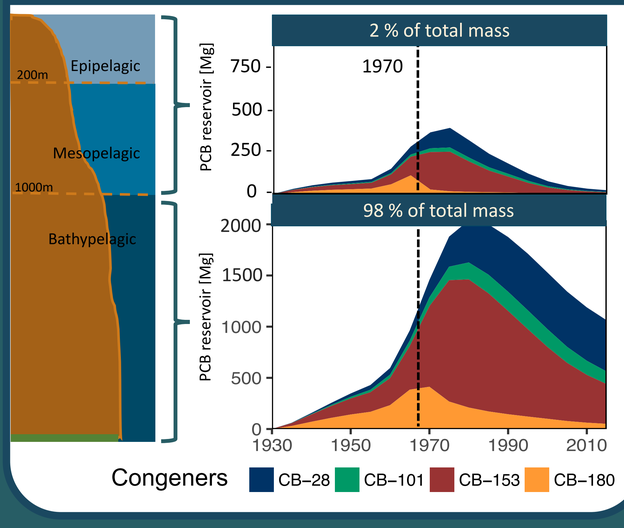
Ocean biogeochemistry drives fate of persistent organic pollutants

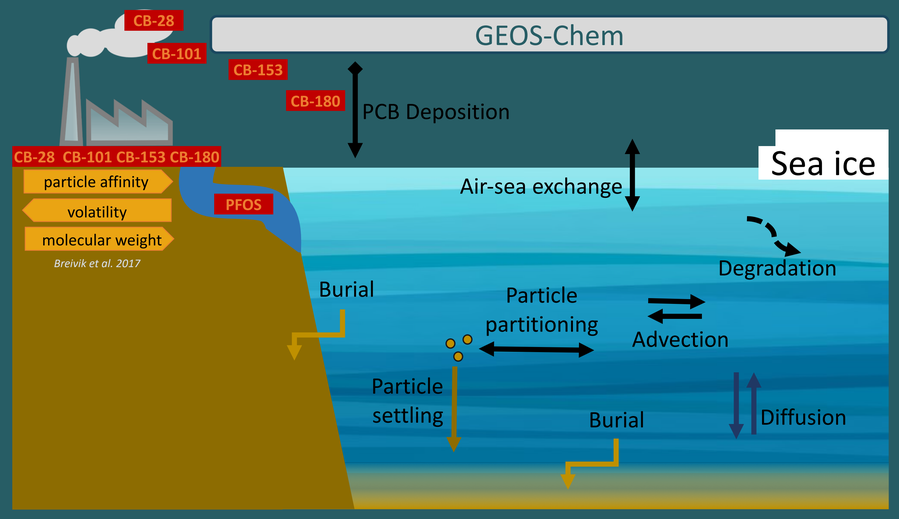
HARVARD School of Engineering and Applied Sciences

Biogeochemistry of Global Contaminants HARVARD

Charlotte C. Wagner* (cwagner@g.harvard.edu), Colin Thackray, Elsie M. Sunderland

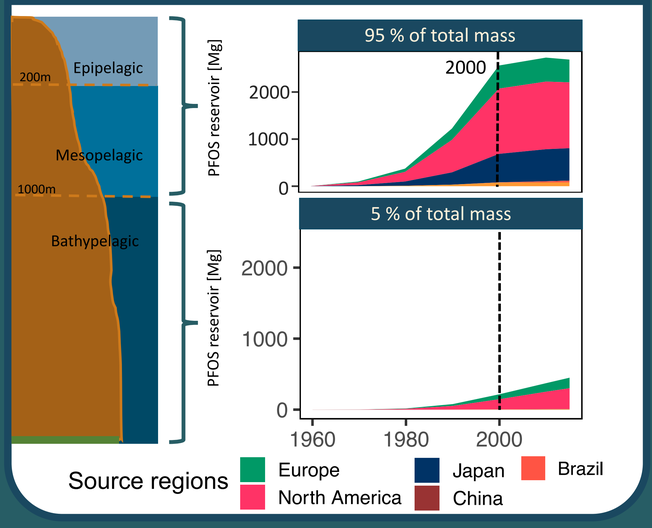
1a. PCB depth distribution





Global oceanic transport model (MITgcm)

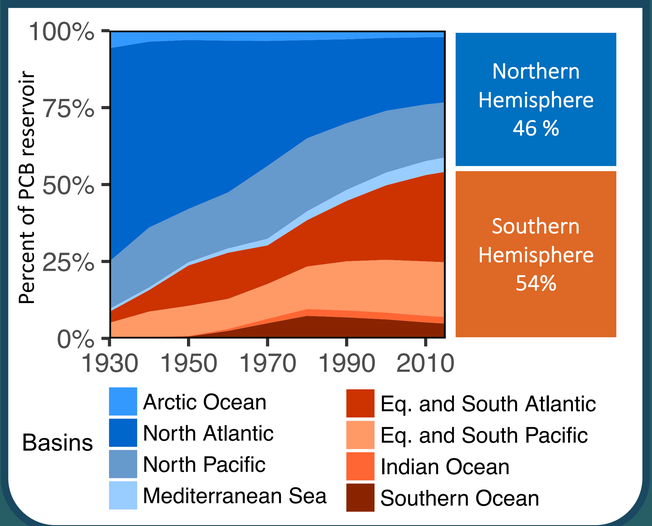
1b. PFOS depth distribution



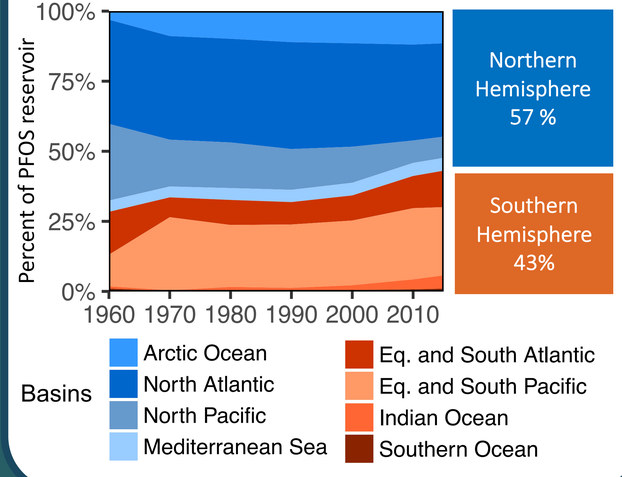
ABSTRACT

Many persistent organic pollutants (POPs) produced by human activity persist in the global oceans, bioaccumulate in marine food webs, and pose health risks to wildlife and humans. POPs are now ubiquitously detected in most seawater and have been linked to many deleterious changes such as declining global killer whale populations. Both primary releases and marine biogeochemical cycles affect the distribution and accumulation of POPs in the global oceans and the influence of ongoing climate driven changes in marine ecosystems is poorly understood. Here we present a global budget for four neutral polychlorinated biphenyls (PCBs) and perfluorooctanoic sulfonate (PFOS) in the world's oceans based on a 3-D ocean simulation that includes embedded ecology (MITgcm + Darwin model). We track the temporal evolution and spatial distribution of both compounds by forcing the model with previously published historical atmospheric PCB deposition data and riverine inputs of PFOS. Improved understanding of interactions of anthropogenic chemicals with natural global biogeochemical cycles is essential for anticipating long-term risks to marine ecosystems. These compounds may also serve as effective tracers of how changes occurring in the Anthropocene are affecting the world's oceans.

2a. PCB accumulation in Southern Hemisphere

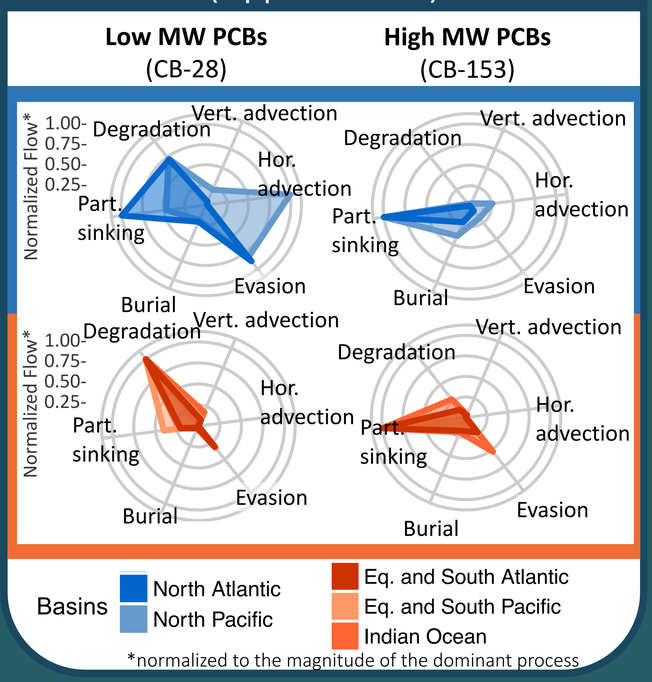


2b. No apparent redistribution of PFOS



3a. Low molecular weight pollutants more susceptible to changes in ocean biogeochemistry

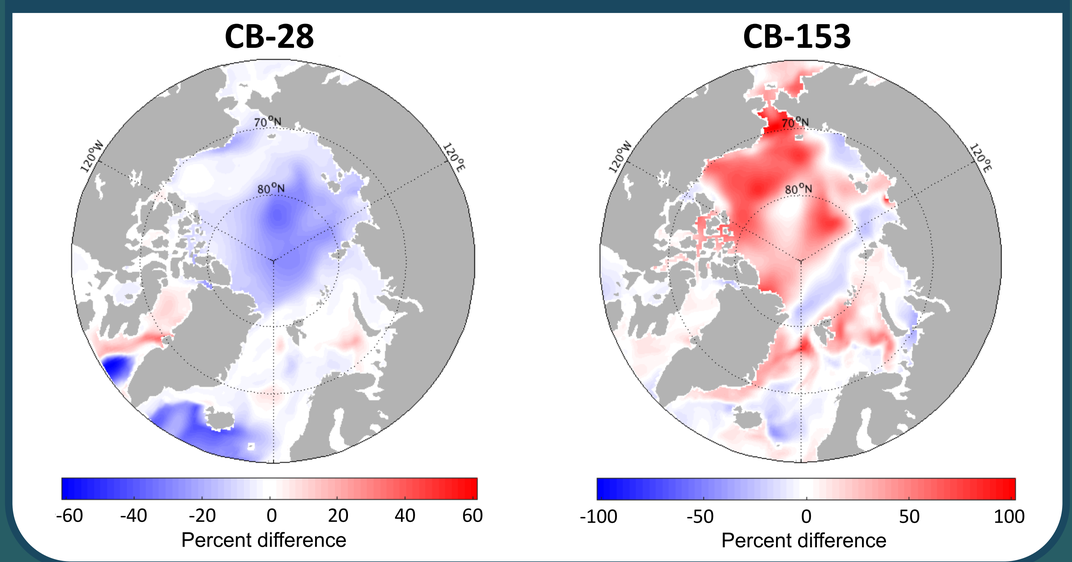
(Upper 1000m)



4. Impact of climate change in the Arctic since 1992

Scenario 1: 1992-1996 climatology until 2015

Scenario 2: Real 1992-2015 climatology

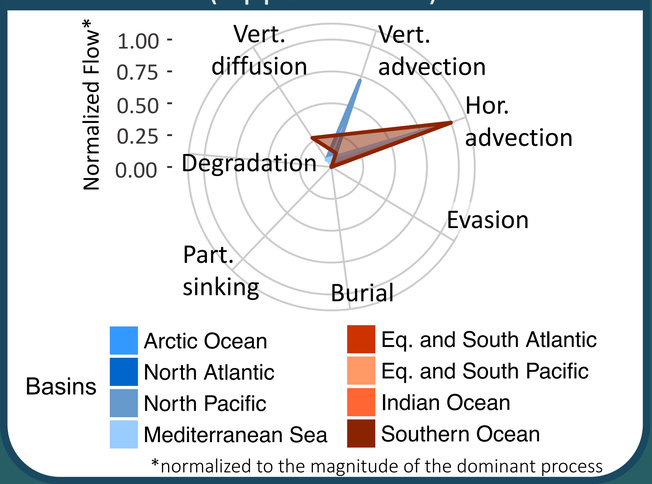


Relative concentration **decrease** of 0.12 pg CB-28 L^{-1} **due to higher evasion**

Relative concentration **increase** of 0.0004 pg CB-153 L^{-1} **due to increased deposition**

3b. Ocean circulation dominates PFOS removal

(Upper 1000m)



*normalized to the magnitude of the dominant process

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