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Discussions

Interactive comment on "The effects of global change upon United States air quality" *by* R. Gonzalez-Abraham et al.

Anonymous Referee #1

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This paper describes a climate model downscaling study to investigate the impact of future climate change (following the IPCC A1B scenario) on US air quality. The authors find that daily maximum 8 h average ozone (DM8O) will increase by 2-12 ppb in the US due to increased temperatures, enhanced biogenic emissions, and land use changes, which will overwhelm the reductions in DM8O that would have happened from reductions in US anthropogenic emissions in the absence of climate change. They also find that PM2.5 levels are expected to increase 2-4 μg m-3 in the Southeast US and nearby regions due to enhanced biogenic emissions and land use changes.

This is a well-written paper on a scientific question relevant to ACP. The methods are valid and clearly outlined, as are the modeling experiments performed. Substantial conclusions are reached that are generally supported by the model results. There

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are a few places where the discussion is confusing or not supported by the results presented, and the tables need some work, but overall I recommend publication after minor revisions to address by concerns below.

Minor Comments

P31844, L13-14: Since you mention evaluating the impacts of Asian emissions as a goal of the study, you should also include your findings on their impacts on O3 and PM2.5 in the abstract.

P31853, L8-11: You say MARKAL was used to get growth factors of NOx, SO2, and PM2.5, but then mention the use of CO2 factors as well. Should CO2 be on the initial list as well?

P31853, L10-11: I'm not sure that it is appropriate to use CO2 growth factors for CO, NH3, VOCs, HCl, and chlorine. I understand doing it in the absence of other data, but how realistic do you think it is that CO will increase proportionally with CO2 even with future control technologies being implemented to reduce NOx and SO2 emissions. This gives a 70% increase in CO and 20% increase in NMVOCs in the Midwest – how realistic is that? And how does this affect your results?

P31857, L12-16: You are really stretching the words "majority" and "most" here – the results in Figure 6 don't look all that great. The claim that PM2.5 meets the guidelines for 4 regions seems false to me –by my eye 5 of the PM2.5 results fall outside the weaker bias and error constraints. I would reword this section to be a little more accurate about the model performance.

P31860, L15-22: This paragraph confused me on my first read-through, as you discus the increases in isoprene, monoterpenes, and overall BVOCs all in the first sentence. I'd try to separate out this discussion, and add a total BVOCs bar to Figure 3 as well. It is also not clear when you say "biggest increase" if you mean biggest percentage increase or biggest absolute increase.

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P31861, L9-10: I think this sentence on monoterpenes belongs in the next paragraph. Also , you say "because of higher across the domain" – higher what?

P31863, L8-9: Cloud cover only increases in the Northwest and Central regions, correct? Can you make that clear here?

P31864, L1-6: I'd like to see more discussion here about how the emissions differ between this study and the previous ones and how the climate simulations differ. Some of this information is in section 2, but it would be nice to restate it here to make the discussion of the results clearer.

P31864, L11: Please be quantitative about the size of the decrease in DM8O you are discussing here.

P31864, L18: Please be quantitative about the size of the reduction in the VOC to NOx ratio and the depletion of DM8O you are discussing here.

P31864, L21: The reduction of BVOC emissions due to land use changes (discussed on P31861, L7-9) also plays a role here, right?

P31864, L28: Instead of saying "mostly" can you be quantitative?

P31865, L13-15: These two statements are not clearly supported by the results in Figure 12. In Figure 12f it looks like Asian emissions lead to a very slight increase in the southern half of the US and very slight increases in the northern half, with no reason to single out the western US as a homogenous group. The impact of climate change and biogenic emissions in Figure 12c seems to increase PM2.5 throughout the US rather than increases and decreases in different regions.

P31866, L1-2: I think you should explicitly state here that your results for sulfate are different than Avise et al. (2009).

P31866, L23: Why is there no discussion of aerosol ammonium here? The effect of the boundary conditions on ammonium is huge in Table 3 and should be addressed in

the text.

P31867, L1: Can you be quantitative instead of saying "insignificant"?

P31867, L19: I think you need to discuss the increases in SOA in the Northwest region here –SOA increased with increases in BVOCs, but sulfate decreased, in contrast to the other regions that had negligible changes in sulfate with increased BVOCs.

P31869, L24: The "positive influence (reduced concentrations)" phrasing is confusing, consider rewording this to make what you mean clear.

Section 4: You should be as quantitative as possible about the magnitudes of the impacts here, as you are in the abstract.

P31870, L3-5: Here I'd stick to the regions you defined in Figure 3 and avoid less specific phrases like "East regions" and "regions with high biogenic emissions."

Table 2: This is like Table 5 for PM2.5, but where is the equivalent of Table 3 for DM8O? I'd suggest adding a table with similar quantitate results for each region.

Tables 2-5: It's not clear in these tables what the scenario names in the column headings mean. Does "BVOC" include climate impacts, so that it is Scenario 2 minus Scenario 0, or does it only look at the impact of BVOCs on top of climate, and so is Scenario 2 minus Scenario 1? The same question applies for the land use changes, which aren't listed in Tables 2 and 5 but are listed in Tables 3 and 4 as BVOC future land use". Is this Scenario 4 minus Scenario 3, 2, 1, or 0? Please clarify this in footnotes in Table 2 and then use consistent definitions for all other tables.

Table 4: You have a row called "SOA" – does that mean these results are only for SOA and not primary organic carbon? Doesn't this contradict your caption? Are the POC results just missing?

Figure 3: Add a bar for the percentage change in total BVOCs in each region as well.

Figure 5: Add a legend to the box and whisker plot as in Figure 4.

Typos and Technical Corrections

P31856, L6: I think you mean Figure 11a, not the top of Figure 10. And I think this should be renumbered Figure 6, as it comes after you mention Figure 5 but before you mention Figure 6.

P31856, L14: I think you mean Figure 12a, not the top of Figure 11. And I think this should be renumbered Figure 7.

P31858, L21: "the result of" instead of "resulted of"

P31864, L11: "The decrease", not "this decrease"

P31865, L24: I think you mean Table 3, not Table 2. And shouldn't the Southeast region also be in this list?

P31867, L14-15: You can't say "in all regions" and then discuss an exception. Try "in nearly all regions" and "The lone exception."

P31868, L8: Just reference Figure 12c here, and then reference Figure 12d in L11 below.

P31868, L11: Shouldn't the Southeast region also be in this list?

P31869, L2: Remove comma after "monoterpene"

P31870, L28: "intended to", not "intended so"

P31871, L1: Typo, remove the "7".

P31871, L3: "take" not "takes"

P31871, L3: The semicolon should go before the word "and" not after.