IMPROVING THE PARAMETRIZATION OF THE MAIN CHANNEL BED ROUGHNESS IN THE MIDDEN-WAAL

Joël Haase

Graduation Date:
20 July 2023

Graduation committee:
University of Twente
Dr. J. J. Warmink
IR. L.R. Lokin

Affiliation
Ir. R.J. Daggenvoorde

The study focuses on improving the parametrization of main channel bed roughness in the Midden-Waal, a river area in the Netherlands. Accurate water level predictions are crucial for flood and drought mitigation, and hydrodynamic river models are commonly used for this purpose. However, the main source of uncertainty in these predictions is the inaccurate parametrization of main channel bed roughness.

River dunes are considered the primary factor affecting main channel roughness. Current parametrization uses implicit 2D river dune geometry parameters, which only capture the dunes on the centreline of the fairway, leading to inaccuracies. Moreover, the implicit bedform does not adequately cover the discharge history-dependent bed evolution in the hydrodynamic model, especially during extreme discharge events.

The research aims to address three potential improvements of in the parametrization of the main channel roughness in the Midden-Waal:

1. Improving bed parametrization: The study explores the potential benefits of using 3D river dune statistics instead of the current 2D parameterization. However, the comparison between 2D and 3D statistics did not yield significant improvements.
2. Discharge History: To improve roughness estimation, the researchers extended the D-HYDRO model's roughness formula with a discharge history-dependent factor, Q/Qhis. The most appropriate period for discharge history was found to be the median bedform turnover time (around 50 days), which showed promising results.
3. New Roughness Sections: New roughness sections were defined in the Midden-Waal based on dune height trends, aiming to increase the physical relevance of the calibrated roughness. However, some calibration issues led to the use of the original roughness section for the final analysis.

The combined knowledge from these investigations led to a final formula for three roughness sections in the Midden-Waal, incorporating discharge fraction and dune steepness as additional variables. The results indicate room for further improvement in the physically based roughness estimates for the Midden-Waal, possibly through new roughness sections and an enhanced parameterization of the riverbed.

In conclusion, the research emphasizes the significance of accurately parametrizing main channel bed roughness in hydrodynamic river models to improve water level predictions for flood and drought mitigation. While 3D parametrization did not provide the expected benefits, incorporating discharge history and dune steepness showed promise. However, further research is needed to refine roughness estimates and better understand the relationship between roughness and bedform statistics in the Midden-Waal area.