# Cycling of polychlorinated biphenyls (PCBs) in the remote marine environment

AMOS, H. M.[1❖], Y. ZHANG[2], S. DUTKIEWICZ[3❖], C. FRIEDMAN[4❖], G. FORGET[5❖], X. ZHANG[6❖], R. LOHMANN[7★], C. SUN[8★], C. THACKRAY[9❖], N. E. SELIN[10❖] AND E. M. SUNDERLAND[11❖]

❖Harvard University, Cambridge, MA
❖Massachusetts Institute of Technology, Cambridge, MA
★University of Rhode Island, Narragansett, RI
[1]hamos@hsph.harvard.edu; [2]yxzhang@seas.harvard.edu; [3]stephdut@mit.edu; [4]clf@mit.edu; [5]gforget@mit.edu; [6]XMZhang@seas.harvard.edu; [7]rlohmann@uri.edu; [8]caoxin@my.uri.edu; [9]thackray@mit.edu; [10]selin@mit.edu; [11]ems@seas.harvard.edu

Measured concentrations of polychlorinated biphenyls (PCBs) in the Arctic remain high despite an international ban on chemical production in 2004. Some PCBs are carcinogenic and they have also been associated with impaired neurocognitive development and immune health in children of fish consumers. Recent work has hypothesized that the ocean buffers the temporal response of ecosystems to declines in anthropogenic releases through sustained re-emissions of PCBs that have accumulated in the ocean from historic sources. Preferential deposition of these compounds in the Arctic means this region is most vulnerable to these sustained releases. Here we quantify the lifetime of PCBs in the global oceans and effects on deposition in the Arctic using a couple atmospheric-oceanic simulation forced by historic emissions. We have developed global three-dimensional simulations of PCB transport and cycling in the atmosphere (GEOS-Chem v9-01-03)[1] and ocean general circulation model (MITgcm, ECCO v4) [2][3] which includes organic carbon and marine plankton ecosystem dynamics (DARWIN)[4]. Using this coupled framework, we simulate accumulation of PCBs in the global oceans from 1930 to present, with a particular focus on relative trends in the atmosphere and ocean and implications for the Arctic Ocean. Model results are evaluated against measured surface and depth profiles of PCBs across the Atlantic and Pacific Ocean collected using passive samplers. We present mass budgets for the major ocean basins, quantify storage of PCBs in shelf sediment and deep waters, and evaluate the role of air-sea exchange as a driver for observed trends in the ocean and atmosphere. We use information about lifecycles as a tool for anticipating future trajectories of environmental concentrations. Our modeling framework can be readily extended to understand the environmental cycling and persistence of other semi-volatile global contaminants.

[1]Friedman *et al*., 2015, in prep. [2]Forget *et al*., 2015, in review. [3]Zhang *et al*., *Global Biogeochem. Cycles*, 2015, in review. [4]Dutkiewicz *et al*., *Global Biogeochem. Cycles*, 2009.