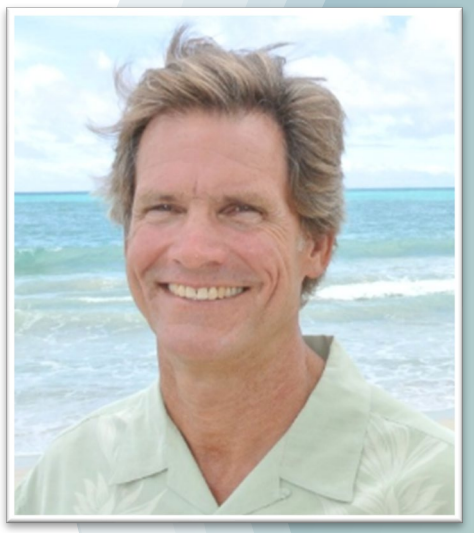
Impacts of Climate Change on Human Health in Hawaii



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East-West Center (EWC)

Volume 3, Issue 4
April 2024

Article Contents

JOURNAL ARTICLE

Earth at risk: An urgent call to end the age of destruction and forge a just and sustainable future

Charles Fletcher ✉, William J Ripple, Thomas Newsome, Phoebe Barnard, Kamanamaikalani Beamer, Aishwarya Behl, Jay Bowen, Michael Cooney, Eileen Crist, Christopher Field ... Show more
Author Notes

PNAS Nexus, Volume 3, Issue 4, April 2024, pgae106,
https://doi.org/10.1093/pnasnexus/pgae106
Published: 02 April 2024 **Article history**

Abstract

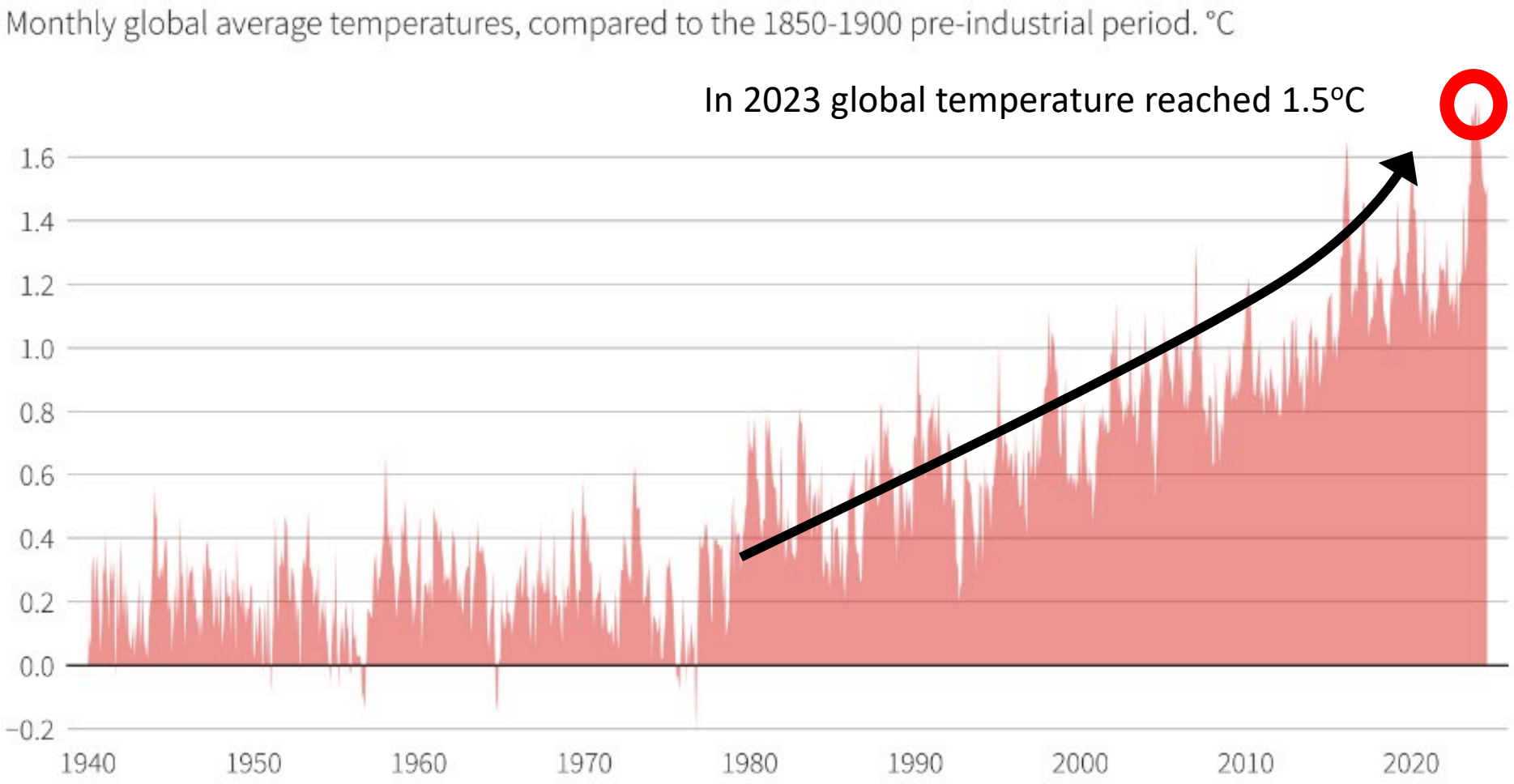
Human development has u
change, ecological destruc
inequality. This review syn
emergencies and underco
action. Propelled by imperi
population, we are speedin
ecosystems, and triggering
underpin the Holocene clir
consequences of these acti
populations, further entre
biomes face critical tipping
water access foreshadow a
backdrop of Earth at risk, we call for a global response centered on urgent decarbonization, fostering reciprocity with nature, and implementing regenerative practices in natural resource management. We call for the elimination of detrimental subsidies, promotion of equitable human development, and transformative financial support for lower income nations. A critical paradigm shift must occur that replaces exploitative, wealth-oriented capitalism with an economic model that prioritizes sustainability, resilience, and justice. We advocate a global cultural shift that elevates kinship with nature and communal well-being, underpinned by the recognition of Earth's finite

1. Climate Change
2. Biodiversity Loss
3. Social Inequality
4. Pollution
5. Disease

Recommended

Trajectories of the Earth System in the Anthropocene
Will Steffen, Proc Natl Acad Sci U S A, 2018

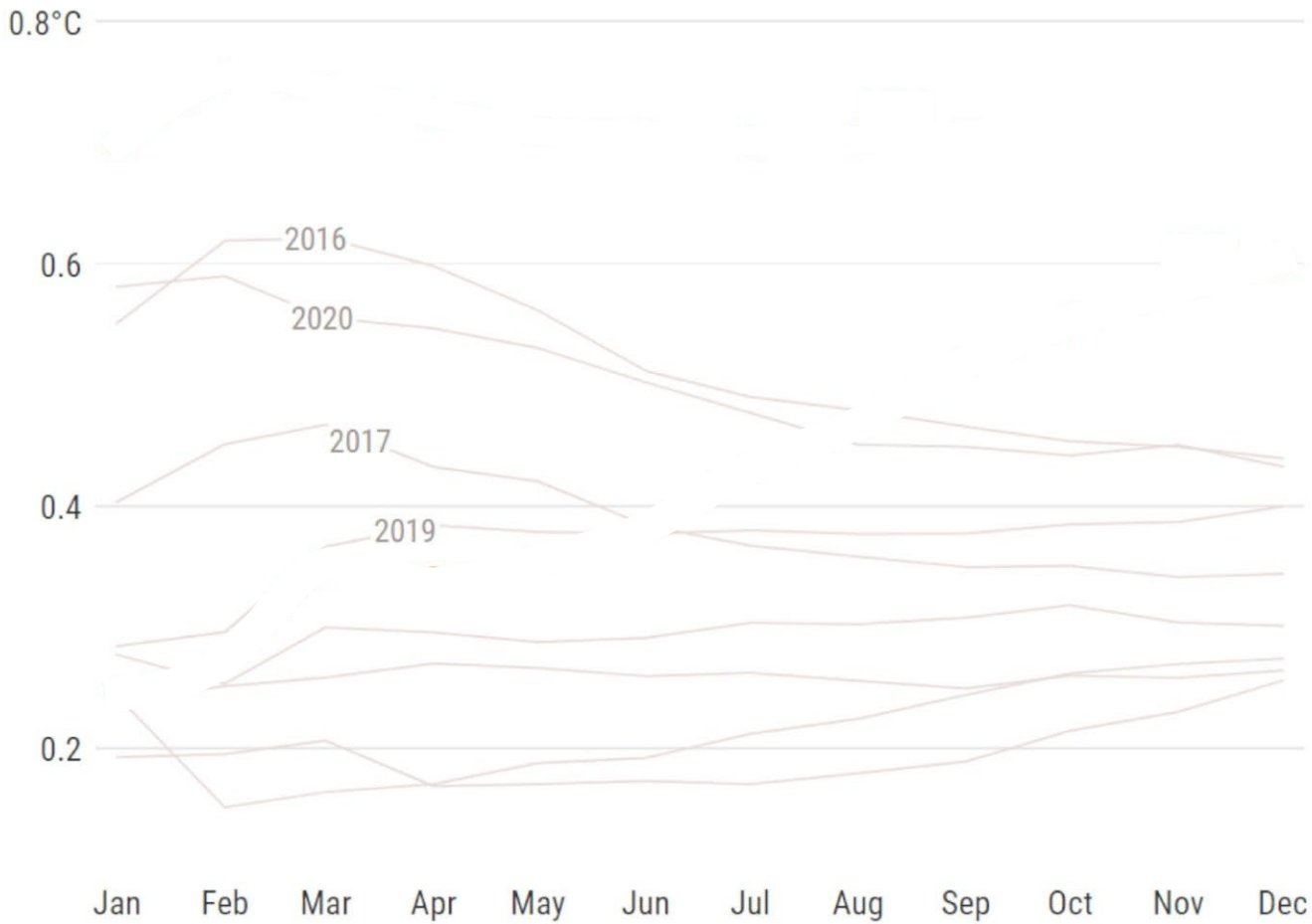
Climate change could reduce global GDP by up to 14% and displace 1.2 billion people as climate refugees by 2050



https://environmentalmigration.iom.int/blogs/extreme-weather-spurs-global-displacement-migration-part-solution

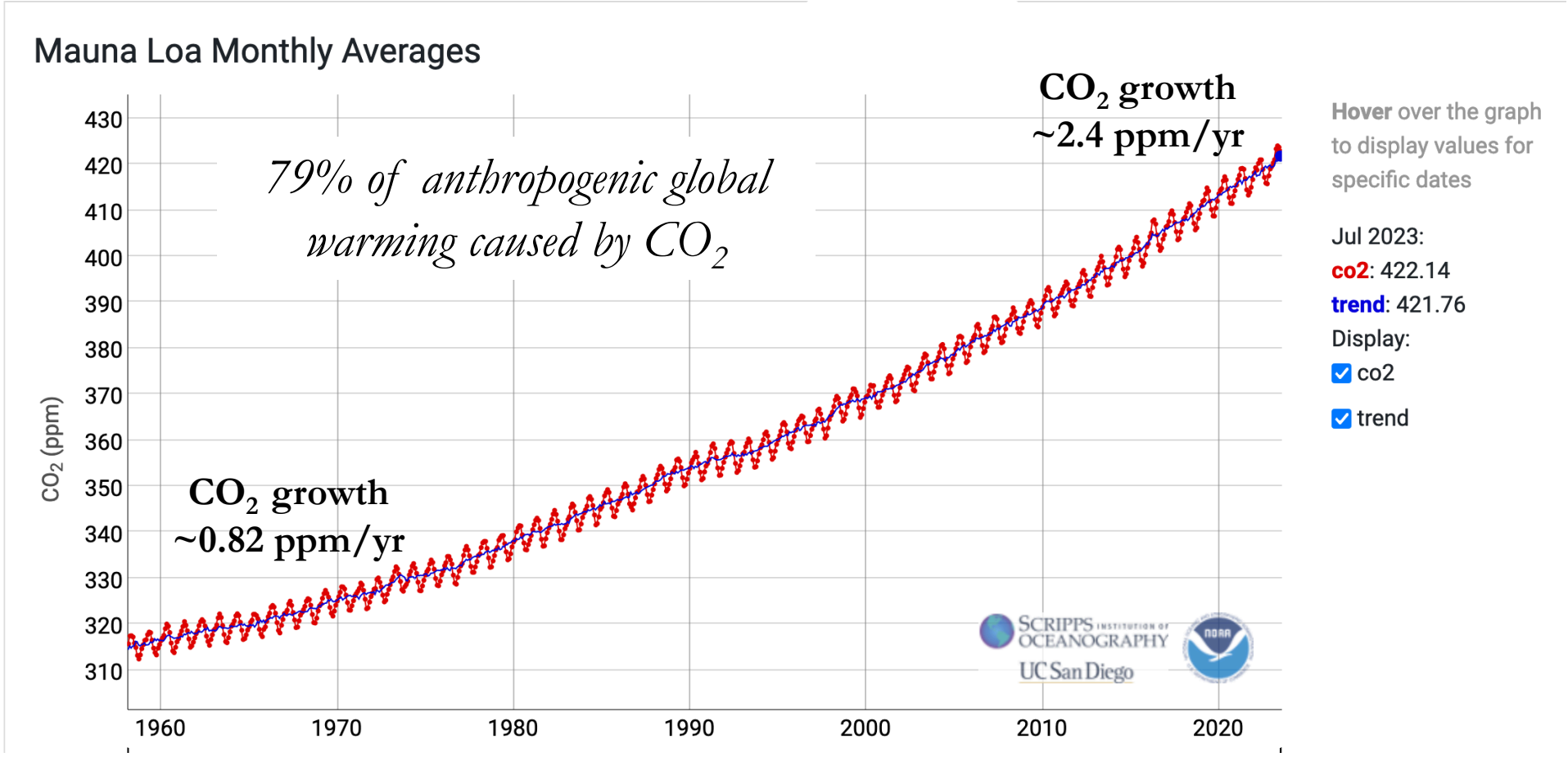
Year-to-date global surface temperature anomalies

Data: ERA5 • Reference period: 1991–2020
Credits: C3S/ECMWF



PROGRAMME OF THE EUROPEAN UNION
opernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
Climate Change Service
climate.copernicus.eu

In 2023, the CO_2 growth rate was 3.4 ppm, 86% above the previous year, and the highest in recorded history



Lourantou, A., et al., "Changes in Atmospheric CO_2 and Its Carbon Isotopic Ratio During the Penultimate Deglaciation," 29 *Quaternary Science Reviews* 1983 (2010).

Frumhoff, P., et al., "The Climate Responsibilities of Industrial Carbon Producers," 132 *Climatic Change* 157 (2015).

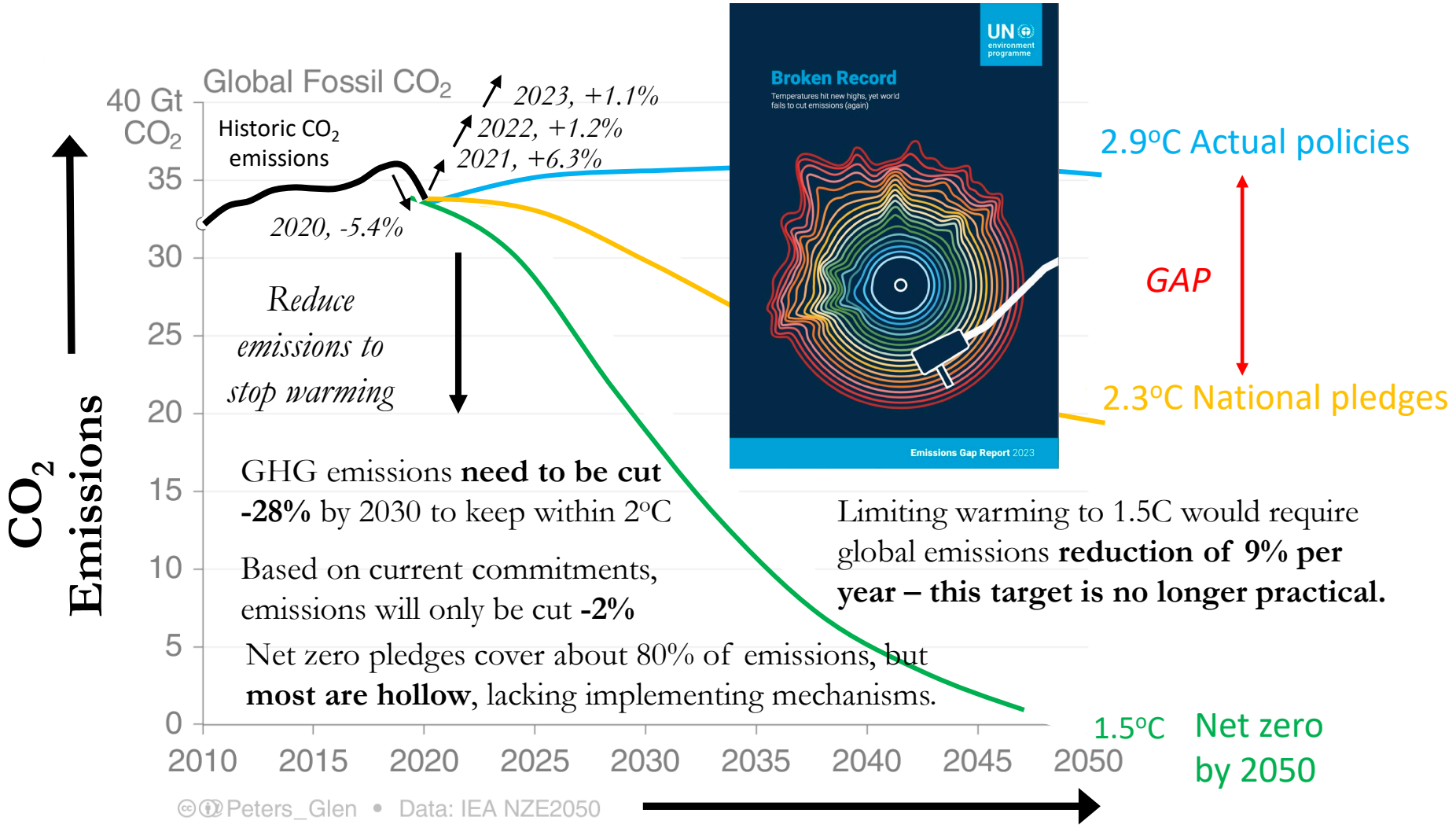
Paris Agreement, 2015

United Nations Framework Convention on Climate Change

Stop global warming before *2°C (3.6°F)*

Pursue efforts to end warming before *1.5°C (2.7°F)*

Progress on Stopping Warming at 1.5°C



Climate Action Tracker (2022) https://climateactiontracker.org/documents/1055/CAT_2022-06-08_Briefing_EnergyCrisisReaction.pdf

Grant, N. (2022) The Paris Agreement's ratcheting mechanism needs strengthening 4-fold to keep 1.5°C alive, Joule, v. 6, p. 703-708, ISSN 2542-4351, https://doi.org/10.1016/j.joule.2022.02.017

Meinshausen, M., Lewis, J., McGlade, C. *et al.* (2022) Realization of Paris Agreement pledges may limit warming just below 2 °C. *Nature* 604, 304–309 https://doi.org/10.1038/s41586-022-04553-z

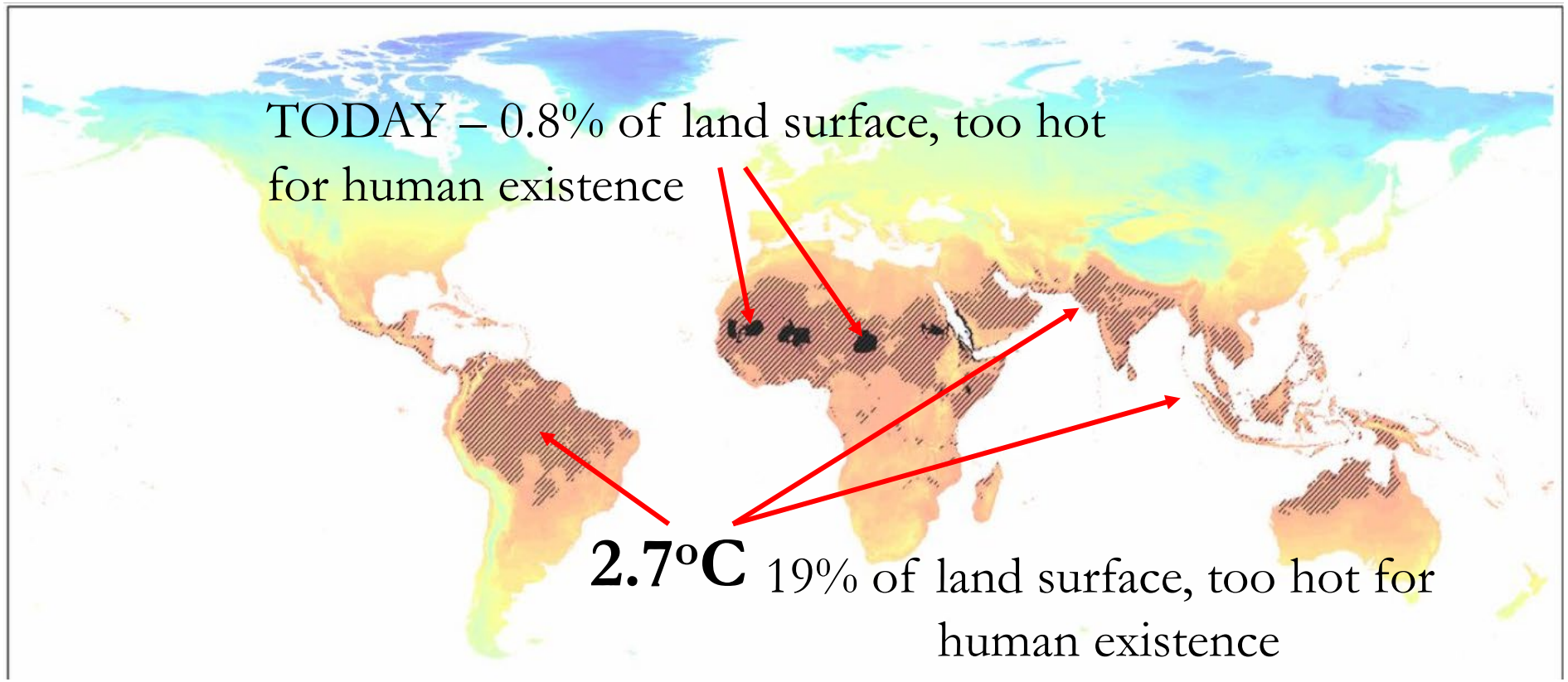
United Nations Environment Programme (2023). Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again). Nairobi. https://doi.org/10.59117/20.500.11822/43922.

Globally, Governments still plan to produce more than double the amount of fossil fuels in 2030 than would be consistent with stopping warming at 2ºC

United Nations Environment Programme (2023). *Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again).* Nairobi. https://doi.org/10.59117/20.500.11822/43922.

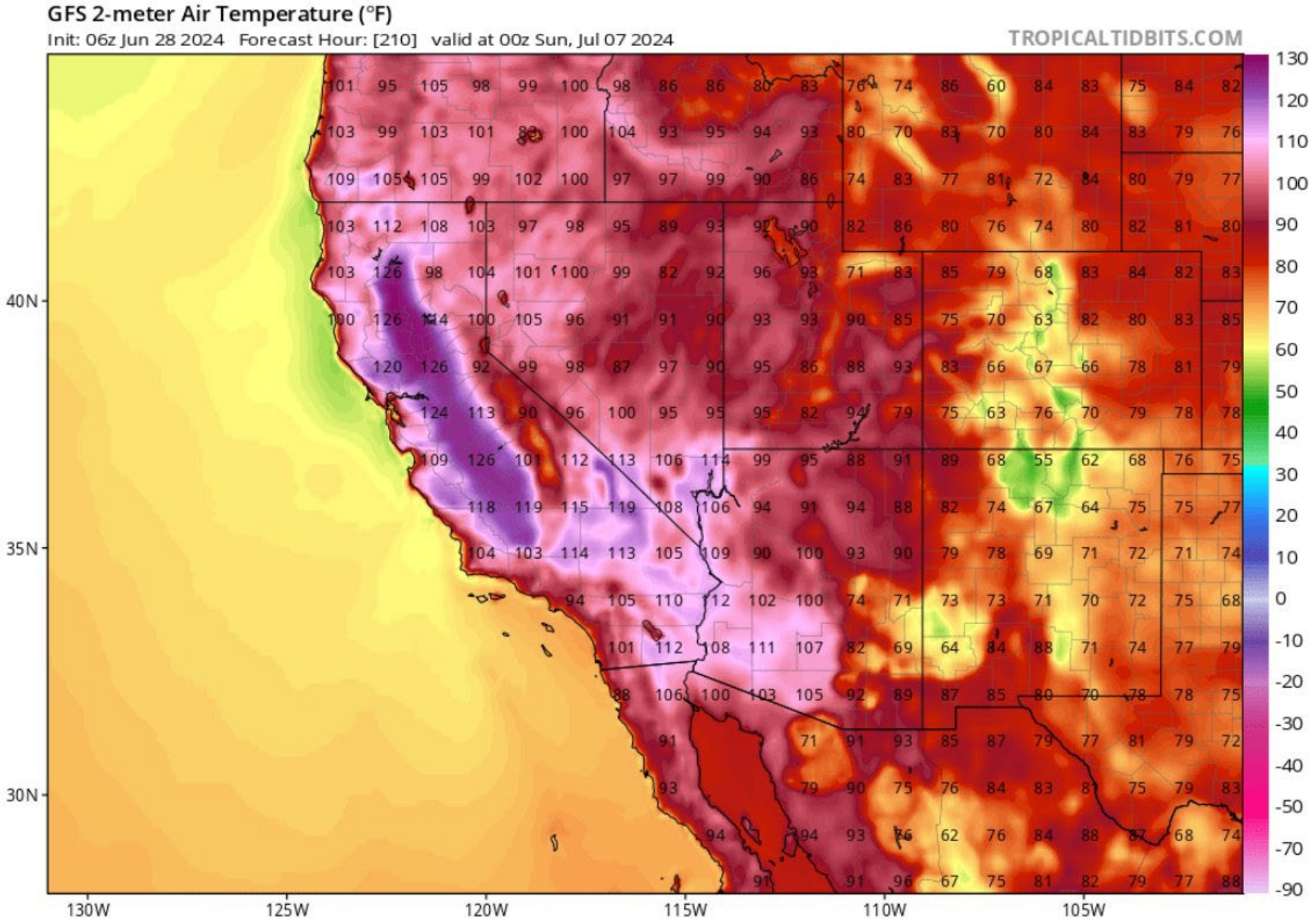
Warming on Land

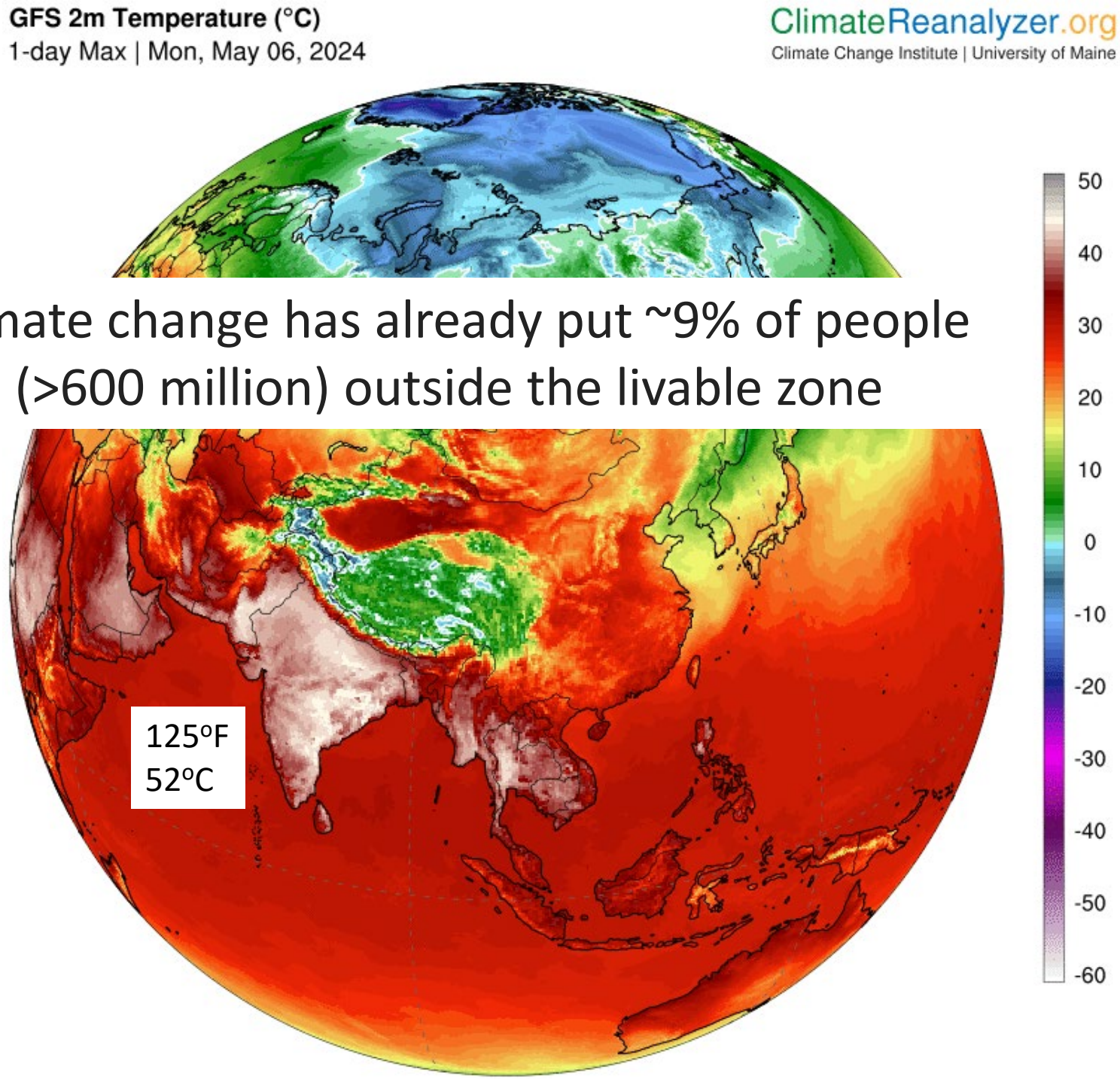
1 billion displaced for every 1°C of additional global warming



Xu, C., et al. (2020) Future of the human climate niche, *PNAS*, May 2020, 201910114; DOI:10.1073/pnas.1910114117

126°F (52°C) in the Central Valley of California





climate change has already put ~9% of people (>600 million) outside the livable zone

Drought affected 1.84 billion people in 2022 and 2023 – nearly one-quarter of all people on Earth – “the vast majority” of whom live in low- and middle-income countries

https://www.droughtglobal.org/_files/ugd/184219_4dcb7a4451514f2281981b04c3848cc.pdf


More than half the world's food production will be at risk of failure within the next 25 years as a rapidly accelerating water crisis grips the planet
Demand for fresh water will outstrip supply by 40% by the end of the decade
https://watercommission.org/

The problem in a nutshell…

Even as renewables accelerate, so does the demand for new energy

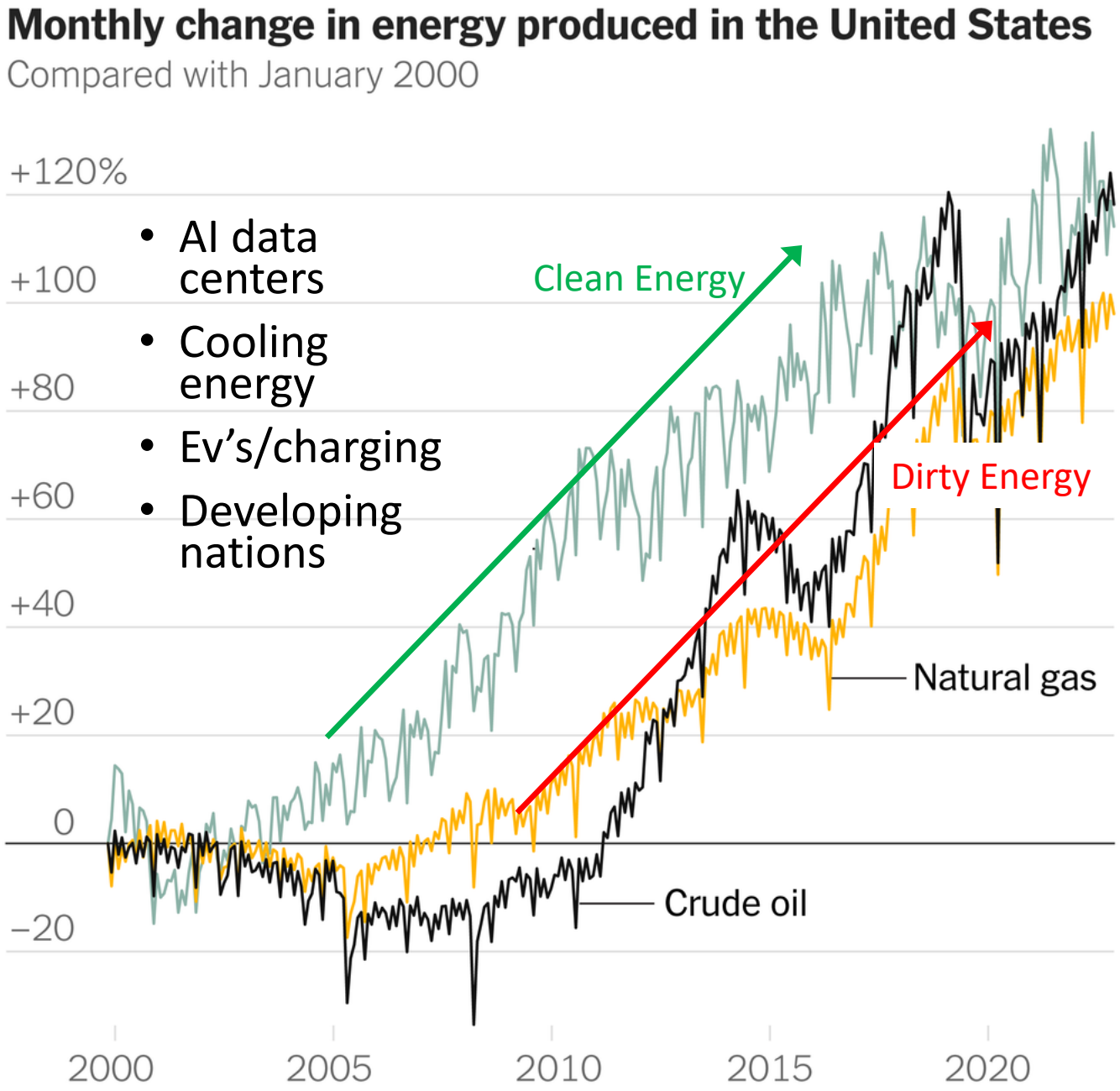
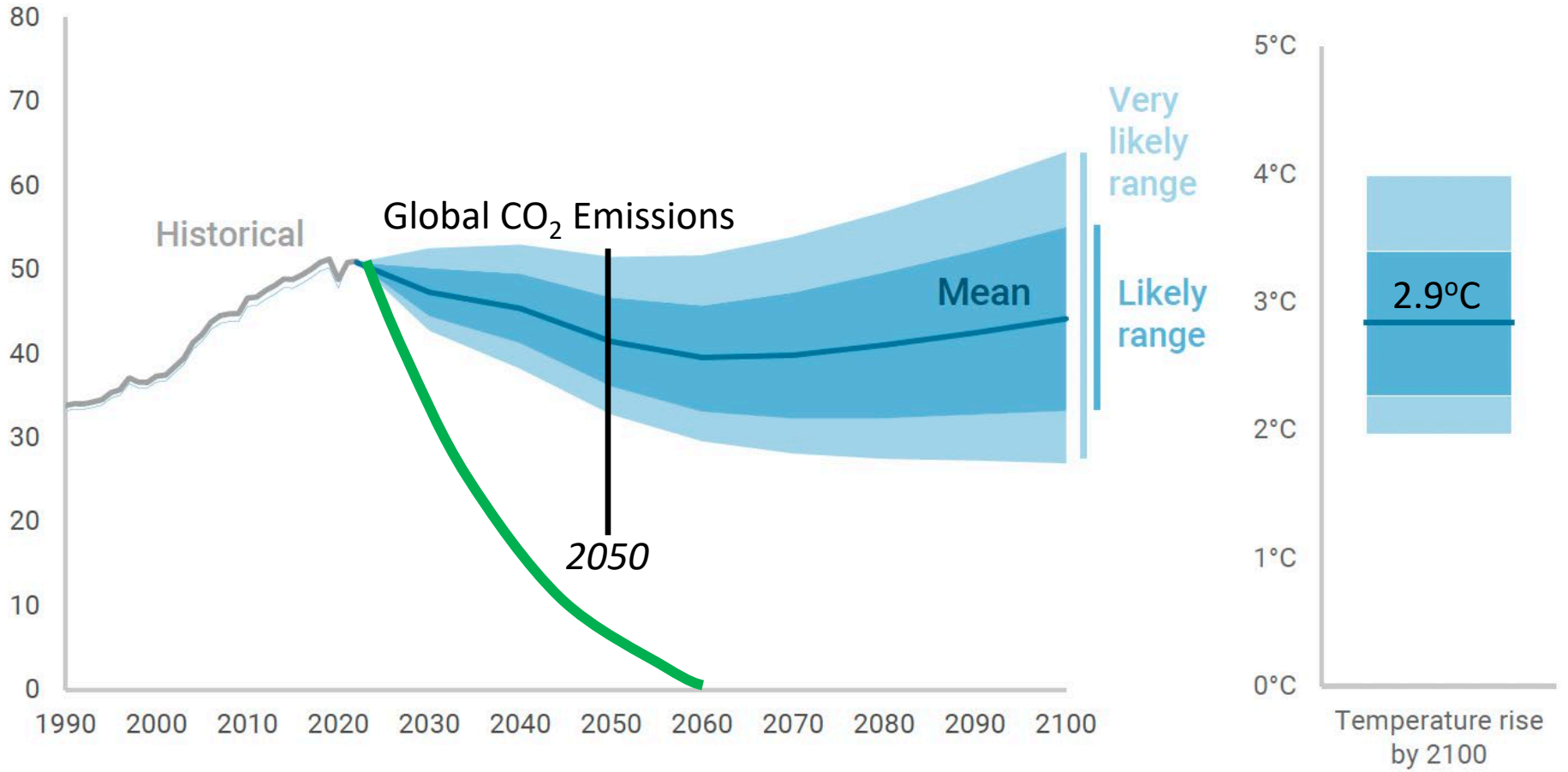


FIGURE 1

Global greenhouse gas emissions and temperature rise

Net emissions including removals (billion metric tons of CO_2-equivalent)



Source: Rhodium Climate Outlook, AR5 100-year GWP values. Following IPCC conventions, this report uses *very likely* to indicate a 90% probability of occurring and *likely* to indicate a 67% probability.

Fate of anthropogenic CO_2 emissions (2010–2019)

Sources = Sinks

35.3 $GtCO_2/yr$

88%

12%

4.7 $GtCO_2/yr$

Budget Imbalance:

(the difference between estimated sources & sinks)

4%

-1.6 $GtCO_2/yr$

18.9 $GtCO_2/yr$

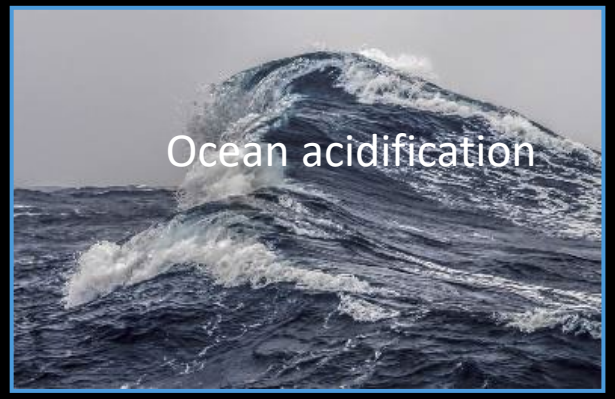
47%

~~31%~~

12.3 $GtCO_2/yr$

26%

10.4 $GtCO_2/yr$



Source: Friedlingstein et al 2023; Global Carbon Project 2023

- Plant *photosynthesis* removes CO_2 from the air
- Plant *respiration* releases CO_2 to the air
- Photosynthesis has a heat limit, past which:
  - Photosynthesis sharply **declines**
  - Respiration continues to **increase**
  - Carbon uptake by land plants is degraded
- With continued emissions,
  - **Carbon uptake may be degraded nearly 50% as early as 2040**
- This effect is **not accounted for** in National Policies

SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

How close are we to the temperature tipping point of the terrestrial biosphere?

Katharyn A. Duffy[1,2]*, Christopher R. Schwalm[2,3], Vickery L. Arcus[4], Liyin L. Liang[4,5], Louis A. Schipper[4]

The temperature dependence of global photosynthesis and respiration d
While the land sink currently mitigates ~30% of anthropogenic carbon emi
system service will persist and, more specifically, what hard temperature l
Here, we use the largest continuous carbon flux monitoring network to cons
temperature response curves for global land carbon uptake. We show that t
quarter (3-month period) passed the thermal maximum for photosynthes
temperatures, respiration rates continue to rise in contrast to sharply decl
business-as-usual emissions, this divergence elicits a near halving of the lan

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JOURNAL OF GEOPHYSICAL RESEARCH
Biogeosciences
AN AGU JOURNAL

Free Access

Are tropical forests near a high temperature threshold?

Christopher E. Doughty, Michael L. Goulden

First published: 17 October 2008 | https://doi.org/10.1029/2007JG000632 | Citations: 162

SECTIONS PDF TOOLS

Abstract

[1] We used leaf gas exchange, sap flow, and eddy covariance measurements to investigate whether high temperature substantially limits CO_2 uptake at the LBA (Large-scale Biosphere-Atmosphere) km-83 tropical forest site in Brazil. Leaf-level temperature-photosynthesis curves, and comparisons of whole-canopy net ecos CO_2 exchange (NEE) with air temperature, showed that CO_2 uptake declined sha during warm periods. Observations of ambient leaf microclimate showed that le oscillate between two states: a cool, dimly lit stage and a hot, brightly illuminate where leaf temperatures are often greater than 35°C. The leaf-level rates of photosynthesis decreased when shaded leaves (~ambi μmol m^{-2} s^{-1}) were transferred into a prewa 38°C and 1000 μmol m^{-2} s^{-1}), coincide evaporative demand, and stomata calculated at 5-min intervals in followed extended cloudy pe temperature and evaporati The forest at km-83 appea CO_2 uptake drops sharply leaf temperature and leaf disproportionately to canop exchange is curtailed.

1. Introduction

[2] Researchers have hypothesized that increasing te on tropical forest production [Clark, 2004], resulting in a positive feedback that amp global climate change [Cox et al., 2000]. High temperatures reduce CO_2 uptake by C through reversible, short-term increases in photorespiration, respiration and stoma closure, and, in extreme cases, irreversible damage to biochemical machinery [Berr Björkman, 1980]. Increases in temperature that increase photorespiration, total eco respiration, or the incidence of stomatal closure would be expected to decrease tro forest primary production. The Amazon Forest contains 93 (±23) PgC (10^{15} g) of live aboveground, and tropical forest accounts for at least 30% of global terrestrial prim

Downloaded from https://www

forests

MDPI

Article

Temperate and Tropical Forest Canopies are Already Functioning beyond Their Thermal Thresholds for Photosynthesis

u [1], Sasha C. Reed [2], Tana E. Wood [3] and Molly A. Cavaleri [1,*]

Forest Resources & Environmental Science, Michigan Technological University, 1400 Townsend Dr., n, MI 49931, USA; acmau@mtu.edu
logical Survey, Southwest Biological Science Center, 2290 S. West Resource Blvd, Moab, UT 84532,

PNAS RESEARCH ARTICLE | ECOLOGY ENVIRONMENTAL SCIENCES

No evidence of canopy-scale leaf thermoregulation to cool leaves below air temperature across a range of forest ecosystems

Christopher J. Still[a,1], Gerald Page[b,c], Bharat Rastogi[d,e], Daniel M. Griffith[a,f], Donald M. Aubrecht[g,h], Youngil Kim[i], Sean P. Burns[j,k], Chad V. Hanson[a], Hyojung Kwon[a], Linnia Hawkins[a], Frederick C. Meinzer[l], Sanna Sevanto[m], Dar Roberts[n], Mike Goulden[o], Stephanie Pau[p], Matteo Detto[q,r], Brent Helliker[s], and Andrew D. Richardson[g,t]

Edited by James Clark, Duke University, Durham, NC; received March 31, 2022; accepted June 28, 2022

Understanding and predicting the relationship between leaf temperature (T_{leaf}) and air temperature (T_{air}) is essential for projecting responses to a warming climate, as studies suggest that many forests are near thermal thresholds for carbon uptake. Based on leaf measurements, the limited leaf homeothermy hypothesis argues that daytime T_{leaf} is maintained near photosynthetic temperature optima and below damaging temperature thresholds. Specifically, leaves should cool below T_{air} at higher temperatures (i.e., > ~25–30°C) leading to slopes <1 in T_{leaf}/T_{air} relationships and substantial carbon uptake when leaves are cooler than air. This hypothesis implies that climate warming will be mitigated by a compensatory leaf cooling response. A key uncertainty is understanding whether such thermoregulatory behavior occurs in natural forest canopies. We present an unprecedented set of growing season canopy-level leaf temperature (T_{can}) data measured with thermal imaging at multiple well-instrumented forest sites in N and Central America. Our data do not support the limited homeother esis: canopy leaves are warmer than air during most of the day and ow air in mid to late afternoon, leading to T_{can}/T_{air} slopes >1 avior. We find that the majority of ecosystem photosynthesis leaves are warmer air. Using energy balance and we show that key leaf leaf-air coupli relationship. Canopy struc- future climate warming is likely mpacts on forest carbon cycling and

omeothermy | photosynthesis | leaf traits

ental control on biological systems and processes at . Its influence spans from enzymatic reactions to ale species distributions. Temperature is also a h of the concern about the impact of climate d by the pervasive influence of temperature on s long been recognized as important for plant ly influences photosynthesis, respiration (1–4), s of T_{leaf} in different habitats are also affected by latitude. A global meta-analysis of leaf size in rela- ound that large leaves occur preferentially in warm riations affecting selection for maximum possible leaf . The temperature of leaves is, therefore, of fundamental ation, productivity, and distribution.

ging appreciation of variation in T_{leaf} and its critical control on plant and ecosystem function. Several studies document temperature ds for positive net photosynthesis at leaf and canopy scales, with evidence that current temperatures are approaching or surpassing such thresholds, particularly in tropical forests (7–10). This has large implications for forest carbon balance and the global carbon cycle. If tropical canopy photosynthesis declines with increasing temperature while respiration continues to increase, then the strength of the carbon sink in the tropics will be reduced. The temperature sensitivity of leaf respiration—and its acclimation to rising temperature—underlines the importance of accurate T_{leaf} measurements and models for predicting carbon fluxes (4, 11–13). Finally, the increasing prevalence of heat extremes and heat waves resulting from climate warming (14, 15) has heightened interest in how ecosystems respond to such events, in particular, how leaves can avoid heat stress and mortality (16). Thus, understanding T_{leaf} variations and controls

Significance

Leaf temperature has long been recognized as important for plant function, and climate warming may lead to outsized impacts on leaf temperature and function. This includes carbon assimilation, as numerous studies suggest that a variety of ecosystems are operating at or near thermal thresholds. However, sustained, high-frequency measurements of canopy-scale leaf temperature across a range of ecosystems and conditions are rare. We show that daytime canopy leaf temperatures do not cool below air as predicted by the leaf homeothermy hypothesis. Leaves are typically warmer than air and the magnitude of this departure varies with leaf size and canopy structure. Almost all ecosystem photosynthesis occurs when leaf temperature exceeds air temperature. Future warming is unlikely to be mitigated by leaf cooling.

Author contributions: C.J.S., D.M.A., Y.K., S.P.B., C.V.H., H.K., M.G., S.P., M.D., B.H., and A.D.R. collected data; G.P., B.R., D.M.G., D.M.A., Y.K., and S.P.B. prepared data; C.J.S., G.P., B.R., D.M.G., S.P.B., L.H., F.C.M., S.S., D.R., M.G., S.P., M.D., B.H., and A.D.R. analyzed data; C.J.S. wrote the paper; and C.J.S., G.P., B.R., D.M.G., D.M.A., Y.K., S.P.B., C.V.H., H.K., L.H., F.C.M., S.S., D.R., M.G., S.P., M.D., B.H., and A.D.R. assisted with editing the manuscript.

The authors declare no competing interest.

This article is a PNAS Direct Submission.

[1]To whom correspondence may be addressed. Email: chris.still@oregonstate.edu.

This article contains supporting information online at http://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2205682119/-/DCSupplemental.

Published September 12, 2022.

"…. numerous studies suggest that a variety of ecosystems are operating at or near thermal thresholds."

The amount of carbon absorbed by land has temporarily collapsed. In 2023 forest, plants and soil – as a net category – absorbed almost no carbon.

The age of extinction
Oceans

Patrick Greenfield

Mon 14 Oct 2024 03.00 EDT

Trees and land absorbed almost no CO2 last year. Is nature's carbon sink failing?

The sudden collapse of carbon sinks was not factored into climate models – and could rapidly accelerate global heating

Read more: What happens to the world if forests stop absorbing carbon? Ask Finland

Phytoplankton in the Baltic Sea. Melting sea ice exposes algae-eating zooplankton to more sunlight, which could cut the amount of carbon stored on the seabed. Photograph: Nasa/Alamy

It begins each day at nightfall. As the light disappears, billions of zooplankton, crustaceans and other marine organisms rise to the ocean surface to feed on microscopic algae, returning to the depths at sunrise. The waste from this frenzy - Earth's largest migration of creatures - sinks to the ocean floor, removing millions of tonnes of carbon from the atmosphere each year.

This activity is one of thousands of natural processes that regulate the Earth's climate. Together, the planet's oceans, forests, soils and other natural carbon sinks absorb about half of all human emissions.

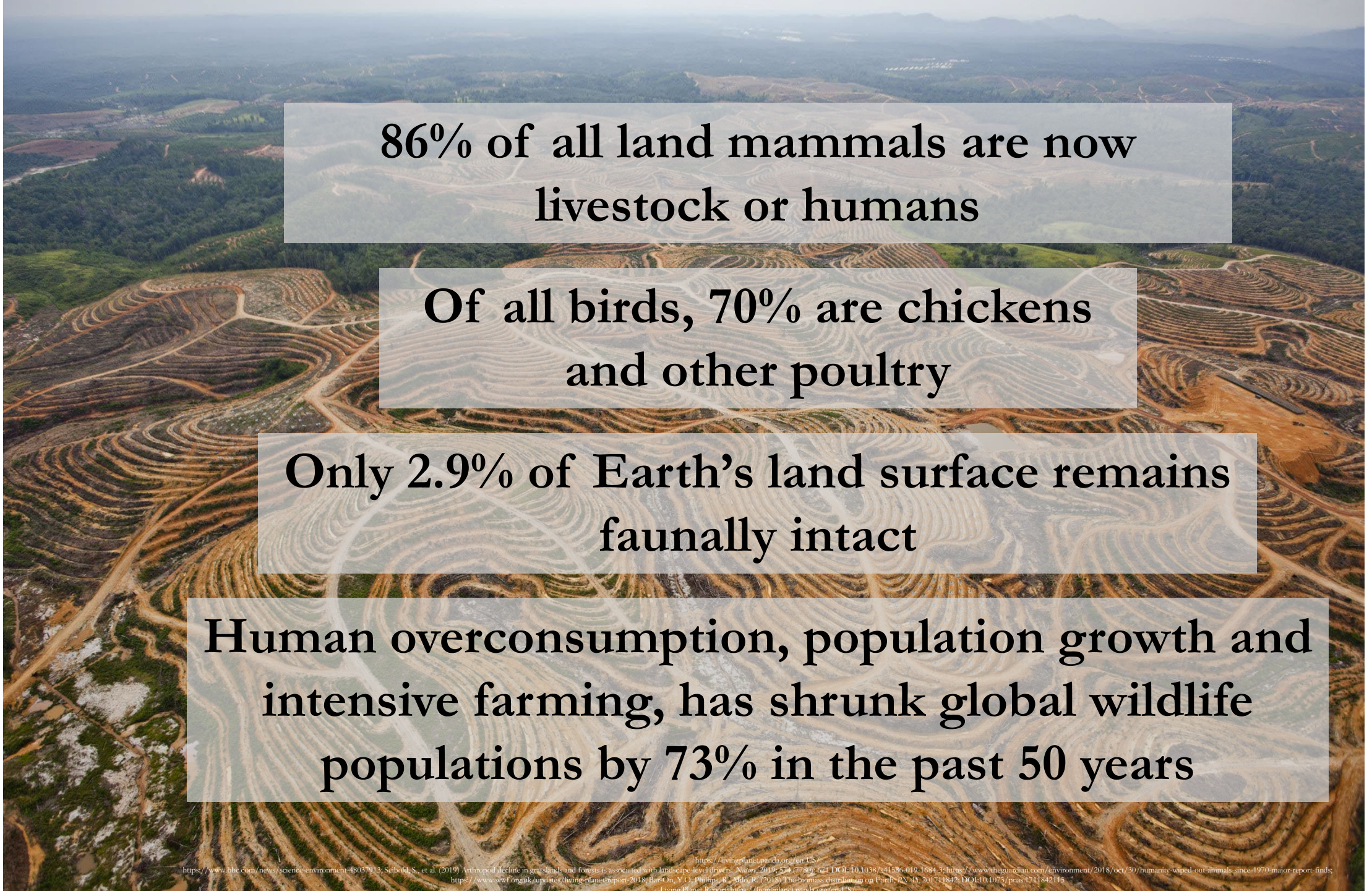
But as the Earth heats up, scientists are increasingly concerned that those crucial processes are breaking down.

In 2023, the hottest year ever recorded, preliminary findings by an international team of researchers show the amount of carbon absorbed by land has temporarily collapsed. The final result was that forest, plants and soil - as a net category - absorbed almost no carbon.

There are warning signs at sea, too. Greenland's glaciers and Arctic ice sheets are melting faster than expected, which is disrupting the Gulf Stream ocean current and slows the rate at which oceans absorb carbon. For the algae-eating zooplankton, melting sea ice is exposing them to more sunlight - a shift scientists say could keep them in the depths for longer, disrupting the vertical migration that stores carbon on the ocean floor.

"None of these models

"We're seeing cracks in the resilience of the Earth's systems.



https://livingplanet.panda.org/en-US/
https://www.bbc.com/news/science-environment-48037913; Seibold, S., et al. (2019) Arthropod decline in grasslands and forests is associated with landscape-level drivers. *Nature*, 2019, 574 (7780): 671 DOI: 10.1038/s41586-019-1684-3; https://www.theguardian.com/environment/2018/oct/30/humanity-wiped-out-animals-since-1970-major-report-finds; https://www.wwf.org.uk/updates/living-planet-report-2018; Bar-On, Y.O, Phillips, R., Milo, R. (2018) The biomass distribution on Earth, *PNAS*, 115, 201711842; DOI:10.1073/pnas.1711842115
Living Planet Report-https://livingplanet.panda.org/en-US/

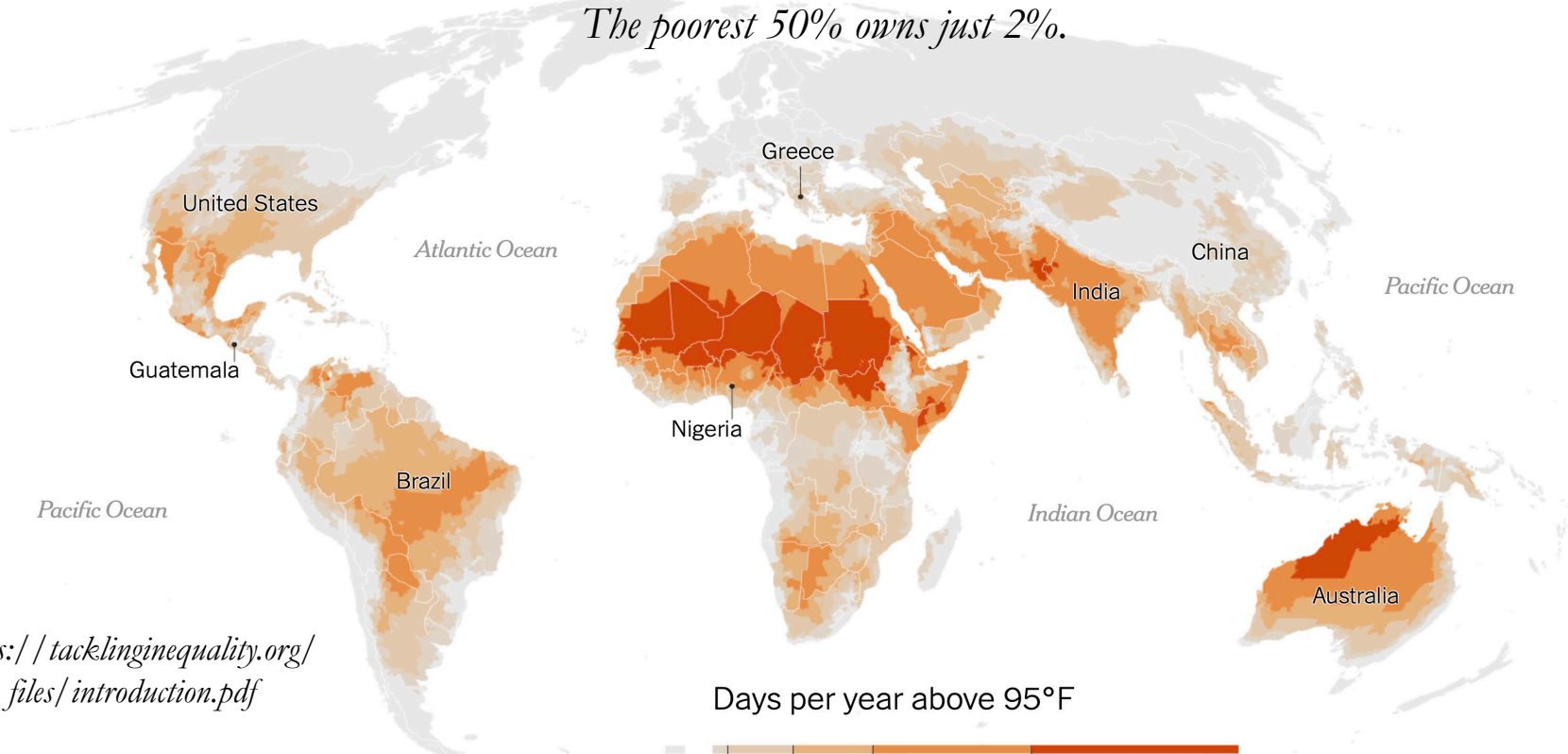
Pandemic Era

- **335 new infectious diseases** have emerged in recent decades
  - 75% of new or emerging infectious diseases are **Zoonotic**, jump species from animals to humans
  - *Ebola, HIV, Malaria, West Nile, Anthrax, Encephalitis, Zika, SARS, MERS, COVID19* and others
  - *Spillover Event* - Microbes carried by **animals** that cross to **humans** through contact with wildlife and livestock
- **Habitat loss** –
  - Roughly 1/3 of new zoonotic diseases are directly attributed to deforestation and habitat loss
  - About 50% of the worlds original forests have been eliminated
  - Globally, we cause a net loss of about 10 billion trees per year
- **Vector expansion** – Tropics expanding, mice, mosquitos, tics, deer and other carriers moving into human communities
- **Extreme weather events** – Flood, wildfire, heat displace humans and pathogens
  - Human *immune systems weakened* – disease is a major problem following disaster events
- **CAFO** – Breeding ground for virulent pathogens, no evolutionary pressure to preserve hosts
  - Pork, poultry, and beef are kept alive by pumping them with antibiotics
  - Nearly two-thirds of drugs important to human medicine in the U.S. are sold for food animal use
  - Overuse of these medicines drive the rise and spread of **bacterial resistance**

Armstrong, A. Forest ecology: Three trillion trees. Nature Plants 1, 15154 (2015). https://doi.org/10.1038/nplants.2015.154, Centers for Disease Control and Prevention: https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html Jones, K., *et al.* (2008) Global trends in emerging infectious diseases. *Nature* 451**,** 990–993. https://doi.org/10.1038/nature06536; Ogden NH, Gachon P. Climate change and infectious diseases: What can we expect? Can Commun Dis Rep 2019;45(4):76–80. https://doi.org/10.14745/ccdr.v45i04a01; Rossati A. Global warming and its health impact. *Int J Occup Environ Med* 2017;**8**:7-20. doi: 10.15171/ijoem.2017.963

Disease, environmental damage, climate change & human inequality form an **amplifying feedback**

- *Disadvantaged groups suffer disproportionately, resulting in greater inequality*
  - *The ratio between the income of the richest and poorest 10% is 25% larger than it would be in a world without global warming*
    - *The richest 10% of the global population owns over ¾'s of all global wealth. The poorest 50% owns just 2%.*



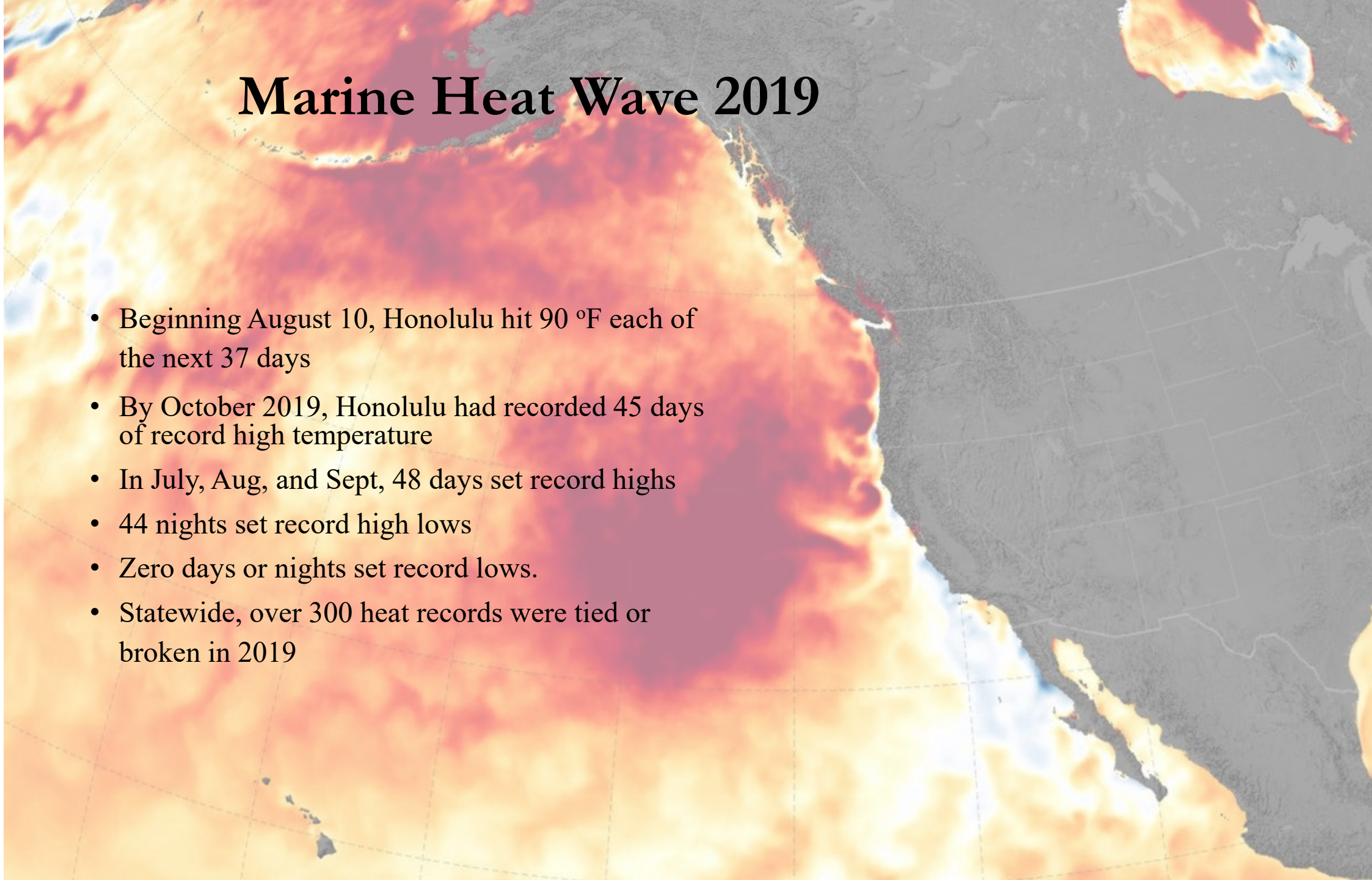
https://tacklinginequality.org/files/introduction.pdf

UN (2020) World Social Report 2020: Inequality in a Rapidly Changing World, https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/01/World-Social-Report-2020-FullReport.pdf

y The New York Times | Source: Climate Impact Lab

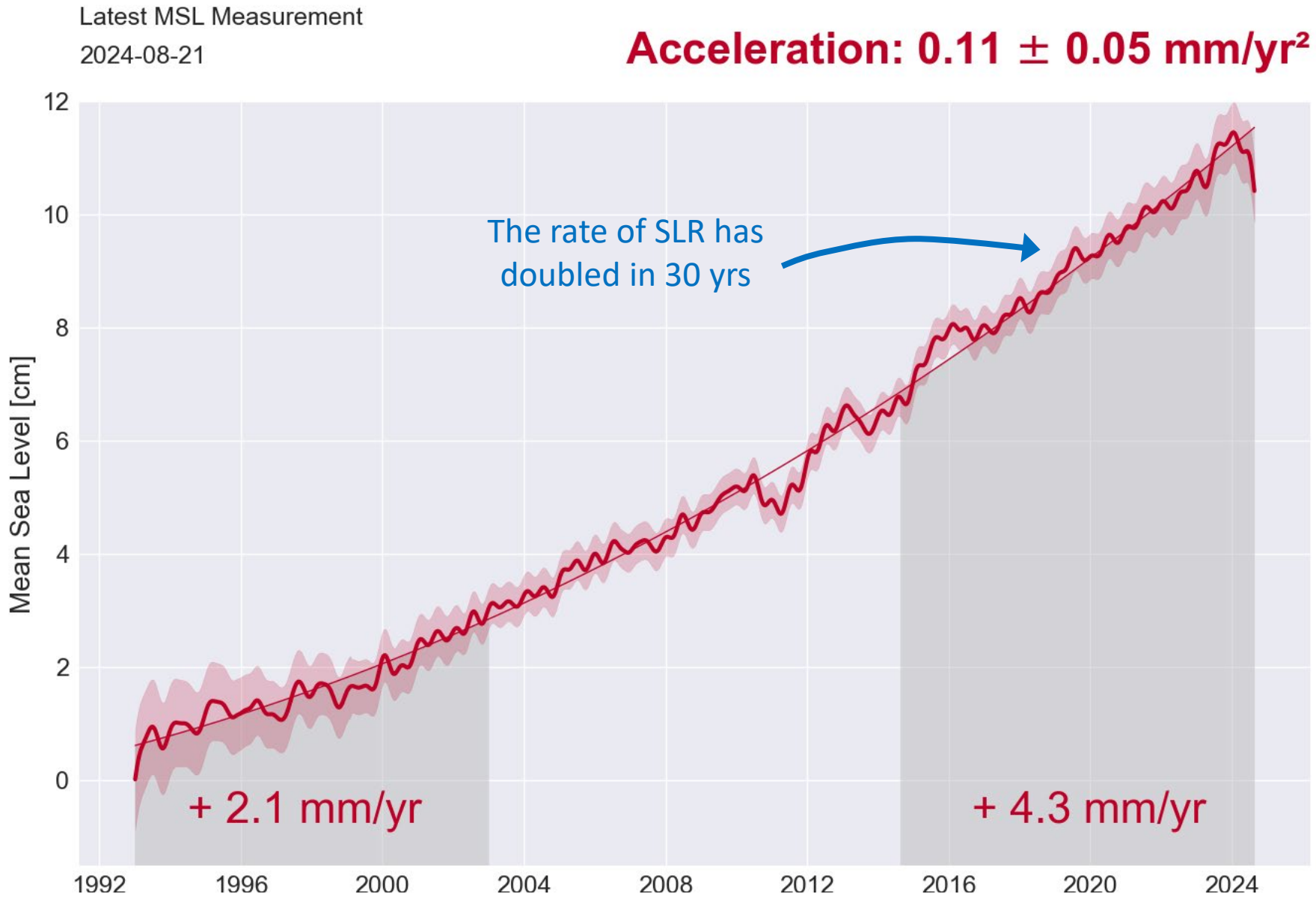

We must urgently redefine our relationship with nature and each other as one of reciprocity, regeneration, and social justice.

Marine Heat Wave 2019



- Beginning August 10, Honolulu hit 90 °F each of the next 37 days
- By October 2019, Honolulu had recorded 45 days of record high temperature
- In July, Aug, and Sept, 48 days set record highs
- 44 nights set record high lows
- Zero days or nights set record lows.
- Statewide, over 300 heat records were tied or broken in 2019

Global Mean Sea Level Rise

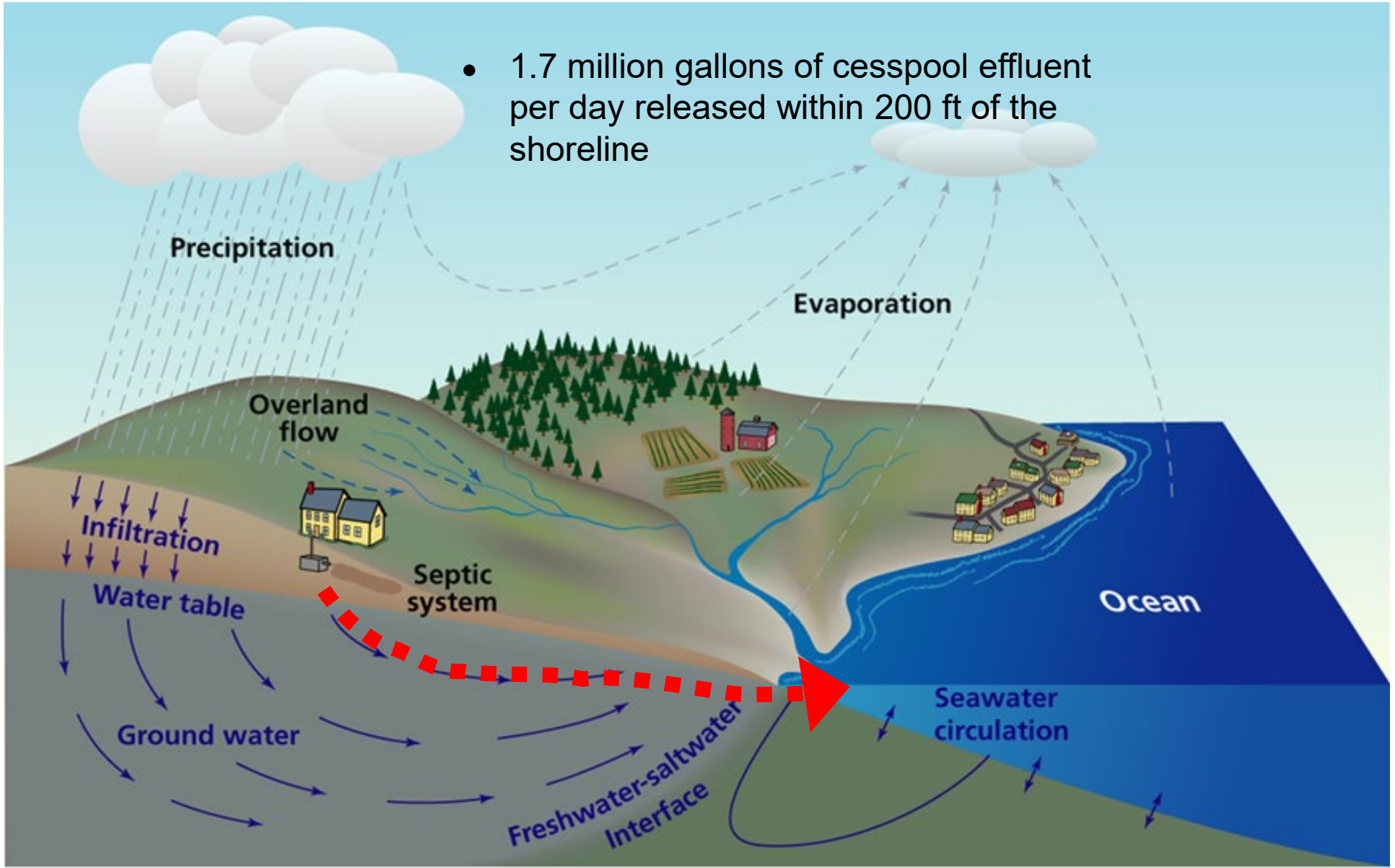


https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html

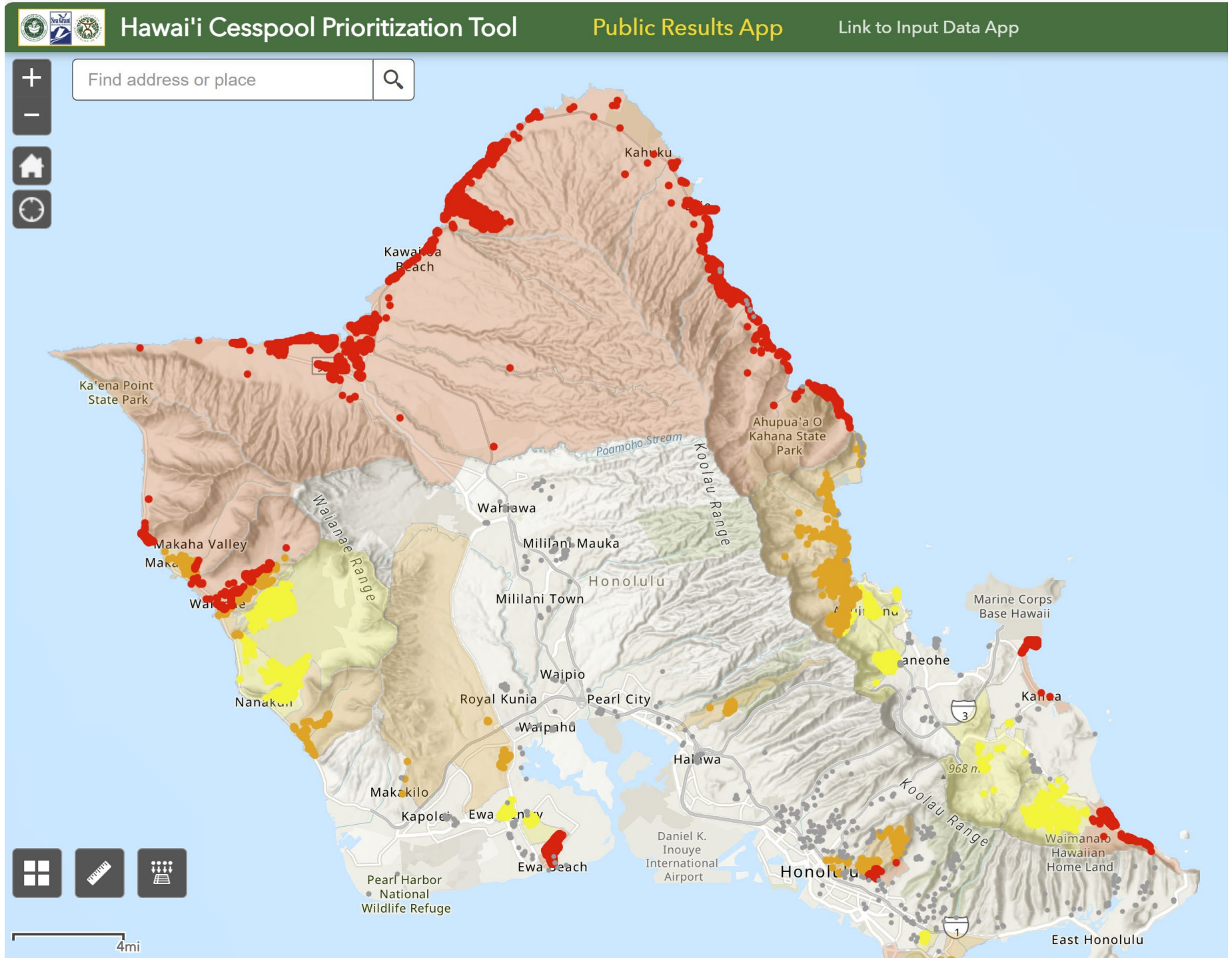
Hamlington, B.D., *et al.* The rate of global sea level rise doubled during the past three decades. *Commun Earth Environ* **5**, 601 (2024). https://doi.org/10.1038/s43247-024-01761-5


As sea level rises, so does
the water table

Subterranean Estuary



- 1.7 million gallons of cesspool effluent per day released within 200 ft of the shoreline


Hawai'i Cesspool Prioritization Tool
Public Results App
Link to Input Data App
Find address or place
Kahuku
Kawailoa Beach
Ka'ena Point State Park
Ahupua'a O Kahana State Park
Poamoho Stream
Koolau Range
Waianae Range
Wahiawa
Mililani Mauka
Makaha Valley
Honolulu
Mililani Town
Marine Corps Base Hawaii
Waipio
Royal Kunia
Pearl City
Nanakuli
Waipahu
Halawa
968 n.
Makakilo
Kapolei
Ewa Beach
Daniel K. Inouye International Airport
Waimanalo Hawaiian Home Land
Pearl Harbor National Wildlife Refuge
East Honolulu
4mi

Chronic Coastal Erosion

Cess Pool

SLR will bring polluted groundwater to the surface

Groundwater Pollution

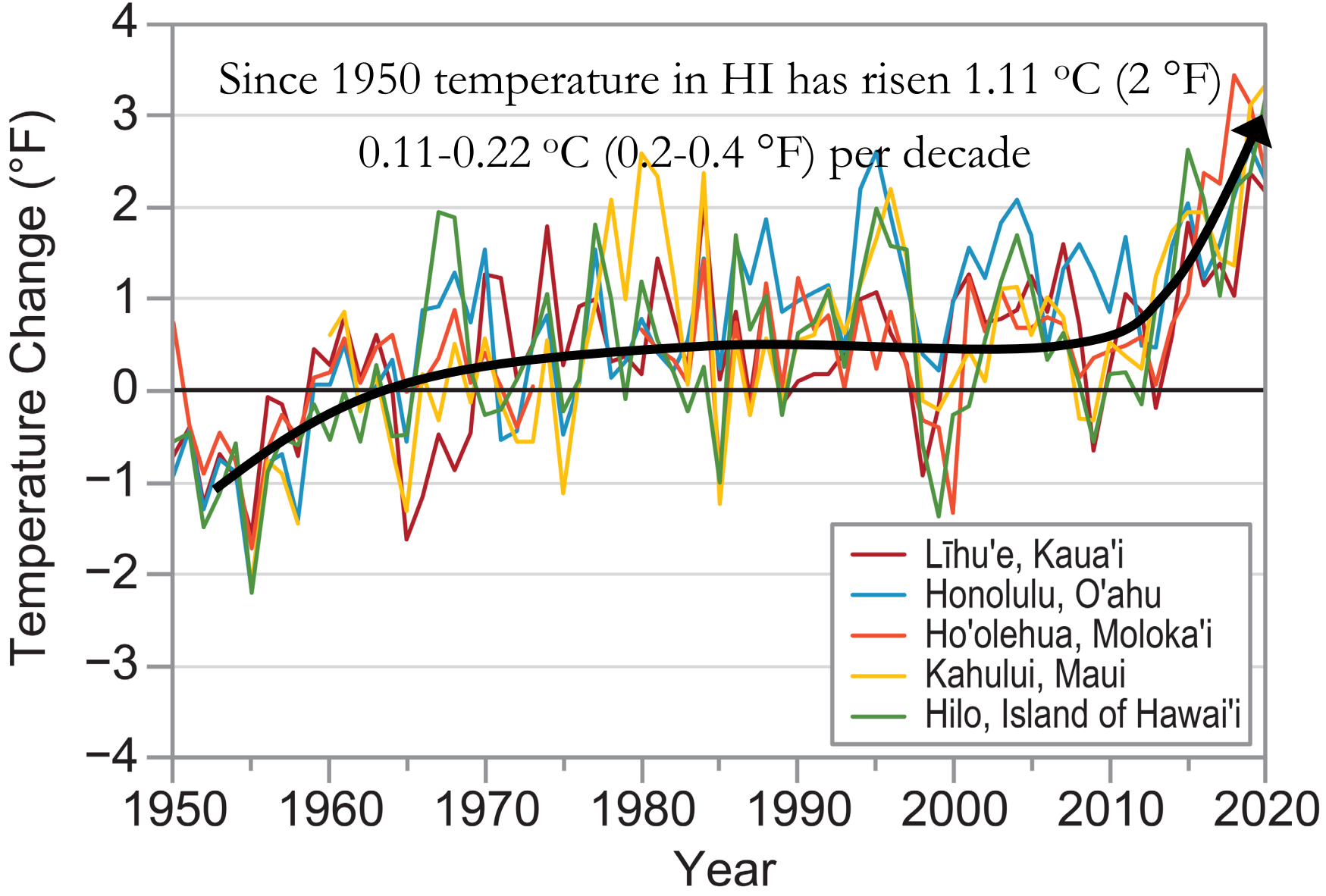
Storm drain backflow


Rain + High Tide = Compound Flooding

Kaua‘i, April 2018
Hanalei River rose 15 ft, jumped its bank, and carved a new channel

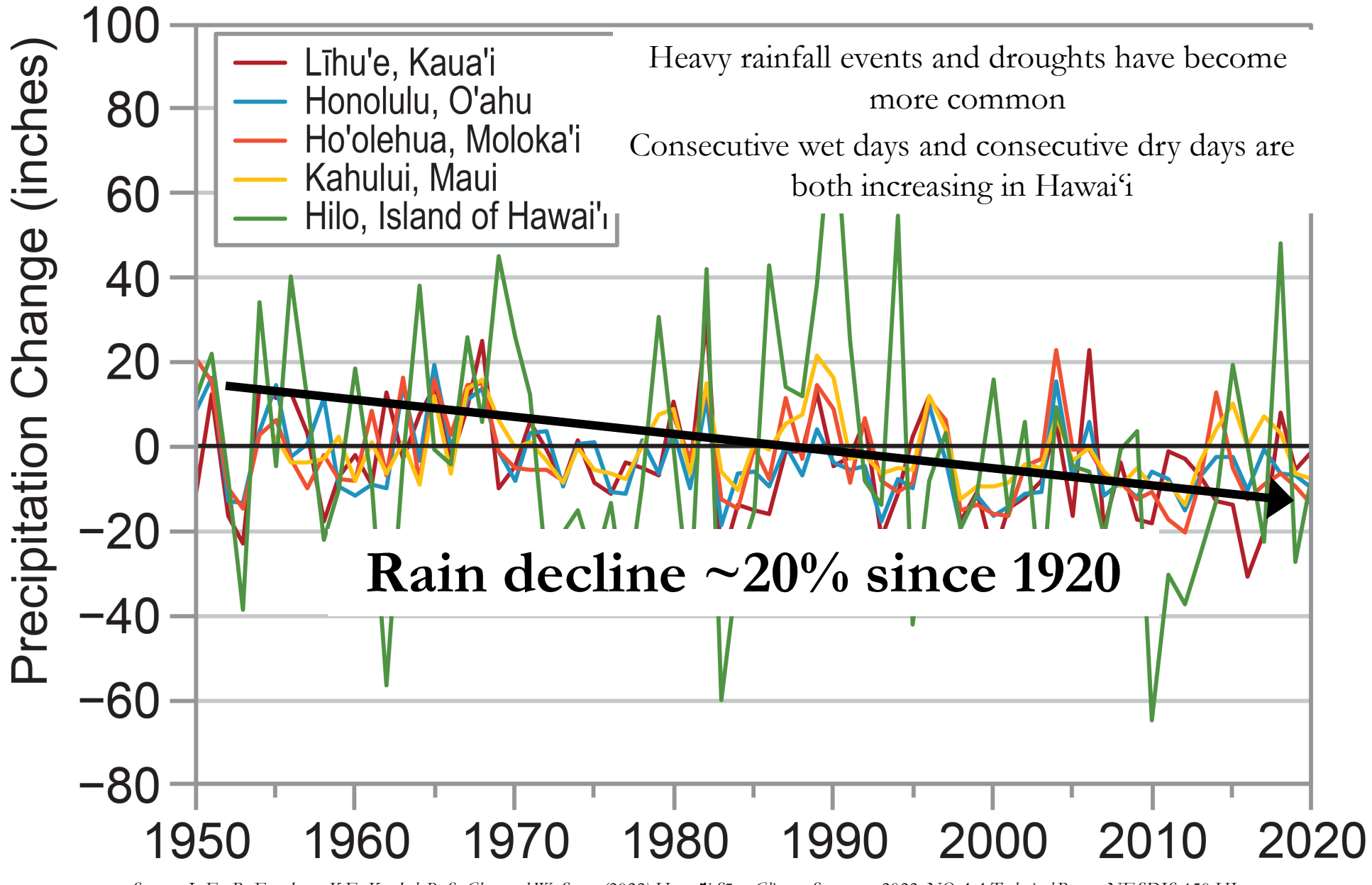

Rising SST's, Acidification
Bleaching
Invasive Species

Observed Temperature Change



Stevens, L.E., R. Frankson, K.E. Kunkel, P.-S. Chu, and W. Sweet (2022) Hawai'i State Climate Summary 2022. NOAA Technical Report NESDIS 150-HI. NOAA/NESDIS, Silver Spring, MD, 5 pp

Observed Precipitation Change



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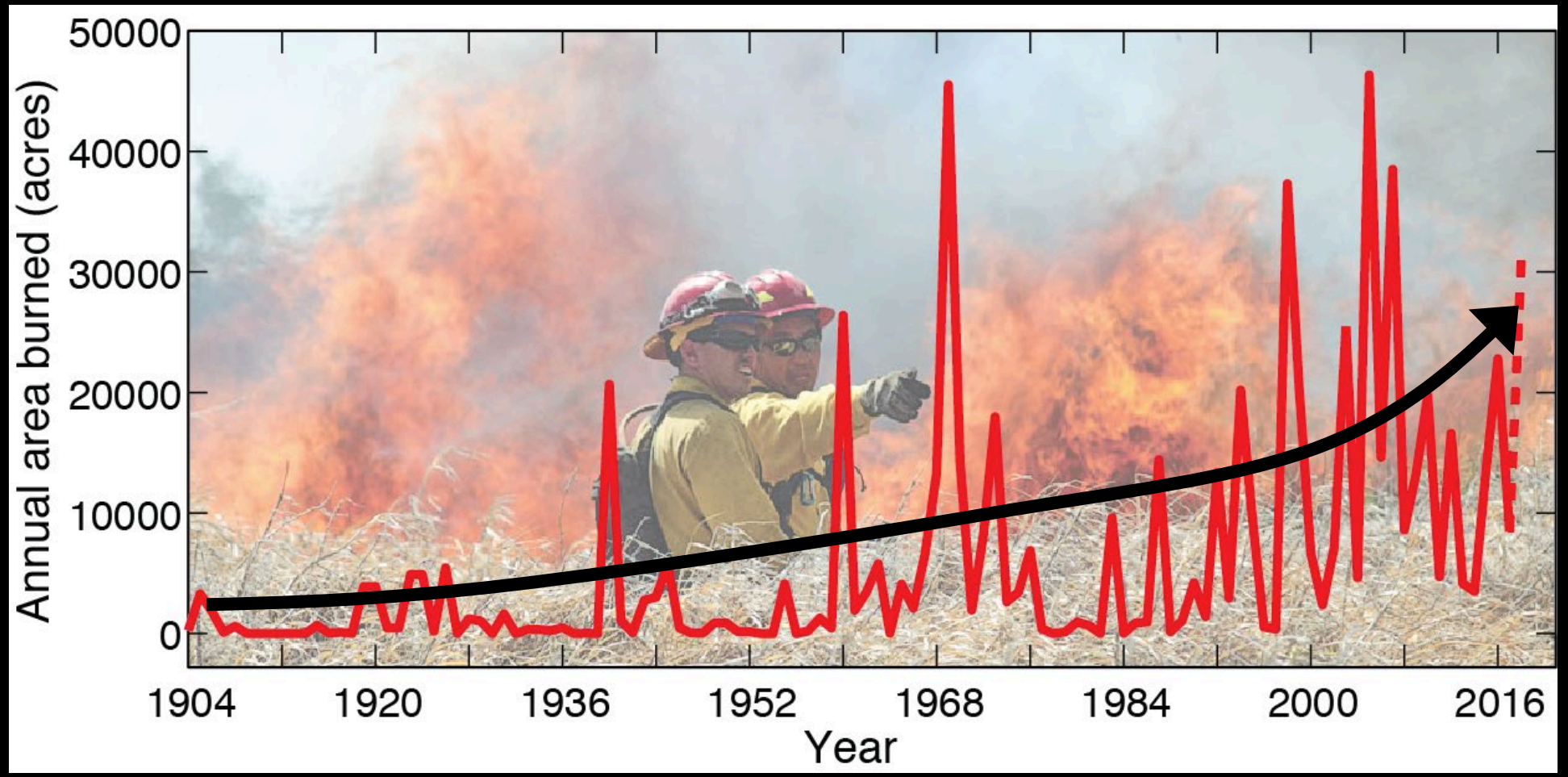
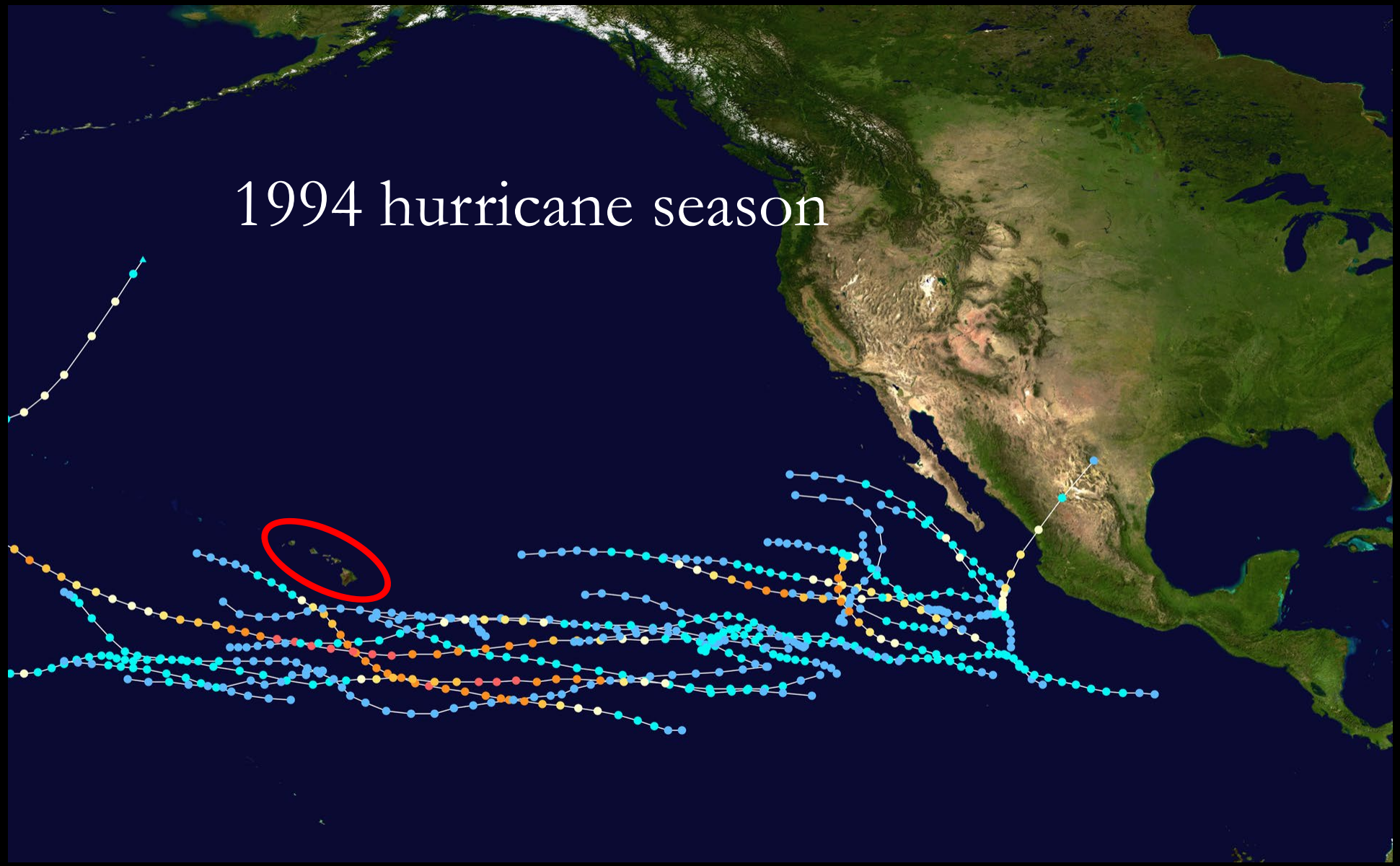
400% increase in wildfire on O'ahu since 1960's



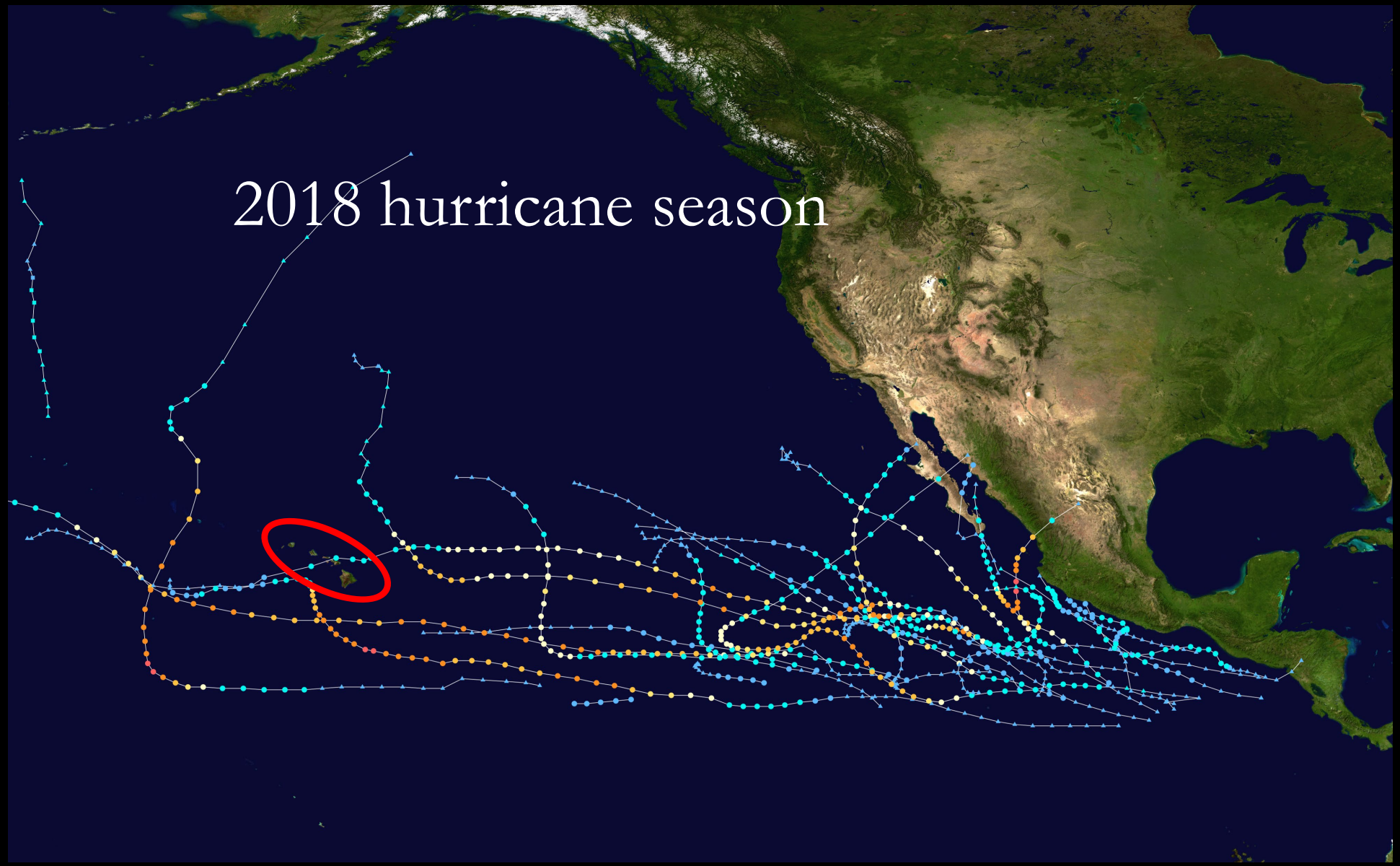
Trauernicht, C., E. et al. 2015 The contemporary scale and context of wildfire in Hawaii. Pacific Science 69:427-444

Average daily wind speeds are declining

Marra, J.J., and Kruk, M.C. (2017) State of Environmental Conditions in Hawai'i and the U.S. Affiliated Pacific Islands under a Changing Climate: https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf.



Kossin et al., 2014 The poleward migration of the location of tropical cyclone maximum intensity, Nature, 509, 349–352 (15 May). Murakami, H., et al., 2013 Projected increase in tropical cyclones near Hawaii, Nature Climate Change, May 5, DOI:10.1038/NCLIMTE1890



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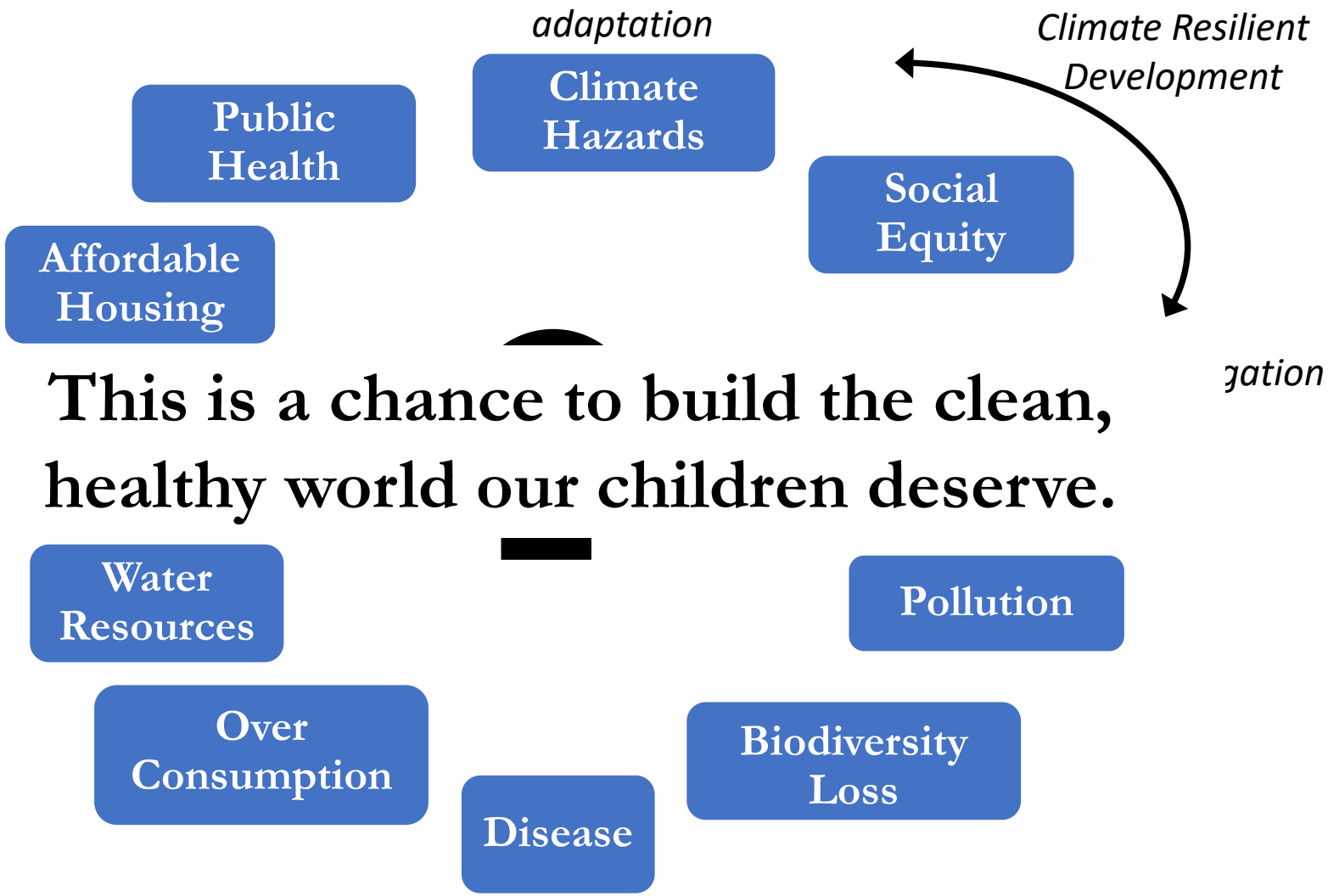
Sustainability Transition



“We don’t choose the times we live in. The only choice we have is how to respond.”

Climate Change and Health in Hawai‘i

Diana Felton, MD
Hawai‘i Department of Health
Climate Change and Health Conference
October 23, 2024

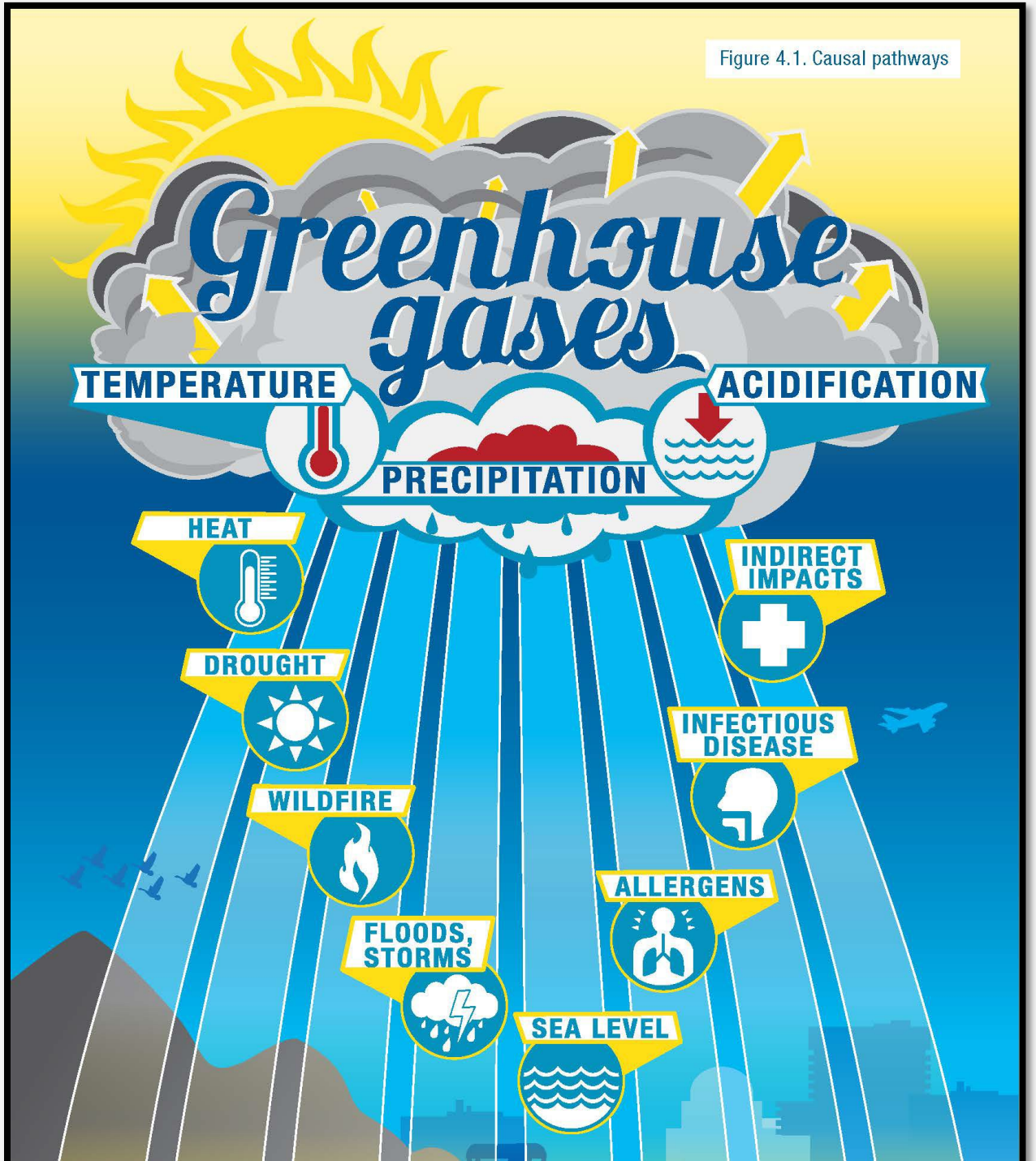

I'M MARCHING FOR
A BRIGHTER FUTURE 4ALL
CHANGE
CLIMATE CHANGE
IS A HEALTH
CRISIS
ACT UP
HEALTH CARE NOW!
HEALTH CARE FOR THE 99%
Climatehealthconnect.org

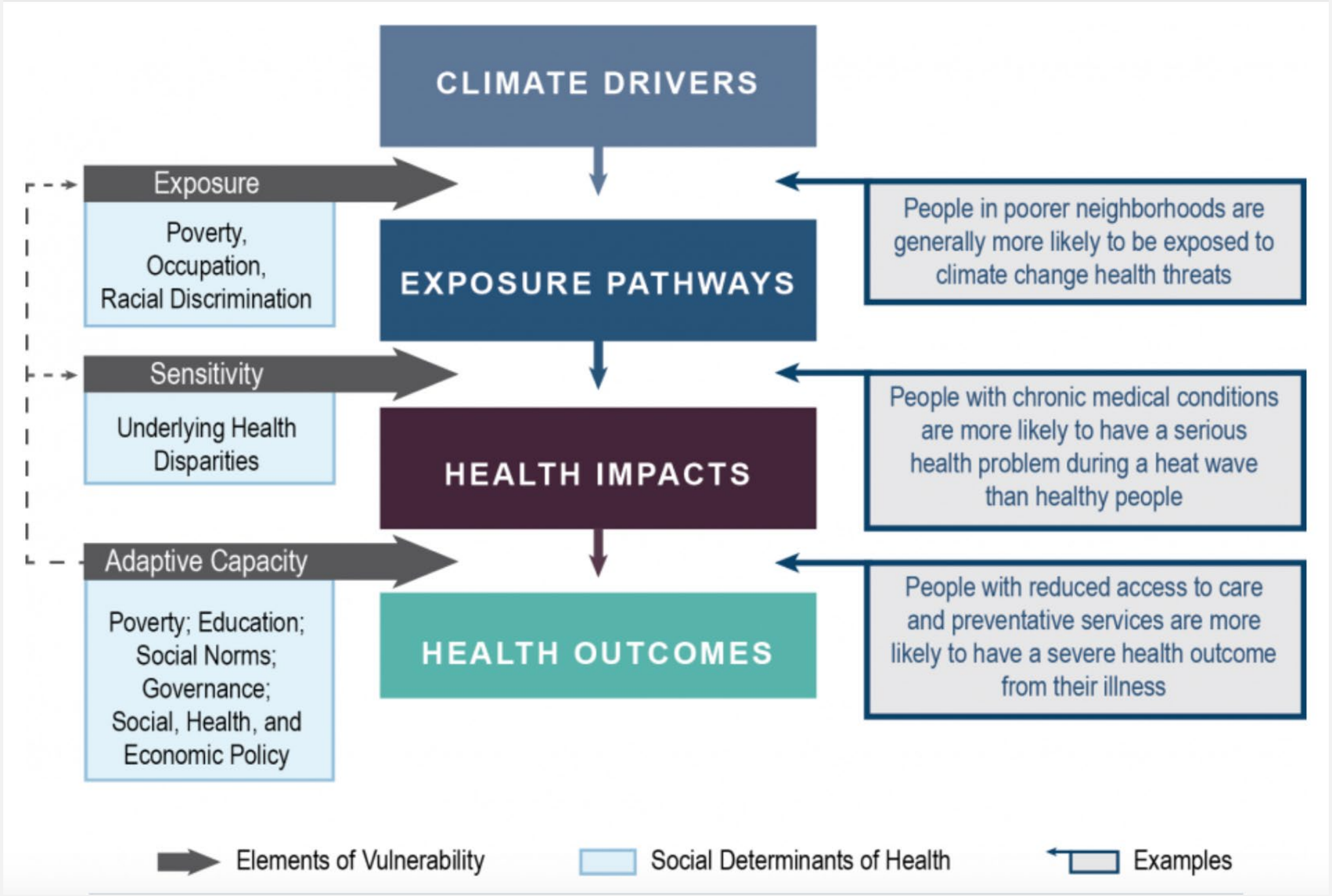
CLIMATE CHANGE

ENVIRONMENTAL DAMAGE

HEALTH IMPACTS

FROM OREGON HEALTH AUTHORITY (OHA) 2014 CLIMATE AND HEALTH PROFILE REPORT

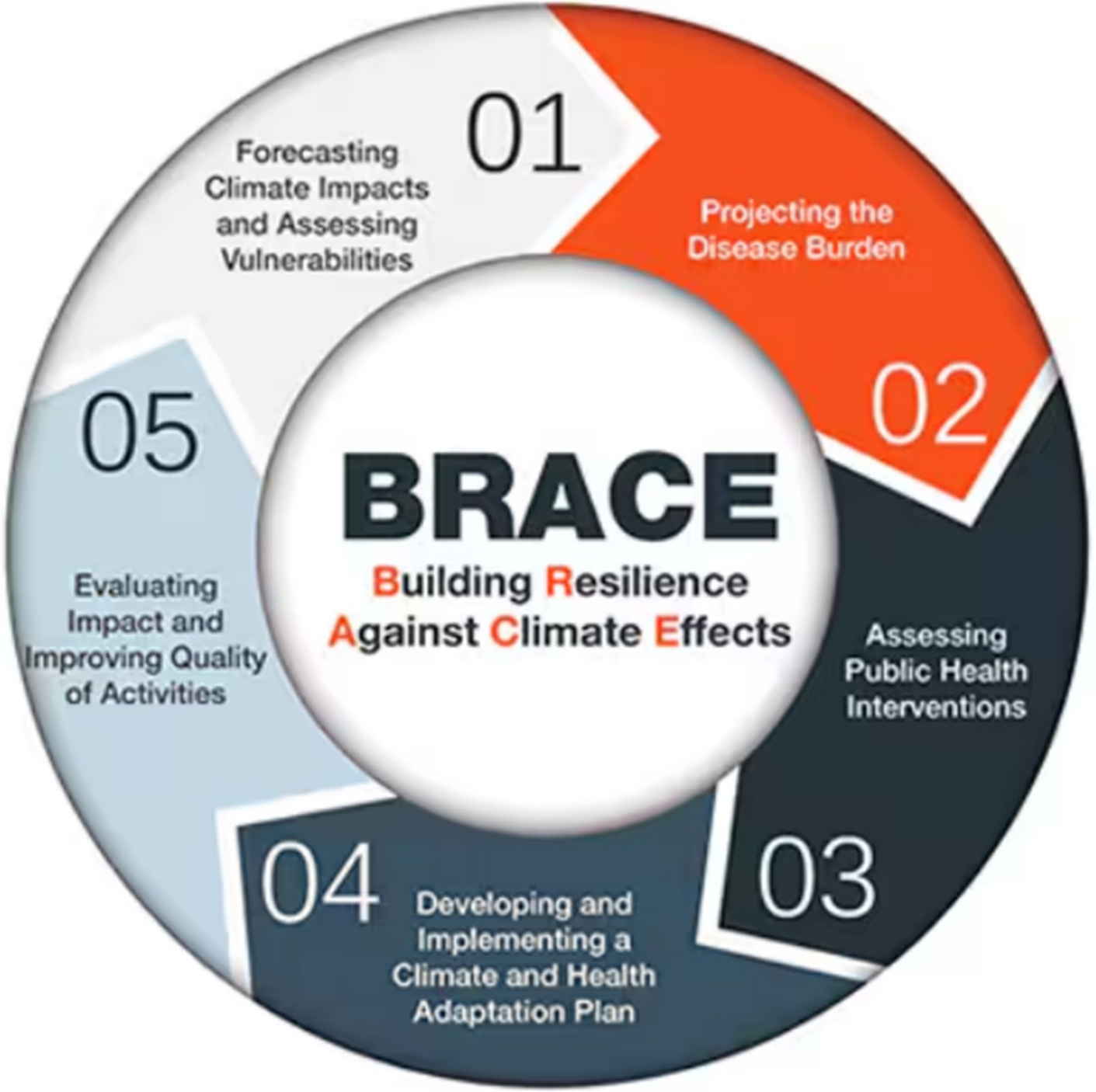


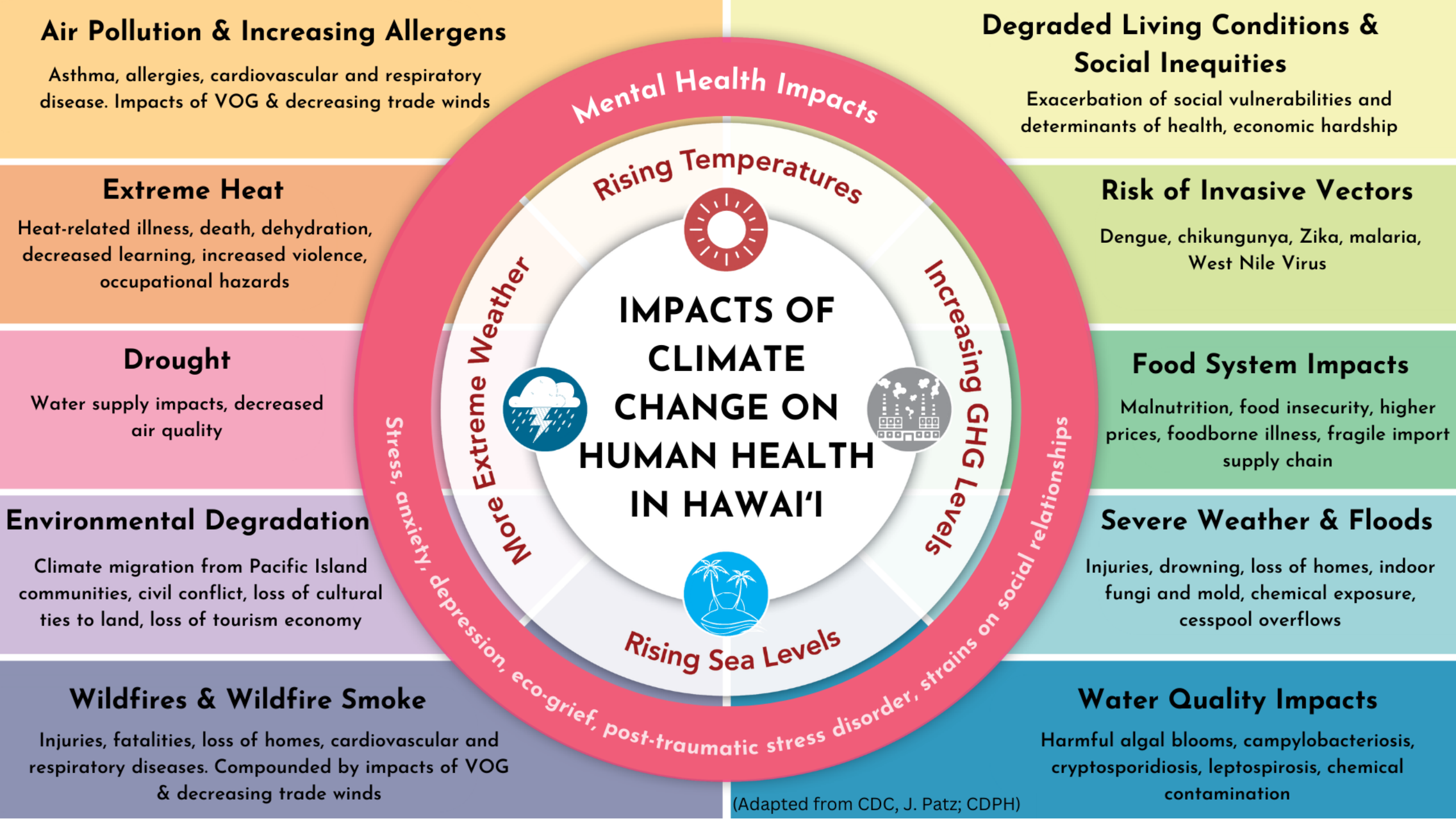


https://health2016.globalchange.gov/populations-concern

BUILDING A CLIMATE & HEALTH PROGRAM AT DOH

- CDC - BRACE
- Person-power
- Partnerships




Air Pollution & Increasing Allergens
Asthma, allergies, cardiovascular and respiratory disease. Impacts of VOG & decreasing trade winds
Degraded Living Conditions & Social Inequities
Exacerbation of social vulnerabilities and determinants of health, economic hardship
Extreme Heat
Heat-related illness, death, dehydration, decreased learning, increased violence, occupational hazards
Risk of Invasive Vectors
Dengue, chikungunya, Zika, malaria, West Nile Virus
Drought
Water supply impacts, decreased air quality
Food System Impacts
Malnutrition, food insecurity, higher prices, foodborne illness, fragile import supply chain
Environmental Degradation
Climate migration from Pacific Island communities, civil conflict, loss of cultural ties to land, loss of tourism economy
Severe Weather & Floods
Injuries, drowning, loss of homes, indoor fungi and mold, chemical exposure, cesspool overflows
Wildfires & Wildfire Smoke
Injuries, fatalities, loss of homes, cardiovascular and respiratory diseases. Compounded by impacts of VOG & decreasing trade winds
Water Quality Impacts
Harmful algal blooms, campylobacteriosis, cryptosporidiosis, leptospirosis, chemical contamination
Mental Health Impacts
Rising Temperatures
Increasing GHG Levels
Rising Sea Levels
More Extreme Weather
Stress, anxiety, depression, eco-grief, post-traumatic stress disorder, strains on social relationships
IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN HAWAI'I
(Adapted from CDC, J. Patz; CDPH)

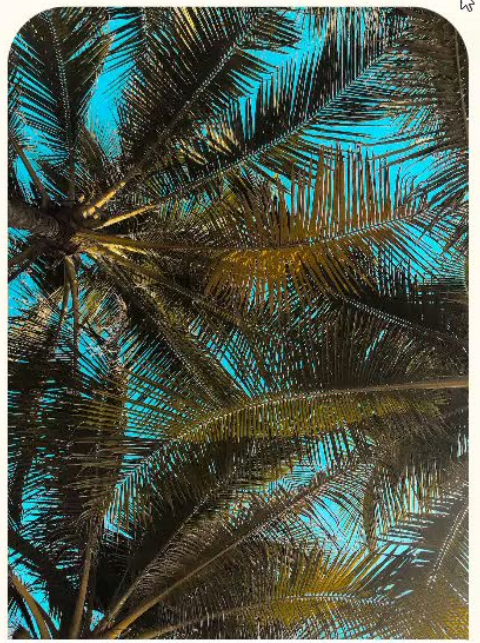
VULNERABILITY ASSESSMENT

- Following CDC's BRACE Framework
- Foundation of DOH's Climate & Health Program
- Living, dynamic story map
- https://view.storydoc.com/qLIKLTH7

Climate Change & Health in Hawai'i

Comprehensive Vulnerability Assessment

Avg. Reading Time: **60 min**



www.climatehealthhawaii.org

QUESTIONS?

diana.felton@doh.hawaii.gov