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Source model of the 2012 Ahar-Varzaghan earthquake doublet using elliptical subfault approximation

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On 11th august 2012 two destructive earthquakes(Mw=6.5, 12:23:15 GMT &Mw=6.3, 12:34:34 GMT) happened in north-western Iran close to Ahar and Varzaghan cities. Their hypocenter were just 4 kilometers far from each other.
Since both mainshocks were close to each other, there was a doubt on their causative faults geometries and their seismotectonic features. On the other hand, seismic cross sections showed a big gap in the middle of aftershocks cloud.
We study the source kinematics using elliptical subfault approximation method to find the best fault(s) geometry and we correlate the slip history of both events with the spatial distribution of aftershocks. We inverted 11 strong motion waveforms within a distance range of 7 to 38 km and used a local velocity model we retrieved from the aftershock sequence.
We inverted each ellipse for slip, rupture speed, rake and rise time. The preferred model for the first event is almost vertical(86 degrees and south dipping) and has strike of 268 degrees which is consistent with the E-W striking 13 km observed surface ruptures. Using this geometry, our calculated kinematic model for event-1 contains 3 ellipses. The largest one has semi-major and semi-minor axis of about 7.5 and 6.0 kilometers respectively. This patch showed maximum slip of about 3.5 meters on its center coinciding with a sizeable gap in the aftershock distribution within the central aftershock cloud. The rupture started from a depth of 10 km beneath this patch with a speed of 2.28 km/s. Two other small patches with lesser displacements on east and west of the main patch were surrounded by aftershocks. The first event occurred in about 10 seconds and exhibited unilateral rupture propagation towards the west. The rupture started from the eastern end of the reported surface ruptures and grown towards the western end of the aftershock sequence.
On the other hand the second event occurred on distinct fault situated just 2 km to the north of the causative fault of the first event. The fault dips 80 degrees to the north and its strike is about 264 degrees, almost parallel to the causative fault of the first event. The best kinematic model for the second event has 3 patches. The maximum slip is 3.22 meters and the rupture lasted for about 6 seconds. The rupture speed changed from 1.8 to 3.0 km/s and started from a depth of 12 km towards the ground surface.
The earthquake doublet is 50 km far from the city of Tabriz with more than 2 million population. The closeness of the causative faults to the North Tabriz fault system characterized by a great history of destructive earthquakes, confirms the importance of a detailed study of the sources of this earthquake doublet. The distinct rupture characteristics of these two earthquakes illuminate differences in seismogenic properties and seismic hazard of such an important fault system.