Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-35

Anonymous Referee #3

Referee comment on "Utilizing an electrical low-pressure impactor to indirectly probe water uptake via particle bounce measurements" by Kevin B. Fischer and Giuseppe A. Petrucci, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-35-RC2, 2021

The authors examine the use of an electrical low pressure impactor (ELPI) to study phase changes in aerosol, focusing on efflorescence, deliquescence, and the formation of viscous amorphous liquid phases. They demonstrate results for ammonium sulfate that are consistent with expectations based on hygroscopic growth and phase change RH's. For sucrose, they show that the starting size is important due to the fact that the RH in the impactor decreases from the inlet to the lowest stage. This results in smaller particles showing more bounce, indicating the formation of a solid or semi-solid phase. Given the RH changes in the impactor, it seems that the observations can be explained in terms of RH-dependent size and viscosity for all these systems, along with size itself for the SOA system.

Overall, the observations appear to make sense based on the described experiments. However, unless the RH can be made uniform across the impactor stages, it is not clear to me that this method could be reliably used for exploring RH-dependent phase. The authors do a good job at stressing the problems relating to the variable RH, but who is this work intended for? As far as I can tell, the only researchers using the ELPI for viscosity and phase measurements are the authors of this manuscript (please correct me if I'm wrong!).

Generally, I think this manuscript should be published with some revision, but the authors need to be more clear about the aims of the work, and describe the broader implications. Are other impactor measurments of phase affected in similar ways? Can the problematic aspects of this experiment be harnessed for new insights?

Additional points:

DRH of 87% is quite a lot higher than the literature - this is not an insignificant difference. Can the authors explain this difference in terms of uncertainty in RH probes or some other factors? 1% RH change per minute seems very fast for such a large chamber - likely this is the source. Where was the RH measured? Why not vary the RH more slowly to better equilibrate the chamber?

The impact design and change in RH means that small particles may enter viscous states before reaching the filter. A small aqueous particle that should splat on stage 4, for example, may instead become viscous and bounce down to stage 1. Authors should try to estimate the amount of expected water loss over 50ms in each stage to estimate impact of this RH gradient. For very small particles, 50 ms can be plenty long enough for gas-phase diffusion controlled evaporation to occur.

In the discussion of the Kelvin effect, providing some estimates of the water activity in the smaller particles as a function of RH would be insightful to see the potential magnitude of this effect.