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Examples of recent active faulting on the Turkish-Iranian Plateau: October 2011 Van (Turkey) and August 2012 Ahar-Varzaghan (Iran) earthquakes

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The Turkish-Iranian Plateau is the end result of the continental collision between the Arabian and Eurasian plates. The convergence is partitioned between thrust and strike-slip faults in the region. In this study we will present two examples of the recent active faulting on these thrust and strike slip zones in the plateau using the satellite radar interferometry (InSAR) technique.

The first example, the Mw 7.1, October 23rd, 2011 earthquake occurred on a blind thrust fault near the city of Van, Turkey, causing over 600 fatalities and extensive damage. Several studies of the earthquake have been completed, but they only rely on available InSAR data from descending orbits, making it difficult to constrain the parameters of the causative fault and the slip distribution on it. The main outcome of these studies is the possibility of a coseismic slip deficit on the shallower parts of the fault, leading to a risk of a damaging shallow earthquake. To better constrain the fault geometry and slip, we make use of pixel offset measurements on point-like scatterers which not only enabled us to incorporate data from the otherwise decorrelated ascending orbit but provided us information from the near-fault zone. In addition to SAR pixel offsets, a new set of measurements of the uplift along the Lake Van coast using dead algae levels as biological markers are also used to improve our final source model.

On August 11, 2012, to the east of the plateau and 300 km away from Van, two earthquakes of magnitudes 6.4 and 6.3, occurred 10 minutes apart near the city of Ahar and about 40 km NE of Tabriz (northwestern Iran). Our field observations revealed a $\sim$11 km long surface rupture with a right lateral sense of displacement of up to 50 cm along the Ahar fault, a prominent structure with a clear morphological expression in the topography. However, the earthquake locations and the focal mechanism solutions could not resolve whether the surface rupture was created by the first or the second event, or even both. A second issue arises due to the nodal plane ambiguity; the second shock might have occurred on a conjugate plane with a left-lateral mechanism. To resolve these issues and to identify the characteristics of the faulting beneath the surface, we used InSAR data from the RADARSAT-2 satellite. Our preliminary analysis of an ascending coseismic interferogram suggests a rupture of two adjacent segments of the Ahar fault. More than 16 fringes are visible to the south of the fault zone indicating a line-of-sight displacement of over 45 cm. The total rupture length seen in these data is around 15 kilometers, or somewhat longer than was detected in the field.

Seismic risk evaluation requires in-depth understanding of the active faulting in a region. As once more demonstrated by these two earthquakes InSAR is an essential tool, especially in cases where the faulting is complex or did not reach the surface.