



NOAA Tsunami Program

Of all Earth's natural hazards, tsunamis are among the most infrequent. Yet, they pose a major threat to coastal populations. Although tsunamis cannot be prevented, community preparedness, accurate and timely warnings and effective response can save lives and protect property. The 2004 Indian Ocean tsunami and the 2011 Tohoku, Japan tsunami focused world attention on the very real threat of tsunamis and underscored the value of a comprehensive warning system and an educated public.

A tsunami is a series of waves created by a large and sudden displacement of the ocean. Most tsunamis are caused by large earthquakes below or near the ocean floor, but they can also be caused by landslides, volcanic activity, certain types of weather and near-earth objects. A tsunami can strike at any time and can be dangerous to life and property when it reaches the shore. It may arrive like a fast-rising flood and can strike with devastating force. Tsunami waves can range in size from inches to more than a hundred feet high and can flood low-lying areas more than a mile inland. The first wave may not be the largest or most damaging, and the danger may last for hours or days.

NOAA's Role

The NOAA Tsunami Program is a cross-NOAA cooperative effort to minimize the impacts of tsunamis. For more than 50 years, NOAA and its predecessor agencies have had operational responsibility for the U.S. Tsunami Warning System. This end-to-end system operates in partnership with federal, state, territorial, international and local organizations as well as industry.

NOAA has led the U.S. effort to build a comprehensive tsunami warning system. The result is a nation better equipped to detect and respond to tsunamis.

Major components include observations to detect tsunami generating earthquakes and tsunamis, models to forecast tsunami impacts, timely and accurate messaging, decision-support services during events and preparedness and mitigation activities.

NOAA's Tsunami Warning Centers

NOAA operates two tsunami warning centers, which are staffed 24 hours a day, 7 days a week. The two centers monitor for tsunamis and the earthquakes that may cause them, forecast tsunami impacts and issue tsunami messages.



Coverage areas for NOAA's two tsunami warning centers: National Tsunami Warning Center (red) and Pacific Tsunami Warning Center (yellow)

The Pacific Tsunami Warning Center (PTWC) in Hawaii was established following a 1946 tsunami that struck Hawaii and killed more than 150 people and caused over \$300 million in damage (2016 dollars). The PTWC directly serves the Hawaiian Islands, the U.S. Pacific and Caribbean territories and the British Virgin Islands and is the primary international forecast center for the warning centers of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization in the Pacific and Caribbean and Adjacent Regions.





In 1964, the largest recorded earthquake in U.S. history generated a number of destructive tsunamis that killed 124 people in Alaska, Oregon and California and caused approximately \$1 billion in damage (2016 dollars). This prompted the creation of the National Tsunami Warning Center (NTWC) in Alaska. The NTWC serves the continental United States, Alaska and Canada.

Detecting and Forecasting Tsunamis

The warning centers depend on seismic and sea-level networks from around the world and forecast models to help them determine when and where to issue tsunami messages. Seismic networks provide information about an earthquake's location, depth and magnitude to help the centers determine if it may have generated a tsunami and if tsunami messages should be issued. If the earthquake meets certain criteria, the centers use sea-level data to ascertain the existence of a tsunami. NOAA has established and maintains two essential sea-level observation networks: a network of Deep-Ocean Assessment and Reporting of Tsunami (DART) systems and an extensive array of coastal water-level stations.



If a tsunami is detected, the centers use data from seismic and sea-level networks as inputs to NOAA's tsunami forecast models. These models use real-time data and pre-established scenarios to simulate tsunami movement across the ocean and estimate coastal impacts. The resulting forecasts, combined with historical tsunami data and additional seismic analysis, help the centers decide whether to cancel messages or adjust them with more accurate, targeted and detailed information. These forecasts also provide local officials

with actionable information that can guide decisions about beach and road closures and evacuation.

NOAA also maintains a global historical tsunami database that includes information on roughly 2,500 tsunamis from 2000 B.C. to the present. It is used to identify regions at risk, validate tsunami forecast models, help position DART systems and water-level stations and prepare for future events.

Preparing Communities and the Public

Preparedness and mitigation activities that enhance response to a tsunami threat and reduce or eliminate potential tsunami impacts are important parts of any tsunami warning system. Inundation mapping, hazard planning (e.g., evacuation and land use) and outreach and education are critical preparedness and mitigation activities. NOAA works with its federal, state, territorial, local and international partners to help coastal communities, residents and visitors understand their tsunami risk and how to prepare for and respond to tsunamis and tsunami warnings.

International Coordination

The NOAA Tsunami Program also plays a vital role in the global tsunami warning system based on its United Nations-directed mission to provide tsunami information to international partners in the Pacific and Caribbean and contribute to the development of a fully functional and interoperable global system made up of regional tsunami warning networks. NOAA monitors international tsunami warning activities; provides international warning, training, data exchange and outreach and education assistance; and uses international data, communications and research to carry out its mission, both internationally and domestically.

Learn more about the NOAA Tsunami Program and tsunamis at <http://tsunami.gov/> and NOAA at <http://www.noaa.gov/>. 

