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Seismological and Geodetic Modeling of the 2014, Mw 6.8 Earthquake of North Aegean Trough

Vasso Saltogianni (1), Michail Gianniou (2), Seda Yolsal-Çevikbilen (3), Tuna Eken (3), Tuncay Taymaz (3), and Stathis Stiros (1)

(1) Department of Civil Engineering, University of Patras, Patras, Greece, (2) National Cadastre and Mapping Agency SA, Athens, Greece, (3) Department of Geophysical Engineering, Faculty of Mines, Istanbul Technical University, Istanbul, Turkey

On 24 May 2014 a strong earthquake Mw 6.8 ruptured the North Aegean Trough (NAT) and produced relatively small accelerations. The distribution of the aftershocks provide evidence of an about 200-250km long seismogenic zone, to the west of the North Anatolian Fault (NAF). At a first approach, this earthquake seems to fill a gap in faulting along the NAT since 1965. Hence, we tentatively suggest that this earthquake does not seem to be directly related with the westward propagation of the faulting along the NAF which should be investigated further.

At a first step, broadband seismological data were analyzed to provide faulting geometry and to constrain the rupture pattern. Best fitting waveform point-source solution of the May 24, 2014 earthquake yielded dominantly right-lateral strike-slip faulting mechanism consistent with the morphology of the NAT and the NAF.

At a second step, GPS-derived displacement vectors were analyzed to obtain a geometric, Okada-type fault model. Co-seismic displacement vectors were calculated from the recordings of 11 continuous GPS stations nearly uniformly distributed along the meizoseismal area of the earthquake. Co-seismic displacements >10cm but no significant post-seismic displacements were found, especially in the near-field, in the nearby Samothraki and Lemnos Islands. Data were analyzed on the basis of the new Topological Inversion (TOPINV) algorithm, which requires the a-priori knowledge of the possible ranges for each of the nine variables defining a fault in the Okada-model, and does not require to fix any of these variables, or to search in the vicinity of any possible solution. As a requirement of this algorithm, a broad range for the possible values of all variables was assumed on the basis of all the available seismological estimates. The computed geometric fault model corresponds to an about 60km-long strike-slip fault, cutting from the surface to the depth of 20km. Uncertainties of all estimated variables (fault parameters) are small, and the derived model fits observations very well.

In summary, the seismological estimates of the preferred body waveform point-source solution, which was used for the waveform finite-fault solution, and the geodetic inversion solution agree within the estimated errors, confirming that geodetic and seismological data favour a simple fault of uniform slip.