1	2003	ANN_1YR_G30_902_#	dv	1	6.678	98	145	20.141	9.394	2.390
HAVO1	2003	ANN_1YR_G30_902_#	dv	1	6.186	104	145	20.141	9.394	2.390

Table E-24

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	dv	1	NA	NA	153	19.719	9.015	2.532
HALE1	2004	ANN_1YR_G30_902_#	dv	1	6.820	100	153	19.719	9.015	2.532
HAVO1	2004	ANN_1YR_G30_902_#	dv	1	6.549	107	153	19.719	9.015	2.532
HACR1	2005	ANN_1YR_G30_902_#	dv	1	NA	NA	159	23.833	9.326	1.772
HALE1	2005	ANN_1YR_G30_902_#	dv	1	6.357	111	159	23.833	9.326	1.772
HAVO1	2005	ANN_1YR_G30_902_#	dv	1	6.041	117	159	23.833	9.326	1.772
HACR1	2006	ANN_1YR_G30_902_#	dv	1	NA	NA	155	22.465	9.126	2.722
HALE1	2006	ANN_1YR_G30_902_#	dv	1	6.580	105	155	22.465	9.126	2.722
HAVO1	2006	ANN_1YR_G30_902_#	dv	1	5.795	117	155	22.465	9.126	2.722
HACR1	2007	ANN_1YR_G30_902_#	dv	1	2.250	156	156	22.152	9.053	2.250
HALE1	2007	ANN_1YR_G30_902_#	dv	1	6.746	104	156	22.152	9.053	2.250
HAVO1	2007	ANN_1YR_G30_902_#	dv	1	5.952	114	156	22.152	9.053	2.250
HACR1	2008	ANN_1YR_G30_902_#	dv	1	2.510	155	156	20.714	8.923	2.117
HALE1	2008	ANN_1YR_G30_902_#	dv	1	7.034	99	156	20.714	8.923	2.117
HAVO1	2008	ANN_1YR_G30_902_#	dv	1	6.149	107	156	20.714	8.923	2.117
HACR1	2009	ANN_1YR_G30_902_#	dv	1	2.835	154	157	18.746	8.307	2.196
HALE1	2009	ANN_1YR_G30_902_#	dv	1	7.084	99	157	18.746	8.307	2.196
HAVO1	2009	ANN_1YR_G30_902_#	dv	1	6.188	107	157	18.746	8.307	2.196
HACR1	2010	ANN_1YR_G30_902_#	dv	1	2.188	151	153	20.096	7.814	2.152
HALE1	2010	ANN_1YR_G30_902_#	dv	1	6.394	97	153	20.096	7.814	2.152
HAVO1	2010	ANN_1YR_G30_902_#	dv	1	5.475	108	153	20.096	7.814	2.152
HACR1	2011	ANN_1YR_G30_902_#	dv	1	2.235	149	150	19.569	8.274	1.595
HALE1	2011	ANN_1YR_G30_902_#	dv	1	6.822	90	150	19.569	8.274	1.595
HAVO1	2011	ANN_1YR_G30_902_#	dv	1	5.185	113	150	19.569	8.274	1.595
HACR1	2012	ANN_1YR_G30_902_#	dv	1	2.438	156	157	18.390	7.868	2.109
HALE1	2012	ANN_1YR_G30_902_#	dv	1	NA	NA	157	18.390	7.868	2.109
HAVO1	2012	ANN_1YR_G30_902_#	dv	1	4.657	121	157	18.390	7.868	2.109
HACR1	2013	ANN_1YR_G30_902_#	dv	1	NA	NA	151	17.358	7.695	1.429
HALE1	2013	ANN_1YR_G30_902_#	dv	1	NA	NA	151	17.358	7.695	1.429
HAVO1	2013	ANN_1YR_G30_902_#	dv	1	6.407	93	151	17.358	7.695	1.429
HACR1	2014	ANN_1YR_G30_902_#	dv	1	1.873	158	159	17.534	8.087	1.466
HALE1	2014	ANN_1YR_G30_902_#	dv	1	NA	NA	159	17.534	8.087	1.466
HAVO1	2014	ANN_1YR_G30_902_#	dv	1	5.946	100	159	17.534	8.087	1.466
HACR1	2015	ANN_1YR_G30_902_#	dv	1	1.859	148	150	16.810	7.794	1.112
HALE1	2015	ANN_1YR_G30_902_#	dv	1	NA	NA	150	16.810	7.794	1.112
HAVO1	2015	ANN_1YR_G30_902_#	dv	1	6.748	87	150	16.810	7.794	1.112

Table E-24

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	dv	1	NA	NA	90	17.102	5.567	1.064
HALE1	2001	ANN_1YR_G10_902_#	dv	1	4.598	60	90	17.102	5.567	1.064
HAVO1	2001	ANN_1YR_G10_902_#	dv	1	4.145	63	90	17.102	5.567	1.064
HACR1	2002	ANN_1YR_G10_902_#	dv	1	NA	NA	125	17.924	6.380	0.220
HALE1	2002	ANN_1YR_G10_902_#	dv	1	4.769	84	125	17.924	6.380	0.220
HAVO1	2002	ANN_1YR_G10_902_#	dv	1	3.936	92	125	17.924	6.380	0.220
HACR1	2003	ANN_1YR_G10_902_#	dv	1	NA	NA	145	16.786	6.487	0.123
HALE1	2003	ANN_1YR_G10_902_#	dv	1	4.286	99	145	16.786	6.487	0.123
HAVO1	2003	ANN_1YR_G10_902_#	dv	1	4.206	100	145	16.786	6.487	0.123
HACR1	2004	ANN_1YR_G10_902_#	dv	1	NA	NA	153	16.286	6.584	0.560
HALE1	2004	ANN_1YR_G10_902_#	dv	1	4.535	102	153	16.286	6.584	0.560
HAVO1	2004	ANN_1YR_G10_902_#	dv	1	3.962	113	153	16.286	6.584	0.560
HACR1	2005	ANN_1YR_G10_902_#	dv	1	NA	NA	159	19.613	6.797	-0.053
HALE1	2005	ANN_1YR_G10_902_#	dv	1	3.742	117	159	19.613	6.797	-0.053
HAVO1	2005	ANN_1YR_G10_902_#	dv	1	3.506	120	159	19.613	6.797	-0.053
HACR1	2006	ANN_1YR_G10_902_#	dv	1	NA	NA	155	18.405	6.323	0.519
HALE1	2006	ANN_1YR_G10_902_#	dv	1	4.505	107	155	18.405	6.323	0.519
HAVO1	2006	ANN_1YR_G10_902_#	dv	1	3.227	122	155	18.405	6.323	0.519
HACR1	2007	ANN_1YR_G10_902_#	dv	1	0.846	154	156	17.746	6.475	0.340
HALE1	2007	ANN_1YR_G10_902_#	dv	1	4.587	103	156	17.746	6.475	0.340
HAVO1	2007	ANN_1YR_G10_902_#	dv	1	4.044	109	156	17.746	6.475	0.340
HACR1	2008	ANN_1YR_G10_902_#	dv	1	0.595	154	156	16.509	6.069	0.079
HALE1	2008	ANN_1YR_G10_902_#	dv	1	4.556	95	156	16.509	6.069	0.079
HAVO1	2008	ANN_1YR_G10_902_#	dv	1	4.071	105	156	16.509	6.069	0.079
HACR1	2009	ANN_1YR_G10_902_#	dv	1	1.278	150	157	15.281	5.801	0.134
HALE1	2009	ANN_1YR_G10_902_#	dv	1	4.589	95	157	15.281	5.801	0.134
HAVO1	2009	ANN_1YR_G10_902_#	dv	1	3.915	109	157	15.281	5.801	0.134
HACR1	2010	ANN_1YR_G10_902_#	dv	1	0.419	151	153	16.528	5.323	0.108
HALE1	2010	ANN_1YR_G10_902_#	dv	1	4.370	88	153	16.528	5.323	0.108
HAVO1	2010	ANN_1YR_G10_902_#	dv	1	3.593	103	153	16.528	5.323	0.108
HACR1	2011	ANN_1YR_G10_902_#	dv	1	0.676	148	150	16.158	5.608	-0.034
HALE1	2011	ANN_1YR_G10_902_#	dv	1	4.758	84	150	16.158	5.608	-0.034
HAVO1	2011	ANN_1YR_G10_902_#	dv	1	3.133	111	150	16.158	5.608	-0.034
HACR1	2012	ANN_1YR_G10_902_#	dv	1	0.800	155	157	15.426	5.493	-0.069
HALE1	2012	ANN_1YR_G10_902_#	dv	1	NA	NA	157	15.426	5.493	-0.069
HAVO1	2012	ANN_1YR_G10_902_#	dv	1	2.909	111	157	15.426	5.493	-0.069

Table E-24

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	dv	1	NA	NA	151	13.895	5.183	-0.599
HALE1	2013	ANN_1YR_G10_902_#	dv	1	NA	NA	151	13.895	5.183	-0.599
HAVO1	2013	ANN_1YR_G10_902_#	dv	1	3.914	95	151	13.895	5.183	-0.599
HACR1	2014	ANN_1YR_G10_902_#	dv	1	0.557	155	159	14.342	5.128	-0.132
HALE1	2014	ANN_1YR_G10_902_#	dv	1	NA	NA	159	14.342	5.128	-0.132
HAVO1	2014	ANN_1YR_G10_902_#	dv	1	3.454	103	159	14.342	5.128	-0.132
HACR1	2015	ANN_1YR_G10_902_#	dv	1	0.299	148	150	14.314	5.063	-0.357
HALE1	2015	ANN_1YR_G10_902_#	dv	1	NA	NA	150	14.314	5.063	-0.357
HAVO1	2015	ANN_1YR_G10_902_#	dv	1	3.999	90	150	14.314	5.063	-0.357

Table E-24: Hawaii IMPROVE site Haze Index (dv) annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	SVR	km	NA	NA	90	171.474	77.191	17.297
HALE1	2001	ANN_1YR_G90_902_#	SVR	km	106.298	24	90	171.474	77.191	17.297
HAVO1	2001	ANN_1YR_G90_902_#	SVR	km	86.720	44	90	171.474	77.191	17.297
HACR1	2002	ANN_1YR_G90_902_#	SVR	km	NA	NA	125	154.448	69.837	17.939
HALE1	2002	ANN_1YR_G90_902_#	SVR	km	112.745	19	125	154.448	69.837	17.939
HAVO1	2002	ANN_1YR_G90_902_#	SVR	km	70.304	62	125	154.448	69.837	17.939
HACR1	2003	ANN_1YR_G90_902_#	SVR	km	NA	NA	145	152.282	64.099	17.162
HALE1	2003	ANN_1YR_G90_902_#	SVR	km	91.008	42	145	152.282	64.099	17.162
HAVO1	2003	ANN_1YR_G90_902_#	SVR	km	48.460	88	145	152.282	64.099	17.162
HACR1	2004	ANN_1YR_G90_902_#	SVR	km	NA	NA	153	167.634	67.119	18.980
HALE1	2004	ANN_1YR_G90_902_#	SVR	km	109.638	40	153	167.634	67.119	18.980
HAVO1	2004	ANN_1YR_G90_902_#	SVR	km	62.571	82	153	167.634	67.119	18.980
HACR1	2005	ANN_1YR_G90_902_#	SVR	km	NA	NA	159	154.628	66.104	12.546
HALE1	2005	ANN_1YR_G90_902_#	SVR	km	102.335	46	159	154.628	66.104	12.546
HAVO1	2005	ANN_1YR_G90_902_#	SVR	km	46.877	98	159	154.628	66.104	12.546
HACR1	2006	ANN_1YR_G90_902_#	SVR	km	NA	NA	155	157.111	64.976	14.685
HALE1	2006	ANN_1YR_G90_902_#	SVR	km	100.641	37	155	157.111	64.976	14.685
HAVO1	2006	ANN_1YR_G90_902_#	SVR	km	53.024	92	155	157.111	64.976	14.685
HACR1	2007	ANN_1YR_G90_902_#	SVR	km	153.924	3	156	171.605	63.408	15.480
HALE1	2007	ANN_1YR_G90_902_#	SVR	km	105.679	35	156	171.605	63.408	15.480
HAVO1	2007	ANN_1YR_G90_902_#	SVR	km	40.697	106	156	171.605	63.408	15.480
HACR1	2008	ANN_1YR_G90_902_#	SVR	km	119.708	19	156	164.324	66.876	12.975
HALE1	2008	ANN_1YR_G90_902_#	SVR	km	68.575	77	156	164.324	66.876	12.975
HAVO1	2008	ANN_1YR_G90_902_#	SVR	km	30.970	138	156	164.324	66.876	12.975
HACR1	2009	ANN_1YR_G90_902_#	SVR	km	133.253	16	157	160.231	69.419	15.925
HALE1	2009	ANN_1YR_G90_902_#	SVR	km	88.327	62	157	160.231	69.419	15.925
HAVO1	2009	ANN_1YR_G90_902_#	SVR	km	20.363	156	157	160.231	69.419	15.925
HACR1	2010	ANN_1YR_G90_902_#	SVR	km	142.695	21	153	172.881	77.447	17.351
HALE1	2010	ANN_1YR_G90_902_#	SVR	km	93.407	71	153	172.881	77.447	17.351
HAVO1	2010	ANN_1YR_G90_902_#	SVR	km	41.284	119	153	172.881	77.447	17.351
HACR1	2011	ANN_1YR_G90_902_#	SVR	km	150.505	11	150	172.387	79.031	15.823
HALE1	2011	ANN_1YR_G90_902_#	SVR	km	98.874	51	150	172.387	79.031	15.823
HAVO1	2011	ANN_1YR_G90_902_#	SVR	km	93.110	60	150	172.387	79.031	15.823
HACR1	2012	ANN_1YR_G90_902_#	SVR	km	143.287	6	157	172.374	77.439	18.361
HALE1	2012	ANN_1YR_G90_902_#	SVR	km	NA	NA	157	172.374	77.439	18.361
HAVO1	2012	ANN_1YR_G90_902_#	SVR	km	81.812	73	157	172.374	77.439	18.361

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G90_902_#	SVR	km	NA	NA	151	172.089	84.606	15.021
HALE1	2013	ANN_1YR_G90_902_#	SVR	km	NA	NA	151	172.089	84.606	15.021
HAVO1	2013	ANN_1YR_G90_902_#	SVR	km	57.789	114	151	172.089	84.606	15.021
HACR1	2014	ANN_1YR_G90_902_#	SVR	km	155.678	10	159	181.563	81.493	15.155
HALE1	2014	ANN_1YR_G90_902_#	SVR	km	NA	NA	159	181.563	81.493	15.155
HAVO1	2014	ANN_1YR_G90_902_#	SVR	km	58.961	116	159	181.563	81.493	15.155
HACR1	2015	ANN_1YR_G90_902_#	SVR	km	160.190	3	150	162.624	78.454	15.975
HALE1	2015	ANN_1YR_G90_902_#	SVR	km	NA	NA	150	162.624	78.454	15.975
HAVO1	2015	ANN_1YR_G90_902_#	SVR	km	58.787	116	150	162.624	78.454	15.975
HACR1	2001	ANN_1YR_G70_902_#	SVR	km	NA	NA	90	229.893	118.004	27.992
HALE1	2001	ANN_1YR_G70_902_#	SVR	km	143.248	30	90	229.893	118.004	27.992
HAVO1	2001	ANN_1YR_G70_902_#	SVR	km	151.705	21	90	229.893	118.004	27.992
HACR1	2002	ANN_1YR_G70_902_#	SVR	km	NA	NA	125	219.244	100.457	29.455
HALE1	2002	ANN_1YR_G70_902_#	SVR	km	138.911	38	125	219.244	100.457	29.455
HAVO1	2002	ANN_1YR_G70_902_#	SVR	km	143.221	31	125	219.244	100.457	29.455
HACR1	2003	ANN_1YR_G70_902_#	SVR	km	NA	NA	145	209.585	98.695	29.983
HALE1	2003	ANN_1YR_G70_902_#	SVR	km	130.870	45	145	209.585	98.695	29.983
HAVO1	2003	ANN_1YR_G70_902_#	SVR	km	116.304	58	145	209.585	98.695	29.983
HACR1	2004	ANN_1YR_G70_902_#	SVR	km	NA	NA	153	228.713	104.033	30.571
HALE1	2004	ANN_1YR_G70_902_#	SVR	km	138.998	49	153	228.713	104.033	30.571
HAVO1	2004	ANN_1YR_G70_902_#	SVR	km	136.076	53	153	228.713	104.033	30.571
HACR1	2005	ANN_1YR_G70_902_#	SVR	km	NA	NA	159	230.316	99.560	19.782
HALE1	2005	ANN_1YR_G70_902_#	SVR	km	139.696	47	159	230.316	99.560	19.782
HAVO1	2005	ANN_1YR_G70_902_#	SVR	km	125.673	58	159	230.316	99.560	19.782
HACR1	2006	ANN_1YR_G70_902_#	SVR	km	NA	NA	155	217.705	98.548	22.436
HALE1	2006	ANN_1YR_G70_902_#	SVR	km	134.424	48	155	217.705	98.548	22.436
HAVO1	2006	ANN_1YR_G70_902_#	SVR	km	118.244	62	155	217.705	98.548	22.436
HACR1	2007	ANN_1YR_G70_902_#	SVR	km	219.357	2	156	225.923	98.532	24.128
HALE1	2007	ANN_1YR_G70_902_#	SVR	km	149.113	37	156	225.923	98.532	24.128
HAVO1	2007	ANN_1YR_G70_902_#	SVR	km	137.451	50	156	225.923	98.532	24.128
HACR1	2008	ANN_1YR_G70_902_#	SVR	km	192.723	4	156	215.080	103.122	27.674
HALE1	2008	ANN_1YR_G70_902_#	SVR	km	129.738	56	156	215.080	103.122	27.674
HAVO1	2008	ANN_1YR_G70_902_#	SVR	km	121.467	63	156	215.080	103.122	27.674
HACR1	2009	ANN_1YR_G70_902_#	SVR	km	196.540	3	157	199.172	108.548	37.841
HALE1	2009	ANN_1YR_G70_902_#	SVR	km	134.316	57	157	199.172	108.548	37.841
HAVO1	2009	ANN_1YR_G70_902_#	SVR	km	81.950	102	157	199.172	108.548	37.841

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2010	ANN_1YR_G70_902_#	SVR	km	206.249	3	153	225.269	119.304	33.143
HALE1	2010	ANN_1YR_G70_902_#	SVR	km	140.594	61	153	225.269	119.304	33.143
HAVO1	2010	ANN_1YR_G70_902_#	SVR	km	131.215	70	153	225.269	119.304	33.143
HACR1	2011	ANN_1YR_G70_902_#	SVR	km	210.876	2	150	217.639	112.859	33.772
HALE1	2011	ANN_1YR_G70_902_#	SVR	km	141.823	56	150	217.639	112.859	33.772
HAVO1	2011	ANN_1YR_G70_902_#	SVR	km	161.611	35	150	217.639	112.859	33.772
HACR1	2012	ANN_1YR_G70_902_#	SVR	km	197.079	4	157	229.059	117.616	41.344
HALE1	2012	ANN_1YR_G70_902_#	SVR	km	NA	NA	157	229.059	117.616	41.344
HAVO1	2012	ANN_1YR_G70_902_#	SVR	km	146.829	48	157	229.059	117.616	41.344
HACR1	2013	ANN_1YR_G70_902_#	SVR	km	NA	NA	151	207.172	121.733	34.449
HALE1	2013	ANN_1YR_G70_902_#	SVR	km	NA	NA	151	207.172	121.733	34.449
HAVO1	2013	ANN_1YR_G70_902_#	SVR	km	129.497	68	151	207.172	121.733	34.449
HACR1	2014	ANN_1YR_G70_902_#	SVR	km	217.538	2	159	233.541	119.267	41.902
HALE1	2014	ANN_1YR_G70_902_#	SVR	km	NA	NA	159	233.541	119.267	41.902
HAVO1	2014	ANN_1YR_G70_902_#	SVR	km	111.899	89	159	233.541	119.267	41.902
HACR1	2015	ANN_1YR_G70_902_#	SVR	km	220.860	3	150	227.874	120.873	35.865
HALE1	2015	ANN_1YR_G70_902_#	SVR	km	NA	NA	150	227.874	120.873	35.865
HAVO1	2015	ANN_1YR_G70_902_#	SVR	km	103.081	93	150	227.874	120.873	35.865
HACR1	2001	ANN_1YR_G50_902_#	SVR	km	NA	NA	90	262.229	148.641	40.918
HALE1	2001	ANN_1YR_G50_902_#	SVR	km	171.728	33	90	262.229	148.641	40.918
HAVO1	2001	ANN_1YR_G50_902_#	SVR	km	181.677	21	90	262.229	148.641	40.918
HACR1	2002	ANN_1YR_G50_902_#	SVR	km	NA	NA	125	267.123	127.605	38.586
HALE1	2002	ANN_1YR_G50_902_#	SVR	km	165.623	38	125	267.123	127.605	38.586
HAVO1	2002	ANN_1YR_G50_902_#	SVR	km	179.474	27	125	267.123	127.605	38.586
HACR1	2003	ANN_1YR_G50_902_#	SVR	km	NA	NA	145	256.924	124.754	39.958
HALE1	2003	ANN_1YR_G50_902_#	SVR	km	161.527	50	145	256.924	124.754	39.958
HAVO1	2003	ANN_1YR_G50_902_#	SVR	km	171.652	42	145	256.924	124.754	39.958
HACR1	2004	ANN_1YR_G50_902_#	SVR	km	NA	NA	153	269.668	130.005	40.544
HALE1	2004	ANN_1YR_G50_902_#	SVR	km	172.301	48	153	269.668	130.005	40.544
HAVO1	2004	ANN_1YR_G50_902_#	SVR	km	173.177	45	153	269.668	130.005	40.544
HACR1	2005	ANN_1YR_G50_902_#	SVR	km	NA	NA	159	266.124	125.202	27.747
HALE1	2005	ANN_1YR_G50_902_#	SVR	km	164.823	52	159	266.124	125.202	27.747
HAVO1	2005	ANN_1YR_G50_902_#	SVR	km	182.029	38	159	266.124	125.202	27.747
HACR1	2006	ANN_1YR_G50_902_#	SVR	km	NA	NA	155	248.564	127.287	30.708
HALE1	2006	ANN_1YR_G50_902_#	SVR	km	163.750	53	155	248.564	127.287	30.708
HAVO1	2006	ANN_1YR_G50_902_#	SVR	km	174.747	45	155	248.564	127.287	30.708

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2007	ANN_1YR_G50_902_#	SVR	km	248.552	2	156	259.655	127.255	31.599
HALE1	2007	ANN_1YR_G50_902_#	SVR	km	172.469	47	156	259.655	127.255	31.599
HAVO1	2007	ANN_1YR_G50_902_#	SVR	km	187.850	34	156	259.655	127.255	31.599
HACR1	2008	ANN_1YR_G50_902_#	SVR	km	238.896	2	156	242.588	129.921	35.604
HALE1	2008	ANN_1YR_G50_902_#	SVR	km	157.701	58	156	242.588	129.921	35.604
HAVO1	2008	ANN_1YR_G50_902_#	SVR	km	172.009	47	156	242.588	129.921	35.604
HACR1	2009	ANN_1YR_G50_902_#	SVR	km	231.441	4	157	238.803	139.640	50.087
HALE1	2009	ANN_1YR_G50_902_#	SVR	km	163.015	57	157	238.803	139.640	50.087
HAVO1	2009	ANN_1YR_G50_902_#	SVR	km	165.907	55	157	238.803	139.640	50.087
HACR1	2010	ANN_1YR_G50_902_#	SVR	km	242.647	4	153	252.519	150.165	42.693
HALE1	2010	ANN_1YR_G50_902_#	SVR	km	175.395	60	153	252.519	150.165	42.693
HAVO1	2010	ANN_1YR_G50_902_#	SVR	km	177.010	56	153	252.519	150.165	42.693
HACR1	2011	ANN_1YR_G50_902_#	SVR	km	248.686	3	150	253.861	145.258	44.472
HALE1	2011	ANN_1YR_G50_902_#	SVR	km	171.908	56	150	253.861	145.258	44.472
HAVO1	2011	ANN_1YR_G50_902_#	SVR	km	203.769	31	150	253.861	145.258	44.472
HACR1	2012	ANN_1YR_G50_902_#	SVR	km	238.547	5	157	253.896	149.165	50.114
HALE1	2012	ANN_1YR_G50_902_#	SVR	km	NA	NA	157	253.896	149.165	50.114
HAVO1	2012	ANN_1YR_G50_902_#	SVR	km	194.202	40	157	253.896	149.165	50.114
HACR1	2013	ANN_1YR_G50_902_#	SVR	km	NA	NA	151	268.984	152.795	56.909
HALE1	2013	ANN_1YR_G50_902_#	SVR	km	NA	NA	151	268.984	152.795	56.909
HAVO1	2013	ANN_1YR_G50_902_#	SVR	km	172.038	58	151	268.984	152.795	56.909
HACR1	2014	ANN_1YR_G50_902_#	SVR	km	257.149	2	159	264.961	147.809	55.682
HALE1	2014	ANN_1YR_G50_902_#	SVR	km	NA	NA	159	264.961	147.809	55.682
HAVO1	2014	ANN_1YR_G50_902_#	SVR	km	170.146	62	159	264.961	147.809	55.682
HACR1	2015	ANN_1YR_G50_902_#	SVR	km	270.232	2	150	274.868	152.345	58.157
HALE1	2015	ANN_1YR_G50_902_#	SVR	km	NA	NA	150	274.868	152.345	58.157
HAVO1	2015	ANN_1YR_G50_902_#	SVR	km	157.071	68	150	274.868	152.345	58.157
HACR1	2001	ANN_1YR_G30_902_#	SVR	km	NA	NA	90	291.327	172.292	54.162
HALE1	2001	ANN_1YR_G30_902_#	SVR	km	204.635	28	90	291.327	172.292	54.162
HAVO1	2001	ANN_1YR_G30_902_#	SVR	km	218.065	19	90	291.327	172.292	54.162
HACR1	2002	ANN_1YR_G30_902_#	SVR	km	NA	NA	125	299.526	160.791	49.578
HALE1	2002	ANN_1YR_G30_902_#	SVR	km	192.504	41	125	299.526	160.791	49.578
HAVO1	2002	ANN_1YR_G30_902_#	SVR	km	213.322	30	125	299.526	160.791	49.578
HACR1	2003	ANN_1YR_G30_902_#	SVR	km	NA	NA	145	298.838	156.575	53.736
HALE1	2003	ANN_1YR_G30_902_#	SVR	km	200.792	47	145	298.838	156.575	53.736
HAVO1	2003	ANN_1YR_G30_902_#	SVR	km	210.870	42	145	298.838	156.575	53.736

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	SVR	km	NA	NA	153	299.194	165.169	55.346
HALE1	2004	ANN_1YR_G30_902_#	SVR	km	197.945	53	153	299.194	165.169	55.346
HAVO1	2004	ANN_1YR_G30_902_#	SVR	km	203.424	47	153	299.194	165.169	55.346
HACR1	2005	ANN_1YR_G30_902_#	SVR	km	NA	NA	159	302.552	159.961	36.532
HALE1	2005	ANN_1YR_G30_902_#	SVR	km	207.667	50	159	302.552	159.961	36.532
HAVO1	2005	ANN_1YR_G30_902_#	SVR	km	213.995	43	159	302.552	159.961	36.532
HACR1	2006	ANN_1YR_G30_902_#	SVR	km	NA	NA	155	277.274	161.887	41.921
HALE1	2006	ANN_1YR_G30_902_#	SVR	km	202.795	49	155	277.274	161.887	41.921
HAVO1	2006	ANN_1YR_G30_902_#	SVR	km	219.342	38	155	277.274	161.887	41.921
HACR1	2007	ANN_1YR_G30_902_#	SVR	km	289.330	2	156	291.761	161.189	43.346
HALE1	2007	ANN_1YR_G30_902_#	SVR	km	199.504	52	156	291.761	161.189	43.346
HAVO1	2007	ANN_1YR_G30_902_#	SVR	km	215.828	40	156	291.761	161.189	43.346
HACR1	2008	ANN_1YR_G30_902_#	SVR	km	282.577	2	156	284.093	166.112	50.128
HALE1	2008	ANN_1YR_G30_902_#	SVR	km	194.107	59	156	284.093	166.112	50.128
HAVO1	2008	ANN_1YR_G30_902_#	SVR	km	211.709	48	156	284.093	166.112	50.128
HACR1	2009	ANN_1YR_G30_902_#	SVR	km	274.154	5	157	282.319	173.589	61.081
HALE1	2009	ANN_1YR_G30_902_#	SVR	km	192.814	63	157	282.319	173.589	61.081
HAVO1	2009	ANN_1YR_G30_902_#	SVR	km	210.746	50	157	282.319	173.589	61.081
HACR1	2010	ANN_1YR_G30_902_#	SVR	km	291.395	3	153	315.490	187.146	53.276
HALE1	2010	ANN_1YR_G30_902_#	SVR	km	206.502	59	153	315.490	187.146	53.276
HAVO1	2010	ANN_1YR_G30_902_#	SVR	km	226.438	46	153	315.490	187.146	53.276
HACR1	2011	ANN_1YR_G30_902_#	SVR	km	289.703	2	150	311.560	178.197	56.145
HALE1	2011	ANN_1YR_G30_902_#	SVR	km	197.768	60	150	311.560	178.197	56.145
HAVO1	2011	ANN_1YR_G30_902_#	SVR	km	233.078	40	150	311.560	178.197	56.145
HACR1	2012	ANN_1YR_G30_902_#	SVR	km	284.359	4	157	293.589	184.987	63.408
HALE1	2012	ANN_1YR_G30_902_#	SVR	km	NA	NA	157	293.589	184.987	63.408
HAVO1	2012	ANN_1YR_G30_902_#	SVR	km	245.709	36	157	293.589	184.987	63.408
HACR1	2013	ANN_1YR_G30_902_#	SVR	km	NA	NA	151	321.864	183.867	70.248
HALE1	2013	ANN_1YR_G30_902_#	SVR	km	NA	NA	151	321.864	183.867	70.248
HAVO1	2013	ANN_1YR_G30_902_#	SVR	km	206.411	63	151	321.864	183.867	70.248
HACR1	2014	ANN_1YR_G30_902_#	SVR	km	299.623	2	159	310.411	182.850	69.130
HALE1	2014	ANN_1YR_G30_902_#	SVR	km	NA	NA	159	310.411	182.850	69.130
HAVO1	2014	ANN_1YR_G30_902_#	SVR	km	216.260	62	159	310.411	182.850	69.130
HACR1	2015	ANN_1YR_G30_902_#	SVR	km	299.944	2	150	309.796	187.628	74.281
HALE1	2015	ANN_1YR_G30_902_#	SVR	km	NA	NA	150	309.796	187.628	74.281
HAVO1	2015	ANN_1YR_G30_902_#	SVR	km	199.446	63	150	309.796	187.628	74.281

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G10_902_#	SVR	km	NA	NA	90	330.312	226.114	74.458
HALE1	2001	ANN_1YR_G10_902_#	SVR	km	248.084	29	90	330.312	226.114	74.458
HAVO1	2001	ANN_1YR_G10_902_#	SVR	km	258.692	25	90	330.312	226.114	74.458
HACR1	2002	ANN_1YR_G10_902_#	SVR	km	NA	NA	125	336.444	211.686	67.984
HALE1	2002	ANN_1YR_G10_902_#	SVR	km	243.673	43	125	336.444	211.686	67.984
HAVO1	2002	ANN_1YR_G10_902_#	SVR	km	264.796	33	125	336.444	211.686	67.984
HACR1	2003	ANN_1YR_G10_902_#	SVR	km	NA	NA	145	350.242	213.578	76.375
HALE1	2003	ANN_1YR_G10_902_#	SVR	km	256.521	49	145	350.242	213.578	76.375
HAVO1	2003	ANN_1YR_G10_902_#	SVR	km	257.575	48	145	350.242	213.578	76.375
HACR1	2004	ANN_1YR_G10_902_#	SVR	km	NA	NA	153	338.523	216.753	80.004
HALE1	2004	ANN_1YR_G10_902_#	SVR	km	249.036	52	153	338.523	216.753	80.004
HAVO1	2004	ANN_1YR_G10_902_#	SVR	km	264.833	37	153	338.523	216.753	80.004
HACR1	2005	ANN_1YR_G10_902_#	SVR	km	NA	NA	159	346.988	211.002	57.561
HALE1	2005	ANN_1YR_G10_902_#	SVR	km	270.652	40	159	346.988	211.002	57.561
HAVO1	2005	ANN_1YR_G10_902_#	SVR	km	276.688	35	159	346.988	211.002	57.561
HACR1	2006	ANN_1YR_G10_902_#	SVR	km	NA	NA	155	329.515	217.055	64.716
HALE1	2006	ANN_1YR_G10_902_#	SVR	km	250.315	51	155	329.515	217.055	64.716
HAVO1	2006	ANN_1YR_G10_902_#	SVR	km	284.575	34	155	329.515	217.055	64.716
HACR1	2007	ANN_1YR_G10_902_#	SVR	km	329.381	2	156	329.671	218.691	69.121
HALE1	2007	ANN_1YR_G10_902_#	SVR	km	248.604	56	156	329.671	218.691	69.121
HAVO1	2007	ANN_1YR_G10_902_#	SVR	km	262.292	46	156	329.671	218.691	69.121
HACR1	2008	ANN_1YR_G10_902_#	SVR	km	337.088	2	156	338.014	219.889	79.983
HALE1	2008	ANN_1YR_G10_902_#	SVR	km	249.047	63	156	338.014	219.889	79.983
HAVO1	2008	ANN_1YR_G10_902_#	SVR	km	261.213	55	156	338.014	219.889	79.983
HACR1	2009	ANN_1YR_G10_902_#	SVR	km	316.809	9	157	339.003	225.783	87.402
HALE1	2009	ANN_1YR_G10_902_#	SVR	km	249.485	68	157	339.003	225.783	87.402
HAVO1	2009	ANN_1YR_G10_902_#	SVR	km	266.137	51	157	339.003	225.783	87.402
HACR1	2010	ANN_1YR_G10_902_#	SVR	km	342.489	3	153	355.068	243.991	77.756
HALE1	2010	ANN_1YR_G10_902_#	SVR	km	253.473	67	153	355.068	243.991	77.756
HAVO1	2010	ANN_1YR_G10_902_#	SVR	km	273.916	52	153	355.068	243.991	77.756
HACR1	2011	ANN_1YR_G10_902_#	SVR	km	334.607	3	150	359.611	236.302	81.042
HALE1	2011	ANN_1YR_G10_902_#	SVR	km	244.286	69	150	359.611	236.302	81.042
HAVO1	2011	ANN_1YR_G10_902_#	SVR	km	287.134	44	150	359.611	236.302	81.042
HACR1	2012	ANN_1YR_G10_902_#	SVR	km	330.964	6	157	345.306	240.806	86.446
HALE1	2012	ANN_1YR_G10_902_#	SVR	km	NA	NA	157	345.306	240.806	86.446
HAVO1	2012	ANN_1YR_G10_902_#	SVR	km	293.706	44	157	345.306	240.806	86.446

Table E-25

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2013	ANN_1YR_G10_902_#	SVR	km	NA	NA	151	367.092	242.312	100.482
HALE1	2013	ANN_1YR_G10_902_#	SVR	km	NA	NA	151	367.092	242.312	100.482
HAVO1	2013	ANN_1YR_G10_902_#	SVR	km	266.079	60	151	367.092	242.312	100.482
HACR1	2014	ANN_1YR_G10_902_#	SVR	km	338.162	5	159	360.004	239.333	96.830
HALE1	2014	ANN_1YR_G10_902_#	SVR	km	NA	NA	159	360.004	239.333	96.830
HAVO1	2014	ANN_1YR_G10_902_#	SVR	km	278.017	58	159	360.004	239.333	96.830
HACR1	2015	ANN_1YR_G10_902_#	SVR	km	346.244	2	150	349.838	245.098	97.015
HALE1	2015	ANN_1YR_G10_902_#	SVR	km	NA	NA	150	349.838	245.098	97.015
HAVO1	2015	ANN_1YR_G10_902_#	SVR	km	263.926	63	150	349.838	245.098	97.015

Table E-25: Hawaii IMPROVE site Standard Visual Range (SVR) annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	90	105.589	25.881	6.843
HALE1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	10.075	89	90	105.589	25.881	6.843
HAVO1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.843	90	90	105.589	25.881	6.843
HACR1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	125	137.545	30.825	6.333
HALE1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	10.166	124	125	137.545	30.825	6.333
HAVO1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.333	125	125	137.545	30.825	6.333
HACR1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	145	131.404	32.409	4.346
HALE1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	10.352	142	145	131.404	32.409	4.346
HAVO1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.346	145	145	131.404	32.409	4.346
HACR1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	153	104.007	28.309	4.042
HALE1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	9.112	152	153	104.007	28.309	4.042
HAVO1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.042	153	153	104.007	28.309	4.042
HACR1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	298.864	26.622	4.131
HALE1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.061	158	159	298.864	26.622	4.131
HAVO1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.131	159	159	298.864	26.622	4.131
HACR1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	155	214.256	30.599	2.760
HALE1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.030	151	155	214.256	30.599	2.760
HAVO1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.760	155	155	214.256	30.599	2.760
HACR1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.281	151	156	238.640	30.935	4.202
HALE1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.816	153	156	238.640	30.935	4.202
HAVO1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.202	156	156	238.640	30.935	4.202
HACR1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.822	156	156	307.051	28.567	3.822
HALE1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.589	152	156	307.051	28.567	3.822
HAVO1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.472	154	156	307.051	28.567	3.822
HACR1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.028	156	157	238.606	25.017	4.007
HALE1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.467	154	157	238.606	25.017	4.007
HAVO1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.007	157	157	238.606	25.017	4.007
HACR1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.286	152	153	217.672	24.246	3.485
HALE1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.598	149	153	217.672	24.246	3.485
HAVO1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.485	153	153	217.672	24.246	3.485
HACR1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.172	149	150	279.751	27.709	2.436
HALE1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.871	145	150	279.751	27.709	2.436
HAVO1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.436	150	150	279.751	27.709	2.436
HACR1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.944	156	157	233.940	28.914	2.734
HALE1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	157	233.940	28.914	2.734
HAVO1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.734	157	157	233.940	28.914	2.734
HACR1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	268.476	24.746	2.962
HALE1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	268.476	24.746	2.962
HAVO1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.962	151	151	268.476	24.746	2.962
HACR1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.625	159	159	321.181	24.335	3.625
HALE1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	321.181	24.335	3.625
HAVO1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.254	158	159	321.181	24.335	3.625
HACR1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.766	149	150	264.551	28.474	3.524
HALE1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	150	264.551	28.474	3.524

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HAVO1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.524	150	150	264.551	28.474	3.524
HACR1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	90	59.544	14.395	3.760
HALE1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.395	80	90	59.544	14.395	3.760
HAVO1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.938	89	90	59.544	14.395	3.760
HACR1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	125	63.359	17.585	4.258
HALE1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.763	114	125	63.359	17.585	4.258
HAVO1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.128	123	125	63.359	17.585	4.258
HACR1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	145	69.415	17.660	4.040
HALE1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	9.602	125	145	69.415	17.660	4.040
HAVO1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.249	144	145	69.415	17.660	4.040
HACR1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	153	58.517	16.288	3.993
HALE1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.939	137	153	58.517	16.288	3.993
HAVO1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.767	152	153	58.517	16.288	3.993
HACR1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	106.419	16.356	2.942
HALE1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.977	146	159	106.419	16.356	2.942
HAVO1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.183	157	159	106.419	16.356	2.942
HACR1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	155	96.623	16.339	3.117
HALE1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	8.052	142	155	96.623	16.339	3.117
HAVO1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.549	153	155	96.623	16.339	3.117
HACR1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.101	155	156	76.324	16.093	3.028
HALE1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.053	148	156	76.324	16.093	3.028
HAVO1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.488	152	156	76.324	16.093	3.028
HACR1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.417	155	156	108.212	14.439	2.922
HALE1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	7.134	142	156	108.212	14.439	2.922
HAVO1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.019	152	156	108.212	14.439	2.922
HACR1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.025	156	157	79.951	13.515	2.655
HALE1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.242	150	157	79.951	13.515	2.655
HAVO1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.655	157	157	79.951	13.515	2.655
HACR1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.261	152	153	80.058	12.902	2.961
HALE1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.747	137	153	80.058	12.902	2.961
HAVO1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.961	153	153	80.058	12.902	2.961
HACR1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.949	149	150	88.494	14.068	2.597
HALE1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.803	129	150	88.494	14.068	2.597
HAVO1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.597	150	150	88.494	14.068	2.597
HACR1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.983	157	157	67.366	13.840	2.983
HALE1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	157	67.366	13.840	2.983
HAVO1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.310	156	157	67.366	13.840	2.983
HACR1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	98.454	12.754	3.199
HALE1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	98.454	12.754	3.199
HAVO1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.199	151	151	98.454	12.754	3.199
HACR1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.957	159	159	73.792	12.302	1.957
HALE1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	73.792	12.302	1.957
HAVO1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.122	156	159	73.792	12.302	1.957
HACR1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.712	150	150	91.355	12.993	2.712

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HALE1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	150	91.355	12.993	2.712
HAVO1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.592	149	150	91.355	12.993	2.712
HACR1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	90	41.998	9.954	2.518
HALE1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.159	78	90	41.998	9.954	2.518
HAVO1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.511	87	90	41.998	9.954	2.518
HACR1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	125	47.368	11.422	2.506
HALE1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.683	107	125	47.368	11.422	2.506
HAVO1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.441	121	125	47.368	11.422	2.506
HACR1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	145	50.315	12.990	2.880
HALE1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.399	128	145	50.315	12.990	2.880
HAVO1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.695	143	145	50.315	12.990	2.880
HACR1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	153	44.597	11.538	2.459
HALE1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	6.226	131	153	44.597	11.538	2.459
HAVO1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.696	151	153	44.597	11.538	2.459
HACR1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	66.631	10.772	2.268
HALE1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.267	138	159	66.631	10.772	2.268
HAVO1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.550	158	159	66.631	10.772	2.268
HACR1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	155	66.177	11.388	1.989
HALE1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.319	137	155	66.177	11.388	1.989
HAVO1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.396	154	155	66.177	11.388	1.989
HACR1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.438	155	156	60.448	10.976	2.372
HALE1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.032	144	156	60.448	10.976	2.372
HAVO1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.372	156	156	60.448	10.976	2.372
HACR1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.113	156	156	70.835	10.637	2.113
HALE1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.242	138	156	70.835	10.637	2.113
HAVO1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.739	153	156	70.835	10.637	2.113
HACR1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.532	156	157	49.905	9.762	2.292
HALE1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.922	138	157	49.905	9.762	2.292
HAVO1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.292	157	157	49.905	9.762	2.292
HACR1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.365	152	153	47.857	9.337	2.297
HALE1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.163	138	153	47.857	9.337	2.297
HAVO1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.877	149	153	47.857	9.337	2.297
HACR1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.933	149	150	48.221	9.453	1.815
HALE1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	5.143	122	150	48.221	9.453	1.815
HAVO1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.115	148	150	48.221	9.453	1.815
HACR1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.922	157	157	43.014	9.366	1.922
HALE1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	157	43.014	9.366	1.922
HAVO1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.271	156	157	43.014	9.366	1.922
HACR1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	50.135	9.018	2.457
HALE1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	50.135	9.018	2.457
HAVO1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.775	150	151	50.135	9.018	2.457
HACR1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.693	159	159	51.093	9.323	1.693
HALE1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	51.093	9.323	1.693
HAVO1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.716	156	159	51.093	9.323	1.693

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.521	150	150	48.959	9.134	1.521
HALE1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	150	48.959	9.134	1.521
HAVO1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.076	147	150	48.959	9.134	1.521
HACR1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	90	32.822	7.014	1.712
HALE1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.308	75	90	32.822	7.014	1.712
HAVO1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.438	83	90	32.822	7.014	1.712
HACR1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	125	37.913	7.954	1.423
HALE1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.836	100	125	37.913	7.954	1.423
HAVO1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.792	112	125	37.913	7.954	1.423
HACR1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	145	36.296	9.660	1.820
HALE1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.319	118	145	36.296	9.660	1.820
HAVO1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.380	140	145	36.296	9.660	1.820
HACR1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	153	30.923	7.845	1.551
HALE1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.043	132	153	30.923	7.845	1.551
HAVO1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.418	149	153	30.923	7.845	1.551
HACR1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	52.628	8.000	1.336
HALE1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.968	144	159	52.628	8.000	1.336
HAVO1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.930	156	159	52.628	8.000	1.336
HACR1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	155	48.599	8.173	1.361
HALE1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.732	130	155	48.599	8.173	1.361
HAVO1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.453	154	155	48.599	8.173	1.361
HACR1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.245	156	156	41.153	8.256	1.245
HALE1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.967	131	156	41.153	8.256	1.245
HAVO1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.956	151	156	41.153	8.256	1.245
HACR1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.033	156	156	44.811	8.082	1.033
HALE1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.633	132	156	44.811	8.082	1.033
HAVO1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.801	152	156	44.811	8.082	1.033
HACR1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.558	156	157	33.873	7.023	1.415
HALE1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.539	130	157	33.873	7.023	1.415
HAVO1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.769	154	157	33.873	7.023	1.415
HACR1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.136	153	153	33.739	6.359	1.136
HALE1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	3.739	116	153	33.739	6.359	1.136
HAVO1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.753	149	153	33.739	6.359	1.136
HACR1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.991	149	150	31.567	6.647	0.895
HALE1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	4.013	105	150	31.567	6.647	0.895
HAVO1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.580	147	150	31.567	6.647	0.895
HACR1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.112	157	157	31.063	6.553	1.112
HALE1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	157	31.063	6.553	1.112
HAVO1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.364	156	157	31.063	6.553	1.112
HACR1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	34.984	6.428	0.908
HALE1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	34.984	6.428	0.908
HAVO1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.941	144	151	34.984	6.428	0.908
HACR1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.058	159	159	36.521	6.910	1.058
HALE1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	36.521	6.910	1.058

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HAVO1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.935	153	159	36.521	6.910	1.058
HACR1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.186	150	150	33.135	6.439	1.186
HALE1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	150	33.135	6.439	1.186
HAVO1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.656	132	150	33.135	6.439	1.186
HACR1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	90	21.677	4.334	0.841
HALE1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.538	73	90	21.677	4.334	0.841
HAVO1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.544	72	90	21.677	4.334	0.841
HACR1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	125	27.884	5.143	0.740
HALE1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.801	94	125	27.884	5.143	0.740
HAVO1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.544	100	125	27.884	5.143	0.740
HACR1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	145	26.451	5.339	0.516
HALE1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.442	116	145	26.451	5.339	0.516
HAVO1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.387	135	145	26.451	5.339	0.516
HACR1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	153	22.614	5.284	0.728
HALE1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.524	124	153	22.614	5.284	0.728
HAVO1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.496	146	153	22.614	5.284	0.728
HACR1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	35.185	4.702	0.668
HALE1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.855	132	159	35.185	4.702	0.668
HAVO1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.780	156	159	35.185	4.702	0.668
HACR1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	155	29.316	4.666	0.672
HALE1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.062	124	155	29.316	4.666	0.672
HAVO1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.711	153	155	29.316	4.666	0.672
HACR1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.611	156	156	28.849	5.038	0.611
HALE1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.107	131	156	28.849	5.038	0.611
HAVO1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.183	146	156	28.849	5.038	0.611
HACR1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.401	156	156	25.446	4.643	0.401
HALE1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.957	123	156	25.446	4.643	0.401
HAVO1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.979	150	156	25.446	4.643	0.401
HACR1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.896	152	157	20.578	4.151	0.566
HALE1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.213	114	157	20.578	4.151	0.566
HAVO1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.778	156	157	20.578	4.151	0.566
HACR1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.439	153	153	20.522	3.992	0.439
HALE1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.200	108	153	20.522	3.992	0.439
HAVO1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.088	140	153	20.522	3.992	0.439
HACR1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.380	150	150	19.494	4.009	0.380
HALE1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	2.452	98	150	19.494	4.009	0.380
HAVO1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.093	139	150	19.494	4.009	0.380
HACR1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.605	155	157	20.008	3.828	0.460
HALE1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	157	20.008	3.828	0.460
HAVO1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.856	150	157	20.008	3.828	0.460
HACR1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	23.743	3.578	0.312
HALE1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	151	23.743	3.578	0.312
HAVO1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.261	131	151	23.743	3.578	0.312
HACR1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.517	158	159	22.392	3.696	0.430

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HALE1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	159	22.392	3.696	0.430
HAVO1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.276	139	159	22.392	3.696	0.430
HACR1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	0.490	150	150	24.761	3.707	0.490
HALE1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	NA	NA	150	24.761	3.707	0.490
HAVO1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o SO4f and SeaSaltf	1/Mm	1.612	126	150	24.761	3.707	0.490

Table E-26: Hawaii IMPROVE site Aerosol Bext without Sulfate Bext and Sea Salt Bext rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	90	0.950	0.000	0.000
HALE1	2001	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	90	0.950	0.000	0.000
HAVO1	2001	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	90	0.950	0.000	0.000
HACR1	2002	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	125	0.950	0.000	0.000
HALE1	2002	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	125	0.950	0.000	0.000
HAVO1	2002	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	125	0.950	0.000	0.000
HACR1	2003	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	145	0.950	0.000	0.000
HALE1	2003	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	145	0.950	0.000	0.000
HAVO1	2003	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	145	0.950	0.000	0.000
HACR1	2004	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	153	0.950	0.000	0.000
HALE1	2004	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	153	0.950	0.000	0.000
HAVO1	2004	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2005	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HALE1	2005	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HAVO1	2005	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2006	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	155	0.950	0.000	0.000
HALE1	2006	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	155	0.950	0.000	0.000
HAVO1	2006	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	155	0.950	0.000	0.000
HACR1	2007	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2007	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2007	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2008	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2008	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2008	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2009	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
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HAVO1	2009	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2010	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HALE1	2010	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HAVO1	2010	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2011	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HALE1	2011	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HAVO1	2011	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2012	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	157	0.950	0.000	0.000
HALE1	2012	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	157	0.950	0.000	0.000
HAVO1	2012	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2013	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HALE1	2013	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HAVO1	2013	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	151	0.950	0.000	0.000
HACR1	2014	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000

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Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HALE1	2014	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HAVO1	2014	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2015	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.670	2	150	0.950	0.000	0.000
HALE1	2015	ANN_1YR_G90_902_#	volcano fract SO4f	1	NA	NA	150	0.950	0.000	0.000
HAVO1	2015	ANN_1YR_G90_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2001	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	90	0.950	0.000	0.000
HALE1	2001	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	90	0.950	0.000	0.000
HAVO1	2001	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	90	0.950	0.000	0.000
HACR1	2002	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	125	0.950	0.000	0.000
HALE1	2002	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	125	0.950	0.000	0.000
HAVO1	2002	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	125	0.950	0.000	0.000
HACR1	2003	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	145	0.950	0.000	0.000
HALE1	2003	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	145	0.950	0.000	0.000
HAVO1	2003	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	145	0.950	0.000	0.000
HACR1	2004	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	153	0.950	0.000	0.000
HALE1	2004	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	153	0.950	0.000	0.000
HAVO1	2004	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2005	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HALE1	2005	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HAVO1	2005	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2006	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	155	0.950	0.000	0.000
HALE1	2006	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	155	0.950	0.000	0.000
HAVO1	2006	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	155	0.950	0.000	0.000
HACR1	2007	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2007	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2007	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2008	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2008	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2008	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2009	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HALE1	2009	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
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HACR1	2010	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HALE1	2010	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HAVO1	2010	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2011	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HALE1	2011	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HAVO1	2011	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2012	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	157	0.950	0.000	0.000
HALE1	2012	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	157	0.950	0.000	0.000

Table E-27

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HAVO1	2012	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2013	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HALE1	2013	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HAVO1	2013	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	151	0.950	0.000	0.000
HACR1	2014	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HALE1	2014	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HAVO1	2014	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2015	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.670	2	150	0.950	0.000	0.000
HALE1	2015	ANN_1YR_G70_902_#	volcano fract SO4f	1	NA	NA	150	0.950	0.000	0.000
HAVO1	2015	ANN_1YR_G70_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2001	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	90	0.950	0.000	0.000
HALE1	2001	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	90	0.950	0.000	0.000
HAVO1	2001	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	90	0.950	0.000	0.000
HACR1	2002	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	125	0.950	0.000	0.000
HALE1	2002	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	125	0.950	0.000	0.000
HAVO1	2002	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	125	0.950	0.000	0.000
HACR1	2003	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	145	0.950	0.000	0.000
HALE1	2003	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	145	0.950	0.000	0.000
HAVO1	2003	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	145	0.950	0.000	0.000
HACR1	2004	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	153	0.950	0.000	0.000
HALE1	2004	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	153	0.950	0.000	0.000
HAVO1	2004	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2005	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HALE1	2005	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HAVO1	2005	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2006	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	155	0.950	0.000	0.000
HALE1	2006	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	155	0.950	0.000	0.000
HAVO1	2006	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	155	0.950	0.000	0.000
HACR1	2007	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2007	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2007	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2008	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2008	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2008	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2009	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HALE1	2009	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HAVO1	2009	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2010	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HALE1	2010	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HAVO1	2010	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2011	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HALE1	2011	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HAVO1	2011	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2012	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	157	0.950	0.000	0.000
HALE1	2012	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	157	0.950	0.000	0.000
HAVO1	2012	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2013	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HALE1	2013	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HAVO1	2013	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	151	0.950	0.000	0.000
HACR1	2014	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HALE1	2014	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HAVO1	2014	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2015	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.670	2	150	0.950	0.000	0.000
HALE1	2015	ANN_1YR_G50_902_#	volcano fract SO4f	1	NA	NA	150	0.950	0.000	0.000
HAVO1	2015	ANN_1YR_G50_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2001	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	90	0.950	0.000	0.000
HALE1	2001	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	90	0.950	0.000	0.000
HAVO1	2001	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	90	0.950	0.000	0.000
HACR1	2002	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	125	0.950	0.000	0.000
HALE1	2002	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	125	0.950	0.000	0.000
HAVO1	2002	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	125	0.950	0.000	0.000
HACR1	2003	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	145	0.950	0.000	0.000
HALE1	2003	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	145	0.950	0.000	0.000
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HACR1	2005	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
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HALE1	2009	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HAVO1	2009	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2010	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
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HACR1	2011	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HALE1	2011	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HAVO1	2011	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2012	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	157	0.950	0.000	0.000
HALE1	2012	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	157	0.950	0.000	0.000
HAVO1	2012	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2013	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HALE1	2013	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HAVO1	2013	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	151	0.950	0.000	0.000
HACR1	2014	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HALE1	2014	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HAVO1	2014	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2015	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.670	2	150	0.950	0.000	0.000
HALE1	2015	ANN_1YR_G30_902_#	volcano fract SO4f	1	NA	NA	150	0.950	0.000	0.000
HAVO1	2015	ANN_1YR_G30_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2001	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	90	0.950	0.000	0.000
HALE1	2001	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	90	0.950	0.000	0.000
HAVO1	2001	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	90	0.950	0.000	0.000
HACR1	2002	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	125	0.950	0.000	0.000
HALE1	2002	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	125	0.950	0.000	0.000
HAVO1	2002	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	125	0.950	0.000	0.000
HACR1	2003	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	145	0.950	0.000	0.000
HALE1	2003	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	145	0.950	0.000	0.000
HAVO1	2003	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	145	0.950	0.000	0.000
HACR1	2004	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	153	0.950	0.000	0.000
HALE1	2004	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	153	0.950	0.000	0.000
HAVO1	2004	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2005	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HALE1	2005	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HAVO1	2005	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2006	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	155	0.950	0.000	0.000
HALE1	2006	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	155	0.950	0.000	0.000
HAVO1	2006	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	155	0.950	0.000	0.000
HACR1	2007	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2007	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HAVO1	2007	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2008	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HALE1	2008	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	156	0.950	0.000	0.000
HAVO1	2008	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	156	0.950	0.000	0.000
HACR1	2009	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HALE1	2009	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	157	0.950	0.000	0.000
HAVO1	2009	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2010	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HALE1	2010	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	153	0.950	0.000	0.000
HAVO1	2010	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	153	0.950	0.000	0.000
HACR1	2011	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HALE1	2011	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	3	150	0.950	0.000	0.000
HAVO1	2011	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000
HACR1	2012	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	157	0.950	0.000	0.000
HALE1	2012	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	157	0.950	0.000	0.000
HAVO1	2012	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	157	0.950	0.000	0.000
HACR1	2013	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HALE1	2013	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	151	0.950	0.000	0.000
HAVO1	2013	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	151	0.950	0.000	0.000
HACR1	2014	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	159	0.950	0.000	0.000
HALE1	2014	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	159	0.950	0.000	0.000
HAVO1	2014	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	159	0.950	0.000	0.000
HACR1	2015	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.670	2	150	0.950	0.000	0.000
HALE1	2015	ANN_1YR_G10_902_#	volcano fract SO4f	1	NA	NA	150	0.950	0.000	0.000
HAVO1	2015	ANN_1YR_G10_902_#	volcano fract SO4f	1	0.950	1	150	0.950	0.000	0.000

Table E-27: Hawaii IMPROVE site Volcano fraction of Sulfate Bext annual rankings by quantile grouping

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	90	231.751	41.923	8.930
HALE1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	15.422	89	90	231.751	41.923	8.930
HAVO1	2001	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.930	90	90	231.751	41.923	8.930
HACR1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	125	229.411	50.760	8.982
HALE1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	15.173	124	125	229.411	50.760	8.982
HAVO1	2002	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.982	125	125	229.411	50.760	8.982
HACR1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	145	244.408	54.504	8.810
HALE1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	18.097	142	145	244.408	54.504	8.810
HAVO1	2003	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.810	145	145	244.408	54.504	8.810
HACR1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	153	212.387	51.594	6.850
HALE1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	14.154	151	153	212.387	51.594	6.850
HAVO1	2004	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.850	153	153	212.387	51.594	6.850
HACR1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	324.927	53.035	8.389
HALE1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	14.271	158	159	324.927	53.035	8.389
HAVO1	2005	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.389	159	159	324.927	53.035	8.389
HACR1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	155	265.129	53.427	6.221
HALE1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	14.417	154	155	265.129	53.427	6.221
HAVO1	2006	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.221	155	155	265.129	53.427	6.221
HACR1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	11.264	155	156	255.050	57.592	9.633
HALE1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	13.954	153	156	255.050	57.592	9.633
HAVO1	2007	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.633	156	156	255.050	57.592	9.633
HACR1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	11.368	156	156	324.694	52.250	11.368
HALE1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	21.541	146	156	324.694	52.250	11.368
HAVO1	2008	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	15.449	154	156	324.694	52.250	11.368
HACR1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.840	157	157	259.285	46.462	10.840
HALE1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	18.453	148	157	259.285	46.462	10.840
HAVO1	2009	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	14.913	155	157	259.285	46.462	10.840
HACR1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.011	153	153	241.609	43.005	9.011
HALE1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	16.461	140	153	241.609	43.005	9.011
HAVO1	2010	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.067	152	153	241.609	43.005	9.011
HACR1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.688	149	150	296.487	41.752	4.147
HALE1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	15.711	140	150	296.487	41.752	4.147
HAVO1	2011	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.147	150	150	296.487	41.752	4.147
HACR1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.412	156	157	246.346	46.638	4.896
HALE1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	157	246.346	46.638	4.896
HAVO1	2012	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.896	157	157	246.346	46.638	4.896
HACR1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	279.794	38.647	6.033
HALE1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	279.794	38.647	6.033
HAVO1	2013	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.033	151	151	279.794	38.647	6.033
HACR1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.186	158	159	337.557	39.470	7.010
HALE1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	337.557	39.470	7.010
HAVO1	2014	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.010	159	159	337.557	39.470	7.010
HACR1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.103	149	150	283.025	45.800	6.364
HALE1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	150	283.025	45.800	6.364
HAVO1	2015	ANN_1YR_G90_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.364	150	150	283.025	45.800	6.364
HACR1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	90	130.885	22.780	6.318
HALE1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.882	88	90	130.885	22.780	6.318
HAVO1	2001	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.318	90	90	130.885	22.780	6.318

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	125	124.090	27.842	6.593
HALE1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	11.665	122	125	124.090	27.842	6.593
HAVO1	2002	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.593	125	125	124.090	27.842	6.593
HACR1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	145	122.121	29.590	6.099
HALE1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	12.342	133	145	122.121	29.590	6.099
HAVO1	2003	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.099	145	145	122.121	29.590	6.099
HACR1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	153	117.349	26.488	5.290
HALE1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.721	148	153	117.349	26.488	5.290
HAVO1	2004	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.290	153	153	117.349	26.488	5.290
HACR1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	187.580	27.423	4.885
HALE1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.578	156	159	187.580	27.423	4.885
HAVO1	2005	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.885	159	159	187.580	27.423	4.885
HACR1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	155	164.034	28.276	4.366
HALE1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.849	152	155	164.034	28.276	4.366
HAVO1	2006	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.366	155	155	164.034	28.276	4.366
HACR1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.379	156	156	151.540	28.731	4.379
HALE1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.180	151	156	151.540	28.731	4.379
HAVO1	2007	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.995	155	156	151.540	28.731	4.379
HACR1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.484	155	156	130.637	27.463	4.825
HALE1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	10.618	150	156	130.637	27.463	4.825
HAVO1	2008	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.825	156	156	130.637	27.463	4.825
HACR1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.062	156	157	93.808	25.618	4.740
HALE1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.752	154	157	93.808	25.618	4.740
HAVO1	2009	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.740	157	157	93.808	25.618	4.740
HACR1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.860	152	153	107.497	21.219	3.631
HALE1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.376	146	153	107.497	21.219	3.631
HAVO1	2010	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.631	153	153	107.497	21.219	3.631
HACR1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.464	149	150	104.765	23.583	2.991
HALE1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	9.115	142	150	104.765	23.583	2.991
HAVO1	2011	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.991	150	150	104.765	23.583	2.991
HACR1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.970	156	157	83.233	22.590	3.820
HALE1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	157	83.233	22.590	3.820
HAVO1	2012	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.820	157	157	83.233	22.590	3.820
HACR1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	108.170	20.560	3.846
HALE1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	108.170	20.560	3.846
HAVO1	2013	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.846	151	151	108.170	20.560	3.846
HACR1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.694	159	159	83.784	20.350	3.694
HALE1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	83.784	20.350	3.694
HAVO1	2014	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.998	158	159	83.784	20.350	3.694
HACR1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.073	150	150	100.974	21.140	4.073
HALE1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	150	100.974	21.140	4.073
HAVO1	2015	ANN_1YR_G70_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.687	149	150	100.974	21.140	4.073
HACR1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	90	86.889	16.173	4.729
HALE1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.891	88	90	86.889	16.173	4.729
HAVO1	2001	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.729	90	90	86.889	16.173	4.729
HACR1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	125	91.258	19.978	4.469
HALE1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.558	119	125	91.258	19.978	4.469
HAVO1	2002	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.731	124	125	91.258	19.978	4.469

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	145	88.437	21.413	4.012
HALE1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	8.351	133	145	88.437	21.413	4.012
HAVO1	2003	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.012	145	145	88.437	21.413	4.012
HACR1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	153	86.138	19.150	3.969
HALE1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.847	146	153	86.138	19.150	3.969
HAVO1	2004	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.969	153	153	86.138	19.150	3.969
HACR1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	130.428	20.160	2.852
HALE1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.050	155	159	130.428	20.160	2.852
HAVO1	2005	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.852	159	159	130.428	20.160	2.852
HACR1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	155	116.799	20.350	2.754
HALE1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.425	151	155	116.799	20.350	2.754
HAVO1	2006	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.754	155	155	116.799	20.350	2.754
HACR1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.269	155	156	112.282	19.921	2.654
HALE1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.465	149	156	112.282	19.921	2.654
HAVO1	2007	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.654	156	156	112.282	19.921	2.654
HACR1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.301	155	156	99.454	19.551	3.091
HALE1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.727	146	156	99.454	19.551	3.091
HAVO1	2008	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.091	156	156	99.454	19.551	3.091
HACR1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.714	156	157	67.370	17.073	2.700
HALE1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	7.088	152	157	67.370	17.073	2.700
HAVO1	2009	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.700	157	157	67.370	17.073	2.700
HACR1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.393	152	153	81.278	15.261	3.188
HALE1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.219	147	153	81.278	15.261	3.188
HAVO1	2010	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.188	153	153	81.278	15.261	3.188
HACR1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.900	149	150	76.413	16.365	2.342
HALE1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.904	138	150	76.413	16.365	2.342
HAVO1	2011	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.342	150	150	76.413	16.365	2.342
HACR1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.154	156	157	66.788	16.005	2.515
HALE1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	157	66.788	16.005	2.515
HAVO1	2012	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.515	157	157	66.788	16.005	2.515
HACR1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	59.327	14.649	3.102
HALE1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	59.327	14.649	3.102
HAVO1	2013	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.102	151	151	59.327	14.649	3.102
HACR1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.679	159	159	59.977	15.304	2.679
HALE1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	59.977	15.304	2.679
HAVO1	2014	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.081	158	159	59.977	15.304	2.679
HACR1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.288	150	150	57.348	15.469	2.288
HALE1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	150	57.348	15.469	2.288
HAVO1	2015	ANN_1YR_G50_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.475	149	150	57.348	15.469	2.288
HACR1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	90	62.535	11.814	3.283
HALE1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.417	87	90	62.535	11.814	3.283
HAVO1	2001	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.601	89	90	62.535	11.814	3.283
HACR1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	125	68.301	13.589	2.845
HALE1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	6.137	116	125	68.301	13.589	2.845
HAVO1	2002	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.960	123	125	68.301	13.589	2.845
HACR1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	145	62.294	14.578	2.609
HALE1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.522	129	145	62.294	14.578	2.609
HAVO1	2003	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.609	145	145	62.294	14.578	2.609

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	153	60.717	13.281	2.599
HALE1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.277	143	153	60.717	13.281	2.599
HAVO1	2004	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.599	153	153	60.717	13.281	2.599
HACR1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	96.774	14.087	2.145
HALE1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.301	155	159	96.774	14.087	2.145
HAVO1	2005	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.145	159	159	96.774	14.087	2.145
HACR1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	155	82.402	13.892	1.670
HALE1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.043	144	155	82.402	13.892	1.670
HAVO1	2006	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.670	155	155	82.402	13.892	1.670
HACR1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.822	156	156	79.823	13.640	1.822
HALE1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.162	145	156	79.823	13.640	1.822
HAVO1	2007	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.148	155	156	79.823	13.640	1.822
HACR1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.806	156	156	67.462	13.372	1.806
HALE1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.152	142	156	67.462	13.372	1.806
HAVO1	2008	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.012	155	156	67.462	13.372	1.806
HACR1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.276	156	157	53.240	12.087	1.972
HALE1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.954	144	157	53.240	12.087	1.972
HAVO1	2009	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.972	157	157	53.240	12.087	1.972
HACR1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.779	153	153	63.097	10.585	1.779
HALE1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	4.881	131	153	63.097	10.585	1.779
HAVO1	2010	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.924	152	153	63.097	10.585	1.779
HACR1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.616	150	150	58.331	11.631	1.616
HALE1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	5.192	127	150	58.331	11.631	1.616
HAVO1	2011	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.731	149	150	58.331	11.631	1.616
HACR1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.825	156	157	50.842	10.911	1.496
HALE1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	157	50.842	10.911	1.496
HAVO1	2012	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.496	157	157	50.842	10.911	1.496
HACR1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	44.887	10.678	2.076
HALE1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	44.887	10.678	2.076
HAVO1	2013	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.168	150	151	44.887	10.678	2.076
HACR1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.616	159	159	45.934	11.162	1.616
HALE1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	45.934	11.162	1.616
HAVO1	2014	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.142	158	159	45.934	11.162	1.616
HACR1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.658	150	150	41.519	10.714	1.658
HALE1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	150	41.519	10.714	1.658
HAVO1	2015	ANN_1YR_G30_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.861	148	150	41.519	10.714	1.658
HACR1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	90	43.562	7.416	1.803
HALE1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.286	82	90	43.562	7.416	1.803
HAVO1	2001	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.641	88	90	43.562	7.416	1.803
HACR1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	125	48.080	8.578	1.527
HALE1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.579	100	125	48.080	8.578	1.527
HAVO1	2002	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.627	117	125	48.080	8.578	1.527
HACR1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	145	42.532	8.686	1.064
HALE1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.129	125	145	42.532	8.686	1.064
HAVO1	2003	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.533	142	145	42.532	8.686	1.064
HACR1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	153	39.847	7.960	1.366
HALE1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.169	137	153	39.847	7.960	1.366
HAVO1	2004	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.602	152	153	39.847	7.960	1.366

Site	Year	Aggregation	Value Type	Value Unit	Site Value	Site Rank (High)	Number of Sites	Max Value (All Sites)	Median Value (All Sites)	Min Value (All Sites)
HACR1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	60.709	8.512	0.883
HALE1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.417	146	159	60.709	8.512	0.883
HAVO1	2005	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.883	159	159	60.709	8.512	0.883
HACR1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	155	52.473	8.184	0.800
HALE1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.815	134	155	52.473	8.184	0.800
HAVO1	2006	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.800	155	155	52.473	8.184	0.800
HACR1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.931	156	156	48.391	7.996	0.931
HALE1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.821	141	156	48.391	7.996	0.931
HAVO1	2007	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.291	155	156	48.391	7.996	0.931
HACR1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.719	156	156	42.219	7.481	0.719
HALE1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.684	137	156	42.219	7.481	0.719
HAVO1	2008	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.093	155	156	42.219	7.481	0.719
HACR1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.279	156	157	34.903	7.365	0.911
HALE1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.900	134	157	34.903	7.365	0.911
HAVO1	2009	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.911	157	157	34.903	7.365	0.911
HACR1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.704	153	153	41.500	6.119	0.704
HALE1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	2.813	125	153	41.500	6.119	0.704
HAVO1	2010	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.186	150	153	41.500	6.119	0.704
HACR1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.713	150	150	38.681	6.630	0.713
HALE1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	3.122	118	150	38.681	6.630	0.713
HAVO1	2011	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.168	148	150	38.681	6.630	0.713
HACR1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.923	157	157	35.560	6.375	0.923
HALE1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	157	35.560	6.375	0.923
HAVO1	2012	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.931	156	157	35.560	6.375	0.923
HACR1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	28.352	6.015	0.623
HALE1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	151	28.352	6.015	0.623
HAVO1	2013	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.371	148	151	28.352	6.015	0.623
HACR1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.817	158	159	30.740	6.336	0.794
HALE1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	159	30.740	6.336	0.794
HAVO1	2014	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.363	156	159	30.740	6.336	0.794
HACR1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	0.712	150	150	30.681	5.737	0.712
HALE1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	NA	NA	150	30.681	5.737	0.712
HAVO1	2015	ANN_1YR_G10_902_#	aerosol_bext w/o volcano fract SO4f and SeaSaltf	1/Mm	1.715	142	150	30.681	5.737	0.712

Table E-28: Hawaii IMPROVE site Aerosol Bext without Volcano fraction of Sulfate Bext and Sea Salt Bext annual rankings by quantile grouping

Number of Positive Measurement Datasets (Value, Unc, MDL)	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005	2006	2006	2006	2007	2007	2007	2008	2008	2008	2009	2009	2009	2010	2010	2010	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant																																													
HACR1	ALf	NA	NA	138	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	74	133	169	77	131	171	92	107	173	97	101	172	107	110	168	89	164	167	87	161	166	99	160	166	88	157	165
HALE1	ALf	22	78	138	52	78	158	39	68	166	65	88	177	92	99	179	91	93	170	87	93	169	73	143	171	88	117	173	97	101	172	99	143	168	46	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ALf	10	125	138	21	154	158	17	161	166	36	163	177	47	171	179	47	164	170	42	166	169	43	168	171	49	168	173	60	163	172	101	132	168	112	112	167	116	75	166	111	118	166	108	139	165
HACR1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	ASf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	13	166	169	18	164	171	24	167	173	16	160	172	26	128	168	21	161	167	26	136	166	19	166	166	17	161	165
HALE1	ASf	31	112	141	19	148	158	30	148	166	30	159	177	25	151	179	37	128	170	28	131	169	14	168	171	39	139	173	16	160	172	25	137	168	10	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ASf	21	129	141	23	141	158	9	166	166	29	161	177	12	176	179	14	170	170	20	157	169	15	167	171	20	169	173	8	170	172	37	68	168	45	48	167	42	56	166	50	40	166	43	55	165
HACR1	BRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	106	147	169	121	28	171	118	69	173	114	112	172	104	134	168	88	164	167	83	162	166	97	161	166	92	157	165
HALE1	BRf	109	69	141	103	127	158	115	95	166	115	112	177	116	95	179	121	20	170	114	97	169	115	100	171	115	99	173	120	44	172	106	123	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	BRf	103	85	141	116	65	158	118	65	166	111	135	177	113	122	179	119	49	170	120	24	169	115	100	171	119	55	173	121	34	172	113	88	168	113	102	167	117	69	166	114	102	166	106	146	165
HACR1	CAf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	106	147	169	121	29	171	119	61	173	116	90	172	112	105	168	95	162	167	88	161	166	101	159	166	97	155	165
HALE1	CAf	108	55	141	104	125	158	115	98	166	115	113	177	116	98	179	121	20	170	114	98	169	115	101	171	115	102	173	120	47	172	106	127	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CAf	105	65	141	117	61	158	118	64	166	112	132	177	113	124	179	120	30	170	120	24	169	115	101	171	119	61	173	122	22	172	119	39	168	122	12	167	121	27	166	116	89	166	110	137	165
HACR1	EC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	103	157	172	104	156	174	115	95	176	101	155	175	102	142	171	88	167	169	88	162	168	92	165	167	77	162	166
HALE1	EC1f	110	73	141	104	125	157	116	95	165	114	119	178	116	99	179	115	100	173	114	108	172	115	96	174	114	108	176	120	43	175	108	123	171	47	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC1f	114	54	141	119	40	157	117	82	165	111	137	178	114	119	179	121	21	173	120	28	172	112	125	174	120	45	176	121	29	175	116	65	171	120	38	169	119	48	168	110	127	167	104	145	166
HACR1	EC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	83	165	172	78	166	174	75	165	176	83	162	175	83	163	171	74	166	169	70	162	168	64	166	167	58	163	166
HALE1	EC2f	98	97	141	90	132	157	105	139	165	110	139	178	104	153	179	100	155	173	92	162	172	88	160	174	87	160	176	102	141	175	90	159	171	39	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC2f	101	88	141	111	102	157	105	139	165	102	155	178	101	160	179	100	155	173	95	160	172	82	161	174	83	163	176	86	159	175	90	159	171	82	162	169	88	157	168	85	160	167	78	155	166
HACR1	EC3f	NA	NA	139	NA	NA	157	NA	NA	163	NA	NA	178	NA	NA	179	NA	NA	173	9	168	172	5	170	173	6	169	176	9	148	175	1	170	170	5	160	169	3	166	167	1	167	167	7	149	166
HALE1	EC3f	3	138	139	2	156	157	10	159	163	2	178	178	16	173	179	9	165	173	11	162	172	6	169	173	7	163	176	5	170	175	10	143	170	1	169	169	NA	NA	167	NA	NA	167	NA	NA	166
HAVO1	EC3f	7	132	139	1	157	157	7	162	163	4	174	178	16	173	179	6	170	173	10	164	172	7	167	173	11	121	176	7	164	175	NA	NA	170	3	168	169	5	164	167	7	154	167	10	84	166
HACR1	OC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	42	165	172	35	163	174	15	174	176	17	172	175	17	164	171	17	167	169	27	162	168	24	166	167	24	156	166
HALE1	OC1f	75	75	141	51	144	157	64	152	165	61	161	178	23	176	179	9	171	173	24	169	172	36	159	174	26	168	176	25	165	175	14	168	171	7	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC1f	101	19	141	98	47	157	60	155	165	63	159	178	16	177	179	9	171	173	29	167	172	33	166	174	22	170	176	21	169	175	11	170	171	10	168	169	28	160	168	26	165	167	37	128	166
HACR1	OC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	88	168	172	78	170	174	87	169	176	74	168	175	63	167	171	56	168	169	80	165	168	81	167	167	69	164	166
HALE1	OC2f	97	98	141	93	130	157	112	103	165	113	122	178	116	90	179	110	123	173	113	110	172	113	108	174	114	87	176	120	38	175	106	119	171	47	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC2f	115	40	141	120	23	157	89	154	165	98	157	178	81	169	179	88	168	173	105	148	172	78	170	174	81	170	176	81	167	175	66	166	171	70	167	169	95	159	168	104	148	167	84	160	166
HACR1	OC3f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	93	168	172	58	172	174	74	171	176	69	168	175	74	167	171	67	168	169	69	165	168	75	167	167	72	163	166
HALE1	OC3f	95	99	141	100	125	157	105	132	165	113	115	178	115	104	179	114	100	173	114	104	172	107	140	174	108	135	176	111	124	175	107	121	171	46	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC3f	104	79	141	114	75	157	75	159	165	91	157	178	103	160	179	108	141	173	111	131	172	77	170	174	81	170	176	88	164	175	87	166	171	93	165	169	89	162	168	96	163	167	94	156	166
HACR1	OC4f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	105	154	172	105	155	174	117	85	176	112	134	175	109	122	171	94	166	169	90	163	168	101	160	167	88	158	166
HALE1	OC4f	109	75	141	104	126	157	116	95	165	114	121	178	116	103	179	115	100	173	114	108	172	115	101	174	115	102	176	120	48	175	108	129	171	47	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC4f	111	65	141	120	33	157	112	116	165	108	147	178	113	124	179	120	41	173	120	27	172	114	113	174	120	47	176	119	63	175	119	38	171	122	19	169	122	17	168	116	94	167	106	145	166
HACR1	OPf	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	100	160	172	97	162	174	102	154	176	90	162	175	90	162	171	75	168	169	76	165	168	86	165	167	73	163	166
HALE1	OPf	99	80	141	95	114	157	99	128	165	100	113	178	113	105	179	112	105	173	114	99	172	115	89	174	108	130	176	117	58	175	107	116	171	45	169	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OPf	103	73	141	107	81	157	104	105	165	95	134	178	111	123	179	112	105	173	118	52	172	109	134	174	104	146	176	110	117	175	101	137	171	95	158	169	108	120	168	107	128	167	100	148	166
HACR1	CHLf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	107	106	169	118	17	171	112	38	173	114	14	172	112	68	168	97	157	166	90	158	165	102	133	164	99	128	163
HALE1	CHLf	68	6	141	68	10	158	81	6	166	115	83	179	116	48	179	120	24	170	116	45	169	113	42	171	114	30	173	117	9	172	108	95	168	47	166	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	CHLf	72	5	141	68	10	158	72	15	166	115	83	179	115	54	179	119	35	170	120	12	169	114	32	171	113	34	173	115	13	172	117	32	168	120	31	166	121	20	165	115	58	164	107	99	163
HACR1	CLf	NA	NA	117	NA	NA	152	NA	NA	163	NA	NA	172	NA	NA	153	NA	NA	160	86	8	159	99	5	165	97	5	166	97	7	166	104	34	168	91	80	167	83	161	166	101	158	166	96	156	165
HALE1	CLf	69	4	117	75	8	152	78	8	163	70	8	172	91	4	153	86	5	160	95	3	159	90	9	165	91	9	166	101	4	166	103	39	168	44	165	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CLf	79	2	117	95	3	152	80	5	163	88	6	172	83	5	153	81	9	160	92	6	159	82	14	165	73	15	166	95	9	166	112	20	168	107	30	167	114	46	166	114	94	166	109	134	165
HACR1	CRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	34	164	169	49	115	170	56	149	172	51	162	171	68	153	167	56	164	167	60	163	166	59	165	166	54	159	165
HALE1	CRf	34	74	141	33	119	158	32	145	166	35	150	177	34	168	179	54	115	170	38	159	169	34	160	170	47	162	172	68	118	171	72	143	167	31	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CRf	44	11	141	20	154	158	36	130	166	28	170	177	41	151	179	54	115	170	46	137	169	29	166	170	63	123	172	55	155	171	68	153	167	77	142	167	79	144	166	73	154	166	73	134	165
HACR1	CUf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	76	161	169	70	160	171	77	146	173	87	139	172	80	143	168	78	161	167	62	163	166	80	162	166	76	155	165
HALE1	CUf	63	120	141	75	129	158	91	133	166	86	139	177	90	122	179	99	113	170	103	109	169	98	110	171	81	139	173	84	143	172	88	116	168	43	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CUf	36	131	141	66	138	158	82	148	166	77	158	177	58	172	179	73	164	170	82	155	169	64	166	171	70	158	173	61	159	172	81	141	168	90	150	167	86	144	166	94	128	166	86	141	165
HACR1	fAbs	NA	NA	0	NA	NA	0	NA	NA	166	NA	NA	176	NA	NA	179	NA	NA	170	88	160	169	86	165	171	96	152	173	93	153	172	95	149	168	77	163	167	61	163	166	53	166	166	65	160	165
HALE1	fAbs	NA	NA	0	NA	NA	0	95	135	166	110	94	176	109	125	179	118	39	170	108	115	169	102	139	171	104	135	173	109	115	172	101	134	168	44	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	fAbs	NA	NA	0	NA	NA	0	86	151	166	98	147	176	104	147	179	87	163	170	101	138	169	91	158	171	72	169	173	91	156	172	89	160	168	76	165	167	76	160	166	78	161	166	86	152	165
HACR1	fAbs_HIPS	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	172	NA	NA	179	NA	NA	170	96	157	169	112	112	171	114	103	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	fAbs_HIPS	99	88	141	101	113	158	107	120	166	75	55	172	107	129	179	114	76	170	110	104	169	112	112	171	113	112	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	fAbs_HIPS	73	123	141	95	124	158	104	134	166	77	49	172	101	150	179	87	161	170	109	109	169	111	122	171	114	103	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	Hf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	104	152	169	121	26	171	117	81	173	104	118	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	Hf	109	69	141	104	125	158	115	97	166	115	115	177	116	98	179	121	17	170	114	98	169	115	98	171	115	97	173	116	36	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	Hf	106	80	141	120	29	158	118	68	166	112	132	177	113	123	179	120	28	170	120	22	169	115	98	171	118	65	173	117	30	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	FEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	106	147	169	121	29	171	119	61	173	116	90	172	111	105	168	95	162	167	87	161	166	100	159	166	92	157	165
HALE1	FEf	109	69	141	104	125	158	115	98	166	115	115	177	115	110	179	121	21	170	114	99	169	115	101	171	115	102	173	120	47	172	106	126	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	FEf	106	80	141	120	30	158	118	69	166	112	135	177	113	126	179	120	31	170	120	25	169	115	101	171	119	61	173	122	23	172	111	105	168	117	74	167	118	66	166	115	102	166	109	138	165
HACR1	PBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	97	160	169	100	148	171	96	150	173	109	122	172	63	163	168	66	165	167	59	163	166	55	166	166	64	158	165
HALE1	PBf	87	107	141	99	123	158	110	102	166	104	126	177	111	114	179	112	100	170	104	143	169	106	126	171	80	167	173	111	113	172	77	143	168	36	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	PBf	82	116	141	101	120	158	105	123	166	89	157	177	106	141	179	114	88	170	106	137	169	103	138	171	101	125	173	116	64	172	69	158	168	87	125	167	81	139	166	82	132	166	76	135	165
HACR1	MGf	NA	NA	128	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	31	108	169	37	135	171	48	107	173	47	142	172	103	80	168	87	152	167	82	159	166	99	149	166	95	152	165
HALE1	MGf	2	116	128	18	78	158	28	57	166	26	77	177	58	14	179	76	10	170	44	50	169	49	73	171	76	27	173	77	32	172	106	62	168	46	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MGf	6	47	128	32	3	158	37	16	166	32	31	177	57	16	179	59	30	170	65	18	169	62	39	171	63	50	173	69	50	172	113	29	168	113	38	167	117	15	166	115	29	166	109	96	165
HACR1	MNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	85	164	169	102	149	171	107	131	173	106	130	172	93	139	168	79	164	167	78	161	166	87	163	166	69	159	165
HALE1	MNf	39	115	141	92	122	158	103	115	166	109	110	177	112	105	179	119	32	170	111	101	169	109	116	171	112	100	173	116	61	172	98	126	168	42	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MNf	36	123	141	74	139	158	81	158	166	82	162	177	88	165	179	99	151	170	83	165	169	83	164	171	100	154	173	93	157	172	74	164	168	89	160	167	80	160	166	92	157	166	84	154	165
HACR1	MT	NA	NA	141	NA	NA	158	NA	NA	164	NA	NA	179	NA	NA	178	NA	NA	170	101	154	169	121	26	171	120	41	173	118	63	172	112	100	168	90	162	166	91	159	165	100	155	164	99	152	163
HALE1	MT	106	80	141	104	121	158	114	95	164	114	118	179	116	78	178	117	70	170	116	66	169	115	99	171	115	92	173	120	37	172	106	128	168	47	166	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	MT	115	49	141	120	32	158	118	54	164	113	125	179	114	102	178	114	97	170	120	19	169	115	99	171	120	41	173	122	11	172	119	35	168	121	28	166	122	18	165	116	84	164	110	135	163
HACR1	MF	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	178	NA	NA	170	106	147	169	121	27	171	119	57	173	116	82	172	112	105	168	96	162	167	87	161	166	101	159	166	98	155	165
HALE1	MF	109	69	141	104	123	158	115	94	166	115	114	177	115	110	178	121	19	170	113	107	169	115	101	171	114	109	173	120	42	172	106	129	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MF	106	79	141	120	29	158	118	62	166	112	132	177	113	123	178	120	26	170	120	25	169	115	101	171	118	67	173	122	21	172	119	40	168	122	13	167	121	29	166	116	88	166	110	138	165
HACR1	NIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	34	133	169	62	77	170	35	98	172	37	130	171	83	101	167	64	161	167	60	161	166	68	163	166	72	133	165
HALE1	NIf	50	43	141	68	54	158	85	40	166	96	33	177	77	55	179	87	37	170	84	51	169	83	42	170	60	47	172	65	73	171	92	75	167	42	165	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NIf	34	79	141	53	85	158	83	46	166	78	63	177	67	76	179	71	62	170	83	52	169	74	56	170	55	58	172	81	44	171	85	95	167	84	110	167	98	61	166	89	88	166	79	105	165
HACR1	NO3f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	107	145	169	118	70	171	118	71	173	116	89	172	109	119	168	94	163	166	89	160	165	96	160	164	90	155	163
HALE1	NO3f	108	75	141	107	115	158	116	97	166	115	125	179	116	107	179	120	42	170	116	82	169	115	104	171	115	101	173	120	41	172	108	125	168	47	166	166	NA	NA	165	NA	NA	164	NA	NA	163

Number of Positive Measurement Datasets (Value, Unc, MDL)	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005	2006	2006	2006	2007	2007	2007	2008	2008	2008	2009	2009	2009	2010	2010	2010	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant																																													
HAVO1	NO3f	108	75	141	110	105	158	118	79	166	115	125	179	115	113	179	117	85	170	119	44	169	116	97	171	117	83	173	119	53	172	115	83	168	114	111	166	121	30	165	114	106	164	105	144	163
HACR1	N2f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	22	167	169	31	165	171	40	165	173	31	168	172	36	159	168	33	163	166	28	163	165	37	163	164	26	162	163
HALE1	N2f	18	129	141	29	142	158	40	146	166	39	169	179	16	177	179	15	167	170	22	167	169	20	170	171	45	159	173	37	162	172	43	155	168	5	166	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	N2f	24	119	141	17	158	158	45	135	166	28	173	179	21	176	179	14	170	170	37	160	169	32	162	171	42	163	173	29	170	172	24	165	168	31	164	166	42	157	165	51	156	164	30	158	163
HACR1	Pf	NA	NA	33	NA	NA	121	NA	NA	107	NA	NA	133	NA	NA	95	NA	NA	92	2	65	104	1	99	99	4	37	110	2	87	114	20	146	168	21	131	167	21	148	166	18	157	166	15	161	165
HALE1	Pf	3	4	33	9	8	121	13	2	107	7	16	133	7	7	95	4	24	92	9	8	104	5	14	99	4	37	110	4	46	114	48	63	168	19	140	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Pf	2	12	33	8	11	121	3	47	107	3	62	133	4	16	95	1	92	92	1	104	104	2	57	99	4	37	110	3	64	114	23	138	168	54	47	167	46	86	166	34	124	166	38	105	165
HACR1	Kf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	106	147	169	121	29	171	119	61	173	116	88	172	112	105	168	96	162	167	88	161	166	102	158	166	98	155	165
HALE1	Kf	109	58	141	104	124	158	115	97	166	115	114	177	116	99	179	121	21	170	114	97	169	115	101	171	115	102	173	120	45	172	106	129	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Kf	106	71	141	118	50	158	118	65	166	112	135	177	113	122	179	120	30	170	120	24	169	115	101	171	119	61	173	122	22	172	119	40	168	122	14	167	121	28	166	116	91	166	110	138	165
HACR1	RBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	176	NA	NA	179	NA	NA	170	45	167	169	57	161	171	56	162	173	42	153	172	50	159	168	53	149	167	56	137	166	51	153	166	48	155	165
HALE1	RBf	67	87	141	62	130	158	53	137	166	58	128	176	53	151	179	70	143	170	68	142	169	67	146	171	69	142	173	58	131	172	58	126	168	26	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	RBf	53	114	141	59	133	158	45	153	166	47	161	176	46	166	179	57	163	170	67	147	169	55	162	171	52	167	173	35	162	172	60	112	168	60	126	167	66	76	166	51	153	166	54	139	165
HACR1	SEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	42	167	169	64	153	171	64	156	173	52	156	172	52	157	168	53	160	167	44	162	166	46	166	166	41	161	165
HALE1	SEf	85	86	141	71	114	158	92	113	166	100	107	177	84	126	179	96	111	170	90	129	169	93	120	171	94	119	173	97	106	172	59	142	168	33	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SEf	64	122	141	80	100	158	99	102	166	95	118	177	88	120	179	100	104	170	108	80	169	96	114	171	111	63	173	97	106	172	83	73	168	81	90	167	93	67	166	87	77	166	85	84	165
HACR1	SIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	98	150	169	111	115	171	115	86	173	107	139	172	111	101	168	88	164	167	85	161	166	94	162	166	87	158	165
HALE1	SIf	106	59	141	99	100	158	101	117	166	105	122	177	109	112	179	115	68	170	110	105	169	109	128	171	112	116	173	110	120	172	103	135	168	44	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SIf	87	104	141	79	137	158	95	141	166	91	156	177	81	166	179	91	161	170	91	164	169	92	162	171	105	147	173	110	120	172	105	127	168	106	138	167	103	143	166	104	148	166	95	153	165
HACR1	NAf	NA	NA	139	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	52	89	169	83	40	171	101	31	173	102	27	172	104	35	168	91	111	167	83	142	166	94	141	166	92	148	165
HALE1	NAf	100	1	139	31	84	158	31	149	166	39	73	177	104	7	179	109	6	170	102	11	169	106	15	171	114	10	173	117	11	172	106	33	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NAf	89	7	139	34	59	158	34	135	166	27	159	177	95	11	179	101	11	170	99	14	169	99	22	171	110	14	173	119	9	172	117	10	168	119	13	167	120	7	166	115	21	166	110	49	165
HACR1	SRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	79	165	169	101	127	171	95	146	173	97	123	172	86	134	168	60	164	167	68	161	166	69	164	166	76	156	165
HALE1	SRf	98	37	141	101	75	158	112	44	166	111	73	177	113	55	179	119	19	170	113	59	169	106	110	171	113	51	173	113	45	172	100	81	168	44	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SRf	87	74	141	104	64	158	110	57	166	104	104	177	108	90	179	113	72	170	115	47	169	100	129	171	108	84	173	106	79	172	93	112	168	99	83	167	89	122	166	92	125	166	88	123	165
HACR1	SO4f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	107	146	169	121	38	171	120	51	173	118	75	172	112	112	168	97	160	166	91	159	165	102	157	164	98	153	163
HALE1	SO4f	109	75	141	107	119	158	116	100	166	105	128	179	116	108	179	120	45	170	116	84	169	115	108	171	115	101	173	120	47	172	108	127	168	47	166	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	SO4f	112	63	141	118	61	158	118	83	166	105	128	179	115	114	179	119	64	170	120	29	169	116	101	171	117	83	173	121	36	172	118	56	168	120	46	166	121	32	165	115	101	164	107	139	163
HACR1	Sf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	106	147	169	121	29	171	119	61	173	116	90	172	112	105	168	96	162	167	88	161	166	102	158	166	98	155	165
HALE1	Sf	109	68	141	104	125	158	115	98	166	115	115	177	116	99	179	121	21	170	114	98	169	115	101	171	115	102	173	120	47	172	106	129	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Sf	106	78	141	119	42	158	118	68	166	112	134	177	113	126	179	120	30	170	120	25	169	115	101	171	119	61	173	122	22	172	119	40	168	122	14	167	121	29	166	116	92	166	110	138	165
HACR1	TIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	103	143	169	118	60	171	119	43	173	113	103	172	109	104	168	92	162	167	87	160	166	97	157	166	92	157	165
HALE1	TIf	98	26	141	103	93	158	112	90	166	114	86	177	114	95	179	121	15	170	113	85	169	115	85	171	115	86	173	118	56	172	105	120	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	TIf	62	122	141	93	124	158	113	82	166	102	148	177	103	147	179	109	116	170	103	143	169	109	127	171	109	134	173	114	98	172	94	154	168	96	158	167	112	96	166	105	138	166	96	151	165
HACR1	Vf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	85	145	169	95	112	171	87	139	173	93	126	172	83	128	168	58	163	167	63	160	166	71	160	166	61	157	165
HALE1	Vf	62	21	141	91	72	158	99	52	166	107	58	177	110	71	179	113	39	170	112	47	169	107	77	171	106	79	173	114	40	172	101	68	168	46	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Vf	42	81	141	86	80	158	95	58	166	91	105	177	96	118	179	93	120	170	99	107	169	94	116	171	76	163	173	96	113	172	107	41	168	96	69	167	102	42	166	93	81	166	90	61	165
HACR1	ZNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	103	153	169	114	104	171	110	132	173	110	132	172	92	154	168	87	163	167	82	162	166	89	164	166	82	159	165
HALE1	ZNf	103	84	141	104	125	158	115	97	166	114	116	177	116	95	179	120	27	170	114	95	169	113	113	171	113	107	173	119	53	172	103	122	168	47	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZNf	94	104	141	118	53	158	118	66	166	108	145	177	112	132	179	115	102	170	114	95	169	104	152	171	113	107	173	117	76	172	100	135	168	107	134	167	113	103	166	110	123	166	101	151	165
HACR1	ZRf	NA	NA	140	NA	NA	158	NA	NA	165	NA	NA	177	NA	NA	179	NA	NA	170	25	164	169	35	70	171	36	122	173	15	168	172	60	114	168	47	163	167	51	157	166	60	150	166	57	151	165
HALE1	ZRf	9	113	140	30	100	158	9	112	165	11	143	177	15	145	179	22	115	170	31	147	169	34	81	171	32	150	173	30	122	172	61	104	168	25	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZRf	4	131	140	24	128	158	7	132	165	14	97	177	12	163	179	14	166	170	26	161	169	19	166	171	33	142	173	26	147	172	60	114	168	65	103	167	56	152	166	60	150	166	53	157	165

Table E-29: Hawaii IMPROVE site Number of Positive Measurement Datasets (Value, Unc, MDL) annual values and rankings

Signal to Noise	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005	2006	2006	2006	2007	2007	2007
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant																					
HACR1	ALf	NA	NA	138	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	6.829	135	169
HALE1	ALf	6.458	113	138	5.279	144	158	3.920	159	166	4.891	162	177	6.062	153	179	7.211	147	170	6.728	141	169
HAVO1	ALf	5.237	128	138	3.878	155	158	2.586	166	166	3.897	173	177	5.399	166	179	5.268	165	170	5.823	157	169
HACR1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0
HALE1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0
HAVO1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0
HACR1	ASf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	3.578	59	169
HALE1	ASf	3.404	80	141	3.232	70	158	2.701	150	166	3.596	76	177	2.587	155	179	4.171	46	170	3.208	81	169
HAVO1	ASf	4.186	25	141	3.866	29	158	5.074	14	166	3.542	85	177	3.004	117	179	2.440	163	170	3.767	52	169
HACR1	BRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	11.667	169	169
HALE1	BRf	12.116	118	141	14.607	92	158	15.055	115	166	13.933	129	177	13.532	131	179	15.051	116	170	15.122	119	169
HAVO1	BRf	9.079	139	141	11.067	157	158	12.491	164	166	10.521	177	177	10.486	179	179	11.885	170	170	13.272	161	169
HACR1	CAf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	15.633	162	169
HALE1	CAf	11.132	75	141	16.313	90	158	16.398	105	166	16.840	101	177	17.254	107	179	17.379	103	170	17.498	100	169
HAVO1	CAf	10.015	106	141	14.957	131	158	15.862	121	166	16.363	121	177	16.864	125	179	16.480	141	170	16.681	132	169
HACR1	EC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	5.224	172	172
HALE1	EC1f	2.790	134	141	4.440	149	157	4.049	157	165	3.122	167	178	6.981	162	179	7.574	151	173	7.253	152	172
HAVO1	EC1f	1.791	140	141	2.989	157	157	3.227	164	165	2.089	176	178	5.445	177	179	5.914	172	173	5.439	170	172
HACR1	EC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	1.578	171	172
HALE1	EC2f	0.796	133	141	1.020	151	157	0.896	161	165	0.874	173	178	2.184	176	179	2.242	170	173	2.025	167	172
HAVO1	EC2f	0.642	137	141	0.681	156	157	0.889	162	165	0.660	177	178	1.675	179	179	1.695	173	173	1.786	168	172
HACR1	EC3f	NA	NA	139	NA	NA	157	NA	NA	163	NA	NA	178	NA	NA	179	NA	NA	173	0.269	43	172
HALE1	EC3f	0.922	29	139	0.607	157	157	0.474	163	163	0.000	178	178	0.238	156	179	0.084	167	173	0.160	129	172
HAVO1	EC3f	0.717	112	139	0.794	152	157	0.756	158	163	0.354	177	178	0.100	179	179	0.000	173	173	0.132	142	172
HACR1	OC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.209	166	172
HALE1	OC1f	0.116	134	141	0.092	157	157	0.143	165	165	0.093	178	178	0.054	178	179	0.002	172	173	0.292	156	172
HAVO1	OC1f	0.690	46	141	0.652	74	157	0.174	162	165	0.171	174	178	0.195	173	179	0.041	170	173	0.461	136	172
HACR1	OC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	1.246	168	172
HALE1	OC2f	0.339	140	141	0.504	156	157	0.890	159	165	0.997	172	178	1.761	171	179	1.832	166	173	1.580	164	172
HAVO1	OC2f	1.729	54	141	2.565	46	157	0.527	165	165	0.288	178	178	0.504	179	179	0.566	173	173	0.949	170	172
HACR1	OC3f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	1.132	171	172
HALE1	OC3f	0.709	140	141	0.871	156	157	1.401	159	165	1.161	174	178	2.112	176	179	2.445	168	173	2.419	164	172
HAVO1	OC3f	0.779	138	141	0.930	155	157	0.522	164	165	0.410	177	178	0.883	179	179	0.896	173	173	1.179	170	172
HACR1	OC4f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	1.231	171	172
HALE1	OC4f	1.766	133	141	2.552	146	157	2.847	149	165	2.195	165	178	2.436	169	179	2.552	164	173	2.650	160	172
HAVO1	OC4f	1.271	138	141	1.643	156	157	2.021	162	165	1.503	175	178	1.476	179	179	1.314	173	173	1.398	170	172
HACR1	OPf	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	4.014	171	172
HALE1	OPf	0.615	132	141	0.862	147	157	0.616	158	165	0.808	167	178	5.179	170	179	5.245	165	173	5.255	161	172
HAVO1	OPf	0.509	134	141	0.453	154	157	0.590	160	165	0.586	170	178	4.168	178	179	4.197	171	173	4.078	170	172
HACR1	CHLf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	7.404	31	169
HALE1	CHLf	2.092	21	141	2.516	25	158	2.697	10	166	13.422	10	179	9.943	5	179	9.929	9	170	10.578	5	169
HAVO1	CHLf	2.182	19	141	2.510	26	158	2.902	9	166	14.173	7	179	9.830	6	179	9.883	10	170	10.559	7	169
HACR1	CLf	NA	NA	117	NA	NA	152	NA	NA	163	NA	NA	172	NA	NA	153	NA	NA	160	15.450	22	159
HALE1	CLf	15.566	11	117	16.238	10	152	16.474	9	163	16.950	8	172	17.407	13	153	17.273	17	160	17.852	5	159
HAVO1	CLf	15.797	9	117	16.852	7	152	17.164	5	163	17.459	5	172	17.725	8	153	17.605	12	160	18.151	3	159
HACR1	CRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	2.652	82	169
HALE1	CRf	1.748	138	141	1.873	131	158	2.400	115	166	1.816	160	177	1.980	145	179	1.818	164	170	1.966	152	169
HAVO1	CRf	2.280	45	141	2.929	32	158	2.293	133	166	2.235	112	177	2.065	137	179	1.941	160	170	1.986	151	169
HACR1	CUf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	4.561	169	169
HALE1	CUf	4.227	138	141	4.889	152	158	5.272	152	166	4.400	164	177	5.170	155	179	6.118	145	170	5.774	152	169
HAVO1	CUf	5.653	104	141	6.728	103	158	7.126	111	166	6.455	116	177	7.976	92	179	9.470	77	170	8.091	102	169
HACR1	fAbs	NA	NA	0	NA	NA	0	NA	NA	166	NA	NA	176	NA	NA	179	NA	NA	170	2.247	168	169
HALE1	fAbs	NA	NA	0	NA	NA	0	7.897	136	166	6.871	146	176	5.785	157	179	6.553	143	170	6.204	146	169
HAVO1	fAbs	NA	NA	0	NA	NA	0	2.123	166	166	2.766	176	176	2.872	179	179	2.226	170	170	2.335	167	169
HACR1	fAbs_HIPS	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	172	NA	NA	179	NA	NA	170	3.590	168	169
HALE1	fAbs_HIPS	6.373	131	141	7.123	137	158	7.216	143	166	6.132	158	172	5.780	157	179	6.268	145	170	6.202	153	169
HAVO1	fAbs_HIPS	3.586	140	141	4.306	158	158	3.728	166	166	3.972	172	172	3.874	179	179	3.471	170	170	3.788	167	169
HACR1	Hf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	9.704	169	169
HALE1	Hf	14.821	126	141	13.728	144	158	13.914	141	166	13.644	139	177	12.815	143	179	12.896	125	170	12.178	139	169
HAVO1	Hf	14.065	132	141	12.481	157	158	13.430	155	166	12.896	162	177	12.358	155	179	12.475	138	170	11.964	149	169
HACR1	FEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	17.239	155	169
HALE1	FEf	17.547	70	141	17.690	92	158	17.526	135	166	17.865	117	177	18.028	129	179	18.294	102	170	18.174	116	169
HAVO1	FEf	14.555	139	141	14.825	157	158	16.327	161	166	16.348	170	177	16.868	171	179	17.006	160	170	16.660	163	169
HACR1	PBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	5.861	169	169
HALE1	PBf	5.561	133	141	6.809	125	158	6.443	139	166	5.634	171	177	5.420	176	179	5.339	170	170	6.959	159	169
HAVO1	PBf	5.802	129	141	7.542	87	158	8.934	57	166	8.251	72	177	8.738	62	179	10.127	38	170	10.422	33	169
HACR1	MGf	NA	NA	128	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	3.344	92	169
HALE1	MGf	3.036	91	128	2.075	130	158	1.856	148	166	1.854	149	177	3.808	37	179	4.219	78	170	4.573	26	169
HAVO1	MGf	2.837	111	128	2.030	136	158	1.848	149	166	1.691	164	177	4.336	17	179	5.015	47	170	4.306	36	169
HACR1	MNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	7.450	161	169
HALE1	MNf	2.726	135	141	7.492	135	158	7.117	153	166	7.569	162	177	9.508	140	179	9.614	148	170	9.337	140	169
HAVO1	MNf	2.192	141	141	4.740	157	158	4.446	166	166	5.322	175	177	6.769	177	179	5.819	170	170	6.666	166	169
HACR1	MT	NA	NA	141	NA	NA	158	NA	NA	164	NA	NA	179	NA	NA	178	NA	NA	170	10.535	166	169
HALE1	MT	19.815	89	141	20.055	104	158	19.301	113	164	17.751	129	179	16.633	135	178	17.851	126	170	18.462	119	169
HAVO1	MT	14.502	129	141	13.888	152	158	17.121	129	164	15.140	154	179	15.231	143	178	13.140	163	170	15.237	149	169
HACR1	MF	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	178	NA	NA	170	7.990	164	169
HALE1	MF	12.417	119	141	13.645	129	158	13.491	132	166	12.164	153	177	11.740	152	178	12.491	143	170	12.887	141	169
HAVO1	MF	10.901	128	141	11.654	146	158	13.761	129	166	11.990	157	177	12.536	143	178	12.805	141	170	13.127	138	169
HACR1	NIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	5.201	61	169
HALE1	NIf	5.957	43	141	6.917	30	158	6.360	38	166	5.411	38	177	5.336	62	179	8.430	19	170	8.005	19	169
HAVO1	NIf	4.938	75	141	5.544	59	158	5.426	57	166	4.222	69	177	4.715	76	179	6.761	41	170	6.884	36	169
HACR1	NO3f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	9.869	153	169
HALE1	NO3f	11.306	86	141	11.460	94	158	8.383	106	166	13.850	116	179	13.242	109	179	15.674	95	170	15.136	103	169

Signal to Noise	Year	2008	2008	2008	2009	2009	2009	2010	2010	2010	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant																								
HACR1	ALf	6.646	156	171	7.763	150	173	8.162	150	172	5.812	153	168	3.973	155	167	3.904	143	166	4.150	158	166	5.012	161	165
HALE1	ALf	6.316	160	171	6.577	163	173	7.150	161	172	6.845	127	168	7.145	88	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ALf	5.528	164	171	5.372	170	173	5.638	168	172	5.163	162	168	3.112	160	167	3.351	158	166	4.752	143	166	6.121	144	165
HACR1	NH4f	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	NH4f	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	NH4f	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	ASf	3.857	54	171	4.623	23	173	3.044	98	172	0.363	166	168	0.294	165	167	0.208	166	166	0.348	149	166	0.323	158	165
HALE1	ASf	3.879	51	171	5.048	12	173	4.262	33	172	0.427	154	168	0.312	164	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ASf	3.443	87	171	4.344	33	173	2.691	139	172	0.654	104	168	0.618	101	167	0.913	51	166	0.772	74	166	1.112	41	165
HACR1	BRf	11.364	171	171	11.163	173	173	10.796	170	172	2.794	167	168	3.010	166	167	3.157	165	166	2.980	166	166	2.741	165	165
HALE1	BRf	13.837	154	171	13.567	152	173	13.187	144	172	4.542	137	168	4.277	155	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	BRf	11.468	170	171	11.172	172	173	10.498	171	172	2.357	168	168	2.808	167	167	2.782	166	166	4.118	161	166	3.714	161	165
HACR1	CAf	15.888	163	171	16.687	160	173	16.240	158	172	4.333	152	168	3.802	157	167	4.076	150	166	3.388	158	166	3.901	161	165
HALE1	CAf	17.302	118	171	17.793	107	173	17.458	112	172	6.887	117	168	8.919	95	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CAf	16.533	152	171	17.116	140	173	16.803	142	172	4.219	154	168	4.310	150	167	4.233	148	166	4.027	151	166	5.738	147	165
HACR1	EC1f	4.404	174	174	3.281	176	176	3.992	174	175	3.716	170	171	4.018	168	169	4.142	168	168	3.737	167	167	3.523	166	166
HALE1	EC1f	6.360	163	174	5.200	164	176	6.044	156	175	6.538	146	171	6.613	151	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC1f	4.435	173	174	3.414	175	176	3.778	175	175	3.332	171	171	3.736	169	169	4.805	167	168	5.190	161	167	5.276	156	166
HACR1	EC2f	1.376	172	174	0.914	176	176	1.068	175	175	1.004	170	171	0.937	169	169	1.185	167	168	0.674	167	167	0.497	166	166
HALE1	EC2f	1.934	166	174	1.293	173	176	1.388	172	175	1.726	167	171	1.503	165	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC2f	1.513	171	174	1.376	172	176	1.164	174	175	1.079	169	171	0.997	168	169	1.096	168	168	1.581	164	167	1.621	163	166
HACR1	EC3f	0.020	155	173	0.000	176	176	0.000	175	175	0.000	170	170	0.000	169	169	0.000	167	167	0.000	167	167	0.000	166	166
HALE1	EC3f	0.000	173	173	0.000	176	176	0.000	175	175	0.072	94	170	0.000	169	169	NA	NA	167	NA	NA	167	NA	NA	166
HAVO1	EC3f	0.000	173	173	0.000	176	176	0.154	17	175	NA	NA	170	0.000	169	169	0.000	167	167	0.092	57	167	0.000	166	166
HACR1	OC1f	0.120	172	174	0.152	173	176	0.015	174	175	0.016	171	171	0.013	167	169	0.176	154	168	0.055	165	167	0.025	166	166
HALE1	OC1f	0.155	169	174	0.309	168	176	0.175	155	175	0.208	137	171	0.135	161	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC1f	0.153	170	174	0.283	169	176	0.171	156	175	0.126	154	171	0.000	169	169	0.091	165	168	0.167	156	167	0.228	137	166
HACR1	OC2f	0.441	174	174	0.656	175	176	0.374	175	175	0.348	170	171	0.370	169	169	0.722	167	168	0.344	167	167	0.302	166	166
HALE1	OC2f	1.402	168	174	1.755	170	176	1.576	169	175	1.671	160	171	1.849	161	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC2f	0.490	173	174	0.537	176	176	0.521	174	175	0.274	171	171	0.673	168	169	0.571	168	168	0.830	166	167	0.537	165	166
HACR1	OC3f	0.621	174	174	0.414	176	176	0.699	174	175	0.674	170	171	0.485	169	169	0.816	167	168	0.542	167	167	0.696	166	166
HALE1	OC3f	1.407	168	174	1.355	172	176	1.751	171	175	2.488	159	171	2.325	165	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC3f	0.792	172	174	0.465	175	176	0.489	175	175	0.546	171	171	1.039	168	169	0.606	168	168	1.111	165	167	0.953	165	166
HACR1	OC4f	0.847	174	174	0.769	176	176	0.865	175	175	0.874	170	171	0.800	169	169	0.868	168	168	0.569	167	167	0.772	166	166
HALE1	OC4f	2.201	166	174	2.026	168	176	2.287	163	175	2.891	139	171	2.169	162	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC4f	1.173	173	174	1.172	175	176	0.989	174	175	0.837	171	171	0.863	168	169	1.013	167	168	1.361	164	167	1.603	163	166
HACR1	OPf	3.703	170	174	2.774	176	176	3.426	173	175	2.965	169	171	2.976	168	169	3.280	167	168	2.943	165	167	2.694	166	166
HALE1	OPf	4.806	165	174	4.225	167	176	4.667	163	175	4.605	158	171	4.409	160	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OPf	3.504	171	174	2.928	175	176	2.852	174	175	2.515	171	171	2.834	169	169	3.677	165	168	3.801	162	167	3.928	161	166
HACR1	CHLf	5.701	33	171	5.447	32	173	4.254	33	172	7.523	26	168	7.976	32	166	7.765	24	165	6.997	31	164	5.905	31	163
HALE1	CHLf	8.588	10	171	8.858	9	173	8.303	8	172	10.180	8	168	10.703	8	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	CHLf	8.836	8	171	7.986	10	173	8.008	9	172	9.878	9	168	10.653	9	166	10.506	8	165	10.303	7	164	9.078	9	163
HACR1	CLf	15.793	25	165	16.694	19	166	16.203	22	166	5.780	8	168	5.696	7	167	5.229	16	166	4.750	23	166	5.075	17	165
HALE1	CLf	17.915	7	165	17.996	7	166	18.157	5	166	5.818	7	168	5.995	4	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CLf	18.100	6	165	18.116	5	166	18.284	4	166	5.749	9	168	5.989	5	167	5.277	15	166	5.212	16	166	4.874	22	165
HACR1	CRf	2.293	132	170	2.969	78	172	2.766	106	171	0.328	139	167	0.508	116	167	0.247	165	166	0.246	166	166	0.330	144	165
HALE1	CRf	1.324	170	170	2.329	147	172	2.431	144	171	0.226	163	167	0.378	153	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CRf	1.661	165	170	2.411	138	172	2.736	110	171	0.438	102	167	0.341	159	167	0.211	166	166	0.440	139	166	0.452	101	165
HACR1	CUf	5.288	159	171	5.178	161	173	4.362	168	172	0.183	168	168	0.537	158	167	0.334	162	166	0.372	161	166	0.420	155	165
HALE1	CUf	6.043	135	171	5.401	156	173	5.328	149	172	0.422	155	168	0.800	140	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CUf	8.517	88	171	8.577	79	173	8.667	79	172	1.038	98	168	1.064	114	167	1.477	84	166	1.220	100	166	1.565	86	165
HACR1	fAbs	2.801	168	171	1.585	171	173	1.762	170	172	2.256	166	168	1.682	166	167	1.997	163	166	1.556	164	166	0.899	165	165
HALE1	fAbs	6.360	132	171	4.602	149	173	3.733	152	172	4.152	152	168	4.226	156	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	fAbs	1.799	171	171	0.859	173	173	1.252	171	172	1.208	168	168	1.059	167	167	0.917	166	166	1.366	166	166	2.608	163	165
HACR1	fAbs_HIPS	4.022	168	171	3.446	170	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	fAbs_HIPS	6.359	146	171	5.373	153	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	fAbs_HIPS	3.863	169	171	3.143	172	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	Hf	10.489	166	171	9.864	173	173	9.482	170	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	Hf	12.107	133	171	11.537	141	173	11.095	137	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	Hf	11.620	151	171	11.812	131	173	10.970	143	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	FEf	17.289	159	171	17.705	153	173	17.662	151	172	5.790	156	168	5.217	155	167	5.203	149	166	4.168	157	166	5.156	160	165
HALE1	FEf	17.961	133	171	18.214	122	173	18.092	123	172	8.627	125	168	9.946	108	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	FEf	16.585	167	171	17.009	167	173	17.070	162	172	3.805	165	168	3.859	163	167	3.322	162	166	3.495	163	166	5.290	159	165
HACR1	PBf	6.338	166	171	4.620	172	173	5.458	172	172	0.337	165	168	0.320	167	167	0.399	146	166	0.249	165	166	0.245	162	165
HALE1	PBf	6.866	150	171	5.527	151	173	6.099	166	172	0.289	168	168	0.337	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	PBf	9.737	42	171	9.428	32	173	9.622	41	172	0.470	155	168	0.595	129	167	0.578	107	166	0.442	132	166	0.645	91	165
HACR1	MGf	3.119	144	171	3.211	152	173	4.427	96	172	3.212	82	168	2.682	123	167	2.984	78	166	2.875	102	166	2.800	89	165
HALE1	MGf	3.778	95	171	4.222	88	173	4.505	92	172	4.690	15	168	4.578	17	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MGf	4.228	80	171	4.497	80	173	4.704	78	172	4.085	38	168	3.598	58	167	4.381	23	166	4.349	27	166	4.342	24	165
HACR1	MNf	6.796	165	171	7.194	166	173	8.034	156	172	0.839	159	168	1.038	154	167	0.863	157	166	0.824	162	166	0.712	157	165
HALE1	MNf	7.943	154	171	7.966	159	173	8.389	151	172	1.085	150	168	1.754	136	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MNf	5.096	171	171	5.601	172	173	5.572	171	172	0.538	167	168	0.714	162	167	0.583	164	166	0.678	165	166	0.582	161	165
HACR1	MT	10.867	165	171	13.246	160	173	11.144	162	172	9.837	165	168	10.886	163	166	10.483	161	165	9.035	163	164	9.195	163	163
HALE1	MT	18.667	118	171	18.407	108	173	17.819	113	172	19.248	98	168	20.234	92	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	MT	15.750	143	171	16.790	130	173	15.764	129	172	13.670	146	168	14.075	151	166	16.692	114	165	16.728	116	164	18.219	101	163
HACR1	MF	8.860	165	171	8.370	173	173	8.227	166	172	7.761	163	168	8.529	162	167	8.649	161	166	7.331	164	166	6.663	163	165
HALE1	MF	14.511	124	171	13.710	132	173	12.831	126	172	13.983	111	168	15.541	100	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MF	14.107	129	171	15.989	97	173	13.204	119	172	10.653	147	168	11.749	151	167	14.151	110	166	15.136	100	166	16.320	78	165
HACR1	NIf	5.210	63	170	4.181	99	172	4.032	121	171	0.541	117	167	0.498	127	167	0.442	131	166	0.220	163	166	0.226	157	165
HALE1	NIf	7.290	20	170	6.146	36	172	5.901	39	171	1.124	68	167	1.052	67	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NIf	5.833	46	170	5.541	45	172	6.008	36	171	1.049	72	167	0.696	101	167	0.945	64	166	0.705	89	166	0.635	70	165
HACR1	NO3f	8.106	157	171	10.373	159	173	7.502	158	172	6.467	152	168	8.833	154	166	7.480	148	165	5.846	151	164	5.724	149	163
HALE1	NO3f	13.443	102	171	16.043	92	173	12.356	103	172	12.464	84	168	14.851	88	166	NA	NA	165	NA	NA	164	NA	NA	163

Signal to Noise	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant															
HAVO1	NO3f	5.379	136	141	5.634	152	158	3.781	160	166	8.522	168	179	7.988	165	179
HACR1	N2f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179
HALE1	N2f	1.252	96	141	1.704	33	158	1.039	39	166	1.508	2	179	0.658	165	179
HAVO1	N2f	2.245	13	141	2.293	4	158	1.223	11	166	1.062	26	179	0.715	149	179
HACR1	Pf	NA	NA	33	NA	NA	121	NA	NA	107	NA	NA	133	NA	NA	95
HALE1	Pf	3.107	30	33	4.331	100	121	4.955	66	107	4.877	81	133	9.111	32	95
HAVO1	Pf	2.186	32	33	3.849	112	121	2.812	104	107	5.205	71	133	4.966	73	95
HACR1	Kf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	Kf	11.730	84	141	16.747	73	158	16.912	83	166	17.343	75	177	17.624	79	179
HAVO1	Kf	9.414	135	141	14.947	148	158	15.850	142	166	16.466	133	177	17.021	127	179
HACR1	RBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	176	NA	NA	179
HALE1	RBf	2.124	92	141	2.106	95	158	1.724	128	166	2.144	112	176	2.009	80	179
HAVO1	RBf	2.448	63	141	2.130	91	158	1.875	115	166	2.222	104	176	2.389	46	179
HACR1	SEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SEf	4.087	124	141	4.674	133	158	5.128	122	166	4.285	142	177	4.712	136	179
HAVO1	SEf	6.396	68	141	8.732	52	158	8.949	56	166	8.408	55	177	8.280	67	179
HACR1	SIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SIf	10.985	112	141	10.548	124	158	9.938	143	166	10.708	148	177	13.005	151	179
HAVO1	SIf	9.932	129	141	8.095	156	158	8.168	165	166	9.102	172	177	11.209	174	179
HACR1	NAf	NA	NA	139	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	NAf	12.572	3	139	3.321	18	158	2.406	114	166	3.431	6	177	8.165	5	179
HAVO1	NAf	11.872	8	139	3.379	7	158	3.645	3	166	2.795	38	177	7.888	9	179
HACR1	SRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SRf	5.433	84	141	6.646	66	158	6.241	79	166	5.646	91	177	6.260	66	179
HAVO1	SRf	4.404	113	141	5.570	101	158	5.638	95	166	5.196	107	177	5.345	92	179
HACR1	SO4f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179
HALE1	SO4f	19.734	94	141	19.299	80	158	19.648	108	166	24.642	108	179	38.053	128	179
HAVO1	SO4f	17.501	113	141	17.869	95	158	20.256	103	166	24.365	113	179	38.924	120	179
HACR1	Sf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	Sf	17.001	93	141	17.979	73	158	17.857	108	166	18.378	71	177	18.497	92	179
HAVO1	Sf	16.509	112	141	17.593	103	158	17.874	105	166	18.283	81	177	18.560	81	179
HACR1	TIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	TIf	5.784	71	141	11.631	64	158	11.895	72	166	12.063	71	177	13.442	58	179
HAVO1	TIf	4.004	139	141	7.063	156	158	7.753	162	166	7.794	171	177	9.427	168	179
HACR1	Vf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	Vf	2.266	59	141	4.576	40	158	4.662	48	166	5.127	59	177	4.330	98	179
HAVO1	Vf	2.546	35	141	4.927	37	158	4.941	42	166	4.865	65	177	5.519	62	179
HACR1	ZNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	ZNf	10.239	135	141	12.656	147	158	13.996	150	166	13.447	151	177	13.158	153	179
HAVO1	ZNf	7.657	141	141	9.888	158	158	12.228	166	166	11.989	173	177	11.530	179	179
HACR1	ZRf	NA	NA	140	NA	NA	158	NA	NA	165	NA	NA	177	NA	NA	179
HALE1	ZRf	0.880	130	140	1.703	140	158	1.152	116	165	2.775	13	177	1.393	139	179
HAVO1	ZRf	1.125	106	140	1.998	112	158	0.728	157	165	1.796	91	177	1.809	60	179

Signal to Noise	Year	2006	2006	2006	2007	2007	2007	2008	2008	2008	2009	2009	2009	2010	2010	2010
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant															
HAVO1	NO3f	8.053	165	170	9.411	158	169	7.729	159	171	8.286	168	173	6.808	164	172
HACR1	N2f	NA	NA	170	0.680	23	169	0.476	7	171	0.444	7	173	0.637	93	172
HALE1	N2f	0.175	146	170	0.751	13	169	0.165	162	171	0.360	16	173	0.752	23	172
HAVO1	N2f	0.169	148	170	0.960	2	169	0.288	74	171	0.225	107	173	0.573	133	172
HACR1	Pf	NA	NA	92	7.461	59	104	4.658	83	99	5.546	78	110	4.167	92	114
HALE1	Pf	10.778	23	92	9.112	44	104	5.891	65	99	7.970	46	110	5.249	82	114
HAVO1	Pf	1.000	92	92	2.974	101	104	5.214	73	99	5.264	81	110	4.597	87	114
HACR1	Kf	NA	NA	170	14.936	166	169	15.270	168	171	15.769	169	173	15.194	169	172
HALE1	Kf	17.680	80	170	17.567	81	169	17.205	124	171	17.598	105	173	17.509	101	172
HAVO1	Kf	16.916	129	170	16.736	138	169	16.422	152	171	16.868	148	173	16.526	140	172
HACR1	RBf	NA	NA	170	2.456	82	169	2.436	87	171	2.474	76	173	2.787	50	172
HALE1	RBf	2.167	118	170	2.157	111	169	2.013	130	171	2.225	109	173	2.114	139	172
HAVO1	RBf	2.018	127	170	2.047	124	169	2.186	111	171	2.293	97	173	2.283	124	172
HACR1	SEf	NA	NA	170	3.532	164	169	5.431	128	171	4.338	146	173	4.090	144	172
HALE1	SEf	5.410	135	170	5.511	133	169	6.416	106	171	5.219	124	173	5.021	123	172
HAVO1	SEf	10.153	51	170	8.317	80	169	8.799	70	171	9.846	44	173	8.702	60	172
HACR1	SIf	NA	NA	170	12.096	157	169	11.949	165	171	13.221	159	173	13.634	145	172
HALE1	SIf	13.571	141	170	13.067	142	169	12.572	159	171	13.586	151	173	13.374	155	172
HAVO1	SIf	10.929	166	170	11.335	162	169	11.300	167	171	12.017	168	173	11.234	166	172
HACR1	NAf	NA	NA	170	5.561	53	169	6.293	61	171	6.449	61	173	6.315	71	172
HALE1	NAf	9.160	9	170	8.423	13	169	8.865	25	171	10.563	14	173	10.170	14	172
HAVO1	NAf	8.884	12	170	8.941	8	169	9.316	19	171	9.991	19	173	10.018	16	172
HACR1	SRf	NA	NA	170	4.886	146	169	4.028	161	171	4.298	145	173	3.991	150	172
HALE1	SRf	7.087	78	170	7.285	75	169	5.538	118	171	5.386	108	173	5.085	121	172
HAVO1	SRf	5.647	119	170	6.266	108	169	4.770	143	171	4.609	136	173	4.355	137	172
HACR1	SO4f	NA	NA	170	40.654	151	169	33.836	129	171	33.780	129	173	30.510	132	172
HALE1	SO4f	39.906	90	170	45.407	108	169	39.802	82	171	39.684	93	173	37.602	85	172
HAVO1	SO4f	39.550	94	170	44.830	116	169	38.818	92	171	39.521	95	173	37.571	86	172
HACR1	Sf	NA	NA	170	17.673	163	169	18.145	137	171	18.319	131	173	18.081	144	172
HALE1	Sf	18.571	64	170	18.462	97	169	18.536	85	171	18.566	84	173	18.478	104	172
HAVO1	Sf	18.470	82	170	18.475	90	169	18.511	90	171	18.558	89	173	18.546	88	172
HACR1	TIf	NA	NA	170	11.195	135	169	11.337	138	171	12.043	130	173	12.451	121	172
HALE1	TIf	13.983	43	170	13.845	49	169	12.800	106	171	13.698	76	173	13.730	81	172
HAVO1	TIf	8.715	167	170	8.953	162	169	8.260	168	171	9.161	168	173	8.797	167	172
HACR1	Vf	NA	NA	170	2.805	117	169	3.148	96	171	2.588	118	173	2.117	150	172
HALE1	Vf	5.635	47	170	5.387	45	169	5.348	37	171	4.328	56	173	3.459	98	172
HAVO1	Vf	5.919	40	170	5.912	35	169	5.782	33	171	3.908	69	173	3.998	76	172
HACR1	ZNf	NA	NA	170	11.128	169	169	10.337	171	171	9.686	173	173	8.872	171	172
HALE1	ZNf	13.797	133	170	13.329	158	169	12.282	166	171	11.173	168	173	10.519	165	172
HAVO1	ZNf	12.884	159	170	12.378	166	169	11.598	167	171	11.129	169	173	9.947	169	172
HACR1	ZRf	NA	NA	170	1.681	158	169	1.600	157	171	1.945	163	173	1.817	131	172
HALE1	ZRf	1.860	39	170	2.035	101	169	1.465	167	171	2.320	74	173	1.999	96	172
HAVO1	ZRf	1.713	58	170	2.427	25	169	1.510	165	171	1.749	170	173	1.703	148	172

Signal to Noise	Year	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Site	Pollutant															
HAVO1	NO3f	5.124	161	168	7.112	161	166	6.371	154	165	5.831	152	164	5.203	157	163
HACR1	N2f	0.562	3	168	0.184	152	166	0.466	21	165	0.389	13	164	0.448	104	163
HALE1	N2f	0.362	15	168	0.174	158	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	N2f	0.339	24	168	0.614	1	166	0.297	120	165	0.249	102	164	0.414	119	163
HACR1	Pf	1.964	112	168	1.869	103	167	1.862	90	166	0.798	158	166	0.939	152	165
HALE1	Pf	2.466	51	168	2.451	48	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Pf	2.031	101	168	2.089	88	167	2.158	58	166	2.002	59	166	1.896	62	165
HACR1	Kf	14.850	162	168	12.726	162	167	14.550	156	166	11.759	163	166	12.502	164	165
HALE1	Kf	22.535	107	168	23.776	95	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Kf	16.423	158	168	14.309	157	167	15.997	152	166	16.668	148	166	20.317	138	165
HACR1	RBf	0.153	163	168	0.223	152	167	0.237	149	166	0.206	144	166	0.235	144	165
HALE1	RBf	0.245	129	168	0.486	54	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	RBf	0.166	159	168	0.198	161	167	0.250	143	166	0.212	142	166	0.265	129	165
HACR1	SEf	0.291	114	168	0.344	105	167	0.172	138	166	0.161	139	166	0.200	144	165
HALE1	SEf	0.301	109	168	0.403	93	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SEf	0.999	41	168	1.038	33	167	1.270	15	166	1.489	9	166	1.635	5	165
HACR1	SIf	5.213	155	168	3.915	156	167	4.079	143	166	3.343	150	166	4.177	162	165
HALE1	SIf	5.793	148	168	7.108	92	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SIf	3.819	167	168	3.646	161	167	3.063	159	166	2.452	164	166	4.416	158	165
HACR1	NAf	5.030	35	168	4.758	45	167	4.834	32	166	4.410	51	166	4.604	42	165
HALE1	NAf	6.010	5	168	6.014	4	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NAf	5.662	12	168	5.786	12	167	5.916	6	166	5.666	15	166	5.699	11	165
HACR1	SRf	0.746	136	168	0.858	129	167	0.612	147	166	0.710	143	166	0.647	146	165
HALE1	SRf	1.057	98	168	1.301	94	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SRf	0.734	138	168	0.789	141	167	0.764	125	166	0.962	116	166	0.998	104	165
HACR1	SO4f	28.938	133	168	28.293	117	166	29.060	125	165	29.289	124	164	34.098	130	163
HALE1	SO4f	36.036	81	168	39.150	45	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	SO4f	32.625	107	168	31.738	99	166	35.638	83	165	37.371	75	164	42.947	60	163
HACR1	Sf	31.976	142	168	31.904	137	167	32.057	137	166	31.966	136	166	31.581	150	165
HALE1	Sf	32.206	112	168	32.212	105	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Sf	32.048	137	168	31.930	134	167	32.242	93	166	32.136	106	166	32.239	77	165
HACR1	TIf	3.061	135	168	3.390	136	167	2.745	139	166	2.575	145	166	2.600	153	165
HALE1	TIf	4.732	69	168	5.240	76	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	TIf	1.487	162	168	1.904	160	167	1.504	164	166	1.798	160	166	2.578	154	165
HACR1	Vf	1.036	140	168	1.316	127	167	1.058	122	166	1.100	124	166	1.190	91	165
HALE1	Vf	2.524	78	168	2.671	65	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Vf	1.663	112	168	1.144	140	167	2.223	53	166	1.642	87	166	1.608	62	165
HACR1	ZNf	1.563	168	168	1.538	166	167	1.370	165	166	1.090	166	166	0.941	165	165
HALE1	ZNf	2.605	165	168	3.383	153	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZNf	2.164	167	168	2.388	163	167	2.960	129	166	1.376	164	166	2.880	138	165
HACR1	ZRf	0.116	158	168	0.227	101	167	0.076	159	166	0.085	157	166	0.180	70	165
HALE1	ZRf	0.166	117	168	0.164	153	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZRf	0.098	162	168	0.184	141	167	0.153	92	166	0.125	132	166	0.148	104	165

Table E-30: Hawaii IMPROVE site Signal to Noise (from measurements and uncertainties) annual values and rankings

	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005	2006	2006	2006	2007	2007	2007	2008	2008	2008	2009	2009	2009	2010	2010	2010	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
90th percentile measurement	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units*	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)
Site	Pollutant																																													
HACR1	ALf	NA	NA	138	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.064	118	169	0.055	140	171	0.049	149	173	0.067	140	172	0.040	128	168	0.067	114	167	0.051	115	166	0.045	131	166	0.060	123	165
HALE1	ALf	0.145	118	138	0.076	147	158	0.040	156	166	0.048	168	177	0.031	167	179	0.043	157	170	0.038	147	169	0.045	151	171	0.039	163	173	0.049	159	172	0.040	125	168	0.109	96	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ALf	0.071	130	138	0.067	153	158	0.061	139	166	0.059	162	177	0.054	132	179	0.029	168	170	0.043	142	169	0.052	143	171	0.066	121	173	0.058	150	172	0.025	157	168	0.030	156	167	0.023	164	166	0.037	141	166	0.039	137	165
HACR1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	NH4f	NA	NA	3	NA	NA	3	NA	NA	13	NA	NA	1	NA	NA	13	NA	NA	3	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	ASf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.000	160	169	0.000	170	171	0.000	173	173	0.000	149	172	0.000	168	168	0.000	167	167	0.000	165	166	0.000	162	166	0.000	161	165
HALE1	ASf	0.000	113	141	0.000	146	158	0.000	137	166	0.000	175	177	0.000	170	179	0.000	169	170	0.000	167	169	0.000	163	171	0.000	132	173	0.000	76	172	0.000	166	168	0.000	167	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ASf	0.000	126	141	0.000	158	158	0.003	1	166	0.000	176	177	0.000	177	179	0.000	170	170	0.000	169	169	0.000	171	171	0.000	165	173	0.000	113	172	0.001	63	168	0.001	79	167	0.001	18	166	0.001	33	166	0.001	20	165
HACR1	BRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.001	167	169	0.001	171	171	0.001	173	173	0.001	171	172	0.001	167	168	0.001	167	167	0.001	165	166	0.001	166	166	0.001	165	165
HALE1	BRf	0.002	121	141	0.002	139	158	0.002	112	166	0.002	167	177	0.001	172	179	0.002	158	170	0.002	161	169	0.002	159	171	0.002	157	173	0.002	135	172	0.002	147	168	0.002	152	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	BRf	0.001	139	141	0.001	158	158	0.001	166	166	0.001	177	177	0.001	179	179	0.001	169	170	0.001	169	169	0.001	170	171	0.001	171	173	0.001	172	172	0.001	168	168	0.001	166	167	0.001	166	166	0.002	159	166	0.001	160	165
HACR1	CAf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.044	135	169	0.032	152	171	0.029	160	173	0.053	117	172	0.030	136	168	0.038	134	167	0.040	115	166	0.027	143	166	0.033	138	165
HALE1	CAf	0.042	121	141	0.040	125	158	0.044	119	166	0.024	169	177	0.030	157	179	0.037	148	170	0.033	148	169	0.038	138	171	0.037	143	173	0.037	146	172	0.033	133	168	0.084	86	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CAf	0.024	138	141	0.028	147	158	0.032	146	166	0.023	170	177	0.029	158	179	0.024	166	170	0.027	156	169	0.024	161	171	0.036	145	173	0.037	147	172	0.024	149	168	0.024	154	167	0.023	151	166	0.028	142	166	0.028	148	165
HACR1	EC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.133	172	172	0.142	173	174	0.112	176	176	0.088	175	175	0.089	170	171	0.079	169	169	0.107	166	168	0.066	167	167	0.076	166	166
HALE1	EC1f	0.185	133	141	0.197	153	157	0.188	160	165	0.197	174	178	0.214	177	179	0.275	167	173	0.254	164	172	0.247	165	174	0.232	170	176	0.194	170	175	0.208	160	171	0.168	162	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC1f	0.126	139	141	0.111	157	157	0.128	164	165	0.126	177	178	0.193	179	179	0.164	172	173	0.184	169	172	0.153	172	174	0.131	175	176	0.100	174	175	0.076	171	171	0.082	168	169	0.105	167	168	0.181	161	167	0.180	163	166
HACR1	EC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.038	171	172	0.034	173	174	0.023	176	176	0.020	175	175	0.020	171	171	0.019	169	169	0.025	167	168	0.015	167	167	0.013	166	166
HALE1	EC2f	0.041	136	141	0.045	154	157	0.059	161	165	0.049	176	178	0.054	178	179	0.044	171	173	0.048	167	172	0.038	169	174	0.034	171	176	0.028	173	175	0.031	168	171	0.028	166	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	EC2f	0.045	135	141	0.039	157	157	0.054	163	165	0.041	178	178	0.042	179	179	0.036	173	173	0.061	164	172	0.039	168	174	0.032	174	176	0.029	172	175	0.023	169	171	0.026	168	169	0.023	168	168	0.035	165	167	0.034	162	166
HACR1	EC3f	NA	NA	139	NA	NA	157	NA	NA	163	NA	NA	178	NA	NA	179	NA	NA	173	0.018	18	172	0.006	136	173	0.003	156	176	0.002	165	175	0.001	169	170	0.003	136	169	0.001	166	167	0.002	154	167	0.001	160	166
HALE1	EC3f	0.028	34	139	0.010	156	157	0.009	163	163	0.003	178	178	0.019	77	179	0.012	115	173	0.010	133	172	0.004	162	173	0.004	122	176	0.003	146	175	0.007	95	170	0.003	138	169	NA	NA	167	NA	NA	167	NA	NA	166
HAVO1	EC3f	0.023	63	139	0.006	157	157	0.098	2	163	0.015	163	178	0.009	178	179	0.002	173	173	0.007	165	172	0.002	170	173	0.001	170	176	0.013	15	175	NA	NA	170	0.000	167	169	0.001	163	167	0.010	37	167	0.001	152	166
HACR1	OC1f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.041	170	172	0.044	166	174	0.029	174	176	0.018	173	175	0.018	169	171	0.015	167	169	0.027	159	168	0.020	164	167	0.015	165	166
HALE1	OC1f	0.083	122	141	0.039	157	157	0.045	165	165	0.045	173	178	0.032	177	179	0.026	171	173	0.041	169	172	0.045	164	174	0.055	150	176	0.033	145	175	0.024	157	171	0.027	155	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC1f	0.185	63	141	0.126	102	157	0.060	161	165	0.041	177	178	0.055	168	179	0.032	170	173	0.085	122	172	0.036	172	174	0.034	171	176	0.026	164	175	0.015	171	171	0.013	168	169	0.028	157	168	0.026	159	167	0.038	128	166
HACR1	OC2f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.115	168	172	0.053	174	174	0.050	175	176	0.042	175	175	0.042	170	171	0.040	169	169	0.061	166	168	0.037	167	167	0.036	166	166
HALE1	OC2f	0.097	140	141	0.089	156	157	0.110	163	165	0.100	175	178	0.114	177	179	0.110	170	173	0.123	167	172	0.103	171	174	0.103	173	176	0.093	173	175	0.086	166	171	0.105	164	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC2f	0.306	67	141	0.356	83	157	0.078	164	165	0.054	178	178	0.066	179	179	0.058	173	173	0.109	169	172	0.071	173	174	0.048	176	176	0.053	174	175	0.033	171	171	0.053	168	169	0.043	168	168	0.064	165	167	0.054	165	166
HACR1	OC3f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.107	172	172	0.092	172	174	0.060	176	176	0.097	174	175	0.071	170	171	0.052	169	169	0.093	167	168	0.070	167	167	0.097	166	166
HALE1	OC3f	0.183	140	141	0.263	155	157	0.455	155	165	0.265	173	178	0.154	176	179	0.175	170	173	0.188	168	172	0.140	169	174	0.141	171	176	0.167	170	175	0.147	166	171	0.133	166	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC3f	0.179	141	141	0.233	156	157	0.132	164	165	0.128	177	178	0.091	179	179	0.085	173	173	0.126	169	172	0.084	173	174	0.063	175	176	0.067	175	175	0.065	171	171	0.076	168	169	0.061	168	168	0.129	165	167	0.099	165	166
HACR1	OC4f	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.076	172	172	0.068	174	174	0.063	176	176	0.062	175	175	0.060	170	171	0.056	169	169	0.063	168	168	0.045	167	167	0.055	166	166
HALE1	OC4f	0.155	137	141	0.207	155	157	0.261	153	165	0.249	162	178	0.107	176	179	0.136	167	173	0.137	165	172	0.105	168	174	0.117	171	176	0.130	170	175	0.149	160	171	0.110	165	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OC4f	0.127	140	141	0.126	156	157	0.144	164	165	0.126	177	178	0.090	179	179	0.087	173	173	0.082	171	172	0.084	172	174	0.089	175	176	0.071	174	175	0.059	171	171	0.060	168	169	0.070	167	168	0.118	162	167	0.110	164	166
HACR1	OPf	NA	NA	141	NA	NA	157	NA	NA	165	NA	NA	178	NA	NA	179	NA	NA	173	0.087	171	172	0.099	172	174	0.073	176	176	0.061	175	175	0.073	170	171	0.058	169	169	0.072	166	168	0.061	166	167	0.061	166	166
HALE1	OPf	0.088	133	141	0.113	151	157	0.095	160	165	0.091	173	178	0.149	176	179	0.175	168	173	0.165	167	172	0.157	167	174	0.143	171	176	0.129	171	175	0.151	164	171	0.112	163	169	NA	NA	168	NA	NA	167	NA	NA	166
HAVO1	OPf	0.073	137	141	0.064	156	157	0.084	162	165	0.074	176	178	0.128	178	179	0.121	171	173	0.130	168	172	0.127	169	174	0.099	174	176	0.073	173	175	0.063	171	171	0.062	168	169	0.081	165	168	0.171	159	167	0.127	163	166
HACR1	CHLf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	0.177	40	169	0.123	48	171	0.135	47	173	0.144	41	172	0.157	49	168	0.146	38	166	0.146	38	165	0.134	40	164	0.198	33	163
HALE1	CHLf	0.440	40	141	0.317	36	158	0.498	15	166	0.294	28	179	0.491	13	179	0.447	17	170	0.448	16	169	0.365	27	171	0.394	24	173	0.437	17	172	0.448	17	168	0.523	14	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	CHLf	0.536	32	141	0.433	29	158	0.454	19	166	0.454	16	179	0.361	24	179	0.434	19	170	0.437	19	169	0.410	22	171	0.398	23	173	0.484	12	172	0.410	22	168	0.410	19	166	0.454	18	165	0.478	15	164	0.519	13	163
HACR1	CLf	NA	NA	117	NA	NA	152	NA	NA	163	NA	NA	172	NA	NA	153	NA	NA	160	0.114	45	159	0.093	65	165	0.102	63	166	0.119	45	166	0.098	30	168	0.101	33	167	0.100	30	166	0.057	37	166	0.109	30	165
HALE1	CLf	0.257	25	117	0.228	23	152	0.334	16	163	0.138	32	172	0.287	30	153	0.279	34	160	0.316	23	159	0.245	34	165	0.317	31	166	0.322	24	166	0.277	14	168	0.435	8	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CLf	0.353	20	117	0.313	17	152	0.312	19	163	0.254	23	172	0.254	34	153	0.238	40	160	0.279	27	159	0.286	31	165	0.369	26	166	0.402	16	166	0.250	16	168	0.295	14	167	0.311	14	166	0.262	13	166	0.385	10	165
HACR1	CRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.000	163	169	0.000	144	170	0.000	146	172	0.000	90	171	0.000	155	167	0.000	77	167	0.000	166	166	0.000	164	166	0.000	158	165
HALE1	CRf	0.002	130	141	0.000	154	158	0.000	151	166	0.000	172	177	0.000	169	179	0.000	170	170	0.000	166	169	0.000	154	170	0.000	171	172	0.000	135	171	0.000	166	167	0.000	163	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CRf	0.002	116	141	0.000	154	158	0.000	159	166	0.000	177	177	0.000	176	179	0.000	166	170	0.000	169	169	0.000	170	170	0.000	172	172	0.000	164	171	0.000	53	167	0.000	131	167	0.000	166	166	0.000	142	166	0.000	110	165
HACR1	CUf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.000	167	169	0.000	170	171	0.000	162	173	0.000	172	172	0.000	168	168	0.000	162	167	0.000	162	166	0.000	163	166	0.000	160	165
HALE1	CUf	0.000	140	141	0.000	154	158	0.000	164	166	0.000	176	177	0.000	175	179	0.000	169	170	0.000	165	169	0.000	124	171	0.000	164	173	0.000	161	172	0.000	162	168	0.000	155	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	CUf	0.001	70	141	0.001	48	158	0.001	40	166	0.001	101	177	0.002	34	179	0.002	27	170	0.001	48	169	0.002	18	171	0.002	17	173	0.003	13	172	0.001	79	168	0.001	87	167	0.001	58	166	0.001	95	166	0.001	40	165
HACR1	fAbs*	NA	NA	0	NA	NA	0	NA	NA	166	NA	NA	176	NA	NA	179	NA	NA	170	1.010	165	169	1.400	165	171	0.950	171	173	0.970	170	172	0.940	166	168	0.750	166	167	0.900	164	166	0.960	163	166	0.600	165	165
HALE1	fAbs*	NA	NA	0	NA	NA	0	2.176	118	166	1.657	160	176	1.300	173	179	1.570	162	170	1.740	159	169	2.590	127	171	2.000	141	173	1.510	150	172	1.560	152	168	1.820	157	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	fAbs*	NA	NA	0	NA	NA	0	0.686	166	166	0.860	176	176	0.820	179	179	0.640	170	170	0.690	169	169	0.770	171	171	0.500	173	173	0.600	172	172	0.690	168	168	0.580	167	167	0.550	166	166	0.720	166	166	1.300	160	165
HACR1	fAbs_HIPS*	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	172	NA	NA	179	NA	NA	170	186.180	164	169	195.450	168	171	168.150	170	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	fAbs_HIPS*	216.890	121	141	204.150	146	158	257.870	130	166	187.510	167	172	176.500	174	179	190.400	162	170	223.010	160	169	311.460	146	171	254.410	150	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	fAbs_HIPS*	118.490	140	141	145.330	158	158	121.380	166	166	142.520	171	172	128.820	179	179	105.120	170	170	127.110	168	169	168.950	170	171	146.140	173	173	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	Hf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.117	165	169	0.184	163	171	0.176	170	173	0.145	168	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HALE1	Hf	0.147	134	141	0.151	157	158	0.236	139	166	0.164	168	177	0.179	173	179	0.213	161	170	0.178	159	169	0.371	81	171	0.238	125	173	0.229	101	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HAVO1	Hf	0.295	71	141	0.280	108	158	0.336	85	166	0.343	88	177	0.416	84	179	0.481	79	170	0.513	59	169	0.545	51	171	0.494	48	173	0.520	44	172	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0
HACR1	FEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.045	138	169	0.029	156	171	0.025	161	173	0.041	144	172	0.030	142	168	0.040	140	167	0.034	138	166	0.026	153	166	0.033	145	165
HALE1	FEf	0.042	124	141	0.042	133	158	0.035	146	166	0.024	166	177	0.032	162	179	0.033	155	170	0.039	145	169	0.030	155	171	0.026	158	173	0.031	159	172	0.029	146	168	0.071	104	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	FEf	0.019	138	141	0.017	158	158	0.016	164	166	0.012	175	177	0.024	169	179	0.015	169	170	0.020	160	169	0.018	167	171	0.021	167	173	0.028	162	172	0.018	162	168	0.025	157	167	0.016	162	166	0.021	160	166	0.025	153	165
HACR1	PBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.001	167	169	0.001	171	171	0.000	173	173	0.001	172	172	0.001	166	168	0.001	160	167	0.001	94	166	0.001	162	166	0.001	147	165
HALE1	PBf	0.001	138	141	0.001	113	158	0.001	152	166	0.001	177	177	0.001	178	179	0.000	170	170	0.001	168	169	0.001	169	171	0.001	171	173	0.001	172	172	0.001	167	168	0.001	166	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	PBf	0.001	114	141	0.001	98	158	0.002	70	166	0.002	108	177	0.002	96	179	0.002	63	170	0.002	66	169	0.002	53	171	0.005	11	173	0.005	10	172	0.001	131	168	0.001	106	167	0.001	83	166	0.001	157	166	0.001	104	165
HACR1	MGf	NA	NA	128	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.031	122	169	0.031	145	171	0.017	167	173	0.056	32	172	0.024	127	168	0.035	115	167	0.028	97	166	0.027	114	166	0.031	93	165
HALE1	MGf	0.040	69	128	0.054	100	158	0.034	158	166	0.069	175	177	0.026	113	179	0.029	142	170	0.041	85	169	0.042	105	171	0.030	108	173	0.040	78	172	0.051	52	168	0.076	28	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MGf	0.077	33	128	0.065	73	158	0.055	100	166	0.092	161	177	0.036	67	179	0.050	78	170	0.044	75	169	0.070	63	171	0.069	25	173	0.048	49	172	0.046	61	168	0.045	87	167	0.050	54	166	0.066	35	166	0.063	31	165
HACR1	MNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.001	155	169	0.001	161	171	0.001	168	173	0.001	157	172	0.001	159	168	0.001	147	167	0.001	140	166	0.001	161	166	0.001	155	165
HALE1	MNf	0.002	136	141	0.001	152	158	0.001	158	166	0.001	168	177	0.001	164	179	0.001	158	170	0.001	158	169	0.001	160	171	0.001	162	173	0.001	163	172	0.001	154	168	0.002	129	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MNf	0.002	138	141	0.000	158	158	0.000	166	166	0.000	177	177	0.001	174	179	0.000	170	170	0.000	168	169	0.000	171	171	0.000	173	173	0.001	170	172	0.001	165	168	0.001	160	167	0.001	163	166	0.001	160	166	0.001	162	165
HACR1	MT	NA	NA	141	NA	NA	158	NA	NA	164	NA	NA	179	NA	NA	178	NA	NA	170	5.024	168	169	5.752	166	171	7.089	170	173	5.978	167	172	4.533	167	168	5.662	163	166	5.501	165	165	4.313	163	164	5.165	163	163
HALE1	MT	10.538	115	141	9.547	146	158	9.451	151	164	7.931	169	179	7.954	161	178	8.055	162	170	8.371	155	169	10.239	144	171	8.535	157	173	9.353	134	172	7.825	150	168	10.814	145	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	MT	9.348	125	141	7.209	155	158	14.175	118	164	11.029	132	179	12.619	125	178	9.854	148	170	15.077	112	169	22.748	37	171	24.044	17	173	16.952	73	172	8.563	144	168	8.519	157	166	12.892	101	165	11.820	114	164	13.261	95	163
HACR1	MF	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	178	NA	NA	170	2.713	166	169	3.711	164	171	2.891	173	173	3.286	167	172	2.924	165	168	3.294	162	167	4.508	148	166	2.725	163	166	2.877	164	165
HALE1	MF	4.381	133	141	4.118	155	158	5.454	149	166	4.283	163	177	3.836	171	178	4.301	163	170	4.483	157	169	6.785	117	171	4.824	144	173	4.448	131	172	4.586	136	168	5.483	143	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	MF	7.295	85	141	7.267	104	158	12.435	55	166	9.473	77	177	11.033	72	178	8.978	81	170	13.813	53	169	19.203	4	171	23.087	2	173	15.854	8	172	8.406	68	168	7.215	102	167	11.131	27	166	10.892	37	166	12.872	9	165
HACR1	NIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.000	99	169	0.000	104	170	0.000	108	172	0.000	127	171	0.000	121	167	0.000	104	167	0.000	146	166	0.000	166	166	0.000	157	165
HALE1	NIf	0.001	75	141	0.000	62	158	0.000	73	166	0.000	73	177	0.000	113	179	0.001	40	170	0.001	40	169	0.000	43	170	0.000	53	172	0.000	60	171	0.000	65	167	0.000	49	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NIf	0.001	62	141	0.000	107	158	0.000	97	166	0.000	90	177	0.000	130	179	0.000	75	170	0.000	60	169	0.000	48	170	0.001	34	172	0.001	33	171	0.000	85	167	0.000	104	167	0.000	48	166	0.000	100	166	0.000	70	165
HACR1	NO3f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	0.169	161	169	0.161	160	171	0.143	164	173	0.162	160	172	0.147	154	168	0.162	157	166	0.174	151	165	0.160	152	164	0.164	151	163
HALE1	NO3f	0.376	103	141	0.385	126	158	0.355	126	166	0.339	141	179	0.338	135	179	0.361	119	170	0.310	137	169	0.307	133	171	0.302	124	173	0.271	126	172	0.293	117	168	0.375	101	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	NO3f	0.174	136	141	0.166	153	158	0.174	159	166	0.149	174	179	0.132	174	179	0.133	166	170	0.138	165	169	0.124	168	171	0.109	171	173	0.130	165	172	0.099	167	168	0.110	163	166	0.138	159	165	0.135	156	164	0.125	157	163
HACR1	N2f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179	NA	NA	170	0.020	105	169	0.029	38	171	0.033	11	173	0.030	47	172	0.037	5	168	0.023	131	166	0.041	43	165	0.063	24	164	0.042	139	163
HALE1	N2f	0.033	108	141	0.041	30	158	0.039	71	166	0.073	1	179	0.021	121	179	0.023	59	170	0.058	4	169	0.018	162	171	0.038	6	173	0.053	5	172	0.022	41	168	0.018	164	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	N2f	0.054	27	141	0.039	39	158	0.052	18	166	0.045	7	179	0.018	169	179	0.020	83	170	0.051	5	169	0.026	59	171	0.023	99	173	0.053	6	172	0.027	12	168	0.053	2	166	0.039	52	165	0.053	50	164	0.047	118	163
HACR1	Pf	NA	NA	33	NA	NA	121	NA	NA	107	NA	NA	133	NA	NA	95	NA	NA	92	0.011	72	104	0.002	94	99	0.004	99	110	0.003	97	114	0.003	123	168	0.006	53	167	0.005	46	166	0.001	153	166	0.001	157	165
HALE1	Pf	0.005	28	33	0.027	41	121	0.011	52	107	0.006	98	133	0.014	44	95	0.051	17	92	0.026	46	104	0.016	49	99	0.017	49	110	0.006	82	114	0.004	93	168	0.008	32	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Pf	0.008	21	33	0.023	45	121	0.004	89	107	0.010	76	133	0.006	71	95	0.000	92	92	0.002	103	104	0.003	88	99	0.009	73	110	0.003	99	114	0.004	95	168	0.007	41	167	0.006	16	166	0.004	17	166	0.002	51	165
HACR1	Kf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179	NA	NA	170	0.034	160	169	0.032	165	171	0.033	164	173	0.043	142	172	0.031	156	168	0.036	158	167	0.035	148	166	0.030	159	166	0.026	162	165

Table E-31

	Year	2001	2001	2001	2002	2002	2002	2003	2003	2003	2004	2004	2004	2005	2005	2005
90th percentile measurement	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units*	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)
Site	Pollutant															
HALE1	Kf	0.052	121	141	0.055	125	158	0.088	52	166	0.047	147	177	0.047	150	179
HAVO1	Kf	0.022	138	141	0.033	154	158	0.030	162	166	0.022	174	177	0.032	169	179
HACR1	RBf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	176	NA	NA	179
HALE1	RBf	0.000	117	141	0.000	139	158	0.000	146	166	0.000	170	176	0.000	171	179
HAVO1	RBf	0.000	111	141	0.000	150	158	0.000	150	166	0.000	173	176	0.000	165	179
HACR1	SEf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SEf	0.000	133	141	0.000	136	158	0.000	126	166	0.000	175	177	0.000	169	179
HAVO1	SEf	0.004	3	141	0.004	3	158	0.008	1	166	0.004	3	177	0.007	1	179
HACR1	SIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SIf	0.116	129	141	0.116	150	158	0.111	156	166	0.078	169	177	0.074	169	179
HAVO1	SIf	0.089	138	141	0.089	154	158	0.182	123	166	0.152	152	177	0.145	142	179
HACR1	NAf	NA	NA	139	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	NAf	0.365	43	139	0.306	105	158	0.316	95	166	0.241	100	177	0.226	50	179
HAVO1	NAf	0.430	39	139	0.550	43	158	1.049	10	166	0.343	47	177	0.270	34	179
HACR1	SRf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	SRf	0.001	117	141	0.001	117	158	0.000	115	166	0.000	153	177	0.001	128	179
HAVO1	SRf	0.000	129	141	0.001	129	158	0.000	113	166	0.000	163	177	0.000	151	179
HACR1	SO4f	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	179	NA	NA	179
HALE1	SO4f	1.726	73	141	1.585	85	158	2.579	66	166	1.852	92	179	2.104	89	179
HAVO1	SO4f	3.333	49	141	4.480	47	158	6.347	23	166	5.236	43	179	6.781	41	179
HACR1	Sf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	Sf	0.532	74	141	0.494	91	158	0.859	65	166	0.563	93	177	0.681	99	179
HAVO1	Sf	0.925	49	141	1.116	56	158	1.720	37	166	1.480	44	177	1.626	61	179
HACR1	TIf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	TIf	0.010	106	141	0.005	102	158	0.004	117	166	0.004	140	177	0.004	123	179
HAVO1	TIf	0.008	126	141	0.002	156	158	0.002	162	166	0.001	175	177	0.003	166	179
HACR1	Vf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	Vf	0.003	109	141	0.001	76	158	0.001	86	166	0.001	103	177	0.001	130	179
HAVO1	Vf	0.004	49	141	0.001	103	158	0.001	114	166	0.001	137	177	0.000	148	179
HACR1	ZNf	NA	NA	141	NA	NA	158	NA	NA	166	NA	NA	177	NA	NA	179
HALE1	ZNf	0.002	125	141	0.002	146	158	0.003	128	166	0.002	170	177	0.002	176	179
HAVO1	ZNf	0.001	138	141	0.001	158	158	0.002	152	166	0.002	171	177	0.002	174	179
HACR1	ZRf	NA	NA	140	NA	NA	158	NA	NA	165	NA	NA	177	NA	NA	179
HALE1	ZRf	0.000	120	140	0.000	130	158	0.000	79	165	0.000	118	177	0.000	169	179
HAVO1	ZRf	0.000	137	140	0.000	146	158	0.000	128	165	0.000	145	177	0.000	75	179

	Year	2006	2006	2006	2007	2007	2007	2008	2008	2008	2009	2009	2009	2010	2010	2010
90th percentile measurement	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units*	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)
Site	Pollutant															
HALE1	Kf	0.050	151	170	0.061	111	169	0.049	145	171	0.046	122	173	0.058	98	172
HAVO1	Kf	0.032	166	170	0.030	163	169	0.039	160	171	0.038	152	173	0.037	156	172
HACR1	RBf	NA	NA	170	0.000	84	169	0.000	167	171	0.000	143	173	0.000	77	172
HALE1	RBf	0.000	163	170	0.000	157	169	0.000	155	171	0.000	164	173	0.000	159	172
HAVO1	RBf	0.000	170	170	0.000	162	169	0.000	150	171	0.000	152	173	0.000	159	172
HACR1	SEf	NA	NA	170	0.000	166	169	0.000	88	171	0.000	138	173	0.000	142	172
HALE1	SEf	0.000	143	170	0.000	139	169	0.000	80	171	0.000	92	173	0.000	101	172
HAVO1	SEf	0.006	1	170	0.006	1	169	0.009	1	171	0.012	1	173	0.016	1	172
HACR1	SIf	NA	NA	170	0.154	141	169	0.140	144	171	0.126	153	173	0.166	138	172
HALE1	SIf	0.081	166	170	0.093	154	169	0.121	150	171	0.112	162	173	0.106	163	172
HAVO1	SIf	0.102	157	170	0.133	146	169	0.258	100	171	0.447	40	173	0.269	95	172
HACR1	NAf	NA	NA	170	0.133	105	169	0.145	112	171	0.178	121	173	0.205	95	172
HALE1	NAf	0.275	63	170	0.306	31	169	0.342	36	171	0.447	41	173	0.479	31	172
HAVO1	NAf	0.359	38	170	0.415	20	169	0.601	16	171	0.834	13	173	0.673	18	172
HACR1	SRf	NA	NA	170	0.001	102	169	0.000	153	171	0.000	162	173	0.001	133	172
HALE1	SRf	0.001	128	170	0.001	142	169	0.001	122	171	0.001	130	173	0.001	135	172
HAVO1	SRf	0.000	160	170	0.000	150	169	0.000	146	171	0.000	136	173	0.000	147	172
HACR1	SO4f	NA	NA	170	1.011	129	169	2.133	68	171	1.367	100	173	0.995	112	172
HALE1	SO4f	1.937	75	170	1.924	75	169	4.226	34	171	2.201	63	173	1.922	67	172
HAVO1	SO4f	5.863	24	170	7.821	18	169	11.770	1	171	12.167	1	173	8.631	1	172
HACR1	Sf	NA	NA	170	0.311	140	169	0.586	90	171	0.525	97	173	0.359	113	172
HALE1	Sf	0.704	79	170	0.565	93	169	1.472	35	171	0.742	68	173	0.682	68	172
HAVO1	Sf	1.598	40	170	2.259	22	169	3.271	1	171	4.266	1	173	2.626	1	172
HACR1	TIf	NA	NA	170	0.004	131	169	0.003	139	171	0.003	132	173	0.004	134	172
HALE1	TIf	0.004	133	170	0.004	126	169	0.004	118	171	0.004	117	173	0.004	138	172
HAVO1	TIf	0.002	170	170	0.002	156	169	0.002	160	171	0.002	154	173	0.003	162	172
HACR1	Vf	NA	NA	170	0.000	151	169	0.000	132	171	0.000	147	173	0.000	159	172
HALE1	Vf	0.001	70	170	0.001	76	169	0.001	57	171	0.001	84	173	0.000	115	172
HAVO1	Vf	0.001	102	170	0.000	121	169	0.001	92	171	0.000	129	173	0.000	141	172
HACR1	ZNf	NA	NA	170	0.002	167	169	0.001	171	171	0.001	173	173	0.001	172	172
HALE1	ZNf	0.002	170	170	0.002	168	169	0.002	168	171	0.002	164	173	0.001	168	172
HAVO1	ZNf	0.003	140	170	0.002	158	169	0.003	155	171	0.004	95	173	0.004	78	172
HACR1	ZRf	NA	NA	170	0.000	150	169	0.000	162	171	0.000	78	173	0.000	107	172
HALE1	ZRf	0.000	152	170	0.000	131	169	0.000	168	171	0.000	83	173	0.000	72	172
HAVO1	ZRf	0.000	166	170	0.000	160	169	0.000	154	171	0.000	173	173	0.000	157	172

	Year	2011	2011	2011	2012	2012	2012	2013	2013	2013	2014	2014	2014	2015	2015	2015
90th percentile measurement	Data Type	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites	Site Value	Site Rank (High)	Number of Sites
	Units*	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)	(ug/m^3)	(1)	(1)
Site	Pollutant															
HALE1	Kf	0.053	97	168	0.066	110	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Kf	0.023	162	168	0.029	162	167	0.025	161	166	0.029	161	166	0.034	153	165
HACR1	RBf	0.000	167	168	0.000	163	167	0.000	159	166	0.000	161	166	0.000	101	165
HALE1	RBf	0.000	145	168	0.000	112	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	RBf	0.000	162	168	0.000	153	167	0.000	159	166	0.000	151	166	0.000	128	165
HACR1	SEf	0.000	135	168	0.000	117	167	0.000	166	166	0.000	147	166	0.000	144	165
HALE1	SEf	0.000	121	168	0.000	71	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SEf	0.003	1	168	0.005	1	167	0.006	1	166	0.006	1	166	0.008	1	165
HACR1	SIf	0.073	131	168	0.123	130	167	0.098	125	166	0.092	129	166	0.120	124	165
HALE1	SIf	0.070	136	168	0.205	103	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SIf	0.057	147	168	0.078	146	167	0.048	161	166	0.072	140	166	0.069	148	165
HACR1	NAf	0.109	81	168	0.129	64	167	0.124	62	166	0.113	69	166	0.147	56	165
HALE1	NAf	0.300	23	168	0.380	15	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	NAf	0.254	26	168	0.267	27	167	0.319	22	166	0.340	18	166	0.342	22	165
HACR1	SRf	0.001	123	168	0.001	114	167	0.000	147	166	0.001	129	166	0.001	137	165
HALE1	SRf	0.001	131	168	0.001	76	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	SRf	0.000	160	168	0.001	150	167	0.000	142	166	0.001	114	166	0.001	113	165
HACR1	SO4f	1.056	103	168	1.357	86	166	2.155	44	165	1.062	94	164	0.971	95	163
HALE1	SO4f	1.644	73	168	2.480	38	166	NA	NA	165	NA	NA	164	NA	NA	163
HAVO1	SO4f	4.483	9	168	3.553	7	166	5.422	2	165	4.405	2	164	5.581	2	163
HACR1	Sf	0.363	107	168	0.450	91	167	0.655	51	166	0.363	99	166	0.321	108	165
HALE1	Sf	0.576	72	168	0.903	35	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Sf	0.833	50	168	0.821	41	167	1.438	2	166	1.363	4	166	1.436	3	165
HACR1	TIf	0.003	122	168	0.005	117	167	0.004	118	166	0.003	134	166	0.004	126	165
HALE1	TIf	0.004	119	168	0.008	83	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	TIf	0.002	157	168	0.002	148	167	0.002	162	166	0.002	149	166	0.002	147	165
HACR1	Vf	0.000	152	168	0.000	128	167	0.000	113	166	0.000	129	166	0.000	87	165
HALE1	Vf	0.001	91	168	0.001	78	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	Vf	0.000	123	168	0.000	137	167	0.001	54	166	0.000	78	166	0.000	68	165
HACR1	ZNf	0.001	168	168	0.001	167	167	0.001	163	166	0.001	166	166	0.001	165	165
HALE1	ZNf	0.001	166	168	0.002	149	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZNf	0.001	164	168	0.002	160	167	0.004	67	166	0.002	148	166	0.002	131	165
HACR1	ZRf	0.001	165	168	0.002	93	167	0.001	164	166	0.001	159	166	0.001	95	165
HALE1	ZRf	0.001	130	168	0.001	162	167	NA	NA	166	NA	NA	166	NA	NA	165
HAVO1	ZRf	0.001	161	168	0.001	145	167	0.002	60	166	0.001	146	166	0.001	140	165

Table E-31: Hawaii IMPROVE site 90th percentile annual measurement values and rankings; *note the units for fAbs and fAbs_HIPS are 1/Mm and 10^-8/m, respectively.

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

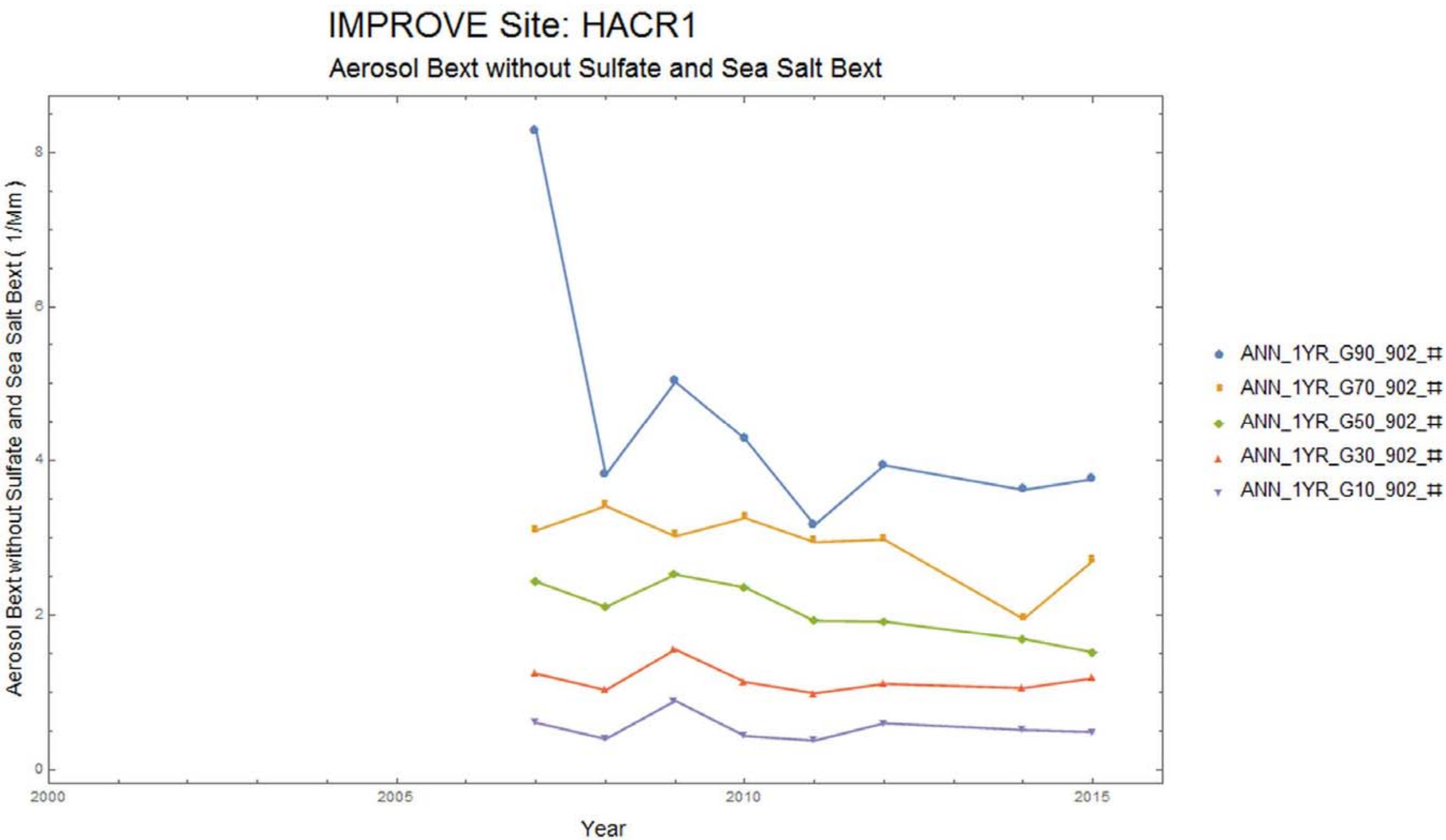

Figure F-1: HACR1 Aerosol Bext without Sulfate Bext and Sea Salt Bext by Quantile Group

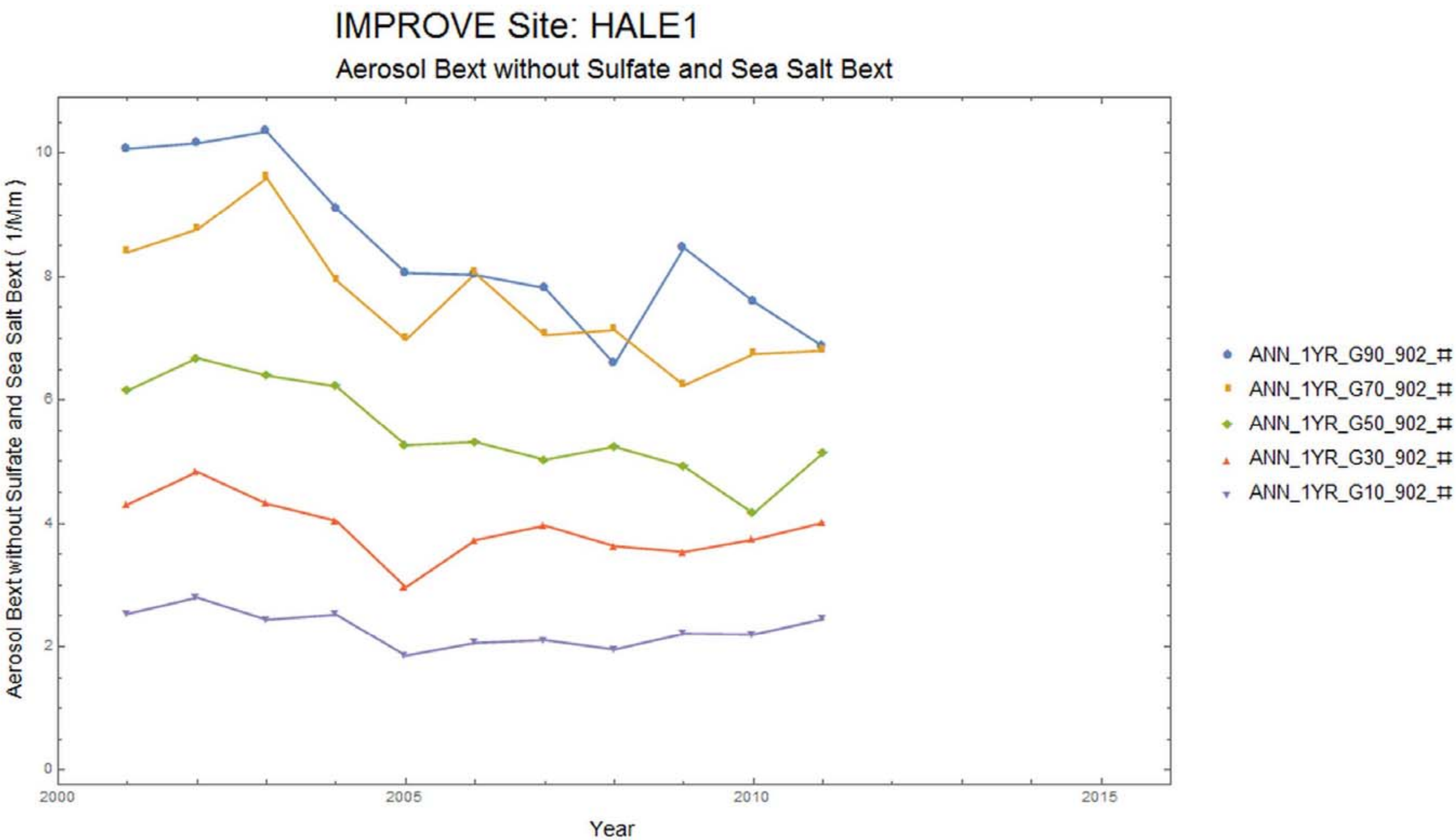

Figure F-2: HALE1 Aerosol Bext without Sulfate Bext and Sea Salt Bext by Quantile Group

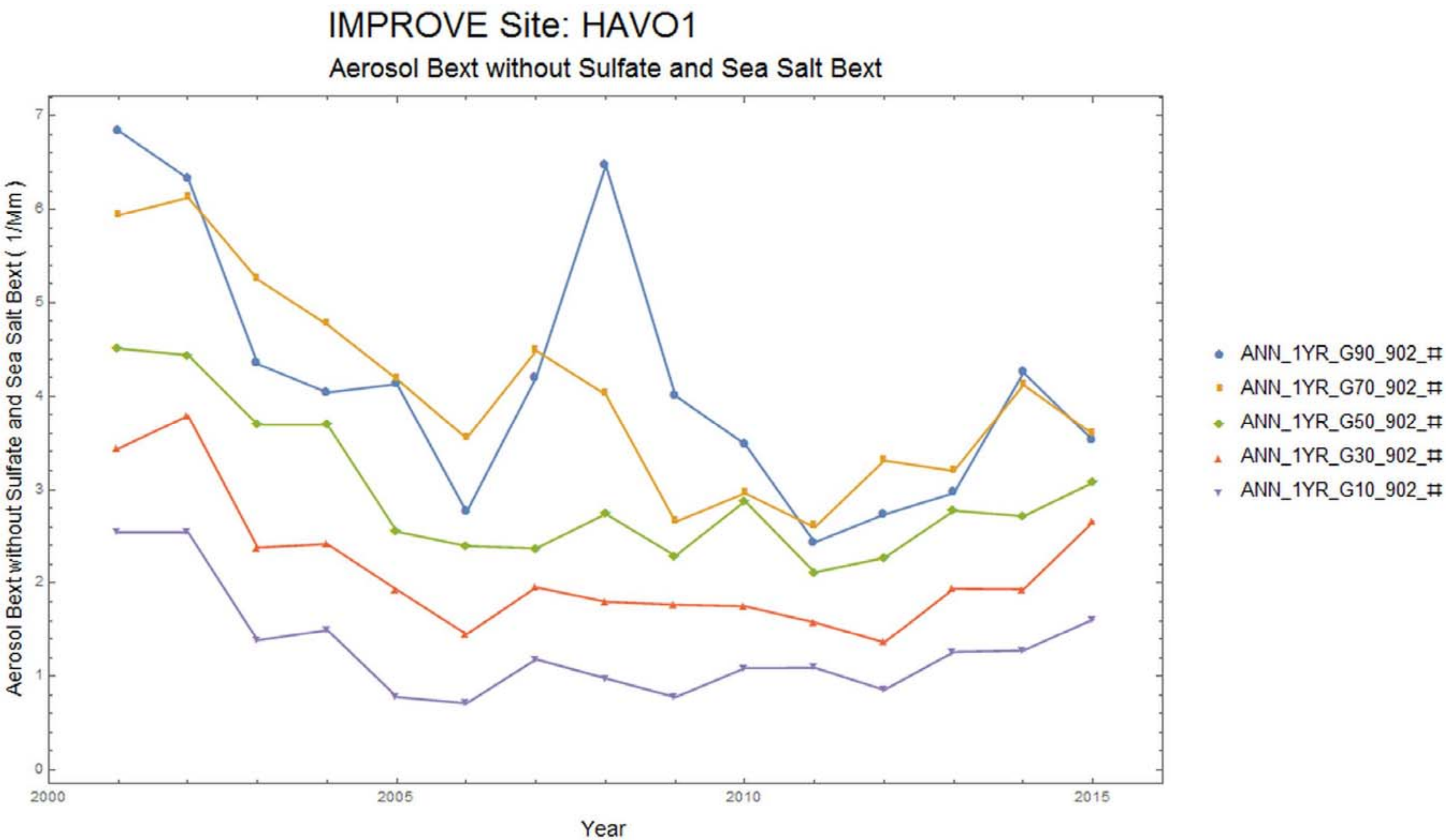

Figure F-3: HAVO1 Aerosol Bext without Sulfate Bext and Sea Salt Bext by Quantile Group

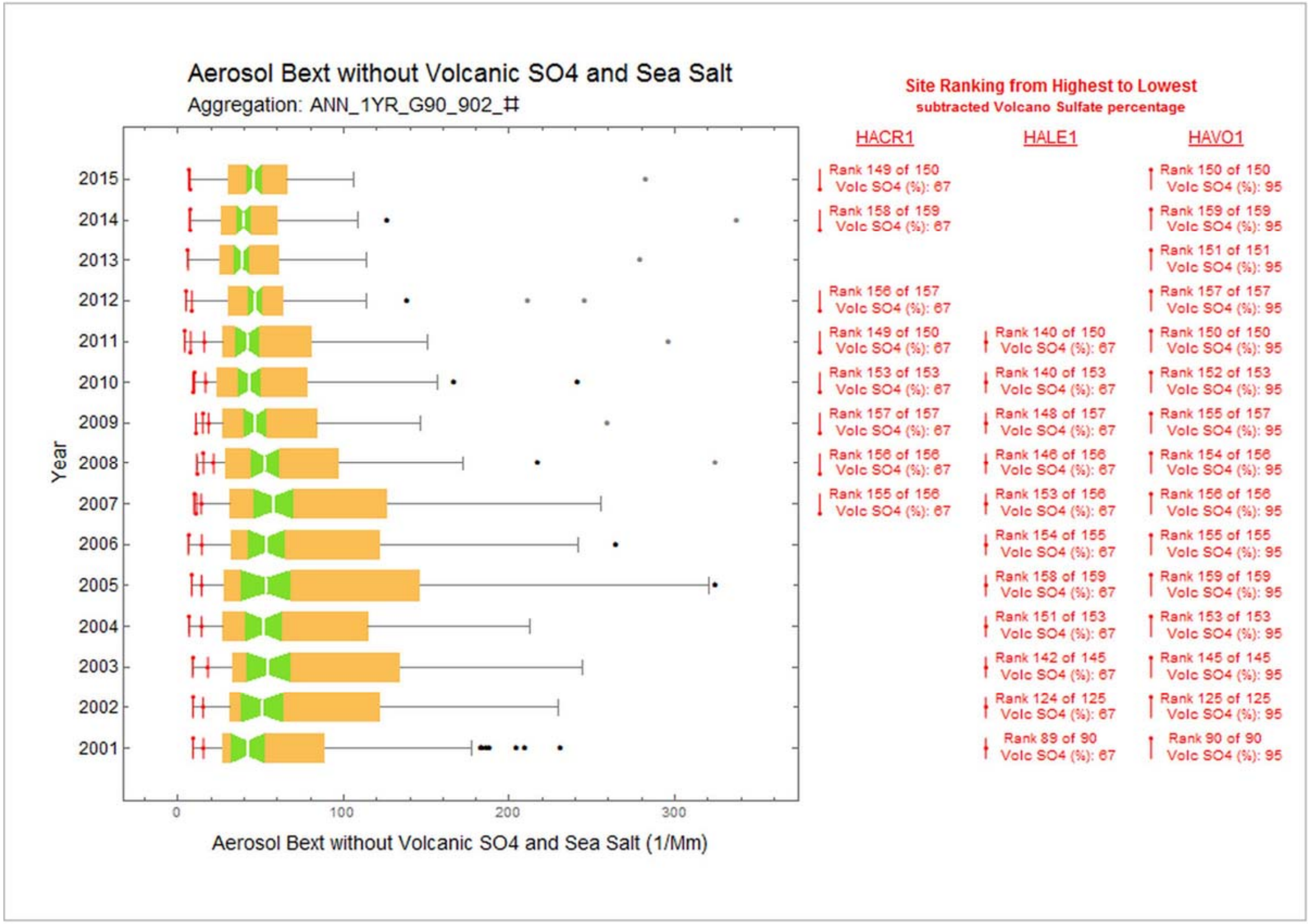

Figure F-4: IMPROVE Aerosol Bext without Volcanic Sulfate Bext and Sea Salt Bext and Hawaii annual rankings by Quantile Group

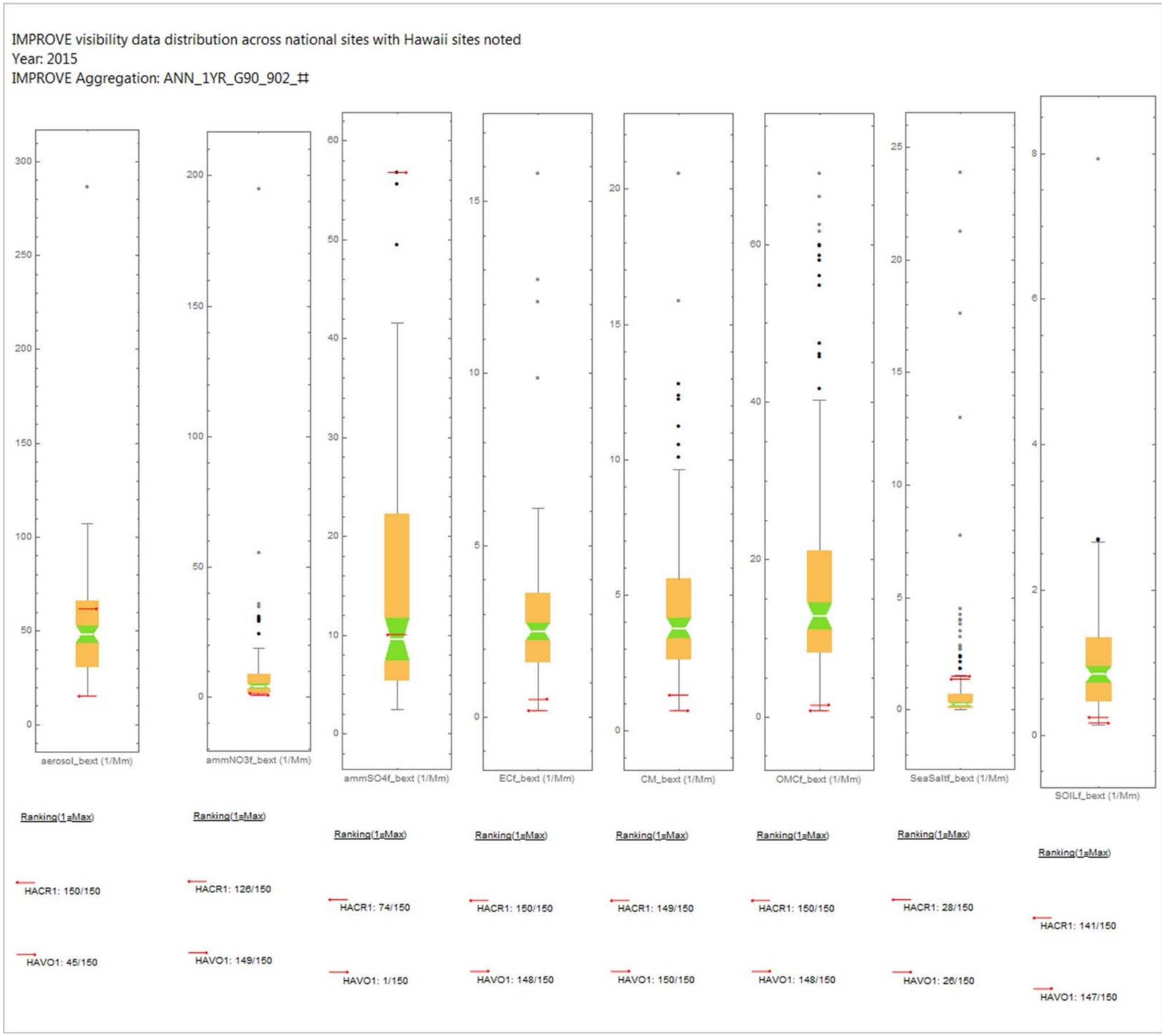

Figure F-5: 2015 IMPROVE visibility impacting Bext contributions data distribution

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

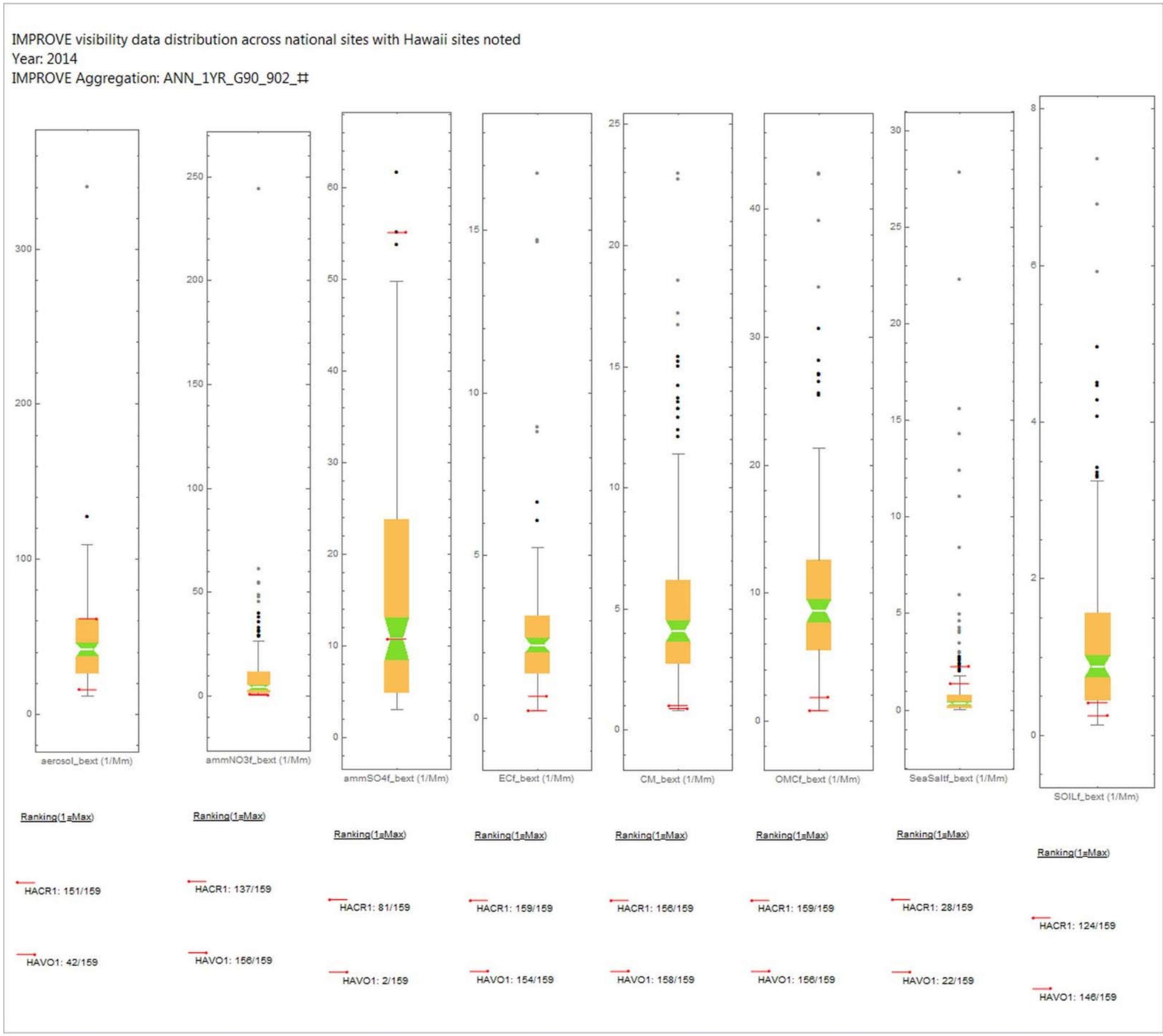

Figure F-6: 2014 IMPROVE visibility impacting Bext contributions data distribution

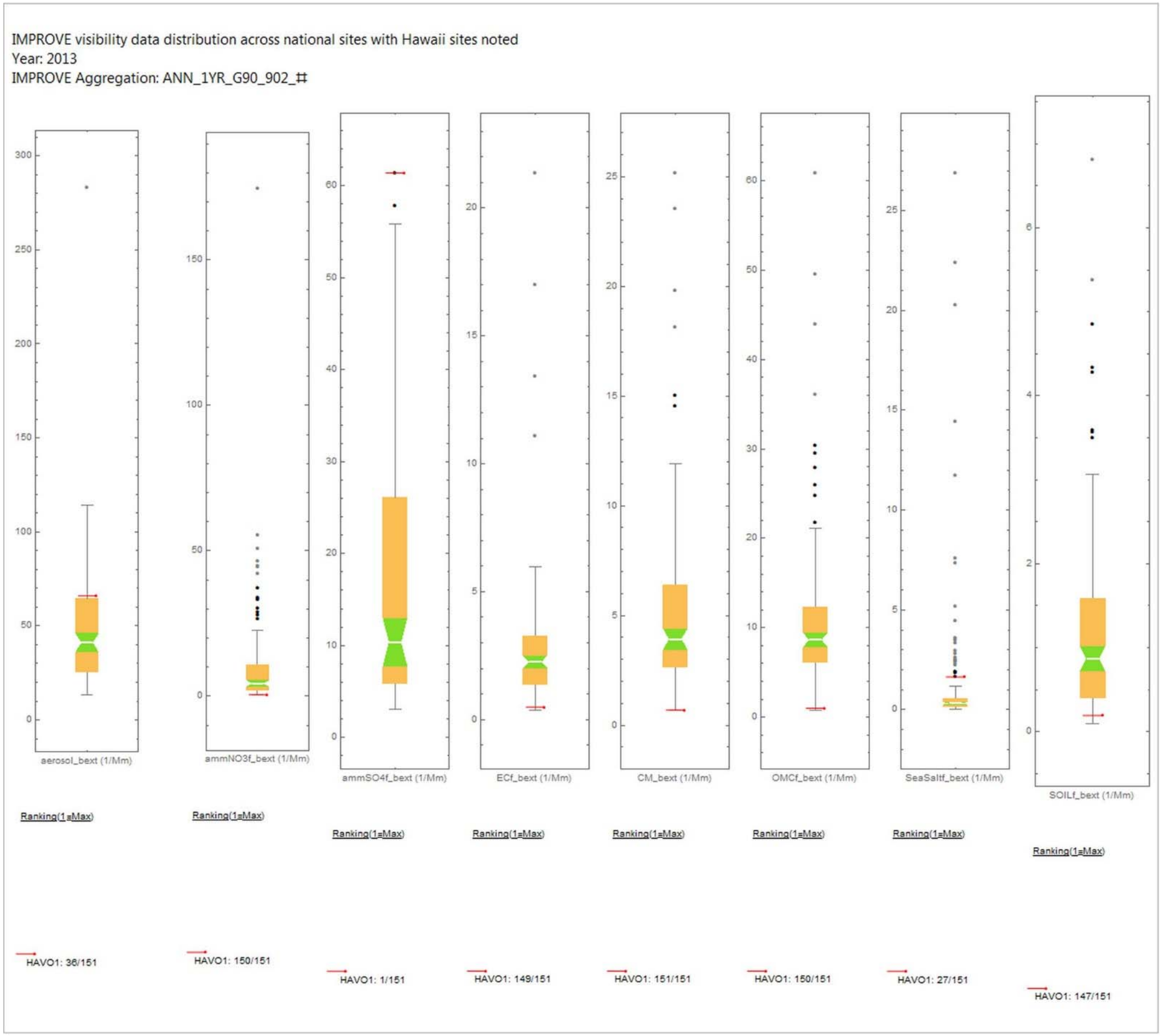

Figure F-7: 2013 IMPROVE visibility impacting Bext contributions data distribution

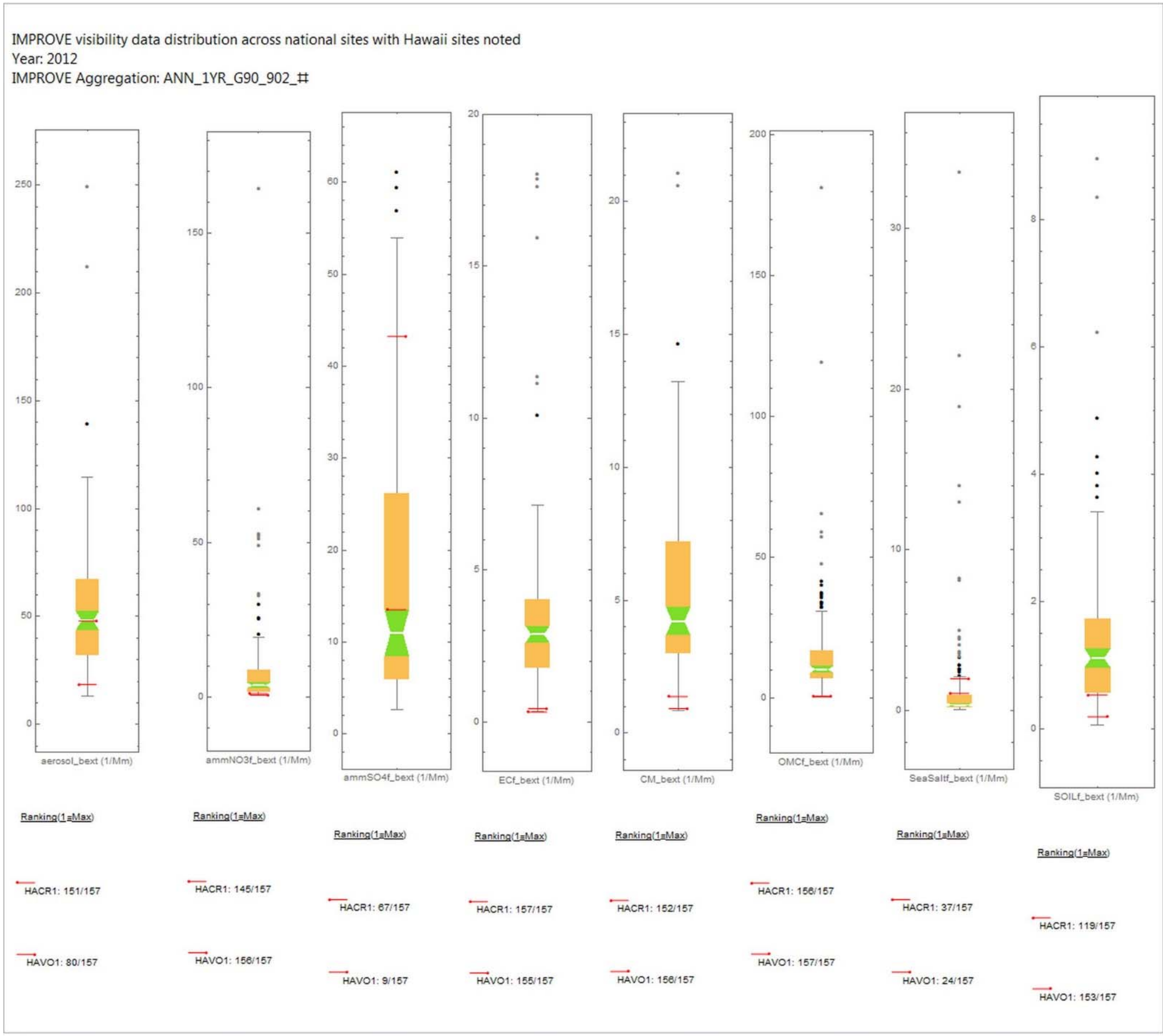

Figure F-8: 2012 IMPROVE visibility impacting Bext contributions data distribution

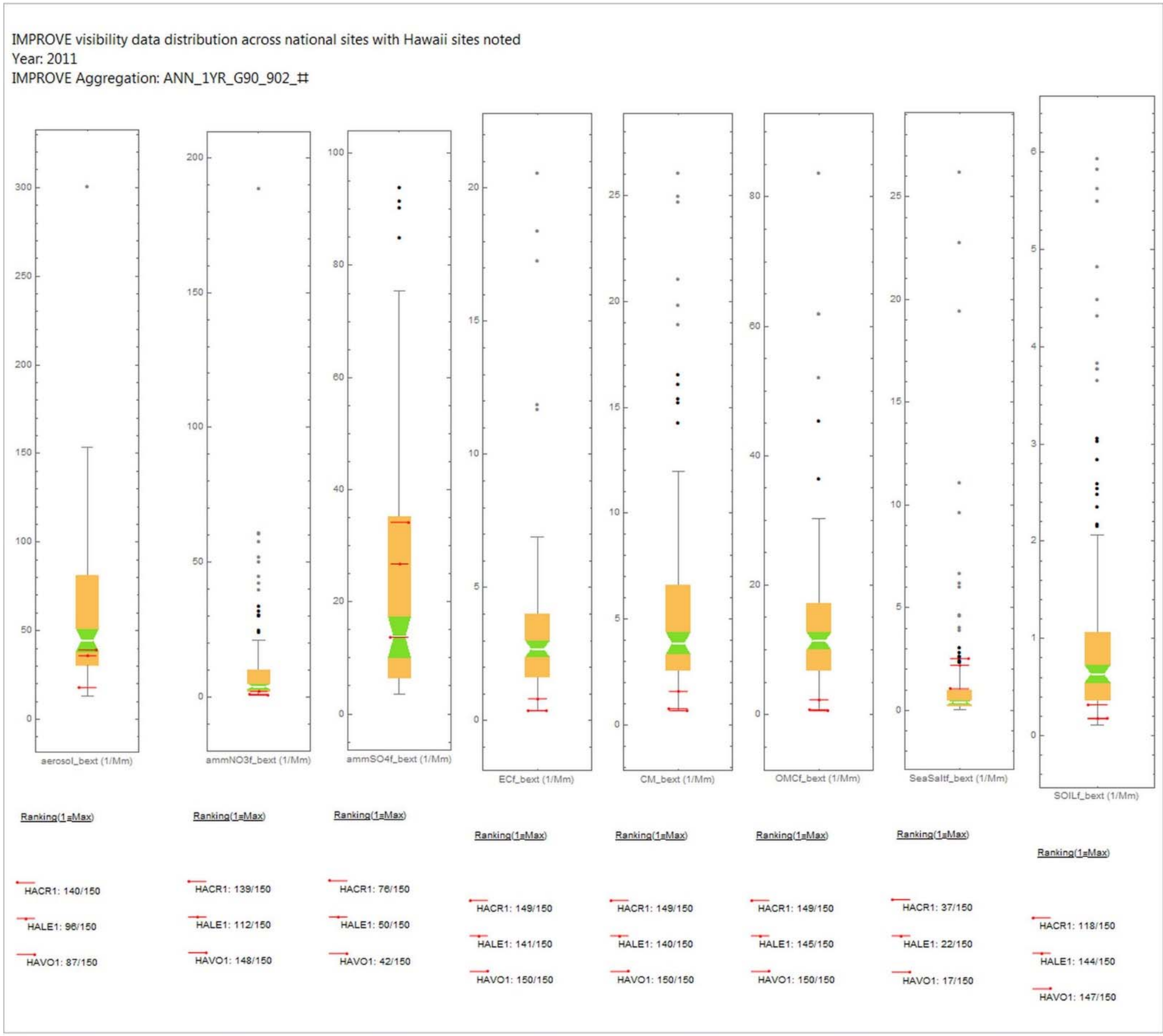

Figure F-9: 2011 IMPROVE visibility impacting Bext contributions data distribution

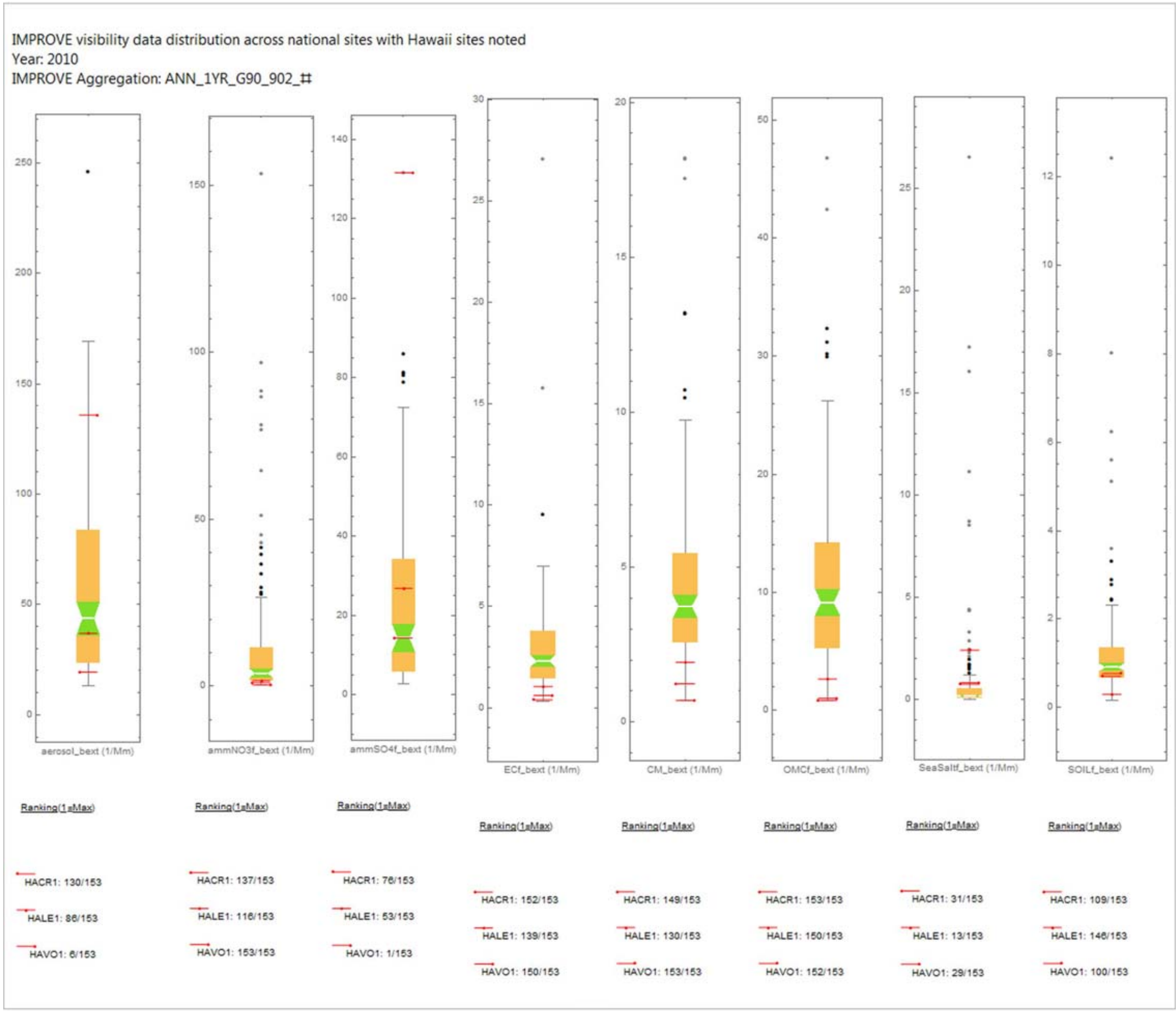

Figure F-10: 2010 IMPROVE visibility impacting Bext contributions data distribution

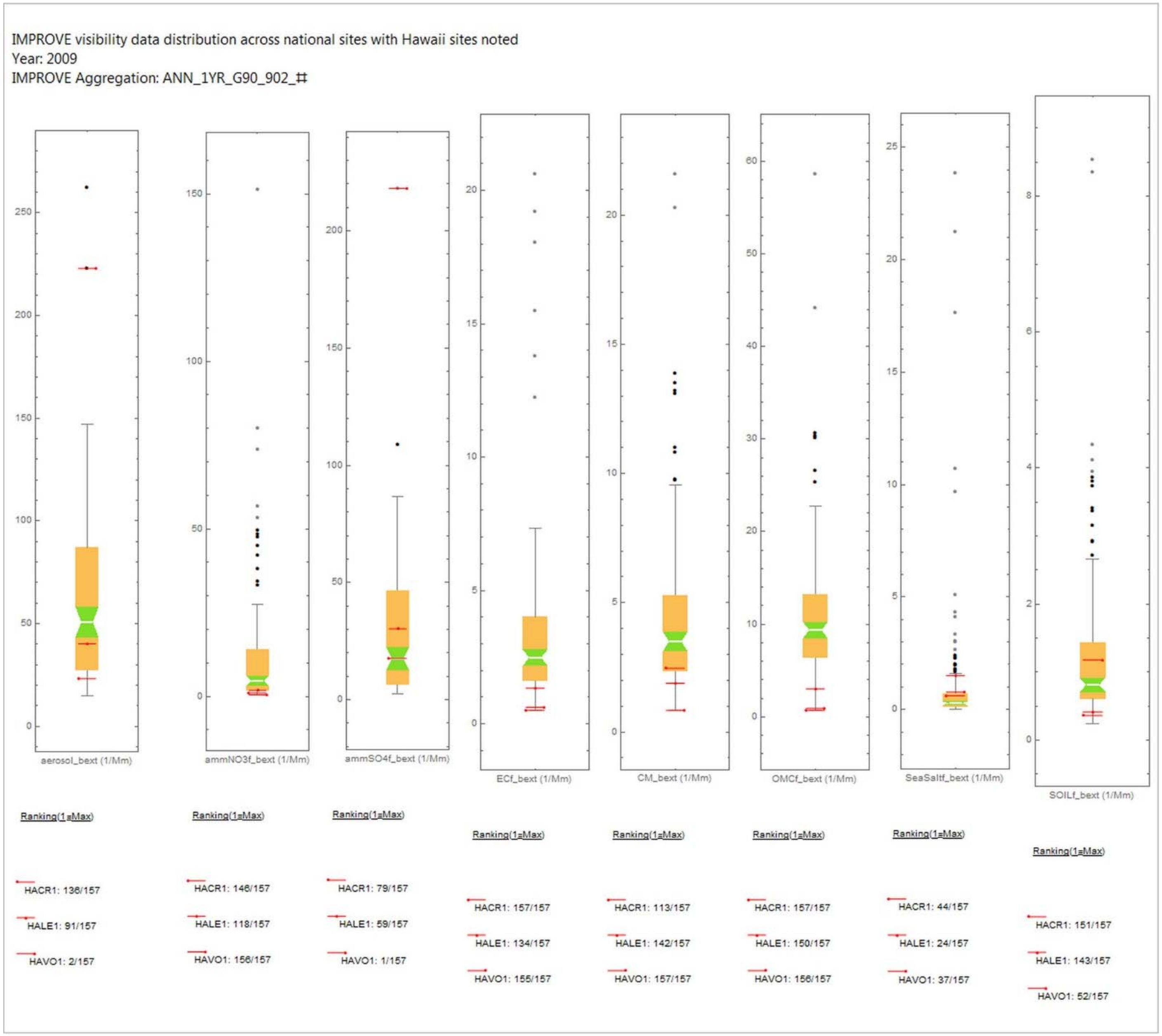

Figure F-11: 2009 IMPROVE visibility impacting Bext contributions data distribution

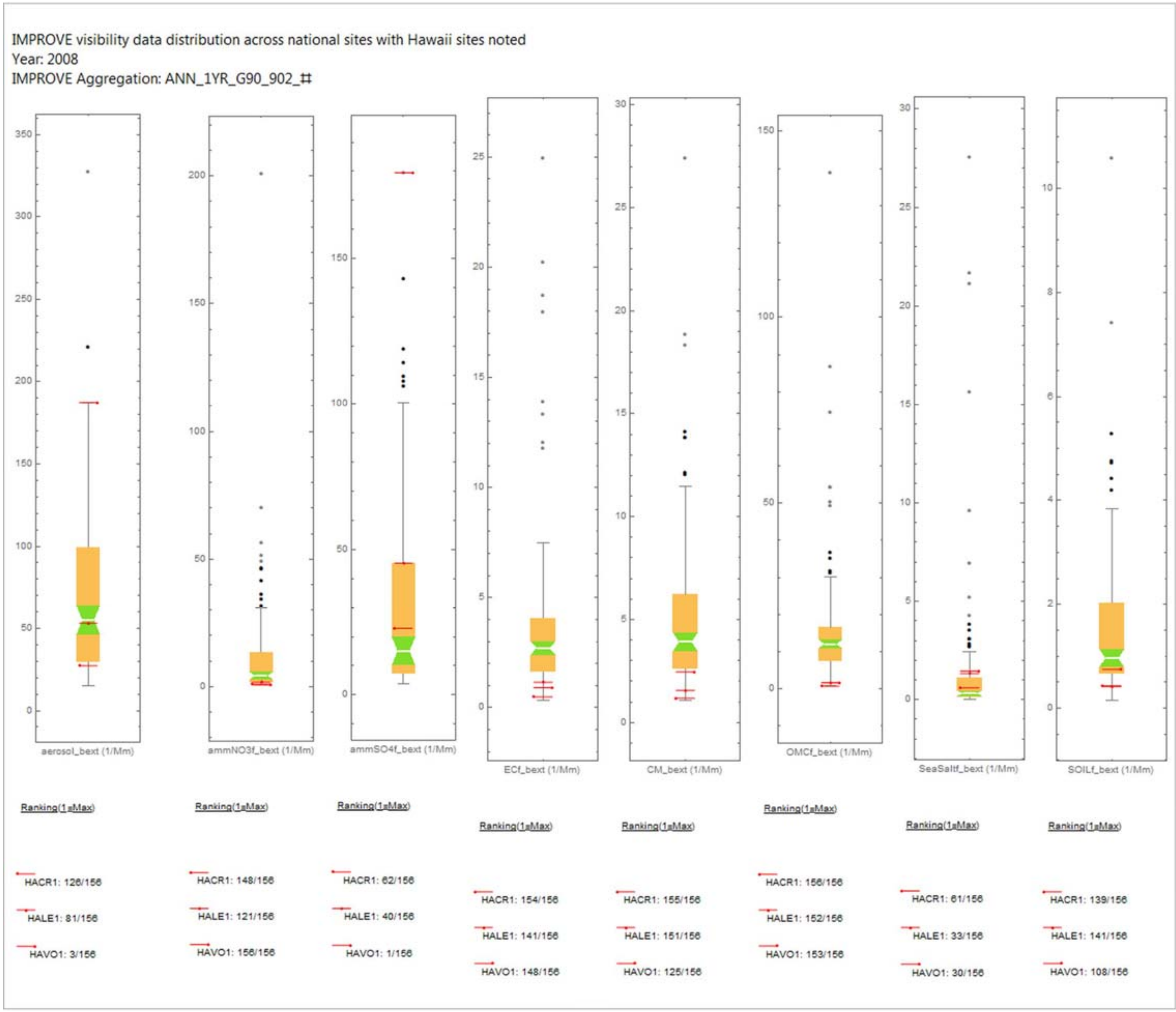

Figure F-12: 2008 IMPROVE visibility impacting Bext contributions data distribution

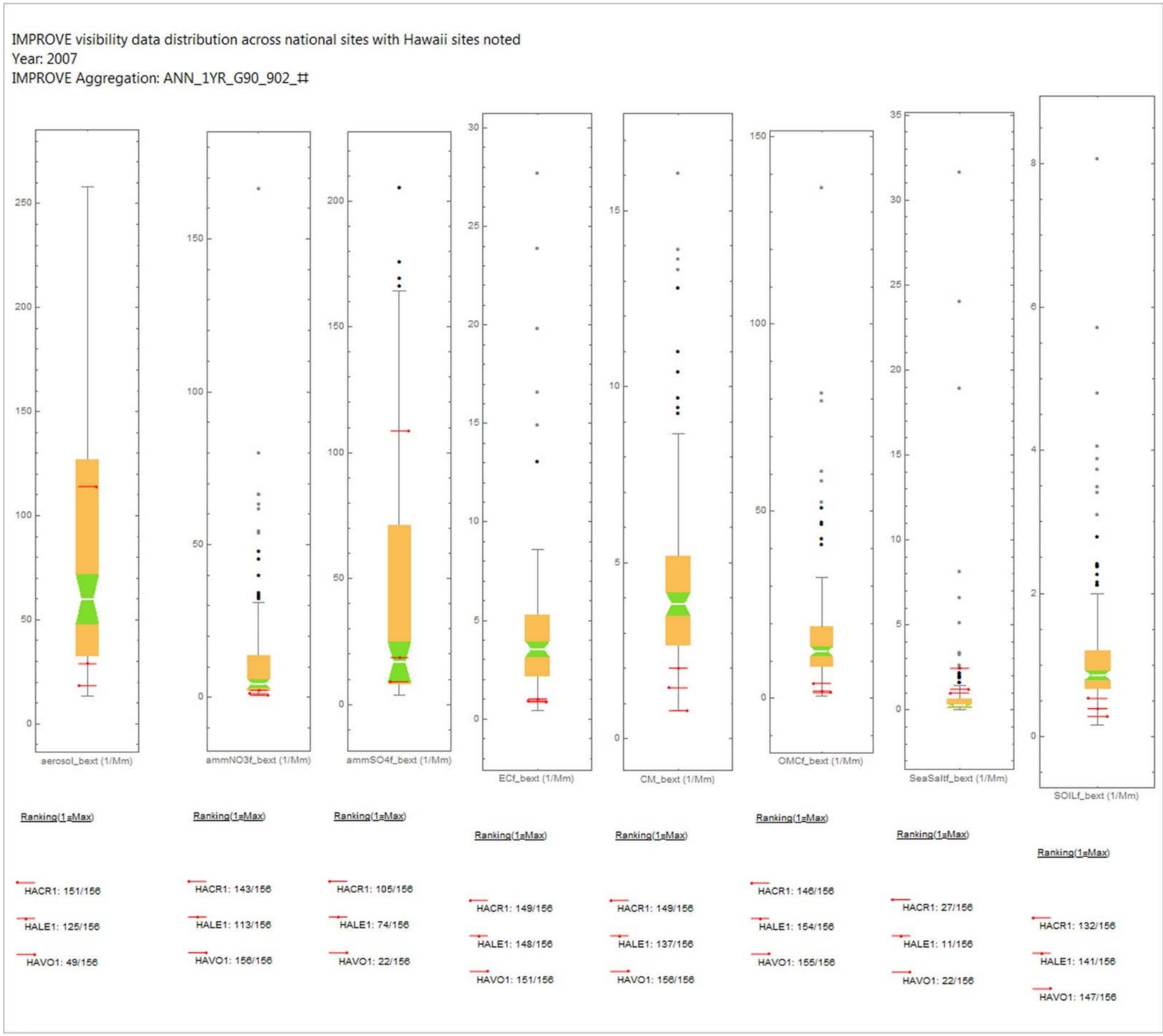

Figure F-13: 2007 IMPROVE visibility impacting Bext contributions data distribution

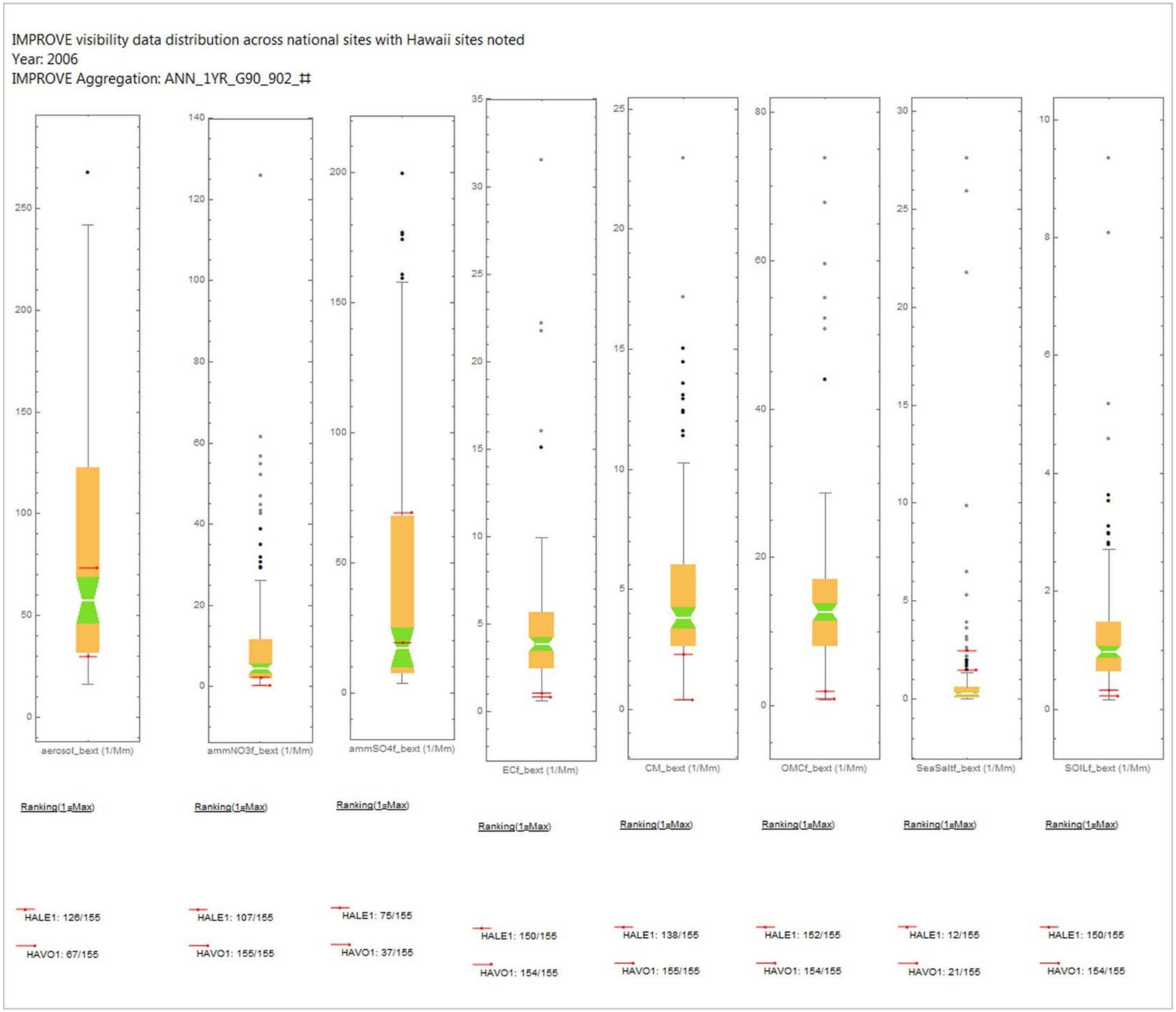

Figure F-14: 2006 IMPROVE visibility impacting Bext contributions data distribution

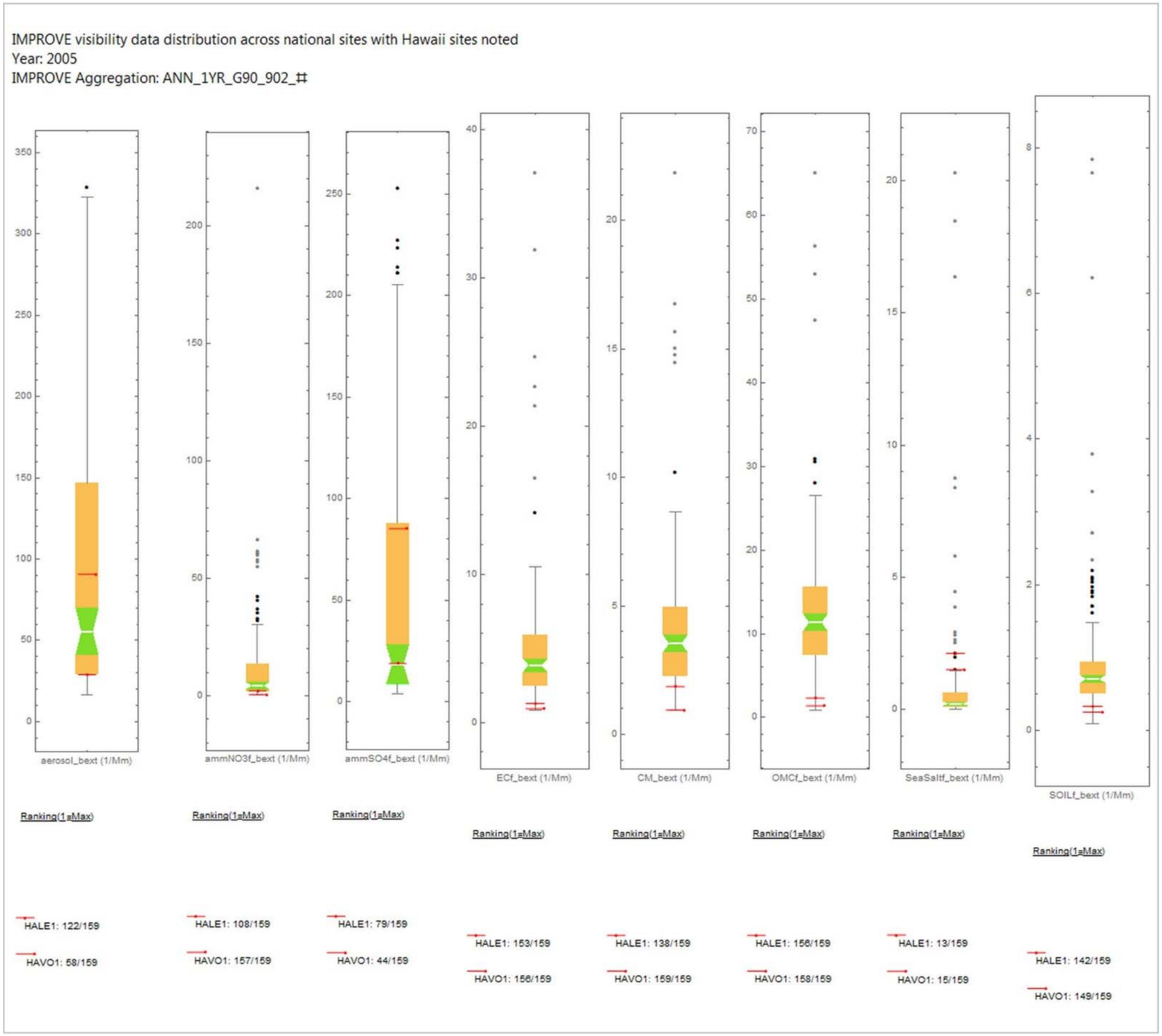

Figure F-15: 2005 IMPROVE visibility impacting Bext contributions data distribution

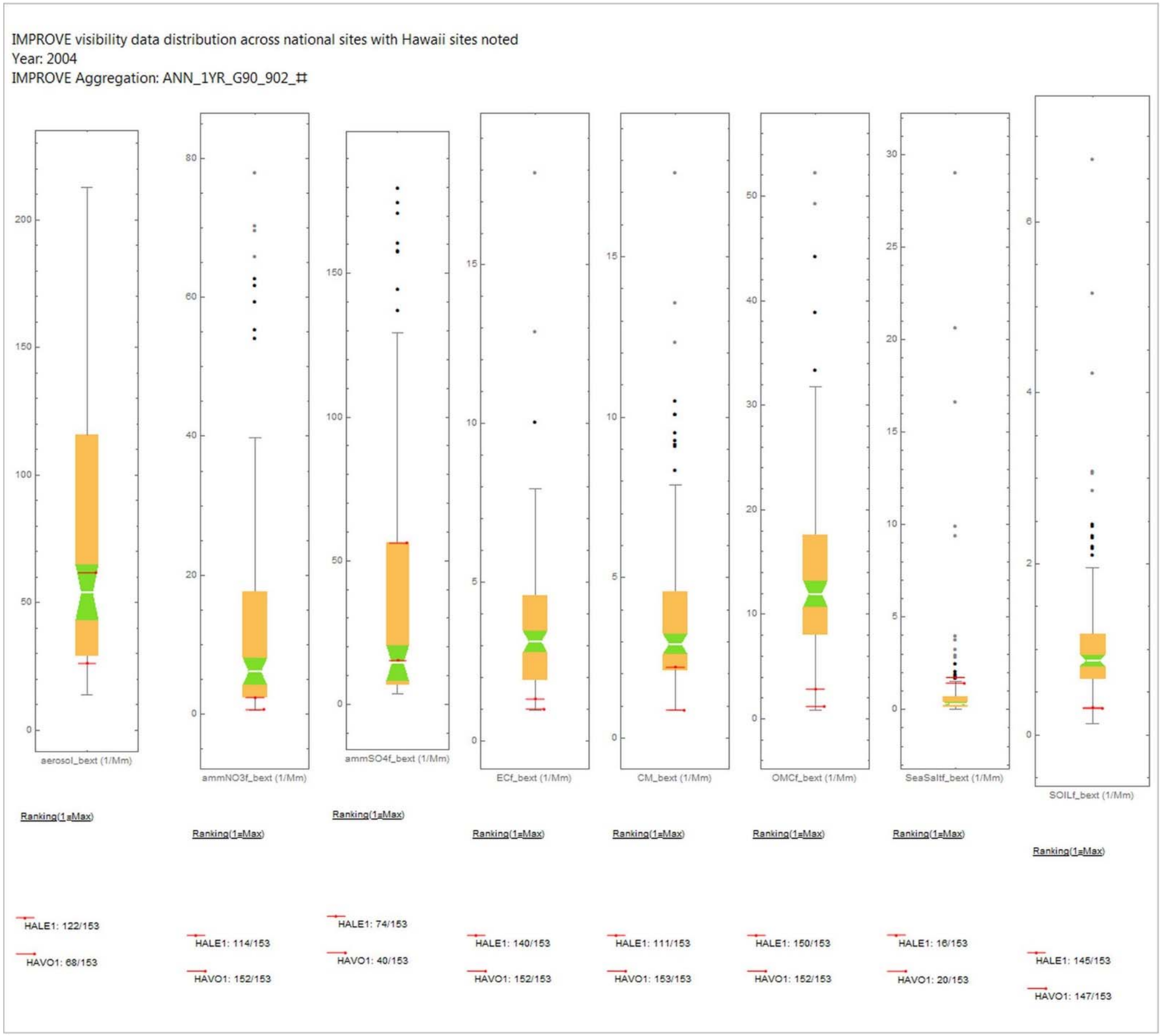

Figure F-16: 2004 IMPROVE visibility impacting Bext contributions data distribution

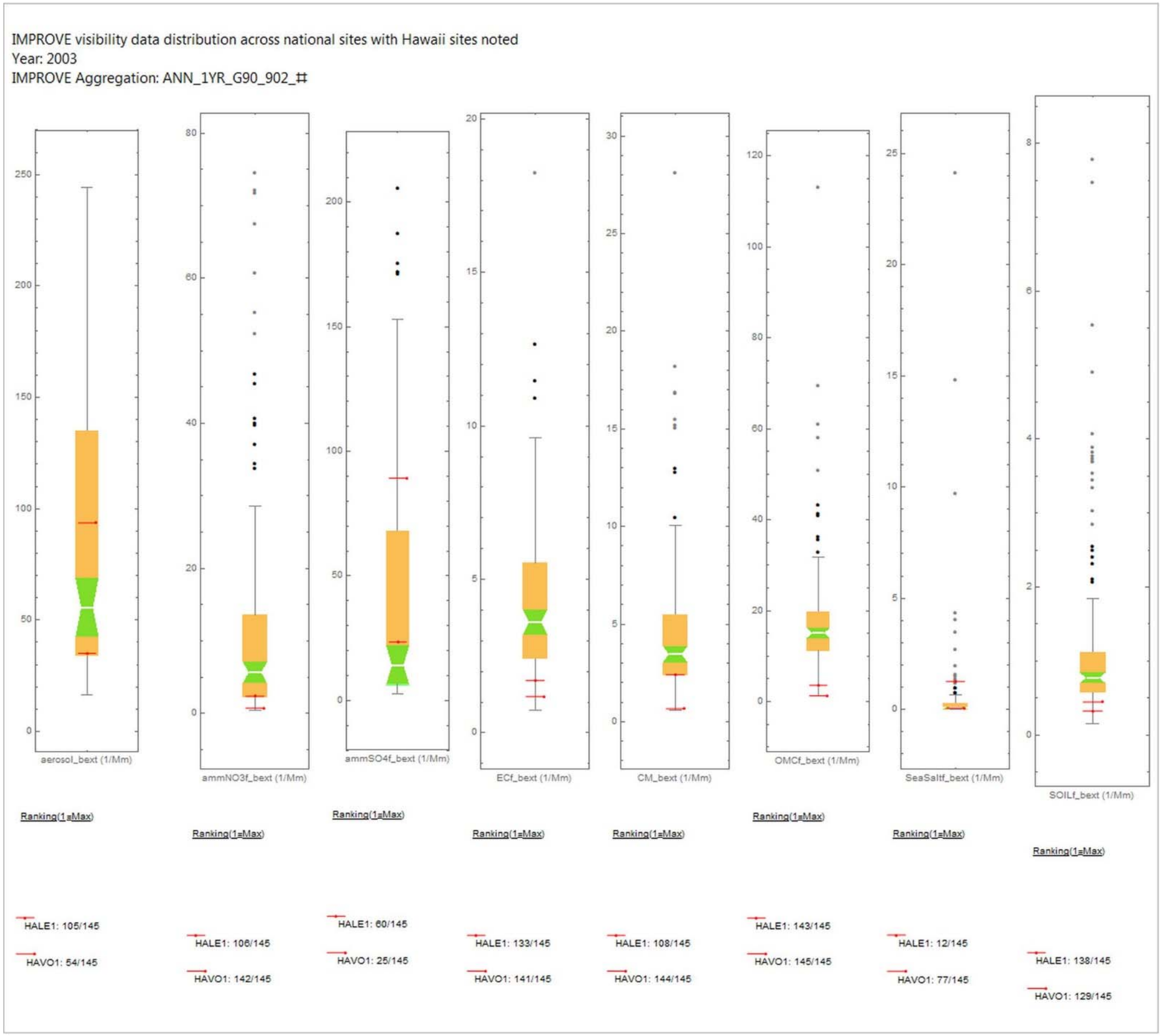

Figure F-17: 2003 IMPROVE visibility impacting Bext contributions data distribution

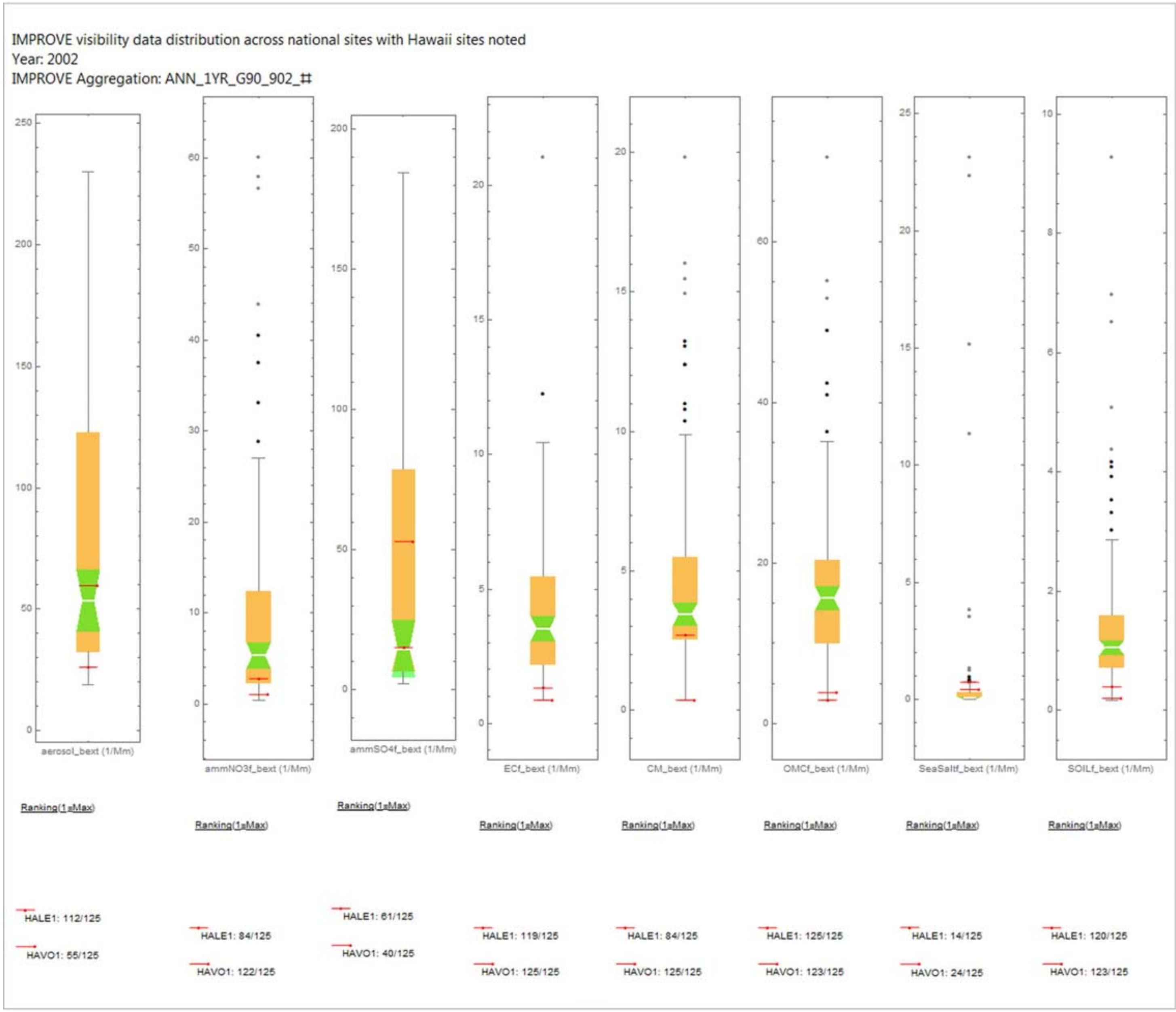

Figure F-18: 2002 IMPROVE visibility impacting Bext contributions data distribution

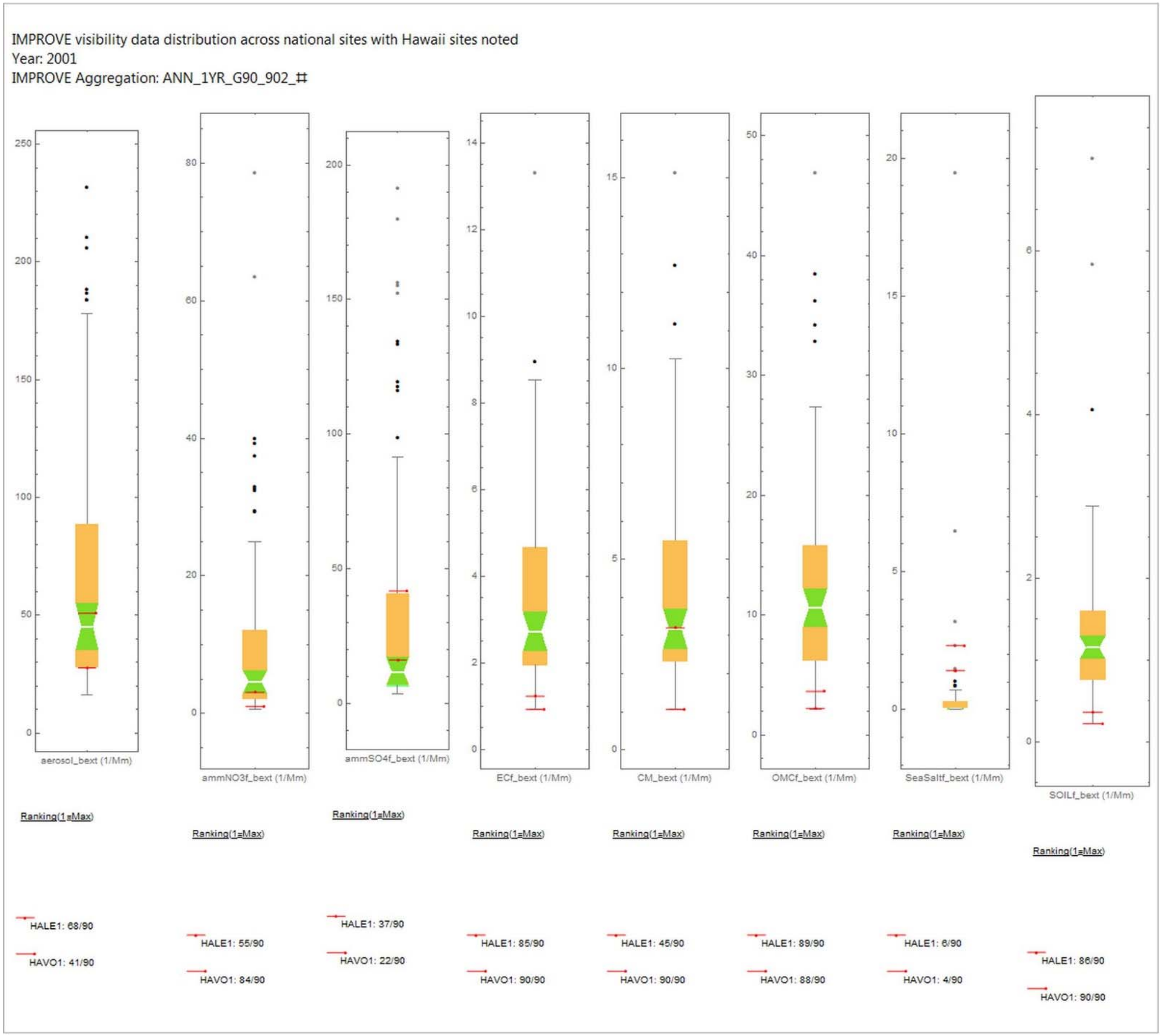

Figure F-19: 2001 IMPROVE visibility impacting Bext contributions data distribution

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

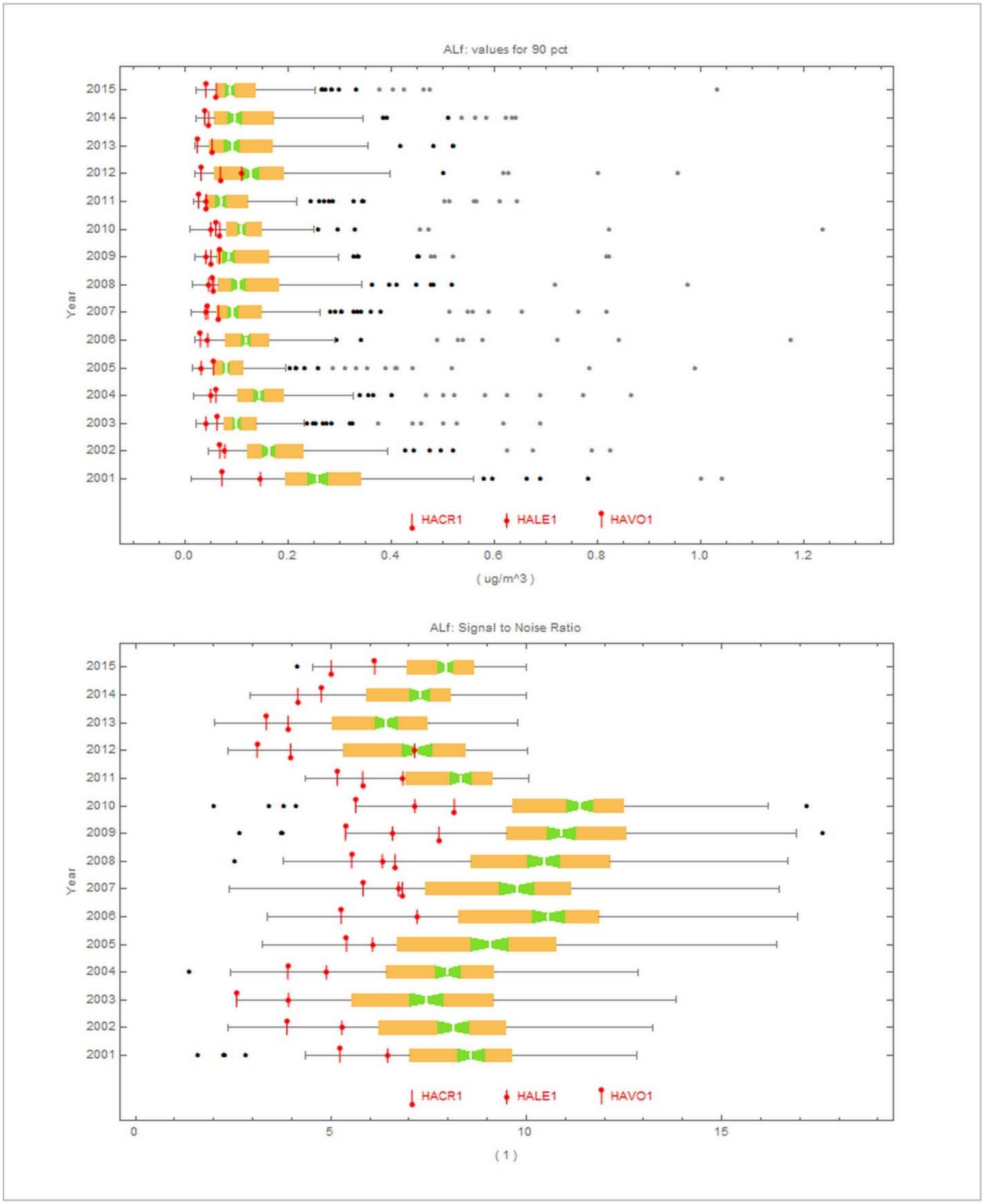

Figure F-20: IMPROVE ALf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

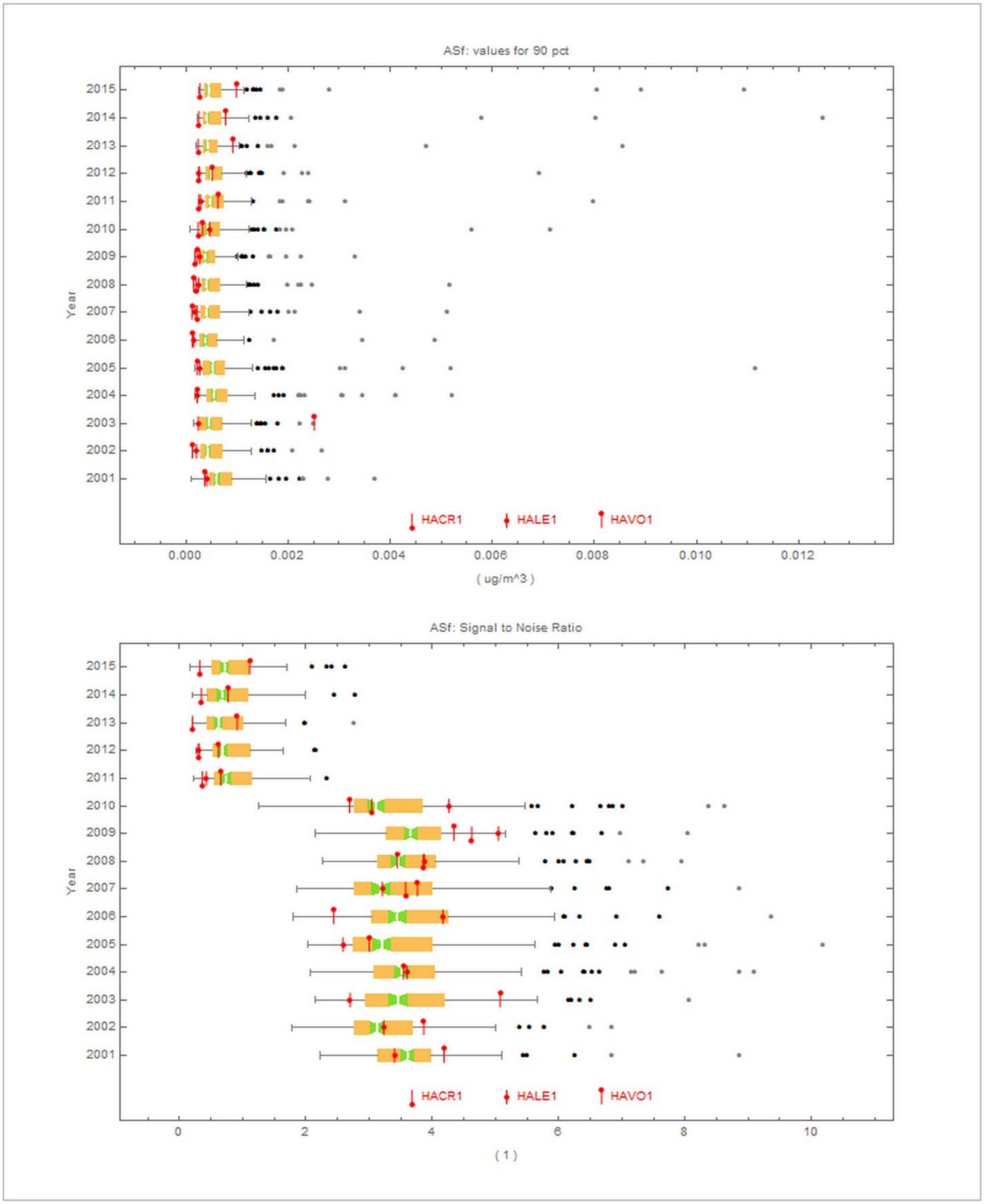

Figure F-21: IMPROVE ASf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

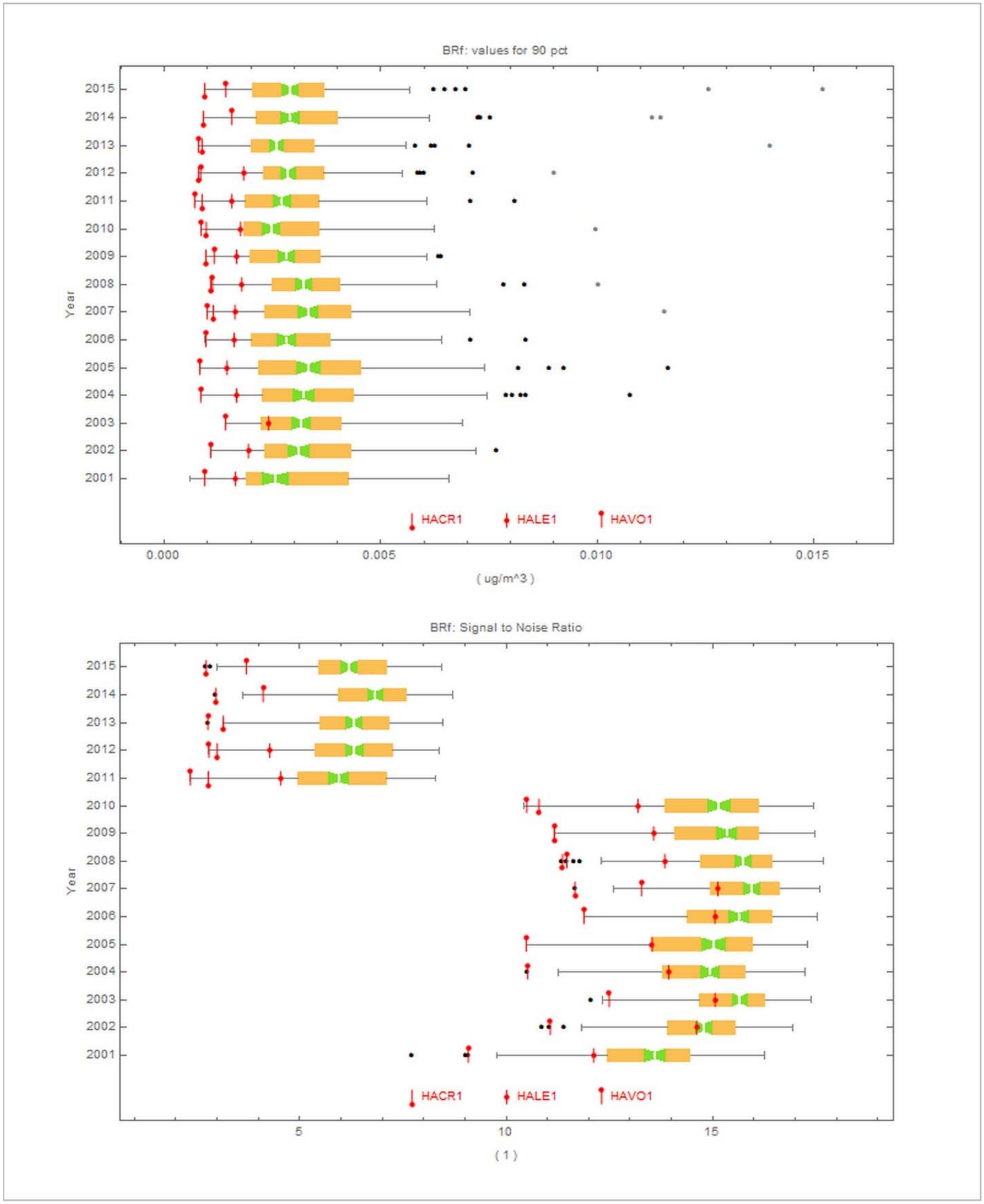

Figure F-22: IMPROVE BRf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

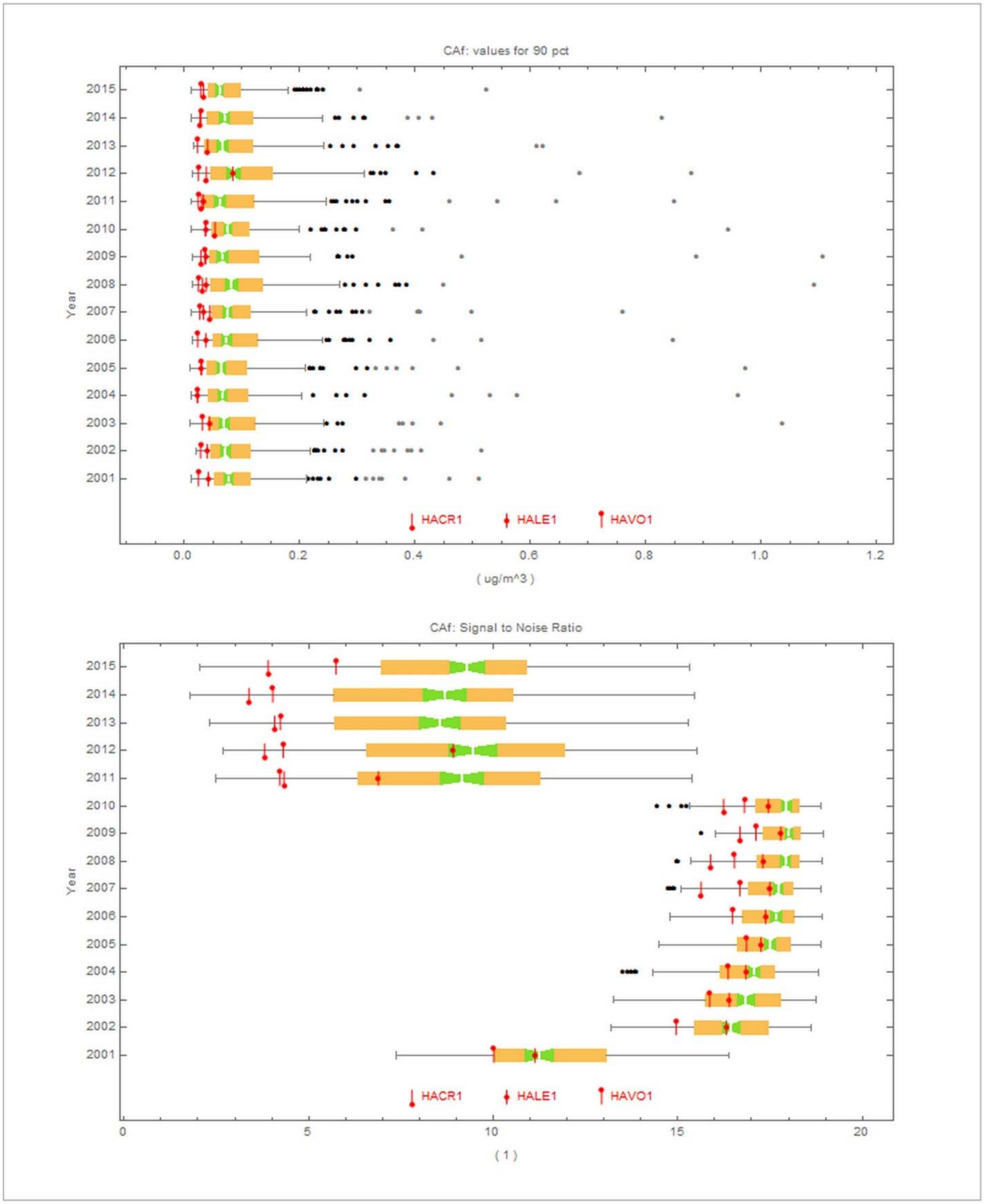

Figure F-23: IMPROVE CAf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

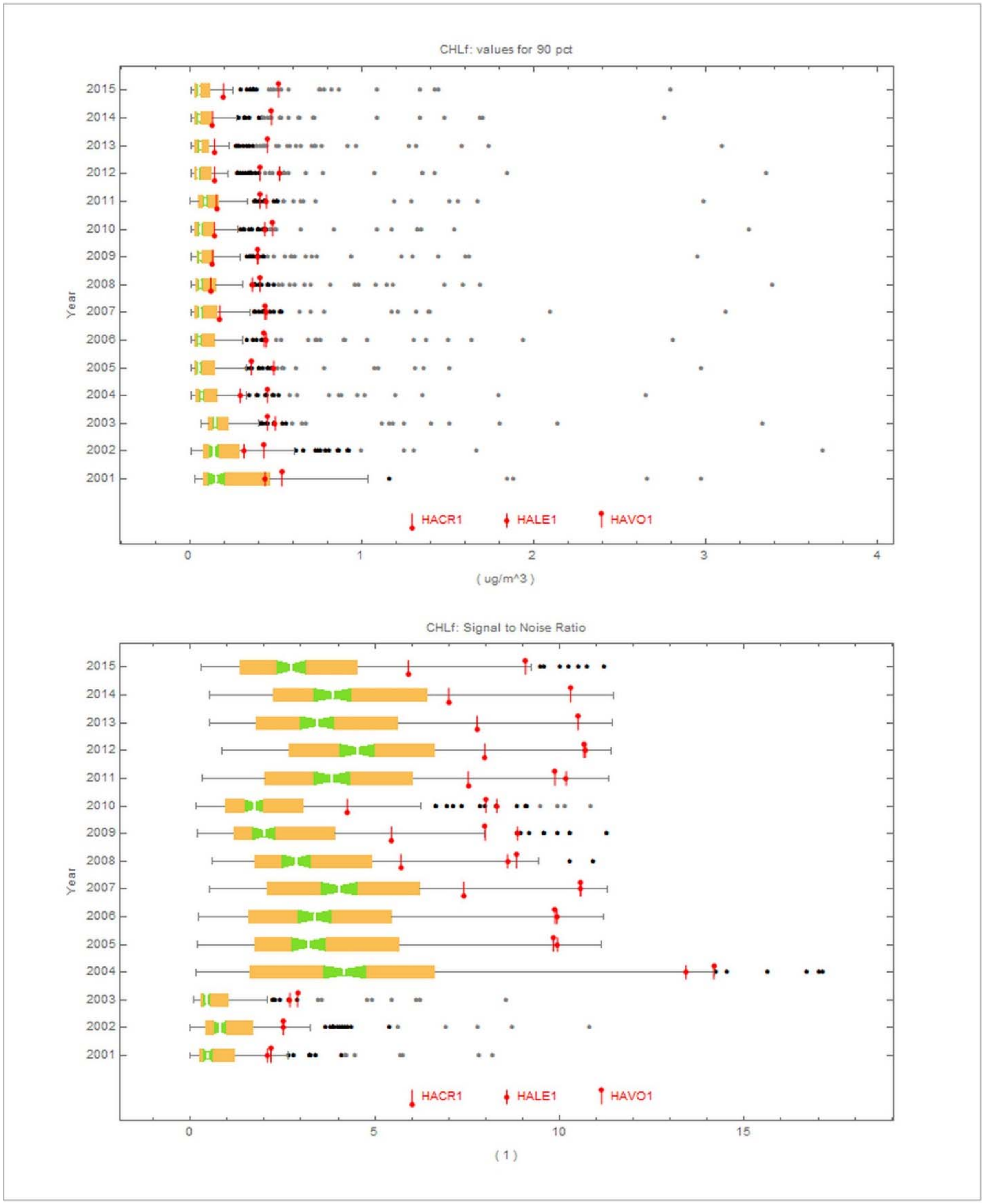

Figure F-24: IMPROVE CHLf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

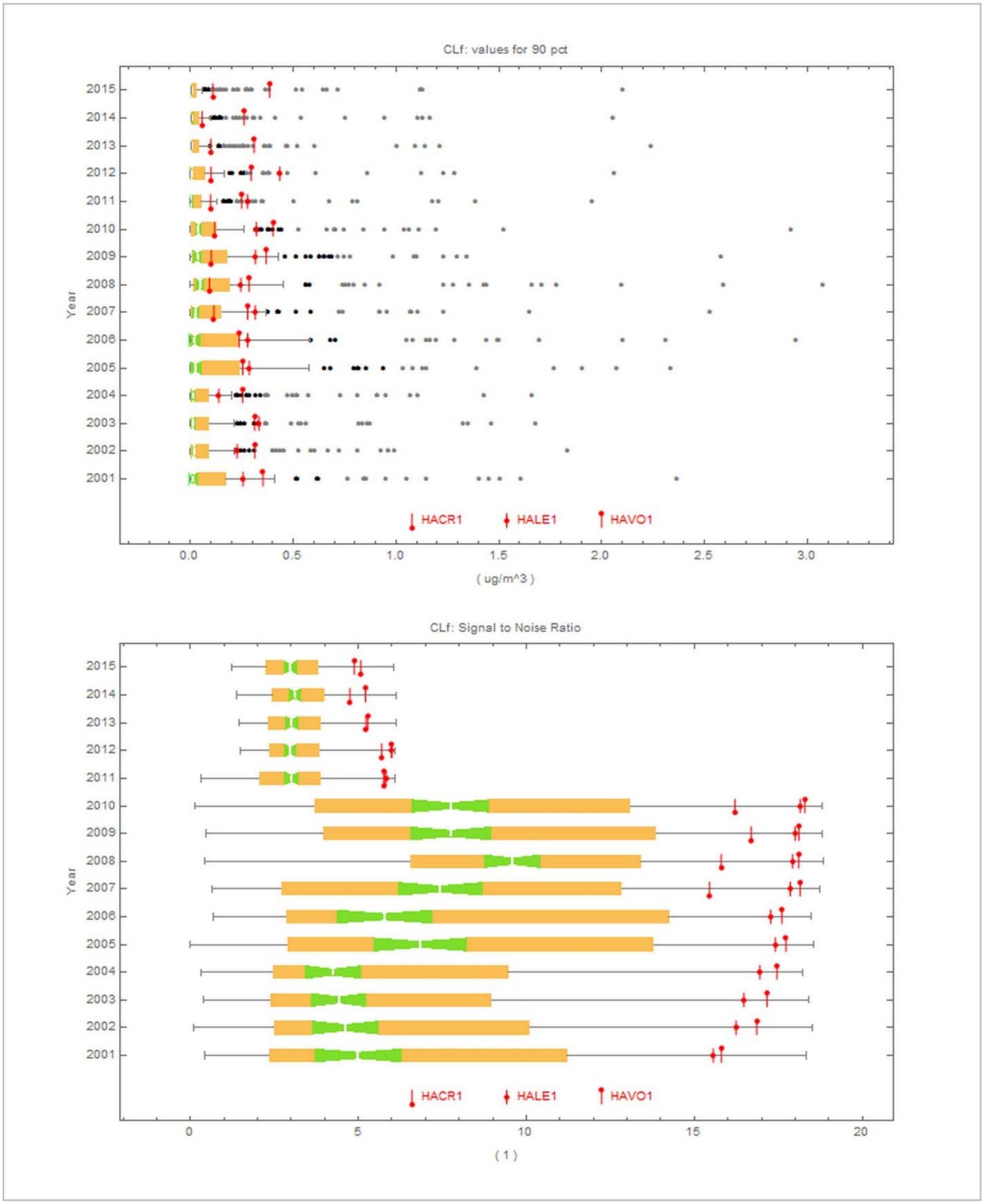

Figure F-25: IMPROVE CLf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

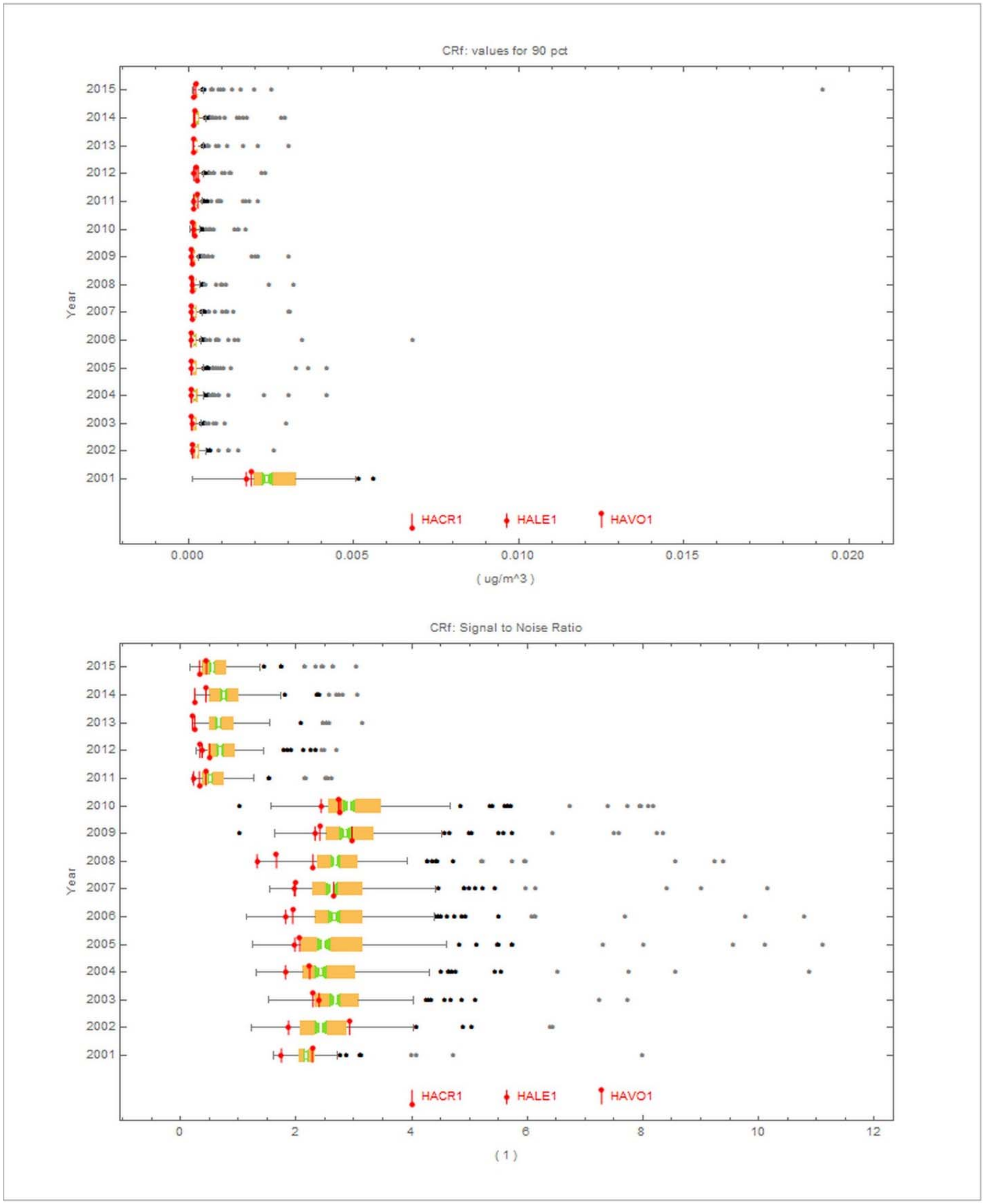

Figure F-26: IMPROVE CRf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

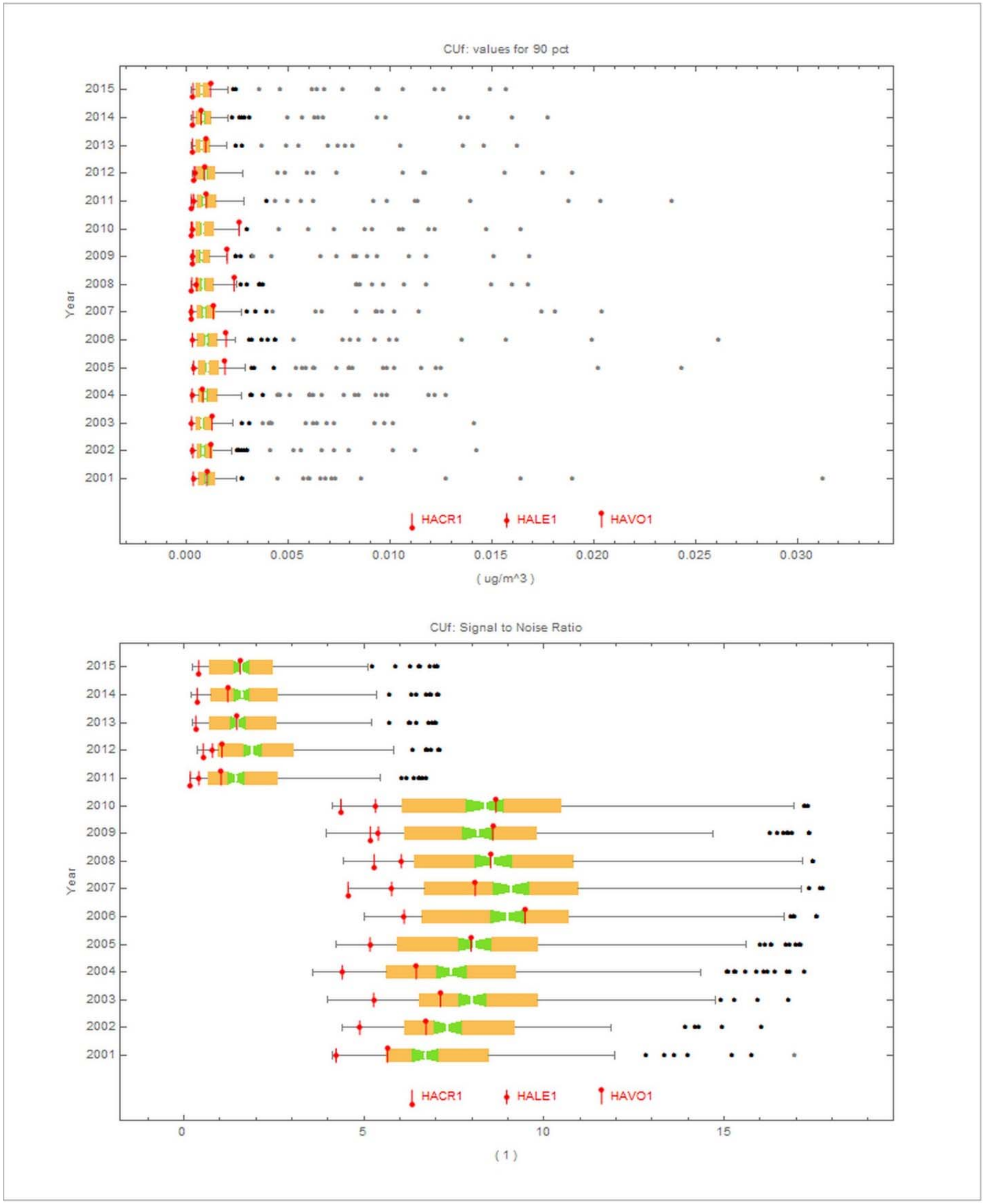

Figure F-27: IMPROVE CUf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

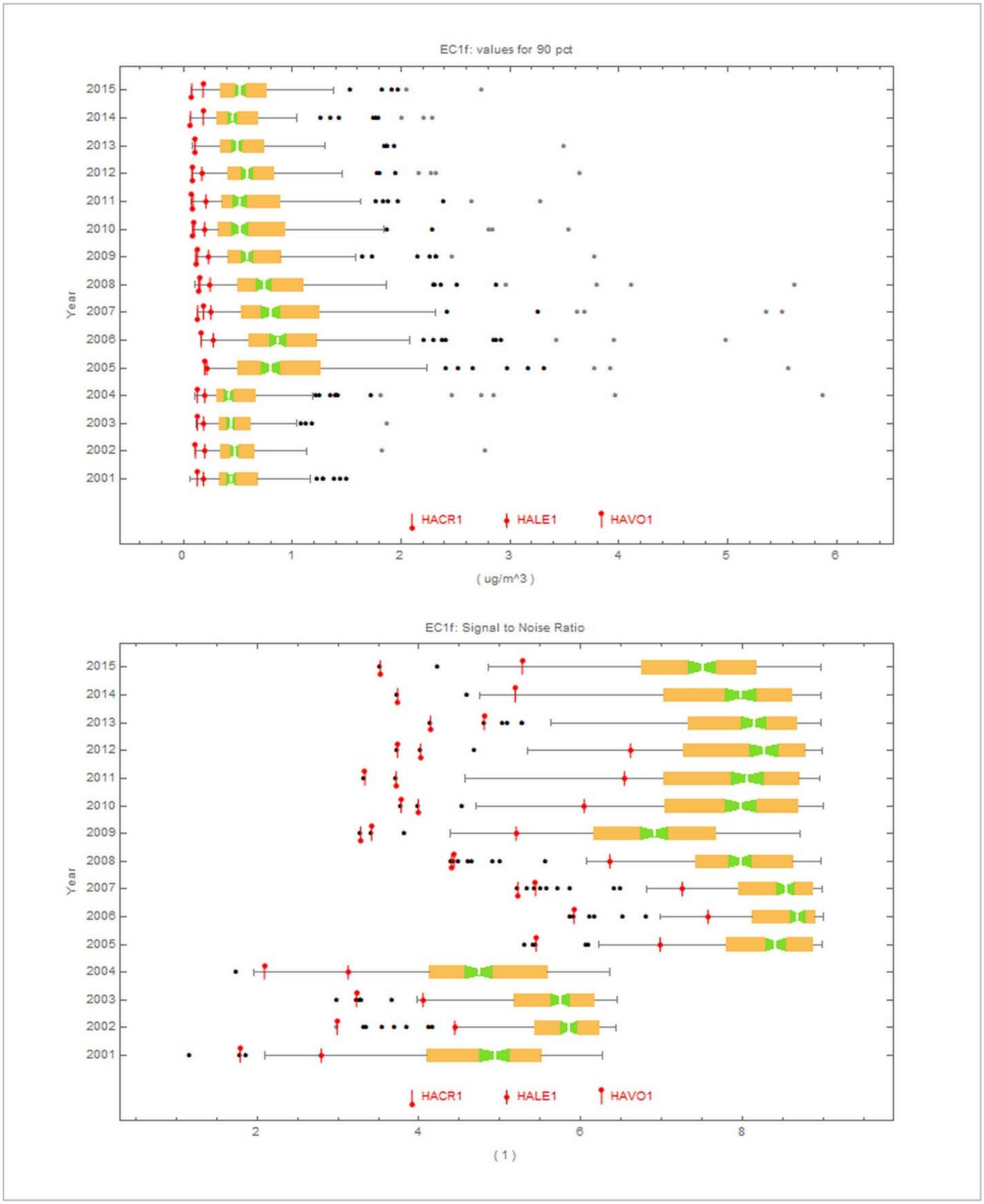

Figure F-28: IMPROVE EC1f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

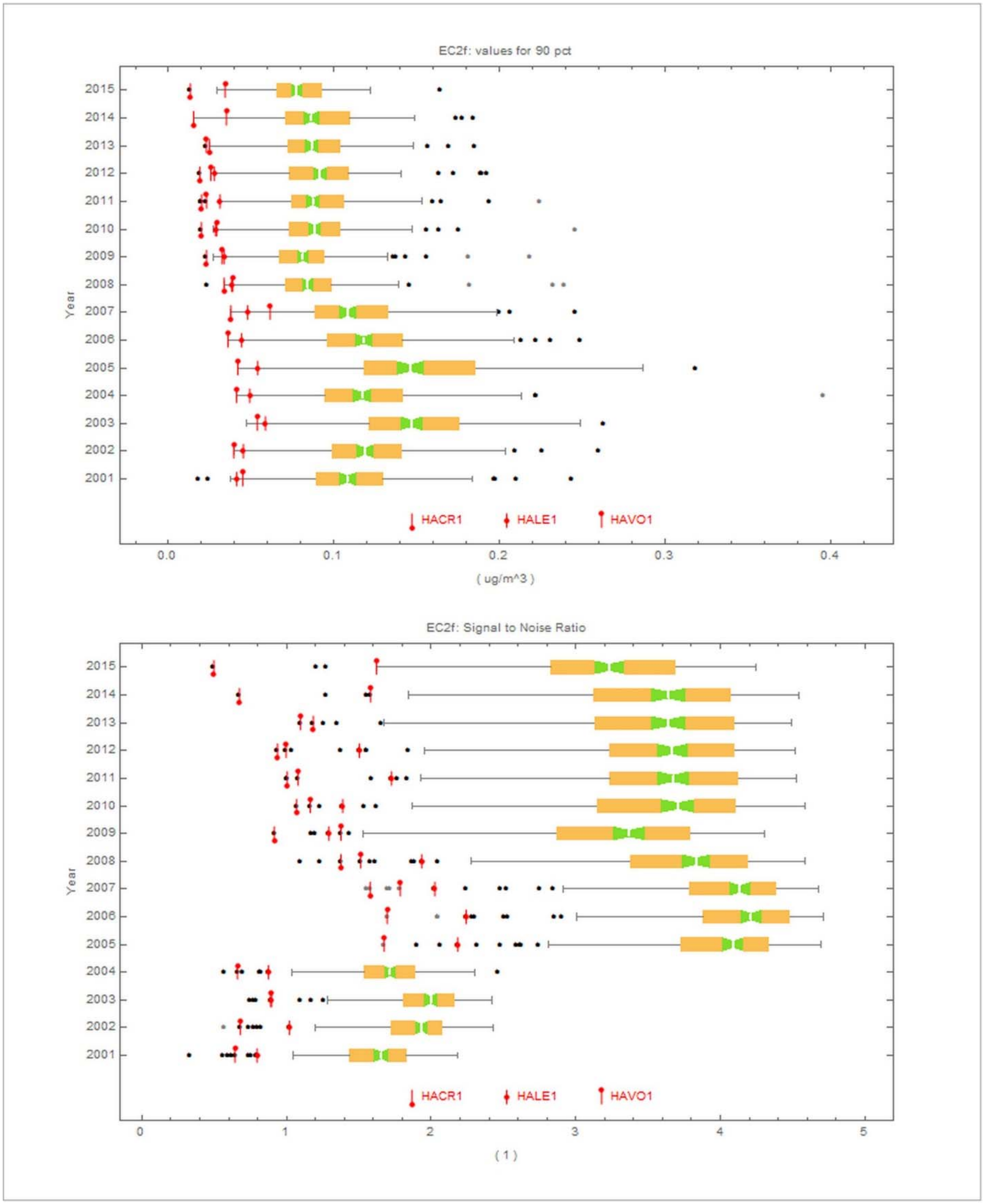

Figure F-29: IMPROVE EC2f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

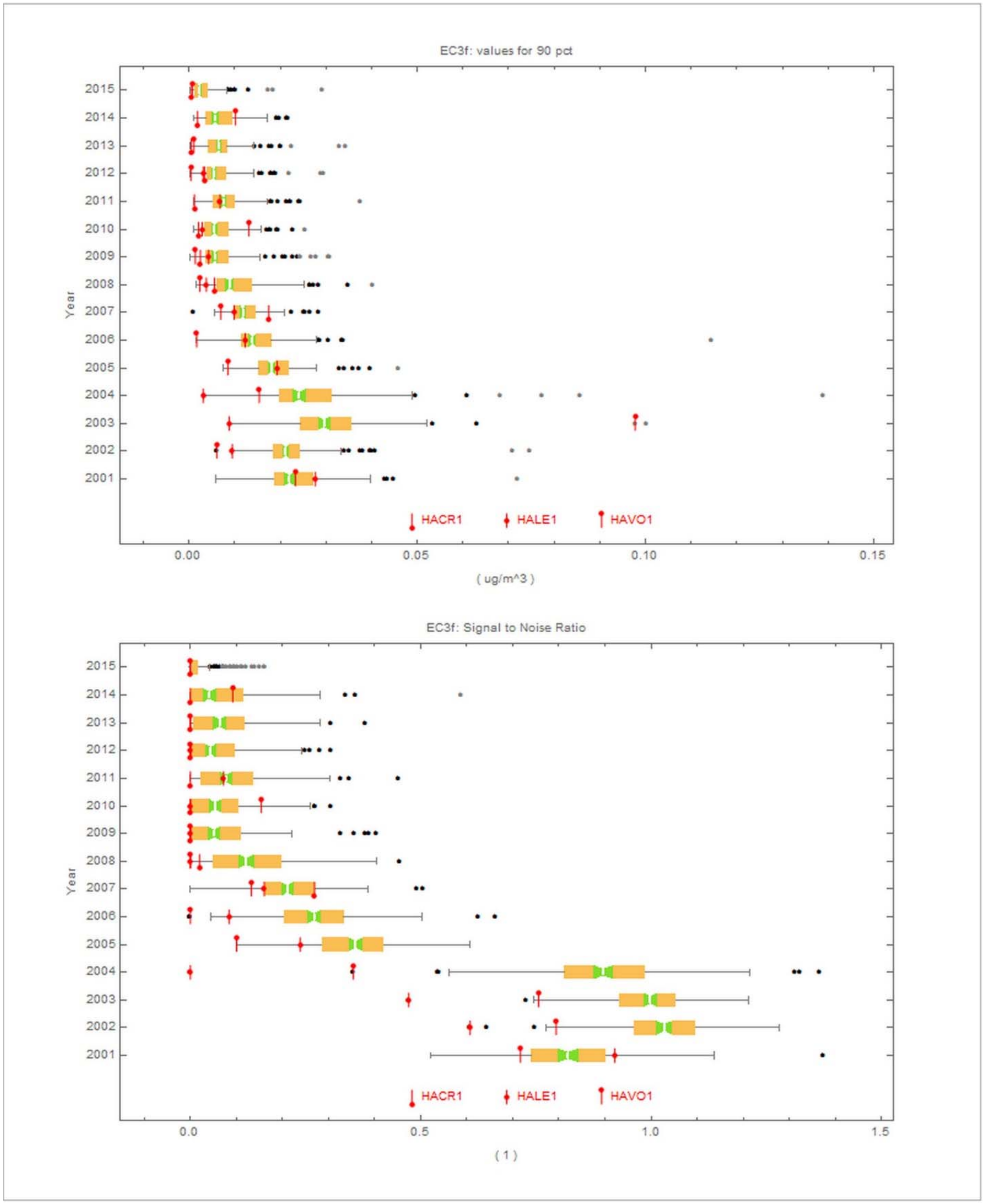

Figure F-30: IMPROVE EC3f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

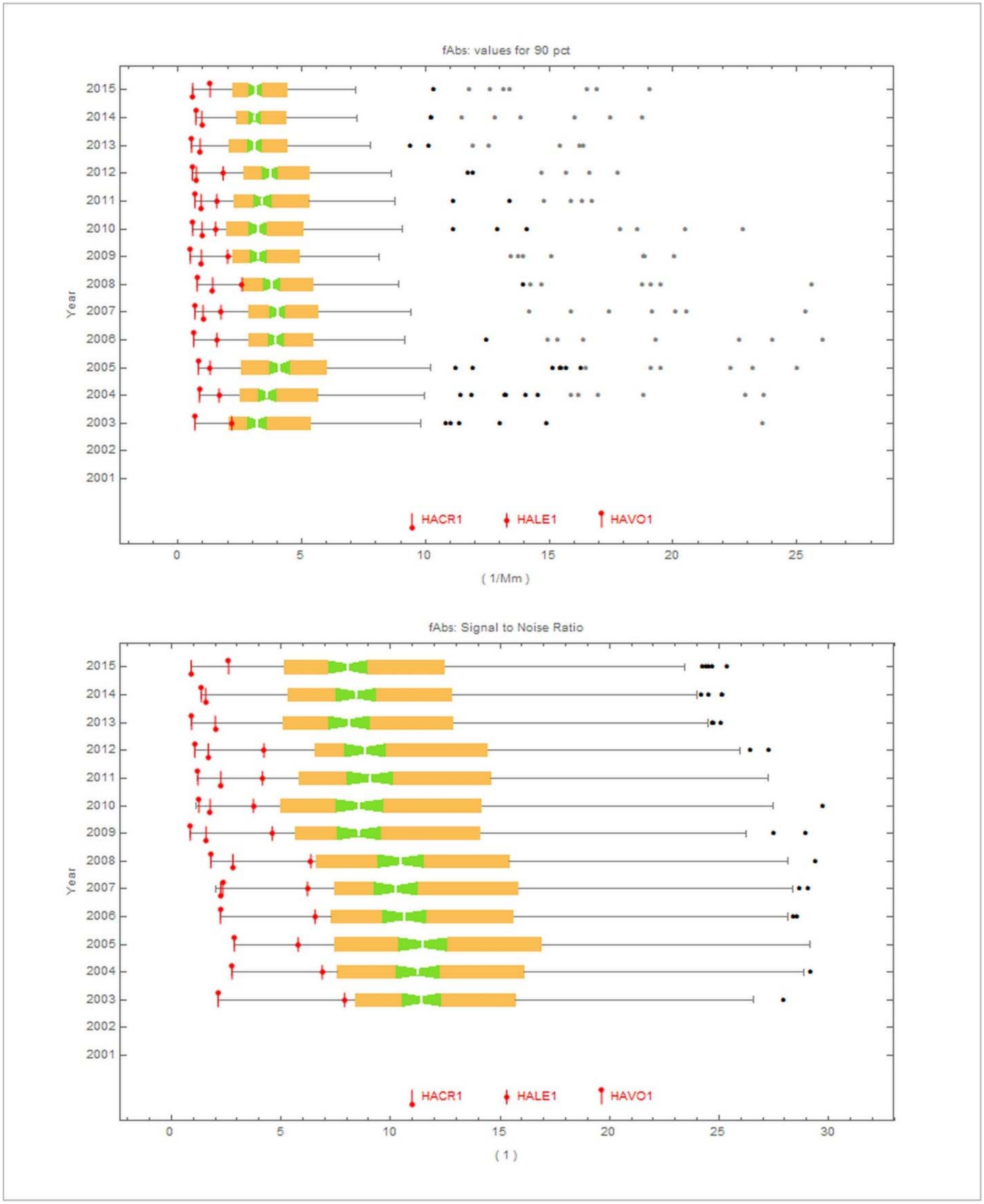

Figure F-31: IMPROVE fAbs Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

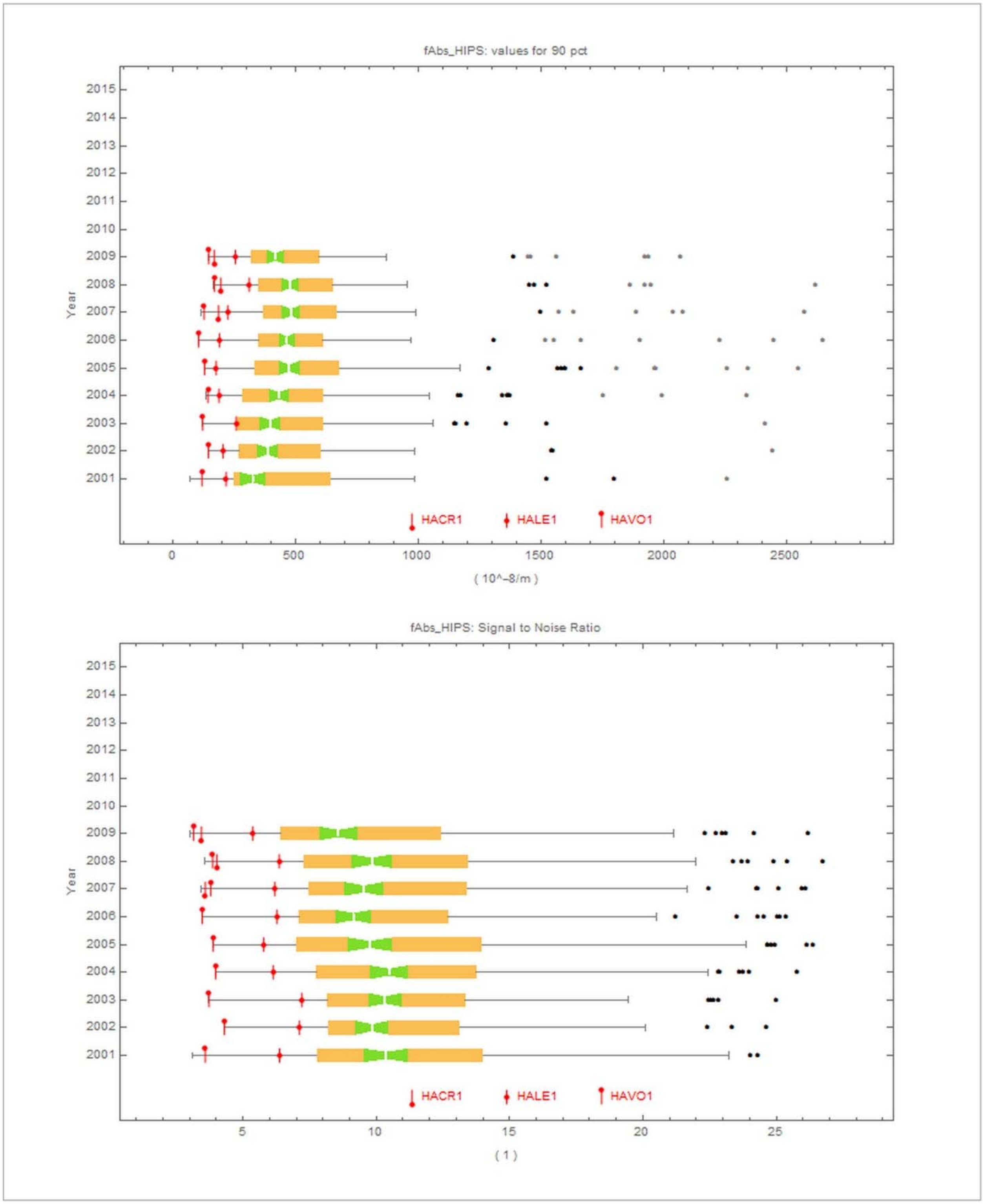

Figure F-32: IMPROVE fAbs_HIPS Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Figure F-33: IMPROVE FEf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

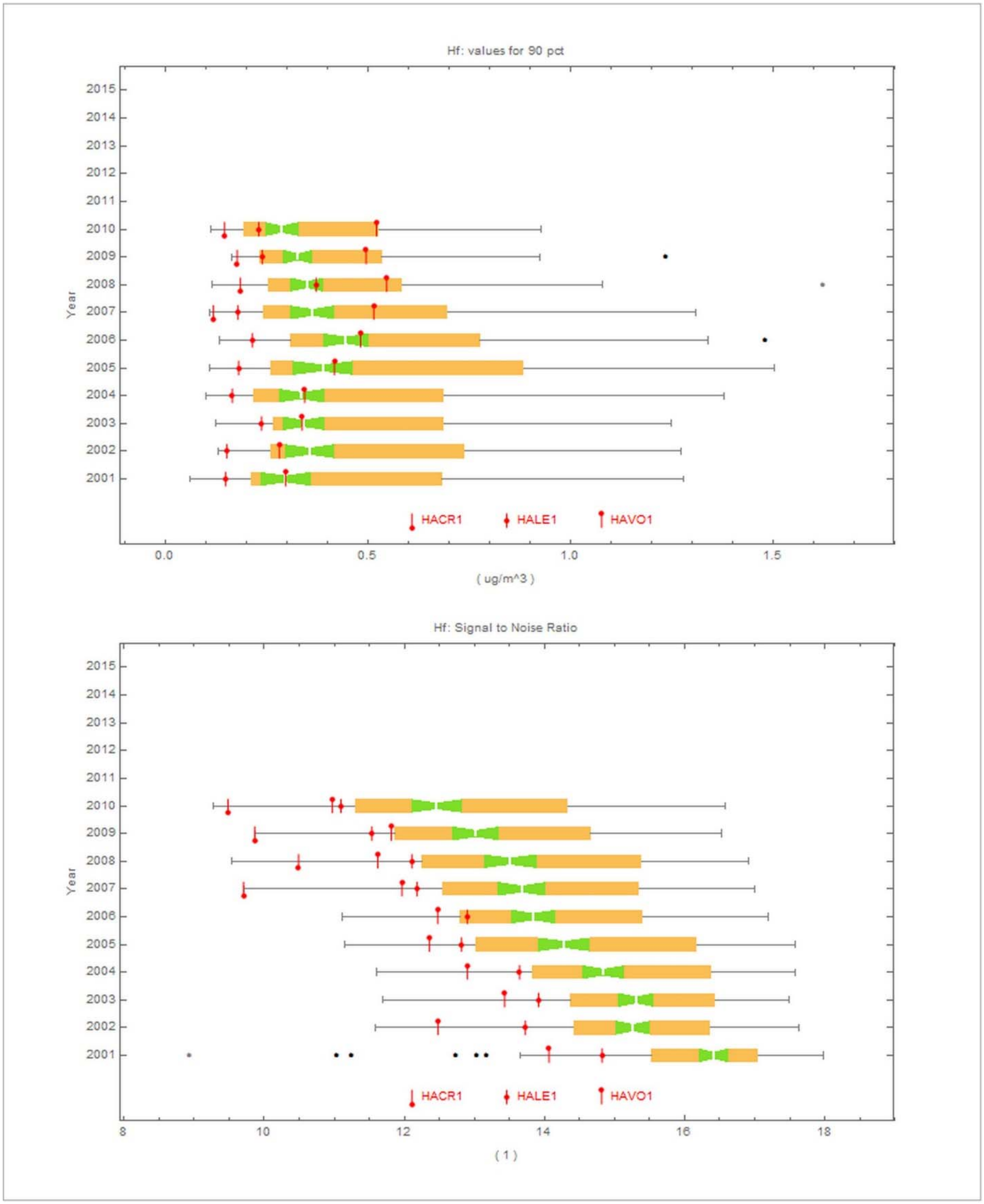

Figure F-34: IMPROVE Hf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

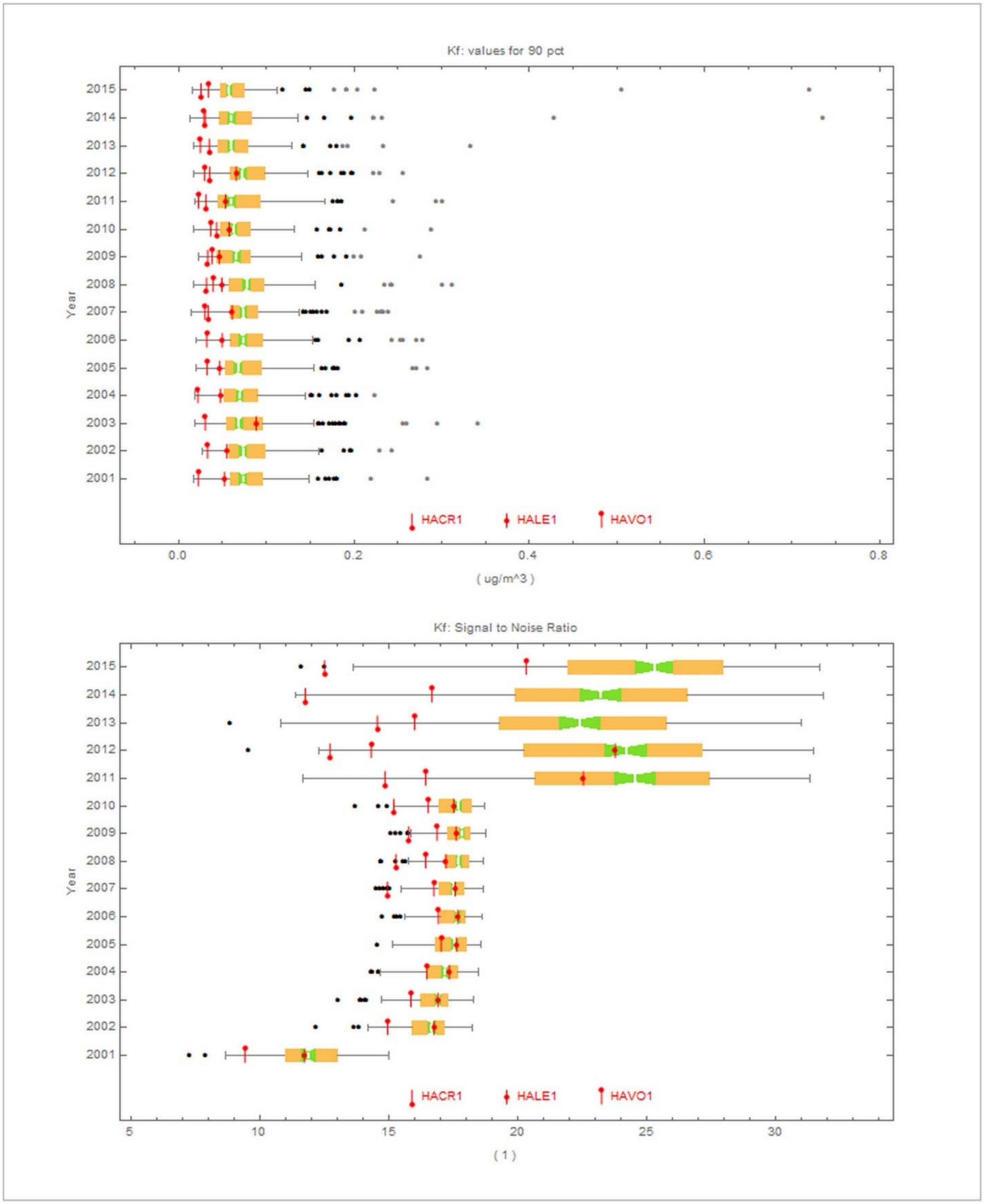

Figure F-35: IMPROVE Kf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

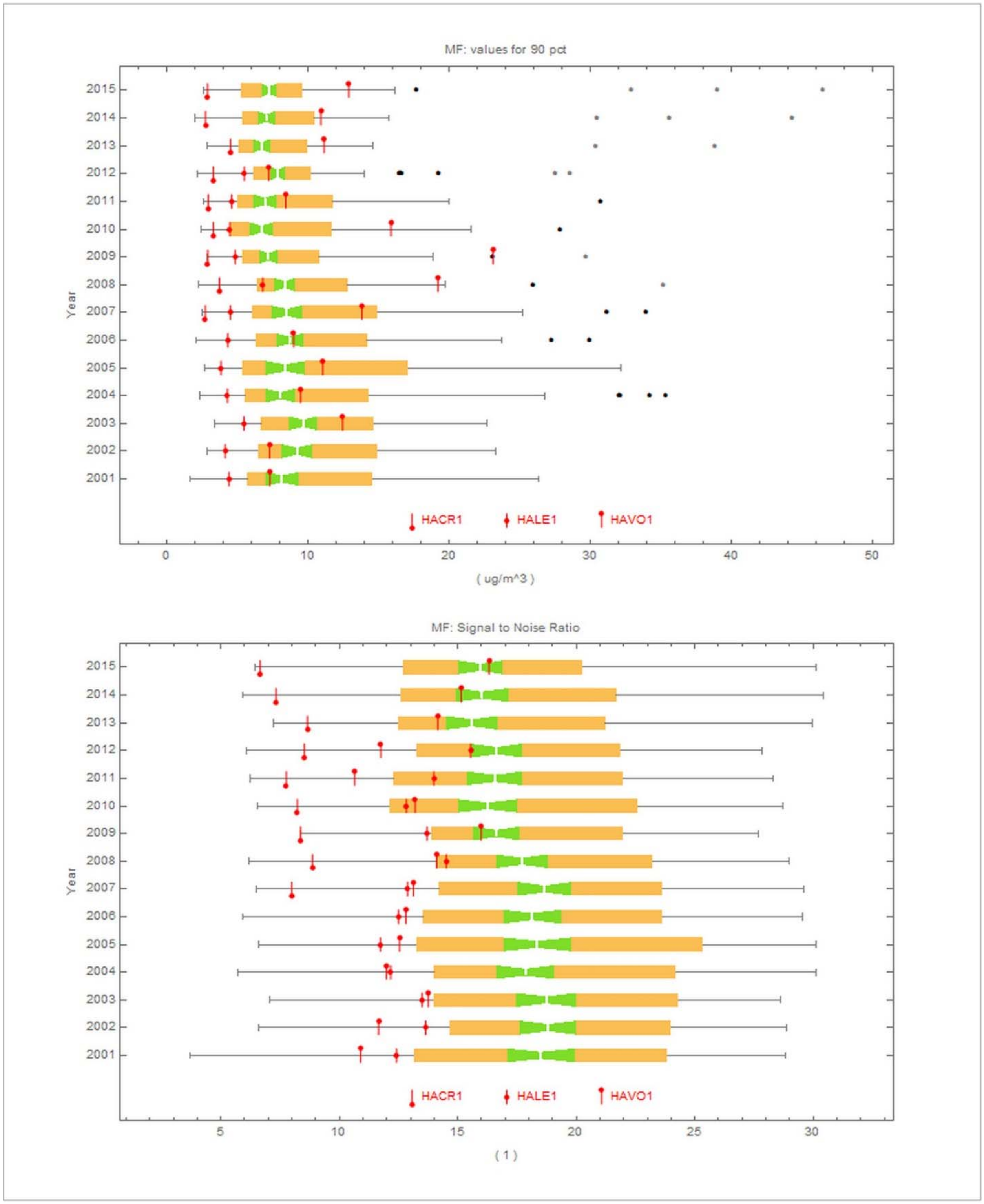

Figure F-36: IMPROVE MF Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

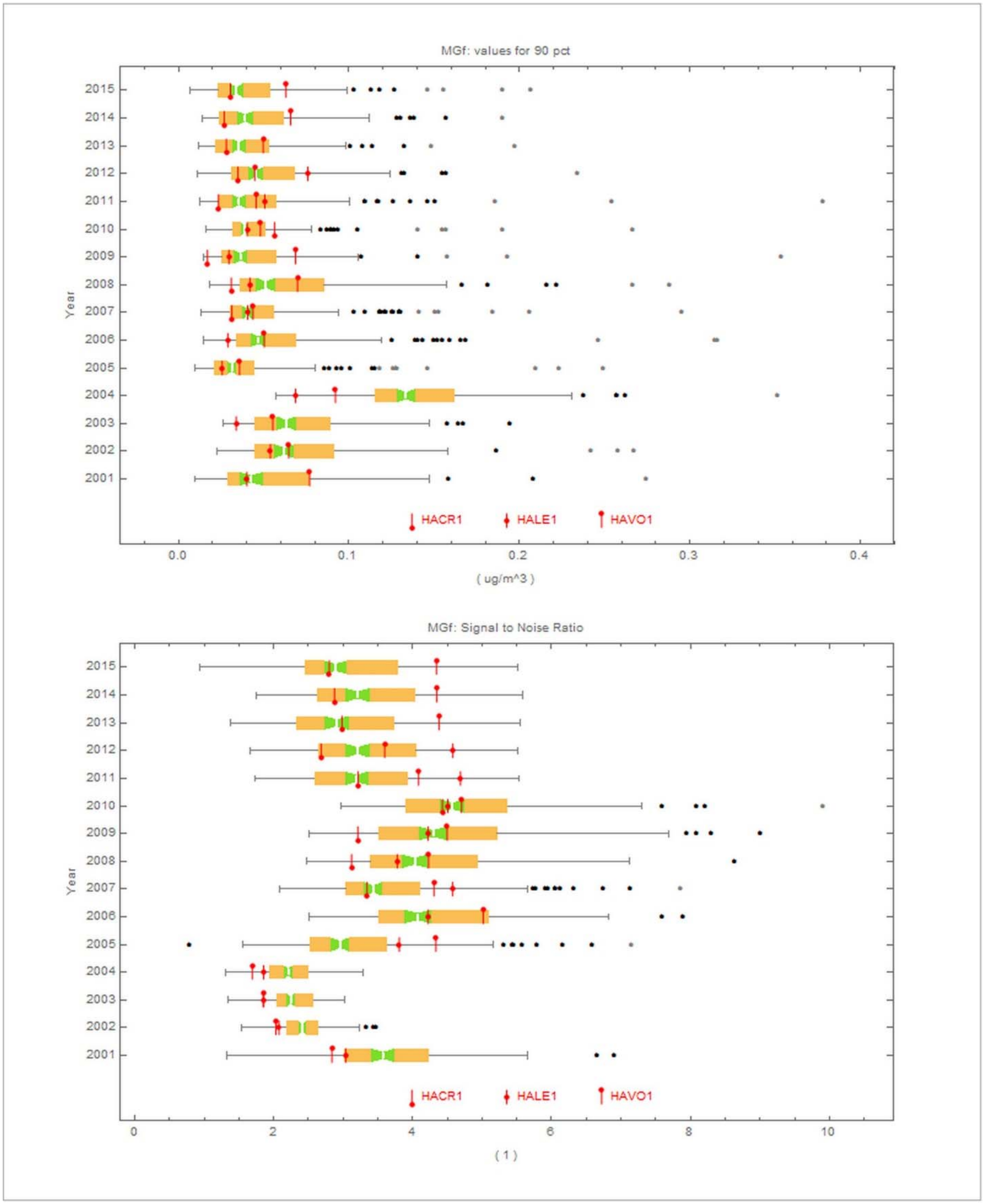

Figure F-37: IMPROVE MGf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

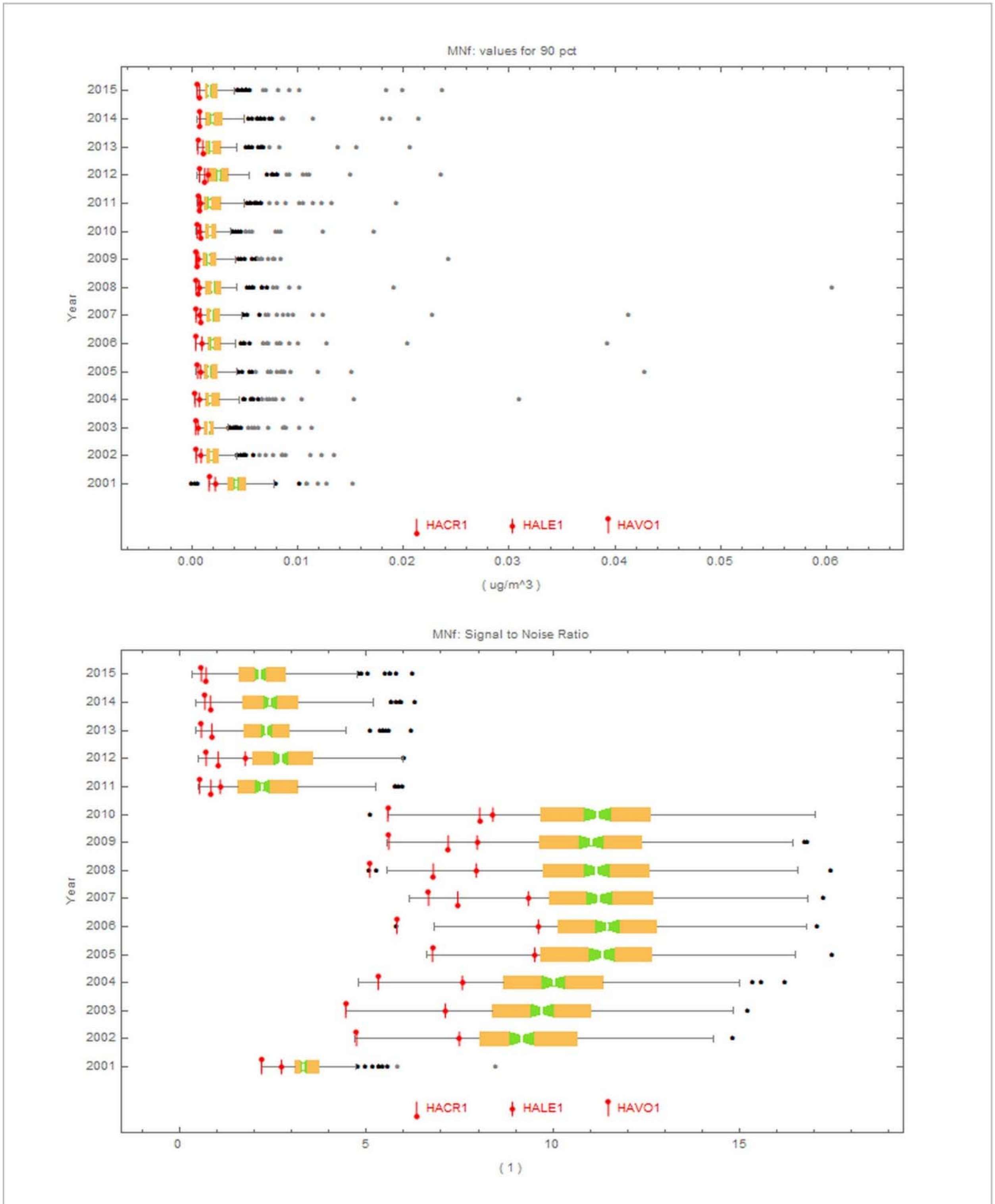

Figure F-38: IMPROVE MNf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

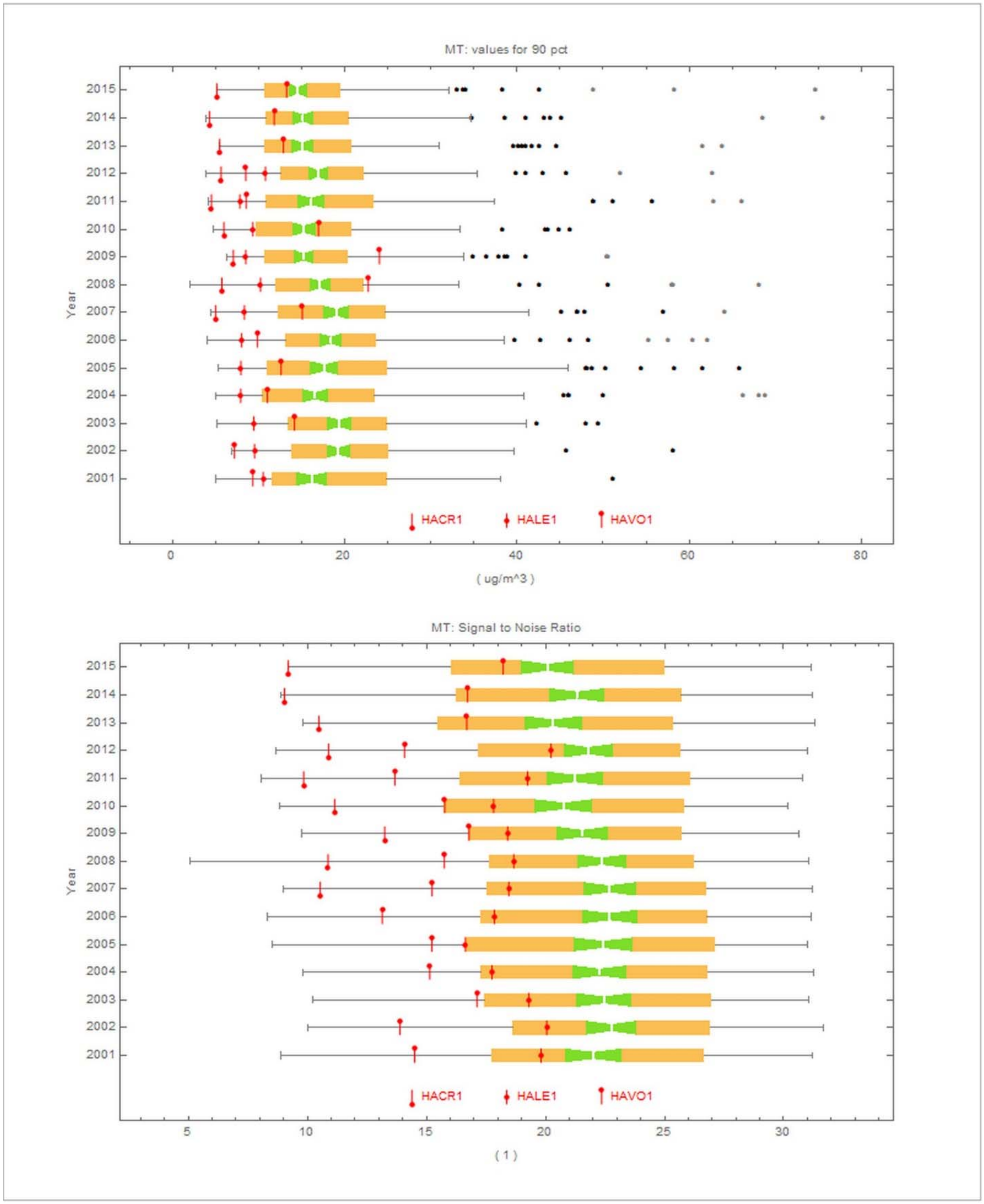

Figure F-39: IMPROVE MT Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

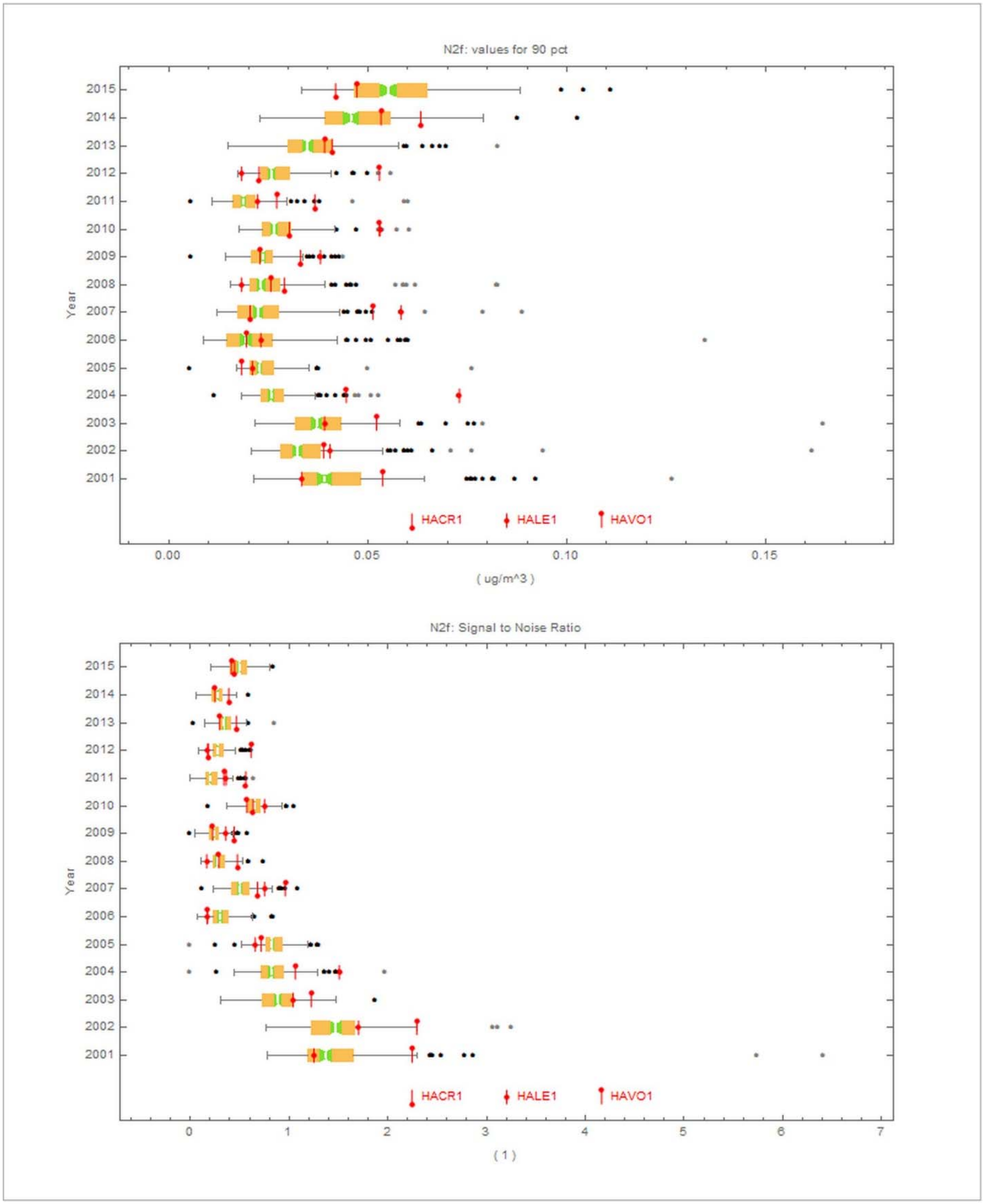

Figure F-40: IMPROVE N2f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

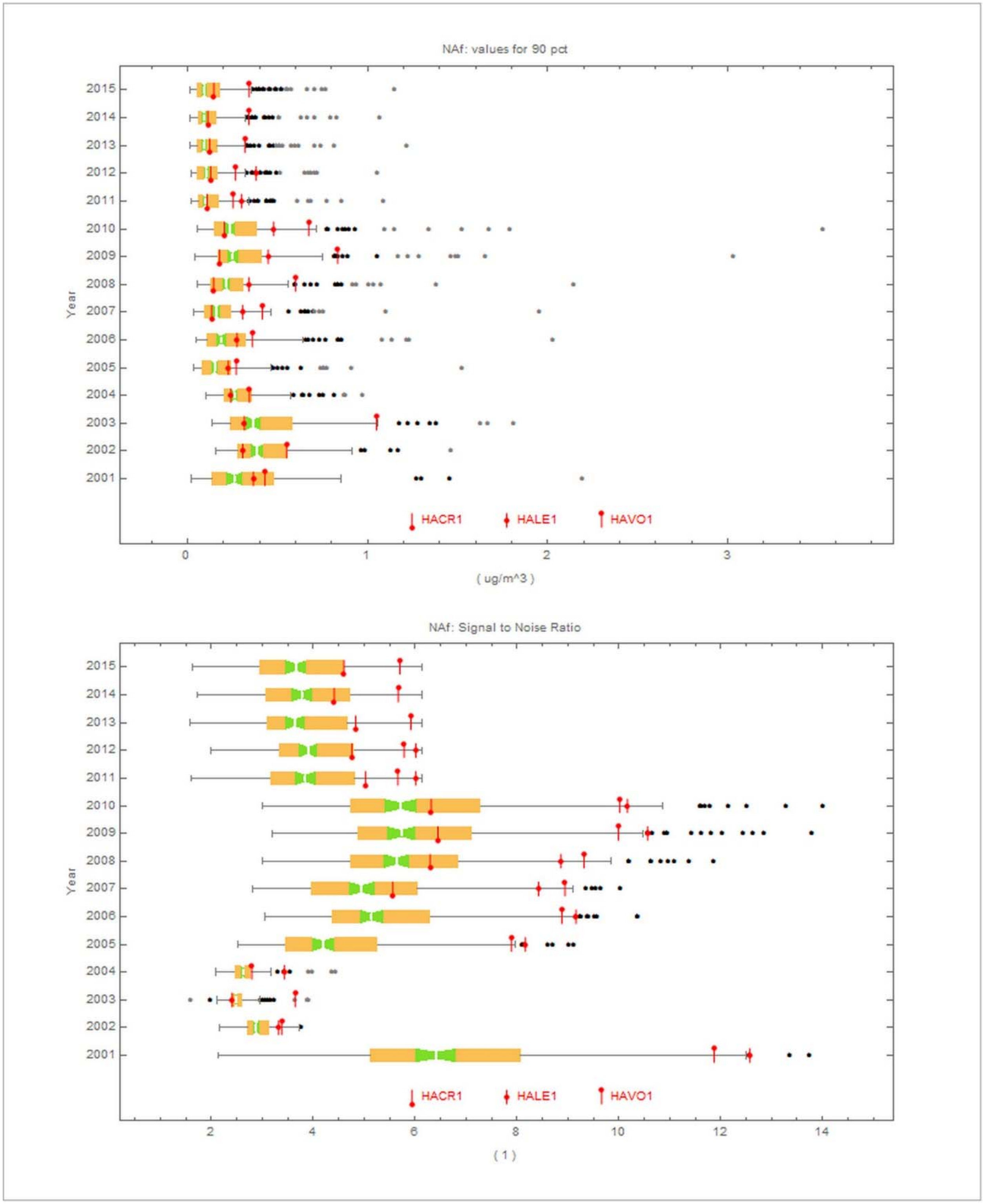

Figure F-41: IMPROVE NAf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

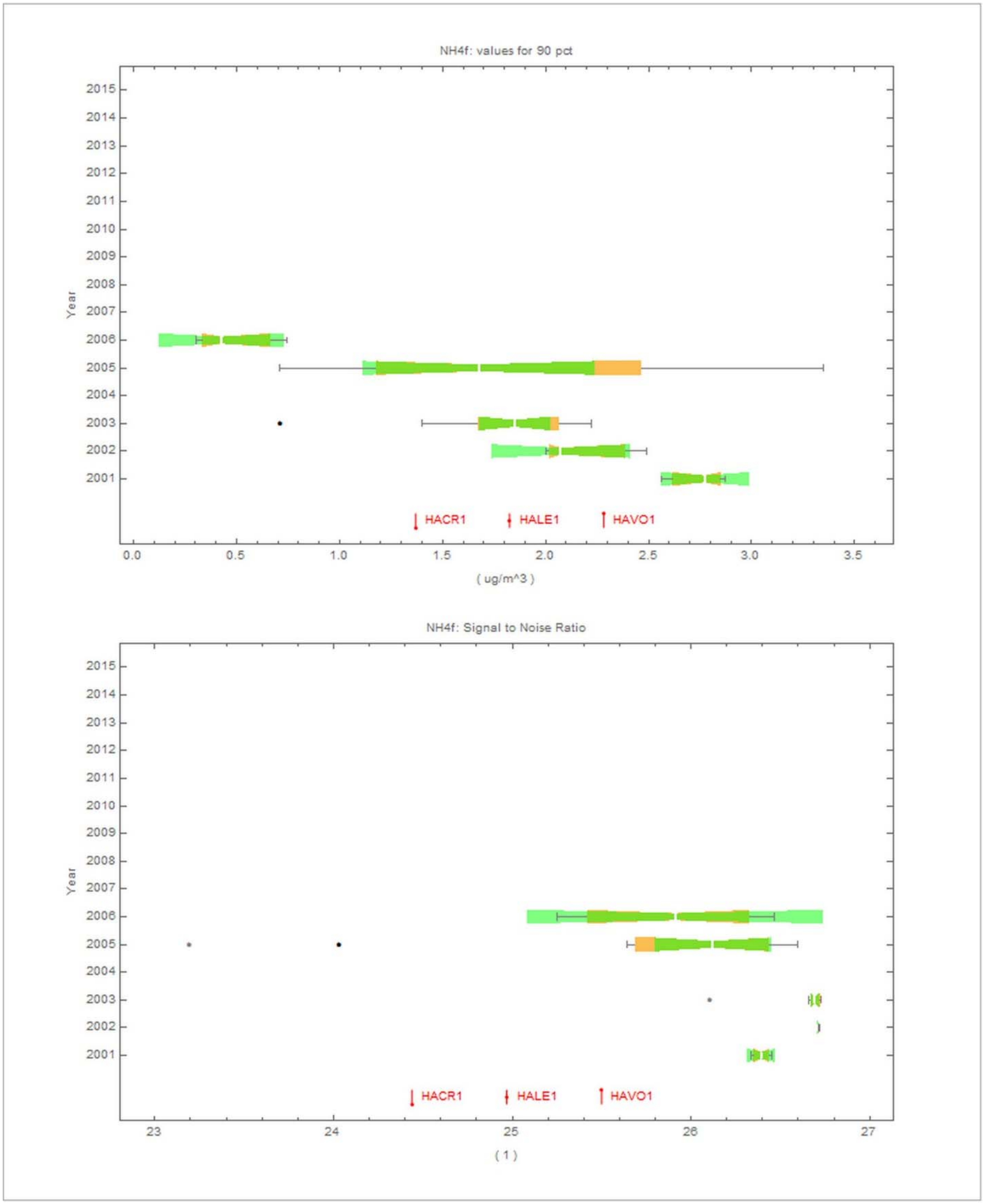

Figure F-42: IMPROVE NH4f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

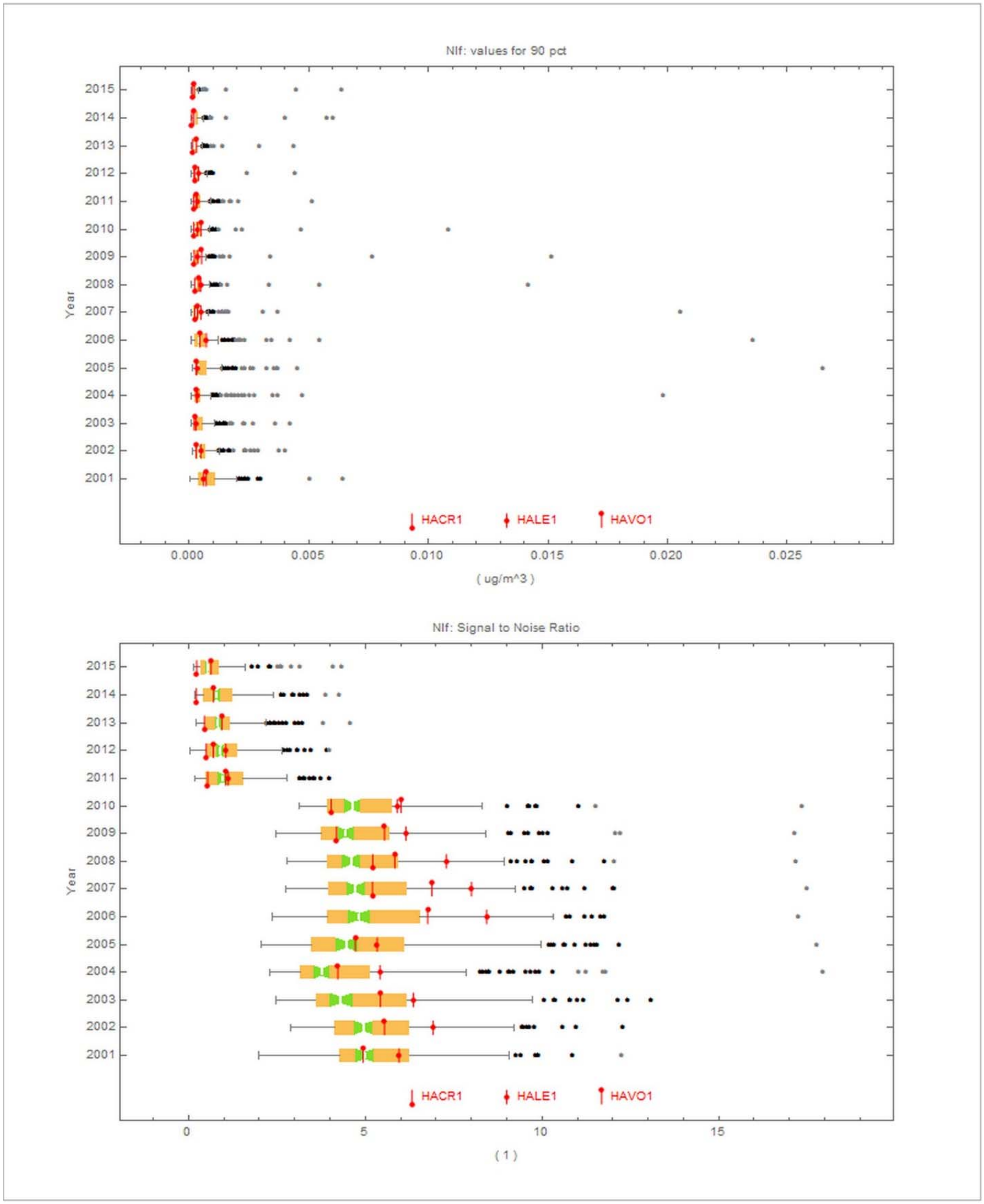

Figure F-43: IMPROVE NIf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

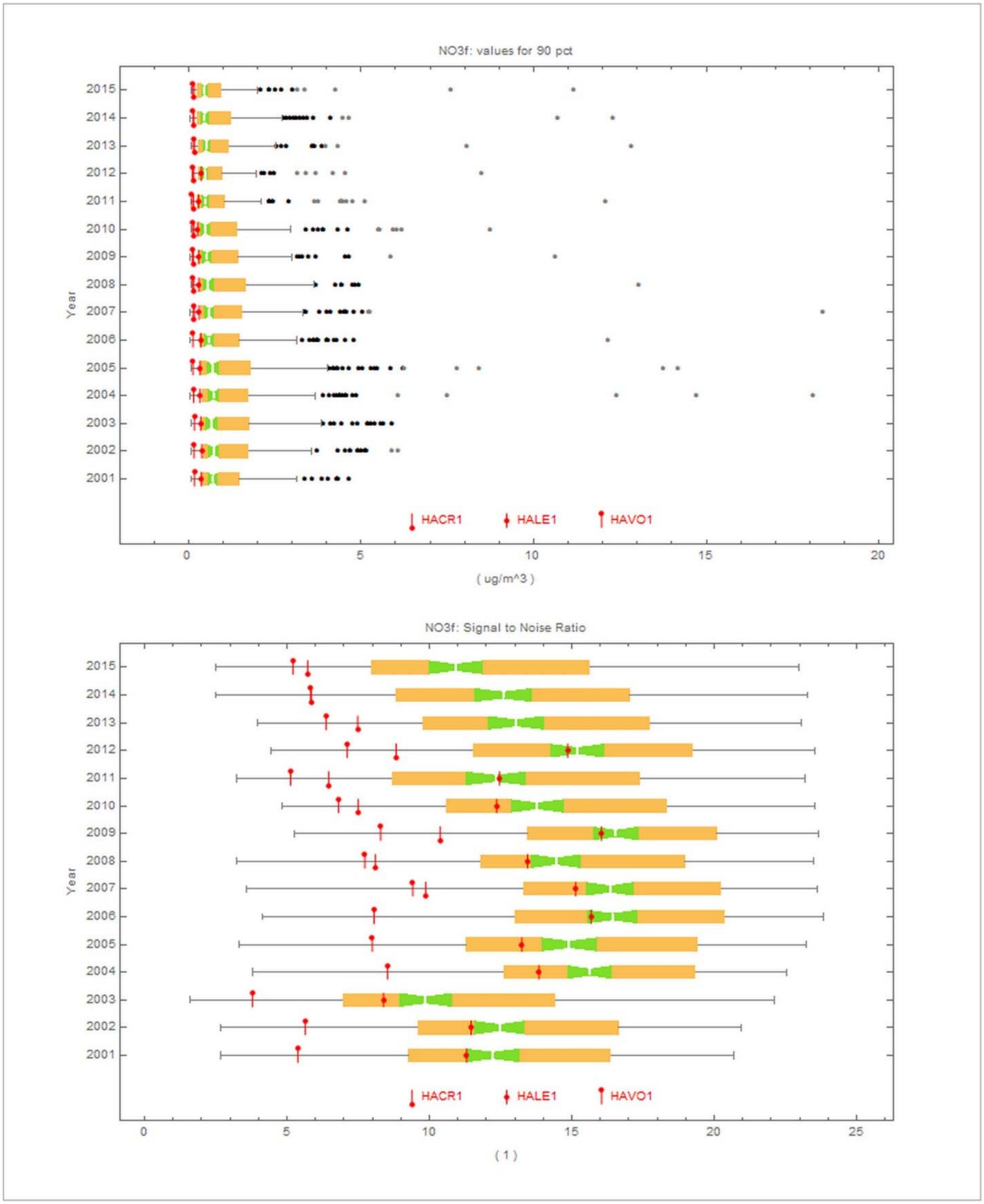

Figure F-44: IMPROVE NO3f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

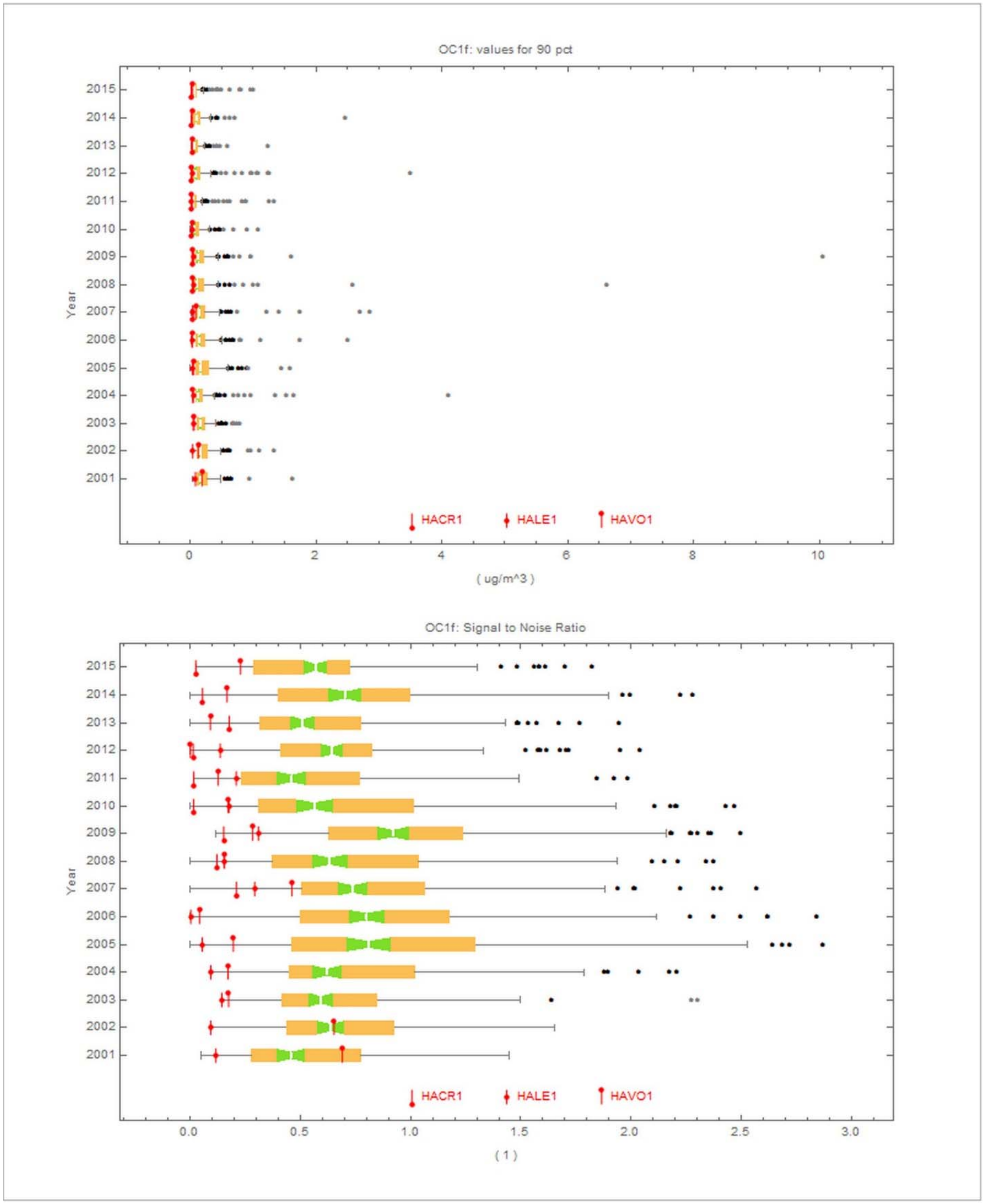

Figure F-45: IMPROVE OC1f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

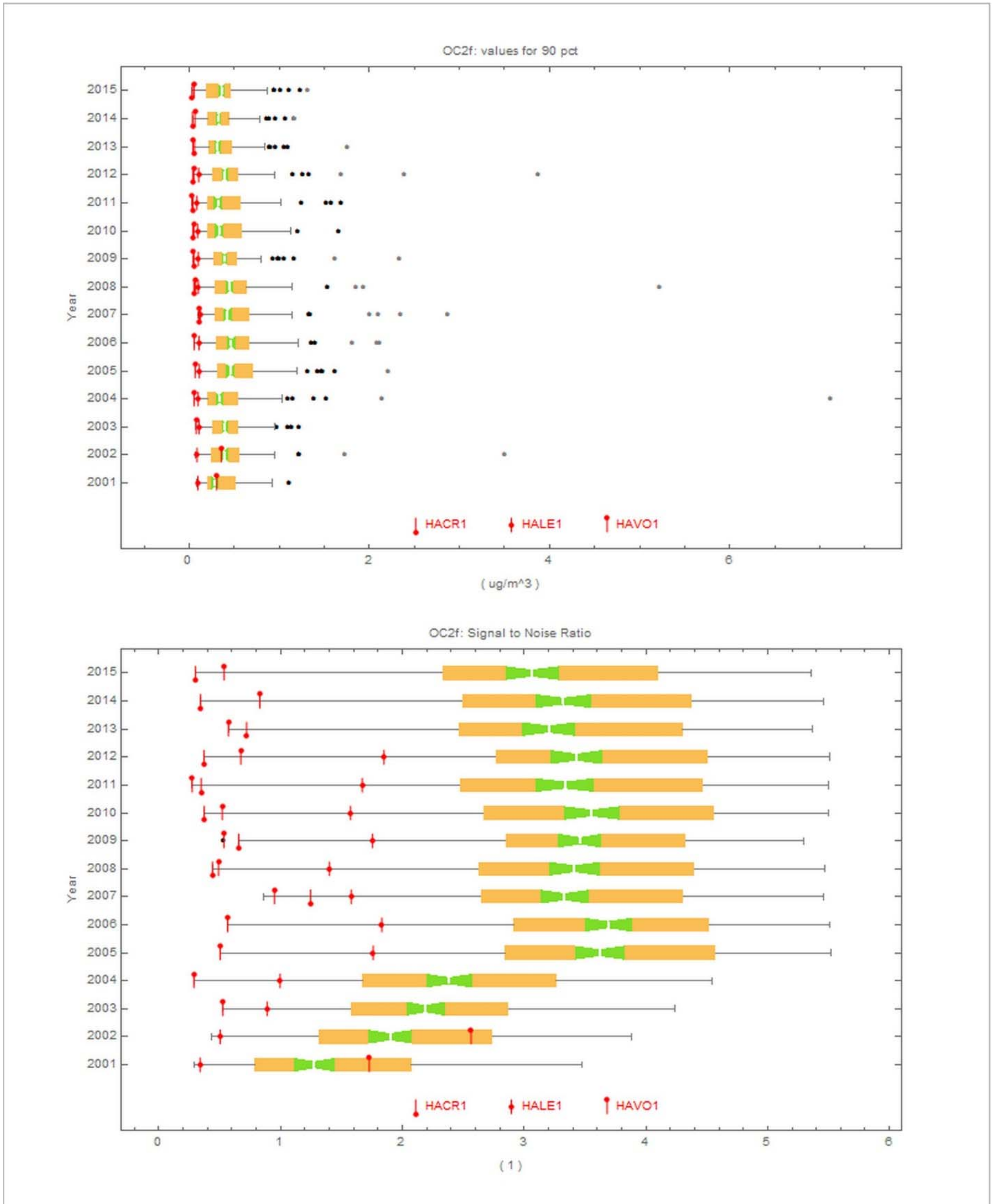

Figure F-46: IMPROVE OC2f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

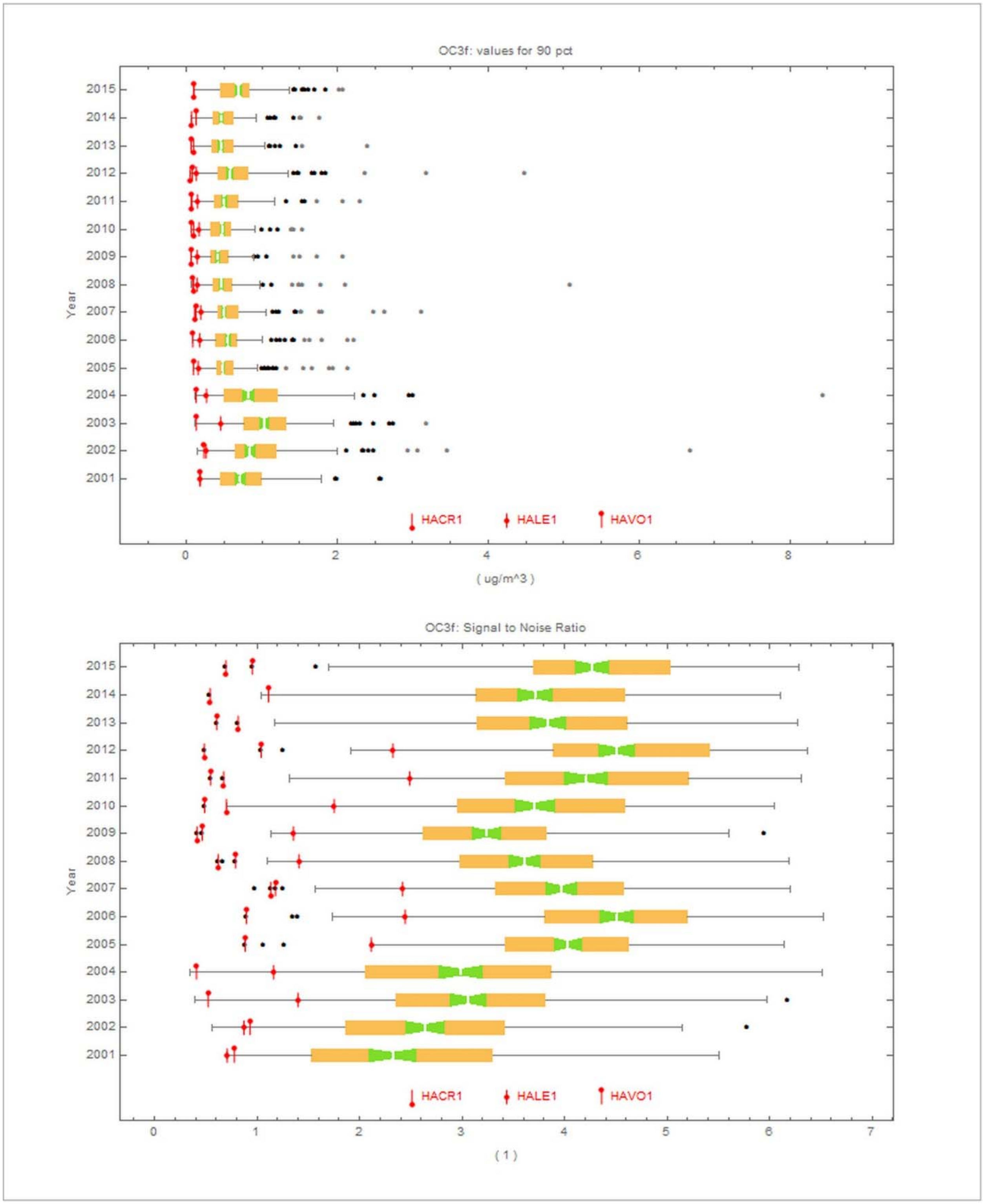

Figure F-47: IMPROVE OC3f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

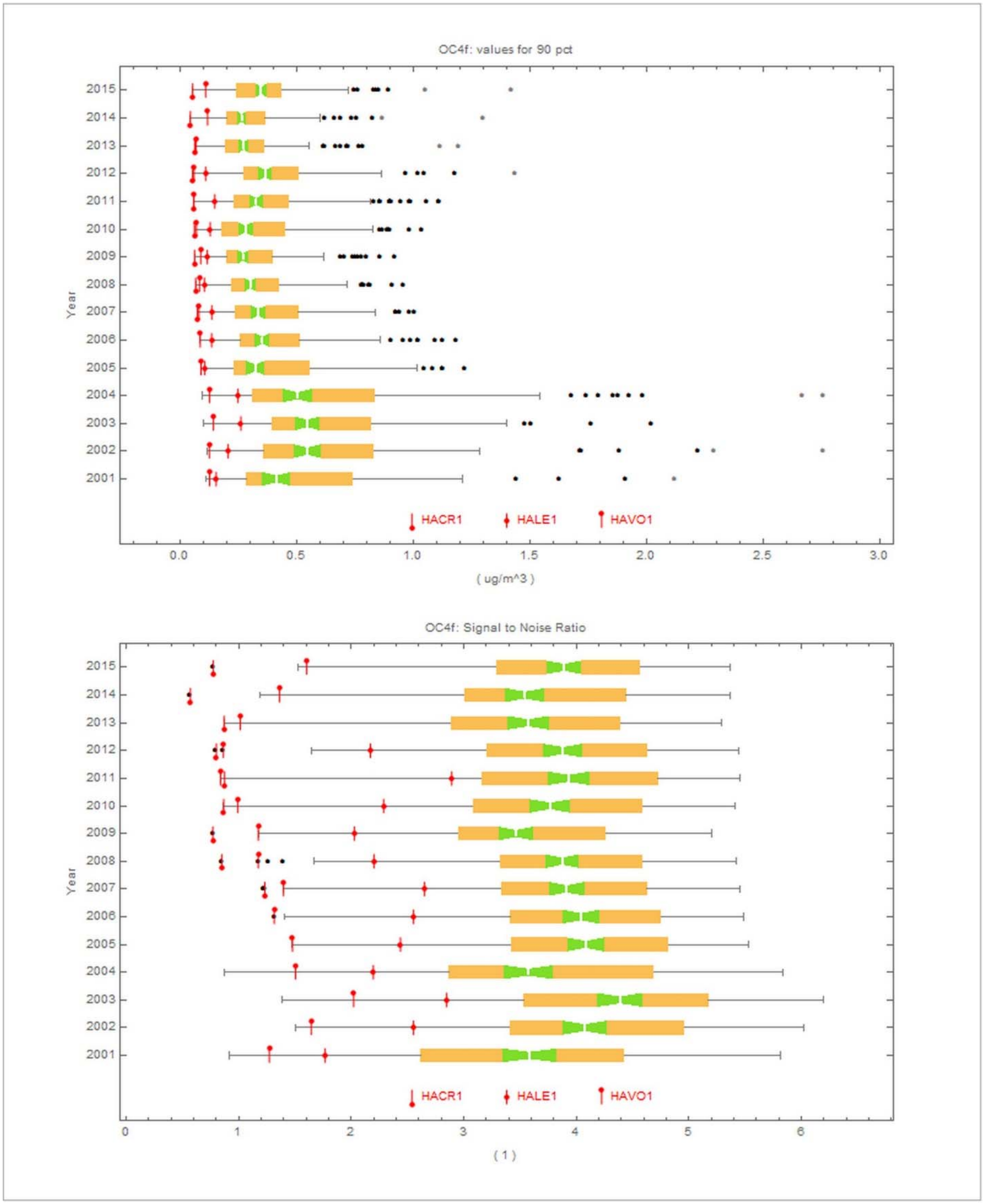

Figure F-48: IMPROVE OC4f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

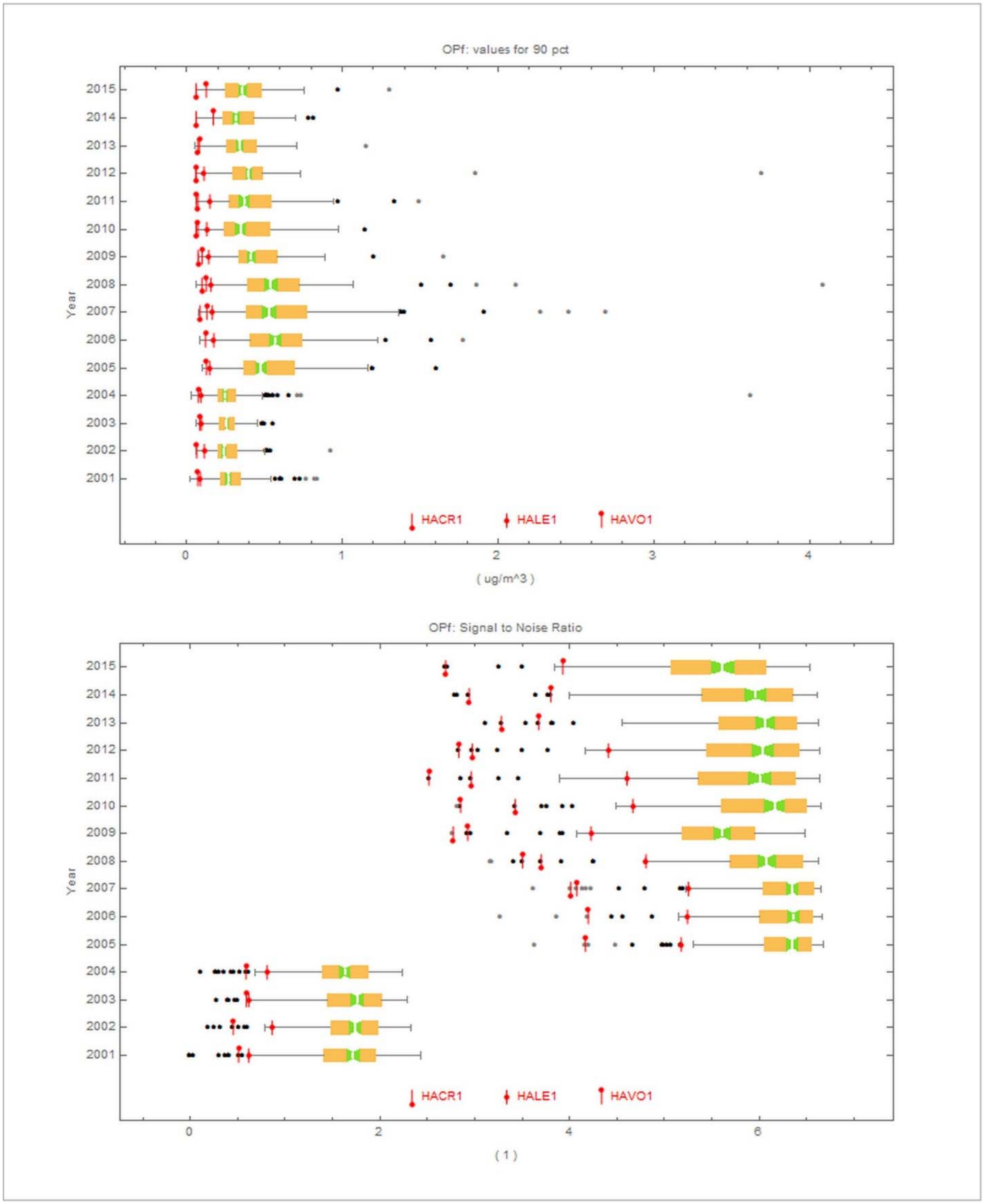

Figure F-49: IMPROVE OP1f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

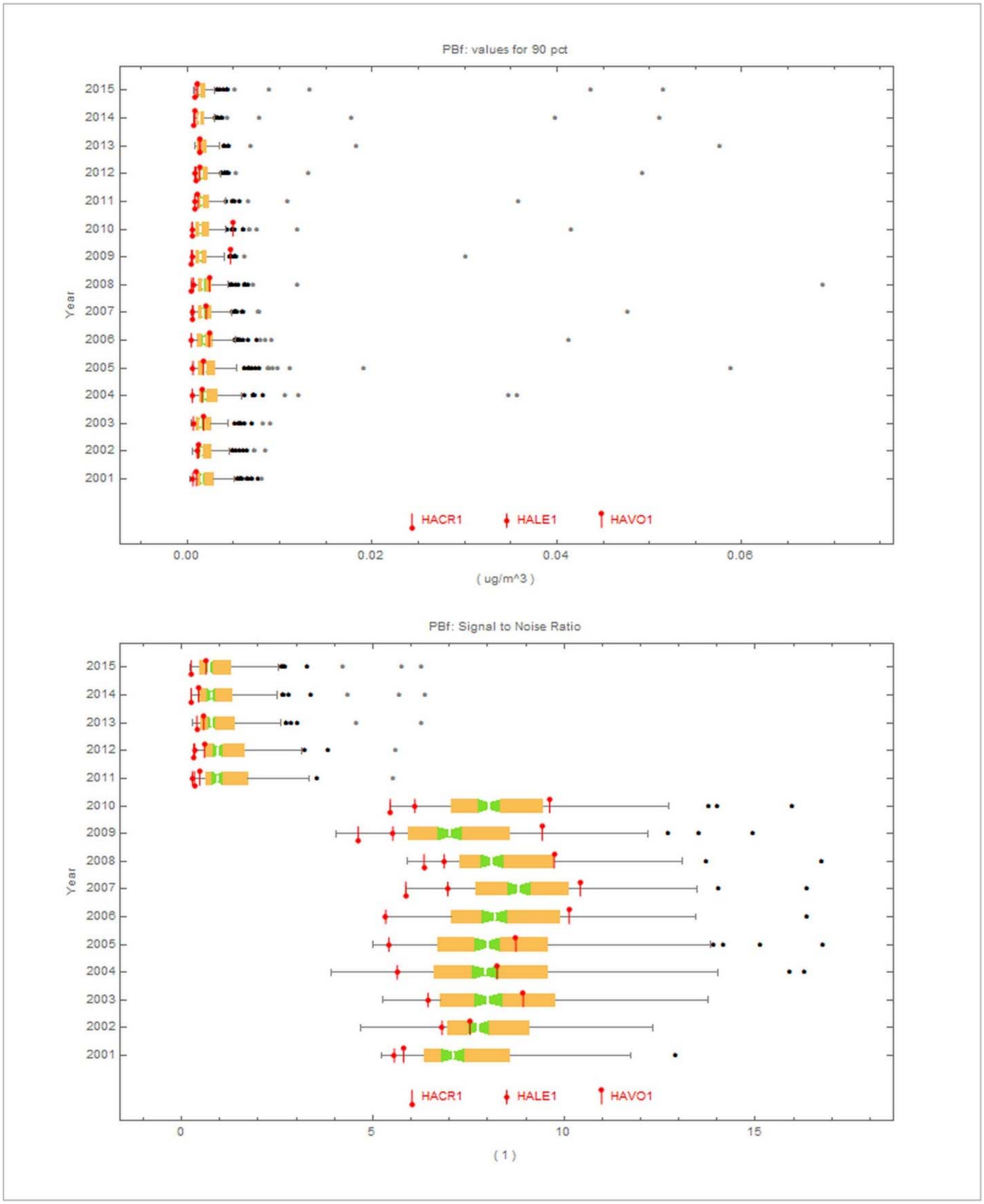

Figure F-50: IMPROVE PBf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

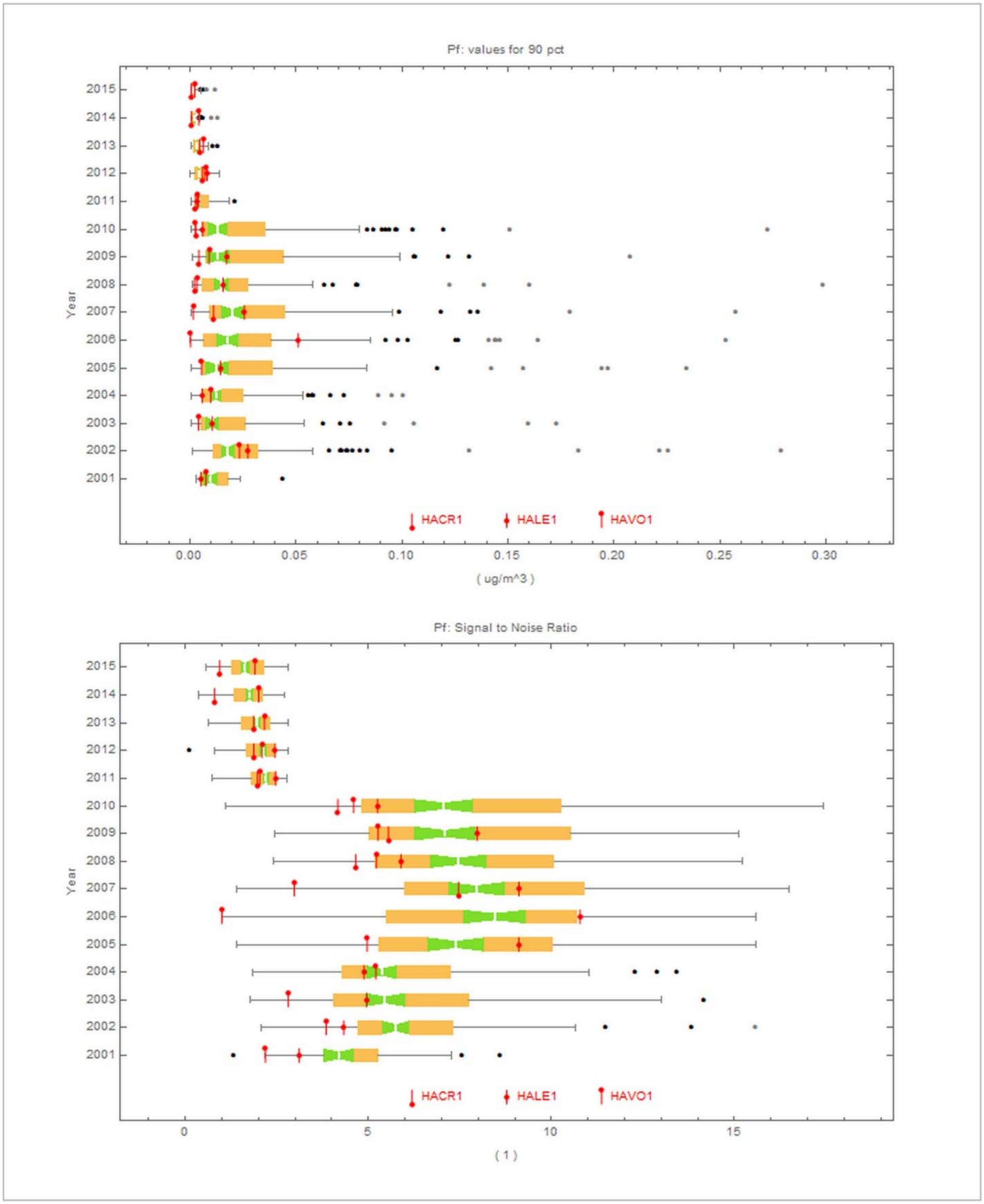

Figure F-51: IMPROVE Pf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

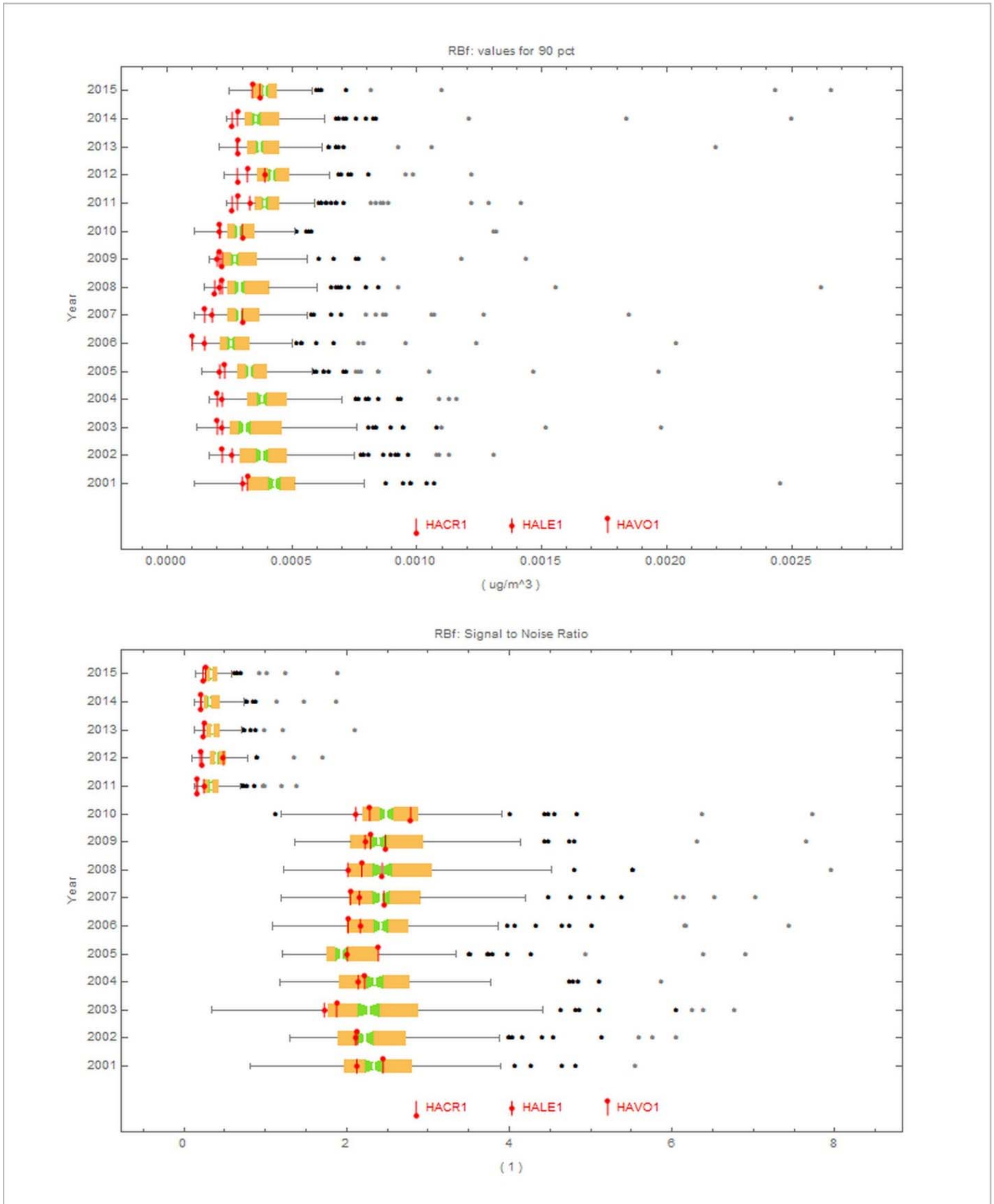

Figure F-52: IMPROVE RBf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

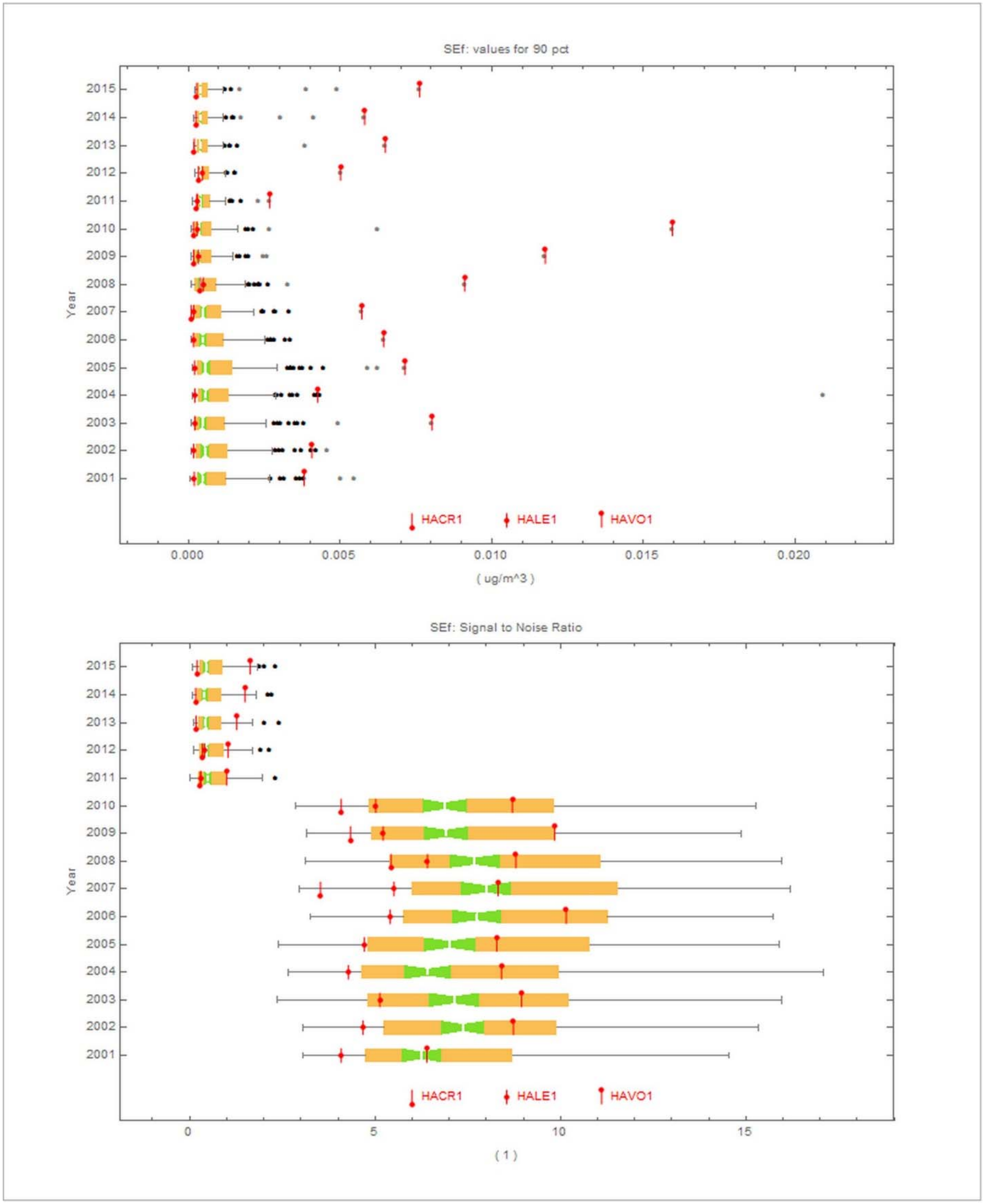

Figure F-53: IMPROVE SEf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

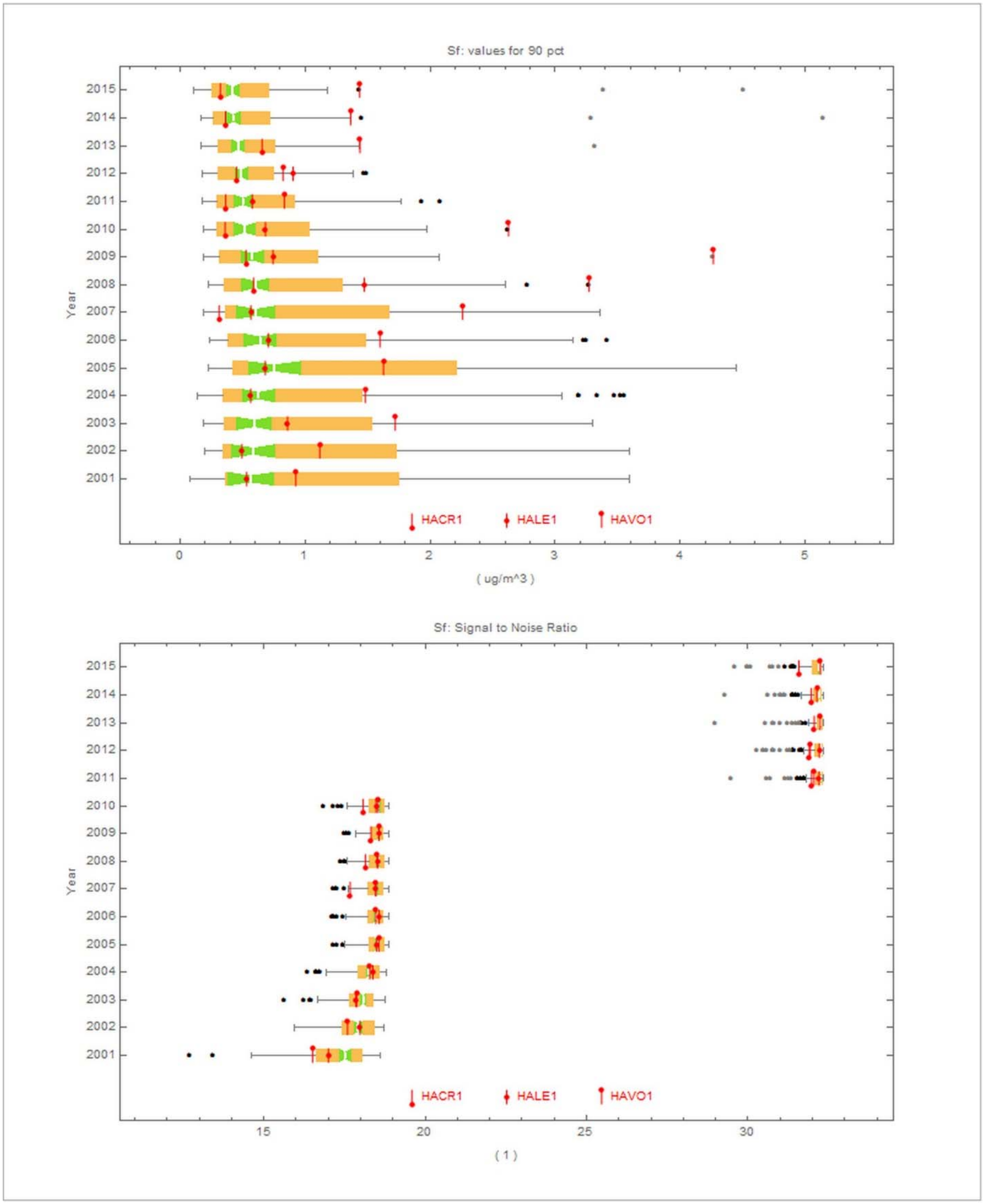

Figure F-54: IMPROVE Sf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

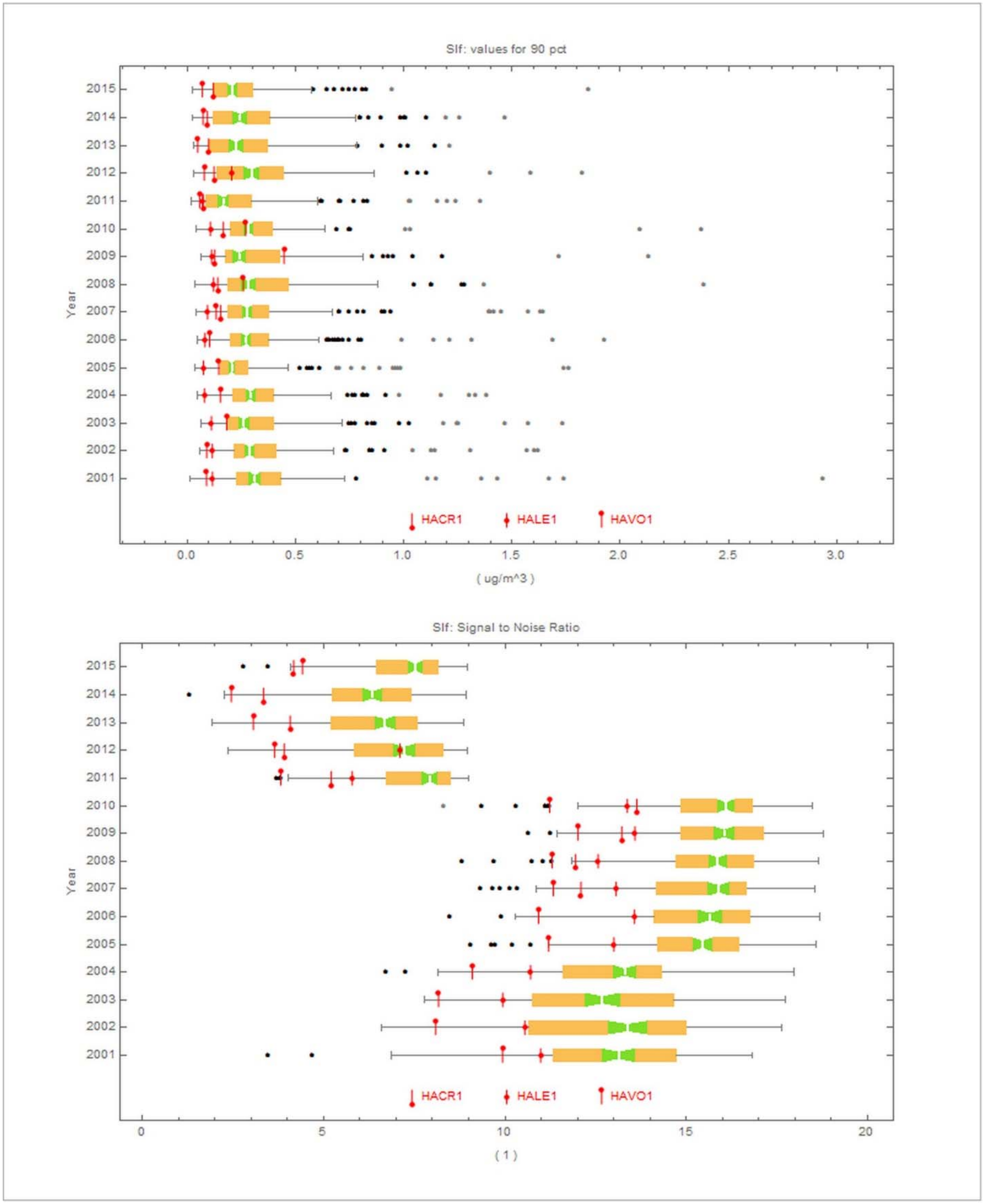

Figure F-55: IMPROVE SIf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

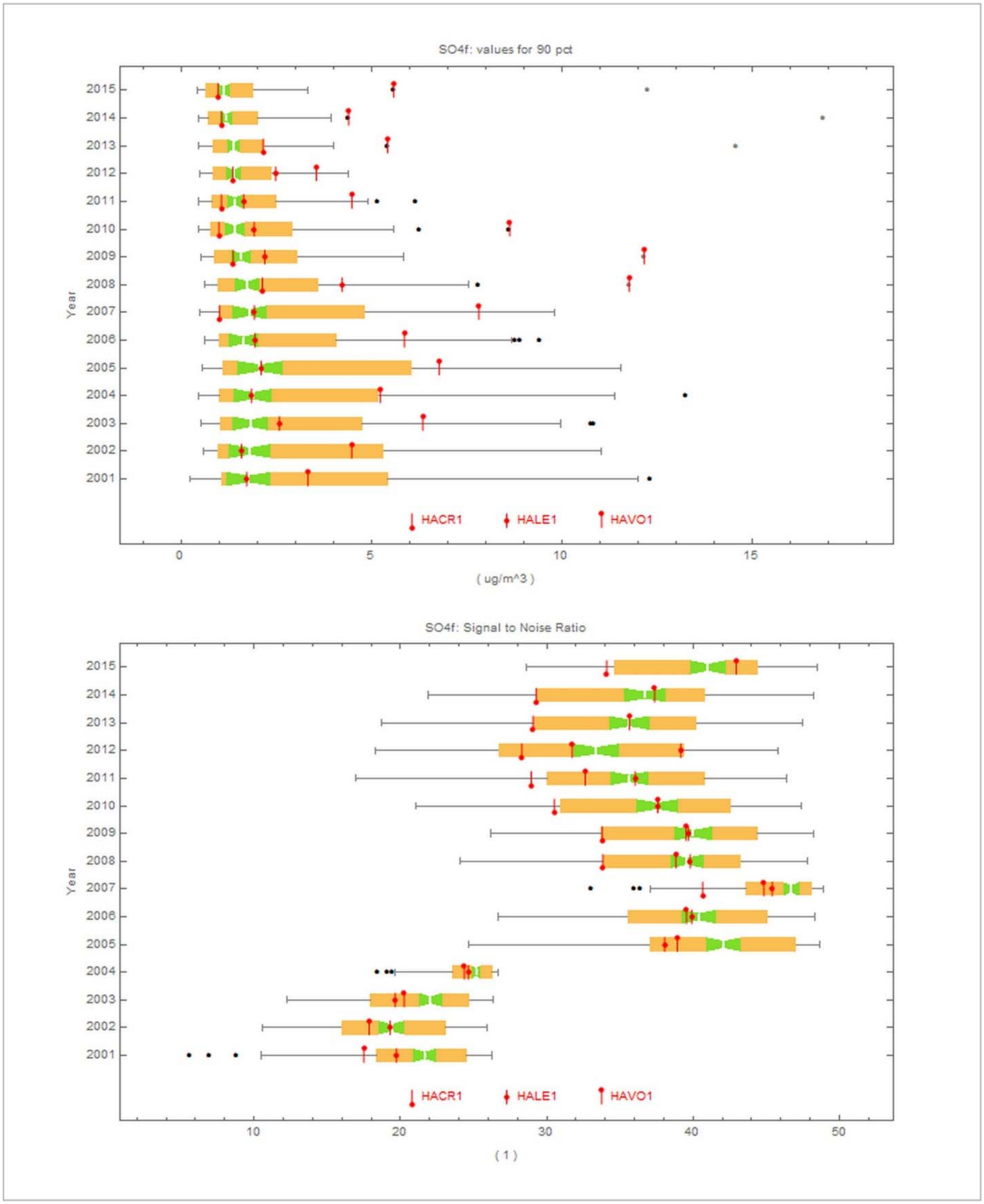

Figure F-56: IMPROVE SO4f Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

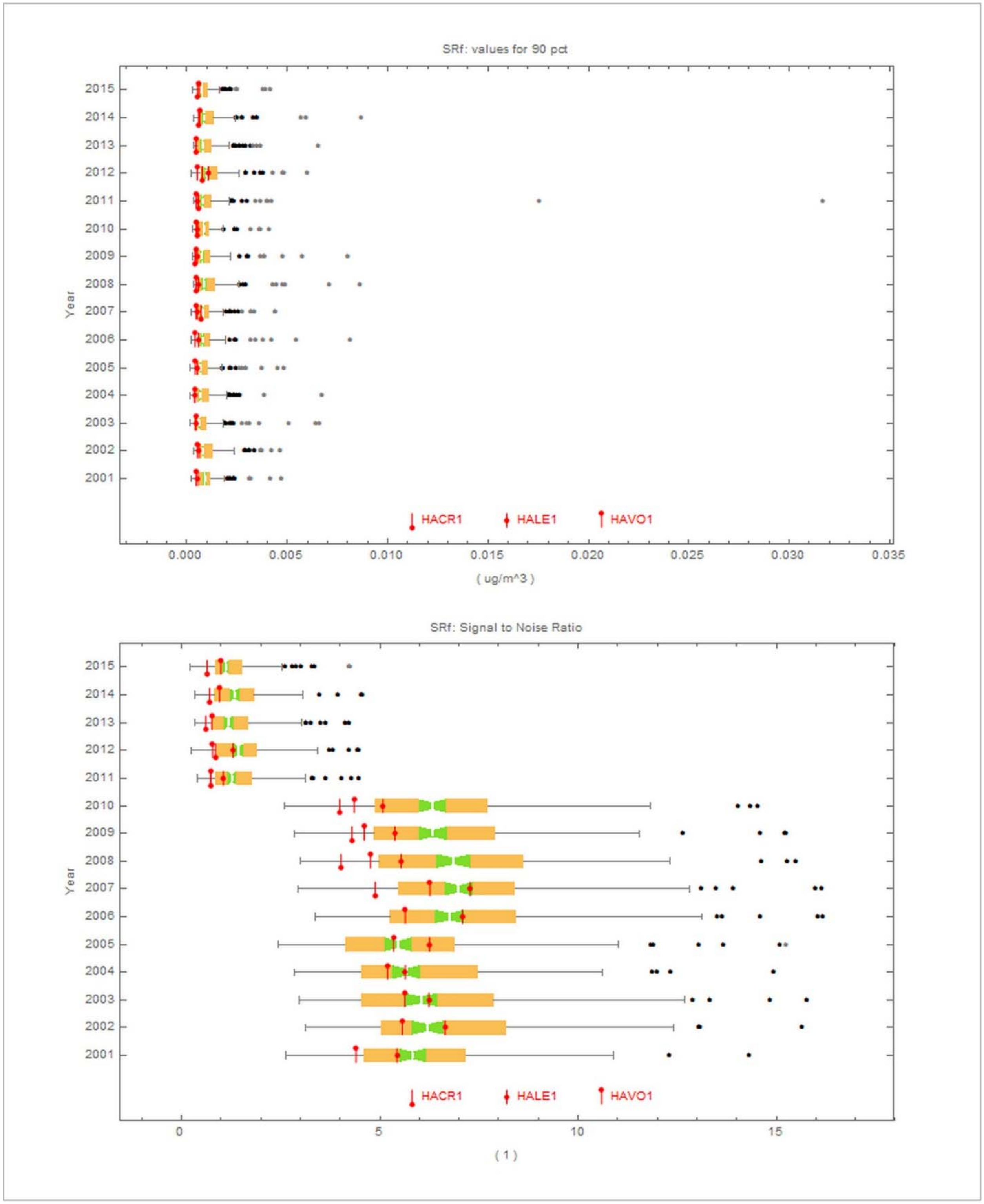

Figure F-57: IMPROVE SRf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

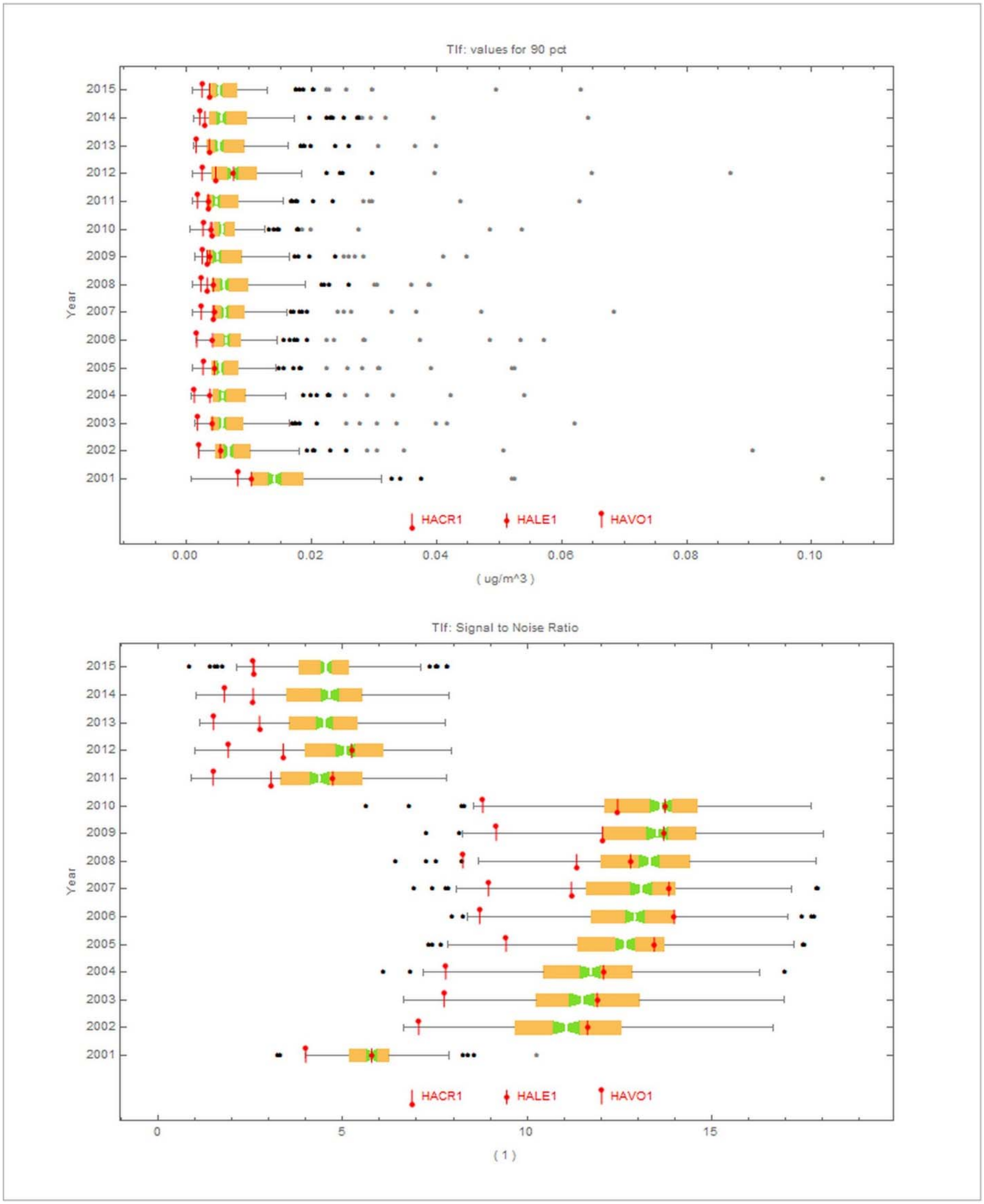

Figure F-58: IMPROVE TIf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

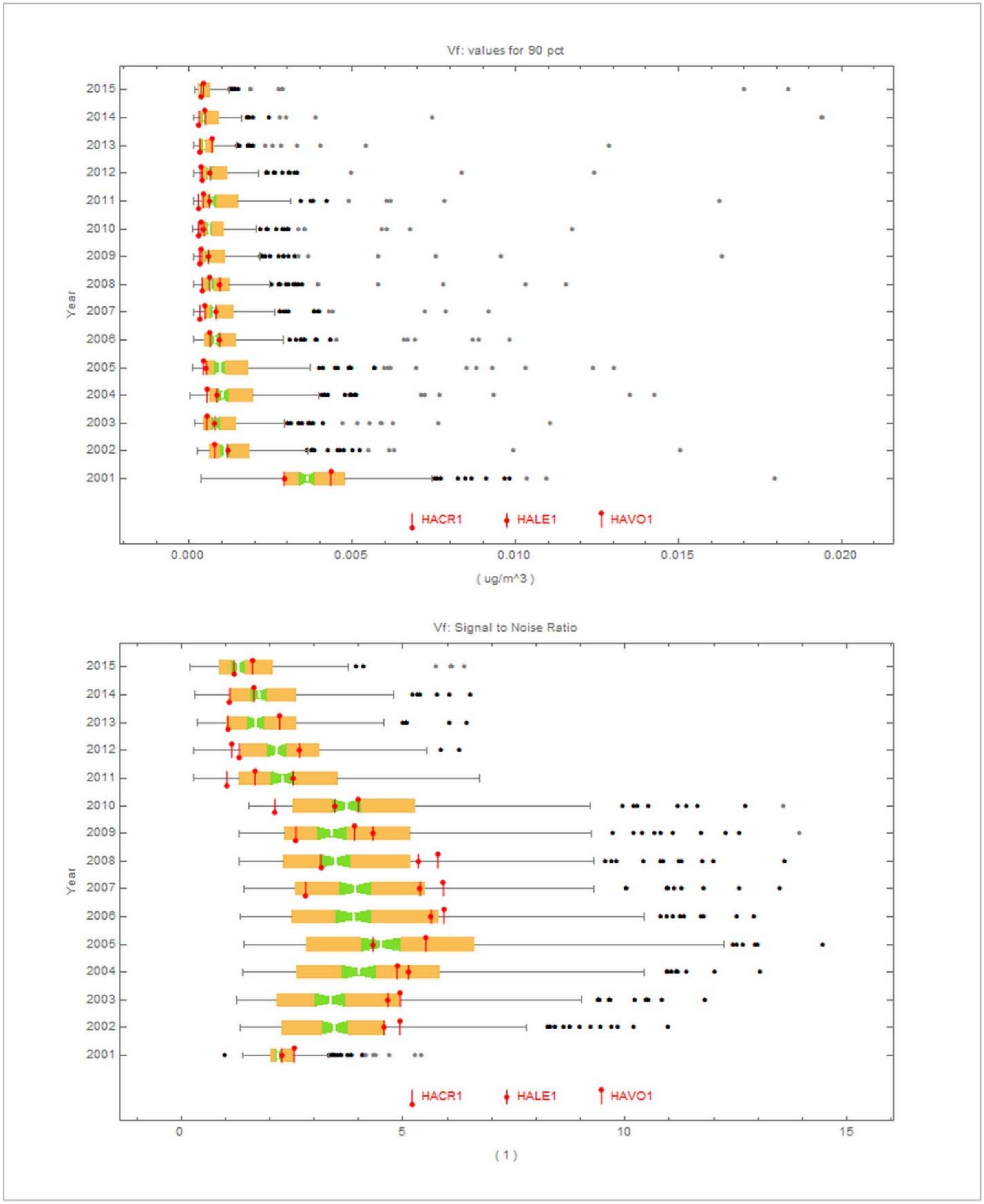

Figure F-59: IMPROVE Vf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

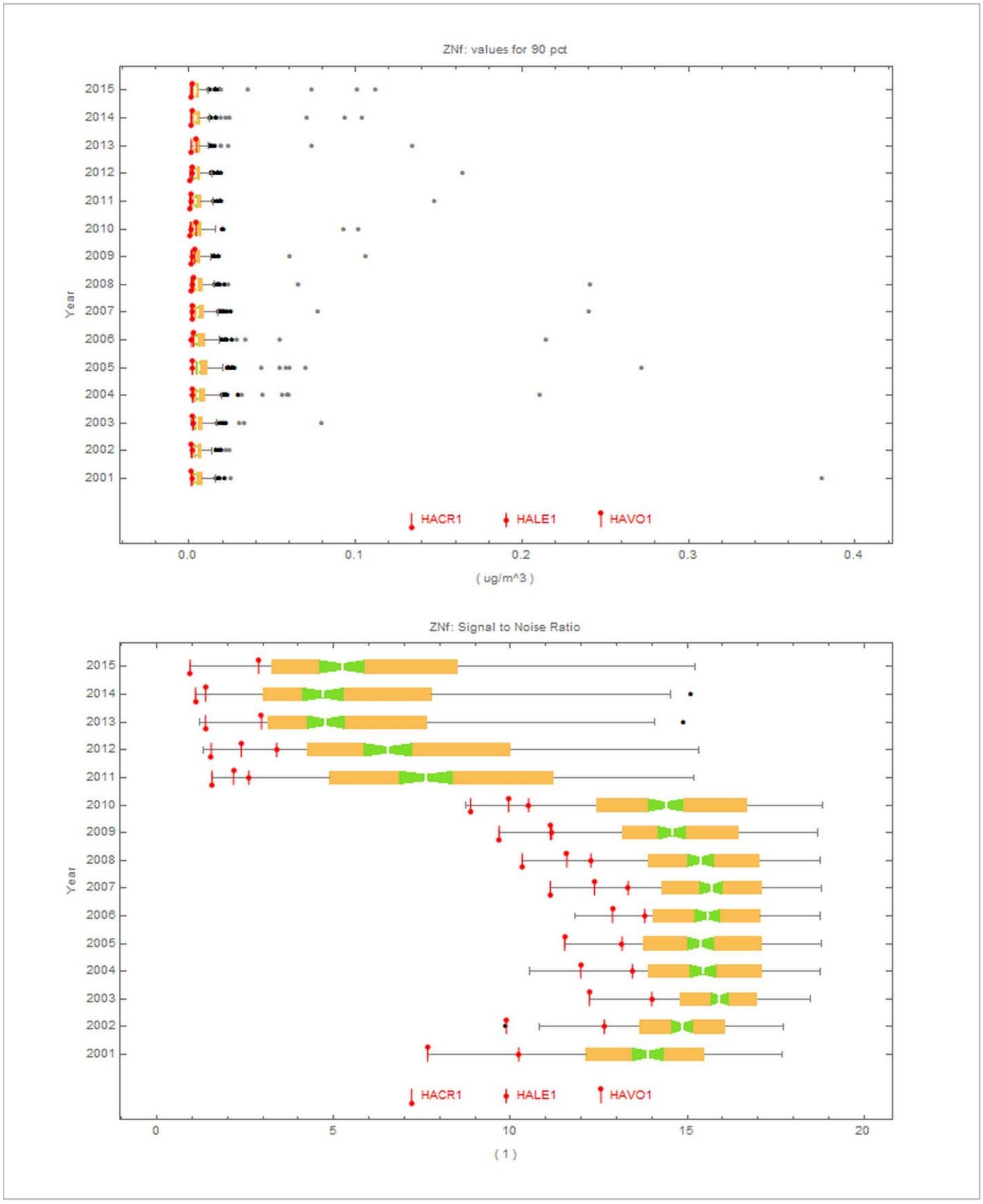

Figure F-60: IMPROVE ZNf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

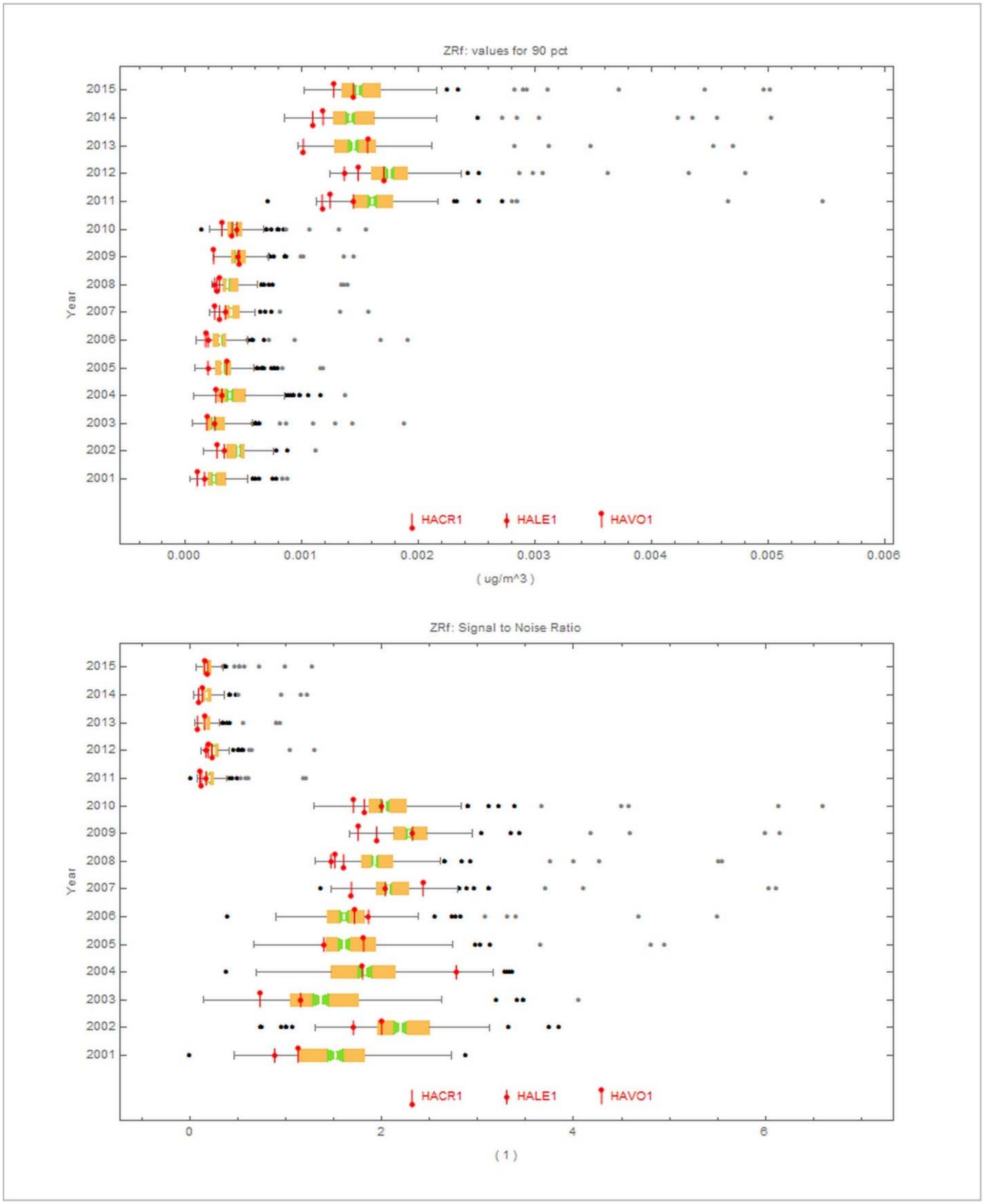

Figure F-61: IMPROVE ZRf Distributions for 90th Percentile Value and Calculated Signal to Noise Value Distributions for All Sites with Hawaii Sites Noted

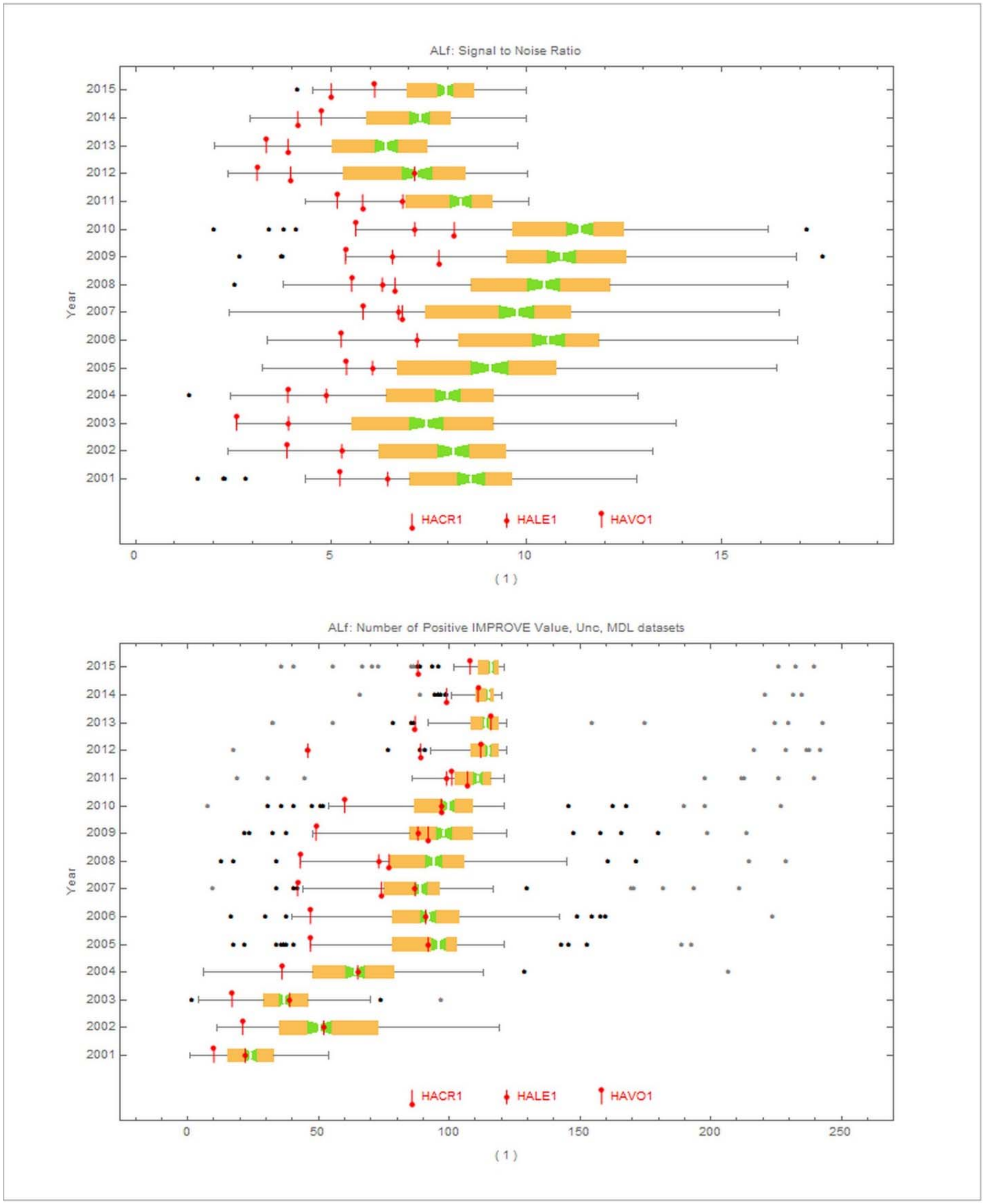

Figure F-62: IMPROVE ALf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

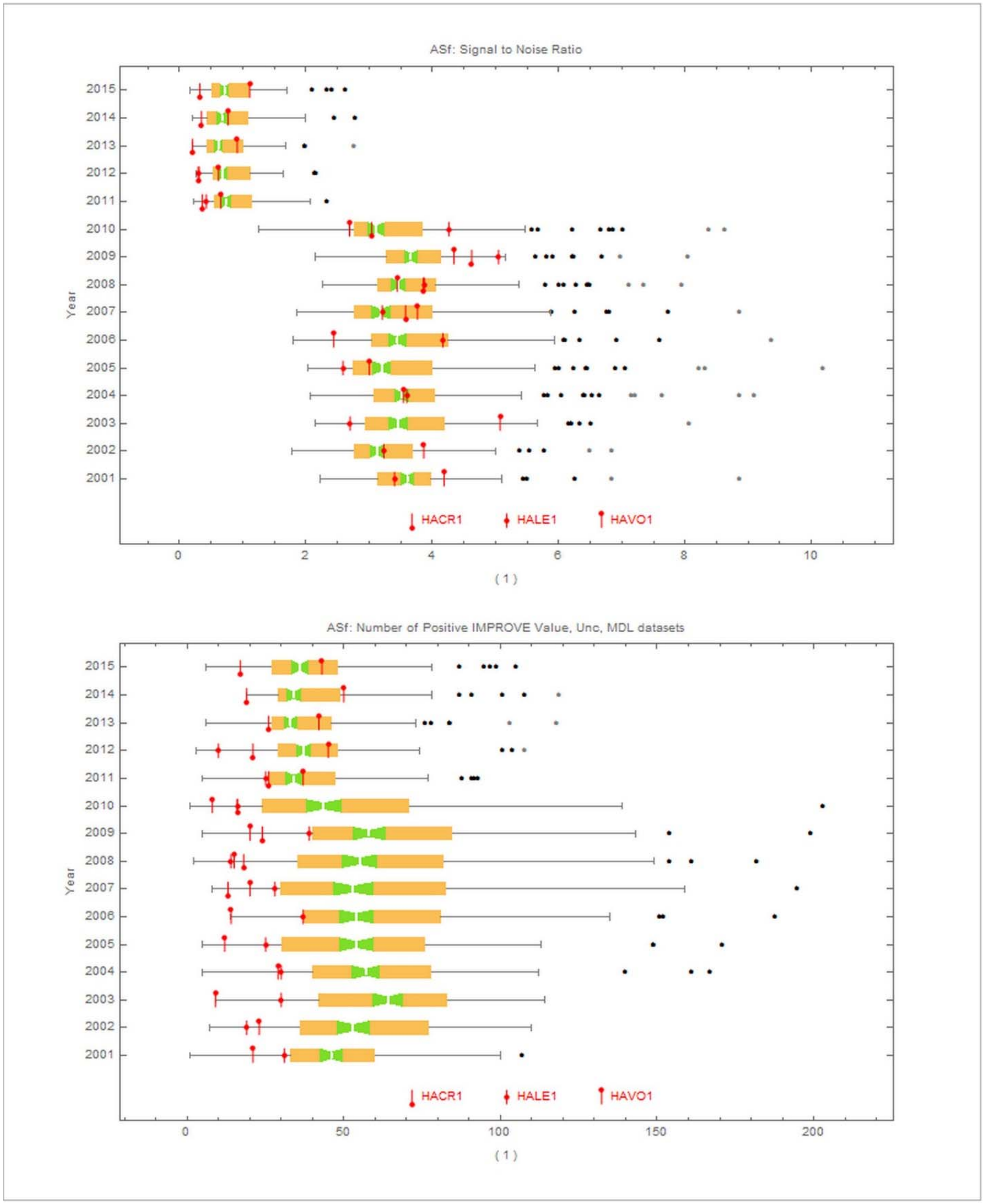

Figure F-63: IMPROVE ASf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

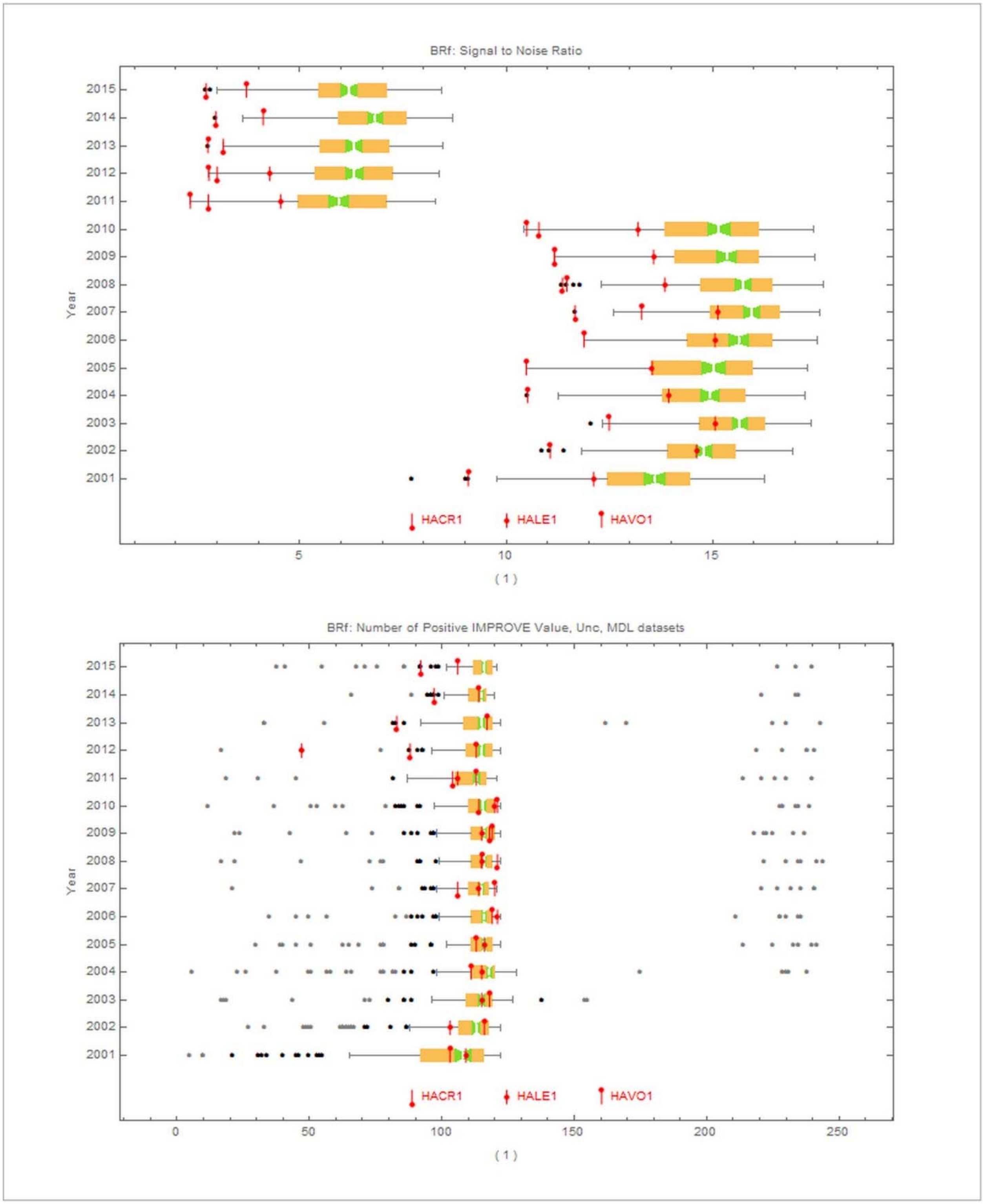

Figure F-64: IMPROVE BRf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

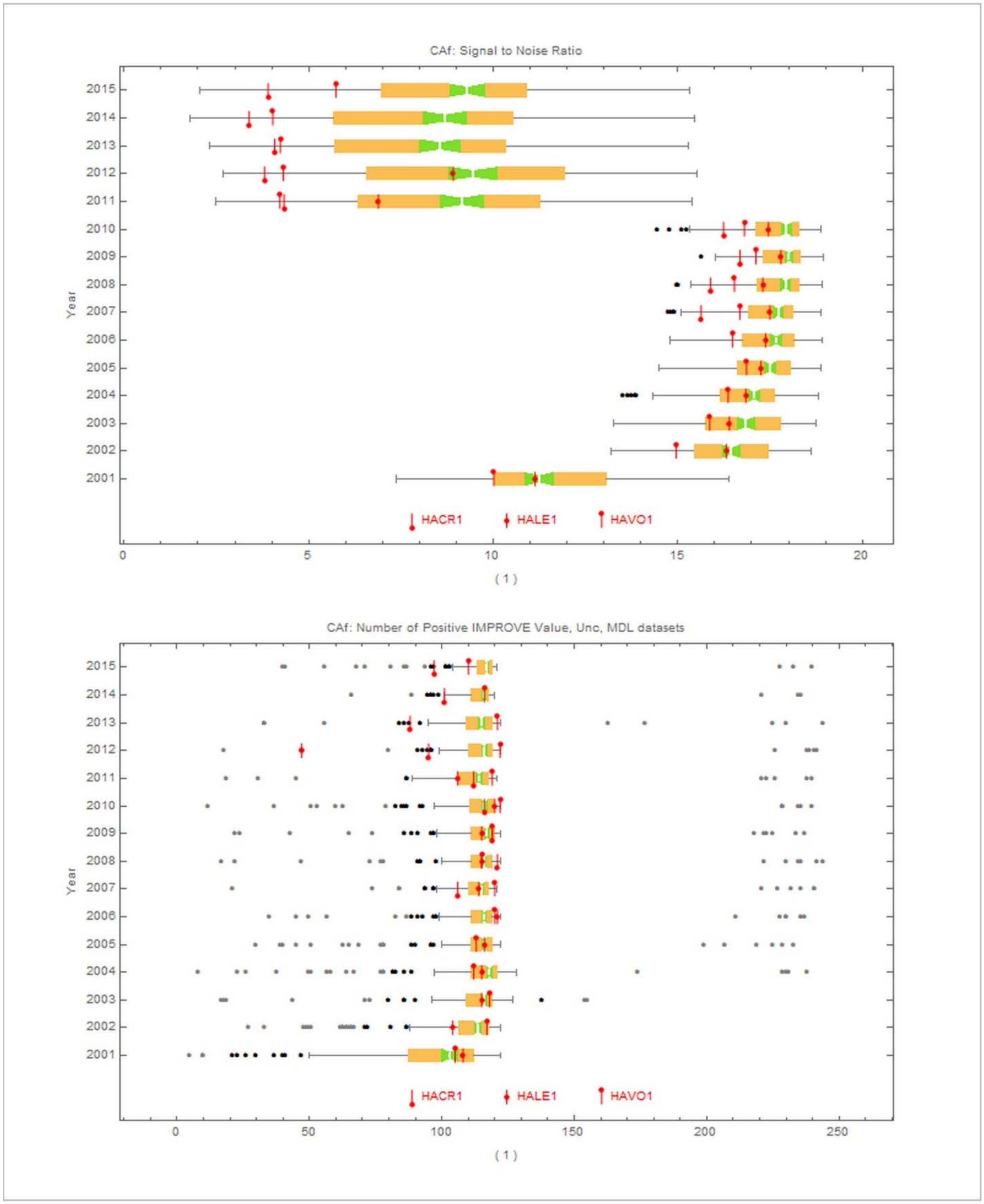

Figure F-65: IMPROVE CAf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

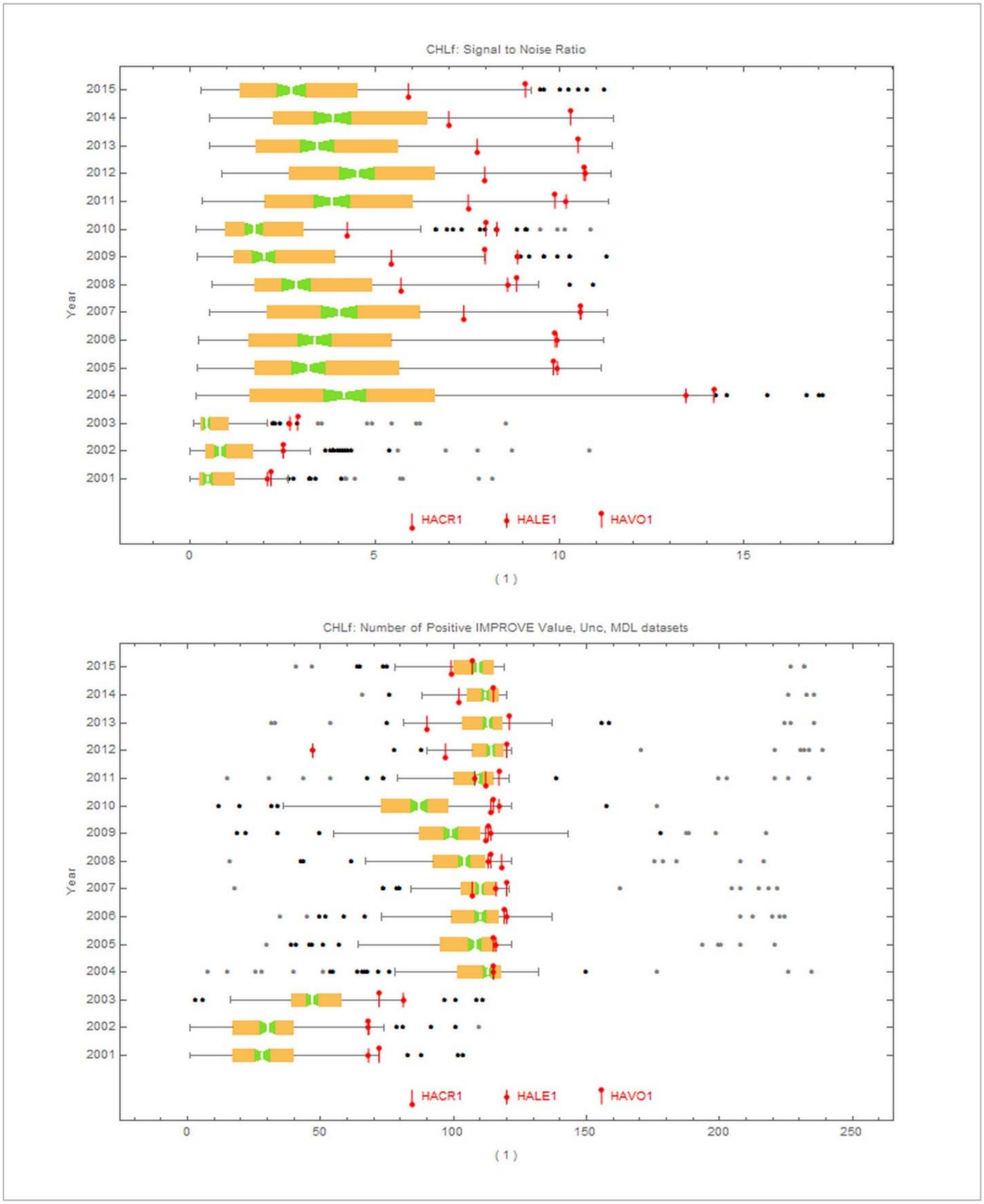

Figure F-66: IMPROVE CHLf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

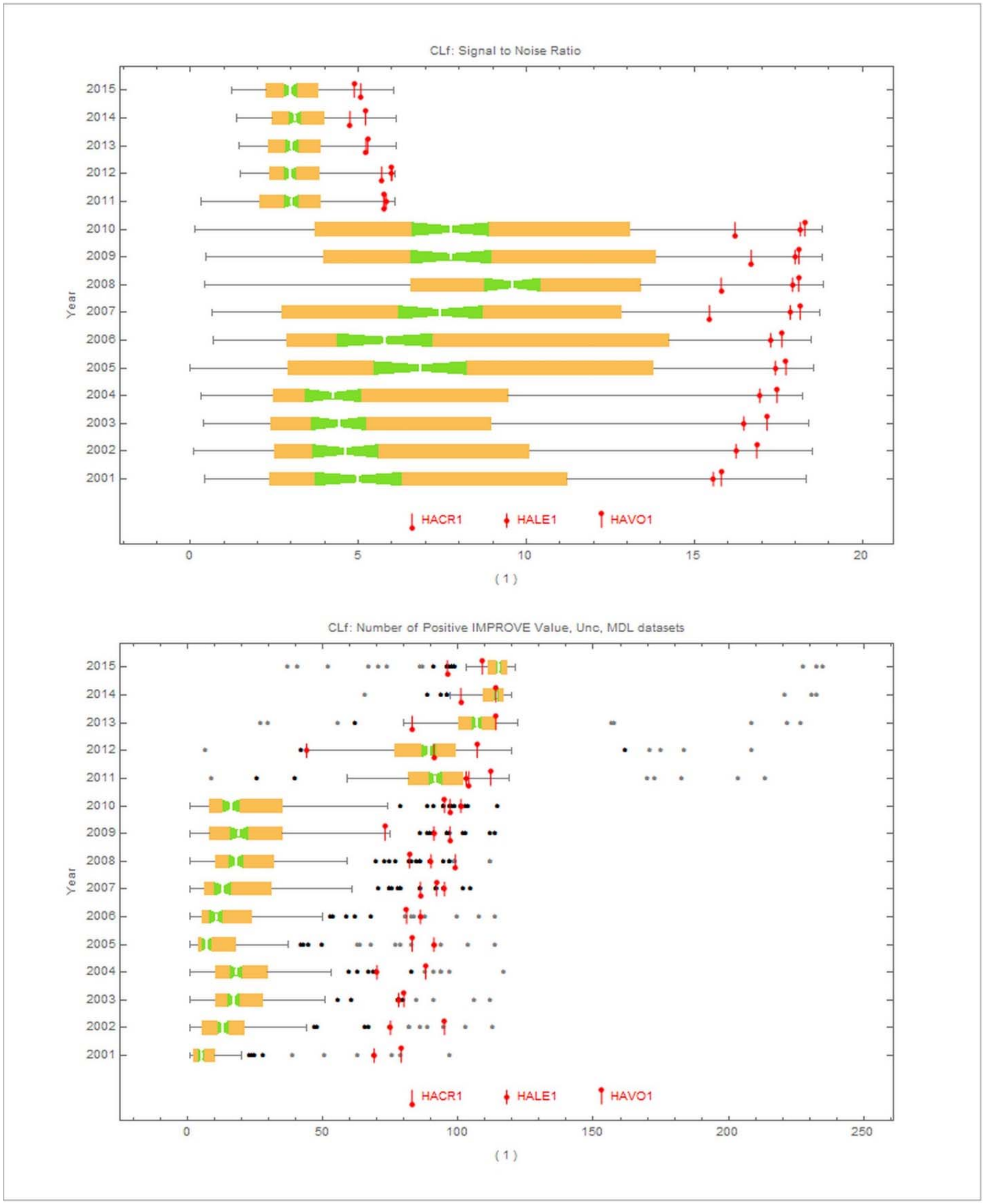

Figure F-67: IMPROVE CLf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-68: IMPROVE CRf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

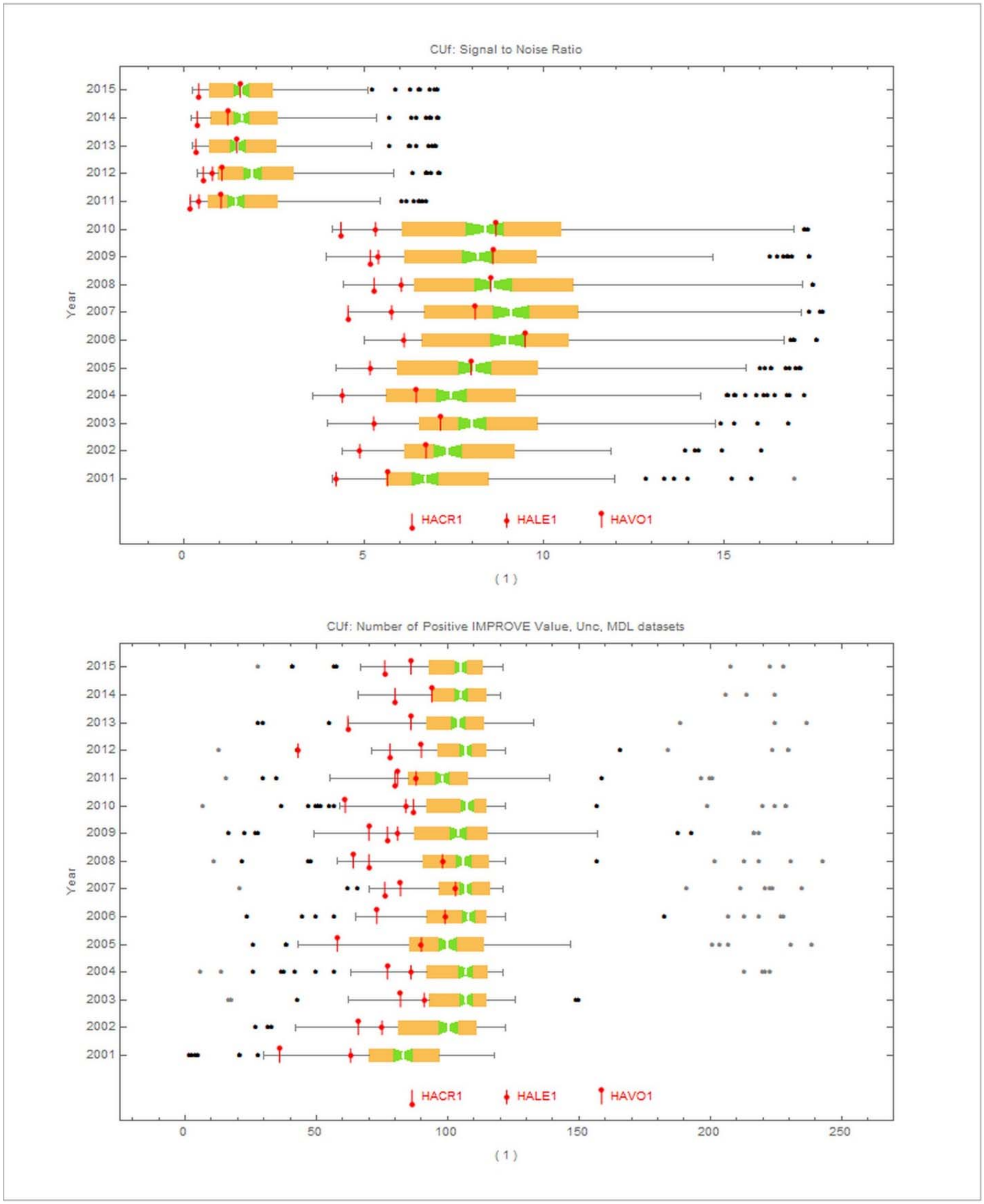

Figure F-69: IMPROVE CUf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-70: IMPROVE EC1f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

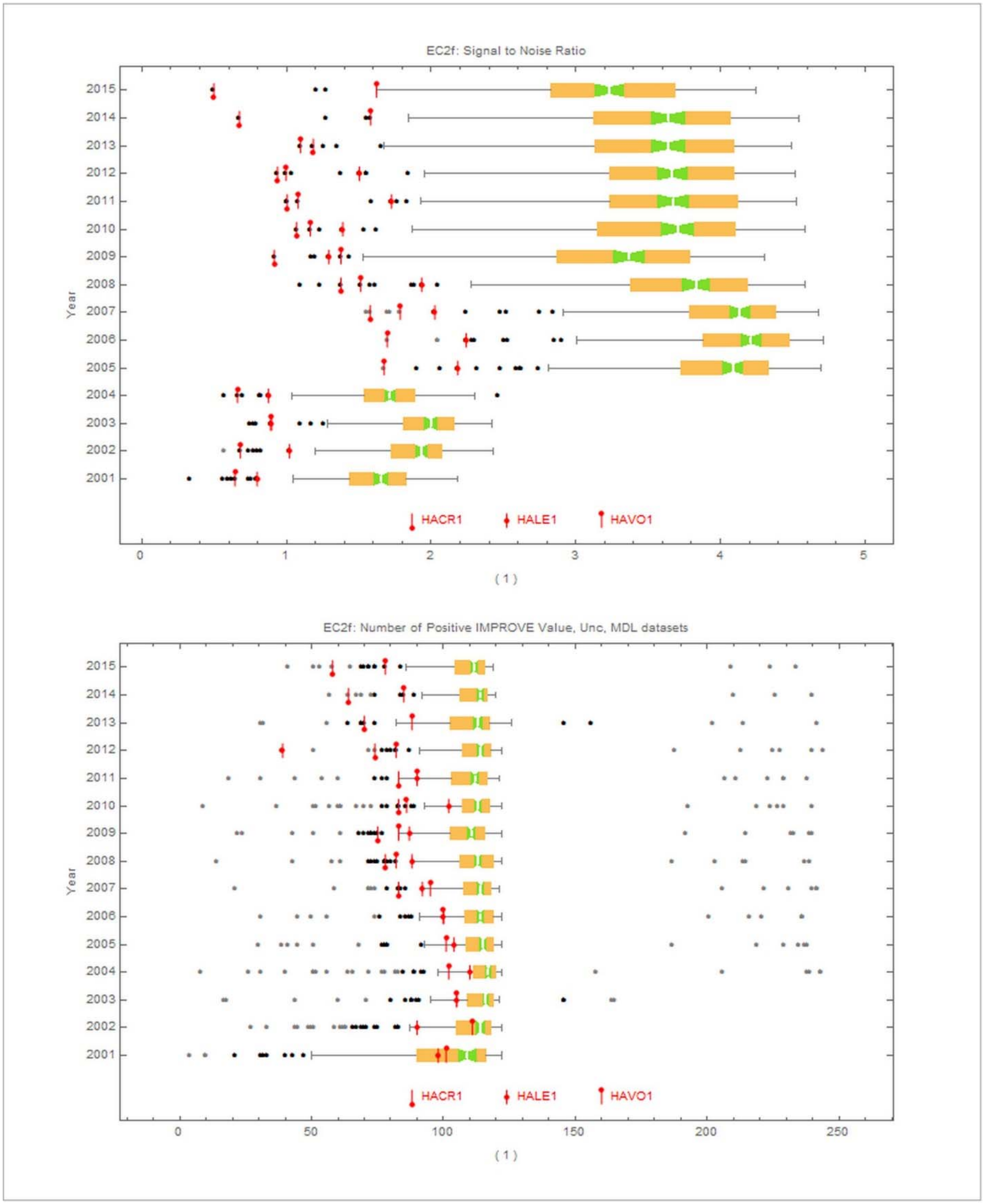

Figure F-71: IMPROVE EC2f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-72: IMPROVE EC3f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

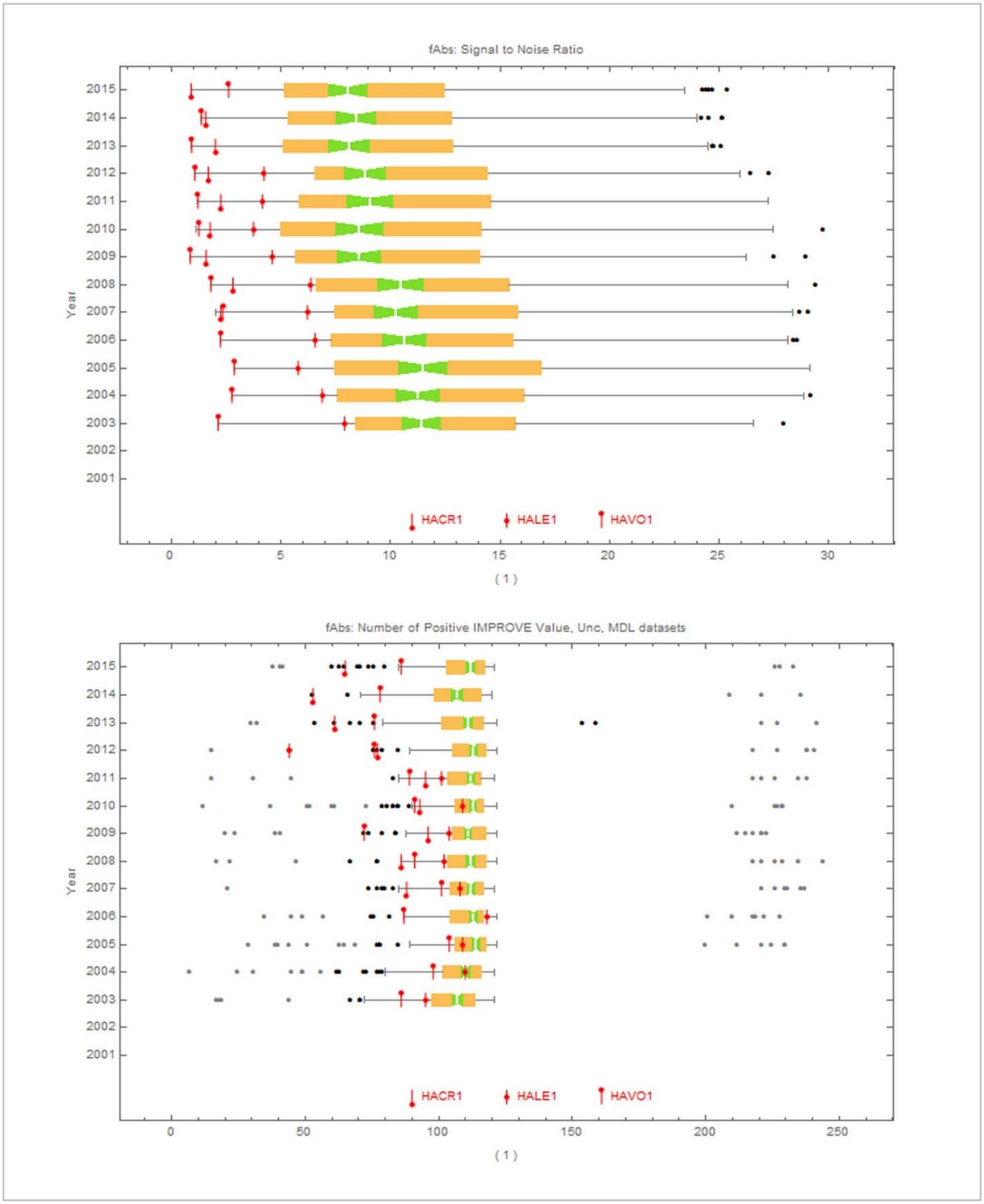

Figure F-73: IMPROVE fAbs Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Figure F-74: IMPROVE fAbs_HIPS Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

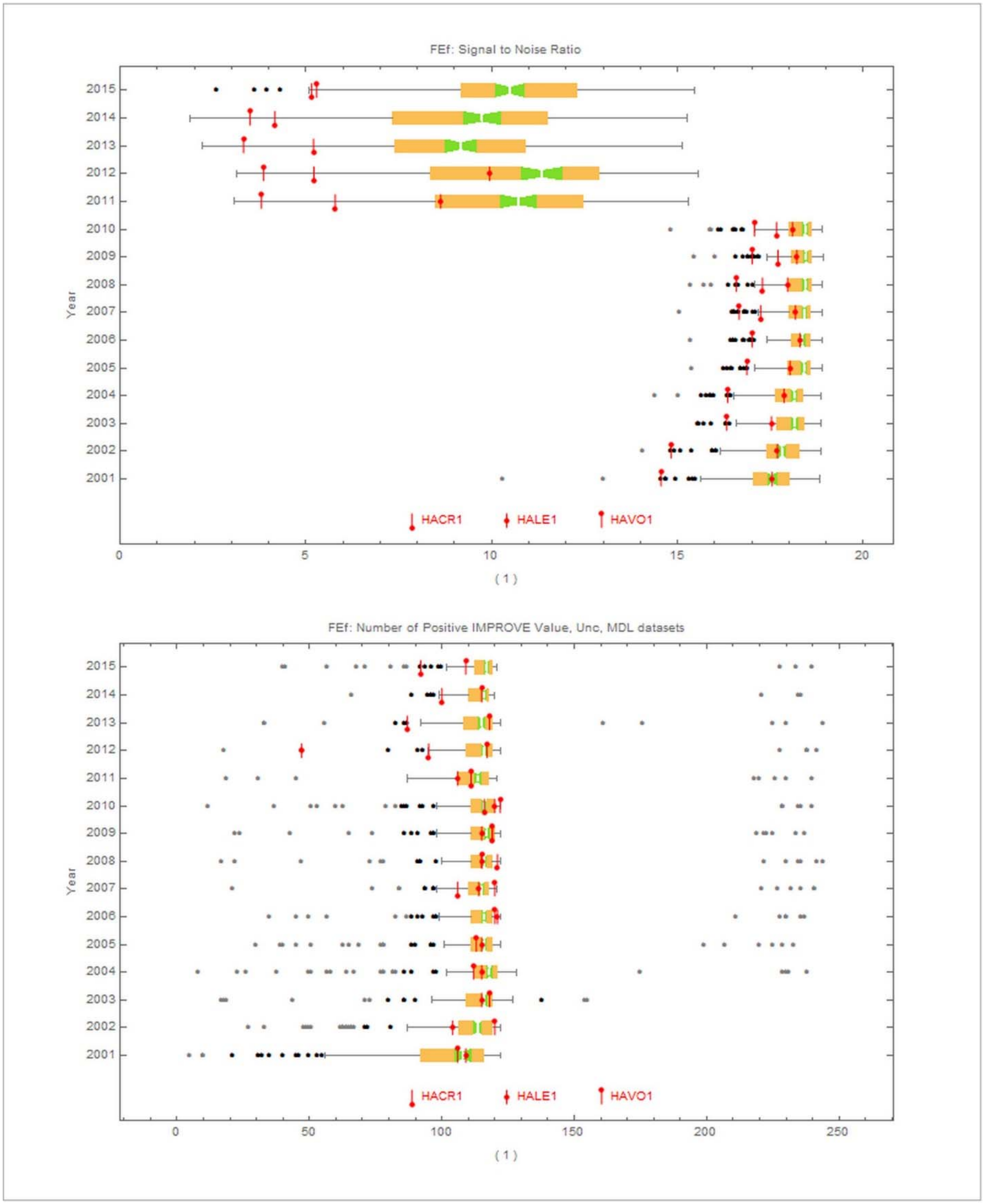

Figure F-75: IMPROVE FEf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

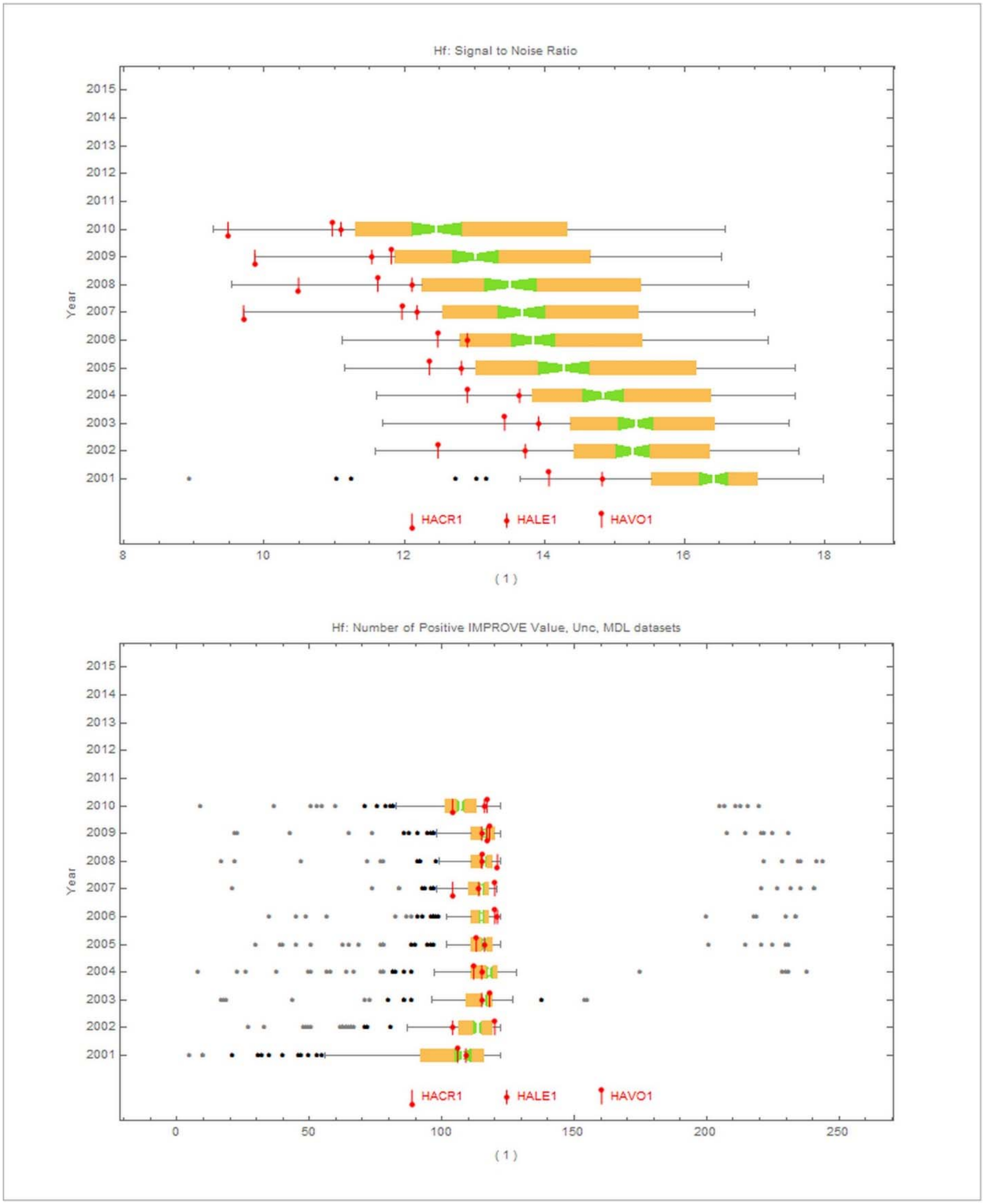

Figure F-76: IMPROVE Hf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

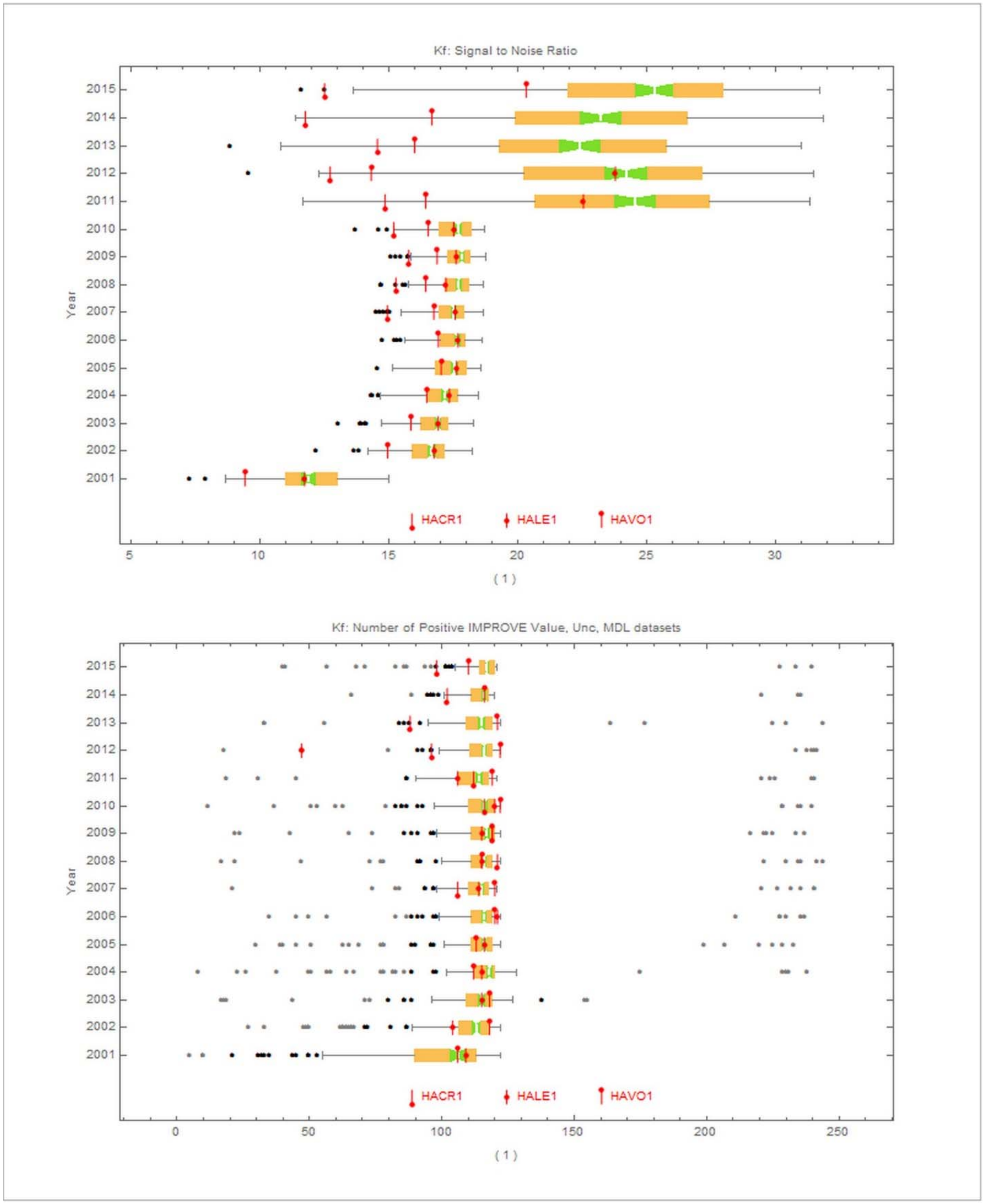

Figure F-77: IMPROVE Kf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

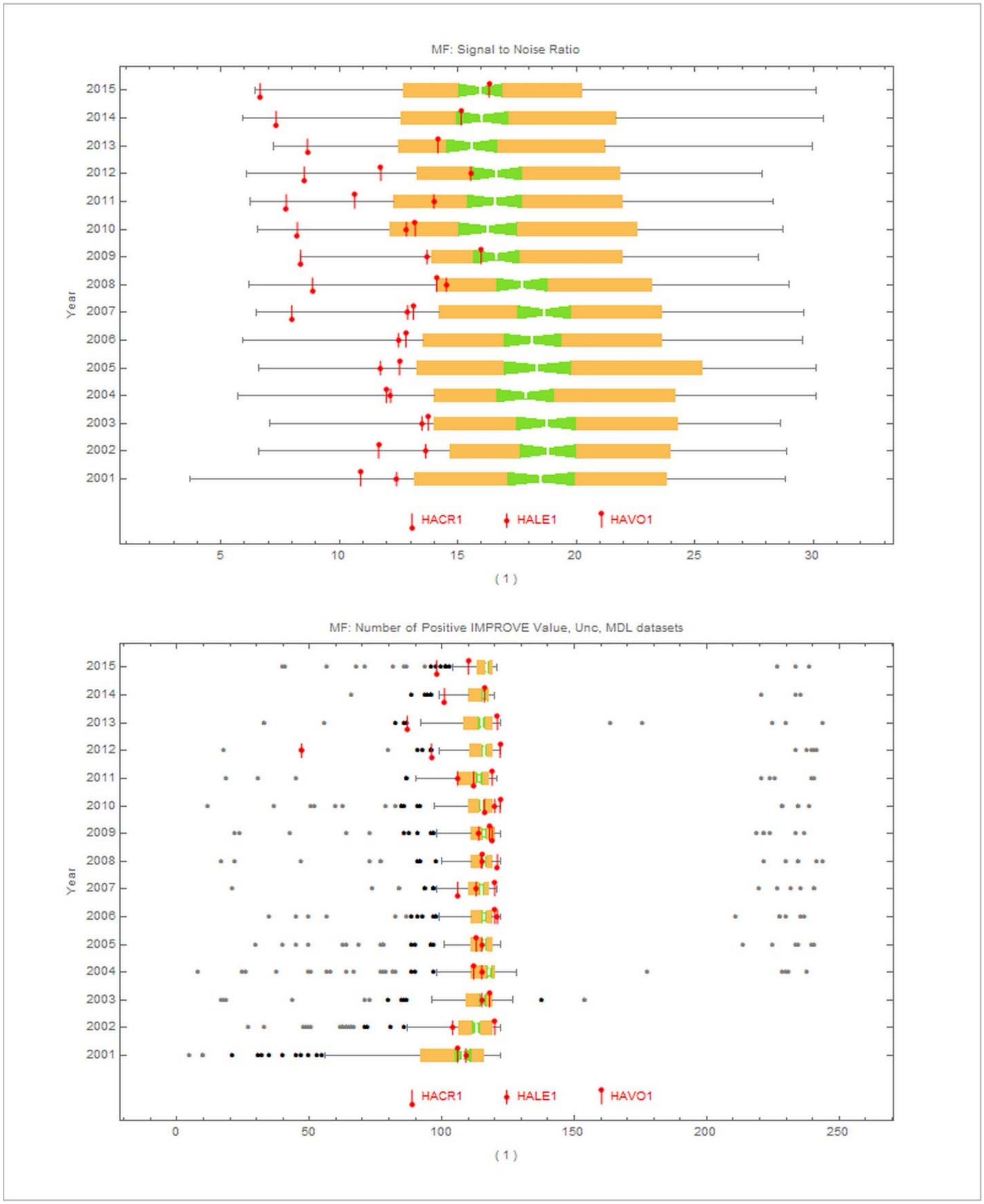

Figure F-78: IMPROVE MF Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

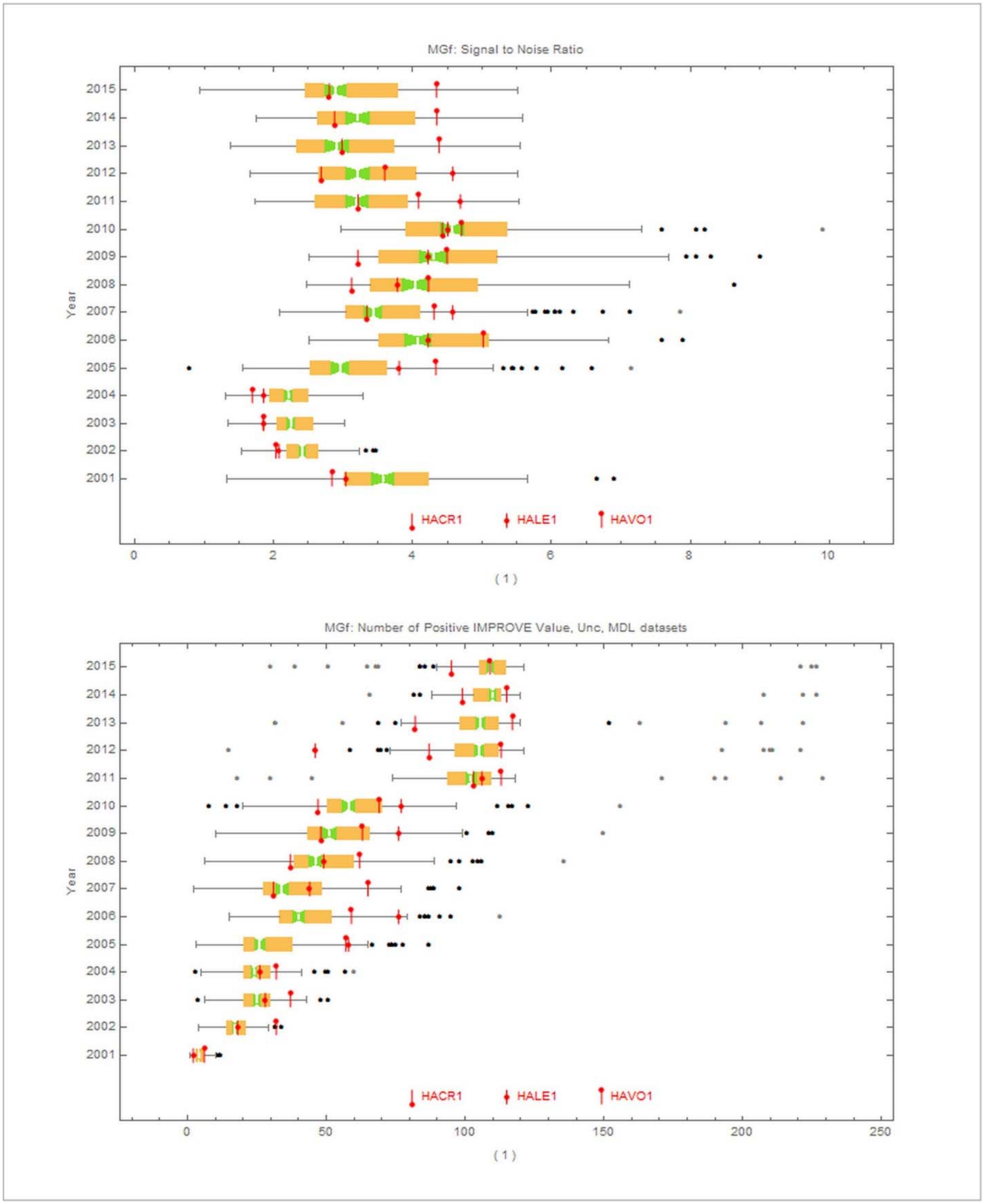

Figure F-79: IMPROVE MGf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

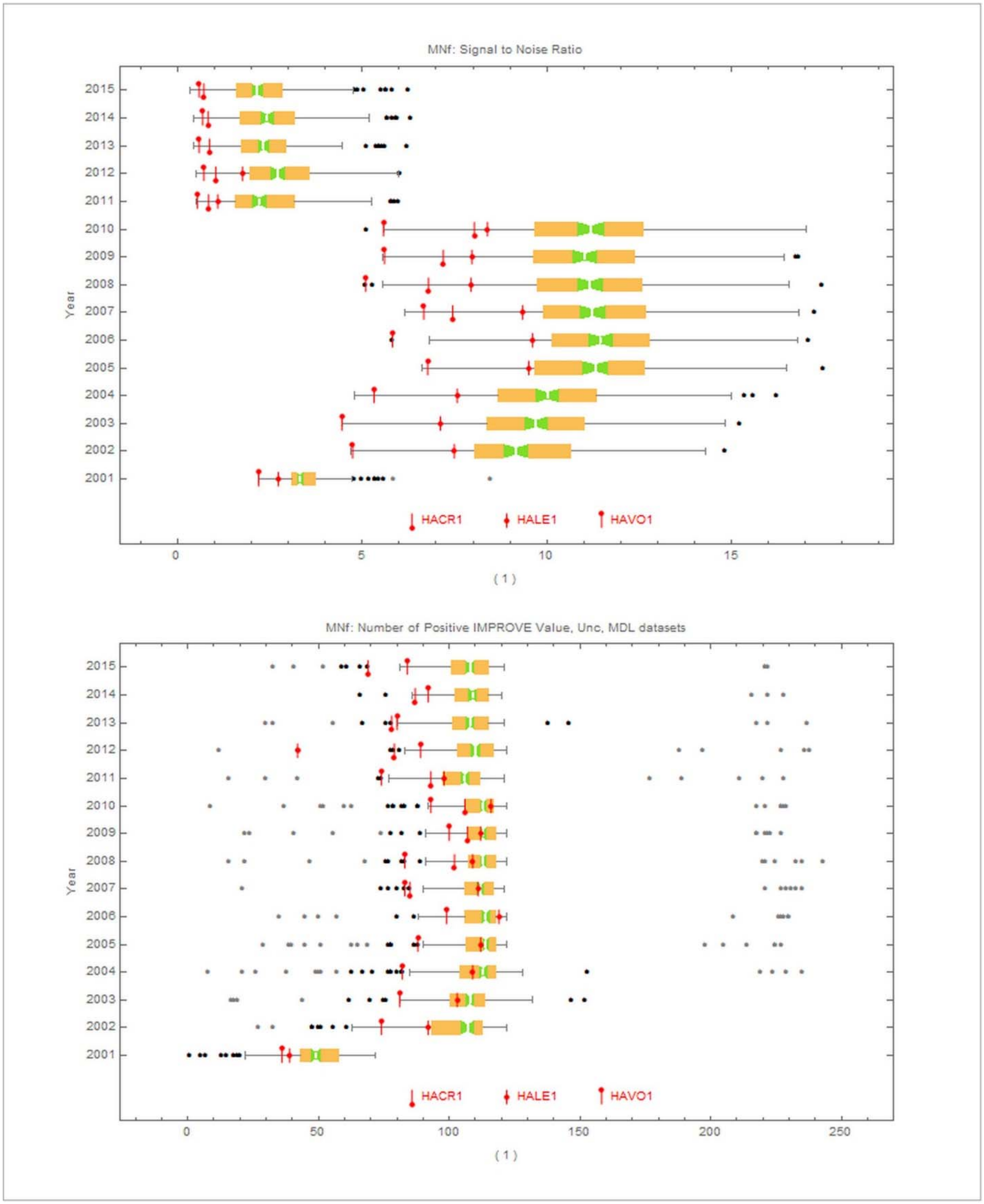

Figure F-80: IMPROVE MNf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

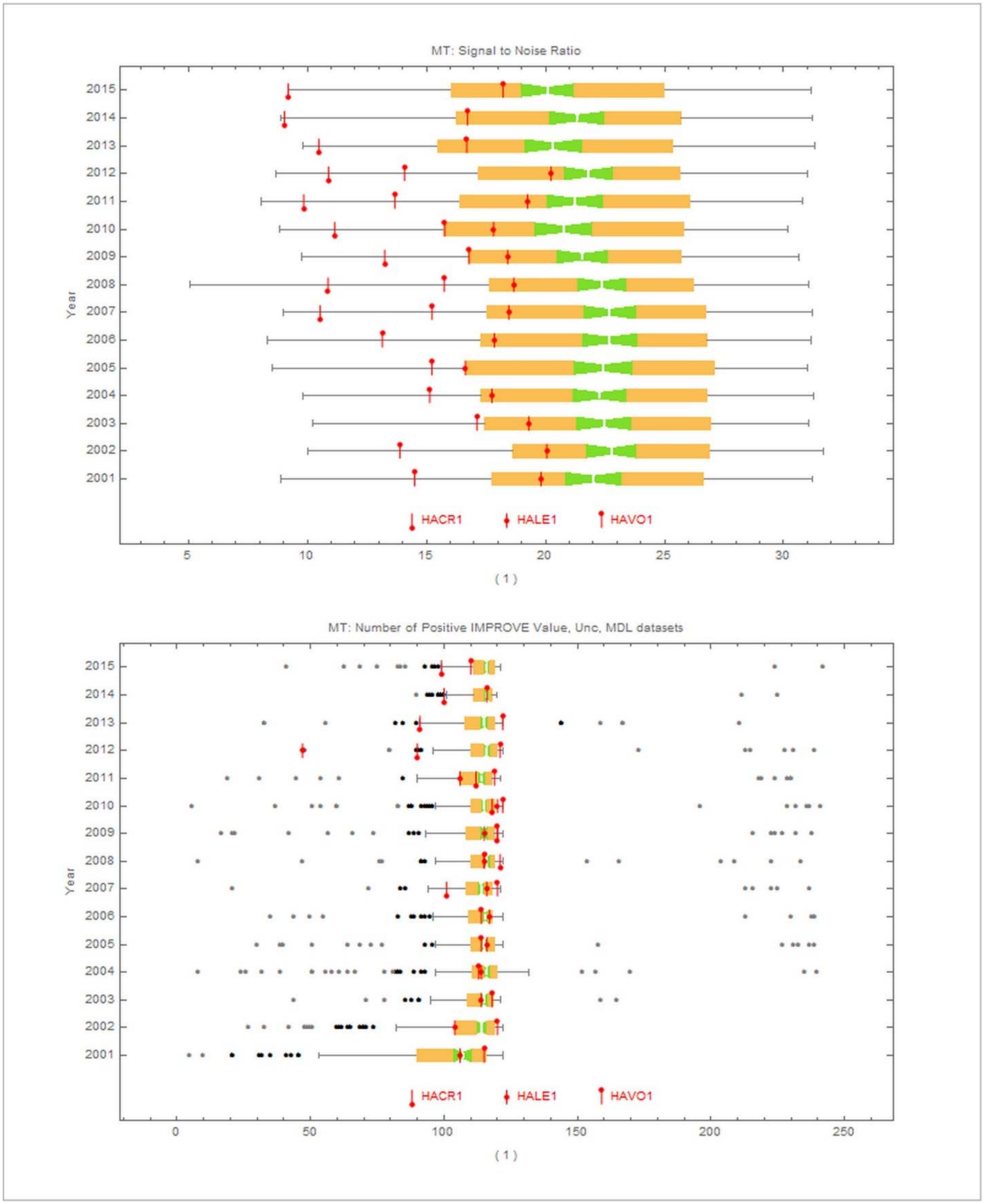

Figure F-81: IMPROVE MT Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

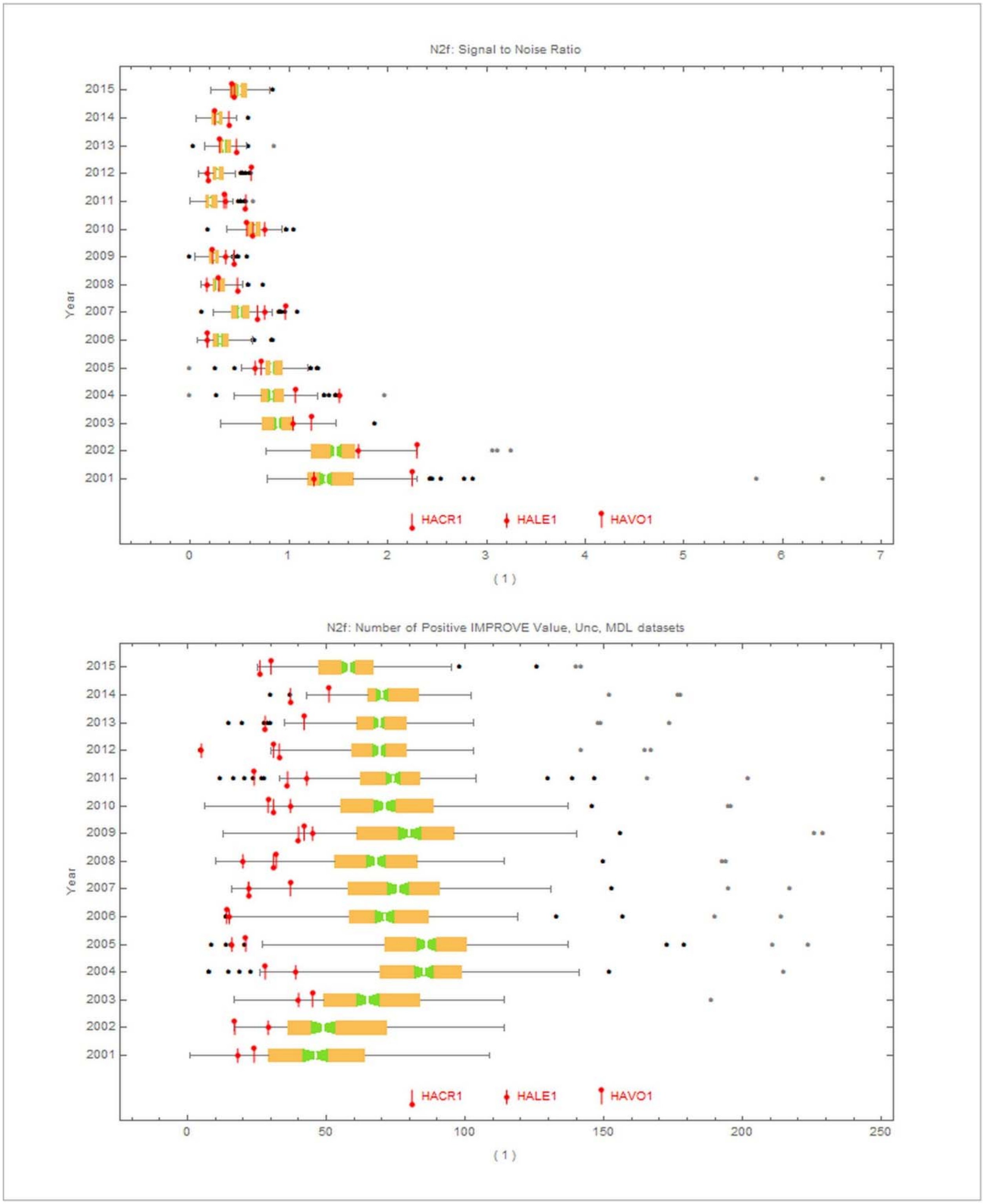

Figure F-82: IMPROVE N2f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

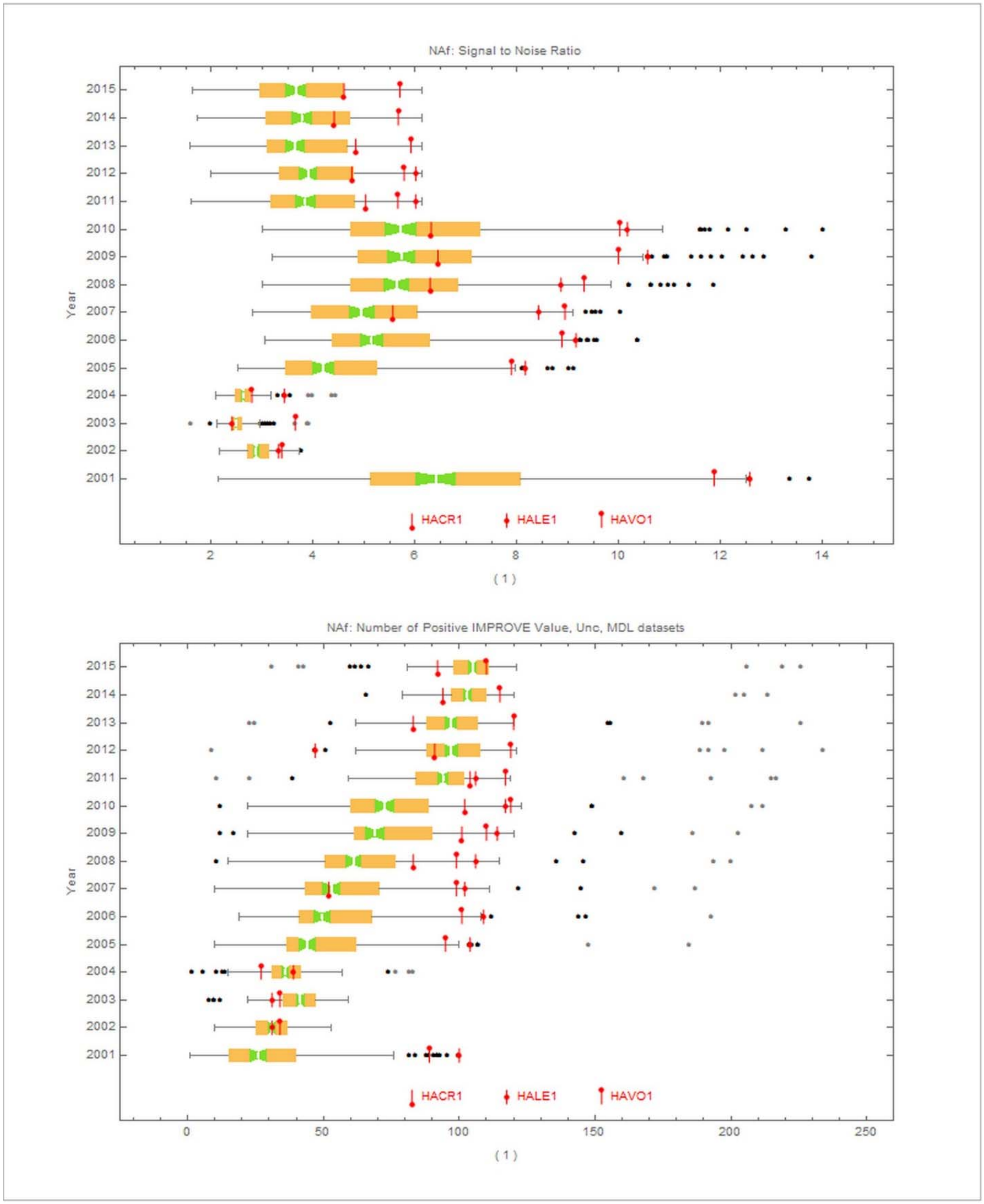

Figure F-83: IMPROVE NAf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

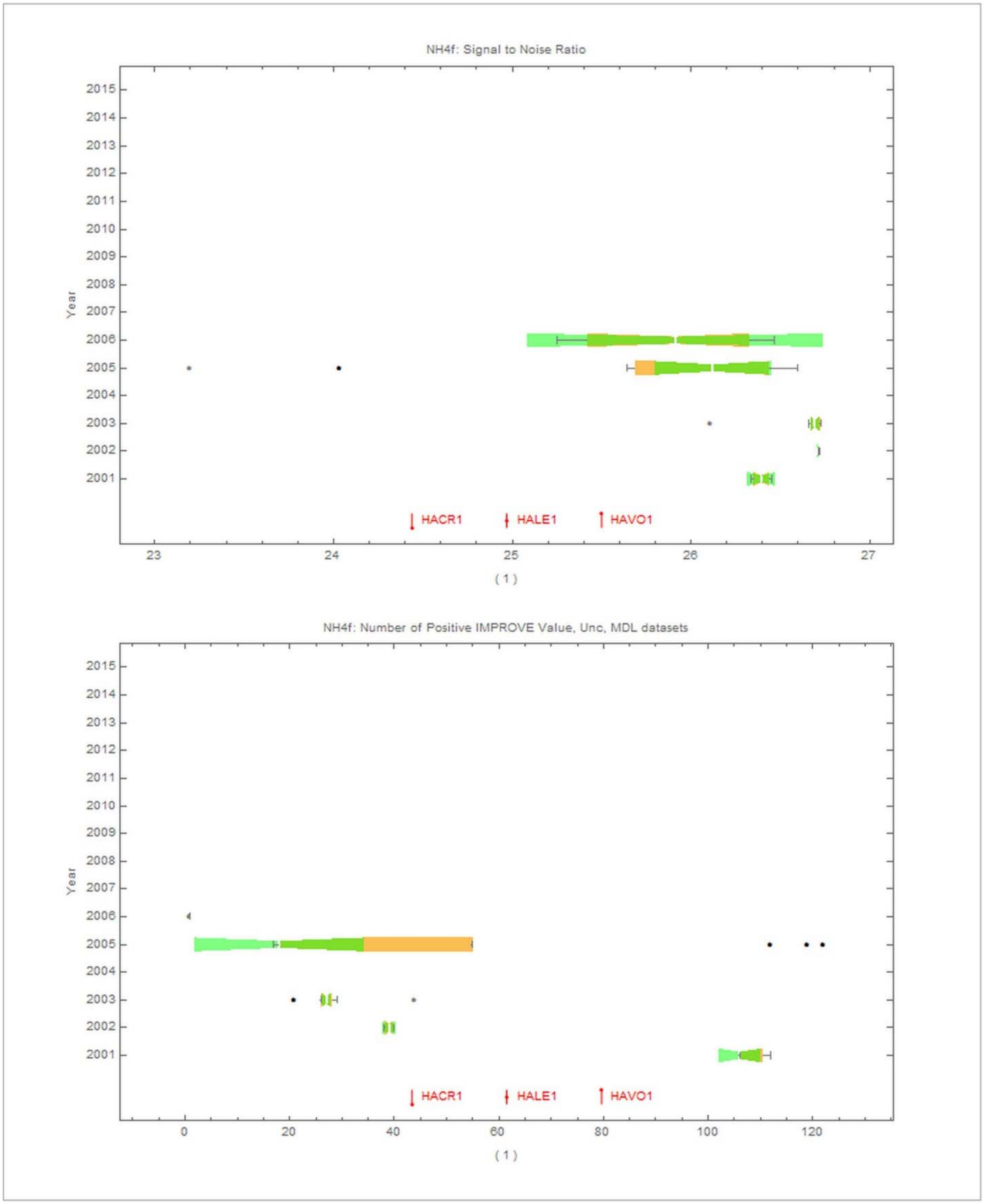

Figure F-84: IMPROVE NH4f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

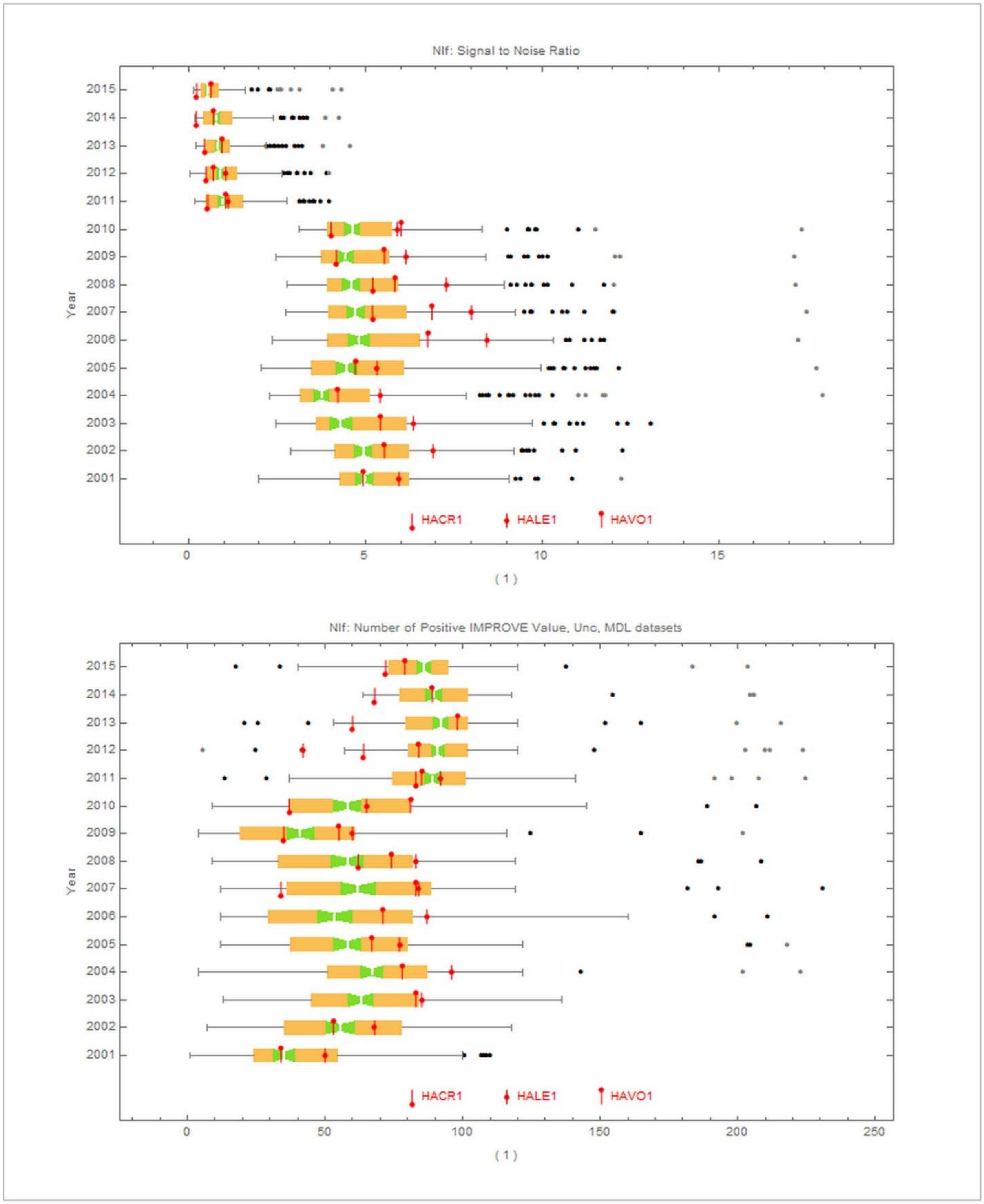

Figure F-85: IMPROVE NIf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

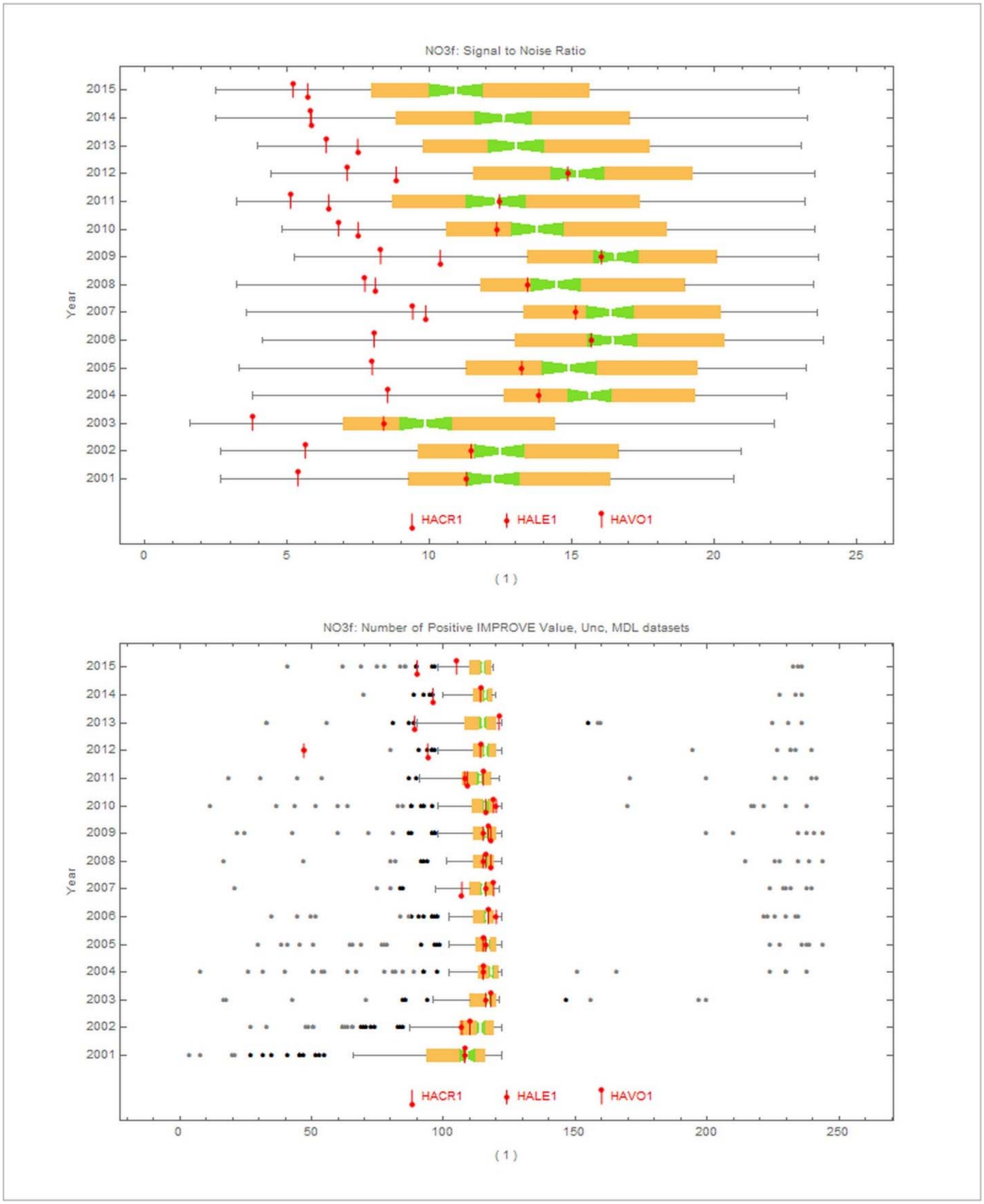

Figure F-86: IMPROVE NO3f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-87: IMPROVE OC1f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

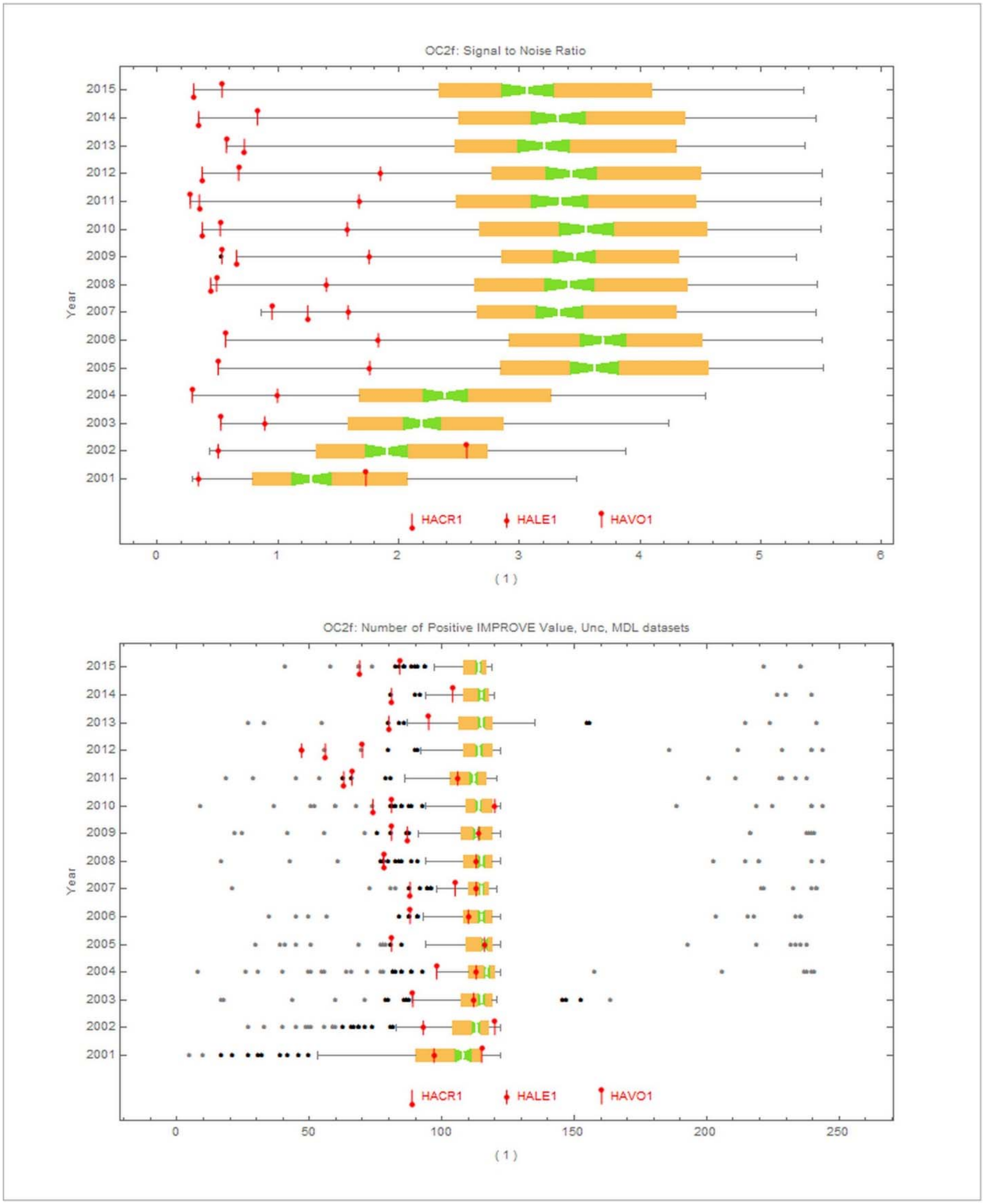

Figure F-88: IMPROVE OC2f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

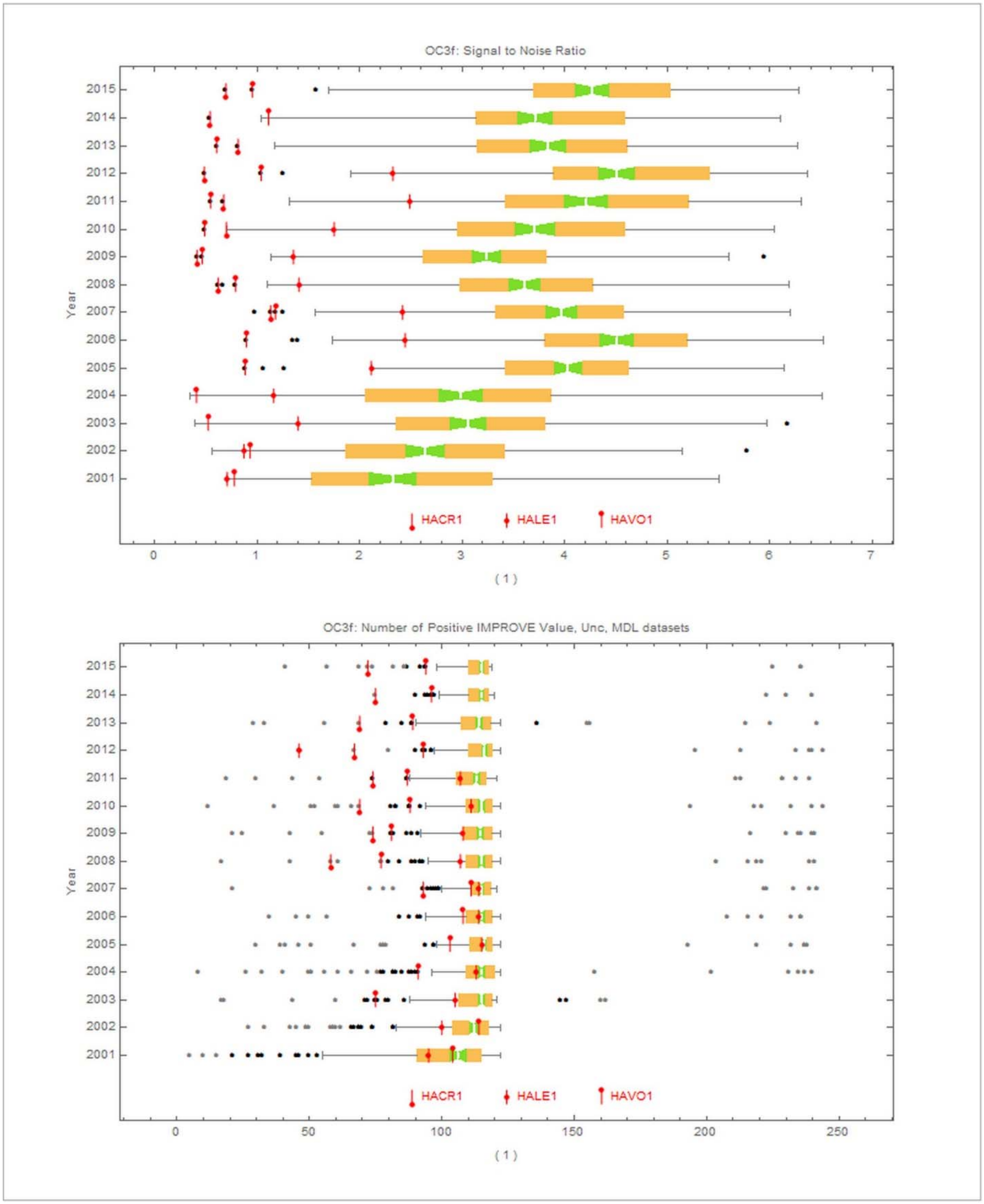

Figure F-89: IMPROVE OC3f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

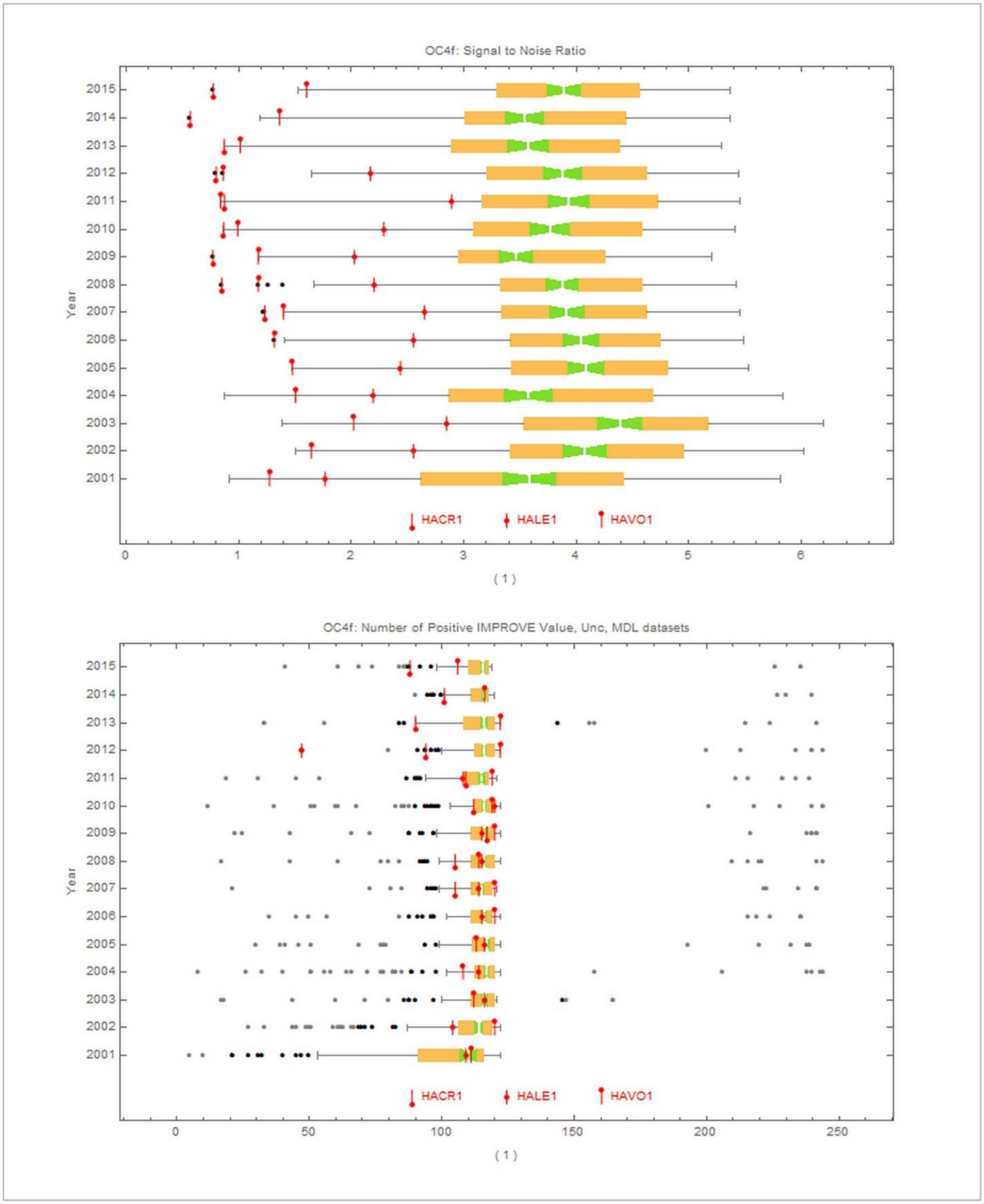

Figure F-90: IMPROVE OC4f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

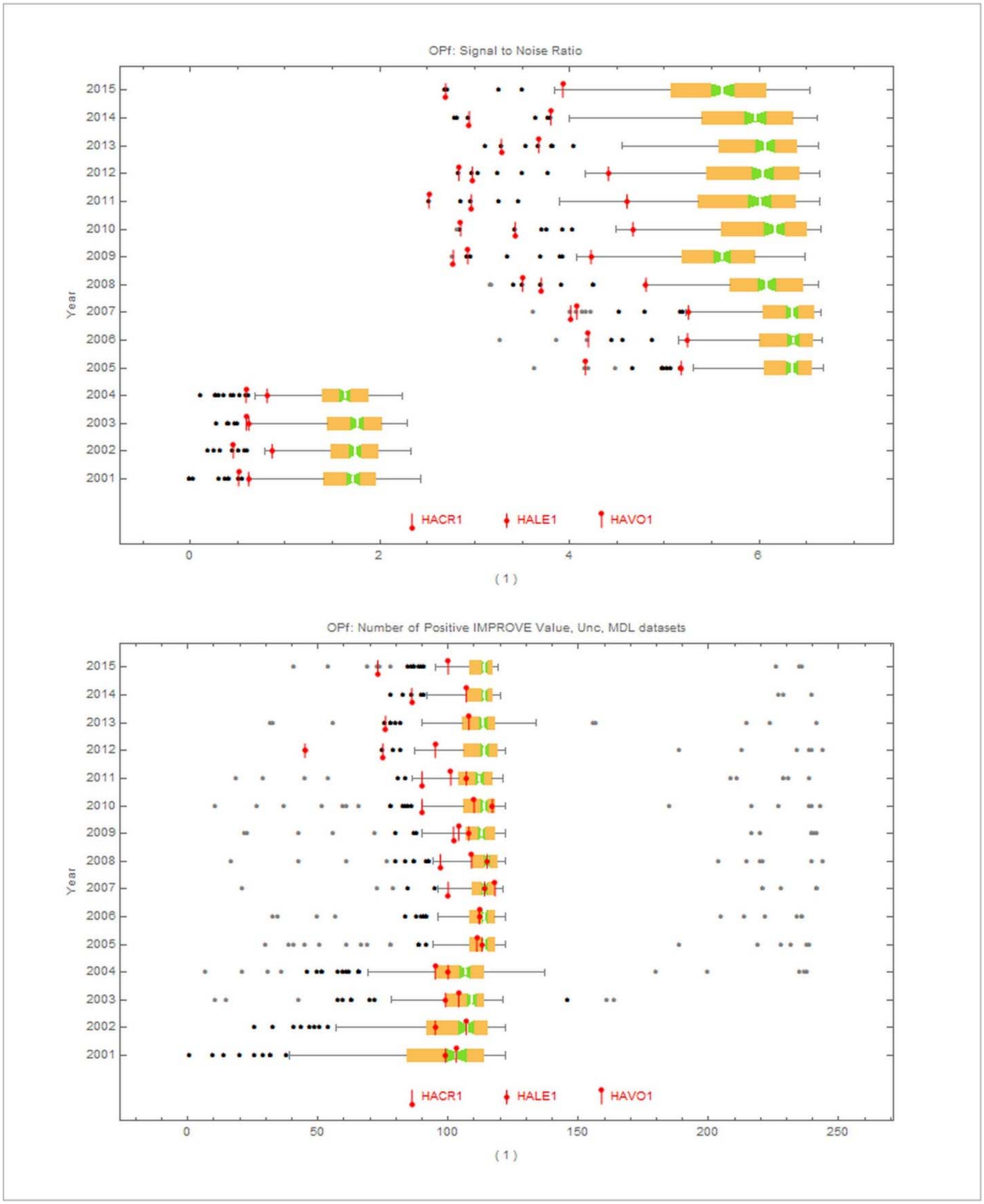

Figure F-91: IMPROVE OPf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Figure F-92: IMPROVE PBf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

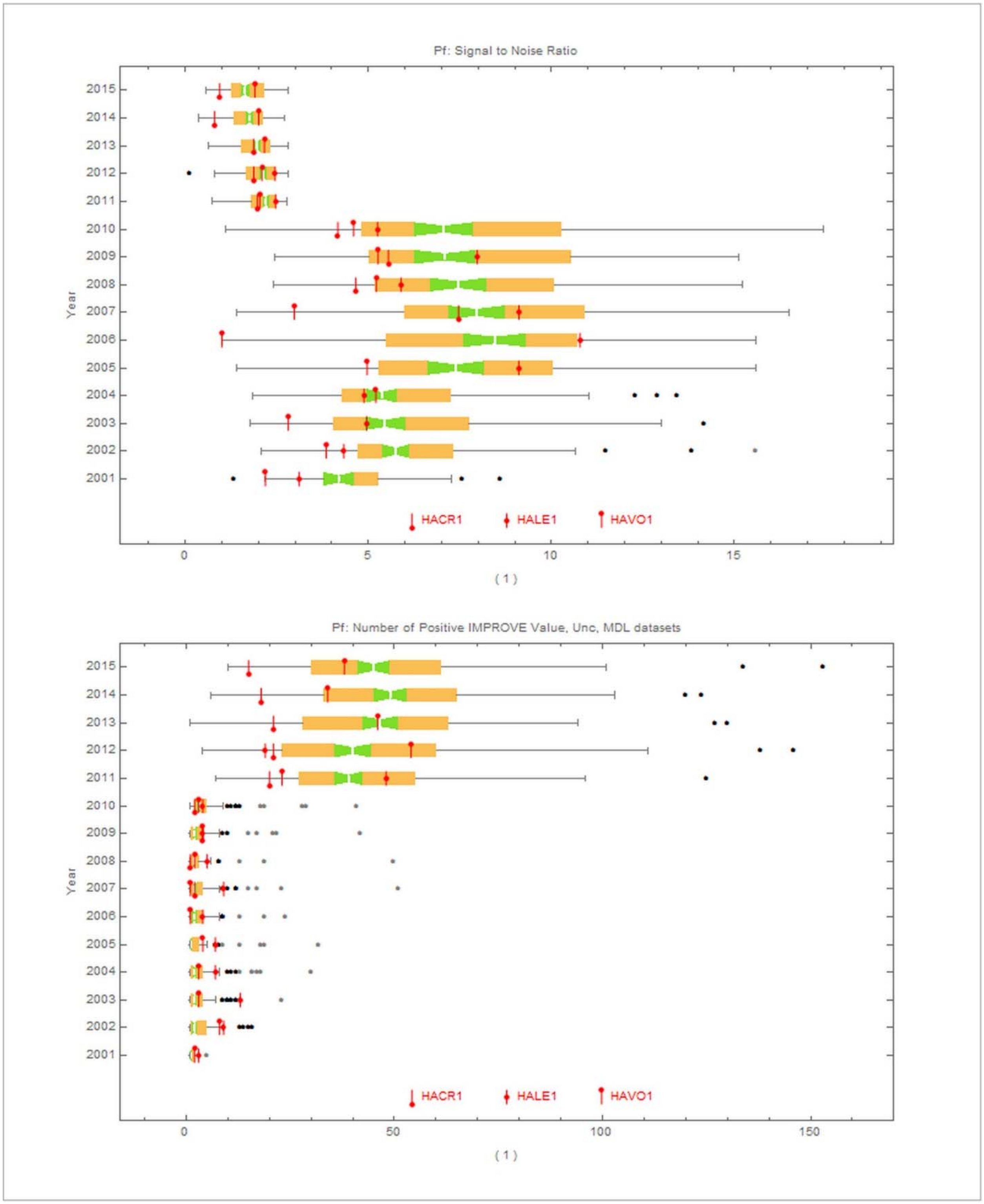

Figure F-93: IMPROVE Pf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

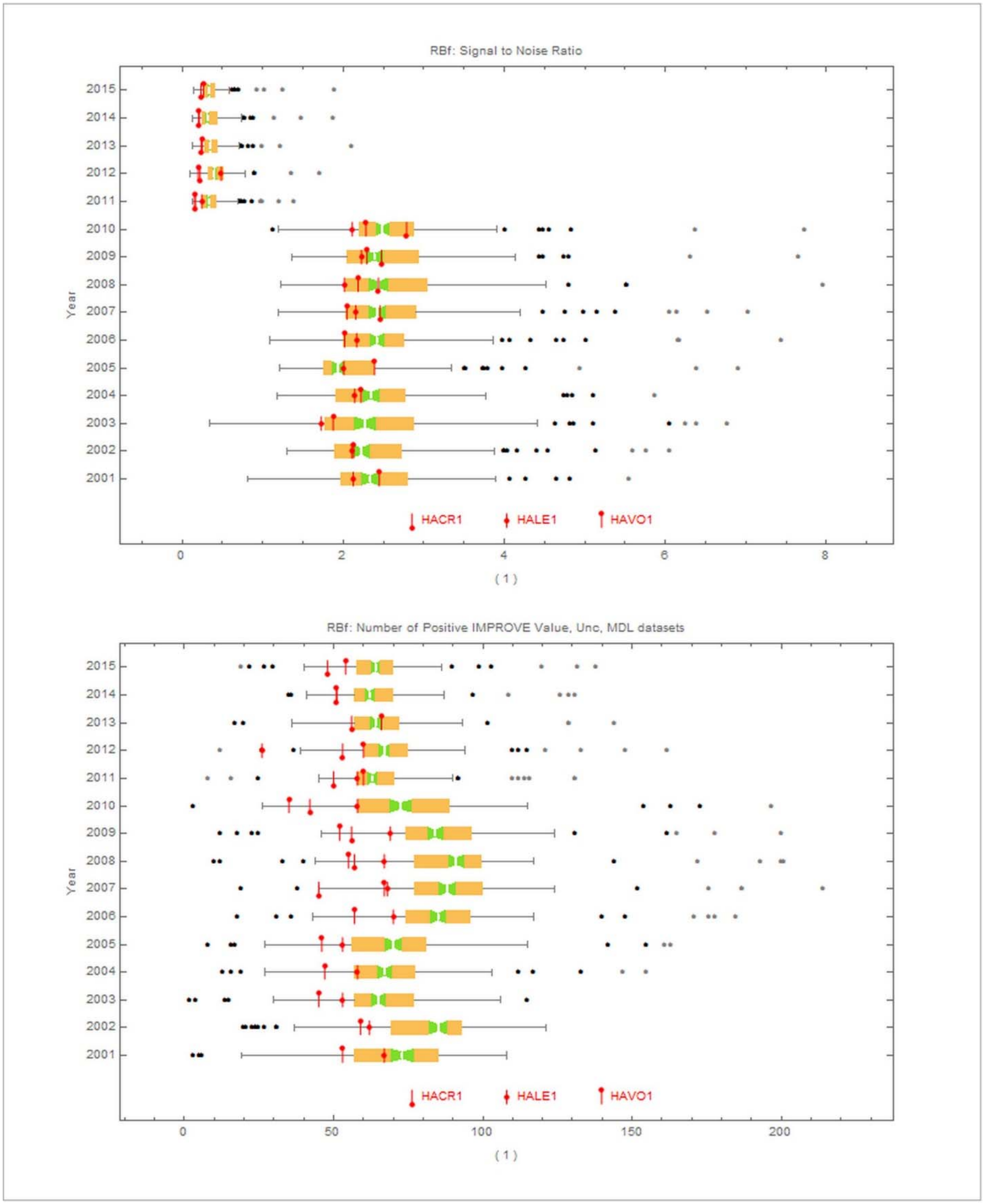

Figure F-94: IMPROVE RBf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

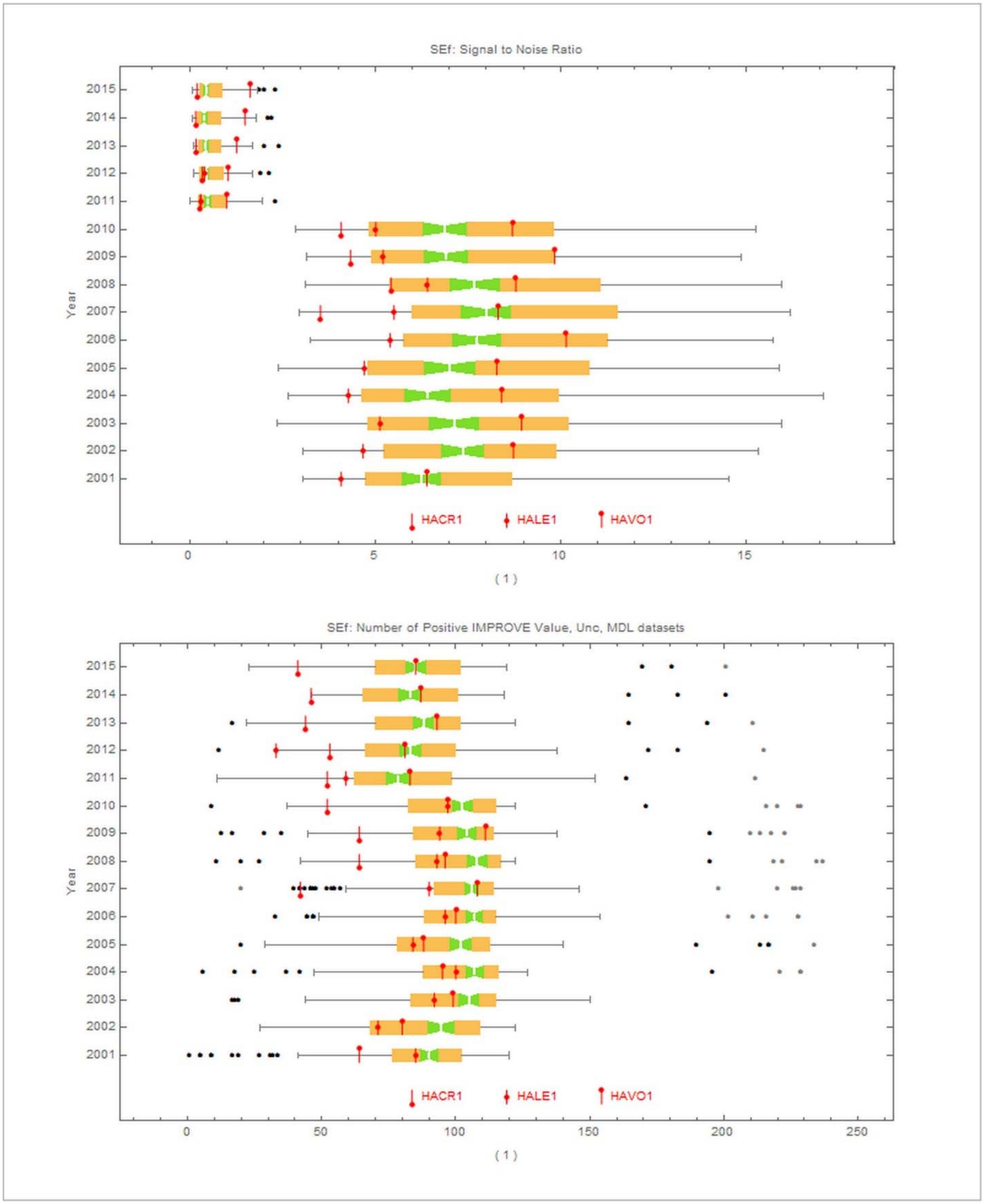

Figure F-95: IMPROVE SEf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-96: IMPROVE Sf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

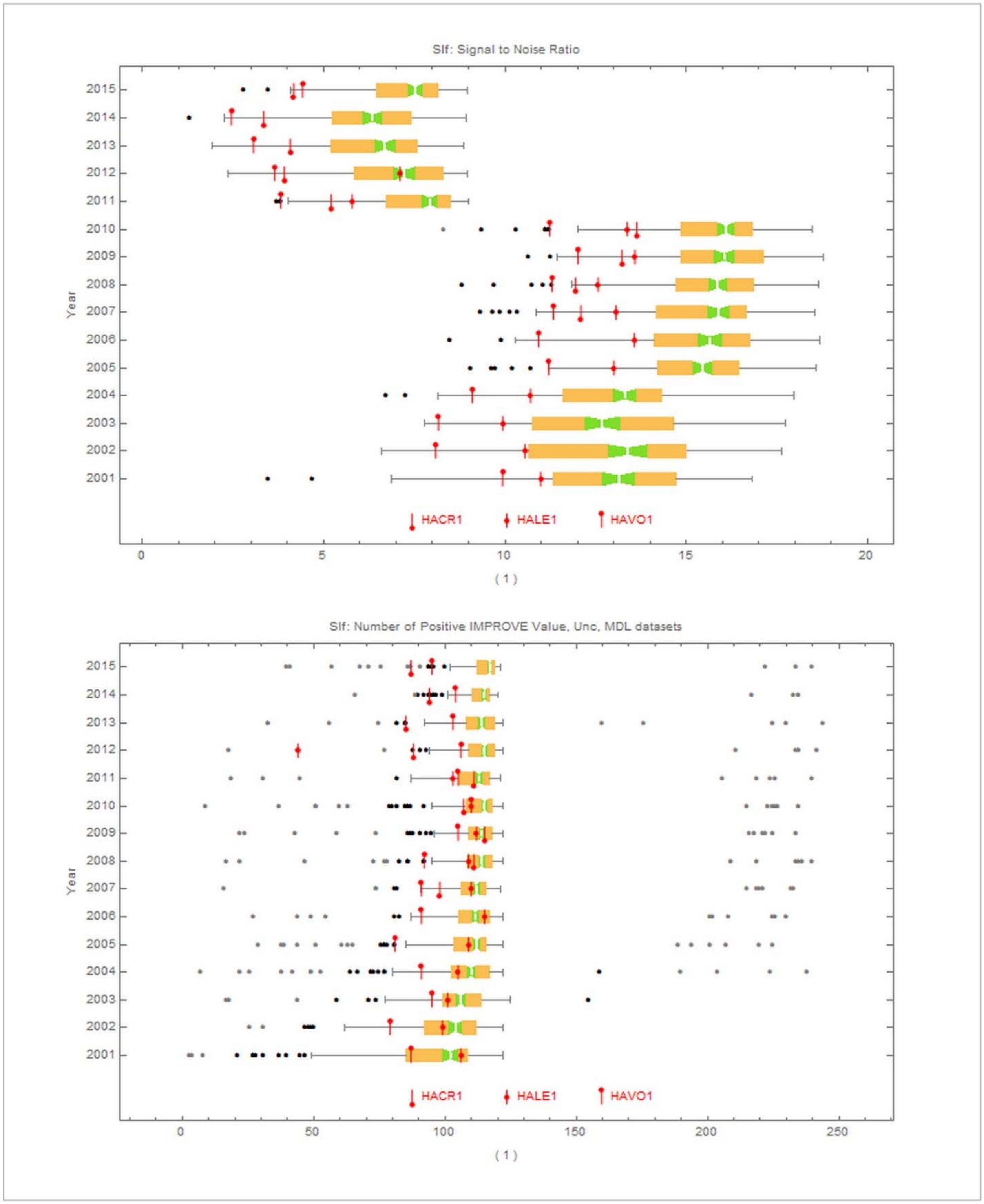

Figure F-97: IMPROVE SIf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

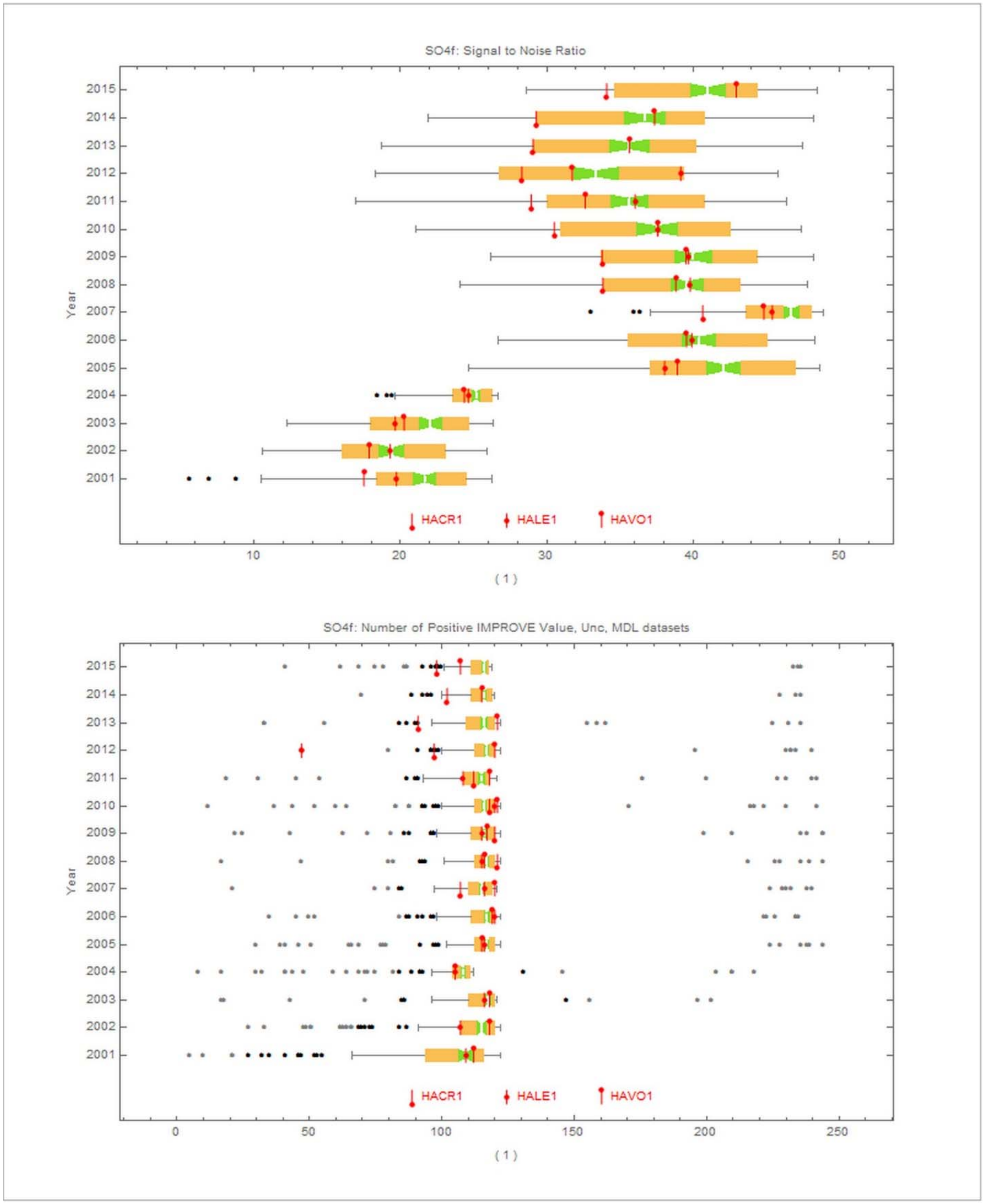

Figure F-98: IMPROVE SO4f Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

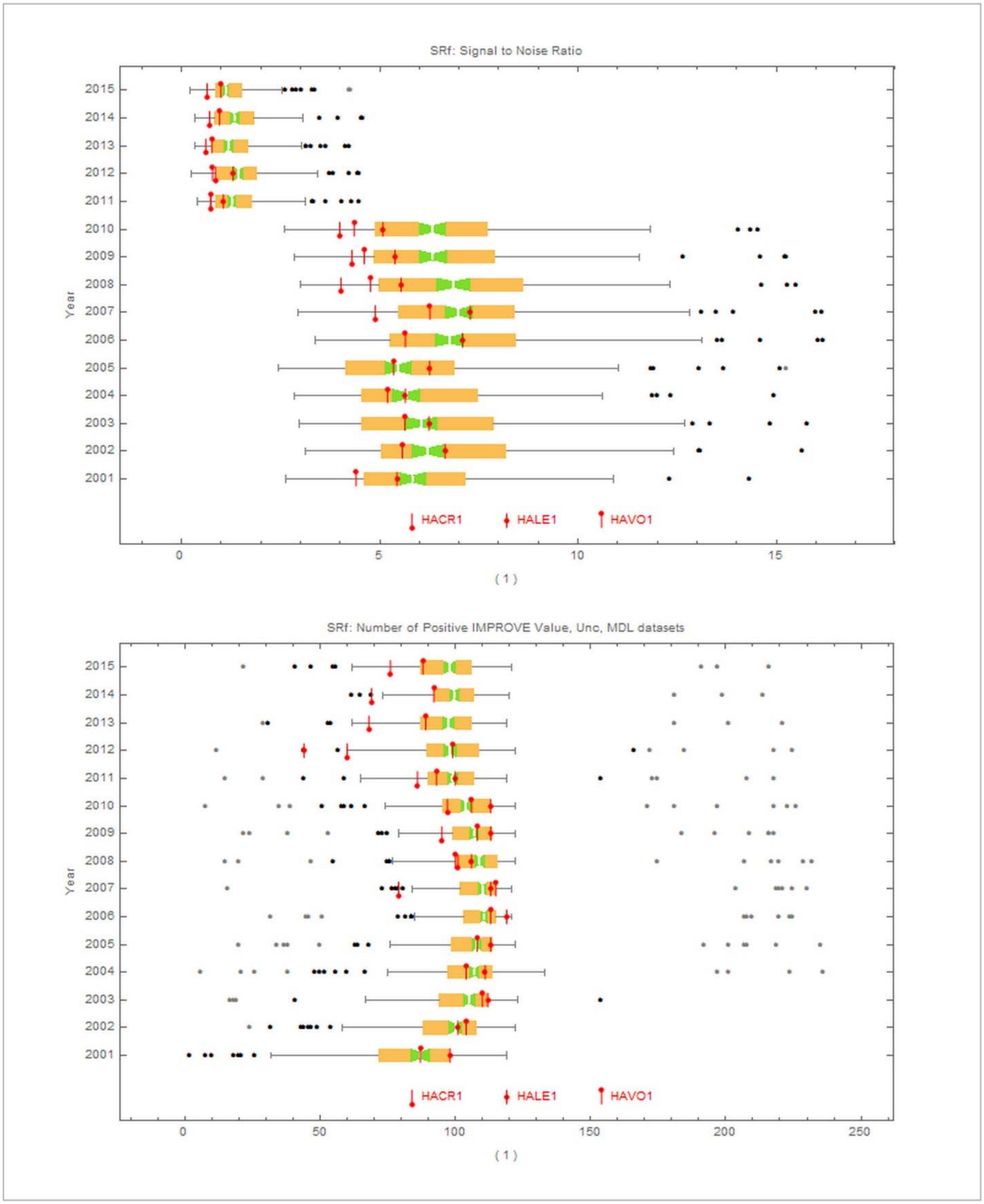

Figure F-99: IMPROVE SRf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

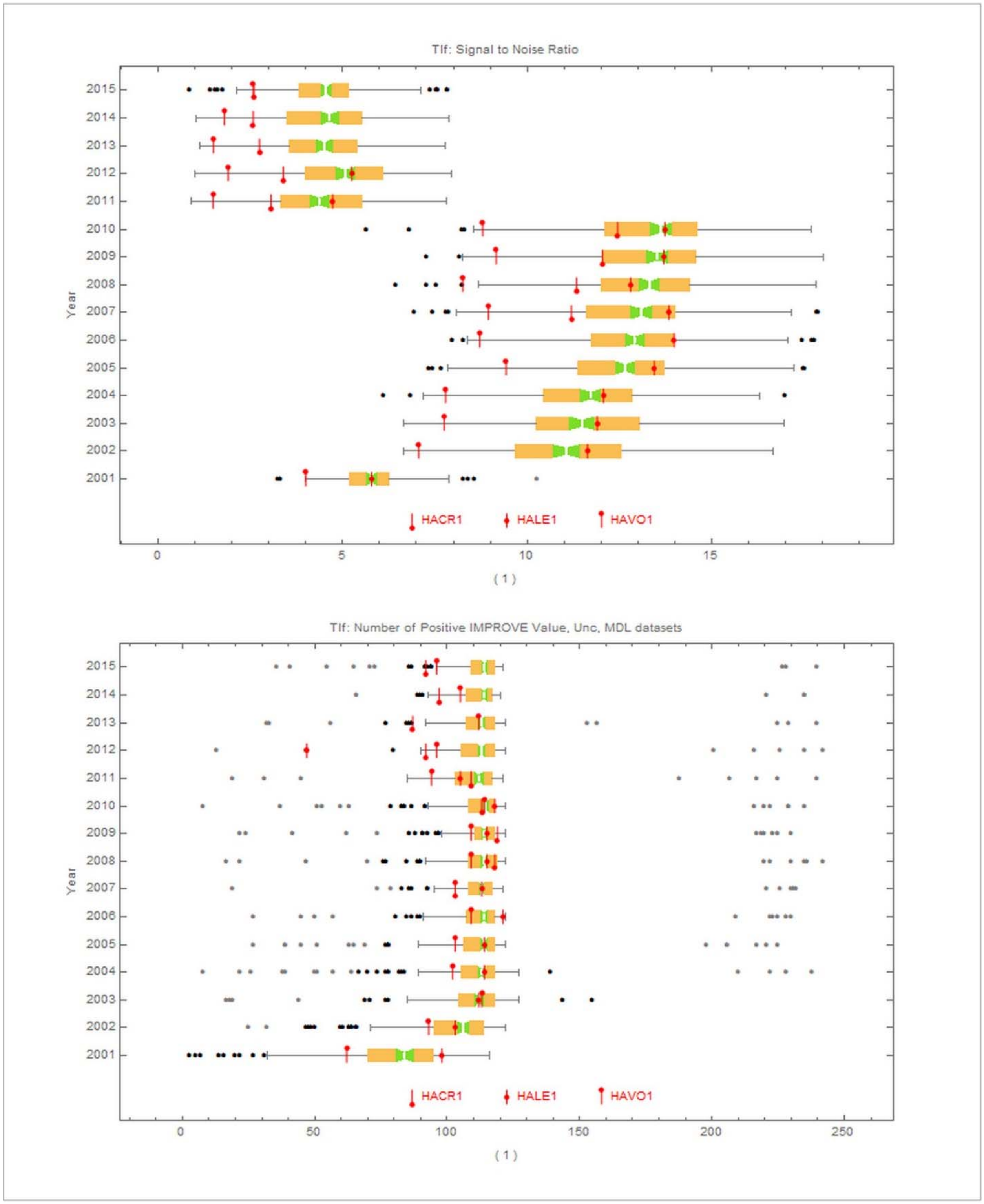

Figure F-100: IMPROVE TIf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

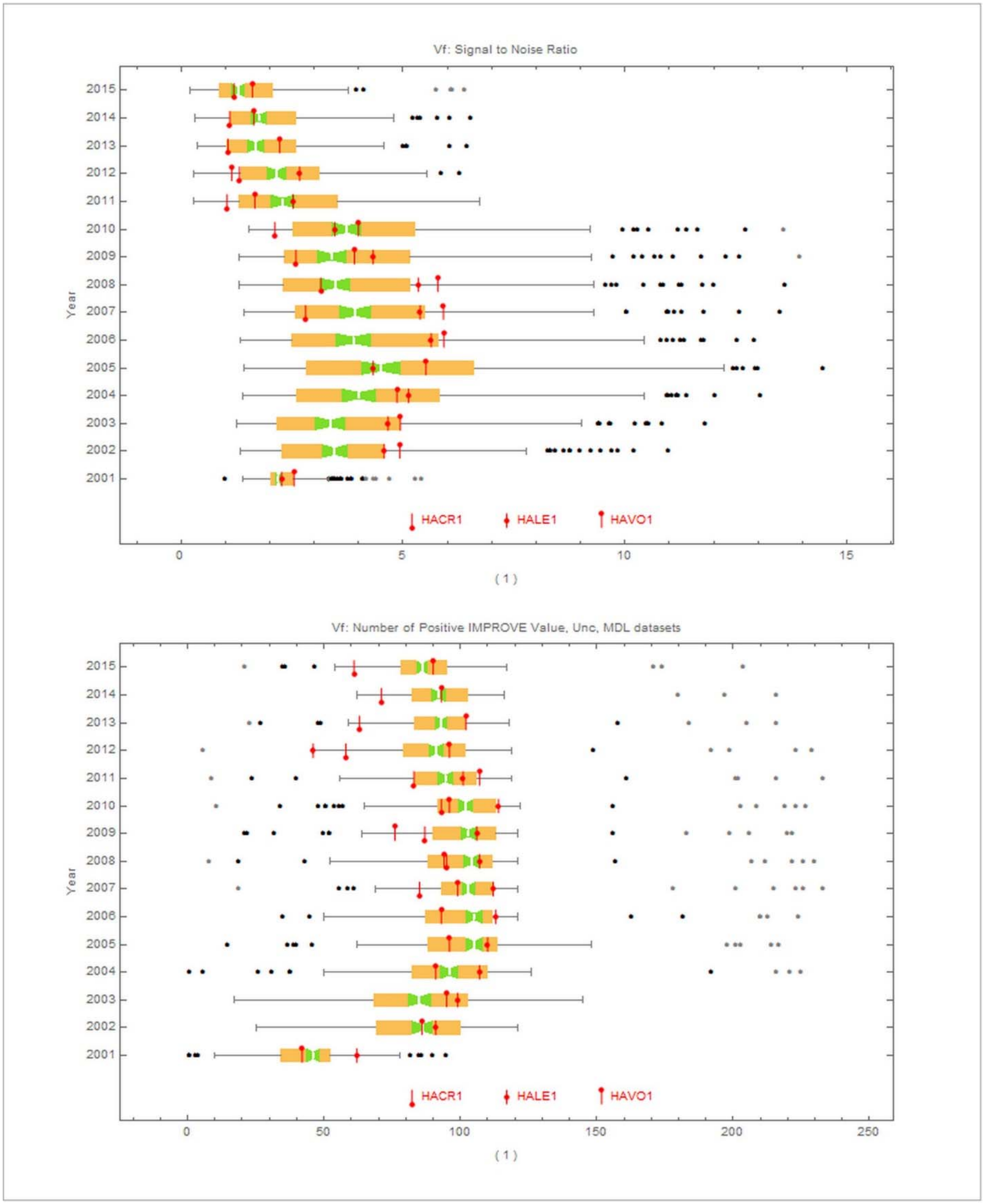

Figure F-101: IMPROVE Vf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

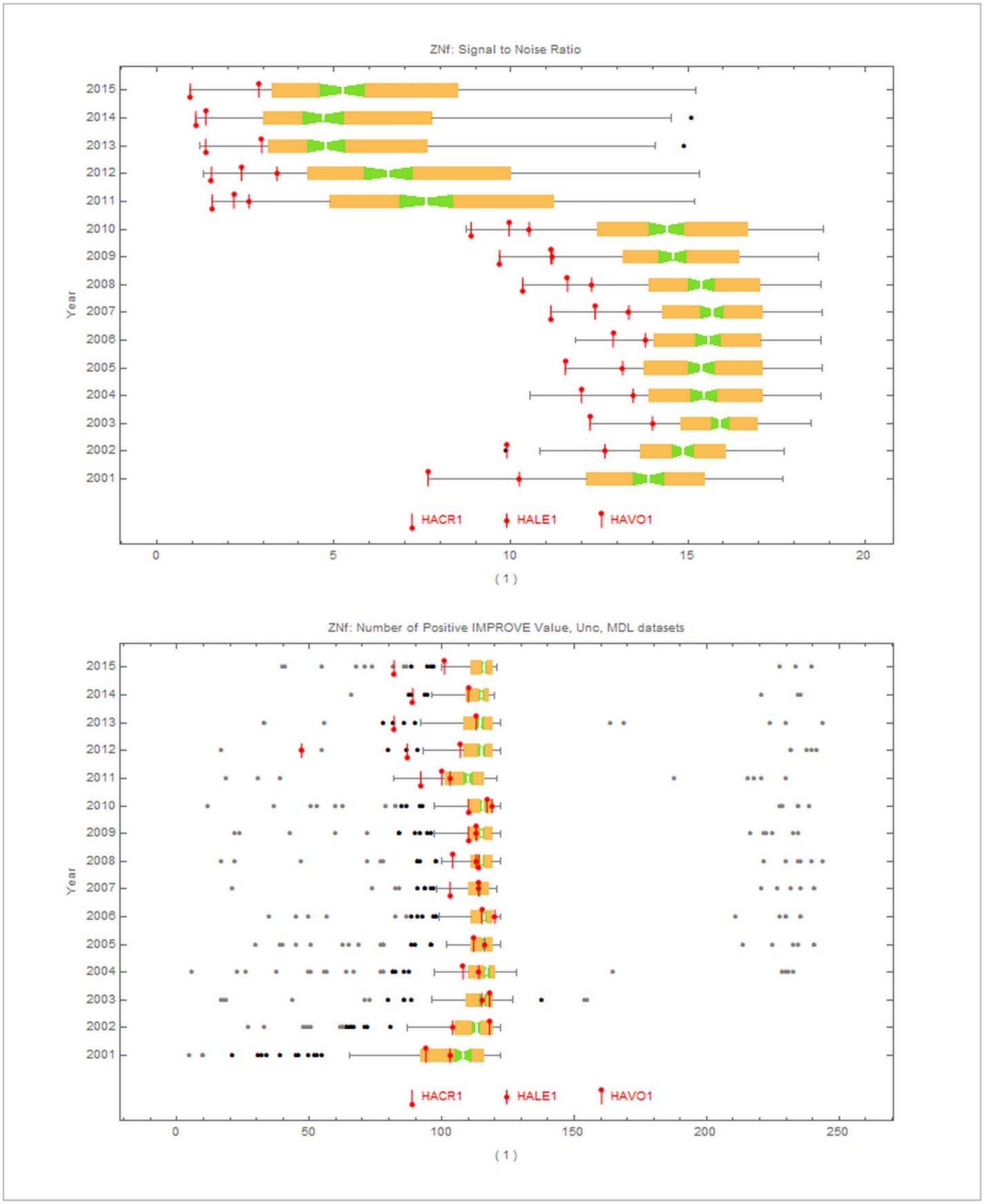

Figure F-102: IMPROVE ZNf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix F: IMPROVE Data Distribution; Figures of Visibility Data Distribution Across National Sites with Hawaii Sites Noted

Figure F-103: IMPROVE ZRf Calculated Signal to Noise Value Distributions and Number of Positive Measurement Datasets Distributions for All Sites with Hawaii Sites Noted

Appendix G: Consultation With Federal Land Managers

From:	Brewer, Patricia <patricia_f_brewer@nps.gov>
Sent:	Thursday, July 06, 2017 1:46 PM
To:	Madsen, Michael A
Cc:	Rossio, Marianne Fuji; McFall, Keith; Hamamoto, Dale; McCoy, Carol; McKaughan, Colleen
Subject:	Re: Hawaii's Regional Haze Progress Report
Attachments:	NPS Comment_HI Haze progress report.pdf

Mike,

Thank you for the opportunity to review the draft regional haze progress report. The report looks good and I had no suggested additions or revisions. A lot of work went into the additional analyses of the IMPROVE data.

Attached is our formal response letter.

Thank you,

Pat Brewer

On Fri, May 12, 2017 at 6:57 PM, Madsen, Michael A <michael.madsen@doh.hawaii.gov> wrote:

Ms. Susan Johnson

United States Department of Interior

National Park Service

Policy, Planning, & Permit Review Branch

Susan_Johnson@nps.gov

Ms. Pat Brewer

United States Department of Interior

National Park Service

Policy, Planning, & Permit Review Branch

Patricia_F_Brewer@nps.gov

Hi Susan and Pat,

The Hawaii Department of Health Clean Air Branch is submitting the attached draft Regional Haze Progress Report for review and comment by the Federal Land Managers (FLMs) in accordance with the Regional Haze Rule. The report contains nine (9) sections and six (6) appendices. Comments from the FLMs will be accepted until **July 15, 2017**. The thirty-day (30-day) public comment period for the progress report will be initiated after addressing comments from the FLMs.

An evaluation of the progress towards the reasonable progress goals for Haleakala National Park on Maui Island and Hawaii Volcanoes National Park on the Big Island (Hawaii) is provided in the report.

Please call or e-mail me if you have any questions. Also, please let me know if you received this email and the attached report.

Thank you,

Mike Madsen

Mike Madsen, P.E.

Environmental Engineer, Clean Air Branch

Hawaii Department of Health

Michael.madsen@doh.hawaii.gov

Office: (808) 586-4200 |Fax: (808) 586-4359

The Health State

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Pat Brewer
NPS Air Resources Division
P.O. Box 25287
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303-969-2153

United States Department of the Interior

NATIONAL PARK SERVICE
Air Resources Division
P.O. Box 25287
Denver, CO 80225-0287

TRANSMITTED VIA ELECTRONIC MAIL - NO HARDCOPY TO FOLLOW

N3615 (2350)

July 6, 2017

Mike Madsen
Clean Air Branch
Hawaii Department of Health
919 Ala Moana Blvd., Suite 203
Honolulu, Hawaii 96814

Dear Mr. Madsen:

Thank you for the opportunity to review and comment on Hawaii's draft 5-Year Regional Haze Progress Report for the Federal Implementation Plan (FIP). The Hawaii Department of Health Clean Air Branch (DOH-CAB) has addressed the requirements for the regional haze periodic progress report as outlined in 40 CFR §51.308(g) and (h) of the Regional Haze Rule. We agree with DOH-CAB that additional revision of the Regional Haze FIP is not needed at this time.

Haleakala National Park and Hawaii Volcanoes National Park are the two Class I areas located in Hawaii. Uniquely, the active Kilauea volcano is the predominant emission source contributing to haze at the IMPROVE aerosol monitors at both Class I areas.

EPA Region 9 prepared the original Regional Haze FIP in 2012, and the DOH-CAB is now summarizing progress in implementing the FIP. EPA set an emissions cap for sulfur dioxide from three electric generating stations on the Big Island (Hawaii). The Shipman Generating Station permanently closed in 2015, and the two other facilities are reducing operations as Hawaii increases reliance on generation from renewable energy sources. Additional closures are planned by 2020. Electric generating stations on Maui are also reducing production and emissions, and the sugar mill on Maui closed in 2016. Beginning in 2012, the North American Emissions Control Area requires marine vessels operating within 200 km of the U.S. coast to reduce emissions of sulfur dioxide, nitrogen oxide, and fine particles. These actions plus federal mobile standards have reduced anthropogenic emissions in and near Hawaii.

Sulfur dioxide emissions from Hawaii Volcanoes are highly variable over time, as reflected in the IMPROVE aerosol monitoring record for sulfate. Clearly the volcanic emissions are natural in origin and uncontrollable by the State of Hawaii. We reviewed the additional analyses of the IMPROVE data that were included in the progress report. We agree with DOH-CAB that EPA's revised impairment metric does not adequately address natural contributions from volcanic emissions. We would like further discussion with you as you refine methods to better account for volcanic emissions for the next regional haze planning period.

We appreciate the opportunity to work with Hawaii to improve visibility in Class I national parks and wilderness areas. If you have questions, please contact me at patricia_f_brewer@nps.gov or 303-969-2153.

Sincerely,

Pat Brewer

Pat Brewer
Acting Branch Chief, Policy, Planning and Permit Review Branch
Air Resources Division

Cc: Colleen McKaughan, EPA Region 9