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Releasing the banks: initial morphological responses after removal of groynes and installation of a longitudinal dam

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Longitudinal dams (LD) are novel engineering structures built parallel to the river channel that support sustainable river management. The recent replacement of groynes by longitudinal dams in low-land rivers such as the Waal has been successful in restoring the ecological river functions while simultaneously achieving its navigation, recreation, and flood-protection functions. However, the impact of the LD on the riverbanks is still unknown despite recent investigations on the flow dynamics in the side channel behind it. We fill this knowledge gap by investigating initial bank responses and quantifying changes in sediment dynamics over five years since the completion of the LD in the Waal at Wamel. We rely on available annual high-resolution LiDAR-derived DTMs, orthophotos, and in situ measurements to estimate erosion and deposition rates and their changes over the study period. A two-stage initial response is revealed with the largest bank erosion (~140 x 10^3 m^3/yr) and deposition (~20 x 10^3 m^3/yr) confined in the first year after installation, as the banks adjust to a new hydrogeomorphic equilibrium. This is followed by successively lower rates of surface-level changes (<70 x \$$10^3$ m^3/yr eroded and <10 x 10^3 m^3/yr deposited) as a response to the hydrogeomorphic dynamics in the new system. The overbank deposits from recent floods have a similar distribution with those prior to LD construction based on the DTMs. However, higher volumes of sandy deposits are found post- compared to pre-LD construction for floods of similar magnitude and duration. This increase is caused by the additional contribution of the bank sediments that have been made available through the removal of groynes. Although eroding banks may be a threat to infrastructure and navigability, they have a positive effect on restoring ecological diversity and floodplain connectivity.