Contribution of very high resolution optical satellite data to the understanding of the 30 October 2016 Mw 6.5 Norcia earthquake, Central Italy

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Abstract

We investigate coseismic surface displacements produced during the 30 October 2016 Mw 6.5 Norcia earthquake, the largest of a sequence of normal-faulting events that occurred between August 2016 and January 2017 in Central Italy. Using Pléiades optical satellite image correlation techniques, we produce horizontal and vertical surface displacement maps that allow us for mapping surface ruptures, measuring coseismic offsets, and quantifying off-fault deformation in the very near field. Coseismic offsets reach 2 m in the Monte Vettore area, whose western flank is cut by a complex network of ruptures. The hanging wall of the West-dipping Monte Vettore fault appears to be cross-cut by a shallower antithetic fault with discontinuous surface expression. A distributed-slip elastic model based on the inversion of ALOS-2 InSAR, GPS and Pleiades optical data was computed, with the aim of fitting both the far-field and near-field observations, in order to investigate how surface ruptures are related to slip taking place in the deeper part of the fault system. Optical measurements were compared to field measurements and both datasets were confronted to the slip reconstructed from the shallowest patches of the model. All observations are reproduced at first order, except on the Monte Vettore area, where optical measurements show notable slip excess in the area of peak coseismic offset at the surface, especially on one rupture described in the model as very superficial and with a very shallow dip. To explain these discrepancies, we suggest that displacement on this specific part of the rupture was partly driven by large scale gravitational movements, which is not taken into account in our model.
Implications of such gravitational movements are significant, as they could increase uncertainties on previous estimates of faults slip rates and earthquake recurrence times in Central Italy derived from paleoseimologic studies.

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