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Interactive comment on “Secondary aerosol formation from stress-induced biogenic emissions and possible climate feedbacks” by Th. F. Mentel et al.

Anonymous Referee #2

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Mentel et al. present laboratory data of the impact of biotic and abiotic (heat/drought) stress on the potential for SOA formation from select boreal tree species. The authors show that emissions of monoterpenes, sesquiterpenes, C17-VOCs and other VOCs change in response to stress, and that these VOC emissions are reflected in changes to SOA formation. The authors extrapolate these data to consider potential climate feedback effects. Overall, this paper is very clear, and presents new and exciting data. The experiments are simple, but their caveats and limitations are generally presented well. The manuscript is relevant and should be published in ACP. That said, this reviewer has several qualms about the extrapolation to climate feedbacks, and definitely

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feels that some comments regarding climate feedbacks (Figure 9 and associated discussion) are overstated considering the dataset. I think this section should be shortened and de-emphasized. My reasons for feeling that section 4.2 and Figure 9 are potentially overstatements are:

(1) The limited number of plants and replicate experiments (typically no replicates of experiments, as far as I can understand) hinder the ability to extrapolate from this dataset to climate-relevant questions. That is not to say that the experiments are not useful - it is to say that I feel that they are potentially over-interpreted. The experiments represent one set of 3-4 trees under laboratory conditions. Before taking these experiments to global interpretation of stress effects on SOA in the boreal regions, I think that substantially more replicates using multiple trees and multiple experiments would need to be done. The experiments themselves show temporal variability, and do not provide any indication of plant-to-plant variability in response. There may be some literature to help address this question of variability between plants (within a single species) - that is, does every plant of the same species respond to stress in the same way? Regarding temporal variability, Figure 1a shows the variation in VOC emissions from the initial set of three trees over five days. The variation is not insignificant - it is potentially on the order of 30%. The total VOC input to the reaction chamber varies from 120 $\mu\text{g}/\text{m}^3$ to 180 $\mu\text{g}/\text{m}^3$ across the five days.

(2) Details on insect infestation used to exemplify 'biotic stress'. I am uncertain as to whether the authors are suggesting that the insect infestation that is used as the single data point for extrapolation of 'biotic stress' in Figure 9 is really representative of all 'biotic stress' - or at least insect infestation - in the environment. Was the aphid infestation mild or severe? Does the literature suggest differences in plant response between mild and severe infestation? Do different insects result in different VOC emissions? Are there other 'biotic stresses' that might cause very different VOC emissions, such as disease? I expect that these experiments do not exemplify all 'biotic stress', or even all insect infestation effects on these plants. Thus I think that Figure 9 is an overstate-

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ment of the impacts of biotic stress. Again, I don't think that these questions make the manuscript any less useful, but I do think that they demonstrate the limitations of the paper, and place heavy caveats on any comments regarding climate feedbacks. In particular, the feedbacks of 'biotic stress' - which is a very general term - are not warranted by the dataset described in the paper.

(3) The authors acknowledge that their interpretation of the data in terms of climate feedbacks ignores many important factors (anthropogenic impacts, shifts in OH, shifts in NO_x). This reviewer feels that those factors are indeed very important - and should not necessarily be ignored. By ignoring the potentially complicating factors, the reader is left with little or no context for understanding the potential importance of these feedback effects. For example, some of the stress impacts are associated with a very short timescale: are these truly relevant on climate-relevant timescales? Perhaps, but I think there is not enough data to evaluate that effect in this paper. Overall, I do not believe that the feedbacks are constrained well enough to warrant the lengthy discussion in this manuscript.

Overall, this manuscript is strong and requires few revisions. The experiments are well described, and the tables and figures (except Figure 9) are constructive. However, I feel that Figure 9 and the Discussion in section 4.2 of climate change impacts should be scaled back according to my reasoning outlined above.

Technical comments. p7466, line 19. Incomplete sentence fragment, ends with "to what extent." p7466, line 21. rewrite to read "...exposed to biotic, heat and drought stress in order to...". p7467, line 24. should read "We allowed 8 h ..." p7472, line 7. should read "...is used as a..." p7478, line 26. Replace 'coherently' with 'consequently' p7479, line 23, delete "In few examples" p7480, line 13. delete "nota bene"

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7463, 2013.

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