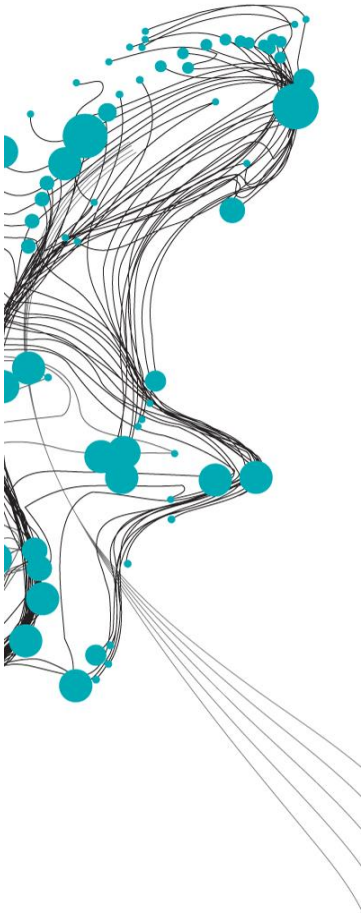
THE SENSITIVITY OF SPATIOTEMPORAL INUNDATION PATTERNS TO THE DIKE BREACH LOCATION



Hydrodynamic models are often used to simulate inundation patterns for evacuation planning. Yet, they are affected by uncertainties in, among others, the dike breach location. Sensitivity analyses are often used to assess the effect of the variability in uncertain input factors on the model output. The aim of this study is to assess the spatiotemporal sensitivity of inundation patterns to the dike breach location.

An accurate and computationally efficient subgrid-based hydrodynamic model (3Di) was setup of the study area, dike ring 48. The computational grid of this model was based on a sensitivity analysis. In this analysis, the effect of the computational grid size on the inundation pattern and the computational time was determined. The sensitivity analysis of the computational grid mainly showed that an incorrect schematization in the computational grid of the underpasses in obstacles can have a large influence on the accuracy of the simulated inundation pattern. Therefore, the computational grid was locally refined around the underpasses. The set-up model was used to simulate a dike breach at 15 potential dike breach locations using the same inflow at all breach locations.

After the simulations, the maximum inundation extents of the different simulations were qualitatively compared to determine clusters of dike breaches which resulted in similar inundation extents. Two clusters were determined. For every cluster, the spatiotemporal sensitivity of the inundation pattern (arrival times and maximum water depth) to the dike breach location in the cluster was analysed. In this analysis, it was found that the spatiotemporal sensitivity of the inundation pattern to the dike breach location are determined by the elevation, the presence of higher line elements and the distance to the dike breach locations. In lower-lying and centrally located areas, the inundation pattern is only slightly sensitive and for a short period. The sensitivity of the inundation pattern tends to get significant in areas which are less-centrally located and/or where the elevation increases. An exemption are elevated areas which are located at the edges of the lower areas and further away from all dike breach locations. In these areas, the inundation pattern will be almost insensitive. Moreover, the inundation pattern in small compartments which are completely enclosed by obstacles is significantly sensitive and for a long period. Furthermore, in general, the sensitivity of inundation pattern decreases over time.

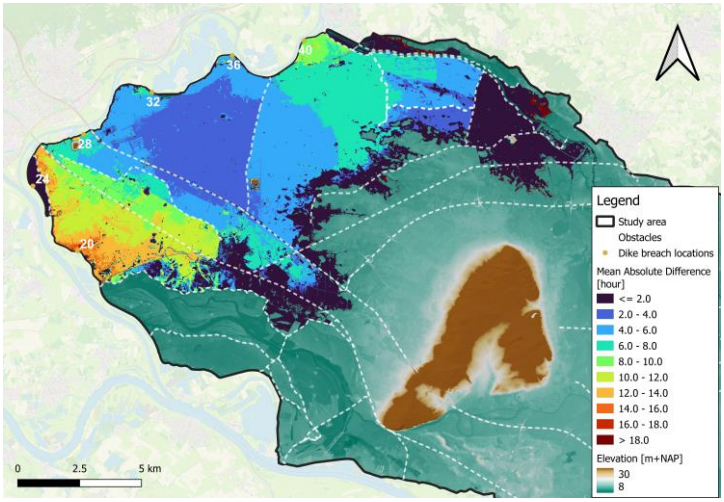


Figure 1: Mean Absolute Difference (MAD) in arrival times between several simulations. A higher MAD means that the sensitivity of the arrival times to the dike breach location is higher. The white dashed lines are the obstacles.

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