AlbatrosDigital

Digital Ships for Design, Controls, and Monitoring
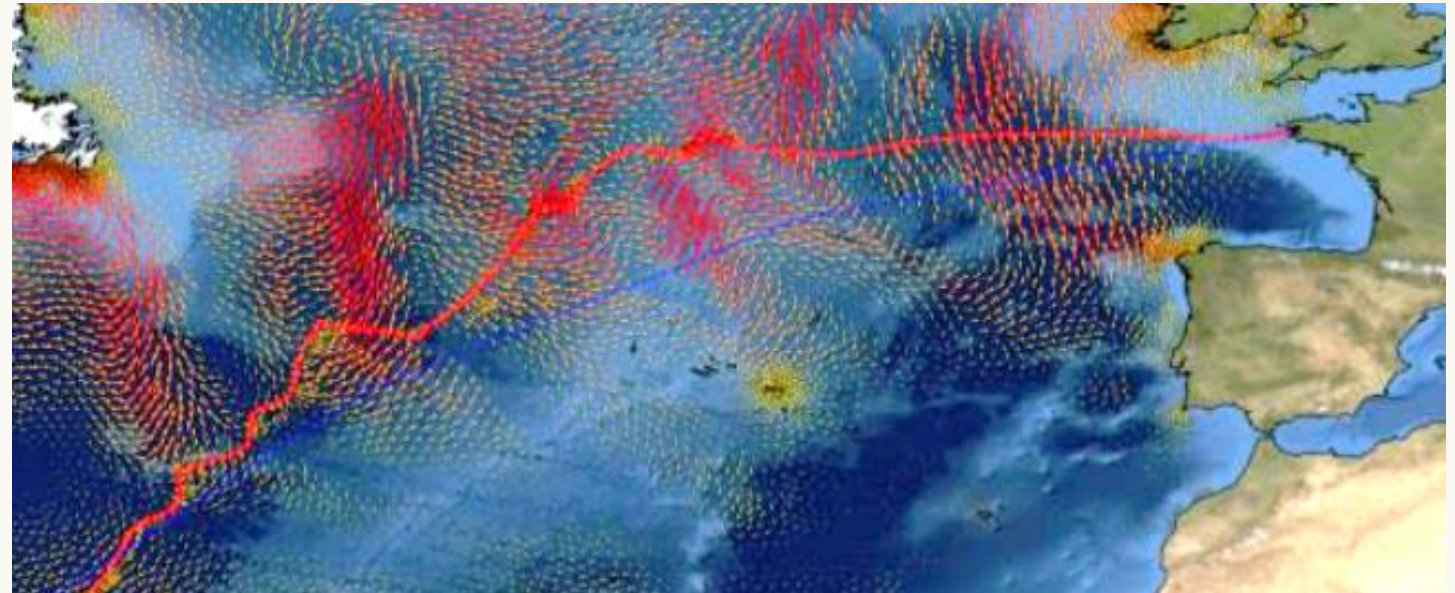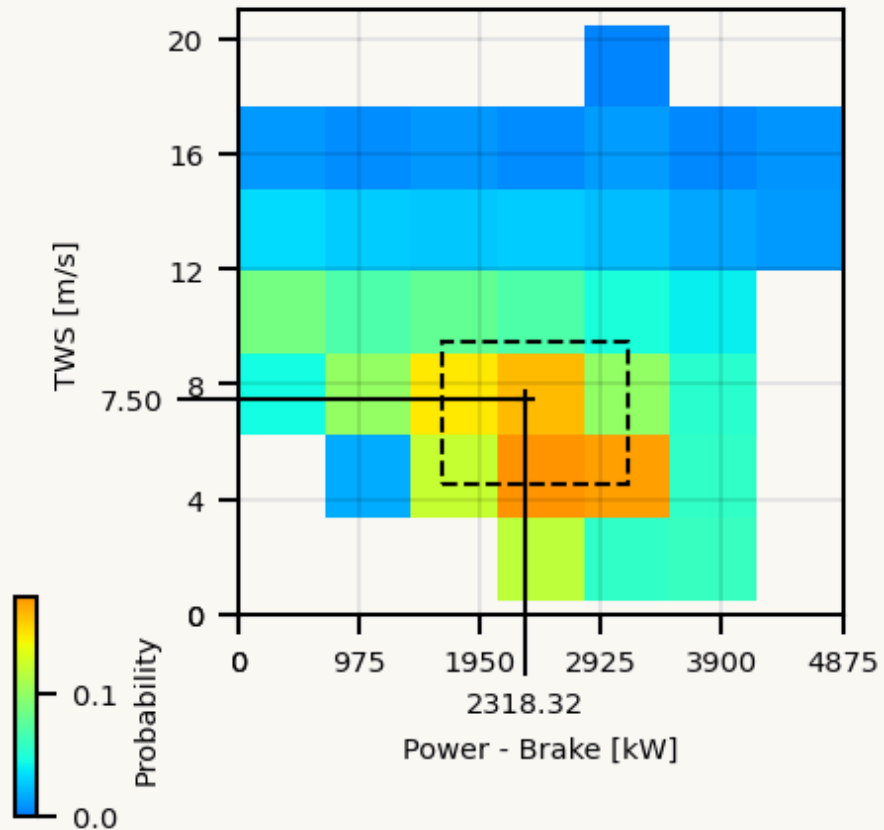
Portfolio

Design methodology with WPS

- A digital ship with wind/ weather dependent modeling

- Analysis on real operational profile with wind/ weather data
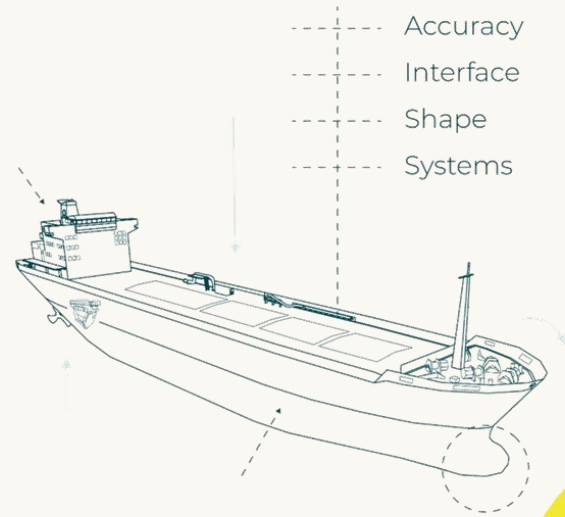
About AlbatrosDigital

- Authority and 15+ experience in ship modelling

- Build on PhD research

- 15+ published papers

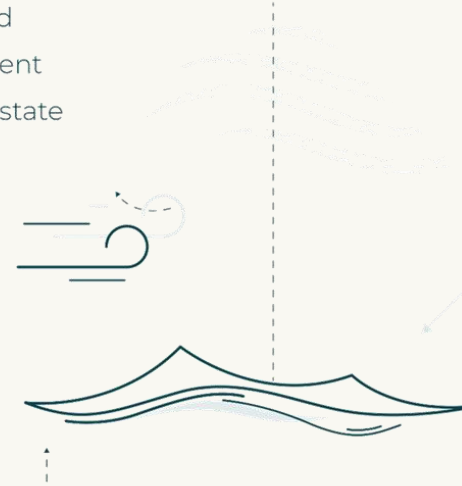- Fleetwide rollout for voyage optimization (600 ships)

AlbatrosDigital

Ship Characteristics

- Accuracy
- Interface
- Shape
- Systems

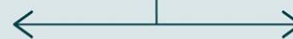**Environmental Parameters**

Wind
Current
Sea-state

AlbatrosDigital
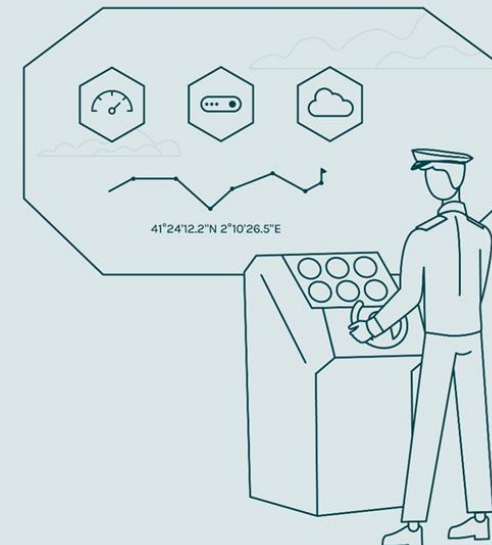
Physics-based
modelling Software

Predict fuel consumption
and ship behavior

Performance of energy
savings technologies

Monitoring and intelligent
control of operations

Ship Behavior

41°24'12.2"N 2°10'26.5"E

Fuel Consumption Prediction Software
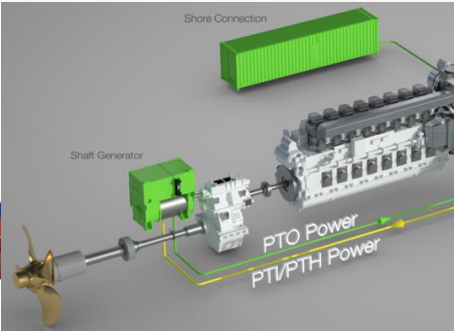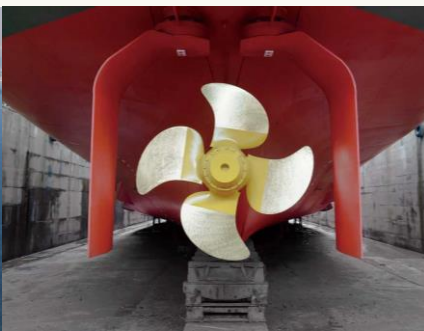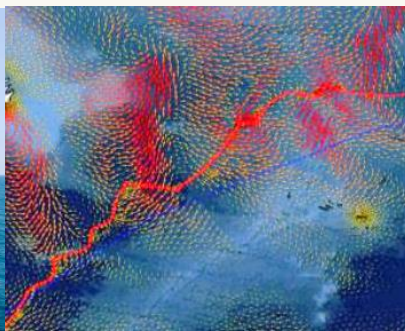
Physics-based ship models

From hull shape to engine type to energy savings device, we model a vessel with up to 95% accuracy.

Predict fuel consumption

Predict vessel behavior and fuel consumption for any sea state.

Refine with in-service data

Use monitoring data to refine and improve model predictions.

Combining Physics- and Data-modelling

- Lite modeling for seemingly complex systems.

  We aim for a data convergence between models and measurements: using measurement data to update specific parameters of the physical model while using the physics-based models to enrich and filter measurement data.

  Our machine learning model for wind assisted ship performance is central to the current simulation tool, enabling high fidelity at low cost.

- Extending beyond the limitations of data-driven modelling.

  Questionable data-quality: Sensors can malfunction, incentives of mariner and/or charter party are not always well aligned to be faithful when making noon reports and voyage records.

  Data is only available for existing ships; simulations can add new energy saving technologies and innovative vessel designs.

AlbatrosDigital

Applications

Voyage optimization

Detailed modelling of the ship's reaction to weather and sea state makes our models exceptionally well suited for voyage optimization applications
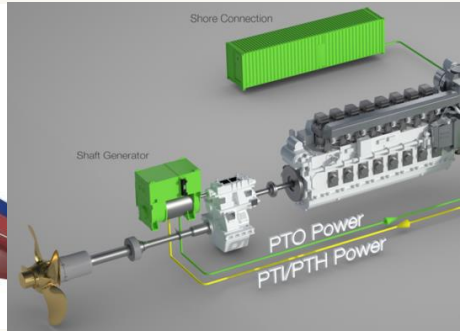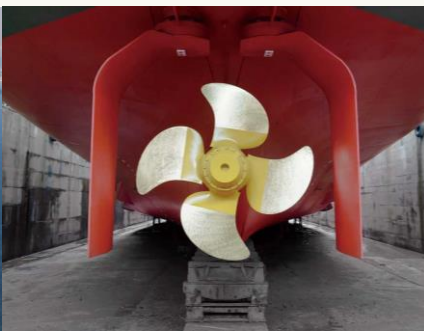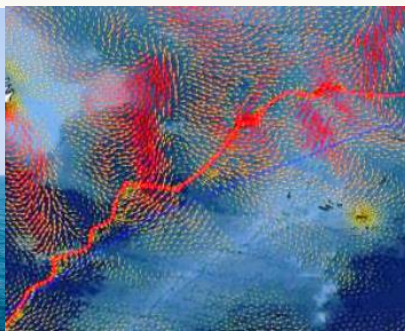
Energy Saving Technologies

Operate ships with installed EST's, then simulate an identical voyages without the EST's. Compare and calculate realized fuel savings

Carbon Intensity Indicator

Predict vessel fuel consumption and CO_2 emissions for compliance.

IMO Ref. Model validation

Comparison error for predicted fuel consumption on a voyage basis.

IMO Ref. Models built on IMO nr. + Engine specification (main particulars and CSR).
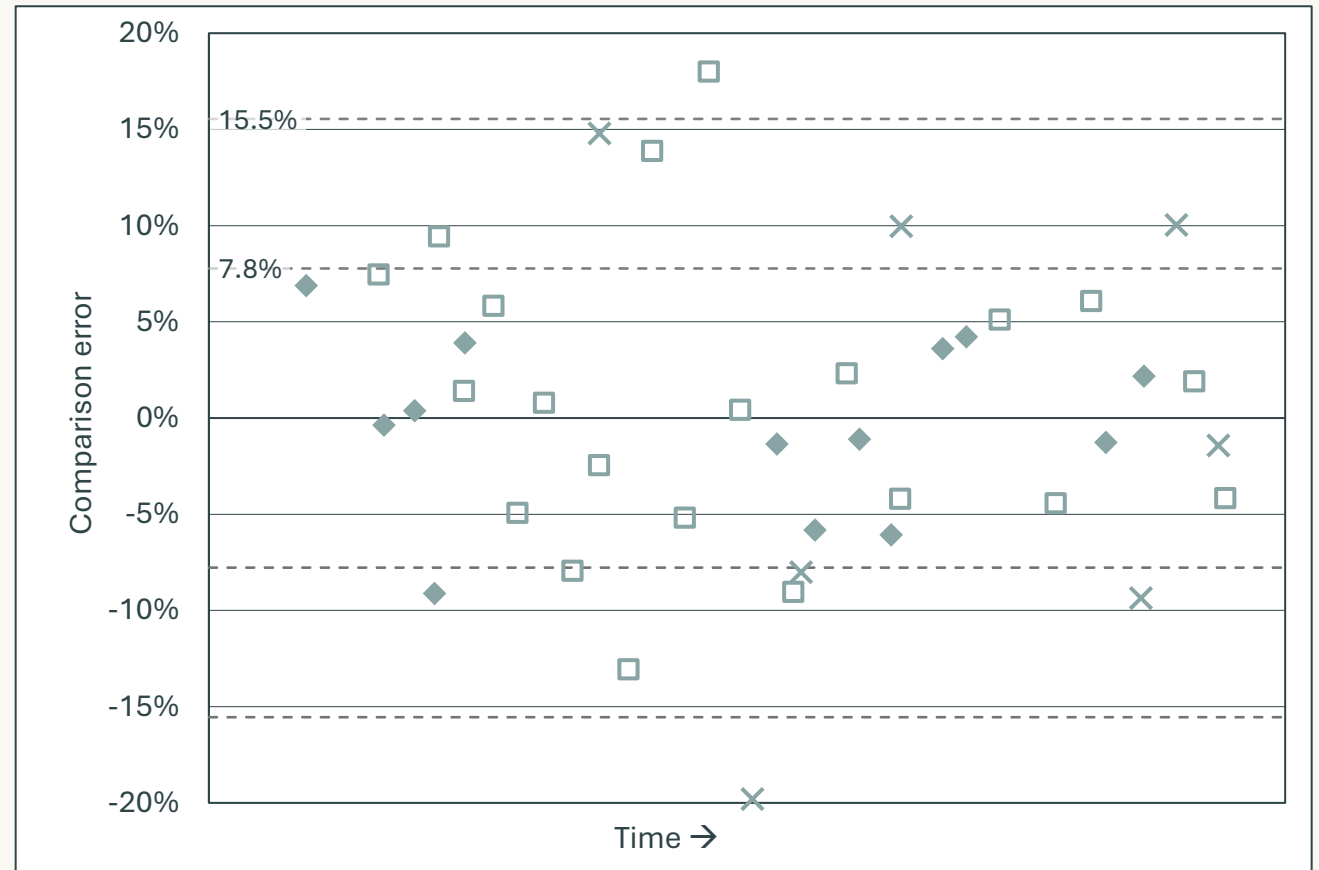
➤ 3 Ships:
  ➤ Capesize Bulker
  ➤ Container ship (4500 TEU)
  ➤ Suezmax Tanker

➤ 41 Voyages of the past year

➤ MAPE Average error of 8.7%

Further improvement with dynamic updates / monitoring data.
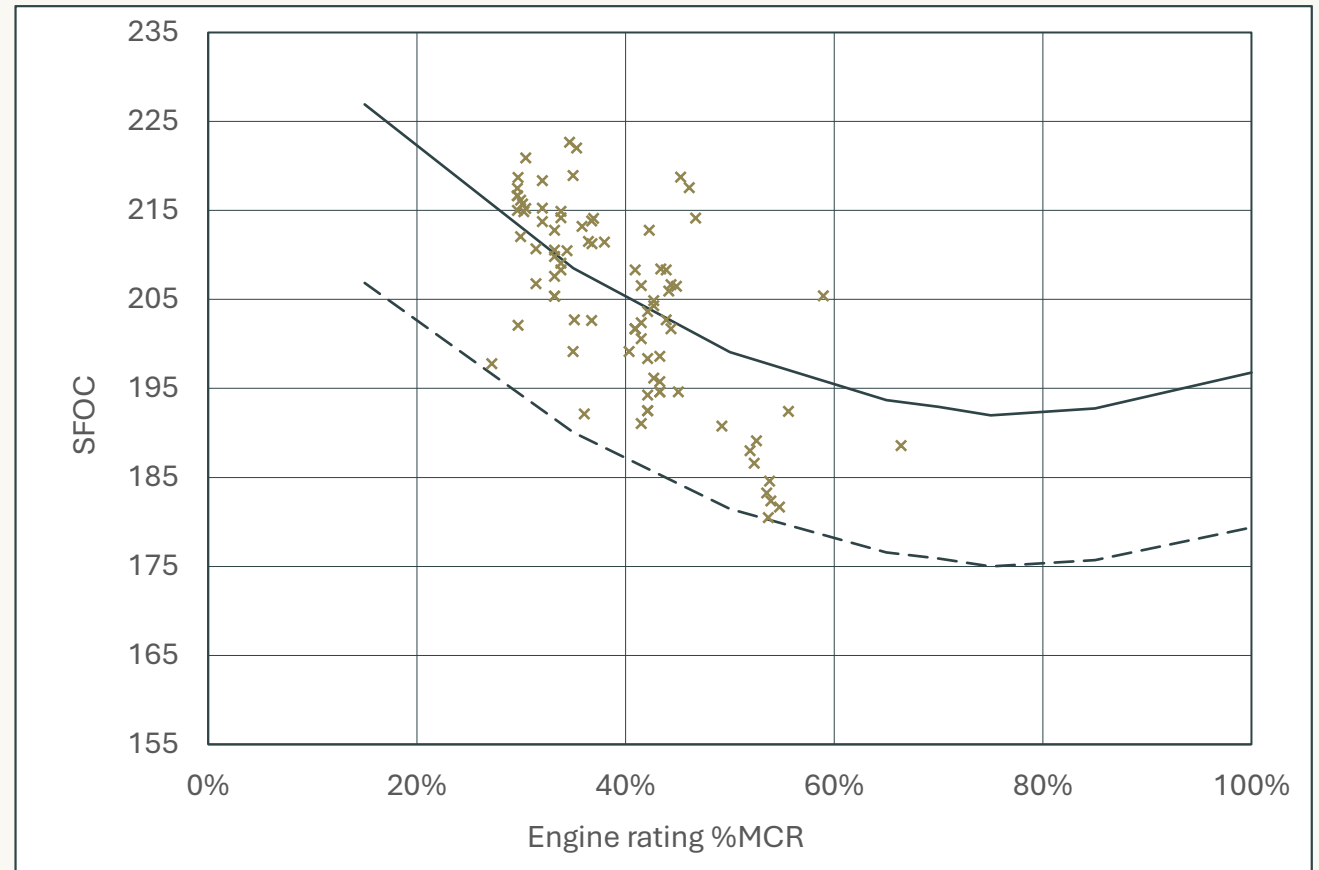

![AlbatrosDigital]

Dynamic Model update

Modern web-based infrastructure includes flexible integration with client data and/or services, including bespoke preconditioners and plug-ins available.

Fuel Margin

➤ Example: Noon-report data set used to update default SFOC map.

   ➤ An 9.7% penalty is imposed (solid line) compared to the original curve (dashed line) to better match the behavior in service.

   ➤ A custom SFOC map can also be imported from OEM spec sheet built directly from the monitoring data.

Similar options in other modules for user-provided data.


AlbatrosDigital

Dynamic Model update

Modern web-based infrastructure includes flexible integration with client data and/or services, including bespoke preconditioners and plug-ins available.
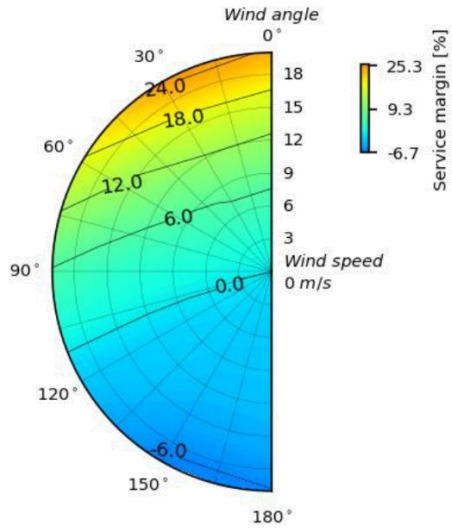
Fouling margin

➢ Example: Naïve fouling model using Hull cleaning / propeller polish datum.

    ➢ 20% default fouling replaced with linear model starting at HC/PP.

    ➢ Further elaboration of fouling model basis operational data under development with client
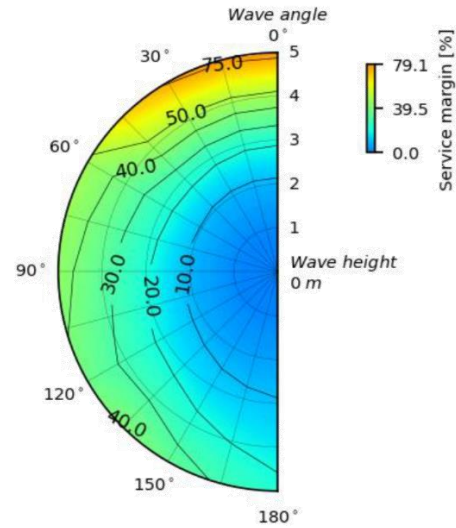
Similar options in other modules for user-provided data.

AlbatrosDigital
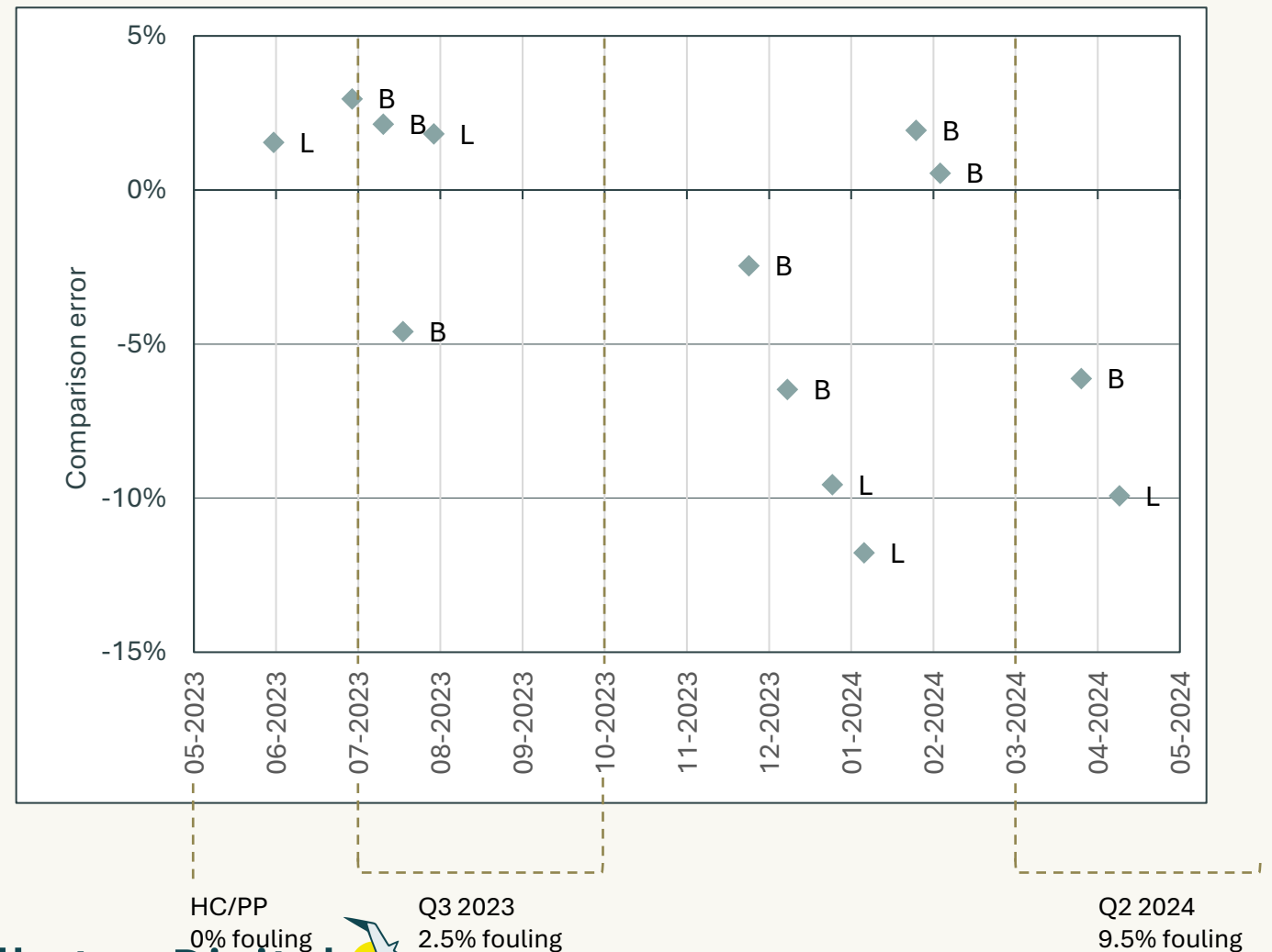
Example output

Service margin due to Windage

Service margin due to Sea-state

Design	Draft	Route	Speed [Kn]	Sailing time [days]	Fuel burn [t/d]	Fuel Savings [t/d]	Fuel Savings [%]	Fuel Savings Voyage [t]	CO2 Savings Voyage [t]
Ship A	Laden	Houston - Rotterdam	11.5	16.9	21.8	2.3	9.4	38.3	122.9
Ship A	Ballast	Houston - Rotterdam	13	15	18.7	4.7	20.2	75.3	241.3
Ship B	Laden	Houston - Rotterdam	11.5	16.9	23	1	4.3	17.7	56.8
Ship B	Ballast	Houston - Rotterdam	13	15	20.4	3	12.8	47.8	153.4

➢ Service margins
  ➢ Due to wind angle and direction
  ➢ Due to wave angle and direction

➢ Scenario design: Comparison of fuel/CO2 savings for configurations 'A' and 'B'
  ➢ Two wind-assist installations on a LR1 Tanker
  ➢ Route: From Houston to Rotterdam
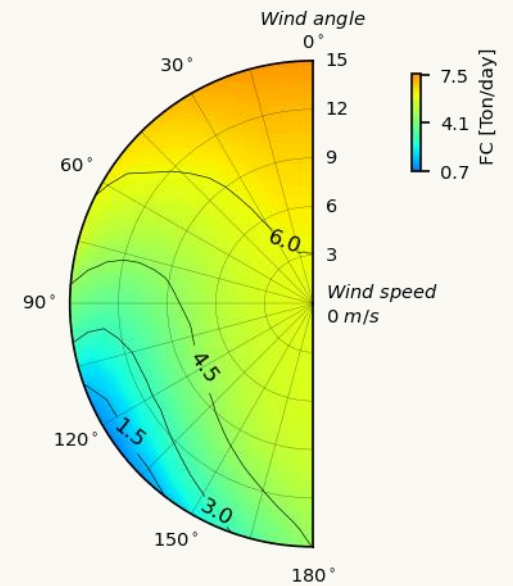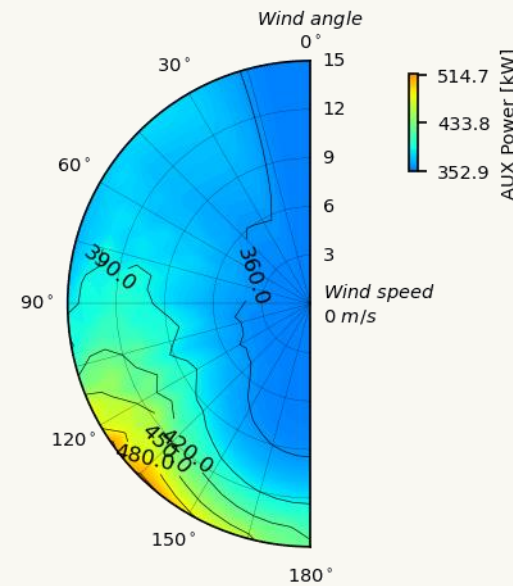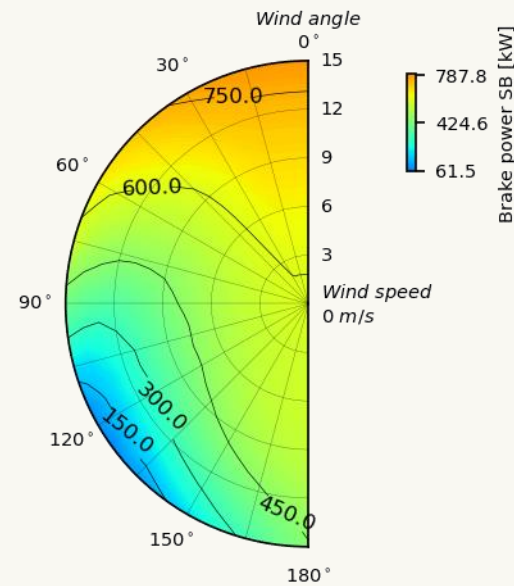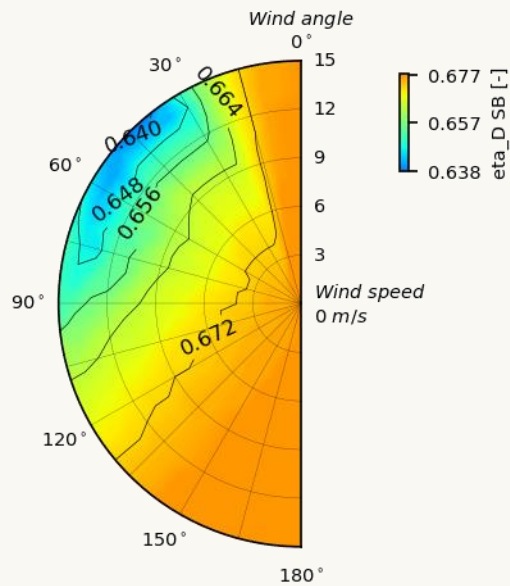 ➢ Based on long-term averaged weather data
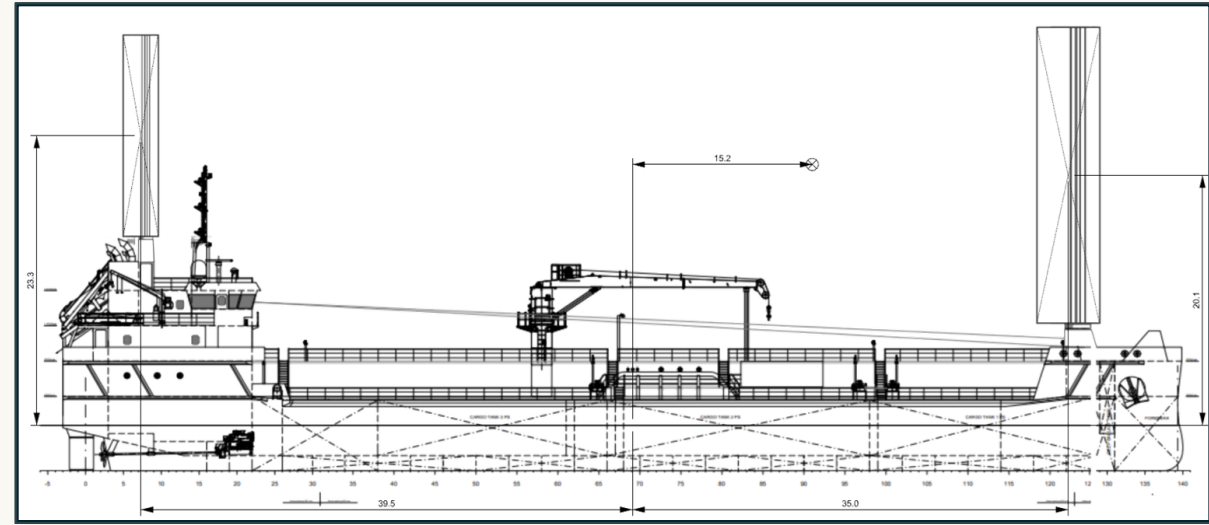
AlbatrosDigital

Example output

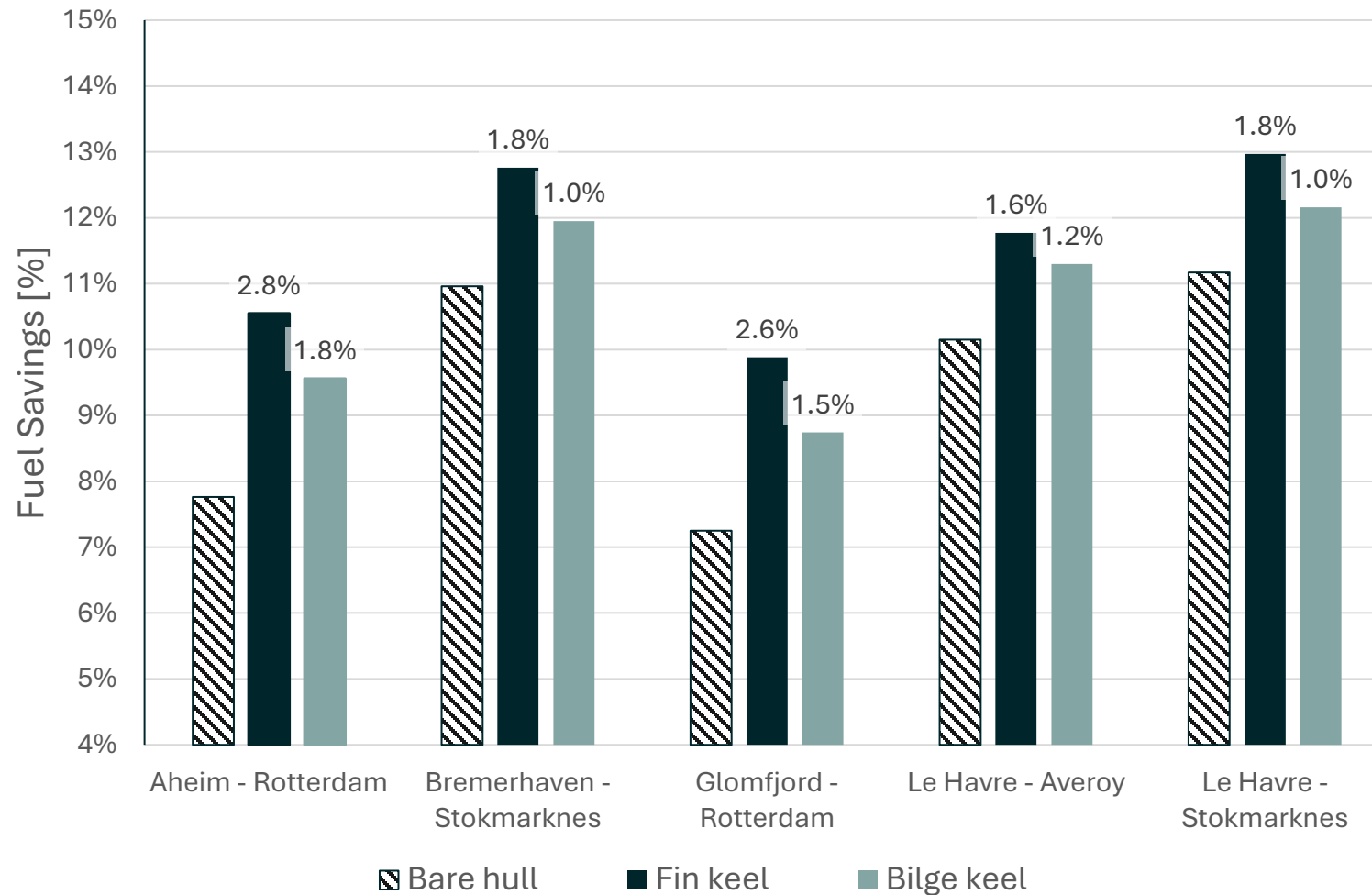- Vessel response: 4-dof solver
- Flexible simulation architecture
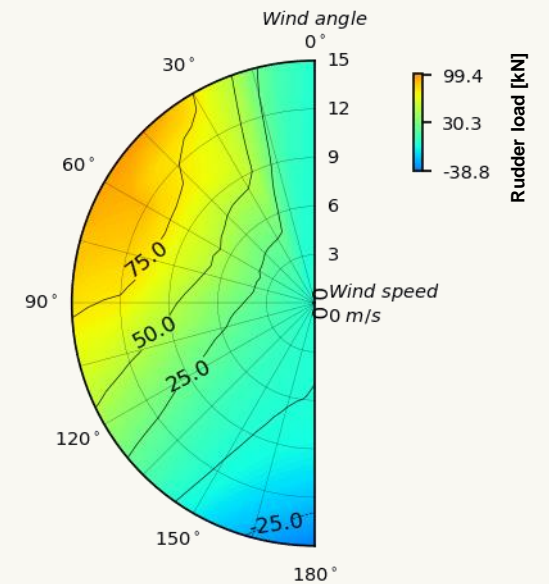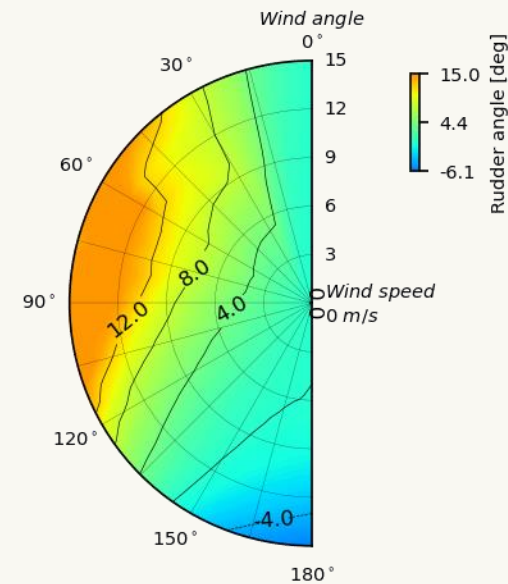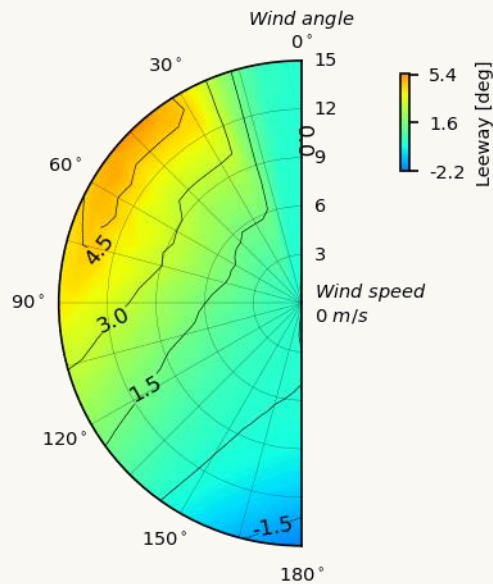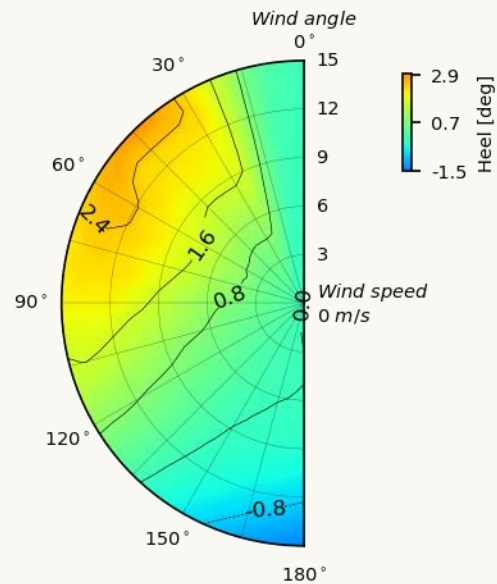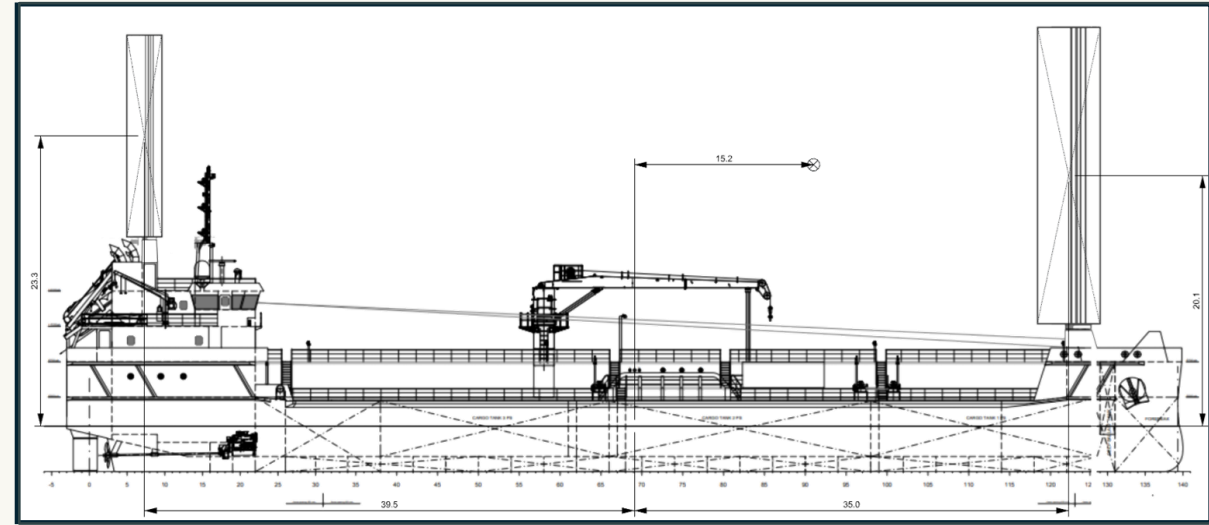
AlbatrosDigital

Vessel powering

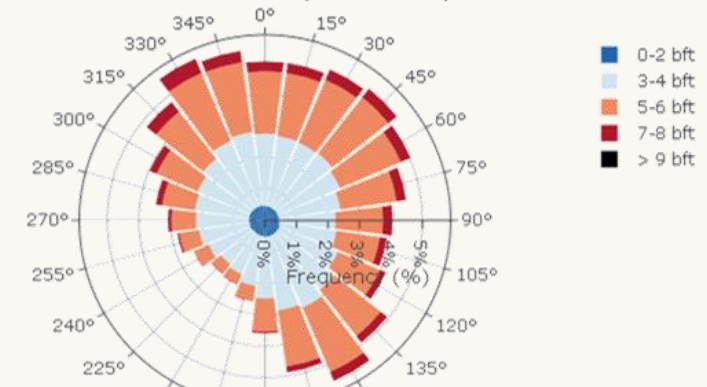- Custom propellor model
- Genset balancing, PTI/PTO, DE, Dual fuel

Route savings using wind-scatter data

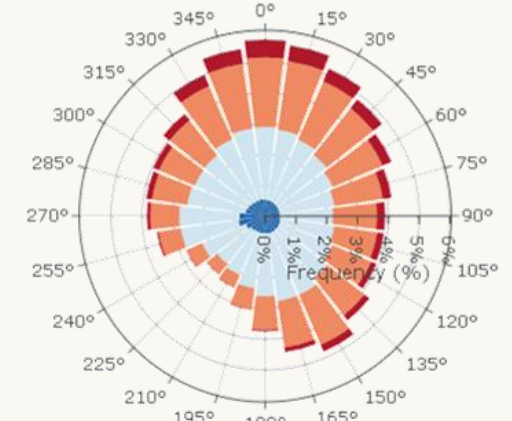Bar chart — Fuel Savings [%] by route:

- **Aheim - Rotterdam**: Bare hull 7.8%, Fin keel 10.6% (2.8%), Bilge keel 9.6% (1.8%)
- **Bremerhaven - Stokmarknes**: Bare hull 11.0%, Fin keel 12.8% (1.8%), Bilge keel 12.0% (1.0%)
- **Glomfjord - Rotterdam**: Bare hull 7.3%, Fin keel 9.9% (2.6%), Bilge keel 8.7% (1.5%)
- **Le Havre - Averoy**: Bare hull 10.2%, Fin keel 11.8% (1.6%), Bilge keel 11.3% (1.2%)
- **Le Havre - Stokmarknes**: Bare hull 11.2%, Fin keel 13.0% (1.8%), Bilge keel 12.2% (1.0%)

Legend: Bare hull, Fin keel, Bilge keel

Apparent Wind @ 0 kn ship speed
Source: ERA-5 (1989-2019)
https://blueroute.application.marin.nl

Legend: 0-2 bft, 3-4 bft, 5-6 bft, 7-8 bft, > 9 bft

Aheim - Rotterdam

Glomfjord - Rotterdam

AlbatrosDigital

AlbatrosDigital

Digital Ships for Design, Controls, and Monitoring

Contact: Dr. Nico van der Kolk   Website: albatros.digital
                 nico@albatros.digital