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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Low hygroscopic scattering enhancement of boreal aerosol and the implications for a columnar optical closure study" *by* P. Zieger et al.

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Review : Low hygroscopic scattering enhancement of boreal aerosol and the implications for a columnar optical closure study. Authors: P. Zeiger et al.

This paper looks at s study of aerosol scattering hygroscopic growth during the summer of 2013 in the boreal forest of Hyytiala, Finland. They compare the surface measurements for ambient extinction corrected for ambient RH to remote sensing of the AOD from a CIMEL sun photometer. A vertical profile of the aerosol extinction was obtained by scaling the surface extinction with aircraft vertical profiles of the total aerosol num-

ber concentration. The calculated extinction was remarkably lower than the reported Cimel AOD values.

I recommend the paper for publication provided the authors make revisions and address the concerns outlined below.

General: The same symbols are used repeated for different variables. Please look through the paper and equations and make sure the symbols are consistent. Sigma or σ should be used for the aerosol extinction and scattering coefficients and lambda or λ should be used for the wavelength. Find another symbol for the power law fit parameter in equation 2 such as g or gamma. Use Å or å for the Ångström exponent.

2. The Field Site:

Can you specify the aerosol inlet heights for the system in the parking lot as well as the cottages in the forest? What were the inlet heights with respect to the forest canopy?

3. Instrumental

The low RH values of the reference nephelometer will lower the scattering coefficients and may not be appropriate especially in a region with high organic and nitrates from forests and agricultural activity. Semi-volatile organics or nitrates will evaporate from the aerosol and greatly reduce the aerosol scattering coefficient. Even for a mostly salt aerosol the low RH values will result in a solid aerosol on the lower part of the hysteresis curve. This will obscure the fRH measurements, as optimally you'd like the fRH value to approach 1.0 around an RH of 40% when water content is minimal, but the aerosol is still on the upper branch of the hysteresis curve. Do you see much variation in the wet/dry scattering ratio with aerosol composition or size (Angstrom exponent) at the lower RH values of the humidifier scans? What was the RH inside the ACSM?

The "a" parameter is the offset between the wet and reference scattering measurements in the lower RH region of the curve. It should become 1.0 around 40% RH, not 0% RH as the equation isn't valid at this low of an RH value. Offsets can result from

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aerosol loss in the humidifier, calibration offsets between the nephs, hysteresis and evaporation of low volatility compounds. For this experiment the values were close to 1.0, but if they were otherwise it wouldn't necessarily be an indication of hysteresis.

Page 3334 The term "successfully compared" is ambiguous. How close did the instruments compare, across what size range or Angstrom exponents and with what type of aerosol? Can you specify that they came with a certain percent of the other using a certain aerosol type of a particular size and growth factor? You don't need to be elaborate, but give more information, otherwise "successful" is open to interpretation.

4. Trajectories

The back trajectory calculations seem long enough to allow for substantial particle loss, dispersion, cloud processing and multiple sources that could obscure the interpretation and disproportionally favor an aerosol source region that had a minor contribution. Would you get different results with 5-day back trajectories?

Equation 4 has the parameter (ψ(t) * ψ(t)) = ψ(t)2 wouldn't this be the same regardless of whether the value was 1 or -1?

5.1 Influence of water uptake on the aerosol The lack of correlation of fRH to the aerosol single scatter albedo and scatter Angstrom is unusual, as most sites even with a high organic fraction will exhibit this behavior. Can you explain the finding? Does the SSA vary with the organic and inorganic fractions of the aerosol the same as fRH? How does the Angstrom vary with the sulfate and OC mass fractions?

5.2 Equation 6 has three different uses for sigma: scattering, wavelength and Angstrom. Please correct.

Instead of using the entire CPC count to scale the extinction coefficient can you use only the counts greater than 50 nm that are more optically active? The altitude-dependent extinction may be skewed by the small particles with a low scattering efficiency.

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Is there a measure of the boundary layer mixing height? Were flights conducted when the mixed layer was at its highest. i.e. 1-3PM LT?

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