Response to Comments of Reviewer #2

Manuscript number: egusphere-2023-2149
Authors: Jiachen Cao, Xu Yue and Mingrui Ma
Title: Simulation of ozone-vegetation coupling and feedback in China using multiple ozone damage schemes

We are grateful to the referee for his/her time and energy in providing helpful comments and guidance that have improved the manuscript. In this document, we describe how we have addressed the reviewer's comments. Referee comments are shown in black and author responses are shown in blue text.

The manuscript firstly explores the different impact of the two commonly used O3 damage parametrizations which is an interesting comparison with relevant conclusions for the community. The authors additionally use measurements of O3 and meteorology to evaluate the model prediction which, however, could be more taken into account. In general, I feel more explanation and interpretation in the result section can imrove the manuscript, though it is overall well written and understandable. Please find my minor comments below:
Thank you for your positive evaluations. All the questions and concerns have been carefully answered.

l. 285: The terms 'warmings' and 'coolings' are not clear. This would more refer to model changes or even climate change experiments
Response: Thank you for your suggestions. We modified the sentence as follows: "The model reasonably reproduces the spatial pattern of higher near-surface temperature in Southeast and Northwest and lower temperature over the Tibetan Plateau (Figure 1a)". (Lines 279-281)

l. 288 "[...] but it shows a high correlation (R=0.96)"
Response: Corrected as suggested.

l. 292 For which model was it also reported ? Is it model-specific?
Response: WRF-CMAQ model was used in Hu et al. (2016) and Liu et al. (2020), and Zhu et al. (2022) used WRF-Chem model. We clarified as follows: "Such overestimation was also reported in other studies using WRF models …" (Lines 286-287)

l. 296 mention the reason for the overestimation of O3 (counteract the overestimation

of wind speed?)

Response: In the revised paper, we clarified as follows: "The model reasonably captures the hotspots over North China Plain though with some overestimations, potentially attributed to uncertain emissions and coarse model resolutions". (Lines 291-293)

l. 298 "reports" of "overestimated" (the model overestimates)

Response: Corrected as suggested.

l. 316 f: But the O3 damage not only depend on O3 concentration, right? How do you come to the conclusion that S2007 is more reasonable here?

Response: We agree with the referee's comments. In the revised paper, we removed the original statement on Lines 316-318 and clarified that S2007 reasonably captured the differences of O_3 damages to photosynthesis of sunlit and shaded leaves, which was supported by observations: "In contrast, the L2013 scheme depends on the accumulated O_3 flux and assumes constant damages for some PFTs (Table 2), resulting in reductions of photosynthesis even at low O_3 concentrations. Consequently, we found limited differences in the O_3 damages between sunlit (Figure 2c) and shaded (Figure 2f) leaves with L2013 scheme. Observations have reported that surface O_3 has limited impacts on the shaded leaves (Wan et al., 2014), consistent with the results simulated by the S2007 scheme. " (Lines 307-313)

l. 333: 5.5% is this an average over the model region?

Response: Yes, 5.5% is this an average over the model region. We clarified as follows: "For S2007 scheme, O_3 causes damages to national average GPP and TR approximately by 5.5% …" (Lines 327-328)

l. 344/345 Please explain the reason for the different changes by the two schemes
You can be more concrete here.

Response: In the revised paper, we added explanations as follows: "The most significant differences are located in Tibetan Plateau with limited damages in S2007 but strong inhibitions of both GPP and TR in L2013. The low temperature (Figure 1a) and O_3 concentrations (Figure 1d) jointly constrain O_3 stomatal uptake (Figure S2), leading to low O_3 damages over Tibetan Plateau with the S2007 scheme. However, the L2013 scheme applies b_p=0.8021 for grassland (Table 2), suggesting strong baseline damages up to 20% even with CUO=0 over Tibetan Plateau where the grassland dominates (Figure S3)." (Lines 338-344)

l.366/367 Why is the L2013 O3 inhibition constant over day?

Response: In the revised paper, we clarified as follows: "the L2013 scheme shows

almost constant inhibitions throughout the day (Figure S1). The zero or near-zero slope parameters (a_p and a_c) in the L2013 scheme (Table 2) lead to insensitive responses of photosynthesis and stomatal conductance to the variations of CUO. As a result, there were very limited diurnal variations in O_3 damage with the L2013 scheme." (Lines 364-368)

l. 388/389: The reffering of the different values is not clear. Perhaps, there is a bug with one unit or the brackets.

Response: In the revised paper, we corrected the numbers as follows: "On the national scale, surface O_3 enhances 4.40 μg m^{-3} (5.08 %) with high O_3 sensitivity and 2.62 μg m^{-3} (3.04%) with low O_3 sensitivity through the coupling to vegetation." (Lines 387-389)

l. 423 ff. please split the sentence in two or shorten it

Response: In the revised paper, we modified as follows: "With the S2007 scheme, we predicted GPP reductions of -5.5% to -8.5% in China. This is similar to the range of -4% to -10% estimated by Yue et al. (2015) using the same O_3 damage scheme. However, it is lower than the estimate of -12.1% predicted by Xie et al. (2019), likely due to the slight overestimation of surface O_3 in the latter study." (Lines 422-426)

l. 433-435: To my knowledge that shouldn't be the case? Didn't the other models consider leaf turnover?

Response: The other model studies did not mention whether their models took into account leaf turnover. Even if the models considered leaf turnover, they should have longer accumulation period of O_3 uptake than us, because they ran models from the beginning of the year while we ran the model from May. In the text, we added the word 'might' to suggest possible causes instead of making conclusions: "The longer time for the accumulation of O_3 stomatal uptake in other studies might result in higher damages than our estimates with the L2013 scheme" (Lines 432-433)

l. 446 f: Be consistent with the O3 unit.

Response: In the revised paper, we modified as follows: "We further predicted that O_3 vegetation damage increased surface O_3 by 1.0-3.33 μg m^{-3} in China, similar to the 2.35-4.11 μg m^{-3} estimated for eastern China using a global model (Gong et al., 2020). Regionally, the O_3 enhancement reached as high as 7.84-14.70 μg m^{-3} in North China Plain, consistent with the maximum value of 11.76 μg m^{-3} over the same domain predicted by Zhu et al. (2022)." (Lines 443-448)

l. 464/465: I would rephrase to "However, this scheme shows no significant different

changes for sunlit and shaded leaves"
Response: Corrected as suggested.