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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aircraft observations of enhancement and depletion of black carbon mass in the springtime Arctic" *by* J. R. Spackman et al.

Anonymous Referee #3

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GENERAL

BC is an important contributor to warming in the Arctic. Most BC measurements in the Arctic have been done at surface stations even though for estimating the atmospheric heating information on the concentrations aloft are of utmost importance. This paper presents vertical profiles of BC measured with a new method, the SP2, in Alaska and north of it. The paper is well written, and figures are mainly clear. The authors have also used a simple model for estimating mixing between BL and FT and dry deposition. This certainly adds value to the paper and I can recommend it to be published in ACP after some additions and modifications.

DETAILLED COMMENTS

P15168, Abstract, L18 – 22. Too long a sentence and cannot actually be understood without reading the section in the actual article. I suggest splitting it and adding some explanation, one sentence?

P15170, L11- "While BC is observed in snow at sites throughout northern high latitudes (e.g., Hegg et al., 2009), scattering aerosol such as sulfate may be preferentially scavenged leaving behind BC aerosol suspended in the atmosphere." References? This is something that requires some explanation. Fresh soot aerosol gets coated with both inorganics and organics very quickly – typically within minutes or hours, externally mixed soot is there practically only in the immediate vicinity of traffic or biomass burning – when the BC particles have gone to the Arctic they most probably are internally mixed with scattering material and the statement that "leaving BC aerosol suspended" is somewhat hard to believe. Or does the SP2 show that there were externally mixed BC particles?

P15173 L8 – " the profiles obtained with the SP2 generally show lower BC mass loadings compared to those from an aethalometer during the Arctic Gas and Aerosol Sampling Programs (AGASP) campaigns conducted in 1983 and 1986." Will you please add some numbers, i.e., actual concentrations from the other campaigns and yours, rather than telling that "generally show lower BC" and let the reader to start digging the papers and numbers. Here it would be good to give some comparison of the concentrations.

P15178, L10 – " In (ii), the black points embedded in the main body of data points for 40<O3<55 ppb and 30<BC<200 ng kg−1, the correlation is a mixing line between the air masses in the ABL and the free troposphere." I cannot really see these points in Fig 7. There is so much data in the plot, it is messy, even though you have used the color coding. I would suggest separate plots, for example 7A, 7B, 7C where there could be one with all data and then separated to different altitudes.

P15178, L17 – Here is the hypothesis of BC dry deposition. I have no objections but I suggest you also consider this: how about if the soot particles are actually internally

mixed with some more hygroscopic material, such as sulfates, nitrates etc. At low altitudes RH is probably larger, especially above the leads. Then hygroscopic particles would grow and that would increase deposition velocity. Later, on lines 22 – you discuss the size distributions. I really would like to see them here, including the modal parameters.

P15179, L19 – I would like to see the differential equations in the final paper. Is it just four differential equations? Please present them, other people may use the same and test them.

P15180, L28 – "The corresponding deposition fluxes are 170 to 1700 ng (m2 day)-1" How did you get these numbers. Add a few lines of explanation, maybe as an equation, so that the reader may follow and possibly recalculate these numbers.

Several lines: you write about gradient when you mean a difference. If you write about gradient, then you should present it as "concentration difference /altitude difference" with the respective units.

Why do you use ng/kg as the unit of BC concentration? In a vast majority of BC literature it is expressed as mass/volume.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 15167, 2010.