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Distance corrections to surface-wave magnitudes of Far East shallow earthquakes

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Surface wave magnitude *MS* has a number of advantages over other magnitude types - more than 100-year period of its determination, the ability to calculate *MS* for earthquakes around the world, established regional and global relationships with other magnitude types, participation of *MLH* (analogue of *MS*) in macroseismic field equations for the regions of the former USSR, which made it possible to use *MLH* and *MS* as a reference magnitude when compiling earthquake catalogs for seismic zoning of the USSR and Russia territories.

However, *MS* has two significant disadvantages - dependence on depth, which the authors of [1] proposed to compensate for using depth corrections, and on distance, as shown in this work.

In most seismological centers, *MS* is determined using the “Prague formula” [2]:

$$MS=\lg(A/T)_{\max}+1.66\times\lg r^{o}+3.3, \qquad (1)$$

where A is the displacement in micrometers, T is the period in seconds corresponding to the maximum velocity, r is the epicentral distance ($2^{o}< r <160^{o}$).

After the IASPEI adopted “Prague formula” as a standard (in 1967), the adequacy of the calibration function (the last two terms in formula (1)) was repeatedly discussed in publications and at conferences, but, despite some changes to the standard procedures for determining *MS*, the formula remained the same.

We checked the compliance of the calibration curve used in the “Prague formula” with the attenuation of A/T values depending on distance for Far East earthquakes with $h\leq 50$ km for 2013–2018, the *MS* magnitudes of which are presented in the Seismological Bulletin of GS RAS (ftp ://ftp.gsras.ru/pub/Teleseismic_bulletin/). The distance dependence of the deviations *dMS* of station magnitudes *MSst* from the network average *MSav* was analyzed. For epicentral distances r=4–80°, a loglinear dependence is established:

$$dMS= MSst–MSav=0.661\times\lg(r^{o}) - 1.06,\ R=0.62,\ N=8738. \qquad (2)$$

At distances r=17–160^{o} absolute values of *dMS* do not exceed the generally accepted error in determining *MS* (±0.25), and only at $r<17^{o}$ *MSst* are significantly lower than average magnitudes *MSav*. When analyzing macroseismic data from 34 earthquakes in Northern Eurasia, we also discovered an underestimation of ISC and MOS magnitudes *MS* of weak earthquakes (*MS*<4.5) compared to the magnitude required in the regional macroseismic field equations. This is probably due to the big contribution to *MSav* of underestimated *MSst* due to small epicentral distances. Such an underestimation can be compensated for either by introducing corrections to *MS* for distance according to eq.(2) or by refining the calibration function.

REFERENCES

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