Seismogenic source model of the 2019 Mw 5.9 East-Azerbaijan earthquake (NW Iran) through Sentinel-1 DInSAR measurements

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On 7 November 2019 (22:47 UTC) a Mₜ 5.9 earthquake struck the East-Azerbaijan region, in the north-western Iran, about 100 km east of Tabriz, the fourth largest city of Iran with a population of over two million. This seismic event caused both widespread damage to the surrounding villages and casualties, killing about 5 people and injuring hundreds. The occurrence of this earthquake is related to the main geodynamic regime controlled by the oblique Arabia-Eurasia convergence and, in particular, this event is inserted in the tectonic context of the East-Azerbaijan Plateau, a complex mountain belt that contains internal major fold-and-thrust belts.

In this work, we first generate the coseismic deformation maps by applying the Differential Synthetic Aperture Radar Interferometry (DInSAR) technique to SAR data collected along ascending and descending orbits by the Sentinel-1 constellation of the European Copernicus Programme. Then, we invert them through analytical modeling in order to better constrain the geometry and characteristics of the main source. The retrieved fault model revealed a shallow seismic source approximately NE-SW-striking and characterized by a left-lateral strike-slip, southeast-dipping faulting mechanism. Our retrieved solution reveals a new minor fault never mapped in geological maps before, whose kinematics is compatible with that of the surrounding structures and with the local and regional stress states. Moreover, we also use the preferred fault model to calculate the Coulomb Failure Function at the nearby receiver faults; taking into account the surrounding geological structures reported in literature, we show that all the considered receiver faults have been positively stressed by the main event. This is also confirmed by the distribution of the aftershocks that occurred near the considered faults. The analysis of the earthquake nucleated along these left-lateral strike-slip minor fault is essential to improve our knowledge of the East-Azerbaijan Plateau; therefore, further studies are required to evaluate their role in seismic hazard definition of northwest of Iran, in order to help in the mitigation of the seismic hazard in seismogenic regions unprepared for the occurrence of seismic events.

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