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CrossWater – Modelling micropollutant loads from different sources in the Rhine basin

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The contamination of fresh surface waters with micropollutants originating from various sources is a growing environmental issue. The challenges for an effective political regulation are numerous, particularly for international water basins. One prerequisite for effective management is the knowledge of water quality across different parts of a basin. In this study within the Rhine basin, the spatial patterns of micropollutant loads and concentrations from different use classes are investigated with a mass flow analysis and compared to the established territorial jurisdictions on micropollutants and water quality.

The source area of micropollutants depends on the specific use of a compound. The focus of this study is on i) herbicides from agricultural landuse, ii) biocides from material protection on buildings and iii) human pharmaceuticals from households. The total mass of micropollutants available for release to the stream network is estimated based on statistical application and consumption data. Based on GIS data of agricultural landuse, vector data of buildings, wastewater treatment plant (WWTP) locations, respectively, the available mass of micropollutants is spatially distributed to the catchment areas. The actual release of micropollutants to the stream network is calculated with empirical loss rates related to river discharge for agricultural herbicides and to precipitation for biocides. For the pharmaceuticals the release is coupled to the metabolism rates and elimination rates in WWTP.

For a first approximation national sales are downscaled to the catchment level to specify the available mass for selected model compounds (agricultural herbicides: Isoproturon, biocides: Carbendazim, human pharmaceuticals: Carbamazepine and Diclofenac). The available mass of herbicides and biocides is multiplied with empirical loss rates independent from discharge or precipitation to calculate the loads. The release of the pharmaceuticals was calculated by multiplying average consumption numbers with the person equivalent of the WWTP and the elimination rates. The comparison of pollutant loads to 7-day composite samples of all compounds at 15 locations along the Rhine yield plausible results.