TSUNAMIS

Of all Earth's natural hazards, tsunamis are among the most irregular and the most infrequent. Yet, they pose a major threat to coastal populations, particularly in the Pacific. The tragedy of the December 2004 Indian Ocean tsunami focused world attention on the rare but very real threat of tsunamis and the need for a comprehensive warning system.

With more than 40 years of experience building effective detection and warning systems, NOAA has operational responsibility for the U.S. Tsunami Warning System. The agency provides a 24-hour detection and warning system and increases public awareness about the threat of tsunamis.

NOAA first began exploring the development of a tsunami warning system in 1946, when a tsunami originating in the Aleutian Islands struck Hawaii, killing more than 150 people. A few years later, in 1949, NOAA established the Richard H. Hagemeyer Pacific Tsunami Warning Center in Ewa Beach, Hawaii.

The West Coast/Alaska Tsunami Warning Center, in Palmer, Alaska, was established by NOAA in 1967 as a direct result of the great Alaska earthquake that occurred March 27, 1964. Of 132 deaths, 122 were attributed to the Pacific-wide tsunami generated by the magnitude 9.2 earthquake.

The two centers are responsible for issuing tsunami advisories, watches, warnings and information messages to emergency management officials and the public. In addition, the Pacific Tsunami Warning Center serves as the operational center for the *Tsunami Warning System of the Pacific*, which is comprised of 26 member nations of the Pacific Rim. In this international role, this center issues tsunami warnings for Pacific Basin teletsunamis (tsunamis traveling across the Pacific Ocean). For local tsunamis (events that travel only a short distance) outside the United States, the tsunami warnings are issued individually from the nations near the occurrence.

A Dart II buoy being lowered into the Pacific Ocean.

The Pacific Tsunami Warning Center, in partnership with the Japan Meteorological Agency, is providing tsunami advisory and watch alerts to 20 Indian Ocean countries on an interim basis, until regional warning centers can be established in these areas.

The warning centers use an extensive network of Deep-ocean Assessment and Reporting of Tsunamis (DART) stations and sea-level gauges to determine if a tsunami has been generated.

DART stations provide real-time tsunami detection as waves travel across the open ocean. Each DART consists of a bottom pressure sensor anchored to the seafloor, and a companion moored surface buoy. An acoustic link transmits data from the bottom pressure sensor to the surface buoy. Satellite links then relay the data to ground stations, and then to the tsunami warning centers for action within a matter of seconds.

Automated sea-level stations are located closer to shore than the DART stations. The sea-level gauges record water level in one-minute intervals, then transmit that data via satellite to the tsunami warning centers. These data become more critical as a tsunami nears the shore.

On the research side, NOAA has developed 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.

NOAA also maintains a long-term archive of tsunami events. This global database includes information on nearly 2,000 tsunamis from 2000 B.C. to the present and is used to identify regions at risk, validate tsunami models, help position detection sensors and prepare for future events.

As with any natural hazard, the more informed the public, the better the chances for survival. Through its voluntary TsunamiReady® program, NOAA works with communities to prepare evacuation plans, enhance communications, and heighten awareness of tsunamis for both residents and visitors.

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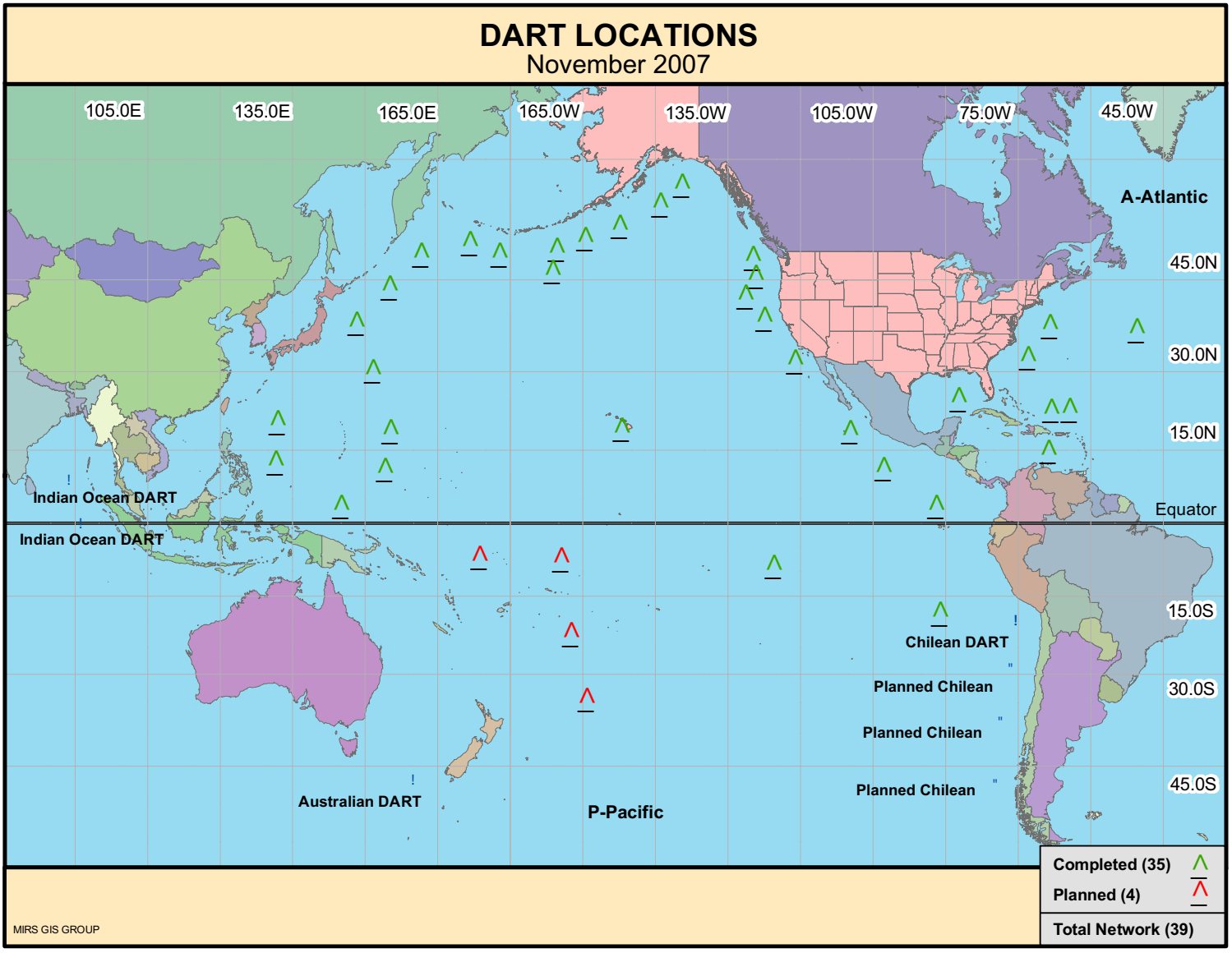
An effective tsunami warning system must include hazard detection, risk assessment, warning dissemination and a public that understands what to do when a warning is sounded. NOAA has led the U.S. effort to build a comprehensive tsunami warning system that includes all of these elements. The result is a nation better equipped to detect a tsunami and alert communities of the impending danger.

General Information about Tsunamis

Tsunami (*soo-NAH-mee*) is a Japanese word meaning "harbor wave." It is a series of ocean waves created by a sudden displacement of seawater. Most tsunamis are generated by earthquakes, but they may also be caused by volcanic eruptions, landslides, undersea slumps or meteor impacts.

Waves radiate outward in all directions from the disturbance and can propagate across entire ocean basins. Tsunami waves are distinguished from ordinary ocean waves by their great length between peaks, often exceeding 100 miles in the deep ocean, and by the long amount of time between these peaks, ranging from five minutes to an hour. The speed at which tsunamis travel depends on the ocean depth. A tsunami can exceed 500 mph in the deep ocean but slows to 20 or 30 mph in the shallow water near land. In less than 24 hours, a tsunami can cross the entire Pacific Ocean.

In the deep ocean, a tsunami is barely noticeable and will only cause a small and slow rising and falling of the sea surface as it passes. Only as it approaches land does a tsunami become a hazard. As the tsunami approaches land and shallow water, the waves slow down and become compressed, causing them to grow in height.



NOAA has installed 35 DART stations -- 28 in the Pacific and seven in the Atlantic/Caribbean. The network of 39 stations is expected to be complete by the end of March 2008.