COMPARING MODEL PERFORMANCE BETWEEN THE HYDRODYNAMIC MODELS SOBEK AND TYGRON

CASE STUDY: OVERIJSSELSE VECHT

TYGRON is a new hydrodynamic model which simulates the flow equations in 2D fast in a square grid. In this study TYGRON is compared with a 1D/2D SOBEK model for a case study in the Overijsselse Vecht between the German border and weir Hardenberg. Flood water levels, flow velocities and inundation where compared to study the practical/hydraulic differences between the two models.

Water levels cannot be retrieved directly as an output parameter from TYGRON. Water levels can be calculated as the sum of the simulated water depth and the bed level, but this introduces errors due to averaging and interpolation over grid cells. Furthermore, boundary conditions such as a Q(-t) or a Q(-h) relation cannot directly be implemented in TYGRON. Hydraulic structures (e.g. weirs, inlets and culverts) cannot be implemented over the width of the main channel. This results in that water flows partly over the structure and along the structure in a scenario where water only should flow over the structure.

Another difference is that TYGRON cannot simulate the expected hydraulic jump after weir De Haandrik in the averaged bank full winter scenario (1/4Q) (Figure 1). The following problems influence the simulated water levels in TYGRON: 1) the absence of water levels as result type, 2) the weirs are not correctly coupled to the DEM and computational grid which results in an incorrect simulation of weir dependent river sections and 3) the square grid does not follow the course of the main channel which results in a large numerical viscosity and hence larger simulated water levels.

Inundation and flow velocities are also compared between TYGRON and SOBEK. This analysis shows that TYGRON can simulate both flow velocities and inundation in detail. The bathymetry accuracy is larger compared to SOBEK due to the high-resolution grid in TYGRON (2x2 m vs 25x25 m). Although, simulating in a high-resolution result in an overshoot of the flow velocities at the steep slope of the main channel, which is inherent to the used algorithm in TYGRON.

Based on the aspects described above can be concluded that TYGRON, at the moment, is not fit for a river study. However, TYGRON excels as a 2D model because it can simulate grid cell sizes in 1x1 m (or lower), while other 2D models generally use grid cell sizes between 5x5 - 25x25 m. This means to that TYGRON can have additional value in rapid river studies where accurate prediction of flood water levels are not necessary. Although small grid cell sizes increase bathymetry accuracy and probably improve flow distribution in downstream direction, it also introduces new problems in hydrodynamic modelling (e.g. overshoot in flow velocities at steep edges). Additional research is necessary to identify the impact of small grid cell sizes on the model results from TYGRON.

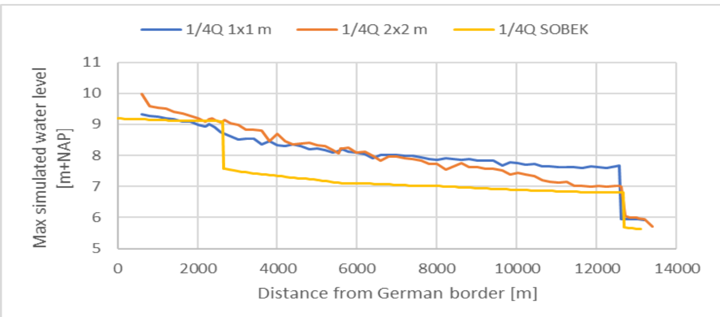

Figure 1: The influence of different grid cell sizes on the simulated water levels in the 1/4Q scenario. The 2x2 m grid (orange line) results in a steeper water level slope compared to SOBEK (yellow line). The water level slope complies with SOBEK in the 1x1 m grid (blue line). However, the water levels are still significantly larger compared to SOBEK.

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