# Polychlorinated Biphenyls in Switzerland – New Insights into their Transport and Deposition Processes

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Polychlorinated biphenyls (PCB) are ubiquitous environmental contaminants and probably the best studied chemicals among the class of persistent organic pollutants (POPs). Because PCBs have high persistence, bioaccumulation potential and toxicity [1], the production and usage of PCBs was prohibited worldwide through the Stockholm Convention on POPs in 2004. In Switzerland, PCBs were prohibited in open applications in 1972 and banned completely in all applications in 1986. Despite the ban of PCBs decades ago, they can still be detected in all environmental compartments, includingsoil, air, water, and sediment. In this study, we modeled the distribution of PCBs in Switzerland over the time period 1930 to 2050. Our goal was to gain a better understanding of the importance of ongoing emissions and the impact of the advective inflow.

For the model of the country, Switzerland was divided into ten regions according to the altitudinal contour lines. The transfer of chemicals in and between the regions and the partitioning of chemicals between environmental compartments of each region, as well as the transformation of chemicals in the environment, is represented through a dynamic multi—media chemical fate model. Each region is divided into well–mixed compartments, with their own specific properties. We applied our model to the six indicator PCB congeners (PCB–28, –52, –101, –138, –153, and –180), which are representatives for this chemical class and for which also most measurements were available. Primary emissions in Switzerland were compiled from Breivik et al. [2] and combined with calculations from Bogdal et al. [3]. Concentrations outside Switzerland, which enter the country with inflowing air, were obtained from the global multi-media fate model BETR Research [4].

The obtained modeled concentrations were in good agreement with the measured concentrations. Best agreement was found for PCB–153, for which 91% of the modelled concentrations deviate less than a factor of four from the measured ones. Of the modeled concentrations for PCB–52, –101, –138, and –180, 88%, 90%, 86%, and 72% deviate by less than a factor of four from the measured concentrations, respectively. This includes concentrations in air, water, snow, forest, bare soil and forest soil. The model also enabled us to calculate fluxes in the environment. The advective inflow of PCBs into the Swiss boundary layer (upper and lower air compartment) is responsible for 80% of PCBs present in air in Switzerland, whereas the Swiss emissions are less relevant (remaining 20%). Regarding loss processes in Switzerland in the upper and lower air compartment, the proportion between advective outflow (out of Switzerland and to other compartments), deposition to the ground and loss to the troposphere depends very much on the PCB congener. For PCB–28 75%, 1%, and 24% can be attributed to advective outflow, deposition to the ground, and loss the troposphere, whereas these numbers change to 73%, 5%, and 22% for PCB–101, and 63%, 28%, and 9% for PCB–180.

Additionally, we could show that the regional deposition fluxes for the higher-chlorinated PCBs depend mostly on the advective influx into the atmosphere and the fraction of particles in air. The regional emissions are less relevant. The obtained results give new insights into the transport and deposition processes of PCBs. Our model proofs to be a versatile tool that can be applied for other semi–volatile organic compounds. With this study, we can make a significant contribution to a better understanding of the behaviour of these substances in the environment.

**References**

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