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Impact of tidal activity on the fate of PCB_{153} in the North Sea

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Over the last century, anthropogenic emissions led to increasing pollution levels in the environment, including coastal areas. Along with hundreds of other persistent organic pollutants (POPs), polychlorinated biphenyls (PCBs) have been introduced into the environment. Due to their long residence time, these pollutants can not only affect the local ecosystem, but they are also able to go on a steady journey to remote areas, such as the polar regions.

In the presented study, we investigate the role of the North Sea for long range transport of PCBs. For northern Europe, the North Sea is the major transit area between land-based emissions and the open ocean (North Atlantic). Here, local hydrodynamic and biogeochemical features determine whether PCBs are deposited or transported into the open ocean. The interplay and seasonality of sedimentation and resuspension processes determine the overall fate of PCBs in the coastal seas. On the one hand, the biological pump transports PCBs to the sediments. On the other hand, turbulence and mixing can lead to the resuspension of previously deposited PCBs. In the North Sea tidal activity strongly impacts not only the local turbulence regime, but consequently also biological production through the resuspension of nutrients.

Here, we investigate the influence of tides on regions with seasonal stratification and permanently mixed areas. For that we used our newly developed PCB model based on the hydrodynamic biogeochemical modelling system GOTM-ECOSMO. The model has been run for 2 different regimes including model runs with and without tidal activity. Simulations are presented exemplarily for one PCB congener – PCB_{153}.

Model results indicate that the seasonality of sedimentation and resuspension has a profound impact on the speciation of PCB in the water column. Removal of PCB from surface waters in summer leads to increased air-sea exchange. Meanwhile, the timing of seasonal resuspension from sediments can lead to peaks of bioavailable PCB species coinciding with primary production peaks leading to increased bio-accumulation.