Geophysical Research Abstracts
Vol. 16, EGU2014-11887, 2014
EGU General Assembly 2014

Coseismic surface displacements from optical and SAR image offset tracking, fault modeling and geomorphological analysis of the Sept. 24th, 2013 M7.7 Balochistan earthquake

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The M 7.7 earthquake in the Balochistan province of Pakistan on September 24th, 2013 took place along a subsidiary fault in the transition area between the Makran accretionary prism and the Chaman transform fault. This tectonics of the Indian and Arabian plate collisions with Eurasia produce primarily oblique left-lateral strike slip in this region. In this work, measurements of displacement and mapping of the rupture trace are achieved through image correlation of Landsat 8 images and SAR offset tracking of TerraSAR-X data. Horizontal displacements from both methods and derived vertical displacements are used to constrain a fault rupture model for the earthquake. Preliminary results show a surprisingly uniform slip distribution with maximum displacement near the surface. The total fault rupture length is $\sim$210 km, with up to 9 m of left-lateral strike-slip and 3 m of reverse faulting.

Additionally, mapping of the rupture trace is made use of for geomorphological observations relating to slip rates and identification of transpressional and transtensional features. Our results indicate a mostly smooth rupture trace, with the presence of two restraining steps, a releasing bend and a 3 km long sliver where the surface rupture jumped from the foot of the range-front into the alluvial fans at their base. A small block at one of the restraining steps shows intermediate displacement in both data sets. At the southern end of the rupture we observe that displacement from the earthquake cuts across a fold-and-thrust belt of the Makran accretionary prism. Preliminary results show a minimum of 12 km of repeated section of the accretionary wedge, and within the southern repeated section we find an offset of 600 m between two parallel ridges across the rupture trace. We relate these observations to conceptual models of fault segmentation and growth.