

Response to Reviewer #2

The authors should consider tempering their assertions with respect to calculations of hygroscopicity; as the BS2 may provide excellent data however the interpretations of the data may be flawed.

A: We agreed your comments. In this manuscript, possible uncertainties of the CCN activation including multiply charged particles that can affect to κ calculation are presented. So, we added the sentence (Line 249-251) in the manuscript with respect to calculation of hygroscopicity.

“As κ values can be derived directly by F_{act} values in the BS2-CCN system, these possible uncertainties of CCN activation need to be carefully considered when deriving κ values.”

Response to Reviewer #3

I commend the authors for having addressed my many previous comments. Readers (and I) can hopefully now appreciate the necessity of this work for a Broad Supersaturation system as the authors have included many useful figures within the supplemental information which outline the key differences between a traditional CCNC and this system. It is useful to have this information available to the reader without having to always refer to previous work. The addition of Subsection 2.1 is welcomed as is the expanded description of your field campaign. Finally, and perhaps best of all, the inclusion of error bars in Figure 6 is extremely useful and demonstrates that there is a statistically significant difference to retrieved k when applying your approach.

There are still some minor technical corrections that would benefit the article.

A: We thank the reviewer for encouraging comments on our manuscript. We also believe that the quality of our manuscript is improved as we reflect the reviewer's comments. Below each of the comments is written with the *Italic font* and then our response is followed with the normal font.

Minor Comments

Q1: Line 29: Should read "Despite the scientific importance of CCN, ..."

A: Corrected (Line 29)

Q2: Line 61: "...modern studies have focused on ..."

A: Corrected (Line 61)

Q3: Lines 97, 144: If you later use ϕ for particle charge (as recommended), it would be good to be consistent here.

A: Thanks for correcting our mistake. We fixed both (Line 97 and 144)

Q4: Line 115: "The algorithm assumes the lognormal size distribution for Scanning the size of particles with an Fact of 0 to 1 is performed, and the algorithm applies starting from larger particle to small particle"

I think this sentence was meant to be two separate sentences, perhaps:

"We note that the algorithm assumes that the particle size distribution is lognormal. Scanning the size of particles..."

A: We agreed your comment and changed the sentence (Line 115-116).

“We noted that the algorithm assumes the lognormal size distribution. Scanning the size of particles with an F_{act} of 0 to 1 is performed, and the algorithm applies starting from larger particle to small particle.”

Q5: Line 149: This is not a continuous integral over charge. Charge is discrete. Use the appropriate symbol for a discrete summation, Σ .

A: We changed the discrete summation, Σ of the Eq. (5) (Line 139).

Q6: Figure 2b: There seems to be some sort of watermark, or white line affecting the readability of 0.8 and 0.2? Could this be fixed?

A: We change the Fig. 2 clearly (y-axis number) for readability as you pointed out.