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Geoscientific Model Development Discussions

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

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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 decribed 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.

- 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 imortant 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:

- 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.