

Interactive comment on “Size-resolved mixing state of black carbon in the Canadian high Arctic and implications for simulated direct radiative effect” by John K. Kodros et al.

Anonymous Referee #2

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The manuscript presents a case study examining radiative forcing by black carbon in the Arctic and its sensitivity to assumed mixing state. It uses observations made by an SP2 (black carbon and associated coatings) and a UHSAS (all aerosol) to constrain mixing state applied in the GEOS-Chem-TOMAS model and examines response of the calculated direct radiative effect. They find different mixing state assumptions lead to differences in DRE on the order of 0.3 W m^{-2} , with observationally-constrained values falling within two bounding cases (complete external versus internal mixtures). The analysis is thorough and well within the scope of ACP, and will be of value to the community. I recommend its publication once the following minor points have been resolved.

General comment Both instruments used in this study are optically based, so they have a refractive index dependence. There should be a little more discussion on the uncertainties related to converting the optical measurements to a size comparable with the model that will be used in the DRE calculations. Further, an assumed RI is provided for the SP2 coating analysis. Could the UHSAS measurements be adjusted to have an RI consistent with this assumption (e.g., 1.5 for coating species applied to all non-rBC containing particles)?

Specific comments Page 5, 16-22 - Were any laboratory tests performed to verify the lower limit for detection or is this number based on literature values?

Page 7 - some mention of refractive index impacts on sizing for both instruments (and a statement regarding how consistent the refractive index assumptions are between the two instruments (SP2 and UHSAS) is needed here.

Section 3.4 - While it may be obvious to most readers, I think it is worth pointing out the limitation of coating information being available only for a subset of the BC particles in this section in addition to the other limitations listed.

Figure 2 - I was a little confused by the wording in the caption: "rshell-constrained mixing state used SP2 measurements of BC core diameter and shell thickness to constrain BC mass". My understanding was that BC mass was always taken from the TOMAS simulation output. Does the caption mean BC mass per particle? Please clarify.

Figure 5 caption - should be "fraction of BC aerosol mass relative to total aerosol mass"? Also, could you provide an "average level" for the observations based on typical flight levels during the study? Same for Figure 6 as well?

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