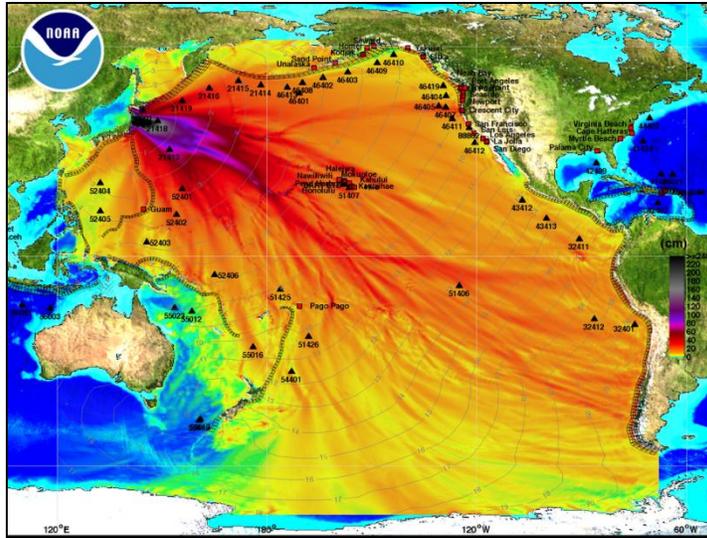


2011 Tōhoku Tsunami

Description

On March 11, 2011, the fifth largest earthquake since 1900 hit Japan, registering a magnitude 9.0. Alternatively known as the Great East Japan Earthquake or the 3.1.1 Earthquake, the quake was a megathrust quake on or near the subduction zone plate boundary of the Pacific and North American plates. Horizontal displacement and subsidence caused some Japanese coastal areas to remain permanently below sea level. The March 11 earthquake ruptured an area roughly 300 km long and 200 km wide on the boundary



Above: Tsunami maximum amplitudes. Image: NOAA

between the subducting Pacific plate and the overriding North American plate. Although minimal structural damage occurred from the quake itself, the resulting tsunami devastated the eastern coast of Japan, with the majority of casualties and damage occurring in Iwate, Miyagi and Fukushima prefectures. The event ultimately precipitated tsunami warnings for over 50 countries throughout the Pacific region; maximum run-up height in Japan was recorded at 127 feet.

Below: Observed tsunami wave heights. Image: Wikipedia Commons, Pekachu

Impact

The event killed over 15,000 people, with more than 130,000 people displaced from their homes. The total economic loss in Japan was estimated at \$309 billion dollars (USD). Electricity, gas and water supplies, telecommunications and railway service were all severely disrupted. Several reactors damaged at a nuclear power plant in Fukushima caused an evacuation of residents within a 50-mile radius, and long-term questions about the safety of the nuclear power plants in Japan.



Unlike the 2004 Indian Ocean Tsunami, the number of children and youth were less than 6.5% of those who died, while more than 65.2% were over the age of 60. The majority of those killed (92.5%) died from the tsunami.

Hawaii, California, and Oregon all sustained extensive damages to boats and docks, and one person died in Crescent City, California, when he attempted to take photos of the incoming tsunami waves.



*Above: Submerged boat in Santa Cruz Harbor.
Image: Santa Cruz Wiki, Alex Darocy.*

Left: Emergency vehicles lined up in Sukuiso, Japan, after the tsunami. Image: US Navy, McCord

Lessons learned

Although Japan is at the forefront of earthquake and tsunami planning and preparedness, the size of the 2011 earthquake and tsunami was larger and more powerful than they thought possible. In addition, many people had become complacent about tsunamis because of the large seawalls that had been constructed along much of the coastline to protect cities and towns. However, at least one tiny village was saved by remembering history. In Aneyoshi, which had been destroyed in both the 1986 and 1933 tsunamis, a tsunami stone had been placed warning residents to not build below it. Because the residents had heeded the warning, no homes were lost even though the tsunami runup height exceeded 127 feet. The northeast coast of Japan has a number of tsunami stones, which carry various warnings but were all intended to remind people of the extreme danger of tsunamis. Now, some researchers have proposed using some of the shells of remaining structures as modern day “tsunami stones” so the message is not forgotten again.

Numerous international teams of engineers traveled to Japan after the tsunami to assess the effectiveness of building and infrastructure design. According to a report from the California Department of Transportation (Caltrans), bridges that had been seismically retrofitted or designed for ground shaking generally performed well under the force of the tsunami.

A positive note from the earthquake and tsunami is that the sheer volume of data collected from this epic event will lead to new understandings for scientists, and better methods for managing future risk. According to USGS, an unparalleled amount of strong ground motion data were recorded that will help reduce uncertainty in seismic hazard assessments in Japan and elsewhere.

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