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Water level uncertainties due to uncertain bedform dynamics in the Dutch Rhine system

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ABSTRACT

Quantitative estimations of water level uncertainties are essential for the design and assessment of flood protection systems. This work aims to quantify the water level uncertainties in the bifurcating Dutch river Rhine system as a result of main channel roughness uncertainty. An one-dimensional hydraulic model of the Rhine branches is used to estimate the water levels in the system for several roughness scenarios. These roughness scenarios represent the limits to the main channel roughness for each branch and are based on available bedform measurements. Model results show that the roughness values in the branches have a large influence on the modelled water levels (see Fig. 1). For the largest downstream branch, the Waal river, a changing discharge distribution counteracts the effect of roughness. Thereby, the range of possible water levels is decreased. For the smaller downstream branches, the Nederrijn and the IJssel, it is possible that the discharge in the respective branch is high even though the branch has a high roughness itself. This is possible for the scenarios in which the larger Waal branch has a high roughness, causing a large increase in discharge towards the Nederrijn and IJssel branches. Thereby, for these smaller branches the variations in discharge distribution increase the range of possible water levels. Concluding, the results show large and varying effects on water levels caused by the roughness uncertainty and the corresponding changes in discharge distributions. Therefore, it is important to consider the bifurcating river system as a whole instead of as separate branches in the design and assessment of river engineering works.

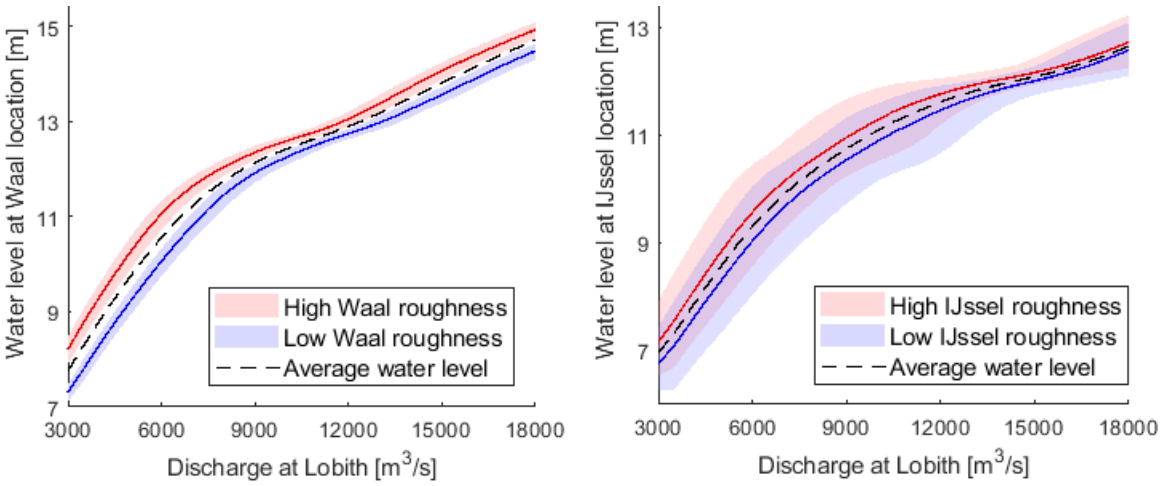

Fig. 1. Modelled water levels under the roughness scenarios for a Waal and an IJssel location. The left figure shows that the effect of the Waal roughness has a large influence on the water levels in the Waal, while there is only a narrow bandwidth around the modelled water levels. The right figure shows that the IJssel roughness has a minor influence on the local water levels, while a varying roughness in the other branches cause large variations in the modelled IJssel water levels.