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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size distribution and coating thickness of black carbon from the Canadian oil sands operations" *by* Yuan Cheng et al.

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This manuscript describes the evaluation of the physical properties of rBC particles produced by activities related to the Canadian oil fields. The analysis is detailed and the document is well written. The conclusions are supported by the observations and there are several interesting results that provide useful recommendations for the climate modeling community, as well as suggestions for quality assurance for those who do rBC measurements with the SP2.

There are several minor issues and questions that I would like addressed, as well as one fairly major omission that needs to be added.

Major omission In general, any study that uses measurements needs to include an error analysis that describes the limitations and uncertainties of the sensing technique. In this presentation, no mention is made of how the aerosols are sampled. I understand that this is probably already done in companion papers, but it is necessary here in order to understand any losses/enhancements that may occur due to the inlet system that is implemented. What is the probability of evaporative losses of the material that coats the rBC? Are there any bends in the sample lines where particles can be lost and what are the losses by diffusion to the walls?

Minor issues and questions

Why were there no passes made upwind of the oil sands? Although I understand that the environment outside the emissions plume is likely similar to the environment upwind of the oil sands, I am quite surprised that the flight plan designers did not consider the need for baseline data upwind that would decisively show how much the downwind aerosol and gas concentrations were elevated over the background. If I was an apologist/defender of the companies operating the oil sand project, I would be asking that question, as well.

As a suggestion, and it should be included only if it provides additional information that is not already in the paper, the authors should look at the ratios of number and derived mass between the rBC and non-rBC measured just by the SP2. This might be a useful indicator of mixing or coagulation processes with age.

Nothing is mentioned about the meteorological conditions for the days of each flight that might have changed the patterns of turbulence, mixing and removal. Were any of the legs in the mixed layer?

The comparison of the non-rBC size from light scattering using the LEO and Gaussian fit is a very good quality assurance procedure that should be followed by anyone analyzing SP2 data and deriving coating thicknesses. I think that this needs to be reiterated in the conclusions.

Line 29: "...a type of unconventional petroleum deposit". Not sure this is relevant unless this type of deposit produces more chance of elevated pollution than oter types.

Line 74: "magnitude" By mass or number concentration?

Line 129: What is the rational for restricting the Dmev range from 70-260 nm?

Line 134: What is the rational for using this scaling method and has this approach been previously used by others?

Figure 5a: Why is MMD on a log scale with 4 orders of magnitude? Wouldn't a linear scale be a better choice to see if indeed there were and shifts? Also, I think that there should be standard deviation bars with these symbols.

Line 219: Change "were" to "was"

Line 303: Scavenging of rBC by diffusion and inertia should be mentioned. The curve fitting masks any broadening that might show up because of these processes. I suggest looking at the ratios of mass of rBC> 100 nm to < 100 nm. This ratio might change with aging due to coagulation.

Line 364: is the OA to rBC ratio by number or mass?

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