Author Comments (ACs): General response to the reviewers
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We thank both reviewers for their careful evaluation of the manuscript and for their constructive and helpful comments and suggestions. The comments have led to a substantial extension of the work and have helped us improve the manuscript considerably.

These Author Comments (ACs) provide a brief overview of the main changes introduced in the revised manuscript in response to the reviewers' comments. A detailed point-by-point response will be provided together with the revised manuscript.

The original manuscript demonstrated the feasibility of expanding volcanic-cloud ensembles using generative AI under a controlled numerical experiment (hypothetical eruption). The revised manuscript extends this work in two important directions:

- application to a real volcanic eruption and,
- assimilation of real satellite observations in latent space.

We believe that the main concerns raised by the reviewers have been addressed through the following major changes:

1. We have carefully revised the manuscript to clarify the current scope and limitations of the approach, strongly emphasizing that this remains an emerging research area that is not ready yet for operational forecasting applications. We believe, however, that we provide evidence that the proposed methodology is promising for volcanic-cloud forecasting or volcanic hazard assessment, and we hope this work will motivate further research into its potential applications.
2. A major extension of the revised manuscript is the application of the methodology to the 24 December 2018 Etna eruption. This allows us to move beyond the controlled numerical experiment of the original manuscript and assess the methodology in the context of a real volcanic eruption.
3. The revised version also introduces the assimilation of real satellite retrievals through an ensemble Kalman filter applied in the latent space, demonstrating how the proposed generative approach can be combined with observations and extending its use beyond ensemble expansion alone. The low-dimensional latent representation allows us to mitigate some of the well-known limitations of conventional ensemble Kalman filtering when applied to high-dimensional problems involving non-negative variables with highly skewed distributions (e.g. aerosol concentrations), while making it computationally feasible to employ large ensembles for data assimilation.
4. The revised manuscript also includes a quantitative assessment of the computational cost of the proposed approach. This provides a clearer comparison between the computational requirements of generating and expanding the ensemble with the generative model and those associated with the corresponding physics-based simulations.

In summary, we have revised the manuscript throughout to make more evident the potential applications of the methodology in real-world scenarios. In addition, we have moderated statements concerning operational applications and clarified that the present work should be regarded as a contribution to an emerging research area, providing a basis for further investigation rather than a ready-to-use operational forecasting methodology.

Finally, given these substantial extensions, we believe that the revised manuscript goes beyond the scope of a purely methodological technical note. We therefore respectfully encourage the editor to reconsider the current *Technical note* designation and to consider the revised manuscript as a standard research article.

The authors
25 August 2026