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Comment on amt-2021-258

Anonymous Referee #1

Referee comment on "Cloud condensation nuclei (CCN) activity analysis of low-hygroscopicity aerosols using the aerodynamic aerosol classifier (AAC)" by Kanishk Gohil and Akua A. Asa-Awuku, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-258-RC2, 2021

In this manuscript the authors are characterizing a measurement system combining the Aerodynamic Aerosol Classifier (AAC) and the DMT CCN counter in order to measure the CCN efficiency of size selected aerosol particles. The purpose is to determine the uncertainty of the AAC classification and propagate the error to the kappa-values determined from the 50% activated fraction of aerosol in the CCN counter. The authors also compare the obtained kappa-values to those measured using a conventional DMA-CCNC system.

The manuscript is well within the scope of AMT, and the measurements appear sound, but the uncertainty analysis could be improved. I have a few comments/questions related mostly to the activated fraction, the sigmoid function, and their impact on the uncertainty of the obtained kappa.

First, the sigmoid curves of the size-resolved activated fractions measured using the AAC-CCNC are much wider than those measured with the DMA-CCNC. This can be seen e.g. by comparing the curve of Fig. 4(b) to the green (?) curve of Fig. S3 (note that there are 7 curves in the latter figure but only 6 rows in Table S2 so it is not completely clear which curve corresponds to which row). What are the reasons for the wider sigmoid? Does it follow directly from wider transfer functions of AAC compared to DMA? Would not a wide sigmoid in itself impact the uncertainty of kappa via making the diameter of 50% activated fraction more uncertain?

Secondly, the fitted sigmoid curves do not appear to reach unity but seem to approach a constant value of something like 0.95. Is this true? (Please provide the sigmoid fitting functions in the supplement.) If it is true, does it mean that about 5% of the particles are lost in the CCN counter? Wouldn't it then be logical to determine the critical diameter from 50% of the maximum activated fraction of the fitted sigmoid curve and not from 50% of the input aerosol concentration? (This obviously applies to the DMA-CCNC measurements

as well).

Finally, there obviously is some statistical uncertainty in the fitted sigmoid curves, For example, at high activated fractions, the blue datapoints in Fig. 6 are rather scattered and mostly below the sigmoid. Can you determine what is the error of the critical diameter associated with the statistical uncertainty of the fitting function, and how it further impacts the error estimate of the resulting kappa value? Or is the statistical uncertainty perhaps within the error limits caused by the uncertrainties of the measured aerodynamic diameters?