



Integrated
Weather Intelligence:
**Routing Shipping
Companies to Safety
and Fuel Efficiency**

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Introduction

Digital solutions are already helping shipowners and operators integrate the enriched weather data they need to improve vessel efficiency and increase crew and vessel safety. However, while there is no doubt that the data provides greater access to operational intelligence, a wide gap exists in the data complexity and integration used among shipowners and operators.

A recent research report by DTN[®] highlights that the single biggest obstacle in bridging the gap is poor data collection processes. Fortunately, advances in cloud computing continue to make it easier to integrate multiple data sets into in-house systems. These advancements support a complete situational analysis to improve operational safety and fuel efficiency.

In this white paper, we dive deeper into some of the DTN research results and what they mean for shipping safety and fuel efficiency, as well as guidance on addressing these challenges as severe weather events become more intense and frequent.

What is enriched weather data?

Since the early days of shipping, weather information has remained crucial to navigation. Today, it tells us so much more than what the weather will do.

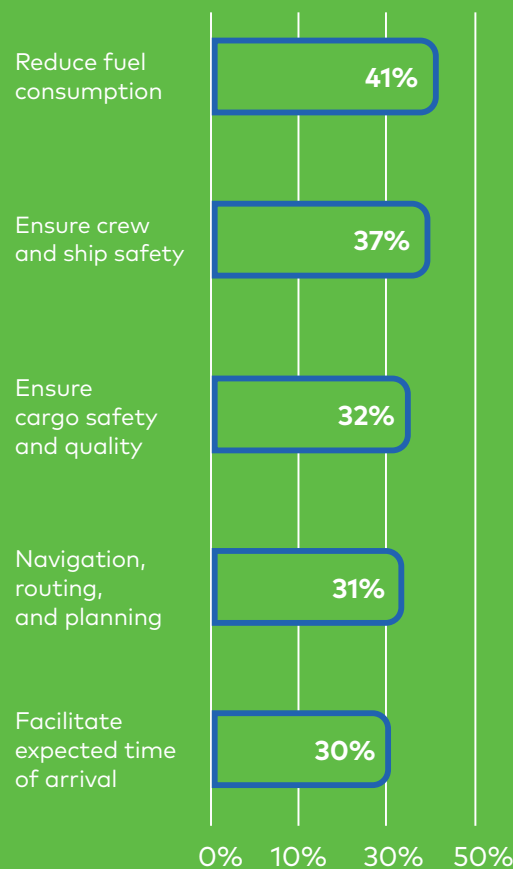
Metocean data — atmospheric and ocean data combined — overlaid with other factors, such as vessel type and voyage routes, can give clear insights to improve overall vessel efficiency, reduce fuel consumption, and keep cargo and crews safe. Enriched weather data provides additional competitive advantages when integrated into business applications for complete situational awareness.

Understanding the business drivers and benefits of weather data integration

To ensure the shipping industry remains competitive, market and regulatory pressures drive the need for integrated data from multiple sources. Weather intelligence is an integral part of operational decisions. Looking at the top drivers for purchasing enriched weather data — fuel consumption and safety — it's clear that the industry is seeking solutions that help reduce costs and carbon emissions while also maintaining high levels of safety.

The shipping industry is at the point where integrating enriched weather data is a strategic imperative to ensure shipping companies are well-positioned to face the challenges ahead. It is clear from the report that shipping experts recognize an overlap between the value found and the business drivers for enriched weather data. Overall, the industry recognizes the importance of enriched weather data to enhance efficiency and improve safety.

Business drivers for weather data integration



“If one captain is making seven or eight voyages in a year and has a life expectancy of 30 years of experience, he is not wise.

Meteorologists support six to eight vessels in a day and work every day with different seafarers — meaning they have over 220 years of experience. So, extensive knowledge always adds value in the decision-making process.”

Lajos Holmslykke, performance manager, TORM

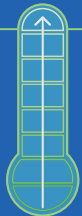


Industry weather impacts

Sea surface temperatures...

are rising at an average rate of **0.14 degrees Fahrenheit per decade**.¹

This is a catalyst for more extreme weather events.²



Tropical cyclones...

that develop into major hurricanes or typhoons will **become even stronger**.

Some may survive mid-latitudes, regaining intensity.²



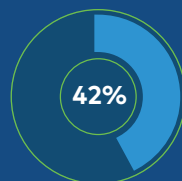
Precipitation...

is intensifying due to higher moisture in the warming atmosphere.

This impacts shipping operations in areas of tropical cyclone landfall.²



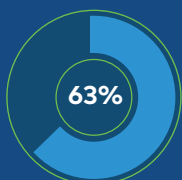
The biggest concerns for extreme weather events with the potential for the most significant business impacts:



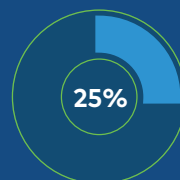
Lightning and thunderstorms



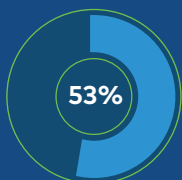
Storm surges



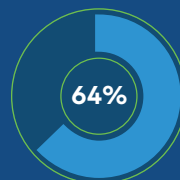
Cyclones, hurricanes, typhoons



Polar ice



Monsoon and heavy rains



High winds and waves

Sea levels...

are rising **up to 100cm**, and may change tidal circulations in shallow water.

Port and terminal accessibility will be affected.²



Arctic ice cover...

is decreasing even further in summer and autumn.

More reliable shipping routes will become available north of Siberia.²



Ocean energy...

is increasing, resulting in rougher oceans.

Expect more powerful winds, increased wave heights, and stronger wave periods.³



¹ EPA, Climate Change Indicators: Sea Surface Temperature
² Intergovernmental Panel on Climate Change, Climate Change 2021
³ University of Melbourne, Ocean Waves and Winds Are Getting Higher and Stronger

Why the maritime industry needs enriched weather data

Weather impacts every part of the shipping industry, from fuel efficiency and carbon dioxide emissions to crew, ship, and cargo safety.

Today, the marine industry must also contend with more volatile weather events, as shown by Intergovernmental Panel on Climate Change (IPCC) [scientific research](#). However, 74% of DTN research respondents don't think the industry is impacted by changing weather patterns and warming oceans. This view may be due to gradual changes that may not be felt immediately, like increasing sea surface temperatures and rising sea levels. However, these changes are catalysts for the most widely known and accepted conditions directly impacting shipping.

For instance, warmer sea surface temperatures increase water evaporation rates, feeding moisture and energy into storms, which is associated with more rapid hurricane intensification — the top concern for respondents.

Also, ocean conditions are becoming increasingly difficult for shipping companies, with more powerful winds, increased wave heights, stronger wave periods, and changing wave direction. Higher moisture content in the warming atmosphere brings heavier precipitation events — the second biggest concern.

It is a given that shipping companies factor weather forecasts into planning their routes. But shipping companies must have room for a flexible response to these more frequent, sudden weather changes that significantly impact safety, operational efficiency, and fuel consumption.

Unlocking new opportunities: high data availability and quality

The shipping industry generates massive quantities of data across every aspect of the supply chain, from sensors in dispatch warehouses to onboard ships, ports, and trucks. More advanced companies are already looking at innovative ways to stretch their data use.

Today, poor data collection processes and data management are considered the two biggest barriers by DTN research respondents. Looking ahead, it is the abundance of data and integration of real-time data that will become the main challenges.

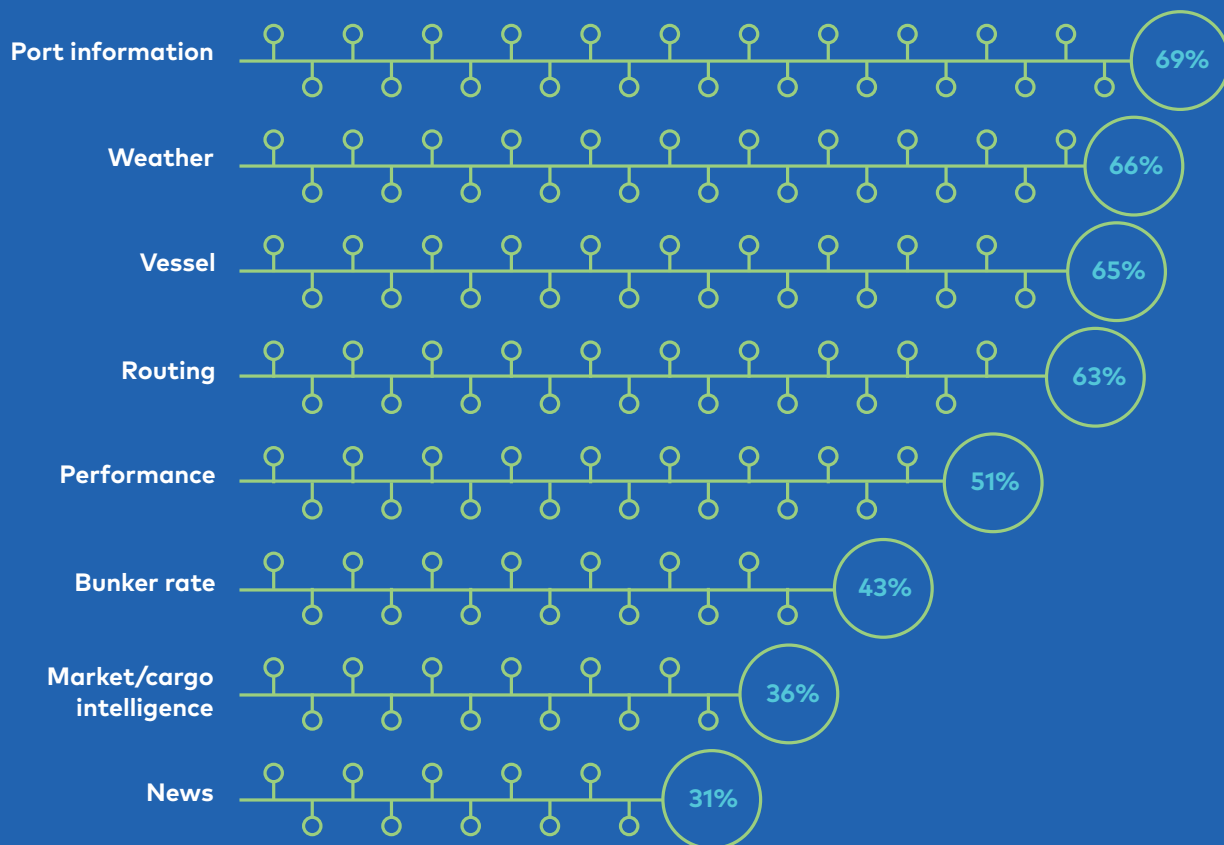
The same is the case for weather intelligence. As computing power and metocean models become more robust, so does the data. For example, one marine weather dataset using an ensemble of models produces terabytes of information for a single wave forecast. The data compounded for hourly forecasts would be too

massive for traditional systems. Cloud-based solutions and flexible APIs integrated into ship systems not only manage the large datasets but also provide mariners with real-time information when and how they need it.

Enriched weather data not only improves crew, vessel, and cargo safety, it also supports efficient operations. For instance, fuel consumption, which can account for half of the operating costs, allows for significant savings when integrated with weather data — especially with [recent spikes in fuel prices](#). Optimal weather routing can offer fuel savings of up to 5%, depending on vessel type, the season, and conditions.

By connecting weather intelligence to port, bunker rate, and market/cargo information, supply chain efficiencies are also improved, as shown in the following graph detailing the key types of data fed into systems.

Types of data feeding into systems



Solving the data integration challenge: the case for single systems

Nearly every shipping company is actively running data integration projects — however, many are siloed. It is not uncommon for a marine operator to use one system to see ocean data and a separate one — or even two — to view weather forecasts and current conditions. With the endless number of decisions to ensure safe passage, these siloed systems can cause greater uncertainty through data overload.


Digitalization delivers the greatest value when performed across an organization, built on a data-sharing culture with processes and people driven by a clear leadership buy-in and company mission.

Many respondents in the research felt that these fundamentals are missing, which provides a significant barrier to accelerating digitalization and data integration projects. The report highlights the single biggest obstacle to digitalization: poor data collection processes, as confirmed by nearly half of the respondents. Several respondents also identified a lack of leadership buy-in as a top barrier.

These sophisticated data integration projects have typically relied on proprietary systems used by market leaders who are more advanced in their integration journey. But, increasingly, the availability of innovative single-system platforms featuring pre-integrated data makes access to similar capabilities possible. With strict regulations on the horizon, the number of shipping companies that adopt a single system will grow as data integration becomes a key requirement.

Single vs. proprietary systems

Shipping companies can bring in external data through three means: internal proprietary systems, single systems, or a combination of each. Internal proprietary systems require customized data integration, bespoke and built for the organization in question, whereas single systems are typically a standard purchased platform with pre-integrated data.



“Weather routing is a vital tool for us to ensure maximum safety for our crews, cargoes, and vessels. It also helps us to save time, money, and, of course, fuel. This is one way we can minimize the environmental impact of our ships. DTN weather routing is used on board of 100 vessels in the Spliethoff Group, and in our office.”

Karel van Zijl, director of business innovation and analytics, Spliethoff

The research report revealed that single-system users are more attracted to convenient, accessible solutions, with 75% choosing an all-in-one solution — even if they can't cherry-pick multiple data partners. Only 55% of respondents using internal proprietary systems would choose an all-in-one solution, forgoing opportunities for advanced solutions integrated into existing systems.

The research report also shows that to make all this data accessible, nearly half of companies use both a single system and an internal proprietary system for vessel performance and maintenance. This approach compares to 37% that only use an internal proprietary system and 19% that use a single system. However, we expect this to change as available data grows to the extent that it is almost impossible to maintain a proprietary system.

Making enriched weather data available through single systems

For most companies, the resource requirements for proprietary IT systems are not practical. As data volumes increase, it will become more costly for organizations to maintain proprietary systems.

Therefore, demand for single systems purchased as a platform with pre-integrated data will increase — especially as these systems become more sophisticated and powerful.



Full weather data integration is an emerging phase in digitalization for the shipping sector. Shipping companies are understandably focused on vessel improvements, like fuel type and ship engine optimization, first. But as companies attempt to navigate increasingly complex market conditions, combining these existing optimization approaches with weather-enhanced use cases helps provide an edge. Incorporating weather data into performance and decision-making systems allows shipping operators to overlay information for a complete situational analysis, supporting greater decision-making confidence. Applying this analysis to a fleet of vessels in different locations multiplies the value weather insights provide.

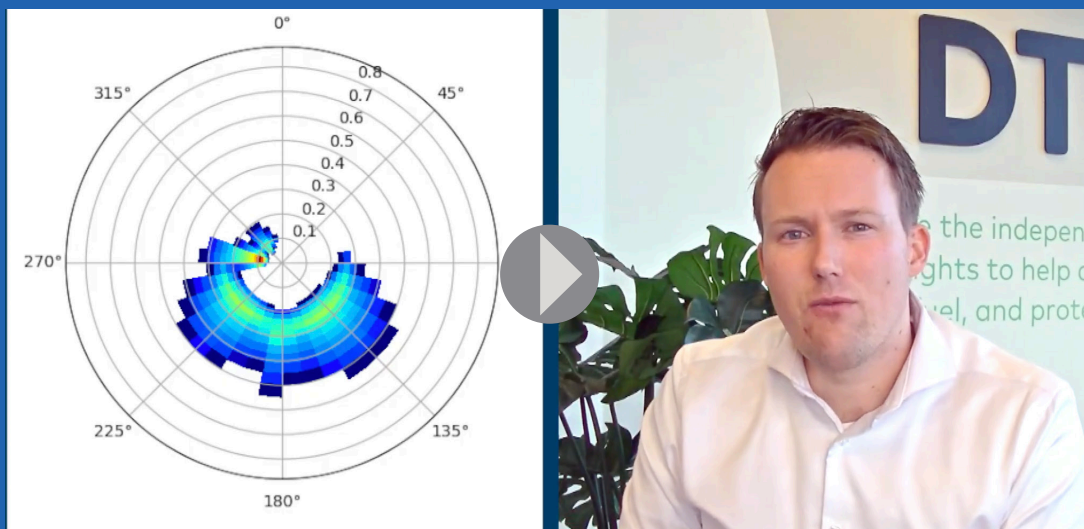
Advancements in technology, cybersecurity, and computing power have enabled shipowners who choose single systems to access rich data from integration partnerships in near real time. For example, DTN works with a range of shipping platform developers to provide integrated weather data within existing systems. At the same time, the market for software-as-a-service (SaaS) platforms is growing fast. This trend enables shipping companies to quickly and easily implement integrated decision-making tools and accelerate digitalization in the industry. As single-source systems advance in capabilities and data aggregation, both large and small ship operators will have more complex and accessible data at their fingertips to support swift, confident decisions.

Confidently making the right calls

In conditions nearing safety limits, enriched weather data helps shipowners and operators confidently make tough calls. Extreme weather can evolve quickly, and having the right data on hand ensures that timely decisions can be made to support safety.

For example, in early 2022, three consecutive storms in the North Sea wreaked havoc on area vessels. The Dutch Coast Guard and other European authorities issued weather warnings as fierce storms moved across the region, with top winds recorded at 122 miles per hour (mph). The high winds and stormy seas unmoored the freighter Julietta D, which collided with the Pechora Star. Although both ships were

damaged, their crews were evacuated safely. However, the storms toppled cargo. The Panama-registered Marcos V, sailing from Bremerhaven, Germany, to Rotterdam, Netherlands, reported that at least 26 empty 40-foot containers were lost overboard, and images showed additional boxes hanging from the ship's side with several stacks collapsed. These disasters highlight the need for enhanced coordination between ships and shore around the options captains have to protect their crew, ship, and cargo from severe weather. Skilled Master Mariners with weather expertise, fueled by actionable insights, can act as Risk Communicators and provide various options based on calculated risk.



Watch our video on integrated weather intelligence benefits for shipping safety and efficiency.

Optimal speed routing: the new vessel routing optimization logic

The optimal speed routing algorithm can optimize routes based on overall costs — fuel, emissions, daily hire, etc. — or total metric tons of fuel used. The optimal speed route is the most inexpensive possible route after accounting for all the applied restrictions.

To find the optimal speed route, the search not only considers all different possible routes but also the possible different speeds along the routes. This will lead to the search determining the best solution with favorable weather conditions, which can help save fuel consumption or overall cost by varying the speed.

It can also find a solution that avoids heavy weather conditions by temporarily speeding up or slowing down the voyage to sail ahead of a storm or allowing it to pass. This means the speed advice is not always the local optimum; the goal is to achieve the most optimum voyage outcome.

For ETA routing, speed changes center around the average speed required to reach the destination on time. In other words, an ETA requirement narrows the range in which the algorithm can change speed. So, if a storm is passing by, the algorithm is limited in how much it can slow the vessel and still make the ETA.

When no strict ETA is required, the algorithm uses nearly the vessel's entire speed range to achieve optimal results. The customer must provide the speed range for input in the route calculation and is responsible for aligning with the vessel and ensuring that the crew can operate within the speed range.

This new algorithm is unique as it considers speed plus weather optimization and results in a safe, navigable, and most cost-efficient route that should positively impact voyage profitability.

How to improve safety and fuel efficiency with enriched weather data

Point solutions are commonly used onboard and are now available through API for onshore integration, providing a consistent view from ship to shore.

Integrating weather data into systems helps operations stay ahead of adverse weather — anywhere in the world — and configures outputs based on needs. The right toolkit can mitigate severe weather impacts, supporting faster decisions that ensure safety, greater efficiencies, and reduced fuel consumption.

There are five essentials for weather optimized routing to maximize safety and fuel efficiency:

1 Weather data:
Process high-resolution weather data parameters for data analysis.

2 Vessel profiles:
Know how the vessel model responds to the environment.

3 Unique routing algorithm:
Connect weather parameters to safety settings and vessel speed or estimated time of arrival (ETA).

4 Weather optimized route network:
Embed oceans, coastal areas, and historical routes.

5 Master Mariners:
Add human expertise to help manage uncertainty and risk.

Master Mariners: the Risk Communicators of the sea

In weather-optimized routing, accurate weather data is not the only piece of the puzzle. Managing uncertainty and risk is also critical. This is where access to Master Mariners — who have navigational experience and expertise and are familiar with vessel characteristics in various wind and sea conditions — add valuable insights. Their knowledge and skills added to the proposed route options enable premium route advice. They are aware of navigational features, including obstacles, sea currents, and navigational restrictions. Plus, they understand the processes onboard the bridge and know when it is feasible and practical to issue new routes or speeds.

For example, during a typhoon, standard weather model data alone is insufficient, and typhoon data is overlaid. When the

forecast is uncertain, the Master Mariner assesses route options to ensure the vessel won't become trapped by the direction of the storm system.

Master Mariners also advise on the best way to navigate the voyage based on specific criteria. Sometimes this means helping customers make the fastest crossing. Other times, the customer needs to arrive at a specific ETA or may need to cover the route as economically as possible. Regardless of the priority, Master Mariners use their expertise, combined with metocean data, to deliver trustworthy, reliable consultations.

Conclusion

We've highlighted how the shipping sector can use enriched weather data to enhance efficiency and improve safety.

As the sector looks to adapt to the rise in extreme weather events, navigate an increasingly complex regulatory landscape, and thrive in a competitive market, utilizing enriched weather data helps provide an edge by ensuring complete situational analysis that supports more confident decisions. The right data, at the right time, and that also integrates seamlessly into existing systems, ensures on-demand access to real-time intelligence that can support timely, confident decisions.

Organizations that enhance their weather data maturity will be better equipped to advance their digitalization journeys and respond to external pressures facing the market.

Easily integrate critical shipping intelligence with DTN Marine Content Services.

[explore APIs](#)

The DTN logo is displayed in a large, bold, black font. To the right of the letters 'DTN' is a small blue circle with a white dot inside, resembling a degree symbol (°). The logo is positioned on the right side of the page, partially enclosed by a large blue arc that sweeps from the top right towards the center.