Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-249-RC3, 2016

Atmospheric Measurement Techniques Discussions

Interactive comment on "Tandem configuration of differential mobility and centrifugal particle mass analyzers for investigating aerosol hygroscopic properties" *by* Sergey S. Vlasenko et al.

Anonymous Referee #3

Received and published: 20 November 2016

The authors outline using a differential mobility analyzer and centrifugal particle mass analyzer to measure the mass-based hygroscopicity of nanoparticles. The overall structure of the paper is appropriate; summarizing previous hygroscopic methodologies, validating the proposed system against previous literature values and using the system to characterize an atmospheric aerosol.

Major Comments:

1. Since the paper is describing a relatively new methodology, greater detail is required to explain the advantages and drawbacks of the proposed system, including:

a. A discussion on the effects of multiply-charged particles, system resolution and

the effect of the experimental design parameters. For example was the intention of introducing the 1 lpm of humidified air prior to the CPMA inlet to decrease the residence time of the aerosol in the CPMA and thus reduce heating effects? The reduction in CPMA classifier resolution due to this increased flowrate should be mentioned.

b. The resolution the CPMA was operated at and how it compares to the width of the unclassified particle size distributions measured. It would be beneficial to explain that operating at higher resolutions, requires higher rotational speeds and thus additional heating effects.

c. A discussion of possible data inversion techniques that could be applied to the mass-to-charge distribution measured by the CPMA and the method that was chosen for this work. For example, asymmetric normal distribution or a lognormal distribution (Tajima et al. 2011; Johnson et al. 2013) or convolution of the DMA and CPMA transfer functions (Emery 2005; Barone et al. 2011).

d. A discussion on the system uncertainty and its propagation into the final results, incorporating DMA and CPMA setpoint uncertainty.

2. The discussion on contact efflorescence on Page 6 assumes that even though the particle contacts a charged surface indirectly through the surface crystals the particle's charge does not transfer and that the CPMA centrifugal force is sufficient to separate the particle from the surface crystals after efflorescence transition. Was there evidence of crystal formation on the CPMA inner electrode during classifier cleaning? Furthermore, if the inner electrode surface crystals grew large enough to alter the CPMA classifier's gap, arcing between the cylinders (especially at higher RHs) would likely become an issue first.

Minor Corrections:

1. Given the CPMA measures a mass-to-charge distribution and the variety of data inversion techniques, each mention of particle mass should be further clarified, such

as changing “mass” on Page 1 Line 16 to “modal mass”.

2. On Page 2 Line 16, it should be reflected that the DMA-HCPMA configuration has been utilized by others to measure the mass-based hygroscopicity of nanoparticles, such as Johnson et al. 2015.

3. Referring to Page 14 Line 20, did the temperature of the CPMA stabilize after extended periods of continuous operation? If so, at what temperature? This information would be valuable for others applying this method in the future.

4. On Page 3 Line 23, it would be valuable to mention that similar to the DMA, the upper RH limit of the CPMA is limited by voltage arcing between the classifier cylinders.

References

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-249, 2016.