Uncovering complex characteristics of earthquake time series using complex network analysis

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A detailed analysis has been performed by mapping the time series of seismic data into a complex network consisting of nodes and links. Each seismic event is considered as a node and the links are determined between pairs of nodes based on the criteria of visibility graph, which is found to be a useful tool in extracting the non-trivial characteristics of a time series. We have investigated both earthquake magnitude time series and inter-event time (IET) series for three different categories of earthquakes, namely, ordinary earthquakes, earthquake swarms, and tremors. Our analysis of the degree distribution of the associated network suggests that the magnitudes of the events for all types of earthquakes are statistically uncorrelated whereas, the inter-event time series show long-range correlations. In connection with the 1/f type noises, the IET series of tremors are found to have distinctly different behavior than the other two types of earthquakes. We also find that the associated networks for both the time series display small-world behavior, high clustering and hierarchical organization. Furthermore, our findings based on the assortativity coefficient reveal that the swarms are more intermittent in nature compared to the tremors.

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