

Interactive comment on “Ion-mediated nucleation as an important global source of tropospheric aerosols” by F. Yu et al.

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Overall, the subject of this manuscript - global production of new aerosols by ion induced (mediated) nucleation - is highly interesting, and appropriate for ACP. I have some concerns, however, that should be adequately addressed before I can recommend acceptance.

1. Validation of the IMN mechanism against measured atmospheric nucleation rates. The authors argue that the overcharging of the freshly formed nm-sized particles in Hyytiälä indicate IMN whereas Laakso and coworkers have argued that homogeneous nucleation can explain most of the nucleation despite the overcharging. The present authors' references are not peer-reviewed, and the debate seems very much ongoing, so that I see no consensus as to whether overcharging indicates dominance of

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IMN or not. I believe that the authors should, instead of just presenting such arguments, examine their predicted nucleation rates against atmospheric rates. The kinetic and activated nucleation mechanisms, presented e.g. by Riipinen et al. (ACP 7,1899, 2007), depend on the second and first powers of sulfuric acid concentration, respectively, and can be viewed as experimental parametrisations that capture the nucleation rates measured in Hyytiälä and in Heidelberg quite well. I recommend that the authors compare the predicted IMN nucleation rates as a function of sulfuric acid concentration at varying ion production rates to the kinetic and activated nucleation parametrisations using the coefficient ranges presented by Riipinen et al. (2007).

2. I think that the comparison in Fig. 2 is misleading, as the IMN rates are annual means but the observed nucleation rates are averages per event, and events do not occur every day of the year. A better comparison is obtained if the authors multiply the observed average rates by (# events)/(length of time period in days) (Table 1).

3. I would advise the authors to be more careful in making statements such as "... it appears that IMN can account for much of the observed particle formation near Earth's surface." (p. 13607). Even if features of annual means can be reproduced, boundary-layer nucleation is a highly nonlinear phenomenon showing many features that remain to be explained. For example, the seasonal event frequency distribution varies very much from place to place (see e.g. Hamed et al, 2006). Showing that a given mechanism can account for (much of the) observations requires more detailed comparisons than those for annual and zonal means.

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