

Interactive comment on “Absorbing aerosol in the troposphere of the Western Arctic during the 2008 ARCTAS/ARCPAC airborne field campaigns” by C. S. Mc Naughton et al.

Anonymous Referee #1

Received and published: 21 March 2011

This paper describes observations of atmospheric aerosol particles during the spring 2008 ARCTAS/ARCPAC program in Alaska. The focus is on the light absorption properties of the particles, specifically the mass absorption efficiencies (MAE) of the absorbing components of the particles: black carbon (BC), brown carbon (BRC) and dust. In the end, the authors estimate the relative contributions of each of these components to aerosol light absorption in the springtime Western Arctic. The MAE results are consistent with previous work and overall this work has the potential to provide a good contribution to our knowledge of light absorption by particles in the Arctic, but there are some technical points to be addressed first. The paper is structured well, but it looks a little hurried towards the end and that makes for a little confusion, on my part

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at least.

Main comments:

1. On lines 591-597, you use BC as a reference to define BrC. The implication of BC as a surrogate is that there is no LAC resulting from secondary organic aerosol (SOA). How does the non-BC refractory carbon mass compare with the OM from the AMS for the cases you use in Figure 7? Unless all SOA is non-absorbing, then the AMS OM may be a better surrogate for non-BC absorbing carbonaceous aerosol. Please discuss this.
2. There is a lot of discussion of dust and its absorption properties in this paper, but I can not find anywhere where dust is defined using anything but simply particle size (submicron vs supermicron). How do we know your “dust” is really dust? And specifically, the ubiquity of the dust mentioned on lines 636-637 is not evident from this paper. Is dust a general feature of the Western Arctic atmosphere or was 2008 anomolous? On line 658, indicate in the conclusions the method(s) used to identify Asian dust.
3. Conclusions and Figure 13 – As you mention at the end of the conclusions, the results shown in this figure are not necessarily representative of the Western Arctic in general. That also needs to be indicated in the figure caption and some of the wording in the earlier part of the conclusions needs to be modified. - Line 637 – “. . . absorption by dust accounted for at most. . .” - Line 647 – “accounted. . .” - Line 651 – You need to express the comparison of the various properties measured on the different aircraft in a more quantitative manner. - Lines 665-667 – “aerosol absorption WAS dominated . . . burning during April 2008.”
4. There is no mention of the effects of particle sizing on absorption and scattering. Is this not important?
5. Section 2.0 – The instrumentation discussion is not very informative. Referring to

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“teams” is insufficient. At very least the main instruments used to derive the results in this paper need to be briefly described along with their calibrations and uncertainties. At a few points in the paper, we are given hints about these things. The main instruments (the SP2s, the PSAPs AND the methods of separation of particles between submicron and supermicron sizes) need to be discussed in section 2.

Minor comments:

6. Line 50 – by all accounts, the Arctic has begun to experience a profound transformation.
7. Line 64 - Please elaborate on what you mean by "accumulation". Where does the aerosol come into and leave the Arctic and in what manner does it accumulate? I can not find where the Shaw reference discusses this.
8. Line 144-145 and line 176– Should have a reference for the Alert measurements: either Sharma, S., E. Andrews, L. A. Barrie, J. A. Ogren and D. Lavoué, Variations and Sources of the equivalent black carbon in the high Arctic revealed by long-term Observations at Alert and Barrow: 1989-2003, *J. Geophys. Res.*, Vol. 111, D14208, Doi:10.29/2005JD006581, 2006 –OR- Gong, S. L., T. L. Zhao, S. Sharma, D. Toom-Sauntry, D. Lavoué, X. B. Zhang, W. R. Leitch, and L. A. Barrie, Identification of trends and interannual variability of sulfate and black carbon in the Canadian High Arctic: 1981–2007, *J. Geophys. Res.*, 115, D07305, doi:10.1029/2009JD012943, 2010.
9. Lines 176-178 – There is no dispute of this statement. However, you must recognize that the aerosol up to 8 km over Alert may have different source regions than that over Barrow. In particular, did the biomass burning plume extend over Alert? Ground measurements may not be so good for representing impacts, but they do reflect emissions trends and in such remote regions they must reflect somewhat the character of the aerosol in the lower troposphere.
10. Figure 3 - We might expect relatively more CO and less BC in BB plumes as

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suggested by the DC8 and WP3D observations, but based on the AMS plot the P3B observations seem to be opposite. Can you explain?

11. Line 232 – “it” rather than “is”.
12. Line 240 - due to instrument malfunctions, zeroes or something else?
13. Line 314 – Reference for intensive aerosol properties?
14. Line 346 – discuss PSAP detection limit in section 2.
15. Line 348 – You should discuss your FFscat threshold of 0.6 in terms of Figure 10. From Figure 10, it looks like the mean contributions from coarse particles are about 25%. How important is this?
16. Lines 372-382 - Can there not be significant brown carbon that will volatilize below 420oC? e.g. Andreae and Gelencser, ACP, 2006.
17. Lines 390-397 – Your screening does not completely remove coarse dust either.
18. One lines 443-445, you say that Kondo et al (2009) attributed a factor of 1.8 to filter matrix effects. One lines 461-464, you state that Kondo et al (2009) found offsetting effects resulting in no enhancement. Please clarify this discussion.
19. Lines 491-492 – Reference for this ubiquity?
20. Lines 492-495 – “after multiplying the integrated supermicrometer volume size distributions by...”
21. Lines 498-500 - In Figure 9, the legend says P-3B not WP-3D.
22. Line 500 – “These data are...”
23. Line 502 – Perhaps panel rather than column, here and elsewhere. Column implies text.
24. Lines 508-511 - In fig 9, why do you have mass for the P-3B and for the WP-3D

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but extinction for the DC8? This discussion needs to be clearer. Also, the inlet to the aircraft is characterized for coarse particles, but with what efficiencies are the coarse particles getting into and being detected by the nephs from the manifold?

25. Line 522 – FT is undefined.

26. Lines 527 and 528 – intex-Na?

27. Line 552 – LAC is undefined.

28. Lines 553-560 – The paper is mostly about measurements from the PSAPs. The noise levels need to be discussed in section 2.0.

29. Lines 588-589 – “the mean and median MASS concentration. . .”. How do we know this is all dust? And how do we know this is all Asian dust?

30. Line 591 – “non-BC refractory mass” - do you mean BrC rather than “(BrC+BC)”?

31. Line 608 – ‘Natural’ dust?

32. Lines 607-617 – These results would be clearer if they were presented in a table.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1543, 2011.