Small scale fault interactions in Southwestern Anatolia as revealed from Seismology & InSAR

Figen Eskikoy1, Semih Ergintav2, Ali Özgün Konca1, Ziyadin Çakır3, Hannes Vasyura-Bathke4, Marius Isken5, and Hayrullah Karabulut1

1Bogazici University Kandilli Observatory and Earthquake Research Institute, Department of Geophysics, Istanbul, Turkey
2Bogazici University Kandilli Observatory and Earthquake Research Institute, Department of Geodesy, Istanbul, Turkey
3Istanbul Technical University, Department of Geodesy, Istanbul, Turkey
4University of Potsdam, German Research Center for Geosciences, Potsdam, Germany
5Christian-Albrecht-University, Department of Geoscience, Kiel, Germany

Southwestern Anatolia is part of a N-S extensional regime mainly driven by rollback along the Hellenic subduction zone beneath the Aegean Sea. This seismically active area is controlled primarily by normal fault systems. The fault structures in the region are segmented and in many cases seismic interaction between these segments can be observed.

2017 seismic activity along the Eastern and Western edges of Gökova Bay. Within the same year, three separate moderate sized (Mw~5) events took place near the town of Ula (Muğla) on the eastern edge of Gökova Bay. One of these earthquakes occurred in April before the Bodrum-Kos earthquake while the other pair occurred in November within two days.

We relocated all the events that occurred in Ula region in 2017 and remodeled the source mechanisms from regional seismic waveforms by using Bayesian Earthquake Analysis Tool (BEAT). The surface deformations can also be clearly observed from InSAR tracks of both ascending and descending orbits. Because of the large noise margins of the interferograms, atmospheric noise corrections and high resolution DEM data were used.

Due to temporal and spatial proximity of the two Mw~5 events during the November sequence, InSAR yields only cumulative deformation of the earthquakes. Therefore, we determined the contribution of each event to the cumulative static displacements observed by InSAR data, using the source models from seismic waveforms. The locations and the source mechanisms of the two Mw~5 earthquake are consistent and explain the observed surface deformation.

Our results imply that these earthquakes occurred on a previously unknown normal fault rather than the southeastern branches of the nearby Muğla Fault as proposed earlier. The results are consistent with the recently mapped fault structure by Akyüz et al. (2018). The November activity implies EW trending, south dipping normal faulting system and the change in the strike direction of the fault on the eastern edge can be clearly seen both InSAR and waveform modelling results of April activity.
Co-seismic and post-seismic InSAR analysis shows that the seismic activity following the 2017 Mw6.6 Bodrum-Kos propagated from western Gökova Bay where rupture occurred toward east including the Ula region. A long term comparison of seismicity beneath Gökova Bay and Ula region shows that the seismicity in these two regions are temporally correlated. Hence, while the aforementioned moderate sized earthquakes are not directly triggered by the Bodrum-Kos earthquake, increased seismic activity following Bodrum-Kos earthquake shows that the stress changes in these two regions affect each other. The location errors of the events especially the depth errors in the catalogs and the active fault structure in the area cannot be realized without any geodetic or seismic data analysis. This study claims that the interpretations of the moderate size earthquakes should be studied by using multidisciplinary data sets.

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