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Emissions of heavy metals into large river basins

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The input of seven heavy metals (Cd, Cr, Cu, Hg, Ni, Pb and Zn) into the river basins of Germany via various point and diffuse pathways is estimated for the period of 1985 through 2005. The objective of this research is to identify the main sources of heavy metal emissions and to quantify the changes in the emission situation within the mentioned period.

For the quantification of the emissions via point sources a nation-wide survey on heavy metal data of municipal wastewater treatment plants and industrial direct discharges was carried out. The diffuse emissions of heavy metals into the surface waters represent the sum of various pathways e.g. erosion, surface runoff, atmospheric deposition and the input from paved urban areas via sewer systems. The input via diffuse pathways was estimated using an adapted version of the model MONERIS (**MO**delling **N**utrient **E**missions in **RI**ver **S**ystems) developed by the Institute of Freshwater Ecology and Inland Fisheries (Berlin).

The resulting heavy metal emissions were validated on datasets of several monitoring stations. For the comparison of calculated heavy metal emissions with measured heavy metal loads the losses due to retention processes within the river systems have to be considered. For the large river basins a good correspondence could be found between estimated and measured heavy metal loads at monitoring stations.

The total emission into the German river systems decreased for each metal during the period of 1985-2005. This reduction is mainly caused by the decline of emissions via point sources. The measures taken by industry and implemented within the scope of a more rigorous water legislation have decisively contributed to an improvement

of environmental conditions. Today's emissions of heavy metals into river basins of Germany are dominated by the input via diffuse pathways. The most important diffuse pathway for Cd, Hg, Cu, Pb and Zn is the input from paved urban areas via storm sewers and combined sewer overflows caused by traffic, atmospheric deposition and the corrosion of metallic surfaces. Other important diffuse pathways are erosion (Cr, Pb) and groundwater (Ni).