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Pre- and co-seismic surface deformation of graviquakes: the 1997 Colfiorito earthquake (Northern Apennines, Italy)

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Normal fault-related earthquakes, or graviquakes, are dissipation of gravitational energy [1,2], which cause vertical ground motion associated with damages and fatalities. The study of seismic-induced ground motions is significant for mechanical analysis of fault zones and seismic hazard assessment within seismically active extensional tectonic settings (e.g., Apennines, Turkey, Greece). In this work, Synthetic Aperture Radar Interferometry (InSAR) was applied to estimate the surface displacement field caused by the 1997 Colfiorito (central Apennines, Italy) M_w 6 extensional earthquake, which nucleated at ~7.5 km depth along the Mt. Pennino normal fault zone. Two months before the mainshock (i.e., during the pre-seismic phase) the onset of ~2 cm of ground subsidence was observed within the future epicentral area. During the month before the mainshock, subsidence continued concurrent with the onset of foreshocks and of fluid migration into the fault zone at depth [3]. Pre-seismic subsidence was probably caused by the onset of fractures closure within the fault zone [1,4]. The co-seismic phase was characterized by a maximum subsidence of ~11 cm within the epicentral area [5] coupled with fluid migration at depth and fluid discharge from springs [4,6,7]. On the other hand, during the post-seismic period, were not observed significant surface deformations. The observed co-seismic subsidence and fluid discharge can be related to the gravitational fall of the hangingwall block volume, which caused fracture closure and related squeezing out of fluids. These observations are important for earthquake forecasting, as, in the future, the measurement of fluid pressure fluctuations (e.g., into deep borehole) during the pre-seismic phase could be a reliable earthquake precursor.

References:

[1] Doglioni C et al. (2015) Scientific Reports 5, 12110
[2] Petricca P et al. (2015) Tectonophysics 656: 202–214
[3] Ripepe M et al. (2000) Journal of Seismology 4(4): 387-399
[4] Doglioni C et al. (2014) Geoscience Frontiers 5(6): 767-780
[5] Stramondo S et al. (1999) Geophysical Research Letters 26: 883-886
[6] Quattrocchi F et al. (2000) Journal of Seismology 4(4): 567-587
[7] Miller S A et al. (2004) Nature 427 (6976): 724-727