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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Empirical predictions of CCN from aerosol optical properties at four remote sites" *by* A. Jefferson

Anonymous Referee #3

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Empirical Predictions of CCN from Aerosol Optical Properties at Four Remote Sites

The manuscript presents empirical correlations between measured CCN concentrations and aerosol optical properties at different geographical sites. Specifically, the author uses backscatter fraction and single scattering albedo to account for variability in aerosol size and chemical composition, both of which influence CCN. The results seem interesting and worthy of publication.

Specific Comments:

1) The study appears to use a two-step method for correlating CCN concentrations to optical properties. First, Twomey's parameterization is used to parameterize the measured CCN concentration as a function of instrument supersaturation, and then the C

and k parameters are correlated to the optical properties as in Figures 3 and 4. How well does the CCN(s)=Csˆk parameterization capture the measured CCN variability? Could the goodness of fit statistics referred to in Section 3 and/or some example spectra be included so that the reader can evaluate how well this parameterization is able to capture the CCN(s) variability at each site.

2) Pg. 9000, Line 7: "There is much support from this study as well as past field studies that small mode particles may have only a minimal contribution to CCN formation. Smaller particles tend to have a higher fraction of absorbing material that may limit their ability to act as CCN. . ." What size range is referred to here, and can some data from these sites or a couple of relevant citations be added in support of these assumptions?

3) Pg. 9001, Line 15: ". . .%SS value at $\sim$0.2 was not used in the analysis. The CCN instrument may have insufficient water or too short a sample residence time for the aerosol to activate under high aerosol concentrations and low %SS." This could easily be confirmed by examining the droplet size distribution measured by the CCNC optical particle counter, in which case, one would expect the droplet distribution to have shifted close to the $\sim$1 um size threshold necessary for droplet detection.

4) Figure 5 shows the calculated CCN from the empirical correlation plotted vs. the measured CCN. Are these the same measurements that were used to train the empirical fit or were the data resampled in some way?

5) Please report the measurement uncertainties of s, BSF, SSA sigmas_sp, and CCN concentration with the instrument descriptions in Section 2. How sensitive is the calculated CCN concentration obtained from the empirical model to variability in s, BSF, SSA, and sigma_sp over the range of measured values? How do these sensitivities compare to the measurement uncertainties?

6) Frequency distributions (# instances vs. distance from the mean/line) would be very helpful for seeing how the data are distributed for the parameters given in Table 1 (especially) and also for the scatter of the data about the fitted lines in Figures 3-6.

Perhaps these could be added to the current figures as small insets?

7) Page 8998, Lines 24-30: It's hard for me to tell from the text whether the model of Lance et al. was used to calibrate supersaturation in the CCN counter or whether measurements of (NH4)2SO4 or NaCl aerosol (following Rose et al.) were used? If the former, did you use an instrument-specific thermal resistance for each site or one specific value? If the latter, which Köhler theory model (from Rose et al.) was used?

Minor comments:

- Please add the citation for Ervens et al., 2007 from Pg. 9000, Line 14 to the bibliography.

- Page 9000, Line 7: Remove "a" from "are essentially a non-activating."

- Please add 1:1 lines in Figure 5.

- I find the meaning of the sentence on Pg. 8996, Line 11 unclear: "The fit quality declined at low CCN concentrations in a region with higher data uncertainty". Please reword.

- Page 8996, Lines 19-20: Change "computational intensive" to "computationally-intensive"

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8995, 2010.