The March 11, 2011 Tohoku Tsunami

In Japan and California

TSUNAMI IN JAPAN:
A magnitude 9.0 earthquake off of northeastern Honshu Island caused a massive tsunami that first arrived on-shore within 20-30 minutes after the earthquake. The tsunami measured 30-feet high at the coast along the Sendai Plain with a maximum run-up to an elevation of 130 feet at Aneyoshi Bay located further to the north.

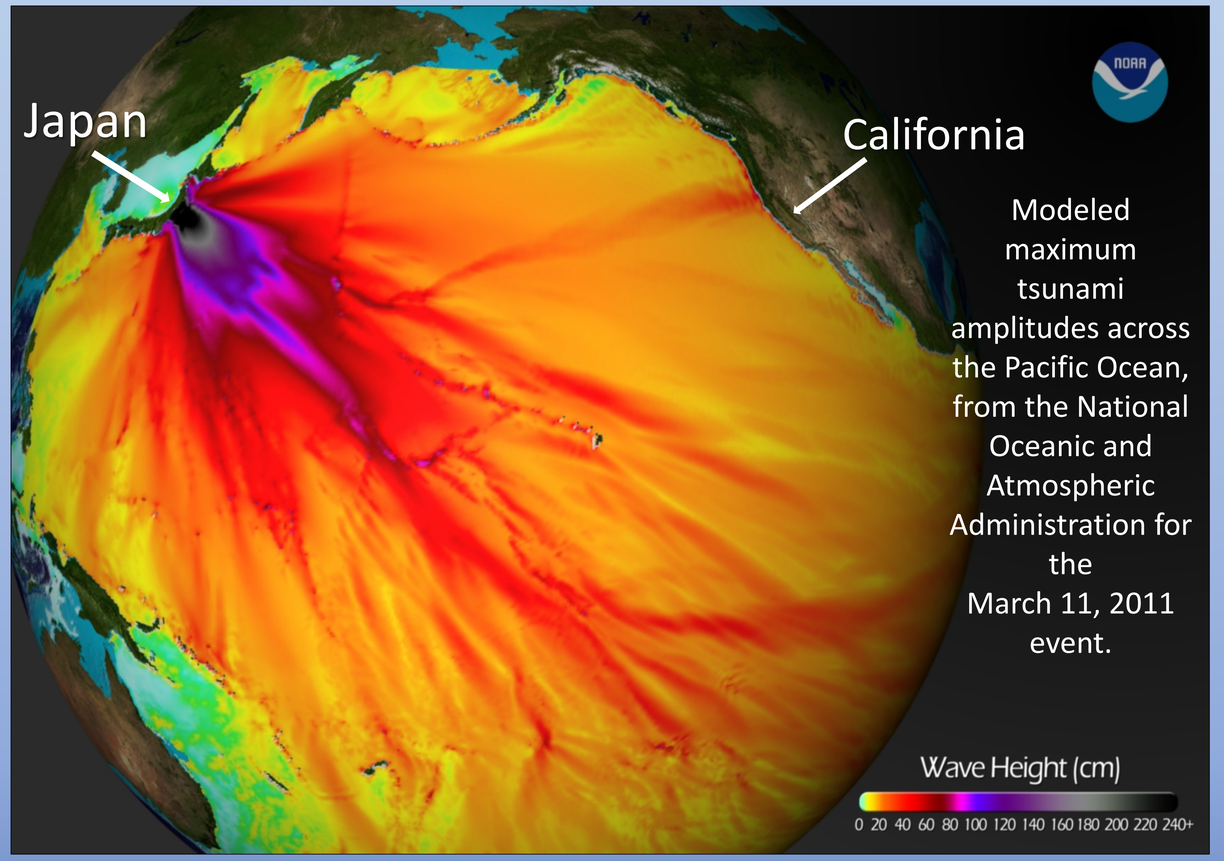
March 11, 2011 – Catastrophic flooding on the Sendai Plain.

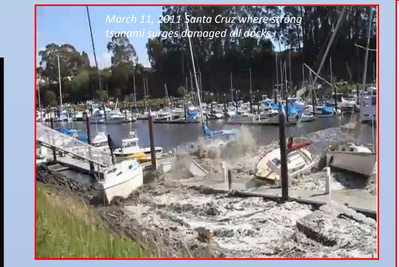
March 11, 2013 Okawa Elementary School, Ishinomaki, where 74 students perished.

IMPACTS IN JAPAN:
Although 200,000 people successfully evacuated, tragically over 18,000 people were killed or remain missing in Japan because of the tsunami. The Fukushima Daiichi Nuclear Power Plant suffered a catastrophic meltdown causing long-term radiation problems. The World Bank estimates the earthquake and tsunami was the costliest natural disaster in world history at $235B.

RECOVERY IN JAPAN:
After several years, communities have started to rebuild using coastal setbacks, raised land, and other engineered, protective measures. Significant segments of the impacted population have moved to other regions and will likely not return. Large portions of the Fukushima Prefecture may not be repopulated because of the nuclear disaster.

2015 Rikuzentakato, where the land level is being raised.



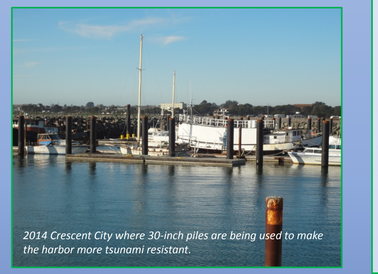


March 11, 2011 Santa Cruz where strong tsunami surges damaged all docks.

TSUNAMI IN CALIFORNIA: Ten hours after the tsunami was generated in Japan, the trans-Pacific tsunami reached the California coast. The largest tsunami wave heights were eight feet in Crescent City. Although only very localized on-land flooding occurred, strong coastal currents in and around harbors and bays were significant.

IMPACTS IN CALIFORNIA: One person was killed and 27 harbors sustained a total of $100M in damages. In particular, all docks in Crescent City and Santa Cruz harbors were damaged or destroyed by several strong tsunami surges that arrived over the next 24+ hours. A major disaster declaration was issued in the state by President Obama.

March 28, 2011 Crescent City where boats and docks were heavily damaged.



2014 Crescent City where 30-inch piles are being used to make the harbor more tsunami resistant.

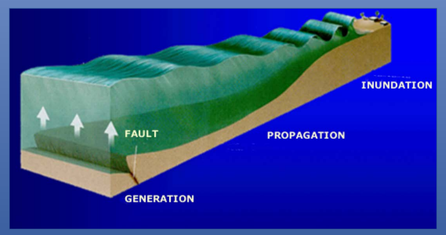
RECOVERY IN CALIFORNIA:
Sedimentation, environmental issues, and damage inside several harbors delayed rebuilding efforts by several years. Larger piles and stronger docks were required in harbors like Crescent City and Santa Cruz to make them more "tsunami resilient" in future events.

CALIFORNIA GEOLOGICAL SURVEY | Cal OES GOVERNOR'S OFFICE OF EMERGENCY SERVICES | NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

THE NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM (U.S.)

What is a Tsunami?

- Tsunamis are long ocean waves which are typically caused by a displacement of the ocean floor, commonly initiated by large earthquakes in the rock beneath the sea floor.
- Tsunamis grow in height near shore because the water shallows.
- Tsunamis form a series of waves which can be very large in the near-source region (like in 2011 in Japan) and potentially large and damaging thousands of miles away (like in 2011 in California).
- Dangerous conditions can include swift moving flooding, strong currents and large eddies, and viscous sediment-laden water. They cannot be surfed.



Preparing for a Tsunami

- First, review information about the tsunami risk to coastal areas where you live, work, or visit.
- Become familiar with your local evacuation plan and practice evacuating to become familiar with your evacuation route.
- For local events, watch for "natural warning signs" like feeling a large earthquake, hearing abnormal ocean roar, or seeing the water recede, and get to high ground immediately. Any one sign could be an indication of tsunami danger.
- Follow the instructions of the local emergency managers.

For More Information

www.tsunami.ca.gov
www.tsunamizone.org

All photos by Rick Wilson or stills from online videos of the tsunami activity and impacts from the March 11, 2011 event.

Central image shows trans-Pacific forecasted maximum tsunami amplitudes from the National Oceanic and Atmospheric Administration (NOAA) for the March 11, 2011 event.

The image at the bottom is from Russian Academy of Sciences illustrating tsunami generation, propagation, and inundation.