The 20-s Regional Surface-Wave Magnitude for the Russian Far East

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A modified surface-wave magnitude scale $M_s(20R)$ is constructed that permits one to extend the common teleseismic magnitude scale $M_s(20)$, originally defined for epicentral distances in excess of 20°, to the regional distance range (0.7-20°) .

The data set used in this study contains digital records of 434 earthquakes of the North-Western Pacific region of 1993-2009 recorded at 12 BB seismic stations. The new scale is based on amplitudes of surface waves within a narrow frequency range 0.04-0.063 Hz (periods 16-25 s) with the central frequency 0.05 Hz = 1/20 s. The use of the wave periods close to 20 s is a standard approach for the common 20-s surface-wave magnitude. In this case, selection of this period range takes place naturally because of wave dispersion. To generalize this approach to distances shorter than 20°, we filter a BB record employing an appropriate digital bandpass filter. Data analysis have revealed that for an optimal representation of amplitude decay with distance, two separate calibration curve must be introduced, one for the marginal areas of NW Pacific and another for adjacent continental areas. The application of the new scale allows one to determine low-frequency parameters of M=3-4 earthquakes, too small for seismic moment determination in an island-arc environment. Single-station rms accuracy of determination of $M_s(20R)$ is 0.22.

In difference with Soloviev's broad-band $M_s(BB)$, also defined for the regional distance range, the new $M_s(20R)$ magnitude scale provides a spectrally-definite parameter for the regional distances; it matches well to $M_s(NEIC)$ and provide historical continuity with the classical Gutenberg's M_s scale.