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Reconstruction of eroded and deposited sediment volumes in the floodplains of the embanked River Waal, the Netherlands, for the period 1650 – 1850 AD

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The embanked floodplains of the River Waal developed as a result of stepwise downstream migration of meander bends between confining dykes. Accretion in the upstream limb of the outer bend – enhanced by groynes and trees – and erosion in the downstream limb have resulted in a series of successively developed sand bars, separated by secondary channels. On top of the sand bars and the secondary channel fills, fine-grained overbank sediments were deposited. Downstream migration ceased around 1850 AD, when the river bed was fixed by large-scale construction of groynes, and only overbank deposition continued.

Eroded and deposited sediment volumes associated with downstream migration are affected by human activities. Goal of the present research is to estimate a sediment budget for a 12-km-long section along the River Waal, by quantifying the amount of erosion and deposition. We estimated these volumes for time slices of 50 years, between 1650 and 1850 AD, in order to be able to assess the variable impact of human interference during this period.

To estimate erosion, we created geomorphological maps for all time slices, based on maps dating from the 17th century to present. In these maps, distinction is made between sand bars, residual channels, and older deposits (all sediments deposited before 1650 AD). Comparison between all maps allowed us to calculate the eroded area per time slice. Eroded volumes were hence estimated by multiplying the eroded area by the average river depth at that period, which is assumed to be the erosion depth.

For estimation of deposition we used lithological cross-sections. These cross-sections are positioned such that every sand bar and every residual channel is represented in at least one cross-section. In every cross-section isochrones were drawn, based on OSL datings, chronologic interpretation of heavy metal profiles, and the historical maps. These isochrones are used to calculate the thickness of the sand bars, the residual channel fills, and the overbank deposits on top of them, for every time slice. Depositional volumes are hence estimated by multiplying the thickness of each deposit by its area on the geomorphological map.

Here, we present above described methods and we show some preliminary results.