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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Growth of a sinkhole in a seismic zone of the Northern Apennines (Italy)" *by* Alessandro La Rosa et al.

Anonymous Referee #2

Received and published: 11 April 2018

1. General comments: The authors present an interesting piece of work with interpretations on the activity of one sinkhole in a seismically active zone. Essentially, the work proposes the following conclusions/interpretations: (1) The dynamics of the analysed sinkhole, characterised by progressive subsidence, punctuated by events of more rapid displacement and ground fissuring (1996, 2016), are attributed to creeping faults in the area that induce fracturing, permeability increase and enhanced dissolution. (2) Based on DInSAR data, ground deformation affects a large area around the sinkhole lake with horizontal displacement rates as high as the vertical ones. However, I consider that such conclusions/interpretations are not properly justified, and authors should consider and discuss other alternative interpretations. Concerning point (1), authors should also consider other potential controlling factors such as precipitation

and groundwater level changes. Moreover, the available data does not seem to be sufficient to rule out the role of major morphogenetic earthquakes on sinkhole triggering. Authors should review the existing literature that document the formation of coseismic sinkholes in Italy. Regarding point (2), authors should consider the option that ground displacement with significant horizontal component on the NW margin of the sinkhole could be related to a landslide, favoured by debuttressing-undermining at the foot of the slope due to sinkhole subsidence.

2. Specific comments:

2.1. The paper lacks essential data on the geomorphic context, including a detailed map. The latter may show the presence of landslides or other sinkholes in the area. A thorough geomorphological analysis is needed to identify the active processes in the study area and distinguish their relative importance in the sinkhole deformation dynamic. Such as: detailed mapping, trenching combined with geochronological data (to study the geological record and increase the temporal registry), and geophysics.

2.2. I believe the sinkhole definition used (lines 29-30) is inadequate since not all the sinkholes form due to cavity collapse. There are other genetic processes. The authors should clearly indicate the type of sinkhole they are investigating, explaining the subsidence mechanisms in relationship with the local stratigraphy. I consider that revising this paper: Parise, M., Closson, D., Gutiérrez, F. et al. Environ Earth Sci (2015) 74: 7823. https://doi.org/10.1007/s12665-015-4647-5; could help. The cover is underlain by flysch. Do you have deep-seated caprock collapse sinkholes?

2.3. The authors conclude that "a source mechanism for the sinkhole formation and growth is seismic creep in the active fault zone underneath the sinkhole". Although this hypothesis looks innovative, it is not well supported by the presented data. The casual relationship between creep tectonic deformation and sinkhole activity remains as an unproved hypothesis. I encourage the authors to add sub-subface geophysical and structural data to test their hypothesis.

3. Technical corrections: I have identified two technical issues.

3.1. (lines 187 and 191) Change 4a for 5a.

3.2. Add a legend to the figures 5 and 6 to help to identify the meaning of the red and yellow lines.

4. Other aspects to take into account:

4.1. Does the paper address relevant scientific and/or technical questions within the scope of NHESS? Yes

4.2. Does the paper present new data and/or novel concepts, ideas, tools, methods or results? Yes

4.3. Are these up to international standards? Yes

4.4. Are the scientific methods and assumptions valid and outlined clearly? No

4.5. Are the results sufficient to support the interpretations and the conclusions? No

4.6. Does the author reach substantial conclusions? Yes

4.7. Is the description of the data used, the methods used, the experiments and calculations made, and the results obtained sufficiently complete and accurate to allow their reproduction by fellow scientists (traceability of results)? No

4.8. Does the title clearly and unambiguously reflect the contents of the paper? Yes

4.9. Does the abstract provide a concise, complete and unambiguous summary of the work done and the results obtained? No

4.10. Are the title and the abstract pertinent, and easy to understand to a wide and diversified audience? Yes

4.11. Are mathematical formulae, symbols, abbreviations and units correctly defined and used? If the formulae, symbols or abbreviations are numerous, are there tables or

appendixes listing them? Yes

4.12. Is the size, quality and readability of each figure adequate to the type and quantity of data presented? No, legend missing in figures 5 and 6.

4.13. Does the author give proper credit to previous and/or related work, and does he/she indicate clearly his/her own contribution? Yes

4.14. Are the number and quality of the references appropriate? Yes

4.15. Are the references accessible by fellow scientists? Yes

4.16. Is the overall presentation well structured, clear and easy to understand by a wide and general audience? Yes

4.17. Is the length of the paper adequate, too long or too short? Is adequate

4.18. Is there any part of the paper (title, abstract, main text, formulae, symbols, figures and their captions, tables, list of references, appendixes) that needs to be clarified, reduced, added, combined, or eliminated? A geomorphological/geological map would help to understand the setting and active processes.

4.19. Is the technical language precise and understandable by fellow scientists? Yes

4.20. Is the English language of good quality, fluent, simple and easy to read and understand by a wide and diversified audience? Yes

4.21. Is the amount and quality of supplementary material (if any) appropriate? -not applicable-

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