**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Long-term trends of black carbon and sulphate aerosol in the Arctic: changes in atmospheric transport and source region emissions" *by* D. Hirdman et al.

Anonymous Referee #1

Received and published: 14 July 2010

This paper uses a Lagrangian transport model and observations of black carbon and sulphate from Arctic surface stations to investigate contributions from changes in atmospheric circulation patterns and changes in source region emissions to the observed BC and sulphate concentration trends. The paper is very well written, provides a thorough analysis of the observed trends, and clearly presents its findings. In addition, the authors have shown careful thought in dealing with uncertainties in and comparability between the different datasets used, and have adequately addressed the statistical significance of their findings. The paper will be of great interest to the atmospheric composition, meteorology and climate science communities, and is suitable for publication in ACP once the following comments have been addressed.

Specific comments:

Page 12136, lines 16 / 22: Description of available data at measurement sites. It would be helpful to state locations (lon/lat) of the sites here, where they are first mentioned, rather than in Sec 2.1.1. Alternatively, lon/lat coordinates could be added to Table 1 and referred to here.

Page 12141, lines 19-21. It is not obvious to the reader why the clean-sector screening may affect the representativeness of the data for analysing the potential source regions. Please add in a sentence to further explain.

Page 12143, lines 27-28. An alternative explanation to changes in sources may be changes in processing affecting efficiency of loss processes en-route. A caveat acknowledging this possibility should be added with a statement that the analysis will assume this is not significant.

Page 12144, line 6: It is not obvious what is meant by 'number of cases'. Is this the number of points from which the backward transport model is started for each observation time series? Please clarify.

Page 12145, line 5: It is not obvious what the 'silhouette technique' is used for or is intended to account for. Please add a sentence just to clarify this.

Page 12150, line 26/27: "reasonably well positively respectively negatively correlated.." This doesn't make sense - please correct / re-write more clearly. In addition, 'reasonably well' is subjective. Please quantify correlation / state significance.

Page 12152, lines 7-10: "The annual EBC concentrations decrease at a rate of -9% / yr...." This sentence does not make clear whether the -9%/yr trend is over the same 2001-2007 period as the Eleftheriadis et al., (2009) trend that is being compared, or over a different period. Please re-write this sentence to make this clear.

Page 12154, line 1: "agrees quite well.." is subjective. Please quantify agreement.

Minor / typographical comments:

Page 12146, line 11: 'insignificant lines' should be 'insignificant trends'?

Page 12154, line 12: 'use' should be 'uses'.

Page 12157, line 8: 'presents' should be 'presented'.

Table 3: 'Specie' should be 'Species'