ESC2016-568, 2016
35th General Assembly of the European Seismological Commission

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4–10 September 2016 Trieste

Multiband magnitude scale for Kamchatka earthquakes: the next step of development

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For mass processing of regional earthquake data, the traditional (ML) magnitude concept permits simple data processing procedure which provides an acceptable earthquake quantification uniformly applicable over a broad magnitude range (ML=1-7). Its weaknesses include: magnitude-dependent spectral response, limited bandwidth, and lack of spectral resolution. Contemporary capabilities of digital recording provide an opportunity to make a next step in regional magnitude technology. A new regional magnitude must be spectrally resolved, i.e. multiband; it should support fast Mw estimates, and preferably also spectral stress drop estimates. To implement this idea, a concept of regional multiband magnitude (MBM) is proposed. MBM is understood as a set of normalized log-amplitudes determined for a set of frequency bands that jointly cover a broad frequency range. Three kinds of MBM are under development for Kamchatka. The first one is the multiband amplitude-based magnitude (MBAM). It uses distance-normalized peak amplitudes of filtered P and S (or maybe S+Love+Rayleigh) wave groups. It follows the line of CHISS or spectral magnitude of Zapolski, Tsujura, Duda and Yanovskaya. However, peak amplitude often does not provide a reliable estimate of spectral energy. Therefore, another kind of MBM is developed: the multiband energy magnitude (MBEM). It uses distance-normalized value of time integral of body-wave energy in each band. At last, multiband coda magnitude (MBCM) is developed following the line of Rautian and Khalturin work, that uses time-normalized rms coda amplitude. Although not based on direct integration, it is in essence an analogue of MBEM because of properties of coda waves. Its great advantage is high accuracy; unfortunately, small earthquakes often do not generate coda with a sufficient S/N ratio. The eventual use of MBM by a regional seismic network will significantly broaden the standard description of source properties of an earthquake listed in the regional earthquake catalogue, and will permit detailed analysis of typical and individual spectral properties of tectonic and volcanic events. After planned absolute calibration, MBEM and MBCM values will be directly converted to moment rate spectrum (earthquake source spectrum) thus providing a routine technology for mass determination of this key function describing a source of each particular earthquake.

The current step of development of Kamchatka regional MBM technique will be presented. It includes a set of calibration curves (decay of amplitude and of energy vs. distance) for normalization of S-wave amplitudes, and also standard coda shapes for coda normalization. We use the set of band filters whose central frequencies span, jointly, in log-uniform way, the 0.04-40 Hz frequency range. For each filter, the bandwidth is 2/3-octave. Additionally, the stability of the previous-generation coda magnitude over Kamchatka network stations and over epicentral distances was verified and confirmed. To support eventual absolute calibration of body wave amplitudes, frequency-dependent attenuation of S-waves was consistently determined by two independent methods, using distance variation of acceleration spectral shapes and the distance decay of band-filtered amplitudes. Also, station corrections for spectral amplification were carried out for Avacha Gulf subregion.

The study was supported by the Russian Science Foundation (project 14-17-00621).