Surface Faulting of the 6 April 2009 $M_w$ 6.3 L’Aquila Earthquake in Central Italy

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• Tectonic Framework of the Study Region
• Historical Seismicity
• Surface Ruptures
• Ruptures along the Paganica Fault
• Coseismic Surface Faulting along Other Faults
• Discussion
• Conclusions
In the night of 6 April 2009, a moderate-sized earthquake (M$_L$ 5.8, M$_W$ 6.3, depth 9 km) rocked the central Apennines in central Italy.
- Earthquakes in the range of Mw 6.0 – 6.5 are hazardous to the Mediterranean region.
- This paper seeks to reconcile the field, geological, geophysical, and remote-sensing observations of coseismic and postseismic slip at the surface.
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Tectonic Framework of the Study Region

• The tectonic history of the Apennines, as well as that of the whole central Mediterranean, is driven by a complex interaction of minor plates within the Africa–Eurasia collision.

• Geodetic data provide velocities that imply extension rates of 4–5 mm/yr across the Apennines.

• The Paganica fault long-term slip rate is about 0.4 mm/yr.
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According to available catalogs, the region experienced several moderate-to-strong earthquakes in historical times.

Active faults, estimate short-term slip rates, minimum thresholds of expected magnitude, and recurrence intervals between major events.

- Paganica fault → long-term slip rates: 0.4 mm/yr
- Aterno valley fault system → long-term slip rates: 0.33–0.43 mm/yr
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Surface Ruptures

- The surface expression of the fault appeared as a narrow line of ground cracks.
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Discussion

- Estimated surface rupture length (SRL) ranges between 2.6 and 19 km.

- The maximum coseismic surface displacement (MD) is well constrained to 10–15 cm.

- We should avoid including in the size of the SRL the ground cracks that are not obviously continuing the main rupture and that lack a clear offset.
Discussion

• We point out that the actual length we measure at the surface is constrained by the shape of displacement contours near the upper tip of the rupture.

• The MD may be a better guide than SRL to paleoearthquake magnitude, given the current SRL–MD datasets.

• Secondary and sympathetic coseismic are common features along faults near the primary seismogenic source of many earthquakes.
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• We provide a conservative estimate of 2.6 km for SRL because this was the extent of continuous surface faulting as opposed to ground cracks.

• The 2009 L’Aquila earthquake dramatically confirmed once more the need for detailed geological studies in seismic hazard assessments.

• Past seismicity and evidence for larger Holocene offsets on this and other capable faults nearby prove that the 2009 event is not a good reference event for assessing the seismic hazard of the region.

• This type of earthquake is rather frequent in the Mediterranean region and is potentially much more destructive than in the past, due to the expanding urban centers and infrastructures inside their epicentral regions and even right above the traces of capable faults.
~ Thank you~