One NOAA: Tsunami Response

From an armada of ocean buoys moored to the sea floor, to orbiting satellites, to advance computer modeling, to around-the-clock forecast and warning centers, NOAA provides the essential detection and warnings necessary to alert emergency officials and the public about the threat of tsunamis. With more than 40 years of experience building effective detection and warning systems, NOAA has operational responsibility for the U.S. Tsunami Warning System.

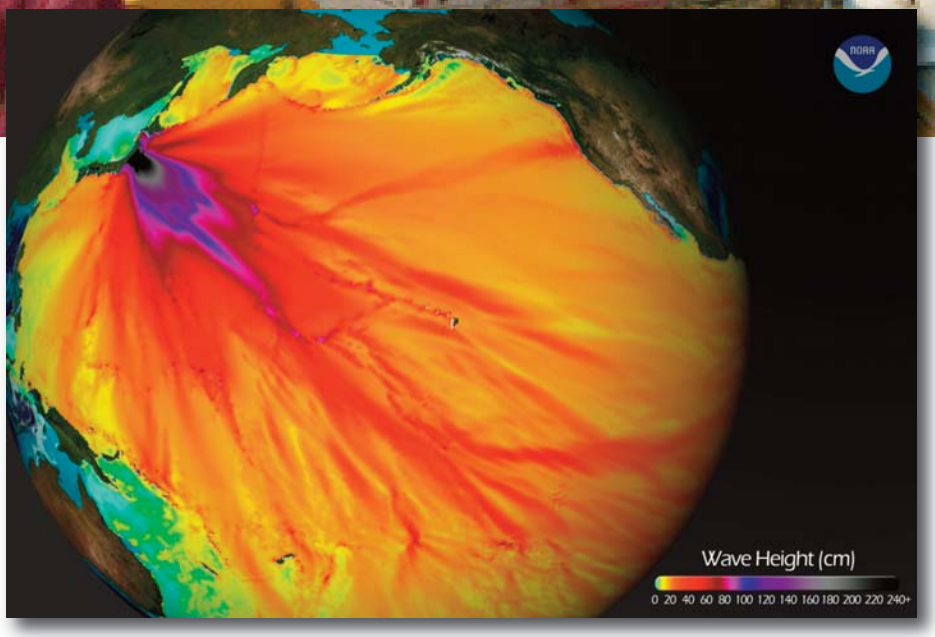
Of all Earth's natural hazards, tsunamis may be among the most infrequent, but they pose a major threat to coastal populations, particularly in the seismically active Pacific Ocean. The tragedy of the March 2011 tsunami in Japan had far reaching effects that included the U.S. West Coast and Hawaii. And in December 2004, the Indian Ocean tsunami focused the world's attention on the very real threat of tsunamis and underscored the value of a comprehensive warning system and an educated public.

All of NOAA's programs are working together, delivering an integrated *one NOAA* response. NOAA drew from capabilities from across all five of its line offices — weather, satellites, research, oceans, and fisheries — demonstrating how NOAA's various components work in concert to save lives and protect property before, during and after a tsunami:

DART buoy.

- The National Weather Service produced life-saving tsunami forecasts and warnings

- The DART (Deep-ocean Assessment and Reporting of Tsunamis) buoy tsunami warning system, which has been deployed in oceans around the world, was the result of research in NOAA's Office of Oceanic and Atmospheric Research
- Those buoys, operated by the National Data Buoy Center, are serviced by NOAA ships and charters managed by NOAA's Office of Marine and Aviation Operations
- Water levels in vulnerable coastal areas are monitored by the National Ocean Service's net work coastal tide and water level gauges
- In addition to marine and weather forecasting data, NOAA's coastal models identify areas most at-risk to tsunami and surge events, assisting federal, state and local emergency managers in decisions about the need for evacuations and other safety measures
- The National Weather Service's TsunamiReady™ program and other outreach efforts such as national Tsunami Awareness Week (March 20-26, 2011) trains local communities how to properly respond to tsunamis
- NOAA's work is done in conjunction with partnering federal agencies including U.S. Coast Guard and FEMA



Here are just some of the ways NOAA is responding to the current international crisis:

National Weather Service

Tsunami Warning Centers

NOAA's National Weather Service issues tsunami advisories, watches and warnings for the entire coastline of the U.S. and its territories and many nations in the Pacific to alert emergency managers and the public to take life-saving actions. Tsunami alerts are issued by two warning centers: the Pacific Tsunami Warning Center in Ewa Beach, Hawaii and the West Coast and Alaska Tsunami Warning Center in Palmer, Alaska.

Within minutes after the earthquake off Japan, NOAA's Pacific Tsunami Warning Center issued warnings for Japan, Russia, Marcus Island, and Northern Marianas Islands. NOAA's West Coast/Alaska Tsunami Warning Center issued tsunami information statement (assessing potential tsunami threat) for Alaska, British Columbia, Washington, Oregon and California. These centers later issued tsunami warnings for Hawaii, Alaska, Washington, Oregon and California. Local National Weather Service forecast offices that serve the U.S. coastline issued highly localized tsunami impacts statements as well.

TsunamiReady Communities

A complete and effective tsunami warning process requires three parts:

- Observations to detect a tsunami and models to forecast path and impact (seismic data trigger the first tsunami product, then DART buoys and tidal gauges confirm the presence of a tsunami, enabling NOAA to update watches or warnings),
- Advance warning (advisory, watch and warning notifications), and
- Proper response to the advance warning as a result of ongoing community awareness activities.

To support proper response, local National Weather Service forecast offices work with counties, cities, and "communities," which may include schools, business and public venues to become TsunamiReady. For communities to achieve this certification they must have the ability to receive NOAA's tsunami alerts, further warn the public, identify evacuations zones and conduct tsunami education activities. Currently there are 83 TsunamiReady communities, including 4 in Hawaii, 7 in Alaska and 42 along the West Coast. NOAA has a goal of 135 TsunamiReady communities by 2012.

National Ocean Service

Center for Operational Oceanographic Products and Services

Since the moment the Japan earthquake struck, real-time water level data from CO-OPS' coastal tide stations positioned in U.S. coastal areas throughout the Pacific provided NOAA's tsunami warning centers with critical up-to-the-minute tsunami detection information for at-risk states and territories. This information was critical in understanding the magnitude and potential impact of the tsunami.

CO-OPS' tides and currents data help modelers at NOAA's National Weather Service and Office of Oceanic and Atmospheric Research, as well as other federal and state scientists and emergency managers, determine which U.S. coastal areas are most at risk to flooding, surges and wave action. These tide stations continue to monitor water level impacts that could occur as a result of aftershocks in Japan as well as future unrelated tsunami events.

Office of Coast Survey

NOAA staff and equipment are on the West Coast assisting with detection of submerged debris in harbors and critical marine transportation arteries along the coast. Using small boats equipped with powerful echo-sounding SONAR equipment, two teams will search the sea floor for sunken vessels, debris, and other hazards dangerous to commercial shippers and recreational boaters. Navigation managers in California, Hawaii, and Alaska are coordinating rapid response survey requests and navigational resources from the impacted areas.

Office of Response & Restoration

OR&R continues to provide the U.S. Coast Guard and California authorities with scientific support services for responding to existing and potential chemical and oil spill situations as a result of damaged vessels and infrastructure.

Office of Ocean and Coastal Resource Management

NOAA's Coastal Zone Management Program is ready to assist partners in Hawaii and West Coast states should recovery planning support be necessary. NOAA is working with state coastal management partners to assess and monitor impacts this tsunami poses to coastal communities and ecosystems.

Integrated Ocean Observing System

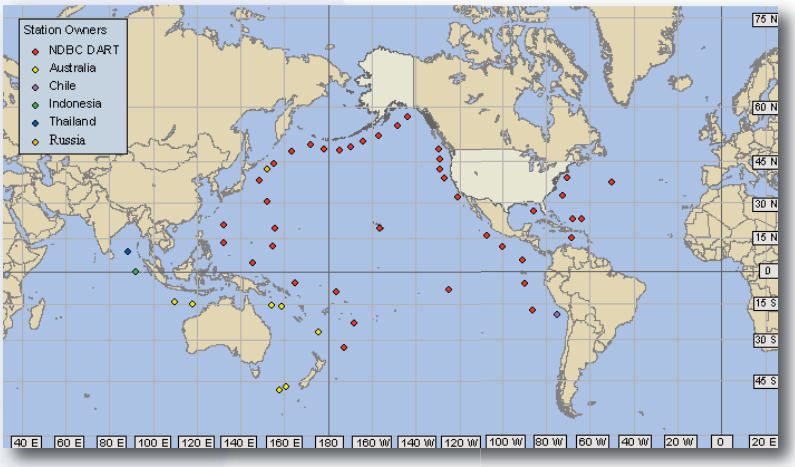
The U.S. Integrated Ocean Observing System, a NOAA-led initiative to enhance the nation's ability to deliver ocean and coastal information, provides real-time water level (tsunami arrival) and turbidity (debris) measurements (via its Pacific Islands regional network) for various Pacific locations.

IOOS also integrates several overlay elements into a map-based visualization system for Hawaii, including tsunami evacuation zones, emergency shelters, and historic tsunami heights for all major tsunamis in the last 60 years.

Office of Oceanic and Atmospheric Research

The DART buoys that encircle the "Ring of Fire" in the Pacific Ocean as well as those moored in the Gulf of Mexico, off the U.S. East Coast, and other locations, were developed by the NOAA Pacific Marine Environmental Laboratory (PMEL) in Seattle and university partners. The system went operational through the National Weather Service in 2003, and in December 2003 the DART system saved the State of Hawaii $68 million in evacuation and lost productivity costs by determining that there would be no damaging tsunami following an earthquake.

PMEL also produces tsunami impact forecast models for major U.S. coastal communities at high risk for tsunamis. The models are used to create inundation (flood) and evacuation maps for emergency managers in the event of a tsunami.



The current deployed DART buoy locations (from National Data Buoy Center).

The Honshu tsunami was generated by a 9.0 earthquake 80 miles east of Sendai, Honshu, Japan. About 25 minutes after the earthquake, a tsunami was first recorded at DART® buoy 21418. The information went into two research forecasts using the MOST (Method of Splitting Tsunami) model that simulates three processes – earthquake, transoceanic propagation, and inundation of dry land. The forecast model provides an estimate of arrival time, wave height, and inundation area immediately after a tsunami event. Confidence in the MOST model has been borne out by comparisons with the actual observations.

NOAA's response and assistance in modeling the movement of radiation or hazardous material plumes is guided by the Nuclear Regulatory Commission, which is the federal lead agency for such events.

National Marine Fisheries Service

NOAA Fisheries is working with the Food and Drug Administration and the U.S. Department of Agriculture to ensure a continuous safe supply of seafood to the American public, including the monitoring of imports.

NOAA Fisheries is working with effected states and the commercial and recreational fishing communities to assess the damages and impacts of the tsunami and provide guidance. NOAA Fisheries is also working to see if the Japanese fishing industry requires any assistance as they recover from the earthquake and tsunami.

NOAA Fisheries with other NOAA offices are working together to understand the need for additional monitoring of living marine resources, protection of these resources, and the implications of the earthquake and tsunami on living marine resources.

Satellite and Information Service

The major contribution from satellites, both geostationary and polar-orbiting, in tsunami detection and warnings is their capability to relay tide gauge observations, which can confirm whether an earthquake has generated a tsunami wave. If no wave has been generated, then no tsunami warning is issued.

The GOES Data Collection System (DCS) is crucial. The DCS enables a large variety of environmental data to be relayed from point sources through GOES and back to Earth, from where these data are sent to the various system users. These point sources are land, sea or mobile-based. All the NOAA National Ocean Service tide gauges use GOES, with several hundred that report every six minutes, specifically for tsunami warnings.

Without the ability to transmit to the GOES DCS, NOAA's National Weather Service Tsunami Warning Centers, state, and local government officials would not have the confidence to make the right decisions. Tsunamis move at roughly 600 miles per hour in the open ocean — every minute counts. Nearly a year ago, a tsunami warning was issued for Hawaii, but was canceled based solely on data delivered through the GOES DCS. This was a significant cost savings for the state.

The National Geophysical Data Center (NGDC) develops Digital Elevation Models, which are high-resolution models that simulate the effects of tsunami and coastal floods and helps scientists and emergency managers target areas most vulnerable to deadly flooding. Scientists have developed 70 DEMs for coastal areas around the U.S. and in the Caribbean and Pacific Islands region.

Just as the different parts of NOAA come together in a crisis to save lives and property and promote recovery, NOAA works closely with our sister federal agencies to provide an integrated response to disasters.

GOES-R satellite.

For more information contact NOAA Communications & External Affairs at 202-482-6090.

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