

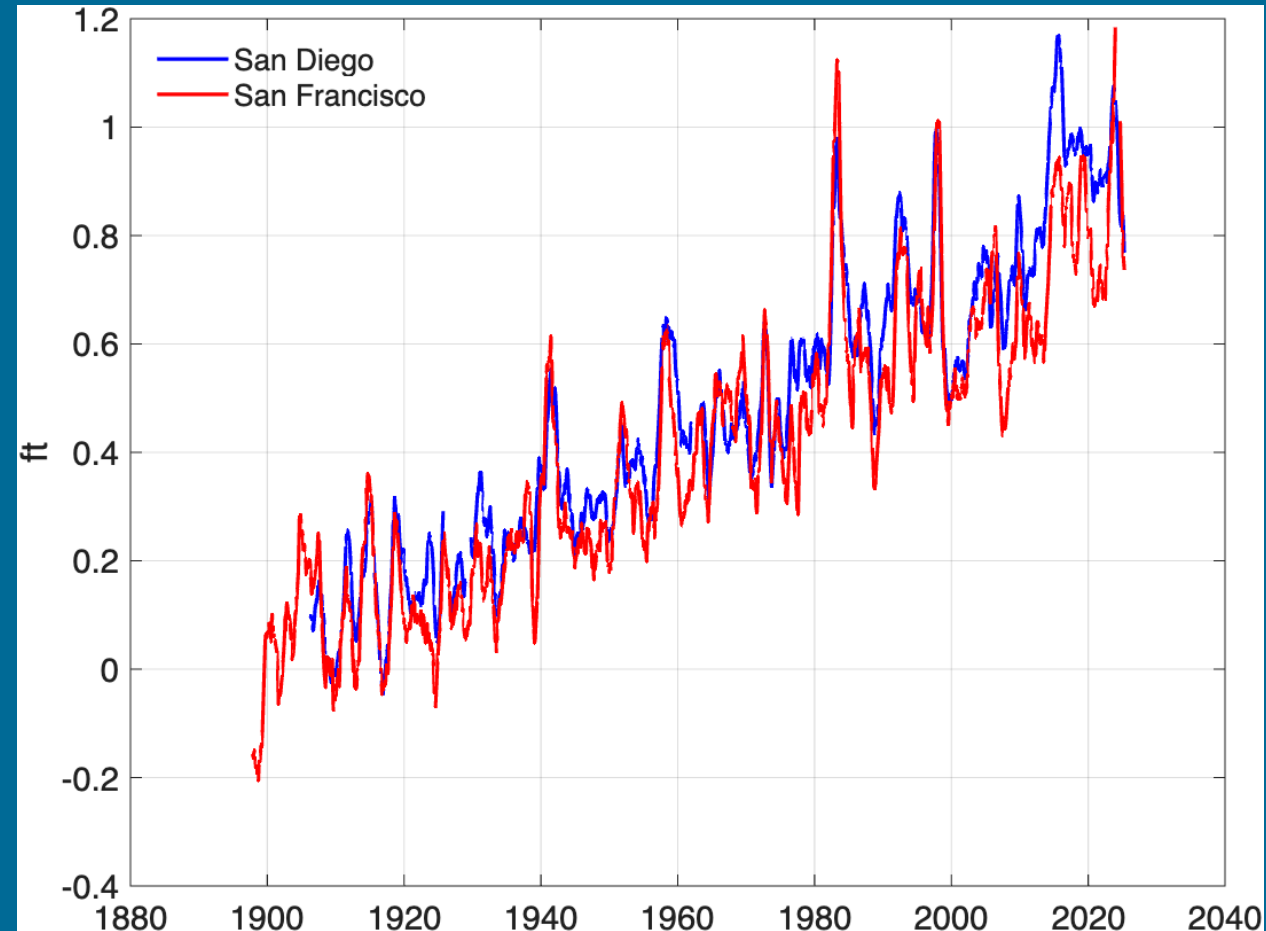


SEA LEVEL RISE AT THE CALIFORNIA COAST

MARK MERRIFIELD

CALIFORNIA SEA-LEVEL RISE SINCE 1900

- Sea level has risen by 0.8-0.9 ft since 1900 at the San Francisco and San Diego tide gauges
- Vertical land motion due to tectonics, sediment compaction, and groundwater and hydrocarbon extraction leads to regional variations
- El Nino events give a glimpse of future sea level highs



NEXT 25 YEARS

- Climate models predict a relatively narrow range of sea level rise across all scenarios (low to high)
- Compared to tide gauge extrapolations, a 0.8 ft increase is expected by 2050 (Intermediate Scenario, relative to 2000)
- The rate of rise is increasing. 0.8 ft change for 2000-2050 matches 1900-2025

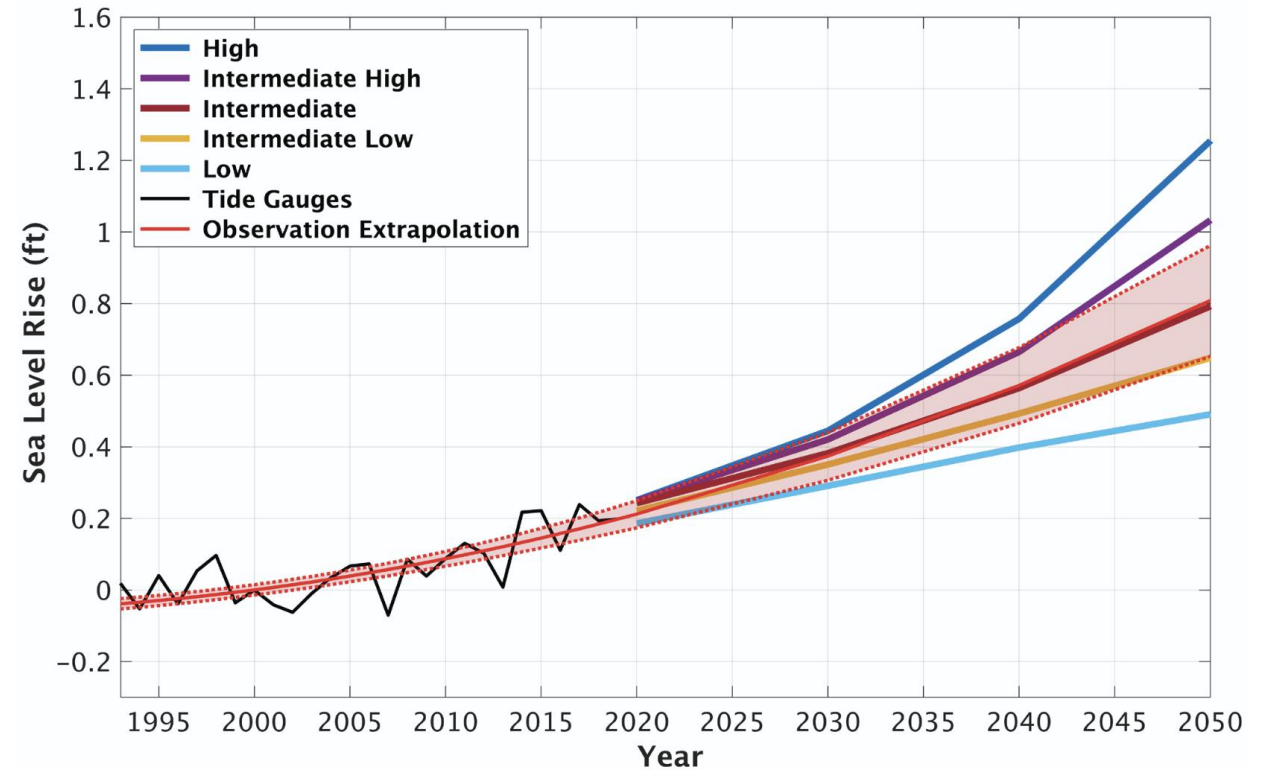
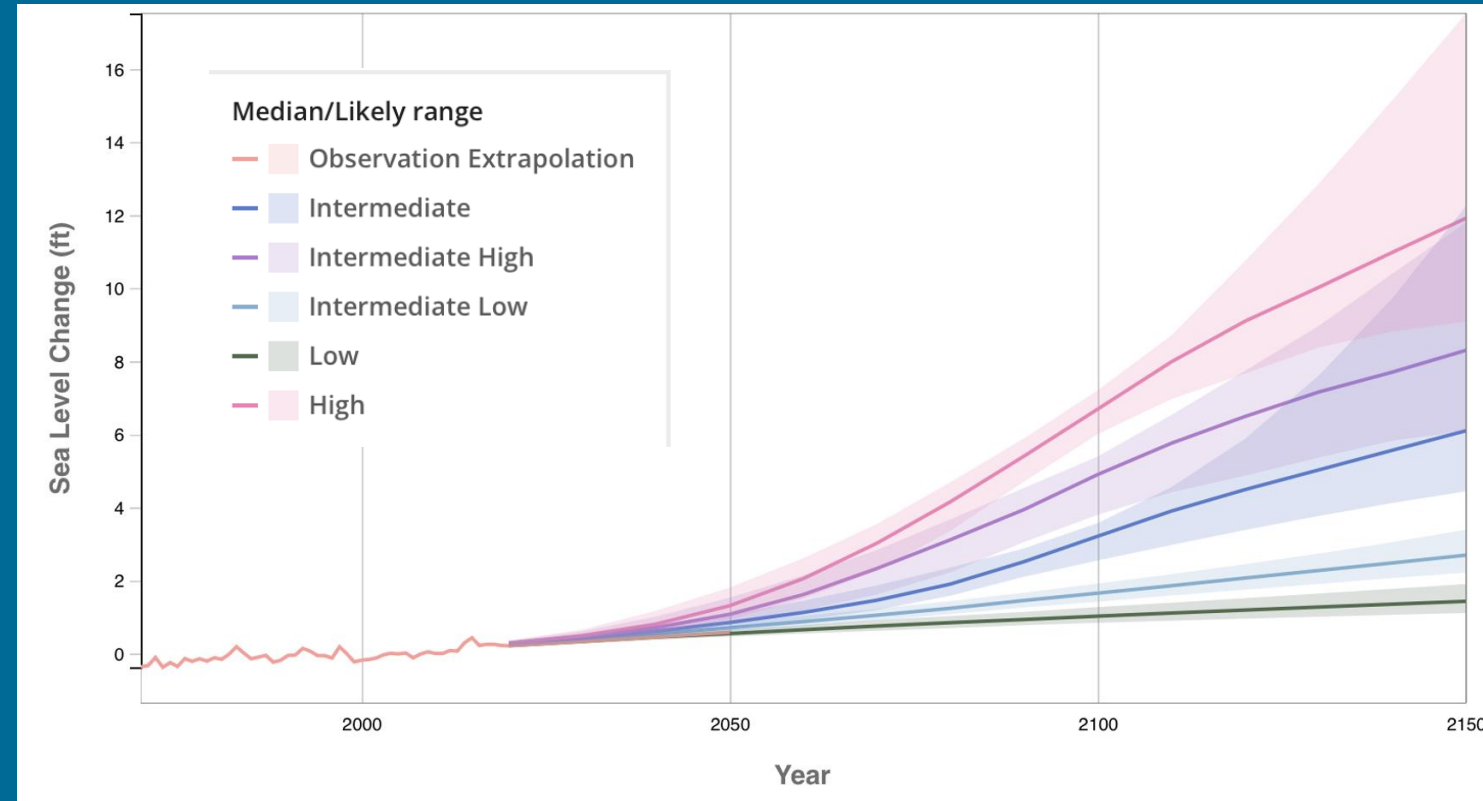


FIGURE 2.5. Sea Level Scenarios for California, in feet, from 2020 to 2050 relative to a baseline of 2000. The past statewide average tide gauge record is used to assess the trajectory of near-term sea level rise and create an observation extrapolation for comparison to the scenarios. The shaded region, bounded by the red dotted line, represents the likely range for the observation-based extrapolation.³⁴

2100 AND BEYOND

- After 2050, wide range of projections due to emission and ice melt uncertainties
- By 2100, 1.6-3.1 ft (intermediate-low to intermediate)
- Beyond 2100, 2.6 ft to 11.0 ft (intermediate-low to high)



https://sealevel.nasa.gov/task-force-scenario-tool/?overlay_open=true



City of Carlsbad



COASTER railroad

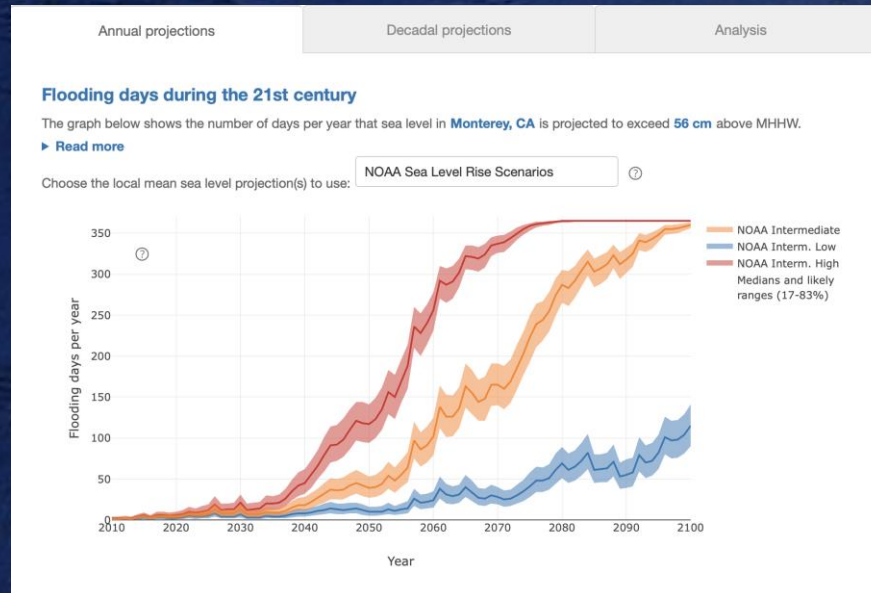


Photo: City of IB December 2015



IB Nourishment Photo: Eddie Kisfaludy

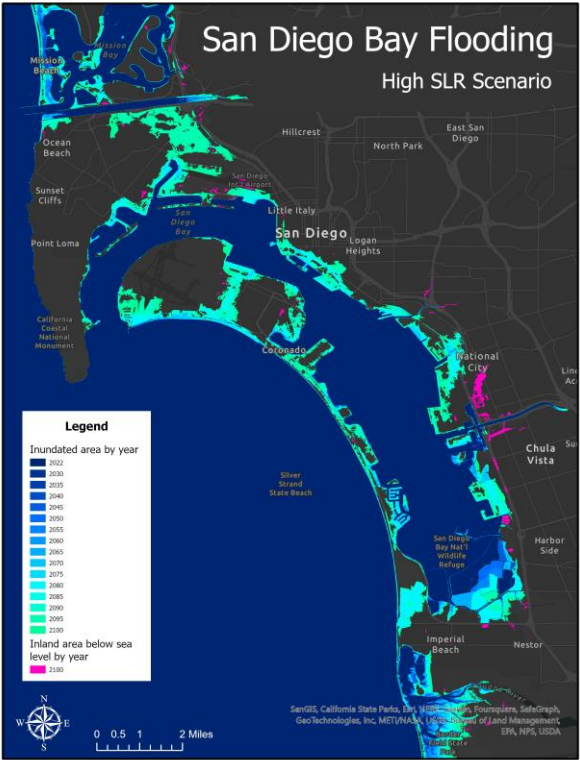
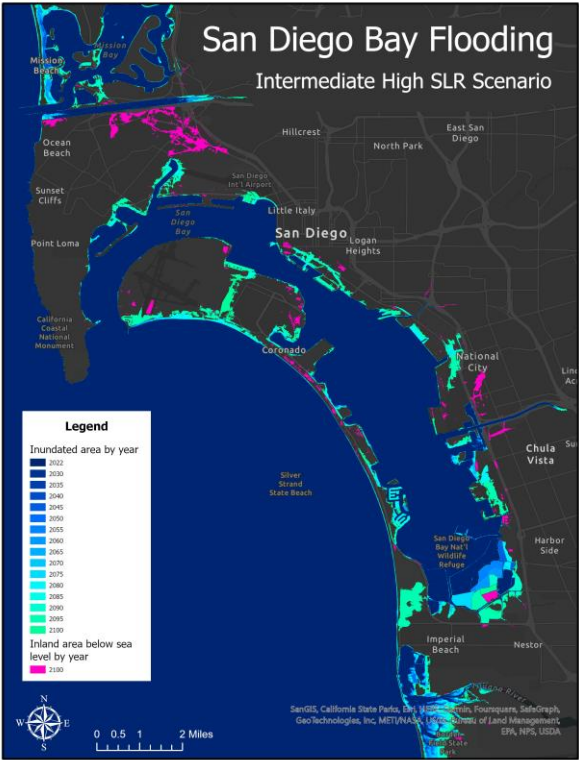
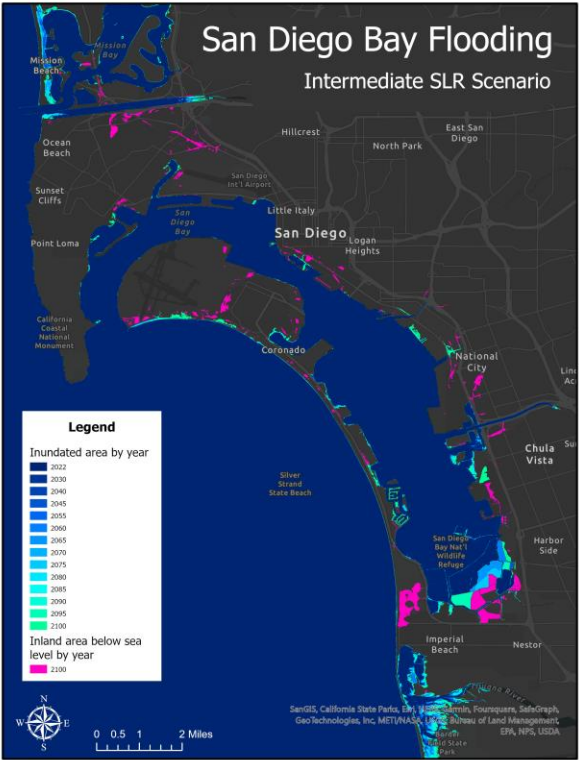
By 2100, San Diego flooding days will occur almost daily.



<https://sealevel.nasa.gov/flooding-days-projection/>



FLOOD PROJECTIONS



Coastal property and infrastructure



Transportation



Ports and Commerce

A Proposed Sea Level Rise Preparedness Approach



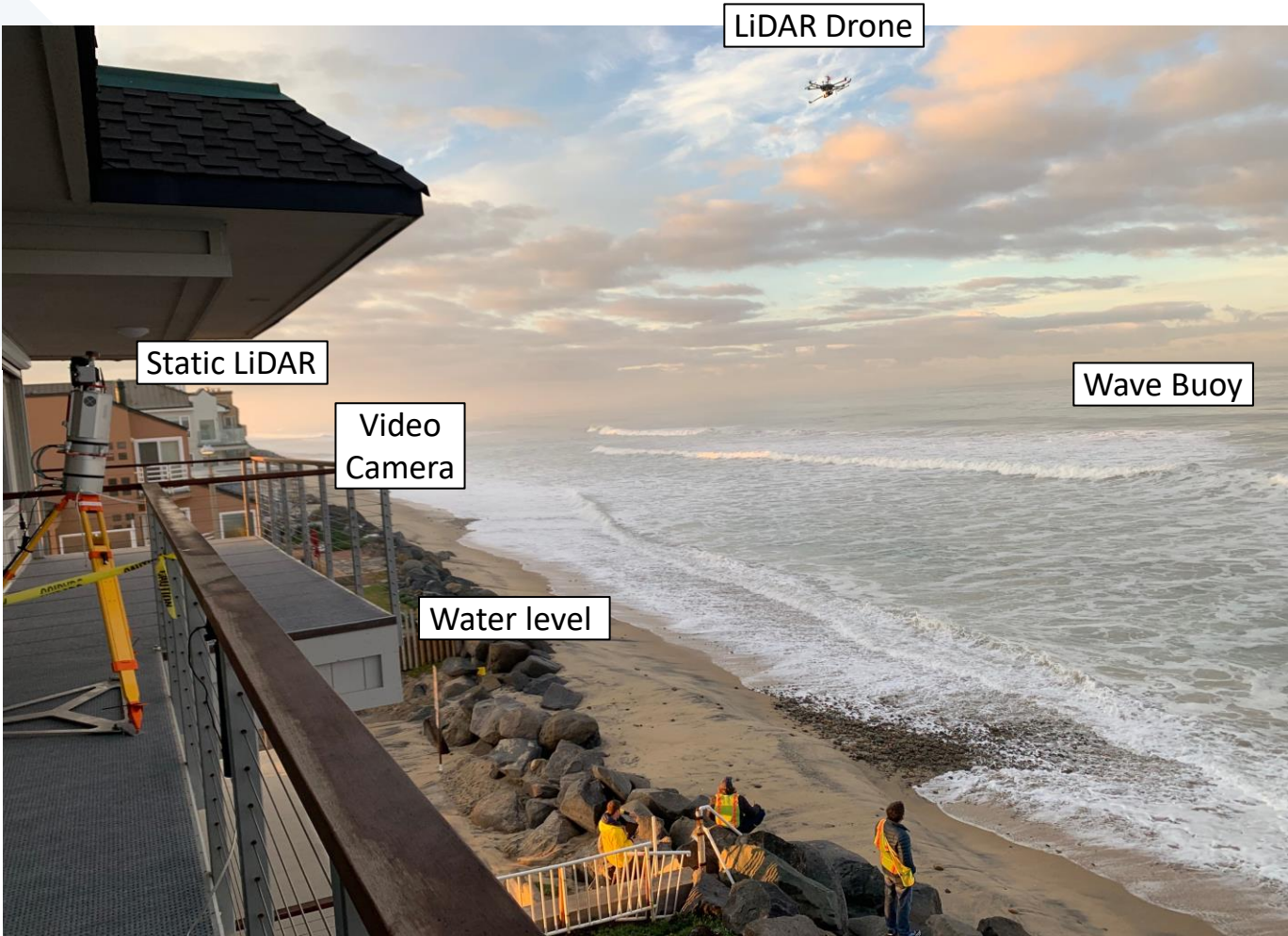
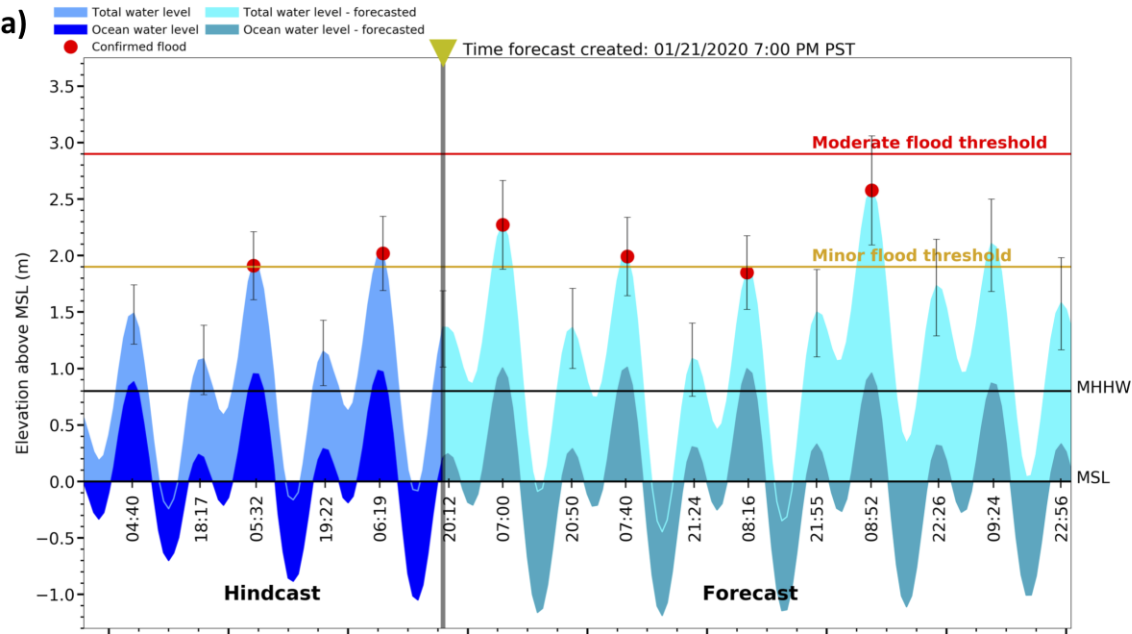
San Diego Bay is home to 15 military facilities, the Port, Airport and other valuable businesses, recreational assets and ecosystems.

National Security



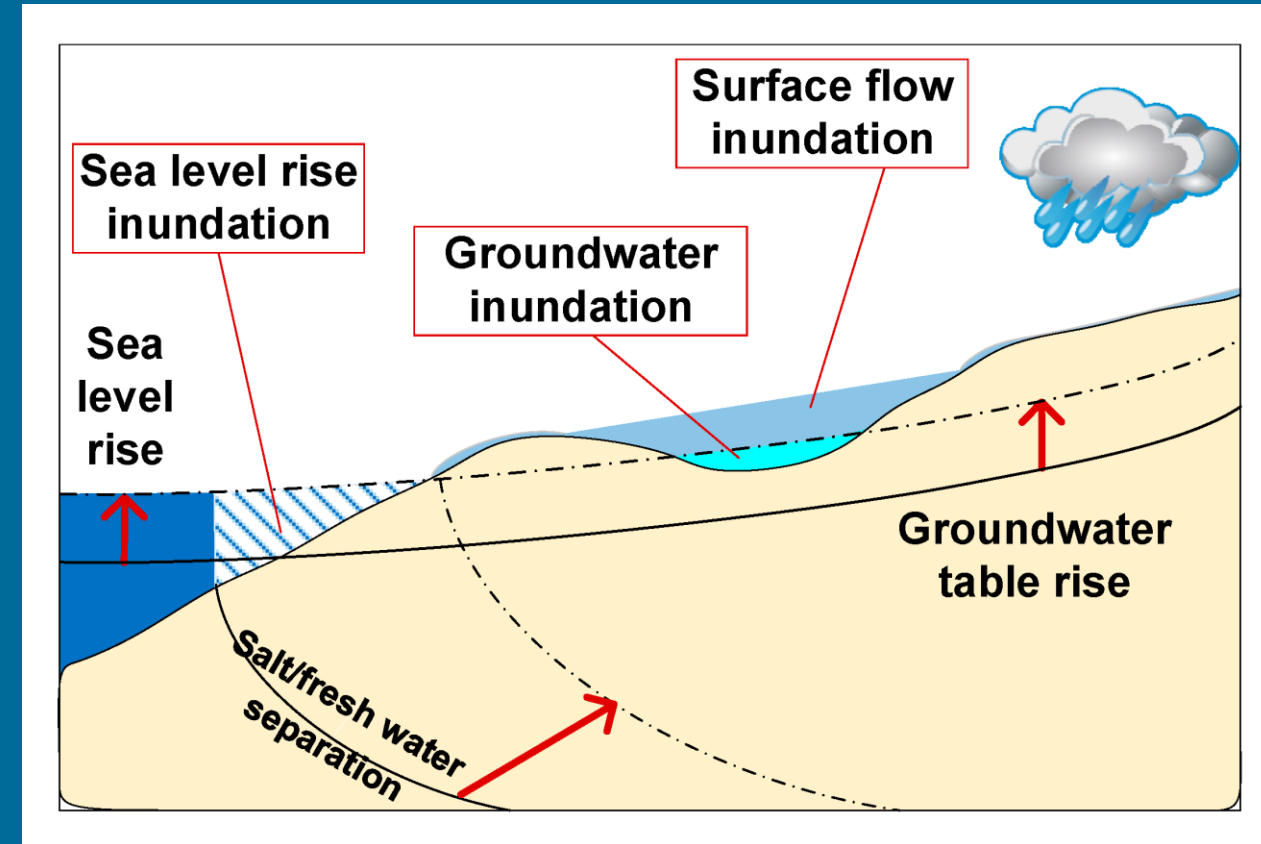


EARLY FLOOD WARNING SYSTEMS



As sea level rises, so too does coastal groundwater

- Causes flooding from below
- Exposes subsurface infrastructure to corrosive saltwater
- Places freshwater aquifers at risk of saltwater intrusions
- Mobilizes subsurface contaminants in soil

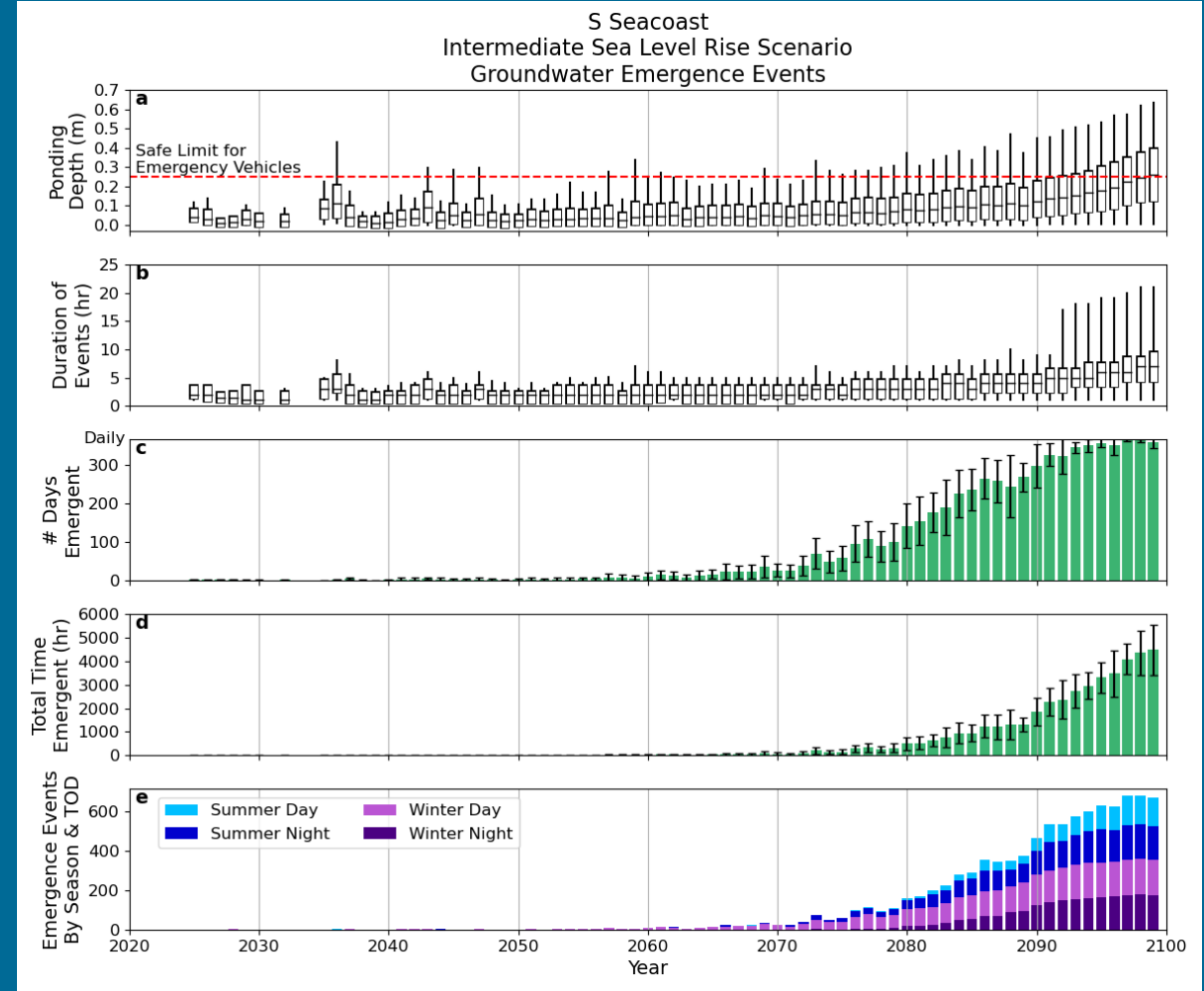


Rahimi et al. (2020)

Flooding due to groundwater emergence

Austin Barnes (2025)

- Study of Imperial Beach CA, Intermediate sea level rise
- Flooding days due to groundwater emergence increase significantly after mid century
- Year-round flooding by end of century





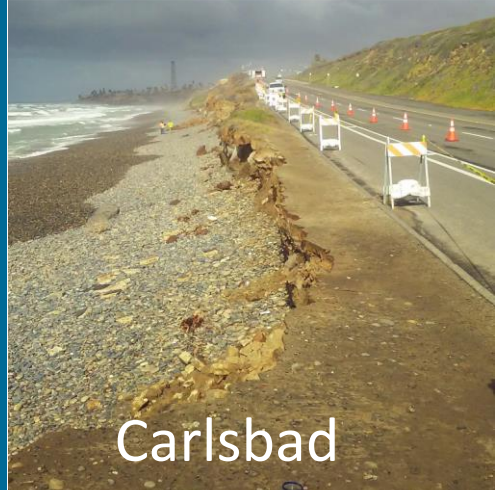
Two minutes later



Sea level rise contributes to cliff and bluff erosion

California landslide halts rail service, homes evacuated

April 28, 2023



Sea level rise impacts for California:

- Permanent submergence of land
- Increases in the duration, frequency and severity of coastal flooding
- Increased beach and cliff erosion
- Salinization of soils, ground water, and surface water
- Destabilization of coastal infrastructure
- Impeded drainage
- Implications for public safety, transportation, power supply, water use, sewage systems, tourism, national security, agriculture, ecosystem health