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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Contrasting ambient fine particles hygroscopicity derived by HTDMA and HR-AMS measurements between summer and winter in urban Beijing" *by* Xinxin Fan et al.

Anonymous Referee #1

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In this manuscript in discussion for publication in Atmospheric Chemistry and Physics (acp-2019-583), Xinxin Fan and co-authors present a field study comparing aerosol hygroscopicity in summer months relative to the those measured in winter. Measured hygroscopicity was compared to hygroscopicity based on HR-ToF-AMS measurements of composition for Beijing and northern China. The focus on this work was mixing state as a potential cause of the discrepancy between measured and estimated hygroscopicity. Interesting observations are presented and discussed in a mechanistic framework. This work is part of a larger effort to understand the air quality in China, and is important and timely. I have significant concerns, however, about the novelty of the study and the presentation of the data, which I have outlined below. The data and study de-

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sign are not novel, and in fact several of the same authors have written a very similar manuscript (published in ACP: https://www.atmos-chem-phys.net/18/11739/2018/acp-18-11739-2018.pdf) from the same field campaign. The preparation of figures as clear and succinct visual aids to the writing is poor, and the authors invoke limited and dated studies on water uptake by mixtures of compounds. These issues could potentially be resolved with appropriate major revisions.

Regarding the novelty of the manuscript, I would urge the authors to share in the introduction the previous findings for the same dataset or the co-located instruments. It is not clear at present the degree of overlap but it is not the policy of ACP to publish the same data, analysis, and interpretation twice. The difference between (for example) the CCN and HTDMA needs to be clearly stated in both the method and the interpretation and discussion of underlying physical processes. If the authors do not differentiate effectively between the scientific questions answered by similar instruments, then the study is essentially the same as the published study. This can likely be resolved but will require careful effort.

Comments on figures and interpretation of figures:

The figures do not always serve as appropriate and helpful guides to the writing. The number of figures in both the manuscript and the supplement could be reduced. Not all figures are discussed, and several figures seem to be entirely redundant. The data in the figures is difficult to interpret due to the overlapping error bars.

Figure 3: It's not clear why this figure does not take the full page width, as it already seems to exceed a 1-column width. It would be helpful to include markers for "morning traffic," "afternoon traffic," or other factors that influence these timeseries. The reader is without a frame of reference. Also, in the caption it would be helpful to see the location for these timeseries, or whether these are averaged for all sites.

Line 218: Figure 3e is referenced before any discussion of all the other panels in Figure 3.

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Figure 5: Authors neglect to describe the two lines on each plot; are the R2 values first or second in the parentheses? Are the 1:1 lines anchored at 0? There seems to be little to no correlation between kchem and kgf.

Line 275: These numbers don't match the figure. With R2 values of 0.01-0.23 for the kchem vs kgf correlations, I would hesitate to report the slope of the fit line. Anchoring the line and a value other than (0,0) would give a different slope with a similar R2 value.

Line 292: In figure 6 the gap between kgf and kchem for larger particles looks similar across all plots. A closer look that kchem is higher in the late afternoon only in winter, and lower in summer. But, all the error bars appear to overlap almost completely. I strongly recommend displaying the data such that the error bars can be distinguished. By way of example: the dotted lines in the background are unhelpful, the resolution of the figure is not high, and the midpoint of the error bar is not entirely necessary if the error bars are symmetric above/below this point. Some authors use overlapping shaded regions (https://andrewpwheeler.wordpress.com/2016/03/08/on-overlapping-error-bars-in-charts/).

In panel B the yellow trace is hard to see. Error bars are omitted.

Figure S6: How is Figure S6 different from Figure 6?

Figure S1 and others: Kappa should not be negative and this could indicate evaporation of some fraction of particles.

Comments on underlying physical processes

The readership may already have an understanding of internal vs external mixtures. The description of internal vs external mixing is not succinct and does not contain many references – I suggest reducing the length of this review and incorporating the following elements: more quantitative information, more references and conclusions drawn from previous work.

Line 53: Are they?

Water uptake by coated particles (including those coated with aliphatic compounds) is likely not inhibited (https://www.pnas.org/content/110/22/8807, https://www.atmos-chem-phys.net/19/3325/2019/acp-19-3325-2019.html).

Line 71-73: There have been continuing studies of the hygroscopicity of mixed aerosols under controlled conditions, which may provide additional framework for mechanistic discussion:

https://pubs.acs.org/doi/full/10.1021/acscentsci.5b00174

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2011JD016823

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2007JD009274

https://pubs.acs.org/doi/10.1021/acs.jpca.5b09373

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