Atmos. Chem. Phys. Discuss., 6, S1041–S1046, 2006
www.atmos-chem-phys-discuss.net/6/S1041/2006/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Factors of air ion balance in a coniferous forest according to measurements in Hyytiälä, Finland" *by* H. Tammet et al.

Anonymous Referee #1

Received and published: 31 May 2006

General Comments

The manuscript describes the theoretical treatment of the air ion balance in a coniferous forest treating explicitly the loss processes of ions on the needles of the trees besides losses due to uptake on aerosol particles and ion-ion recombination. The model is used to analyze measurements done with two Balanced Scanning air ion Mobility Analyzers (BSMA) at 2 m and 14 m (tree tops) above ground. The ionisation rates and ion average lifetimes are calculated and the relative importance of the sink terms is determined. Differences in the measurements at 2 and 14 m are discussed. Discrepancies in the determination of ionization rates derived from earlier measurements and model calculations are reduced with the present model.

In general it is an interesting paper and the described study of the air ion balance and the ionisation rate with height in a forest is important to improve the limited understanding of atmospheric ion processes near ground and atmospheric ion-aerosol interaction.

A major weakness of the paper is the very short time interval of measurements. Only one night of measurement of 16.5 hours is presented. Out of these 16.5 hours 3.5 hours are classified as "disturbed" and the data is not discussed. Why were the measurements not repeated or continued? It would add a lot of credibility if more data were collected. It cannot be judged in how far instrumental problems may have influenced also the other time periods. A measurement period of more than a week would usually be expected as a minimum requirement for such ground based measurements. This is especially important because the BSMA is not a widely used, well described and characterized instrument. It would be interesting to see in how far the measurements vary with time and in how far the presented measurements are typical. Potential instrumental problems could also have been identified in a longer or repeated measurement. It should also be discussed in how far not only the vertical difference of 12 m is responsible for the different results at the two sites, but also the horizontal difference of 50 m may explain at least part of the observed differences (local inhomogeneities of radon sources and beta radiation from ground etc.). Test measurements should also be performed at the tower at 2 m height. As the authors state at the very end of the paper, "the presented results are based on short-term measurements and are not verified with simultaneous measurements using different methods. Thus the conclusions have a provisional character...." Therefore the most interesting conclusions remain speculative.

A comprehensive description and characterization of the BSMA should be given because the cited reference (Tammet, 2004) is not easily accessible.

The choice of the rough estimate for the needle density of 100 m-2 (p3150, l 14) for both sites seems arbitrary. In how far does this choice influence the derived results? In how far do the conclusions, e.g. regarding the differences in ionzation rate with height

ACPD

6, S1041–S1046, 2006

depend on this choice? In how far would an assumption of e.g. 180 m-2 at 14 m height and of 50 m-2 at 2 m height change the essential conclusions?

The presentation quality needs to be improved. Numerous corrections are necessary especially concerning the use of articles. Various sentences need rewording. Please consider to consult a native speaker. A list of sentences and phrases to be corrected or reworded is given below.

In general the paper is suitable for publication in ACP but it suffers from the limited amount of measurement data. The credibility of the statements and the usefulness of the model approach would be increased greatly if longer measurement periods were presented and discussed.

List of technical corrections:

The whole abstract should be revised to improve English language style and readability.

p 3137, l 14: ...for the ten-year period...

", l 19: ...substances contained in the ground.

p 3139, l 6: applying a simplified model...

", l 7: effect of the atmospheric electric field

", l 14: The atmospheric electric field undergoes strong variations...

p 3140, l 9: In eqs. (1) and (2) the properties of negative cluster ions are regarded as being different from the properties of positive cluster ions in a similar way as...

p 3141, l 19: The diffusion coefficient... to the Einstein equation...

p 3142, l 6: ...which greatly simplifies the analysis...

p 3143, l 6: ...accumulation mode... errors of about a few percent...

", l 9: Table 1.

ACPD

6, S1041–S1046, 2006

EGU

", l 9: "used below in the present study", please reword.

", l 21: ...dry deposition of particles in coniferous forest..."

p 3146, l 6: ...depends via the Schmidt number...

p 3148, l 15: "This follows in the high values of cluster ion concentrations typically 500-800 (...), which about twice....", please reword.

p 3149, l 14: ... is estimated to be about 5 %...

", l 18: The main experiment was performed from 17:30, 17 August, until 10:00, 18 August, lasting 16.5 hours.

", l 28: "It follows the full height...", please reword this sentence.

p 3150, l 11: origin on the basis of...

", l 12: using a rough estimate of the value...

", l 15: are presented as average values over 10-min time intervals.

", l 18: values of the following meteorological parameters

p 3151, l 14: in the size range

", l 19: above a few hundred nanometers.

", l 21: ...was determined mainly by the particles, which sizes are in a relatively ..., please reword

", l 25: ...is caused by particles with sizes larger than 1000 nm which are not recorded by the SMPS.

p 3152, l 2: using an Aerodynamic...

", l 11: explained in the following...

", l 20: are caused by instrumental problems.

ACPD
6, S1041–S1046, 2006

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p 3153, l 8: "...is evaluated low and the neglecting of it...", please reword.

", l 17-l 21: please reword this paragraph.

p 3154, l 5: is included in two ways:

", l 6: allows to estimate the effect

p 3155, l 26: "...numerical experiment, which results are...", please reword.

p 3156, l 1-l 4: "It follows ...." please reword paragraph.

", l 6: ...is the discovery of an essential...

", l 22: "and its role ... is little known". please reword.

p 5157, l 13: Possible factors that explain the higher ionisation rate at the height of 2 m ... are assumed to be:

p 3158, l 3: ...role of the different factors...

", l 6: according

p 3159, l 4: ...on average...

p 3159, l 8: The parameters describing positive and negative ions are assumed to be different.

", l 15: ...are limited to periods without....

", l 16: ... because of its small effect which is proven by nearly identical values of the...

", l 20: please reword sentence.

", l 25: ...appears to be fairly large...is about half of its typical value.

", l 27: ... inside the Scots pine forest...

p 3160, l 10: are the neglect of... and the underestimation of...

ACPD

6, S1041–S1046, 2006

p 3160, l 26: ... of the air and its fraction carried by particles.

Reference Laakso et al., 2004b, there is no reference 2004a; please correct

p 3167, caption Table 2: ... during four time intervals and...

p 3173, caption Fig 2: ... are delimited with bold vertical lines.

Table 3 is called for the first time on p 3151, without proper explanation, then Table 2 is called on p 3153, then Table 3 is called again on p 3154, now with explanation. Please rearrange properly.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 3135, 2006.