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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ion production rate in a boreal forest based on ion, particle and radiation measurements" *by* L. Laakso et al.

Anonymous Referee #1

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This paper presents interesting results on measurements of the ion production rate in a boreal forest. This work is important for understanding the role of ion-induced nucleation (IIN) in forests. The authors compare ionization rates derived from measurements of cluster ion and particle concentrations and measurements of radiation and radon. This work is suitable for publication in ACP. Some specific comments that should be considered prior to publication:

1. p. 3955, eqn (1). It is not clear from the text and symbols if equation (1) specifically includes the recombination of small cluster ions with charged aerosol. If not this could lead to an underestimation of the cluster ion loss since the rate coefficients for cluster ion plus oppositely charged aerosol are significantly larger than those for cluster ion plus neutral aerosol.

2. p. 3955, eqn (2). Equation (2) applies "in case of charge equilibrium". Is this valid for all conditions, e.g. during nucleation? Some remarks regarding the validity of this assumption would be useful.

3. p. 3959, line 20. Presumably the mechanism of IIN is ion cluster growth followed by recombination to make new stable neutral particles that grow spontaneously. What is the specific mechanism for "the additional sink of small ions"? Are the authors referring to enhanced ion-ion recombination during nucleation? This would require an increase in the concentration of ions during nucleation, which seems unlikely. Note that this comment is also relevant to statements on p. 3948 line 14 (abstract), p. 3955 line 11 and on p. 3962 line 11 (conclusion).

4. The consistent lower ion production rates derived from analysis of the cluster ion and particle concentrations are interesting. It may be very valuable to look more carefully over the whole measurement period at possible correlations between the discrepancy (the difference between the ion production rates derived from the two methods) and e.g. the concentration of 3 nm particles (a measure of nucleation), surface area, radon, temperature, rh, etc. This may help to reduce the number of possible explanations for the discrepancy.

5. What are the estimated uncertainties in the derived ionization rates? Are the differences between the two methods significant?

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Interactive Comment