DECISION SUPPORTING TOOLS FOR DETERMINING TIDAL WINDOWS FOR DEEP-DRAFTED VESSELS

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A computer program called ProToel has been developed with the purpose of supporting the decision making of pilots and the in advance planning of daily traffic schemes for deep-drafted shipping traffic in harbours, based on up-to-date environmental data, such as tide, currents and waves.

The access to harbours is, especially for deep-drafted vessels, often restricted to so-called tidal windows: the time span in which the tidal elevation is high enough for vessels to pass. The length of these windows depends on the draft of the ship, the planned route, the water depth, tide, and the ship speed along the route. For a more accurate representation of the time span in which a ship may arrive at or depart from a harbour, additional factors can be taken into account, such as the ship's penetration into the soft mud layer on the seabed and the speed of cross-currents at the harbour mouth. Furthermore, a transition to a probabilistic tidal window can be made by taking account of waves and the resulting probability of bottom touch, instead of a more traditional, deterministic way of defining tidal windows, based only on a required minimum gross under keel clearance during the transit.
A computer program has been developed that calculates probabilistic tidal windows for the harbour of Zeebrugge, based on either astronomic tide, current tables and standard wave spectra, or short term predictions of tide, currents and waves that are made available through the HYDRA-server. For the calculation of the probability of bottom touch, the motion characteristics of deep-drafted ships that are of interest for the traffic to Zeebrugge were obtained through model tests and additional numerical calculations using the 2D strip theory program Octopus Office (formerly Seaway) and the 3D BEM program Aqua+.
The user can define a route, a ship, her loading condition and the date and time of departure to calculate whether the ship can arrive (or depart) at that time with an acceptable probability of bottom touch. To calculate tidal windows, such a calculation is performed consecutively for a number of departure times, with a constant time step between each other. The output is given in a table view, where each column represents one time of departure. Through the colouring of the table, it can be easily seen where tidal windows begin and end.
If data are available, the program can easily be extended to other regions. In the past this was done for the harbours of Flushing and Antwerp, where only the astronomical tide was taken into account for a long-term accessibility assessment.
To extend the probabilistic approach to the river Scheldt however, further work on the program is necessary, because the vertical motion of a ship sailing on a river mainly depend on other parameters than waves, such as wind, drift, other shipping traffic, etc..

References

[1] Vantorre, M.; Richter, J.; Lataire, E.; Laforce, E.; Eloot, K.; Verwilligen, J. (2008) Ship Motions in Shallow Water As the Base for a Probabilistic Approach Policy 27th Annual Conference on Offshore Mechanics & Arctic Engineering (OMAE2008-57912), Estoril, Portugal

[2] Eloot, K.; Vantorre, M.; Richter, J.; Verwilligen, J. (2009) Development of Decision Supporting Tools for Determining Tidal Windows for Deep-drafted Vessels. 8th International Navigational Symposium on Marine Navigation and Safety of Sea Transportation, TransNav 2009, Gdynia, Poland.