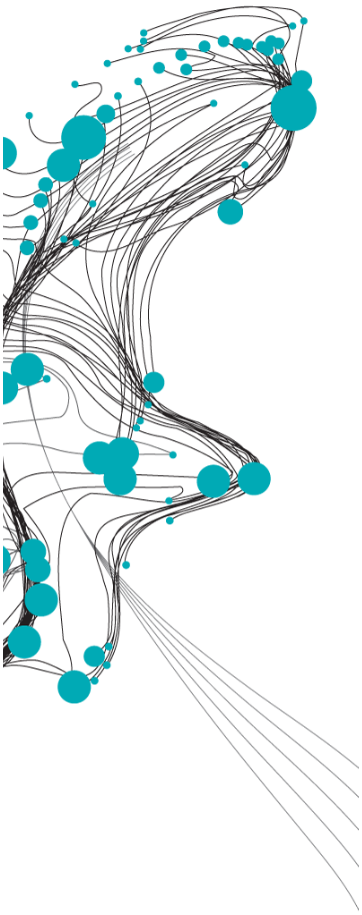
THE MORPHOLOGICAL MODELLING OF RIVER INTERVENTIONS



Rivers fulfil an important function in the natural ecosystem. They are a source of drinking water, a popular place for recreation, and enable transport over water. To maintain these functions and to guarantee safety against floods many river projects have been executed. The construction of river interventions affects the river morphodynamics. The interventions generally reduce the discharge that is conveyed within the main channel resulting in a smaller sediment transport capacity, and subsequent aggradation in the main channel. The objective of this research is to gain insight into the effects of river interventions on bed elevation in a quick way. We divide the equilibrium state into two components. The static component of the equilibrium is found by a space-marching method, based on the model of Arkesteijn et al. (2019). This means that the solution is found by stepping through space without the necessity of computing the transient phase. It significantly reduces the computation time compared to the more ”traditional” models. An abridged version of the Backwater-Exner Model is used to find the dynamic component of the equilibrium state.

The model is verified with field measurements and the results of a Delft3D computation. We have run deterministic as well as stochastic computations to make quick estimations of the morphological effect of different types of river interventions separately and we looked at the combined effect. The stochastic model approach is done by a Monte Carlo Simulation to quantify the range of uncertainties.

We see that river interventions in the floodplains cause the largest bed level fluctuations. These fluctuations are highly uncertain due to variations in discharge. However, at high discharge levels, the maximum bed level changes seem to reach a limit. River interventions in the main channel cause the smallest bed level fluctuations. These fluctuations are less sensitive to varying discharges. Combining river interventions with an opposite morphological effect can reduce the negative effect of a single intervention (see Fig. 1). The rapid method makes it possible to get insight into the single effect of the river interventions to understand the combined morphological effect of a complex river project. In this way, the rapid method that we developed is a useful tool in river management to gain insight into the morphological effect of river interventions in a quick way.

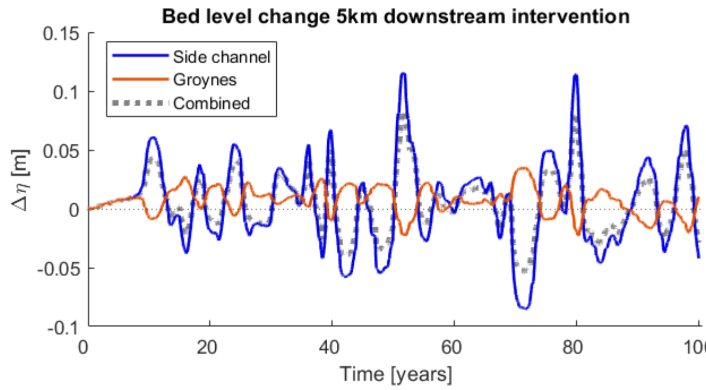


Figure 1: Bed level fluctuations 5 km downstream of the river intervention for a side channel, filling up the groyne fields and the combined effect based on the historical discharge series from 1900-1999 of the river Waal.

Arkesteijn, L., Blom, A., Czapiga, M. J., Chavarrıas, V., & Labeur, R. J. (2019). The quasi-equilibrium longitudinal profile in backwater reaches of the engineered alluvial river: A space-marching method. *Journal of Geophysical Research: Earth Surface*, *124*(11), 2542–2560.

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