

NOAA Tsunami Program

Advancements and Future Plans

Since the devastating Indian Ocean tsunami in 2004, NOAA has made great improvements in tsunami detection, forecasting, warning, and preparedness capabilities. As a result, U.S. and international coasts are far better prepared to respond to a tsunami. These improvements include the following:

Observations

- In 2004, the United States had a total of six experimental Deep-Ocean Assessment and Reporting of Tsunamis (DART) tsunami buoy stations in place in the Pacific (and Chile had one). Today, a global network of **60 DART stations** (39 are U.S. owned and operated) monitors tsunami activity in the Pacific, Indian and Atlantic Oceans.
- In 2004, the number of coastal water-level stations directly supporting tsunami detection was limited, and high-frequency data were not available. Today, **188 coastal water-level stations** have been installed or upgraded to fully support tsunami warning operations.
- In 2004, 80 percent of the Global Seismographic Network data was transmitted in real-time. Today, with the support of the U.S. Geological Survey and its partners, the network has been fully upgraded to transmit 100 percent of its seismic data in real-time. In addition, NOAA upgraded its seismic networks in Alaska and Hawaii and developed and implemented new seismic processing capabilities to resolve the nature of seismic events more efficiently, significantly reducing the time to issue tsunami alerts.

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.

Warning and Forecasting

- In 2004, the **two U.S. tsunami warning centers** were staffed eight hours a day, five days a week with on-call coverage. Today, both centers are staffed 24 hours a day, 365 days a year and their areas of responsibility have been expanded to include all U.S. and Canadian coastlines. In addition, the Pacific Tsunami Warning Center (PTWC) serves as the primary international forecast center for the Pacific and Caribbean basins. Most recently, the PTWC began issuing enhanced tsunami products for all Pacific countries. The new wave height forecasts are provided to support national decision making. Between 2005 and 2012, the PTWC also provided interim warning services for the Indian Ocean. In 2013, this responsibility was transferred to the International Indian Ocean Tsunami Warning System, of which Australia, India, and Indonesia are primary information providers.
- In 2004, NOAA had limited tools available for accurately forecasting tsunami wave heights along U.S. coastlines. Today, the two U.S. tsunami warning centers use an array of numerical **tsunami forecast models** in conjunction with high-resolution **coastal inundation models** to provide accurate and reliable real-time inundation forecasts for tsunami-threatened coastal communities.
- In 2004, there was no mechanism available in the United States for mobile device dissemination of real-time tsunami warnings. Today, tsunami warnings can be sent out as Wireless Emergency Alert messages.





Preparedness

- In 2004, there was no functional international coordination outside the Pacific basin. Today, NOAA provides other countries with technical assistance, improved preparedness and capacities, and equipment to detect and communicate tsunami threats. In addition, NOAA now promotes sharing of data, best practices and policies, and has established education and training programs in several countries.
- In 2004, five states were members of the [National Tsunami Hazard Mitigation Program](#). Today, 28 U.S. coastal states, territories, and commonwealths (states) are members. Through the program, the states have received almost \$32 million in federal grants to support tsunami preparedness in their states.
- In 2004, 14 U.S. sites were prepared for a tsunami through the [TsunamiReady program](#). Today, NOAA recognizes 178 sites as TsunamiReady.

Other

- In 2004, there was no U.S.-wide tsunami hazard assessment. The first [U.S. States and Territories National Tsunami Hazard Assessment](#) was completed in 2008. This assessment helps to identify what is needed to further improve our capabilities. An update is currently underway.
- Since 2004, NOAA has improved the quality and accuracy of the [long-term archive of tsunami events](#), which is used to identify regions at risk, validate models, help position detection sensors and prepare for future events.

Looking to the Future: Tsunami Research and Development Projects

In 2004, there was also no national plan for tsunami research and the transfer of the resulting technology to operations. Today, NOAA has a plan in place that continues to make improvements to tsunami observation networks, warning operations and forecasting capabilities. Some of the research projects currently underway to improve the accuracy and timeliness of alerts include:

- Improving the speed, accuracy and reliability of tsunami detection and evaluation and ultimately tsunami warning products by:
 - > Strengthening local tsunami detection and forecast capabilities. This includes development of a tsunami buoy station that will be able to detect and measure a tsunami closer to the earthquake source, providing valuable information to warning centers even faster than the current stations.
 - > Establishing a ship-based real-time Global Positioning System (GPS) network and data collection capability to better measure sea-level changes associated with tsunami waves.
 - > Assimilating seismic and tsunami data from existing undersea cables and water-level stations into tsunami forecast models.
- Operationalizing a web-based tsunami modeling tool that allows the warning centers to run forecast models and share results, thereby enabling stakeholders to access the results to support local decision making (Tweb).
- Improving forecast models to incorporate data from water-level stations, including other flooding hazards (storm surge and tides), and further automate how they process data.
- Continuing to develop, maintain and enhance inundation forecast modeling for high-risk locations.
- Providing forecast guidance to remote locations in the Pacific and Caribbean where models are not available.
- Establishing a protocol for identifying meteorological conditions that supports development of a meteotsunami detection capability in order to provide accurate and timely alerts.

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