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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Formation and characteristics of ions and charged aerosol particles in a native Australian Eucalypt forest" *by* T. Suni et al.

T. Suni et al.

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Referee #1

Specific comments:

1. We have clarified the classification method as suggested by the referee, paying special attention to the nocturnal events. We also added a figure describing non-event and unclear days and changed the nocturnal event figure so that it illustrates the whole night starting from 10 am and ending at 10 am the next day. The referee also asked how we explain that nocturnal formation was the major mechanism of aerosol formation in Tumbarumba if this phenomenon has not been observed anywhere else in the world. We cannot answer this question yet as a detailed analysis of this phenomenon

is beyond the scope of this paper. After publication in ACPD, we learned that something similar has been seen in Abisko, northern Sweden, and we will be collaborating with the researchers there to write a new paper about nocturnal aerosol formation.

2. We added an explanation as to why we grouped non-events and unclear days together in the analysis of the effect of meteorological variables on aerosol formation: unlike in Hyytiälä, where the numbers of event and non-event days are roughly the same, in Tumbarumba we only had 21 non-events against 148 normal events. Statistically, it makes no sense to compare such groups. Furthermore, since an unclear day is as frequent (145) as a normal event, considering them in this sort of an analysis is justified. As recommended by the referee, we added error bars in the corresponding figure (Fig. 4 in the revised MS) and denoted statistically significant differences with an asterisk.

3. We added a map of the station location as suggested by the referee (Fig. 1 in the revised MS). However, we feel wind roses would make comparing the GR vs. wind direction and seasons more difficult. Furthermore, it would be very difficult to include both negative and positive ion results (black and white bars in current Figs. 5 & 6) in a wind rose. The result would be too cluttered.

4. Because there usually is a statistically significant difference in growth rates among different sizes of particles (1.5 - 3, 3 - 7, and 7 - 20 nm, see e.g. Table 2 in this MS), we feel comparing growth rates obtained from DMPS or SMPS measurements (3 - 25 nm) is indeed difficult.

5. The referee is right in pointing out that we should not base our conclusion of radon as the source of high cluster ion concentrations on evidence this weak although radon is the only ground-based source known to have a role in producing cluster ions and its concentrations were undeniably high in Tumbarumba. Therefore, we weakened our statement accordingly. Furthermore, the referee asked whether it is absolutely certain that such high cluster ion concentrations have not been observed anywhere else. In

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fact, after the publication of this MS in ACPD, we learned of similar high concentrations in Abisko, northern Sweden. Those results have not been published yet, and we are proceeding to collaborate with the researchers there to organise measurement of radon. However, the high cluster concentrations are likely to be related to nocturnal formation because Abisko also features quite strong nocturnal formation resembling what we have observed in Tumbarumba. As stated earlier, we will pursue this and aim at a new MS about nocturnal formation with the Abisko group.

6. We left out the unnecessary references to soil and profile measurements in Site description.

Technical corrections:

- In Introduction, we pointed out which references report significant and negligible effect of ions in aerosol formation.

- We corrected Morawska et al. 2007 -> Thomas et al. 2007 and SE -> South East.

- Grammatically, new-particle formation must have the hyphen because the phrase "new particle" is an attribute to the term "formation". Otherwise, the unfamiliar reader may mistake the phrase as "new" "particle formation"

- We added x-axis title to Fig. 2 (Fig. 3 in current version of MS) and unified the way we refer to months in the figures.

- We believe Fig. 6 (Fig. 7 in the current, revised MS) should stay as one entity so the reader can easily compare the behaviour of ions of different sizes in day and night time.

- We added a map of the measurement site (Fig. 1 in current version).

Referee #2

1. The journal does not allow referring to personal communication or work in progress in any other way than this, a footnote.

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2. We have not looked at CPC data carefully in terms of the nocturnal events because we are going to write a separate paper about them later. Furthermore, during the strongest nocturnal formation (February to April), CPC data was available only for March. A brief look at the data shows that the CPC did not usually see the nocturnal particles no matter how high the concentrations. Because the AIS was located on the ground and the CPC at the height of 70 m, this suggests that the nocturnal ions are indeed formed near the ground, probably because of radon efflux from the soil. The SMPS we borrowed for May-June 2006 had a cut-off size of 15 nm and the CPC about 14 nm, and it did confirm these events. However, it was located on ground level next to the AIS and its inlet was about 1 cm away from the AIS's inlet.

3. There are two manuscripts in preparation/being submitted (Junninen et al., Lee et al.) that I am aware of in addition to the new Abisko findings I describe above that deal with nocturnal formation. In both of them, nocturnal formation has been observed but to a much lesser degree than in our findings. However, since people usually focus on daytime formation, we cannot say with certainty that strong nocturnal formation has not been observed somewhere else, too. We agree with the referee about the importance of our finding, but because careful analysis would be beyond the scope of this MS, we only report the phenomenon here briefly and will write a new MS about it in the near future.

4. We agree that some more statistical analysis would improve the MS and have added it now.

5. We added statistical analysis to the comparison of growth rates as well.

6. We clarified the discussion about growth rates as recommended by the referee.

7. The referee asked about the seasonal pattern of sulphuric acid in comparison to that of organic vapours. The precursors of sulphuric acid are largely anthropogenic and, therefore, the seasonal pattern is likely to be less pronounced than that of biogenic terpenes.

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8. The results about seasonal and wind-direction dependencies of particle formation rates changed because of the recommended statistical analysis, and the discrepancy between these patterns for large ions vanished. The section is now updated accordingly.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 10343, 2007.