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Similarity and Cluster Analysis of Intermediate Deep Events in the Southeastern Aegean

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In order to gain a better understanding of geodynamic processes in the Hellenic subduction zone (HSZ), in particular in the eastern part of the HSZ, we analyze a cluster of intermediate deep events in the region of Nisyros volcano. The cluster recorded during the deployment of the temporary seismic network EGELADOS consists of 159 events at 80 to 200 km depth with local magnitudes ranging from magnitude 0.2 to magnitude 4.1. The network itself consisted of 56 onshore and 23 offshore broadband stations completed by 19 permanent stations from NOA, GEOFON and MedNet. It was deployed from September 2005 to March 2007 and it covered the entire HSZ.
Here, both spatial and temporal clustering of the recorded events is studied by using the three component similarity analysis. The waveform cross-correlation was performed for all event combinations using data recorded on 45 onshore stations. The results are shown as a function of frequency for individual stations and as averaged values over the network. The cross-correlation coefficients at the single stations show a decreasing similarity with increasing epicentral distance as well as the effect of local heterogeneities at particular stations, causing noticeable differences in waveform similarities. Event relocation was performed by using the double-difference earthquake relocation software HypoDD and the results are compared with previously obtained single event locations which were calculated using nonlinear location tool NonLinLoc and station corrections. For the relocation, both differential travel times obtained by separate cross-correlation of P- and S-waveforms and manual readings of onset times are used. It is shown that after the relocation the inter-event distance for highly similar events has been reduced. By comparing the results of the cluster analysis with results obtained from the synthetic catalogs, where the event rate, portion and occurrence time of the aftershocks is varied, it is shown that the event-time distribution follows almost a random Poisson time distribution with a slightly increasing event rate without indications for substantial inter-event triggering. The spatial distribution of the cluster can be modeled by a two-dimensional Gaussian distribution on a plane parallel to the subduction interface with standard deviations of less than 15 km. The most likely inter-event distance is about 20 km. These properties of the intermediate deep seismicity at a preferred depths within an about 30 km by 50 km width zone point to fluid release at those depths and not to triggering by fluid migration.