

## ***Interactive comment on “PCBs in the Arctic atmosphere: determining important driving forces using a global atmospheric transport model” by C. L. Friedman et al.***

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Dear Ladies, Sirs,

I apologise for my late reply. Here now my review on the paper "PCBs in the Arctic atmosphere: determining important driving forces using a global atmospheric model" which I read with great interest.

General comments

1.) The ability of PCB to cycle through different environmental phases is described. However, the importance of "lipophilicity" as inherent property required to follow the

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lipid transfer along the food web should be mentioned here as an important feature for the transfer along the Arctic food webs but in particular as prerequisite for the elevated levels found in indigenous people of the North like the Inuit heavily relying on local lipid rich (fatty) marine food sources (mentioned in the introduction).

2.) The "differential removal hypothesis" postulated by "von Waldow and co-authors" (2010) does not exclude ambient temperature as important driving force for the global distribution of POPs but rather includes a new defined "gradient of remoteness" into the list of driving factors of global POP distribution. It should, thus, be rather considered as an extension of the global fractionation theory than as a competing theory, as explained here.

3.) The importance of deposition processes is stressed in the here discussed study. Deposition from the atmosphere is considered a key-process for the here discussed "differential removal hypothesis". In order to appreciate these deposition processes, please discuss and compare wet and dry deposition (gas- and particle phase) equally as important processes for the transfer of PCBs from the atmosphere into the biosphere supported and illustrated by the here chosen model approach. The deposition pathways for PCBs is obviously dependent on the degree of chlorination and, thus, the volatility and the ad-/absorptive interactions of the respective congeners with the particulate/ aerosol phase. The implication of dry deposition (Gaseous ad particulate) is mentioned and discussed. However, wet deposition should also be considered and discussed (since it is not mentioned here) in the model when discussing PCB deposition properties. Wet deposition is a strong seasonal feature in the Arctic where deposition occurs as rain during the short summer period and mainly as snow during the colder season (around August – Mai). The scavenging effect of snow has been identified earlier as important seasonal property for PCB deposition already (i.e., Gregor D.J., Gummer W.D. (1989) Env. Sci. Technol 23/5: 561-565 and Herbert B.M.J. et al (2005) Env. Sci. Technol. 39/9: 2998-3005 and many others).

4.) Please provide a list of abbreviations in the Supplementary material section

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5.) Explain why PCB 28 (2,4,4'-trichlorobiphenyl, C<sub>12</sub>H<sub>7</sub>Cl<sub>3</sub>) and later PCB 153 (2,2',4,4',5,5'-Hexachlorobiphenyl, C<sub>12</sub>H<sub>4</sub>Cl<sub>6</sub>) was selected as model congeners for the sensitivity simulations and discuss the strategy for the parameter tests (single parameter modifications and/or combined modifications) in detail in order to understand fully your research concept.

6.) When discussing the influence of ambient temperatures on PCB re-emission and seasonal trends, the inverse correlation to degradation, specifically biotransformation (Arrhenius), of lower chlorinated congeners should not be neglected in such a scenario assessment.

7.) How is the meteorology, and specifically the location of the "Polar Front system", reflected in the here discussed seasonal PCB distribution patterns? As the lack of significant primary PCB emissions is postulated, the seasonality of the direct atmospheric transport into the Arctic should not be dependent on the position of the Polar front system (meteorological barrier) and, thus, the seasonality of LRTAP should be weakened (which is obviously not the case here).

8.) Similar model based simulations were conducted earlier also for PCBs in the Arctic atmosphere. It would therefore be worth considering a critical comparison with earlier investigations such as the recent paper by Octaviani M., Stemmler I., Lammel G., Graf H.F. (2015) *Env. Sci. Technol.* 49/6: 3593-3602, and an older study by Armitage J.M., Wania F. (2013) *Environ. Sci. Processes Impacts* 15:2263-2272 where also the role of the (organic) particulate phase in LRTAP into the Arctic atmosphere is discussed.

#### Detailed Comments

P30858/L24 "Consequently, their production was banned internationally when the Stockholm Convention was adopted (2001) and entered into force (2004)." This postulate is not entirely correct! The international regulation and ban of PCBs started in the early 1970s already by the official regulation of the US and EU legislation. PCBs as environmental pollutants were, however, adopted and implemented by Stockholm

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convention and, thus, recognized as global pollutants. Please consider revision.

P30865/L 10 "The fraction of snow/ice in a grid box is estimated by adding the fractions of snow, sea ice, and land ice (provided by meteorological data)" Please provide information about the origin of this information or refer to an appropriate publication.

Final recommendation: I, thus, recommend the here submitted and discussed manuscript for publication in "Atmospheric Chemistry and physics" after major revisions, for details please see above.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 30857, 2015.

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