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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Response of surface ozone to climate change over the Eastern United States" *by* P. N. Racherla and P. J. Adams

Anonymous Referee #1

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General comments:

The authors have provided an interesting and straightforward statistical analysis of present and future climate impacts on ozone. This issue has been discussed in several recent papers (e.g., Hofgrefe et al. 2004; Mickley et al., 2004; Murazaki and Hess, 2006) with some conflicting results, so further analysis with additional models and techniques is warranted and appropriate for publication in ACP. The authors show that future climate has the potential to increase the severity and frequency of ozone events, as well as the duration of the ozone season. They attribute about half of the increase in ozone due to climatically-induced increases in isoprene emissions. Interestingly, they show that only about five years are needed to assess the interannual ozone variability. I recommend this manuscript for publication with the discussion of

the points detailed below.

Specific comments

1. Section 3.1: The use of a 4-hour average surface ozone concentration seems arbitrary. Why was this selected over the 8-hour average (the US EPA standard) or even a one-hour average (the former US EPA standard)? This averaging period is consistent throughout the study and should be explained in full.

2. Section 3.1: The spatial distribution of the present day ozone 4-hour exceedances seems unusual compared to surface ozone concentrations in the US. Figure 3 shows 37 non-land grid cells, of which the grid cell with the largest number of exceedances is predominantly over water. Additionally, there are very few exceedances over the majority of Texas (with the exception of one partial grid cell). This could be perhaps due to the 4-hour definition, but the spatial patterns seem limited by the resolution. A more complete discussion of this result would be helpful.

3. Section 3.1: For the impact on changes in cyclone frequency (Figure 4), why were these specific grid cells selected? It does not seem to be consistent with the grid cells that show the greatest number or increase in ozone episodes (Figure 3a,b). Also, are the results in this figure for the full seasonal cycle? I would expect that this SLP effect would be more pronounced in the summer and this could account for differences between this and other studies.

4. Section 3.2: Paragraph 2 states that 50-60% of the ozone increase is due to isoprene emissions, and that the remainder is due to temperature effects. The sensitivity study with isoprene shows the amount of ozone that can be attributed to isoprene, but the other half is not clearly due to temperature effects. What about relative humidity effects, changes in photolysis rates due to cloud cover changes, height of the boundary layer? Some evidence and further discussion of this conclusion is necessary.

5. Section 3.2: Paragraph 5 concludes that the decrease in ozone lifetime is “primarily

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due to an increase in dry deposition rates." Yet there are seasons indicated in Table 2 (e.g., MAM) where the ozone lifetime decreases and the dry deposition rates are exactly the same. This indicates that the decreased lifetime is more complicated than the simple relationship to dry deposition. Could this be related to the increased wind speeds (Table 2) increasing net transport (Table 3) rather than dry deposition? A comment on how this relates to changes in cyclone frequency and stagnation events would also be an interesting discussion point.

6. Section 3.2: Figure 6 and the increase in the ozone season: Is there a spatial pattern to this increase? In the conclusions (section 4, paragraph 3) states that this is probably due to isoprene emissions in the US, yet there is no spatial information provided in Figure 6.

7. A comment about the coarse resolution of this study is necessary in the discussion or conclusions. Relating to the comment about the spatial pattern of ozone episodes in Figure 3 above, these conclusions are based on a relatively large scale chemistry simulation (4 degrees by 5 degrees), with one grid cell often covering one or more US states. This resolution could in effect dilute the signature of urban ozone episodes, leading to different results on the number, frequency and duration of ozone events.

Minor editorial comments

1. Abstract: reword line beginning "Increased chemical production and shorter average lifetime" - phrasing of "the former's magnitude for a location largely a function of surface ozone response" is awkward.

2. Table 1: a percent change to the mean would be helpful here.

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