

## ***Interactive comment on “Influence of particle size and chemistry on the cloud nucleating properties of aerosols” by P. K. Quinn et al.***

**P. K. Quinn et al.**

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General response to all referees:

Model analysis. We have changed the modeling analysis at the suggestion of the referees. The model study was performed to determine to what degree calculated CCN concentrations would be under- or overestimated if the variability in the HOA mass fraction observed during GoMACCS was neglected. Modeled size distributions were constructed using a geometric mean diameter varying between 20 and 140 nm (the entire range of values observed during the experiment). For each size distribution, regardless of D<sub>gn</sub>, the total number concentration was set to 3000 cm<sup>-3</sup> as a normalizing factor and the geometric standard deviation was set to 1.5 representative of observed number-size distributions. Using critical diameters calculated from Köhler theory, CCN concentrations were determined for a matrix of insoluble mass fractions ranging from

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0 to 1 and mean diameters ranging from 20 to 140 nm.

The percent under- and overestimation of the CCN concentration due to neglecting the variability in the HOA mass fraction observed during GoMACCS was calculated by taking the difference between a matrix where the insoluble fraction was set to 0.4 for all diameters and a matrix where the insoluble mass fraction varied from 0 to 1.0 at each diameter. Hence, the base case was an insoluble mass fraction of 0.4 which corresponded to the average sub-200 nm HOAMF for GoMACCS. Although we perform these model calculations initially assuming a full range of aerosol insolubility (insoluble mass fraction ranging from 0 to 1), we focus our discussion on the plus or minus 1 sigma standard deviation of the mean HOA mass fraction measured during GoMACCS. We find that relative to the mean HOA mass fraction of 0.4 plus or minus 0.2 (average plus or minus 1 sigma standard deviation) for the entire experiment, CCN concentrations are underestimated by up to 50% (at 0.22% S) for -1 sigma and overestimated by up to 50% for + 1 sigma.

Assuming that the HOA mass fraction represents the insoluble mass fraction requires assuming that HOA is insoluble and all the other chemical components present are either fully or highly soluble. As is discussed throughout the paper (Sections 3.1.1 and 3.3), the little information available about HOA suggests that it is fully or highly insoluble (e.g., mass spectra, CCN activity and combustion particles). The new version of the paper shows that the difference between the HOAMF and Dc relationship and the POM mass fraction and Dc relationship is significant (Table 1) indicating that HOA has chemical properties very distinct from the bulk POM aerosol. The result of the factor analysis (Dc being proportional to the HOA mass fraction and inversely proportional to the sulfate and OOA mass fractions) indicates a similarity between the solubility of OOA and sulfate while HOA was distinctly different. Finally, measurements of marine aerosol when HOA mass fraction were near zero and Dc values were near that of  $(\text{NH}_4)_2\text{SO}_4$  (Figure 5 Gulf-Southerly Flow) indicate that highly soluble aerosol was encountered during the experiment.

Given these factors, equating HOA mass fraction to the insoluble fraction and considering an aerosol ranging from fully soluble to fully insoluble serves as a reasonable starting point. The analysis is ripe for further refinements in subsequent studies that include more extensive chemical information about the measured POM and HOA.

Comparisons to Dusek et al. and Hudson. We have removed the comparisons to these two data sets as all referees were concerned about the compatibility of the data between the three experiments.

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 14171, 2007.

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