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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.

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The authors used the SP2 and UHSAS measurements of BC mixing states to provide important observational constraints for model estimates of DRE over the Arctic. This work provides valuable information to advance the current understanding. I have a few comments/suggestions.

1. Previous observations (China et al., 2015) have shown a large variety of non-core-shell BC coating/mixing structures/morphology. Recent modeling studies (e.g., He et al., 2015, 2016) further indicated a substantial variation (up to a factor of 2) in BC optical properties by using those different coating/mixing structures/morphology. The

authors used a core-shell assumption for internally mixed BC, which may lead to some uncertainty. I suggest including these recent studies and add some discussions on this coating/mixing structure issue.

References:

China, S., et al.: Morphology and mixing state of aged soot particles at a remote marine free troposphere site: Implications for optical properties, Geophys. Res. Lett., 42, 1243–1250, doi:10.1002/2014gl062404, 2015.

He, C., et al.: Variation of the radiative properties during black carbon aging: theoretical and experimental intercomparison, Atmos. Chem. Phys., 15, 11967-11980, doi:10.5194/acp-15-11967-2015, 2015.

He, C., et al.: Intercomparison of the GOS approach, superposition T-matrix method, and laboratory measurements for black carbon optical properties during aging, J. Quant. Spectrosc. Radiat. Transf., 184, 287–296, doi:10.1016/j.jqsrt.2016.08.004, 2016.

2. Page 3, Lines 13-15: For the authors' information, a recent study (Qi et al., 2017a) also used the GEOS-Chem adjoint model to investigate the BC source contributions to the Arctic, which included most recent BC emissions (e.g., gas flaring, small-fire biomass burning, anthropogenic). This recent study is a useful reference that can be cited here.

References:

Qi, L., et al.: Sources of Springtime Surface Black Carbon in the Arctic: An Adjoint Analysis for April 2008, Atmos. Chem. Phys., 17, 9697-9716, doi:10.5194/acp-17-9697-2017, 2017a.

3. Section 2.5.1: recent studies (Qi et al., 2017b,c) have improved BC dry and wet deposition schemes in GEOS-Chem model, which leads to better BC simulations over the Arctic. The authors did not describe the BC dry and wet deposition scheme used in

the present study, which are key factors influencing BC simulations. I suggest adding some descriptions on BC deposition scheme used in the model and also including some discussions associated with the aforementioned recent improvements.

References:

Qi, L., et al.: Factors controlling black carbon distribution in the Arctic, Atmos. Chem. Phys., 17, 1037-1059, doi:10.5194/acp-17-1037-2017, 2017b.

Qi, L., et al.: Effects of the Wegener-Bergeron-Findeisen Process on Global Black Carbon Distribution, Atmos. Chem. Phys., 17, 7459-7479, doi:10.5194/acp-17-7459-2017, 2017c.

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