



## ***Interactive comment on “A reversed hierarchy of active normal faults: the 6 April 2009, $M_w$ 6.3, L’Aquila earthquake (Italy)” by L. Bonini et al.***

### **Anonymous Referee #2**

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#### General Comments

This manuscript uses a combination of field observations and an analogue model to infer that the 2009 L’Aquila earthquake occurred on a blind fault and therefore the risk from earthquakes in the central Apennines is greater than that on those with a surface expression – the so-called “reversed hierarchy”.

I think the manuscript presents an interesting idea and, if their inferences were correct, this would be an important consideration in seismic hazard assessment.

However, it seems the authors are too focussed on their interpretation and ignore an extensive set of literature that shows that (1) Historical earthquakes have occurred on faults with a clear surface expression, (2) Trench data shows that large historical

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earthquakes have reached the surface, and (3) A fault that has an earthquake in 2009 may still have a lower slip-rate than that which has not had an earthquake for hundreds of years (slip rates on faults in this region are of the order of 0.1mm/yr – 2mm/yr and thus recurrence intervals of many thousand years are common). Although the notion of blind faults in the Apennines is not new, the idea that they represent the majority of potential seismic sources is not consistent with most of the literature.

I also think the analogue model needs to be justified – they seem to have used parameters that fit their interpretation, but have not shown what the results would look like if the fault were not assumed to be blind.

Overall I think the conclusions need to be put in the context of the literature more and the analogue modelling assumptions need to be justified.

#### Specific Comments:

Page 119 Line 14: “the region is criss-crossed by many 5-10 km-long normal faults”.. It should be noted that the region also has many faults longer than 5-10km (e.g. Boncio et al., 2004; Cinque et al., 2000; Faure Walker et al., 2010; Galadini and Galli, 2000)

Page 120 Line 26 some authors found greater surface offsets (e.g. Boncio et al., 2010; Roberts et al., 2010)

Page 123 Lines 23-25 – This needs examples and references.

Page 124 Lines 25 – 28: There is no evidence for this. Even if one does believe the blind fault theory proposed in this paper, there have been other earthquakes (both recent and in the historical record (see Galli et al., 2008 for a review of surface faulting revealed by trench data)) that have occurred on the faults with the greatest surface expressions. It seems they are basing their ideas of all Italian Apennine earthquakes on the interpretation of one event, an interpretation that is unlikely to be widely accepted.

#### Technical Comments

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Page 123 Line 25-26: This sentence needs to be rewritten

References (note this is a small sample of what could be included)

Boncio, Lavecchia and Pace (2004), Defining a model of 3D seismogenic sources for Seismic Hazard Assessment applications: The case of central Apennines (Italy), *Journal of Seismology*, 8, 407-425

Boncio, Pizzi, Brozzetti, Pomposo, Lavecchia, Di Naccio, and Ferrarini, (2010), Coseismic ground deformation of the 6 April 2009 L'Aquila earthquake (central Italy, Mw6.3), *Geophys. Res. Lett.*, 37, L06308, doi:10.1029/2010GL042807

Cinque, Ascione, and Caiazzo, Distribuzione spazio-temporale e caratterizzazione della fagliazione quaternaria in Appennino meridionale, in: Galadini F., Meletti C., and Rebez A. (Eds), *Le ricerche del GNDT nel campo della pericolosità sismica (1996-1999)*, CNR-Gruppo Nazionale per la Difesa dai Terremoti - Roma, 203-218, 2000

Faure Walker, Roberts, Sammonds, and Cowie, (2010), Comparison of earthquake strains over 102 and 104 year timescales: insights into variability in the seismic cycle in the central Apennines, Italy, *Journal of Geophysical Research* 115, B10418

Galadini and Galli, (2000) Active Tectonics in the Central Apennines (Italy) – Input Data for Seismic Hazard Assessment, *Natural Hazards* 22, 225-270

Galli, Galadini, and Pantosti, (2008), Twenty years of paleoseismology in Italy, *Earth Science Reviews*, 88, 89-117

Galli, Messina, Giaccio, Peronace and Quadrio, (2012), Early Pleistocene to late Holocene activity of the Magnola fault (Fucino fault system, central Italy), *Bollettino di Geofisica Teorica ed Applicata*, 53, doi: 10.4430/bgta0054

Roberts, Raithatha, Sileo, Pizzi, Pucci, Faure Walker, Wilkinson, McCaffrey, Phillips, Michetti, Guerrieri, Blumetti, Vittori, Cowie, Sammonds, Galli, Boncio Bristow, Walters, (2010), Shallow subsurface structure of the 2009 April 6 Mw 6.3 L'Aquila earthquake

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surface rupture at Paganica, investigated with ground-penetrating radar. *Geophysical Journal International* 183(2), 774-790 doi:10.1111/j.1365-246X.2010.04713.x.

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Interactive comment on *Solid Earth Discuss.*, 5, 117, 2013.

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