Geophysical Research Abstracts
Vol. 13, EGU2011-6607, 2011
EGU General Assembly 2011

Postseismic Deformation of the 2009 L'Aquila Earthquake (M6.3) Surface Rupture Measured Using Repeat Terrestrial Laser Scanning

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We have conducted an innovative surface rupture survey using repeat terrestrial laser scan technology (TLS) at four sites on the NW-SE striking surface rupture of the 2009 L'Aquila earthquake (M6.3), Central Italy. Between 8 – 126 days after the earthquake we repeatedly laser scanned the surface of four road sections cross-cut and vertically offset by the surface rupture. A method was developed to quantify the postseismic deformation occurring over the survey period. We registered the laser scan data from each site into a footwall static reference frame and interpolated the laser scan data to form representative road surfaces. Using these surfaces we were able to model rupture afterslip and associated near-field postseismic deformation occurring in the immediate hangingwall at each site with millimetre to sub-centimetre precision. We found that the magnitude of postseismic deformation observed at site PAG, towards the centre of the rupture, persists at sites SP and EP near the SW tip of the rupture. The postseismic deformation observed at site TM, towards the NW tip of the rupture, however shows a decrease in postseismic deformation from that seen at PAG. The large postseismic deformation at sites near the SW end of the rupture coincides with an increased coseismic slip deficit at depth in this part of the fault zone. Conversely, the lack of significant postseismic deformation observed along the NW section of the rupture at site TM corresponds to a lack of a significant coseismic slip deficit within this part of the fault zone. Repeat survey of actively deforming surface ruptures using TLS technology provide a new and exciting method with which to monitor and quantify postseismic afterslip and associated hangingwall deformation. At Paganica, there is a good agreement between the monitored postseismic deformation and regions along the fault that experienced significant shallow coseismic slip deficit. Hence, we suggest that this is the driving mechanism for afterslip and near-field postseismic deformation.