

Interactive comment on “Long range transport of mercury to the Arctic and across Canada” by D. Durnford et al.

Anonymous Referee #2

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General comments

The manuscript presents results of a modeling study of mercury long-range atmospheric transport with a focus on the Arctic pollution. General character and details of the airborne transport of different substances (including sulfur, aerosols, ozone, black carbon, etc.) to the Arctic is studied in a variety of modeling and measurement works and documented in the literature. However, only few studies were focused on peculiarities of the Arctic airborne pollution with mercury.

The presented research includes detailed analysis of mercury ambient concentrations and extensive source attribution at a number of arctic, sub-arctic and mid-latitude Canadian sites involving detailed observations and simulation results of a chemical transport model for mercury. Application of the mercury transport model with detailed on-line

C1580

meteorology in combination with highly resolved measurements allowed identifying individual episodes of mercury long-range transport to the Arctic as well as contribution of different source regions to mercury pollution of the region.

The subject of the manuscript is relevant to the scope of the journal and the work makes up a new and original contribution. The data collection and interpretation techniques are sound and the drawn conclusions are convincing and justified. The manuscript will be suitable for publication after addressing the specific comments mentioned below.

Specific comments

1. Page 3, line 1: “Mercury, which is non toxic...” - probably, this strong statement requires specification of the mercury form and conditions mentioned (metallic/elemental, background concentrations - ?).
2. Page 3, lines 31-33: The list of previous works on the long-range mercury transport is definitely incomplete. I would suggest to add, for example, for the Arctic (Christensen et al., 2004; Dastoor et al., 2008), for North America (Bullock et al., 2008), for East Asia (Pan et al., 2008), globally (Seigneur et al., 2001; Selin et al., 2007)
3. Page 4, line 31: “... fully-coupled online chemical transport model, where meteorological and mercury processes are fully integrated” - the term ‘coupled’ is often used in the environmental modeling with different meanings. For example, a “atmosphere-ocean coupled model” or a chemically coupled model when chemistry of different pollutants is considered in complex. Therefore, some more extensive explanation of the online meteorology-to-mercury chemistry integration is required.
6. Page 15, line 11, “... from the surface to 516 sigma ...” - the units ‘sigma’ require some explanation. To my knowledge the common sigma co-ordinate varies from 0 to 1.
5. Figure 4 seems to be too cumbersome for a journal paper. A number of different aspects are considered simultaneously at the same figure – variation of source contri-

C1581

bution with the site location, with seasons and with altitude. The parameter changes appear to be insignificant so that it makes difficult finding the peculiarities mentioned in the text. I would suggest to consider different aspects separately and present them in more aggregated form. These detailed information could be moved to the supplementary materials. The same relates also to Figures 6 and 8.

Technical corrections

1. Page 4, line 30: Acronym of the Global Environmental Multiscale model (GEM) coincides with that of gaseous elemental mercury (GEM). Some replacement is needed to avoid confusion.
2. Page 4, lines 25-26: "... the observations are expected to be more variable than the observations." Probably, it should be "... the observations are expected to be more variable than the simulations."

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