

Interactive comment on “Calibration and evaluation of broad supersaturation scanning (BS2) cloud condensation nuclei counter for rapid measurement of particle hygroscopicity and CCN activity” by Najin Kim et al.

This manuscript presents a novel broad supersaturation scanning CCN (SB2-CCN) system, which can measure the CCN activity with a high time resolution. Overall, this manuscript clearly explained the set-up and calibration of the instrument, and applied it in the field measurement. This manuscript is well-written and easy to follow. The following comments must be addressed before consideration for publication.

Major comments:

1. I recommend some of the figures can be moved from the main text to supplement, such as Fig. 7 and Fig. 8. Figures 3 and 4 can be combined into one figure. Figures 10 and 11 can be combined also. I prefer a compact and relatively short manuscript to introduce such a new instrument.
2. In Sect. 3.1.2, the double charged aerosols effect of the calibration of $F_{\text{act}} - S_{\text{aerosol}}$ relation was discussed. Did you consider the double charged effect in ambient measurement?
3. In Sect. 3.1.3, the water depletion in the activation tube by high number concentration was discussed. I was wondering do you pre-humidify the particle for ambient aerosol measurement. What is the total particle number concentration of the ambient measurement in this study? In Lines 217-218, it was mentioned that the aerosol concentration needs to be considered when it is high. Do you think is it worth testing the water depletion by high number concentration (such as $>1000 \text{ cm}^{-3}$) with lab-generated particles or in a polluted environment?
4. In Sect. 4.1, the AS and Su mixed particles are internally or externally mixed? If externally mixed, can it be seen in the $F_{\text{act}} - S_{\text{aerosol}}$ curves?

Monir comments:

Line 50-60: When talking about the fast measurement of size-resolved κ , Zhang et al. (2021) introduced a novel method/technique to rapidly measure the size-resolved κ values under sub-saturation.

Line 79: I realized that Fig. S1 was originally from Su et al. (2016). You probably need to mention that in the manuscript. I recommend moving Fig. S1 from supplement to main text because this figure is important for readers to understand the F_{act} .

Line 114: Why particle number concentration is the number concentration of condensation nuclei? N_{CCN} and N_{CN} are the same abbreviations?

References:

Zhang, J., Spielman, S., Wang, Y., Zheng, G., Gong, X., Hering, S., and Wang, J.: Rapid measurement of RH-dependent aerosol hygroscopic growth using a humidity-controlled fast integrated mobility spectrometer (HFIMS), *Atmos. Meas. Tech. Discuss.* [preprint], <https://doi.org/10.5194/amt-2021-90>, in review, 2021.