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Interactive comment on "Terpenoid emissions from fully grown East Siberian *Larix cajanderi* trees" *by* M. K. Kajos et al.

Anonymous Referee #1

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General comments

Kajos et al. measured emission rates of biogenic volatile organic compounds (BVOC) from shoots of two mature larch trees in three campaigns during summer 2009. In contrast to many other studies on boreal forest species, Kajos et al. for the first time investigated emissions from Larix cajanderi in their natural habitat near Yakutsk in Eastern Siberia. As the Arctic warms, BVOC emissions in the Arctic will likely increase and this could have important feedbacks with the climate. Monoterpenes accounted for the vast majority of emissions from Larix cajanderi, with Δ3-carene being the most important. Emission potential and reaction rate constants for oxidation with ozone and hydroxyl radicals were calculated. Concentrations of hydroxyl radicals and ozone were derived from previous studies in Finland. The results were compared to other boreal

tree species.

This study addresses existing information gaps on Arctic and Subarctic BVOC emissions. Also, among all the studies on Boreal emissions, Siberia remains underrepresented. The study therefore contributes to eliminate white spots on the map. It demonstrates that a lot more information is needed to improve emission models for the boreal forest.

Overall, the manuscript is comprehensibly written but appears to be based on only a very small dataset. The authors should more clearly explain if their presented data are representative and if they recommend their use in BVOC model development for Siberian forests. The boundary layer VOC oxidation calculations should be based on ambient concentrations/flux measurements. The scale up procedure from measurements of just a few leaves to the canopy likely has very large errors which should be discussed. In the methods part, all the equations are carefully deduced and explained. My specific comments are mostly focused on detail information for general understanding and less on chosen methods, since these concerns largely have been addressed by reviewer #2.

Specific comments Do you really need the sorbent material used in the abstract?

l-106: you are not avoiding stress BVOCs by simply waiting one day before measurments. Perhaps you should say to minimize stress-induced BVOCs. . ..

The authors should remember that the total BVOC emissions is likely much greater and include compound not easily measured including oxygenated VOCs, aromatics, and fatty acid oxidation products. Thus, the use of relative emission rates is useful, but the absolute emission rates should be included, especially in the abstract.

1-4638, line 1: "Volatile compounds"

Since only BVOCs are measured in this study, the term "biogenic volatile organic compounds" should be used instead

2-4638, lines 5-6: "In this study the shoot scale terpenoid emission rates from mature Larix cajanderi trees growing in their natural habitat in Eastern Siberia were measured."

It should be specified how many trees have been sampled, where exactly, and how long. At least the station name and maybe coordinates and the location close to the Lena river should be mentioned. Also, the number and time of campaigns and the year should be indicated, since in line 12 it is referred to the campaign in June. This would help a lot to assess the scope of this study. In comment #1, reviewer #2 is concerned about the representative character of this study for modeling. The authors do not appear claim that they provide representative data for this purpose, as pointed out in the conclusion. If this is the case, it would limit the impact this paper will have on BVOC model improvements from Siberian forests. It would help to clarify this from the beginning, to avoid any misconceptions about transferability of the results.

3-4638, lines 11-12: "Linalool emissions were also substantial, especially in June."

Please give the exact values here

4-4639, lines 2-3: "growing the initially formed nanoparticles to climatically relevant particle sizes"

Could you give one example of how these particles are climatically relevant? It would help to show the general importance of these measurements.

5-4641, lines 8-9: "two fully sunlit shoots of two diïňĂerent trees"

Could you give more detail about the two trees? Why were they chosen, how old are they, how tall are they, how big are the measured shoots? I ask that because the trees are denoted as "mature" in the introduction, and on page 4646, lines 21-25, emissions are compared to a "young, 5-yr-old L.sibirica".

6-4641, line 10: "Teflon chamber"

What is the volume of the chambers?

C1777

7-4642, lines 4-5: "After each of the measurement campaigns, the measured shoots were cut"

Did you somehow monitor the effects of cutting on VOC emission? Since cutting itself is a stress factor, how did you make sure that cutting shoots after the first campaign hat no influence on the later campaigns?

8-4645, lines 9-11: "Hydroxyl radical and ozone concentrations were not measured at the site, therefore typical daytime concentrations in boreal forest environment need to be used for estimating the patterns of above-canopy concentrations of VOCs"

The values that have been used here as well as the studies they originate from are mentioned on 4652, lines 1-3. I think it should be mentioned here instead. And could you point out in what way are these values are typical for the entire boreal zone? Could you underpin this statement with a reference?

9-4647, lines 25-26: "A few other sesquiterpenes were also detected, but due to the lack of suitable laboratory standards these could not be identiïňĄed"

What was their contribution to total sesquiterpene emission? This should be included in the pie charts in fig.4 or at least mentioned here.

10-4649, lines 7-8: "It is possible that the diïňĂerence in the observed emission rates reïňĆects within-species variation of L. cajanderi"

Is this a speculation or could you add a reference here to support this hypothesis?

11-4651, lines 18-19: "In order to assess the role of VOC emissions in the atmospheric chemistry and SOA formation"

Throughout section 3.4, results for above-canopy concentrations are shown and discussed, but there is no actual assessment of their role in the atmosphere or even formation of SOA. I suggest to either outline the linkage between discuss it in more detail and ouor to move it entirely to the introduction

C1778

12-4652, lines 23-28:

This is a summary of a study on Scots pine. Could you discuss how the findings of this study are related to that of Larix cajanderi?

13-4653, lines 2-3: "Also linalool emissions were substantial, especially in June."

As in comment #3 for the introduction, please repeat the value, since you refer again to linalool emission in lines 12-13.

14-4653, lines 12-13: "its contribution to air chemistry and SOA formation was most significant"

Reviewer #2 already made reservations about the use of the term "significant" in comment #12. I agree with that and suggest to include necessary statistics to valide this statement or soften this conclusion.

15-4654, lines 2-4: "except for the highest emission potential values of the tree B . . . with the exception of L.sibirica"

I suggest to rephrase this sentence to unnecessary confusion.

16-4654, lines 15-16: "As a result, this would increase the derived SOA and regional radiative forcing due to SOA"

Why is this brought up here and not already in the discussion? This should be explained in more detail earlier.