

Solid Earth Discuss., author comment AC2
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Reply on RC2

Alessandro Tibaldi et al.

Author comment on "Mapping and evaluating kinematics and the stress and strain field at active faults and fissures: a comparison between field and drone data at the NE rift, Mt Etna (Italy)" by Alessandro Tibaldi et al., Solid Earth Discuss.,
<https://doi.org/10.5194/se-2020-211-AC2>, 2021

Dear Dr Rizzo,

thanks for the very useful suggestions, which have been all taken into account in the new version of the manuscript. The point-by-point replies to all suggestions are listed below. The Editor advised me that we will be allowed to upload the new version of the manuscript only in a successive stage when we will have received all the reviews.

Replies point-by-point:

General Comments:

The manuscript is well-written, and all inferences made by the authors are very well supported by data. In the manuscript, most of the "Methods" section is devoted to a detailed description of acquisition, processing and interpretation of drone images, as well as the authors have dedicated a separate discussion section to drone imagery. At the same time, the authors have only swiftly mentioned the "Lissage", and "ATMO-STRESS" software used to calculate the stress/strain field in the studied area, in turn fundamental for the general tectonics' interpretations made by the authors.

Reply: we have expanded the description of this method.

As it is written now, it is unclear to me if the authors' goal is an original research paper, or rather methodological paper.

Reply: we now detailed in the Introduction that the paper has a double focus: on one side it describes new data useful for the scientific interpretation of the activity of the NE Rift, and on the other side it wants to present a methodology useful for similar studies.

I have also found that the paper falls a bit short in making use of all the dataset collected: for example, the collected data of fault/fracture sizes (i.e., length) and vertical offset collected for this work could have combined to further study fault development and growth

in the Mount Etna area.

Reply: In the new version of the paper we added a new section presenting data on: length distribution of fissures and faults, relationships length-offset for both structure types, relation fracture strike-offset, and relation fracture strike-length, adding also three new graphs. The various correlations have been discussed.

I would suggest reducing the section dedicated to UAV acquisition and SfM processing, while expanding on the scientific results obtained using these data acquisition methods (please see the 'specific comments' for more detailed indications).

Reply: Done.

Specific comments:

Line 53: I don't want to impose any style; however, I think that "huge" has a colloquial connotation. I would suggest changing it with "... large amount..."

Reply: Done.

Lines 65 – 68: This sentence is a bit hard to read. Can you please clarify the statement? At line 66, please consider deleting "so high"; as for my previous comment, this is a colloquial expression.

Reply: We rephrased it and eliminated "high".

Line 89: As for my first comment, please consider using a different term instead of "huge". In addition, "grows" should be in the past tense.

Reply: Done.

Line 91: As you are describing a general process, please consider deleting "one of these" for the sentence in this line.

Reply: Done.

Line 92: Please consider substituting "focused" with mostly.

Reply: Done.

Figure 1. On the map in figure 1C it is hard to see the acronym, PF, for the Piano Provenzana fault.

Reply: we moved the acronym PF in a better position.

Line 115: Can you please add in the text a definition for "dry fracture"? if this term refers to simple dilatant fractures please be consistent with the terminology.

Reply: Done.

Lines 116 - 117: This sentence is not very clear to me. Can you please further explain the statement where you're claiming that "part of ..." the fault and fractures in the central portion of NE rift indicates "pure extension or both right-lateral and left-lateral transtension"?

Reply: we rewritten this phrase.

Line 125: Please consider changing "Actually" with "Both".

Reply: Done.

Lines 129 - 130: Only referencing to Guardo et al., 2020 does not fully explain the correspondence between the described structures in this paper and the "upper slip surface". Please consider adding a concise description of "upper slip surface" by Guardo et al., 2020.

Reply: a phrase has been added on this issue.

Line 201: Can you please consider integrating this sentence with the section in Lines 186 to 189?

Reply: we now specified at line 201 that: "since both have an arcuate shape and seismicity recalls the bow shape of the faults and fracture distribution."

Line 205: For brevity, can you please consider modifying the current "the position of which" with "whose position"?

Reply: Done.

Line 209: Please delete "here" before 'identified as a cluster'.

Reply: Done.

Line 211: is M>2 supposed to be ML as in Line 212?

Reply: yes, thanks, we corrected it.

Lines 234 – 242: I found this information not necessary in main body of the paper, and I would suggest moving this to an appendix section.

Reply: part of this section has been deleted, but details on the methodology to maintain a correct fixed distance between the drone flight and topography has been requested by another reviewer.

Lines 253 – 254: The expression “plenty of time” is rather colloquial, and I would suggest to either delete this sentence or expanding it giving more information regarding the amount of time saved using the described method and also, how the suggested method helps in reducing processing time.

REPLY - The use of natural targets allows us to speed up the GCPs collection significantly. This method allowed us to avoid the recovery of the targets after the survey enabling us to halve the overall surveying time. In this specific case, considering the extension of the monitored area (2.2 km²), the numbers of GCPs collected (34), and the terrain’s roughness, we saved one day (6/8 hours) of fieldwork. We modified the sentence in the text as follows: “We targeted 34 natural targets, as already successfully performed by Bonali et al. (2020), to speed up the GCPs collection avoiding the deployment and recovery of artificial targets. This method allowed us to save one day of fieldwork.”

Lines 263 – 264: I would suggest deleting the part of the sentence after the reference to the SfM processing software.

Reply: Done.

Lines 267 – 269: I feel that this information can be moved to an appendix section.

Reply: We deleted it.

Lines 308 – 311: Can you please give more information regarding the choice of the 20 cm threshold for classifying features as either normal fault or extension fractures?

Reply: Such threshold value is based on our field experience and plenty of observation focused on studying extension fractures and normal faults worldwide, from South America to Iceland.

Line 316: Please consider using a more specific terminology, instead of a generic and colloquial term as “plenty”. In addition, can you please report here how many structural data have you collected?

Reply: we substituted the word “plenty” with the exact number of data collected at faults

and those collected at fractures.

Line 332 – 333: Can you please double check that the reported number of 54 fissure is correct? As, from the map in Figure 5, I could not count 54 fissures.

Reply: we have checked and in Fig. 5 we have actually 54 yellow lines. Some of them are very close to each other, and in the figure they seem like a single one.

Lines 339 – 341: Can you please make any further inferences about the differences between NW dipping segments the other segments? Why are the NW dipping segments short compared to others?

Reply: we added a section on this in the chapter “5.1. Rift geometry, structuring and kinematics”.

Lines 342 – 343: Since data quality and quality collected for this work, have you considered looking at the statistical distribution of fracture/fault length in the area to find a possible underlying statistical distribution able to describe the general behaviour of faulting in the area? In addition, it would be very interesting how this attribute (i.e., length) scales with vertical offset (throw). This type of analysis could potentially add further information on the kinematics of faulting in the studied area: please see Ranalli, 1977 and/or Gudmundsson et al., 2013 (both on Tectonophysics) for more details on length-throw relationships. Particularly relevant is the work of Gudmundsson et al., 2013 as they show data from Mt. Etna.

Reply – In the new version of the paper we added a new section presenting data on: length distribution of fissures and faults, relationships length-offset for both structure types, relation fracture strike-offset, and relation fracture strike-length, adding also three new graphs. The various correlations have been discussed. For the length/displacement ratios values, we compared our values with those by Gudmundsson et al. (2013) in the Discussion section.

Similarly, have you considered mapping fault/fracture density distribution? This can help in visualising where most of the ground deformation has accumulated.

REPLY – We have considered this kind of representation, but we prefer to make this kind of analyses afterwards, when the entire NE rift will be surveyed with drones in order to work on a complete, homogeneous and larger dataset of fractures.

Line 364: Please consider inverting the position of “We” and “thus” so to read “Thus, we...”

Reply: Done.

Line 372: Please consider substituting “represent the” with ‘show’.

Reply: Done.

Line 397: For brevity and readability, please consider modifying "... characterized by the dominance of..." with "dominated by".

Reply: Done.

Lines 424 – 425: Can you please briefly describe the Lissage and ATMO-Stress softwares?

Reply: done, by adding the following text: Lissage is a C-based software designed to reconstruct paleostress trajectories in a given area (Lee and Angelier, 1994), using as input data multiple local stress determinations, including P and T axes derived from seismological data, the direction of principal stress axes from stress inversion and any other data that describe the azimuth of σHMax/Min. Such software can be used to reconstruct stress trajectories both using local field data and regional paleostress database (e.g. Hu et al., 1996; Munoz-Martín et al., 1998; Maestro et al., 2007; Bonali et al., 2019). ATMO-Stress software is the online version of such software.

Line 447: Please consider modifying "much more data", with "wider dataset".

Reply: Done.

Lines 467 – 468: Please consider modifying "for massive high", with "to increase".

Reply: Done.

Line: 478: Please consider modifying the sentence in point ii as: "the proposed approach reduces work-time compared to...". The second part of the sentence at point ii (after the comma) is not clear, can you please rephrase it?

Reply: Done.