

Integrated monitoring approach to investigate the contamination, mobilization and risks of sediments

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The use of surface water bodies for manufacturing purposes has been common not only in Germany since the beginning of industrialization, and this has led to a high accumulation of different chemical contaminants in the sediments of aquatic ecosystems. In particular, water bodies with very low flow conditions like the "Rummelsburger See", an anabranch of the Spree River located in the centre of Berlin, have been highly affected. Given that, it has become necessary to obtain improved knowledge concerning the current sediment dynamics, the rate of sedimentation and the current level of contamination and toxicity compared to earlier conditions. Against this background, a survey was set up, consisting of an integrated monitoring approach that focuses on hydraulics, sediment dynamics and contamination, including boundary conditions, such as weather and motor-boat activities to find information, which would help design appropriate treatment in the future.

To detect the spatial distribution of pollutants in the sediment, over 200 sediment samples were collected via drill cores at 16 locations. The upper 15 cm of each drill core was systematically divided into 5 layers (each of 3 cm) for separate examination. The investigation of sediment deposition and remobilisation rates was accomplished by installing 18 sediment traps. The presence of selected heavy metals and organic pollutants in the sediments was determined for every sampling location and layer of the drill cores, as well as for all sediment traps. Changes in boundary conditions which influence the spatial and temporal distribution of deposition and resuspension were monitored by placing devices within the water body and taking different mobile measurements (3-D flow conditions, oxygen, turbidity, chlorophyll-a, temperature). The analysis of sediment and suspended matter included the determination of the total content of inorganic (Hg, Cd, Cr, Pb, Ni, Cu, Zn) and organic compounds (polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), selected nitro-compounds, selected organotin compounds and polychlorinated biphenyls (PCB, AOX and EOX) in the sediment and suspended matter. The physico-chemical conditions of the samples were examined as well. The research into soluble and mobilizable sediment-bounded pollutants is based upon a 24 hour batch test. Certain toxic effects of the sediments were determined by different ecotoxicological test methods. In addition, the thresholds of the sediment quality guidelines published by de Deckere et al. (2011) were used to assess the solid contents. Because of the high concentrations of the pollutants, the consensus 2 values are used as thresholds in this study.

The results provide important details on the spatial and temporal distribution of sedimentation and contamination. All sediments of the analysed cores and traps remain highly contaminated with heavy metals and organic compounds. The results indicate the resuspension, transport and accumulation of these sediments and show at least that toxic effects for the benthic taxa are expected. This kind of approach is necessary to create a basis for a remediation programme for, and a risk assessment of, polluted water bodies.