U.S. Tsunami Programs: A Brief Overview

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Japan Earthquake and Tsunami

An 8.9 magnitude massive earthquake struck off Japan's northeast coast near Honshu in the afternoon on Friday, March 11, 2011 (12:46 a.m. eastern time in the United States). The earthquake triggered a tsunami[1] that, according to early reports, has caused widespread devastation to parts of the coastal regions in Japan closest to the earthquake. The tsunami traveled across the Pacific Ocean, and the National Oceanic and Atmospheric Administration (NOAA) tsunami warning centers in Hawaii and Alaska issued tsunami warnings for coastal areas of Hawaii, Guam, the Commonwealth of the Northern Marianas, American Samoa, Alaska, and California. The first tsunami waves reached Hawaii in the early morning of March 11,[2] and reached the west coast of the United States later in the morning (Pacific time). Although the tsunami appears to have caused widespread damage along the northeast coast of Japan, tsunami warnings issued from the tsunami warning centers appear to have given the above U.S. Pacific territories, Hawaii, and the U.S. West Coast ample warning to prepare for incoming waves. In addition, the long distance traveled across the Pacific from the earthquake epicenter has likely attenuated the energy associated with the tsunami thousands of miles from its source. In contrast, the city of Sendai, Japan, is just 80 miles west of the epicenter.[3]

Tsunami Warning Centers

NOAA's National Weather Service (NWS) manages the two tsunami warning centers that monitor, detect, and issue warnings for tsunamis generated in the Pacific Ocean. The NWS operates the Pacific Tsunami Warning Center (PTWC) at Ewa Beach, HI, and the West Coast/Alaska Tsunami Warning Center (WC/AKTWC) at Palmer, AK. The PTWC monitors for tsunamis and issues warnings for the Hawaiian Islands, the U.S. Pacific territories, and other U.S. and international interests in the Pacific Basin. The center was established in 1949, after a strong earthquake and massive landslides off the coast of southwest Alaska caused a disastrous tsunami for the Hawaiian Islands only hours later. The WC/AKTWC was established in 1967, following a magnitude 9.2 earthquake that struck Anchorage, AK, in 1964 and caused major earthquake and localized tsunami damages.[4] The WC/AKTWC is responsible for issuing tsunami warnings to emergency management officials in Alaska, British Columbia (Canada), Washington State, Oregon, and California. The WC/AKTWC also serves as the center for warning U.S. populations located in the western Atlantic.

[1] A tsunami is a large ocean wave typically caused by a subsea earthquake or volcanic eruption that can cause extreme destruction when it strikes land.

[2] CNN U.S., *Tsunami Waves Reach Hawaii, Eye West Coast*, CNN Wire Staff, March 11, 2011, http://www.cnn.com/2011/US/03/11/tsunami/index.html?hpt=T1.

[3] U.S. Geological Survey, Earthquake Hazards Program, http://earthquake.usgs.gov/earthquakes/eqinthenews/2011/usc0001xgp/#details.

[4] See NOAA, NWS, "How *TsunamiReady* Helps Communities and Counties at Risk," http://www.tsunamiready.noaa.gov/.

The National Tsunami Hazards Mitigation Program

The National Tsunami Hazards Mitigation Program (NTHMP) assists states in emergency planning and in developing maps of potential coastal inundation for a tsunami of a given intensity. The NTHMP also operates tsunami disaster outreach and education programs through NOAA's *TsunamiReady* program. In 1992, NOAA launched the NTHMP to address the credibility of Pacific tsunami warnings and to reduce the number of "false alarms." The goal of NTHMP is to ensure adequate advance warning of tsunamis along all the U.S. coastal areas and appropriate community response to a tsunami.[5]

Detecting Tsunamis and Issuing Warnings

The tsunami warning centers monitor and evaluate data from seismic networks and determine if a tsunami is likely based on the location, magnitude, and depth of an earthquake.[6] If the center determines that a tsunami is likely, they transmit a warning message to NOAA's weather forecasting offices and state emergency management centers, as well as to other recipients. The centers monitor coastal water-level data, typically with tide-level gages, and data from NOAA's network of Deep-ocean Assessment and Reporting of Tsunamis (DART) detection buoys to confirm that a tsunami has been generated, and if not, to cancel any warnings.[7]

NOAA first completed a six-buoy DART array in 2001 in the Pacific Ocean. Shortly after the 2004 Indian Ocean earthquake and tsunami that killed over 200,000 people, Congress passed H.R. 1674, the Tsunami Warning and Education Act (P.L. 109-424), to enhance and modernize the existing Pacific Tsunami Warning System to increase coverage, reduce false alarms, and increase the accuracy of forecasts and warnings, among other purposes. In part, the 2004 tsunami provided the impetus to expand and upgrade the DART system and to improve the U.S. capability to detect and issue warnings for tsunamis generally. As a result, the array was expanded to a total of 39 DART buoys in March 2008.[8]

In 2010, the Government Accountability Office (GAO) found that NOAA had made progress since 2005 in expanding and strengthening its tsunami warning and mitigation capabilities, including the deployment of the 39 DART buoys. GAO also found that operating and maintaining the buoys has proved difficult and costly, consuming about 28% of the total NOAA Tsunami Warning Program budget in FY2009.[9] GAO noted that NOAA is exploring ways to reduce maintenance costs by improving buoy reliability.

[5] NOAA FY2012 Blue Book, Chapter 5, National Weather Service, p. 691, http://www.corporateservices.noaa.gov/nbo/fy12_presidents_budget/National_Weather_Service_FY12.pdf.

[6] Nearly all tsunamis are triggered by subsea earthquakes, although some may also be caused by underwater volcanic eruptions or landslides.

[7] U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, April 2010, p. 5.

[8] According to NOAA, 33 of the DART buoys are deployed in the Pacific Ocean, and the rest are deployed in the Atlantic Ocean and Caribbean. NOAA National Data Buoy Center, Deep-ocean Assessment and Reporting of Tsunamis (DART) Description, http://www.ndbc.noaa.gov/dart/dart.shtml.

[9] U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, p. 21.

Funding for the Tsunami Program

Funding for the NOAA tsunami program supports three main categories of activities: (1) *warning*, such as the activities of the tsunami warning centers and DART network; (2) *mitigation*, such as the activities of NTHMP; and (3) *research*, including activities conducted by the Pacific Marine Environmental Laboratory and the National Buoy Data Center.[10] In the NOAA budget, these activities are cross-cutting among different activities under the NWS line item.[11] GAO, which analyzed funding data for the three general categories, noted that total funding for all these activities ranged from $5 million to $10 million between FY1997 and FY2004, but increased after the 2004 Indian Ocean tsunami from approximately $27 million in FY2005 to $42 million in FY2009.[12] According to GAO, the proportion of funding allocated to warning activities increased from about 40% of the total in FY2004 to approximately 70% of the funding in FY2009.[13] The proportion allocated to mitigation decreased from approximately 50% of the total in FY2004 to about 30% in FY2009, while the proportion for research remained steady between about 6% to 10%.

Funding for the NWS tsunami program for FY2010 was approximately $41 million, allocated as follows:

- $23 million—Strengthen U.S. Tsunami Warning Program;
- $13 million—Spectrum Auction funding;
- $4 million—NWS/Local Warnings and Forecasts; and
- $1 million—Office of Oceanic and Atmospheric Research/Pacific Marine Environmental Laboratory.[14]

Additional Reading

CRS Report RL33861, *Earthquakes: Risk, Detection, Warning, and Research*, by Peter Folger

CRS Report RL33436, *Japan-U.S. Relations: Issues for Congress*, coordinated by Emma Chanlett-Avery

CRS Report R41023, *Haiti Earthquake: Crisis and Response*, by Rhoda Margesson and Maureen Taft-Morales

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[10] U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, p. 7.

[11] For example, the FY2010 enacted budget contains a line item: Strengthen U.S. Tsunami Warning Network—$23.264 million. However, research activities for tsunamis are included in the overall budget for the Pacific Marine Environmental Laboratory and for the National Buoy Data Center.

[12] Starting in FY2009, the tsunami program received funding from the proceeds of the Federal Communication Commission's auctioning of broadcast frequency spectrum. In FY2012, the program will be augmented by $12.7 million from auction proceeds, according to NOAA. Total funding received from auction proceeds will be approximately $50 million for the tsunami program at the end of FY2012, according to GAO.

[13] U.S. Government Accountability Office, *U.S. Tsunami Preparedness: NOAA Has Expanded Its Tsunami Programs, but Improved Planning Could Enhance Effectiveness*, GAO-10-490, p. 8.

[14] E-mail from Lara Hinderstein, NOAA Budget Outreach and Communications, March 11, 2011.

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