Geophysical Research Abstracts
Vol. 17, EGU2015-5301, 2015
EGU General Assembly 2015

Earthquake Cluster Analysis for Turkey and its Application for Seismic Hazard Assessment

Andreas Schaefer, James Daniell, and Friedemann Wenzel
Geophysical Institute, Karlsruhe Institute of Technology, Hertzstrasse 16, 76187 Karlsruhe, Germany

Earthquake clusters are an important element in general seismology and also for the application in seismic hazard assessment. In probabilistic seismic hazard assessment, the occurrence of earthquakes is often linked to an independent Monte Carlo process, following a stationary Poisson model. But earthquakes are dependent and constrained, especially in terms of earthquake swarms, fore- and aftershocks or even larger sequences as observed for the Landers sequence in California or the Darfield-Christchurch sequence in New Zealand. For earthquake catalogues, the element of declustering is an important step to capture earthquake frequencies by avoiding a bias towards small magnitudes due to aftershocks. On the other hand, declustered catalogues for independent probabilistic seismic activity will underestimate the total number of earthquakes by neglecting dependent seismicity. In this study, the effect of clusters on probabilistic seismic hazard assessment is investigated in detail.

To capture the features of earthquake clusters, a uniform framework for earthquake cluster analysis is introduced using methodologies of geostatistics and machine learning. These features represent important cluster characteristics like cluster b-values, temporal decay, rupture orientations and many more. Cluster parameters are mapped in space using kriging. Furthermore, a detailed data analysis is undertaken to provide magnitude-dependent relations for various cluster parameters. The acquired features are used to introduce dependent seismicity within stochastic earthquake catalogues. In addition, the development of smooth seismicity maps based on historic databases is in general biased to the more complete recent decades. A filling methodology is introduced which will add dependent seismicity in catalogues where none has been recorded to avoid the above mentioned bias.

As a case study, Turkey has been chosen due to its inherent seismic activity and well-recorded data coverage. Clustering features are obtained and used to build and compare multiple stochastic earthquake catalogues for a probabilistic seismic hazard assessment using both independent and dependent seismic activity. The impact of dependent seismicity is investigated as well as a comparison with established declustering methodologies. Furthermore, the historic earthquake record of Turkey is stochastically filled with clustered events which are not included in the historic catalogues to investigate the effects of dependent-historic seismicity fillings on seismic density maps. In addition, a full earthquake cluster catalogue for Turkey since 1900 is presented.