

This manuscript describes a CCN activity in highly polluted location as observed at the Xianghe Atmospheric Observatory, China, and presents the analysis of the aerosol size and chemical composition effects on the CCN activity. While the data set is interesting and could provide new information, especially considering the location, the analysis and discussion is lacking clarity and thoroughness.

General comments

The fact that MAF is always significantly below 1 raises some questions, it well may be due to externally mixed hydrophobic particles as explained by the authors; however, this has to be proven. First of all, it should be shown or at least checked if MAF is equal to 1 for the calibration particles (e.g. ammonium sulphate) at high number concentrations (~25000). This would rule out effects of water depletion and system setup. Once this is proven, an evidence or indication that externally mixed fresh black carbon particles were present during these observations should be provided. Actually, black carbon is not even mentioned here, some vague explanation of "externally mixed particle composition" (page 14901, L 19) is presented, which, to my opinion, is not enough to prove such a significant effect.

Also, the paragraph 4.2 on κ dependency on D_p requires more details. What is D_p in this case? How the dependency is derived? I assume it is the same D_p as in Figure 4. If data presented in figure 2 are averages of the data shown in Figure 4, then I see some inconsistency, which has to be verified: $\kappa_{\text{cut_POL}}$ at $D_p=163\text{nm}$ would average out to ~0.46, which contradicts the number presented in figure 2 (<0.4), but would be in line with other kappa's at different sizes and there would be no more reduction in kappa with D_p ... I may be wrong, but this should be checked. In any case, one should be cautious by basing the conclusion on one point, which seems to be outlier. However, if you trust this point and think that it is outside a kappa uncertainty range, then it should be shown and proven in this paragraph.

The potential of information on chemical particle composition has not been fully used here. κ_{chem} differs from other kappa's derived in this paper, which is attributed to incorrect kappa used for the organics, then why not to try different and correct kappa's? Why not to link organic kappa with f44, especially that authors indicate AF dependency on f44 in polluted cases.

Figure 5 indicates two modes, at least for the background κ , thus two values at ~0.35 and 0.45 would be consistent with figure 2, which shows different kappa at different sizes. Could you check if this would be consistent with particle size distribution: if lower κ_{chem} occurs for the events dominated by smaller particle mode and vice versa – larger κ_{chem} for particle distributions dominated by larger particles (size distributions could be obtained from concurrent smps measurements).

The whole paragraph on chemical composition (4.6) is very qualitative, it requires more quantitative approach: I suggest the authors provide scatter plots with proper statistics, or at

least quantify ‘high correlation’, ‘well correlated’, ‘moderate correlation’. Time trends are not enough for proper analysis.

Specific comments:

P14895 L3 and L13: RH range should be specified.

P14896 L1: More details on ACSM operation should be provided, e.g. collection efficiency applied in this study; information on the inlet: particles were or were not dried; calibrations.

P14896 L11: Specify N_{cn}, what were the lowest and highest size limits?

P14899 L14: Why sea salt and dust are expected to be negligible for the size range of < 500 nm? Give some more information, discussion, references.

P14899 L15: Define size (mobility diameter, vacuum aerodynamic?) why 10-500nm if ACSM measures 50-1000 nm, I guess it is in D_m, but it should be specified.

P14903 L17-18: This sentence is confusing – reduction due to good activity?

P14905 L17: To me the range is 0.15-0.52 as shown in Figure 5.

P14908 L8, L11, L25, L24 and others: define goodness with R or R².

P14910 L22-23: this sentence is confusing- smaller particles were more aged and coated than larger particles? It requires better explanation.

Figure 5: Include a description of the red line at 0.3 and fittings into the caption.

P14910 L13: Provide a reference for the typical atmospheric SS of 0.4 %.