

Author's response:

"Dear authors, thank you for submitting a revised manuscript. In a very critical second-round review it was suggested to reject the manuscript due to the lack of scientific evaluation of the model developments (especially against laboratory data), a lack of a clear and concise presentation, and an insufficient translation of the responses made by the authors to the reviewer's report into changes of text within the manuscript. It is standing policy at GMD to generally reject manuscripts rated poor in at least one category I do mostly concur with the reviewer's points of view.

The amount of comparison against observations is indeed very limited. A number of recent field studies (e.g. ATom, ACCLIP), also under conditions where strong SOA production is expected like a wildfire (e.g., BBFLUX, WE-CAN, FIREX), as well as chamber experiments (e.g., CLOUD, AIDA) are readily available to test the model developments under a much broader range of conditions, which would lend much more credibility to the usefulness of the developments.

Responding in detail to points raised by a reviewer but not translating these changes into substantial changes within the manuscript text is a common fallacy - one that leads an improper representation of the peer-review process within the final manuscript. The final manuscript must reflect the agreed-upon state after discussion between reviewers and authors. All the (highly useful) scientific content within the review comments and author responses would be lost to the reader (of the published paper) otherwise.

In summary, I do think the developments shown in the manuscript merit publication, but considering the justified criticism by the reviewer and given standing policy at GMD to generally reject manuscripts rated poor in at least one category, I would like to ask the authors for major revisions consisting of (1) a proper inclusion of responses to the reviewer into changes within the manuscript text and (2) adding more evaluation against observations before we can proceed."

We agree with the reviewers and the editor, that some reviewer responses were not properly represented in the revised manuscript. The implementation of a new section on model limitations and the additional evaluation that was possible within the revision time frame is hopefully sufficient to satisfy the major issues raised by the reviewers.

Major revision referring to (1)

Major comments were reevaluated and the most significant modifications to the manuscript are included as follows.

- We added Section 2.2 "model limitations" to the manuscript. With some more additions to the "Specification" section this includes all responses to questions on model capabilities and limitations (Referee #1, comments: 1, 11 and 16; Referee #2, Major comment: 1, Minor comment: 4).
- In the "Specification" section we included further statements on the influence of non-linear effects on Henry's law coefficients (Referee #1, comment: 10; Referee #2, Major comment: 2).
- We extended the mechanism details given in the supplement by adding the reactions displayed in the figure in kpp format. The figures were also revised to enhance comprehensiveness (Referee #2, Major comment: 3).

Major revision referring to (2)

Comparison to measured data was added to the manuscript as follows.

- For further evaluation against measured data, we added Section 3.2 to the manuscript (Referee #1, comment: 2). This Section presents the setup and comparison of model simulations to chamber experiments. The limonene-ozone and isoprene-NO₃ mechanisms are evaluated. With the assessment of the IEPOX chemistry in Section 3.1, this covers a wide range of the newly implemented mechanism.
- Additional information on the experimental setup and the model-experiment comparison is given in Section 5 of the supplement.