



February 6, 2023, Mw 7.8 and 7.6 Kahramanmaraş (Türkiye) Earthquake Sequence: Insights from Co-seismic and Post-seismic Surface Deformation

Seda Özarpacı¹, Alpay Özdemir¹, Efe Turan Ayruk¹, İlay Farımaç¹, Muhammed Turğut¹, Yusuf Yüksel¹, Figen Eskiköy², Uğur Doğan¹, Semih Ergintav², Cengiz Zabcı³, Rağsan Çakmak³, Mehmet Köküm⁵, and Ziyadin Çakır³

¹Department of Geomatic Engineering, Yıldız Technical University, 34220, Istanbul, Türkiye

²Department of Geology, Istanbul Technical University, 34469 Istanbul, Türkiye

³Department of Geophysics, Kandilli Observatory and Earthquake Research Institute, Bogazici University, 34684 Istanbul, Türkiye

⁵Firat University, Geological Engineering, Elazığ, 23200, Türkiye

On 6 February 2023, 04:17 in local time, Mw 7.8 earthquake and nine hours later, 13:24 in local time, Mw 7.7 earthquake struck the same region resulting a massive destruction with loss of lives more than 41,000 in Türkiye and 4,000 Syria. The earthquake took place on the East Anatolian Fault Zona (EAFZ) which is a plate boundary (~600 km) between the Anatolian and Arabian plates from Karlıova triple junction between Arabian, Anatolian and Eurasian plates to the Dead Sea Fault Zone (DSFZ) and parts of another triple junction at the south end between Adana block, Anatolian and Arabian plates at Kahramanmaraş. Secular plate velocities between Arabia and Anatolia range from 6 to 10 mm/yr and has resulted in destructive earthquakes in eastern Turkey as documented by historical records. The largest known earthquakes along the EAFZ occurred on November 29, 1114 (M > 7.8), March 28, 1513 (M > 7.4) and March 2, 1893 (M > 7.1). The activity of these large devastating historical earthquakes contrasts with the low-level activity during the 20th century. The quiescence ended with the Mw 6.9 1971 Bingöl earthquake, which is followed about 50 year later by the Mw 6.9 January 24, 2020 Sivrice, Elazığ earthquake that ruptured only 45 km of the 95 km long Sivrice-Pütürge segment. With the latter event, seismicity accelerated along the rupture zone and activity moved towards to the SW.

Our aim is to monitor and estimate the co- and post- deformation field from geodetic measurements (InSAR and GNSS). While maximum co-seismic displacement at the ANTE GNSS station was 0.4 m in the first event (KMRS, Kahramanmaras), the biggest co-seismic displacement observed in the second event was 4.5 m in EKIZ (Ekinozu) station which is ~1.5 km away from the epicenter of the second earthquake. This co-seismic deformation field was estimated from open station of TUSAGA-Active GNSS Network. Following the earthquakes, we established three new continuous GNSS stations to monitor the postseismic deformation in Hatay province close to Türkoğlu segment of the East Anatolian Fault. Preliminary analysis indicates about 20 mm of postseismic deformation 10 days following the earthquakes. We have also conducted a GNSS campaign and occupied nearfield benchmarks. We will also monitor postseismic deformation using Sentinel and CosmoSkyMed SAR data field.

This work is supported by TUBITAK project number 121Y400 and 1002-C project "Mw 7.7 Pazarcik (Kahramanmaras) Earthquake Sequence".

Keywords: 06.02.2023 Turkiye Earthquake Sequence, Kahramanmaras Earthquake, GNSS, InSAR, Coseismic and Postseismic Deformation