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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling impact of climate change on atmospheric transport and fate of persistent organic pollutants in the Arctic" *by* K. M. Hansen et al.

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Reply to anonymous referee #1

Referee: The paper describes a model to predict effects of climate changes on the long range transport of POPs. The model is not new. The paper apply an existing model to specific scenarios suitable to describe transport and fate patterns to the Arctic in present and future climatic conditions. The topic is of relevant interest and the modelling approach is sound. Therefore, the paper may be suitable for publication. However, it is not always clear and reader friendly. Some information is incomplete or

not reported. Some major and minor weaknesses need to be revised before publication.

Referee: The model is applied to a present (1990-2000) and a future (2090-2100) temporal interval. In both cases the same emission hypothesis is made, with (W) and without (W0) initial concentration. These scenarios should allow assessing distribution and fate of new emitted chemicals (the W0 scenario) and a combination of new and already present chemicals (the W scenario). Why not considering a scenario with initial concentration and no emissions? It would allow assessing disappearance patterns of POPs in a realistic condition, considering control and phase-out measures in act, according to international agreements (e.g. Stockholm Convention).

Answer: We thank the referee for the suggestion to make another model scenario with only initial environmental concentrations and no emissions. We have done this and included the results in the manuscript. As a result we have renamed the model scenarios to 'E' – Emissions only, 'S' – spin-up concentrations only, and 'ES' – emissions and spin-up concentrations.

Referee: The scenarios are insufficiently described. A detail of the climatic conditions in the two temporal intervals should be reported, at least in the supplementary material. The initial concentrations of the chemicals in the different environmental compartments should also be reported. Table S2 shows total emissions of the chemicals. They are emissions for the whole 10 years period? Emission is constant and continuous? In which compartment emissions occur?

Answer: We have described the major differences between the two simulated periods for the SRES A1B climate scenario in the introduction section on page 5, line 19-26. The initial concentrations applied in the 'ES' and the 'S' scenarios have been added to table S2 as well as more detailed information on the temporal resolution of the emissions and to what compartment they enter.

Referee: Section 3 is a detailed description of the results. This section is too long, in

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some parts unnecessary (describing some quite obvious issues), without focusing on some relevant issues that are not immediately understandable from the figures. For example: (Figures S1, S6, S10) why some chemicals show strong seasonal variability and other are almost stable? Why chemicals with comparable properties (e.g. α-, β- and γ-HCH) show a completely different behavior?

Answer: We have rearranged the results and discussion section. We have removed the unnecessary parts of the results section and as a result the section has become shorter and more focused. As for the comment on the seasonality this is a question of the scale of the plots, where seasonal signals can be 'hidden' for the compounds with high mass. We have strengthened the discussion of the difference of the HCHs following the Referee's suggestion.

Referee: A more schematic, synthetic and less dispersive description of what happens (highlighting differences between: present and future; total domain and arctic; light and heavy chemicals) would be more reader friendly.

Answer: We thank the referee for the comment. We have produced a table displaying either positive or negative differences in mass in total, in air, water and soil, in the entire model domain and in the Arctic for the three model scenarios. The new table presents the major results in a schematic way that is more reader friendly. We have furthermore rearranged the results and the discussion sections following comments from Referee #2 with a more strict discussion of the individual compounds.

Referee: Moreover, many statements in the description does not correspond to the figures. For example: Page 6, lines 11-12: "The total mass of α-HCH decreases over the modelled decades for the 'W' simulations with a more rapid decline for the 2090s than for the 1990s" I can not see any substantial difference. The two trends are practically identical. Page 6, lines 13-14: "The mass of β-HCH and the intermediately chlorinated PCBs (PCB101 –PCB118) display the same pattern". Not true. β-HCH shows a decrease of about 40% in the W scenario and negligible increase in the W0.

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PCB 101-118 show much smaller decrease in W and substantial increase in W0. Many other inconsistencies are present in the discussion.

Answer: We have thoroughly revised the result and discussion section and the inconsistencies mentioned (as well as others) have been removed.

Referee: In conclusion, it is my opinion that the paper should be rewritten, checking for inconsistencies in the description, eliminating un-necessary parts, synthesizing the most relevant outcomes and providing clear interpretations of the most relevant differences.

Answer: Thanks to the Referees suggestions we have revised the manuscript thoroughly. Apart from adding the information the Referee has requested on the climate scenario, on the initial concentrations and the emission as well as data for the additional model scenario, we have revised the results and discussion section thoroughly as mentioned above, and the resulting manuscript is now much more reader friendly.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6509, 2015.