

## ***Interactive comment on “Size-resolved aerosol composition and link to hygroscopicity at a forested site in Colorado” by E. J. T. Levin et al.***

### **Anonymous Referee #1**

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The manuscript describes ambient measurements of cloud condensation nuclei (CCN) concentration and fine particle chemical composition during a six-week campaign in a forested site in Colorado. The authors discuss particle hygroscopicity at the light of organic and inorganic species concentration in particles smaller than 350 nm. The results of this study are then used to investigate seasonal variation in particle composition observed during a one-year long field experiment at the same site.

The main conclusion of this work relates to the hygroscopicity parameter  $k$ . Assuming a known hygroscopicity for the inorganic fraction of fine particles, composed mainly by ammonium sulfate, the best estimate of  $k$  for biogenic secondary organic aerosol (SOA) is 0.13, and does not depend on particle size. This finding supports the limited literature results regarding parameterization of biogenic SOA hygroscopicity based on

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ambient measurements.

Overall the manuscript is clear and exhaustive. The study is properly put into the context of the existing literature and the current knowledge.

#### Major comments

The conclusions are based on a series of assumptions including knowledge of aerosol component density, knowledge of inorganic aerosol  $k$ , negligible concentration of dust and black carbon in particles smaller than 350 nm, and internally mixed aerosol. Literature works cited in the manuscript proves that most of these assumptions hold. The internal mixing assumption is not discussed in the text, but it is reasonable, considering that the site is a background area not affected by fresh primary emissions. Nevertheless, the assumption about black carbon needs further discussion.

The authors claim that BC mass fraction is below 5% in fine particles (the term “fine” usually refers to PM<sub>2.5</sub> or PM<sub>1</sub>). No information is given about BC mass fraction in the size range considered in this study (particles smaller than 350 nm). To support the assumption that BC is not affecting particle mass below 350 nm the author should add some information about expected size distribution of fresh and processed BC, for example citing literature studies (Onasch et al., 2012; Massoli et al., 2012).

Since no data on BC size distribution are available, it would be useful to clarify what would be the effect of BC presence on the estimated  $k$ . Evaluate also if BC presence could affect density calculation and thus the conversion of vacuum aerodynamic diameter into mobility diameter.

#### Minor comments

In the discussion section the authors mention that a larger variability of  $k$  has been observed for aged SOA (Page 23827, line4). It would be useful to present these data in the introduction (for example at page 23819, line 17), referring to smog chamber experiments and ambient observations in SOA dominated environments (Pringle et al.,

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2010; Pierce et al., 2012; Jimenez et al., 2009).

Page 23822, line 12. Limit of detection of daily average organic and sulfate are presented. It is not clear if these limits are measured with the “mass Spec” mode or with the pTOF mode. Since the discussion focuses on the concentration data from pTOF analysis, it would be recommendable to report detection limit for pTOF data in the investigated size range (50-350 nm).

Page 23823, line 14. Sentence is misleading. It is correct to neglect dust contribution to particle population below 350 nm, but it is not correct for the “accumulation” mode particles. Please clarify that the authors actually refer to the particle size range here investigated.

#### References

Massoli, P. et al., Pollution Gradients and Chemical Characterization of Particulate Matter from Vehicular Traffic near Major Roadways: Results from the 2009 Queens College Air Quality Study in NYC, *Aerosol Science and Technology*, 46, 1201–1218, 2012.

Onasch, T. B. et al., Soot Particle Aerosol Mass Spectrometer: Development, Validation, and Initial Application, *Aerosol Science and Technology*, 46, 804–817, 2012.

Jimenez, J. L. et al., Evolution of Organic Aerosols in the Atmosphere, *Science*, 326, 1525–1529, 2009

Pierce J. R., et al., Nucleation and condensational growth to CCN sizes during a sustained pristine biogenic SOA event in a forested mountain valley, *Atmospheric Chemistry and Physics*, 12, 3147-3163, 2012.

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