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Real time earthquake information and tsunami estimation system for Indonesia, Philippines and Chile regions

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Southeast Asia as well as South American regions are within the most active seismic regions in the world. To contribute to the understanding of source process of earthquakes and long term seismic activity, the National Research Institute for Earth Science and Disaster Prevention NIED maintains the international seismic Network (ISN) in the Asian-Pacific region. Continuous seismic waveforms from broadband seismic stations in Indonesia (148), Philippines (12), and Northern Chile (18) are currently received in real time at NIED, and used for automatic location of seismic events. Using these data we perform automatic as well as manual routine estimation of moment tensor of seismic events (Mw>4.5 in Indonesia and Philippines, and Mw>4.0 in Northern Chile) by using the SWIFT program developed at NIED (Nakano et al. 2008). Since January 2015 we started the real time calculation of local tsunamis in Indonesia, Philippines and Northern Chile using a tsunami simulation code and visualization system developed at NIED (Inazu et al. 2014), as well as earthquake source parameters estimated by SWIFT. The goals of the system are to provide a rapid and reliable earthquake and tsunami information in particular for large seismic events in the region, and produce an appropriate database of earthquake source parameters and tsunami simulations for research.

The system uses the preliminary hypocenter location and magnitude of earthquakes automatically determined at NIED by the SeisComP3 system (GFZ) from the continuous seismic waveforms in the region, to perform the automated calculation of moment tensors by SWIFT, and then carry out the automatic simulation and visualization of tsunami. The system generates maps of maximum tsunami heights within the target regions and along the coasts and display them along with the fault model parameters used for tsunami simulations. Tsunami calculations are performed for all events with available automatic SWIFT/CMT solutions. Tsunami calculations are re-computed using SWIFT manual solutions for events with Mw>5.5 and centroid depths shallower than 100 km. Revised maximum tsunami heights as well as animation of tsunami propagation are also calculated and displayed for the two double couple solutions by SWIFT. Detailed procedure for tsunami simulation is as follows;

1. Calculate two finite fault models based on seismic moment, fault mechanisms and centroid location by SWIFT, as well as by an empirical scaling relating seismic moment and fault dimensions. We use a large stress drop model by assuming, a fault length over fault width ratio of 2, and a fault average slip to fault length ratio of 5e-5 (Utsu 2001). These values approximately correspond to a fault average stress drop of 5MPa, implying larger values of simulated tsunami as compared to the values obtained from other scalings (i.e. Murotani et al 2008).

2. Compute the seafloor deformation using the dislocation theory (Okada 1985), for the source models obtained in step 1. In addition to the vertical seafloor deformation, we incorporate the contribution of horizontal seafloor deformation to the vertical component due to sea-floor gradient (Tanioka and Satake 1996 GRL).

3. Carry out the tsunami simulation based on a linear long-wave model and a long-wavelength filtering effect in the deep seas (Kajiura 1963).

4. Automatically publish the earthquake parameters and tsunami simulation results in the following web site:

http://www.isn.bosai.go.jp/en/index.html

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Keywords: Indonesia, Philippines, Chile, Earthquake parameters, Tsunami forecast, Realtime