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Seismic clustering algorithms

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Although ongoing research and modern technologies have provided valuable information about the seismic phenomenon our understanding of the physical processes responsible for the distribution of earthquakes in space and time remains limited. Satellite and earth-based investigations of the earth's interior have revealed an underground faults network spanning throughout regions of intense seismic activity. This paper aims to complementary enhance ongoing research by developing a custom modular software implementation to identify and visualize individual earthquake event clusters within the Mediterranean vicinity. The main self-developed algorithms incorporate dynamic filters based upon models derived by Dobrovolsky et al [1,2] and Zubkov, Stein and Liu, etc. [3,4,5] to cluster events in both the spatial and temporal domains. Since expandability was a key feature considered during development, different models for the computation of the total earthquake preparation time, aftershocks duration and radius of the sphere of earthquake preparation region can be imported as software modules of the original implementation. A series of software modules have also been developed based on spatial clustering techniques such as density based functions [6], gradient descent [7,8], centre of gravity, evolutionary allocation and even human-assisted techniques. Processing can be performed on entire datasets, main earthquake events alone, or even be limited geographically to specific regions of interest. Analysis of data from earthquake event catalogues [9,10] has identified the presence of several distinctive seismic swarms, demonstrating similarities in terms of shape and dimensions for most clustering algorithms, forming within the region of the seismic Hellenic arc, which appear to be either distinct or interacting together in groups of two or more.

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