Correlation Dimension of Hypocentral Distributions Based on Information Entropy

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We analyze statistical characteristics of hypocentral distributions for earthquakes worldwide, using correlation dimension.

Correlation dimension D is calculated by correlation integral method (Kagan and Knopoff, 1980; Grassberger and Procaccia, 1983). In the method, the distances between all the pairs of two hypocenters of earthquakes are calculated. Then, the number $N(r)$ of pairs of two hypocenters of which distance is less than r is evaluated. In case when $N(r)$ is proportional to r^D approximately, D is called the correlation dimension. Analyzed data are taken from USGS download files for earthquakes worldwide during the period of 1973-2008, the total number of earthquakes is 47181. It is found that the correlation dimension D changes from about 2 to 1 as the scale r increases. Especially in the scale of 500-1,000 km, D is stable about 1.1. If hypocentral distribution is on a line, D is 1.0. To explain their variation of correlation dimension we consider a new mathematical model. The model is characterized by two parameters, clustering of hypocentral distributions with various scales and finiteness of the scale. The model generates many hypocentral distributions with different correlation dimensions. The most probable correlation dimension can be evaluated by maximizing information entropy of the clustered hypocentral distributions.