

Interactive comment on “Indirect radiative forcing by ion-mediated nucleation of aerosol” by F. Yu et al.

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The authors thank the referee for the constructive and useful comments. Additional simulations and analysis are needed to address some of the comments. Therefore, we will give a full reply after we carry out these simulations. Here we would like to reply to the first major comment before the closing of the ACPD open discussion period. More importantly, we would appreciate if the referee can provide us the references to “new CLOUD results show that the importance of ions on nucleation diminishes in the presence of many organics, and that continental BL nucleation rates cannot be reproduced without these organics” so that we can check the results out in detail and discuss accordingly in the revised manuscript.

While the role of organics in growing freshly nucleated particles is well established,
C6619

their exact role in promoting initial formation of critical clusters remains to be clarified. For example, both Janson et al. (Tellus B, 2001) and Sellegrí et al (ACP, 2005) concluded that, based on measurements made during two different boreal forest field campaigns (BIOFOR and QUEST), the oxidation products of terpenes were not the primary nucleating species observed at Hyttiälä. The main reasons for their conclusion include: (1) that the concentrations of the terpenes and their oxidation products were higher at night when no nucleation was observed; (2) that organic oxidation products were not significantly elevated during event days compared to non-event days based on the results from the BIOFOR campaign; and (3) that organic compounds including terpenes are generally lower during event days compared to non-event days based on QUEST data.

We are aware of a number of laboratory chamber studies which investigated nucleation processes close to atmospheric conditions (e.g., Zhang et al., Science, 2004; Berndt et al., Science, 2005; Berndt et al., GRL, 2006; Hanson and Lovejoy, JPC, 2006; Benson et al., GRL, 2008; Metzger et al., PNAS, 2010; Sipila et al., Science, 2010; Enghoff et al., GRL, 2011; Kirkby et al., Nature, 2011) but the results from various studies differ significantly, probably as a result of different level of contaminations (Kirkby et al., Nature, 2011) and/or sampling issues (Sipila et al., Science, 2010). Further researches are apparently needed to reconcile these differences and assess the laboratory results against field measurements.

As pointed out in the paper, Yu and Turco (ACP, 2011) demonstrated that the state-of-the-art multi-instrument field measurements (including overcharging ratios of freshly nucleated particles) taken in a boreal forest appear to strongly support the dominance of IMN mechanism, which is further supported by the most recent cluster mass spectrometer measurements at the site showing the absence of small neutral clusters (Jokinen et al., ACP, 2012). It remains to be studied if the new CLOUD results the referee mentioned (i.e., “the importance of ions on nucleation diminishes in the presence of many organics”) are consistent with the state-of-the-art multi-instrument field measure-

ments taken in the boreal forest where a lot of organics are known to be around.

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C6621