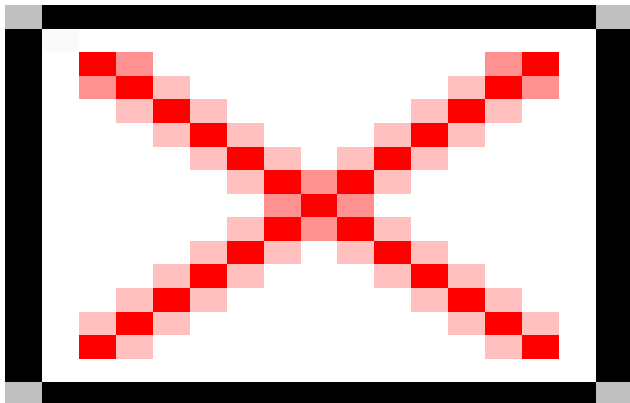


IMDC
Hydrodynamic and morphologic studies
Inland navigation
Location:
Belgium
Client:
Flanders Hydraulics Research



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Eddy-induced cross-currents in the Westerschelde estuary

The Westerschelde estuary is located in The Netherlands and is a major shipping route connecting the North Sea to the Port of Antwerp (Belgium). Cross currents up to three knots occur at high water during extreme spring tides and are increasingly hampering navigation in the Westerschelde near Hansweert resulting in one major incident leaving a container vessel stranded on a nearby sand bank (Figuur 1).

IMDC was assigned simulate, predict and assess the large eddy (stretching over the complete navigation channel) which produces these cross currents. A numerical model was set up in Delft3D encompassing a 20 km stretch of the estuary and is nested in larger models of the complete estuary and North Sea. Since a large amount of measurements was available through an extensive measurement campaign, a detailed calibration of the hydrodynamic model was executed.

A good agreement was obtained between model and measured data on the location of the eddy and the strength of the cross currents (Figuur 2). Flow fields produced by the numerical model subsequently have been implemented in a nautical simulator in which pilots are trained on sailing in these exceptional conditions.

The detailed spatial output of the model has given the opportunity to study the driving mechanisms and ambient conditions causing the formation of an eddy extended enough to hamper navigation. This has led to new insights in the dynamics of the eddy and its interaction with the estuarine geometry, such as the influence of tidal amplitude, high water level and nearby intertidal sand flats.

The current Traffic Control warning system had proved to be insufficient in some cases and still ships were sailing without warning in dangerous cross current conditions. The simulation results and analysis have clarified the conditions in which the eddy grows sufficiently to cause cross currents with the potential to cause incidents. A new criterion for sending out a navigation warning has been proposed: the new criterion combines different ambient conditions such as high water level and rate of water level rise in one parameter. It shows a better correlation with occurrence of cross currents, hence pilots will have a higher probability to be warned in case of cross currents.

This research frames in the study 'Evaluation and improvement of models for the Flemish tidal waters and

(coastal) harbours?, assigned by the Flemish Hydraulics Research.
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