

Interactive comment on “CAPRAM reduction towards an operational multiphase halogen and DMS chemistry treatment in the chemistry transport model COSMO-MUSCAT(5.04e)” by Erik H. Hoffmann et al.

Anonymous Referee #1

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Hoffmann et al. developed simplified multiphase halogen and DMS chemistry schemes that consumed less CPU time and could be implemented into the chemical transport models. Along with the development of observation techniques, halogen chemistry is getting more attention in the atmospheric chemistry community during recent years. DMS chemistry is critical for the climate through formation of sulfate aerosols and clouds. Both halogen and DMS chemistry involves many chemical species and reactions and thus are difficult to model, especially the multiphase chemistry parts that are generally not included in CTMs. The chemistry schemes developed in this study will

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benefit the atmospheric chemistry community. It is within the scope of GMD. However, I think the manuscript can be improved through more discussion about the results (some unclear scientific reasoning), doing sensitivity tests, and adding references to the reaction coefficients used in this study. I recommend it to be accepted after some revisions.

General comments

1. In the Model Setup section, Lines 105-110, it states that the simulations were performed at 48 hours, different latitudes, different seasons, and different relative humidity levels. But I was not able to find where the results for all these simulations are in the manuscript. Please clarify this.
2. The CPU time evaluation was shown for the box model with the new chemistry schemes. It will be worth showing the CPU time evaluation for the 2-D modeling before and after using the new schemes.
3. References should be added or clarified to all the coefficients shown in the tables in the Supplement.
4. There should be discussions about wet scavenging of reactive halogens by clouds when explaining the cloud impacts on halogen and sulfur chemistry.
5. It will be useful to have a section discussing the main uncertainties of the new chemistry schemes (e.g. reaction coefficients).

Other comments

1. Page 3, Line 32: What is the HOX-driven sulfite oxidation? Was it included in the model?
2. Line 120: Please give references.
3. Fig. 1: Please clarify shading in the figure. Nighttime?
4. Lines 362-363: Please clarify this sentence.

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5. Line 489: 200 horizontal columns – does it mean 222 km?
6. Fig. 5: Please clarify the x-axis “Distance in grid”. What does it mean and what unit.
7. Line 515, BrO gas-phase concentration section: Please explain the differences of BrO in two scenarios shown in Fig. 6.
8. Sect. 3.3.2 Vertical DMSO distribution: It will be useful to show plots of DMSO production and loss rates when discussing the DMSO profiles.
9. Line 595: Why particularly BrCl? What about Br₂?
10. Lines 598-599: Please clarify more why DMSO concentration profile is shifted to the right compared to the BrO one.
11. Line 612: Please explain “O₃ is the preferred oxidant in the aerosol phase whereas OH is in the cloud droplets”?
12. Line 617: Please explain “In the grid cells before cloud occurrence, the DMSO concentration is high and consequently the MS- formation is as well”.
13. Line 625: Please clarify “As for MSA, the formation of sulfate is enhanced in the grid cells directly or indirectly affected by clouds”.
14. Line 649: How much does the HOBr+HSO₃⁻ in clouds affect the bromine budget through converting HOBr into Br⁻?

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