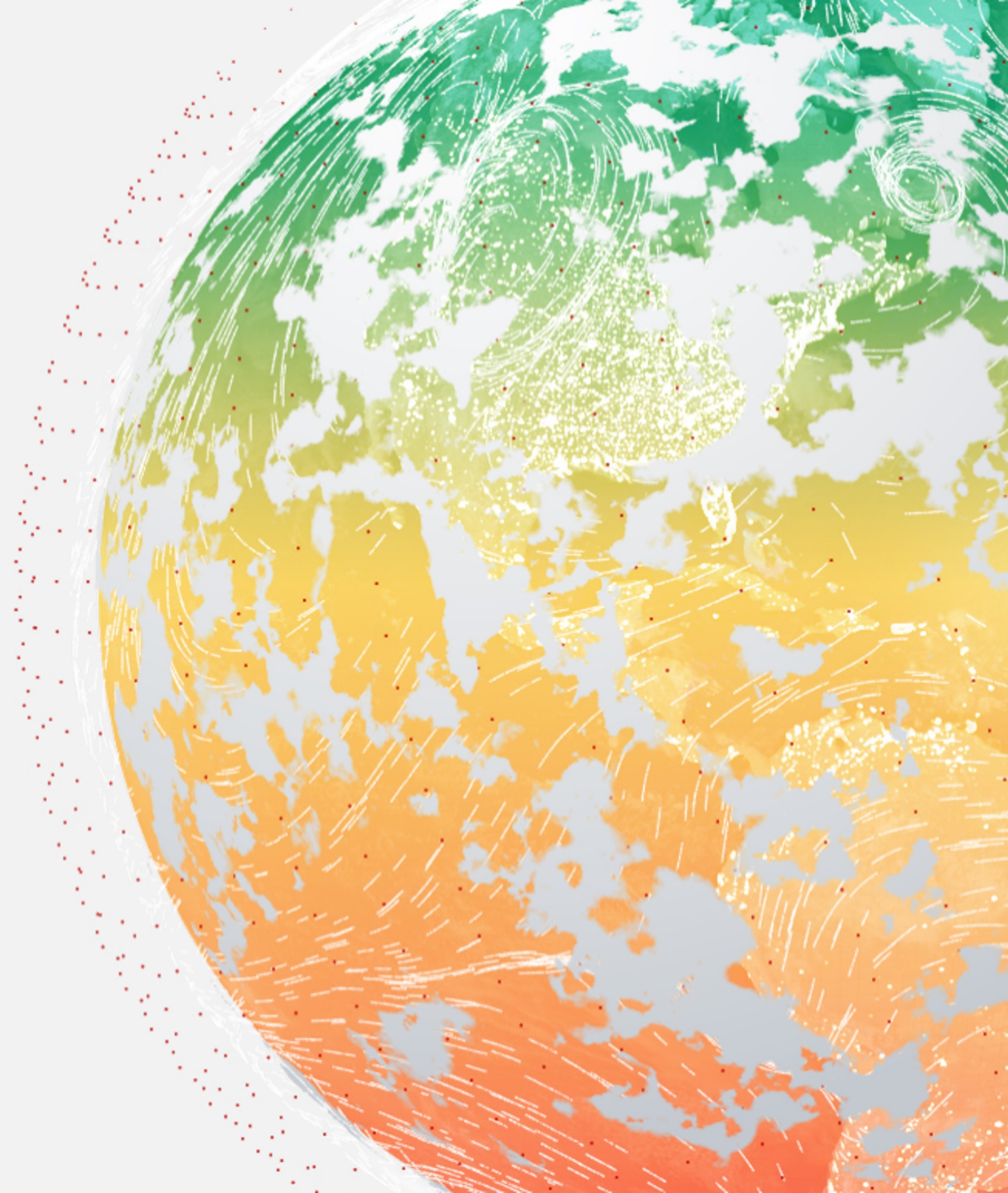




Introduction

Gerald van der Grijn
Product Manager

Spire - Weather & Earth Intelligence



Leverage Space to solve problems on Earth



- Founded in September 2012
- Focused on Earth's greatest challenges
- Launched 1st nanosatellite in 2013
- 120+ Satellites in Orbit
- Only weather company with a private satellite constellation
- Went IPO on NYSE in 2021
- Over 600 customers
- 375+ people across 8 offices worldwide

"Spire wants the information we collect and analyze to help make our world a safer, cleaner, more prosperous, and more equitable place."

Serving a broad range of Industries



Maritime

Highly accurate ship monitoring, ship safety and route optimisation



Aviation

Highly accurate aircraft monitoring, safety and route optimisation



Weather

Highly accurate weather forecasting



Space Services

Low risk development lifecycle and proprietary infrastructure



Earth Intelligence

Surface data, weather patterns, atmospheric monitoring, and more



Federal

mission-critical satellite data to drive federal government initiatives

Customers



Aerospace



Agriculture



Automotive



Aviation



Construction



Govt.
(Civilian)



Govt.
(Defense)



Academia



Energy



Fishing



Financial
Services



Insurance



Logistics



Maritime



Mining



Oil & Gas



Real Estate



Scientific
Research



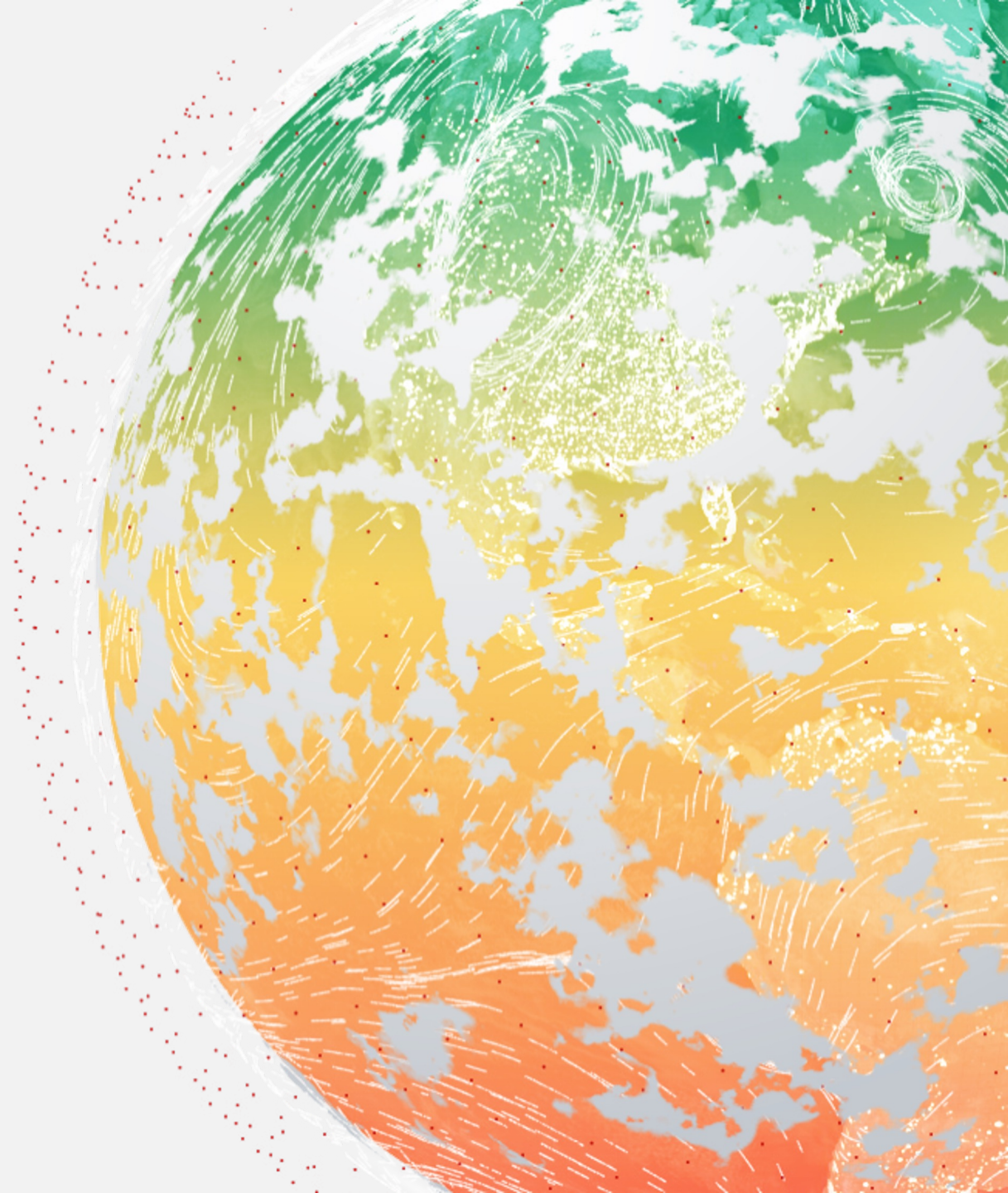
Telecom /
IoT



Transportation



Harnessing the power of weather data to decarbonize the global maritime industry

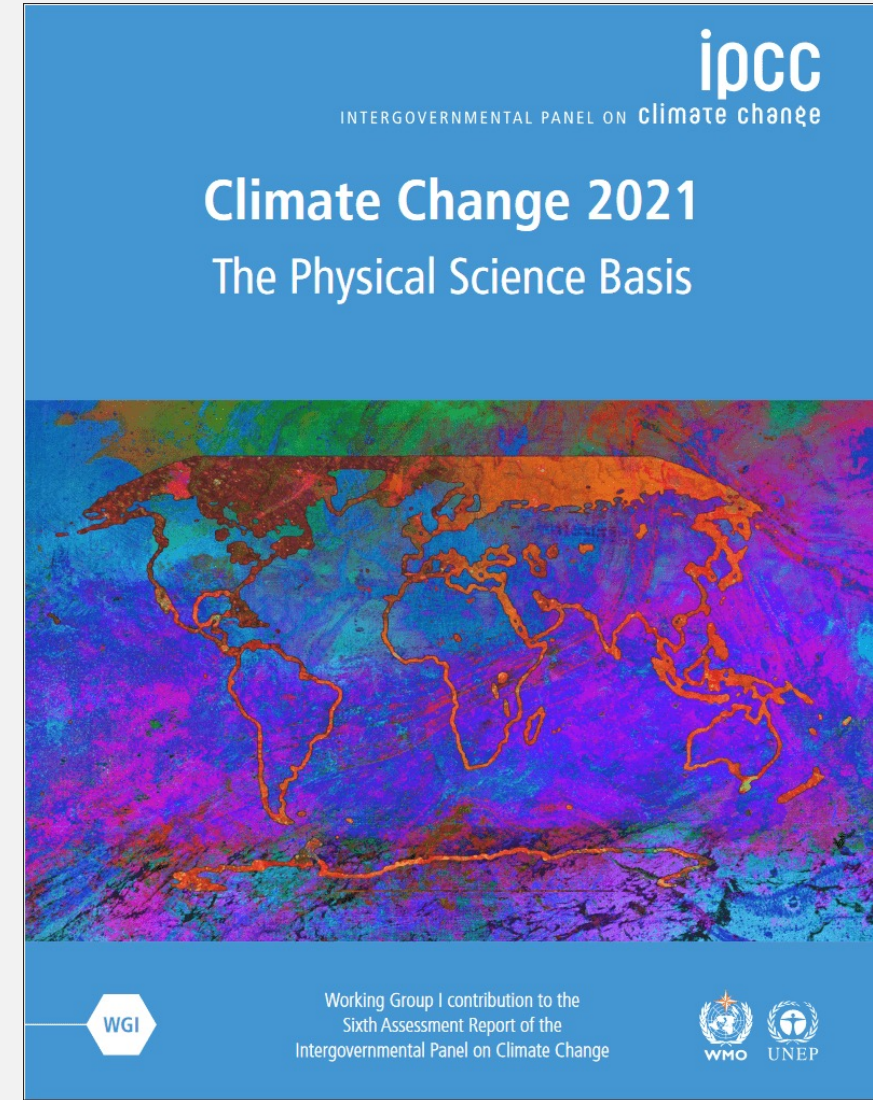


Evolving Climate

From the latest IPCC report

- The proportion of **intense TCs**, average peak TC wind speeds, and peak wind speeds of the most intense TCs will increase on the global scale with increasing global warming (high confidence).
- Future wind speed changes are expected to be small, although poleward shifts in the **storm tracks** could lead to substantial changes in extreme wind speeds in some regions (medium confidence).
- Many **ocean currents** will change in the 21st century as a response to changes in wind stress associated with anthropogenic warming (high confidence).
- The Arctic Ocean will likely become practically **sea ice** free during the seasonal sea ice minimum for the first time before 2050 in all considered SSP scenarios. There is no tipping point for this loss of Arctic summer sea ice (high confidence).

source: <https://www.ipcc.ch/report/ar6/wg1/>

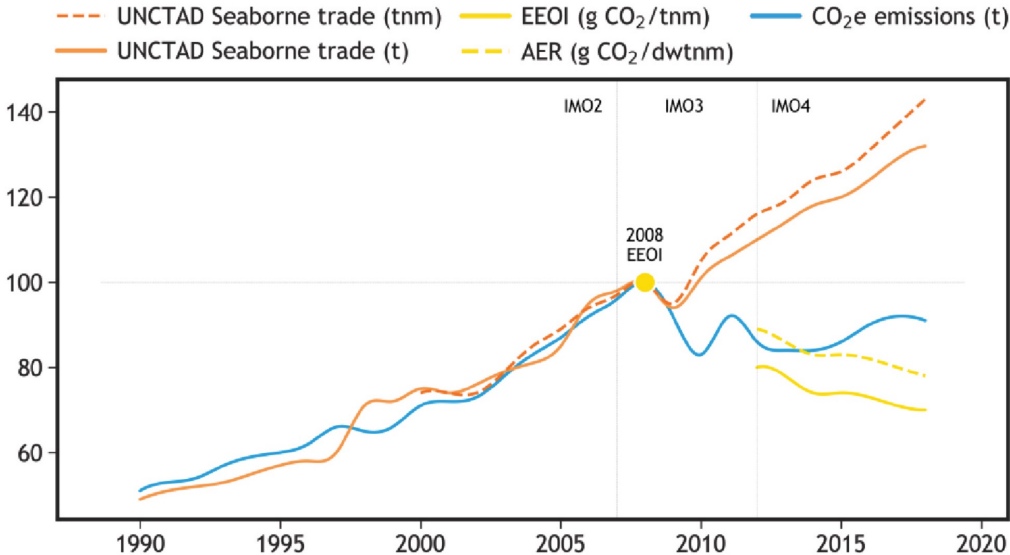


The need for decarbonizing international shipping



“In 2018, vessel-based International shipping was responsible for approximately 919 million tonnes of CO₂ per annum contributing more than 2.5% to the total CO₂ emissions worldwide”

source: Fourth IMO GHG Study 2020



International shipping emissions and trade metrics, indexed in 2008, for the period 1990-2018, according to the voyage-based allocation of international emissions.

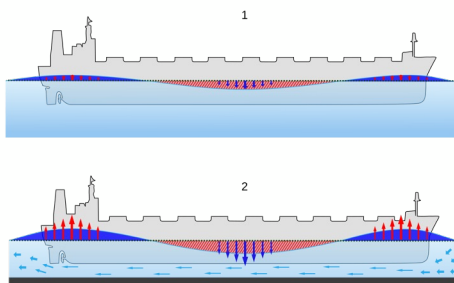
source: Fourth IMO GHG Study 2020

Optimising Fuel Consumption Using Weather data

How to tap into the power of nature: wind, currents and waves.

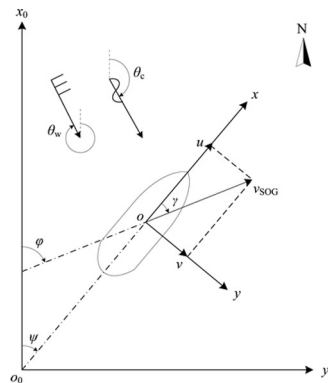
Currents

- Maximize favorable currents to save fuel and reduce transit times
- At the port's entrance : Tidal currents can cause trouble for captains when maneuvering their vessels into narrow entrances
- Avoidance of squat effects in shallow waterways/channels



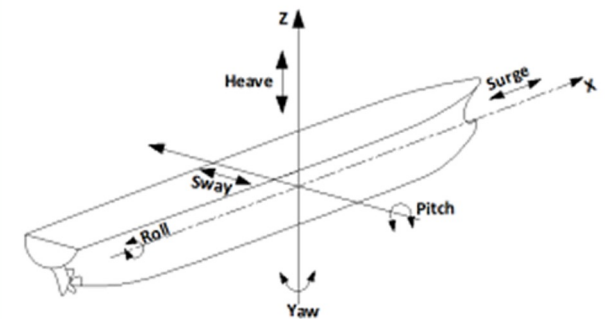
Surface winds

- Cargo loss (Safety)
- Increased fuel consumption
- Vessel motion
- Extra tug assistance



Ocean Waves

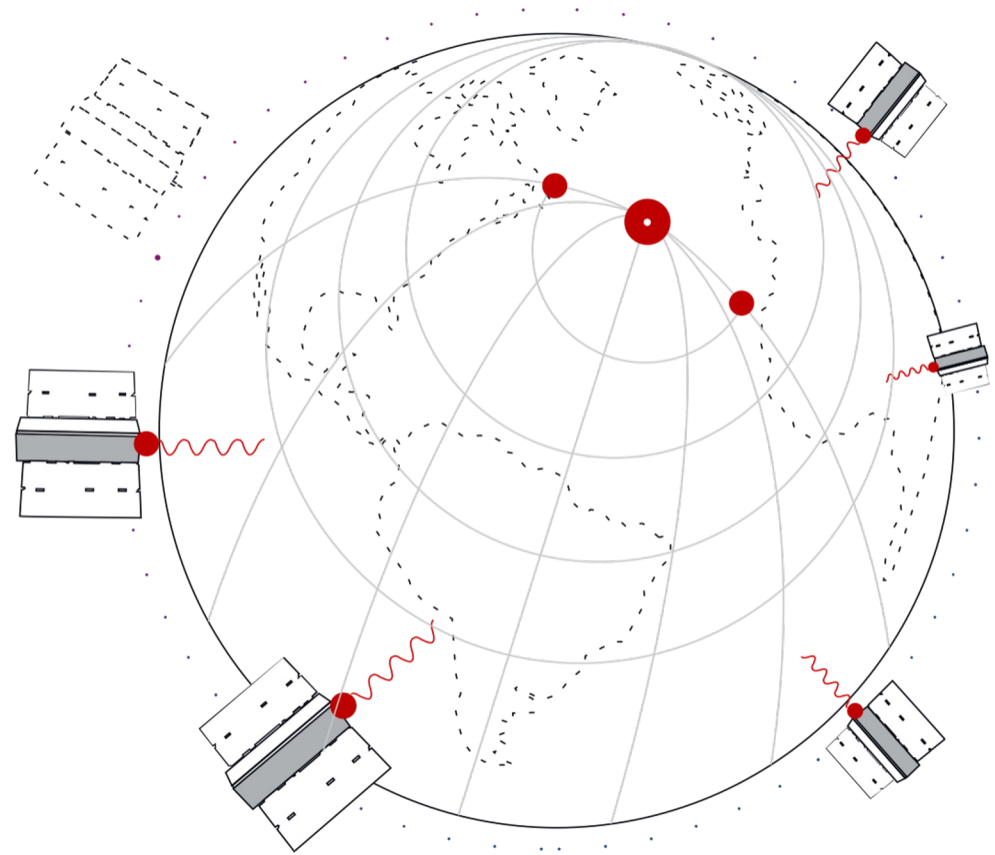
- Vessel motion
- Mooring rope tension
- Increased fuel consumption
- Safety



Affects vessel behaviour

Satellite Powered Weather Forecasts

- We are the **largest producer** of radio occultation and space weather data
- Our data provides a **global view** with coverage in remote regions like oceans and not observed by traditional systems.
- We are continuously launching **improved sensors** and upgrading them in-orbit
- Spire owns the **entire chain** of the constellation build from design and manufacturing to on-orbit data processing and software upgrades



30+

Ground stations

120+

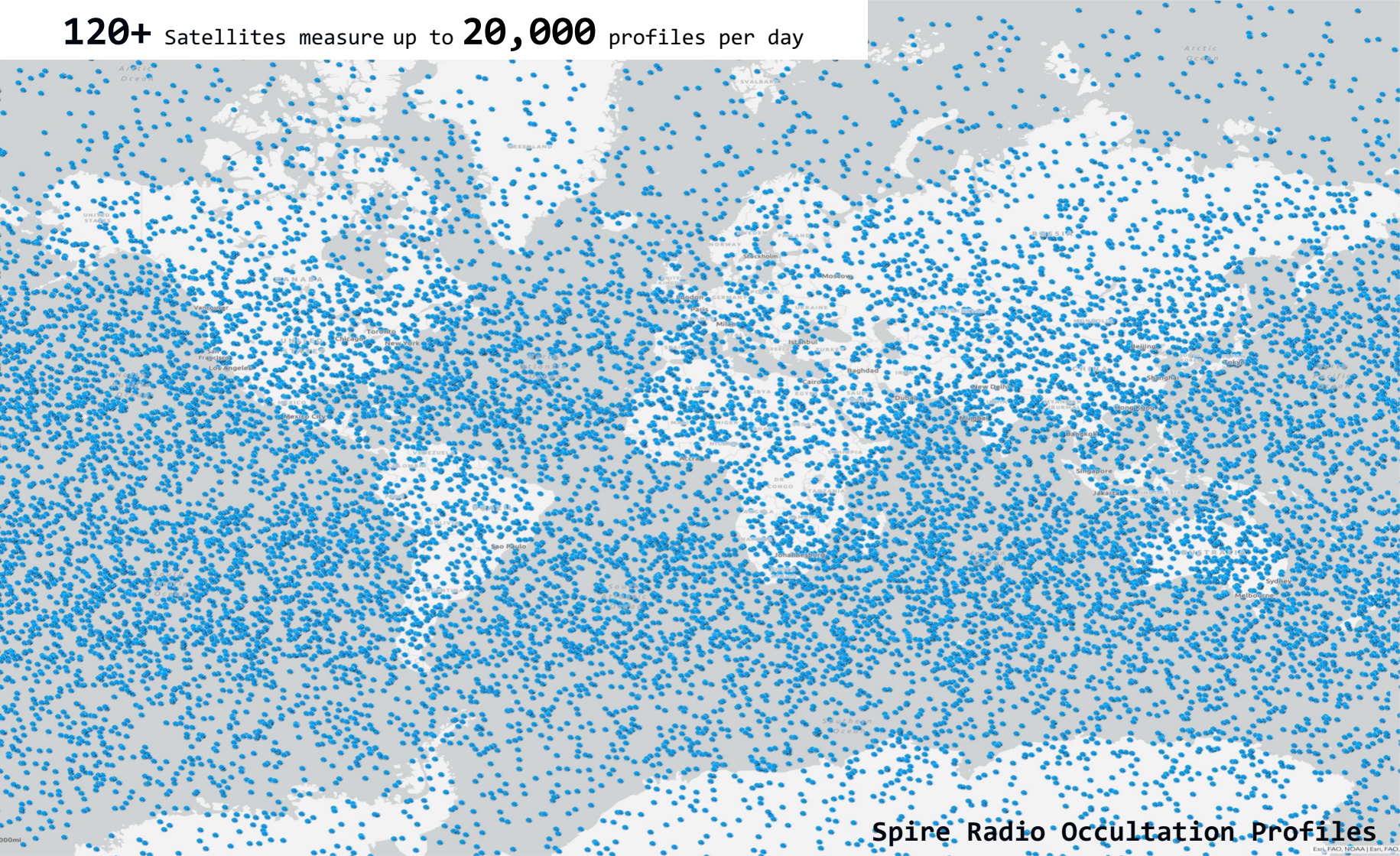
Satellites

19.4M

Messages in one day

Spire's Unique Vantage Point

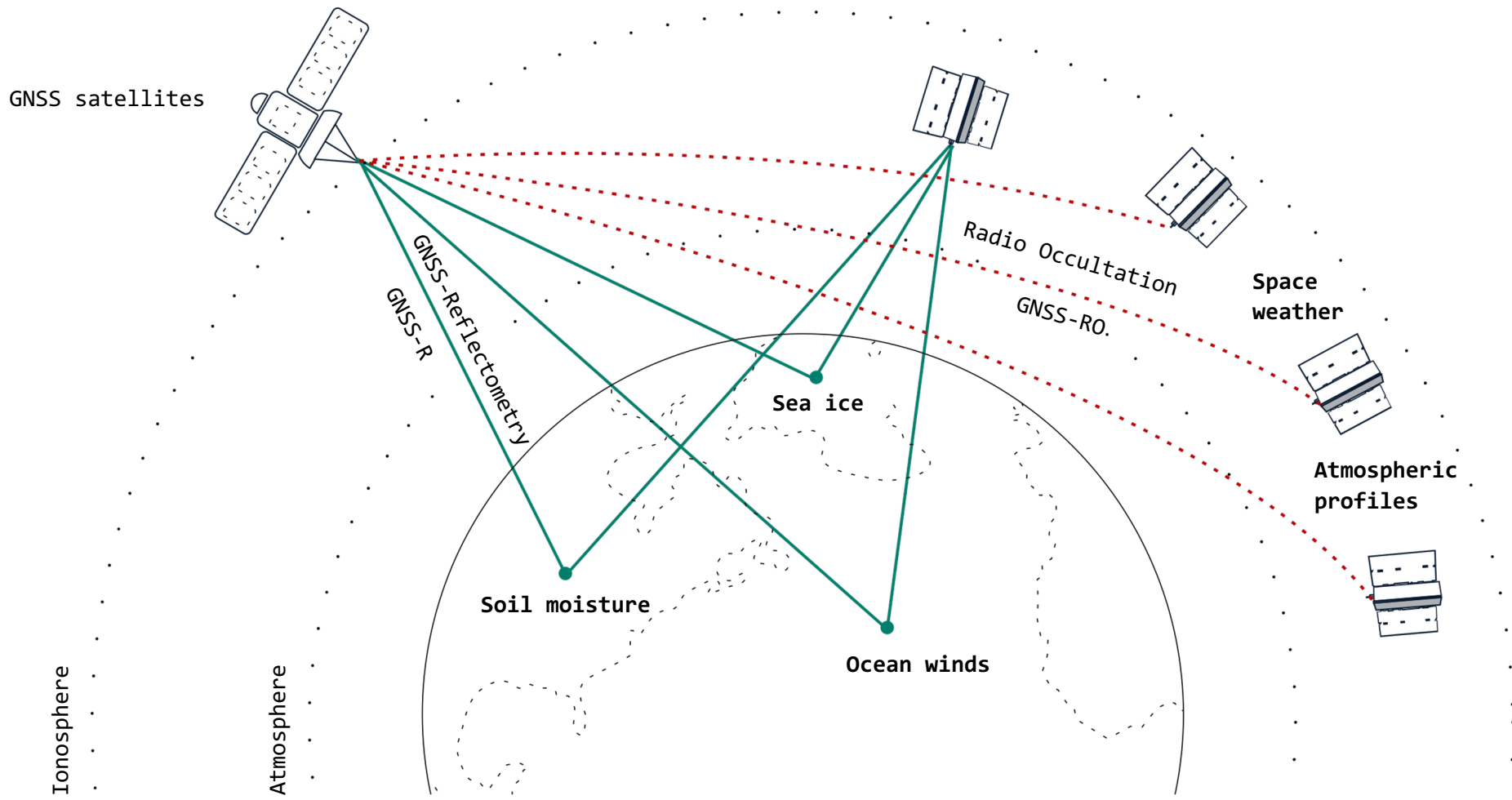
120+ Satellites measure up to **20,000** profiles per day



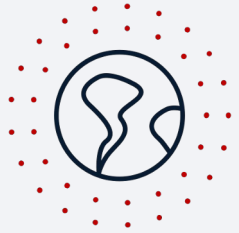
Spire Radio Occultation Profiles

Additional Earth Observations

2024 Planned:
4x 16U cubesats with
hyperspectral microwave
sounders



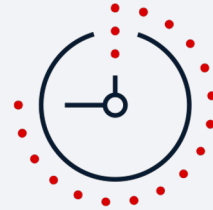
Spire's Unique Weather Forecast



Initial State

Similar atmospheric conditions are used to 'initialize' a forecast in the weather forecast industry

- Spire generates 20,000 RO profiles to enhance long range model accuracy
- Spire 3D Cloud Analysis - enhances model accuracy in the short term



Forecast Model

Government Organizations, Research Institutes and Universities create or make improvements

- Spire runs its own NWP forecast out to 15 days using the enhanced initial state



AI / Machine Learning

Post-processing the forecast data for accuracy and added value products

- Optimised model blend forecast to get the most out of all leading global forecast models
- Local sensors used to continually tune model bias and improve accuracy

Spire is innovating across the entire weather forecast process; from observations to model post-processing

Spire Weather Forecasts



Global Gridded

- Coverage: Global
- Spatial Resolution: 1/8th-degree (12km)
- Vertical Resolution: Surface up to 1 hPa or FL450
- Temporal Resolution: 15 days forecast
 - Hourly (to 2 days)
 - 3-hourly (to 5 days)
 - 6-hourly (to 15 days)
- Refresh Rate: Updated every 6-hours (short-range) or 12-hours
- API: Available as a point request (based on a coordinate) or as area/global download (GRIB2)
- Deterministic, Optimised Model Blend & Probability Forecasts



Premium Optimised Port Forecast

- Coverage: Available at pre-configured sites (10,500 weather stations, all the busiest ports globally)
- Spatial Resolution: Optimised to the exact location
- Temporal Resolution:
 - 15-days forecast (hourly)
 - 2-days forecast for Wind/Solar (15-min steps)
- Refresh Rate: Updated every hour
- API: Available as a point request or a bulk CSV download for several stations (based on the location ID)

Our Data is Trusted by Agencies & Institutes...



“It was found that there is a substantial forecast benefit from assimilating Spire Radio Occultation data”

[UK Met Office Study on Spire RO Impact](#)

...and the Industry



Combining accurate Weather with advanced Voyage Optimisation



Spire Weather
2,004 followers
3w · 🌐

We're happy to announce that we're partnering with [Theyr](#) to power their voyage optimization software.

"We are incredibly pleased to be working in close collaboration with Spire Global to continue enhancing our voyage performance AI technology with the most advanced weather data and Forecasting services," says [Peter Mantel](#), Chief Commercial Officer at Theyr.

Read more here → <https://bit.ly/3leM7ZZ>

[#spireweather](#) [#collaboration](#) [#weatherforecasting](#) [#maritimeindustry](#)

Theyr
460 followers
1mo · 🌐

[Spire](#) and [Theyr](#) announce a unique partnership for integrating weather data and distributing the T-VOS Weather and Voyage Optimisation engine. ...see more

Theyr **spire | weather**

17 February 2023

Spire Global to partner with Theyr and to provide Maritime Weather Data to Power the T-VOS Voyage Performance Optimisation Engine

[Spire Global](#), a leading global provider of space-based data, analytics and space services, have entered into a new partnership agreement with Theyr to provide global weather data sets to power Theyr's weather and voyage performance optimisation engine and to relicense the integrated solution.

Spire has the ultimate vantage point from space to collect global weather data through its constellation of over 100 satellites, reaching remote areas like the open oceans that have traditionally been difficult to gain insight into. Spire's unique weather observations, coupled with cutting-edge machine learning techniques to enhance the data, provides a reliable and accurate global weather forecast. This is especially important in the maritime industry, where ships may be confronted midway through their journeys with hazardous weather conditions that pose a threat to crew safety and can significantly delay their arrival.

Merging Spire's accurate weather insights into Theyr's AI-powered voyage optimisation software and high-quality meteocean data will give the maritime industry direct access to managing their resources more efficiently, optimising fuel, safety and ETAs. This integrated solution will deliver "unprecedented accuracy, reliability and availability" and will reshape the future of performance routing.

"We're happy to contribute to Theyr's vision of maritime innovation that will help build more sustainable shipping operations," said [Mike Ellis](#), General Manager of Weather and Earth Intelligence, Spire. "With 80% of our world's ocean remaining unmapped and unexplored, it's difficult to predict ocean weather through traditional, terrestrial-based methods. Our satellites, which scan all points across the globe from the remote regions to the vast oceans, fill a critical gap in collecting weather observations, allowing us to run proprietary models and produce best-in-class forecasts."

Peter Mantel, Chief Commercial Officer at Theyr, further comments, "We are incredibly pleased to work in close collaboration with Spire Global to continue enhancing our voyage performance AI technology with the most advanced weather data and Forecasting services."

- Ends -

Theyr Voyage Optimization System (T-VOS)



Genetic Algorithm

Growing consensus that Genetic Algorithms provide the most accurate optimisation outcomes

- Provide solutions across large search spaces
- Significant benefits over traditional optimisation methods (A*, Dijkstra, NN-based models)
- No training needed



Multi-objective Optimisation

Optimisation based on multiple parameters simultaneously

- Shortest duration, minimum fuel consumption, Time Charter Equivalent
- Provides multiple outcomes with different preferences (fixed speed, constant power, just in time arrival, ship model plug-ins)



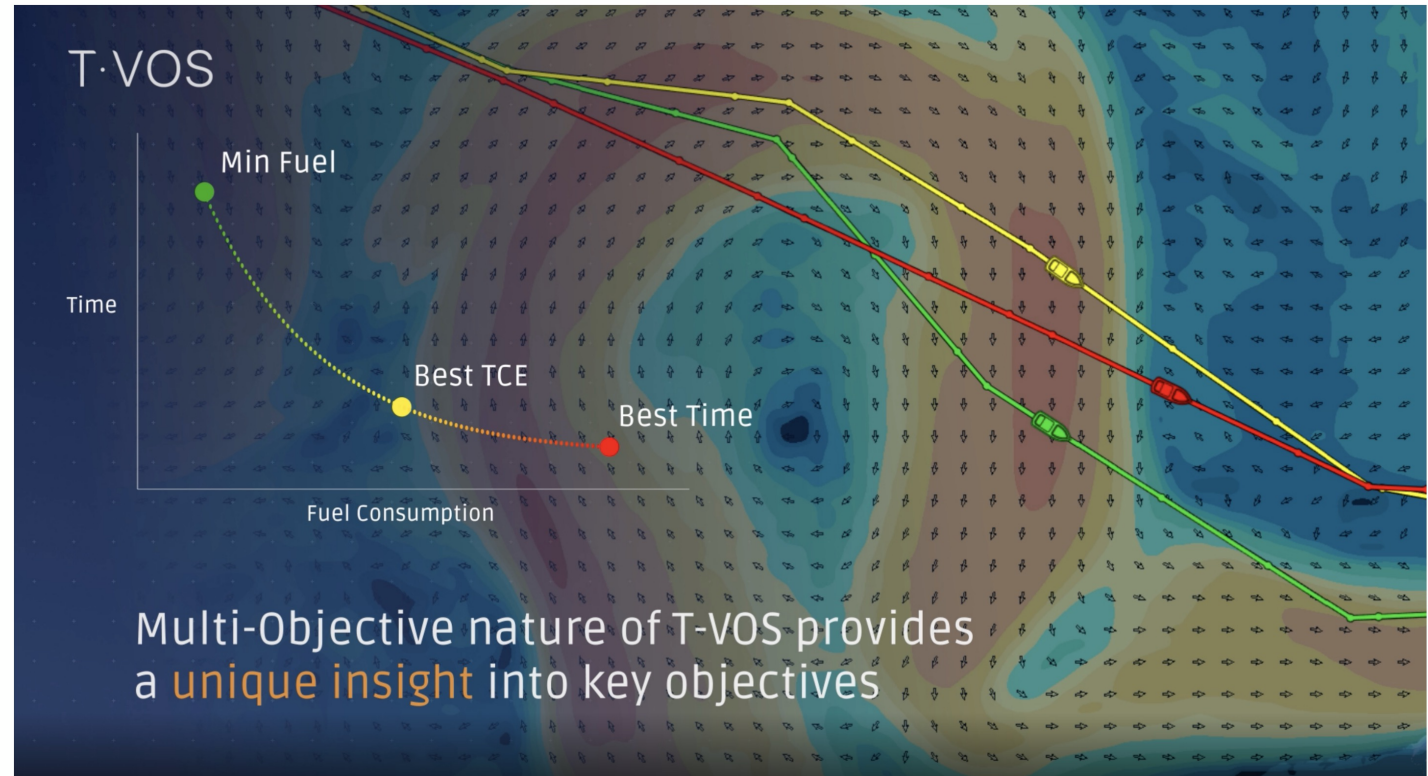
State-of-the Science

Developed in collaboration with renowned Research Partners

- University of Southampton
- The Alan Turing Institute
- Papers available on request

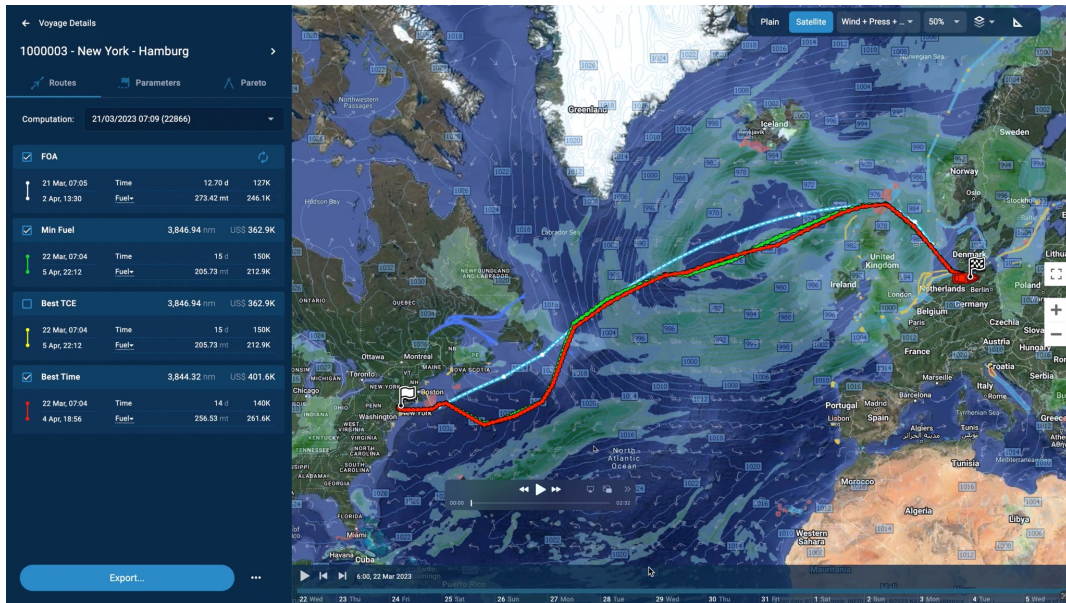
Spire's Ship Voyage Optimisation (powered by Theyr)

- Optimisation based on Spire weather and wave data
- Multiple voyage options are calculated simultaneously during the optimisation process.
- **Min Fuel** - Lowest fuel consumption
- **Best TCE** – Time Charter Equivalent
- **Best Time** - Optimal route in terms of voyage duration.
- Flexible Departure and Arrival Time Windows
- JITA – Just In Time arrival (JITA)
- Fixed Speed, RPM & Power
- CO2 Emissions
- Access to 1,000 voyage options



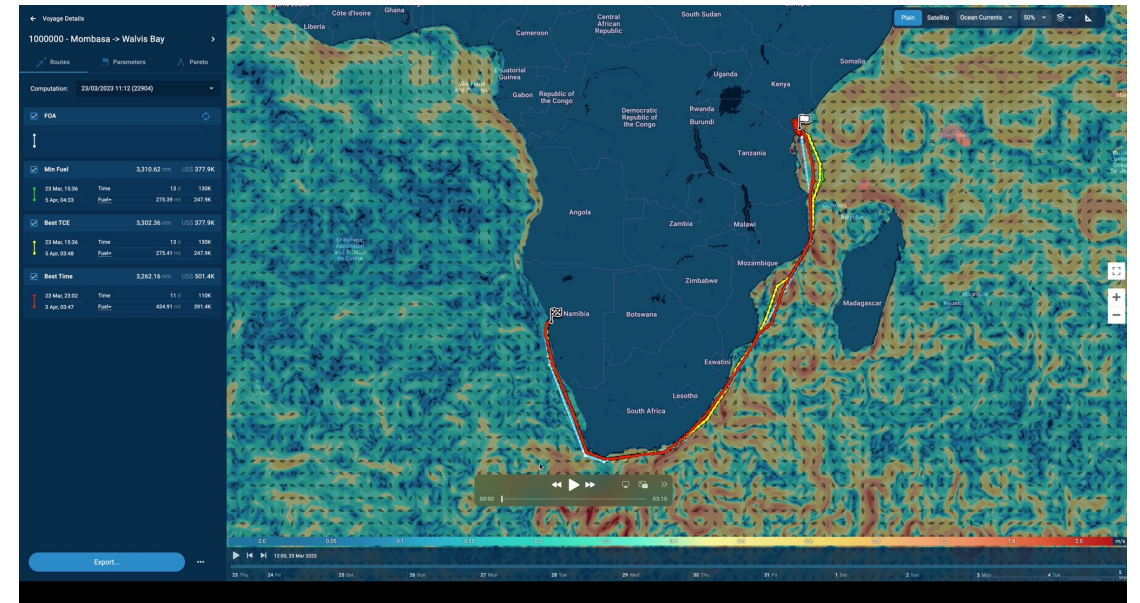
Optimisation Examples

New York – Hamburg



50 metric tonnes of fuel savings when optimising on minimum fuel.

Mombasa – Walvis Bay



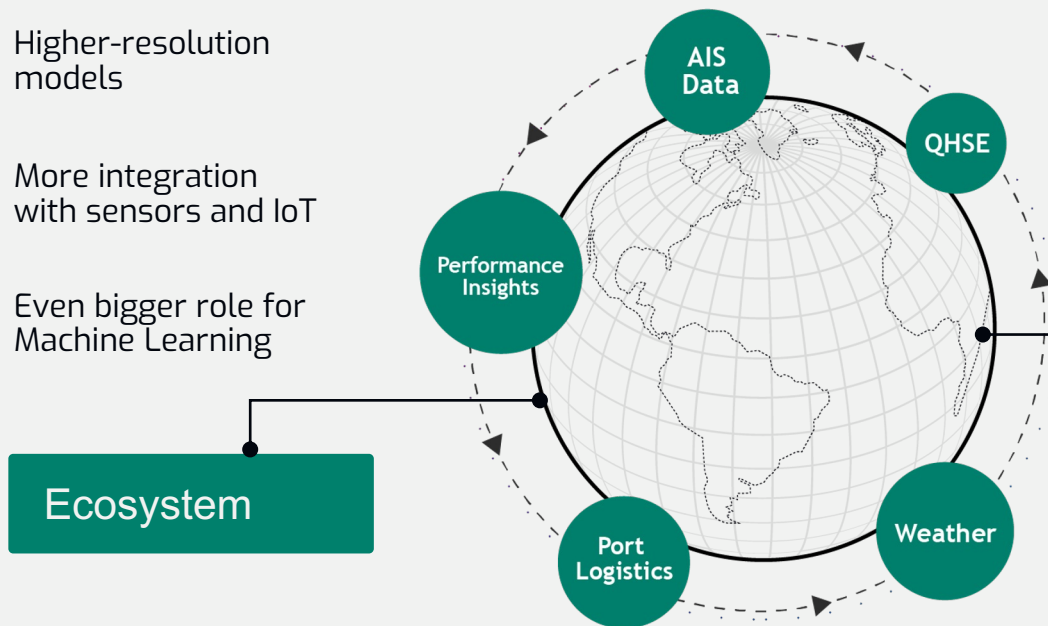
160 metric tonnes of fuel savings when optimising on minimum fuel.

Forecasting the Future

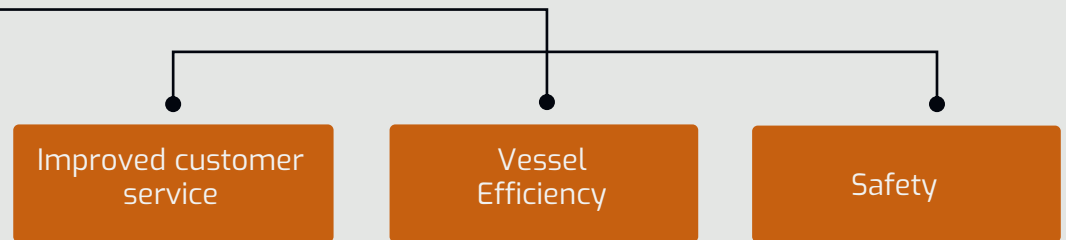
The continuing challenge to decarbonize the maritime industry will require continuous innovation to improve the Industry's capability to monitor and forecast the weather, ocean and other environmental conditions on route and in port.

The mission to meet the new CO2 targets, will require collaboration between all stakeholders in the maritime industry.

- Higher-resolution models
- More integration with sensors and IoT
- Even bigger role for Machine Learning



- More commercial remote sensing data (space, ocean)
- Increased processing capacity (from traditional servers to cloud processing)
- More probabilistic information



 spire | weather

Thank you!

From our team, to yours.

