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Mining Subsidence-generated legacy sediments in a Mid-European low-order stream floodplain as an archive for historic human activity and flooding events

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Legacy sediments, which were deposited as a consequence of mining subsidence in a floodplain area, can be used as an archive for human activity and past flooding. The morphodynamics of the Wurm River, a low-order stream in the Lower Rhine Embayment at the border between Germany and the Netherlands, is significantly influenced by a long colliery history, which caused alterations in the natural river landscape. In addition, substances which are transported via municipal wastewaters as well as contaminants emitted by specific regional industries were deposited in the floodplain sediments. This study aims at the reconstruction of human activity and past flooding events derived from geochemical and sedimentological data for different time slices within the 20st century. The spatial and chronological distribution of contaminants is investigated on the basis of several sections and drilling cores along the middle reaches of the Wurm River. Sections within mining subsidence areas and outside of those are compared regarding their sedimentation rates and element contents. Additional information is gathered from digital terrain models, historical documents such as the Tranchot map (early 19th century), and interviews of contemporary witnesses. Sedimentation rates derived from Cs-137 measurements allow a temporal assignment of the legacy sediments. A section within a segment of the Siegfried Line (Westwall), constructed in 1939, that crosses the Wurm River shows a significant increase in sedimentation rates in contrast to the floodplain area that is unaffected by subsidence processes. Furthermore, source-specific contaminants can be used to refine the stratigraphy, since source and period of emission are known. The evaluation of past flooding events is supported by numerical modeling of flood scenarios, which provides detailed information about flooded areas depending on the discharge, particularly for the areas which are under influence of mining subsidence. Besides the reconstruction of the contamination history, issues of remobilization, downstream dilution effects, and transport pathways are addressed within the study. As the discharge is strongly affected by regulation due to a wastewater treatment plant in the upper reach, the import of drinking water from the Eifel Mountains (Rhenish Massif) and the increased urbanization of the Wurm catchment since 1930, natural morphodynamics is superimposed in this “humanized fluvial system”.