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Atmospheric Chemistry and Physics Discussions

Interactive comment on "In situ measurements of volatile organic compounds in a boreal forest" *by* H. Hakola et al.

H. Hakola et al.

hannele.hakola@fmi.fi

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We thank the anonymous referee 2 for valuable comments that increased the quality of the manuscript. We have answered to the specific comments below.

1. The weeks for the measurements were chosen randomly as they best fitted to the other work. This has been added to the manuscript.

2. For enantiomeric studies we selected α-pinene, camphene and limonene, because they were the only ones available to us. This has been added to the manuscript.

3. The observed winter episodes when monoterpenes suddenly increased simultaneously with NOX concentrations were excluded from the dataset. Other forest activities therefore cannot be detected so clearly and could not be excluded.

4. Budbreaks have been shown to increase emissions a lot, but since the biomass of the buds is quite small compared to the needle biomass, their effect cannot be clearly seen in the ambient air samples.

5. Standard deviations have been added to the diurnal curves and also to the monthly mean mixing ratios of aromatics and monoterpenes.

6. Concentrations are changed to mixing ratios when ppt units are used.

7. The forest where the measurements were conducted was the same where Bäck et al made their study. However, the different genotypes are so evenly distributed in the forest that it is not possible to find any specific genotype sectors.

8. Tampere is located to the south-west of the site. This is mentioned in chapter 2.1

9. The atmospheric chemistry will indeed affect the concentrations of very reactive compounds inside the forest and small openings. A detailed trajectory model for transport inside the specific forest canopy is not available but we can estimate the transport time by assuming that the horizontal speed inside the canopy in in the order of 0.5 m/s and the distance to the nearest trees about 4 m. This giver us a transport time of 8 s. Thus even the concentration of a highly reactive compound (e.g. b-caryophyllene, lifetime 90-110 s, Rinne et al., 2012) is not much altered by chemistry while being transported from nearest tree to the sampling inlet. The chemistry may partly explain the abundance of longifolene relative to b-caryophyllene as the first mentioned is significantly less reactive than the latter. A detailed modeling of below-canopy transport and chemistry is beyond the scope of this paper.

10. It would be really nice if we had simultaneous emission measurements, but unfortunately we only had one on-line GC-MS at that time and no parallel measurements could not conducted. This would really give more information about the loss processes.

11. In mid-winter the emission of monoterpenes is at its minimum. However, most monoterpenes react significantly also with ozone and thus the chemical sink even in

winter is significant. In spring (diurnal cycles in Figure 7) the monoterpene emissions are already increasing and also there is enough solar radiation to cause mixing in the boundary layer. Thus our interpretation of the Figure 6 is that the diurnal cycle is caused by the diurnal cycle in the mixing overwhelming the similar cycle in emission. Also chemistry may play some role, but as ozone is a major sink for monoterpenes the chemical sink exists also at night.

12. We are sorry, but the boundary layer heights are not available.

13. The distance to the city of Tampere is 50 km. with a typical wind speed of 5 m/s we get a transport time longer than 2.5 hours. Typical summertime daytime life time of e.g. a-pinene is just two hours, meaning that over 60 % of the a-pinene released into the air volume has been oxidized before the air mass reaches Hyytiälä. Estimate of the traffic emission of monoterpenes from Tampere area is much harder to obtain, and in order to estimate the contribution of emissions from Tampere one should also take into account the dispersion of the plume, which goes beyond the scope of this manuscript.

14. There was no change in ozone concentrations in June 22 and in September they were lower than in spring and early summer. However, monoterpene emission pattern of Scots pine changes and limonene standard emission potential is stronger during spring than in June (Tarvainen et al., 2005).

15. Our enantiomer samples were always taken at about midday, when light conditions did not change much and can have caused only little variability in the enantiomeric distribution.

16. The sampling location has been checked and corrected.

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