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Assessment of PCB trajectories along French river corridors between 1945 and 2018

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The reconstruction and modelling of contamination trajectories in rivers is a key concern to investigate spatio-temporal impacts of long-term anthropogenic activities. This issue is highly significant for persistent organic pollutants, such as polychlorinated biphenyls (PCBs), known for their toxicity, their low degradation rates and their hydrophobic properties leading to their accumulation in sediments and biota. Increasingly produced and released worldwide from the 1930s to the 1970-1980s, PCBs were analysed in numerous studies dealing with river sediment quality. However, data syntheses are uncommon at the scale of large hydrosystems, and source-to-estuary approaches along rivers are still needed. Accordingly, we propose an original work integrating PCBs analyses on different solid matrices (sediment cores, bed and flood deposits, suspended particulate matters, and dredged sediments) originating from both research programmes and monitoring. Based on more than 1400 validated analyses, temporal trends of the PCB contamination were reconstructed since 1945 along the four main fluvial corridors in France (Rhône, Seine, Loire and Garonne Rivers). The relationships with socio-environmental factors were also deciphered by integrating hydrological and human spatio-temporal data (cumulative river discharge, population hot spots, urban and industrial surfaces). This work highlighted that the main contaminant trends were driven by regulation, but also by sediment transport and accidental releases (especially since the 1990s). In general, urban and industrial areas were the main contributors to the PCB contamination of rivers: around and downstream of Paris and Rouen (Seine River), Lyon and its “Chemical Valley” (Rhône River), Saint-Etienne and Nantes conurbations (Loire River), and probably downstream of Toulouse and Bordeaux (Garonne River). Relatively high concentrations persisted after the end of the PCB production due to chronic diffuse inputs and accidental releases, particularly on the Rhône River. Moreover, the estimation of specific fluxes revealed that up to 12 µg/m²/yr (i.e. 0.9 t/yr on average) of PCBs were brought by French rivers, especially by the Rhône, Seine and Loire Rivers (ranked in order of importance) to Western European seas since the 1970s.