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Network of recurrent events: an application to aftershock sequences and the ETAS model of seismicity

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Many striking features of geophysical processes can be portrayed as patterns or clusters of localized events including, but not limited to, solar flares and earthquakes. A generic attribute in all these cases is that one event can trigger or somehow induce another one to occur - or possibly numerous further events. Studying the spatiotemporal clustering of such localized events is often the only way to gain insight into the underlying microscopic dynamics that causes the triggering.

A recently introduced approach (Geophys. Res. Lett. 33, L11304 (2006)) allows one to quantify non-trivial spatiotemporal clustering and to infer the causal structure of activity patterns based on the view that any suitable definition of clustering should be purely contextual and depend only on the actual history of events. The approach utilizes the notion of space-time records and maps the activity pattern onto a network.

Here, we apply this method to compare the spatiotemporal clustering of aftershock sequences (Parkfield and Hector Mine) to that of synthetic catalogs generated by the epidemic type aftershock sequence (ETAS) model.