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## DETERMINING THE ACCURACY OF WEATHER FORECASTS EMITTED IN NAVTEX SYSTEM ON THE KLAIPEDA – BAYONNE ROUTE

### ABSTRACT

The study assesses the accuracy of 24-hour weather forecasts on the Klaipeda (Lithuania) – Bayonne (France) navigational route emitted in NAVTEX system. There were analysed the parts of the forecasts concerning wind direction and force, visibility and precipitation. The verification was based on the real state of these factors, stated the next day on areas concerned. A high degree of forecast accuracy was stated in all five broadcasting stations of the NAVTEX system, particularly with reference to visibility and precipitation.

### Keywords:

NAVTEX, forecast accuracy, wind direction, wind force, visibility, precipitation.

### INTRODUCTION

The study was aimed at analysing the accuracy of weather forecasts made by coastal broadcasting stations in the NAVTEX systems, most frequently used by vessels leaving the Baltic via the North Sea and the English Channel onto the Atlantic.

NAVTEX is an automated system of transmitting navigational information, including meteorological, within the framework of the Global Maritime Distress and Safety System (7). Its name was coined from two English words: *navigation* and *telex*. The system works on the frequency 518 kHz and is obligatory for all sea-going vessels of gross capacity above 300 GRT (3). The coverage area of the system depends on the power. Under average conditions this zone reaches 250 – 400 miles from the shore. Transmission of information takes place in an orderly manner – each station in a given NAVAREA region, into which the world's marine water areas have been divided into, there being 16 of them, broadcasts (1) at a different time in order to exclude mutual disturbances. The system essentially consists in reports from water services and other institutions responsible for navigational safety reaching coordination

centres for navigational warnings, from which they are directed to NAVTEX coordination centre, and are next emitted on the air (7).

It is likewise with meteorological announcements – they are sent from meteorological stations to coordination centres of meteorological announcements, and on being verified to NAVTEX coordination centre and next to the recipients (7). The announcements are transmitted from each station a few times daily at fixed times and successively contain: storm warnings, description of the general baric situation and 24-hour weather forecasts for particular prediction regions a given water area is divided into (e.g. the Baltic or the North Sea) (9). Making use of a NAVTEX receiver on a ship boils down to establishing in the ‘Admiralty List of Radio Signals, vol. 3’ (1) the NAVAREA region the vessel is in, finding the transmitter station signal and programming the required information (7).

## RESEARCH MATERIALS AND METHODS

NAVTEX coastal transmitter stations covered by the analysis are as follows, starting from the East: Gislövshammar (Sweden), Rogaland (Norway), Netherlands Coastguard, Niton (England) and Corsen (France). The first four of them are in NAVAREA I region, covering the north-eastern part of the Atlantic, whereas the fifth is in the NAVAREA II region, neighbouring with it in the south. Material to be analysed was collected from 20<sup>th</sup> May to 7<sup>th</sup> November 2004 on the bulk cargo carrier ‘MIELEC’ plying between Klaipeda (Lithuania) and Bayonne (France) – fig. 1. It was constituted on the one hand by 24-hour forecasts received in the afternoon concerning the most essential factors for navigation – wind direction and force, visibility and precipitation, received from the coastal station closest in relation to the position planned for the next day; on the other hand, it was constituted by the real condition of those factors found at 12.00 hrs on the next day. In the Baltic part of the route they were announcements from Gislövshammar station, in Danish straits and the eastern part of the North Sea from Rogaland station, in the central and western part of this sea from Netherlands Coastguard station, in the English Channel from Niton station and in the Bay of Biscay from Corsen station.

In the period given above the vessel made 15 both-way journeys (one-way journey about 5 days, discharging and charging in the port 1 to 2 days), receiving from 23 to 30 messages, depending on the station.

As the forecast data about wind direction concerned real wind, whereas on the moving vessel it was the relative wind direction that was felt, the real direction was established by means of a diagram from Navigational Tables TN – 89 (8). The

speed of relative wind shown by the vessel's anemometer was also converted by means of the same diagram into real wind speed, and as wind force was forecast in the announcements, this speed was assigned to various degrees of the Beaufort scale (9). In the case of visibility range, one of the radar's numerous functions was used, the distance ring. Precipitation and its intensity were described visually.

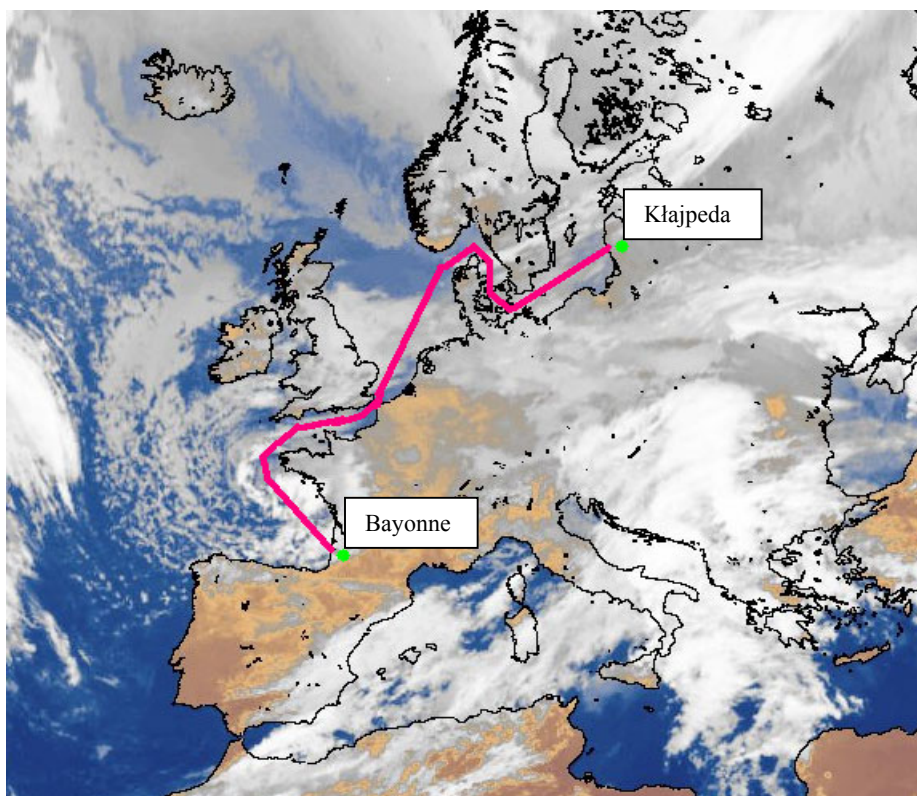


Fig. 1. Vessel route from Klaipeda – Bayonne

### CRITERIA OF ASSESSING FORECASTS

To assess the degree of accuracy of predicting wind direction, it was assumed that if the difference between real wind and forecast wind did not exceed  $22.5^\circ$ , that forecast was considered to be accurate; if it was contained between  $22.6^\circ$  and  $45.0^\circ$  it was considered to be partly accurate; if the difference was larger, the forecast was considered inaccurate (table 1).

Table 1. Wind direction

Assessment	Difference (° angular)
Accurate	0 – 22.5
Partly accurate	22.6 – 45.0
Inaccurate	Above 45.0

In the case of wind force, it was assumed that if the forecast wind force did not differ from the real force by more than 1°B, such forecast was accepted as accurate, if it was 1 – 2°B as partially accurate, and inaccurate if it was more.

Table 2. Wind force

Assessment	Difference (°B)
Accurate	0 – 1
Partly accurate	1 – 2
Inaccurate	Above 2

Visibility range was determined by radar and reading the distances to the vessel still in visibility range. If the predicted range differed by not more than one mile of that vessel's position, the forecast was considered accurate; if it differed by 2 to 5 miles – as partly accurate, if the difference was more than that, the forecast was considered inaccurate (table 3).

Table 3. Visibility

Assessment	Difference (nm)
Accurate	to 2
Partly accurate	2 – 5
Inaccurate	Above 5

Two forms of precipitation were distinguished for forecasting: rain and showers. As it is frequently difficult to assess where a given kind of precipitation should be classed, the forecast was considered accurate if the phenomenon occurred at all, independently of its intensity, and inaccurate if it did not occur.

### ANALYSIS OF RESULTS

The numbers of accurate, partly accurate and inaccurate forecasts in the four weather factors analysed, received from particular coastal stations have been presented in the tables below.

Table 4. Numbers of accurate, partly accurate and inaccurate forecasts regarding wind direction

Transmitting stations	Forecasts		
	Accurate	Partly accurate	Inaccurate
Gisløyshammar	24	5	1
Rogaland	13	9	3
Netherlands Coastguard	16	2	5
Niton	20	3	4
Corsen	24	2	2
Total	97	21	15

It follows from the table that in all stations accurate forecasts concerning wind direction are in the overwhelming majority. Corsen is the most reliable with 86%, followed by Gisløyshammar – 80%. Rogaland has the lowest reliability rate – 52%. The average of accurate forecasts for all stations equals 73%, and including partly accurate forecasts – almost 89%.

Table 5. Number of accurate, partly accurate and inaccurate forecasts regarding wind force

Transmitting stations	Forecasts		
	Accurate	Partly accurate	Inaccurate
Gisløyshammar	29	1	0
Rogaland	21	2	2
Netherlands Coastguard	22	1	0
Niton	25	1	1
Corsen	27	1	0
Total	124	8	3

Accurate forecasts also clearly predominate in all five stations with regard to wind force. In four of them they exceed %: Gisløyshammar – 97%, Netherlands Coastguard and Corsen – 96% and Niton – 92%. At Rogaland station they constitute 87%. The average is very high for all stations, equalling almost 92%. Together with partly accurate forecasts they make up almost 98%.

Table 6. Number of accurate, partly accurate and inaccurate forecasts concerning visibility

Transmitter stations	Forecasts		
	Accurate	Partly accurate	Inaccurate
Gislöyshammar	17	13	0
Rogaland	12	13	0
Netherlands Coastguard	12	11	0
Niton	16	11	0
Corsen	21	7	0
Total	78	55	0

With regard to visibility, Corsen has the highest accuracy level – 75%. Niton comes second, with considerably lower accuracy – 59%, followed by Gislöyshammar – 57%, Netherlands Coastguard – 52% and finally Rogaland – 48%. The average for all stations is slightly above 58%; compared to the two weather factors analysed previously, this is much less. At the same time, a high percentage is made up by partly accurate forecasts: Rogaland – 52%, Netherlands Coastguard – 48%, Gislövshammar – 43%, Niton – 41% and Corsen – 25%. In total, accurate and partly accurate forecasts make up 100% of all.

Table 7. Number of accurate and inaccurate forecasts concerning precipitation

Transmitter stations	Forecasts	
	Accurate	Inaccurate
Gislöyshammar	12	1
Rogaland	11	4
Netherlands Coastguard	10	3
Niton	11	0
Corsen	14	2
Total	58	10

Precipitation forecasts are also characterised by high accuracy level. At Niton it equals 100%, at Gislövshammar – 93%, Corsen – 89%, Netherlands Coastguard – 77% and at Rogaland 73%. Average for all stations is almost 85%. Throughout the period analysed there were only a few cases of precipitation not predicted in the forecasts.

It follows from the above analysis that Corsen station (France) has the highest accuracy level as far as predicting wind direction goes – 86%. It is also high at Gislövshammer (Sweden) – 80%, Niton (England) – 74% and Netherlands

Coastguard (Holland) – 69%; it is lower, however, at Rogaland (Norway) – 52%. Together with partly accurate forecasts these values are as follows: 91%, 82%, 79%, 85% and 93%.

The accuracy degree of predicting wind force is higher in all stations as compared to forecasts predicting wind direction: at Gislövshammer it reaches 97%, at Netherlands Coastguard and at Corsen 96% each, at Niton 92% and at Rogaland – 84%. Together with partly accurate forecasts at Gislövshammer, Netherlands Coastguard and Corsen they make up 100%, at Rogaland 92% and at Niton 96%.

In the case of visibility the number of accurate forecasts is in each station significantly lower in comparison with weather factors discussed previously, ranging from 48% at Rogaland to 75% at Corsen. Together with partly accurate forecasts, however, they make up 100% in each of them.

The accuracy level of forecasts concerning the occurrence precipitation is very high in all stations: at Niton it equals 100%, at Gislövshammer 93%, at Corsen 89%, at Netherlands Coastguard 77% and at Rogaland 73%.

## **SUMMARY**

Although the study shows that all stations working in the NAVTEX system are marked by high accuracy of diurnal forecasts concerning direction and force of wind, as well as visibility range and likelihood of precipitation, they must not be assumed uncritically, as:

- in assessing wind direction, the assumed angular range is relatively wide, equaling 22.5°;
- in the case of wind force, particular degrees and the Beaufort scale correspond to wide intervals of wind velocity (from a few to a few dozen m/s);
- the visibility range was given in a barely three-degree scale, which is why the range of tolerance of this estimation performed on the vessel was wide;
- precipitation was announced in the forecasts in merely two forms: rain or shower, but they were not discriminated in the study, each of them being assumed, as well as all other, to be one and the same phenomenon.

To sum up, it can be stated that in spite of these remarks, all NAVTEX stations whose weather announcements are used by vessels proceeding from the Baltic heading for the Atlantic, are characterised by a very high accuracy level of all analysed weather factors, presenting a fully reliable source of weather information in these water areas.

To close, it should be stressed that there is lack in scientific literature of published studies dealing with this subject matter. On the other hand, analyses of weather prediction accuracy have been performed at the Navigation Institute of the Maritime University of Szczecin for a few years, issued by the world's chief meteorological centres in textual form (NAVTEX) and graphic form (analysis charts and forecasts of pressure and waving distribution) with regard to main routes in the northern Atlantic.

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