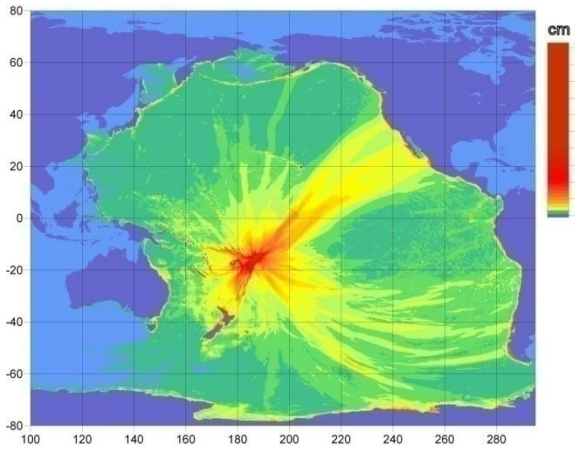
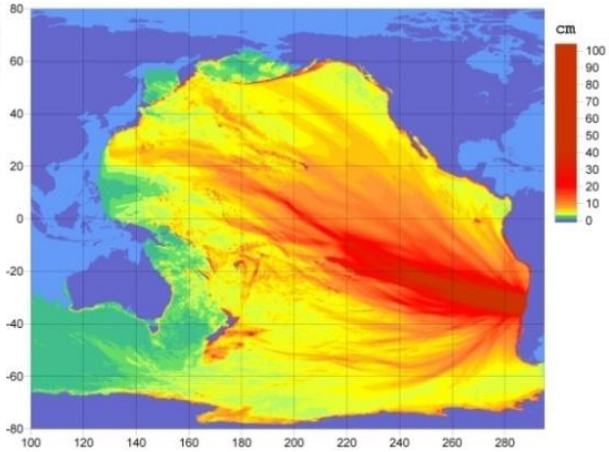
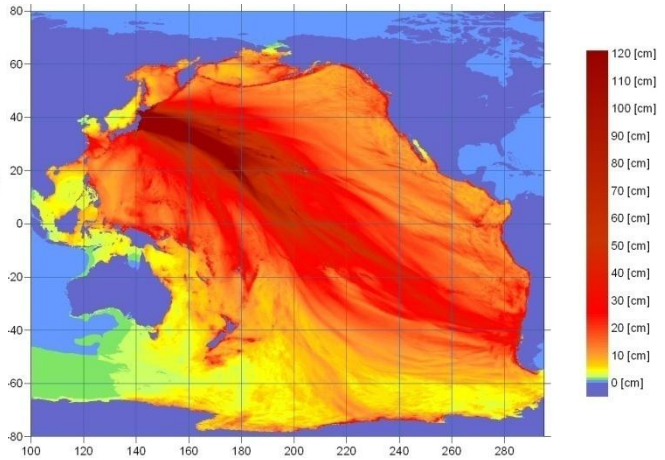
California Tsunami Response Team and Instrumentation



2009 Samoa



2010 Chile



2011 Japan

Rick Wilson, California Geological Survey

Kevin Miller, California Office of Emergency Services

Comparison – Three recent tsunamis

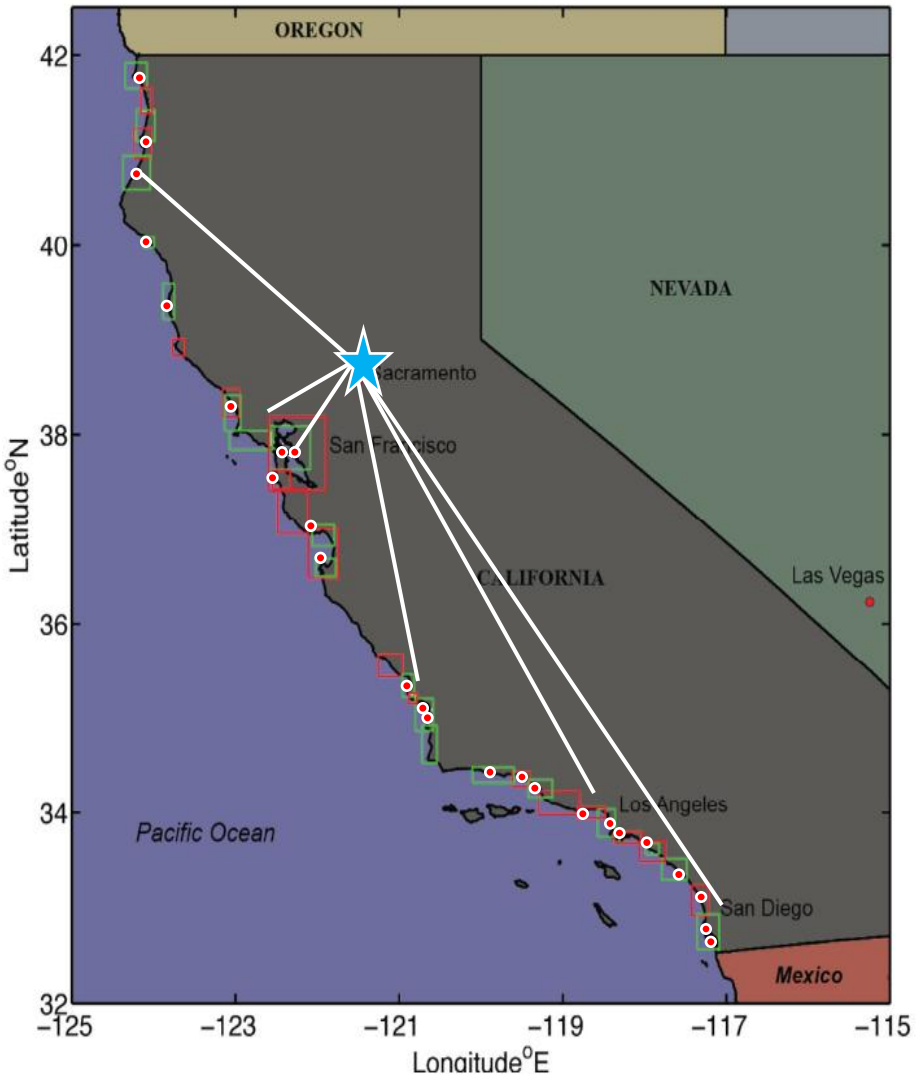
Example: Santa Cruz Harbor

	Sept. 29, 2009	Feb. 27, 2010	March 11, 2011
Earthquake magnitude/location	M8.1 Tonga/Samoa	M8.8 Maule, Chile	M9.0 Tohoku, Japan
Warning Center Alert Level for California	Advisory	Advisory	Warning, then Advisory
Approximate travel time of tsunami to Santa Cruz Co.	11 hours	13 hours	10 hours
Approximate peak wave amplitude in Santa Cruz Co. (Andy Ritchie, USGS)	1-2 feet	2-3 feet	+5-6 feet
Approximate duration of strong wave action in parts of California	~ 4 hours	~ 8 hours	+ 24 hours
Effects/Damage in State	- Minor to moderate currents in harbors - $0 in damages	- Moderate currents in harbors - $3M in damage	- Strong currents in harbors - ~$100M in damage - One death
Effects/Damage in Santa Cruz Co.	- Moderate currents - $0 in damages	- Mod to Strong currents - Tens of thousands	- Strong to very strong currents - +$22M in damage

Fortunate: Last two events occurred at low tide.

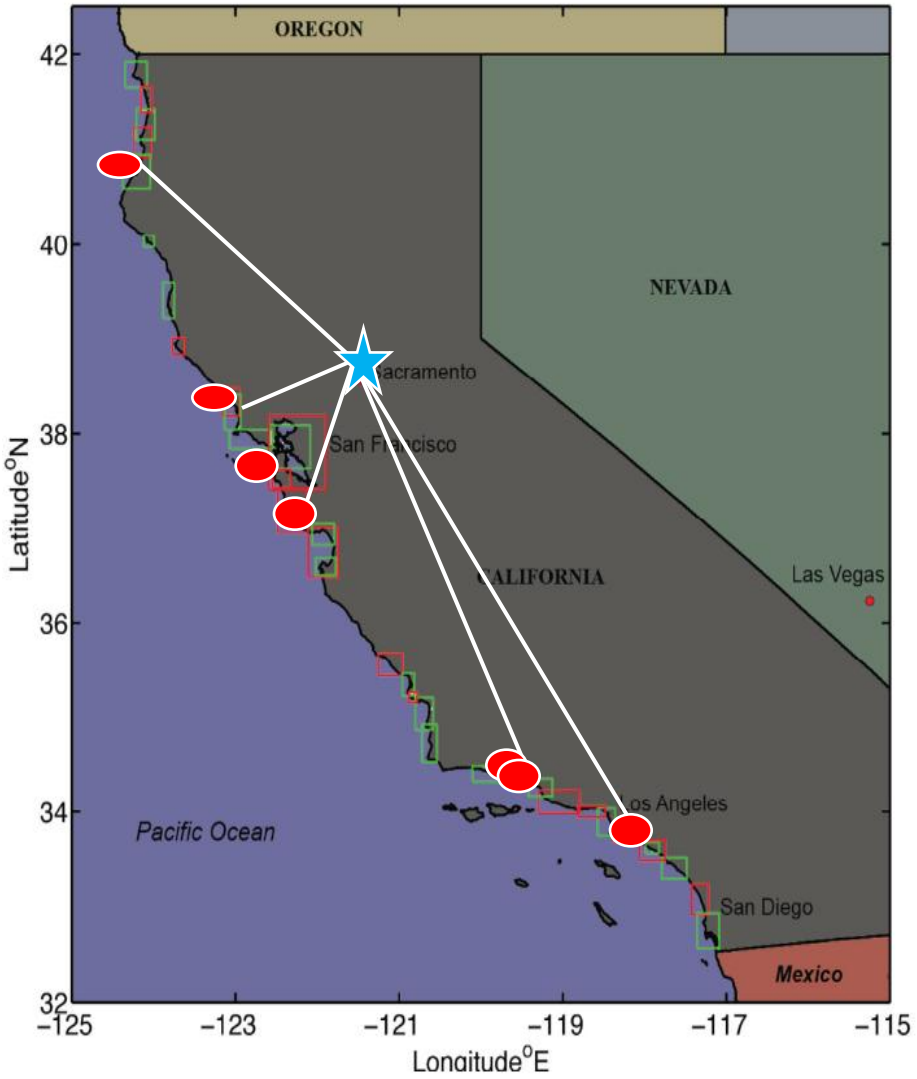
Pre- and Post-Tsunami Field Team and Information Clearinghouse Plan

- **Before event**
  - Work with local entities
  - Establish project network
  - Determine field partners/locations
- **During event**
  - Collect real-time information
  - Information Clearinghouse to CalEMA, Counties, and WC/ATWC-WFOs
- **After event**
  - Collect perishable post-tsunami data
  - Report



Response to March 11, 2011 Event

- **Early March, 2011 - Four regional CGS personnel selected… then March 11 occurred**
- **Before event**
  - Six people in field at prime locations
  - Contacted and assisted local officials
- **During event**
  - Clearinghouse to CalEMA
  - Collect real-time information
- **After event**
  - Eight field teams and email surveys collect information at 160 coastal locations; Use of EQ Clearinghouse website
  - Damage reports to CalOES; Federal Disaster Declaration
  - Reported results in posters and peer-reviewed articles
  - Implementing new work based on results



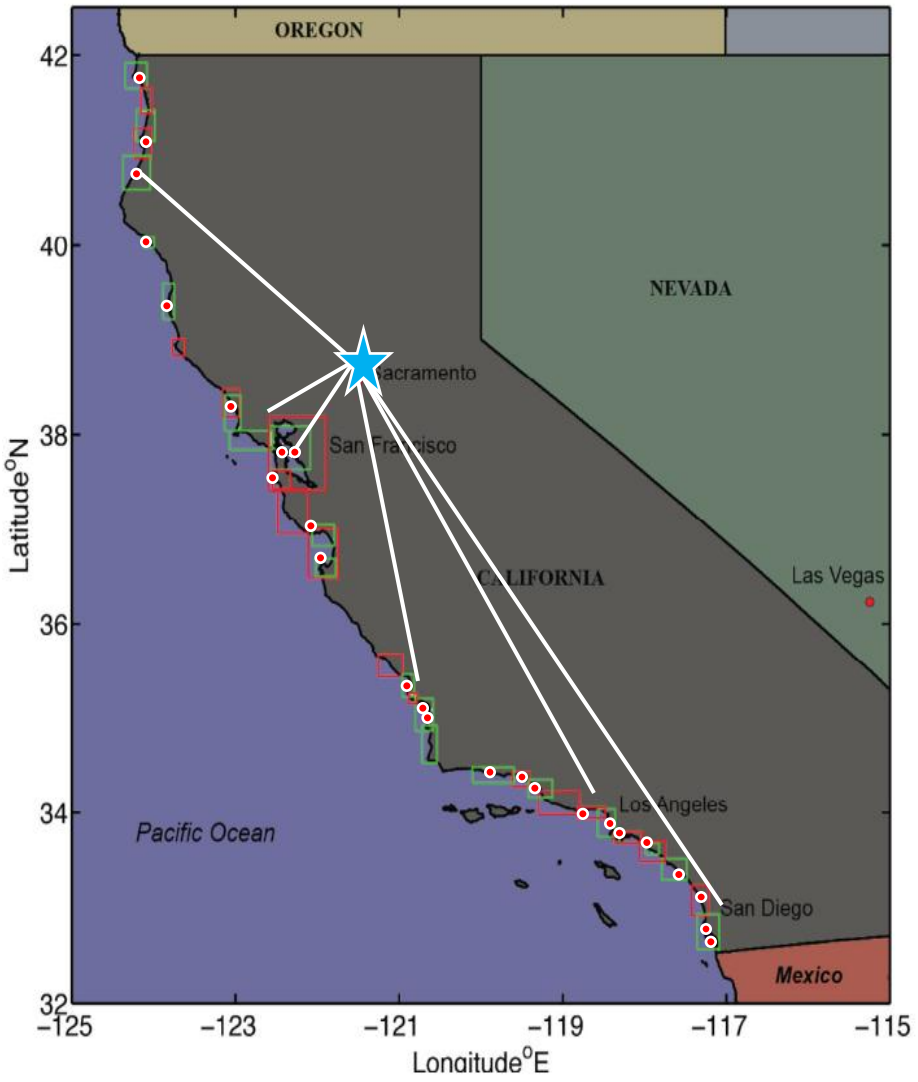
Lessons Learned for CGS Field Team Plan

- **Before event**
  - Selection of primary field locations critical; work closely with locals
  - Teams need guidance
    - Incorporate new IOC-UNESCO field guide
    - Regional field team workshops
- **During event**
  - Improved communication between field and CGS Clearinghouse
- **After event**
  - Set up of online data sharing point
  - Request video from locals/harbors
  - Seek additional funding source for post-tsunami field teams and data compiling

South end Shelter Island, San Diego Bay

Priority sites for real-time observations, based on:

- Population
- Harbors
- Higher potential run-ups based on modeling
- Historical run-up noted
- No tide gauges

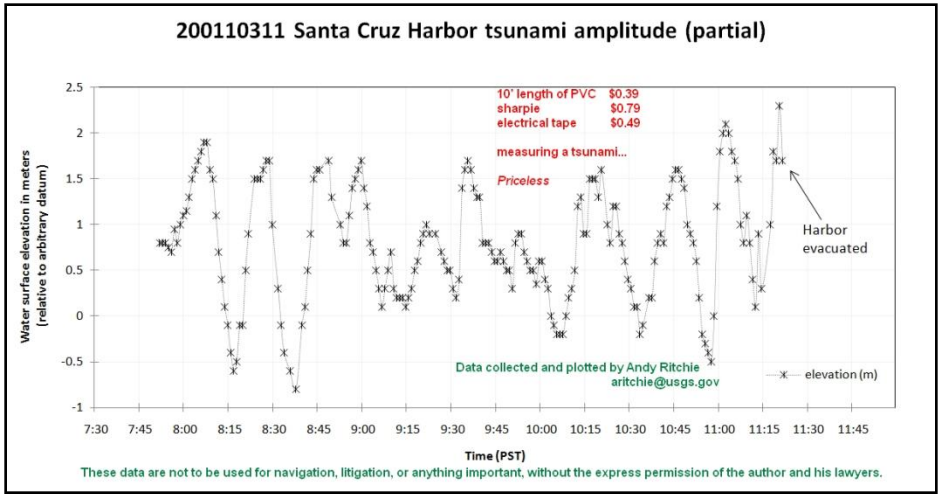


Tsunami Response Project Data Collection

CGS Pre-Tsunami Field Teams

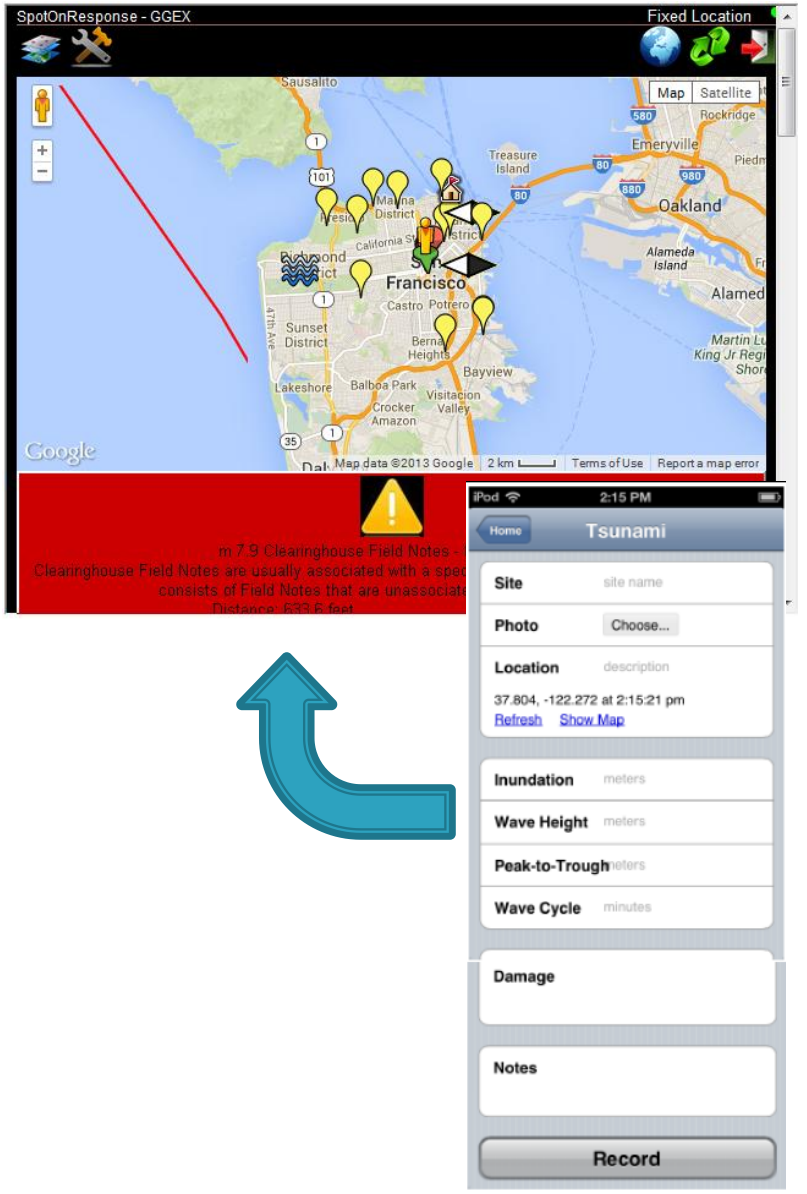
Information collected/provided during tsunami to clearinghouse and counties:

- Location
- Maximum amplitude/wave height
- Maximum/peak velocity
- Maximum peak-to-trough of wave
- Average time of wave cycle
- Damage
- Actions taken by/Issues for local community or harbor
- Photos/video



Update on Tsunami Field Team Project

- Developing tsunami observation teams
  - Integrating into State EM plan and the online CA Earthquake Clearinghouse
  - USGS Field Note App
  - Held several workshops and field trips
  - Identified key locations, many without tide gauges
  - Over 50 geologist/engineers state-wide
- Guidance report on developing teams and team member tasks available Fall of 2013
- Preliminary call-down exercise has been completed
- Extended exercise in March 2014



Expand Tide Gauge and ADCP Currents Network

- Tide gauges assist Warning Center and EMs
  - Forecast updates
  - Changes to Alert level
  - Post-tsunami evaluation
- Developed NOAA and NTHMP priority locations
- Tide gauges through NOAA-NOS and Warning Centers
- Tide gauges = Ft Bragg, Santa Cruz, Ventura, Newport Beach
- ADCP = Acoustic Doppler Current Profiler; Crescent City (implemented soon) and Santa Cruz (proposed)

Develop Real-time Online Webcam Network

- Cameras either mobile (with field team members) or fixed locations
- Locations – primarily harbors where strong currents or damage expected
- Objectives:
  - Real-time “eyes on the water” for Ems
  - Data collection of tsunami evaluation
- Multi-state proposal in 2014

Idealized multiple webcams statewide capturing tsunami in real time

Field Teams and Instrumentation Plan Summary

- Ready for implementation or still demonstration project?
  - Field teams and instruments can be implemented
  - Webcams still demo project under “research and development”
  - NEEDS: 1) guidance for field teams and webcams; and 2) state-level field team protocol plans
- Importance to NTHMP: MODERATE to HIGH, based on: 1) partial support in Strategic Plan; 2) importance in assisting NOAA Warning Centers and emergency response activities; and 3) assisting post-event disaster declarations (recovery funds)