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Biogeosciences Discussions

Interactive comment on "Evaluation of simulated biomass damage in forest ecosystems induced by ozone against observation-based estimates" *by* Martina Franz et al.

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1 Answers to Anonymous Referee # 1

Q: The authors assume that the modelled accumulation of ozone fluxes at the top canopy layer equals POD during the model-observation comparison process. Please justify this assumption. I think this is important for the evaluation of model against observation, considering the ozone damage is explicitly calculated through the canopy and integrated to derive the whole tree damage. The modelled POD value largely influences the slope of the resultant dose-response curve and its distance with observed

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dose-response curve. I am wondering how would the authors account for this treatment in influencing the evaluation of different algorithms against observed data.

A: We designed our study such that our way to calculate POD is consistent with those from Büker et al. (2015), from which we took the dose-response-relationships. They calculate the $PODy$ used for their analysis in accordance with the LRTAP-Convention (2010), which states 'the index PODY is used to quantify the flux of ozone through the stomata of the uppermost leaf level that is directly exposed to solar radiation and thus no calculation of light exclusion, caused by the filtering of light through the leaves of the canopy, is required'. We calculate the $PODy$ based on the LRTAP-Convention (2010), to be able to compare our simulation results to those of Büker et al. (2015).

We will add a citation of the LRTAP convention to the explanation on the calculation of POD in the text: 'For comparison to observations, the Phytotoxic Ozone Dose (POD, $mmolm^{-2}$) can be diagnosed by the accumulation of $f_{st,l}$ for the top canopy layer (l = 1), in accordance with LRTAP-Convention (2010) and Büker et al. (2015).'

Of course, there will be uncertainty in the calculation of the POD by both Büker et al. (2015) and our study compared to the real-world POD, given both are based on different, but evaluated models (Emberson et al., 2000; Franz et al., 2017), but in the absence of direct measurements of POD it is impossible to judge whether or not this would introduce any systematic bias into the comparison.

Q: I am curious why did not the author try to use different damage functions at different depth of the canopy?

A: Each of the damage functions is applied to all canopy layers in separate simulations for each damage function. The ozone damage differs within the canopy, as increasing canopy depth leads to lower leaf-specific photosynthesis, conductance, and therefore ozone uptake and damage.

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Our aim was to investigate the suitability of different damage functions to reproduce observed biomass damage relationships. Following this we always only applied one damage function in one simulation. The application of different damage functions in one simulation, e.g. different damage functions for different canopy layers, can not contribute to answer our research question.

Evidence exists that sunlit and shades leaves exhibit a different sensitivity to O_3 (Tjoelker et al., 1995; Wieser et al. 2002). Following this the application of different damage functions for different canopy layers might yield improved damage estimates. However damage relationships for different canopy depth are to our knowledge not available as well as independent data to evaluate them.

Q: 3) Another important, but still largely missing, aspect in simulating ozone impacts on vegetation is the huge diversity of species-sensitivity in an ecosystem. Dealing with vegetation to the PFT level is not enough, though totally make sense in terms of large scale modelling and data scarcity. This work could be improved by further talking about diversity of species response to ozone. To this end, I found the following work could be a good reference: Wang, B. et al. Forests and ozone: productivity, carbon storage, and feedbacks. Sci. Rep. 6, 22133; doi: 10.1038/srep22133 (2016)

This study, though without sophisticated ozone damage simulation, had an explicit simulation of species sensitivity to ozone using an individual-based model and found dampened responses to ozone over long-term simulations.

A: We will include this study in our discussion.

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1.1 Minor comments

Q: L27 on page 4: please justify the statement of highest N concentration at the top of the canopy and its exponential decline with increasing canopy depth.
A: We base this statement on the publications by Friend (2001) and Niinemets et al. (2015) and will add these references in the manuscript.

Q: L18 on page 5: in equation 2, how is the stomatal conductance of O3 calculated?
A: Explanation added.

Q: L28 on page 8: identical →identically.
A: Done.

Q: L5-6 on Page 18: this sentence should be restructured to make it easier to follow.
A: Done.

Q: L7 on page 18: ‘’all in all’ should be followed a comma.
A: Done.

2 References

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