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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud condensation nuclei production associated with atmospheric nucleation: a synthesis based on existing literature and new results" *by* V.-M. Kerminen et al.

Anonymous Referee #2

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This paper presents a review of field and modelling studies of CCN production from atmospheric new particle formation events. NPF is potentially a very important source of CCN, and I therefore find the paper useful and timely. However, I believe that the paper could be improved especially in the sense that comparisons between the results obtained and techniques applied in the referenced papers could be more quantitative. I therefore have a few comments that the authors should address during revision of the paper.

Overall, I am somewhat disappointed in the literature review of section 3. I think the comparison of the observations should be made more quantitative, for example a table

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showing how much NPF events have been found to contribute to CCN populations in the different studies would be very useful.

An important reference missing from section 3.1 is Hamed et al. (ACP 10, 1071, 2010). They considered CCN production in NPF events in Melpitz, Germany, and showed that although the new particle production (both in terms of event frequency and new particle formation rates) has decreased considerably between the two periods studied (1996-97 and 2003-06), CCN production from the events did not decrease between the study periods. This was attributed mainly to higher temperatures during the latter period, causing increased SOA production and faster particle growth rates, and thus increased survival probability to CCN size range.

In section 3.2.3 the authors note that their approach of calculating CCN production lead to clearly different results from those of Asmi et al. (2011) who used a somewhat different way of calculation. This should be made more quantitative: How big were the differences? In fact, it would be very useful (and make the excercise of presenting new results quite a bit more valuable) if the authors calculated the CCN production from the Hyytiälä, Pallas, Botsalano and Vavhill events using all the different methods that have been presented in the papers reviewed in section 3.1.

Section 5.3: Another way of combining the different approaches would be to use regional models with high spatial resolution to investigate how reliable the field studies are in quantifying the CCN production from NPF events. An inherent weakness in the field studies is that they are Eulerian, the pre-existing particle concentrations can fluctuate cosiderably between the start of NPF and the time that particles reach CCN sizes, creating uncertainty in the number of CCN actually formed due to particle formation and growth. Using models, it should be possible to both quantify the CCN number formed in a regional event and to investigate how well the CCN production can be estimated from increase of CCN numbers in a single gridpoint.

Minor:

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- P. 22145, regarding the chemical effects potentially affecting CCN activation, the adsorption activation mechanism (Sorjamaa and Laaksonen, ACP 7, 6175, 2007) should be mentioned. Note that in the adsorption mechanism, the slopes of S* vs D(dry) are different than in the tradiotional Köhler theory (see e.g.Kumar et al., ACP ,11, 8661 2011).

- P. 22158, it is said that "The absolute CCN increase depends mainly on particle formation and growth rates". I would argue that it depends very much also on the pre-existing aerosol that acts as coagulation sink, because the growth rate and the coagulation sink together determine the survival probablity of the particles to CCN size range.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 22139, 2012.