Ship's travelling time in approaching the Port of Rotterdam

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Abstract. This study determines the standard or expected travelling time of inbound liner ships in the approach area of the Port of Rotterdam based on AIS ship data. Non-standard or non-expected behaviour is mainly due to ships waiting to be serviced by a pilot, tugboats or the terminal and examples are speed changes, anchoring, drifting and turning circles. Voyages were constructed from the AIS data by collecting information of ships crossing the boundaries of the study area. For each crossing line at the border of the Port of Rotterdam approach area and for each ship size class the standard travelling time was determined.

Keywords: AIS data, ship behaviour, port approach, vessel traffic

1 Introduction

The Port of Rotterdam has introduced Vessel Traffic Management (VTM) which is about sharing reliable information, about minimizing unnecessary delays along the chain and about planning and coordination [1]. By sharing reliable information between stakeholders regarding for example the availability of a pilot or the accessibility of the terminal, ships are able to plan their journeys more efficiently. It may be expected that this leads to a reduction of so-called non-standard behaviour in the approach area of Rotterdam, especially for inbound liner ships.

For liner shipping, non-standard behaviour in the approach area happens when ships are waiting to be serviced by a pilot, tugboat or terminal before they enter the actual port area. It includes drifting, making turning circles, speed changes and anchoring. This non-standard behaviour leads to unnecessarily use of fuel and thus emissions.

To determine the effects of the VTM measures, the study focussed on determining the standard or expected travelling time of inbound liner ships in the Port of Rotterdam approach area. These standard travelling times are determined by analysing the AIS data of the approach area.

2 Method

The main dataset for this study is the AIS data of 2010 collected by the Netherlands Coastguard from the validated traffic image of the Port of Rotterdam. The study area contains the traffic approaching the Port of Rotterdam (Fig. 1).

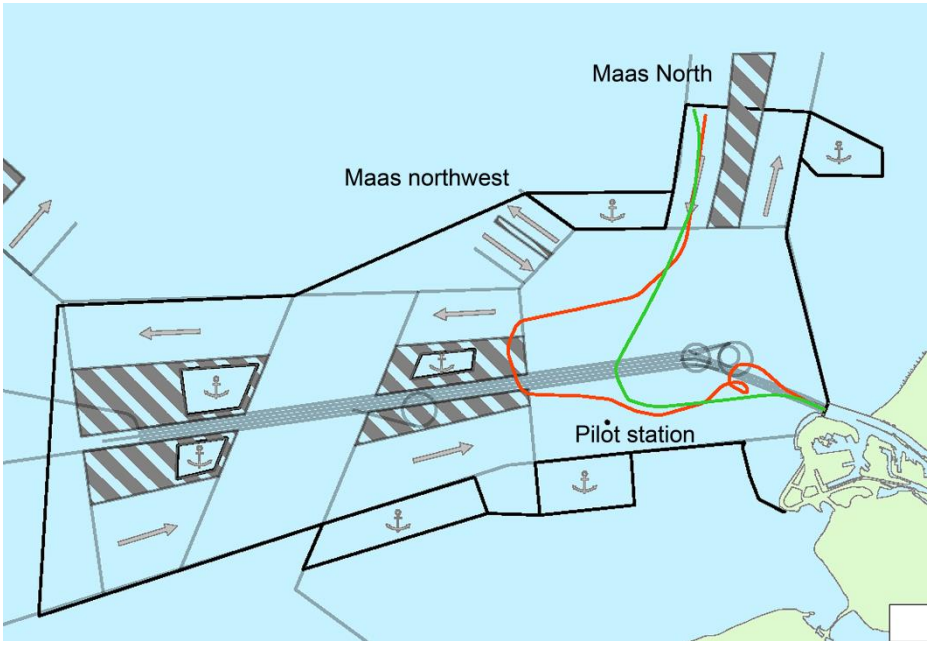

Fig. 1. Study area with an example of a standard and non-standard voyage

MARIN has developed several tools to read, analyse and visualize AIS-data. These tools were used to define a crossing line at the port entrance (Maasmond) and to collect information of all voyages of ships passing this line. The collected information contains the ship's MMSI number, call sign, IMO number, name and the date and time.

Next, the liner ships were selected by coupling the information with a ship characteristics database containing vessel types. Liner ships were defined as container ships, general dry cargo ships, roro cargo/vehicle carriers, reefer and passenger ships. The ships were divided in five size classes depending on the ship's length and for the ships with a length above 300 meter also on the draught. Unfortunately for the year 2010, the AIS draught is not accurately enough because of an error during the AIS storage process at the Netherlands Coastguard. Therefore, the draught was checked against data from the IVS (Harbourmaster Information System) of the Port of Rotterdam.

In the third step, crossings with the outside boundaries of the study area were collected for all the MMSI numbers of the liner ships for 2010. The resulting data was

sorted on time and MMSI number. Equations were used to group all results in voyage categories: inbound, outbound, round trips and transits. Because the expected results of the VTM measures have the most influence on the inbound voyages in the port approach area, only these voyages were used in the remainder of the study.

After selecting all inbound voyages from liner ships, the travelling time in the port approach area was calculated based on the passing time of the outer border and the passing of the line at the port entrance (Maasmond). These travelling times in the approach area were sorted decreasingly for each outside boundary line and size class.

3 Results

For each crossing line at the border of the port approach area and for each ship size class, a figure was made containing the number of voyages with the same travelling time in the approach area (Fig. 2). This figure shows the distribution of the different travelling times and gives an indication where to find the transition between standard and non-standard travelling time. Ships with a longer travelling time have probably shown non-standard behaviour. This has been investigated by watching animations of the approach manoeuvres based on the AIS tracks concerned.

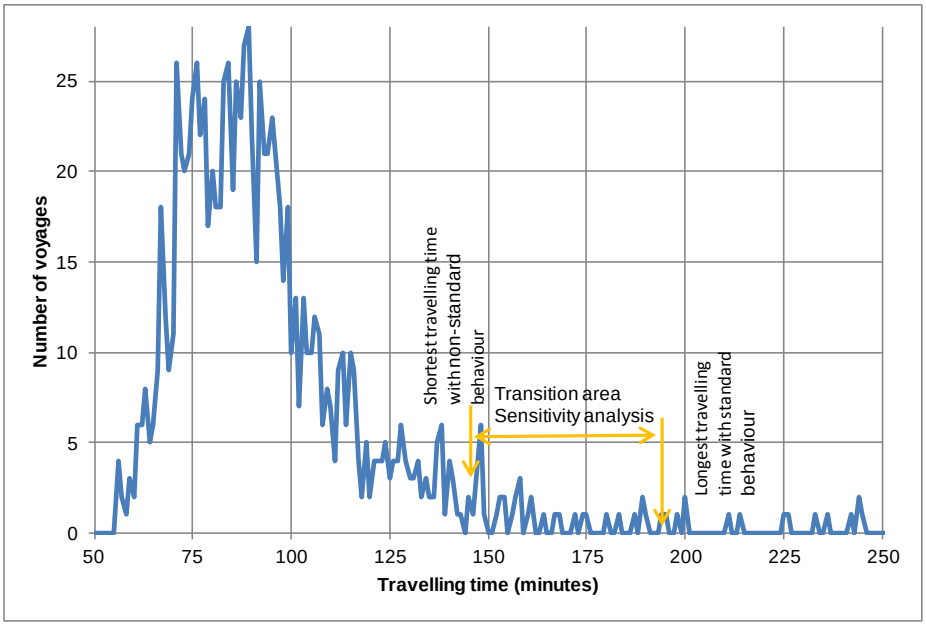

Fig. 2. Distribution of the travelling times for one size class entering the approach area via the Maas North route. The longest travelling time with standard behaviour and the shortest travelling time with non-standard behaviour were determined by animation

Standard behaviour doesn't necessarily mean that a ship follows the shortest possible route. Most ships for example have to take a pilot on board. This means that it sails towards the pilot station and if necessary because of the waves, it makes lee for the pilot boat. This is the reason why the green track in Fig. 1 contains a large bend. By consulting a VTS expert, a better feeling for the difference between standard behaviour and non-standard behaviour was obtained. After this consultation, the shortest travelling time with non-standard behaviour and the longest travelling time with standard behaviour were determined. The time in between can be seen as the transition between non-standard behaviour and standard behaviour.

4 Discussion

The standard or expected travelling time of inbound liner shipping in the Port of Rotterdam approach area is determined for different ship classes, as well as the transition area between non-standard and standard travelling time. This enables estimating the delays encountered for each crossing line at the border of the port approach area and for each ship size class. This information can be used to calculate the potential effect on emissions by VTM measures, assuming that such measures can remove this unnecessary downtime. For the transition area, a sensitivity analysis can be performed.

Acknowledgement

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References

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