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Interactive comment on "Impact of nucleation on global CCN" *by* J. Merikanto et al.

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We thank Referee 2 for the instructive comments on our manuscript. Below we will address each of the comments presented by Referee 2, and present the changes that we will make to the manuscript.

Referee 2 asks why we have neglected dust in our simulations. The GLOMAP model can be run with or without dust emissions. Dust represents a major aerosol component in terms of aerosol mass, but due to the large sizes of dust particles the number concentrations of dust particles are always low compared to other types of aerosol. Our resent modelling results including dust have shown that dust contributes only little to CN or CCN even during severe dust storms (Manktelow et al., ACPD 9, 14771-14823, 2009). We will add to the model description:

"In this study we have neglected dust as an aerosol component in favour of compu-

tational efficiency. While dust can be an important source of ice nuclei and makes a significant proportion of aerosol mass in some regions, the number concentration of dust is always low compared to other aerosol types. Our resent modelling results including dust have shown that dust makes only a minor contribution to CN or CCN even during severe dust storms (Manktelow et al., 2009). Therefore, neglecting dust has no significant impact on our results."

Referee 2 asks why we age hydrophobic organic primary particles to hydrophilic ones through condensation of one monolayer of sulfuric acid or secondary organics instead of using volume fraction. Our approach relies on the assumption that condensation results in externally mixed coated aerosol with a carbonaceous core, and these particles are treated as hydrophobic until they become fully coated. Through coagulation organic particles become internally mixed. The whole hydrophilic aerosol distribution is best characterized as internally mixed. In this approach we largely follow Mark Jacobson's (M. Jacobson, Nature 409, 695-697, 2001, M. Jacobson, Geophys. Res. Lett. 27, 217-220, 2000) findings and suggestions.

Experiment 8 where we switch off all primary emissions aims to study the link between primary emissions and nucleation. It is largely a thought experiment which, nevertheless, demonstrates that CCN concentrations respond nonlinearly to changes in primary emissions. While anthropogenic particle and gas emissions often decrease or increase more or less proportionally, there can be several cases where this is not true. Examples include technological inventions with improved filtering of primary particles but unchanged gaseous emissions, and geo-engineering scenarios involving cloud seeding. We will rewrite the description of experiment 8 as:

"8. UTN+BLN: Runs with UTN represented with Kulmala et al. (1998) parameterization and BLN using A=$2\times10-6$. This run examines the effect of primary emissions on nucleation, and involves a hypothetical removal of all primary emissions."

Referee 2 points out that table captions in Table 2 are not defined specifically enough.

We will mention in the revised table caption that minimum, standard and maximum schemes refer to the relative strength of the sources in producing particles globally.

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