Review of "Particle hygroscopicity and its link to chemical composition in the urban atmosphere of Beijing, China during summertime" by Wu et al.

This paper presents summertime measurements of aerosol chemical composition and hygroscopicity in Beijing. The authors do a good job of presenting and discussing the data and their results should be useful in increasing our understanding of aerosol chemical composition and CCN behavior in this region. I recommend that this paper be published after the following comments are addressed.

General Comments:

1) Some more discussion of the air masses and aerosol sources impacting the sampling site during the study would be very useful. What are the major local and regional aerosol sources? Is long range transport an important contributor to aerosol concentrations during this time? If so, what source regions are air masses coming from? More meteorological information should also be added. Was this time period characterized by stagnant conditions? Were there any rain events of frontal passages? If so, did these meteorological events lead to any changes in the measured aerosol properties? All of this information would greatly improve the utility of the findings presented here.

2) The authors include non-refractory aerosol components and black carbon in there analysis but no mention is made of other aerosol species. Please discus the role of dust and sea salt and any potential uncertainty or bias that may be introduced by neglecting these aerosol types

3) There are a number of studies that have examined aerosol hygroscopicity and chemical composition in various environments around the world. The authors allude to a few of these in the introduction but do not discuss their findings in the context of these previous measurements or compare results. For example, Paramanov et al. (2013) present size resolved κ values compiled from four different studies which agree very well with those presented here, even though they were all from remote locations. The analysis performed here is also very similar to that done by Levin et al. (2012; 2014) who compared measured aerosol hygroscopicity with that calculated from aerosol composition and also measured during new particle formation events. The results presented here for the hygroscopicity of newly formed particles is actually the opposite of that found by Levin et al. (2012) who saw a decrease in κ for newly formed particles. This difference might indicate the different roles of organic versus inorganic condensing vapors on new particle growth in remote and urban environments. Putting the results of this paper into the

context of such previous measurements would again greatly help to increase the usefulness of these findings and strengthen the paper.

4) Before publication the paper should be thoroughly proof read for English grammar and word usage.

Specific Comments:

Page 11500, Line 8: What was the size range for the SMPS measurements?

Page 11501, Line 25: Was this a home built PAX instrument? Please provide more information.

Page 11501, line 25: The reference here should be (Arnott et al. 1999). This is also wrong in the list of references.

Page 11503, line 14: Please add a figure showing the SOA and POA fractions during the study and discuss their relative importance during different time periods.

Page 11504, line 9: Were wind speed and direction also measured? If so, please add them to Figure 1 and discuss how they may have impacted the measured aerosol properties.

Page 11505, Line 3: Please show the GF-PDF mentioned here.

Page 11505, Line 21: Was $PM_{2.5}$ calculated from number size distributions or is this from a separate measurement?

Page 11505, Line 27: Were there other changes in aerosol characteristics (i.e. chemical composition, size distribution or κ) during high PM events?

Page 11506, Line 16: Please show a timeline of BC concentrations. This could be added to Figure 1.

Page 11507, Line 8: While the fitted slopes are close to one, indicating no systematic bias, there is considerable scatter around these lines in Figure 4. This means that in specific cases κ may not be well predicted, as claimed here. Please mention this and discuss what might be causing the scatter.

Page 11508, Line 3: The slope of the κ_{org} vs O:C line from this work is much flatter than those of the other studies shown in Figure 5. Given the small slope and large scatter, it appears that one of the main conclusions from these measurements is that O:C is not a good predictor of κ_{org} for this data set (as stated in the discussion). I feel this should be stated in the abstract and conclusions instead of presenting the empirical relationship between κ_{org} and O:C, which is weak.

Page 11508, Line 17: Please show, and discuss, how measured aerosol composition and κ changed during the NPF event.

Page 11509, Line 7: It appears that there was an air mass change prior to the NPF, as indicated by the sharp decrease in aerosol concentrations. The change in 250 nm aerosol properties could just be due to this change and it may not be correct to directly compare these particles before and after the event.

Figure 2 Caption: This should say "Mass fraction of inorganics" since this is what is actually plotted.

References:

Paramonov, M., Aalto, P. P., Asmi, A., Prisle, N., Kerminen, V. M., Kulmala, M. and Petaja, T. (2013). The analysis of size-segregated cloud condensation nuclei counter (CCNC) data and its implications for cloud droplet activation. *Atmospheric Chemistry and Physics* 13:10285-10301.

Levin, E. J. T., Prenni, A. J., Petters, M. D., Kreidenweis, S. M., Sullivan, R. C., Atwood, S. A., Ortega, J., DeMott, P. J. and Smith, J. N. (2012). An annual cycle of size-resolved aerosol hygroscopicity at a forested site in Colorado. *Journal of Geophysical Research-Atmospheres* 117.

Levin, E. J. T., Prenni, A. J., Palm, B. B., Day, D. A., Campuzano-Jost, P., Winkler, P. M., Kreidenweis, S. M., DeMott, P. J., Jimenez, J. L. and Smith, J. N. (2014). Size-resolved aerosol composition and its link to hygroscopicity at a forested site in Colorado. *Atmospheric Chemistry and Physics* 14:2657-2667.