Introduction

ProToel (PRObabilistisch TOELatingsbeleid = probabilistic admittance policy) is a computer program that calculates tidal windows to support the decision making of pilots and the in advance planning of daily traffic schemes for deep drafted shipping traffic in harbours, with special regard to the harbour of Zeebrugge.

Tidal window

A tidal window is the time span in which the tidal elevation is high enough for a vessel to pass. Depending on the parameters that are accounted for, different types of tidal windows can be defined:

- **CLASSICAL DETERMINISTIC TIDAL WINDOW** accounts for:
  - Minimal allowed under keel clearance (UKC) towards the solid seabed

- **EXTENDED DETERMINISTIC TIDAL WINDOW** also considers:
  - Maximal allowed penetration into soft mud layer on the seabed
  - Maximal allowed speed of cross-currents, e.g. at the entry of a harbour

- **PROBABILISTIC TIDAL WINDOW** additionally considers:
  - Maximal allowed probability of bottom touch

Each parameter depends on environmental conditions, as depicted by the table below. If the environmental conditions and the critical values of each zone are known, the safety of a travel can be assessed for each time of departure and tidal windows can be identified.

Workflow of the program:

- Define ship dimensions, type and loading condition;
- Pick a route and optionally define speeds along the route;
- Define date and time of departure;
- Optionally: define number of additional computations before and after the defined time of departure to generate a tidal window view.

Based on the choices in the workflow, the best fitting vertical ship motion characteristics are taken from a local database. For each point along the route either from a local or a remote database. The local database contains data for astronomical tide, currents from current tables and standard wave spectra, allowing long term assessments. The remote Hydra database (http://waterstanden.vlaanderen.be) can be accessed by the program for up-to-date predictions of waves, tide and currents, allowing for an accurate short term prediction of tidal windows.

Based on these data, the possibility of passing each region along the route is calculated and outputted in a table. For consecutive departure times, this leads to the representation of a tidal window.

Extending the program

If environmental data are available, the program can easily be extended to other regions. In the past this was done for the harbour of Flushing and, for a long term assessment of deterministic tidal windows, for the harbour of Antwerp.

To extend the program for the safety assessment on a river, the probabilistic admittance approach will additionally need to consider: wind, heel in bends, drift, other shipping traffic, bank effects, etc. Not only with respect to the probability of bottom touch but also with respect to the probability of collisions with fixed and moving structures.