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SPATIAL VARIATIONS of EARTHQUAKE CLUSTERS in EASTERN MARMARA

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The North Anatolian Fault Zone (NAFZ) in Turkey is one of the most seismically active strike-slip fault that has produced many large earthquakes in the last century. One of the major fault segments of the western part of the NAFZ is the one crossing the Cinarcik Basin at a distance of ∼15 km to Istanbul. This also corresponds to a seismic gap south of the city producing few and very low magnitude microseismicity.
In order to study the fault zone, a cooperative project is initiated between Bogazici University Kandilli Observatory and Earthquake Research Institute (Istanbul, Turkey) and GFZ German Research Centre for Geosciences, Helmholtz Centre (Potsdam, Germany). In this context, two seismic arrays (PIRES) are installed on two islands (Sivriada and Yassiada) to permit high resolution monitoring of eastern end of this seismic gap, within 3-5 km distance to the fault. In addition to the arrays, PIRES seismic network is extended by installing at least one station to each of the neighboring islands (Balikciada, Burgazada, Heybeliada, Kinaliada and Buyukada).
In order to understand the differences in the strength of fault, friction properties and spatial variations of heterogeneity in finest detail, we have systematically studied the earthquake clusters nearby the arrays. The small magnitude earthquakes that have occurred within ∼15 km distance to the PIRES arrays, between the years 2007-2013, have been used for the earthquake cluster comparison. We have used the events detected in the conventional way (2.0<Ml<=3.0) as waveform templates for detecting similar ones with smaller magnitude, using cross correlation of continuous waveform We have stacked the cross-correlation traces from all of the stations from the two arrays like in the beam forming approach. This technique allowed identification of events down to a magnitude of Ml=0.0.
We will focus on the scaling properties, seismic moment, source size and stress drop of the clusters that were detected. In the present application, we estimate the source parameters from multiple traces stacked at three different components (vertical, EW and NS) and at ten different stations of PIRES seismic arrays. This allowed both noise cancelling and stable estimation of the final spectrum. Additionally, in order to improve the estimation process, the signal is divided into smaller segments that partially overlaps with each other. The spectrum of each sub-segment is calculated separately and the final spectrum of the entire signal is obtained by taking the average of Power Spectral Density (PSD) estimates. Special emphasis is given to remove any spurious spectral peaks that may originate from the resonance of any local structure. An iterative model fitting procedure is developed for that purpose. This allowed precise estimation of the stress drop of even smaller events within all clusters. The clusters in the fault zone area, are also compared to an off-fault event which occurred on land, near Buyukçekmece (19 October 2012, Ml=3.8) considered to correspond to an off-fault zone. Observed differences are evaluated in terms of seismic moment, source size, stress drop and seismic efficiency. Results are interpreted in terms of the space variation of the mechanical properties of the fault zone.