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Atmospheric Measurement Techniques Discussions

Interactive comment on "A method to resolve the phase state of aerosol particles" *by* E. Saukko et al.

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The authors thank Referee #2 for positive comments and constructive points raised in the review. The points brought up by the referee are discussed below:

The paper states (page 6236) that 0.9 s *is sufficient to reach equilibrium in impactor. Can the authors justify this claim?*

For ammonium sulfate particles the clear efflorescence seen at the values established in the literature shows that for this compound the residence time is sufficient.

For amorphous particles the question is very relevant, as particles of high viscosity

may exhibit large time constants with regard to diffusive water uptake(Shiraiwa et al., 2011). This point is also relevant for all the HTDMA studies that have equilibration times of the same order of magnitude. We tested the effect of residence time with several substances, both for the humidifier and for the impactor and did not see changes in bounce behaviour.

This clarification with respect to ammonium sulfate and levoglucosan has been added to the manuscript.

Page 6238 –"as well as possibly on the surface of the collection substrate." It seems like the surface could play a role in determining bounce. I.e. bounce is due to interaction of particle with surface. I realize the authors clean the plate before an experiment (pg 6233) but are there any concerns with material build up during an experiment.

Material does build up moderately onto the substrate. The effect of this on the hysteresis of the bounce has been tested by going down in humidity after stepping the humidity up and seeing the bounce drop. The bounce increases back to close to the noise limits, so the buildup has only little effect on the bounced fraction with the substances used. In this paper, the concentration in ammonium sulfate experiment was between 1.7 and 2.6 $\times 10^3$ cm^{-3} and around 10^4 cm^{-3} for the levoglucosan experiment. The effect is expected to be loading-dependent, and with proper concentration control and RH cycling it can be monitored and managed.

This clarification has been added to the manuscript along with the "downscan points" to the figures.

The authors employ a low pressure impactor. Could that alter the phase state of the particles, e.g. by inducing evaporation of more volatile components of the particles.

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4, C2363–C2365, 2011

This is a good point regarding experiments where the particles are formed from volatile material or a mixture of volatile and semi- or nonvolatile substances. In this study, the particles were carefully produced to have only one compound in them, and these substances have very low vapor pressures in ambient temperature. For multicomponent particles the evaporation is of similar concern as in any experiments where the carrier gas of the particles is diluted by mixing, such as in DMA size classification with other sheath gas than the aerosol carrier gas, or by pressure drop as in any vacuum-involving measurements. In general the problem is equivalent to the RH drop in the impactor, which is discussed in the manuscript.

Reference: Shiraiwa, M., Ammann, M., Koop, T., Pöschl, U., Gas uptake and chemical ageing of semisolid organic aerosol particles., Proc. Natl. Acad. Sci. U.S.A., 108, 11003-11008, 2011.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 6229, 2011.