Geophysical Research Abstracts
Vol. 14, EGU2012-12176, 2012
EGU General Assembly 2012

Space-time evolution of postseismic afterslip following the Mw 6.3, 2009 L'Aquila earthquake (central Italy) from principal component analysis inversion of GPS position time-series.

A. Gualandi (1,2), E. Serpelloni (3), L. Anderlini (1,2), and M.E. Belardinelli (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Bologna, (2) Dipartimento di Fisica, Settore di Geofisica, Università di Bologna, (3) Istituto Nazionale di Geofisica e Vulcanologia, Centro Nazionale Terremoti

We use daily GPS position time-series from continuous and survey-mode GPS stations to study crustal deformation following the April 6, 2009 Mw 6.3 L'Aquila earthquake. Although GPS provides spatially sparse data, compared to denser InSAR maps of crustal deformation, the higher temporal sampling and accuracies allow for more details on the temporal evolution of fast transients during seismic sequences, including coseismic and postseismic deformation. The 2009 L'Aquila mainshock occurred on a NE-trending, SW-ward dipping normal fault, and activated a complex system of SW-dipping segments, the Paganinca and Campotosto faults, forming a ∼40 km long NW-trending en echelon system. In this work we use a principal component analysis inversion method (PCAIM) to study the evolution of postseismic afterslip on the complex normal fault systems interested by the seismic sequence of aftershocks inverting daily GPS position time-series. We develope realistic fault model geometries by using the aftershocks catalogue, adopting a clustering algorithm and a singular value decomposition approach to estimate the fault planes that best fit the aftershocks distribution. The Paganica fault shows a sub-horizontal geometry for the shallower portions (∼0-4 km of depth) and a mostly planar geometry with a dip between 44° and 48° for the deeper region (∼4-10 km). The Campotosto fault, instead, shows a listric geometry, composed by planar segments with different dips along depth. The input GPS time-series have been obtained by analyzing raw data with the GAMIT/GLOBK software. We use a PCA method to estimate spatially-correlated common mode noise errors (CME) for a wider area in the Euro-Mediterranean, using a set of 640 cGPS stations, while excluding those in the epicentral area and its surroundings. Filtering the time-series provides a significant gain in the signal-to-noise ratio, which is particularly important for studying moderate earthquakes. The PCAIM method used in this work estimates the principal components that best describe the temporal and spatial evolution of time-dependent postseismic deformation. The first three principal components show a fast deformation transient in the first week, and have been used to fit the time-series data. The method adopted, unlike other studies, doesn't assume an a-priori temporal function (e.g. exponential or logarithmic), and it better fits the first week rapid transient. The temporal evolution of deformation follows the temporal eigenvectors of the decomposition. It is worth noting that a logarithmic function significantly better fits the first temporal component with respect to an exponential function. We use elastic dislocation theory and a least-squares procedure to invert for afterslip on the model fault planes. An inversion that account for afterslip to occur on both the Paganica and Campotosto fault segments provides a better fit to the time-series data, than using only the Paganica fault segment. Afterslip shows a stationary spatial evolution and it is localized in portions of the fault planes that are complementary to the estimated coseismic slip. The postseismic moment released after 250 days from the mainshock is ∼1.5 [U+2A2F] 10ˆ18 Nm and the maximum postseismic slip is ∼30 cm.