

Response to Referee 1:

We thank referee #1 for taking their time to carefully review our manuscript and provide detailed feedback. We have taken into consideration all comments and suggestions and have made appropriate changes where applicable.

1) clarify whether (and how if any) the defined $\Delta i_{\text{fractional},t}$ can be translated to bounce factor, e.g., through a relationship shown in Figure S1?

The $\Delta i_{\text{fractional},t}$ cannot be quantitatively translated to bounce factor, as it is a more qualitative representation of particle bounce. It is possible to compare it to the bounce factor method, though, which is shown in Fig S1. We have added text clarifying that a comparison can be found in Fig. S1.

2) use consistent y axis scales (i.e., 0 to 1 or 1 to 0) for Figures 1 and 6.

We have revised Figure 6 and the y-axis is now consistent with the y-axis scales found in the previous figures.

Response to Referee 2:

We thank referee #2 for taking their time to carefully review our manuscript and provide detailed feedback. We have taken into consideration all comments and suggestions and have made appropriate changes where applicable.

L184: the author should list the range of DRH/ERH from the literature.

We agree and have added DRH (80 – 82% RH) and ERH (31 – 48% RH) to the text.

Fig.2: Can the author discuss a bit more why the current for stage 3 is smaller than stage 2? The trend is a bit weird.

We agree that this appears a bit peculiar, but is likely due to higher noise on this particular channel relative to the others. The main objective of Fig. 2 is to demonstrate that, even though a majority of ammonium sulfate particles impacted on impactors with impactor RH close to or below the ERH, particle bounce was shut down and therefore no significant drying occurred (in contrast to 70 nm sucrose).

Once the particle hit the electrometer, can charge transfer happen even if the particle bounce? Will this lead to any error in the calculation of the ELPI current and bounce calculation? For now I believe the author thinks the current from ELPI indicated the particle hit onto the impactor, but it is also possible the particle also bounced back and did not stay on the impactor

Charge transfer can happen even if the particle bounces. When particles bounce, our method assumes they bounce all the way down to the filter stage (stage 1). When particle bounce occurs, a large amount of current is recorded on the filter stage (stage 1). In fact, as the smooth impaction stages were used here, particle bounce was enabled for the more solid-like particles, while liquid particles do not bounce. This is all discussed more in detail by (Jain and Petrucci, 2015), which is cited in the manuscript.

Can one particle bounce multitudes on different impactor stages and will this lead to any issue in interpreting the data? The author should clarify this in the manuscript.

Please see above.

Figure 6: The y axis is plotted inversely compared with previous figures, which is confusing when comparing other figures. The y axis should be the same descending order as other figures. Please revise.

We have revised Figure 6 and the y-axis is now consistent with the y-axis scales found in the previous figures.

L275: did the author compare the inflection RH when the change of bounce occurs with the transition RH reported from other a-pinene SOA bounce studies? If so please list the results of the literature comparison.

This comparison was not made because other studies were able to observe a full shutdown of particle bounce with their respective impactor setups. For the ELPI here, particle bounce persisted. We do not believe it is appropriate to make this comparison to other impactor setups that do not feature a drop in pressure and RH within the impactors.

To verify the conclusion that drying RH within the impactor is the reason for different bounce behaviors of a-pinene SOA with different concentrations, I would suggest the author perform a calibration study using sucrose of different sizes. In section 3.2, the author only used monodisperse AS only in one size and monodisperse sucrose only in two sizes. So adding more data points will help strengthen the explanation why the bounce behaviors of a-pinene SOA are different

While we agree that more data points would certainly assist in our investigation, the choice of 70 nm and 190 nm sucrose was made based off of the D_{50} diameters of the ELPI and the corresponding impactor RH values. The purpose of selecting these two diameters was to choose particles on more extreme ends of the size spectrum. In other words, particles that would impact on impactors having a local impactor RH well below that of the chamber RH, and on the other hand to choose particles that would impact on impactors having a local impactor RH negligibly different from that of the chamber RH. Additionally, sucrose is known to deliquesce and ceases to bounce past its DRH (Bateman et al., 2015).

Did the author compare this result with that from Grayson et al. Grayson et al. Seem to suggest that the concentration of a-pinene SOA also affect the viscosity while in this study the author did not seem to observe this effect. Any explanations?

We agree that concentration of a-pinene SOA affects viscosity. However, this was not the focus of this study. Here, physical uptake of water was the focus. Due to the RH artefact experienced by the ELPI, the particle bounce for a-pinene derived SOA sampled from high RH environments cannot be measured accurately, regardless of the concentration. Since particle bounce cannot be measured accurately for a-pinene derived SOA with the ELPI, it is not possible to discern whether or not we observed a difference in particle bounce (which is a surrogate for viscosity).

Bateman, A. P., Bertram, A. K., and Martin, S. T.: Hygroscopic Influence on the Semisolid-to-Liquid Transition of Secondary Organic Materials, *J. Phys. Chem. A*, 119, 4386-4395, 10.1021/jp508521c, 2015.

Jain, S., and Petrucci, G. A.: A New Method to Measure Aerosol Particle Bounce Using a Cascade Electrical Low Pressure Impactor, *Aerosol Sci. Technol.*, 49, 390-399, 10.1080/02786826.2015.1036393, 2015.