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Time series analyses of organic contaminants in the river Rhine

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Most of the Persistent Organic Pollutants (POPs) listed in the Stockholm Protocol are of anthropogenic origin and released into the environment during production, transport, use and dumping. Soils and sediments are major sinks of POPs due to the hydrophobic properties of many of POPs. Bound to particles or in aqueous solutions POPs are transferred into groundwater and river water. Thus, they can also be found in water, suspended matter and sediments of the river Rhine. Few reports about the Rhine deal with the quantification of the seasonal variations of POPs and the quantitative input of contributing rivers, such as the rivers Mosel or Main. The aim of the project was to investigate the temporal occurrence and fate of selected priority POPs in the river Rhine, such as chlorinated hydrocarbons (CHC), polychlorinated biphenyls (PCB), polychlorinated hydrocarbons (PAH) or pesticides. Databases were compiled and analyzed with respect to water concentrations and suspended matter concentrations for the selected POPs. Time series analyses were performed for the time period 1990 to 2003. The statistical relationship of chemical and hydrological parameters and the chemical load was investigated for various river-gauging stations to recognize and evaluate temporal trends of POPs. First results show that e.g. the concentration of the CHC trichloromethan was constantly above Rhine water quality limit in the early 90's until 1996 at the station Koblenz, Germany. PAHs (mostly originating from pyrolytic processes), PCBs (used as plasticizers or cooling agents) and pesticides (e.g. Lindane) seem to decrease with time in suspended matter, but suspended matter load was quite stable. The concentration of PCB 52 and PCB 101 (after Ballschmiter) and the concentration of the PAHs fluoranthene and benzo(a)pyrene in suspended matter decreased between 1991 und 2003 to approximately 50% - 70%. These trends can be superposed by discharge variations and seasonal cycles, e.g. Fluoranthene is showing a yearly concentration cycle with a maximum in winter. In general the relationship of

suspended matter versus discharge shows a typical nonlinear increase with increasing standard deviation. Data analysis focuses on the question, whether seasonal variations as well as overall trends in POP concentrations are linked to the compounds chemical-physical properties or international river protection measures.