



Numerical modelling of fine-grained sediments remobilization in heavily polluted streams. Case study: Elbe and Bílina River, Czech Republic.

Jana Kaiglová (1,2), Jakub Langhammer (1), Petr Jiřinec (2), Bohumír Janský (1), and Dagmar Chalupová (1)

(1) Charles University in Prague, Faculty of Science, Department of Physical Geography and Geoecology, Prague, Czech Republic, (2) DHI a.s., Prague, Czech Republic

The study aimed to estimate remobilization of channel and riparian cohesive sediment of streams, heavily polluted by industrial emissions. There were analyzed four stream stretches in Czech Republic: (1) Elbe River from Usti nad Labem to the boundary with Germany; (2) Bílina river, draining industrial and mining areas of Northwest Bohemia; (3) Midstream reach of Czech Elbe by the confluence with Vltava river, affected by chemical industry and (4) fluvial lakes in the riparian zone of Czech Elbe river downstream of Pardubice burdened by old loads from heavy chemical industry.

Sediments of clay and silt character bedded in the riparian water-courses are regarded heavily polluted by wide range of toxic matters. In the sediment samples, there were found elevated concentrations of persistent organic matters (DDT, PCB, HCH, Fluoranthen), Heavy metals (Hg, As, Cd), and others. The pollution in sediment is resulting from the unregulated heavy industrial production in the area in the second half of 20th century during the socialistic regime in Czech republic that still play an important role in Elbe river water quality.

The main goal of the study was to evaluate the risk of remobilization of polluted sediments by the assessment of discharge (values and return periods), initiating remobilization of sediment from the river bed. The modeling stems on basic assumption, that once the sediment is elevated from the bed, it could be transported far downstream in the form of suspended load. The evaluation was made on the basis of numerical hydrodynamic calculation coupled with sediment transport model. The MIKE by DHI modelling software with different levels of schematization was used according the flow conditions and available data sources. For 50 km stretch of Bílina river the 1D schematization (MIKE 11) was selected as the discharges driving remobilization were expected within the extent of channel capacity due to the stream regulation. For the lower and middle course of Elbe river and the riparian sediment evaluation the 2D schematization (MIKE 21 C) was selected. It enabled to distinguish flow characteristics in the zone with complicated hydrodynamic conditions. The risk of remobilization of fine-grained sediments was evaluated in order to define a threshold discharge value after that the spreading of pollution can be expected.

The major contribution of the study, realized in the framework of international initiative ELSA was the identification of threshold values for potential remobilization of sediment burdened by old loads in different environments. These threshold values are important information for identification and mitigation of risks related with old loads and hydrological extremes. From methodological point of view the study verified validity of applied distinct approaches for fine-grained sediment remobilization assessment and identified limits for their application.

Key words: sediment, remobilization, old loads, modelling, hydrodynamics, Elbe river