

Interactive comment on “Influence of future climate and cropland expansion on isoprene emissions and tropospheric ozone” by O. J. Squire et al.

Anonymous Referee #1

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This study uses a global climate simulation to contrast the influence of climate, anthropogenic emissions and land use change on future ozone, and specifically addresses whether changes in ozone will affect future crop productivity. The subject is quite interesting and the paper is well written. However, there is a major hurdle which prevents publication of these results at this time: the inconsistent use of different climate scenarios. The authors use the B2 climate scenario to drive the dynamic vegetation model and to specify greenhouse gas concentrations, but then use the A1B scenario to estimate cropland expansion and specify the future climate in the atmospheric simulation (via SST, etc) and the B2+CLE scenario for future anthropogenic emissions of NO_x,

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CO and VOCs. These scenarios are quite different and combining them in this way does not present a consistent view on changing forcings. This is particularly egregious in the case of land use where natural vegetation responds to B2 forcing, but cropland expansion follows the A1B scenario. Overall this is problematic given that much of the paper contrasts the influences of climate, emissions and land use changes, and characterizes the “balance” between these effects. They are simply not comparable here given these inconsistencies, nor is the net change in O₃ meaningful, nor is the study comparable to other literature results. The authors mention this inconsistency on page 18315, suggesting that they are “investigating how O₃ responds to changes in a range of parameters”. However this justification is insufficient – had the authors investigated a full suite of scenarios for each driver, they could indeed focus less on a specific scenario and more on a general sensitivity, but having picked a single scenario for each driver, these should be consistent. I suggest that the authors harmonize their choice of a scenario and repeat their analysis accordingly.

Additional minor comments:

1. Abstract: should specify that both anthropogenic and natural land use change are included in the analysis
2. Section 2.1: Is the SDGVM run continuously (from 2000 to 2095) or in time slices?
3. Section 2.2: How does CO₂ fertilisation impact the LAI?
4. Section 2.2: Figure 1 suggests that the SDGVM does not predict an expansion of broadleaf trees northwards with future climate. Why?
5. Section 2.2: What was the total increase in crop area? (in both absolute and percentage values)
6. Section 3: The authors suggest that their simulated climate impact (both T and CO₂ fertilisation) on isoprene emissions (+78 Tg/yr) is similar to several studies. While the sign (i.e. an increase) is the same, the values are substantially different (factor

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of 2-4 less) than previous studies (eg. Young et al., 2009; Heald et al., 2009, both cited). Given these differences, which appear to be associated with the Amazonian die-back mentioned, it would be useful to separate the T effect and the CO₂ fertilisation (or natural land use change) effect. In this way the authors could more meaningfully compare the first and contrast the second with previous studies.

7. Page 18317, line 17: Close to a factor of 3 hardly seems “slightly greater”. I suggest this be reworded.

8. Page 18318, lines 9-12: This is only true if the land use scenario projects an overall decrease of vegetation cover and LAI for isoprene emitters

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 18307, 2013.