Title of the project: Enhancing Hydraulic River Modelling: Application of a Mesh Modification Algorithm to the Vecht River

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Assignment no.: 10.24

External:
Waterboard Vechtstromen

Head graduation committee:
tbd

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Name(s) of participating companies or institutes:
Waterboard Vechtstromen

Start of the project:
asap

Required courses:
Hydraulic modelling
River Flow and Sediment Dynamics
River Morphodynamics

Short description of the project

2D hydraulic models play a vital role in accurately simulating water levels for effective river management. The resolution of the mesh in these models significantly impacts the accuracy of simulated water levels by influencing the representation of bathymetry and discharge capacity. Given the importance of precise water level predictions, it is imperative to develop methods that enhance the mesh setup in 2D hydraulic models.
The objective of this master thesis project is to implement an improved Python algorithm for enhancing mesh setup in 2D hydraulic models. The focus is on applying this algorithm to the river Vecht in the Netherlands to achieve more accurate water level simulations and the existing model For Vecht river (D-Flow FM 2D Overijsselse Vechtdelta) will be the base.
The proposed algorithm aims to develop a low resolution mesh having equal flow volume compared to the high resolution bathymetry volume. This is achieved by vertically adjusting the mesh elevation nodes within a limited range. Figure1, briefly shows how the algorithm works. By implementing this algorithm, we aim to decrease the computational time of the hydraulic model while maintaining accurate water level predictions for the River Vecht.
Implementing an improved mesh setup algorithm for the river Vecht holds promise for enhancing water level simulations and supporting effective river management practices. At the conclusion of this research, several important practical questions should be addressed:

Model Optimization: Is it possible to accelerate the existing 2D model for use instead of 1D models? Currently, a 1D model is used for predictions because the existing 2D model is too slow, particularly for ensemble forecasts. Identifying the right balance between speed and accuracy, particularly for high water safety measures, is essential.
Recommendations for Future Models: What recommendations can be made to RWS for creating new meshes in the next version of the D-Flow FM 2D Overijsselse Vechtdelta-model?

Practical Use of the Method: How practical is the method in real-world scenarios? Initially, the focus will be on the River Vecht, with the possibility of applying the method to other rivers, both larger and smaller, in the future. This assessment will help determine the broader applicability of the approach. It is essential to emphasize that proficiency in Python coding is required for the successful execution of this project.

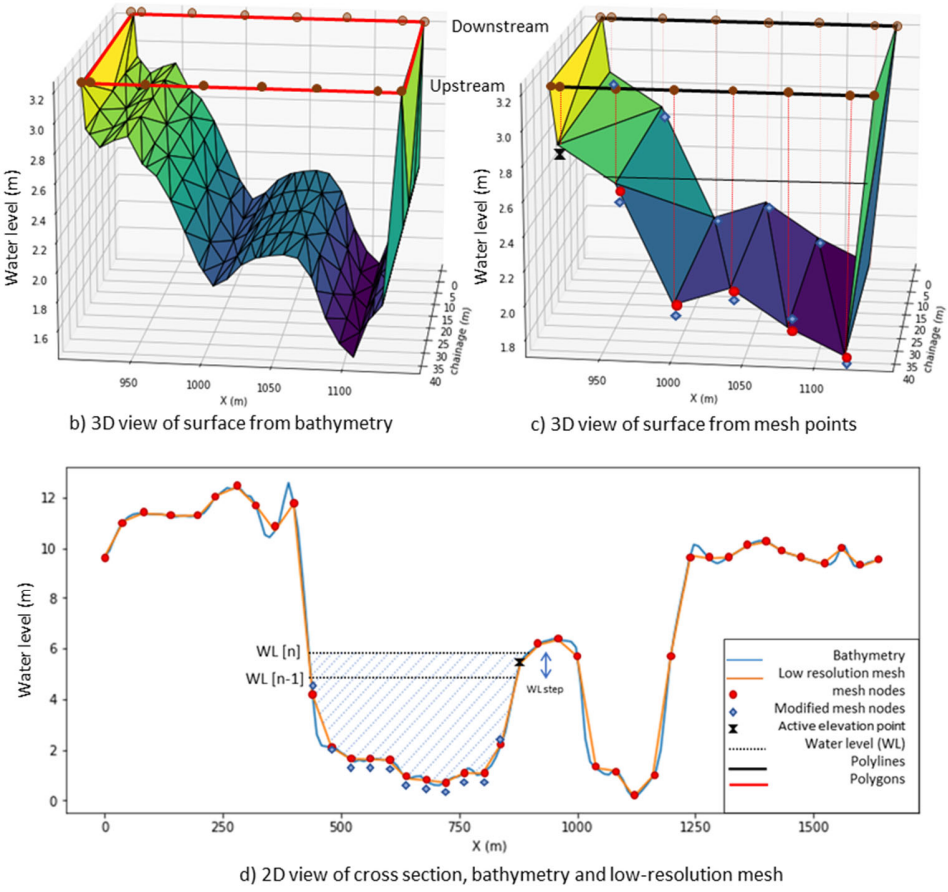

Figure 1, Schematic representation of the algorithm