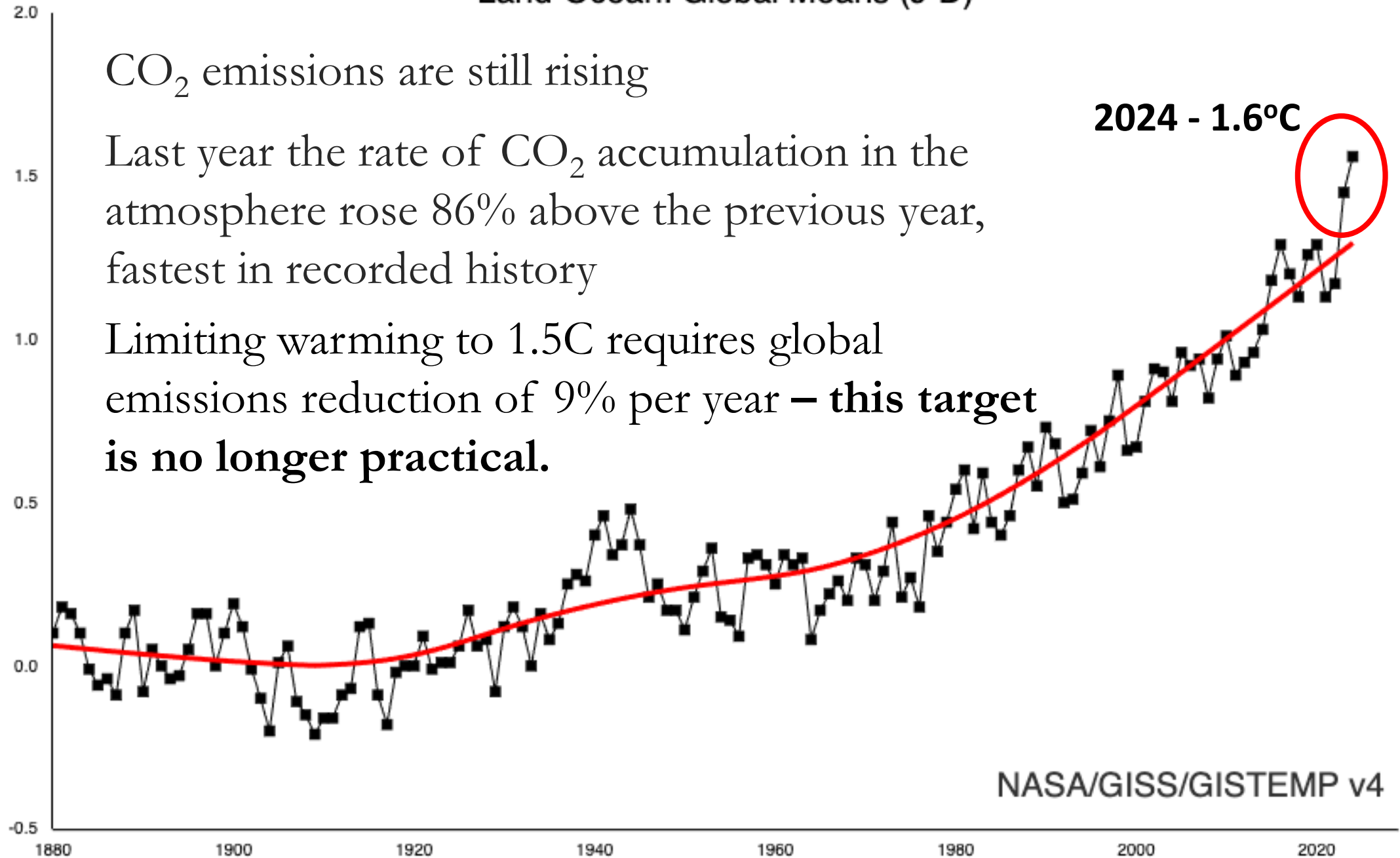
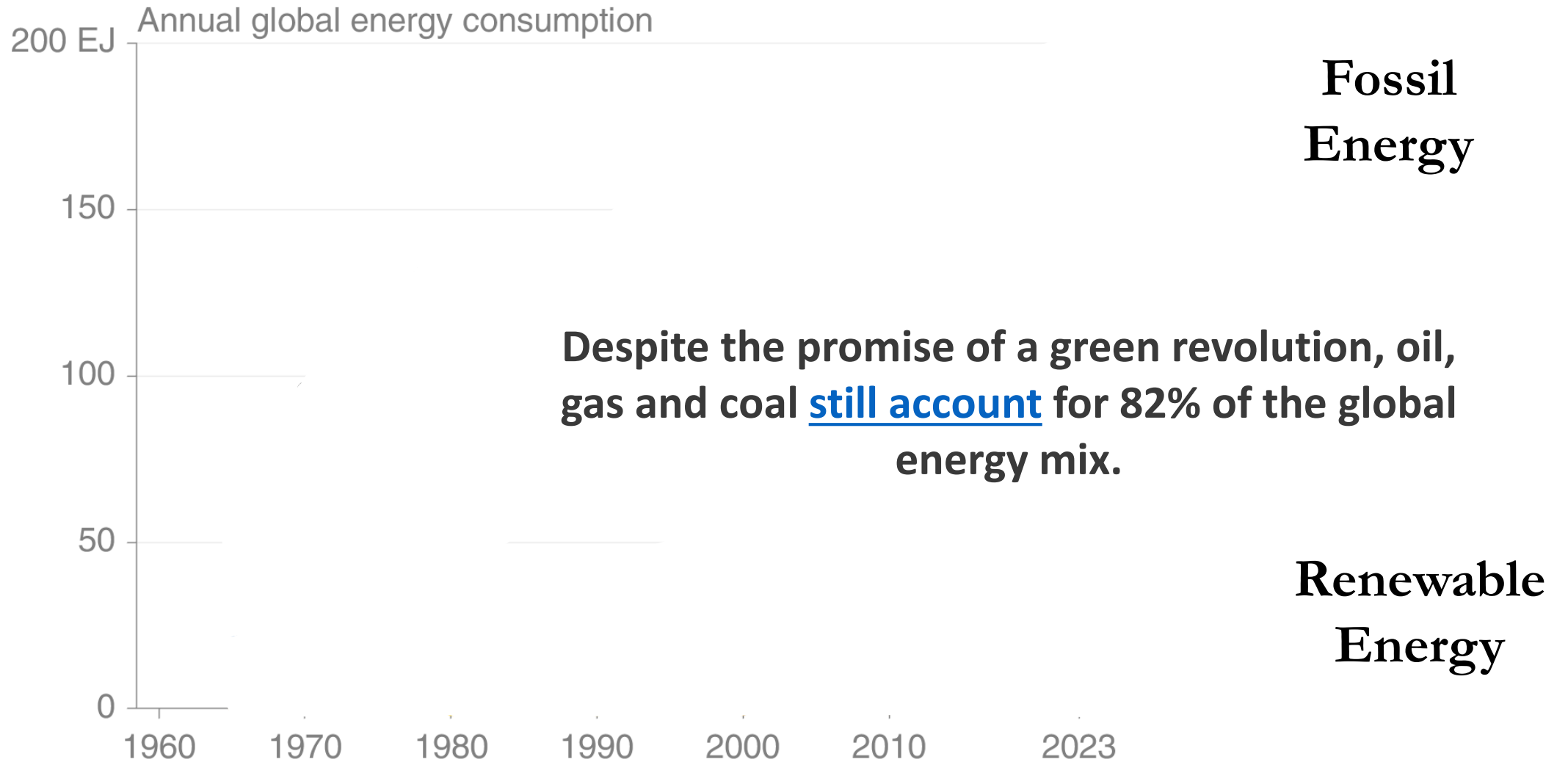


Land-Ocean: Global Means (J-D)

Temperature Anomaly w.r.t. 1880-1920 (°C)



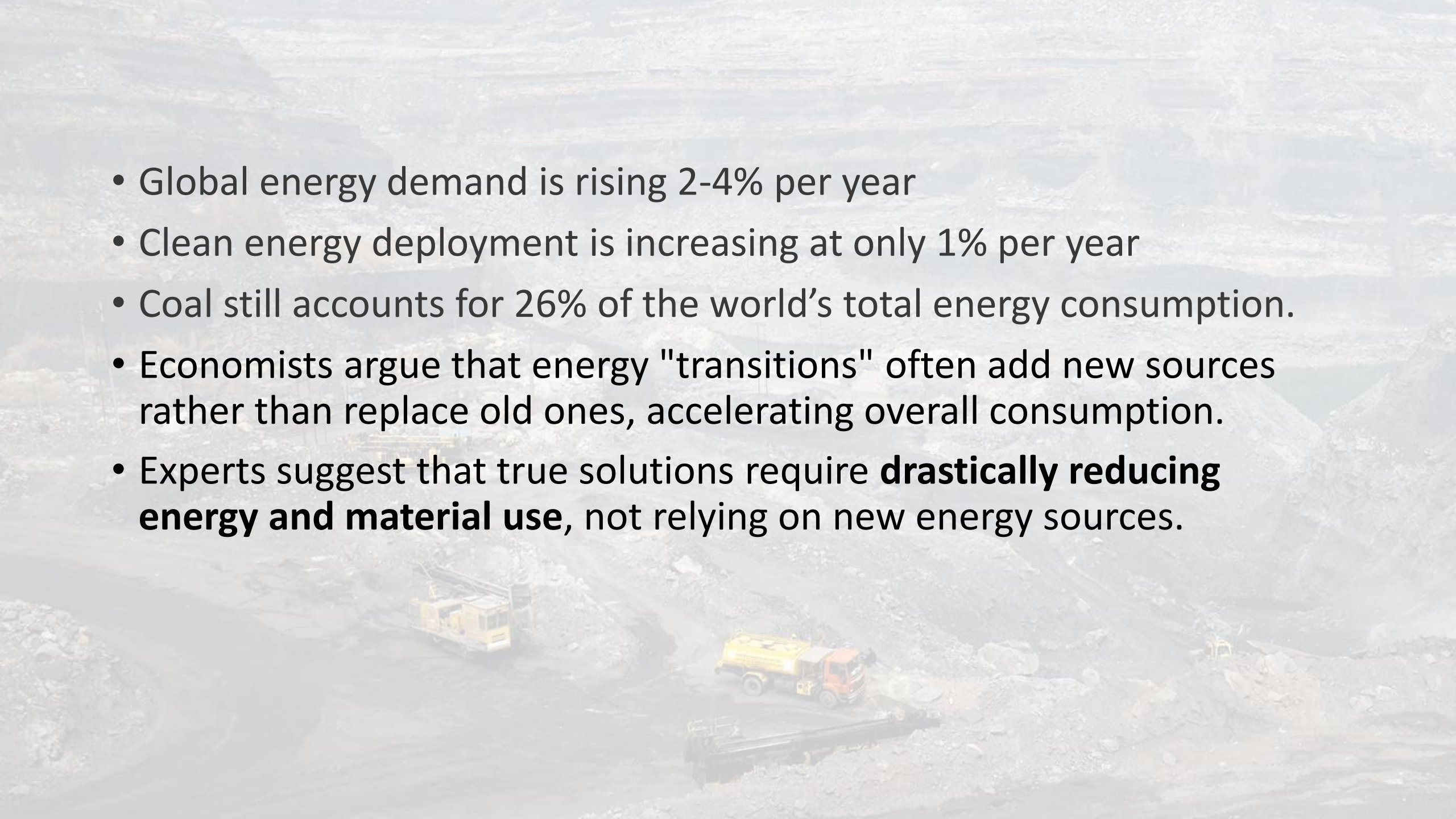
Energy use by source



© Global Carbon Project • Data: Energy Institute, IEA (bioenergy)

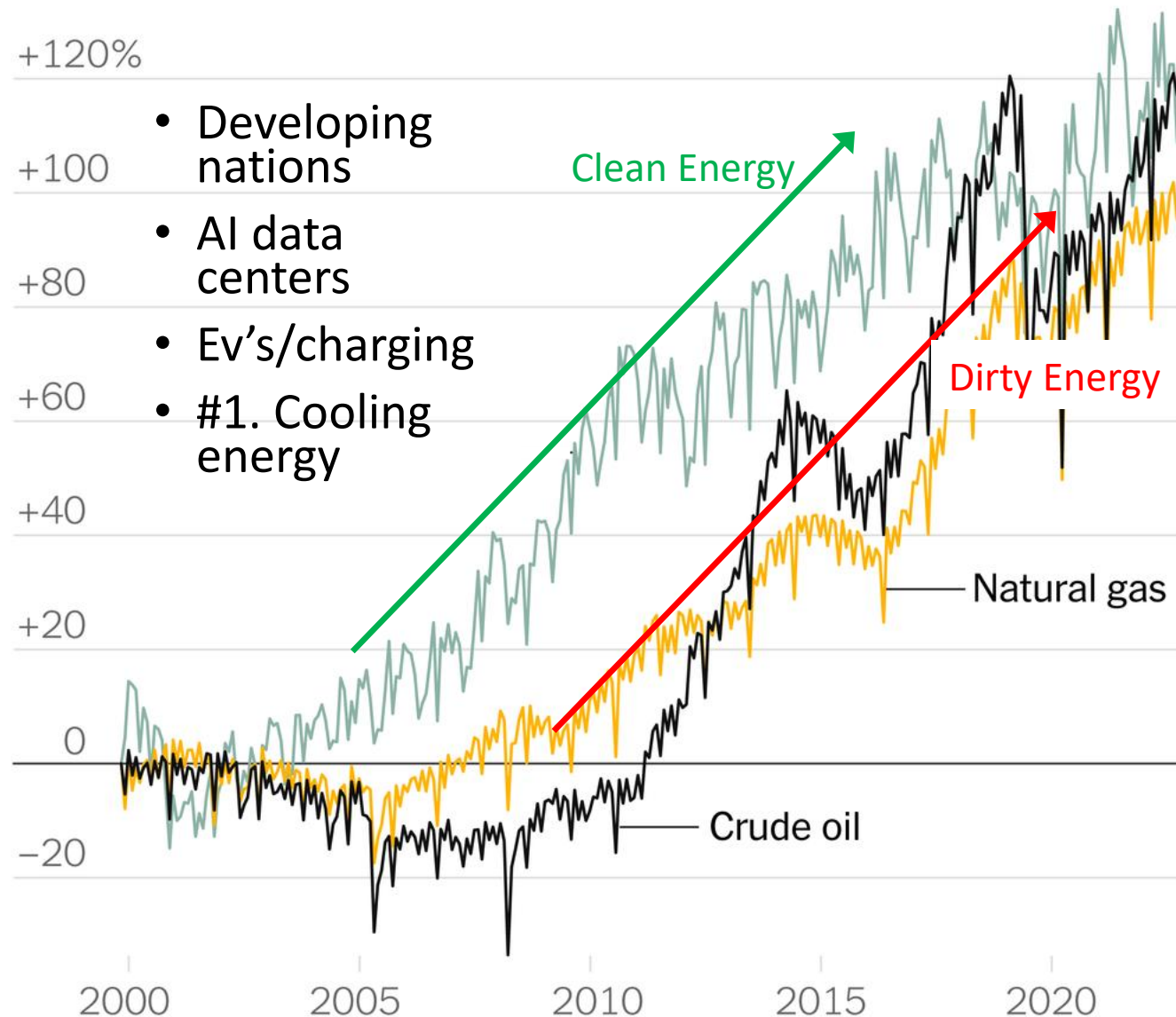
This figure shows “primary energy” using the substitution method (non-fossil sources are scaled up by an assumed fossil efficiency of approximately 0.38) Source: [Energy Institute 2024](#); [Global Carbon Project 2024](#)

- Global energy demand is rising 2-4% per year
- Clean energy deployment is increasing at only 1% per year
- Coal still accounts for 26% of the world's total energy consumption.
- Economists argue that energy "transitions" often add new sources rather than replace old ones, accelerating overall consumption.
- Experts suggest that true solutions require **drastically reducing energy and material use**, not relying on new energy sources.



Monthly change in energy produced in the United States

Compared with January 2000

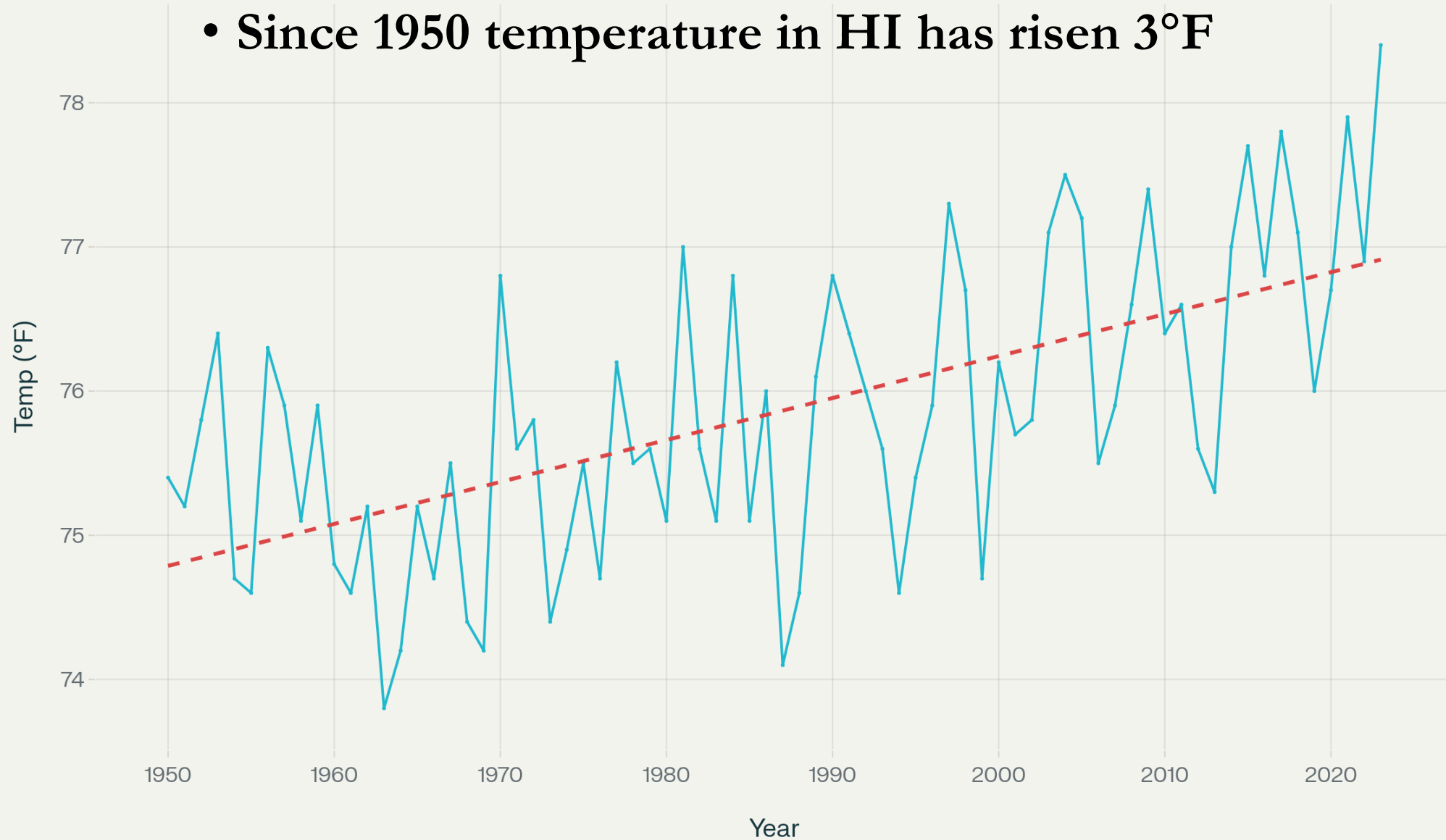


Even as renewables accelerate, so does the demand for new energy

Hawaii Temp 1950-2023 (+3.0°F)

Annual Temp Trend Line

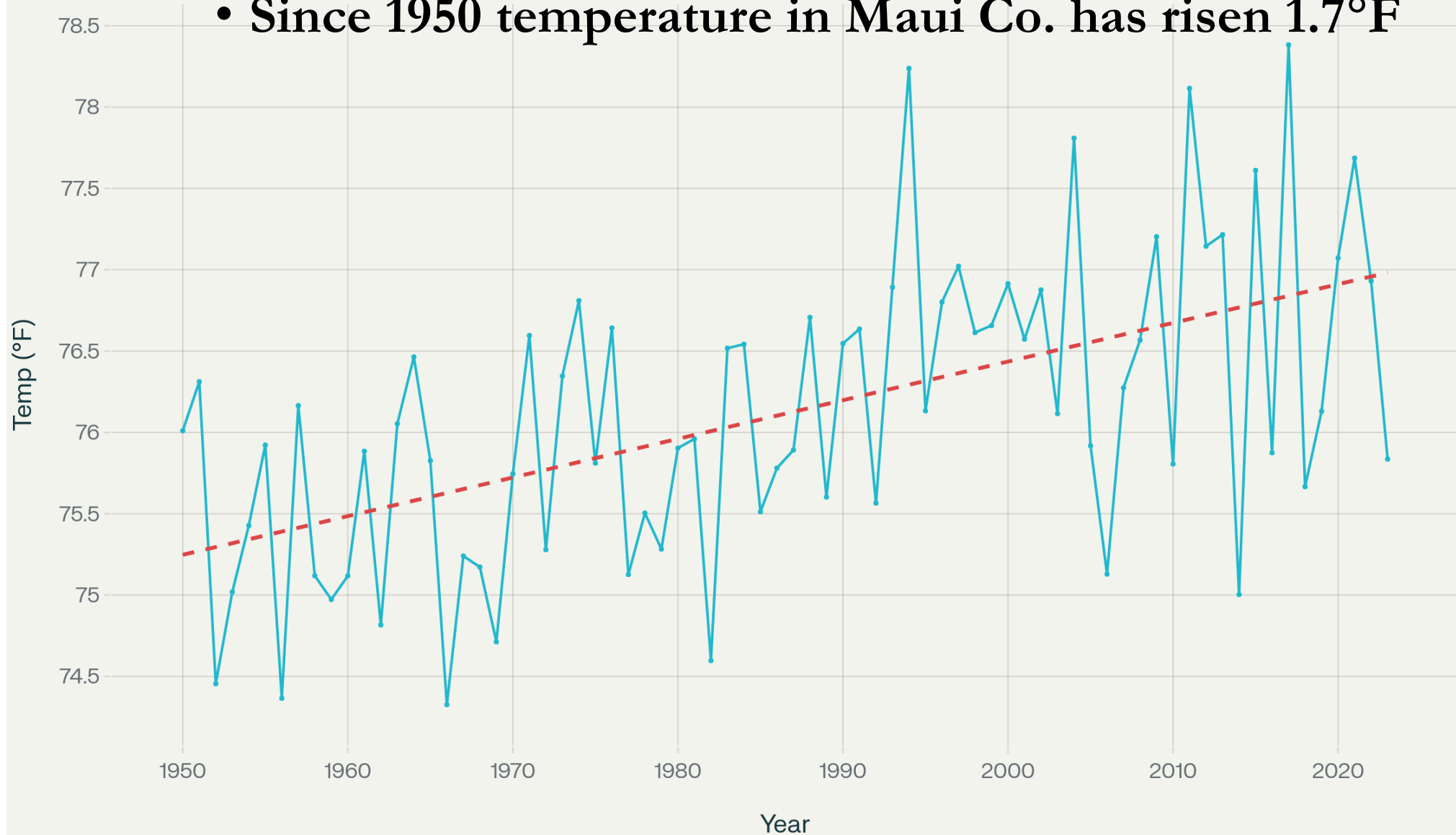
- Since 1950 temperature in HI has risen 3°F



Maui County Mean Annual Temp

Annual Temp Trend Line

• Since 1950 temperature in Maui Co. has risen 1.7°F



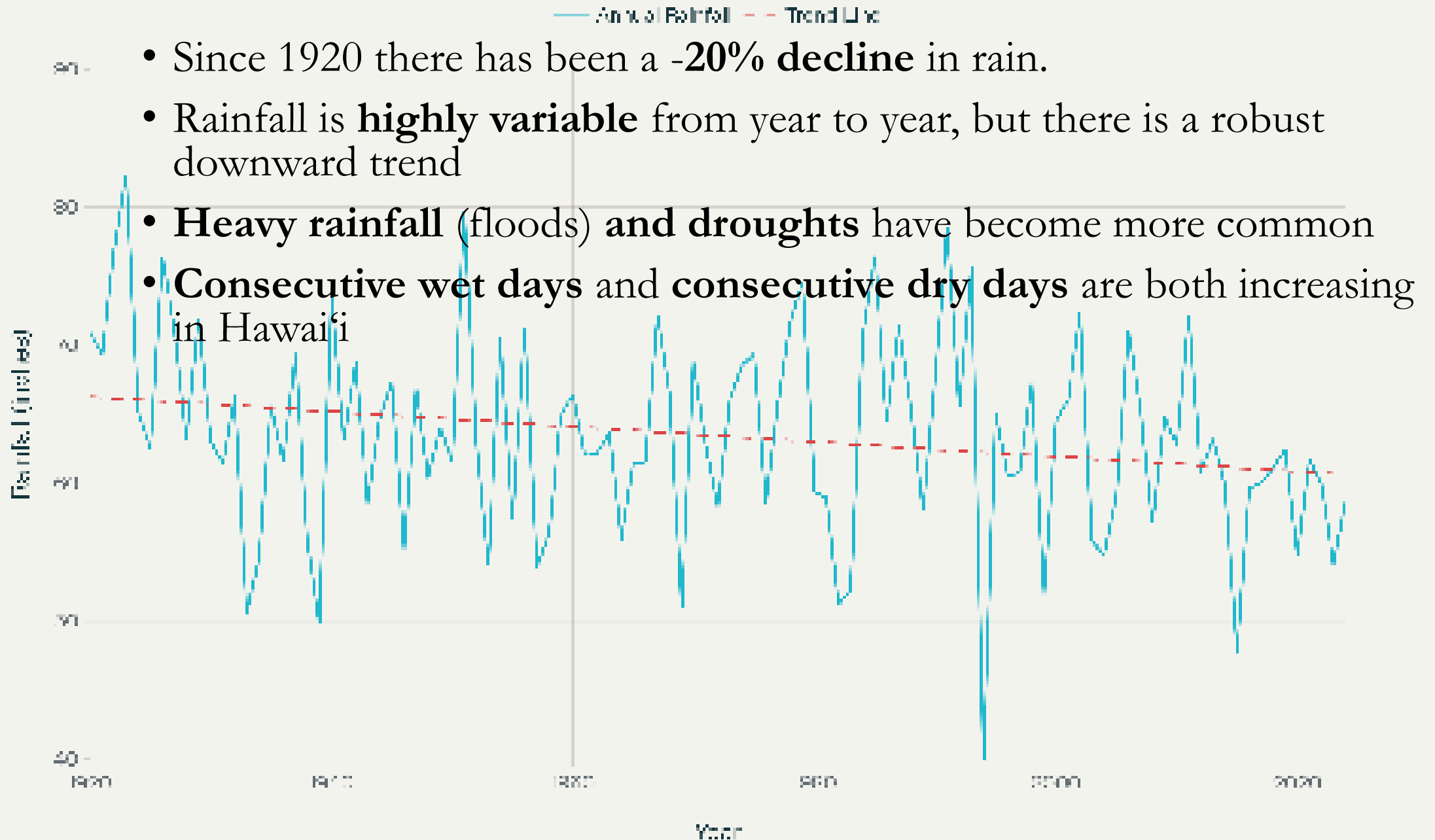
Average daily wind speeds are declining
The number of trade wind days is declining



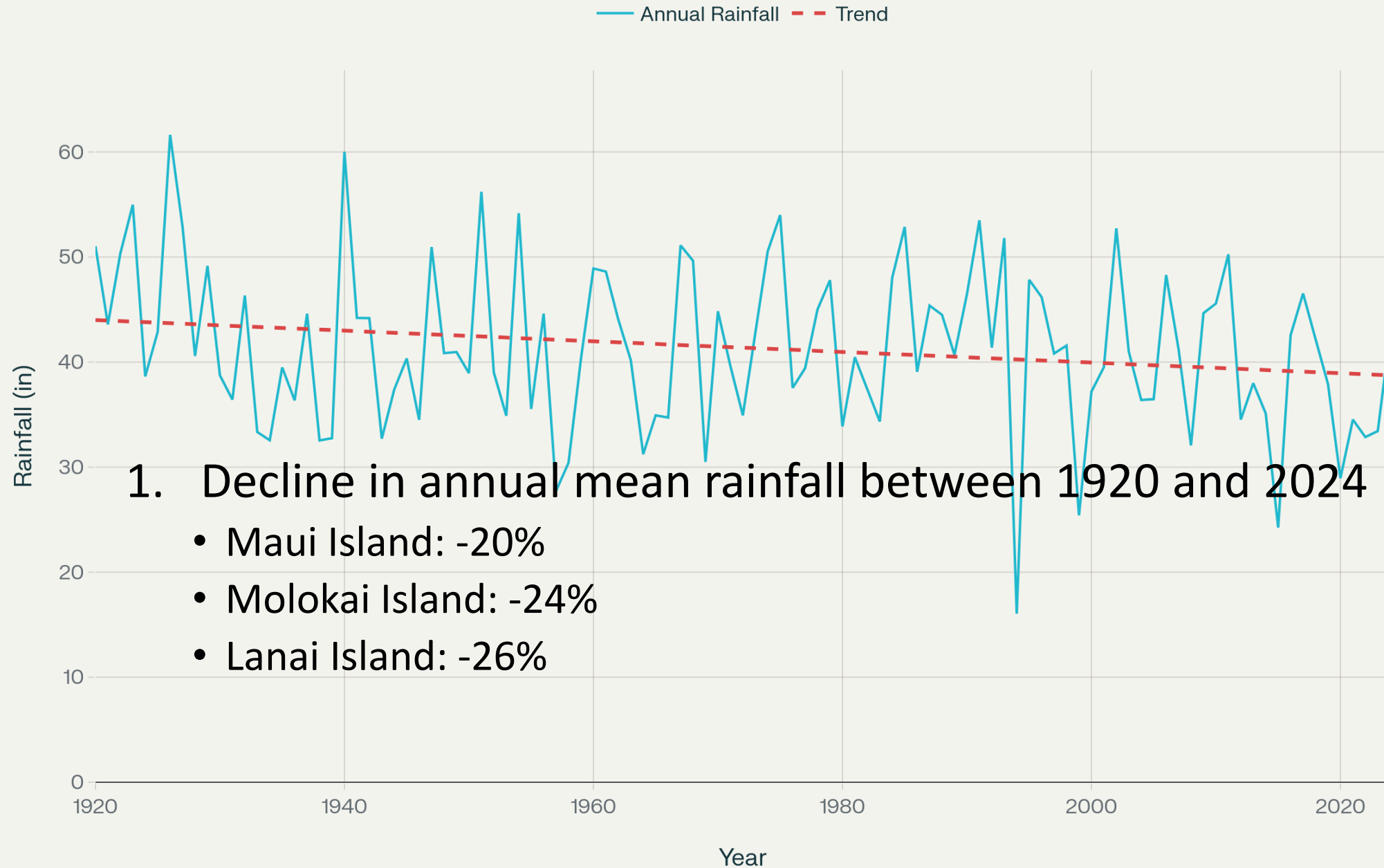
Marra, J.J., and Kruk, M.C. (2017) State of Environmental Conditions in Hawai'i and the U.S. Affiliated Pacific Islands under a Changing Climate:

https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf.

Hawaii Annual Rainfall 1920-2024



Maui County Annual Rainfall 1920-2024

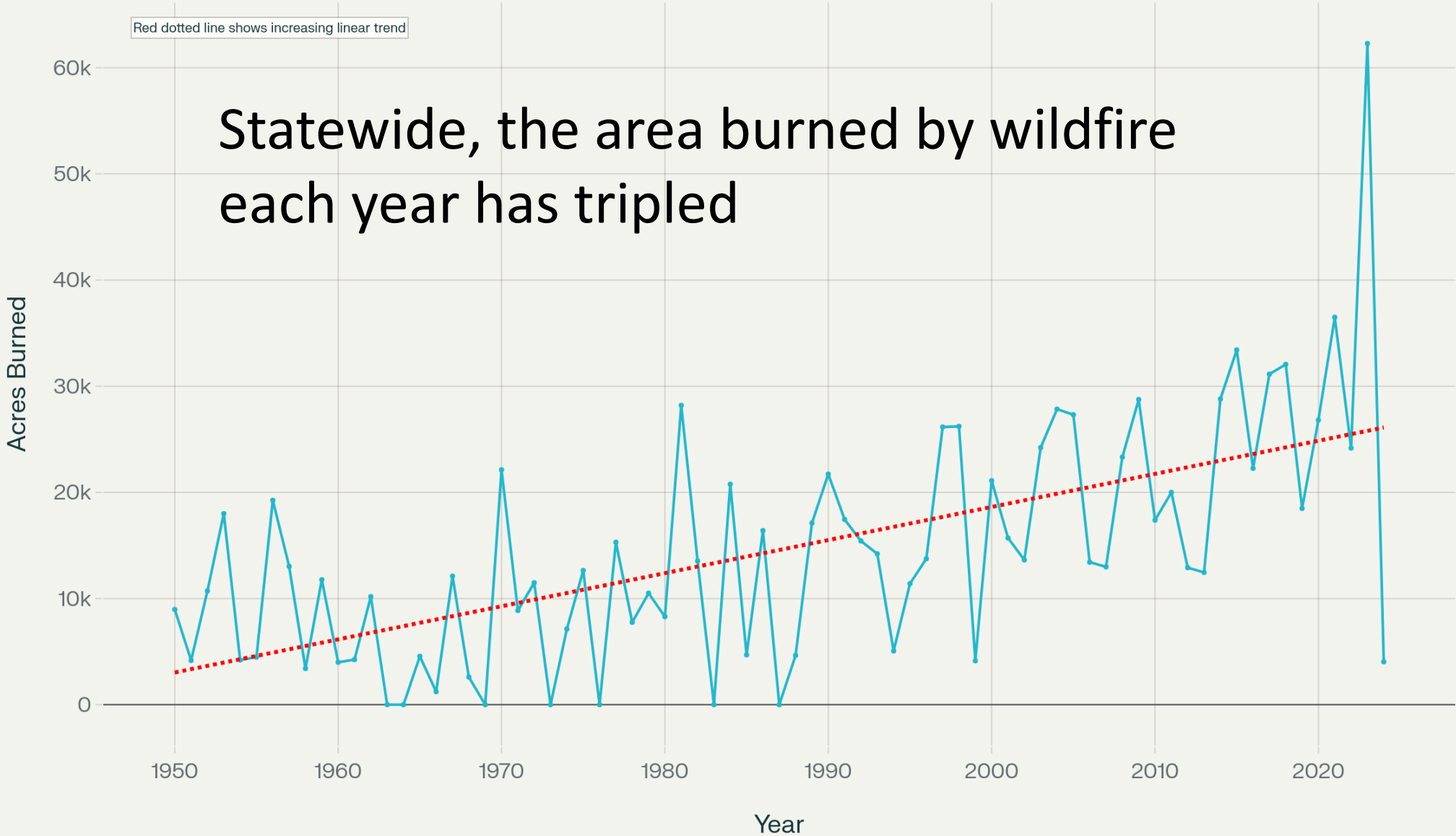


Hawaii Wildfire Area Burned 1950-2024

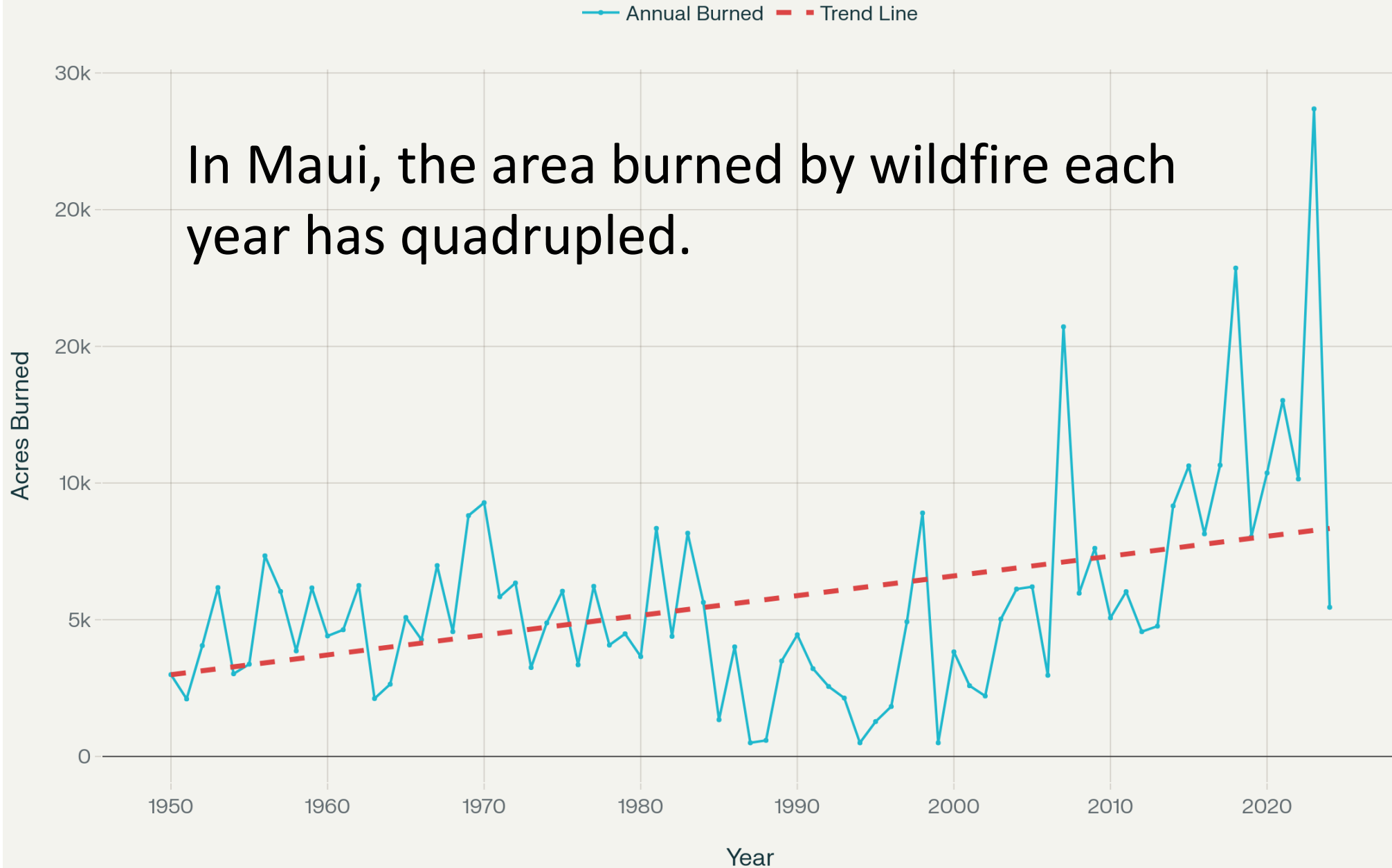
Annual Acres Linear Trend

Red dotted line shows increasing linear trend

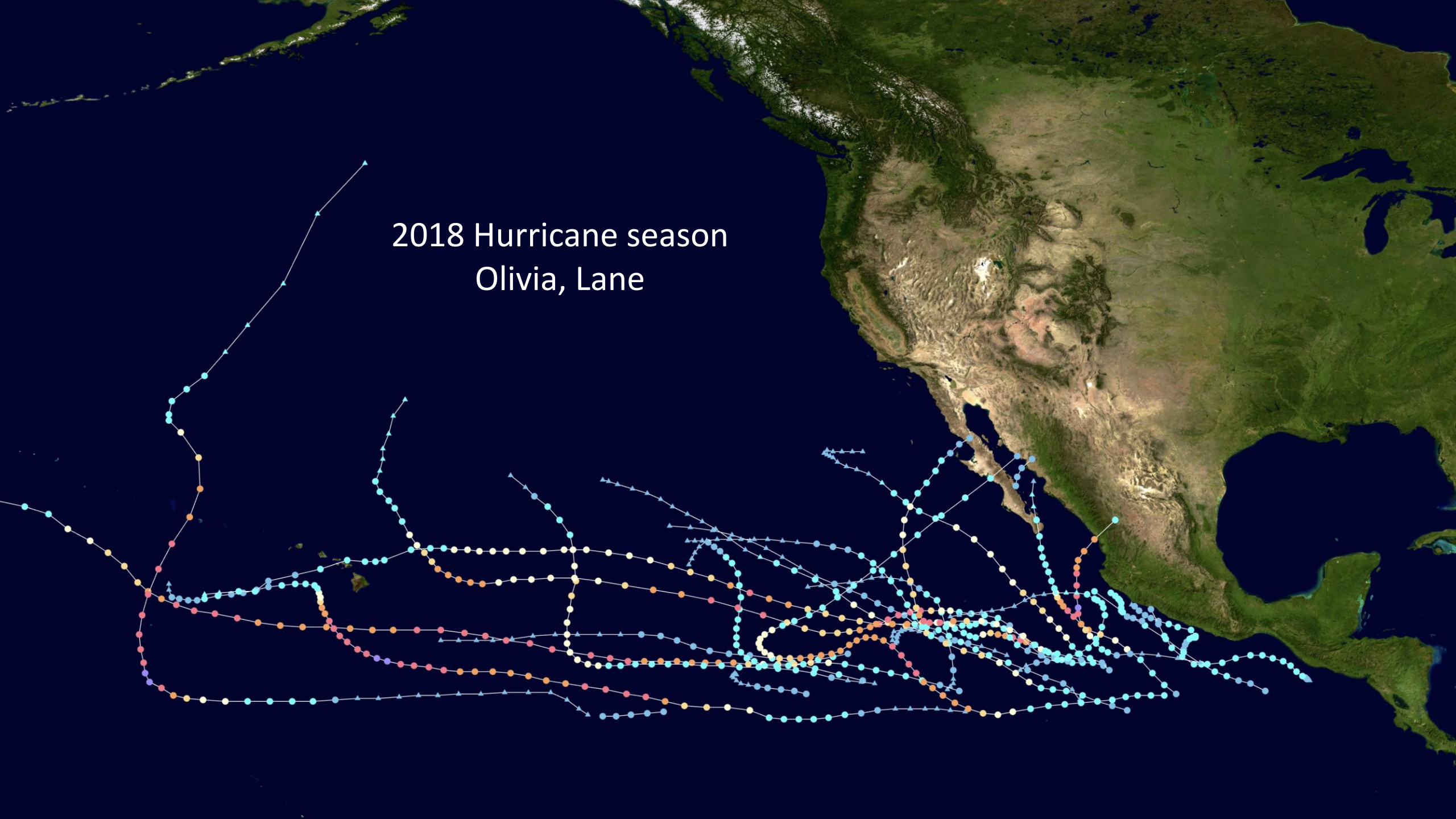
Statewide, the area burned by wildfire each year has tripled



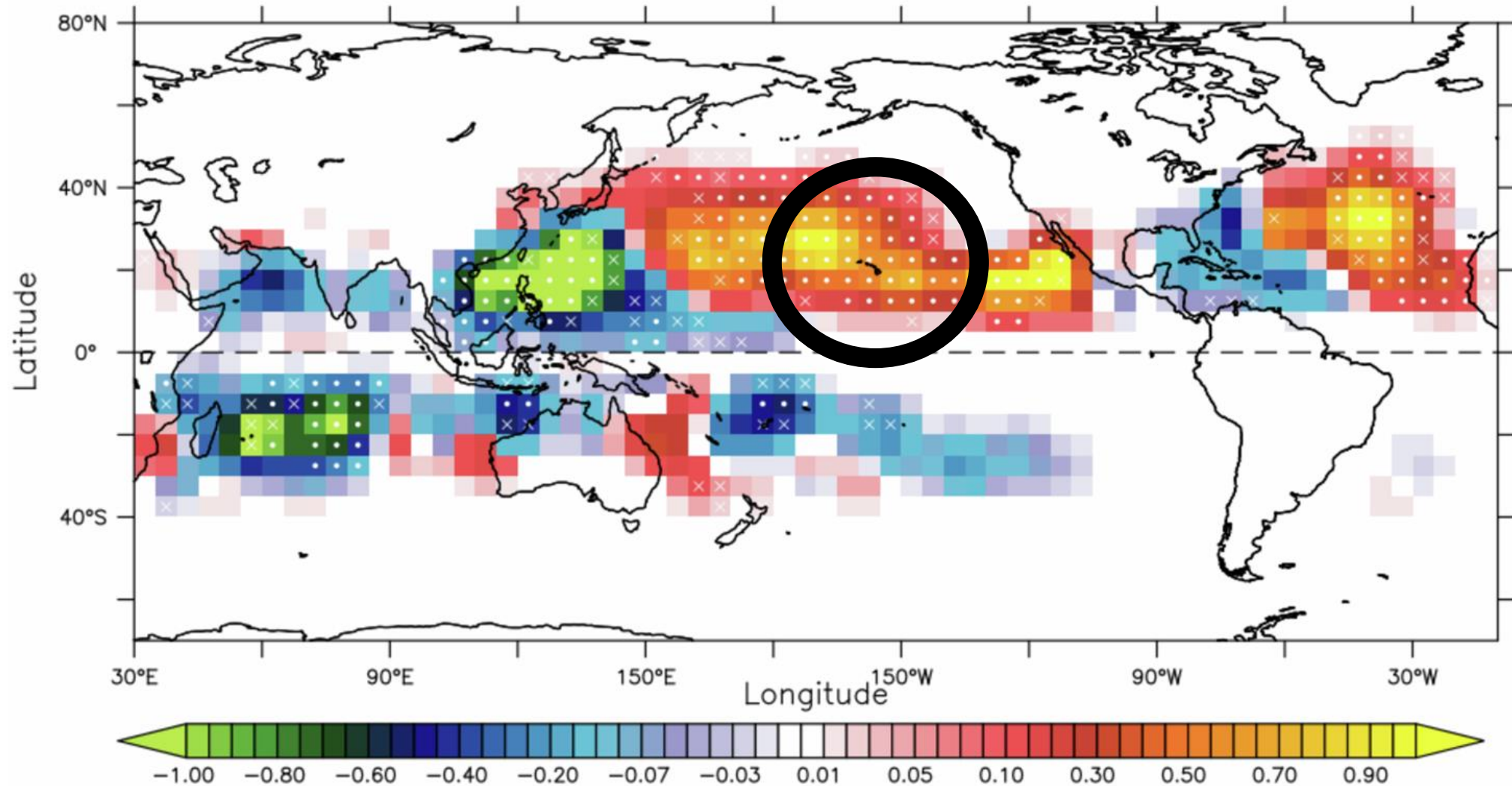
Maui County Wildfire Area Burned 1950-2024



2018 Hurricane season
Olivia, Lane



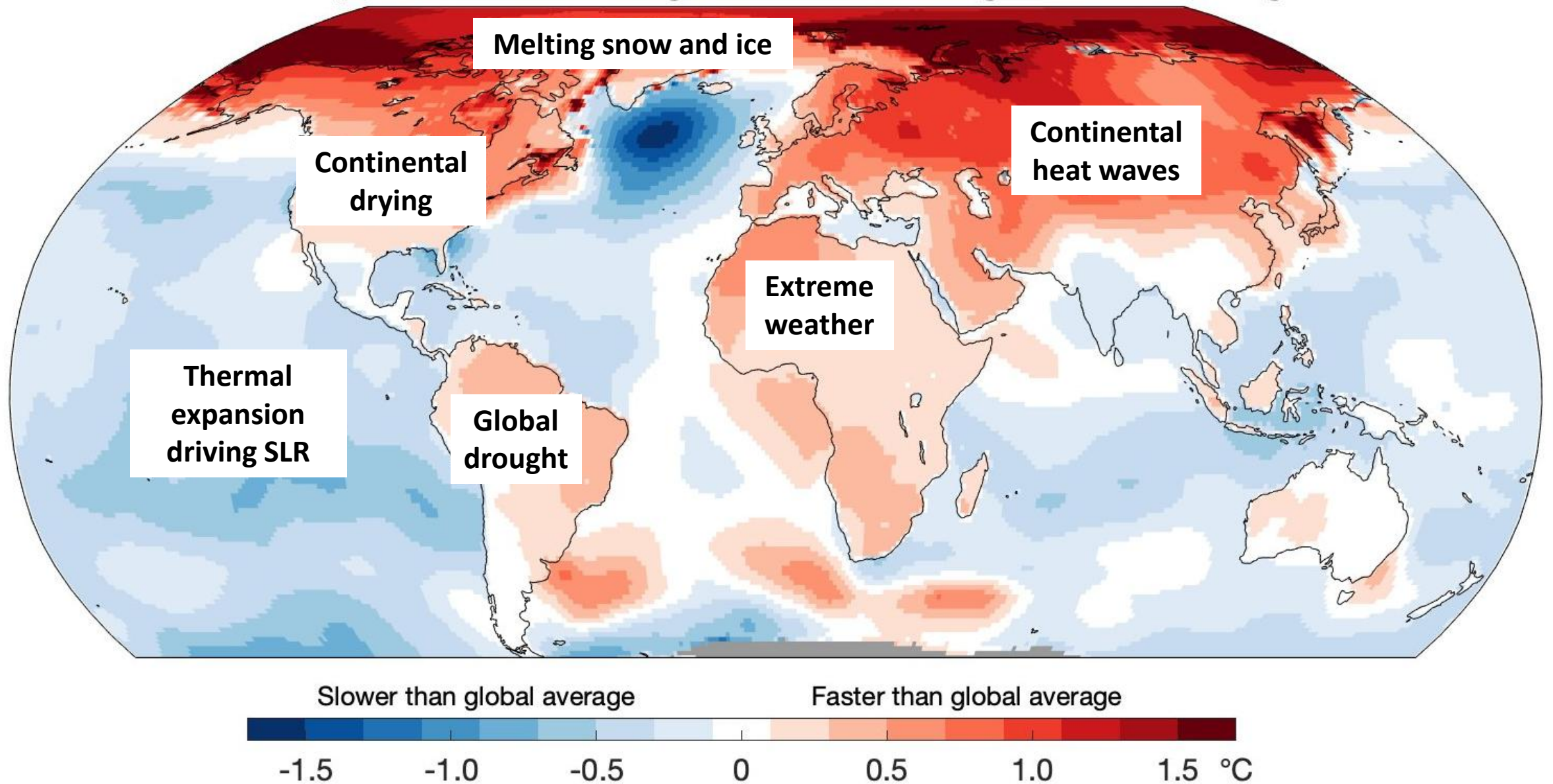
Tropical Cyclone Occurrence is Projected to strongly increase



Murakami, H., *et al.* Robust future projections of major tropical cyclones and sea level pressure gradients. *Commun Earth Environ* 5, 479 (2024).

<https://doi.org/10.1038/s43247-024-01644-9>

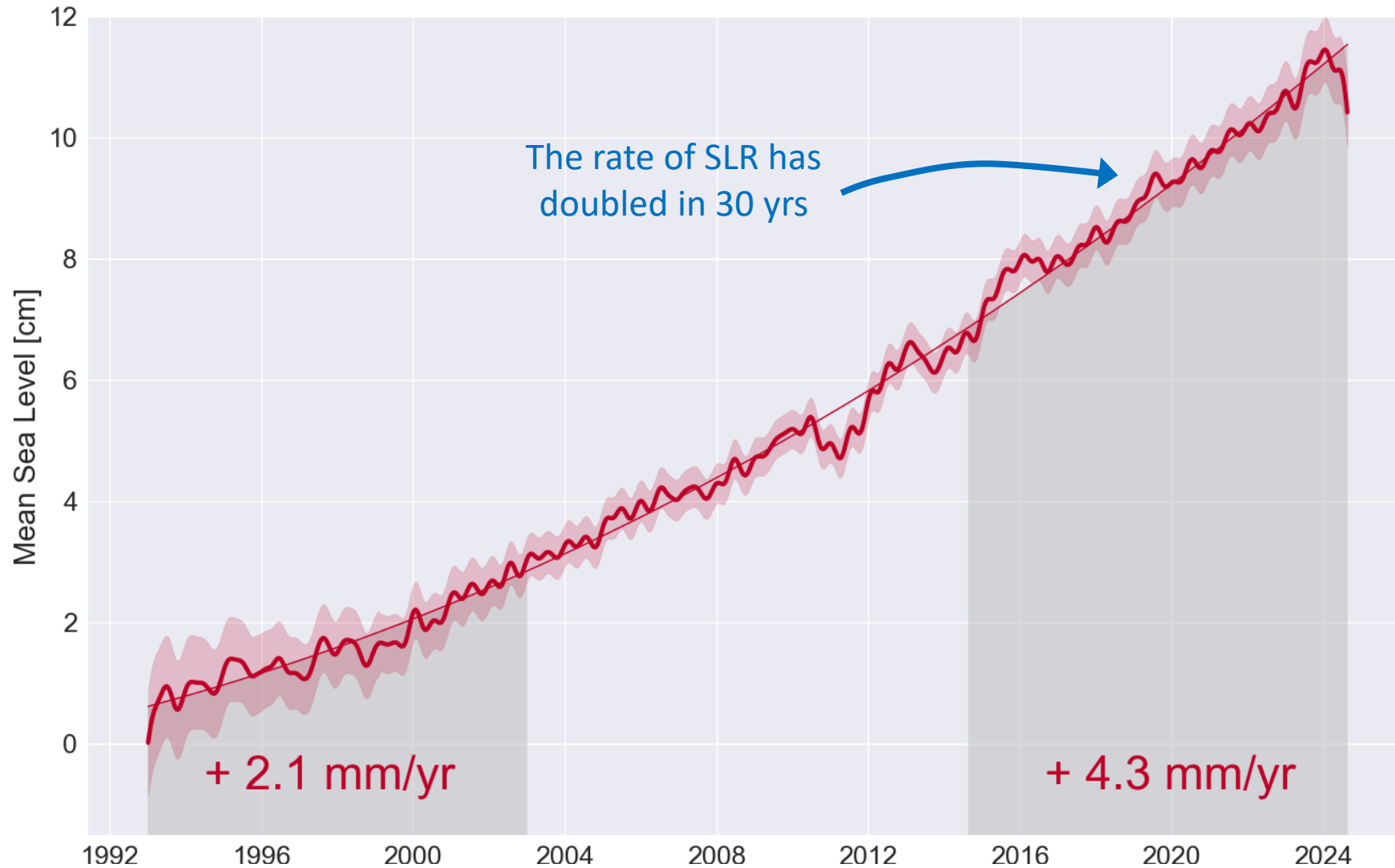
Temperature change relative to global average



Global Mean Sea Level Rise

Latest MSL Measurement
2024-08-21

Acceleration: $0.11 \pm 0.05 \text{ mm/yr}^2$

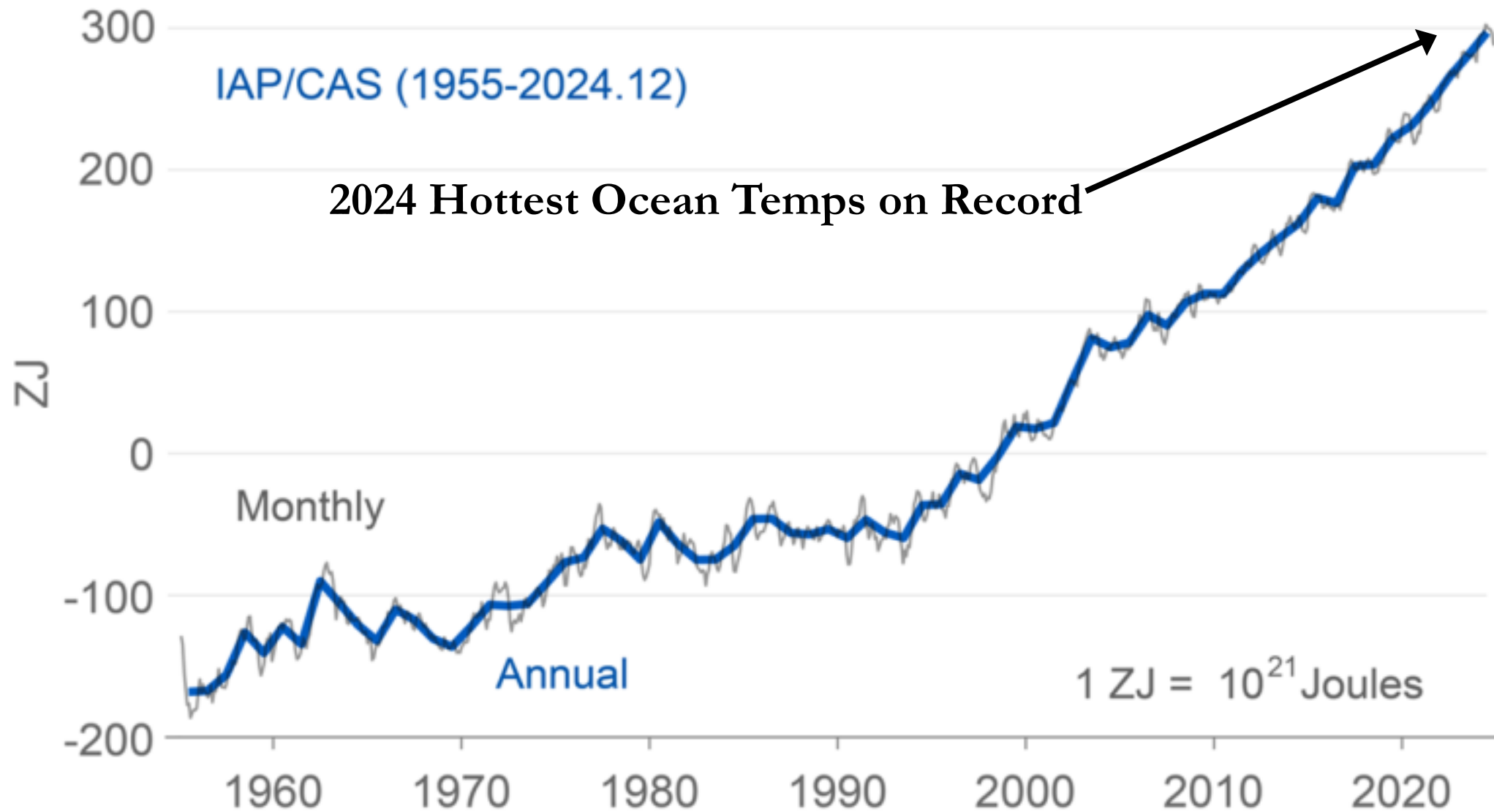


<https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html>

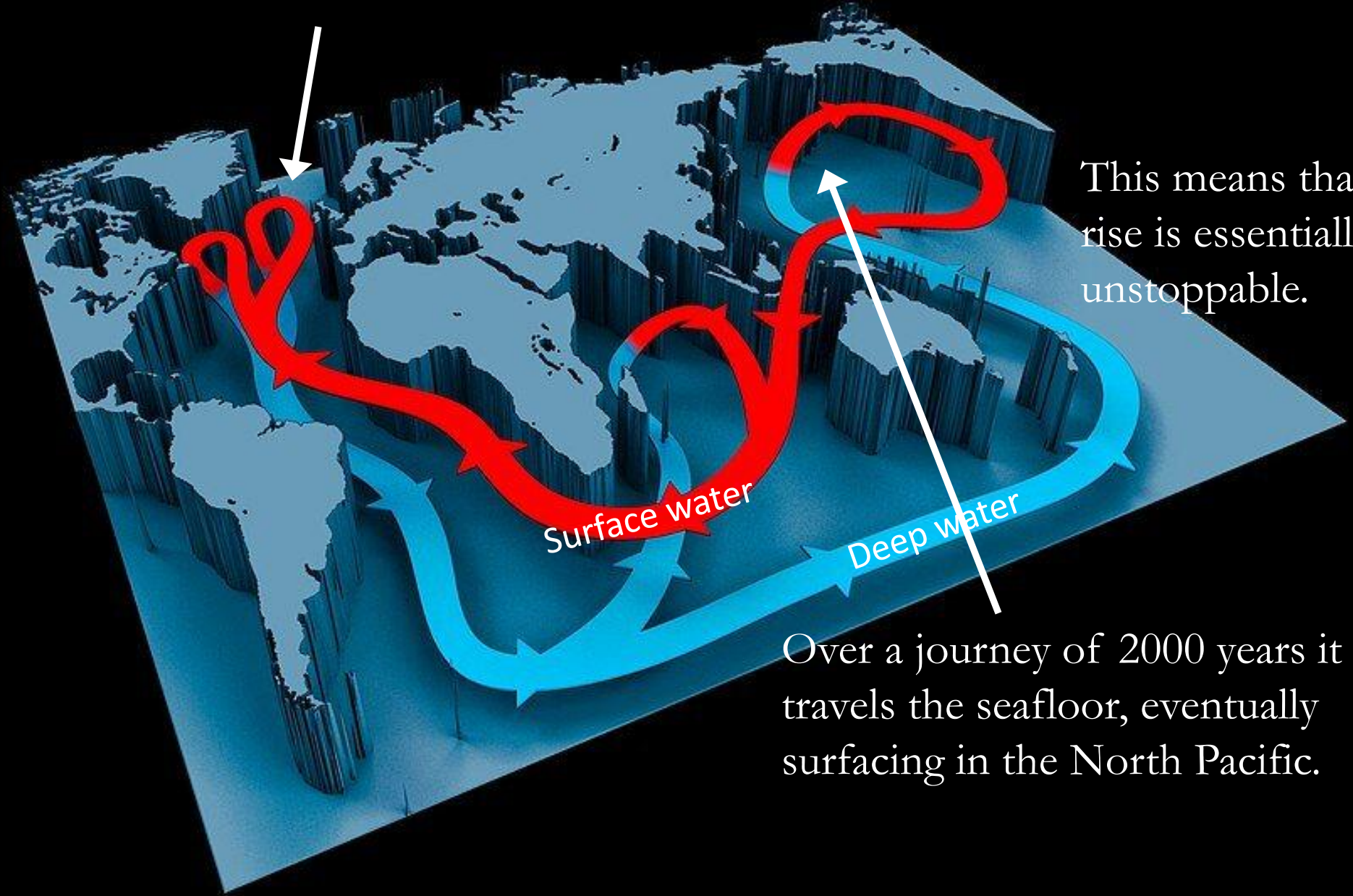
Hamlington, B.D., *et al.* The rate of global sea level rise doubled during the past three decades. *Commun Earth Environ* 5, 601 (2024). <https://doi.org/10.1038/s43247-024-01761-5>

Global upper 2000 m ocean heat content (OHC) change

Difference from 1981-2010 average



Warm surface water circulates into the deep sea causing thermal expansion wherever it goes.



This means that sea level rise is essentially unstoppable.

Over a journey of 2000 years it travels the seafloor, eventually surfacing in the North Pacific.

IPCC, 2021 Assessment Report 6

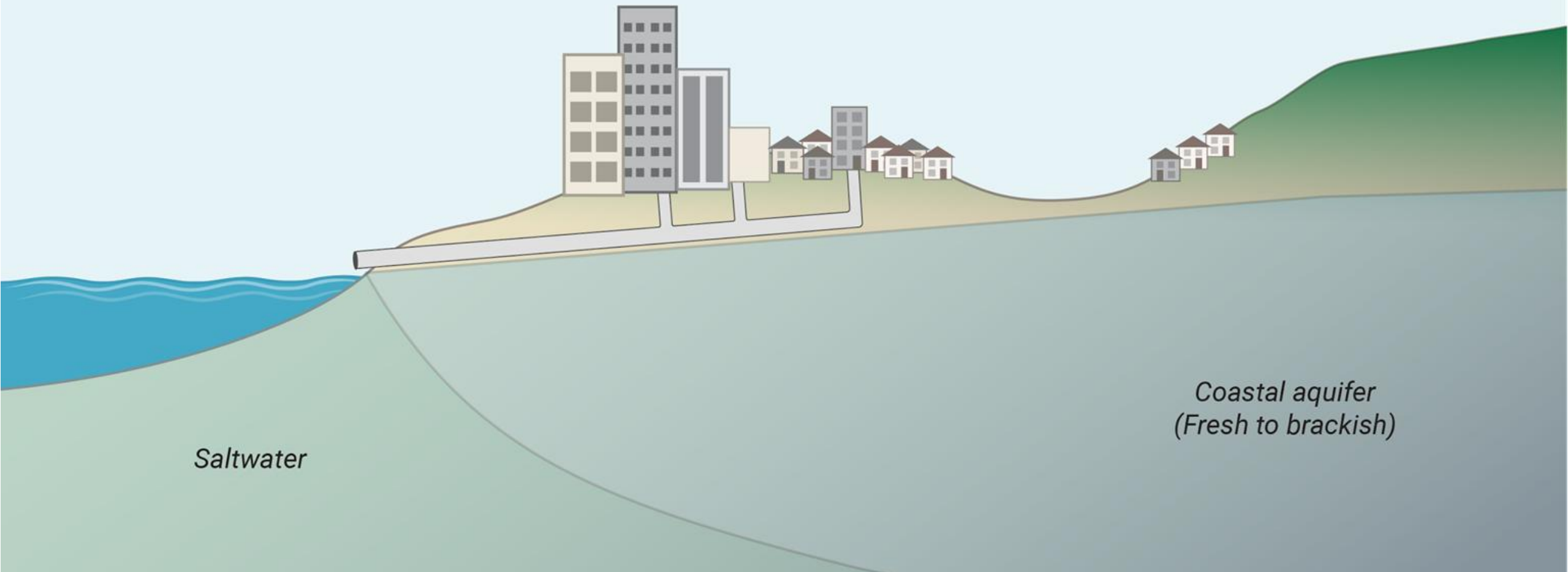
Sea level is **committed to rise for centuries to millennia** due to continuing deep-ocean warming and ice-sheet melt and will remain elevated for thousands of years (high confidence). *[AR6 WGI SPM p.21 B.5.4]*

An aerial photograph showing a residential neighborhood with several houses and palm trees. In the foreground, large, white, foamy waves are crashing against the shore, partially obscuring the houses. The water is a mix of white foam and greenish-brown. The houses have various roof colors, including brown, grey, and dark blue. Some houses have white railings on their balconies. The scene is captured from a high angle, looking down on the houses and the ocean.

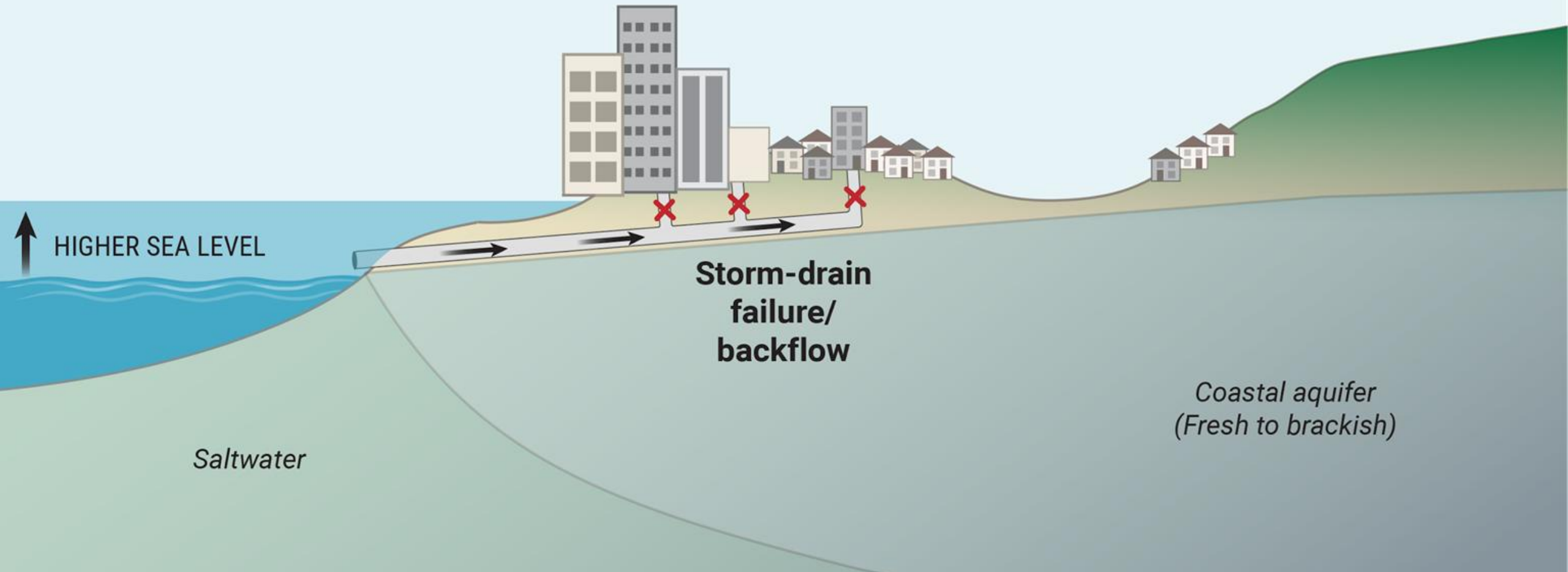
Sea level rise, an unstoppable reality

Photo, S. Habel

Multiple Impacts from Sea Level Rise



Stormwater Drainage Failure

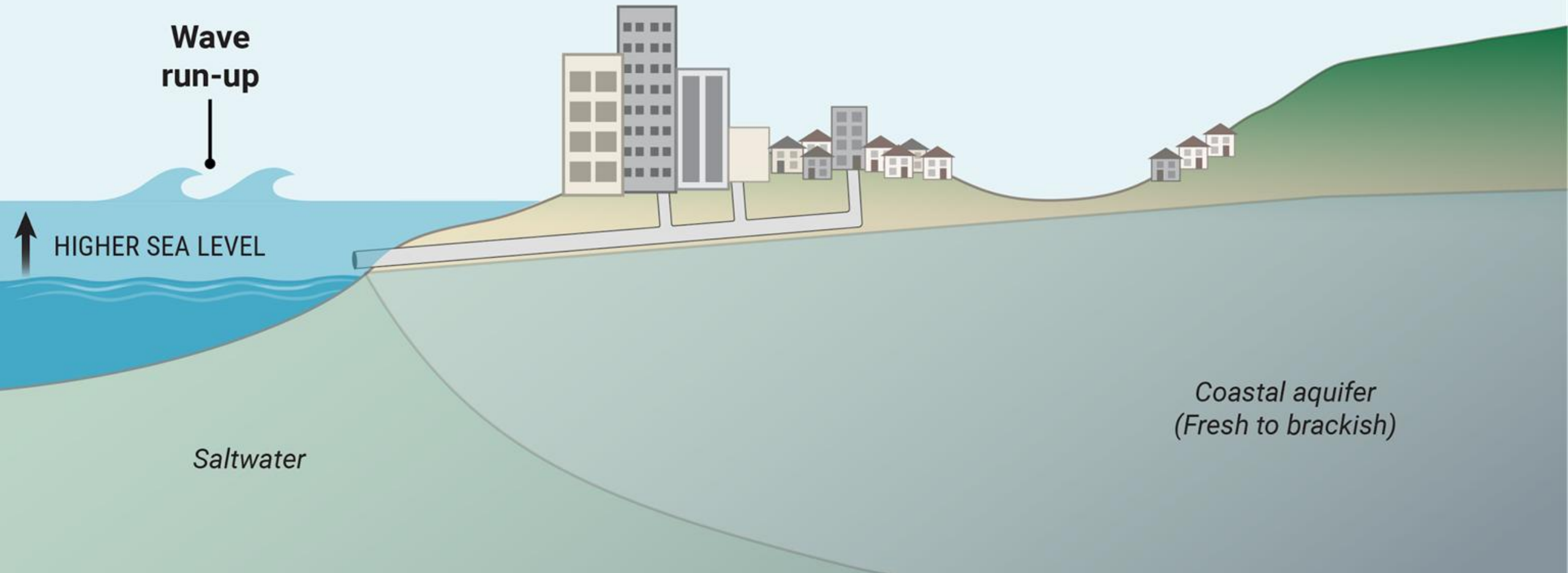


Storm
drain
backflow



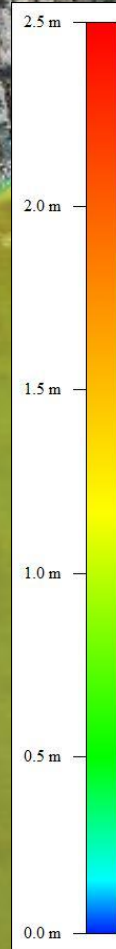
- 
- 71% of storm drain outfalls in Waikīkī are submerged below water at present MHHW
 - 100% of outfalls will be submerged by MHHW + 2 ft of SLR

Seasonal Wave Flooding



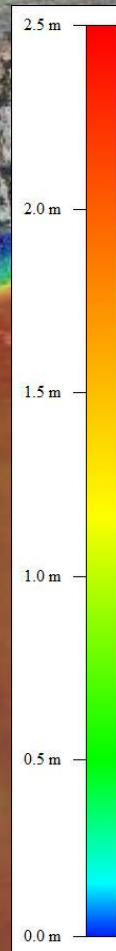
Ewa Beach – Wave Flooding, 1ft

2050



Ewa Beach – Wave Flooding, 2-3ft

2060-2070

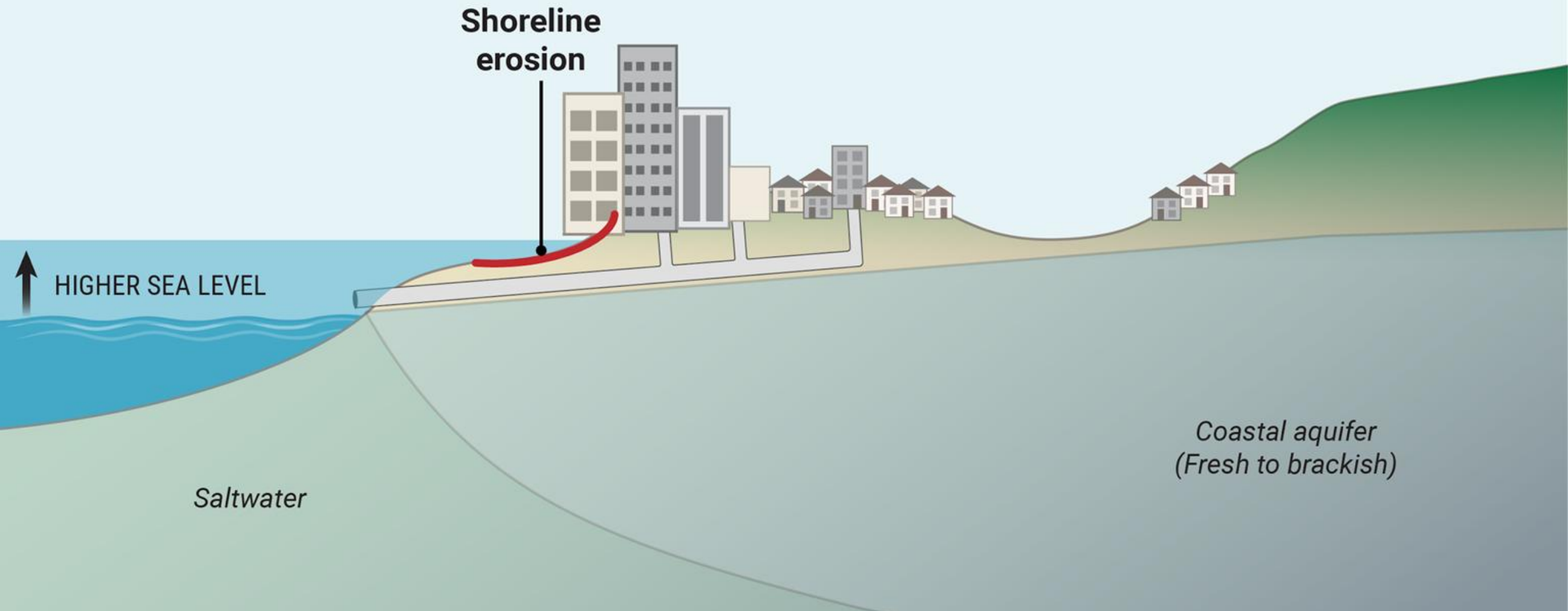


Ewa Beach – Wave Flooding, 4ft

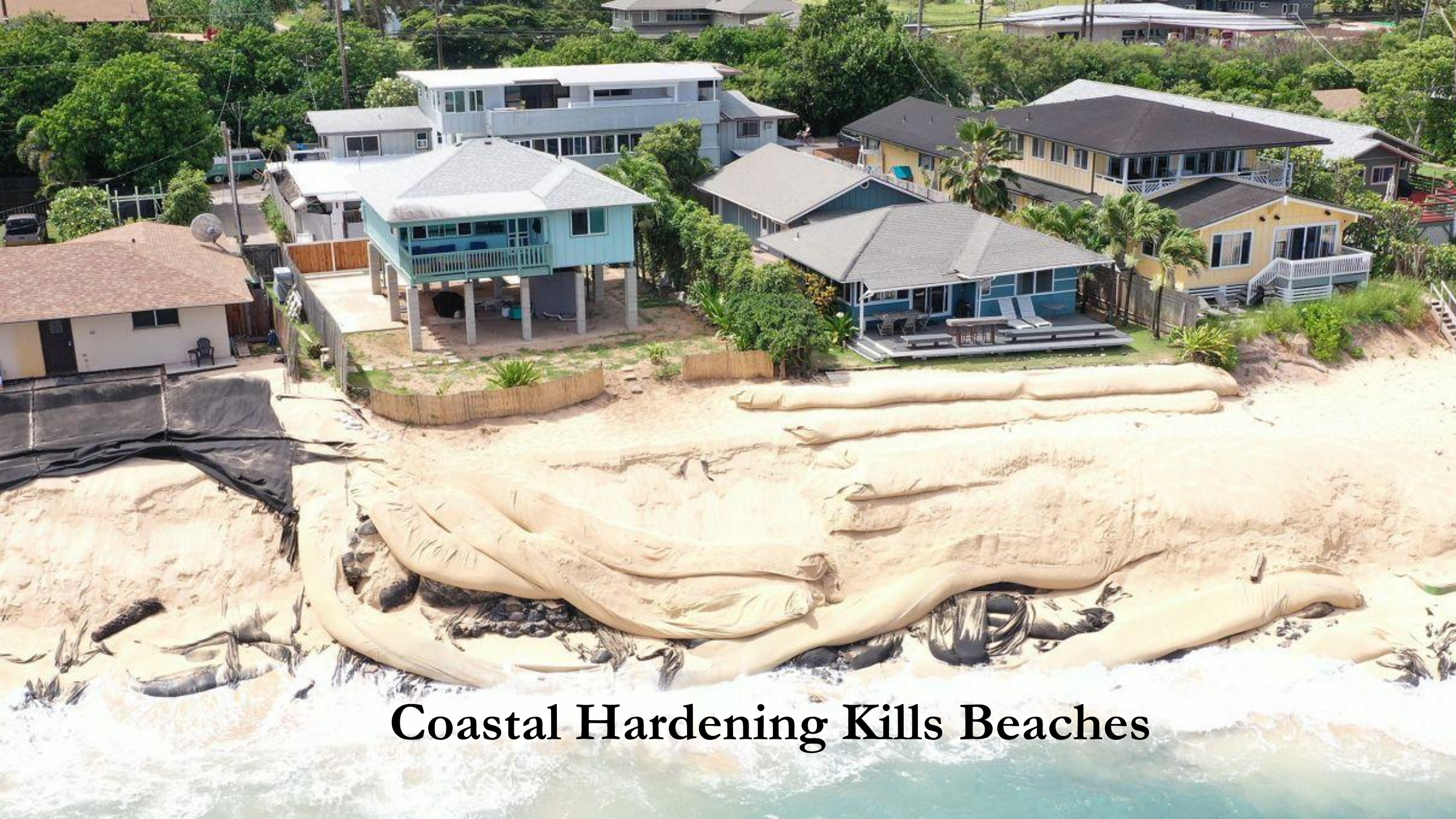
2080-2100



Shoreline Erosion

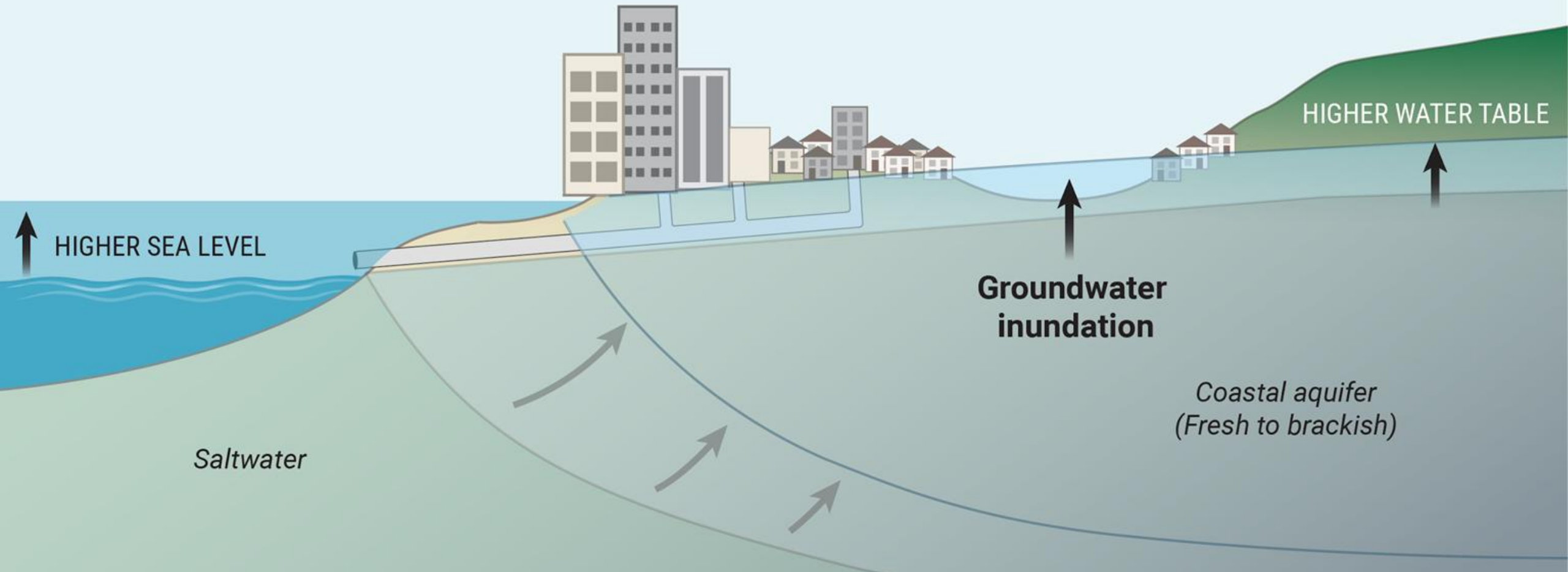






Coastal Hardening Kills Beaches

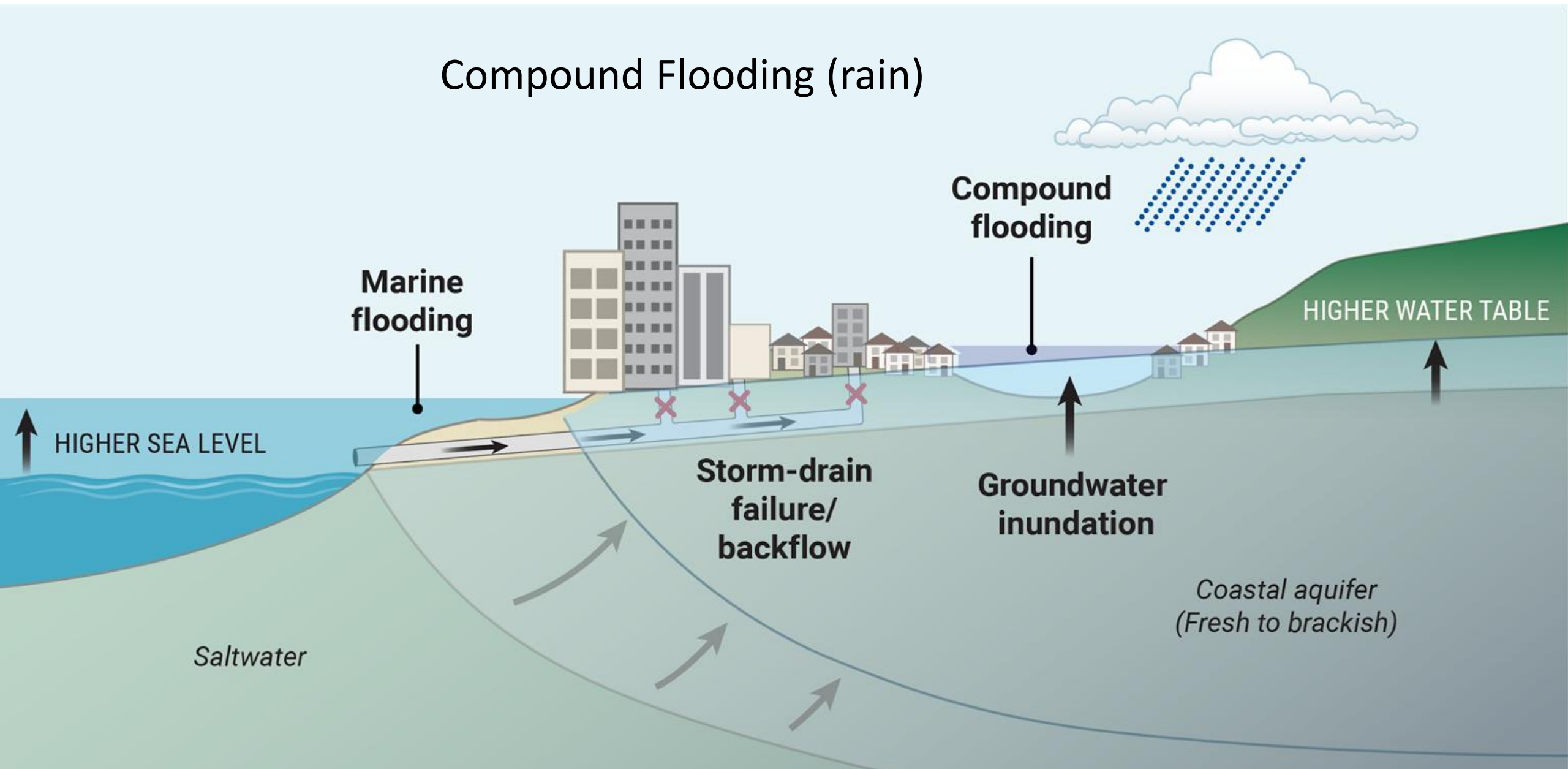
Groundwater Inundation



As sea level rises, so does
the water table



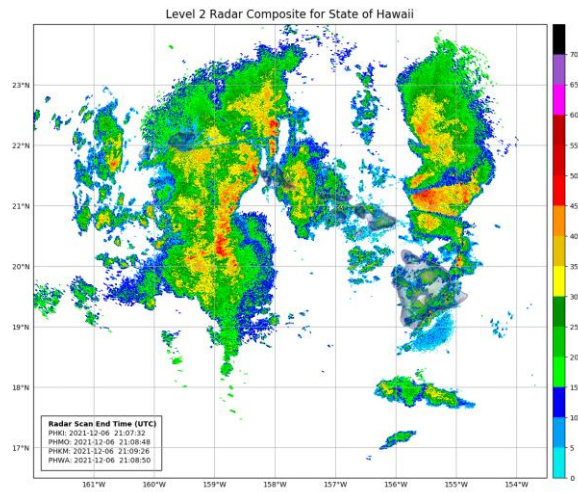
Compound Flooding (rain)



Waikiki

Dec. 5, 2021

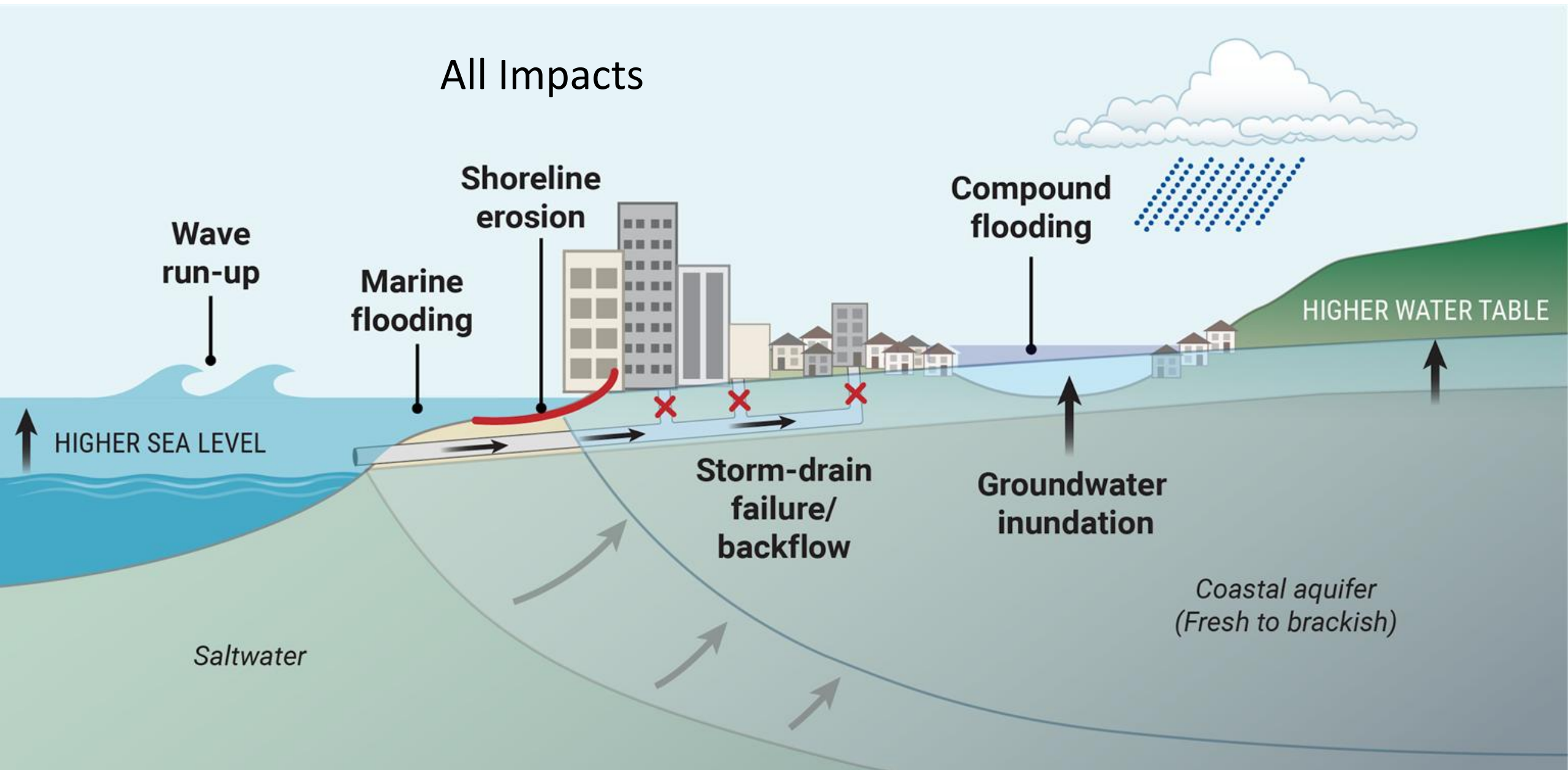
- Sea level rise flooding today involves
 - Rain
 - Extreme tides
 - Onshore winds
 - Large waves



Rain + High Tide = Compound Flooding



All Impacts

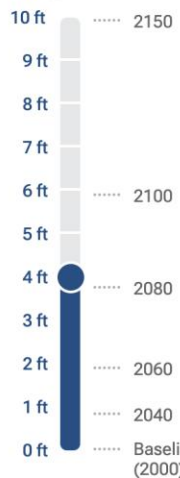


SEA LEVEL:
+ 4 ft

SEA LEVEL RISE SCENARIO ⓘ

Intermediate Intermediate High

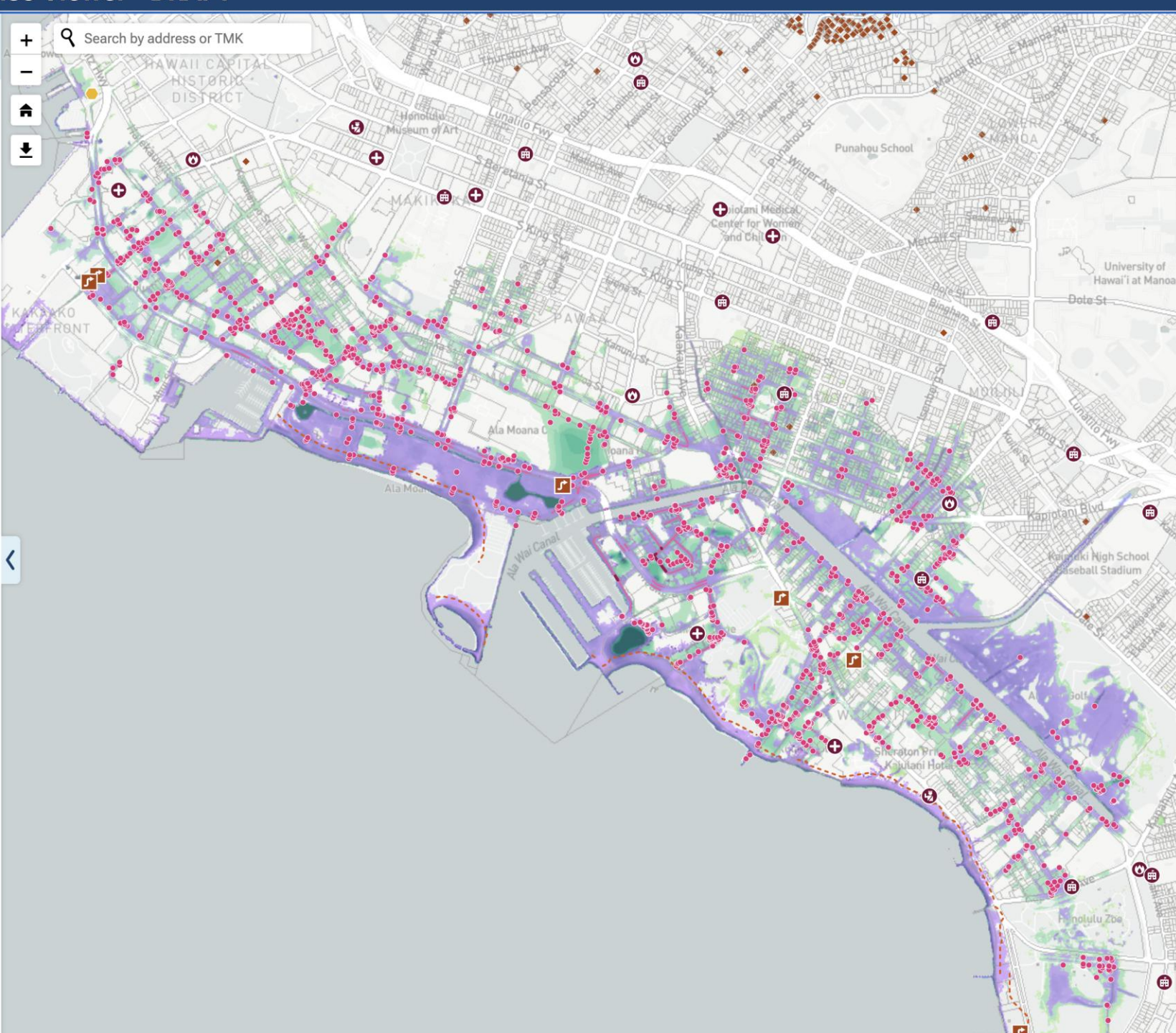
MHHW ⓘ EXPECTED BY



Timing of sea level rise based on local projections for:

MOKU O LO'E ISLAND

Data source:
[2022 Sea Level Rise Technical Report](#)



BASEMAPS

EXPOSURE

Unselect all

☒ Passive Flooding

☒ Marine Connected Flooding

Marine flooding: water depth

0 ft 10+ ft

☒ Lowlying Area

Lowlying: depth below sea level

0 ft 10+ ft

☒ Groundwater Inundation

0 ft 10+ ft

☐ Emergent and Shallow Groundwater

☒ Drainage Backflow

0 ft 10+ ft

☒ Annual High Wave-Driven Flooding

Water depth

0 ft 10+ ft

☒ Compound Flooding Scenario
(December 2021 Kona storm)

Floodwater Depth

0 ft 10+ ft

☒ Future Erosion Hazard Zone

— Shoreline Position

☐ Transect Historical Change

IMPACTS

Unselect all

☒ Flooded Roads

— Flood depth > 1 ft

— Flood depth > 2 ft

☒ Stormwater Drainage Failure

• Stormwater structures below sea level

☒ Critical Facilities

☒ Hospitals and Clinics

☒ Fire Stations

☒ Police Stations

☒ Public Schools

☐ Wastewater Infrastructure

☐ Electrical Infrastructure

OTHER OVERLAYS

Unselect all

☐ Community Plan Areas

☐ Moku Boundaries

☐ Ahupua'a Boundaries

☐ Neighborhood Board Areas

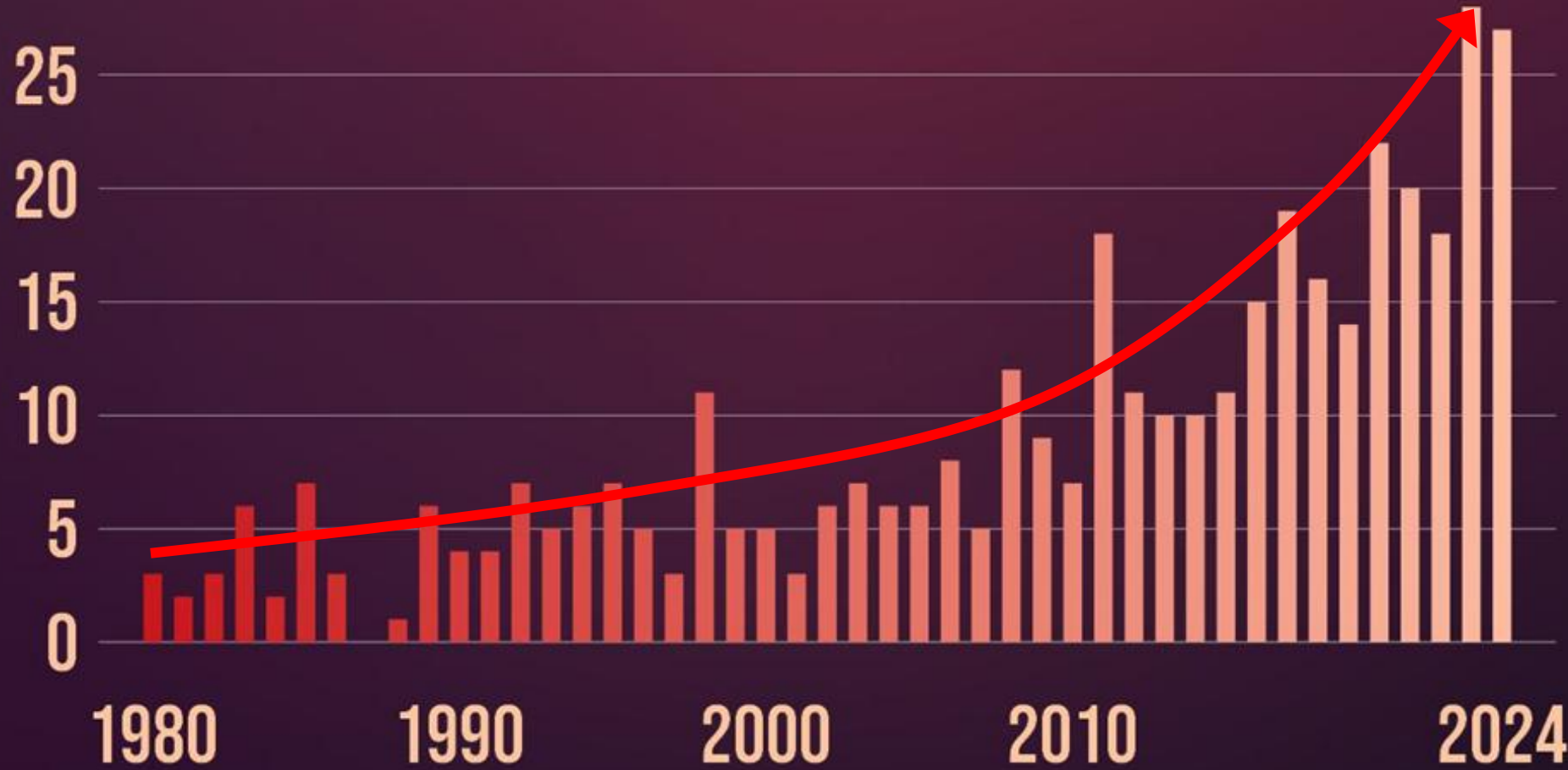
Thank you for your Time

Hawaii Climate Summary

- Sea level has risen about 5 inches since 1970, the pace is accelerating; projections show up to 3.5 feet additional rise by 2100 under intermediate scenarios, threatening beaches, homes, roads, and freshwater through saltwater intrusion.
- Average air temperature has increased by at least 3°F statewide since 1950, with Honolulu rising about 3.6°F over the same span; further increases of 1.8–7.2°F are projected by the end of the century depending on emissions.
- Annual rainfall has declined across most islands, especially leeward areas, increasing the risk of drought and reducing freshwater supply; wet season precipitation for the last decade ranked among the lowest on record.
- Droughts are more frequent, longer, and more severe, with about 90% of Hawaii now receiving less rainfall than a century ago and ecological impacts intensifying, particularly for native forests and agriculture.
- Wildfires are increasing in frequency, extent, and severity, culminating in events like the 2023 Maui fire disaster, attributed to hotter, drier conditions and rapid spread of invasive grasses.
- Coral reefs are under extreme stress: ocean warming, acidification, and bleaching threaten to destroy up to 90% of reefs even if warming is kept to 1.5°C, with economic impacts projected to exceed \$1 billion per year by 2050 due to reef loss.
- Coastal flooding, groundwater inundation, and chronic high tide events are now regular threats for low-lying areas, especially former wetlands and fill lands, making infrastructure and homes increasingly vulnerable.
- Heavy rainfall events are becoming more intense and more frequent, while wet season rainfall on average is declining—a pattern that increases risk for both drought and flash floods.
- Trade wind patterns have shifted; decreased frequency of cooling northeast trades increases exposure to heat waves, poor air quality, and amplifies urban heat.

U.S. BILLION-DOLLAR DISASTERS

Annual number of events



- As the planet warms, extreme weather events are becoming more frequent and intense
- Since 1980, the U.S. suffered 403 billion-dollar weather disasters that claimed 17,000 lives and caused more than \$2.9 trillion in direct costs.
- The average length of time between disasters fell from 82 days during the 1980s to 19 days during the last 10 years

No disasters in 1987. Data through 12/31/2024.

Source: NOAA/NCEI