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Slip Distribution of the 2020 Mw6.9 Samos Earthquake Using a Bayesian Approach

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On 2020 October 30, an M_w6.9 earthquake struck offshore Samos Island. Severe structural damages were observed in Greek Islands and city of Izmir (Turkey). 114 people lost their lives and more than a thousand people were injured in Turkey. The earthquake triggered local tsunami. Significant seismic activity occurred in this region following the earthquake and ~1800 aftershocks (M>1) were recorded by KOERI within the first three days. In this study, we analyze the slip distribution and aftershocks of the 2020 earthquake.

For the aftershock relocations, the continuous waveforms were collected from NOA, Disaster and Emergency Management Authority of Turkey (AFAD) and KOERI networks. The database was created based on merged catalogs from AFAD and KOERI. For estimating optimized aftershock location distribution, the P and S phases of the aftershocks are picked manually and relocated with double difference algorithm. In addition, source mechanisms of aftershocks M>4 are obtained from regional body and surface waveforms.

The surface deformation of the earthquake was obtained from both descending and ascending orbits of the Sentinel-1 A/B and ALOS2 satellites. Since the rupture zone is beneath the Gulf of Kusadası, earthquake related deformation in the interferograms can only be observed on the northern part of the Samos Island. We processed all possible pairs chose the image pairs with the lowest noise level.

In this study, we used 25 continuous GPS stations which are compiled from TUSAGA-Aktif in Turkey and NOANET in Greece. In addition to continuous GPS data, on 2020 November 1, GPS survey was initiated and the earthquake deformation was measured on 10 GNSS campaign sites (TUTGA), along onshore of Turkey.

The aim of this study is to estimate the spatial and temporal rupture evolution of the earthquake from geodetic data jointly with near field displacement waveforms. To do so, we use the Bayesian Earthquake Analysis Tool (BEAT).

As a first step of the study, rectangular source parameters were estimated by using GPS data. In order to estimate the slip distribution, we used both ascending and descending tracks of Sentinel-1 data, ALOS2 and GPS displacements. In our preliminary geodetic data based finite fault model, we used the results of focal mechanism and GPS data inversion solutions for the initial fault plane parameters. The slip distribution results indicate that earthquake rupture is ~35 km long and the maximum slip is ~2 m normal slip along a north dipping fault plane. This EW trending, ~45° north dipping normal faulting system consistent with this tectonic regime in the region. This seismically active area is part of a N-S extensional regime and controlled primarily by normal fault systems.

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