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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Land cover change impacts on atmospheric chemistry: simulating projected large-scale tree mortality in the United States" *by* J. A. Geddes et al.

Anonymous Referee #2

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Review of Geddes et al., Land cover change impacts on atmospheric chemistry: simulating projected large-scale tree mortality in the United States.

This paper uses GEOS-Chem to test the atmospheric effects of projected tree mortality from insects and disease in the U.S. in 2013–2027. To do this work, the authors have created a new module for the model harmonizing multiple processes, which will also facilitate other GEOS-Chem investigations on atmospheric impacts of land cover changes in the future. The authors test three tree mortality effects: reduced BVOCs emissions, changes in soil NOx emissions and reduced canopy uptake of these emissions, and slower dry deposition rates. The authors discuss these effects in terms

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of their impacts to surface ozone concentrations, reactive nitrogen concentrations and speciation, and SOA concentrations. Ideas for future work are also presented. This paper has a clear objective, the methods are sound, and the conclusions are well supported and provide new insight. I recommend the paper be published after attention to the following comments.

1. While four simulations are listed and numbered in Section 4 (page 29313), it is sometimes difficult to tell which specific simulation is being discussed or pictured. I recommend adding the simulation numbers throughout the text or changing the descriptive language such that the different simulations can be identified unambiguously.

2. Please clarify exactly how soil NOx is impacted by tree mortality. On page 29313 it says tree mortality does not impact the basal soil NOx emission factor, but lower LAI reduces canopy uptake. However, it is not obvious to me whether the lower LAI induce changes in the soil temperature and moisture, therefore changing the magnitude of NOx emissions, or if the discussed changes in soil NOx emissions are purely a result of the changes in canopy uptake.

3. To say that changes in nitrogen oxide speciation and abundance are evidence for changes in the NOx-HOx chemistry (page 29319, line 20) is not particularly meaningful without some knowledge of the specific chemistry in the model, at least as related to this result. Also, when I read NOx-HOx I think of daytime chemistry, but presumably nighttime formation is also altered. How large are changes in nighttime versus daytime formation? What is the relative impact to daytime nitrate production due to reductions in BVOC derived RO2 precursors, as compared to changes in the net alkyl nitrate branching ratio, i.e. the fraction of NO + RO2 that forms RONO2 versus O3? Additional discussion of the organic nitrates and uncertainties is warranted.

4. Information on how GEOS-Chem predicts SOA and the uncertainties at play, at least as they relate to these experiments, should be added. Because of the extreme brevity of Section 2.1, this paper appears to target the GEOS-Chem users community

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exclusively. While I appreciate that the authors have not bogged the paper down with superfluous model details, adding back some chemical description, especially since the paper tests chemical impacts, would speak to a wider audience.

5. The land type updates have a large impact on various BOVCs emissions (Section 2.4). To me, similarities in the O3 spatial distribution and in the modeled-gridded measurement agreement are not convincing evidence that model has not been degraded (or altered, or improved). Rather, I am inclined to interpret this to mean that O3 is not a sensitive metric. Can something more be said about the land use update? At least about why O3 is not observed to respond?

6. The abstract states, "these simulations suggest that changes in biosphere–atmosphere exchange must be considered when predicting future air quality and climate." This conclusion would strengthened be with some kind of quantitative comparison between the size of the impacts predicted in this work and the effects predicted by some air quality-climate studies.

7. Because this paper is concerned with chemical impacts, the authors might consider (although it is not necessary) also reporting BVOCs emission changes in chemically meaningful terms, such as changes to the total BVOC reactivity to OH, reactivity to NO3, RONO2 yields, and/or SOA yields.

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