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High precision Differential Earthquake Location in 3D models: Evidence for a rheological barrier controlling the microseismicity at the Irpinia fault zone in southern Apennines

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A non-linear, global-search, probabilistic, double-difference earthquake location technique is illustrated.
The main advantages of this method are the determination of comprehensive and complete solutions through the probability density function (PDF), the use of differential arrival-times as data, and the possibility to use a 3D velocity model both for absolute and relative locations, essential to obtain accurate differentials locations in structurally complex geological media. The joint use of this methodology and an accurate differential times data-set allowed us to carry out an high-resolution, earthquake location analysis, which helped to characterize the active fault geometries in the studied region.
We investigated the recent micro-seismicity occurring at the Campanian-Lucanian Apennines, in the crustal volume embedding the fault system which generated the 1980, M 6.9 earthquake in Irpinia. In order to obtain highly accurate seismicity locations we applied the method to the P and S arrival time data set from 1312 events (M<3) that occurred from August 2005 to April 2011, and used the 3D P- and S-wave velocity models, optimized for the area under study. Both catalogue and cross-correlation first arrival-times have been used.
The refined seismicity locations show that the events occur in a volume delimited by the faults activated during the 1980 Irpinia M 6.9 earthquake on sub-parallel, predominantly normal faults.
Corresponding to a contact zone between different rheology rock formations (carbonate platform and basin residuals), we evidence an abrupt interruption of the seismicity across a SW-NE oriented structural discontinuity. This "barrier" appears to be located in the area bounded by the fault segments activated during the first (0 sec) and the second (20 sec) rupture episodes of the 80's Irpinia earthquake.
We hypothesize that this geometrical barrier can have played a key role during the 1980 Irpinia event, and possibly controlled the delayed times of activation of the two rupture segments.