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Biogeosciences Discussions

Interactive comment on "Predicting photosynthesis and transpiration responses to ozone: decoupling modeled photosynthesis and stomatal conductance" *by* D. Lombardozzi et al.

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The paper "Predicting photosynthesis and transpiration responses to ozone: decoupling modeled photosynthesis and stomatal conductance" by Lombardozzi et al. builds on their just published work to provide a more accurate method of modeling the effects of ozone on vegetation in terrestrial ecosystem models. The approach is based on years of laboratory research with Tulip Poplar, and is applied to the NCAR CLM model. The key point is that ozone reduces photosynthesis more than transpiration, so that older models overestimated the effect of reduced transpiration due to chronic ozone exposure. The paper should be published with minor modification discussed below.

1. P. 4, lines 12,13 – specify that these equations appear in section 2.1.1.

2. One key addition I would make to the paper is to include and discuss effects of ozone on soil moisture (in addition to just relative humidity). If the new method results in a relative increase in transpiration relative to the old (Psn) method, then that would mean less soil moisture. On p. 24, lines 9-10, it is stated that the largest transpiration decreases occurred in the mid-to-high latitudes of the northern hemisphere. How much larger would these decreases be with the Psn method? The point is, in moisture-limited regions like the Western U.S. that are already expected to get drier, the difference in transpiration may be the difference between a threshold in moisture-limitation response of vegetation. Soil moisture would be the best (well, easiest) way to track this change, and would provide one additional figure. This effect can be pointed out in the Introduction (p. 5, line 13) and Results (p. 19, line 5).

3. How do the ozone uptake levels (p. 11, line 16) translate to actual ozone exposure per model time step?

4. Make sure the Tables are in order – it looks like Table 2 is mentioned in the text before Table 1.8

5. Somewhere in section 2.2.3 it should be stated clearly that the CLM runs are done to compare two models, PG and Pg.

6. Figure 2 can use some more text to help provide clarity. A suggestion is to list the CUO value within each of the 9 boxes. Also, indicate on the sides that the first and second rows are light curves and the third rows are the A-Ci curves. Also, in Table 1 (or now Table 2?) list "Figure 2, g-i" under the first photosynthesis, "Figure 2, d-f" under the second photosynthesis, and "Figure 2, a-c" under Conductance.

7. P. 17, lines 4-5: What are the units for the rates?

8. Please elucidate the statement on p. 22, line 22 ("the only simulation to our knowledge that reports changes in transpiration caused by O3").

9. There are two items listed as “not clear” (p. 25, line 10; p. 26, line 18). Since this is a modeling study, is it possible to take one model grid and try to determine what exactly is happening? That may be too difficult with CLM, so I don’t want this to hold the paper back, but I know with other models I have worked with, that is possible.

10. P. 27, lines 3-10: How do tropical ozone levels compare to those in mid-latitudes? It would be interesting to point out something about the actual differences, so that even though the effect is larger in the tropics, are the ozone levels comparable or much less (or larger) than in the mid-latitudes?

11. Some speculation at the end as to the effects of using CLM-CN, i.e. Nitrogen feedbacks, would be good.

12. So, it should be stated clearly at the end that the recommendation from this paper is that modelers should use the PG approach, i.e. applying different limitations on photosynthesis and stomatal conductance – so that one does not affect the other – as a result of ozone. Is it true that thus far, these empirical relations only exist for Tulip Poplar? Are there other data that can be mined from the literature, or is this a topic of future laboratory research? Most importantly from the modeling perspective, can the authors speculate on what limited number of species would need to be studied in order to cover all the PFTs currently used in the CLM? Remember that most previous models based ozone damage on 2-3 species applied to vegetation world-wide.

Interactive comment on Biogeosciences Discuss., 9, 4245, 2012.