

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1  
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## Comment on nhess-2021-213

Anonymous Referee #1

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Referee comment on "A unified probabilistic framework for volcanic hazard and eruption forecasting" by Warner Marzocchi et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-213-RC1>, 2021

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### General comments

A translation to volcanoes and eruption forecasting of the Marzocchi and Jordan (2014,2017,2018) framework. The m/s would benefit from some tidying up before publication.

### Specific comments

- As a statistician, I had a lot of problems with the decidedly non-Statistics system of notation. In Statistics, the 'hat' notation is reserved for estimates. In the m/s, the hat notation is used to denote the (unknown) true value. Less important is the use of  $f()$  to denote a survival function (in Statistics,  $\bar{F}()$  or  $S()$  would be used).  $F$  would typically be the (unknown) distribution from which the variable is drawn, a niche which in the m/s is occupied by  $\hat{\phi}$ . The estimate would be  $\hat{F}$ , rather than  $P(\phi)$ . As the paper is written from a subjectivist viewpoint, should appropriate Bayesian notation be used throughout? I do understand the need for backward compatibility, but at minimum a glossary could be provided.
- More clarification could be devoted to the (sometimes fine) distinction between epistemic uncertainty and ontological error. Is the latter simply an extreme case of the former? At Line 89-96, it appears that ontological error is only identified as a consequence of a Bayesian model checking procedure (P-value), and so itself is subject to uncertainty.
- The tutorial example, while mathematically correct, does not seem to reflect an actual problem in volcanology. In practice the actual variable would be exceedance given an eruption, and so  $i$  should index the eruption number, to be consistent with the example in Section 3, not the year. Otherwise, as eruptions are not point events in time, exchangeability would be invalidated by whether an eruption was in progress at year begin/end. Presumably the exceedance is measured at a single location, such as a critical installation. Further discussion is needed on the degree to which the magnitude of individual eruptions are exchangeable. Seasonal wind patterns could also be mentioned here for the tephra example.

- Line 83 states that “The unknown true aleatory variability is often estimated by different models ...”, but this seems to be the procedure followed later in the m/s to estimate the epistemic uncertainty?
- Need discussion about where  $\pi_i$  comes from at Lines 83-84. The notation in Marzocchi and Jordan (2017) is clearer in this regard.
- At Lines 108-113, the discretization of time is causing further confusion. A clear distinction would need to be made between an earthquake \_preceding\_ an eruption and one following it.
- I think what the authors are saying in Lines 113-117 is that uncertainty can be apportioned between aleatory and epistemic, and that uncertainty assigned to the former cannot result in ontological error? Some clarification would be welcomed.
- I don’t understand L143-144 in view of the (blurry-)definition of aleatory and epistemic uncertainty earlier in the paper, belying Objective (1) at Lines 64-5. The concepts do not seem to be clearly and consistently separated. From a subjectivist viewpoint, the aleatory uncertainty is a probability distribution, the epistemic uncertainty is a prior on the parameters of the probability distribution, and ontological error is a probability that the aleatory/epistemic system fails to represent the data.
- Should “underestimation” at Line 157 be “misestimation”?
- The sentence ending on Line 223 might be overstated. Decision makers have enough difficulty with means, variances may be completely beyond them. There is a considerable body of research on this....
- As the earlier (seismic) papers refer to the SSHAC guidelines, should similar (eg. IAEA SSG-21?) citations be made here?

#### Technical corrections

Line 100 “...simultaneously for one ...”

Line 166 “... recent book by Nate Silver (Silver, 2012) ...”

Line 203 Bebbington (2010) is not in the reference list

Line 232/3 These references are not cited in the text.