**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Atmospheric transport of persistent semi-volatile organic chemicals to the Arctic and cold condensation at the mid-troposphere – Part 2: 3-D modeling of episodic atmospheric transport" *by* Lisheng Zhang et al.

L. Zhang

lisheng.zhang@ec.gc.ca

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First of all, we would like to thank the referee's comments and suggestions that improve the manuscript. In the response, the questions raised by the referee are listed with Q and our answers are given with A.

Q1) The model is driven by the data obtained from the archived analysis of meteorological fields available on a global grid every six hours. How does this relatively coarse

resolution affect the accuracy of the estimates of the boundary layer fields and the parameters describing the exchange between soil and atmosphere?

A1: The meteorological data driving our model was collected from 6-hourly interval NCAR/NCEP reanalysis data. These data was interpolated into every 30 minutes interval, the time step of our model. We acknowledge that the data are actually temporally smoothed. In terms of the well-known similarity theory, in the surface boundary-layer (below 100m above a surface under neutral condition) winds (and other scalars) are always in equilibrium with underlying surface conditions, and hence independent with time. Theoretically, soil/air exchange is a molecule exchange process which occurs even below the roughness length height (the lower boundary of turbulent boundary-layer), while this process is parameterized using winds in the surface boundary-layer. We therefore expect the coarse resolution of meteorological data would not affect soil/air exchange. On the other hand, because turbulence activities can extend to planetary boundary layer (about 1000 m from a surface in neutral condition), coarse resolution would influence the parameterization of turbulent mixing and diffusion of meteorological variables and air concentration. In both MEDIA and CanMETOP models, turbulence mixing is dealt with well-known sub-grid scale parameterization methods using large-scale (coarse) winds and temperature data. These have been described in the revised paper.

Q2) Is the advection scheme used in the models mass conserving to make it acceptable for long term simulations?

A2: As stated in our previous study with MEDIA (Zhang et al., 2008), we have implemented and modified the advection scheme. An embedded advection-diffusion module to transport chemical species has been adopted in the upgraded version of the MEDIA. The algorithm was designated in particular for mass conservative for chemicals and has been applied in Canada's Global Environmental Multiscale (GEM) model as well as regional and global climate models (GCM) (Cote et al., 1998). These statements have been added to the revised paper and a new reference on the embedded

advection-diffusion algorithm is also added to the Reference list.

Q3) How is the information concerning the concentration of toxic substances in the ocean handled? It is not clear whether or not this information is calculated dynamically in the model or is obtained from observations.

A3: Because transport of pesticides dissolved in oceans is much slower than that in the atmosphere (time scales of the order of years and days respectively) and sparse measurements, following Koziol and Pudykiewicz (2001) we assumed constant ocean concentration of selected substances (ïAğ-HCH in particular) in the present study. These statements have been added to the revised manuscript.

Q4) The authors state that "significant improvement in solving the atmospheric tracer transport equation was made by a state-of-science numerical algorithm (Zhang et al., 2008)". After reading the aforementioned paper I cannot clearly see how this new algorithm is formulated. Some additional information on this subject will improve the paper.

A4: The details were described in Cote et al (1998)'s article which has been added to revised Reference list.

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