# Seismic density and its relationship with three great historical earthquakes in North China

Jian Wang

Institute of Geophysics, China Earthquake Administration, No.5 Minzu Daxue Nan Rd., Beijing 100081, China

We develop a method to calculate seismic density index of quantifying the degree of earthquake clustering in the spatial distribution. The value of seismic density in each node is proportional to the magnitude and number of earthquakes, but inversely proportional to the distance *r* measured from the node to earthquake epicenters. We also emphasize the accuracy of epicenter location in dealing with seismic pattern. Sensitivity analysis of seismic density was carried out.

In North China, there are three great earthquakes with magnitude 8, which were devastating enough to be recorded in a large written archive. Although these extreme events occurred several hundred years ago, small earthquakes continue to occur around the epicenters till now. Seismic densities were calculated using the catalogue from 1970 to 2007. The result illustrated that the seismic density of present-day is very similar with the intensity of historical earthquakes.

**Table 1** Parameters of three great historical earthquakes in North China

| No. | y-mo-d | Lat(° N) | Long(° N) | $M_s$ | $I_0$ | Location |
|---|---|---|---|---|---|---|
| 1 | 1303-09-25 | 36.3 | 111.7 | 8.0 | Ⅺ | Hongdong, Shanxi |
| 2 | 1668-07-25 | 34.8 | 118.5 | 8.5 | Ⅺ | Tancheng, Shandong |
| 3 | 1679-09-02 | 40.0 | 117.0 | 8.0 | Ⅺ | Sanhe&Pinggu, Hepai |

Finally, we can get such conclutions:

(1) The quantitative method to calculate seismic density at grid nodes can depict earthquake clustering concentration precisely. The seismic density is a combination of magnitude, number of events, and the degree of clustering.

(2) In North China, three great historical earthquakes have detailed intensity data. Present-day seismic density zones are consistent with the maximum intensity region in each case. The macro-intensity of historical earthquakes and present day seismic density zones reveal the persistent weakness of local crustal medium together.

(3) The relationship between seismic density and strong historical earthquakes may help us to understand the earthquake population dynamics and (in some cases at least) to improve estimates of the epicenters of strong historical earthquakes with poor archives.

The results of this paper can be used to judge correct locations of strong historical earthquakes with poor archives.