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Surface creep along the 1999 Izmit earthquake's rupture (Turkey) from high temporal resolution interferometric synthetic-aperture radar data

Gokhan Aslan (1,2), Ziyadin Cakir (3), Cécile Lasserre (4), François Renard (1,5), and Semih Ergintav (6)

(1) ISTerre, Université Grenoble-Alpes, Grenoble, France; gokhan.aslan@univ-grenoble-alpes.fr, (2) Eurasia Institute of Earth Sciences; Istanbul Technical University, 34469, Istanbul, Turkey, (3) Department of Geological Engineering; Istanbul Technical University, 34469 Istanbul, Turkey; ziyadin.cakir@itu.edu.tr, (4) Laboratoire de Géologie de Lyon : Terre, Planètes, Environnement (LGL-TPE), cecile.lasserre@univ-grenoble-alpes.fr, (5) Physics of Geological Processes (PGP) , The NJORD Centre, Dept of Geosciences, UiO, NO-0316, Oslo, Norway, (6) Department of Geodesy, Kandilli Observatory and Earthquake Research Institute (KOERI), Bogazici University, 34684, Istanbul, Turkey; semih.ergintav@boun.edu.tr

The determination of the slip budget is essential to estimate the seismic potential of faults. Studies based on Interferometric Synthetic-Aperture Radar (InSAR) and Global Positioning System (GPS) satellite observations until 2012 have shown that the central segment of August 17, 1999, Izmit earthquake on the North Anatolian Fault (NAF) began slipping aseismically following the event. To monitor this long-lasting afterslip and characterize its spatiotemporal behavior, we compute InSAR time series by using 32 TerraSAR-X radar images acquired between 2011 and 2015 and 275 ascending and descending Sentinel 1A/B TOPS images acquired on three tracks, spanning the period from October 2014 to July 2017. Results over the period 2011-2017 show that afterslip on the central segment of 1999 Izmit fault rupture is still taking place for more than 18 years, becoming the longest recorded afterslip. Our results are in agreement with previous studies suggesting that surface creep on active faults may also initiate as postseismic afterslip that decays logarithmically with time lasting for a long period of time, possibly late in the earthquake cycle. Creep rate fluctuates along the fault and is maximum (6 mm/yr) on the segment that showed supershear rupture. Time series analysis reveals stable steady state creep of 6 mm/year and a large transient creep event (creep burst) in December 2016. Vertical velocity fields obtained with decomposition of velocity fields on ascending and descending tracks show the persistent subsidence on the hanging wall block of the Golcuk normal fault that also ruptured during the Izmit earthquake. These results demonstrate that high-resolution temporal InSAR data allow detecting deformation signals that were not seen previously and that active continental deformations in the east-southeast of Istanbul is more complex than what was previously assumed as they vary along the North Anatolian Fault both in space and in time.