

## Reexamination of intensity distribution of Japanese historical earthquakes using attenuation relation

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Sources of historical earthquakes are usually estimated from seismic intensity distributions based on the descriptions on historical documents. Ceaseless efforts to collect historical earthquake documents leads to sourcebooks such as Dai-Nihon Jishin Shiryo (Collection of Historical Documents on Earthquakes in Great Japan) (Tayama, 1904a,b), Zotei Dai-Nihon Jishin Shiryo (Collection of Historical Documents on Earthquakes in Great Japan, Enlarged and Revised Edition) (Musha, 1941, 1943a,b), and Shinshu Nihon Jishin Shiryo (Historical Documents on Earthquakes in Japan, New Collection) (Earthquake Research Institute of the University of Tokyo, 1981-1994) etc. The location of epicenter or hypocenter, origin time, and magnitude of the historical earthquakes are estimated utilizing the descriptions in the sourcebooks. Conversion table from description of damage of building etc. to seismic intensity is used to derive seismic intensity distribution. The location and magnitudes are estimated by drawing isoseismals. The basic procedure for identification of historical earthquakes are: (1) discovery and transcription of historical documents describing earthquake, (2) estimation of intensity distribution from the description, and (3) estimation of epicenter or hypocenter and magnitude. Attenuation relation of seismic intensity can be used to (1)-(3).

Although plenty of historical earthquake documents are published as the sourcebooks mentioned above and used for preceded researches, more historical documents are necessary to know details of historical earthquakes. One possible collaboration between historians and seismologists is search for historical documents related to earthquakes. An exhaustive search for large earthquakes is sometimes hard to be done, because damaged or felt area become wide for the large earthquakes. Seismic intensity of historical earthquake can be estimated assuming attenuation relation and location and magnitude of the earthquake. We can make an effective search plan for historical documents based on the estimated seismic intensity distribution.

Various conversion tables are suggested to estimate seismic intensity of historical earthquake from damage description in historical documents. The tables correlate, for example, the extent of building damage or rate of the damage to seismic intensity. We examined the validity of a conversion table using the damage of cultural property by the earthquakes including the one occurred in northern part of Osaka. Based on the conversion table, the damage of cultural properties was converted to seismic intensity. The estimated seismic intensity is consistent with distribution of seismic intensity at the locations of the cultural properties predicted by attenuation relations.

Attenuation relation of seismic intensity can be used for estimation for location of epicenter or hypocenter. The magnitude of an earthquake can be estimated by fitting attenuation relation to spatial distribution of seismic intensity. The location and magnitude of Japanese historical earthquake are estimated using attenuation relation, which is consistent with the location and magnitude obtained by preceded studies.

Keywords: Historical earthquakes, Attenuation relation, Intensity distribution, MDPs

