9th Alexander von Humboldt International Conference
Istanbul | Turkey | 24 – 28 March 2014
AvH9-37

Examining the post-seismic processes in a hazard perspective

Ali Deger Ozbakir (1), Mehmet Sinan Ozeren (2), Semih Ergintav (3), and Hayrullah Karabulut (1)

(1) Bogaziçi University KOERI, Department of Geophysics, Istanbul, Turkey (aozbakir@gmail.com), (2) Istanbul Technical University, Eurasia Institute of Earth Sciences, Istanbul, Turkey (ozerens@itu.edu.tr), (3) Bogaziçi University KOERI, Department of Geodesy, Istanbul, Turkey (semih.ergintav@boun.edu.tr), (4) Bogaziçi University KOERI, Department of Geophysics, Istanbul, Turkey (kara@boun.edu.tr)

1999 Izmit M7.4 and Duzce M7.2 earthquake sequence ruptured the western part of the North Anatolian Fault (Turkey) and possibly loaded the fault segment to the south of Istanbul metropolitan area further west in the Sea of Marmara. This brought both the megacity and country to a very delicate situation, as the city is the financial hub of Turkey. While the inter- and co-seismic motions are instrumentally readily recorded and more easily understood, the post-seismic phenomena present challenges, because various processes can be at play at different temporal and spatial scales. In a region where there is geodetic and seismic evidence of laterally inhomogeneous medium such as the western part of North Anatolian Fault, the problem is even more complicated. Thus, it is imperative to study the earthquake-cycle with special emphasis on the post-seismic phenomena, as the yielding recurrence times lead to hazard assessment.

The post-seismic behaviour of the zone surrounding the Izmit earthquake has been the subject of various studies, focusing on the afterslip and/or the viscoelastic behaviour of the deforming medium. Recently, however, InSAR interferograms show an ongoing surface creep along the ruptured segment following the Izmit earthquake, which was not taken into account in any of the previous post-seismic studies. This probably led to overestimation of the depth extent of afterslip and erroneous conclusions in the viscoelastic regime in the far field. In this study, we prescribe the co-seismic slip as the initial condition and specify the observed creep on the superficial part of the ruptured fault plane obtained from InSAR studies in order to compute synthetic time series of deformation. We use a 3D semi-analytical approach to solve for displacements and stresses. We compare our results with seven years of GPS time series in several stations, recorded after the Izmit earthquake.

Preliminary results based on a 2D grid search on the velocity weakening parameters show that we obtain a good fit of the near-field GPS data using an afterslip patch distribution shallower than the previous models. We also show that far-field fits get slightly better if we use lateral variations of viscosity for the viscous substratum underneath the brittle layer in such a way that it is weaker to the south of the fault. This is in agreement with the bulk viscosity models obtained in the dynamical studies that use secular GPS data.