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Section 3: Sediment management at the river basin scale

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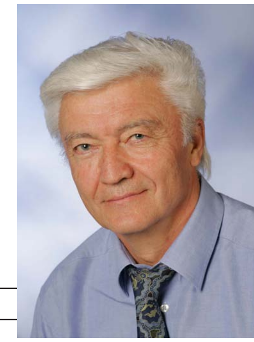

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Objectives

Sustainable sediment management is a future challenge for interdisciplinary research in natural and engineering sciences. Although the relevance of sediment quality is not explicitly considered in the European Water Framework Directive (WFD), the risk of contaminated sediment mobilization for the aquatic environment, water and soil quality is an important issue in river engineering, restoration, management and maintenance dredging as well (Salomons and Brils 2004). Sediment associated contaminants deposited in the headwater of river dams, lock chambers, near bank dead water zones and harbours can be mobilized by extreme hydrological events, transported and deposited far downstream in unpolluted river sections, on wetlands, floodplains and partly discharged to the sea. Long-term risk reduction policy requires a holistic view of the hydrological, hydrodynamic and geochemical processes on local and catchment scale. Moreover, the impact of climate change on discharge and transport processes has to be considered in a site specific risk assessment. Numerical models are powerful tools to integrate knowledge from different disciplines and to describe interacting processes of different spatial and temporal scale. They allow the prediction of large scale emission-immission relationships for different hydrological scenarios and hence, and provide basic data for planning and design of remediation and mitigation measures for sustainable sediment management.

Main research subjects

Sediment erodibility plays a key role for contaminated deposits mobility assessment. Erosive sediment or particulate contaminant mass flux results from the interaction between hydrodynamic forces acting at the sediment water interface and deposited sediment resistance. The complex interaction of physical, chemical and biological processes involved in erosion stability of fine cohesive sediments requires an in depth experimental investigation on undisturbed natural sediment samples (Sanford 2005). Therefore, specific equipment for laboratory and field tests (Westrich and Förstner 2007) have been developed and applied to provide data on critical erosion shear stress and erosion rate of various types of sediments from different rivers and sampling sites. By using the principal component analysis spatial and temporal pattern (Gerbersdorf et al. 2005) and master variables can be found for physical based modelling of erosion and sedimentation processes. A combined stochastic and deterministic modelling allows to account for the hydrological boundary conditions and statistical sediment properties, whereas the pathway and fate of the dissolved and particulate pollutants are captured by a reactive transport model including sorption, transformation and volatilization (Jacoub and Westrich 2006). The applicability and predictability of numerical models is limited by the fact that reliable and consistent field data on sediment bound pollutants (heavy metals of organic pollutants) are lacking and, therefore calibration and validation are subject to uncertainties. However, numerical exposure models have been proven an indispensable instrument for contaminated sediment mobilization risk and impact assessment as a contribution to future sediment quality management.

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