Network of Earthquakes and Identification of Recurrences

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March 1, 2010

We quantify the correlation between earthquakes and use the same to distinguish between relevant causally connected earthquakes. Our correlation metric is a variation on the one introduced by Baiesi and Paczuski (2004). A network of earthquakes is constructed, which is time ordered and with links between the more correlated ones. Data pertaining to the California region has been used for the study. Recurrences to earthquakes are identified employing correlation thresholds to demarcate the most meaningful ones in each cluster. The distribution of recurrence lengths and recurrence times are analyzed subsequently to extract information about the complex dynamics. We find that the unimodal feature of recurrence lengths helps to associate typical rupture lengths with different magnitude earthquakes. The out-degree of the network shows a hub structure rooted on the large magnitude earthquakes. In-degree distribution is seen to be dependent on the density of events in the neighborhood. Power laws are also obtained with recurrence time distribution agreeing with the Omori law. The method is also applied to seismic catalogs of Japan and Himalayas to draw out the robust universal features of the method.

Key Words: Network Analysis, Earthquake Networks, Earthquake Correlations, Earthquake Recurrences, Nonlinear Dynamics.