

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-173

Anonymous Referee #2

Referee comment on "Ambient aerosol properties in the remote atmosphere from global-scale in situ measurements" by Charles A. Brock et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-173-RC2>, 2021

This is an excellent manuscript. They have extremely unique measurements in the ATOM campaign with a comprehensive list of state-of-the-art instruments and conducted highly detailed data analysis to derive ambient aerosol properties including composition-resolved size distributions, CCN concentrations, and various optical properties. Understandably, the analysis involves some key assumptions and assumed parameters, which appear to be mostly reasonable to this referee. The manuscript is overall very well written and I do not have major comments. I applaud huge efforts by the authors. Given there are two very detailed comments, I have only a few comments as below. I strongly support the publication of this manuscript in ACP.

- For calculations of optical properties of black carbon particles, core-shell Mie theory was applied leading to absorption enhancements by coatings. Some studies indicated that coatings may not enhance absorption as expected by core-shell Mie theory. Refractive index of BC is assumed (Table 2), but this may be subject to uncertainty. Given absorption from coated BC contributes significantly to extinction (L580), can you estimate uncertainties associated with assumed refractive index and morphology on your calculations?

- Average K_{org} of 0.18 appears to be a bit higher than previous ambient measurements and modeling (e.g., Gunthe et al., ACP, 9, 7551, 2009; Pringle et al., ACP, 10, 5241, 2010, etc.). You used parameterizations of Rickards et al., which is based on lab measurements of model organic compounds. I wonder the impact and uncertainty associated with this application.

- BrC optical properties may change upon chemical aging and photolysis, as shown by recent laboratory studies (e.g., review by Laskin et al., Chem. Rev., 2015). I understand that it is very challenging to accurately estimate BrC optical properties and you do acknowledge relatively large uncertainty (L399). It may be worth to also mention dynamic and complex nature of BrC optical properties with appropriate references.

