

Rapid Source Parameter Determination for Tsunami Early Warning System in Indonesia

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In order to establish the tsunami early warning system in Indonesia, the Meteorological and Geophysical Agency (MGA), Badan Meteorologi dan Geofisika (BMG), Indonesia has been installing many seismic instruments spreading around Indonesia area. These seismic networks are integrated to the headquarter in Jakarta. The instruments and processing software are upgraded to determine hypocenter parameters as quick as possible to issue early warning after a big earthquake occurs offshore. One of important hypocenter parameters that used to issue early warning is magnitude. BMG used body wave magnitude that calculated by GEOFON-GFZ Germany in rapid hypocenter determination. The hypocenter parameter will be released automatically several minutes after earthquake shake directly through Internet server. BMG now is ongoing to establish the own rapid parameter determination automatically under cooperation with the Japan Meteorological Agency (JMA) especially to determine magnitude of JMA-type.

Regarding to this purpose, we propose a magnitude determination method of BMG for the regional network. The BMG magnitude is generated from the empirical formula from Richter's magnitude. We use accelerogram from regional accelerometer network of BMG for one month range. Each station is equipped with a three-component Metrozet TSA-100S, which has a wide frequency response of DC to 225 Hz. We collected a raw continuous waveform data from database in BMG server which keeps data of one-month period. Further, this raw data was converted to SAC format through Xfiles format (a waveform format from Nanometrics Inc.) and seed format. The accelerogram was converted into displacement record with SAC transfer command to measure maximum displacement. A third-order Butterworth filter of 0.1Hz cut-off was used as the high-pass filter. Also we retrieved earthquake event list from the CMT global catalog with the same time range to use M_w as reference magnitude. We got only 8 events from this continuous waveform data due to many bad waveforms.

To construct a calculated magnitude of BMG, we used an empirical formula from Richter's magnitude,

$$\log A = a M_w + b \log R + c$$

where A (micrometer) is maximum amplitude of displacement seismogram, M_w is moment magnitude, a is coefficient correction for magnitude, b is coefficient correction for distance, R is hypocentral distance, c is a constant coefficient, respectively. By using least squares method, these coefficients can be found to introduce a magnitude determination formula of BMG as follows:

$$\log A = M - 2.18 \log R + 1.88$$

This formula is similar to Tsuboi's formula (1954) for displacement records obtained with mechanical seismographs for earthquakes occurring in and near Japan. The comparisons between this formula and Tsuboi's formula and also with M_w from Global CMT indicates that this formula could be improved after seismic records are accumulated in BMG.