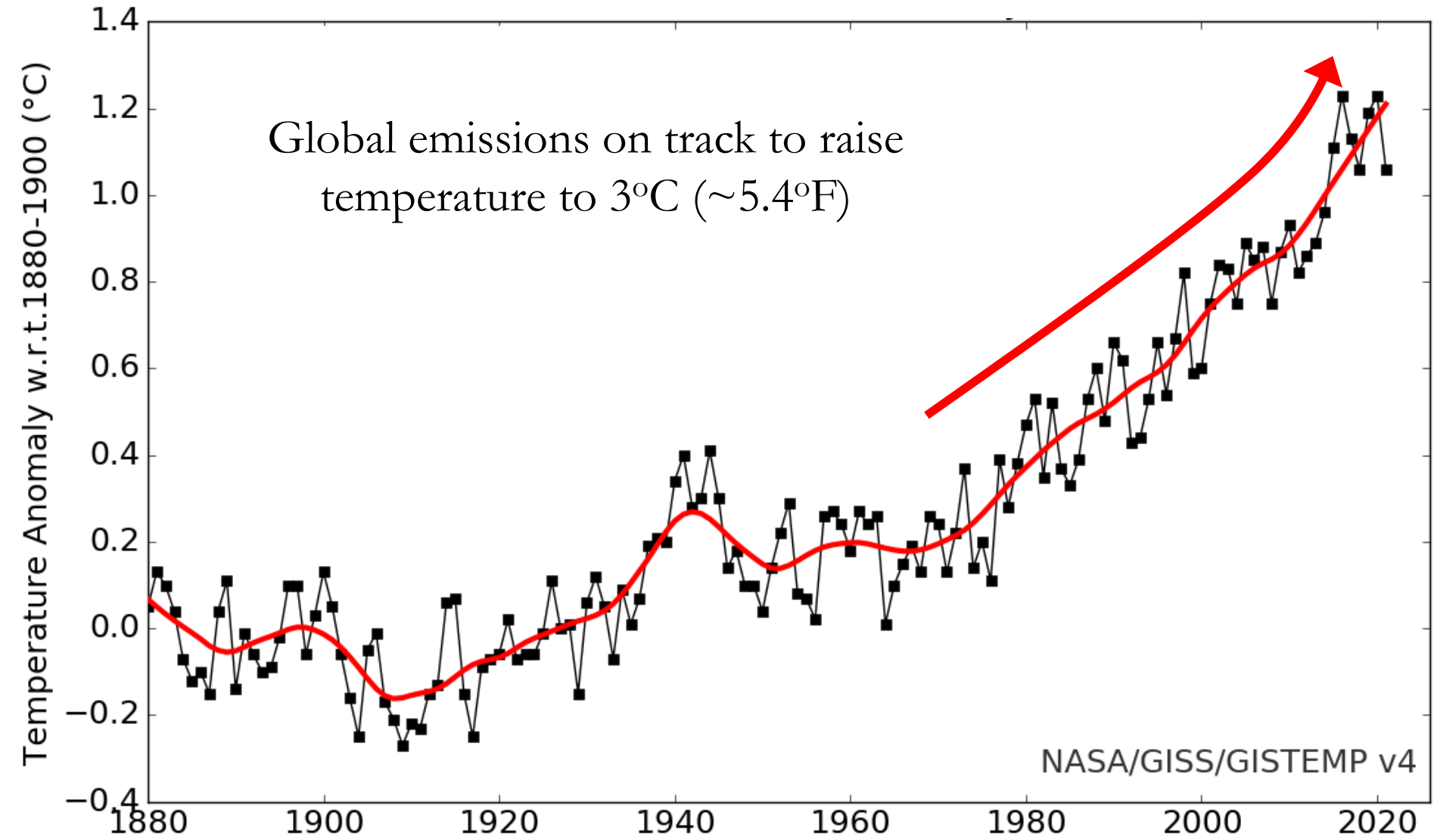


Global Warming +1.2°C (~2.2°F)

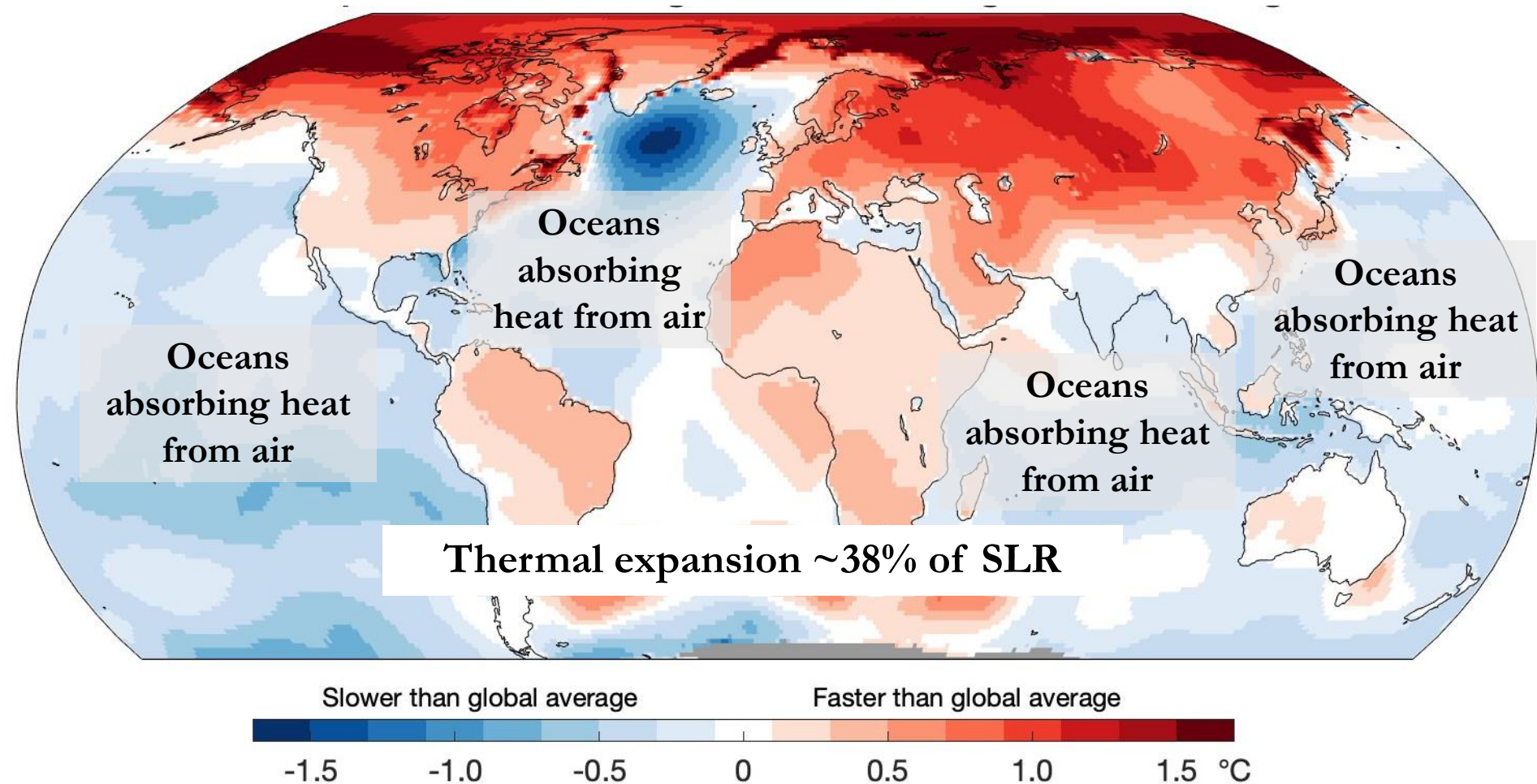


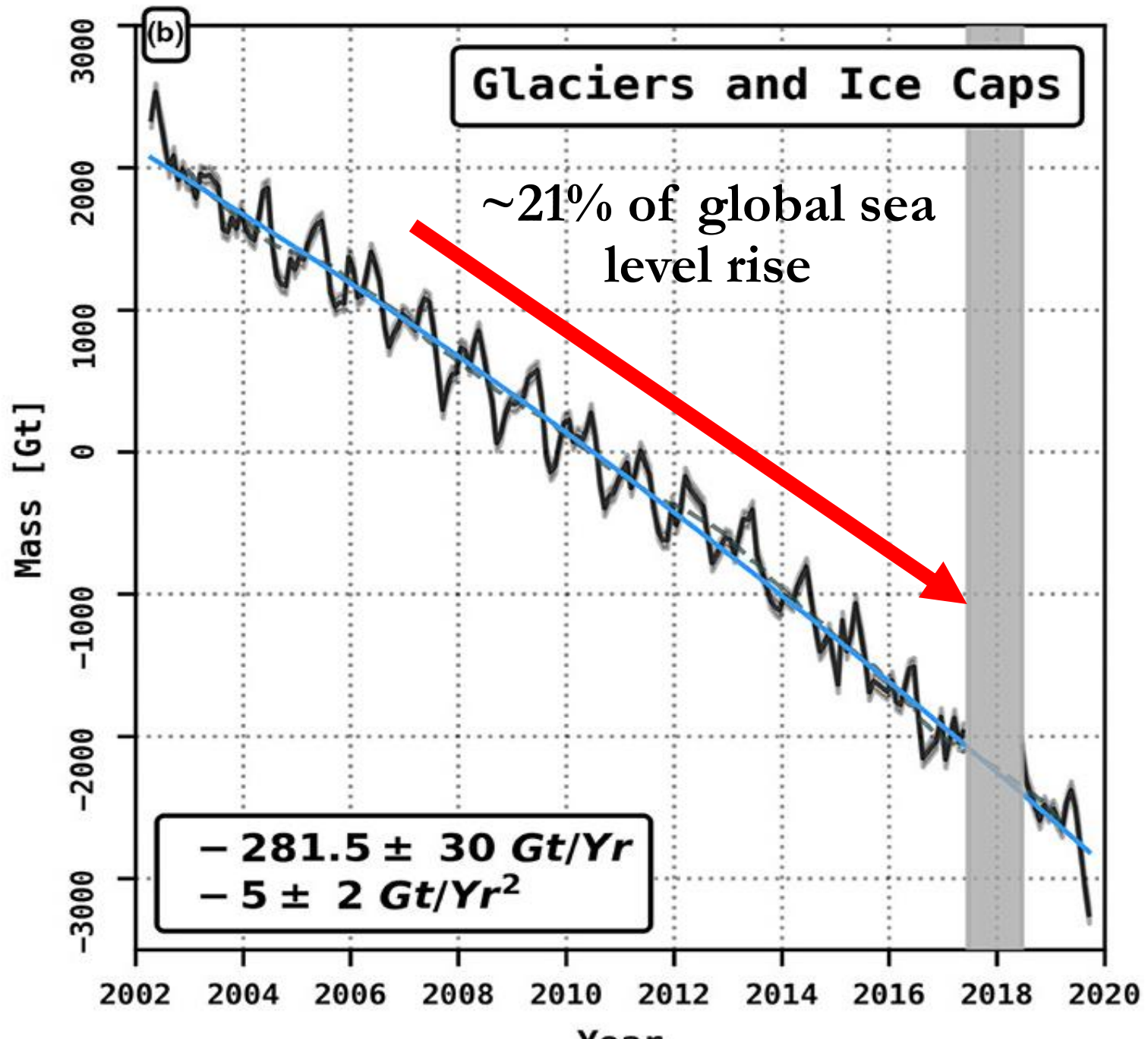
Temperature change relative to global average

Continents warming faster than oceans,
breadbaskets and communities at risk

Arctic Amplification

Arctic warming faster than global average

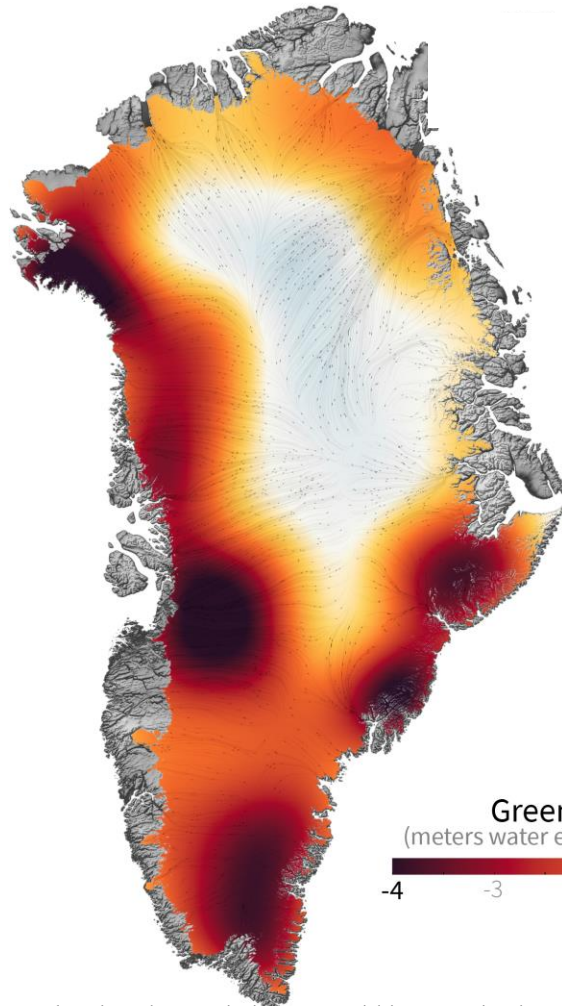




Greenland melting has quadrupled since 2010

~20% of global sea level rise

Ice loss, billions of tonnes



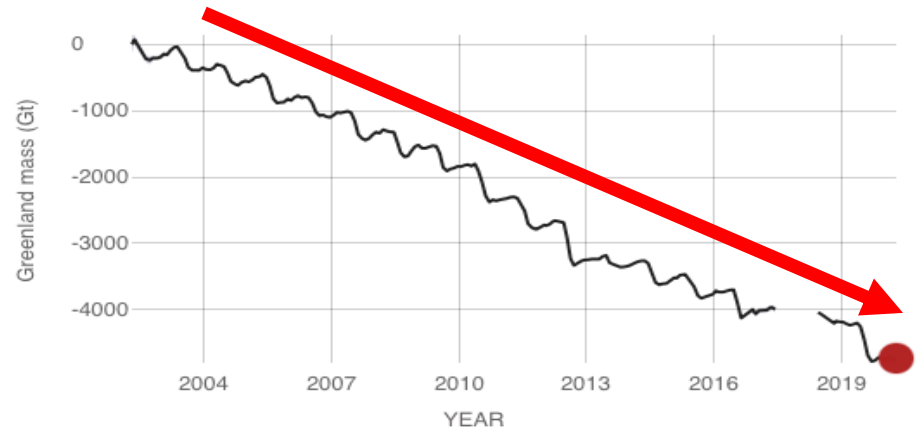
Greenland Ice Loss
(meters water equivalent relative to 2002)

-4 -3 -2 -1 0 0.5

Greenland Mass Variation Since 2002

Data source: Ice mass measurement by NASA's GRACE satellites. Gap represents time between missions.
Credit: NASA

RATE OF CHANGE
↓ 280.0
Gigatonnes per year



Antarctic ice melt has tripled since 2010

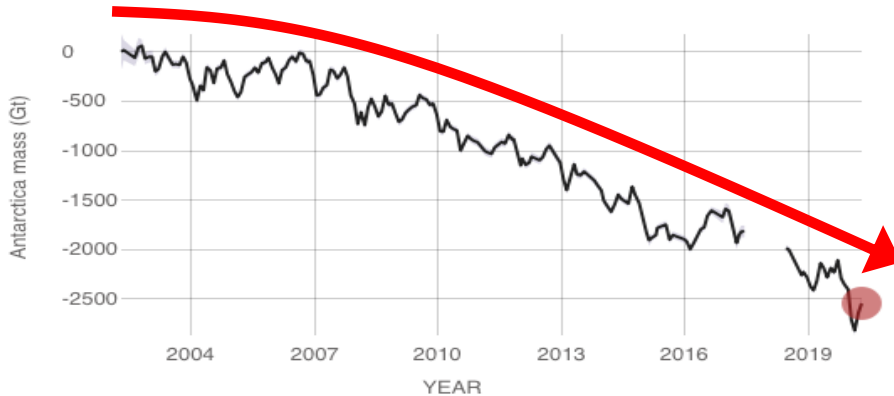
~9% of global sea level rise

West Antarctic Glaciers are in Irreversible Retreat

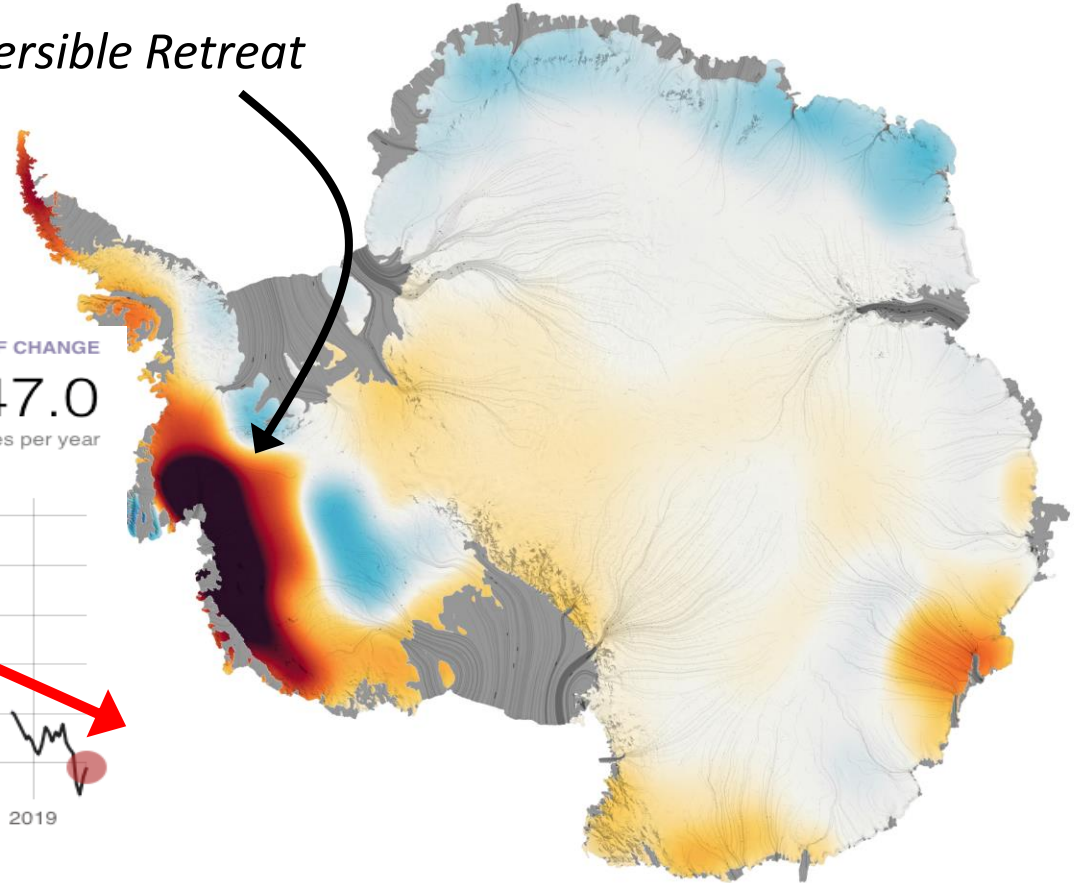
Ice loss, billions of tonnes

Antarctica Mass Variation Since 2002

Data source: Ice mass measurement by NASA's GRACE satellites. Gap represents time between missions.
Credit: NASA



RATE OF CHANGE
↓ 147.0
Gigatonnes per year

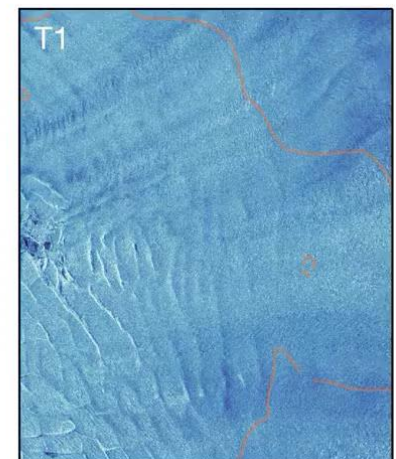
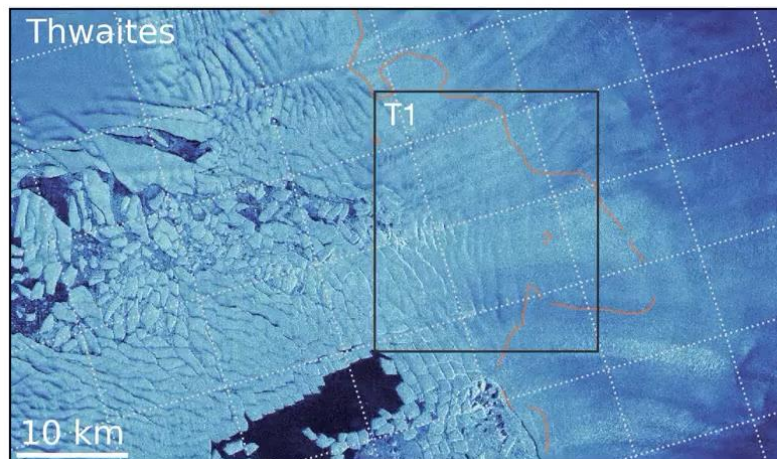
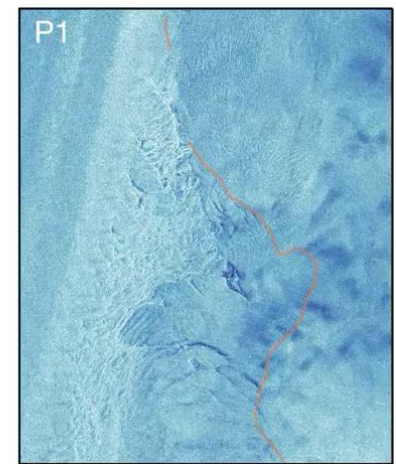
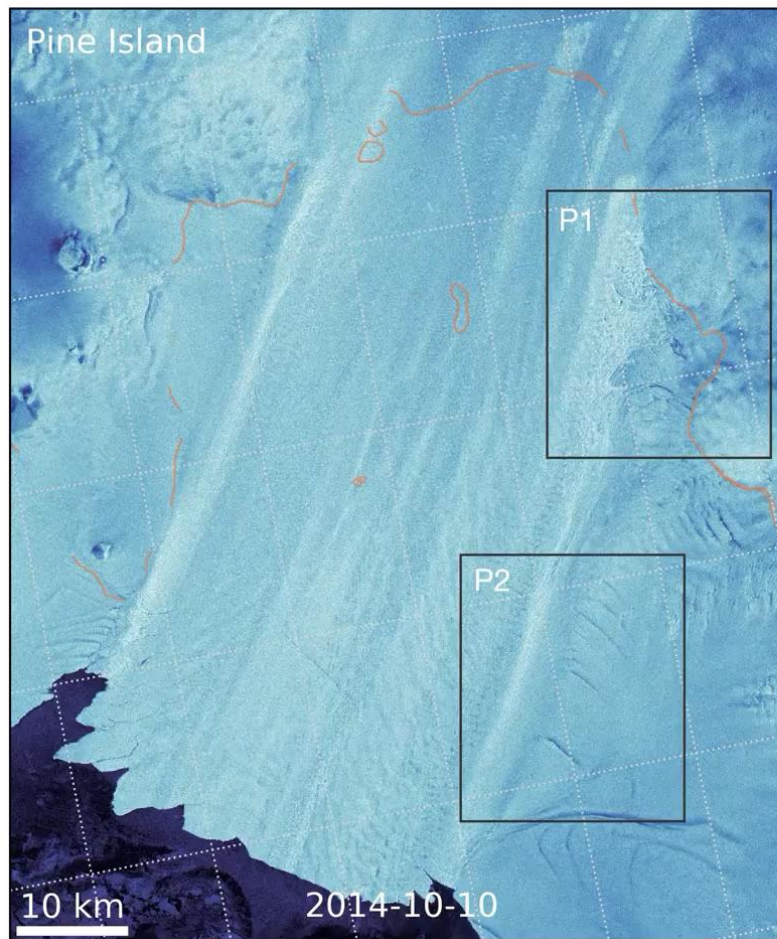


Antarctic Ice Loss
(meters water equivalent relative to 2002)

-3 -2 -1 0 1

“The natural buffer system preventing Pine Island and Thwaites glaciers from flowing rapidly is **breaking down**.

The ice shelves are showing **new damage areas** that are the first signs of structural weakening and precondition these ice shelves for **disintegration.**”



Groundwater Depletion ~10%



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]

Global mean sea level will rise by about

- 6.5 to 10 ft at 1.5°C,
- 6.5 to 20 ft at 2°C and
- 62 to 72 ft with 5°C of warming,

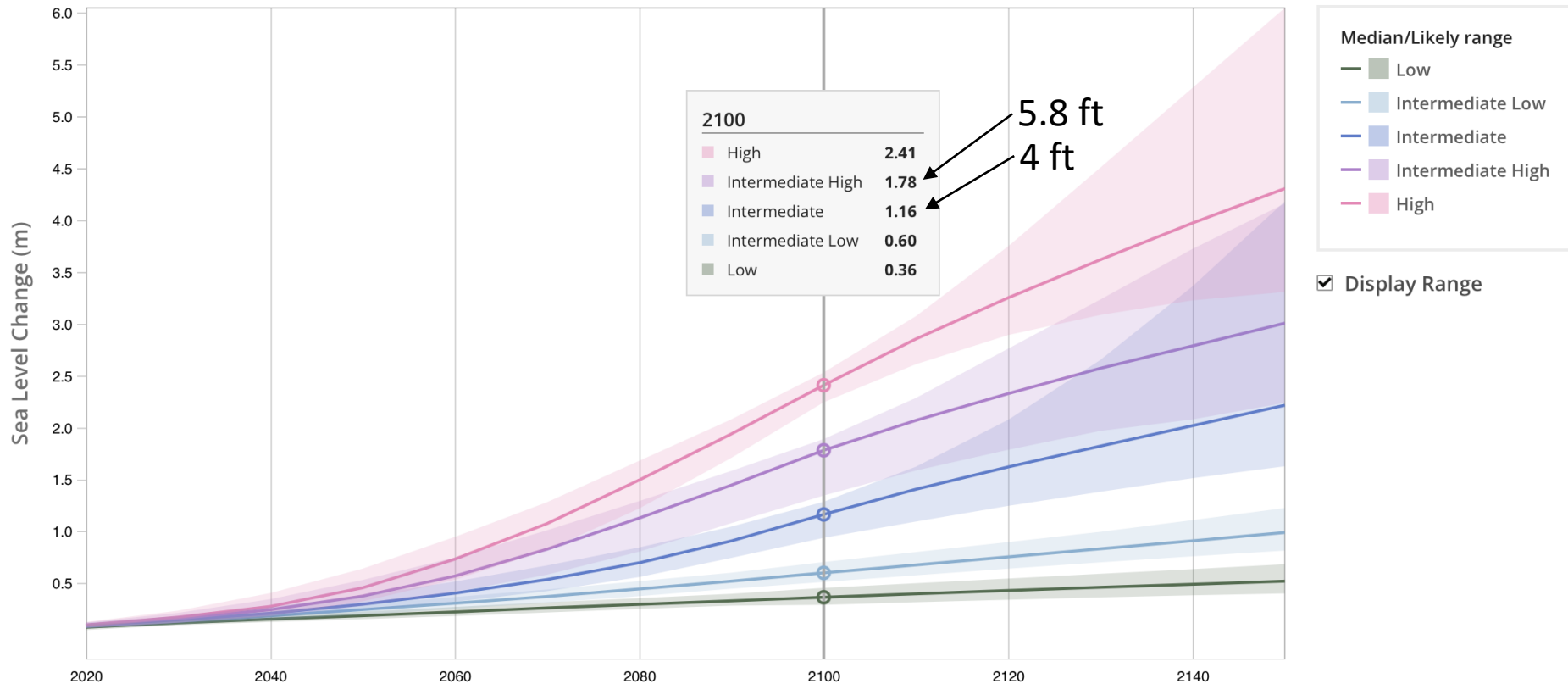
and it will continue to rise over subsequent millennia

An aerial photograph showing a coastal town with several houses and a large wave crashing against the shore. The wave is white and turbulent, with a large shadow cast onto the houses. The houses have various roof colors, including grey, brown, and blue. The water is a mix of green and white. The text "Sea level rise, an unstoppable reality" is overlaid in the center of the image.

Sea level rise, an unstoppable reality

Photo, S. Habel

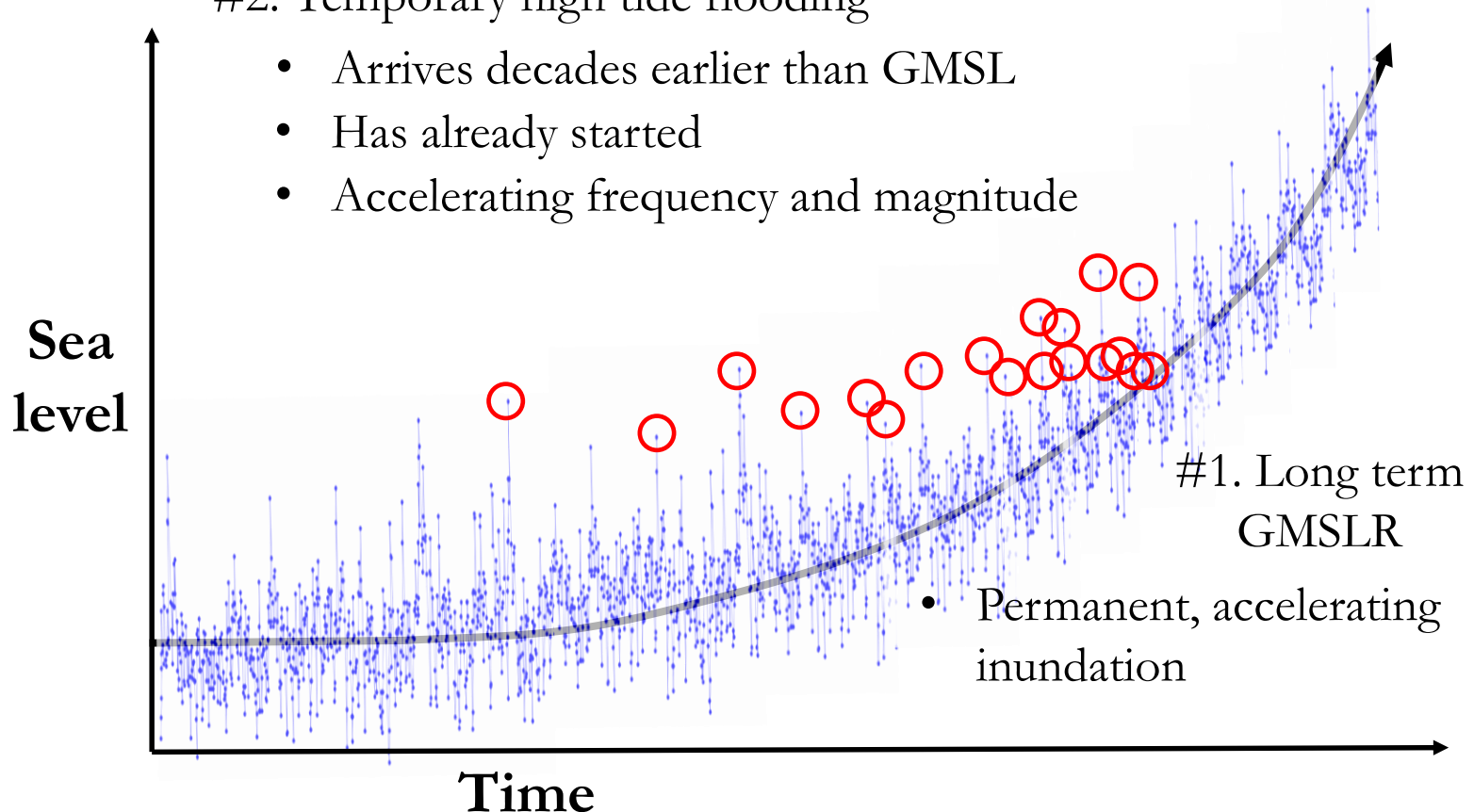
NOAA/NASA SLR Planning Scenarios Honolulu, Oahu



SLR Flooding: Nuisance and Permanent

#2. Temporary high tide flooding

- Arrives decades earlier than GMSL
- Has already started
- Accelerating frequency and magnitude



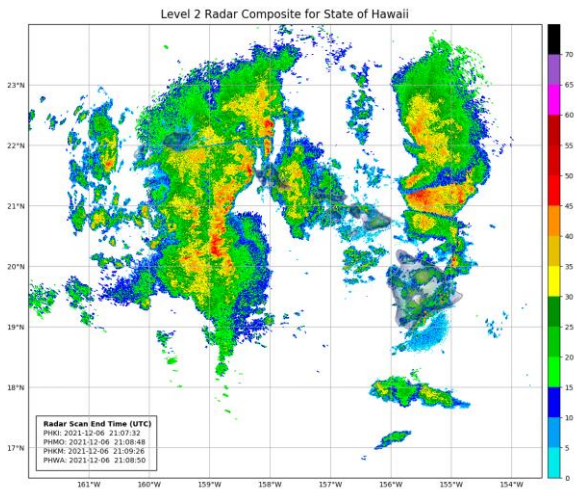
Storm
drain
backflow



Waikiki

Dec. 5, 2021

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



Rain + High Tide = Flooding





Ewa Beach – Wave Inundation



Ewa Beach – Wave Inundation



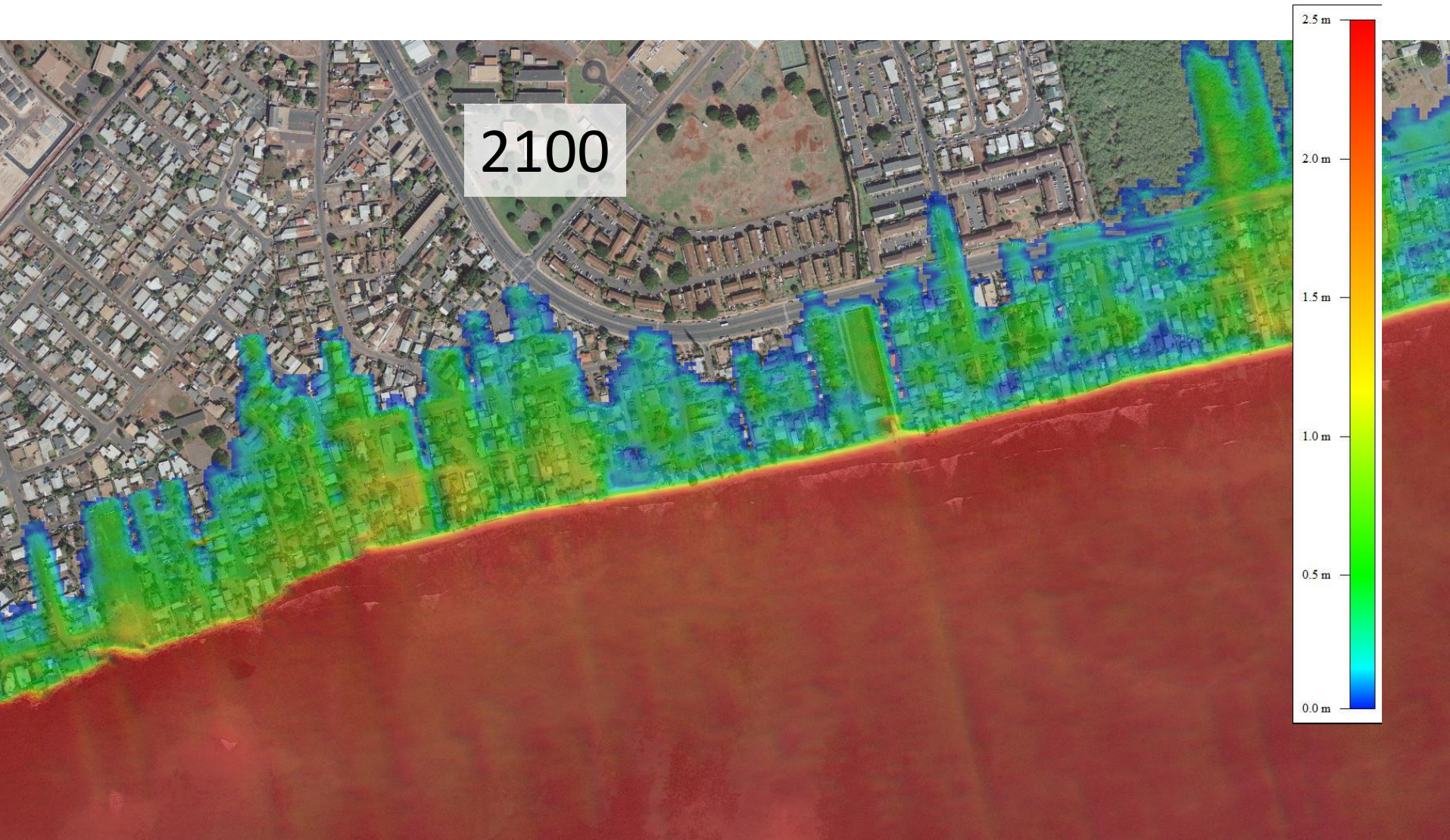
Ewa Beach – Wave Inundation, 1ft



Ewa Beach – Wave Inundation, 2-3ft



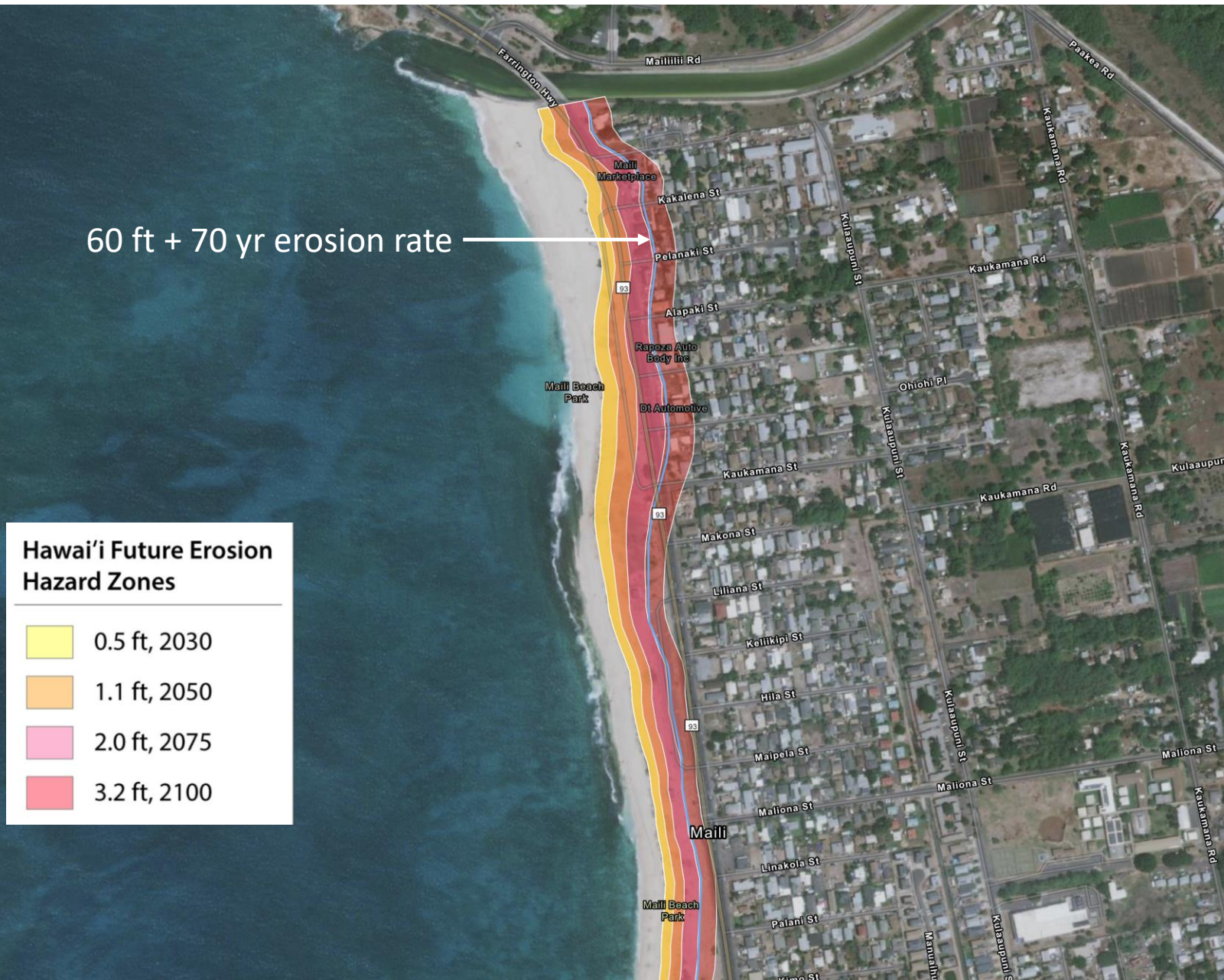
Ewa Beach – Wave Inundation, 4ft



Kokololio Beach Park, Laie

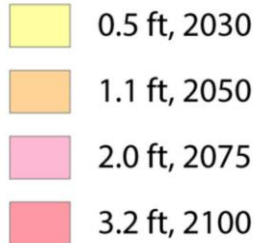


Mali Beach Park, Mali



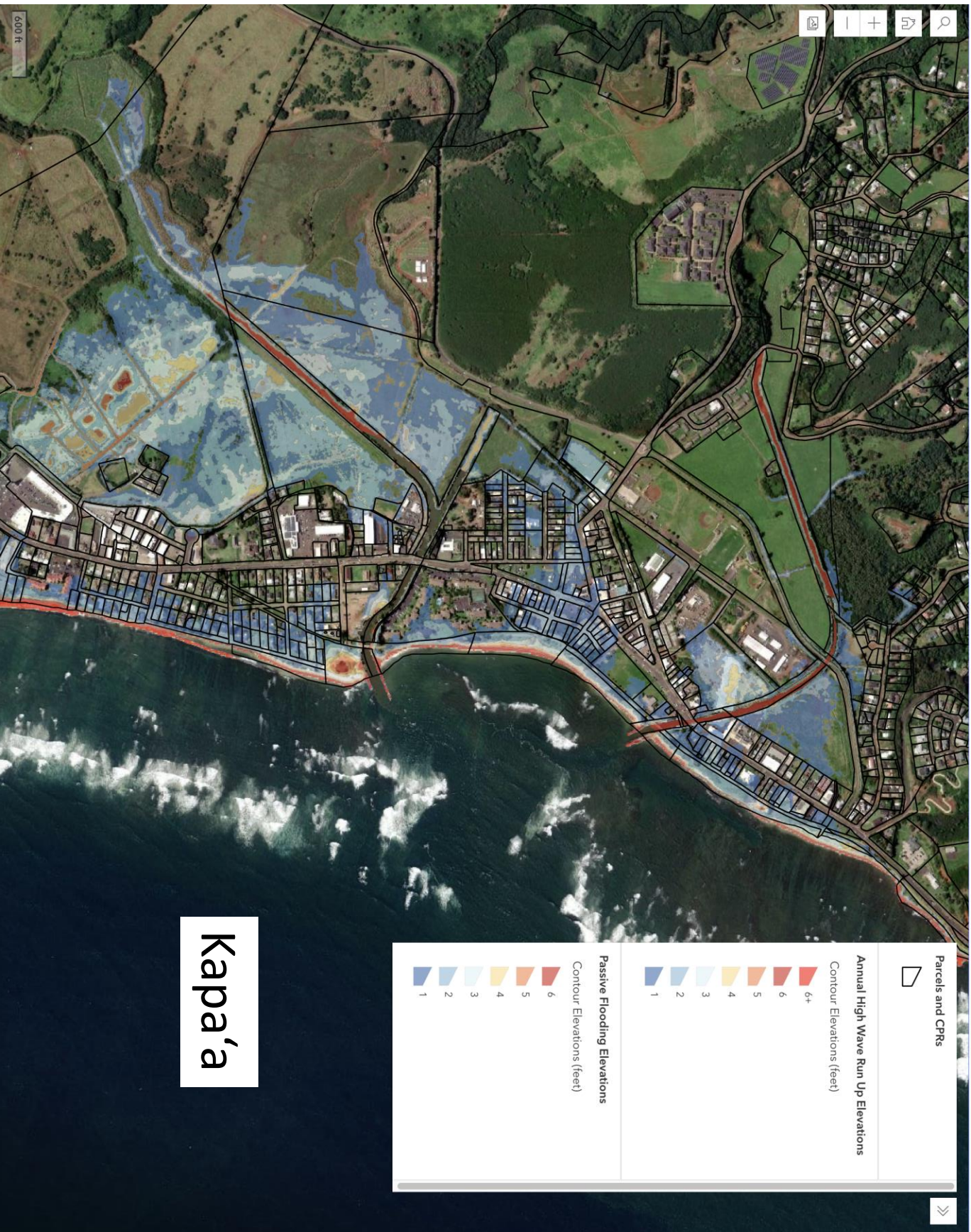
Sunset Beach Park, North Shore

Hawai'i Future Erosion Hazard Zones



Thank you





Kapa'a