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Atmospheric Chemistry and Physics Discussions

Interactive comment on "VOC measurements within a boreal forest during spring 2005: the role of monoterpenes and sulphuric acid in selected intense nucleation events" *by* G. Eerdekens et al.

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We are very grateful for the astute comments and suggestions of the reviewer. We believe we have addressed all of the issues raised in the revised version. The detailed responses to the reviewer's comments are given below.

General comments

1) We agree with the reviewer's comment that Event 2 probably is not an in-situ nucleation event, rather particles advected to the measurement site from a nucleation event upwind. Hence to avoid any confusion, we have changed the wording in the title (and text) to read by "during night time intense particle concentration events" in our running

title and throughout the text.

2) We agree with the reviewer and have moved the analysis of the enantiomeric ratio to the result section for Event 2. It′s importance is now discussed under "discussion and conclusions".

Specific comments

1. All graphs have been simplified as suggested and the labelling on each graph has been improved for greater clarity.

2. Figure 2 has been reorganised to improve the readability and completeness. The gaps in the data were due to a failure in the data logging system, which is now stated in the text. The height of the dew point measurement was 23 m and this information has been added to the legend of figure 2.

3. Figure 3 has been stretched horizontally to increase the readability. The marker used for the monoterpenes in Figure 3 has been changed such that the variation in the mixing ratios is easier to see, particularly diel variations. As now noted in the text, those compounds with a clear diel variation are shown in figure 6 in box & whisker plots. Events 1 & 2 have also been marked in Figure 3. A small typo has been uncovered in the text concerning profile times, following the reviewer′s question. At a rate of about 50 seconds per measurement cycle and 40 measurement cycles per level, the measurement interval on each level was $\sim$30 minutes each, rather than 20 minutes. The text now reads: "At a rate of approximately 50 seconds per measurement cycle and 40 measurement cycles per level, the PTRMS sampling interval per level was $\sim$30 minutes from April 17 to April 24. The PTR-MS sequentially monitored at all the aforementioned measuring heights, whereas the TD-GCMS and NMHC systems sampled from 8.2 m. From 24 April to 29 April all 3 instruments sampled from the 8.2 m level only."

4. As suggested, the discussion on the ratio of acetone to methanol has been omitted

as the level of biomass burning was low.

5. The reviewer is correct that Event 2 is not an in-situ monitored nucleation event like Event 1. To avoid any confusion we have decided to amend the title by replacing the "intense nucleation events" by "intense particle concentration events". We keep the term "intense" as both kinds of events are important to aerosol burden in the area. Moreover, we agree with the reviewer that Event 2 might represent a situation of sequential advection of air masses heavily loaded with particles of all sizes interrupted with short moments of cleaner air. However, the overall agreement with the laboratory studies on the ozonolysis of monoterpenes by Bonn and Moortgat, (2002) is convincing enough to say that Event 2 and similar occasions with peaks in aerosols and monoterpenes on the nights before, are not ordinary.

6. The reviewer is right to believe that the box & whisker plots have been obtained by grouping the daytime and night time data for each level. Daytime and night time exclude the hours around sunrise and sunset. It should be noted that the meteorological conditions as well as the origin of the encountered airmasses during which the vertical profile were taken was very similar. As requested we now present the vertical profile of a VOC after normalisation to its daily average mixing ratio. Normalisation to the average value for the period over which that vertical profile was done resulted in very similar normalised profiles.

7. As the ratio of methanol to acetone is no longer discussed, it also has been removed from Figure 7.

8. Methane has been removed from Figure 8 and is only briefly mentioned in the text.

9. The text includes now a more complete discussion on wind speed and wind direction.

10. The relative humidity is now shown for Event 1 in connection with solar radiation, H2SO4 and the particle concentration. The reason for selecting the absolute humidity over the relative humidity was the higher time resolution and fewer data gaps for Event

2. We note that only a small decrease in RH from $\sim$56 % to $\sim$43 % occurred during Event 1 suggesting that water vapour was of minor importance. In contrast, the absolute humidity showed substantial changes at the moment of change in the growth rate of the aerosol particles. In other words, the relative humidity hardly showed a difference at the moment when there was a change in the growth mechanism of the aerosol particles in contrast to what the absolute humidity.

11. The difference in the ozone concentrations for more polluted to non-polluted airmasses measured during spring 2005 was about 60 ppbv to 25 ppbv respectively. This sentence has now been added to the text for clarity.

12. The reviewer is right that the link between observed increasing SO2 mixing ratios prior to Event 1 and the city of Jyväskylä is rather weak. Much stronger increases in the SO2 mixing ratios have been observed e.g. right after Event 2 which was not followed by a nucleation event during daylight. Following the reviewers advice on this point we now simply state "the city of Jyväskylä may be the SO2 source in the case of continuous transport of air masses from the NE sector.

13. The SMEAR II data logging system has had some failures during this campaign. We have been unsuccessful in recovering the data from SMEARII system. All figures now show discontinuous lines to clarify gaps in the data. Furthermore we add the explanatory sentence. "Gaps in the data were caused by occasional data logging failures."

14. The relative humidity is now shown and discussed in the text for both events.

15. As mentioned before, we now make use of the term intense particle concentration event.

16. We agree with the reviewer that the data speak for themselves regarding the implication of the sawmill. The description/discussion of this plot has been shortened accordingly. The term footprint has been avoided as suggested.

17. See issue 6 of these specific comments.

18. We have now moved the paragraph on the change in the enantiomeric ratio of alpha-pinene during new particle formation to the results section for Event 2. Note that the PTR-MS and GC-MS unfortunately have not both covered the entire period during which the most intense peaks occurred due to periodic system calibrations. We were careful to have at least one monoterpene in measurement mode at all times but unfortunately one event occurred during the calibration of one system. There have indeed been several burst over several nights and they all occurred in airmasses that stayed close to the ground (less than a few hundred metres) transported from the direction of the saw mill. This sentence is now added to the text as it strengthens the arguments as noted by the reviewer.

19. We agree with the reviewer that the final sentence is too strong, and the evidence presented does not support the sawmill industry influencing the boreal forest in a general sense. However, we do make the point that we have shown that a sawmill in the vicinity of a boreal forest measurement has the potential to influence VOCs and particles measured there.

Technical corrections

1. Both events are now marked in Figure 3

2. A legend has now been added in Figure 4 indicating that the “error bars” are part of the 5-95p box & whiskers.

3. Figure 5 has now been restyled to take away the confusion

4. The word “and” has been replaced by the word “until”

5. A missing r has been added to the word close and reads now: “According to the NOAA Hysplit model, the airmass stayed closer to the surface in the two days before arrival than on the days before.”

6. Figure 7 no longer contains the ratio of [acetone]/[methanol]

7. A title has been added to the legend of both figures.

8. The monoterpene measurement height was 8m above the forest floor which has now been indicated in the graph’s caption.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 12781, 2009.