

The New Japan Meteorological Agency (JMA) Magnitude

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The JMA magnitude has been a standard scale in various fields of seismology, since it is possible to compare the scale of old earthquakes and new earthquakes. It had been based on Tsuboi (1954) displacement magnitude formula and Katsumata (1964) displacement magnitude formula applied for deeper earthquakes and velocity magnitude formula (Kanbayashi and Ichikawa, 1977 and Takeuchi, 1983) applied for smaller earthquakes.

However some following problems can be found recently. (1) There is a shift of magnitude because of a major change of the JMA seismic network in the year 1995. (2) The velocity magnitude is not suitably adjusted to the displacement magnitude, wherein the velocity magnitude is smaller compared to the displacement magnitude for bigger earthquakes, while the velocity magnitude is bigger than the displacement magnitude for the smaller earthquakes. (3) The Tsuboi displacement magnitude and the Katsumata displacement magnitude are not well related to a depth of 60 kms. This is considered boundary depth of these two formulas. (4) The velocity magnitude cannot be used for earthquakes with depth of deeper than 60 kms.

To resolve these problems JMA introduce a new displacement magnitude formula based on the study of Katsumata (2004) and velocity magnitude formula based on the study of Funasaki et al.(2004). The new displacement magnitude formula includes a correction value for the modern JMA seismic network, and the new velocity magnitude formula includes a correction value estimated for each type of seismometer respectively. To adjust the velocity magnitude to the displacement magnitude, the factor on the logarithm of maximum velocity amplitude in the new velocity magnitude formula is estimated as $1/0.85$ according to the study of Watanabe(1971). Both formulas can be use to depth of 700 kms.

Expression for the magnitudes in the JMA Earthquake Catalog has been changed since September 25, 2003 (Japan Meteorological Agency, 2003). The calculation of displacement and velocity magnitude and displacement magnitude was 5.5 or less, JMA represented only one magnitude as the result of mean or selection of two. After the revision, we represent both displacement magnitude and velocity magnitude.

The result of the new JMA magnitude formula has almost the same result as using the old JMA magnitude formula for earthquakes with Magnitude 5 or more, while the new JMA magnitude formula yields a smaller result for earthquakes with magnitude 4 or less when compared to the result of the old JMA magnitude formula. This means that the velocity magnitude is adjusted to the displacement magnitude in a small magnitude range. can be clearly shownThe new JMA magnitude fits with calculated magnitude of other organizations such as NIED and other universities. The Gutenberg-Richter relation can be clearly shown in the accumulation graph according to the new JMA magnitude. However, in some smaller area, there is a difference between the displacement and velocity magnitude, and thus Gutenberg-Richter relation cannot be clearly shown.