



## SHIP'S LOG

### Weather routing provides a major role in vessel economy

A combination of weather forecasting and the study of ocean currents has led to the rise of the shipping route agencies

**W**eather routing of ocean-going shipping has been practiced for many hundreds of years. Early Arab traders used the regular monsoons of the Arabian Sea to navigate to East Africa and to the Indian subcontinent, while 15<sup>th</sup> century sailors took advantage of their knowledge of prevailing trade winds and currents to optimize their routes from Spain and Portugal to the New World and back.

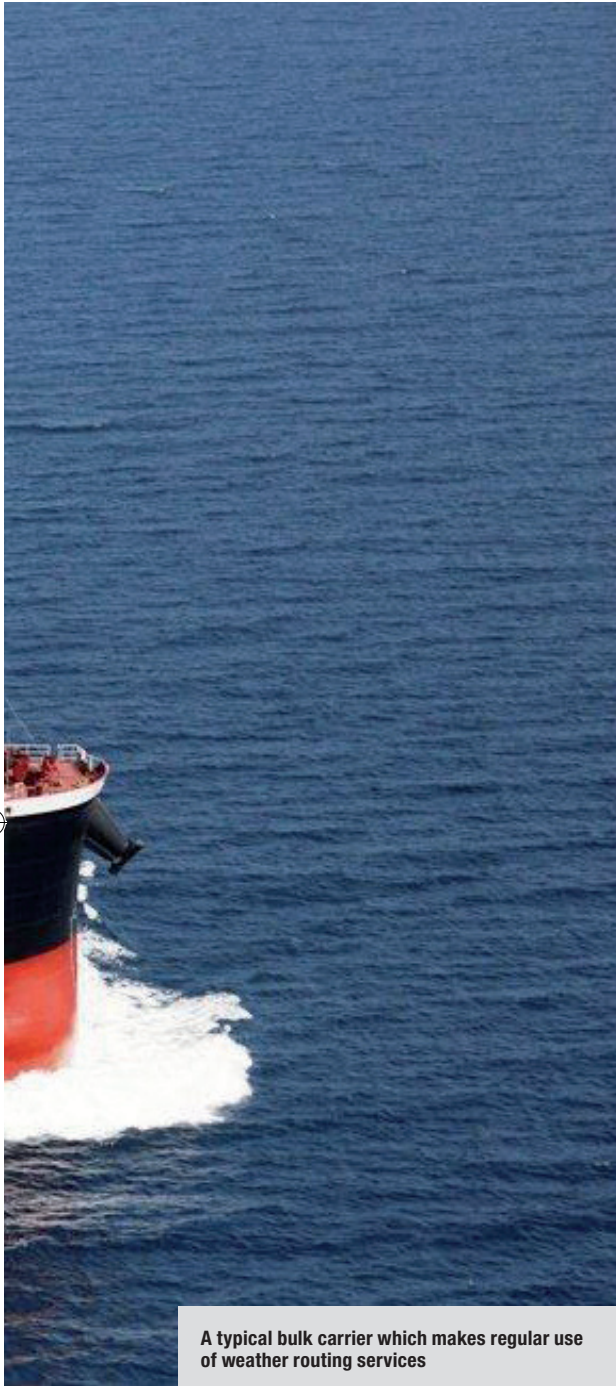
In the 19<sup>th</sup> century, systematic

compilation of atmospheric and oceanographic data from ships' log books meant that climatological averages of ocean weather and ocean currents became available to mariners, and this information was used by early pioneers to develop seasonally recommended routes for sailing ships and early steam-powered vessels.

In the mid 20<sup>th</sup> century the modern concept of ship weather routing began to be put into operation by national

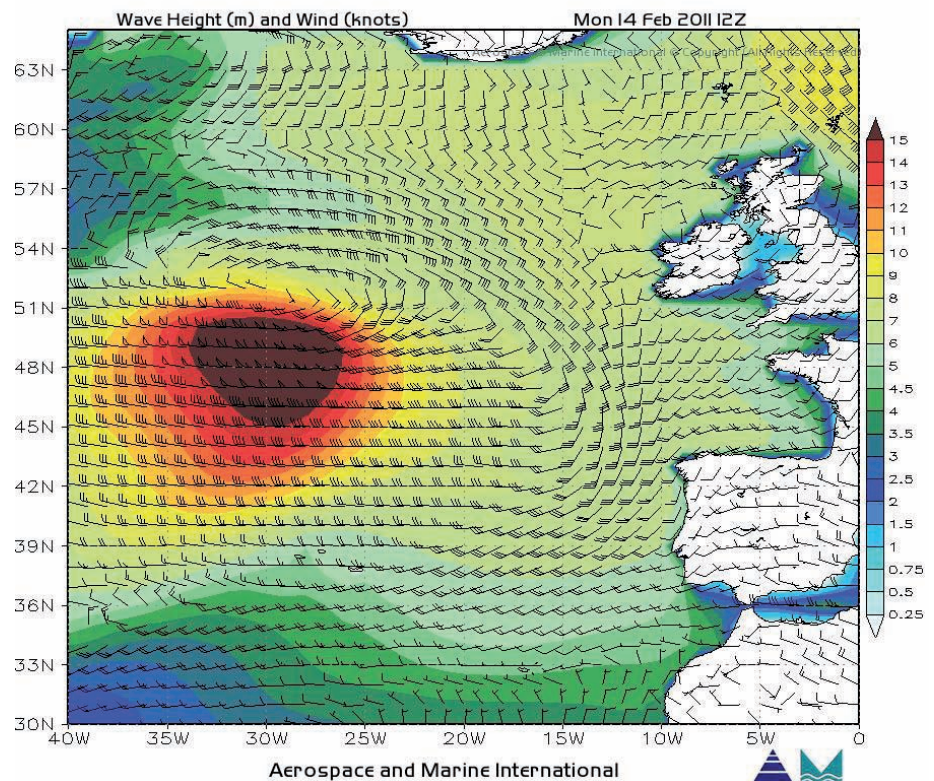
meteorological centres and private meteorological companies, and by applying available surface and upper air forecasts to transoceanic shipping, it became possible to effectively avoid much heavy weather while generally sailing shorter routes than previously.

In the last 20 years, the rapid development of computers, the internet and communications technology, together with advances in meteorological analysis



A typical bulk carrier which makes regular use of weather routing services

“The more accurate the starting analysis of the atmosphere from which the model is run, the better the final forecast will be”



Output of forecast winds (wind barsbs) and wave height (colored contours) from present day atmospheric and ocean wave models

techniques and atmospheric modeling, has made a much more detailed and accurate weather routing service widely available to marine users on all scales.

### Weather routing services

There are several private companies and publicly funded bodies providing ship routing services. One such private company is Aerospace & Marine International (AMI) which has been providing weather services

to the maritime industry for more than 20 years. The company maintains two operations centers; one in the USA and one in the UK. Together the two offices deliver 24 hour marine weather forecasting and ship routing services to a global client base.

Across the industry there are different variables to the traditional weather routing service. To a large extent two different groups can be identified; those actively optimizing a vessel's sea passage to achieve a

pre-determined goal (fuel savings, avoiding damage to cargo on deck and so on) and those services dedicated to passively tracking a vessel's progress to evaluate the speed and consumption performance for contractual purposes. In the case of Aerospace & Marine these services are Optimum Voyage Routing (OVR) and Performance Monitoring (PMO).

The goal of OVR is to develop the best route for a ship based on existing weather

forecasts, ocean current patterns, ship characteristics and special cargo requirements. For most transits this will mean the minimum transit time that avoids significant risk to the vessel, crew and cargo. The aim is not to avoid all adverse weather but to find the best balance to minimize time of transit and fuel consumption without placing the vessel at risk to weather damage or crew injury. During the voyage, regular forecasts and route recommendations are provided to the vessel to aid the master in choosing the best route as described.

In contrast to active routing, the goal of performance monitoring is to measure and prepare a report on the performance of the subject vessel in terms of speed and consumption of fuel along its route versus the contractual speed and consumption for the same vessel. This report requires an independent analysis to determine what loss of speed was due to weather and currents, and what was due to the vessel's 'malfunction' if any.

The route forecaster uses specialized geographic information system software which enables display of the vessel route on charts overlain with wind, wave, current, and several other types of relevant meteorological factors such as sea ice, icebergs, and freezing spray. The route waypoints are plotted and compared to several other reasonable variations of the same route. The full set of routes is then simulated taking into account the vessel characteristics, forecast weather and ocean currents so that the optimum route can easily be determined. Once underway the vessel's actual positions are added to the route, and the vessel's progress is continuously monitored and updated when necessary, due to adverse weather or other factors.

### Latest technologies in forecasting

There have been major advances in recent years in meteorological analysis techniques and atmospheric modeling. Much effort has been applied to developing methods to assimilate the vast amounts of available satellite and other forms of remotely measured data into global atmospheric models.

The more accurate the starting analysis of the atmosphere from which the model is run, the better the final forecast will be. As a result these models are now capable of producing accurate global forecasts of winds and waves for up to a week ahead, and to give some detail about larger scale patterns for another week beyond that.

An example of the type of output available from such models is shown in the

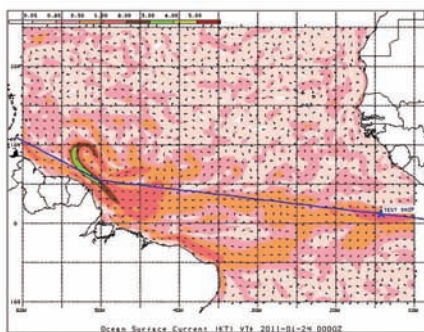
## OPTIMUM SHIP ROUTING

For most transits optimum shipping routing will mean the minimum transit time that avoids significant risk to the vessel, crew and cargo. The goal is not to avoid all adverse weather but to find the best balance to minimize time of transit and fuel consumption without placing the vessel at risk to weather damage or crew injury.

Route planning normally will start by reviewing the appropriate Pilot Chart Atlases and Sailing Directions (planning guides) to determine the normal weather patterns, weather risks and prevailing ocean currents. The Routing Service then reviews recent weather patterns and weather forecast charts to determine the most likely conditions during the course

to the voyage. A preliminary routing message is transmitted to the master of a vessel prior to departure with a detailed forecast of expected storm tracks, an initial route proposal with reasoning behind the recommendation, and also the expected weather conditions to be encountered along that route.

This allows the master to better plan his route and offers an opportunity to communicate with the service any special concerns that he or she might have due to special cargo requirements or ship condition. Once the vessel departs, the vessel's progress is monitored closely with weather and route updates sent as needed.



**Ocean current chart showing a vessel route to take maximum advantage of favorable Brazil westerly current**

graph on the previous page. This means that vessels can be routed to avoid an expected storm which may not even exist yet, but which with a high level of certainty will form somewhere ahead along the vessel's present track. The global models are also now beginning to pick up some tropical storm development days before the storm has even been officially recognized by the respective regional forecast centers.

Another area where there has been a significant improvement is in the modeling of ocean currents. In the past, current data was painstakingly extracted from ships' logs by comparing distance sailed over ground with distance actually sailed through the water, and these observations were collated into charts of monthly averages which were the main source of ocean current information for masters and other interested parties. The introduction of satellites capable of measuring to a high degree of accuracy the elevation of the sea

surface has meant that dynamic ocean current models are now initialized with real-time surface elevation data. This allows much greater precision in the modeling of ocean currents down to a fine scale of a few miles and it means that ships can be routed much more accurately in relation to adverse or favorable currents.

For example, strong current gyres in the Gulf of Mexico change only slowly over a period of days and these can be used to great effect by the routing agency to reduce sailing times by a couple of hours for the addition of a few extra miles. Slower vessels are much more affected by currents, as the speed of the current is a much larger percentage of the vessel speed, and the vessel remains under the influence of the current for longer. A good example is shown in the graph above left which depicts a typical westbound track taking advantage of the current patterns off the north-east coast of Brazil, close to the Equator.

A very strong current flows parallel to the coast from east to west throughout the year, and this strong current occasionally breaks down into an eddy so that there is a branch moving from west to east some way to the north. A slow vessel, say a drilling rig being towed by a tug, can save three days or more on a trip from the Gulf of Mexico to Brazil despite adding 100-200 miles to the journey, by remaining to the north of the strong adverse current core and in the following current branch of the eddy. Vessels sailing east to west stay further south within the core of the current and in this way can improve voyage times by several days.

These regions of strong current were depicted on the historic monthly averaged

# Weather routing

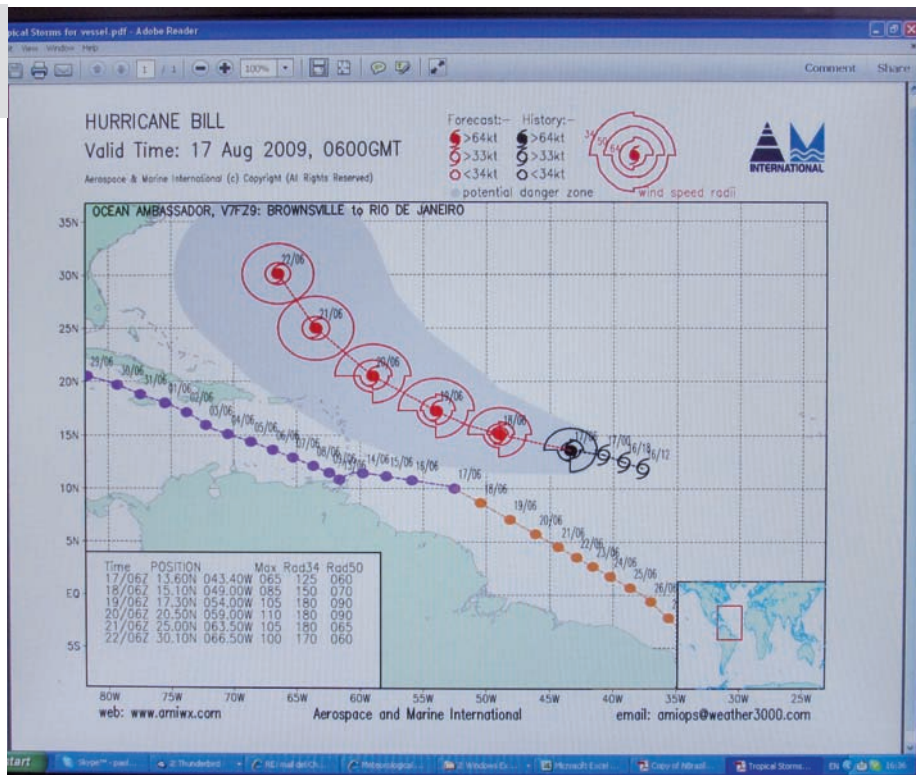
**Tropical storm charts depicting historic and forecast track and area of uncertainty in relation to a deep sea tow's track**

charts, but the day-to-day fine detail was not available from these charts and masters would find the favorable currents or avoid the adverse currents by trial and error. Nowadays the routing company has access to this fine scale current detail and voyages can be tweaked and updated on a daily basis to ensure the best and most favorable route is used which takes maximum advantage of the currents.

### Other routing considerations

Other non-meteorological factors also influence the choice of routes available. A recent and unforeseen development has been the rapid increase in piracy in the Indian Ocean originating from the failed state of Somalia. As recently as five years ago, vessels sailed with impunity across the Arabian Sea into and out of the Gulf of Aden.

Attacks were carried out by small groups of pirates in skiffs which were vulnerable to strong winds and rough seas. The attacks then began to become more sophisticated, making use of larger hijacked vessels as mother ships, pushing the area at risk across the Arabian Sea to the west coast of India. This has meant a drastic change in routing patterns over the area, so that safety is now the sole concern. What used to be one of the

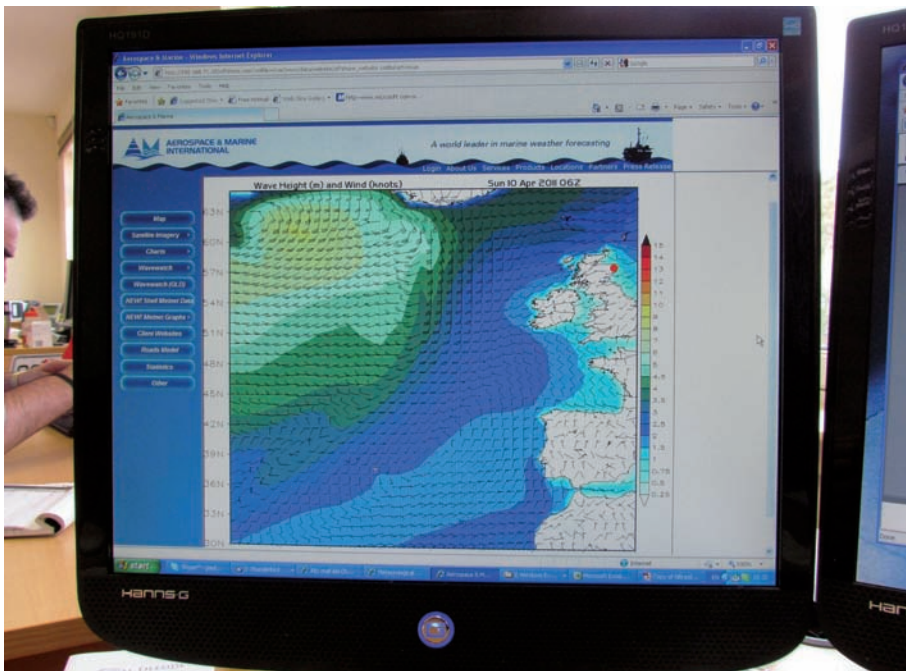


busiest sea routes in the world connecting the Far East with Europe via the Red Sea and Suez Canal is now a risky undertaking, and some operators are sending their vessels around South Africa and adding many days to their voyages.

Another factor which is having a major impact on vessel routing is the price of fuel. Recent geopolitical events have conspired to send the price of crude oil to historically high levels.

Traditional weather routing still plays a vital role in minimizing fuel consumption, but other methods of fuel conservation are being practiced regularly by operators, including sailing at most economical speed or suggesting an optimal RPM setting for a given voyage. All these 'variants' to traditional weather routing continue to be totally dependant on accurate weather and ocean currents data to provide meaningful advice to the vessel. These methods will continue to be expanded on in the coming months and years, especially in scenarios of high fuel price and increased concern over greenhouse emissions regulations for shipping.

Weather routing is a tool which can be used to reduce fuel consumption and greenhouse gas emissions in the global shipping industry. Collaboration between routing providers and vessel operators will result in improvement of existing services and development of new ideas, ensuring that weather routing continues to play an important role in vessel economy and safety in the future. ■



**Five days outlook animated wind and wave charts for Atlantic north east**

*Keith Thomson is the UK operations manager of Aerospace & Marine International (UK) Ltd*