

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

Anonymous Referee #1

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1). general comments

This paper presents interesting reflexions. However, there are fundamental knowledges that are incompletely presented and others that are missing. Hence, in its present state, the document should be considered as a first iteration regarding a topic that deserve to be analyzed. The methodology should be strengthened and the workflow combining different sources of data clarified. I suggest major revision.

2). specific comments

About the strategy: the comparison of four independent datasets is a good strategy to deduce a model. However:

- the few number of independent sources (SBAS, historical data, field survey, and seis-

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mic analysis);

- their variable quality levels (field observations not enough extended);
- their limited nature (there is no geomorphological map, no structural map, no trenching, no SBAS field validations, no sub-surface geophysics, no boreholes);
- their very partial temporal and spatial overlap (most information are concentrated in the last two decades);

does not allow a clear understanding of the sinkhole formation.

The idea of seismic creep seems to me not supported by a robust analysis performed at local and regional scales. The sub-surface geophysical facet is missing and therefore it is very difficult to be convinced with this explanation. Much deeper investigations are still needed.

The authors are performing some comparisons with the Dead Sea sinkholes. In Israel, lot of geophysical studies have been performed in the last 15 years to create a robust model combining geomorphological mapping, structural inputs, Insar ground deformations and shallow geophysical study results (e.g. Ezersky et al.). In this paper, most of the data are not sufficient to quantify/to observe a possible link between seismic creep and the dynamic of the collapsed area. Aware of the literature regarding the Dead Sea sinkholes, I would like to point out the attention of the authors on a circular depression located in the Jordanian Dead Sea zone and named "Birkat El Haj". It is described as a salt collapse structure. A priori, it seems to me that a comparison in term of genesis could be established.

The goal of using different data sources is to find independent observations leading to the same conclusions. In that framework, opposite conclusions are also interesting because they highlight knowledge gaps in the overall strategy. Having said that, here are some remarks on the data sources:

- the historical records is a too limited set of observations. They are informative but

could become much more relevant if they were complemented by trenching and dating as it is done in paleo-seismology in combination with historical data;

- the authors described the depression as a circular feature. However, the analysis of the contours indicates that the depression is more elliptical than circular. The lowest elevations (lake) are not located in the center of the ellipse but rather in the SW side. This asymmetry and the cracks mapped during the field survey suggest a gradual migration SW wards from the original collapse. Is this SW-NE direction important with regard to the structural data in the region? If validated, this interpretation would mean that trenches could be excavated in the NE part of the depression to potentially reveal former shorelines of the lake;

- the SBAS analysis presents interesting results but the reference point is not indicated. Besides, what is the stability of the reference point chosen?

- SBAS deformation pattern suggests that the subsidence area is much wider than the actual depression revealed by contour lines. SBAS coherence threshold 0.8 is much too high and a map with coherence level at 0.4-0.5 should be drawn to try to display the whole deformation pattern. Of course there will be much more noise but this is the conditions to get the maximum from the images;

- SBAS points selected with coherence at 0.8 level indicated important ground movements that should have created series of fissures and fractures in the buildings of the nearby village. The collection of those pieces of evidence is necessary to validate the SBAS observations. Further more, those evidences should be linked to the structural context of the depression;

- structural map is not presented while this source of data is interesting to link the genesis of the depression with a possible seismic creep;

- geomorphological maps, at local and regional scales, should be drawn in order to confirm that this depression is really a singularity in the landscape. There is no evi-

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dence anywhere that this depression is an isolate case or that similar phenomena can be observe elsewhere in the region. It is really important to clarify the status of this depression because if it is an isolated case, then, it can be considered a very interesting indicator regarding the tectonic activity in the region;

- the stratigraphy is very poorly described and the thickness of the different layers below the depression is incomplete. A carbonate layer is mentioned in the text (Tuscan Nappe Unit) but not its depth while this layer is a good candidate to be the siege of dissolution phenomena leading to ground subsidence at the surface.

3). technical corrections": typing errors, etc.

n/a at this stage.

4). Q&A

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

yes

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

yes

- Are these up to international standards?

yes

- Are the scientific methods and assumptions valid and outlined clearly?

no

- Are the results sufficient to support the interpretations and the conclusions?

no

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- Does the author reach substantial conclusions?

yes

- 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

- Does the title clearly and unambiguously reflect the contents of the paper?

no

- Does the abstract provide a concise, complete and unambiguous summary of the work done and the results obtained?

no

- Are the title and the abstract pertinent, and easy to understand to a wide and diversified audience?

no

- 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?

n/a

- Is the size, quality and readability of each figure adequate to the type and quantity of data presented?

no

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

yes

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yes

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yes

- 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?

figures 1 & 2 should be redrawn

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yes

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yes

- Is the amount and quality of supplementary material (if any) appropriate?

n/a

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