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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The relationship between aerosol and cloud drop number concentrations in a global aerosol microphysics model" *by* K. J. Pringle et al.

**Anonymous Referee #2**

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This is a modeling study of the dependence of cloud droplet activation on aerosol properties. It shows that the large variations in the model-calculated aerosol size distribution contribute in part to those in droplet number concentration, and that empirical relationships between aerosol and droplet numbers applicable to a particular region could give rise to substantial biases elsewhere. The major weakness is the absence of observational evidence for these findings. Nonetheless, they are reasonable in theory, and could be helpful to the community's effort to better understand aerosol-cloud interactions. So, I recommend the paper's publication after minor revisions. The specific comments are as follows.

P3210 L4: The recent mechanistic parameterizations should be cited.

P3212 L4-5: Which system is the binary homogeneous nucleation for? Is it based on theory, laboratory, or field measurements? My understanding is that the picture of atmospheric nucleation is rather murky now. Multiple nucleation mechanisms, including some "exotic" ones (e.g., ion-mediated), exist in the literature. Is your approach sufficient enough?

P3212 L19-20: It is entirely possible that you got right answers for wrong reasons. For example, organic carbonaceous aerosols are a very important, if no dominant, source of CCN in the stratocumulus region off the west coast of Africa, of course during the biomass burning season. This has to be properly acknowledged.

P3212 L24-25: This statement on the relative importance of size and composition is way too loose. If a particle is entirely composed of insoluble species, it will not activate irrespective of size. I know that this is an extreme case, but it illustrates the point. A general question is how long your integration is. And how often is the activation calculation?

P3213 L22: Wrong spelling. It should be "Bennartz". Please also fix it in the reference.

P3215 L20: It is not obvious to me at what aerosol number the "flattening"; starts at the high updraft. Could it because some data points are above 600 per cc, thus not showing up in the plot?

P3217 L12-13: Are you assuming a fixed width for the log-normal distribution?

P3219 L20-23: Is there any physical explanation for this? "In-cloud processing" is singled out, but no discussion on its effect.

P3223 L7: Again, can you offer any physical explanation? Note that both the CCN and the droplet number concentrations over the Arctic are already rather low in the base case (Figure 1). This leads me to another question. Can your model capture the well-observed seasonality of Arctic aerosols (i.e., hazy conditions in winter and early



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Interactive Comment



spring)? If not, are the Arctic-specific findings based on your model simulations robust enough, particularly in light the statement made in P3224 L21-22?

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3207, 2009.



**ACPD**

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Interactive Comment