

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-459

Sara Barsotti (Referee)

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-RC2>, 2021

This manuscript investigates the improvements obtained in forecasting dispersal of fine ash and SO₂ by using the ICON-ART model once it is coupled with a model to reproduce the plume dynamics. FPlume model is used for this intention and the Raikoke eruption is adopted as test case. It also investigates the cloud transport dynamics and the processes which might explain the differentiation between SO₂ and ash clouds.

A good description of Eruption Source Parameters is of paramount importance when trying to reproduce the dispersal of volcanic emissions, and it becomes even more essential within operational environment. In this sense, contributions like this manuscript are welcome and needed to keep working and identifying the best technical solutions for optimizing numerical effort and moving forward more reliable predictions.

This manuscript is a valid contribution to such discussion, however I'd recommend to review the following points and to make it even more clear and readable.

Few general comments

- please clarify somewhere in the text if the plume height is intended above sea level or above ground.

- the multiple reference to Muser et al. 2020 paper, makes the reading sometime difficult and incomplete

- I'm worried there is some confusion about the use of the word „plume“ which often is also used instead of „cloud“. Please clarify throughout the text so that the readability and the understanding of the results will be improved. See my comments below.

- Please be consistent throughout the text if you refer to ash or fine ash.

- Please in the abstract specify how long lasted the eruption.
- Line 7: what do you mean with „the simulated effect... is in the order of 6 km??“
- Line 103: 7 in word
- Line 126: ... by Marti et al. (2017)
- Line 135: please provide references for this statement.
- Line 142: what do you mean with: „... to ensure an uninterrupted simulation?“
- Paragraph 2.3: the Radius of the vent is also part of the equation, so I'm wondering which value or range of values you adopted here?
- Line 166: what Sc layer means?
- Line 176: please refer to Table 1
- Table 1: I'd suggest to make this table more complete. I'd add in the first column the day the phases refer to. I'd then also add a column specifying the Fine fraction flux (kg/s) or specify in the caption of the table that the flux for fine ash is shown in Figure 2. Please specify in the caption how the SO₂ flux is estimated. Please explain the caption the source of all data showed in the table.
- Line 186: Figure 2 shows only the MER and not the height
- Figure 2: Fine ash is <30 or <32 micron? Please correct the title of the plot. What means E on the y-axis? Please clarify. In the caption: ...calculated with Fplume MER times....and calculated with Mastin MER times...
- Line 200: H_T is not the plume height averaged over the entire eruption duration? Please clarify.
- Line 237: Please check the dates, aren't they 21 June and 22 June, instead?
- Line 239: (compare Fig. 3 top and bottom)
- Line 242: is the temporal evolution of ash loading on a hourly basis?
- Line 243: plateau? Is not a peak??
- Line 244: please start a new line when „Muser et al....“
- Figure 3: Please double check the dates
- Line 246: please double check the timing, I guess it is 18 UTC of 21 June as the plot shows the hours since the June 21, 12UTC
- Line 251: in the bracket add: in Figure 4
- Line 254: here you refer to the effect of meteorological conditions. I guess it would be useful to add some vertical profiles of wind speed in correspondence of the vent.
- Figure 4: Please be consistent with terminology: is this ash or fine ash? Are these

hourly values? I'd much like to see the occurrence of pulses in these plots, to understand when the eruption dynamics affected the detection.

- Line 276: here you are suggesting that the fact that you are not describing the gravitational spreading occurring nearby the source is affecting your capability in reconstructing the SO₂ forecast in its initial phase. Then please explain why this is not also impacting the quality of the ash forecast?
- Line 281: so from Figure 4 it turns out that the total amount of ash compares well with the satellite retrieval. However figure A2 shows a wider extent than what is retrieved. In this sense I'd have expected that this meant forecasted concentration lower than the observed and in this sense an Amplitude < 0 (as at Line 223-225 you say that when the model overestimates the parameter A is positive, and negative otherwise). But Figure 5 shows positive Amplitude for ash at all time intervals. Please explain.
- Line 285: here you say that S for ash in the beginning is negative. You justify the same results for SO₂ saying that this is most likely due to the ash thick presence that obscures the gas component in the retrieval. What might be affecting the negative S for ash?
- Paragraph 3.3: please double check the dates you refer to...
- Figure 6: please clarify how the different heights are obtained. Here I see grey heights, are they coming from Fplume or satellite? Please specify. How are you getting the different heights for SO₂ and ash? Are you maybe referring to the cloud height?? Please clarify.
- I guess the caption in Figure 7 and A3 partly clarifies it as it mentions this „horizontally averaged vertical distribution of mass“. Please spend more words in explaining the methodology, referring to Muser et al. 2020, is not enough. And use the words „plume“ and „cloud“ in a distinct manner.
- Line 358: I think the statement about the „dense ash plume“ hampering the validity of the comparison needs to be demonstrated. Please rephrase the conclusion.