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Atmospheric
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Discussions

Interactive comment on "Effect of chemical mixing state on the hygroscopicity and cloud nucleation properties of calcium mineral dust particles" *by* R. C. Sullivan et al.

Anonymous Referee #2

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Comments on Sullivan et al.:

General comments:

Overall, a very nice paper on CCN activation of mineral dust and processed mineral dust.

Specific Comments:

1. You mention that κ, the hygroscopicity parameter, can deviate from is theoretical, or intrinsic value based on a variety of factors, most of which are related to available soluble mass, either due to particle size, solubility, phase, etc. You quickly mention

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that surface tension can also play a role. It seems that the hygroscopicity parameter is best suited for inorganic systems where hygroscopicity or solubility plays the key role. It does not strike me as nearly as useful a parameter for organic particles which may have significant surface tension effects. In fact, as you mention, dust may undergo in cloud processing with sea salt and thus may accumulate surfactants which are a small percentage of the mass, contribute very little to hygroscopicity or soluble mass, but may have a quite profound effect on CCN activation. It seems a bit tortured to fit the treatment of strongly surface active particles under this κ umbrella as you try to do with oxalic acid aged dust. κ is clearly a useful parameter for inorganic systems, but could you comment on the usefulness of κ for strongly surface active systems, especially ones in which the surface active component is a minor component, such as a strong surfactant?

2. You assume an impurity in your insoluble compounds of approximately 1 percent to explain the observed κapp. One could hypothesize that in the case of CaCO3, this impurity was likely a soluble calcium salt or a soluble carbonate. Regardless, it should be fairly straightforward to attempt to determine possible contaminant using relatively simple analytical techniques. Your single particle mass spectrometer might also have sufficient sensitivity. Was any attempt made to identify contaminants in any of the off-the-shelf compounds used? If not, why? That would seem to strengthen your case for trace impurities being the driver of CCN activation in the cases of insoluble to sparingly soluble salts.

3. A minor point, but the calibration of the CCN chamber using ammonium sulfate seems a bit strange. Why not use a more ideal compound that may better approximate a sphere and an ideal solution, something like a highly soluble organic with minimal or known surface tension effects? Ammonium sulfate seems like a very non-ideal calibration salt. If this has been discussed in detail elsewhere in the literature, I apologize.

Technical Corrections: none

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