

## ***Interactive comment on “Long-term volcanic hazard assessment on El Hierro (Canary Islands)” by L. Becerril et al.***

**K. Németh (Referee)**

k.nemeth@massey.ac.nz

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### Overall Impressions

I read the paper “L. Becerril et al., Long-term volcanic hazard assessment on El Hierro (Canary Islands)” with great interest. The paper presented a very interesting approach to understanding volcanic hazards in El Hierro in the Canary Islands. Recent eruptions off-shore of El Hierro place this location in the spotlight of the volcanic community, and there is general interest to understand and characterise the potentially complex volcanic hazards of this volcanic island. This paper is a very well-organised and detailed summary of a volcanic hazards study of El Hierro, and will surely have a great impact on the community of the island in terms how to view, weigh and understand its volcanic

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hazards. I found this paper to be a very progressive work that combined probabilistic tools with eruption scenario-based methods. Personally I think such an approach is essential, especially in understanding volcanic hazards on volcanic islands, where the complexity of the volcanism can be very high in regard to eruption styles and durations, and the effect of eruptions on the surrounding environments, due to the quickly changing hydrology, topography and structural elements of the island setting. I think this paper sets an example of how to combine probabilistic and eruption scenario-based volcanic hazards studies, and how such abundant data can be used in practical sense; this is critical for end-users who could use such studies for developing volcanic emergency management strategies. I also feel that this paper will be very well cited and potentially will set an example of how pure geological data can be structured into a framework that can be developed further for geomathematical analysis. While there is no doubt that such a method is very critical on volcanic islands where dispersed vents form a “volcanic field”, such as El Hierro, the proposed method is perfectly adaptable for other dispersed volcanic systems, such as intracontinental volcanic fields (eg. Auckland Volcanic Field in New Zealand). While for me this applicability is evident, and the benefits of using such methods elsewhere are clear, the Authors provide too little to introduce this early in the paper. In the Introduction, the Authors state the benefits of this dual approach to understanding volcanic hazards, but I find the examples listed too few and too Canary Islands-specific, which, for me as a reader, does not give a very strong impression that the Authors see the potential of their work in a much broader sense. From the citations it can be seen that there are some examples outside of the Canarian realm, but to spell out those locations, and methods, would have been a good addition. I believe the Authors are missing a great opportunity to make their point in a more effective, convincing and interesting way at the start of the paper. I hope that this will not turn potential readers away.

I also found that a little bit more explanation of the definition of “long-term” hazard(s) could have been useful. In general “long-term” can mean many things, and just for clarity it would have been useful to explore and define this term. In the Introduction, I

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would have liked to have seen slightly more detail (1-2 extra paragraphs) on the specific hazard susceptibility maps. A list of the specific hazard types you were aiming to analyse and create a susceptibility map for, with a brief justification as to why those specific hazard types were selected, would be very beneficial and would give the reader an appreciation of the power of the method published in this paper. This is also valid because there is no other section in the paper where such definitions and methodological approaches are described.

In the Geological Section, it is stated that El Hierro's recent volcanic eruptions are "monogenetic". Such a term is critical for understanding volcanic hazards, and I think it is essential to provide, in this section or earlier, a definition for the term in this context, as well as describing the eruptions' styles (and their landforms, potential hazards, following a scenario-based approach). Interestingly, in this section I found very little information about the eruption styles of past eruptions (other than a reference to Strombolian style eruptions etc). For clarity it would have been really useful to have more detail about the eruptions (styles, intensities etc) that these "monogenetic" volcanoes produced in the past. Again, I think such a summary would have been a very nice starting point for the reader to understand the volcanic hazards of El Hierro. Overall I think, in the first sections, the paper misses great opportunities to convince the reader how and why the proposed method is "revolutionary" and very "progressive". I think there are plenty of good studies published from other volcanic islands, such as Hawaii, Ambrym, Ambae, Tenerife, etc., that could have been compared and contrasted with this work, putting this work on a global level. Unfortunately the Authors missed this opportunity in their Discussion section as well, which I found a bit disappointing. The results and methods the Authors proposed, and very nicely applied to El Hierro could have been far better linked to other dispersed volcanic systems, either on islands or in continental regions.

In summary, I think this paper is a very good and progressive contribution; however, I think the Authors missed too many opportunities to make their excellent work even

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more globally linked and applicable.

Some Specific Comments

P1800/L20 – some citations would be useful here, at least to some key works that are relevant to the statement.

P1801/L11 – an explanation for the long-term hazard would be helpful here (e.g. contrasting with short-term hazards)

P1801/L20 – "Long-term forecasting is based on historical and geological data, as well as on theoretical models, and refers to the time window available before the volcanic system becomes unstable again" – I found this statement difficult to follow, and more explanation would be helpful, especially about the meaning of "... volcanic system becomes unstable again" - what does "unstable" mean in this context?

P1801/L28 ... – this is a good statement, but I think there would be great value in making the citations a little more global. The work would then be more linked to global research using examples outside of the Canary Islands.

P1802/L3 ... – "The Canary Islands are the only area of Spain in which volcanic activity has occurred in last 600 yr and represent one of the world's principal volcanic zones" – is "600 yr" a typographical error? Also, the statement that the Canary Islands are one of the "world's principal volcanic zones" is very relative and, without reference points, its meaning is unclear.

P1801/L17 ... – "Despite being small and submarine in nature (Martí et al., 2013), the most recent eruption on El Hierro (October 2011–February 2012) highlighted the need for volcanic hazard studies given the negative impact on tourism and the local economy of any volcanic event ..." – this is a very important statement. It would have been very beneficial to put this in context, eg. highlighting the commonness, or rarity, of such eruptions from the geological record, highlight the volume (DRE) and the potential hazard (and destructiveness etc.), in order to provide details to justify the need to define

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the volcanic hazards not only from a probabilistic standpoint but also from an eruptive scenario perspective.

P1802/L15 – “violent Strombolian” – citation is needed here to define in what sense this term is being used.

P1802/L18 – “Timanfaya eruption” – please refer to a figure where this location is shown.

P1802/L22 – please cite a key paper to underline the term monogenetic.

P1802/L25 – are the volume data here the volume of the island or the eruptive volume eg. DRE?

P1804/L27 – what type of structural data are you referring to?

P1804/L28 – are the volume data DREs? How were the data calculated? A line of explanation would be useful here. In general, the map figures are not frequently referred to. The reader would be able to follow the text better if the map and figure citations were utilised more often. P1806/L1-15 – explanation of how the volume calculation was made would be a valuable addition.

P1806/L14 – what type of lava flow simulation(s) are being referred to? Add citation(s) to the text here.

P1807/L24 – the “nodes” should be introduced first prior to being used in the text. The HASSET section is a simple and easy to follow, well-written part of the paper.

P1810/L17-20 – “Given the data regarding such episodes in the past geological record, we considered that the offshore zone between the bathymetric line of 200m and the on-shore area near the coast, which already includes several hydrovolcanic edifices, was suitable for the occurrence of such processes (Fig. 3)” – while, in a very first order approach, this is probably a good estimate, I think this issue is far from being resolved. At this stage, it is probably sufficient to assign shorelines as the most susceptible sites

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for hydrovolcanism, but in the future this need to be evaluated much more carefully. As demonstrated in other locations, there are plenty of other controlling parameters that can create hydrovolcanism, and they could be far from coastlines. Maybe a brief statement about this would be useful here.

P1811/L15 – an explanation of how the volume numbers were obtained is needed here, perhaps with some citations. Also, to make the work globally relevant, some comparison data from similar types of volcanoes would be of use.

P1816/L25 – violent Strombolian is given as the most likely high intensity eruption on the island, but it is not clear (from the text) what is meant by this type of eruption in this context. It would be great to have an example (eg. a type locality on the island) on which the scenario is based. This statement is generally true across the entire paper for other scenario descriptions. On the next line, it is stated that sub-Plinian events should not be discarded. Therefore, it is essential to give definitions in order to be able to distinguish between these two types of eruptions.

P1818/L1 – it is stated that mafic monogenetic eruptions are the most common, but no citations or data are provided to prove this (eg. refer to the table)

P1818/L7 – “violent Strombolian (when hydrovolcanic phases occurred)” – from this statement, it appears that you are stating that violent Strombolian has causal links to hydrovolcanism? This needs to be clarified.

In the Discussion, a broader and more global comparison and evaluation of the method is needed.

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