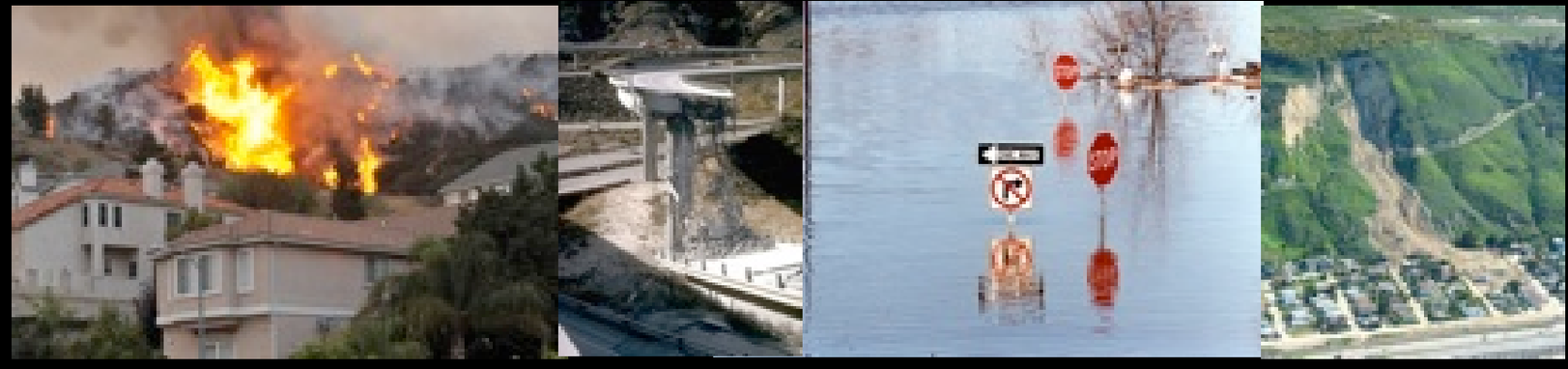

NATURAL HAZARDS MISSION AREA SAFRR Project: Science Application for Risk Reduction

The SAFRR Tsunami Scenario: Improving Resilience for California from a Plausible M9 Earthquake near the Alaska Peninsula

A product of the USGS SAFRR project in partnership with CGS, Cal OES, NOAA and others

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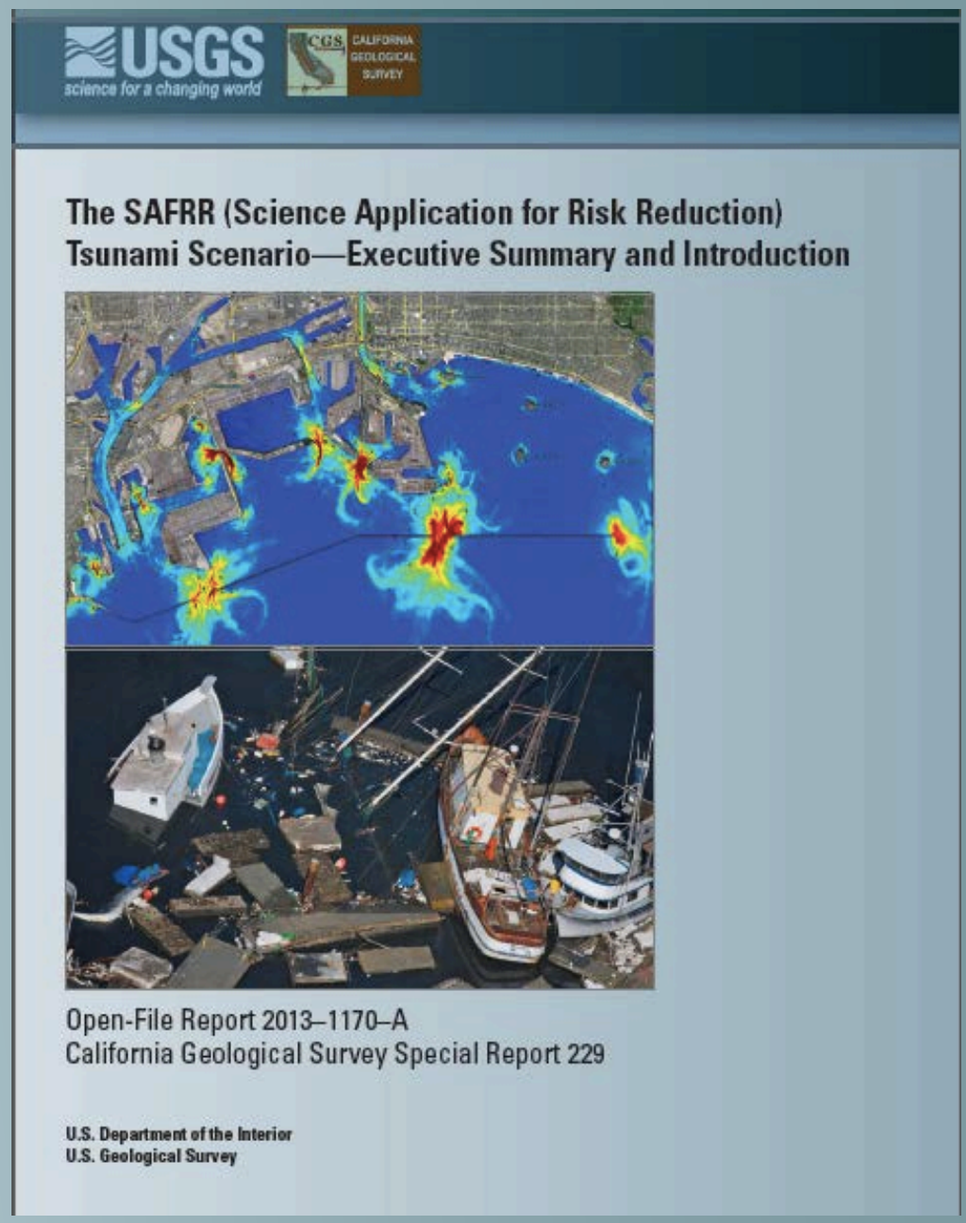
Natural Hazards: Earthquake • Volcanic Eruption • Landslide • Flood • Geomagnetic Storm • Wildfire • Tsunami • Coastal Erosion

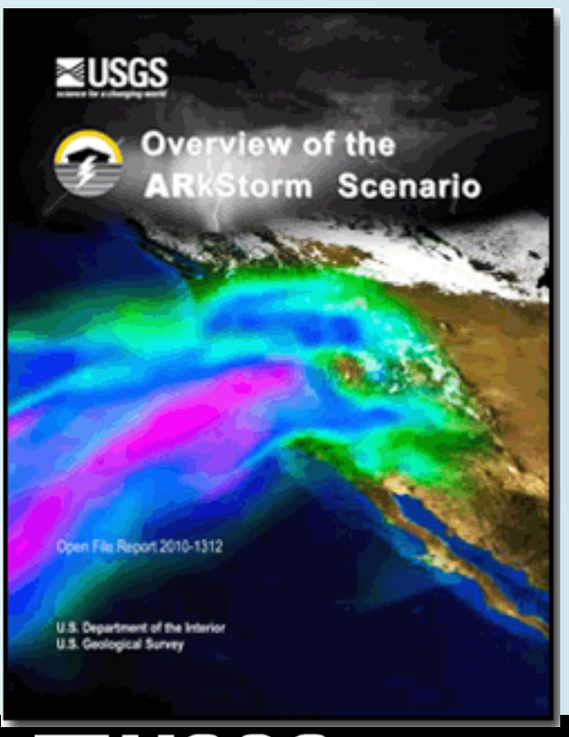
By the numbers

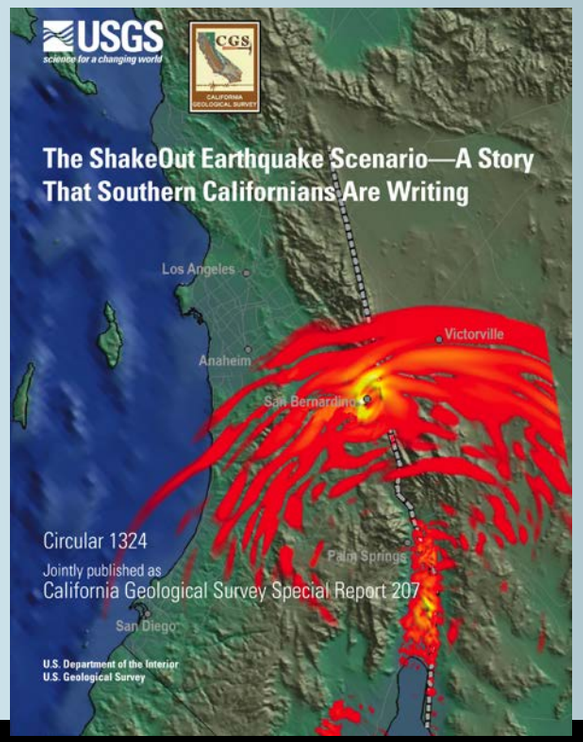
- One Tsunami Scenario published September 4, 2013
- 4-page Fact Sheet
- 13-chapter Report with over 900 pages
- 17-page Executive Summary and Introduction
- 29-member coordinating committee, representing 13 organizations
- 31 additional authors, 9 additional organizations
- 174 additional contributors, 50 additional organizations
- Over 700,000 web hits in the first three months

SAFRR Scenario principles

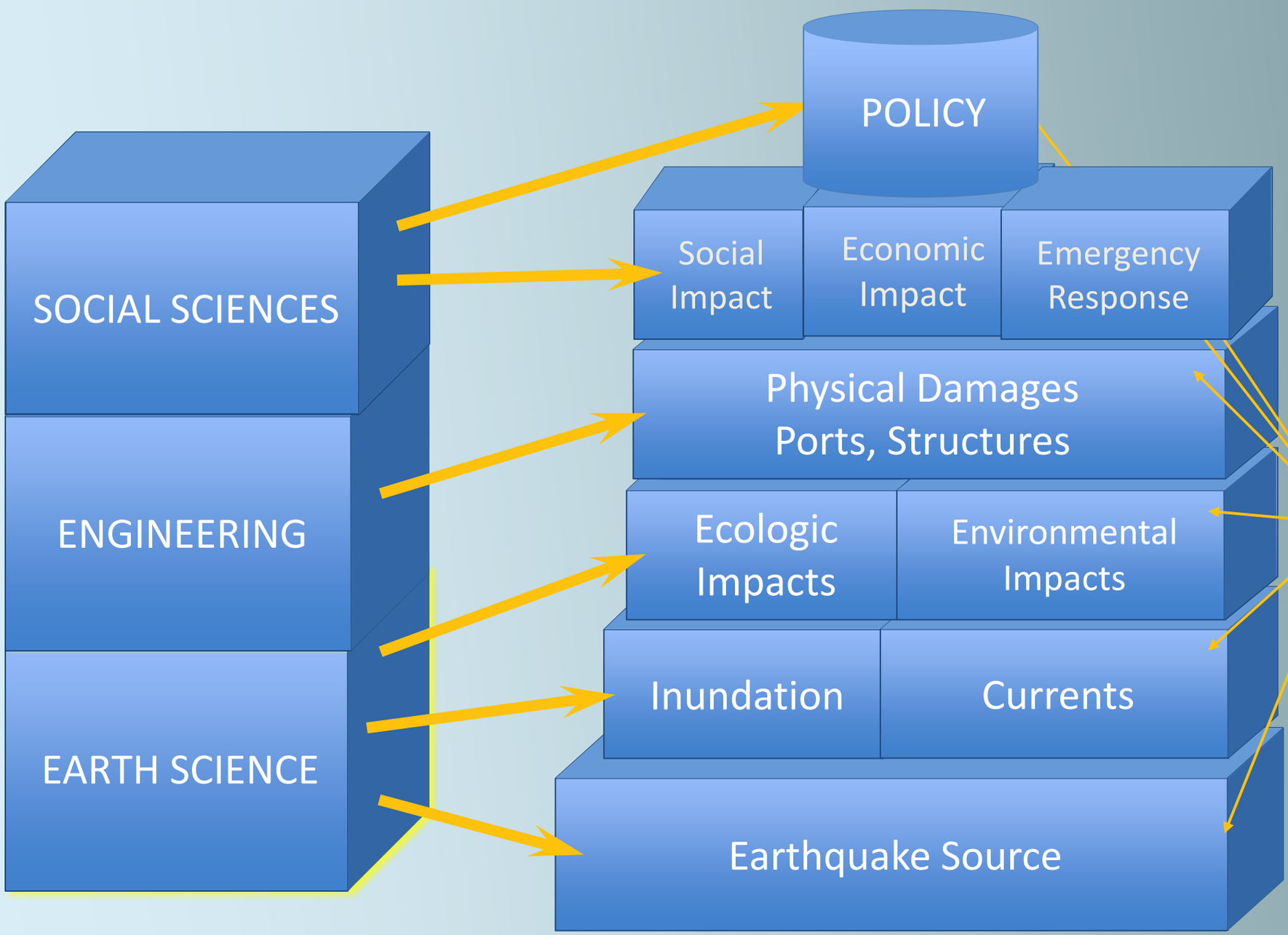
- A single, large but plausible event
- An event we need to be ready for
- Craft study with community partners
- Consensus among leading experts







The Tsunami Scenario



Mw9.1offshore of Alaska Peninsula

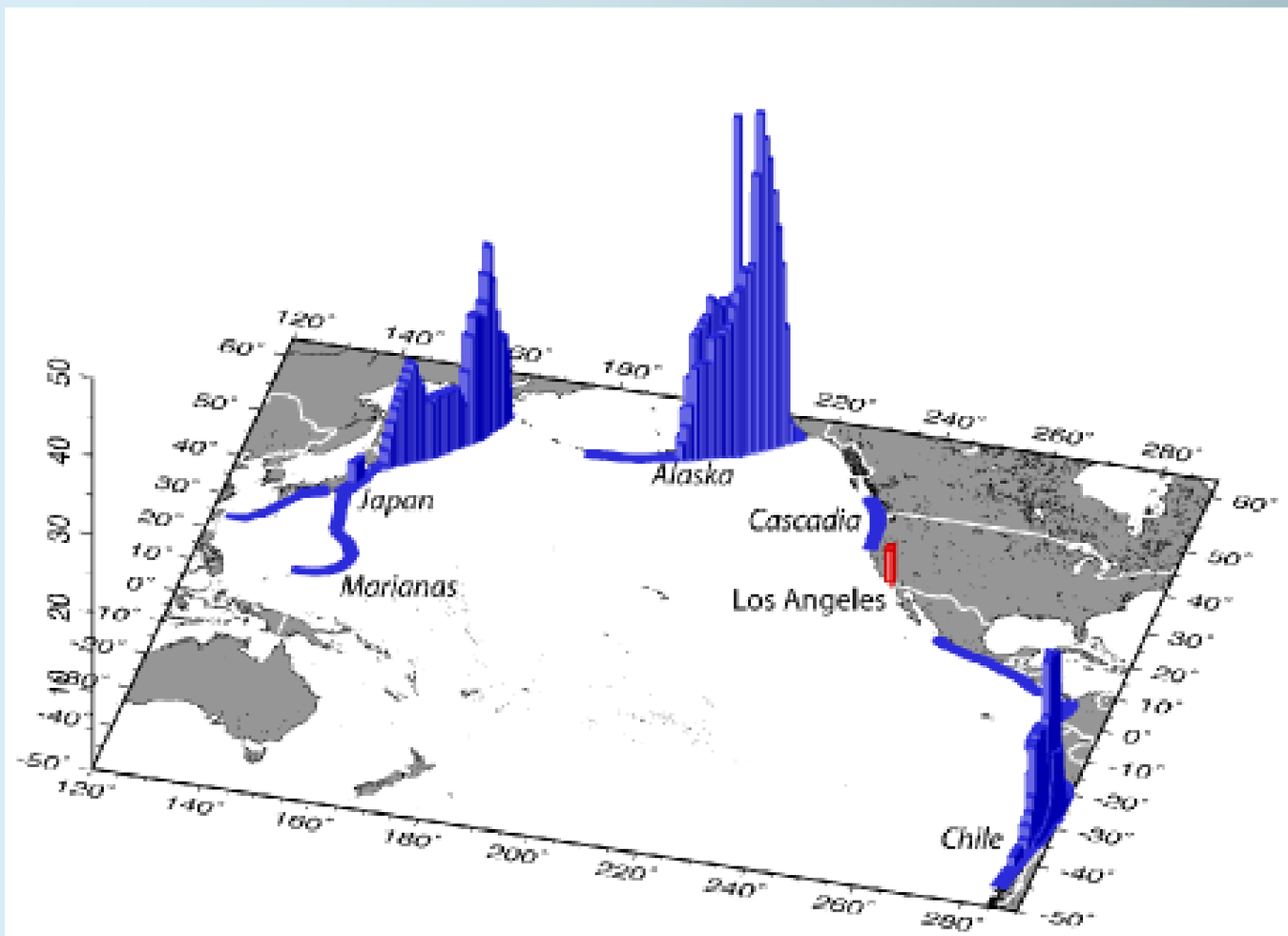
Similar to Tohoku

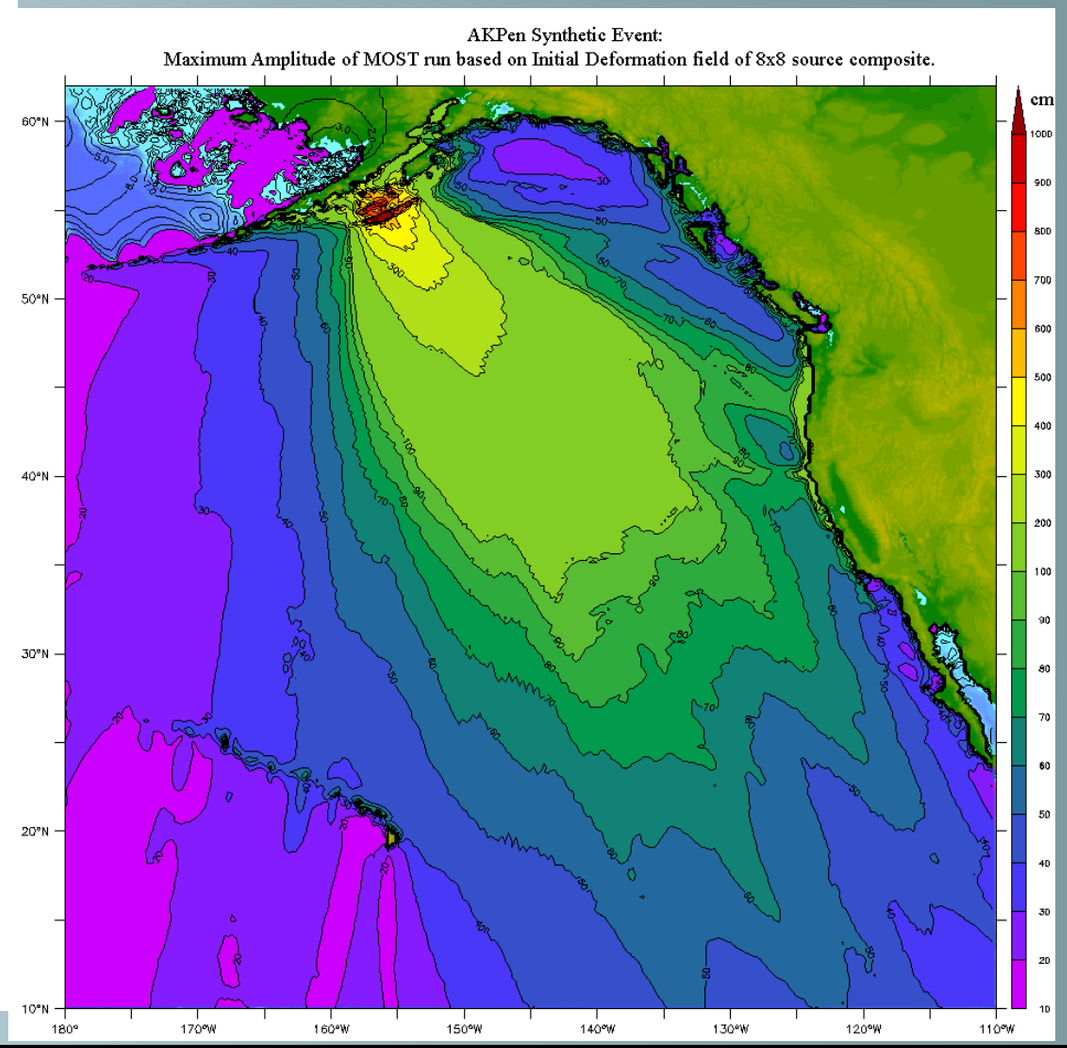
Between 1946 and 1964 sources

Biggest contribution to LA's tsunami hazard

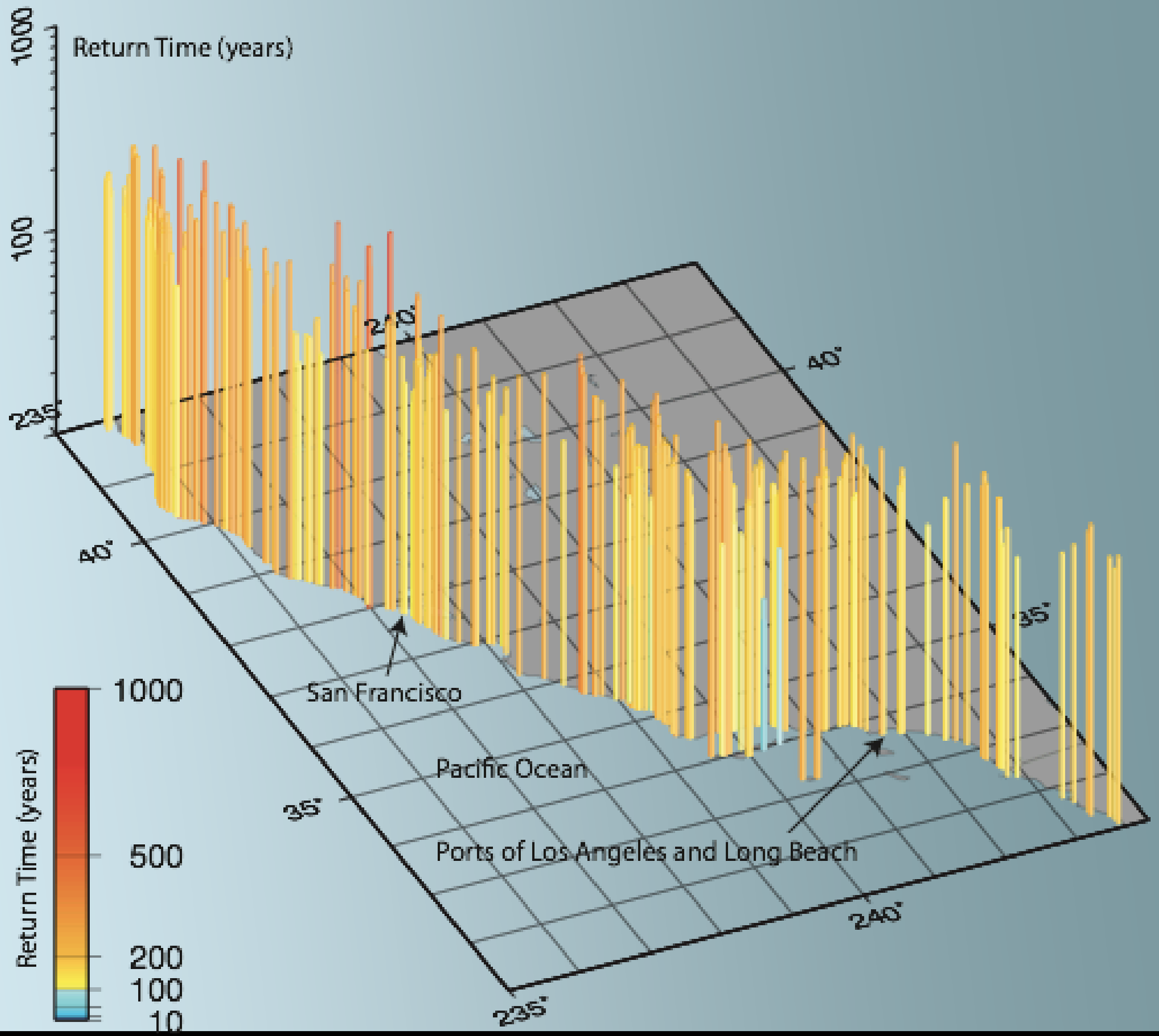
Does not exceed county tsunami evacuation zones

Waves hit near high tide to assure preparations are adequate.

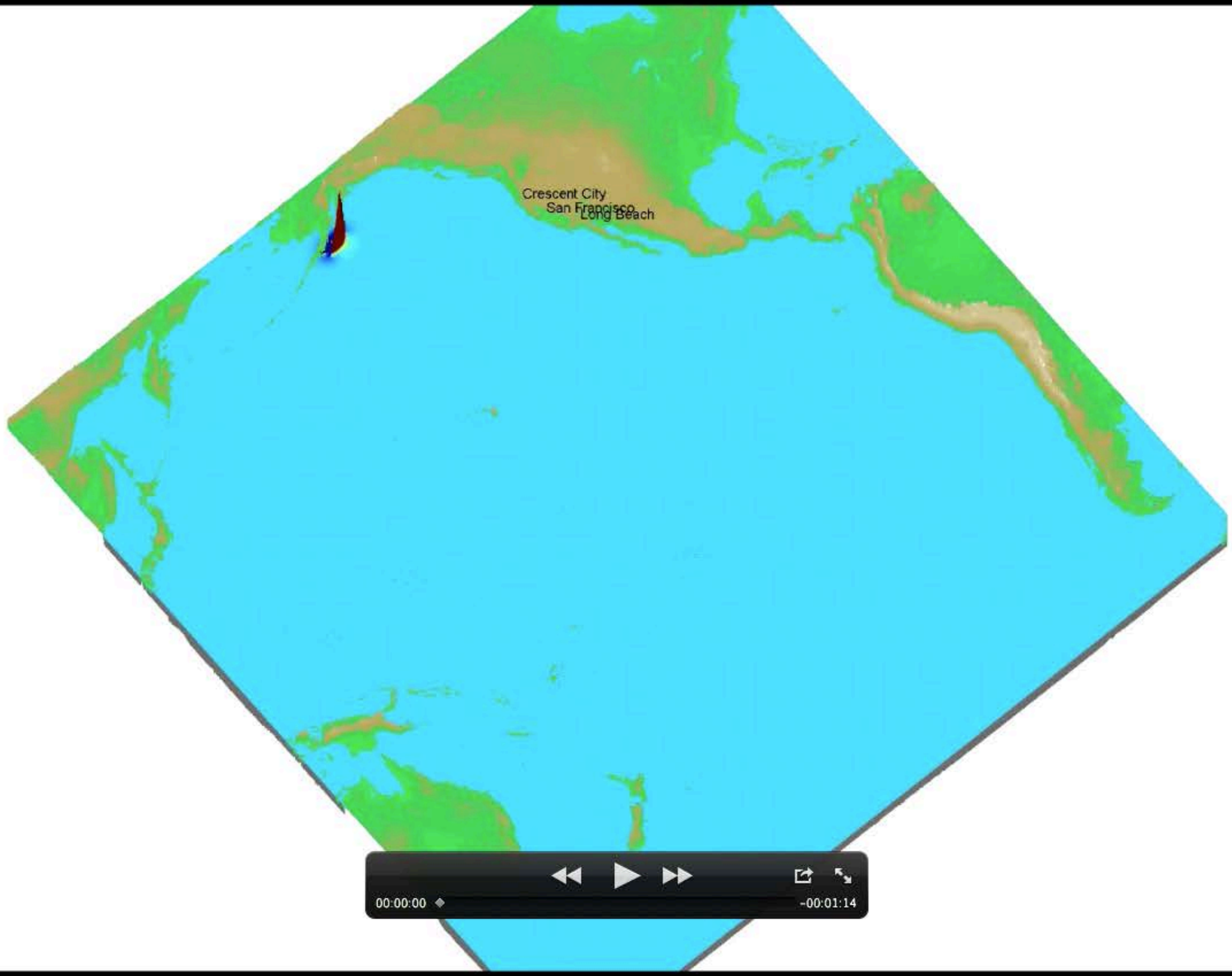




How likely is it?



SAFRR: Science Application for Risk Reduction



SAFRR: Science Application for Risk Reduction

TWC Message #1 – 11:54 PDT – Mw 8.2 Tsunami WARNING/WATCH
ccurred 100 miles SE of Chignik, AK.
iles.
om Alaska to British Columbia
Washington to California/Mexico border
es (PDT) provided. Crescent City=16:12, San Francisco=17:06, Santa
21, San Pedro=17:37, and La Jolla=17:48.

TWC Message #2 – 12:31 PDT - Mw 8.6 Tsunami WARNING/WATCH
buoys indicate tsunami generated.
g adjacent Alaska coast could be 22 feet.
n effect for California
es (PDT) updated. Crescent City=16:08, San Francisco=17:02, Santa
28, San Pedro=17:34, and La Jolla=17:45.

TWC Message #3 – 13:03 PDT - Mw 9.0 Tsunami WARNING/WATCH
nami 4.5 feet high at Sand Point, AK
n effect for California
es (PDT) updated. Crescent City=16:06, San Francisco=17:02, Santa
18, San Pedro=17:35, and La Jolla=17:46.

TWC Message #4 – 14:05 PDT - Mw 9.0 Tsunami WARNING
California
nformation:

	Arrival	Duration	Wave Ht
ty	16:06	21hrs	5-6ft
sco	17:02	9hrs	2-3ft
ara	17:18	9hrs	2-3ft
	17:35	6hrs	1-2ft
	17:46	12hrs	2-3ft

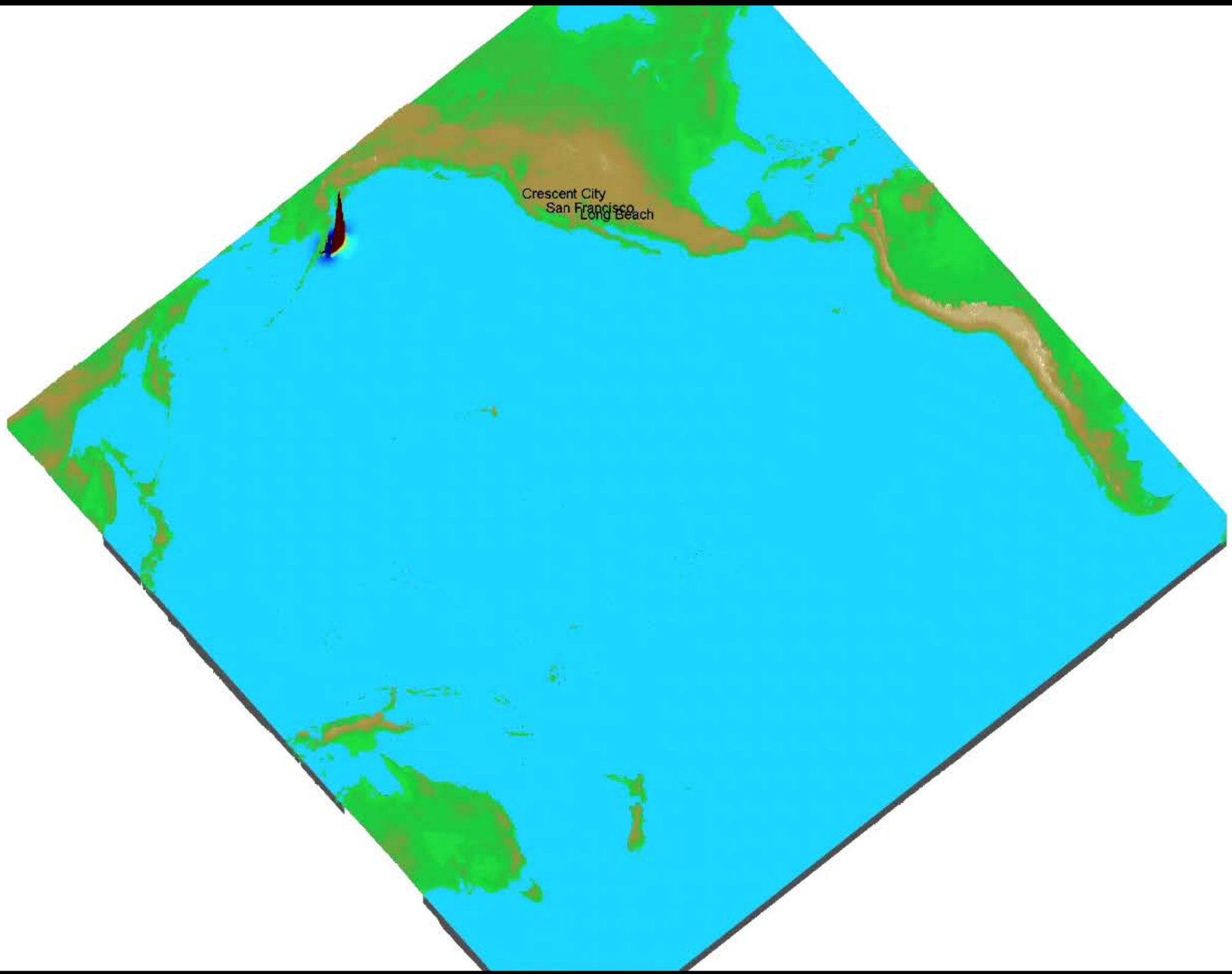
TWC Message #5 – 15:05 PDT - Mw 9.0 Tsunami WARNING
California
nformation:

	Arrival	Duration	Wave Ht
ty	16:06	21hrs	5-6ft
sco	17:02	9hrs	2-3ft
ara	17:18	9hrs	2-3ft
	17:35	6hrs	1-2ft
	17:46	12hrs	2-3ft

TWC Message #6 – 16:05 PDT - Mw 9.0 Tsunami WARNING
California
nformation: Arrival times the same; duration statewide increased to 24hrs.
ave heights slightly increase

TWC Message #7 – 17:05 PDT - Mw 9.0 Tsunami WARNING
California
erved maximum tsunami wave heights: Crescent City=5.9ft; Eureka=2.8ft;
5.6ft, Pt Reyes=3.2ft, San Francisco=2.4ft, and Monterey=4.0ft.

SAFRR: Science Application for Risk Reduction



Inundation maps

Orange County – Huntington Beach:
Flooding overtops some levees and floods areas inland.

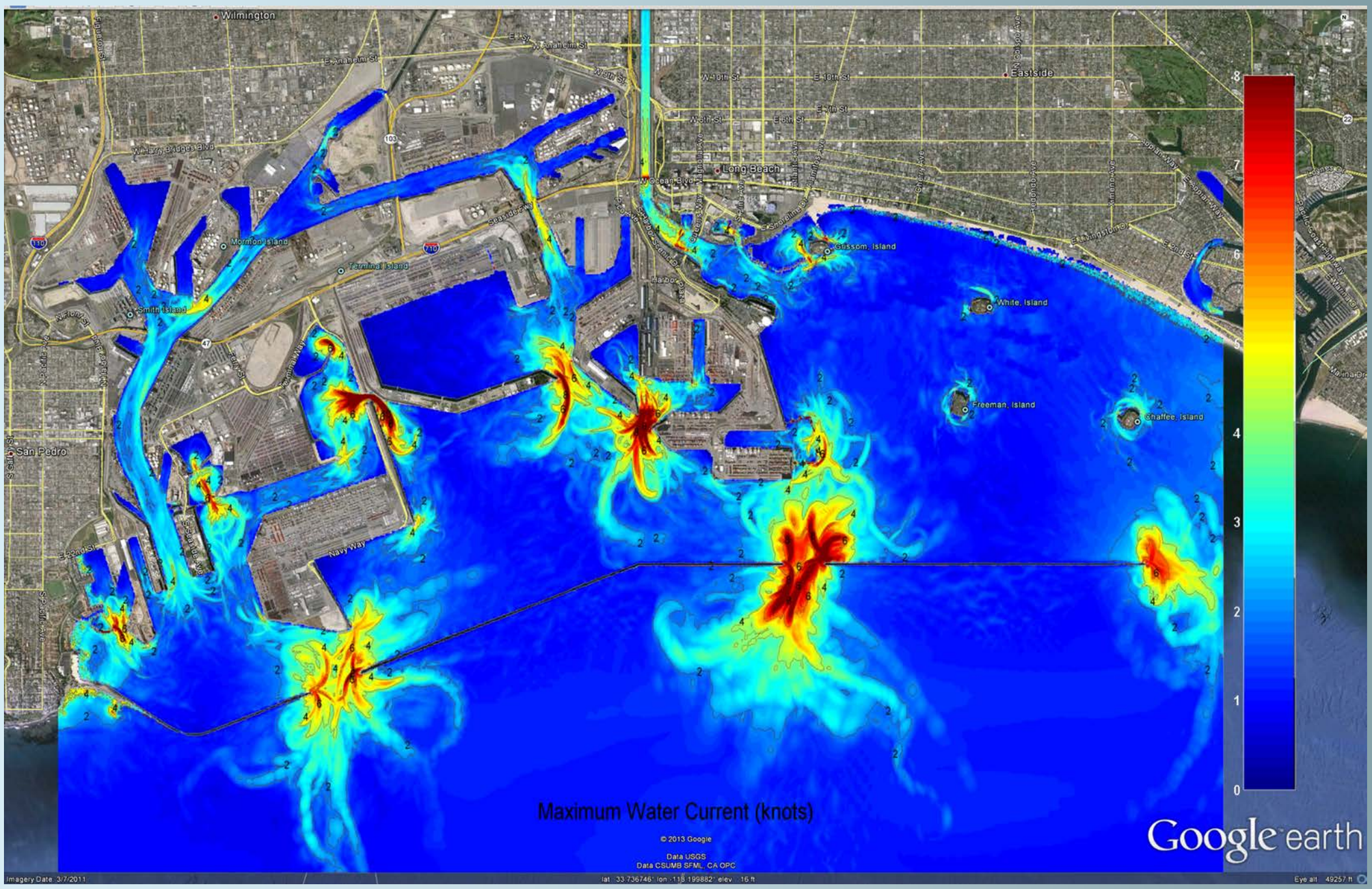
Los Angeles County – Long Beach: Flooding of downtown area occurs where many businesses and convention center are located.

Inundation maps

Marin County – Belvedere and Tiburon: A large number of low-lying homes are flooded.

Alameda County – Oakland: Large portions of Bay Farm Island and Oakland Airport are flooded.

Maximum Currents at Ports of Los Angeles and Long Beach



Ports of Los Angeles and Long Beach

- Shut down for at least 2 days due to strong currents.
- Inundation would cause $100 million in damage to cargo and additional downtime.
- Direct cost of port shutdown would total over $1.2 billion.
- Business interruption losses in California would more than triple that amount.
- Business interruption losses can be reduced by 80-90% with business continuity and resilience strategies.

Marinas

- 1/3 of boats and over half of docks in California marinas would be damaged, destroyed or sunk.
- $700 million to repair boats and docks plus additional costs to due to sediment transport and environmental contamination.
- Fires could start at many sites where fuel and petrochemicals are stored in ports and marinas.
- Debris cleanup and recovery could take months or years depending on severity of impacts and available resources.

Other Damages

- $1.8 billion of property damage.
- $85 million for highway and railroad repairs.
- $4 million of agricultural losses.
- $2 million of fishing interruption losses due to damage to boats, harbors, and fish processing facilities.
- 130 million square feet of coastal homes and businesses would be inundated: the area of approximately 70,000 dwellings.

Total losses could be $5-$10 billion depending on resilience strategies

Evacuations

- 500,000 people would be present in inundation zone.
- 750,000 people would be evacuated from State of California maximum inundation zones due to limited time to make decisions.
- 8,500 residents would need shelter facilities.
- Island and peninsula communities with limited access present evacuation challenges.
- Dependent-care populations present additional challenges.

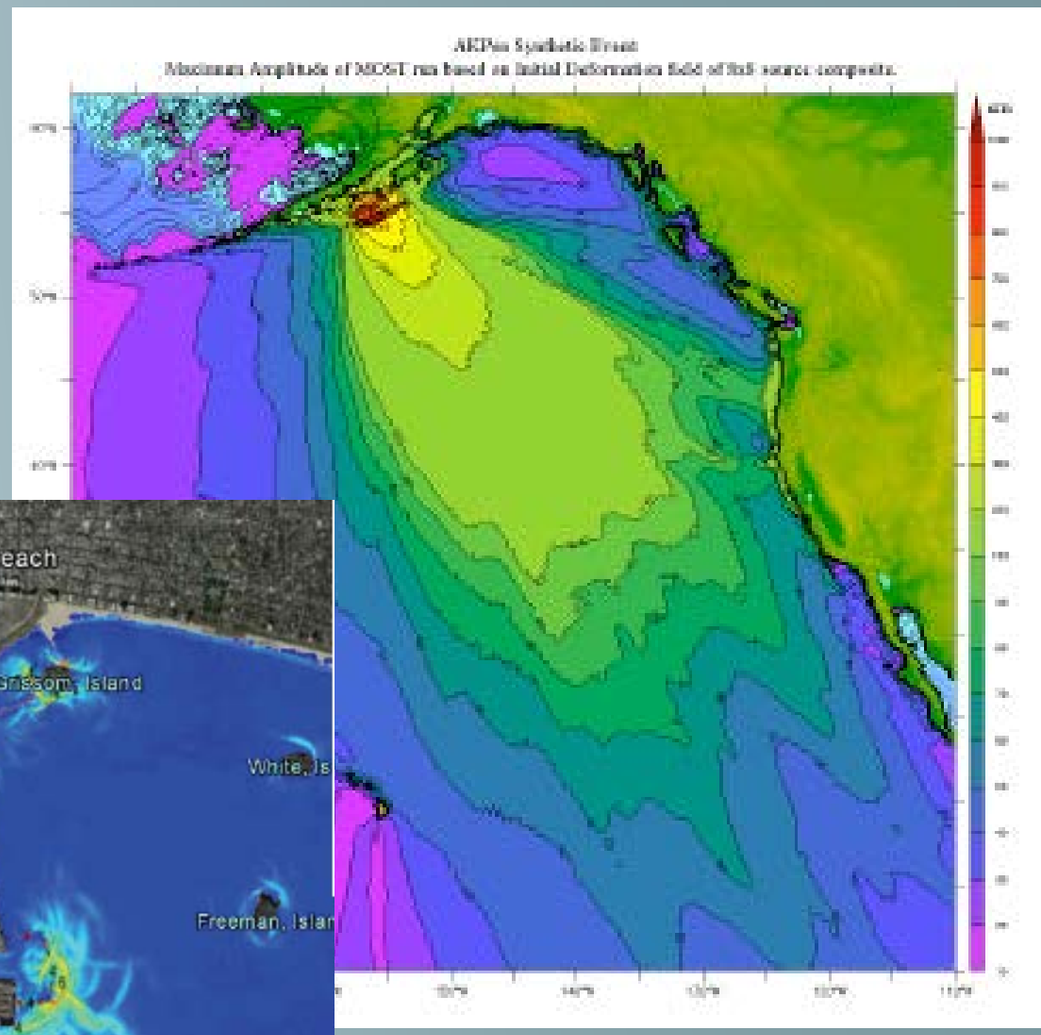
Some Early Benefits

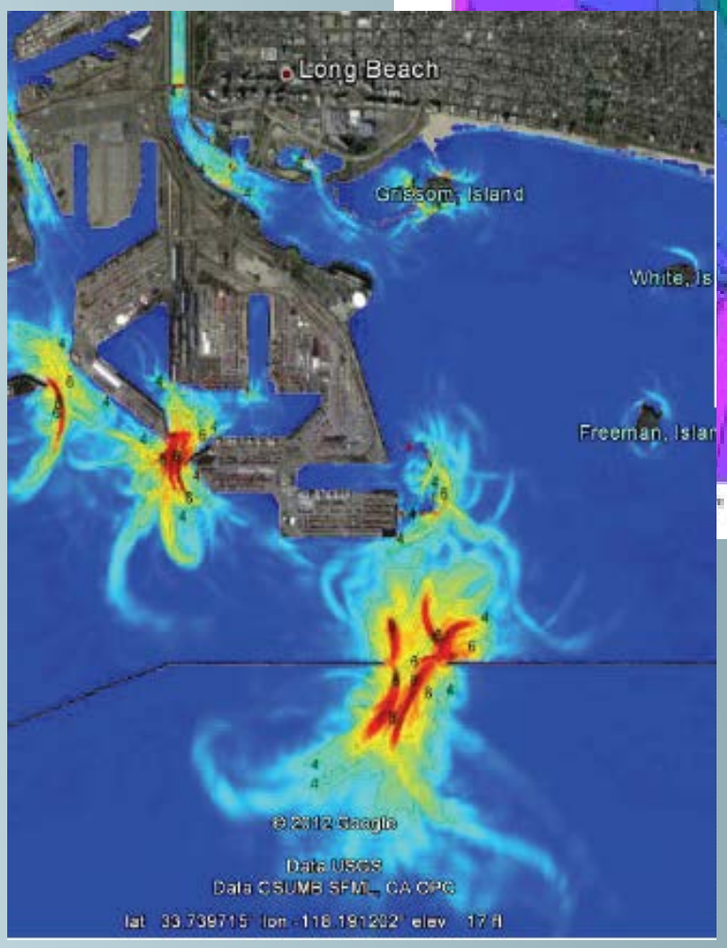
- CA tsunami evacuation plans have been updated where the scenario inundation exceeds the state's maximum inundation zone (due to higher resolution modeling, not due to a larger source)
- The State of CA and NOAA have modified warning protocols to facilitate evacuations
- Several regional workshops were held with emergency managers and local officials
- Scenario is being used to develop preparedness exercises

SAFRR Tsunami Scenario Roll-Out

Looked at:

- M9.1 EQ Alaska Tsunami Scenario
  - Inundation
  - Scientific Basis
- Tsunami Deposits
- Physical Impacts
- Economic Impacts
- Environmental Impact
- Emergency Management
  - Considerations
- Population Vulnerability
- Evacuation Challenges
- State Program
- Policy





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SAFRR Tsunami Scenario Roll-Out

Regional Stakeholder Workshops

- Emergency Managers, Maritime Authorities, Land-Use Planners, Elected Officials/Staffers
  - **Aug. 15th - Webinar (Heads Up for Emergency Managers)**
- **Sept. 4th – Los Angeles/Orange**
- **Sept. 5th – Santa Barbara/Ventura/San Luis Obispo**
- **Sept. 6th – San Diego**
- **Sept. 9th – Santa Cruz/Monterey**
- **Sept. 10th – San Francisco Bay Area**

To get the reports

http://www.usgs.gov/natural_hazards/safrr/projects/tsunamiscenario.asp

Or Google:

- USGS Tsunami Scenario
- SAFRR Tsunami

The SAFRR Tsunami Scenario Team