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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Factors affecting the atmospheric occurrence and deposition of polychlorinated biphenyls in the Southern Ocean" *by* C. J. Galbán-Malagón et al.

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Responses to Reviewer 2

We appreciate the general positive comments of both reviewers, and their constructive comments that have allowed us to improve the manuscript. Below, we respond to Reviewer 2 and explain how the manuscript is improved following this revision.

1) We apologize for the references missing, we have added these references in the new version.

2) Please, note that Kp values for heavier congeners are below the 1:1 line (and not

above), while low chlorinated congeners are above the 1:1 line (and not below). So the model (equation [1]) overpredicts the partitioning for the more chlorinated congeners (not underpredicts).

In our previous version of the manuscript, we discussed the slopes of the figures of measured versus predicted Kp. The slopes lower than unity can be due to either different activity coefficients for the different PCB congeners (in this case, higher for the high chlorinated congeners) and to lack of equilibrium. We never discussed the intersection, nor compared the values measured and predicted Kps. The overprediction of Kp values for the high chlorinated congeners is presumably due to the assumption that the term γOct MWOct/γOM MWOM equals unity. This may not be true, in fact, it is very much possible that the activity coefficient in organic matter is much higher than that in octanol driving to lower values of this ratio. In addition, the MW of organic matter is presumably higher than that of octanol. Therefore, if this ratio was between 1 and 2 orders of magnitude higher (between 10 and 100), then the predicted and measured values of Kp would be similar for the high chlorinated congeners. Similar observations can be found in the literature, for example Götz et al. (EST 41, 1272-1278) suggest in page 1277 to use an aerosol organic matter MW of 500 because the predictions overestimate the observations. However, in order to fit the Kp values for both the high and low MW PCBs, we would need to use congener specific values for γOct MWOct/γOM MWOM, implying different γOM for the different congeners. This is consistent with the observation of Goss and Schwarzenbach (EST 1998) that slopes different than unity can be explained by γOM different for the different congeners. A detailed discussion of these issues is beyond the objectives of this manuscript. However, we have improved and completed the discussion of the gas-particle partitioning in the new version of the manuscript.

3) We compare the dry deposition fluxes with the accumulation fluxes in the sediment in the new version. It is true that the dry deposition fluxes are closer to the sediment accumulation fluxes. However, this does not mean that what reaches the sediment comes

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from the aerosol, only. Once in the water column, the particle (including aerosols) and dissolved phase exchange PCBs through water-particle partitioning, then there are several biogeochemical processes that will control the fraction of export of these pcbs, and during settling, there is re-mineralization of organic matter, inducing a “solvent depletion” process (Macdonald et al. EST 2002) which will induce a re-solubilization of PCBs in deep waters. We have improved the discussion in the new version, in addition to including the comparison with the dry deposition fluxes.

We have included all the small modifications suggested by reviewer.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 18779, 2013.