Post-seismic analysis of the Kahramanmaraş triple junction using GNSS data acquired following the 2023 Kahramanmaraş earthquakes

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Understanding the evolution of the crustal kinematic/dynamic response of the Kahramanmaraş triple junction after the occurrence of the destructive earthquake doublet on 6 February 2023 is of great interest to seismologists and geodesists. Along with the near-field postseismic effects such as the afterslip, it is also essential to study relatively far-field effects where the interaction of the brittle upper crust with the lower crust and upper mantle can be relevant in how the stress is redistributed during the months/years following the earthquake. The latter seems to be a particularly interesting problem for this case because the earthquake perturbation to the interseismic velocity field is very significant and extends approximately 400 km to the west of the rupture zone. The affected region seemingly comprises a large part of the Central Anatolian Block where the interseismic internal deformation was less than 10 nanostrain/yr prior to the large event. Most tomographic studies show that the lithospheric mantle beneath Central Anatolia is either very thin or absent. This indicates a necessity to test various upper mantle and lower crust viscosity scenarios for the far-field effects.

We conducted a GNSS (Global Navigation Satellite System) campaign in July 2023, reoccupying 18 sites around the triple junction area to monitor the intermediate and far-field post-seismic effects caused by the ruptures and the subsequent loading behavior of the faults therein. Our primary aim was to characterize: (1) the postseismic effect on the relatively far-field, which likely includes viscoelastic responses in central Anatolia where the lower crust and mantle are presumably weak; (2) variations of the strain field stemming from aftershocks of the large earthquakes; and (3) the response of secondary faults such as the Ecemiş, Deliler, and Sarız faults in Adana and Kayseri provinces. 1-year GNSS time series of continuous stations broadly reveal the postseismic field behavior. The occurrence of a postseismic signal is clear northwest of the rupture zone however,
the signal is weak for the stations southwest of the earthquake area. The preliminary analysis of
the survey mode sites is in agreement with continuous stations. Here we present the resulting
post-seismic velocity, the strain rate field and its contrast from the pre-event strain rate field and a
preliminary viscoelastic model to shed light onto the underlying physical processes.