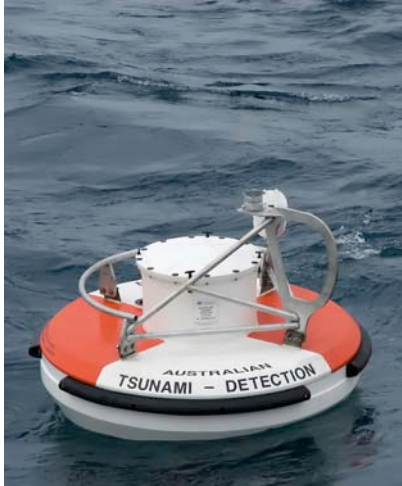


Deep Ocean Tsunami Detection Buoys



The surface component of an operational deep-ocean tsunami detection buoy.

What is a deep-ocean tsunami detection buoy?

Deep-ocean tsunami detection buoys (DART™) are one of two types of instrument used by the Bureau of Meteorology (Bureau) to confirm the existence of tsunami generated by undersea earthquakes. These buoys observe and record changes in sea level out in the deep ocean. This enhances the capability for early detection and real-time reporting of tsunami before they reach land.

Interesting Fact: Deep-ocean tsunami detection buoy technology was initially developed in the United States of America by the Pacific Marine Environmental Laboratory (PMEL) of the National Oceanic and Atmospheric Administration (NOAA).

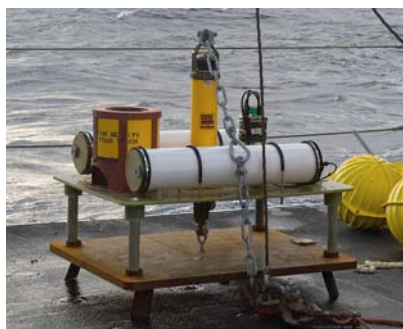


Australian Government
Bureau of Meteorology

How does a deep-ocean tsunami detection buoy work?

A typical tsunami buoy system comprises of two components; the pressure sensor anchored to the sea floor and the surface buoy. The sensor on the sea floor measures the change in height of the water column above by measuring associated changes in the water pressure. This water column height is communicated to the surface buoy by acoustic telemetry and then relayed via satellite to the tsunami warning centre.

The system has two modes – ‘standard’ and ‘event’. The system generally operates in ‘standard’ mode, where it routinely collects sea level information and reports via satellite at relatively low frequency transmission intervals (i.e. every 15 minutes). This helps to conserve battery life and hence extend the deployment life. The tsunami buoy is triggered into ‘event’ mode when the pressure sensor first detects the faster moving seismic wave moving through the sea floor. It then commences reporting sea level information at one minute intervals to enable rapid verification of the possible existence of a tsunami. The system returns to standard mode after 4 hours if no further seismic events are detected.



A pressure sensor ready for deployment on the sea floor.

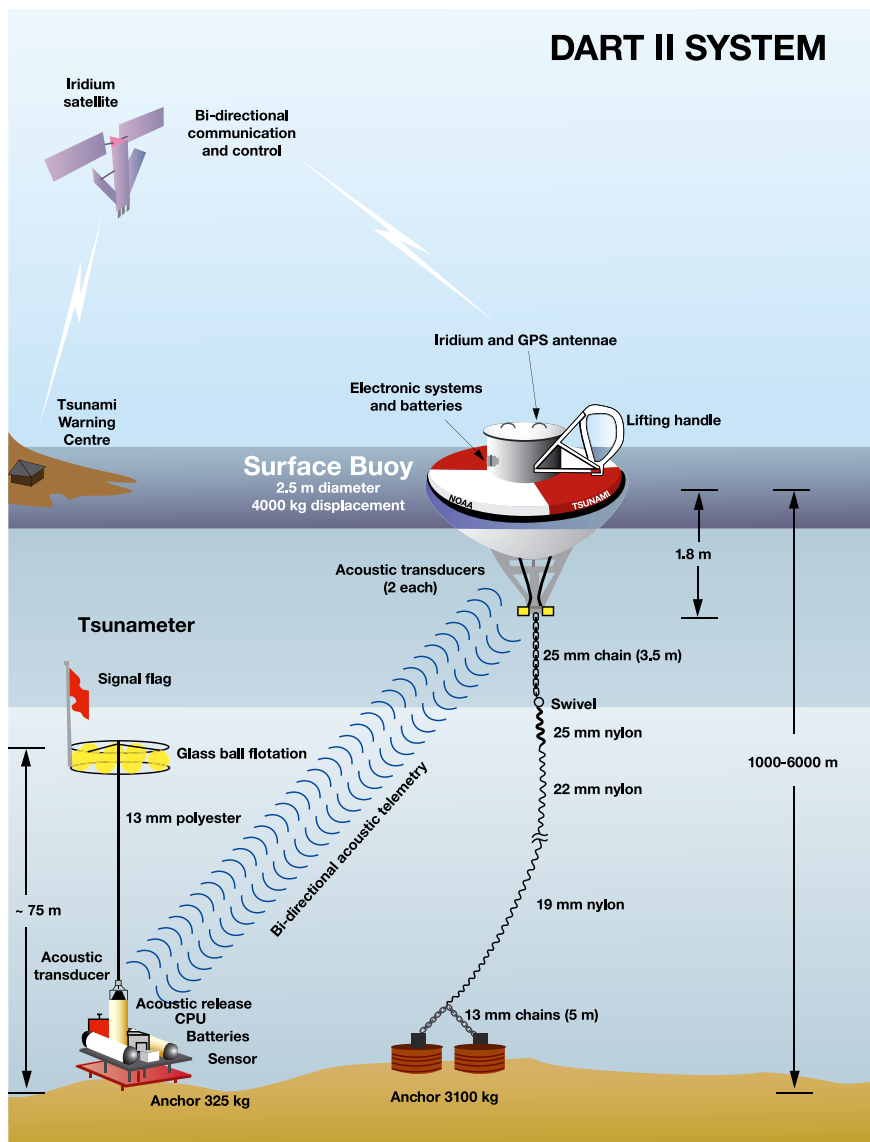
Data from Australia's tsunami detection buoys are made freely available to the international community and the tsunami warning centres of other countries in real-time using the World Meteorological Organization's dedicated Global Telecommunication System (WMO GTS).

Interesting Fact: The deep-ocean tsunami detection buoys (DART™) systems contain two independent and redundant communications systems as back-up.

How is the location for deployment of a tsunami buoy determined?

The best location for deployment of a tsunami buoy is determined by careful consideration of a number of factors. The tsunami buoy needs to be far enough away from any potential earthquake epicentre to ensure there is no interference between the earthquake signal at the buoy and the sea-level signal from the tsunami. On the other hand, the tsunami buoy needs to be close enough to the epicentre to enable timely detection of any tsunami and maximise the lead time of tsunami forecasts for coastal areas. In addition, tsunami buoys must ideally be placed in water deeper than 3000 m to ensure the observed signal is not contaminated by other types of waves that have shallower effects (e.g. surface wind-waves). International maritime boundaries must also be considered when deploying tsunami buoy systems.

Interesting Fact: These systems are capable of measuring sea-level changes of less than a millimetre in the deep ocean.



A schematic representation of a deep-ocean tsunami detection buoy (DART™).

Where are Australia's tsunami buoys being deployed?

Australia is potentially vulnerable to tsunami generated by undersea earthquakes along subduction zones (where the earth's tectonic plates are moving under each other) to the northwest, northeast, east and southeast of Australia. Deep-ocean tsunami detection buoys (and coastal sea level stations) are used to monitor the oceans in each of these regions. There are also spare buoys on hand to ensure maintenance regimes and emergency replacements can be carried out if necessary.

Australia's first tsunami detection buoy was deployed on 15 April 2007 in the South East Tasman Sea, some 1200 km from Tasmania. The deployment was

carried out in collaboration with NOAA. This buoy captures critical tsunami data from the oceans near the Puysegur fault line southwest of New Zealand.

How do these buoys contribute to tsunami warnings in Australia?

Due to the complexity and uncertainty as to whether an undersea earthquake has the potential to generate a tsunami, the observation of sea levels is a critical factor in verifying whether a tsunami has actually been generated. The use of actual sea level observations, as compared with reliance on seismic observations alone, therefore helps to significantly reduce the risk of false tsunami warnings being issued. All Australian-owned buoys, as well as deep-ocean buoys operated by other countries in the



The deployment of a DART™ buoy in the Tasman Sea.

Australian region, provide critical data to Australia's tsunami warning system.

The buoys are just one part of Australia's sea-level observing system, which also includes a number of new and long standing coastal sea level stations that now have the ability to report sea level variations in real-time to monitor for tsunami. Combined, these technologies provide a constant stream of sea level data for the Joint Australian Tsunami Warning Centre (JATWC) operated by the Bureau of Meteorology and Geoscience Australia, enhancing tsunami warnings for the Australian public.

Interesting Fact: Two-way communication between the tsunami buoy and the tsunami warning centre means that the buoy can be controlled remotely. This two-way communication allows for troubleshooting of the system and also allows people to put the systems into 'event' mode in case of a possible tsunami or for research purposes.

Interesting Fact: The acronym DART stands for Deep-ocean Assessment and Reporting of Tsunami.

What is the in-water life of a tsunami detection buoy?

The life cycle of a deployed tsunami buoy is approximately 2 to 4 years. The Bureau's maintenance regime will involve the replacement of the surface buoy and the sea-floor pressure sensor every one to two years. The devices retrieved during regular maintenance are refurbished and made ready for the next redeployment.

For further information please see www.bom.gov.au