Dear Editor,

We would like to express our gratitude for the comments provided by the reviewer. We have revised our manuscript to address these comments and improve the quality of our work. Your patience and assistance throughout the review process are greatly appreciated.

Your sincerely,

Xiaohong

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Response to Major comments:

1. On-site calibration was not conducted during this campaign. However, the authors posit that there was merely a ±5 % uncertainty in the determination of supersaturation (SS), leading to potential analytic errors of up to 18 % in the measured N_{ccn}*. However, the influence of ambient pressure variations on SS in CCN counter is similar to that of temperature difference between the top and bottom of the CCN counter column (Eq. (16) in Lance et al., 2006; Fig. 5d and 8c in Rose et al., 2008). The divergence in height between the observation site and the calibration location can significantly perturb the SS within the CCN counter. Specifically, considering that the site's elevation is roughly 1000m, resulting in a potential pressure decrease of around 10 % compared to that of Beijing city, employing calibration outcomes from Beijing city could lead to a 10 % systematic overestimation of SS in CCN measurements at this particular site, even if we overlook variations in calibration between locations at the same elevation. If, as stated by the authors, an 18 % error can arise due to a ±5 % uncertainty in SS, thus the overestimation of SS by 10 % might consequently result in errors of up to 36 % in measured* N_{ccn}*. However, these deviations in measured* N_{ccn} *can exhibit a non-linear pattern depending on variations in particle number size distribution and hygroscopicity distribution. This non-linear effect is also significant for the calculation of critical diameter and, subsequently, kappa values. Given the potential complexity of these issues, a meticulous examination is imperative. Neglecting this could cast doubt upon the credibility of the findings presented in this study.*

Response: We appreciate the valuable suggestions. In absence of on-site calibration, we agree that the use of 10 % reduction in supersaturation (SS) is a reasonable approximation at the mountain site when comparing with values derived from laboratory calibration in Beijing. Consequently, we have revised the manuscript accordingly.

In Page 4, lines 28–37, of the revised version, it reads "However, the SS values were referred as lab-calibrated values in this study since no on-site calibration was conducted during the campaign. The divergence in height between the observational site and the calibration location (~1000 m) may introduce uncertainties on SS and the consequently measured N_{ccn} (Lance et al., 2006; Rose et al., 2008; Lathem and Nenes, 2011). Based on these previous studies, the on-site five SS at the mountain site might be approximately 10 % smaller than the corresponding lab-calibrated values, i.e., 0.18 %, 0.36 %, 0.54 %, 0.72 % and 0.9 %. These smaller SS values were referred as the approximated on-site values in this study. Furthermore, the errors in the measured N_{ccn} between each pair of lab-calibrated and approximated on-site SS were found to be smaller than 10 %, as presented in Supporting Information (Figs. S6–S10)."

Text S4 in Supporting Information was newly added to analyze N_{ccn} and κ values at lab-calibrated SS and the approximated on-site SS. Moreover, additional results were added in the main text to support the related analysis, by considering the approximated on-site SS.

Response to Minor comments:

1. The authors acknowledge the potential for significant errors when calculating kappa values using Eq. (1). Eq. (1) is Eq. (10) in Petters and Kreidenweis (2007), which is an approximate expression of Eq. (6) in Petters and Kreidenweis (2007) when kappa values were larger than 0.2. Thus I suggest including a comparison between the kappa values calculated from these two equations (i.e., both Eq. (6) and Eq. (10) in Petters and Kreidenweis, 2007) in the supplementary materials. Incorporating a note of caution alongside the comparison within this paper will be also helpful.

Response: Eq. (6) and Eq. (10) presented in Petters and Kreidenweis (2007) provide two methods for calculating κ values. The Eq. (6) was the derivation of Kohler equation, which can be applied across entire range of supersaturation levels and solute hygroscopicity, resulting in smaller errors. However, this equation requires the growth factor obtained from HTDMA measurements, which were not available in this study. In fact, the absence of simultaneous HTDMA measurements was also the exact reason for most studies to use the Eq. (10).

2. Page 11, Line 29: The term "less CCN-activated organic vapor " lacks clarity. It may lead to a misunderstanding that there is a reduced presence of "organic vapor which is CCN-activated" condensing on particles.

Response: Agree. It reads as "It is possible that the growth of pre-existing particles was driven by organic vapor with lower CCN activation since κ values at 0.4 % SS decreased from 0.11 to lower values." in Page 11, L38–40.

3. Page 12, L24-25: This sentence "Thus, at least 1 % of the grown new particles were large enough to be activated as CCN." seems to be problematic in its expression. The conclusion that "only 1 % of the newly grown particles can serve as cloud condensation nuclei" itself lacks meaningful significance.

Response: In the revision, it reads as "Thus, at least 1 % of the grown new particles (61–73 cm^{-3}) were large enough to be activated as CCN. Supposed that the part of grown new particles were totally activated as cloud droplets, they should yield an appreciable contribution to *CNDC*." in Page 12, L35–37.

4. Page 16, Line 39 - Page 17, Line 9: A notable disparity exists between the observed N_{ccn} and satellite-derived CDNC. This discrepancy is attributed to the likelihood that the actual SS in the atmosphere could be considerably less than 0.2 %. However, the SS value mentioned by the authors was obtained in a fog at a rural site within the NCP. While it's not guaranteed that the SS in clouds near the mountain site in this study is necessarily close to or higher than 0.2 %, it's also improbable for it to be close to SS values in fogs at significantly lower altitudes. Stronger evidence is necessary.

Response: In the revision (Page 17, lines 18–29), we added "This large difference between the observed N_{ccn} and satellite-derived *CDNC* implies that the actual SS in the atmosphere might be substantially smaller than 0.2 %. In fact, Gao et al. (2021) recently conducted aircraft observations over Beijing and calculated the SS at cloud base to be approximately 0.048 %. Moreover, Shen et al. (2018) also reported the actual SS values ranging from 0.01 % to 0.05 % during fog events observed in the NCP. Iwamoto et al. (2021) reported the mean SS around 0.34 % during cloud-shrouded periods at Mt. Fuji in Japan. Notably, their observed SS decreased to 0.24 % when the air mass originated from continental sources. The higher SS observed at Mt. Fuji might be related to substantially lower N_{ccn} (around 108 cm^{-3} at 0.21 % SS) than those in Beijing. The reduced effect on SS levels with increasing N_{ccn} was also obtained in Oklahoma (Jia et al., 2019), in which the estimated SS of stratocumulus and cumulus in relatively polluted atmospheres approximately equaled to 0.2 %. However, the N_{ccn} in their relatively polluted atmospheres were smaller than half of the observed N_{ccn} in this study."