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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The role of organic aerosols in homogeneous ice formation" *by* B. Kärcher and T. Koop

**Anonymous Referee #1**

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This paper provides a relevant and useful discussion of how the freezing of organic-containing aerosols is likely to differ from the traditional inorganic aerosol case. Several cases are highlighted using idealized model results that clearly illustrate the various effects. Although, as the authors admit, additional factors will need to be taken into account before such model results can be directly tested against measurements, this paper provides a good foundation for understanding the key relationships. The discussion of the effect of organics on hygroscopicity and water activity is particularly welcome, since it demonstrates that even using the Koop et al. [2000] treatment of freezing it is possible for aerosol composition to affect the freezing rate.

One area in which the paper could be improved is by providing a few more details about

the assumed accommodation coefficient. In particular, do the authors believe that solutions containing only highly soluble organic acids, such as malonic acid, could have the very low accommodation coefficents explored in this paper? Or is it most likely that the extremely low (e.g., $10^{-3}$) accommodation coefficients can only be caused by organic films coating the aerosol surface? This is an important distinction, because it determines whether the two effects (hygroscopicity vs accommodation coefficient) described in this paper are fundamentally coupled or independent. If in fact hygroscopicity is primarily caused by soluble organics, but low accommodation coefficients are primarily due to insoluble inorganics, then establishing the relative amounts of these various organics in atmospheric aerosols will be critical in unraveling their impacts.

Specific comments:

p. 6723, l. 20-21: the statement "our results are insensitive to variations of upper tropospheric pressure" needs clarification... presumably the freezing temperatures, for example, are sensitive to the pressure

p. 6727, l. 8-12: is the reduced freezing due solely to the smaller volume of the particles in the second mode, or are there are also effects from the different, non-equilibrium composition (higher solute fractions, lower water activity) of the growth-inhibited particles?

p. 6728, l. 17: W is inversely related to volume, not proportional; this also needs to be fixed in the caption of Figure 1.

p. 6729, l. 17-24: The assumed SUL/MAL particle concentrations should also be specified here, to provide a proper context for the SUL concentrations.

p. 6732, l. 7-10: Is there evidence that the PALMS particles are indeed homogeneous mixtures of H2SO4 and organics? Or could the organics be non-soluble? This is important in establishing whether the the PALMS particles are truly similar to the modeled SUL/MAL particles.



**ACPD**

4, S2932–S2934, 2004

Interactive Comment

p. 6735, l. 23-25: How does this reduction in condensation coefficient differ from that considered in the model, either in terms of mechanism and in terms of the effect on freezing?

Technical corrections:

abstract, l. 1: "fraction of organics containing aerosol" Should this be "fraction of organic-containing aerosol"?

abstract, l. 7: "pure malonic acid" change to "pure malonic acid solution"

p. 6727, l. 11: "0.05-1" Should this be "0.05-0.1"?

p. 6728, l. 2: "effect" should be "affect"

p. 6728, l. 6: "remains to" Should this be "continues to"?

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6719, 2004.