Atmos. Chem. Phys. Discuss., 13, C8020–C8024, 2013
www.atmos-chem-phys-discuss.net/13/C8020/2013/

Atmospheric Chemistry and Physics Discussions

ACPD

13, C8020–C8024, 2013

Interactive Comment

Interactive comment on "Aerosol measurements at a high elevation site: composition, size, and cloud condensation nuclei activity" *by* B. Friedman et al.

B. Friedman et al.

bfriedma@uw.edu

Received and published: 15 October 2013

We thank Referee #1 for reading the manuscript and providing helpful comments; below we provide responses to each comment individually.

Friedman et al. report on the relationship between physical and chemical characteristics of aerosol at a high-elevation site and their propensity for activation to cloud condensation nuclei (CCN). Significant variations in CCN activation are observed during the case studies detailed, and the description of the aerosol mixing state and composition afforded by the SPLAT instrument is very useful for investigating the influence of mixing state on the CCN activation. A couple of expansions on the current discussion could significantly enhance the scientific content of this study:

The variations in the different observed particle classes, descriptions of the classes and the CCN activity are well described; however, an attempt to utilise the mixing state information from SPLAT (ie ratios of particle classes of interest) by correlating this to the CCN activity would, I feel, greatly enhance the impact of this study. Otherwise the reader is forced to study the time-series patterns and it is difficult to gauge to which parameter the CCN activity is most sensitive. Although SPLAT is not quantitative in the true sense of the word, if the %age of pure organic particles were to correlate inversely with the CCN activity, for example in the sulfate-dominated case study, this would be an important result. As would a lack or correlation, which would suggest mixing state is less relevant. I would recommend some carefully-selected correlations plots, showing trends or not, be included in a revised version of the paper.

**This is a good suggestion; we have looked at the correlation between the activated fraction and the sulfate particle types as well as the organic particle types. Correlation plots are shown below; these plots include the SPLAT data and activated fraction data for the 4 days presented, as well as the critical diameter for activation and the calculated kappa. The plots have been included in the text in section 4 as figure 8. We have also expanded the discussion in section 4 to include more of the importance of these correlations and the uncertainties associated with determining kappa.

One of the principal aims of such studies is, as indeed stated, to try an help simplify the description of aerosol chemical and physical properties required for global CCN modeling. The "kappa" parameter is often discussed in this light. The statement in this study that the observed kappa of _0.2 is consistent with that of sulfates and organics, whilst technically true, is tenuous and deserves a little more discussion than presented. This study indeed demonstrates kappa values in a similar range to those previously reported, but it is still lower than the components would suggest, particularly if SPLAT reports that 2/3rds of the particles are sulphate dominated. The authors state

ACPD

13, C8020–C8024, 2013

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

(18291 L16) that mixing state information is still required to assess the *individual* contributions to CCN, but the key for the models is how the bulk behaves (so they can do away with the need to account for mixing state). Can the observed kappa be related in any way to the SPLAT measurements? A correlation here would be most useful. A negative result is still worth mentioning.

**As seen in the correlation plots, there is a positive correlation of the activated fraction with sulfate (and negative with organic). There is a similar correlation with the critical diameter (decreases with increased sulfate particle types, increases with increased organic particle types), and a lesser correlation with the derived kappas. We hypothesize this lesser correlation is largely due to the uncertainties in the kappa calculation related to the uncertainties propagated through the cube of the critical diameter and the square of the supersaturation in the kappa equation. We also hypothesize that kinetic limitations of droplet growth may be contributing to the lower kappa (ie an organic coating on an inorganic particle) [Chuang et al., 1997].

Following an expansion of the discussion to include these two points, I would recommend publication in ACP; a deserving addition to the important global database being continuously assembled on this topic.

2.1. Please detail info only for the SPL site, and restrict funding agency plugs to the Acknowledgements

**This change has been made.

2.2 I think it is optimistic to claim SPLAT can measure particle number concentation.

**The sentence has been revised to remove the reference.

3.2 Replace "Salt Lake", with "Salt Lake City, population XX million" Particle class description is confusing: does "organic particles" include Org_Sulf or Org43_sulf aswell as the more "pure" Ox_Org and POA?

**The above changes have been made and the sentence containing “organic particles” has been revised to clarify that the “organic particles” includes Org_Sulf, Org43_sulf, and Ox_Org and POA.

3.3 Emphasize that the CCN pattern is following the so4:organic ratio, this is presumably a mixing state issue rather than how much sulfate is on a given particle.

**This has been emphasized.

3.4 Last sentence: clarify that "the particles" are those <80nm diameter, if indeed that is the case.

**This change has been made.

**References: Chuang, P.Y., Charlson, R.J., Seinfeld, J.H.:Kinetic Limitations on Droplet Formation in Clouds, Nature, 390,594-596. 1997.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 18277, 2013.

ACPD

13, C8020–C8024, 2013

Interactive Comment

ACPD
13, C8020–C8024, 2013

Interactive
Comment

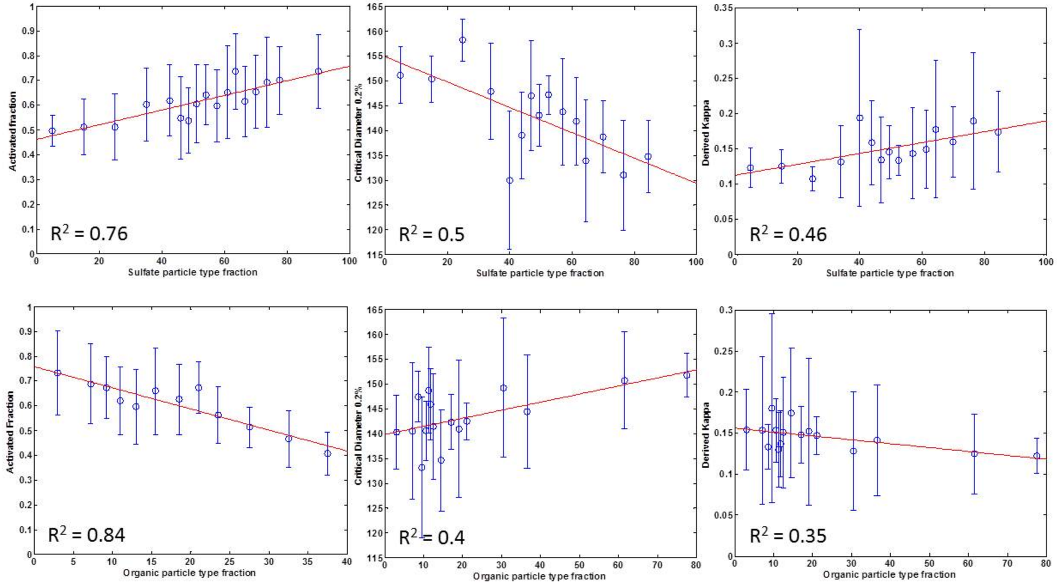

Fig. 1. Correlations between the fraction of sulfate-type (top) and organic-type particles (lower); activated fraction (left panels), critical diameter at 0.2% SS (middle panels), and derived kappa (right)