Author's response to comments from the editor:

"Land cover change influence on atmospheric organic gases, aerosols, and radiative effects"

by Ryan Vella et al.

The comments from the editor (from November 06, 2024) are reproduced in black, while our comments are presented in blue.

From the editor's final response:

The reviewers were unified in their evaluation of this manuscript, assigning scores of good to excellent in all of the primary review categories. The authors provided detailed responses to reviewer comments and made changes to the manuscript where appropriate. I have some minor questions and comments for the authors, largely focused on the areas of the manuscript where significant changes were made in response to the reviewers. Following minor revisions in response to those additional questions and comments, the manuscript to be suitable for publication.

We sincerely appreciate the insightful comments provided by the two anonymous referees, which we believe have significantly improved the quality of this work. We also thank the editor for their careful handling of the manuscript. Detailed responses are provided below.

P.S.: Throughout the manuscript, we used the term "land cover change (LCC)" rather than "Land use change". LCC is more widely used in the literature, and therefore I decided to update the title accordingly; from *"Land use change influence on atmospheric organic gases, aerosols, and radiative effects"* to *"Land cover change influence on atmospheric organic gases, aerosols, and radiative effects"*.

Abstract line 6: Suggestion to add "model" after chemistry-climate to improve clarity (" . . . a global atmospheric chemistry- climate model coupled with a dynamic global vegetation mode. . . "

Thank you for pointing out this typo. The text was updated to "...a global atmospheric chemistry-climate model..."

Lines 43-45: The processes being described are not necessarily unique to biogenic precursors. Minor wording changes are suggested to make that, and the rest of the paragraph, clearer: As a result, monoterpene precursors may have distinct climate impacts given their influence on the aerosol numbers. Through condensational growth, bSOA participates in the absorption and scattering of solar short-wave radiation,

contributing to aerosol-radiation interactions (ARI). Furthermore, newly formed bSOA particles can grow into sufficient sizes to activate as cloud droplets, thereby modifying cloud properties such as albedo and lifetime, and effectively contributing to aerosol-cloud interactions (ACI) (Forster et al., 2007).

Thank you. The text was updated to "As a result, monoterpene precursors may have distinct climate impacts given their influence on the aerosol numbers. Through condensational growth, bSOA participates in the absorption and scattering of solar short-wave radiation, contributing to aerosol-radiation interactions (ARI). Furthermore, newly formed bSOA particles can grow into sufficient sizes to activate as cloud droplets, thereby modifying cloud properties such as albedo and lifetime, and effectively contributing to aerosol-cloud interactions (ACI) (Forster et al., 2007) In this study, we do not include organic new particle formation (NPF) and focus only on the role of organic precursors in supporting aerosol condensational growth."

Question: One of the reviewers asked about the role of biogenic compounds in NPF. As I understand it (based on your response and edits to the manuscript), in the GMXe model, biogenic compounds are not considered and do not affect number concentrations. They can only contribute to condensational growth. If this is correct, I suggest to add a sentence in the introduction (after lines 43-45), clarifying that only the contribution to ARI is considered in this work (or alternatively, that the contribution to REaci by this mechanisms is not considered). I do see that you report on changes in REaci. I'm not sure what the mechanism of change would be (since it is not enhanced NPF by biogenic precursors), and maybe that needs to be clarified in the results if it has not been already (e.g., in paragraph starting on line 273, 295, 461).

We agree that further clarification is needed. In the setup used here, we account for the condensational growth of secondary organic aerosols (SOA), which, as you noted, directly influences aerosol-radiation interactions (ARI). Additionally, this growth affects CCN and CDNC, as condensation can enable particles to reach the critical radius required to act as CCN. To enhance clarity, we have added the following paragraph: "Although this model setup excludes organic NPF, aerosol growth via the condensation of organics can still impact CCN and CDNC by increasing particle size. This growth pushes existing particles closer to the critical radius required for them to act as CCN and activate into cloud droplets, as described by Köhler theory in the activation parameterisation used by the CLOUD submodel in EMAC."

In the Discussion section the following sentence was added to point out the relatively weak signals in CDNC and REaci suggested here may be indeed due to the lack of organic NPF descriptions in the model: "The lack of organic NPF descriptions in the model may also underestimate the real influence of bSOA on CDNC and REaci reported in this work."

Line 300: Suggestion to remove "Dot hatching. . . " sentence starting on line 300, since it was noted in the text already (for a different variable) and is noted in the figure captions.

Thank you, this sentence is now removed.

References

65 Forster, P., Ramaswamy, V., Artaxo, P., Berntsen, T., Betts, R., Fahey, D. W., Haywood, J., Lean, J., Lowe, D. C., Myhre, G., Nganga, J., Prinn, R., Raga, G., Schulz, M., and Van Dorland, R.: Changes in Atmospheric Constituents and in Radiative Forcing, in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.