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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Modeling ground deformation associated with the destructive earthquakes occurring on Mt. Etna's southeastern flank in 1984" *by* Flavio Cannavò et al.

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Replies to Comments from Reviewer #2

1) For example it is necessary to frame the aseismic slip in process of gravitational sliding involvig the eastern flank of Mt. Etna. In particular , the Authors assert that "in the May 1980-October 1984 period, the Fiandaca Fault was affected by a strike slip and normal dip slip of about 27 and 23 cm. This result is in fairly good accord with field observations of the co-seismic ground ruptures along the fault but it's notably large compared to displacements estimated by seismicity, then suggesting that most of the slip over the fault plane was aseismic". The problem is that, according to the Authors, the ground ruptures immediately after the main event seem to be in accord

with the geodetic measurement: so, the displacement should be largely coseismic. . .. Conversely, the Authors conclude that "only a part (from 5% to a maximum of 30%) of the stick-slip obtained by modeling is related to the co-seismic effects of the earthquakes recorded along the FF, suggesting that most of the slip over the fault must be aseismic." This inconsistency could be due to the scarcity of geodetic data, acquired in a limited number of campaigns from 1977 to 1980, and again only after the earthquakes in 1984, or to a mistake in data comparing. This issue could be easily addressed calculating the resulting S vector that should be larger than the measured ground rupture.

R: We thank the reviewer for this comment. On lines 327-330 we wrote: "This result is in some ways comparable with field observations that detected a co-seismic ground rupture of the northwestern and southeastern sectors of the fault of up to 20 cm (Azzaro, 1999 and reference therein), while a discrepancy between the seismic and geodetic moment is present." We have made a mistake in defining the ground rupture (measured in the days after the earthquakes) as "co-seismic ground rupture" cause the ground ruptures linked to shallow earthquakes on Mt. Etna are the sum of coseismic and aseismic movements (e.g. Obrizzo et al., 2001). In this sense, we have rewritten the sentence as following: "This result is in some ways comparable with field observations that detected ground ruptures (co-seismic and aseismic) of the northwestern and southeastern sectors of the fault up to 20 cm (Azzaro, 1999 and reference therein). The discrepancy between the seismic and geodetic moment allows us to quantify the amount of aseismic deformation."

2) Moreover, it is not clear which is the role of the similar ground rupture that affected the southeastern part of FF on occasion of the VII EMS event of June 19 1984.

R: This is an interesting comment: we think that the ground rupture that affected the southeastern part of FF (on occasion of the VII EMS event of June 19 1984) represents the first phase of a process that involved all the FF ending on 25

October 1984. Indeed, a northwards "migration" of the rupture sequence was suggested by Azzaro (1999) and our model is in accordance with this hypothesis showing that the entire FF was activated (even if data do not allow us to discern the time-space sequence). We have added these considerations in the discussion/conclusions.

3) Finally, in the Chapter Discussion and conclusions the last paragraph "These considerations again confirm the high level of seismic risk, in particular ground rupture hazard of the Fiandaca Fault and generally of the Timpe Fault System, for the several towns and villages located on these structures" should be deleted, since the authors have asserted before that most of the displacement is aseismic.

R: We thank the reviewer for this comment. We made a mistake in using the term "seismic risk". We have changed it in "geological hazard" embracing both the hazard due to seismic shaking effects and the one due to ground rupture effects.

Other comments:

1) there are references from other research groups missing (see the attached pdf file);

All the suggested references have been added to text.

2) the regional framework should be updated (see suggestions in the attached pdf file);

We have accepted all the suggestions.

3) the formula of line 192 seems to be wrong, probably due to misprint;

It's a misprint we have corrected the formula

4) computation of lines 296-297 should be extended;

We have extended the computation of lines 296-297 also taking in account the reviewer 1 comments (see reviewer 1 reply).

5) the June 19 1984 event is rated as VIII EMS at line 145 and as VII EMS at line 308.

We have corrected in VII EMS at line 145.

6) the straight dashed lines shown in fig. 4 are forced, being the eastern flank of Mt. Etna subject to episodic motion related to volcanic dynamics and gravitational motion;

We have redrawn figure 4 removing the dashed lines

Other comments are listed in the attached pdf file

All the comments on the attached pdf file have been considered and accepted.

References

- Azzaro, R. 1999. Earthquake Surface Faulting At Mount Etna Volcano (Sicily) And Implications For Active Tectonics, Journal of Geodynamics, 28 (2-3), 193-213.
- Obrizzo, F., Pingue, F., Troise, C., De Natale, G., 2001. Coseismic displacements and creeping along Pernicana fault (Mt. Etna) in the last seventeen years: a detailed study of a structure on a volcano. Journal of Volcanology and Geothermal Research 9, 109–131.

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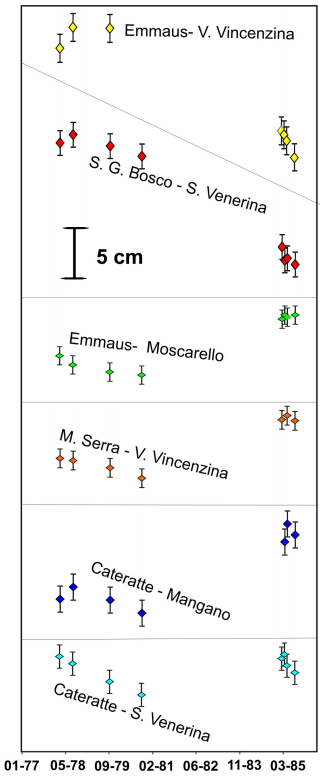
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11-83
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Fig. 1.