

Interactive comment on “The Volcanoes of Naples: how effectively mitigating the highest volcanic risk in the World?” by Giuseppe De Natale et al.

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Answers to the Reviewer 1 (Roberto Moretti)

We thank the reviewer for his helpful suggestions; we are going here to answer point by point:

1) I would spend words to distinguish between long-term and short-term assessment; This is particularly about hazard, and it is about forecasting during unrest. At Campi Flegrei caldera this is an even hotter topic. More in general, I think the paper would benefit of this: the nice introduction seems to prelude to some discussion of the short-term forecasting, especially when false and missing alarms are described or where it is said that successful decision were taken “in progress” (e.g., Hekla or Montserrat). So

C1

a brief description of the state-of-the-art, including contradictions, can be given, very likely when describing each of the three Neapolitan volcanoes. Of course, most of the interest turns around Campi Flegrei and its ongoing unrest. This has a peculiar relevance, given the high-level of OV monitoring and the impressive amount of publications that have appeared based on monitoring data.

Answer: we thank the reviewer for such an interesting suggestion. We therefore added a little more discussion about the actual difficulty to distinguish real precursors, mainly at Campi Flegrei caldera where somewhat anomalous activity associated to the unrest lasts since many decades.

2) The concept of progressive evacuation is important. Phasing is already invoked for other emergency plans (e.g. the La Soufrière the Guadeloupe one approved by Préfecture de Guadeloupe in France). It would be highly interesting if more insights and/or point of views could be given for CF caldera, where the main vent of next eruption is known probabilistically and where a robust local phreatic phase could start anticipating the magmatic one, which in turn can evolve following different scenarios. I think that the concept of phasing/progressive evacuation might already be introduced around line 330, where the logistical non-sense of an immense red area is discussed.

Answer: thank you, we agree the concept of progressive evacuation is absolutely important, and should be necessarily included in any emergency plan for Neapolitan volcanoes. In fact, it is non realistic to think to evacuate in few days 600,000-700,000 people, given the very high probability of false alarm even in presence of macroscopic ‘anomalies’ of seismicity, ground deformation, geochemistry of gases and waters, and any other signal. Actually, the two evacuations of 1970 and 1984 implicitly followed the concept of ‘progressive evacuation’, because only the areas considered at highest immediate risk in case of eruption were involved, not excluding further evacuation of larger areas. We have followed the reviewer’s suggestion, and introduced the concept of progressive evacuation in the part where we discuss the problems of defining a very large red zone.

C2

Answers to specific comments follow:

-Line 60 "as it can be". . . -Personally I think that entire cycles of public conferences should be given around the concepts of "false" and "missing" alarms. This is likely one of the best way to make people understanding and appreciating the uncertainty of (short-term) hazard assessment, eruption forecasting and decision-making. It implies, of course, that whatever one may do in hazard assessment and forecasting is likely to be wrong for someone else. I think that in the case of many codes of law those two concepts may lead to opposite juridical implications and force a priori the decision (think about the "procurato allarme" and "mancato allarme"). I wonder if the Authors wants to spend few words on this.

Answer: thank you, this is a very intriguing question, which rightly involves also juridical aspects, which can become more and more important in natural disaster management. In Italy, we have a very good example of that in the case of 2009 L'Aquila earthquake. This is a further, very good reason why the very hard problem of volcanic risk management in the Neapolitan area has to be afforded with maximum transparency and rationality, without understating any of the numerous problems involved. This very important question is the background to the paper content. However, we agreed to discuss even more this point, in the revised version.

-Line 140, about the De Natale et al; (2000) interpretation: please say few words on the explanation offered in that paper.

Answer: Ok, we added some more explanation of that. This request is common to the one from reviewer 1. Thank you.

-Line 190: I think that the reference here should be also given to Moretti, R., Troise, C., Sarno, F., & De Natale, G. (2018). Caldera unrest driven by CO₂-induced drying of the deep hydrothermal system. *Scientific reports*, 8(1), 1-11. In this paper the symmetry between post-1984 subsidence and the on-going unrest is described for the first time.

C3

Answer: Yes, of course. We completely agree and included that reference.

-Line 206: there is place to cite papers that promote this hypothesis: Moretti et al 2017 G3, Moretti et al., 2018 SciRep, Troise et al. 2018, but also Moretti et al. 2013 (on EPSL) where it was first formulated. The paper that better summarizes interpretations and querelles is certainly "Moretti, R., De Natale, G., & Troise, C. (2020). Hydrothermal versus magmatic: geochemical views and clues into the unrest dilemma at Campi Flegrei. In *Vesuvius, Campi Flegrei, and Campanian Volcanism* (pp. 371-406). Elsevier. Åz ÌÛ Again, a brief description of the short-term hazard assessment (i.e. outcomes of monitoring quantities) could help, especially for CFc and its unrest.

Answer: Thank you for the suggestions. We included all of them in the revision.

-Line 345 on: people reallocation and 2nd life is a really good point of discussion Is any previous experience about this ? perhaps from different experiences such as cyclones. If yes, please cite.

Answer: It is a very interesting question. At our knowledge, there has not been a similar experience till now, regarding programmed evacuation to avoid a disaster in a very hazardous area. There has been experience of relocation after a disaster (there are some experience of partial relocation of population also in Italy, after large tectonic earthquakes). We found a good example of complete relocation of a small town (900 people): Valmeyer, Illinois, where population, after a catastrophic flood of the Mississippi in 1993, moved the whole own at a new site in 1995 (Rozdilsky J. *Environment and Planning Newsletter*. Indianapolis, IN: Environmental, Natural Resources and Energy Division, American Planning Association, Center for Urban Policy and the Environment, School of Public and Environmental Affairs, Indiana University – Purdue University; 1996. Flood-related relocation of Valmeyer: Implications for the development of sustainable cities.). Kiruna, Sweden, 23,000 inhabitants, is another town which is going to be moved 3 km apart, because of hazard posed by ore activities which are causing continuing ground sinking and felt seismicity (Dineva, S & Boskovic, M 2017,

C4

'Evolution of seismicity at Kiruna Mine', in J Wesseloo (eds.), Proceedings of the Eighth International Conference on Deep and High Stress Mining, Australian Centre for Geomechanics, Perth, pp. 125-139, https://doi.org/10.36487/ACG_rep/1704_07_Dineva).

-Line 355 on. Please take it as a very minor point that you can obviously disregard: could you do some parallel with the economic impact of the covid19 pandemics ? I say that because it would help a lot in terms of perception.

Answer: Ok, it is an intriguing question. Obviously, when we submitted the paper there was not such experience. However, we have now included a small discussion on what we could learn from the pandemic, useful for our problem.

-Line 445 on. Still about 2nd life. Given the "size" of the problem you outline, I wonder if this could be part of a general socio-economic development plan of Keynesian nature at a national scale. Again, do you know if similar experiences have been done in this sense, even at a smaller scale and for different risks ?

Answer: At our knowledge, there has not been a similar experience till now, at las on large economic scale

We hope to have now satisfied all the reviewer concerns.

Best Regards

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Please also note the supplement to this comment:

<https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2020-51/nhess-2020-51-AC3-supplement.pdf>

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-51>, 2020.