UNVEILING THE IMPLICATIONS OF SCHEMATISATION CHOICES IN FLUVIAL FLOOD MODELS

DIKE BREACH INDUCED FLOODS IN BETUWE TIELER EN CULEMBORGERWAARDEN

Flood modelling software is constantly updated, and new software is developed, such as D-HYDRO. As there is no Dutch data of large floods after 1953, these models are validated by expert judgement. The results of fluvial flood models are therefore largely dependent on the modelers' choices. The impact of these choices is not always well described. This research showed the impact of several schematization choices on model results and placed them in a larger flood modeling context.

This research has shown that simple weir equations for dike breach flow, as used in the established Delft-FLS software, produce a much higher dike breach flow than the more accurate D-HYDRO calculations. Dike breach flow in D-HYDRO is sensitive to all kinds of local factors and largely sensitive to river flow direction. The modelers' choice of dike breach location can therefore largely influence dike breach flow, even within the same normative dike section. It also means that alternative river schematizations like a 1D river in combination with a dike breach, are unable to produce the same results as a 2D river schematization. Several factors contribute to a large overestimation of dike breach discharge in 1D river schematizations in D-HYDRO.

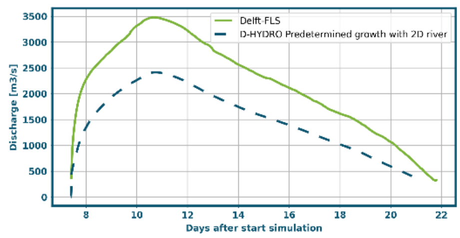

Figure 1: Breach flow in Delft-FLS and D-HYDRO.

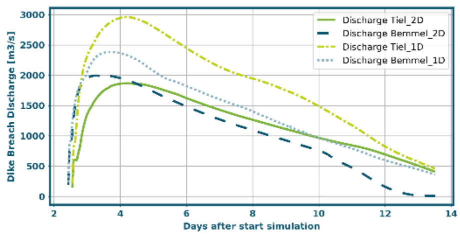

Figure 2: Breach flow in 2D and 1D.

To calculate the growth of a dike breach after breach initiation, the Verheij-vdKnaap equation is used as a standard in Dutch flood modeling. This research has unveiled considerable limitations of this equation and has introduced viable alternatives. The Verheij-vdKnaap equation does not consider underlying developments in flow velocity or flow height. This makes dike breach growth insensitive to breach initiation moment and limits the final breach width. The introduced alternative growth equations include a flow velocity factor and are therefore sensitive to breach initiation moment and the underlying hydraulic conditions in the breach.

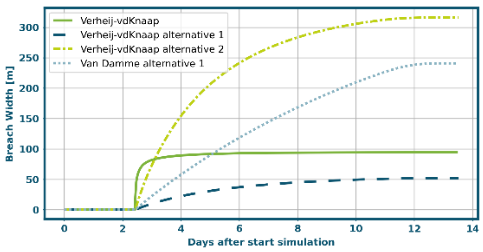

Figure 3: Breach growth by four different growth equations.

In the distribution of water, this research has looked into the impacts of local waterways and fixed weirs on the 2D grid and flood simulation results. Fixed weirs reduce the flow velocity over elevated elements and can largely delay a flood wave compared to elevated grid cells. This has large effects on arrival times but less effect on maximum water depths. Accurately schematizing the size of elevated elements is far more important for the latter variable. The effects of fixed weirs and waterways on flood simulation results are largely dependent on their size, the magnitude of the flood wave and the flooded area.

This research can be used as a guide for modelers to improve the accuracy of current flood models and to make the right schematization choices for their modelling goals in future fluvial flood models.

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