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Humans reshaped the floodplain geoecology in NW Europe through intense agricultural impact

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Floodplain deposition rates have increased markedly under influence of anthropogenic land use throughout the Late Holocene in many Western and Central European catchments. These variations in sedimentation rates have changed the geomorphology and ecology of many floodplains as is shown here for the River Dijle (760 km^2) in the Belgian Loess Belt. Based on coring and pollen data, the geomorphology and ecology of the floodplain as well as the regional vegetation has been reconstructed for four different locations within the catchment. The chronology of changes in geoecology was determined through 54 radiocarbon dates. Our data shows that peat growth started at ca 9-10 ka cal BP and reached a thickness between 1 and 3 m. This unit was deposited in a marshy environment where no clear river channel was present. At that time, the floodplain was dominated by a wet alder forest (Alnion glutinosae). Between 2500-500 cal BP, the peat growth stopped and was gradually replaced by a unit dominated with silty to clayey overbank deposits (1-4 m thick). The transition is due to the gradual built-up of levees that laterally expanded over the backswamp areas when the sediment input increased. Afterwards, the entire valley is dominated by clastic sediments and the river system changed towards a single channel meandering river. The floodplain vegetation changed during this transition from a wet alder forest towards a more open vegetation dominated by Poaceae and Cyperaceae. The Late Holocene regional pollen data shows that the changes in the local floodplain geoecology do not coincide with the onset of agricultural activities in the catchment and subsequent soil erosion and sediment transport. Only when agriculture further increased such that sediment delivery crossed a certain threshold, discernible changes in floodplain geoecology occurred. This time lag between the start of human impact in the catchment and the changing floodplain geoecology differs for different sub-catchments, which can be attributed to the differences in sensitivity of the sub-catchments towards environmental disturbances. This indicates a non-linearity in the process-response.

Overall, the results shed light on the sensitivity of the floodplain geoecology towards environmental disturbances, and on the interaction between the ecology and geomorphology of a floodplain. From these results, it is clear that the meandering river morphology, typical for many West and Central European rivers, has an anthropogenic origin. However, contrary to many streams in the Eastern US, this is not due to sub recent mill damming but rather to millennial old intensive agriculture.