FACTSHEET
Ocean Instrumentation

GITEWS

German Indonesian Tsunami Early Warning System

Establishment of a Tsunami Early Warning System in the Indian Ocean – The German Contribution

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Ocean Instrumentation

The German-Indonesian Tsunami Early Warning System processes a multitude of information to comprehensively and accurately evaluate the risk inherent in every seismic event. Within just a few minutes, measurements of the vertical and horizontal seafloor movements off the coast of Indonesia provide a clear picture of the location and intensity of a seaquake. However, not every seaquake causes a tsunami, nor is every tsunami caused by a seaquake. To avoid nerve-wrecking and costly false alarms and also to alert for tsunamis caused by landslides, the oceanic sea level must be measured directly. This

goal is pursued in the GITEWS work package "ocean instrumentation" with a highest degree of reliability and redundancy by developing a set of independent instruments, which measure the sea level height both offshore in the deep ocean and at the coast on the islands off Indonesia.

The Components

The ocean instrumentation activities comprise ocean mapping (bathymetry), shore-based (sea-level gauges) and buoy related activities (GPS, PACT, Seismic recorders).

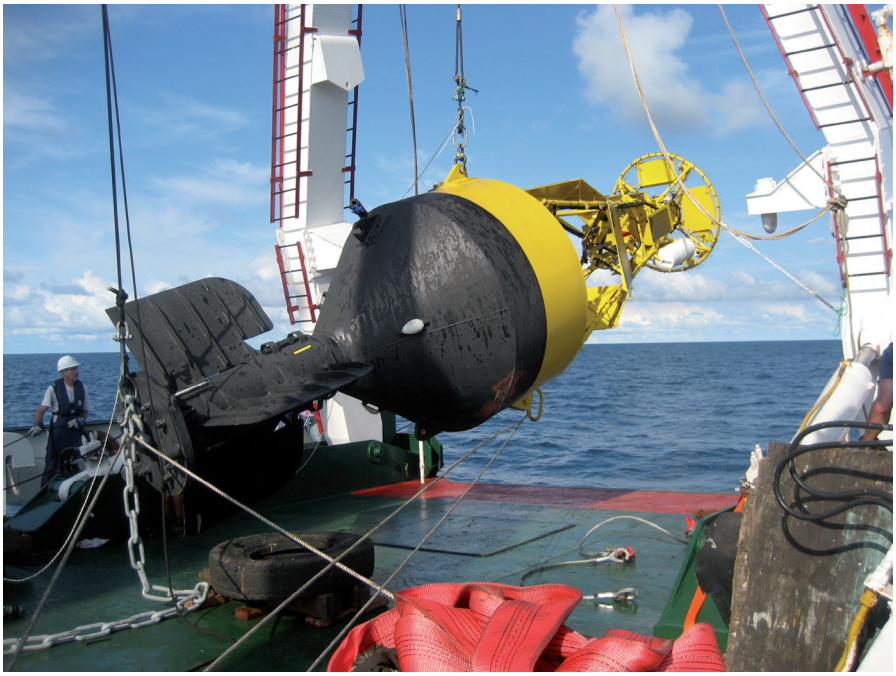
Sea Level Gauges

Tide gauges installed along the Indonesian coastline are able to monitor the instantaneous sea level in near real-time. For GITEWS, an

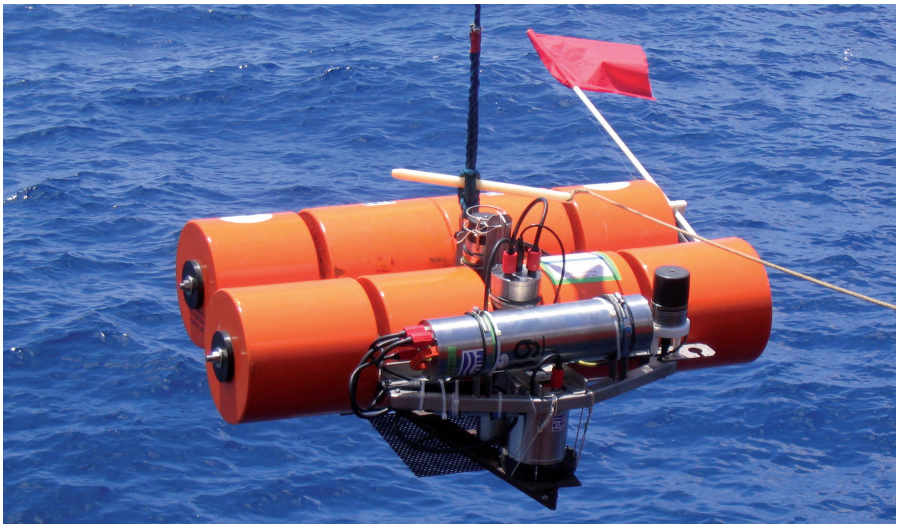
integrated concept was developed, which comprises three different tide gauge sensors and a GPS receiver for vertical control at each site. On-site, the data is quality checked and a detection algorithm for rapid changes in sea level monitors the station independently. All data are transmitted by using GTS/Meteosat and INMARSAT/BGAN. Solar arrays deployed on-site and different communication lines ensure an autonomous operation with minimal maintenance requirements.

GPS

Off-shore measurements of sea level deviations play an integral part



in the concept of tsunami warnings. Since a few years concepts have been developed to use GPS technology for the monitoring of the instantaneous sea level. This concept was introduced into GITEWS to increase the system reliability for tsunami warnings. Using a modern GPS receiver and additional sensors, the newly developed buoys are able to independently measure the sea level to an accuracy of better than 5 cm under a wide range of sea state conditions.
Today the buoys are able to provide data within less than five minutes to the warning centre. This is sufficient for most of the potential tsunami scenarios of Indonesia. In addition, the buoys are monitoring several meteorological parameters.



PACT

PACT (Pressure based, acoustically coupled tsunami detector) was derived from the well-proven US Dart system. It records ocean bottom pressure, performs on-board tsunami detection and acoustically relays the data to the surface buoy. However, employing computational power and communication tech-

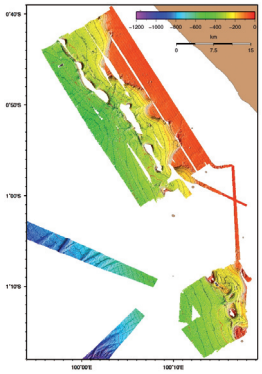
nologies of the new millennium, PACT integrates the entire sea-floor package (pressure gauge, data logger and analyzer, acoustic modem, acoustic release and relocation aids) into a single unit, i.e. a standard benthos sphere. PACT, thereby, reduces costs, maximizes reliability and minimizes the deployment efforts while maximizing reliability and maintenance intervals.

Seismic Recorders

In order to better discriminate between tsunami induced pressure changes and earthquake induced pressure changes, and for a better estimate of source parameters from offshore earthquakes, some of the buoys shall be connected via an acoustic link to bottom stations. These stations are equipped with a three-component broadband seismometer, a hydrophone and a pressure sensor. The data are permanently recorded and stored in the bottom station. In case of a sudden pressure change of more than 3 cm, a tsunami alarm is generated by the bottom station and sent to the buoy, from where it will be transmitted to the warning centre. From the warning centre, the pressure history data can be requested from the bottom station at any time, they will be automatically sent from the buoy every 48 hours. Regarding seismological data, these can be requested from the warning centre at any time, specifying the start and end time of the desired data stream.

Bathymetry

A detailed knowledge of the bathymetry is required to enable the determination of reliable tsunami propagation scenarios. In a first step, all available data from scientific cruises to Indonesia have been compiled, with input from Germany, France, United Kingdom and Japan. Furthermore, one of the Indonesian research vessels, the Baruna Jaya IV, received an upgrade of their old multibeam echosounder system to a dual-frequency shallow to medium water depth high resolution SEA Beam 1050D system including all necessary peripherals and training of Indonesian personnel. This will enable the Indonesian partners to fill remaining gaps where data coverage is sparse or not existing.



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Consortium German Marine Research (KDM)

Indonesian and International Partners:

National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL)
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