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The GNSS data processing component within the Indonesian tsunami early warning centre provided by GITEWS

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Introduction

Within the GITEWS (German Indonesian Tsunami Early Warning System) project a near real-time GNSS processing system has been developed, which analizes on- and offshore measured GNSS data. It is the first system of its kind that was integrated into an operational tsunami early warning system. (Indonesian Tsunami Early Warning Centre INATEWS, inaugurated at BMKG Jakarta on November, 11th 2008)

Brief system description

The GNSS data to be processed are received from sensors (GNSS antenna and receiver) installed on buoys, at tide gauges and as real-time reference stations (RTR stations), either stand-alone or co-located with seismic sensors. The GNSS data are transmitted to the warning centre in real-time as a stream (RTR stations) or file-based and are processed in a near real-time data processing chain.

The fully automatized system uses the BERNESE GPS software as processing core. Kinematic coordinate time-series with a resolution of 1 Hz (landbased stations) and 1/3 Hz (buoys) are estimated every five minutes. In case of a recently occured earthquake the processing interval decreases from five to two minutes. All stations are processed with the relative technique (baseline-technique) using GITEWS-stations and stations available via IGS as reference. The most suitable reference stations are choosen by querying a database where continiously monitored quality data of GNSS observations are stored. In case of an earthquake at least one reference station should be located on a different tectonic plate to ensure that relative movements can be detected. The primary source for satellite orbit information is the IGS IGU product. If this source is not available for any reason, the system switches automatically to other orbit sources like CODE products or broadcast ephemeris data.

For sensors on land the kinematic coordinates are used to detect deviations from their normal, mean coordinates. The deviations or so called displacements are indicators for land mass movements which can occur, e.g., due to strong earthquakes. The ground motion information is a valuable source for a fast understanding of an earthquake's mechanism and consequences with possible relevance for a potentially following tsunami.

Regarding kinematic coordinates of a buoy only the vertical component is of interest as it corresponds to the instant sea level. The kinematic coordinates are delivered to an oceanographic post-processing unit which applies dipping-, tilting- and tidal-corrections to the data. Deviations to the mean sea level are an indicator for a possibly passing tsunami wave. By this means the GNSS system supports the decision finding process whether a tsunami has been released or not.

A graphical user interface (GUI) was developed which monitors the whole processing chain from data transmission and GNSS data processing to the displaying of the kinematic coordinate time series. It supports both, a quick view for all staff members at the warning centre (24h/7d shifts) and deeper analysis by GNSS experts. The GNSS GUI system is web-based and allows all views to be displayed on different screens at the same time, even at remote locations. This is part of the concept, as it can support the dialogue between warning centre staff on duty or on standby and sensor station maintenance staff.

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