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Comparing coseismic slip with cumulative displacements at various time scales on the Mt. Vettore- Mt. Bove fault system after the 2016 Central Italy earthquakes: insights into growth and segmentation processes of an active extensional system

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The morphotectonic and structural geology of the Mt. Vettore - Mt. Bove normal faults system (VBFS) in central Apennines is studied to unravel its evolution over time. In Aug-Oct 2016, this normal fault system broke during three earthquakes (Mw6.0, Mw5.9, and Mw6.5) associated with clear coseismic ruptures.
Based on topographical, geological and high resolution satellite images, as well as original field observations integrated with the available surface rupture maps (e.g. Villani et al. 2018), we identify three types of faults: 1- active faults with coseismic ruptures, morphological evidence of activity over the post-glacial period and geological displacements; 2- faults with geological displacements and morphological evidence but that did not rupture during the 2016 event; 3- faults with geological displacement but with no morphological evidence and no surface faulting in 2016. The cumulative offset is assessed on each fault portion exhibiting morphological evidence of activity by topographic profiles extracted from a high-resolution DEM (derived from Pleiades images acquired after the 2016 earthquakes, DEM resolution is 2 m). Those 122 offsets measurements yield the distribution of the post-glacial cumulative throw over the 19 km-long studied portion, between Mt. Vettore and Mt. Bove. The maximum throw is observed on the southern portion of the fault system, on the Mt. Vettore segment, reaching 25 m and progressively decreasing northward. From seven geological cross-sections levelled across the fault system, using published geological maps and field geological survey, we derived the geological offsets on the active fault segments (type 1 and 2) but also on normal faults associated with cumulative geological displacement but with no evidence of recent activity (type 3). The distribution of coseismic displacement along the fault length is similar to the one observed for the morphological offsets, with the highest displacements localized on the same fault segments. Such evidence suggests that, for similar geo-tectonic contexts, the investigation of Holocene fault scarps represents an important contribution in assessing the seismic hazard. However, faults with the highest geological throw (600-1100 m) do not show evidence of activity over the post-glacial period, while fault segments with the highest rate of recent activity commonly exhibit small geological throw. This suggests a recent shift of the tectonic activity on younger fault segments clearly visible in the morphology.