Responses to Anonymous Referee #2

General Response: Thank you for your positive review of our manuscript. We sincerely appreciate the efforts you have put in the review process, and we improve this work based on your comments and suggestions. Below we will respond to your comments one by one. Your comments are in italics, and my responses are in plain text. All the changes have been included in the newest version of our manuscript.

Specific comments:

The manuscript by Shen et al. report size-resolved aerosol hygroscopicity measurements over an extended size range of 50-600 nm. This size range covers the mode diameter of ambient aerosol particles, and can thus provide more useful information about the optical properties and the climate impact of aerosol hygroscopic growth. They show that on average the number fraction of more hygroscopic mode particles decreases with increasing particle size for 400 nm or larger. However, the more hygroscopic mode in the larger size range is dominant during the polluted events, consistent with the general consensus that aqueous production of secondary species plays an important role in the formation of winter haze in Beijing. I think the measurement data and analysis are solid. The paper is overall clearly written but could be further improved in English. I, therefore, recommend publication in ACP once the authors address a few issues:

1. *In Line 16, the authors mention "unexpected low hygroscopicity"; however, in line 18 they say "this result is supported by previous chemical composition analysis". These two statements seem to be contradictory. Also, the authors should briefly discuss why the hygroscopicity decreases with particle size for large particles, based on previous chemical analysis (inorganic/organic fraction, dust, etc).*
   response: Thank you for your comment. These two statements are not contradictory. The "unexpected low hygroscopicity" means that the relatively low average hygroscopicity, especially during clean conditions, is unexpected because the accumulation mode particles used to be thought as more hygroscopic. However, when the pollution evolves, the growth and expansion of MH (more hygroscopic) group particles is consistent with general consensus that secondary species play a dominant role in the pollution evolution. For the second comment, we have some discussions in the section 3.1 (line 175-183). In the discussion, we compare our results with previous chemical analysis and find that the decreased hygroscopicity may be related to the increased mass ratio of EC, dust, or other undefined mass in larger sizes. Since we didn't have simultaneous chemical constituent measurements, we cannot give direct chemical evidence.

2. *It might be helpful to explain why the TDMA used in this study can extend the measurements to larger particle sizes. Is this because of a lower sheath flow rate or different geometry of the DMA?*
   Response: The TDMA can extend the upper size limit because of its unique geometry design. For the DMA, the relationship between electrical mobility size and voltage follows the equation:

$$V = \frac{Q_{sheath} \cdot \ln(\frac{R_{outer}}{R_{inner}})}{2\pi L_{DMA} Z_p}$$

For the same electrical mobility diameter, a lower voltage is needed if the $\frac{R_{outer}}{R_{inner}}$ is smaller. That's to say, a lower ratio of R_{outer} to R_{inner} will extend the upper size limit within the same voltage limit.

We compare the commonly used TSI 3080 DMA with the BMI 2100 DMA in the table below. It can be seen that the special geometry of the BMI 2100 DMA ensures that it can have a larger size limit.

Model	V	L_{DMA} (cm)	$\frac{R_{outer}}{R_{inner}}$
TSI 3080	10000	44.37	$\frac{1.961}{0.937} = 2.09$
BMI 2100	5600	34.02	$\frac{3.613\ cm}{3.120\ cm} = 1.16$

3. *What does the red line in Fig. 1c mean?*

Response: the red line in Fig.1c represents the mean values of calculated size-resolved light extinction coefficients during the whole measurement period. Please check the text in red in the following legend:

Figure 1: Frequency distribution of (a) aerosol number size distribution during the whole measurement period, (b) corresponding volume size distribution and (c) size-resolved light extinction coefficient contribution calculated from Mie theory. The red lines in (a-c) represent the mean values. The lines with marks in Fig. 1(c) denote the hygroscopicity measurement by HTDMA in previous and our studies.

4. *The citation and bibliography styles should be consistent with the ACP format.*

Response: Thank you for your suggestion. We updated the citation and bibliography format in the new manuscript.