Rupture history and source complexity of the 2009 L'Aquila earthquake

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The 2009 L'Aquila earthquake (M_w 6.3) struck the Central Apennines (Italy) on April 6th at the 01:32 UTC and caused nearly 300 casualties and heavy damages in the L'Aquila town and in several villages nearby.

Numerous buildings downtown and a high percentage of those in the villages to the southwest were severely damaged or totally collapsed. This area was already recognized as one enclosing the highest seismic hazard in Italy and was already struck by damaging earthquakes in the past (e.g. 1703 M_w 6.7, 1461 M_w 6.4, 1762 M_w 5.9). The earthquake allowed the collection of an excellent data set consisting of seismic data, strong motion accelerograms, GPS measurements (including continuous GPS) and SAR interferograms. The main shock was a typical earthquake for this sector of the Apennines: shallow hypocenter (shallower than 10 km), normal faulting on NW-SE-trending, ~50° SW dipping faults. The two largest aftershocks occurred on April 7th and 9th (M_w 5.7 and M_w 5.3, respectively) and were located to the SW and to the N of the main shock hypocenter. A foreshock sequence preceded the main shock. The aftershock sequence displayed a clear migration of hypocenters toward the edges of the structure. Most of the aftershocks are also associated with normal faulting, which is consistent with the present-day tectonic setting of this sector of the Apennines. The identification of the fault geometry of the L'Aquila main shock relies on the aftershock pattern, the SAR interferometric data, the GPS displacements as well as the induced surface breakages. An impressive agreement is found among the results inferred by modeling different datasets. In this work an overview and an integrated interpretation of the different results inferred by modeling seismological and geodetic data is presented.
The goal is to discuss the rupture history, the structural complexity and the rheological properties of the fault zone.