

## ***Interactive comment on “High–Arctic aircraft measurements characterising black carbon vertical variability in spring and summer” by Hannes Schulz et al.***

### **Anonymous Referee #3**

Received and published: 10 September 2018

This paper discusses and analyzes the measurements of the vertical distribution of refractive black carbon (rBC) in the high Arctic during the spring and summer measured with a single particle soot photometer (SP2) during the NETCARE project. The mean and variance of the vertical profiles of total rBC mass, mass-mean diameter, and the ratio of rBC to CO and total aerosol number are discussed, along with the changes in transport patterns and sources that lead to the distinct vertical layers observed in the profiles.

The data gathered in this campaign helps to fill an important gap in previous observations of the Arctic. The work presented in the paper is an excellent, detailed analysis

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of the sources and mechanisms (e.g., wet deposition) leading to the observed vertical profiles of rBC, helping to provide a conceptual model that explains key features displayed in the observations. Generally, the conclusions of the study are well-justified by the results shown and the potential for alternate explanations is appropriately discussed.

I don't have any major concerns with the methodology, results, or conclusions of the study. Most of my comments below focus on either unclear wording in the manuscript text or issues with the figures that made it difficult to identify some of the features discussed in the text. I've only focused on cases where it was unclear to me what the authors intended to say. There are numerous other language choices that struck me as odd, but rather than list them here I would suggest that these be addressed by an English language copy-editor before publication.

Minor concerns:

P1, L3: You might discuss what you mean by “high Canadian Arctic” here to clarify the region your results apply to.

P1, L6: “caused and changed” is an odd phrase. I think you mean the cyclonic disturbances caused additional transport of pollution, correct?

P3, L5 “spread of more than one order of magnitude” in what? rBC concentrations, deposition, or emissions? Please clarify what you are referring to here.

P5, Table 1: Please add a note to the table explaining that the “station” is the location the plane left from.

P10, Figures 2 and 3: The black triangles are very hard to see against the blue and green colors. Consider making the triangles white instead?

P11, Figure 4: The two blue shades for Alert and Eureka are very hard to tell apart. Can you make them easier to distinguish?

C2

P12, L1-2: I'm not sure the ARCTAS and NETCARE observations discussed in this paragraph are enough to conclude that "wet removal becomes more efficient during summer within the polar dome, but as well already during northward transport outside the dome." Do you have other evidence supporting that the changes seen in both campaigns are due to more efficient wet removal?

P12, L7-9: Are you saying that mixed Asian outflow is a source of the Arctic haze you observed in this campaign, or is it just an example to show that the haze concentration is usually lower than near the source?

P12, L15-16: I'm not clear what you mean by "could indicate a partitioning of rBC particle size within polluted layers." Can you please clarify what you mean by this sentence?

P12, L21-22: I think you need to be careful with the writing here. rBC could have a significant impact on solar light extinction (measured in  $W/m^2$ ) even if the number fractions of rBC particles relative to total aerosol was low. However, the low ratio, combined with the low rBC mass concentration, means the impact in this case is negligible. Thus, I think you have to mention the low mass concentration of rBC here before concluding rBC has a negligible impact.

P17, L31-32: How does this choice of only using trajectories that encountered above average  $M_{rBC}$  potentially impact your analysis and results? Is there a potential for bias from this choice?

P18, L1-2: Why did you not use the ECMWF boundary layer heights to determine the hatching instead?

P19, L1-2: I don't see the difference between Levels II and III discussed in this sentence in Figure 7. What should I be looking for in the figure?

P20, Figure 7 and P21, Figure 8: These figures are very difficult to see, maybe due to their small size in the combined figure. The color bar for the overpass frequencies

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should also be included in both figures. I'm also wondering if the color for high rBC/CO values is too similar to the red colors used for high overpass frequencies, so in Figure 7 a, I'm not sure if the red near the surface sites is just high overpass frequencies or also high rBC/CO ratios at the endpoints.

Typos and other style issues:

P1, L4: expand the acronym "NETCARE" here.

P1, L10: "factor of 10", not "factor 10"

P1, L22: "rBC was affected" not "got affected"

P7, L32: "As opposed to aerosol", not "Other than aerosol"

P21, L2: There isn't a Section 6, so what should this refer to?

P25, L10: "available ton the Government"?

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-587>, 2018.

C4