



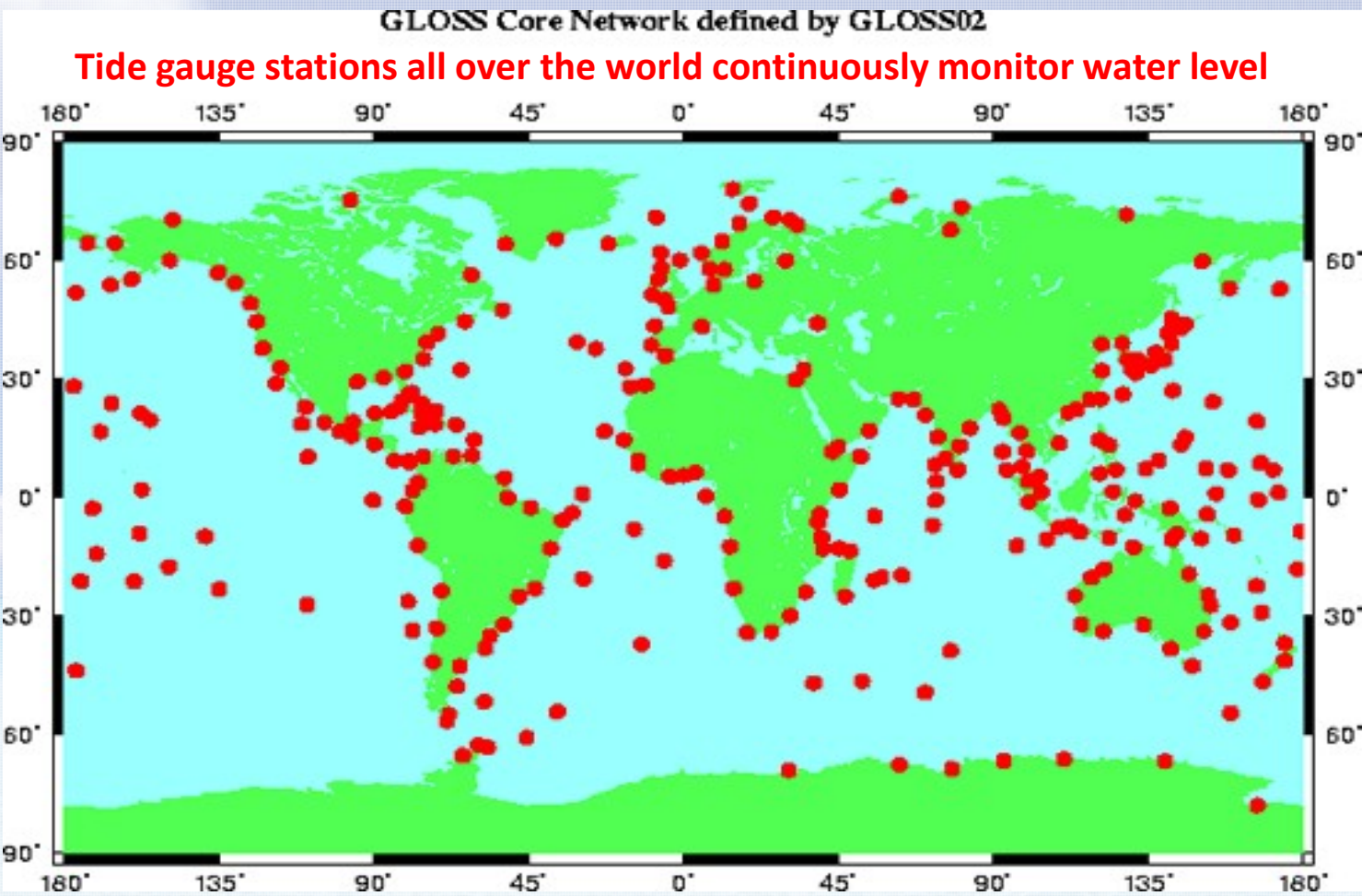
ATMO 102 Pacific Climates and Cultures

Lecture: Sea Level Rise



Coastal Wave Buoy Measurements

Sea Level Stations



What affects sea level on short time scales?

• Tides

- High and Low Tides
- Changes in the future

• Weather

- Storms, hurricanes, waves
- Intensity, timing, and amount

• El Niño

- Can lower or raise sea level depending on location
- Can change precipitation amount and timing.



Case Study: Marshall Islands

- **Article in NY Times Dec 2, 2015**

- http://www.nytimes.com/interactive/2015/12/02/world/The-Marshall-Islands-Are-Disappearing.html?_r=0



Case Study: Marshall Islands

Rising seas are claiming a vulnerable nation.

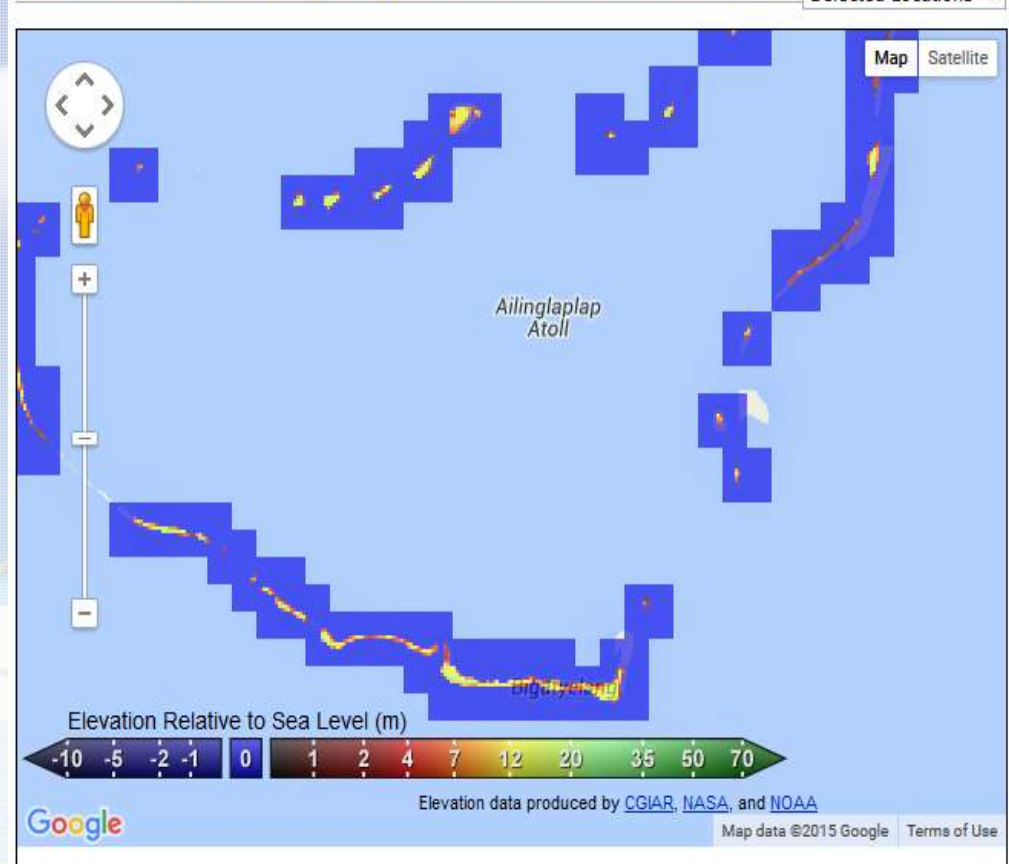
BY CORAL DAVENPORT. PHOTOGRAPHS AND VIDEO BY JOSH HANER.

EBEYE, MARSHALL ISLANDS — Linber Anej waded out in low tide to haul concrete chunks and metal scraps to shore and rebuild the makeshift sea wall in front of his home. The temporary barrier is no match for the rising seas that regularly flood the shacks and muddy streets with saltwater and raw sewage, but every day except Sunday, Mr. Anej joins a group of men and boys to haul the flotsam back into place.

“It’s insane, I know,” said Mr. Anej, 30, who lives with his family of 13, including his parents, siblings and children, in a four-room house. “But it’s the only option we’ve got.”



Sea Level Rise Explorer





Case Study King Tides in Kiribati

- A family climbs to safety when their house is hit by a king tide in Betio, on the South Pacific island of Kiribati, in February, 2005.

Sea Level Rise Explorer

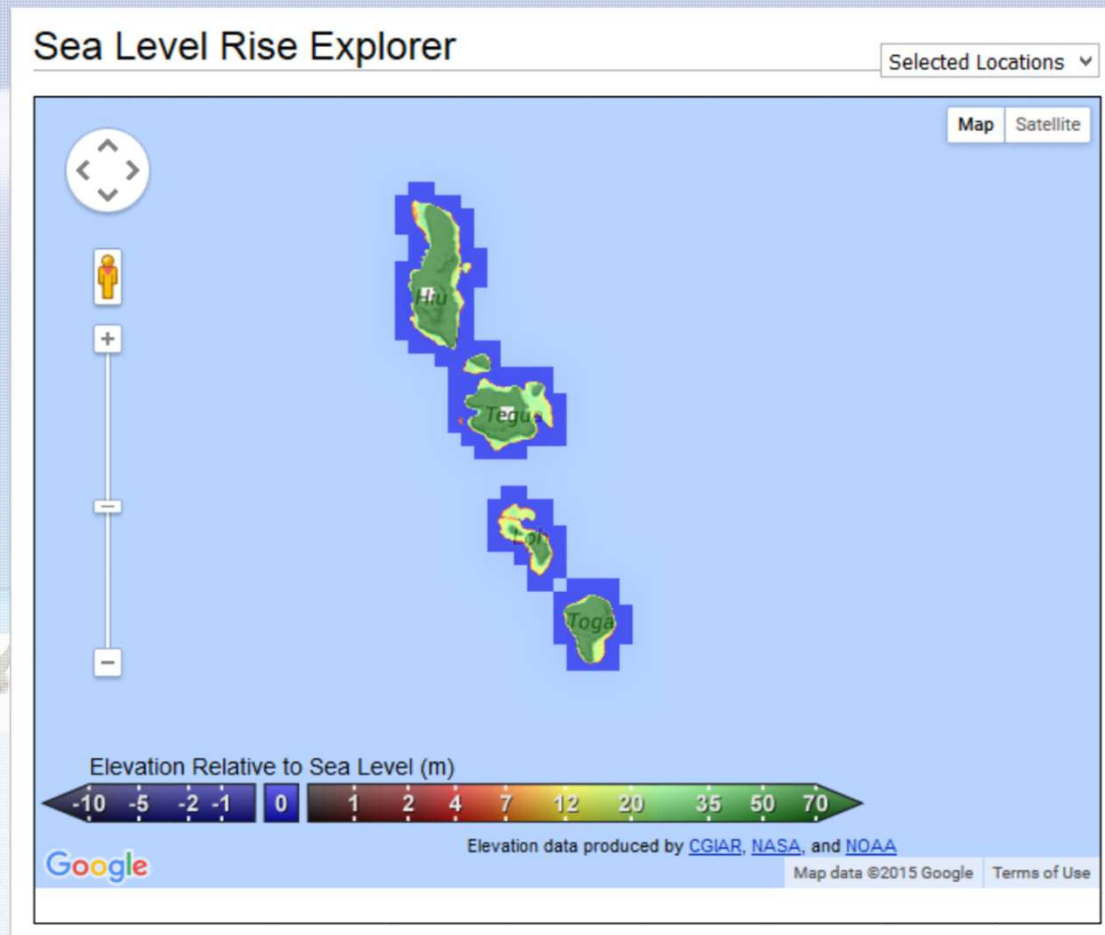


- **King tide** is a colloquial term for an especially high tide. "**King tide**" is not a scientific term, nor is it used in a scientific context.
- **Waves peaked at 2.87 metres!**



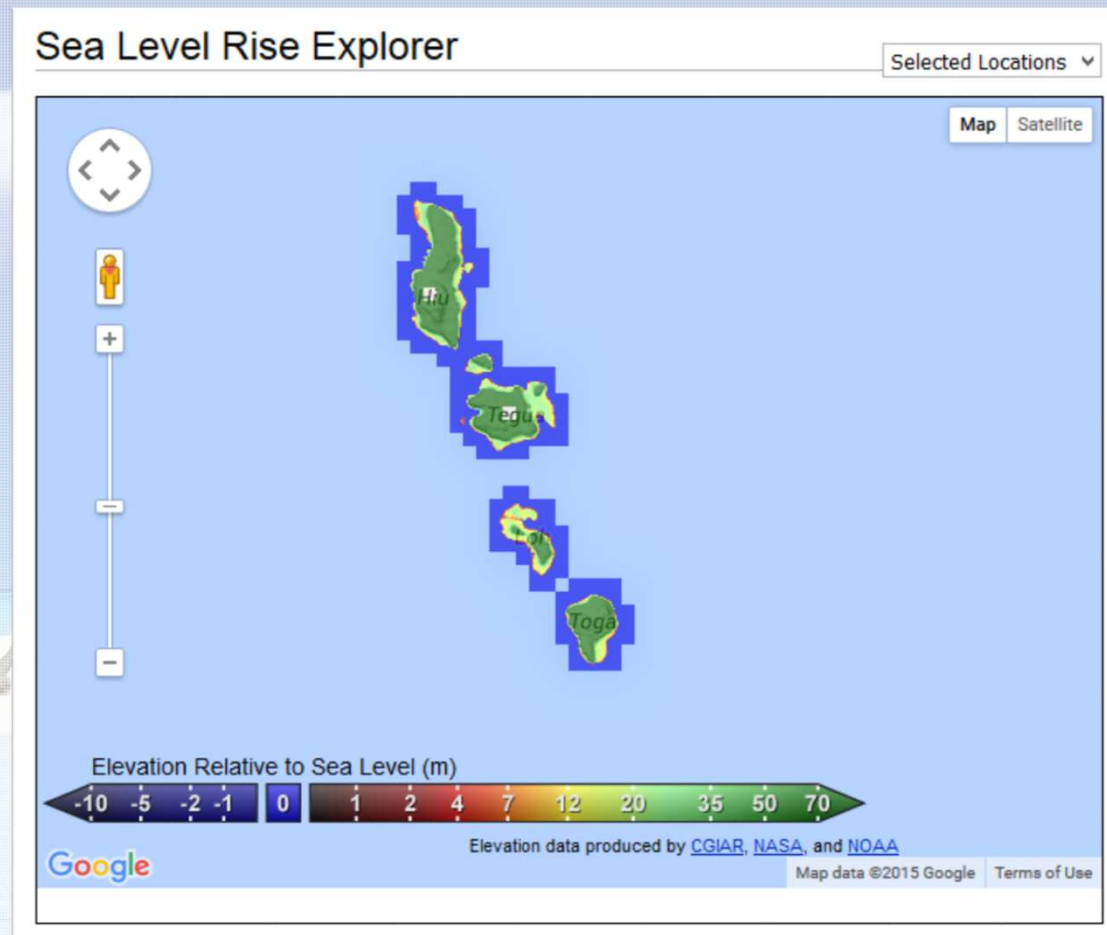
Case Study: Tuvalu

- The threat of sea level rise may bring complete disaster to the 11,000 Tuvaluans currently residing on nine extremely low-lying coral atolls with its entire population having to **relocate to other countries** over the next few decades.
- *Assistant Secretary for Foreign Affairs in Tuvalu, Paani Laupepa made it clear that “we feel threatened, our whole culture would have to be transplanted”*
- Already, warmer ocean temperatures are eating away at the coral reefs that form Tuvalu's archipelagic spine.
- Tuvaluans themselves point to more tangible indicators of trouble:
 - "king tides" that increasingly inundate their homes
 - the briny water oozing up into the "grow pits" where they used to cultivate taro and other vegetables.



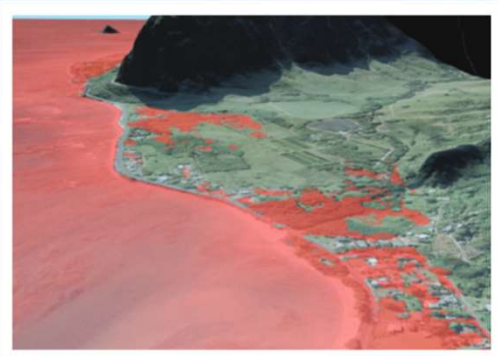
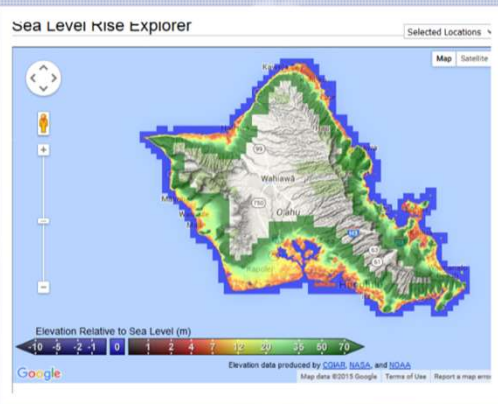
The Case of Tegua, Vanuatu

- A small community living in the Pacific island chain of Vanuatu has become one **of first to be formally moved** as a result of climate change.
- The community has been relocated **higher into the interior** of Tegua Island after their coastal homes were repeatedly swamped by storm surges and waves.



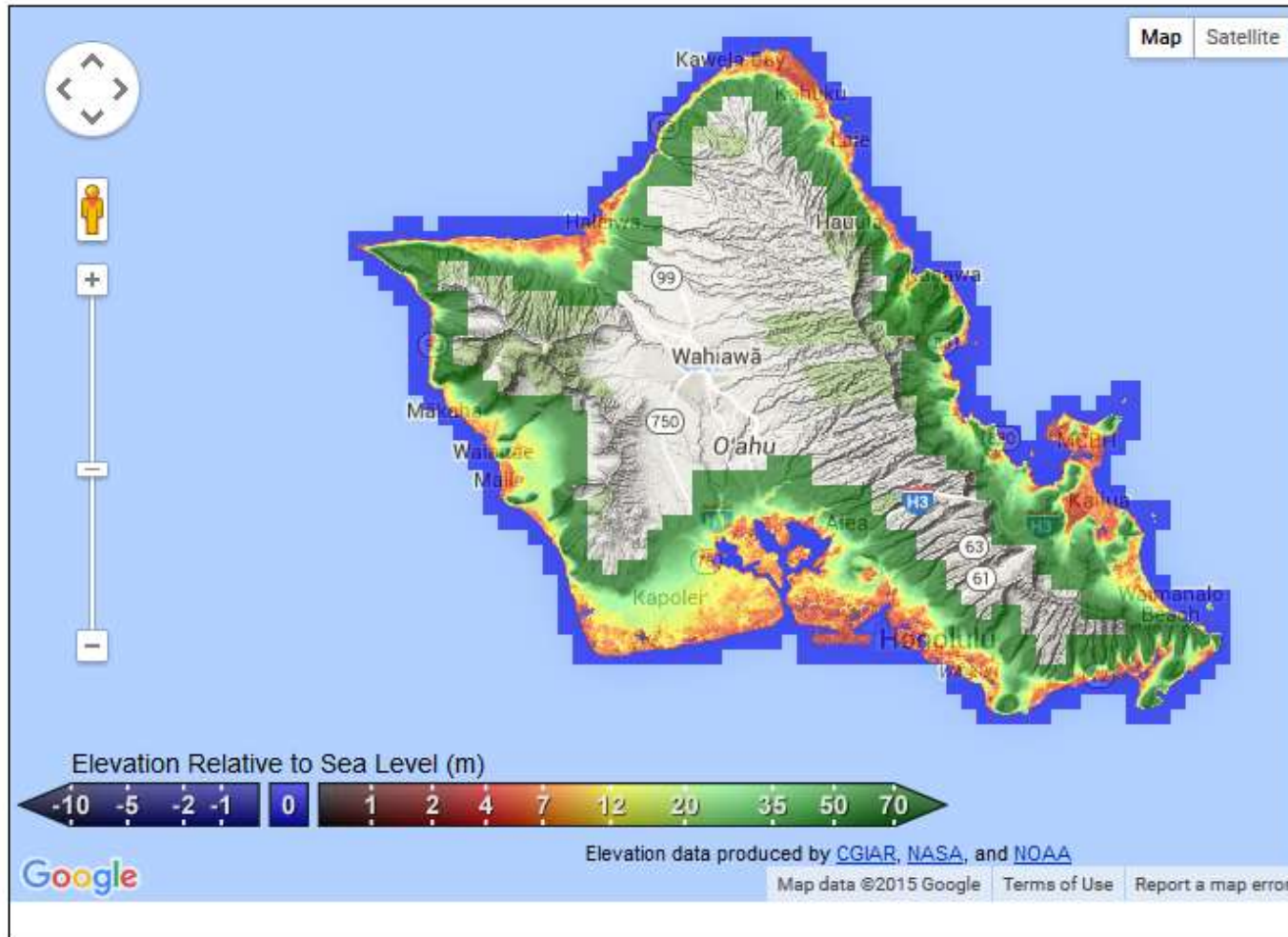
Sea-Level Rise Impacts in Hawai'i

- Sea-level rise can intensify the effects of **coastal hazards** and processes by making areas more **vulnerable** to:
 - Wave inundation
 - Hurricanes
 - Tsunamis
 - More frequent and extreme high water events.
- Long-term sea-level rise will **exacerbate chronic coastal erosion, flooding, and drainage problems**.
- **Water table levels are closely tied to sea level**
 - As sea levels rise, groundwater may break through land surface under roads, buildings and houses.
 - High water tables also prevent rainwater from filtering into the ground.
 - Compounded with high tides, heavy rains, and high surf, high water tables may lead to large-scale inundation of low-lying areas and roads.
- As sea levels rise and shorelines erode, **coastal land may be permanently lost**



Sea Level Rise Explorer

Selected Locations ▾

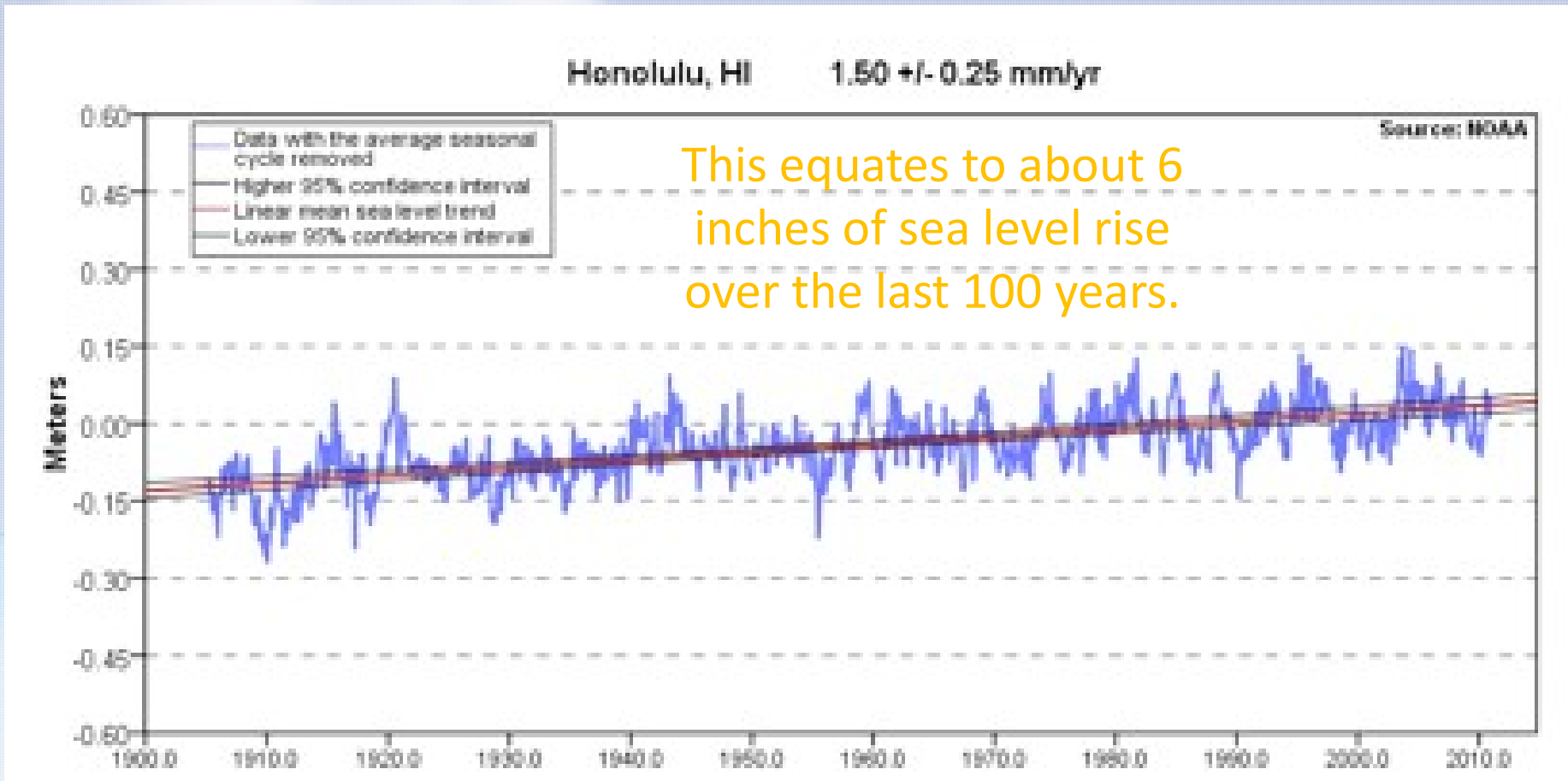


Vulnerable Areas on Oahu

- Red means more likely to see an impact from rising seas!!
- Notice that the majority of the coastline, Honolulu, and the Airport are red.
- Remember it's not just the sea level rise that's important you need to consider the tides, wave heights, storm surges, etc.

<http://www.globalwarmingart.com/wiki/Special:SeaLevel>

Honolulu – Sea Level 1900-2010

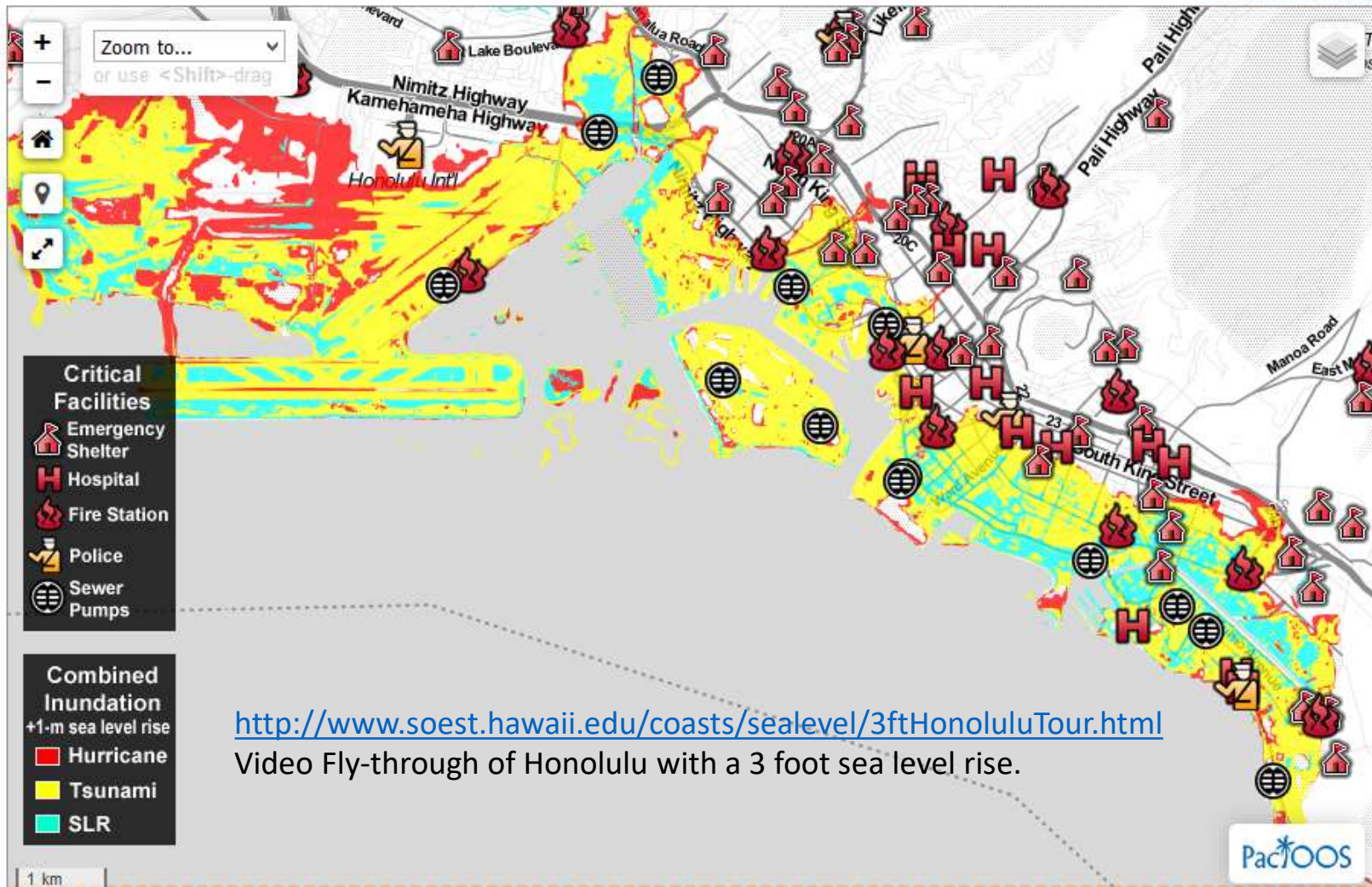


Sea Level Rise Inundation Risk

Honolulu, Hawai'i

<http://oos.soest.hawaii.edu/pacioos/projects/slr/>

[view full-screen map](#)



<http://www.soest.hawaii.edu/coasts/sealevel/3ftHonoluluTour.html>

Video Fly-through of Honolulu with a 3 foot sea level rise.

Honolulu – 3 Feet Rise in Sea Level



Sea-Level Rise Adaptation in the Future?

There is irrefutable evidence that global warming is real and occurring at an alarming rate. As the planet warms over the next fifty years, sea levels are rising, impacting our coastal areas. Hawai'i could also be struck by stronger and more frequent storms because of these changes. Homes, hotels, businesses, harbors and waterfront properties are increasingly at risk. We must aggressively address the impact of global warming and rising sea levels for our island state. Our state has some of the best scholars and researchers in the world housed at the University of Hawai'i. We must take advantage of their expertise and ensure that we are prepared to address the realities of climate change.

Hawai'i 2050 Sustainability Plan.³¹



Annual high tides, such as this one at Waikīkī Beach in 2009, will become more frequent as sea level rises. Credit: Chris Conger, University of Hawai'i Sea Grant College Program

- **Three basic approaches to sea-level rise adaptation have been identified:**
 - **Accommodation** – Adjustment of an existing system to changing natural conditions (e.g., strengthening flood-proofing regulations or expanding hazard zones).
 - **Protection** – Hardening of a system in its existing location to withstand impacts from changing conditions (e.g., shoreline hardening such as seawalls and revetments).
 - **Retreat** – Relocating existing structures to avoid impacts.

Challenges to Adaptation and Implementation

- **Four major obstacles to long-term sea-level rise adaptation planning:**
 - **Government and public resistance** – Resistance to acknowledging sea-level rise (i.e., skepticism concerning human-caused climate change)
 - **Limited effectiveness of resource management** – to address a “slowly emerging disaster” (e.g., overlapping state and county regulatory jurisdictions, irregularities in the law, and political resistance and legal challenges)
 - **Environmental and social justice concerns** – equitable allocation of protection measures for varying degrees and types of shoreline development
 - **Government incentives** – these can shield property owners from the risks of their decisions (e.g., FEMA policies and flood insurance programs that incentivize rebuilding in vulnerable areas.

