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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #2

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This paper presents novel data of black carbon (BC) aerosols obtained by aircraft observations over the Canadian Arctic in summer 2014 and spring 2015. The authors report clear seasonal variations of BC mass concentrations, mass-mean diameter, BC/total aerosols number ratio, and BC/CO ratio, and then try to understand the mechanisms that controlled vertical profiles of BC properties based on the analysis of potential temperature and back-trajectory. The instrumentation is clearly written in the Method section. Because the data of the vertical profiles of BC in the Arctic is very important to assess their radiative impacts and validate numerical models, the novel data presented in this paper is valuable to the community.

One aspect of the paper that I thought could be improved is the discussion on the mechanisms controlling vertical profiles. In many parts of the paper, the authors try to interpret the profile variations by "wet removal" or "nucleation scavenging". However, their conclusion is rather speculative and not well supported by data. I understand that the wet removal process is complex (especially ice-cloud scavenging) and difficult to examine, but if the authors can use any supporting data such as precipitation amount or humidity that air masses had experienced along the back-trajectory paths, more quantitative discussion on the observed variability (and also related new insights) may be achieved in the paper. In addition to this general suggestion, specific comments are given below.

Specific comments:

P6, Line 5: "avalanche photo-diode" should be "photomultiplier tube"?

P7, Line17: "STP" is used here, but defined later in Line 18.

P8, Line 31–33: I could not fully understand what the authors meant here (i.e., the meaning of "threshold filtering"). Please clarify this sentence.

P11, Figure 4: I suggest adding BC/CO data to Figure 4 so that it can correspond to Figure 5.

P12, Line 15: I could not understand what the "partitioning of rBC particle size within polluted layers" meant. Please clarify it.

P14, Figure 5 and 6: In Figure 5, are the colored profiles examples chosen from all the spring fights? (because they are indicated as like "YYYYMMDD_F1" in the legend). On the other hand, in Figure 6, the colored profiles are simply indicated as "YYYYMMDD". Is there any difference?

P15, Line12–13, The low R_numTA does not necessarily suggest that rBC has been depleted by nucleation scavenging, because total aerosols can be also depleted by nucleation scavenging and thus modify the R_numTA value.

P17, Line 18–19: In Figure 6, the level (III) starts at 294 K. Is it correct?

P21, Line 2: “Sec. 6” should be “Sec. 3.3.2”?

P22, Line 19: Sahu et al. (2012) reported mass “median” diameter by applying log-normal fit to the observed size distributions. On the other hand, the present paper reports mass “mean” diameter. For comparison of the data, it should be noted that the definition of “MMD” is different between these studies.

P23, Figure 9: X-axis should be log-scale?

P23, Line 4: “asses” should be “assess”.

P23, Line 9–15: Moteki et al. (2012) discussed coating volume (mass), not shell/core diameter ratio. Because a BC particle with core of 220 nm and shell/core diameter ratio of 1.4 actually has larger coating volume than a BC particle with core of 140 nm and shell/core diameter ratio of 1.6, the results explained here are not contrasting but rather consistent with Moteki et al. (2012).

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