Improving mesh set-up to increase cross-sectional-area accuracy for water-level prediction[1]

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An accurate prediction of river water levels using hydraulic modelling is essential for adequate river management. 2D models are one of the best choices for simulating river hydraulics as they enable more detailed and accurate simulations of water levels and flood patterns. The bathymetry in 2D models generally is described with a continuous mesh covering the main channel and floodplain. The mesh set-up can affect the simulation results significantly, and selecting a suitable mesh is as crucial as applying an appropriate calibration method. The mesh resolution affects bathymetry discretization, discharge capacity, and, consequently, simulated water levels. A higher resolution leads to more precise results, but on the other hand high resolution models are time consuming. This study aims to develop a modified mesh set-up with the same cross-sectional flow area as the measured cross-section at the highest resolution. The modified mesh is developed using an algorithm which changes the nodes of the mesh vertically for a limited range to determine the mesh with the same flow area as observed, but at a lower resolution. Then, D-Flow-FM software is used to model a hypothetical river for 100 kilometers with one uniform cross-section to exclude the effect of longitudinal variability in cross sections on the results. A constant roughness is considered to exclude the effect of roughness on the results and evaluate the effect of mesh set-up on the discharge capacity and predicted water levels. Moreover, a steady inflow of low, intermediate and high flows is used as upstream boundary condition. For comparison, simulated water levels for the high-resolution mesh, the current mesh in the D-Flow-FM model and the modified mesh are compared. Differences between water levels simulated with the current mesh and the modified mesh are around 3 to 10 centimeters, but the modified mesh and the high-resolution mesh simulate the same water levels for different types of cross sections and discharge levels.

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