



## **Space distribution of cluster activity in and near Bulgaria**

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Examination of the space-time distribution of earthquakes is of fundamental importance for understanding the physics of the earthquake generation process. One challenge in applying statistical methods to study the earthquake occurrence is to distinguish objectively the nonrandom from the random.

Foreshocks are one of the few well-documented precursors to large earthquakes. Foreshocks (rarely observed) are those earthquakes that occur prior to the main event in the same area. Even if it is not considered a prognostic sign, the foreshocks show stress accumulation in the surroundings before the large earthquake. Therefore, understanding their nature is very important for earthquake prediction.

Aftershocks occur after the main shock and their frequency decays through time with approximately reciprocal of time elapsed since the main earthquake. The spatial clustering of aftershock activity is the dominant non-random element of seismicity. When foreshocks and aftershocks are removed, the remaining seismic activity can be modeled (as first approximation) as a Poisson process. The properties of aftershock sequences (distinct cluster in space and time) allow time-dependent prediction of aftershock probabilities. Consideration of recent earthquake sequences suggests that large aftershocks although they are still, by definition, smaller events, can be very damaging and should be addressed in emergence planning scenarios. Because of the factors such as location and radiation pattern and the cumulative nature of building damage, aftershocks can cause more damage than the main shock.

Swarms are sequences of earthquakes that are clustered in space and time and are not associated with an identifiable main shock. Swarm activity may take days, weeks or months.

The present study was aimed at presenting the peculiarities in the space distribution of the cluster activity in Bulgaria and surroundings. Statistical analysis is applied to examine spatial pattern of earthquakes in the foreshock, aftershock and swarm sequences. Differences in the space distribution of events in the sequences are highlighted.