International Journal on Marine Navigation and Safety of Sea Transportation
Volume 6 Number 3 September 2012

Incidents Analysis on the Basis of Traffic Monitoring Data in Pomeranian Bay

L. Gucma & K. Marcjan
Maritime University of Szczecin, Poland

ABSTRACT: In this paper preliminary analysis of grounding incidents was presented for the future use in navigational safety management system development. The analysis is focused on the area of Pomeranian Bay. Grounding incidents model is created with use of AIS data. The distance of vessel from the dangerous depth and draught/depth ratio was considered as the main factors of navigational incident in presented model.

1 INTRODUCTION

Marine transport development causes the increase of the intensity of ships traffic and ships dimensions. The navigational risk increase requires more sophisticated methods of its assessment. Marine accidents such as grounding are very rare and serious safety analysis should also include incident (near misses) analysis. The incident analysis is very important factor in navigational safety analysis due to the incidents are usually not reported. Probability of the ships grounding is one of the most important factors influencing the navigational safety [2]. Based on the data from HELCOM in 2008, there were 60 reported groundings in whole Baltic Sea, and 32 of them were reported in the south western Baltic Sea. As it is shown on Figures 1 and 2, in 2009 the number of reported groundings decreases to 38, but still about half of them were reported in south-western Baltic Sea.

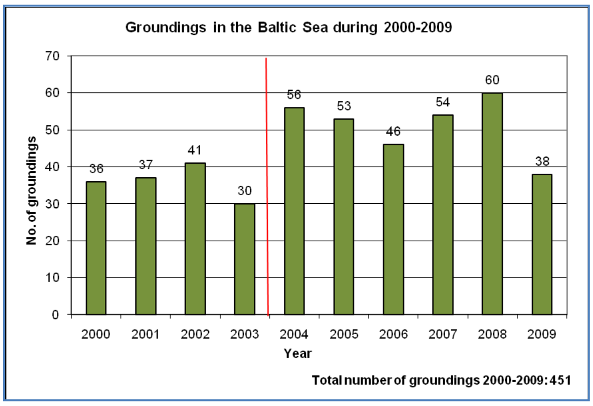

Figure 1 Grounding accidents between (2000-2009) in south-western Baltic Sea

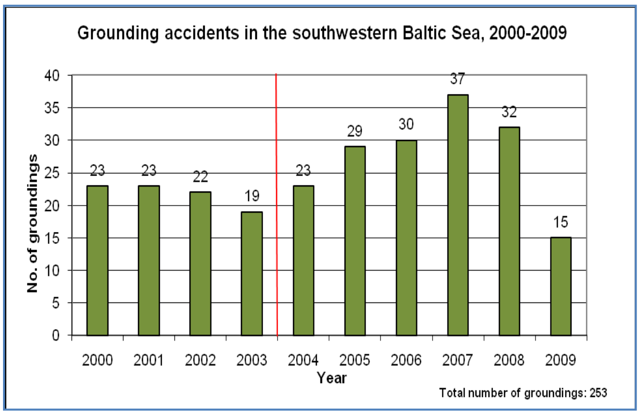

Figure 2 Grounding accidents between (2000-2009) in Baltic Sea

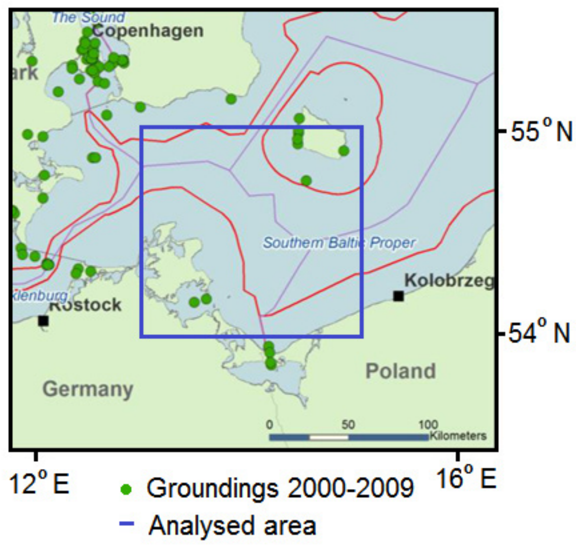

Figure 3 Ships groundings on southern Baltic, analysed area [4]

Presented in this paper analysis of grounding incidents is devoted to the Pomeranian Bay area exactly the area between 13^0 00'E - 15^0 00'E and 54^0 00'N - 55^0 00'N. This area extends between Bornholm, Rügen and the approach to Świnoujście. It may be considered as costal area, where some places have relatively low depth. Those are depicted in Figure 4. Regions with depth of 10 m or less extends around the Rügen Island, around Bornholm close to Polish and German shore and also north of approach to Świnoujście.

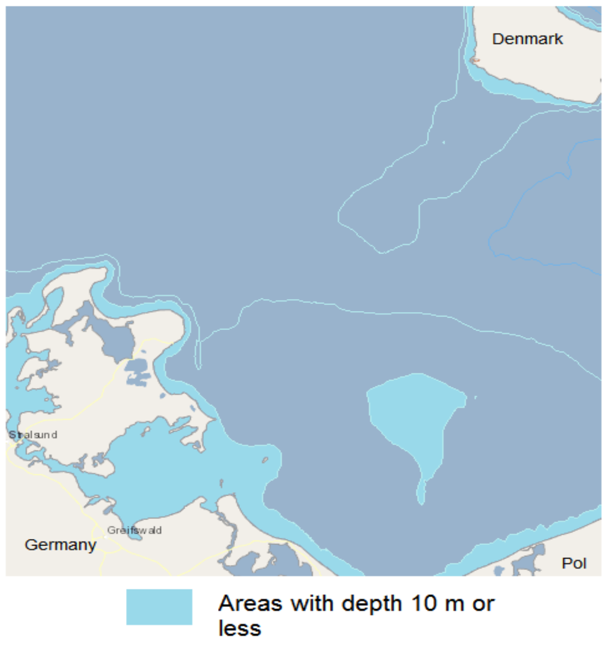

Figure 4 Map of selected area with isobaths.[5]

2 MODEL DETERMINING THE GROUNDING INCIDENTS

Model used for determining the grounding incidents on selected area. The model is based on AIS data, from where static and dynamic data allow one to determine the information on the ship and its positions. Application written in C# [3] consists of three sections:

1 First section decodes data retrieved from the AIS and records the routes of vessels navigating within the analysed area. Data is segregated and written to the appropriate database tables. Vessels of 6m depth or more are taken into account.

	Date	MMSI	NavStat	Latitude	Longitude	Sog	Cog	Heading
▸	31 22:58:27	265276...	0	3259,320	837,912	9,8	313,4	315,0
	2008-01-...	308079...	0	3250,800	847,525	10,3	333,0	334,0
	2008-01-...	255801...	0	3255,170	851,210	9,8	302,0	304,0
	2008-01-...	235642...	0	3277,290	889,569	17,5	80,0	82,0
	2008-01-...	261392...	0	3283,820	804,886	8,3	255,9	255,0

Figure 5 Database table with AIS dynamic data.

2 Second section examines individual positions of the vessel in terms of distance from depths. The depths of less than 140% of vessel's draught are taken into account. Then the lowest depth, and the smallest distance to this depths is recorded.

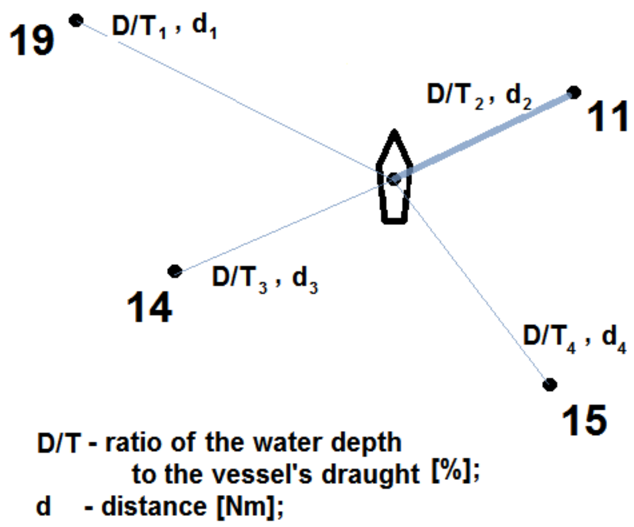

Figure 6 A diagram of lowest depth and distance selection.

3 Third section is a model of positions extrapolation. On the basis of dynamic data this part of programme is searching for the previous position (φ(t0), λ(t0)) and following position (φ(tn), λ(tn)) of the vessel in vicinity of the dangerous depth. Both positions are taken into account only if the time difference between them and the reference position (φ(tr), λ(tr)) is less than 6 minutes. Extrapolation algorithm calculates every second position and the distance from the depth between the previous, reference and the following position. The result is a position of a vessel that is the closest to the smallest depth in vicinity of the vessel.

$$\lambda_i = \lambda_0 + \sum_{j=0}^{i} \sin(COG_j) \cdot V_j + i \cdot \frac{\lambda_r - \sum_{k=0}^{r} \sin(COG_k) \cdot V_k}{r} \qquad (1)$$

$$\varphi_i = \varphi_0 + \sum_{j=0}^{i} \cos(COG_j) \cdot V_j + i \cdot \frac{\varphi_r - \sum_{k=0}^{r} \cos(COG_k) \cdot V_k}{r} \qquad (2)$$

where:

φ_i – latitude in time t_i between previous position and reference position of the vessel,

λ_i – longitude of position number i between previous position and reference position of the vessel,

COG_j – Course Over Ground in time t_j,

V_j - speed of the vessel in time t_j,

r – number of extrapolated positions between previous position and reference position of the vessel.

$$COG_j = COG_0 + (t_j - t_0) \cdot \frac{dCOG}{dt} \qquad (3)$$

$$V_j = V_0 + (t_j - t_0) \cdot \frac{dV}{dt} \qquad (4)$$

3 RESULTS

The result of the analysis of grounding incidents on the area between 13^0 00'E - 15^0 00'E and 54^0 00'N - 55^0 00'N within 6 month time period (1th January 2008 – 30th June 2008) were 230 grounding incidents calculated by the algorithm. Figure 7 is presenting analysed area with marked vessel position divided due to the ratio D/T. The 10m and 12m isobaths are shown, to mark the places with low depth. All the ports and their surroundings were excluded from the examined area.

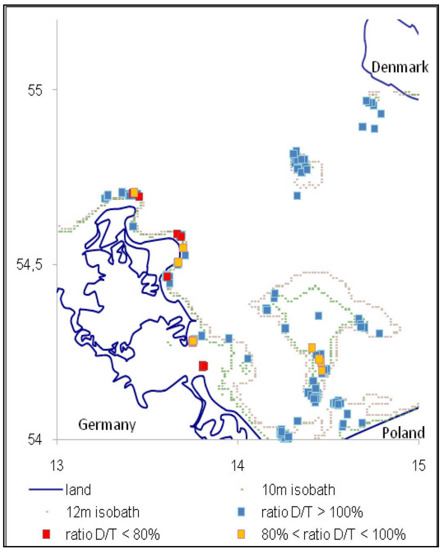

Figure7 Grounding incidents on selected area from 01.01.2008 to 30.06.2008

The ratio of vessel draught to the depth of the water is shown in figure 8. 42 vessels were passing close to the depth which was lower than their draught. The other 188 vessel were close to the depth which might have been a problem to pass it safe.

Figure 8 Number of vessels close to depth with assigned ratio D/T

Generally there were 3 ships that were passing the dangerous depth with distance of 2 cables or less. It must be remembered that the distance is measured between the calculated depth and the position of vessel's antenna. The actual distance from the depth could have been lower than 2 cables. All the distances of the ship to the depth are depicted in figure 9. According to experts the distance of 0,7 Nm can be interpreted as a safe distance, but taking into account the conditions of open water, getting so close to a dangerous depth contours can be regarded as an unjustified risk situation or a grounding incident.

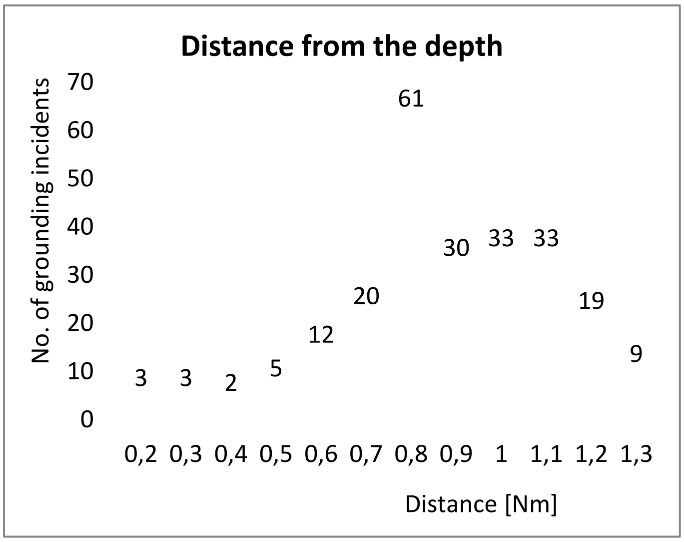

Figure 9 Number of vessels approaching to dangerous depth with assigned distance.

Length of most of the vessels which had approached close to dangerous depths is between 101m and 160m. Most vessels length range extends between 101m and 120m, these are vessels of draught (5-7m). Such depth are mainly found in coastal areas. It means it is very likely that some surroundings of ports aren't sufficiently cut off.

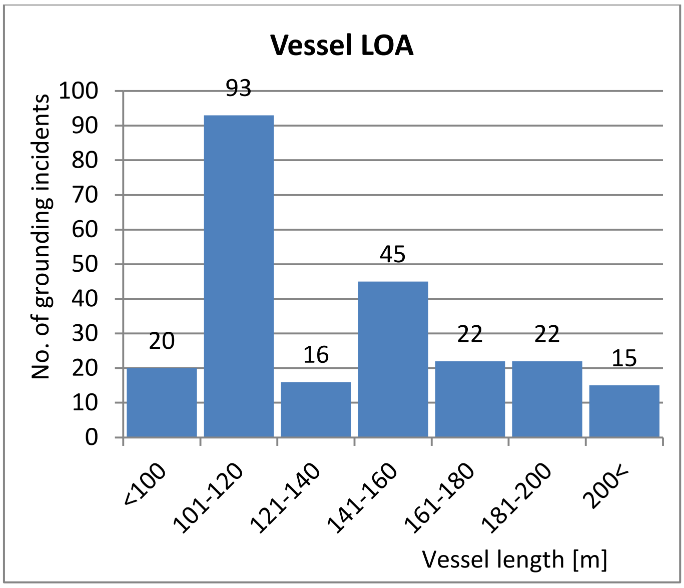

Figure 10 Number of grounding incidents based on vessel length.

4 CONCLUSIONS

Presented results of grounding incidents constitute a valuable source of information about the areas with low water depth around which vessels are passing with dangerous distances. The incident places obtained by presented model are very close to the grounding accidents on analyzed area (Fig.3). Obtained results will be used in navigational safety management system development, which is described in [1]. There is still some work to be done to verify models results but partially verification of the results presented, is overlapping positions of calculated grounding incidents to real groundings, in the examined area.

REFERENCES

Gucma L., Marcjan K. 2011. The Incident Based System of Navigational Safety Management of on Coastal Areas. Proceedings of the 8th International Probabilistic Workshop. Szczecin.

Przywarty M. 2008. Models of Ships Groundings on Coastal Areas. Journal of Konbin   Vo-lume 5, Number 2 / 2008. Versita, Warsaw.

ECMA International. 2006. C# Language Specification (4th ed.).

HELCOM. 2009. Report on shipping accidents in the Baltic Sea area during 2009.

http://maps.helcom.fi/website/mapservice/index.html

http://www.io-warnemuende.de/topography-of-the-baltic sea.html