Dear Authors,

I have reviewed your manuscript on the spatial forecasting of future eruptions in the Auckland Volcanic Field (AVF). The topic is relevant and potentially valuable. However, I believe that the manuscript would benefit from substantial revision, particularly to clarify its main objective and novelty and to improve the presentation of the methods, figures, and results.

The main issue is that the manuscript does not yet distinguish its contribution sufficiently clearly from that of Le Corvec et al. (2013). To understand the purpose of the present study and how it differs from previous work, I found it necessary to consult that paper. Le Corvec et al. (2013) already used convex hulls and simulations, discussed Poisson distributions, and focused on the same study area. The manuscript should therefore explain explicitly what question remains unresolved and how the present analysis addresses it.

Le Corvec et al. (2013) discussed the probable composition, timing, and volume of a future eruption, whereas the location of the next eruption appears to be the principal focus of the present study. If this is indeed the key distinction, it should be stated clearly from the outset. As I understand it, the manuscript uses statistical analyses and sensitivity tests to evaluate how spatial parameters affect forecast accuracy. This objective, and its significance relative to earlier work, should be made explicit in the Introduction and consistently reflected throughout the manuscript. A reader should be able to understand the rationale, novelty, and importance of the study without having to consult another publication.

The following comments are intended to help the authors clarify the context and purpose of the study and improve the presentation of the analysis.

Major comments

1. Title

The title should be more specific and more clearly reflect the study's main objective. In its current form, it may suggest a broad review of the geological evolution of the AVF rather than a methodological investigation of spatial eruption forecasting.

Possible alternatives include:

- *Influence of Spatial Boundaries on Future Eruption Forecasting in the Auckland Volcanic Field*
- *Sensitivity of Eruption Forecasts to Spatial Boundary Definition in the Auckland Volcanic Field*
- *Effects of Study-Area Boundaries on Spatial Forecasts of Future Eruptions in the Auckland Volcanic Field*
- Sensitivity of Next-Vent Location Forecasts to Spatial Boundary Definition in the Auckland Volcanic Field

The second or third option may be particularly appropriate if the central aim is to quantify the sensitivity of forecast results to the definition of the study-area boundary.

2. Abstract

In addition to describing the dataset as high precision, please report the number of eruptions or volcanic centres included in the analysis. This information is important for assessing the scope and statistical basis of the study.

3. Introduction and framing of the study

The statement that hazard assessment is important because the population *inevitably* overlaps with the volcanic field is not sufficiently precise. The word *inevitably* is unnecessary and may invite questions that are not relevant to the study. A stronger justification would be to state the extent of the volcanic field, identify the urban areas located within it, and provide the approximate population exposed. These facts would establish the significance of the hazard more directly.

The statement that the extent or boundary of monogenetic volcanic fields "may also show alignment" requires clarification and supporting references. Are there documented cases both with and without such alignment? If so, please distinguish between them explicitly. If alignment is consistently observed in the cases considered, the modal verb *may* should be reconsidered and the statement reformulated more precisely.

The Introduction should also explain why Monte Carlo simulations are appropriate for this problem. The relationship between the assumed stochastic process, the fit to a Poisson distribution, and the choice of simulation framework should be introduced before the Methods. At present, this rationale becomes apparent only after consulting Le Corvec et al. (2013).

4. Reproducibility of the synthetic simulations (Section 2.2)

The synthetic simulation procedure requires a substantially more detailed description. In particular, please explain why each simulation contains 250 volcanic centres when the observed dataset contains 51. The choice may be methodologically justified, but that justification should be stated clearly.

More generally, referring only to "simulations" does not provide enough information for the analysis to be reproduced. Please describe the simulation algorithm, parameter values and distributions, number of realizations, spatial domain and boundary conditions, assumptions, and any criteria used to compare the synthetic and observed datasets.

5. Interpretation of the physical constraint (Section 3.4, lines 221–223)

If the reported behaviour follows directly from an underlying physical constraint, the present interpretation risks sounding self-evident. The discussion would be more informative if it addressed why that constraint cannot currently be characterised or monitored directly—for example, because it may reflect deep crustal or mantle structure operating over timescales of thousands of years. This limitation could then be used to explain why a probabilistic approach is appropriate given the current state of knowledge and observational capability.

6. Poisson models and organisation of the results

Poisson models are apparently introduced for the first time in Section 4 (line 245), although they seem relevant to results presented earlier, particularly Figure 7 in Section 3.2. If the Poisson

interpretation comes from Le Corvec et al. (2013), this should be attributed explicitly (for example, “According to Le Corvec et al. [2013], the volcanic centres are consistent with a Poisson model”). If the present study independently tests or demonstrates this behaviour, the corresponding method and result should be reported.

In either case, the concept should be introduced before it is used to interpret the figures. The current ordering makes the logic of the analysis difficult to follow.

7. Interpretation of Figure 8 (line 277)

Please clarify whether Figure 8 represents synthetic data. If it does, the purpose of discussing orientation in a synthetic dataset needs further explanation. Is orientation imposed by the simulation, produced emergently by the model, or used as a diagnostic against the observed pattern? Explaining this point would make the interpretation of the figure more meaningful.

Specific comments

Section 1.1

- **Figure 1:** Please add an inset map showing the location of the study area within New Zealand. The explanatory information currently placed in the caption could be incorporated into a map legend where appropriate. There appears to be enough space to label the 51 volcanic centres, or at least the principal centres subsequently discussed in the text. Moving the colour scale outside the main map could create additional space and improve readability.
- The statement that “for some statistical tests there was substantial variation” should be more specific. Which tests showed substantial variation, what varied, and why might this matter for the subsequent interpretation of the results?
- **Lines 69–71:** The meaning of these sentences is unclear, possibly as a result of an editing error. Please revise them for coherence.
- **Line 72:** Please provide appropriate references for the convex hull method, including relevant methodological or foundational studies and applications in this context.
- **Lines 75–77:** The relevance of this information to the study is unclear. Please explain how it supports the analysis or consider removing it.

Section 1.2

- **Lines 82–83:** This information helps establish the significance of the study area and would be more effective in the general Introduction.
- Please clarify the assumptions concerning spatial and temporal randomness. Why is the temporal distribution considered potentially non-random while the spatial distribution is treated as random? The rationale and supporting evidence should be stated explicitly.

Section 2.5

- Please define *buffer* when it is first introduced and explain how the buffer distance is selected and used in the analysis.
- **Line 155:** The expression “a behavioural shift” is too general. Please describe the observed change more precisely and, if possible, quantify it.

Organisation of Section 3

- Section 3.3 appears to be more appropriately placed as Section 3.2.1, depending on its relationship to the preceding analysis. Please review the subsection hierarchy.

Section 3.5

- **Line 235:** Please correct the typographical error.

Overall recommendation

The manuscript addresses a relevant question, but its objective, novelty relative to previous work, methodological rationale, and simulation procedure need to be presented more explicitly. Clarifying these points would substantially strengthen the paper and allow readers to understand both the contribution of the study and the significance of its results.

I hope that these comments will help the authors strengthen the manuscript and communicate the significance of their work more clearly.

Sincerely,

Dr Helena Seivane Ramos

References

Le Corvec, N., Bebbington, M. S., Lindsay, J. M., and McGee, L. E.: Age, Distance, and Geochemical Evolution within a Monogenetic Volcanic Field: Analyzing Patterns in the Auckland Volcanic Field Eruption Sequence, Geochemistry, Geophysics, Geosystems, 14, 3648–3665, https://doi.org/10.1002/ggge.20223, 2013