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Flood Plain Lakes Along the Elbe River – a Forgotten Risk

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Introduction: Along the German part of the Elbe River, more than 1000 “side structures” form potential sinks of contaminated sediment. They are mostly remains of previous river courses which have been cut off by natural causes or anthropogenic alterations of the river (oxbow lakes), or are floodplain lakes that were formed during high water conditions. These water bodies sometimes have a small opening towards the Elbe, or are hydrodynamically connected only in situations of high discharges. High discharges in the Elbe River, however, are mainly responsible for transporting historic contaminants along with suspended matter from former historic sources in the middle Elbe downstream. As these may settle when the current dies down at the end of a high discharge period, side structures have been under suspicion to have accumulated contaminated material over the last decades.
Until this study was conducted, nothing was known about erodibility and contamination of sediment in these lakes even though they could have a large impact on the Elbe River itself: A preliminary investigation showed that the total surface of side structures in the Elbe floodplain adds up to about 50 km2. In case that deposited sediment is contaminated and only the upper 20 cm are prone to resuspension and transport during flooding, 10 Mio m3 of contaminated sediment could potentially be added to the contaminant load during a high water event.
This study was carried out to evaluate the risk from these side structures for the environmental quality of the Elbe River.

Methods:
15 side structures were investigated. Sediment cores were taken on 1 to 3 locations per water body in order to obtain the following information:
• Depth of sediment layer
• Erodibility of surface sediment, measured immediately after sampling – using the “Gust Microcosm”,
• Eroded mass at over-critical shear stress, measured in the lab by eroding a sediment core for one hour and collecting the suspended sediment matter.
• Chemical contamination
• Ecotoxicological effects

Results and Discussion
All side structures that were sampled exceeded the national quality guidelines for sediments which have been set by the International Commission for the Protection of the Elbe. In some cases very high concentrations were reached such as 1300 μg/kg dw for p,p-DDD, up to 61 mg/kg for Hg and 39 mg/kg for Cd. Erodibility varied a lot with critical shear stresses of less than 1 cm/s to more than 2 cm/s. Ecotoxicological data were also very different between side structures and sampling locations, but partly indicating very high inhibitions. Methanol extracts of sediments on all locations were screened using the luminescence bacteria test with Vibrio fischeri. Selected sediemt samples were tested applying the sediment contact test with Arthrobacter globiformes and the algae growth inhibition test with Pseudokirchneriella subcapitata.
An integrated evaluation of all information led to a classification of 7 sites out of 15 to be of high risk, 7 to be of medium risk and only one site to be of low risk for the environmental quality of the Elbe River.