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Rupture Kinematics and Structural - Rheological Control of the 2016 Mw6.1 Amatrice (Central Italy) Earthquake from Joint Inversion of Seismic and Geodetic Data

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We investigate the rupture process of the 2016, Mw6.1 Amatrice earthquake, the first shock of a seismic sequence characterized by three damaging earthquakes occurred in Central Italy between August and October. We jointly invert strong motion, High-Rate GPS data, GPS and DInSAR displacements and we adopt ad-hoc velocity profiles of the crust below each station. The retrieved source model reveals a high degree of complexity, characterized by a prominent bi-lateral rupture with low slip at the hypocentre, two well-separated slip patches and a rupture front accelerating when breaking the largest patch. The rupture of the main asperity features a slip-velocity pulse that is impeded ahead of its current direction and splits into two pulses. This result is supported by the analysis of the relationship between the rupture mode and the rupture velocity. We observe that the rupture propagates in mode II along a narrow downdip area around the hypocentre, in mode III in regions of the fault plane adjacent to the nucleation slipping more than 0.5 m and where the fault ruptures bilaterally along the strike direction; while a transition from mode III to mode II occurs where the rupture front rotates and the slip-velocity pulse splits.
In this fault section we find clues of structural and rheological control of the rupture propagation due to the fault system segmentation, typical of central Apennines.
In order to identify the reliable feature of the imaged rupture process, we provide a quantitative analysis of the retrieved kinematic model parameters uncertainties.