

Interactive comment on “A trajectory analysis of atmospheric transport of black carbon aerosols to Canadian High Arctic in winter and spring (1990–2005)” by L. Huang et al.

Anonymous Referee #3

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An analysis of source region impact on measured BC concentrations at Alert is described. The technique used is unique and provides another measure of which source regions have the greatest impact as a function of season (winter vs. spring). The results are in agreement with previous analyses (e.g., Stohl (2006)). The paper should be published as it contributes to the understanding of which source regions impact the Arctic and the importance of emissions vs. transport. That said, the paper needs appreciable revisions before it is publishable in ACP. See detailed comments below. Finally, the paper would benefit by being edited for English grammar.

Abstract, line 1 -2: Change to: “Black carbon (BC) particles accumulated in the Arctic

C410

troposphere and deposited ON snow HAVE BEEN CALCULATED to have significant effects on radiative forcing of Arctic regional climate.” This wording should be used throughout the paper.

Abstract and throughout: Emission intensity is never defined.

Abstract, line 6: Transport frequency relative to what? For different geographical regions? Please define this in the abstract.

Abstract, line 9: Why only January and April? Have any trajectory analyses been done that demonstrate that these months are representative of winter and spring or just January and April?

Abstract, line 12 – 13: It would be useful to add a sentence saying “Other factors, such as deposition, could also contribute to the variability in BC concentrations but were not considered in this analysis.”

Abstract, line 22: “It is also found that the change in Eurasian contributions...” What change is being referred to here? Seasonal change? Decadal change?

p. 2223, lines 1 – 2: Again, each of these references is a model study. Wording here should be changed to “have been calculated to have significant effects...”

p. 2223, line 16: Name the two different sites, give latitude and longitude for both, and explain why it is hypothesized that they are impacted by different sources regions.

p. 2223, lines 20 – 22: Change sentence to “...a broad peak in BC concentration is observed from January to April...”

p. 2223, lines 22 – 24: State whether the observed decreasing trend in BC concentrations occurs for year-round data, Arctic Haze season data, and/or summer data.

p. 2223, line 26: Should be “associated with”.

p. 2224, line 10: which two sectors?

C411

- p. 2224, line 15: Explain how the “average length” of the 10-day back trajectories relates to the strength of transport. Is “average length” the distance covered in 10 days?
- p. 2224, line 18: Again, what is the definition of the BC emission intensity?
- p. 2224, line 23: Change to “Continuous hourly measurements of aerosol light absorption at Alert. . . .”
- p. 2226, lines 4 – 5: Change to “. . .black carbon in the northern mid-latitudes is predominantly. . .”
- p. 2226, line 5: should be “BC trend”
- p. 2226, line 7: what is meant by “transaction amounts”?
- p. 2226, 1st paragraph: I found the discussion of emission inventories to be confusing. Did the authors use data from United Nations (2007) and the method of Cooke et al. (1999) to construct emission inventories for the different regions and years mentioned? What is the 50% reduction in BC emissions from the former USSR and the 10%/yr increase in South Asia based on? Why are the Bond et al. (2007) global emissions mentioned when regional emissions are used in this analysis? On lines 15- 16, it is stated that “only emissions every 10 years until 2000 are made available to the public on their web site. . . .” Whose web site? Last line of the paragraph: were your emissions determined using the method of Cooke et al? In other words, it needs to be more clearly stated how regional surface fluxes were calculated. Also, this paragraph describes the development of regional emission inventories but not “BC emission intensity.” What is the BC emission intensity and how was it derived? It would be helpful if all of these terms (emission, emission intensity, surface flux) were defined.
- p. 2226, line 19 – 22: Sentence is poorly constructed. Change to “Based on the work of Stohl (2006), North America, the European Union, and the former USSR are the major BC source regions affecting Alert.”

C412

- p. 2227, lines 21 - 22: As mentioned above, Section 2.1 – 2.3 needs a clearer description of the methodologies used to derive emission intensity.
- p. 2228, line 2: Change to “. . .that BC emissions other than. . .”
- p. 2228, line 6: Presumably this should be “. . .for the case of a high LATITUDE Arctic surface site. . . .”
- Figure 2 caption: State in the caption that these are average 10 day backward trajectories.
- p. 2228:, line 26: Is Cluster 2 (20%) significantly different from Cluster 1 (17%) or Cluster 6 (18%)?
- p. 2229, lines 9 – 10: Based on the figure, it is not clear that trajectories in cluster 1 originated in Europe. The trajectory shows flow from the west and then northwest over Greenland.
- p. 2229, line 10: Change to “. . .and Europe.”
- p. 2229, line 15: Change to “. . .amount of time traveling. . .”
- p. 2229, lines 24 – 25: Change to “Such long range transport is found during the winter 18% of the time.”
- p. 2229, lines 25 – 26: Clarify what is meant by the sentence that starts with “Transport from Eastern Siberia. . . .”
- Tables 1 and 2: It would be easier to see the temporal trends and variability in the transport frequency if these data were presented as figures instead of tables. I would do this as individual panels in a figure where each panel has the winter and spring data for one cluster.
- p. 2230, line 18: Change to “Given monthly average BC concentrations. . . .”
- p. 2230, line 23: Change to “. . .monthly average BC concentrations. . . .”

C413

p. 2230, line 26: Change to “. . . indicates the fraction of the inter-annual variations. . . .”

Figure 3 caption: squares should be squares.

p. 2231, lines 23 – 28: It would be more useful to put the degree of under- and overestimation in terms of percent difference between measured and modeled concentrations.

p. 2232, line 7: Omit “According to the model. . .”

p. 2232 and Figure 4: Why are the contributions of BC transport from the North American and Eurasian sectors averaged over January and April? Why not consider the two months separately as BC deposited in winter vs. spring could have very different radiative impacts?

p. 2232, lines 14 – 17: Sentence needs to be re-written for clarity.

p. 2232, line 23: Change to “. . .the first 8 – 10 years after 1990..”

p. 2233, lines 3 – 6: It is stated that, for the North American source region, BC concentrations at Alert did not depend only on “regional BC emission, but also on other factors, especially atmospheric transport patterns.” What were the other factors? Provide a discussion to support the phrase “especially atmospheric transport patterns”.

p. 2233, lines 19 – 21: Again, the limitation of this method to account for the impact of the removal of BC from the atmosphere should be included in this discussion.

p. 2233: lines 22 – 23: Sentence needs to be re-written for clarity

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 2221, 2010.