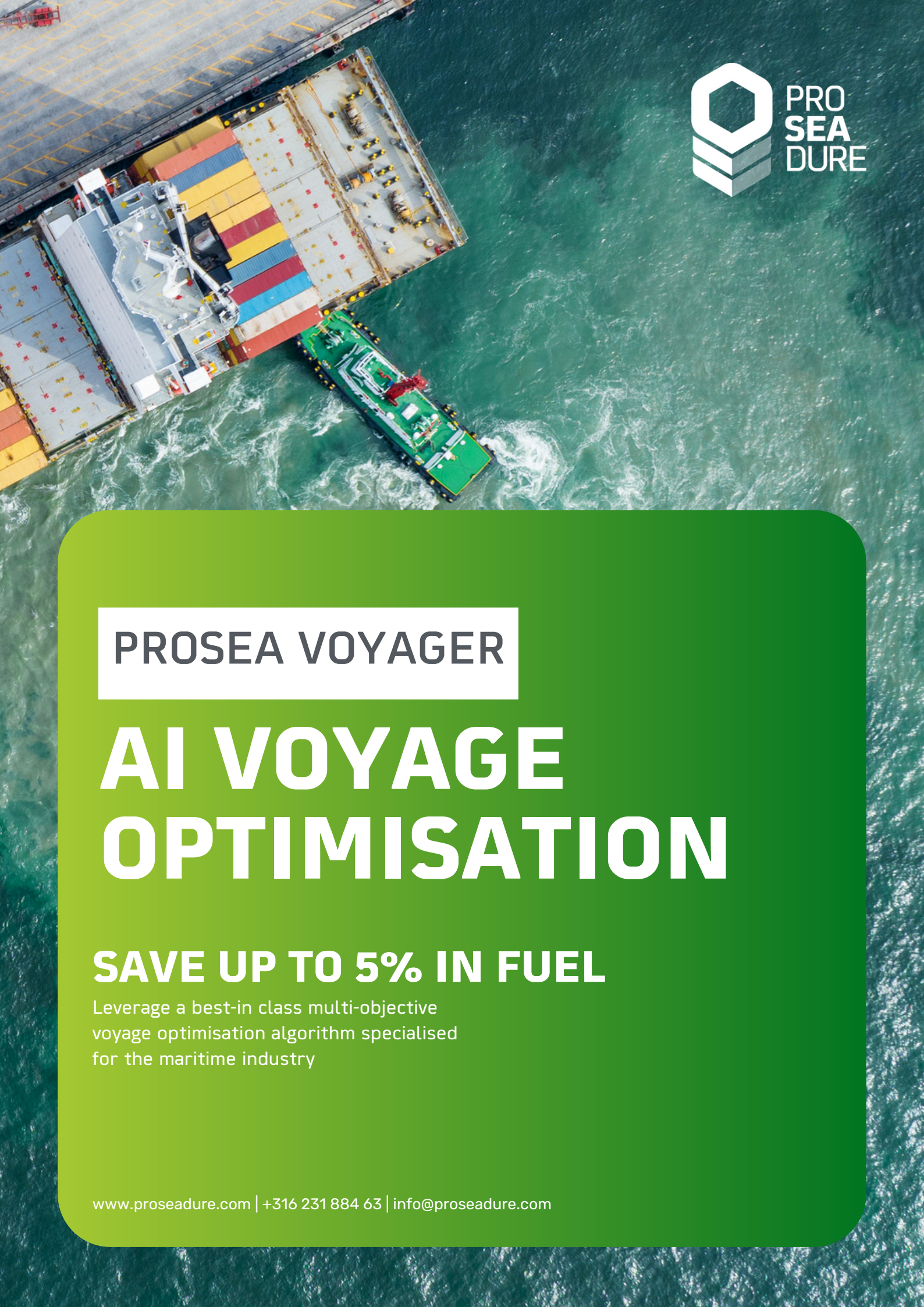

PROSEA VOYAGER

AI VOYAGE OPTIMISATION

SAVE UP TO 5% IN FUEL

Leverage a best-in class multi-objective voyage optimisation algorithm specialised for the maritime industry

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VOYAGE OPTIMISATION: THE FASTEST WAY TO CUT EMISSIONS AND COSTS

To achieve IMO's **net-zero goal** in 2050, the maritime industry faces significant challenges. While cleaner fuels are in their early stages and require retrofitting or replacing vessels needing substantial upfront investments, **voyage optimisation** offer an almost **immediate** and **cost-effective** solution to reducing carbon emissions, fuel consumption and costs.

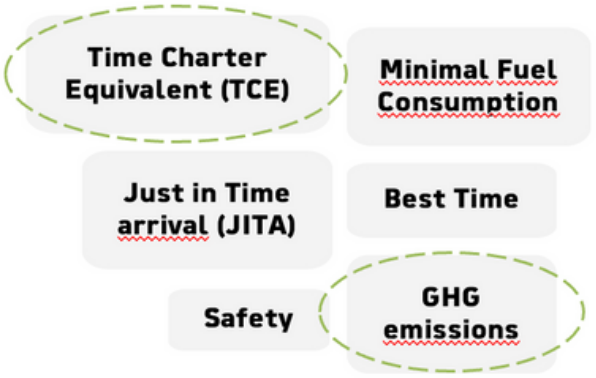
AI MAKES IT POSSIBLE TO BALANCE MULTIPLE OBJECTIVES

Creating a route from point A to B is straightforward, but doing so while balancing costs, fuel, regulatory compliance and safety at sea is far more complex. Traditional route optimisation such as weather routing, primarily focused on navigating safely. However, these basic algorithms become less accurate when additional objectives such as cost efficiency, minimising fuel and Just-in-Time Arrival (JITA) objectives are added.

AI leverages its vast computational power to solve for this complex problem. Infinite amount of sea routes can be plotted finding the perfect balance between multiple objectives such as cost savings and safety.

TRADITIONAL VOYAGE OPTIMISATION

1-3% FUEL SAVINGS[1]



AI VOYAGE OPTIMISATION

>5% FUEL SAVINGS[2]

1) Based on IMO's findings in 2015 on the effectiveness of voyage optimisation in the marine industry. 2) Based on benchmarking done by the Univeristy of Southampton & The Alan Turing Institute.

KEY COMPONENTS TO VOYAGE OPTIMISATION

Even the most sophisticated AI is only as good as the data it processes. High-quality inputs lead to higher quality outputs. Therefore, the most effective voyage optimisation platform must incorporate also the following aspects:

- **Weather Forecasts:** Accurate, up-to-date weather data to navigate around adverse weather conditions
- **Ship Models**: Detailed vessel performance data
- **Client Input:** Business constraints and priorities
- **Navigational Restraints:** Safety and regulatory requirements that define accessible shipping lanes

By ensuring all these elements are best-in class, you ensure the most efficient path is suggested at all times.

Navigational Restraints

- ENC Validated Base Routes
- TSS Compliance
- Avoidance of High-Risk Areas or Restricted Areas

Weather Forecasts

- Wind speed & Direction
- Currents
- Wave Heights & Direction

AI Algorithm

Client Input

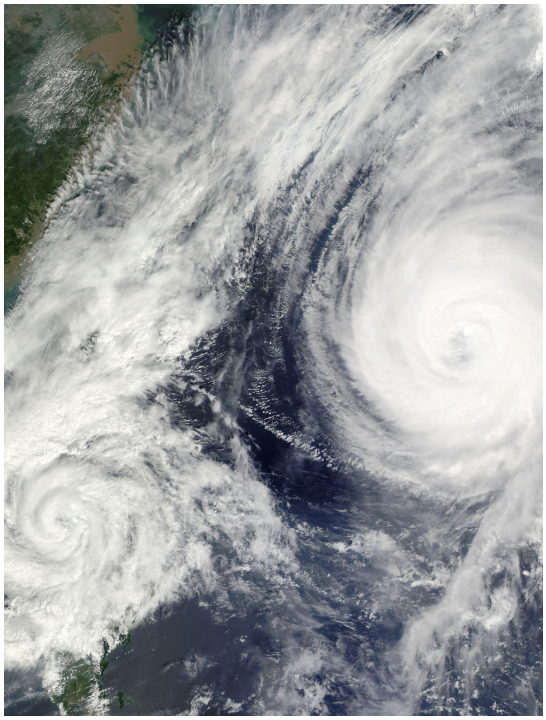
- Desired Time of Arrival
- Charter Party Agreements
- Safety Parameters

Ship Characteristics

- Vessel Performance Models in various weather conditions
- Engine Details
- Hull Efficiency

THE CRITICAL ROLE OF HIGH-QUALITY WEATHER FORECASTS

Marine weather forecasts are essential for ensuring vessel routes remain safe. They factor in critical information such as wind patterns, wave heights, currents and the presence of storms or icebergs which must be avoided. Accurate weather insights optimise fuel expenditure, shorten voyage time and increase overall navigational safety.



When evaluating the quality of weather providers, it is important to consider:

- **Resolution:** The spacing of the model's computational grid. Smaller grid cells (e.g., 12 km) capture finer-scale atmospheric and oceanic features leading to more accurate forecasts.
- **Coverage:** The geographic detail of a model. Robust global coverage ensures consistent forecasts across regions and open oceans.
- **Data Sources:** The breadth and reliability of observational inputs. Assimilating publicly shared data with propriety input can boost the model's accuracy.
- **Update Frequency:** How often the forecast is re-initialised with new observations.
- **Forecast Horizon:** The amount of days in the future the weather model predicts. A longer forecast horizon helps with the strategic voyage planning, however, accuracy drops after 7 days requiring mid-route updates.
- **Parameters:** The range of outputs provided such as wind velocity and wave height. The availability of the amount of parameters directly affect route optimisation.

TAKING THE 'UNKNOWN' OUT OF THE OPEN OCEAN

Spire uses a unique blend of advanced weather modelling and its own **private satellite observations** to produce **high-resolution (12 km)** forecasts with a **15-day horizon**. Its Lemur satellite constellation gathers over **10.000 radio occultation profiles** per day, capturing vital atmospheric data in **remote oceanic regions** where ground stations are scarce. By assimilating these proprietary measurements alongside open sources like NOAA and ECMWF, Spire extends global coverage far beyond standard weather forecasts. Filling **a critical data gap** over the open seas.

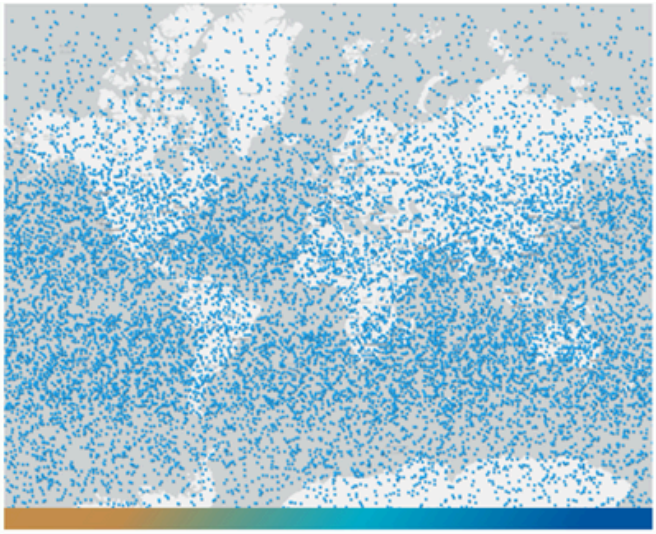
By incorporating Spire's satellite-driven weather data into our voyage optimisation algorithm, routes are optimised against currents, wave heights and numerous other marine parameters. This not only **avoids dangerous conditions** but also leverages favourable winds and currents for **faster, more efficient voyages.**

100+
SATELLITES

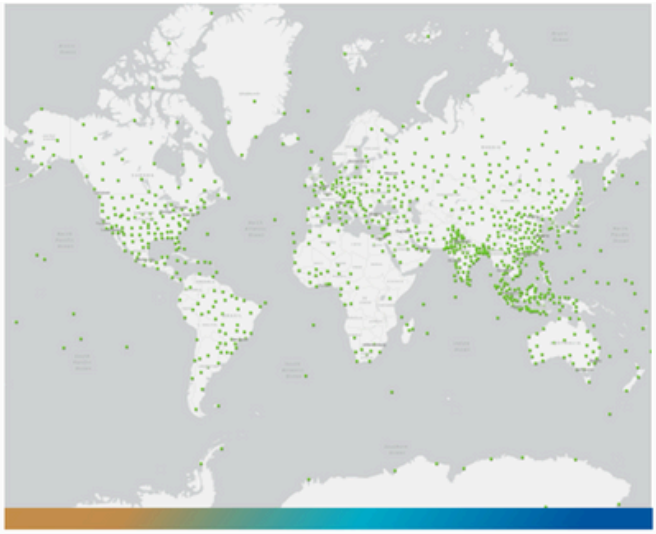
30+
GROUND STATIONS

10+
YEARS IN FORECASTING

DAILY MEASUREMENT POINTS



Radio Occultation Profiles
10.000



Weather Balloons
1.800

VESSEL MODEL INPUT FOR OPTIMAL PERFORMANCE

The next essential component of voyage optimisation are the **vessel models**. A vessel model, or digital twin, is a **virtual representation** of a ship's performance under varying conditions. By incorporating factors such as engine configurations, hull design, draft, speed-power curves, along with weather and ocean data (wind, waves, currents), these models can accurately predict a vessel's fuel consumption, speed, and maneuverability in various conditions.

KEY COMPONENTS OF A VESSEL MODEL

- **Hull & Resistance:** The shape of the hull together with the added drag from fouling or trim issues affect hydrodynamic efficiency.
- **Propulsion System:** Detailed engine performance curves, propulsion type and any energy-saving devices influence how speed and fuel burn vary with each increment of power output.
- **Loading Conditions:** Draft, trim and cargo directly impacts the vessel's buoyancy and balance which can alter fuel consumption over longer voyages.
- **Environmental Inputs:** Wind, waves, and currents drive external forces on the vessel's speed, stability, and power requirements.

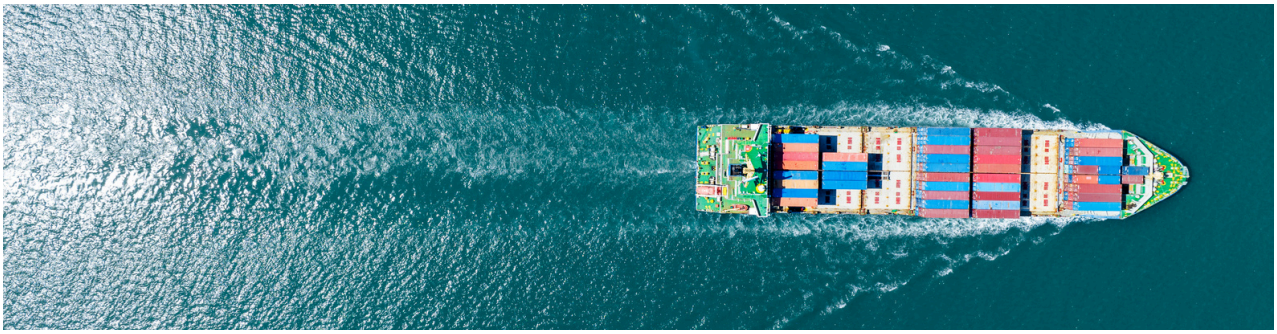
> **GENERIC SHIP MODELS START AT 80% ACCURACY**

Predicting how a ship will behave in different settings, enables the route-planning algorithm to choose the ideal speeds and paths that **minimise engine loads, cut fuel consumption** while precisely scheduling **Just-in-Time Arrivals (JITA).**

Our voyage optimisation engine uses a range of **generic digital models**, automatically selecting the one that best aligns with your vessel's characteristics. Capturing around **80%** of your ship's unique performance profile. For even **higher fidelity**, we collaborate with third-party providers to build **ship-specific models** with up to **95% accuracy**, enabling more precise routing. The result is a safer, more efficient operation.

TAILER ROUTES TO OPERATIONAL NEEDS

Beyond the data input the voyage algorithm receives from weather forecasts and the vessels model, **client input** plays a significant role in **tailoring the route recommendations** to reflect the unique needs and priorities vessel operators have. By integrating **business constraints** such as **safety parameters** (e.g., permissable wave heights for certain speed regimes), **charter party terms** and **performance thresholds** (e.g., minimum and maximum service speeds) allows the algorithm to remain within your chosen operational needs.



SAFETY PARAMETERS

Define detailed safety thresholds, ensuring that every route adheres to strict operational limits. Such as, **maximum wind speeds, wave heights, under-keel clearances,** and **turning angles**.

CHARTER PARTY TERMS

Input **contractual requirements** such as **agreed speeds, fuel consumption limits**, and **performance criteria**, the system ensures that voyage plans comply with established commercial obligations.

PERFORMANCE THRESHOLDS

Define **optimal engine settings**, **service speeds**, **power outputs, desired time of arrival (DTA)** and **departure windows**. These metrics allow the algorithm to balance fuel efficiency with operational speed, ensuring that the vessel remains within its most efficient performance while still meeting port schedules.

SAFELY DEFINED ROUTING BY MASTER MARINERS

Finally, to optimise the voyage you will need to use reliable and validated routes. To ensure this, our system uses AtoBviaC, which provides precise ENC-validated navigational routes that are calculated by Master Mariners and Marine Navigators. By utilising these official chart resources, Proseadure ensures each generated route meets internationl and regulatory standards.

TRAFFIC SEPARATION SCHEME COMPLIANCE

Routes generated adhere strictly to international Traffic Separation Schemes (TSS). These IMO-regulated navigational frameworks help vessels navigate safely in heavily trafficked maritime areas, significantly reducing collision risks and enhancing safety.

HIGH-RISK & RESTRICTED AREA AVOIDANCE

AtoBviaC systematically incorporates high-risk and restricted-area data into route calculations. It proactively routes vessels around piracy zones, marine protected areas, and geopolitical hotspots, ensuring vessels avoid operationally sensitive regions.

THE FOUNDATION FOR ROUTE OPTIMISATION

Starting with AtoBviaC's generated base route serves as a robust starting point. Our advanced AI optimisation algorithm then refines this by integrating real-time weather forecasts, vessel performance data and client-defined operational constraints. This ensures the final voyage estimation is both compliant and efficient.