

Ships' ocean route programming with adaptation to "Cyclone" program

Programowanie tras oceanicznych statków z adaptacją programu „Cyklon”

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Key words: tropical cyclone, cyclones' avoidance program, adaptation

Abstract

Cyclones are an important limitation in the ships' route programming. "Jawor" ship voyage from Italy to the U.S. (Baltimore) was an example where "Cyclone" program was used for effective avoidance of "Julia" and "Igor" cyclones in September 2010.

Słowa kluczowe: cyklon tropikalny, program omijania cyklonu, adaptacja

Abstrakt

Cyklony są istotnym ograniczeniem w programowaniu tras statków. Na przykładzie trasy statku „Jawor” z Włoch do USA (Baltimore) wykorzystano program „Cyklon” do efektywnego omijania cyklonów „Julia” i „Igor” we wrześniu 2010 roku.

Introduction

The significant decrease in ocean shipping is the occurrence of tropical cyclones. On the cyclone eye border wind speeds are always higher than 64 kts (12°B). There is the principle that the ship of each class and size avoids entry into the strong winds impact area greater than 34 kts (8°B). This is due to the fact that there are many dynamics and variability of winds in cyclones. Even in the 24 hours forecast range there is some uncertainty as to the cyclone's movement track and the cyclone's eye position [1, 2, 3].

In years 2010–2012 Polish Steamship Company's vessels exploits in their voyages Ship Performance Optimisation System. Navigation and weather analysis of selected voyages (55 routes) has shown that recognizing of specific tropical cyclones' dangers for shipping is not possible. SPOS calculation does not include wind speed greater than 50 and the wave's height over 8 meters

(limited speed characteristics). Choosing routes, SPOS does not reflect the recommendations of the cyclone's avoidance rules [4, 5].

Outside the range of its predictions (A+216 hrs) SPOS includes in its calculation the seasonal conditions. If it is known that at that time in the relevant water area tropical cyclones will be moved and the calculations will be unreliable (e.g. ETA) and should be analyzed by the master using other sources of information and calculation methods ("Cyclone" program, reports about cyclone) [2, 4, 5, 6, 7].

Route's analysis and test results

The vessel MV "Jawor" at its voyage to Baltimore (USA) left the port of Civitavecchia (Italy) on 12/09/2010 / 1000 UTC and arrived at Gibraltar on 15/09/2010 / 0300 UTC. Even then, obtaining weather forecasts master could predict their positions in the North Atlantic and "Julia" and "Igor" cyclones' positions in the range up to 216 hours.

"Cyclone" program could shown dangerous sectors if the ship remains the Great Circle course. This day the ship has got SPOS to proceed the most convenient route (H-W route) that the ship will sail very close to the Great Circle (Figs 1, 2, 3, 4).

Figures 1–4 generated by SPOS and illustrating the weather from 15 to 22/09/2010 show that the ship would entry in the cyclone's impact area.

On this basis, master could decide to sail close to the rhumb line already on 09/15/2010.

The most important fact is that the vessel which is at exit from the Straits of Gibraltar does not include the impact of tropical cyclones in its calculations (cyclone "Igor" – maximum wind 100 kts and wave's height up to 5 m) which can be seen on charts (Figs 1–4). If the vessel had have "Cyclone"

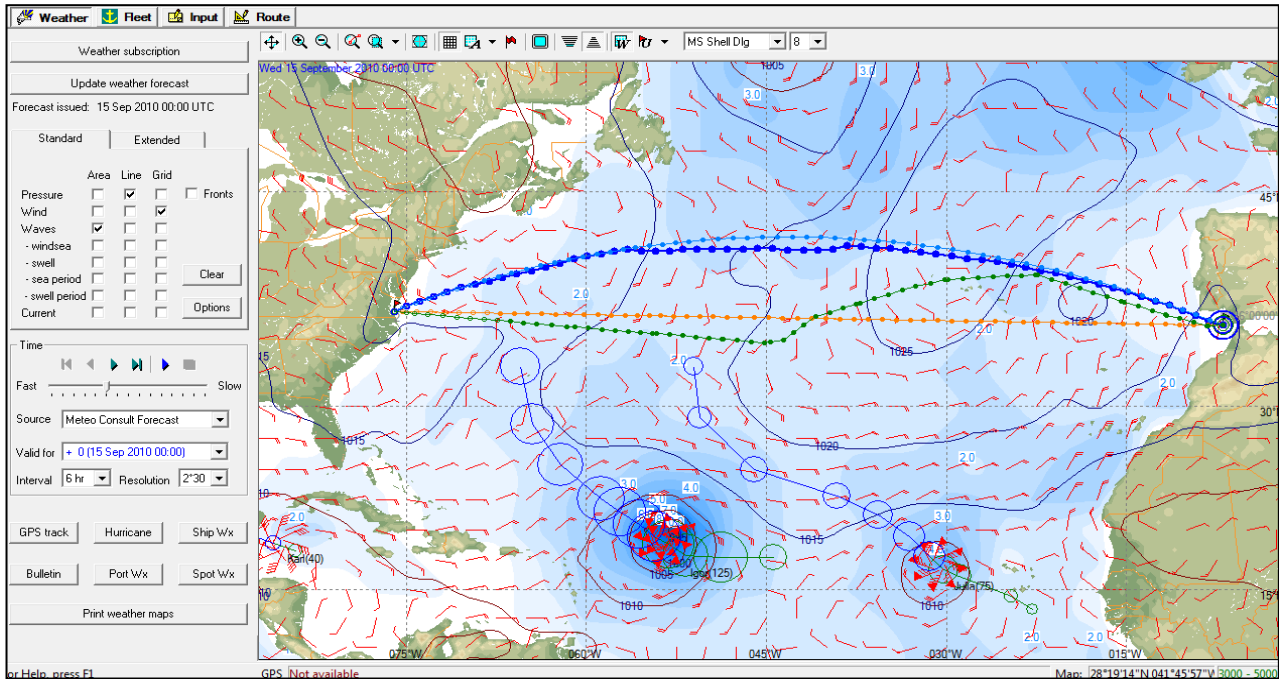


Fig. 1. Weather conditions on 15/09/2010 / 00 UTC (analysis) and routes' variants (test on 15/09/2010 / 00 UTC)
Rys. 1. Warunki pogodowe w dniu 15.09.2010 r. / 00 UTC (analiza) i warianty tras (testowanie 15.09.2010 r. / 00 UTC)

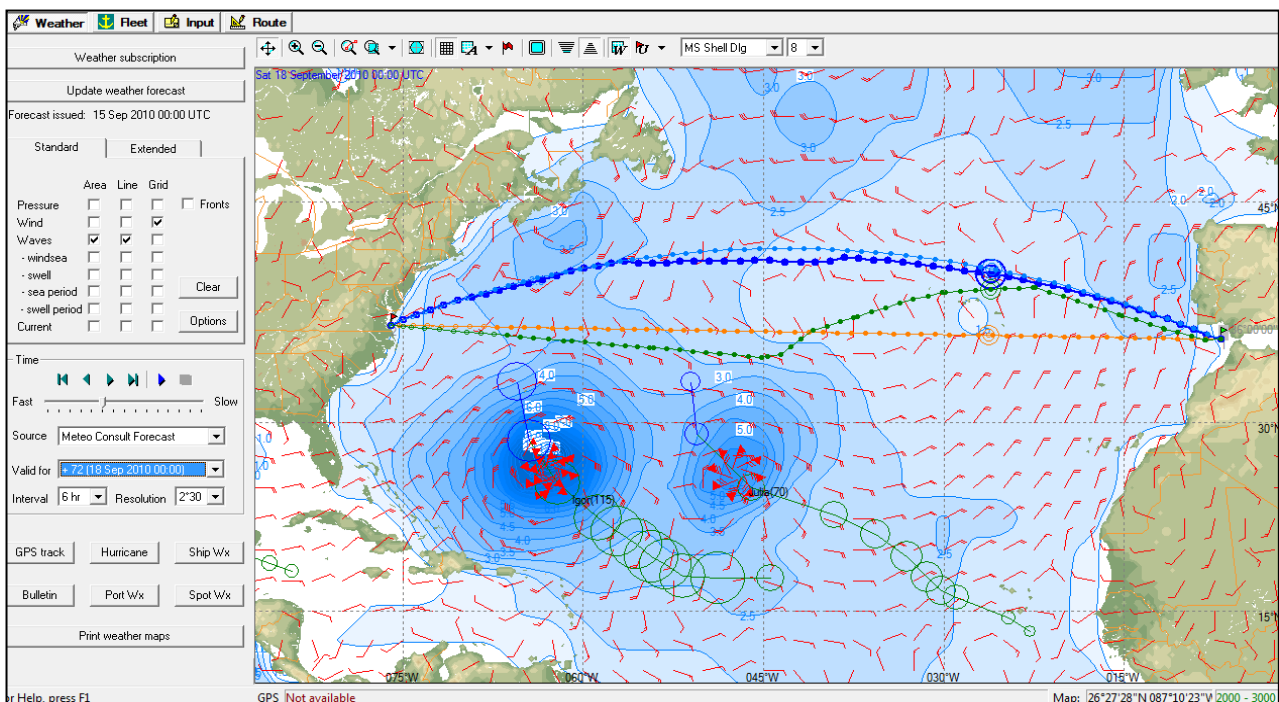


Fig. 2. Projected weather conditions on 18/09/2010 / 00 UTC and routes' variants (test on 15/09/2010 / 00 UTC + 72 hrs)
Rys. 2. Prognozowane warunki pogodowe na 18.09.2010 r. / 00 UTC i warianty tras (testowanie 15.09.2010 r. / 00 UTC + 72 godz.)

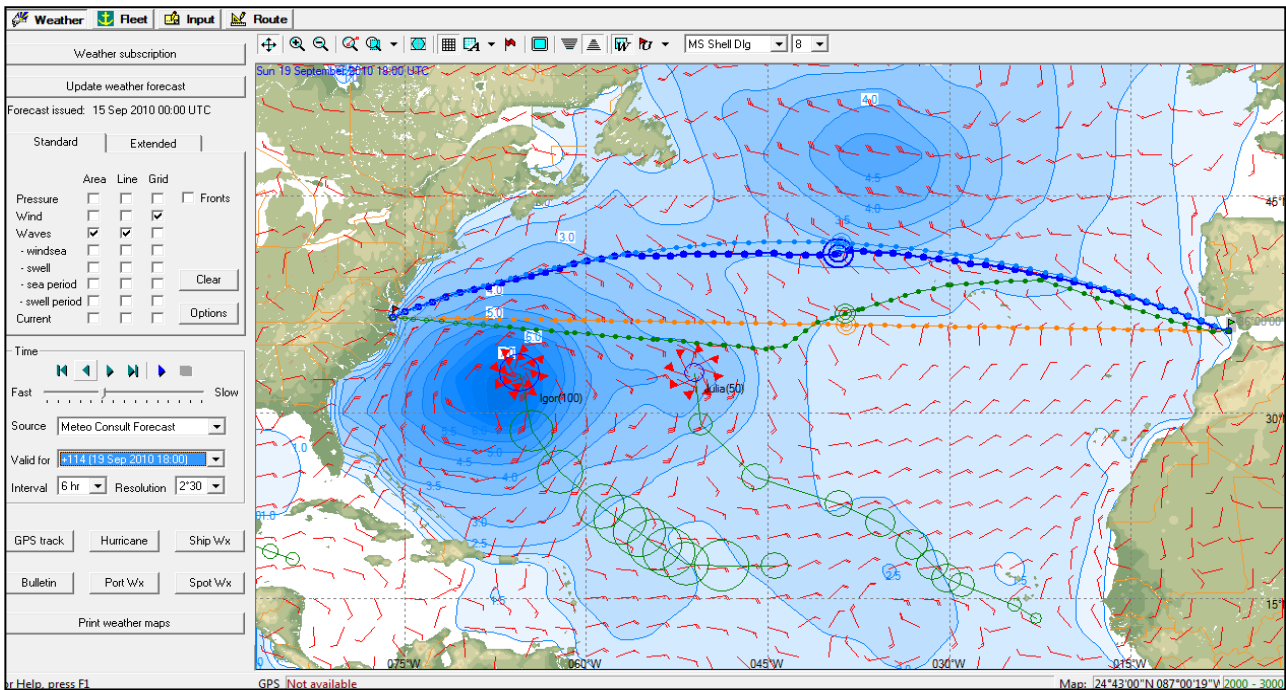


Fig. 3. Weather conditions on 19/09/2010 / 1800 UTC (test on 15/09/2010 / 00 UTC + 114 hrs)
 Rys. 3. Warunki pogodowe w dniu 19.09.2010 r. / 1800 UTC (testowanie 15.09.2010 r. / 00 UTC + 114 godz.)

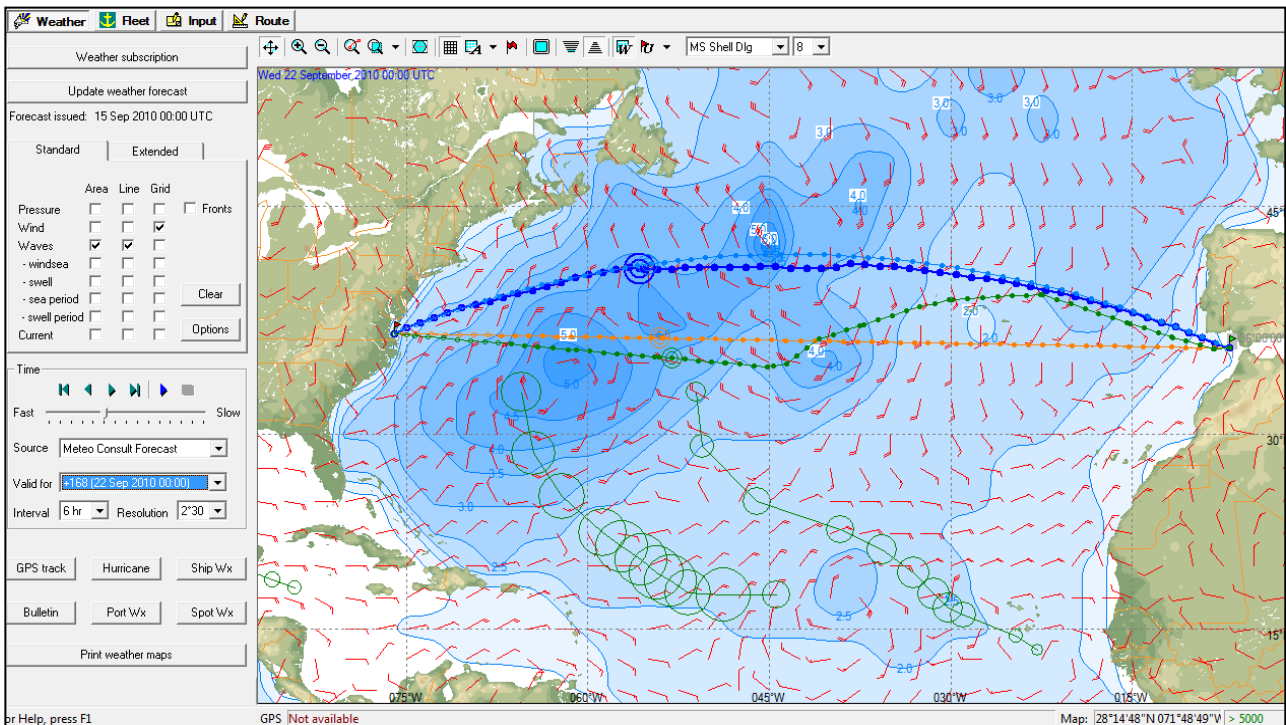


Fig. 4. Projected weather conditions on 22/09/2010 / 1800 UTC and routes' variants (test on 15/09/2010 / 0700 UTC + 168 hrs)
 Rys. 4. Prognozowane warunki pogodowe na 22.09.2010 r. / 1800 UTC i warianty tras (testowanie 15.09.2010 r. / 0700 UTC + 168 godz.)

program and made test that would show dangerous course's sectors from "Julia" and "Igor" cyclones from NW sector from 18/09/2010 / 1200 UTC and entry into the "Julia" cyclone's impact area on 21/09/2010. This is due to the fact that the cyclones' paths (shown in figures) does not intersect

four routes' variants selected by SPOS. Therefore, the route close to optimal (H-W) near Great Circle was recommended by SPOS. At the beginning up to 17/09/2010 / 1200 UTC the ship executed a route recommended by SPOS (and similar to H-W) and obtained the position of 39°32' N and 22°33' W.

At that time the ship altered its course made good (KdD) from 288° to 266° following navigation recommendations and using anti collision figure of cyclone's avoidance.

In following days the ship received analyses and forecasts from SPOS (Figs 5–8), where a new ship's position and ship's head were given. SPOS generally changed the recommended route from the

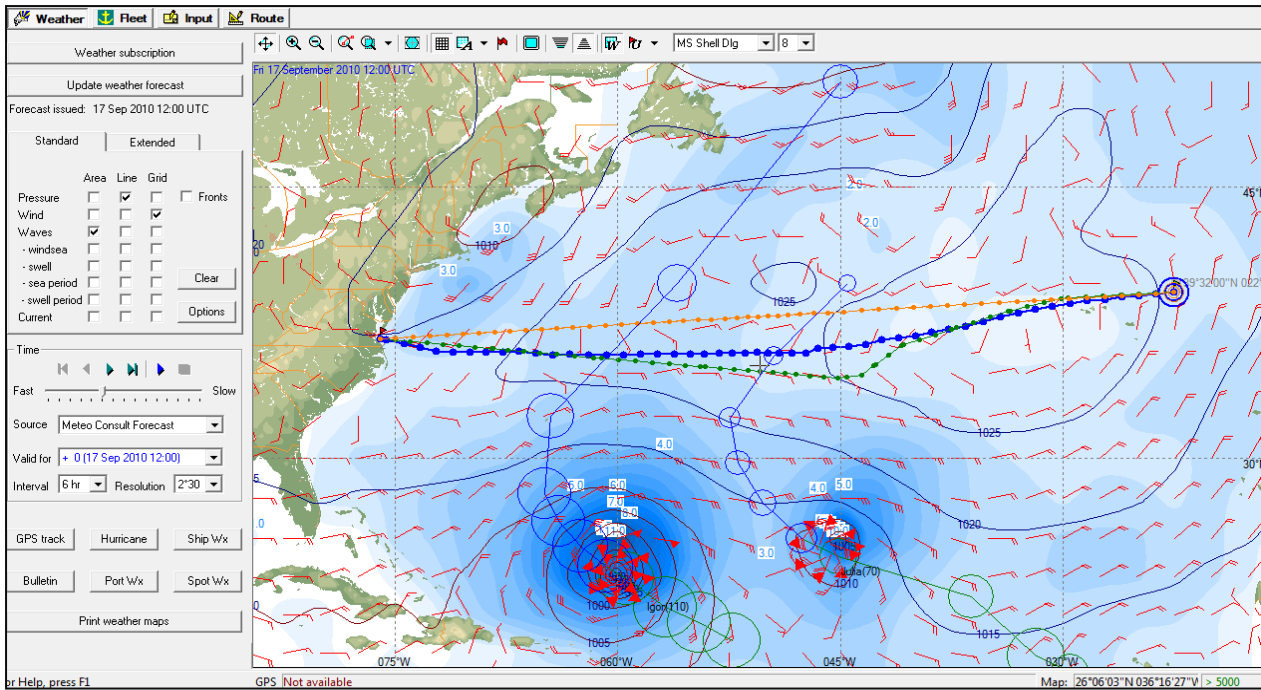


Fig. 5. Weather conditions on 17/09/2010 / 1200 UTC (analysis) – ship's positions and routes' variants (test on 17/09/2010 / 1200 UTC)

Rys. 5. Warunki pogodowe w dniu 17.09.2010 r. / 1200 UTC (analiza) – pozycje statku i warianty tras (testowanie 17.09.2010 r. / 1200 UTC)

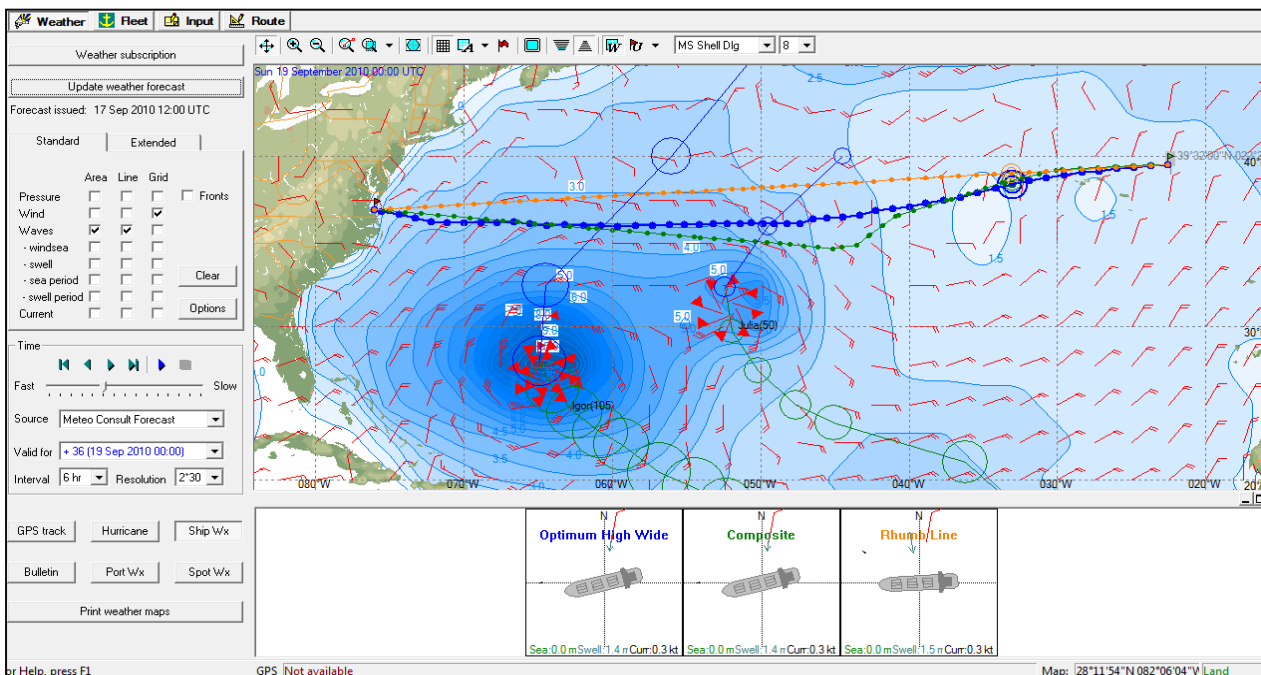


Fig. 6. Projected weather conditions on 19/09/2010 / 1800 UTC and routes' variants (test on 17/09/2010 / 1200 UTC + 36 hrs)

Rys. 6. Prognozowane warunki pogodowe na 19.09.2010 r. / 1800 UTC i warianty tras (testowanie 17.09.2010 r. / 1200 UTC + 36 godz.)

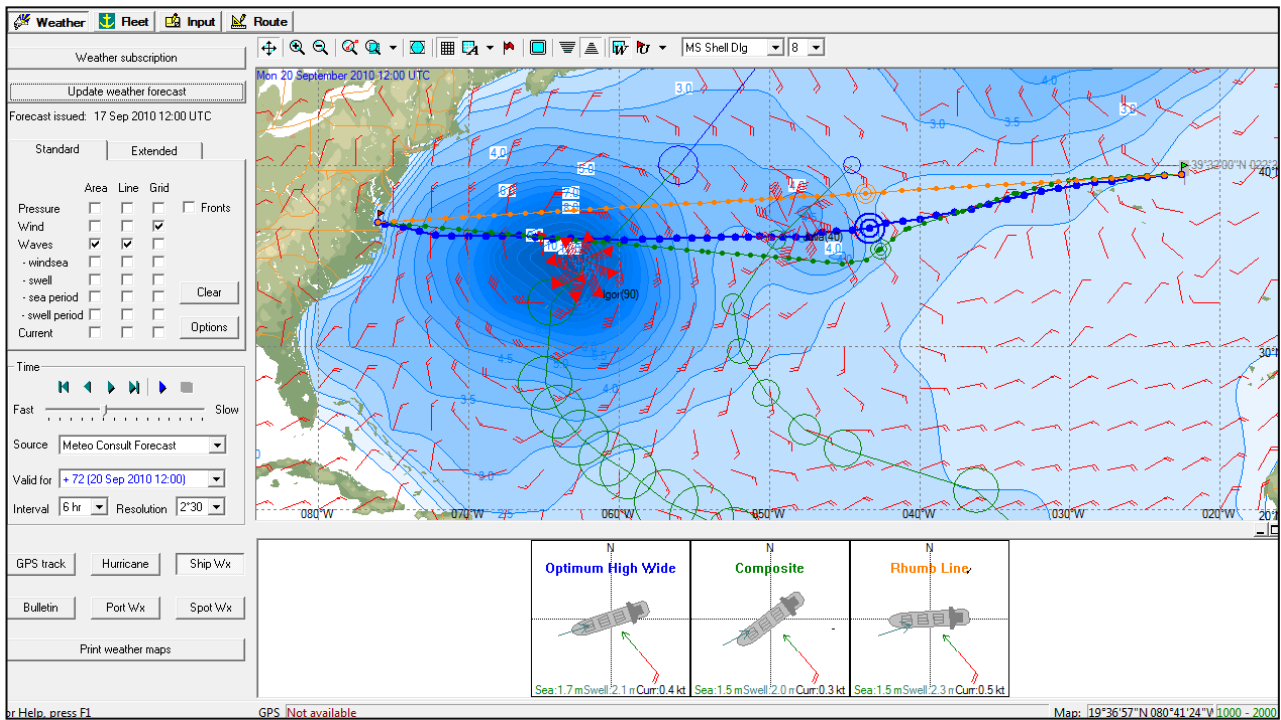


Fig. 7. Projected weather conditions on 20/09/2010 / 18 UTC and routes' variants (test on 17/09/2010 / 1200 UTC + 72 hrs)
 Rys. 7. Prognozowane warunki pogodowe na 20.09.2010 r. / 18 UTC i warianty tras (testowanie 17.09.2010 r. / 1200 UTC + 72 godz.)

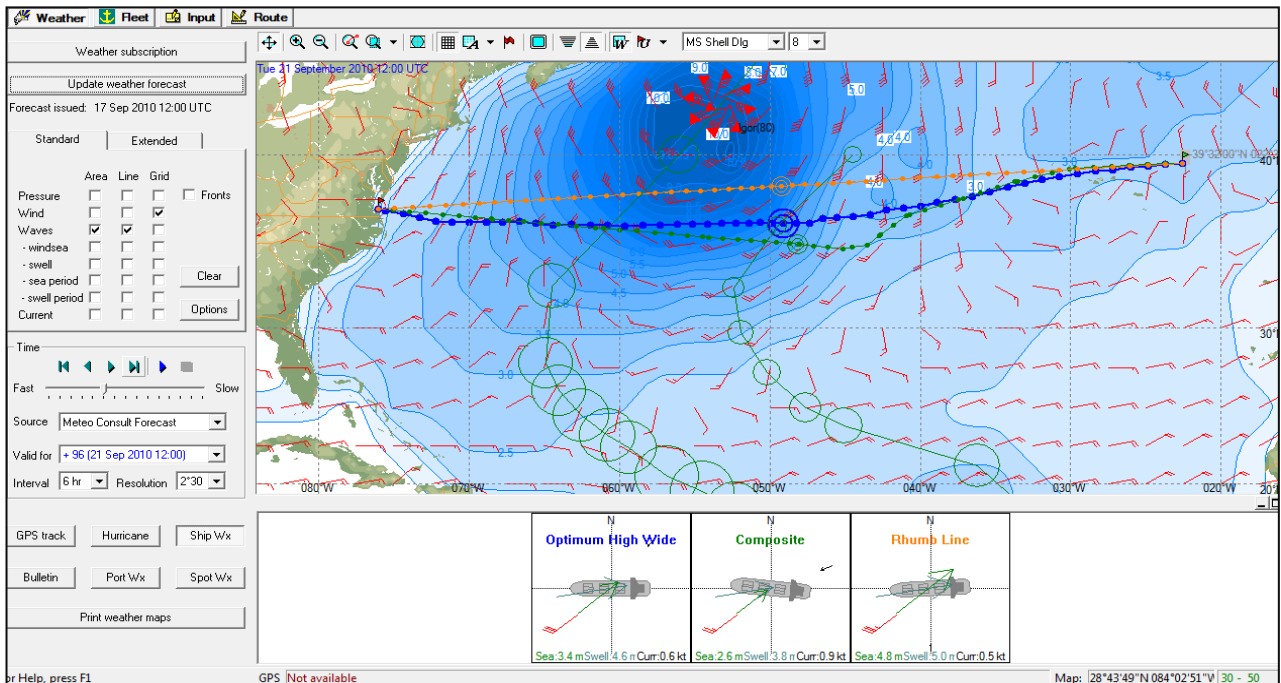


Fig. 8. Projected weather conditions on 20/09/2010 / 18 UTC and routes' variants (test on 17/09/2010 / 1200 UTC + 96 hrs)
 Rys. 8. Prognozowane warunki pogodowe na 20.09.2010 r. / 18 UTC i warianty tras (testowanie 17.09.2010 r. / 1200 UTC + 96 godz.)

Great Circle route to route between the rhumb line and the actual waypoints' route described in SPOS as composite (route calculated on V-P real route made by ship). Figure 9 and table 1 confirm that the

route chosen by the ship (the actual route) was characterized by the smallest wave's heights and the best vessel's speed (the shortest voyage time – 195 h – table 1).

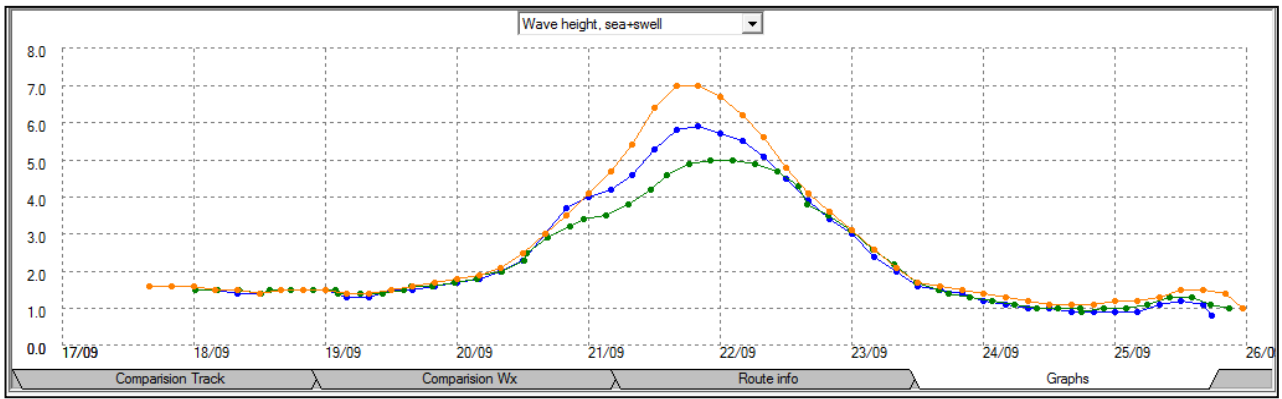


Fig. 9. Wave heights on particular routes (test on 17/09/2010 / 1200 UTC)
 Rys. 9. Wysokości falowania na poszczególnych trasach (testowanie 17.09.2010 r. / 1200 UTC)

Table 1. Third phase's test summary
 Tabela 1. Podsumowanie III etapu testowania

| | | | | | | | | |
|-------------|-------------------|------------------------|-----------------|---------------------|-----------------|---------------------|--------------------|-------|
| Podróż nr: | z | CIVITAVECCHIA (WŁOCHY) | do | BALTIMORE (USA) | | | | |
| 3(a) | Data wyjścia/czas | 17-09-2010/1200 | ETA | 25-09-2011/1500 | | | | |
| III etap | Odległość [Mm] | Prędkość [w] | Maks. wiatr [w] | Maks. wys. fali [m] | ETA | Czas podróży [godz] | Zużyte paliwo [MT] | |
| | RL | 2530,4 | 12,4 | 34 | 7,0 | 25-09-10/2318 | 203 | 305,0 |
| | GC | | | | | | | |
| | Composite | 2642,4 | 13,2 | 27 | 5,0 | 29-09-10/2037 | 201 | 300,9 |
| | Optimum HW | 2594,8 | 13,1 | 29 | 5,9 | 29-09-10/1729 | 197 | 296,2 |
| RZECZYWISTA | 2642,4 | 13,6 | 28-33 | 5,0 | 25-09-2010/1500 | 195 | | |

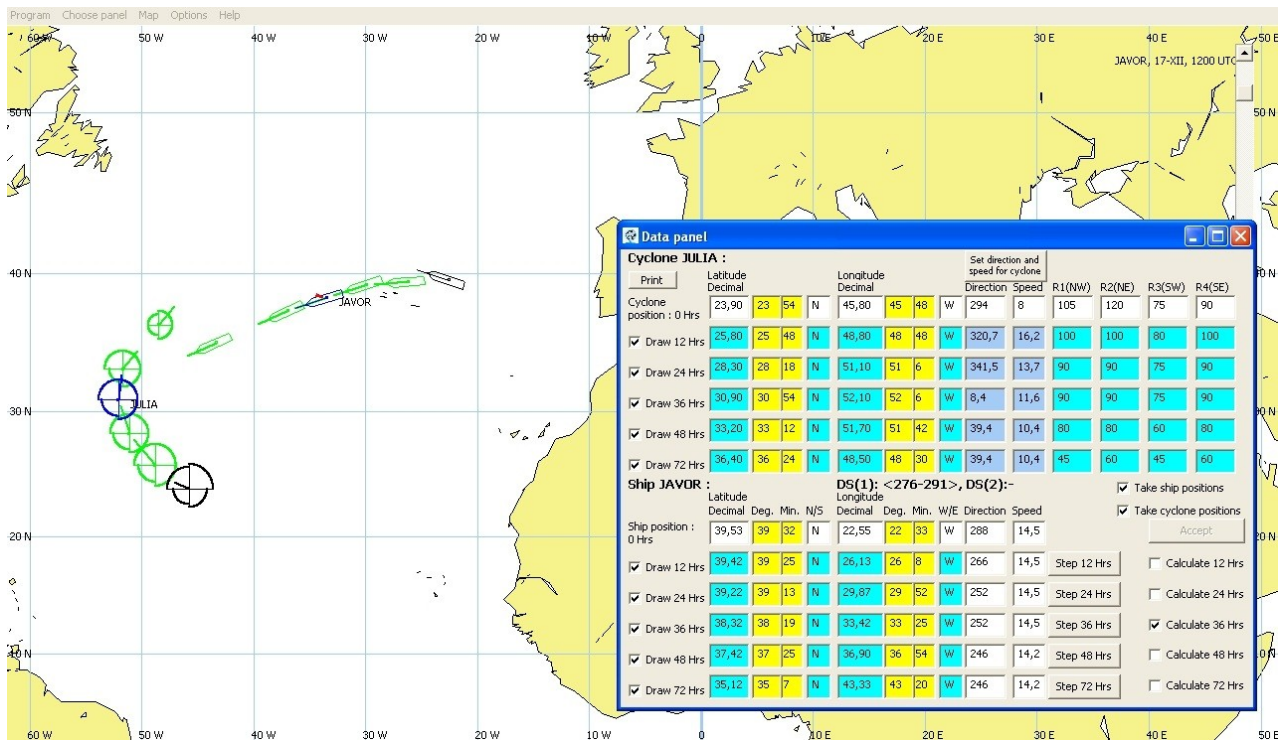


Fig. 10. Test results made on 17/09/2010 from the ship's position 39°32' N / 22°33' W as "Julia" cyclone's projected avoidance by M/V "Javor"
 Rys. 10. Rezultaty testowania wykonane 17.09.2010 r. z pozycji statku 39°32' N / 22°33' W, jako przewidywanie omijania cyklonu „Julia” przez statek MV „Javor”

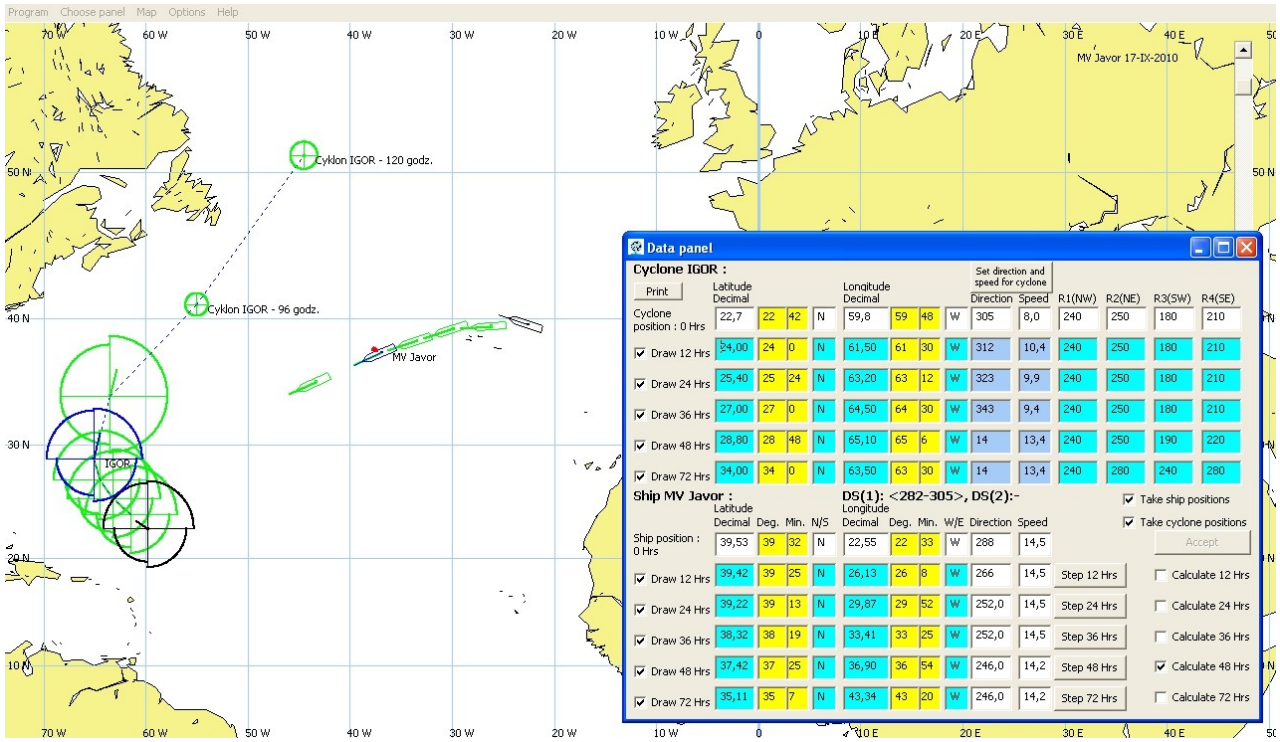


Fig. 11. Test results made on 17/09/2010 from the ship's position 39°32' N / 22°33' W as "Igor" cyclone's projected avoidance by M/V "Javor"

Rys. 11. Rezultaty testowania wykonane 17.09.2010 r. z pozycji statku 39°32' N / 22°33' W, jako przewidywanie omijania cyklonu „Igor” przez statek MV „Javor”

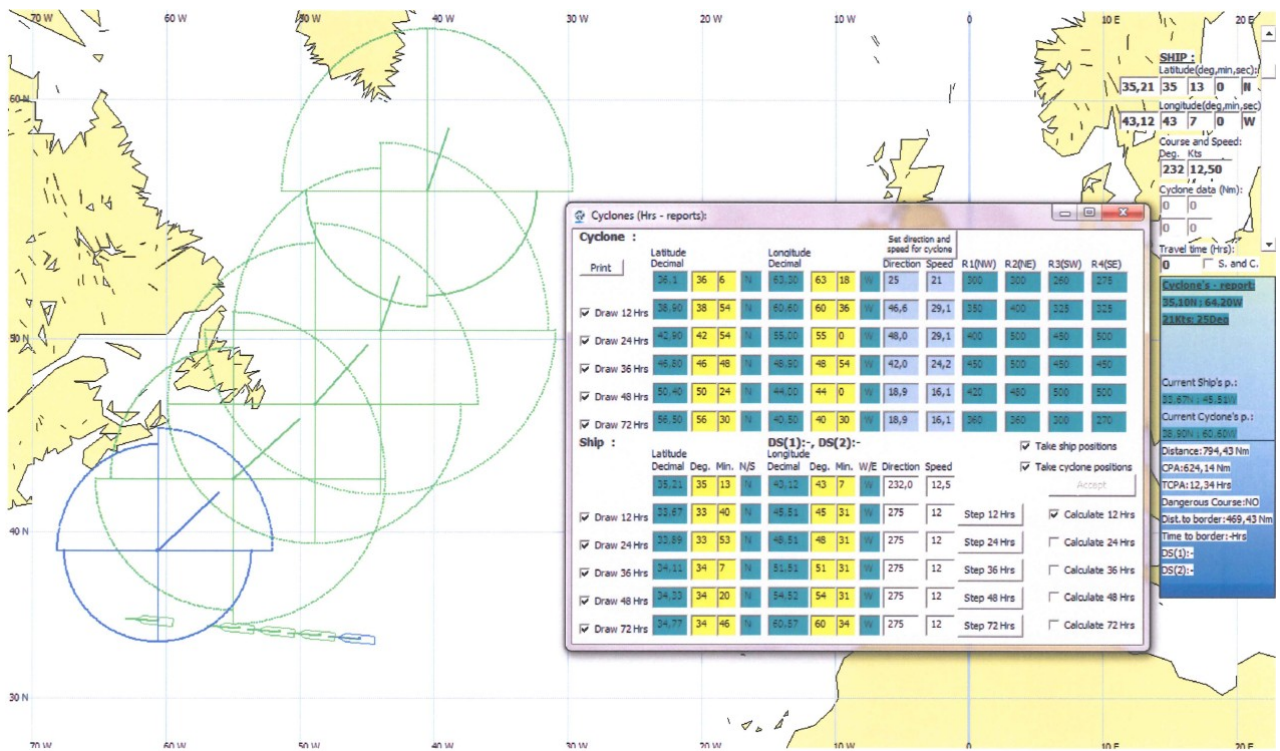


Fig. 12. Test results made on 20/09/2010 from the ship's position 39°32' N / 22°33' W as M/V "Javor" chose destination course to Baltimore KdD = 275° not endangered by "Igor" cyclone

Rys. 12. Rezultaty testowania wykonane 20.09.2010 r. z pozycji statku 39°32' N / 22°33' W, gdy statek „Javor” wybrał kurs docelowy do portu Baltimore KdD = 275° niezagrożony cyklonem „Igor”

In result on 17/09/2010 / after 1200 UTC captain decided to change course from $KDd = 288^\circ$ to $KDd = 266^\circ$. The good master's decision was confirmed by "Cyclone" program test illustrated in figures 10 and 11. Then on 18/09/2010 / 1700 UTC the ship changed course to $KDd = 252^\circ$ and approaching "Igor" cyclone on 20/09/2010 / 0600 UTC changed course to $KDd = 232^\circ$. In this way, the shipping was to position $34^\circ 56' N$ and $43^\circ 33' W$.

On 20/09/2010 / 1800 UTC stating that the cyclone was passed from the equator site the ship was back on the destination course to Baltimore $KDd = 275^\circ$ with a reduced speed to 12 kts due to the wave's field by passing the cyclone (wind's wave up to 5 m, swell up to 5 m) This manoeuvre was confirmed by "Cyclone" test as a very good (Fig. 12).

Summary and conclusions

On example of "Javor" ship's ballast voyage from Civitavecchia (Italy) to Baltimore (United States) from 09/12/2010 to 09/25/2010 the correction and supplementation in route planning by SPOS were suggested. Test and "Cyclone" program proposals were made.

It is recommended to supplement the global routing system e.g. SPOS in "Cyclone" program which may include the cyclone's track trend consideration apart from the officially obtained forecasts range and guides by the principle to not cross by its course the projected cyclone's track. Moreover, it is recommended to pass the cyclone from the equator site in which cyclone's track direction probably do not change. In practice navigators can perform anti collision figure on charts but it is obvious that the accuracy obtained from "Cyclone" will be higher, made faster and with a small amount of confusion. In example of "Javor" ship's voyage "Cyclone" test proved to be useful and have intro-

duced a correction to the general route designated by SPOS.

Conclusions from test and obtained results:

- by the lack of certainty the projected tropical cyclone's route should not be crossed by ship's course,
- by the strategic choice of course and speed it is recommend to pass the cyclone from the equator site,
- it is recommended to pass the cyclone from the its "safety" half or back quarters.

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