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Atmospheric
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Discussions

Interactive comment on "Biogenic emissions and land-atmosphere interactions as drivers of the diurnal evolution of secondary organic aerosol in the southeastern US" *by* Juhi Nagori et al.

Anonymous Referee #1

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The paper by Nagori et al. summarizes results from a coupled land-atmosphere chemical modeling study to predict daytime SOA formation and evolution in SEUS. The model is constrained by observations of trace gases and organic aerosol measurements from different platforms (ground and airborne). SOA formation sensitivity to future temperature changes in the range of +/-2 degrees was also tested. Results indicate that daytime OH oxidation of monoterpenes and isoprene are the most important sources of SOA. Sensitivity runs show that future SOA formation is relatively insensitive to warming or cooling in the region (+/-2 degrees). There have been a lot of studies on SOA formation in SE-US. The unique aspect of this paper is in using a coupled-land/atmosphere chemistry model to consider daytime evolution of SOA. The

paper is overall well-written and figures/tables are good quality and clear.

Technical comments: My major concern is regarding the nighttime oxidation of monoterpenes. The paper as written is very confusing to know if NO3 chemistry of BVOCs at night was modeled or not. I understand that the reported diurnal profiles are from 6 am to 6 pm, but without a full simulation of nighttime chemistry, starting values of SOA at 6 am cannot be correct. I think the title needs to indicate specifically that the focus is the evolution of SOA during 'daytime'. Also, there was no indication of the chemistry of sesquiterpene VOCs. I think at least some discussion of why such VOCs were not considered should be provided. Please see below my other comments/concerns/questions. I would like to see the authors' response to my comments before the paper is accepted for publication.

P3, L5: nighttime SOA formation. Many of the papers that the authors cite have indicated a significant effect of NO3 chemistry on SOA formation in the region, so why does this study not include such chemistry? Contradicting to the sentence on P3, L5, on P6, L27 and 31 (also Table B2) authors indicate that NO3 oxidation of BVOCs were considered, so how can these two statements be both true? Does it mean spin up time includes nighttime chemistry so what you start at sunup includes such products? Related to this, on P16, L28: Why isn't NO3 oxidation to form SOA in the early morning hours significant in this study? It's not surprising that daytime contribution is almost zero, but early morning should be showing this contribution (according to other studies for the same region). P23, L8: Again, do you mean NO3 reactions were not included only during the day or not even at night?

P7, L6: It was mentioned long range transport wasn't modeled. If your model includes only local reactions/production of SOA, wouldn't you be able to estimate how much local production of MO-OOA there was if entrainment is set to zero?

P8, L6-7: since uptake coefficient of IEPOX depends on inorganic composition of SOA, how is that estimated? It seems that only OA is simulated in the model.

P9, section 3.4. Is there a direct input from the coupled land-surface mode to MEGAN to include the effects of modeled soil moisture variabilities on monoterpene emissions or is the soil moisture emission activity factor insensitive to the range of soil moisture changes in this environment?

P15, L6: it's mentioned that ISOPOOH SOA peak is not captured in the model, but no explanation is provided.

P18, L5: How is the entrainment curve in Fig. 8 determined?

P19, L2: Monoterpenes have a continuous source as long as there is light and warm temperature, so I don't think the statement in this sentence that most of monoterpenes have reacted in the morning makes sense. Please clarify.

P19, L16: I would clarify that OH is the most important daytime oxidant during for SOA formation.

P20, L5-12: looking at the diurnal pattern of LO-OOA, it actually appears that LO-OOA concentration decreases in early morning and then increases, suggesting that LO-OOA is locally produced. This trend is in contrast to the trend in MO-OOA, so doesn't this suggest that MO-OOA is actually more regional and present at higher conc. in the RL than the BL? This is mentioned in the conclusions, but not in this section. I think both of these trends are worth highlighting again here.

P21, L5: Does the impact of higher air temperature on soil moisture content and response of vegetation's BVOC emissions to changes in soil moisture content also represented in the climate sensitivity runs? If not, how would such results be different?

Editorial comments:

P2, L20: Another recent paper discussing importance of monoterpenes in SE-US by Xu et al. (ACP, 2018) should also be referenced. (Xu, L., Pye, H. O. T., He, J., Chen, Y., Murphy, B. N., and Ng, N. L.: Experimental and model estimates of the contributions from biogenic monoterpenes and sesquiterpenes to secondary organic

aerosol in the southeastern United States, Atmos. Chem. Phys., 18, 12613-12637, https://doi.org/10.5194/acp-18-12613-2018, 2018.)

P5, L6: add "...(model results) are shown..."

P5, L15: change "sides" to "sites"

P5, L25: remove one "been"

P7. Numbering for tables and figures seems not to be in the right order

P7, L26: "an early morning..."

P8, L17: I would remove "the" of "the emissions..."

P9, L9: consider changing "," to ";" or start a new sentence

P19, L30: "...leads to overestimated values compared to ..."

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