

## ***Interactive comment on “Role of black carbons mass size distribution in the direct aerosol radiative forcing” by Gang Zhao et al.***

### **Anonymous Referee #1**

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This study uses combined two most common instruments to achieve the characterization of particle size for BC-containing particles, in addition addressing the importance of evaluating the radiative forcing impacts of BC by introducing the particle size. This study is well structured but needs to consider the following points before publication.

1. The observed two modes of the BCMSD in this study was the key conclusion, however the author should consider if the absorption measured by AE51 could be amplified due to the coating on BC particles at large size mode. As the aethalometer can only measure the absorption of the aerosol, it will bear large differences to convert the absorption of BC to BC mass at different size modes. The measured BCMSD will be also biased.

2. The radiative forcing impacts due to introducing the BC size information is rather

vague. As there is no direct measurement of vertical profile, how could SSA be so low in the upper level, which means there is a large fraction of BC, as shown in Fig. S6? It has not been demonstrated in the main text that how and why the BC size could influence the DARF results, due to the influence of asymmetry parameter? The DARF section needs a thorough revision I suggest.

#### Other comments

1. p. 1, line 23: the author should consider the BC mixing state on influencing the absorption at large mode.
2. p. 2, line 57: “and the BCMSD properties under different polluted conditions are not known yet”, it was not correct since BCMSD have been measured using SP2 for years.
3. p. 2, line 58: BCMSD is not correct, the author should mention that the diameter measured by MOUDI, SP2 and DMA is different. The diameter for the MOUDI was aerodynamic diameter, and the DMA was the mobility diameter. BC diameter of the SP2 was the diameter of BC core. The value could change due to different density and shape factor. I strongly recommend the authors to rewrite this paragraph.
4. p. 3, line 72: there are some mistakes with the reference “(Xiaofeng Huang et al., 2006)”.
5. p. 4, line 111: what does the “the ambient aerosol BCMSD” mean?
6. p. 5, Sec 3.1.1: The authors just mention how to correct the “loading effect” of the aethalometer, but not mentioning the multiple scattering correction of the filter which might overestimate the mBC value.
7. p. 5, line 145: If the measurement of AE33 haven’t been corrected for the multiple scattering effect, it should not be treated as a reference.

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