# High-resolution imaging of the surface ruptures associated with the August 24th and October 30th, 2016 earthquakes in Central Italy

Eugenie Perouse (1), Lucilla Benedetti (1), Stéphane Baize (2), Pierrick Bornemann (3,4), Arthur Delorme (5), Nathalie Feuillet (5), Jules Fleury (1), Matthieu Ferry (6), Eric Jacques (5), Hervé Jomard (2), Yann Klinger (5), Frédérique Leclerc (7), Jean-Philippe Malet (3), Odin Marc (3), Bruno Pace (8), Julien Point (3), Irene Puliti (9), Magali Rizza (1), Oona Scooti (2), Grzegorz Skupinski (4), and the Jim Tesson 1, Jerome Van Der Woerd 3, Alessandro Valentini 8, INSU-OT Med Team

(1) Aix-Marseille Université, CEREGE, Labex OT MED, CNRS-IRD UMR 34, Aix en Provence, France. , (2) Institut de Radioprotection et Sûreté Nucléaire ; BERSSIN ; Fontenay-aux-Roses, France, (3) Université de Strasbourg, CNRS, Institut de Physique du Globe de Strasbourg UMR 7516, Strasbourg, France, (4) Université de Strasbourg, CNRS, Laboratoire Image Ville Environnement UMR 7362, Strasbourg, France. , (5) Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Paris, France, (6) Université de Montpellier, CNRS, Géosciences Montpellier UMR 5243, Montpellier , (7) Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, IRD, Géoazur, (8) Università degli Studi "G. d'Annunzio" Chieti-Pescara, DiSPUTer, Chieti, Italy., (9) Università degli studi di Perugia, Perugia, Italy.

We present results from two multidisciplinary field surveys carried out 11-16 September 2016 (post Mw=6.0 August 24 earthquake) and 5-14 November 2016 (post Mw=6.5 October 30 earthquake) in the Castelluccio-Amatrice area, with a focus on the southern Mt Vettore fault, that has been activated during the two events. Field observations and geological measurements (shared with the EMERGEO group) acquired over a ≈ 10 km-wide and 45-km-long area between Preta to the south and Cupi to the north, allowed constraining the extent of the area affected by these events (including the event on October 26th Mw=5.9), and to distinguish the fault segments that ruptured from the ones that did not. Those field observations are complemented with detailed mapping using high resolution Pleiades images (50 cm pixel resolution) acquired before and after the 30th October shock.

Our major contribution is a dataset of high-resolution instrumental measurements (scanner 3D Faro, TLS LiDAR Riegl, photogrammetry) of the surface ruptures along the southern tip of the Mt Vettore fault. Acquisition of high-resolution topography of surface rupture outcrops before and after the October 30th earthquake allows to precisely quantifying the 3D kinematics of these two shocks. In addition, geodetic measurements of benchmark points, fixed on both sides of the Mt Vettore fault just after August 24th, also allows deriving co-seismic displacement vectors at three spots along the fault for the October 30th shock (maximum distance between the points is 1.5 km).

Our field observations suggest a mean vertical co-seismic displacement of about 10-15 cm for the August 24th event and of about 1m for the October 30th one. Co-seismic displacement for the 30th October shock has been observed over a length of ≈ 7km-long. The largest rupture trace runs along the main cumulative bedrock fault plane (southwest-dipping normal fault plane, with an average strike of N140E and a dip greater than 70°) and cuts through all morphological features (colluvial fans, gullies) with an average strike of N140. At least 2 rupture strands of smaller extent and displacement are found in the hangingwall less than 1 km from the main rupture trace.

The maximum co-seismic displacements, reaching up to 30 cm and 2 m, for the August 24th and the October 30th events, respectively, occurred along the same portion of the fault, i.e. a ≈1-km-wide area localized on the Cima del Redentore. Interestingly, this area appears to also spatially coincide with the maximum cumulative longer-term displacement.