This manuscript “On the evolution of sub- and super-saturated water uptake of secondary organic aerosol in chamber experiments from mixed precursors” presents a series of laboratory studies on SOA hygroscopicity at 90% RH and RH above 100 % under the different chamber conditions from single or multi-precursors. Comparison and discussion of hygroscopicity and CCN activity (k) of SOA are very important to understanding the aerosol-cloud interaction in atmosphere. Therefore, the manuscript fit well the scope of ACP. I recommendation its publication in ACP after addressing the following general and minor comments.

Minor comments:

1. Page 2: line 34-38 “With the increase of condensed SOA on seed particles throughout the experiments, the discrepancy of κ_{HTDMA} and κ_{CCN} became weaker (down to ~ 0 %) and finally the mean κHTDMA was ~ 60% higher than κCCN on average when the SOA mass fraction approached ~ 0.8. This is possibly attributable to the non-ideality of solutes at different RH or the different co-condensation of condensable organic vapours within the two instruments.” The explanation is not clear. Also. I would suggest explain “non-ideality” of solutes at different RH.

2. Page 3: line 47-48 “The reliability of cloud condensation nuclei (CCN) activity predicted from the aerosol hygroscopic growth under sub-saturated condition remains unresolved” I would like to suggest that “ the problem or issue of reliability….. remains unresolved”

3. Page 9: line 207-208 “Fig. 1 and Fig. 2” should be “Figure 1 and 2” please check other sentence in the whole of manuscript.

4. Page 12 line: 281-283 “As shown in Sec. 3.1-3.2, the aerosol chemical composition is size-dependent. It is essential to ensure the chemical composition are comparable for HTDMA and CCN measurements for the reconciliation study if their measured dry particle sizes are different” “are” should be “is”

5. Page 14 line 341-343: “It is worth noting that the prediction of critical diameter and CCN number concentration from κ_{HTDMA} are based on the concurrently measured critical supersaturation and particle number size distribution.” I would appreciate more explanation here.

6. Page 14 line 343-346: “The broader influences of the observed trend of $\kappa_{HTDMA}/\kappa_{CCN}$ as a function of MRSOA/PM on CCN activity prediction can vary a lot under different conditions of supersaturation and particle size distribution, which need further investigations.”
What does author mean “under different conditions” please explain it.

General comments:

1. The authors should emphasize the novelty of the paper. The systems they chose have been somewhat studied by others in laboratory experiments. Comparison with the literature results are encouraged when appropriate.

2. What is the residence time for HTDMA system? As author discussed “non-ideality”, does mean residence time affect SOA hygroscopicity, especially for formed viscous organic compounds?

Chan, M. N. and Chan, C. K.: Mass transfer effects in hygroscopic measurements of aerosol particles, Atmos. Chem. Phys., 5, 2703–2712, https://doi.org/10.5194/acp-5-2703-2005, 2005.

3. Mixing state effect on hygroscopicity and CCN activity of SOA under the sub-saturated and super-saturated condition are encouraged discussed in the main text. Have author perform experiments on morphology or mixing state of SOA at different RHs (e.g., RH<100% or RH>100%) using an optical microscopy or AFM?

4. Fig. 3 shows that there is a weak size dependence of GF ((κ_{HTDMA}) between 100 and 200 nm aerosol particles, with up to ~ 0.2 due to non-uniform size-dependent chemical composition. Could author estimate uncertainty of GF ((κ_{HTDMA}) at different sizes in the HTDMA system? or what is GF uncertainty of SOA aerosol nanoparticles with diameters from 75 to 300 nm at 90% RH as well as calculated k_{HTDMA} uncertainty? Please see Table 2 from Mochida and Kawamura (2004).

5. Page 13 line: 302-304 "A higher κ_{HTDMA} (κ_{CCN}) of the multi-component SOA-inorganic mixtures at the same level of MRSOA/PM indicated a higher κ of the SOA, according to the ZSR mixing rule of κ demonstrated in Petters and Kreidenweis (2007)." It is not clear, could author explain more in details? And could author evaluate $ZSR_{multi\text{-}component\ SOA\text{-}inorganic}$ according to Eq. (7) from Petter and Kreidenweis (2007)?

6. Page 13 line: 319-324: I would appreciate more discussion that how these factors (e.g., surface tension, molecular volume) affect the kappa, the following references are recommended:

Wang, J., Shilling, J. E., Liu, J., Zelenyuk, A., Bell, D. M., Petters, M. D., Thalman, R., Mei, F., Zaveri, R. A., and Zheng, G.: Cloud droplet activation of secondary organic aerosol is mainly controlled by molecular weight, not water solubility, Atmos. Chem. Phys., 19, 941–954, https://doi.org/10.5194/acp-19-941-2019, 2019.

Davies, J. F., Zuend, A., and Wilson, K. R.: Technical note: The role of evolving surface tension in the formation of cloud droplets, Atmos. Chem. Phys., 19, 2933–2946, https://doi.org/10.5194/acp-19-2933-2019, 2019.