



Evidence of the return of past organic pollution in the ocean - a model study

Gerhard Lammel (1,2) and Irene Stemmler (3)

(1) Max Planck Institute for Chemistry, Mainz, Germany (g.lammel@mpic.de), (2) Masaryk University, Research Centre for Toxic Compounds in the Environment, Brno, Czech Republic, (3) University of Hamburg, Institute for Hydrobiology and Fisheries Sciences, Hamburg, Germany

Persistent organic pollutants are of great concern because of their long residence time and long-range transport potential in the environment and because they are readily bioaccumulated along food chains and toxic for wildlife and humans.

Recovery of the environment from exposure to widespread and persistent chemical pollution is determined by the spatiotemporal emission pattern and storage capacity and transports in environmental compartments.

We studied the 3D exposure of the global ocean changing over time in response to historic emissions of polychlorinated biphenyls (PCB) and dichlorodimethylphenyltrichloromethane (DDT), 1950-2010 using the multi-compartment chemistry-transport model MPI-MCTM, which encompasses atmosphere (ECHAM5) and ocean general circulation models (MPIOM), dynamic sub-models for atmospheric aerosols and the marine biogeochemistry, two-dimensional surface compartments (topsoil, vegetation surfaces, ice, and temporal snow cover) and intercompartmental mass exchange process parameterisations [1-3].

The pollution wave received by the surface waters through atmospheric deposition is propagating downward. Besides considerable time lags with respect to the year of peak emission, temporal bimodal exposure to the pollutants is found in mid level and deep waters (200-1500 m) in some areas, e.g. in the western and eastern North Atlantic. This is a consequence of the combination of downward pollution transport by advection, diffusion, and particle settling.

It is suggested that the combination of the same processes will lead to re-rise of pollutant concentrations in seawater in other regions in the future.

References

- [1] Guglielmo F, Lammel G, Maier-Reimer E: Global environmental cycling of DDT and gamma-HCH in the 1980s - a study using a coupled atmosphere and ocean general circulation model. *Chemosphere* 76 (2009) 1509–1517
- [2] Stemmler I, Lammel G: Cycling of DDT in the global oceans 1950-2002: World ocean returns the pollutant. *Geophys. Res. Lett.* 36 (2009) L24602
- [3] Hofmann L, Stemmler I, Lammel G: The impact of organochlorines cycling in the cryosphere on their global distributions and fate – 2. Land ice and temporary snow cover. *Environ. Pollut.* 162 (2012) 482-488