

Co-seismic and Post-seismic Models of the 23 October 2011 (Mw=7.2) Van Earthquake (Turkey) from GPS Measurements

Deniz Oz Demir (1), Uğur Doğan (1), Ziyadin Çakır (2), Semih Ergintav (3), Seda Çetin (1), Alpay Özdemir (1), Haluk Özener (3), and Robert Reilinger (4)

(1) Yıldız Technical University, Department of Geomatic Engineering, Istanbul, Turkey (denizoz@yildiz.edu.tr), (2) Istanbul Technical University, Dept. of Geology, Istanbul, Turkey, (3) Bogazici University, Kandilli Observatory, Dept. of Geodesy, Istanbul, Turkey, (4) Massachusetts Institute of Technology, Dept. of Earth, Atmospheric, and Planetary Sciences, Cambridge, USA

As there were almost no GPS stations in the epicentral region of the 2011 Van earthquake, previous studies used the GPS data from the CORS-TR network that is rather scattered over entire Turkey (roughly in a 50x50 km grid). We have recently obtained GPS data collected at 25 sites in the earthquake region before the earthquake by local institutions for mainly cadastral purposes at different times. Most of the sites are located within the city and to the south of the fault rupture. Nevertheless, the presence of some sites to the east is critical for constraining the eastern tip of the fault rupture that is poorly known due to lack of measurements and presence of the Erçek Lake. Sites near by the surface rupture north of the city are also useful for constraining the fault parameters. Therefore, to estimate coseismic displacements in the near field we conducted a field campaign and all the sites were reoccupied and measured around 10 hours after the earthquake. Then, we modeled the results using elastic dislocations on triangular faults embedded in a homogenous and elastic half space. We use the same fault surfaces used by Doğan et al. (2014) to model the postseismic GPS displacements. Estimated seismic moment, M_0 , is $6.4858 \cdot 10^{19}$ Nm ($M_w = 7.1$), in good agreement with seismologically and geodetically estimated seismic moment. Modeling predicts a simple elliptical slip patch centered at around 8 km depth with a maximum slip of about 2.5 m, which is consistent with the previous estimates based on InSAR measurements. However, as the GPS measurements span a postseismic period of 47 months, our model predicts slip also on the shallow sections of the fault, which is due to the postseismic afterslip shown by Doğan et al. (2014). The measurements confirm that the fault splay west of the fault that was reactivated following the earthquake did not experience any significant coseismic slip. Modeling also confirms that the rupture does not go straight to the east as suggested by Emre et al. (2011), but veers to the northeast in the Erçek Lake.

The last (i.e. the tenth) postseismic GPS campaign was carried out in September 2015. Thus, we were able to obtain a long time series since November 2011 at about every 6 months. Analysis of our time series together with the continuously operating GPS stations nearby suggests that the postseismic relaxation has not ceased yet. Modeling of the total postseismic displacements shows aseismic thrust slip with left lateral component up to 65 cm, equivalent to an earthquake of $M_w=6.7$ ($M_0= 13.8822 \cdot 10^{18}$ Nm) (This study is supported by TUBITAK no: 112Y109 project).

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