

Atmos. Chem. Phys. Discuss., referee comment RC2
<https://doi.org/10.5194/acp-2021-858-RC2>, 2022
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Comment on acp-2021-858

Anonymous Referee #2

Referee comment on "Refining an ensemble of volcanic ash forecasts using satellite retrievals: Raikoke 2019" by Antonio Capponi et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-858-RC2>, 2022

The paper "Refining an ensemble of volcanic ash forecasts using satellite retrievals: Raikoke 2019" by Antonio Capponi et al. presents a methodology to improve numerical forecasts of volcanic ash by assimilating satellite retrievals of the investigated ash cloud. The authors apply this methodology to the volcanic cloud produced by the recent Raikoke eruption, and show interesting results with implications for volcanic hazard assessment. I found the paper timely, interesting and clear. The methodology is well described, and the application to the Raikoke eruption is clear. The discussions are in line with the results presented and the conclusions are very interesting. For these reasons, I suggest publication after minor revisions. Here below my comments and questions.

L68 The recent paper "Data assimilation of volcanic aerosol observations using FALL3D+PDAF" by Mingari et al., 2022 could be cited as well.

L140 Just for curiosity, with this retrieval algorithm can you also provide estimates of plume height? For the future, I think it would be very interesting to include in the data assimilation methodology the height of the volcanic cloud. Would it be feasible?

L162 "All simulations" indicate the simulations forming all the ensembles, not only the first one, right? Please add information.

L212 Could you provide information on the computational time necessary to run 1000 simulations? Do you run them in parallel or in serial mode?

L268 Please describe all the parameters of eq. 1. not only H, but also g,h and r.

L310 Is MOGREPS-G the same as MOGREPS?

L397 Why did you exclude ENS03?

L423-428 I think that more details should be given on the resampling strategy for the posterior pdfs. The correlation matrix (also in Fig.4) and the Cholesky decomposition should be better described.

L434 Is the trend of the distributions confirmed also for the ensembles not shown in Fig. 5? I think that this figure should be described giving more details. In particular, the fact that most of the ESPs are skewed towards the lower end of the initial range is interesting and I am curious to understand if you could validate these findings on the ESPs with independent observations of the same quantities. Could you compare the height of the column that emerges from this methodology with independent observations? Particle density seems to be conserved. Could you provide an explanation for that?

L461 The figure is well done, but it is really difficult to see the contour lines. Is there a way to improve the readability of the panels?

L532 It is not immediately evident that panels (a) and (b) indicate the concentration risk of the prior ensemble and ens08, respectively. Maybe subtitles could be added in order to make the comparison between the prior ensemble and ens08 more easy and immediate. The same for the ash dose risk of panels (c) and (d)