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CHARACTERIZING SURFACE RUPTURE IN THE 1990 RUDBAR EARTHQUAKE (IRAN) USING OPTICAL IMAGE CORRELATION

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The 1990 June 20th Rudbar earthquake (7.3 Mw) was a catastrophic event that killed ~40,000 people, made ~500,000 people homeless, and destroyed three cities and 700 villages in Northern Iran. The earthquake ruptured a previously unknown left-lateral strike slip fault over a distance of 80 km in the western Alborz Mountain belt. The field study indicated a maximum horizontal displacement of ~60 cm and a vertical displacement of ~95 cm (Berberian et al., 1992; Berberian and walker, 2010). The main shock was followed by several aftershocks, with many occurring north of the fault plane, and displaying strike-slip or reverse focal mechanisms. The reported surface slip displacements are surprisingly low given the relatively shallow and high moment release in this event, coupled with the pure nearly vertical left-lateral fault (e.g. ~2.5 m of slip would be expected from a Mw 7.3 event with a fault surface of 15 in depth and 80 km in length). The Rudbar earthquake occurred before InSAR and GPS eras, thus we re-examine the surface displacement field using optical image correlation to better understand the faulting associated with the Rudbar earthquake. This method allows the retrieval of near-field fault displacements by cross-correlation of pre- and post-earthquake satellite and aerial images (Leprince et al., 2007; Avouac et al., 2015). We use SPOT images from before (1989) and after (1994) the earthquake to document the horizontal deformation produced by the Rudbar earthquake. We find much larger surface slip (~1 to 5 m, Figure 1.) than those reported by field measurements (~60 cm, Berberian et al., 1992). The disparity between the two measurements is related to a distributed deformation occurring in a volume around the fault. We found that the horizontal displacement happened within an average width of ~770 m centered around the Rudbar fault. Furthermore, we identify a newly mapped surface rupture with length of 23 km in the eastern end of the Rudbar fault.

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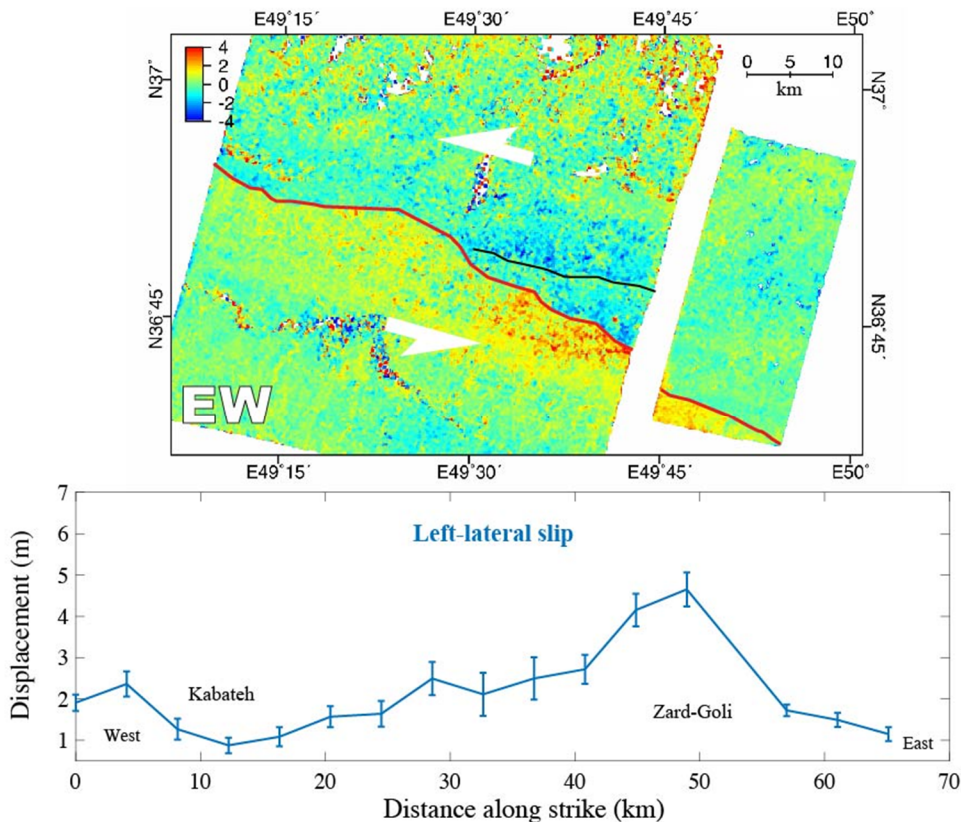

Figure 1. Correlation map in east-west direction of SPOT images. The red line shows the surface trace of Rudbar fault as mapped by our method. The black line shows a new surface rupture for the Rudbar event. The lower panel show the horizontal displacement along the Rudbar fault (solid red lines) strike. The vertical lines show error for each measurement.