

Interactive comment on “Towards a representation of halogen chemistry within volcanic plumes in a chemistry transport model” by L. Grellier et al.

Anonymous Referee #2

Received and published: 23 June 2014

Grellier et al. present an interesting model with the aim to facilitate the inclusion of volcanic plume chemistry into a CTM. Although this is scientifically very relevant, I think that before the manuscript can be published in GMD, it needs major revisions as described below.

General comments:

- In the model description section, the chemistry mechanism is only described very vaguely. It seems to be a combination of REPROBUS, RACM, and some additional halogen reactions. However, a much more detailed description is necessary in order to understand the model results better. I suggest to show the full mechanism (including rate coefficients and references) in the supplement of the GMD paper.

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- Resulting from the oversimplified description of the chemistry mechanism, it is not quite clear to me if the model distinguishes between Br₂ and BrO. If yes, then how can BrO be a night-time reservoir of bromine compounds in the Plume 2 simulation? If no, then the model cannot not provide any information about the partitioning between BrO and Br₂ and the corresponding text should be removed.

- Why does the analysis of ozone destruction focus on BrO+HO₂ (R3) and BrO+NO₂ (R4)? In contrast, reaction BrO+BrO (R13) is only briefly mentioned. Since R13 is second-order with respect to BrO, it should be dominant at high BrO concentrations. This applies especially to the subgrid-scale parameterizations with higher concentrations.

- What is a 1D model without any horizontal and vertical transport? Isn't this just a accumulation of box models? If there is no transport, I don't understand how the plume dilutes with time.

- The conclusions are much too long (more than 5 pages), and they only repeat the text of the previous sections. Instead, they should be short and answer the following questions: Which of the simulations from Tab. 3 do you recommend? What problem areas have been identified? What needs to be done next?

- In the conclusions you write that "even with this dilution the model still estimates reasonable BrO values compared to the values obtained with a regional resolution". This may be true for BrO but not for ozone, according to Fig. 12. Ozone is very important and I think this discrepancy should be investigated in detail before this parameterization is applied in a CTM.

- I expect that the results of the Plume 1 and Plume 2 simulations depend strongly on the chosen emission time step. Did you try values other than 15 min, e.g. 10 min or 20 min?

Specific comments:

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- p. 2588, l. 20-21: change "Hörmann and al. (2013)" to "Hörmann et al. (2013)"
- p. 2592, l. 18: What is a "rapid description"?
- p. 2594, l. 6: Since R11 and R12 are not identical, change "leads to the same results" to "leads to similar results".
- p. 2598, l. 3: Why are heterogeneous reactions accommodation-limited when the uptake coefficients are high?
- p. 2601, l. 6: Is the time step in the model grid box larger or smaller than the MOCAGE time step used in standard simulations?
- p. 2608, l. 22-24: If "Br atoms are provided to the model" as HBr, then they are not provided as Br atoms. Maybe rephrase to "bromine compounds are provided to the model".
- p. 2616, l. 8: What are "weak values"? Do you mean "small fractions"?
- p. 2638: What is "ppv"?

Interactive comment on Geosci. Model Dev. Discuss., 7, 2581, 2014.

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