Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2021-141-RC2, 2021

Comment on acp-2021-141

Anonymous Referee #2

Referee comment on "Modelling the influence of biotic plant stress on atmospheric aerosol particle processes throughout a growing season" by Ditte Taipale et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-141-RC2, 2021

This manuscript provides an interesting new model study on the possible impact of stress induced BVOC on aerosol formation. They provide interesting case studies to illustrate the possible impacts of different stresses, including providing suggestions for the timing of infection dynamics, and impacts of stresses on LAI as well as emissions.

In reading the manuscript I find that my main concerns are very similar to those raised by Ref #1: that the authors overplay the need and possibility of including such SIE emissions into atmospheric models. Indeed, it was amusing to read on L288 that it is "unreasonable to assume that [oxidants] can be accurately predicted", but still the authors advocate adding another layer of hugely uncertain SIE algorithms to Earth System models.

This paper (and its predecessors) does make a strong case that SEI can be important in certain situations, but we are far from knowing how important that are in the real atmosphere. The great need is for new observations to constrain the role of such SEI in SOA formation, and for new ideas on how such emissions could be realistically included in 3-D models. What would it take for example to try to simulate gypsy-moth frequency on global or even European scales? Do we have any chance to tackling such issues in a robust way in the next 5-10 years?'

On the same theme, the authors seem to play down the possibility that SIE emissions are not that important. L467 does cite the work of Ylivinkka et al 2020 who did not find any significant sign of SIE being important for aerosols, but another important but uncited study is that of Berg et al (2013), which as well as providing one of the first 3-D modeling studies of SIE emissions, also suggests that the impacts of beetle-attacks on SOA are quite small in comparison to the impacts of wildfires. As far as I can see, the evidence is mixed, but this reinforces the need for observational studies to sort out the issues.

I must admit I also found the results section (p14-27) rather long and detailed considering

the large uncertainties and the simplicity of the (unexplained) modeling scheme used. Lots of details are given about growth rates, and comparison with literature values, but the assumption of prescribed oxidants makes these predictions very difficult to interpret. I think the authors need to bear in mind more strongly that they are presenting a very conceptual model, and not a real atmospheric simulation. I think their modeling is sufficient to make the case that SEI may be important, and deserve much closer attention, but I would try to be more concise, possibly by tabulate more of the results.

Despite these misgiving, this paper is suitable for ACP since it makes a new contribution to the existing literature on this interesting and potentially very important topic. It should be considered for publication after addressing the various issues raised by the referees.

Detailed comments:

L51, and elsewhere. I think it would read better if the authors used the terms "increased" rather than "induced" in many places. Here I would say that "emissions of other (induced) VOC are greatly increased" (I am not sure "greatly induced" is correct English anyway.). Actually, a small explanation of constitutive and induced VOC might help readers for which such terms are not obvious.

L61. The phrase "until now" suggests that the current paper is providing the "consistent mechanism" mentioned in this sentence. I don't think the authors mean that. Re-phrase.

L80-81. Add "over short periods at least"

L109- Add references for the statements made about these insects

L114 - define vast areas. More generally, what percentage of national forest cover do the authors think are affected by these stressors?

L134. What is "instar"?

L142. The caption is confusing with e.g. "(c). d-g, then on explanation of (d) on L143. I suggest omitting "a-c" and "d-g" bits.

L186. Give Institute for pers.comm.

L212. Why use 25C as the base, instead of 30C as used in most BVOC papers?

L212. Do you mean 1-sided or projected LAI, or something else?

L247. The symbol D is usually used in the BVOC literature for foliar biomass. Could another symbol be found for degree of stress?

L247 On: I found Table confusing in many respects. On L249 it is stated that for some species a factor 0.57 has been used, but on L250 others have been "upscaled", whatever that means. Emissions rates include per m2 terms, but are these m2 LAI or m2 ground-area? Clarify.

Table 1 in general is very hard to interpret, since so many equations and factors are used. It would be very helpful to add another column or two with some kind of standard or typical emission rate, so that one sees emissions factors in ug/m2/s at say 25C, LAI 2.5, 1000 umol/m2/s PPFD, and some degree of stress.

Figure 4. Why different styles (line versus scatter) for (a) and (b)?

L286 on, Sect 2.6. As noted by Ref #1, there is no information given on the type of model used. As BLH is used as a parameter, we can guess that it is a box model, but it is remarkable to omit both a description of the model, and any information on whether the model used has any abilities to reproduce SOA formation at all.

L329 and generally. The only oxidants considered are ozone and OH. The NO3 radical is known to be an important oxidant for SOA formation; why is this not considered?

Additional reference:

Berg, A. R., Heald, C. L., Hartz, K. E. H., Hallar, A. G., Meddens, A. J. H., Hicke, J. A., Lamarque, J. F., and Tilmes, S.: The impact of bark beetle infestations on monoterpene emissions and secondary organic aerosol formation in western North America, Atmos. Chem. Phys., 13, 3149–3161, doi:10.5194/acp-13-3149-2013, 2013.