



Continuous creep measurements on the North Anatolian fault

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Surface creep was observed as early as 1969 on the North Anatolian fault near Ismetpasa and continues to the present day at rates of the order of 5 mm/yr. Although subsurface creep is currently monitored using INSAR and GPS, continuous creep measurements on the trace of the surface fault have been intermittent. In 2014, we installed a carbon-fiber rod creepmeter at Ismetpasa and a second creepmeter across the surface rupture of the 1999 Izmit earthquake, which is also known to be creeping at depth. The creepmeters have a resolution of 5 μm and a dynamic range of 2.2 m. Each creepmeter uses two sensors: 1) a subsurface LVDT (resolution 5 μm , range 10 mm) and an above-ground rotary Hall effect sensor (resolution 25 μm , range 2.2 m) and the data are transmitted via Iridium satellite communications as 30 minute samples every 2 hours. The hybrid sensors on the creepmeters are similar to others currently operating on the Hayward, Calaveras, and San Andreas faults. The sensor's ability to capture slow slip, coseismic rupture or afterslip has been tested in deployments on the rapidly creeping Jackson, Wyoming landslide (1-3 mm/day). In addition, we have installed six borehole strainmeters to measure creep on the Princess Island segment of the North Anatolian fault to the west of Ismetpasa. The tensor strainmeters are able to measure strain events on 10e-10 strain and they can resolve 1 mm creep events on the order of 500 m² at distances of 4 km away based on observations from deployed instruments along the San Andreas Fault in Southern California. The tensor strainmeters are unique geodetic instruments in that they are capable of imaging the creep in high resolution where the North Anatolian fault (NAF) is submarine in the Sea of Marmara. The newly installed creepmeters and strainmeters will be powerful tools to examine the possibilities of the transient or episodic creep along the NAF and they will be used to validate the results of on-going monthly INSAR, continuous, and campaign GPS studies, along the NAF.