

Comment on acp-2021-459

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Referee comment on "Online treatment of eruption dynamics improves the volcanic ash and SO₂ dispersion forecast: case of the 2019 Raikoke eruption" by Julia Bruckert et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-459-RC1>, 2021

A. Folch Comments on "Online treatment of eruption dynamics improves the volcanic ash and SO₂ dispersion forecast: case of the Raikoke 2019 eruption" by Bruckert et al.

Summary

This paper couples the ICON-ART atmospheric chemistry model with the FPLUME volcanic plume model to furnish source conditions for ash and SO₂ emissions from the 21-22 June 2019 Raikoke eruption. Time-averaged column mass loads are compared with AHI data from Himawari-8 satellite and from previous off-line studies (Muser et al. 2020). This is done for 3 configurations: FPLUME-Rad, FPLUME-norad and Mastin-rad. The "Rad" options turn on aerosol-radiation coupling on SO₂ plume dispersion. The authors conclude that the coupling with FPLUME improves the ash loading comparison during the first hours and days after the eruption and that, afterwards, the aerosol dynamical processes become more important.

General Comments

- The FPLUME model actually outputs MER and vertical distribution of mass from plume height. However, it seems that, in the online ICON-FPLUME coupling, only MER is considered whereas a Suzuki parameterisation (with fixed parameter values of 4 and 5)

is imposed for the vertical distribution of mass. Is there a particular reason for this? To derive both ESPs (i.e. MER and profile) from FPLUME would seem a much more consistent approach. Note that, in addition, FPLUME gives size-resolved vertical profiles, whereas the authors assume the same values for the Suzuki parameters (4 and 5 according to eq.1) for all particle/aerosol bins.

- Vent conditions (Sec.2.3.1). As noted in the text, FPLUME is sensitive to vent conditions, particularly in the case of low plumes. Insufficient momentum (low exit velocity) and/or insufficiency energy at inlet can yield, together with other atmospheric factors, to lack of model convergence. This is not necessarily a model shortcoming, but actually reflects configurations in which a plume could not be sustained and therefore collapses. Please check if this could be the case for columns below 10 km, particularly if exit velocities drop below 80-90m/s (this seems to be the case according to values from Table 1). Rather than using Mastin-derived MERs (see next comment), I suggest re-running FPLUME for the Raikoke phases 01, 02, 04, and 10 with higher values of exit velocity (see if this converges FPLUME). On the other hand, it is also true that FPLUME is a model for sustained plumes. Application to short-lived burst-like transient puffs may certainly fail.
- I do not see the need for the Mastin-derived modelling option in this study. Which is the purpose of it? First of all, with respect to FPLUME-rad only affects the strength of the source (given that same Suzuki is used in both cases). It should, therefore, imply only a scaling of the Amplitude component of the SAL metric. Unfortunately, comparison (e.g. in Figure 5) is not given to check this. If this is modelling option not relevant to the paper it could be removed. Results and conclusions would be unaltered. The paper could then focus on: i) comparison with previous off-line (Muser 2020) and, ii) comparison rad/norad. This would be simpler and easier to follow.
- ICON model configuration (section 2.4). Is there any particular reason for running ICON globally? Can the model be run only over a limited area? If not, could you comment on the grid approach over the area of interest or, if none, is the resolution of the R3B07 configuration uniform across the globe?
- Figure 5. Why it only shows results for FPLUME-Rad? Why the other FPLUME.norad and Mastin-Rad are never shown? On the other hand, can you comment on the poor Structure-component results for ash?
- Any particular reason for doing 6-hourly model output averages? Considering that Himawari-8 observations can be available 4-times hourly, other approaches having less impact on the results could be considered. Averaging over such long intervals smooths out (e.g. peaks) and has substantial impact on instantaneous model results. How is SAL affected by this? Can this mask disagreements?

Specific Comments

- L36 (and throughout the text). Should multiple reference citations be ordered chronologically?
- L103. Could you specify the size ranges for each aerosol mode?
- L166. Sc layer?
- Table 1. Please specify that heights are a.s.l. (and not above vent as required by FPLUME) and that emission rate of SO₂ is computed using (2). Also, the emission rate of ash is not reported.
- Figure 2. Why is FPLUME (red dots) given in all phases?
- Figure 3. Is the color scale adequate? Should the higher value be at around 2 gm-2 or similar?

