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Detecting Transient Creep Events on the Ismetpasa Segment of the North Anatolian Fault with Continuous GNSS Time Series

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Twenty six years after the Mw 7.3 Bolu/Gerede Earthquake of 1944, Ambraseys (1970) first recognized, in the offset of a manmade wall constructed across the fault in 1957, the signature of slow aseismic slip along the central segment of the North Anatolian Fault (NAF). Following this discovery, many studies have characterized the behaviour of this aseismic slip with land- and space-based geodetic techniques, and with creepmeters. It is now recognized that the rate of aseismic slip decreases logarithmically from more than 3 cm/yr in the years following the Gerede Earthquake to approximately 6±2 mm/yr today. Of this rate, approximately 1.2 mm/year is residual afterslip and the remainder appears to be linear creep interrupted by creep events. In the last two decades, InSAR allowed the derivation of maps of ground velocities that indicates aseismic slip extends along a 100-km-long section of the fault, with a spatially variable aseismic slip rate, reaching its peak value approximately 15-24 km east of the city of Ismetpasa. Furthermore, creepmeter measurements and InSAR time series indicate that surface aseismic slip in the region of Ismetpasa is largely episodic, alternating between quiescent periods and transient episodes of relatively rapid aseismic slip. These observations raise questions about how slip accommodates tectonic stress along the fault with significant implications in terms of hazard along the seismogenic zone.

In July 2016, we established ISMENET (Ismetpasa Continuous GNSS Network) to monitor spatial and temporal variations in the aseismic slip rate and detect slow slip events along the fault. ISMENET stations are distributed along 120 km long segment of the fault. In order to explore the shallow, fine spatio-temporal behavior of aseismic slip, 19 stations are located within 200 m to 10 km of the fault with 30 and 1 sec sampling rate. We analysed the GNSS time series to extract the signature of aseismic slip using a principal component analysis to reduce the influence of non-tectonic noise. We compared results with creep events quantified by creepmeters.

Keywords: Ismetpasa, Aseismic slip, GNSS, PCA, Time Series Analysis, NAFZ