

PANEL 2

**Paddling Together to Accelerate Action
for Adaptation to Sea Level Rise**

NEW RESEARCH IN

Physical Sciences

Social Sciences

Climate-change-driven accelerated sea-level rise detected in the altimeter era

R. S. Nerem, B. D. Beckley, J. T. Fasullo, B. D. Hamlington, D. Masters, and G. T. Mitchum

PNAS published ahead of print February 12, 2018 <https://doi.org/10.1073/pnas.1717312115>

Edited by Anny Cazenave, Centre National d'Etudes Spatiales, Toulouse, France, and approved January 9, 2018 (received for review October 2, 2017)

Article

Figures & SI

Authors & Info

PDF

Significance

Satellite altimetry has shown that global mean sea level has been rising at a rate of -3 ± 0.4 mm/y since 1993. Using the altimeter record coupled with careful consideration of interannual and decadal variability as well as potential instrument errors, we show that this rate is accelerating at 0.084 ± 0.025 mm/y², which agrees well with climate model projections. If sea level continues to change at this rate and acceleration, sea-level rise by 2100 (-65 cm) will be more than double the amount if the rate was constant at 3 mm/y.

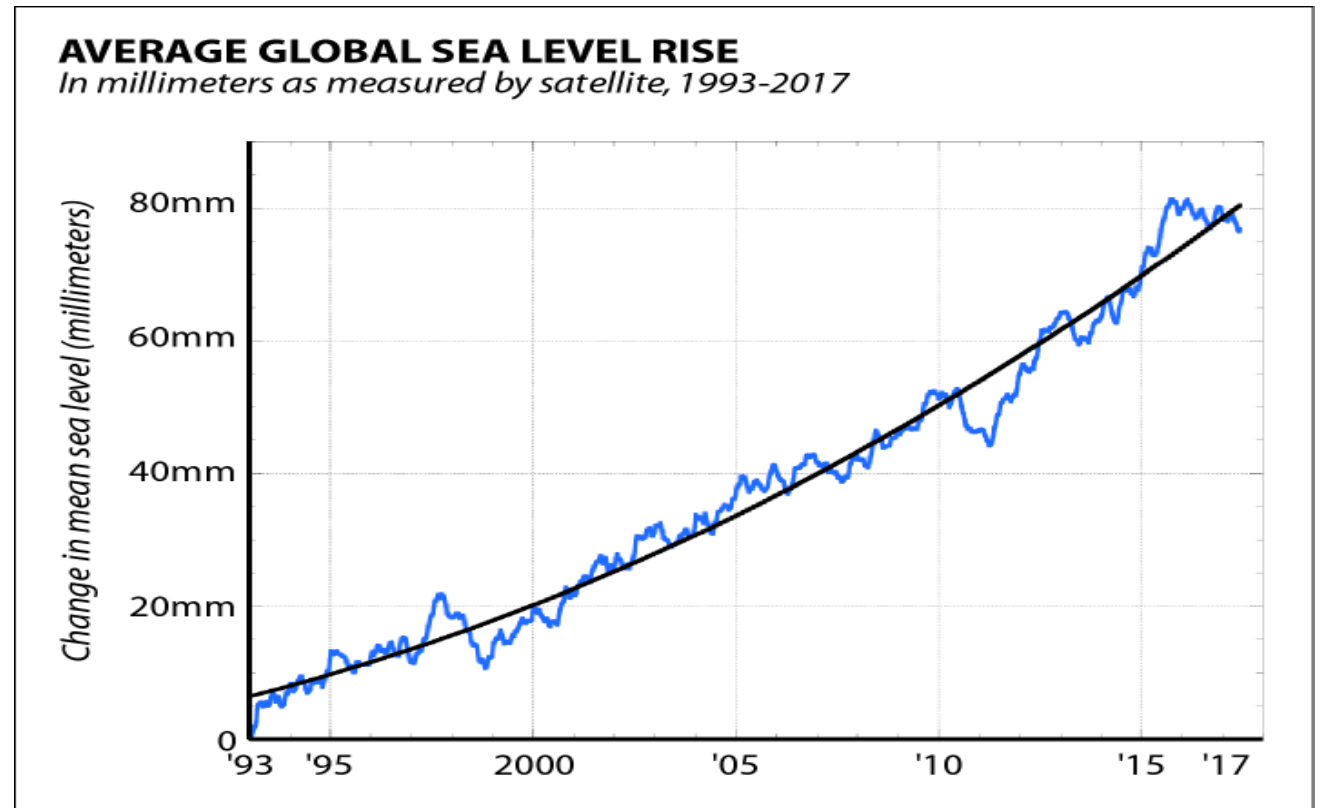
Abstract

Using a 25-y time series of precision satellite altimeter data from TOPEX/Poseidon, Jason-1, Jason-2, and Jason-3, we estimate the climate-change-driven acceleration of global mean sea level over the last 25 y to be 0.084 ± 0.025 mm/y². Coupled with the average climate-change-driven rate of sea level rise over these same 25 y of 2.9 mm/y, simple extrapolation of the quadratic implies global mean sea level could rise 65 ± 12 cm by 2100 compared with 2005, roughly in agreement with the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) model projections.

[sea level](#) [acceleration](#) [climate change](#) [satellite altimetry](#)

Satellite altimeter data collected since 1993 have measured a rise in global mean sea level

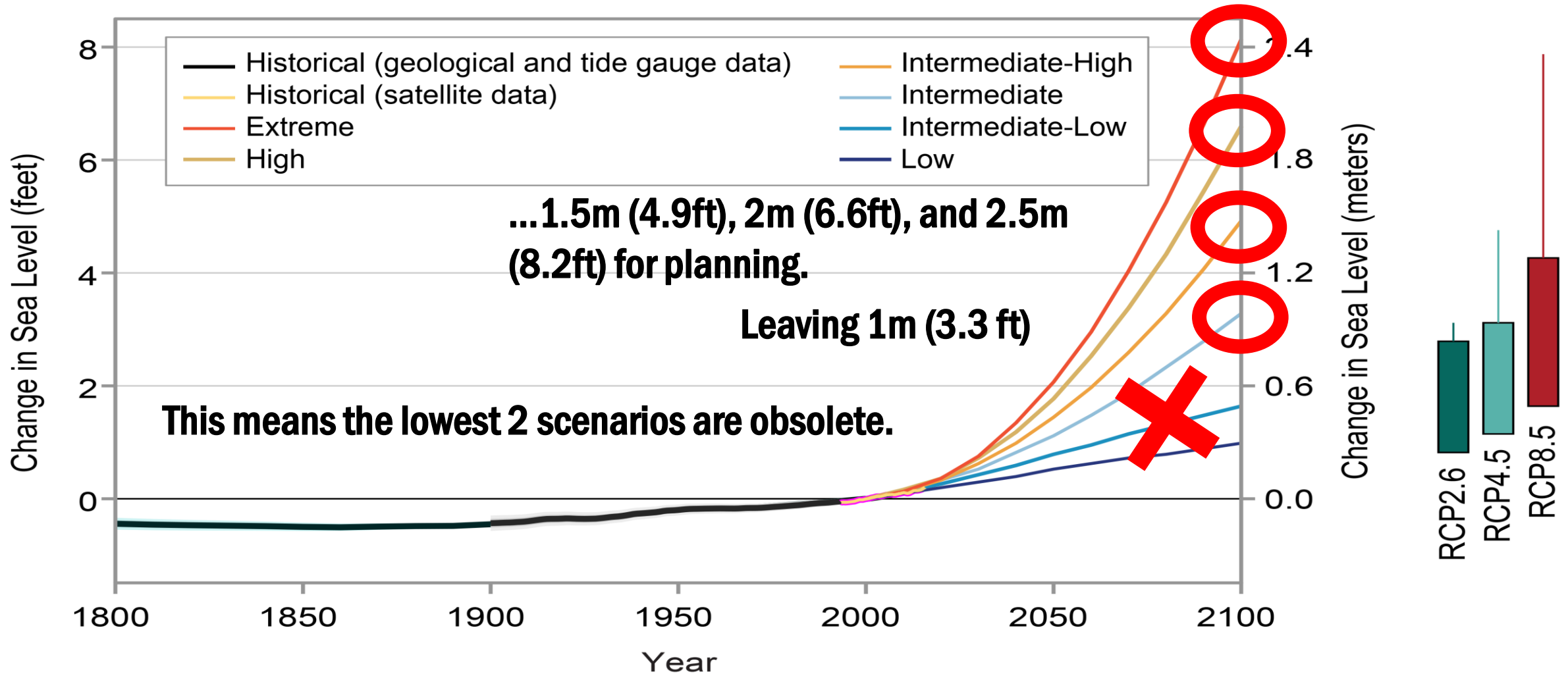
- We know SLR is accelerating
- = 65cm (2.1ft) by 2100
- In line with models that do not account for rapid melting.



SOURCE: Steve Nerem/University of Colorado, Boulder

InsideClimate News

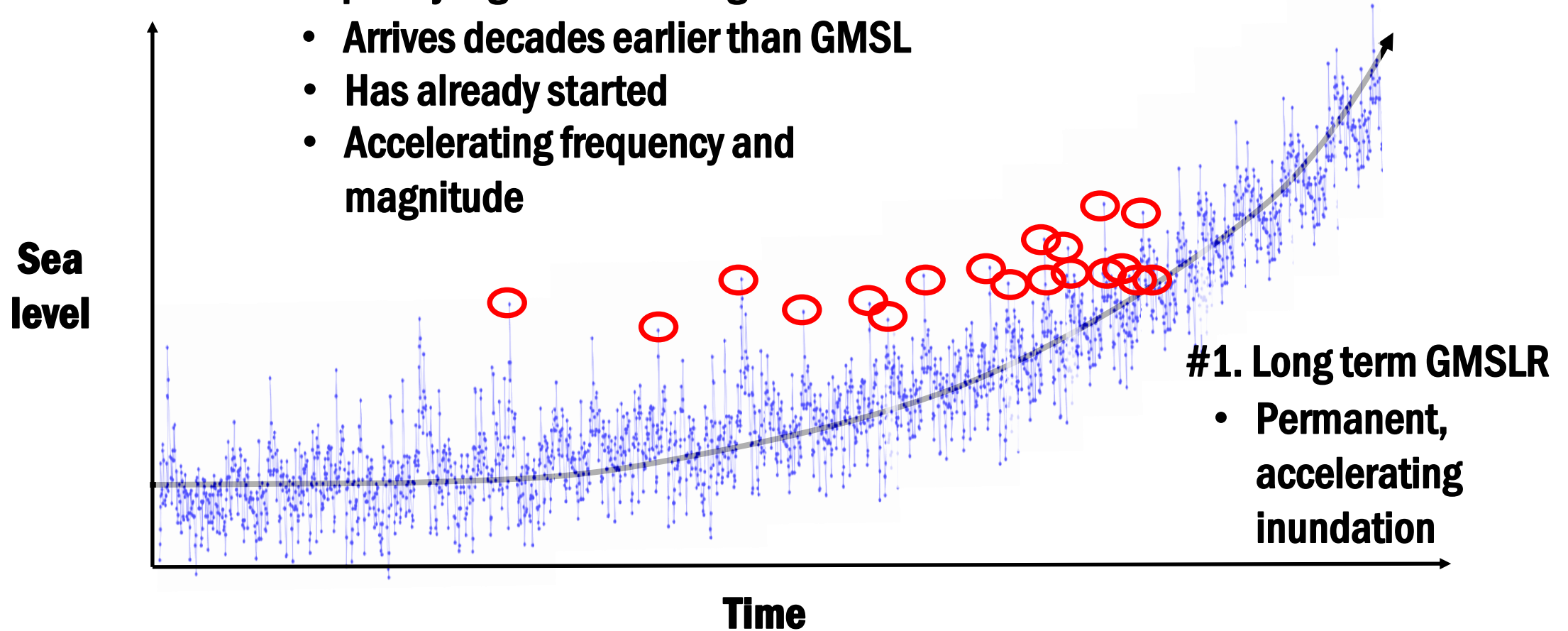
NOAA & 4th NCA SL Scenarios



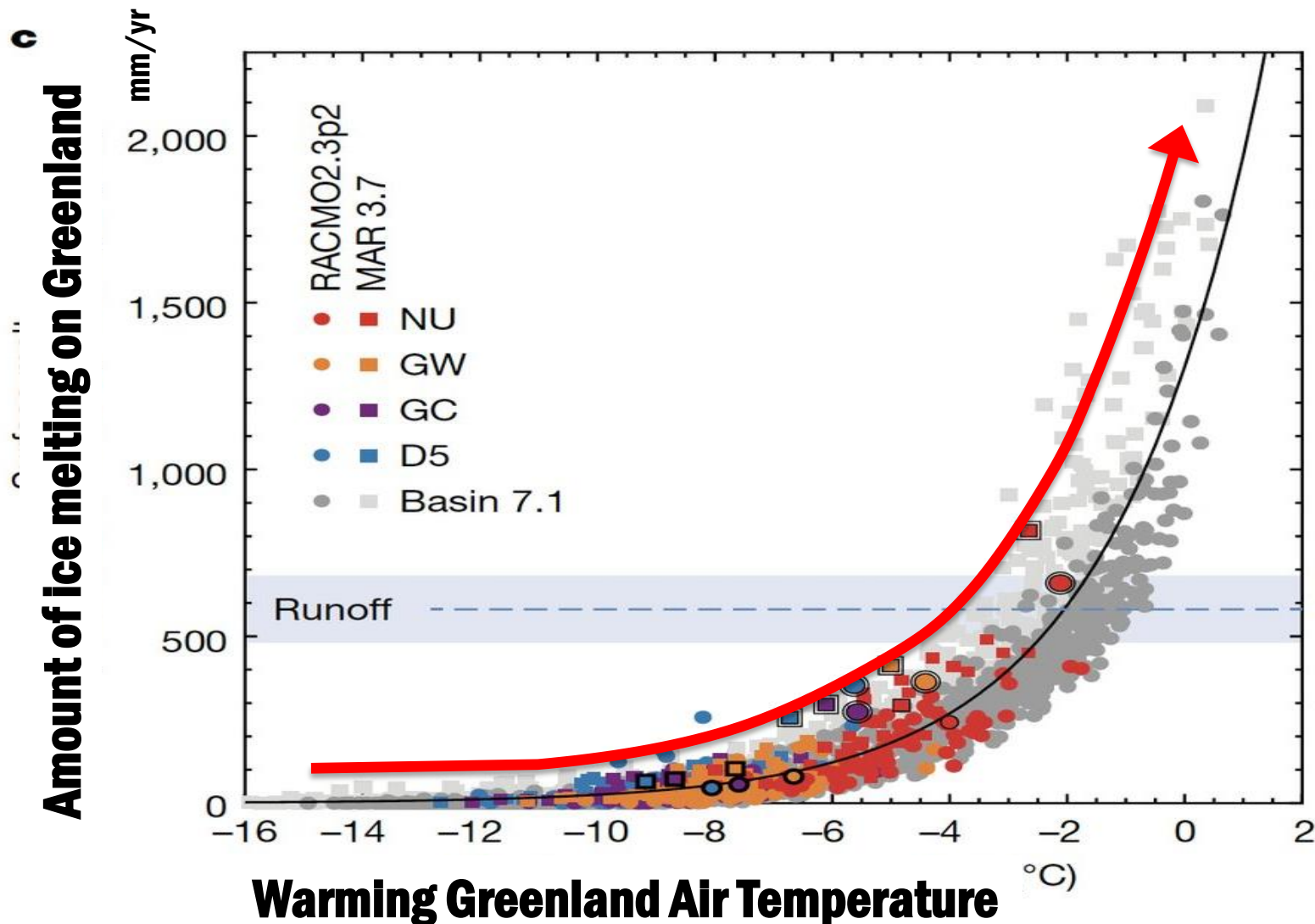
Sea Level Floods Communities in 2 Styles

#2. Temporary high tide flooding

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



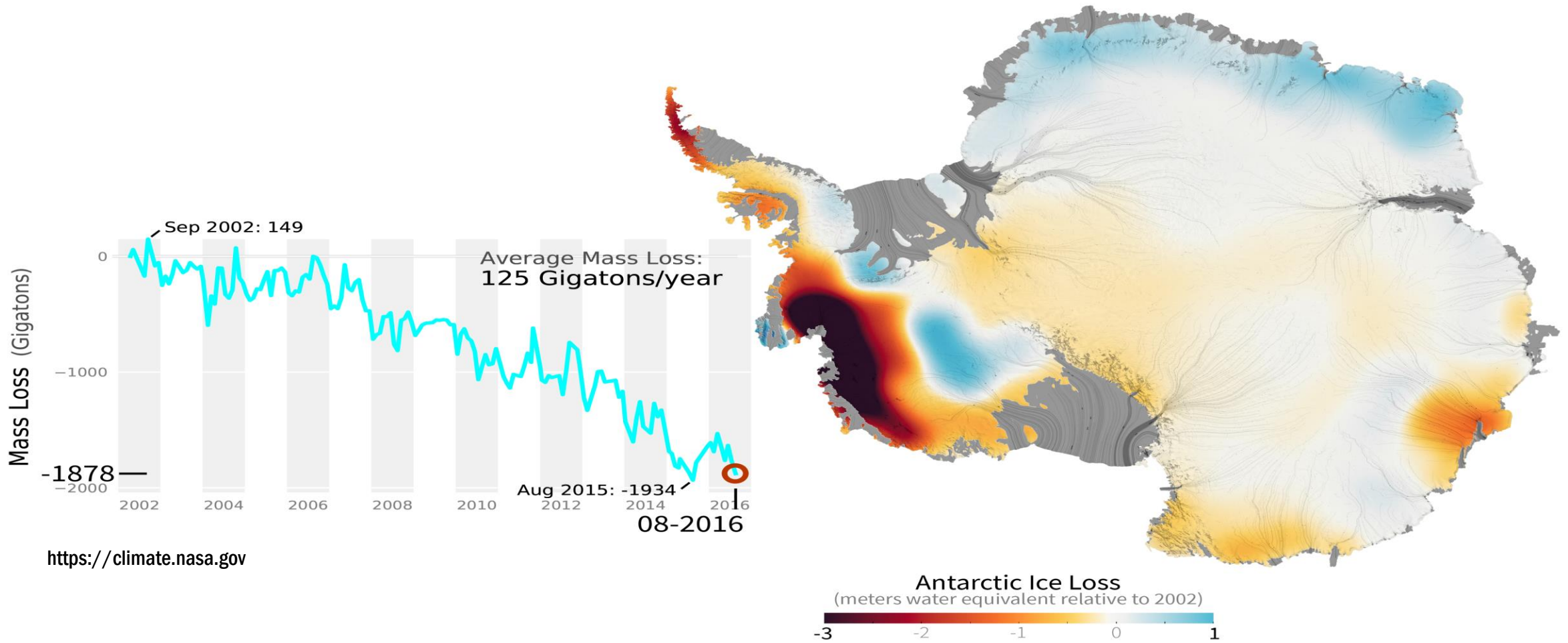
Greenland is Exponentially Melting



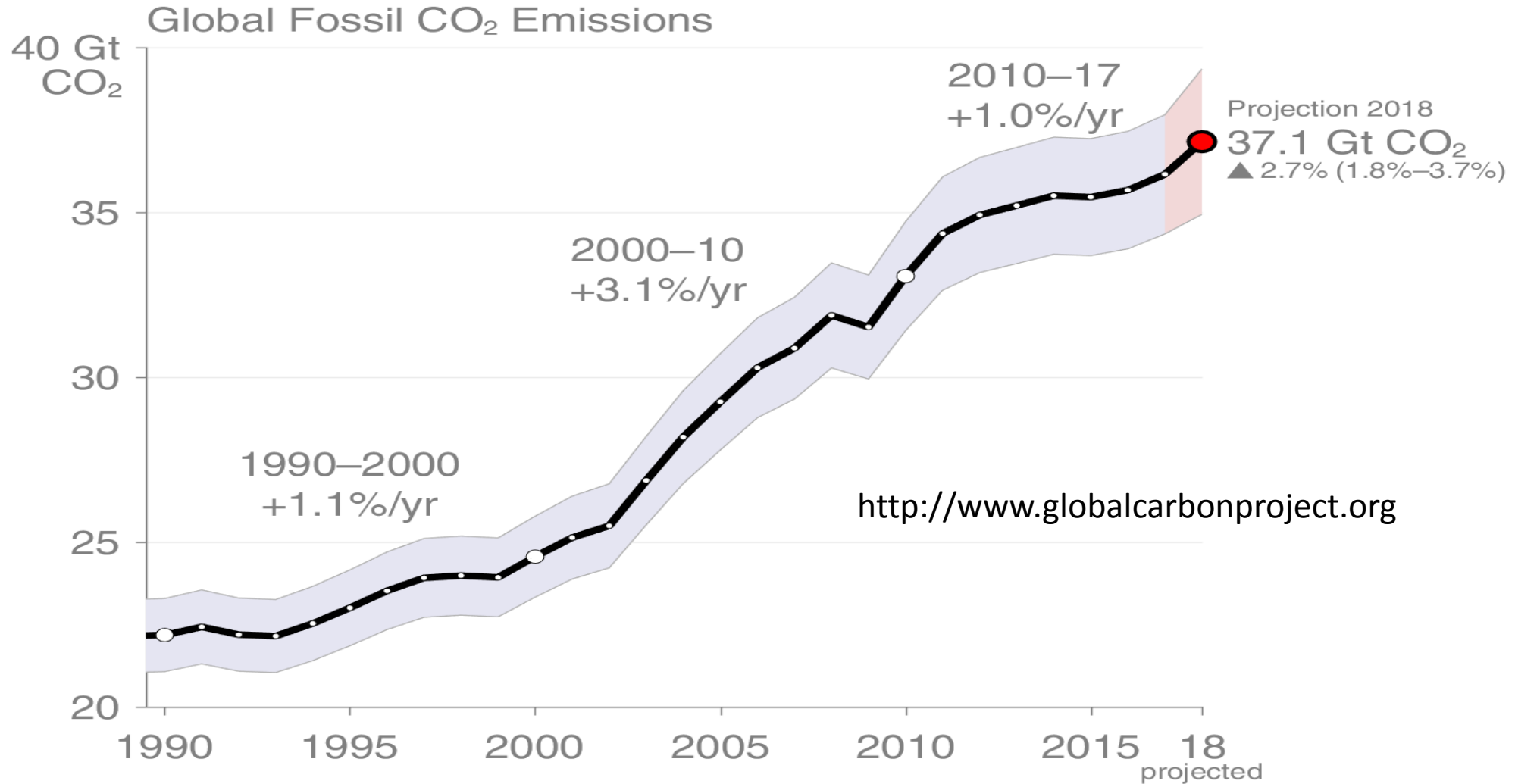
Melting 50% more than pre-industrial

33% more than 20th century

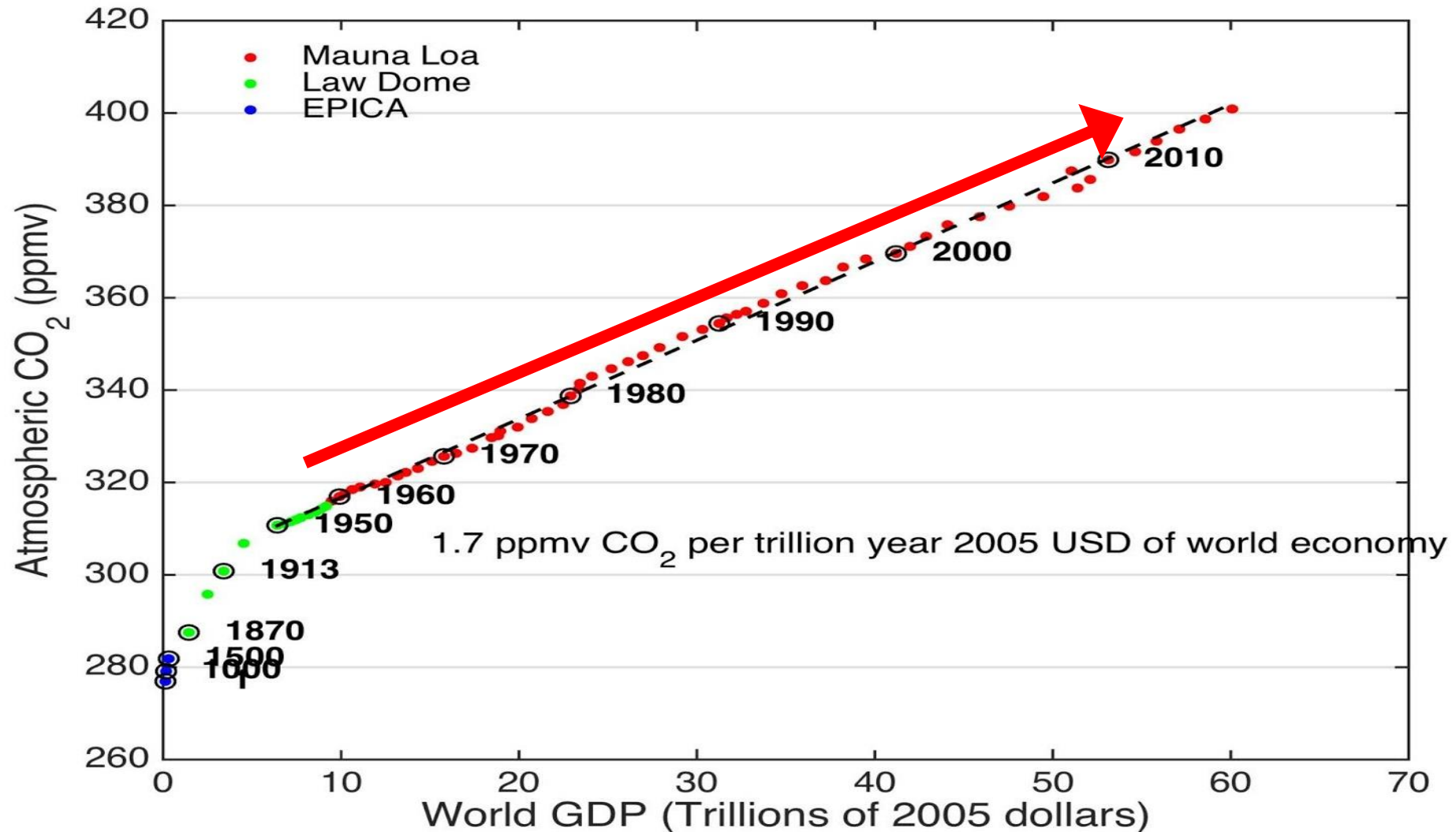
Antarctic Ice Melt has 'Tripled Over the Past Five Years'



Carbon Dioxide Emissions Have Risen 3 yrs in a Row



Emissions Follow World GDP, +130% by 2050



Price Waterhouse Consultants (PwC) <https://www.pwc.com/gx/en/issues/economy/the-world-in-2050.html>



World Energy Outlook

The gold standard of energy analysis

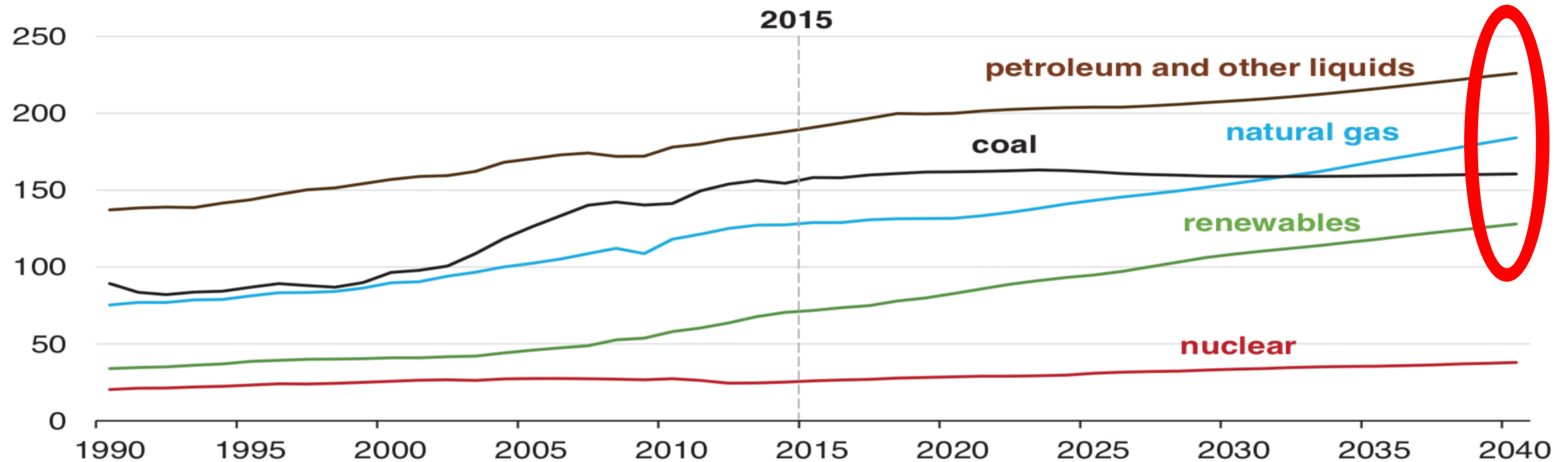
Explore WEO 2018

- Energy demand set to grow >25% by 2040
- Renewables make up only two-thirds of new capacity
- Oil consumption grows due to rising demand for petrochemicals, trucking, aviation, energy (India, China, other developing nations)
- CO₂ emissions increase to mid-century

U.S. Energy Information Administration

Energy Consumption increases to 2040 for all fuels but coal

World energy consumption by energy source
quadrillion Btu



Data: CDIAC/GCP/IPCC/Fuss et al 2014

Emissions from fossil fuels and cement (GtCO₂/yr)

Scenario categories

- >1000 ppm CO₂eq
- 720–1000 ppm
- 580–720 ppm
- 480–580 ppm
- 430–480 ppm

RCP8.5
3.2–5.4°C
relative to 1850–1900

3-4°C

RCP6
2.0–3.7°C

RCP4.5
1.7–3.2°C

RCP2.6
0.9–2.3°C

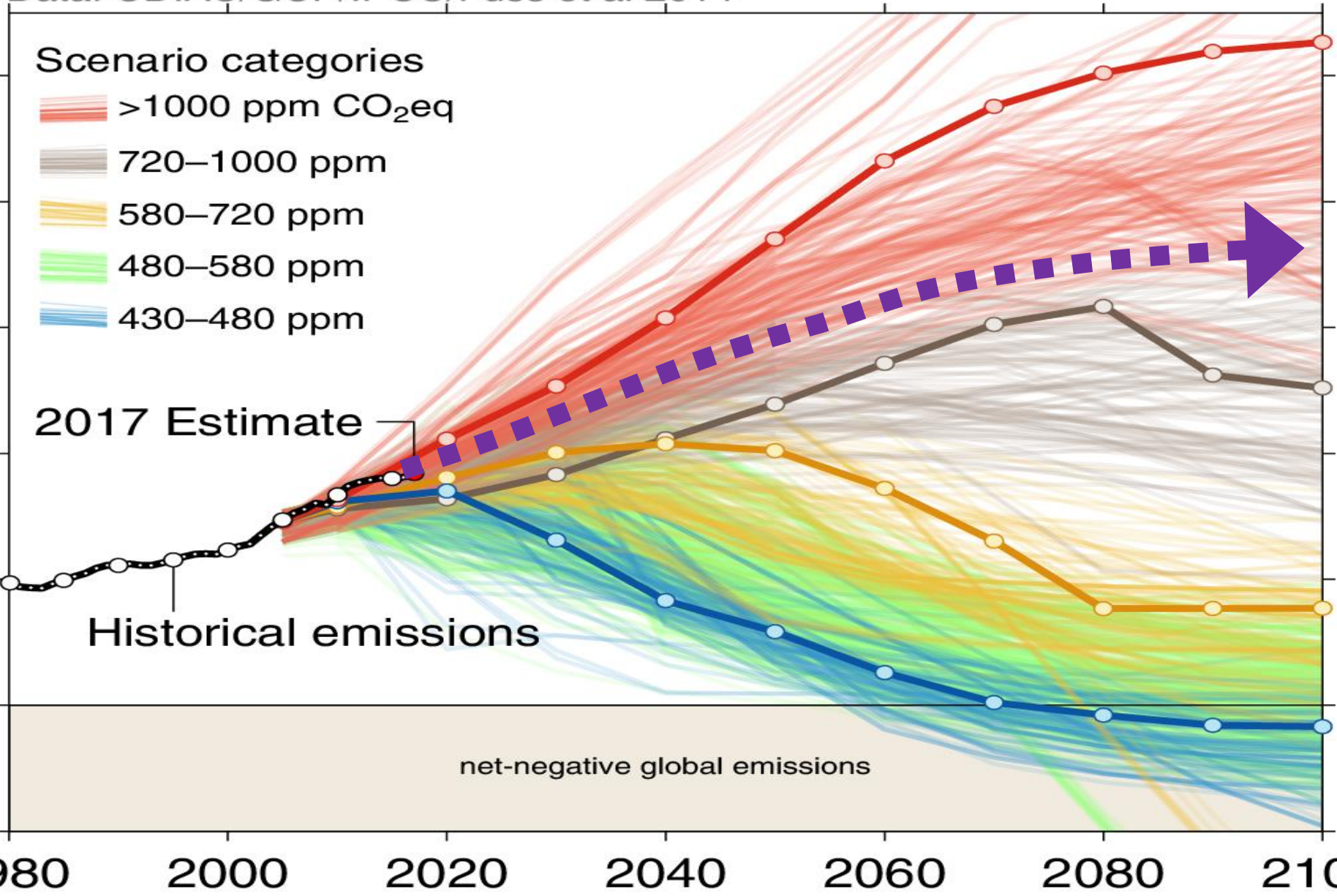
2017 Estimate

Historical emissions

net-negative global emissions

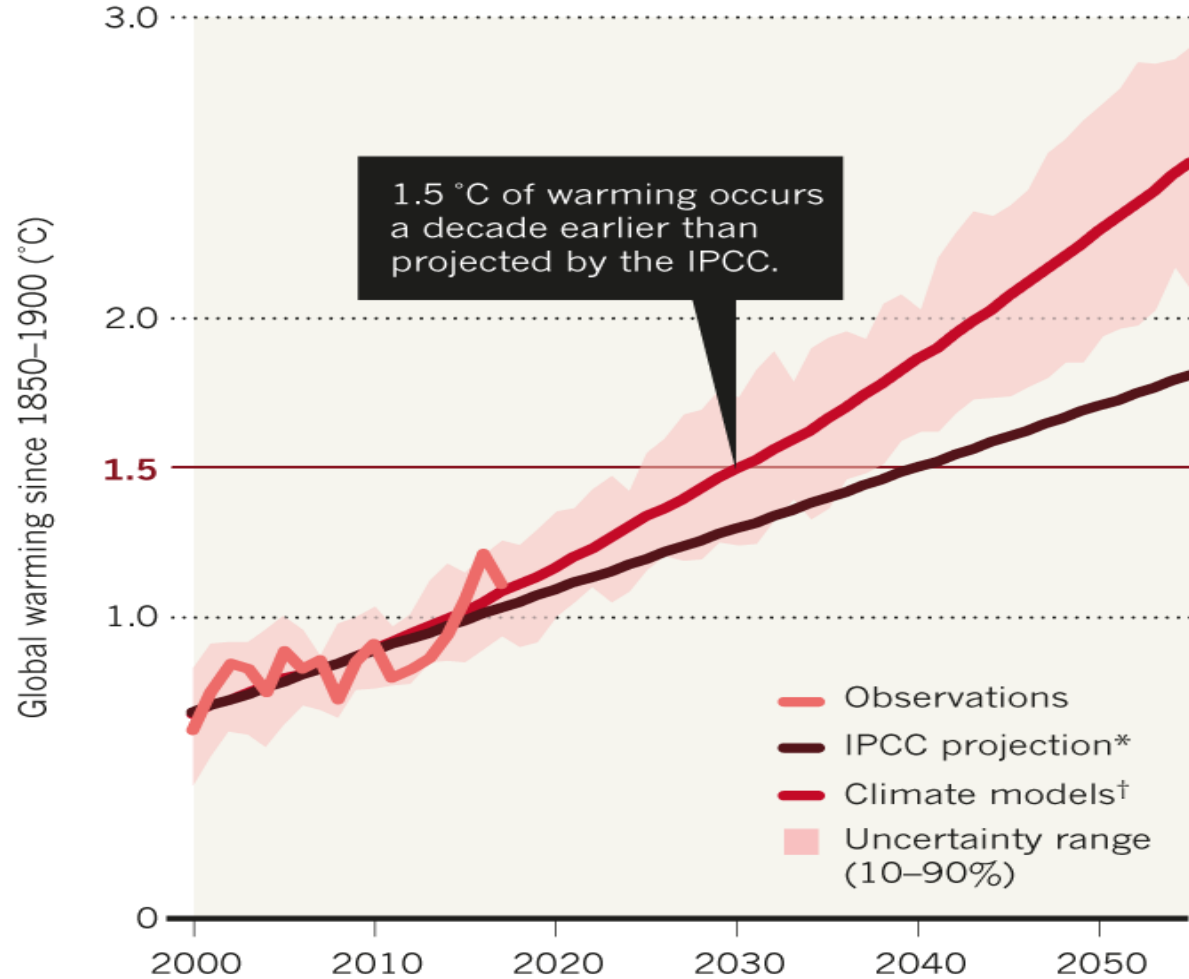
100
80
60
40
20
0
-20

1980 2000 2020 2040 2060 2080 2100



ACCELERATED WARMING

Climate simulations predict that global warming will rise exponentially if emissions go unchecked.



*Trend for 2001-15 extended with a constant rate of 0.2 °C per decade, as per IPCC special report. †Ten-year average, 37 climate models for the RCP8.5 scenario (IPCC Fifth Assessment, 2014).

©nature

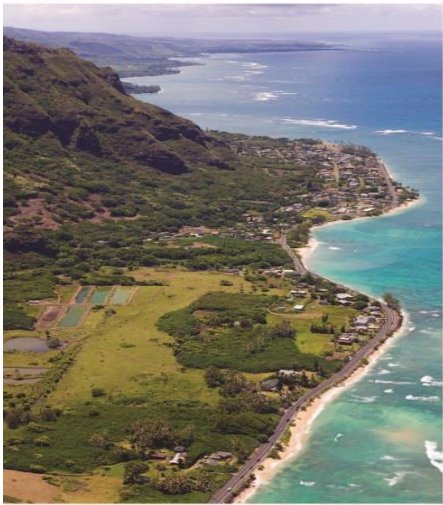
- **Global Warming is Accelerating**
 - Emissions rising
 - Emissions cleaner
 - Decreased ocean circulation
 - Pacific shifting to + IPO
- **Oceans 40% warmer than previously thought**
- **1.5°C by 2030**
- **2.0°C by 2045**

Xu, Y. et al. (2018) Global warming will happen faster than we think, *Nature*, v. 564, Dec. 6

We have built too close to eroding and flood-prone shorelines.



...leaving our communities vulnerable, and damaging coastal environments.



Roads

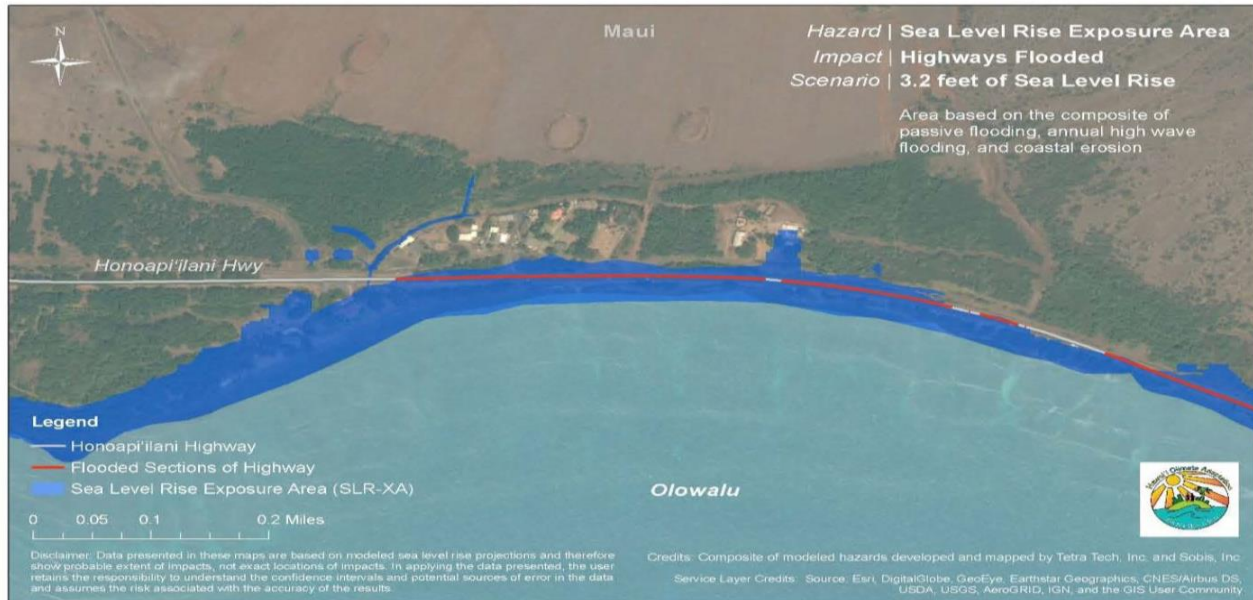
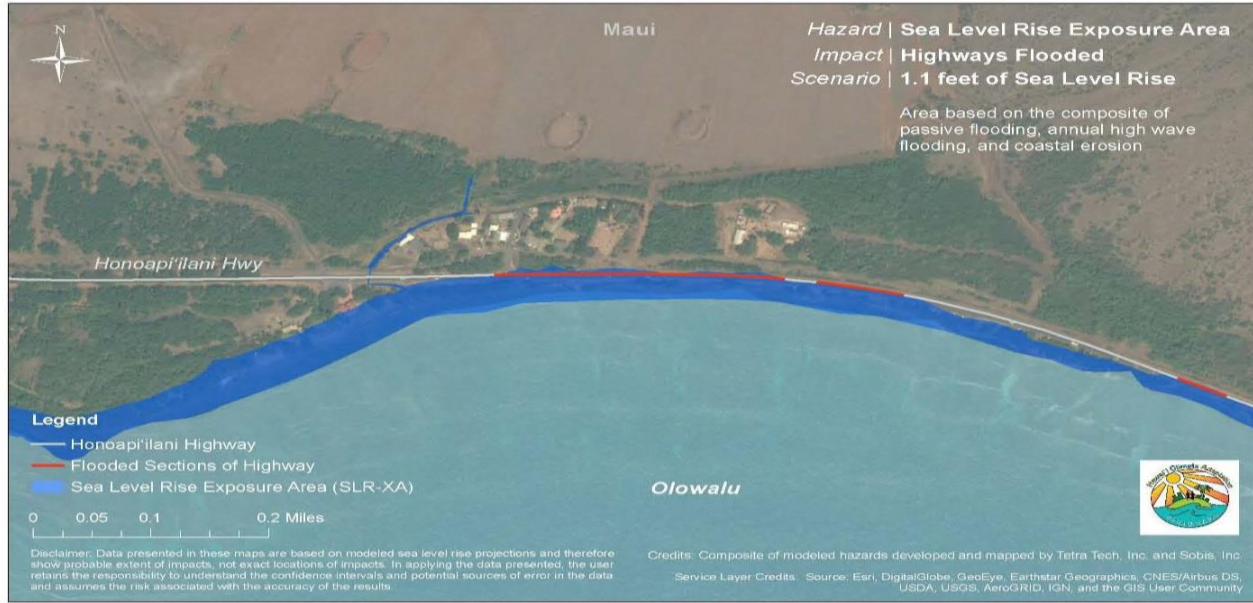


Figure 62. Projected chronic flooding of Honoapi'ilani Highway in the SLR-XA (red) with 1.1 feet (top) and 3.2 feet (bottom) of sea level rise road flood in Olowalu, Maui

Harbors & Airports

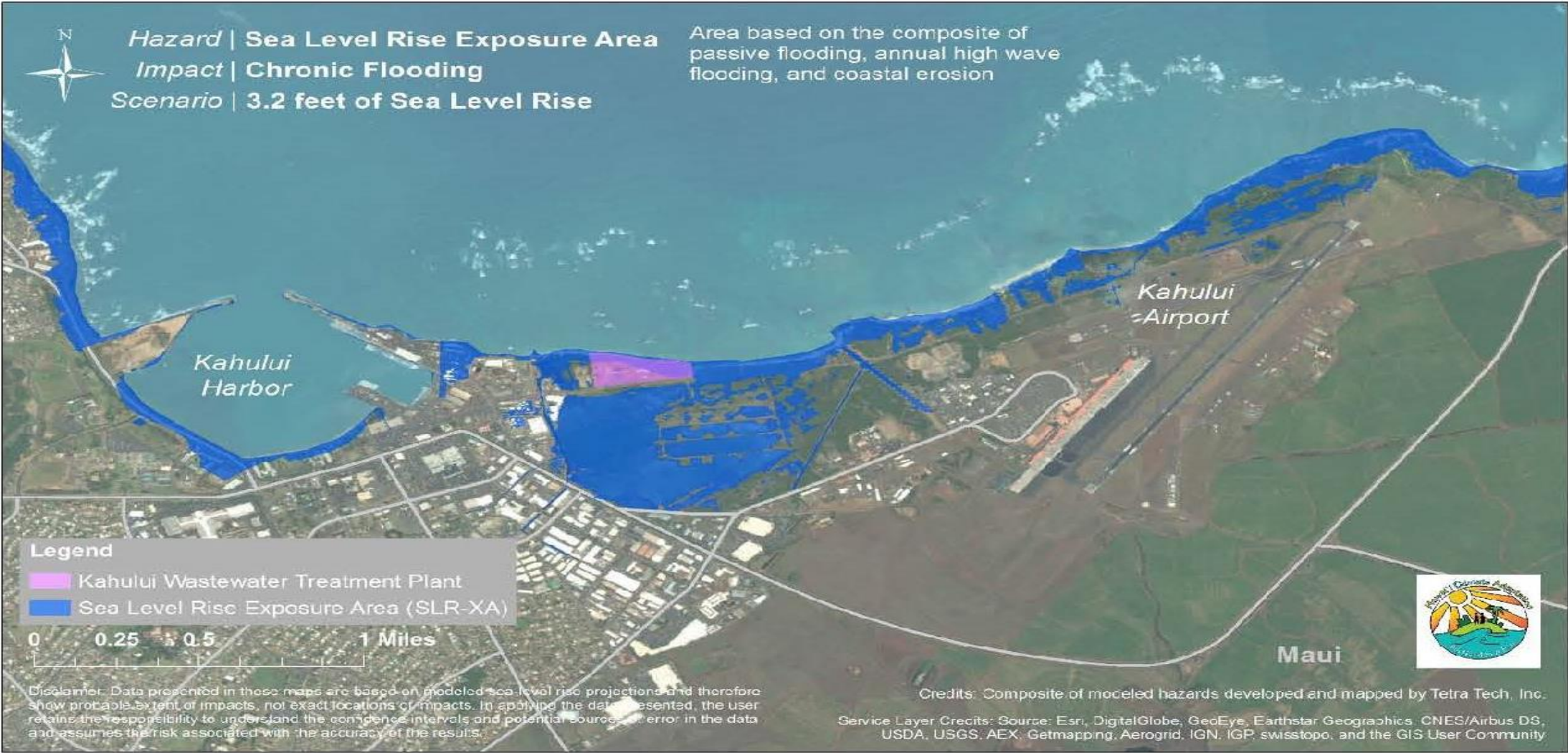


Figure 63. Kahului Harbor and Kahului Airport in the SLR-XA with 3.2 feet of sea level rise on Maui

Hawaiian Home Lands & Cultural Sites

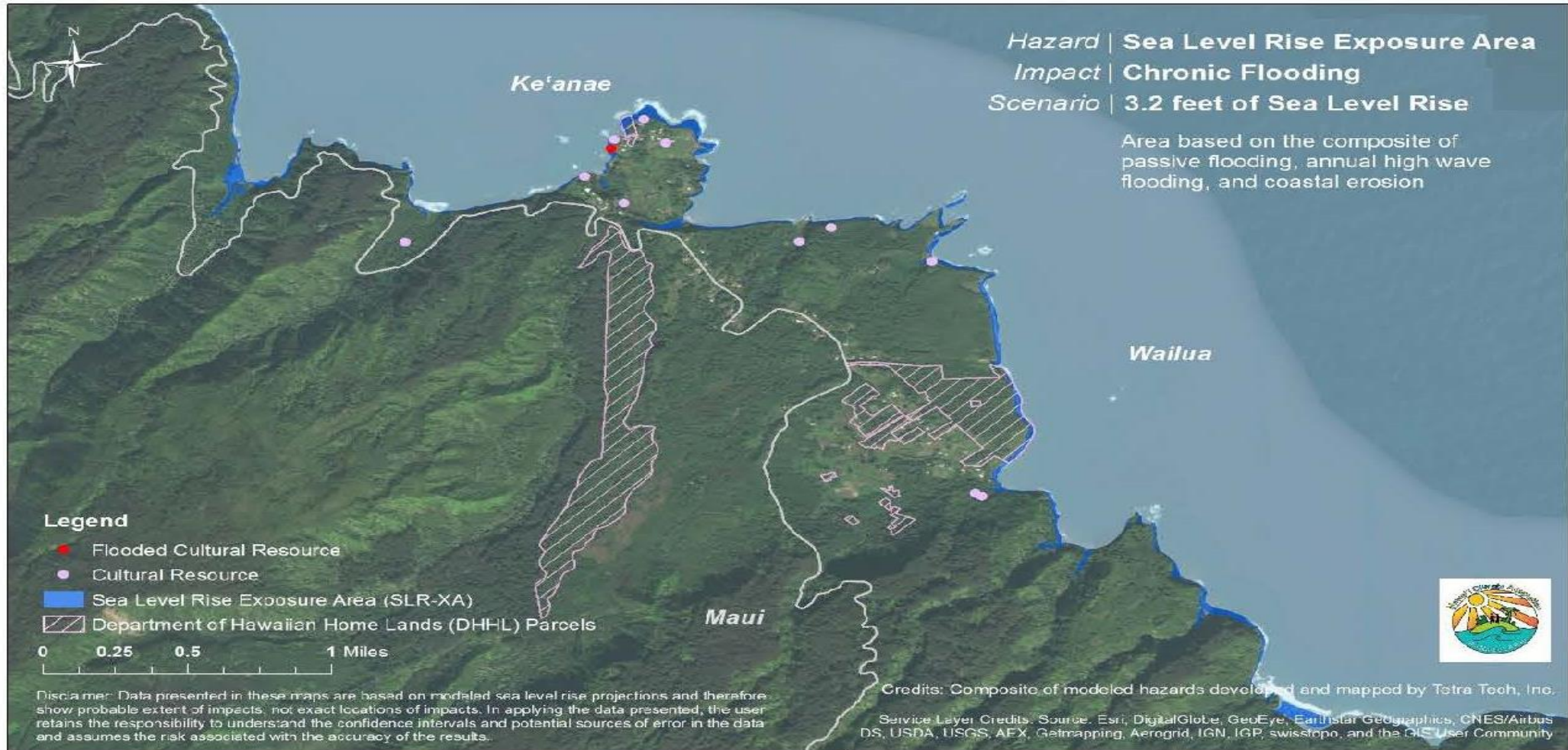


Figure 64. Potential chronic flooding of Ke'anae and Wailua Hawaiian Home Lands on Maui (pink) and cultural resources (red) in the SLR-XA (blue) with 3.2 feet of sea level rise

Parks

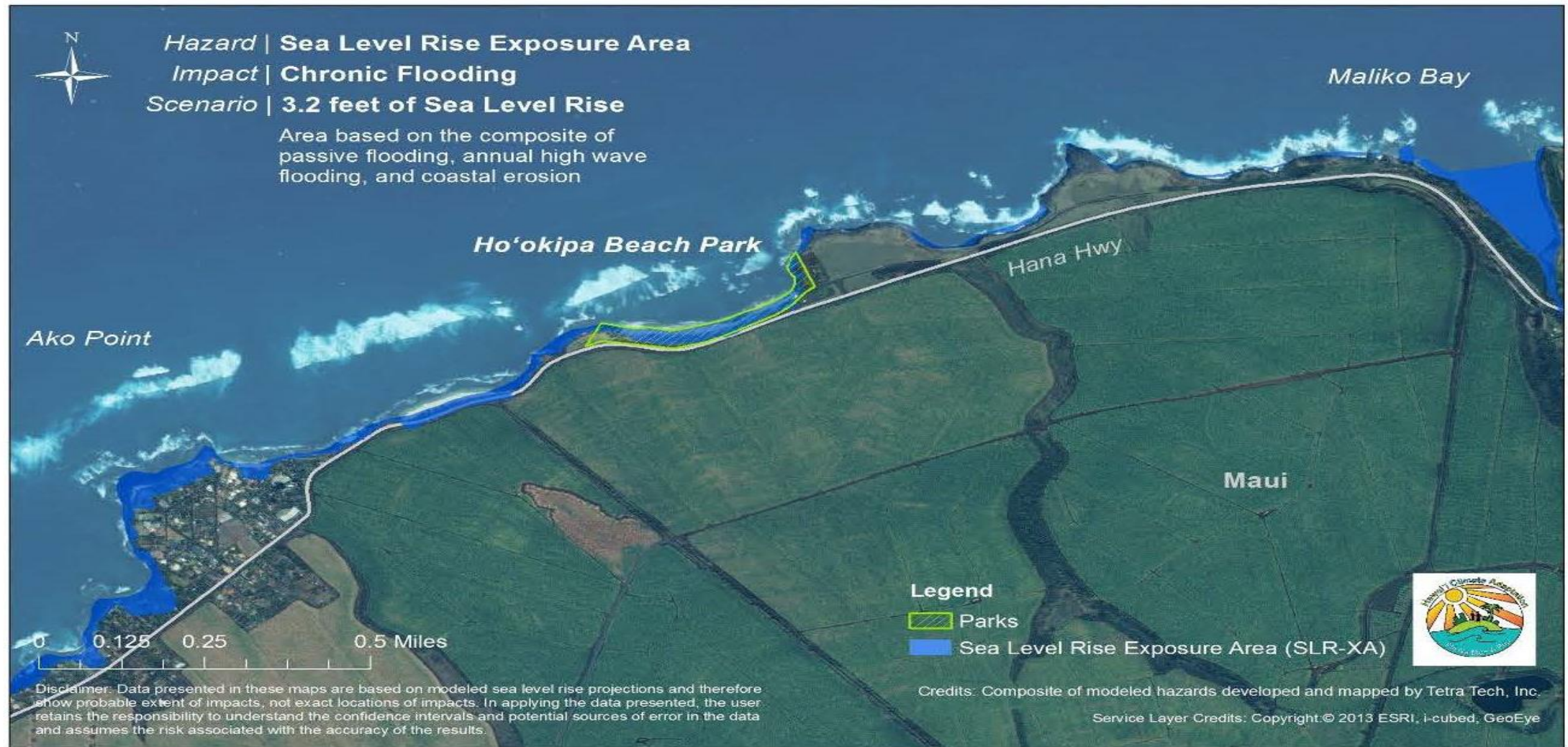


Figure 65. Potential chronic flooding of Ho'okipa Beach Park in the SLR-XA with 3.2 feet of sea level rise along Maliko Bay, Maui

Wildlife Sanctuary



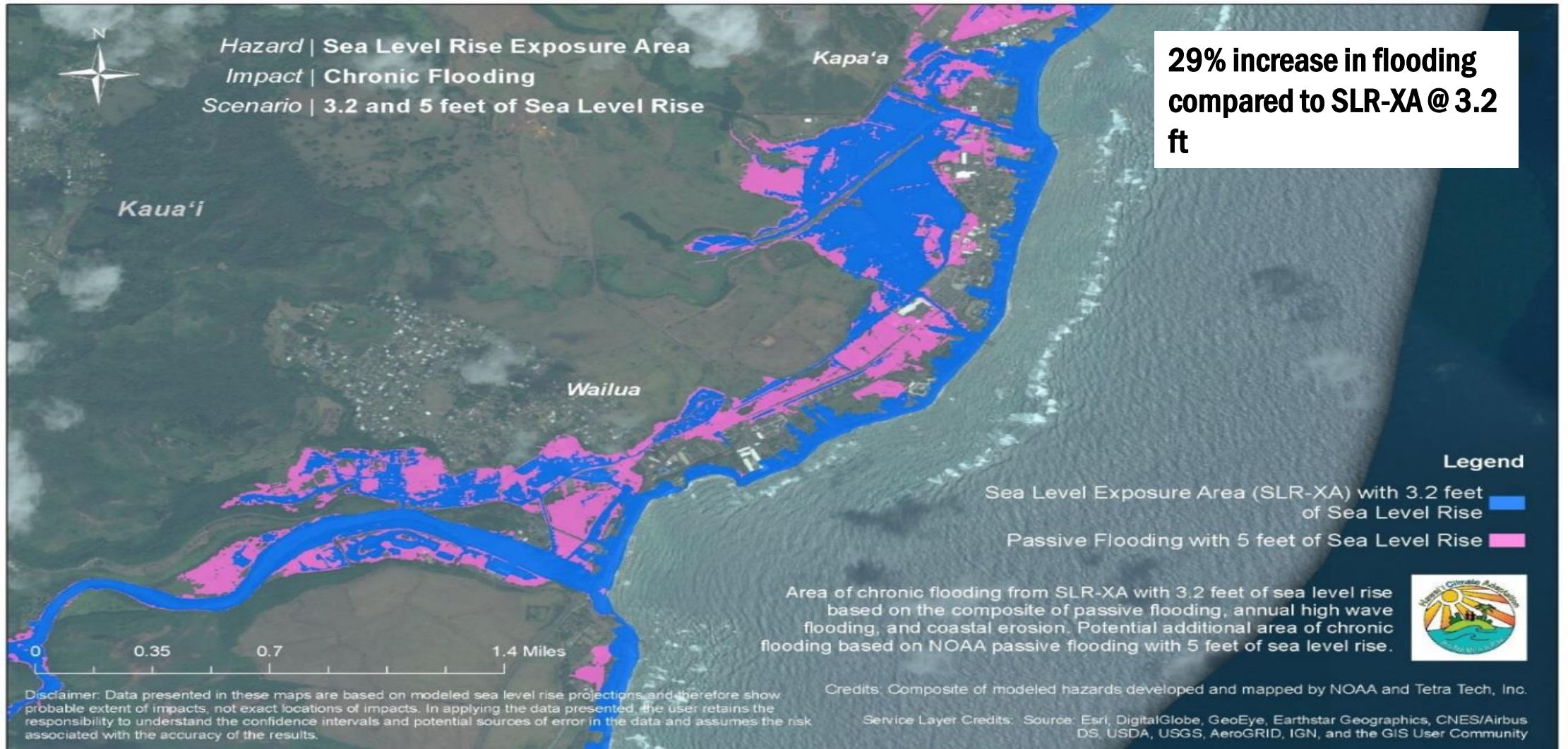
Figure 66. Kanahā Pond State Wildlife Sanctuary in the SLR-XA with 3.2 feet of sea level rise in Kahului, Maui

On-site Sewage Disposal Systems

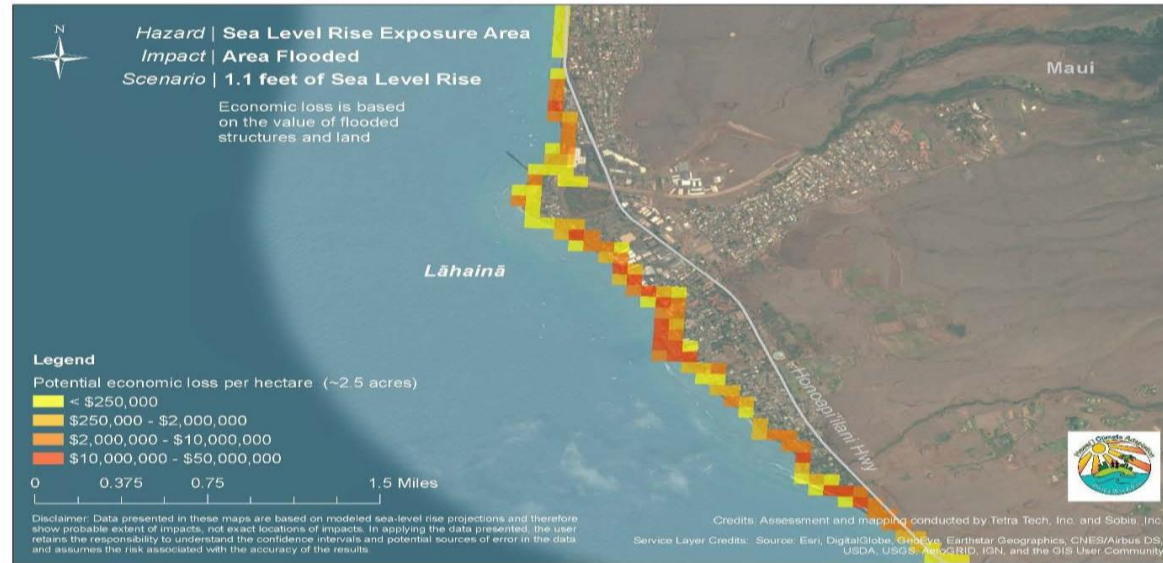


Figure 67. On-site sewage disposal systems flooded in the SLR-XA with 3.2 feet of sea level rise along Mā'alaea, Maui

Comparison of Potential Chronic Flooding with 3.2 & 5 Feet of SLR



Economic Loss



- Parcel based
- Property/structures
- Aggregated into one hectare grids

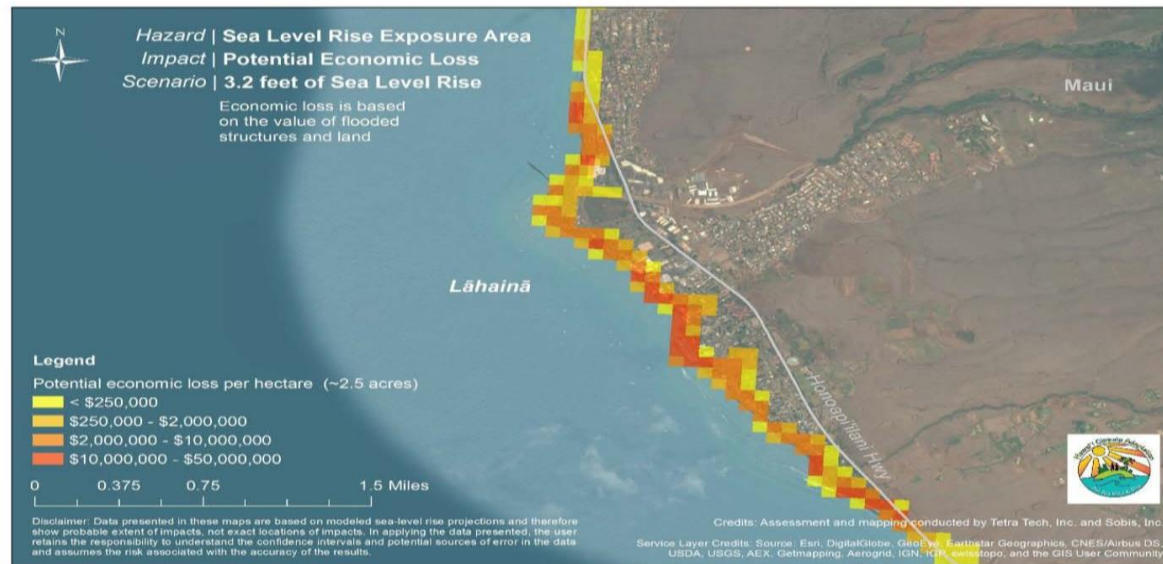


Figure 61. Potential economic loss in the SLR-XA with 1.1 feet (top) and 3.2 feet (bottom) of sea level rise in Lāhainā, Maui



"Maybe it isn't going to be so bad."