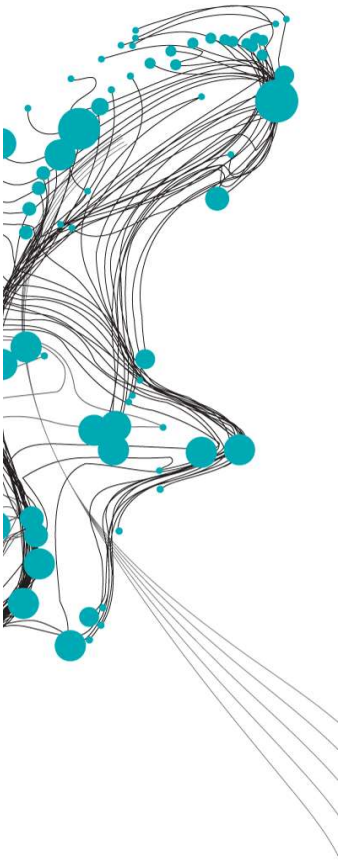
MODELLING SHIP WAVES FOR THE PURPOSE OF OVERTOPPING



In the Netherlands, inland waterways are an important part of the transport infrastructure. On the Waal alone, 120-140 million tonnes of freight gets transported annually. Every ship sailing on these waterways causes waves. Along low-lying quays and dikes, overtopping by ship waves can pose hazards for pedestrians and vehicles.

Although a lot of effort has been spent on quantifying the effects of ship waves since 1949, there is no accurate way of estimating overtopping by ship waves. Up till now, the short, secondary ship waves were the limiting factor of comparable models. In SWASH the dispersion of secondary waves should be accurately represented. In this study, three steps are undertaken to find out how SWASH performs when modelling ship-induced waves for overtopping.

The first step is the implementation of the pressure field method in SWASH. In the pressure field method, a ship is represented as a time-varying atmospheric pressure field. The successful implementation is a proof of concept for simulating ship passages in SWASH (see Figure 1). The generated wave signal proved to be sensitive to the horizontal resolution of the computational grid. The biggest limitations for application of the model are the computational effort required and the numerical instability.

The second step in this research is the validation of the model to measurements and comparison of SWASH to existing analytical methods. The simulations show that SWASH can model the wave signal in complex geometries. When comparing estimated wave characteristics with conventional methods, SWASH outperforms both Dutch and German guidelines (Figure 2).

The third step is to explore the potential of the ship-wave model to include overtopping. It was shown that with the grid at a resolution useful for overtopping, the calculation time is unfeasible. Therefore alternative approaches need to be explored in further research.

Overall, SWASH is a promising tool for estimating ship-induced wave conditions. The model has proven to be able to generate both primary and secondary ship waves. Wave signals and components can be estimated more accurately than with other methods. For the purpose of overtopping, SWASH can be used to generate the wave signal that serves as input for an overtopping model. Further study on the certainty and sensitivity in the outcomes of the wave signals modelled by SWASH is necessary to increase the reliability of the model to levels acceptable for engineering applications.

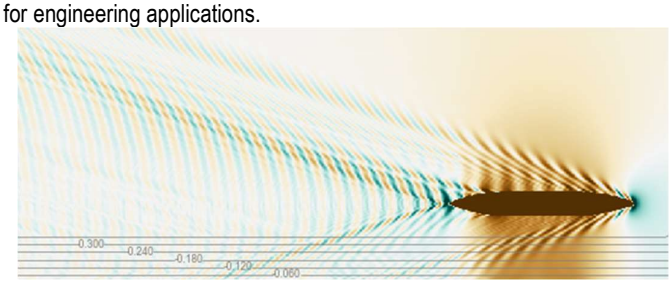


Figure 1: Primary and secondary ship waves as modelled by SWASH

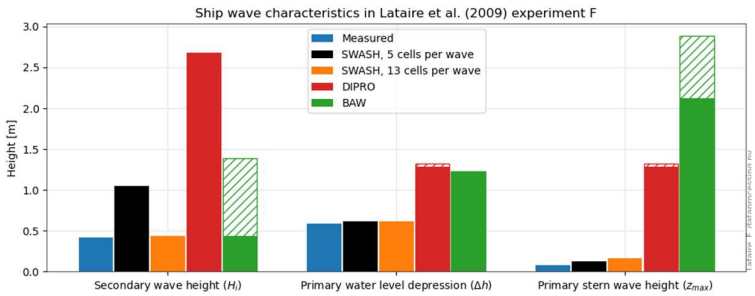


Figure 2: Characteristics of the ship waves as measured (blue), modelled by SWASH (black and orange) and calculated with much used analytical methods (red and green)

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