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FEM inversion of DInSAR data of the 2009 L'Aquila Earthquake (Italy)

Elisa Trasatti, Christodoulos Kyriakopoulos, Simone Atzori, Marco Chini, and Stefano Salvi
INGV, Rome, Italy (elisa.trasatti@ingv.it)

Slip distribution on fault planes is usually retrieved by geodetic data assuming the local crust as an elastic, homogeneous and isotropic half-space. However, realistic complexities such as non-homogeneous elastic structure and topographic relief can be handled only by numerical methods. Such elaborated models are computationally expensive and are usually implemented for forward modelling rather than for inversion purposes. On the other hand, spatially dense geodetic data (e.g. DInSAR displacement maps) often reveal complex patterns of coseismic deformation, pointing out the oversimplification of the analytical models. We develop a procedure to perform inversion of geodetic data based on Finite Element (FE) method, accounting for a more realistic description of the Earth crust, e.g. medium heterogeneity, anisotropy, topographic relief. FE computed Green functions are implemented in an inversion framework to constrain the fault slip distribution in complex media. The method is applied to the 2009 L'Aquila earthquake (Mw 6.3). The fault geometry is constrained by three DInSAR maps of coseismic displacement from ENVISAT and COSMO-Skymed satellites. In addition to these re-computed images, we use near-field GPS data. The fault dip is fixed at 50°, in accordance to recently relocated aftershocks of the L'Aquila earthquake. We build a FE model including the fault geometry previously determined and the heterogeneities of the local crust. A linear inversion is performed to constrain the slip distribution in the heterogeneous medium. Results from inversions highlight the non-negligible influence of the medium structure: homogeneous and heterogeneous models show discrepancies in the fault slip distribution values up to 20%.