Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-180

Anonymous Referee #2

Referee comment on "Halogen chemistry in volcanic plumes: a 1D framework based on MOCAGE 1D (version R1.18.1) preparing 3D global chemistry modelling" by Virginie Marécal et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-180-RC2, 2022

Marecal et al. evaluate volcanic plumes in the 1D-version of the model MOCAGE. They also test a sub-grid scale parameterization. The sensitivity studies are very interesting, and the chemistry scheme is adequate to describe bromine explosions.

General comments:

My main criticism is that I do not find the comparison to the Etna eruption of 10 May 2008 very convincing because there seem to be hardly any useful observations for this comparison:

- I didn't see any observational BrO data mentioned with one exception: a single data point from GOME-2 (2.3E14).

- Bromine is systematically below the detection threshold of FTIR (page 5, lines 158-159).

- No reports of near-downwind volcanic BrO are available for 10 May 2008 (lines 159-162).

- It is said (lines 730-731) that the bromine partition is realistic during the night. I did not see any nighttime measurements mentioned that can support this statement.

If any additional experimental data are available, I suggest to show them in the Figures for comparison. If not, it may be better to make a general comparison between volcanic observations and the model instead of focusing on a case study for a specific Etna eruption.

Specific comments:

- Page 4, line 112: It is unclear what is meant by the "explicit representation of Br2 species". There is only one Br2 species: molecular bromine. Did you mean "Bry" species instead of Br2?

- Why do you say on page 7 that there is "no mixing with background air" even though it is included when setting the X value to 0.1 or 0.3?

- The caption of Table 3 does not explain the meaning of the X value, and when the table is mentioned in the text for the first time, X hasn't been mentioned yet.

- I first had the impression that the N.Ref simulation is identical to a simulation with X=0. Why, however, is the X value for N.Ref in Table 3 listed as "N/A" and not as "0"? Does this mean that a simulation with X=0 would be different from N.Ref? I checked "XFP" in the model code which seems to be the same as "1-X". As far as I can see, there is no difference between setting XFP=1 and PLUME2=.TRUE.

- The caption of Fig. 1 says that the Model-P Box is defined as the shaded blue square minus the big blue square. This would be a negative number. Is this correct?

- A vertical 1D model has no horizontal resolution. What do you mean on page 31 with "The 1D simulations were run with resolution of 0.5° longitude x 0.5° latitude"?

- Page 3, line 89 and page 30, lines 717-719: The chemical lifetime of BrO is on the order of minutes. Therefore, it will not undergo long-range transport.

- The plots of BrO and BrO/SO2 in Fig. 2 are very similar. This means that SO2 is nearly constant, which makes sense for N.Ref. However, shouldn't SO2 decrease a lot via plume dilution during the model runs N.Plume.0.1 and N.Plume.0.3? Can you add SO2 to the plots in Fig. 2? This would help to compare the dilution rates of SO2.

- In Fig. 2 it can be seen that BrO starts to decrease even before the volcanic eruption emissions stop (i.e., inside the green zone). It would be interesting to explain this behaviour.