



## **GNSS in Support of Sea Level Monitoring: Early Warning to Long-Term Corrections**

Tilo Schöne (1), Julia Illigner (1), Cornelia Zech (1), Cecep Subarya (2), Pak Khafid (2), Wahyu Pandoe (3), Imam Mudita (3), and Roman Galas (4)

(1) Deutsches GeoForschungsZentrum GFZ, Department 1, Section 1.2, Potsdam, Germany (tschoene@gfz-potsdam.de, +49-331-288-1755), (2) Badan Koordinasi Survei dan Pemetaan Nasional (BAKOSURTANAL), Indonesia, (3) Badan Pengkajian Dan Penerapan Teknologi (BPPT), Indonesia, (4) Institut für Geodäsie und Geoinformationstechnik, TU Berlin, Germany

Over the past years GNSS technology has gained substantial interest in support of sea level studies. Corrections of tide gauge records using continuous GPS are widely used in different applications. With the new capabilities of real time or near real-time GNSS this technology now supports also early warning systems.

For the operation of an efficient Tsunami Early Warning System in Indonesia (InaTEWS) BAKOSURTANAL (Indonesia) and GFZ Potsdam (Germany) densified the existing network of tide gauges with the installation of GPS-equipped gauges along the Indian Ocean coastline of Indonesia. The tide gauge stations are capable to monitor rapid (e.g. tsunamis) but also long-term sea level changes. High-rate continuous GPS either directly mounted on the tide gauge hut or on more stable ground nearby are used to monitor long-term local and tectonic movements as well as earthquake related ground shaking or displacements.

For the tsunami warning system especially the stability of the tide gauge measurements and the integrity of derived tsunami parameters during and shortly after the earthquake is important (rapid vertical displacement). To broaden the use of this network for scientific applications, all stations are designated IGS - Tide Gauge Benchmark Monitoring (TIGA) stations. BAKOSURTANAL is already routinely processing GPS data from this network.

A second emerging application is the use of GNSS technology on off-shore buoys. In past years GPS water level measurements have become a standard in cal/val-campaigns for radar altimeters. As part of the Indonesian TEWS, GPS-equipped buoys have been developed and operated together with BPPT (Indonesia). High-rate continuous GPS mounted on top of a buoy is monitoring the instantaneous sea surface height. In case of a tsunami alert, the Tsunami Warning Center activates the buoy communication and GPS data is transmitted to the shore and processed. Tsunami wave parameters (time of arrival, amplitude) can be estimated from the filtered sea level record. Although this technology does not yet reach the accuracy of standard ocean bottom pressure data, GPS-equipped buoys are providing valuable support information especially for near-field tsunamis.

This presentation will provide information on both the early warning aspect and long-term monitoring aspect.