

Dublin Port 3FM Development

Navigation simulation study

Document information

Document permissions	Confidential - client
Project number	DJR6822
Project name	Dublin Port 3FM Development
Report title	Navigation simulation study
Report number	RT001
Release number	01-00
Report date	28 February 2023
Client	RPS
Client representative	Mark McConnell
Project manager	Jonathan Woodhams
Project director	Mark McBride

Document history

Date	Release	Prepared	Approved	Authorised	Notes
28 Feb 2023	01-00	ATU	JWO	MMCB	Released with summary conclusions

Document authorisation

Prepared	Approved	Authorised
Ashley Tuton	Jonathan Woodhams	Mark McBride

© HR Wallingford Ltd

This report has been prepared for HR Wallingford's client and not for any other person. Only our client should rely upon the contents of this report and any methods or results which are contained within it and then only for the purposes for which the report was originally prepared. We accept no liability for any loss or damage suffered by any person who has relied on the contents of this report, other than our client.

This report may contain material or information obtained from other people. We accept no liability for any loss or damage suffered by any person, including our client, as a result of any error or inaccuracy in third party material or information which is included within this report.

To the extent that this report contains information or material which is the output of general research it should not be relied upon by any person, including our client, for a specific purpose. If you are not HR Wallingford's client and you wish to use the information or material in this report for a specific purpose, you should contact us for advice.

Contents

1	Introduction	5
2	Port configuration	5
3	Simulator configuration	6
3.1	Simulated layout	6
3.2	Environmental conditions	7
3.2.1	Wind conditions	7
3.2.2	Currents	8
3.2.3	Bathymetry and water depths	8
3.2.4	Wave conditions	8
3.2.5	Visibility and light levels.....	8
3.3	Visual scene.....	8
4	Design ships	9
5	Navigation simulation	12
5.1	Simulation sessions	12
5.2	Simulation runs	12
5.3	Grading of runs.....	13
5.4	Presentation of results.....	13
5.4.1	Simulation run summary.....	14
5.4.2	Simulation track and data plots	14
6	Conclusions and recommendations	22
6.1	3FM manoeuvring area	22
6.2	Unified Ferry Terminal	22
6.3	New South Bank Container Terminal	22
6.4	NORA Oil Berth.....	23
6.5	Berth 46 / 47	23
6.6	Berths 44 and 45	23
6.7	Channel occupancy	23
6.8	Training and familiarisation.....	24
6.9	Tug fleet	24

Appendices

- A Ship and tug simulation at HR Wallingford**
- B Simulation track and data plots**

Tables

Table 4.1:	Simulated tug response delay times.....	10
Table 4.2:	Ship Characteristics.....	11
Table 5.1:	Simulation run summary for Session 1	15
Table 5.2:	Simulation run summary for Session 2	19

Figures

Figure 2.1: Dublin Port 3FM masterplan layout	6
Figure 3.1: Modelled 3FM layout (including previous MP2 configuration).....	7
Figure 3.2: Wind rose at Dublin Airport	7
Figure 3.3: Modelled tidal cycle.....	8
Figure 3.4: Example visual scene from simulation	9
Figure 4.1: Degradation of tug power with speed.....	10

1 Introduction

As part of the 3FM project at Dublin Port, Dublin Port Company (DPC) are planning to develop a container terminal at the location of Berth 48, develop two new RoRo berths at Berth 44 and 45, along with providing a turning circle adjacent to Berth 49.

In order to assess the navigational aspects, a navigation simulation study was required. The aim of this study was to formally assess the proposed developments to ensure safe ship navigation.

The navigation simulation study that was carried out is described in this report.

2 Port configuration

DPC are planning new developments that comprise a container terminal at the present location of the NORA oil berth (Berth 48) will provide 650 m of berth length for container ships up to 250 m in length. Dolphin structures and loading arms on the eastern end of the terminal will allow NORA oil tankers to continue to call at the berth.

A dual linkspan will also be installed at the location of the existing Berths 42 to 45 to provide two RoRo berths for ships up to 235 m in length. The “Nib”, a small structure perpendicular to the berthing line at eastern end of Berth 45, is expected to be removed.

The existing Sludge Jetty between the existing Berth 47 to the west, and the proposed New South Bank Container Terminal to the east, includes two dolphins on which tern colonies are known to nest. These are, or are likely to be, protected structures. Whilst these structures limit the development on the south side of the river, it provides an area in which ships can manoeuvre to and from existing and proposed berths. This will include a 325 m diameter turning circle, dredged to the same depth as the main channel, at -10 mCD. Sheet piling and slope stability structures are to be in place on the southern side.

The proposed layout is shown in Figure 2.1.

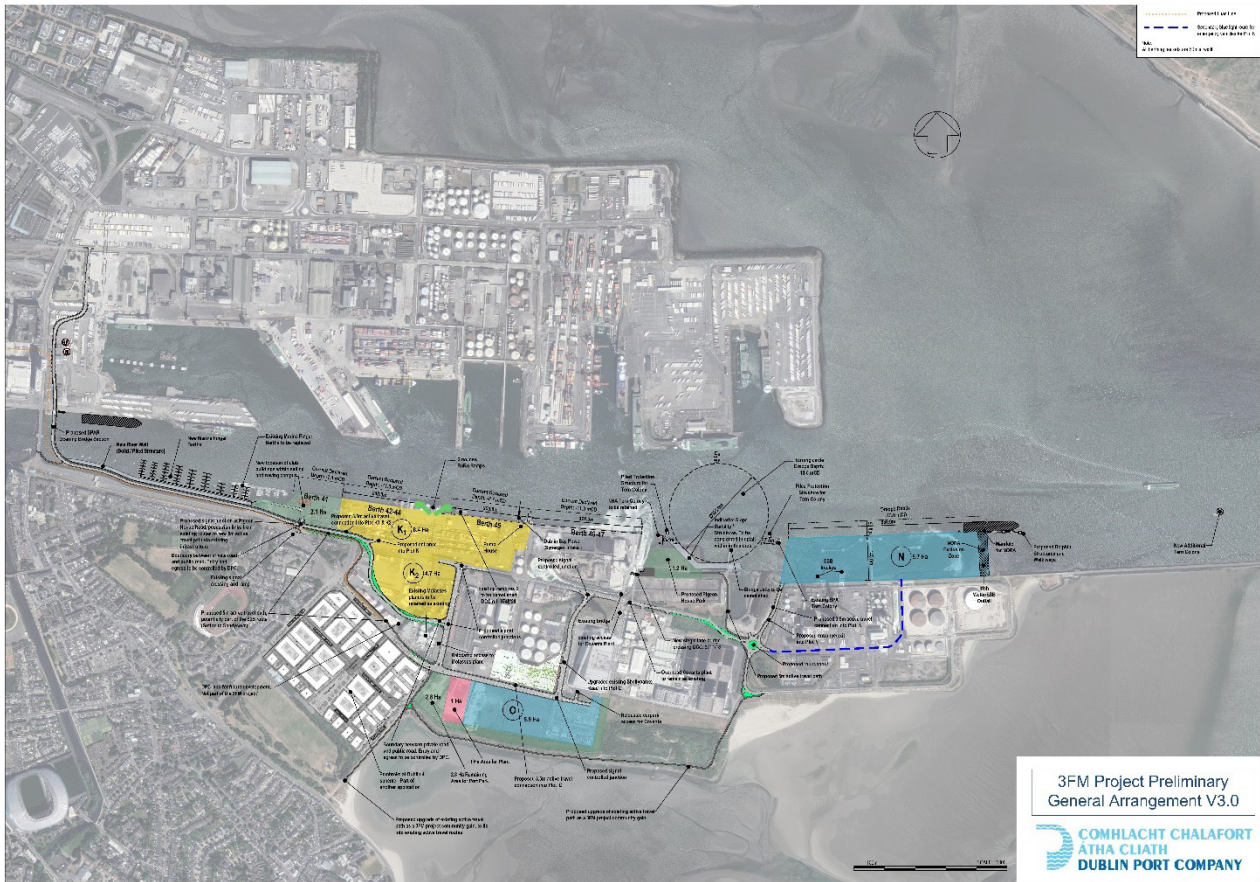


Figure 2.1: Dublin Port 3FM masterplan layout

Source: 3FM Project Prelim GA V3.0 2022-2-4, Dublin Port Company (Received 04/11/2023)

3 Simulator configuration

3.1 Simulated layout

HR Wallingford’s existing simulation configuration of Dublin Port was revised to feature the proposed 3FM layout. This includes the proposed RoRo Berths 49, 52 and 53 on the north side of the channel and RoRo Berths 44 and 45, the new Container terminal and the NORA oil berth on the south side of the river.

The simulated configuration is shown in Figure 3.1.

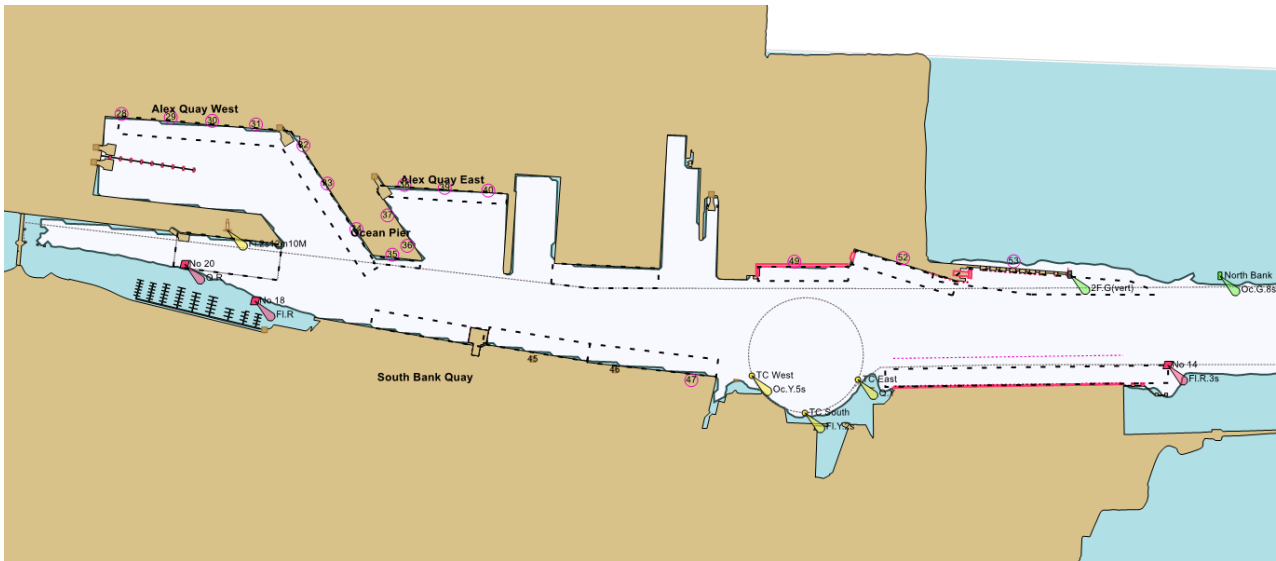


Figure 3.1: Modelled 3FM layout (including previous MP2 configuration)

Source: HR Wallingford's Ship Simulation System

3.2 Environmental conditions

3.2.1 Wind conditions

The wind speeds and directions used in each simulation run were determined in discussion with the Simulation Team prior to each run, and using a wind rose for Dublin Airport, as presented in Figure 3.2. The wind speeds were based on a measured elevation of 10 m above sea level and were scaled appropriately based on the ship characteristics. No wind sheltering was considered as part of the simulation and so the wind speed represented was that experienced at the ship. When the winds were considered as gusting they were based on an hourly mean between the two wind speeds stated (Section 5.4.1). A range of common and navigationally challenging wind directions were considered during the simulation runs.

Windrose Dublin Apt 1-Jan-1942 to 31-Dec-2014

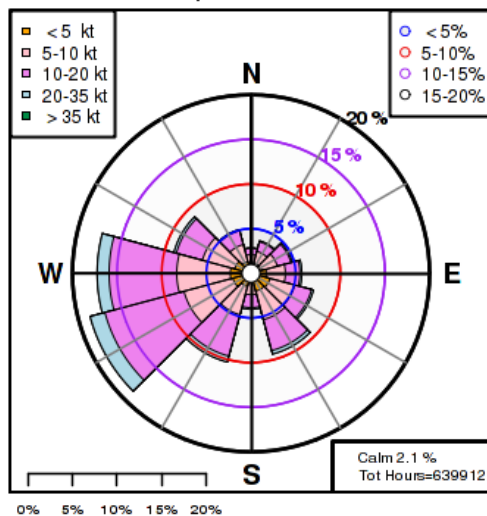


Figure 3.2: Wind rose at Dublin Airport

Source: <https://www.met.ie/climate-ireland/wind.asp#>

3.2.2 Currents

The currents within the Dublin Port simulation were based on outputs from the updated RPS Group numerical flow model of the proposed port layout. This flow model included both fluvial and tidal currents.

Currents associated with a full tidal cycle (from low water to high water to low water) for a tide with a 4.2 m range were available in the simulation (see Figure 3.3). This represented a large spring tide (mean spring tidal range is 3.4 m). Current speeds were depth averaged through the water column.

In the simulation runs, the tidal conditions were selected based on the wind conditions and proposed manoeuvre, to model the most challenging conditions.

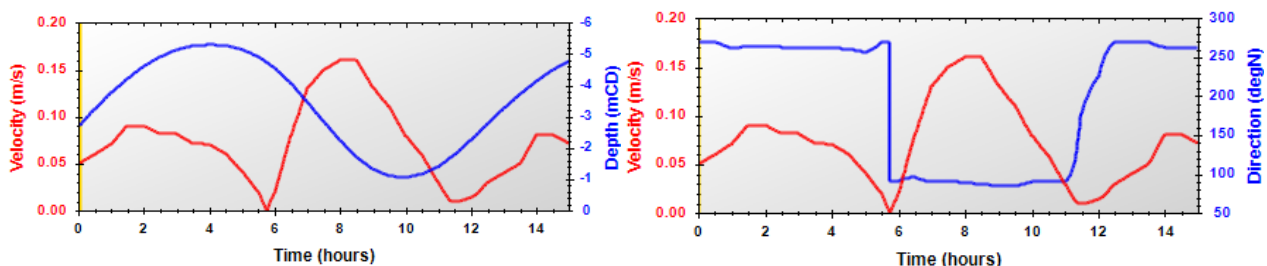


Figure 3.3: Modelled tidal cycle

Source: HR Wallingford's Ship Simulator

3.2.3 Bathymetry and water depths

The base bathymetry included in the Dublin Port simulation configuration was based on the bathymetry (survey) data embedded within the RPS Group numerical flow model of the proposed port layout. This represents the proposed channel depth at the port. Further dredging of berth pockets and the proposed manoeuvring area were added separately.

3.2.4 Wave conditions

Wave conditions within the port were not expected to impact ship navigation or manoeuvring significantly and therefore, the effect of waves was not included in the simulation.

3.2.5 Visibility and light levels

All of the simulation runs were conducted in daylight and good visibility.

3.3 Visual scene

A realistic visual scene is a critical aspect of the simulation, as it provides the pilot with important visual cues which are used in manoeuvring the ship. The visual scene was created using local photographs, drone footage, satellite imagery and other public domain imagery.

An example screenshot of the simulation is shown in Figure 3.4.

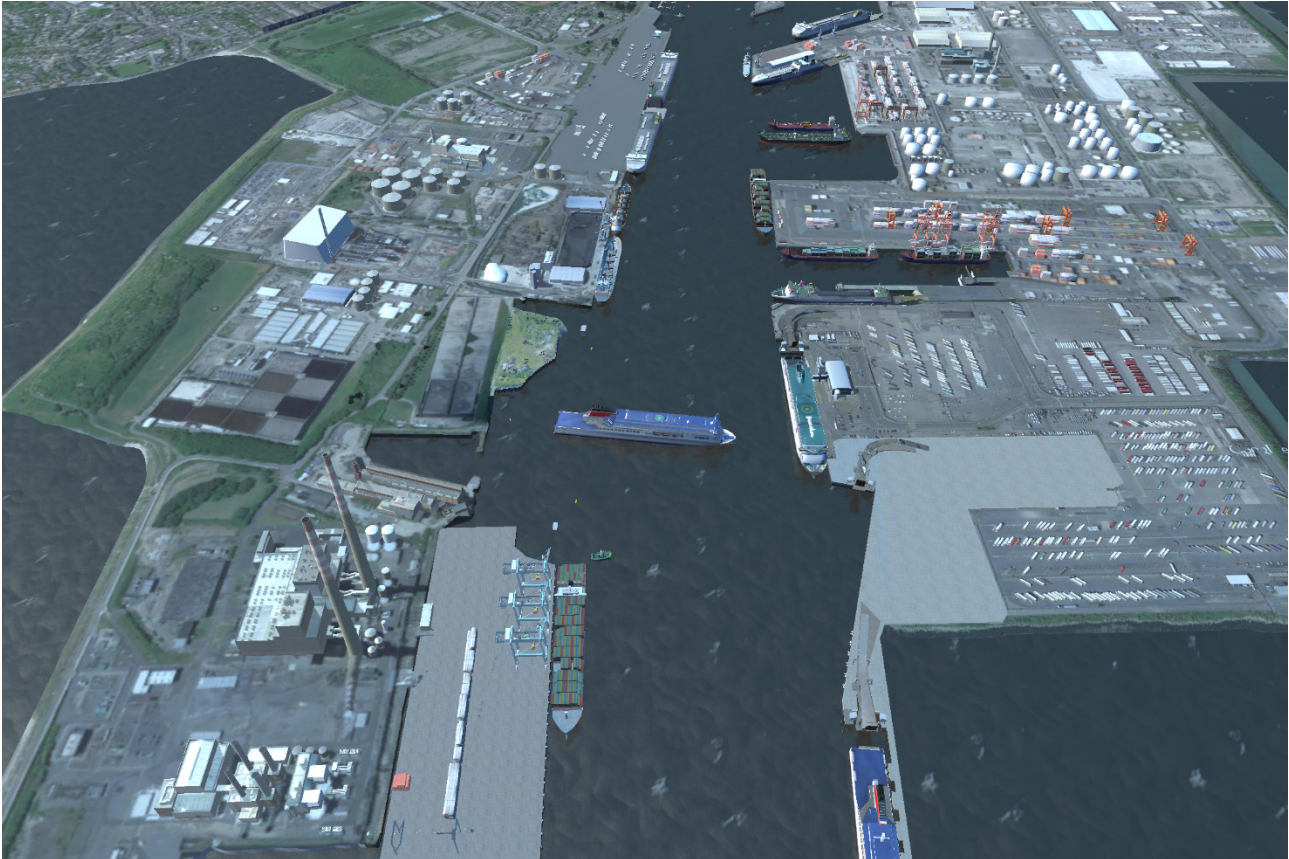


Figure 3.4: Example visual scene from simulation

Source: HR Wallingford's Ship Simulator

4 Design ships

A range of ships were selected for the simulation study based on the range of ships expected to call at proposed and existing berth as part of the 3FM development. The following design ships were considered during the simulation sessions, with further details provided in Table 4.1:

- RoPax:
 - 240 m long RoPax based on Stena Britannica (twin screw, 80 t bow thruster);
 - 240 m long RoPax 'Future Ferry' based on specification for Ulysses (twin screw, 123 t bow thruster, 41 t stern thruster).
- RoRo:
 - 235 m long RoRo based on MV Celine (single screw, 69 t bow thruster, 63 t stern thruster).
- Container ships:
 - 250 m long container ship (single screw at 10.5 m draught, 23 t bow thruster, 17 t stern thruster);
 - 148 m long container ship (single screw at 7.0 m draught, 10 t stern thruster, 10 t bow thruster).
- Tanker:
 - 185 m long tanker (single screw at 7.0 and 10.5 m draughts, 10 t bow thruster).
- Bulk carrier:
 - 185 m long bulker (single screw at 8.0 m and 11.0 m draughts, no thrusters).

- Tugs:
 - The tugs were centrally controlled tugs representing the existing harbour tugs Beaufort and Shackleton, which are both 24 m long 50 tBP VSP tugs. The centrally controlled tugs were controlled by the Simulator Operator, following the pilot’s commands. These were subject to realistic delays, as outlined in Table 4.1, when manoeuvring or connecting to the ship. The tugs in the simulation had their effectiveness realistically degraded by the speed through the water at which they will be required to operate. The degradation of the tug effectiveness is shown in Figure 4.1.

Table 4.1: Simulated tug response delay times

Tug Response Delay			Delay
Time to attach and secure			5 minutes
Time to react to new thrust level command			1 minute
Time to react to change in thrust level			20 seconds
Time to change thrust direction	Direct	up to 90°	Up to 1 minute
		90 to 180°	Up to 2 minutes
	Indirect	Roll into assist	Up to 30 seconds
		quarter to quarter	Up to 1 minute
Time to Detach	Push/pull mode		1 minute
	Working on line		3 minutes

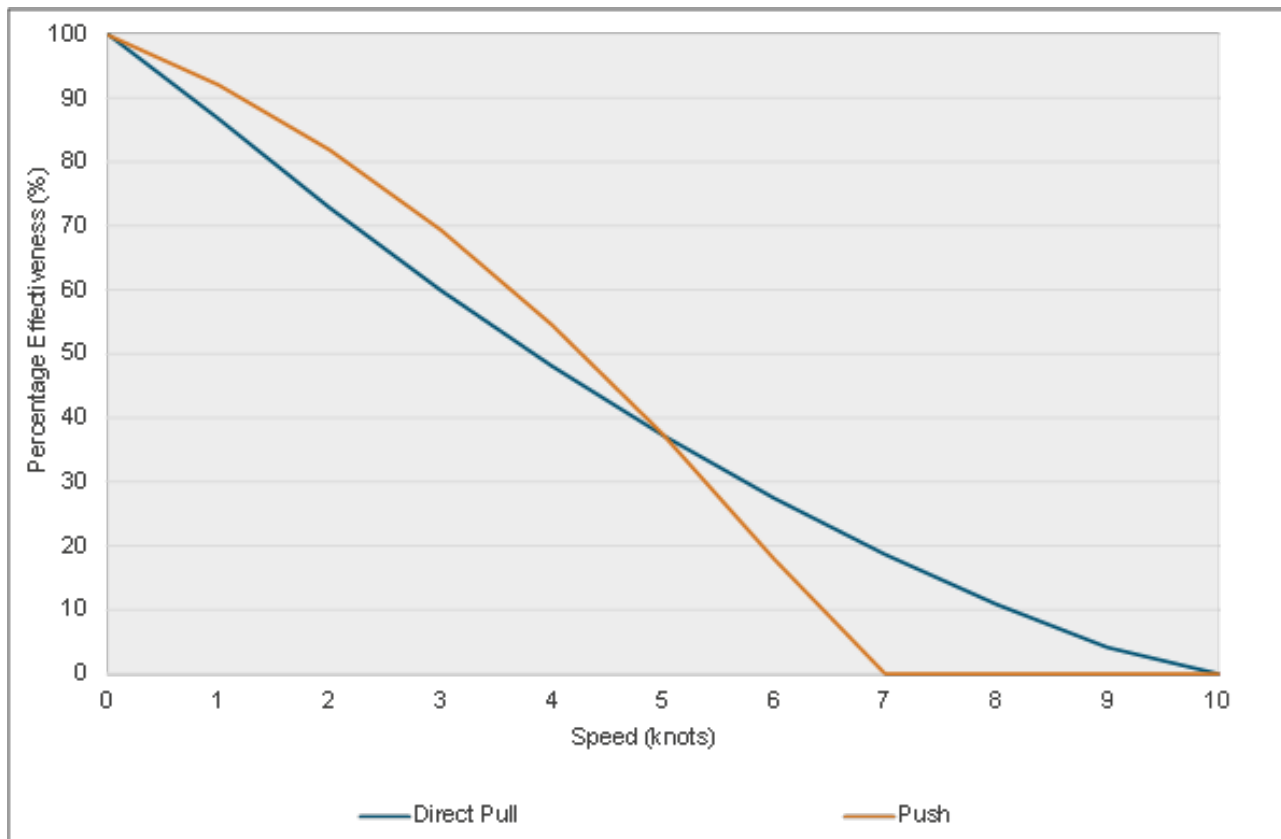


Figure 4.1: Degradation of tug power with speed

Table 4.2: Ship Characteristics

Name	Stena Britannica	Future ferry	MV Celine	250 m container ship	148 m Container ship	185 m tanker	185 m bulk carrier
Type	RoPax	RoPax	RoRo	Container	Container	Tanker	Bulk carrier
Characteristic							
Length overall (m)	240	240	234	249.12	148	185	185
Length between perpendiculars (m)	224	223.4	226	235	140.3	176	180
Beam (m)	32	32	35	37.4	23.25	32.2	32.2
Draught (m)	6.4	6.4	7.51	10.5	7	7 / 10.5	45238
Distance bridge to stern (m)	216	216	216	59.9	14.035	34.5	31.7
Block coefficient	0.716	0.696	0.7714	0.66	0.68	0.83	0.8
Displacement (t)	34,000	32,000	47,000	62,400	15,900	337,00 / 50,900	38,000 / 52,900
Propulsion							
Main engine type	MAN BW Diesel x4	4 x CAT MAK 9M43	MAN BW 9L60ME	MAN BW 6S80ME-C9	Slow Speed Diesel	Slow Speed Diesel	Slow Speed Diesel
Engine power (total) (kW)	33,600	31,200	21,060	23,000	8,206	7,460	10,000
Number of propellers and type	2 x CPP	2 x CPP	1 x CPP	1 x fixed pitch	1 x CPP	1 x fixed pitch	1 x fixed pitch
Bow thruster(s) (t)	80	123	69	23	10	10	none
Stern thruster(s) (t)	none	41	62.5	17	10	none	none
Rudder type	Becker flap	Flapped	Flapped	Standard	Semi-balanced	Semi-balanced	Standard
Rudder angle (max) (degrees)	45	45	45	35	35	35	35
Engine order							
	Manoeuvring speeds (RPM/Pitch) (knots)						
Full Ahead	(100) 22	(100) 20.7	(100) 19.6	(47) 14.3	(100) 14.4	(100) 12.8 / 12.5	(85) 13.5 / 12.5
STOP	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0
Full Astern	(100) -11	(100) -13.5	(100) -13.7	(-47) -9.3	(100) -9.2	(100) -8.8 / -8.5	(-65) -8.8 / -8
Windage							
Windage lateral (m ²)	6,523	6,504	6,791.75	6,341	2,350	3,115 / 2,475	3,154 / 2,599
Windage frontal (m ²)	876	1,048	1,214.5	1,288	513	679 / 567	672 / 576
	Wind speed (knots)	Beam wind forces (t)					
	15	24	24	25	23	9	11 / 9
	20	42	42	44	41	15	20 / 16
	25	66	66	69	64	24	32 / 25
	30	95	95	99	92	34	45 / 36

5 Navigation simulation

5.1 Simulation sessions

The study was supported by two navigation simulation sessions at HR Wallingford's UK Ship Simulation Centre in Wallingford, Oxfordshire. The first session was held over 3 days between 9th and 11th January 2023, and the second session was held over a further 3 days from 25th to 27th January 2023.

The following personnel attended the simulation sessions, and so formed the Simulation Team in each case:

Session 1: Monday 9th – Wednesday 11th January 2023

- Capt Michael McKenna Harbour Master, Dublin Port;
- Capt Maurice Mahon Pilot, Dublin Port;
- Sean Reilly Programme Management Office, Dublin Port;
- Mark McConnell Director of Maritime Infrastructure and Ocean Energy, RPS;
- Capt Ian Love Pilot, HR Wallingford;
- Jonathan Woodhams Project Manager, HR Wallingford;
- Ashley Tuton Simulator Operator, HR Wallingford.

Session 2: Wednesday 25th – Friday 27th January 2023

- Capt Maurice Mahon Pilot, Dublin Port;
- Capt William Dempsey Pilot, Dublin Port;
- Capt Ian Love Pilot, HR Wallingford;
- Jonathan Woodhams Project Manager, HR Wallingford;
- Ashley Tuton Simulator Operator, HR Wallingford.

5.2 Simulation runs

A total of 55 simulation runs were completed during the two sessions to assess the proposed 3FM port layout. The simulation runs were carried out to and from different berths for a range of conditions, including the most onerous wind and current combinations that would be expected for such operations.

All simulation runs were facilitated by HR Wallingford's Pilot Captain Ian Love, who is a Senior Harwich Haven Authority Pilot and has extensive experience with the size and class of vessels used in this simulation. The simulation runs were piloted by Dublin Port Pilots Capt Maurice Mahon (Session 1 and 2) and Capt William Dempsey (Session 2) who have valuable experience and knowledge of current operations at Dublin Port, as well as by Capt Ian Love.

Each simulation run began with a briefing for the pilot on the conditions and objectives for the run, and finished with a detailed debriefing discussion, examining all aspects of the run. All of those attending the simulation session (the Simulation Team) participated in the briefing and debriefing discussions.

The conditions for each simulation run were based on the results of the previous simulation runs and the objectives of the simulation session, and so were confirmed in discussion with the participants before each run.

During arrival runs the ship was positioned a suitable distance from the berth so that the simulated motions settled following run commencement. Appropriate speeds, headings and the deployment of tugs (where applicable) were determined prior to each run.

During departure runs the ship was initially positioned at the berth with zero ground speed and without any mooring lines attached.

5.3 Grading of runs

Immediately after completion, each simulation run was graded by the Simulation Team. The runs were graded as Successful, Marginal or Fail, according to the evaluation criteria below:

Successful

Standard manoeuvres:

- The ship remains under full control at all times without resorting to aggressive manoeuvring techniques;
- The ship stays within the channel / manoeuvring area boundaries with acceptable clearances to all port and other structures, and other ships berthed at the port. For the purposes of the simulations a clearance of more than 50 m was considered successful unless it was shown that the ship was well controlled and / or moving away from the structure;
- Tugs are operating safely and within sustainable limits;
- For berthing manoeuvres, the ship ends the run alongside, or in such a position that lines would be ashore without appreciable difficulty, at zero speed, with an acceptable sway velocity and no appreciable yaw rate;
- For departure manoeuvres the ship exits smoothly, without risk of drifting onto port structures or other ships.

Marginal

Standard manoeuvres:

- The Pilot considers the ship is at the limit of control during standard manoeuvres;
- The ship stays within the channel / manoeuvring area boundaries, but with unacceptable clearances;
- The ship clears all port structures, and other ships berthed at the port, but with unacceptable clearances;
- Tugs are operating safely, but approaching their sustainable operating limits (e.g. being used at 100% power for more than 15 minutes);
- For approach manoeuvres, the ship ends up alongside, but may have a high approach velocity. The manoeuvre can be concluded, but minor damage may occur;
- On departure, the ship is manoeuvred off the berth but with some difficulty. The manoeuvre is completed with the potential for minor damage only.

Fail

Standard manoeuvres:

- The Pilot loses control of the ship;
- The ship strays outside the channel / manoeuvring area boundaries and / or grounds;
- The ship either contacts, or has a near-miss with port structures and / or other ships berthed at the port;
- Tugs are required to operate in an unsafe manner, or exceed sustainable operating limits (e.g. being used at 100% power for more than 30 minutes);
- For approach manoeuvres, the ship cannot get alongside at all, or contacts the berth with sufficient force that severe damage may have occurred;
- On departure, the ship either cannot be manoeuvred off the berth, or encounters significant difficulty in manoeuvring, such that severe damage may have occurred.

5.4 Presentation of results

A full digital record of each simulation run was made, which was sufficient to replay the run following completion.

The data and results from each real time simulation run are presented in a range of formats, which are described in the following sections.

5.4.1 Simulation run summary

Following each run, a simulation run summary table entry was completed. These are shown in Table 5.1 and Table 5.2 for Sessions 1 and 2, respectively. The table details the configuration of each run, including the ship used, the manoeuvre conducted and the environmental conditions used. It also describes key aspects of the manoeuvre and captures the remarks and comments made by the pilot and the rest of the Simulation Team. The grade for each run is also included in the run summary tables.

5.4.2 Simulation track and data plots

The results of each navigation simulation run are available in the form of plots of the vessel tracks and graphs of key data parameters recorded during the run. These data are presented in Appendix B.

The vessel data and track plots show:

- The position of the ship (and any tugs) at relevant intervals is indicated by a succession of vessel outlines. Red vessel outlines indicate the vessel's position every 10 minutes from the start of the run;
- The positions of port structures and aids to navigation;
- A north arrow;
- A scale bar.

The data graphs plot the variation of various key parameters against elapsed simulation time. The ship ID is identified in the text block on the bottom right of each page.

The ship graphs comprise:

- Ship's heading in °N;
- Ship's drift angle in degrees;
- Ship's speed (over the ground and through the water) in knots, expressed in terms of longitudinal and lateral components relative to the ship's head;
- Ship's rate of turn (°/min), rudder angles and propeller pitches;
- Ship's bow and / or stern thruster power (%);
- Current speed in knots acting on the ship along the ship's track;
- Speed (knots) and direction (°N) of the wind acting on the ship.

Where there are no plots for a particular parameter, for example for bow thruster power, this indicates that the particular parameter was not relevant for the particular run or no bow thruster was available.

Table 5.1: Simulation run summary for Session 1

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
1	IL	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	SW 15 knots	Success	Familiarisation run. A starboard swing was carried out in the manoeuvring area before proceeding to the berth. Well controlled manoeuvre, only came close to ship on Berth 49 on the final approach to the berth whilst coming ahead.
2	IL	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	SW 15 knots	Success	Repeat of Run 01 with similar outcome.
3	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	SE 25 to 30 knots	Marginal	Carried out a starboard swing in the manoeuvring area, backing the stern in to the southern side. Protective dolphin structures are impacting the manoeuvre when trying to keep clear, which pushed the ship to the northern side of manoeuvring area leading to lower clearances off Berth 49.
4	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	SE 25 to 30 knots	Success	Repeat of Run 03 with port swing and bow in the southern side of the manoeuvring area. Able to control the ship throughout the manoeuvre with the available power on the ship.
5	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 25 to 30 knots	Success	Carried out a starboard swing before proceeding to the berth. Came within 22 m of the protective dolphin on the western side of the manoeuvring area but pilot felt the ship was under control throughout particularly given the environmental conditions from the south-west / south. The clearance from the existing Sludge Jetty dolphin was approximately 45 m.
6	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 25 to 30 knots	Success	Starboard swing carried out with revised methodology to increase clearances from the protective dolphins. It was a difficult manoeuvre given size of vessel and available space. There was 60 m clearance from the ship on Berth 49 with no forward motion and good clearances off the protective dolphins. Used approximately 75% to 80% of available power. Using correct methodology and training, a successful outcome can be achieved.
7	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	SE 25 to 30 knots	Success	Carried out a port swing with the bow to the south in the manoeuvring area. There was no overuse of thrusters with power still available in reserve. Maintained over 50 m from the protective dolphins with the wind pushing the ship away. The clearance from 48 m from ship on Berth 49, but it was under control.

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
8	IL	MV Celine	Arrival from North Bank to Berth 45	HW+3 Ebb)	SW 15 knots	Success	Swung the ship to starboard with the stern in to the southern side of the manoeuvring area. South-westerly wind was considered more difficult to transit astern from manoeuvring area to the berth when all berths are occupied. There was a large swept path in the astern transit. Stronger winds will cause more of an issue and the manoeuvre has more of an impact on the surrounding berths. Following the run it was decided to remove the protective structures and replace them with yellow special marks.
9	IL	MV Celine	Arrival from North Bank to Berth 45	HW+3 Ebb	SE 15 knots	Success	Carried out a port swing in the south-easterly conditions. The ship was under control throughout but could have manoeuvred further to the west before swinging. The yellow special marks do not visually guard the structure and were therefore moved further north (from Run 12).
10	IL	MV Celine	Departure from Berth 44 to North Bank	HW-3 Flood	SE 15 knots	Success	Lifted off the berth and manoeuvred astern to the turning circle, swinging to starboard. Careful repositioning of special marks would improve visual reference (changed from Run 12). It was considered that marking the southern side of the turning circle would be required. This could be achieved with a pile (due to the outfall to the south).
11	IL	MV Celine	Departure from Berth 44 to North Bank	HW+2.5 Ebb	SW 15 knots	Success	Similar manoeuvring strategy carried out to Run 10. It is important that the speed is managed once vessel is heading east and not to cause passing ship effects on other berth vessels east of manoeuvring area.
12	MM	250 m container ship with 10.5 m draught	Arrival from North Bank to Container Berth East	HW-1 Flood	SE 20 knots	Success	A port swing was carried with the tugs allowing for a swing in the centre of the manoeuvring area. Aids to navigation, which were moved prior to the run, were useful. Straightforward manoeuvre and under control throughout.
13	MM	250 m container ship with 10.5 m draught	Departure from Container Berth West to North Bank	HW-2 Flood	SE 20 knots	Success	The ship was lifted off the berth, with the bow taken to the southern side of the manoeuvring whilst lifting the stern to starboard. Straightforward manoeuvre.
14	MM	250 m container ship with 10.5 m draught	Arrival from North Bank to Container Berth East	HW-0.5 Flood	SW 20 to 25 knots	Success	Aids to navigation were very useful. Straightforward manoeuvre and well under control throughout. The tugs allowed for a swing in the centre of the manoeuvring area.

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
15	MM	250 m container ship with 10.5 m draught	Arrival from North Bank to Container Berth East	HW-0.5 Flood	SW 25 to 30 knots	Success	Repeat of Run 14 with similar outcome.
16	IL	250 m container ship with 10.5 m draught	Departure from Container Berth East to North Bank	HW-1 Flood	SE 25 to 30 knots	Success	Lifted off berth before swinging in manoeuvring area and departing. Straightforward and well controlled.
17	MM	MV Celine	Departure from Berth 44 to North Bank	HW+3 Ebb	SW 15 knots	Success	Examined swinging in Alexandra Quay West in to not impact the channel. The manoeuvre was shown to be feasible but there were limited clearances which increases the risk of carrying it out. This manoeuvre is similar to existing manoeuvres currently carried out.
18	IL	Stena Britannica	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 15 knots	Marginal	Carried out a port swing in the manoeuvring area. The ship came within 15 m of the sheet pile wall. Whilst the pilot felt the ship was under control this was considered marginal. A revised manoeuvring strategy with this should would improve the clearances.
19	IL	Stena Britannica	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 15 knots	Success	Repeat of Run 18 but swinging to starboard which improves the clearances.
20	MM	Stena Britannica	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 20 knots	Success	Repeat of Run 20 with wind speed of 20 knots. Minimum distance to ship on Berth 49 was 49m during swing although the ship was moving astern at the time. Getting towards the upper wind limit for this ship without tugs.
21	MM	Stena Britannica	Arrival from North Bank to Berth 52	HW-2.5 Flood	SE 20 knots	Success	Good manoeuvre in south-easterly wind. Easterly buoy proved useful in positioning of the ship to end swing and progress to Berth 52.
22	MMC K	Stena Britannica	Departure from Berth 53 to North Bank	HW-2.5 Flood	SE 15 knots	Success	Lifted off berth and transited west into manoeuvring area before swinging to port. Good clearances throughout and placement of buoys in manoeuvre area were useful.
23	IL	Stena Britannica	Departure from Berth 52 to North Bank	HW+3 Ebb	SW 20 knots	Success	Lifted off the berth swung to port in the manoeuvring area. Good clearances from ship on Berth 49.
24	IL	Stena Britannica	Departure from Berth 52 to North Bank	HW-2.5 Flood	SE 20 knots	Success	Lifted and manoeuvred astern off the berth before swinging in the manoeuvring area and departing. Straightforward manoeuvre.

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
25	MM	240 m RoPax future ferry	Arrival from North Bank to Berth 52	HW-2.5 Flood	NE 25 to 30 knots	Success	Swing carried out on the western side of the manoeuvring area which could be improved by holding the ship to east.
26	MM	240 m RoPax future ferry	Departure from Berth 52 to North Bank	HW-2.5 Flood	NE 25 to 30 knots	Success	Straightforward manoeuvre in the off berth conditions.
27	IL	240 m RoPax future ferry	Departure from Berth 53 to North Bank	HW+3 Ebb	SW 25 to 30 knots	Success	Straightforward manoeuvre.
28	IL	240 m RoPax future ferry	Departure from Berth 53 to North Bank	HW+3 Ebb	SW 25 to 30 knots	Success	Repeat of Run 27 using flow model for existing port layout for comparison. Straightforward manoeuvre.
29	MM	240 m RoPax future ferry	Departure from Berth 52 to North Bank	HW-2.5 Flood	SE 25 to 30 knots	Success	Ship lift and manoeuvred astern from the berth before swinging in the manoeuvring area and departing.

Table 5.2: Simulation run summary for Session 2

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
30	IL	Stena Britannica	Arrival from North Bank to Berth 52	HW+3 Ebb	NE 20 knots	Success	The ship was swung to starboard in the manoeuvring area. A tug on standby but was not required. Straightforward with adequate clearance forward and aft easily achieved. There was reserve power if the wind was to exceed 20 knots.
31	IL	Stena Britannica	Departure from Berth 52 to North Bank	HW+3 Ebb	NE 20 knots	Success	The ship was lifted off and manoeuvred astern off the berth before swinging to starboard in the manoeuvring area. A tug was on standby but was not required. This was considered better than a port swing off berth. There was adequate power in reserve when considering the north-easterly wind direction.
32	IL	Stena Britannica	Arrival from North Bank to Berth 52	HW+3 Ebb	SW 25 to 30 knots	Success	The ship was swung to starboard on arrival. One tug was used to assist the swing and control berthing. The aft tug was considered essential for this class of vessel to make a timely manoeuvre. The tug was not used above 50% power throughout.
33	IL	Stena Britannica	Arrival from North Bank to Berth 49	HW-2.5 Flood	SE 20 knots	Success	Manoeuvre swung close to TC East Buoy. Greater clearances could be achieved by swinging further west.
34	IL	Stena Britannica	Arrival from North Bank to Berth 53	HW+3 Ebb	SW 20 knots	Success	Examined manoeuvre to Berth 53, having to pass Berth 52 following the swing. Good control throughout.
35	MM	185 m bulk carrier in ballast	Departure from Berth 47 to North Bank	HW+3 Ebb	SW 20 to 25 knots	Success	Swung the bow to starboard off the berth using 2 tugs. In practice the pilot would keep stern closer to Berth 47 during the swing.
36	MM	185 m bulk carrier in ballast	Arrival from North Bank to Berth 47	HW-2 Flood	SW 25 to 30 knots	Success	Set by wind at the start of the run, but otherwise a straightforward manoeuvre. No impact from the TC West Buoy. These bulk carriers always berth port side alongside.
37	MM	185 m bulk carrier in ballast	Arrival from North Bank to Berth 47	HW+3 Ebb	NE 25 to 30 knots	Success	Good control throughout with two tugs and no bow thruster. No issue with the location of the TC West Buoy.
38	MM	185 m bulk carrier laden	Arrival from North Bank to Berth 47	HW-1 Flood	SE 25 to 30 knots	Success	Straightforward run with good control throughout. There were no issues with the TC West Buoy.
39	MM	185 m tanker with 7.0 m draught	Arrival from North Bank to NORA oil berth	HW+3 Ebb	SW 25 to 30 knots	Marginal	Incorrectly used ballast draught. High windage from ballast draught and strong wind led to drift to the north and a 35 m clearance off ship on Berth 52. Remainder of run was successful.

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
39B	LD	185 m tanker with 10.5 m draught	Arrival from North Bank to NORA oil berth	HW+3 Ebb	SW 25 to 30 knots	Success	Repeat of Run 39 with a laden draught. The ship carried too much speed out of turn up to berth but it was controllable. Would be improved keeping the speed below 3 knots on approach to the berth, which would save having to use aft tug on port quarter and enable it to push sooner. Improvement on methodology on approach to berth would improve clearance.
40	MM	185 m tanker with 7 m draught	Departure from NORA to North Bank	HW-2 Flood	NE 25 to 30 knots	Success	The ship was swung off the berth, bringing the bow to starboard. Straightforward to control clearances forward and aft.
41	MM	185 m tanker with 10.5 m draught	Arrival from Buoy 9 to NORA oil berth	HW-2 (Flood)	NE 25 to 30 knots	Success	Buoy 14 was moved for more of a chamfered dredged area for run in to berth. Speed of 3 knots or more recommended to be maintained until past buoy 14. Good control throughout although movement of buoy did not impact the manoeuvre, although it might for smaller ships not using tugs.
42	MM	185 m tanker with 10.5 m draught	Arrival from Buoy 9 to NORA oil berth	HW-2 (Flood)	NE 25 to 30 knots	Success	Moved dredged Buoy 14 back to original position, still successful manoeuvre.
43	MM & IL	148 m container ship	Arrival from Buoy 5/7 to Container Berth West	HW Flood	SW 15 knots	Success	Examined ships passing the channel. Seatruck Power passed parallel in channel at Berth 53. Good clearance, minimum 49 m from ship on Berth 53. The ship was swung just north of TC East before manoeuvring to the berth.
44	LD & IL	MV Celine	Arrival from Buoy 5/7 to Berth 45	HW-2 Flood	NE 15 knots	Marginal	Examined larger passing ship in the channel. Seatruck Power passed at Berth 53 with a clearance of 30 m from the ship on Berth 53. Pilot was comfortable with the position due to the wind, but clearances to the moored ship are low. Manoeuvre to berth was successful.
45	MM	MV Celine	Arrival from North Bank to Berth 45	HW+3 Ebb	SW 20 to 25 knots	Success	The ship was swung to starboard before manoeuvring astern to the berth. The strong wind meant high power was required to maintain sternway.
46	IL	MV Celine	Departure from Berth 44 to North Bank	HW-2 Flood	NE 20 to 25 knots	Success	Lifted stern off berth before manoeuvring astern to manoeuvring area. Good control throughout and positioning due swing provide good clearances.
47	MM	MV Celine	Arrival from North Bank to Berth 45	HW+3 Ebb	SE 20 to 25 knots	Success	Swung the ship to port in the manoeuvring area before manoeuvring astern to the berth. Successful manoeuvre.

Run	Pilot	Ship	Manoeuvre	Tidal condition	Wind	Outcome	Comments
48	LD	250 m container ship 10.5 m	Arrival from North Bank to Container Berth East	HW+3 Ebb	SW 25 to 30 knots	Success	The ship was swung to port in the manoeuvring area using both tugs. In the high wind conditions it would be beneficial to have more tug power.
49	MM	250 m container ship with 10.5 m draught	Arrival from North Bank to Container Berth East	HW-2 Flood	NE 25 to 30 knots	Success	Carried out a starboard swing in the manoeuvring area. Kept position north of channel, using the bow thruster to hold position. The tugs were close to the limit of available power.
50	LD	250 m container ship with 10.5 m draught	Departure from Container Berth West to North Bank	HW-3 Flood	NE 25 to 30 knots	Success	Lifted off the berth and came ahead in to the manoeuvring area. High amounts of tug power were used, more tug provision would be beneficial.
51	MM	250 m container ship with 10.5 m draught	Departure from Container Berth West to North Bank	HW-3 Flood	NE 15 to 20 knots	Marginal	Repeat of Run 50 to examine if as much tug power is needed for same vessel in lower wind. Clearance of 30 m from ship on Berth 49 due to the position of the swing. Whilst under control it would be beneficial to swing further west to improve clearances.
51B	LD	250 m container ship with 10.5 m draught	Departure from Container Berth West to North Bank	HW-3 Flood	NE 15 to 20 knots	Success	Repeat of Run 51 with revised manoeuvring strategy which showed increased clearances.
52	MM	Stena Britannica	Departure from Berth 53 to North Bank	HW-3 Flood	SE 25 to 30 knots	Success	Tug power required to clear berth. Would be better placed leading / pull 45° on the stern.
53	LD	240 m RoPax future ferry	Departure from Berth 53 to North Bank	HW-3 Flood	SW 25 to 30 knots	Success	Straightforward manoeuvre.

6 Conclusions and recommendations

6.1 3FM manoeuvring area

With regard to the 3FM manoeuvring area, the following conclusions and recommendations were drawn from the study:

- The manoeuvring area was shown to be sufficient for swinging and turning all of the design ships considered during the study. The runs were carried out using appropriate manoeuvring strategies and best practice with adequate clearances achieved from berth structures, moored ships, channel boundaries and the Tern Colony Dolphins throughout;
- The proximity of the manoeuvring area to the bulk and container berths (with ships typically utilising tugs) is beneficial as it helps minimise the impact on channel occupancy;
- Structures initially modelled to protect the Tern Colony Dolphins were not considered appropriate. These would not provide increased protection (due to the required size of the structure) and leads to an increased navigational hazard;
- Buoys marking the east Tern Colony Dolphin (TC East), the southern boundary of the manoeuvring area (TC South) and the West Tern Colony Dolphin (TC West) were proposed and shown to be beneficial for navigation. These provided sufficient aids to the positioning of the ship and tugs whilst in the manoeuvring area;
- The sheet piling at the boundary of the manoeuvring area should be lit adequately during times of low visibility (fog / night time);
- The type and location of the aids to navigation marking the southern boundary of the manoeuvring area (TC South) could be altered due to the proximity of an outfall to the south and potential further developments.

6.2 Unified Ferry Terminal

With regard to the Unified Ferry Terminal, the following conclusions and recommendations were drawn from the study:

- Manoeuvres to and from Berths 49, 52 and 53 were carried out using the 3FM manoeuvring area. The manoeuvring strategy was based on the environmental conditions and any limitations of the design ships;
- It was shown that manoeuvres to and from Berths 49, 52 and 53 were feasible for the 240 m long RoPax future ferry (based on uprating the power and windage specification of the Ulysses) in winds speeds gusting 25 to 30 knots from all directions;
- It was also shown that manoeuvres to and from Berths 49, 52 and 53 were feasible for the Stena Britannica in winds speeds up to 20 knots from all directions. Manoeuvres in wind speeds gusting 25 to 30 knots were shown to be possible with the assistance of a tug.

6.3 New South Bank Container Terminal

With regard to the New South Bank Container Terminal, the following conclusions and recommendations were drawn from the study:

- Whilst the terminal is to be configured for port side alongside berthing, manoeuvres to both port and starboard sides to the terminal were considered;
- The manoeuvring area was shown to be adequate for ships up to 250 m in length calling at the container terminal;

- It was shown manoeuvres to and from the New South Bank Container Terminal were feasible for a 250 m long container ship assisted by 2 x 50 tBP tugs in wind speeds gusting 25 to 30 knots from all directions;
- Manoeuvres with a 148 m long container ship were carried out which showed it was possible to swing the ship adjacent to the berth;
- Limiting depths at the western end of the terminal should be marked, based on the final dredged depths and expected draughts of the ships at the container terminal;
- There was no impact from the operations at the proposed New South Bank Container Terminal (ship-to-shore crane booms etc) on the manoeuvres to and from the Unified Ferry Terminal. It is expected that operations at the container terminal would continue uninterrupted during manoeuvring.

6.4 NORA Oil Berth

With regard to the NORA Oil Berth, the following conclusions and recommendations were drawn from the study:

- It was shown that manoeuvres to and from the NORA Oil Berth were feasible in winds gusting 25 to 30 knots from all directions;
- Consideration should be given to the profile of the berth pocket and location of Buoy No. 14 to provide a chamfer, similar to the existing NORA Oil berth, to enable a shallower approach and departure angle for small ships that will not be using the assistance of a tug.

6.5 Berth 46 / 47

With regard to Berth 46 / 47, the study found that manoeuvres to and from Berth 46 / 47 with a 185 m long bulk carrier were feasible. The position of the buoy marking the West Tern Colony Dolphin was adjusted further south to ensure it does not impact on manoeuvres to and from Berth 46 / 47.

6.6 Berths 44 and 45

With regard to the Berths 44 and 45, the following conclusions and recommendations were drawn from the study:

- Manoeuvres to and from Berth 44 and 45 were shown to be feasible in winds gusting 20 to 25 knots from all directions with a 235 m long RoRo ship;
- It is recommended that the “Nib” at the eastern end of Berth 45 is removed to improve manoeuvring to and from Berths 45 and 46, and to lower the risk of contact due to not being adequately fendered;
- A manoeuvre, swinging in Alexandra Basin West, was carried out to limit the impact on the channel occupancy. This was shown to be feasible, but carried a higher navigational risk due to the proximity of the port infrastructure. Manoeuvres using the 3FM manoeuvring area were shown to be faster overall (from berth to departing the port), but utilised the channel east of Berth 46 for 6 minutes longer than when manoeuvring in Alexandra Basin West.

6.7 Channel occupancy

With regard to the channel occupancy, the following conclusions and recommendations were drawn from the study:

- During the simulation session, the occupancy of the channel was discussed. It is recommended that a preliminary assessment is carried out to examine any potential delays to traffic due to manoeuvring ships within the channel;
- There were two simulation runs carried out with ships passing adjacent to the New South Bank Container Terminal. It was shown that two small ships (a 148 m long container ship and a 142 m long RoRo vessel) could

safely pass within the channel. When considering a larger passing ship (a 148 m container ship and a 235 m long RoRo vessel), clearances to adjacent ships were reduced with an expected increased in possible interaction with moored ships. Further consideration regarding the passing ship sizes, speeds and distances is required.

6.8 Training and familiarisation

The study found that:

- The 3FM layout requires changes to existing manoeuvring strategies. It is therefore recommended that Pilots, Tug Masters and potentially PEC holders carry out initial real time navigation simulation based familiarisation;
- Consideration should be given to supplying and training Pilots with PPU's when manoeuvring larger ships as part of mitigating the risk of the manoeuvres within the port.

6.9 Tug fleet

The study found that the adequacy of the tug fleet should be considered further for manoeuvres with the larger ships expected as part of the 3FM project.

Appendices

A Ship and tug simulation at HR Wallingford

Ship and tug simulation at HR Wallingford

Overview

At HR Wallingford, we operate ten real time simulators from our Ship Simulation Centres in Wallingford, UK and Fremantle, Australia. Our simulators are full bridge, real time manoeuvring simulators specifically designed for port design and ship operations applications, but are also used for training and pilot familiarisation purposes.

They have been developed over 25 years and have been used successfully in over 350 studies world-wide in the last 15 years alone. They have proved to be reliable, flexible and cost-effective design and evaluation tools that can be used for optimising harbour layouts, establishing operational strategy, and training in safe manoeuvring procedures.

We operate a combination of ship simulators and dedicated tug simulators, and to maximise the flexibility of our simulation capability, all of our ship simulators can also be adapted to represent tugs with suitable consoles and controls.

Our simulators are fully integrated such that they can be used to represent one or more piloted ships, or a ship and independently manned tugs, all within the same simulated environment. Alternatively the simulators can be used independently, which enables more "hands-on" time for pilots and tug masters during training or familiarisation sessions. When operating in this mode, an independent ship can also be controlled from another simulators to maximise the training opportunities for tug masters.

The system is capable of real time simulation of vessel behaviour in a range of environmental conditions making the simulators suitable for a wide range of design, assessment and training tasks including:

- Pre-feasibility studies, in the form of desk studies or simulation aided desk studies
- Optimisation of site specific terminal/port/harbour and approach channel designs
- Assessment of safety standards and procedures for shipping and port management operations
- Feasibility studies for new vessels using existing harbours / ports
- Effective training in manoeuvring procedures for pilots, tug masters and ships' officers

A mobile version of the real-time simulator can be used for on-site pilot training and port design.

Ship Simulation Centres

Our Ship Simulation Centres in the UK and Australia house the simulators within a dedicated suite of rooms including separate ship's bridges with their own briefing/observation rooms, control rooms, a dedicated tug bridge, and a conference room.

Ship Simulator Bridges

For the Ship Simulators the main room in each facility provides a representation of the bridge of a ship. From the bridge, a pilot can view and control ship manoeuvres and monitor the vessel's status throughout the simulation. A

wide range of controls can be provided to represent conventional, azipod or other ship specific control systems. The console also provides radar and electronic chart display (ECDIS).



Figure 1: Ship Simulator bridge

Visual scene

The visual scene is a major component of navigation simulation, as piloting a ship or tug is essentially a visual process. Most manoeuvring decisions are made by interpretation of the view from the bridge windows. It is therefore essential that this information is presented in a realistic manner.



Figure 2: Photograph taken at study site



Figure 3: Simulator visual scene

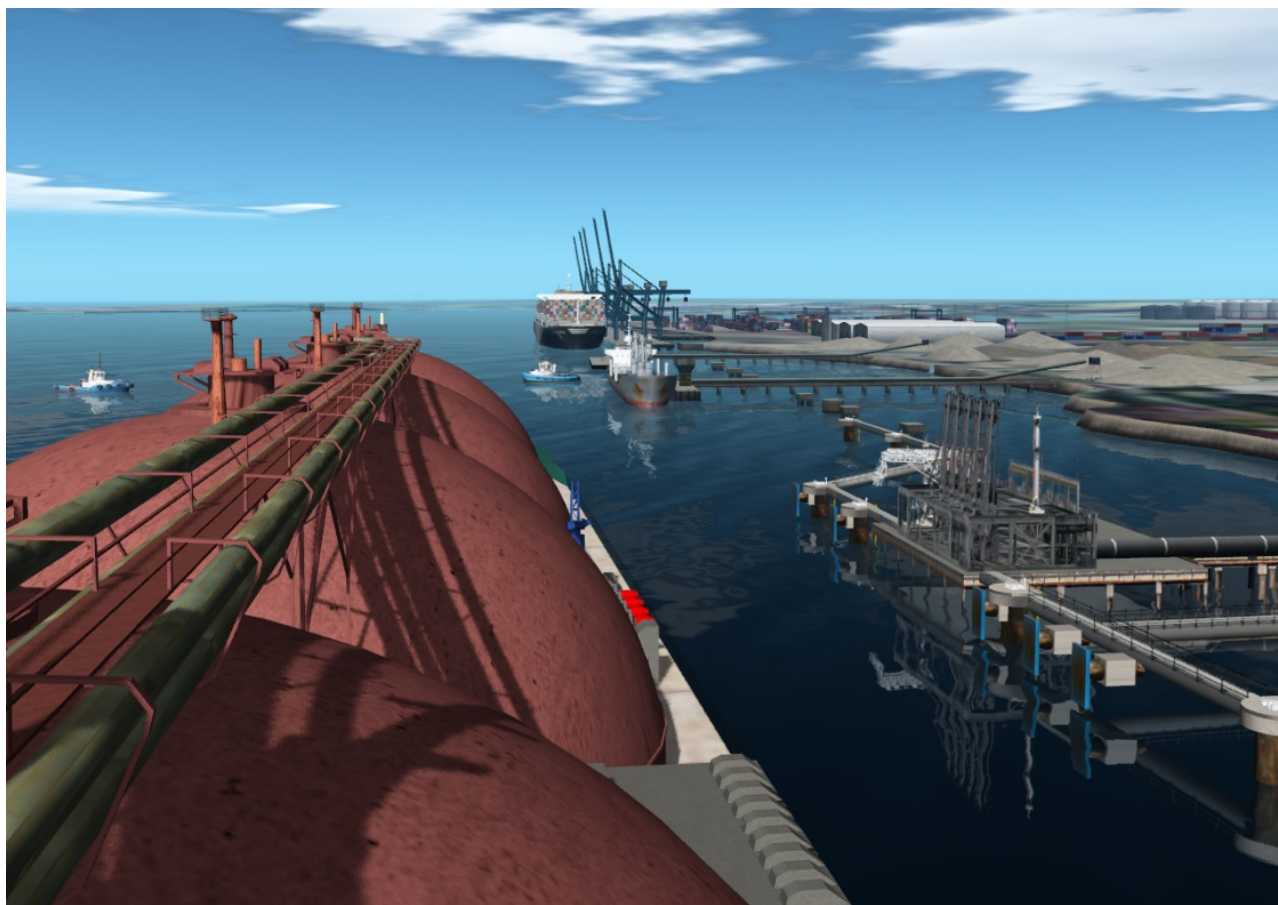


Figure 0.4: Example visual scene for LNG terminal from ship's starboard bridge wing



Figure 5: Example visual scene for cruise terminal

The screens wrap around the bridge console and provide a continuous visual angle of 280°, in addition to an astern view presented on a 42" TFT monitor. A "look-around" facility is also incorporated that allows the pilot's viewpoint to

be moved from the centre of the bridge to either bridge wing, and all around the ship allowing 360° vision, along with viewing down along the ship's side.

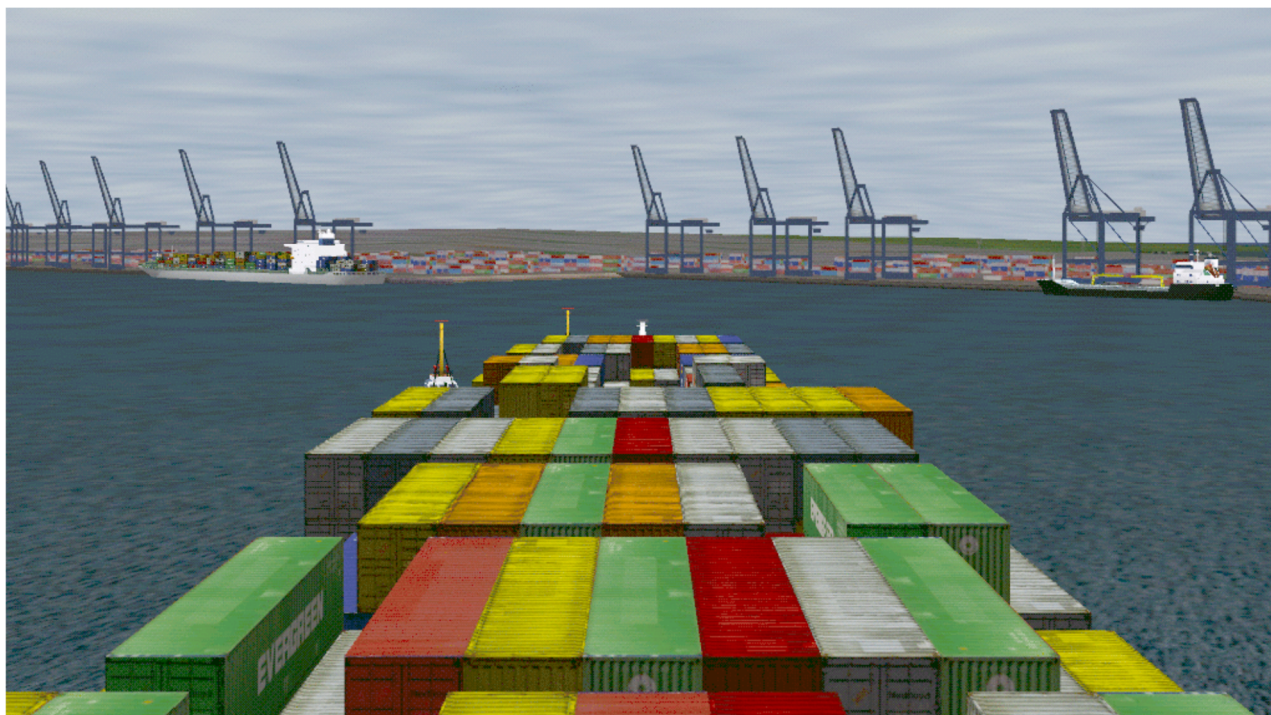


Figure 6: Example visual scene for container terminal



Figure 7: Realistic tug modelling

The lighting level can be adjusted between full daylight and full night time, in a range of visibility conditions, from excellent, long range visibility to thick fog. In night time simulations, shore lights and other vessel lights can be included, and all navigation marks can be set with the correct light configuration and characteristics.



Figure 8: Example visual scene of bulker terminal at night, with ship lights in distance



Figure 9: Example visual scene in mist

Control consoles

The control console on each bridge is flexible, but the conventional configuration has ship helm, engine and thruster controls along with instrument, radar, ECDIS/situation displays.

A range of helm and engine controls are available including:

- Wheel, tiller or joystick or twin rudder controls
- Single or twin engine telegraph controls
- Azipod propulsor controllers
- Bow and stern thruster controls.

Alternative control consoles can also be provided if required.

The instrument display presents information on the ship status including:

- Ground or water speed ahead and athwartships at midships or at bow, stern and midships
- Heading
- Rate of turn in graphical or digital display form
- Depth under the keel in graphical or digital display form
- Relative wind speed and heading
- Engine settings
- Helm indicator, showing applied wheel
- Rudder indicator, showing actual rudder angle.

There is also an electronic situation display available, in place of the ECDIS, where required, which enables the pilot to monitor the ship's position relative to key features. This displays information in the form of a plan view, similar to an electronic chart/ECDIS display, and includes a scaled ship outline and any planned developments in the area of interest.

Tug bridges

The dedicated Tug Simulators comprises a bridge with a chair and two consoles. Similarly to the Ship Simulators, from the bridge a tug master can view and control tug manoeuvres in a realistic manner and can monitor the vessel's status throughout the simulation.

A wide range of controls can be provided to represent ASD, (Aquamaster) type controls, throttle and joystick or Voith Schneider type controls. The consoles also provide radar and electronic chart display (ECDIS), along with line tension meters, where applicable.

In addition, a winch control panel is also provided and the simulated winch can represent a standard, static type winch or a dynamic, render recovery type winch.

As with the Ship Simulators, the tug visual scene is generated using three dimensional, fully textured, computer generated graphics, which are projected onto three large screens at the front of the bridge, and an array of 13 x 50" plasma monitors, to provide a full 360 degree view.

A 3 channel intercom system is available to enable communications with the central Control Room, and the simulated ship when operating in the integrated mode.



Figure 10: Tug Simulator bridge



Figure 11: Tug Simulator bridge

Simulator control room

Each simulation scenario is configured and initiated by a Simulator Operator, who is stationed at a dedicated console in one of the Control Rooms, immediately adjacent to the bridge on each of the Ship Simulators. There is a window and intercom system between the bridge and Control Room allowing full visual and verbal communications at all times. During a simulation run, the operator can monitor the simulation but can also control the application of the tugs (that are not independently controlled), anchors and mooring lines, and adjust light and environment settings as required. The operator can also introduce failures at any time, along with other vessels in the simulation.

Briefing / observation and meeting rooms

Immediately adjacent to each bridge are Briefing/Observation Rooms, with a suite of monitors that relay the instrument and situation displays from the bridge control console, along with simulation visuals, as seen from the bridge.

These enables project team members to observe and monitor the simulation runs without disturbing either the pilot. There are also meeting rooms nearby, which can act as a base for the Client's project team, and where all members of the Simulation Team can gather to discuss each simulation in detail and to consider any issues raised by the runs.

Ship and tug manoeuvring models

Within the simulators, the behaviour of the ship or tug, in terms of its response to any helm and engine actions and the local environmental effects, is governed by a mathematical manoeuvring model which includes the following effects:

- Shallow water effects including increase in turning radius and drag
- Squat
- Bank effects
- Wind response allowing for both lift and drag
- Response to waves
- Response to current
- Tug operations
- Ship to ship interaction
- Collision/contacts with any fixed structure or another vessel
- Mooring lines
- Anchors
- Lock blockage.

Mathematical manoeuvring models are tailored to particular studies based on the design ship(s)/tug(s) dimensions, drawings and, whenever possible, ship trials data. HR Wallingford also has an extensive library of ship and tug models for vessels of different sizes and hull forms.

All ship manoeuvring models are verified by professional mariners/pilots and navigation experts.

Real time navigation simulation runs

During the simulation runs, a professional mariner or pilot is in command of the simulated ship. This may be either a visiting, local pilot, who is familiar with the particular ship or study site, or one of HR Wallingford's experienced pilots.

At the start of each run, the desired scenario (vessel, port layout, tidal state, wind and wave conditions, lighting level and visibility) are configured within the simulator and the ship is initialised with a suitable position, heading, and forward and transverse speeds. During the run, the wind, waves, light levels and visibility can be altered as required. Furthermore, the pilot can call upon the assistance of tugs, which are controlled in response to verbal commands from the pilot.

Effective and appropriate use of tugs is often essential to safe manoeuvring at slow speed. Consequently the performance of assisting tugs needs to be realistically simulated. This is achieved in the Ship Simulators by representing the interaction of a complex series of factors including the type of tug, the number, type and position of the tug's propulsors, the prevailing wind and wave conditions, the location of the tug with respect to the ship (ie. it may be protected from some wave activity by the ship), the ship's speed, the current speed and direction, and the operating mode of the tug.

Alternatively, the Ship Simulator(s) can be integrated with the Tug Simulator so that one or two of the tugs are operated independently by a tug master.

Of particular importance at many sites is the effectiveness of tugs in waves. HR Wallingford has considerable experience of this issue based on detailed discussions and simulated trials with a range of tug operators. This has resulted in a series of tug efficiency curves for varying wave heights and periods for each operational mode.

Any number of other vessels can also be present in the simulation. These can be used as vessels on berths or in passing ship manoeuvres. The position and behaviour of these ships are either controlled in a simplified manner or the two Ship Simulators can be integrated so that a pilot can operate the other ship from other Ship Simulator bridge.

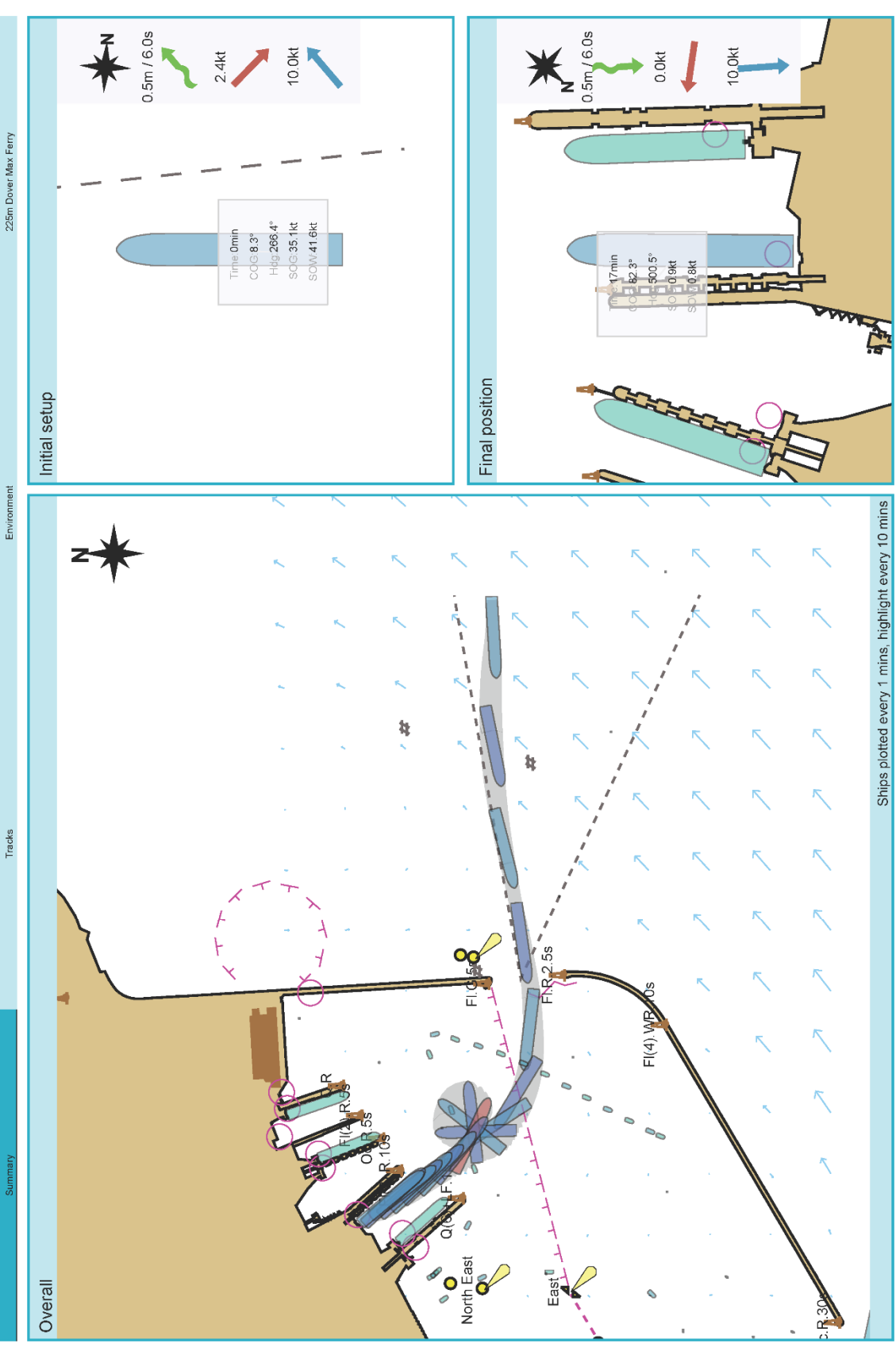
As each simulation run proceeds, the pilot is presented with the visual and other information that allow representative ship handling decisions to be made, based on accepted navigation practice, skill and experience. In particular, the use of experienced mariners ensures that realistic limits of ship controllability are reproduced and accounted for within the simulation.

Simulation data is recorded at an appropriate frequency (typically every 1 second) for later analysis and reporting. The list of data parameters recorded can vary, but typically includes:

- Elapsed time
- Ship position and heading
- Speed and rate of turn
- Rudder and engine settings
- Under keel clearance
- Tug and thruster activity
- Current and wave conditions at the ship
- Position and heading of any target ships.

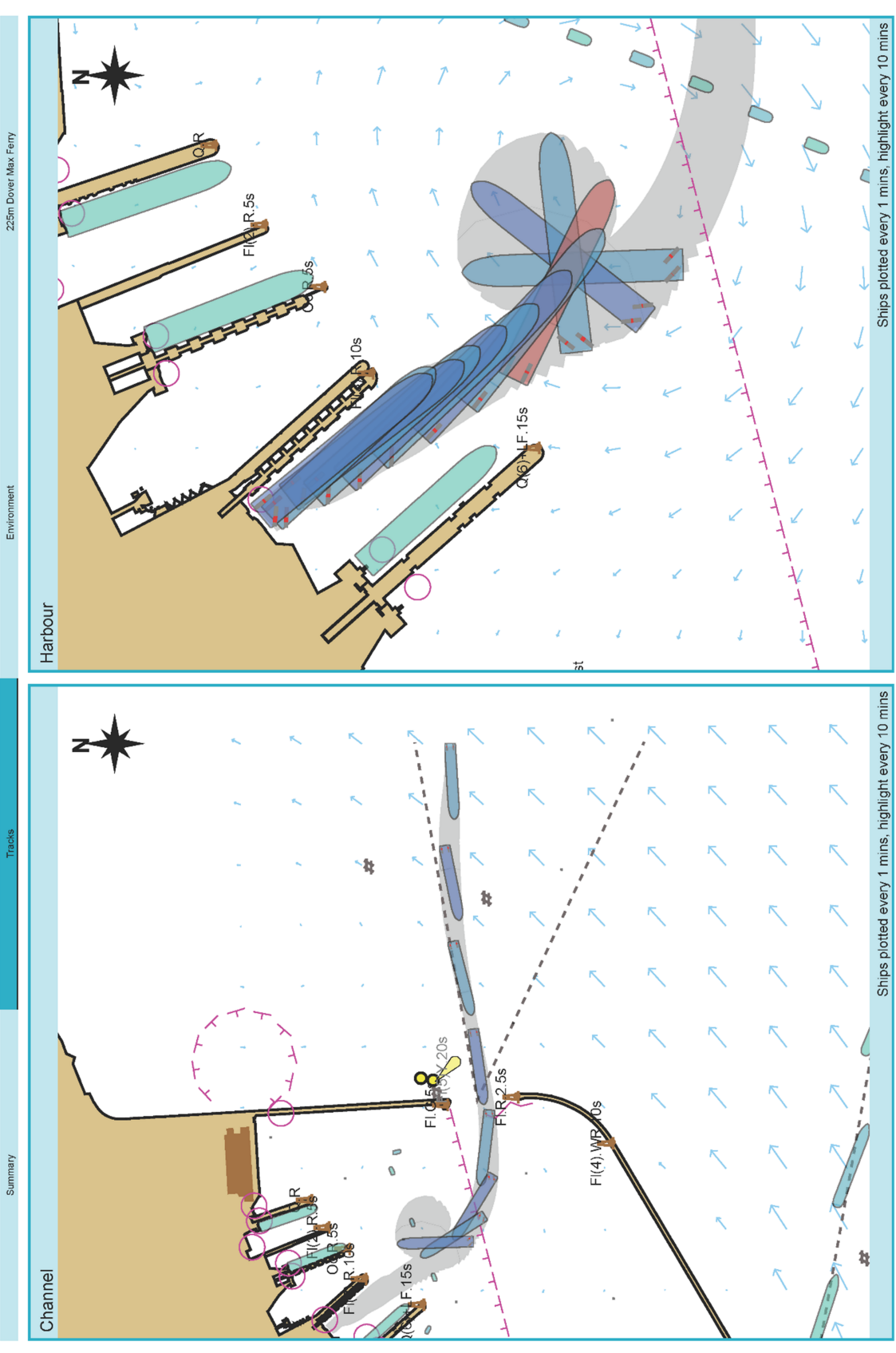
This information is presented in a series of vessel track and data plots as shown in the following figures.

Project: Dover
 Session: Demo
 Configuration: Dover_HW+1
 Run: Example

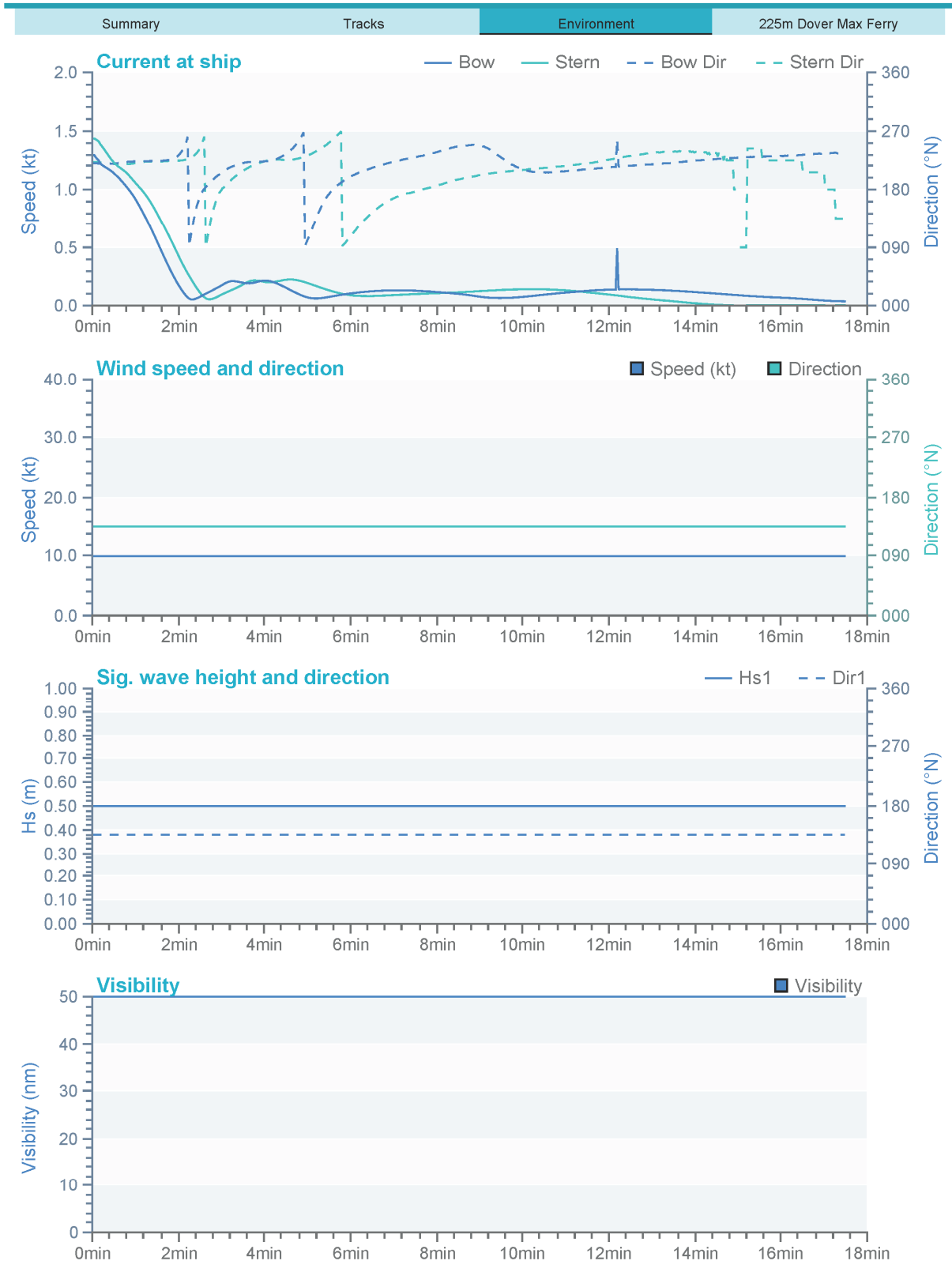


Ships plotted every 1 mins, highlight every 10 mins

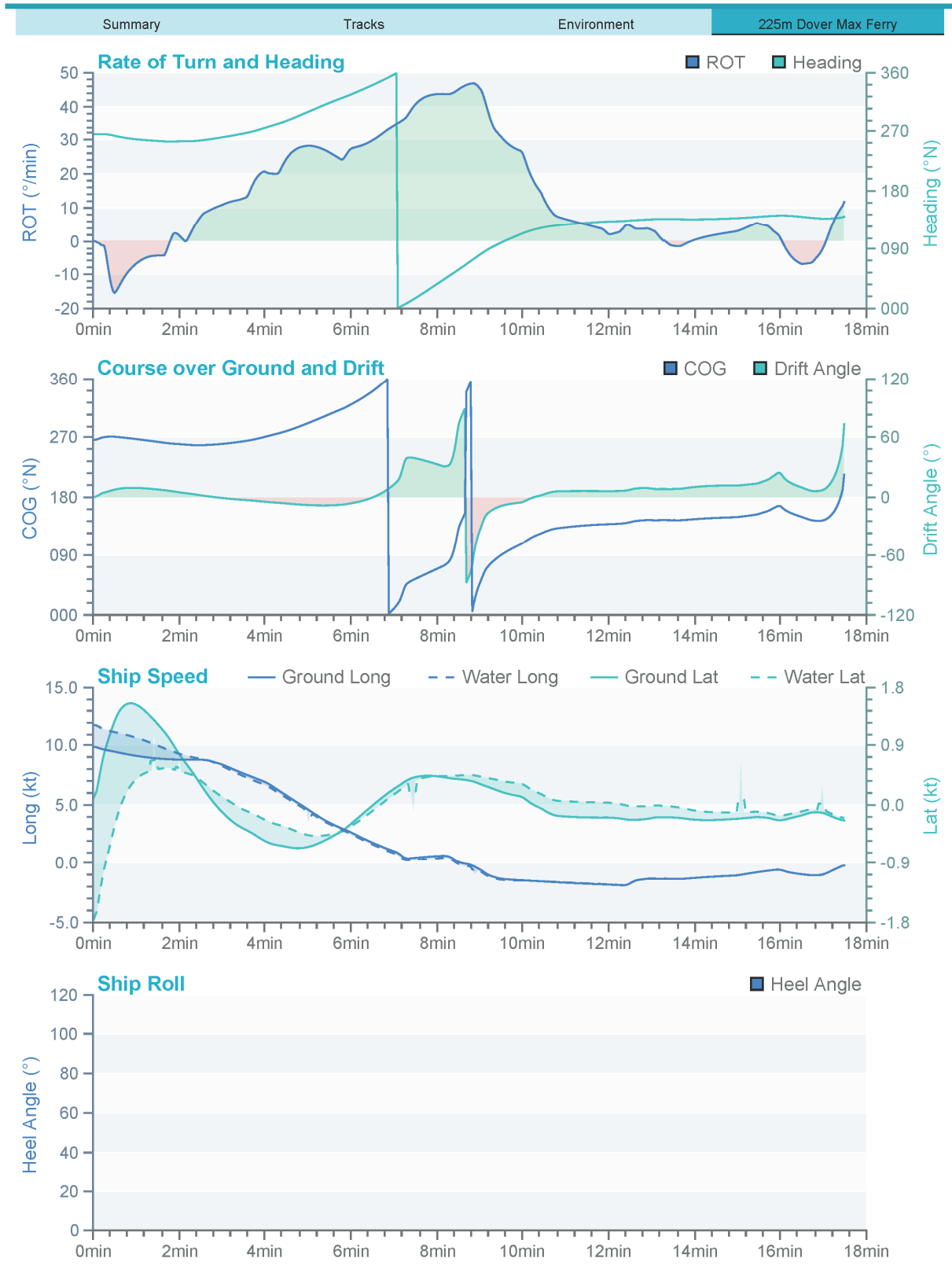
Project: Dover
 Session: Demo
 Configuration: Dover_HW+1
 Run: Example



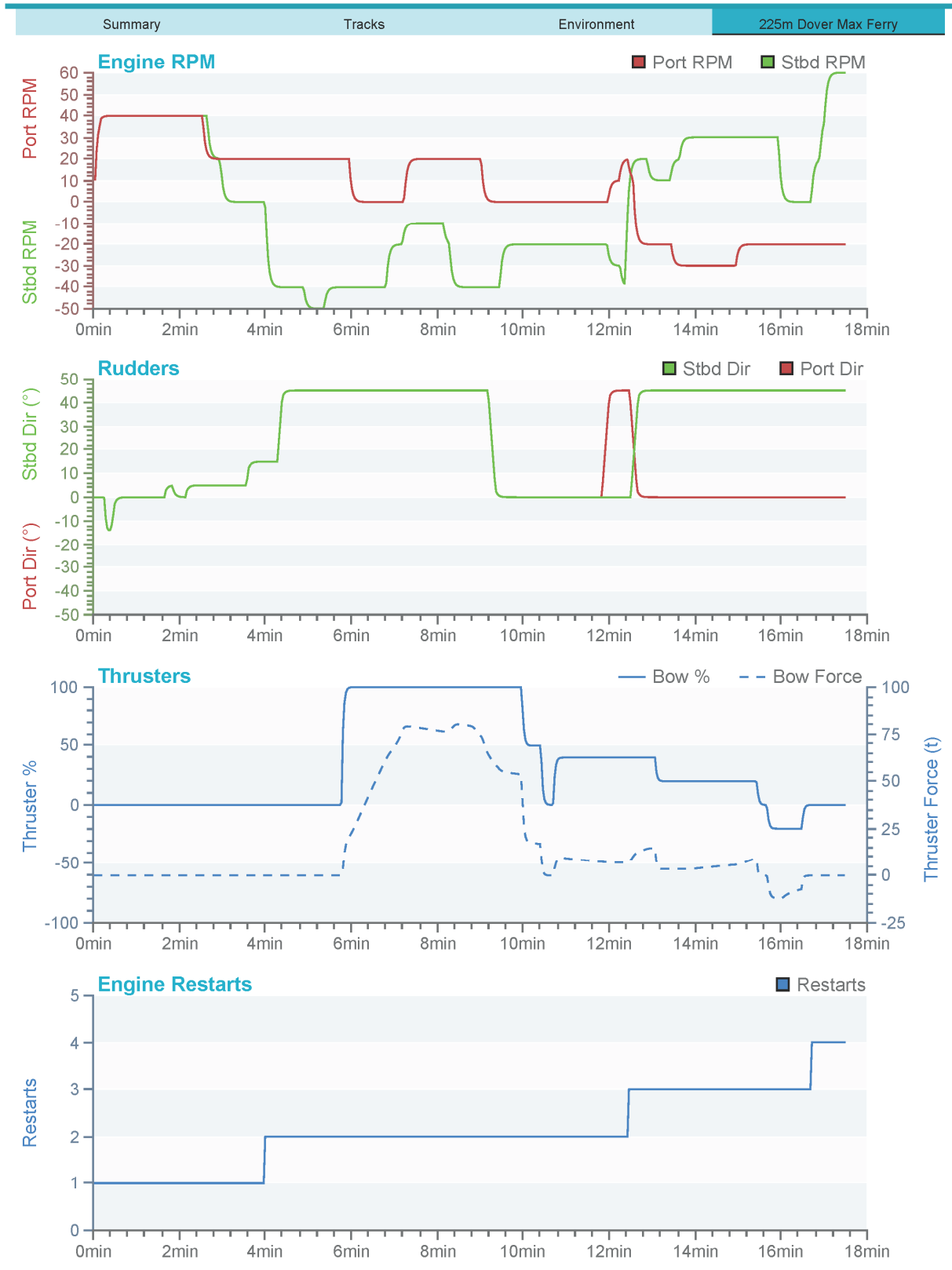
Project: Dover
 Session: Demo
 Configuration: Dover_HW+1
 Run: Example



Project: Dover
 Session: Demo
 Configuration: Dover_HW+1
 Run: Example



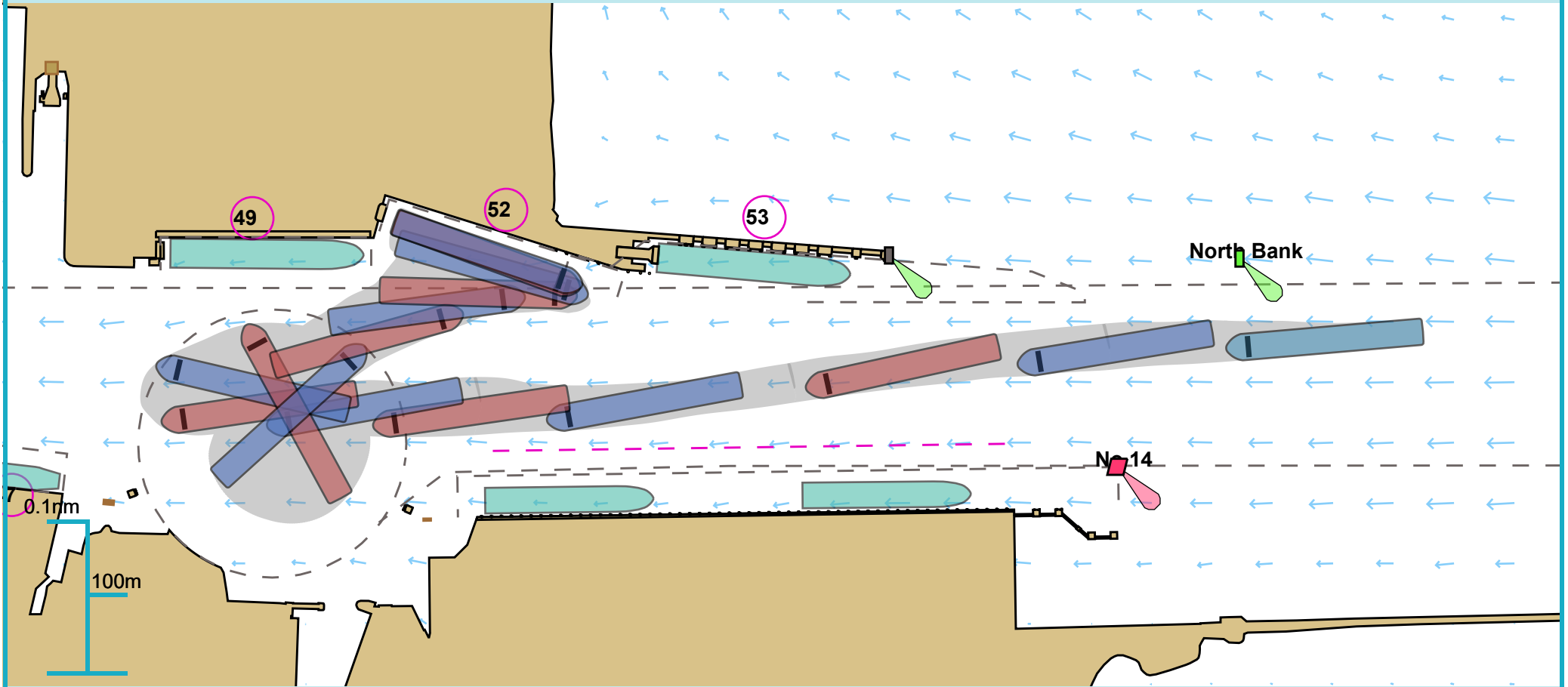
Project: Dover
 Session: Demo
 Configuration: Dover_HW+1
 Run: Example



B Simulation track and data plots

Full Run Overview

53° 20.380 N, 006° 11.938 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

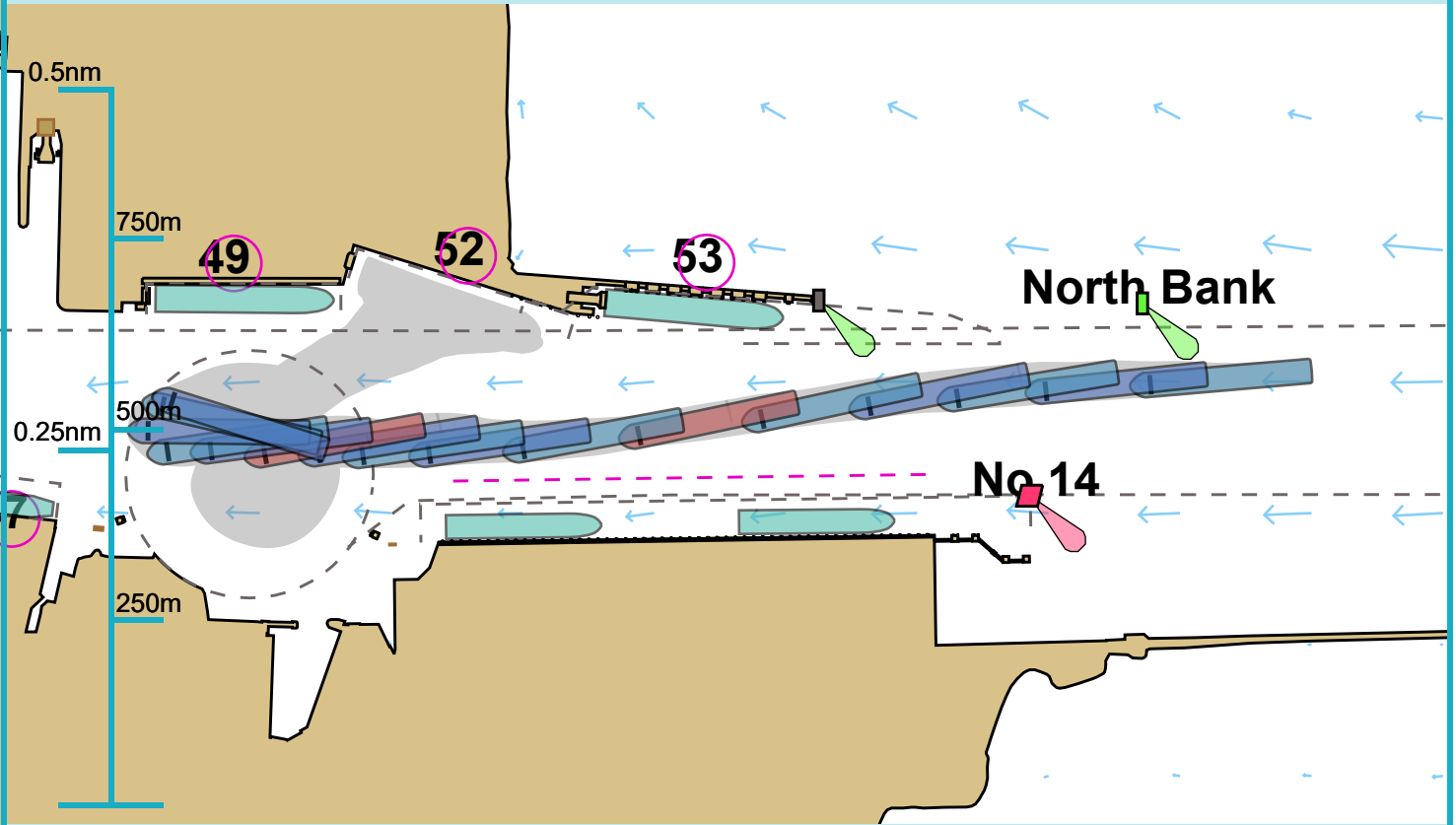
Run length: 29 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

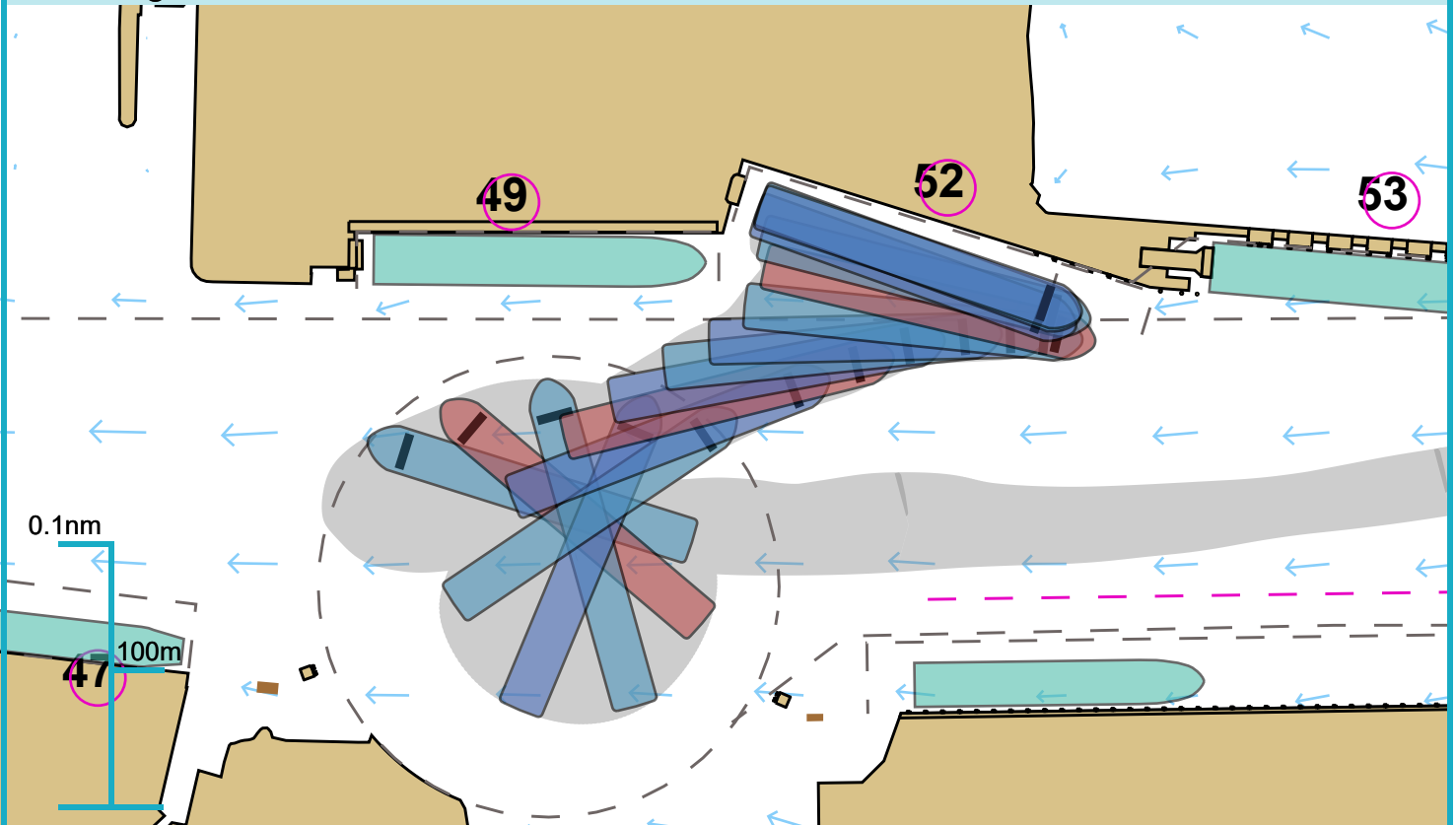
Comments:

Approach



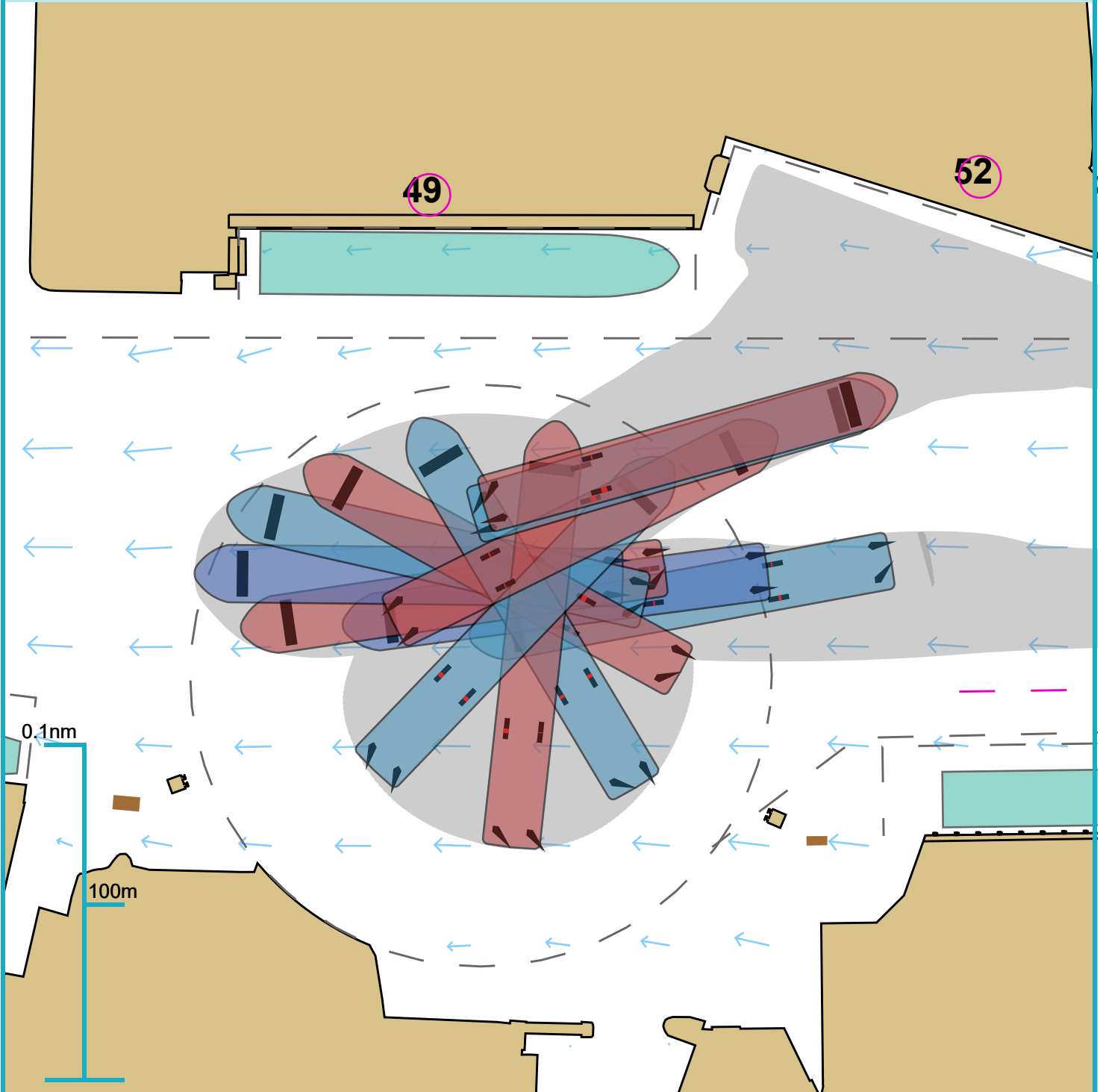
Ships plotted every 1 mins, highlight every 5 mins

Berthing

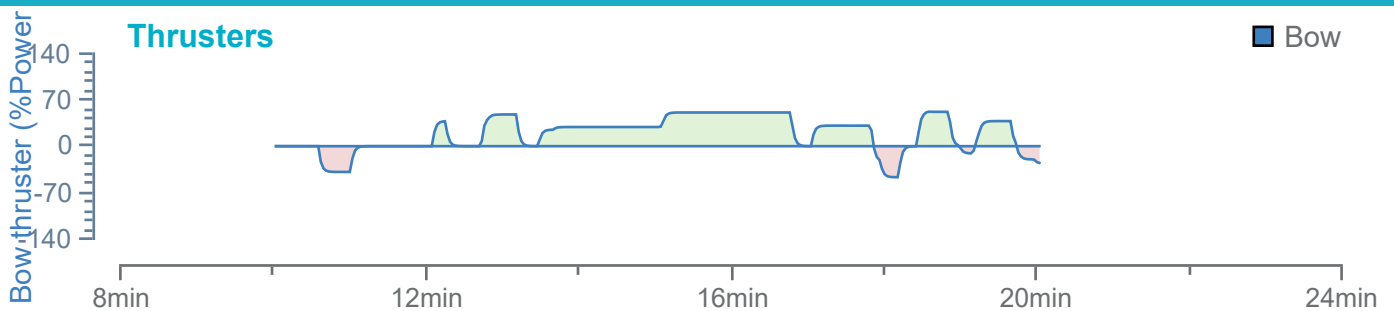


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

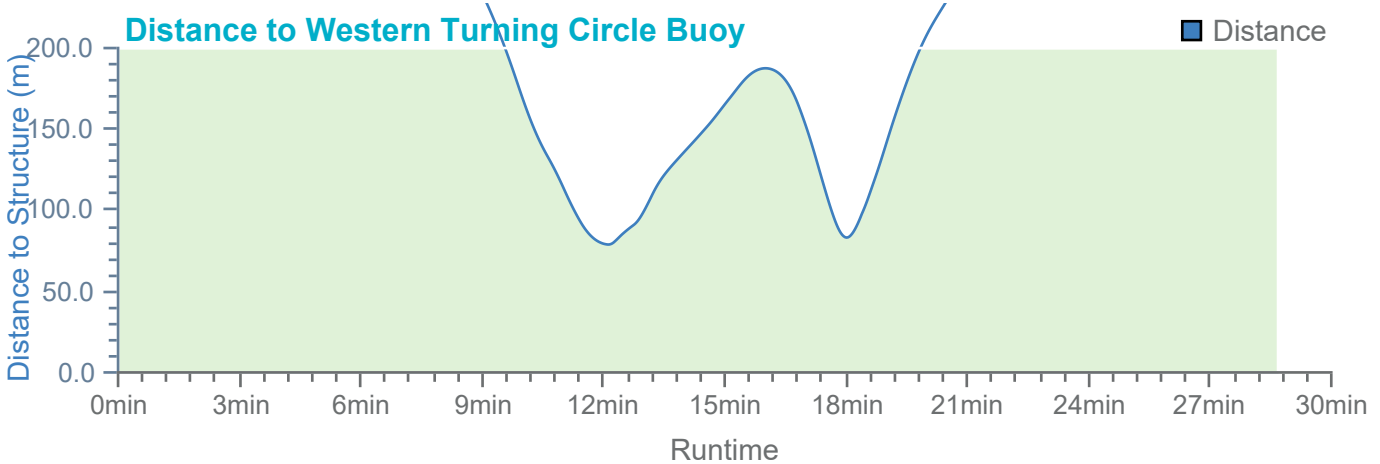
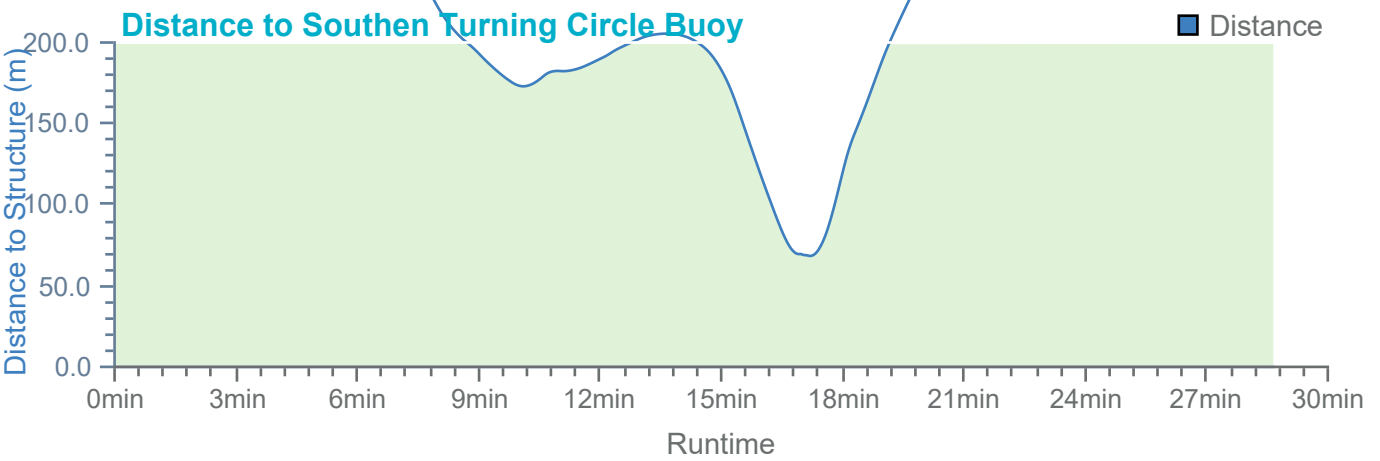
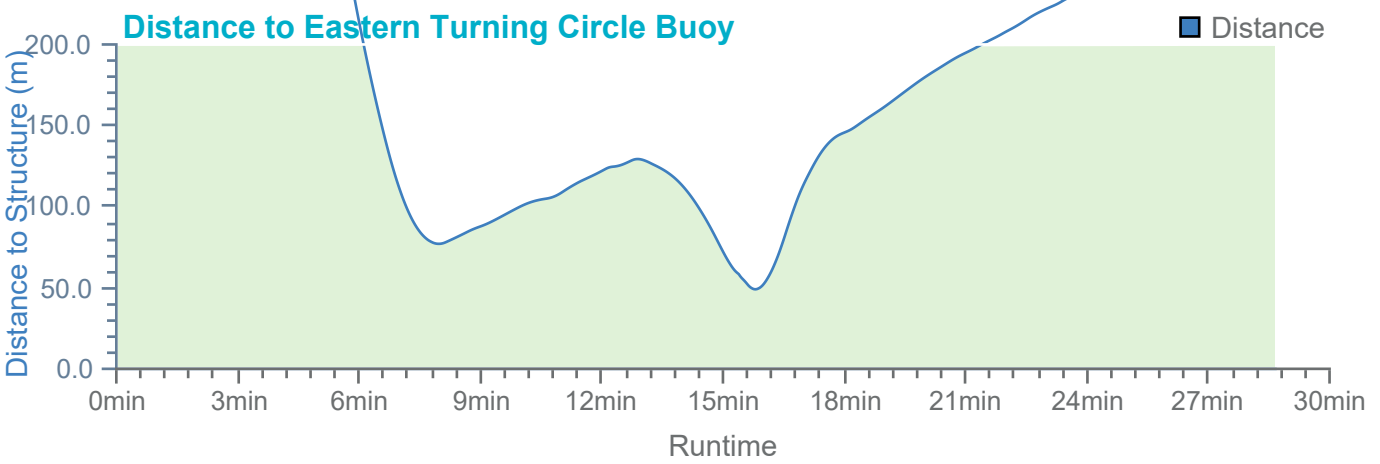
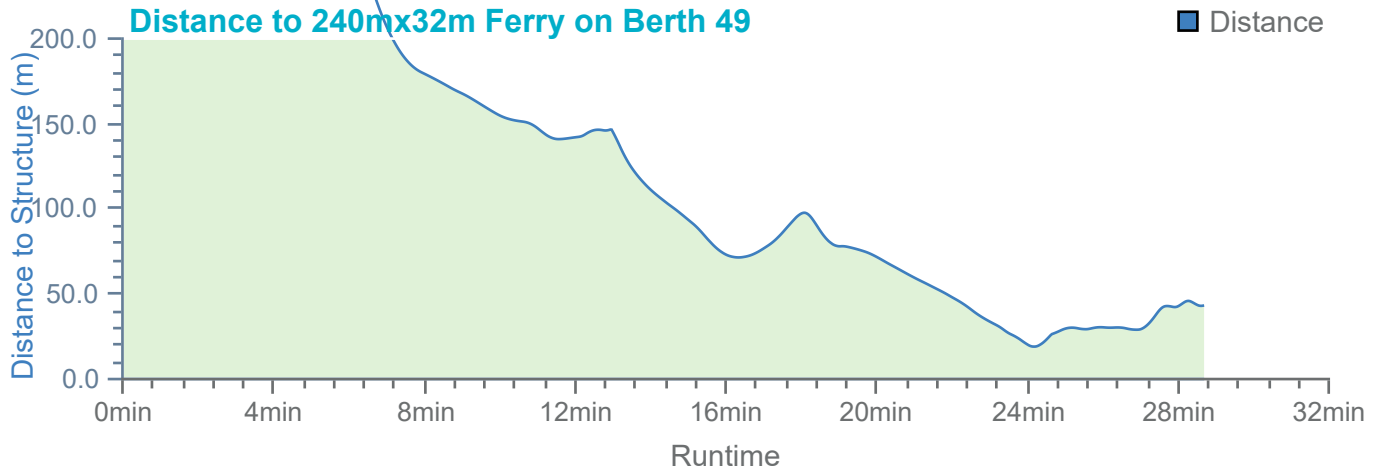


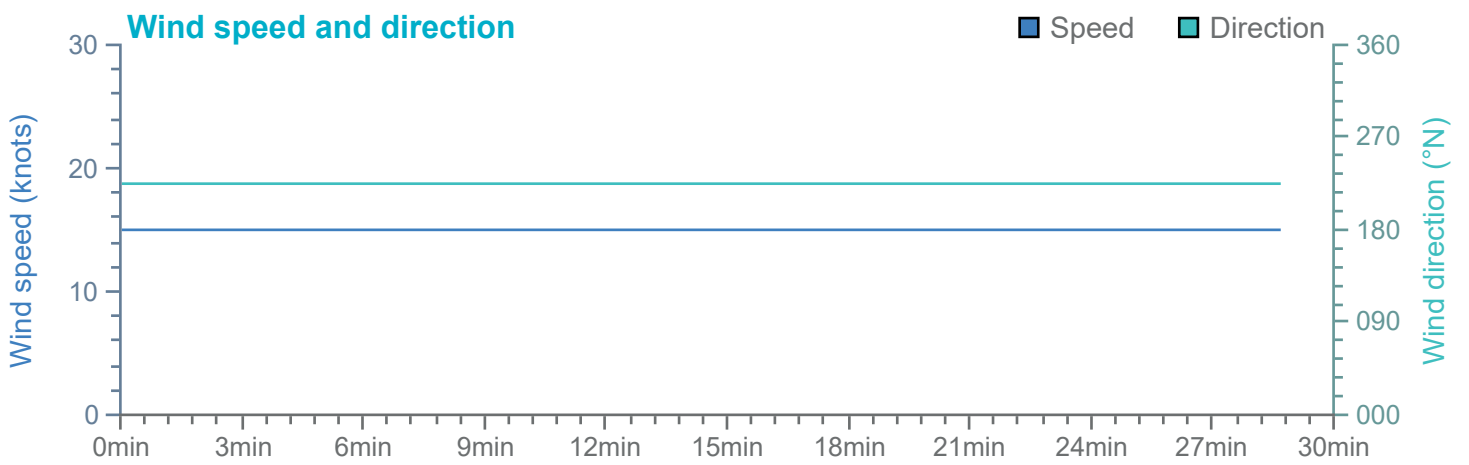
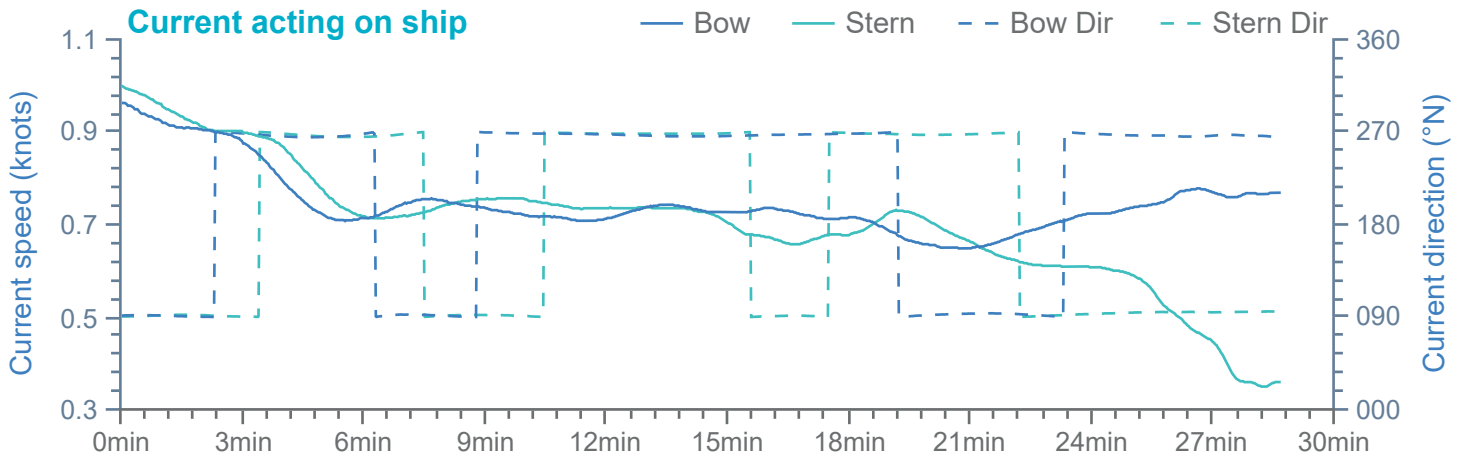
Overview

Environment

240m x 32m RoPax

Thruster and engine use



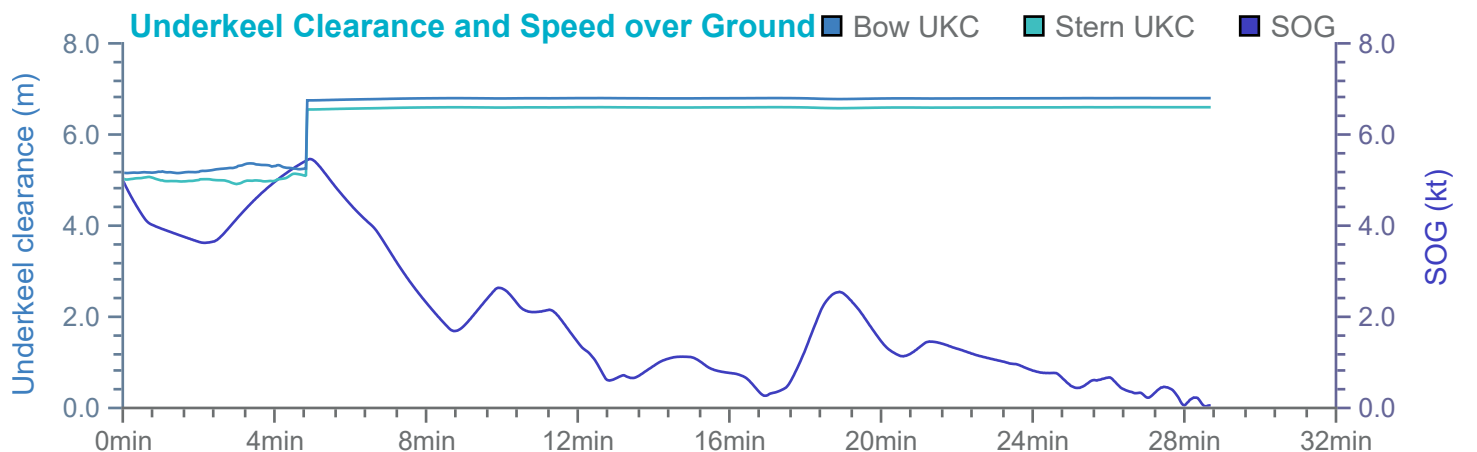
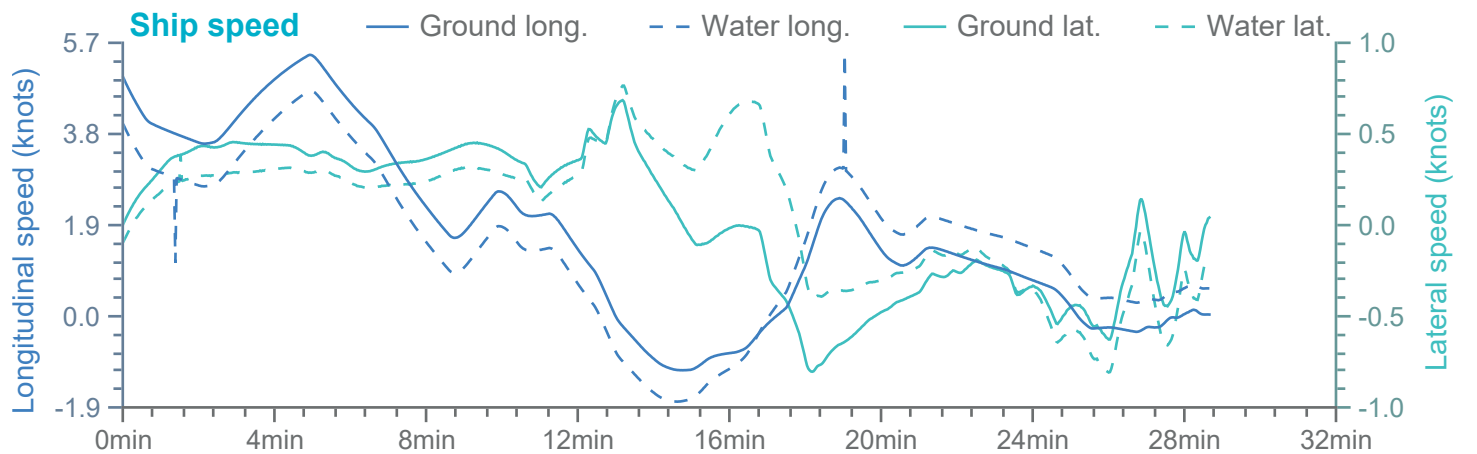
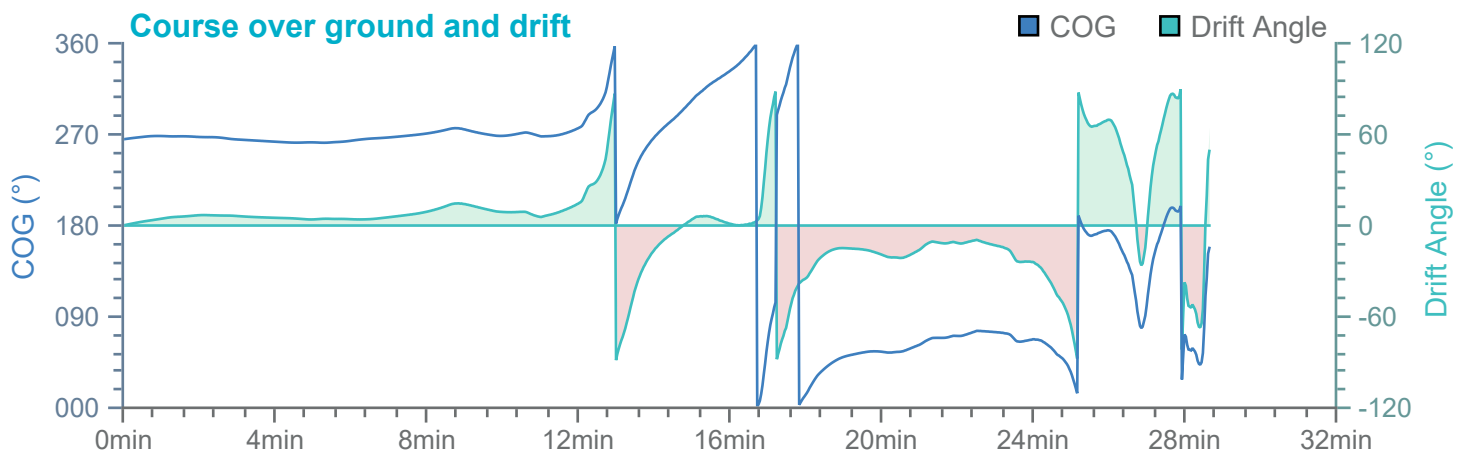
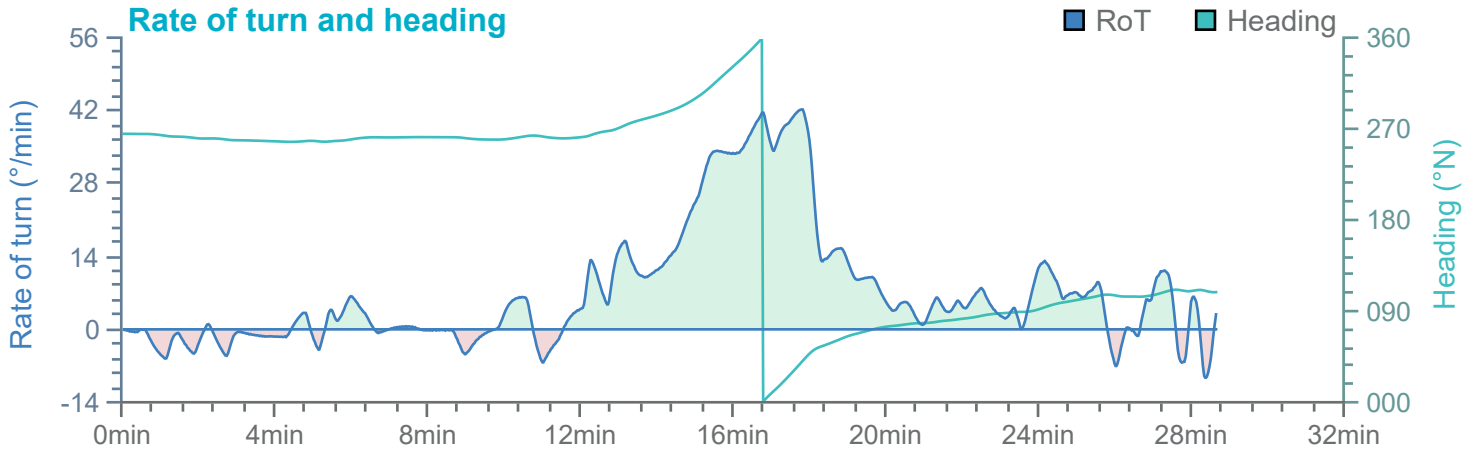


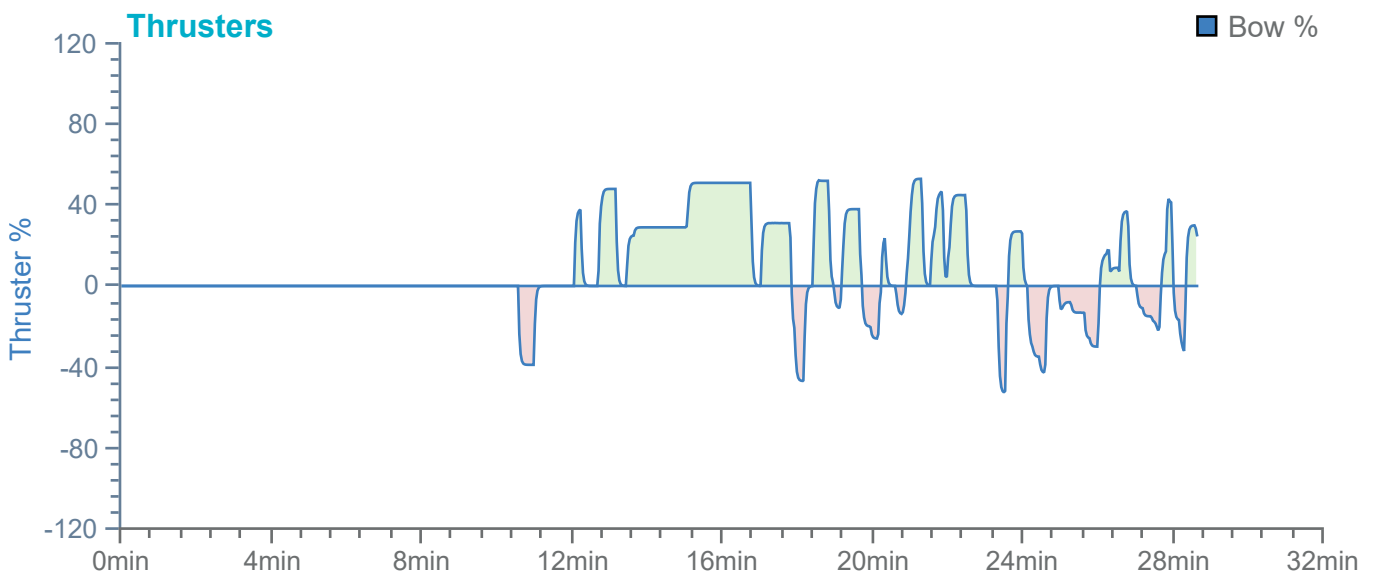
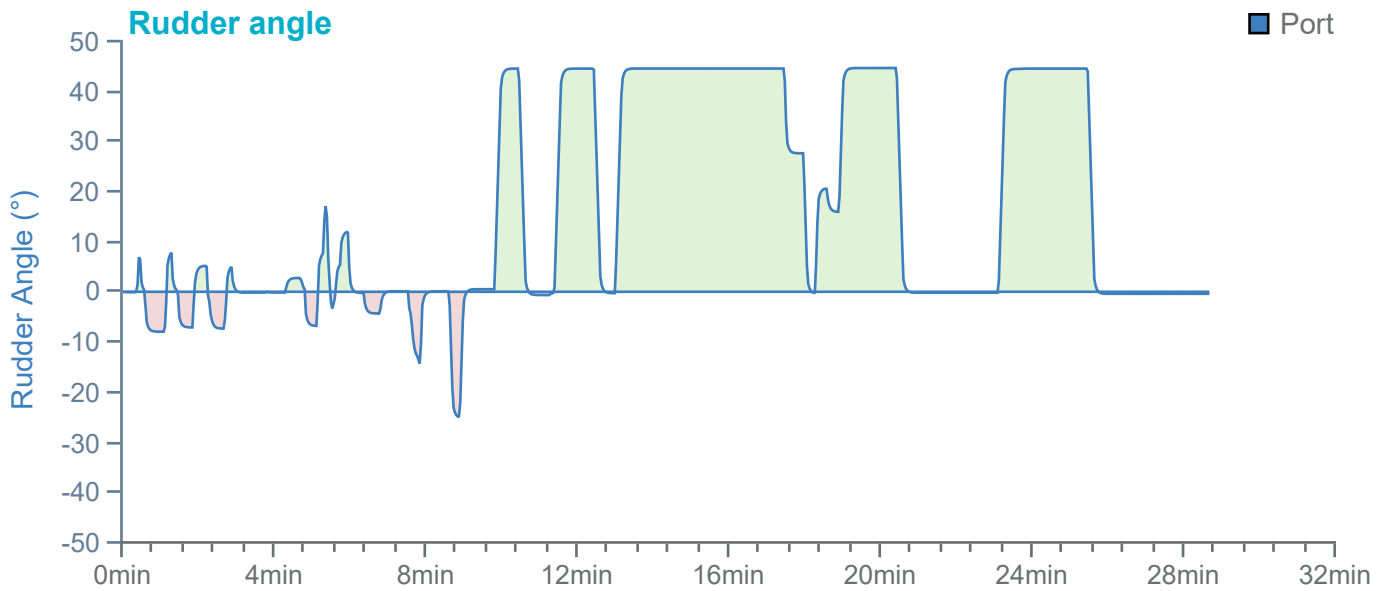
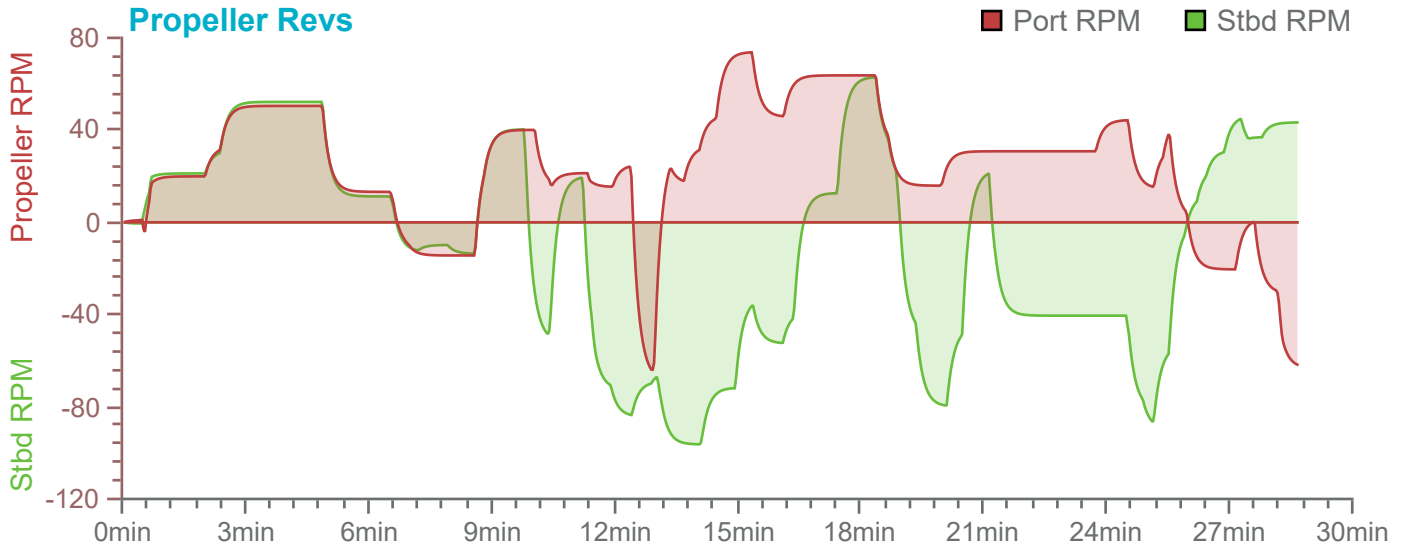
Overview

Environment

240m x 32m RoPax

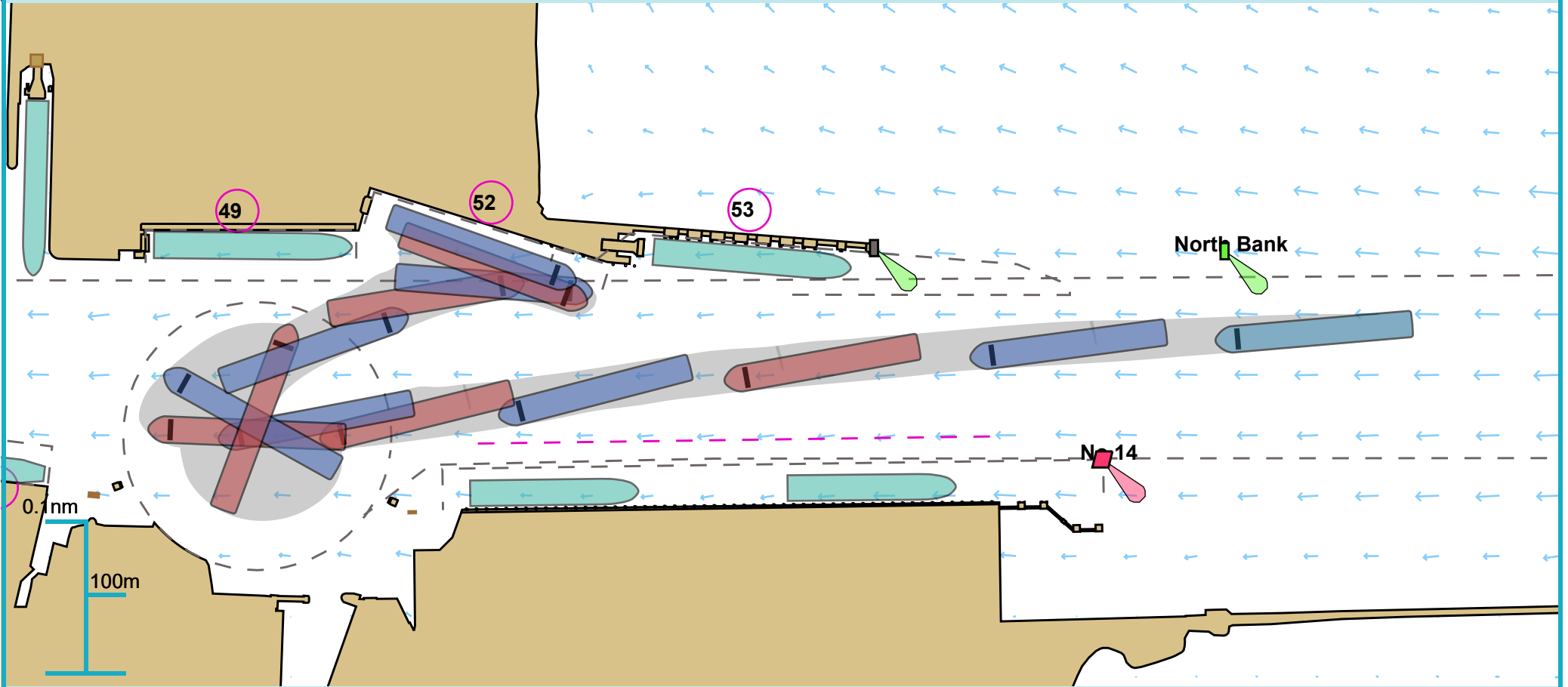
Thruster and engine use





Full Run Overview

53° 20.375 N, 006° 11.924 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

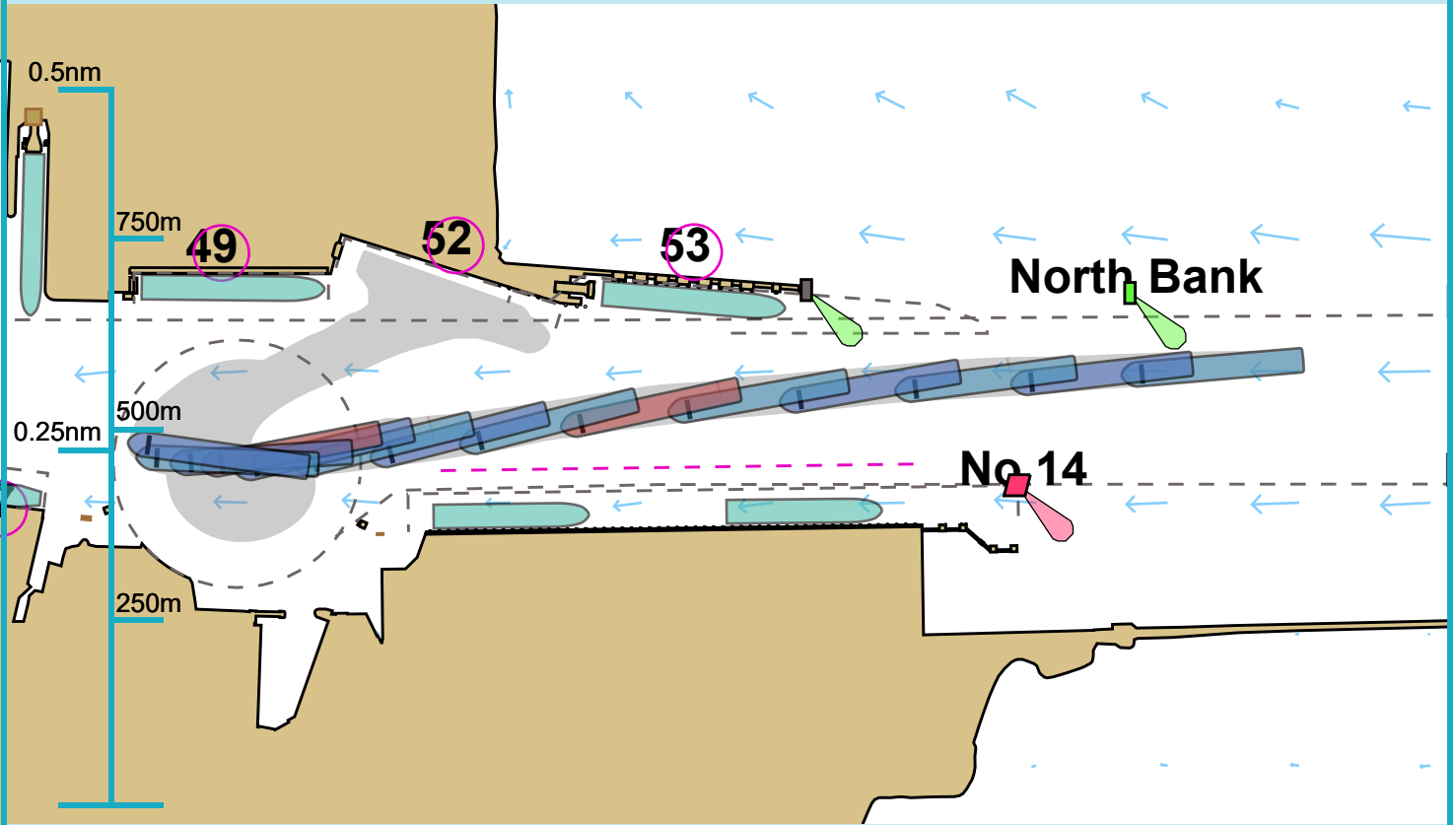
Run length: 26 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

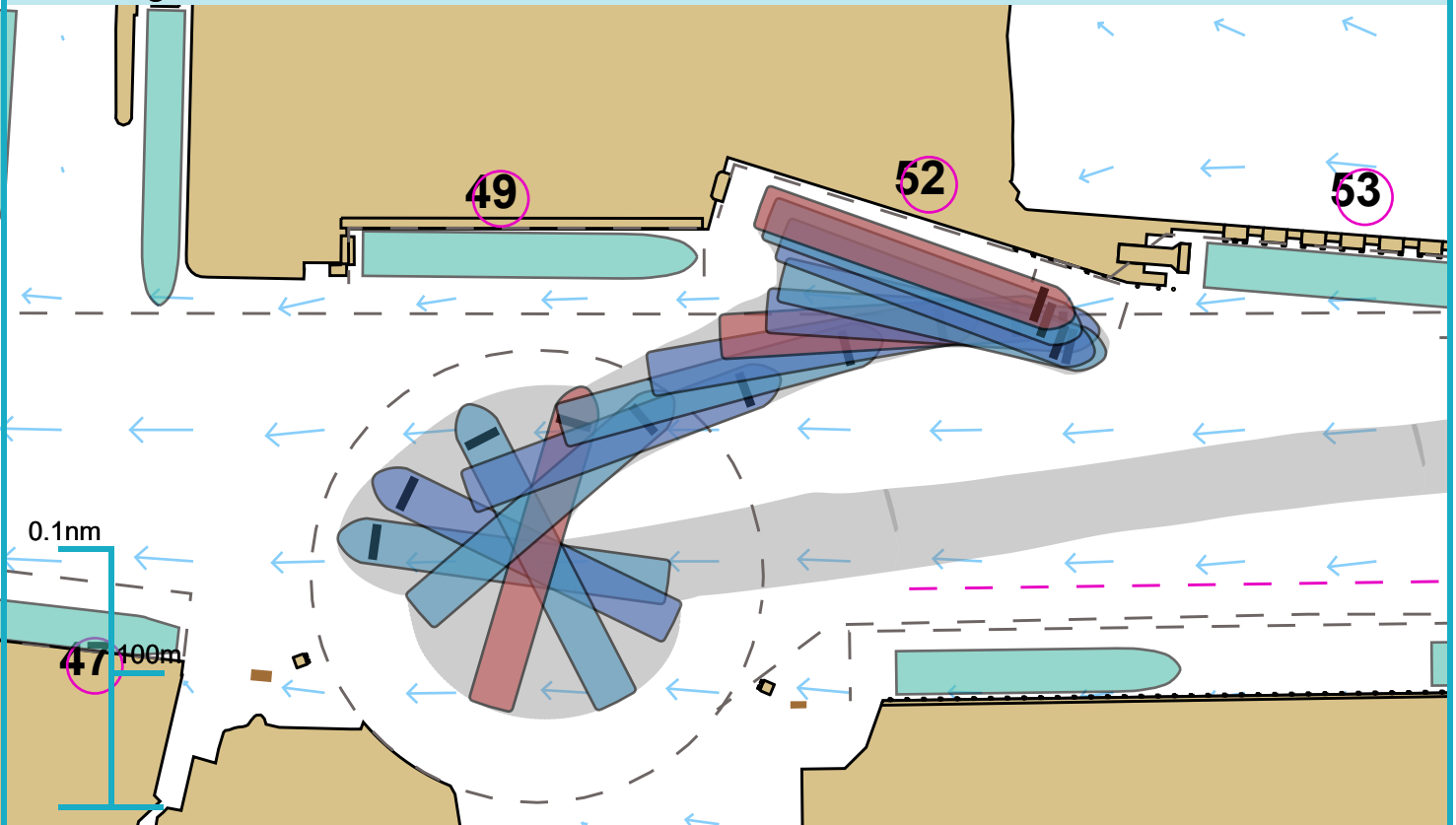
Comments:

Approach



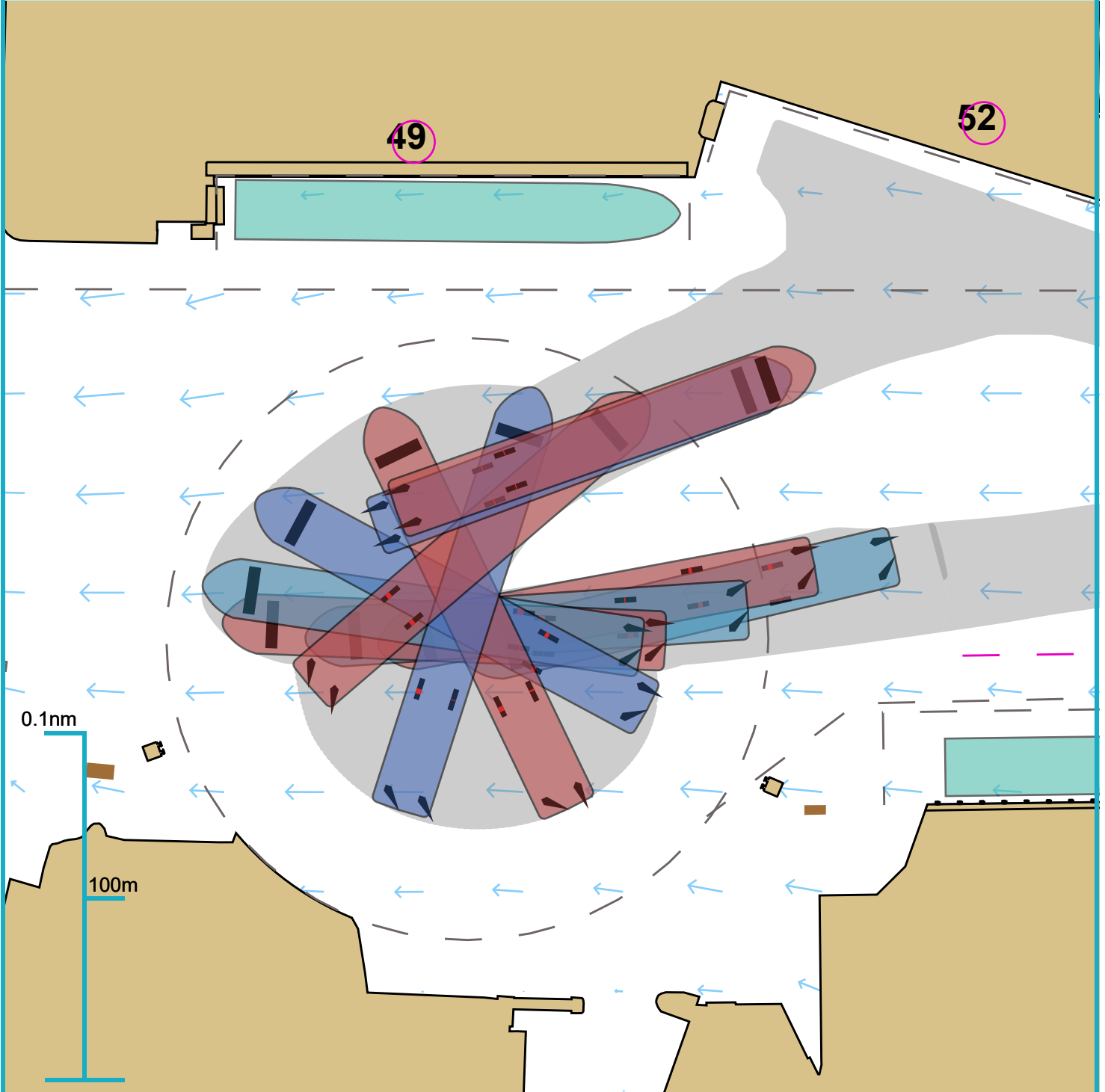
Ships plotted every 1 mins, highlight every 5 mins

Berthing

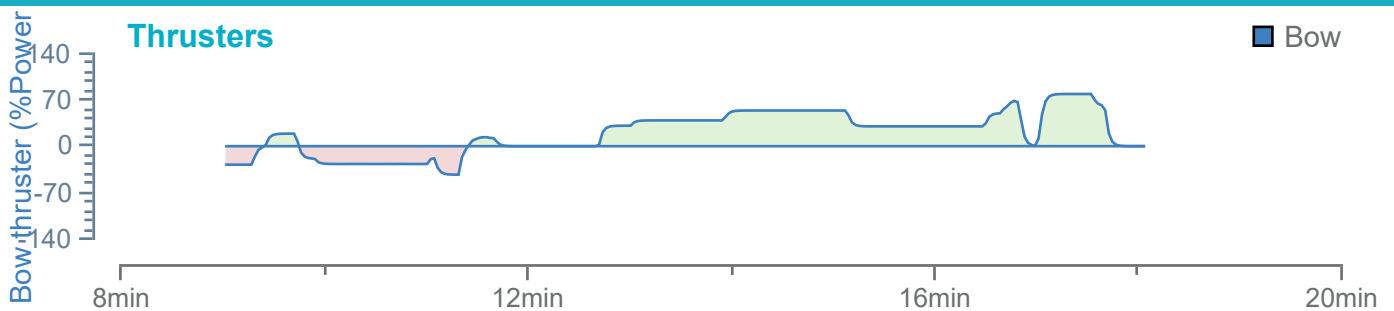


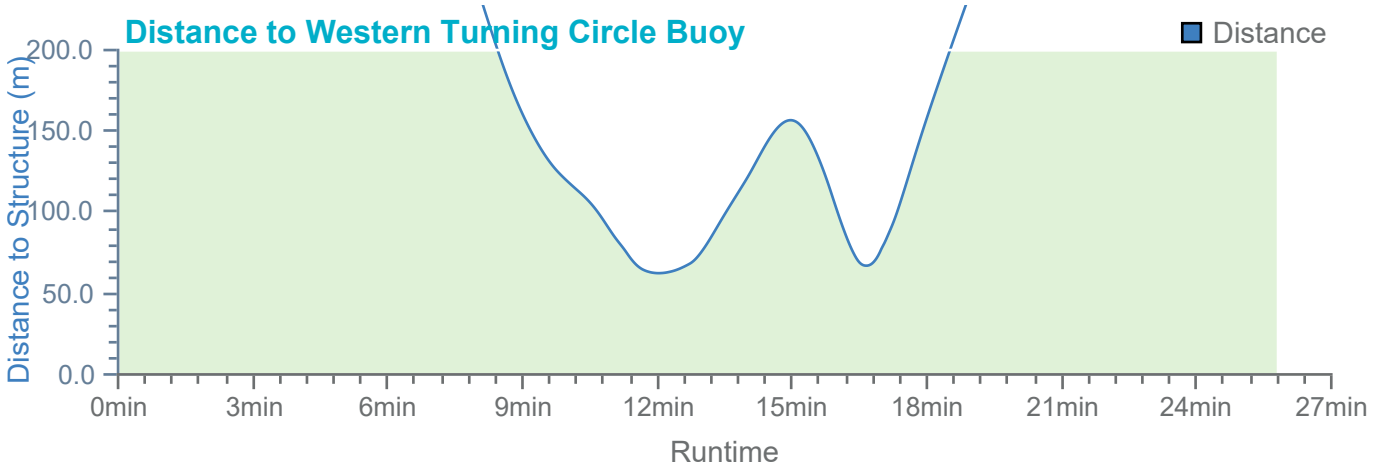
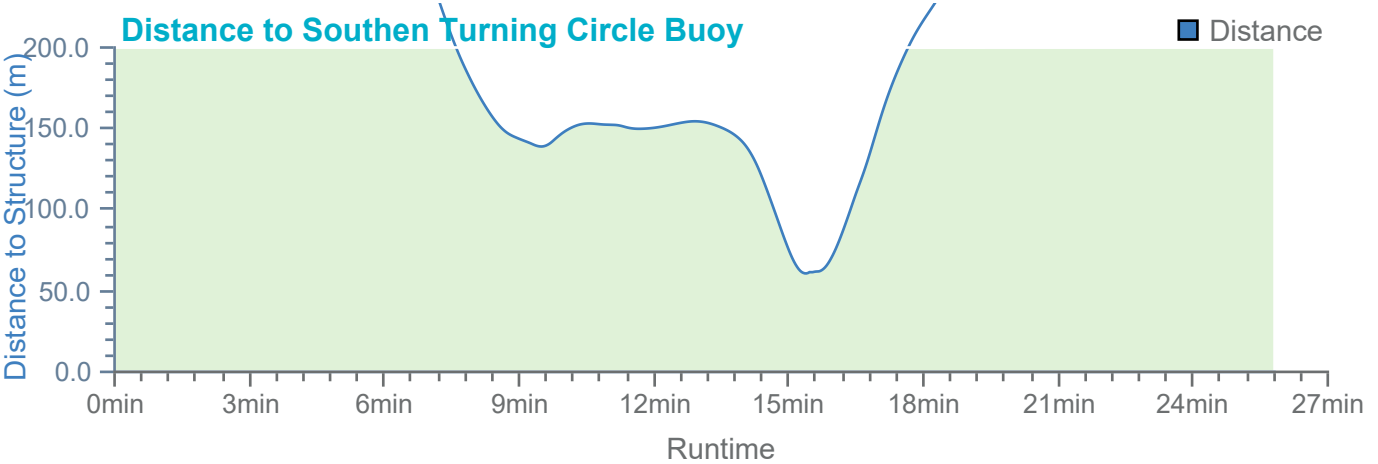
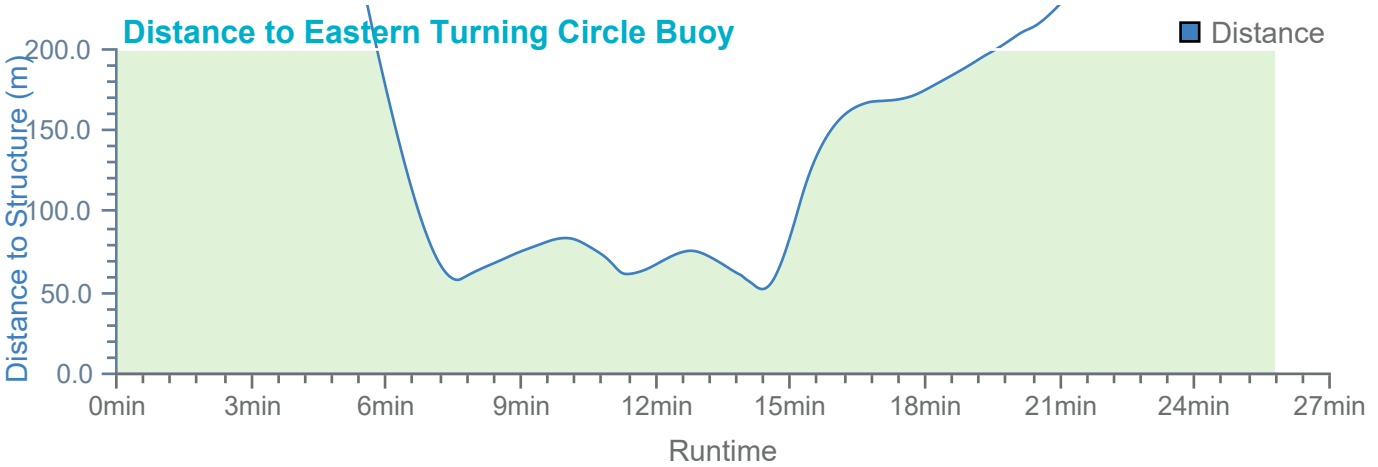
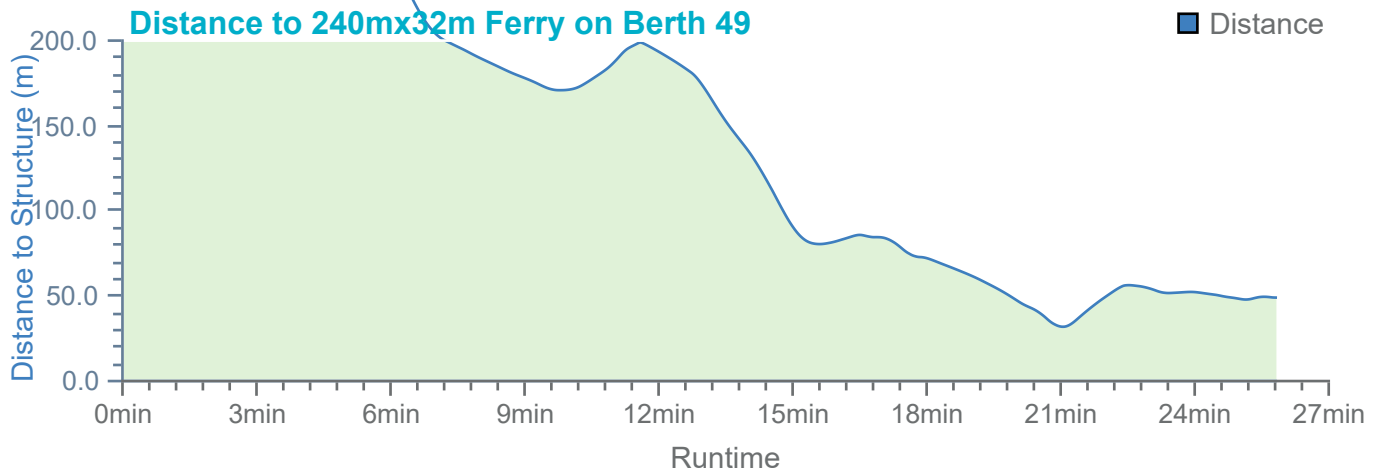
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



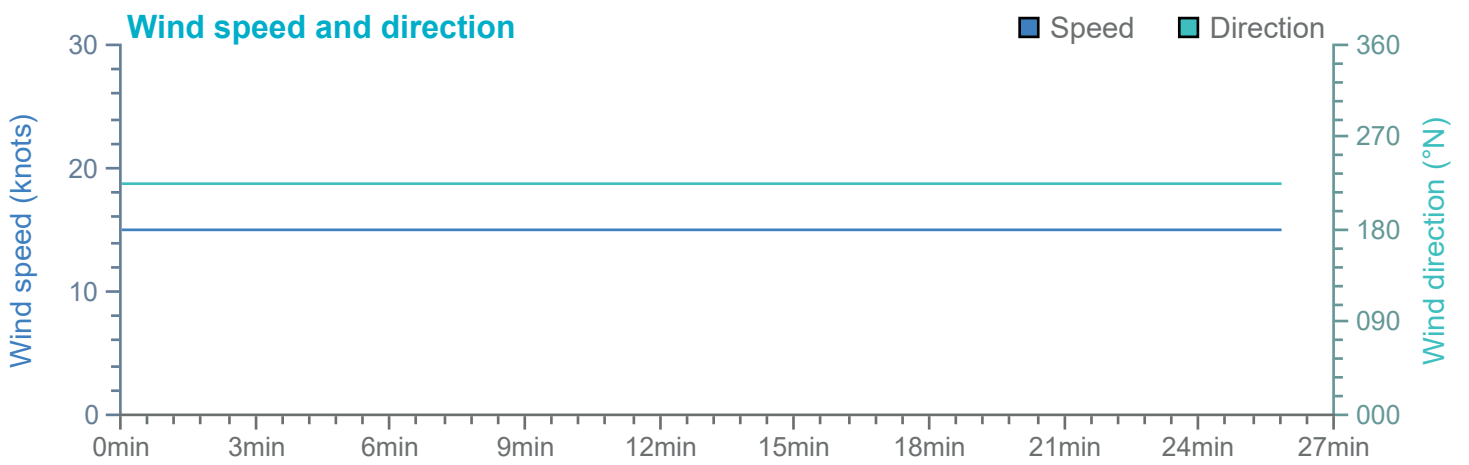
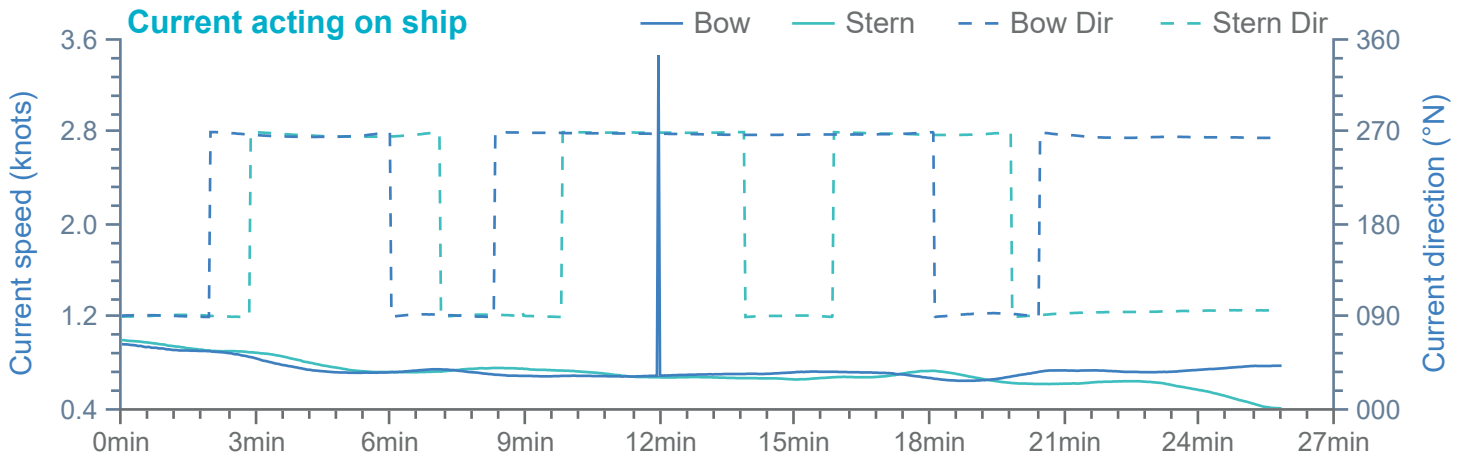


Overview

Environment

240m x 32m RoPax

Thruster and engine use

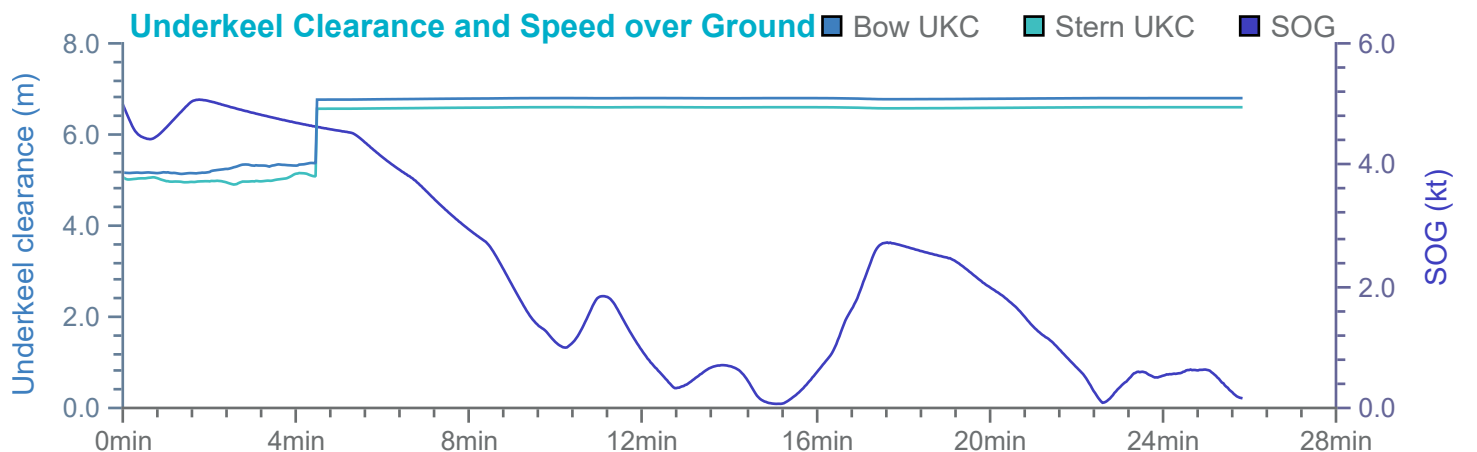
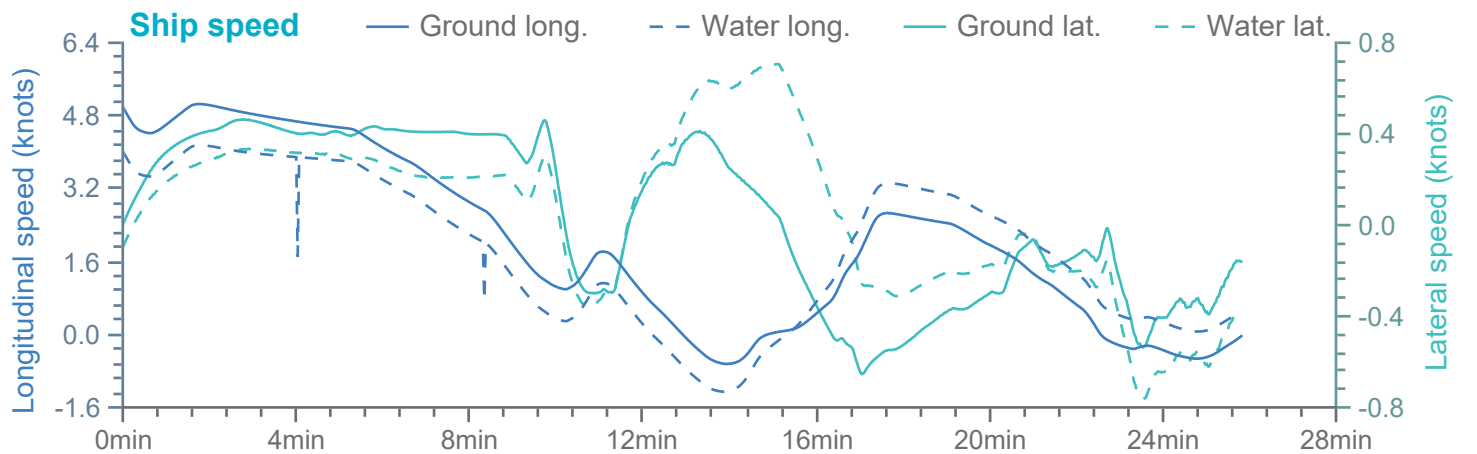
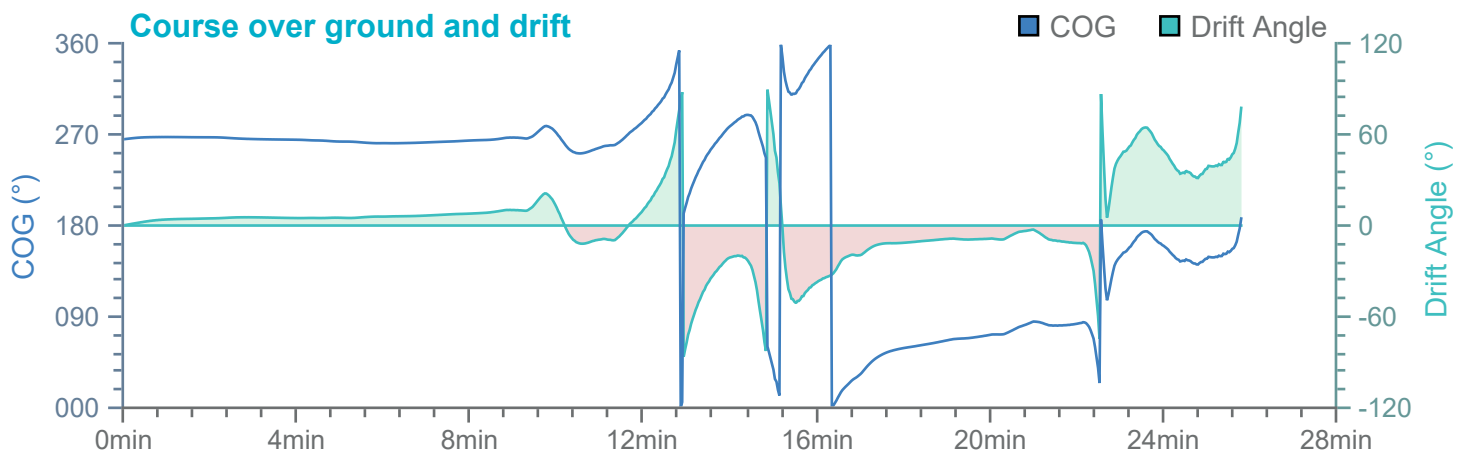
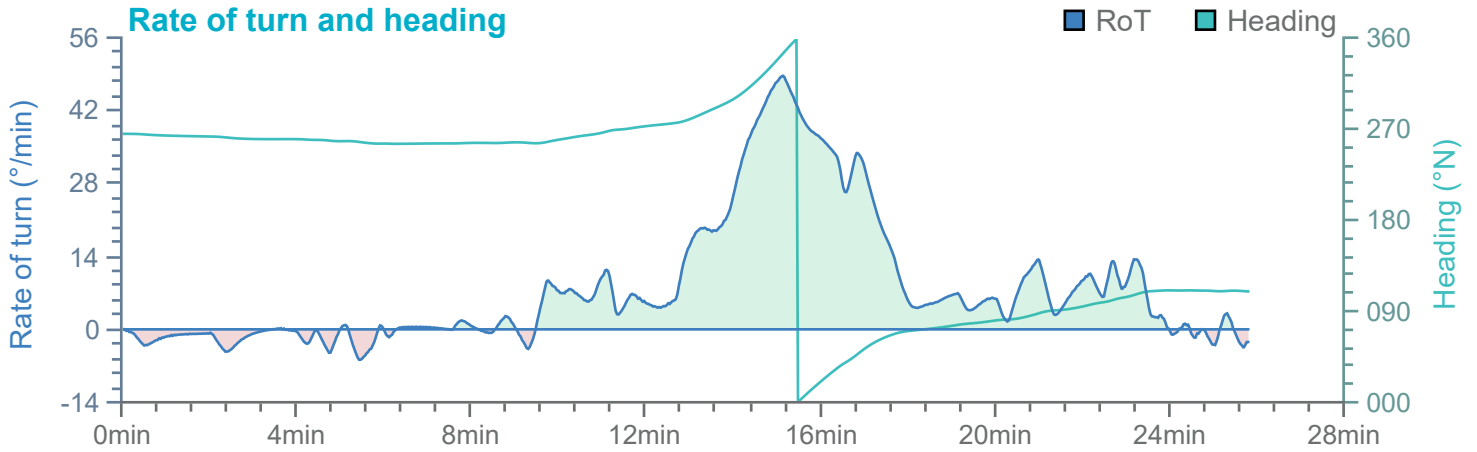


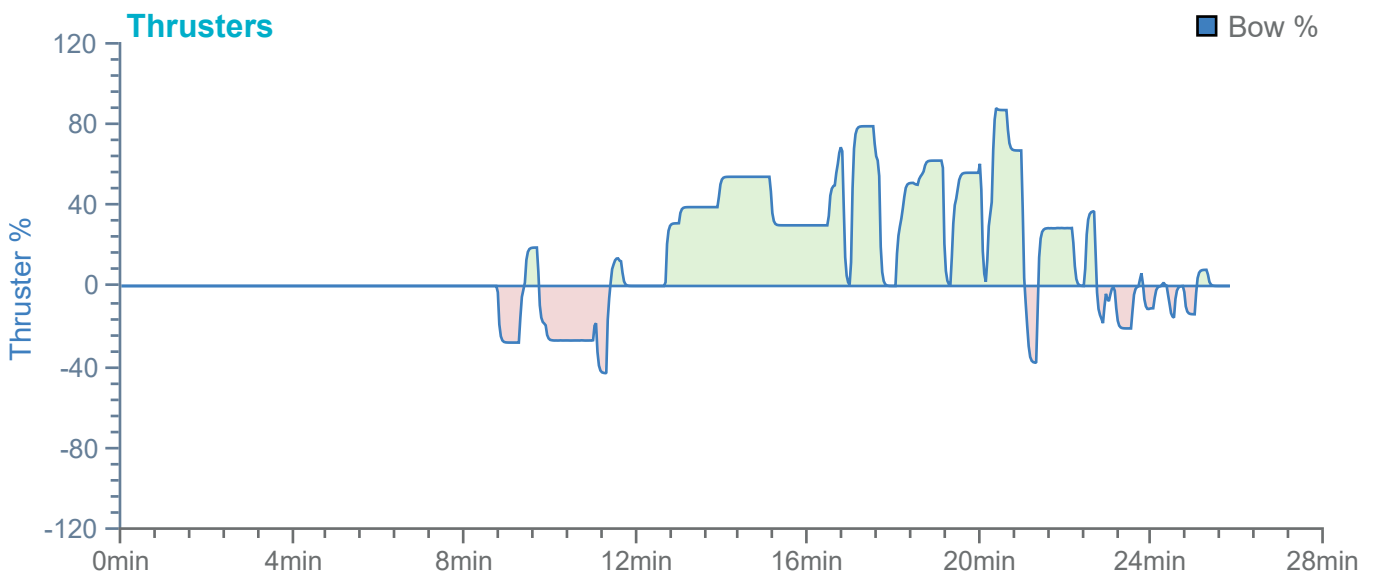
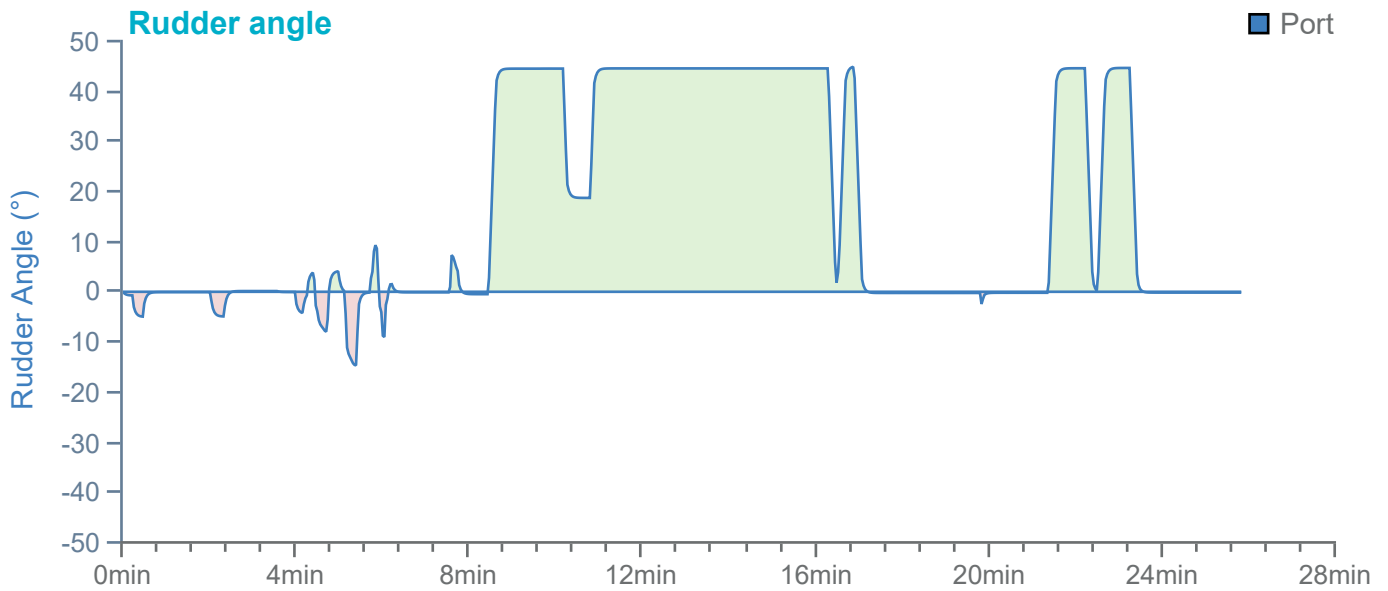
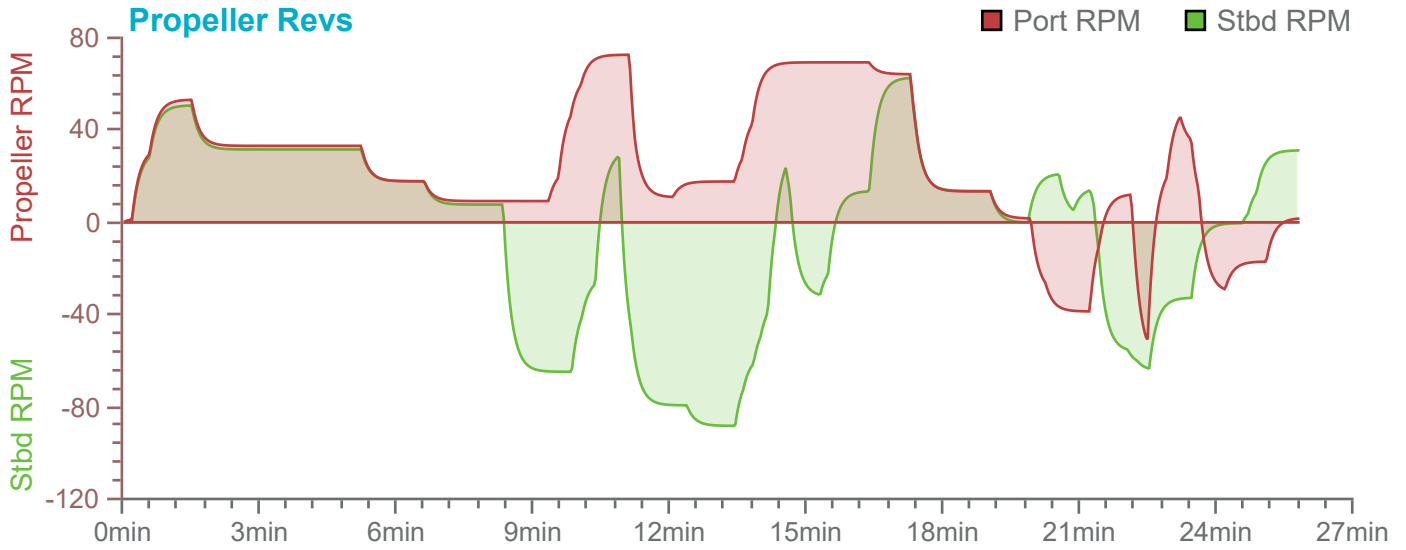
Overview

Environment

240m x 32m RoPax

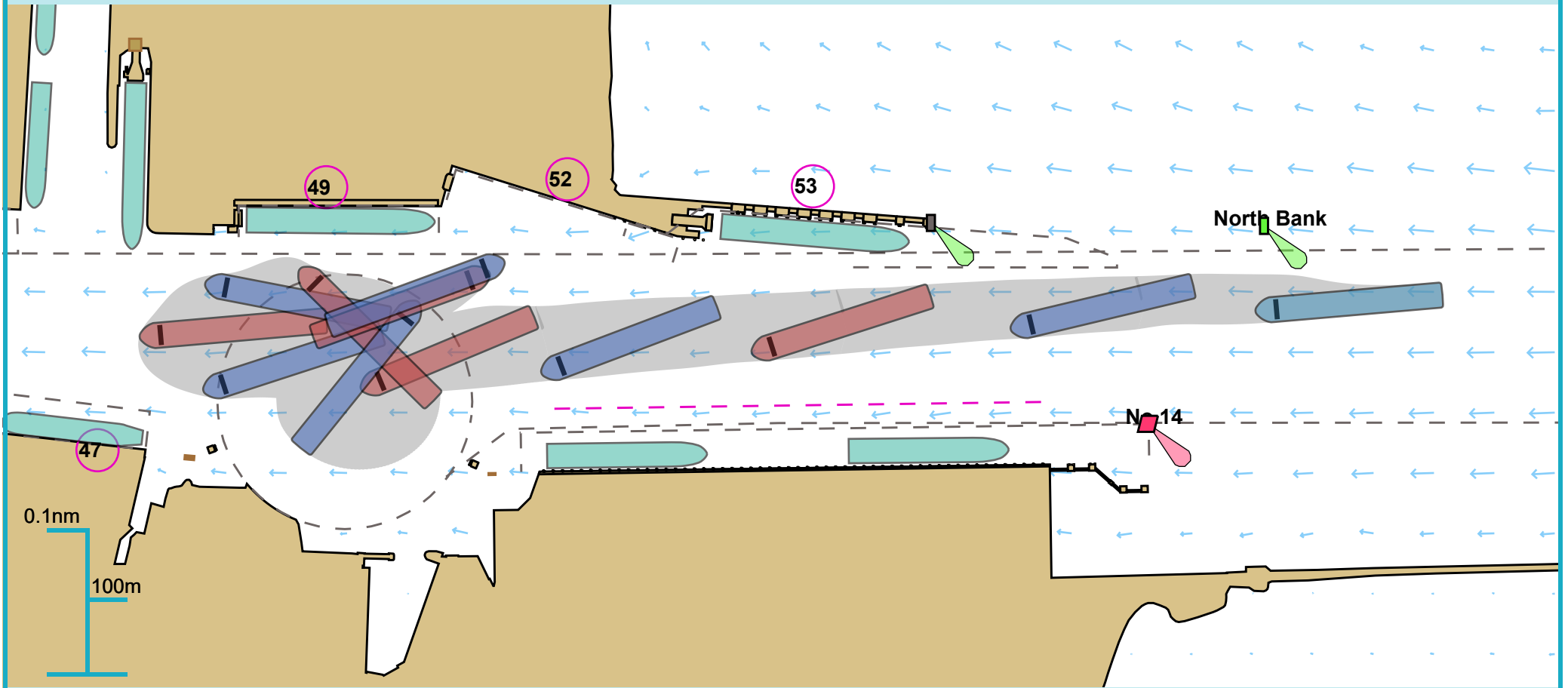
Thruster and engine use





Full Run Overview

53° 20.341 N, 006° 12.037 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

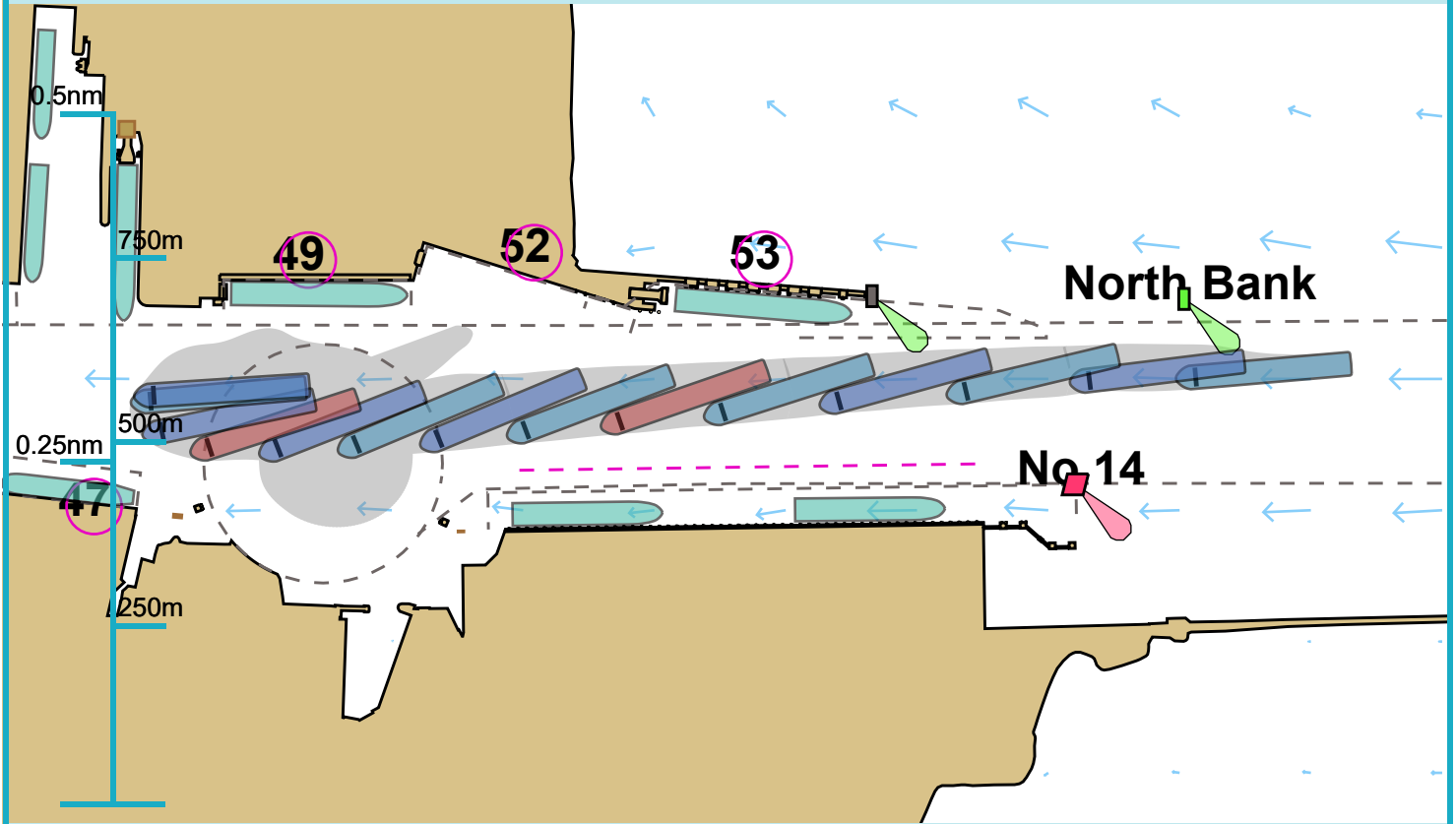
Run length: 20 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

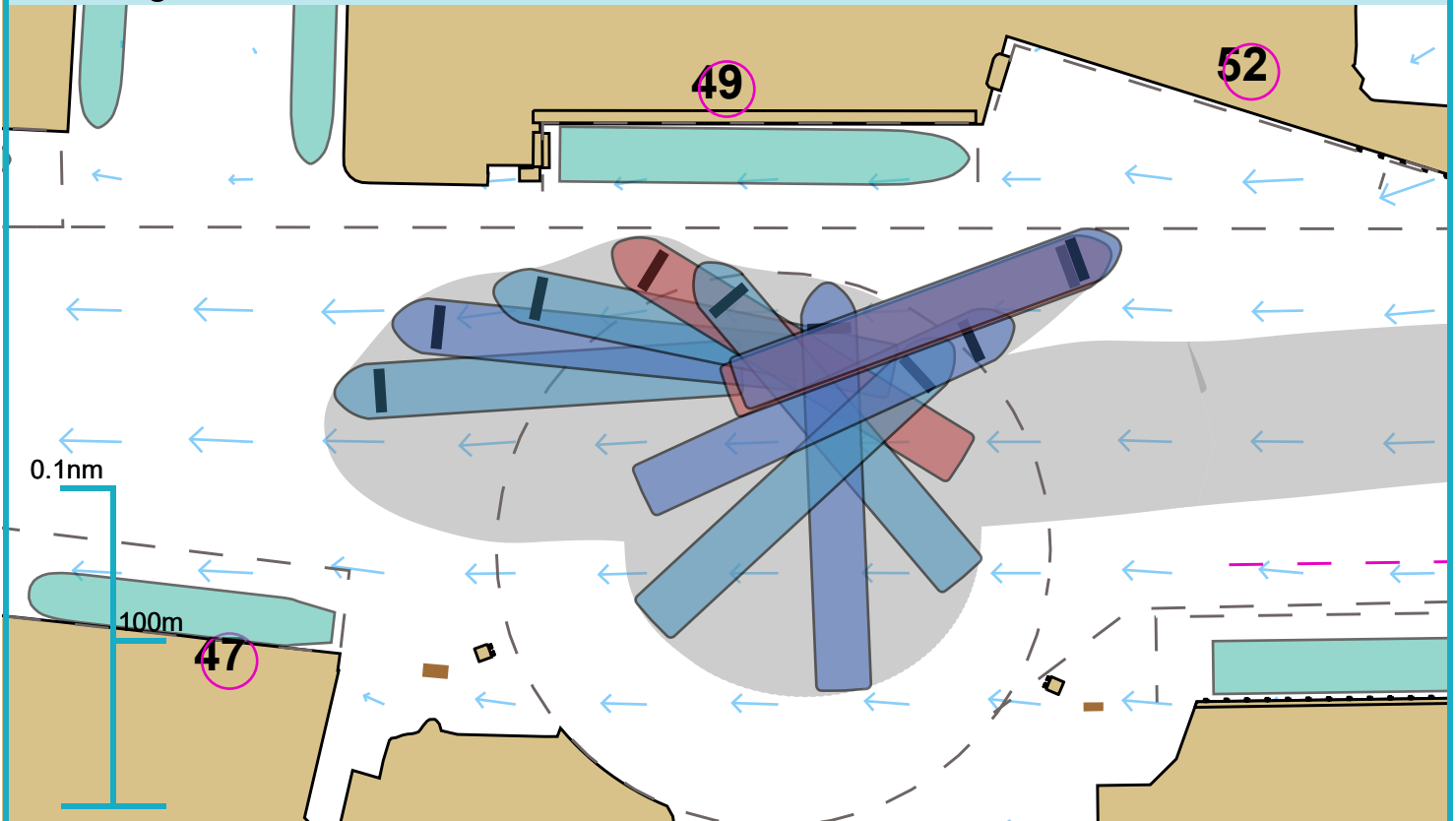
Comments:

Approach



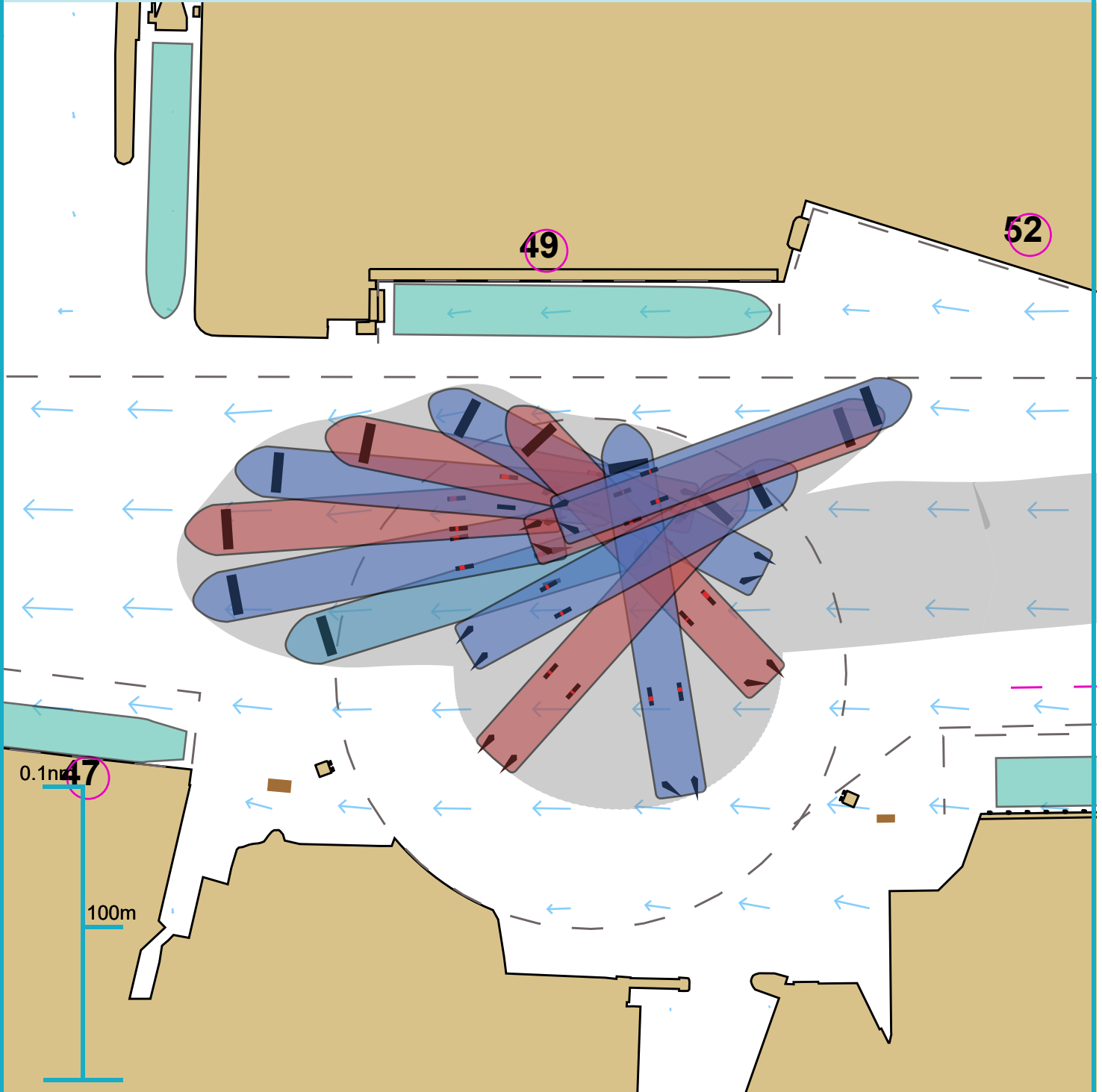
Ships plotted every 1 mins, highlight every 5 mins

Berthing

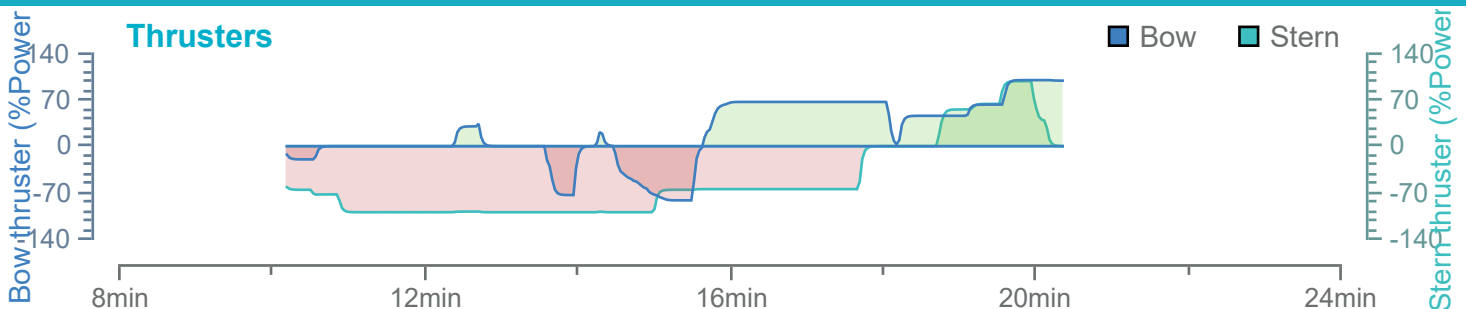


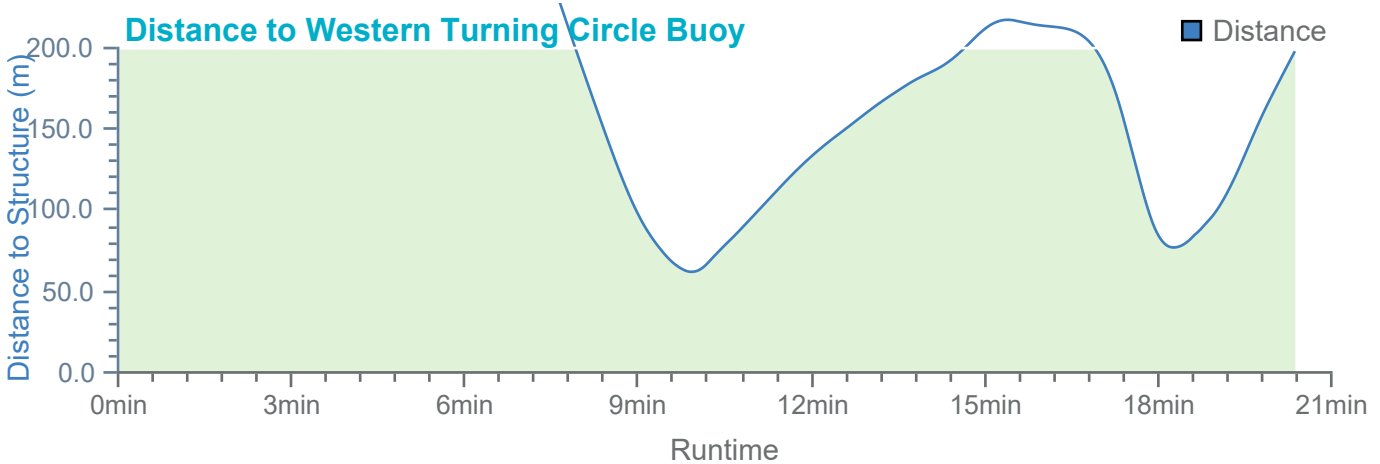
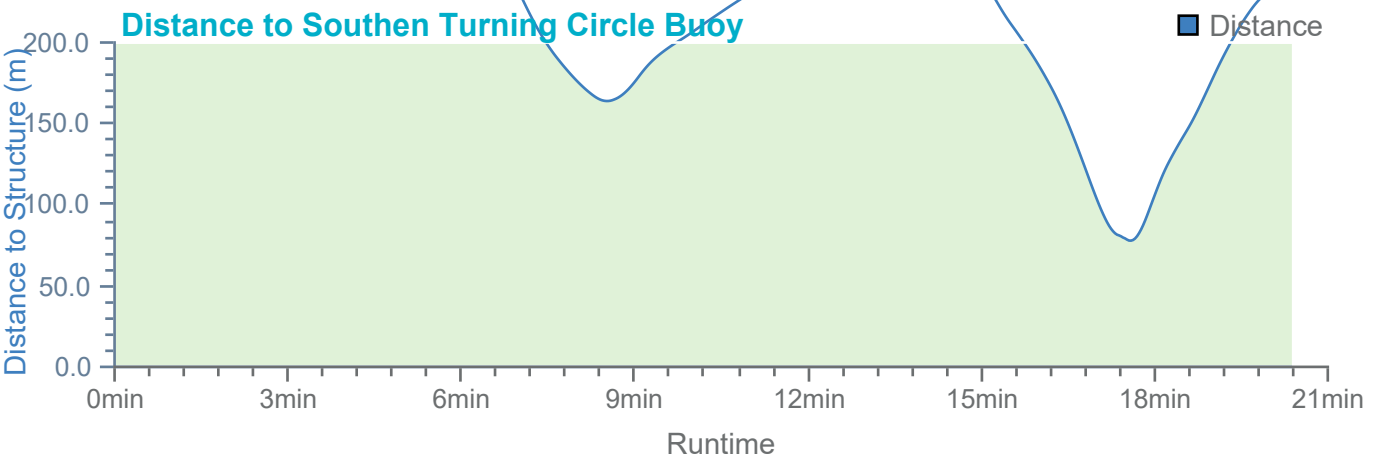
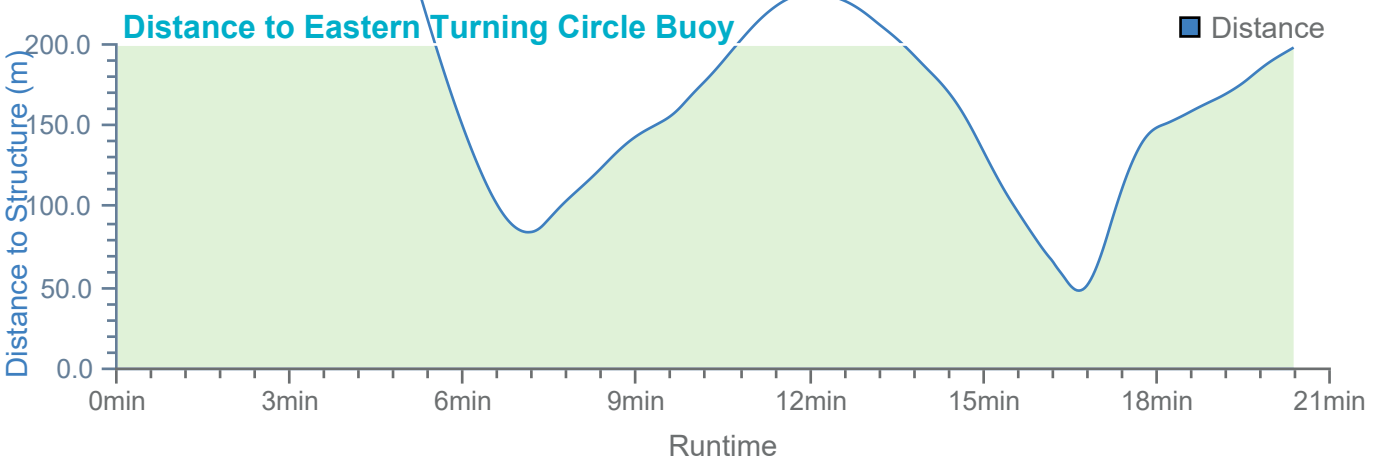
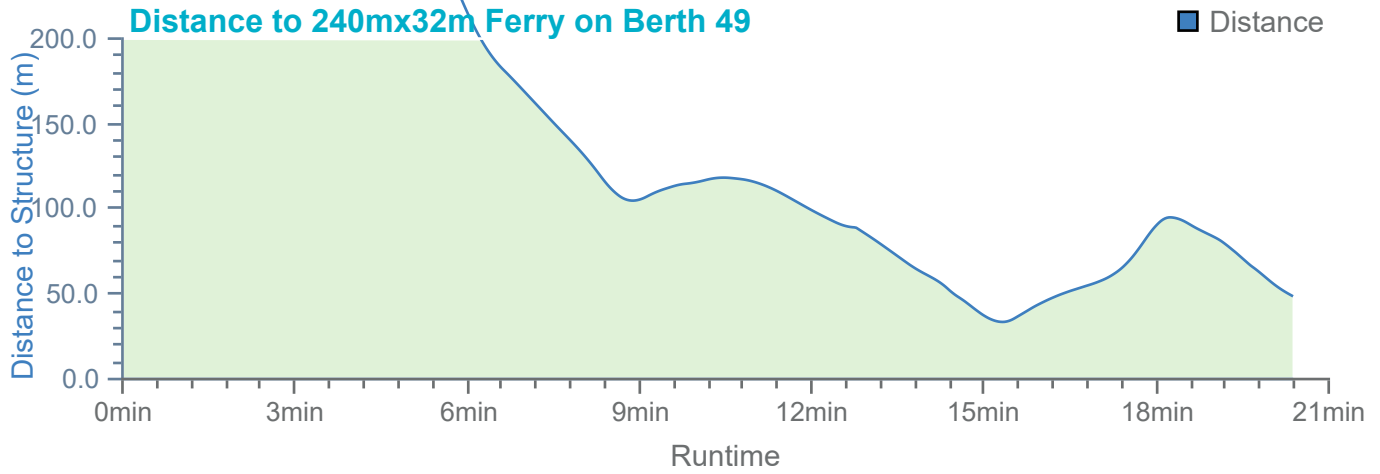
Ships plotted every 1 mins, highlight every 5 mins

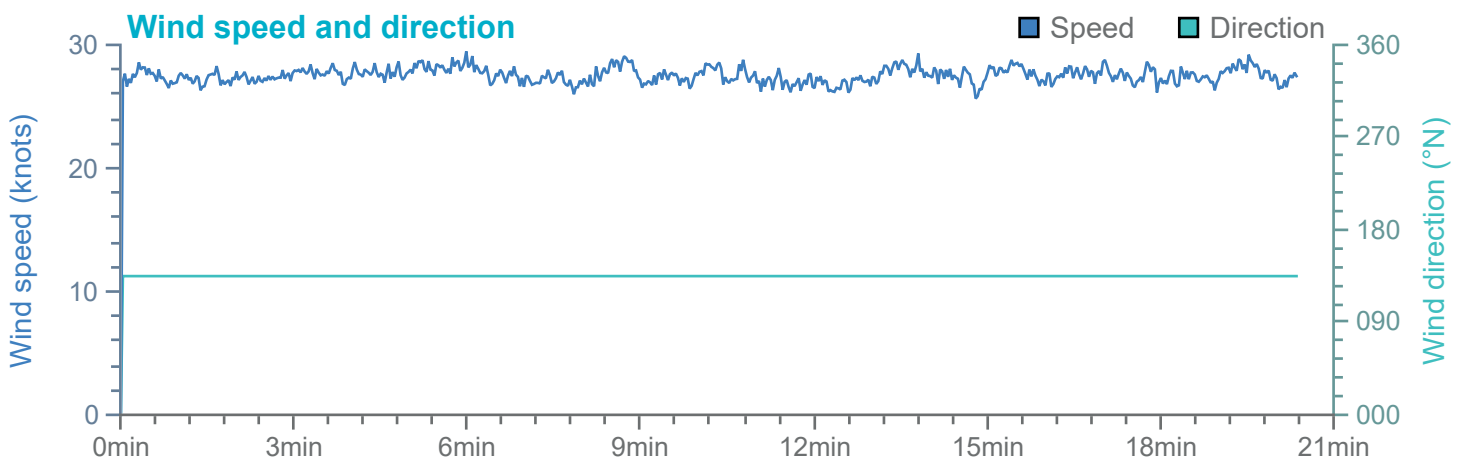
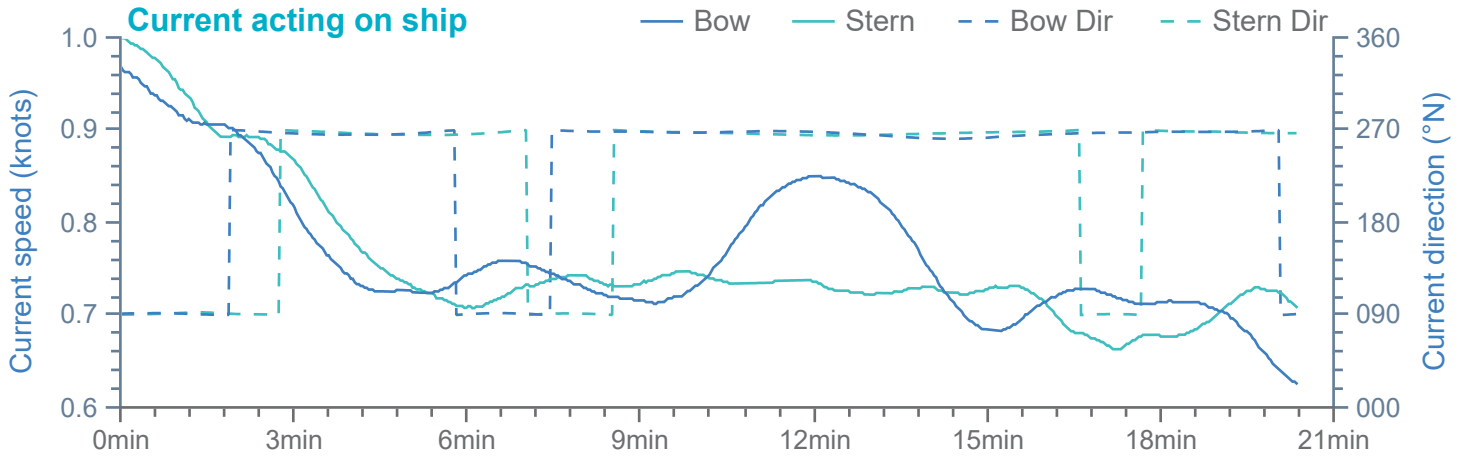
Swing



Ships plotted every 59 seconds, highlight every 2 mins





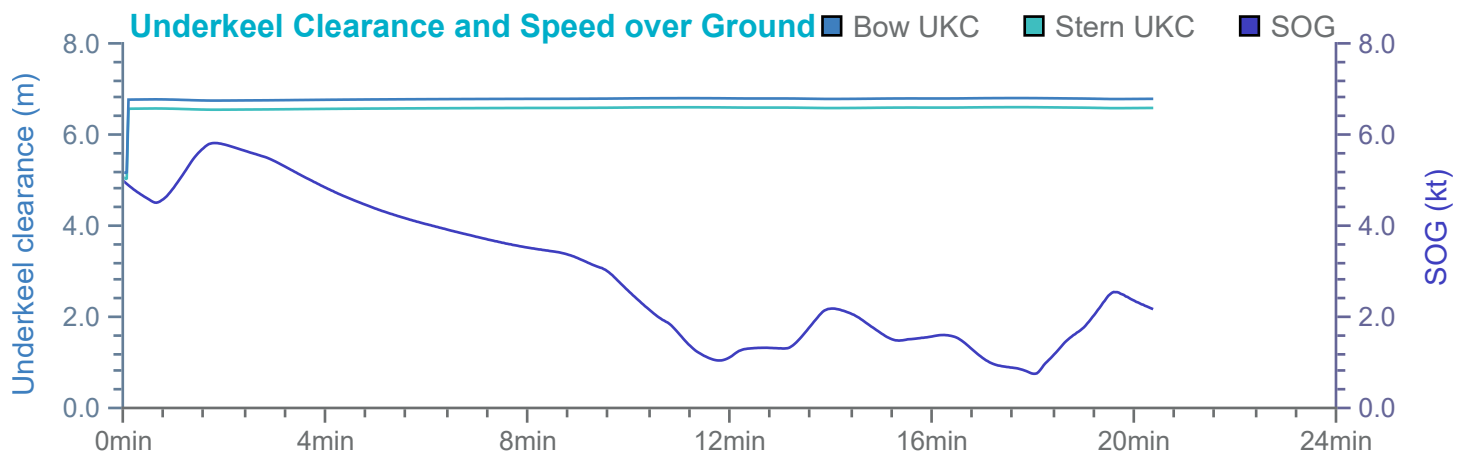
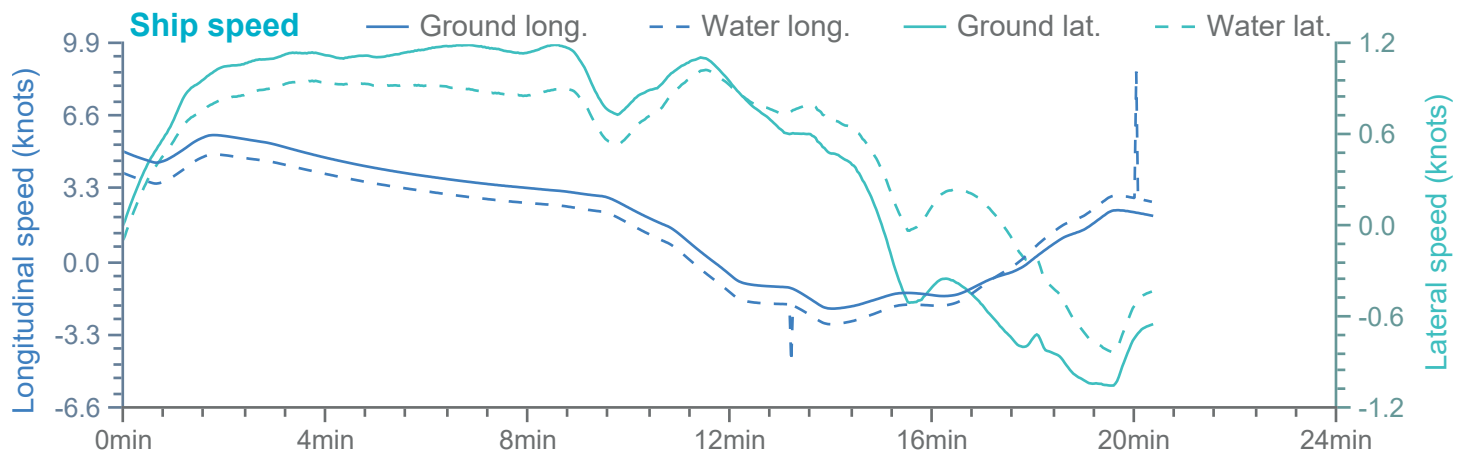
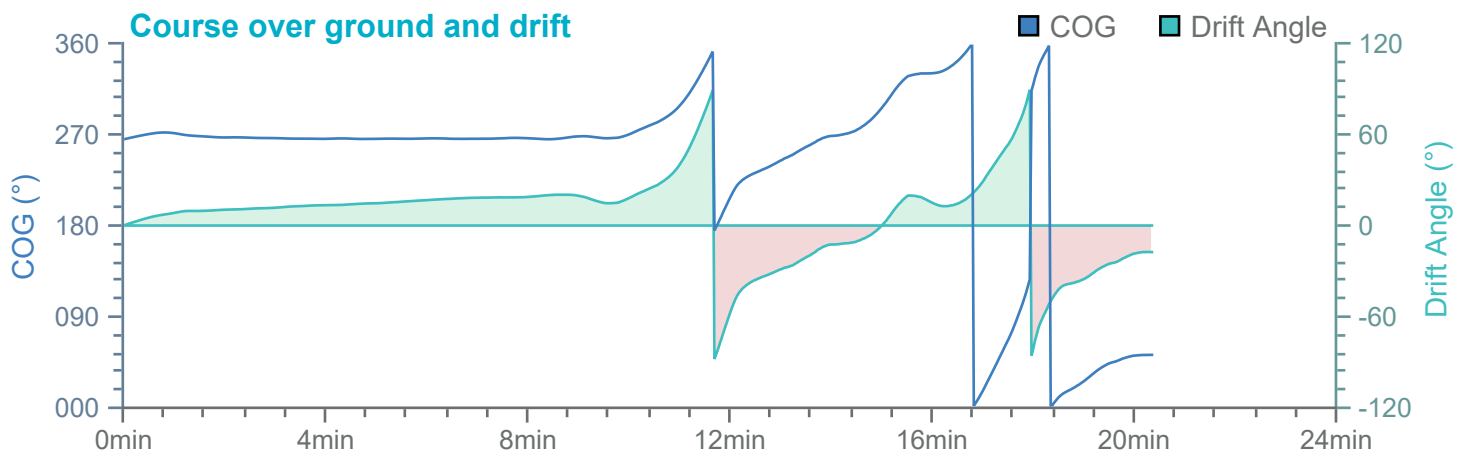
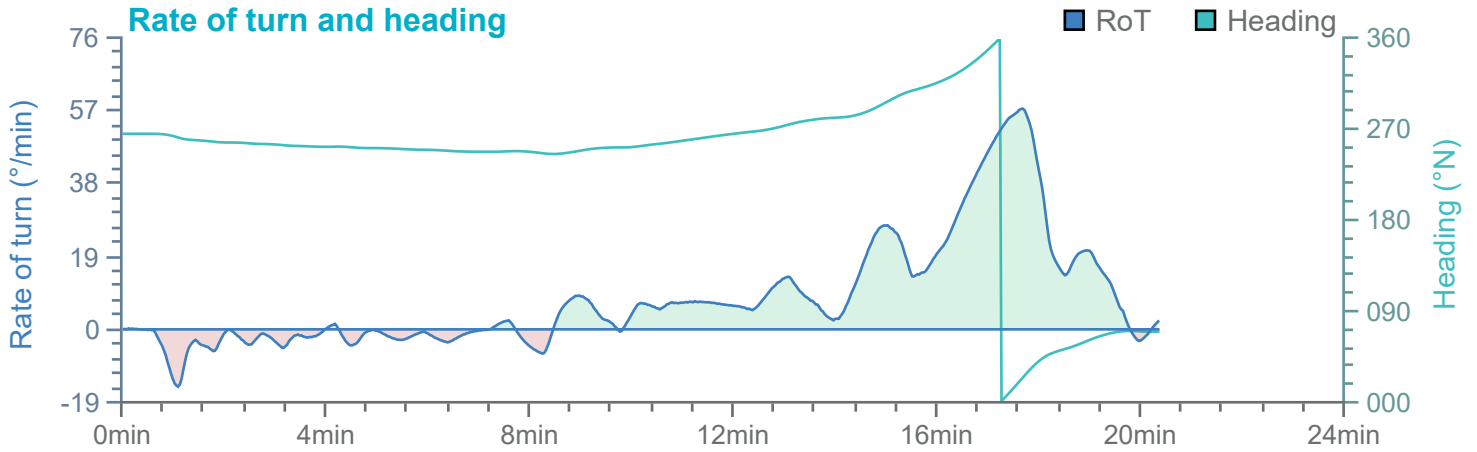


Overview

Environment

240m x 32m RoPax

Thruster and engine use

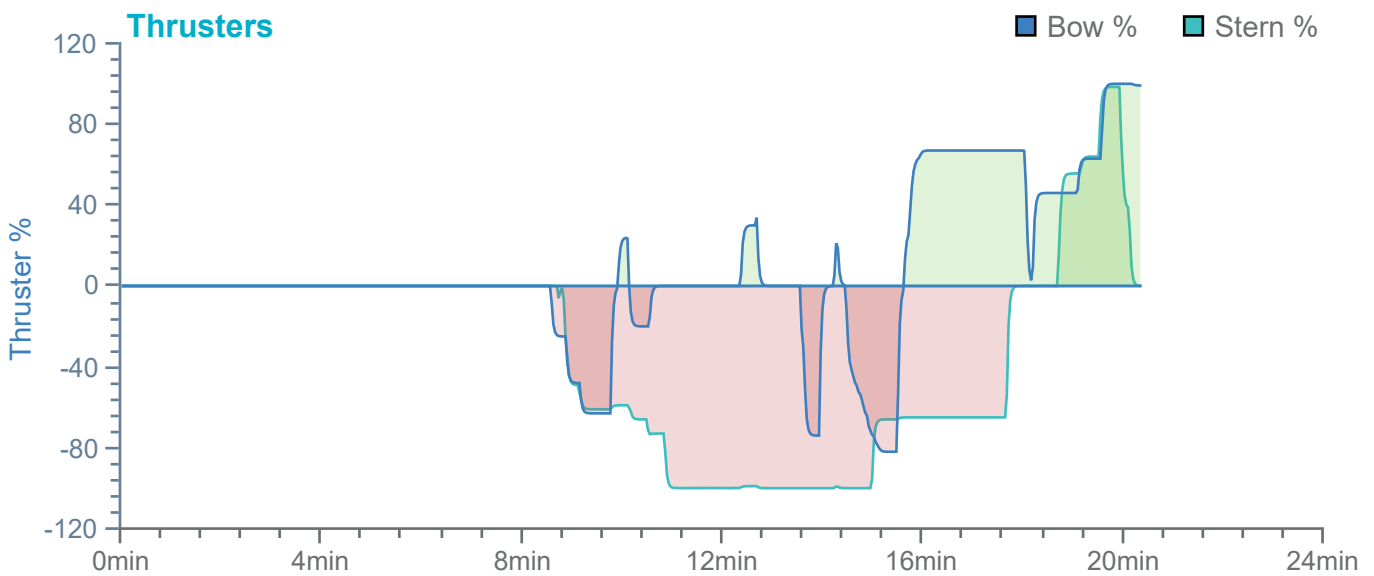
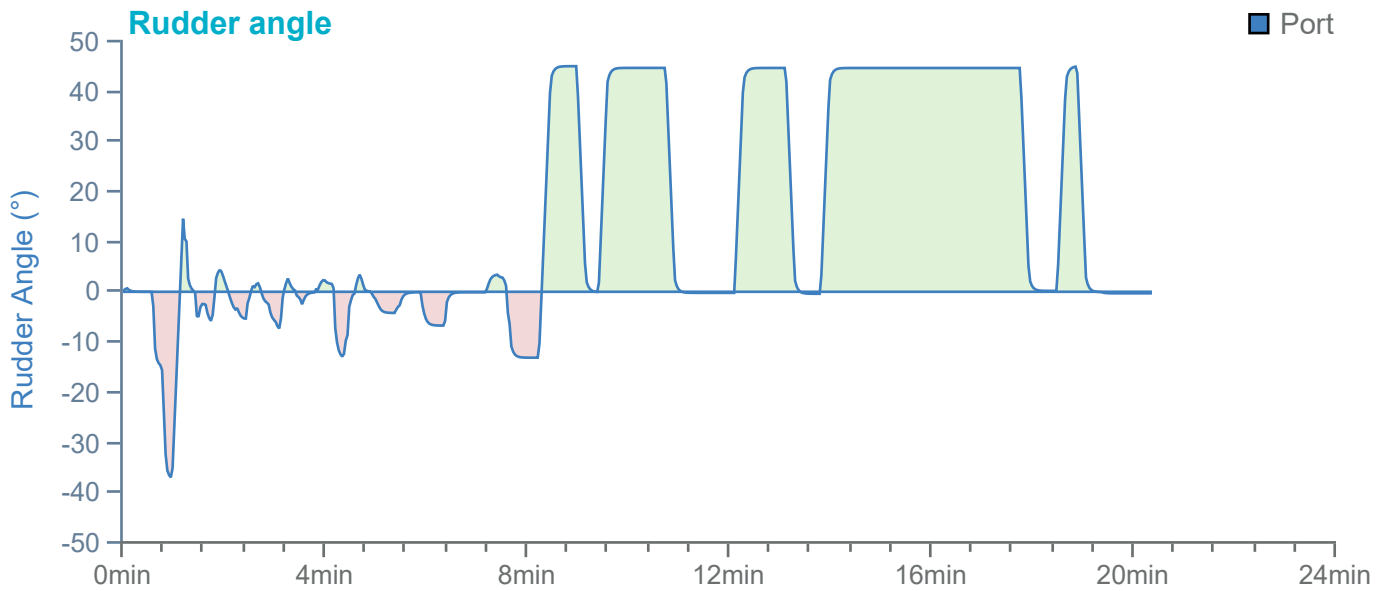
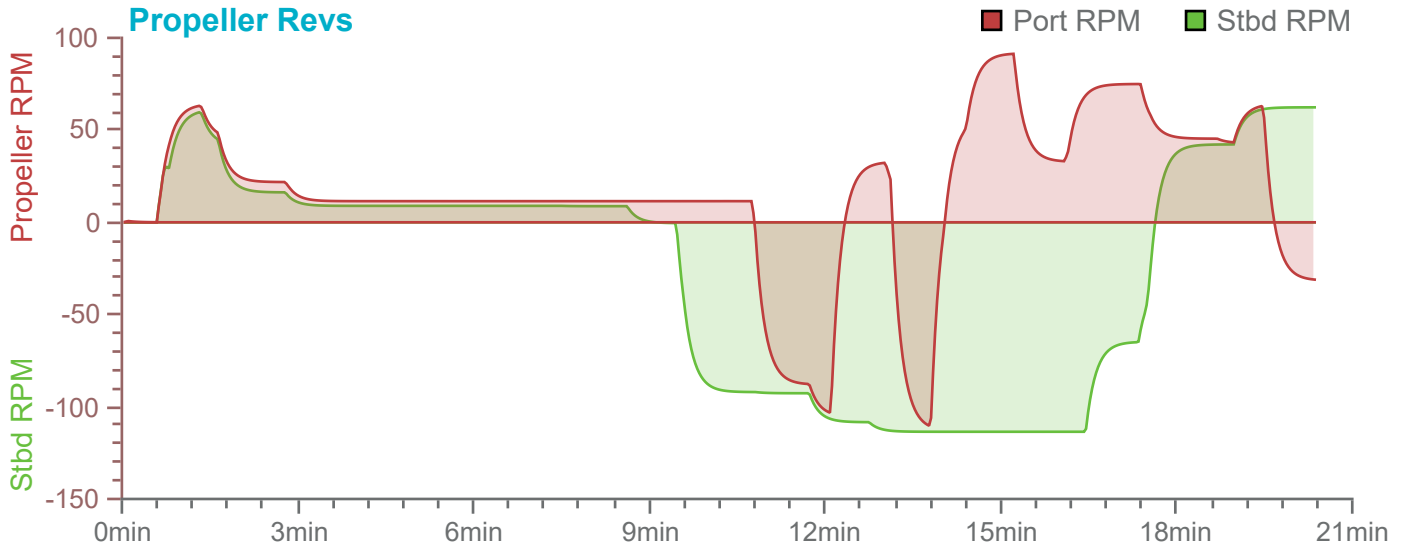


Overview

Environment

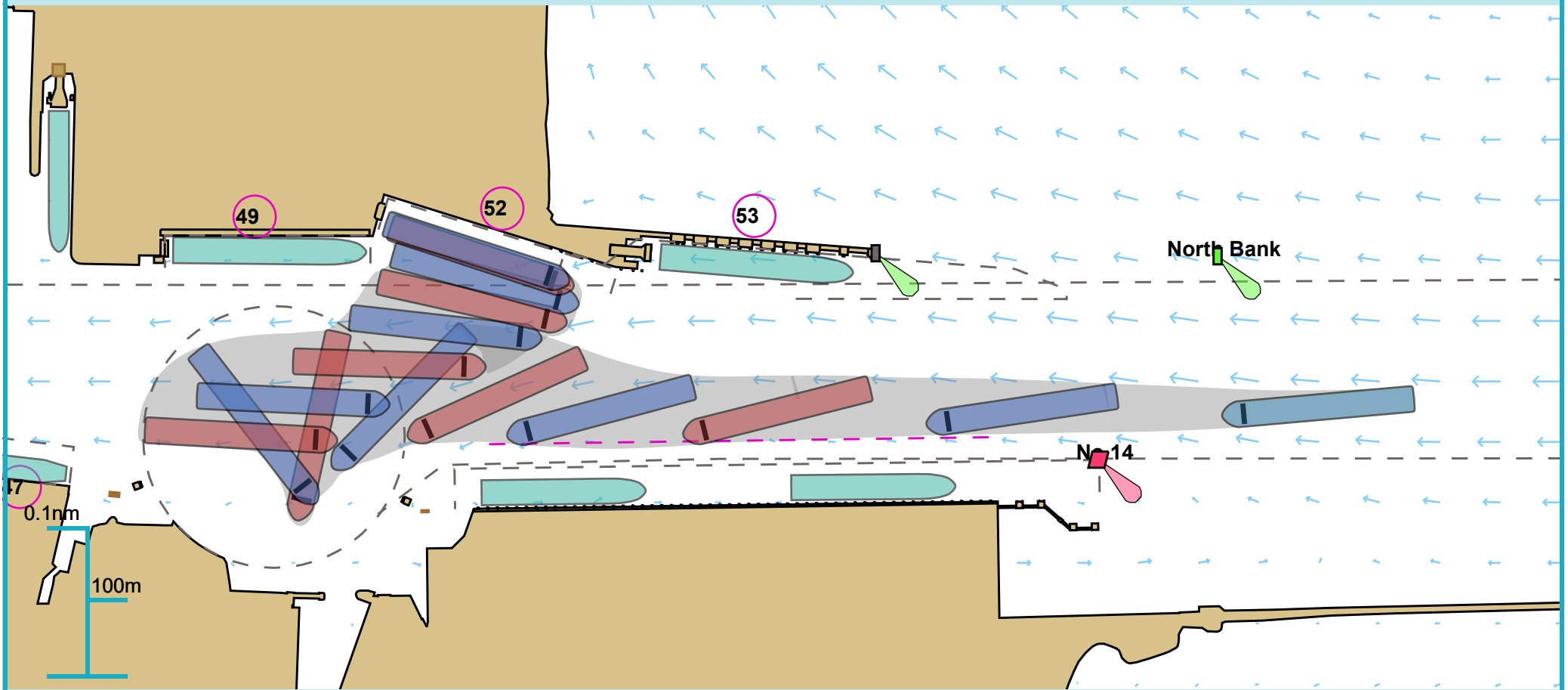
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.369 N, 006° 11.947 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

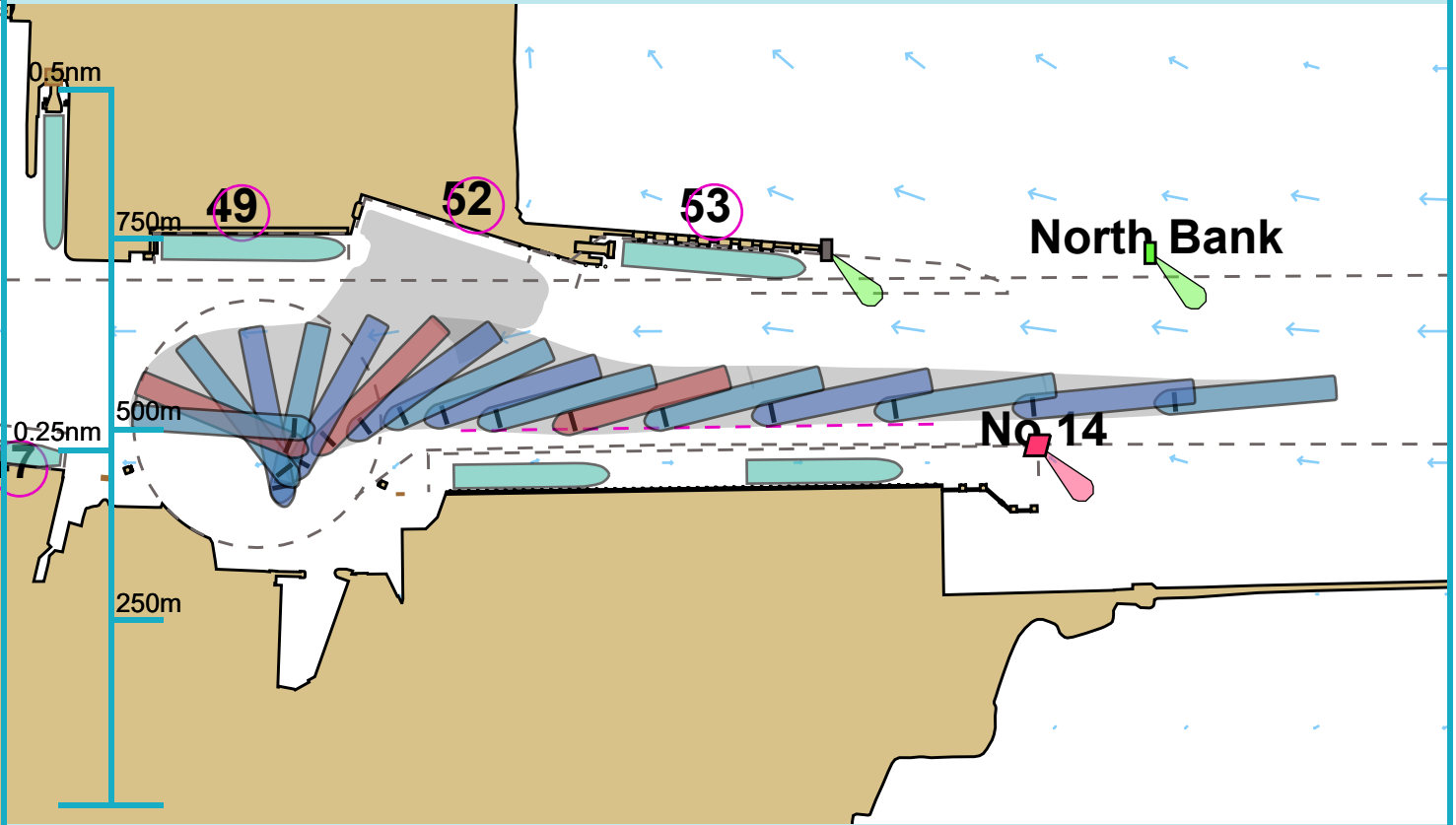
Run length:29 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

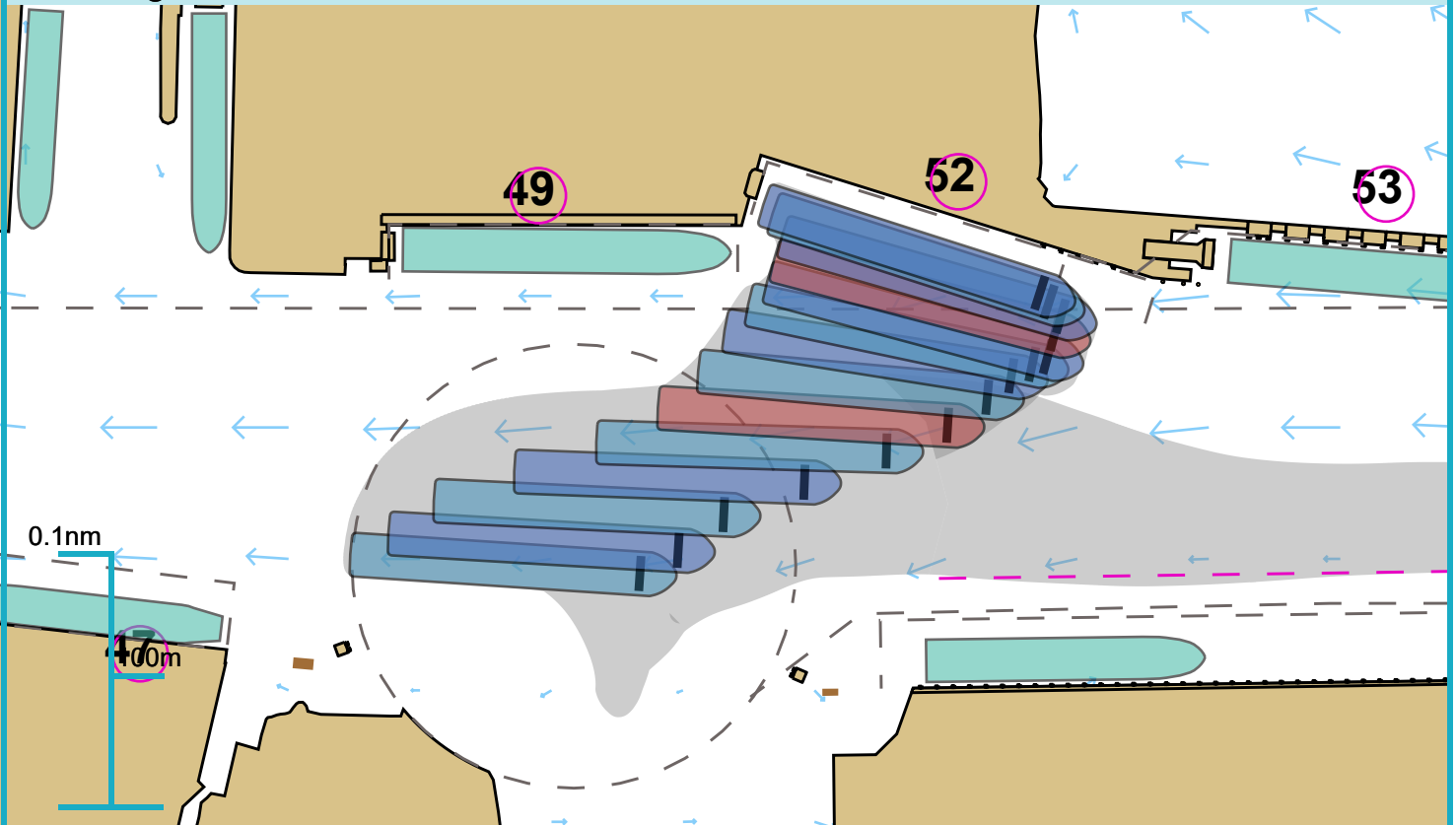
Comments:

Approach



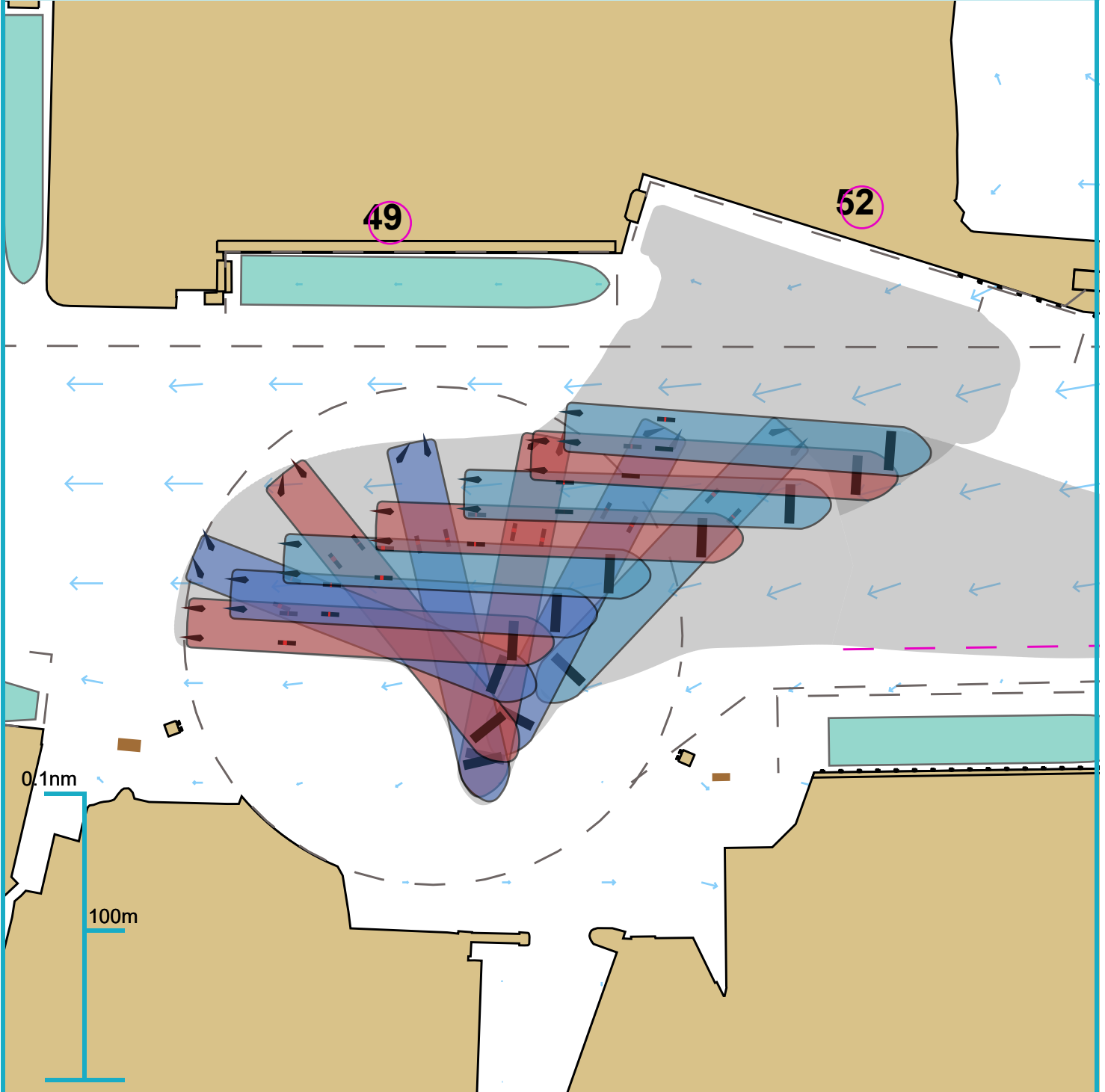
Ships plotted every 1 mins, highlight every 5 mins

Berthing

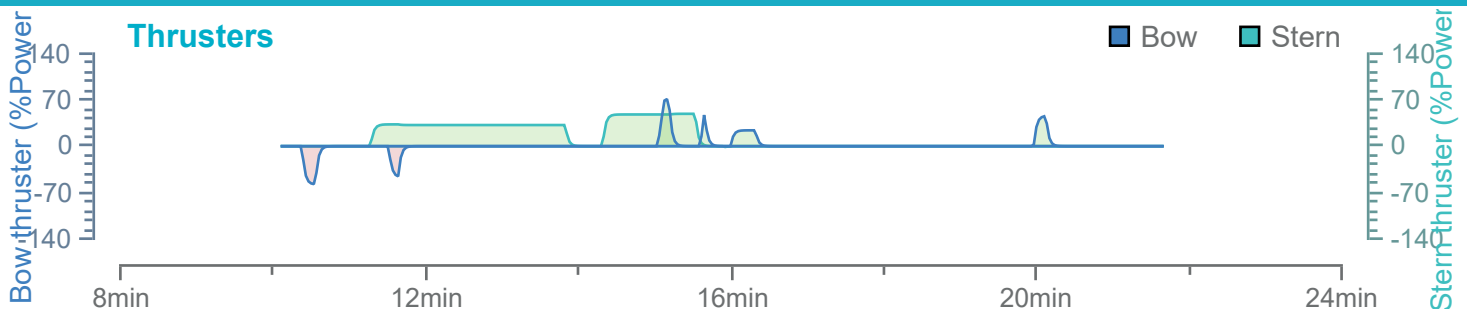


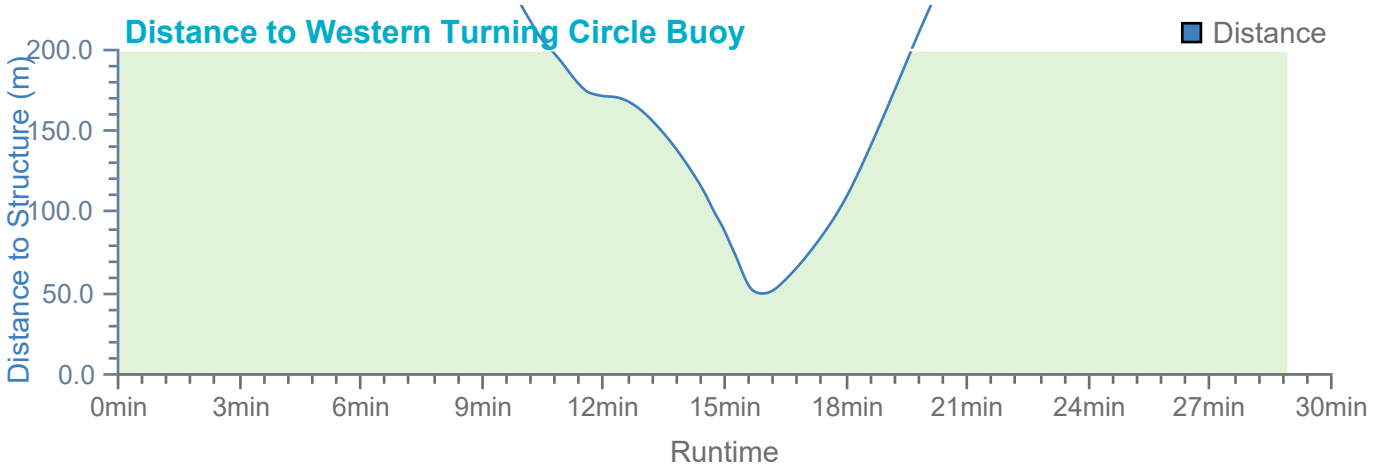
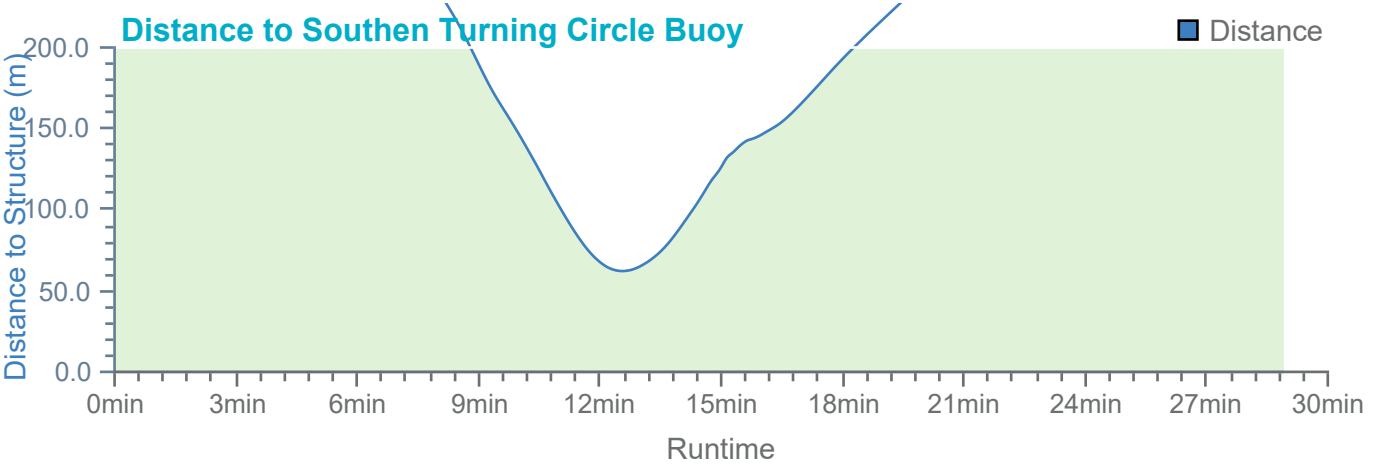
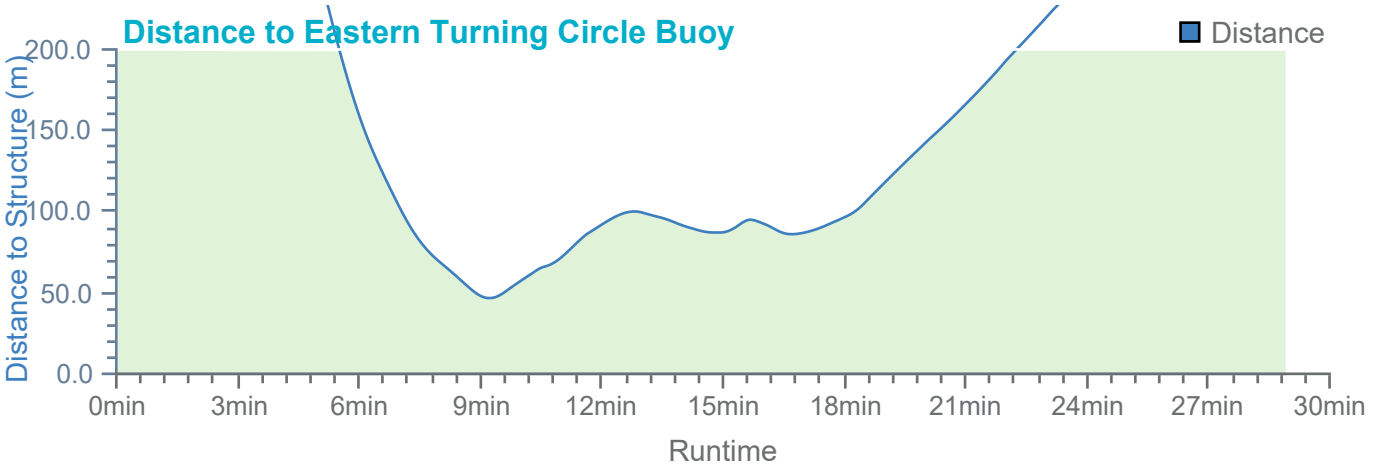
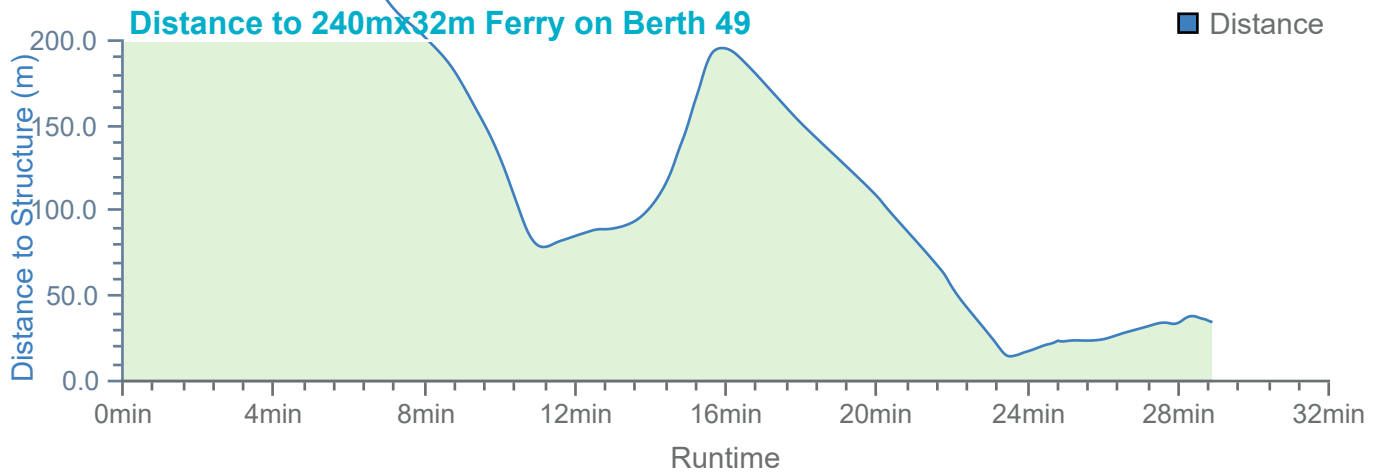
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



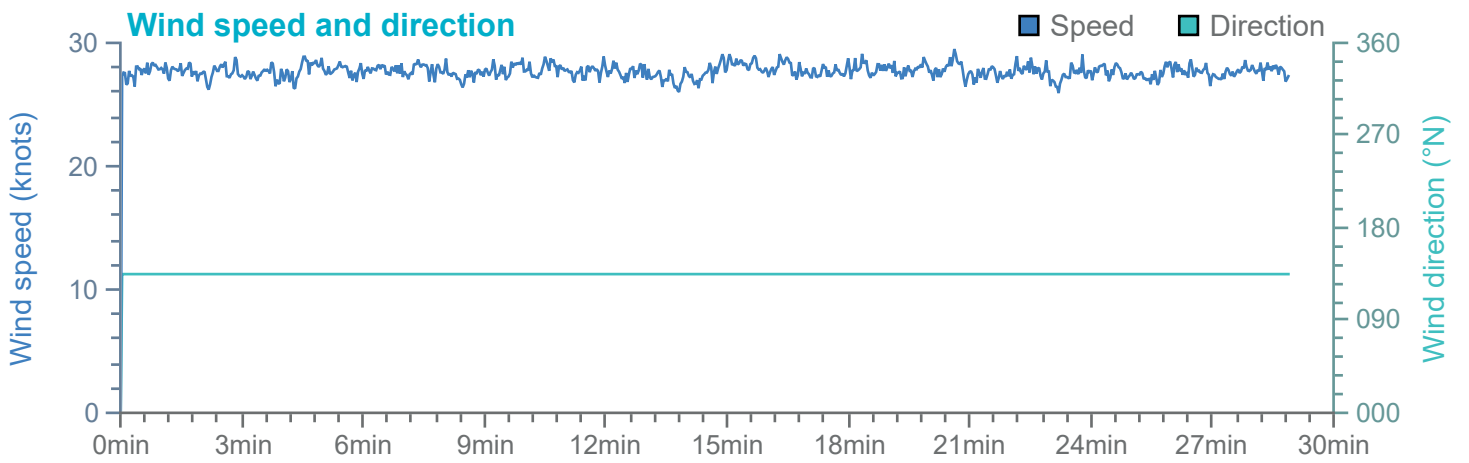
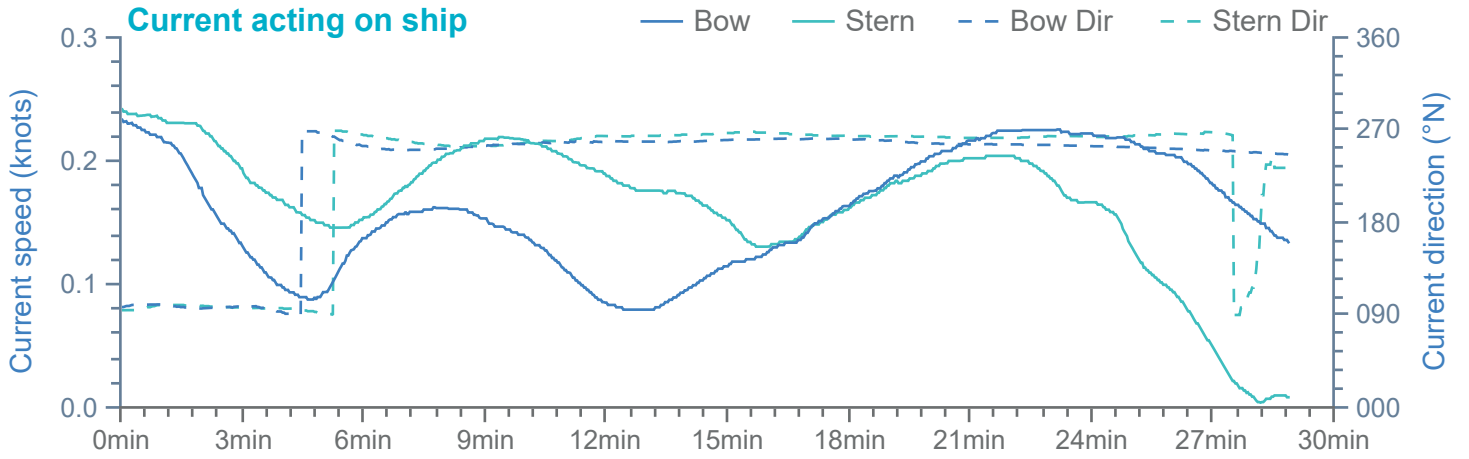


Overview

Environment

240m x 32m RoPax

Thruster and engine use

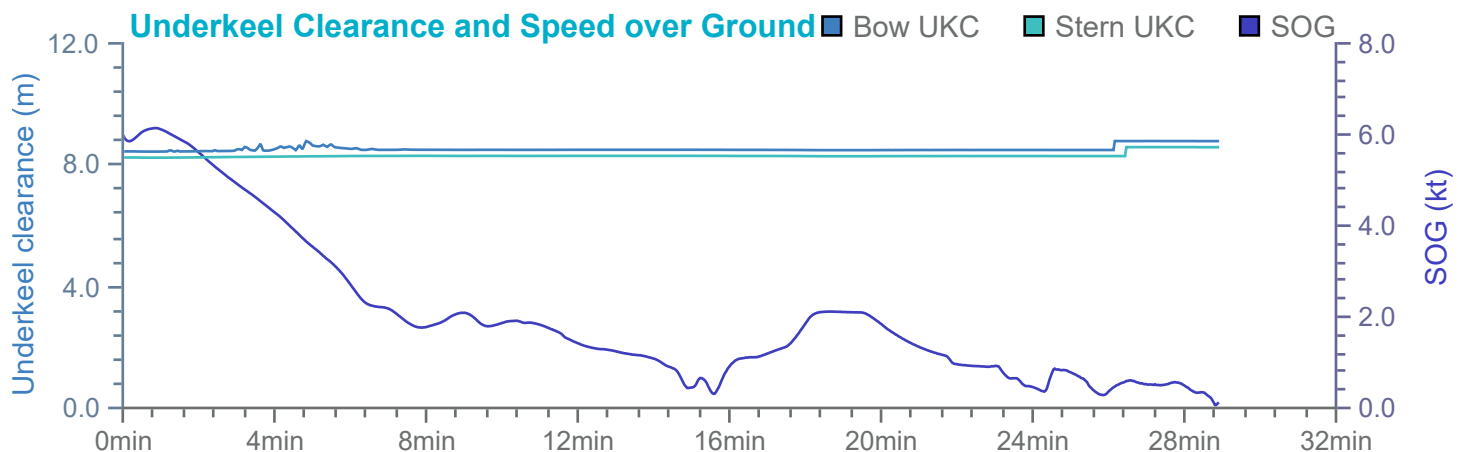
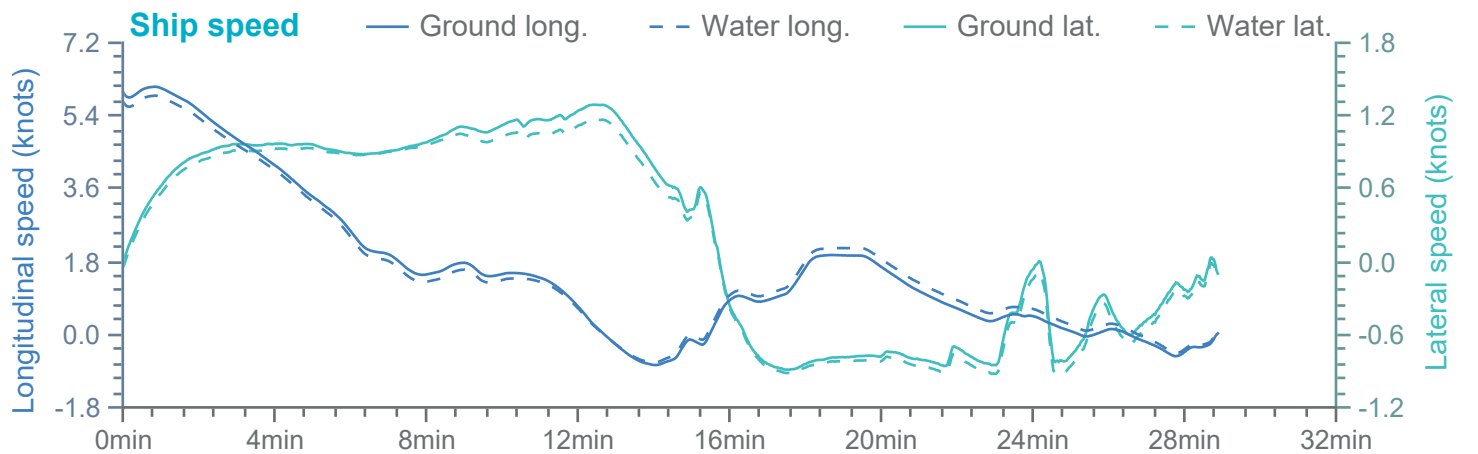
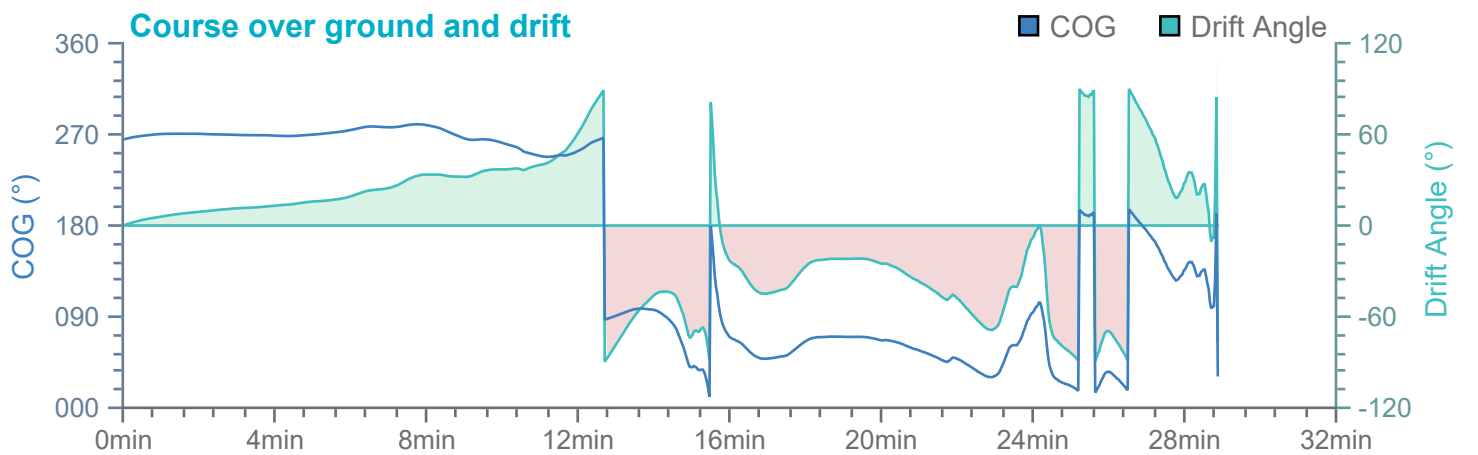
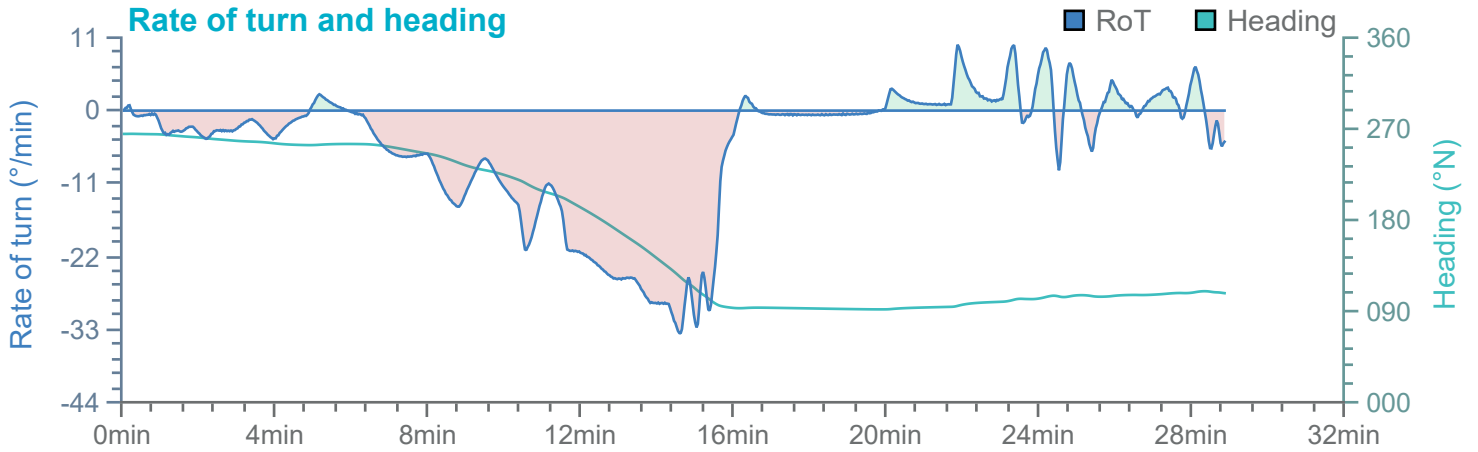


Overview

Environment

240m x 32m RoPax

Thruster and engine use

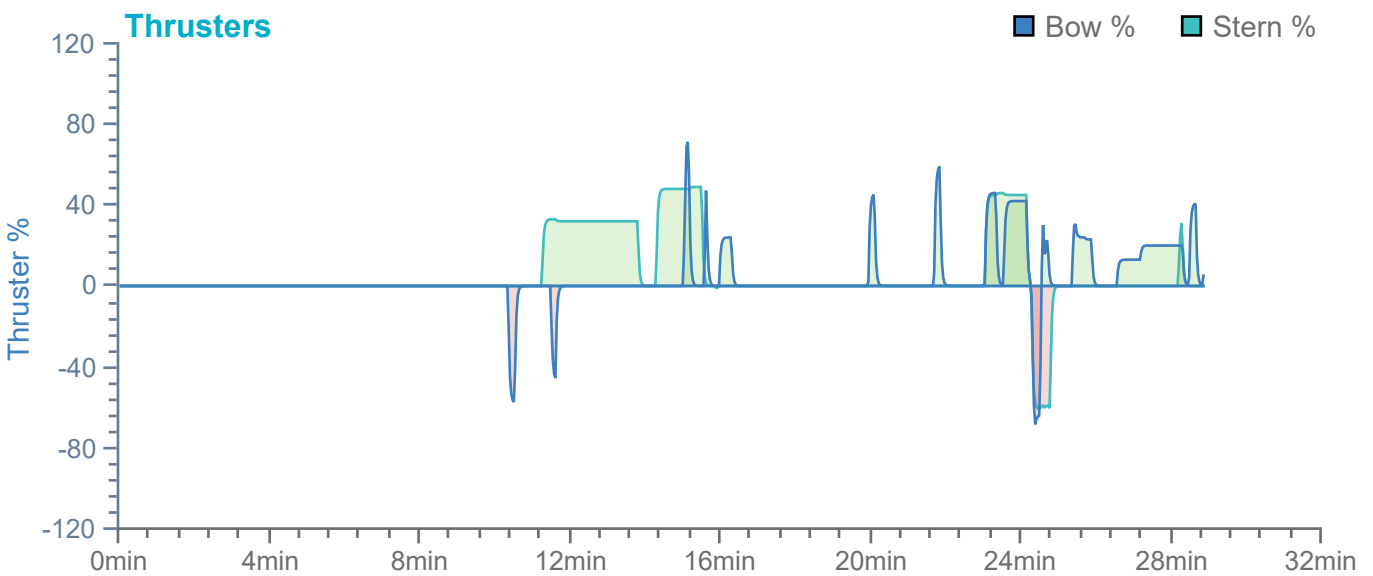
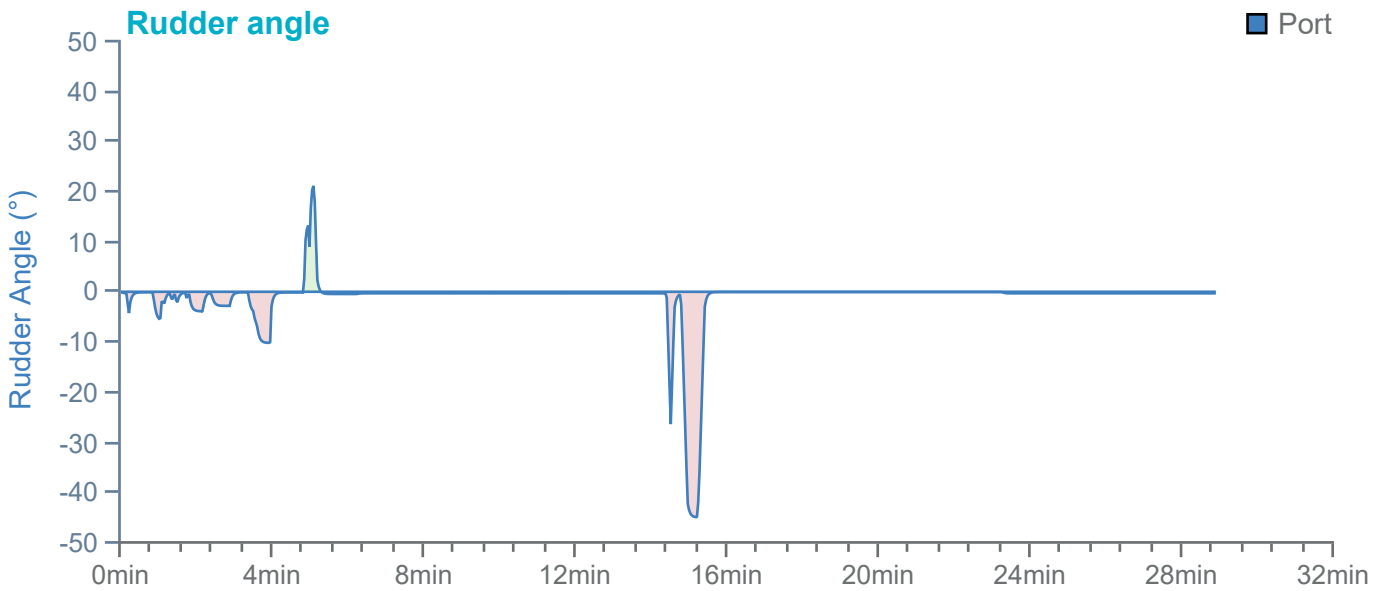
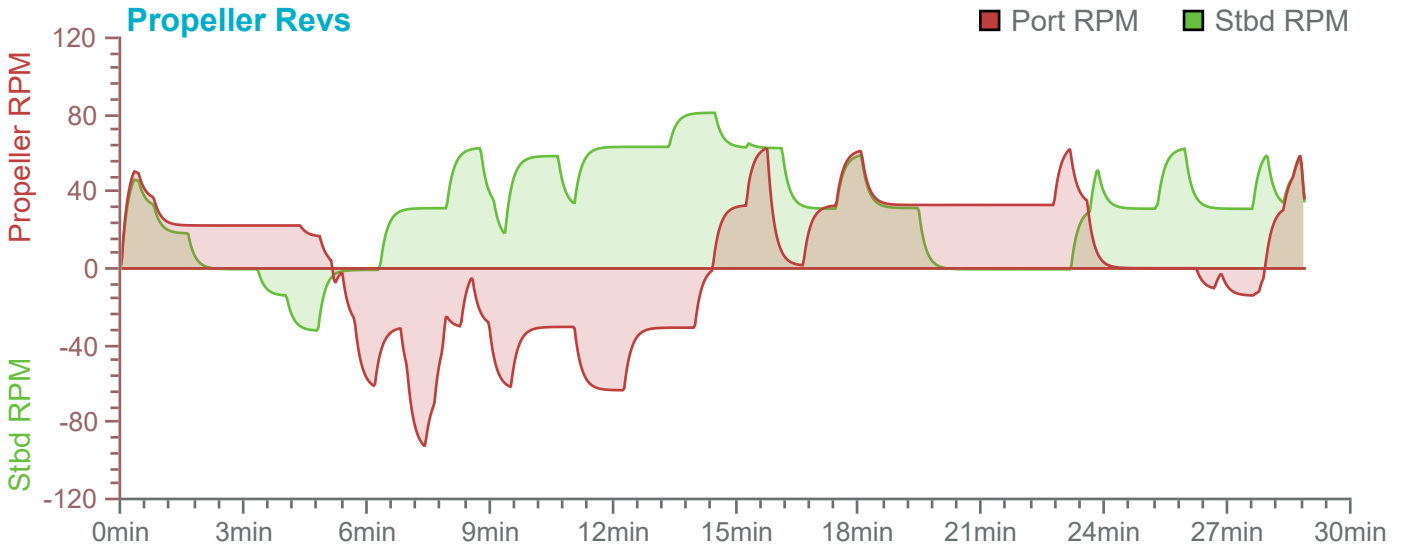


Overview

Environment

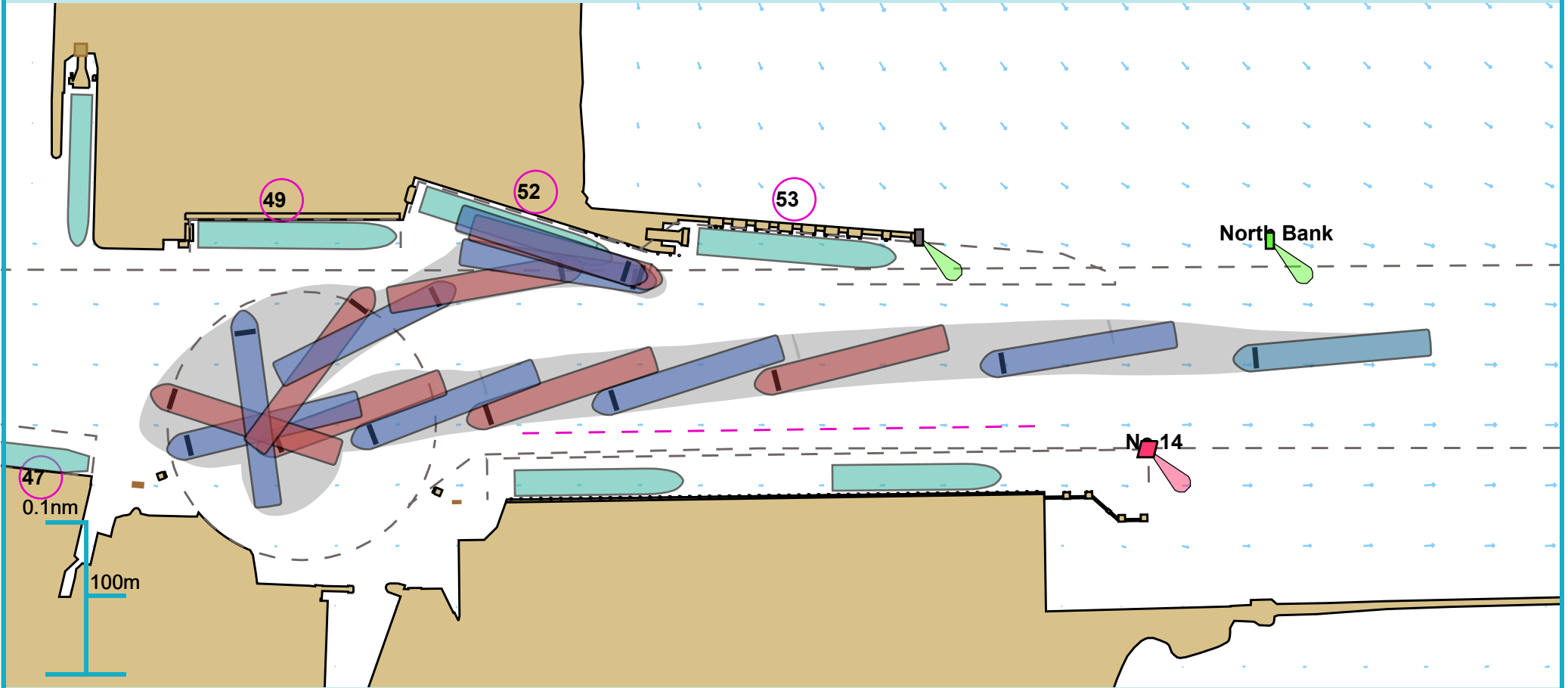
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.368 N, 006° 11.972 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:30 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

Comments:

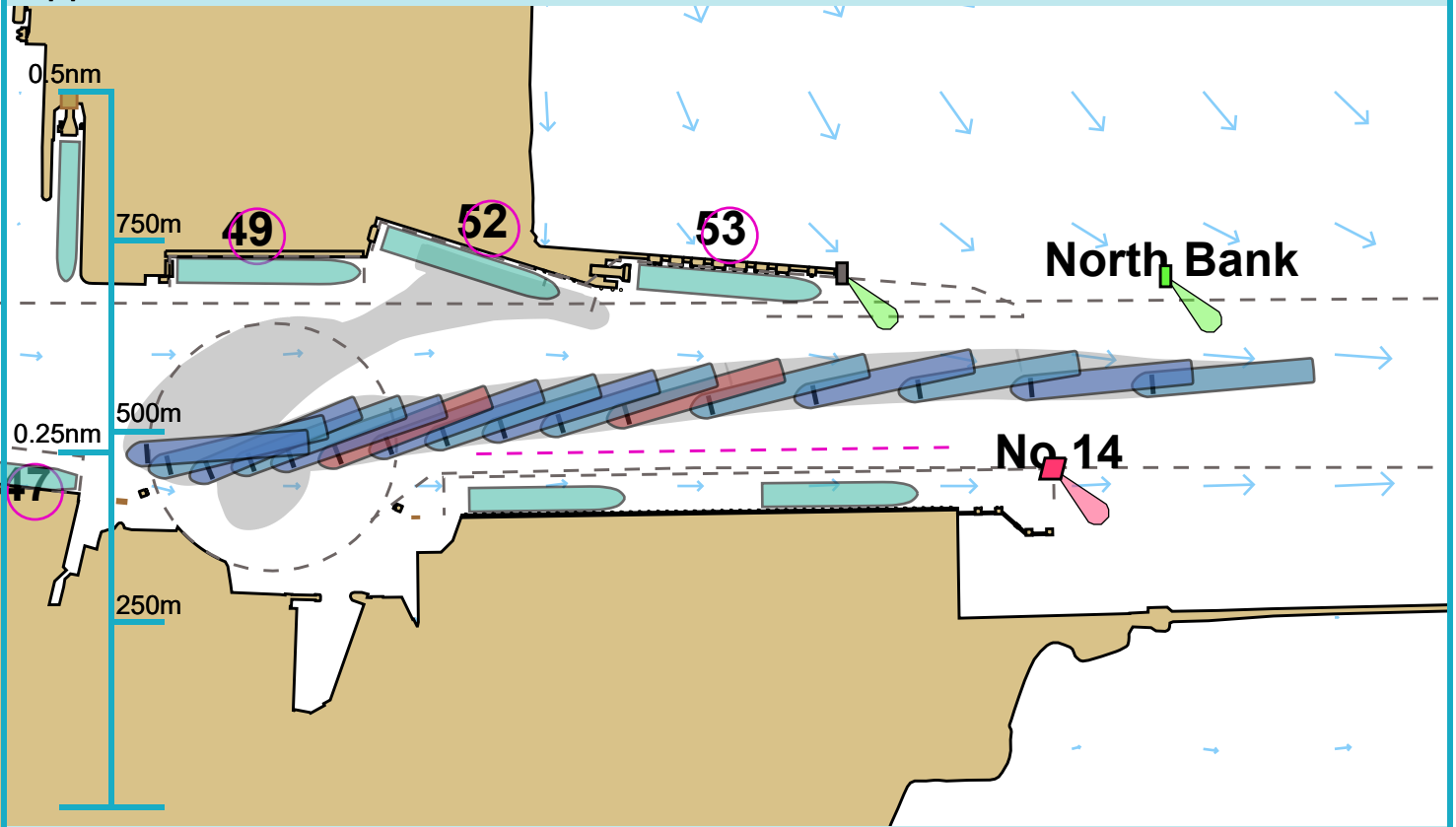
Overview

Environment

240m x 32m RoPax

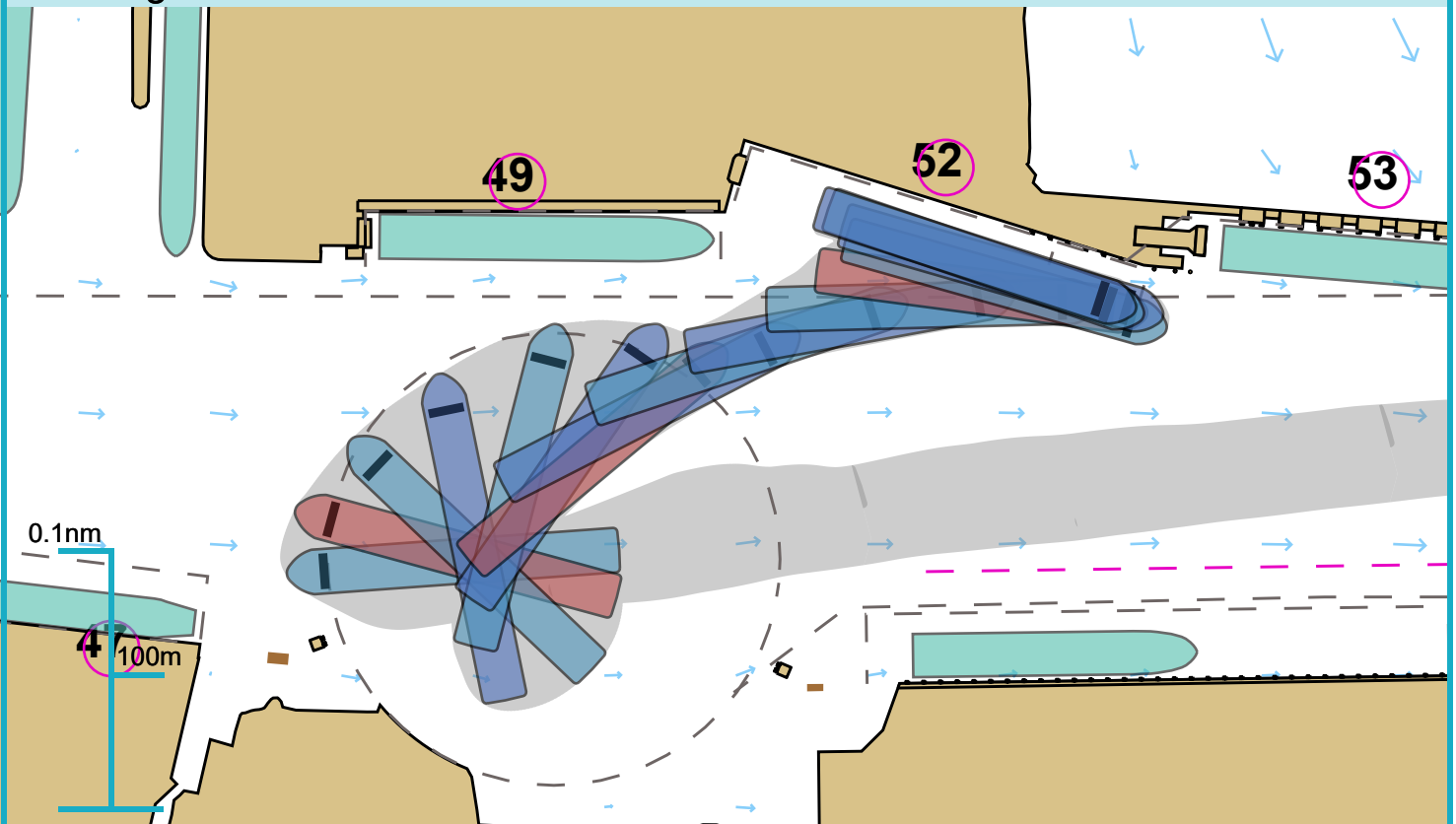
Thruster and engine use

Approach



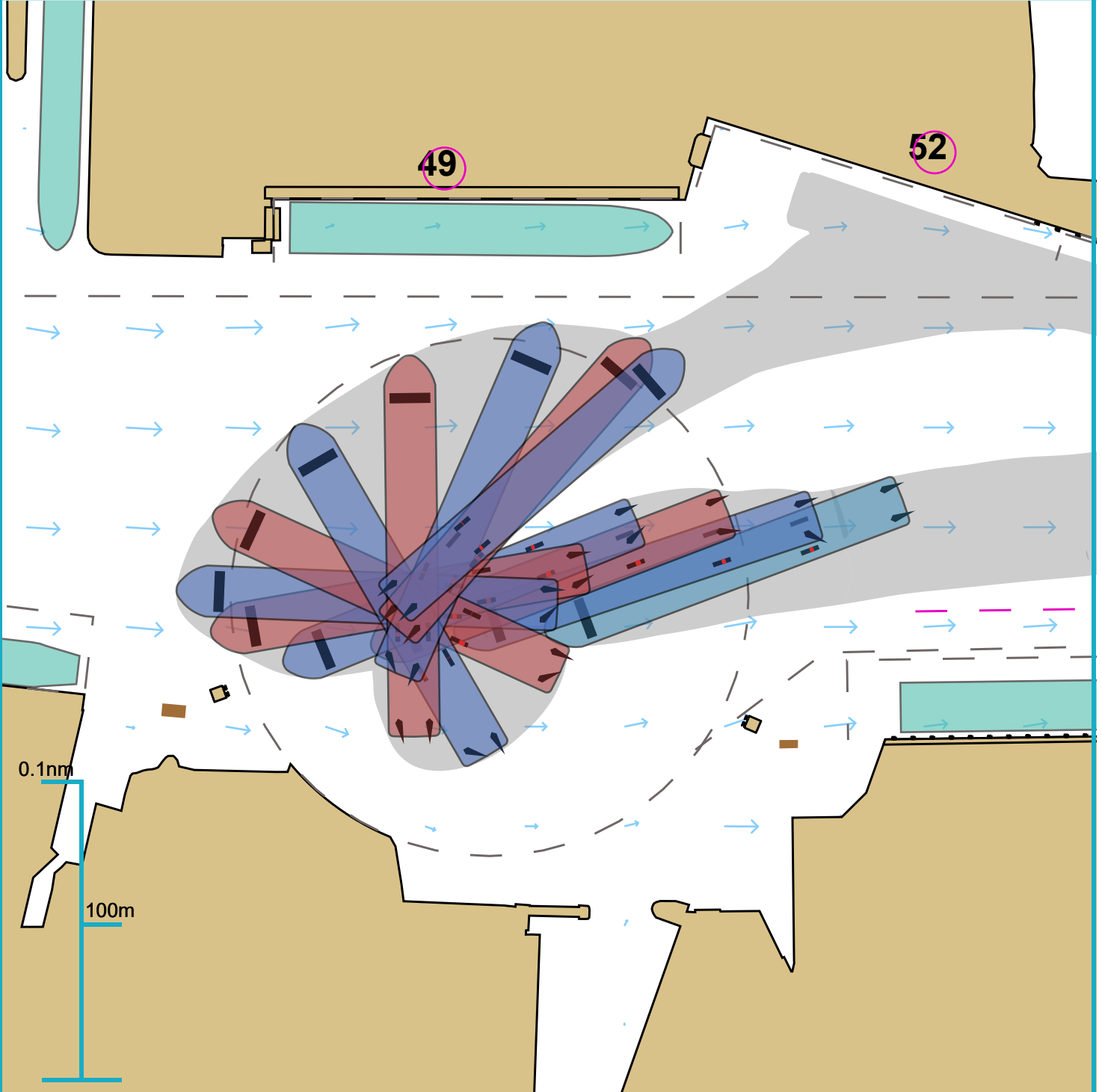
Ships plotted every 1 mins, highlight every 5 mins

Berthing

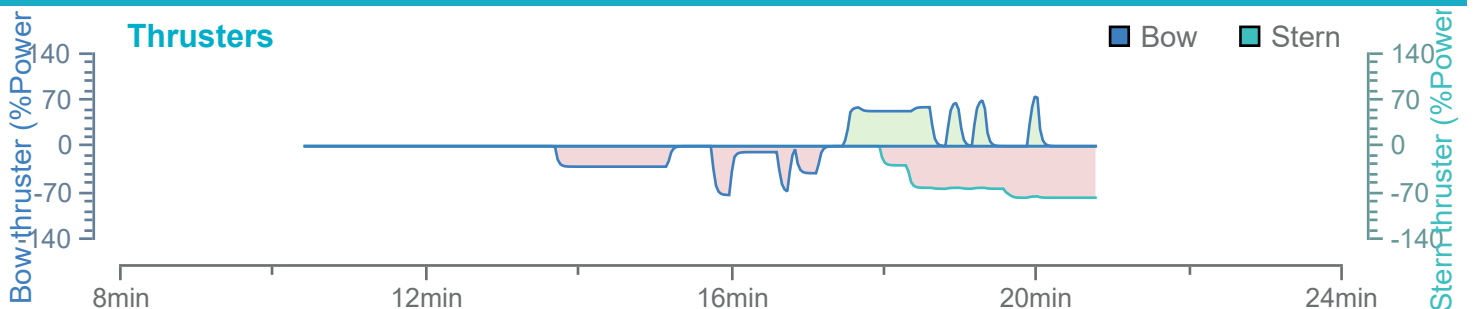


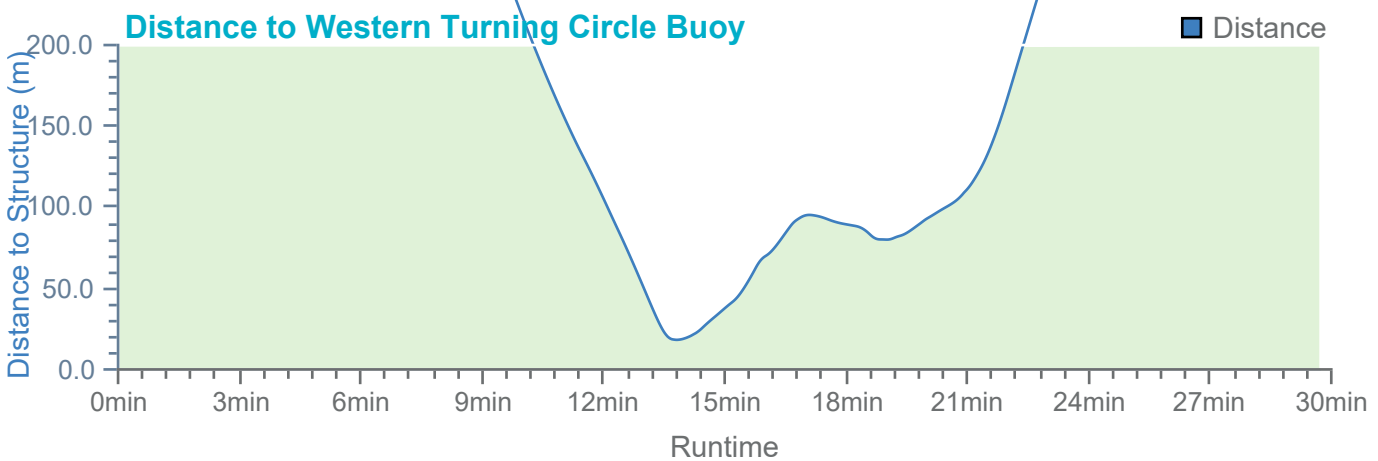
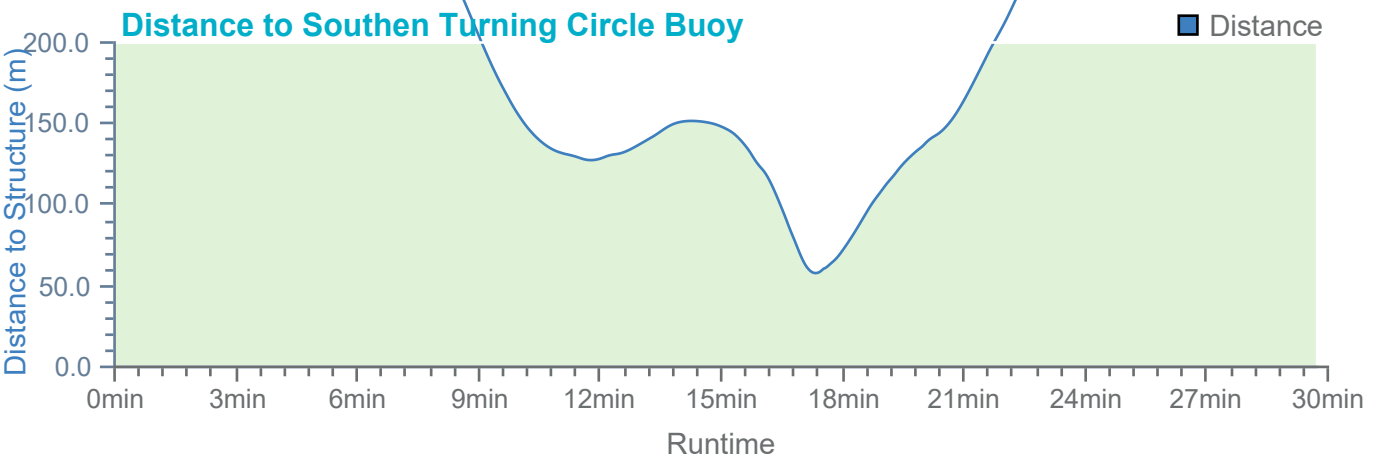
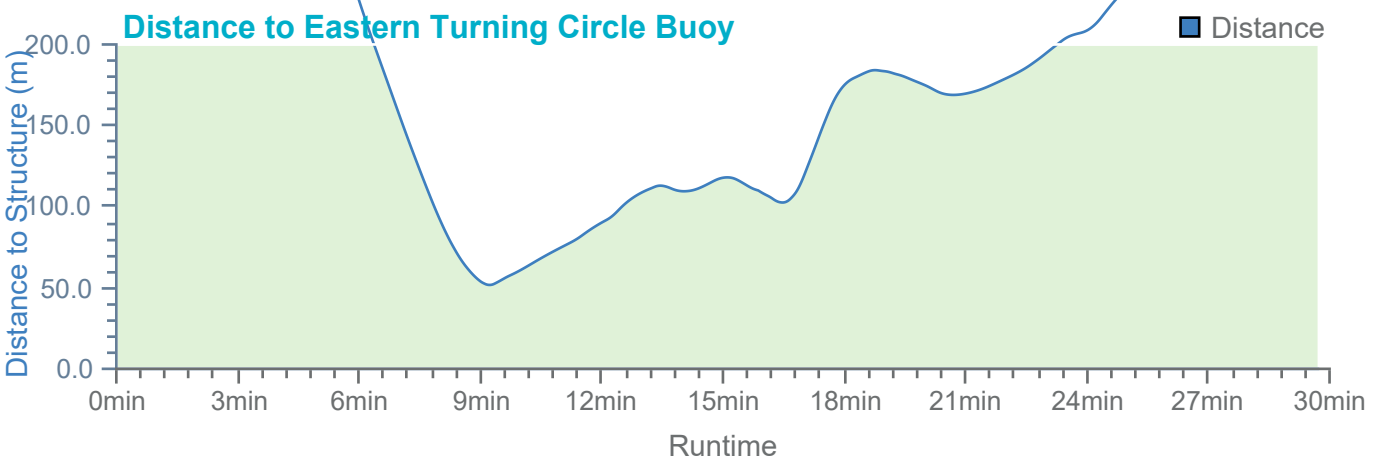
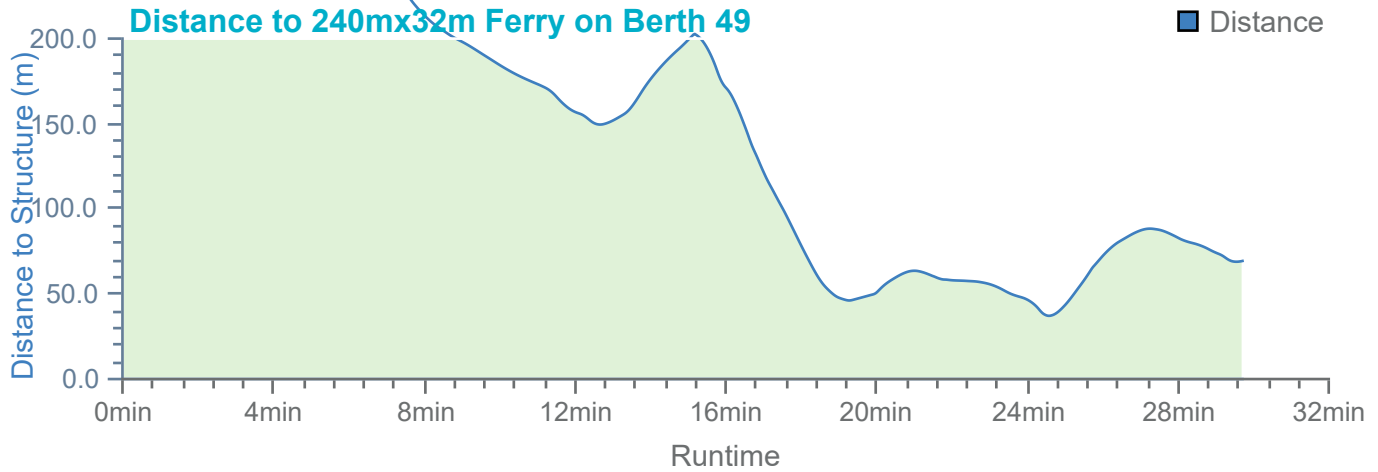
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



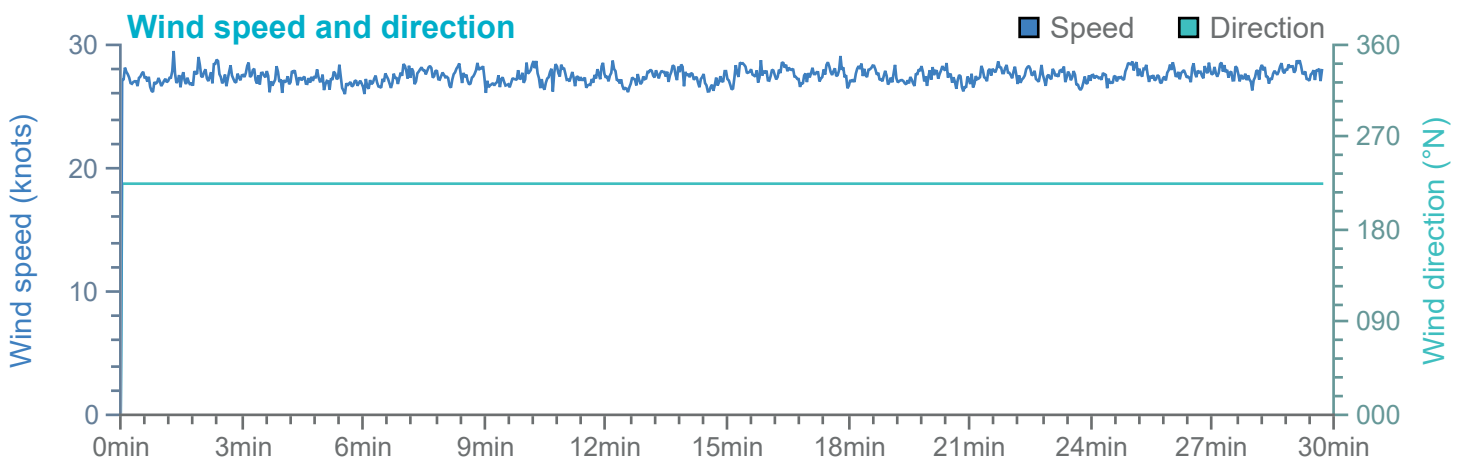
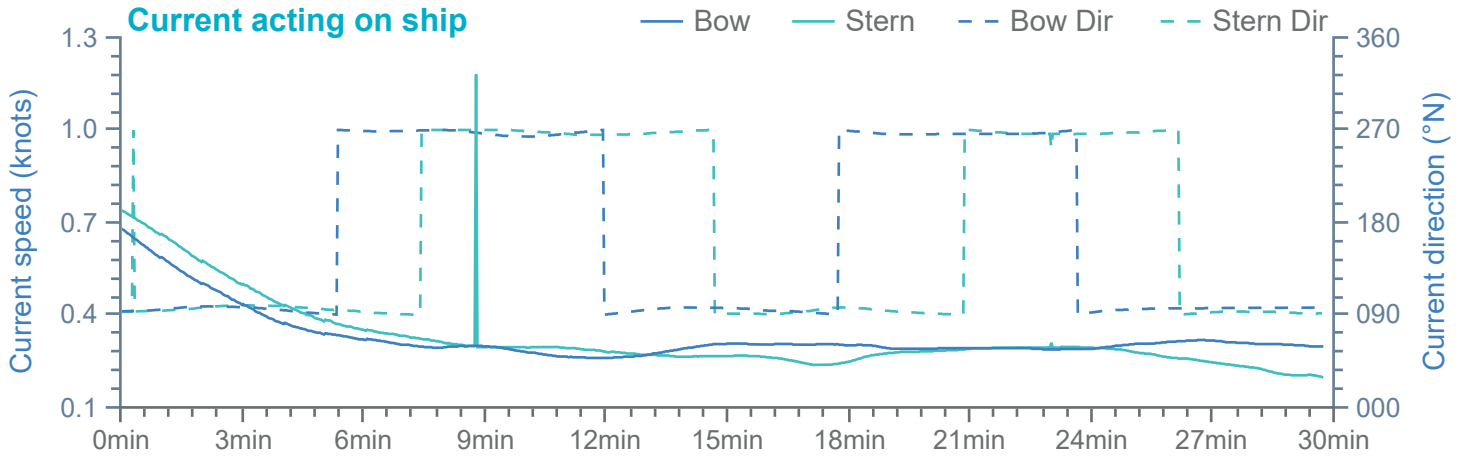


Overview

Environment

240m x 32m RoPax

Thruster and engine use

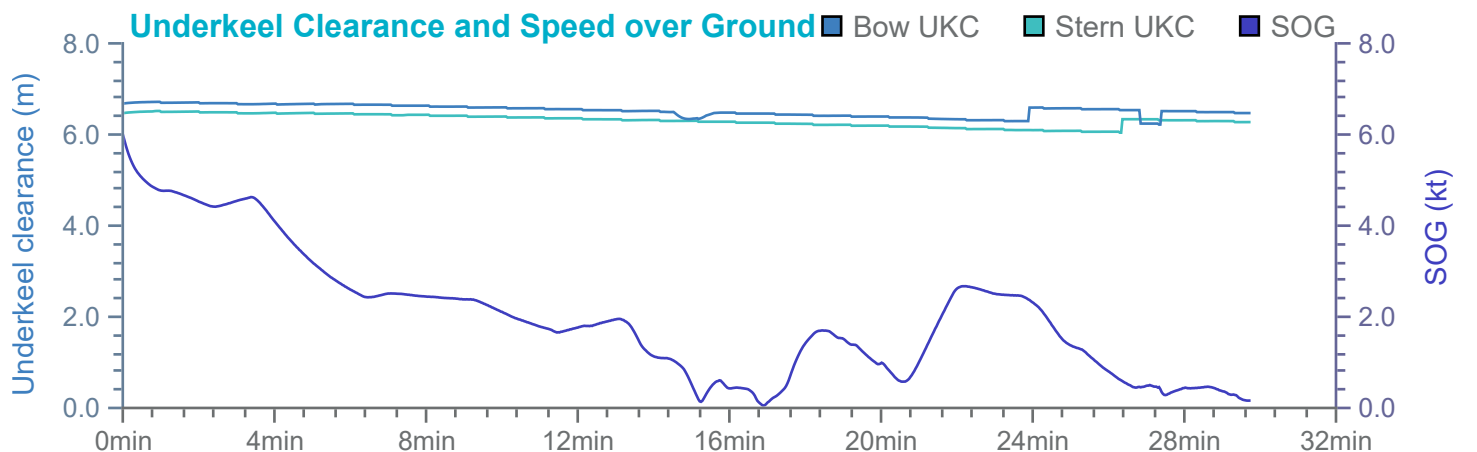
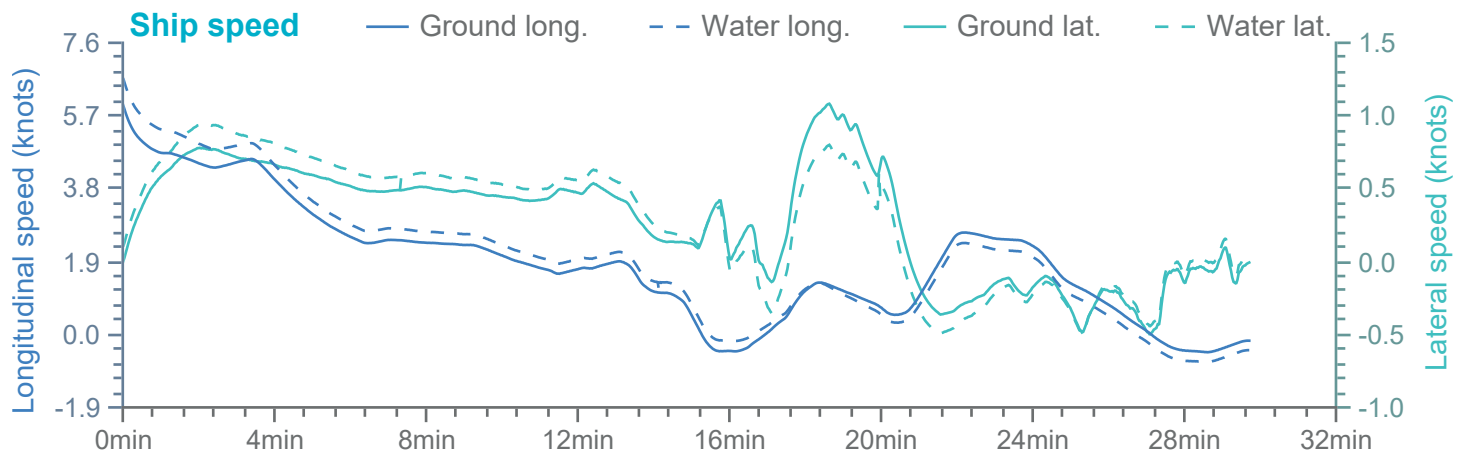
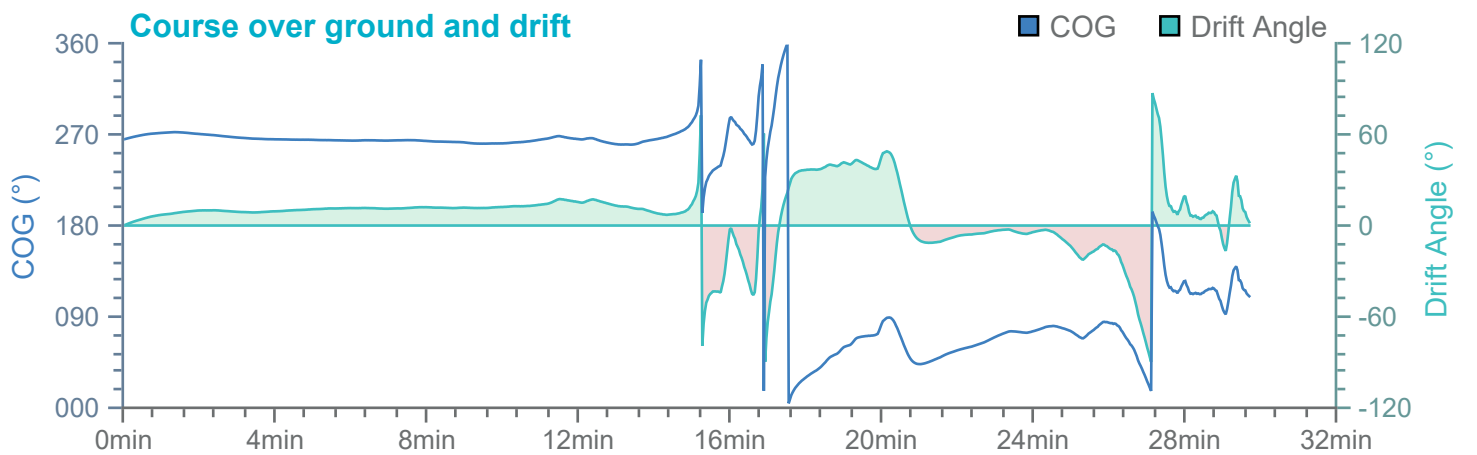
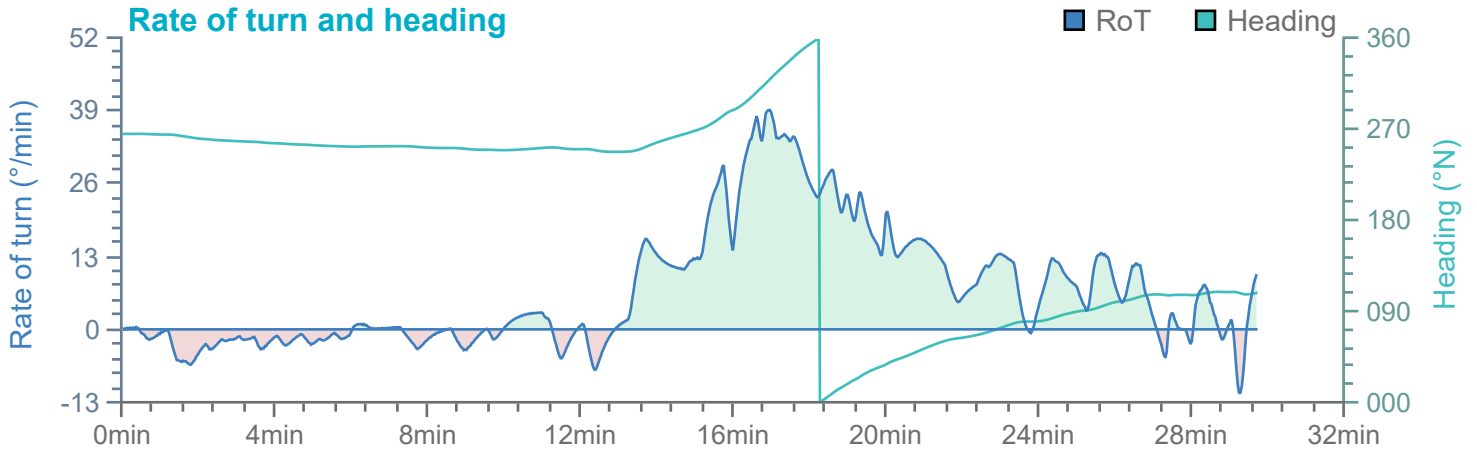


Overview

Environment

240m x 32m RoPax

Thruster and engine use

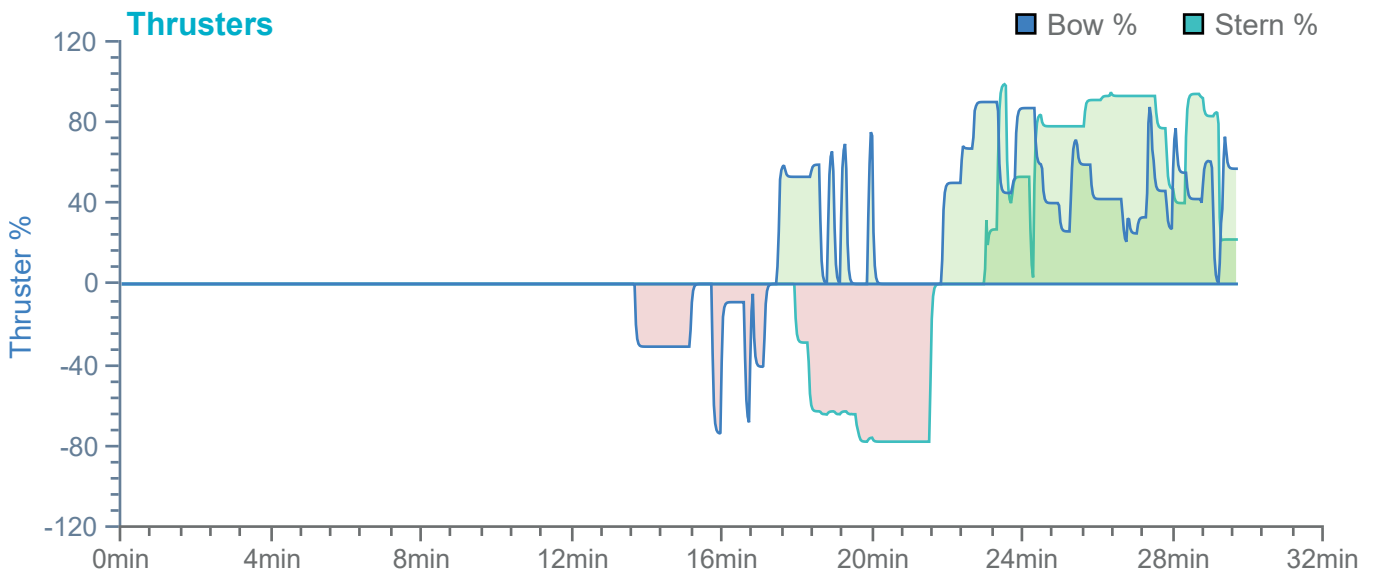
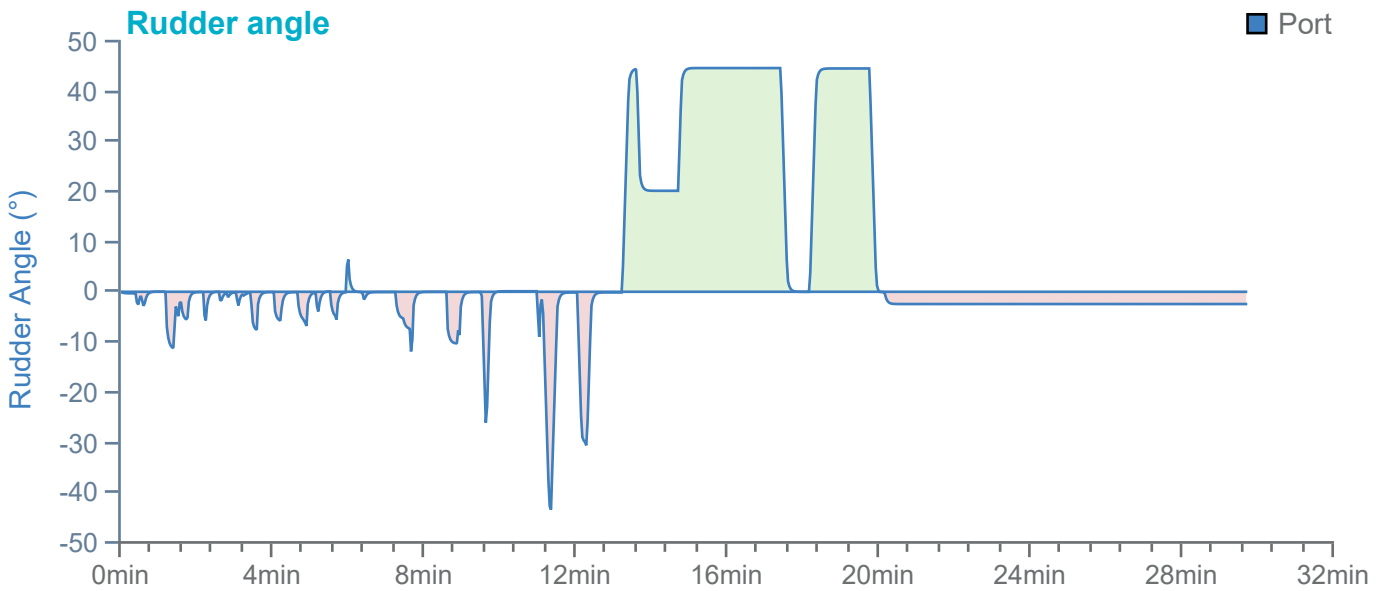
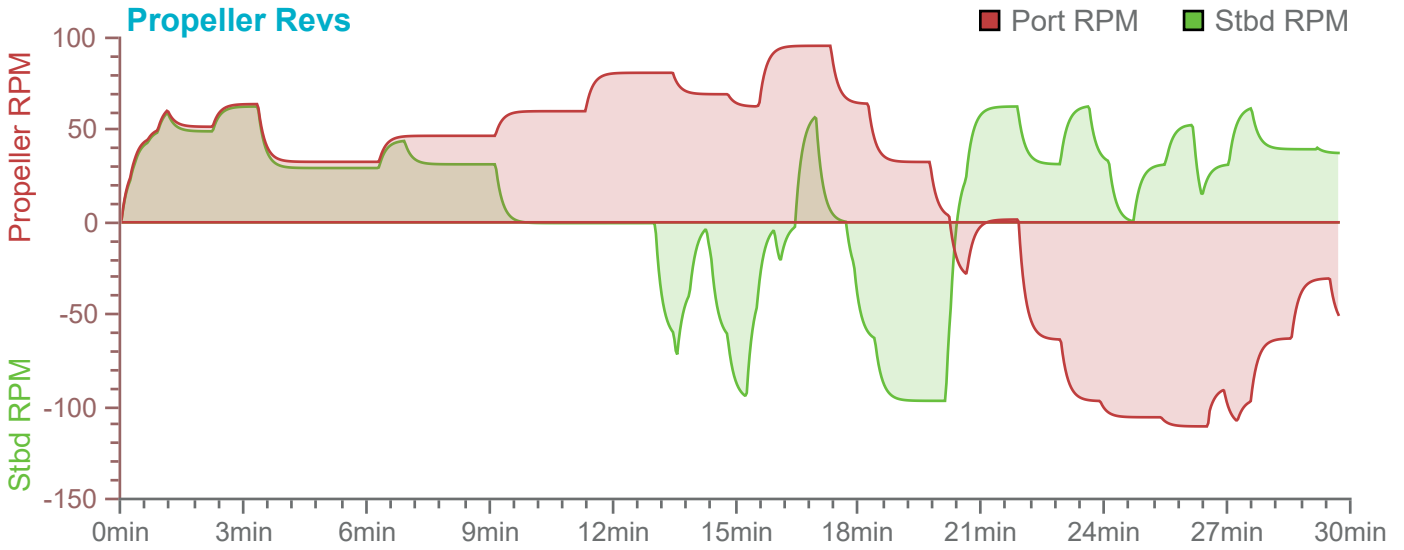


Overview

Environment

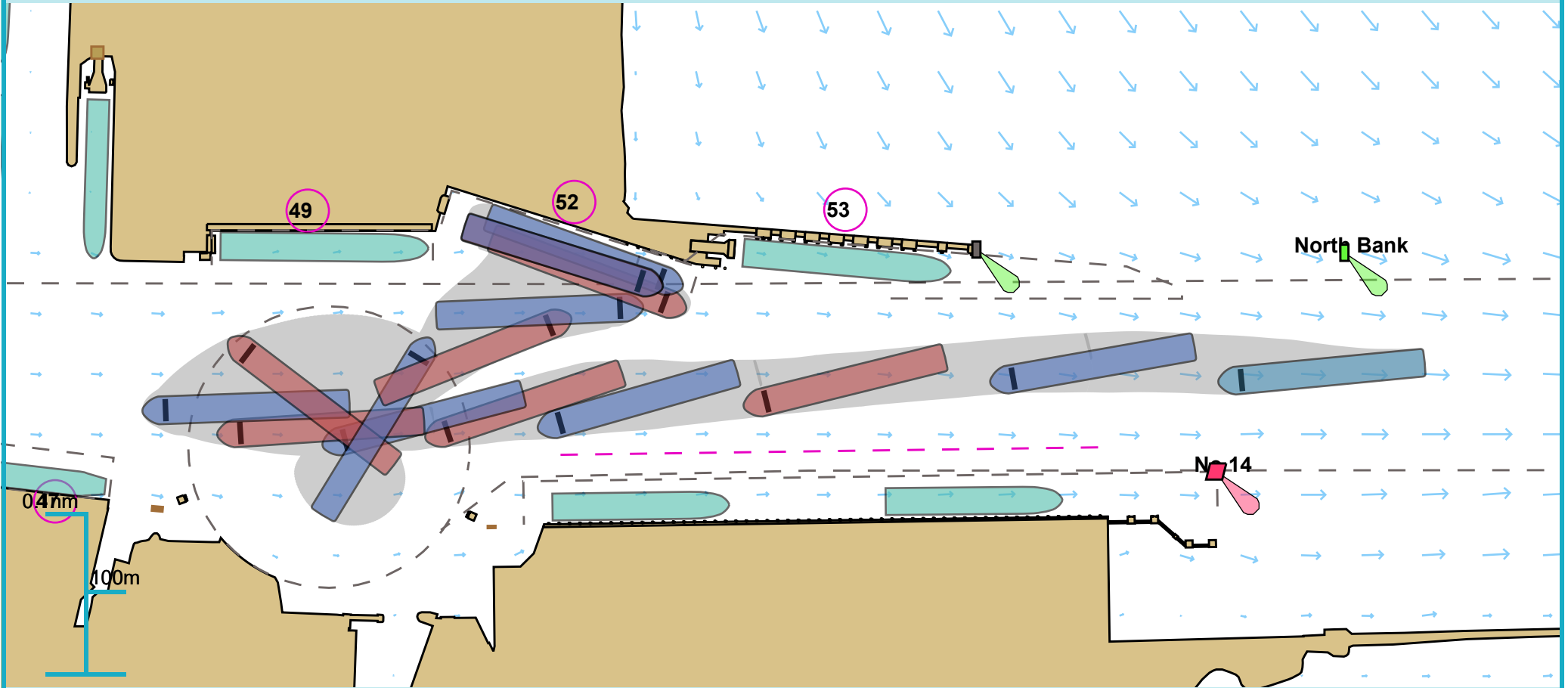
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.391 N, 006° 11.985 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

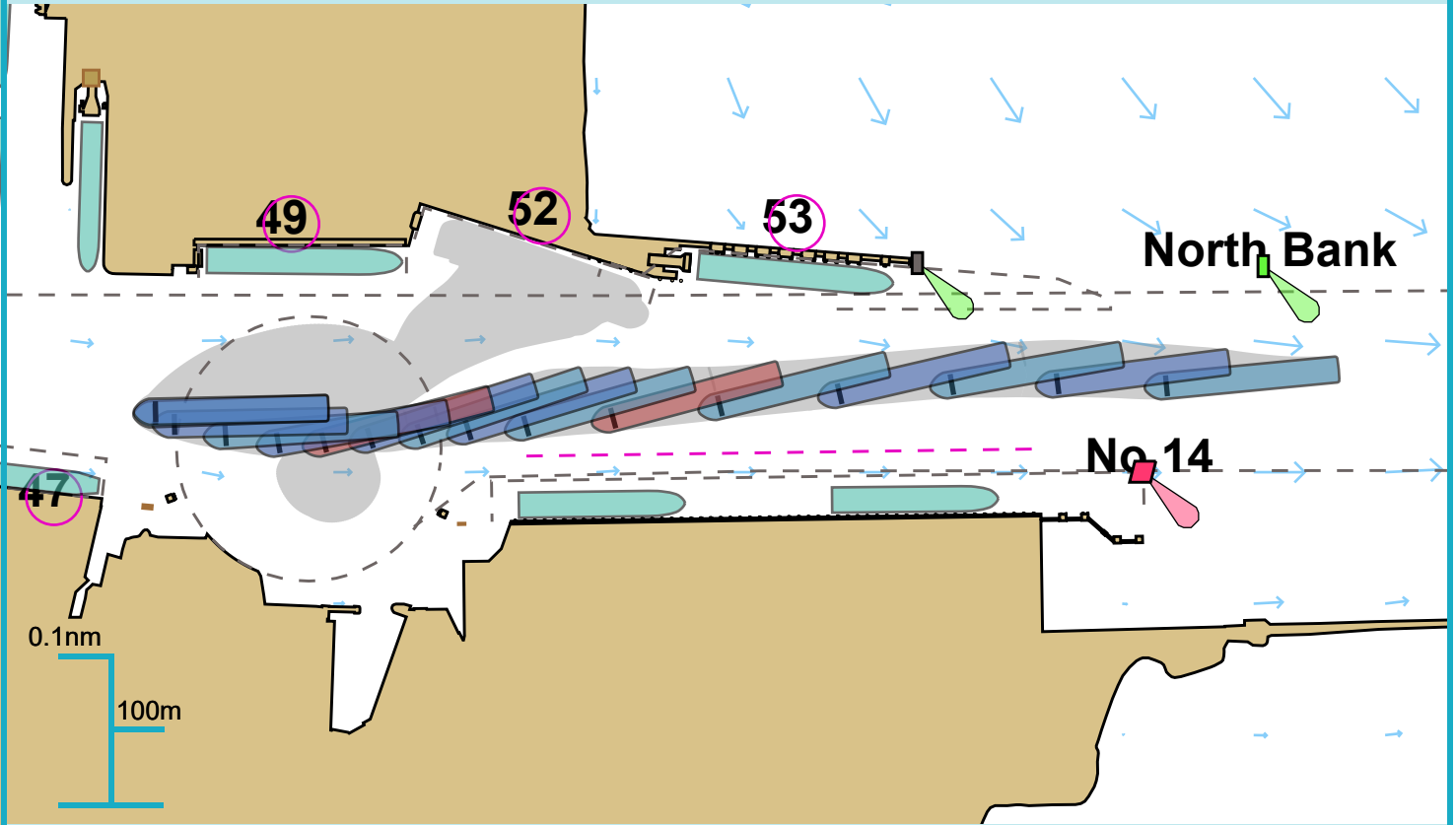
Run length:28 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

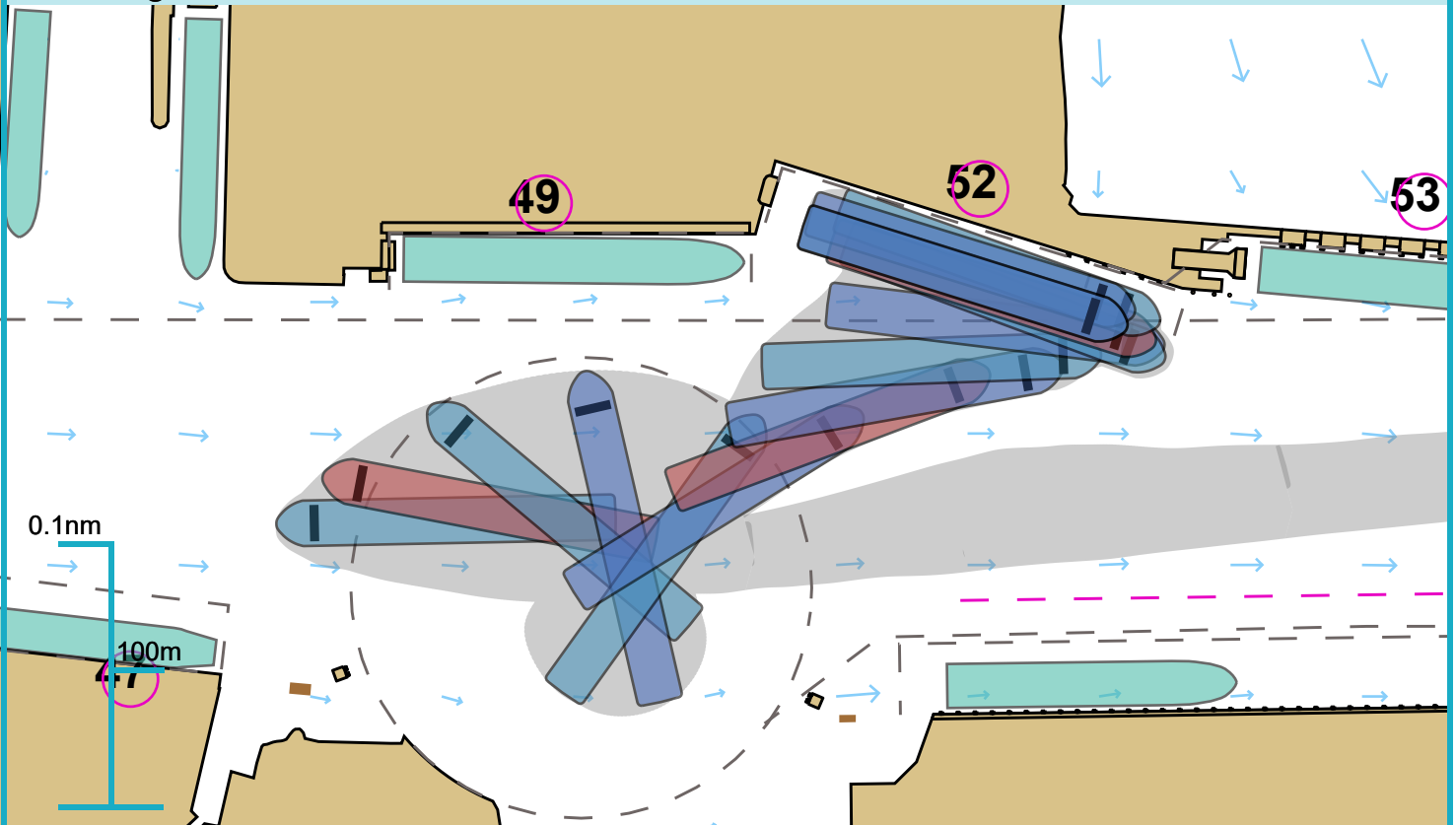
Comments:

Approach



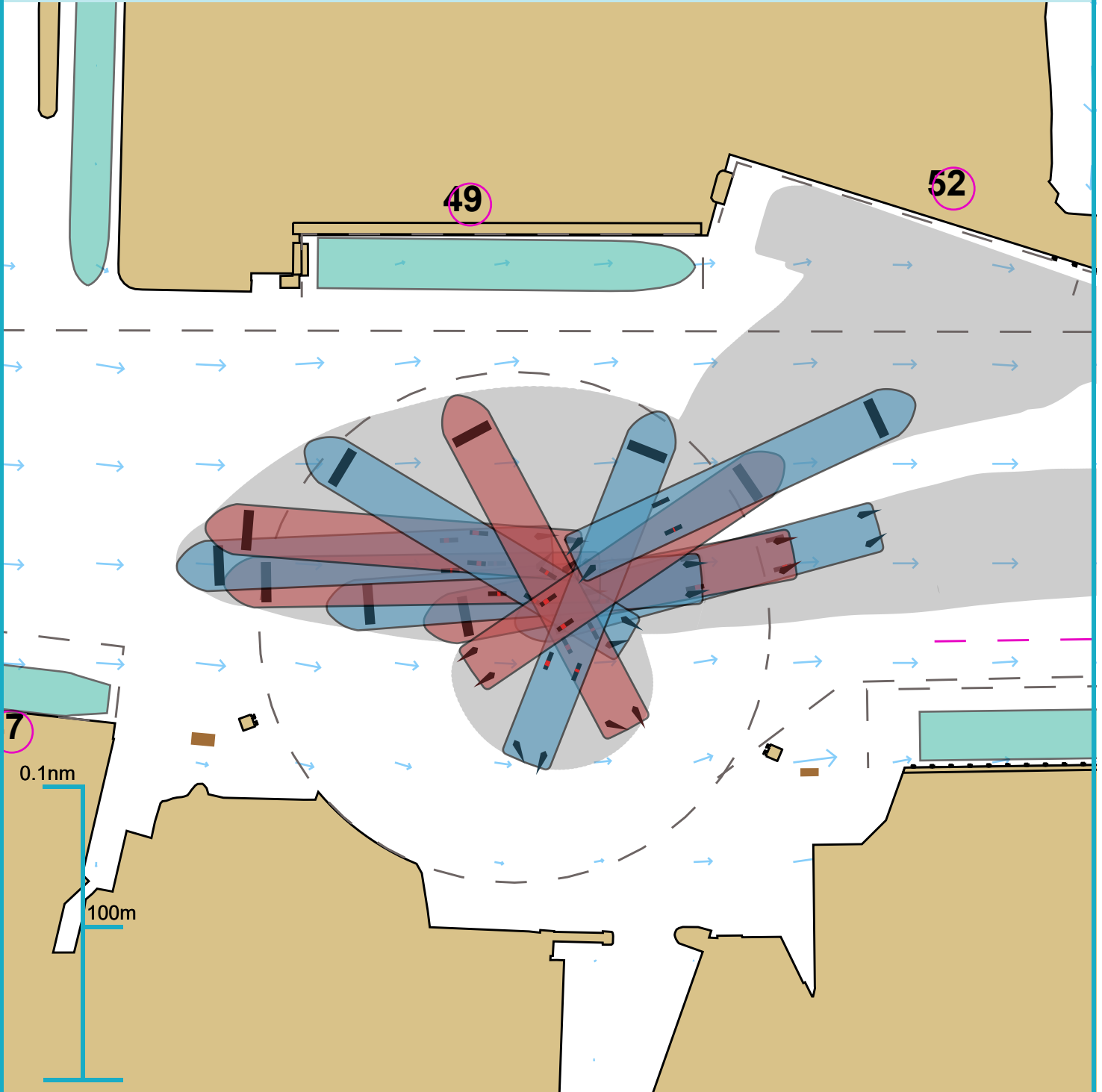
Ships plotted every 1 mins, highlight every 5 mins

Berthing

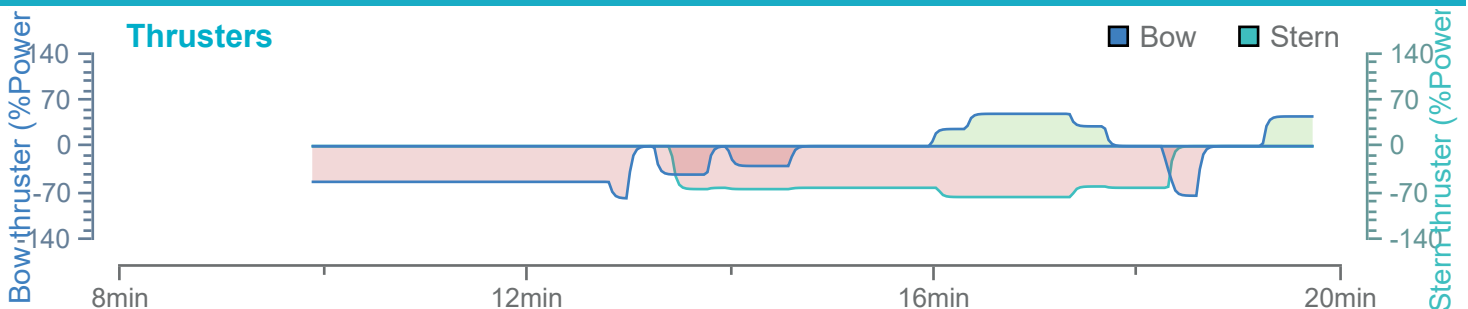


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

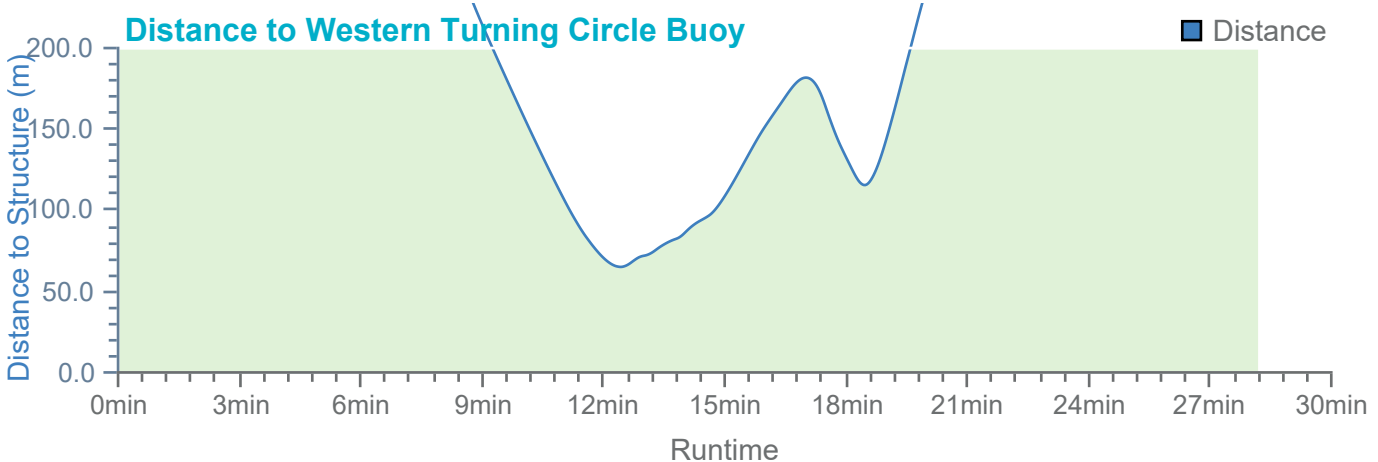
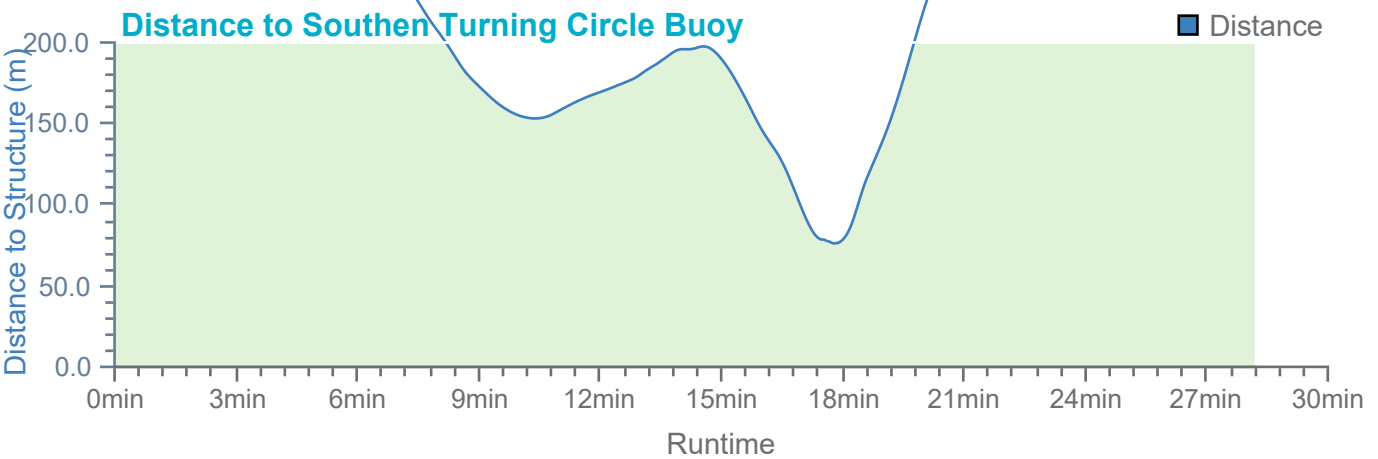
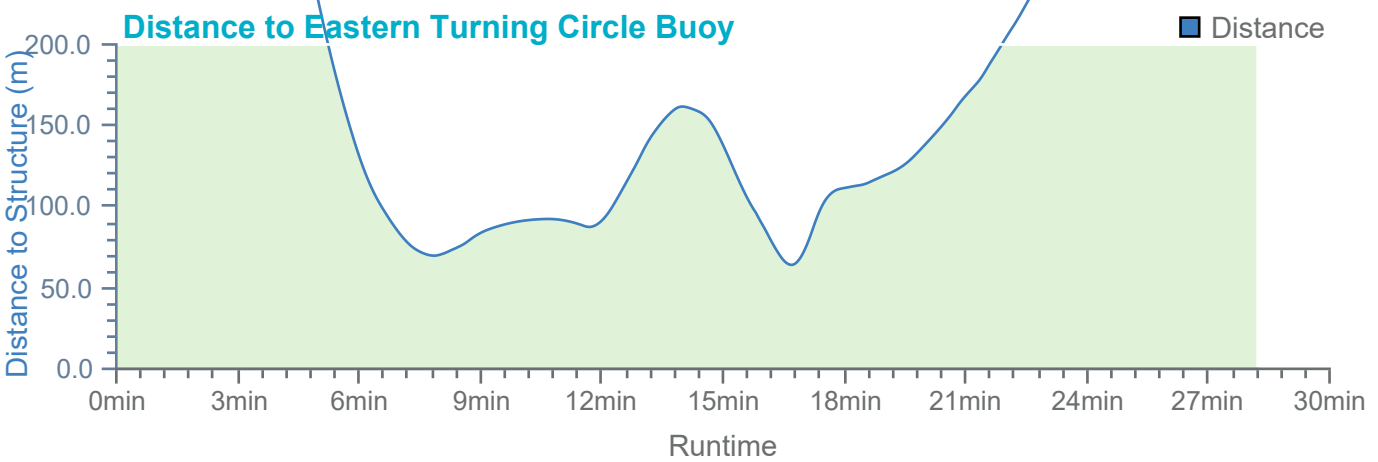
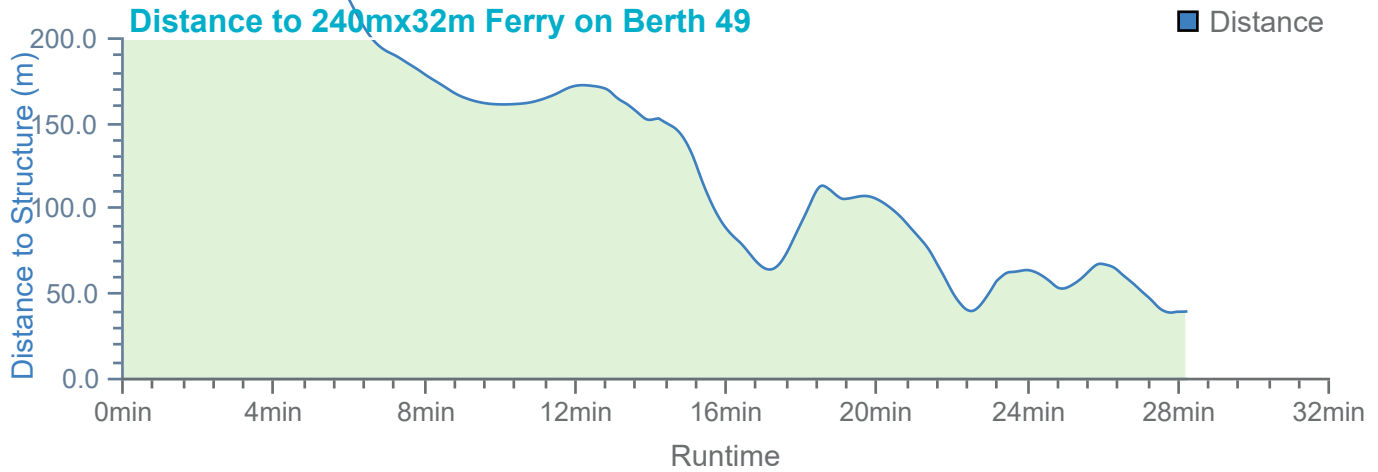


Overview

Environment

240m x 32m RoPax

Thruster and engine use

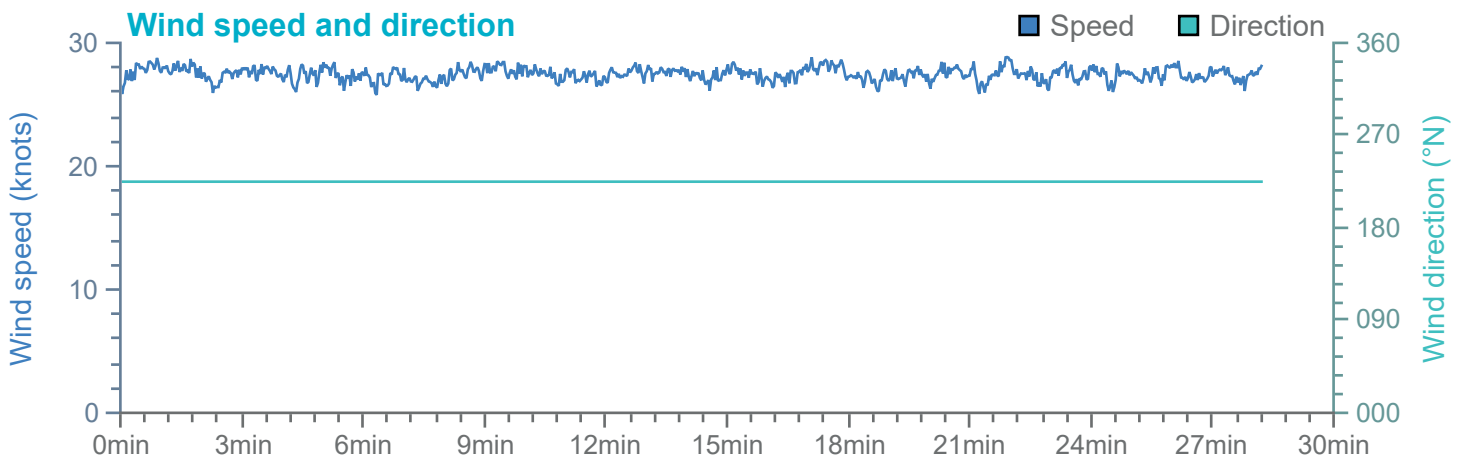
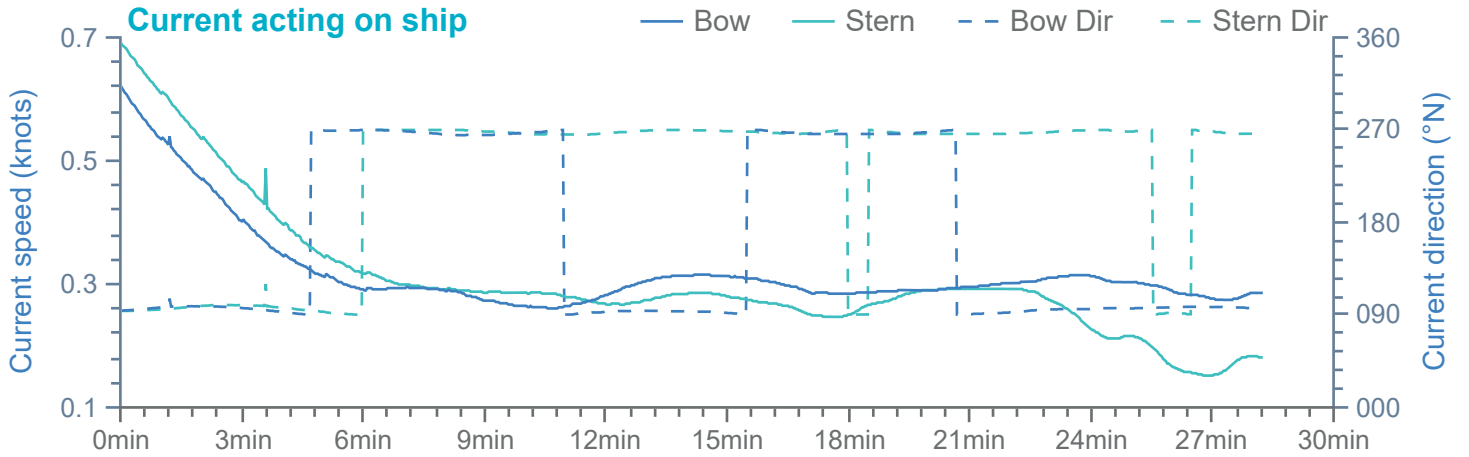


Overview

Environment

240m x 32m RoPax

Thruster and engine use

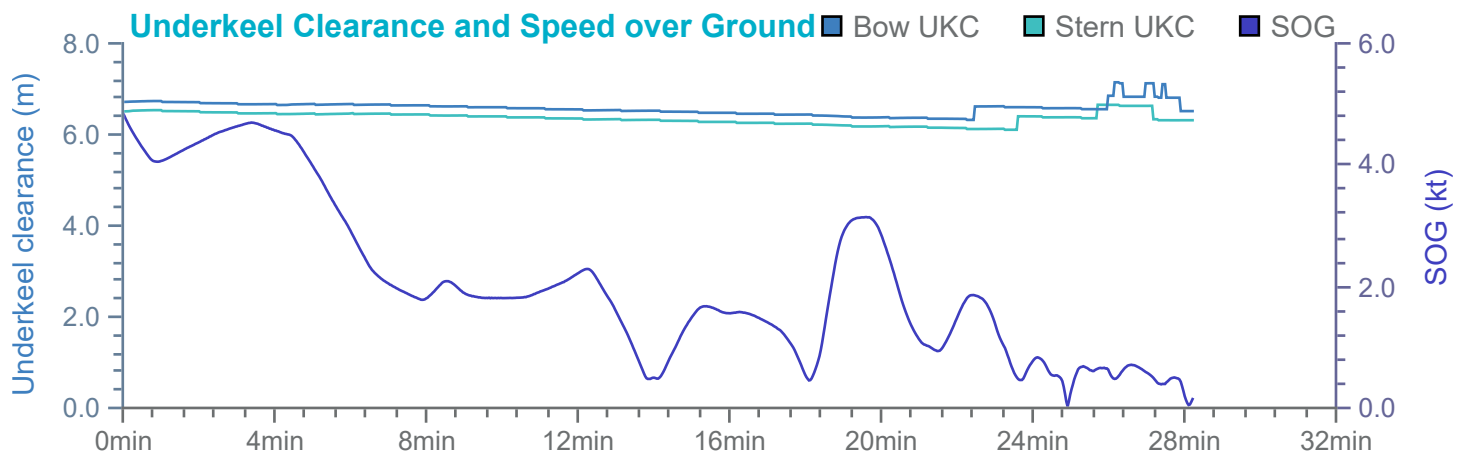
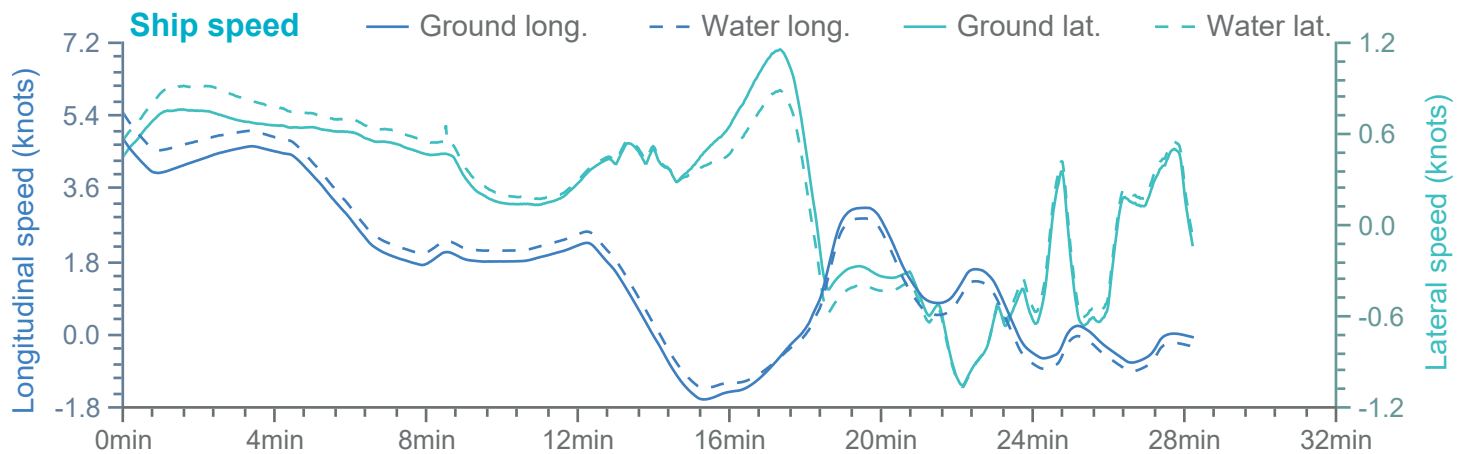
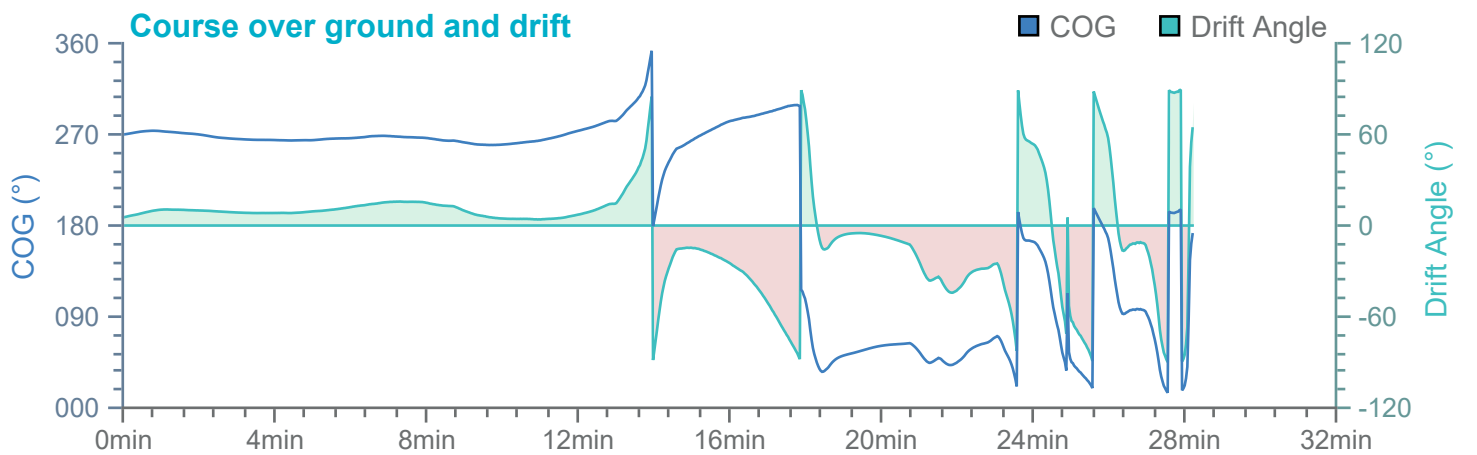
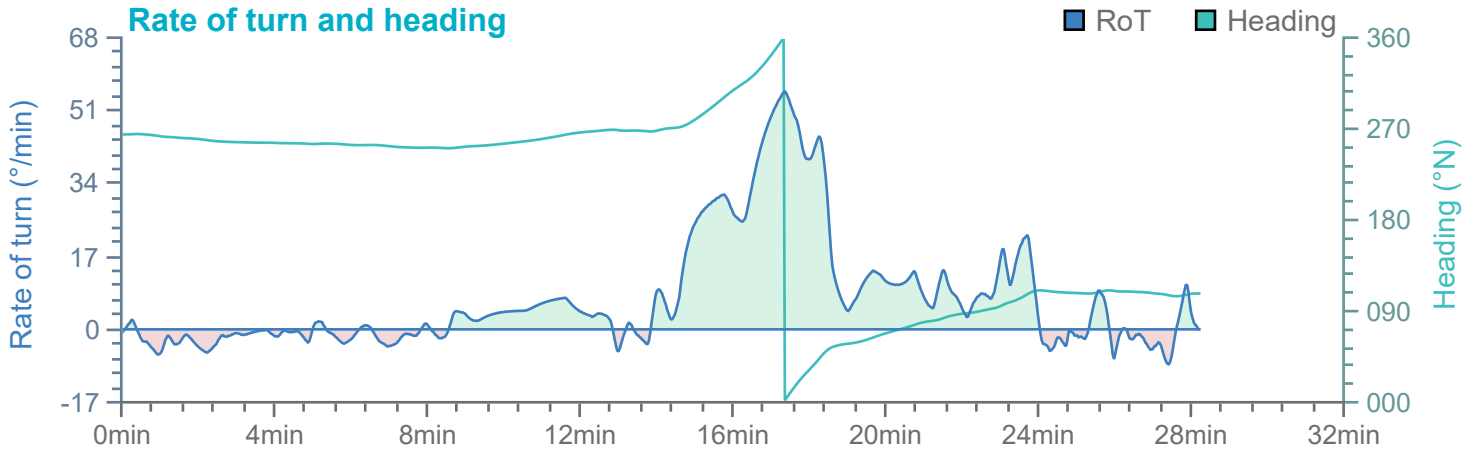


Overview

Environment

240m x 32m RoPax

Thruster and engine use

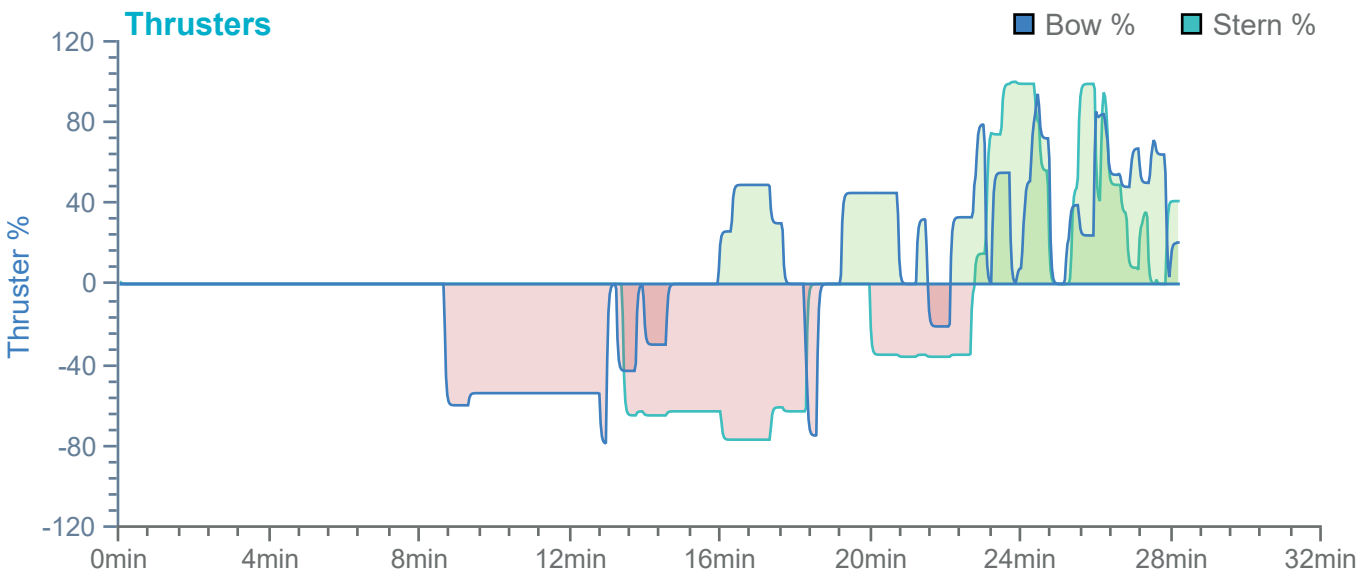
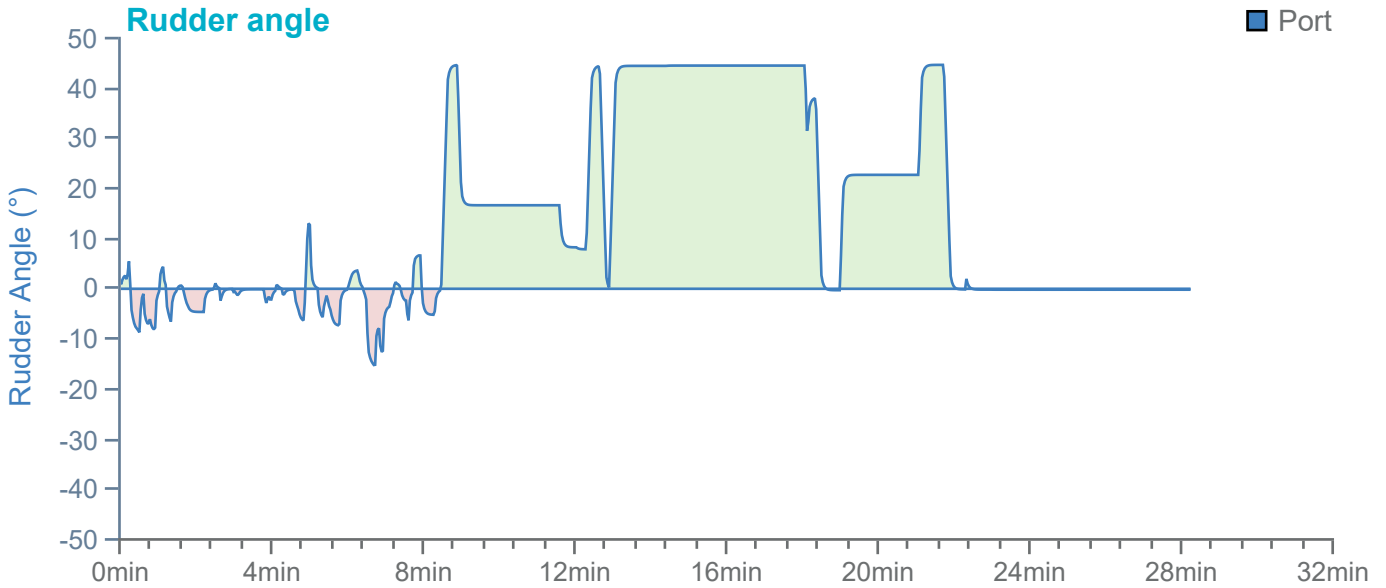
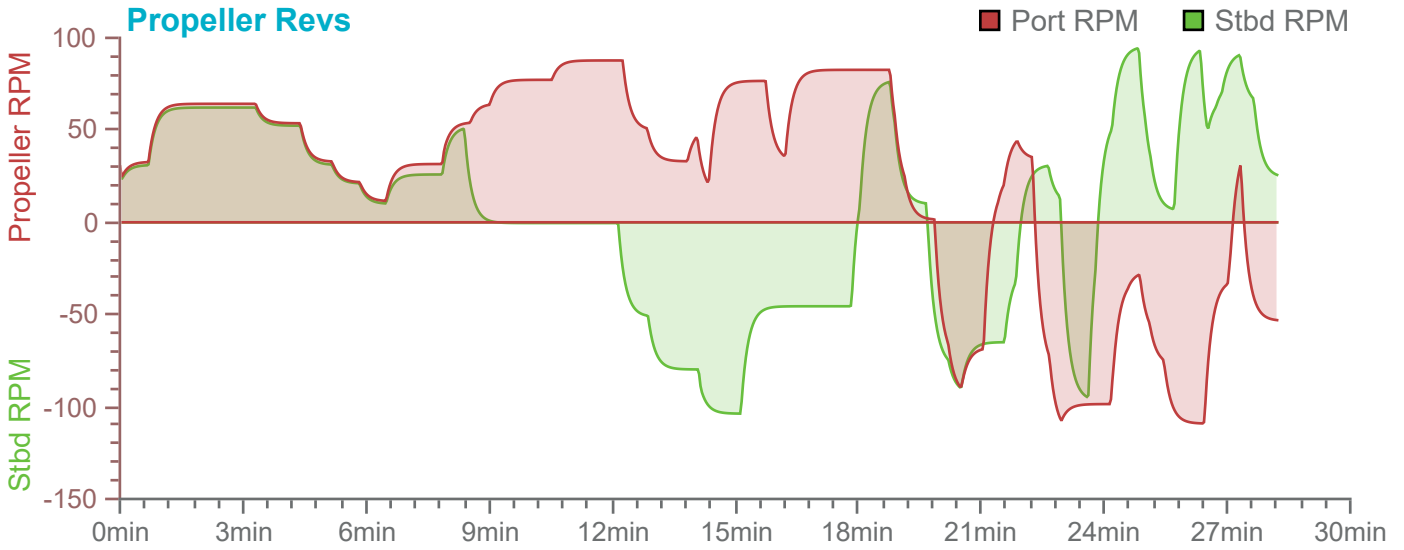


Overview

Environment

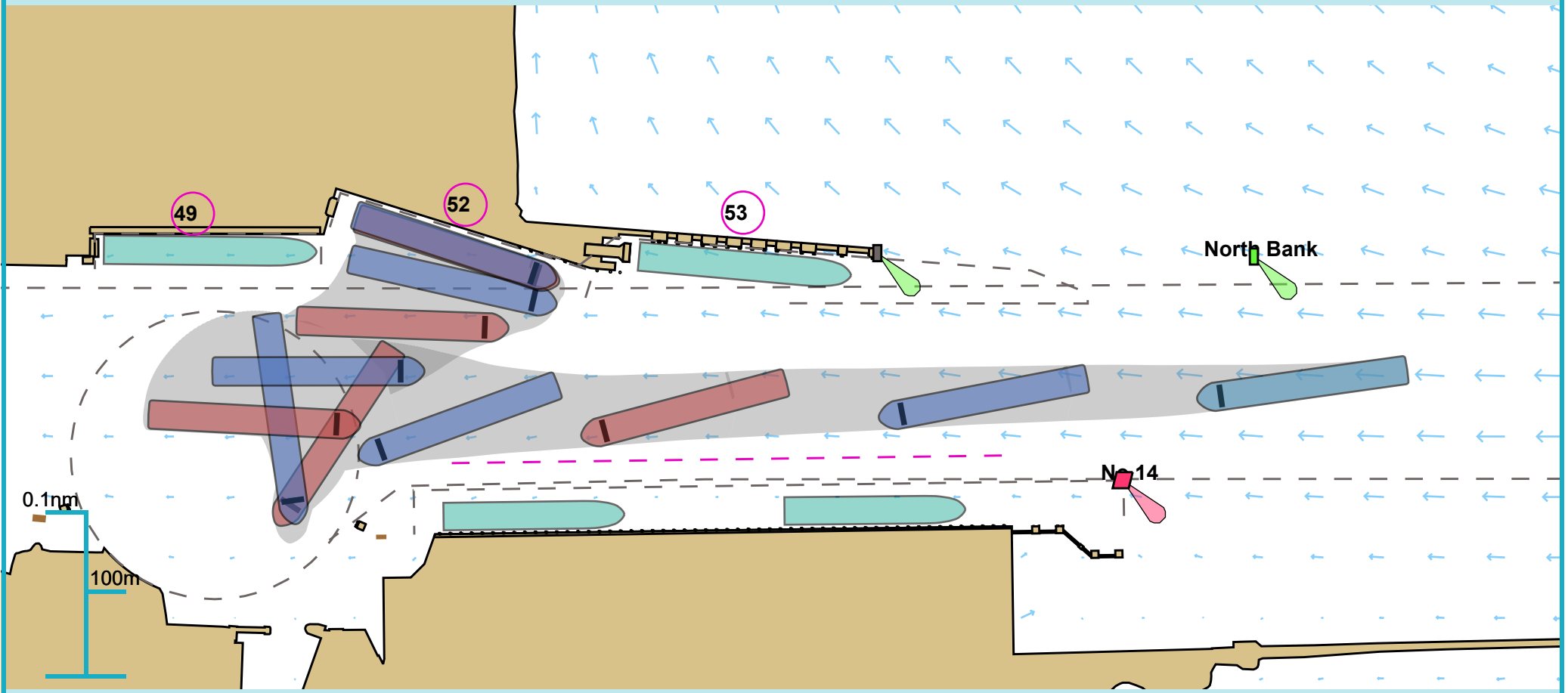
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.399 N, 006° 11.861 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

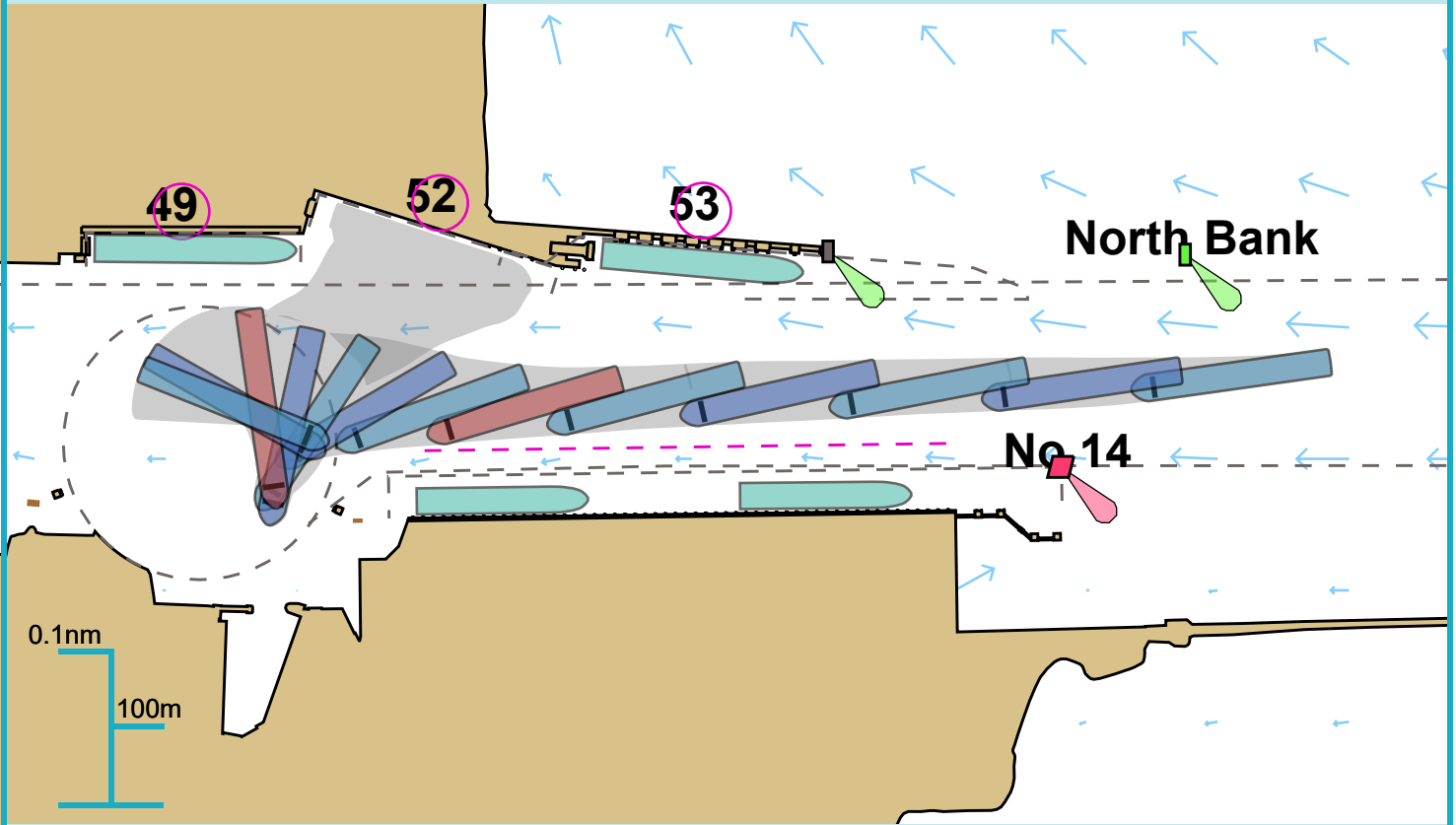
Run length:20 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

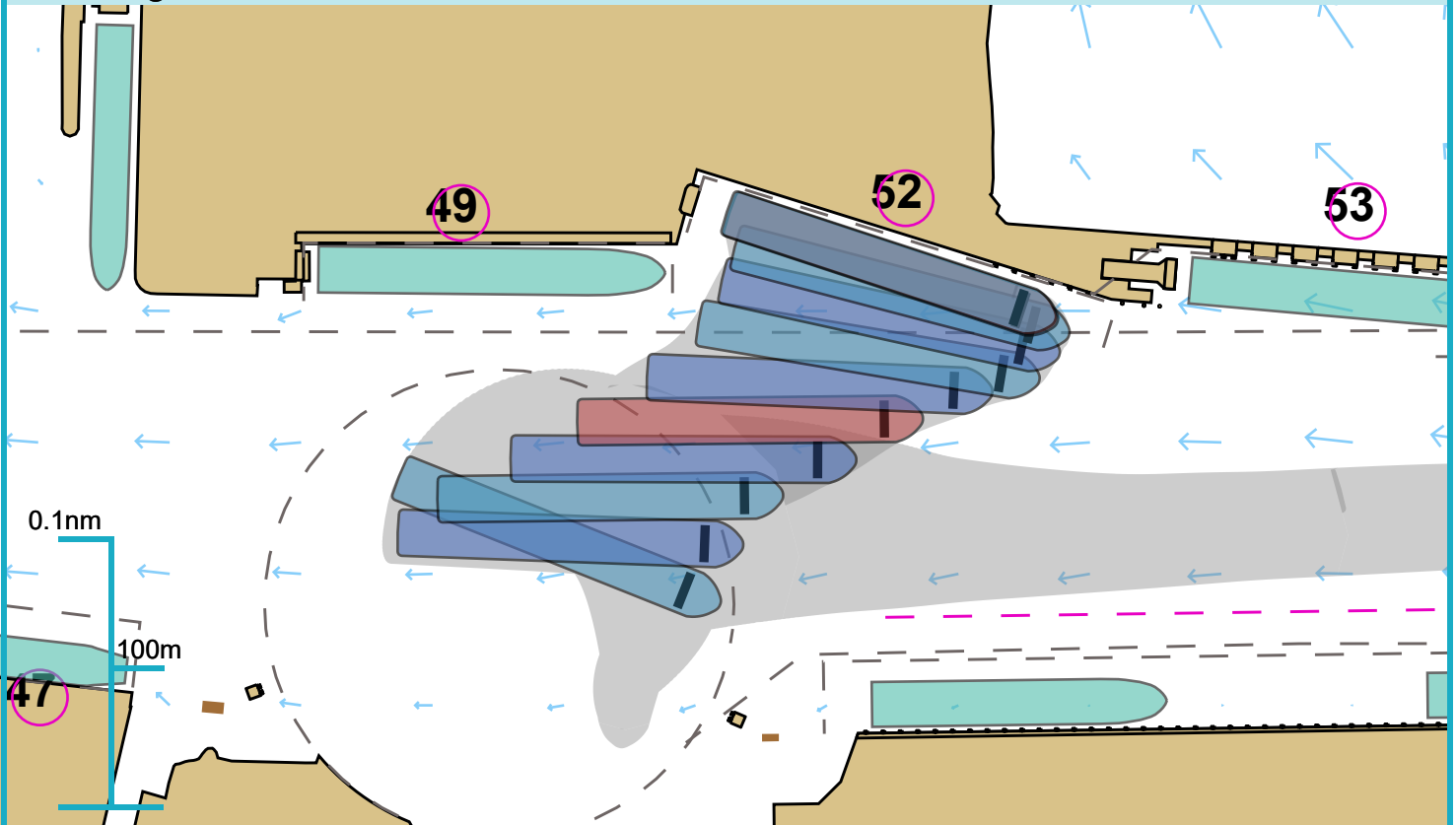
Comments:

Approach



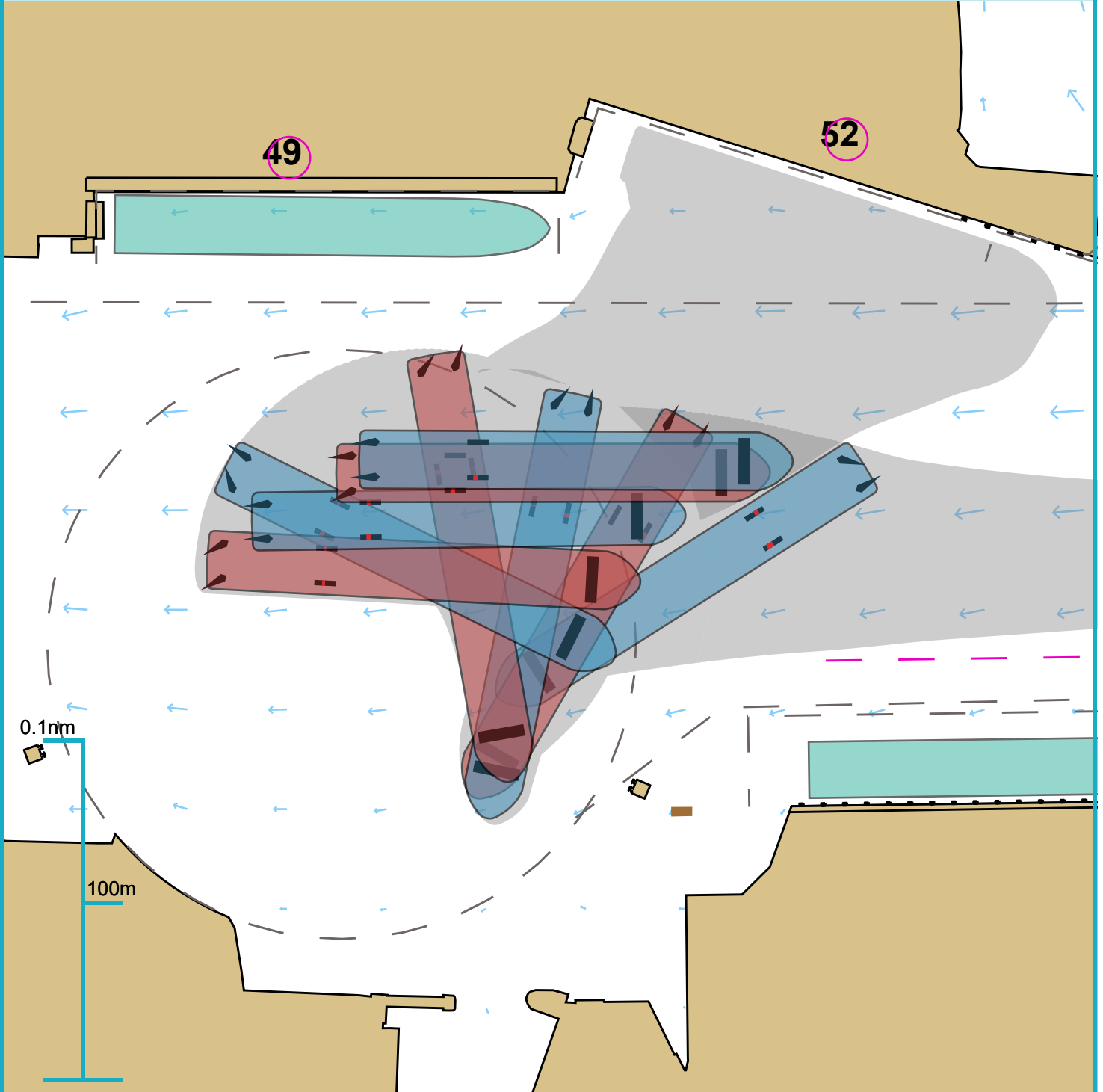
Ships plotted every 1 mins, highlight every 5 mins

Berthing

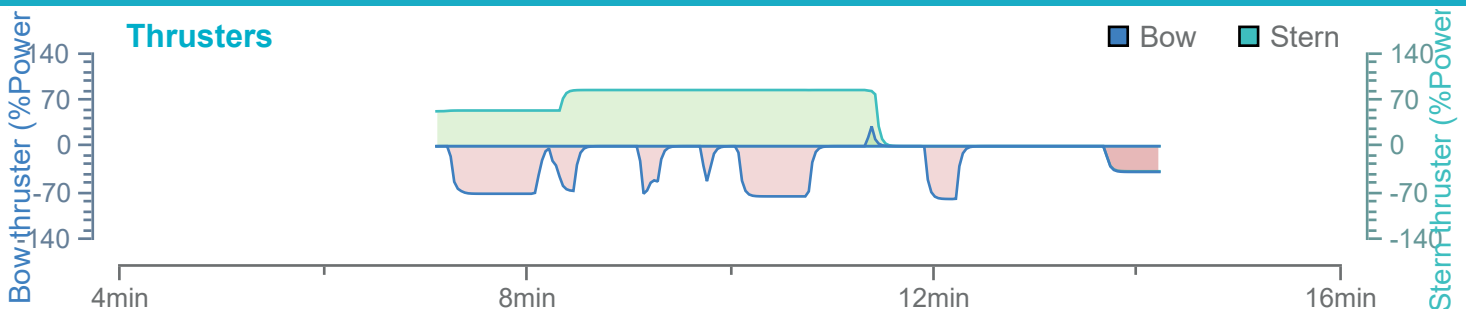


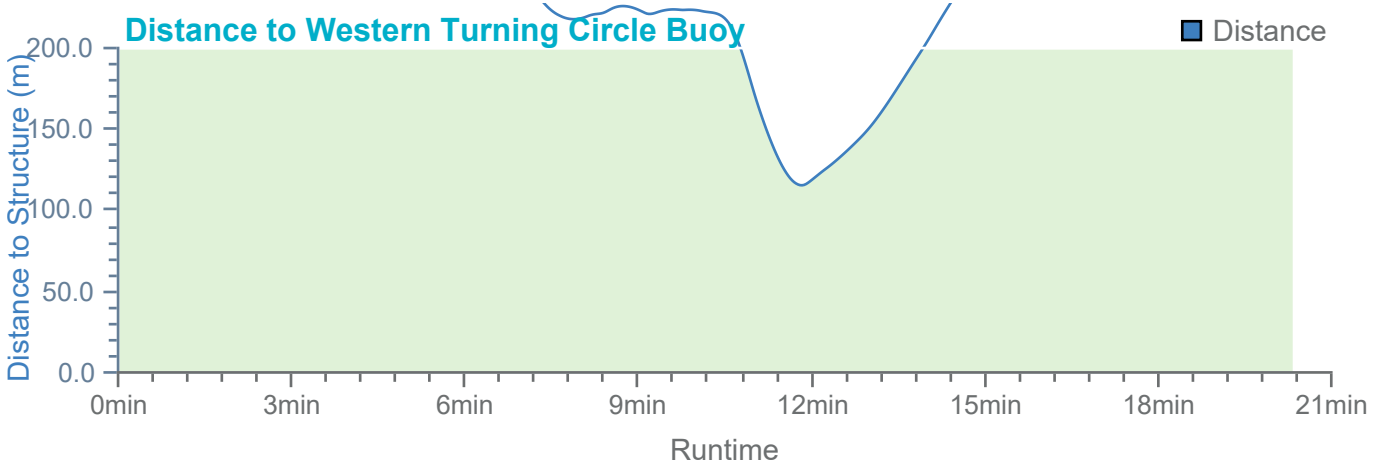
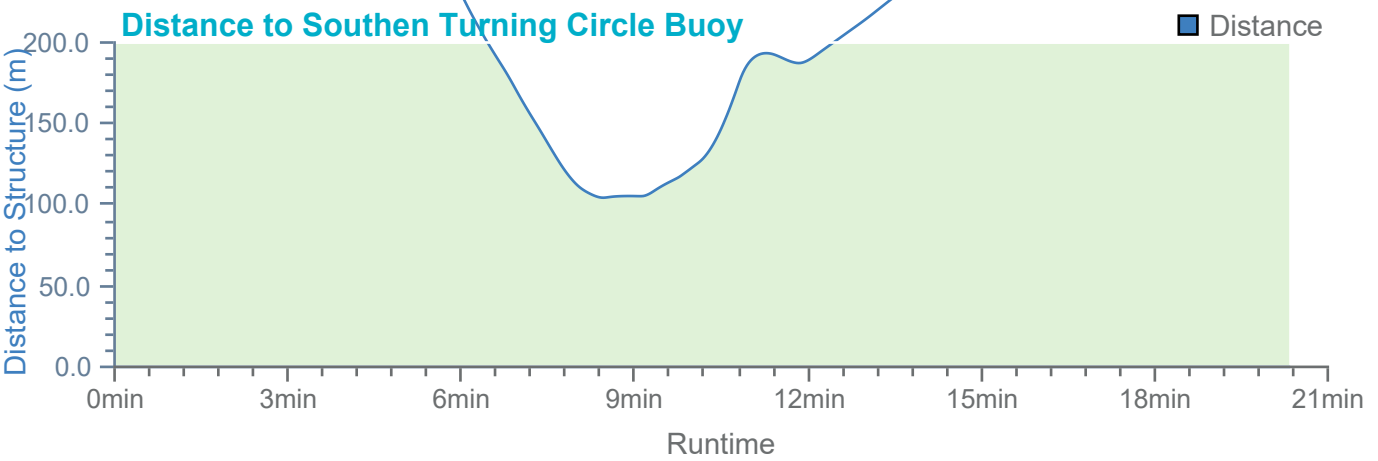
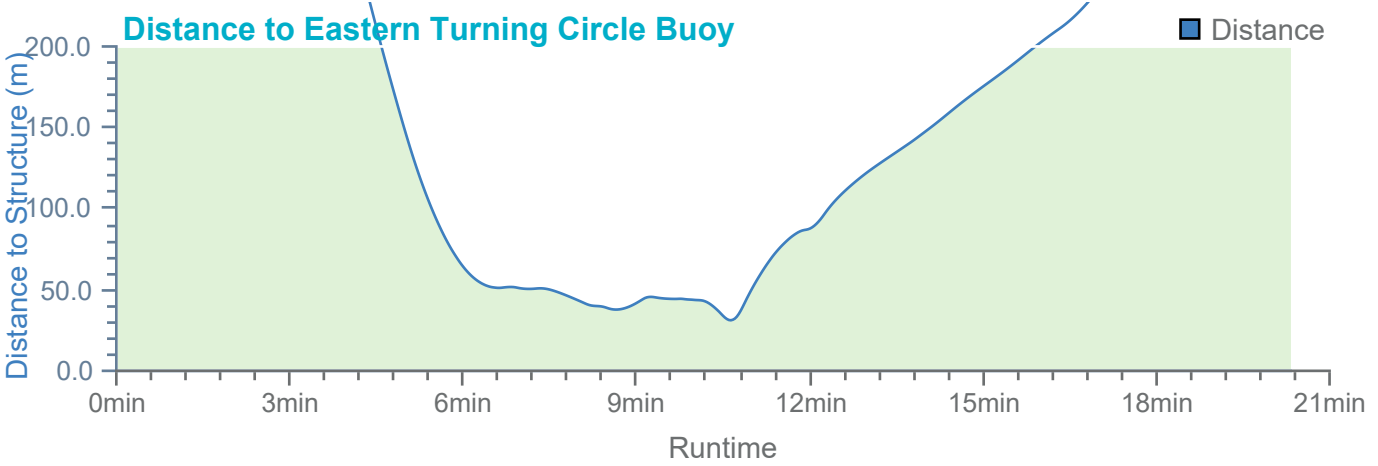
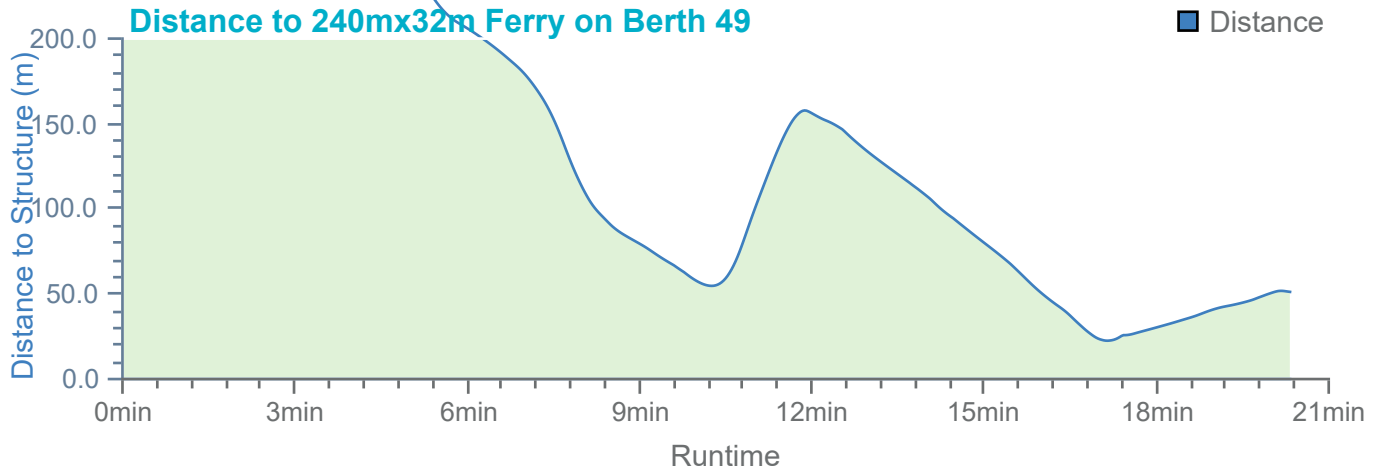
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



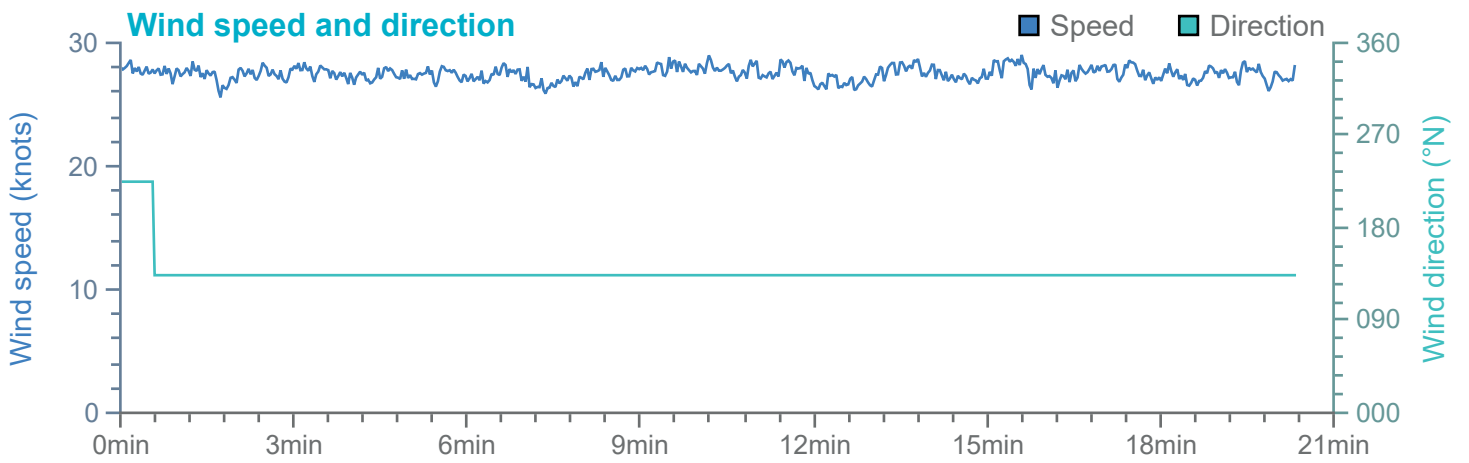
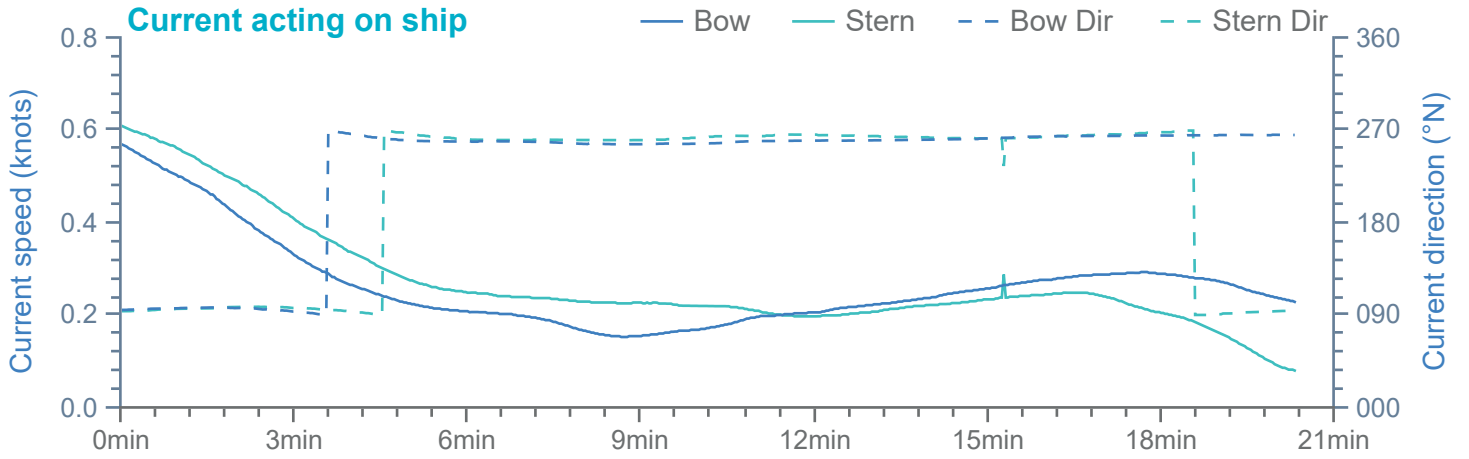


Overview

Environment

240m x 32m RoPax

Thruster and engine use

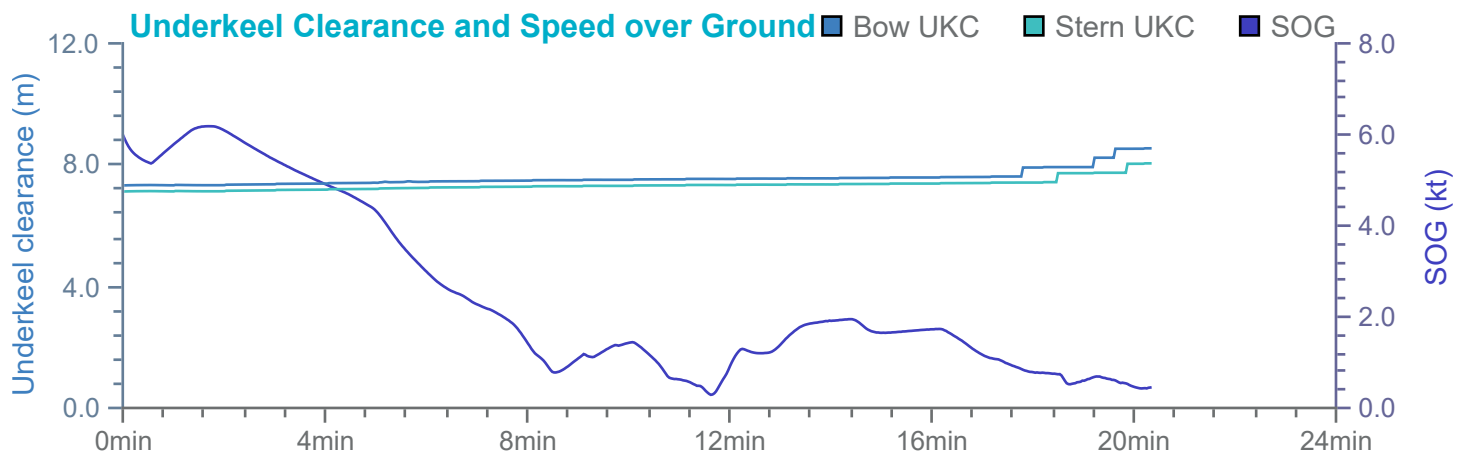
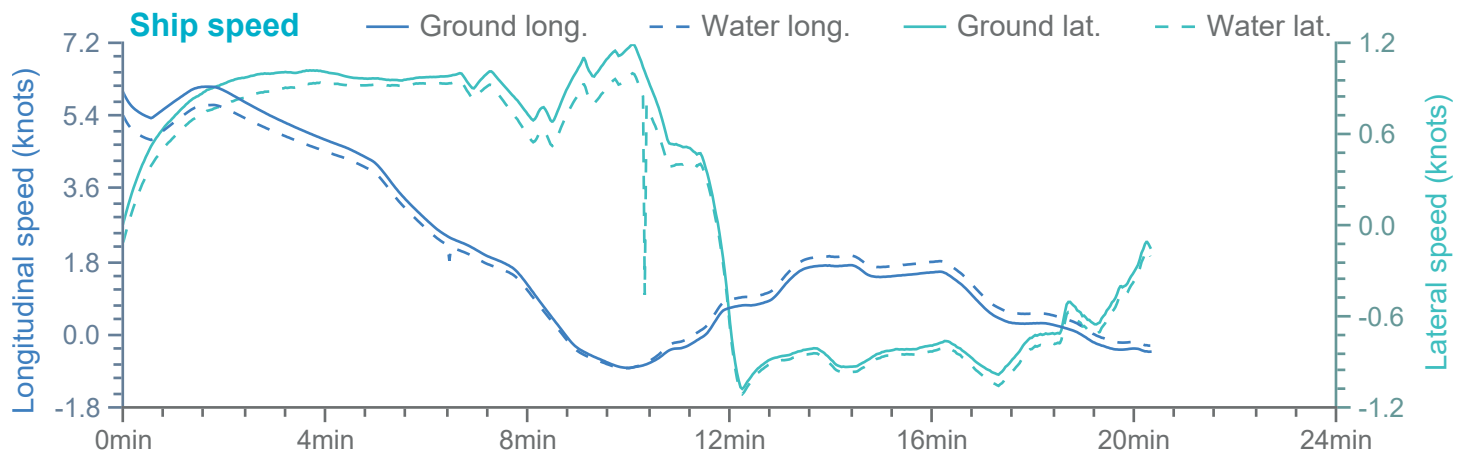
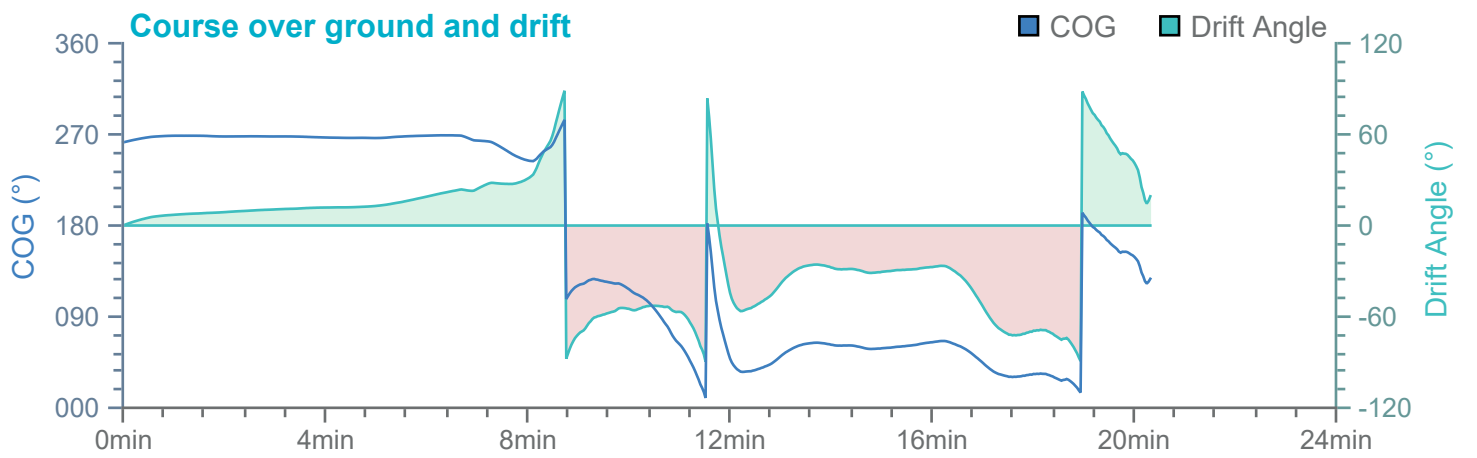
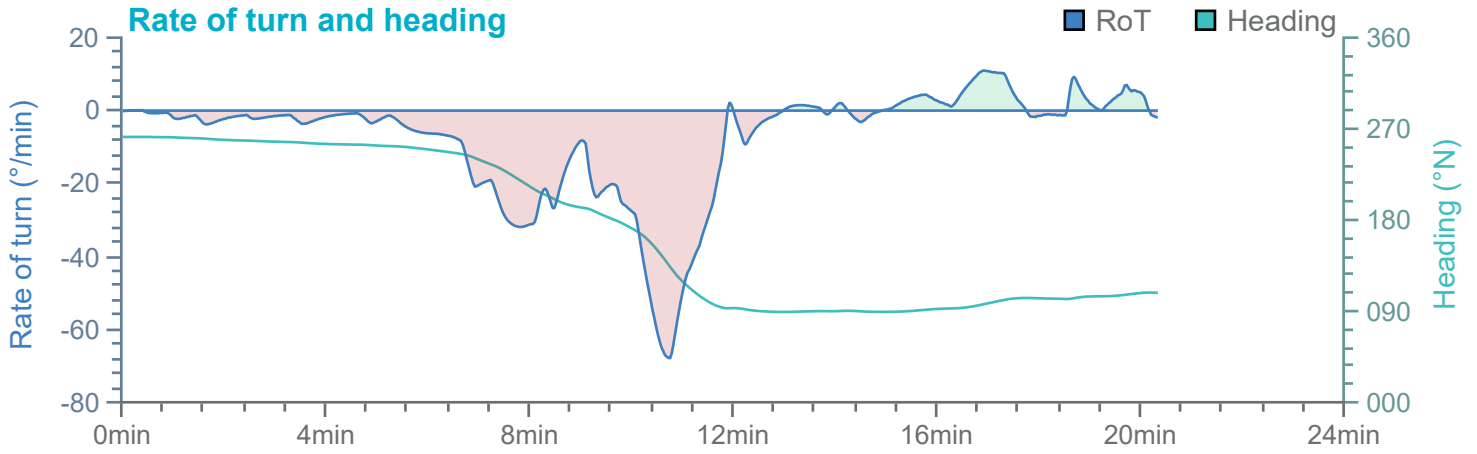


Overview

Environment

240m x 32m RoPax

Thruster and engine use

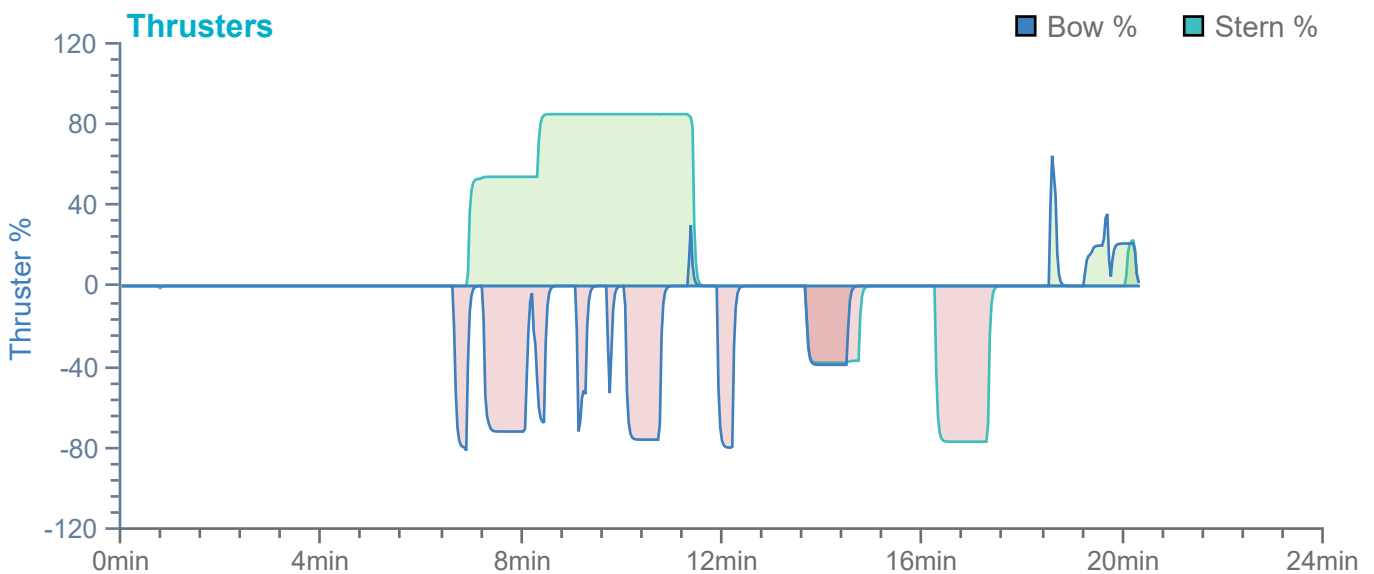
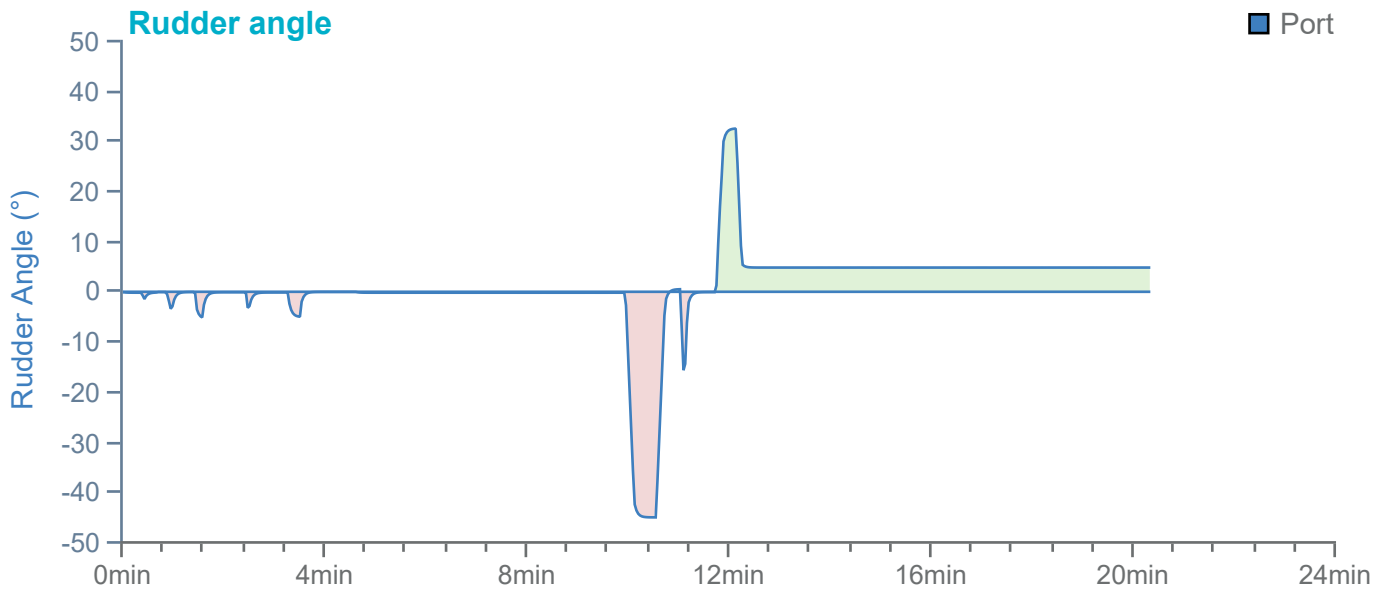
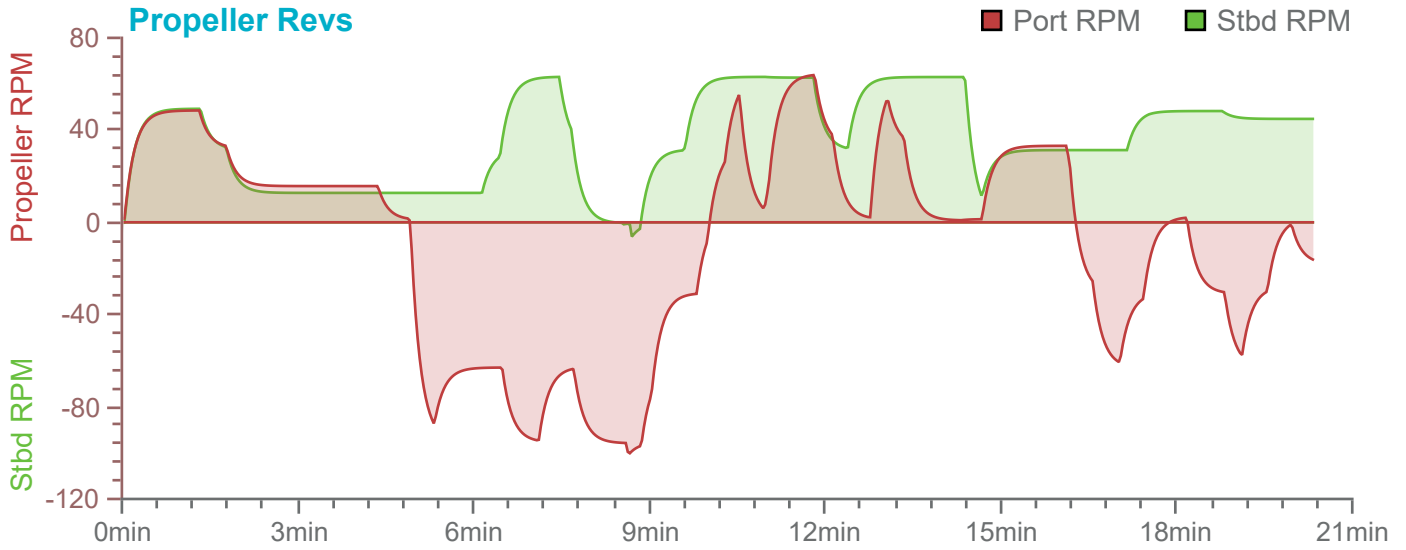


Overview

Environment

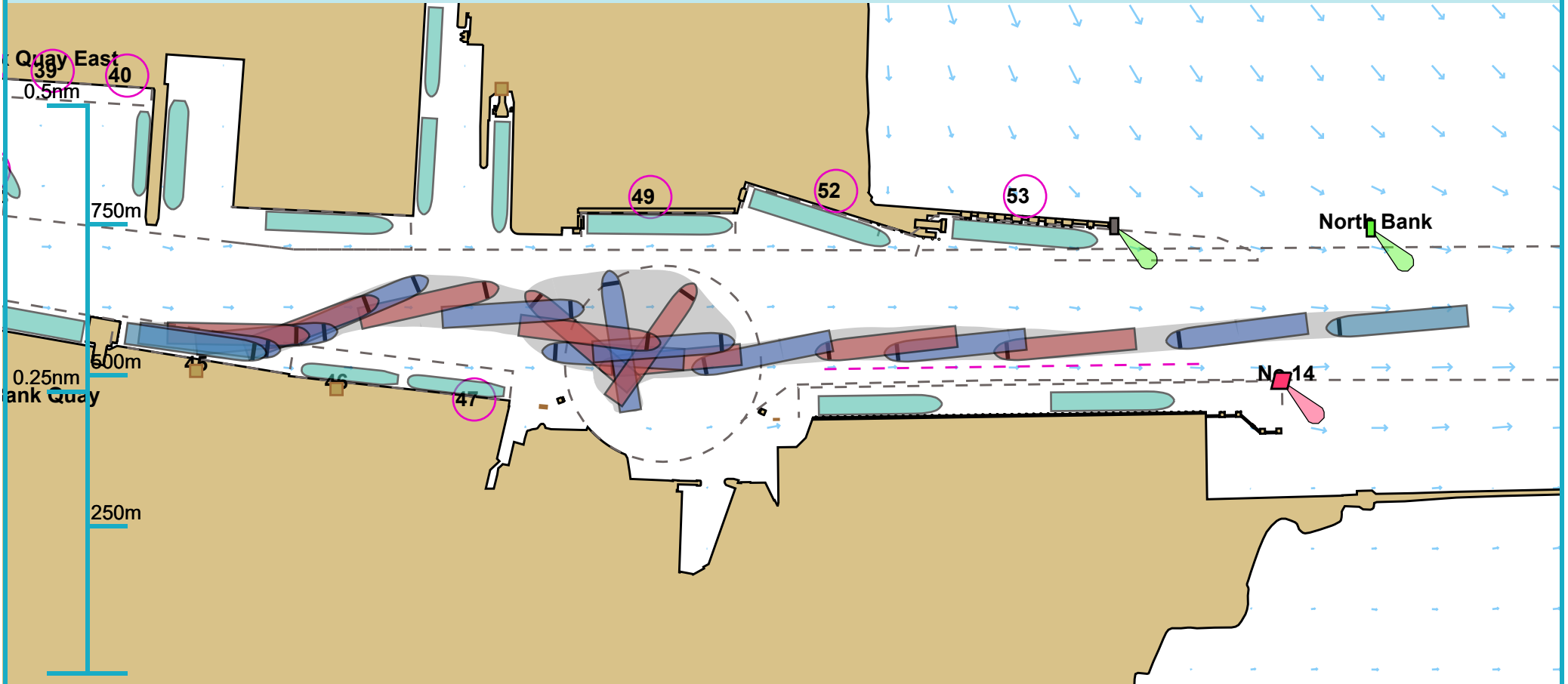
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.239 N, 006° 12.628 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

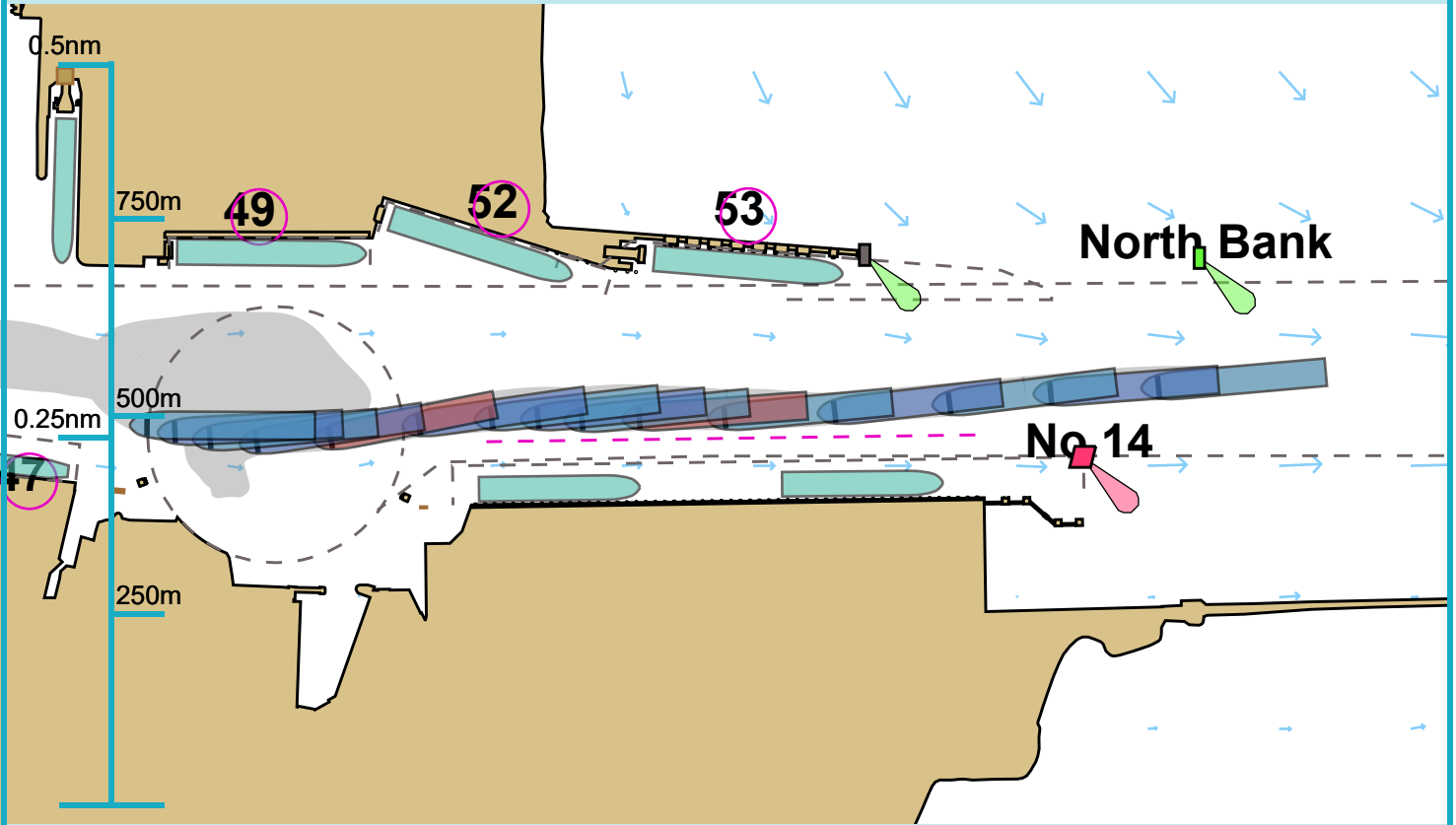
Run length: 39 minutes

Manoeuvre: Other

Ownship(s): MV Celine

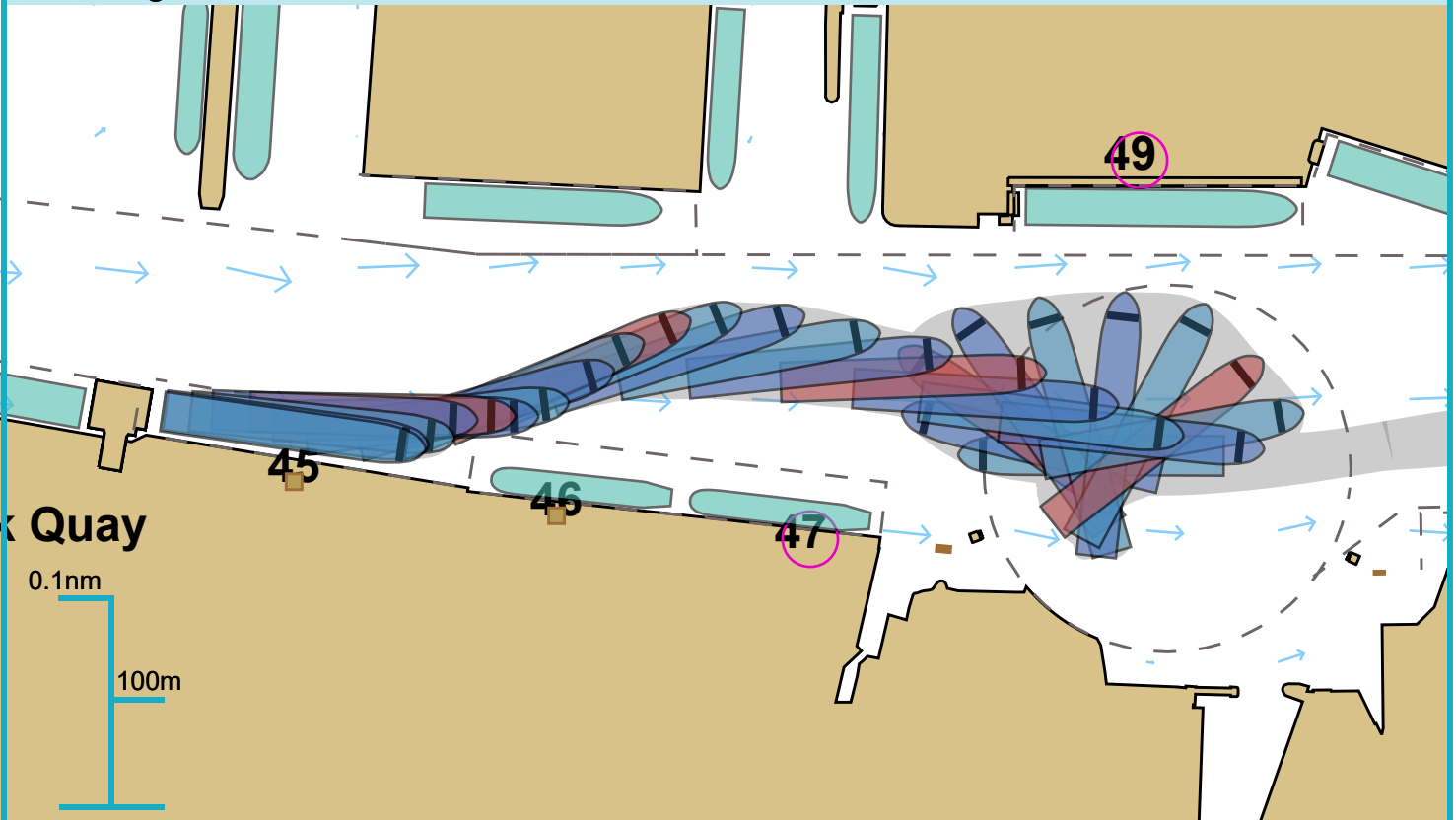
Comments:

Approach



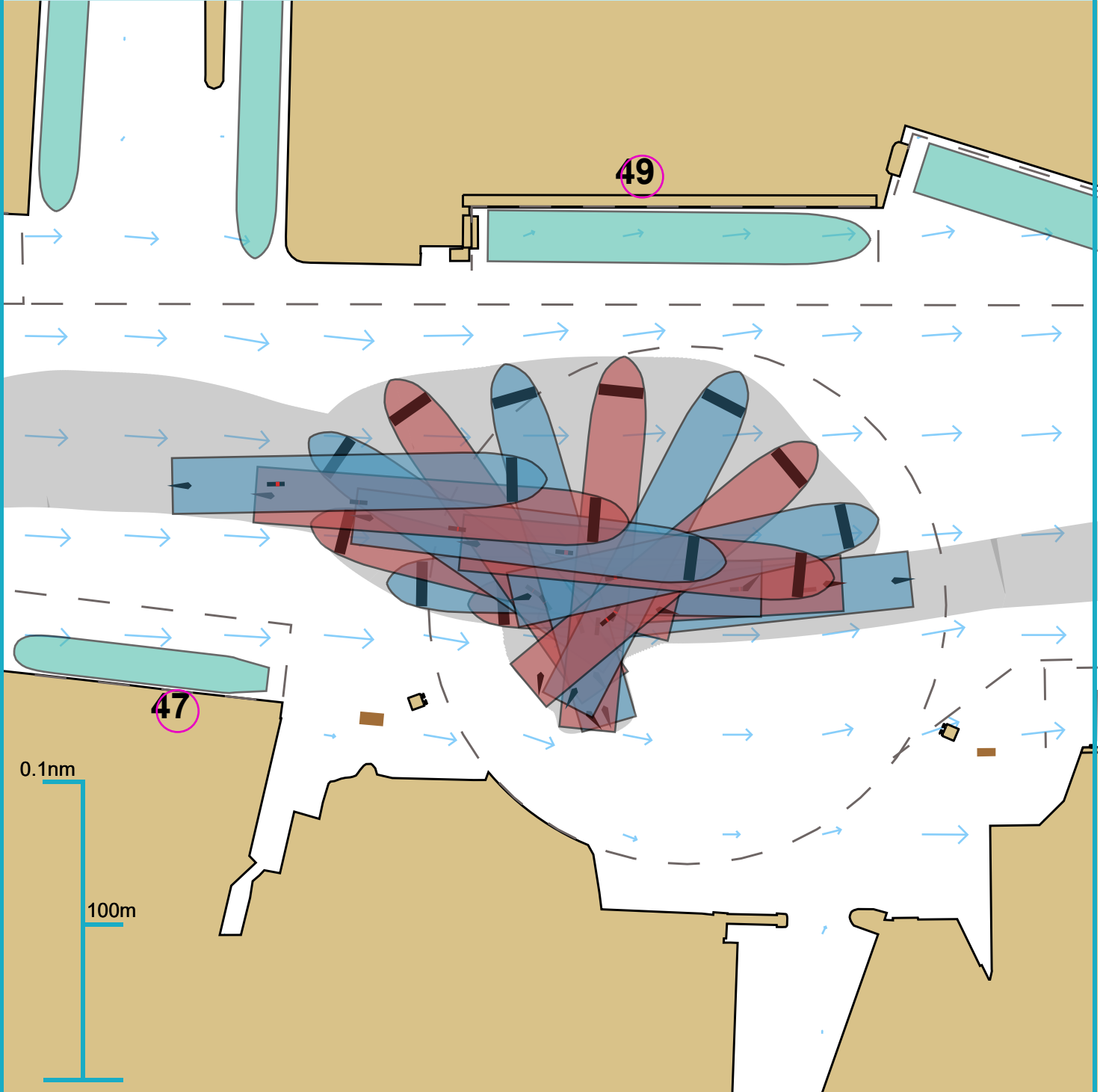
Ships plotted every 1 mins, highlight every 5 mins

Berthing

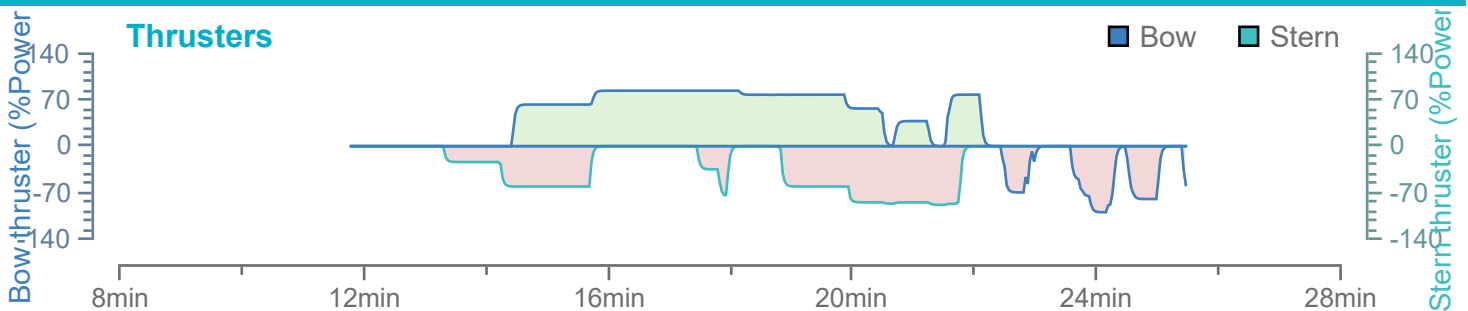


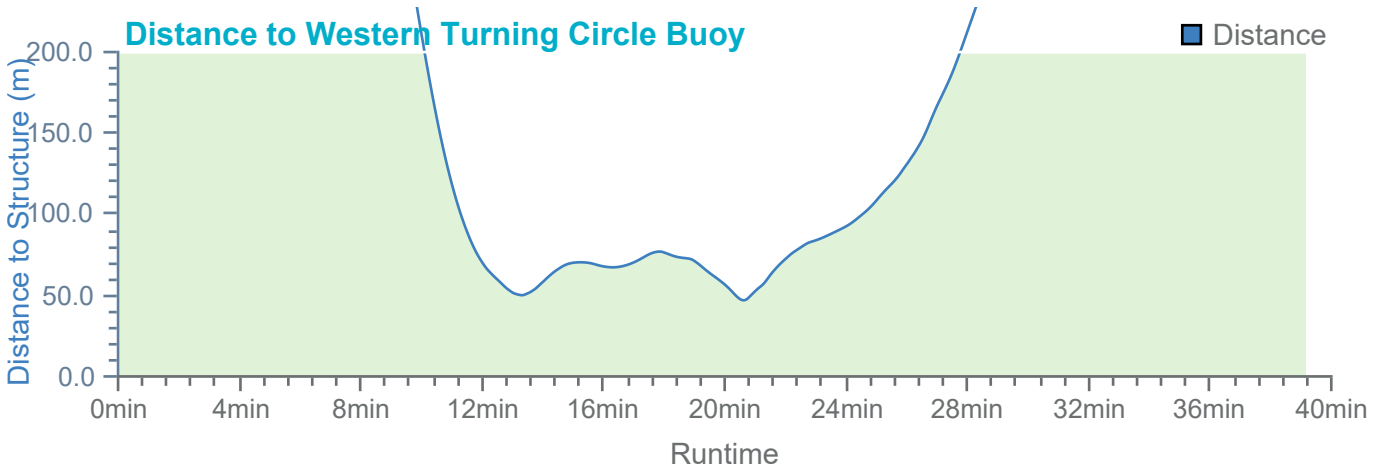
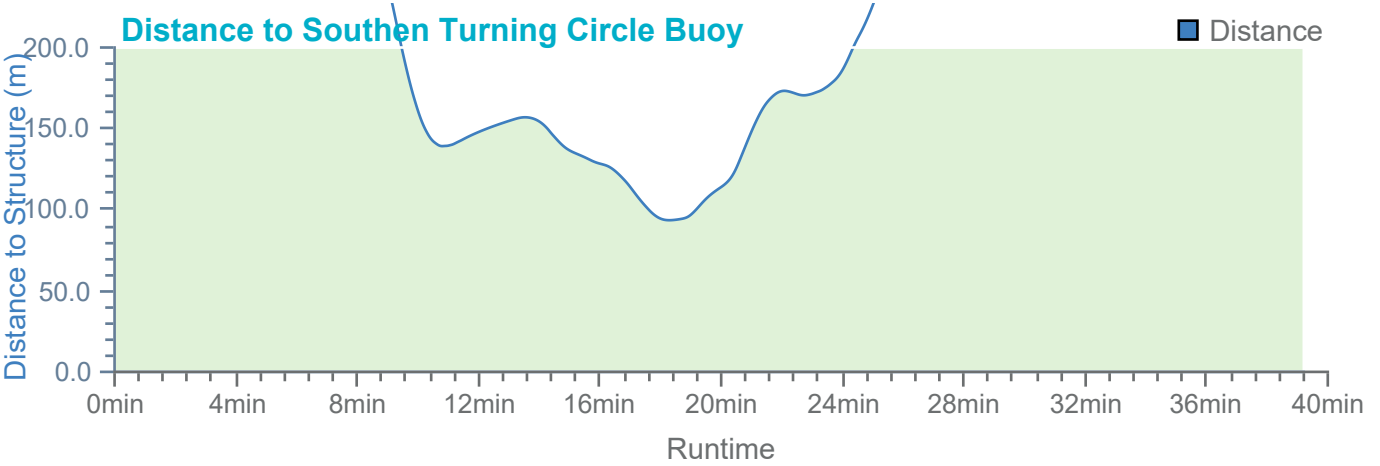
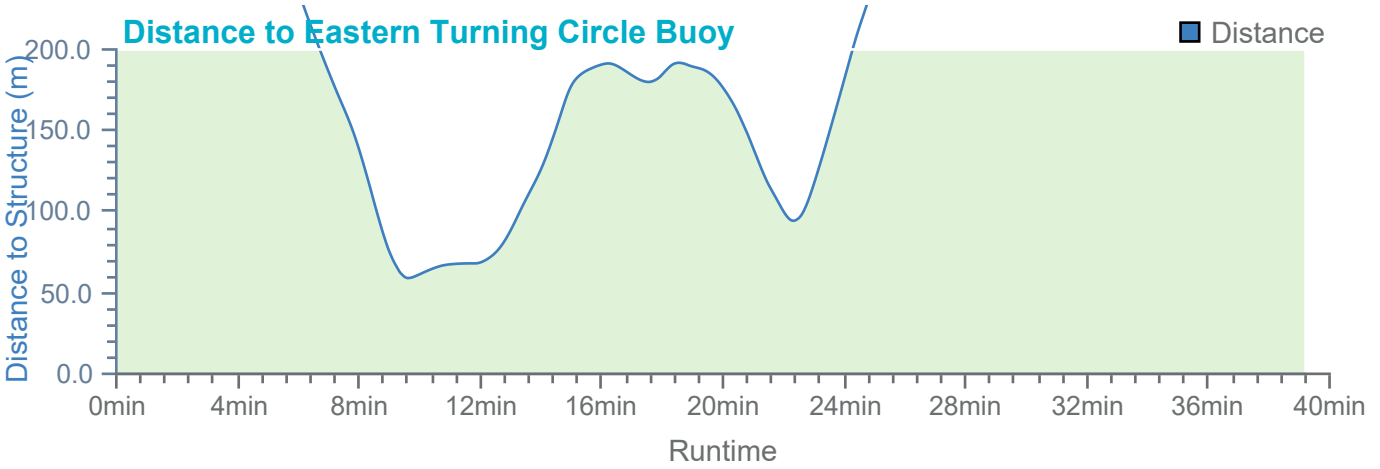
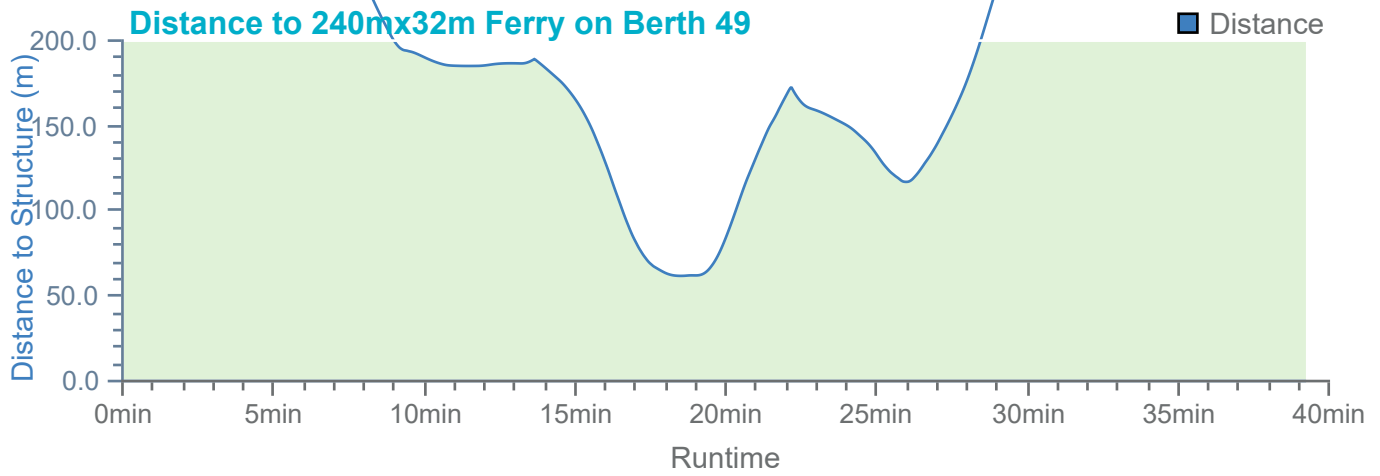
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



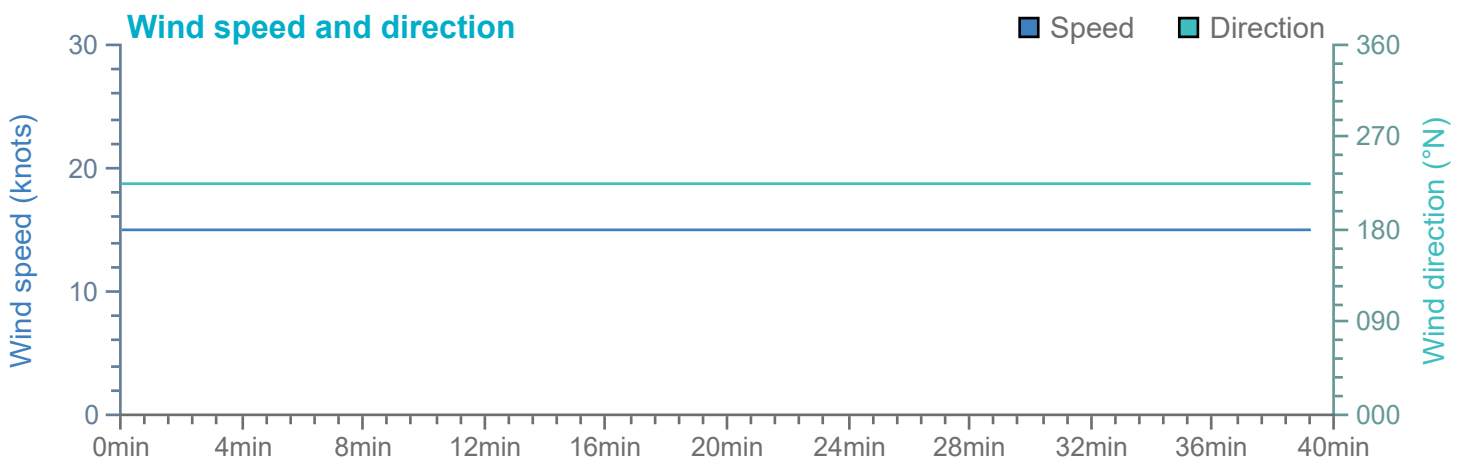
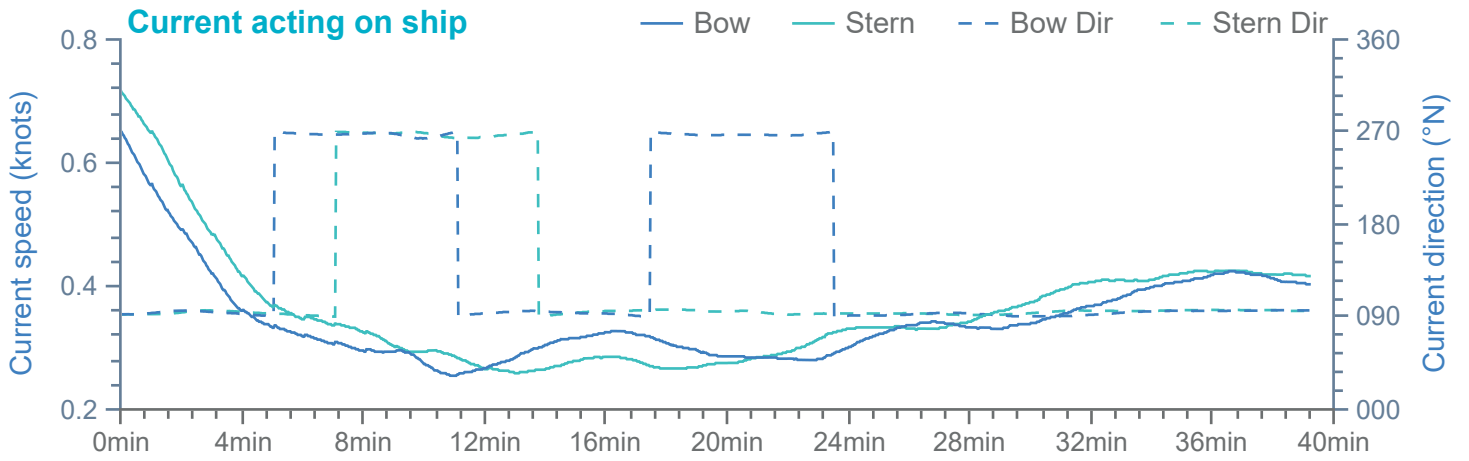


Overview

Environment

MV Celine

Thruster and engine use

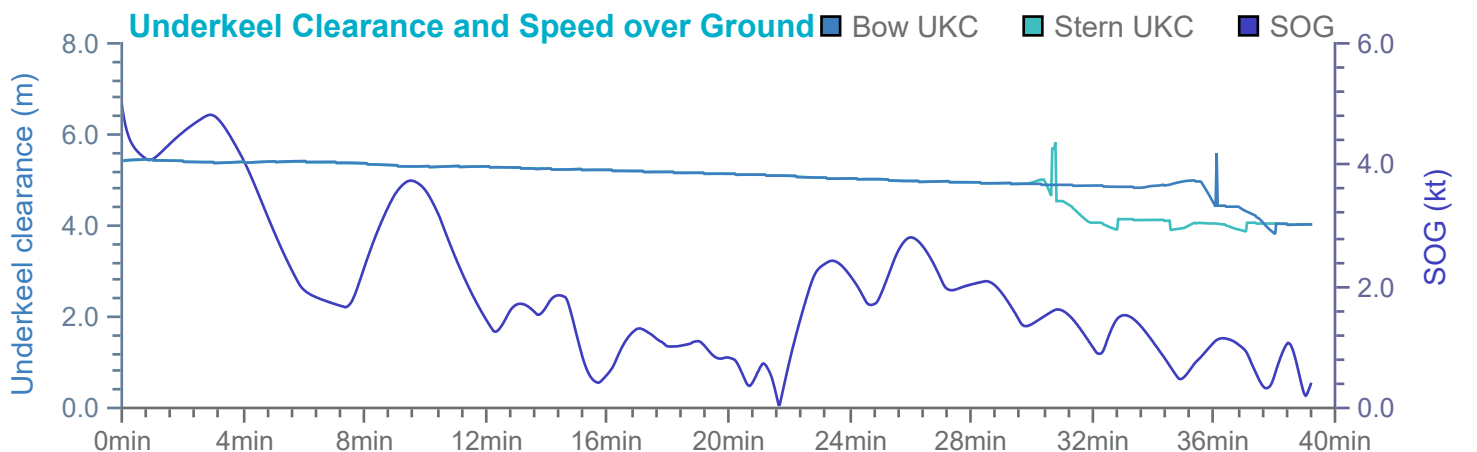
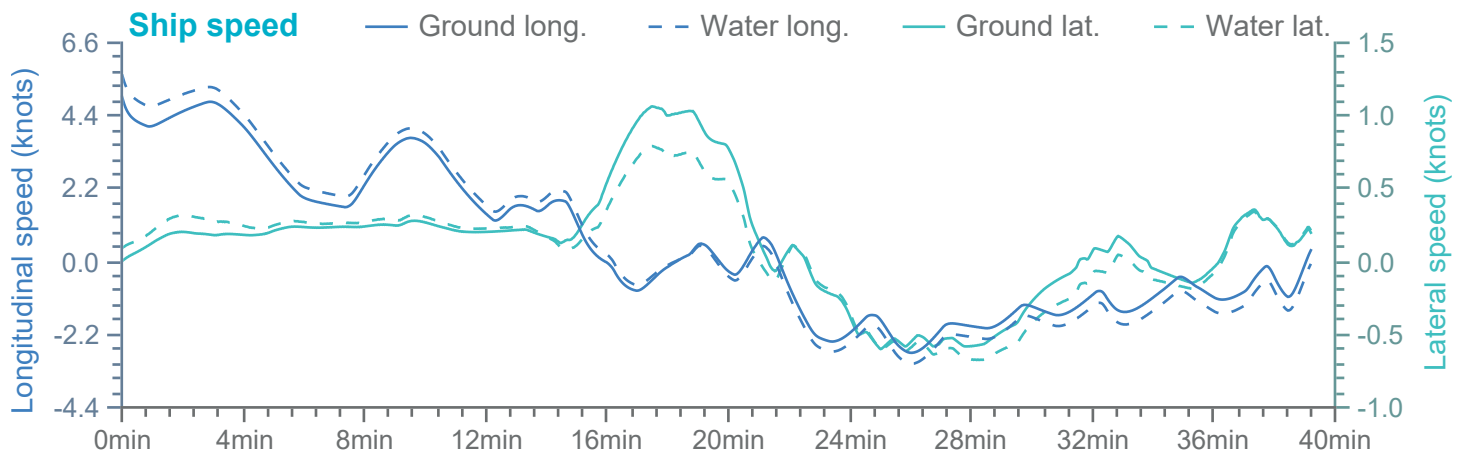
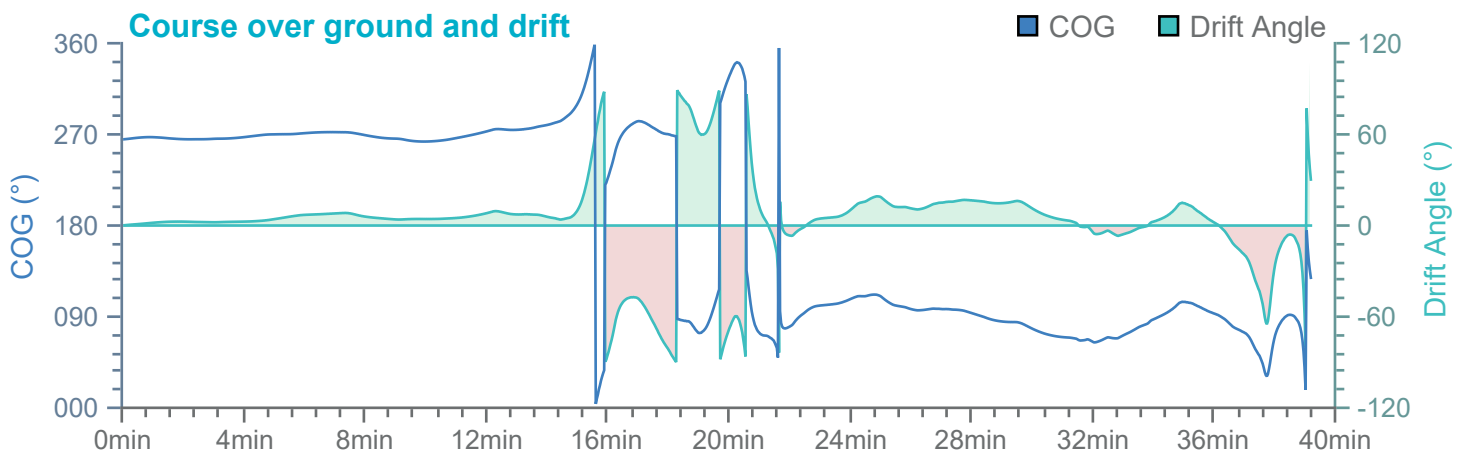
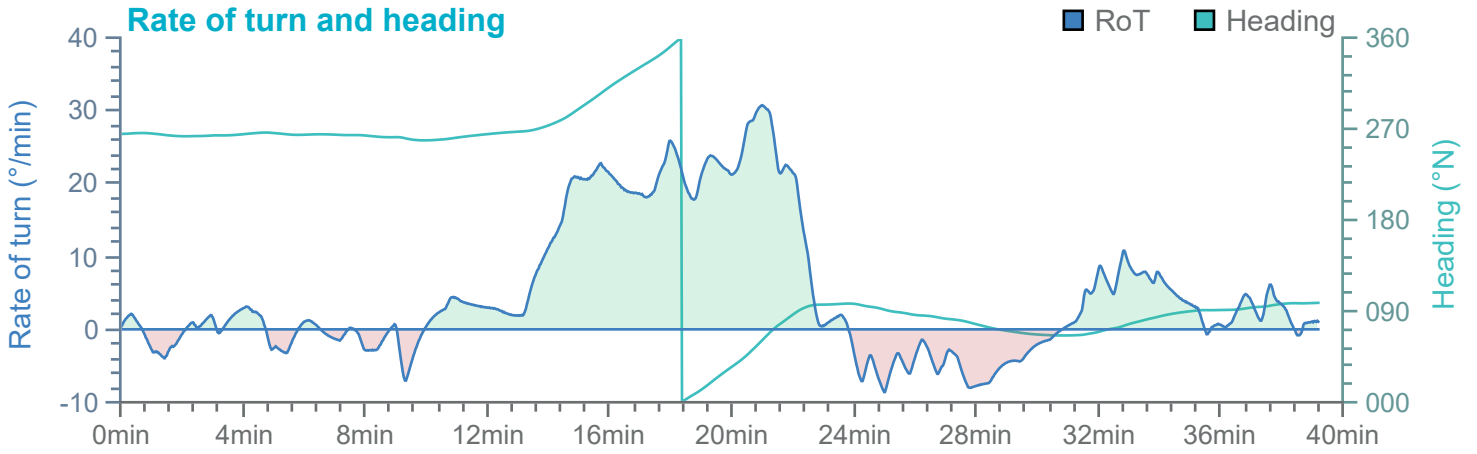


Overview

Environment

MV Celine

Thruster and engine use

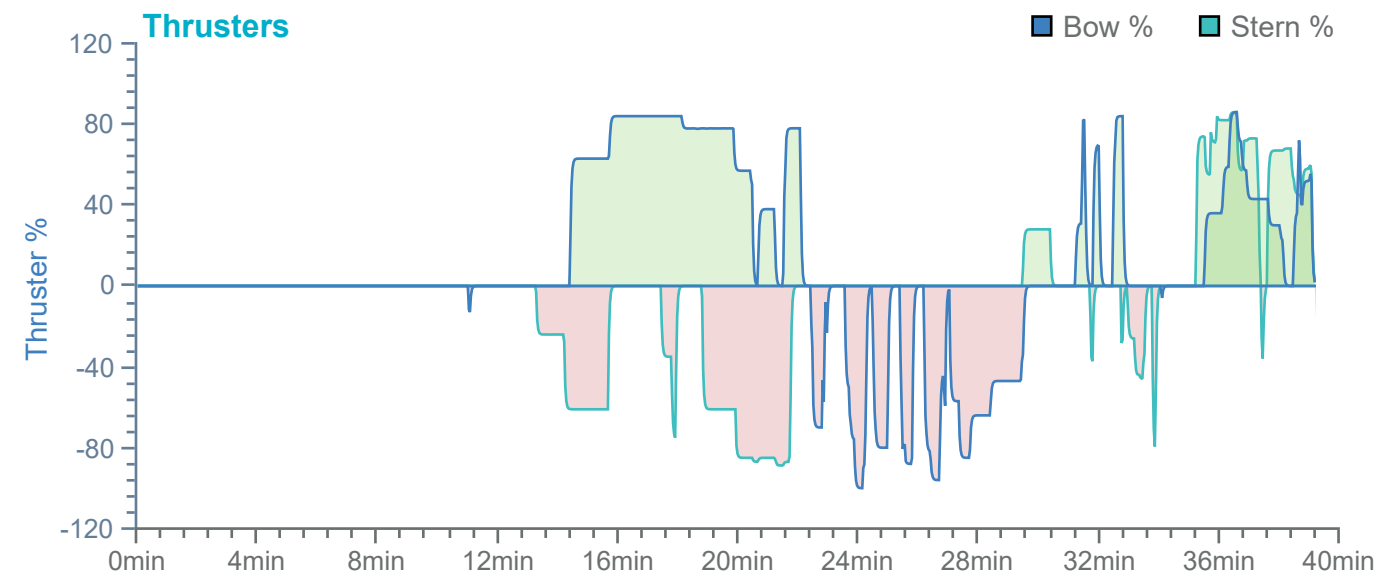
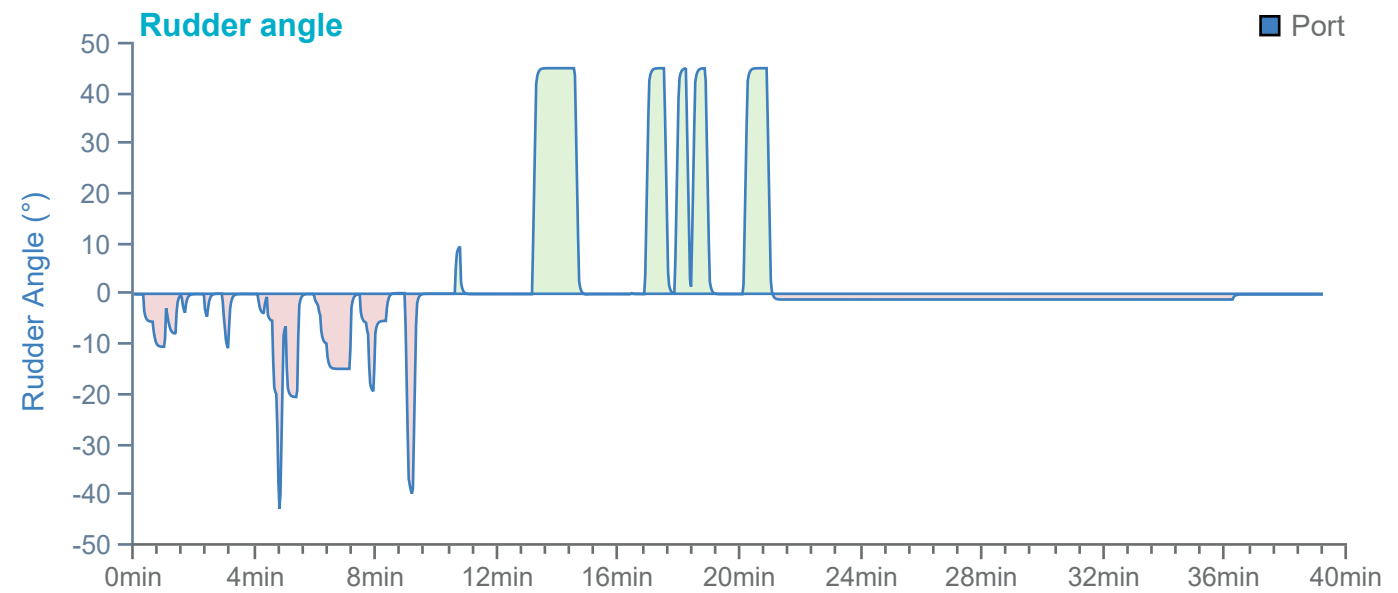
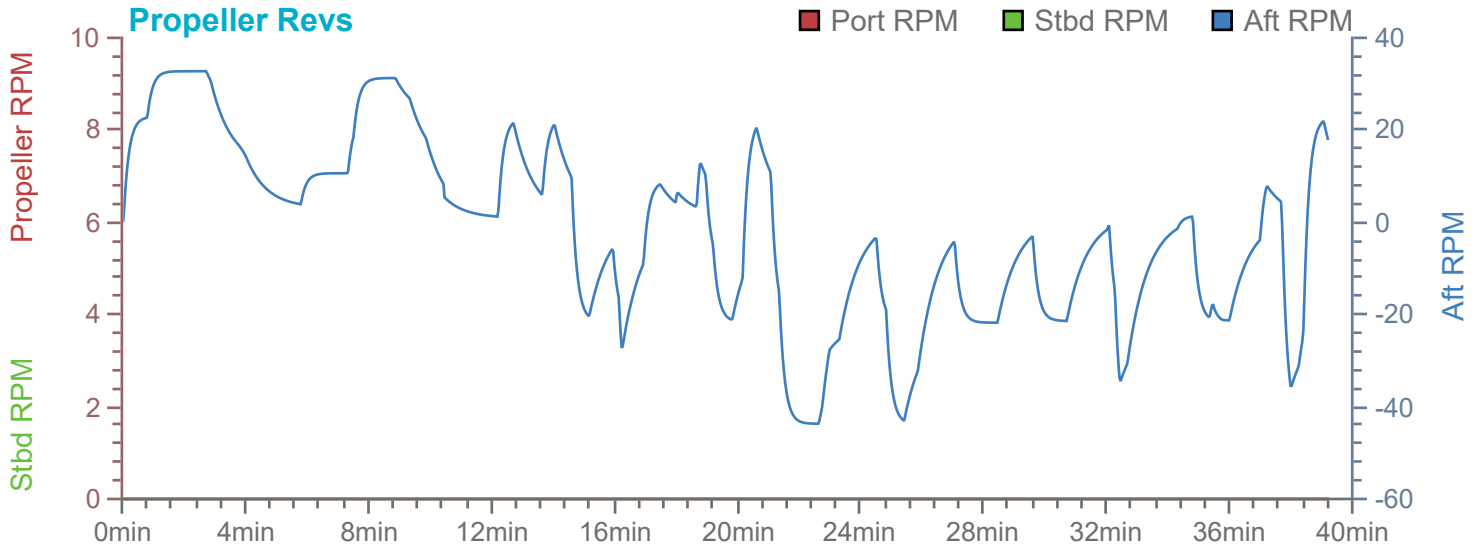


Overview

Environment

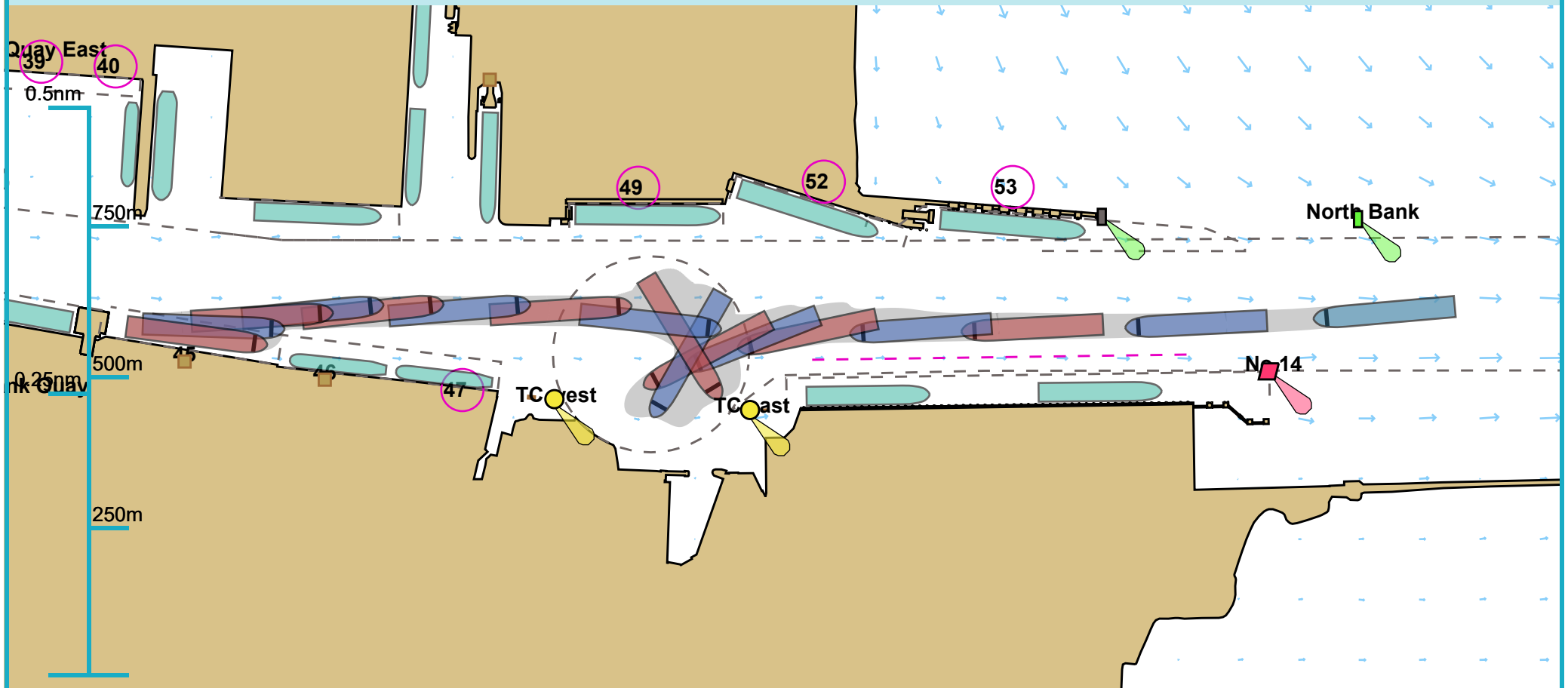
MV Celine

Thruster and engine use



Full Run Overview

53° 20.229 N, 006° 12.609 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

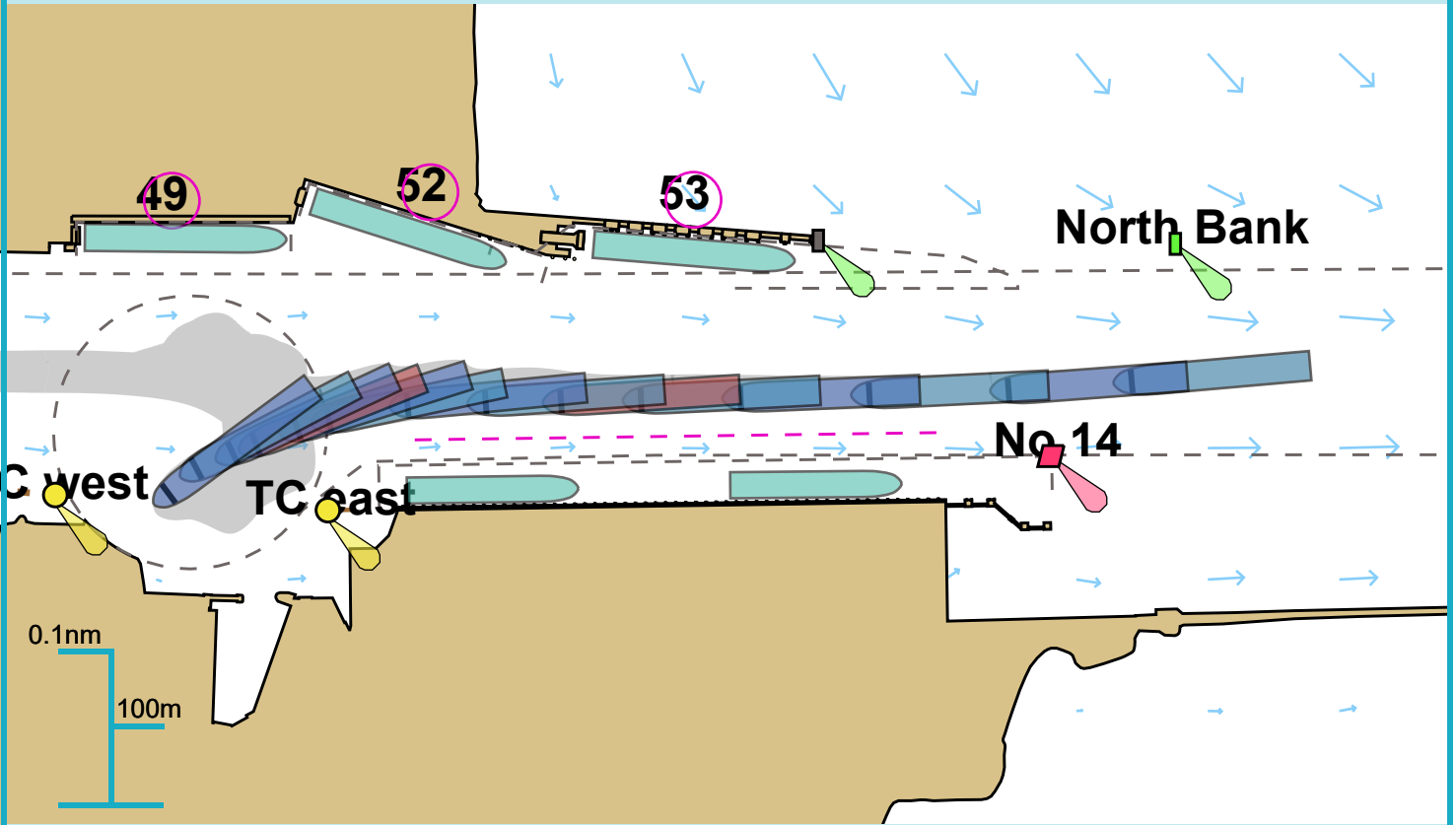
Run length: 32 minutes

Manoeuvre: Other

Ownship(s): MV Celine

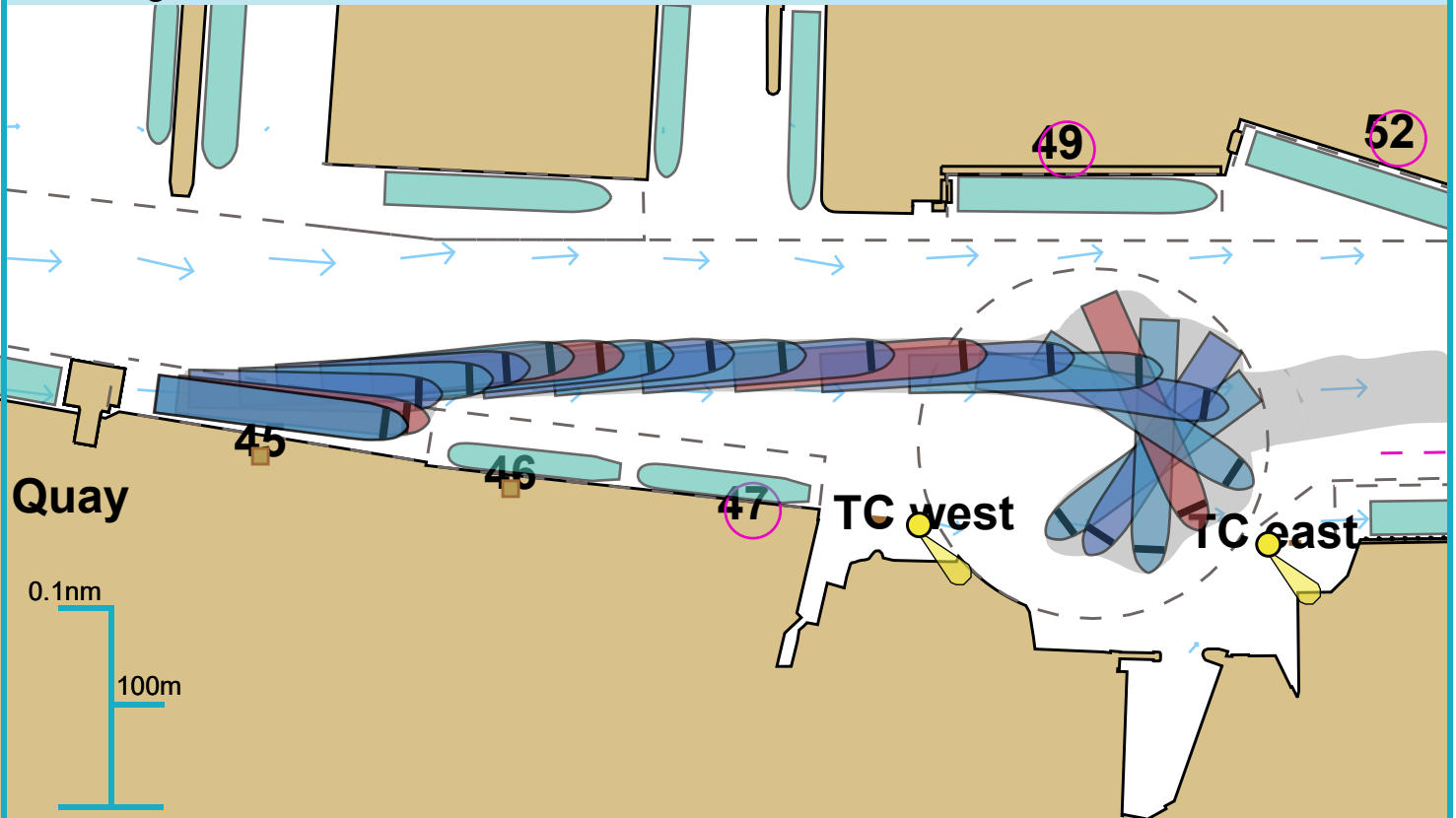
Comments:

Approach



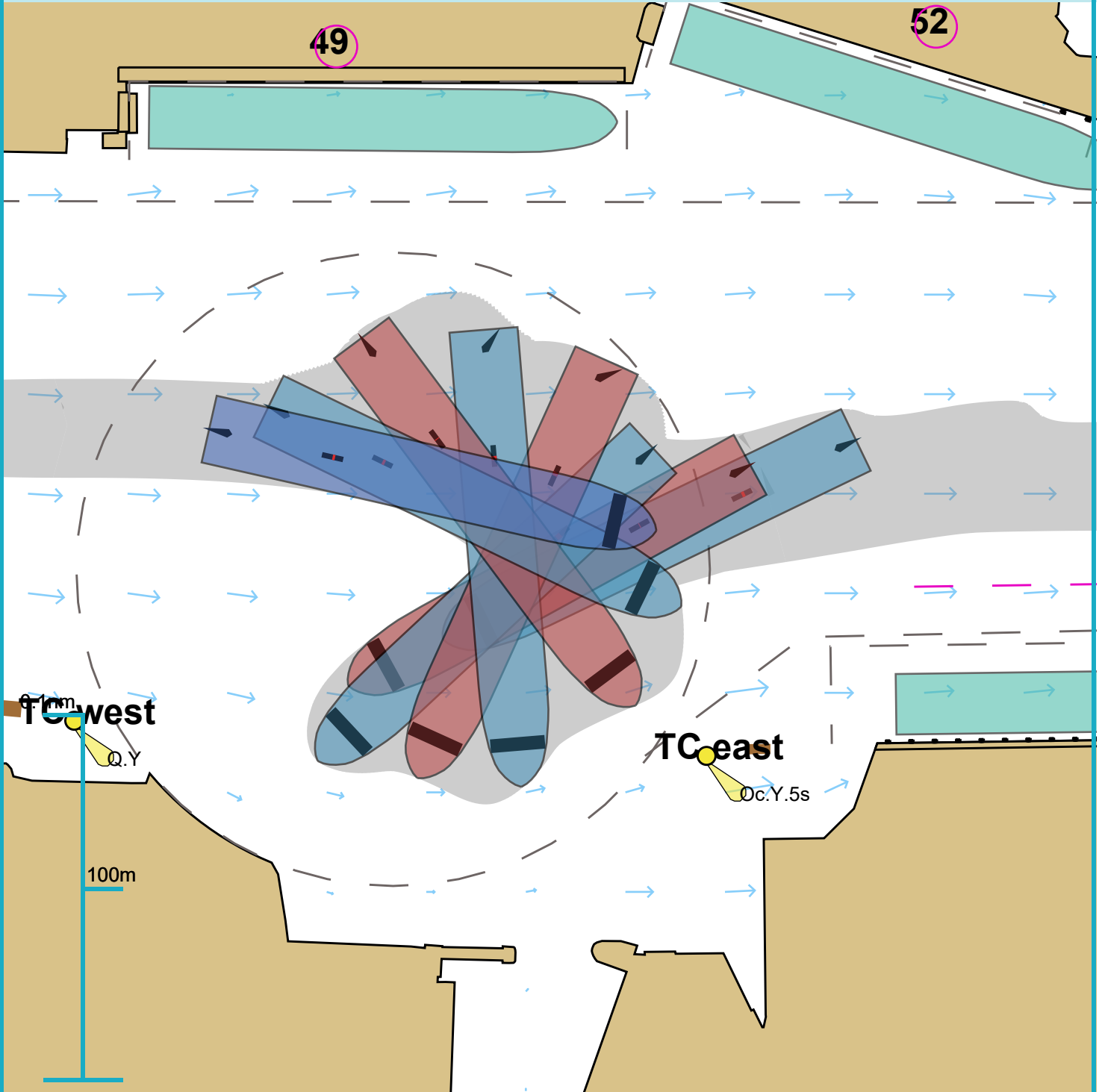
Ships plotted every 1 mins, highlight every 5 mins

Berthing

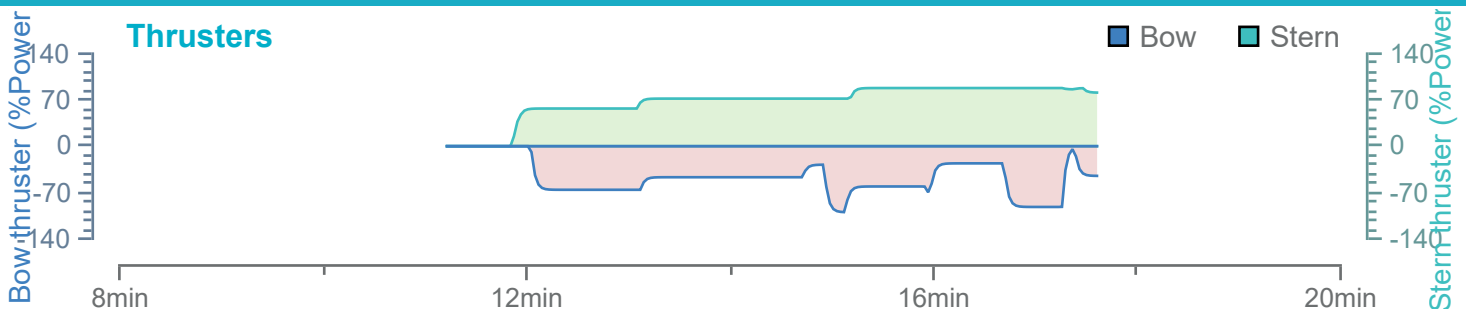


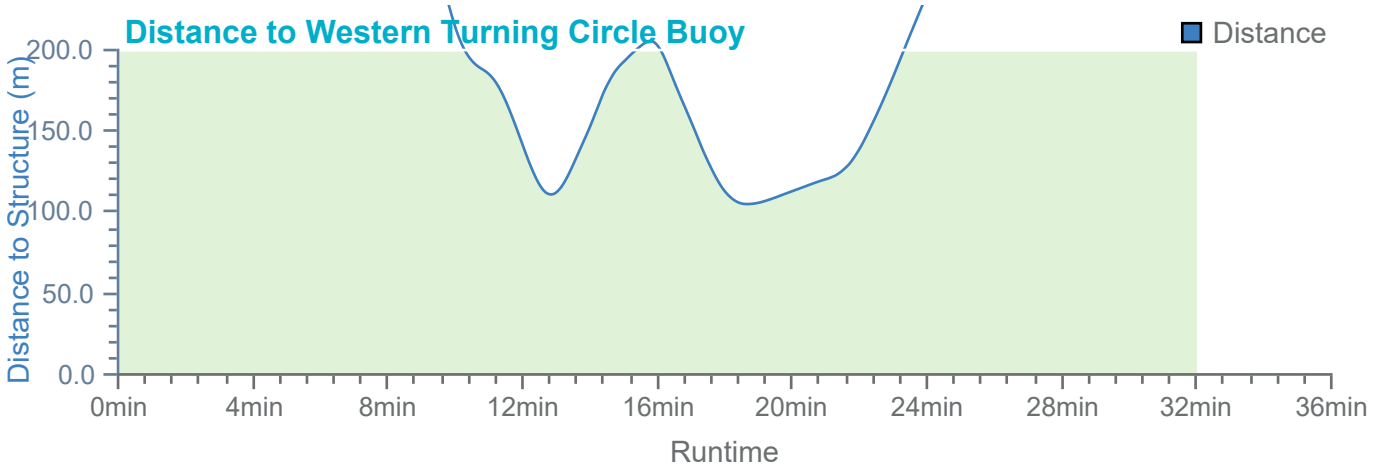
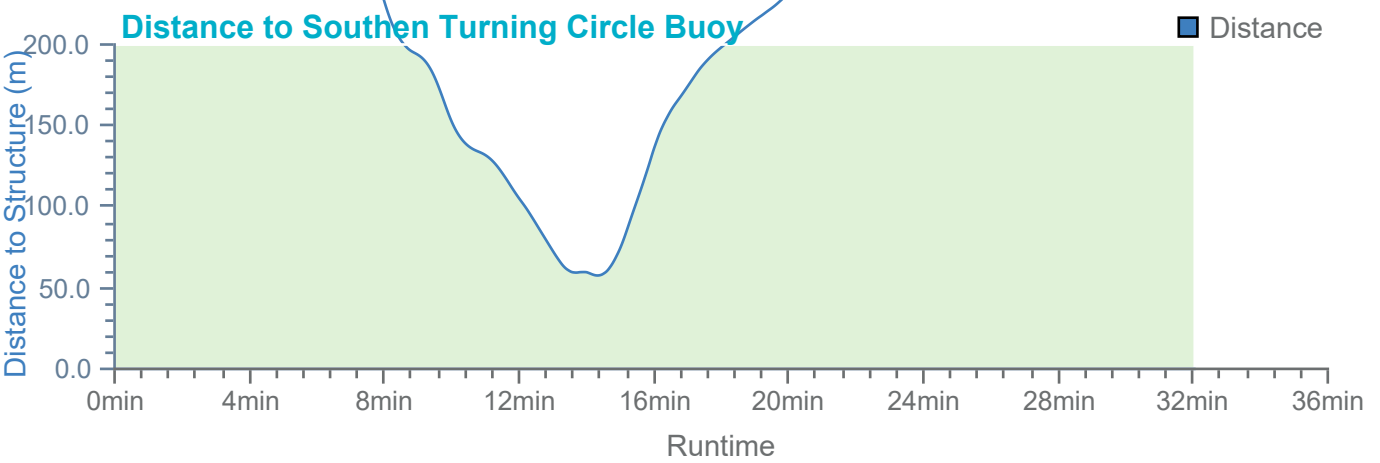
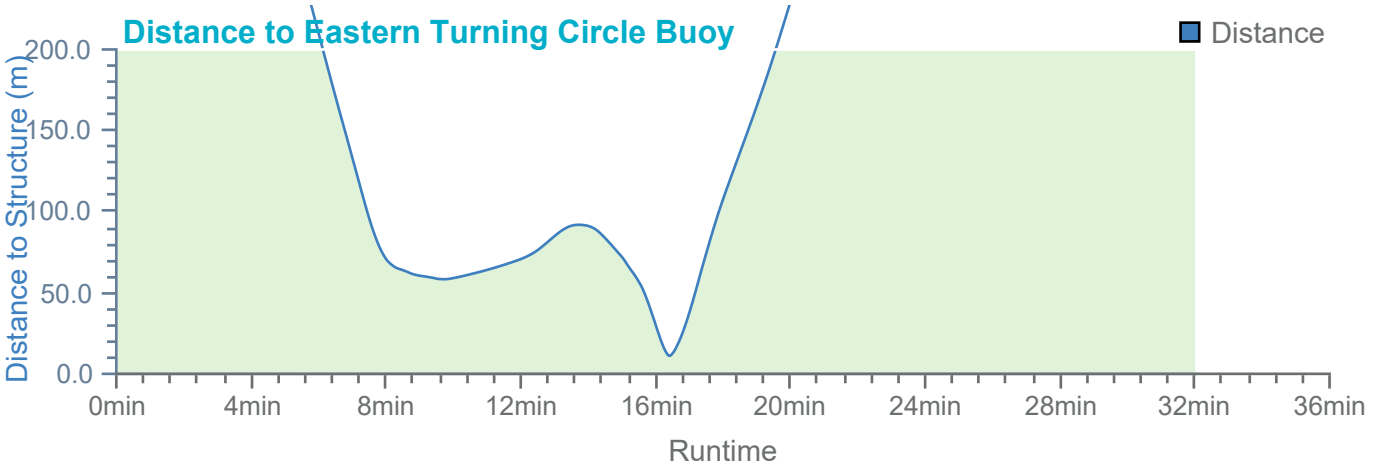
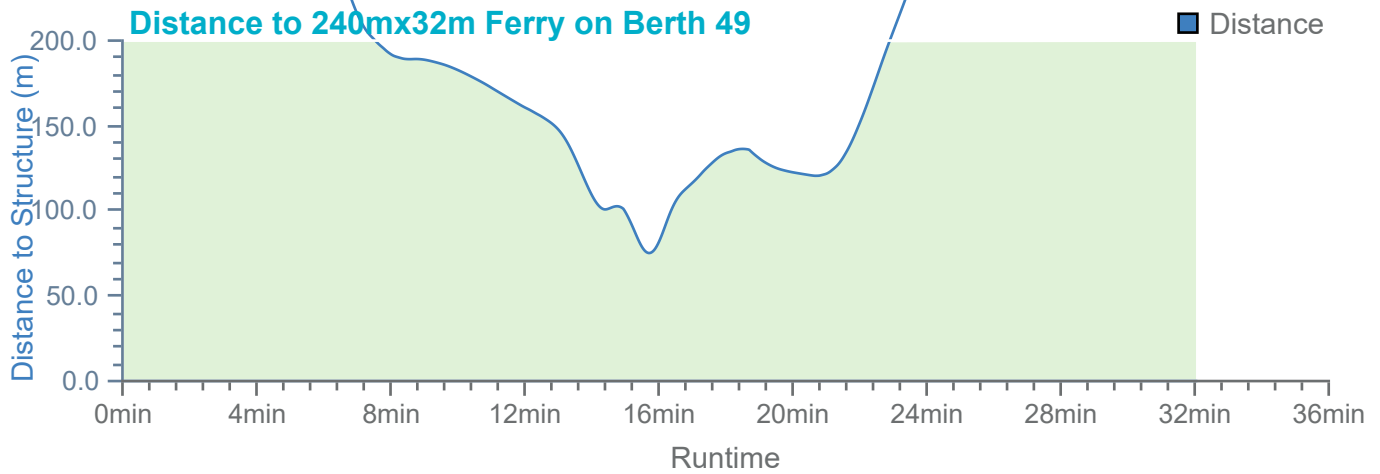
Ships plotted every 1 mins, highlight every 5 mins

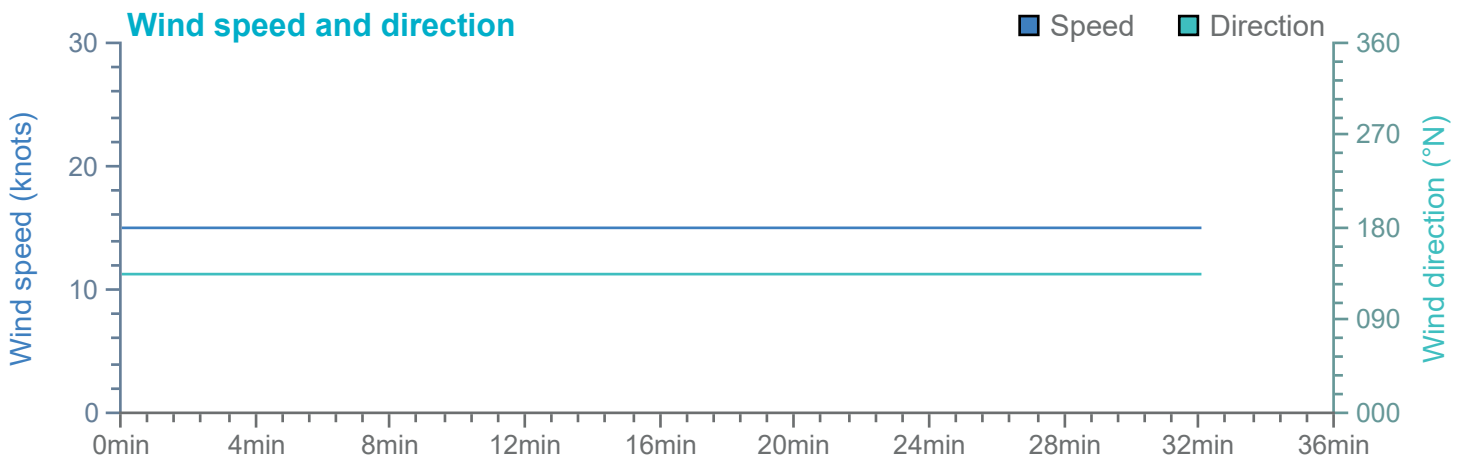
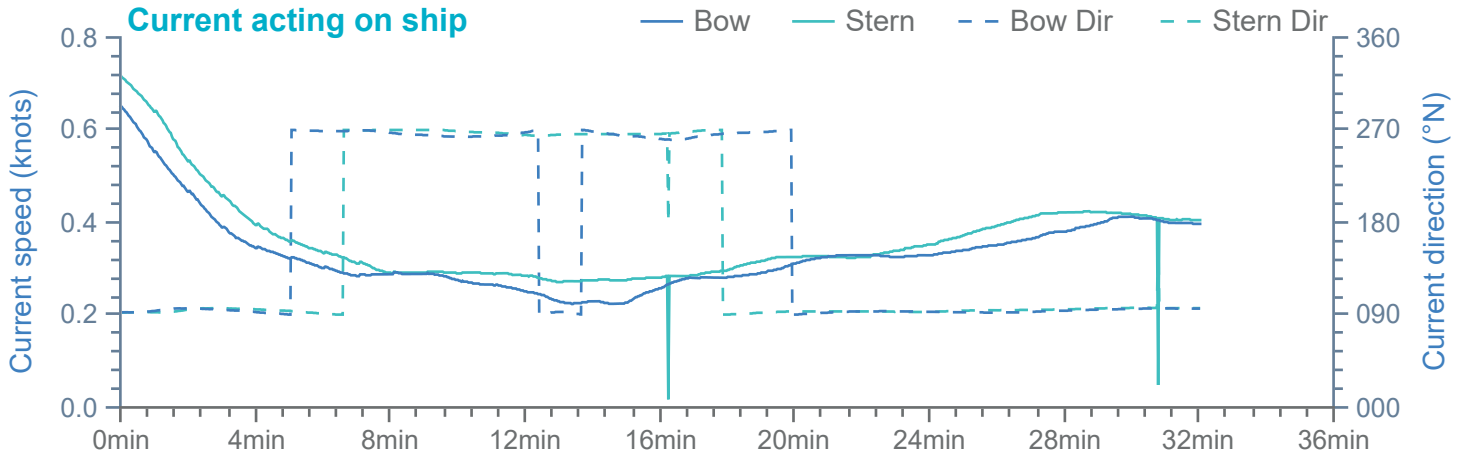
Swing



Ships plotted every 59 seconds, highlight every 2 mins





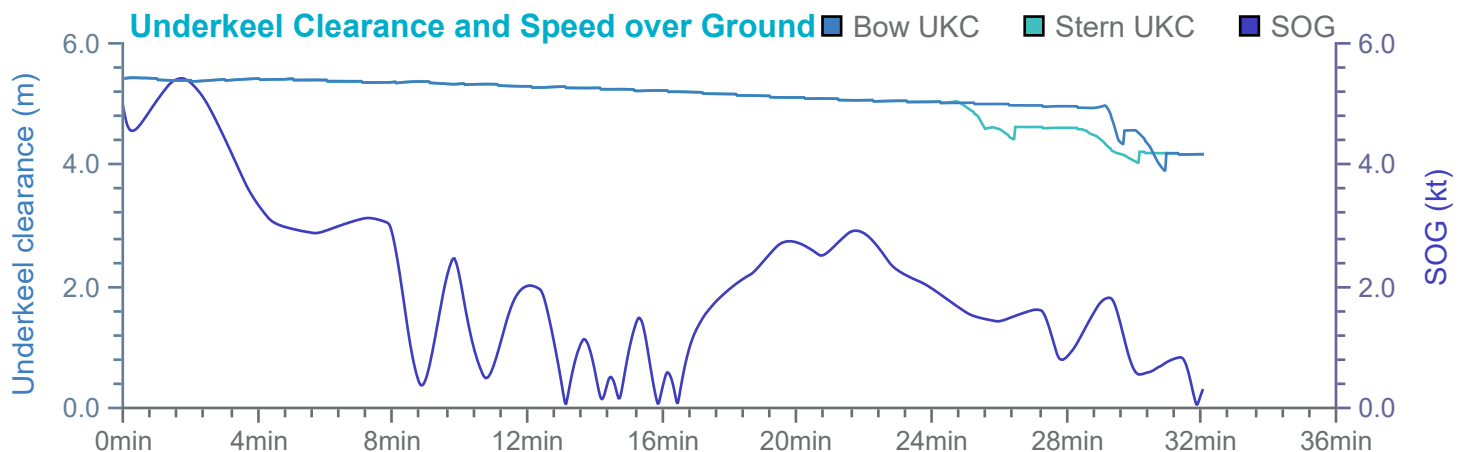
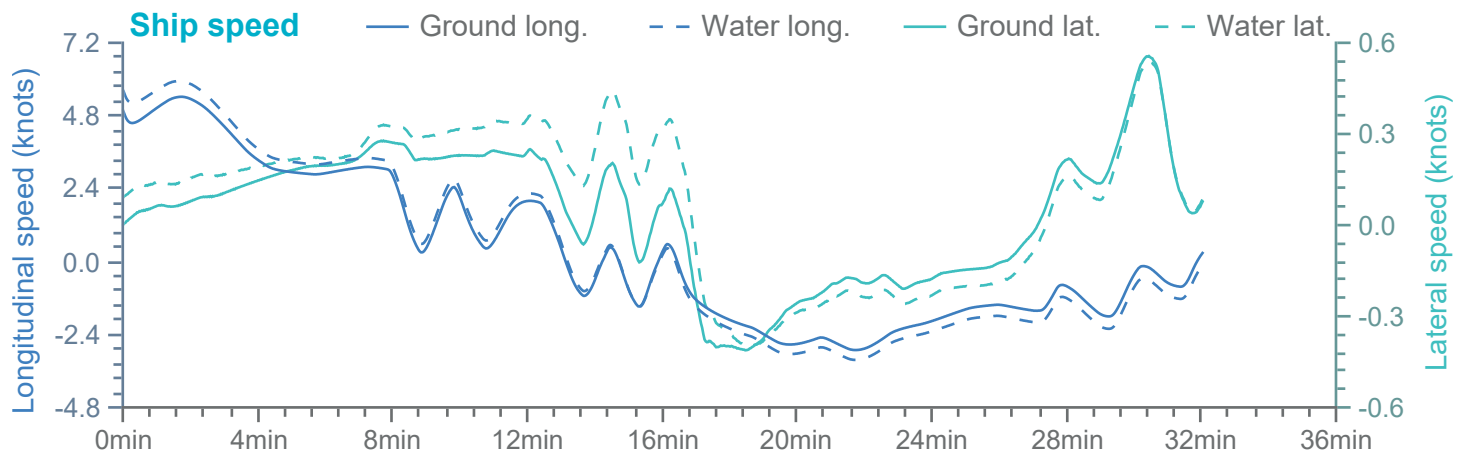
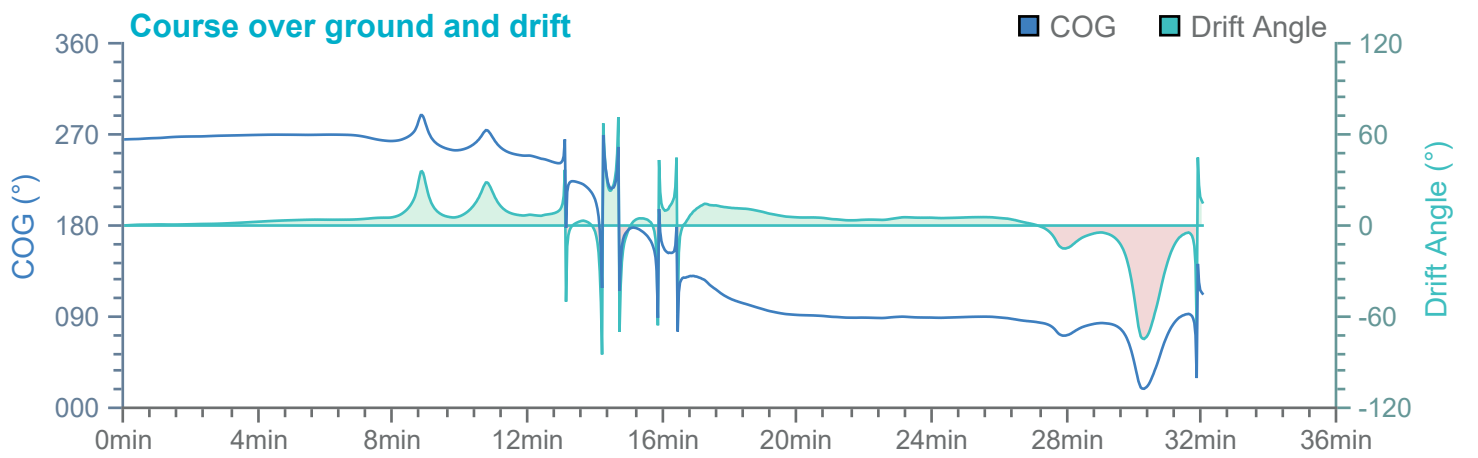
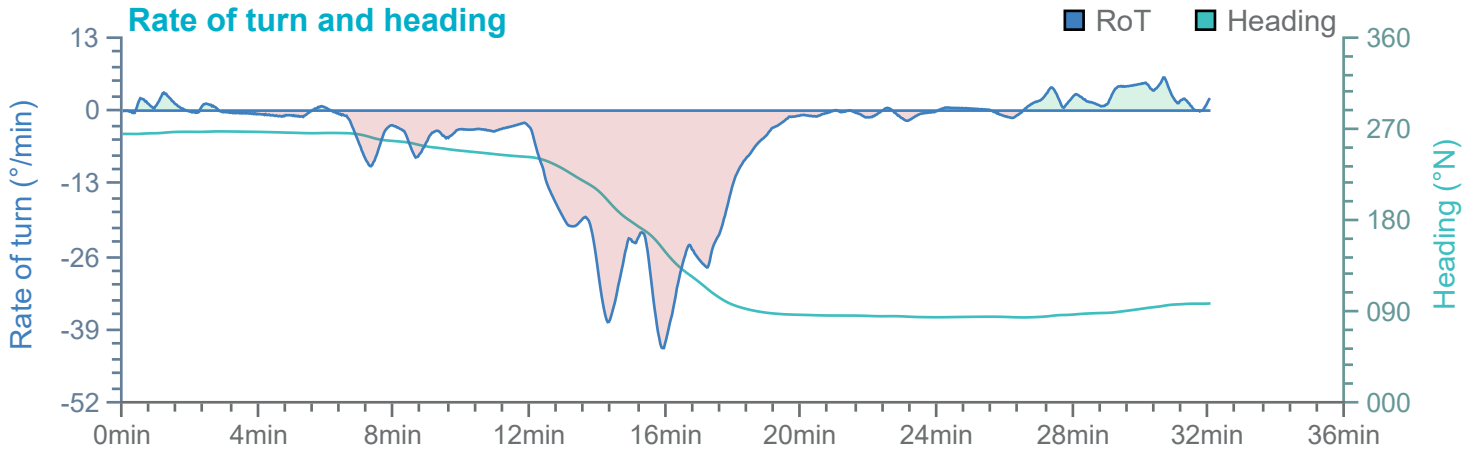


Overview

Environment

MV Celine

Thruster and engine use

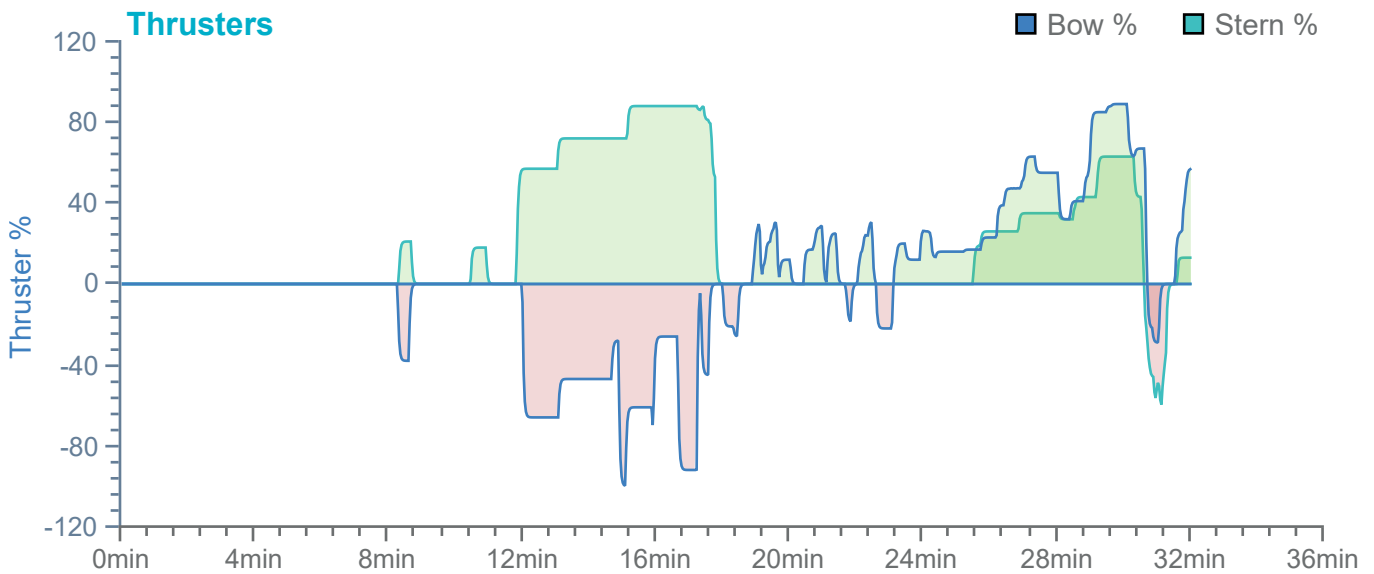
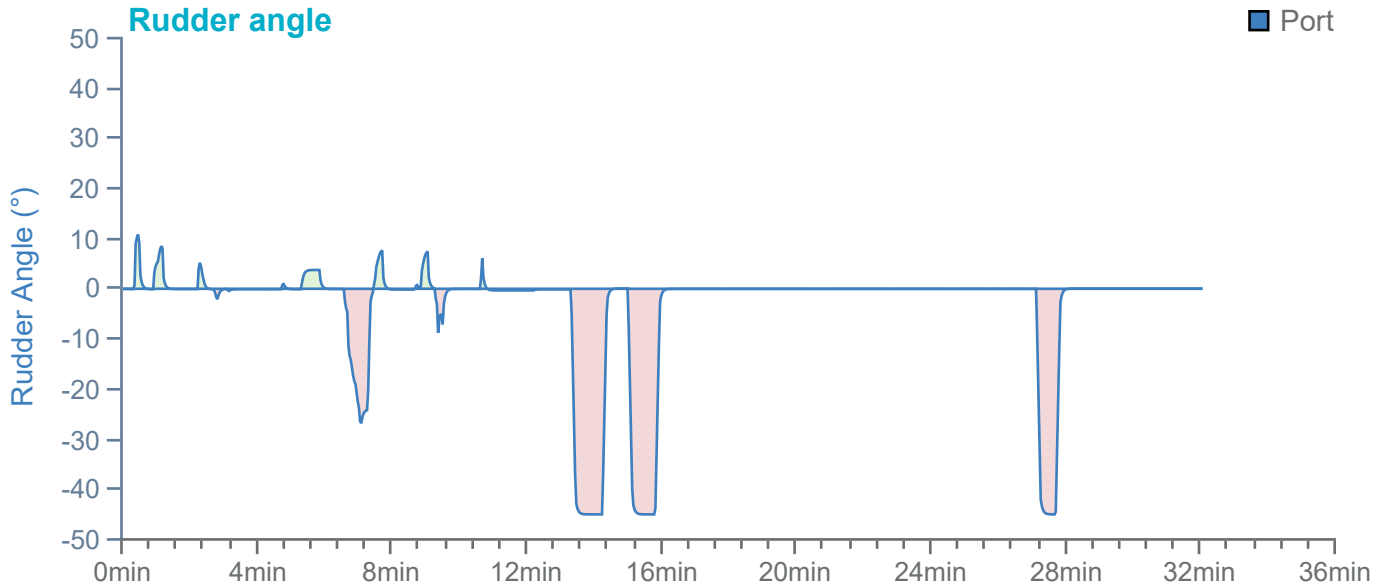
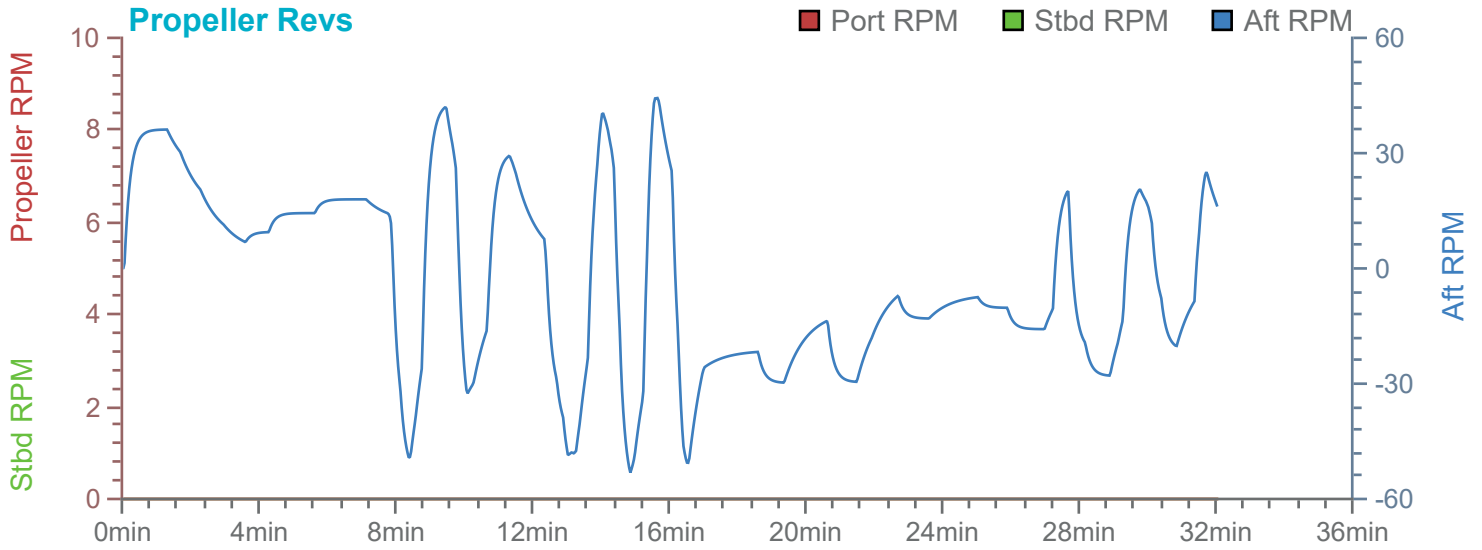


Overview

Environment

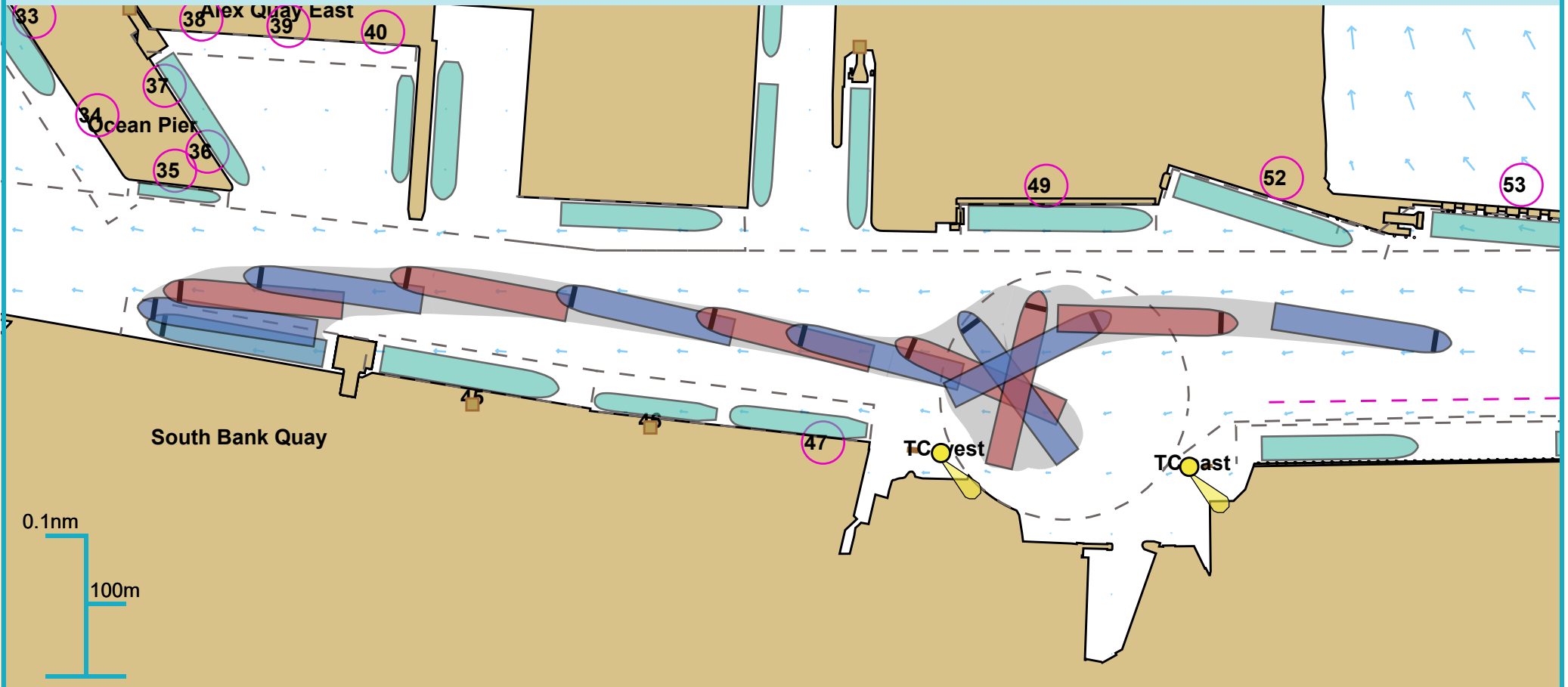
MV Celine

Thruster and engine use



Full Run Overview

53° 20.329 N, 006° 12.894 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

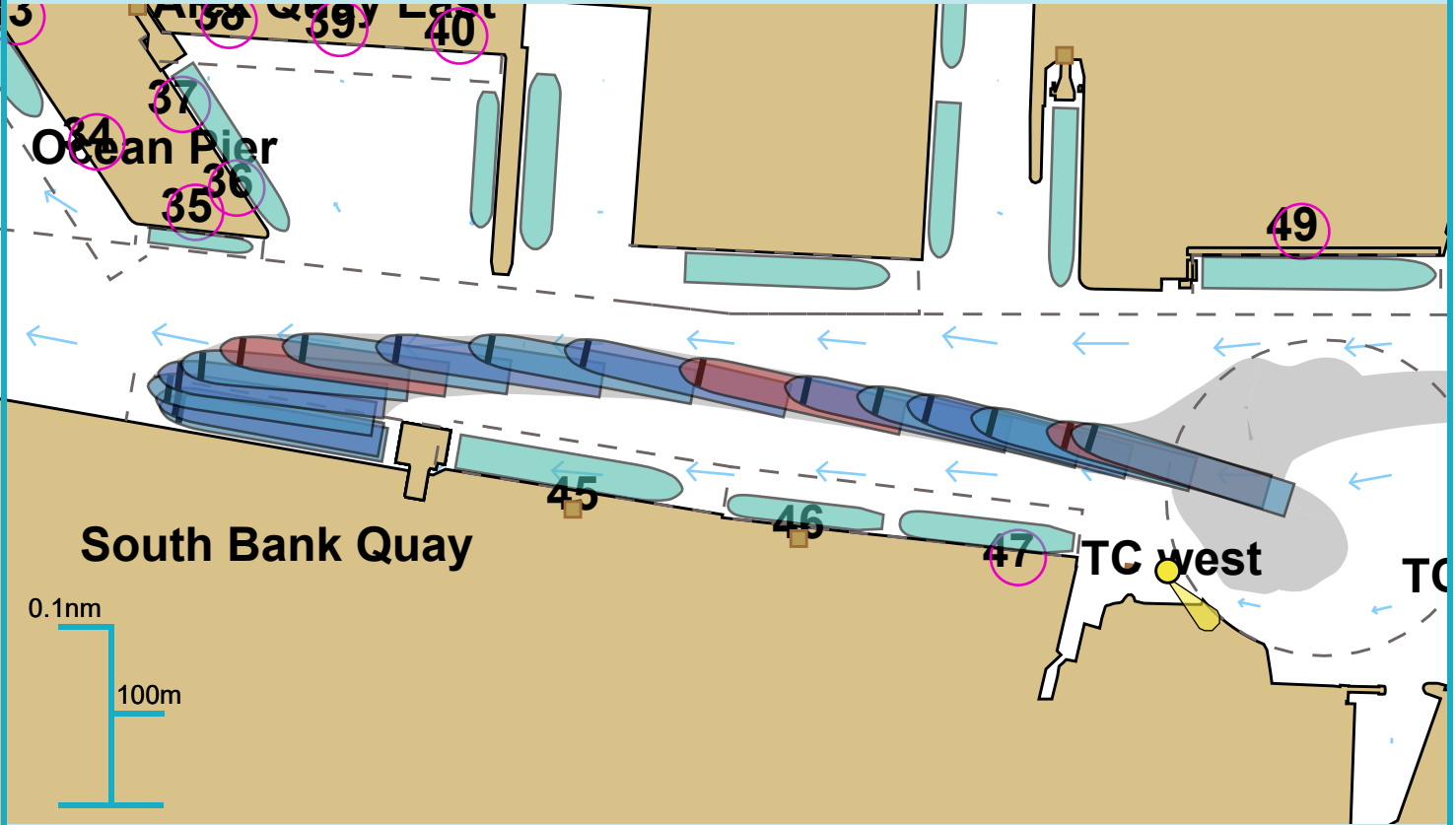
Run length: 26 minutes

Manoeuvre: Other

Ownship(s): MV Celine

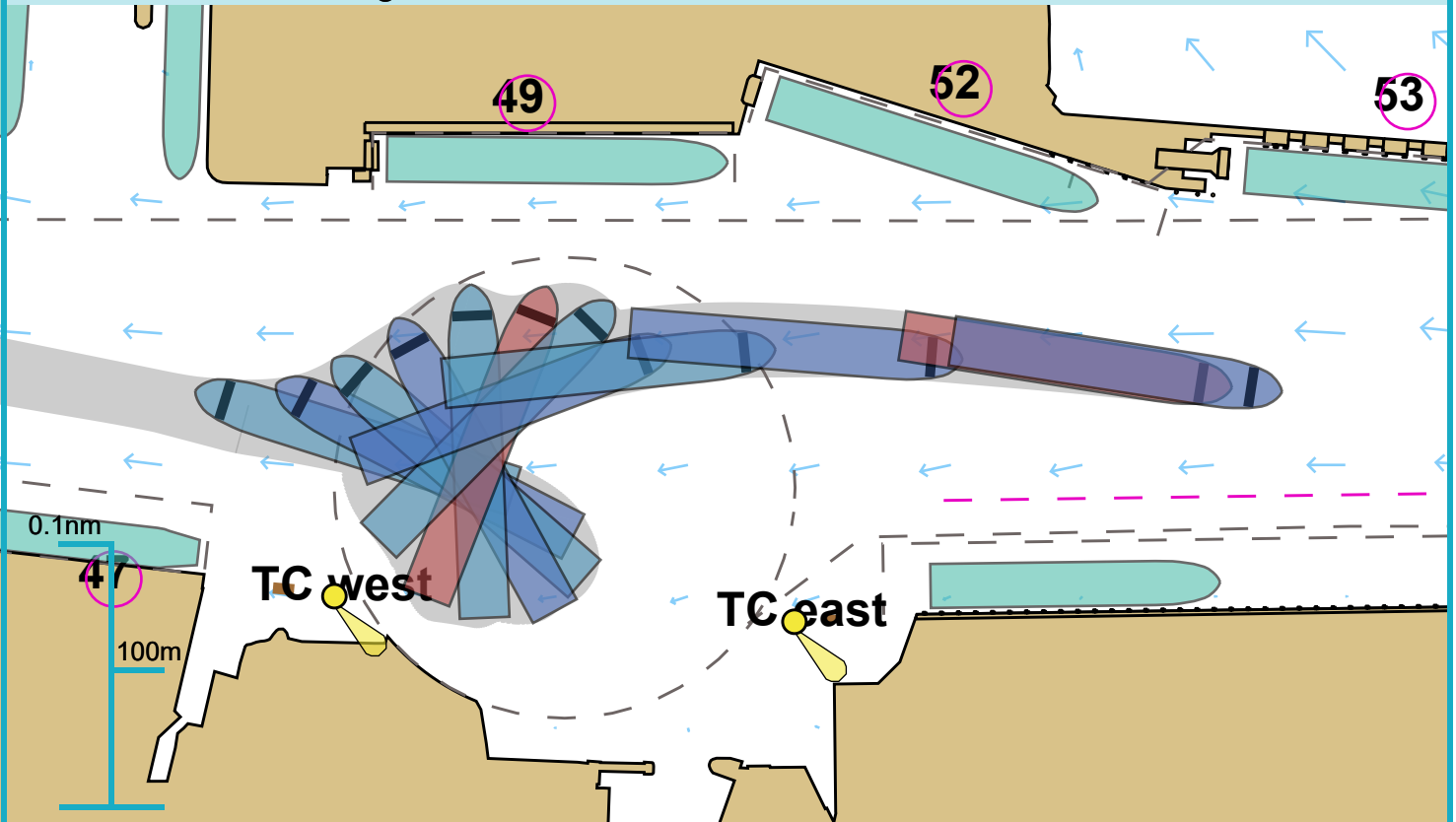
Comments:

Approach



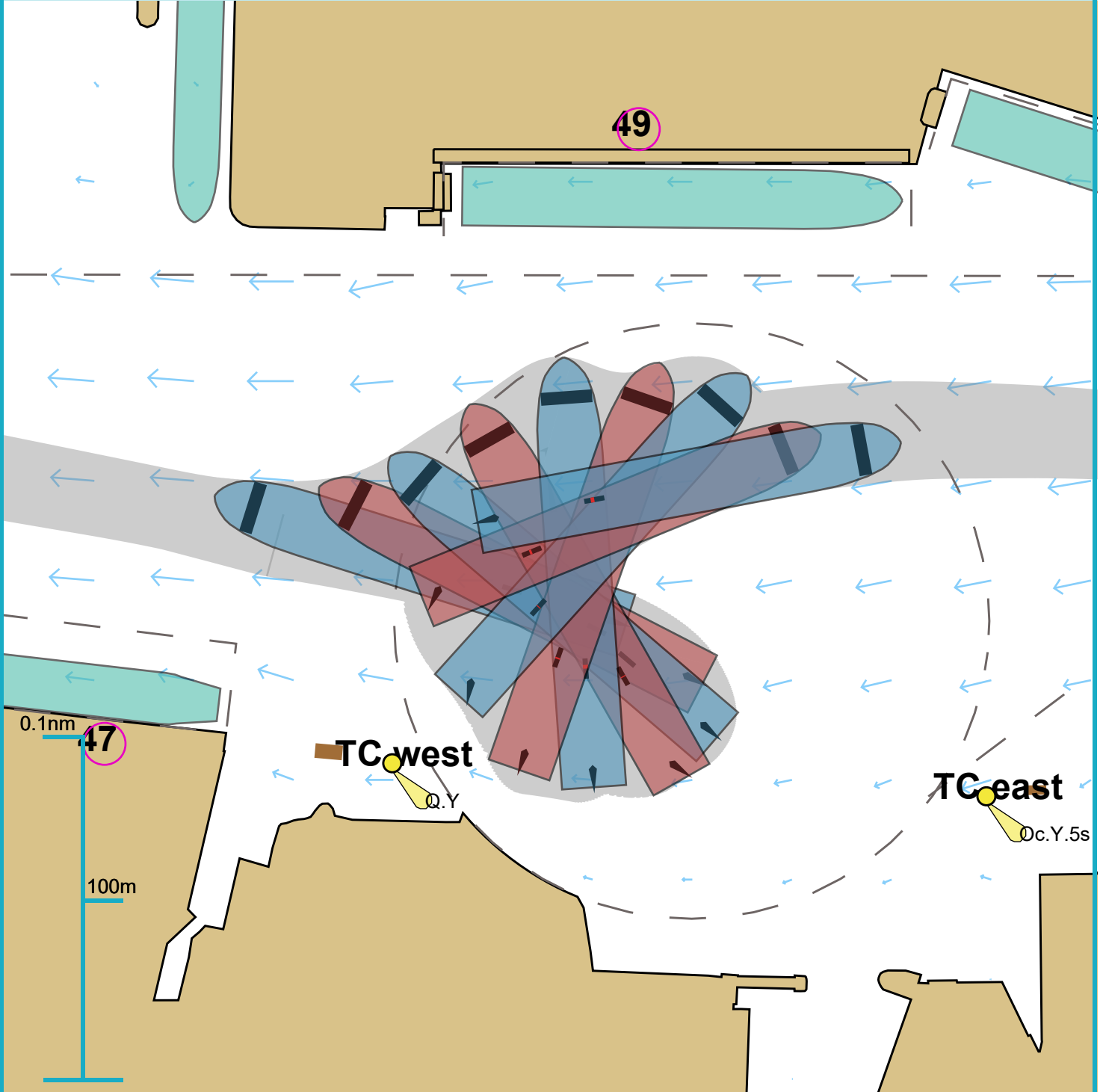
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

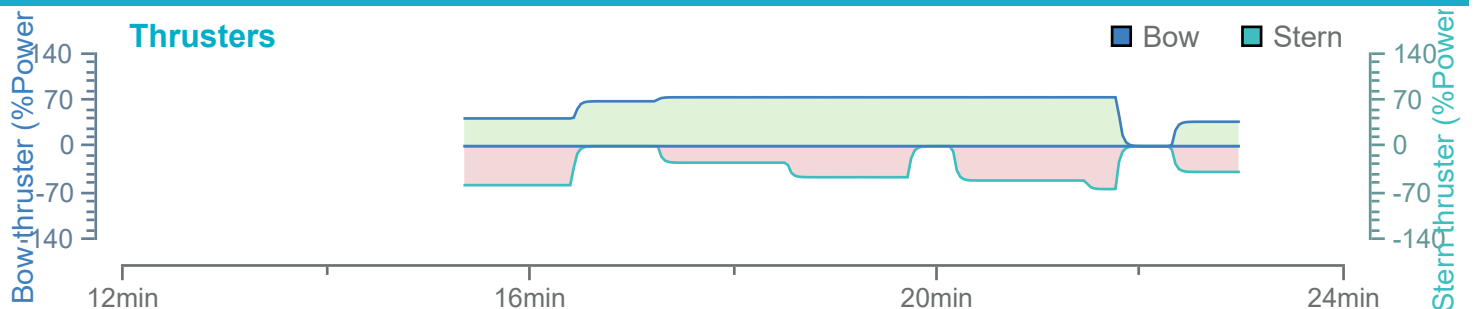


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

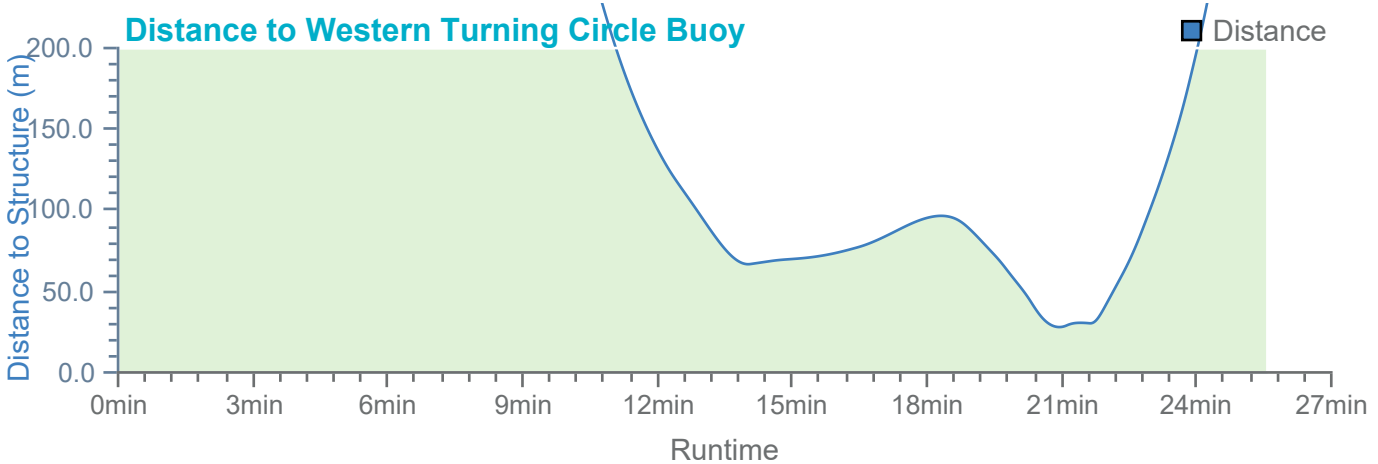
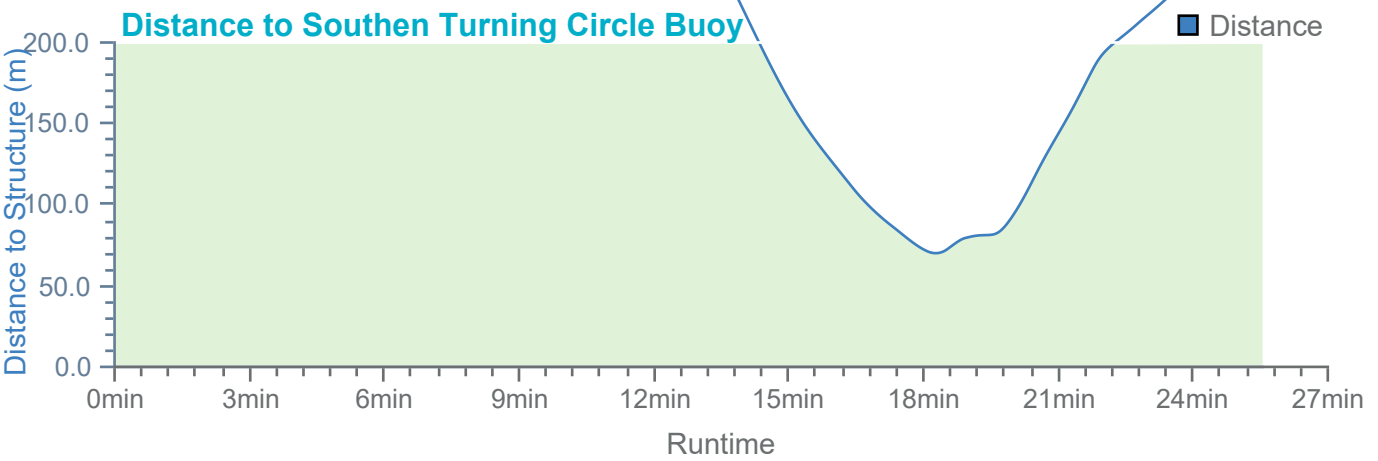
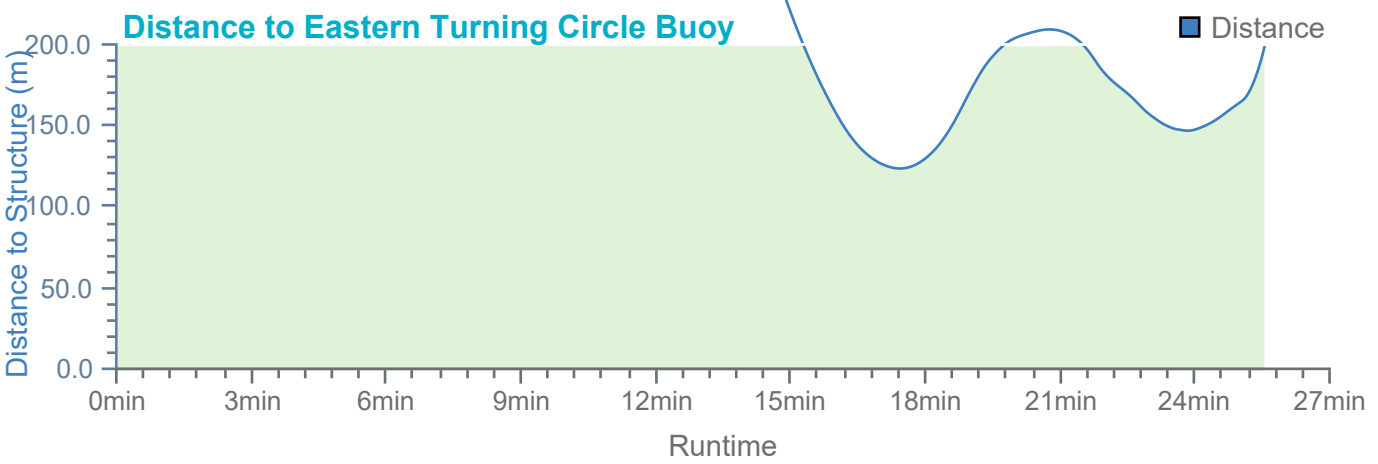
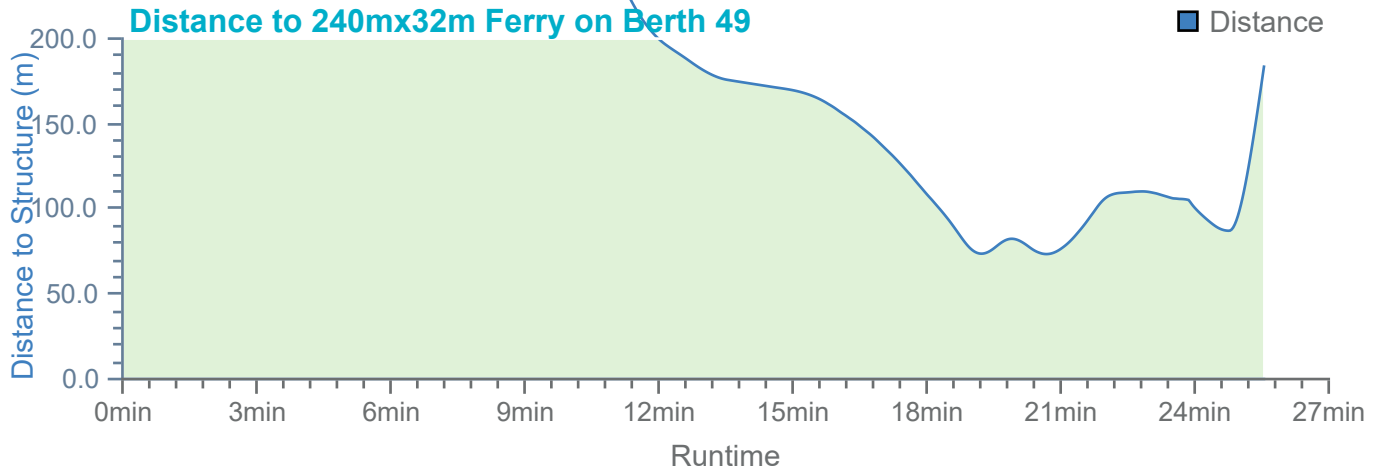


Overview

Environment

MV Celine

Thruster and engine use

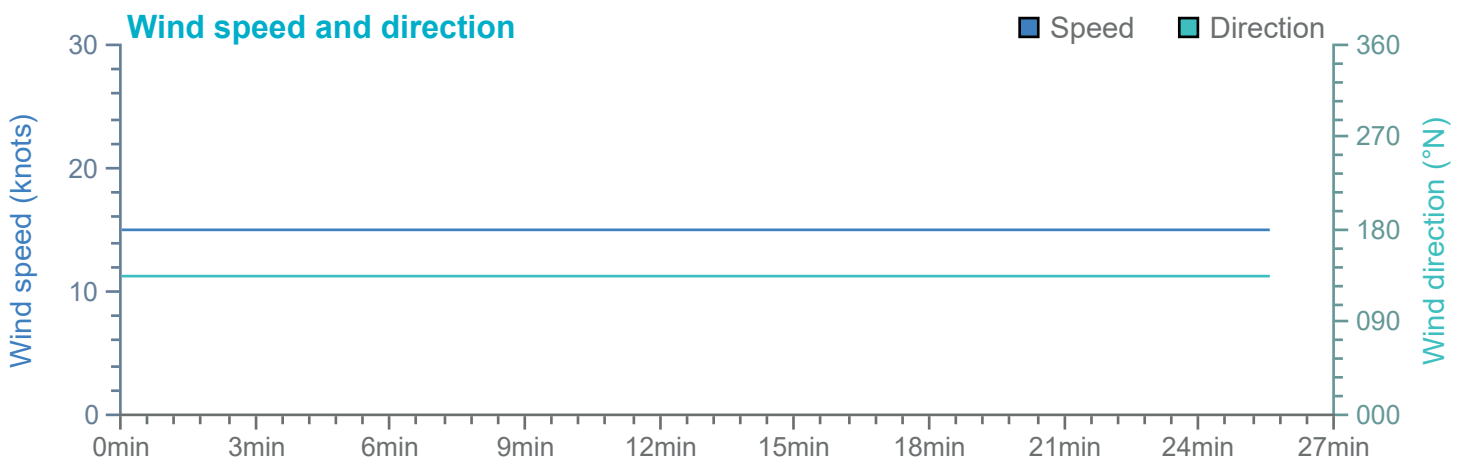
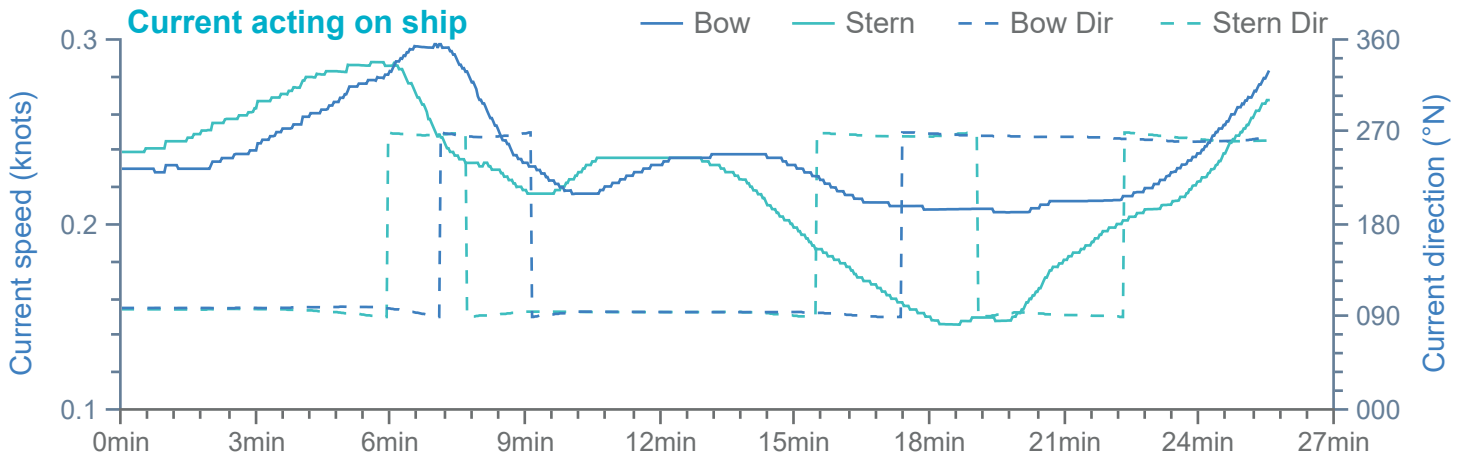


Overview

Environment

MV Celine

Thruster and engine use

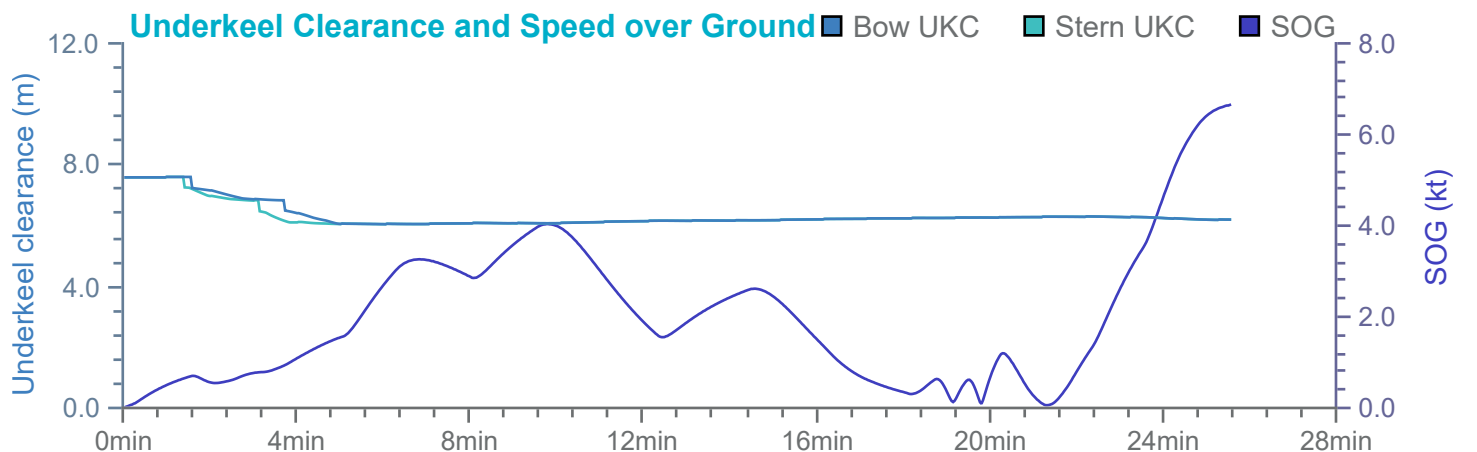
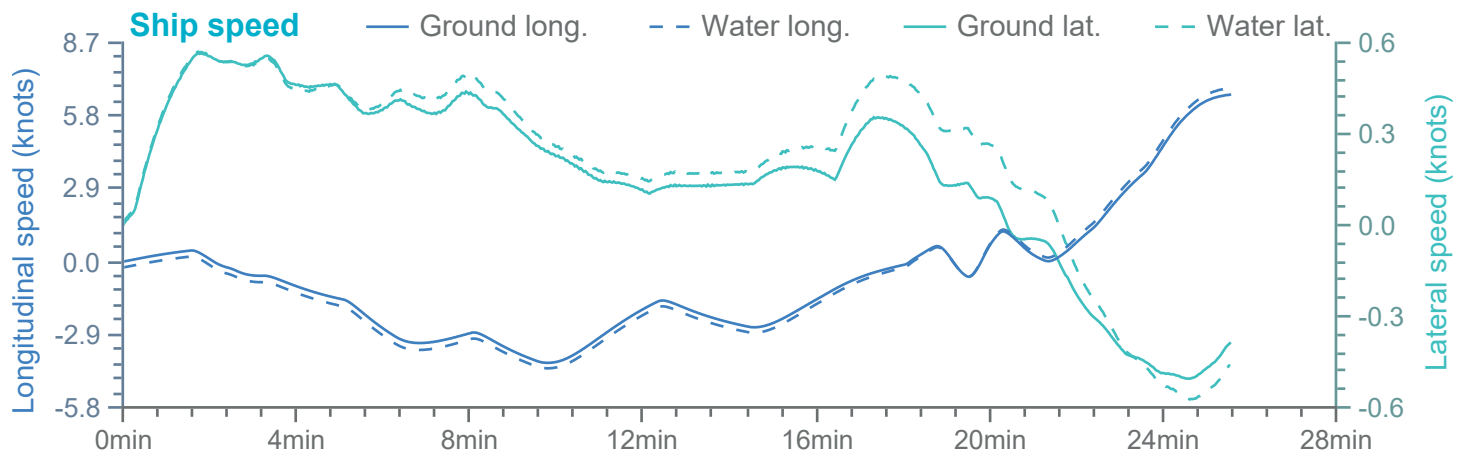
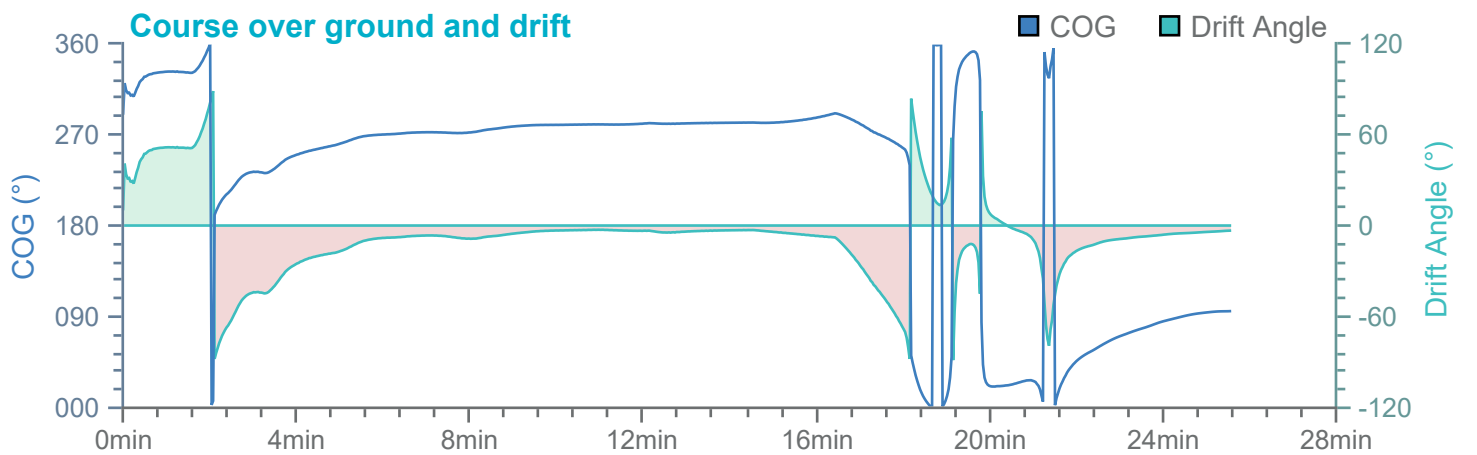
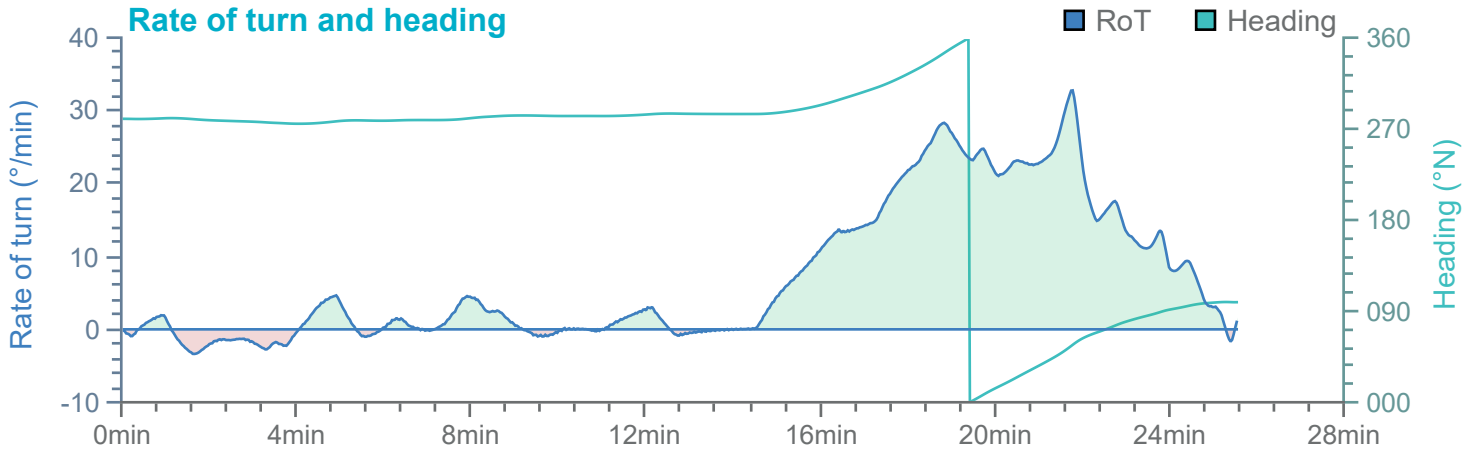


Overview

Environment

MV Celine

Thruster and engine use

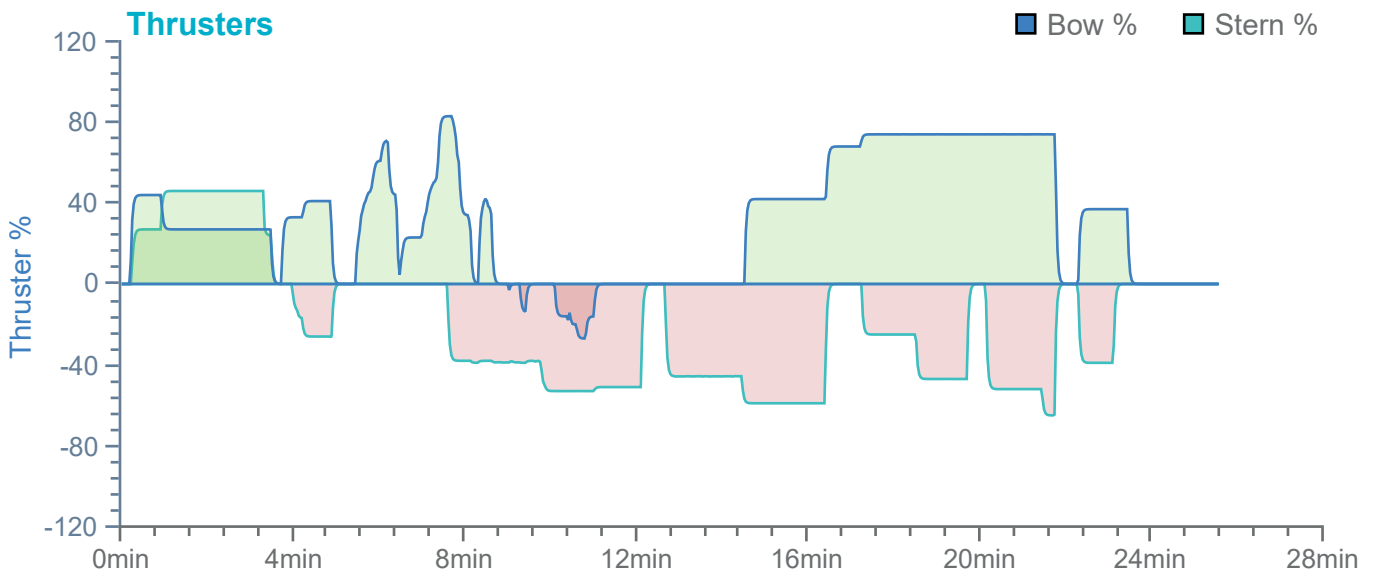
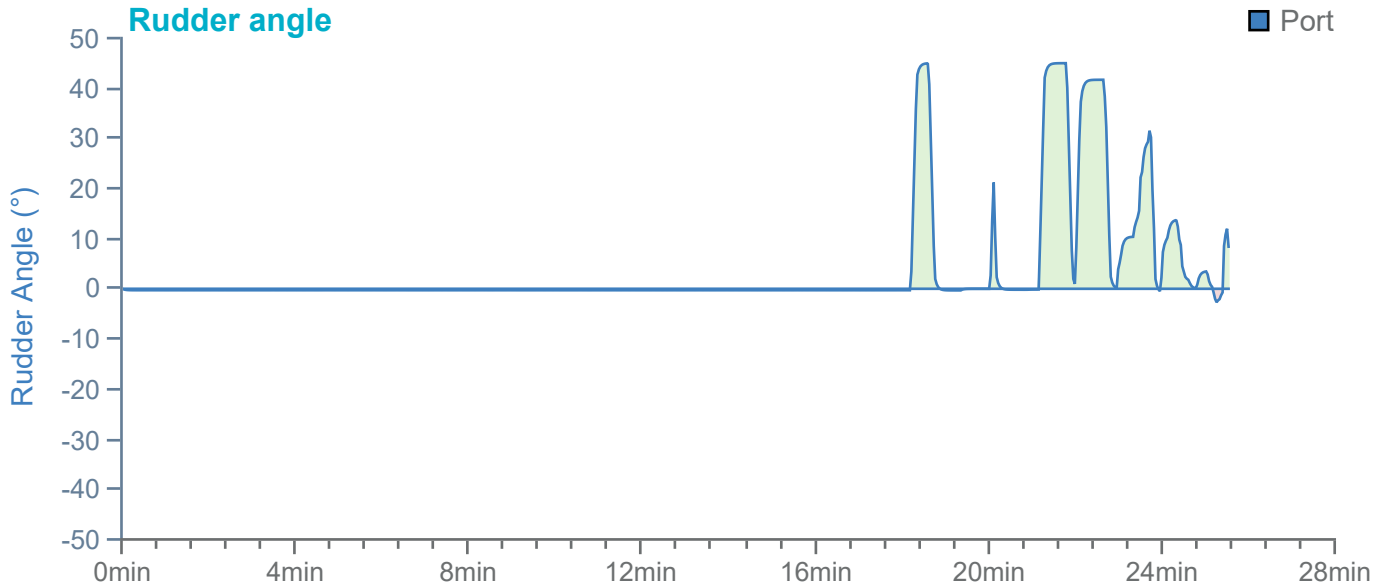
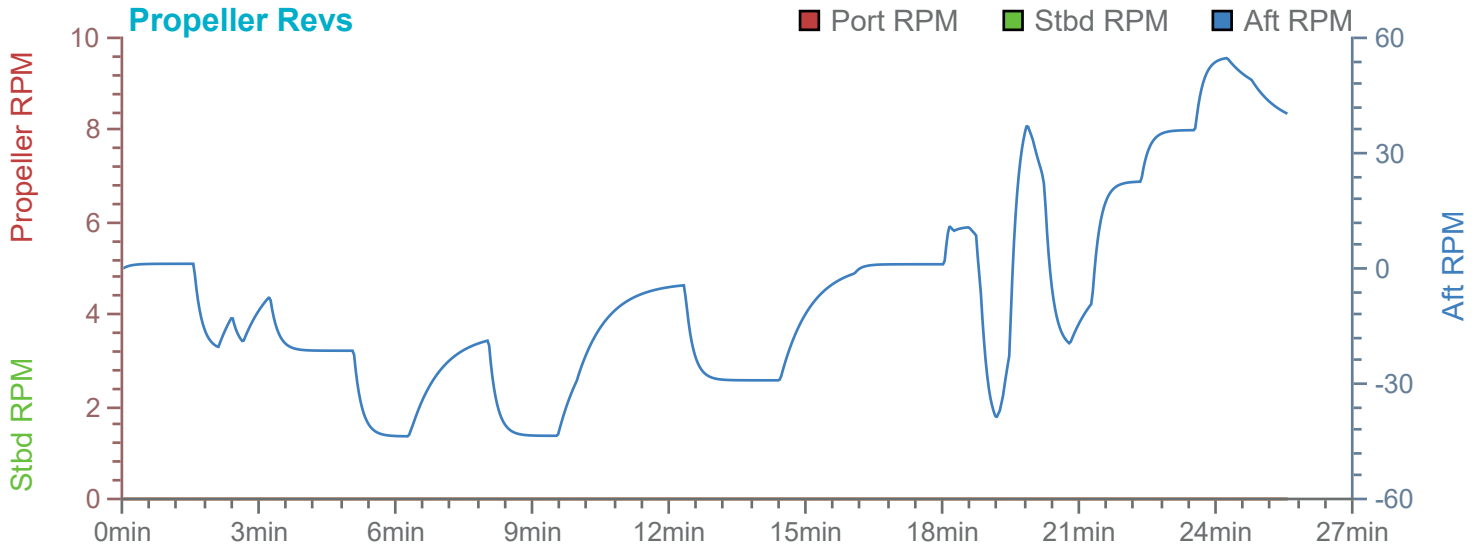


Overview

Environment

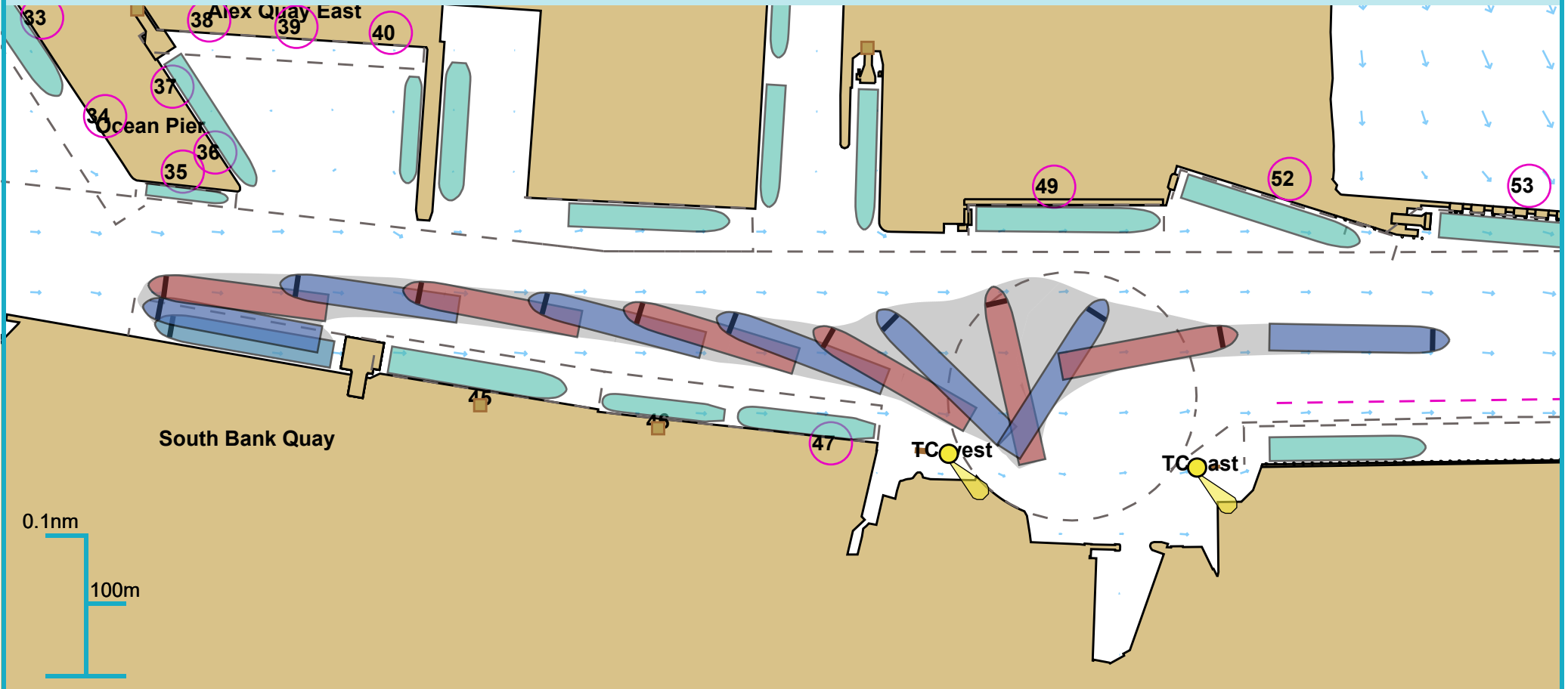
MV Celine

Thruster and engine use



Full Run Overview

53° 20.330 N, 006° 12.903 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

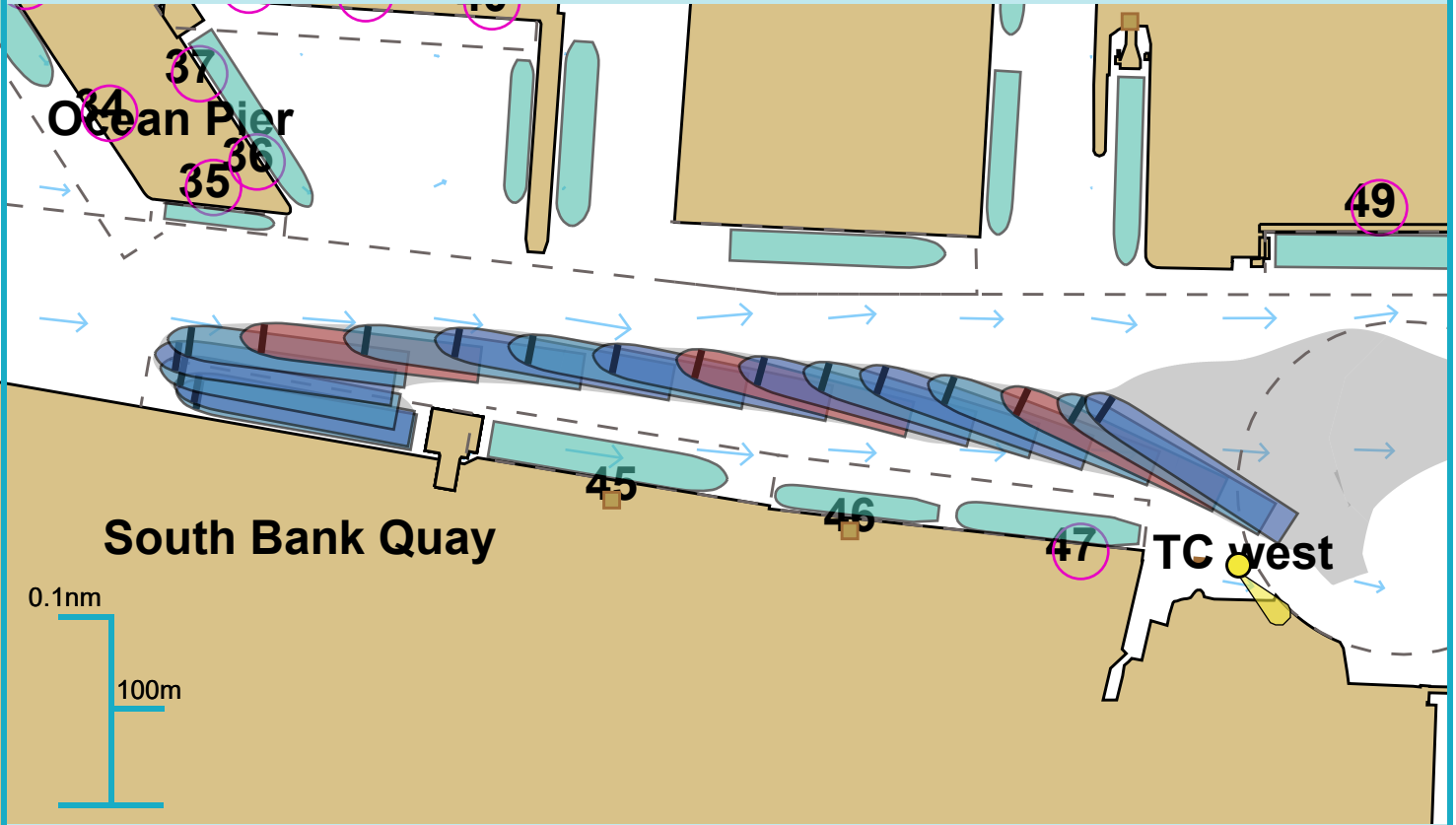
Run length:26 minutes

Manoeuvre:Other

Ownship(s):MV Celine

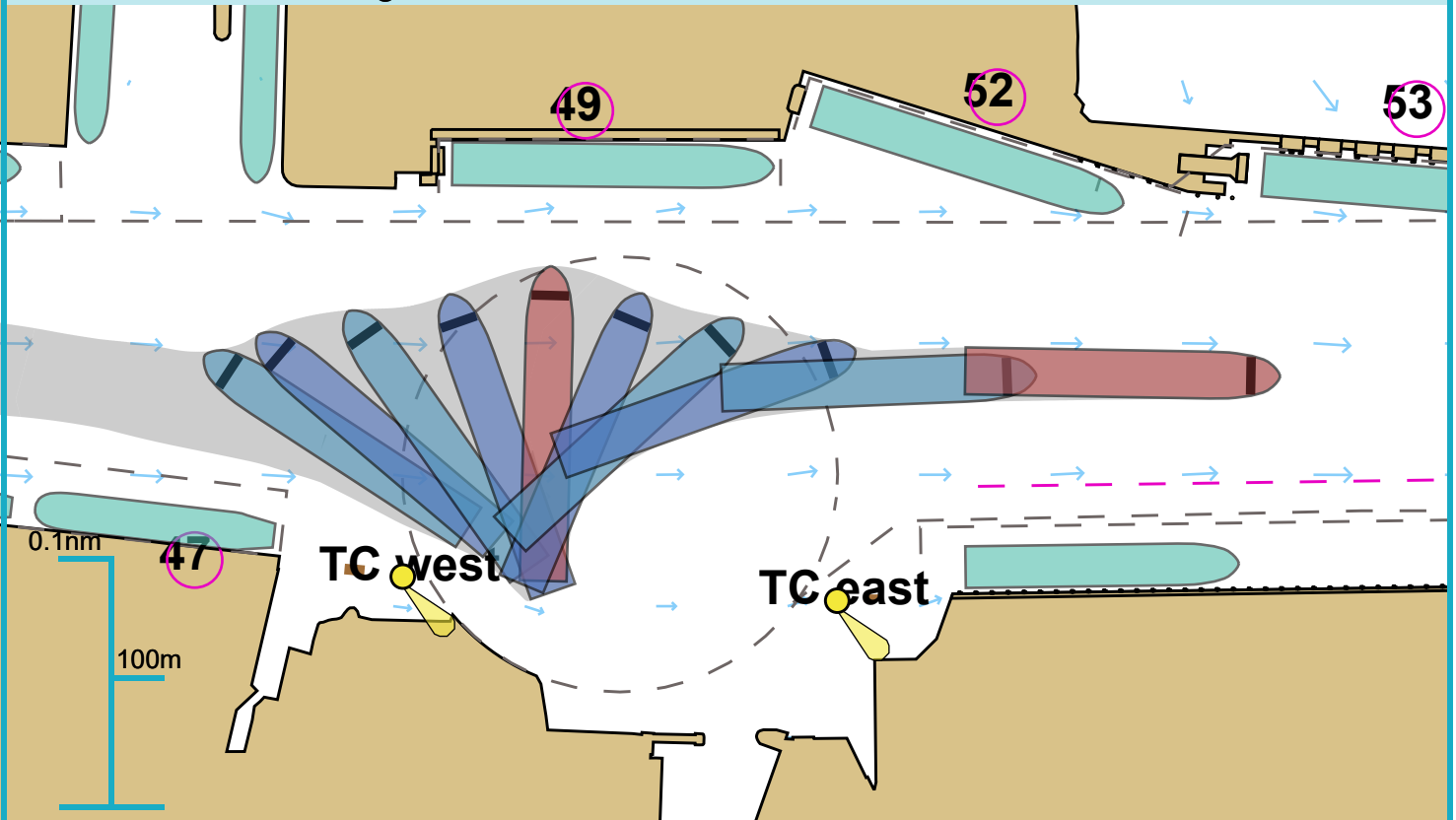
Comments:

Departure



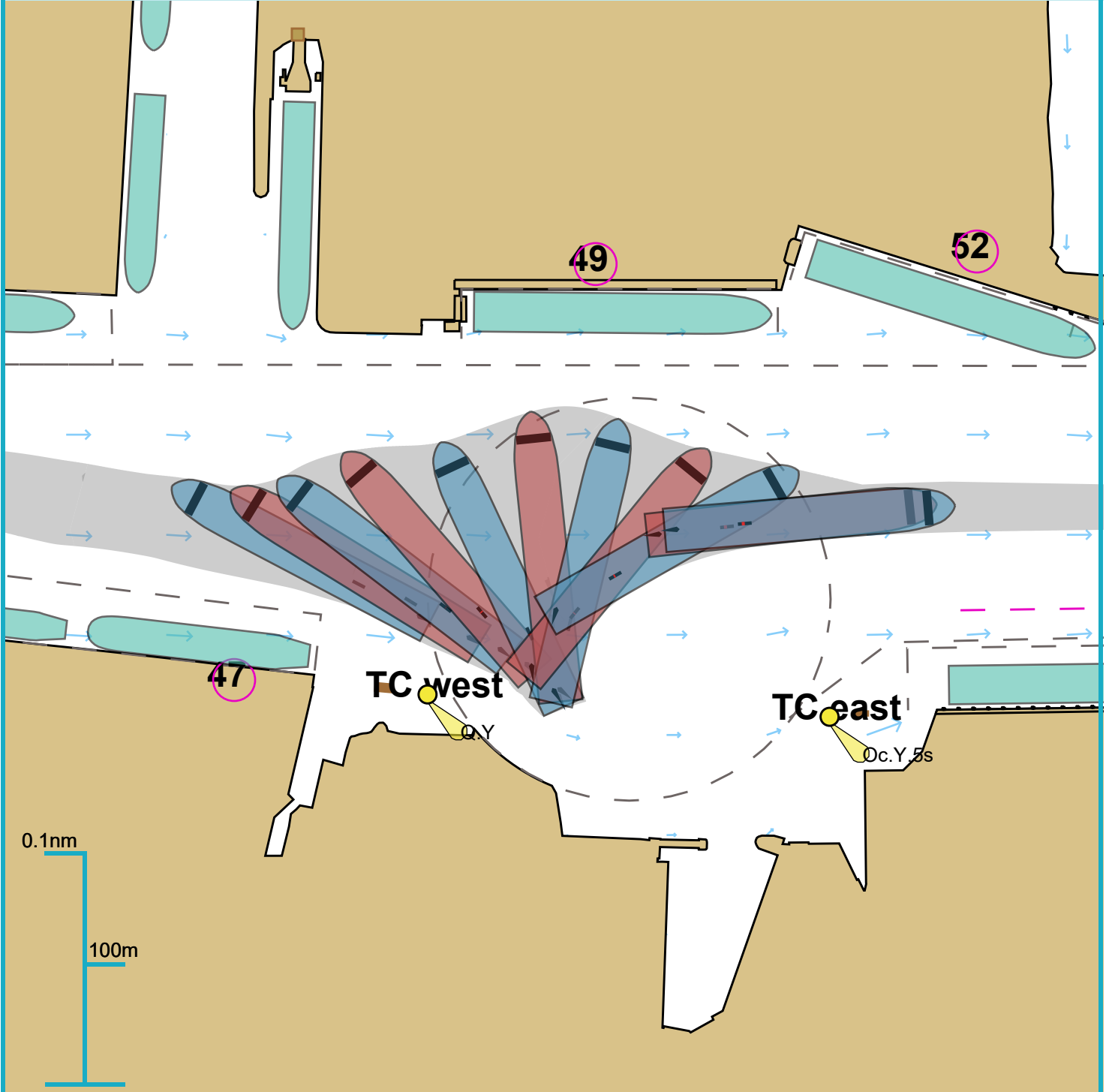
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

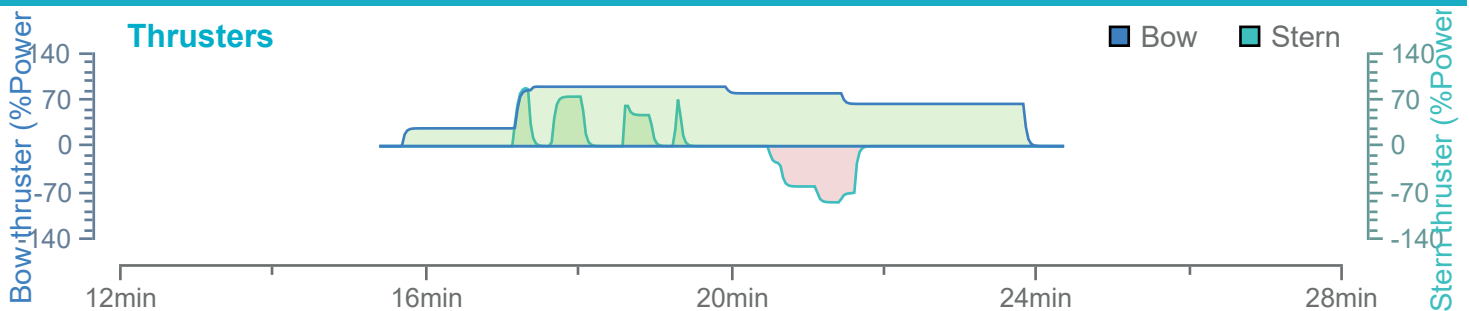


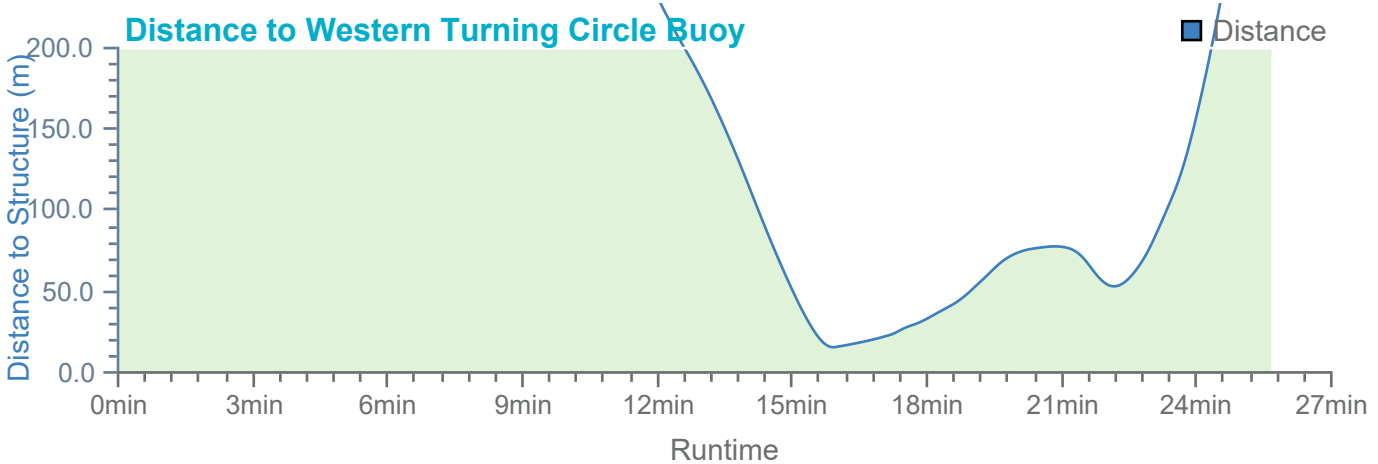
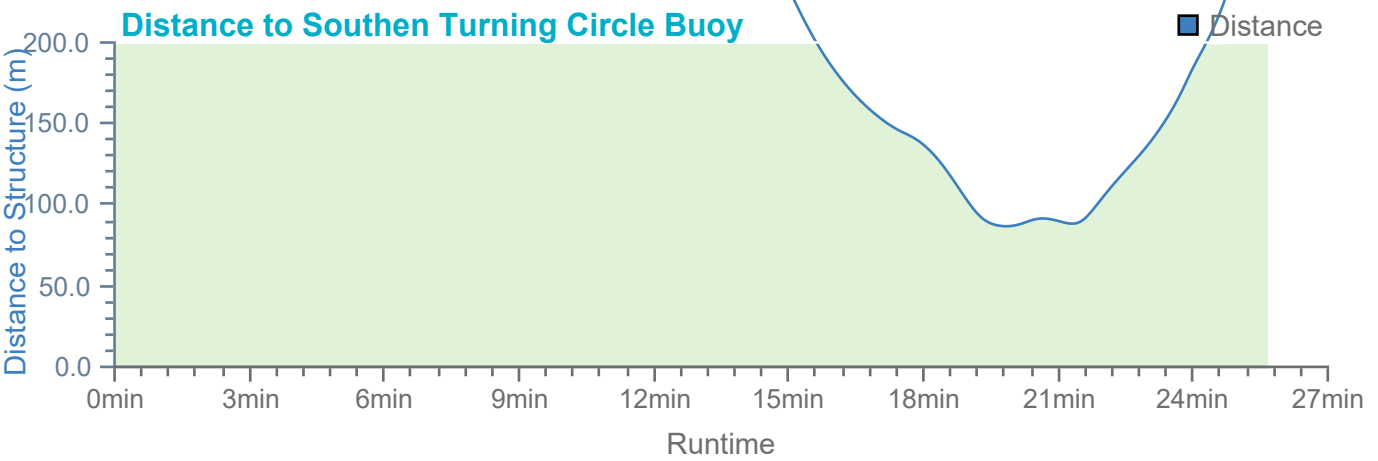
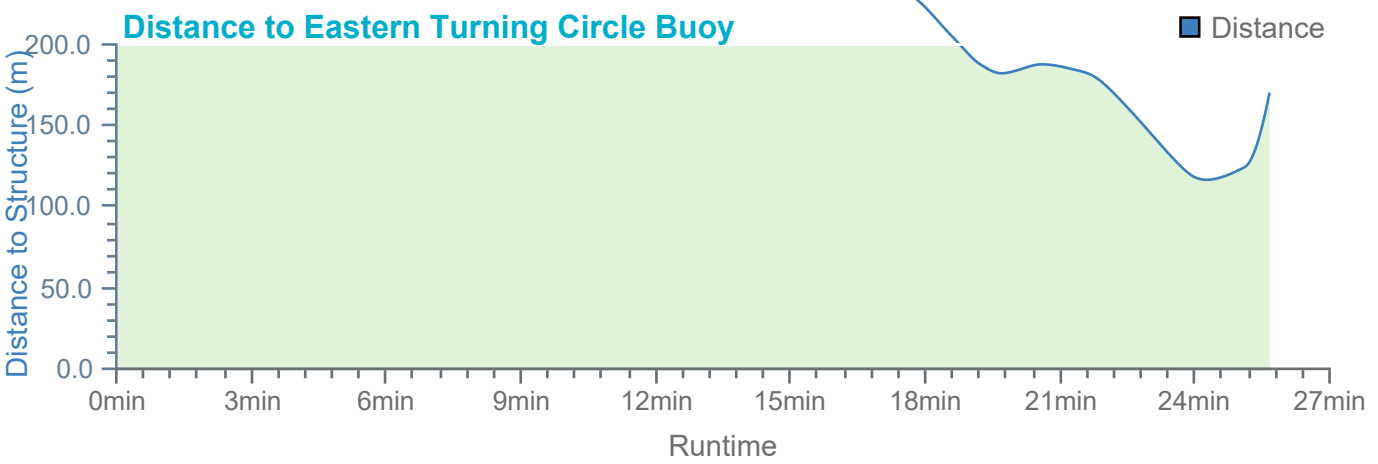
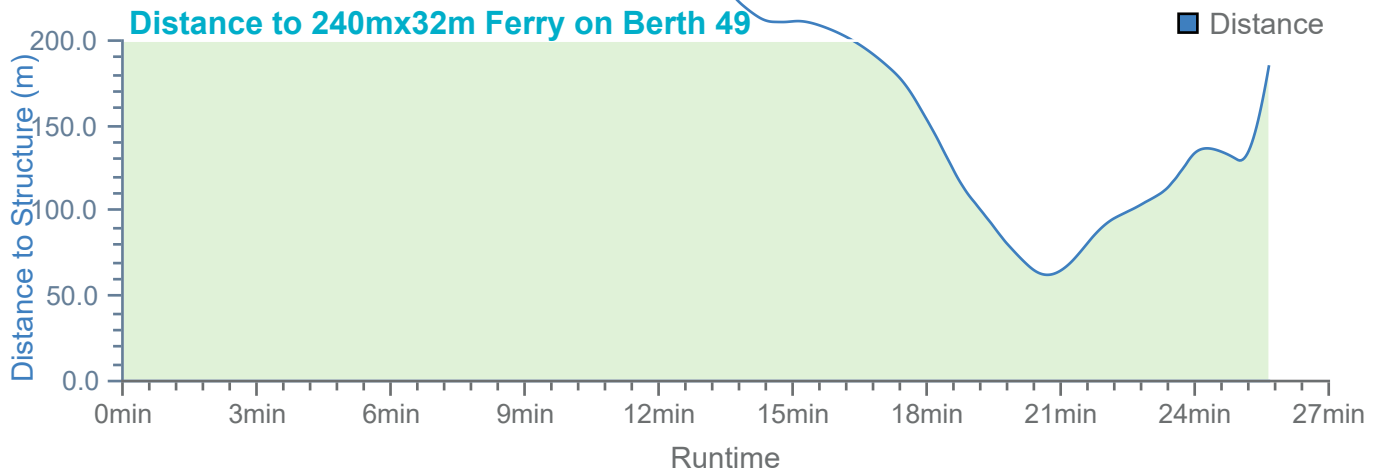
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



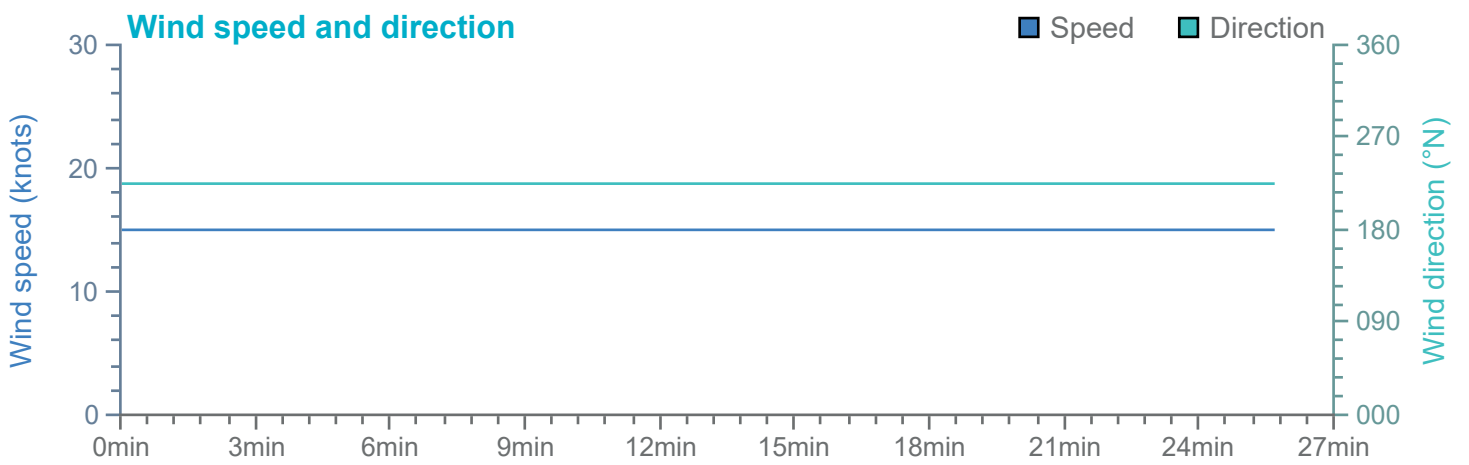
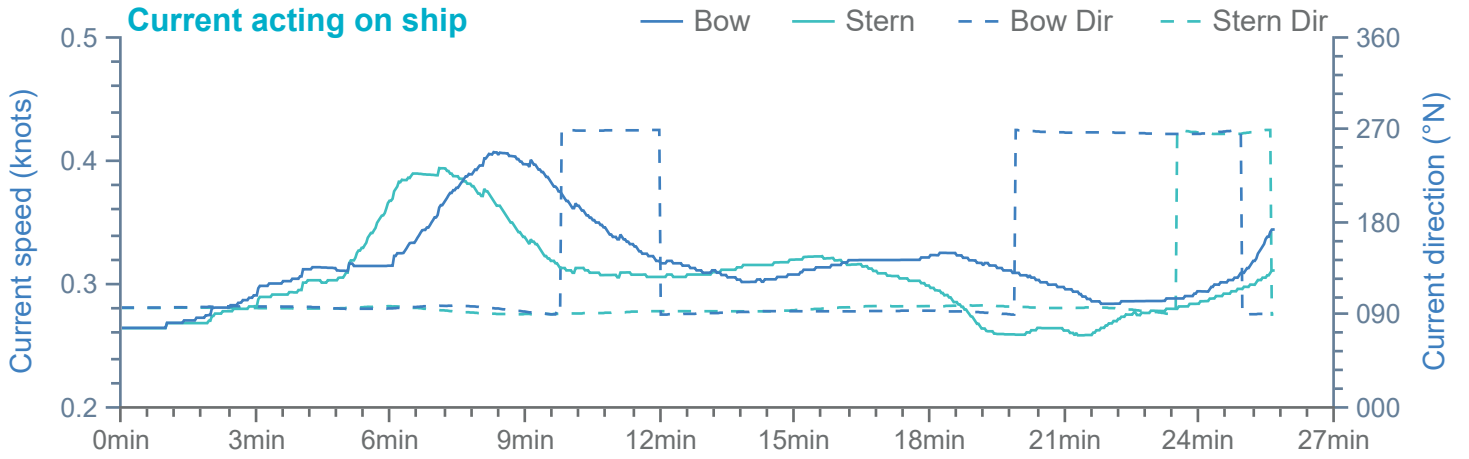


Overview

Environment

MV Celine

Thruster and engine use

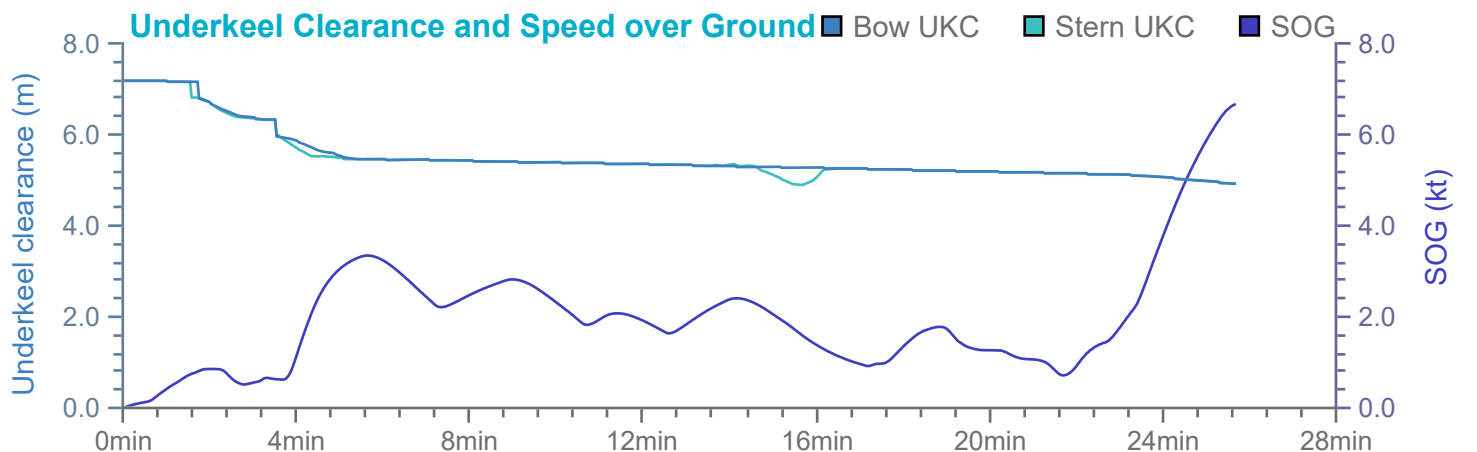
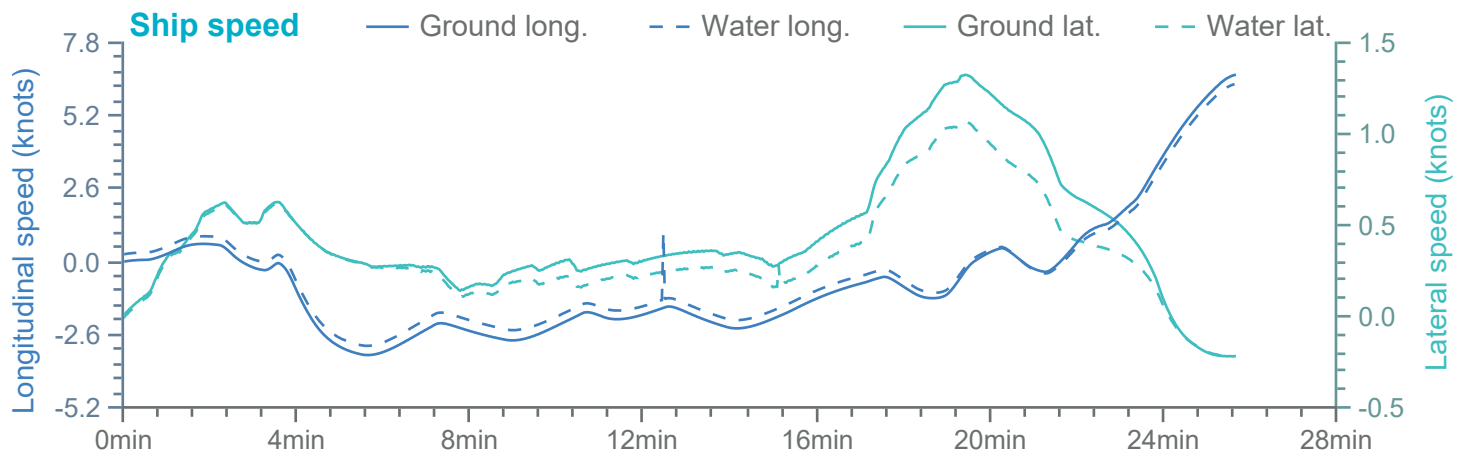
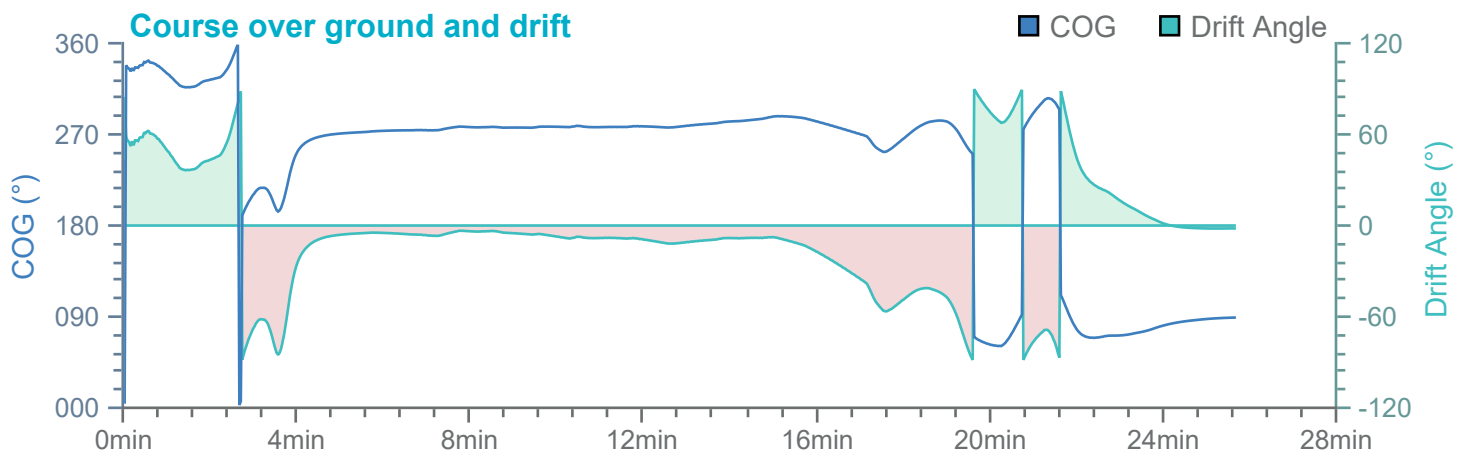
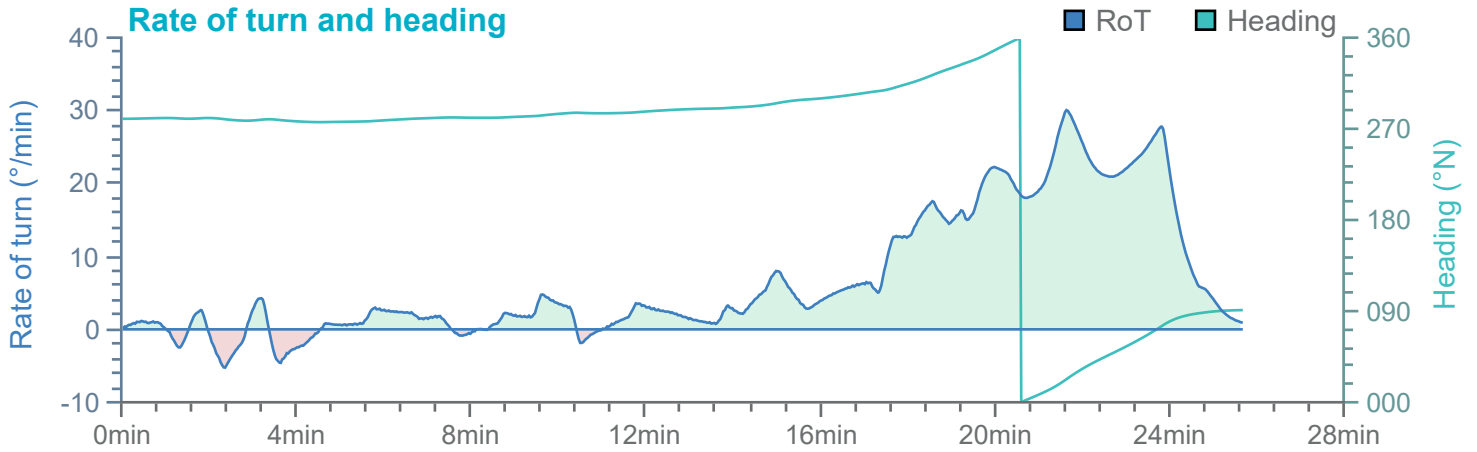


Overview

Environment

MV Celine

Thruster and engine use

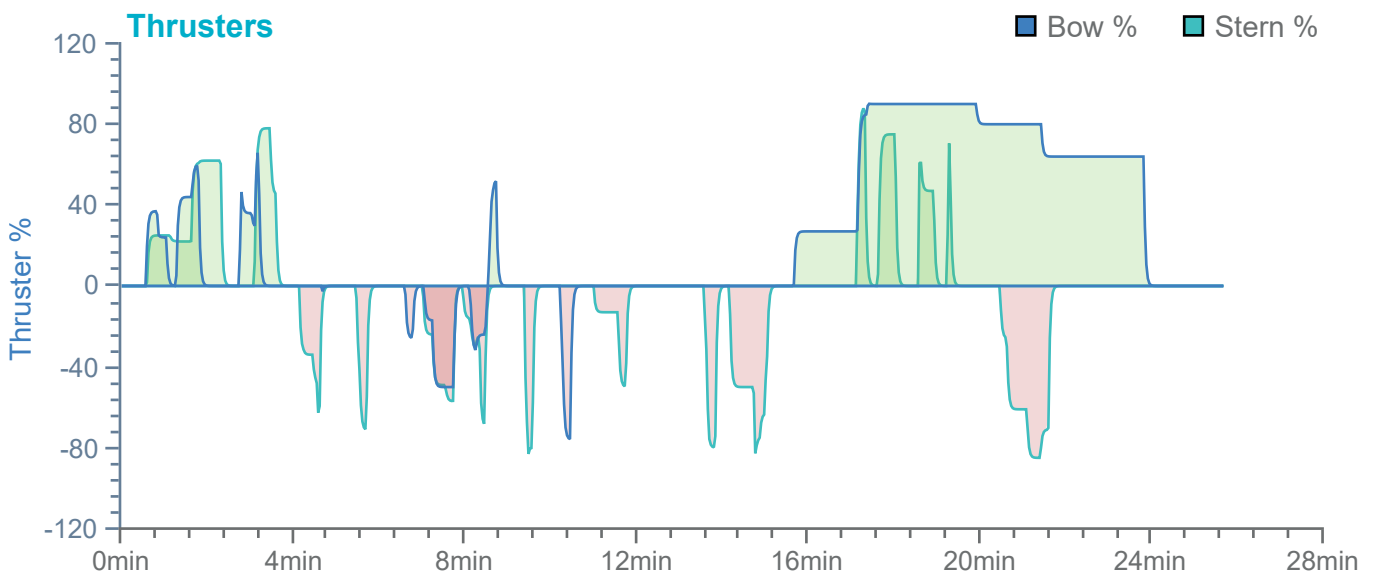
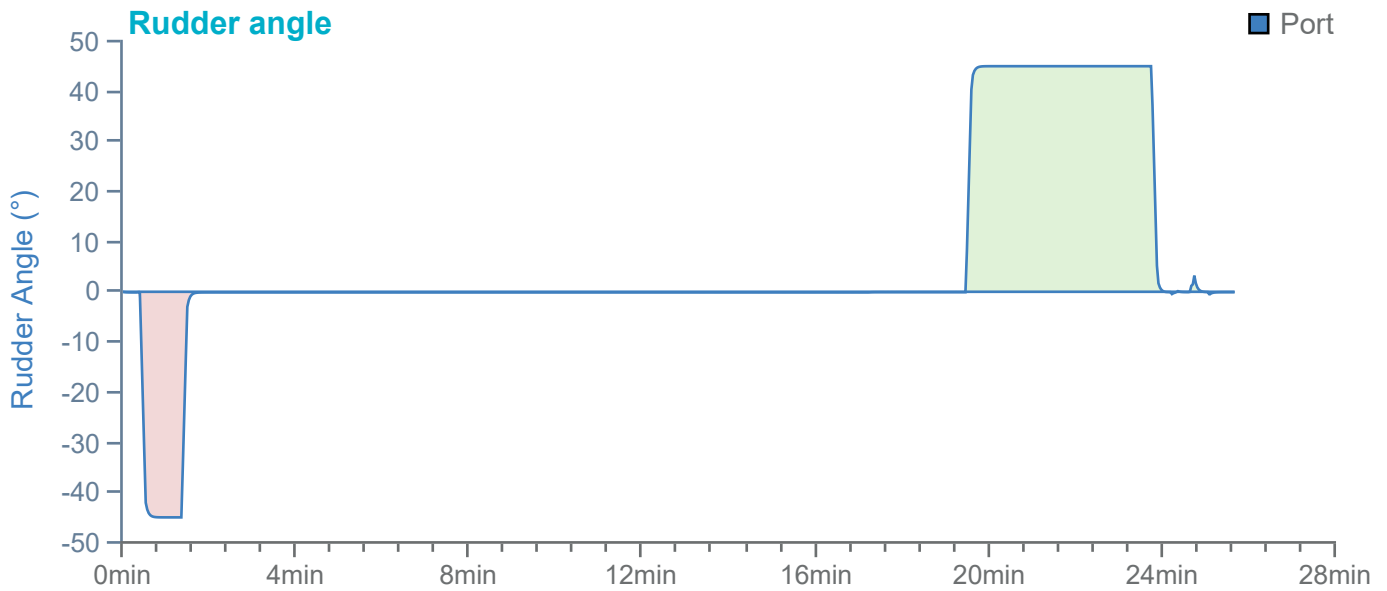
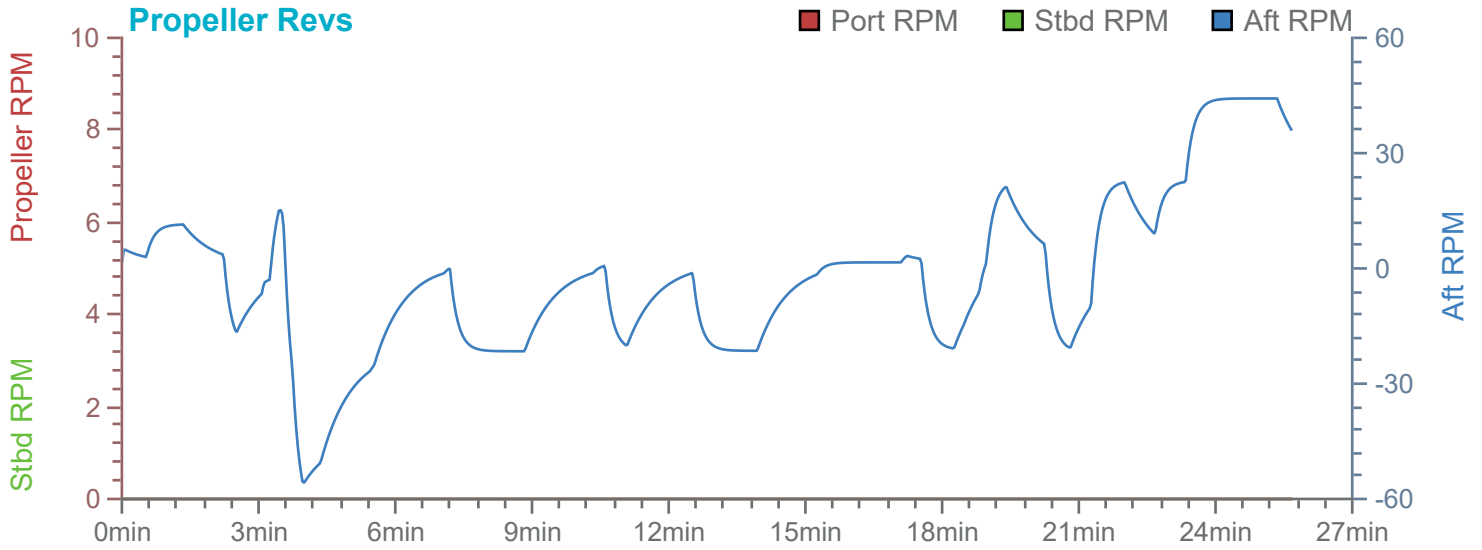


Overview

Environment

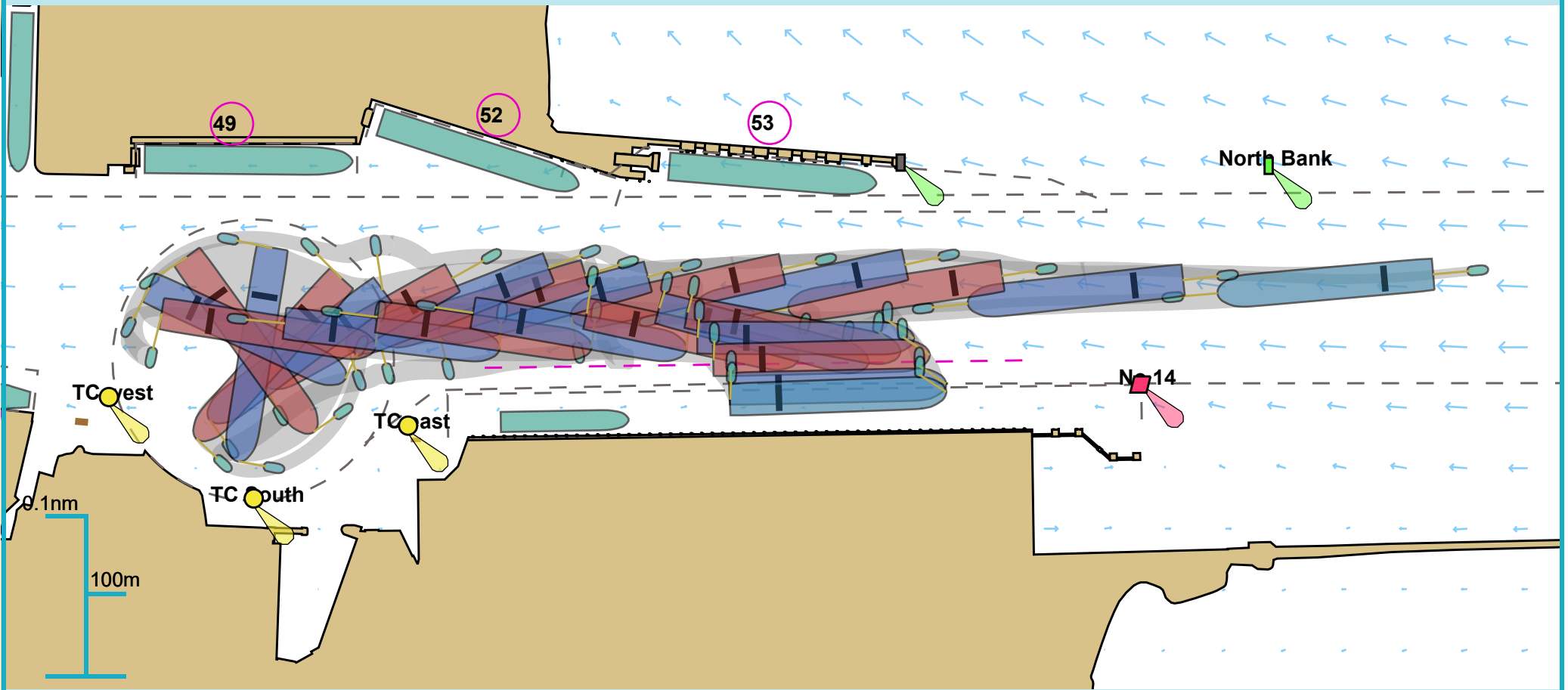
MV Celine

Thruster and engine use



Full Run Overview

53° 20.336 N, 006° 11.906 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:47 minutes

Manouvre:Other

Ownship(s):250m Container

Comments:

Overview

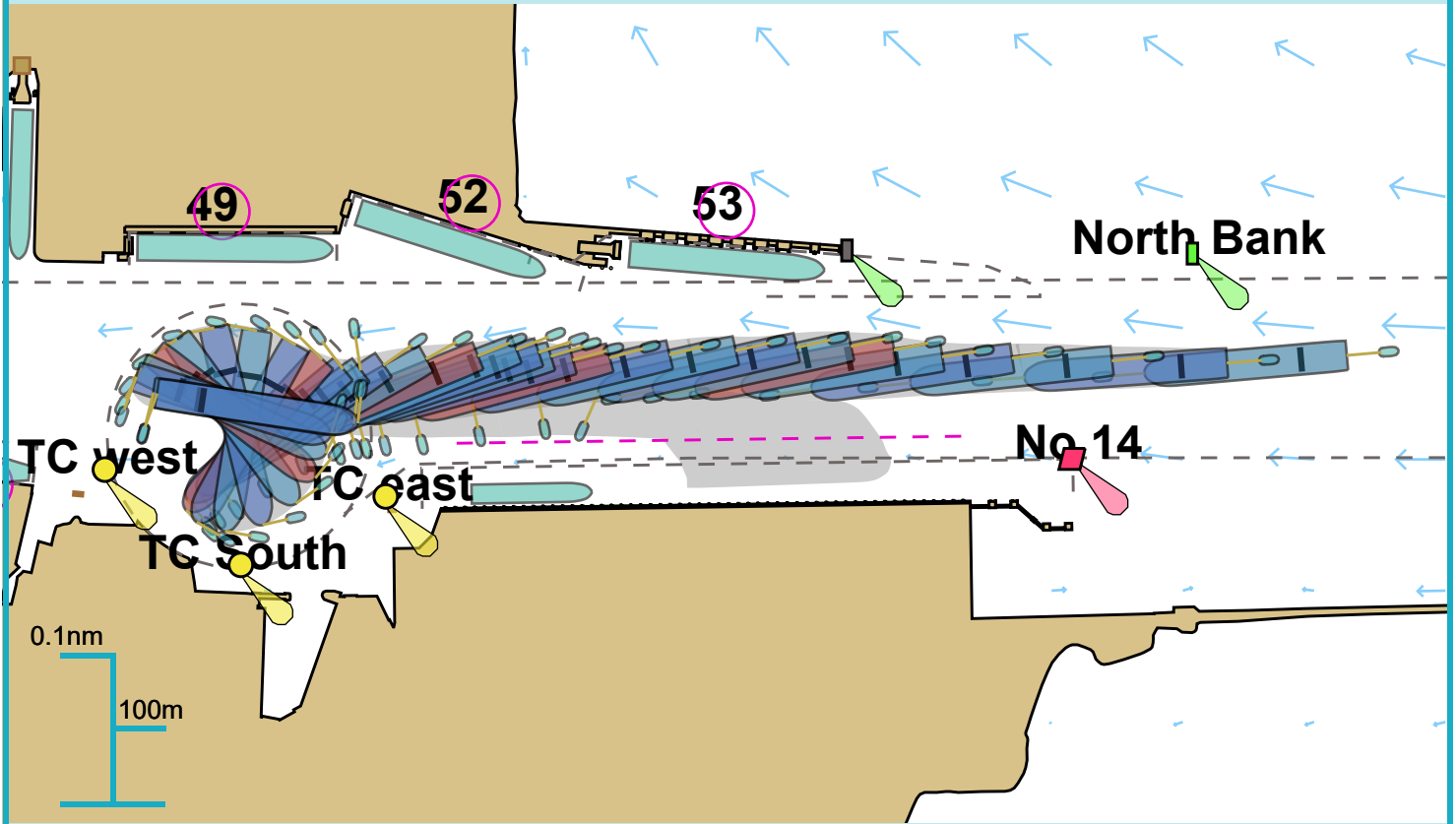
Environment

250m Container

Thruster and engine use

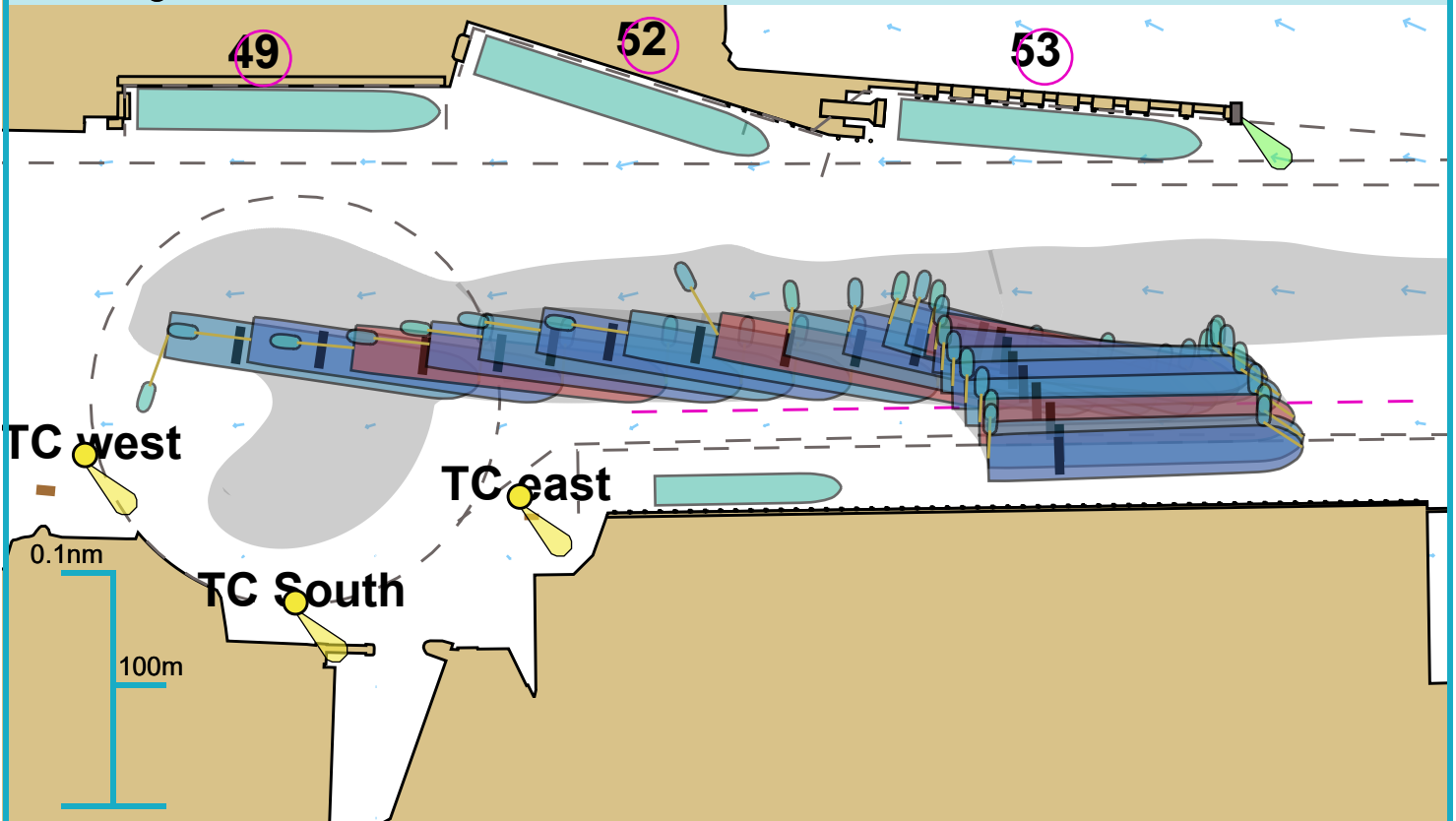
Tug use

Approach



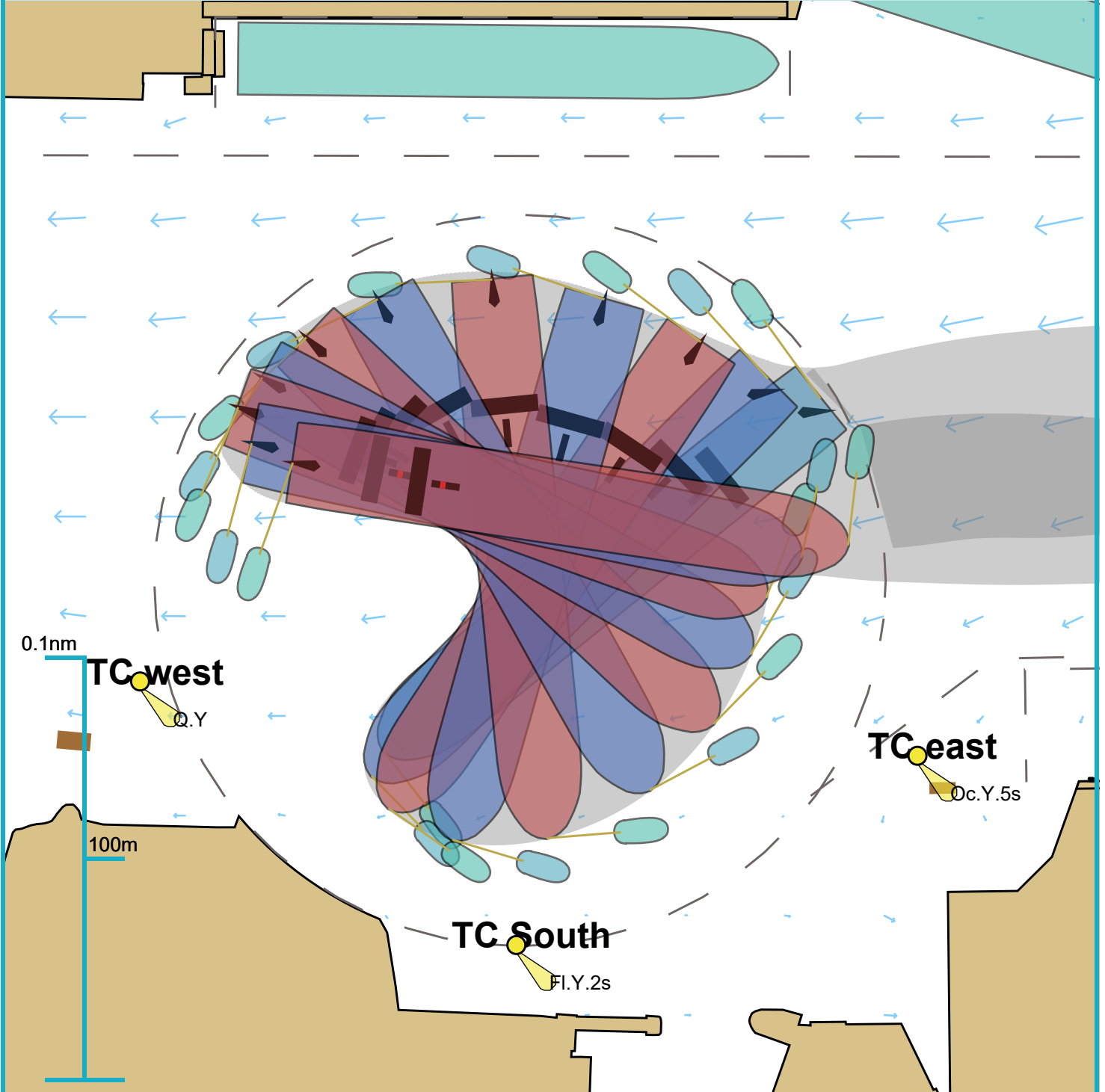
Ships plotted every 1 mins, highlight every 5 mins

Berthing

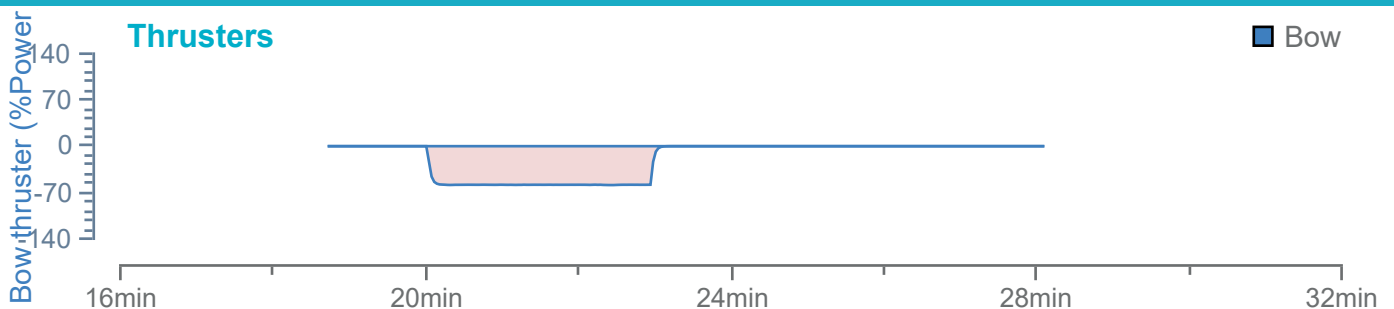


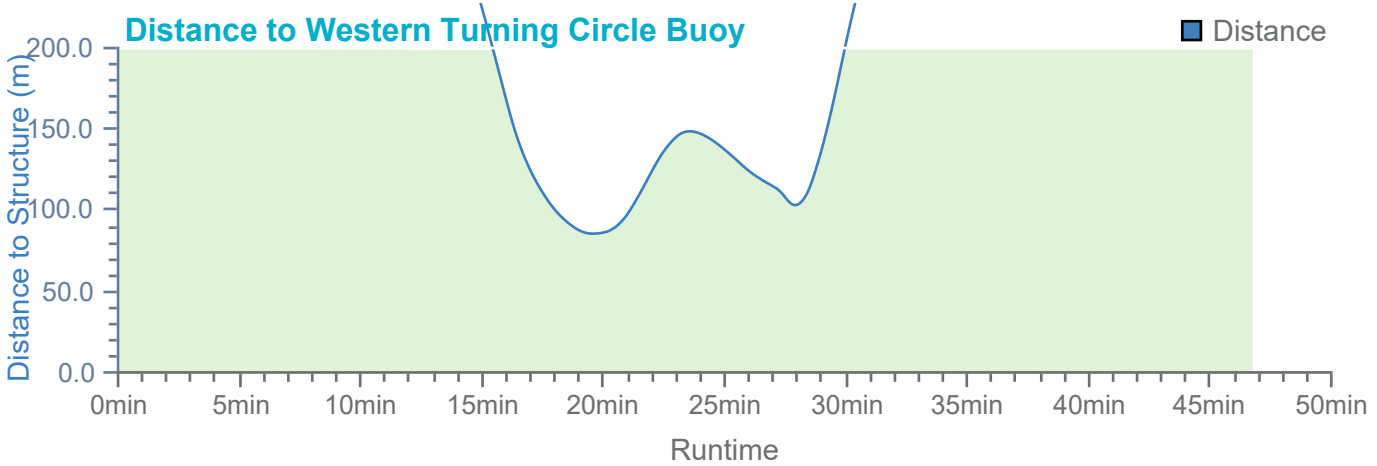
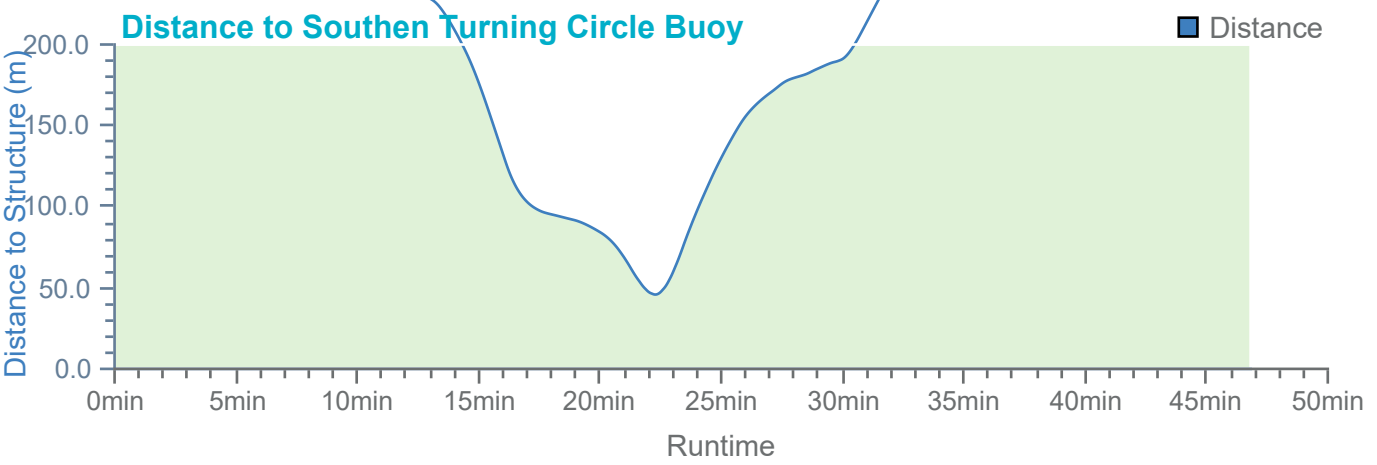
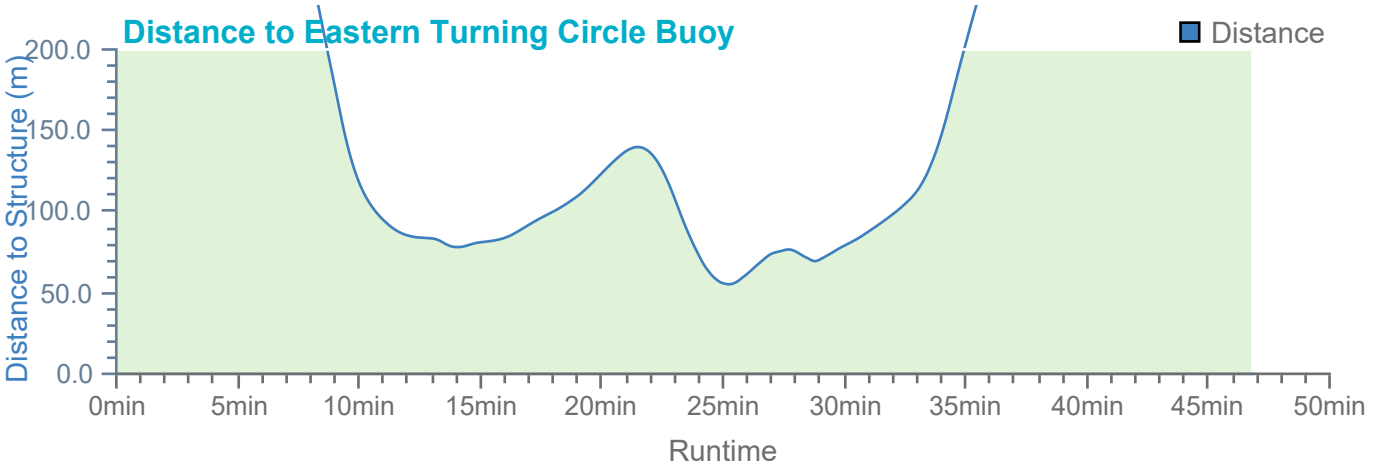
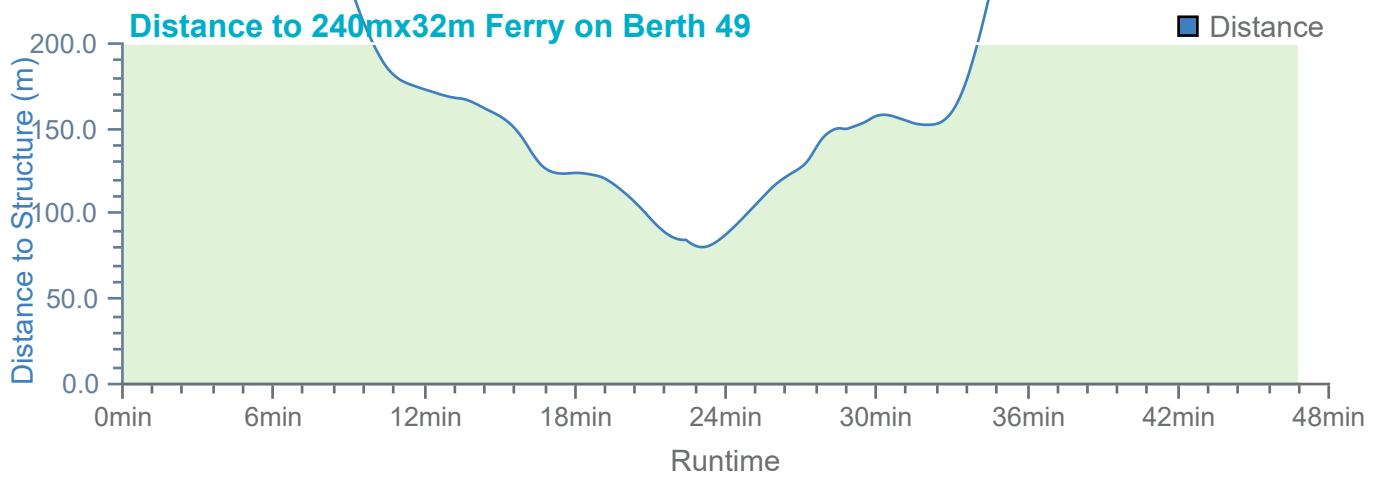
Ships plotted every 1 mins, highlight every 5 mins

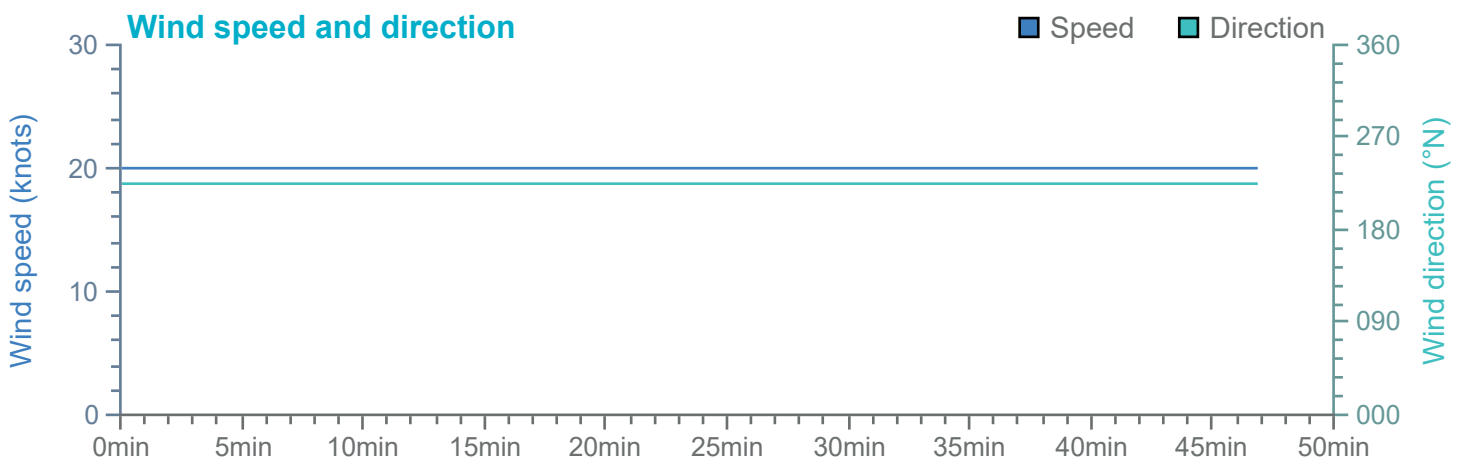
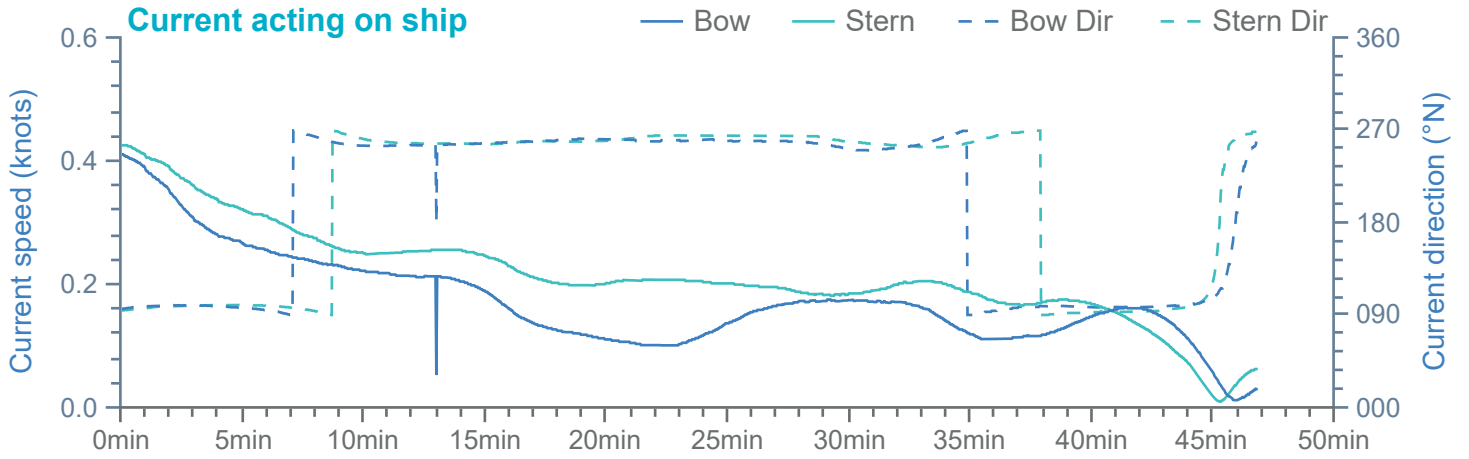
Swing



Ships plotted every 59 seconds, highlight every 2 mins







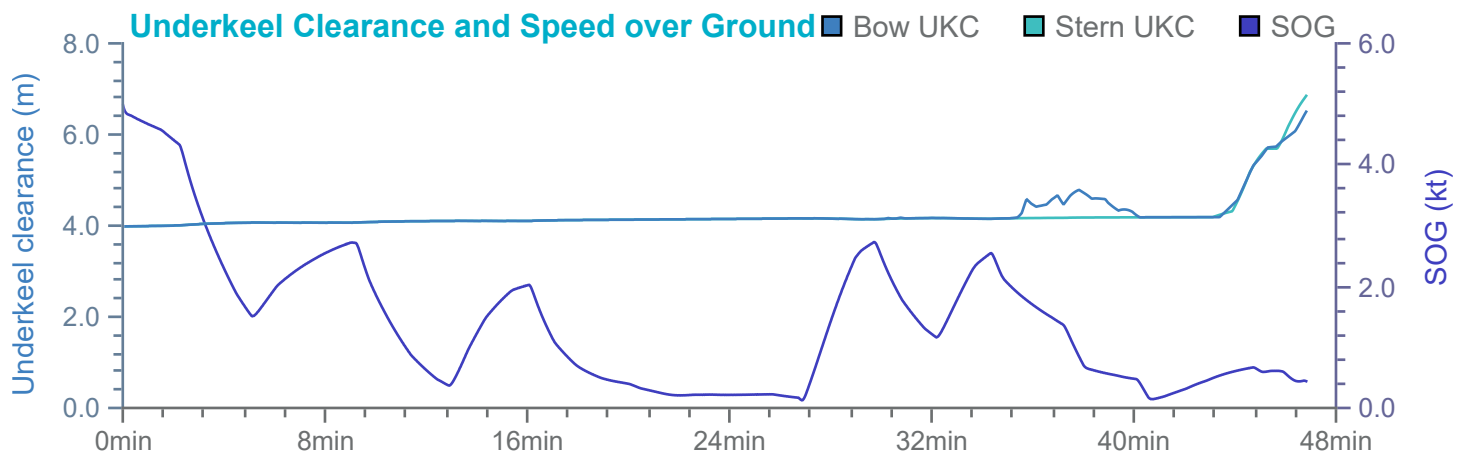
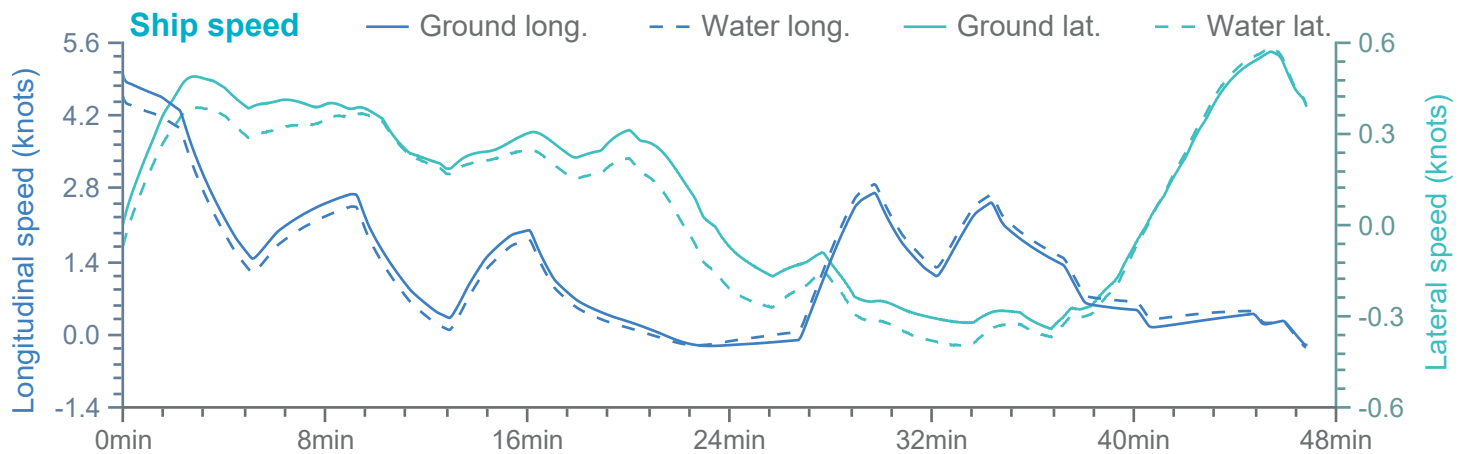
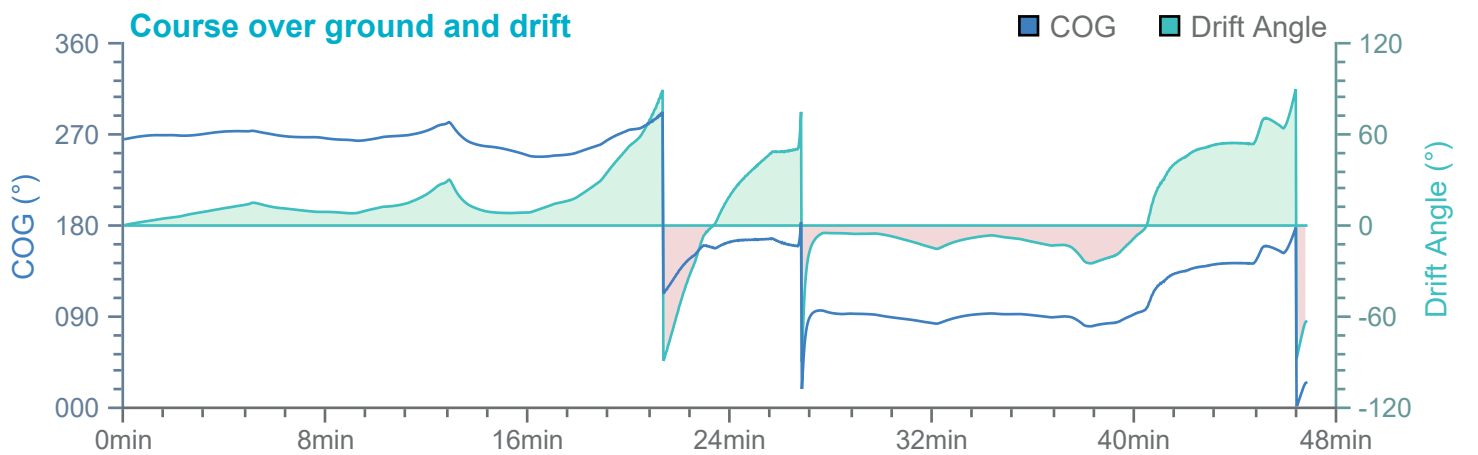
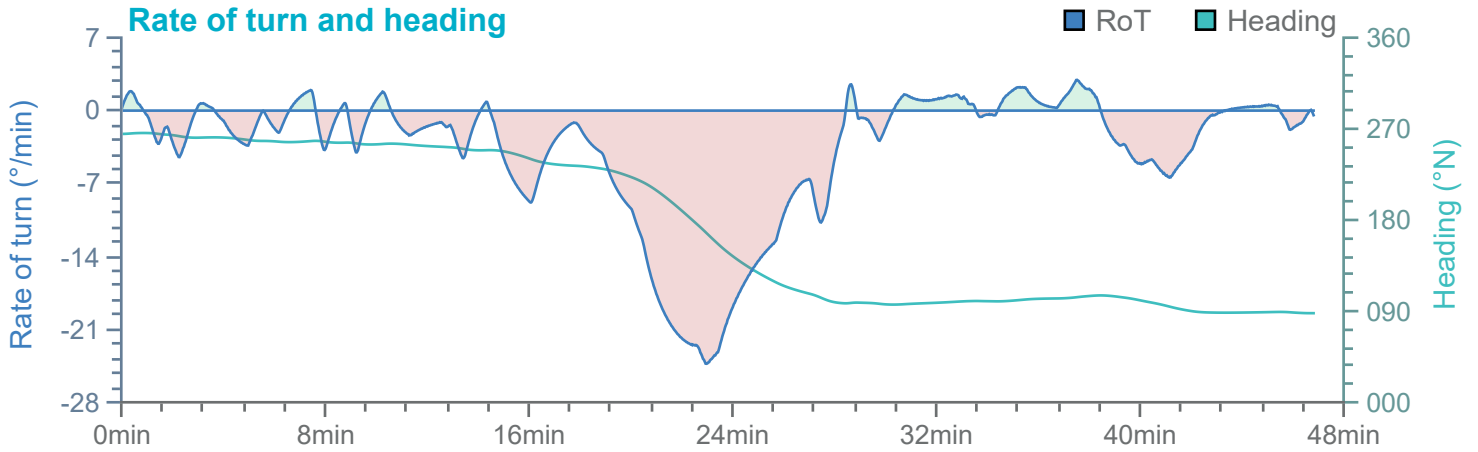
Overview

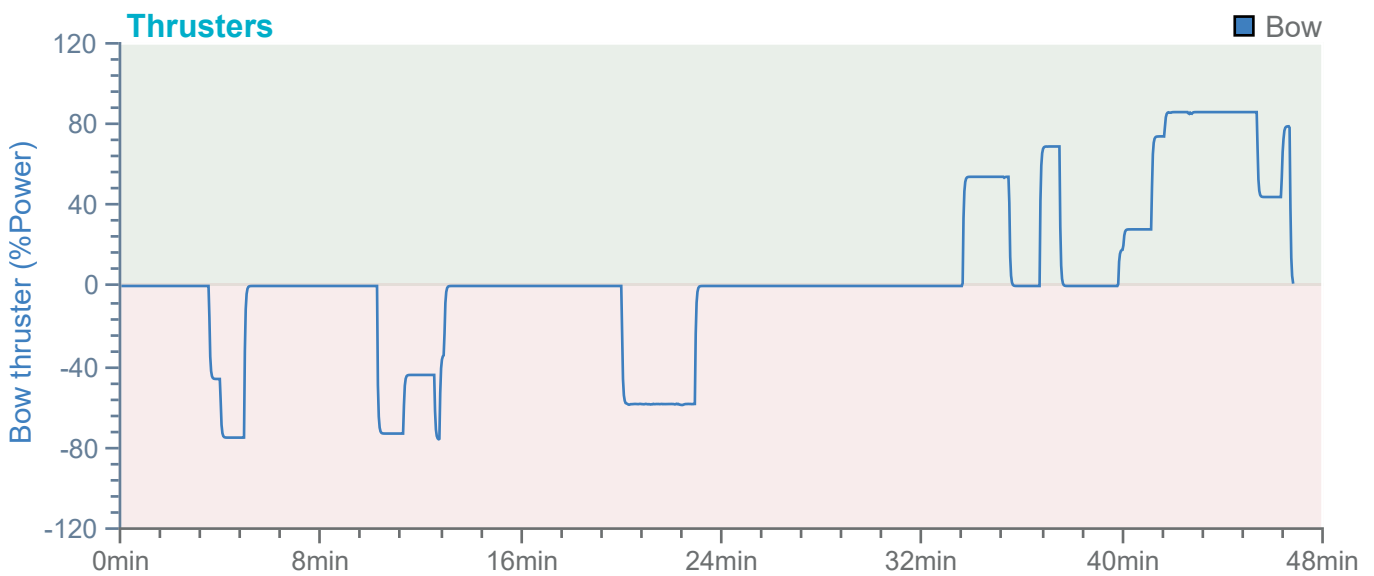
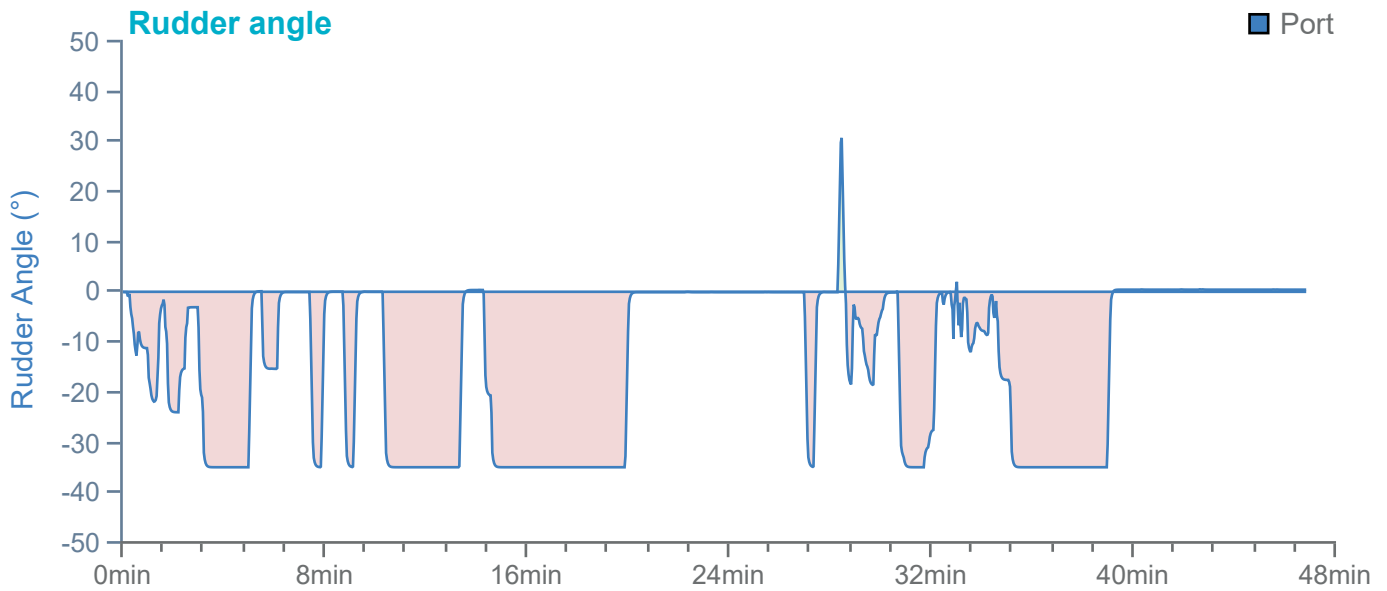
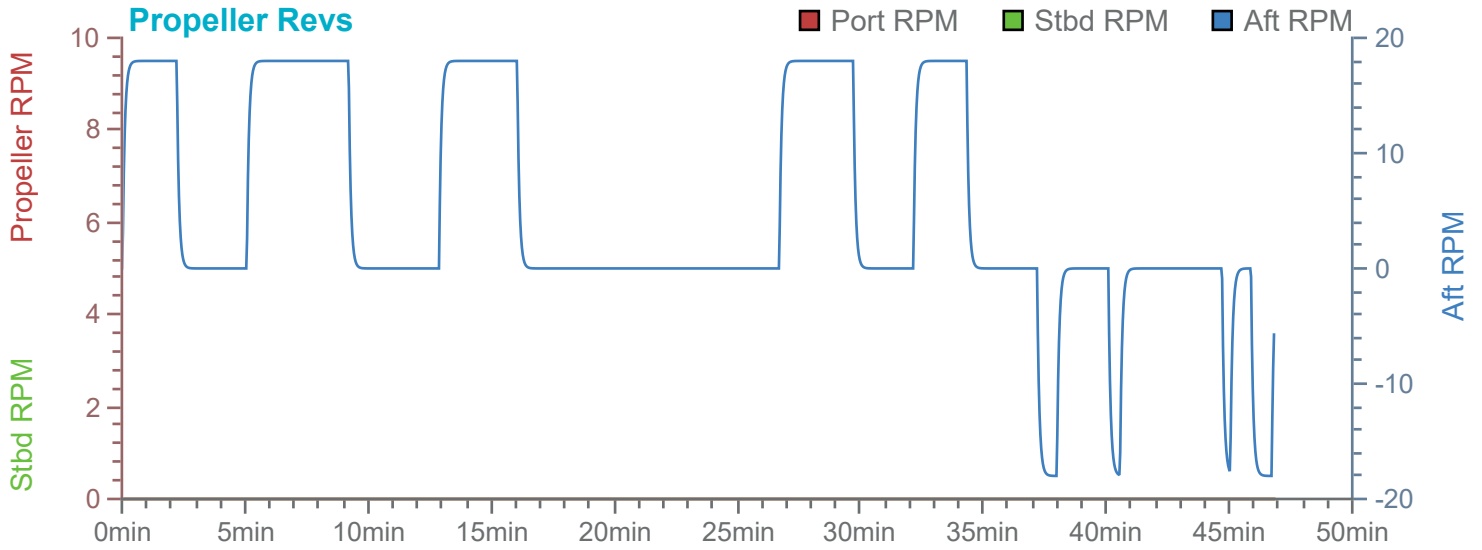
Environment

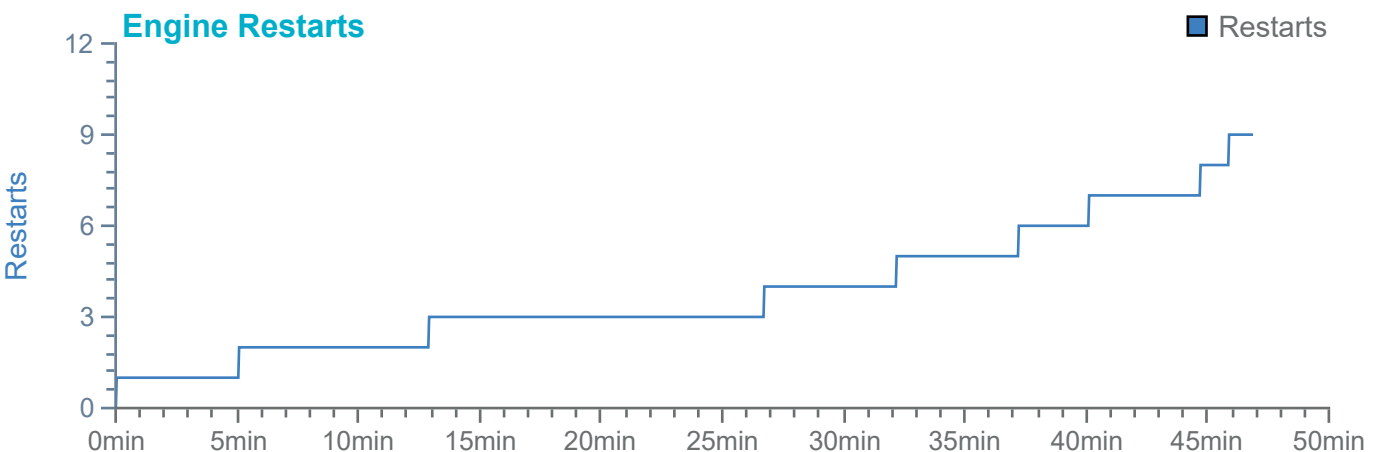
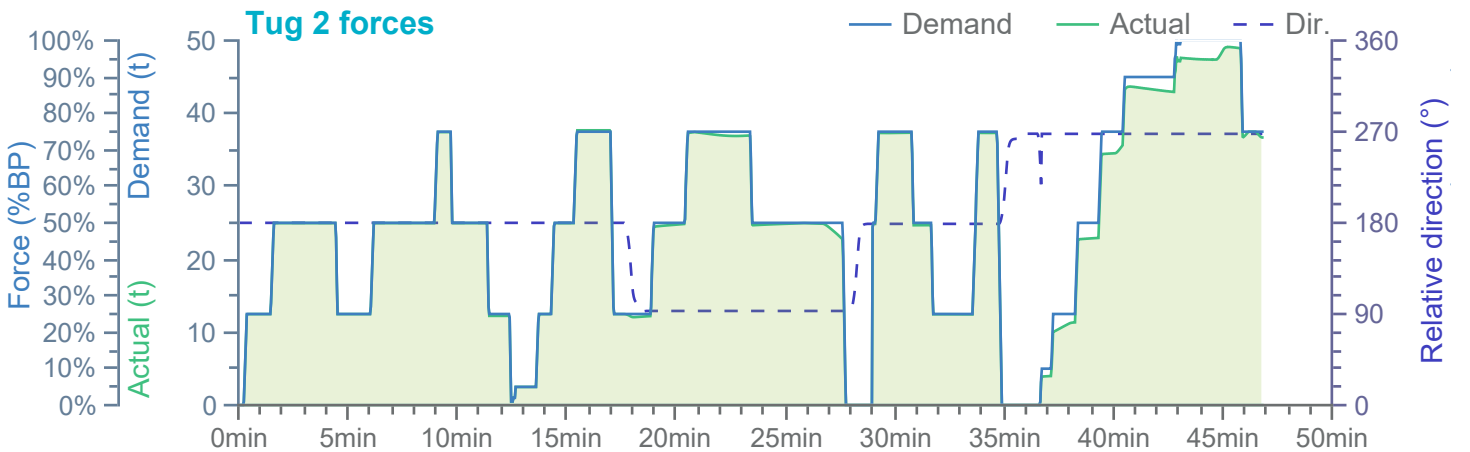
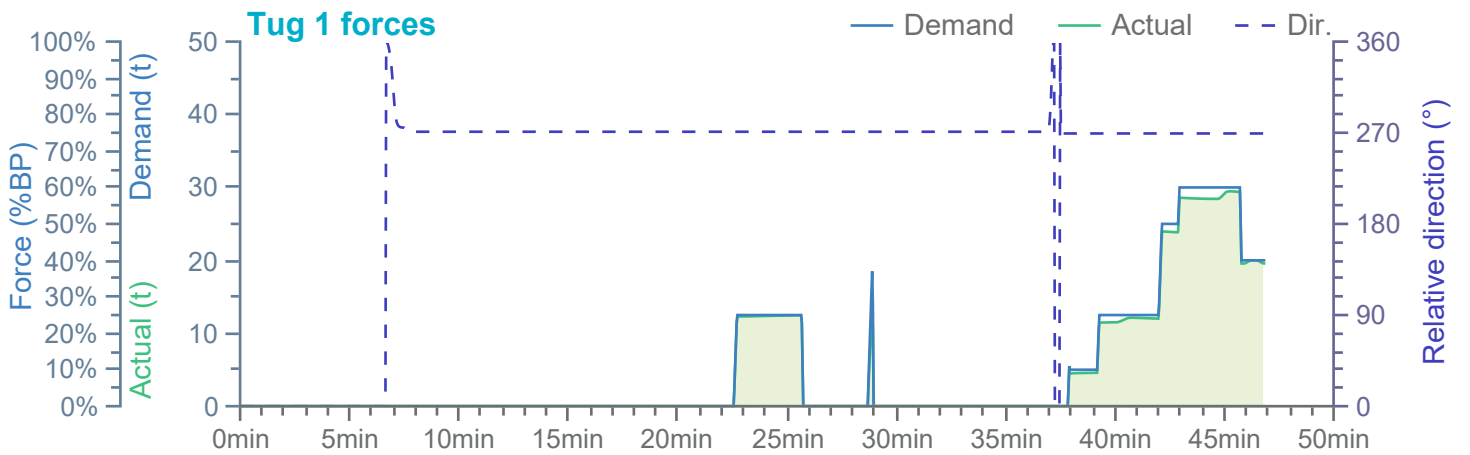
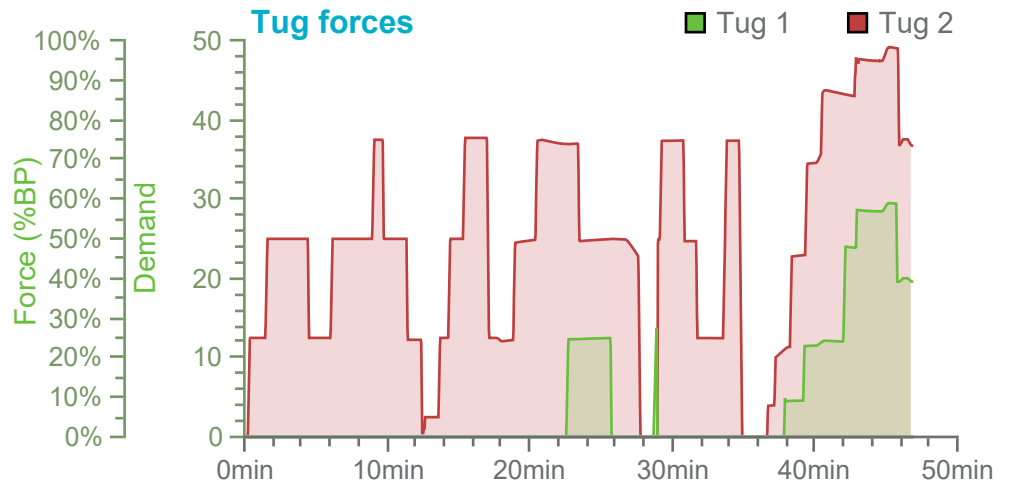
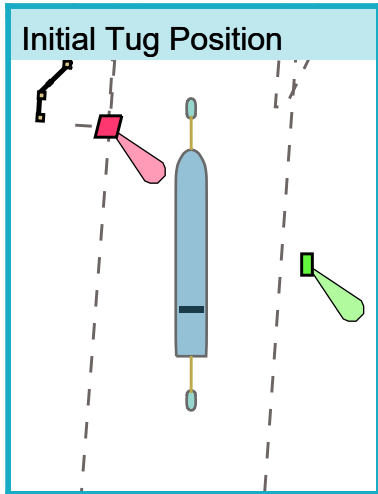
250m Container

Thruster and engine use

Tug use

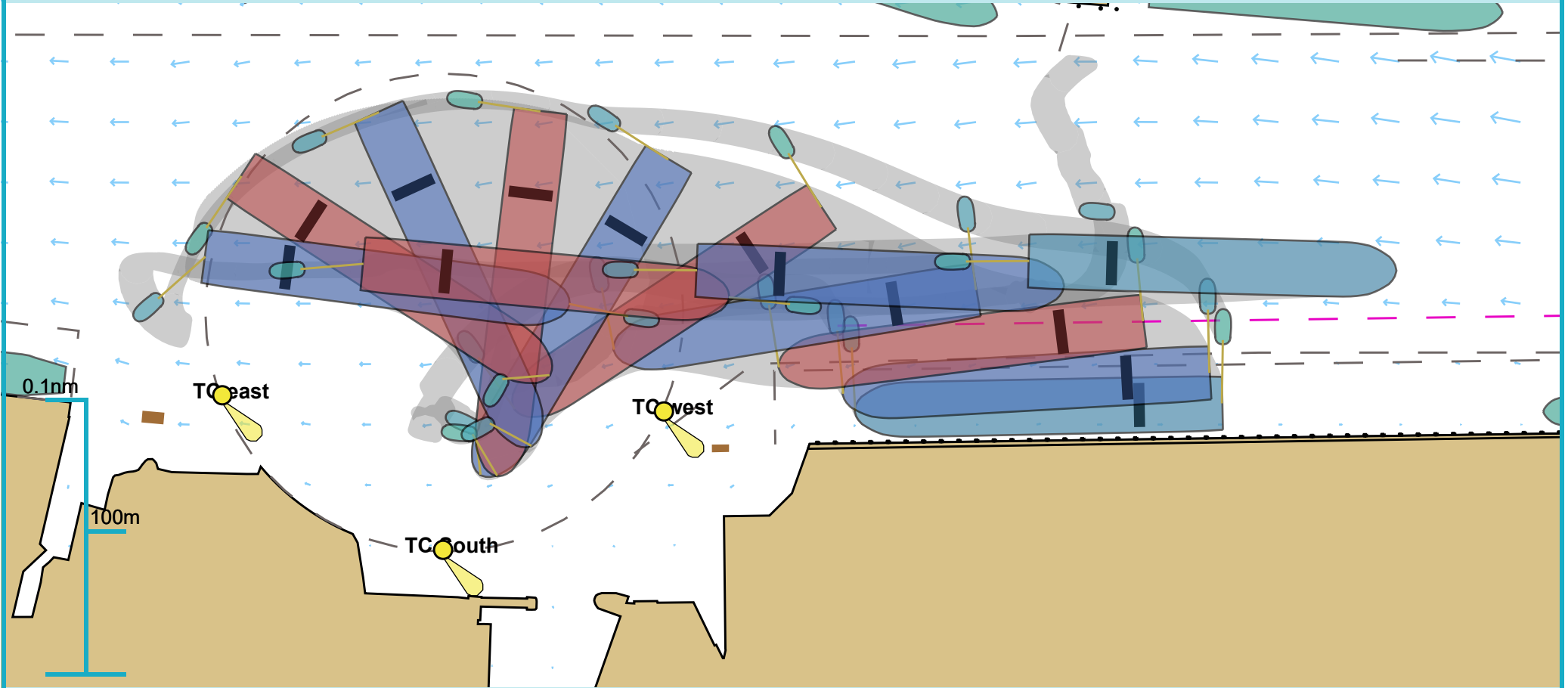






Full Run Overview

53° 20.416 N, 006° 11.916 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM
Run length:23 minutes
Manouvre:Other
Ownship(s):250m Container

Comments:

Overview

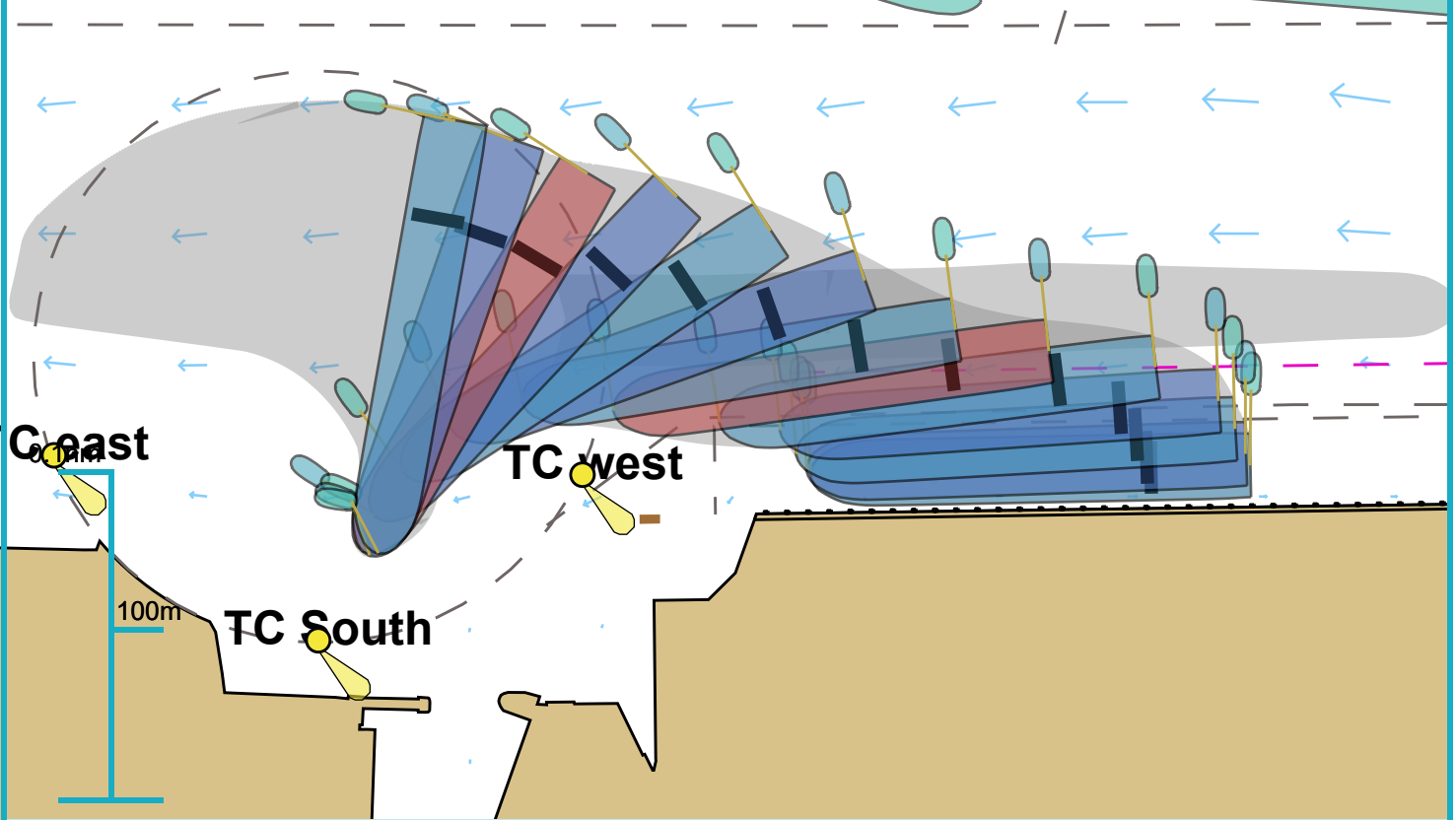
Environment

250m Container

Thruster and engine use

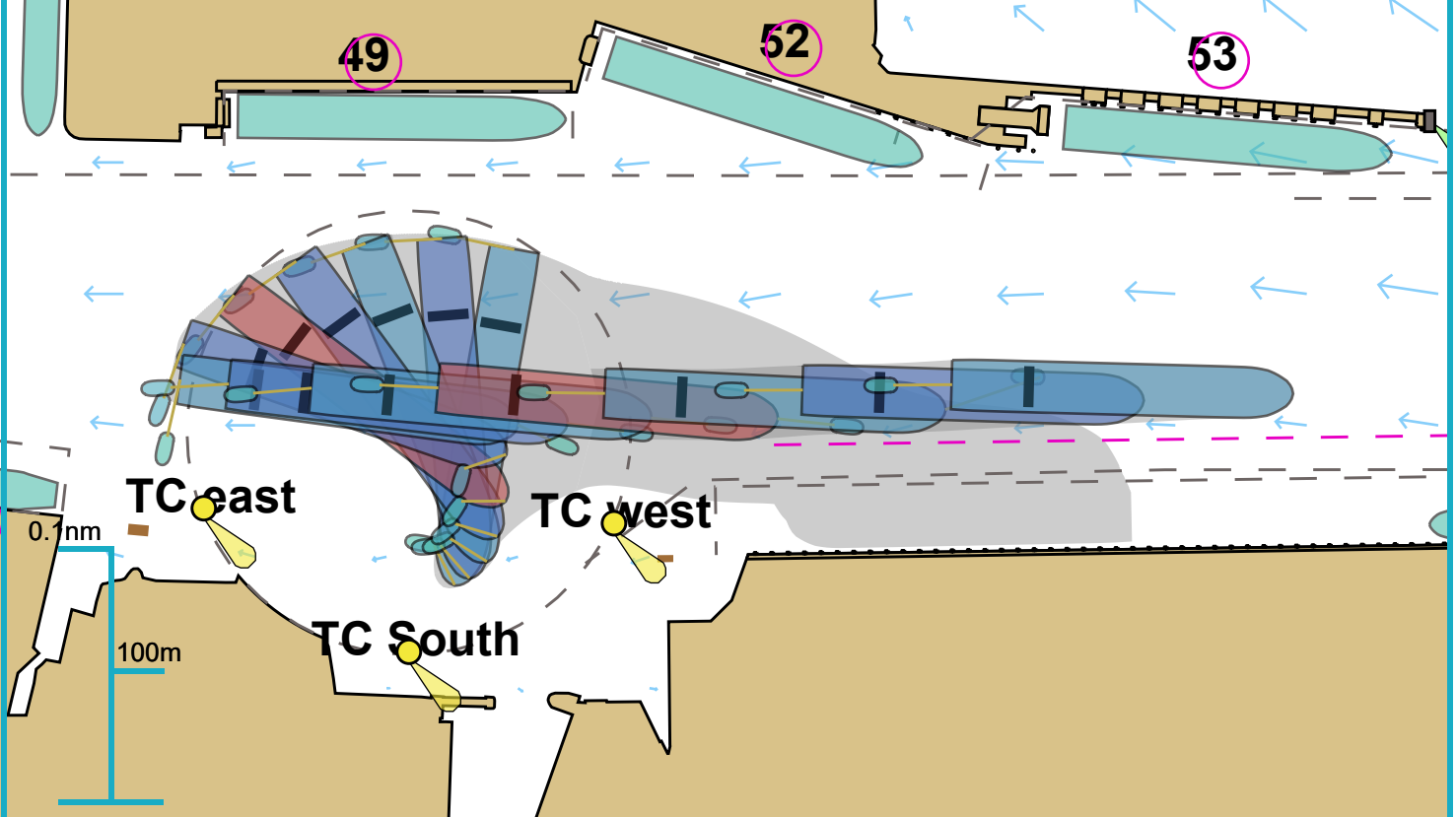
Tug use

Departure



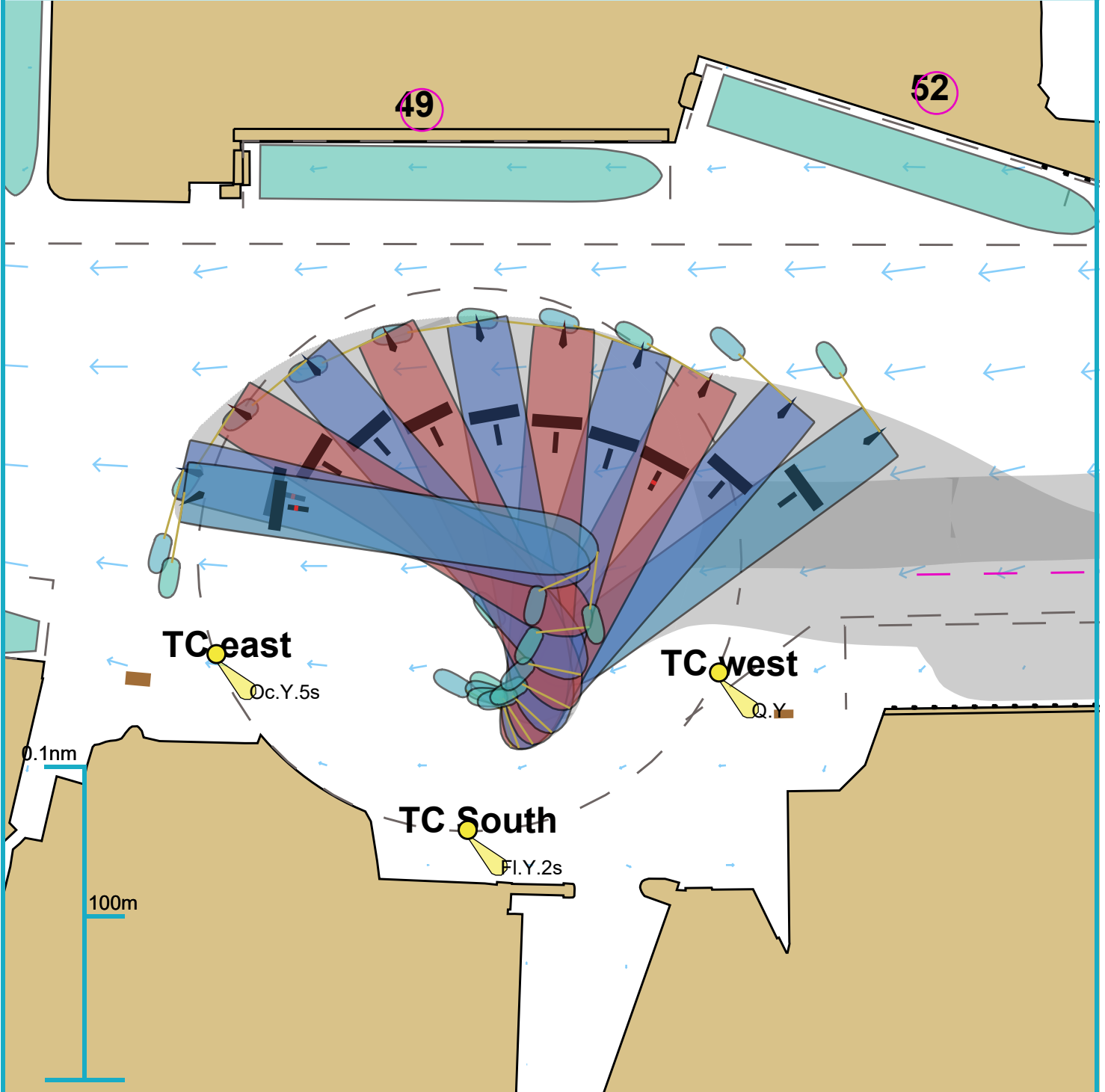
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

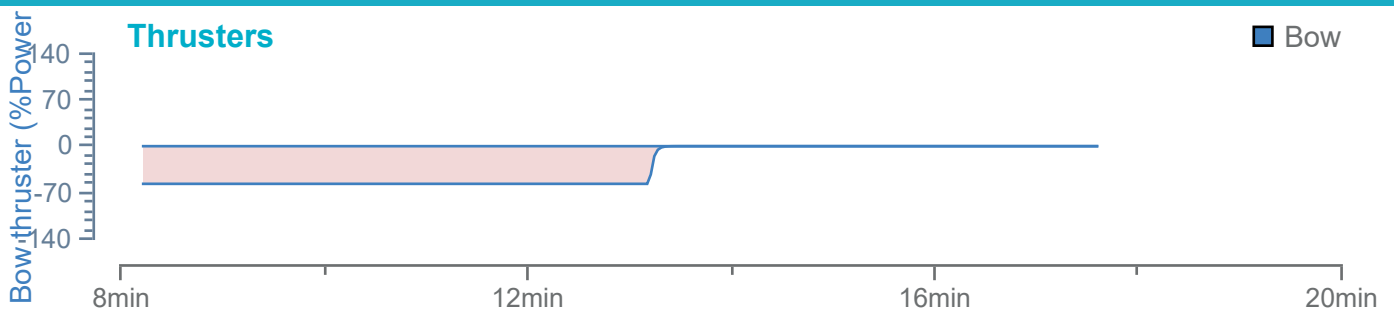


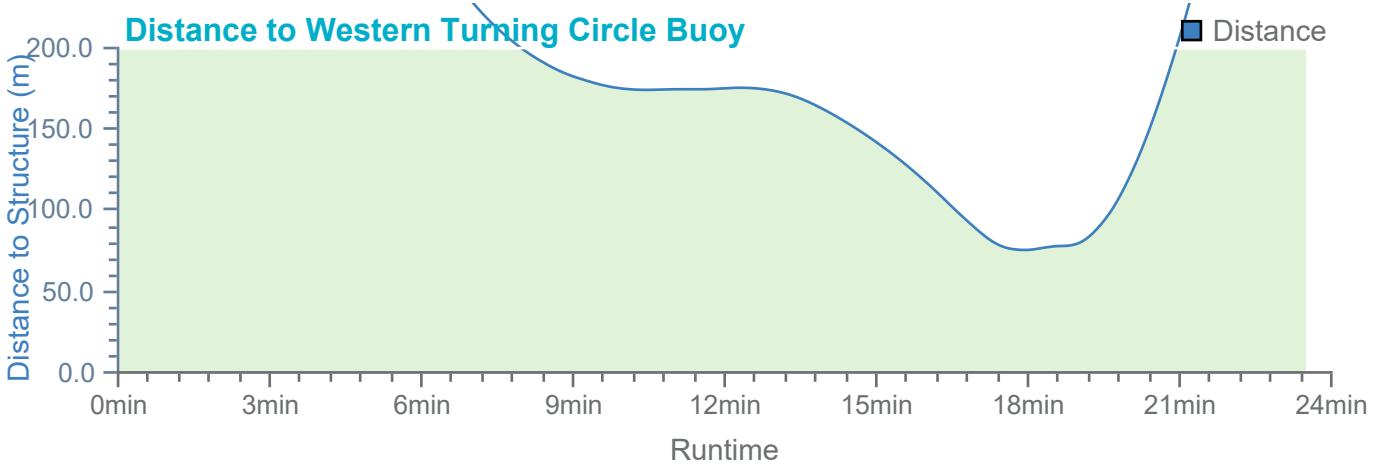
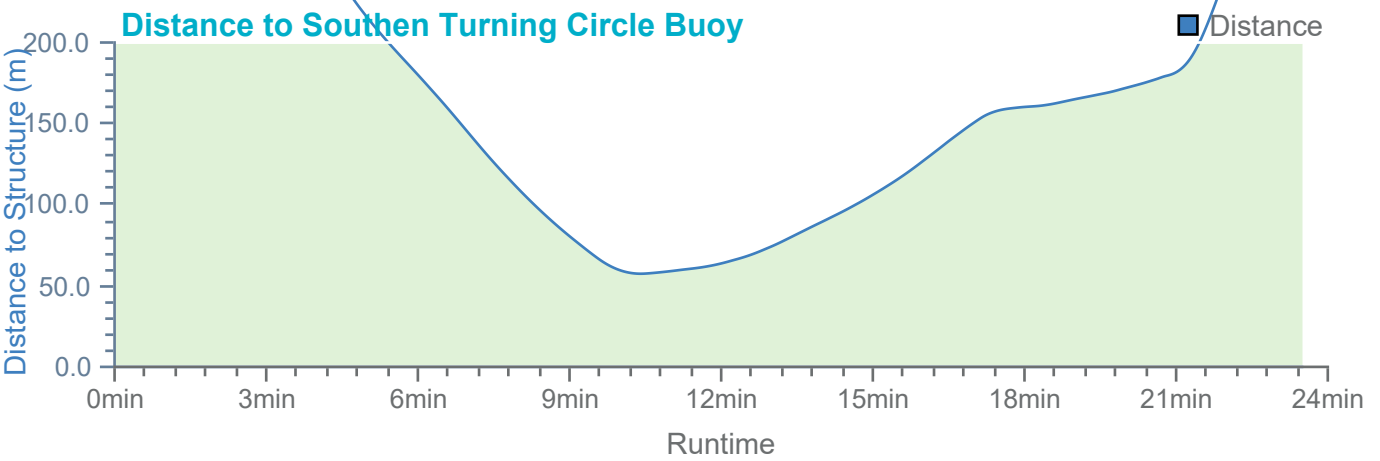
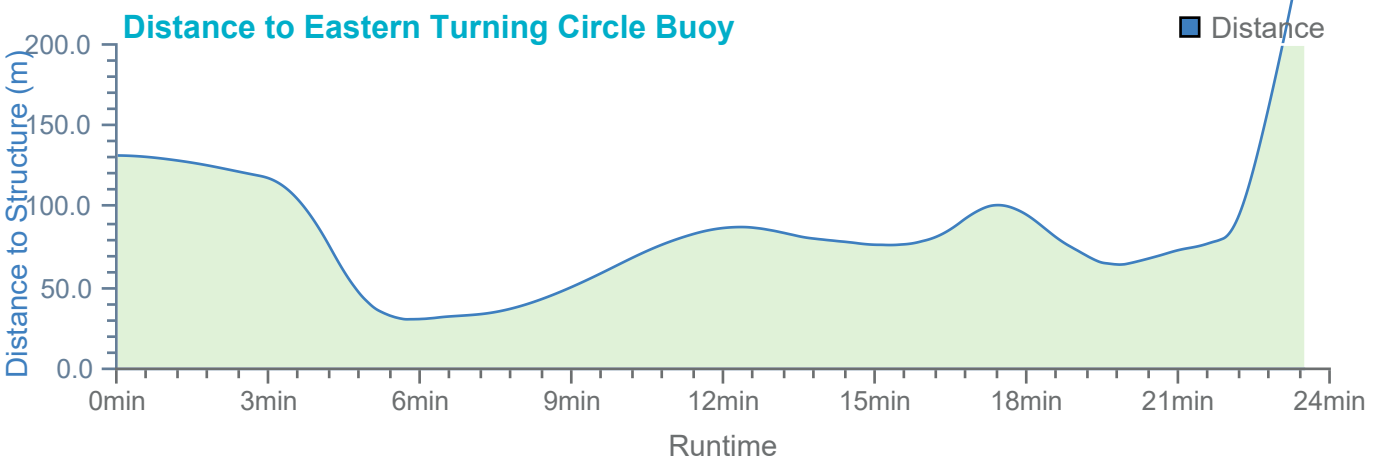
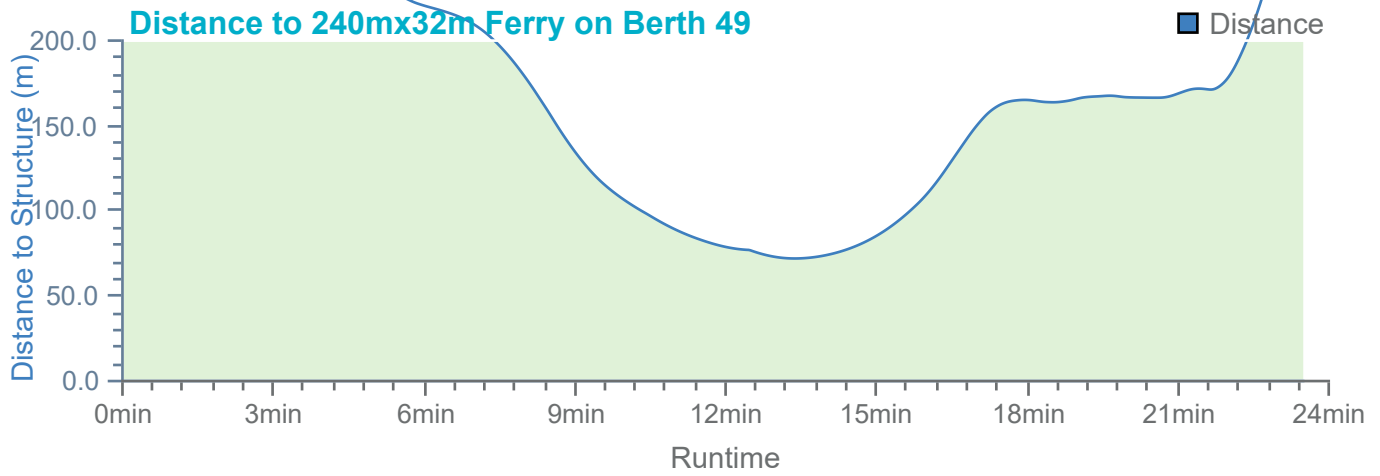
Ships plotted every 1 mins, highlight every 5 mins

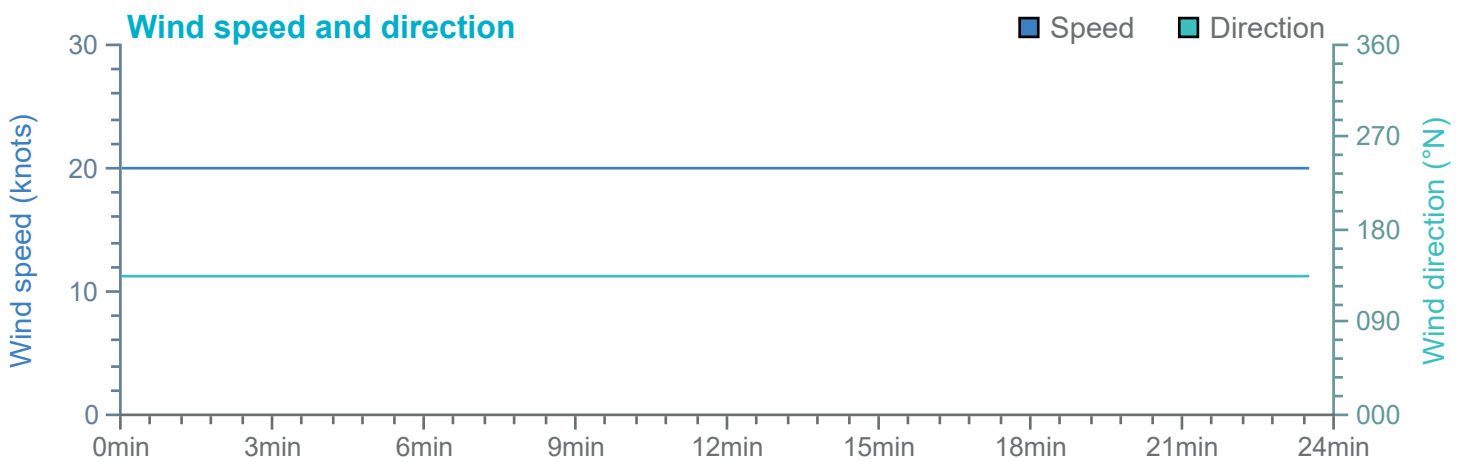
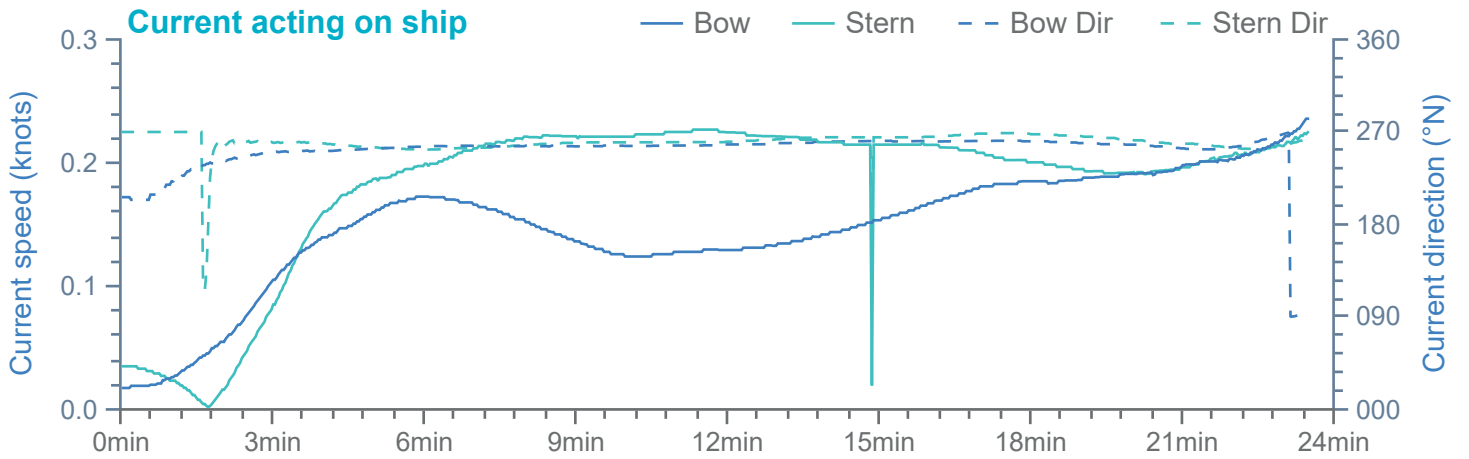
Swing

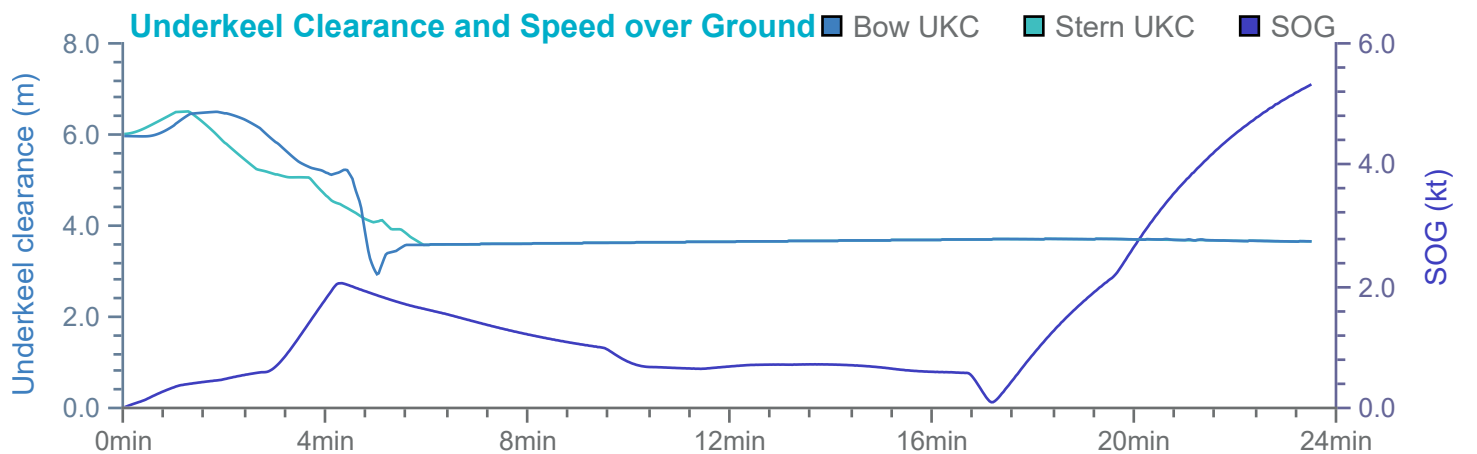
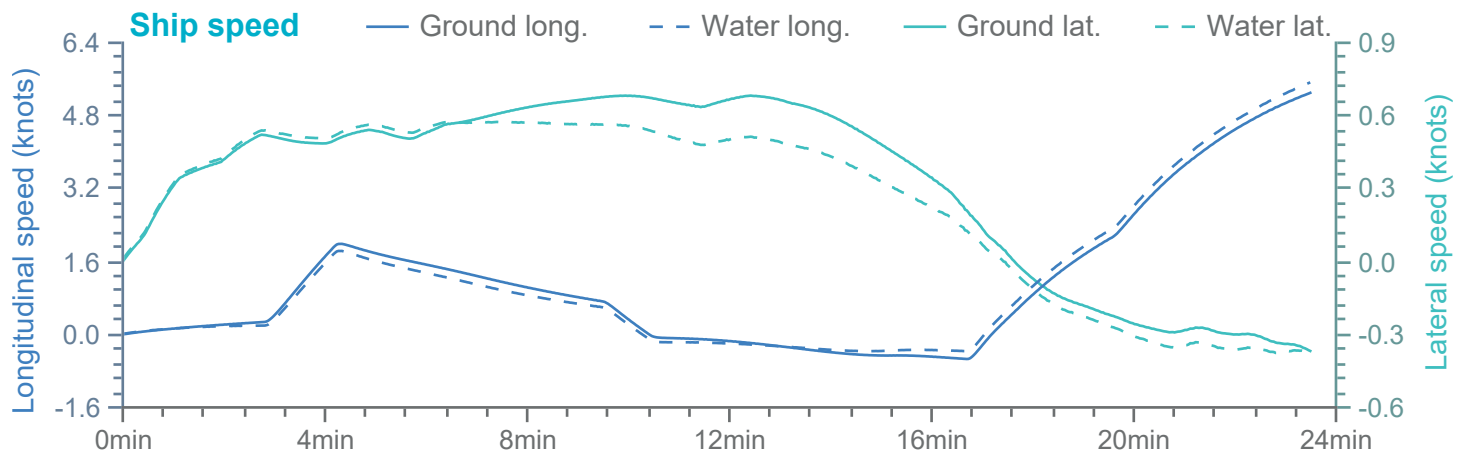
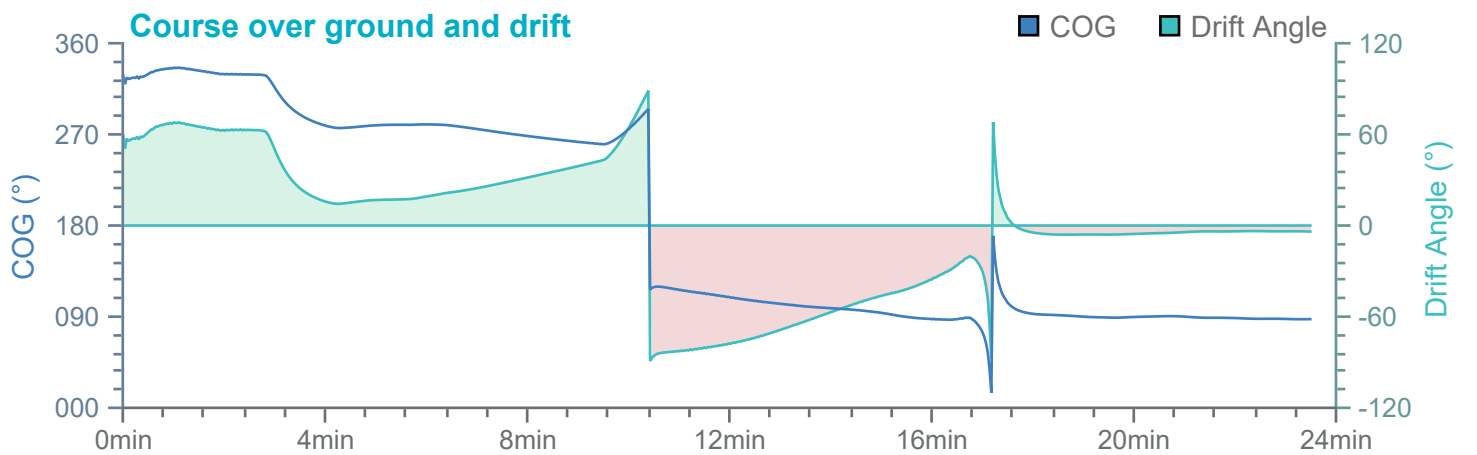
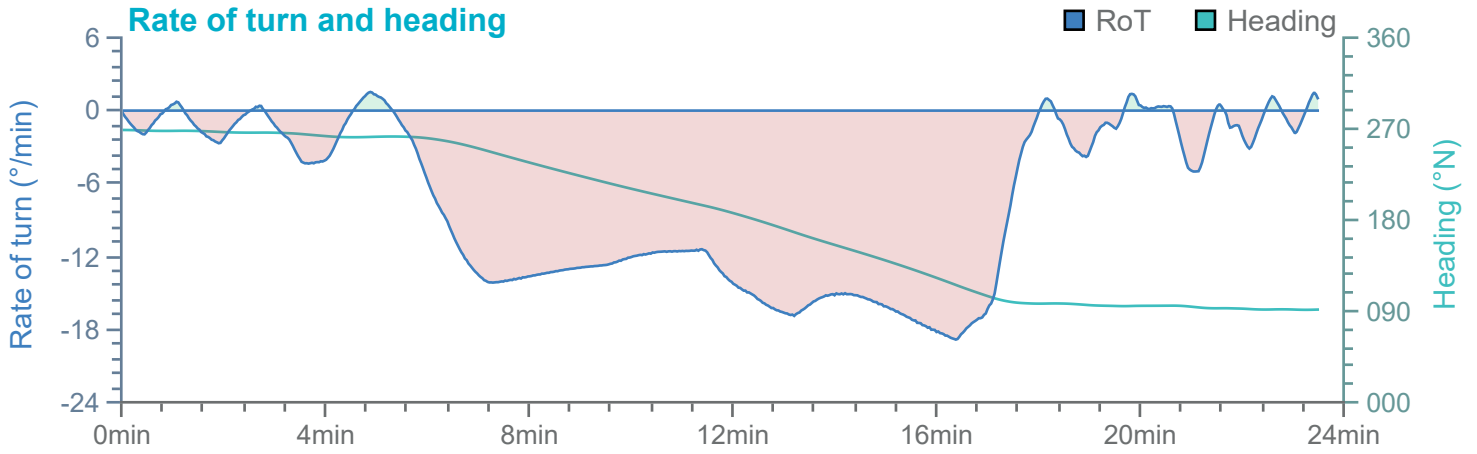


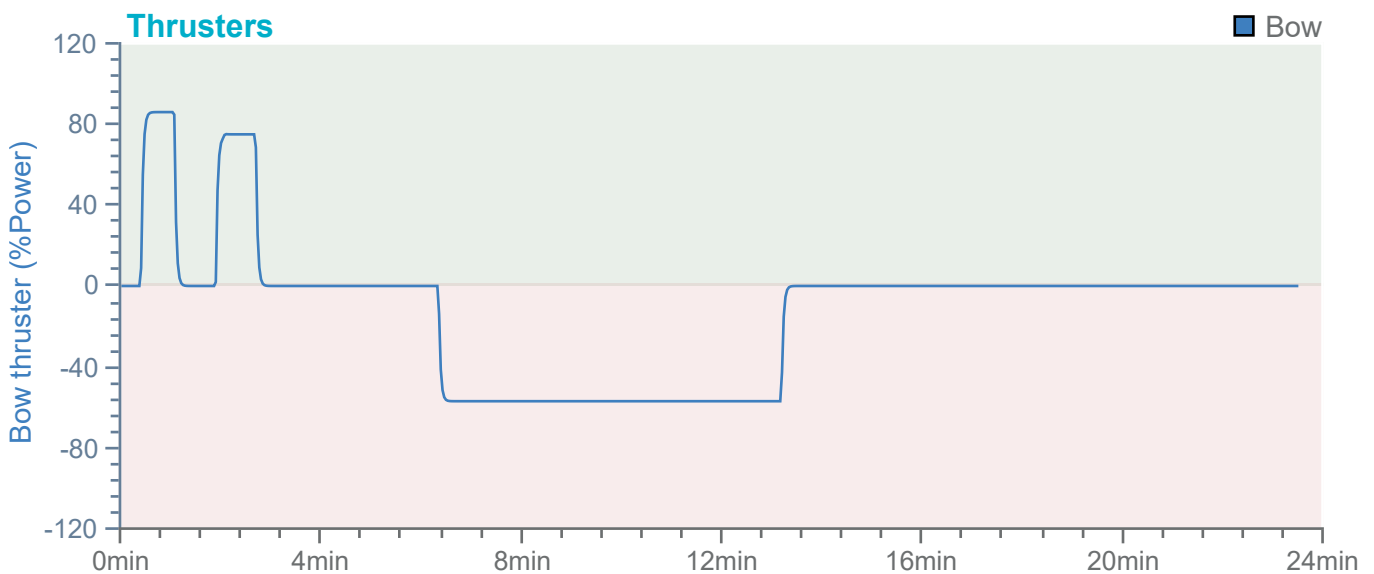
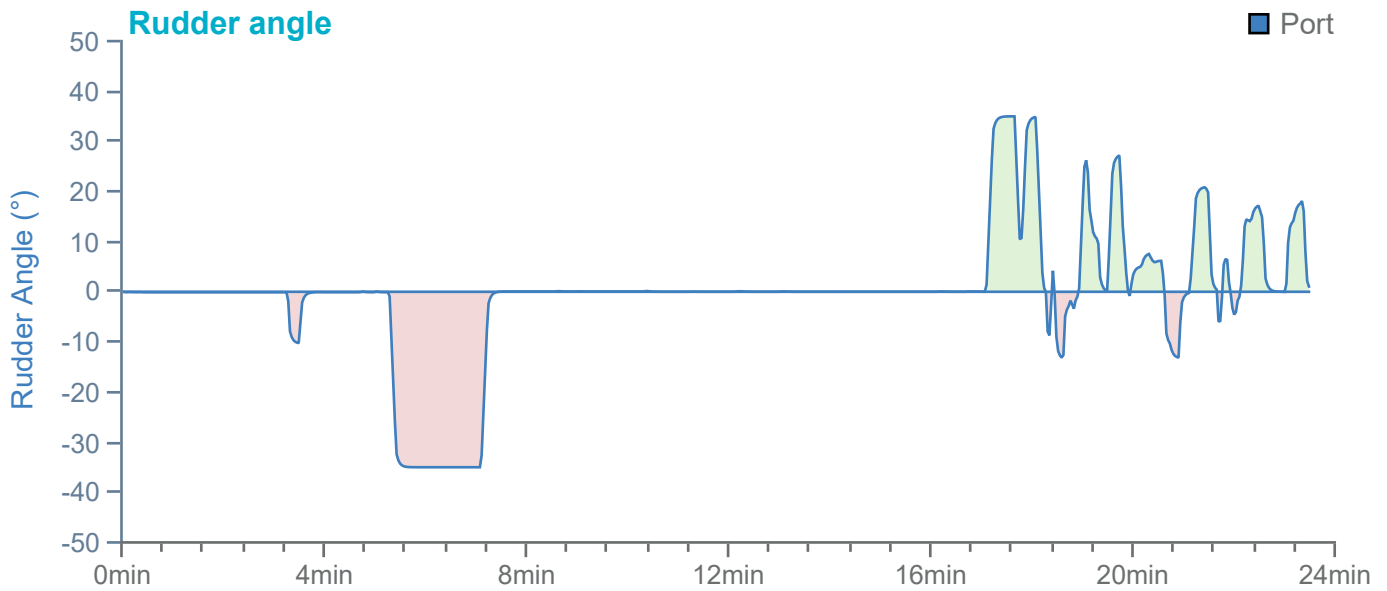
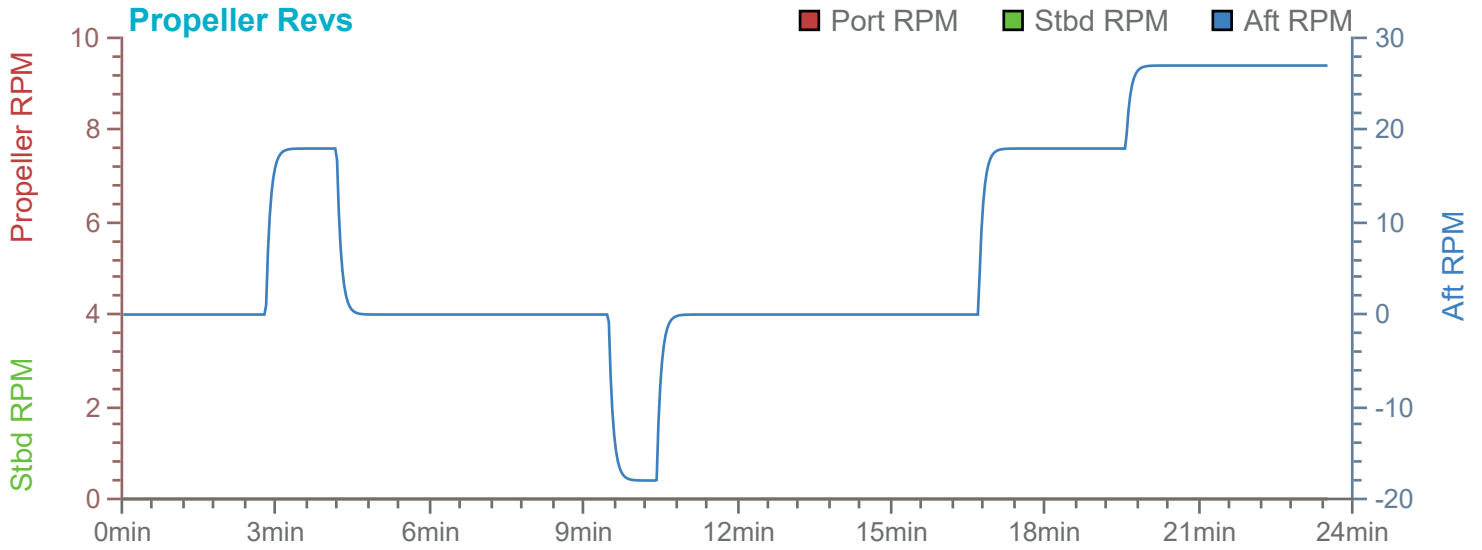
Ships plotted every 59 seconds, highlight every 2 mins

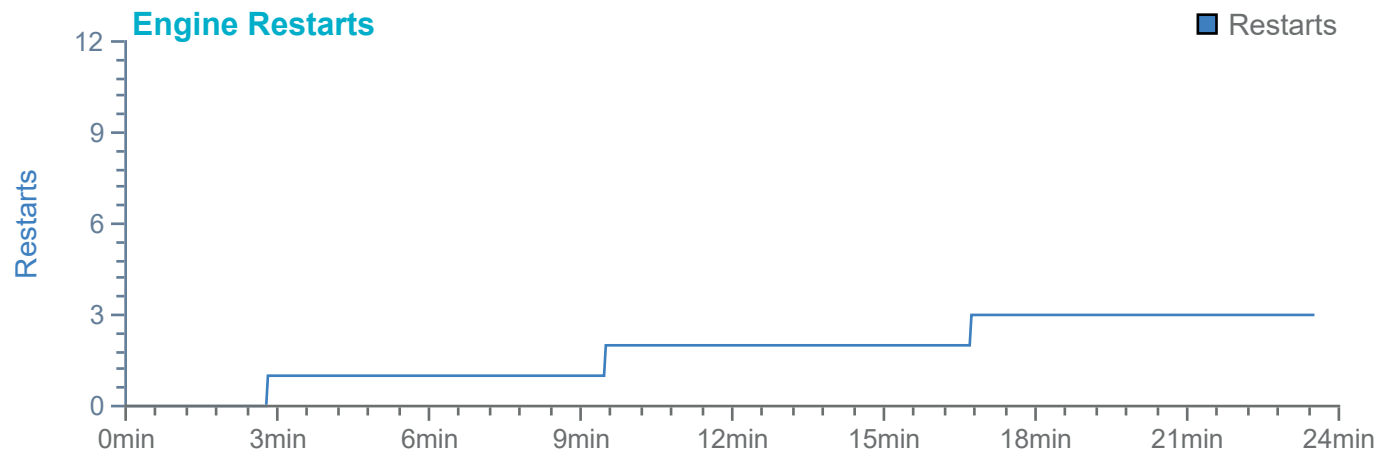
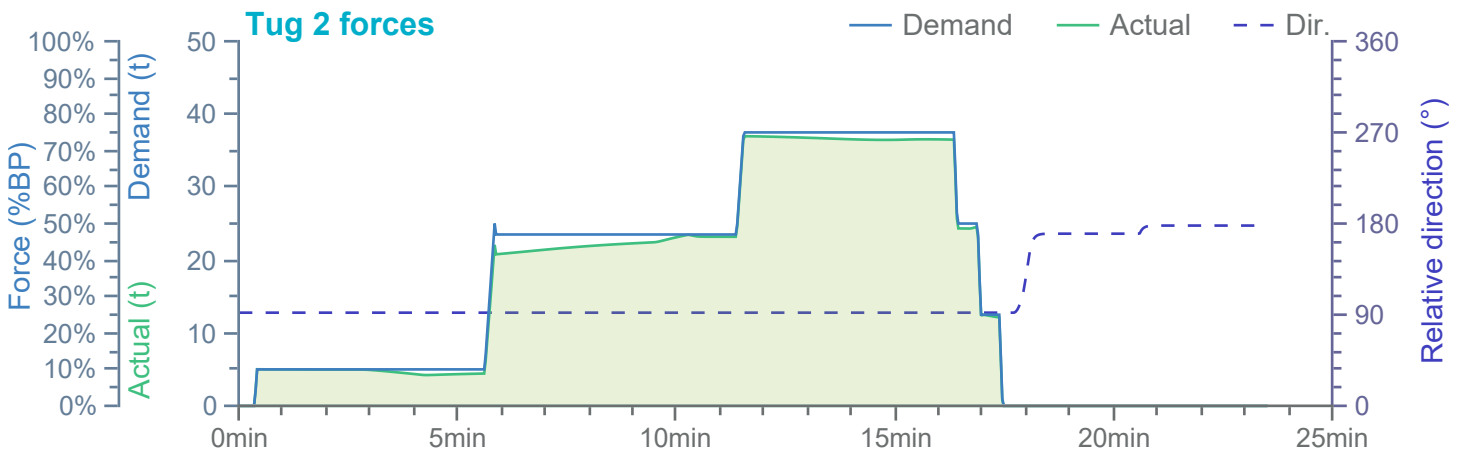
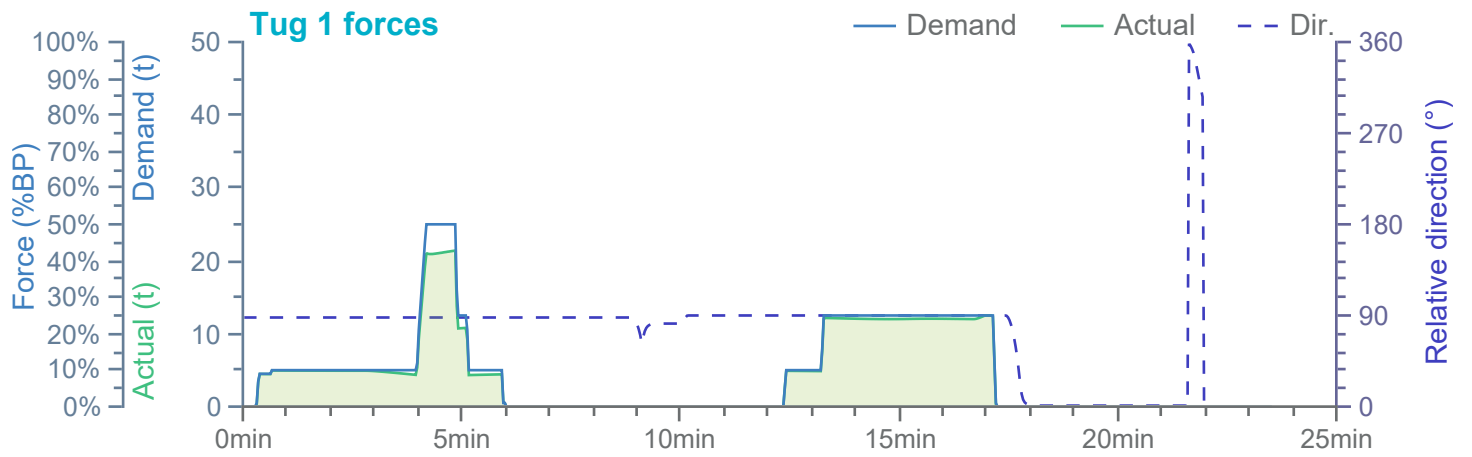
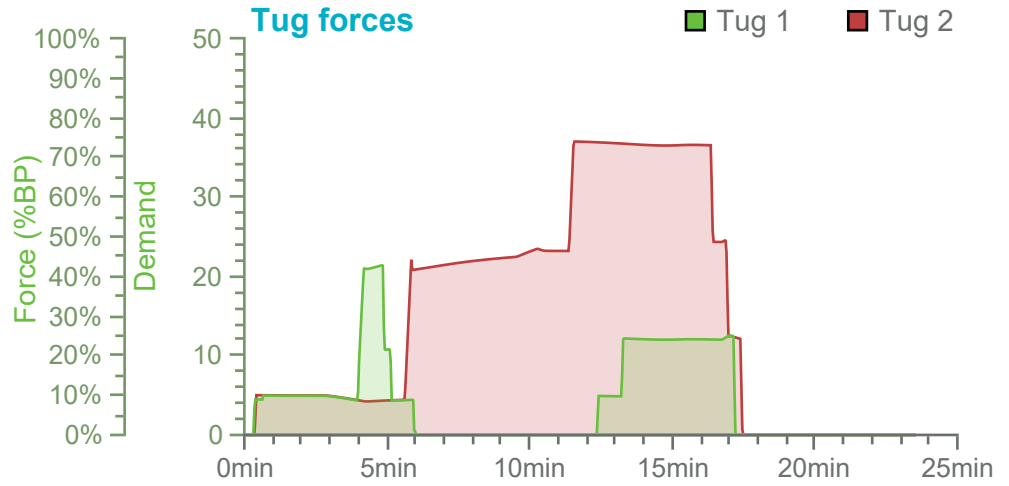
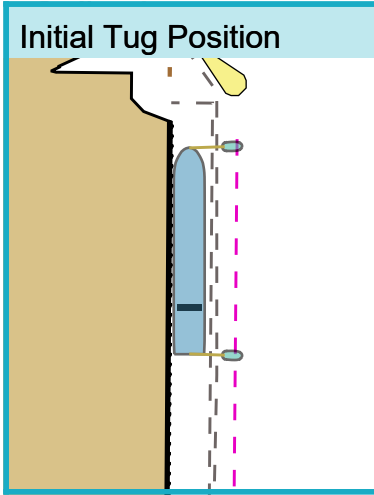






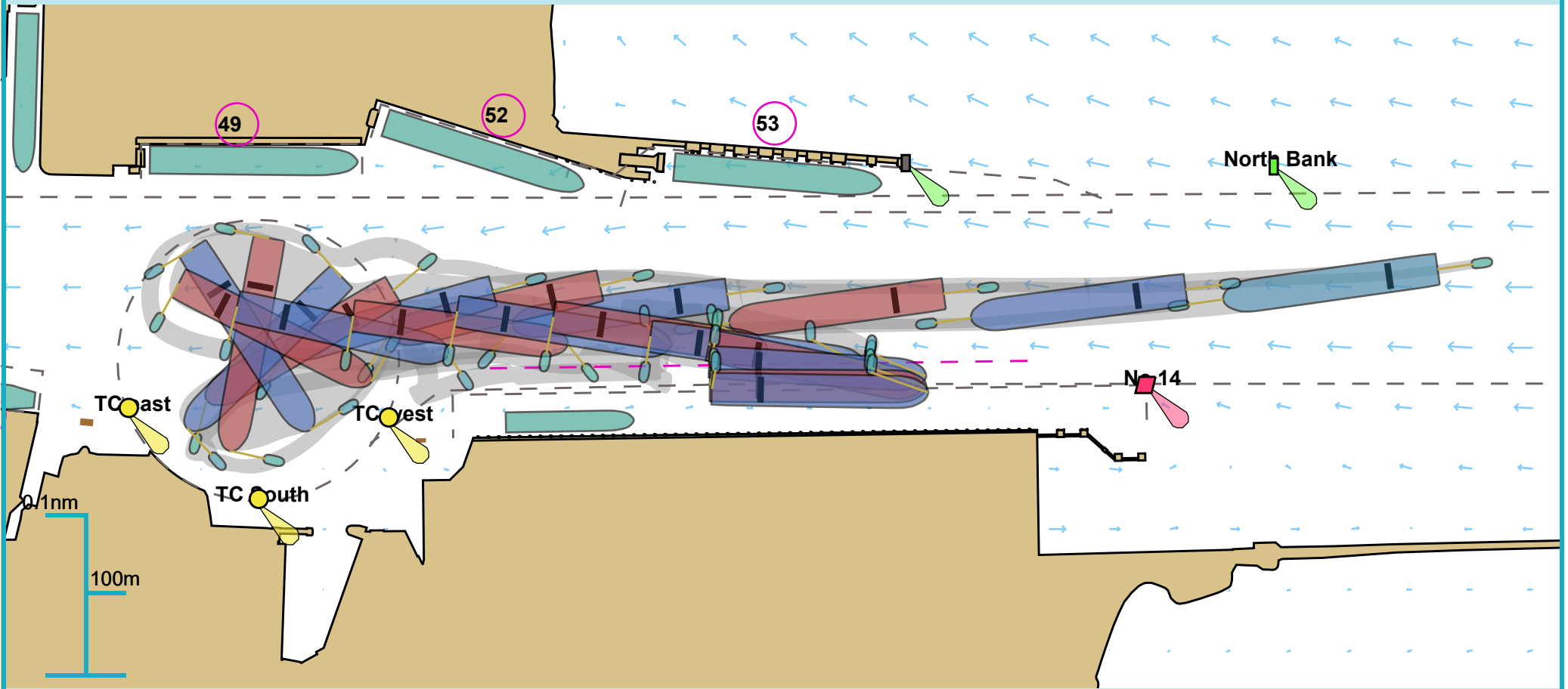






Full Run Overview

53° 20.336 N, 006° 11.911 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

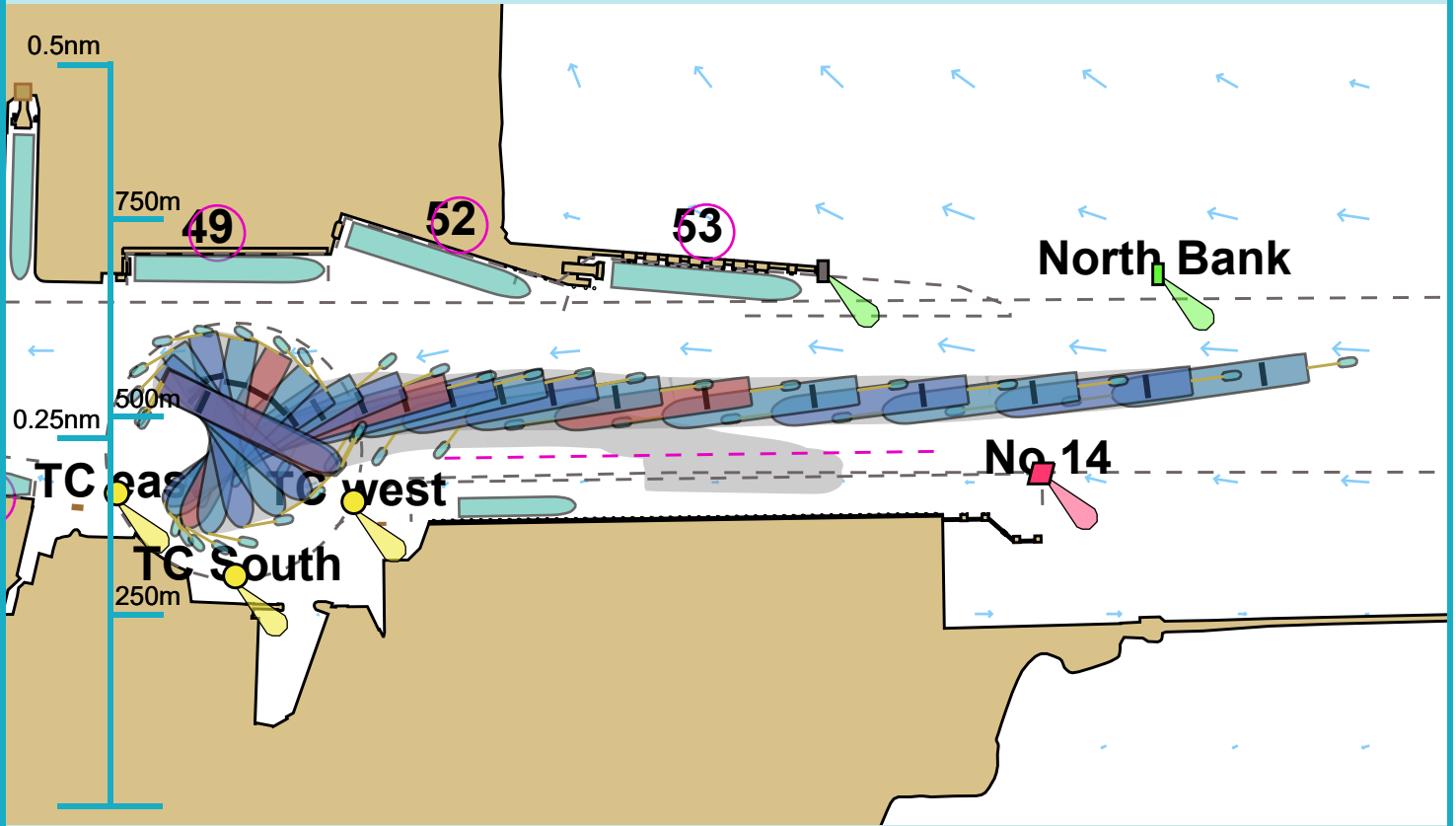
Run length: 37 minutes

Manoeuvre: Other

Ownship(s): 250m Container

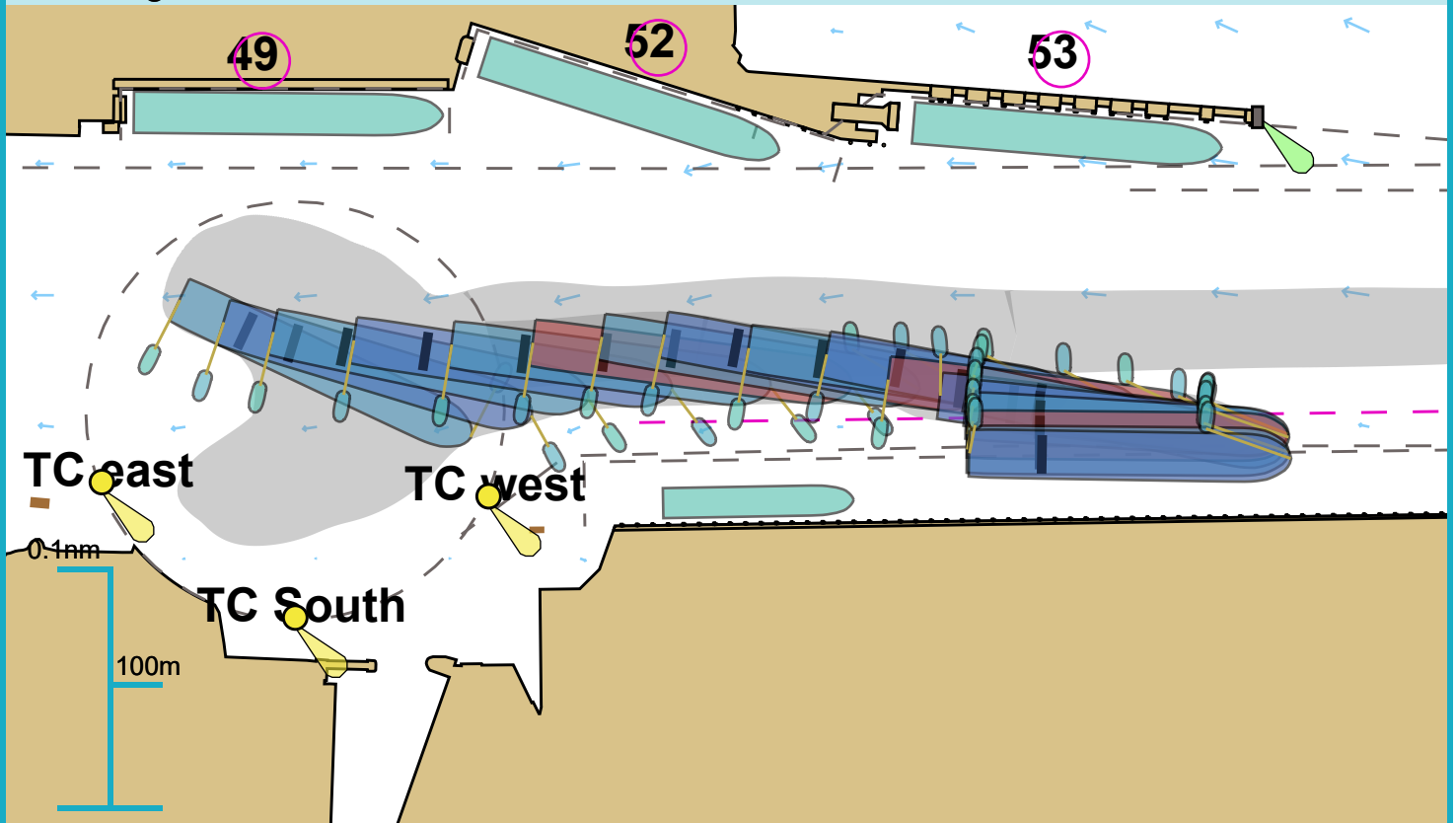
Comments:

Approach

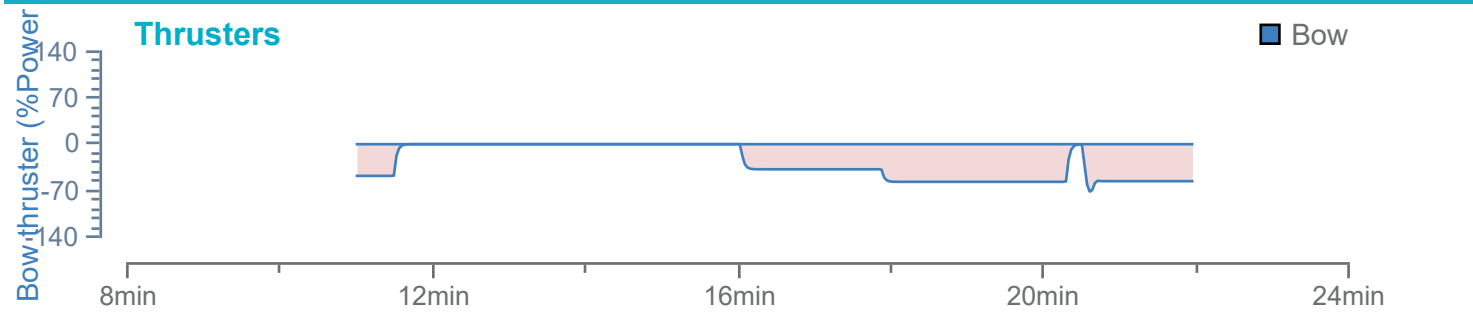
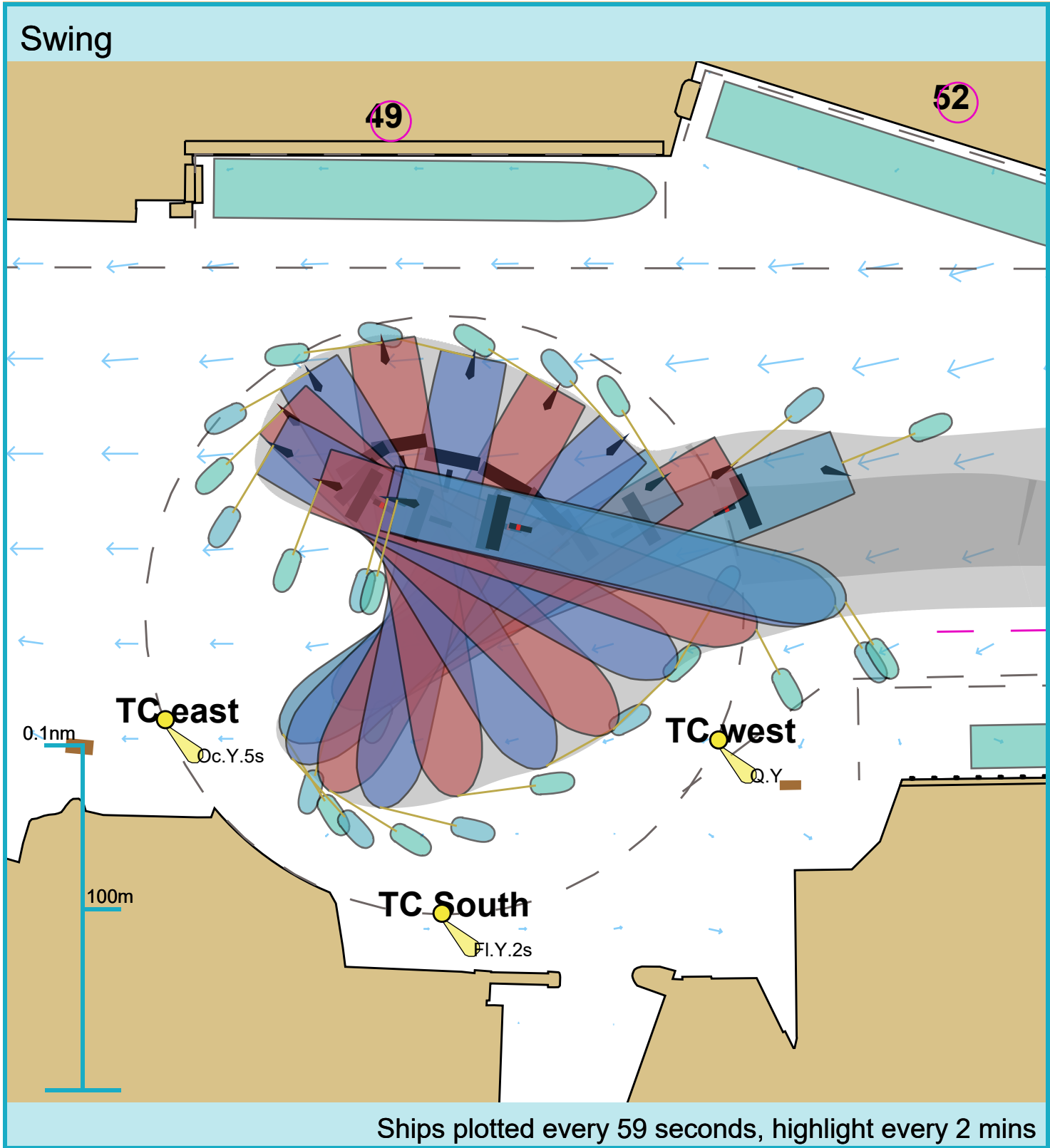


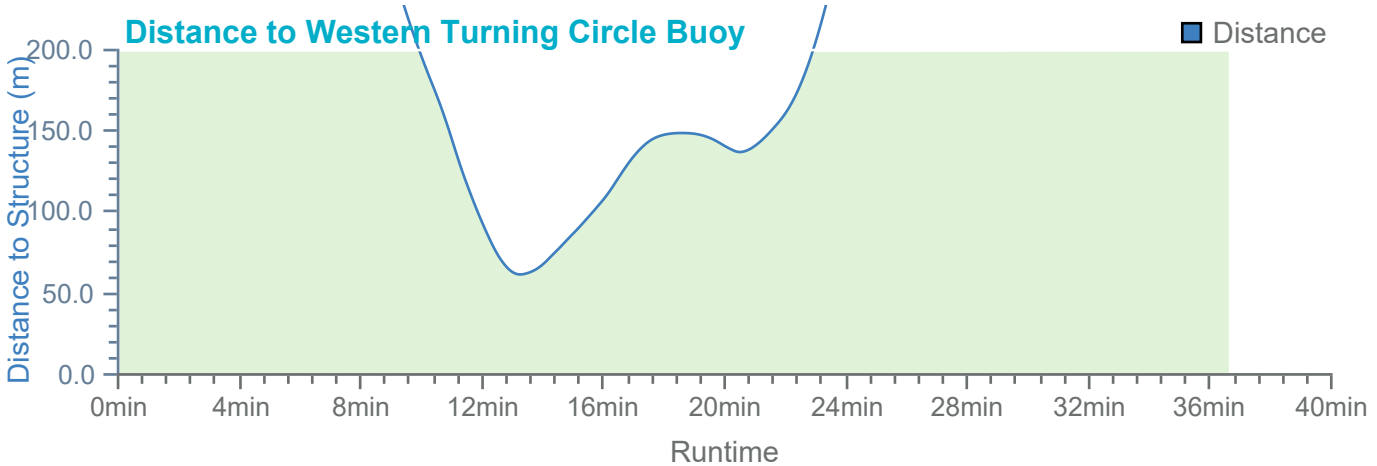
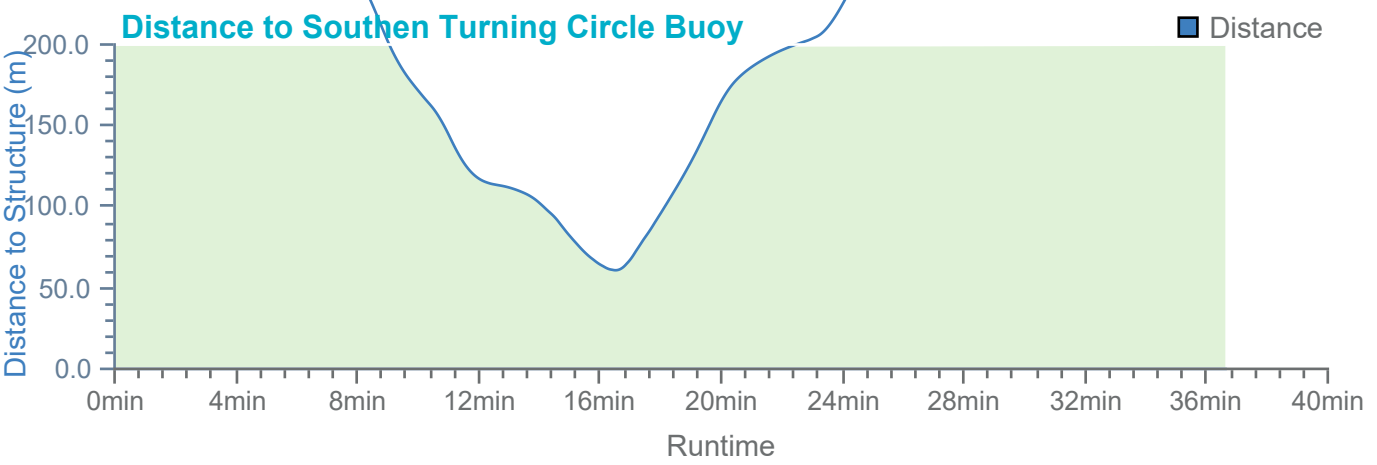
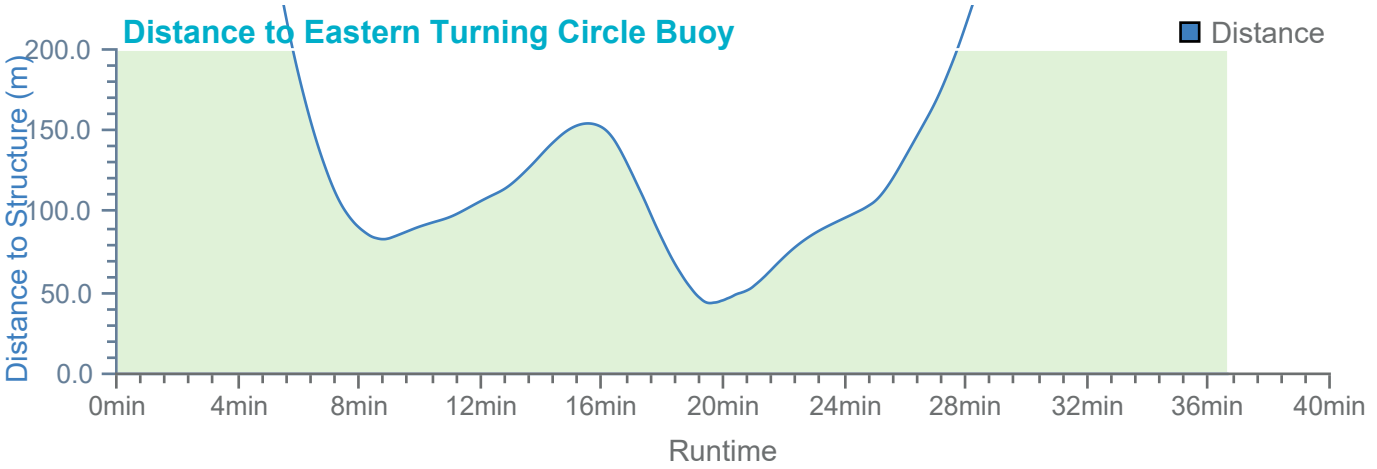
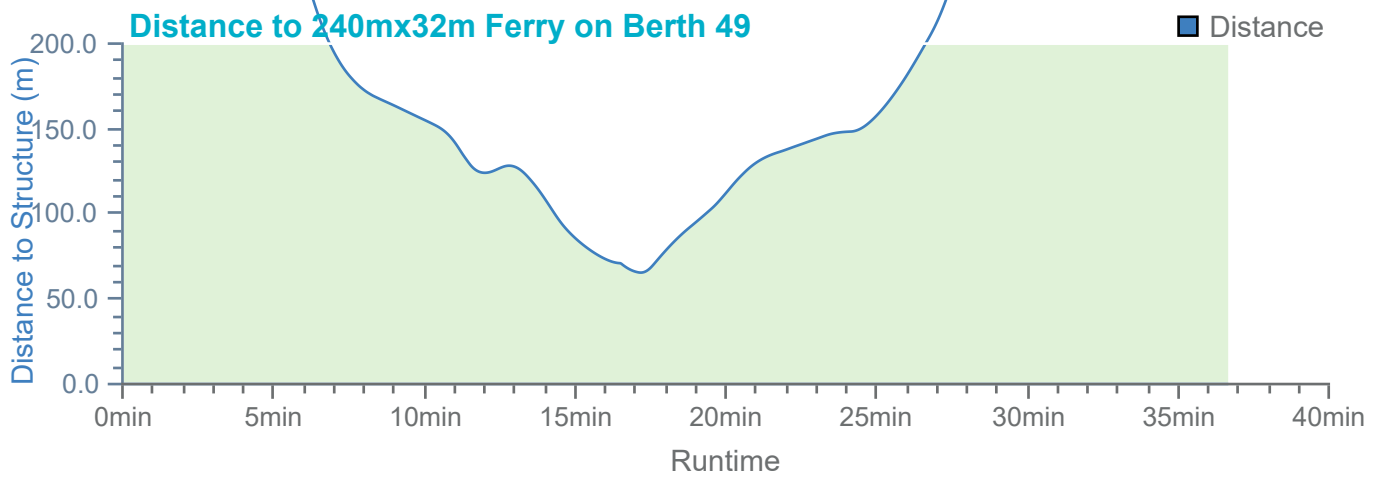
Ships plotted every 1 mins, highlight every 5 mins

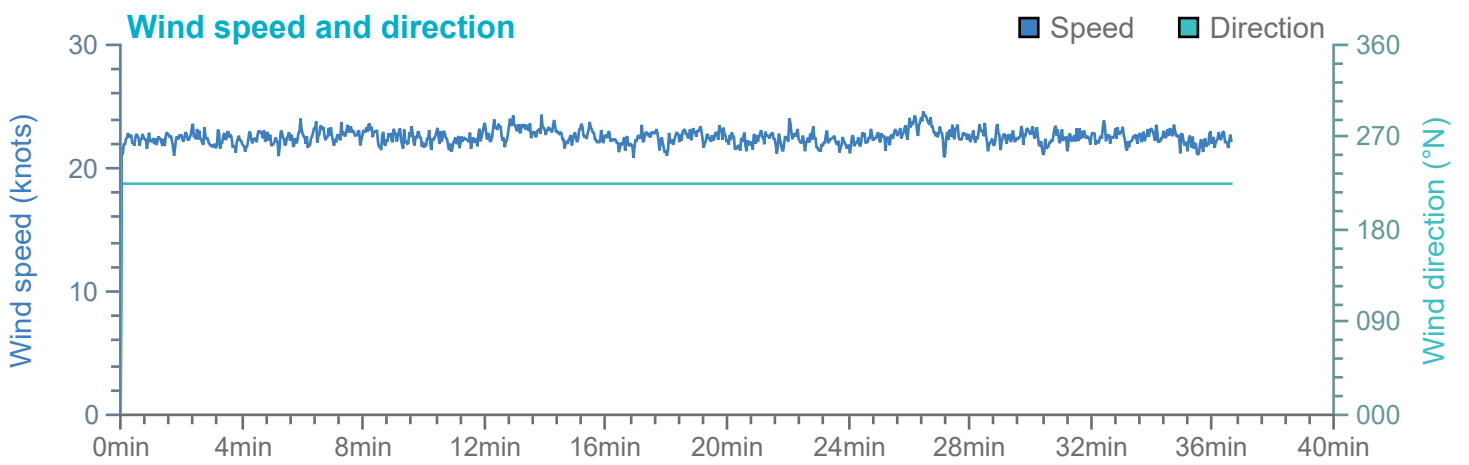
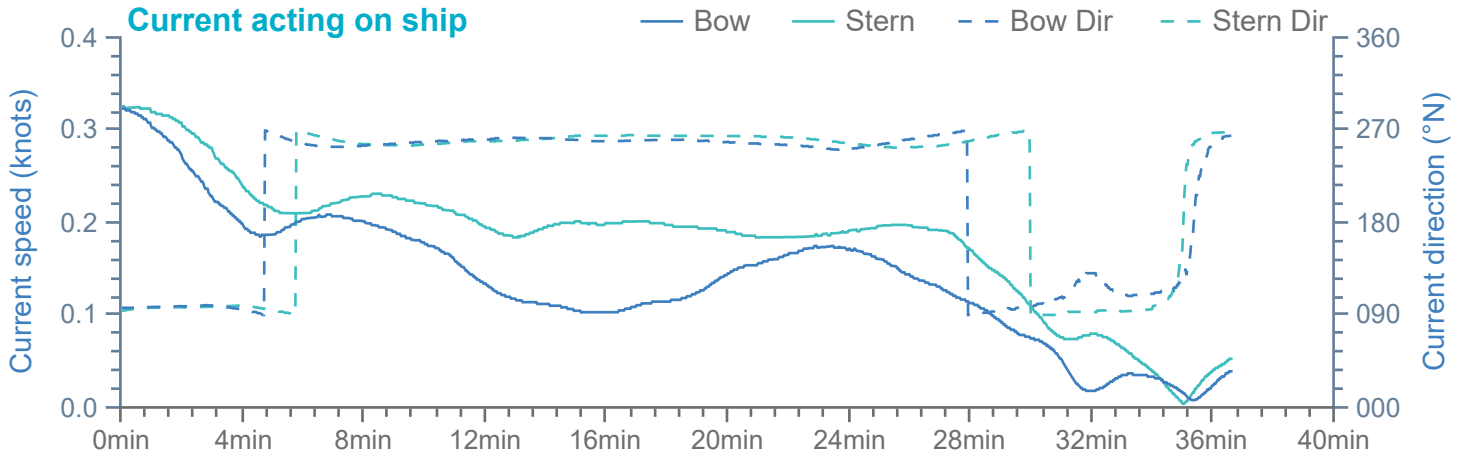
Berthing

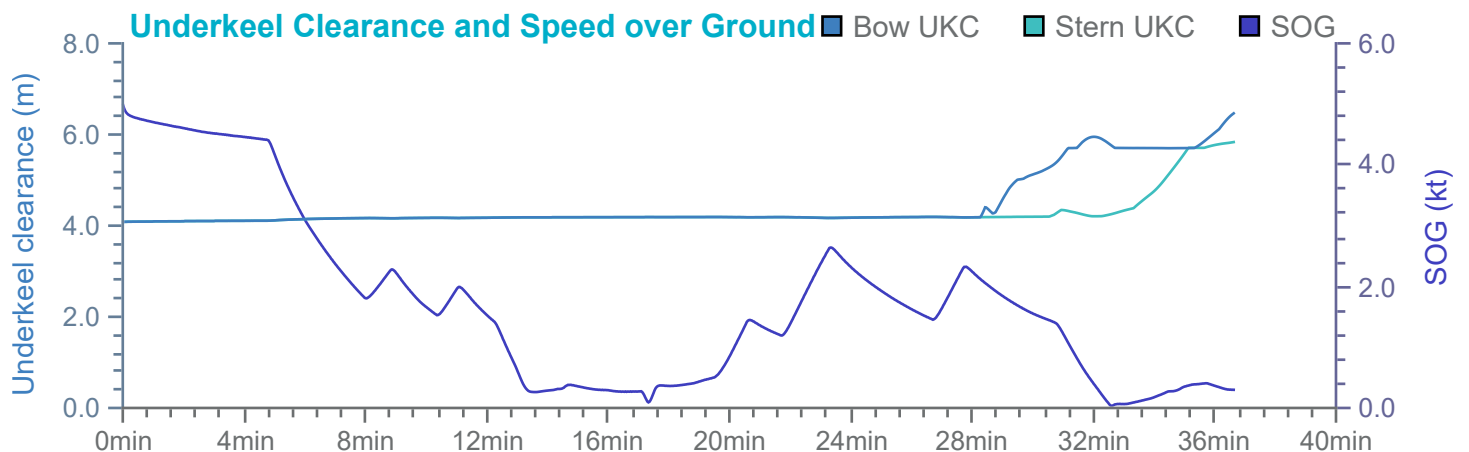
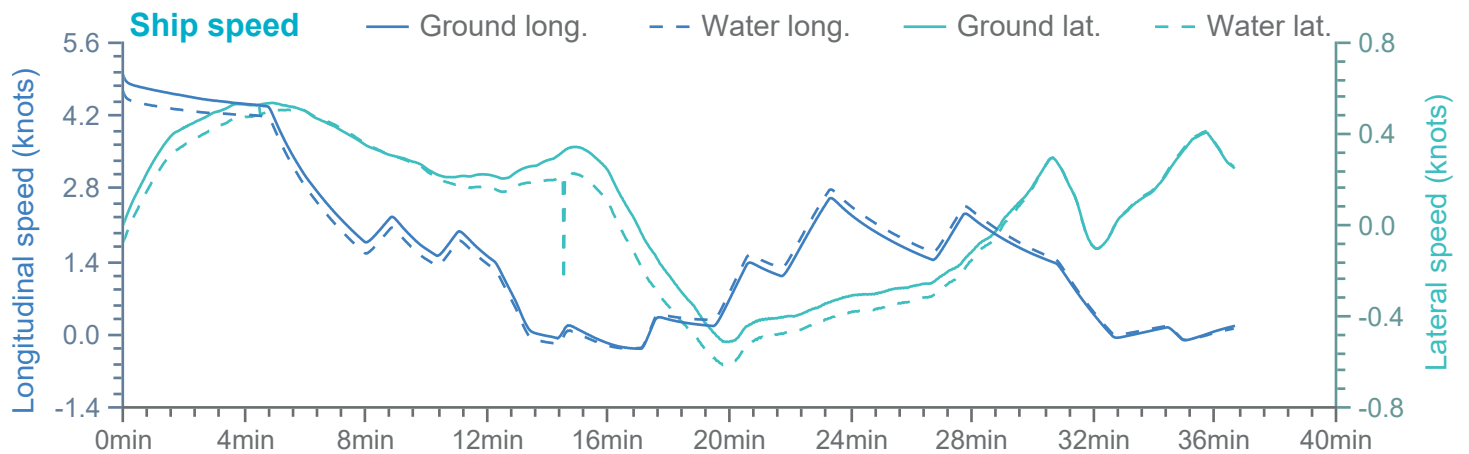
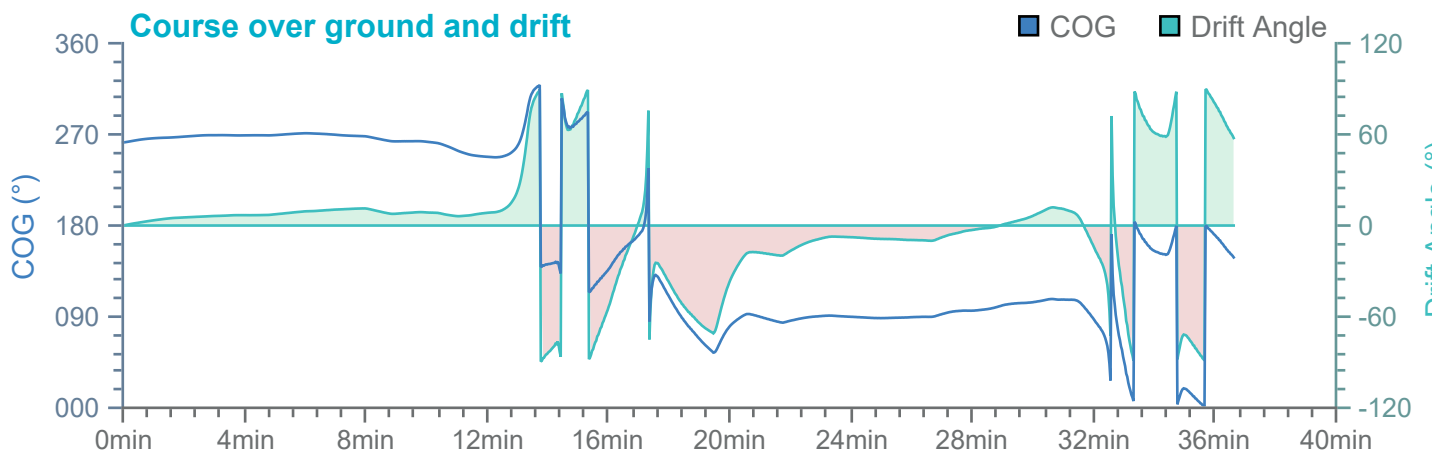
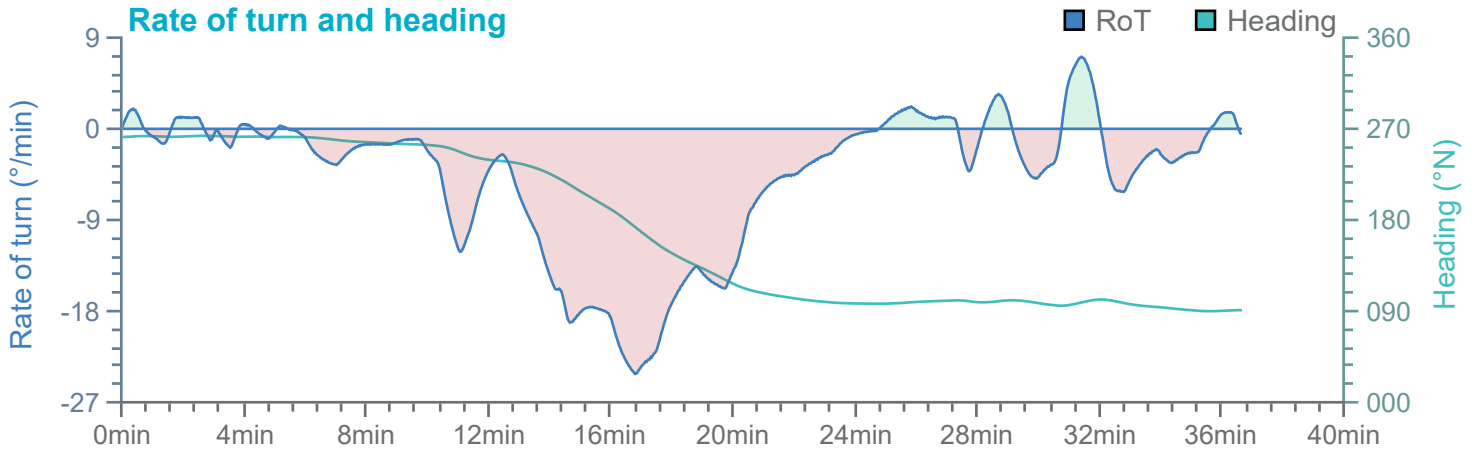


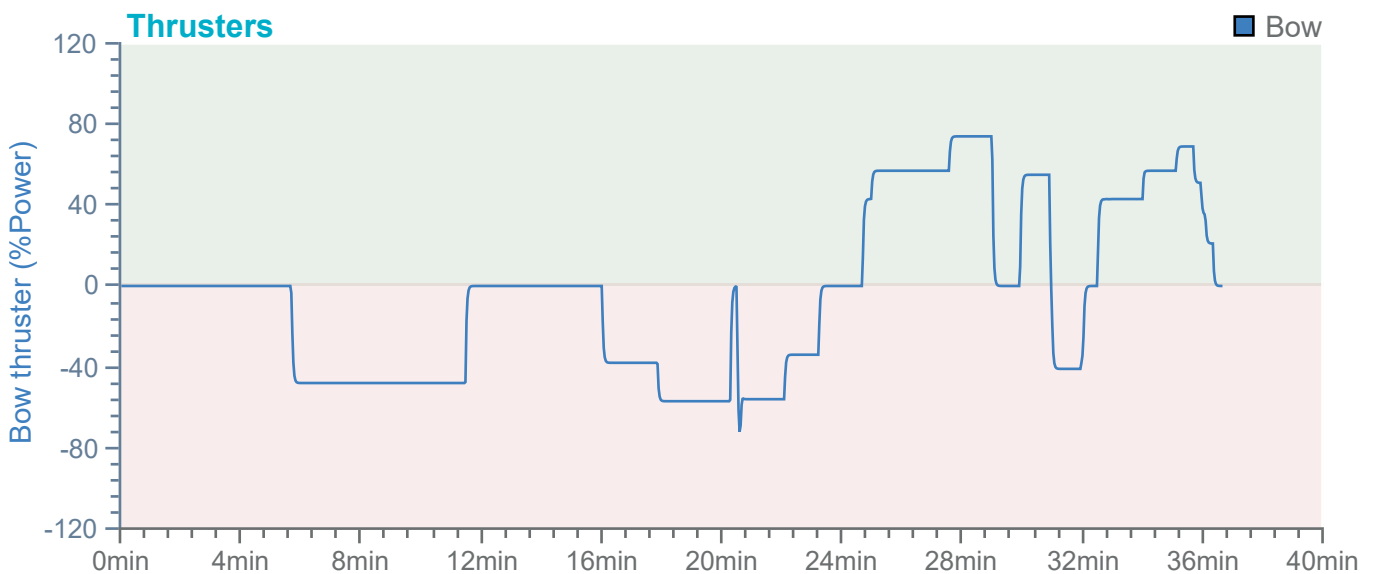
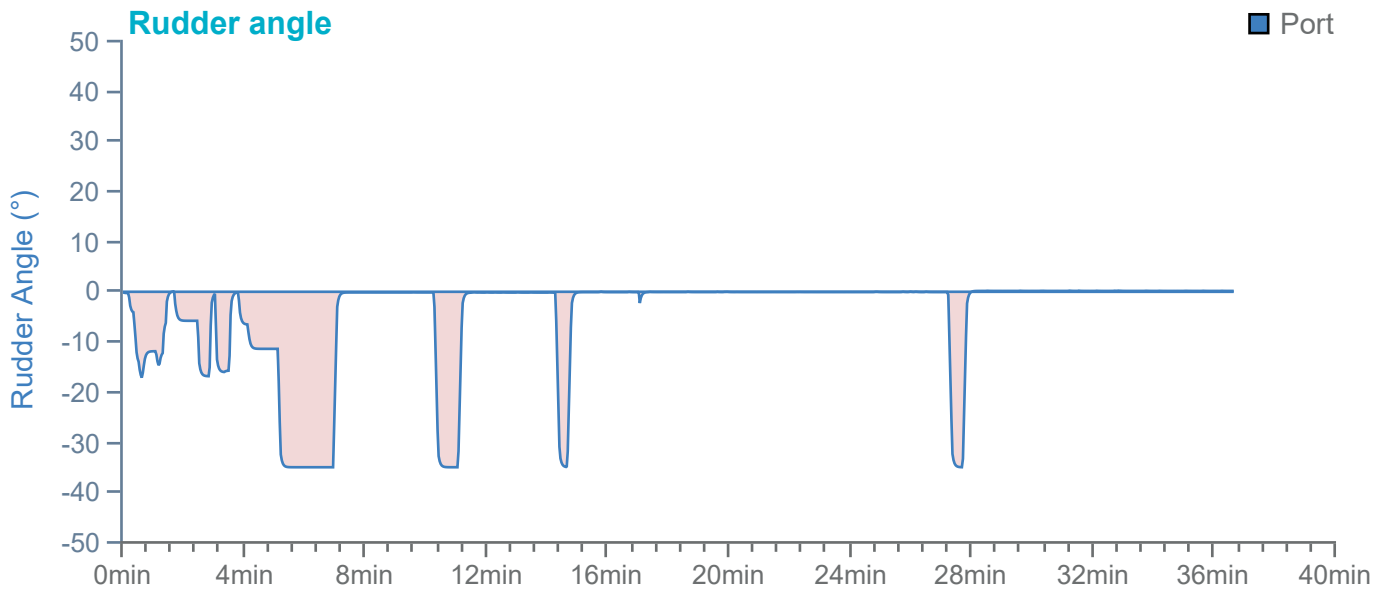
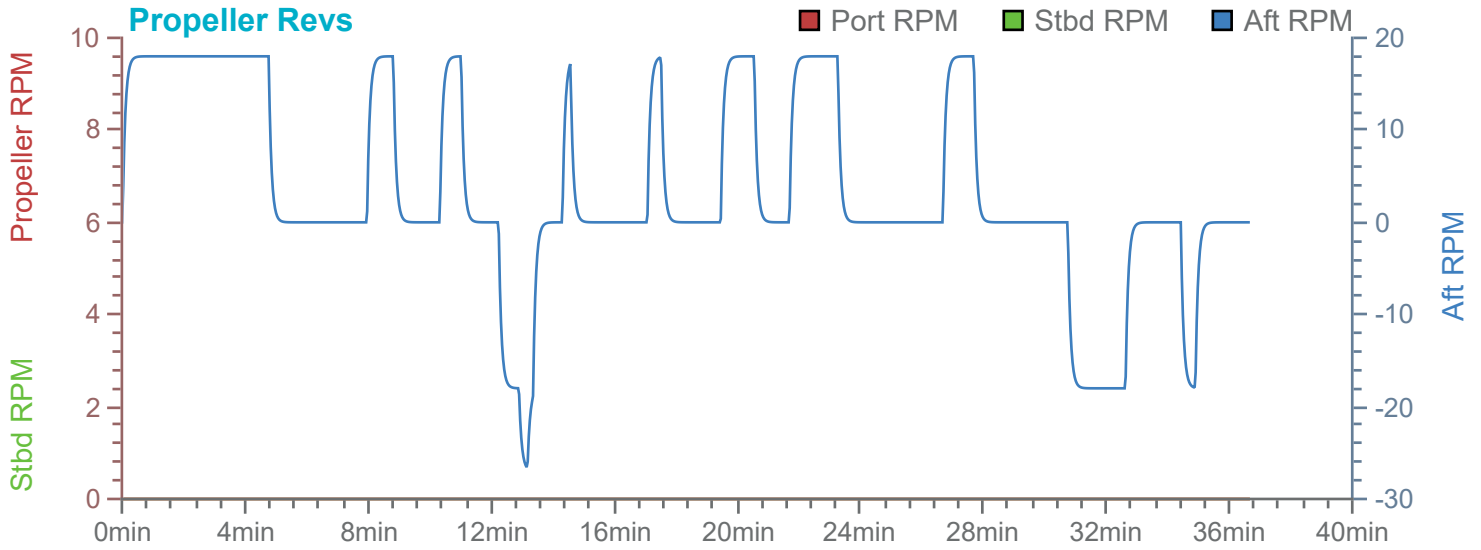
Ships plotted every 1 mins, highlight every 5 mins

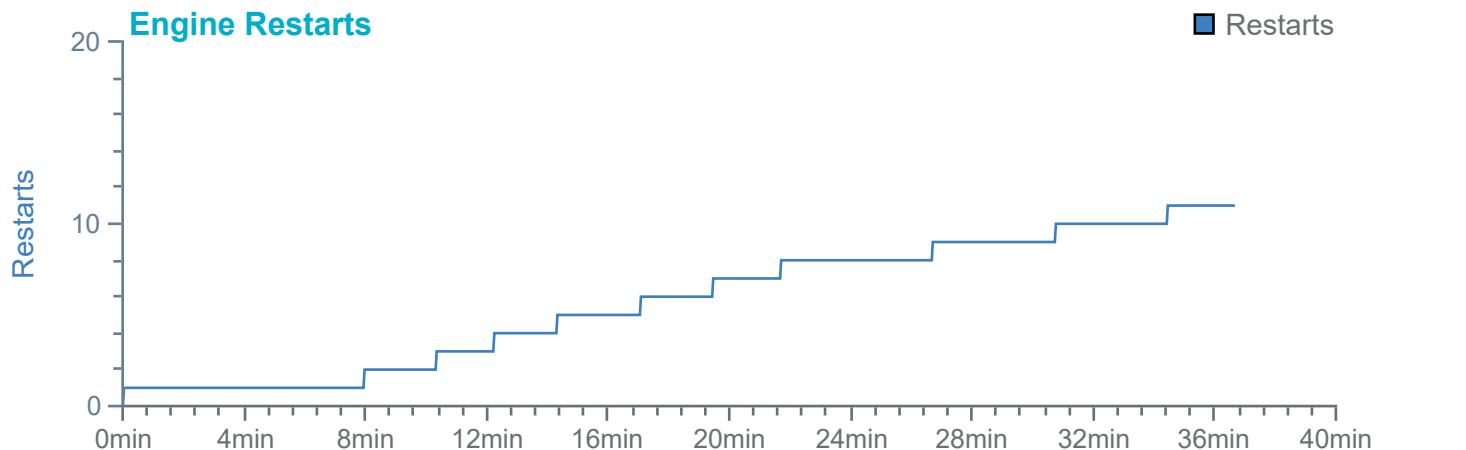
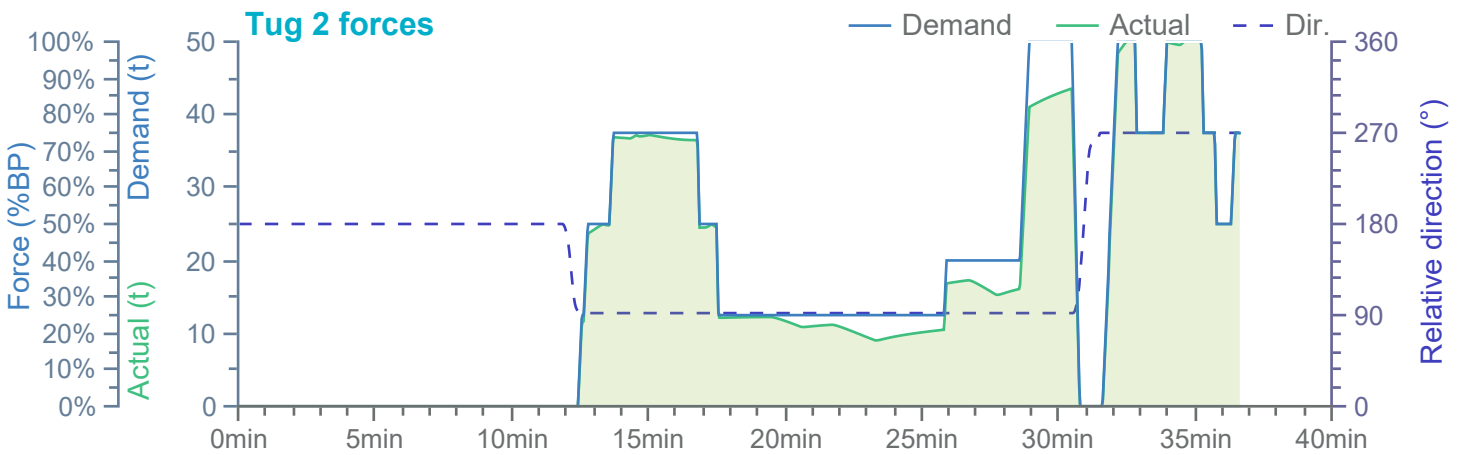
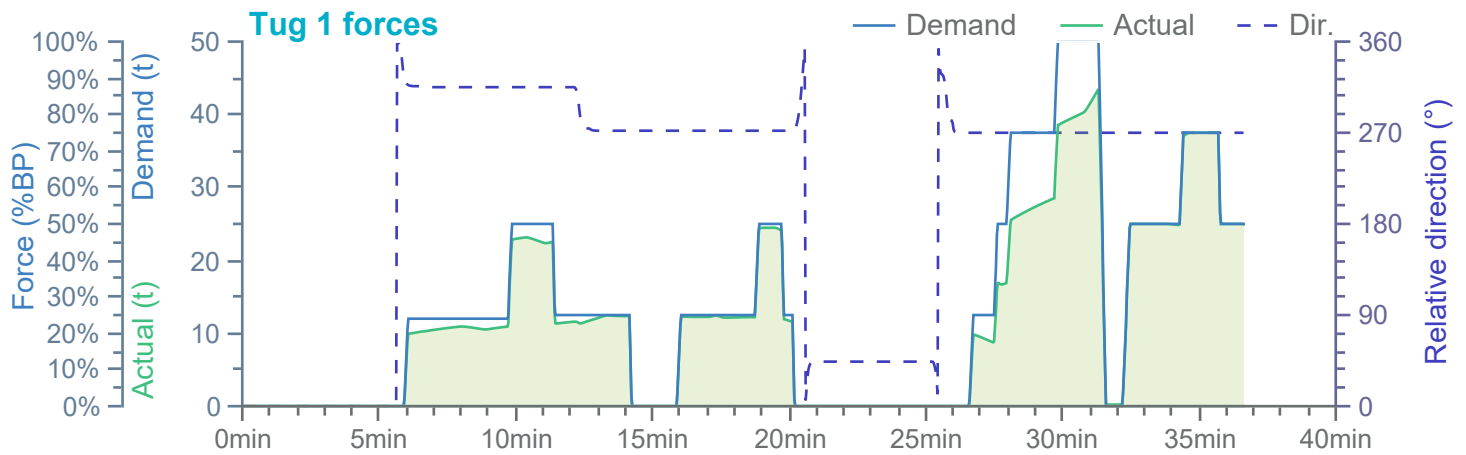
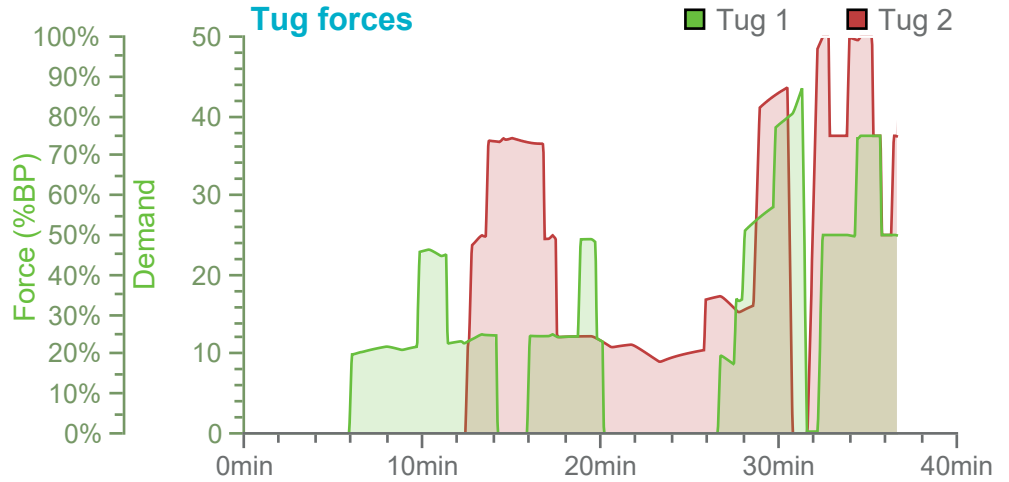
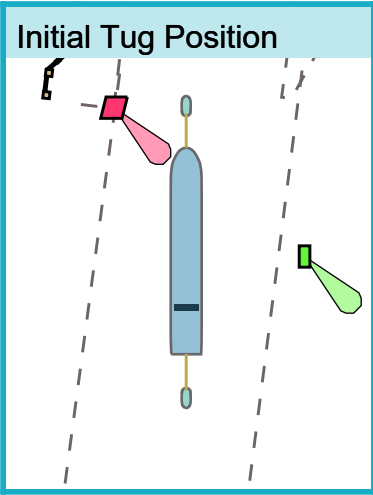






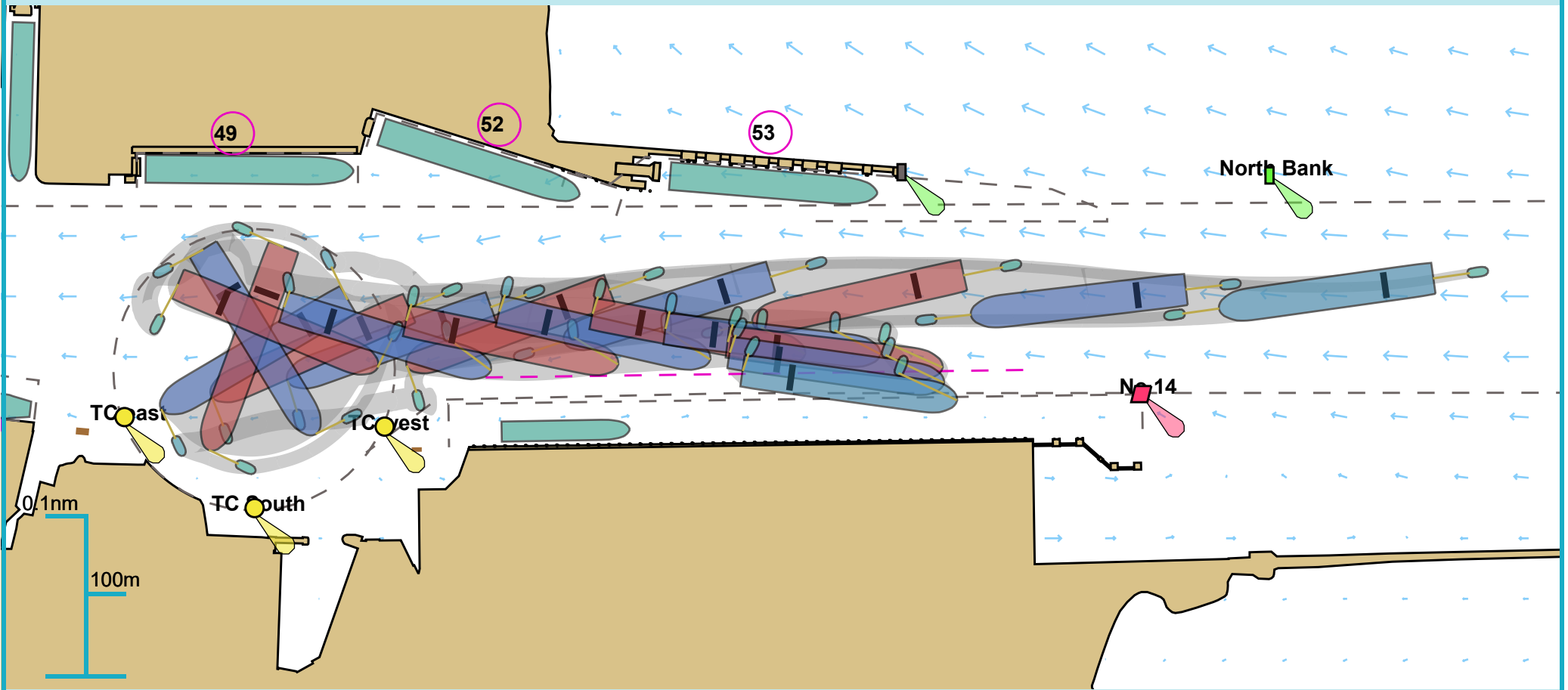






Full Run Overview

53° 20.341 N, 006° 11.907 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:36 minutes

Manoeuvre:Other

Ownship(s):250m Container

Comments:

Overview

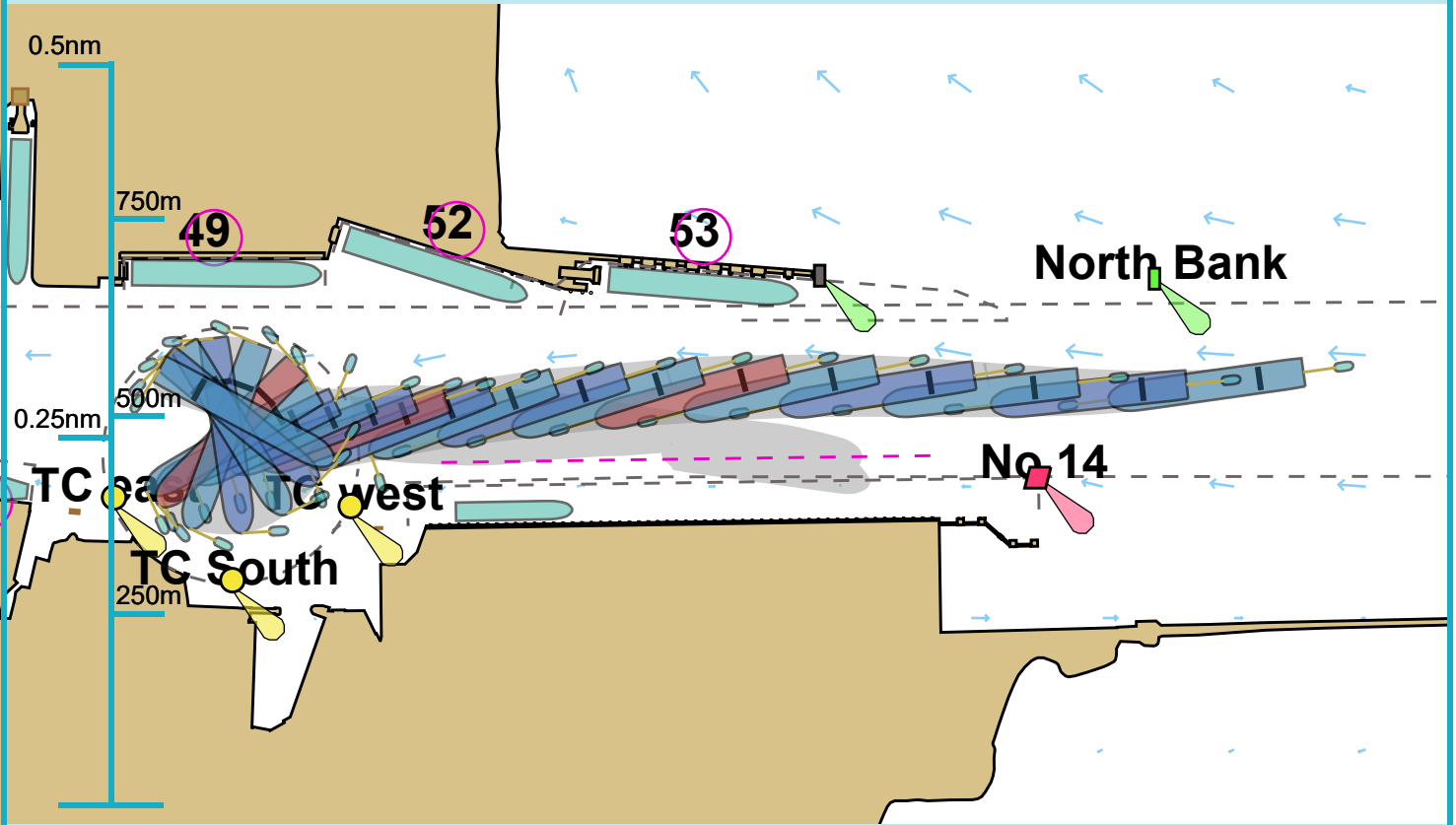
Environment

250m Container

Thruster and engine use

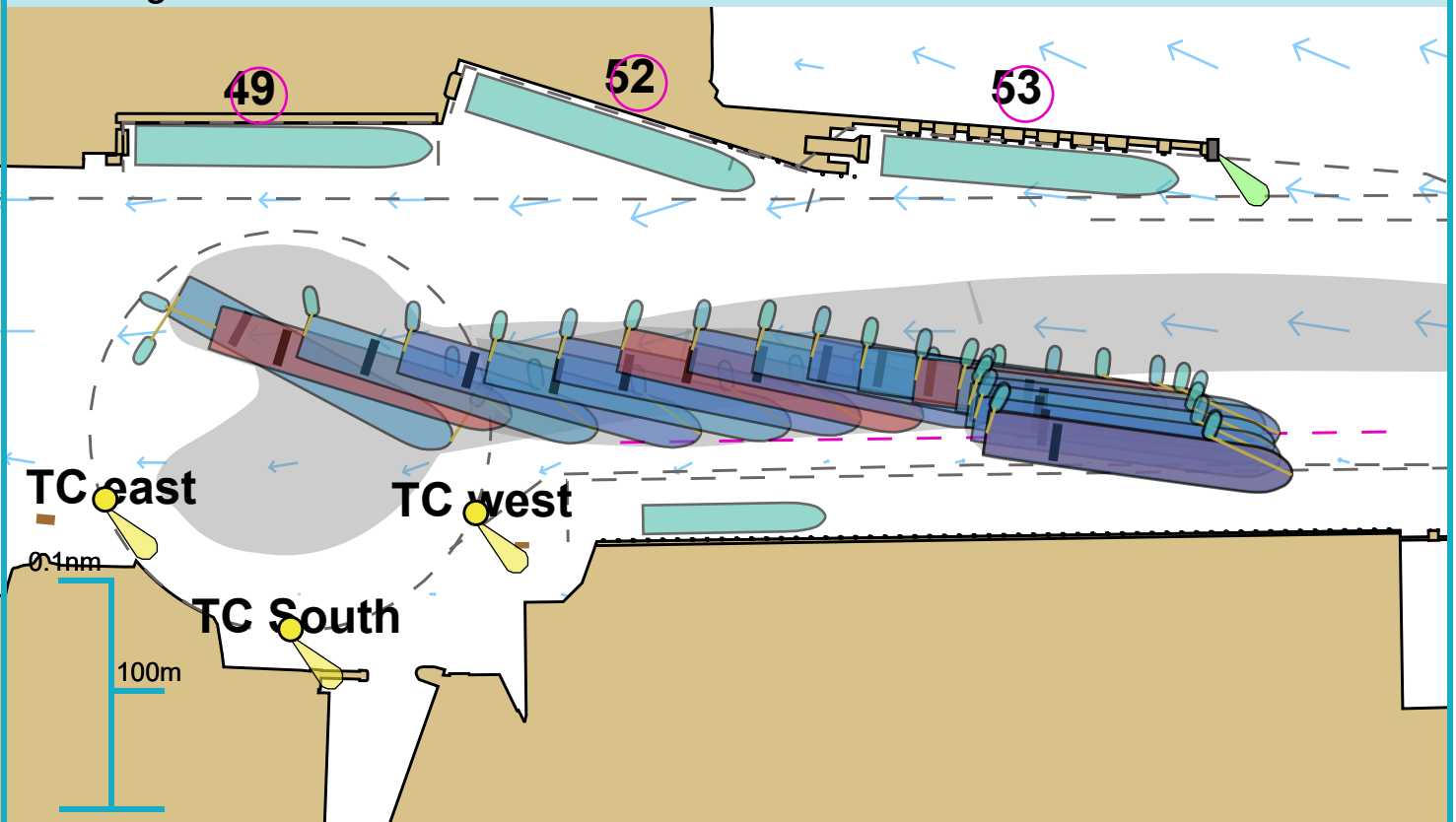
Tug use

Approach



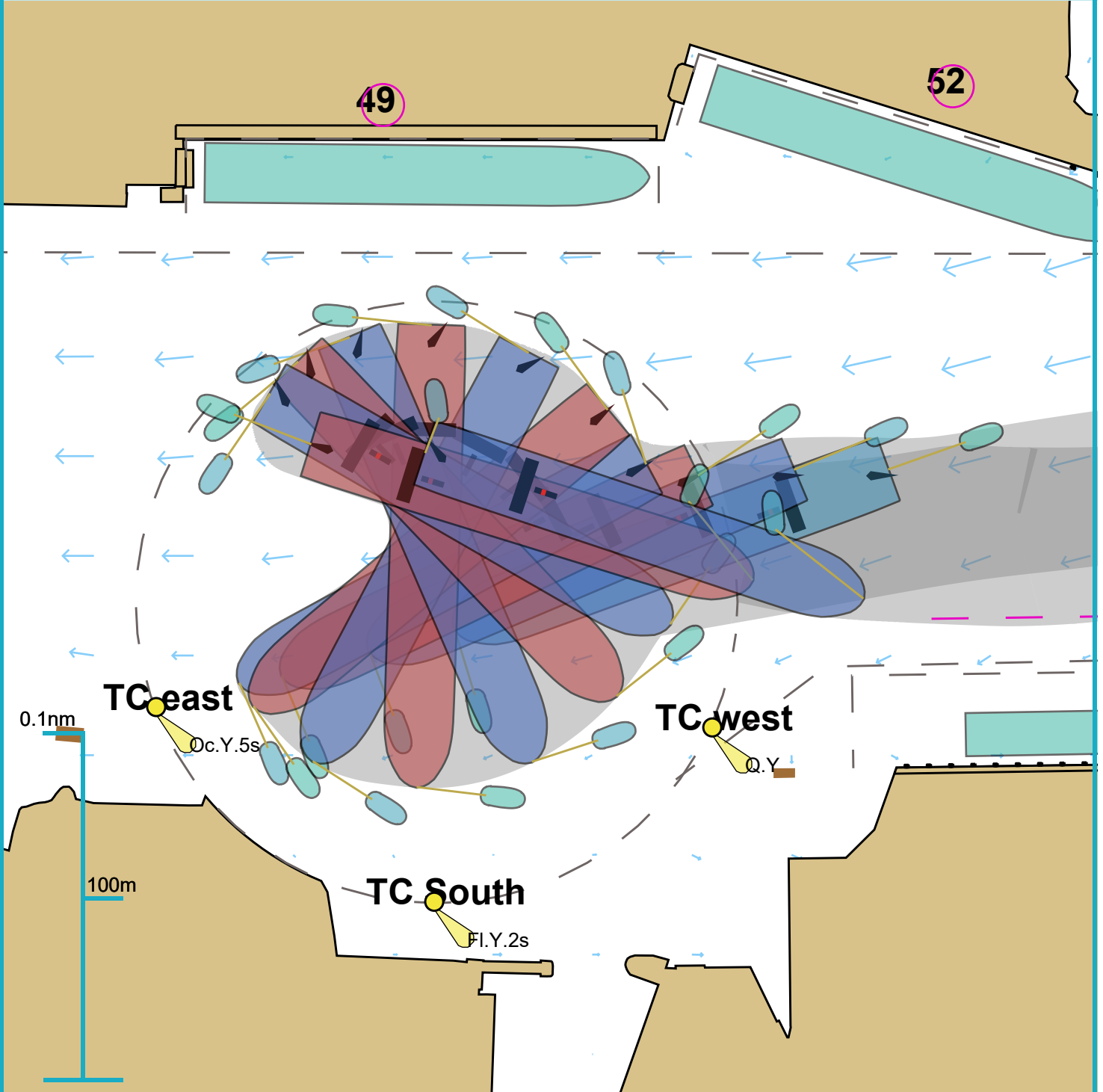
Ships plotted every 1 mins, highlight every 5 mins

Berthing

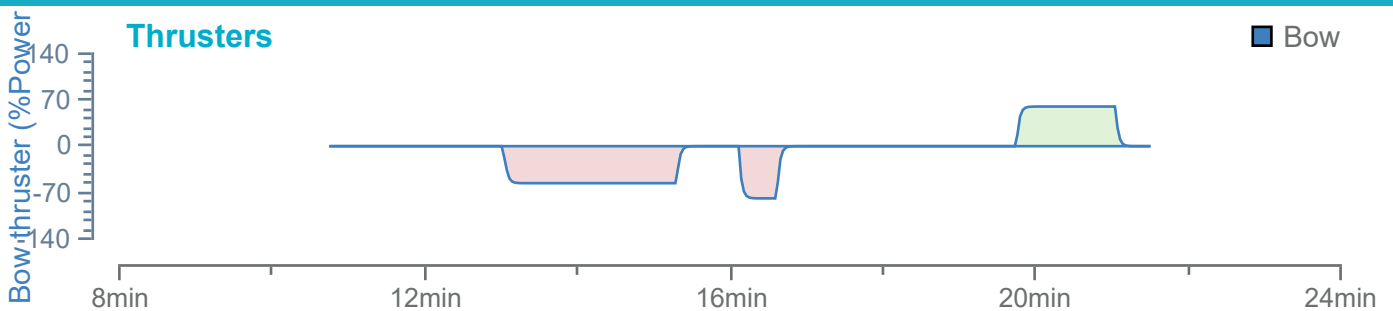


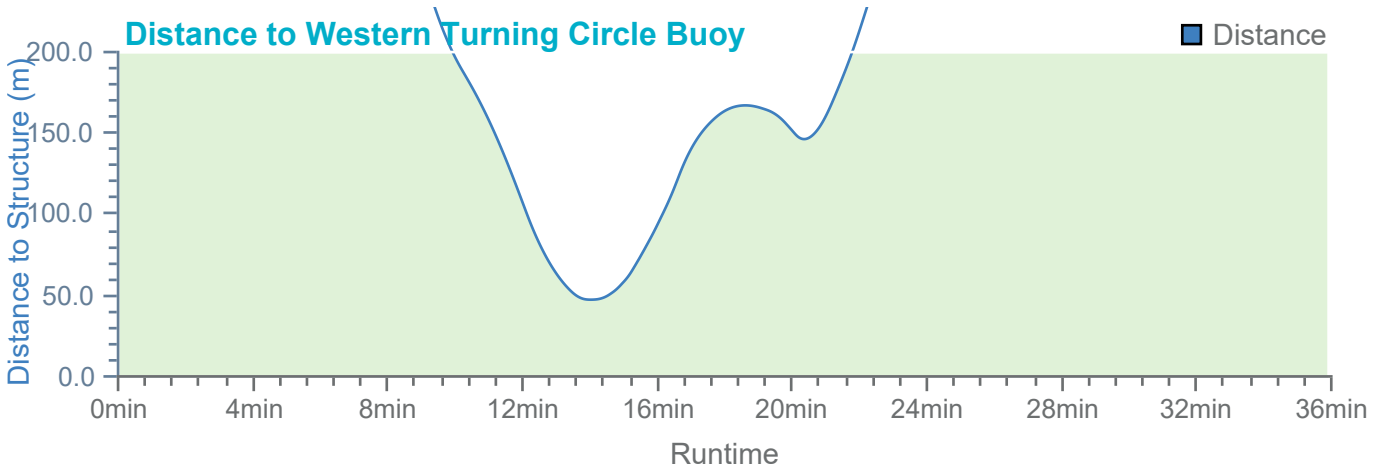
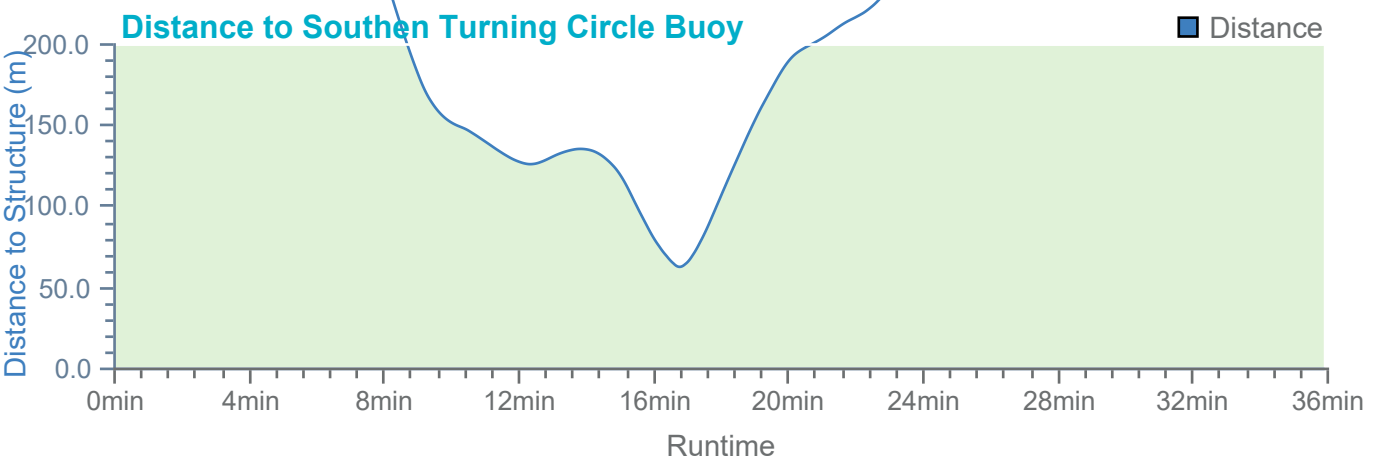
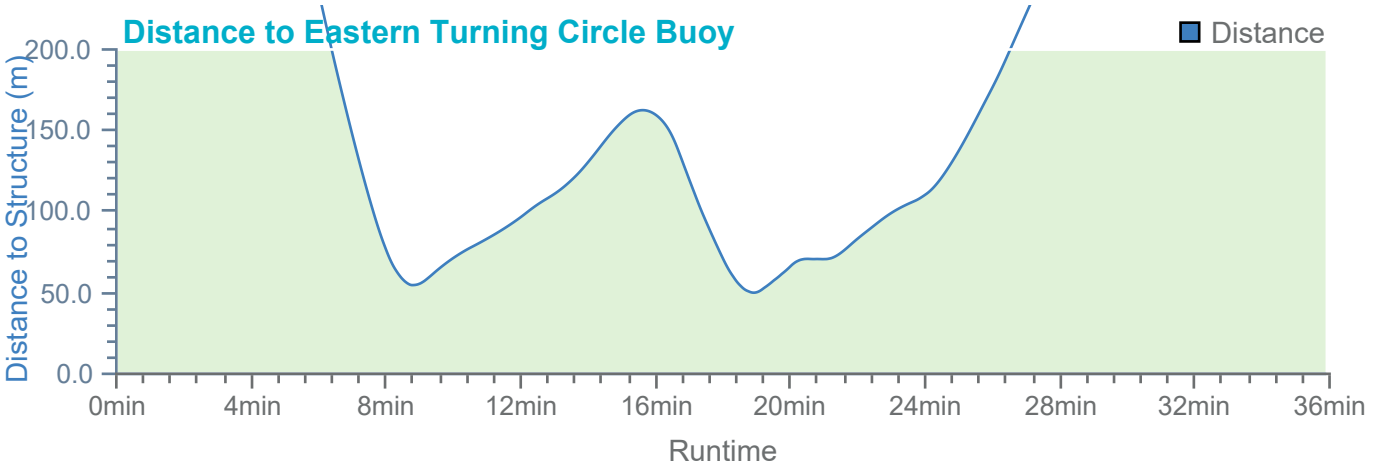
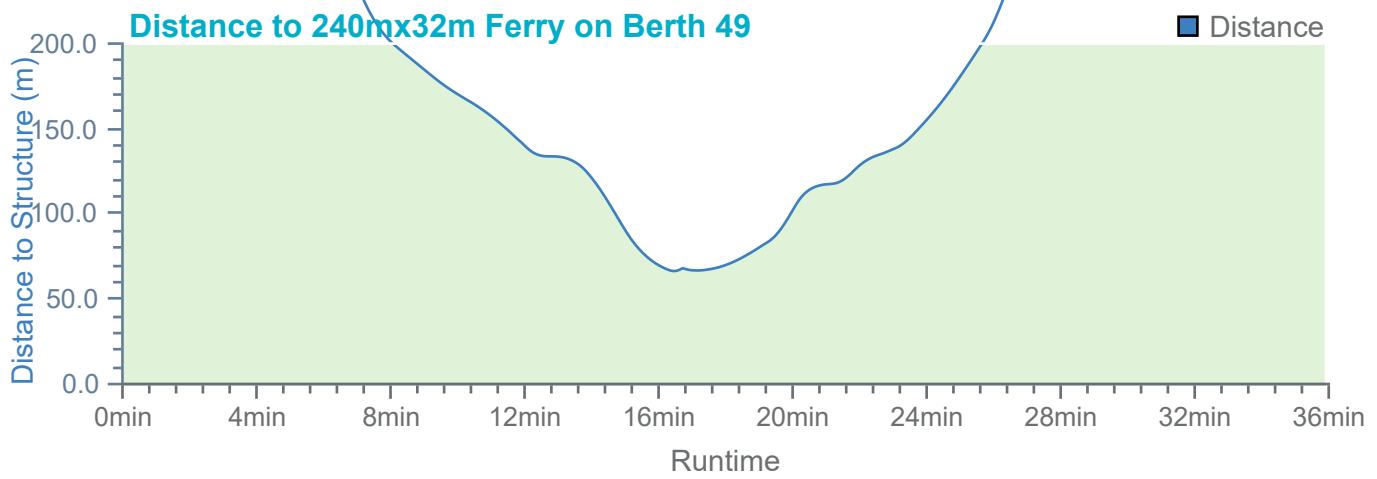
Ships plotted every 1 mins, highlight every 5 mins

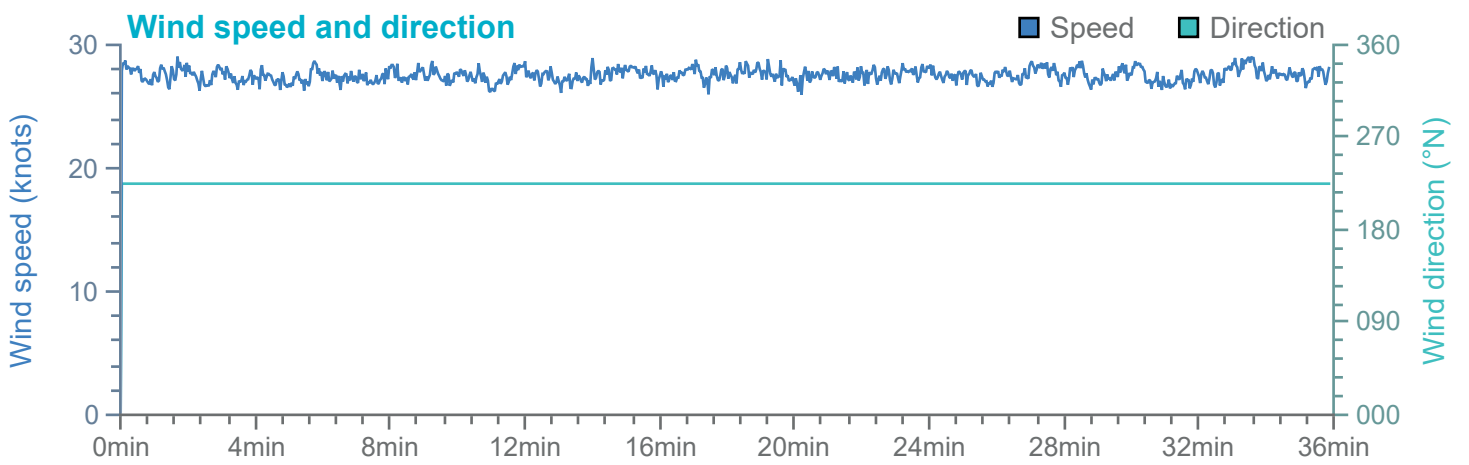
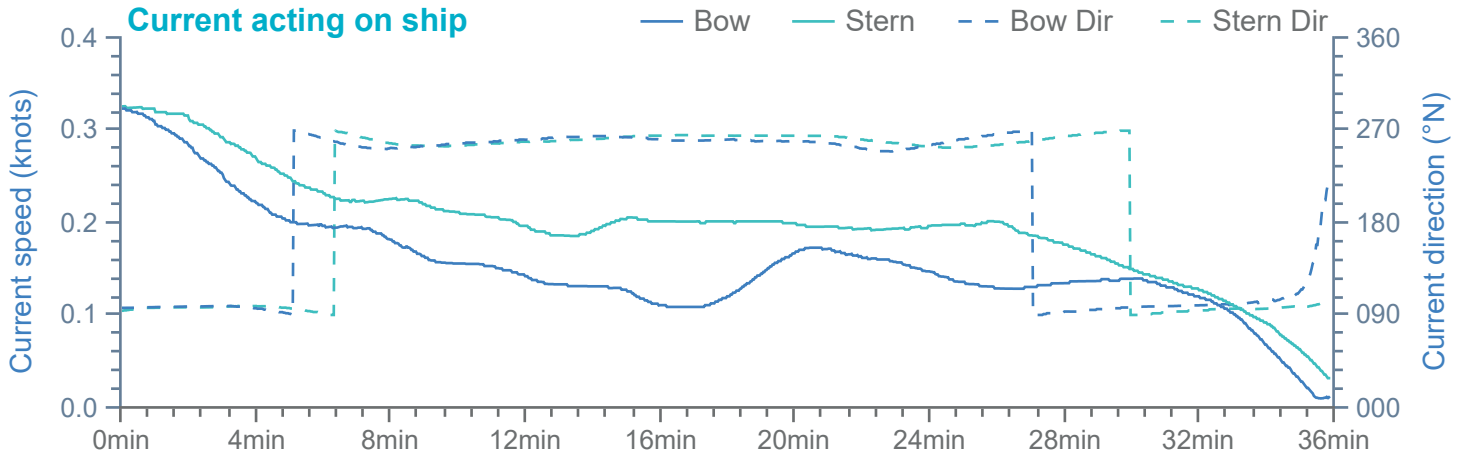
Swing



Ships plotted every 59 seconds, highlight every 2 mins







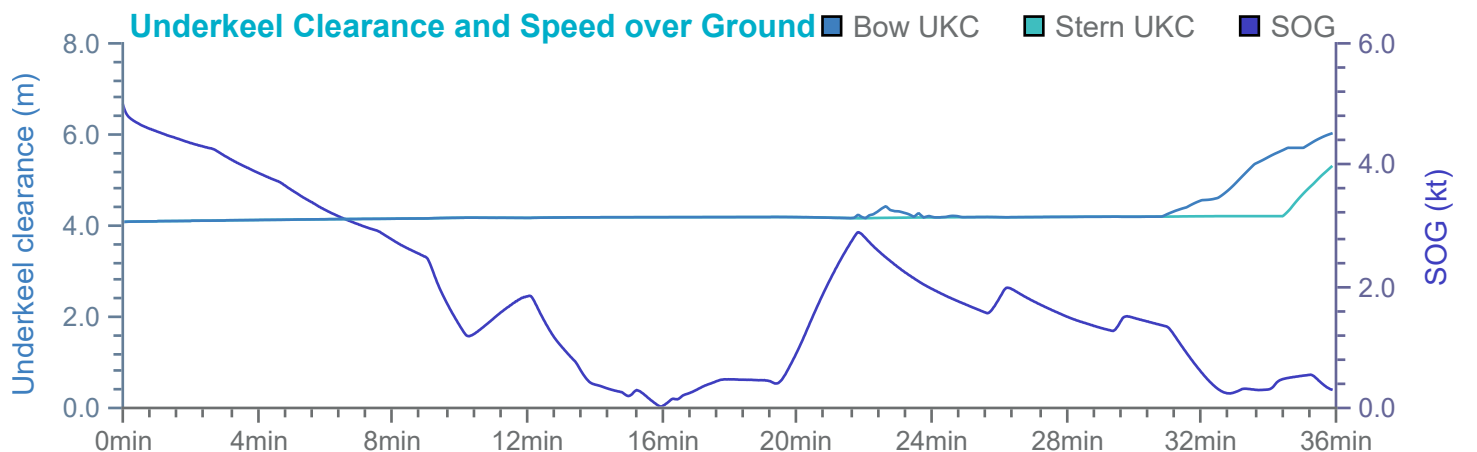
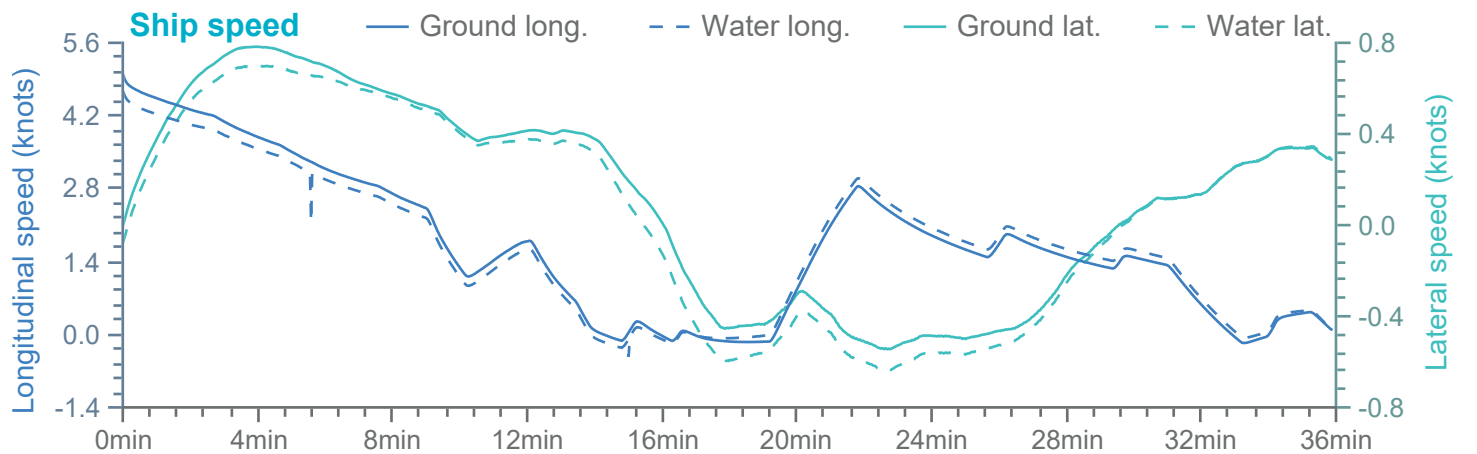
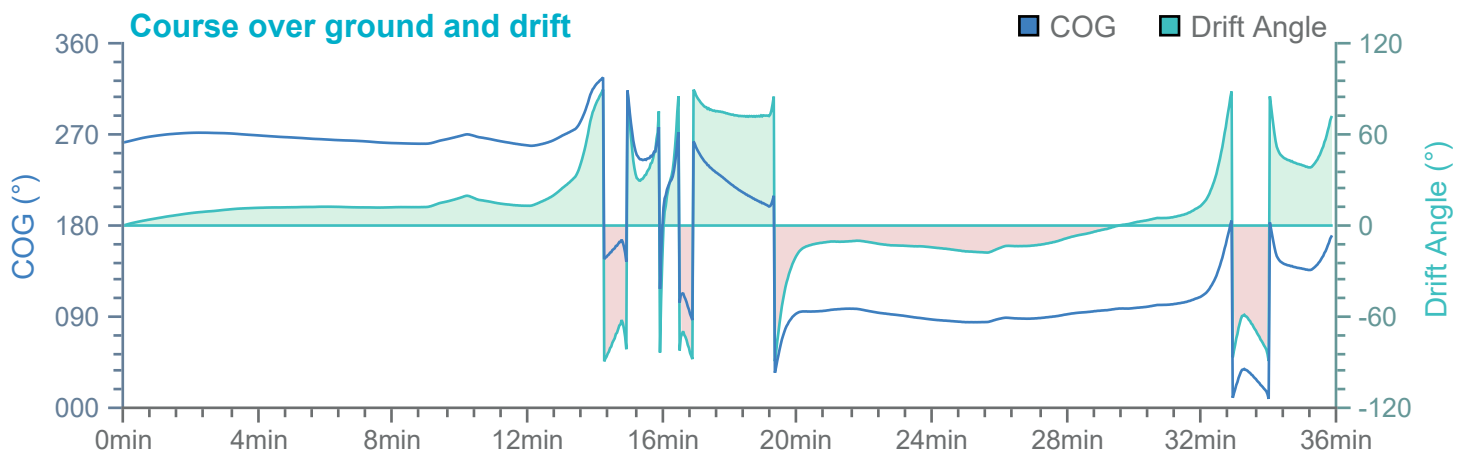
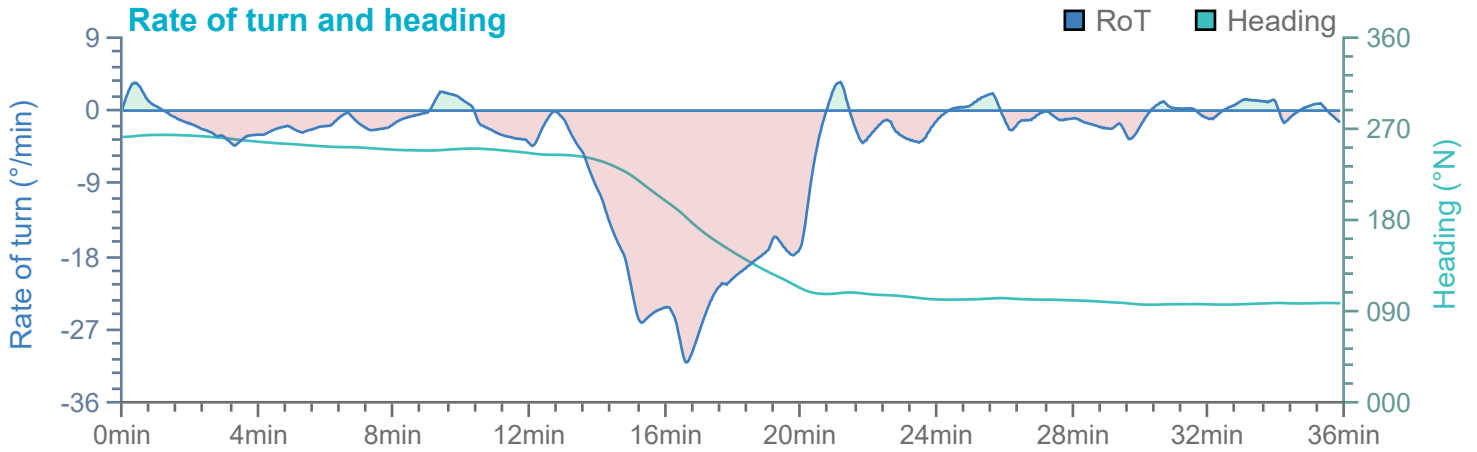
Overview

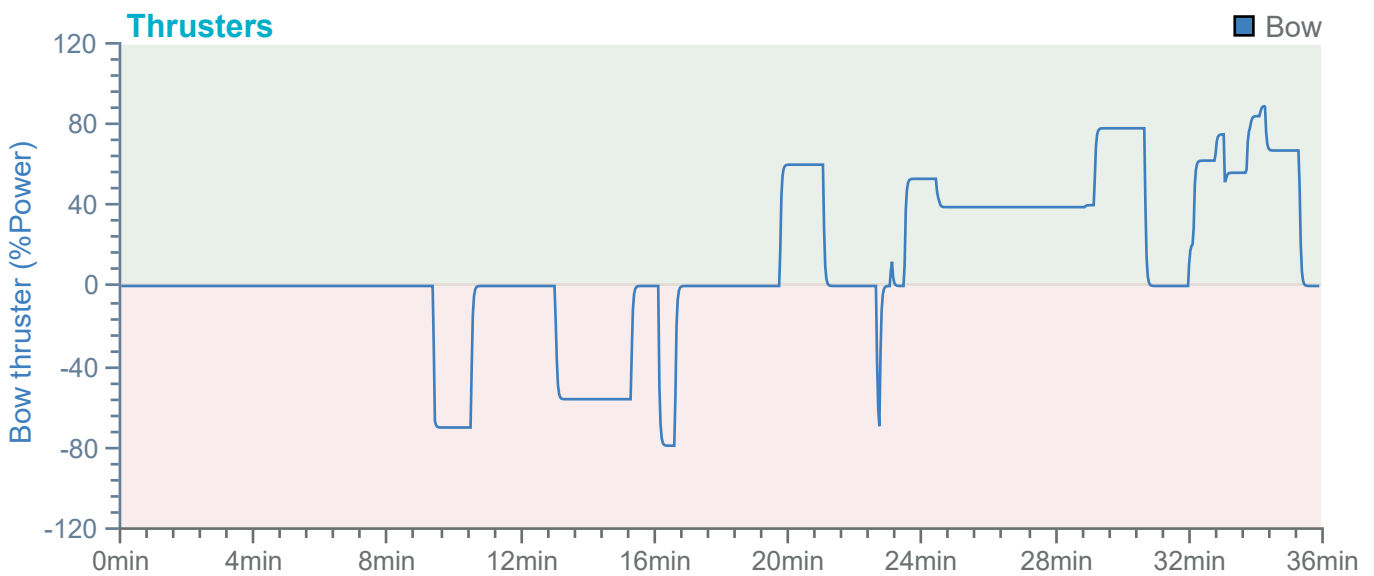
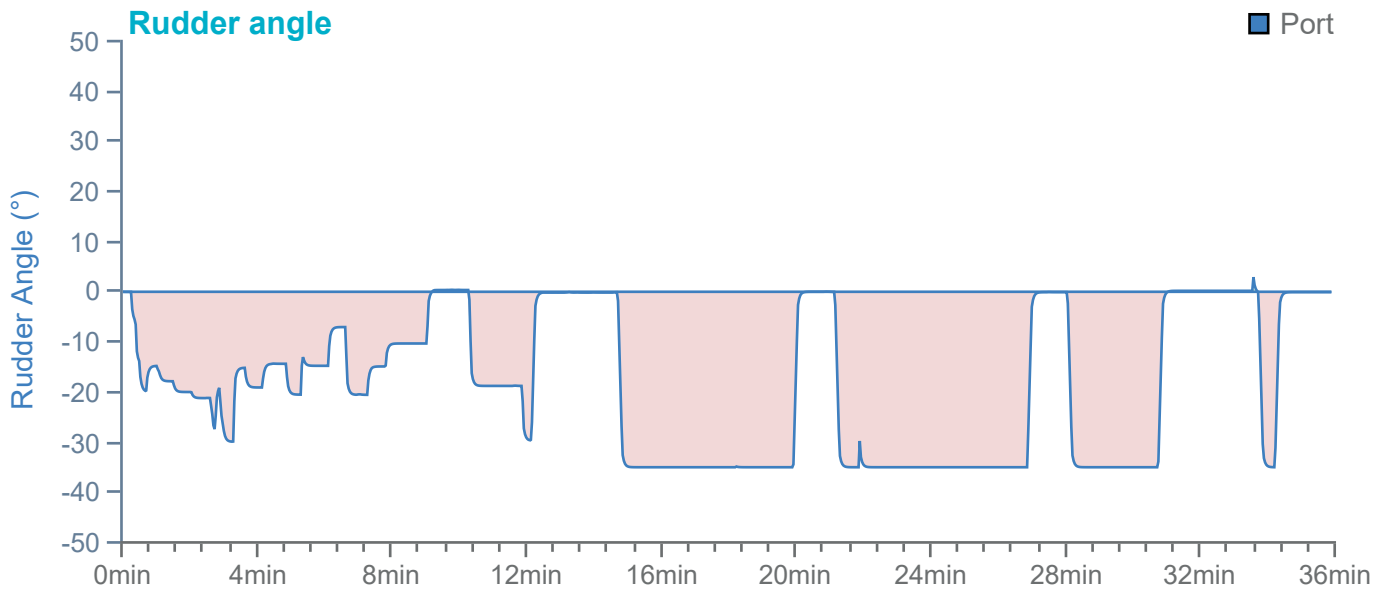
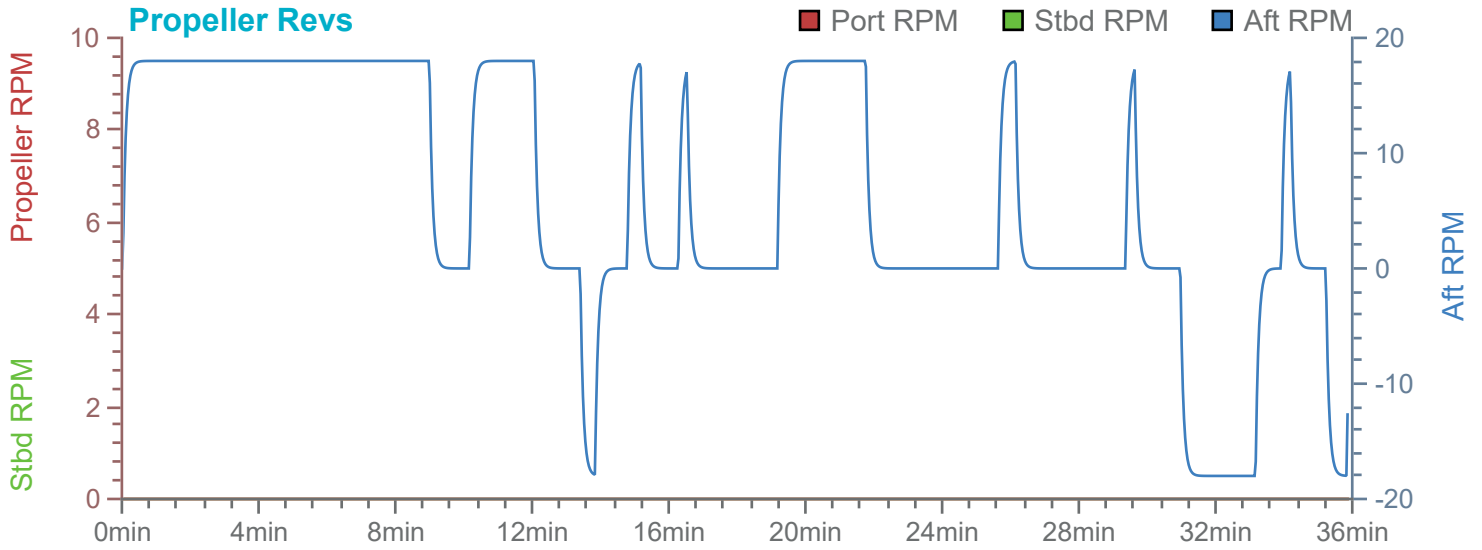
Environment

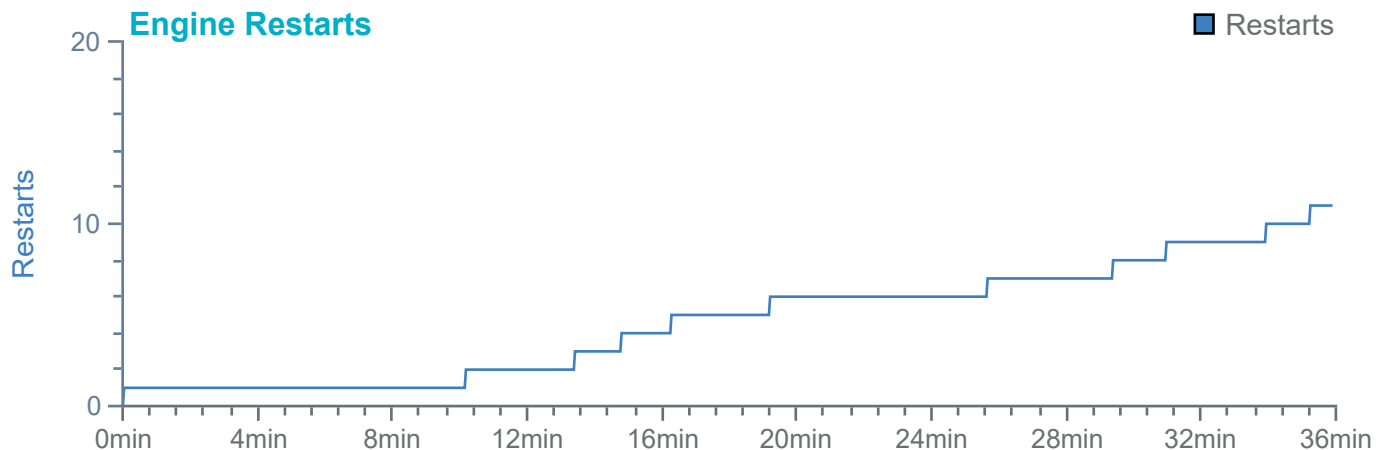
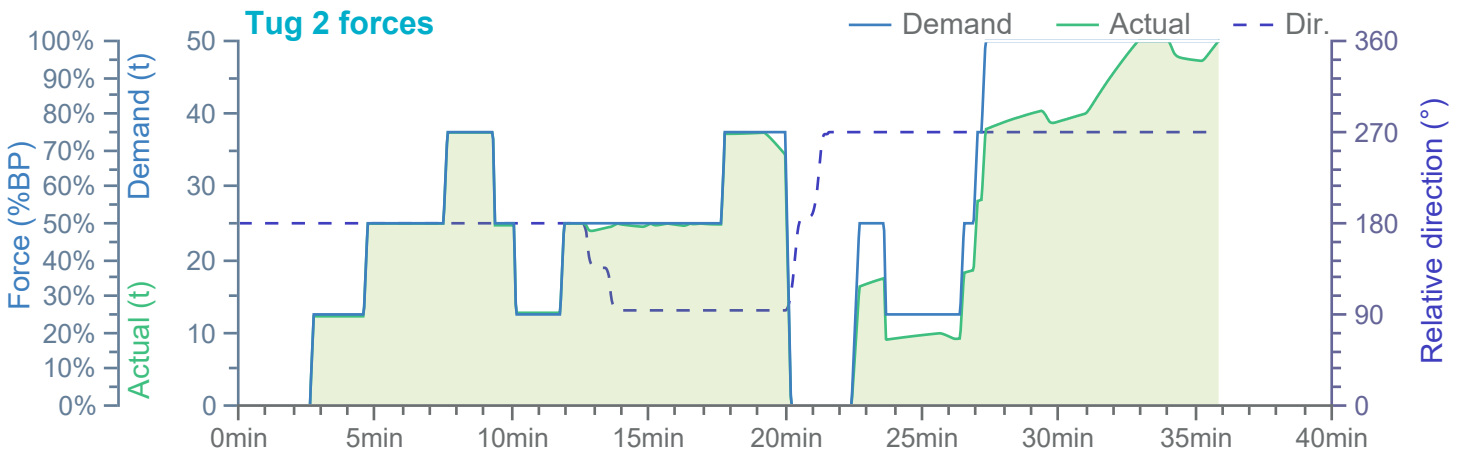
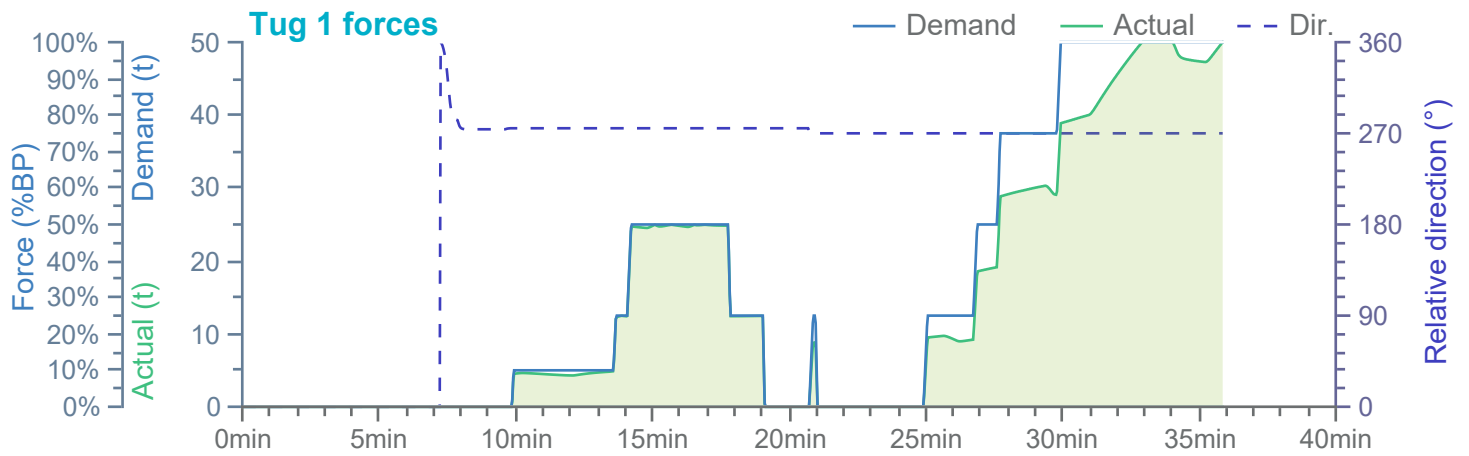
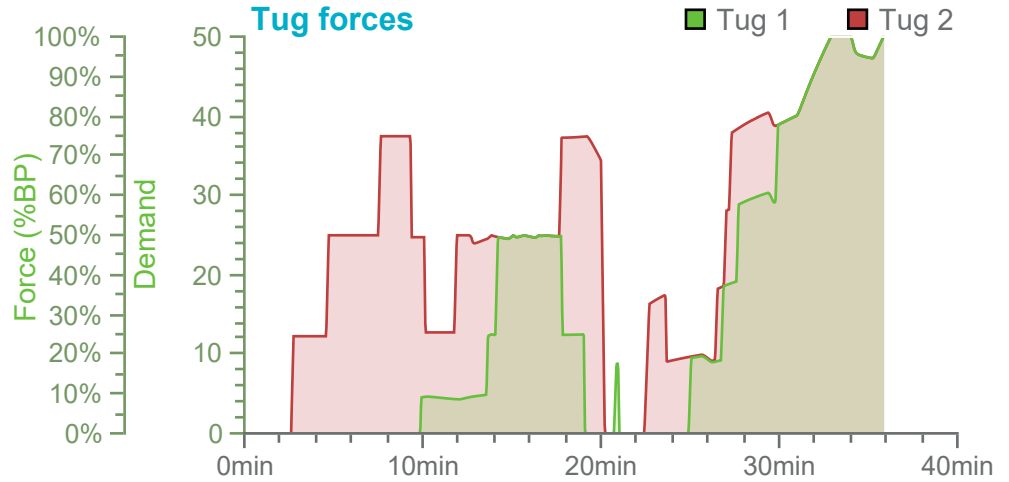
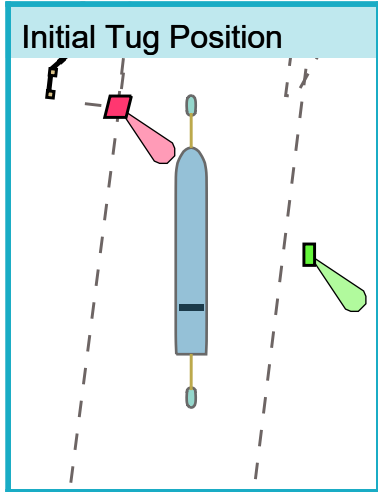
250m Container

Thruster and engine use

Tug use

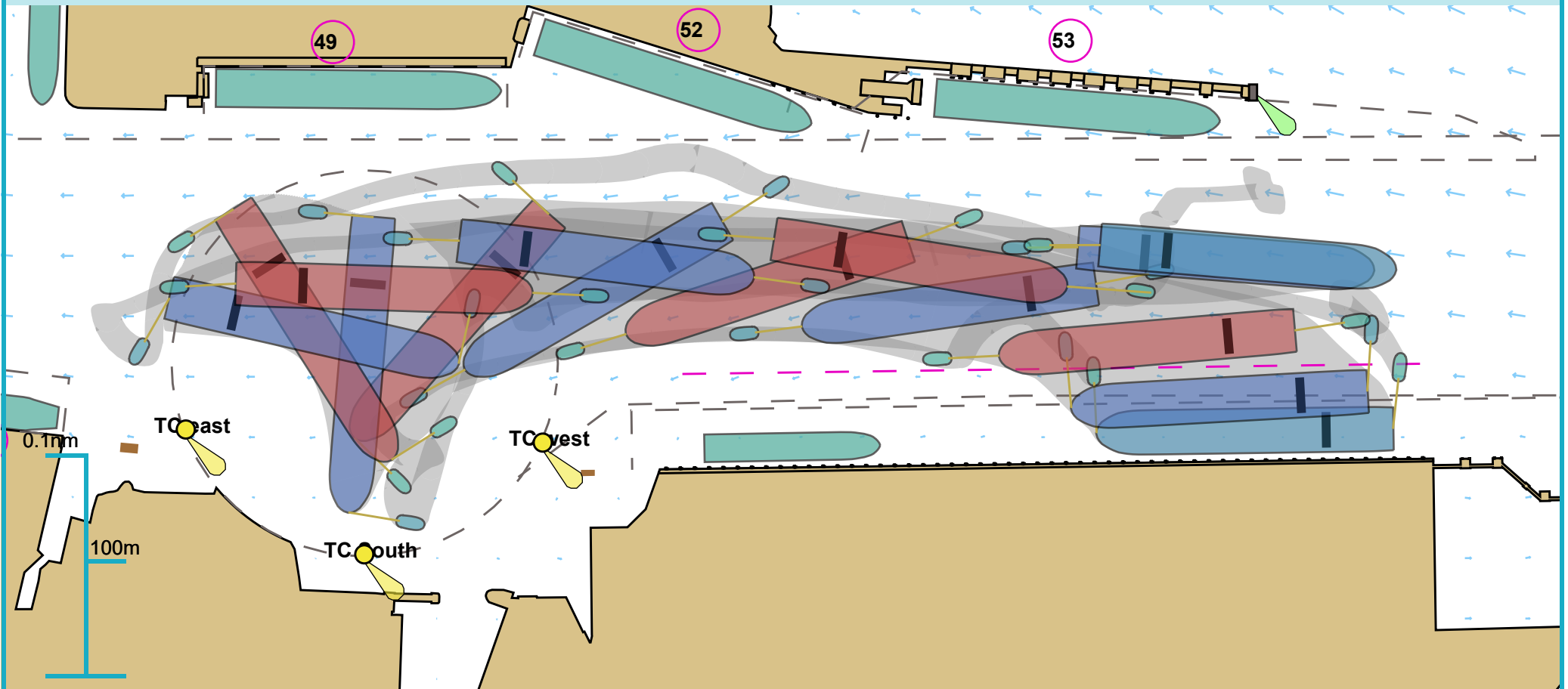






Full Run Overview

53° 20.401 N, 006° 11.920 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

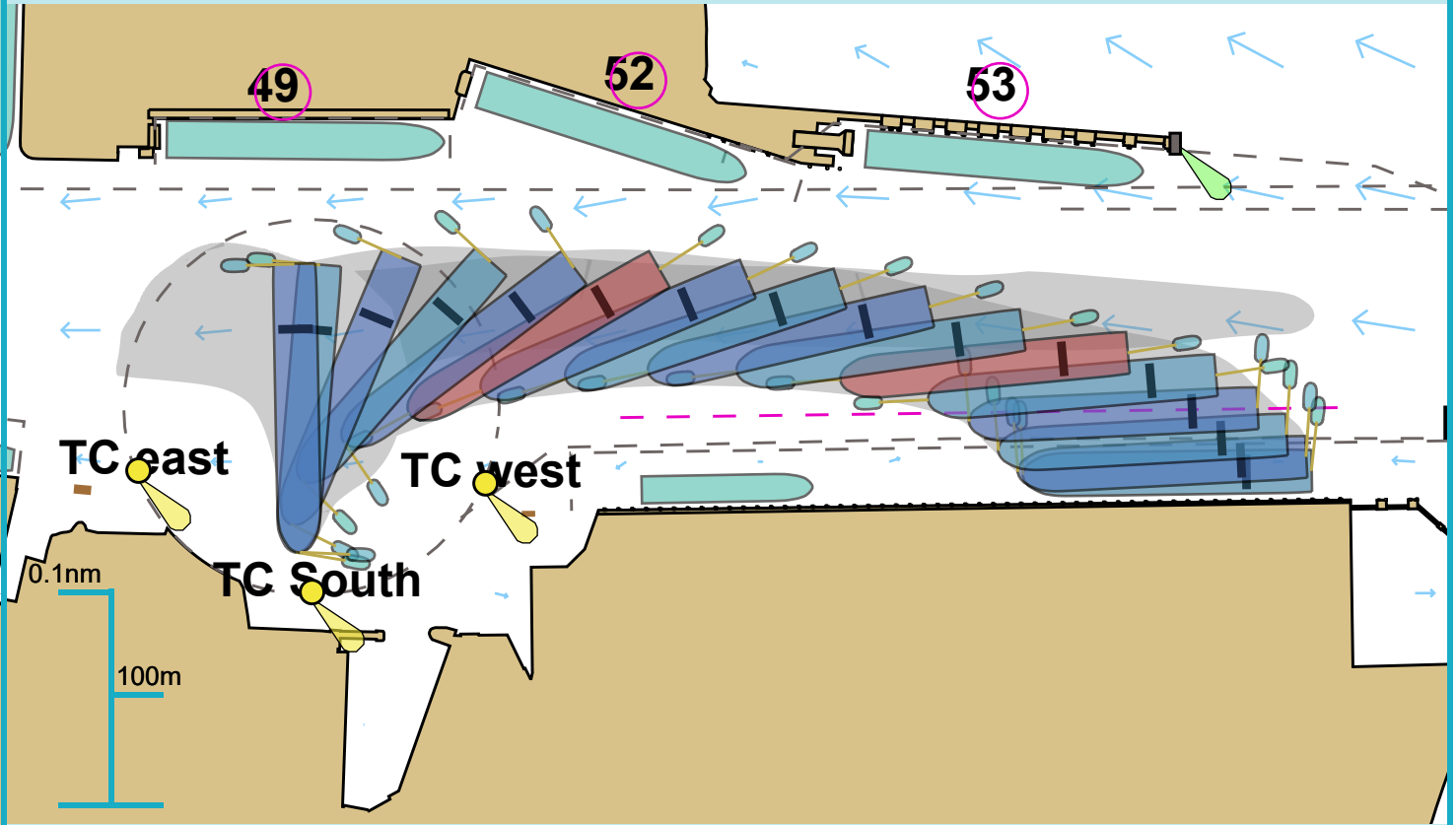
Run length:26 minutes

Manoeuvre:Other

Ownship(s):250m Container

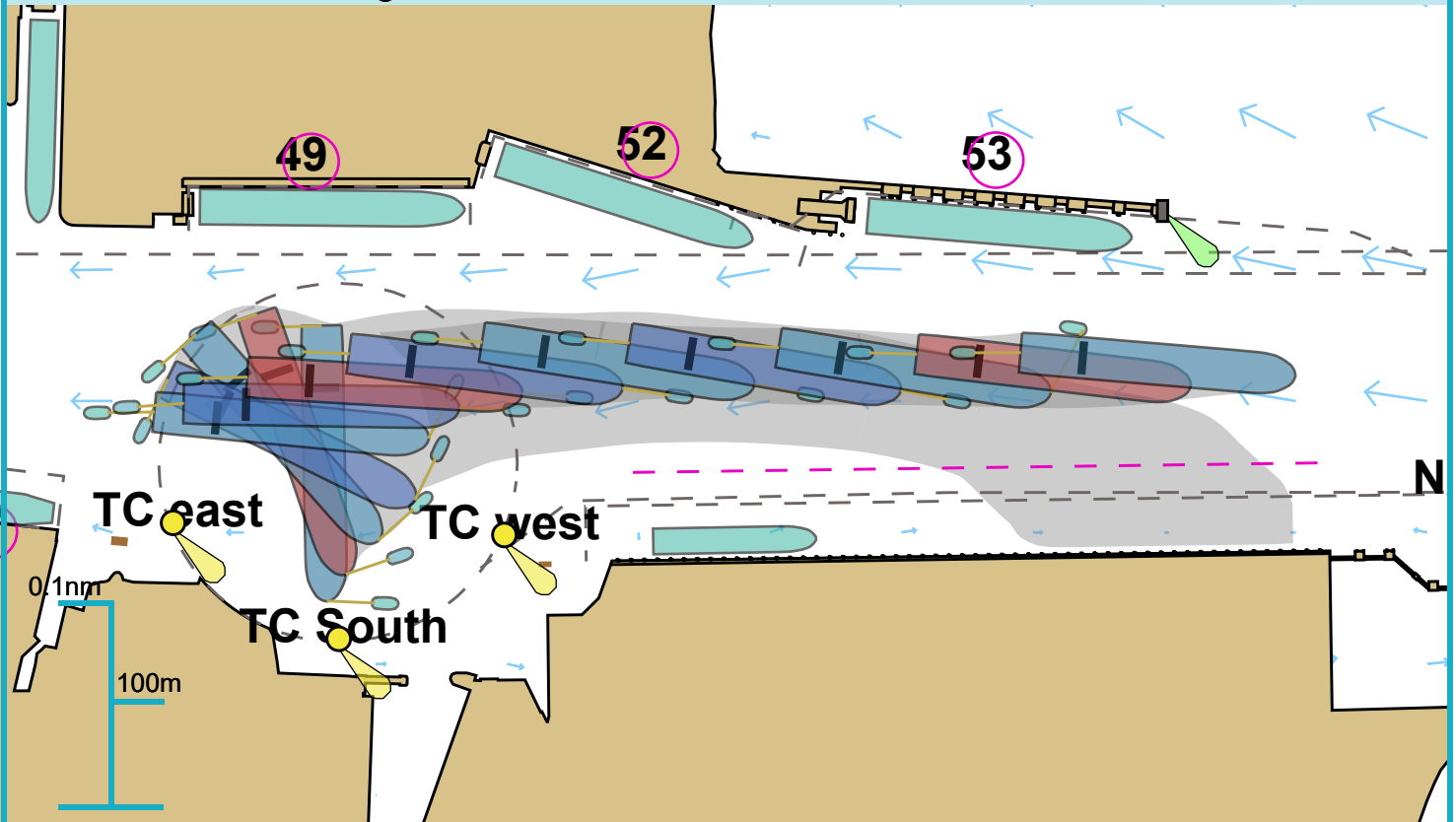
Comments:

Departure



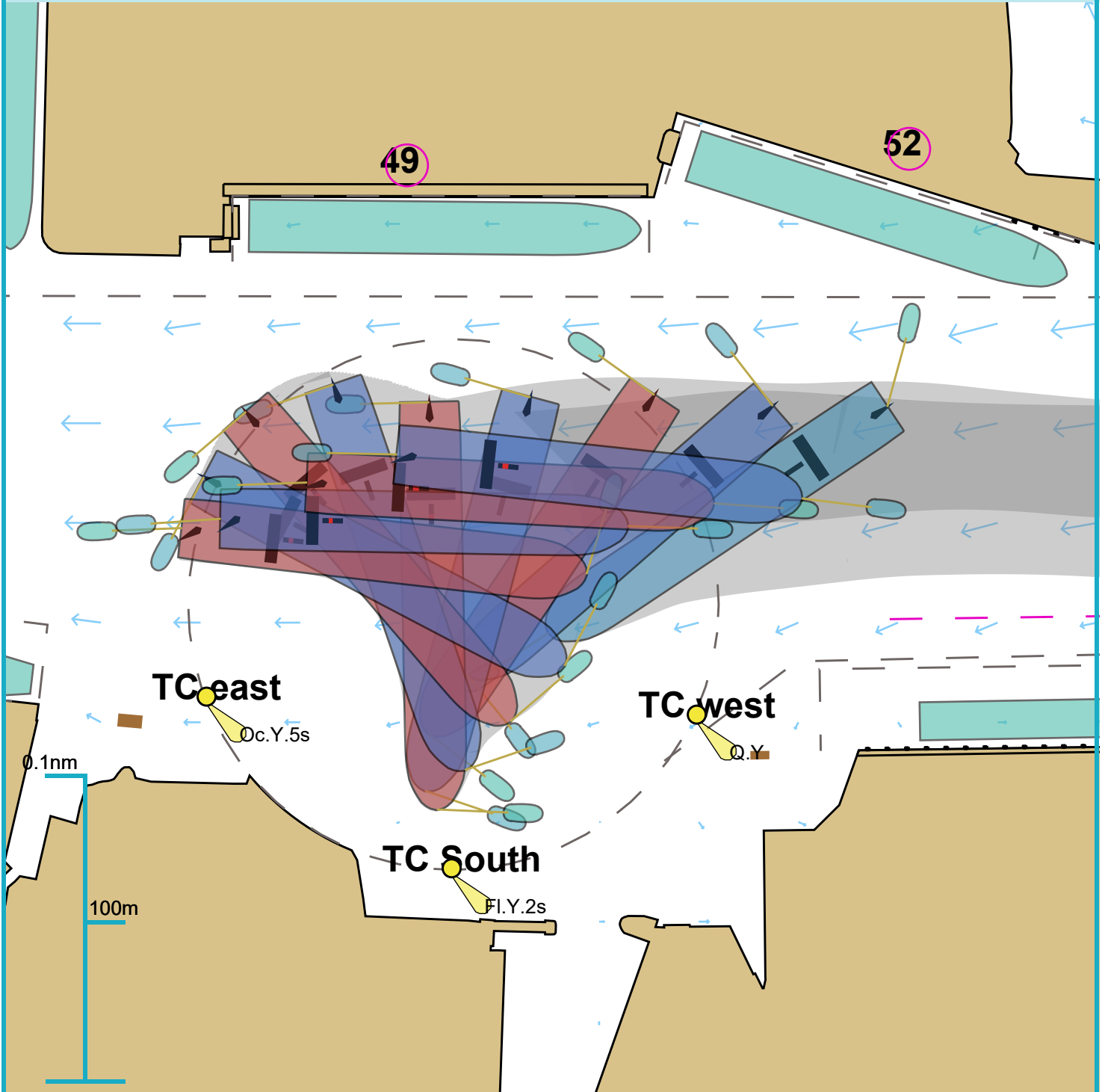
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

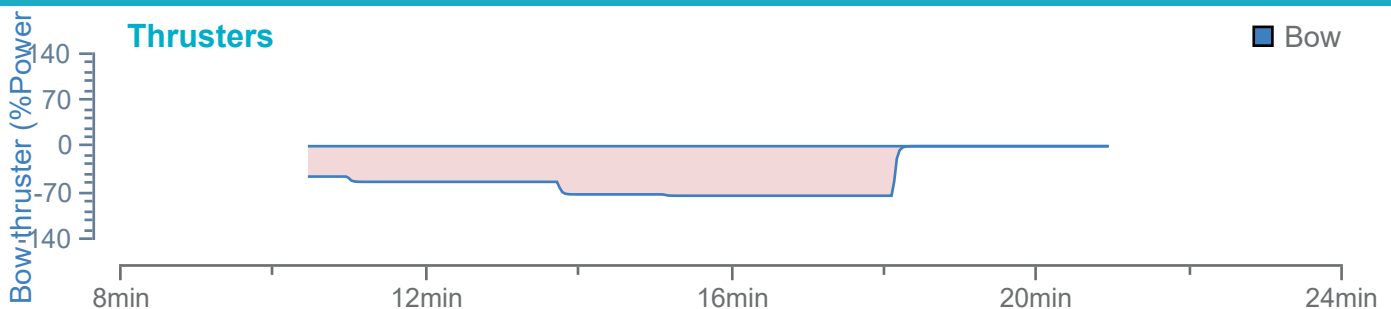


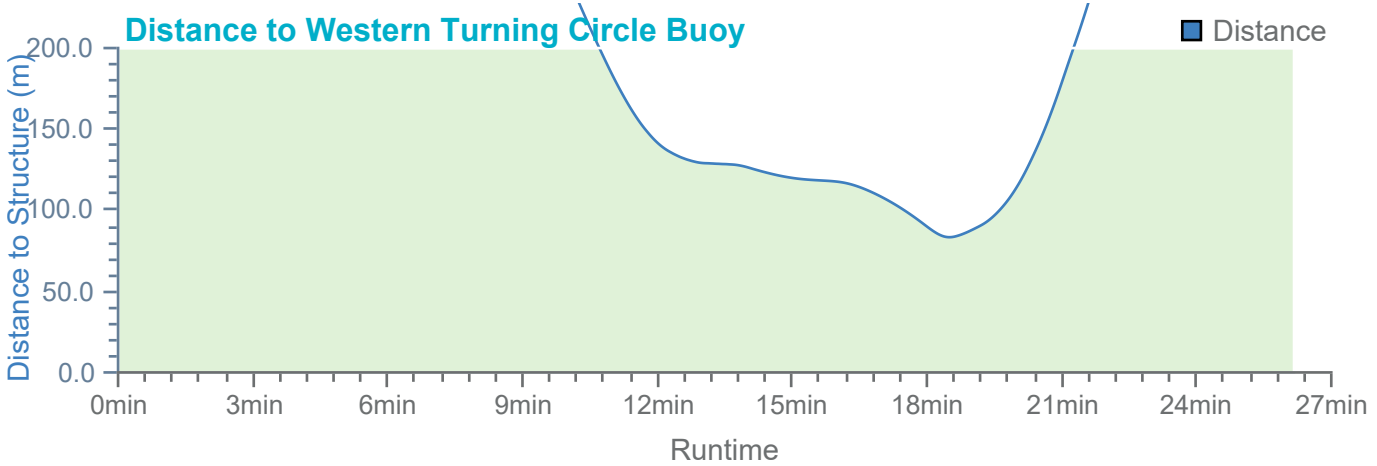
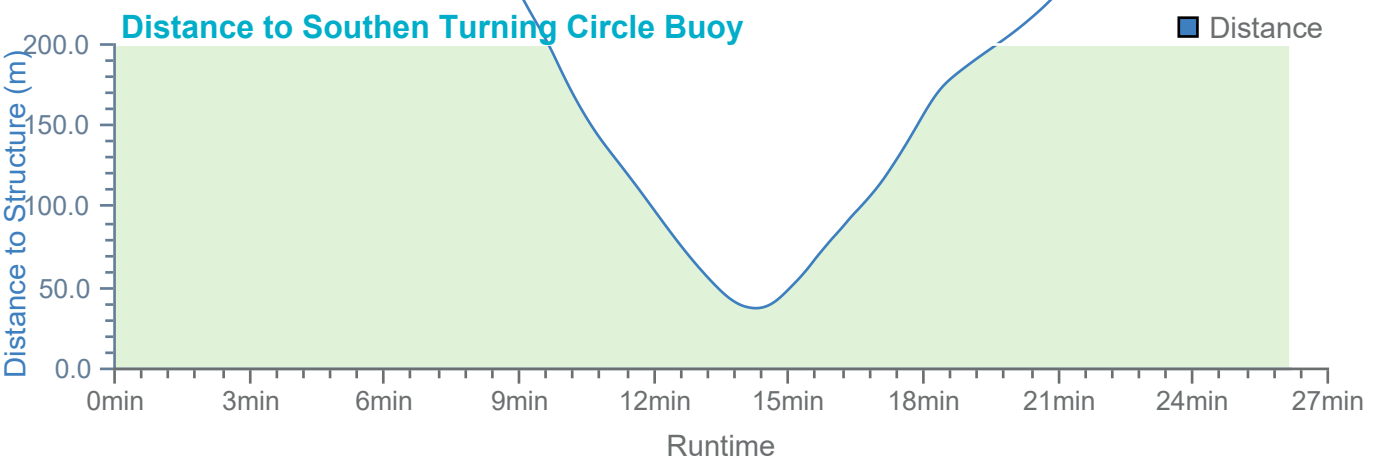
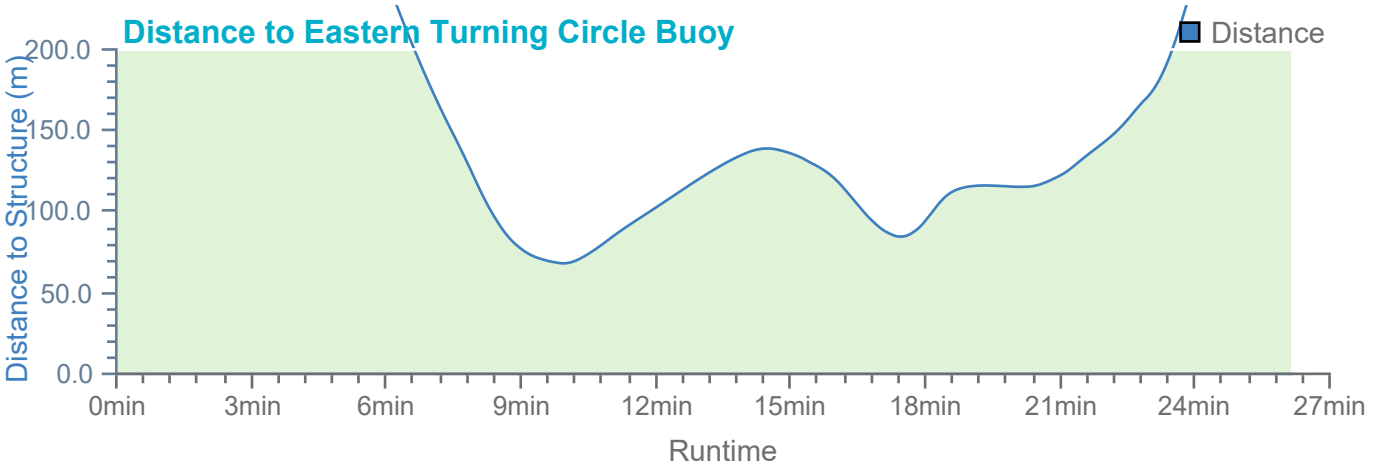
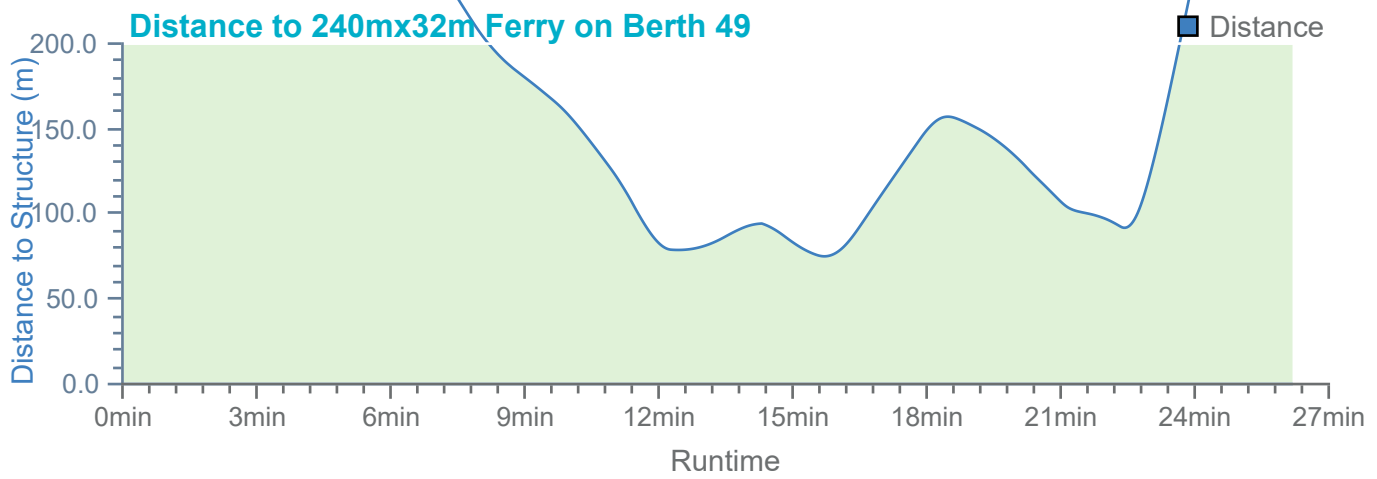
Ships plotted every 1 mins, highlight every 5 mins

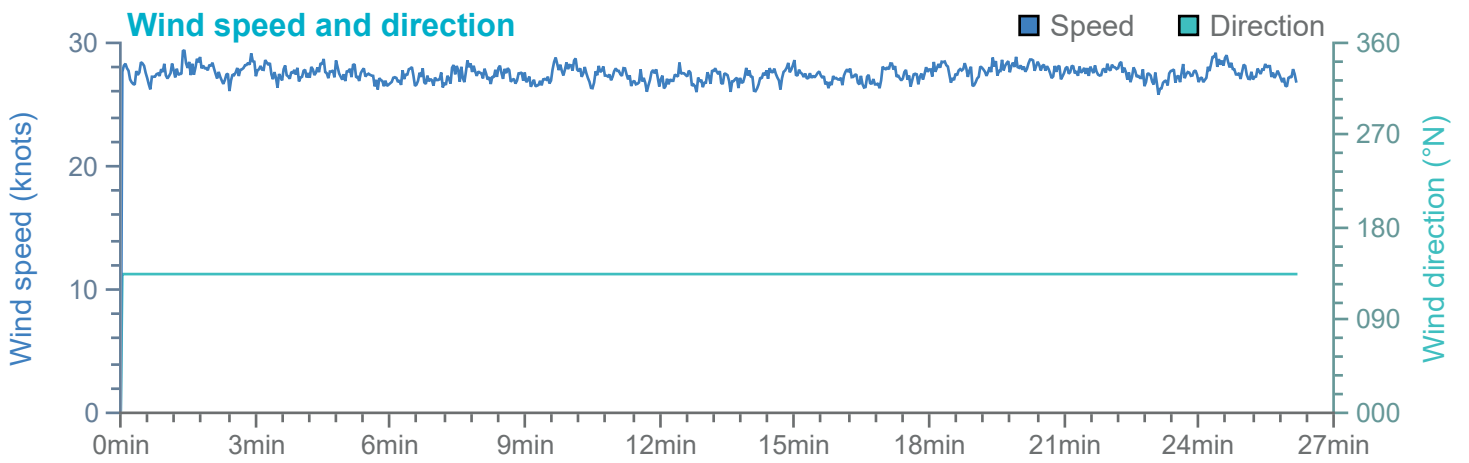
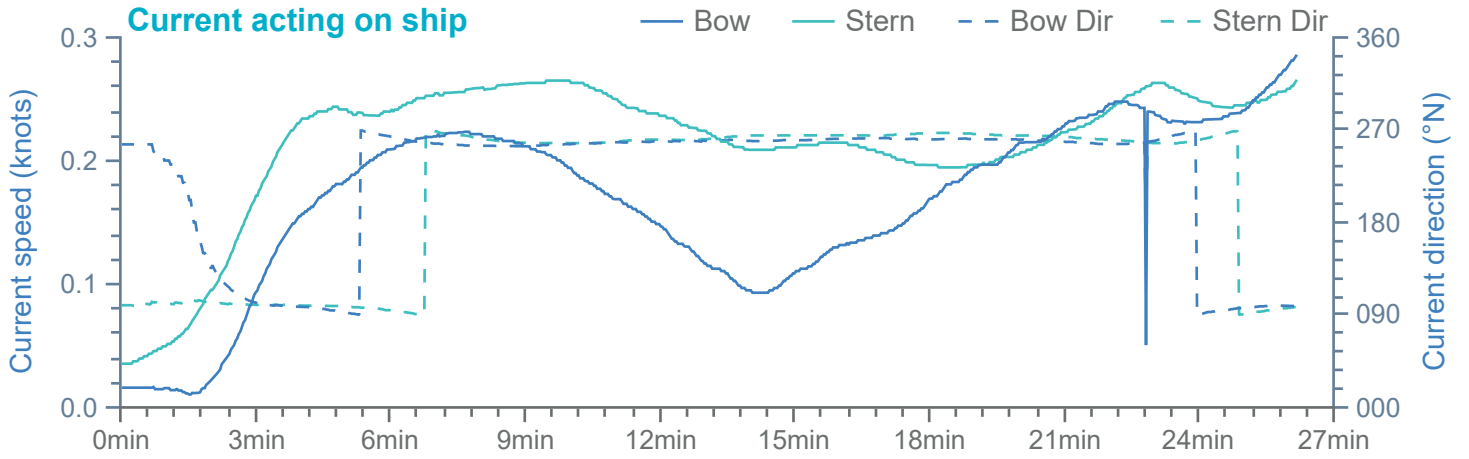
Swing



Ships plotted every 59 seconds, highlight every 2 mins







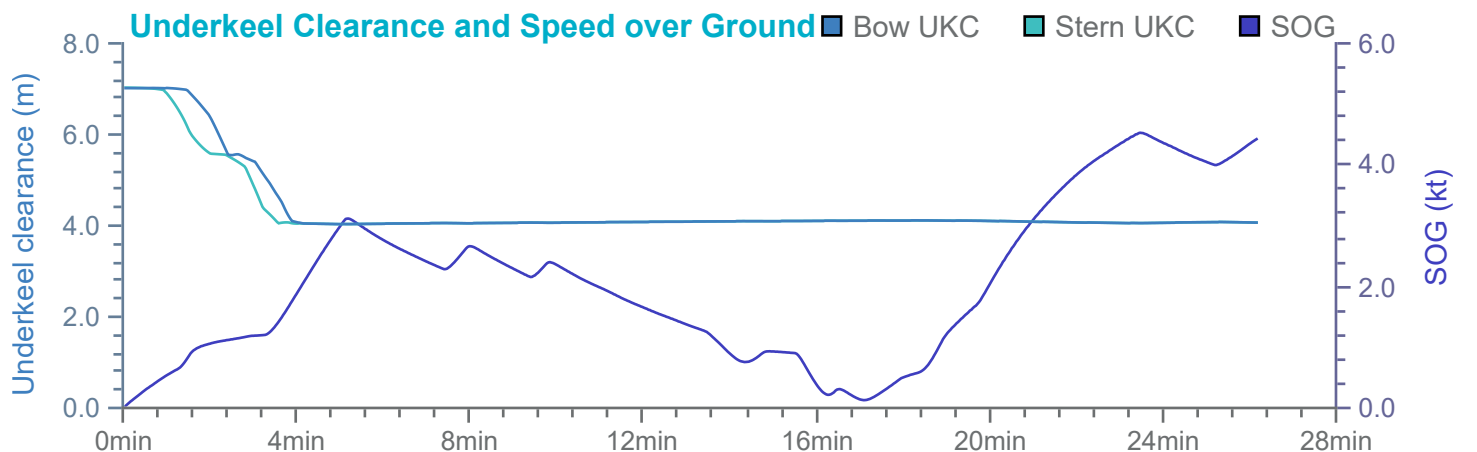
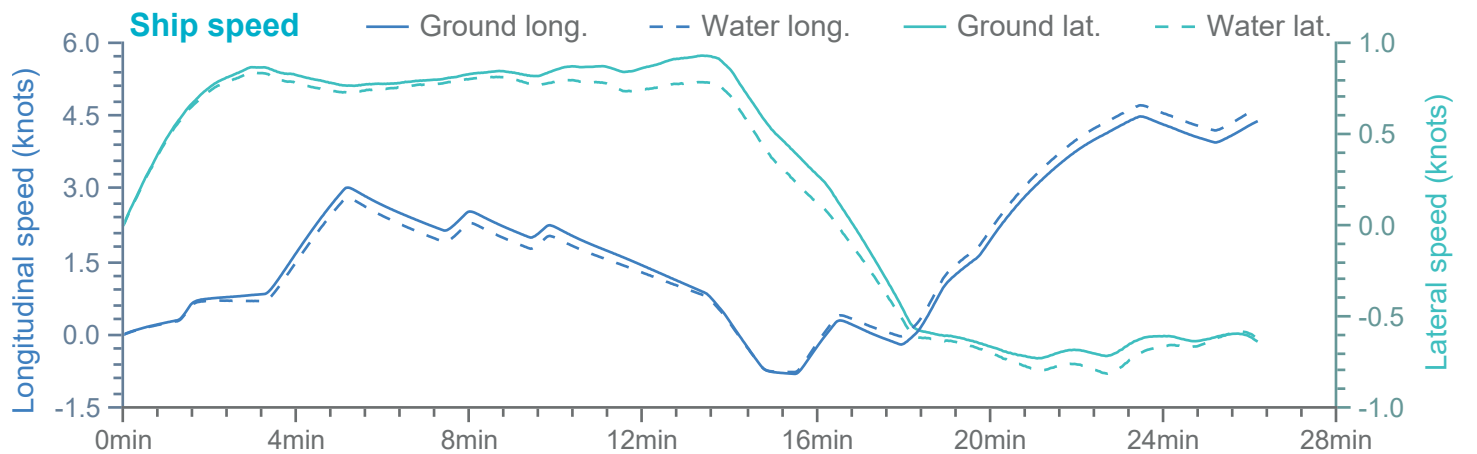
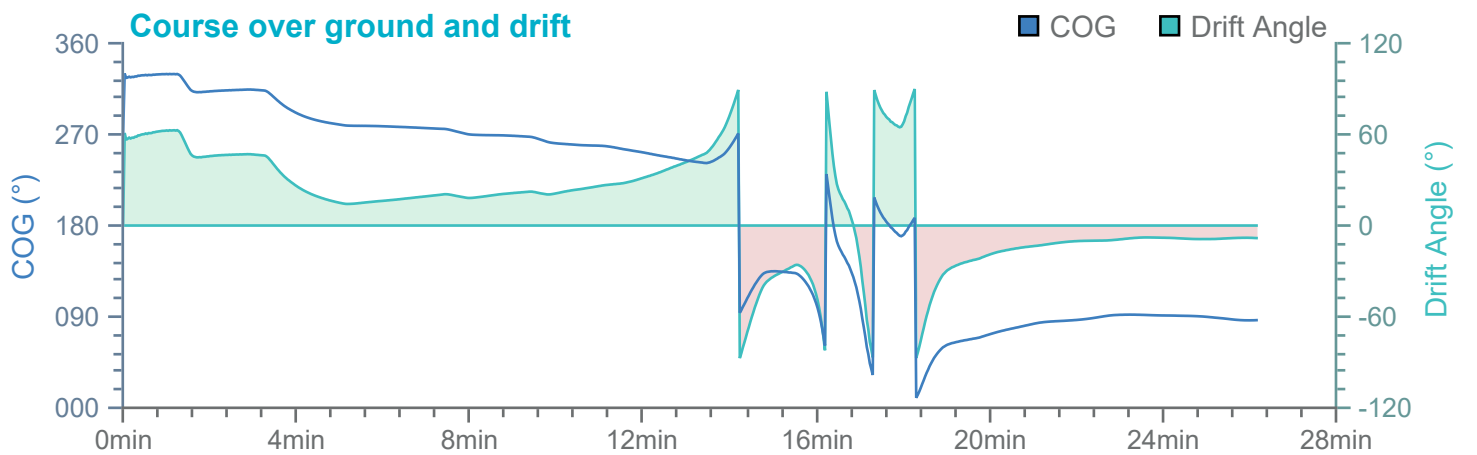
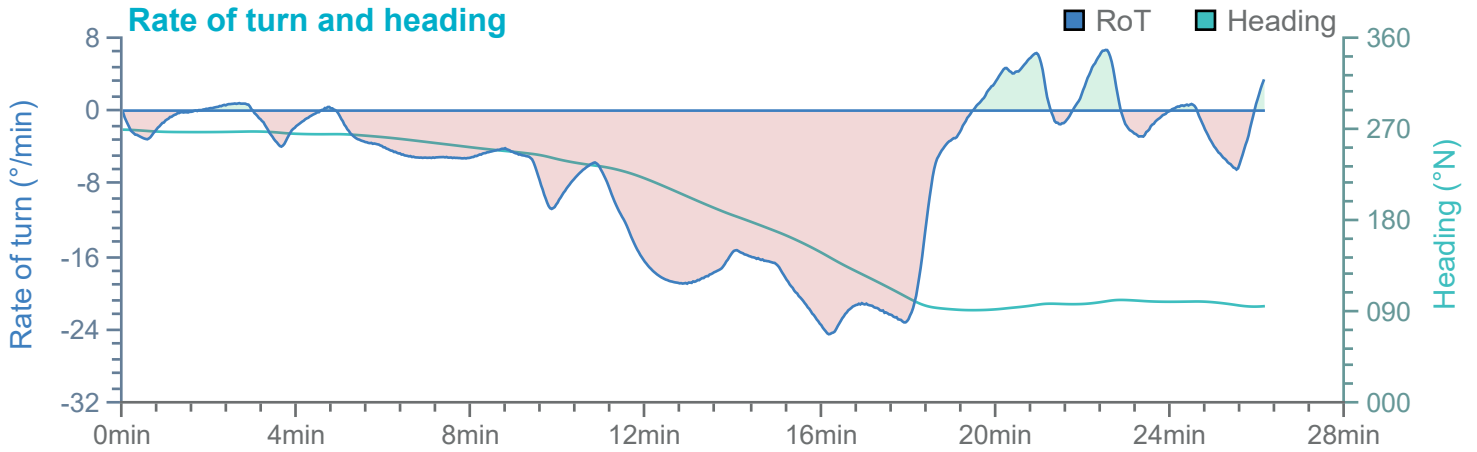
Overview

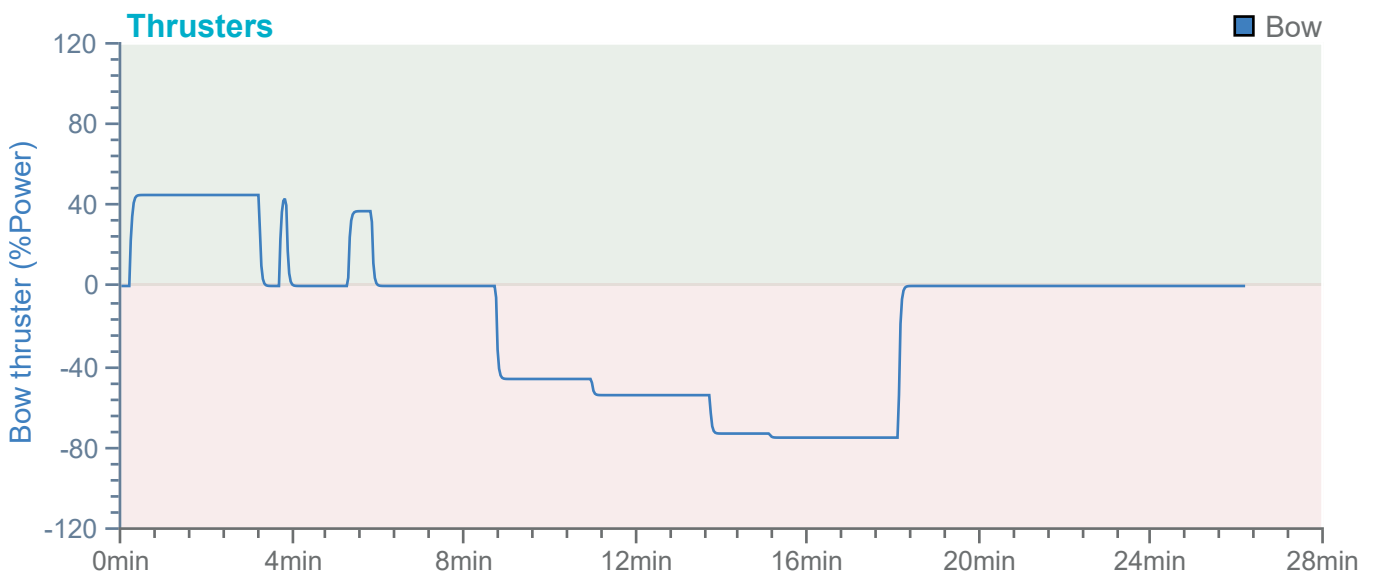
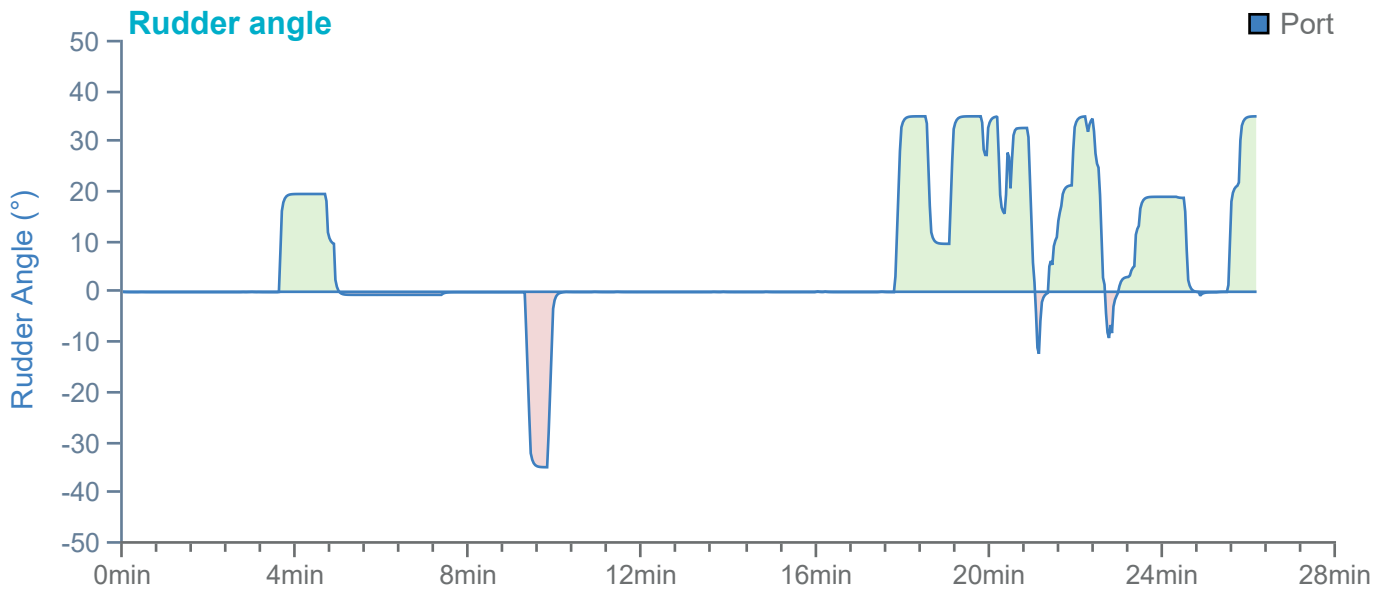
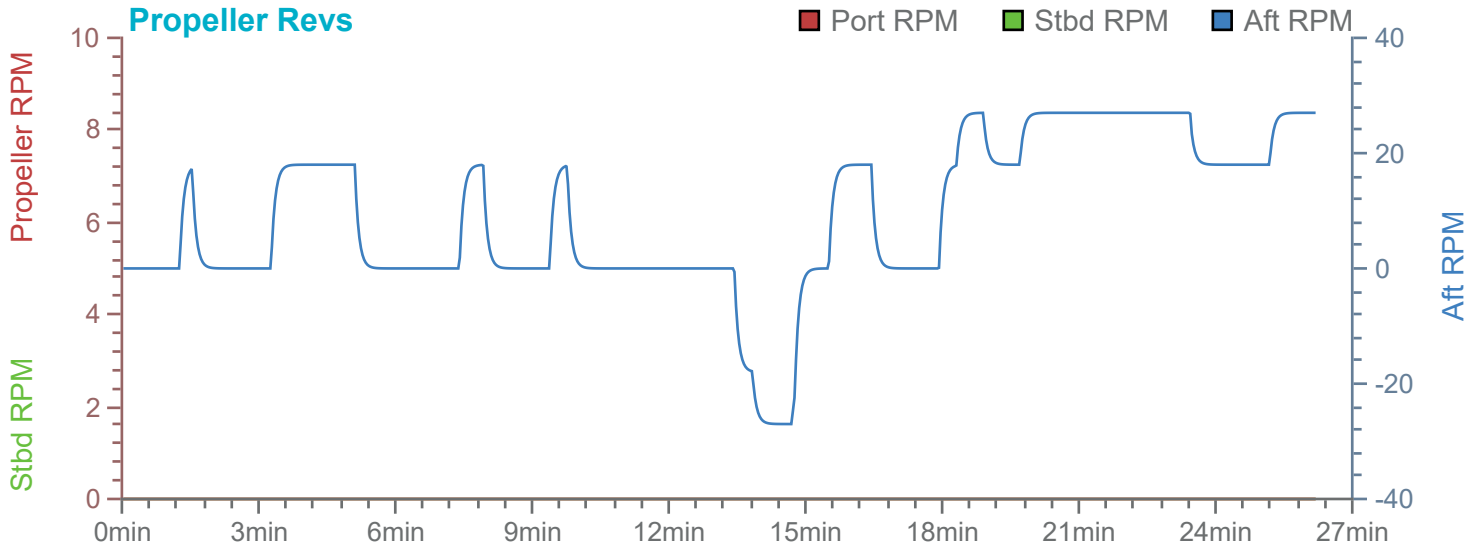
Environment

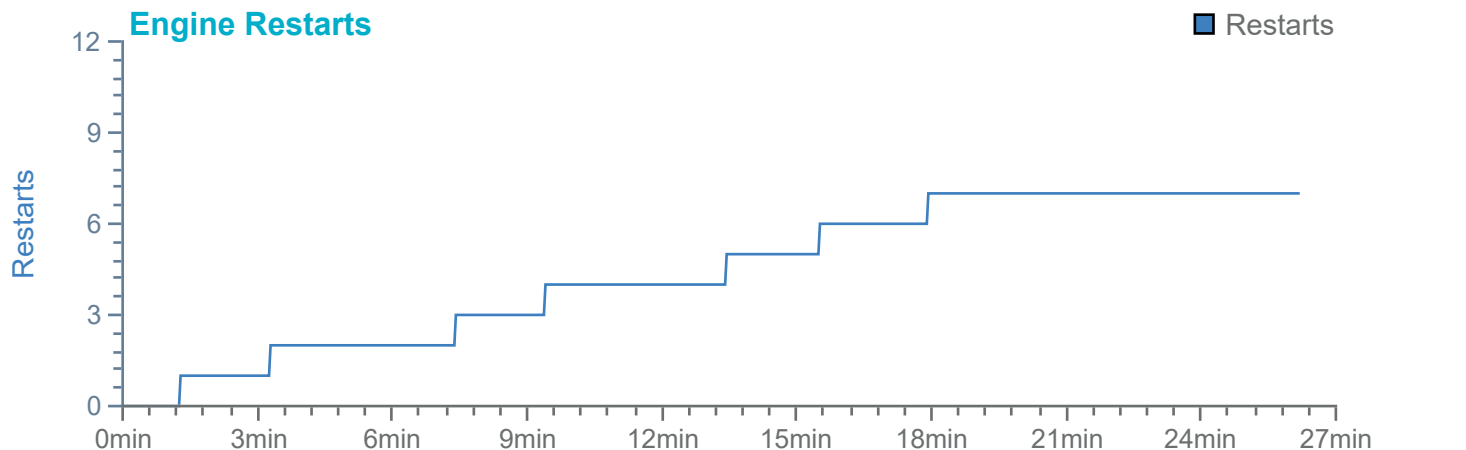
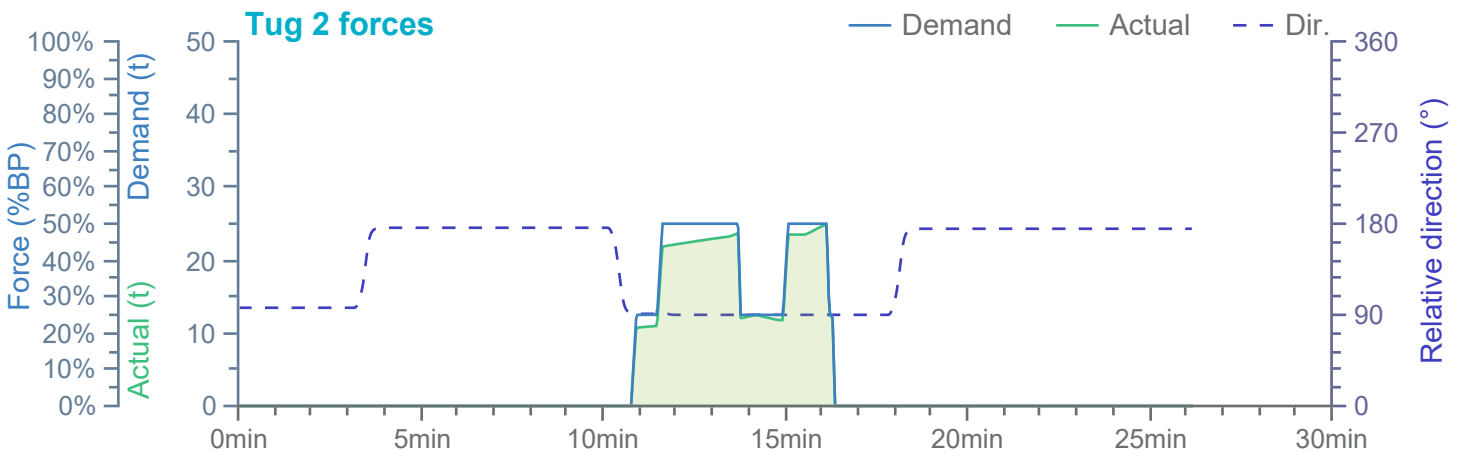
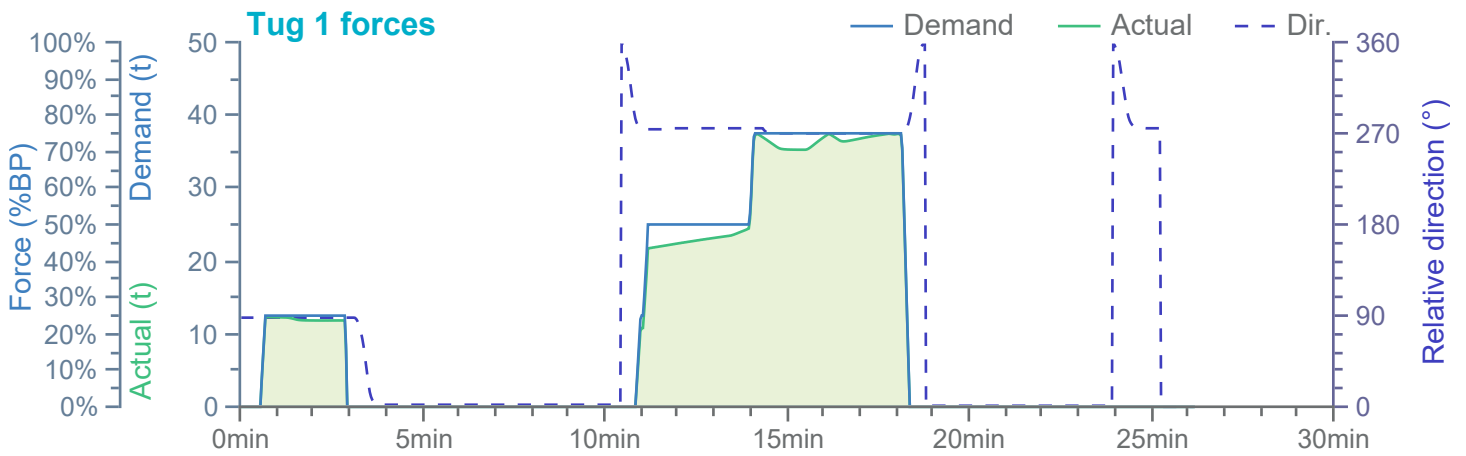
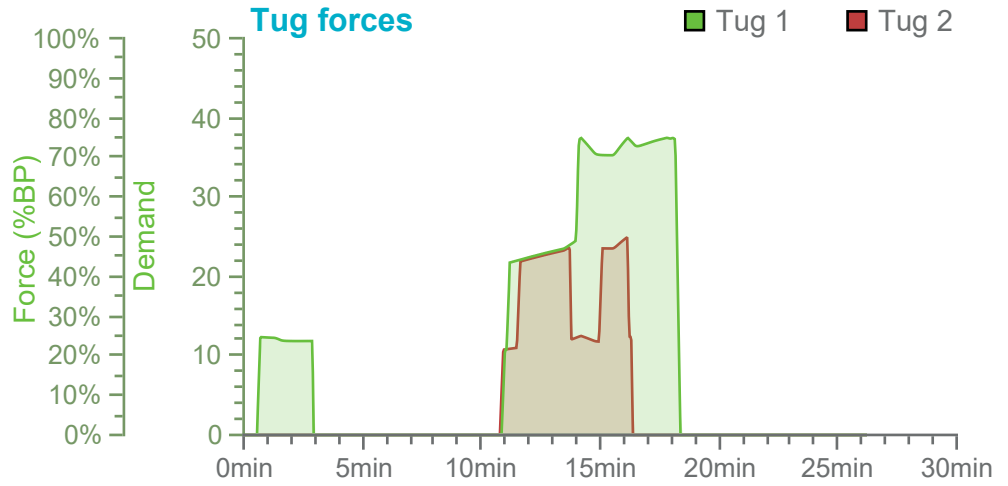
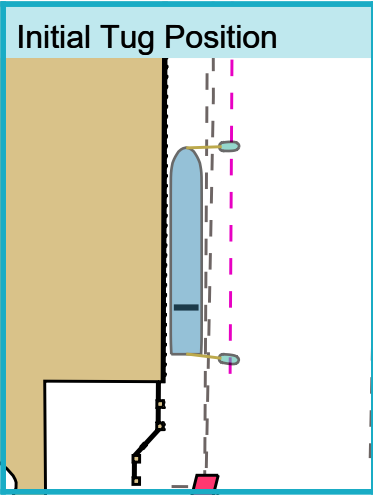
250m Container

Thruster and engine use

Tug use

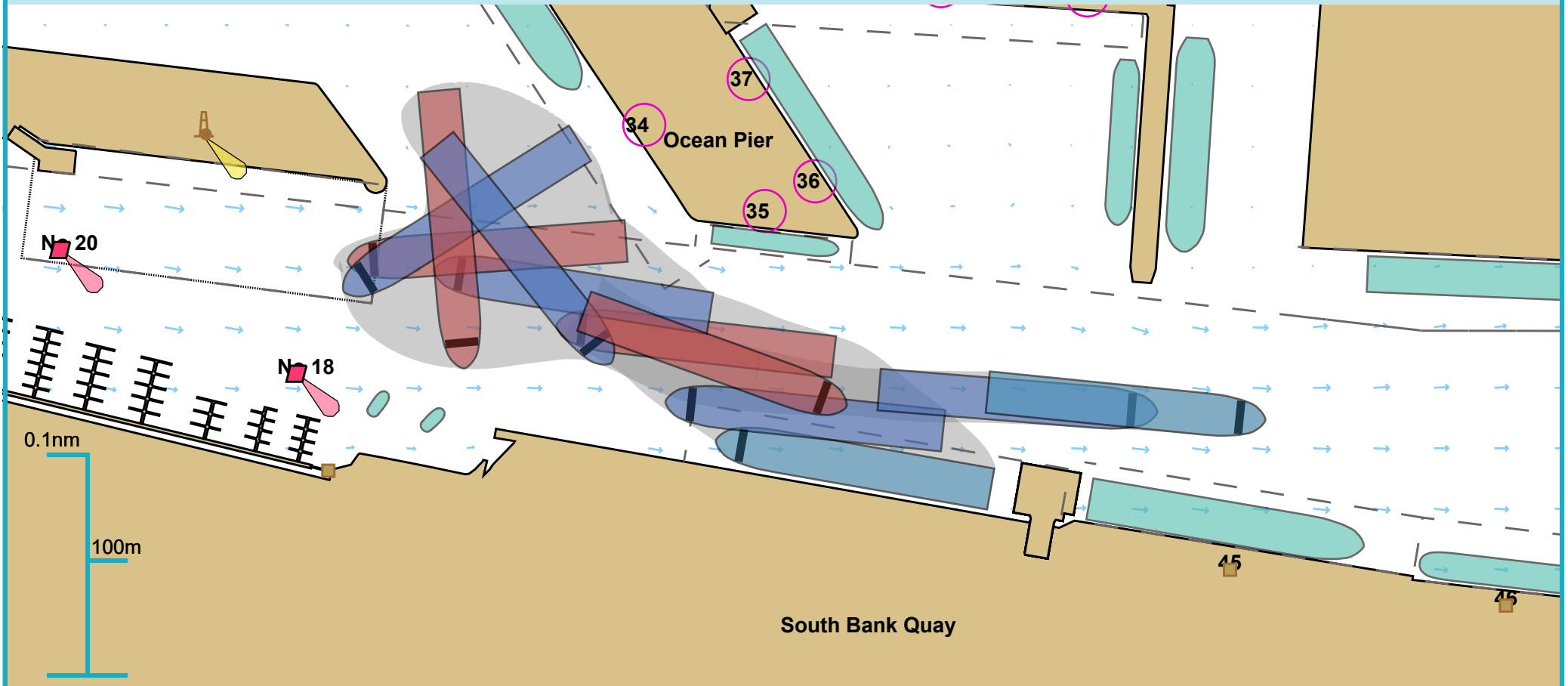






Full Run Overview

53° 20.489 N, 006° 13.270 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

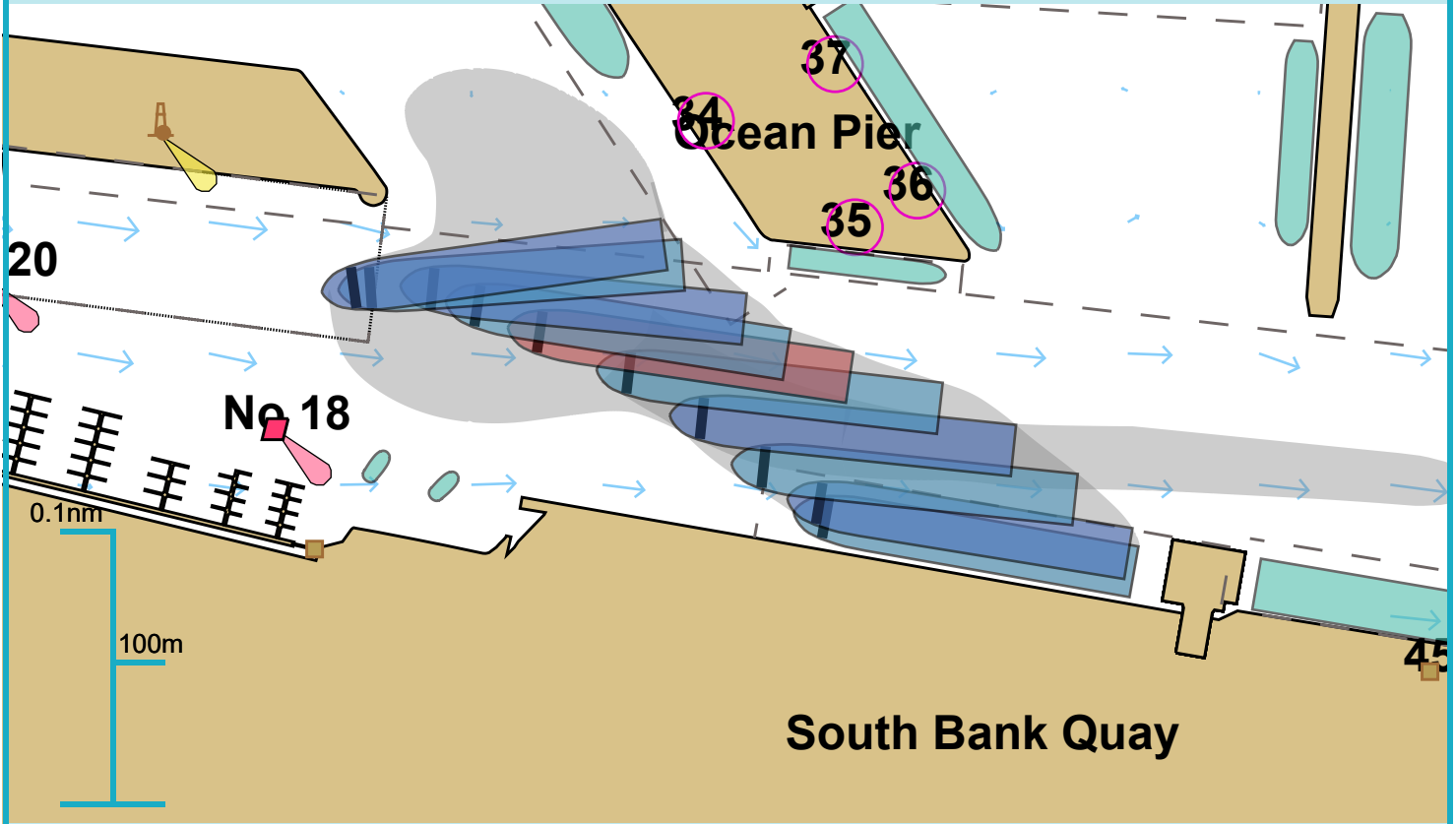
Run length:19 minutes

Manouvre:Other

Ownship(s):MV Celine

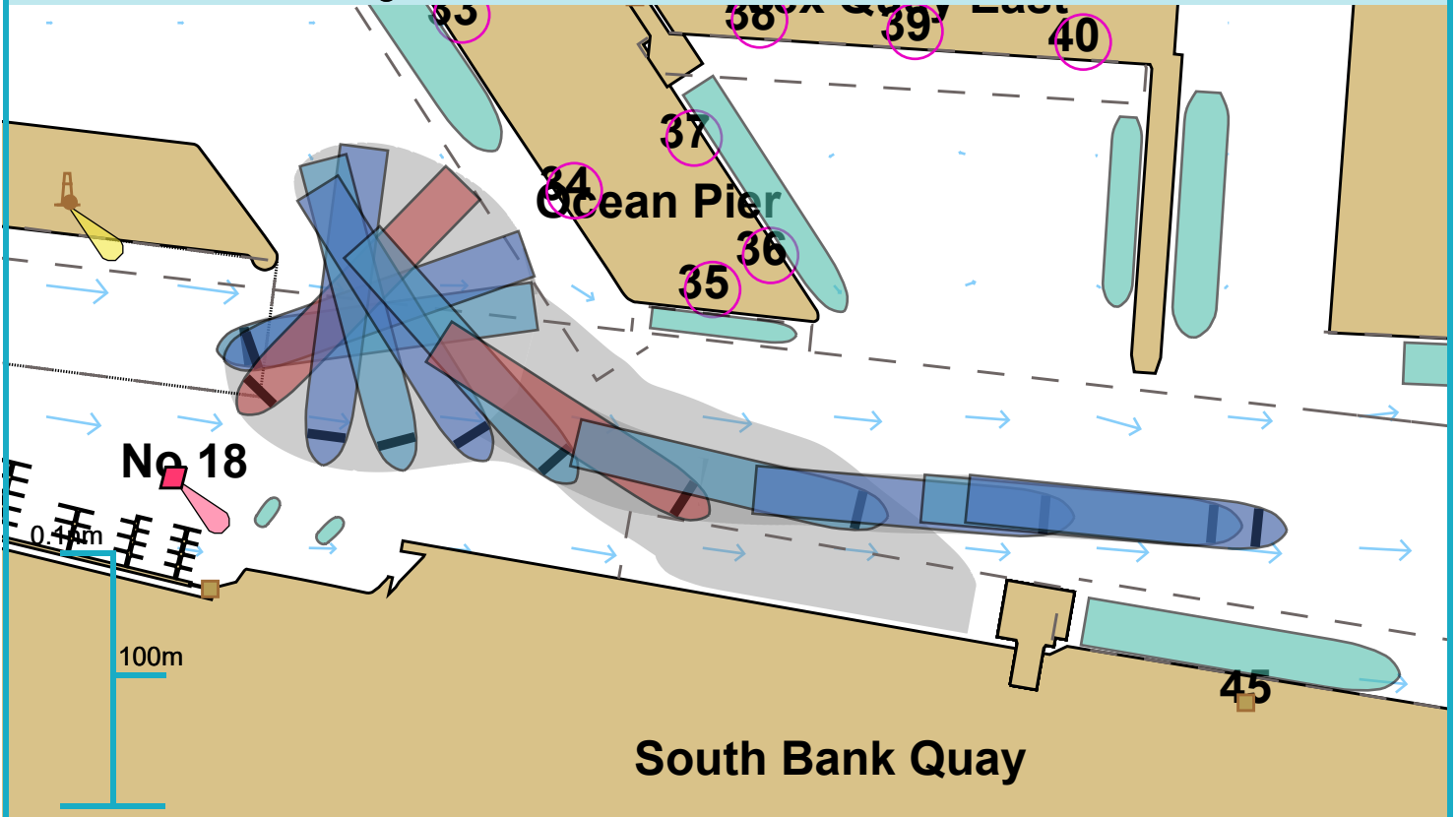
Comments:

Departure



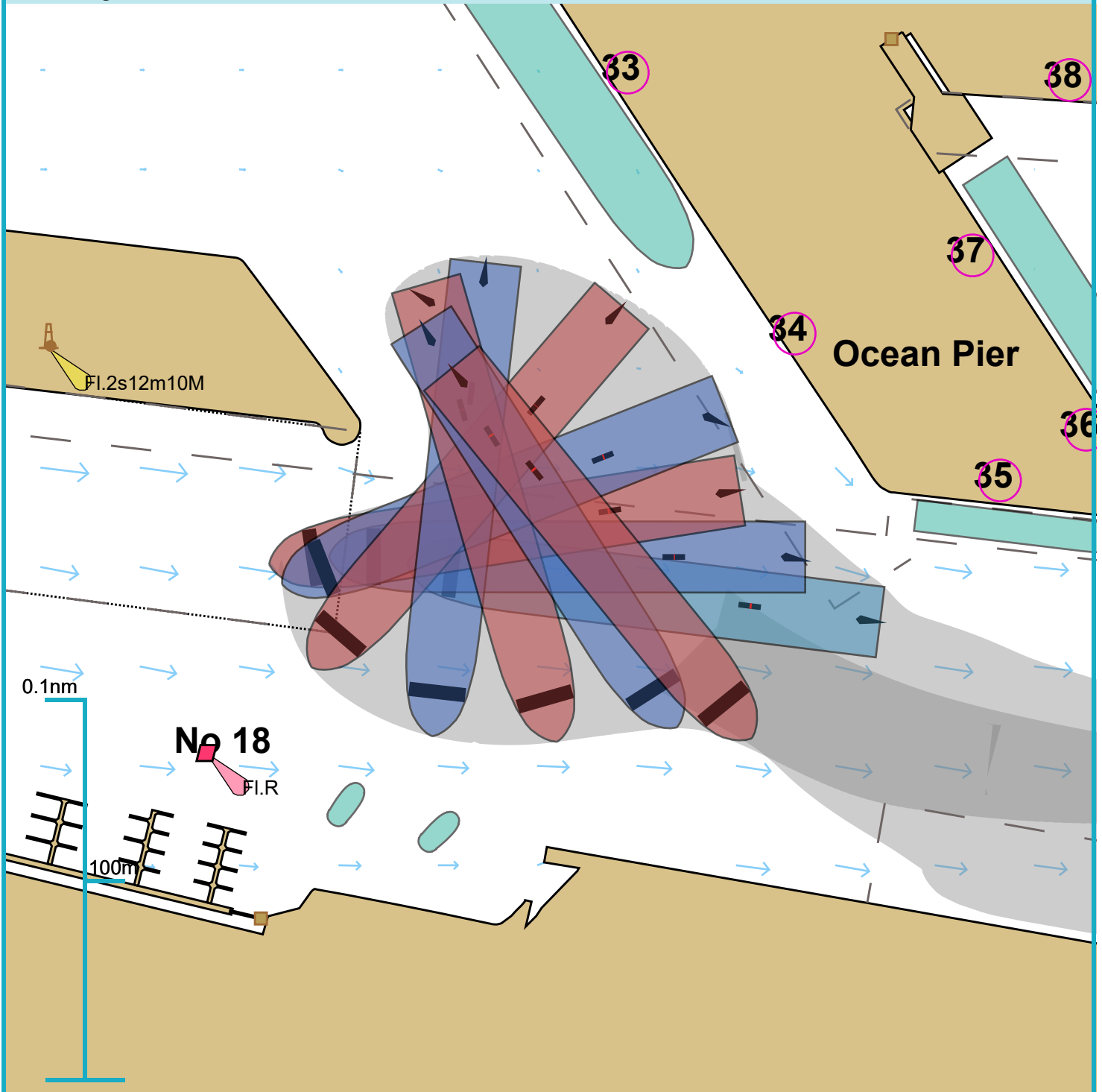
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

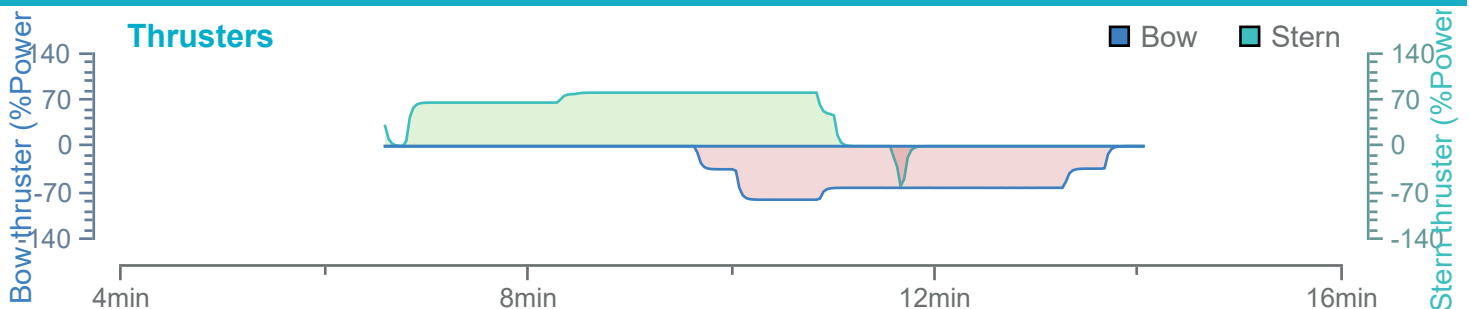


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

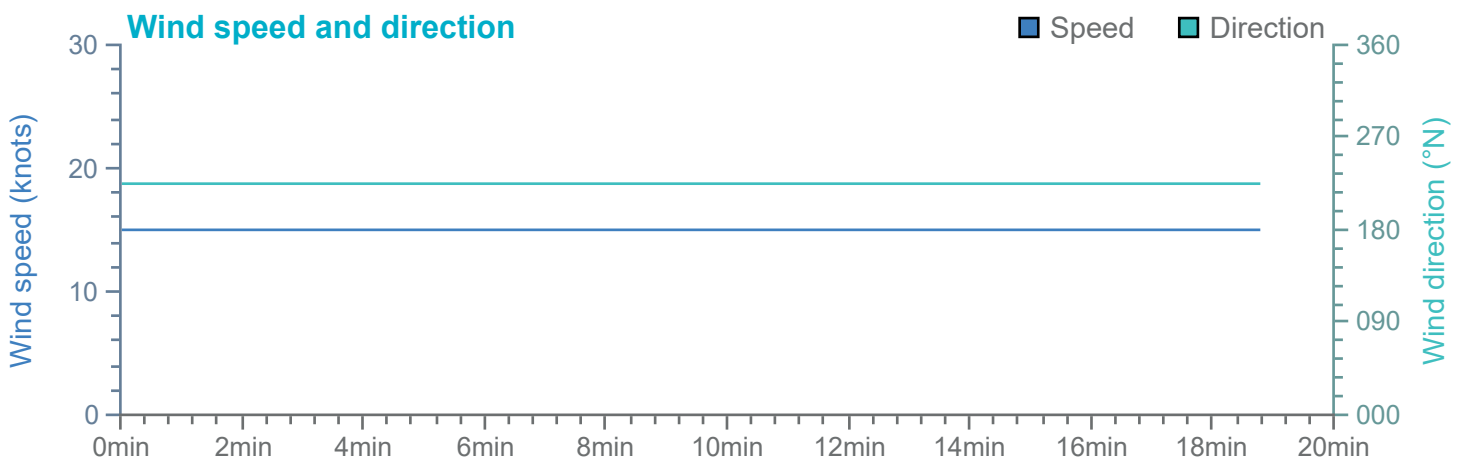
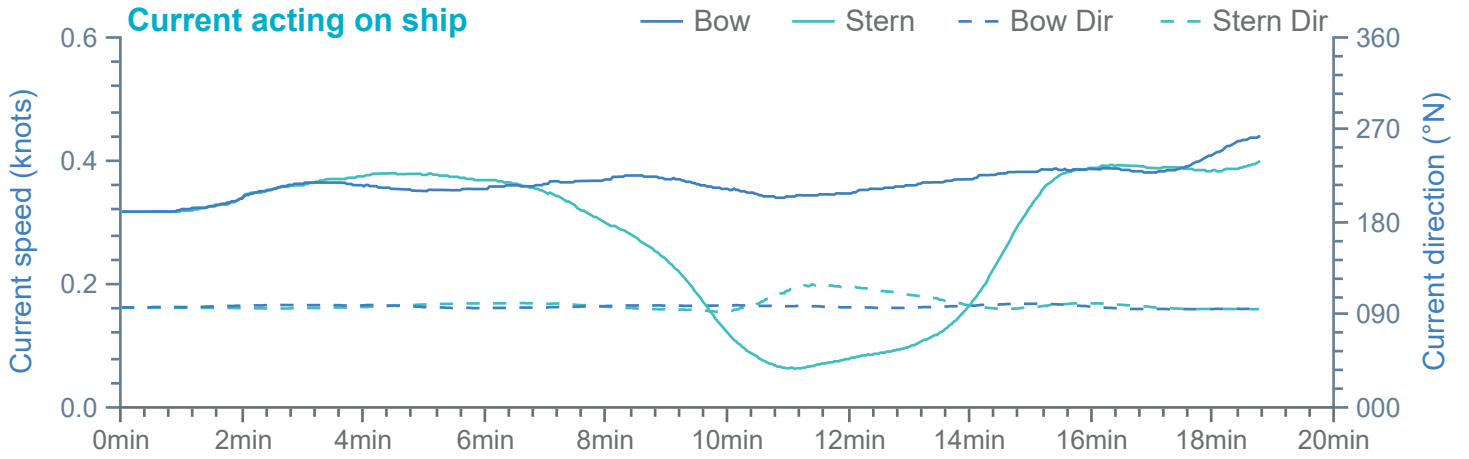


Overview

Environment

MV Celine

Thruster and engine use

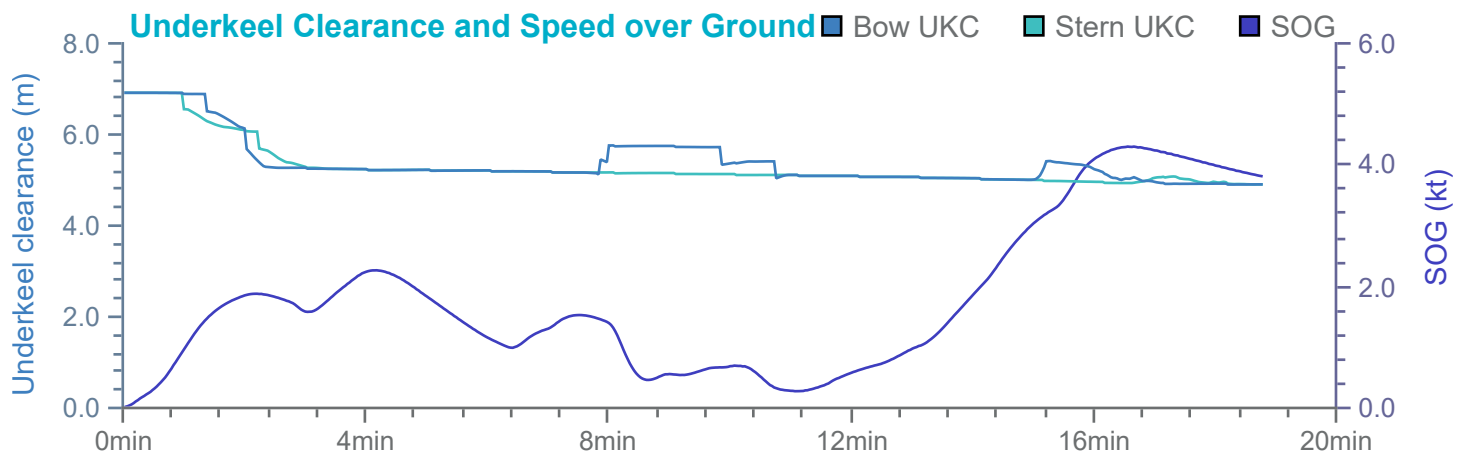
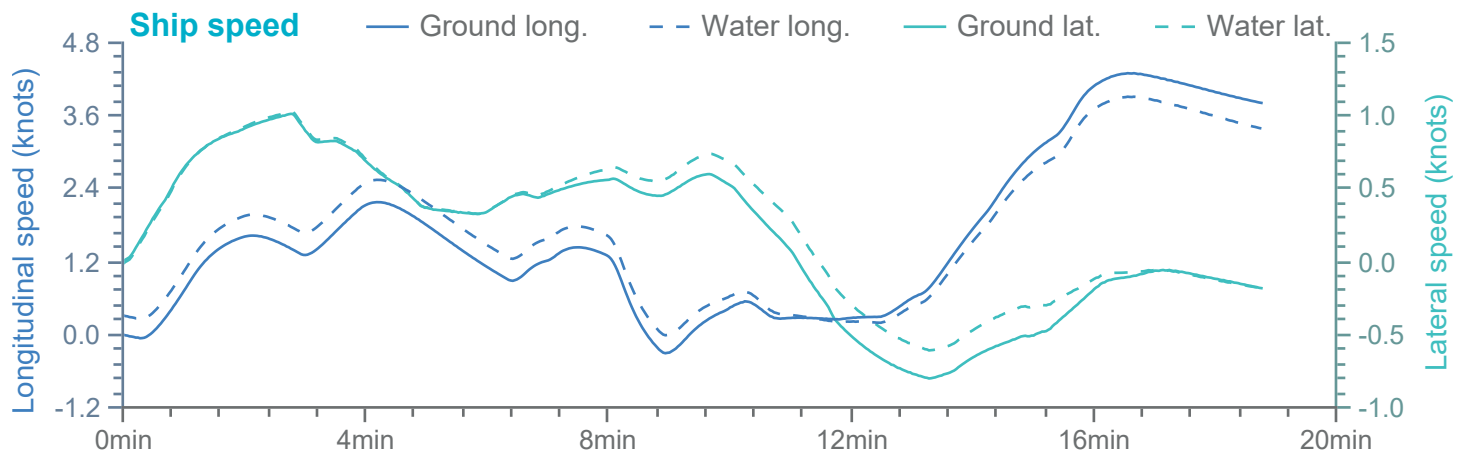
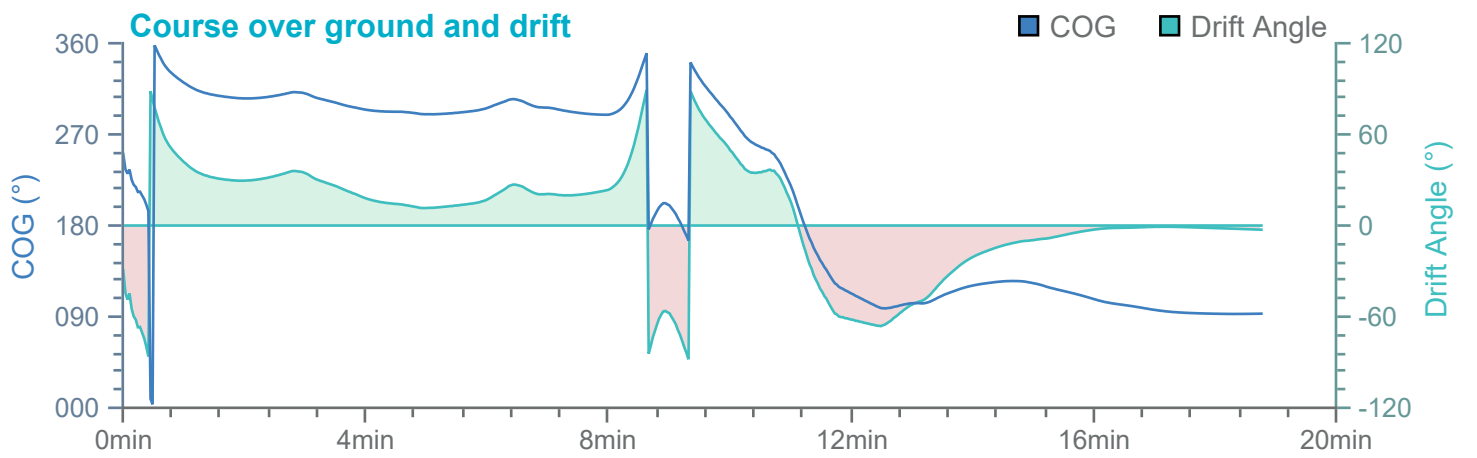
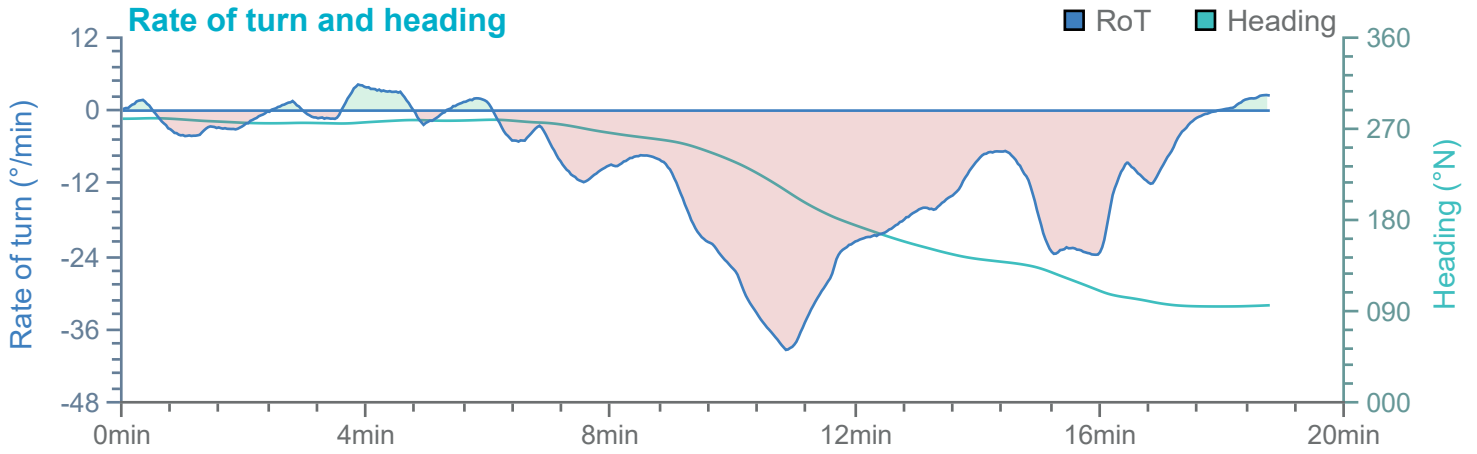


Overview

Environment

MV Celine

Thruster and engine use

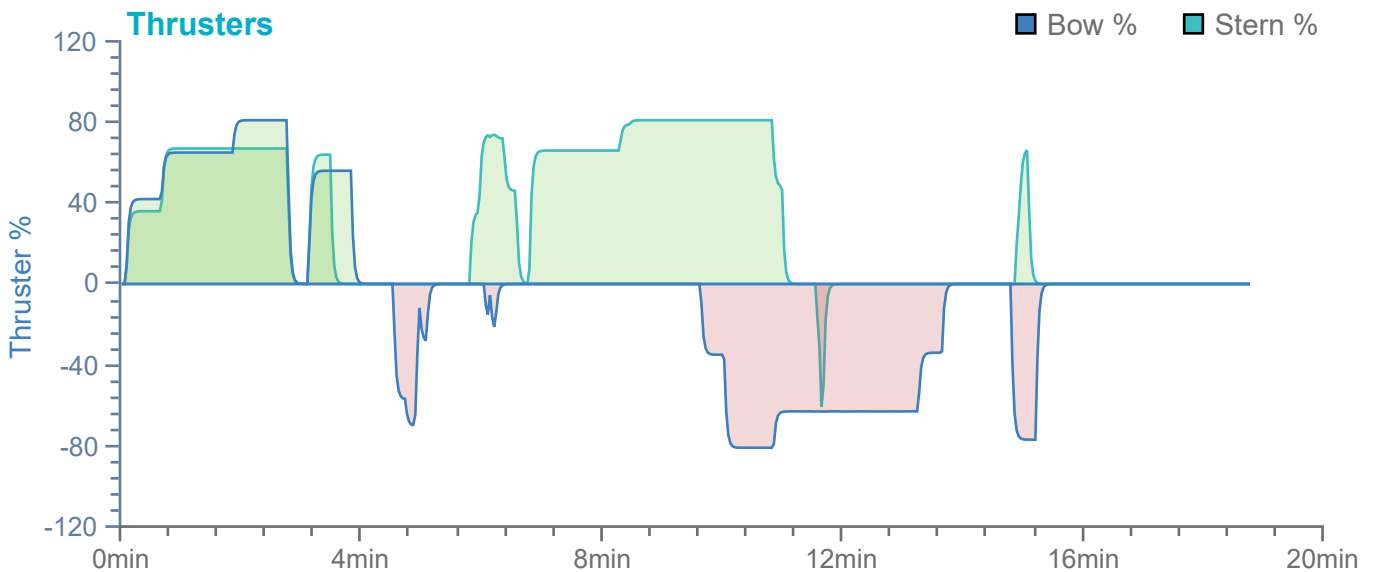
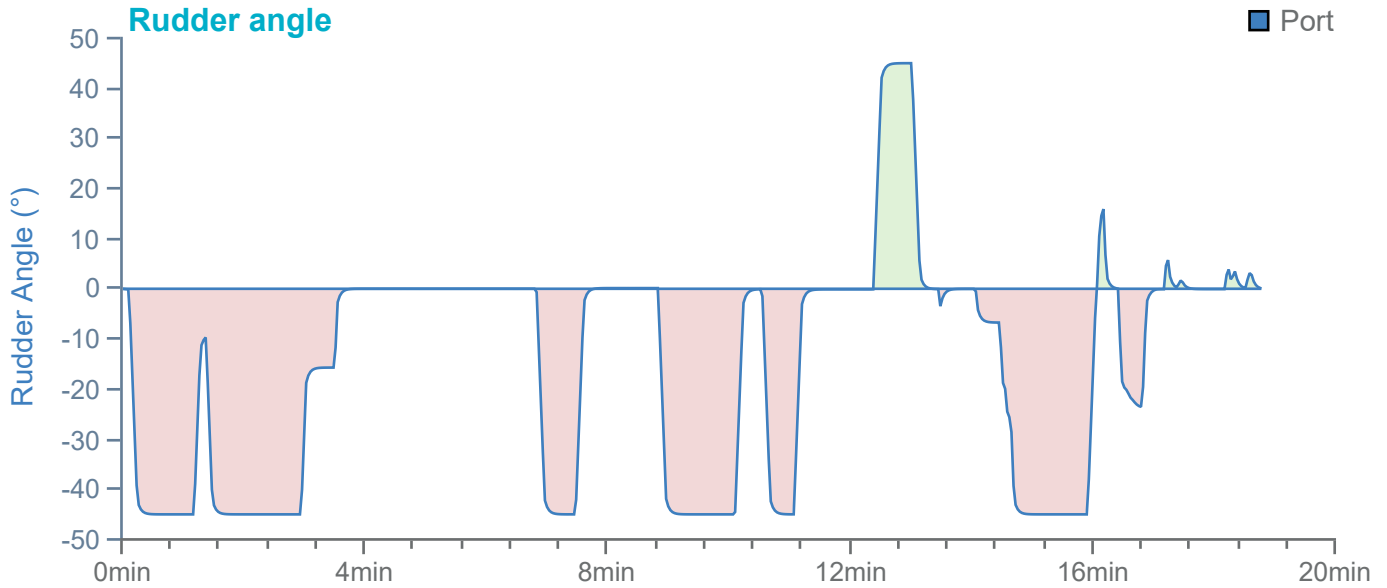
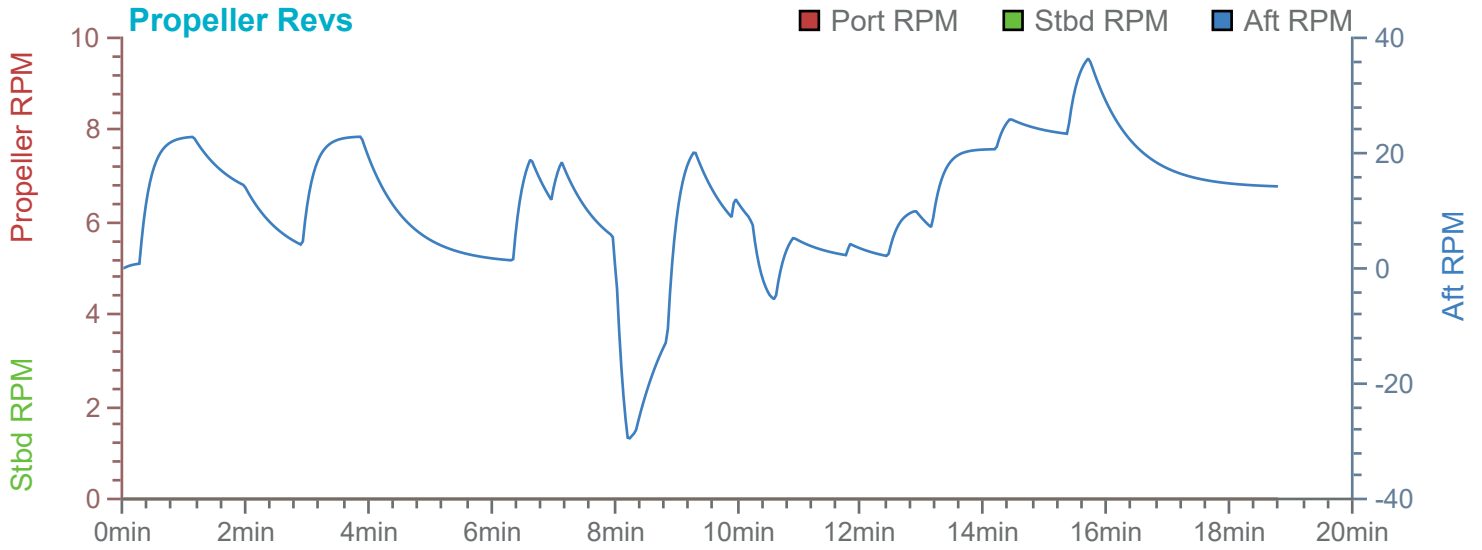


Overview

Environment

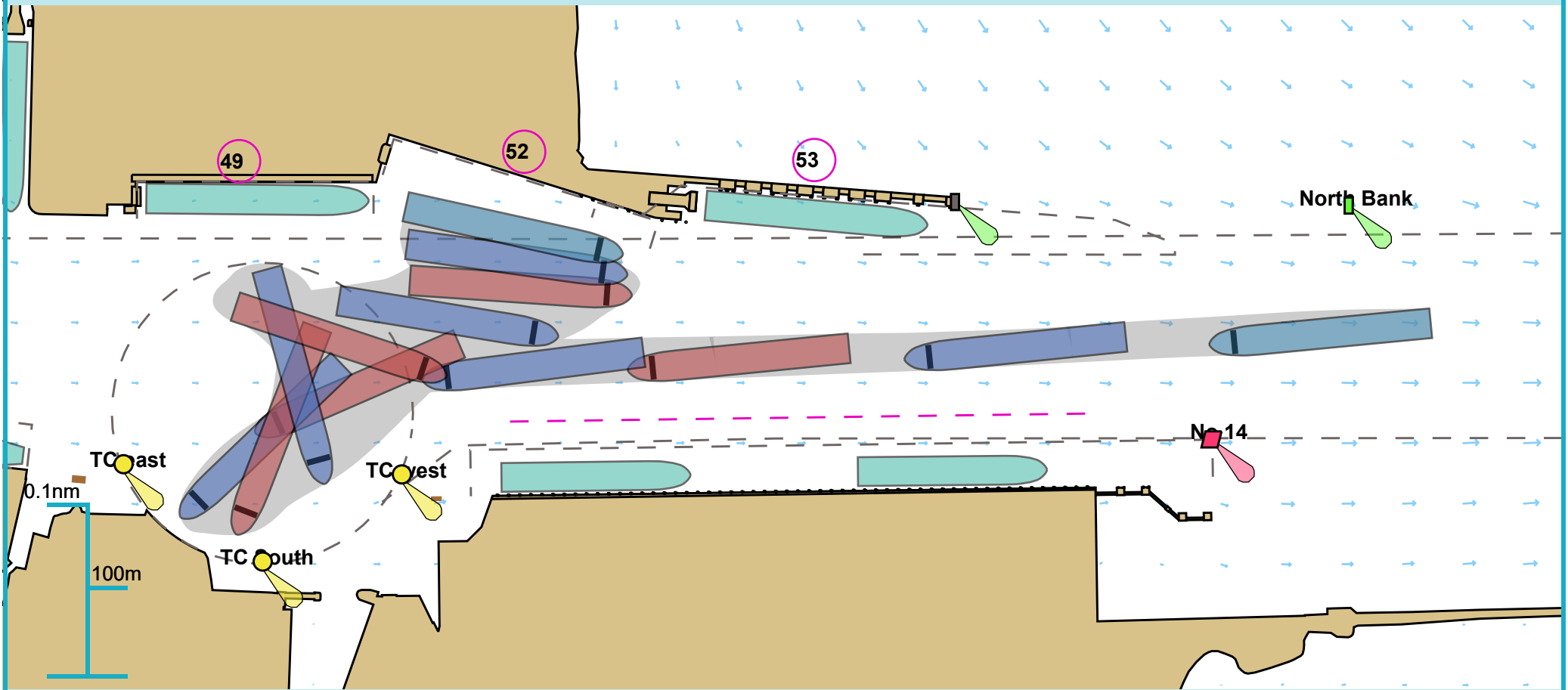
MV Celine

Thruster and engine use



Full Run Overview

53° 20.382 N, 006° 11.896 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

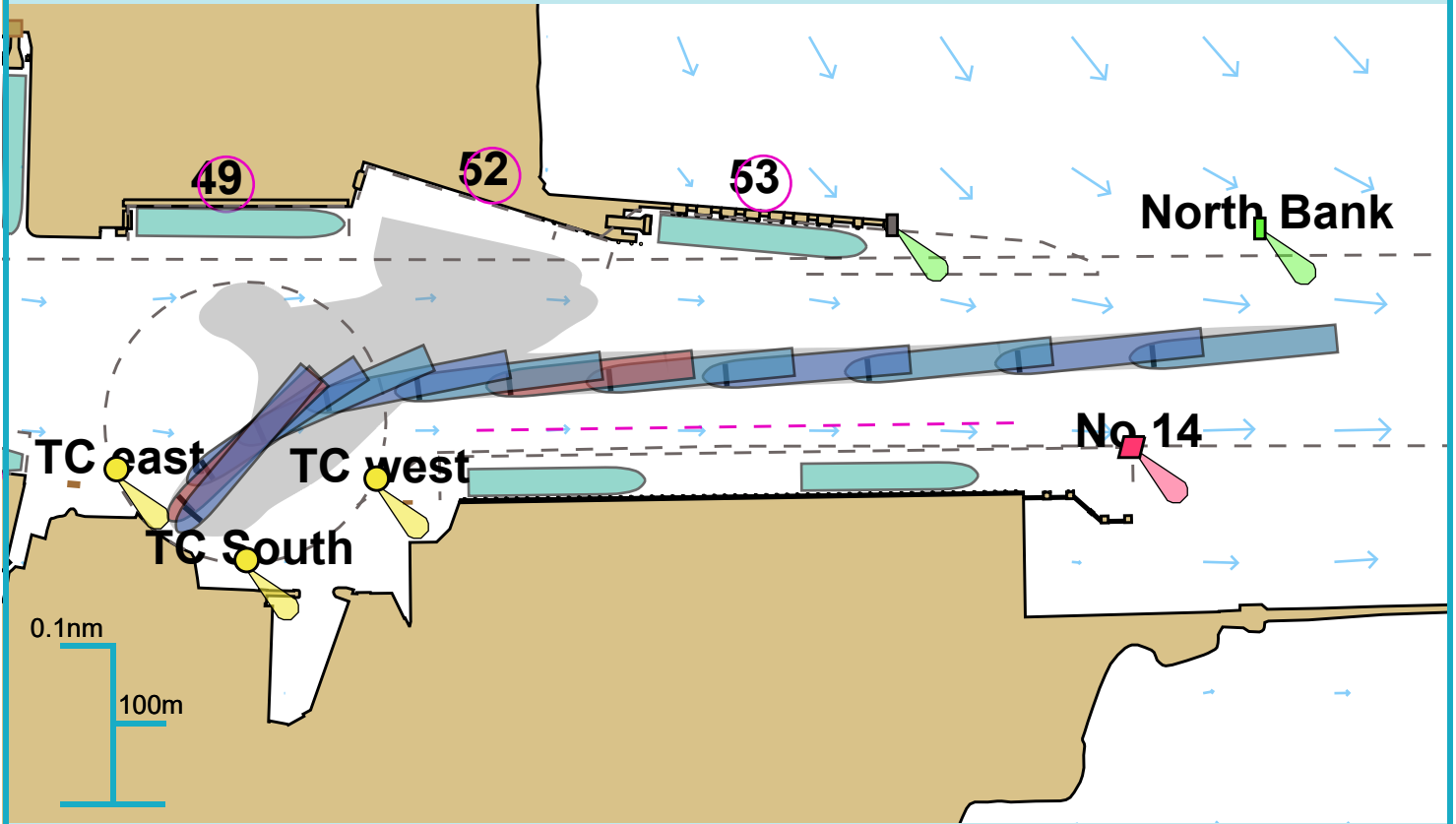
Run length: 23 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

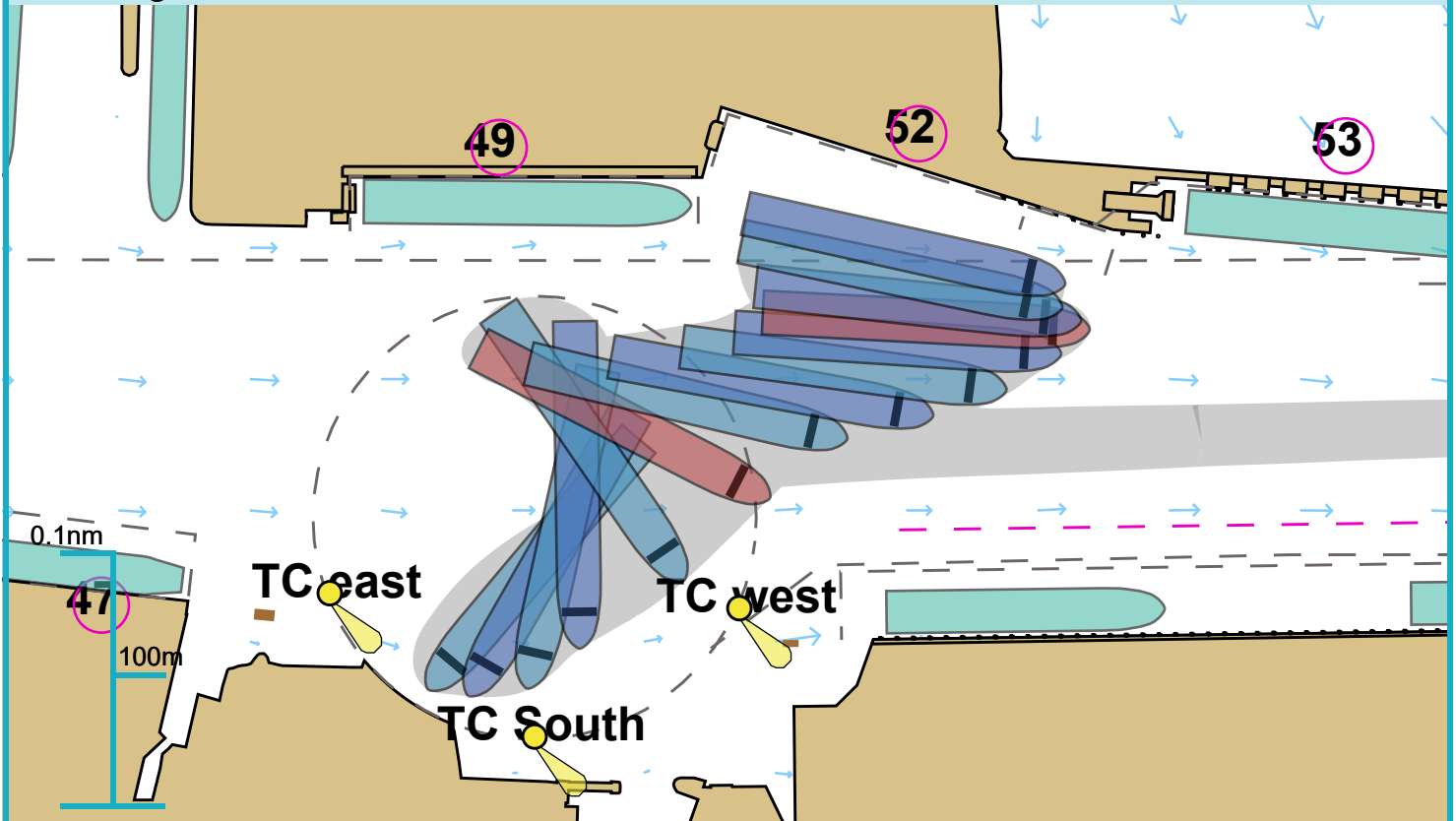
Comments:

Approach



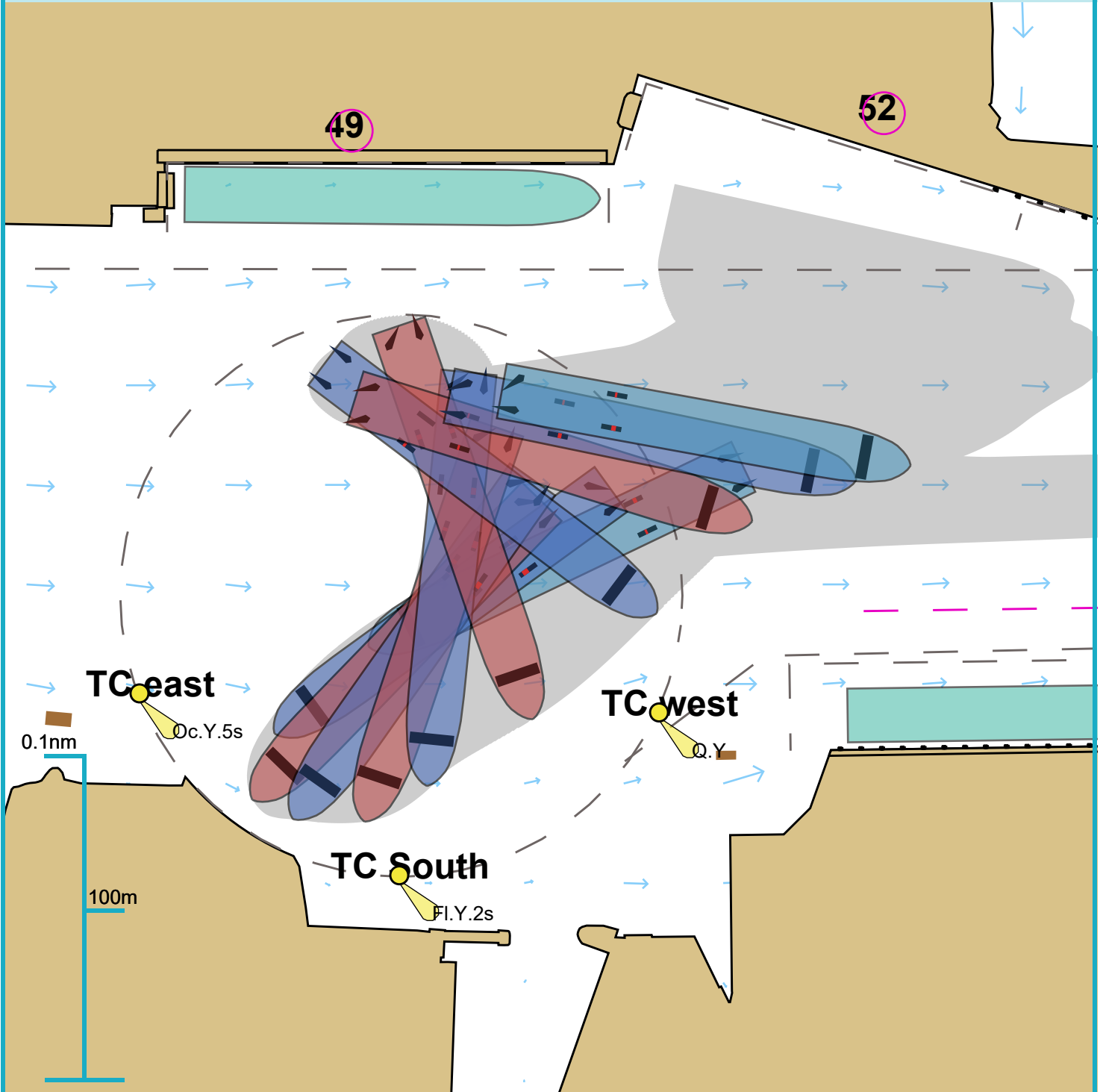
Ships plotted every 1 mins, highlight every 5 mins

Berthing

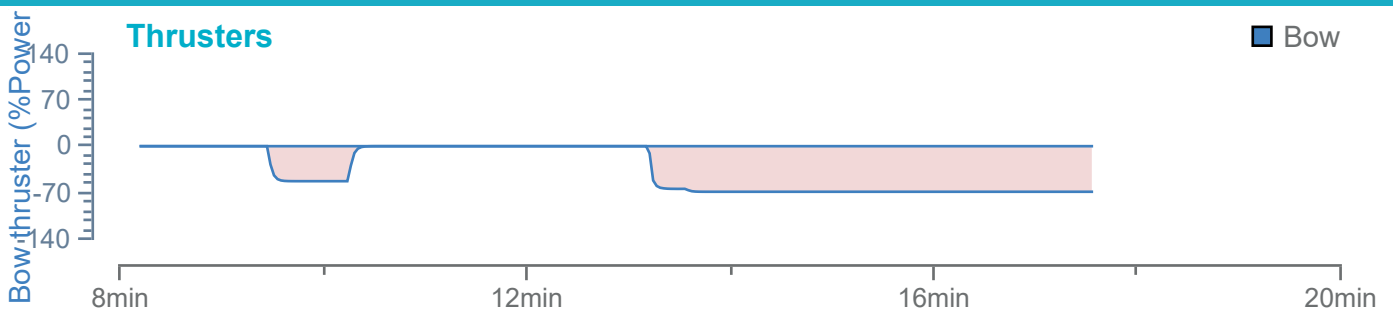


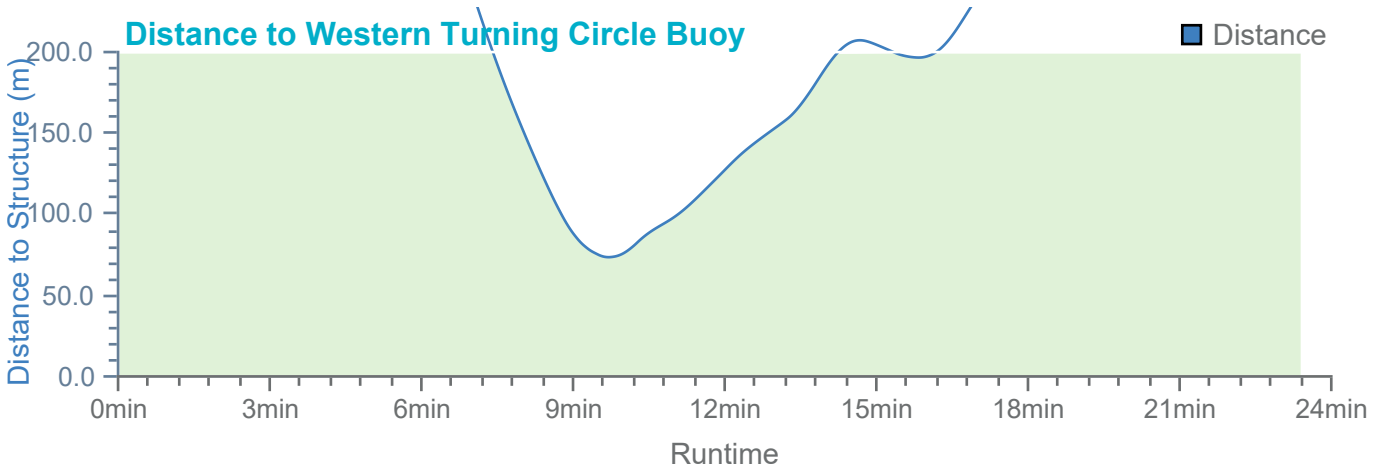
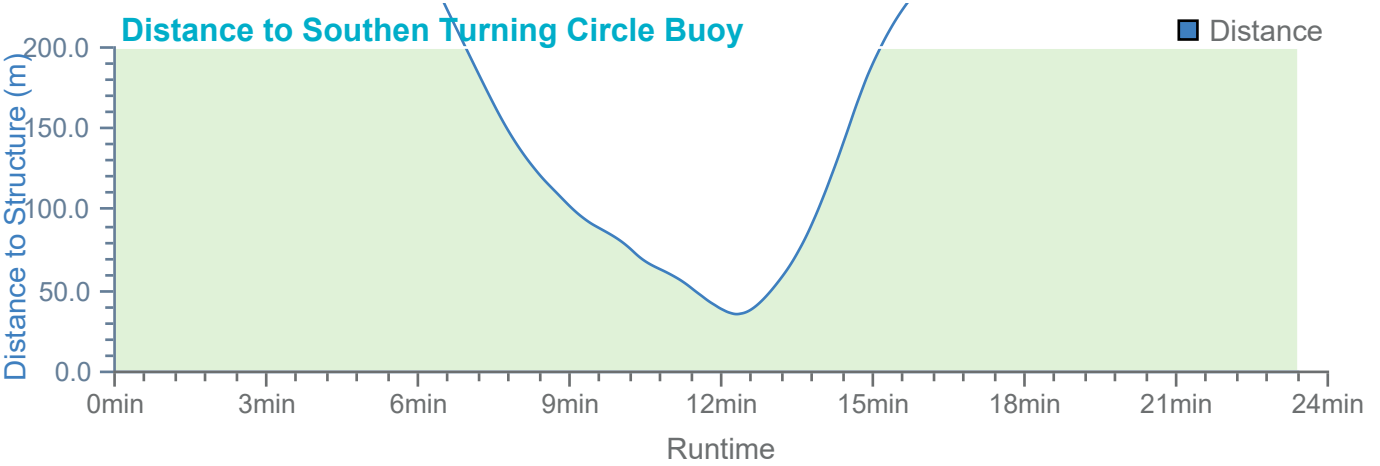
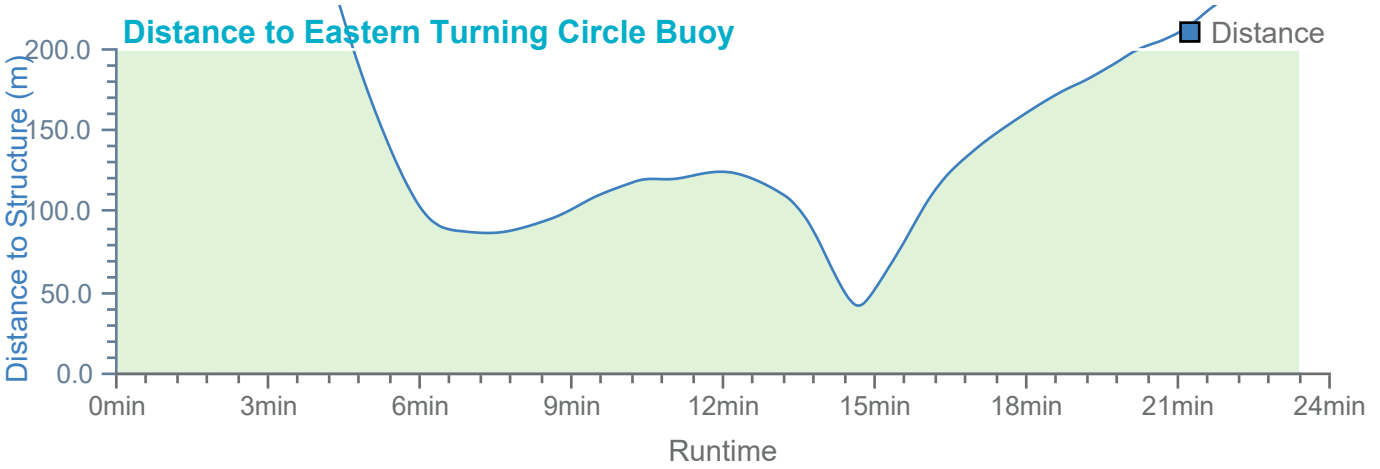
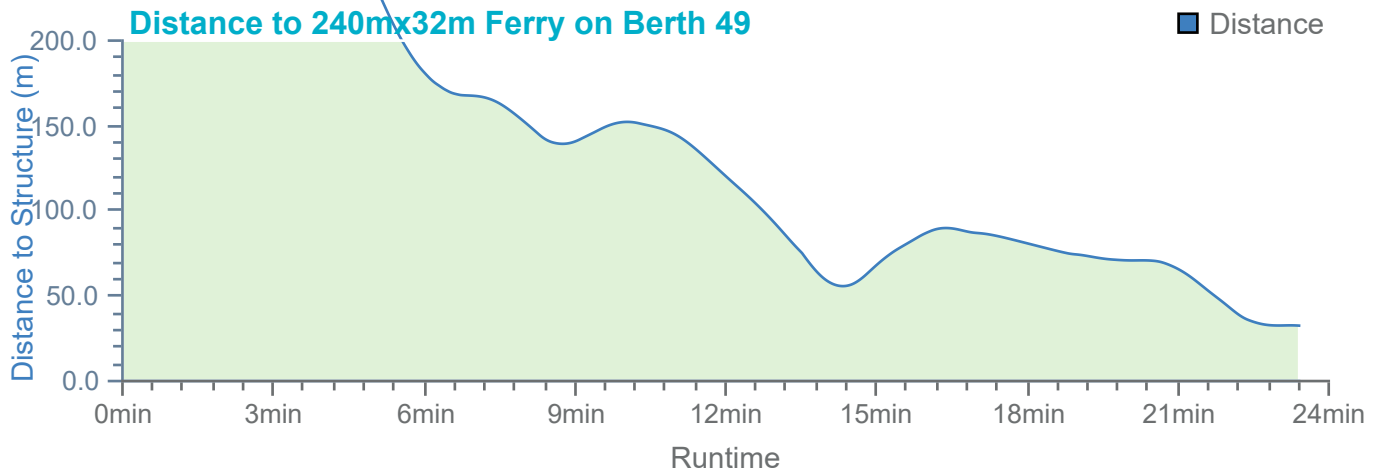
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



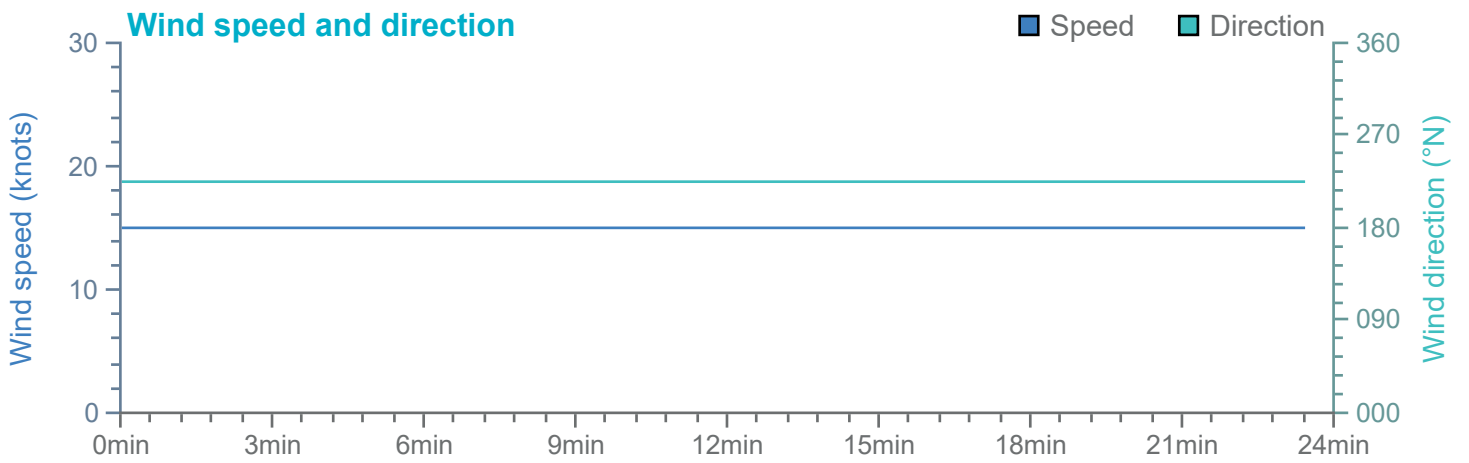
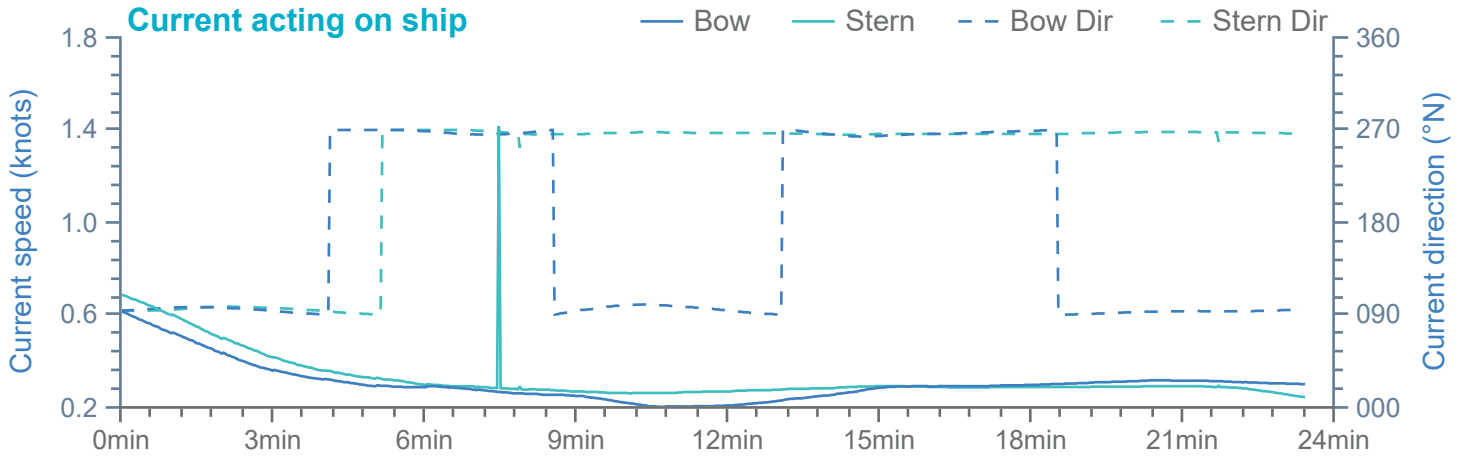


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

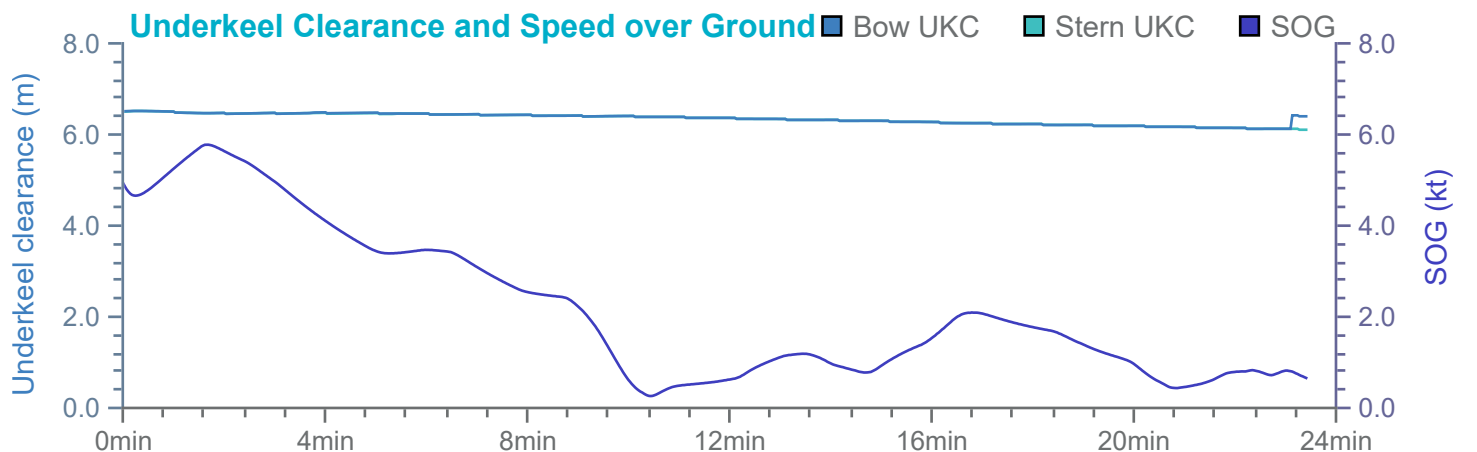
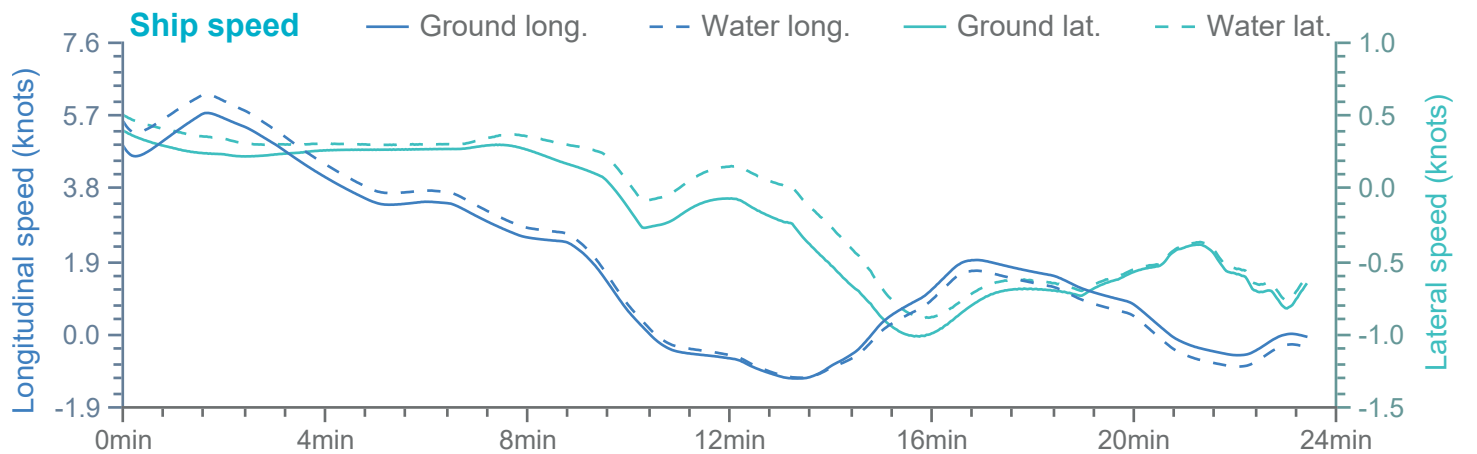
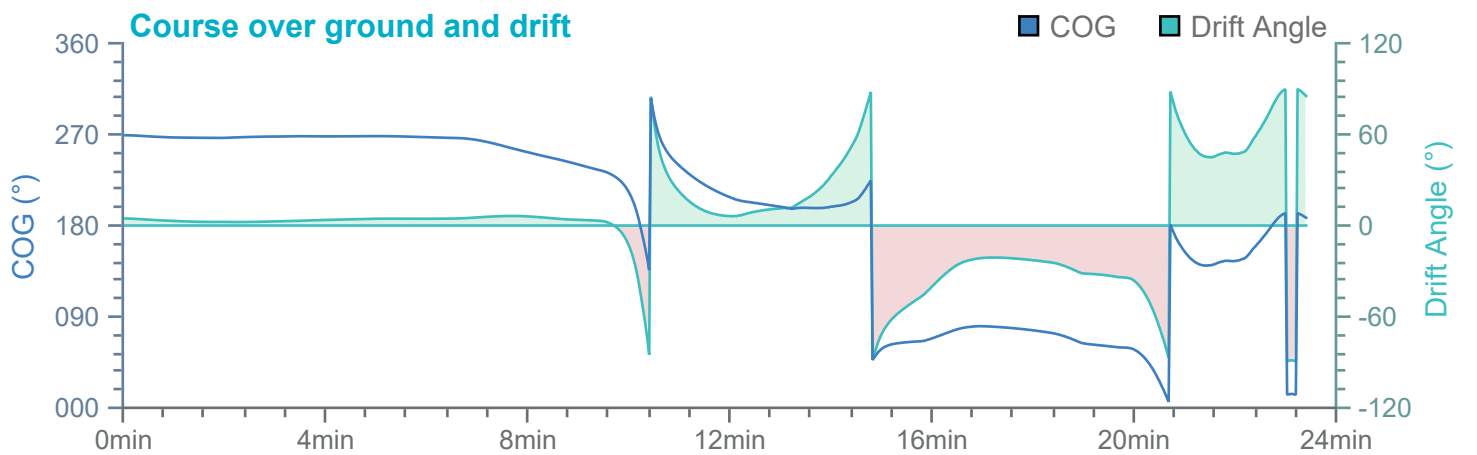
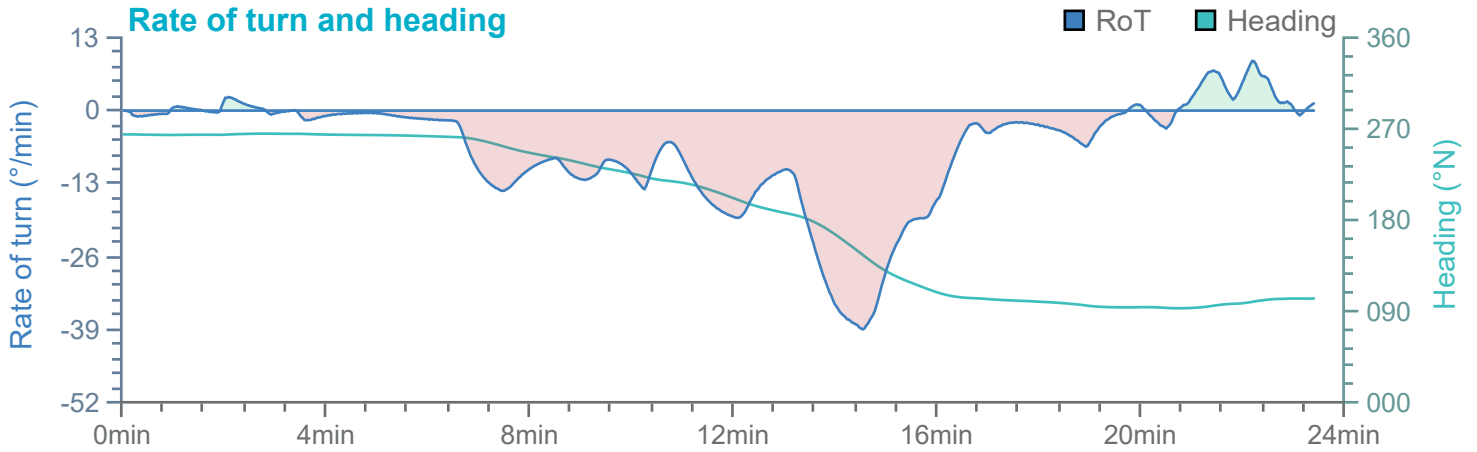


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

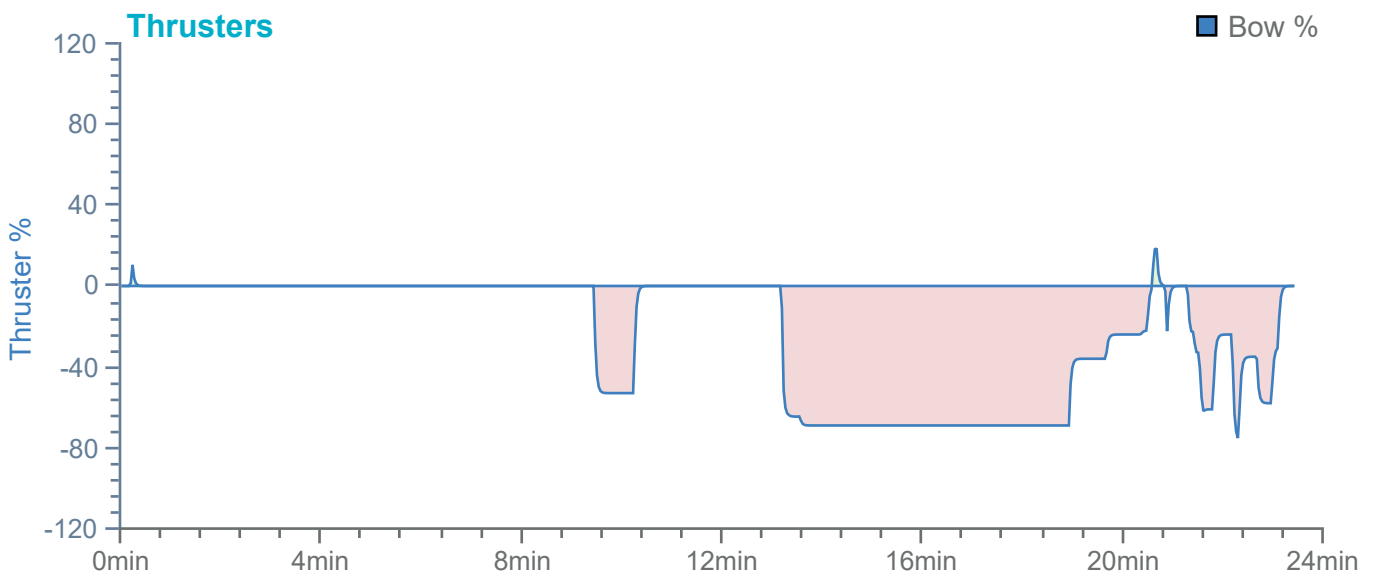
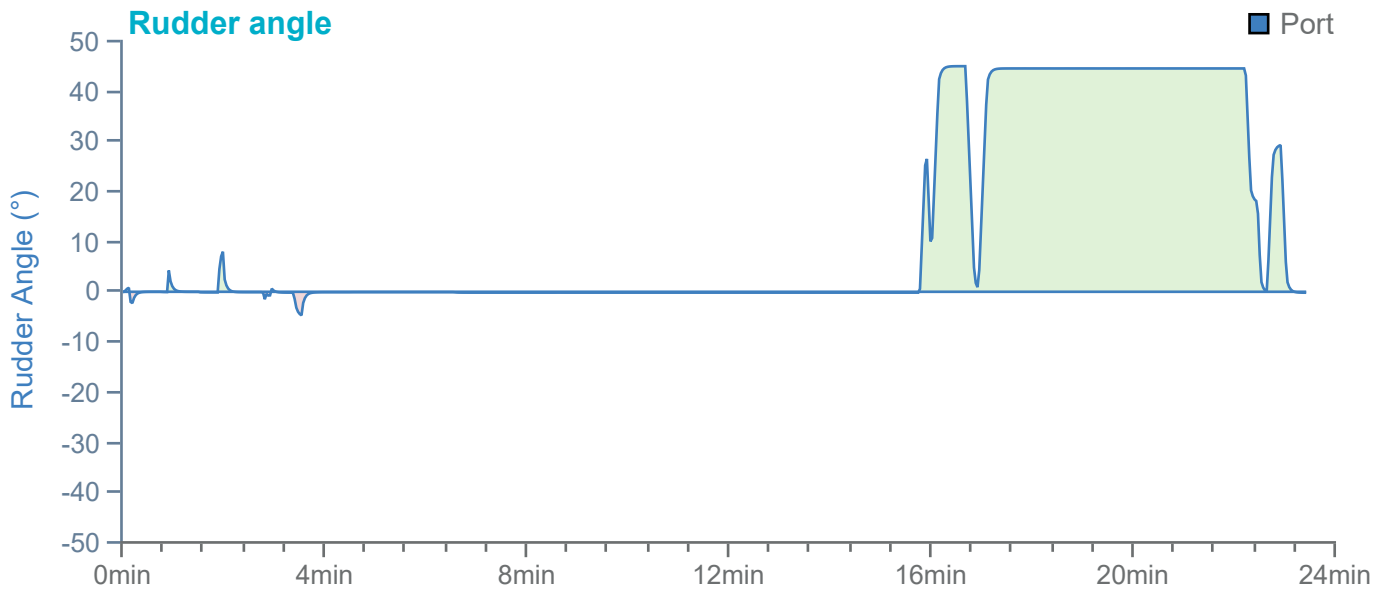
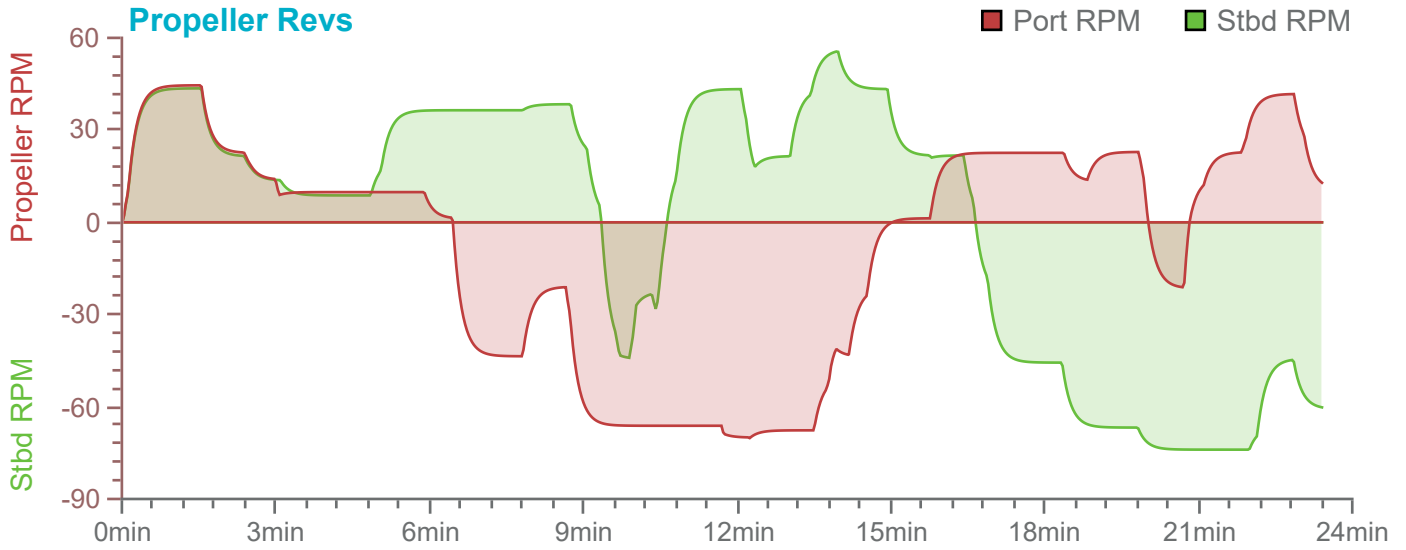


Overview

Environment

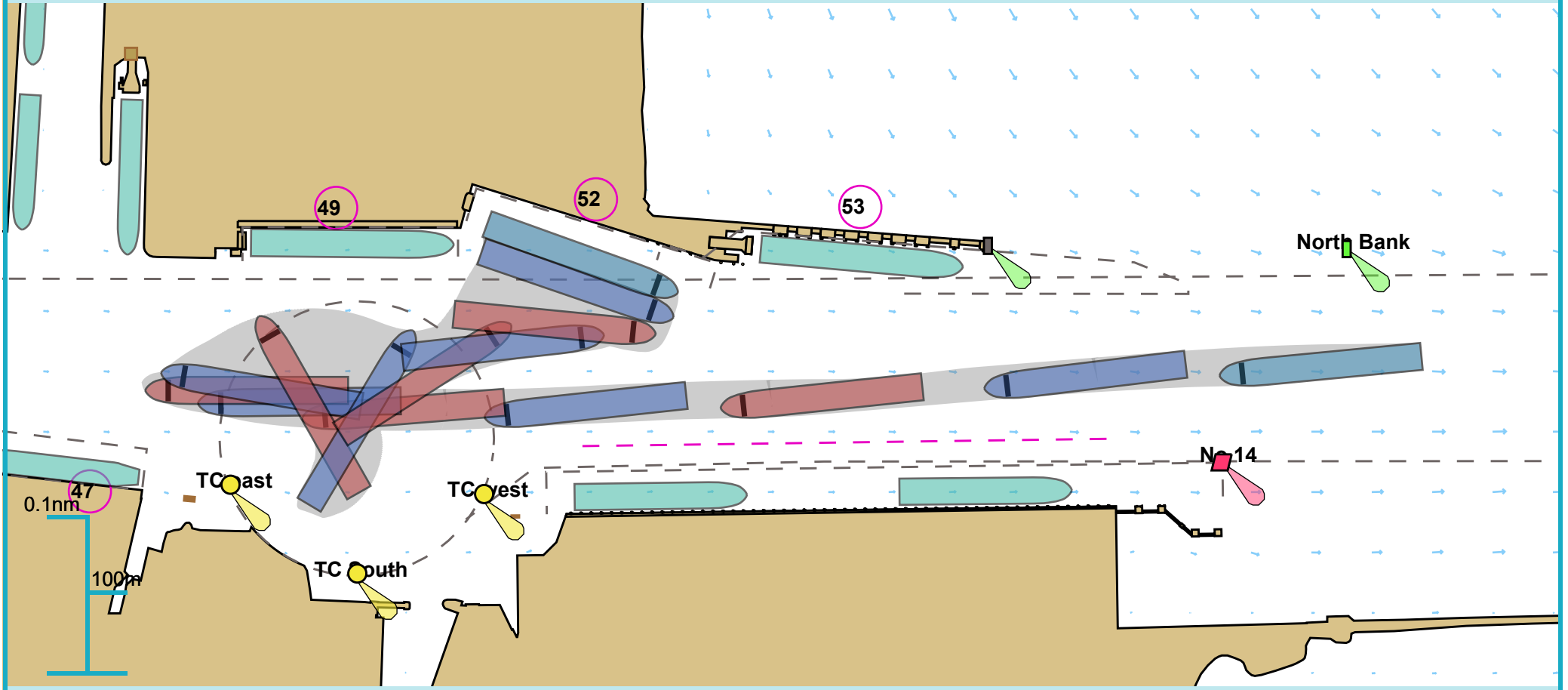
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.382 N, 006° 12.022 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

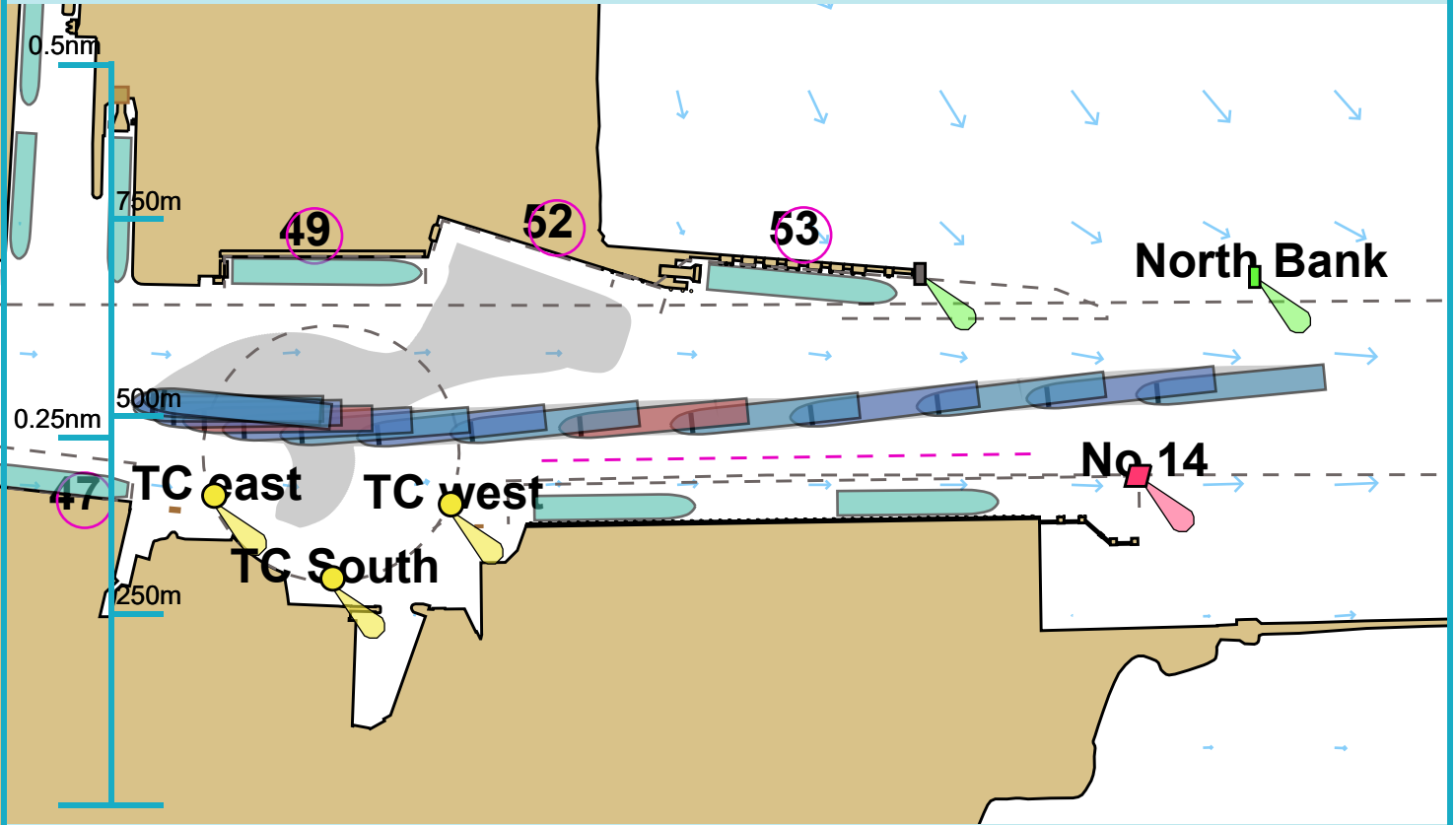
Run length:27 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax Ferry

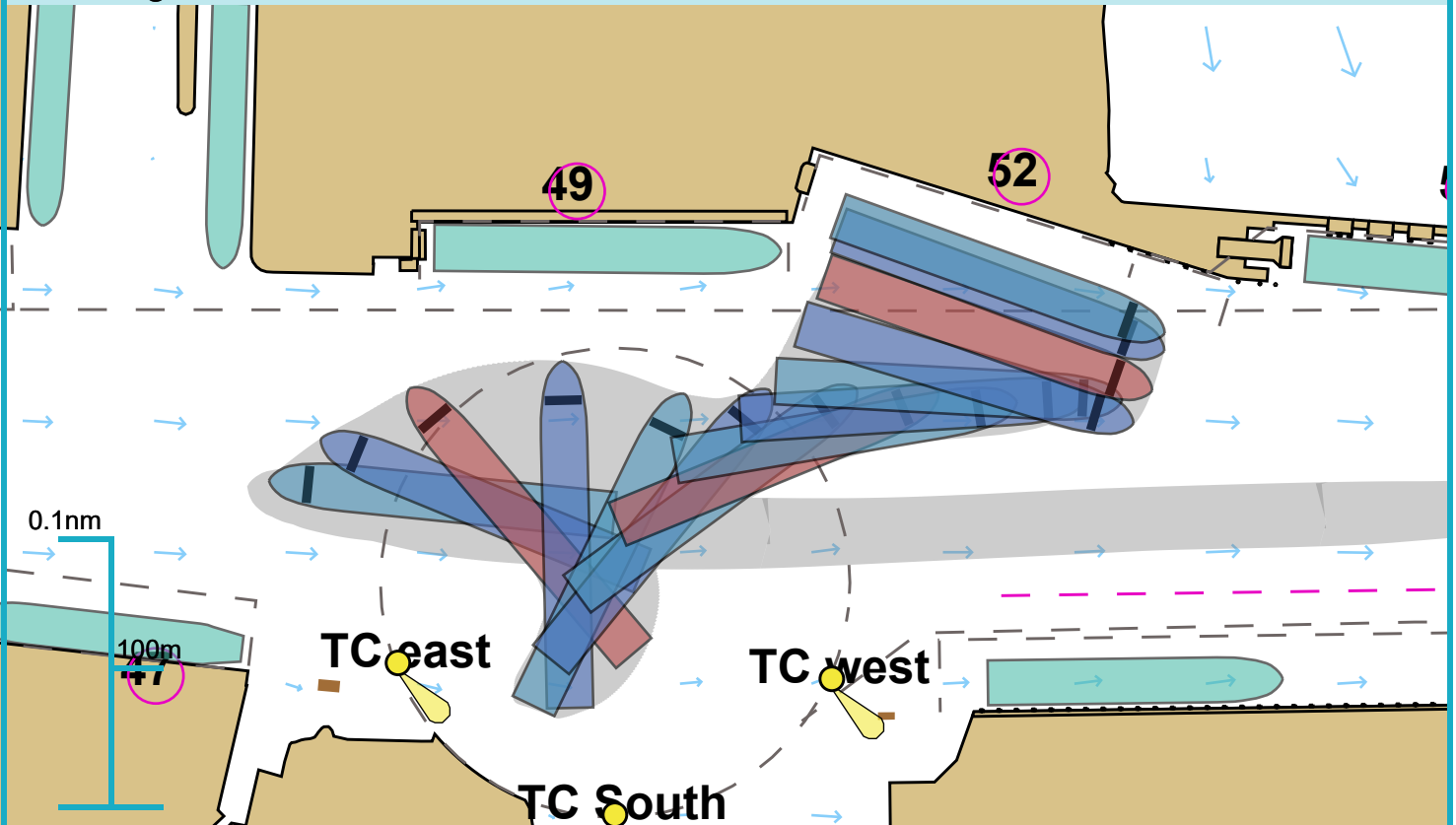
Comments:

Approach



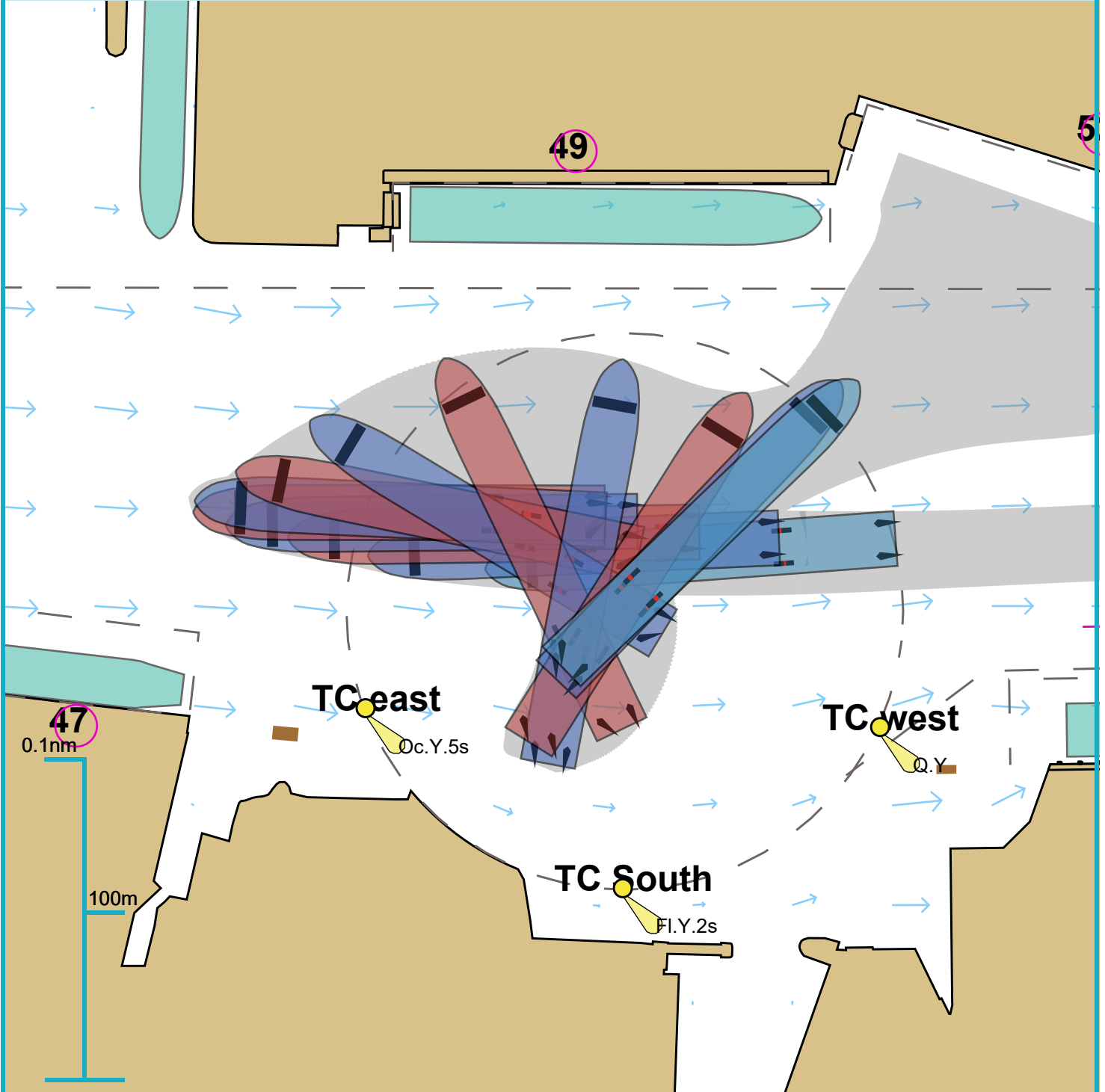
Ships plotted every 1 mins, highlight every 5 mins

Berthing

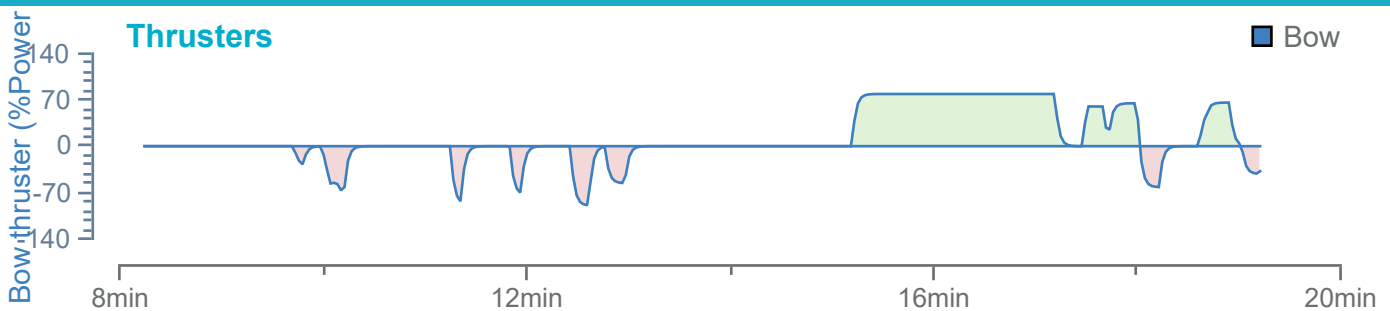


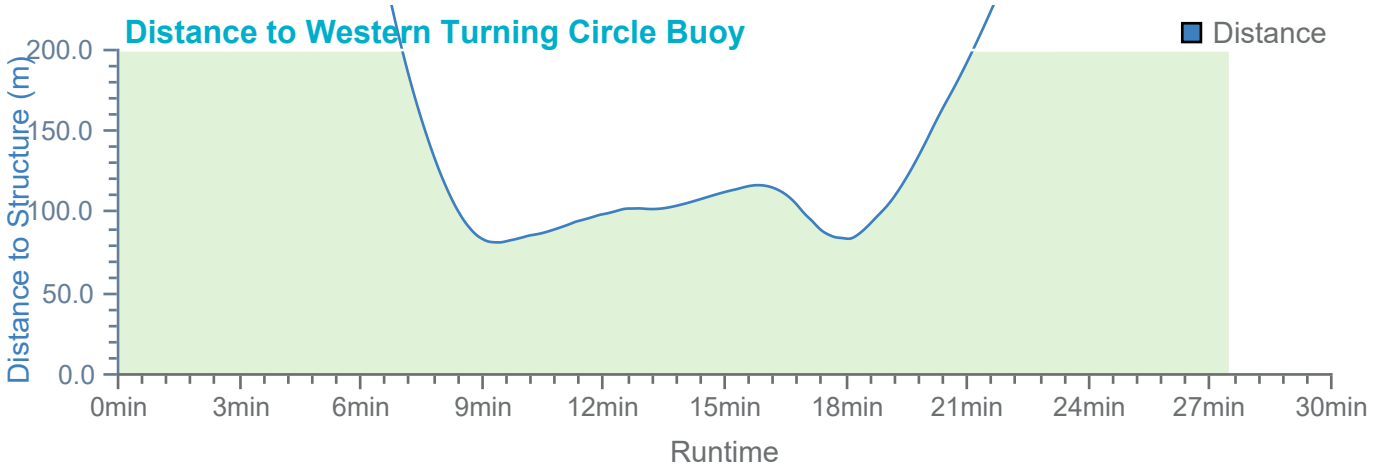
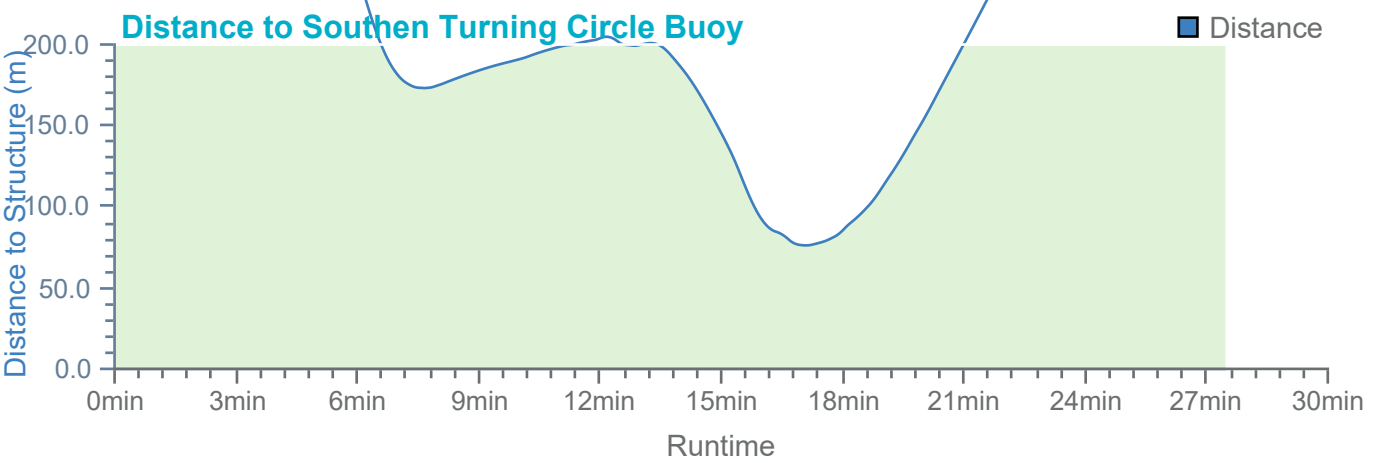
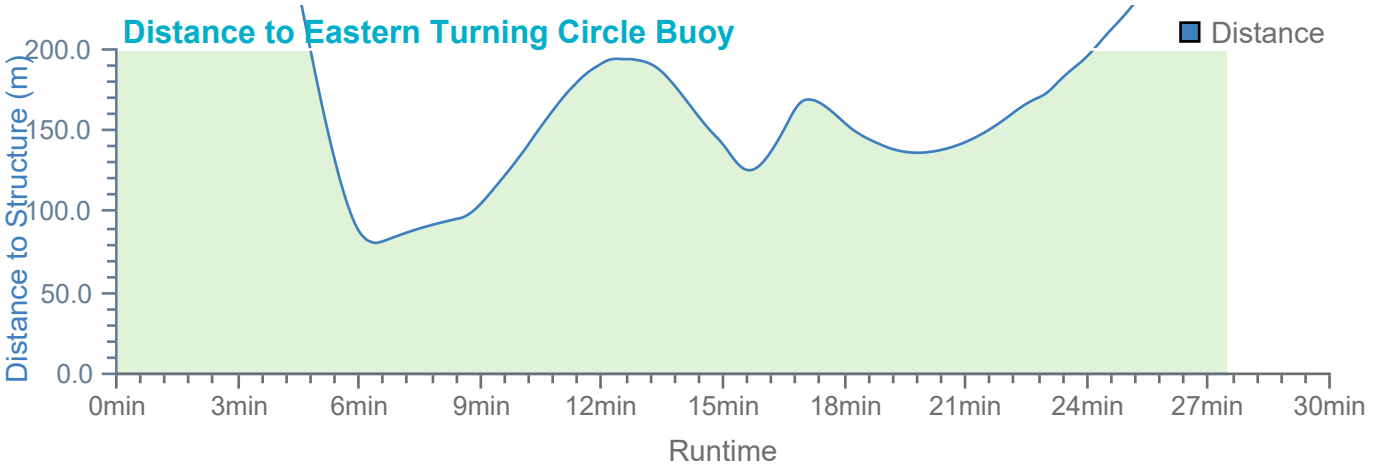
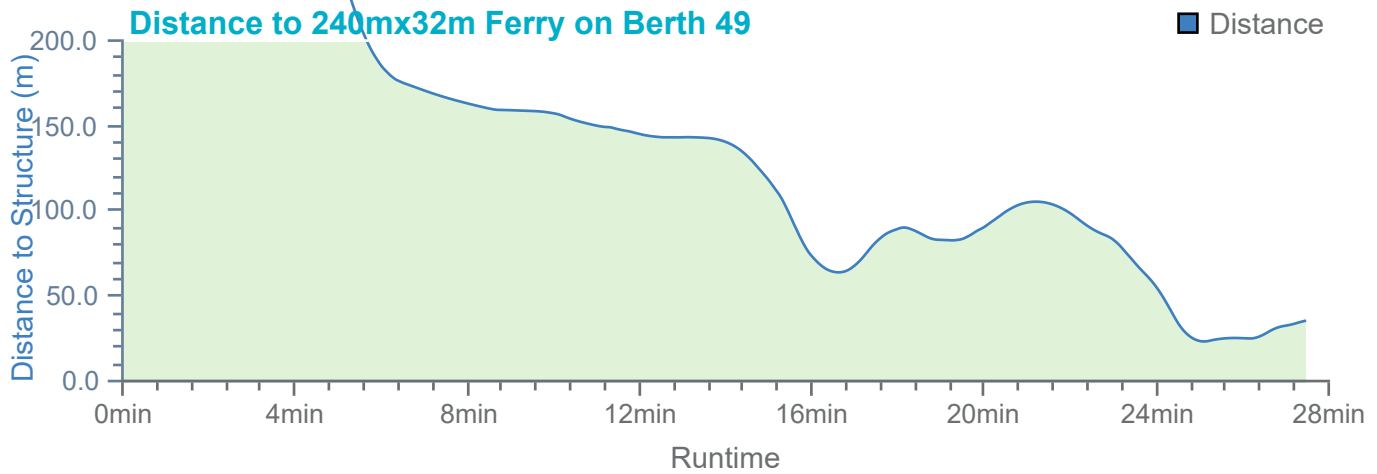
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



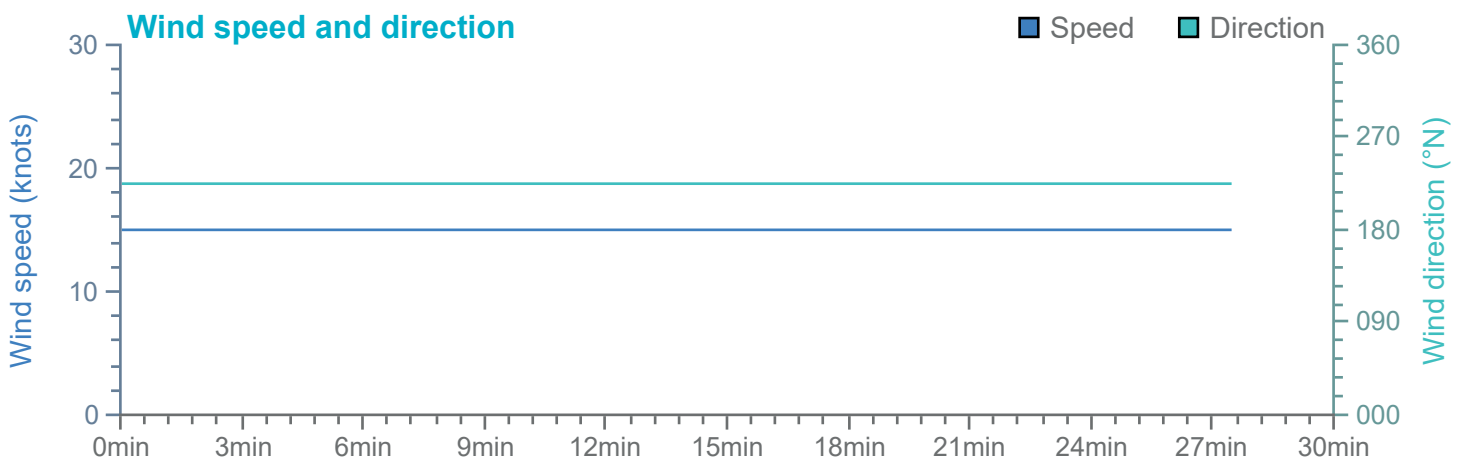
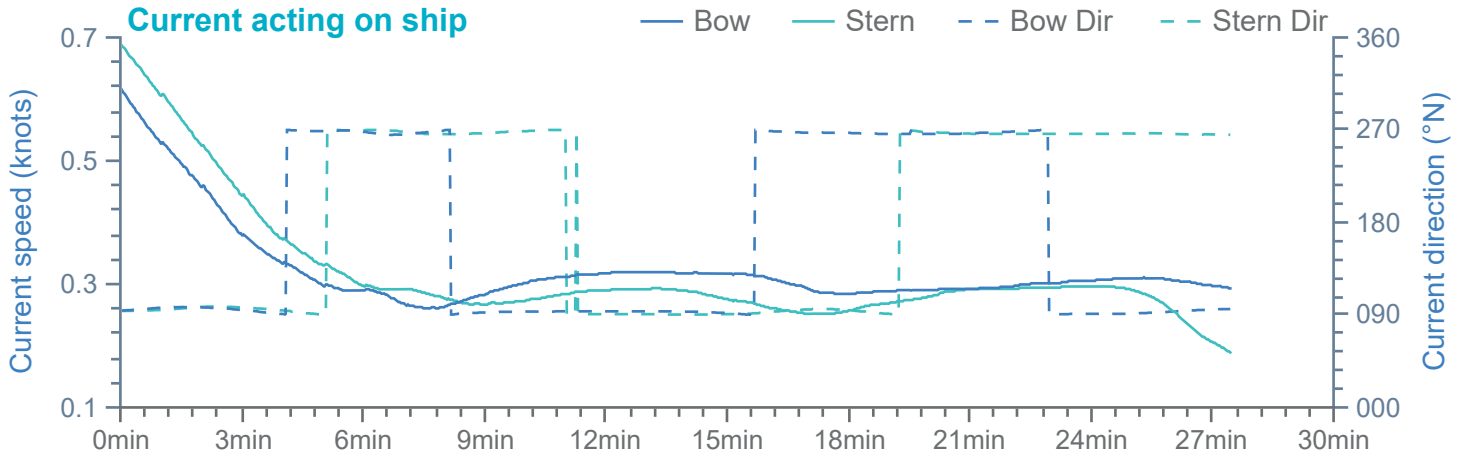


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

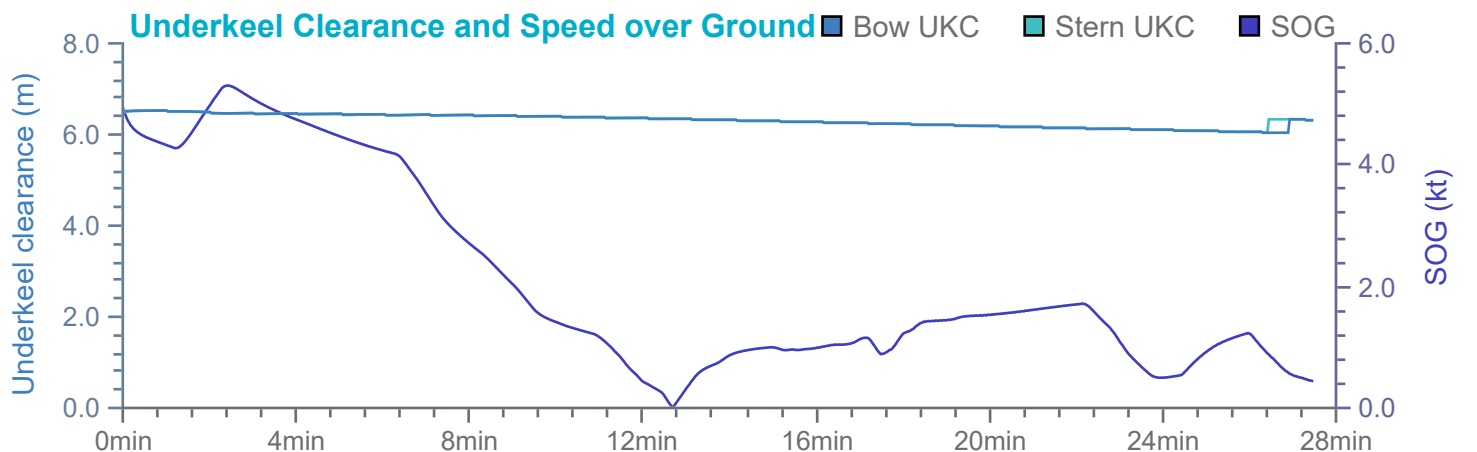
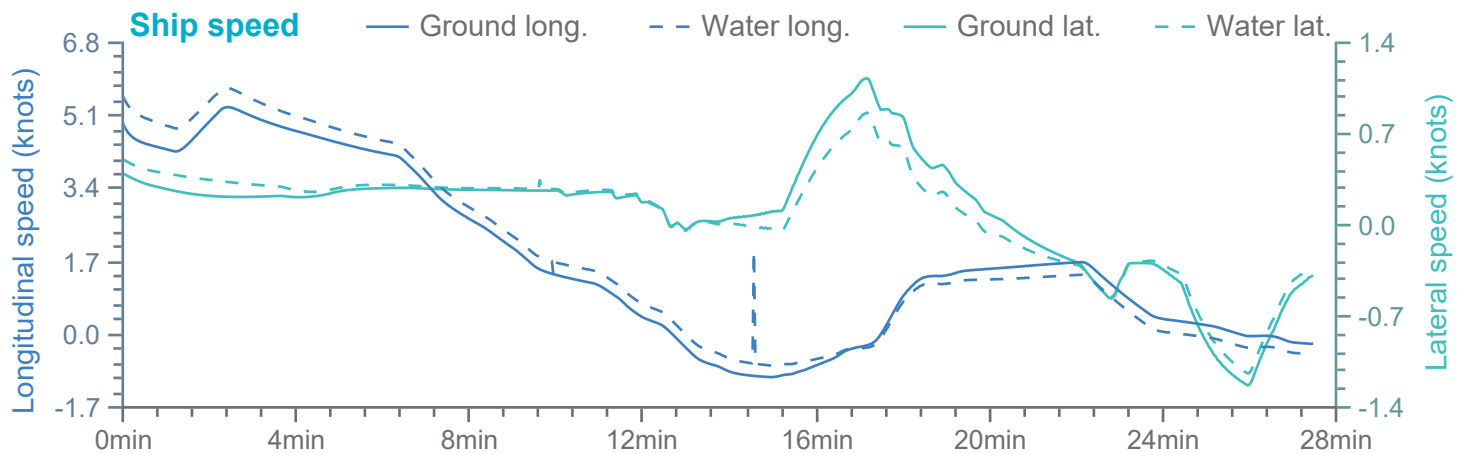
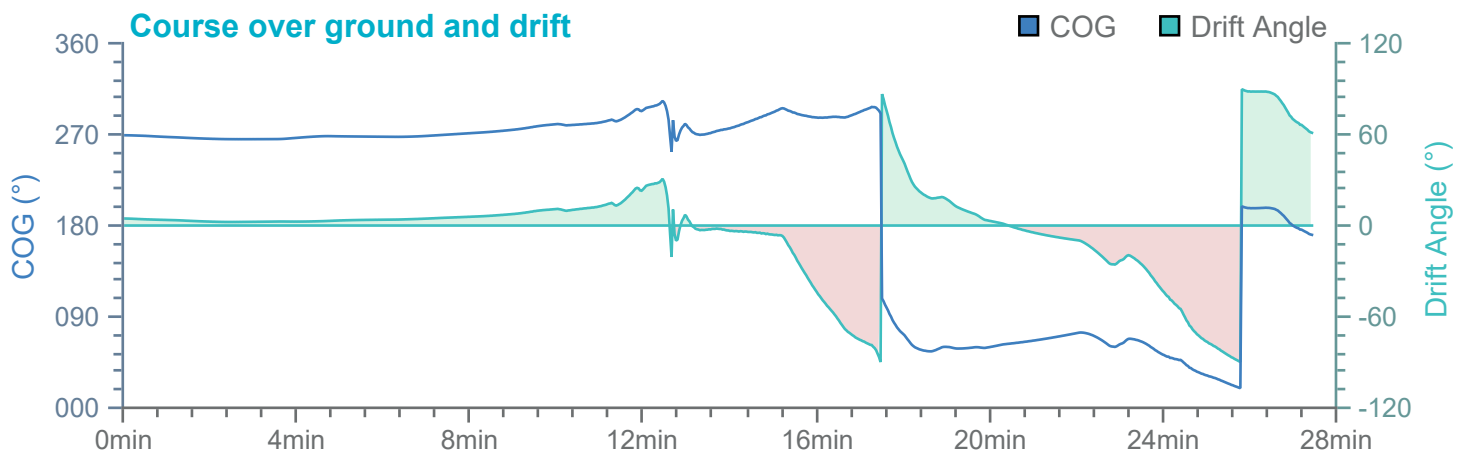
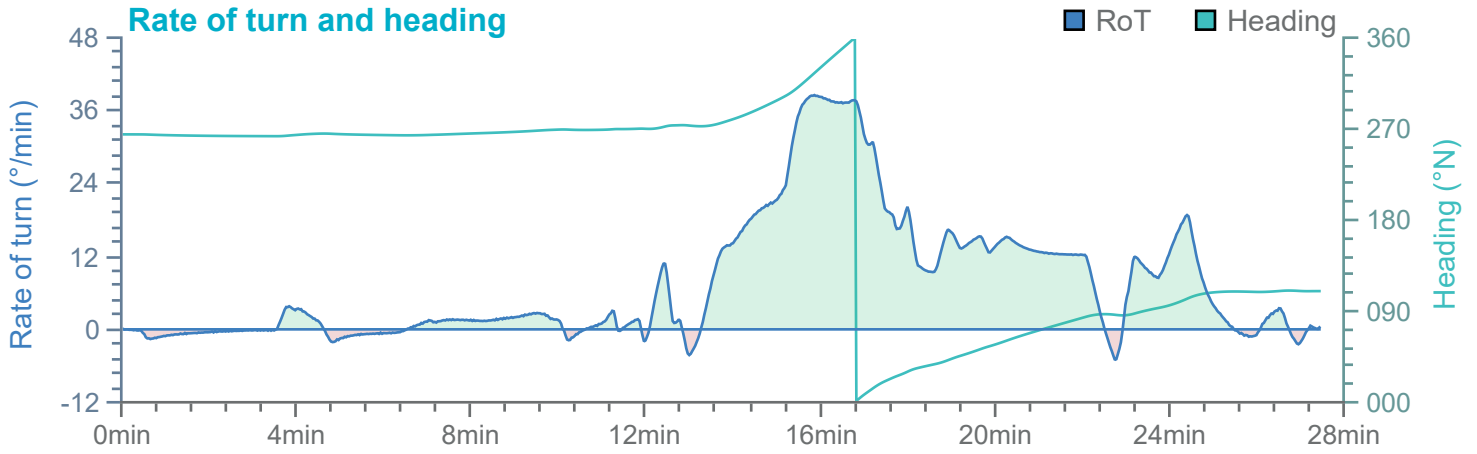


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

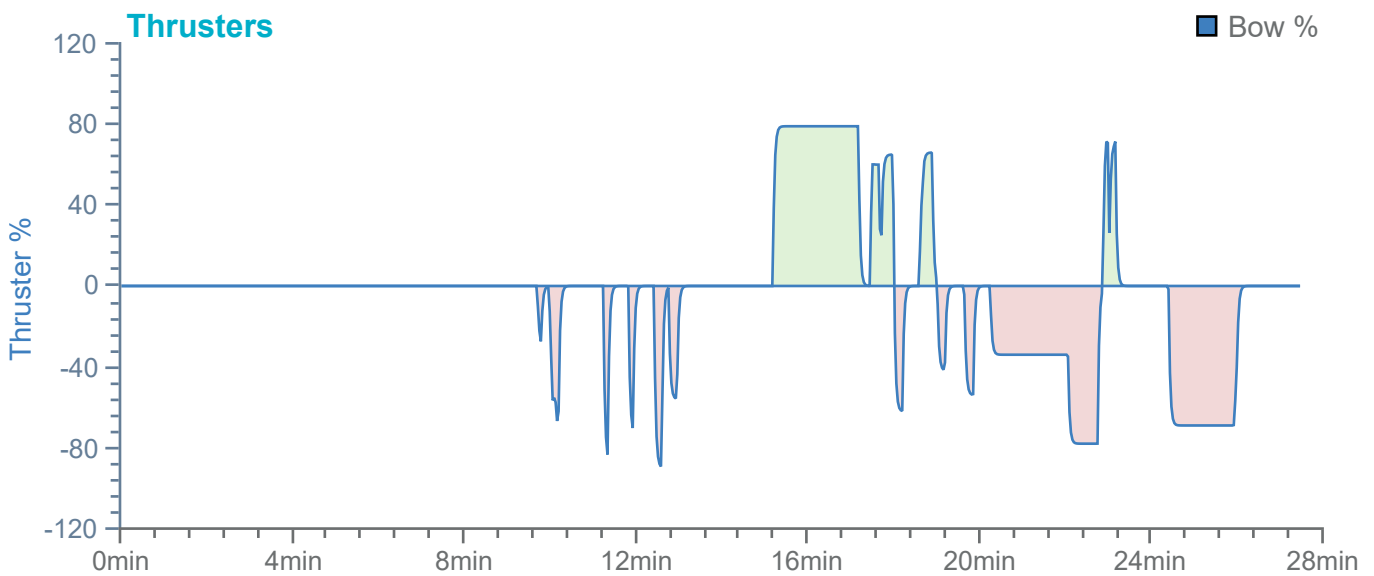
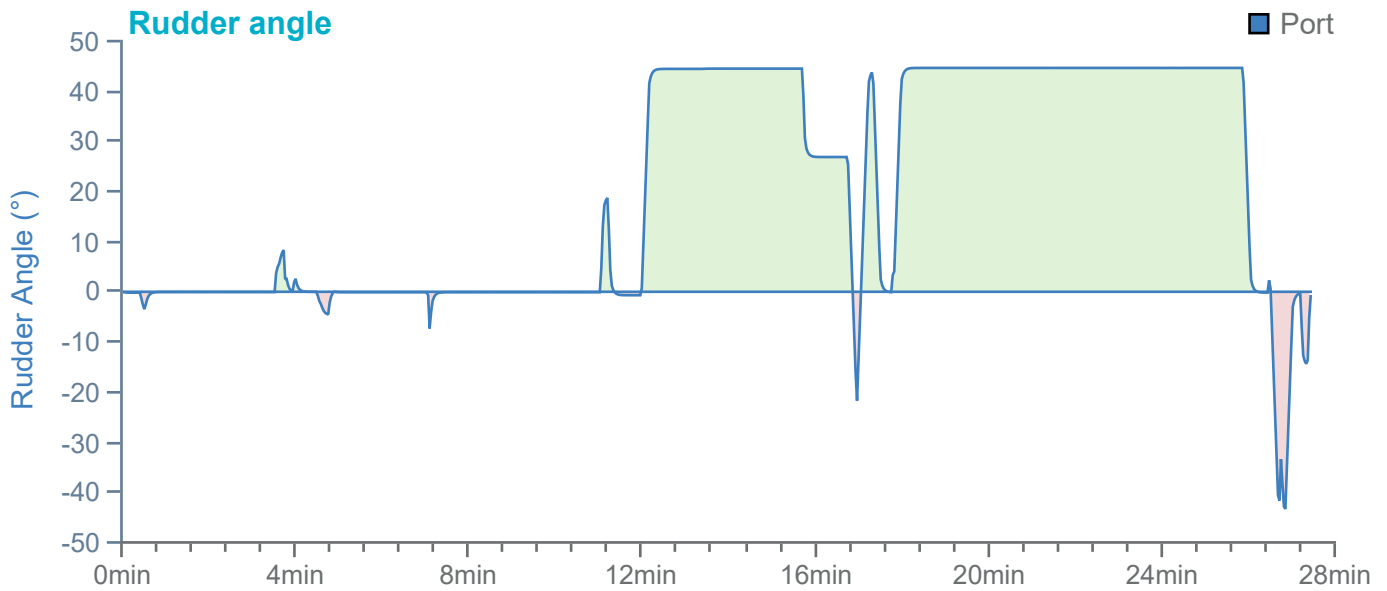
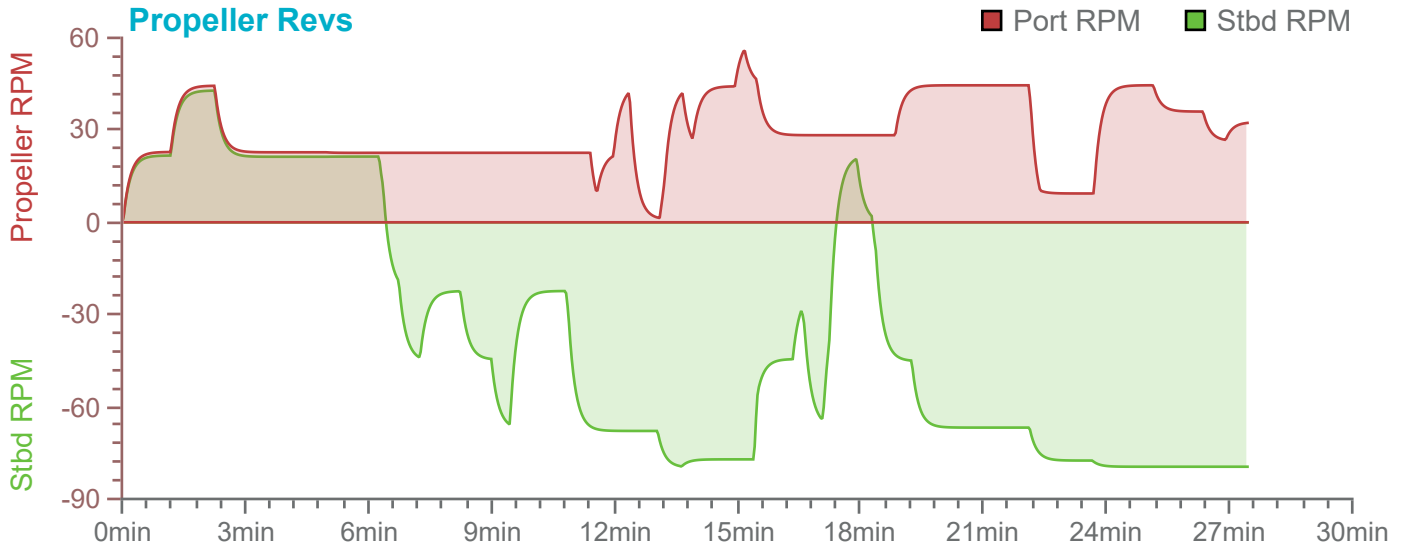


Overview

Environment

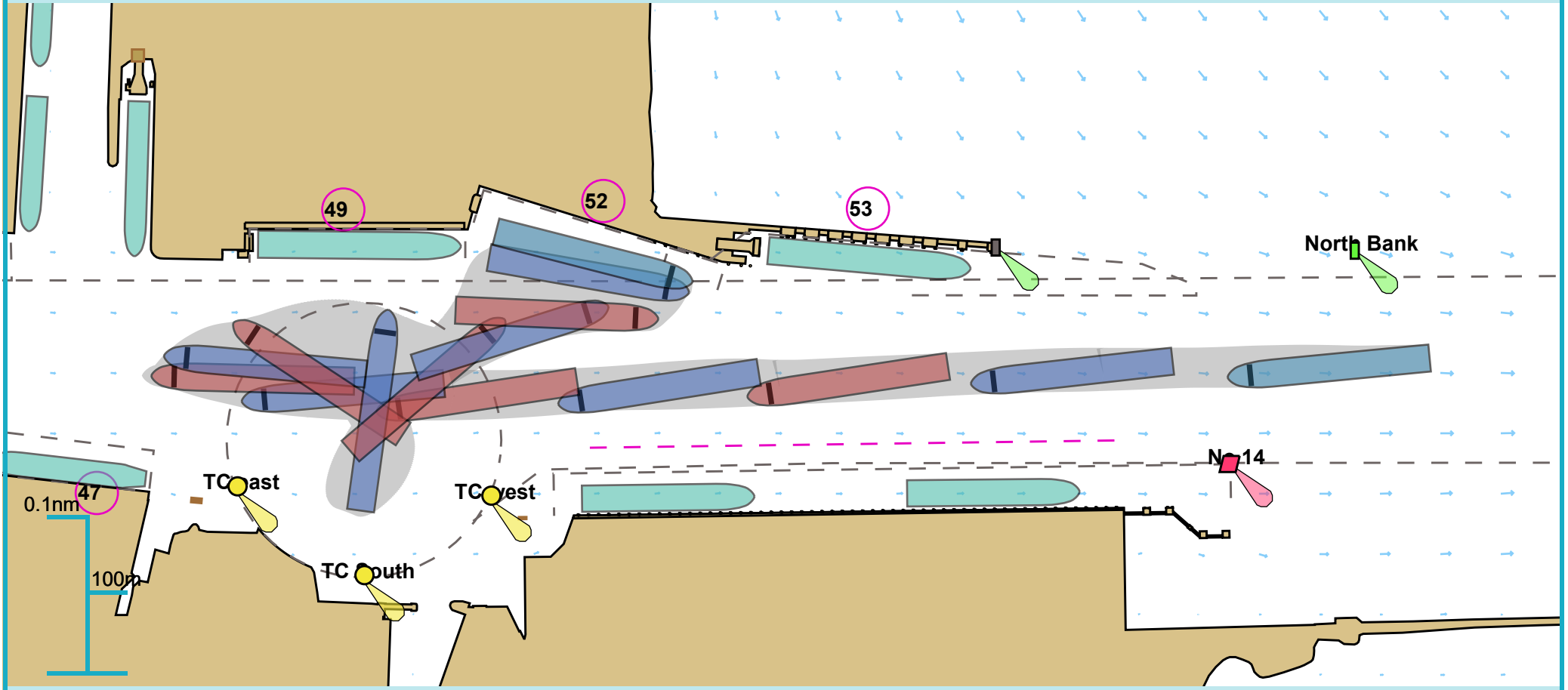
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.383 N, 006° 12.029 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

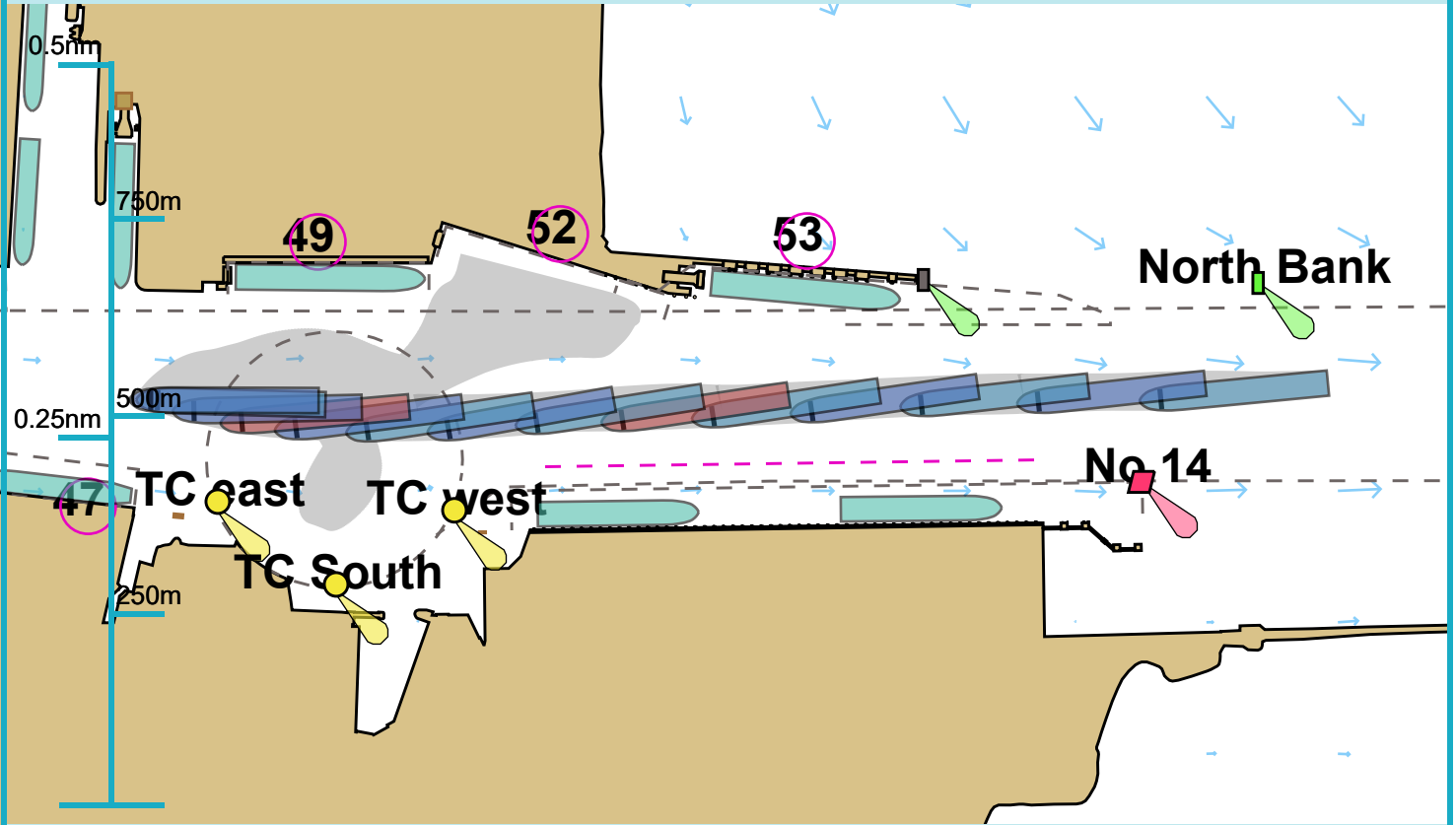
Run length:28 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax Ferry

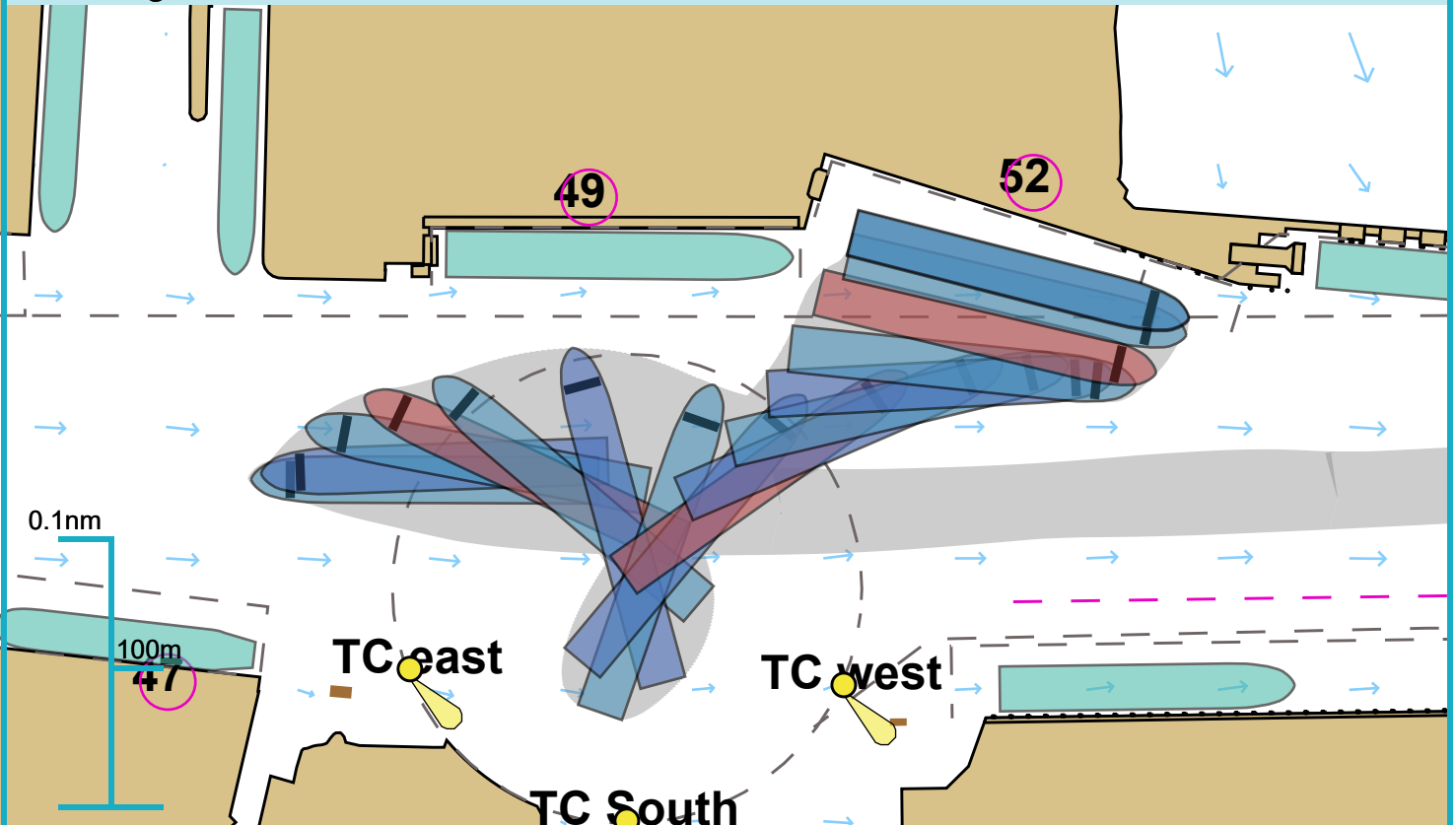
Comments:

Approach



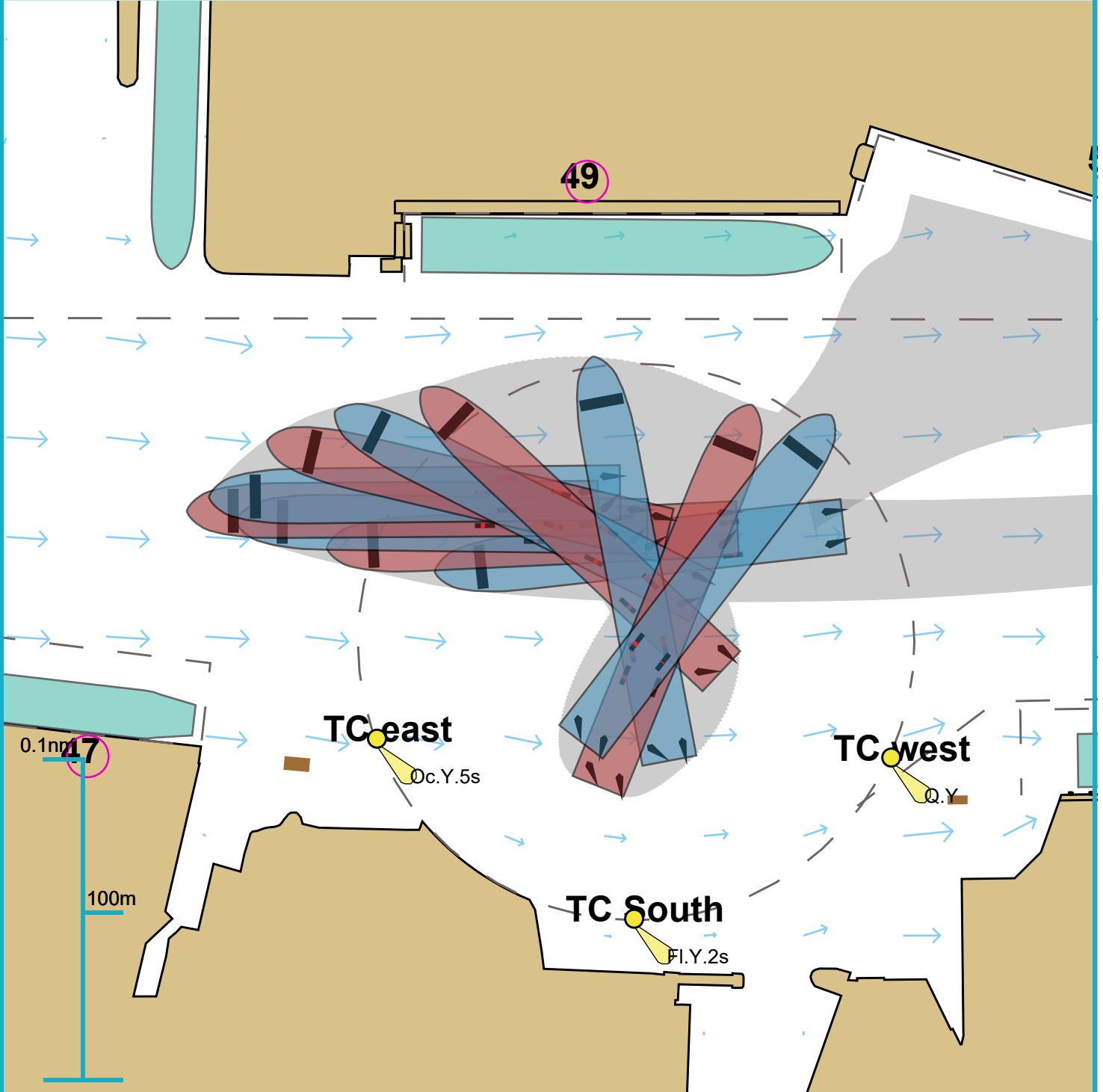
Ships plotted every 1 mins, highlight every 5 mins

Berthing

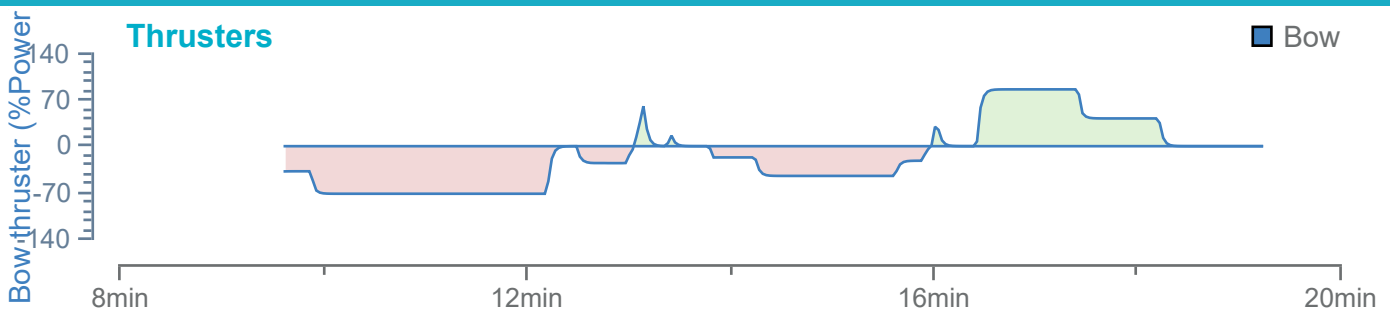


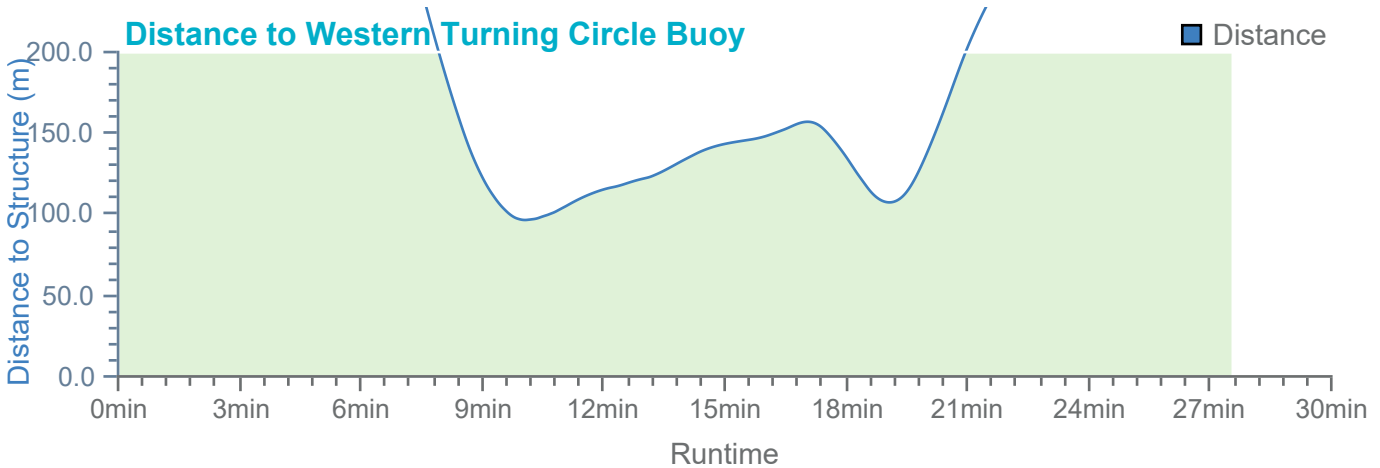
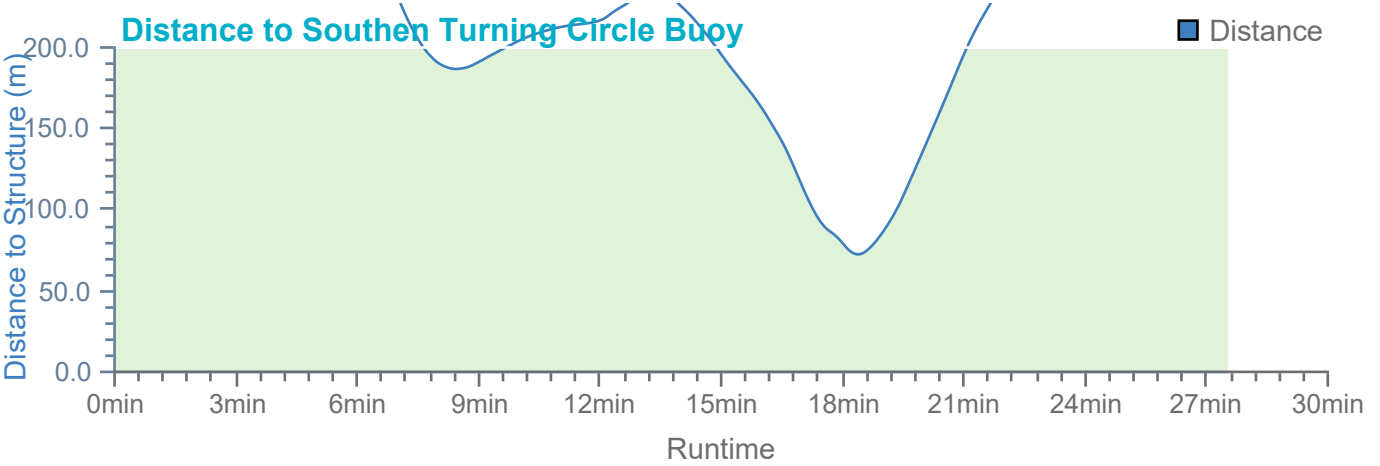
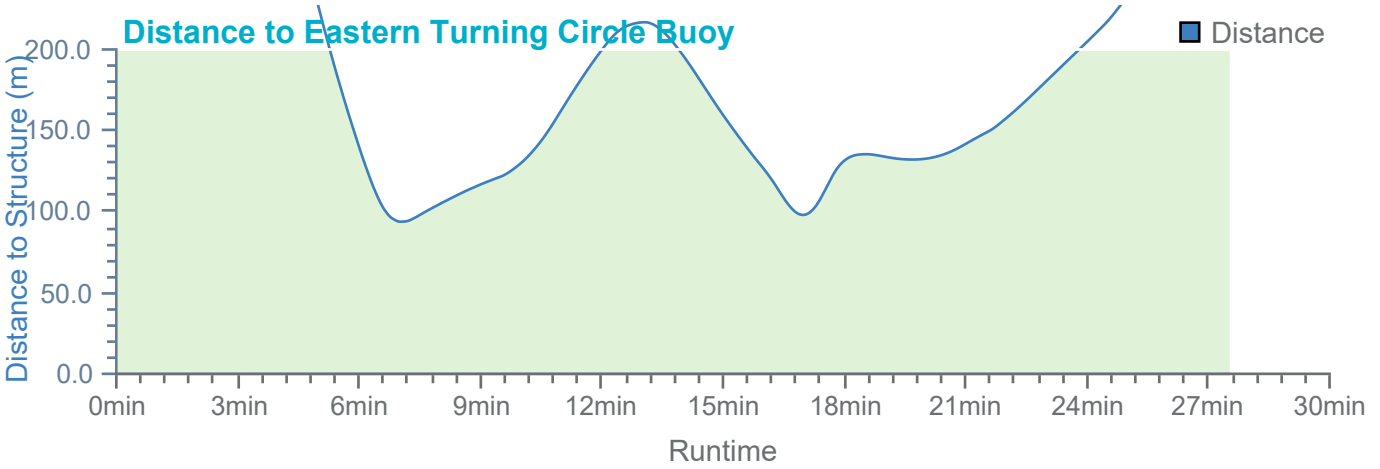
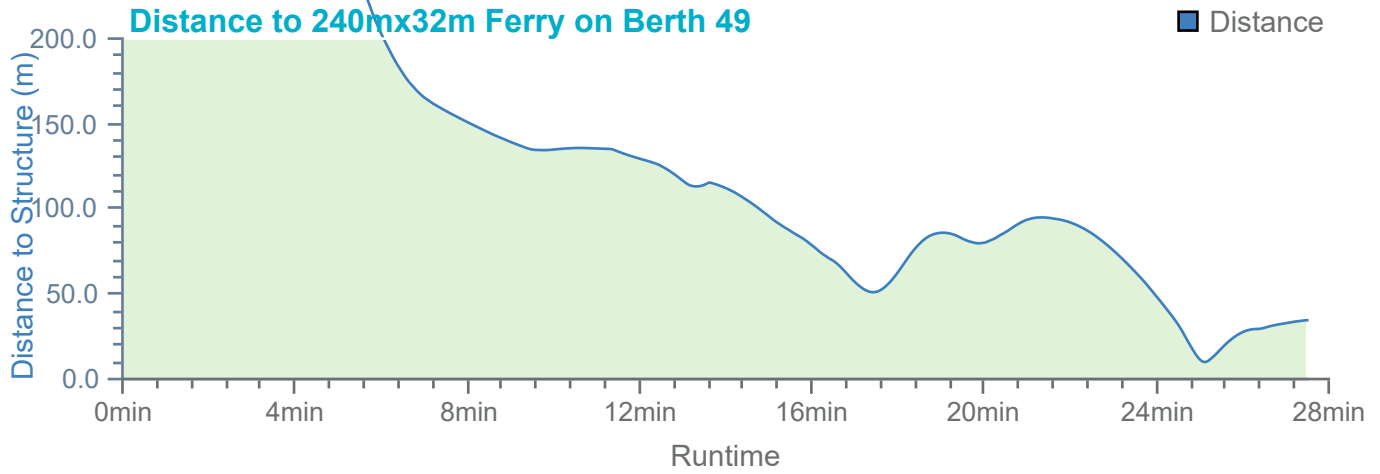
Ships plotted every 1 mins, highlight every 5 mins

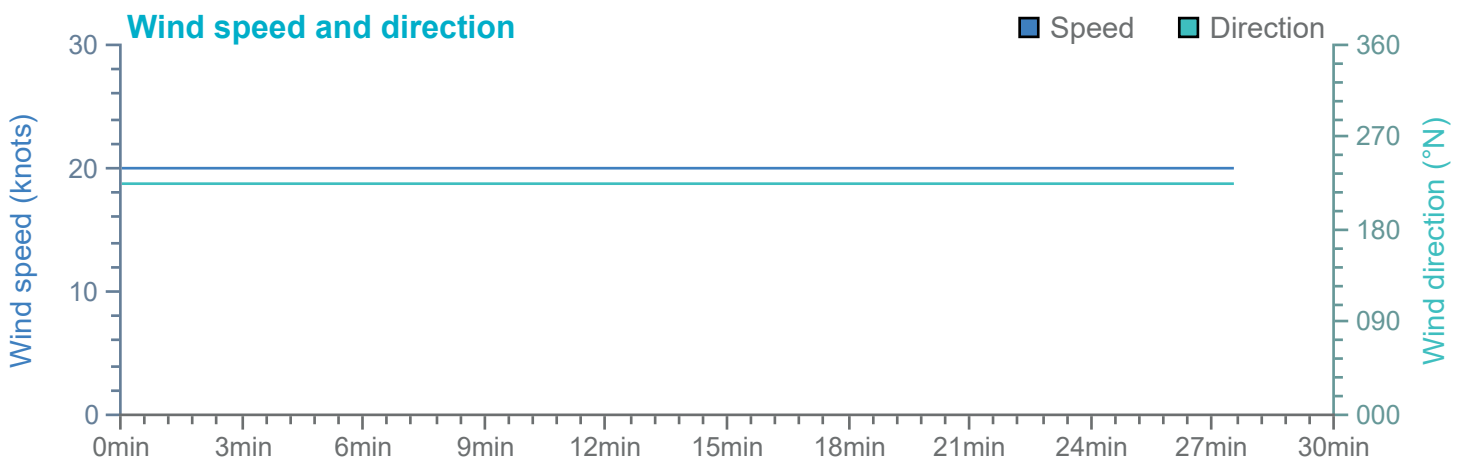
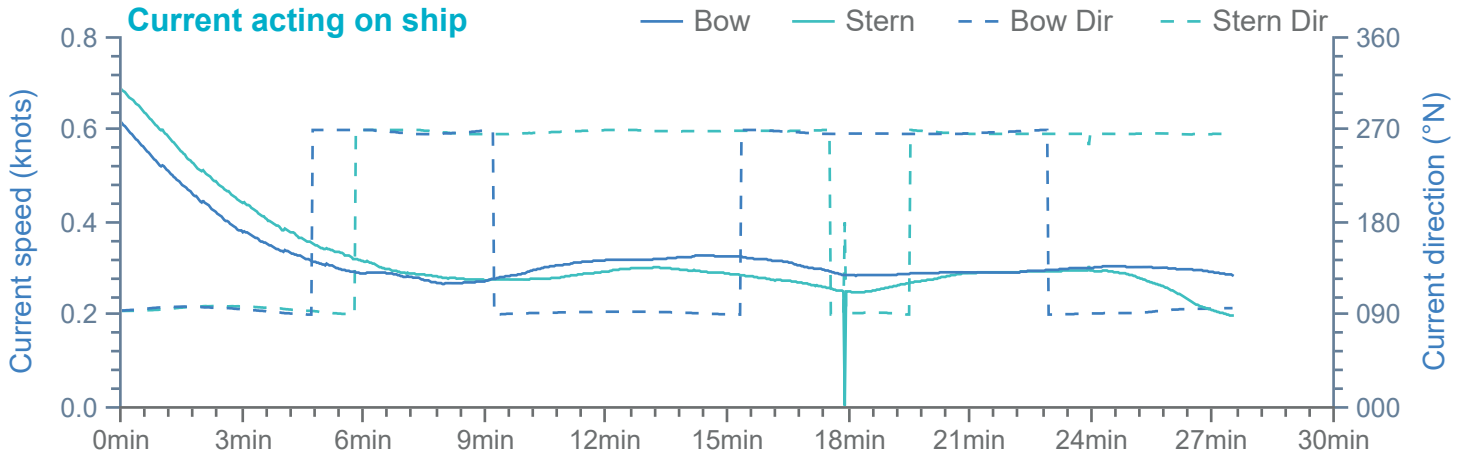
Swing



Ships plotted every 59 seconds, highlight every 2 mins





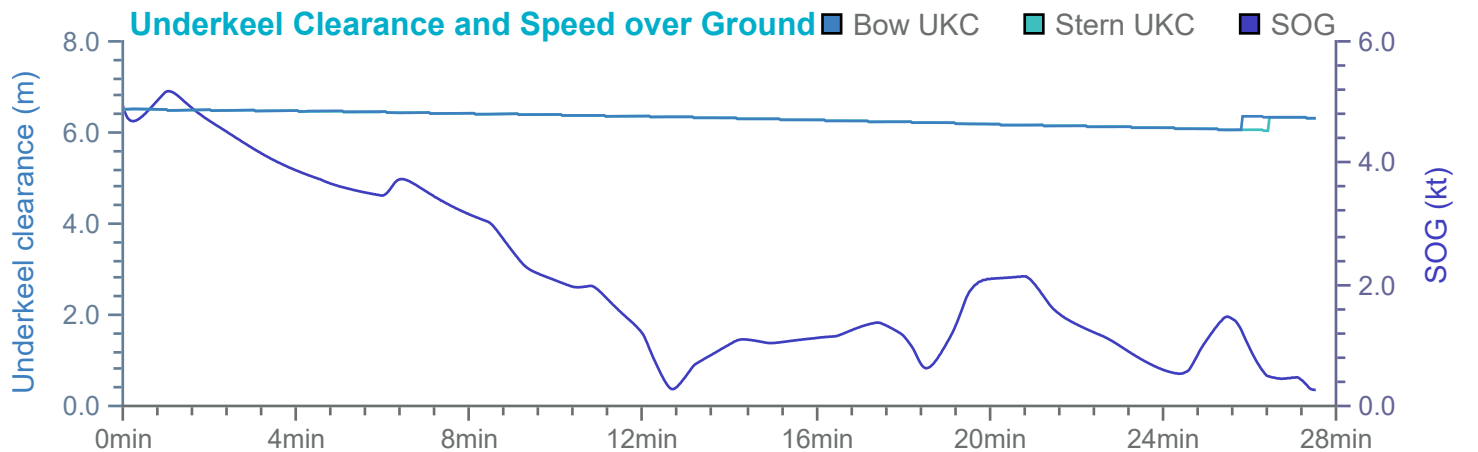
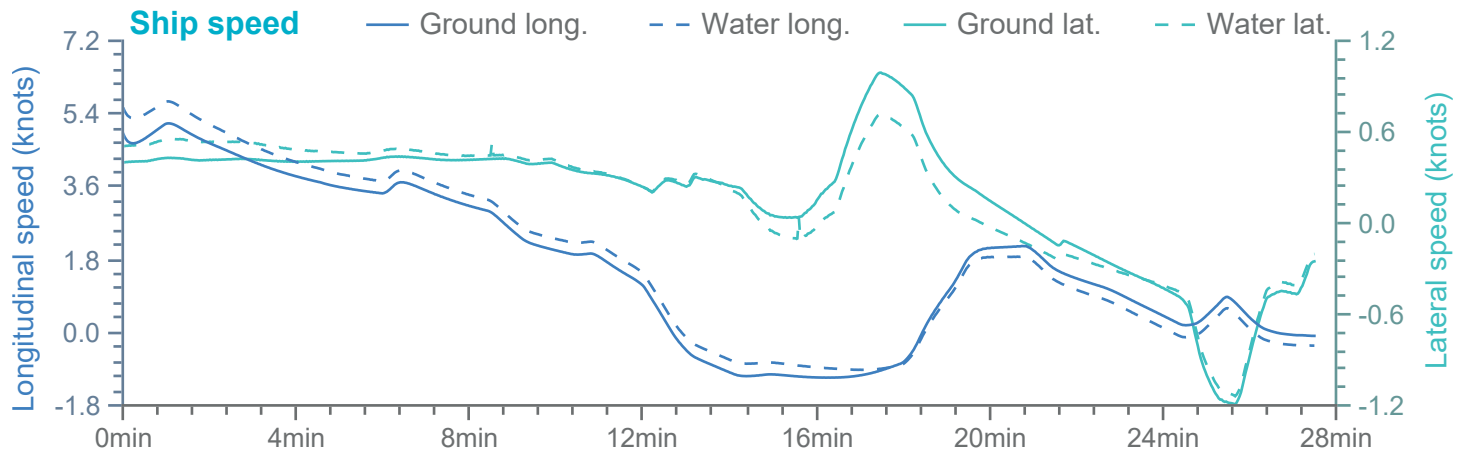
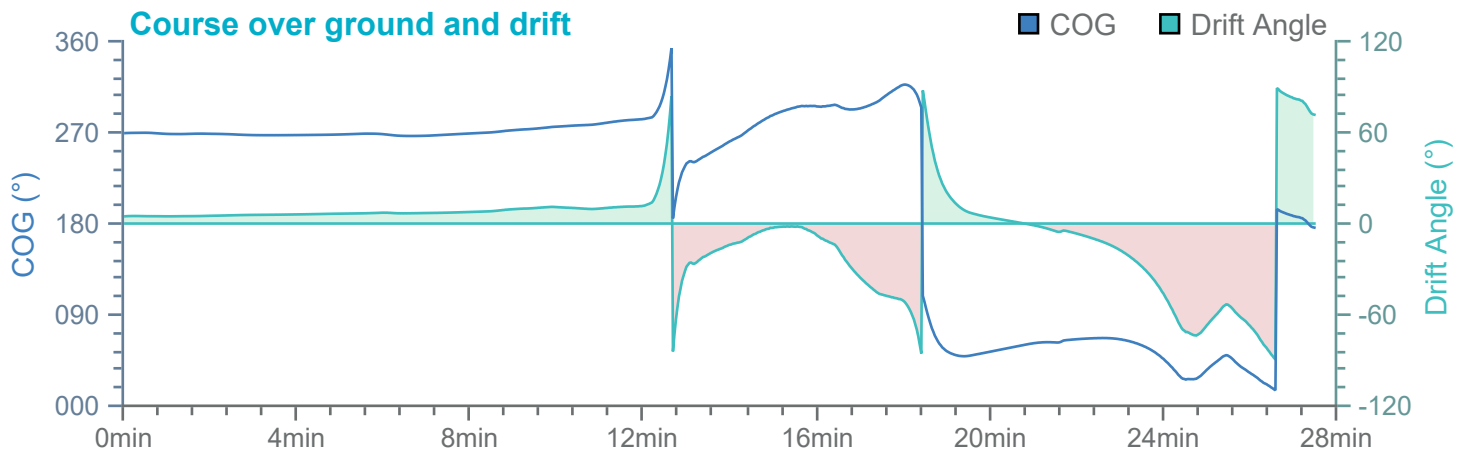
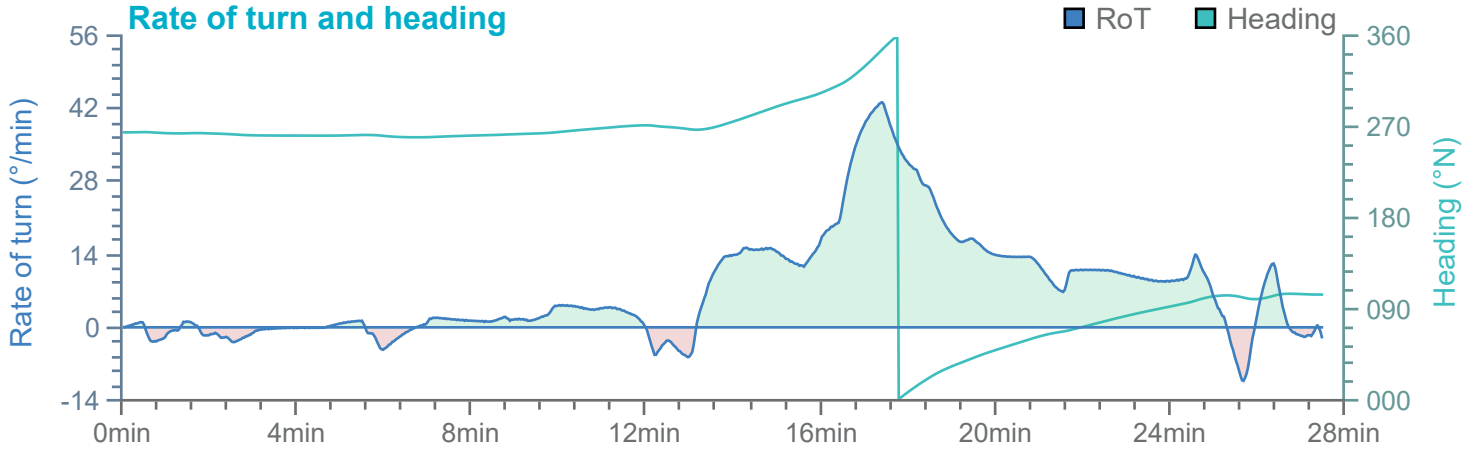


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

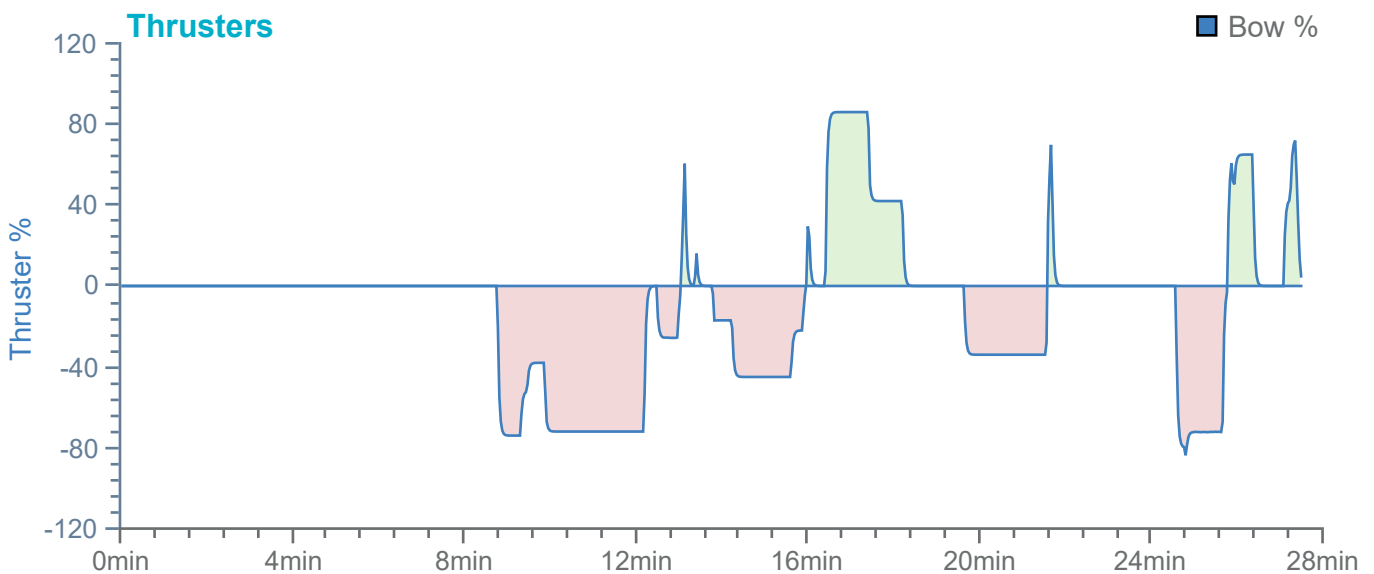
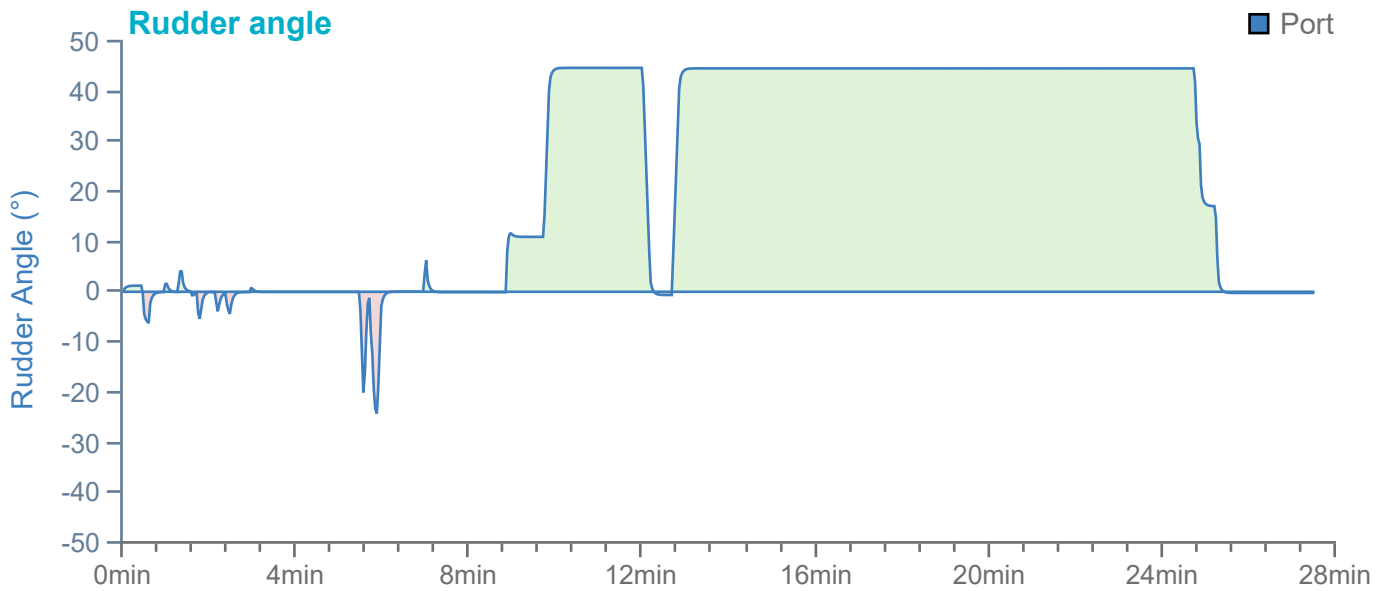
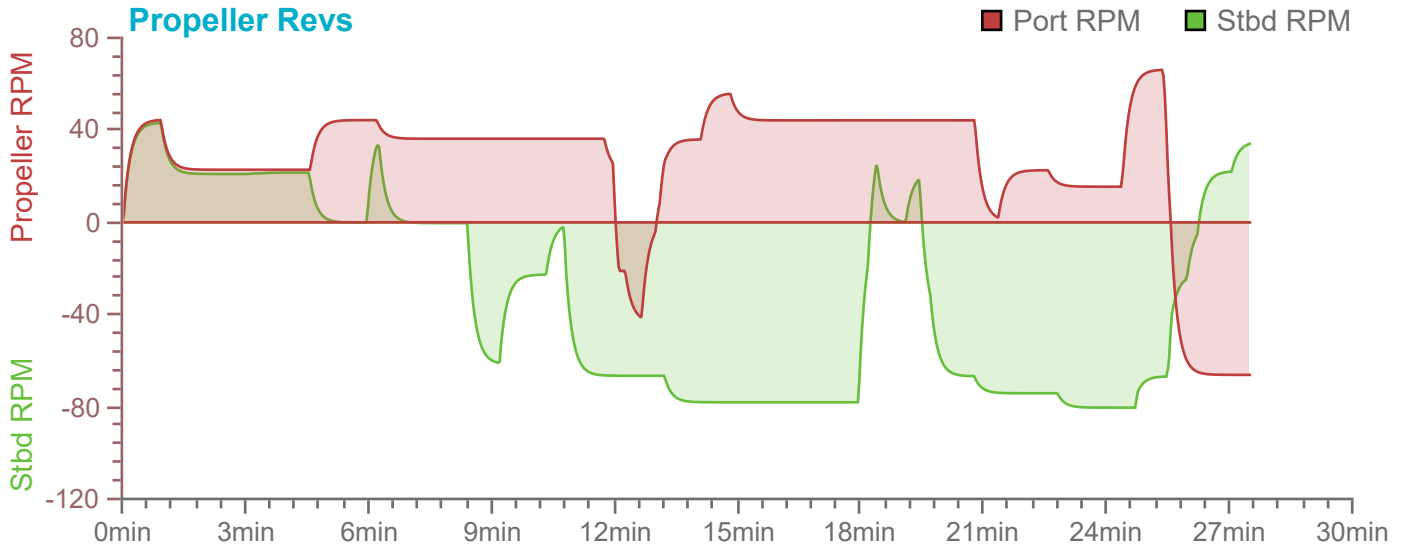


Overview

Environment

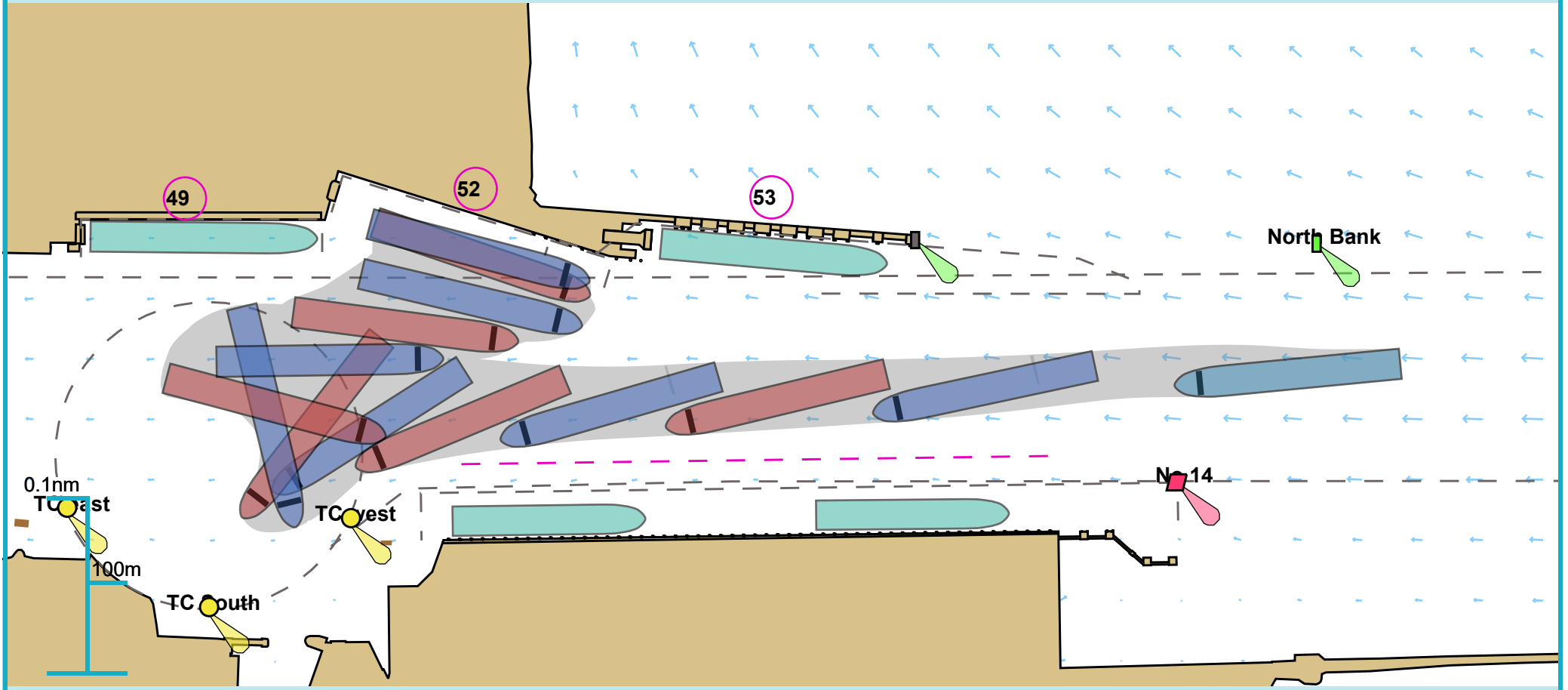
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.412 N, 006° 11.841 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

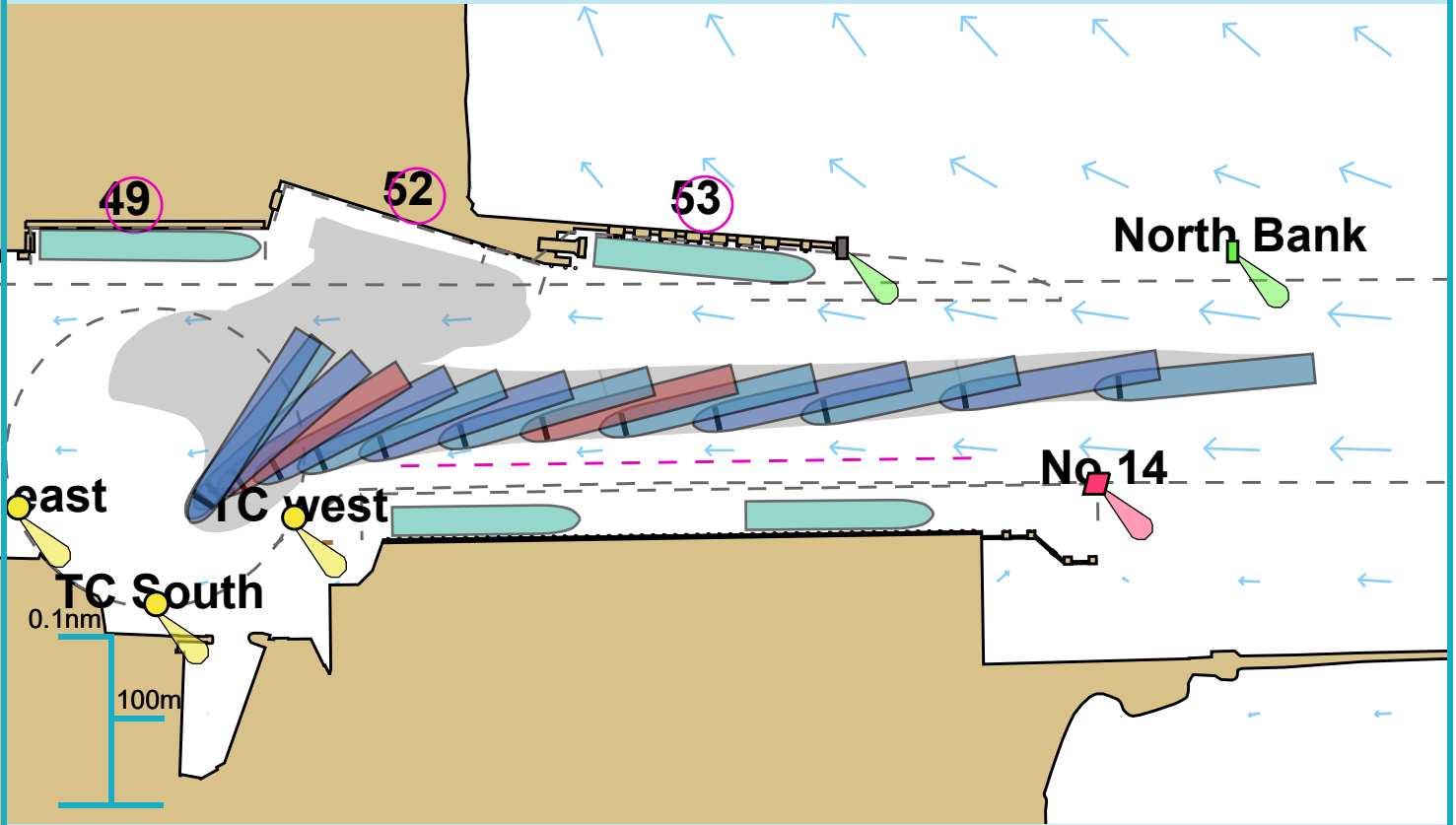
Run length:25 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax Ferry

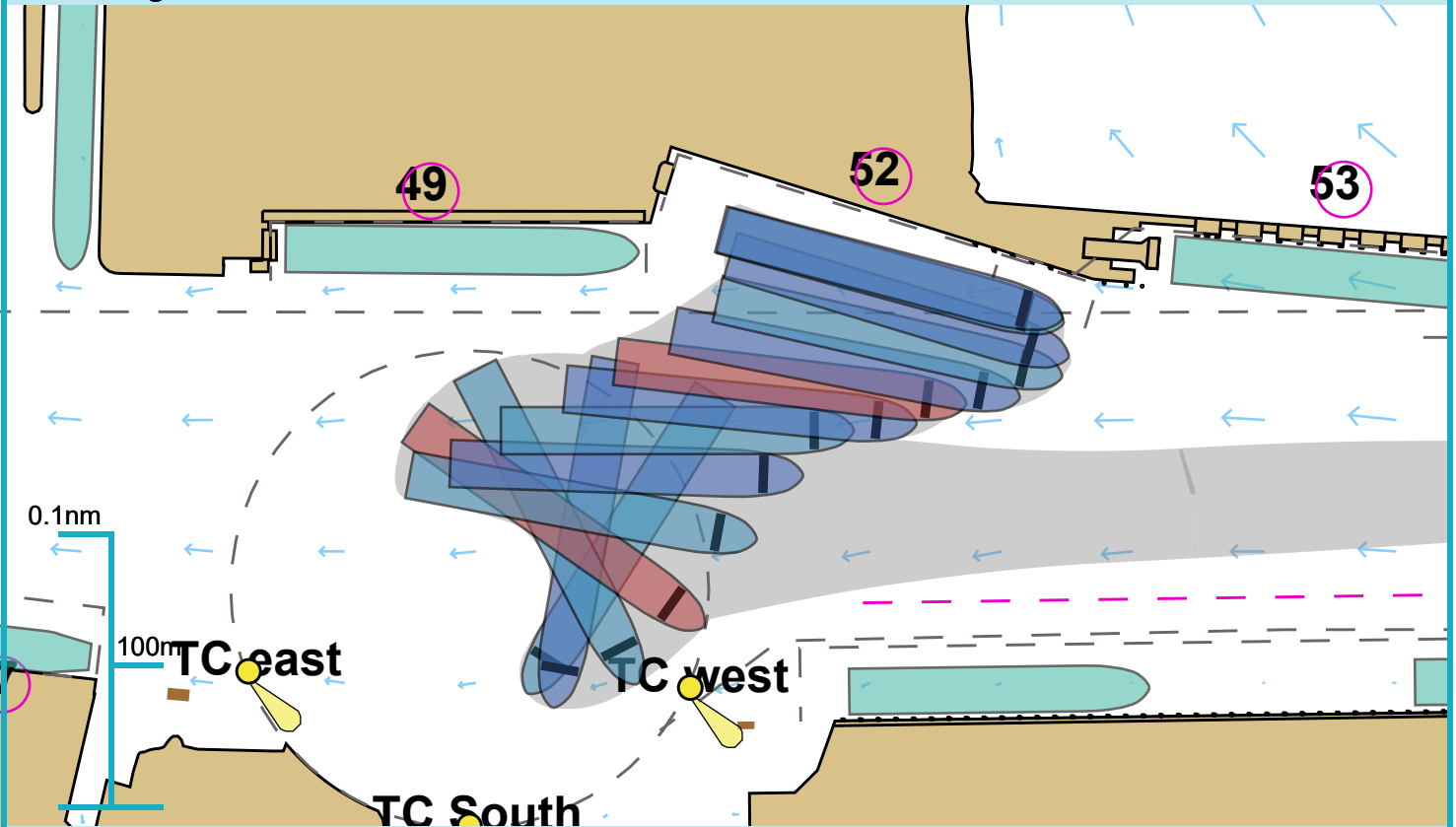
Comments:

Approach



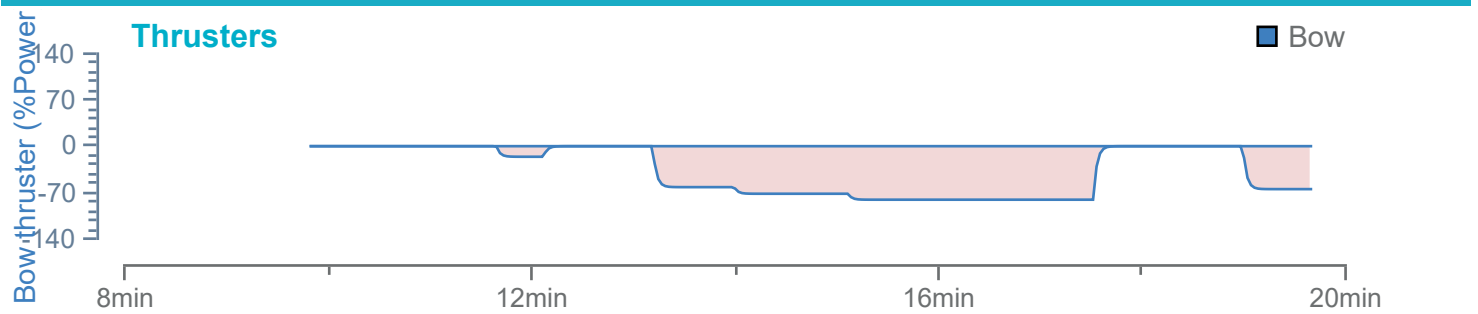
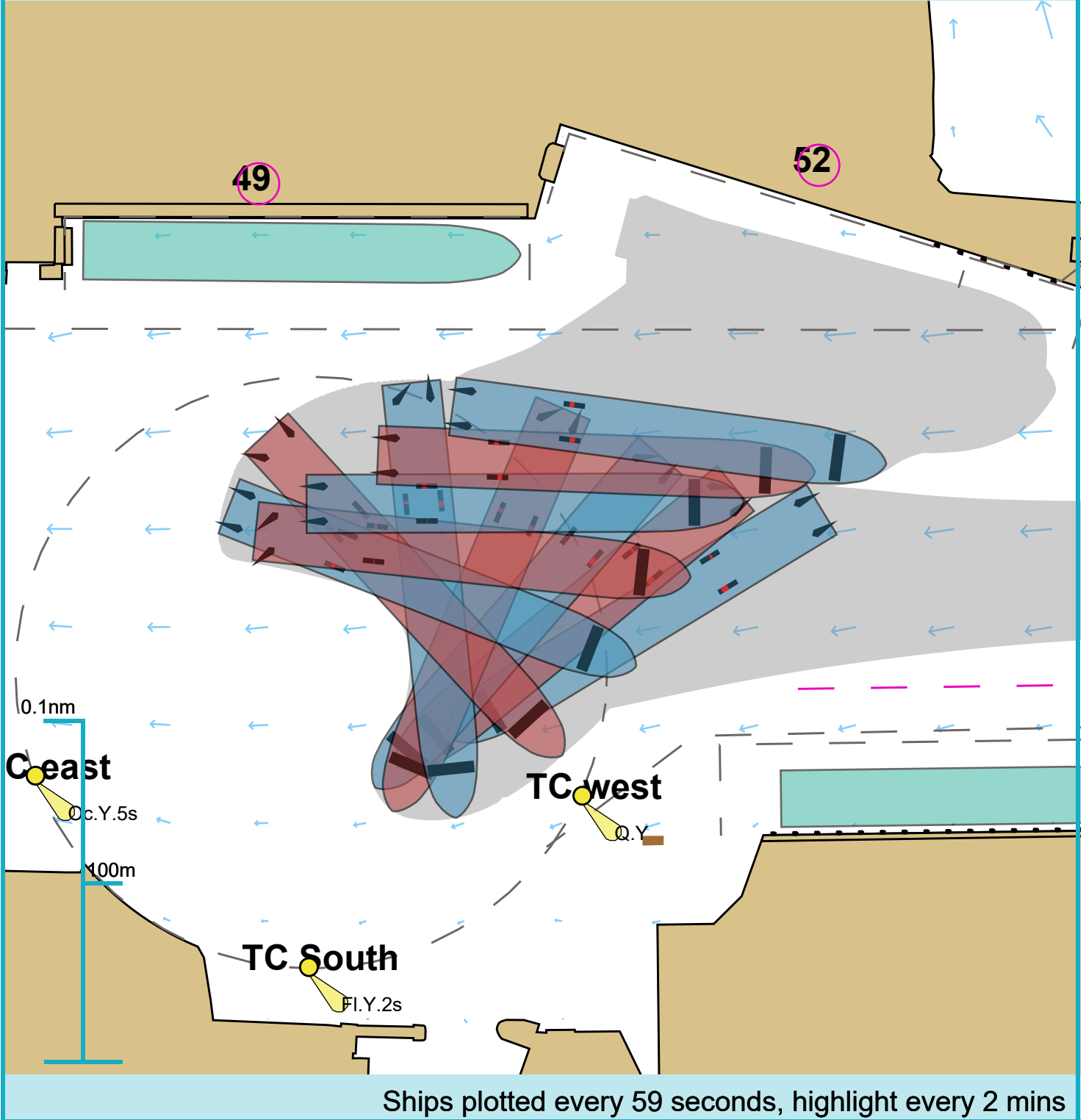
Ships plotted every 1 mins, highlight every 5 mins

Berthing



Ships plotted every 1 mins, highlight every 5 mins

Swing

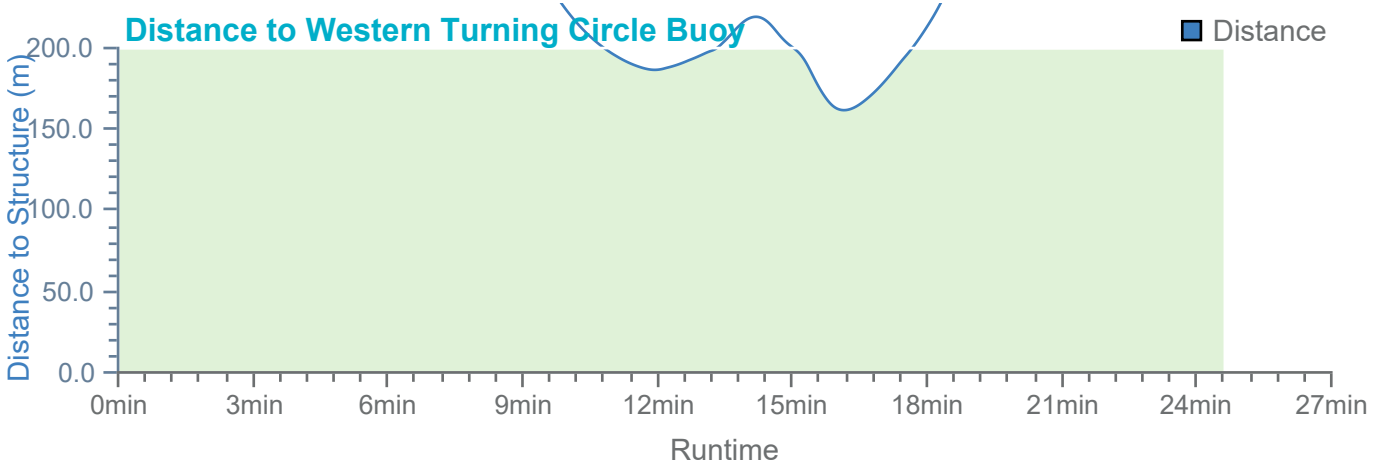
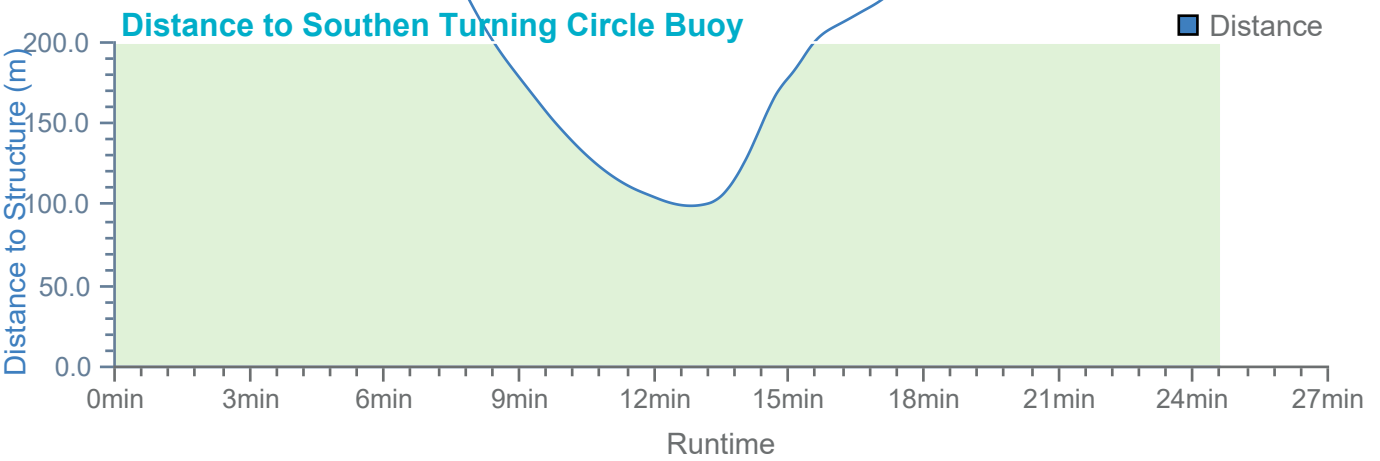
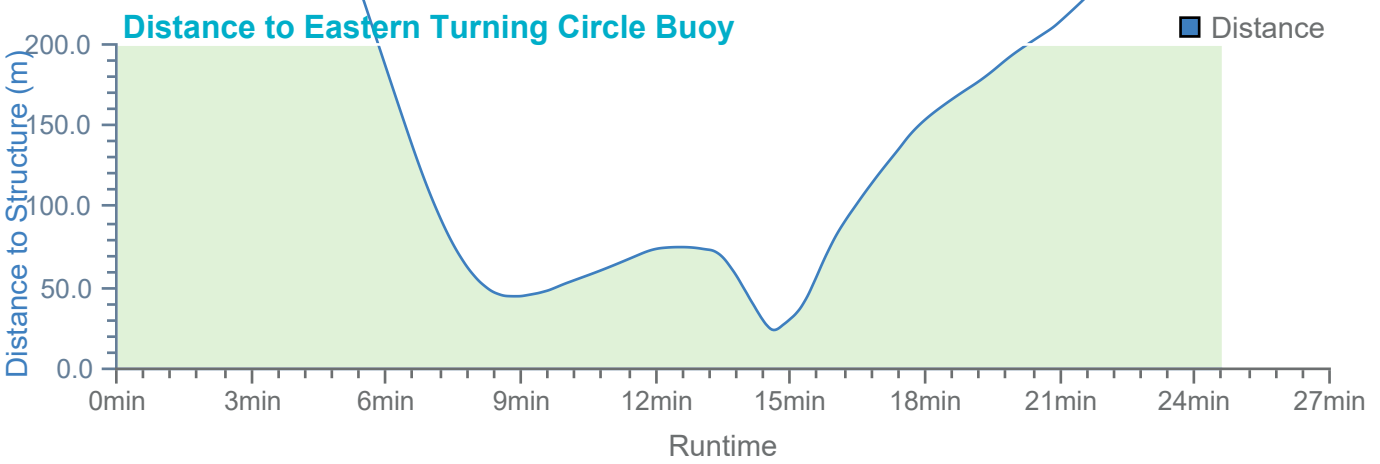
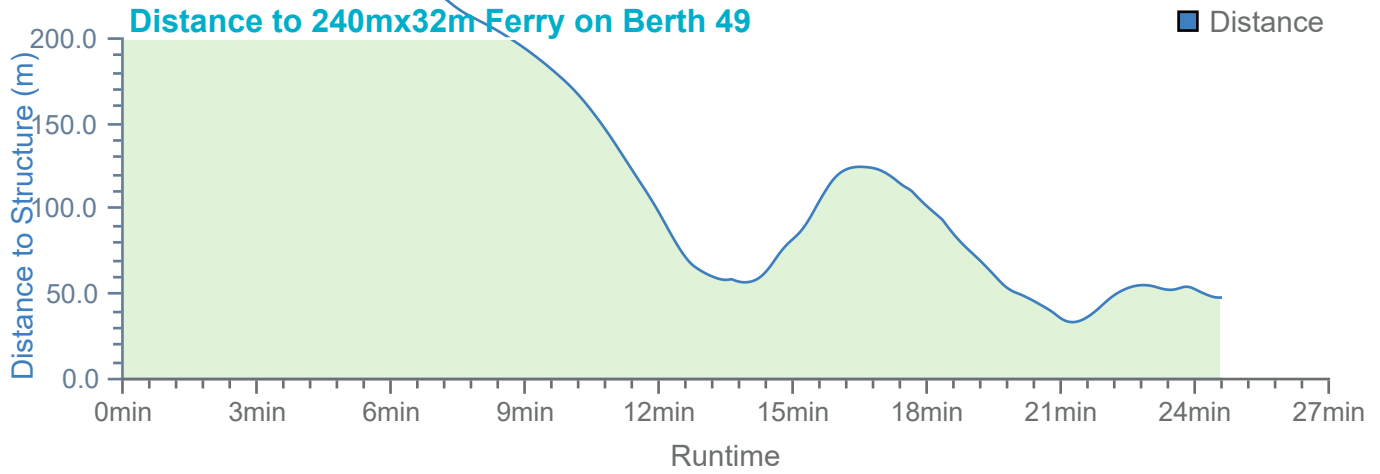


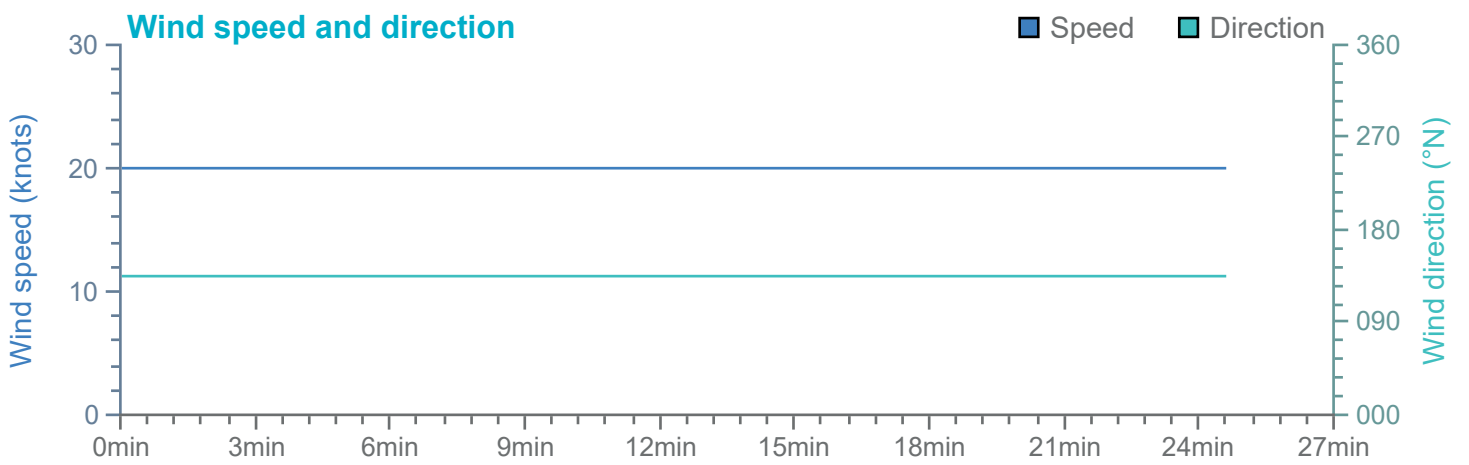
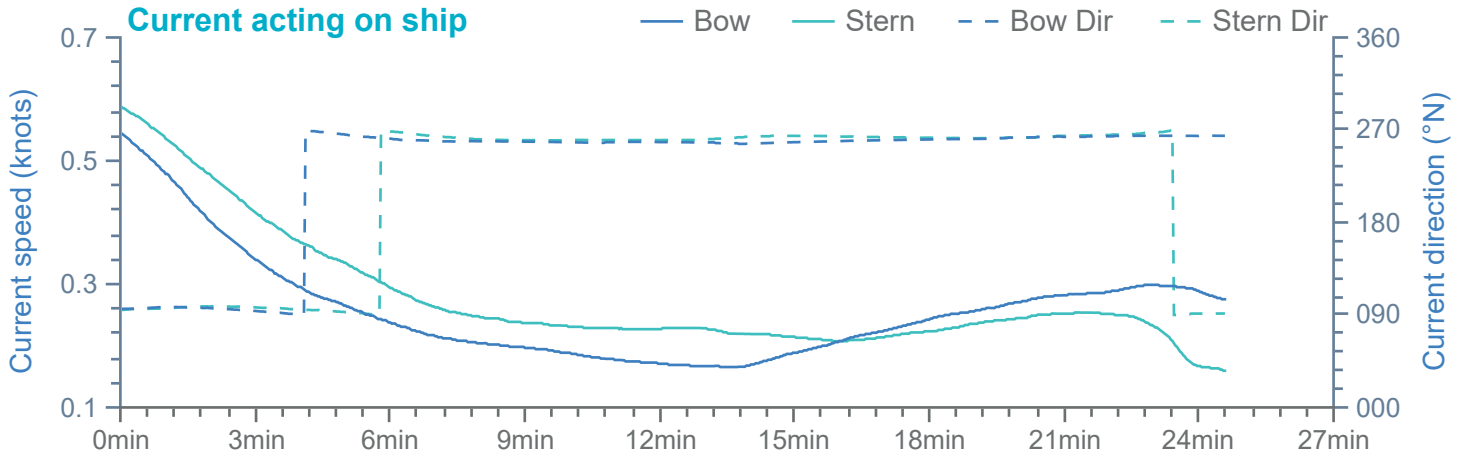
Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use



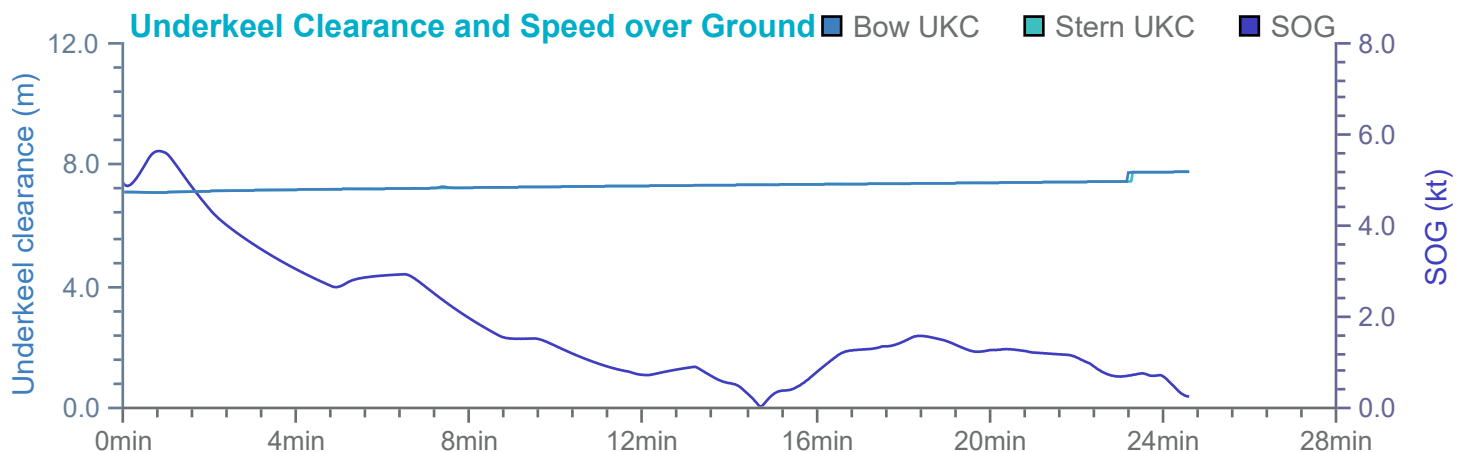
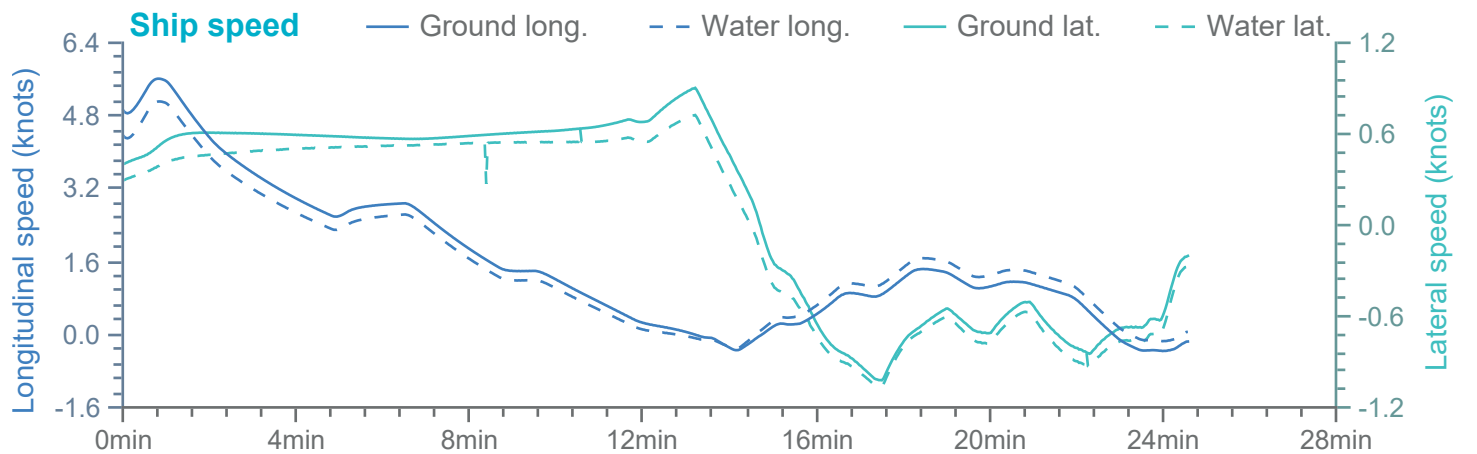
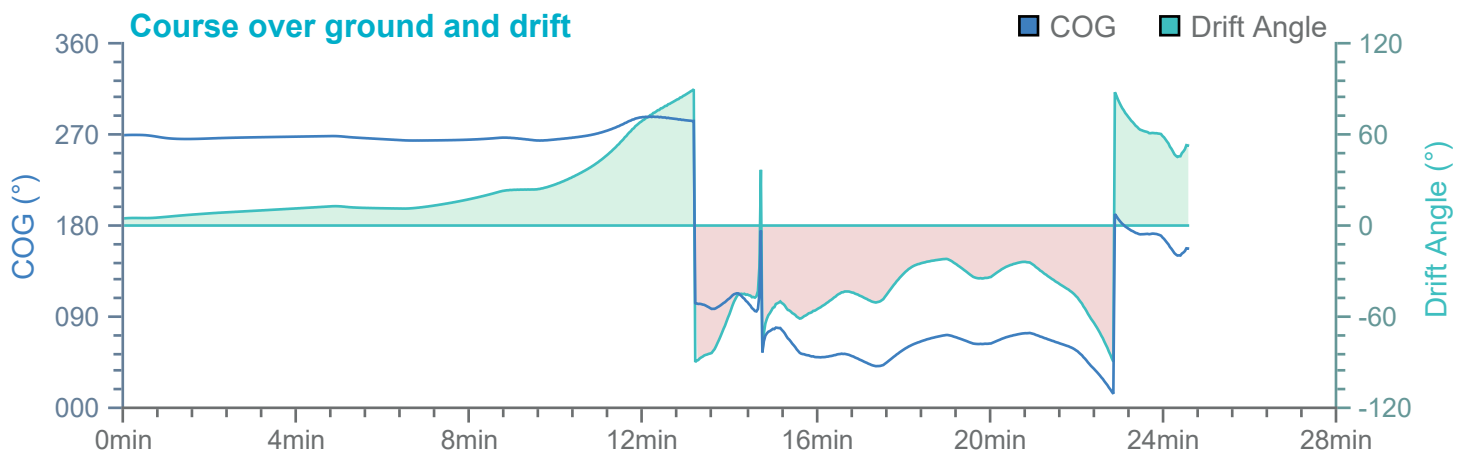
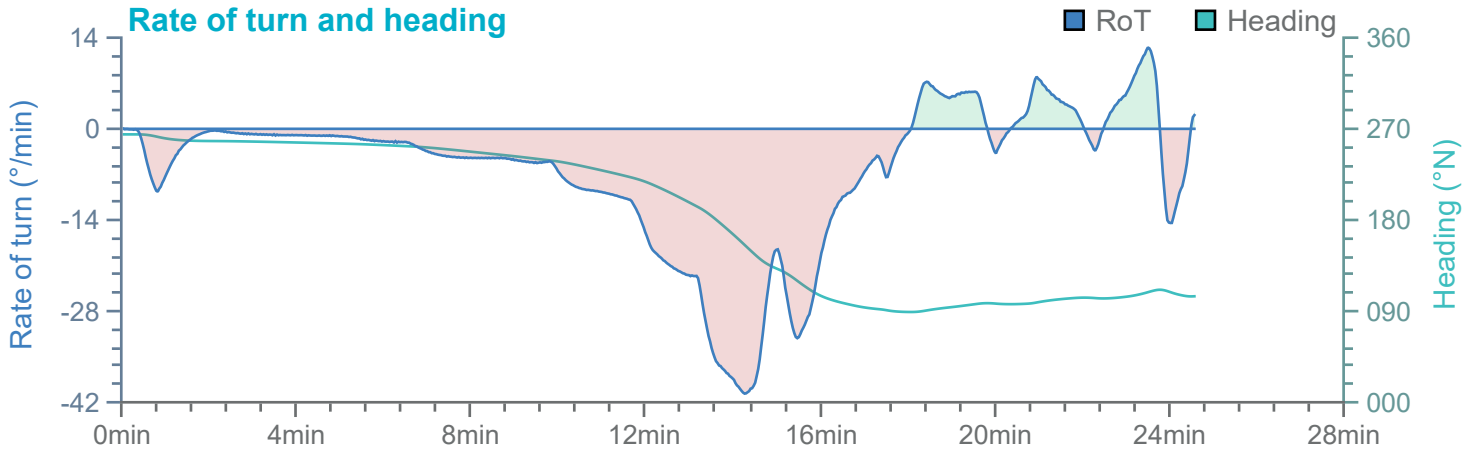


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

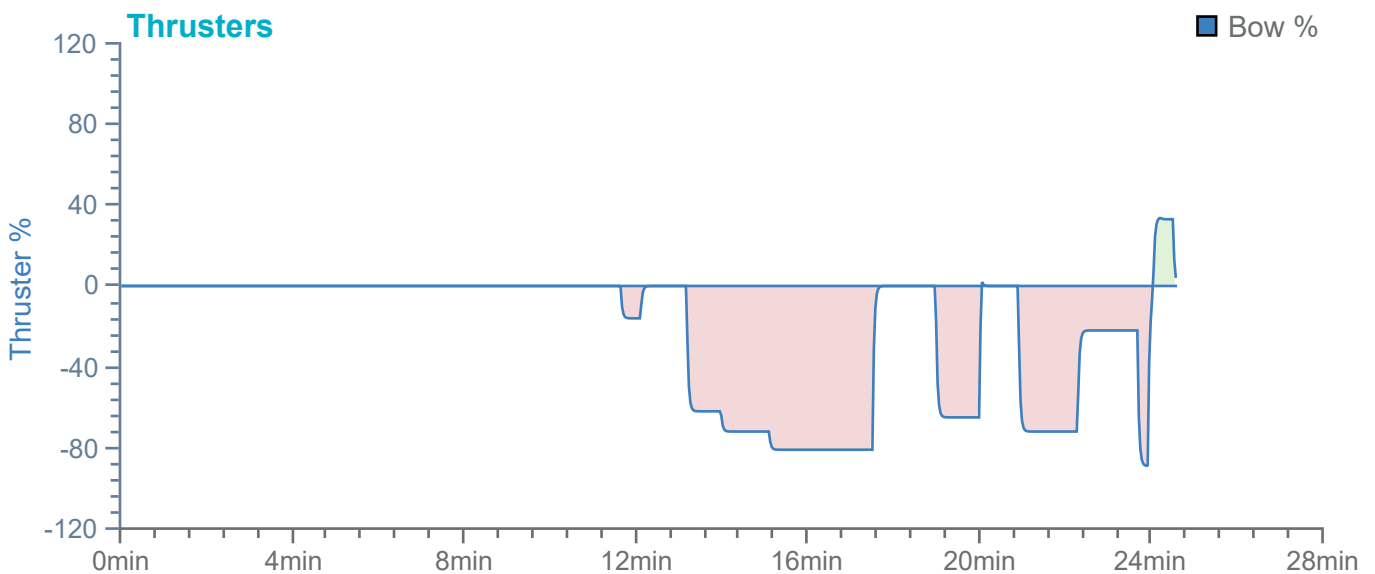
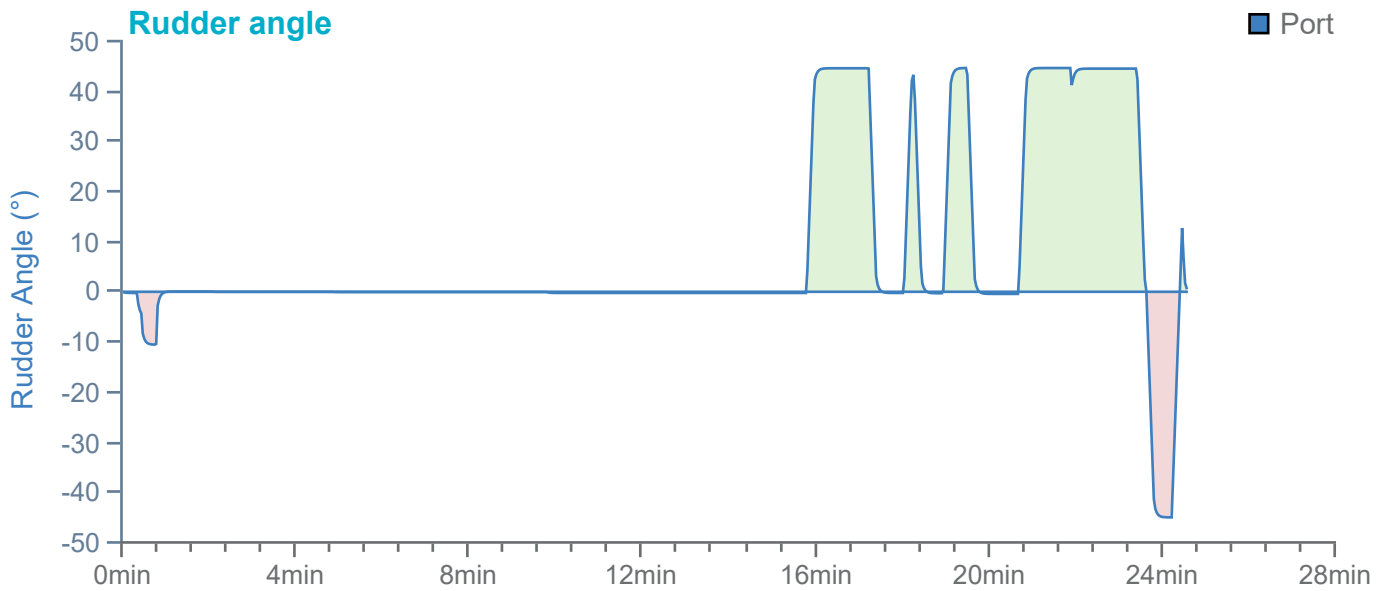
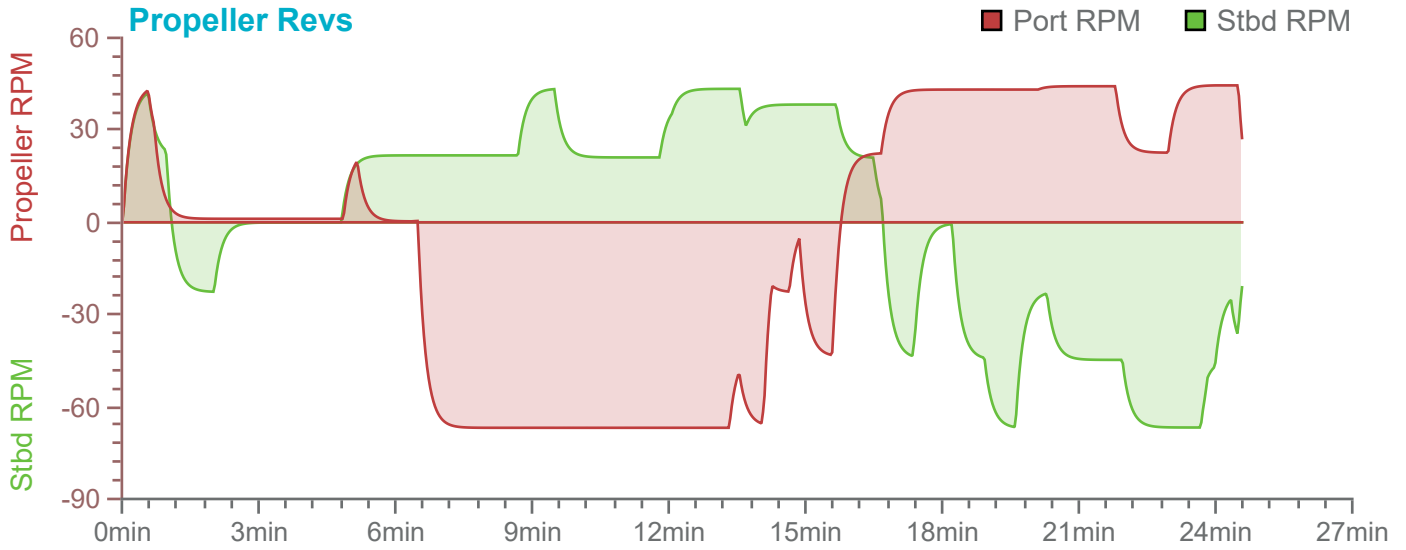


Overview

Environment

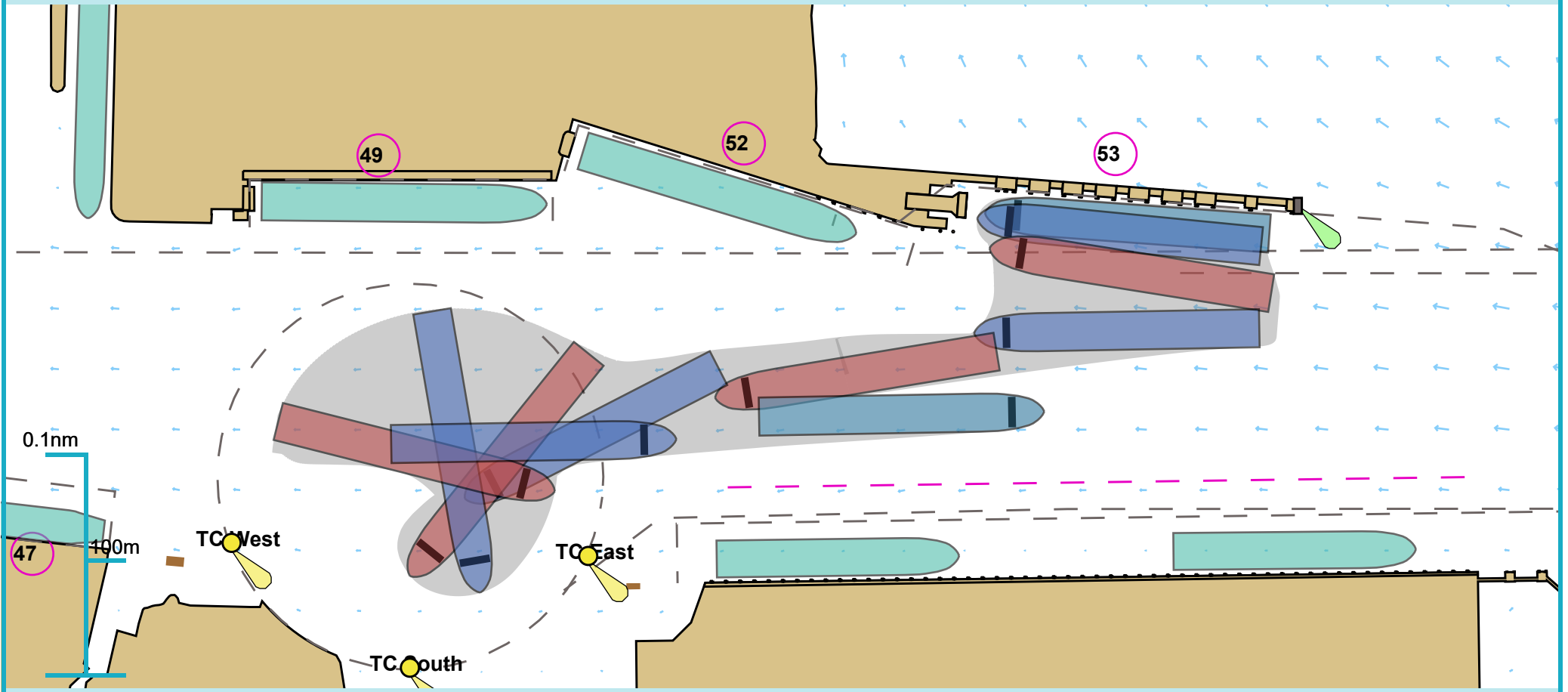
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.453 N, 006° 11.954 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: M

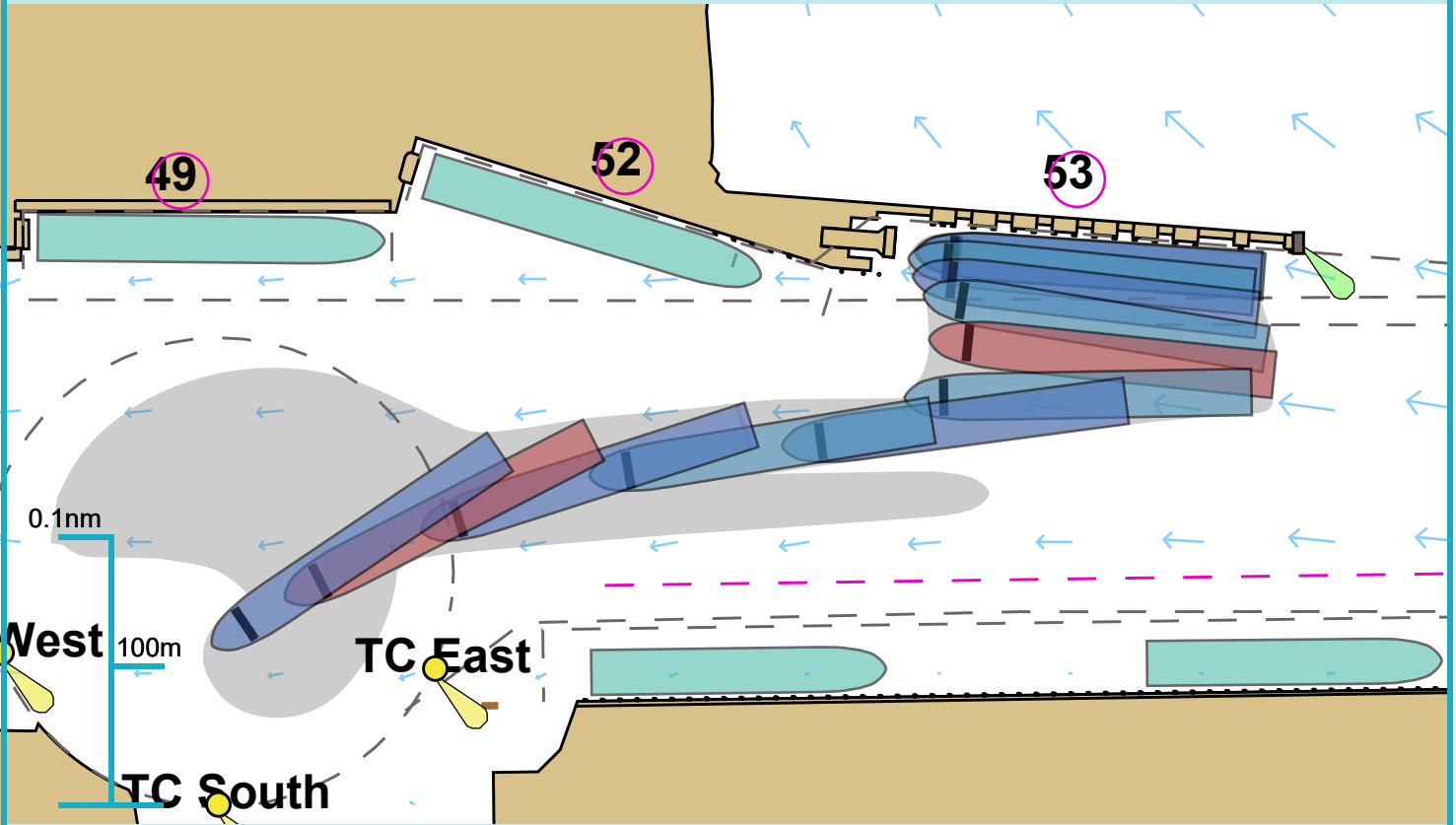
Run length: 20 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

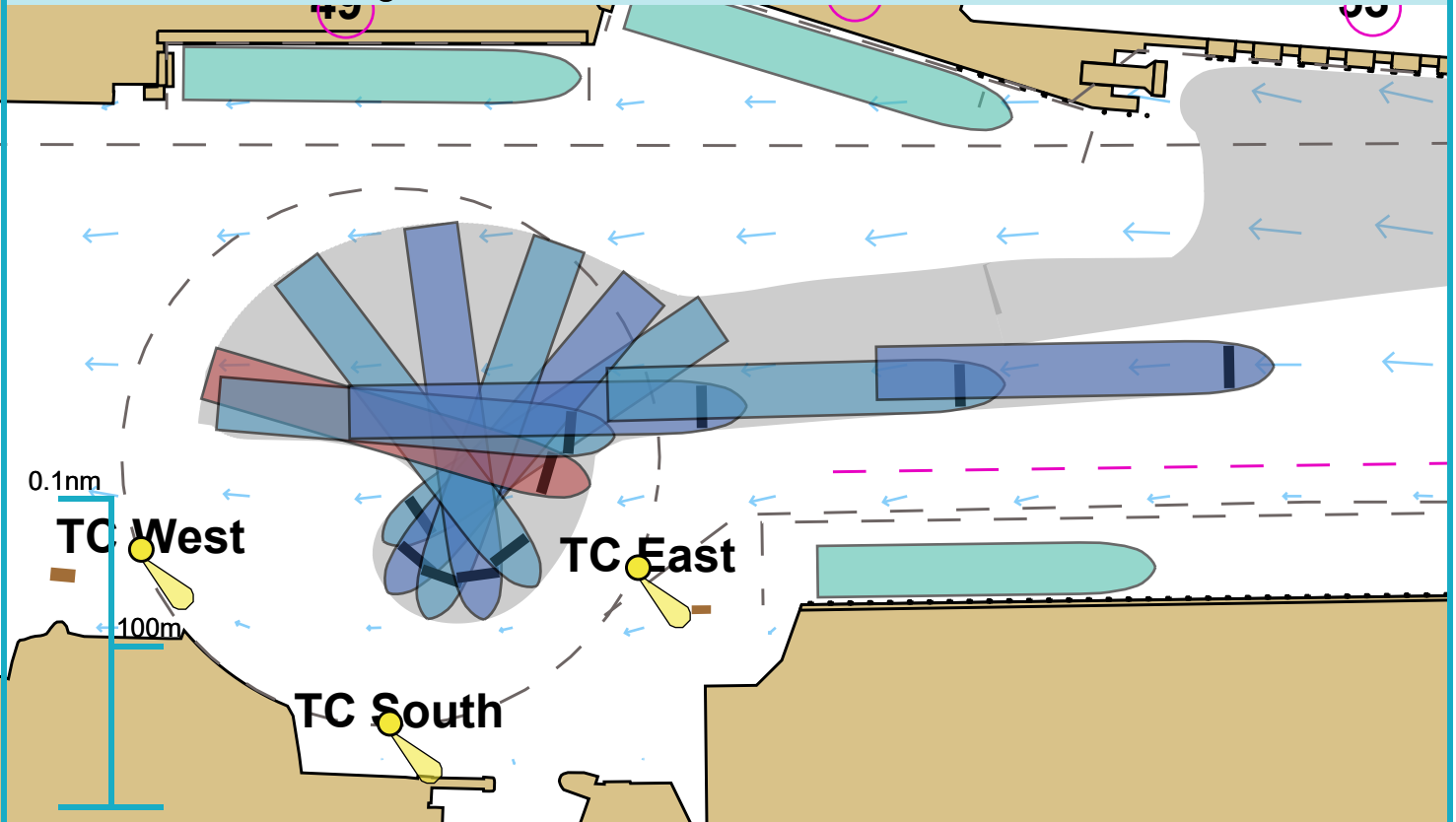
Comments:

Departure



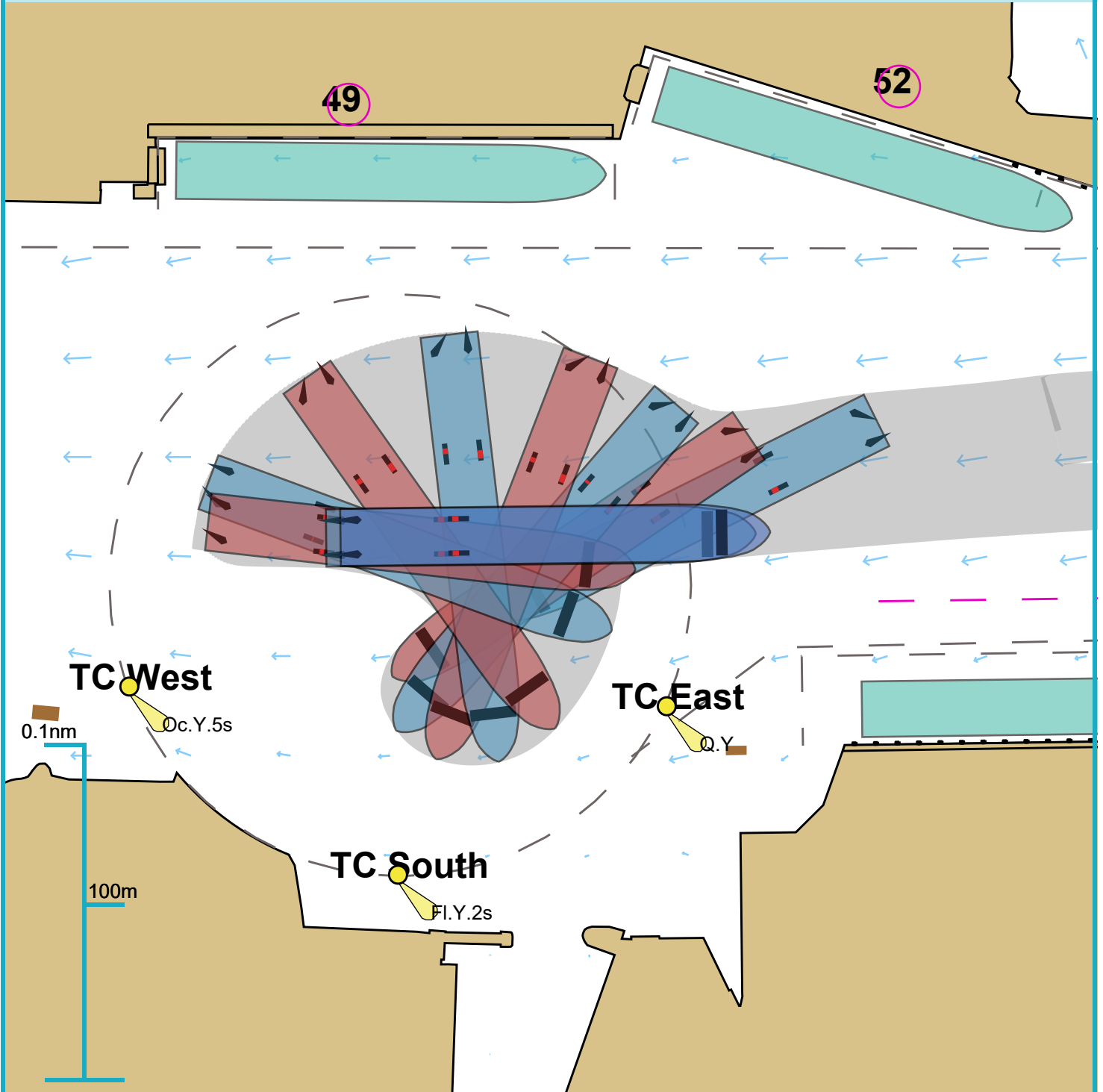
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

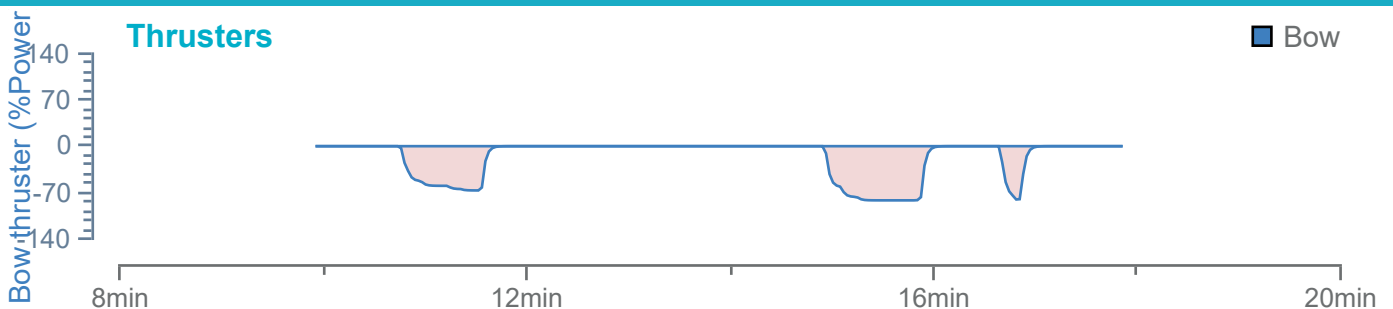


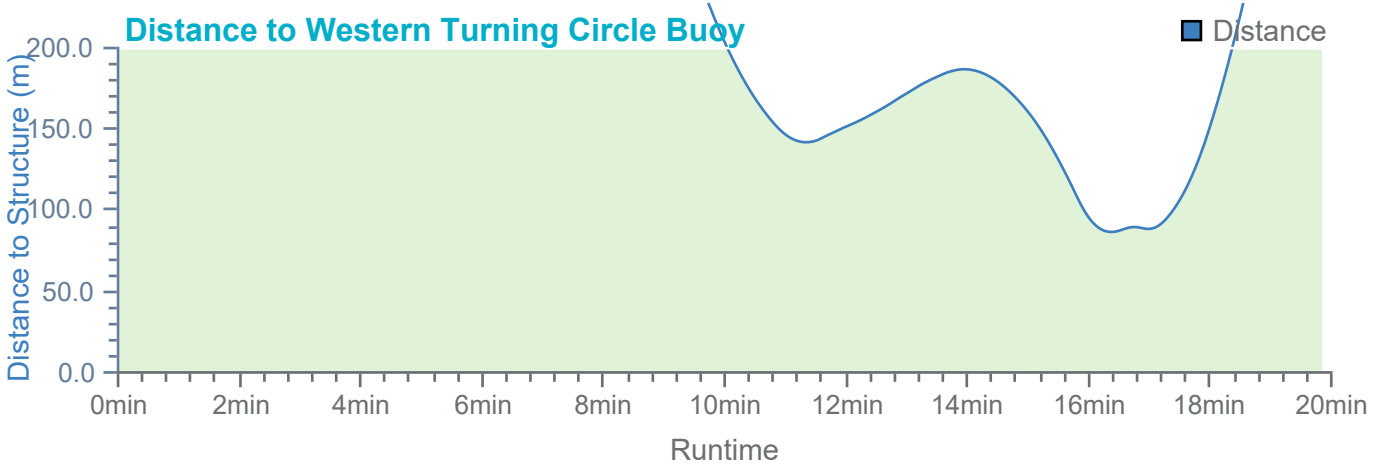
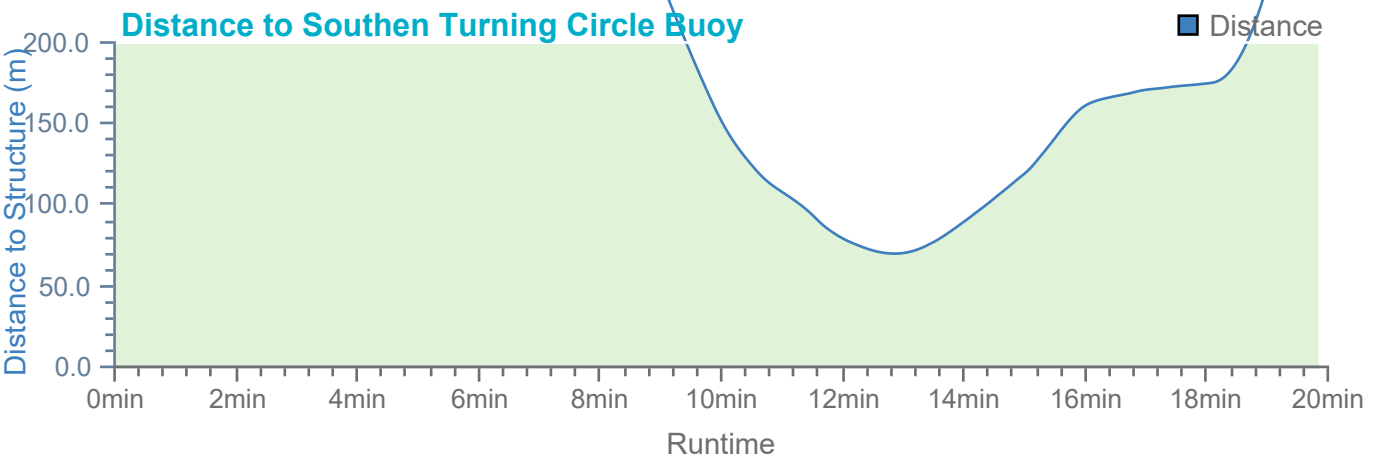
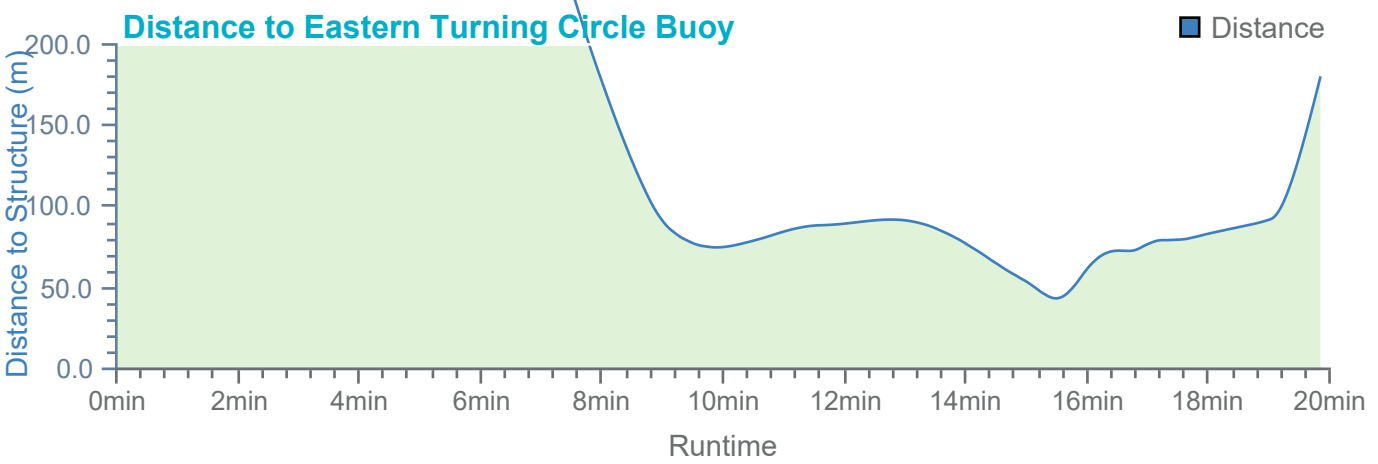
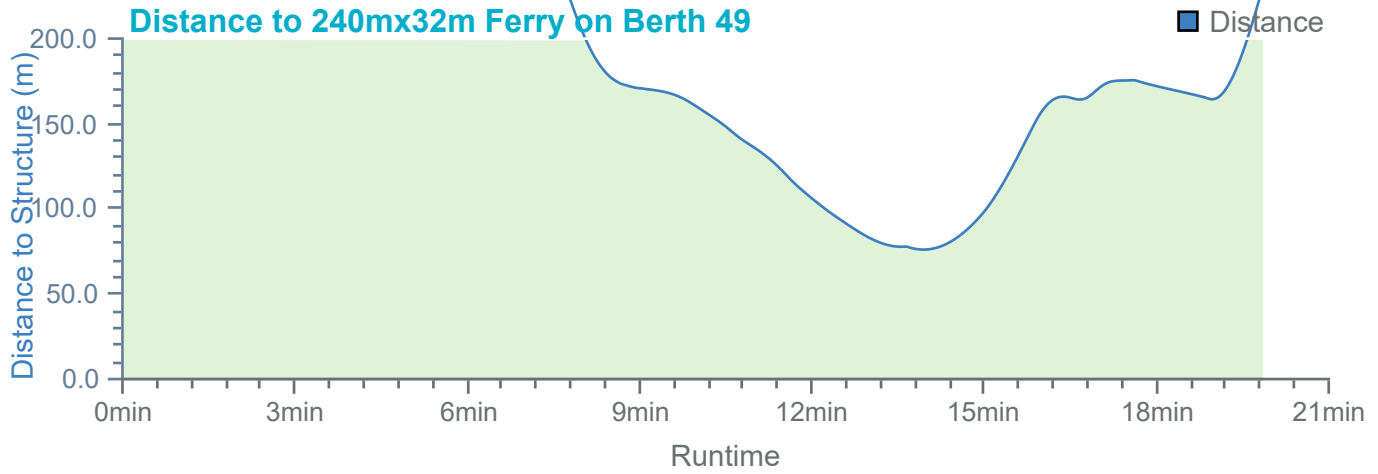
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



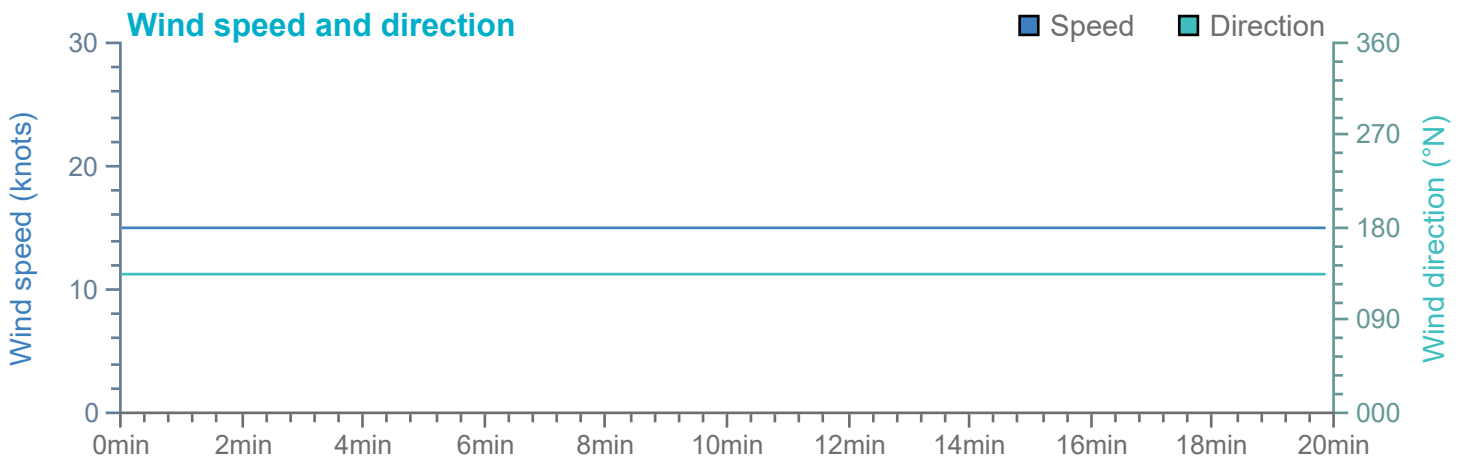
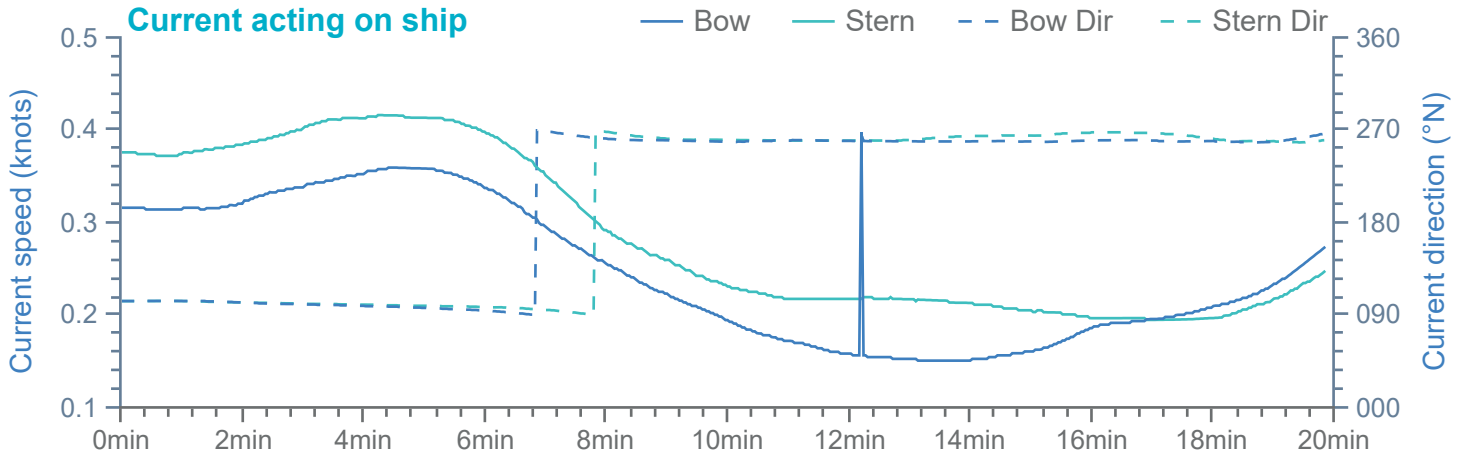


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

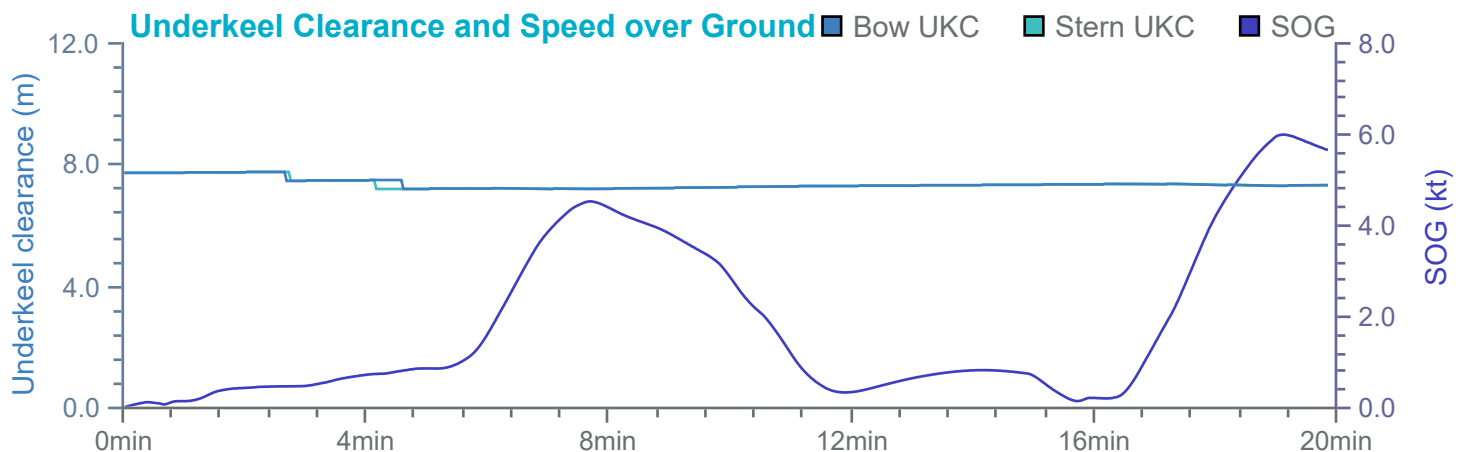
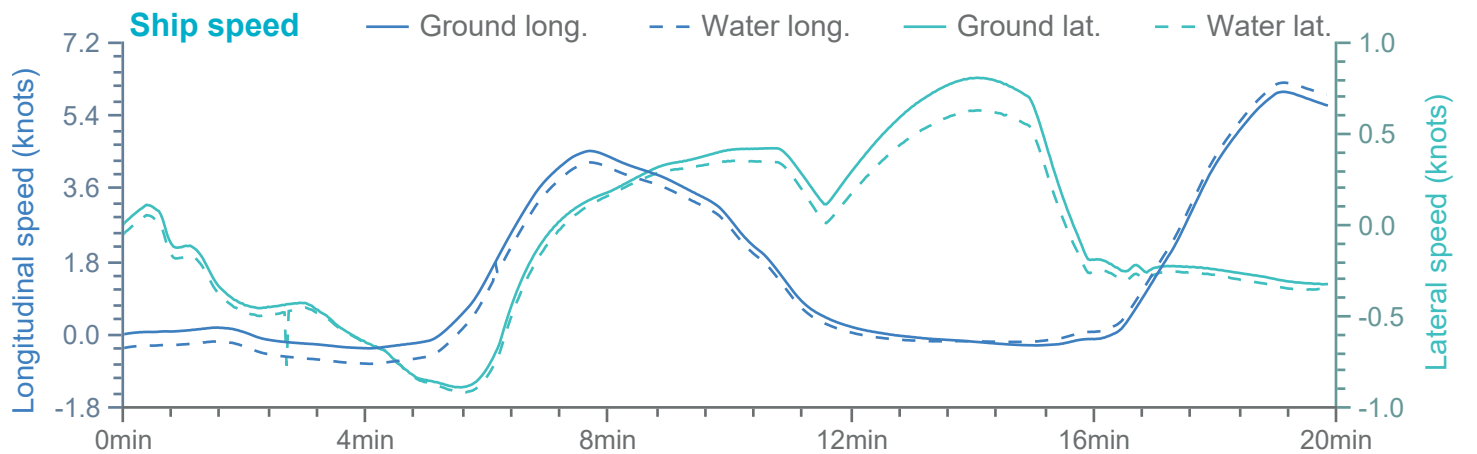
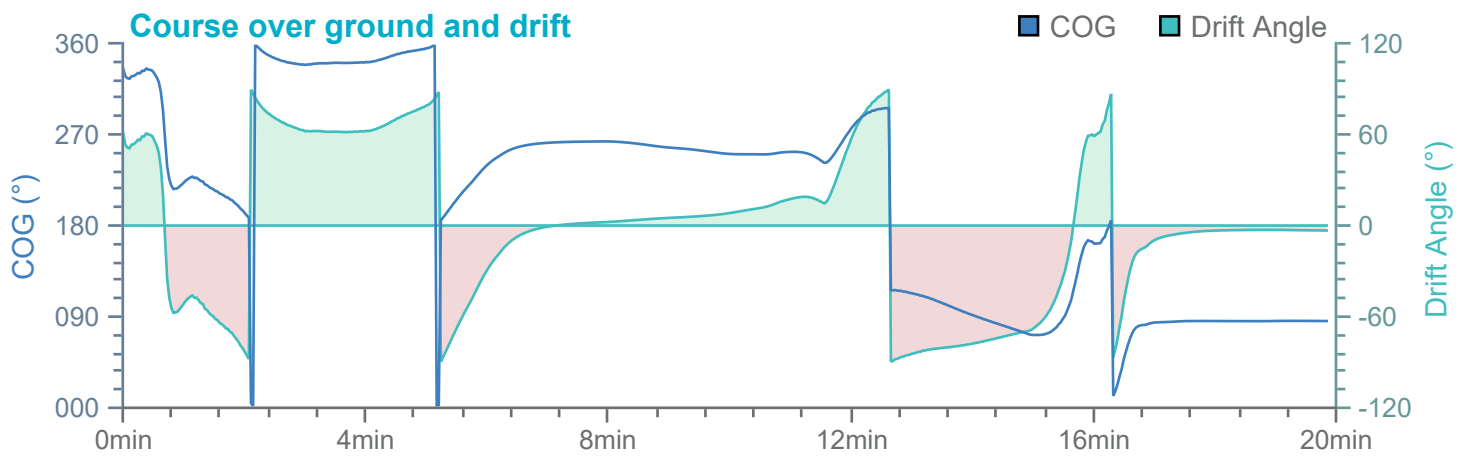
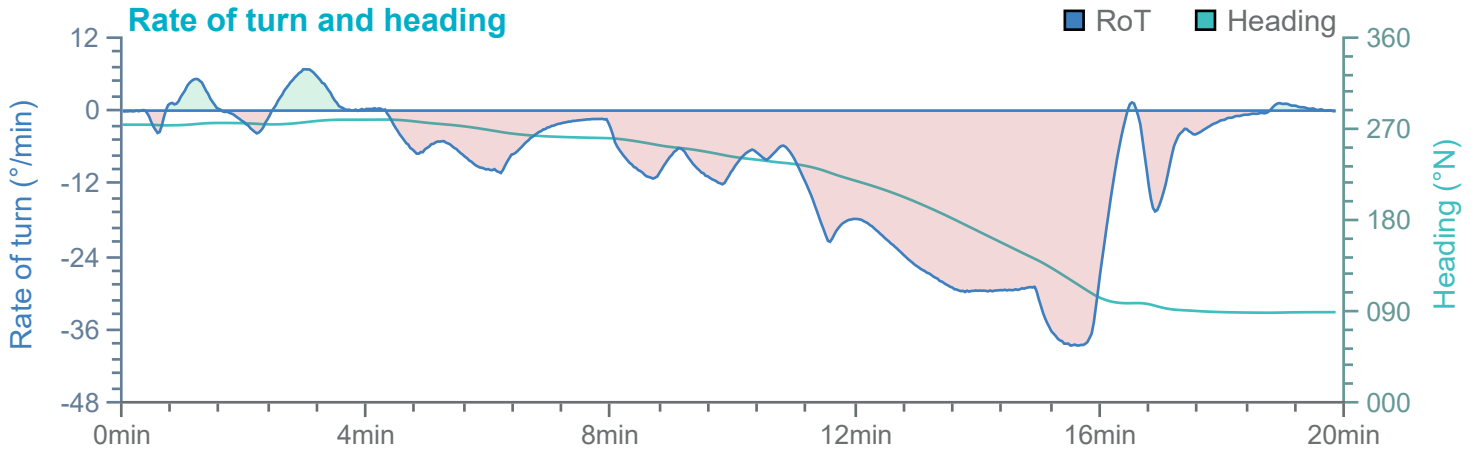


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

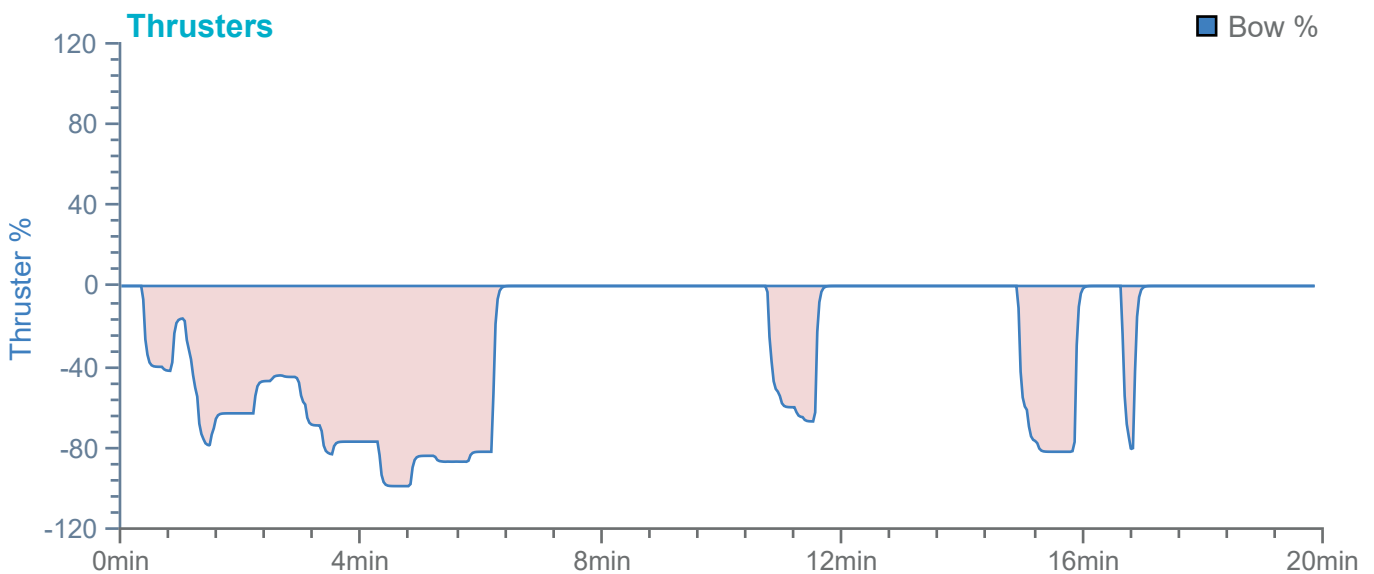
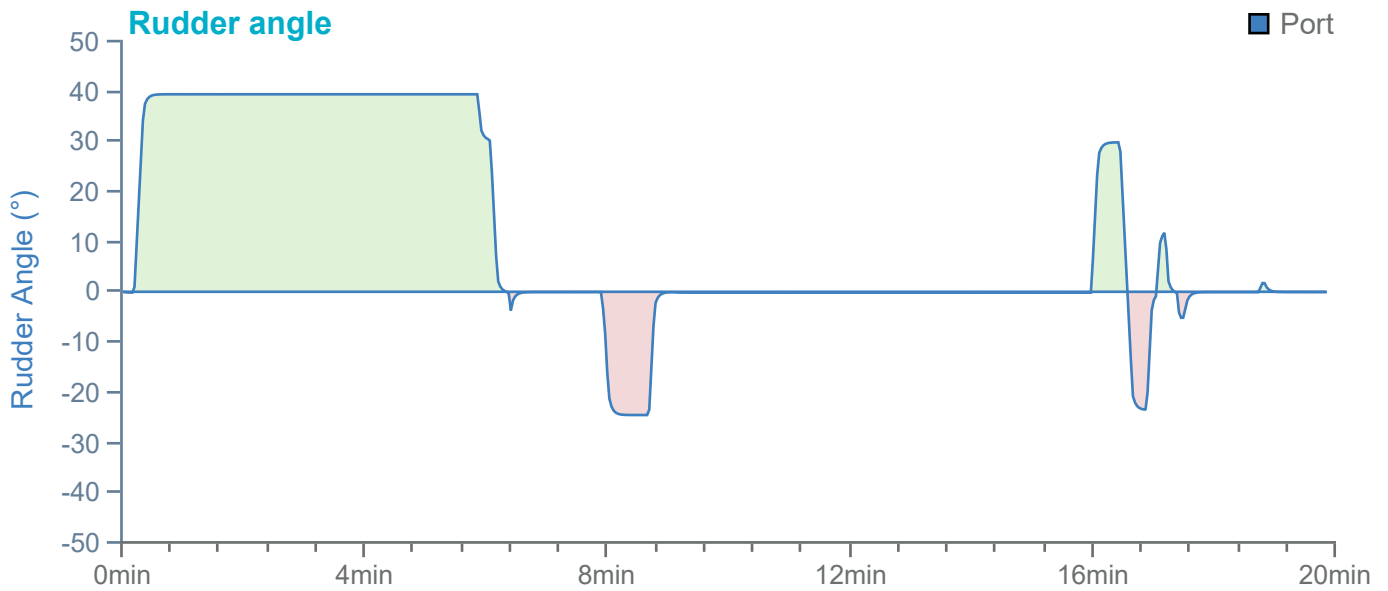
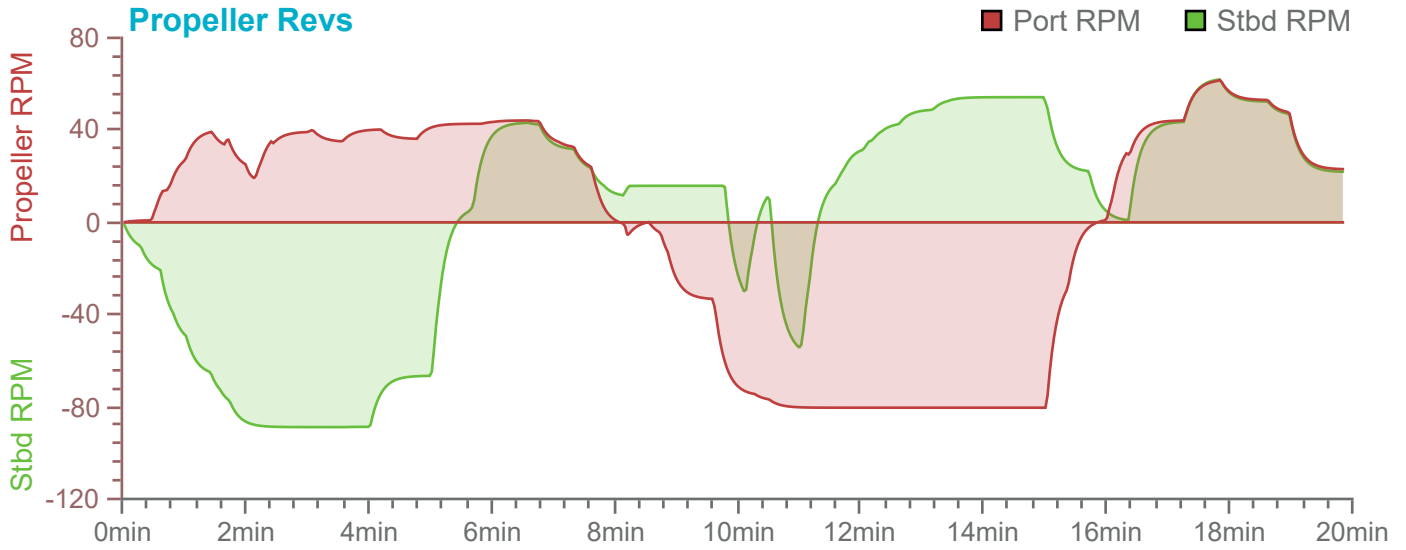


Overview

Environment

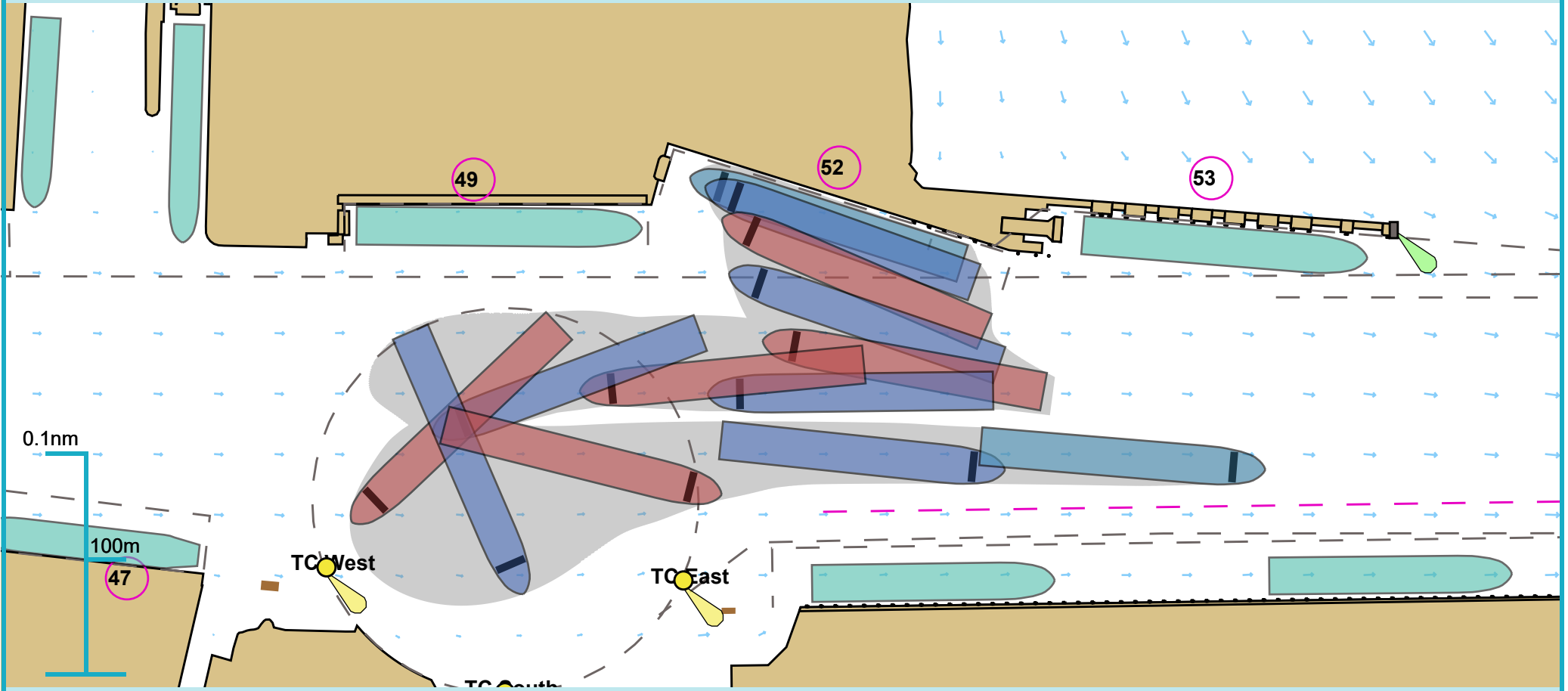
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.464 N, 006° 12.026 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

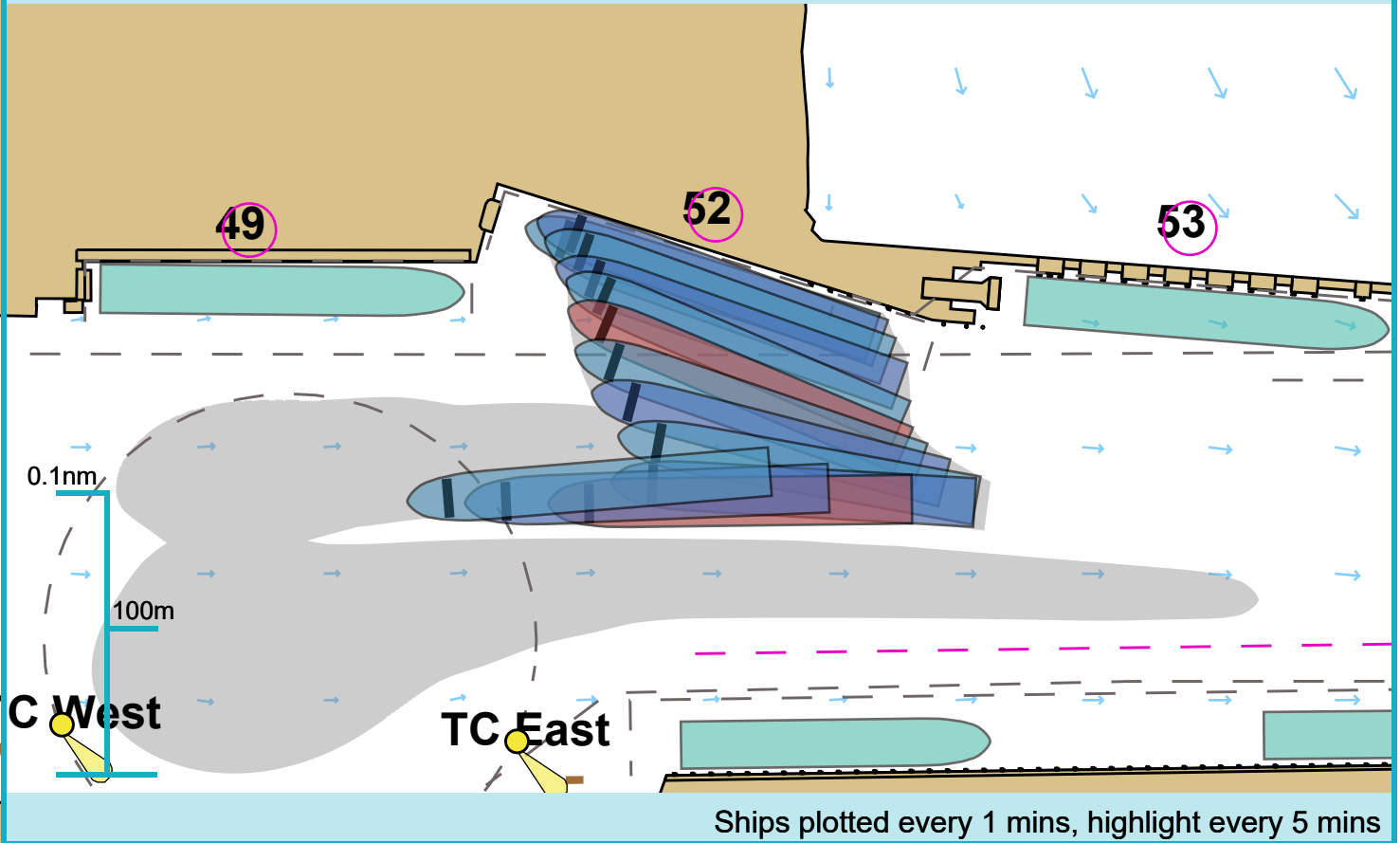
Run length: 23 minutes

Manoeuvre: Other

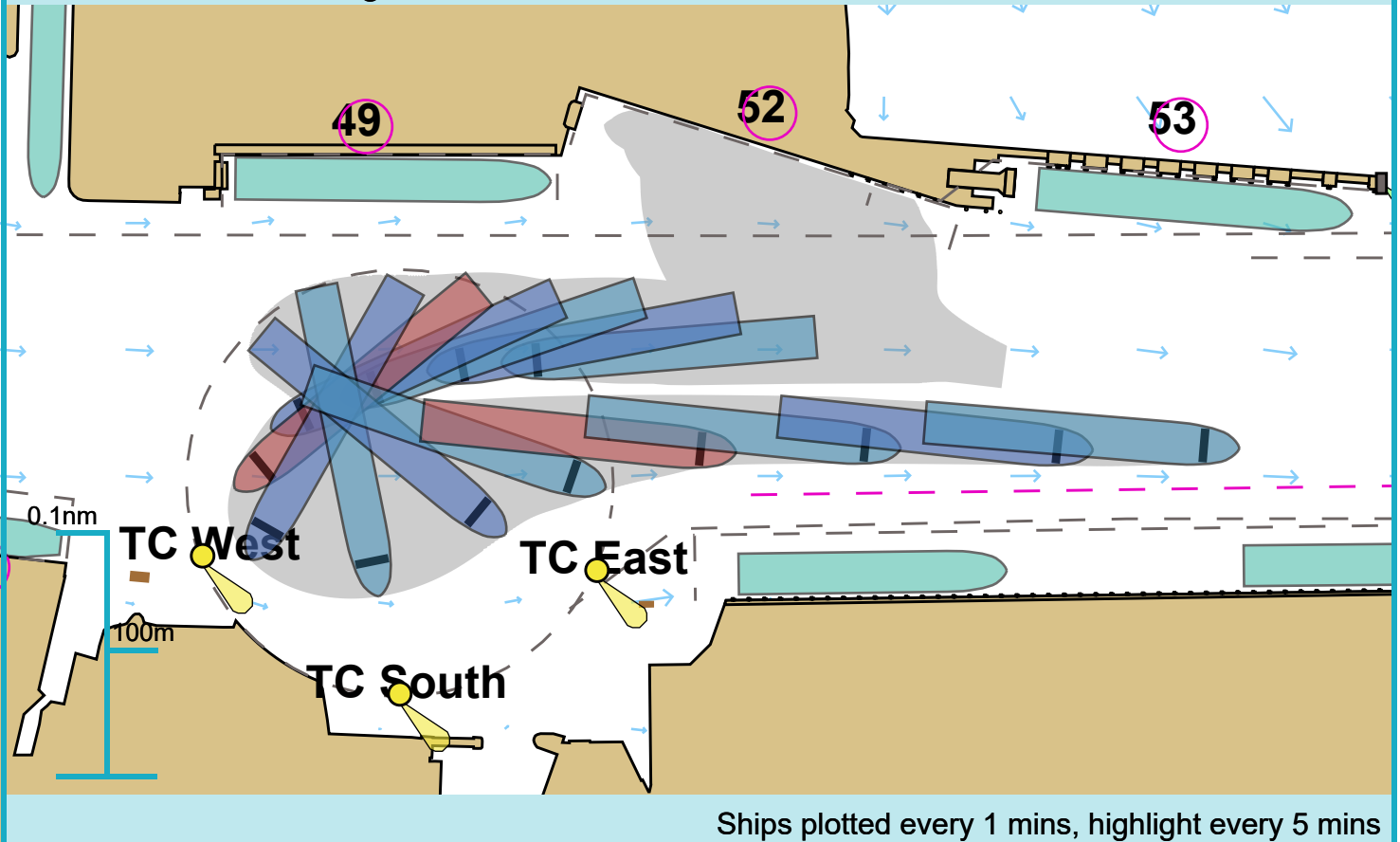
Ownship(s): 240m x 32m RoPax Ferry

Comments:

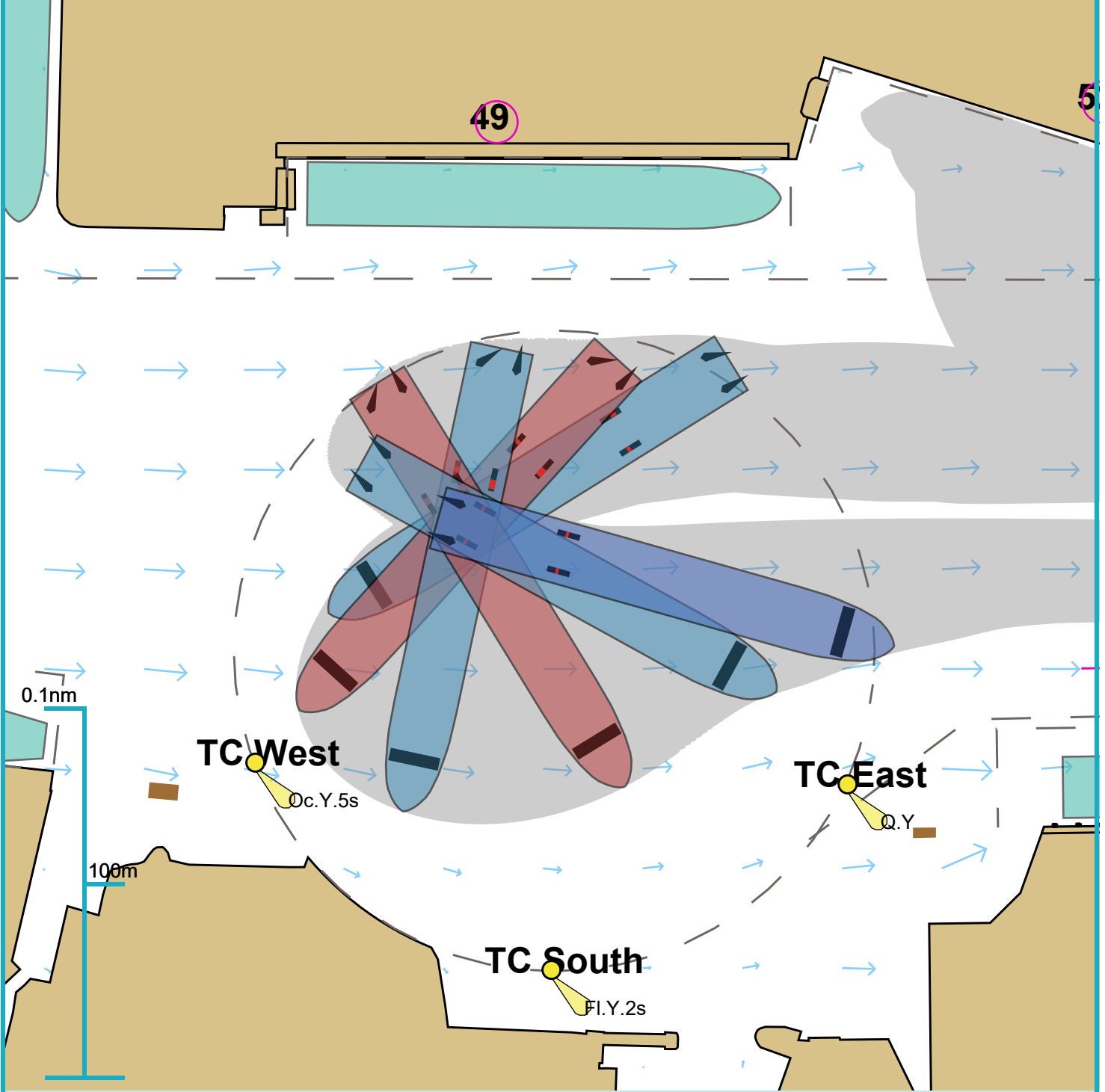
Departure



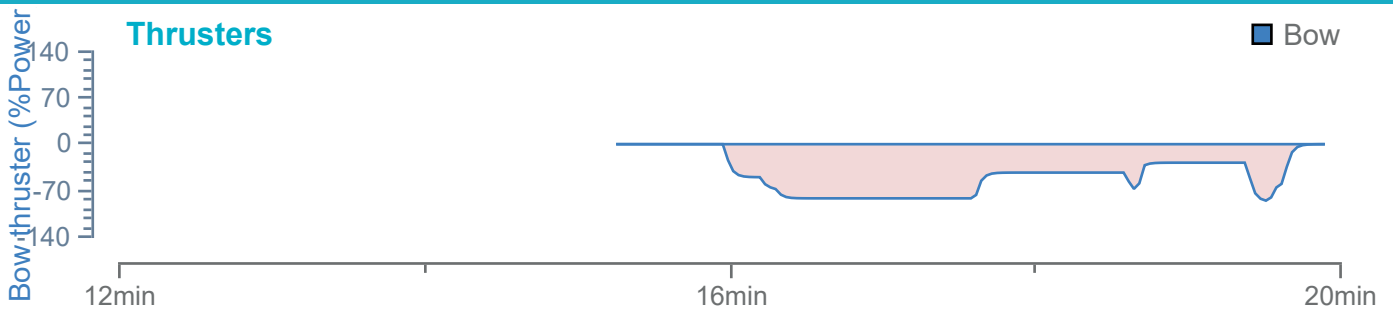
Manoeuvre & Passage

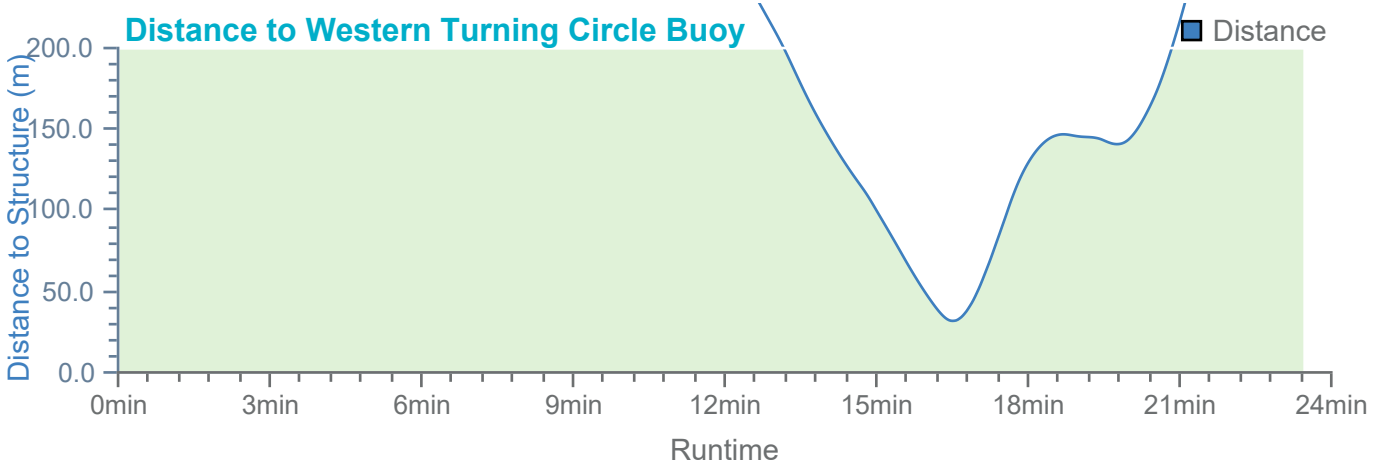
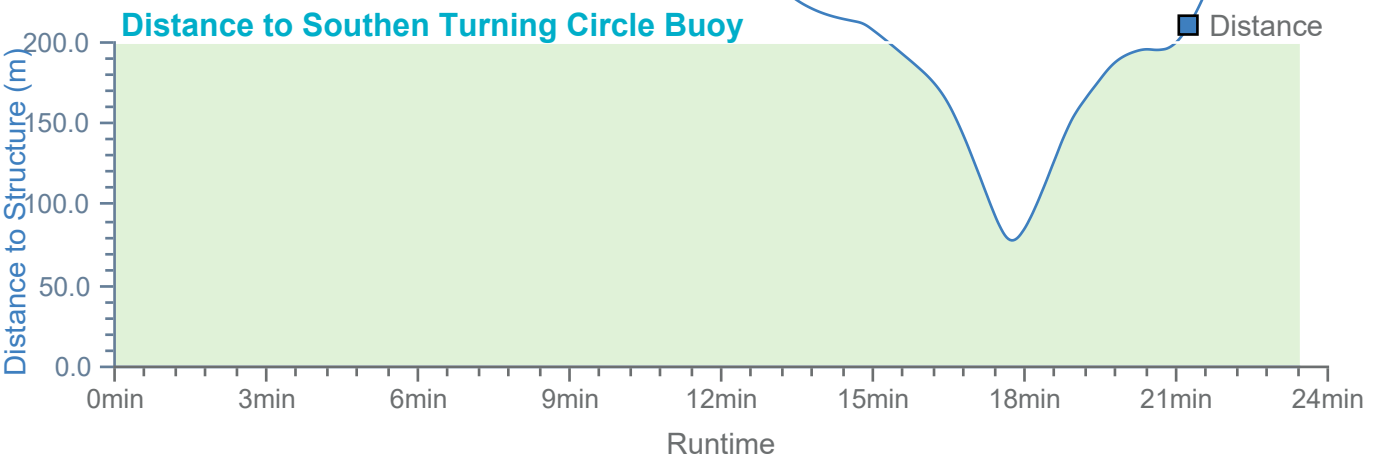
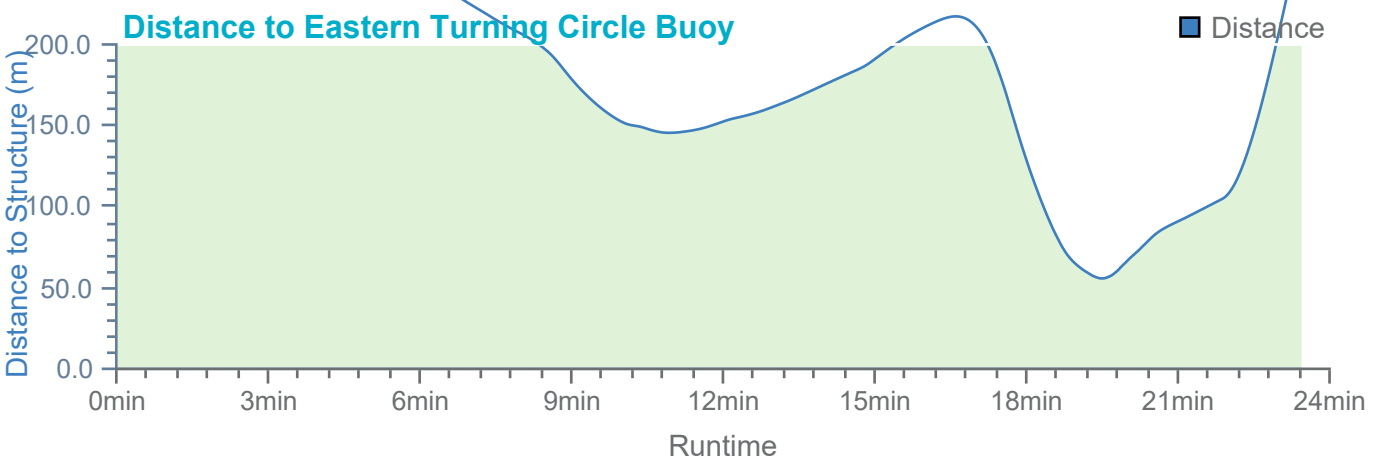
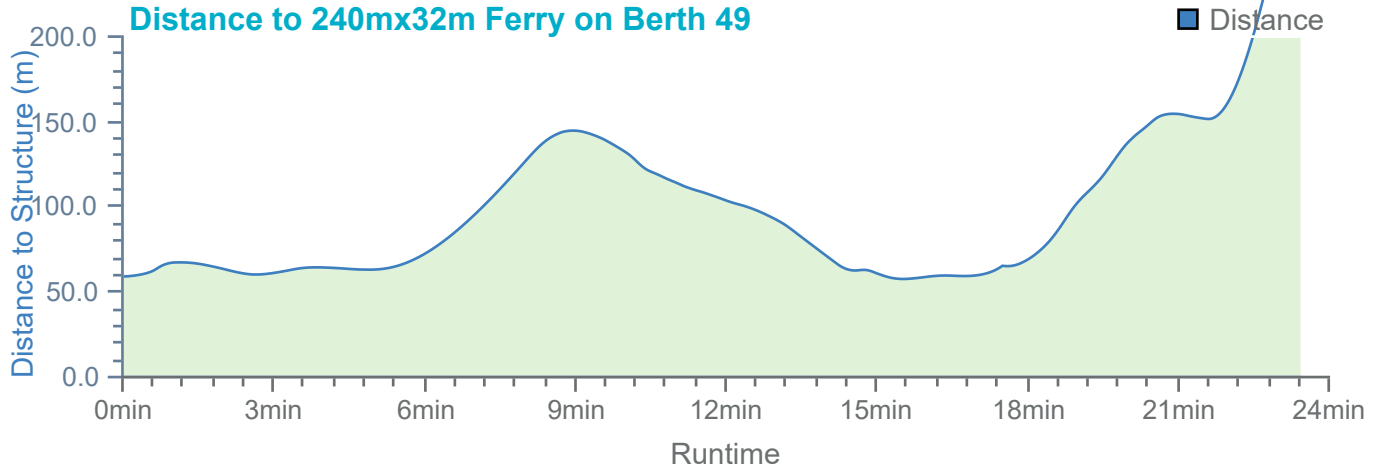


Swing



Ships plotted every 59 seconds, highlight every 2 mins



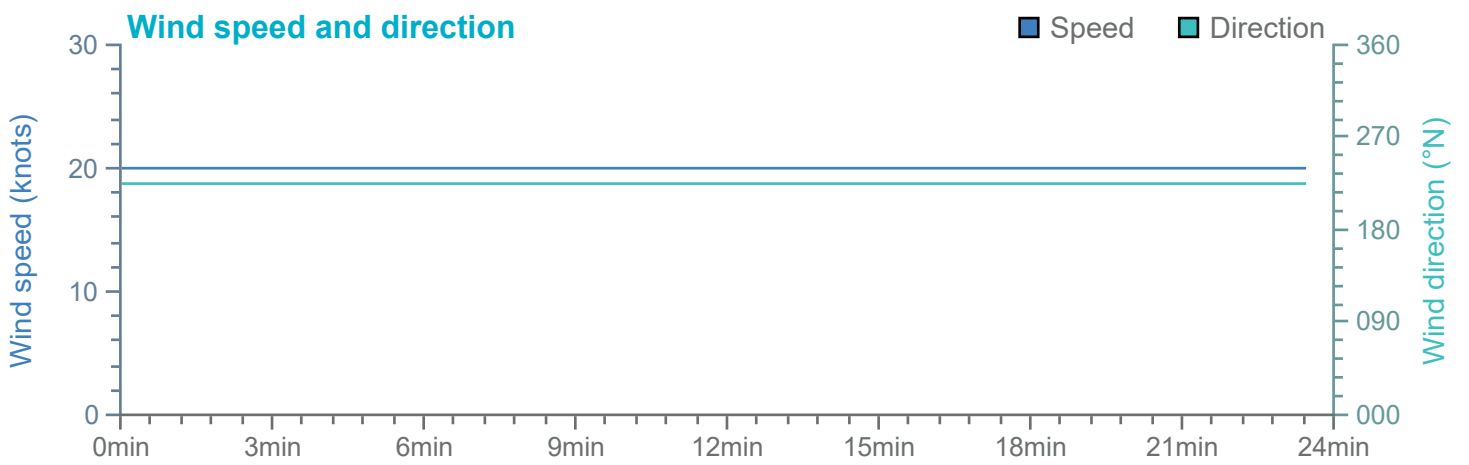
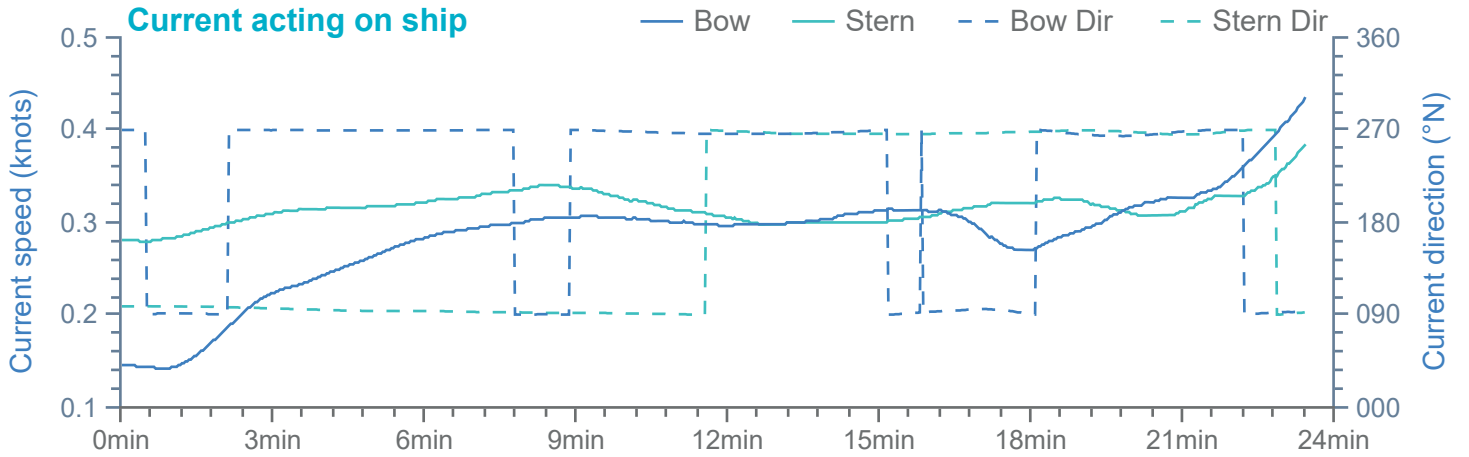


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

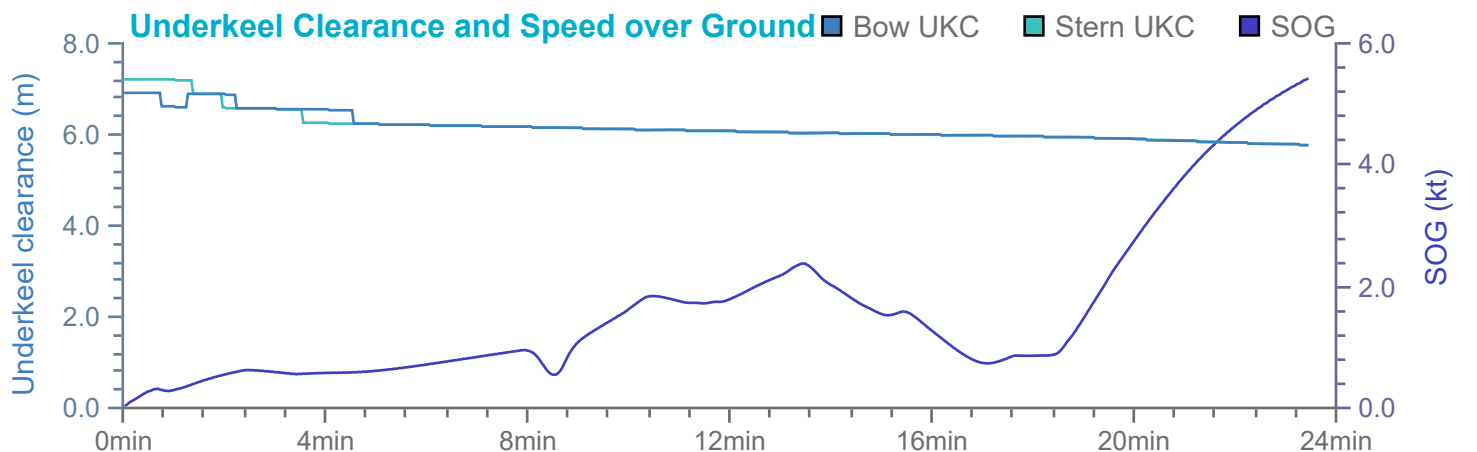
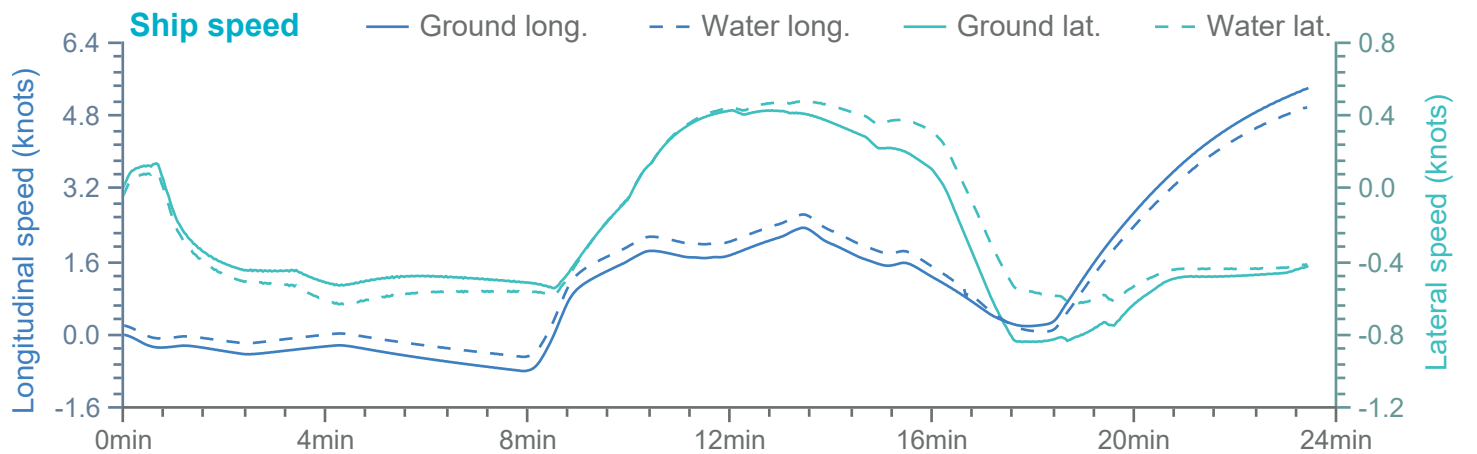
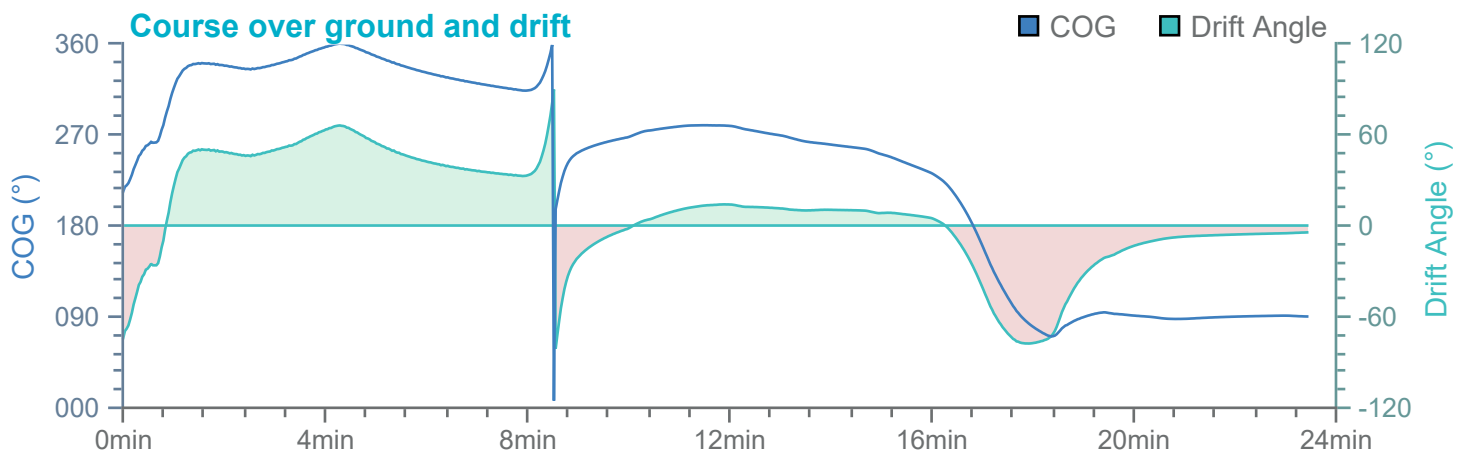
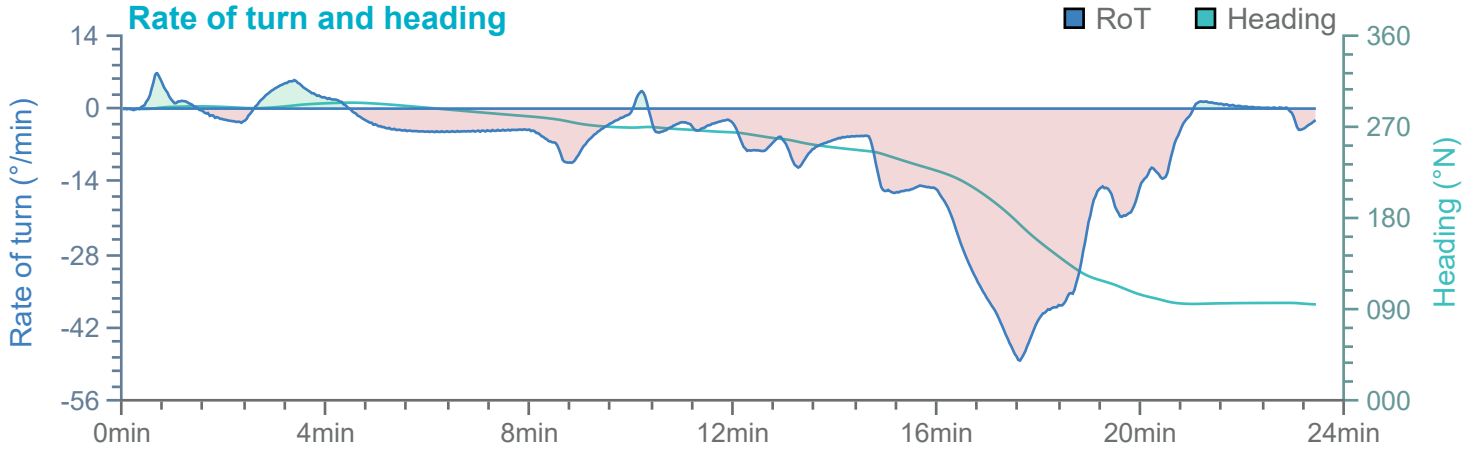


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

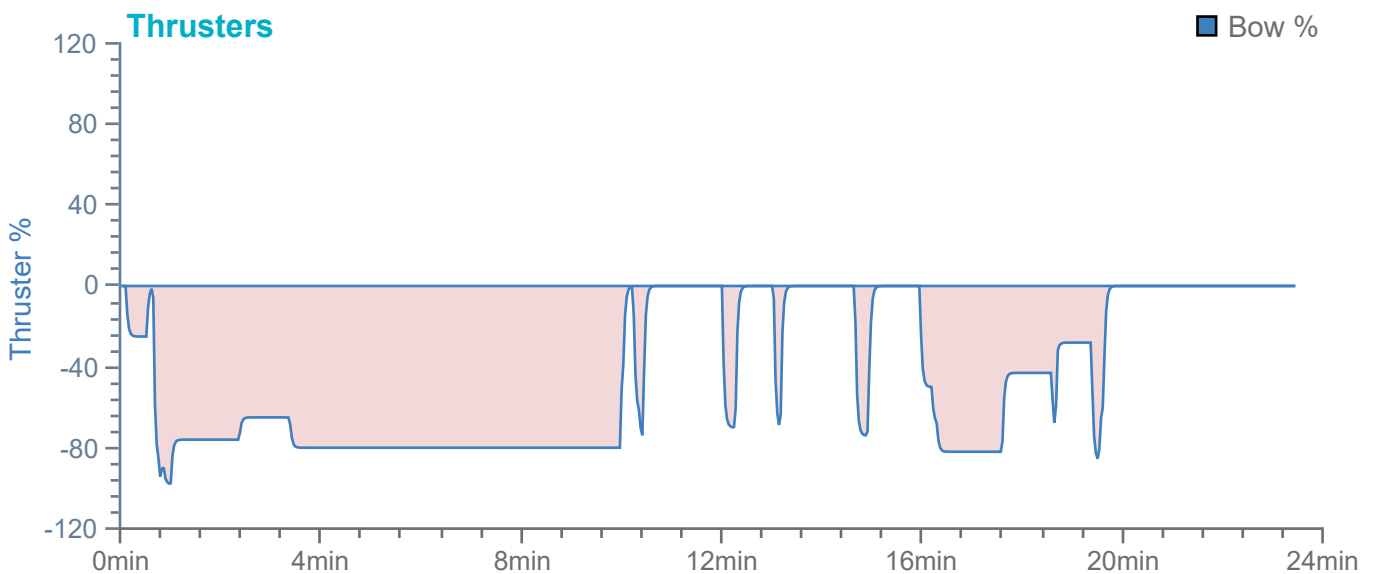
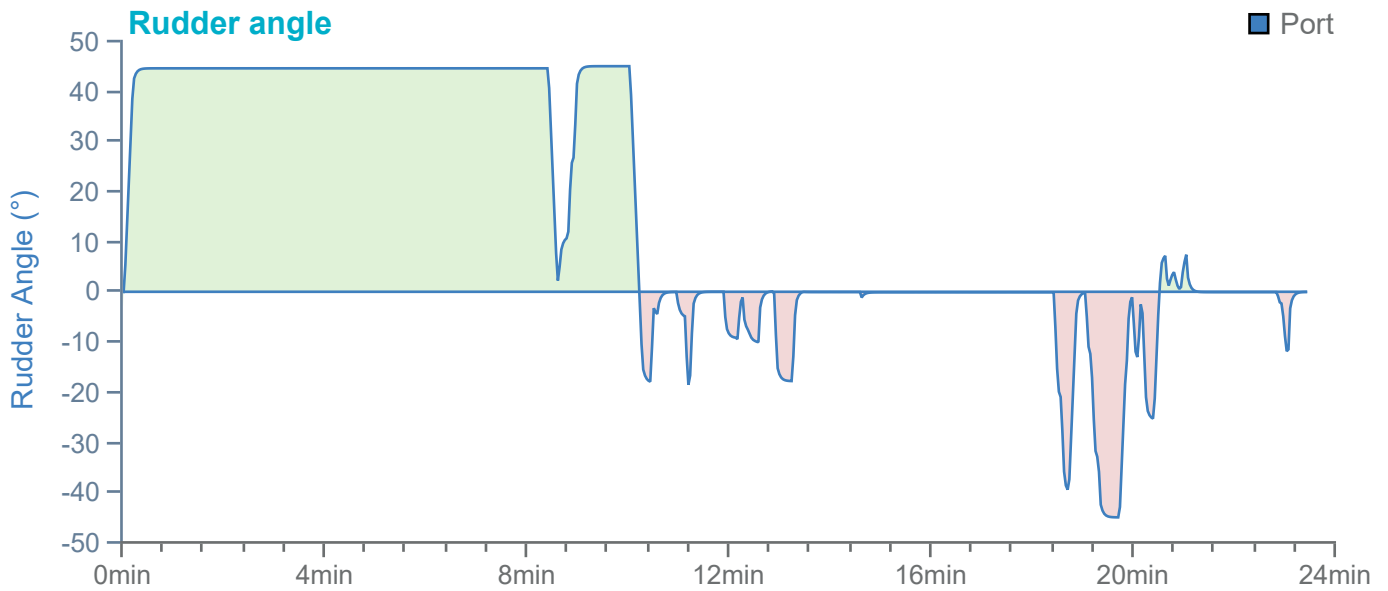
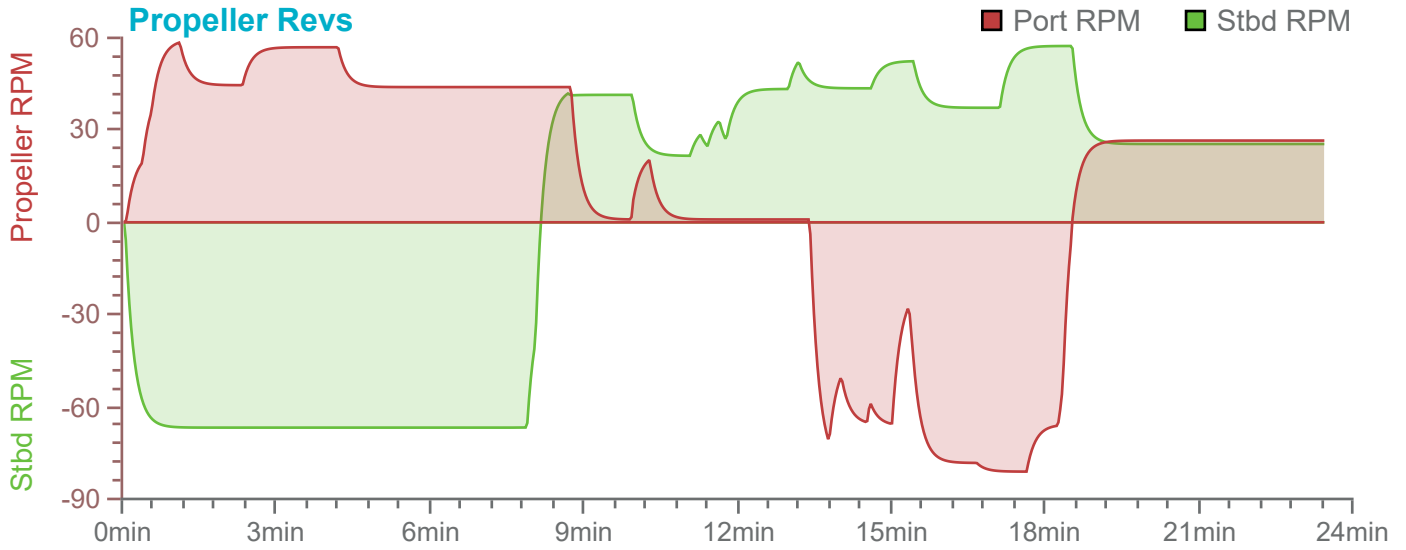


Overview

Environment

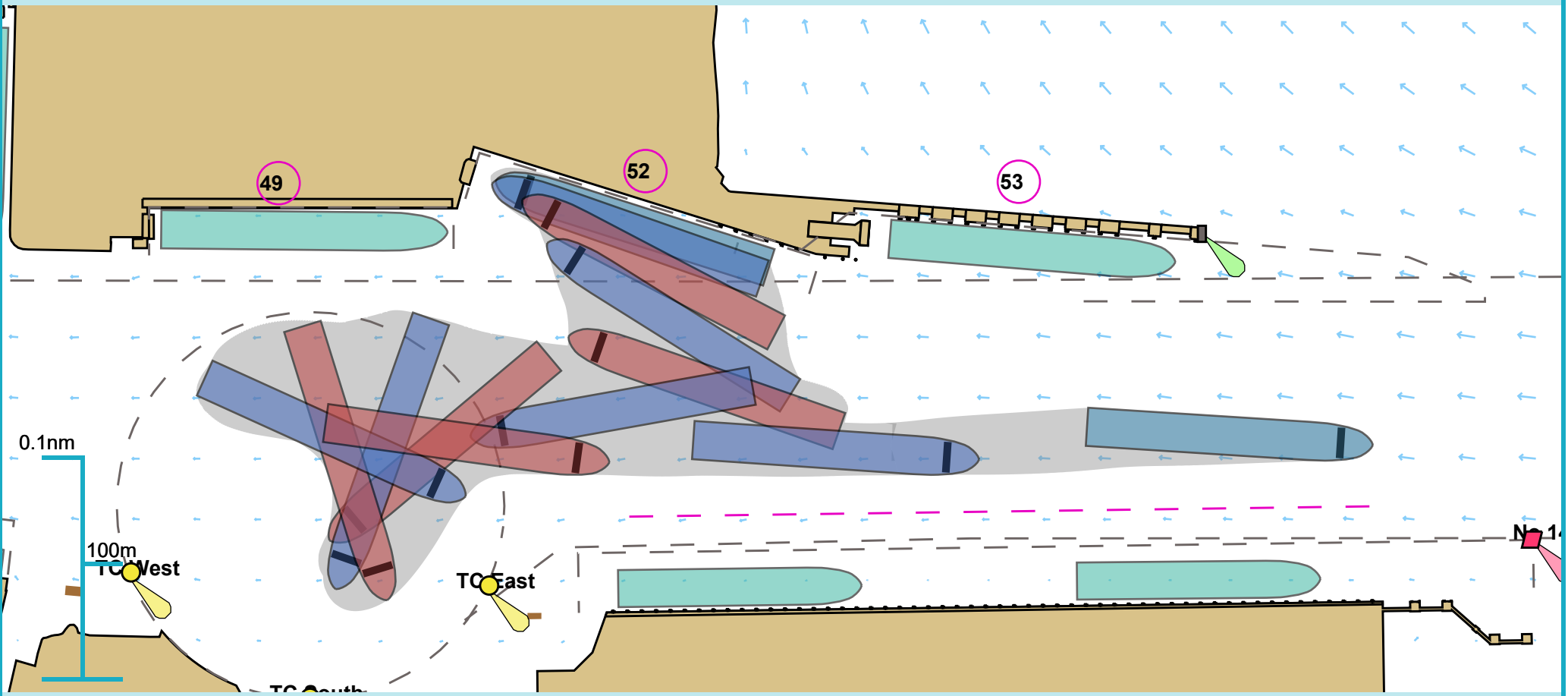
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.465 N, 006° 11.881 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

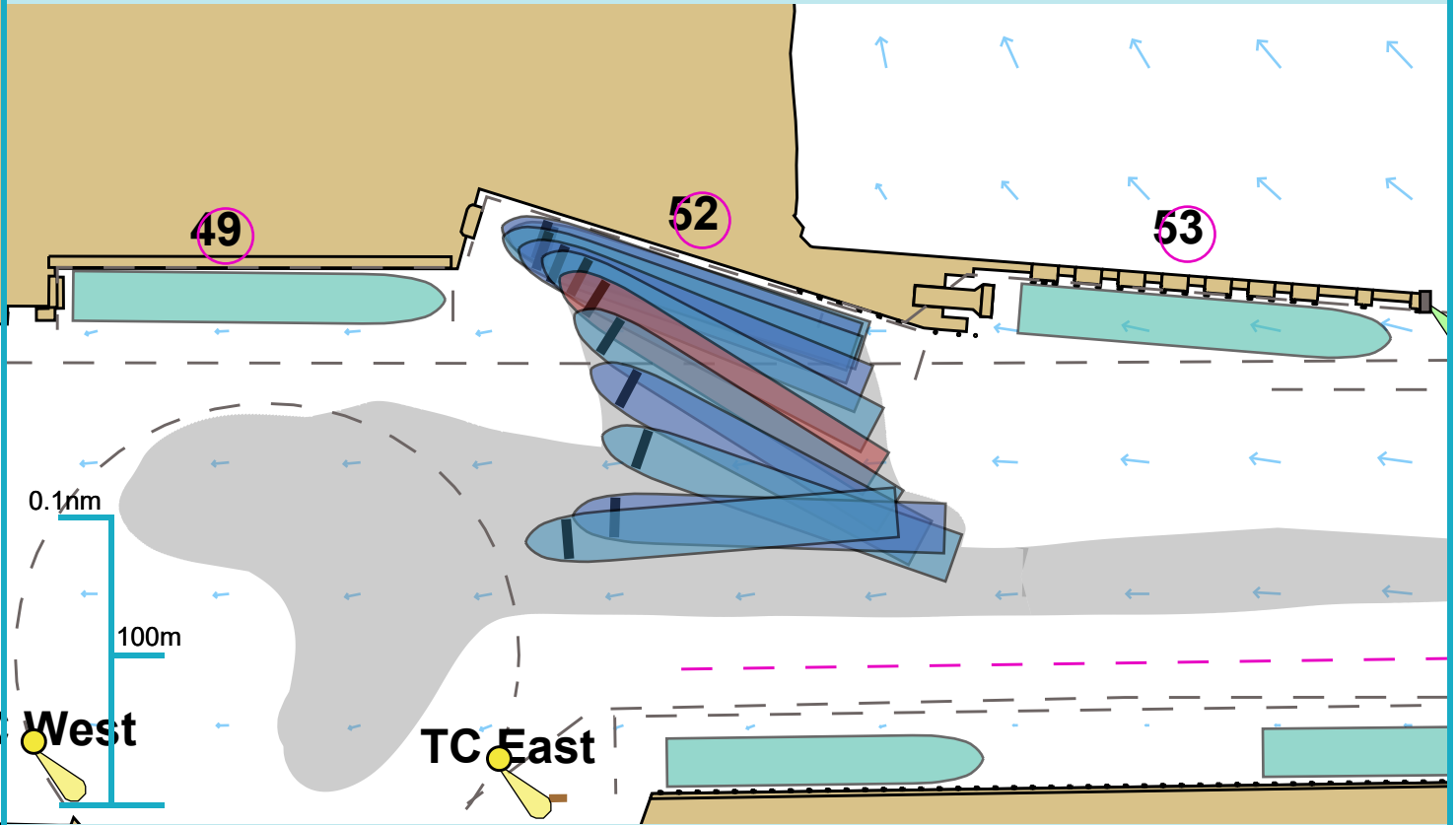
Run length: 24 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

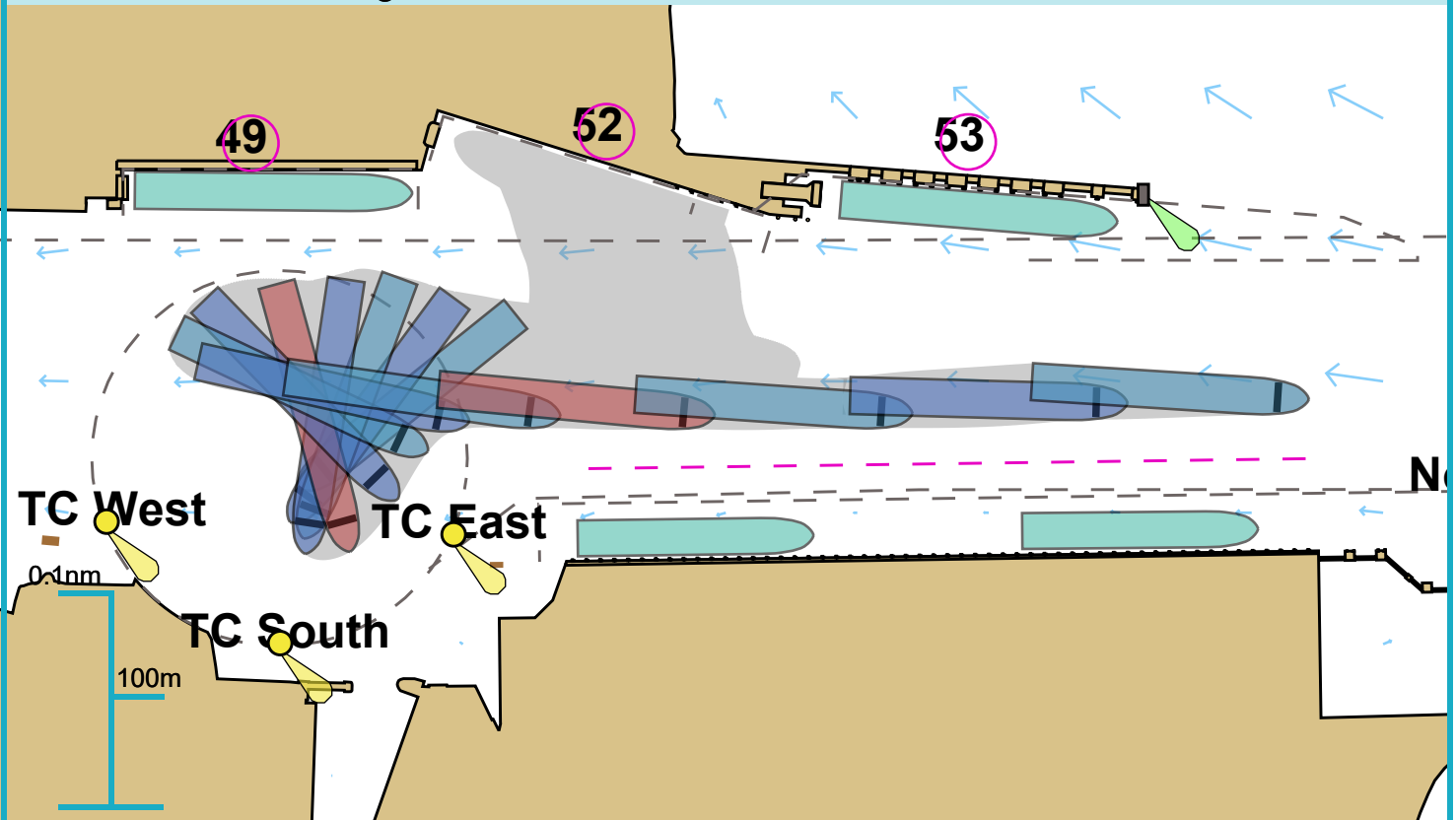
Comments:

Departure



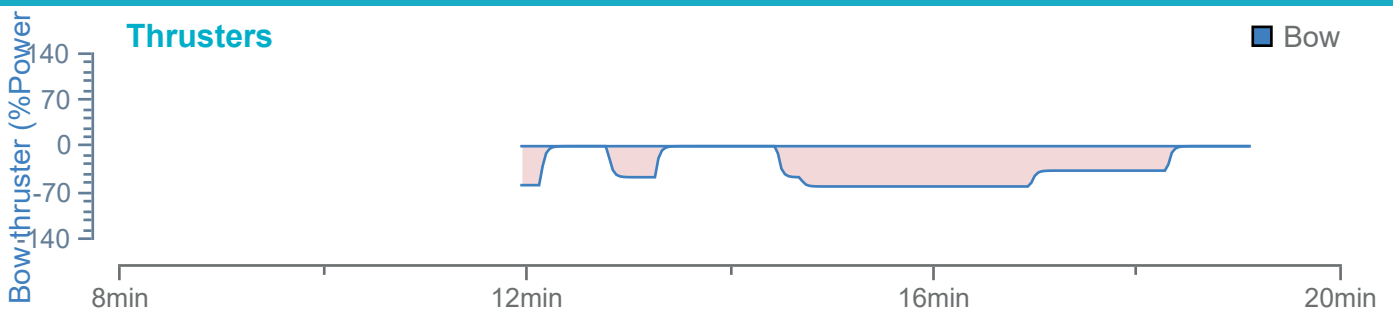
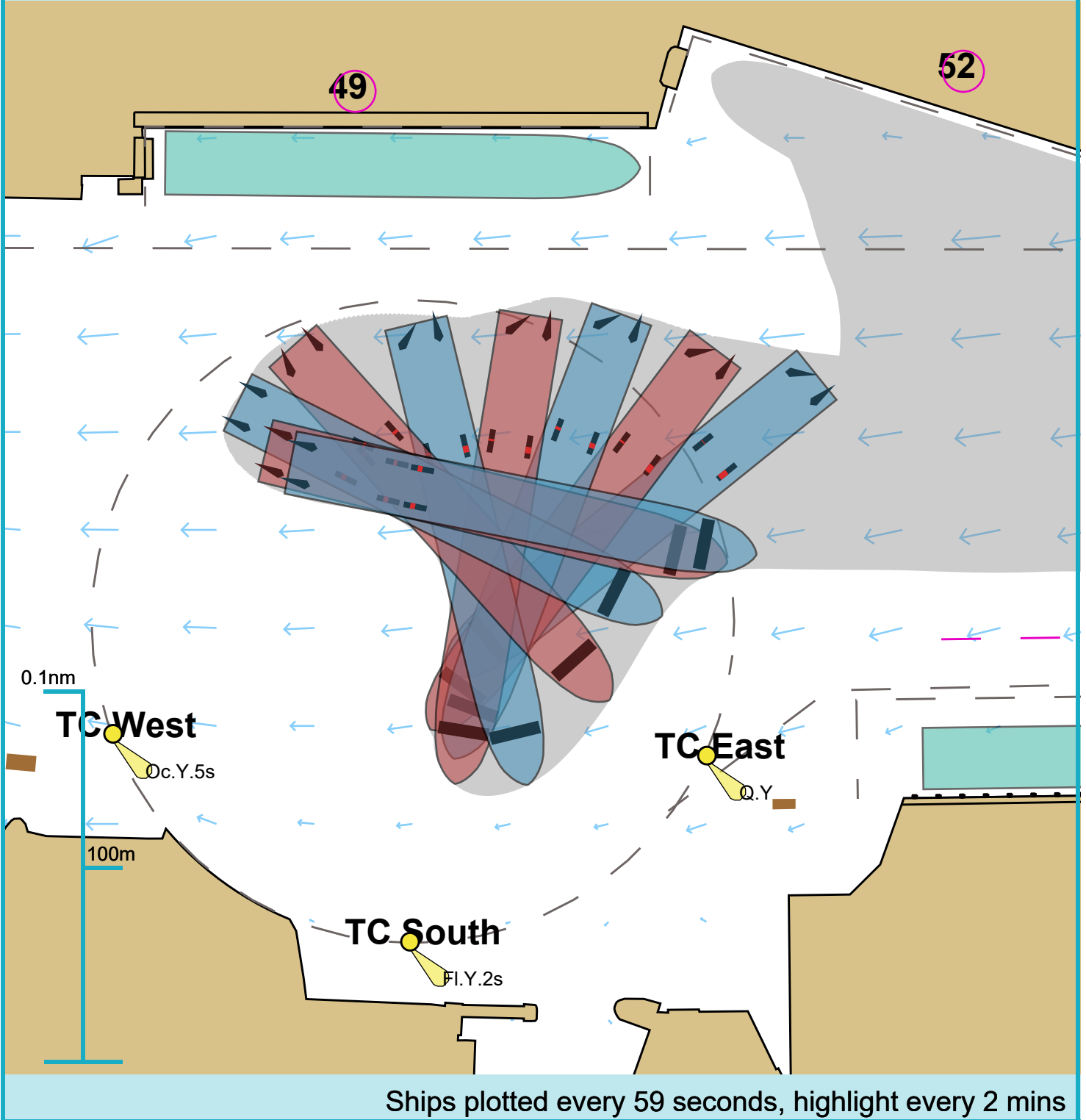
Ships plotted every 1 mins, highlight every 5 mins

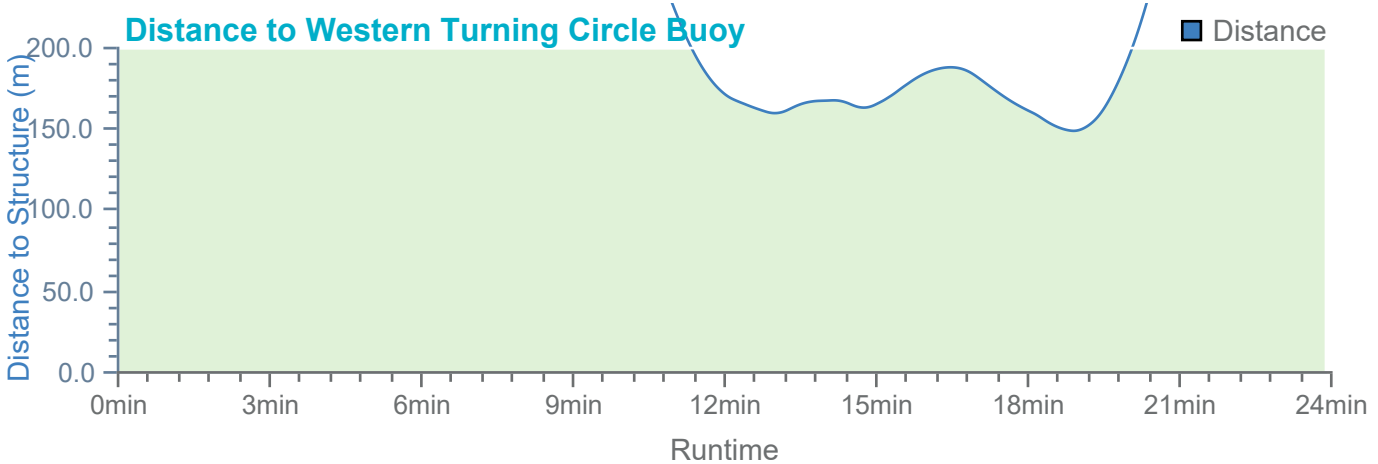
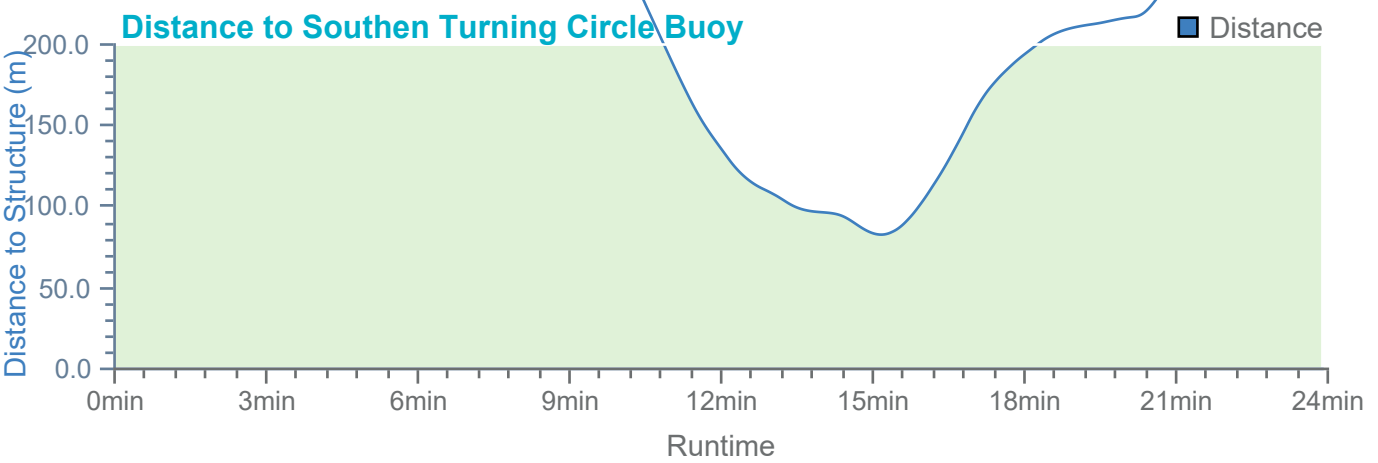
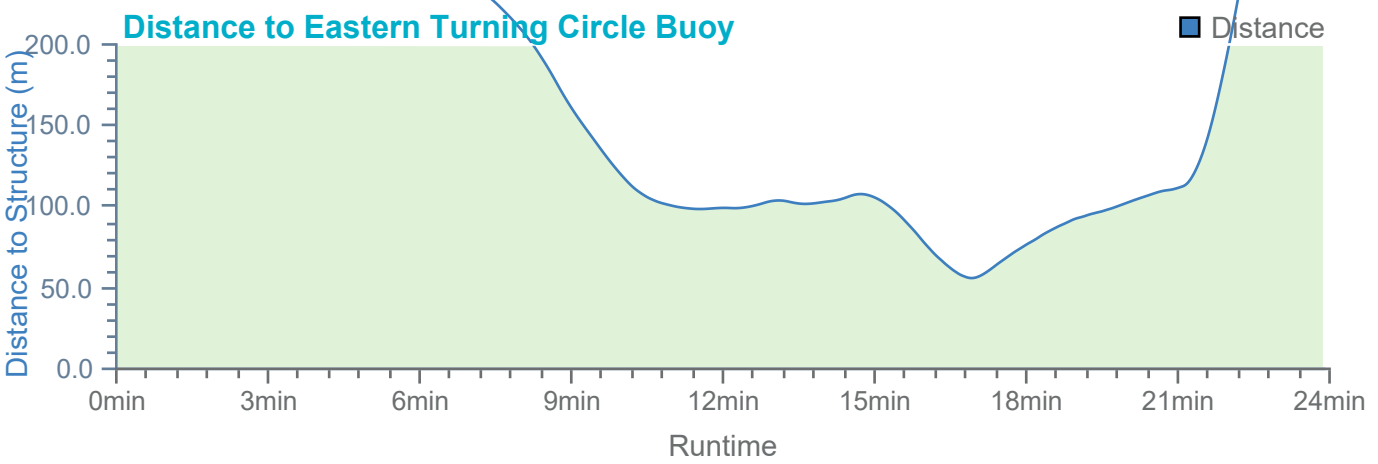
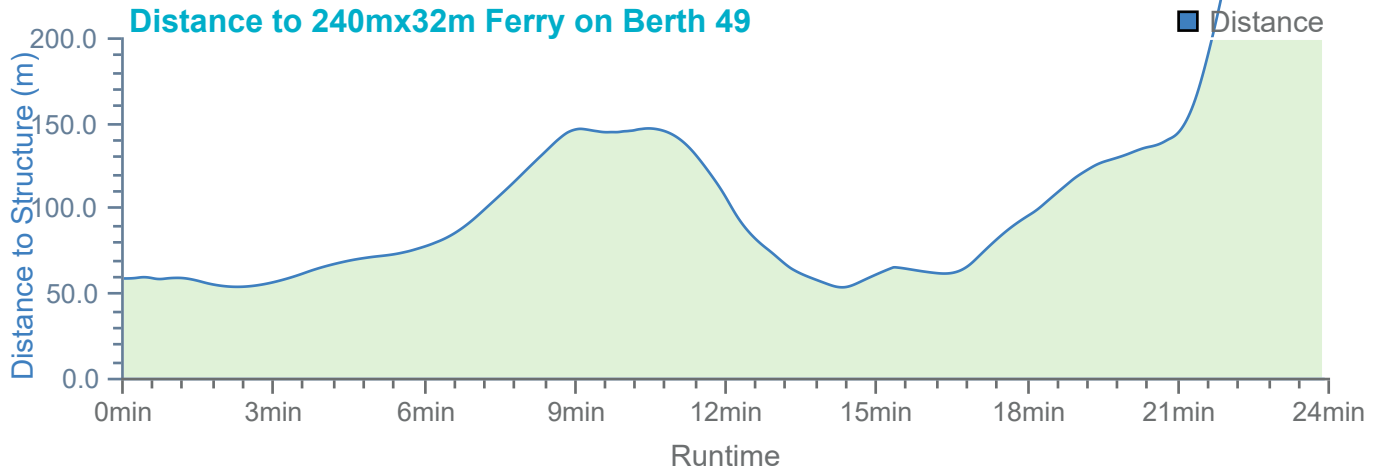
Manoeuvre & Passage



Ships plotted every 1 mins, highlight every 5 mins

Swing



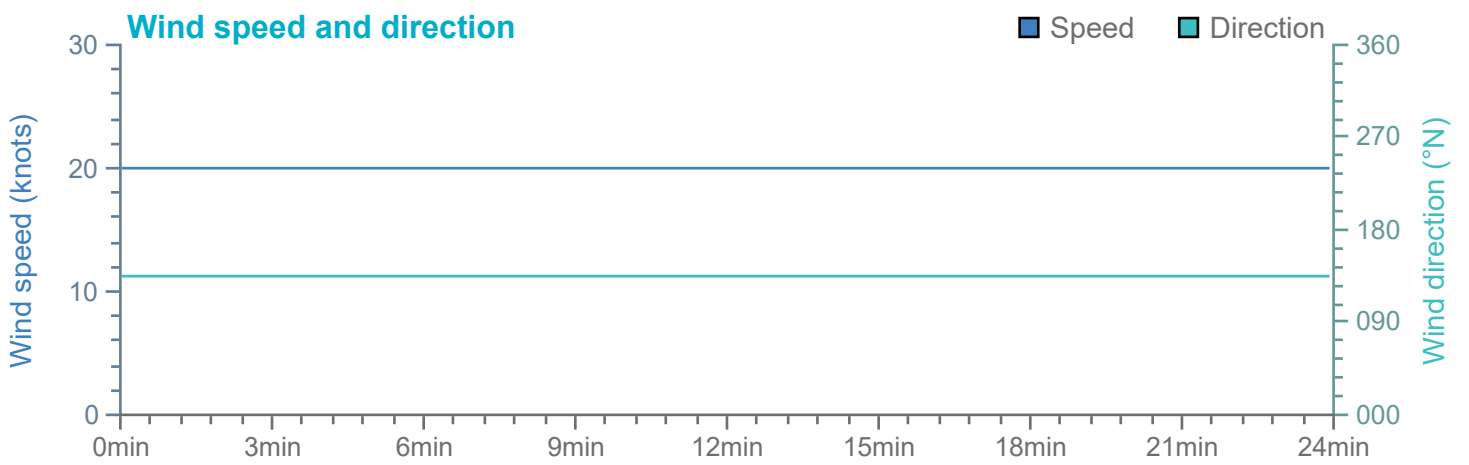
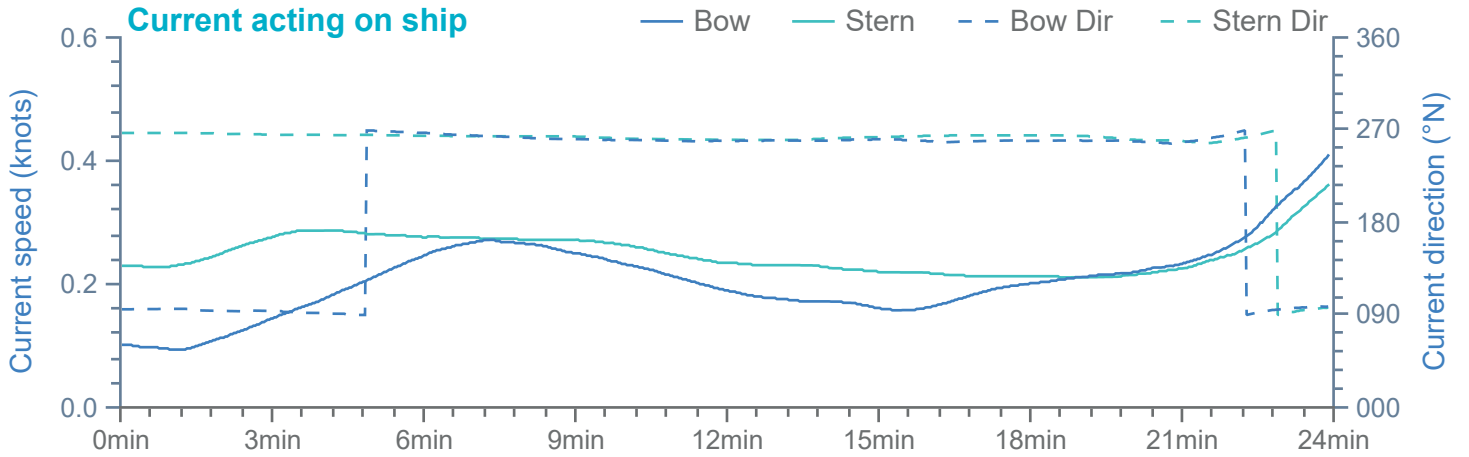


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

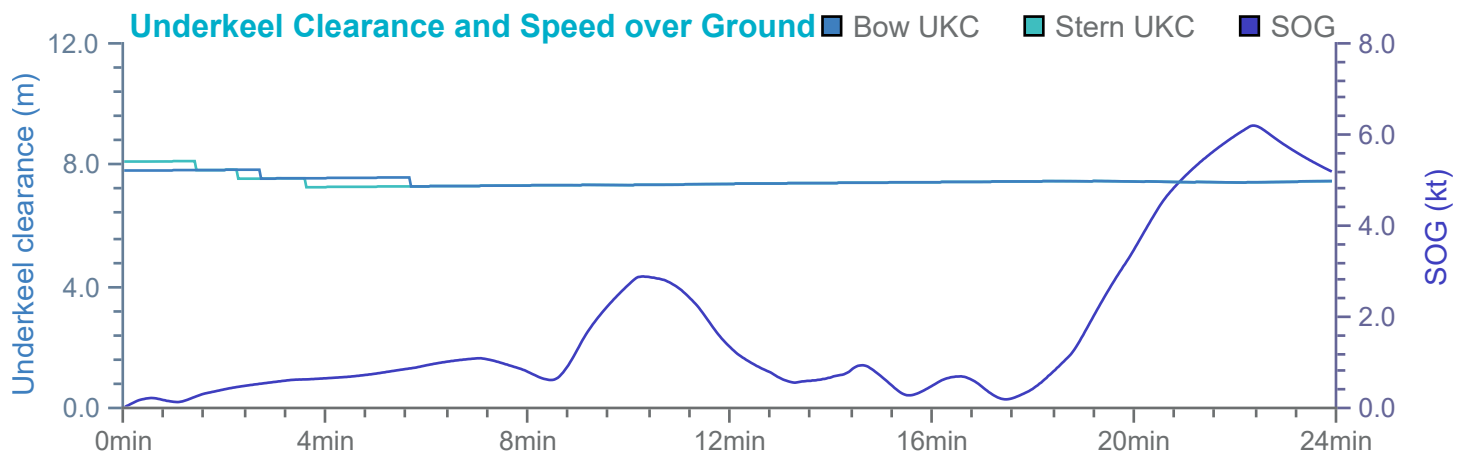
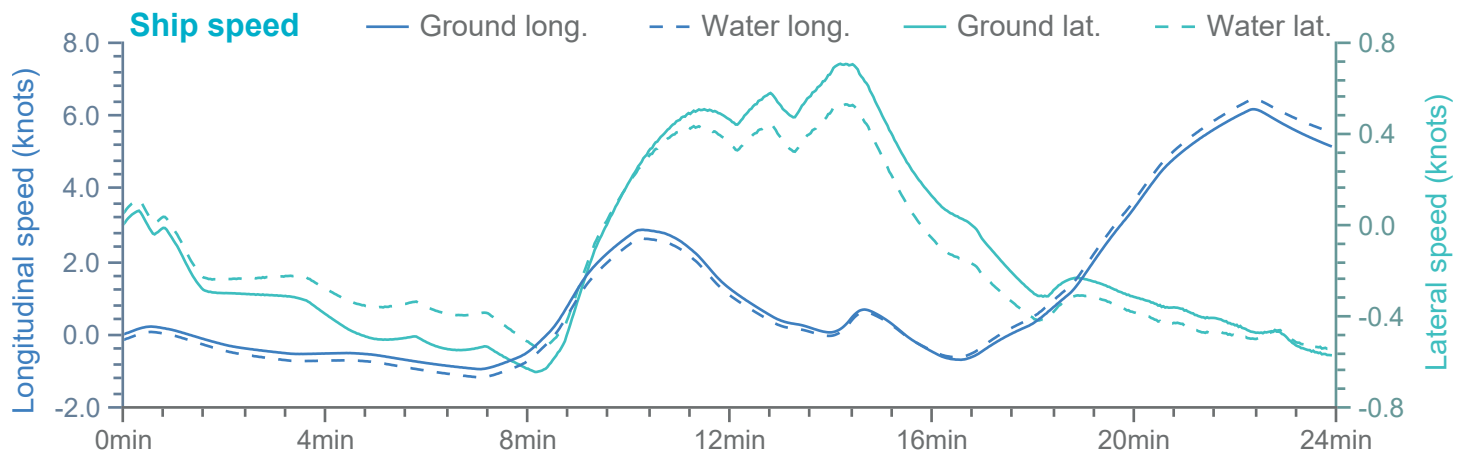
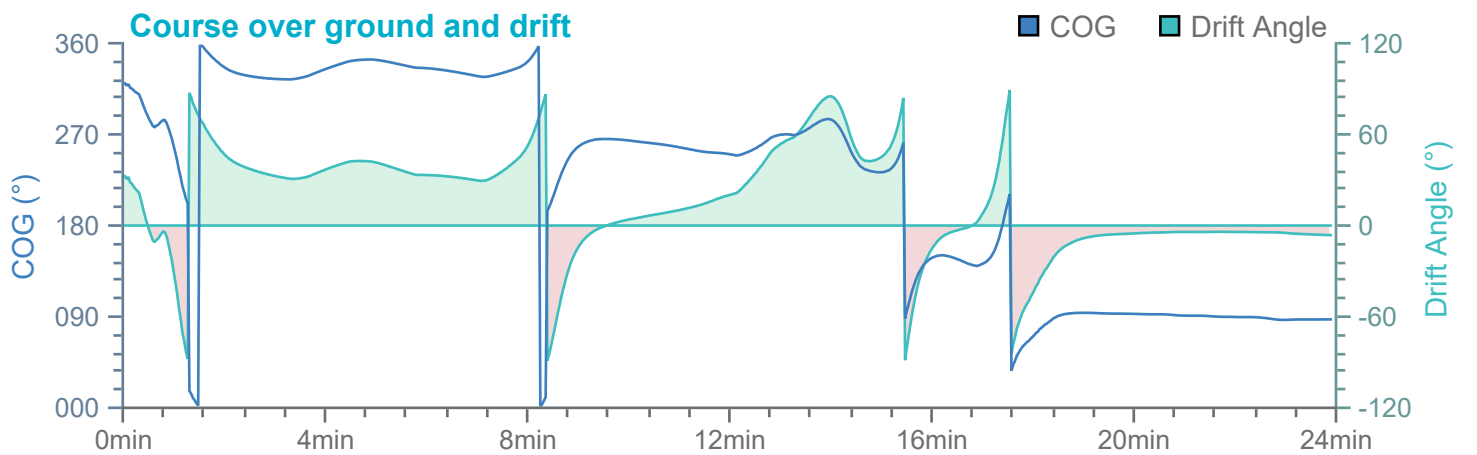
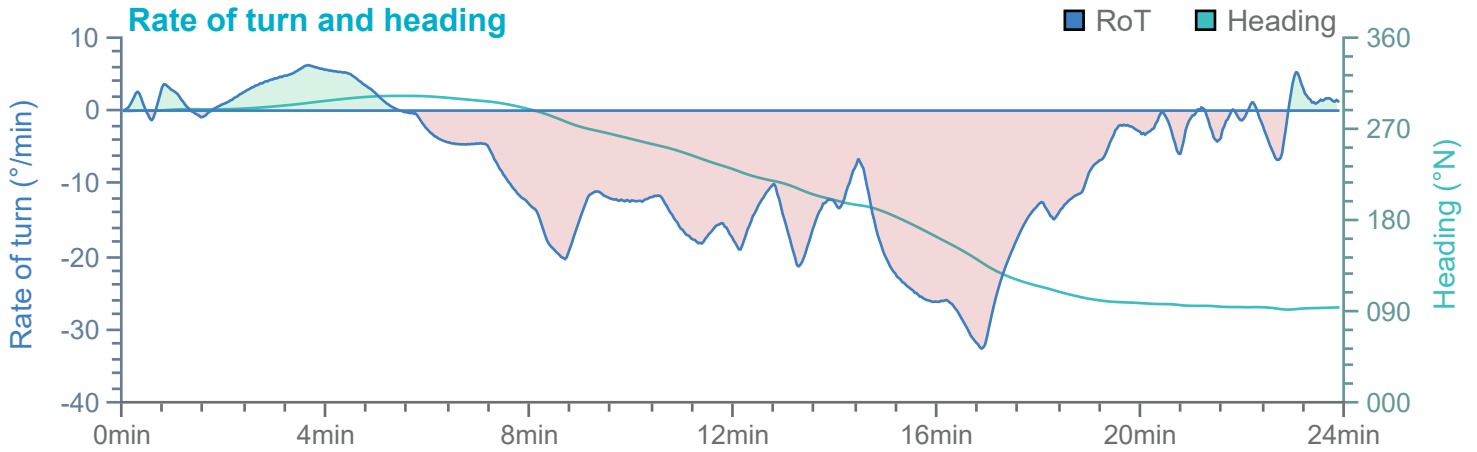


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

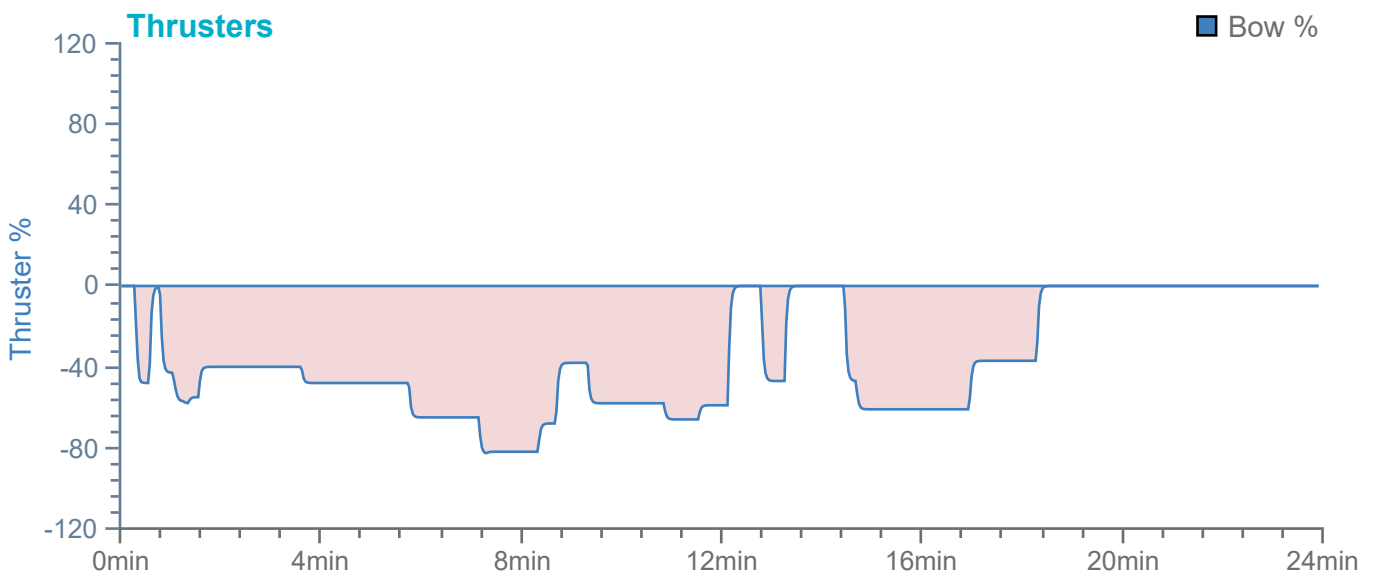
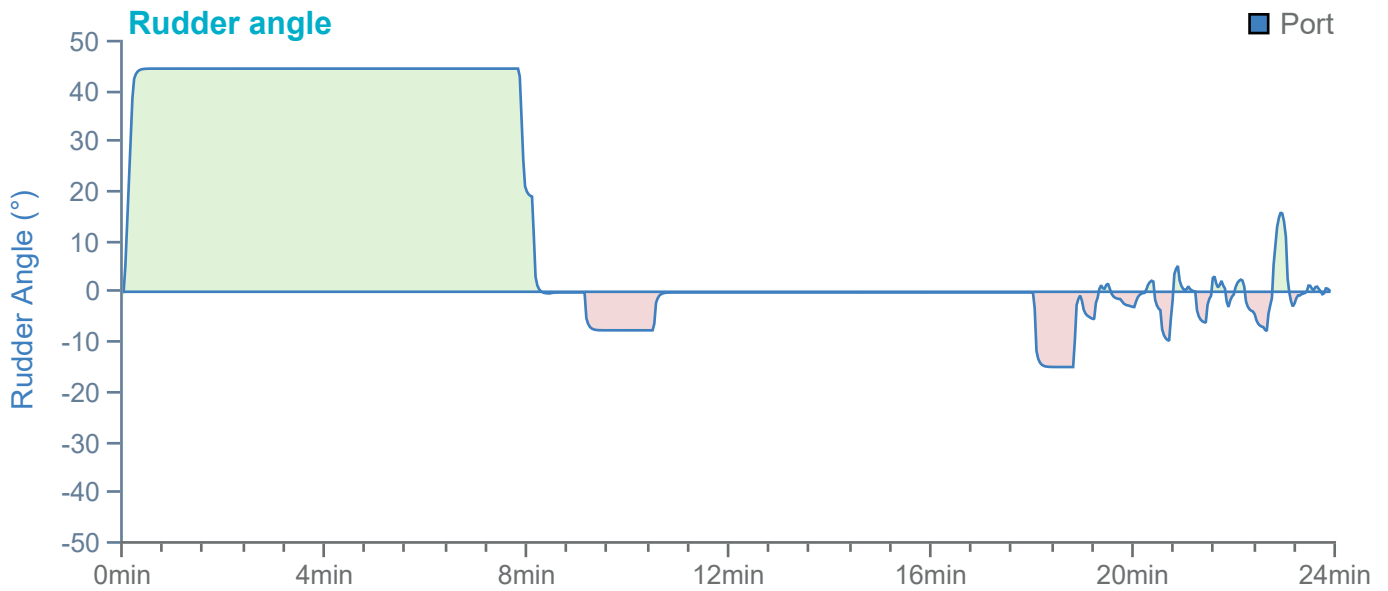
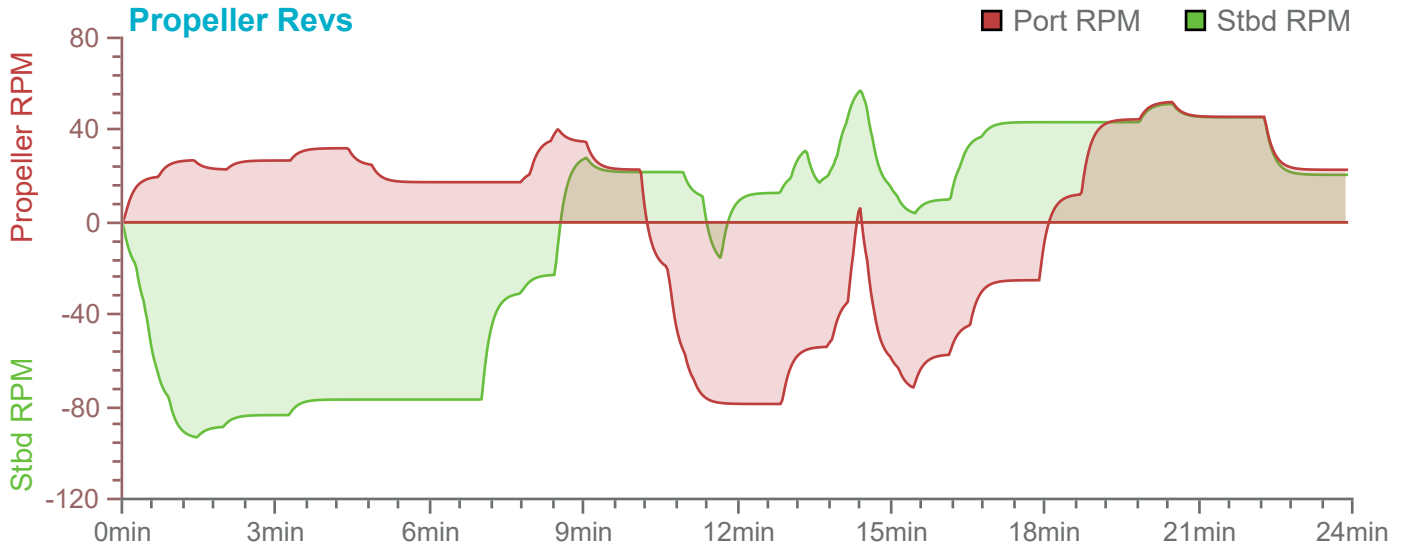


Overview

Environment

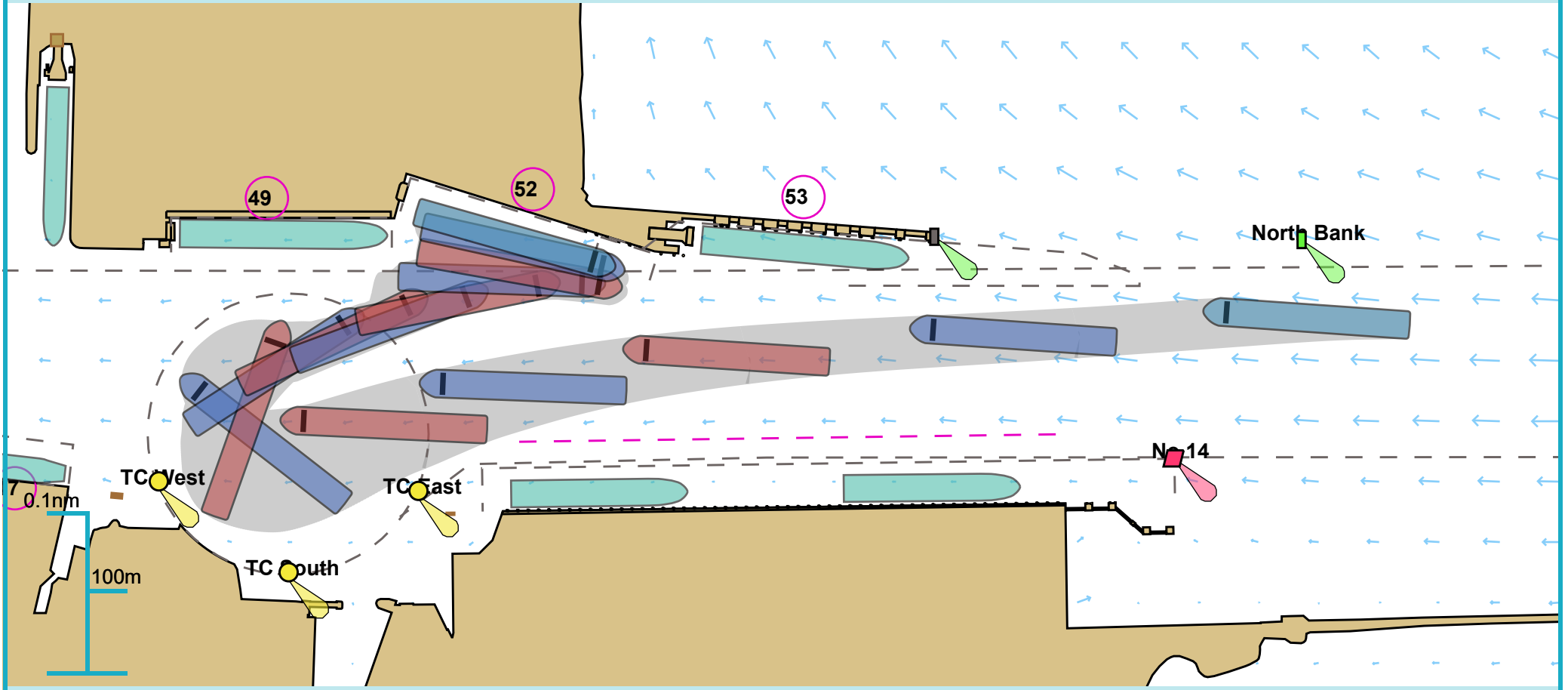
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.383 N, 006° 11.941 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

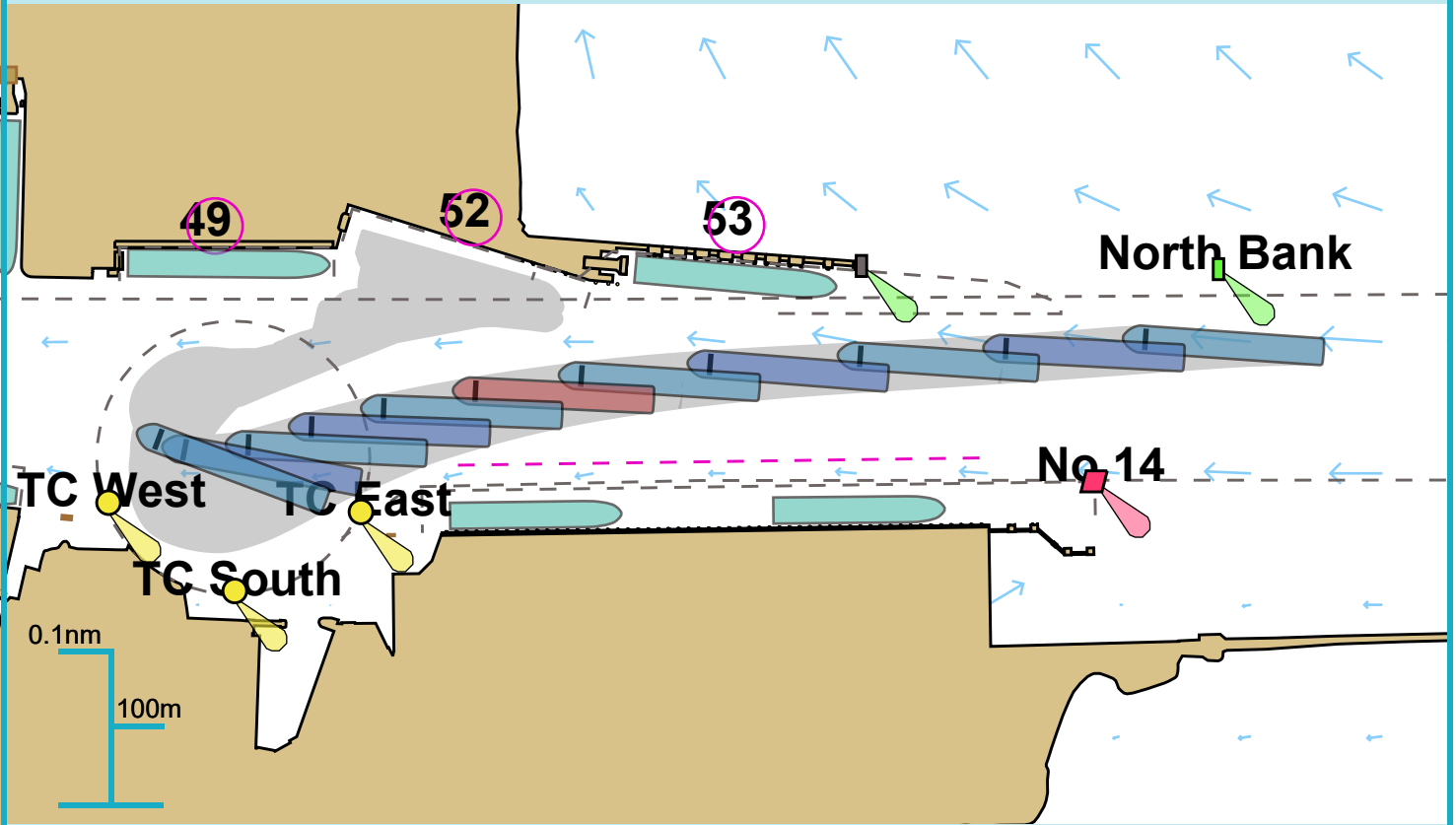
Run length:27 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

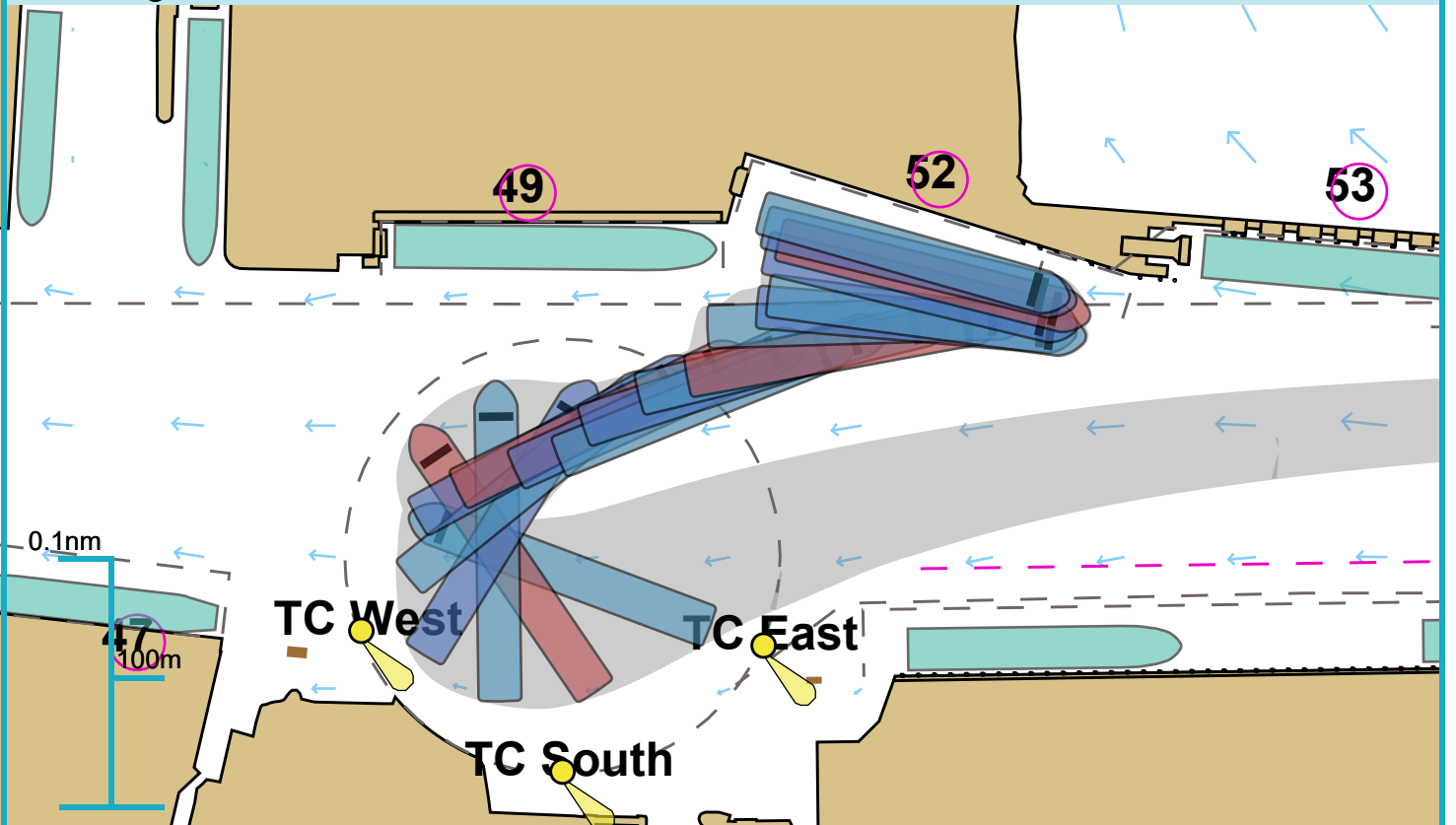
Comments:

Approach



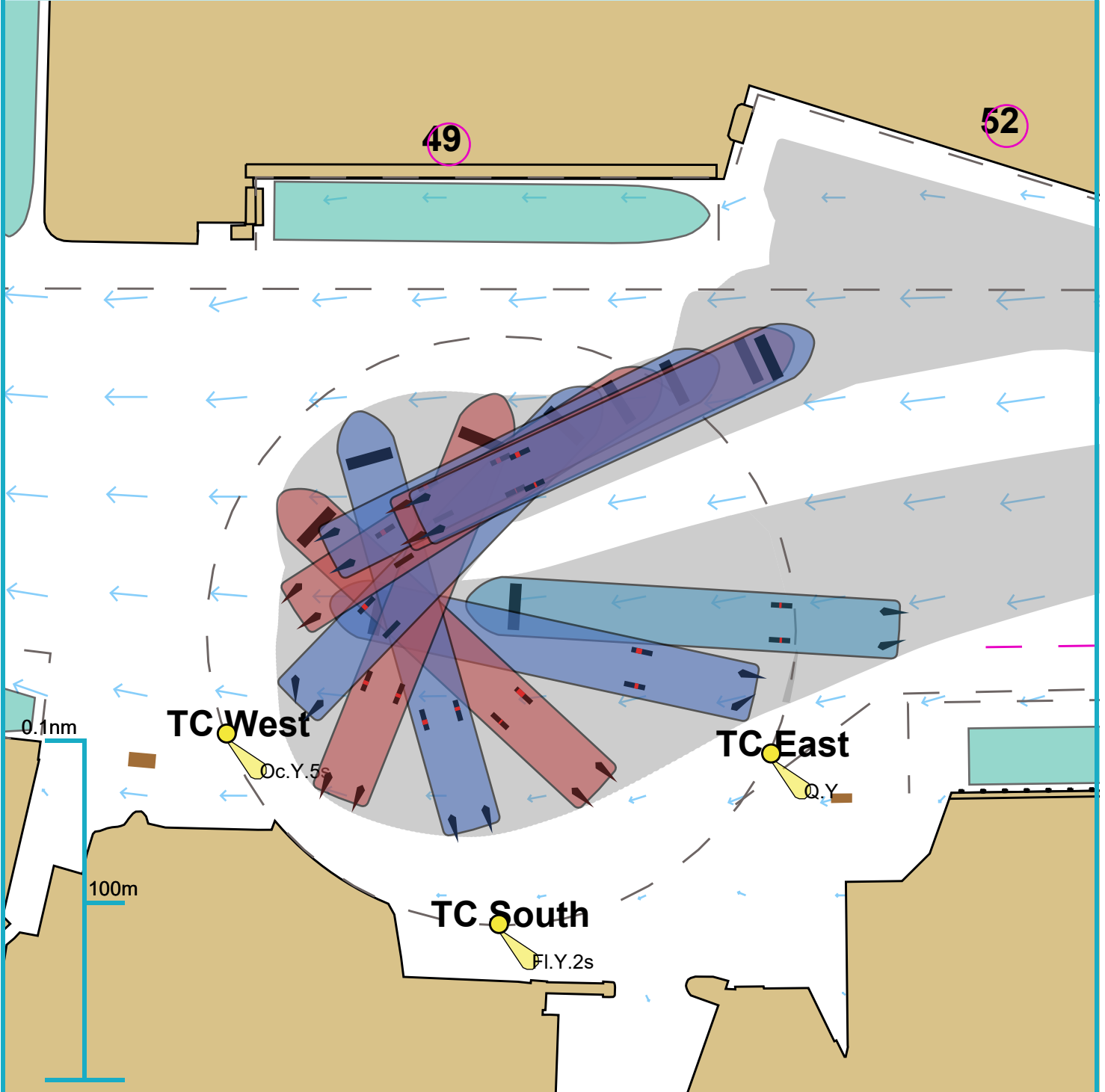
Ships plotted every 1 mins, highlight every 5 mins

Berthing

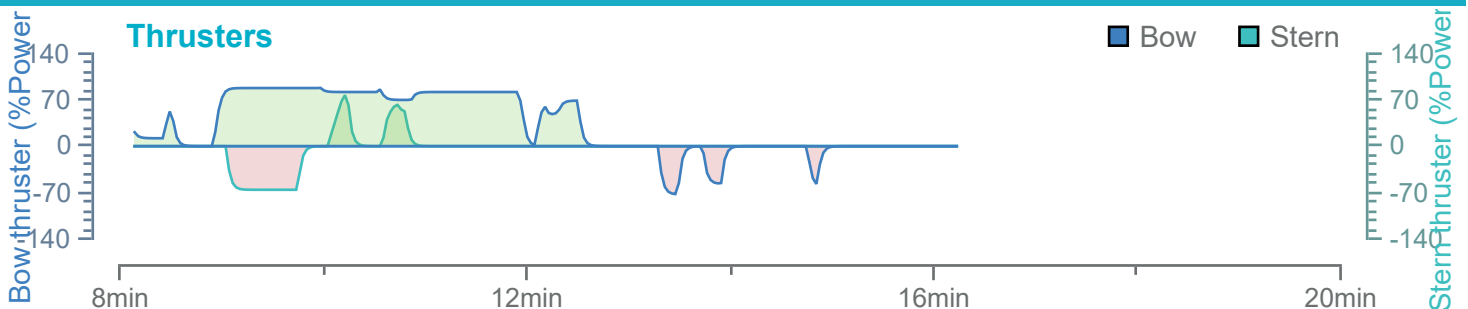


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

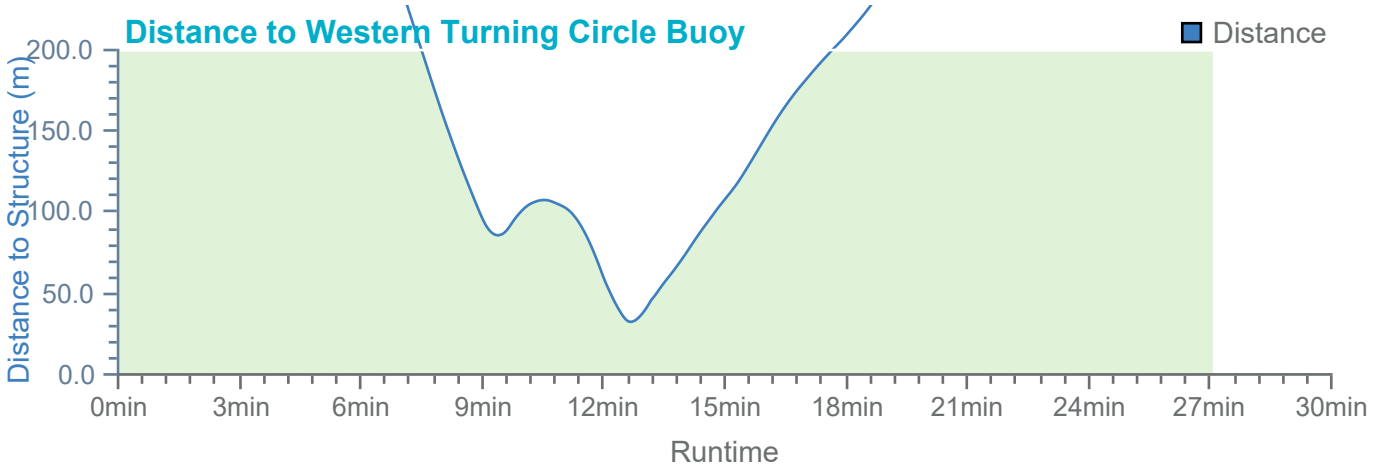
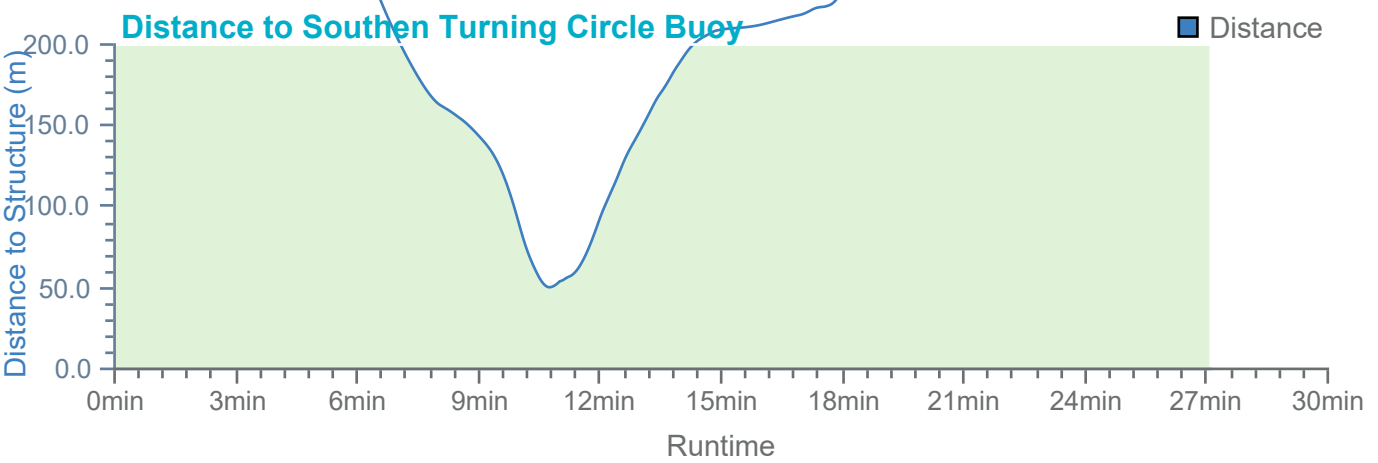
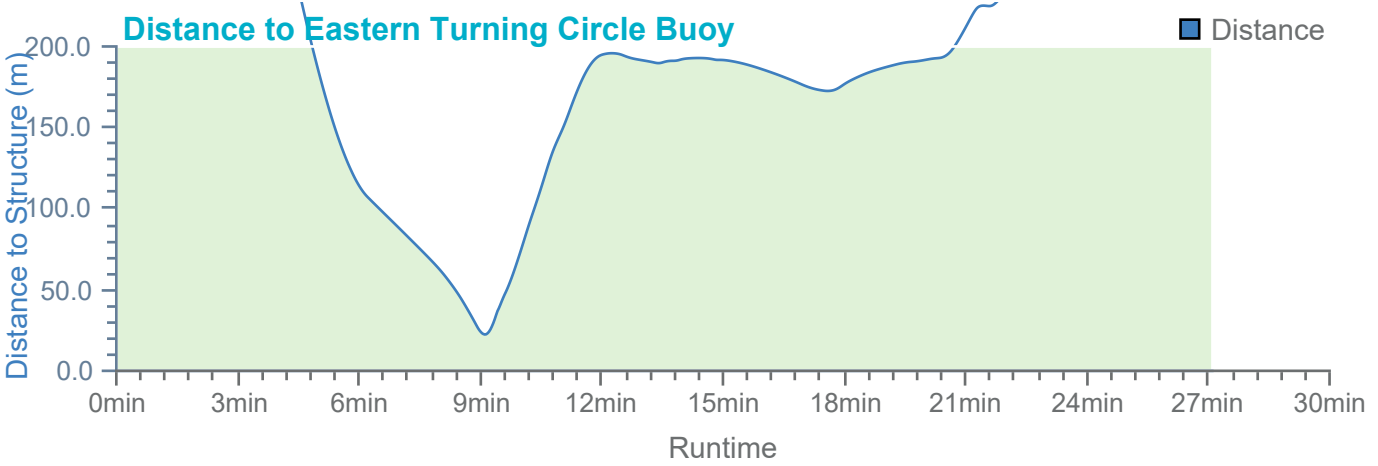
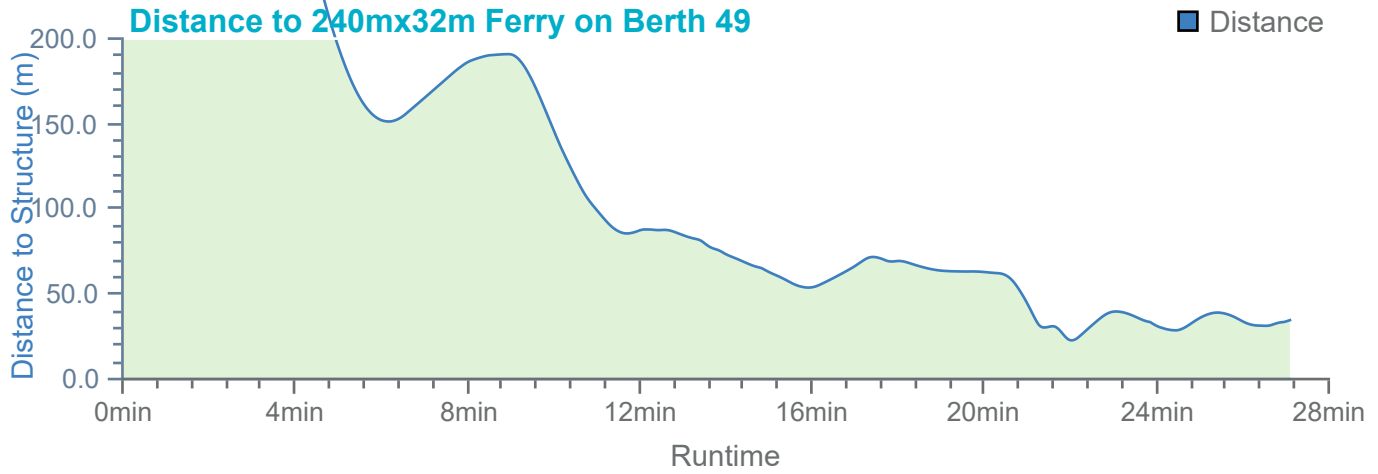


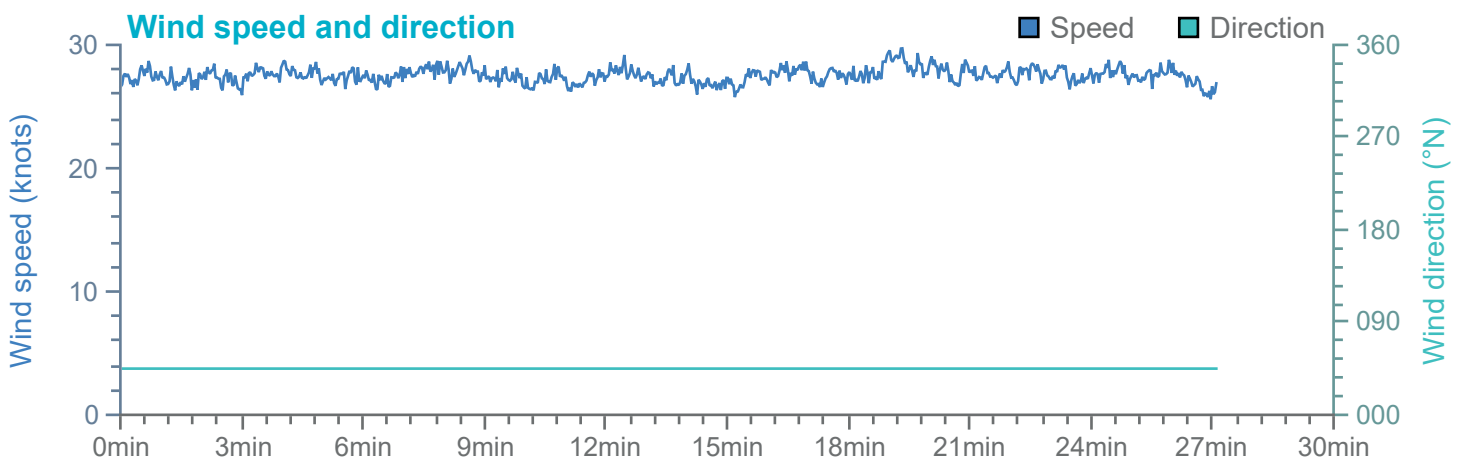
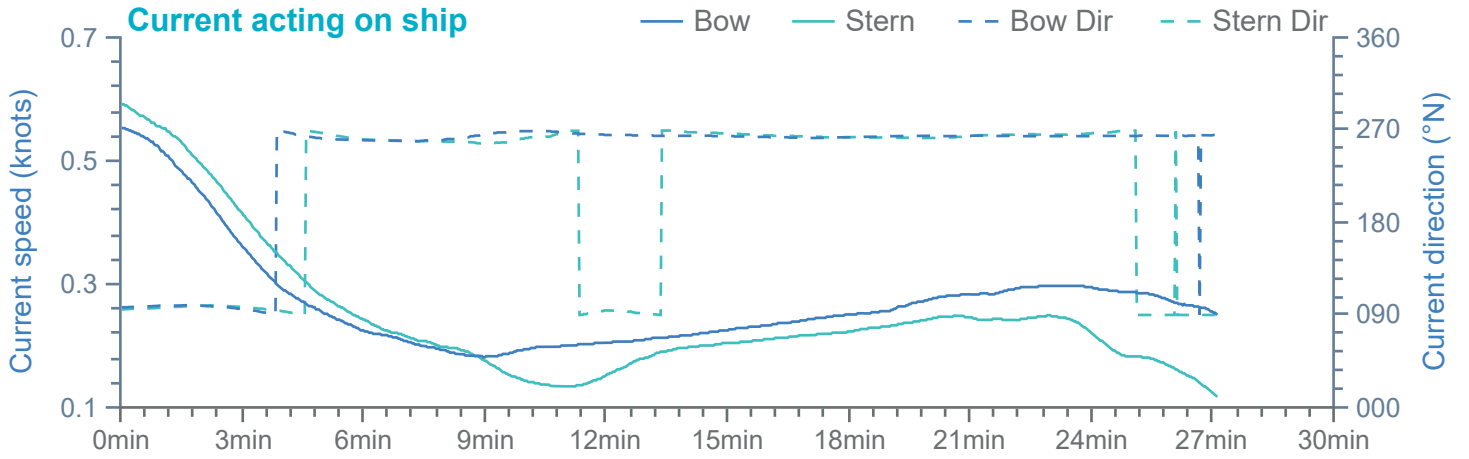
Overview

Environment

240m x 32m RoPax

Thruster and engine use



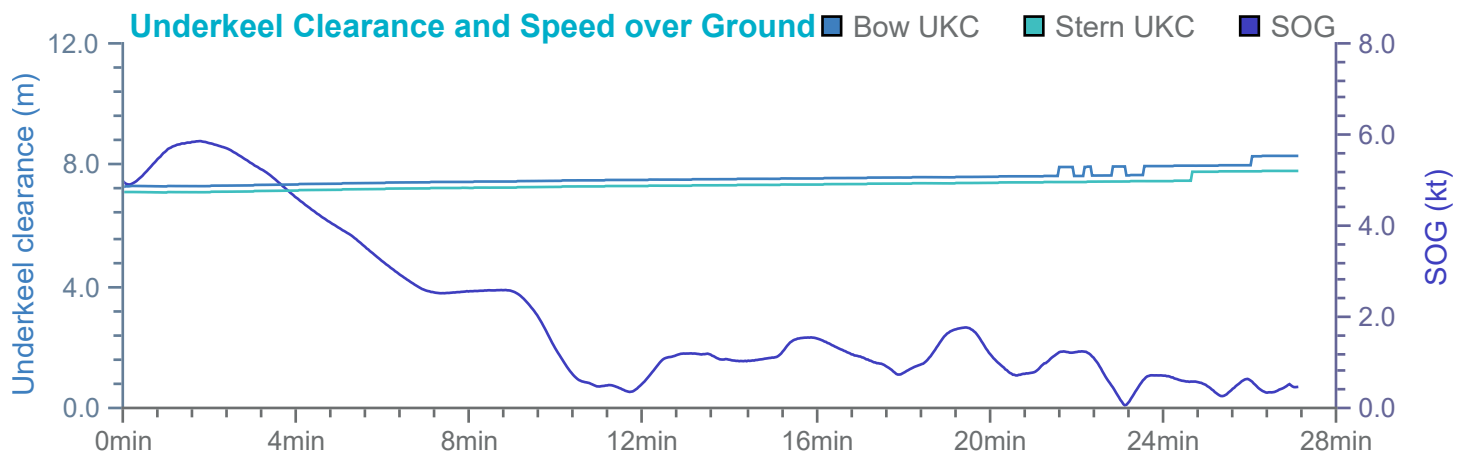
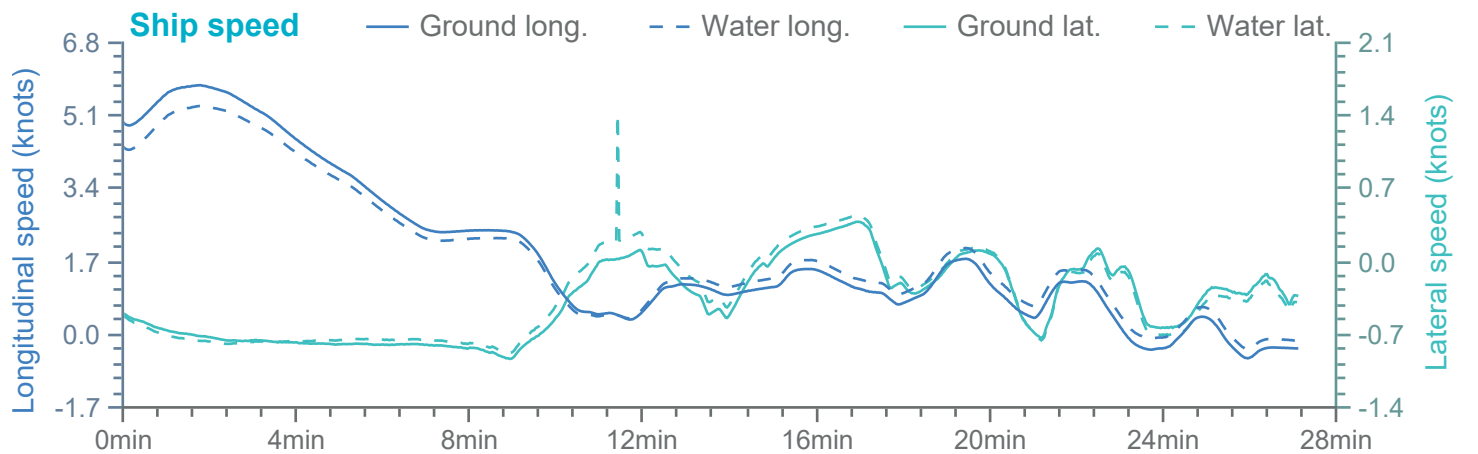
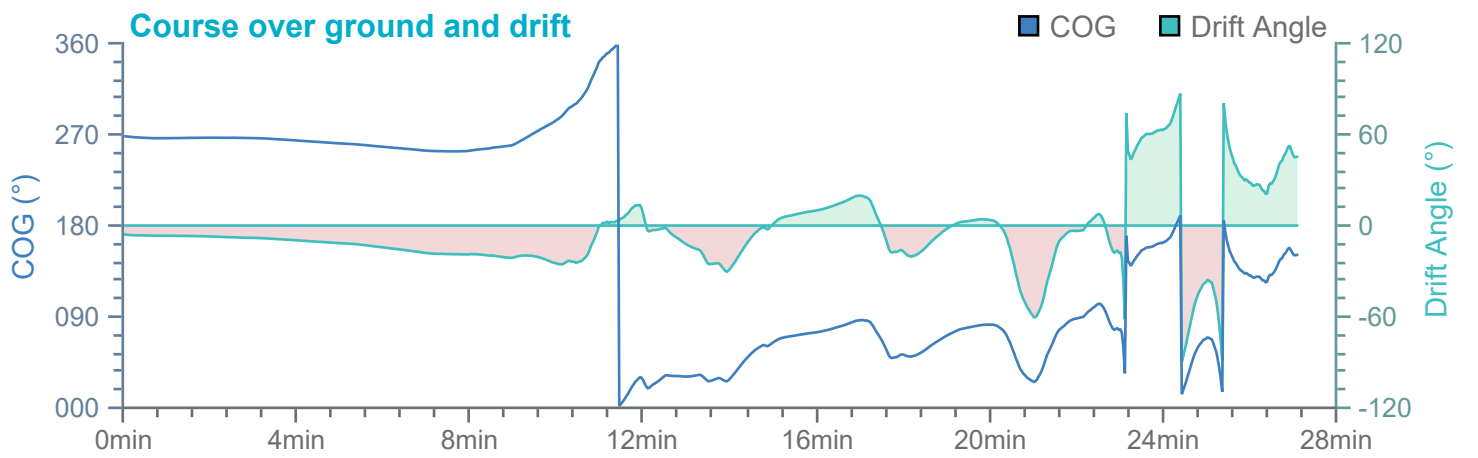
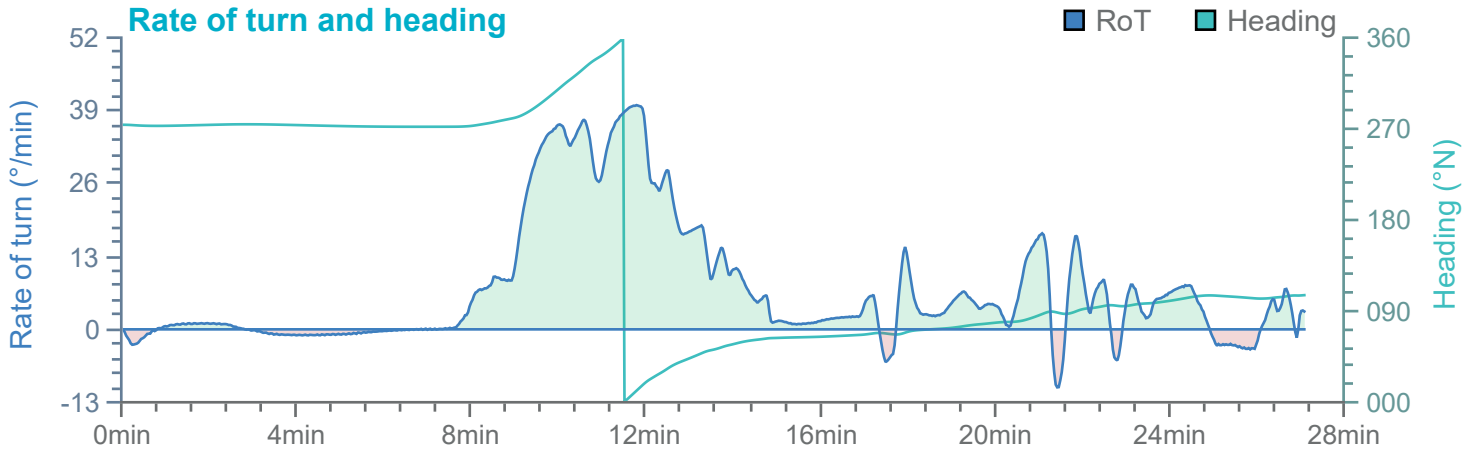


Overview

Environment

240m x 32m RoPax

Thruster and engine use

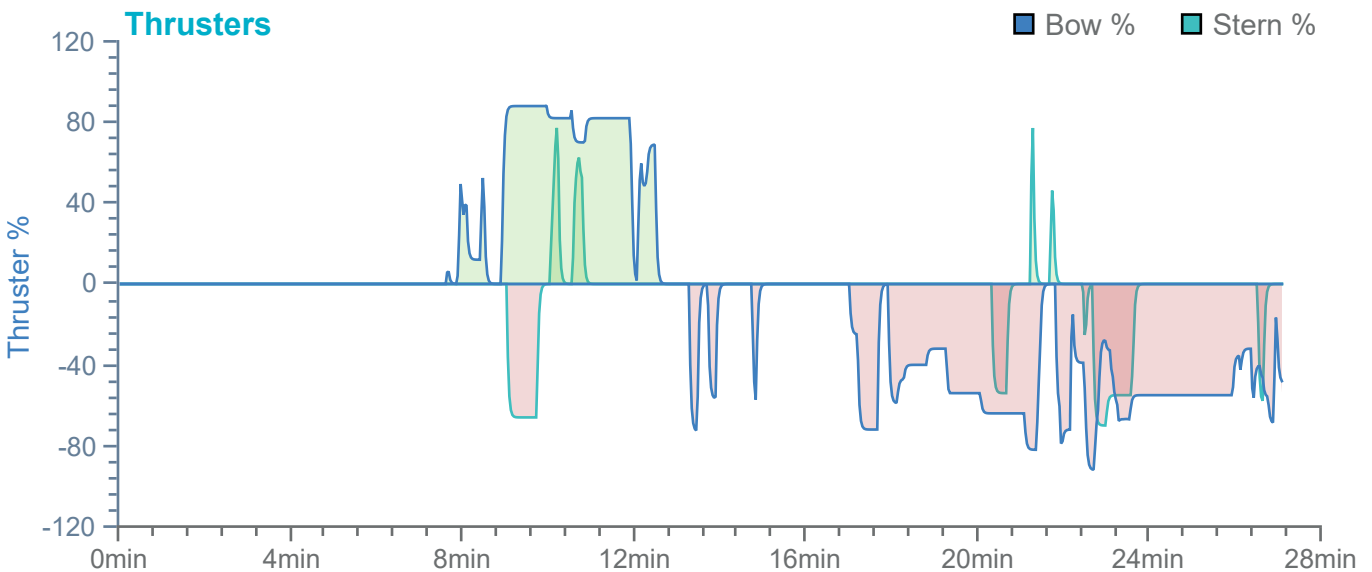
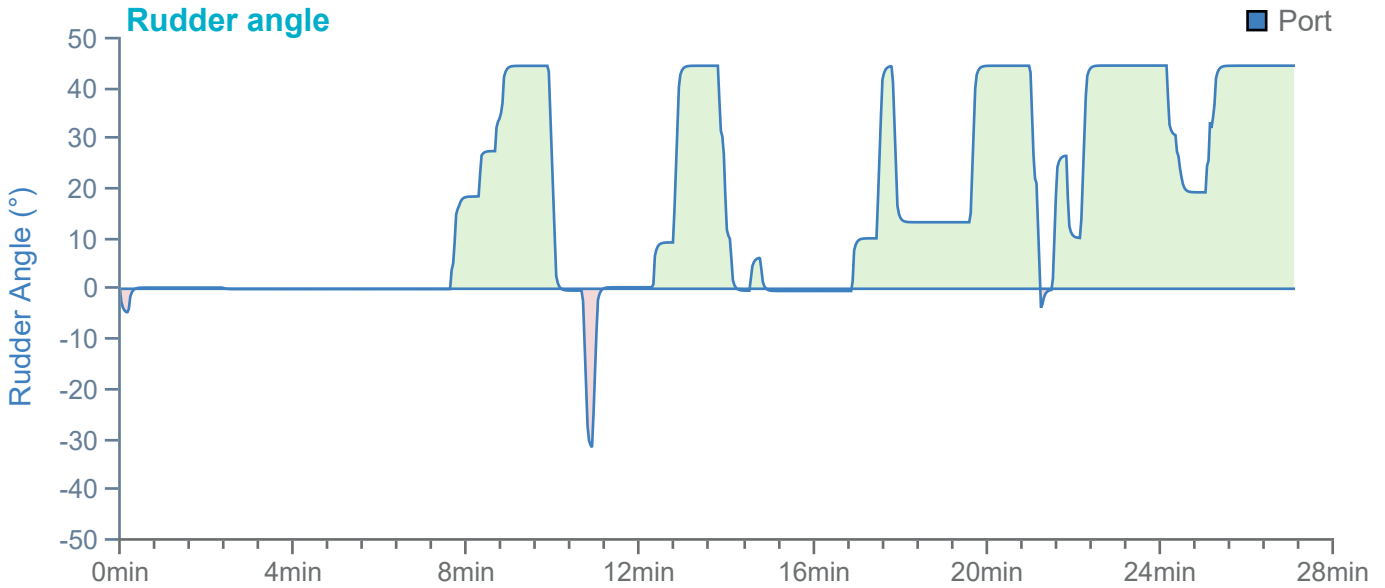
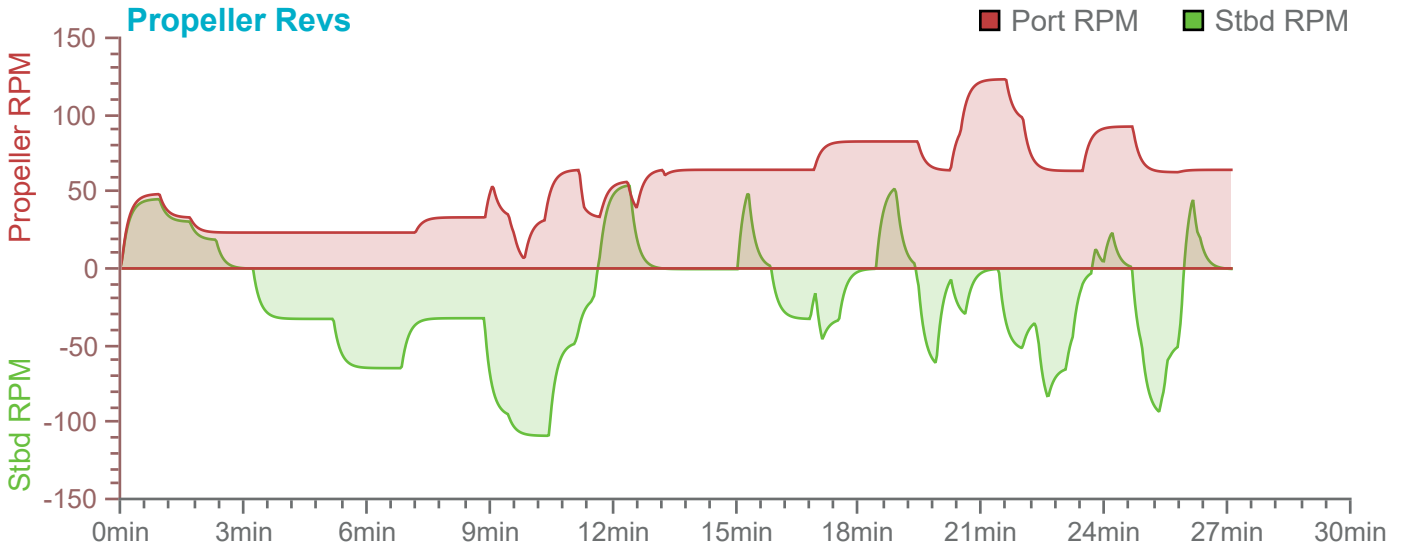


Overview

Environment

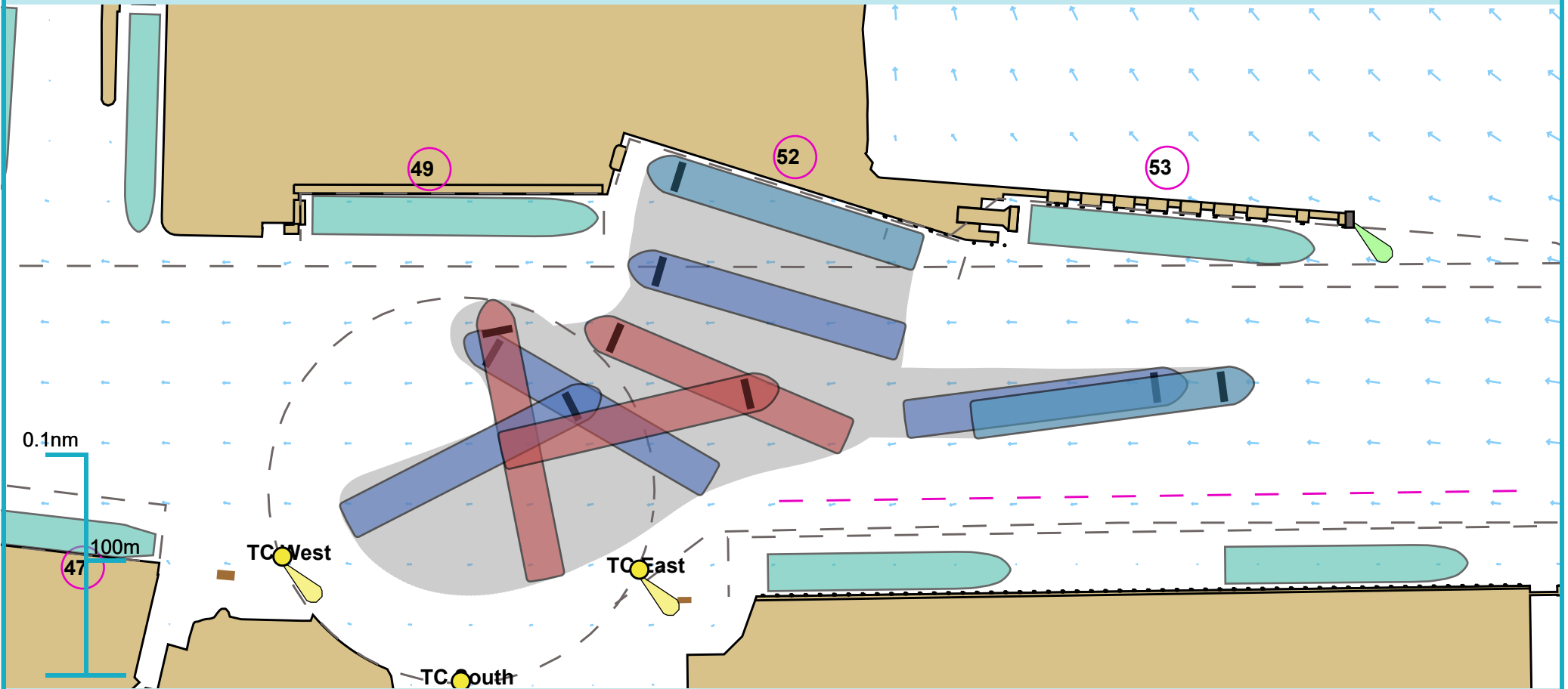
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.459 N, 006° 11.993 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

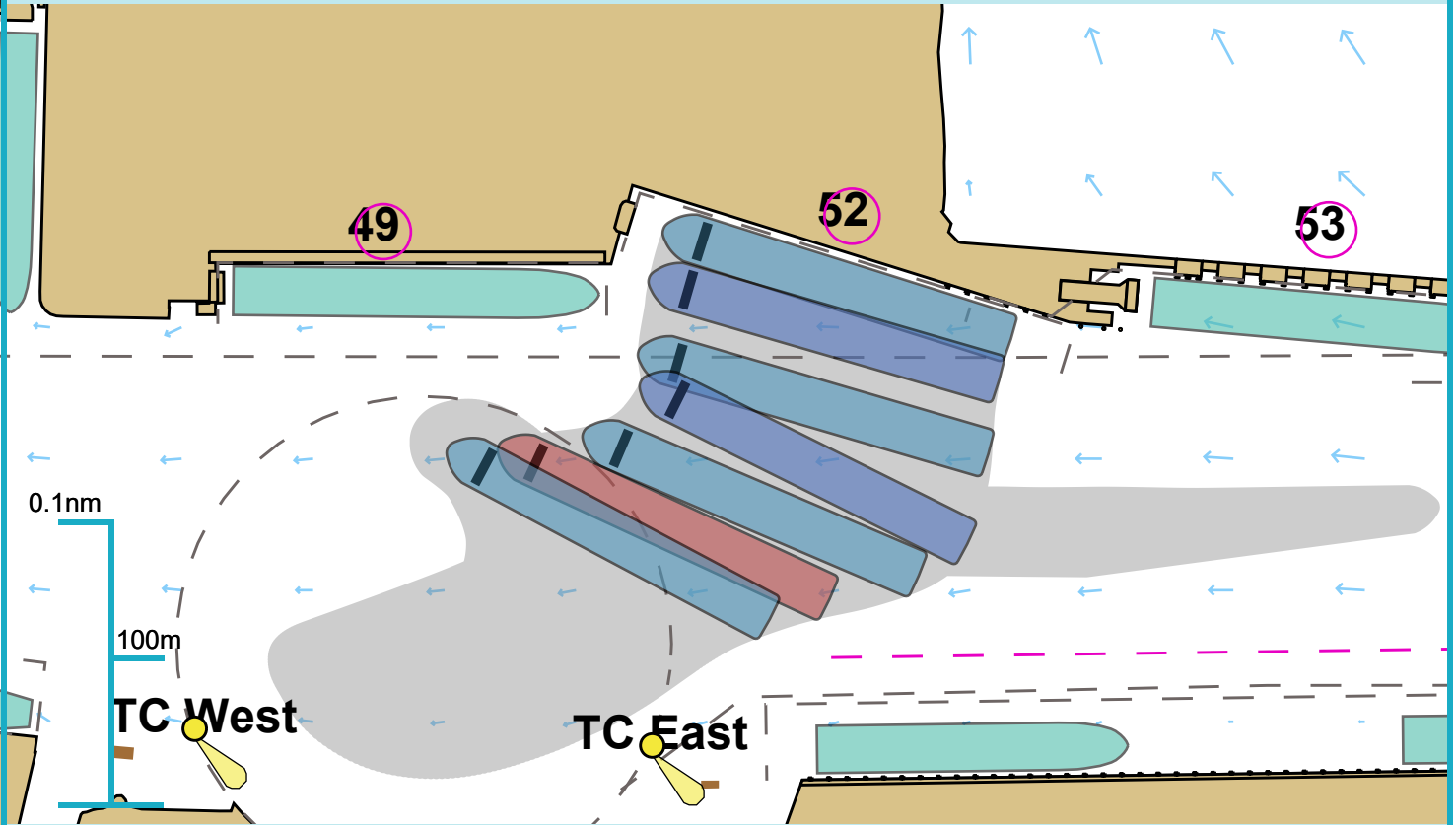
Run length: 14 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

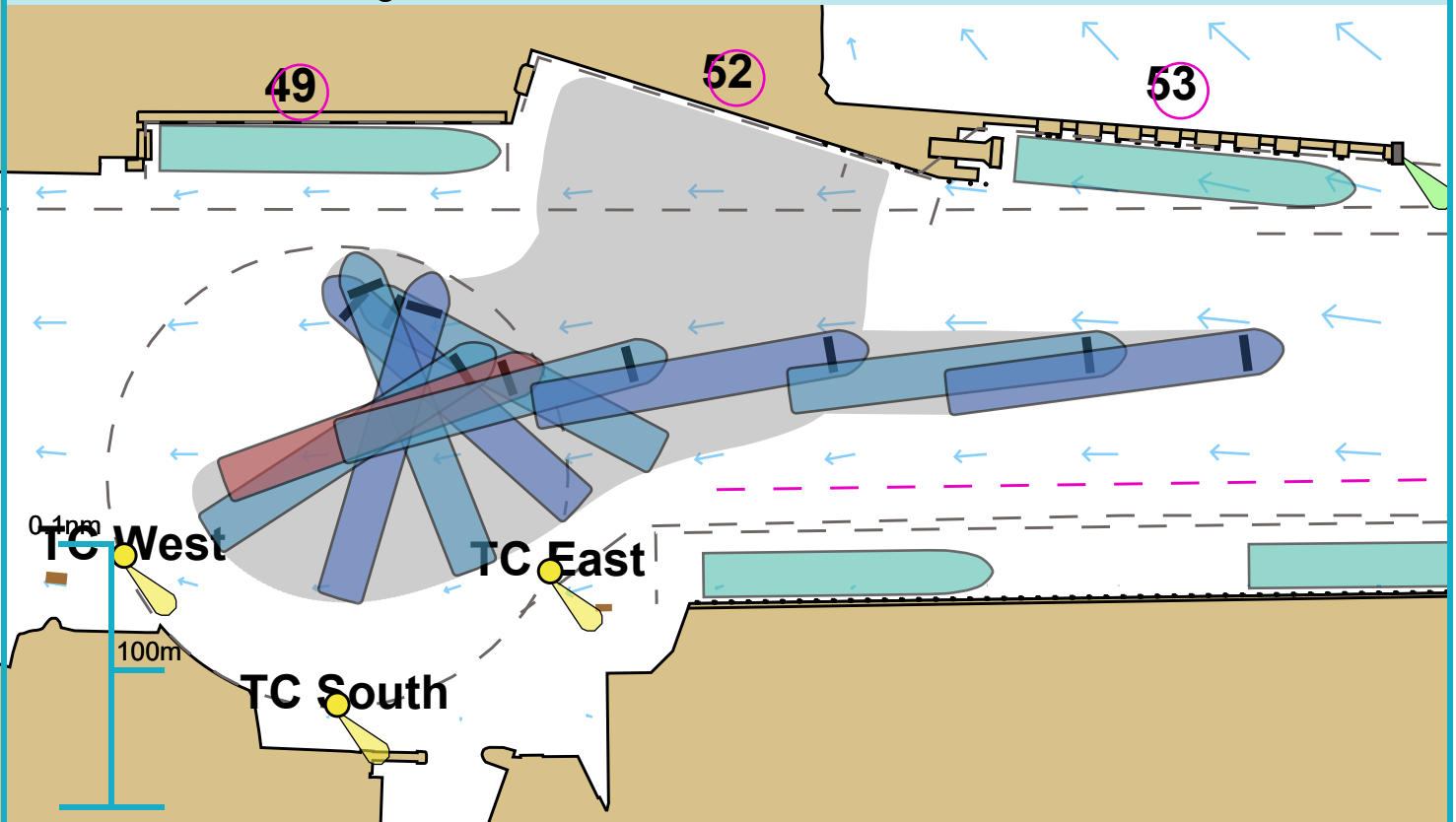
Comments:

Departure



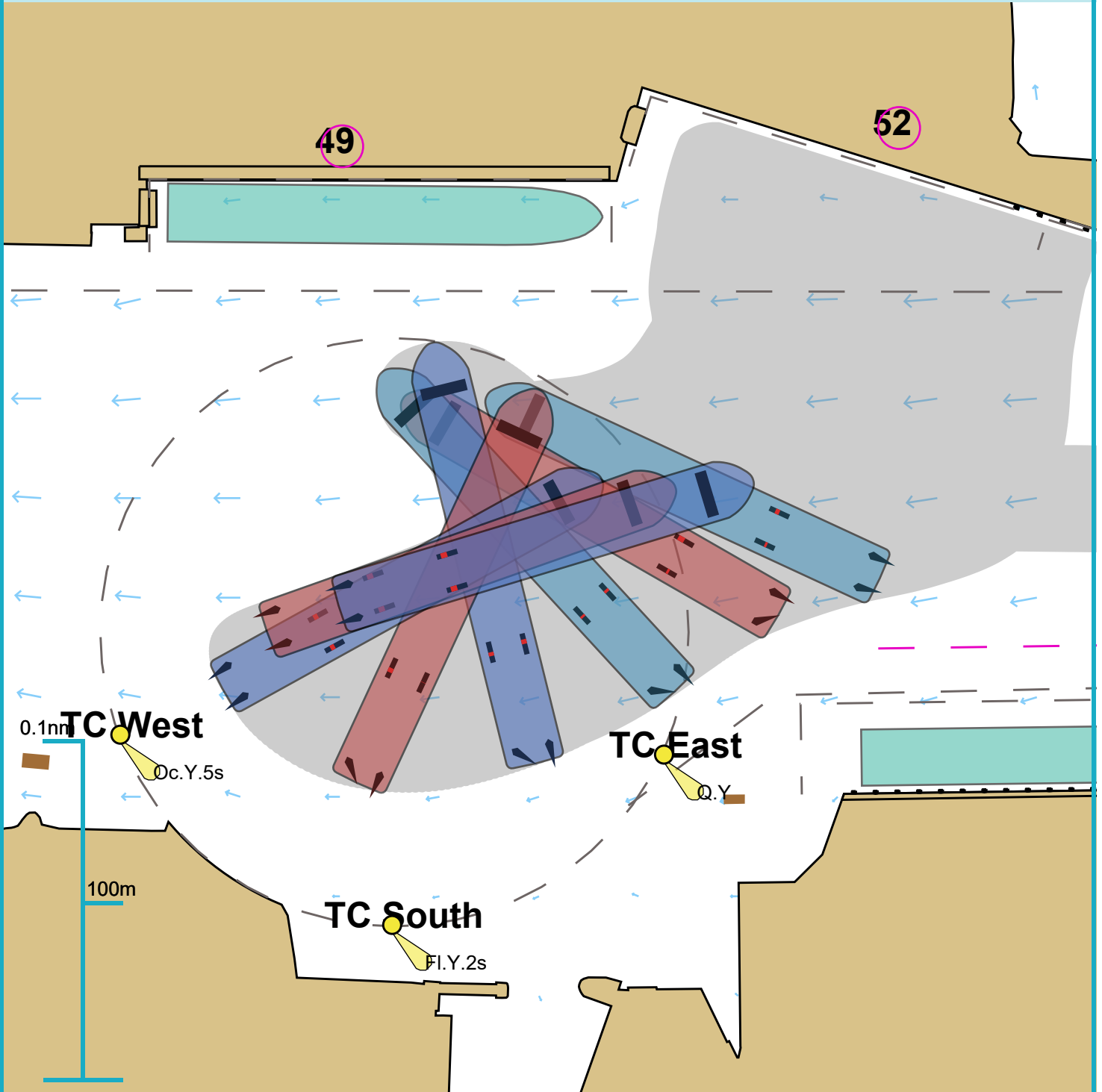
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

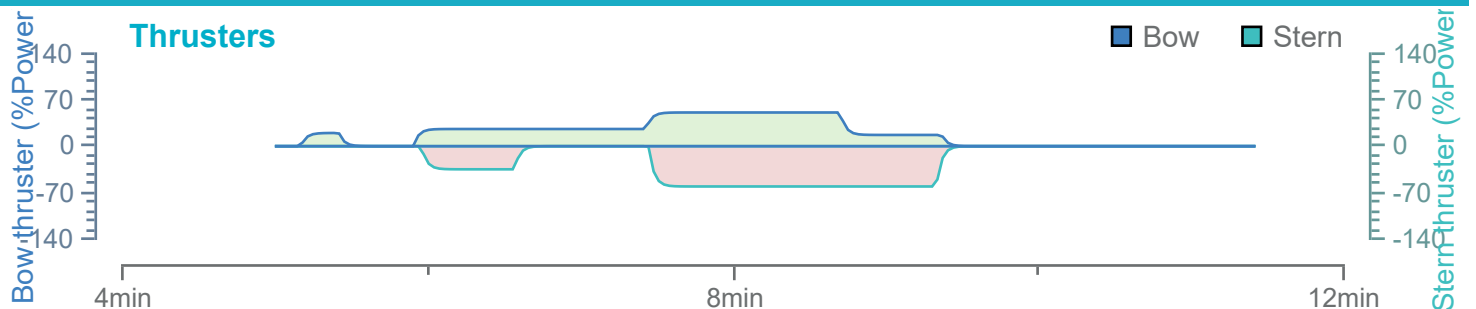


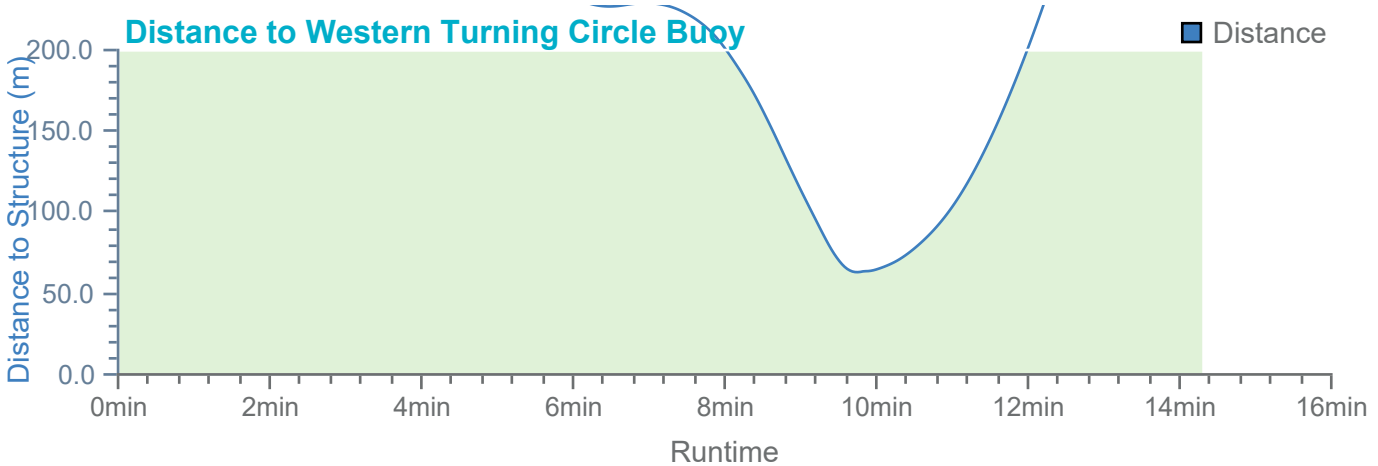
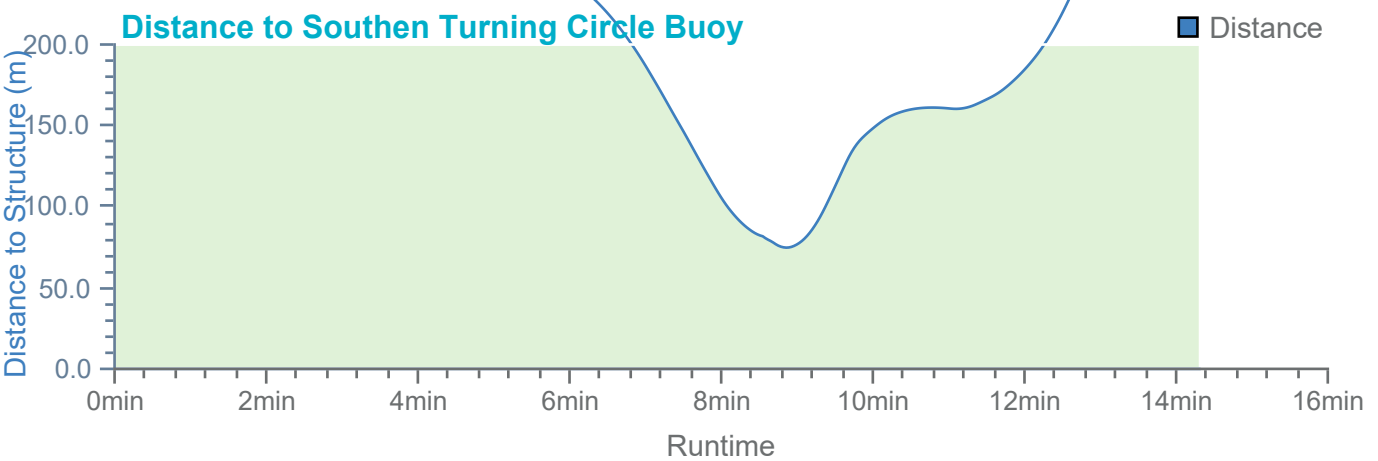
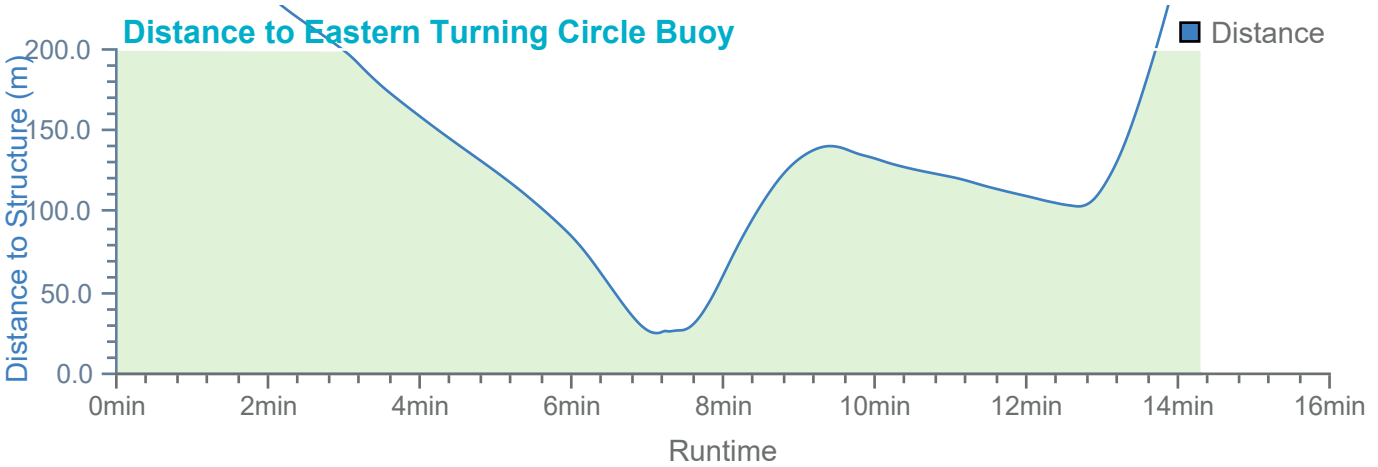
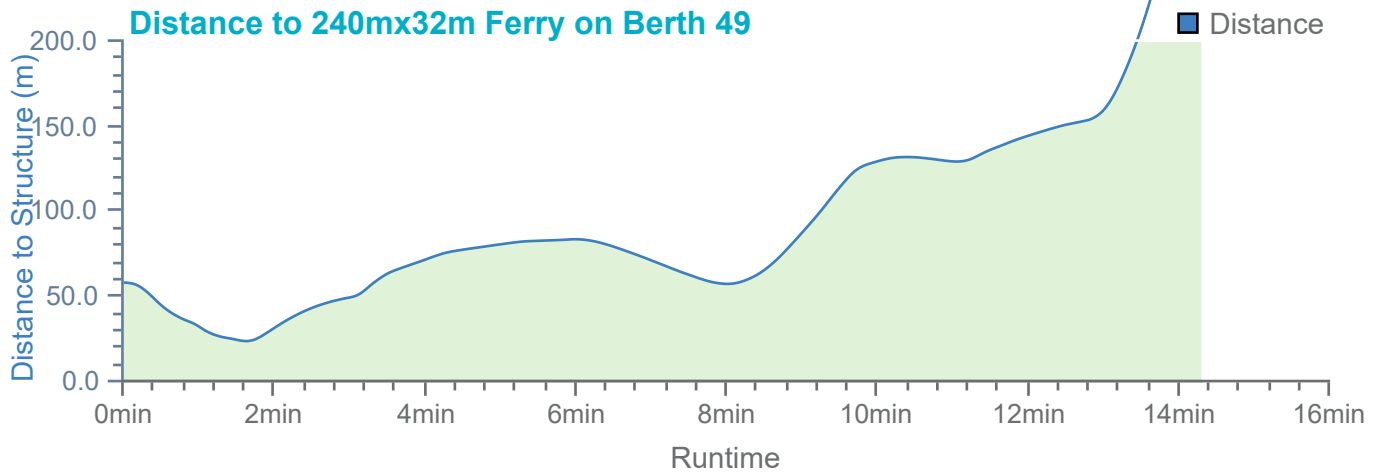
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



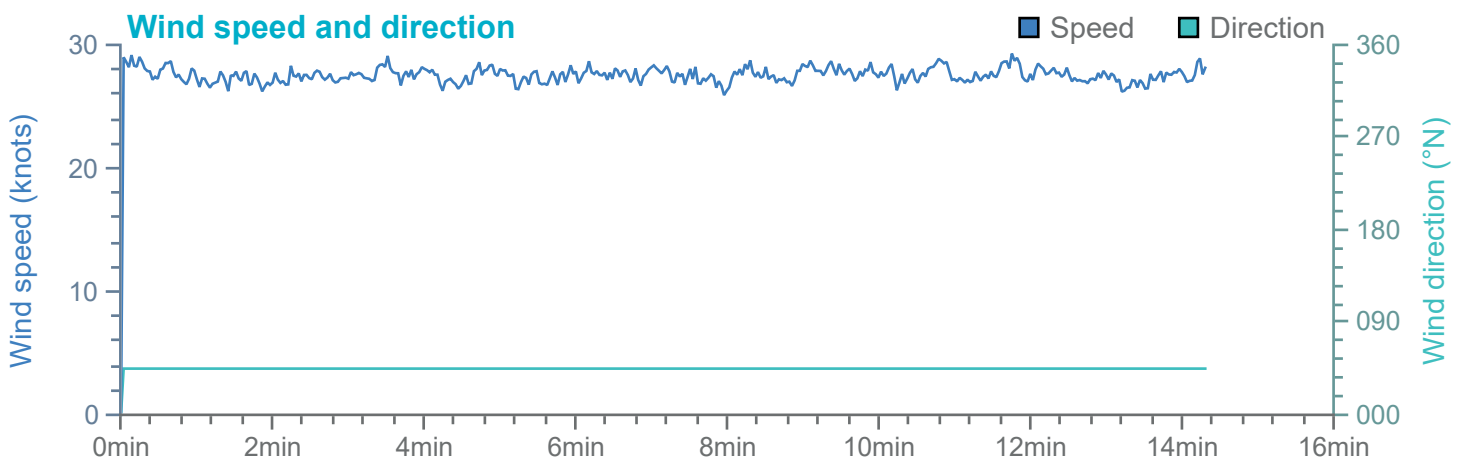
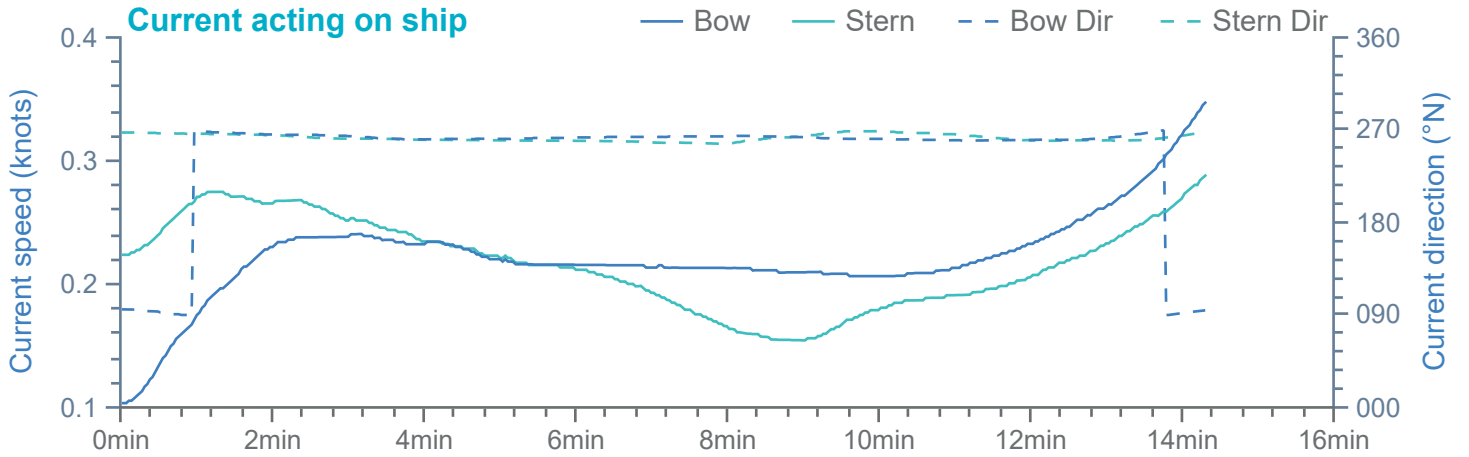


Overview

Environment

240m x 32m RoPax

Thruster and engine use

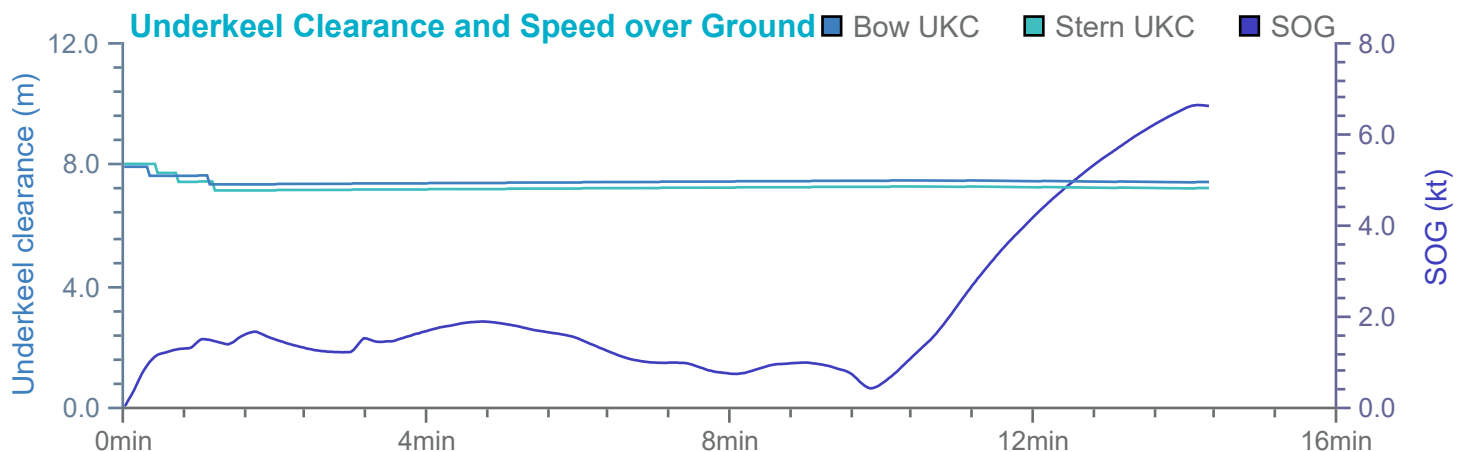
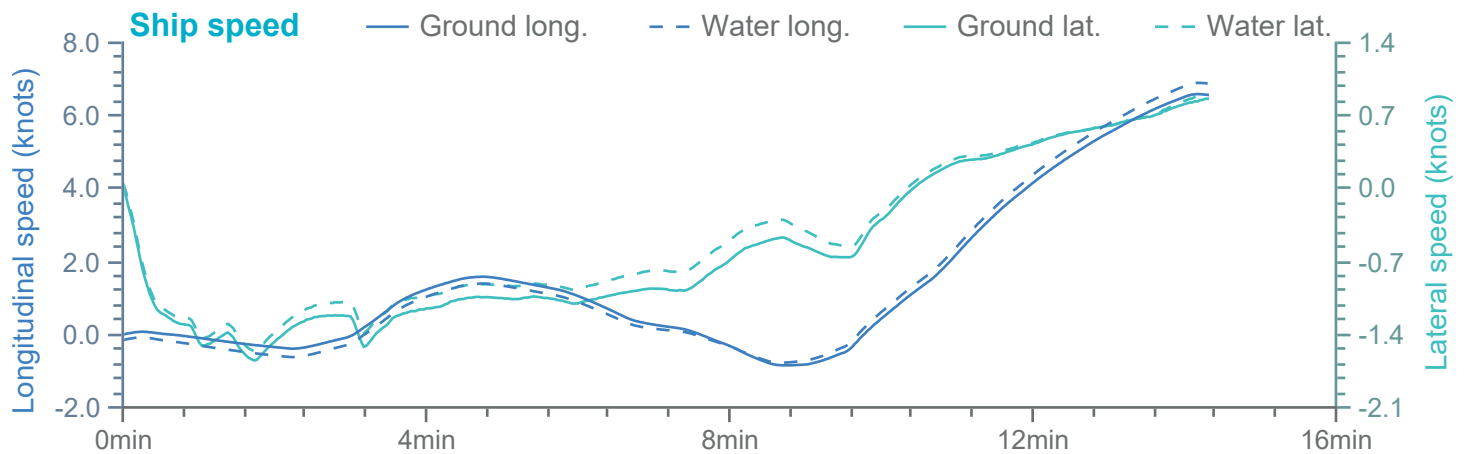
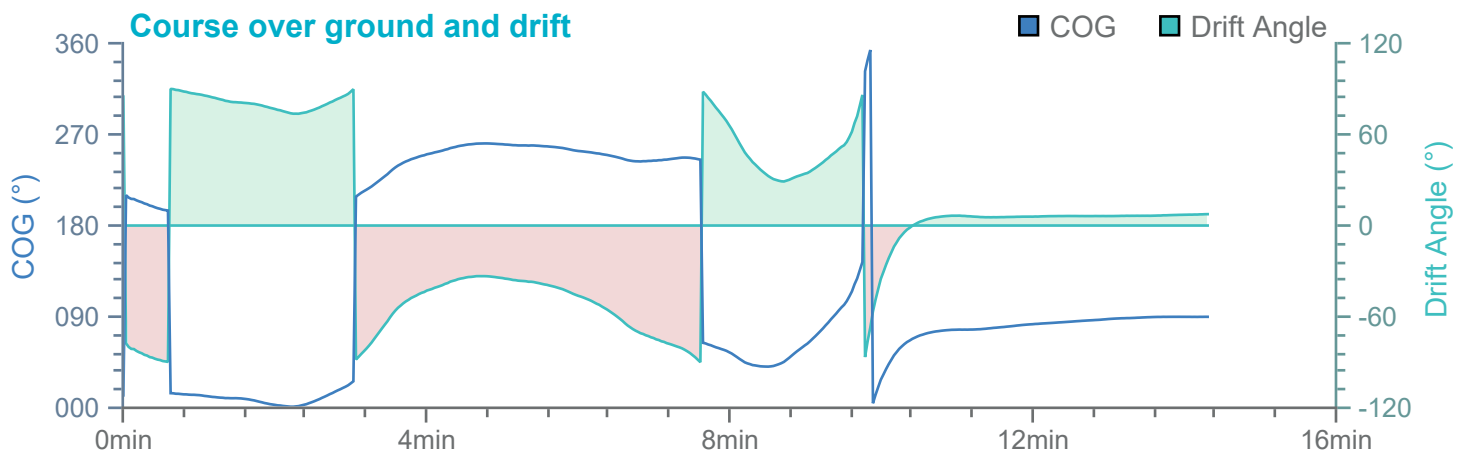
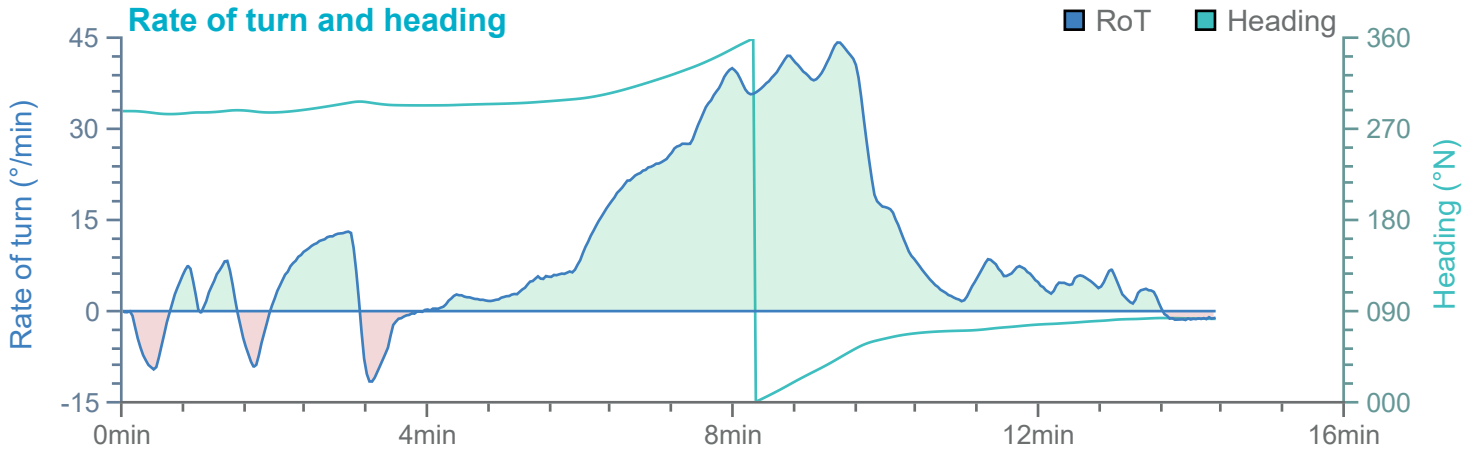


Overview

Environment

240m x 32m RoPax

Thruster and engine use

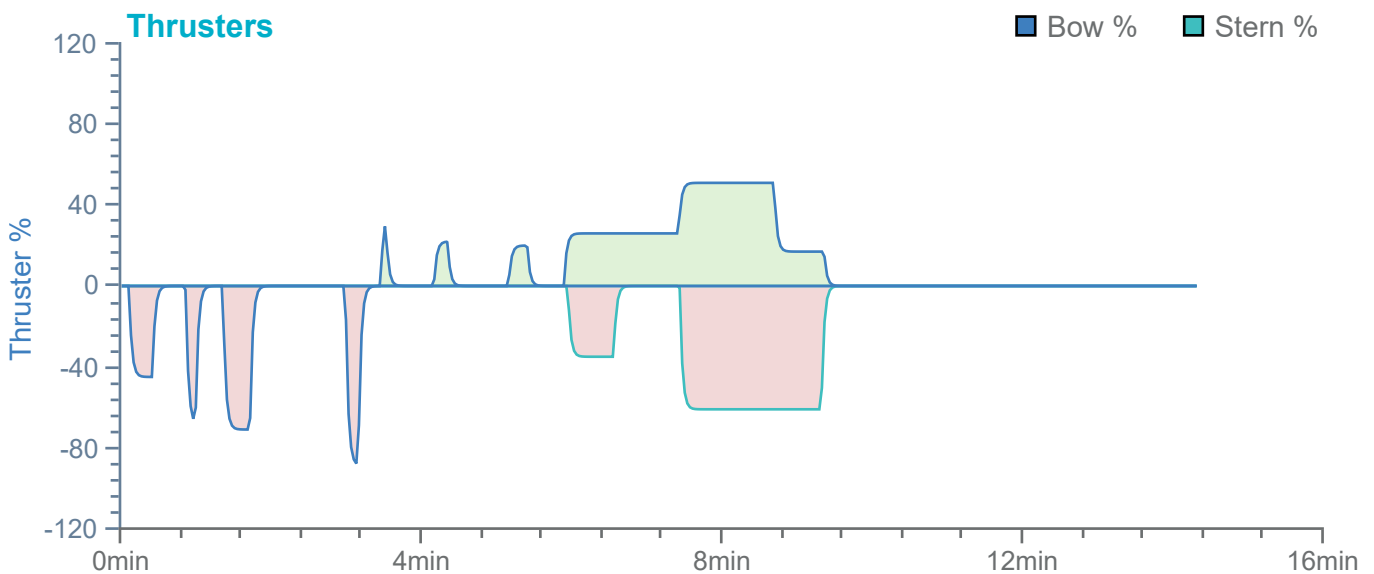
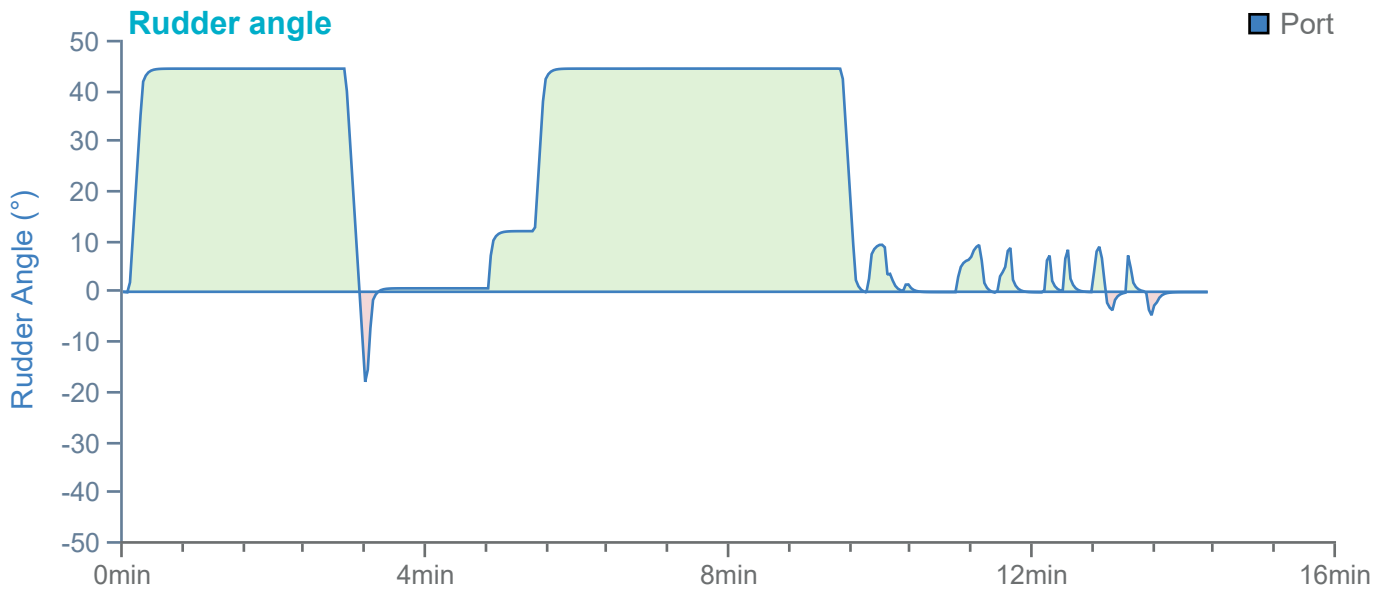
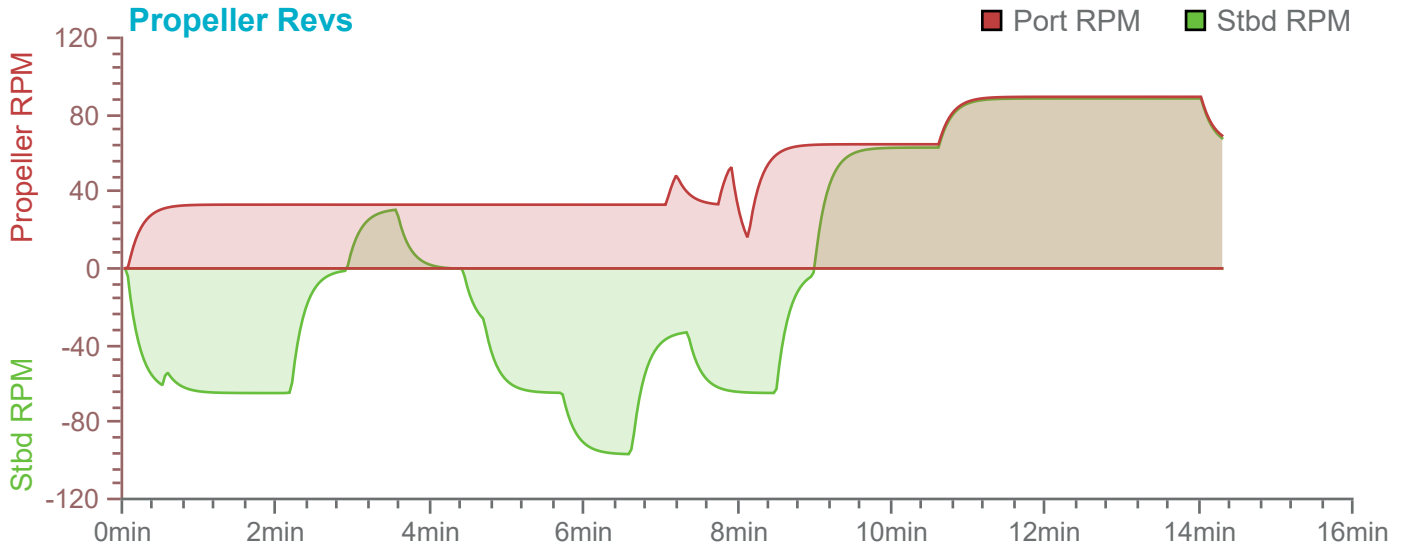


Overview

Environment

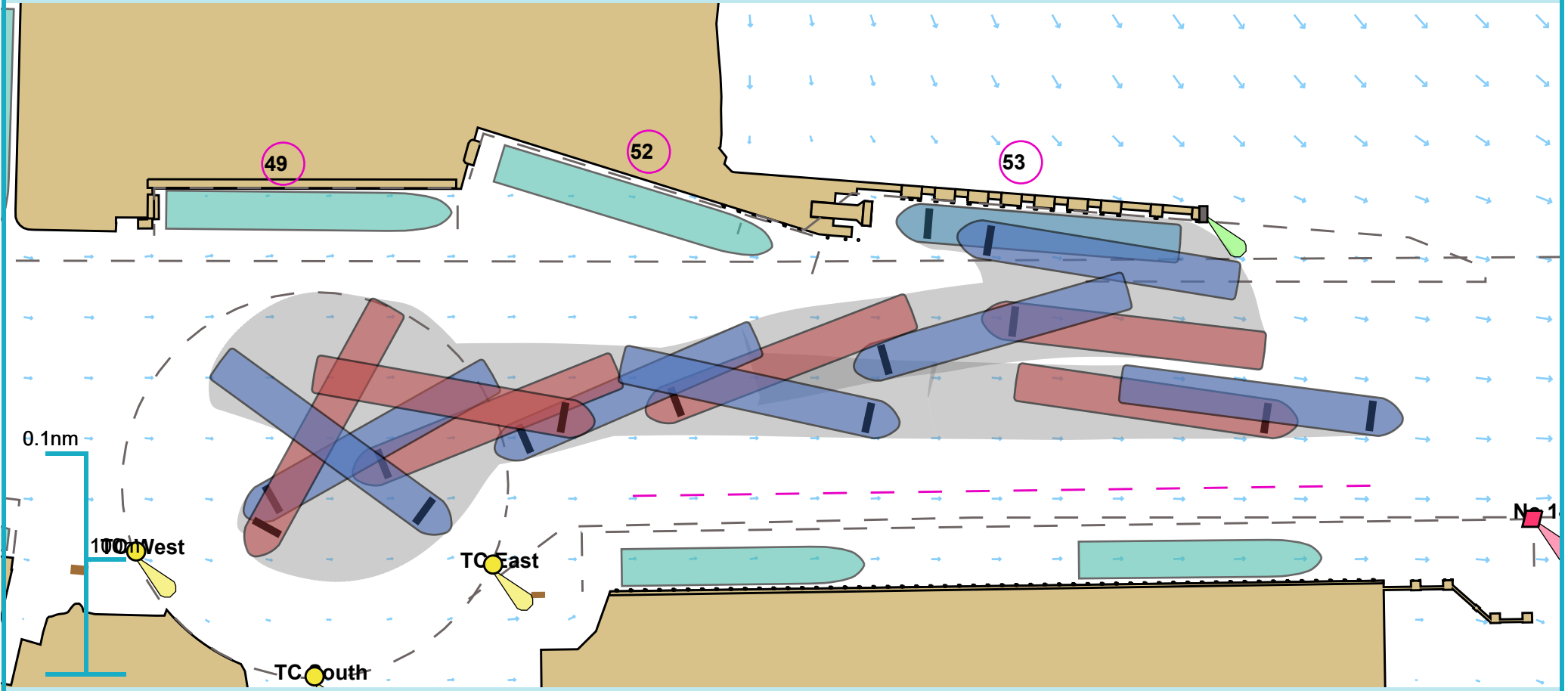
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.457 N, 006° 11.882 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

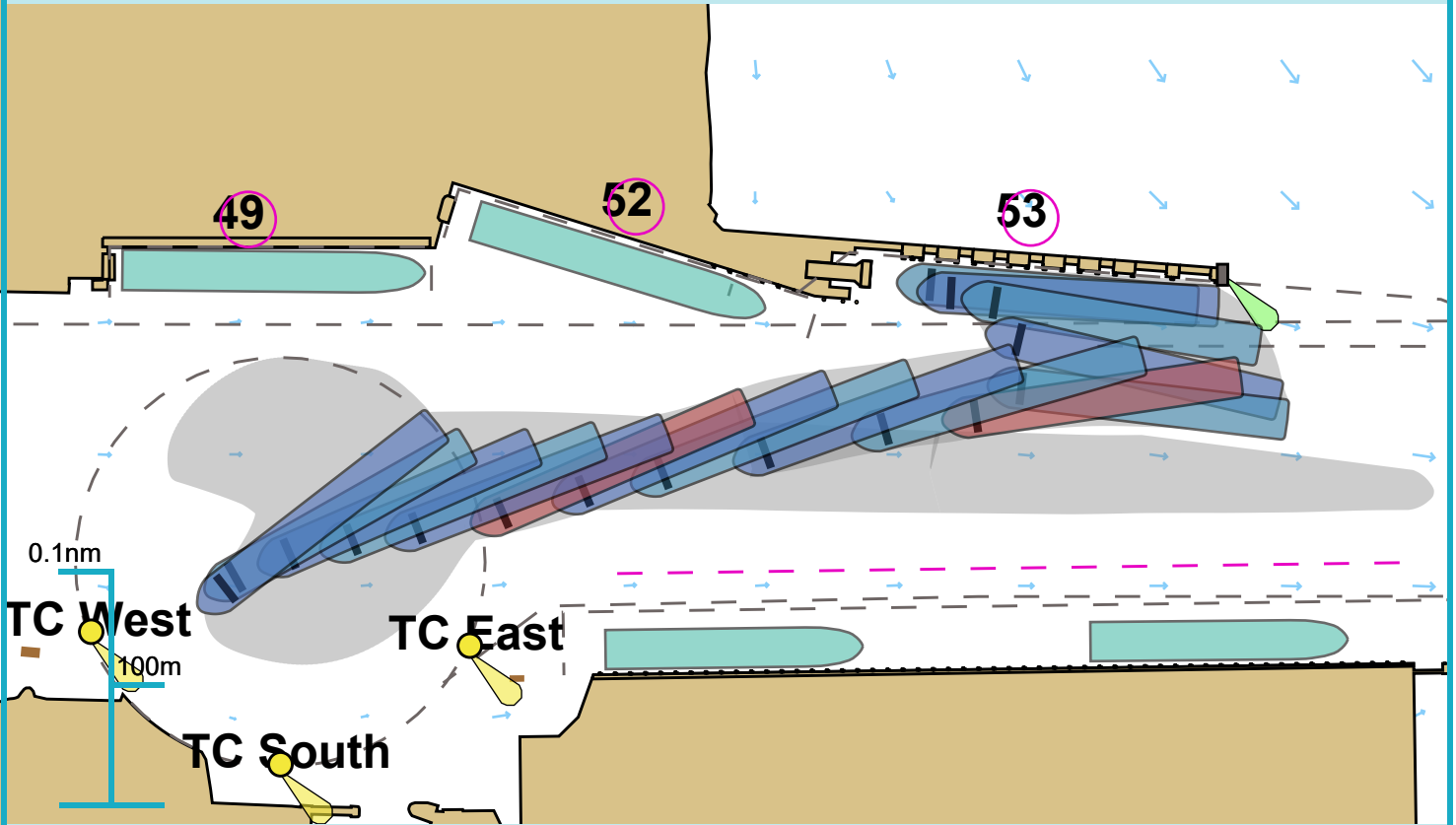
Run length: 25 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

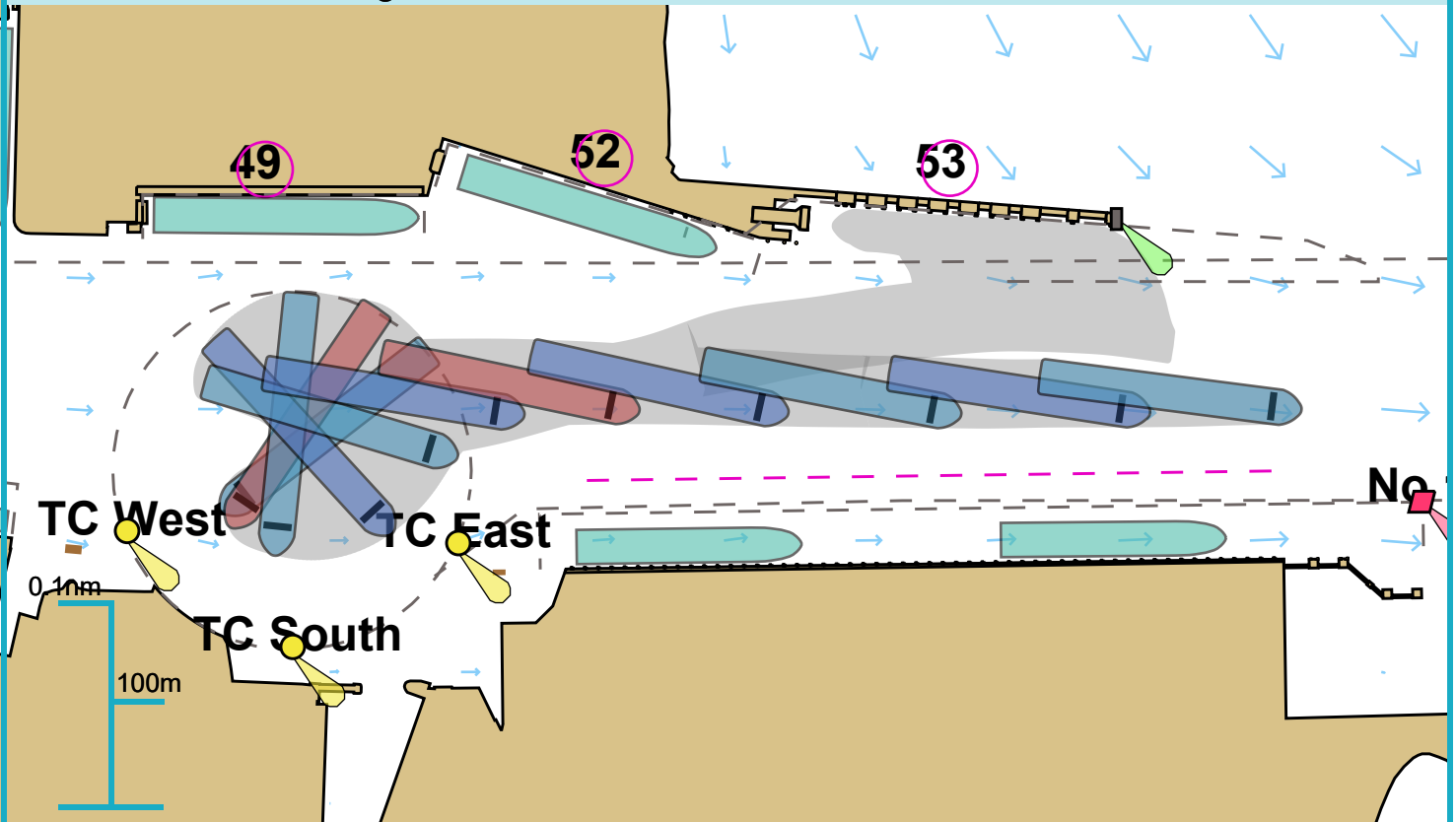
Comments:

Departure



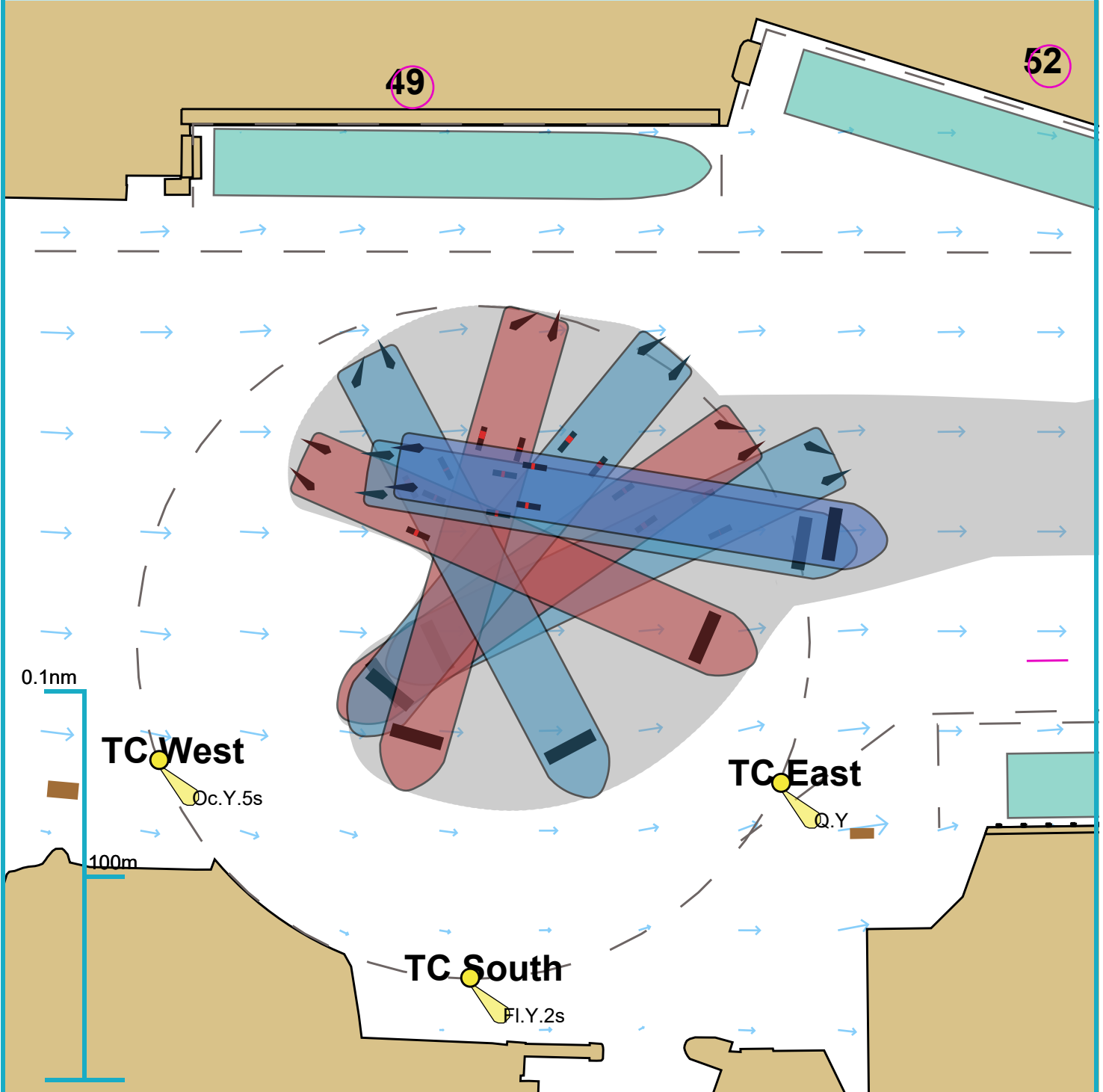
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

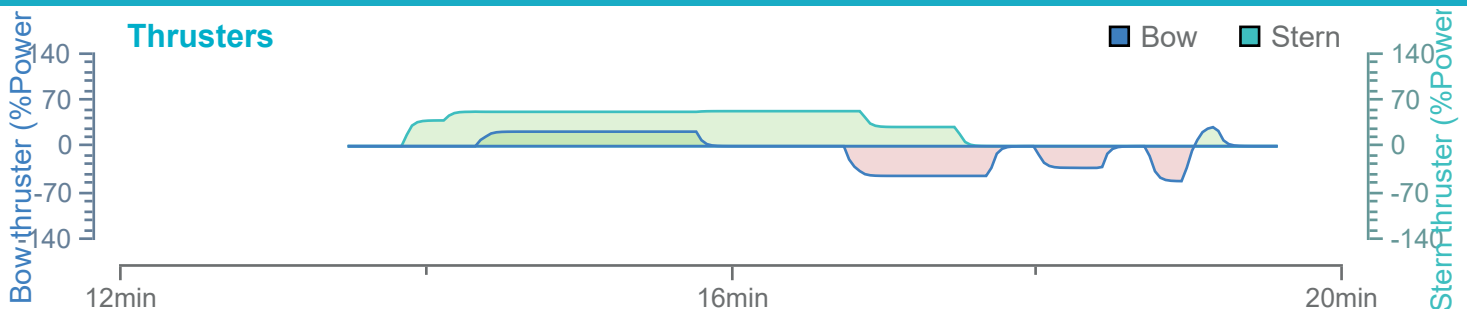


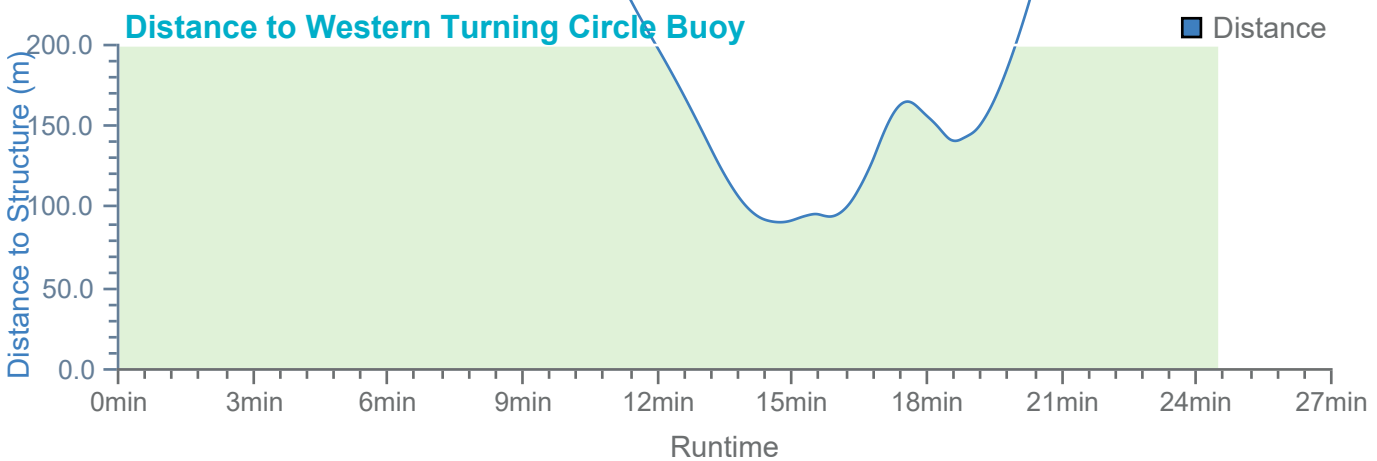
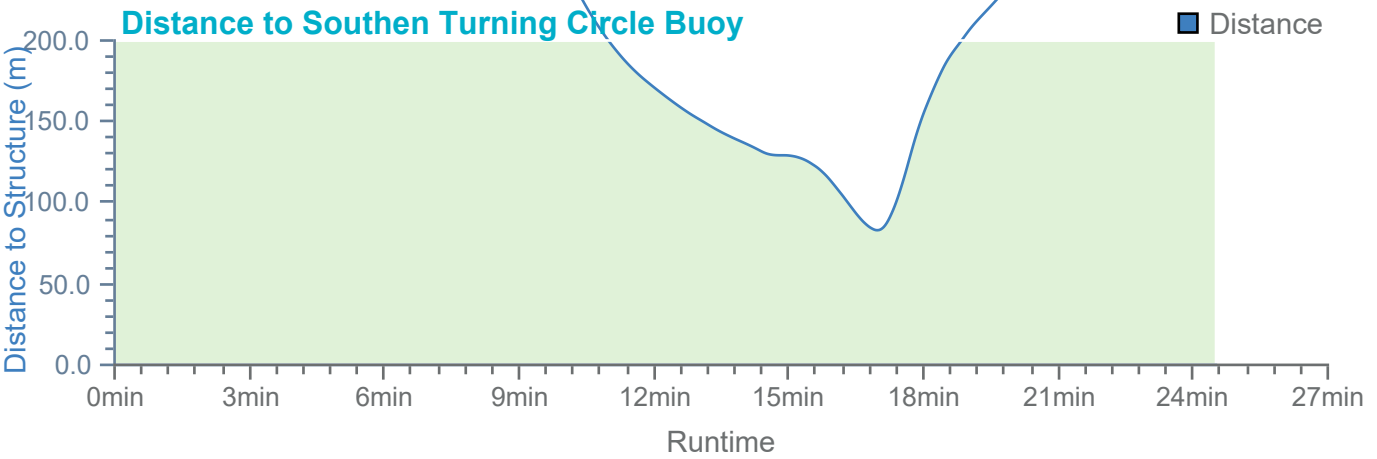
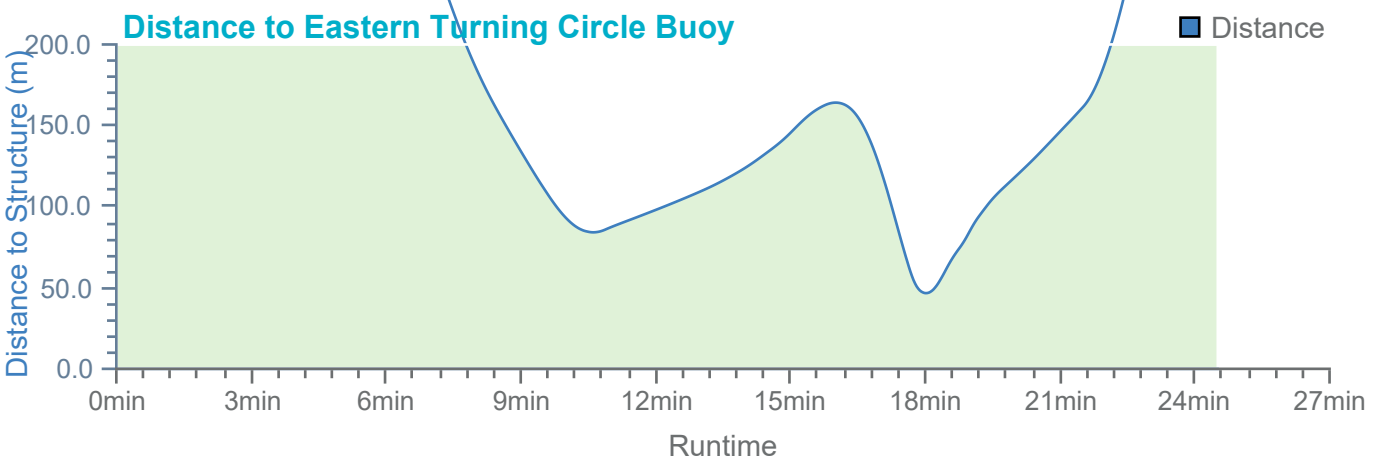
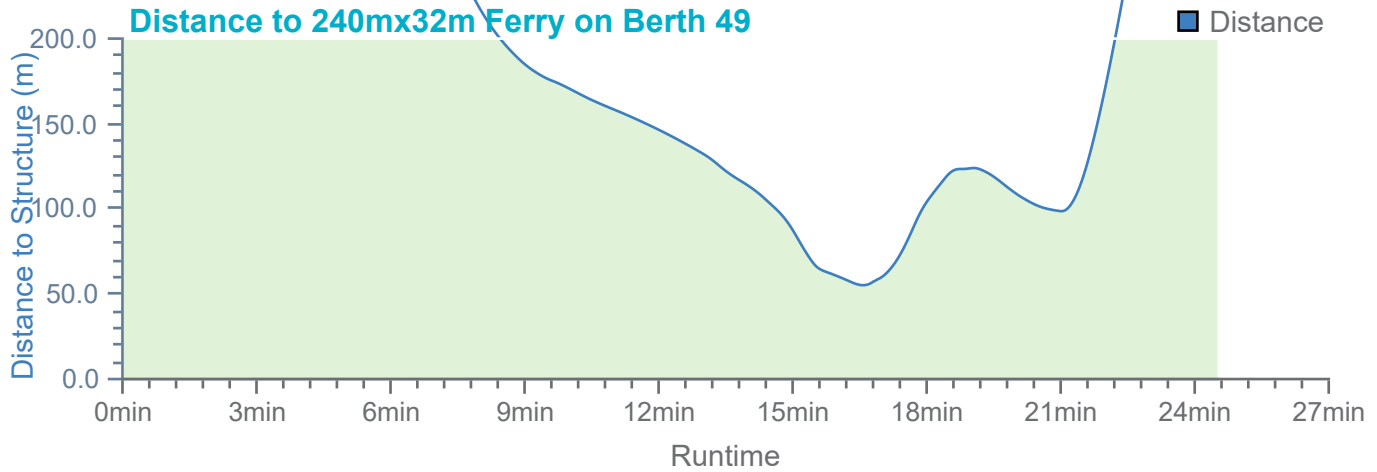
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



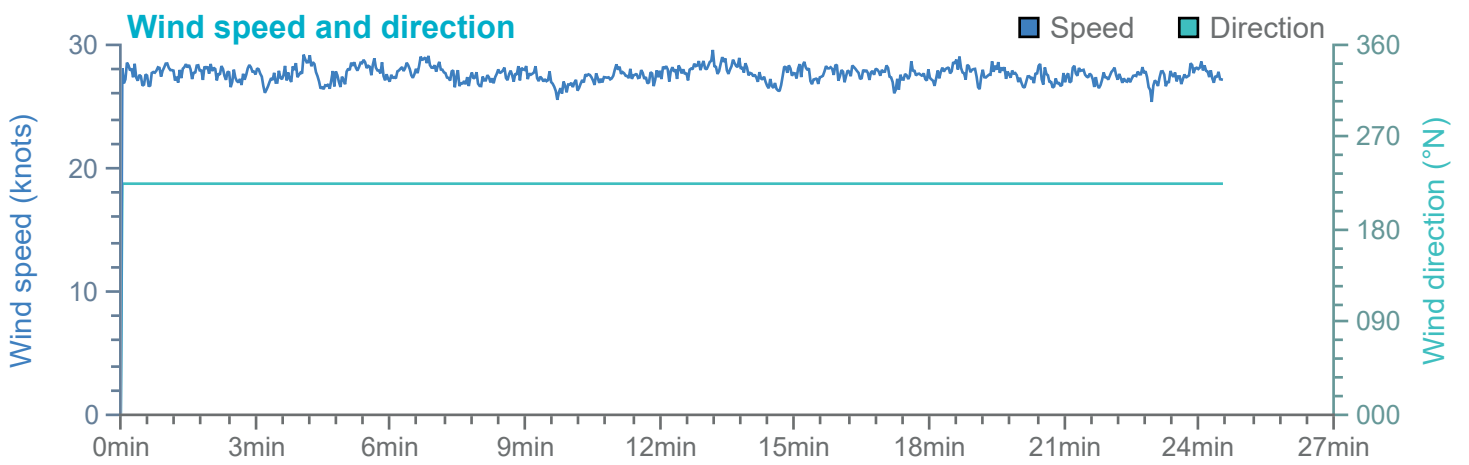
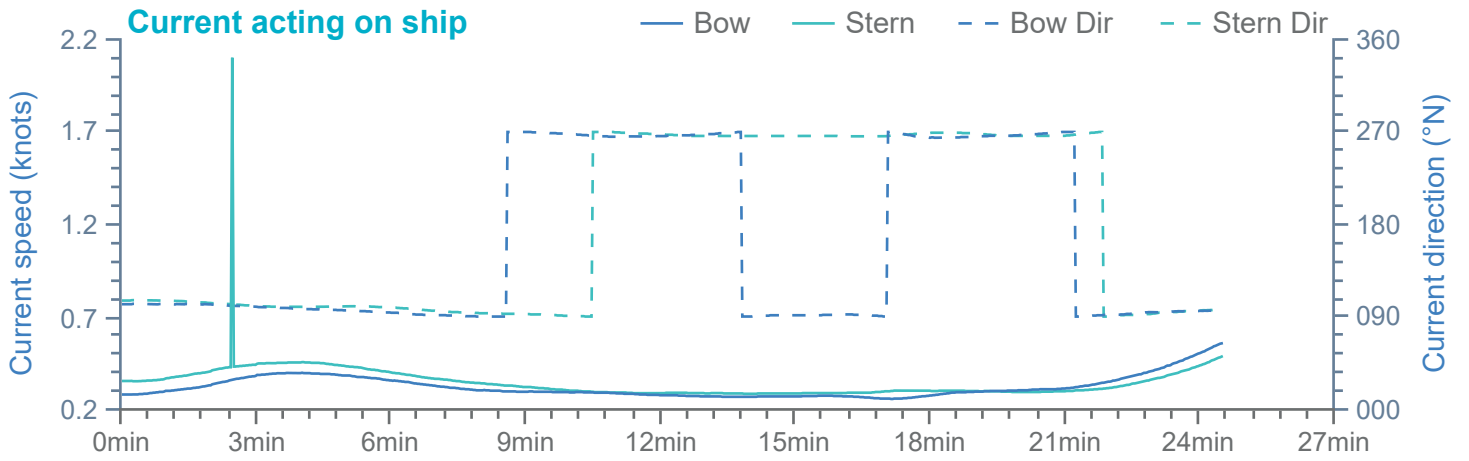


Overview

Environment

240m x 32m RoPax

Thruster and engine use

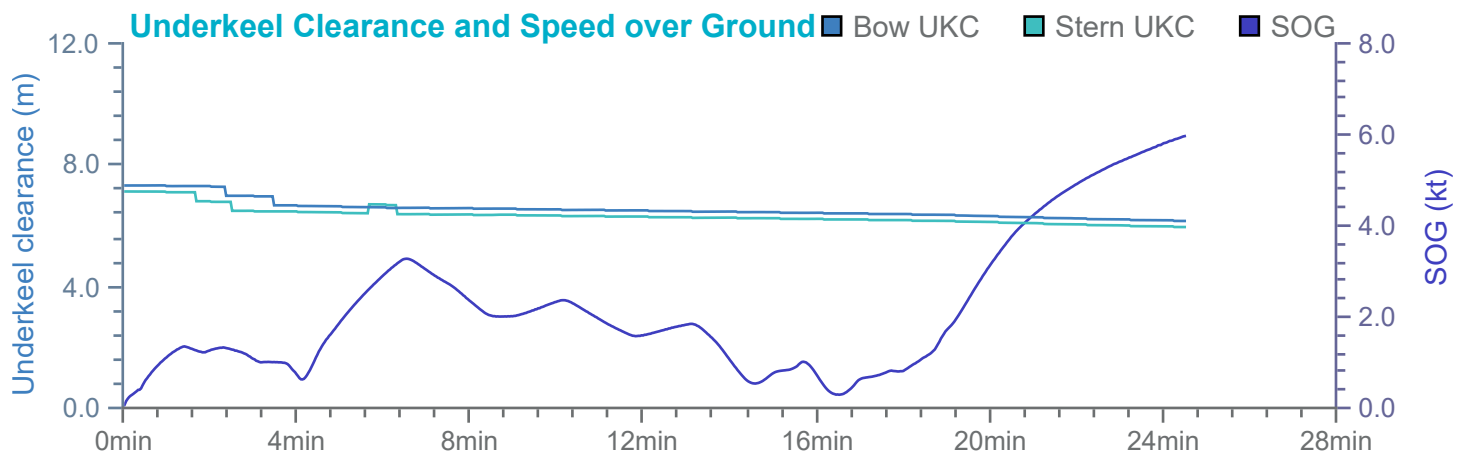
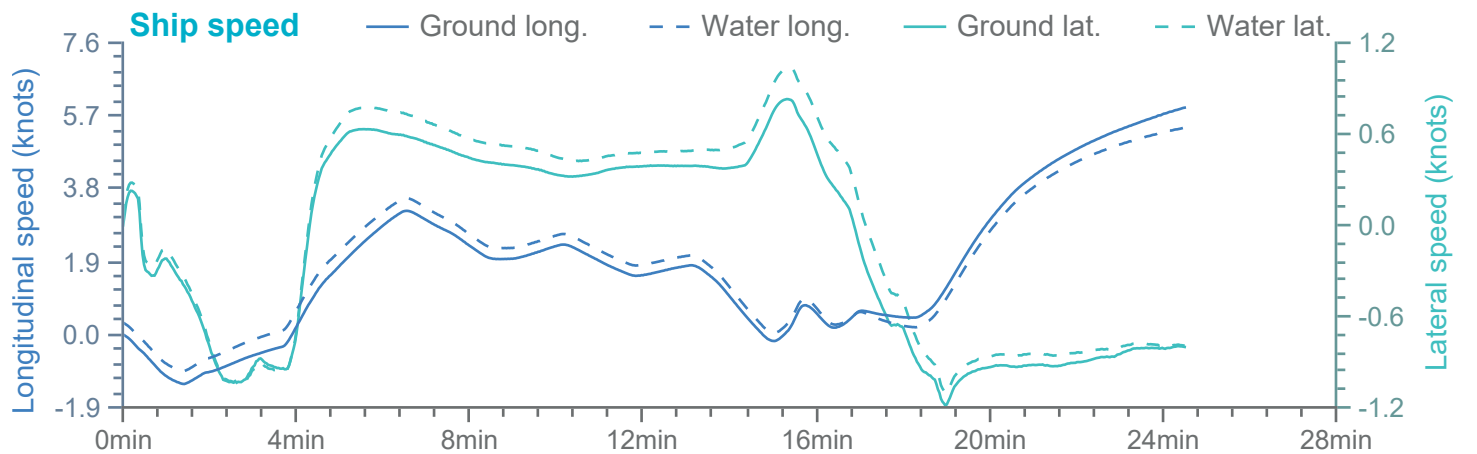
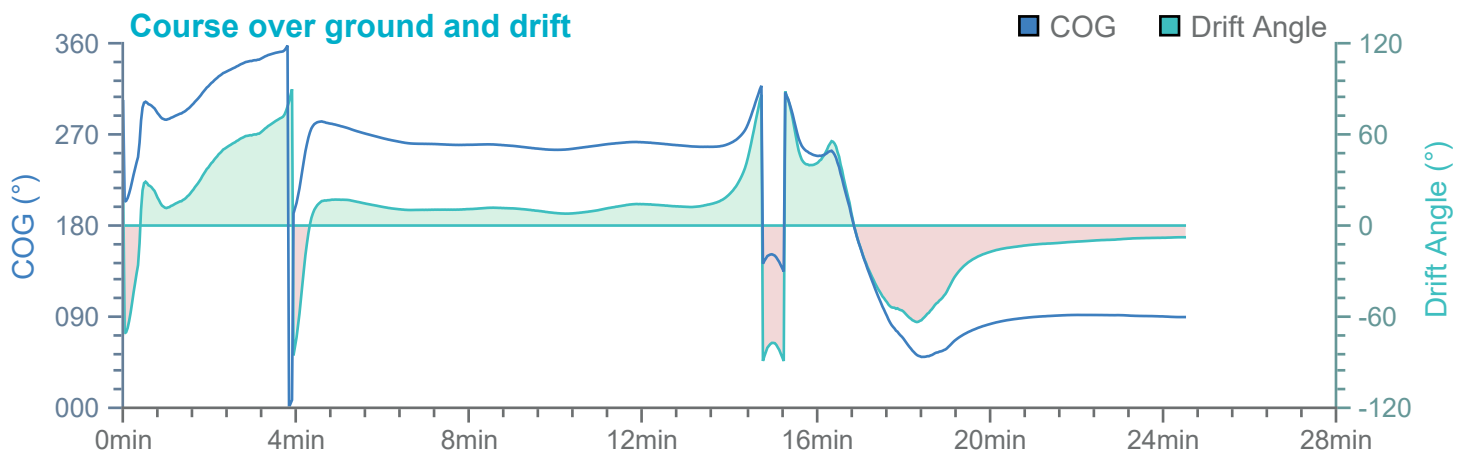
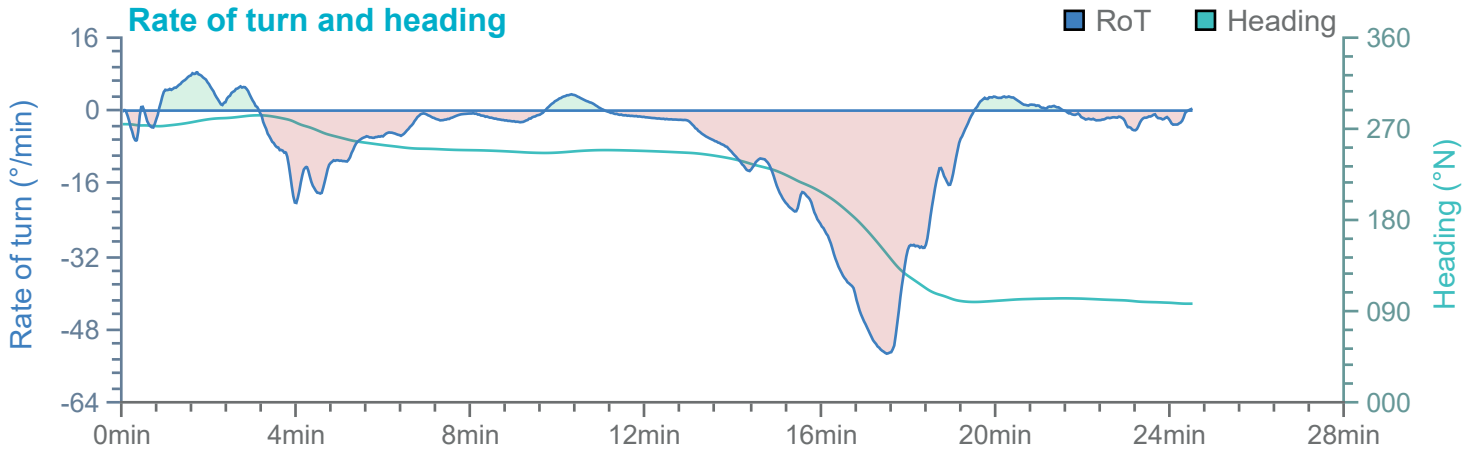


Overview

Environment

240m x 32m RoPax

Thruster and engine use

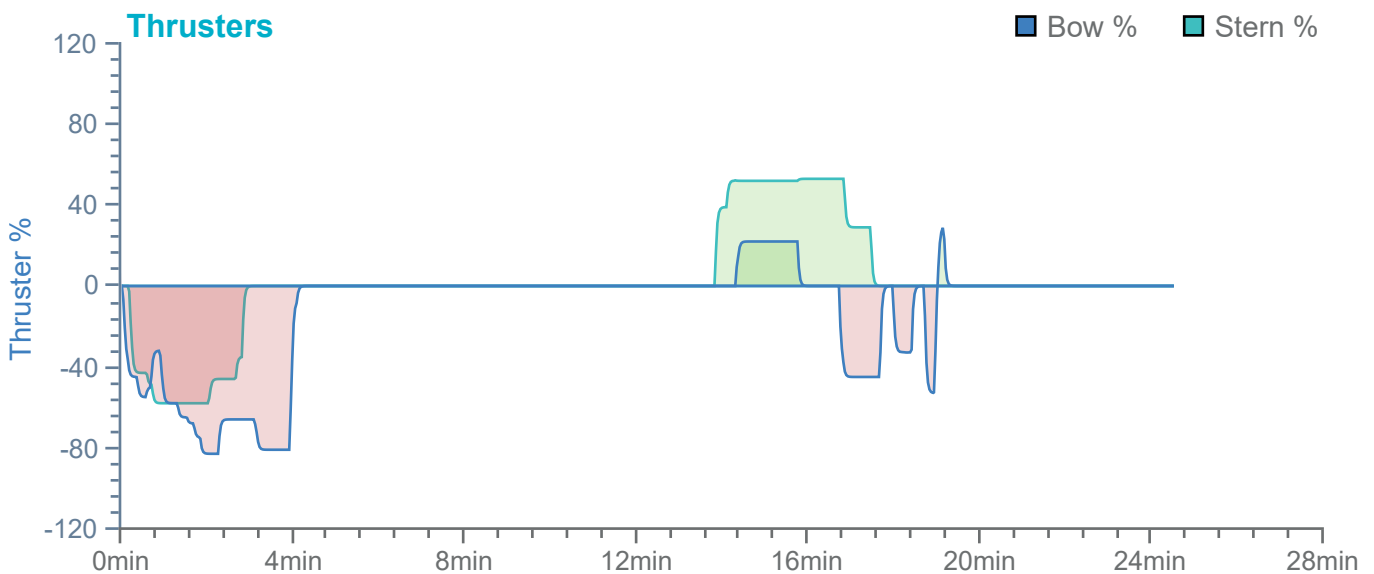
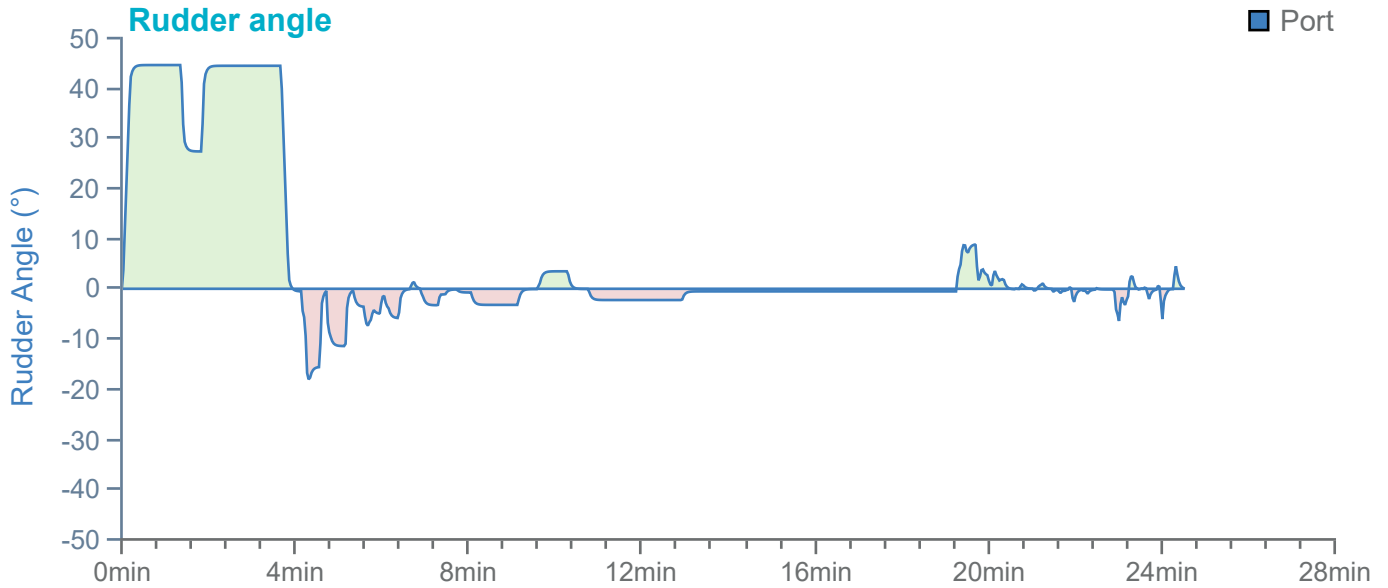
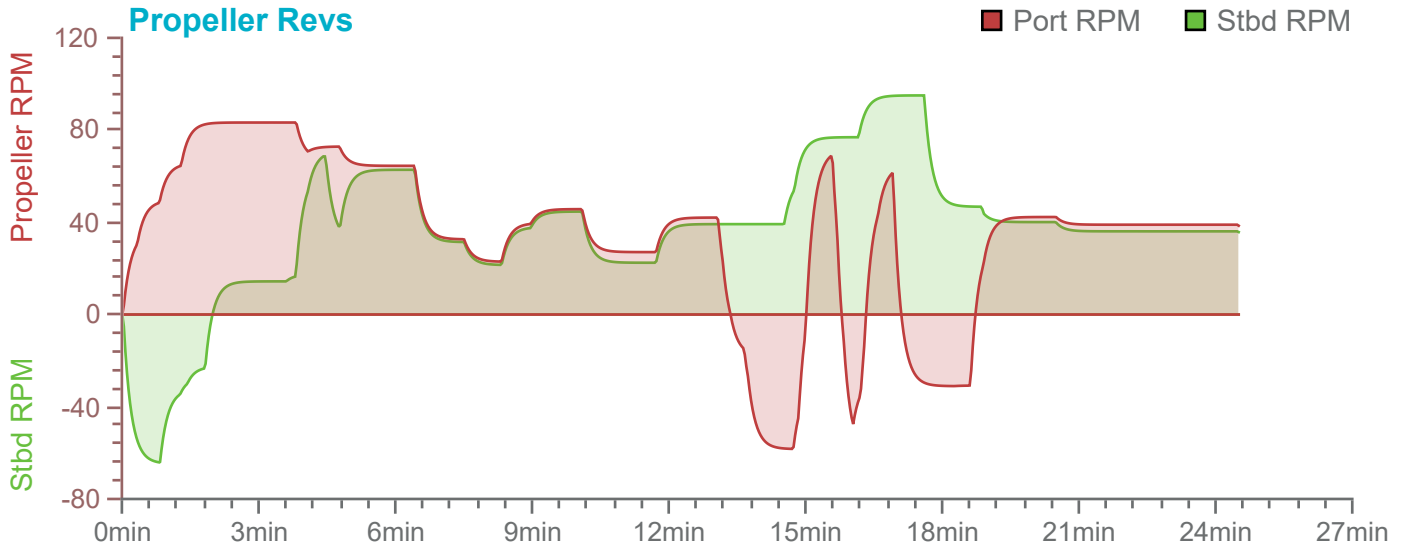


Overview

Environment

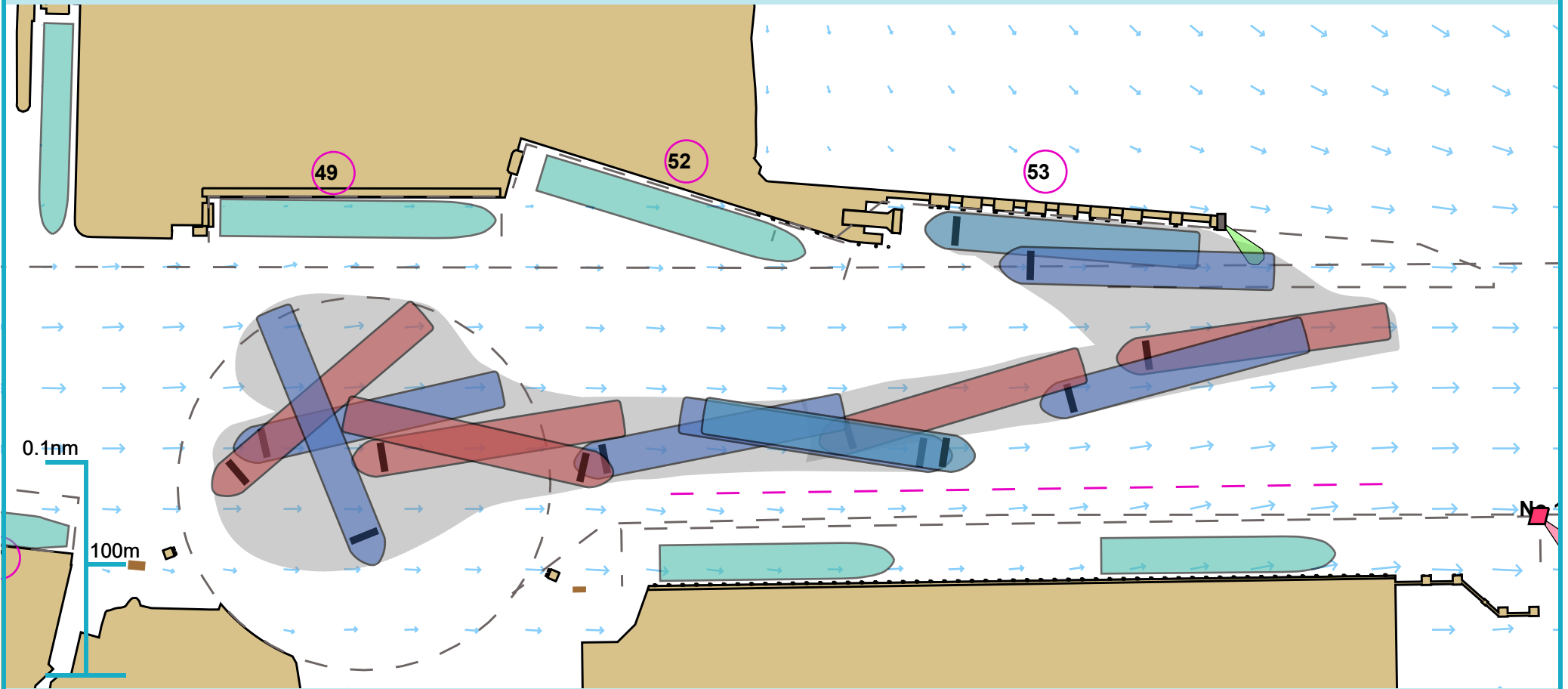
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.452 N, 006° 11.929 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

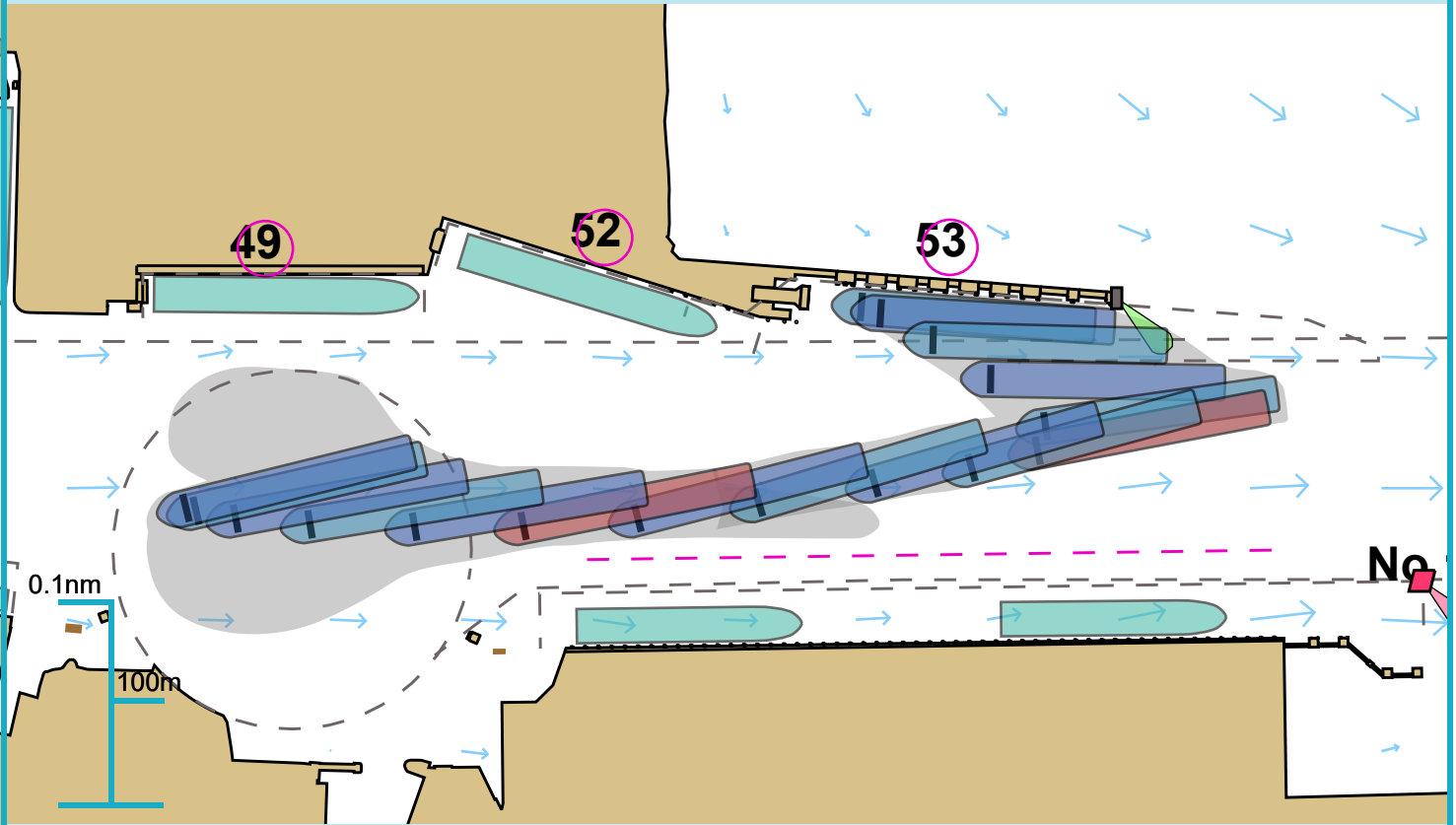
Run length: 22 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

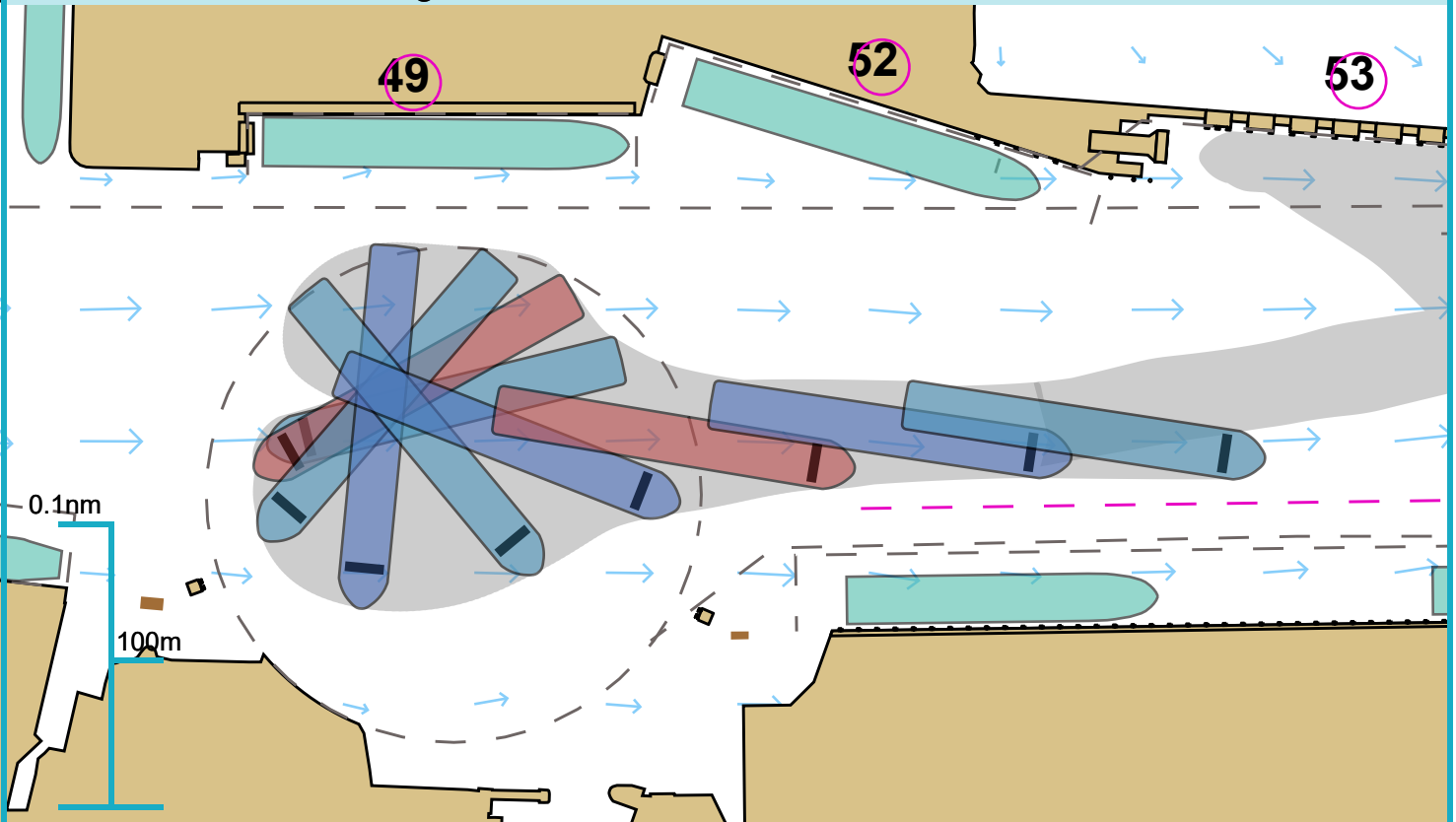
Comments:

Departure



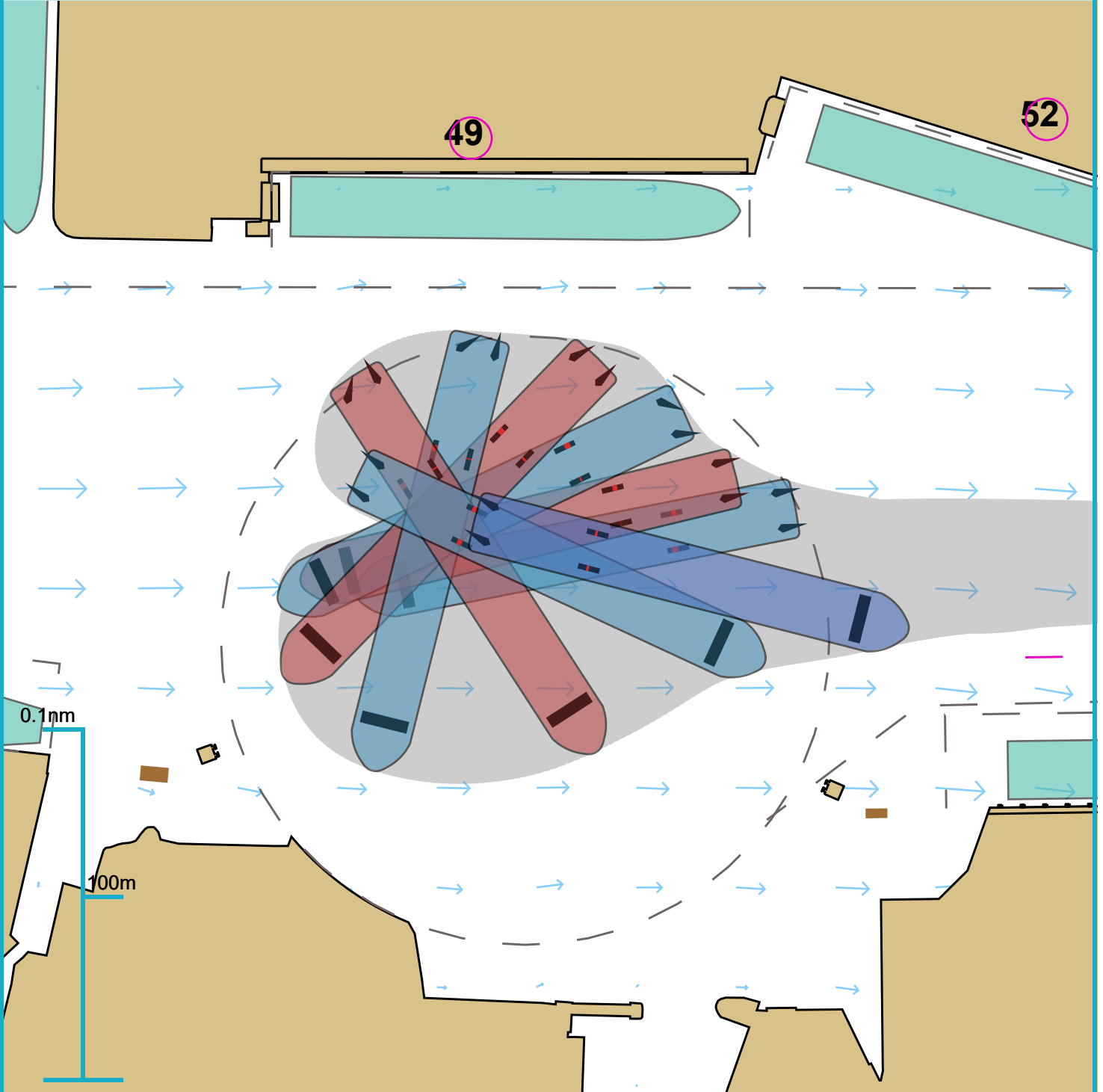
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre and Passage

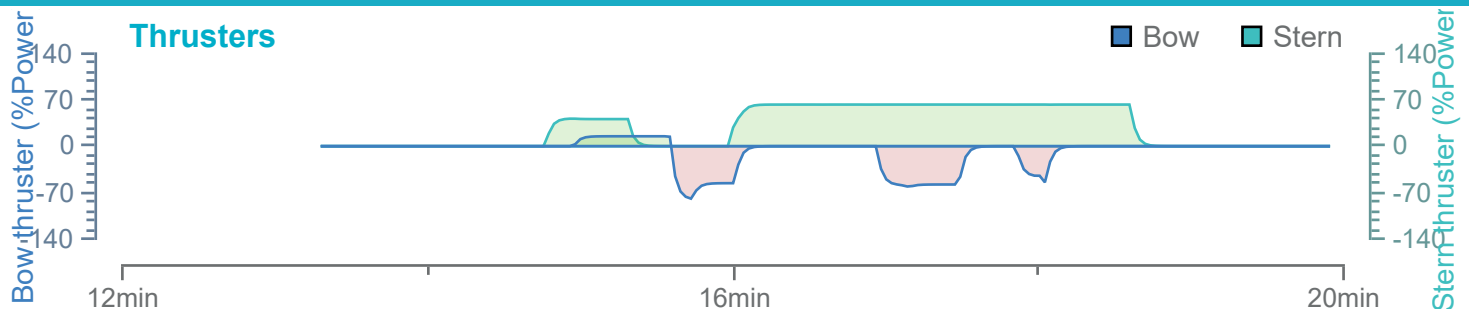


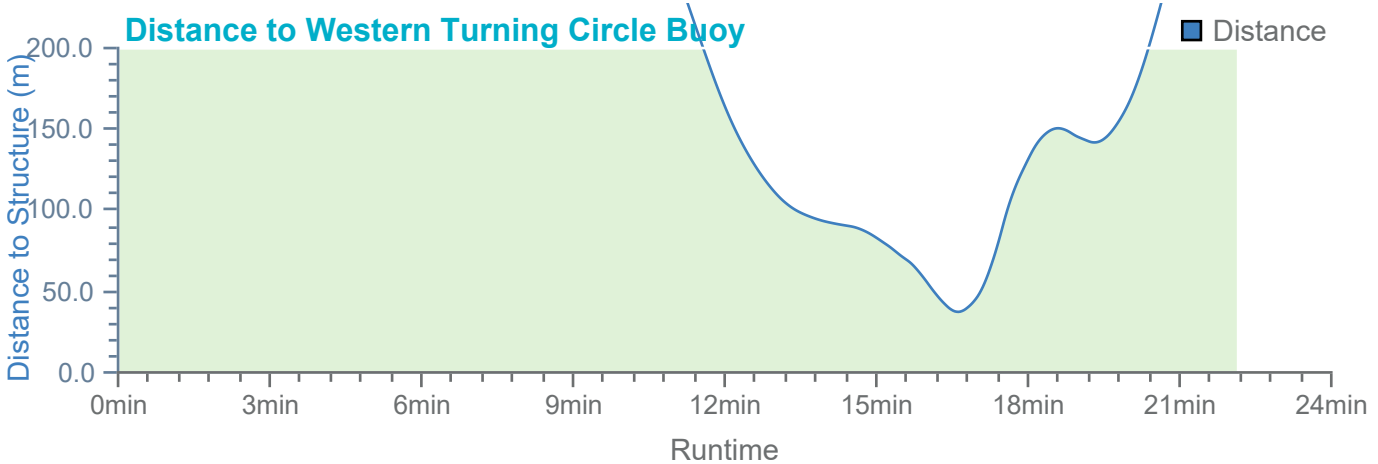
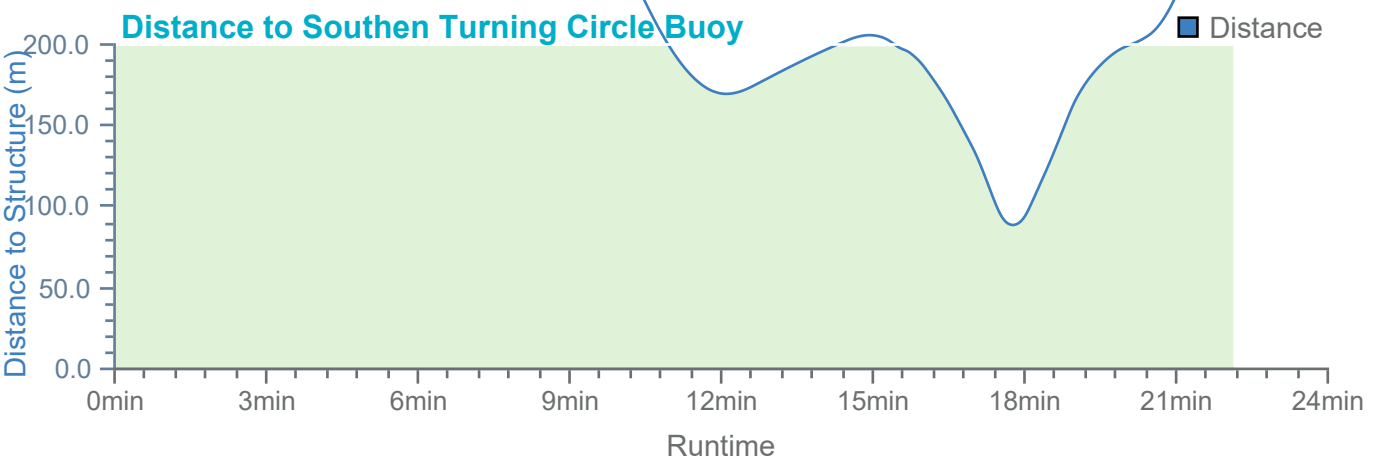
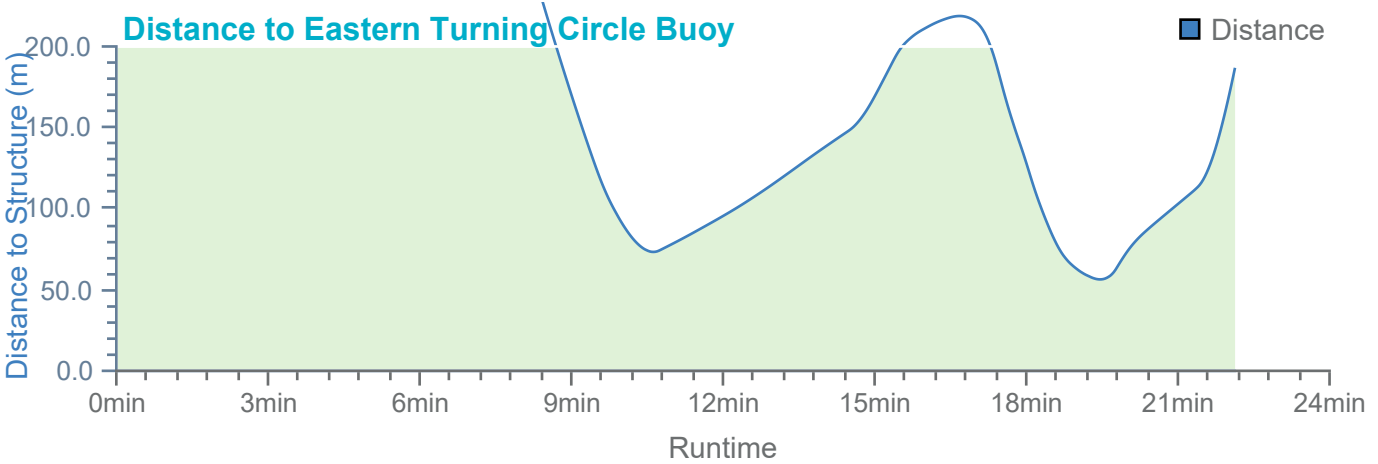
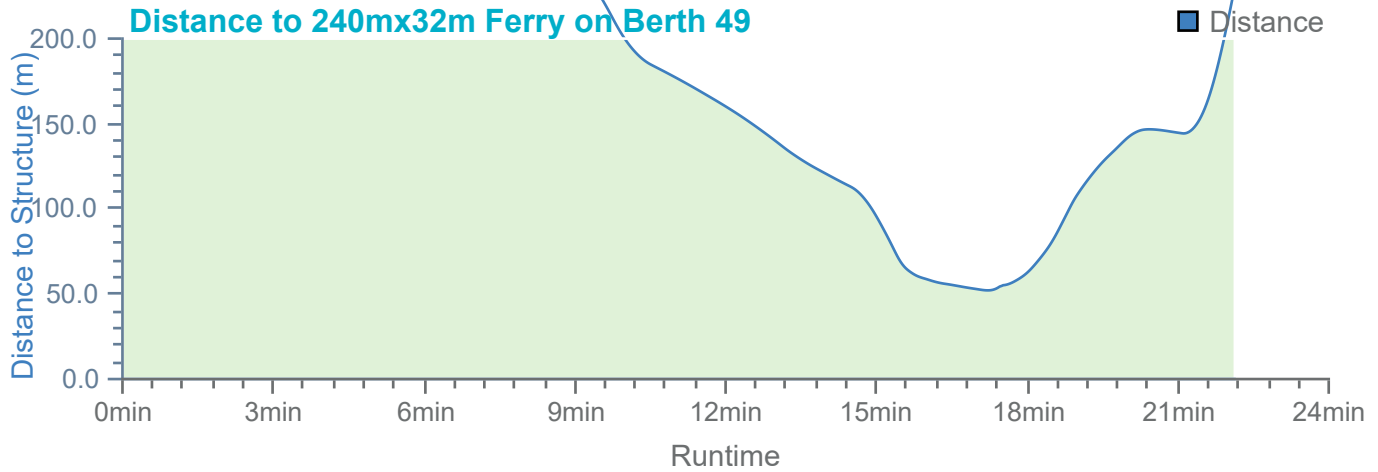
Ships plotted every 1 mins, highlight every 5 mins

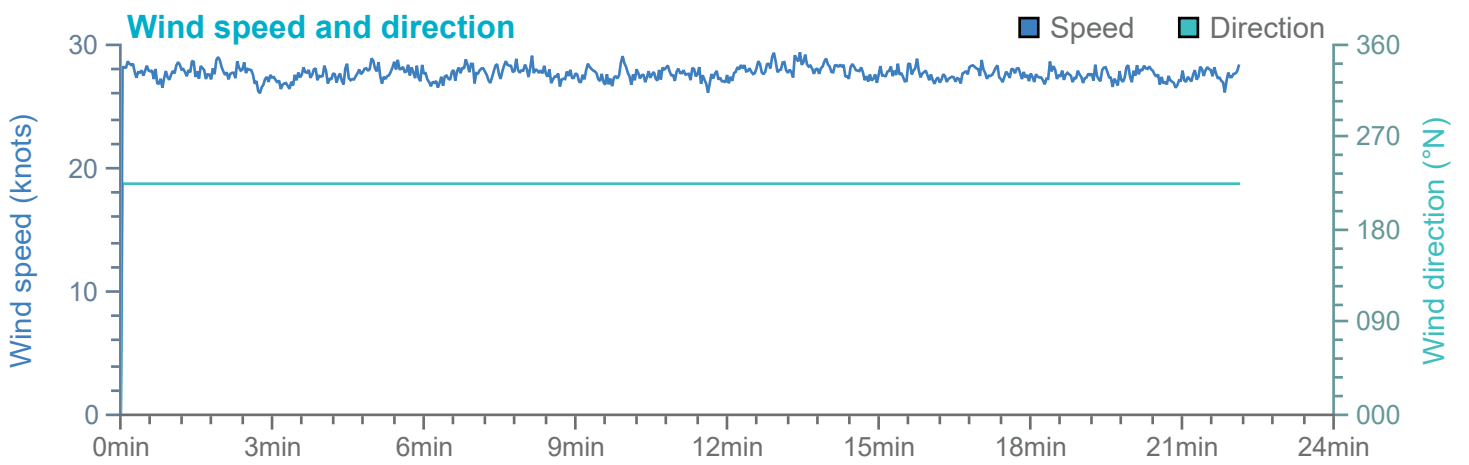
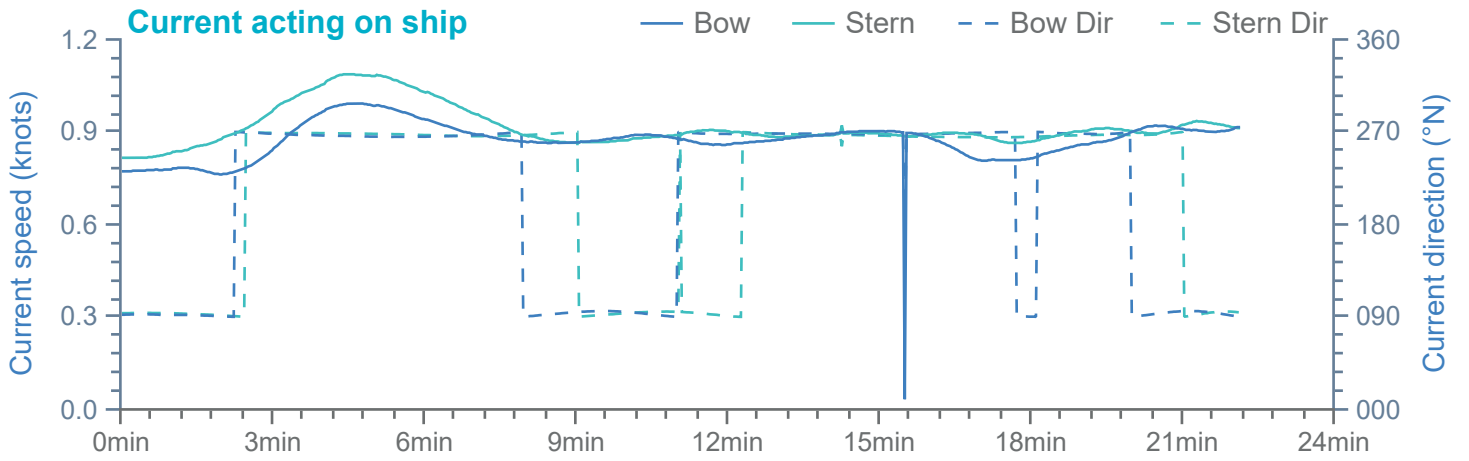
Swing



Ships plotted every 59 seconds, highlight every 2 mins





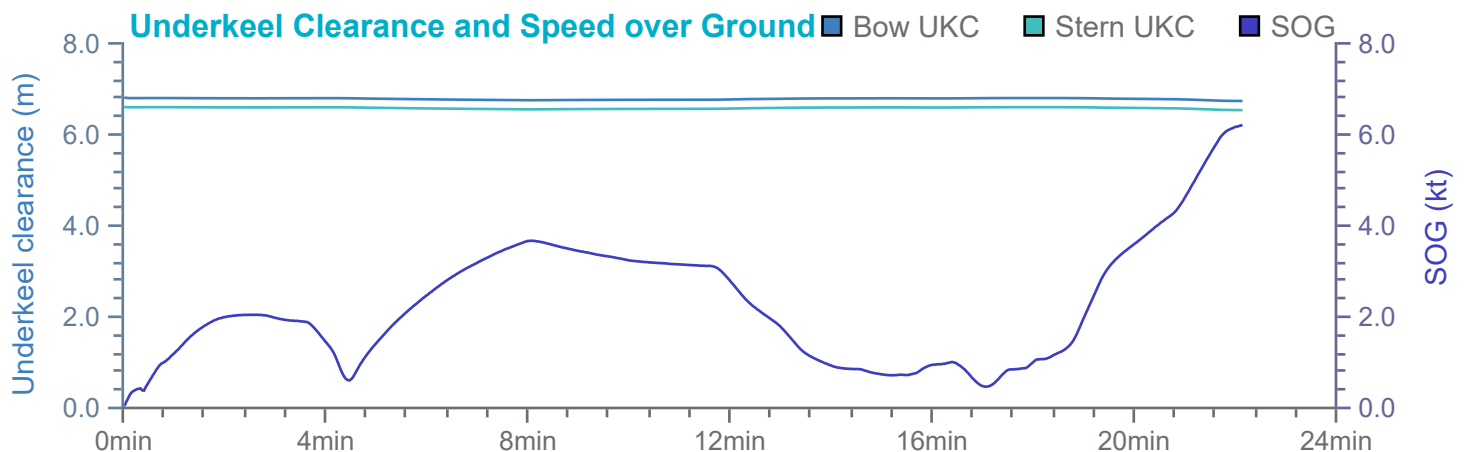
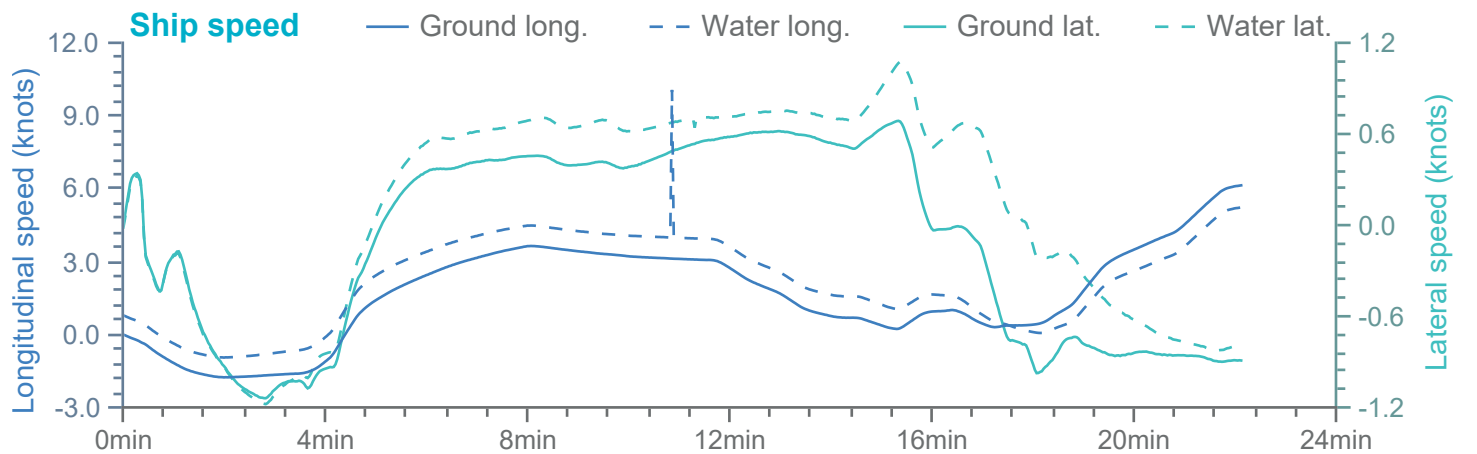
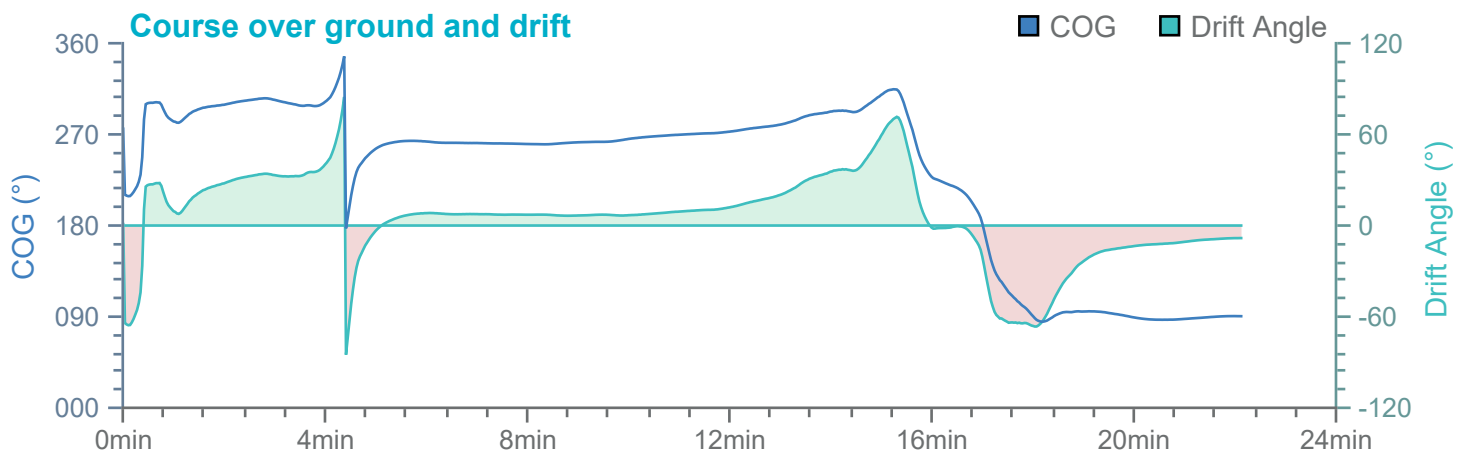
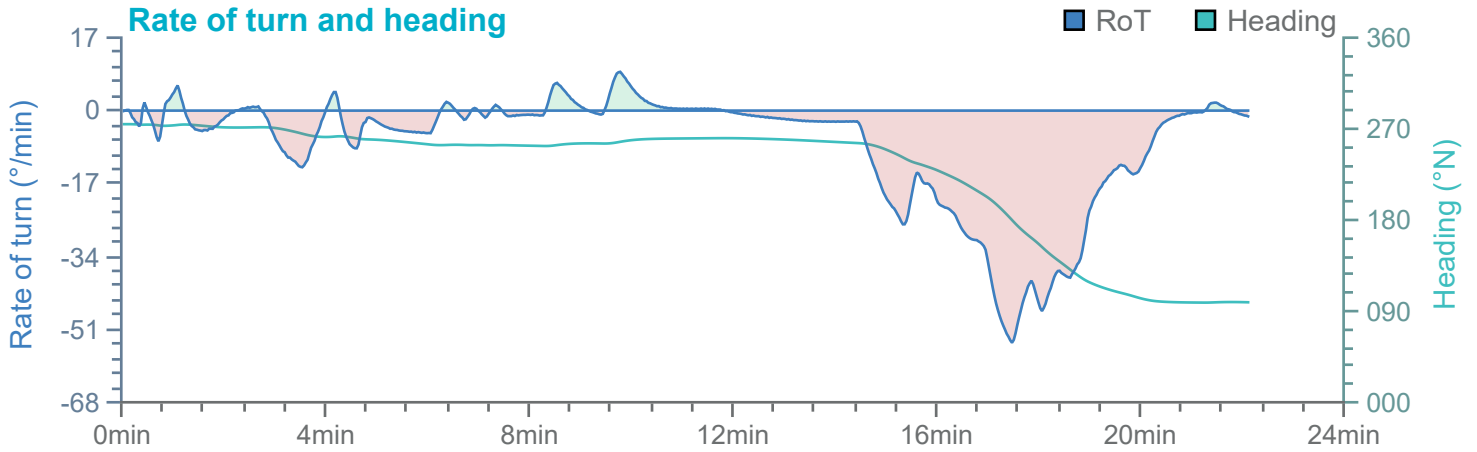


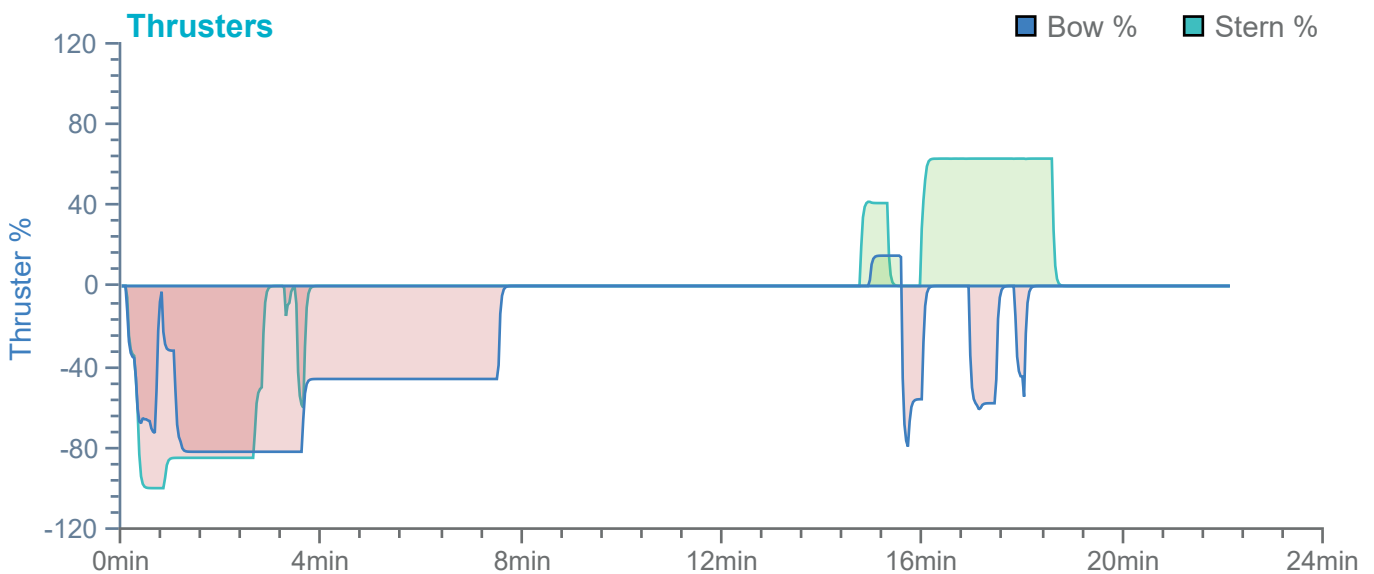
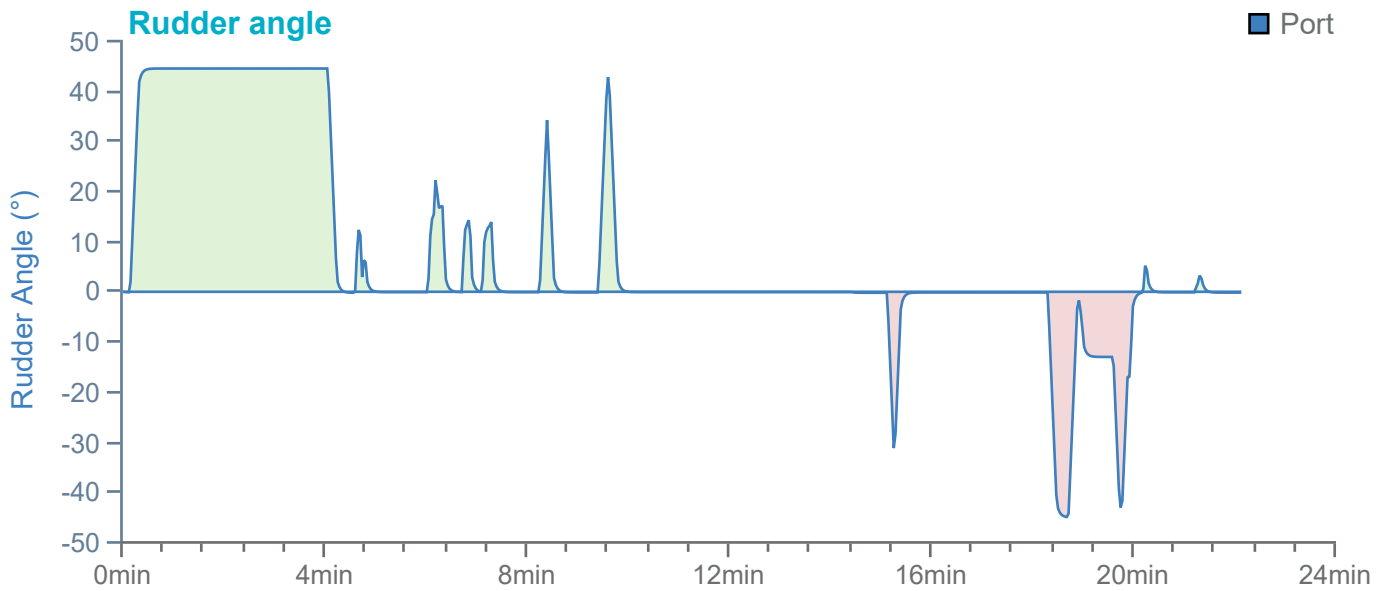
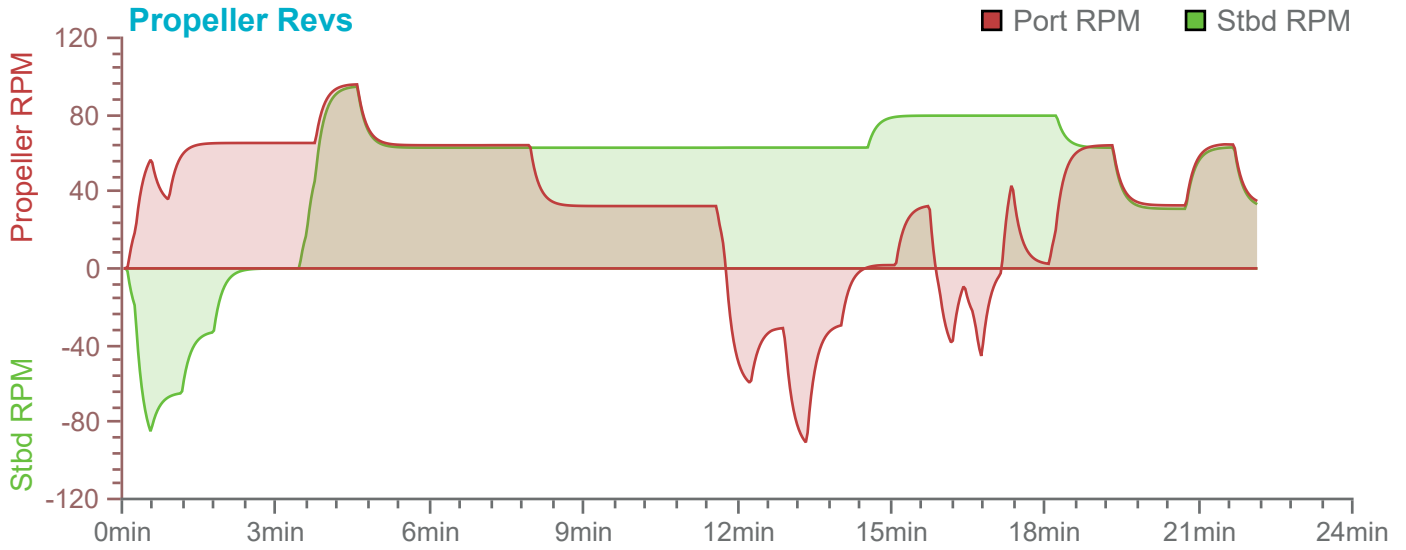
Overview

Environment

240m x 32m RoPax

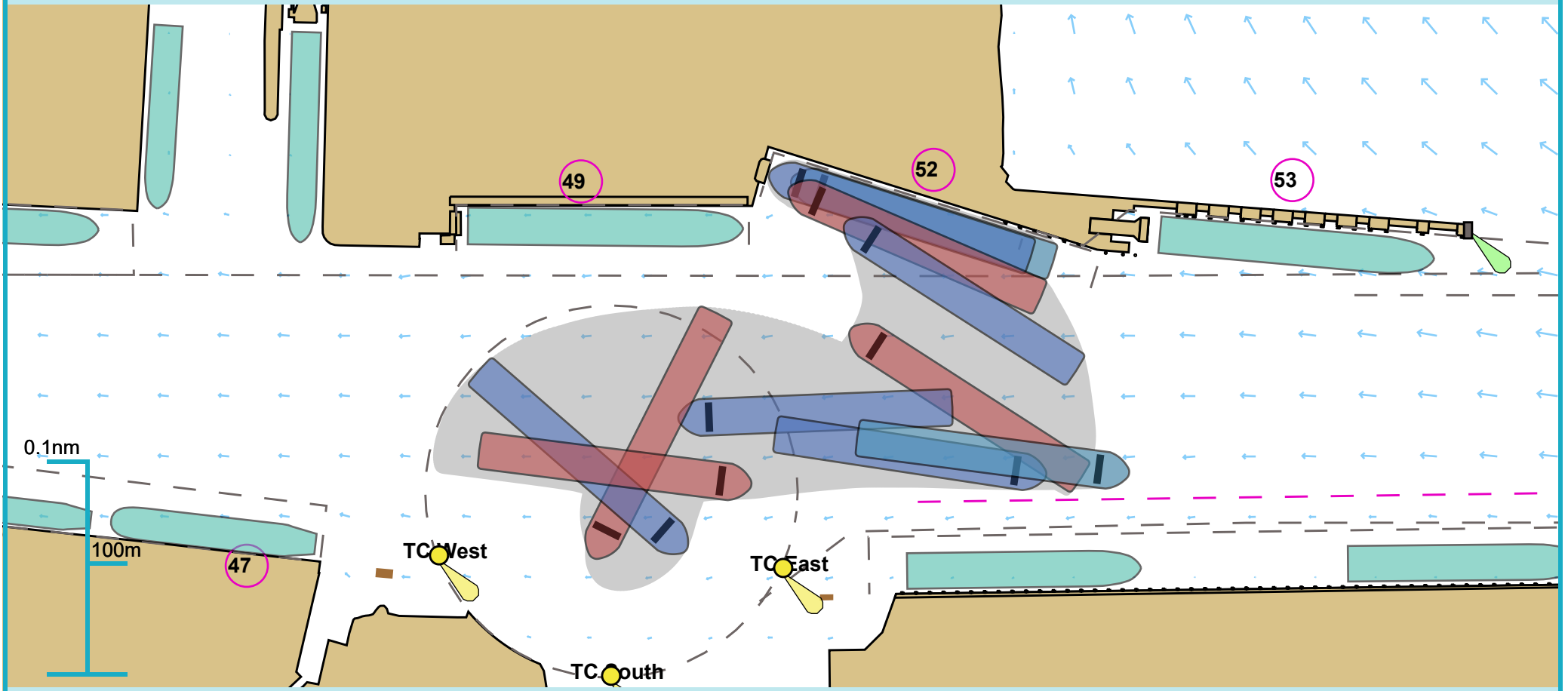
Thruster and engine use





Full Run Overview

53° 20.456 N, 006° 12.122 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

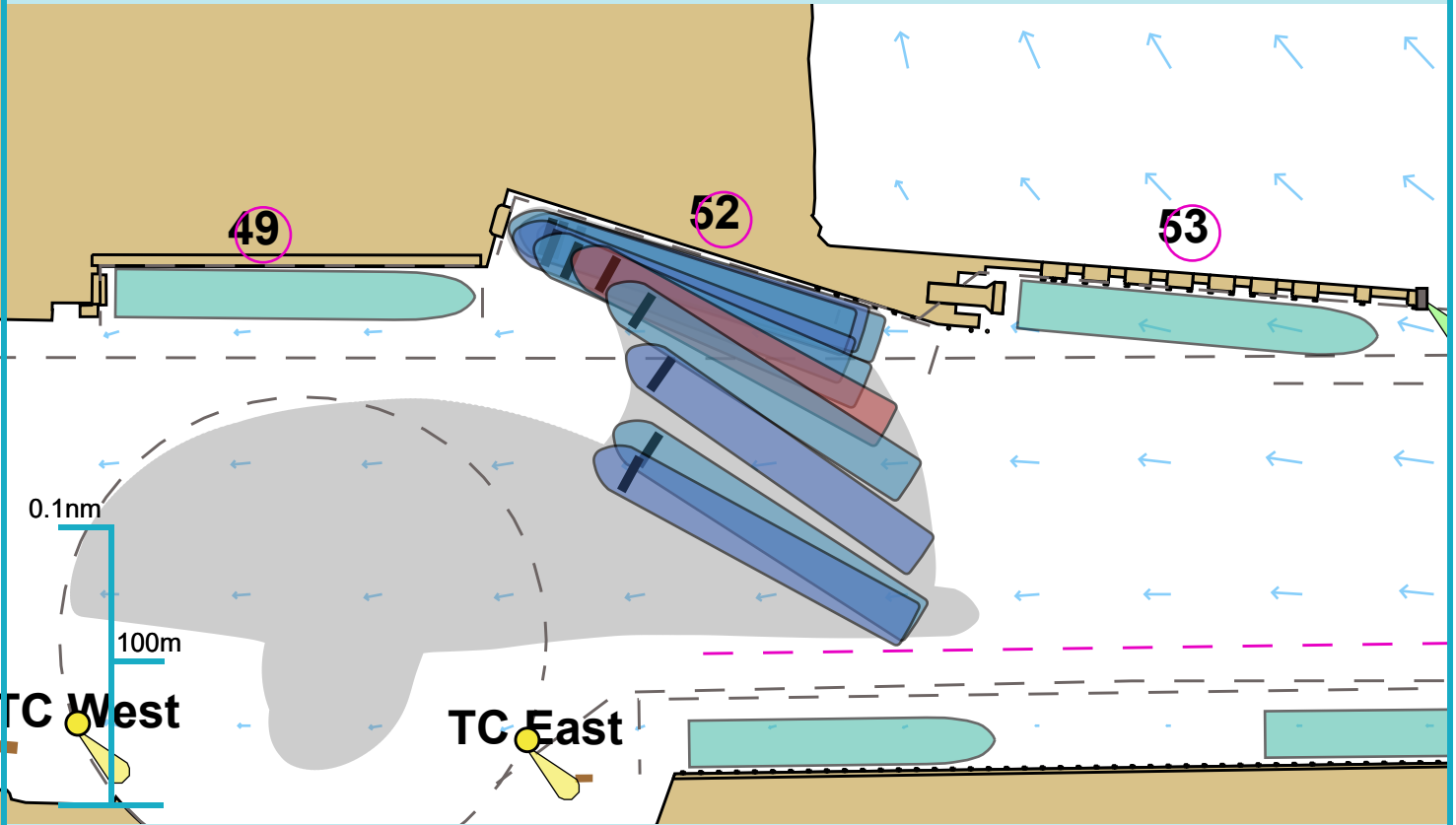
Run length:18 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax

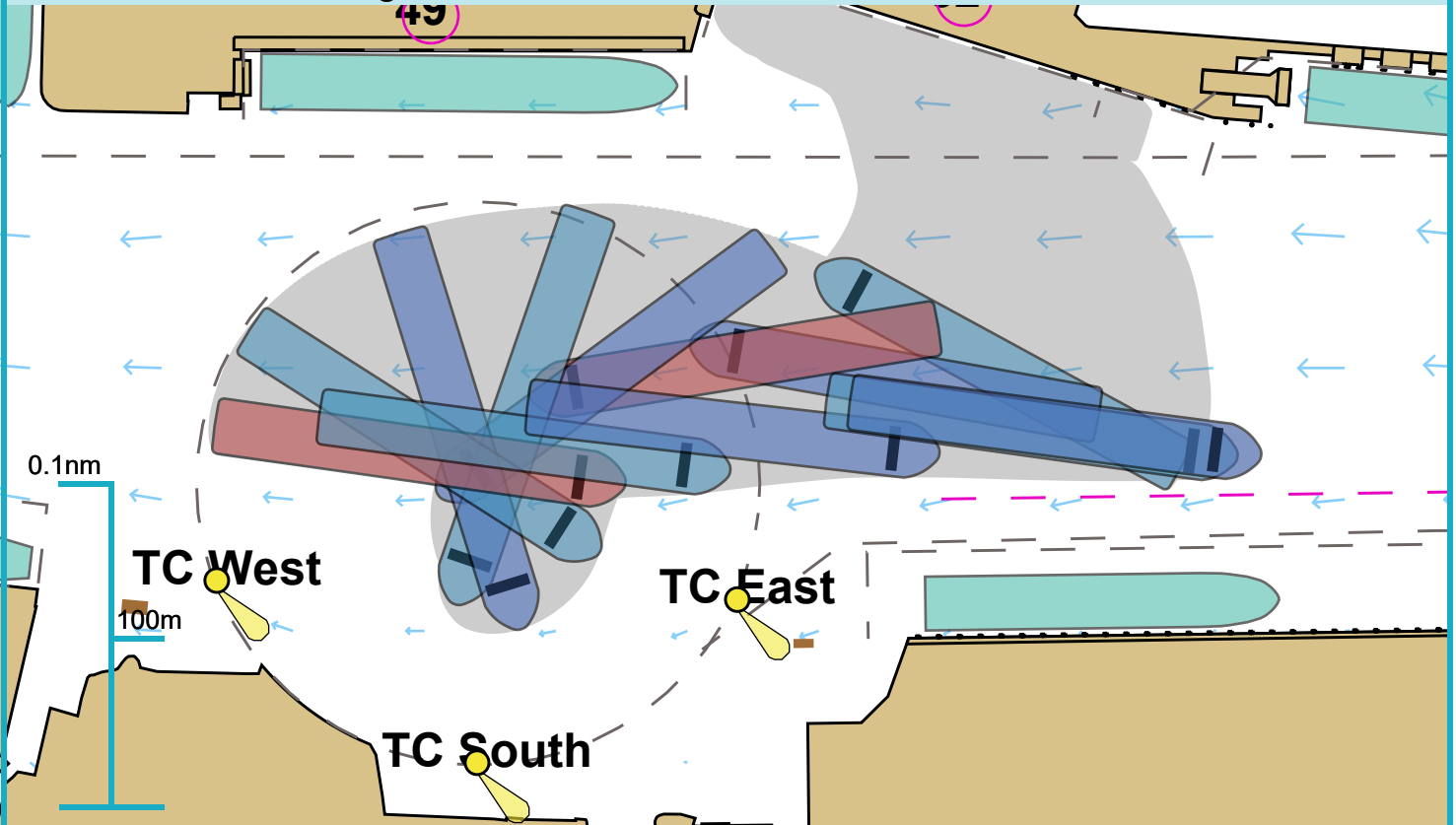
Comments:

Departure



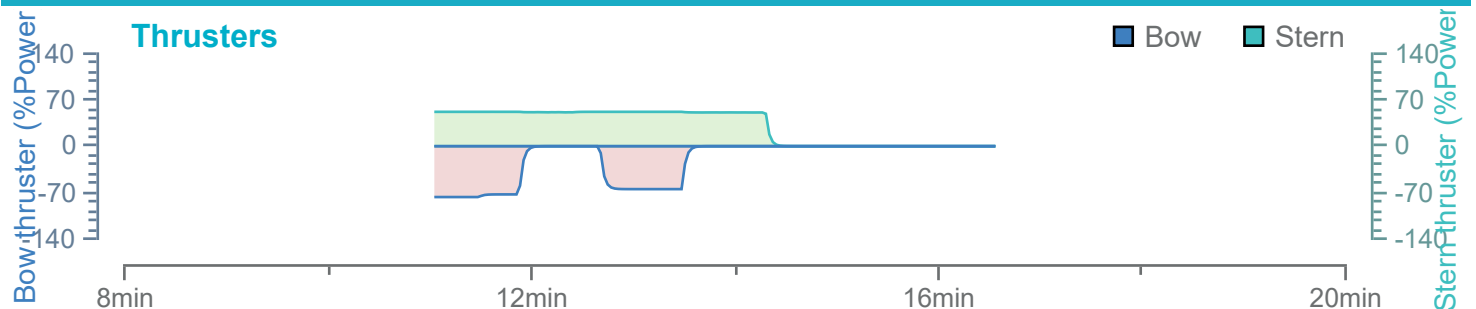
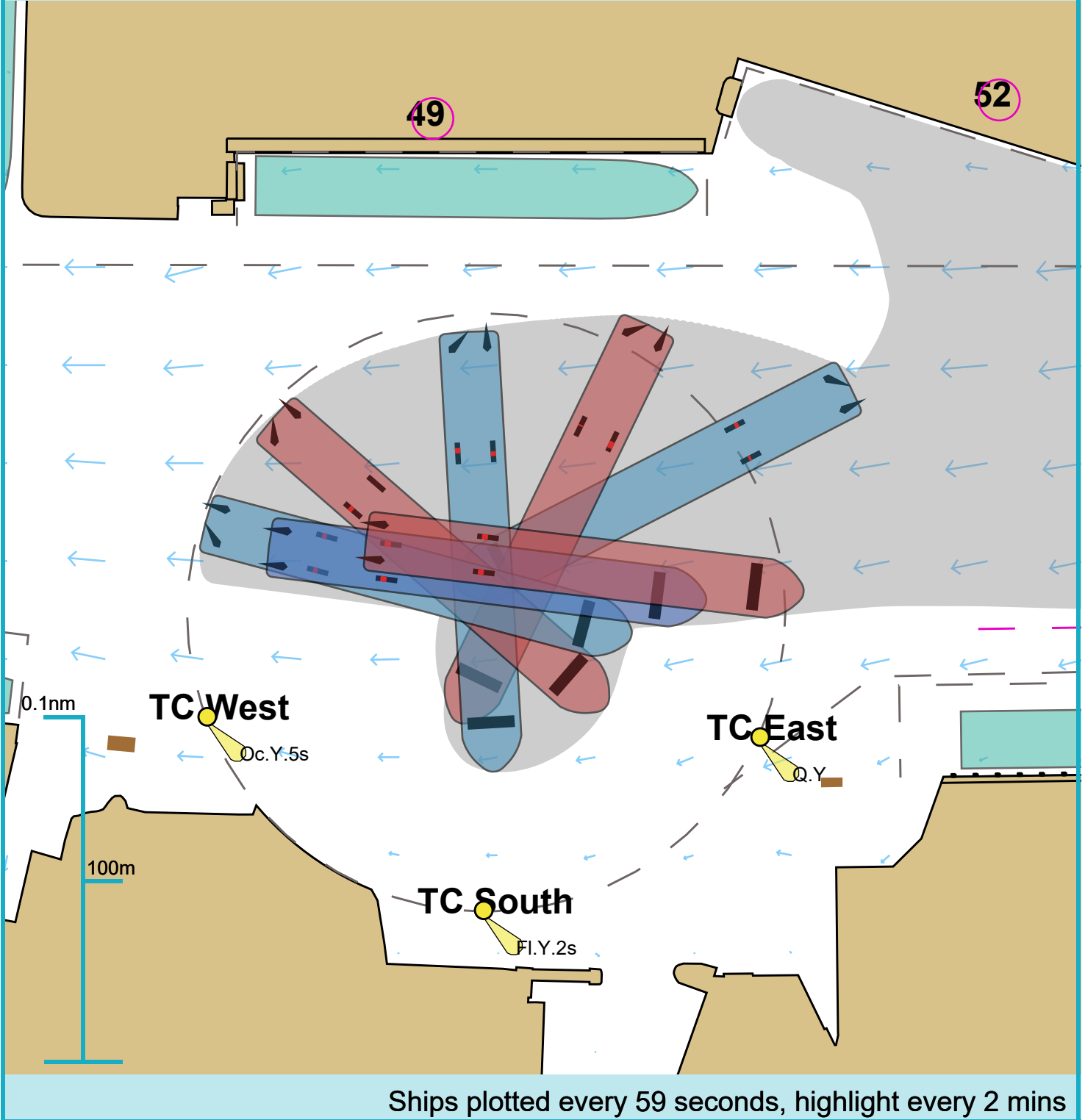
Ships plotted every 1 mins, highlight every 5 mins

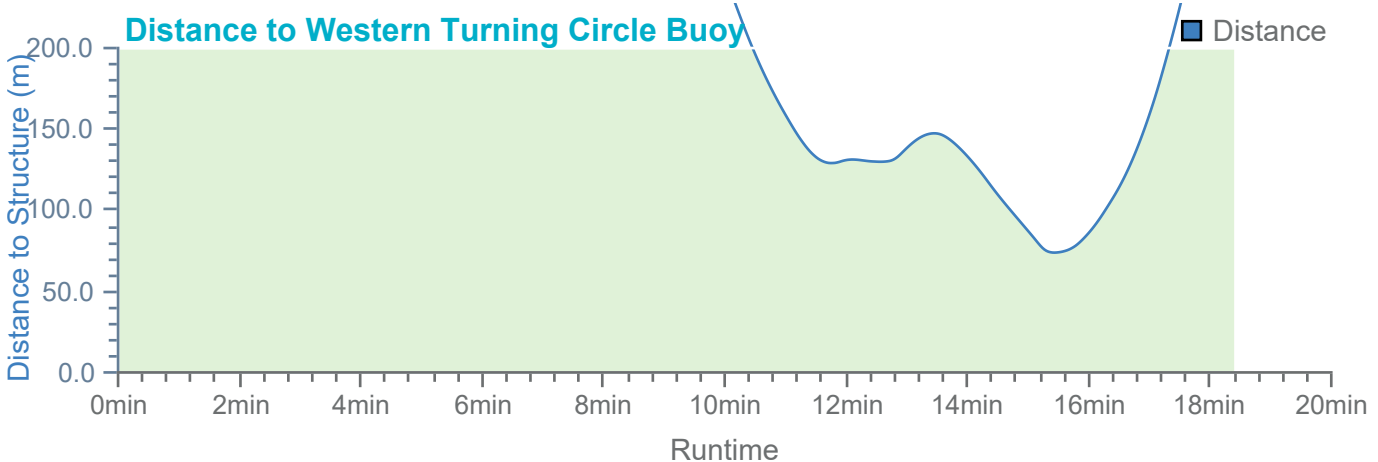
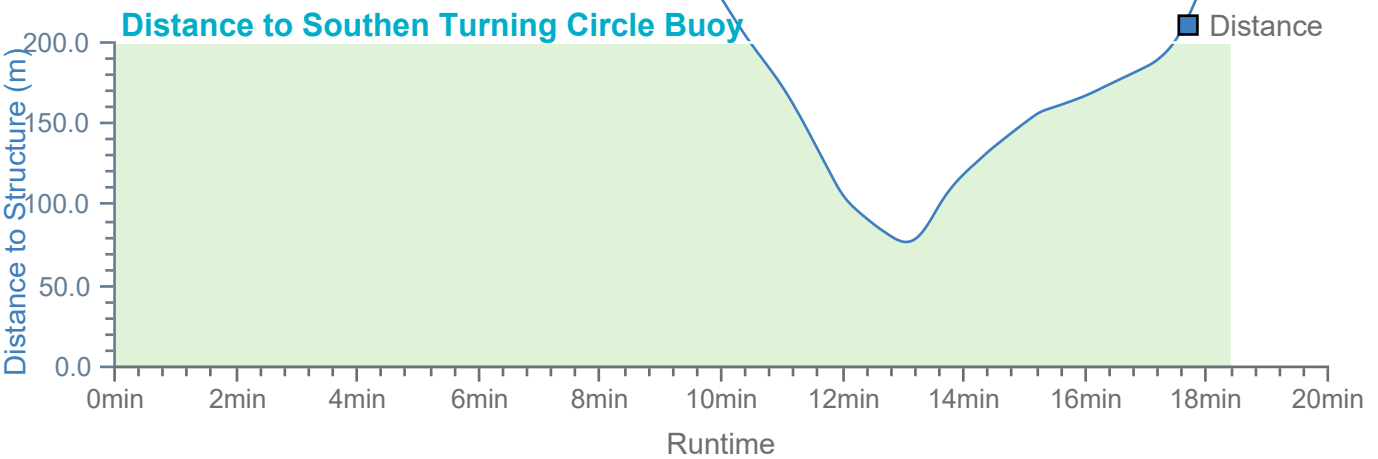
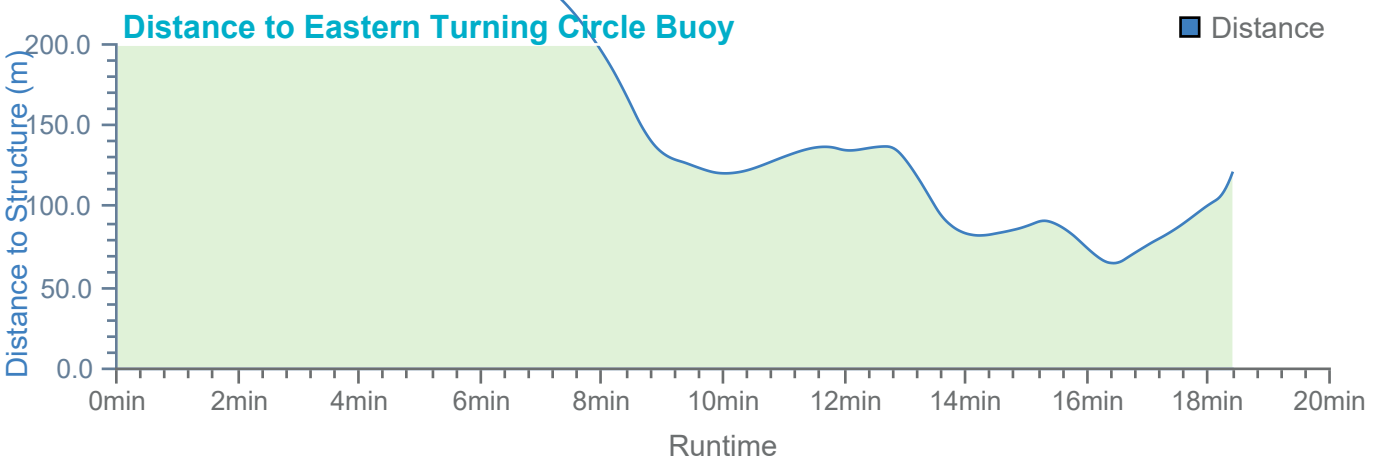
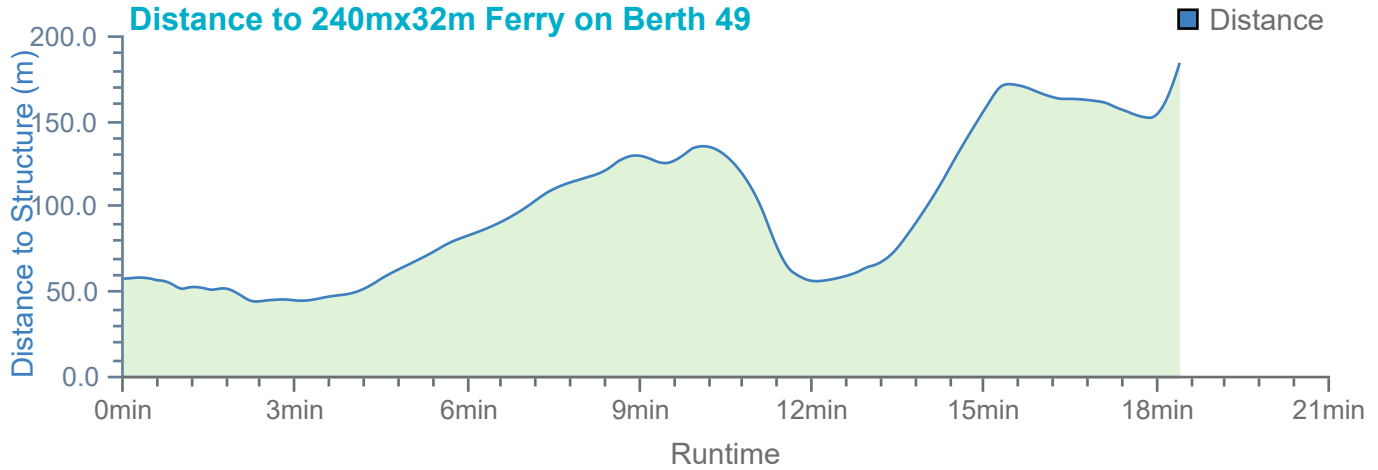
Manoeuvre & Passage



Ships plotted every 1 mins, highlight every 5 mins

Swing



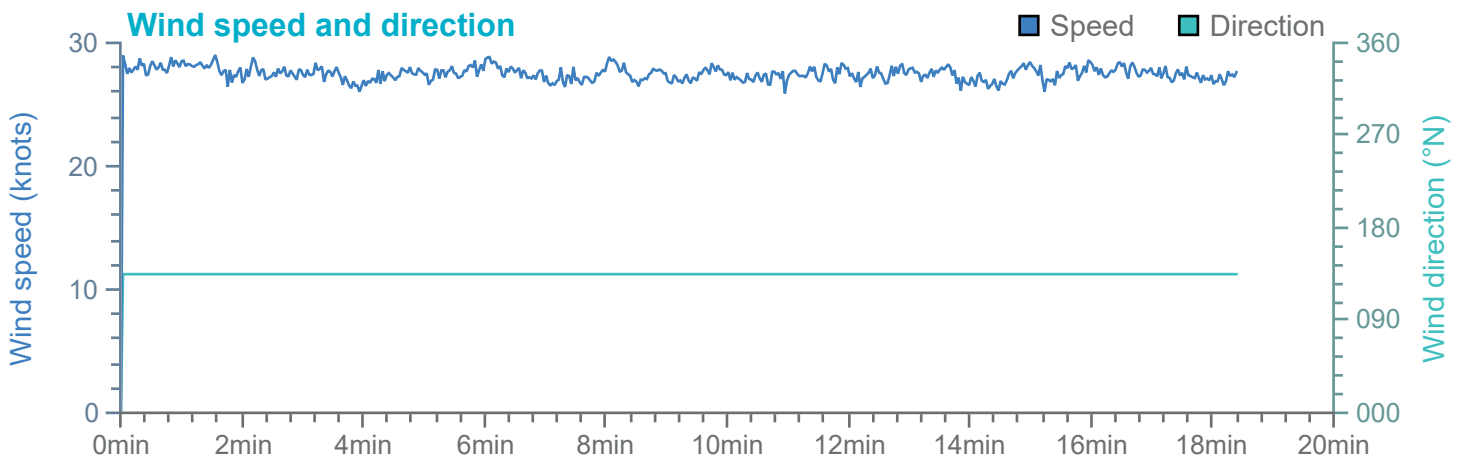
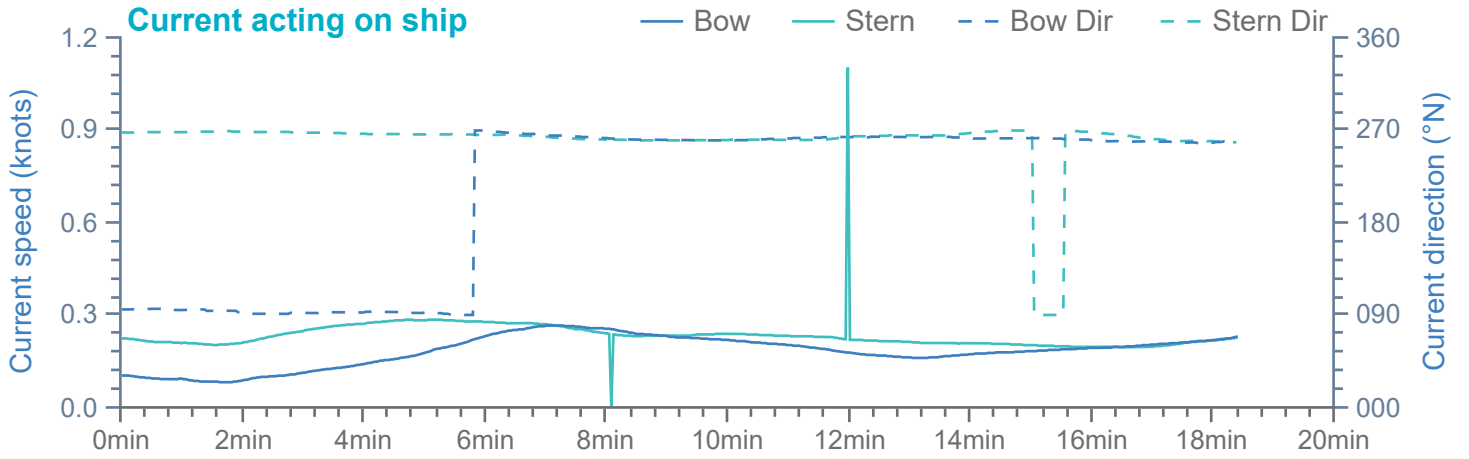


Overview

Environment

240m x 32m RoPax

Thruster and engine use

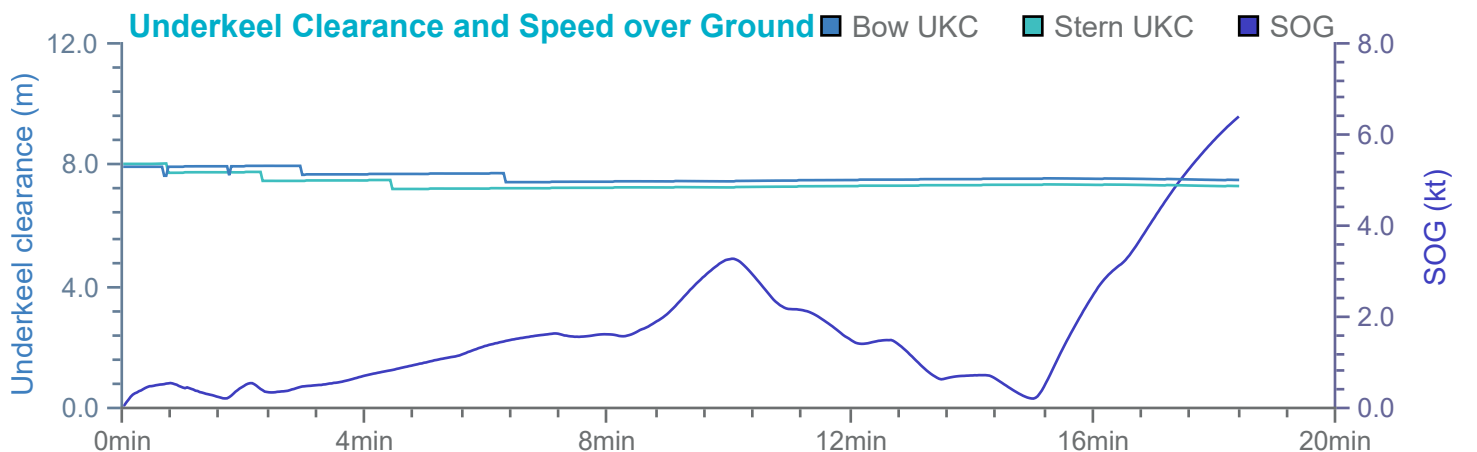
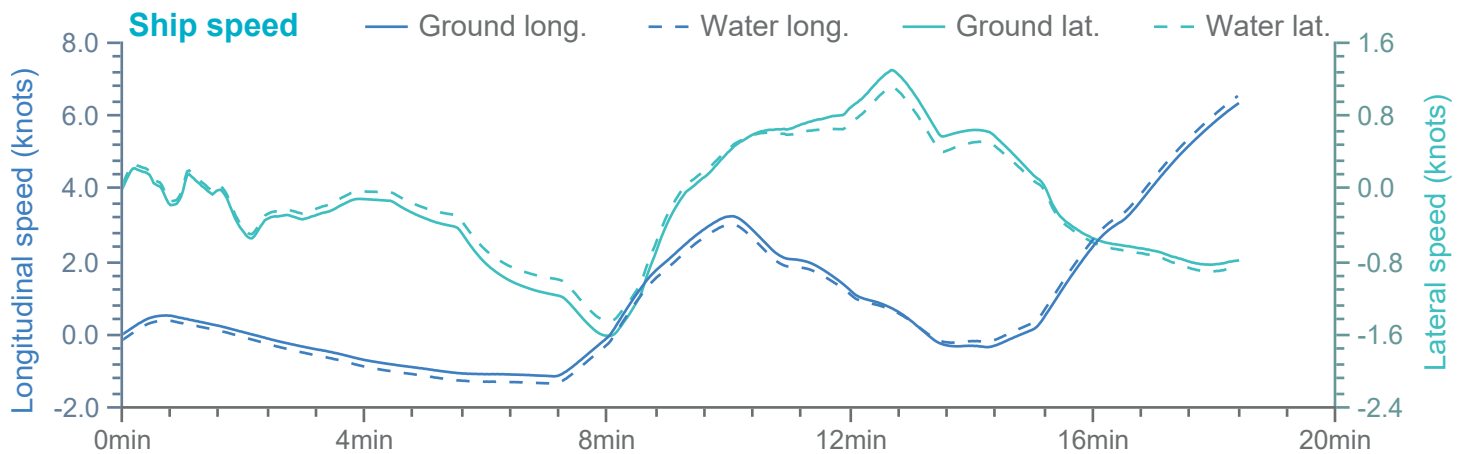
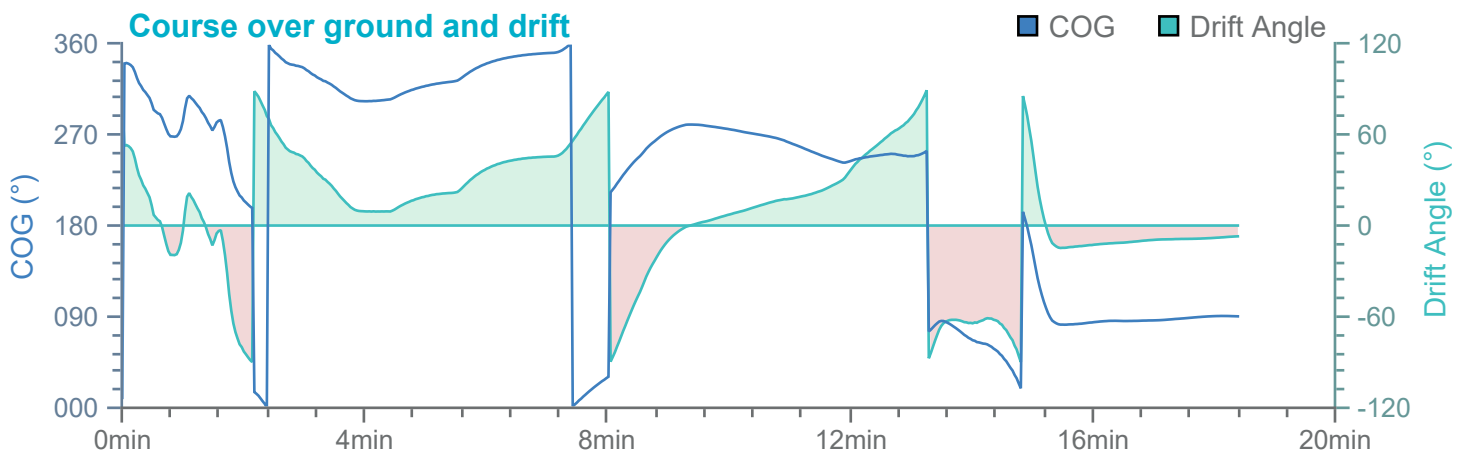
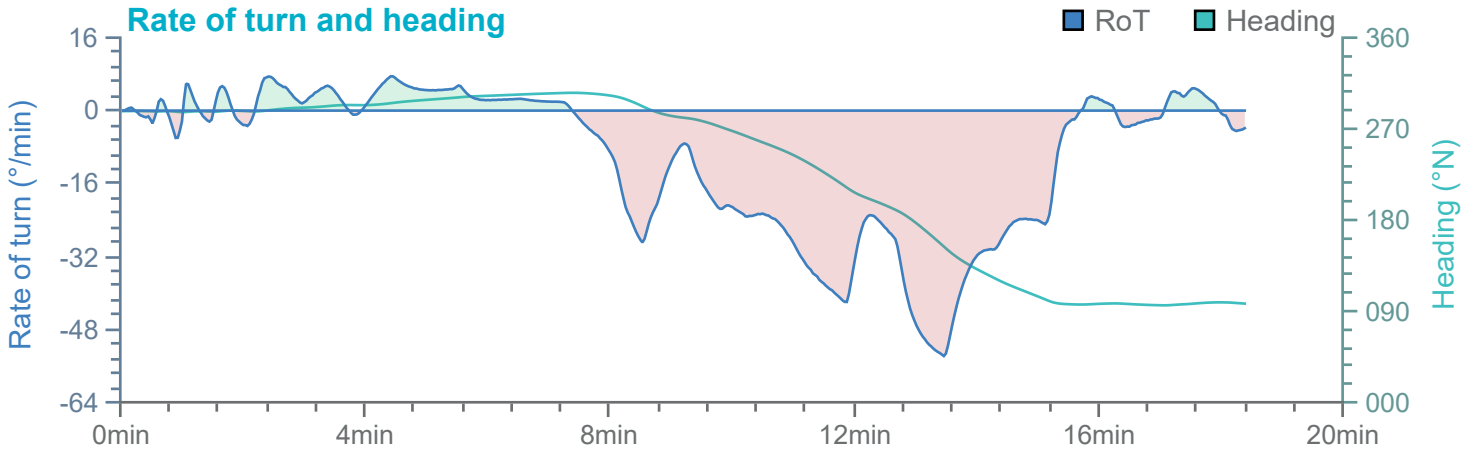


Overview

Environment

240m x 32m RoPax

Thruster and engine use

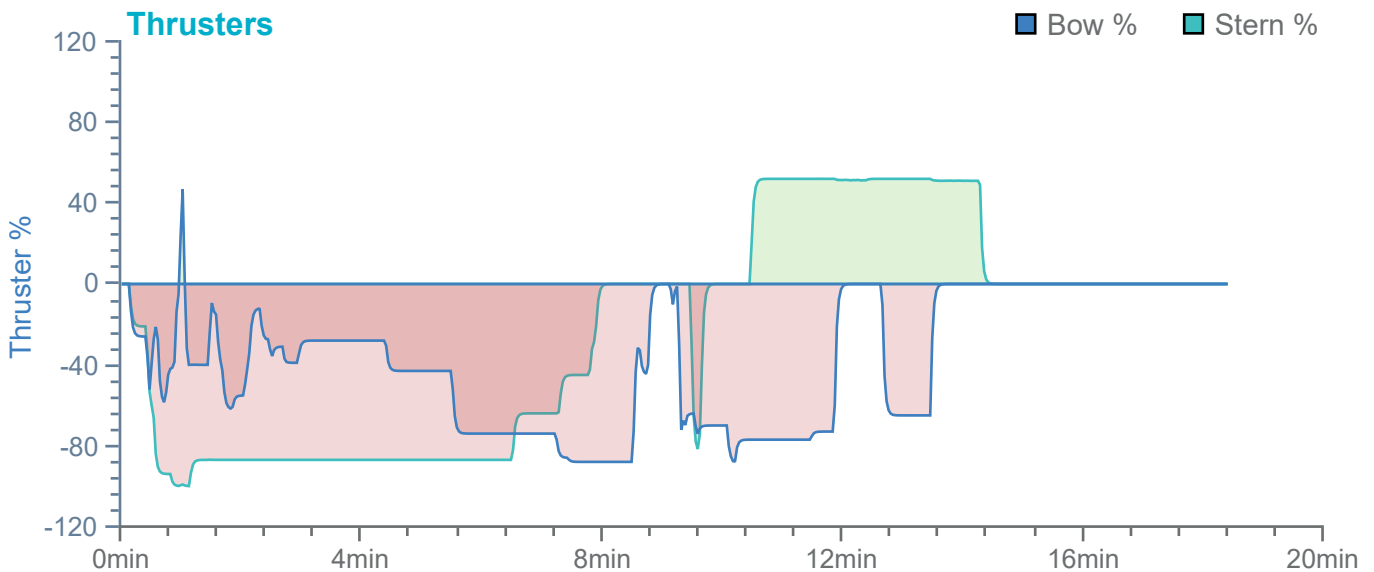
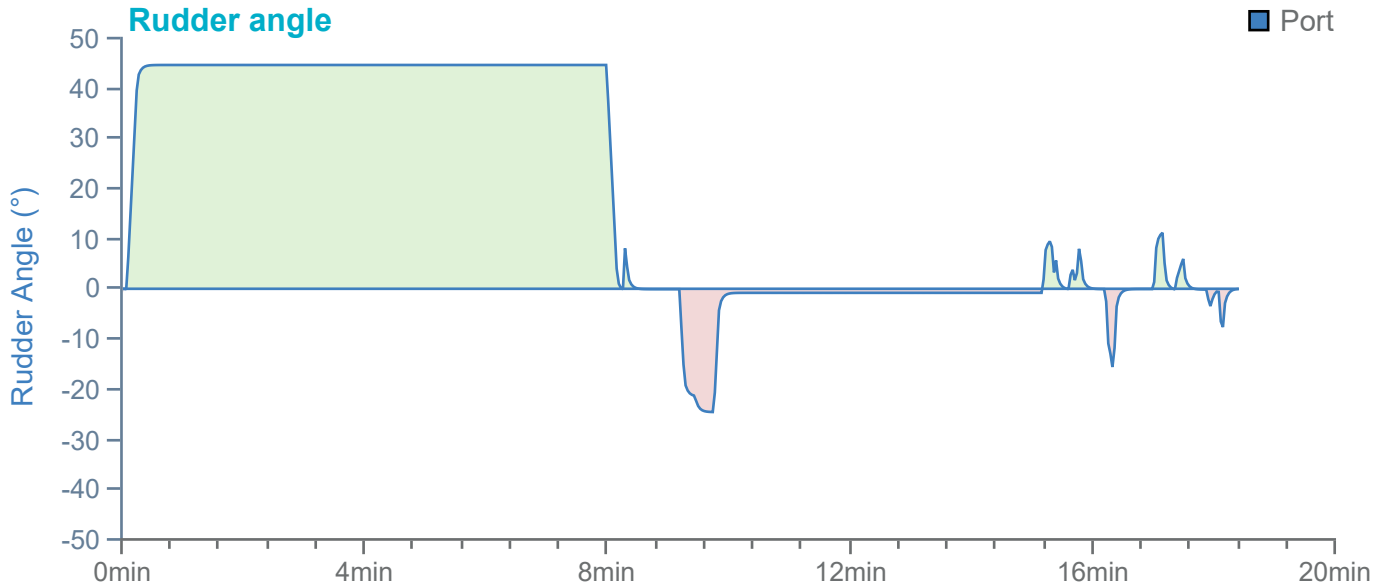
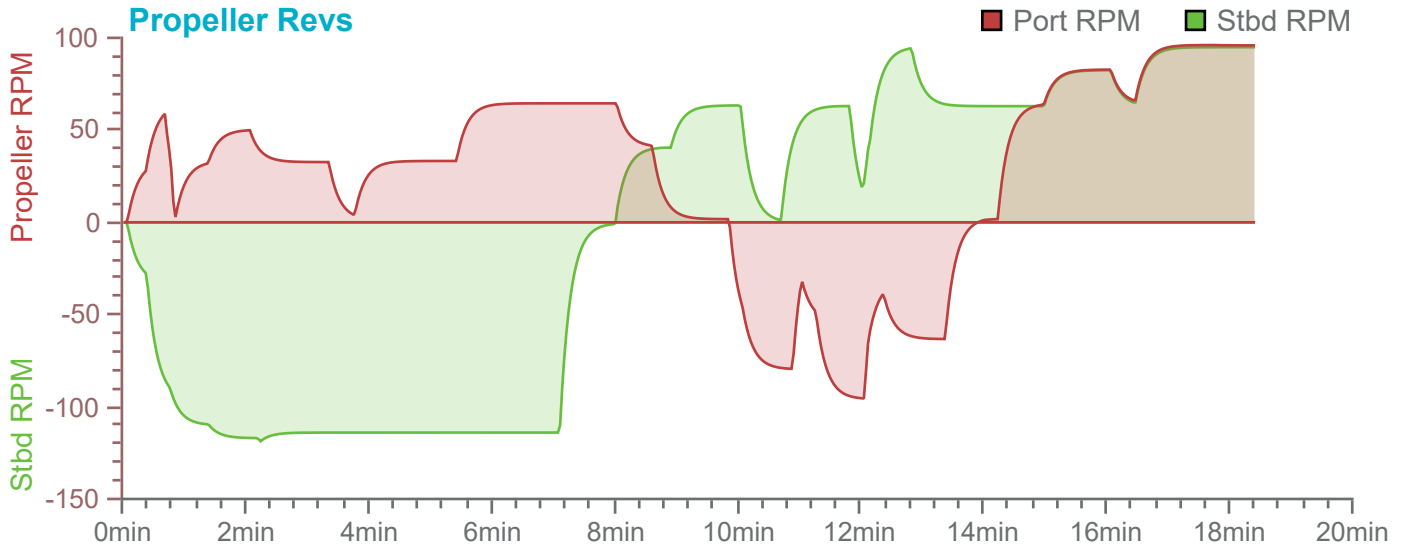


Overview

Environment

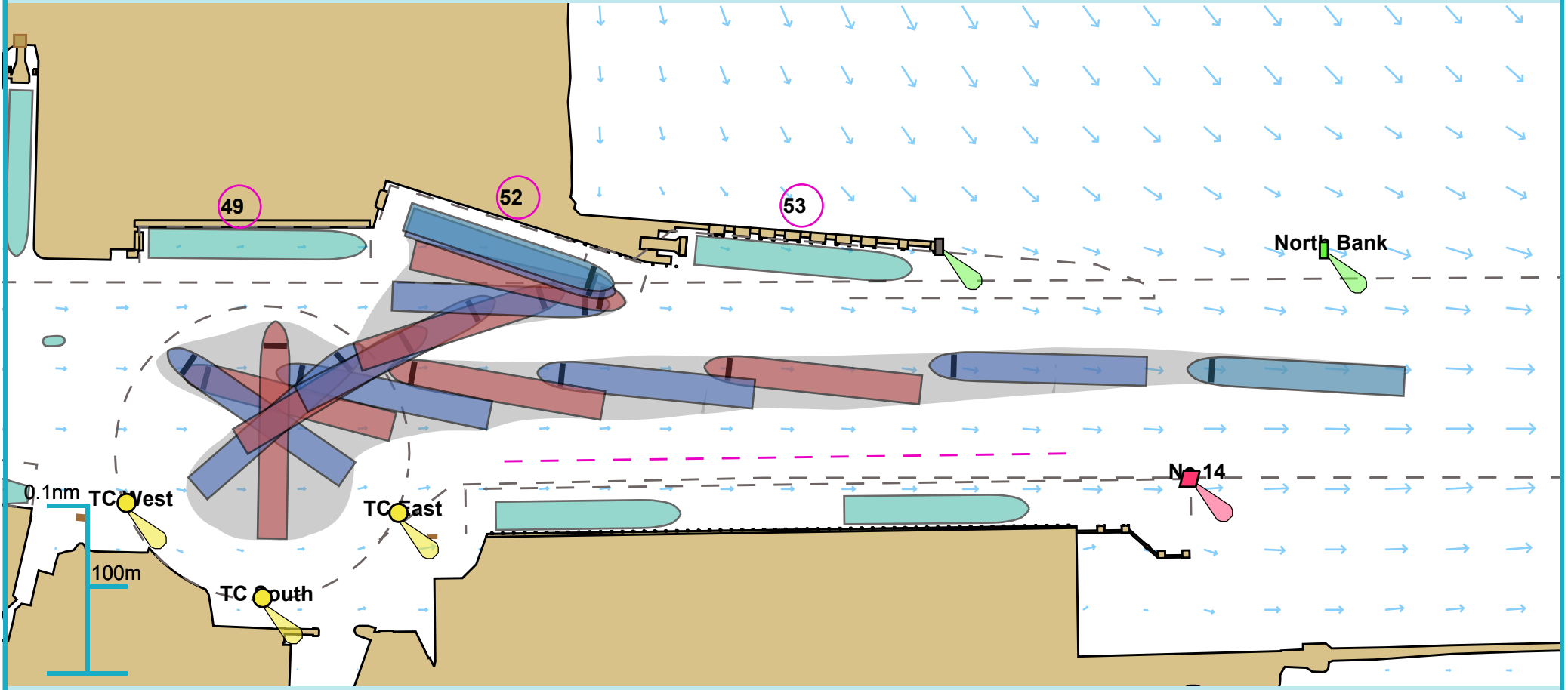
240m x 32m RoPax

Thruster and engine use



Full Run Overview

53° 20.403 N, 006° 11.902 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

Run length: 31 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

Comments:

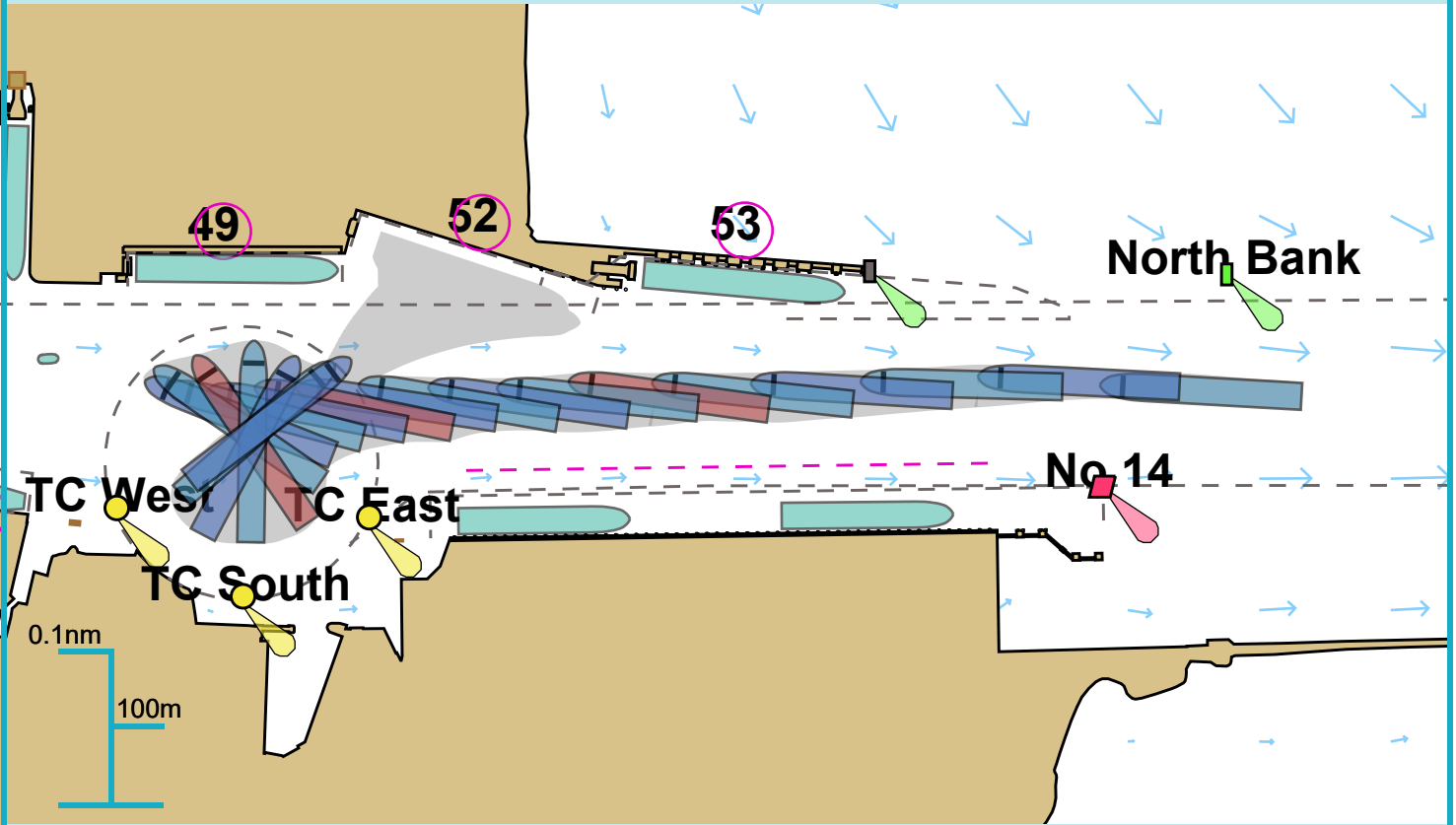
Overview

Environment

240m x 32m RoPax Ferry

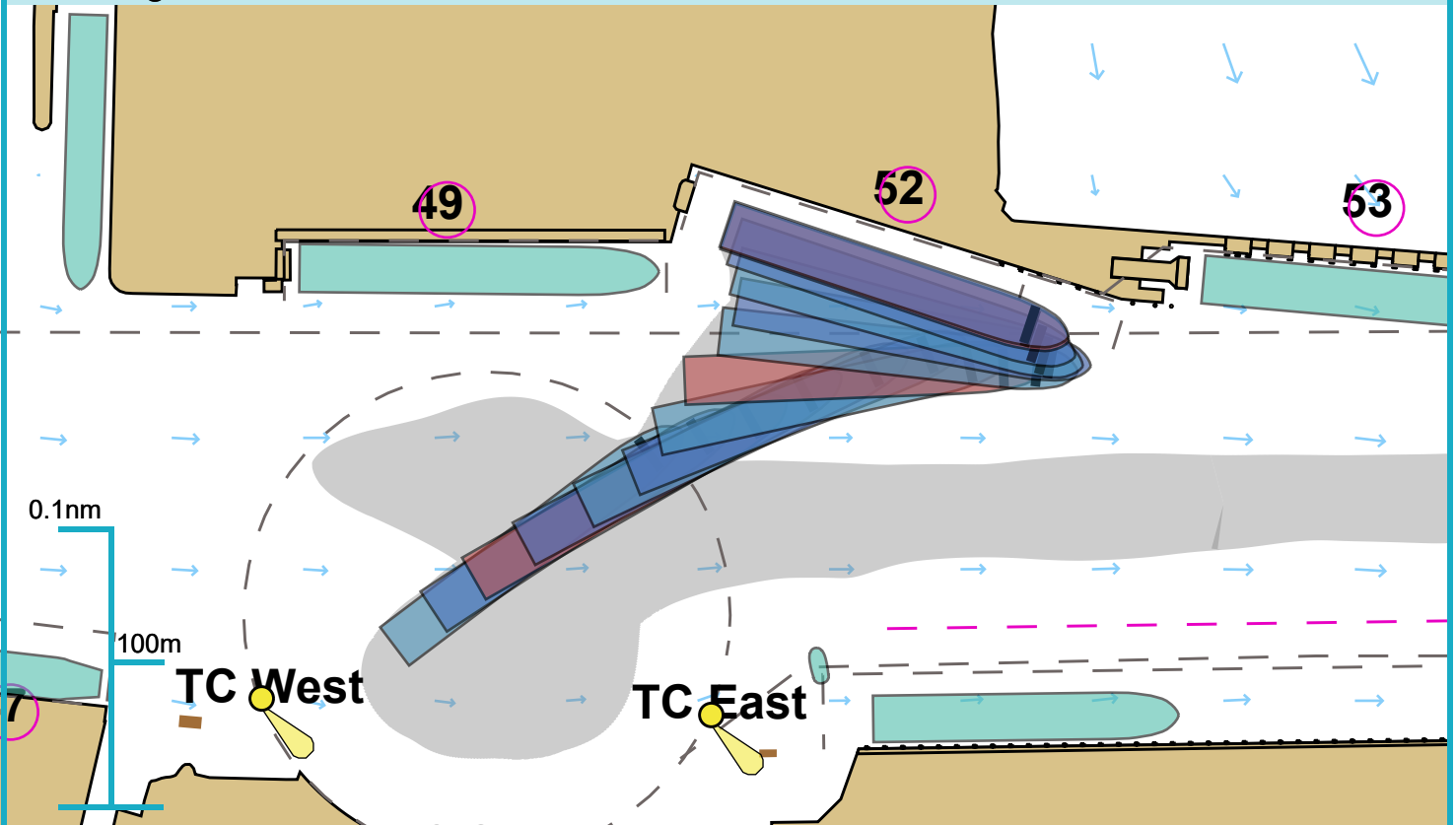
Thruster and engine use

Approach



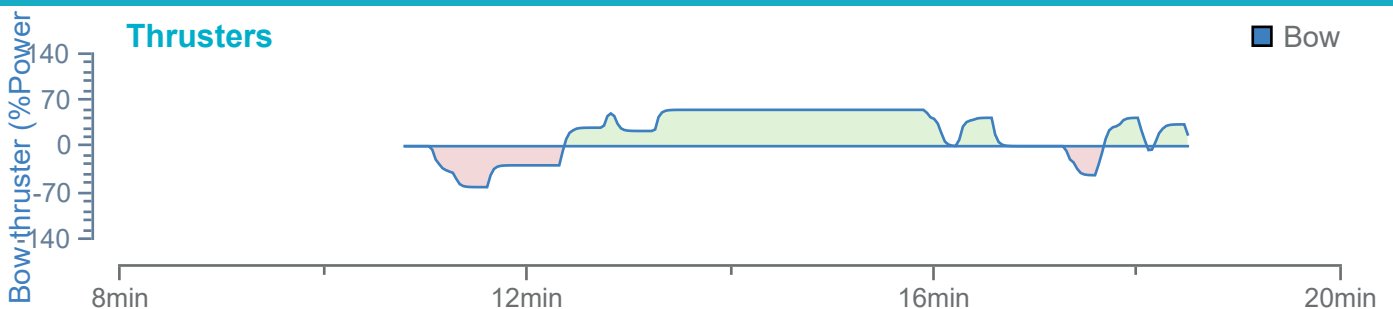
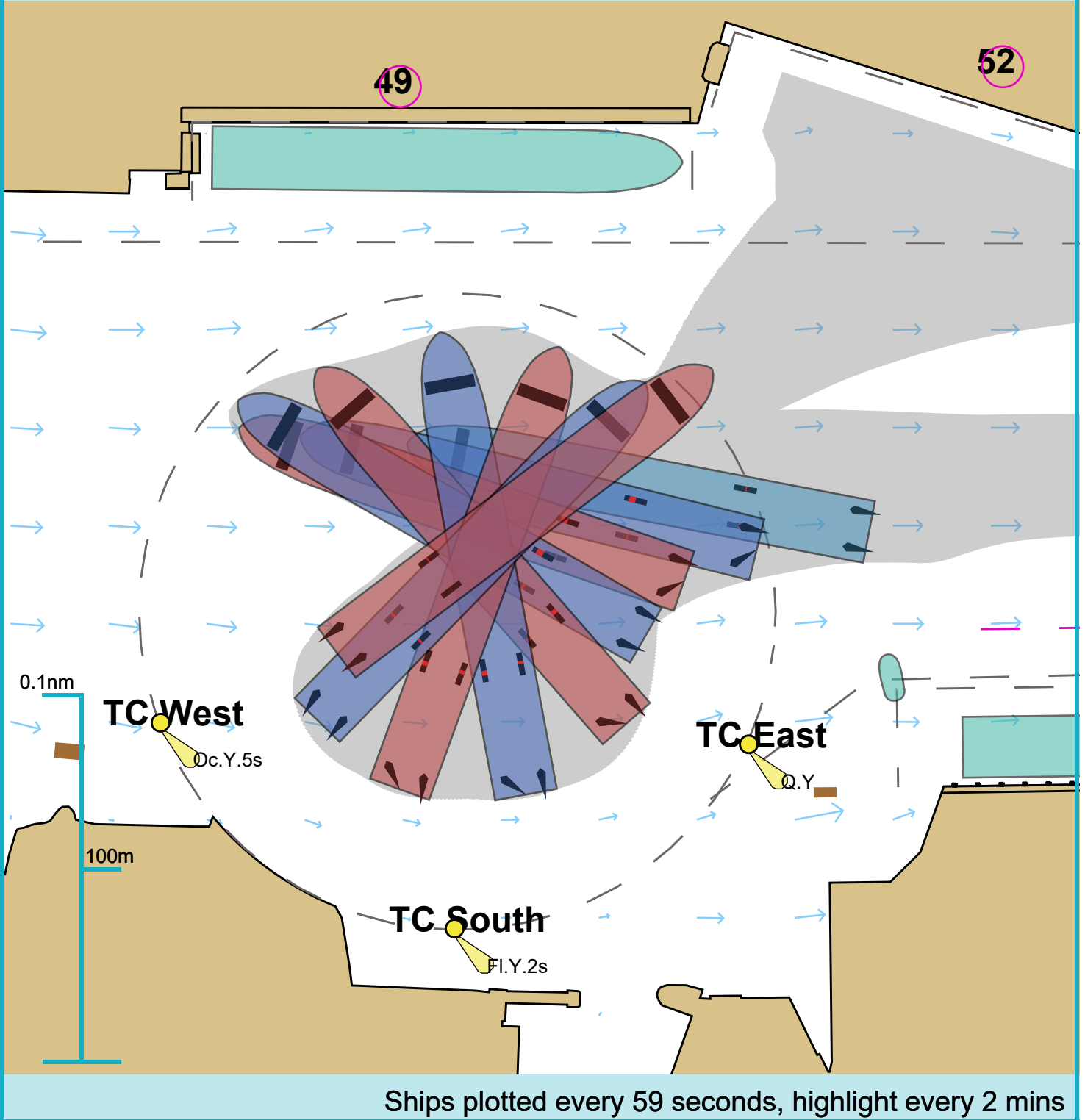
Ships plotted every 1 mins, highlight every 5 mins

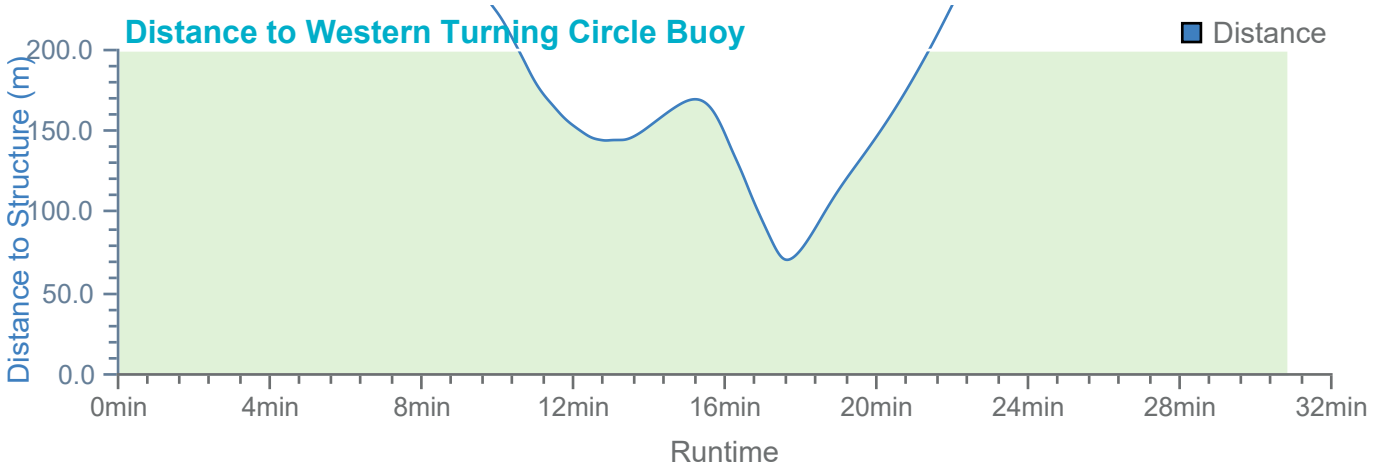
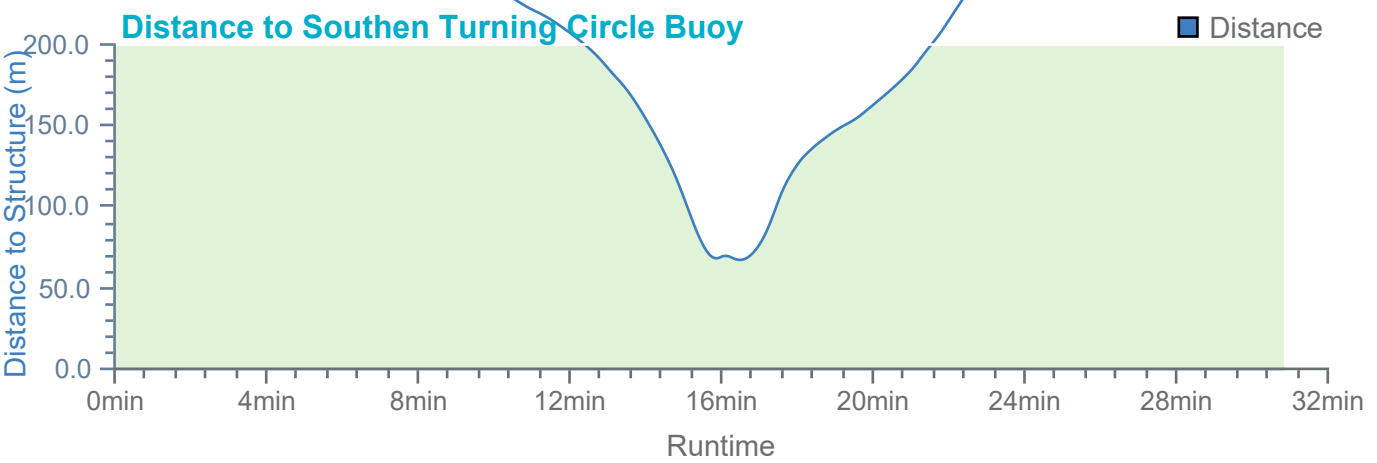
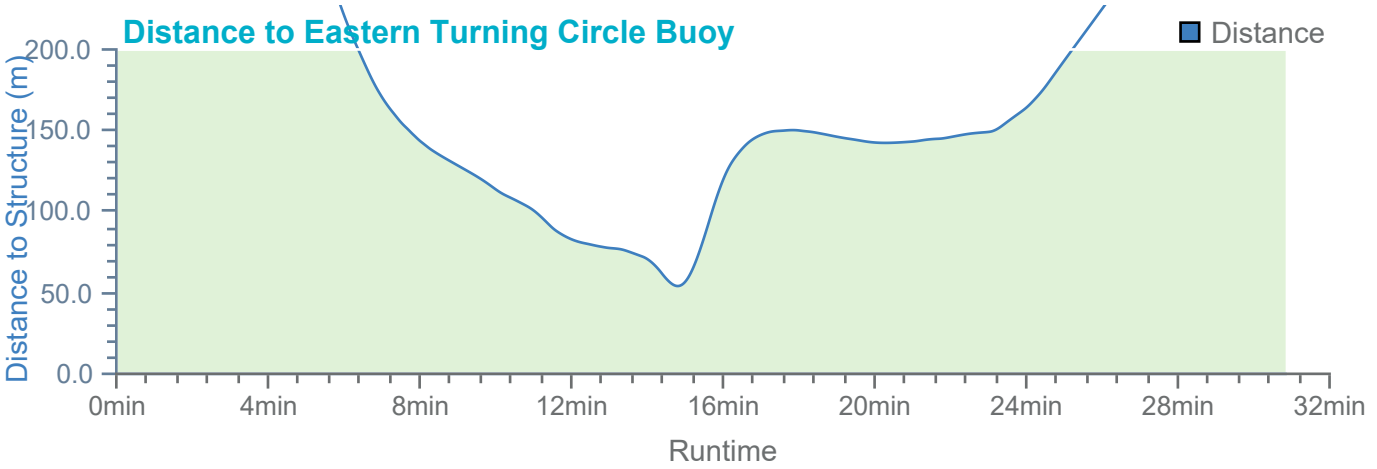
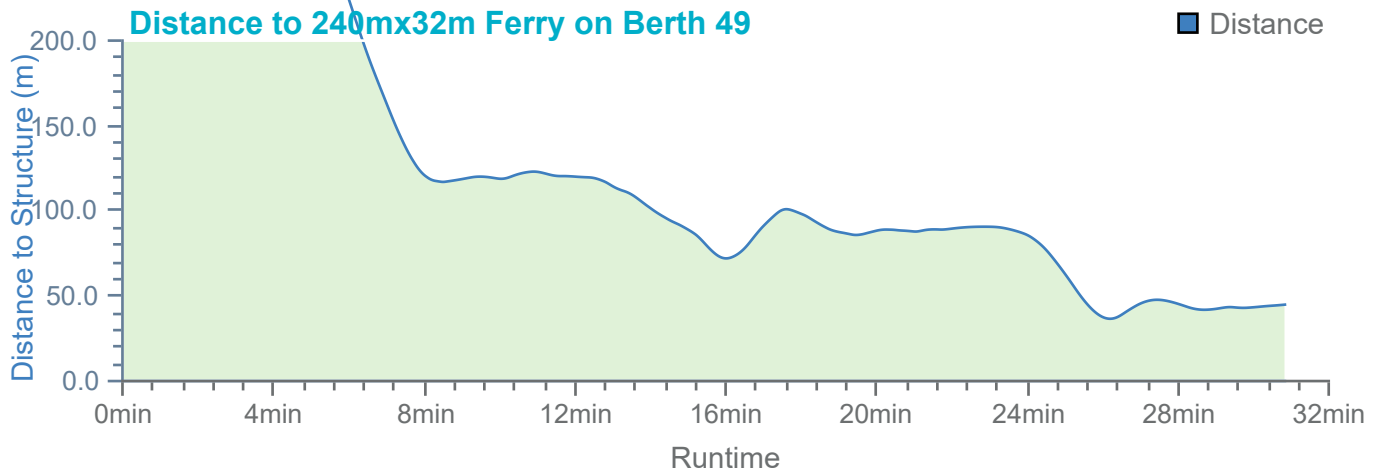
Berthing



Ships plotted every 1 mins, highlight every 5 mins

Swing



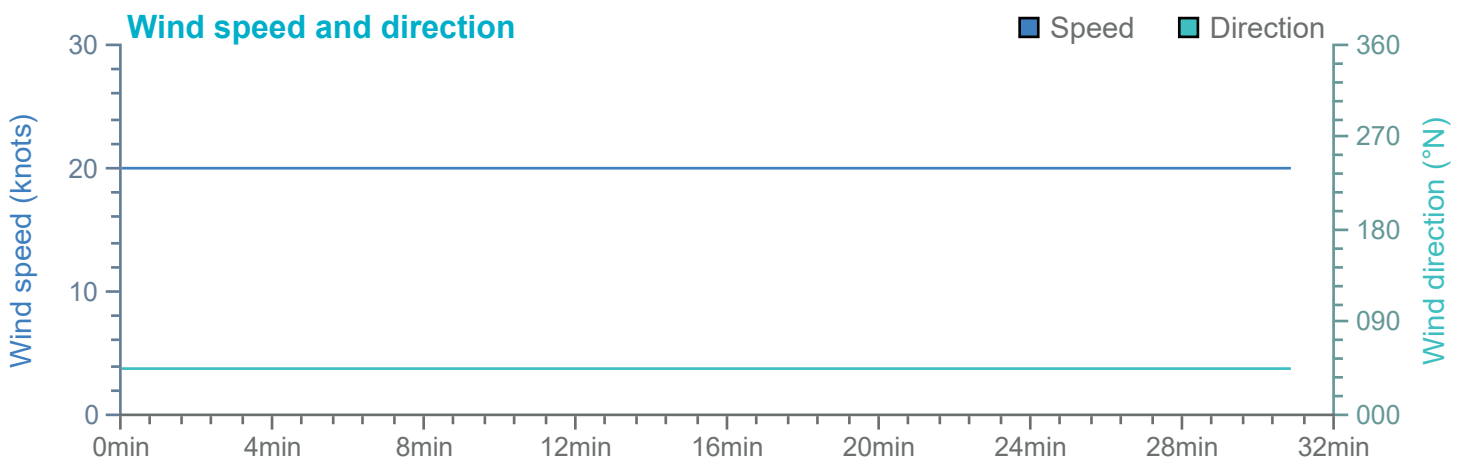
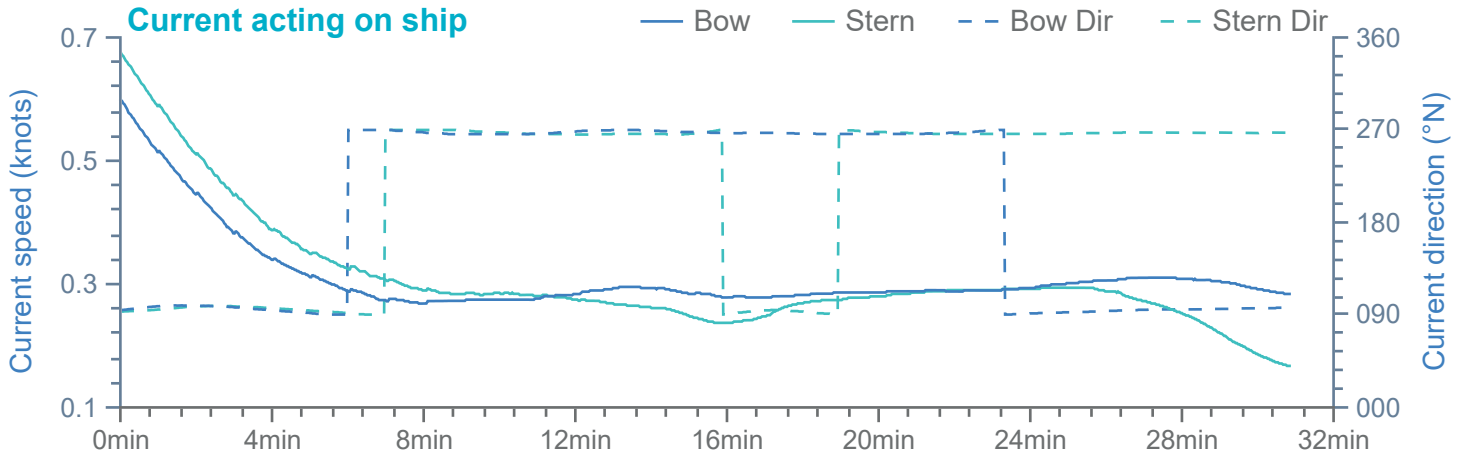


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

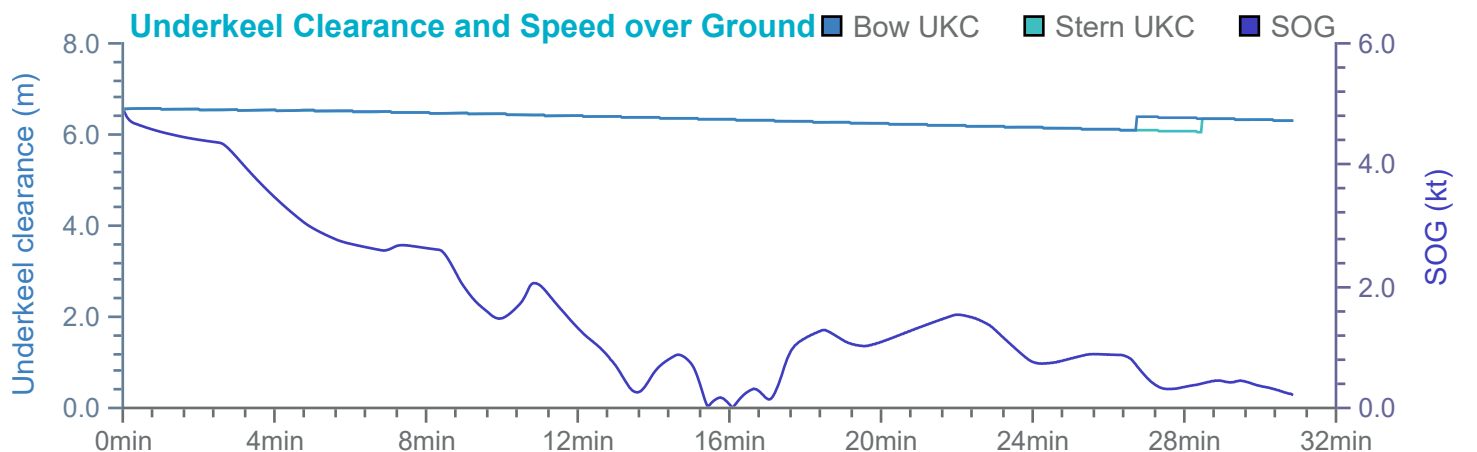
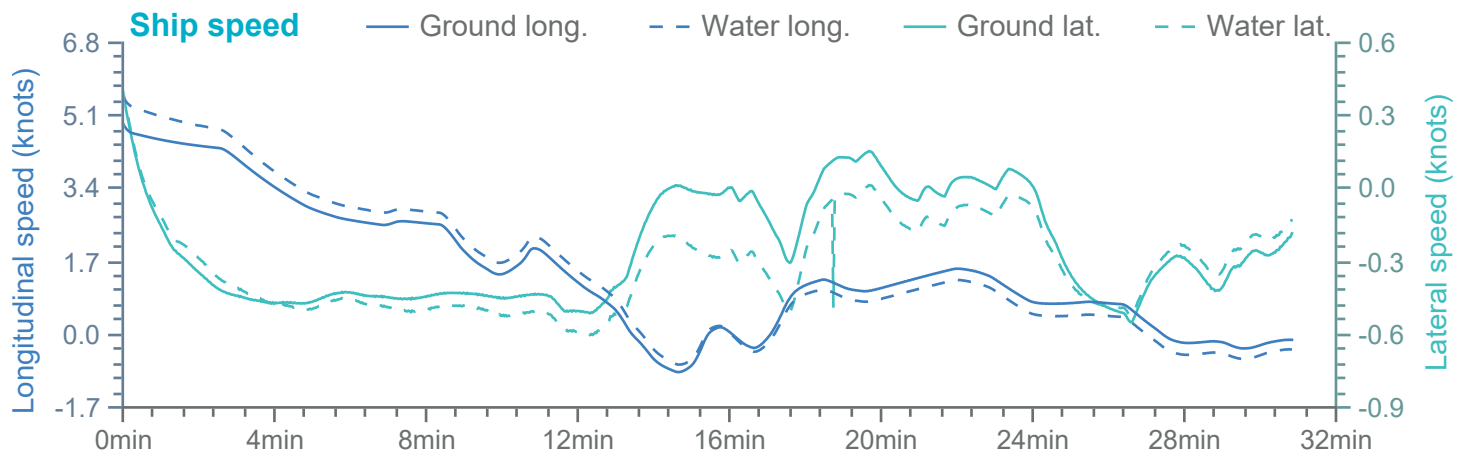
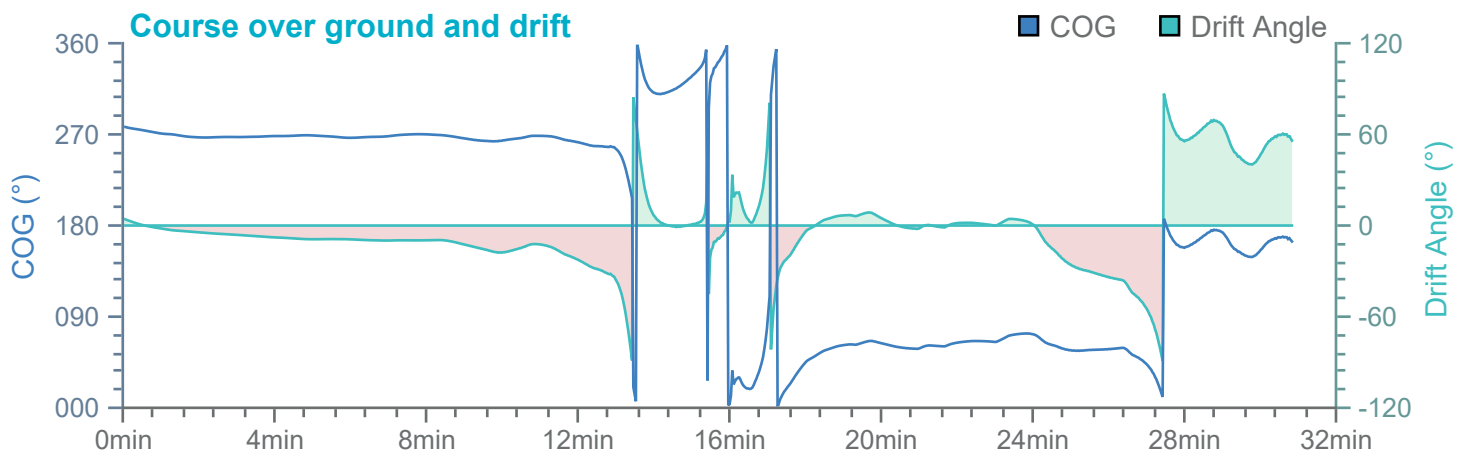
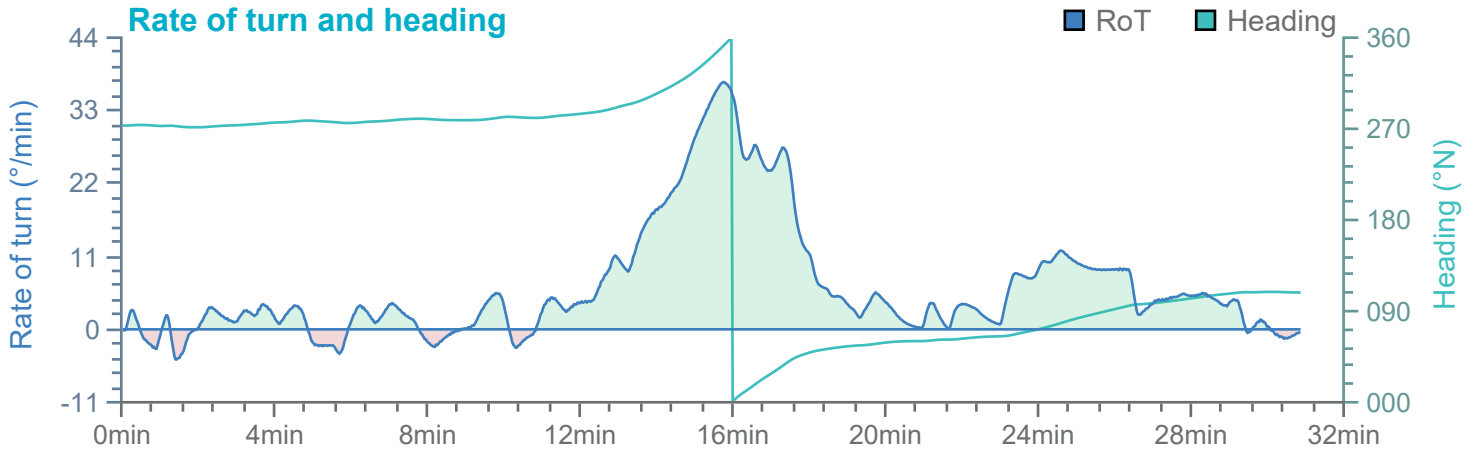


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

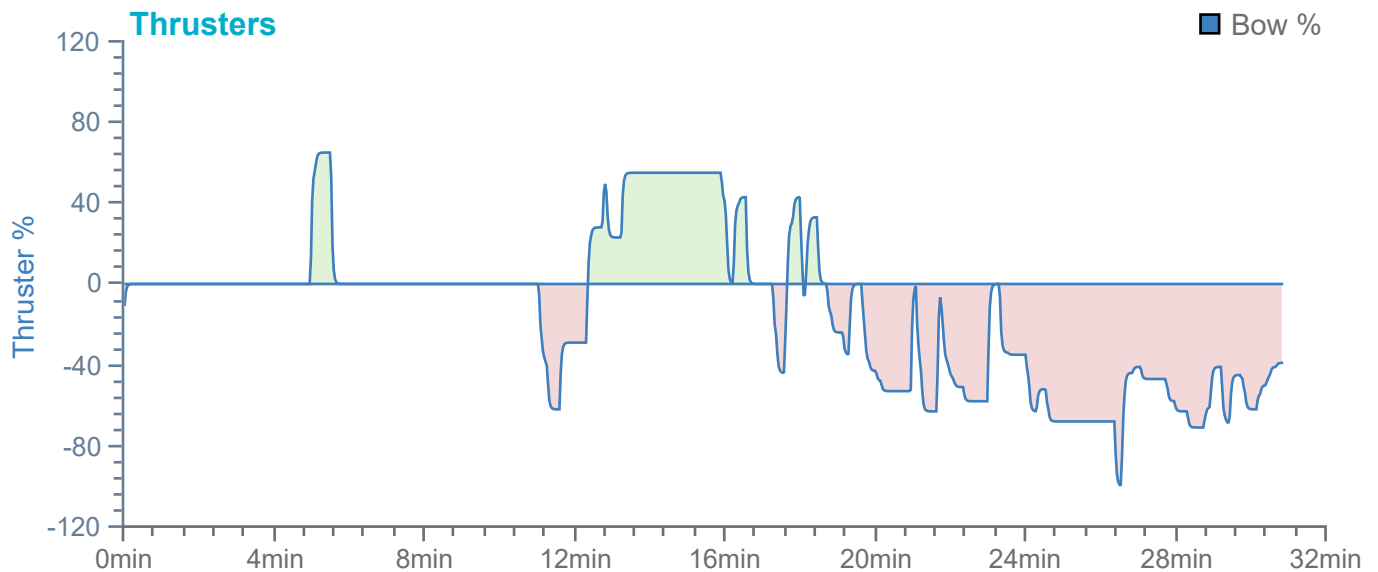
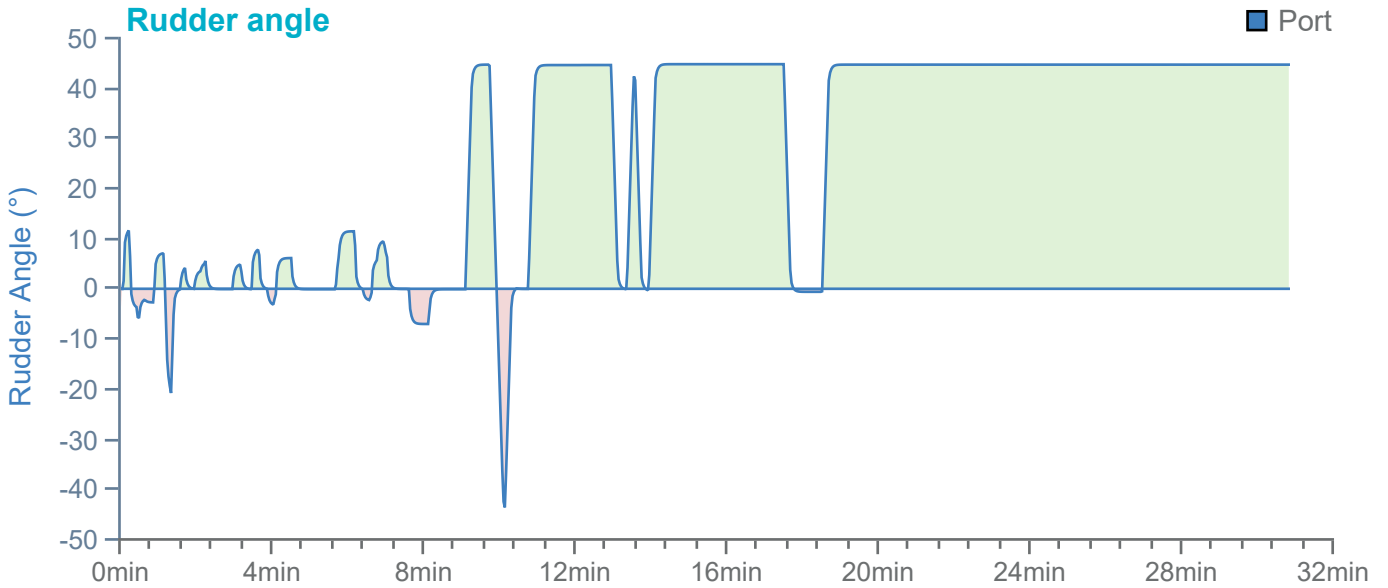
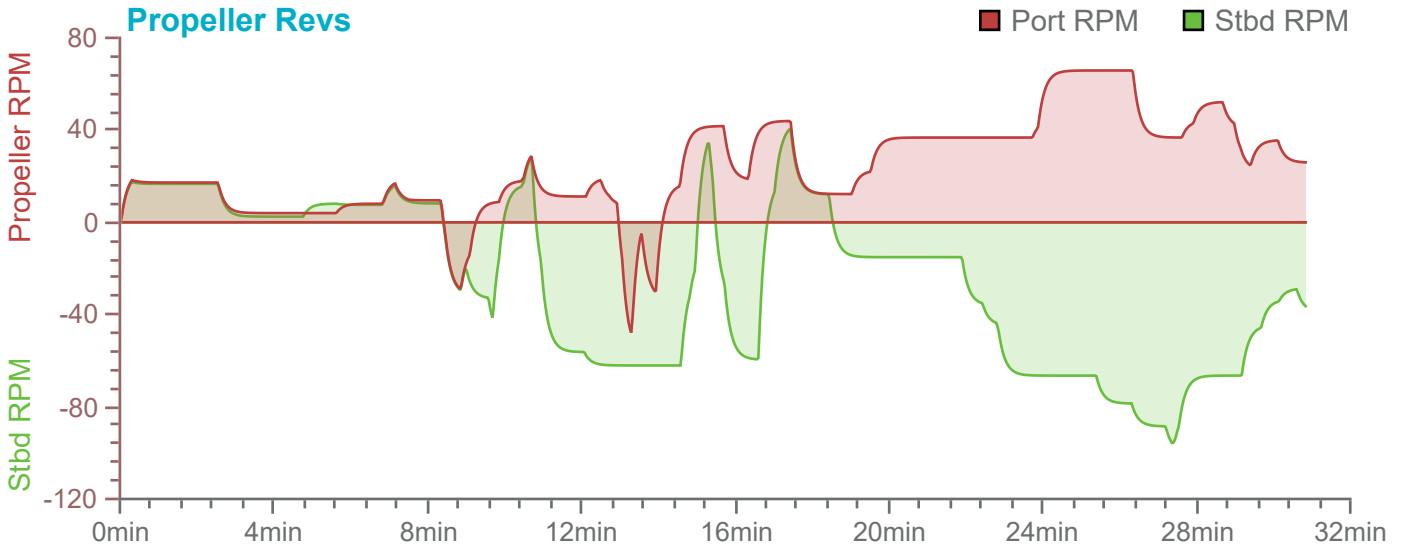


Overview

Environment

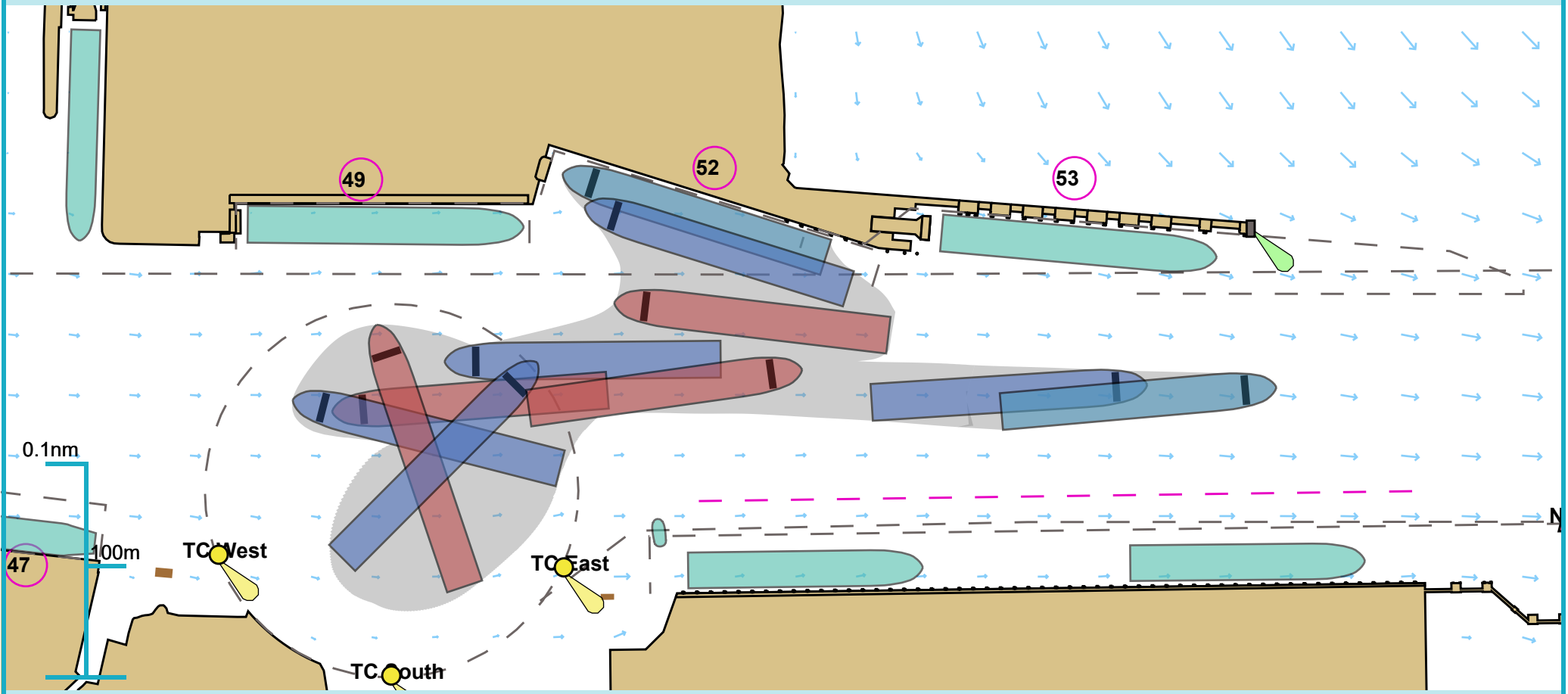
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.455 N, 006° 11.950 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

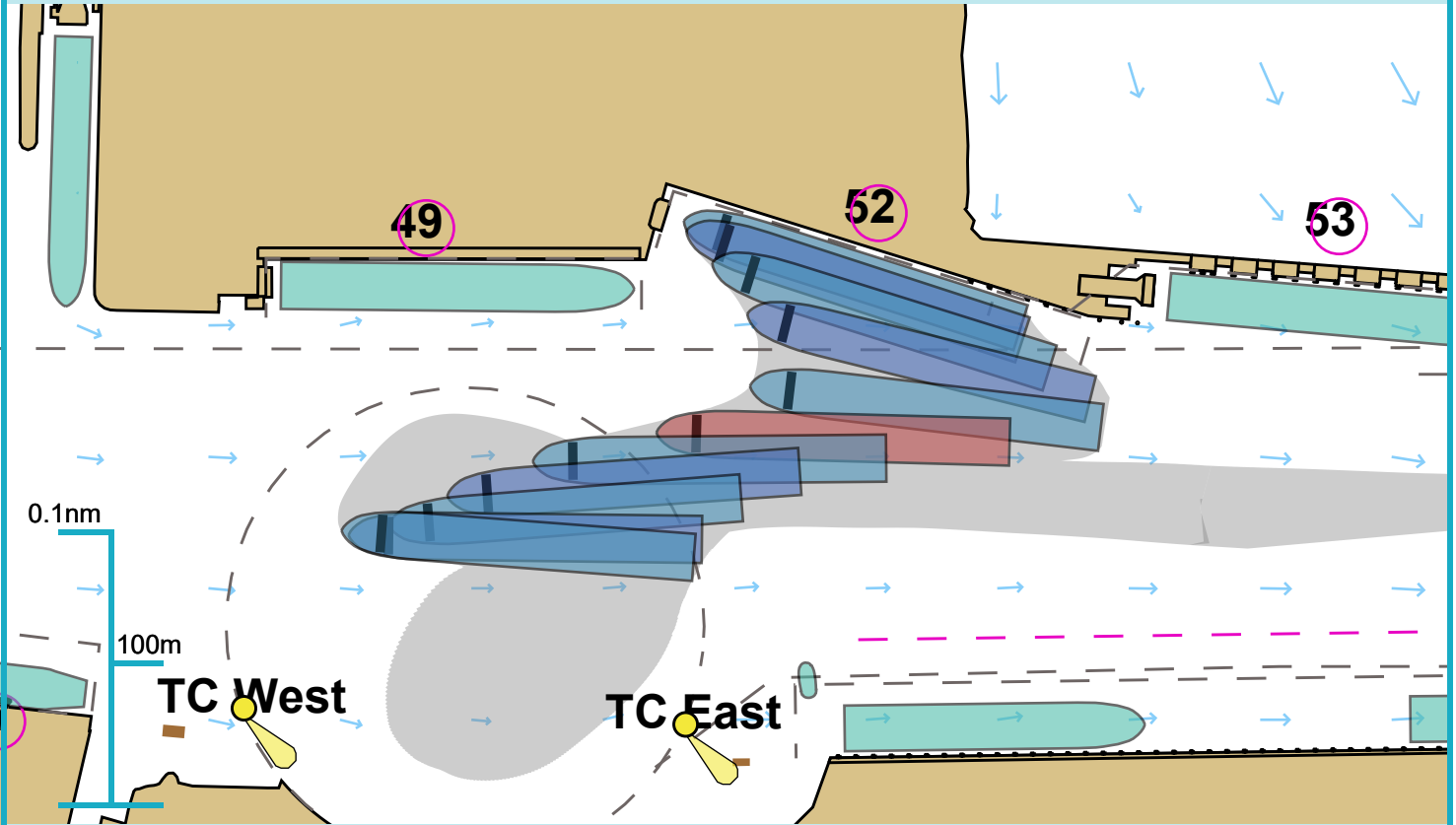
Run length: 19 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

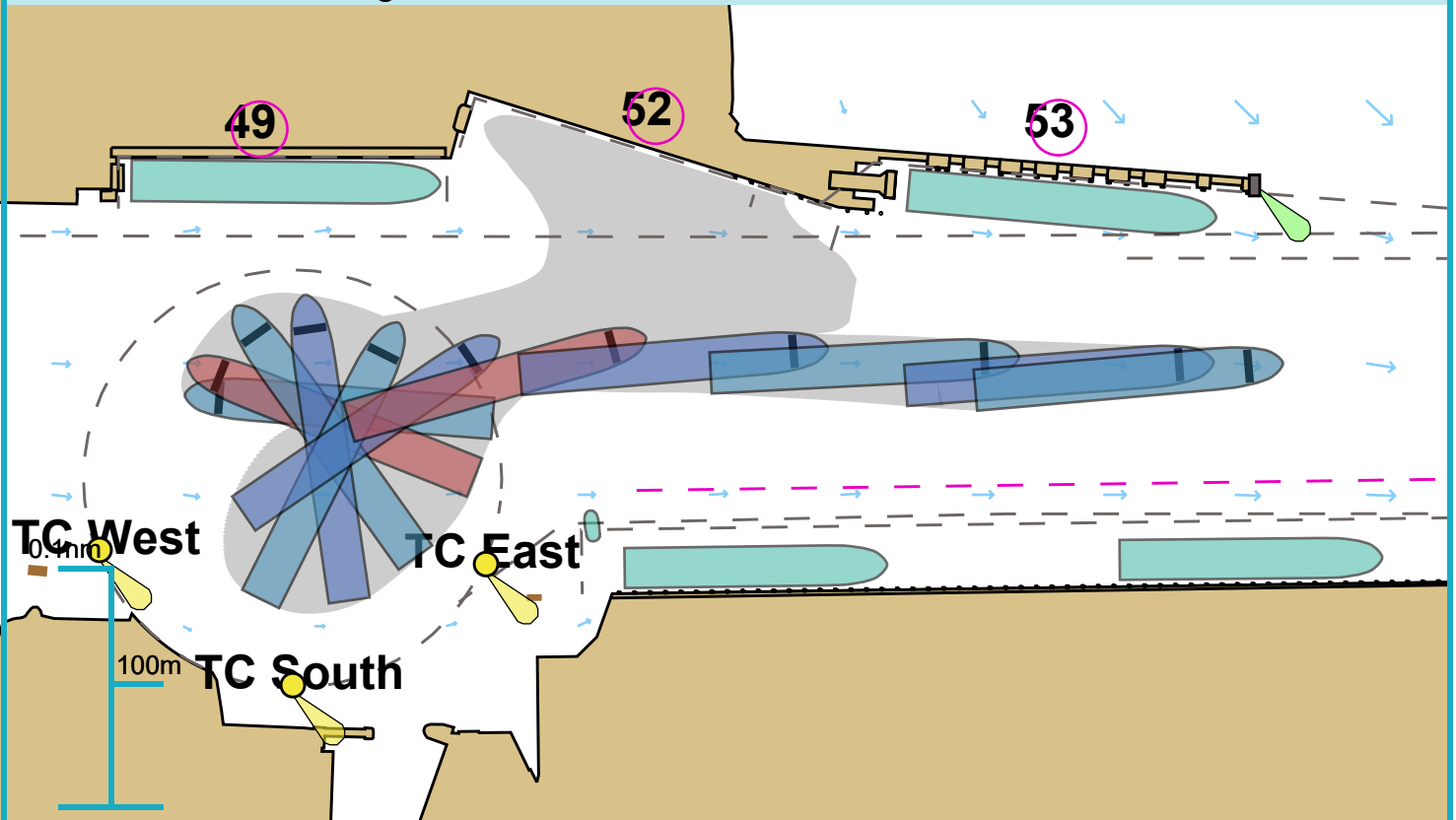
Comments:

Departure



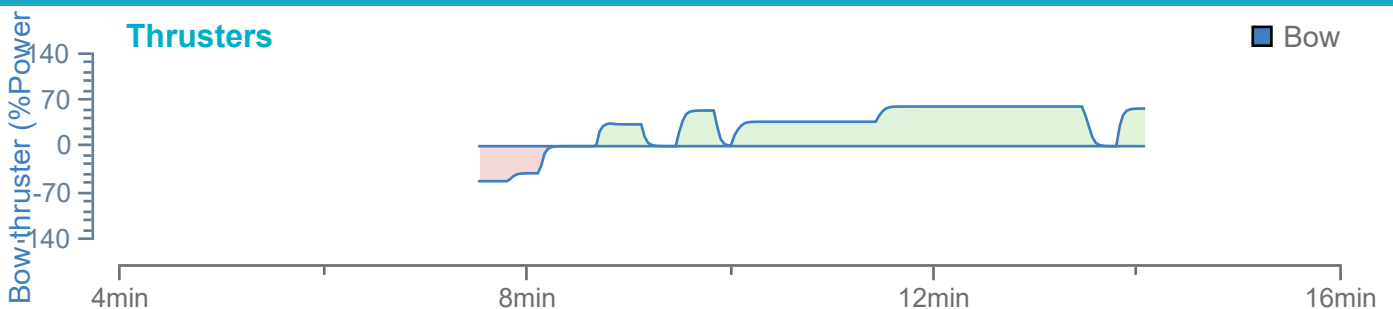
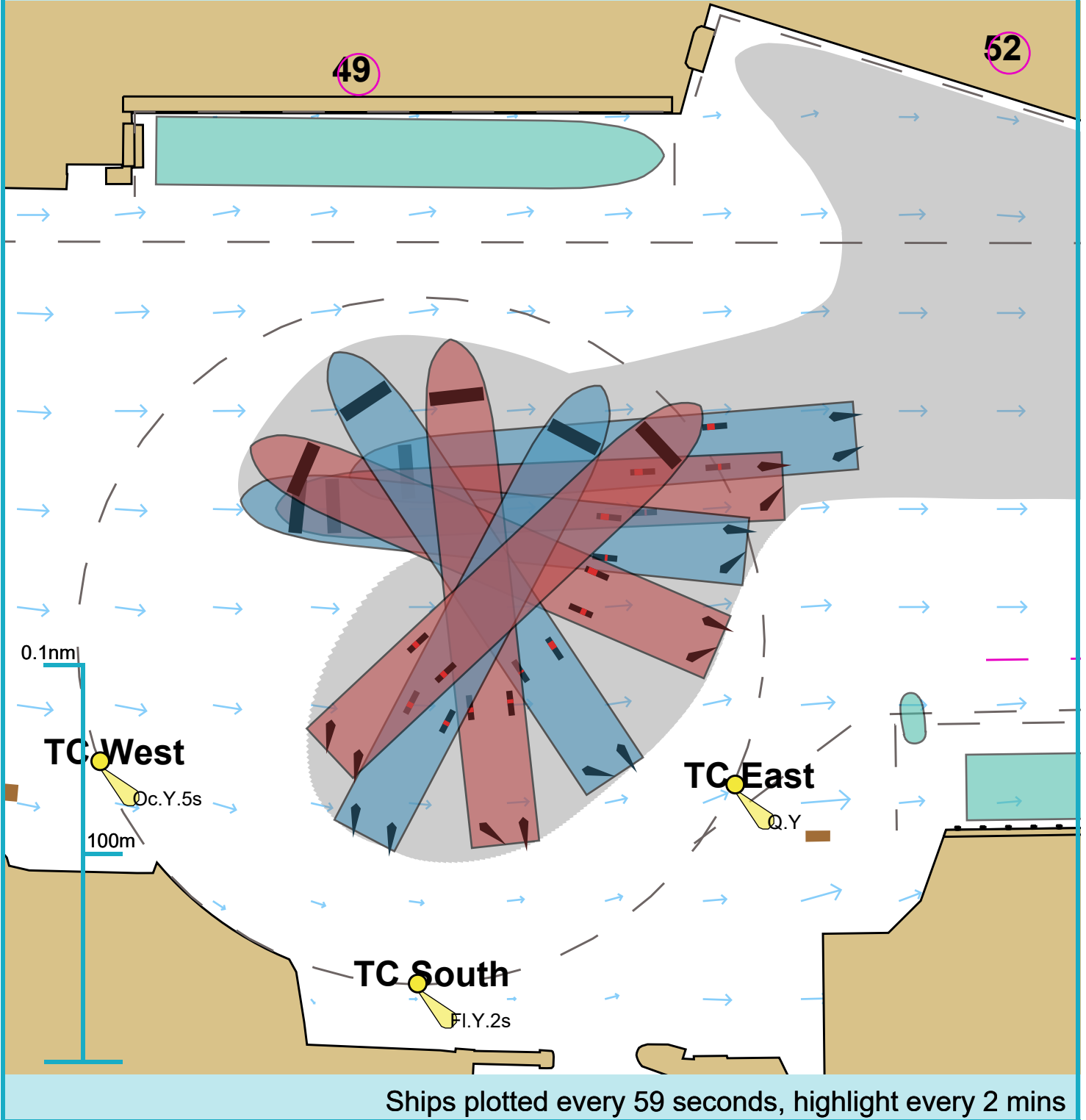
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage



Ships plotted every 1 mins, highlight every 5 mins

Swing

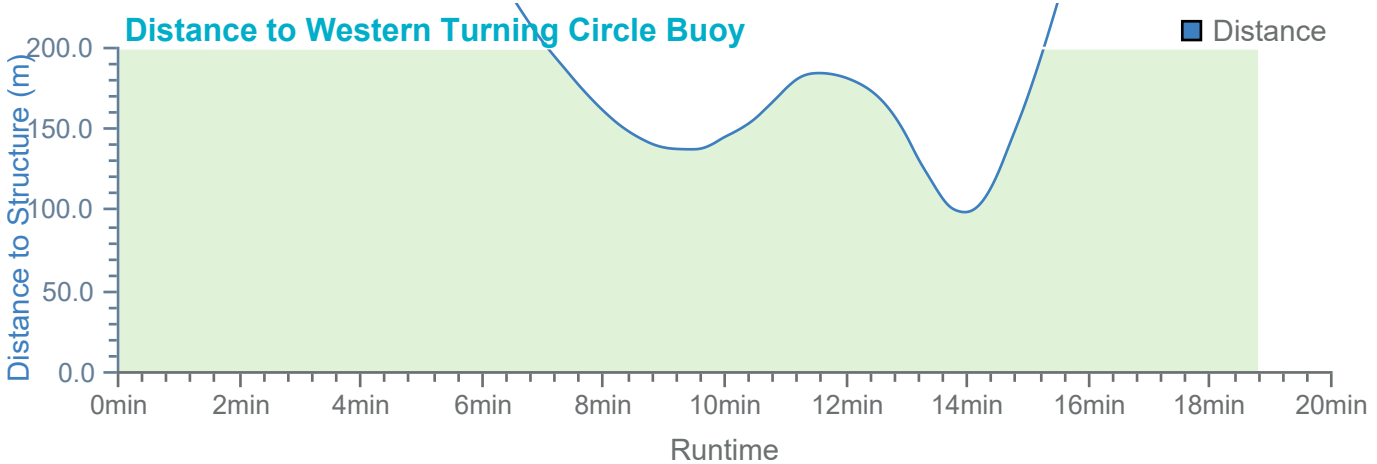
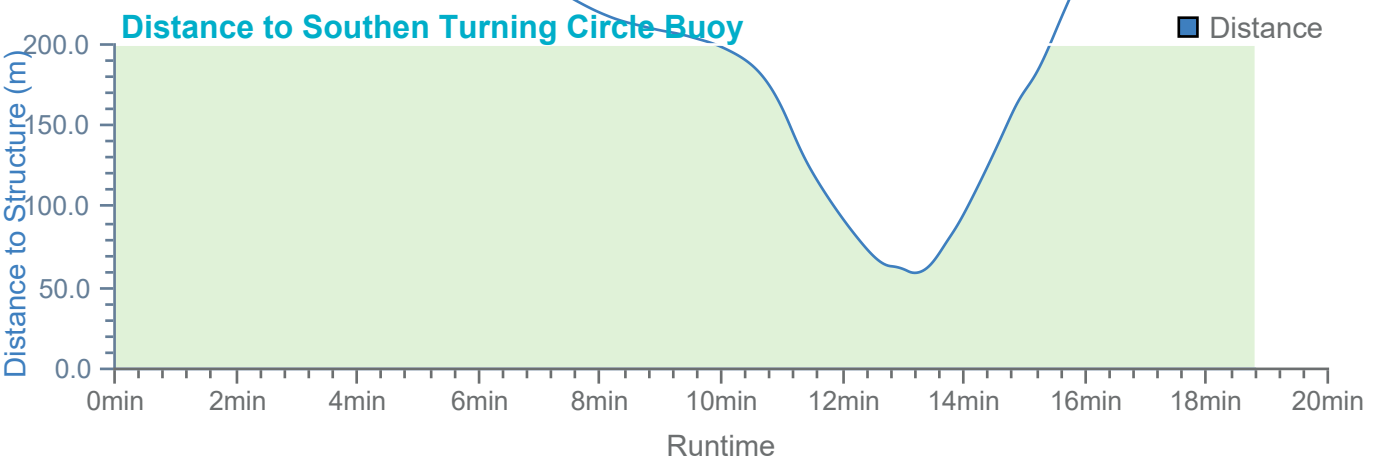
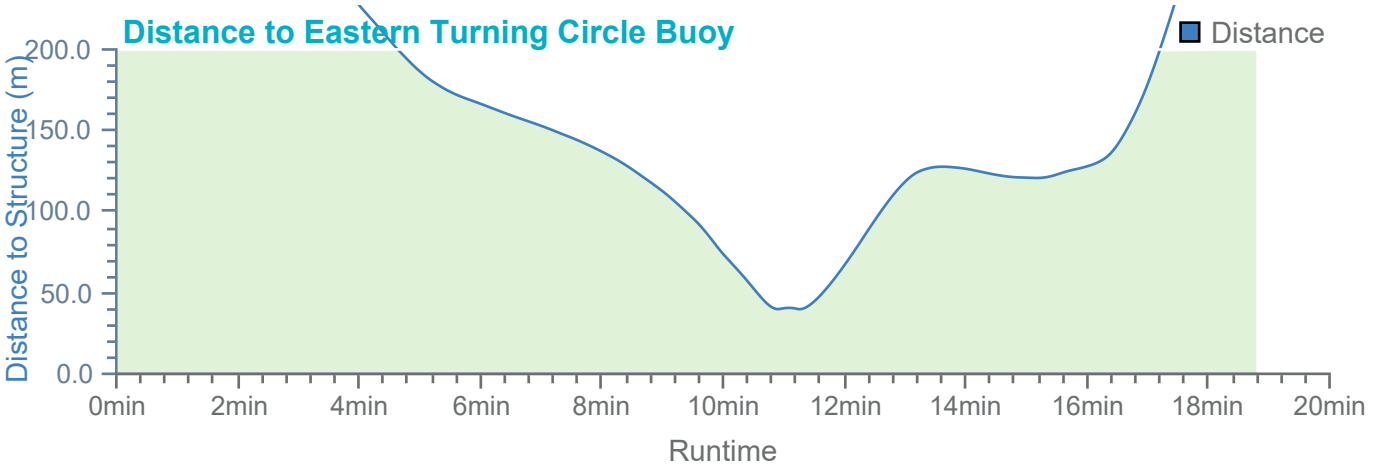
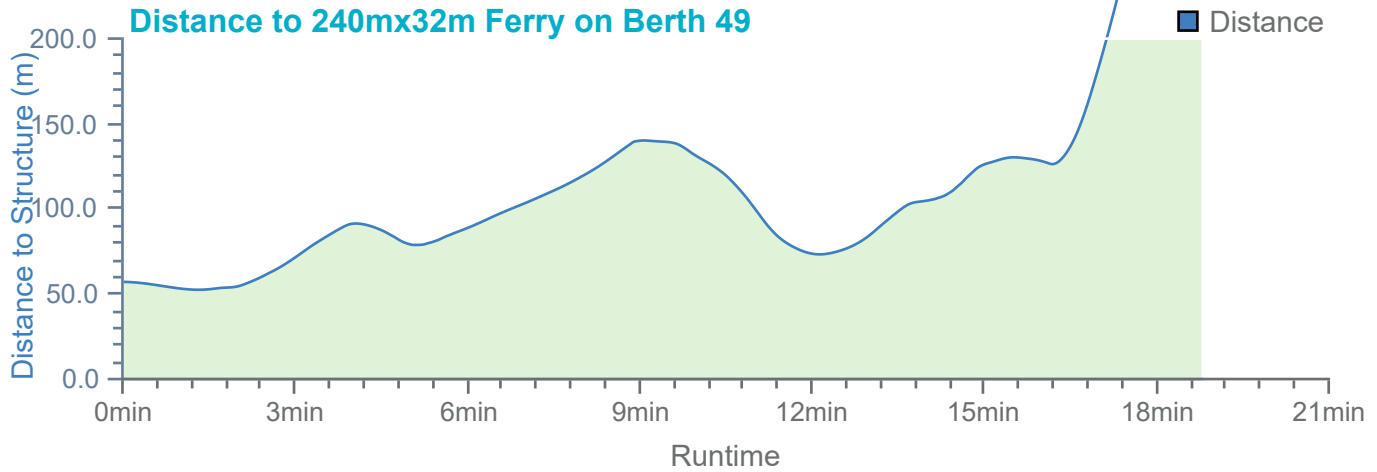


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

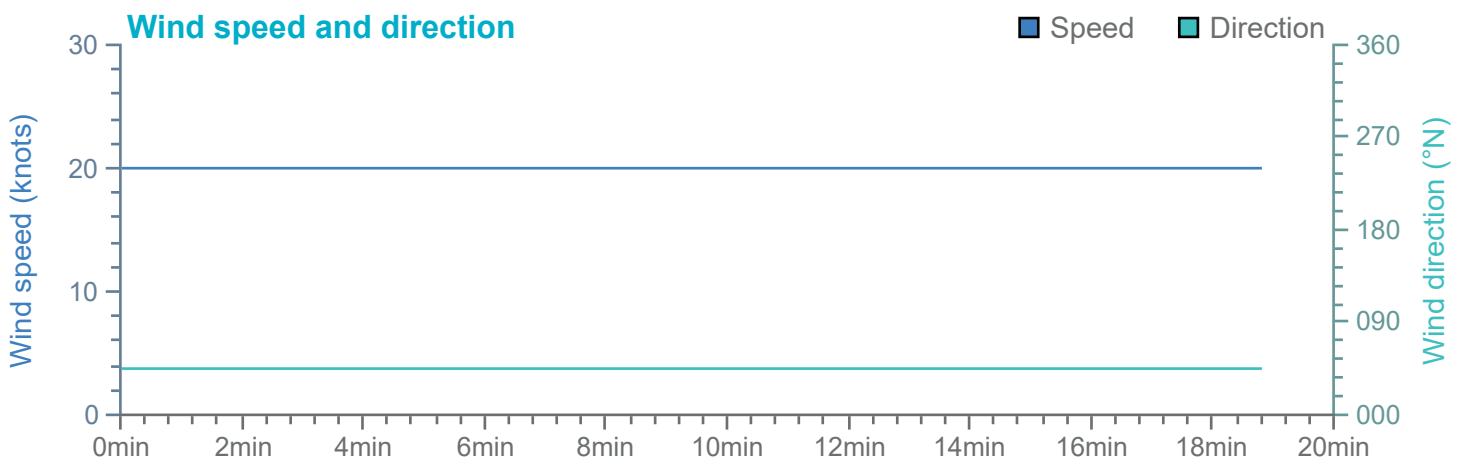
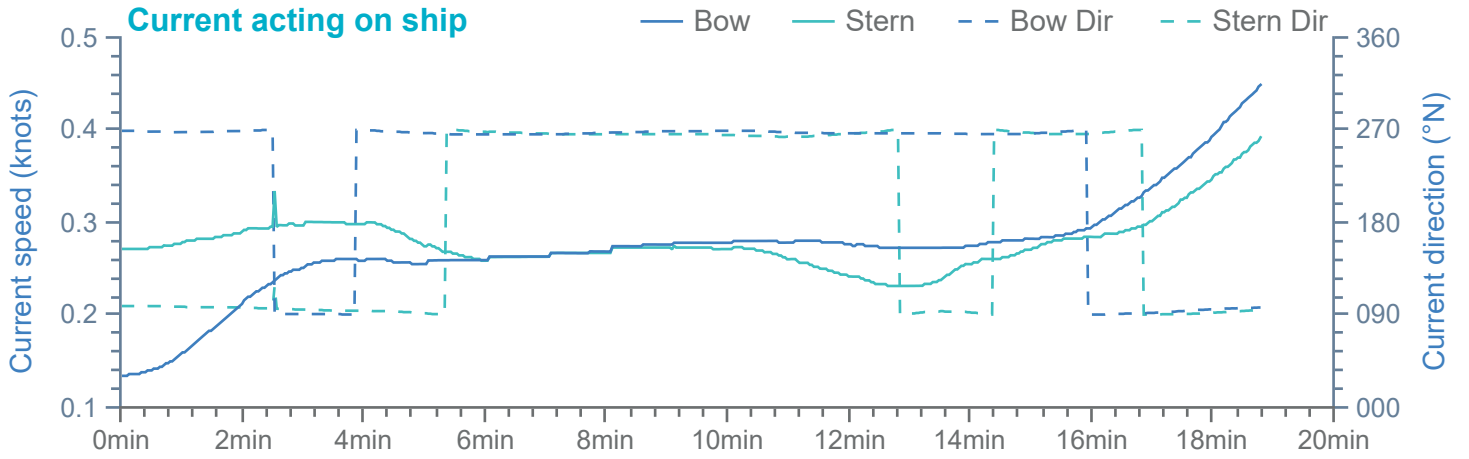


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

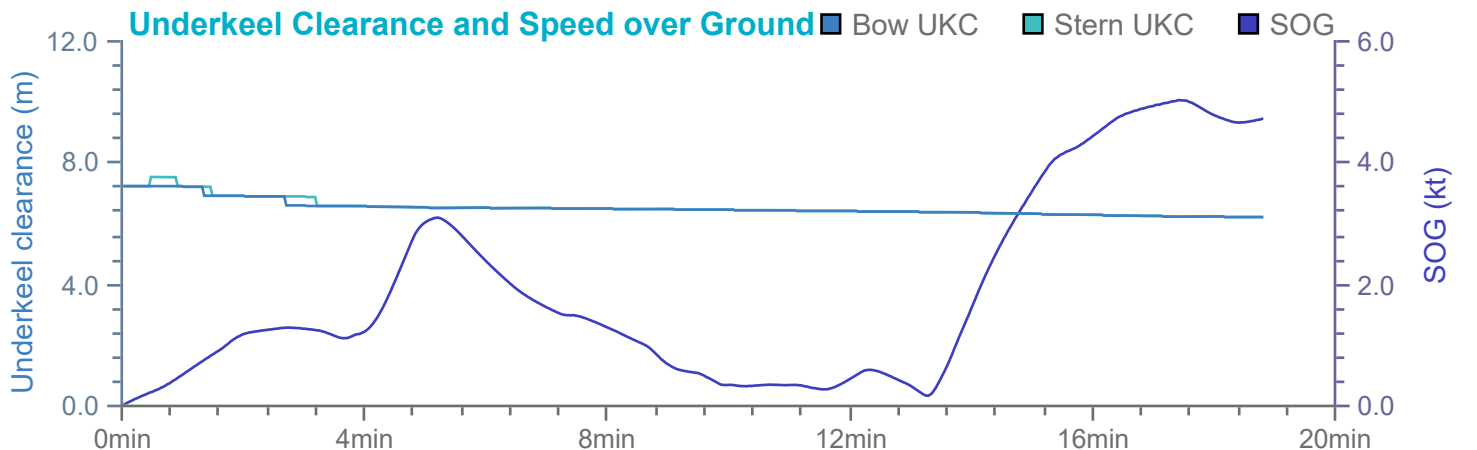
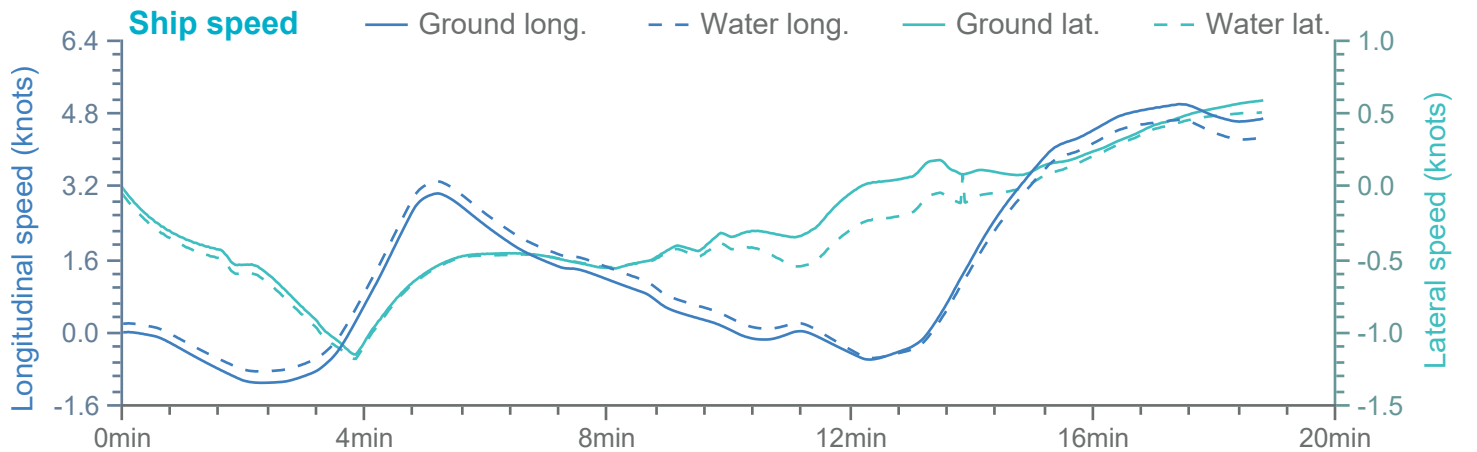
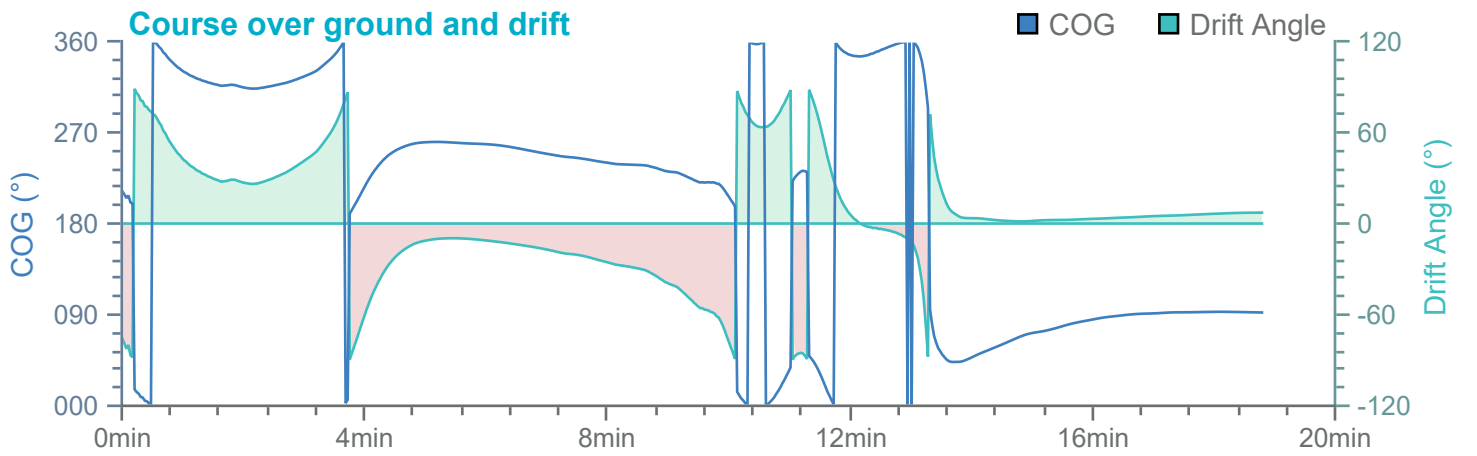
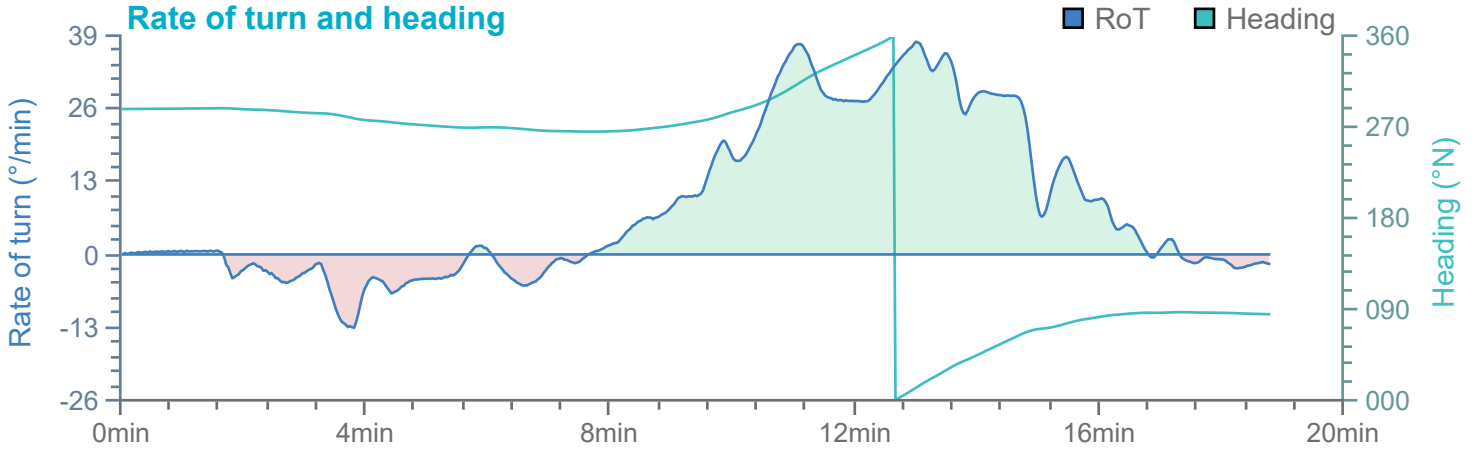


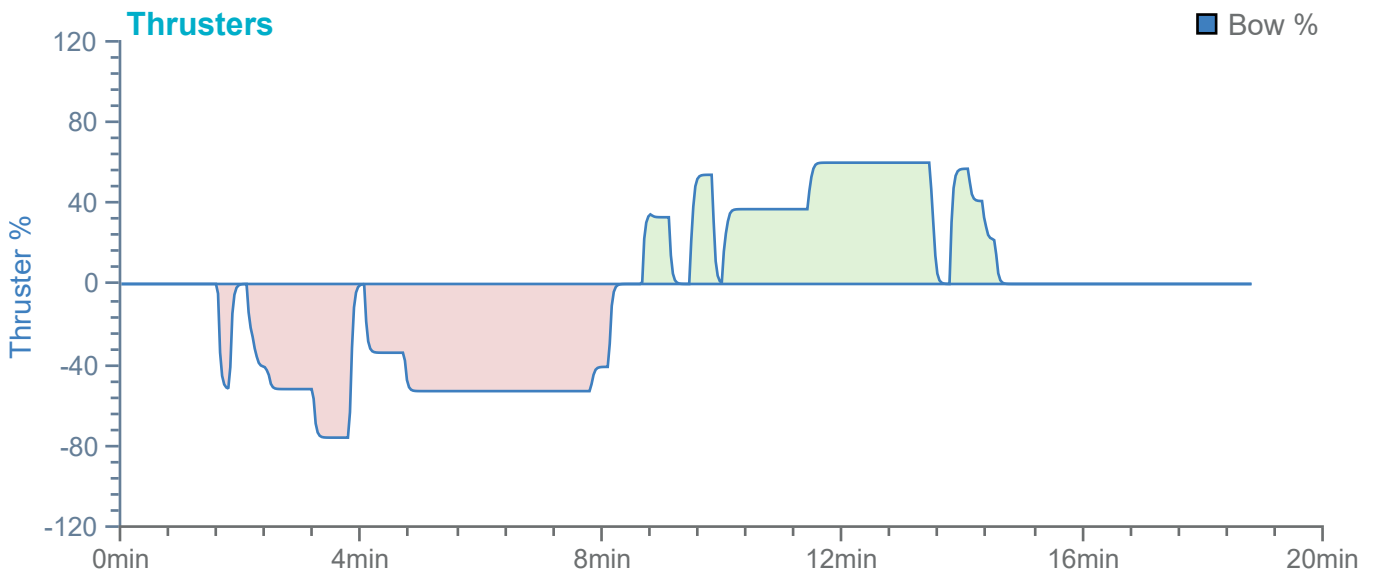
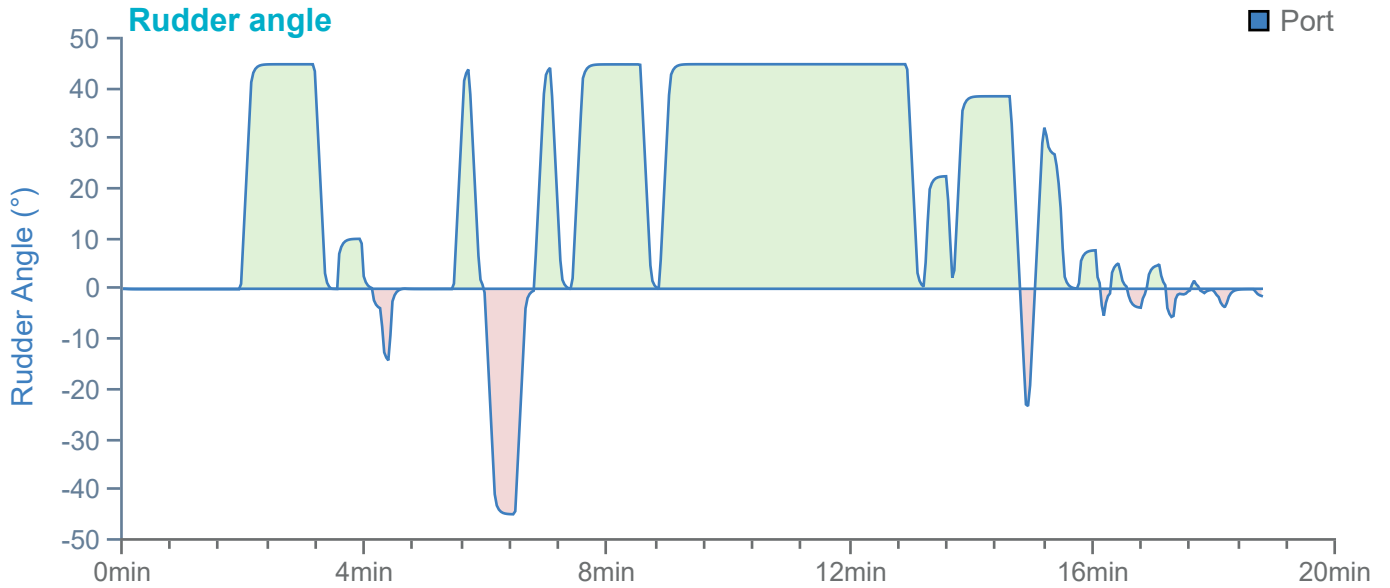
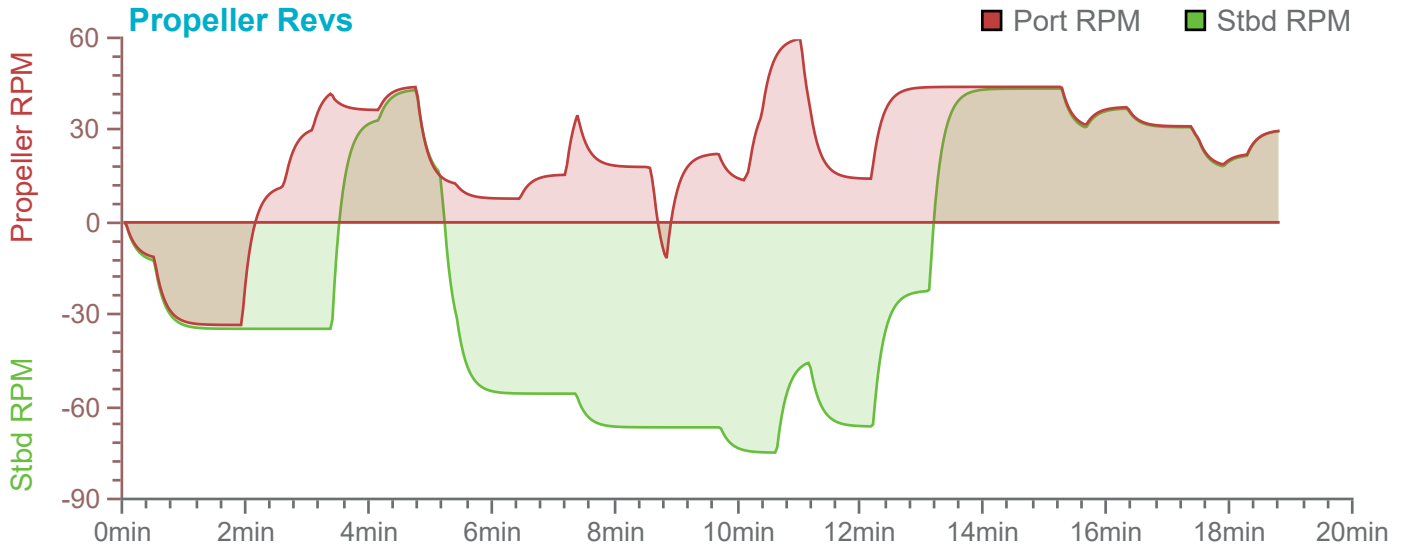
Overview

Environment

240m x 32m RoPax Ferry

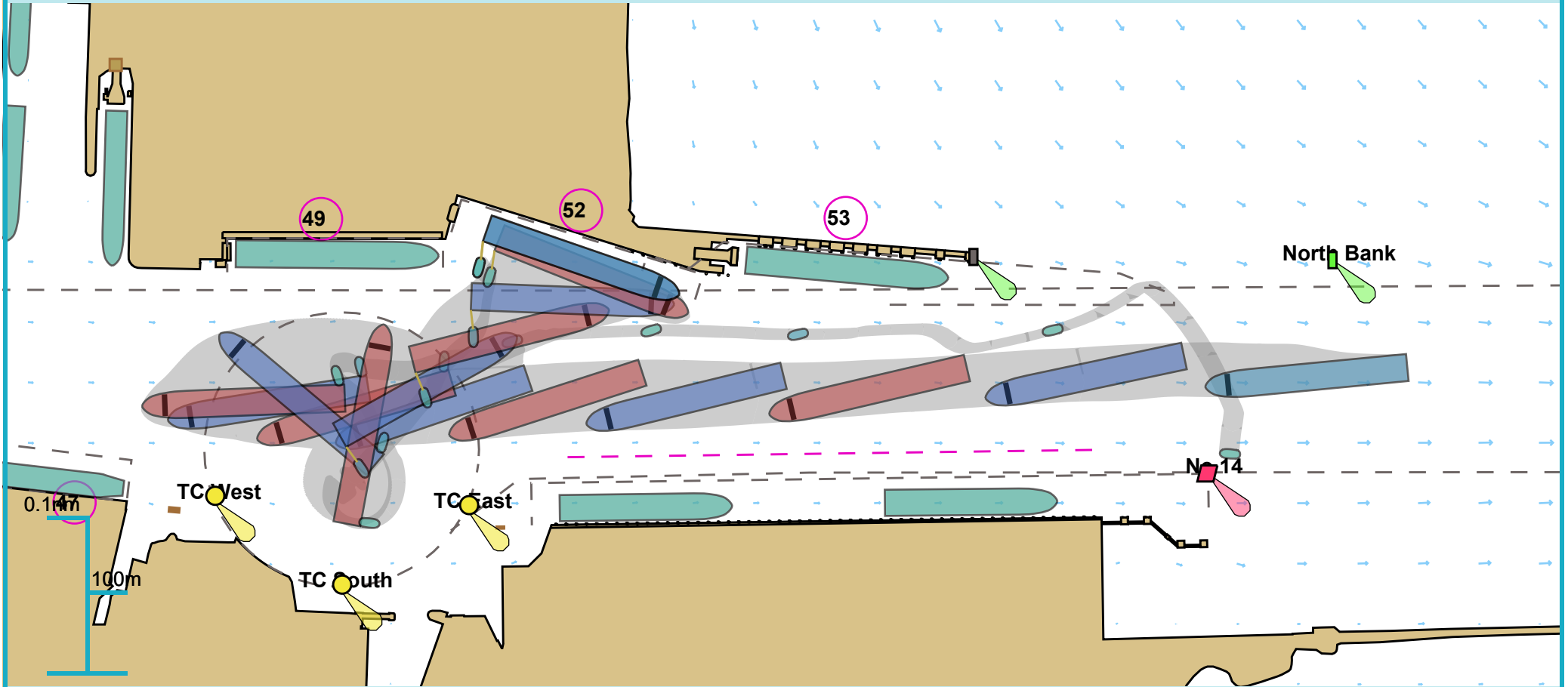
Thruster and engine use





Full Run Overview

53° 20.389 N, 006° 12.005 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

Run length: 30 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

Comments:

Overview

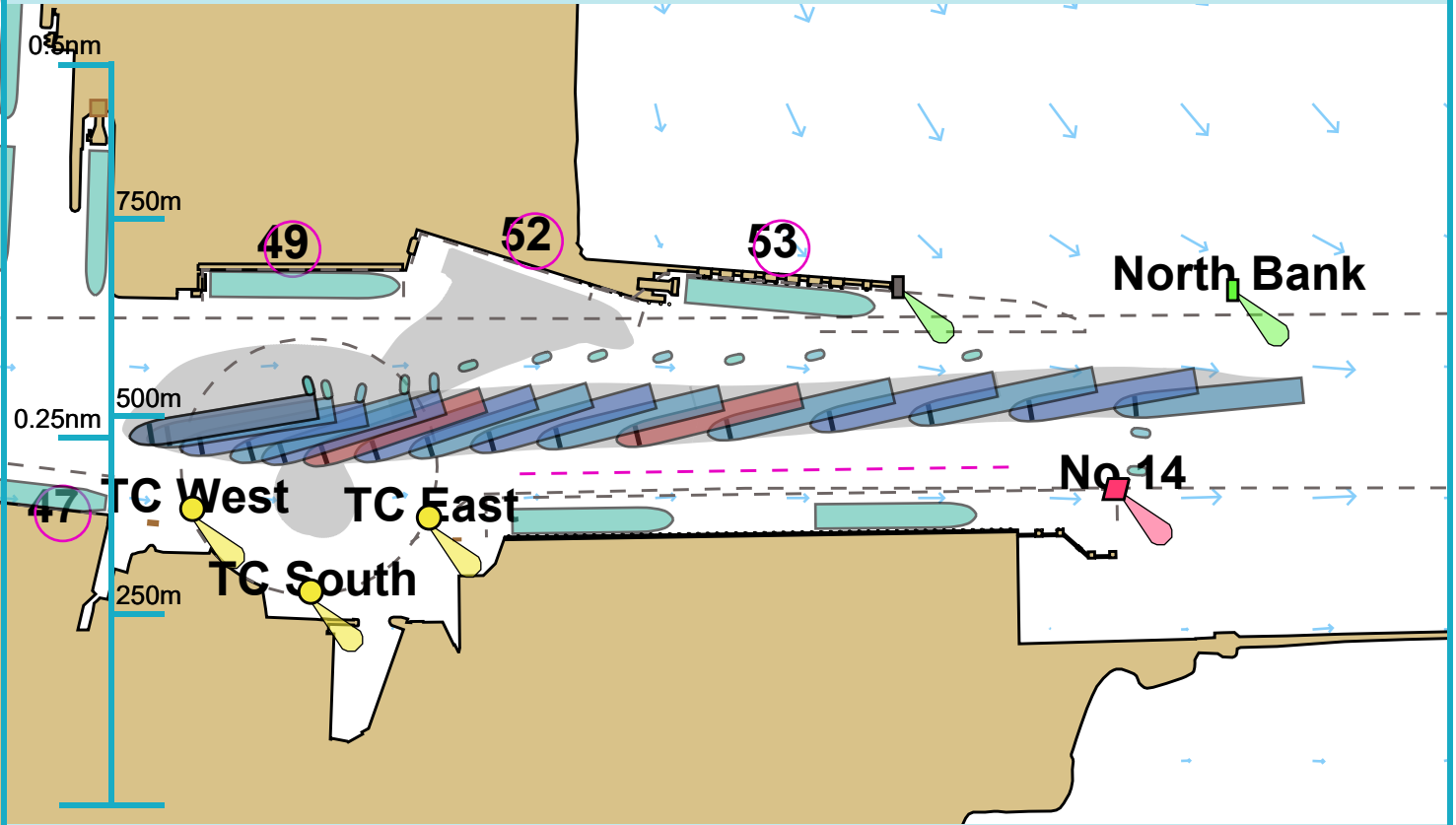
Environment

240m x 32m RoPax Ferry

Thruster and engine use

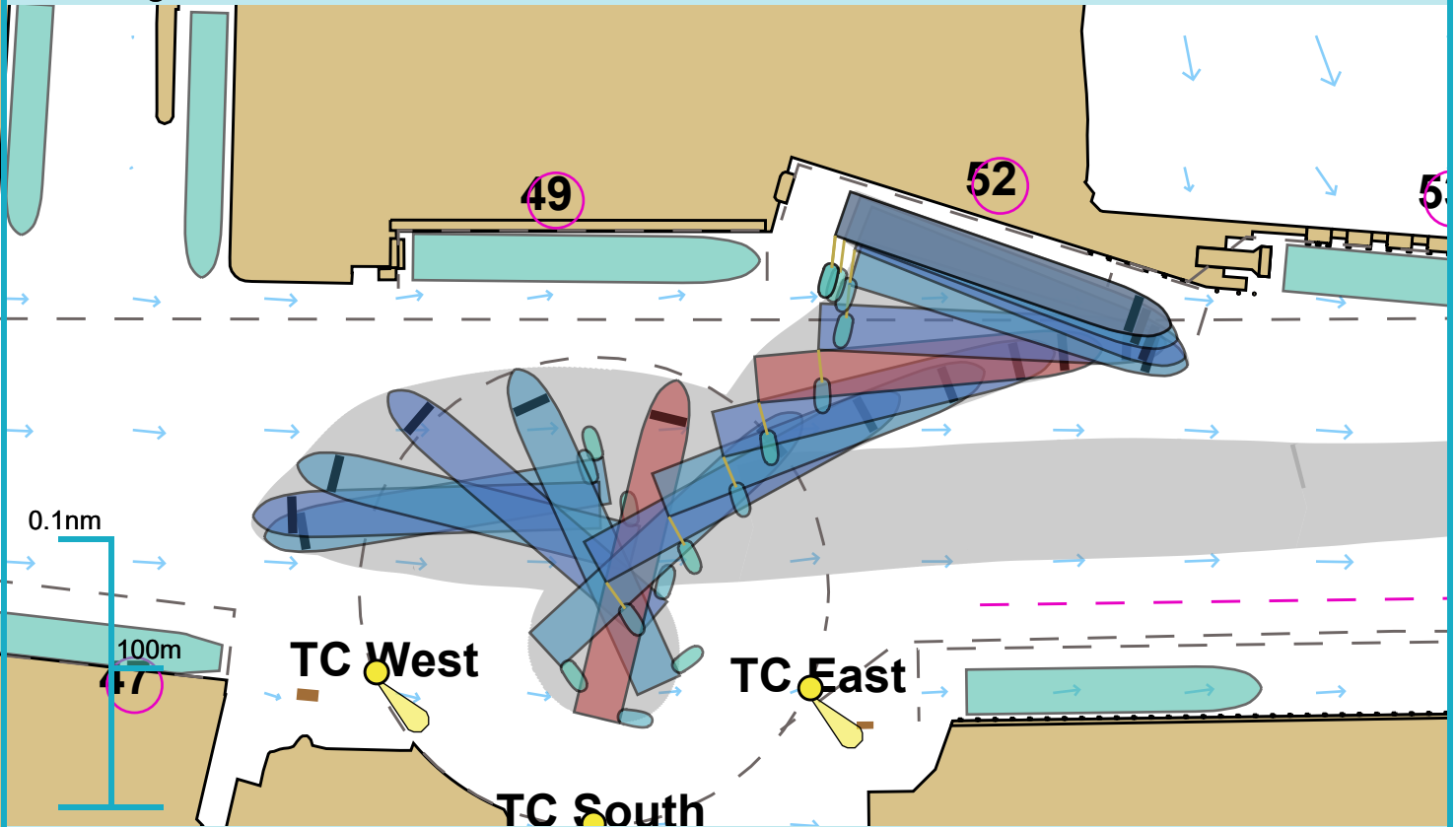
Tug use

Approach



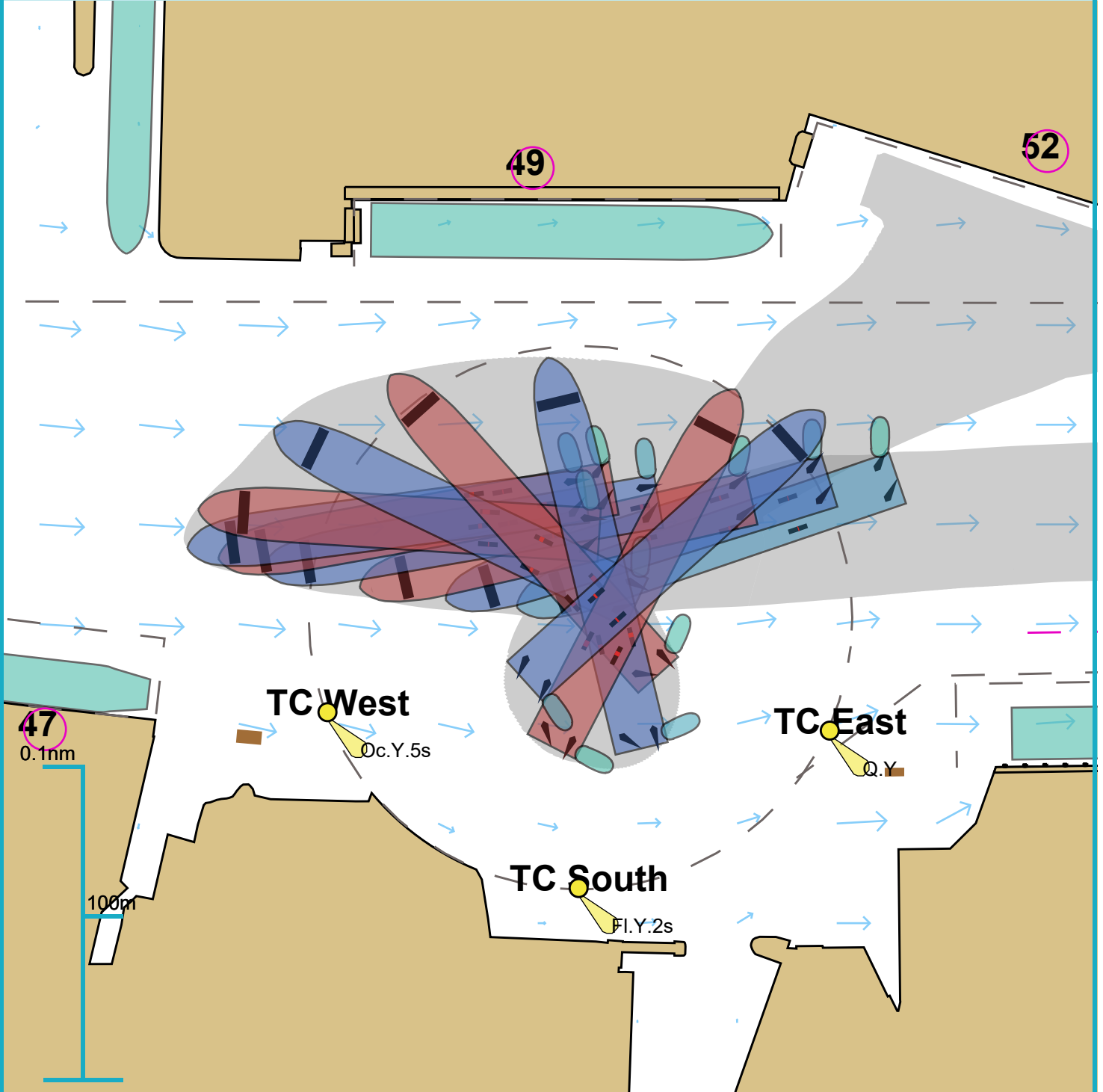
Ships plotted every 1 mins, highlight every 5 mins

Berthing

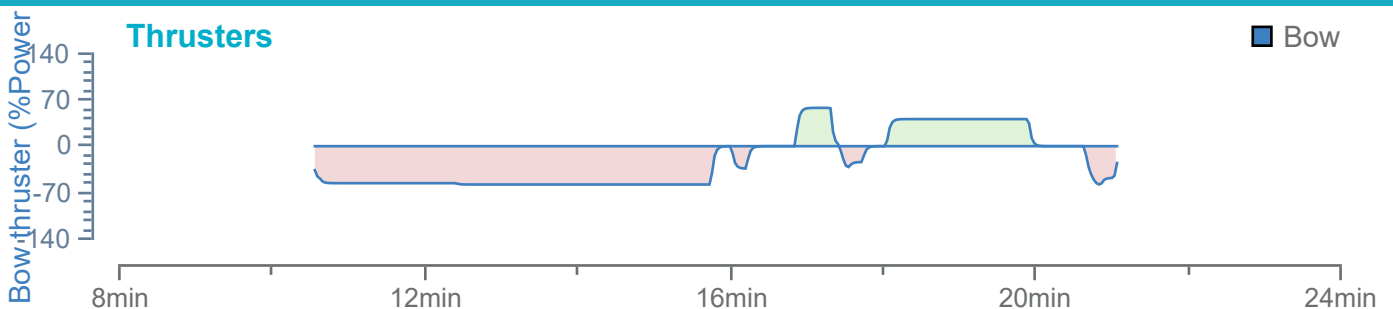


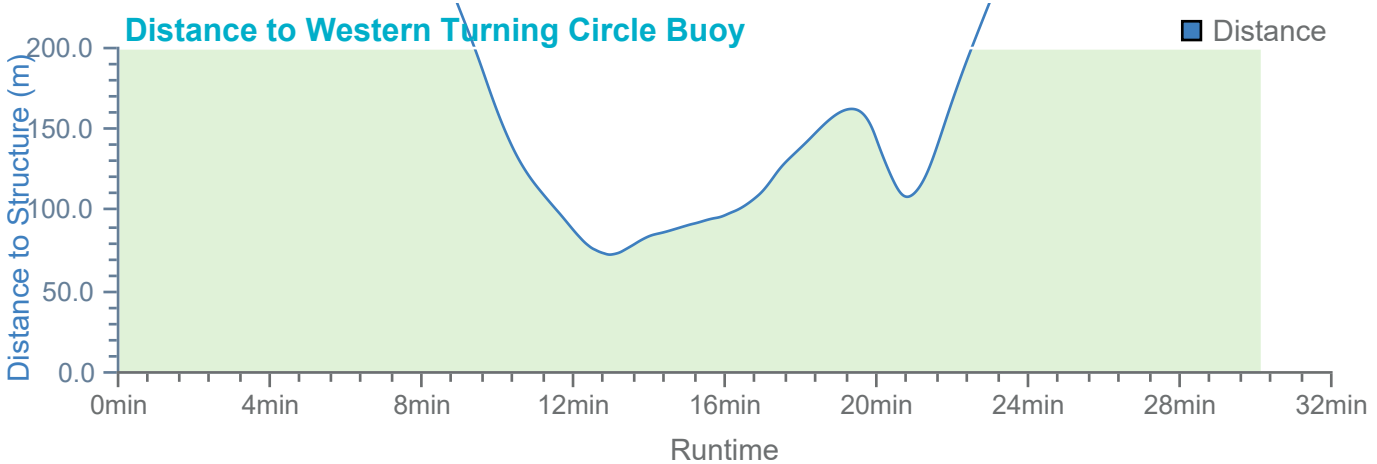
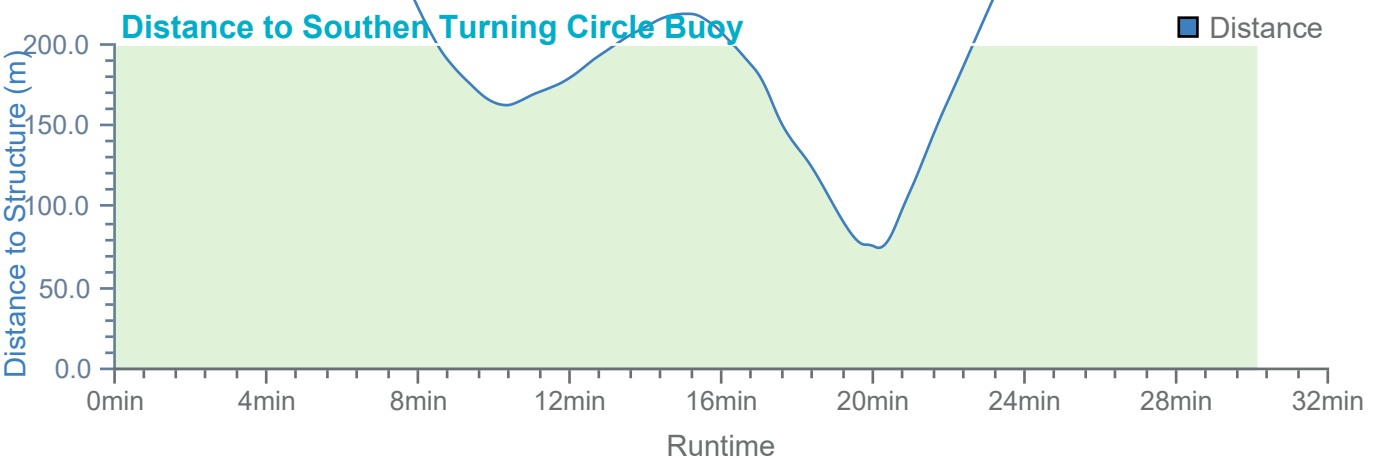
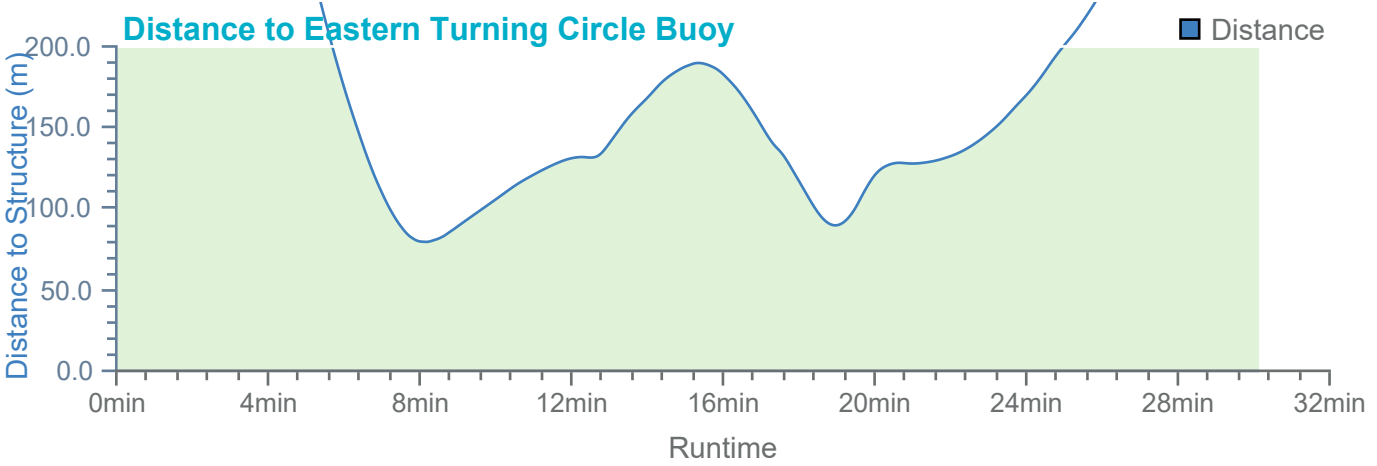
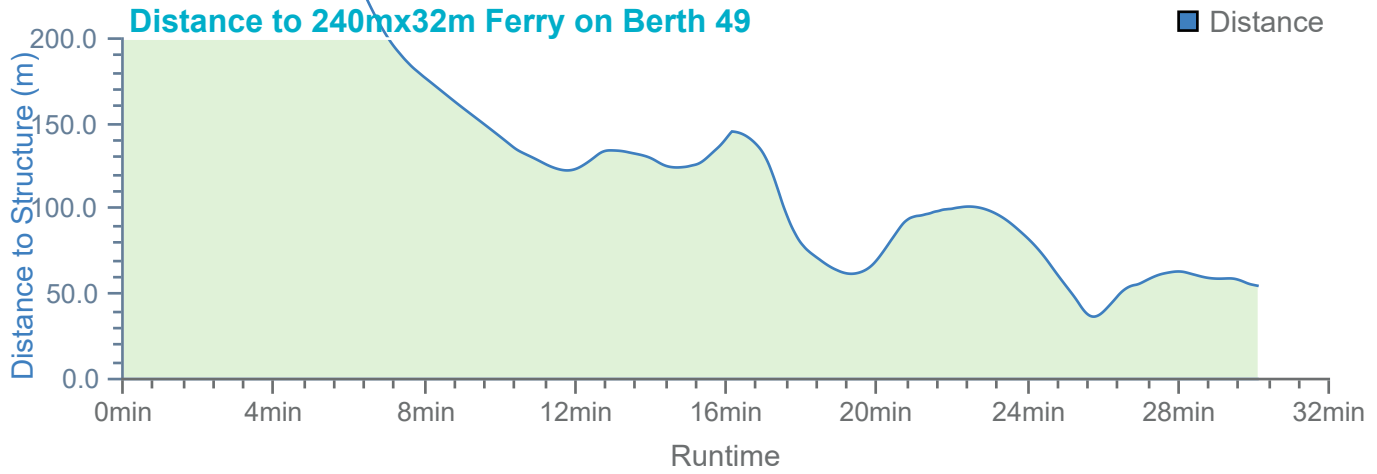
Ships plotted every 1 mins, highlight every 5 mins

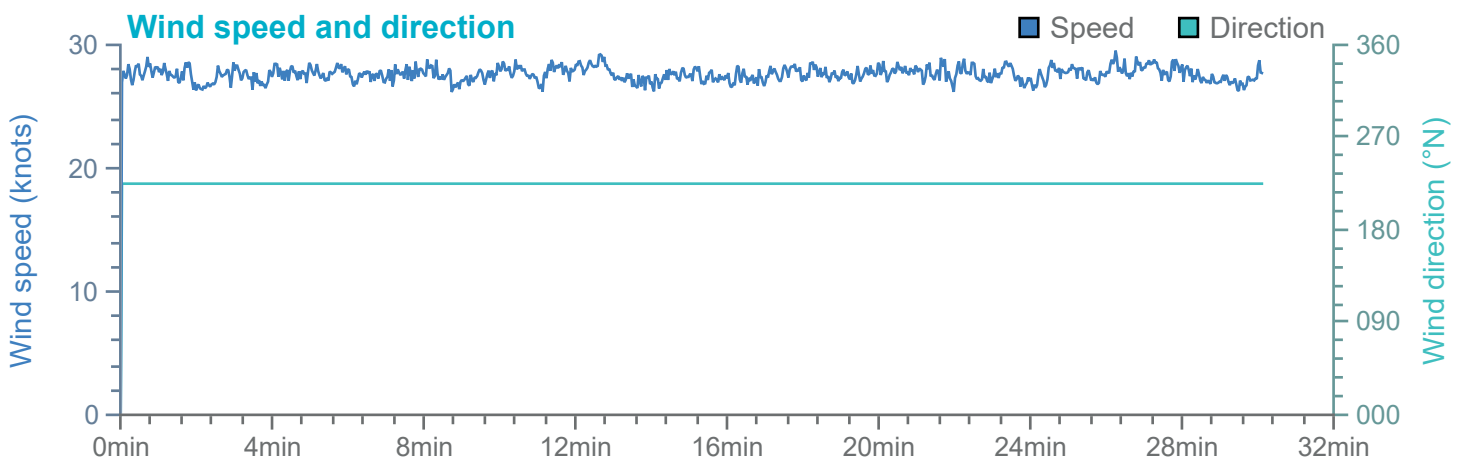
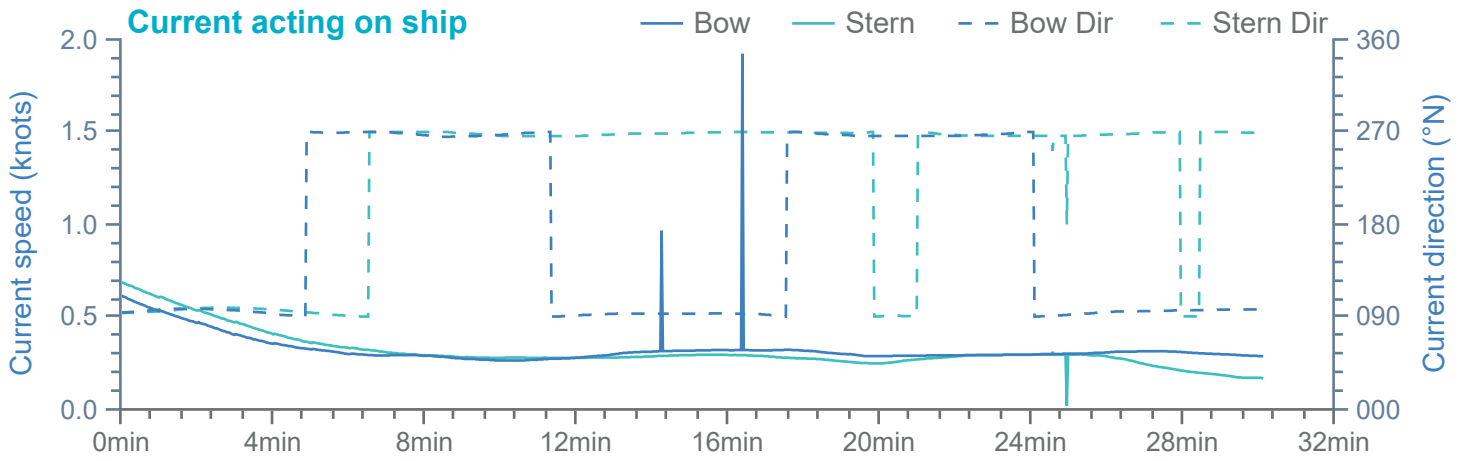
Swing

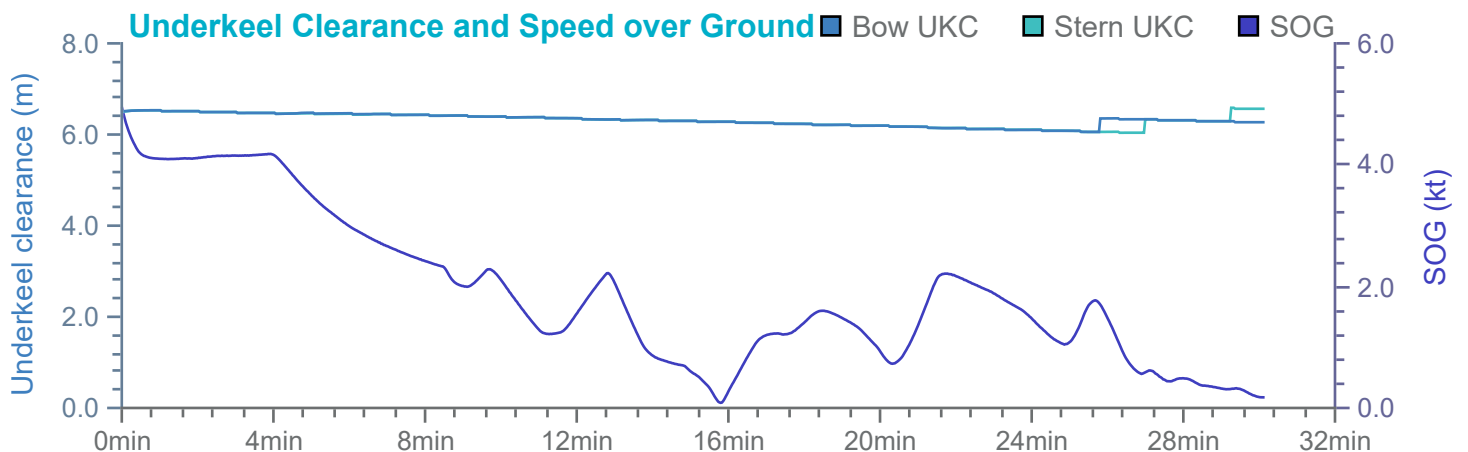
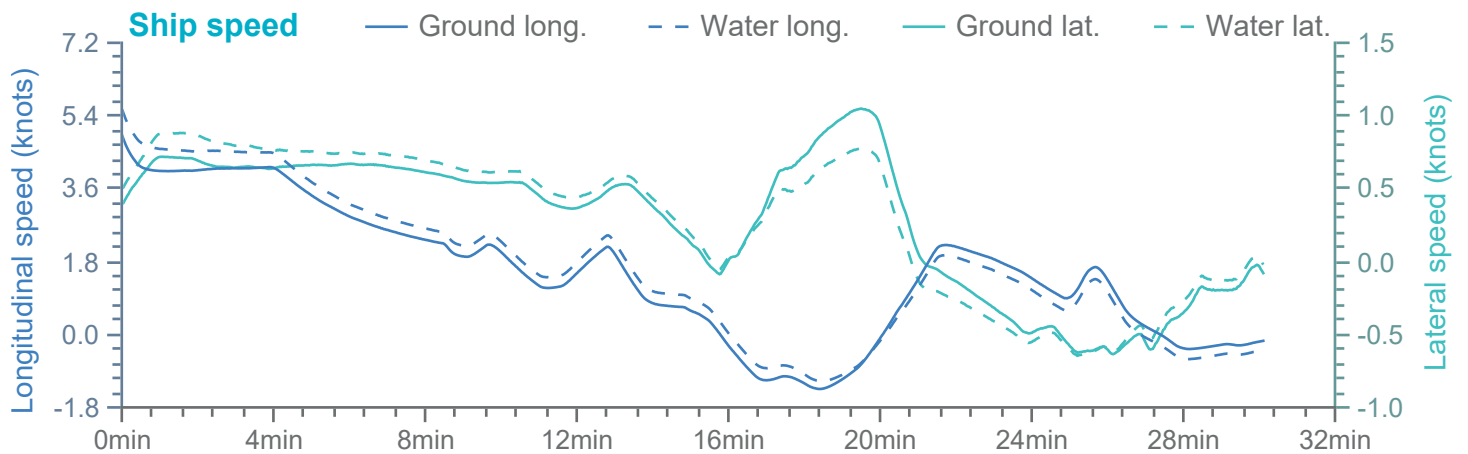
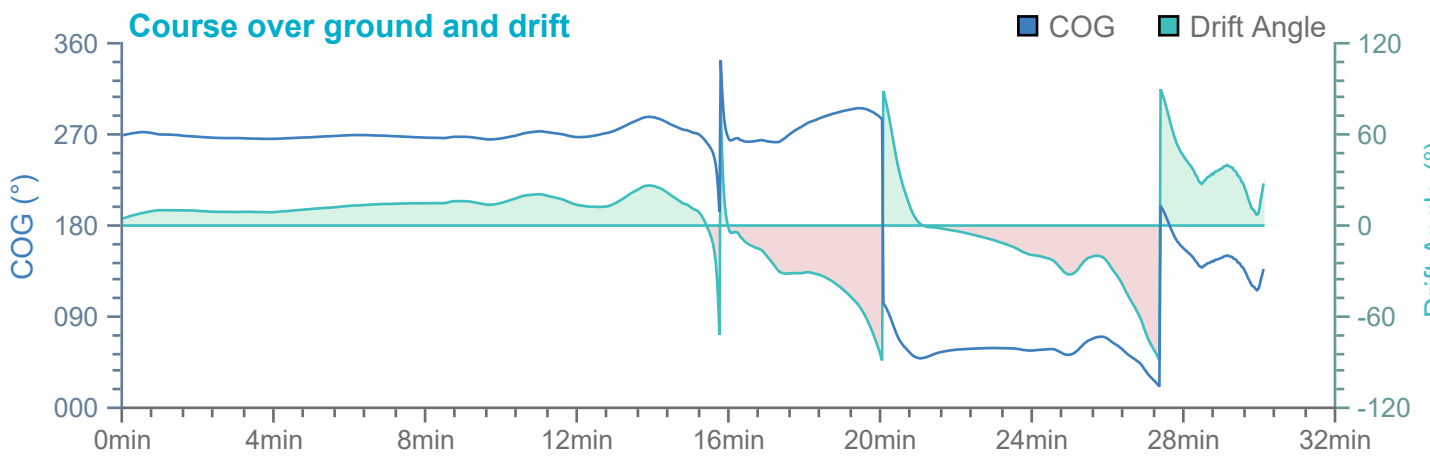
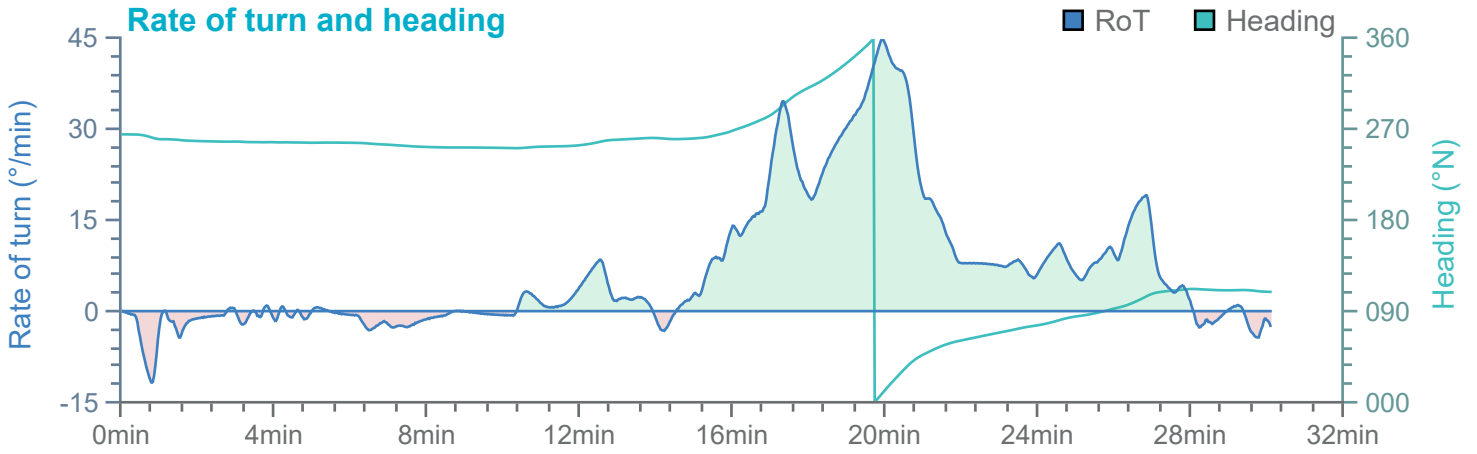


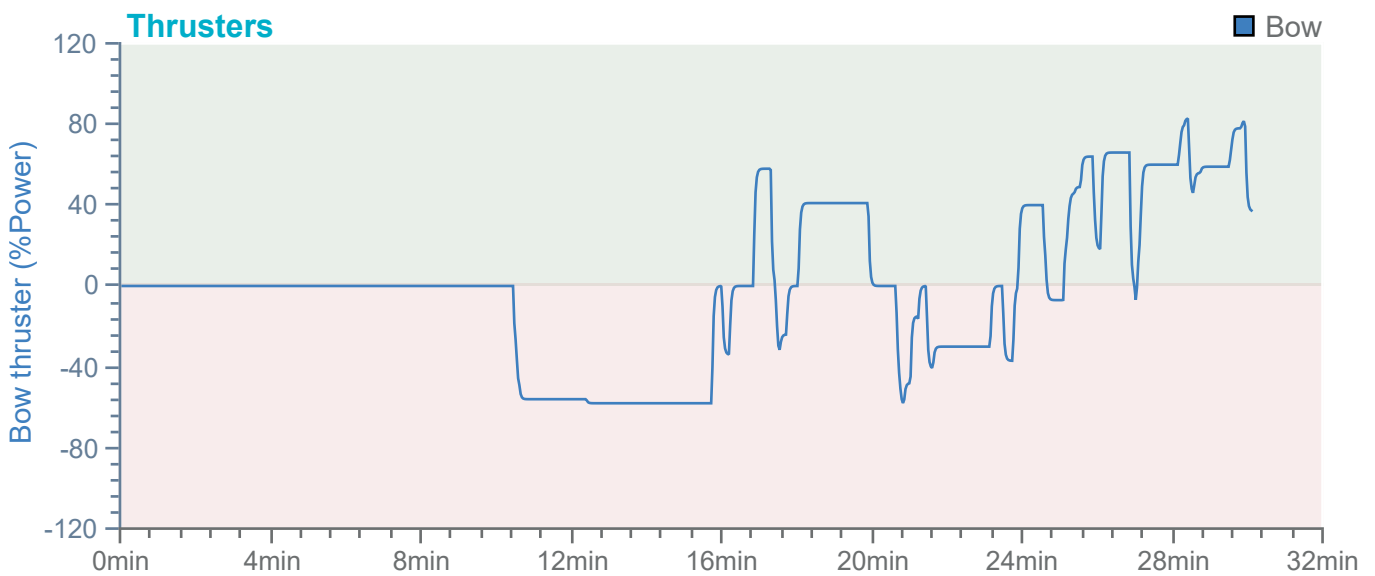
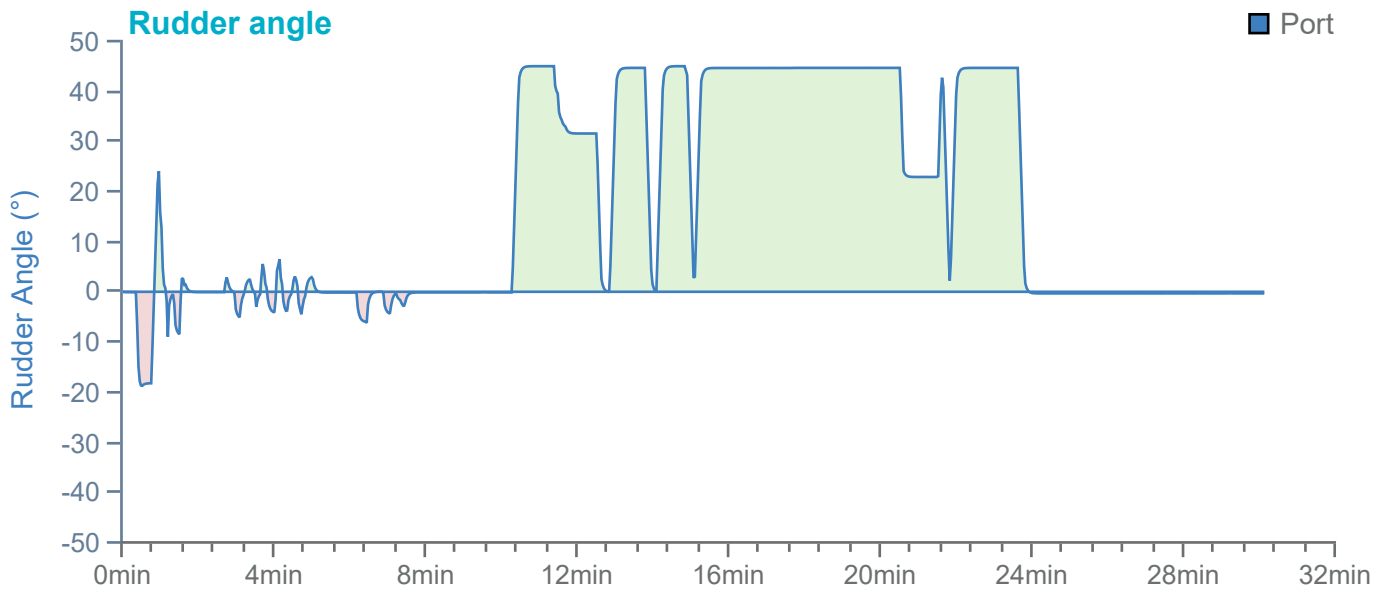
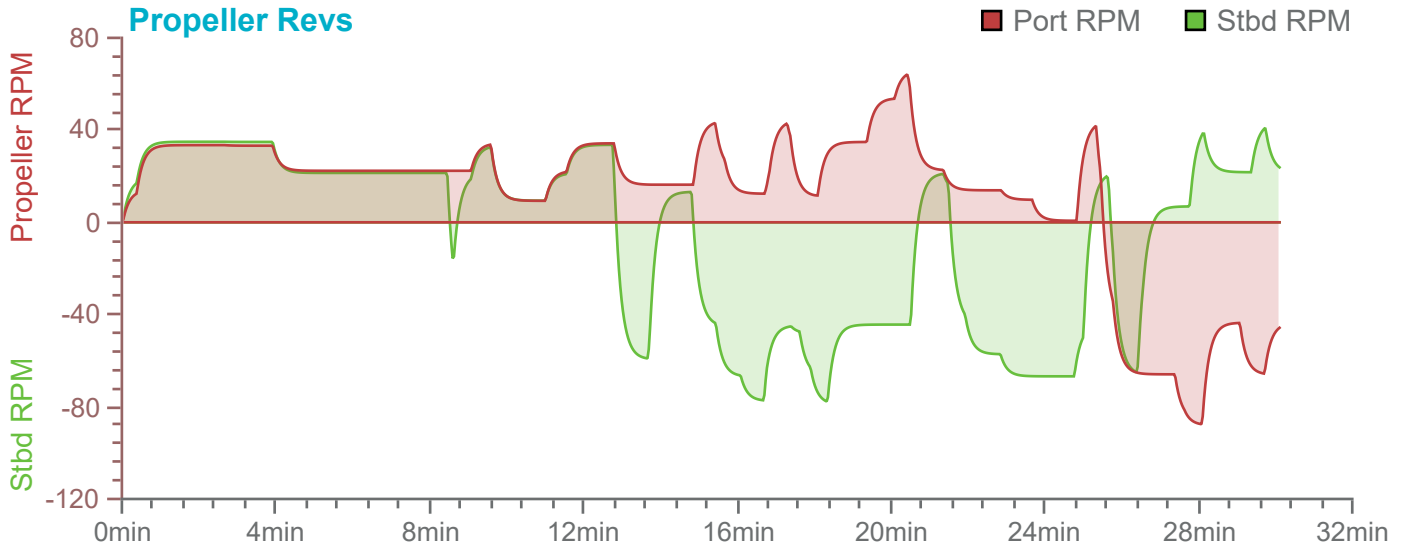
Ships plotted every 59 seconds, highlight every 2 mins

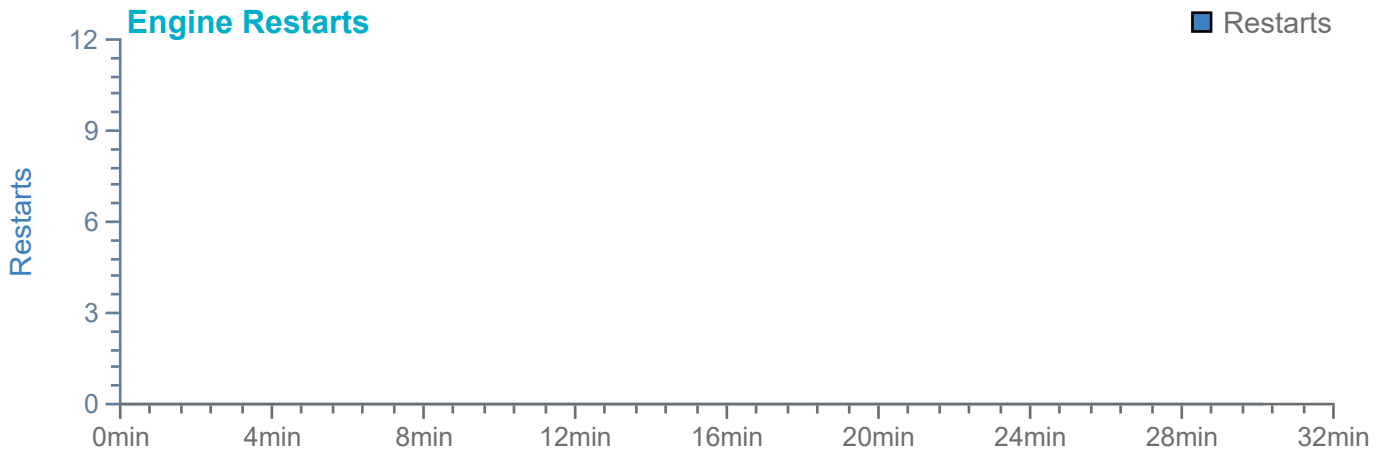
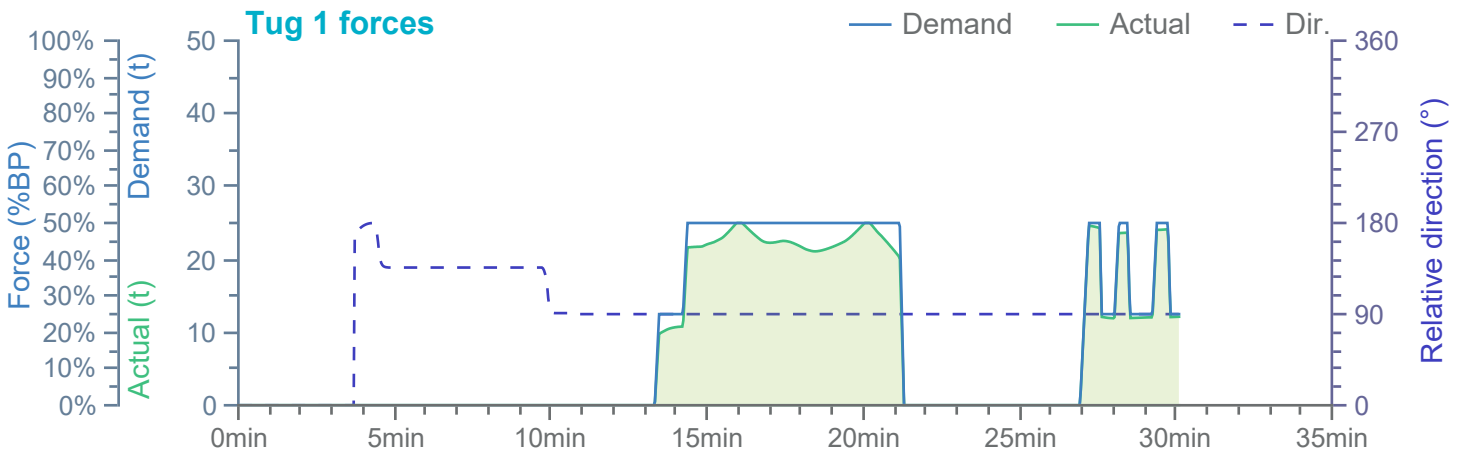
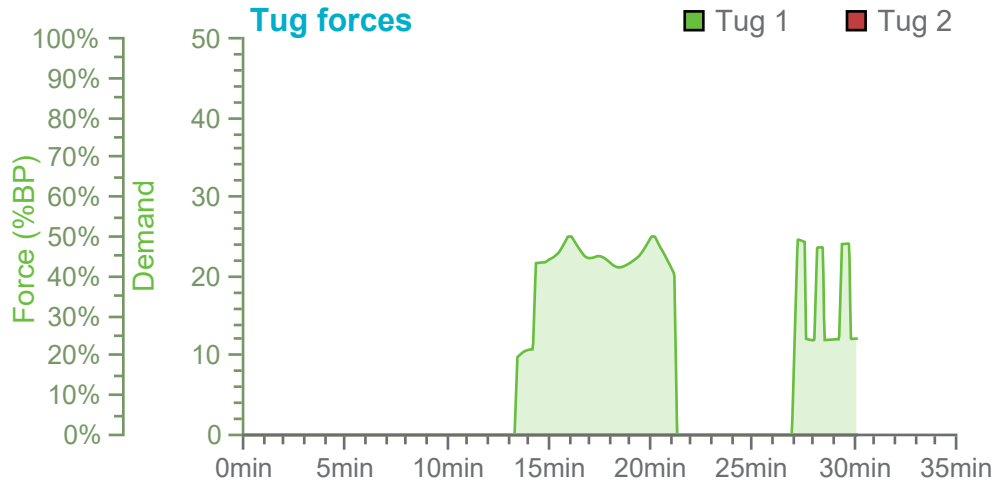
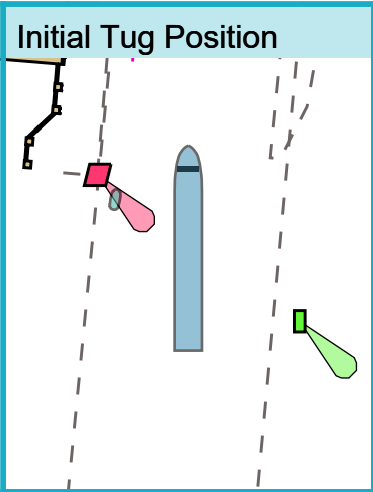






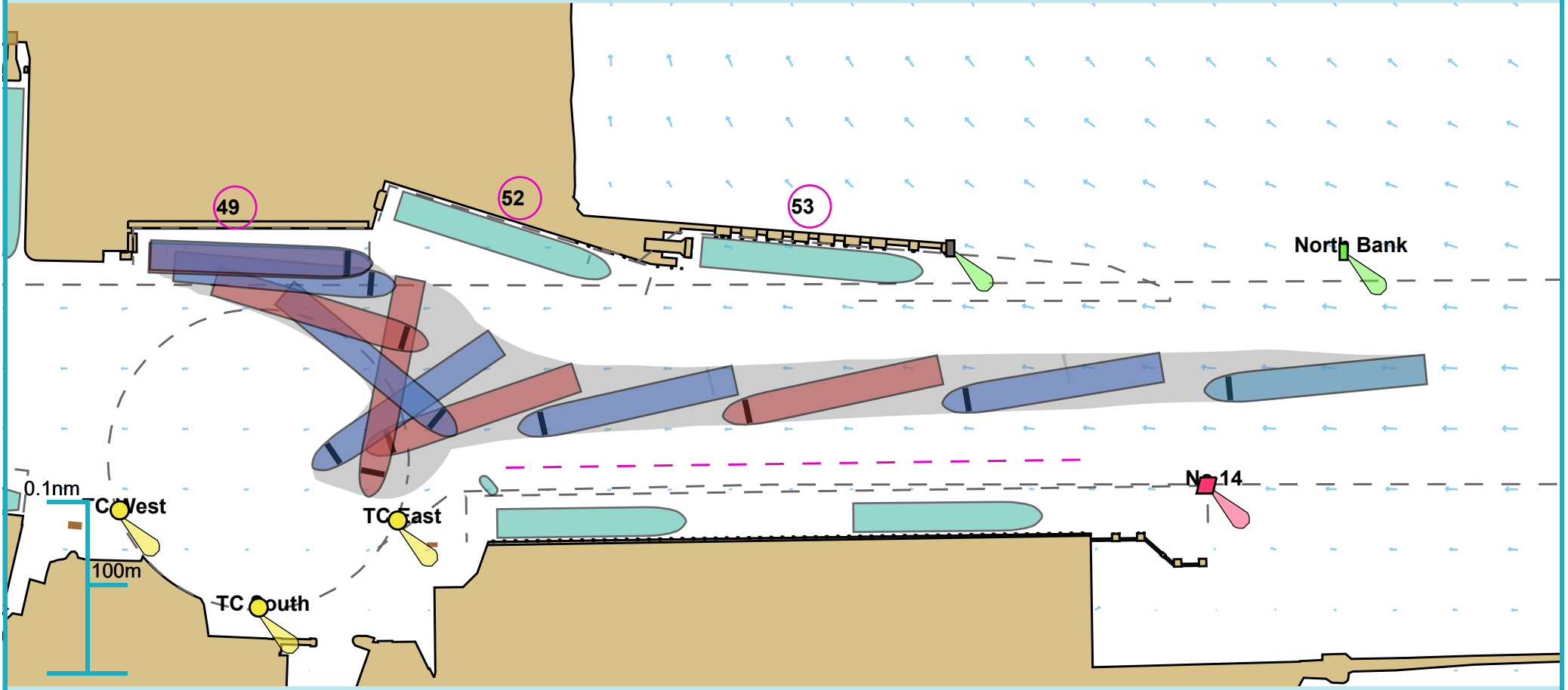






Full Run Overview

53° 20.410 N, 006° 11.893 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

Run length: 21 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

Comments:

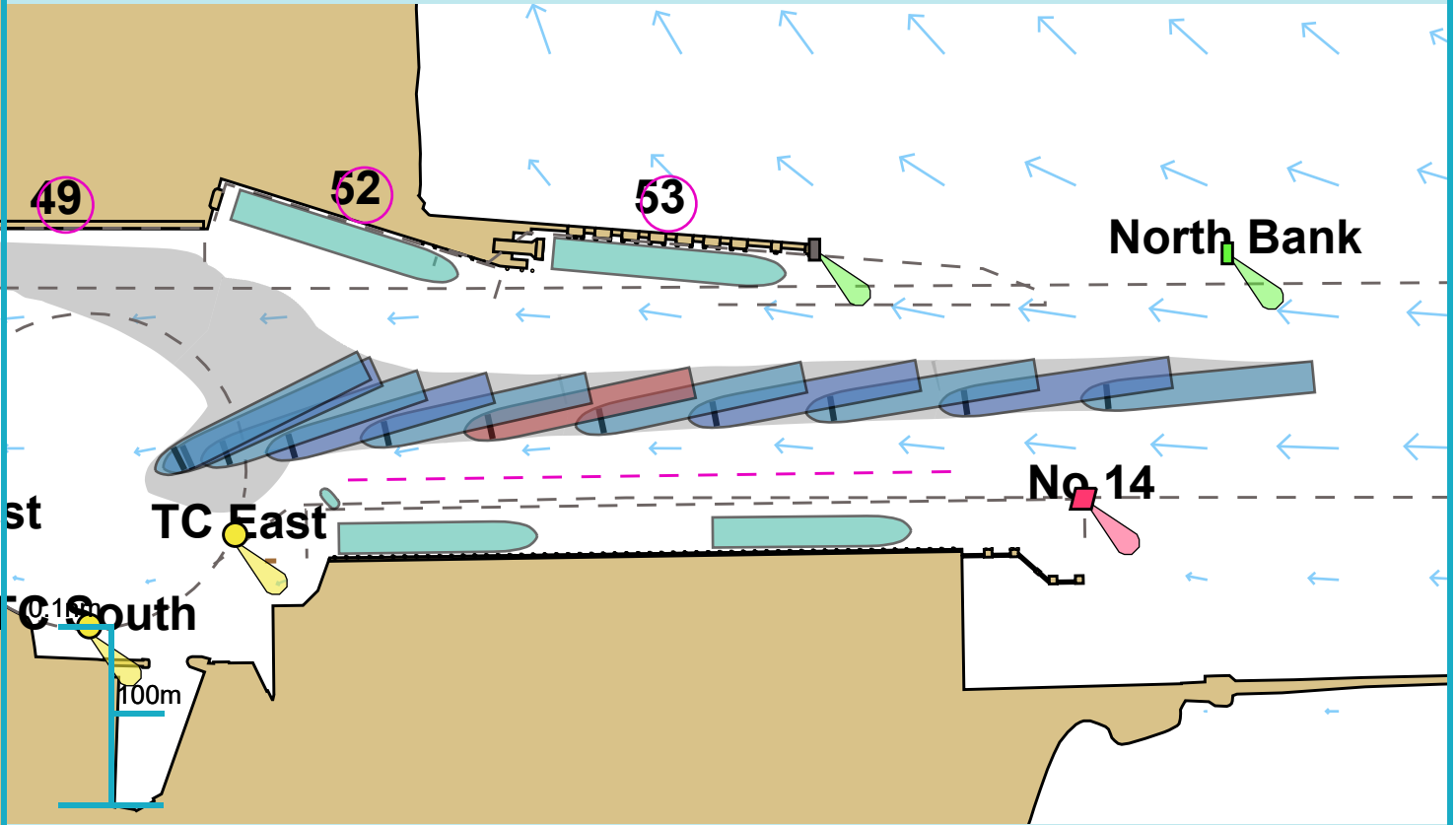
Overview

Environment

240m x 32m RoPax Ferry

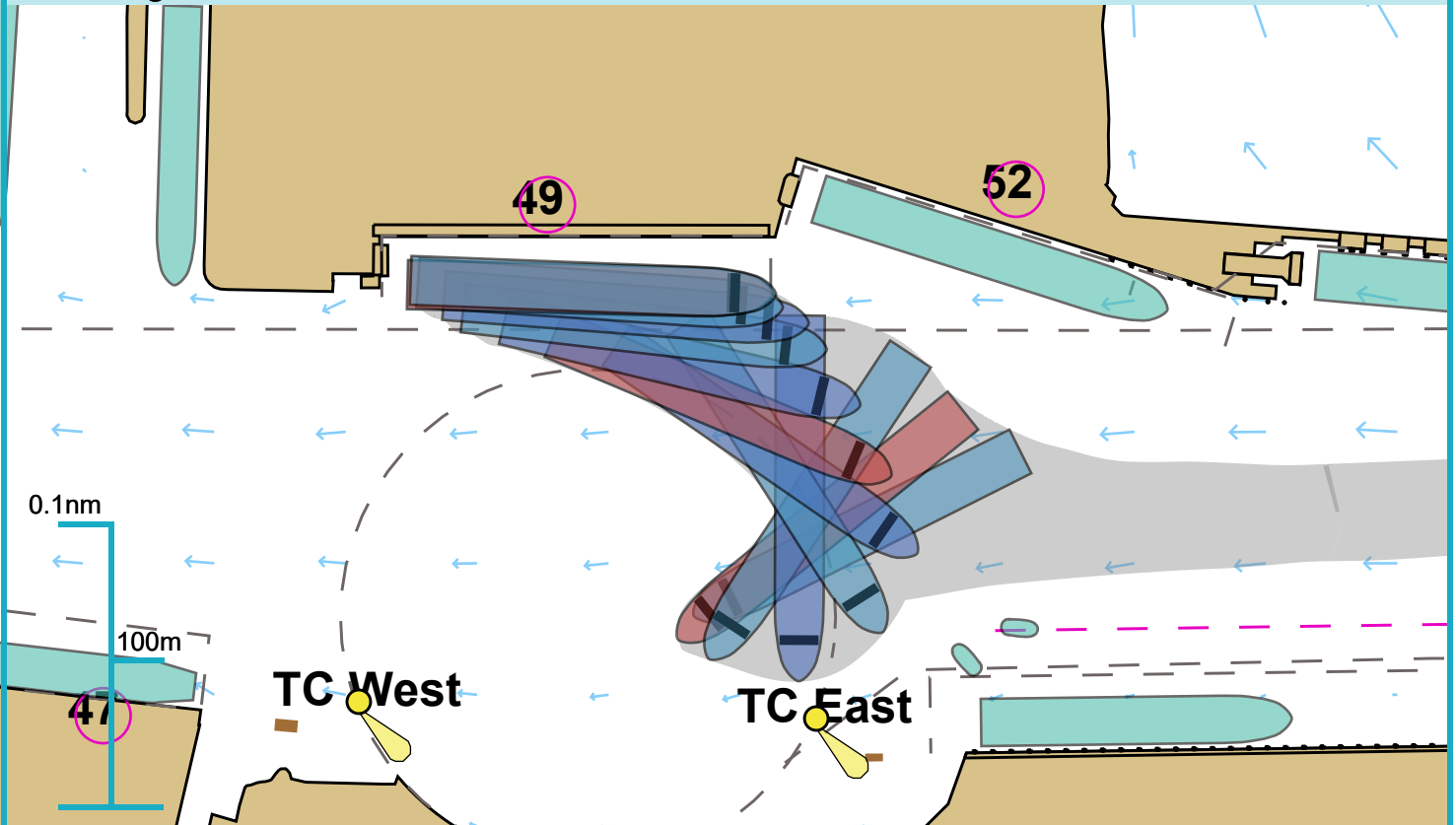
Thruster and engine use

Approach



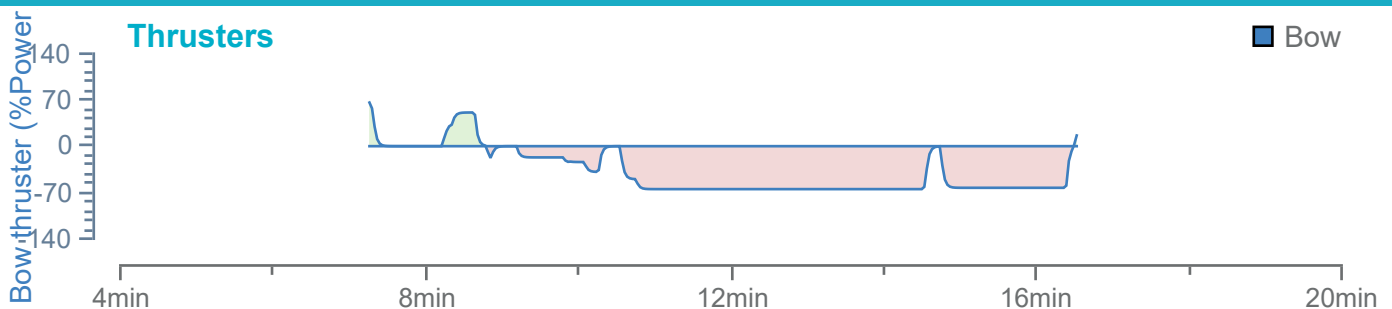
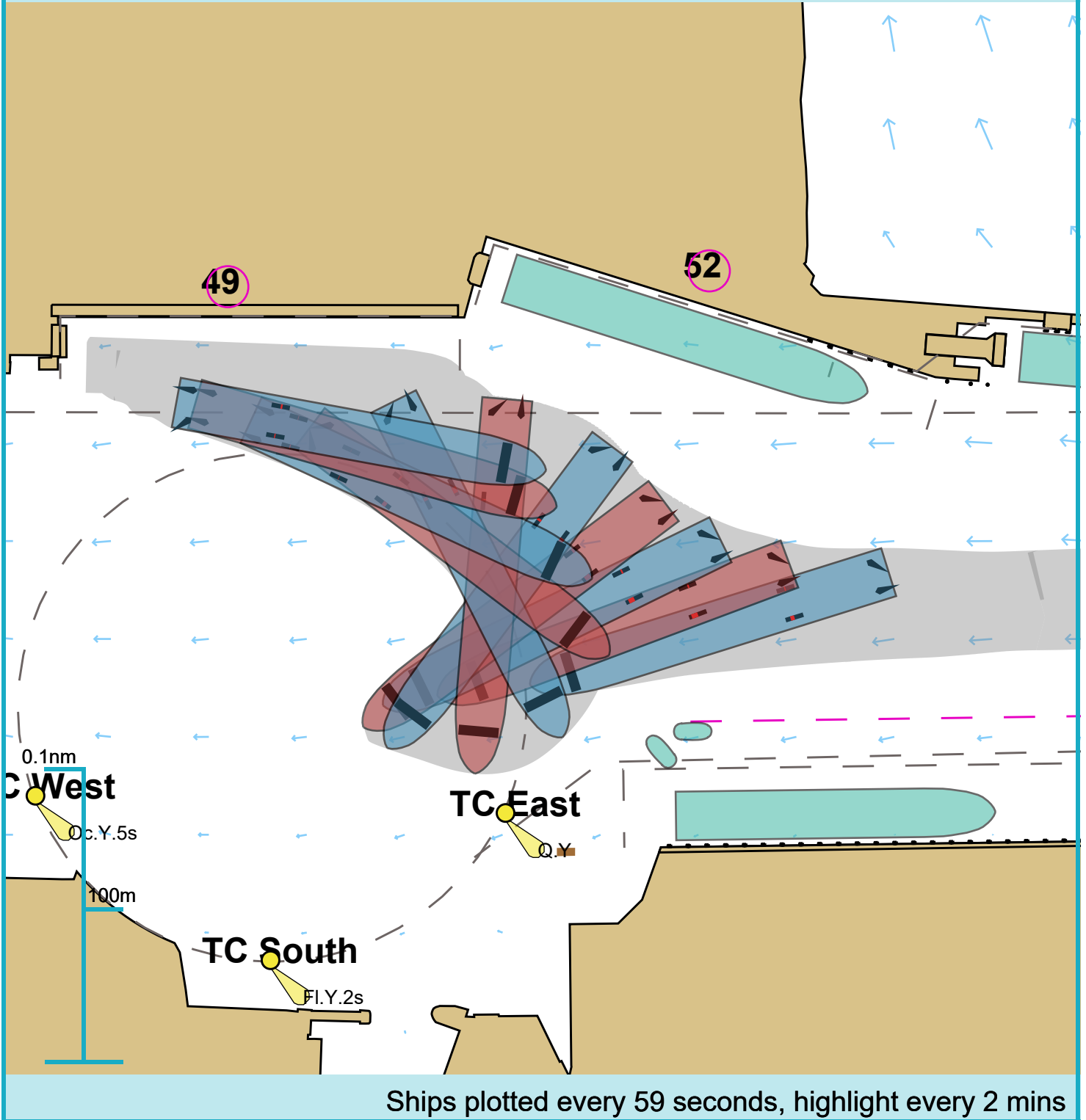
Ships plotted every 1 mins, highlight every 5 mins

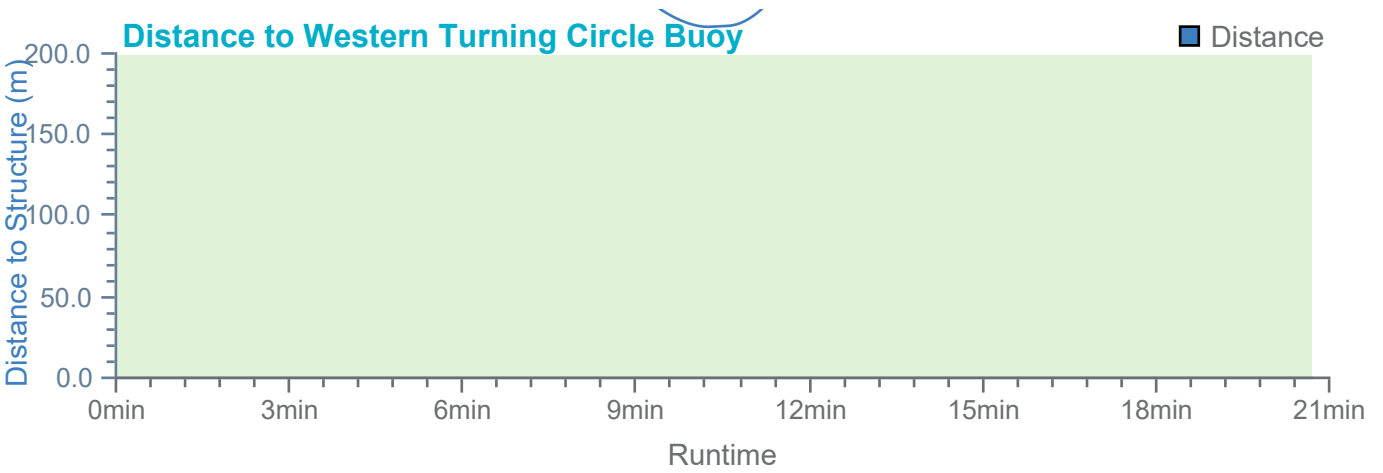
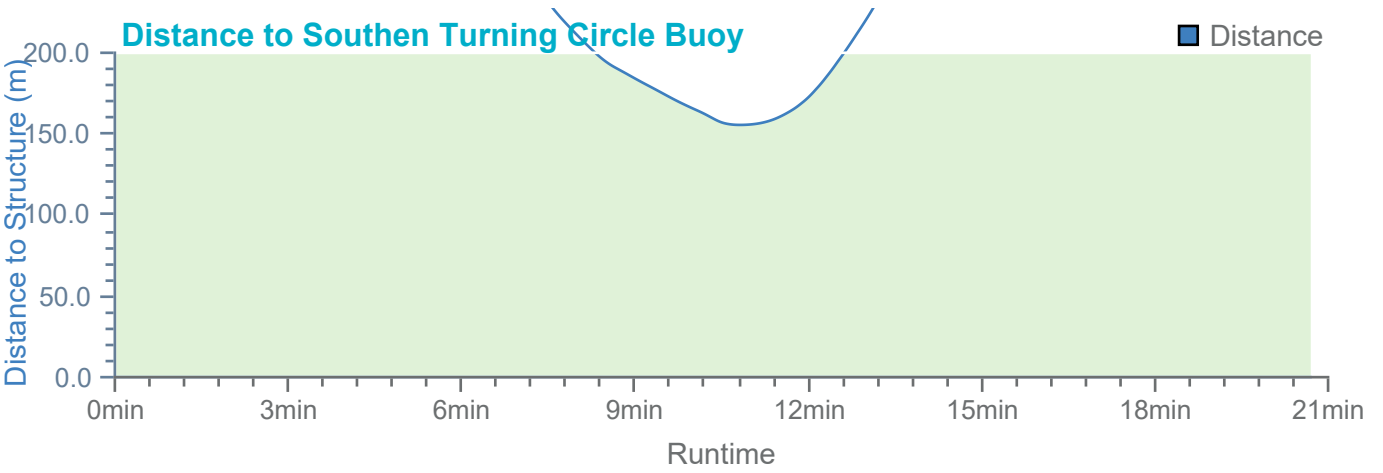
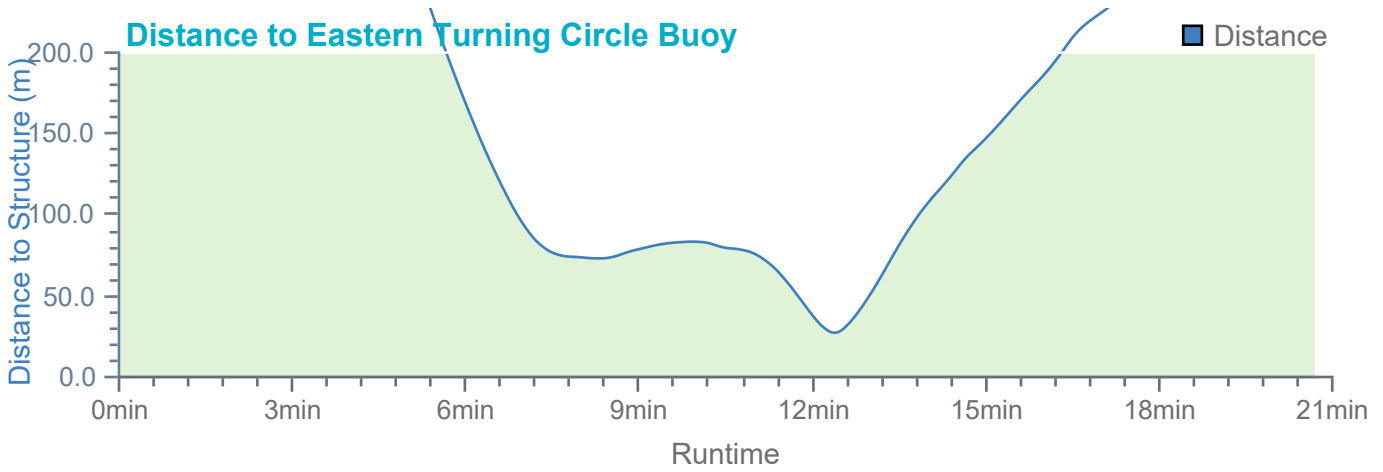
Berthing



Ships plotted every 1 mins, highlight every 5 mins

Swing



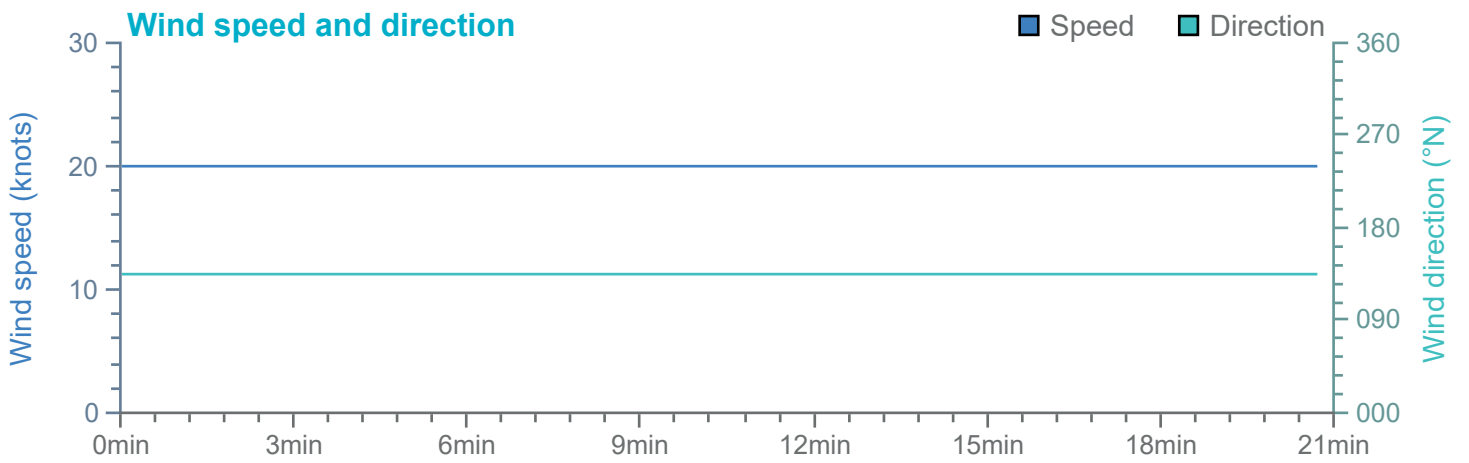
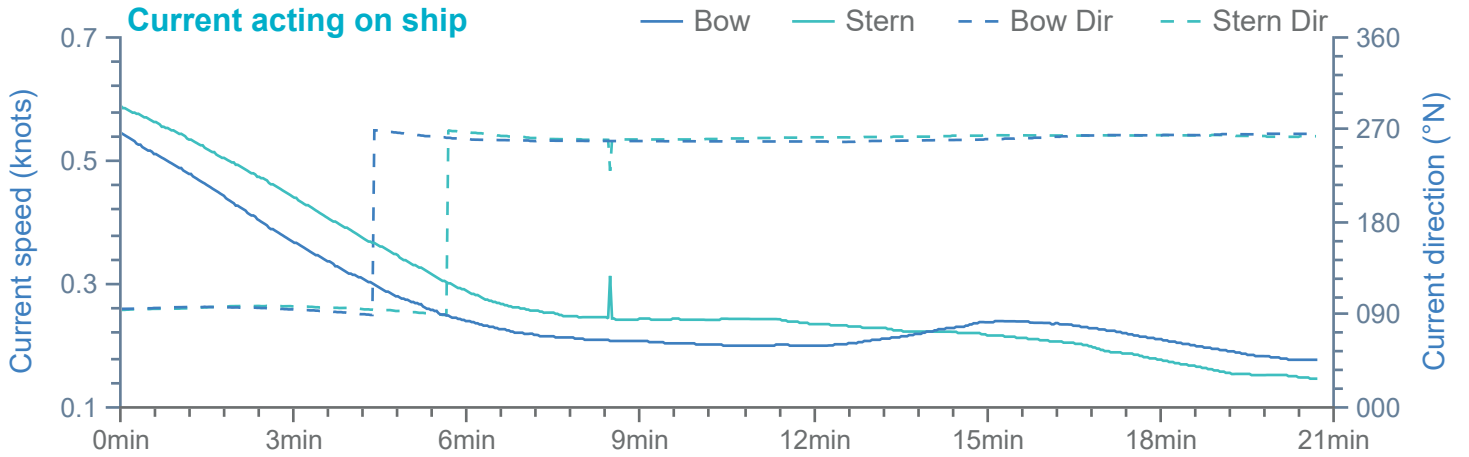


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

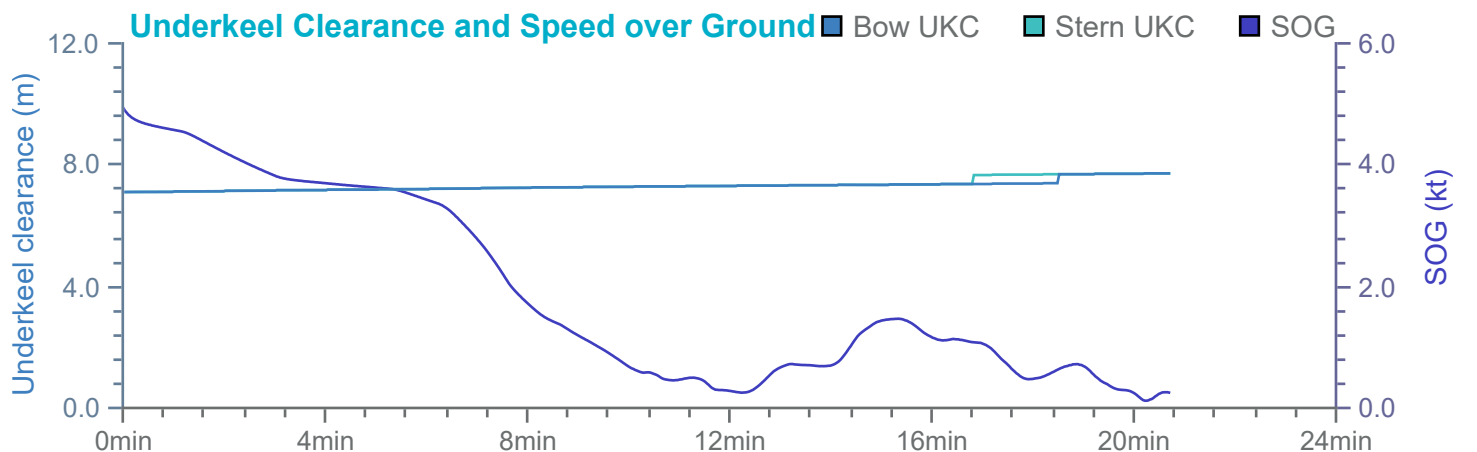
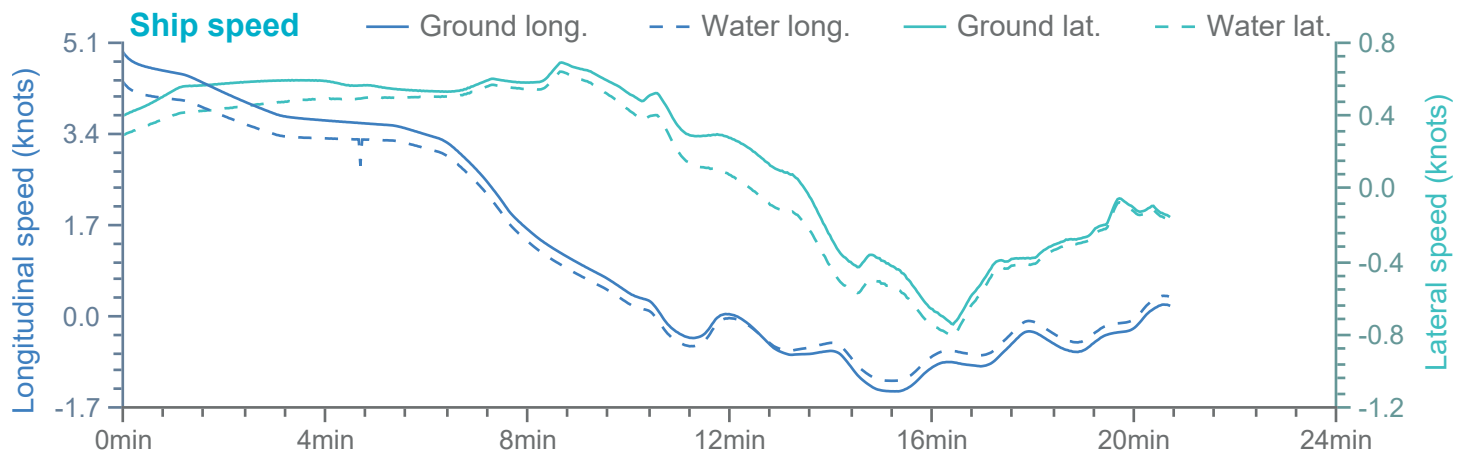
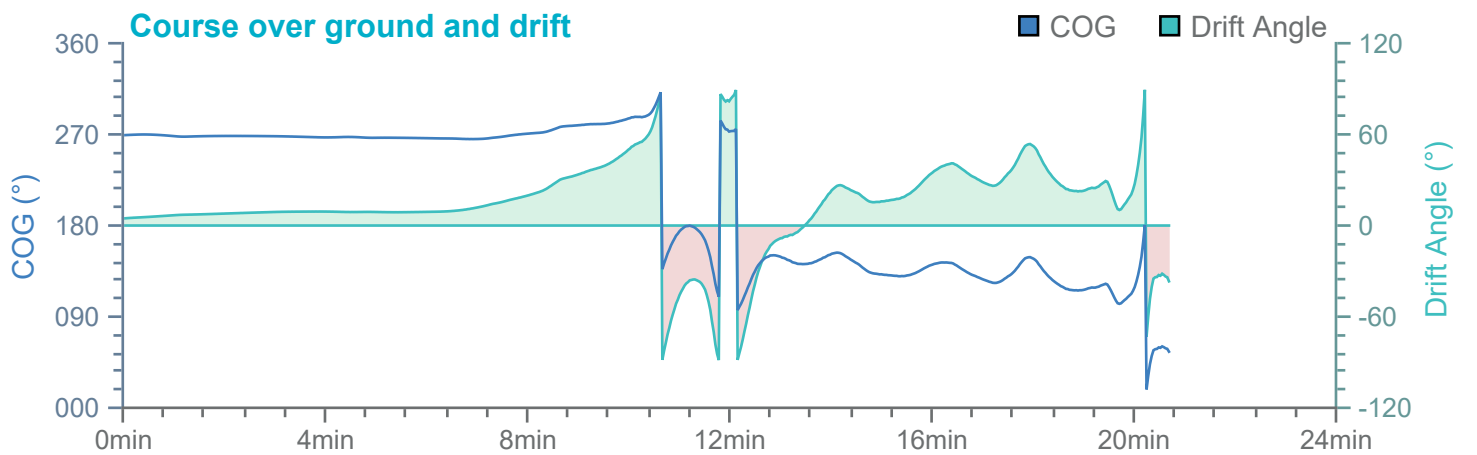
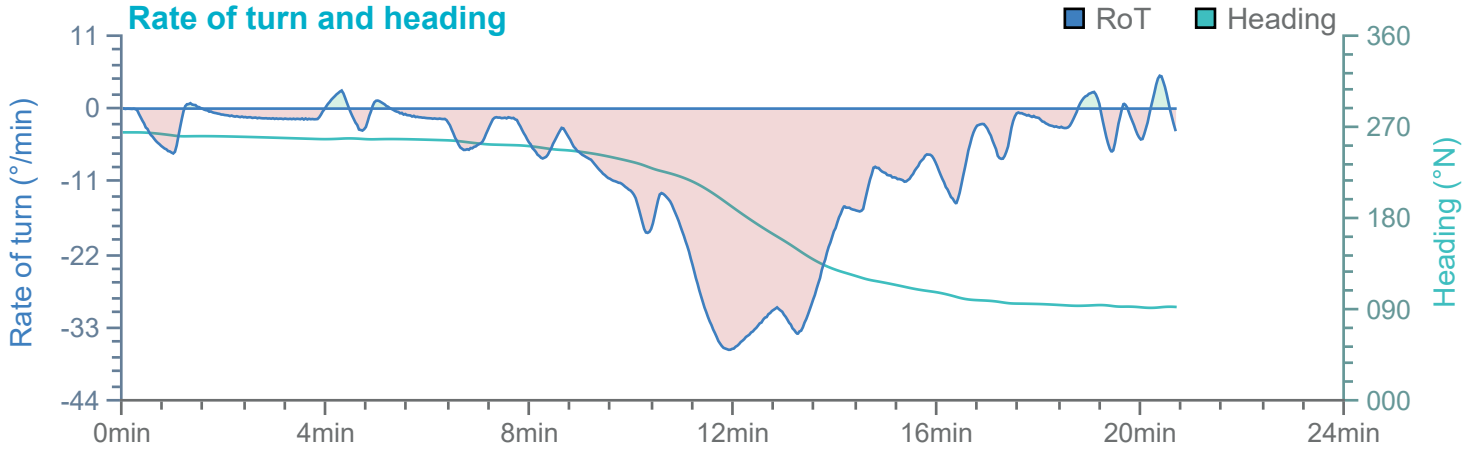


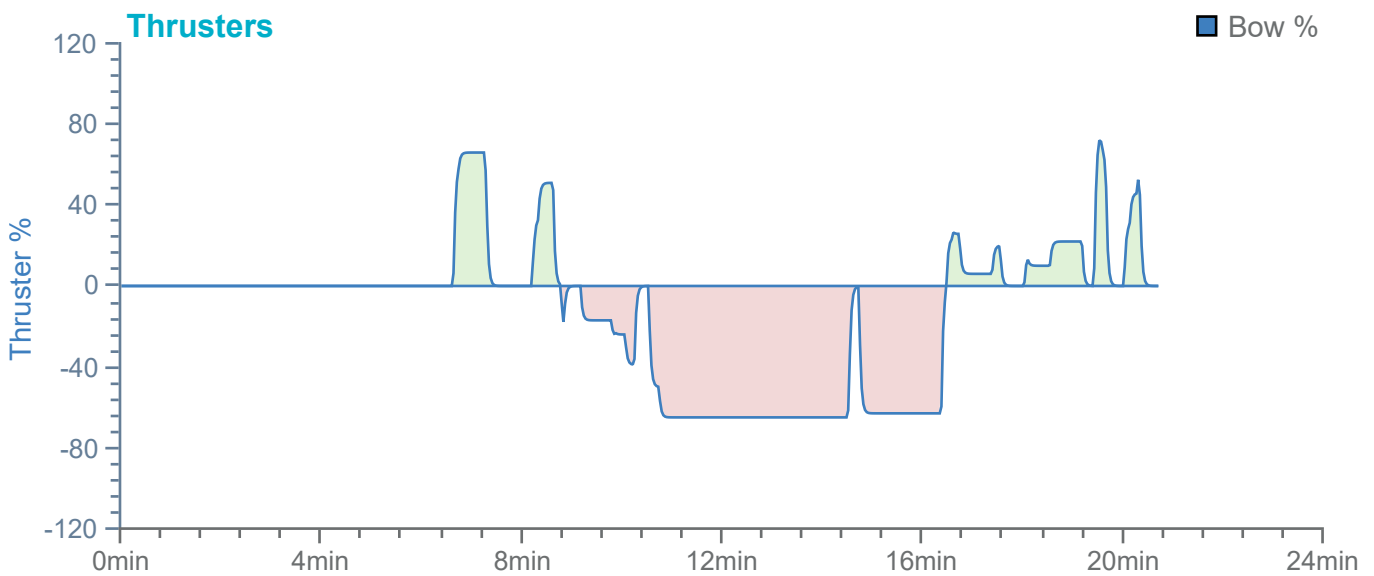
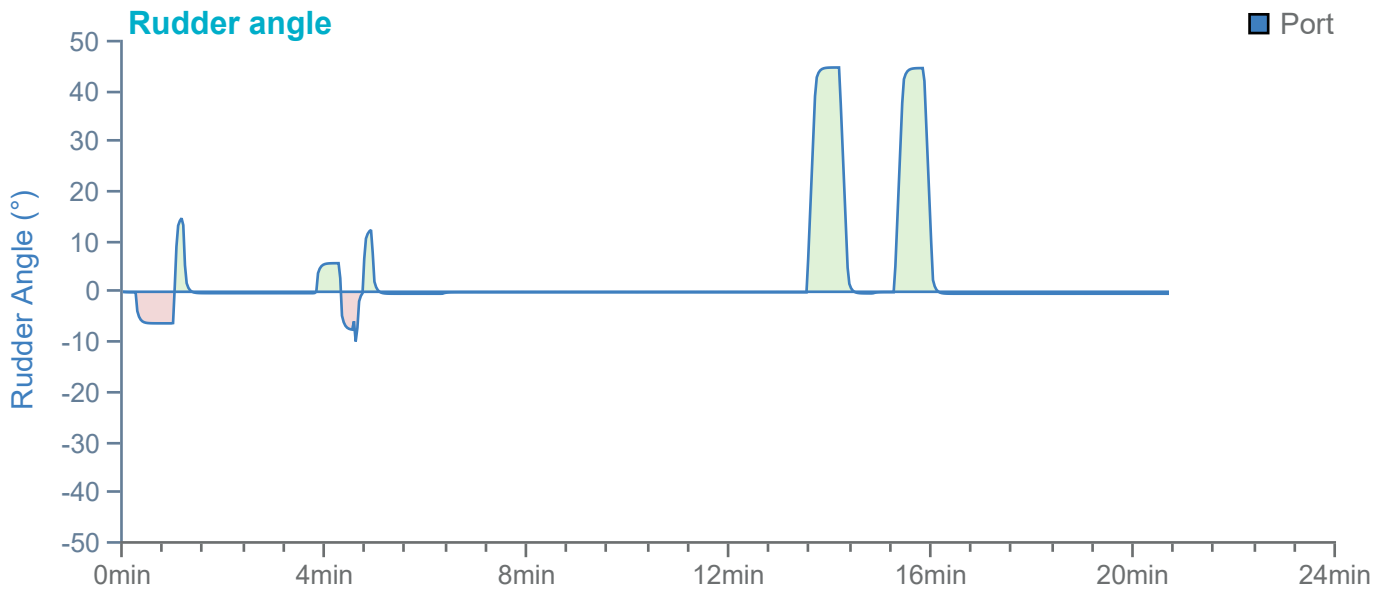
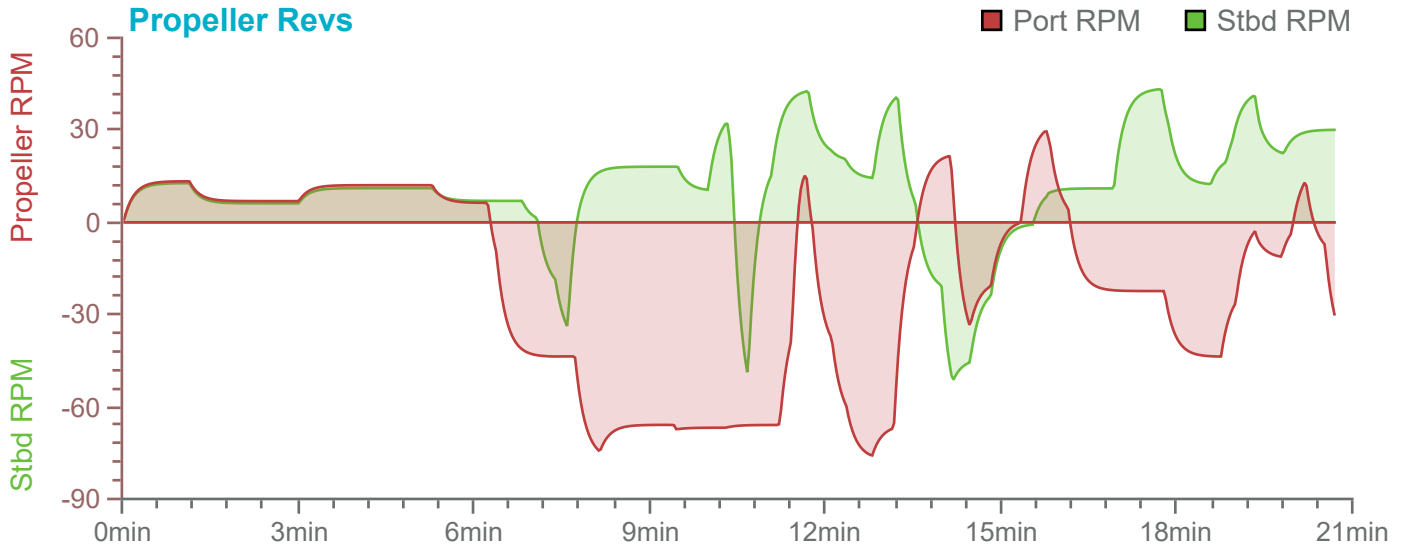
Overview

Environment

240m x 32m RoPax Ferry

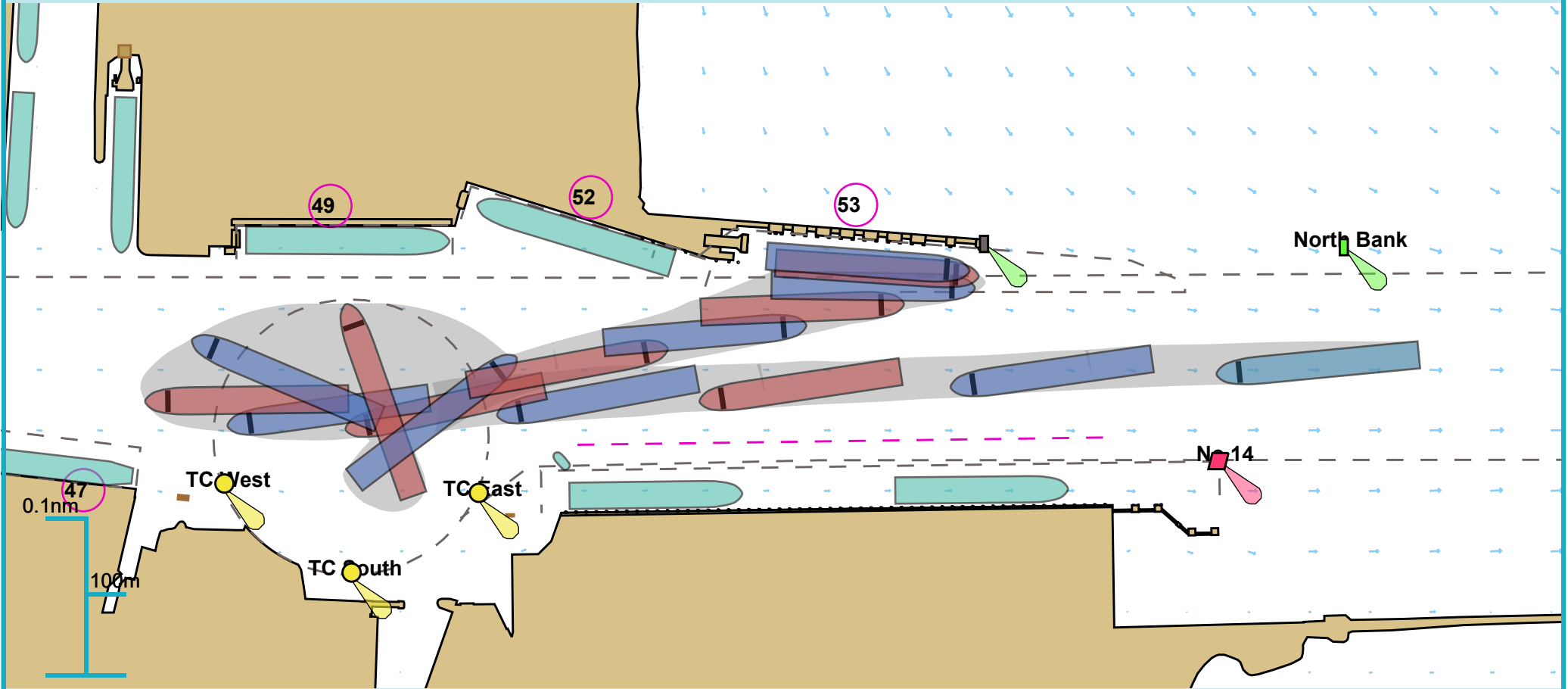
Thruster and engine use





Full Run Overview

53° 20.380 N, 006° 12.016 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: IL

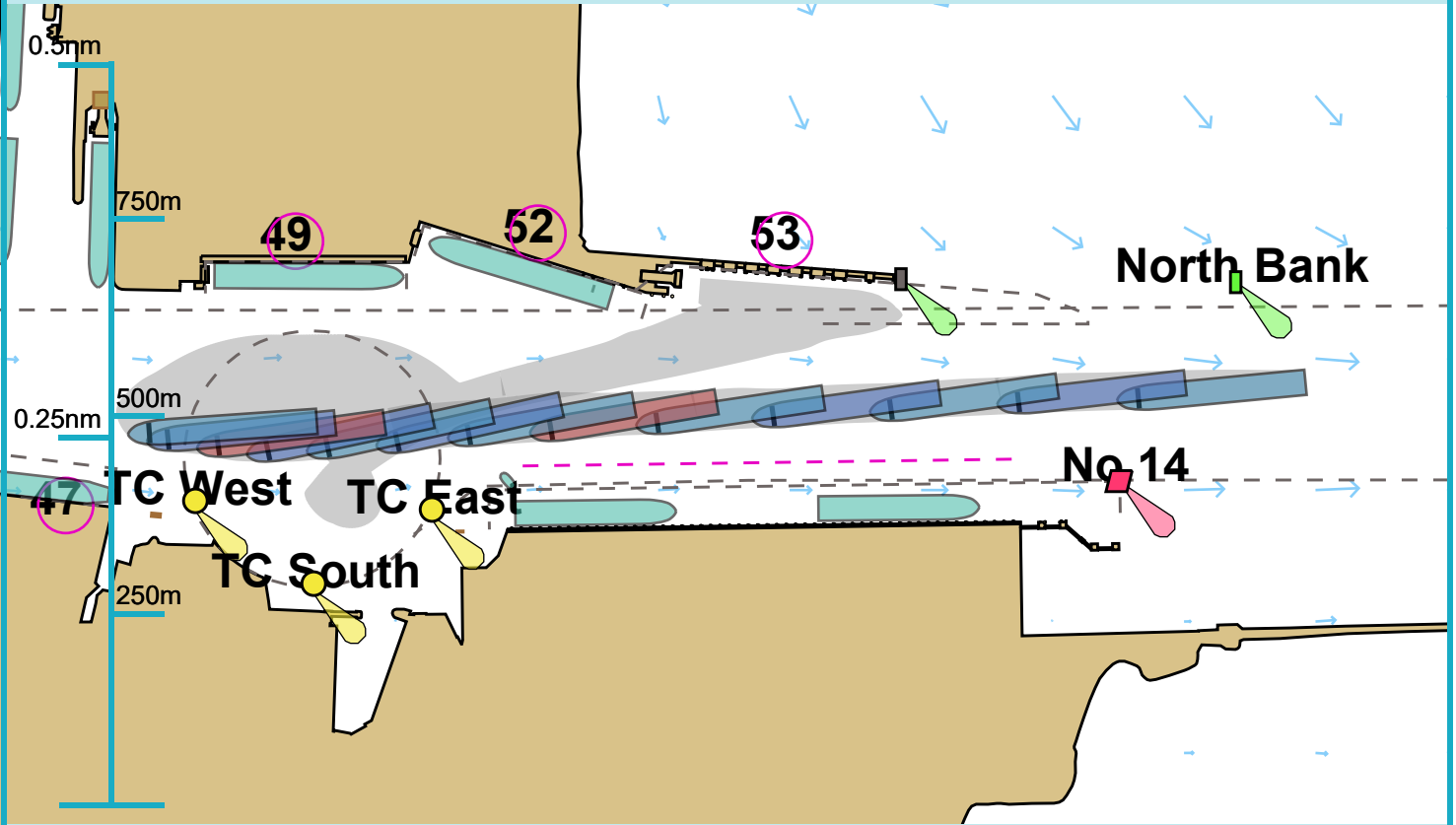
Run length: 29 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax Ferry

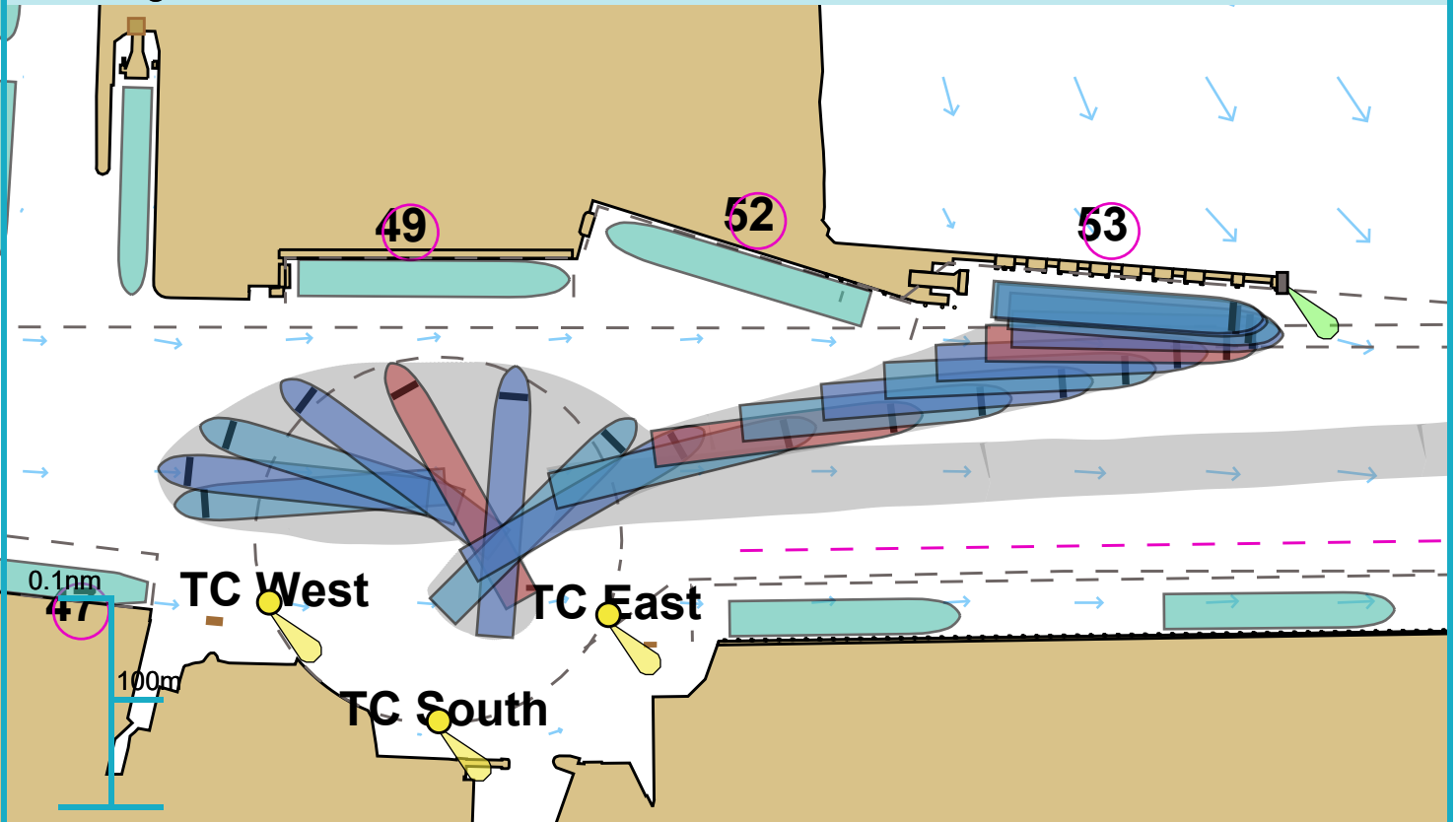
Comments:

Approach



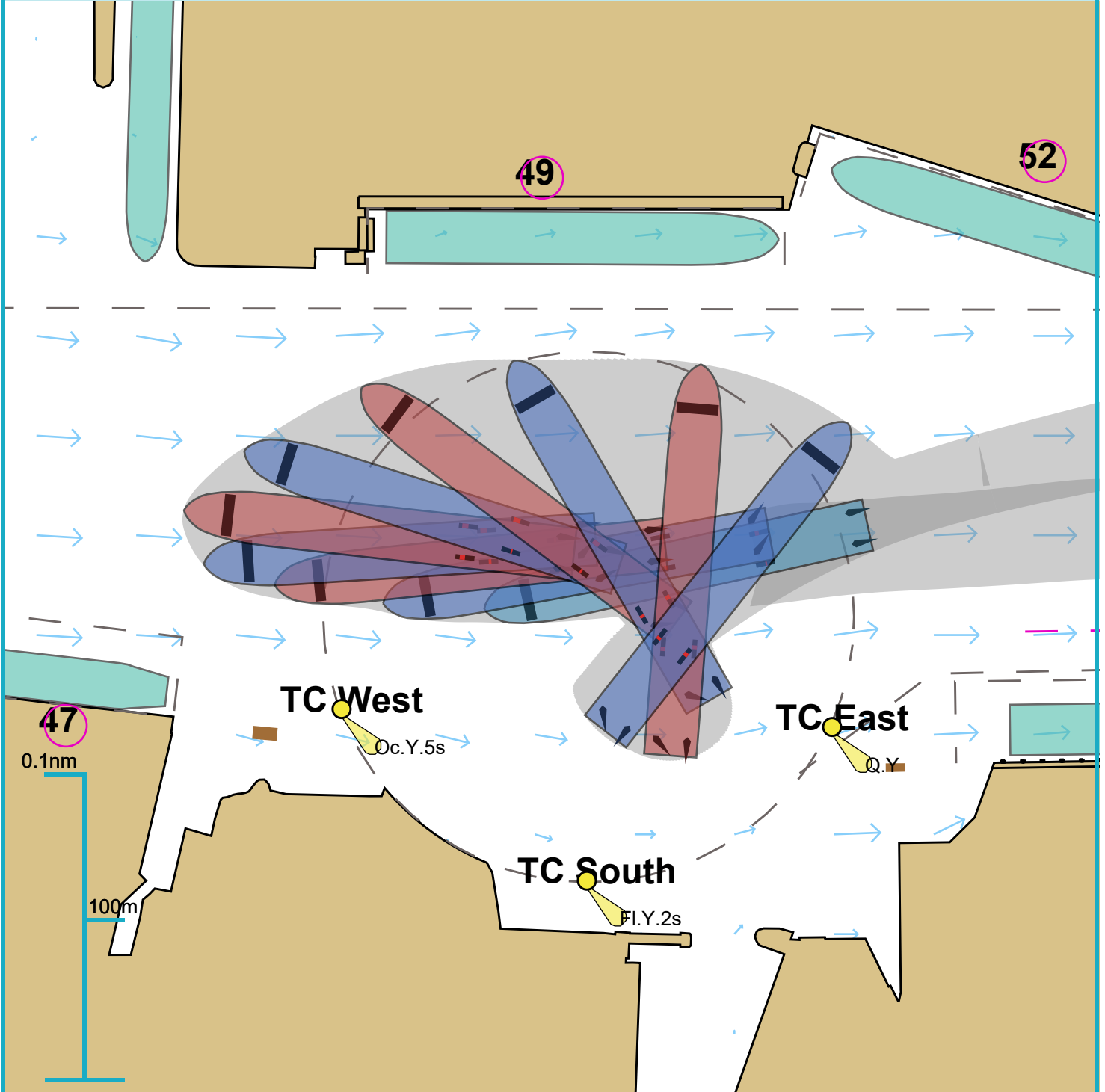
Ships plotted every 1 mins, highlight every 5 mins

Berthing

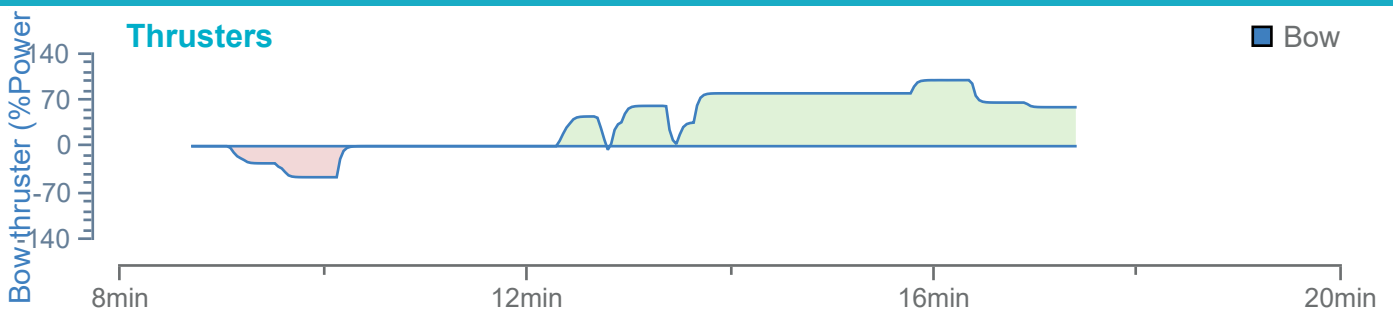


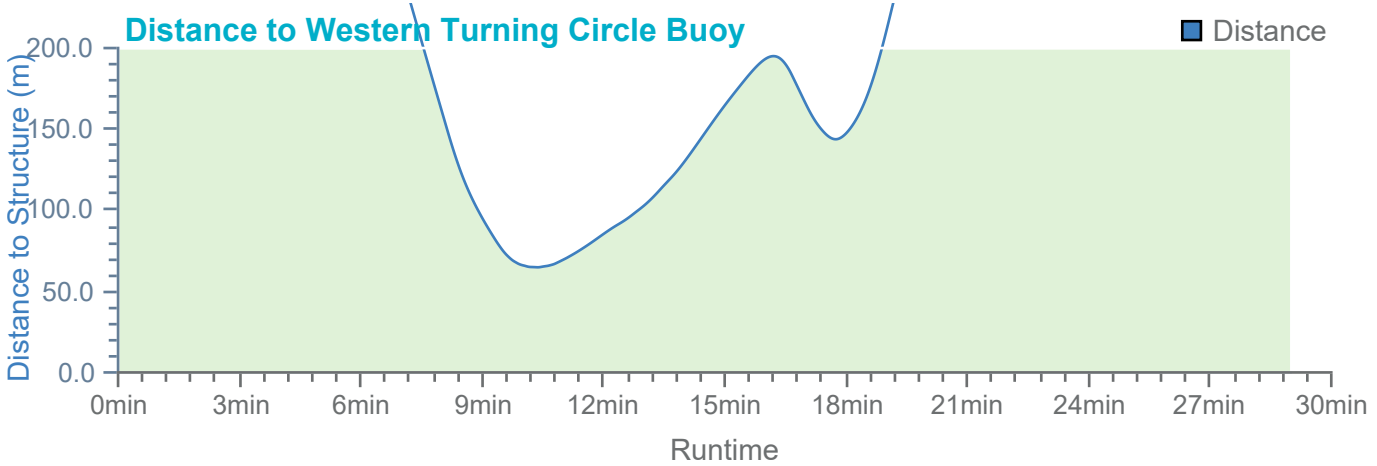
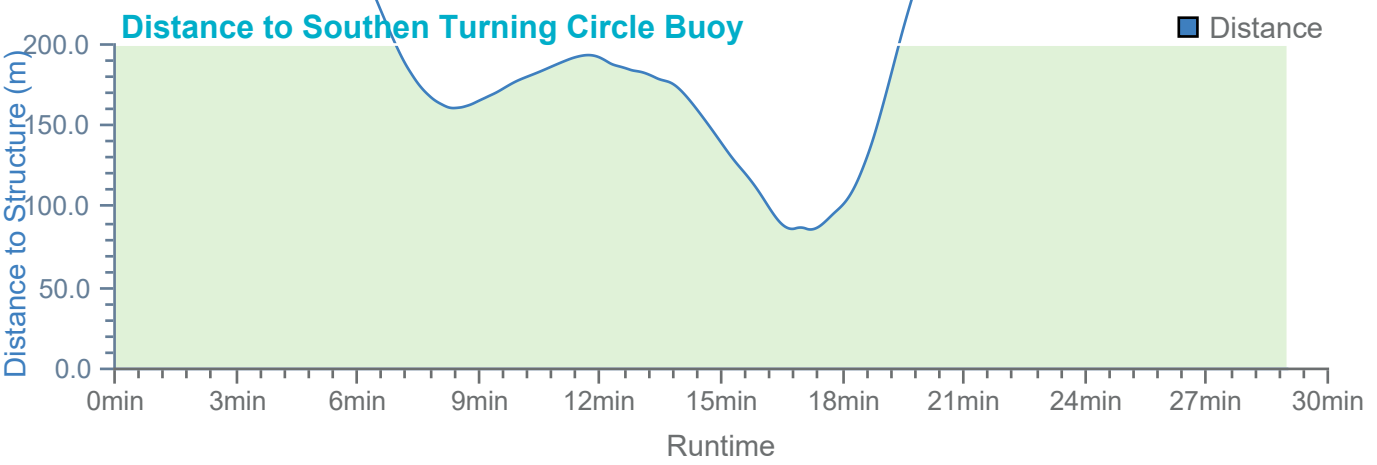
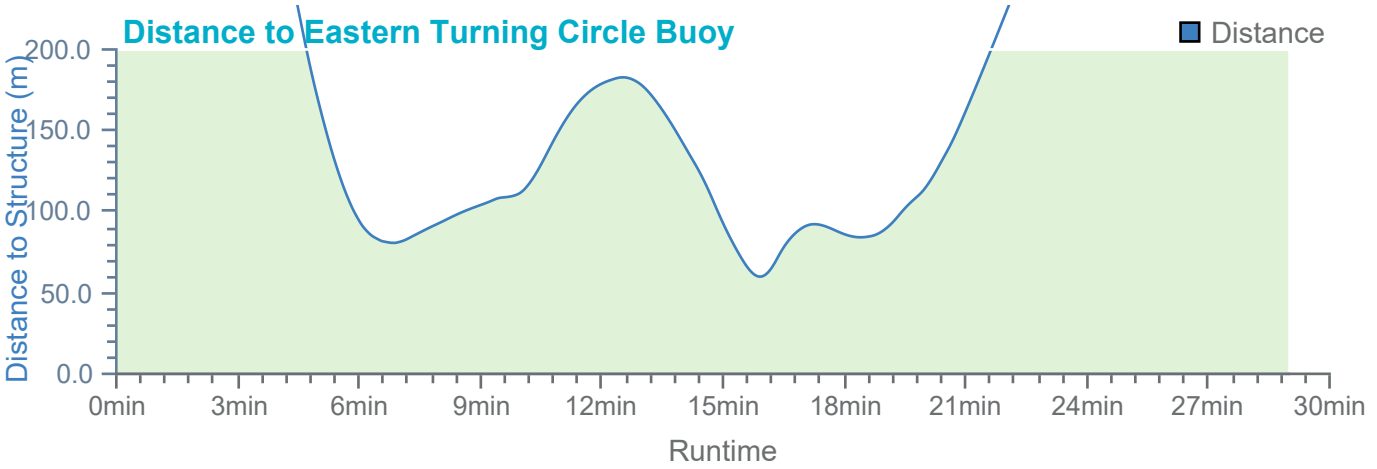
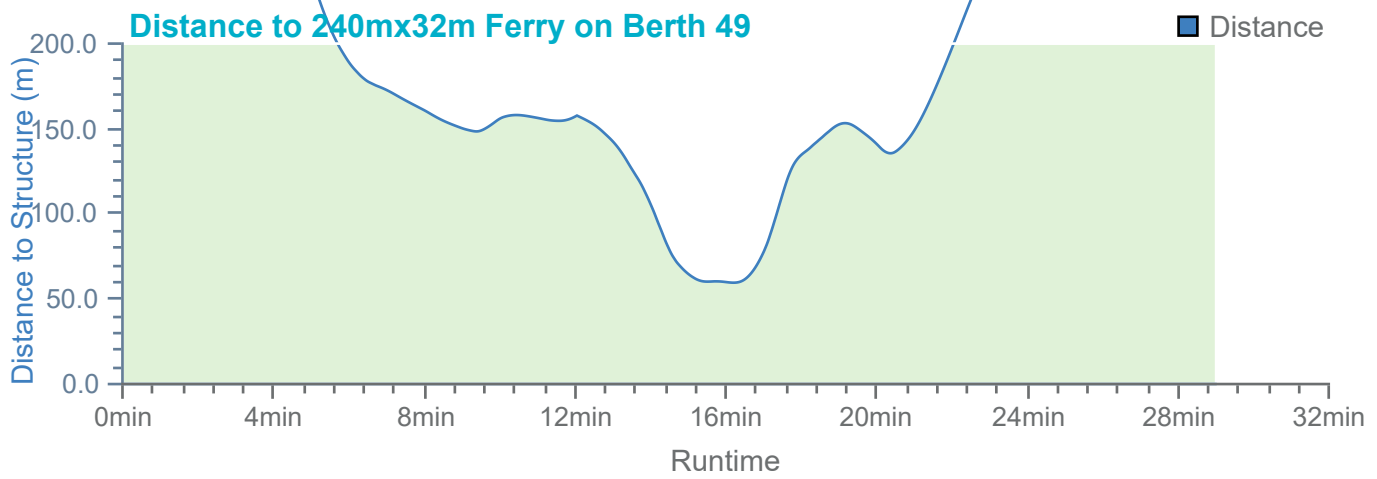
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



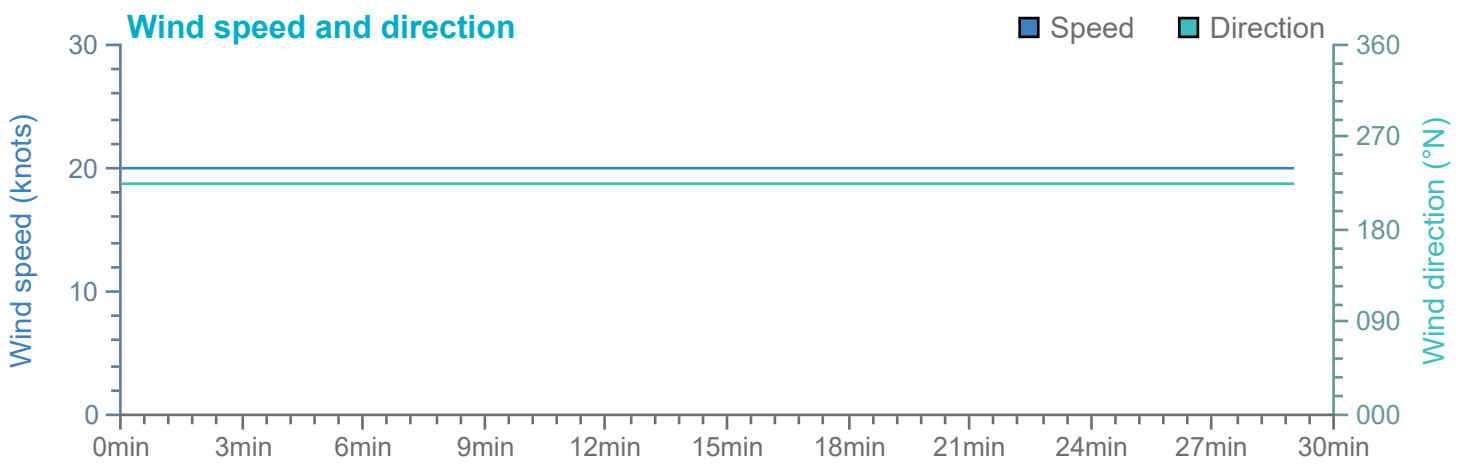
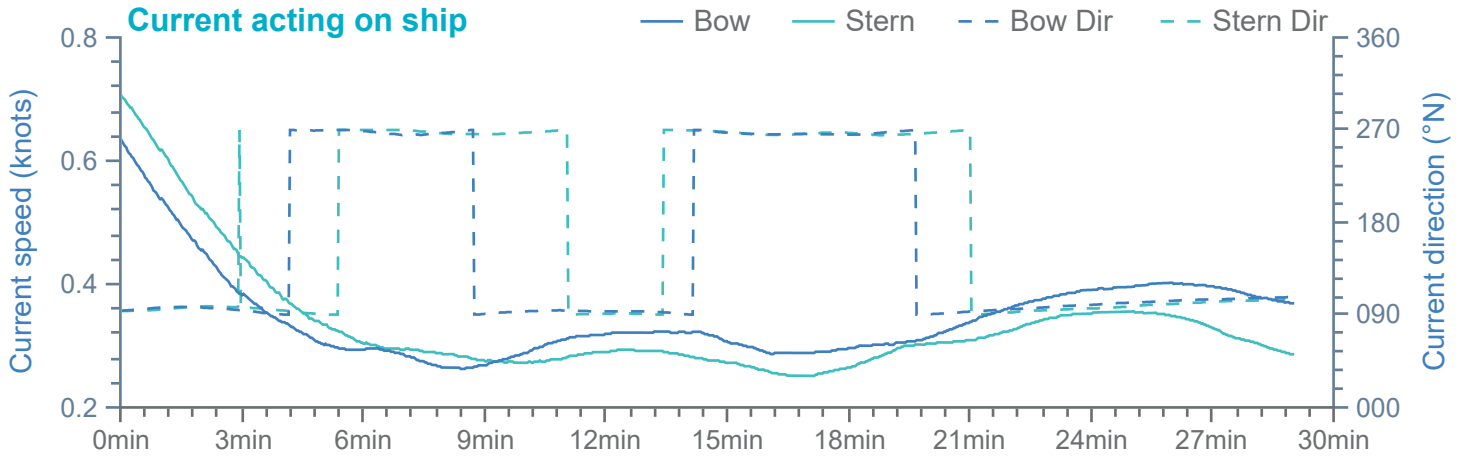


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

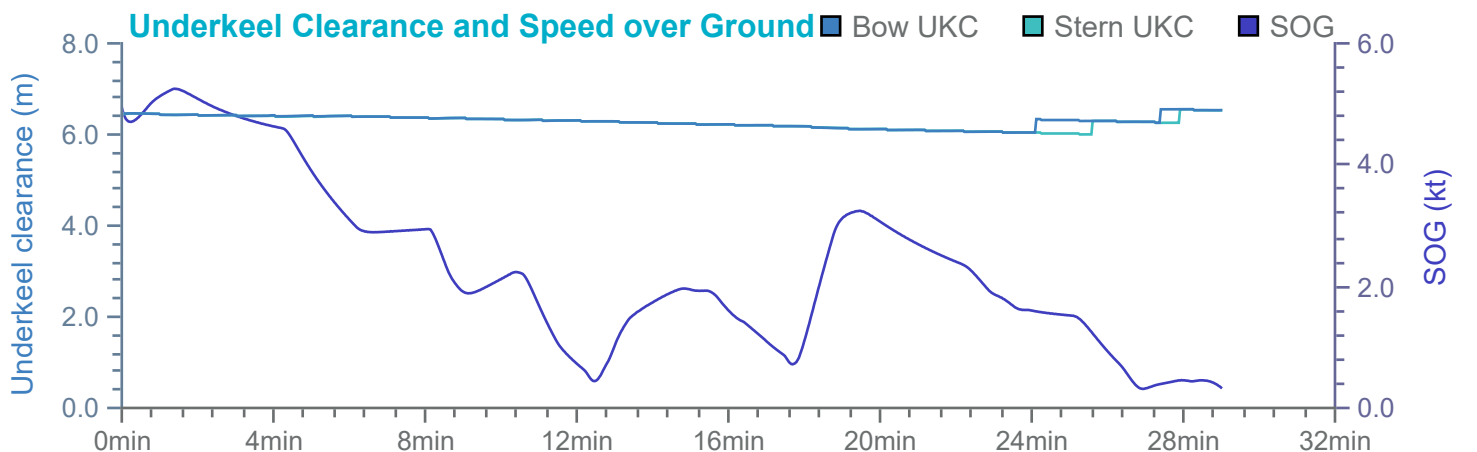
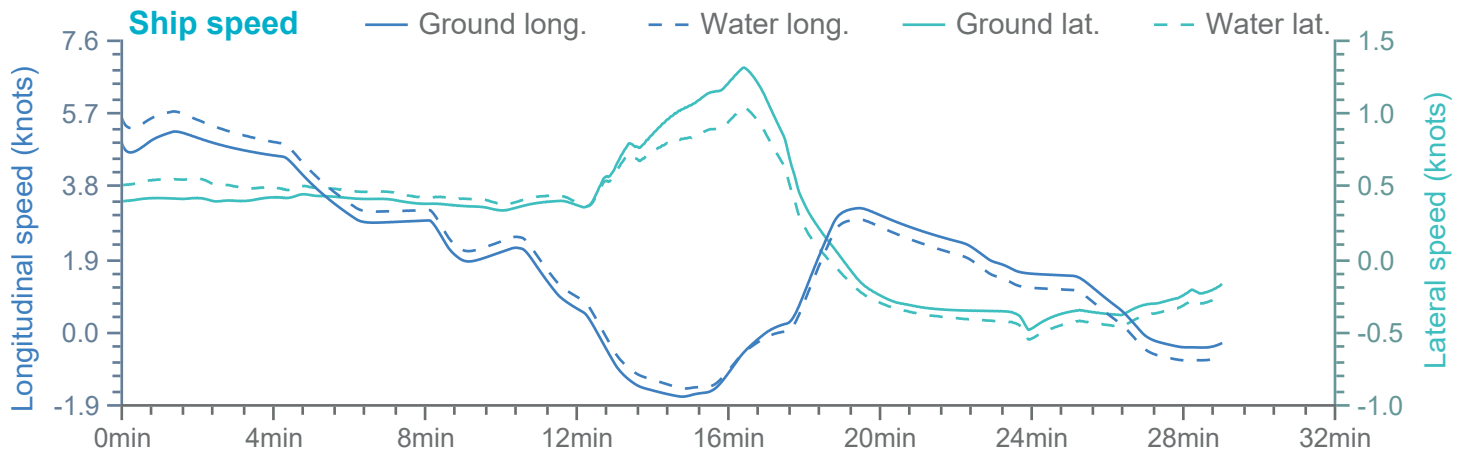
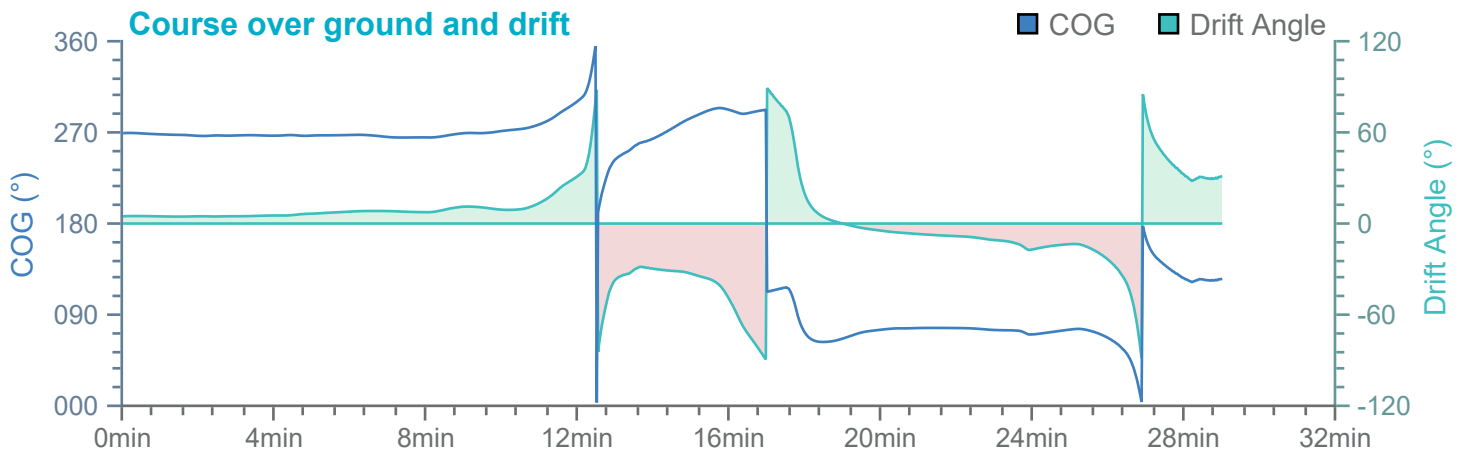
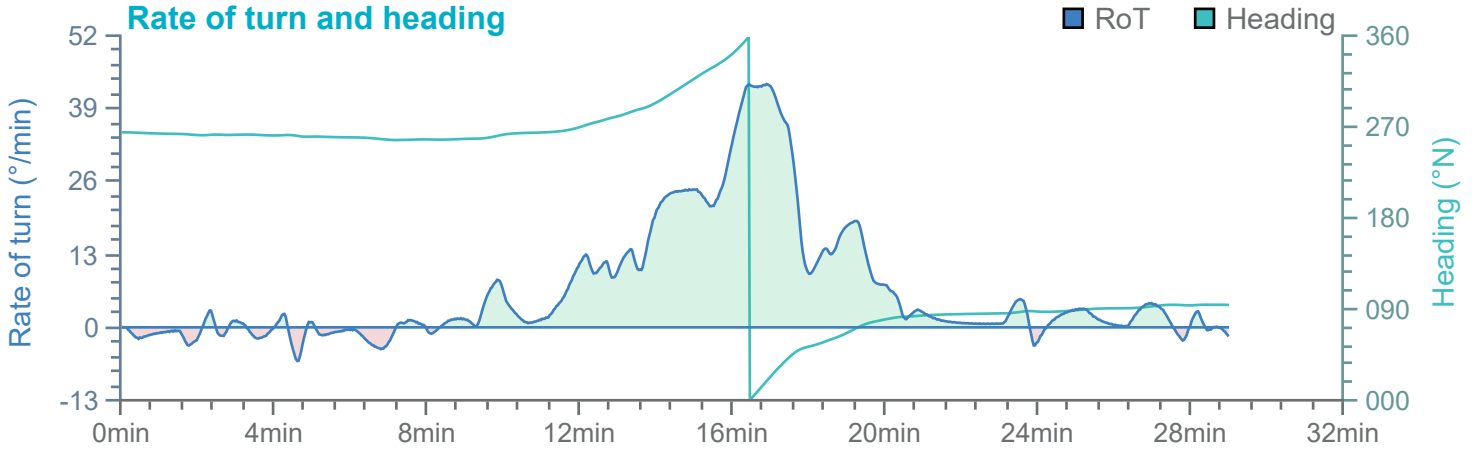


Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

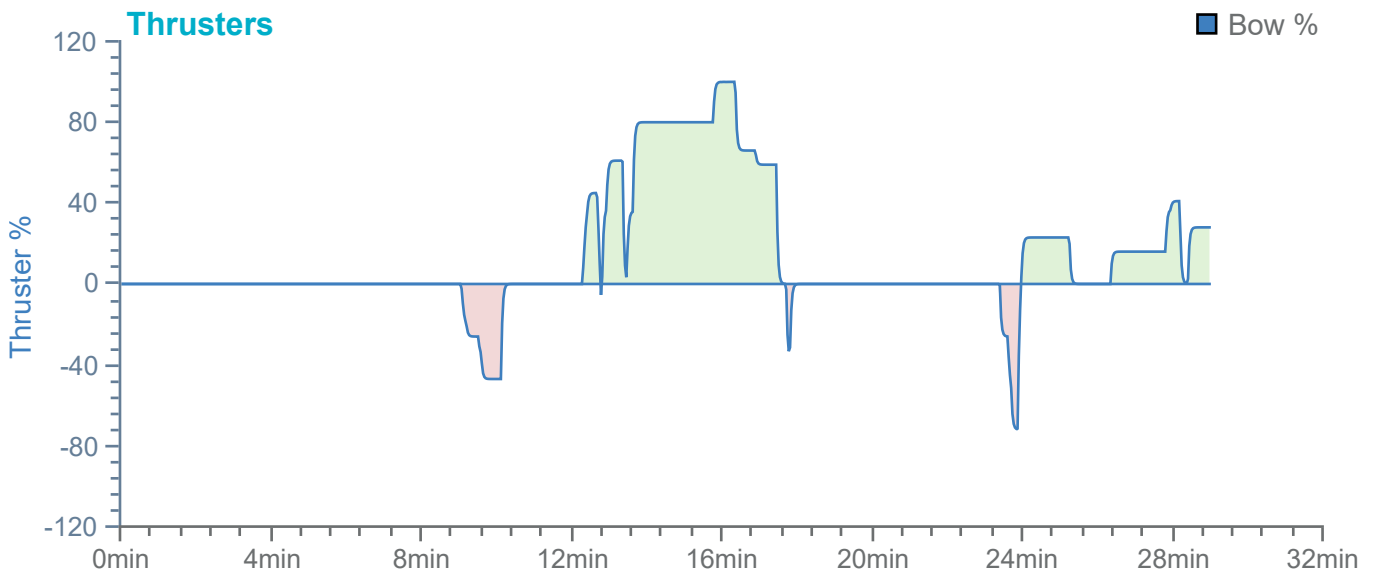
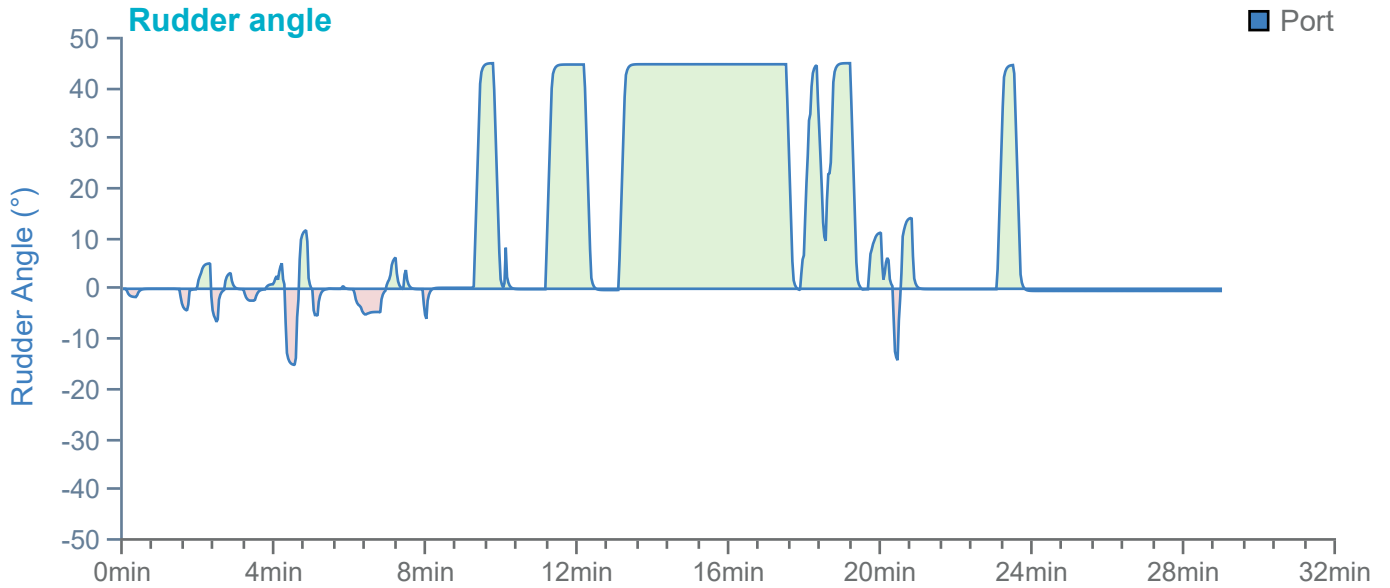
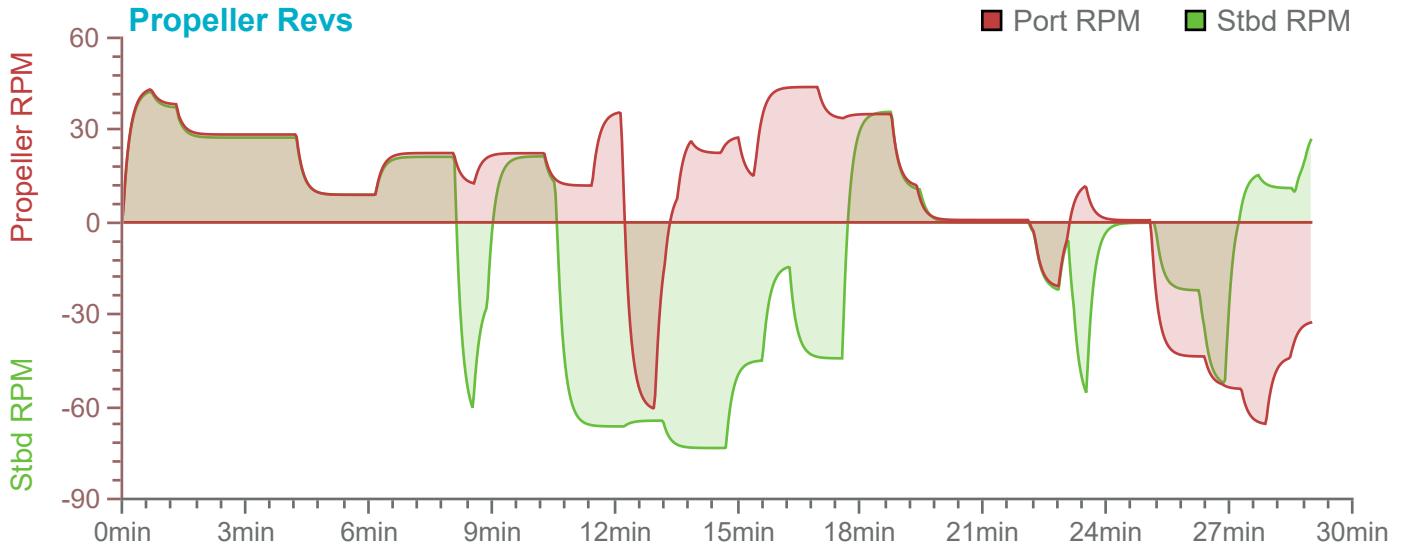


Overview

Environment

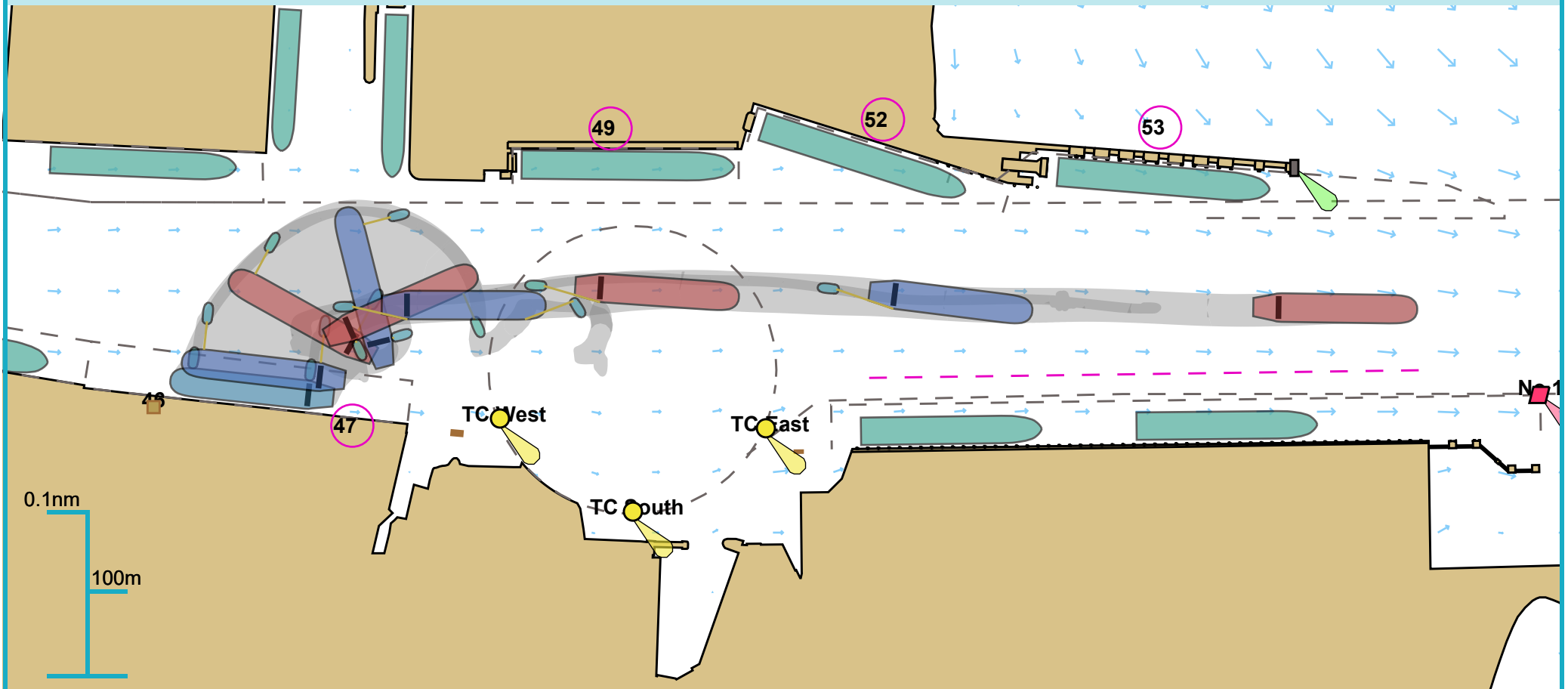
240m x 32m RoPax Ferry

Thruster and engine use



Full Run Overview

53° 20.347 N, 006° 12.284 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:16 minutes

Manoeuvre:Other

Ownship(s):185m x 32m Bulker Ballast

Comments:

Overview

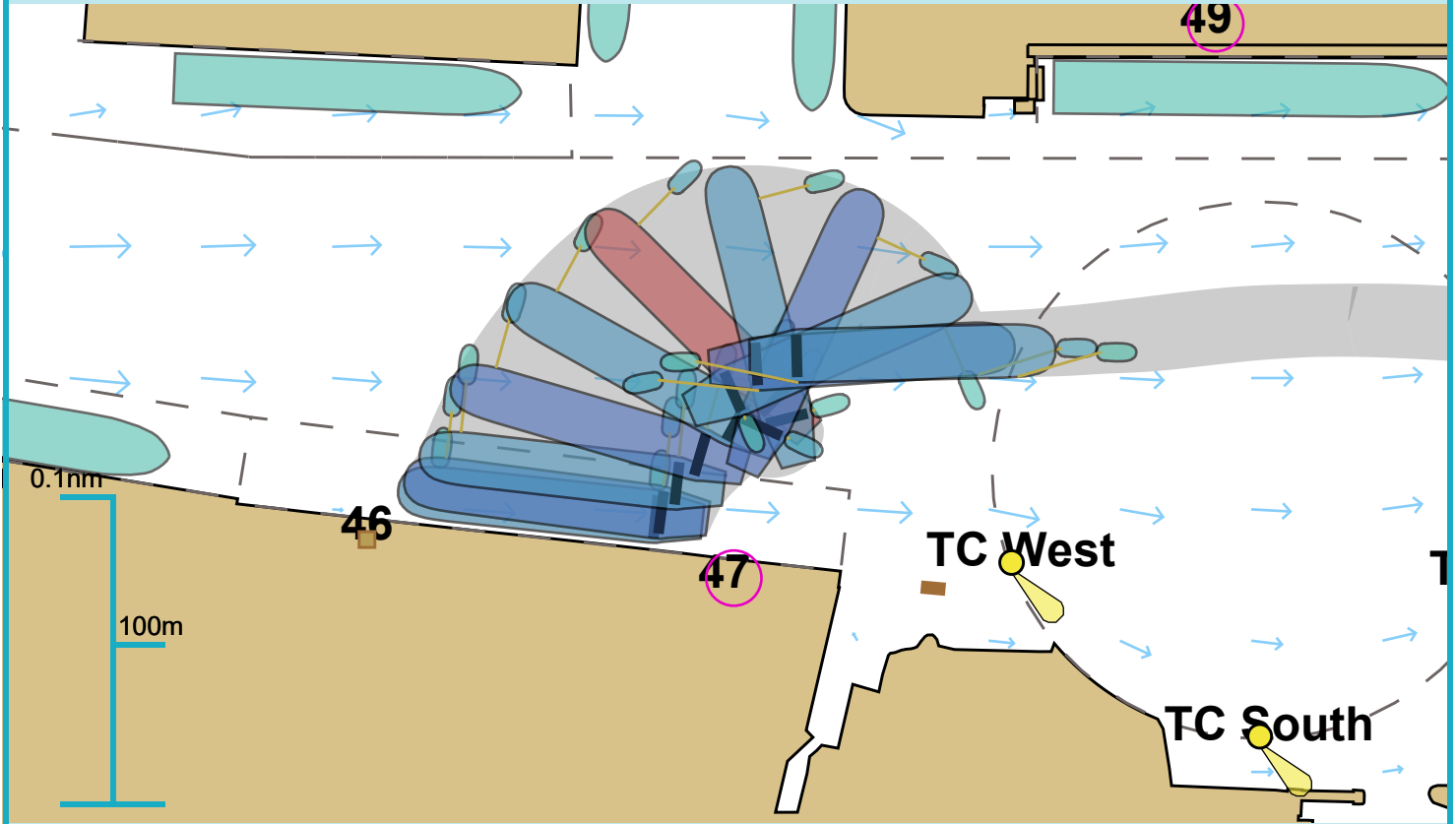
Environment

185m x 32m Bulker Ballast

Thruster and engine use

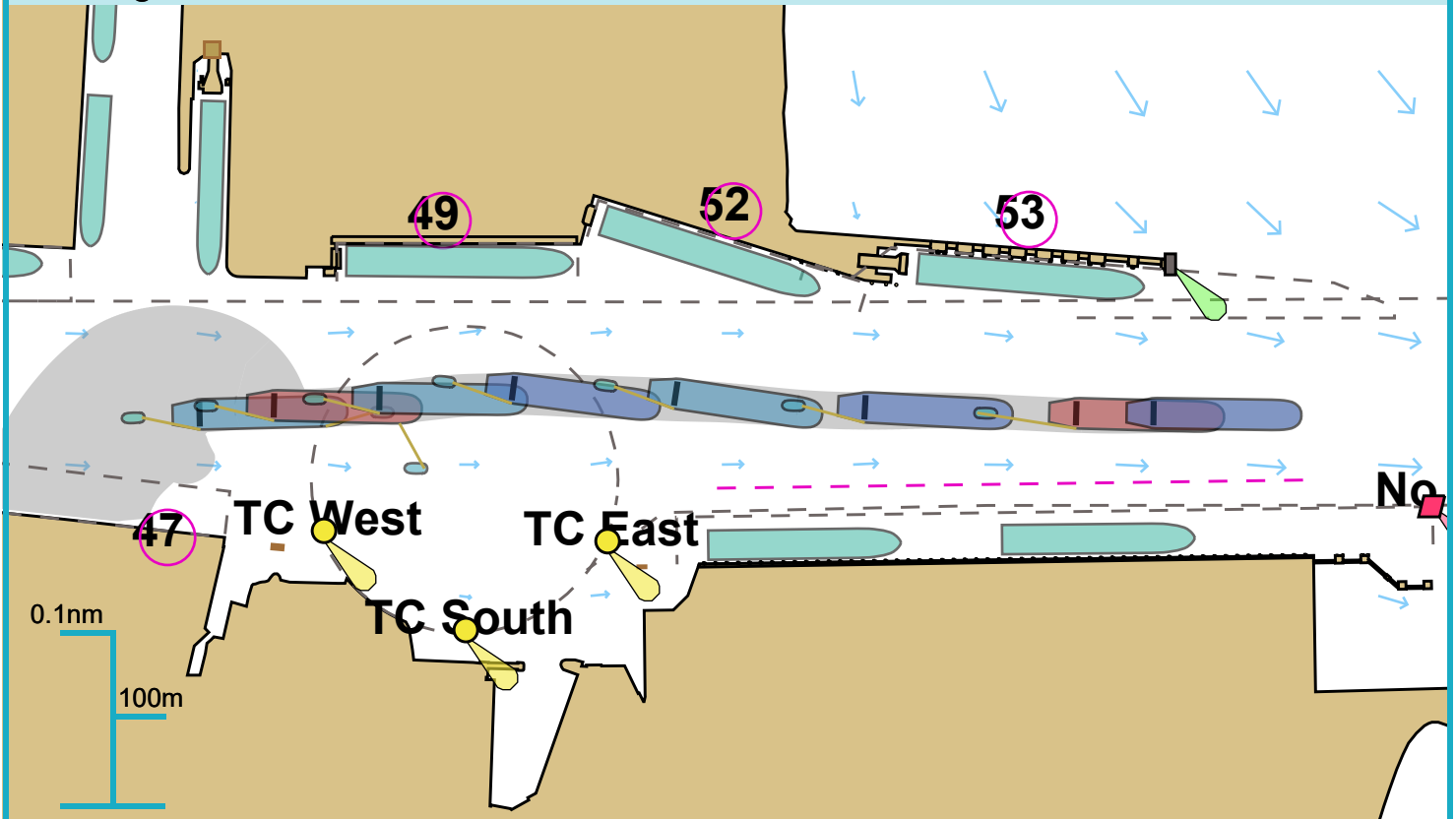
Tug use

Departure



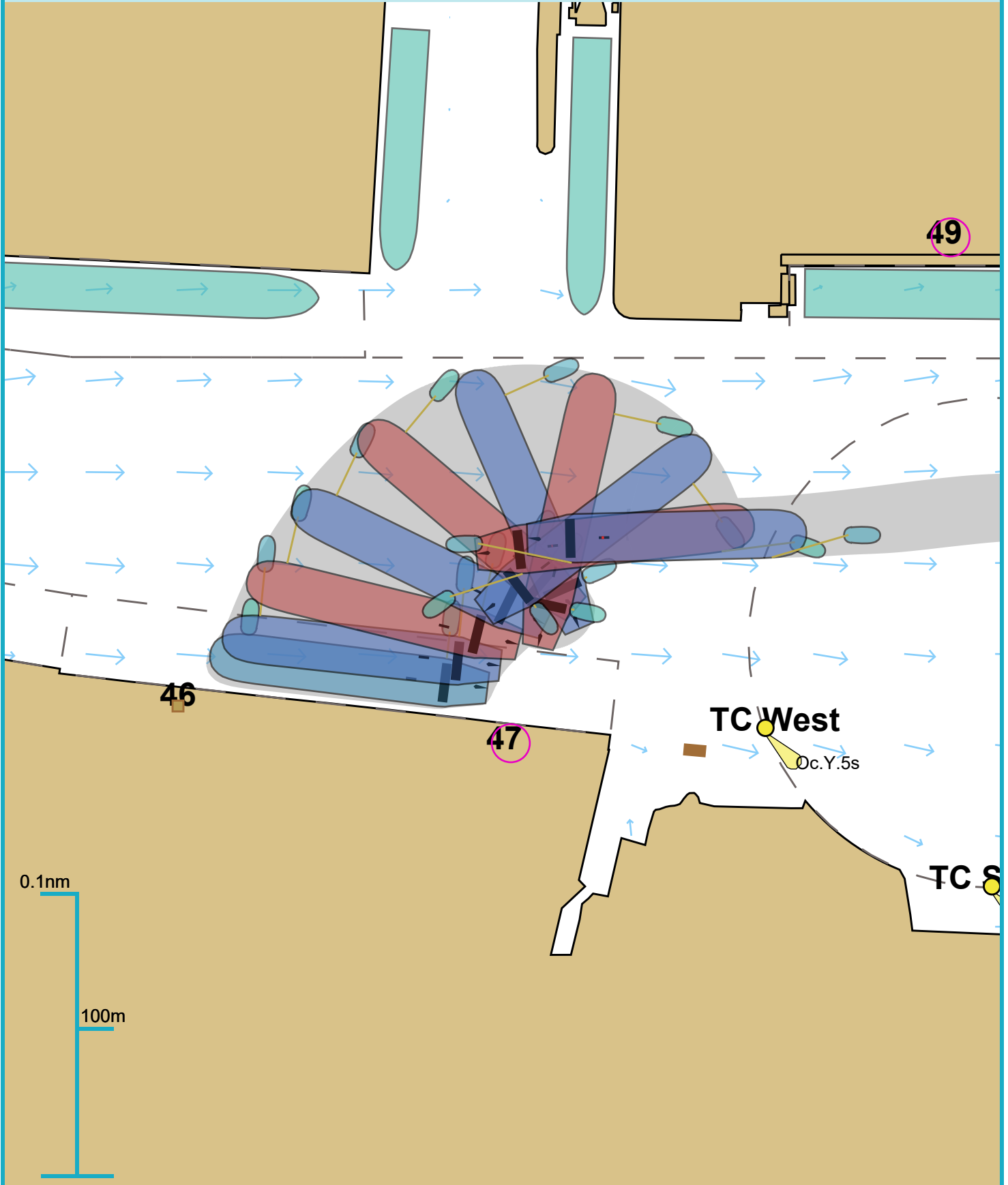
Ships plotted every 1 mins, highlight every 5 mins

Passage

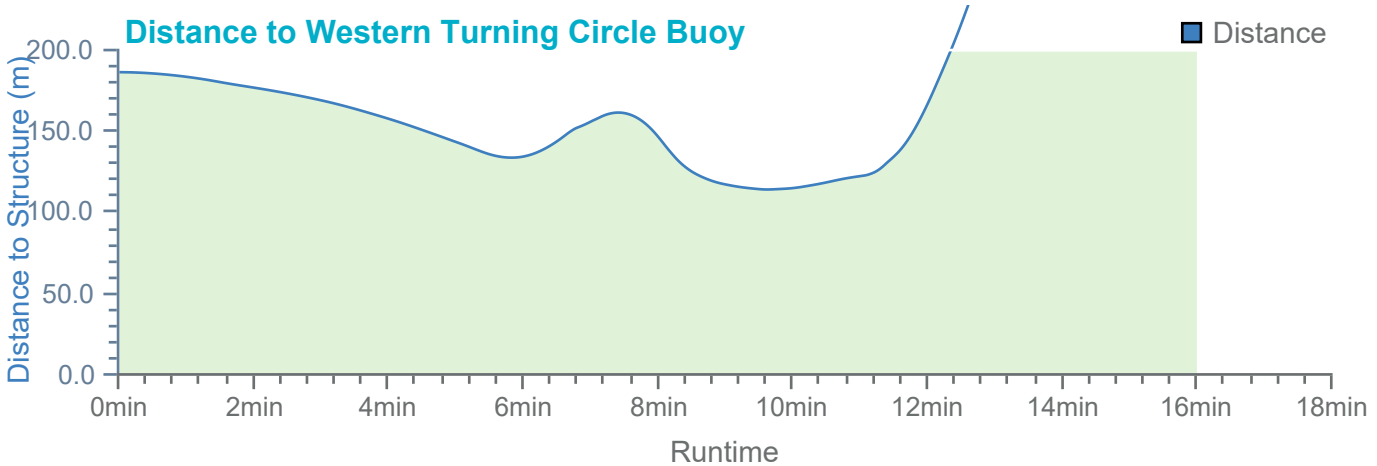
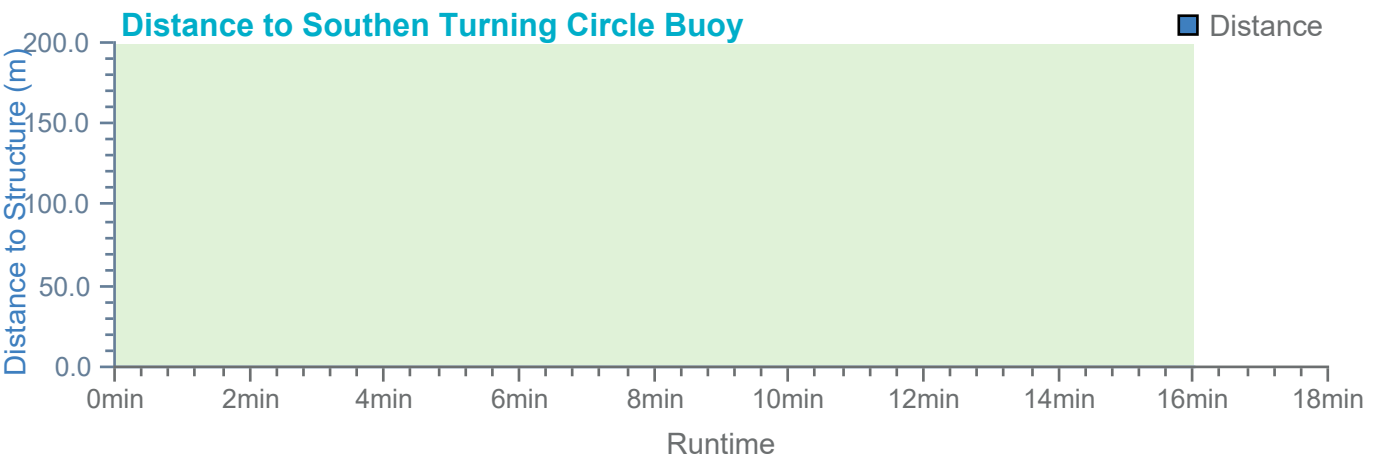
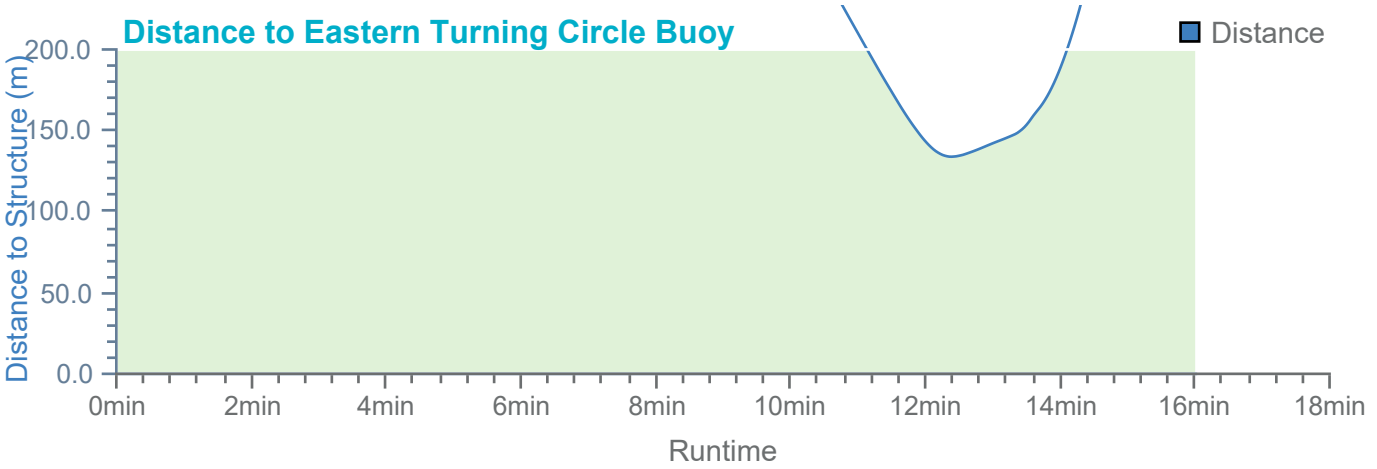
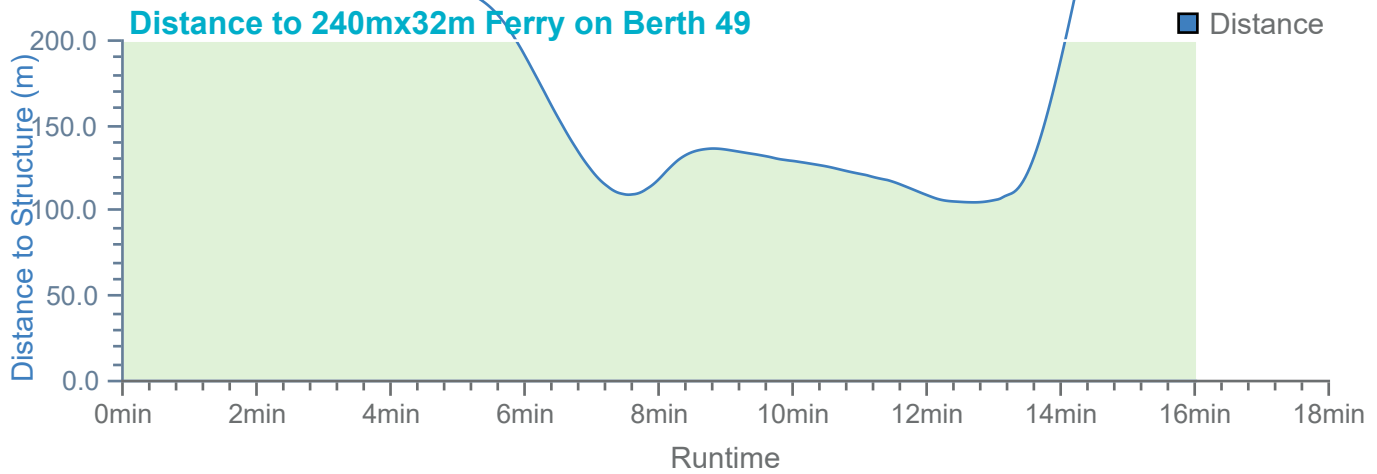


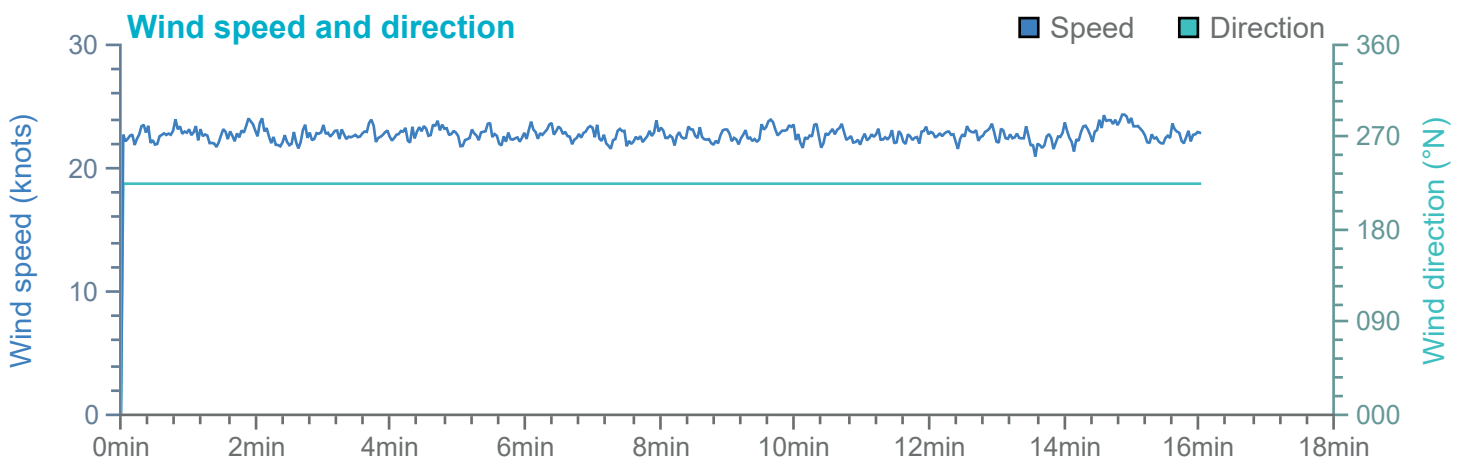
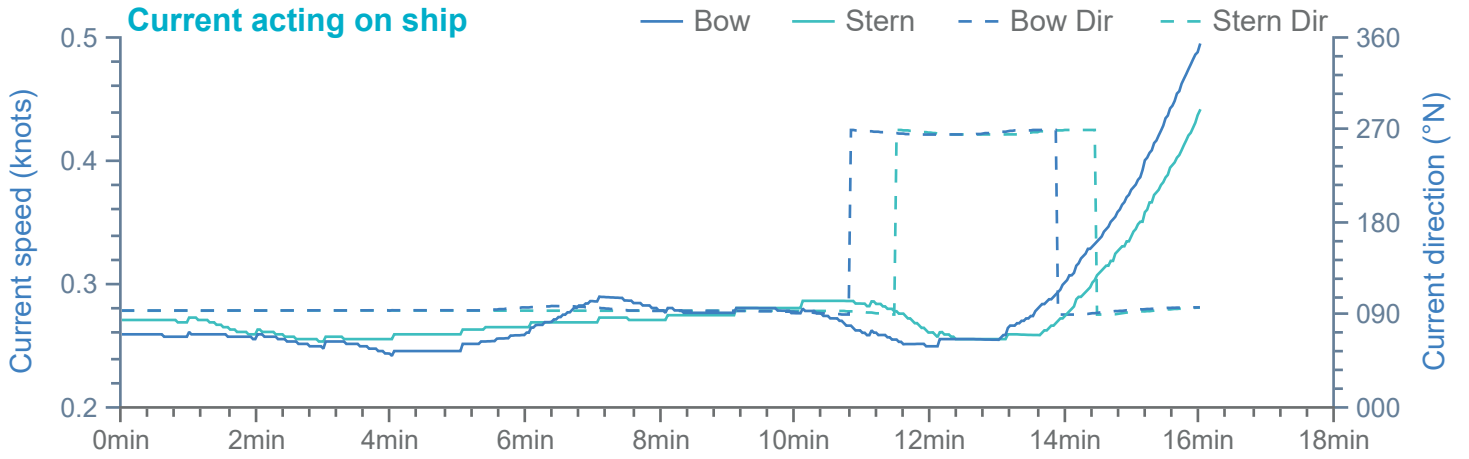
Ships plotted every 1 mins, highlight every 5 mins

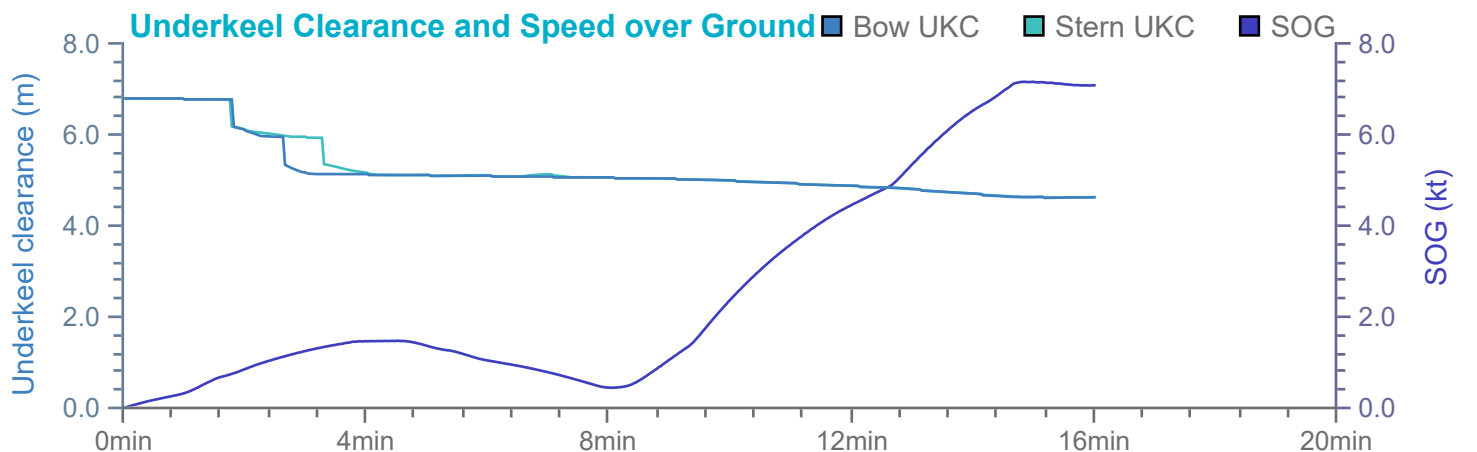
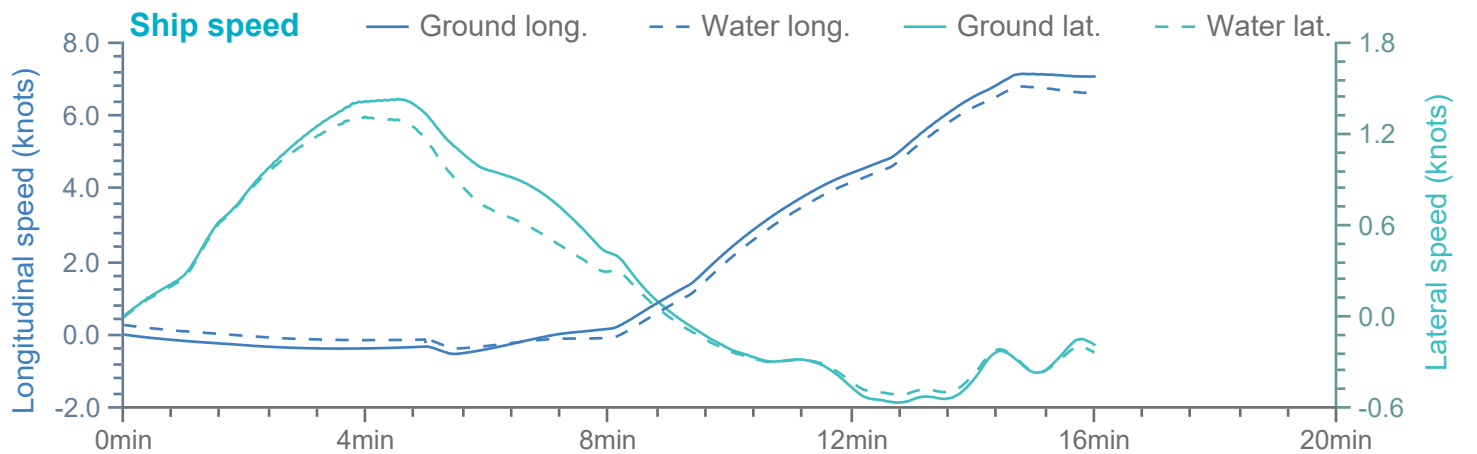
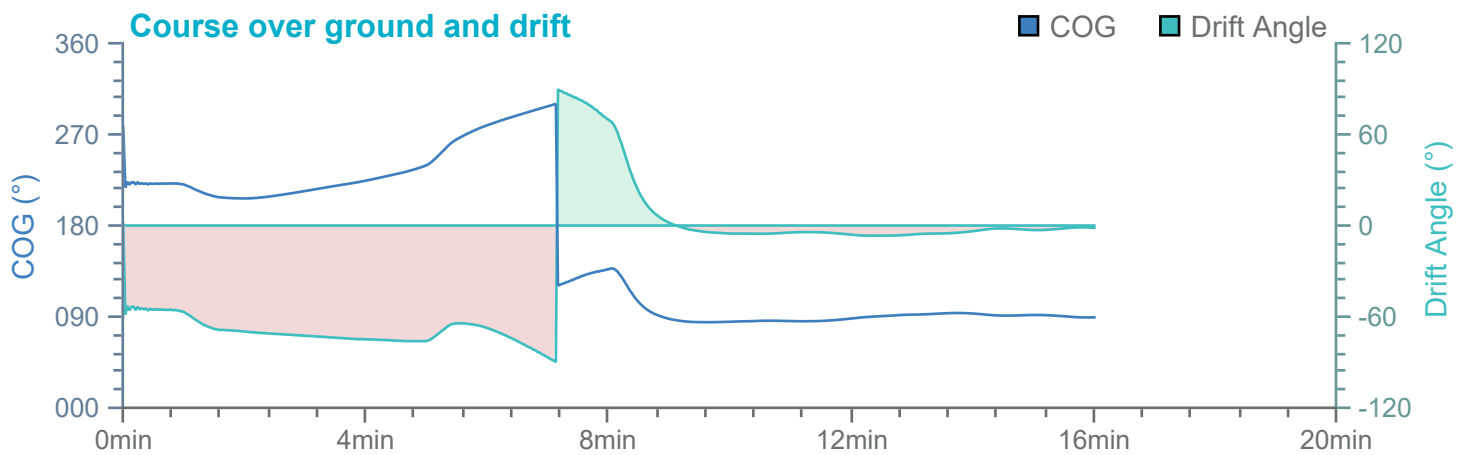
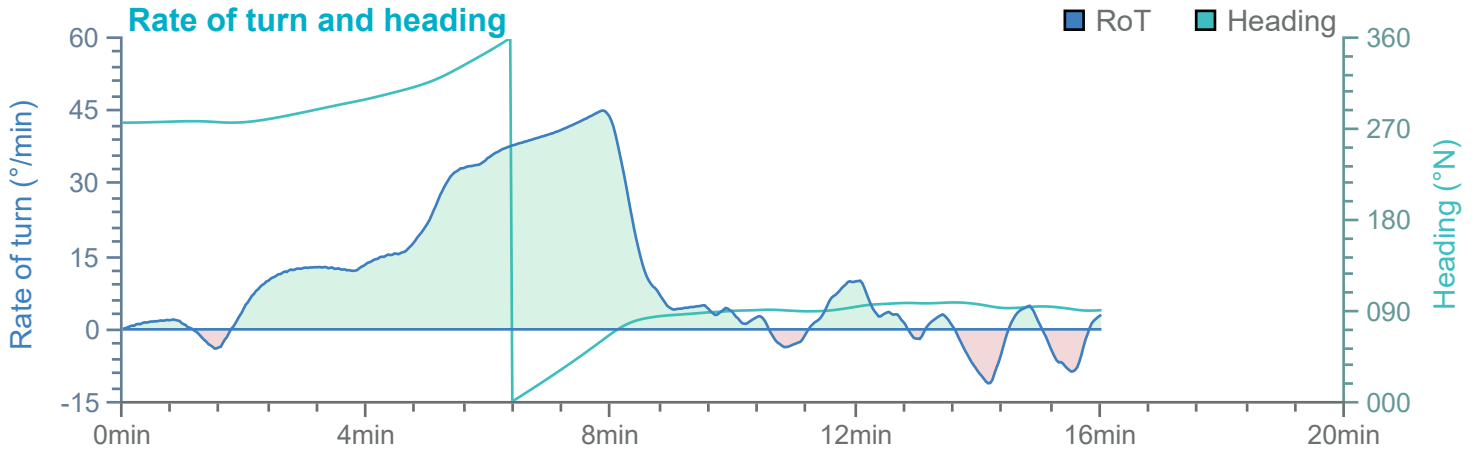
Swing

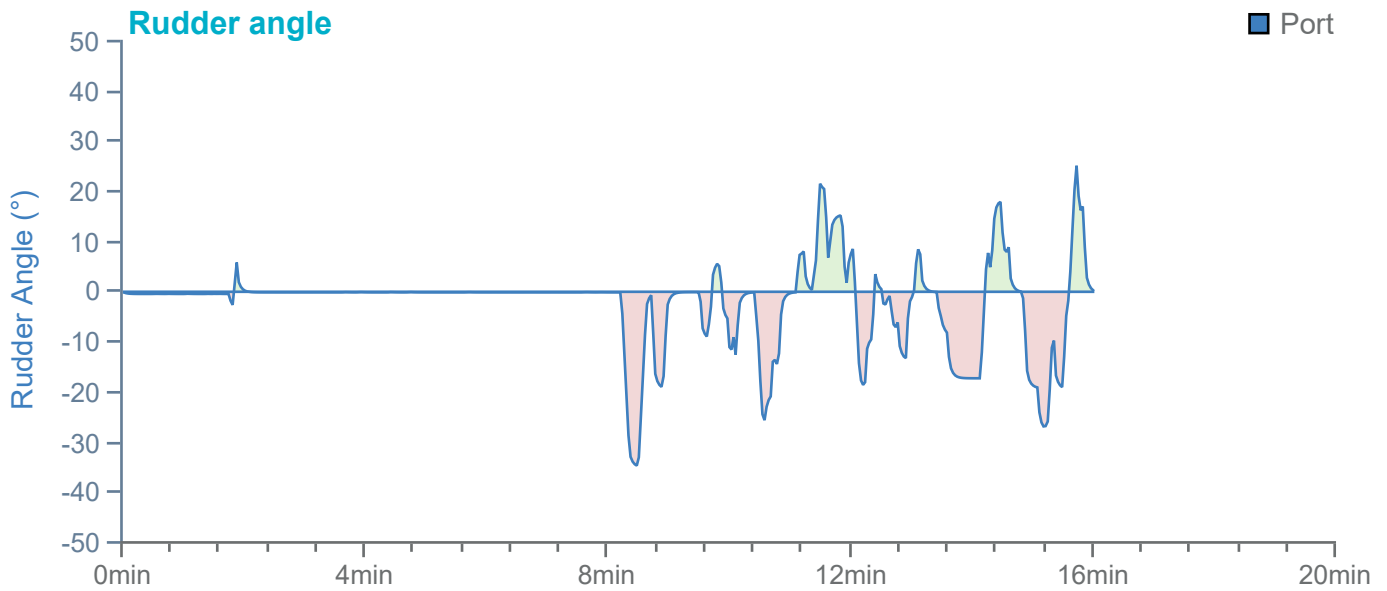
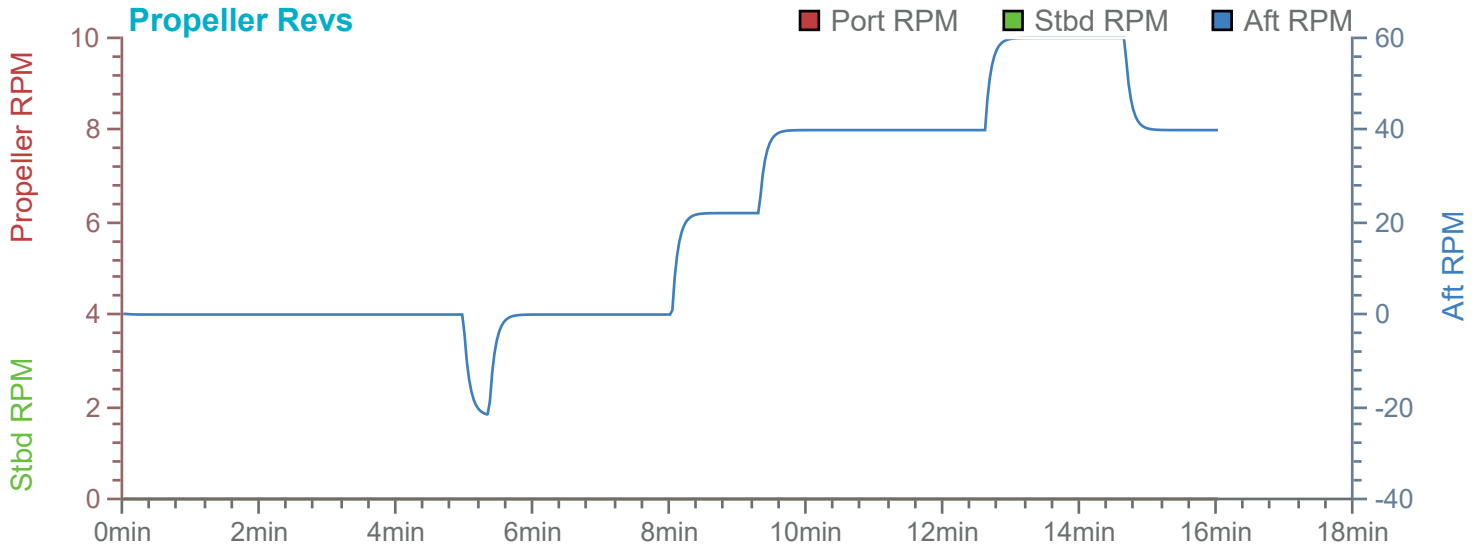


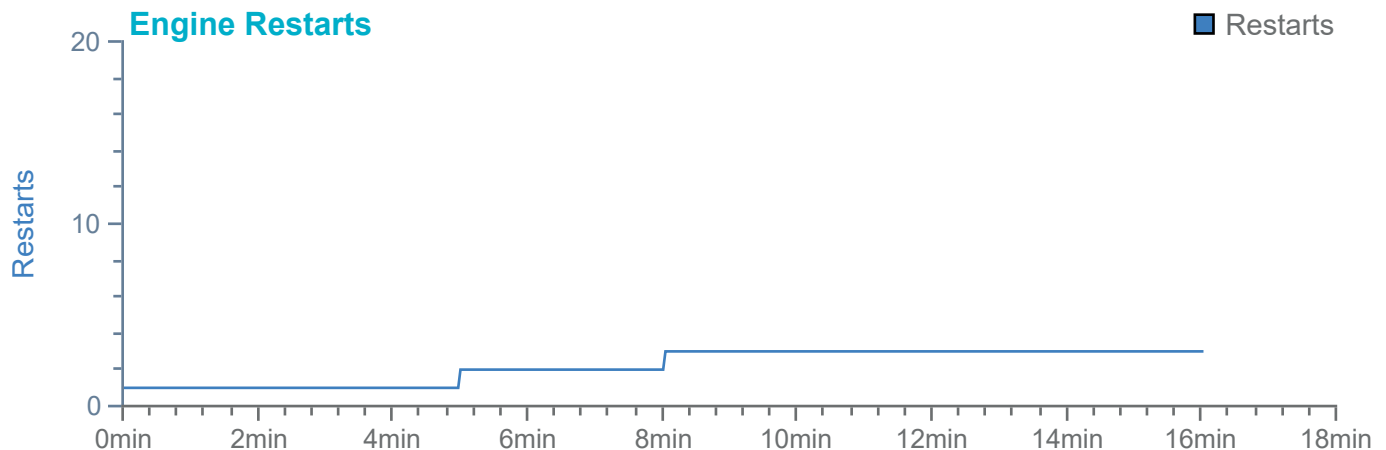
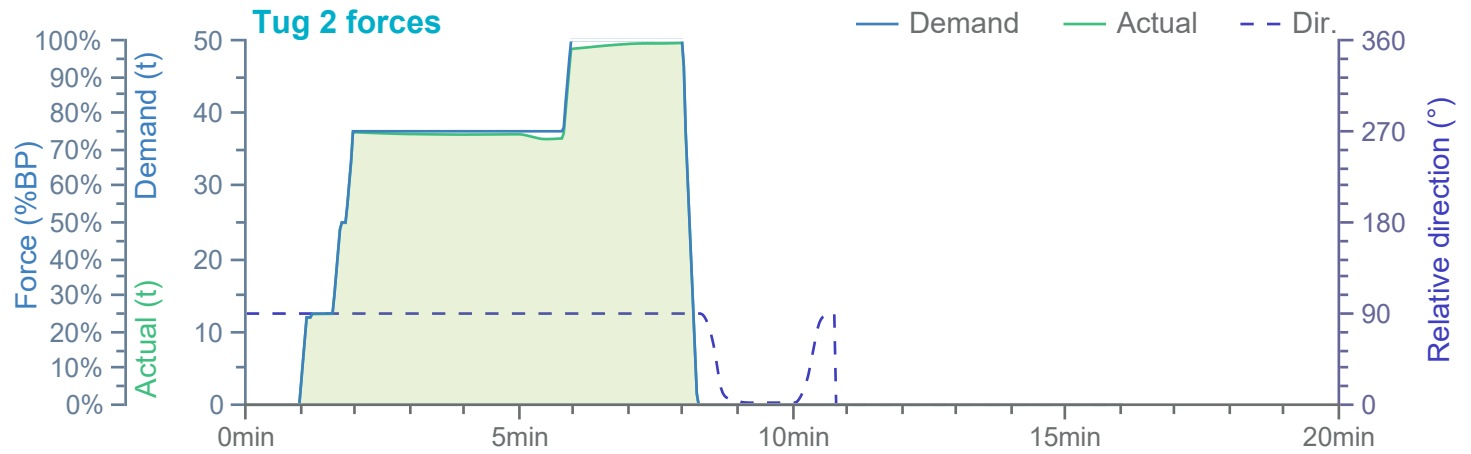
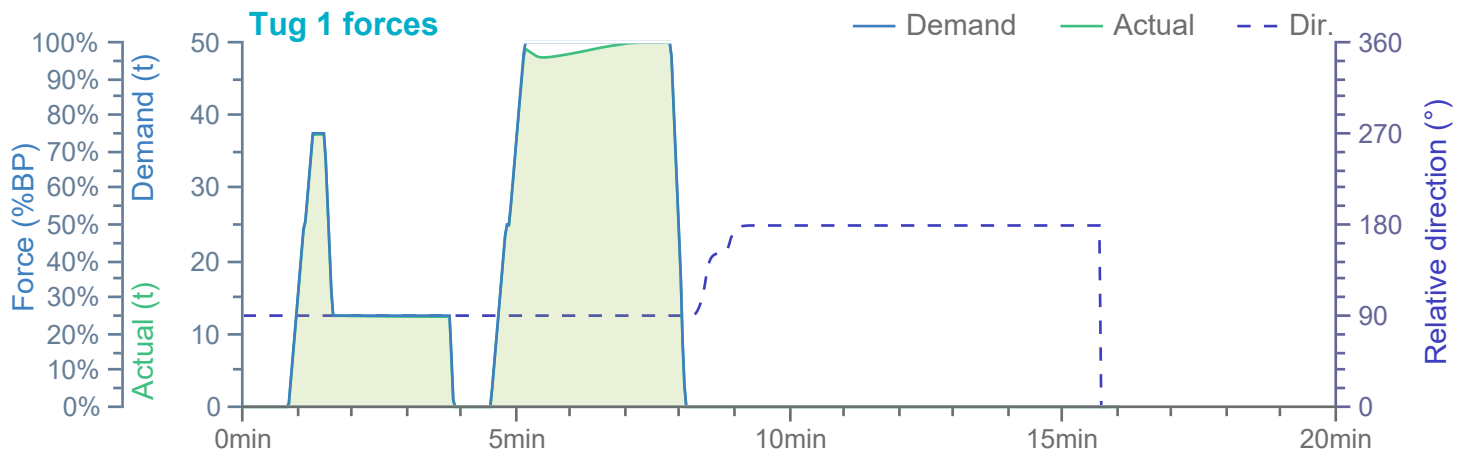
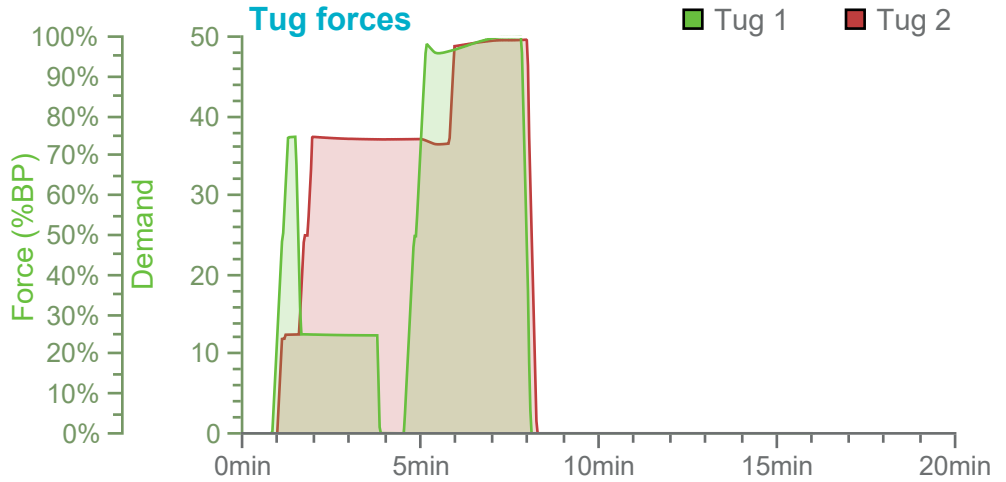
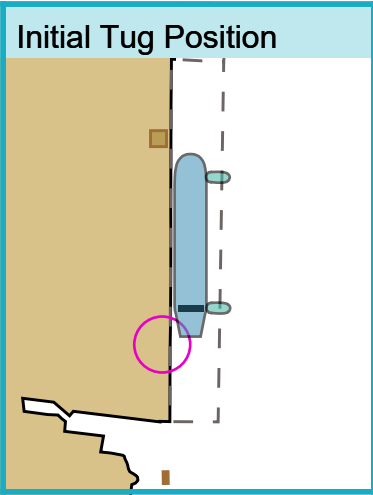
Ships plotted every 59 seconds, highlight every 2 mins





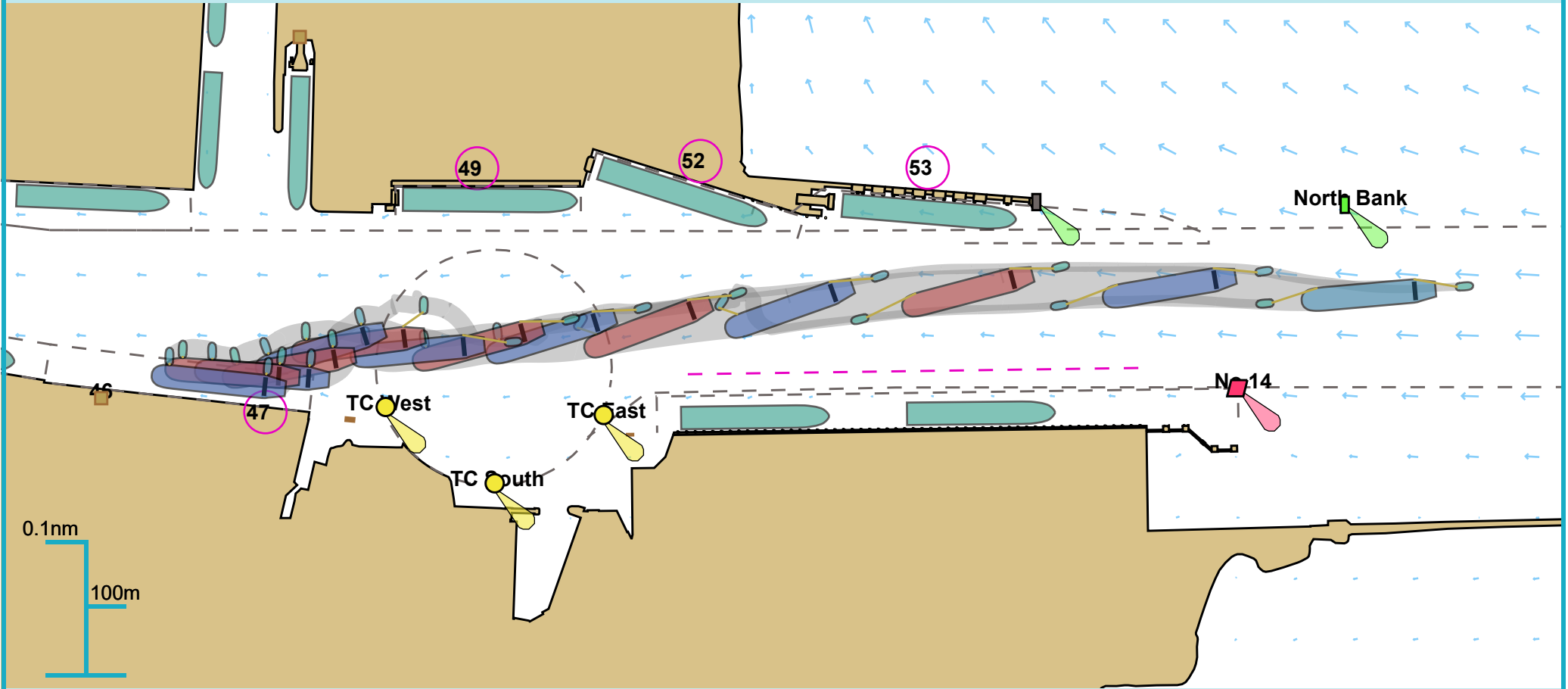






Full Run Overview

53° 20.296 N, 006° 12.255 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:25 minutes

Manoeuvre:Other

Ownship(s):185m x 32m Bulker Ballast

Comments:

Overview

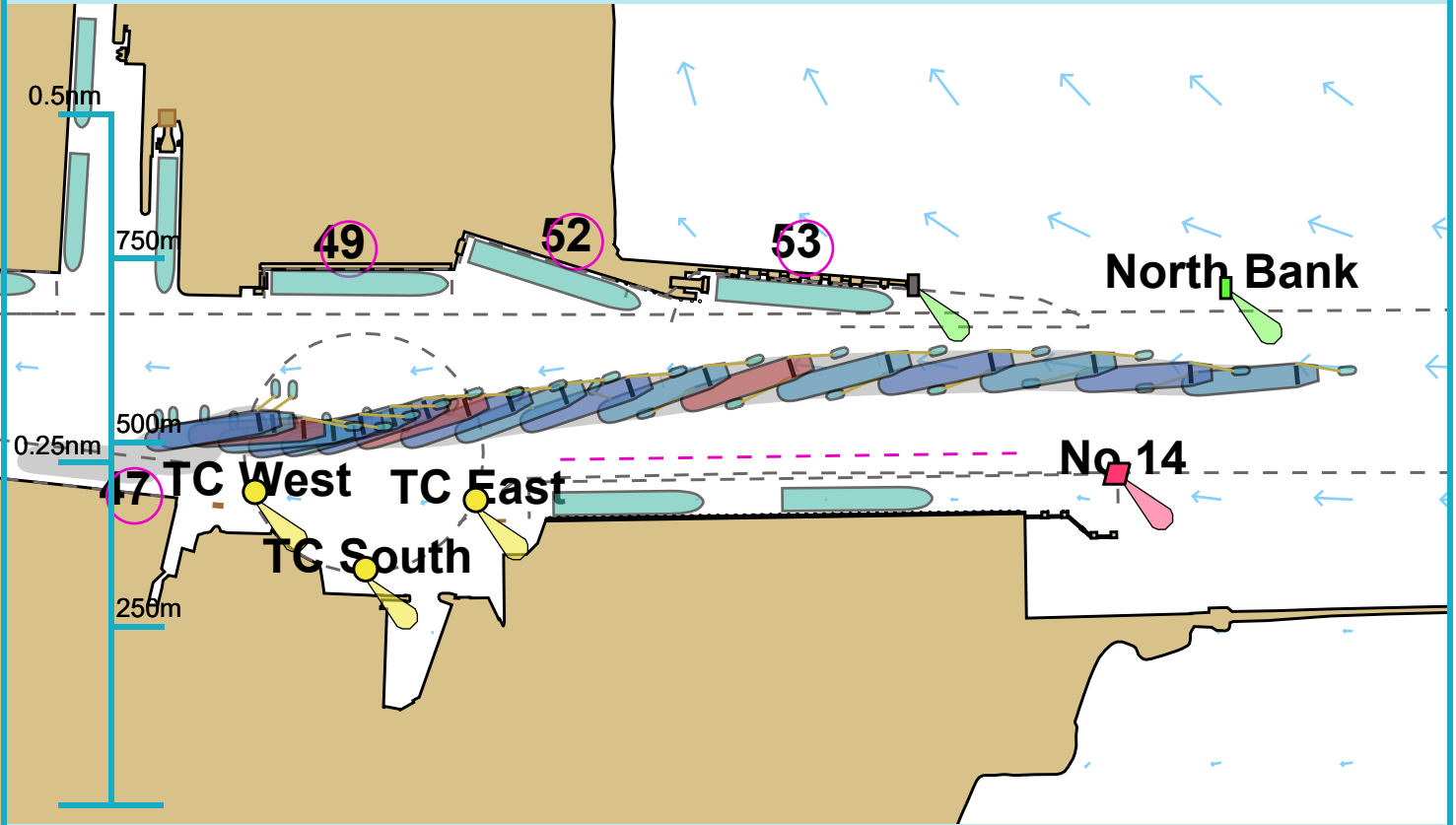
Environment

185m x 32m Bulker Ballast

Thruster and engine use

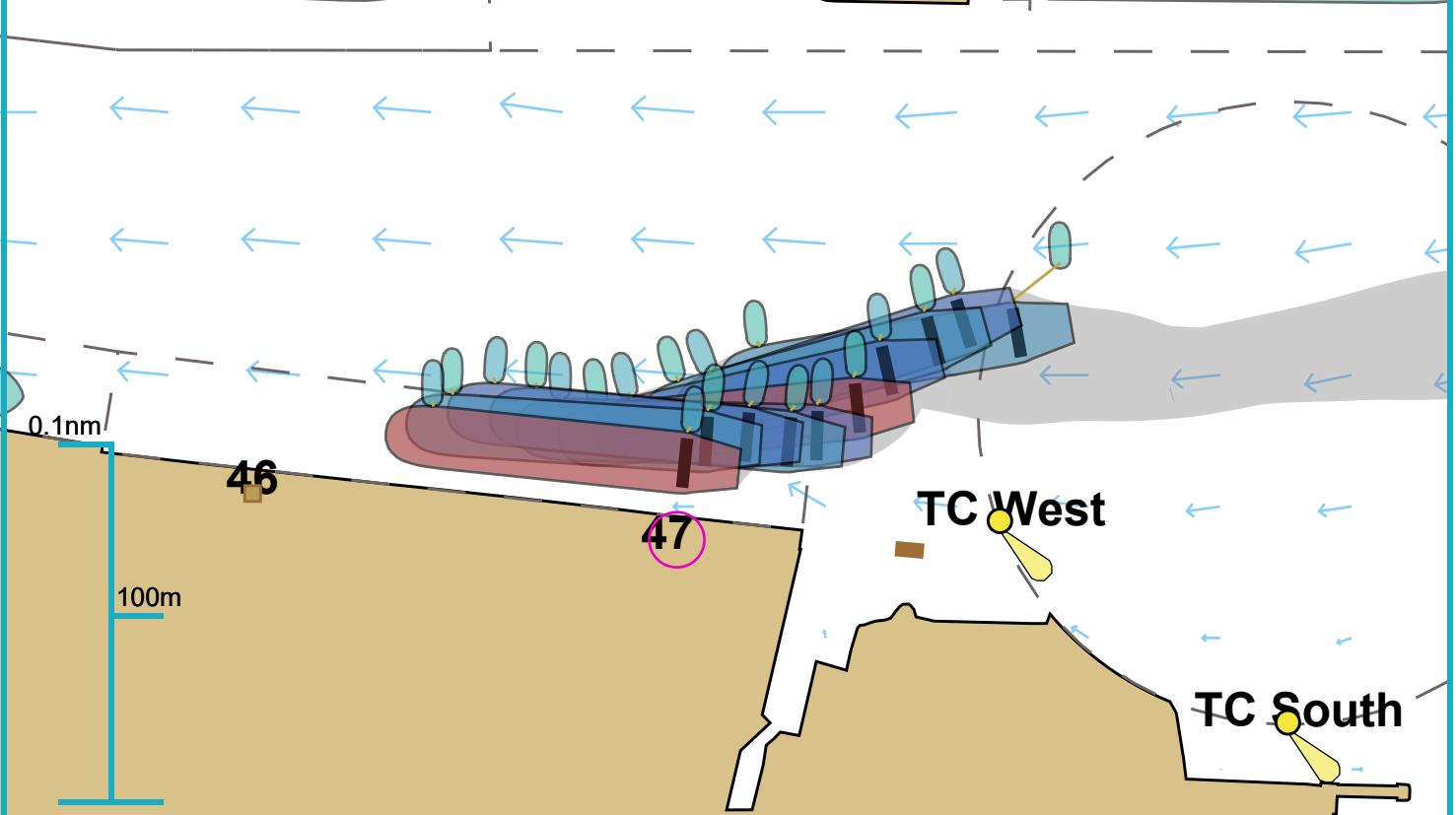
Tug use

Approach

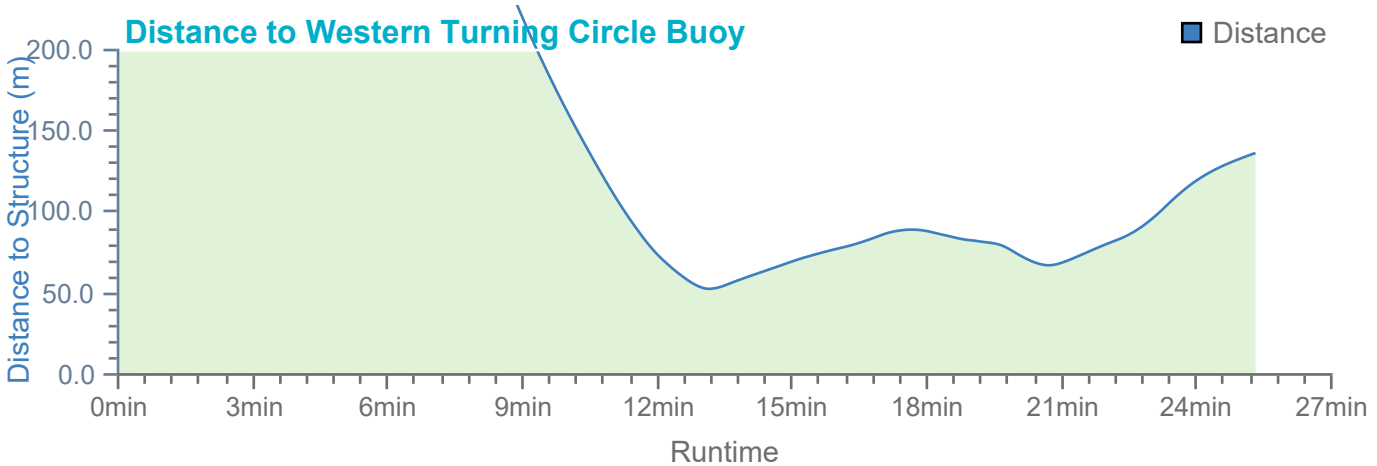
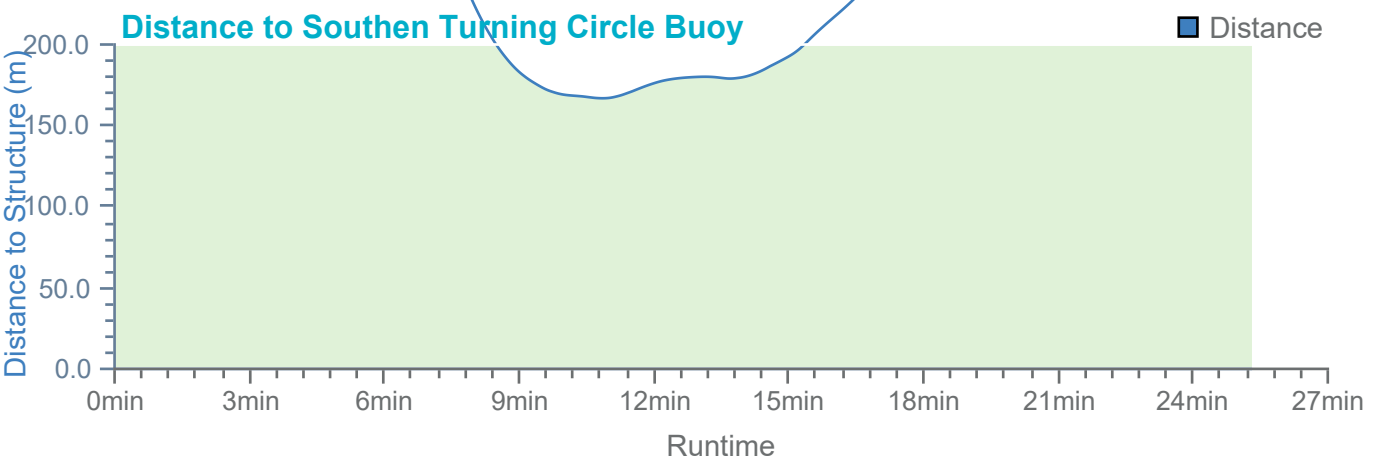
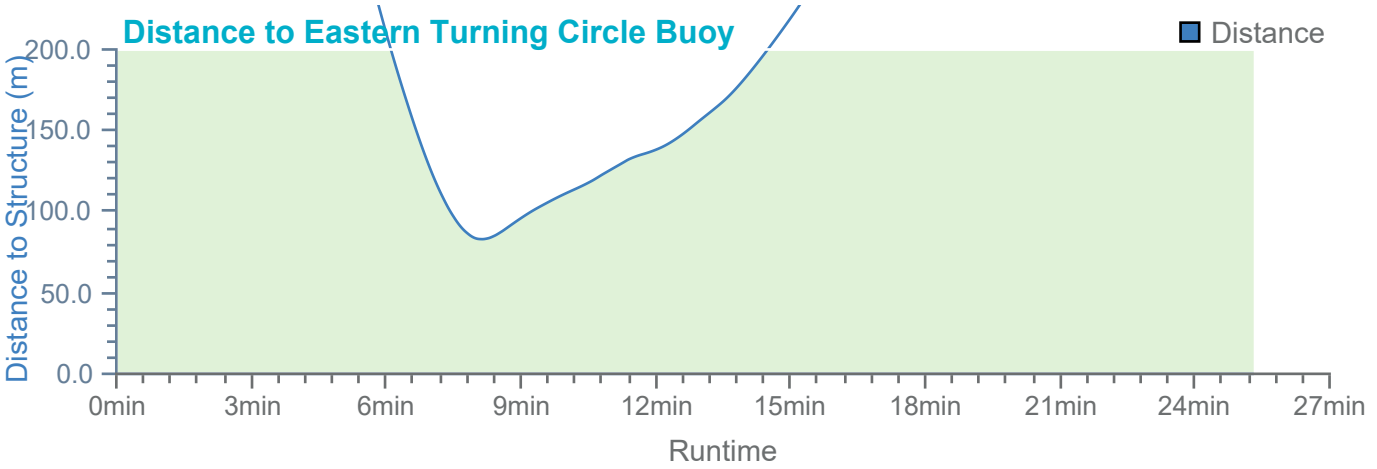
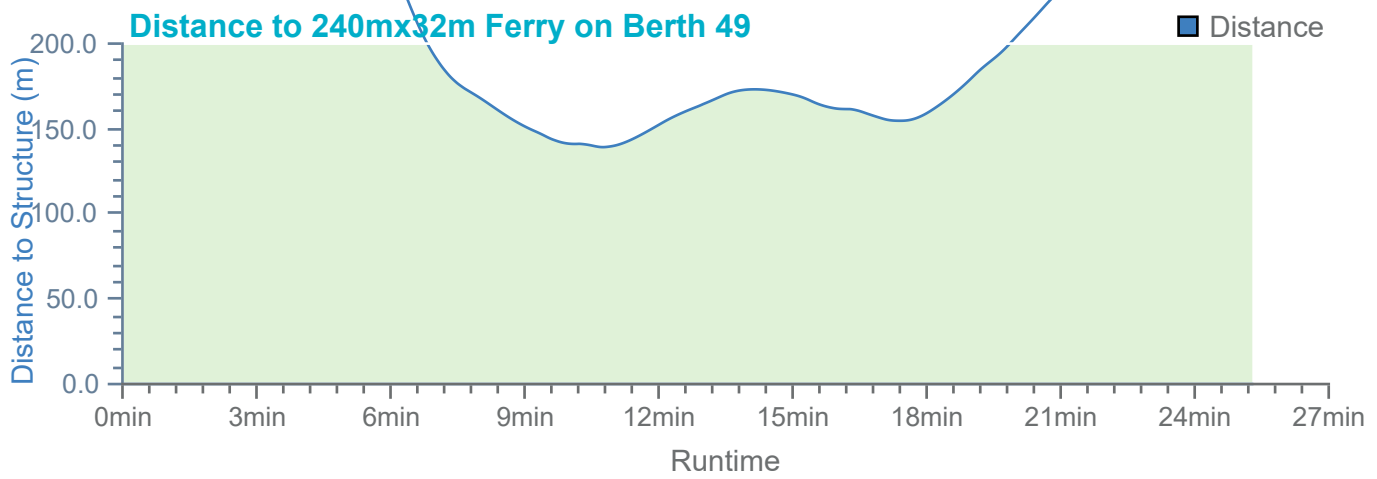


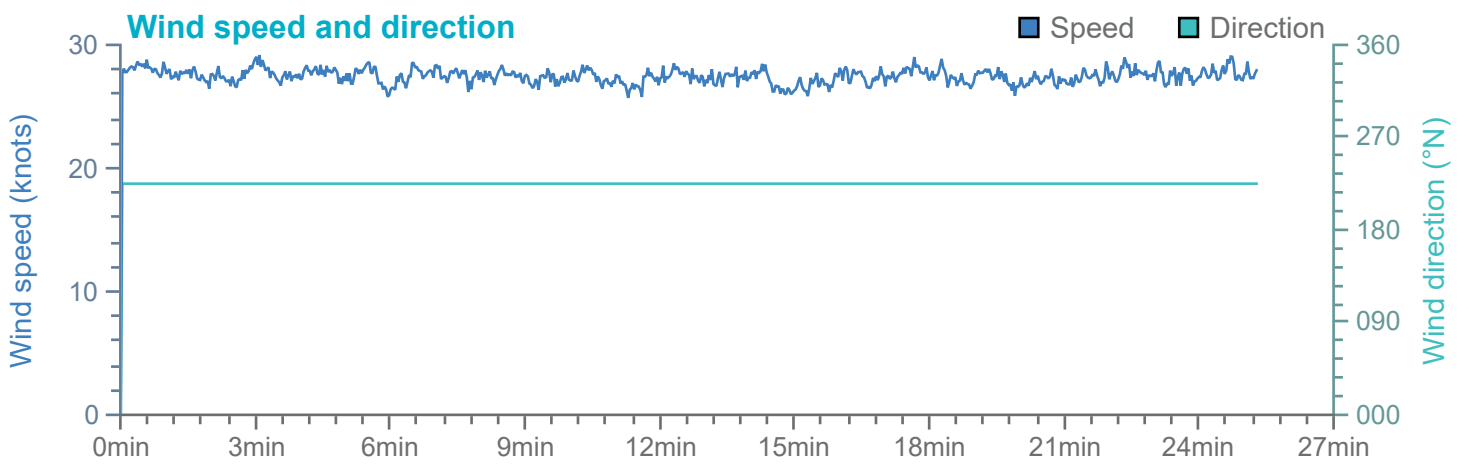
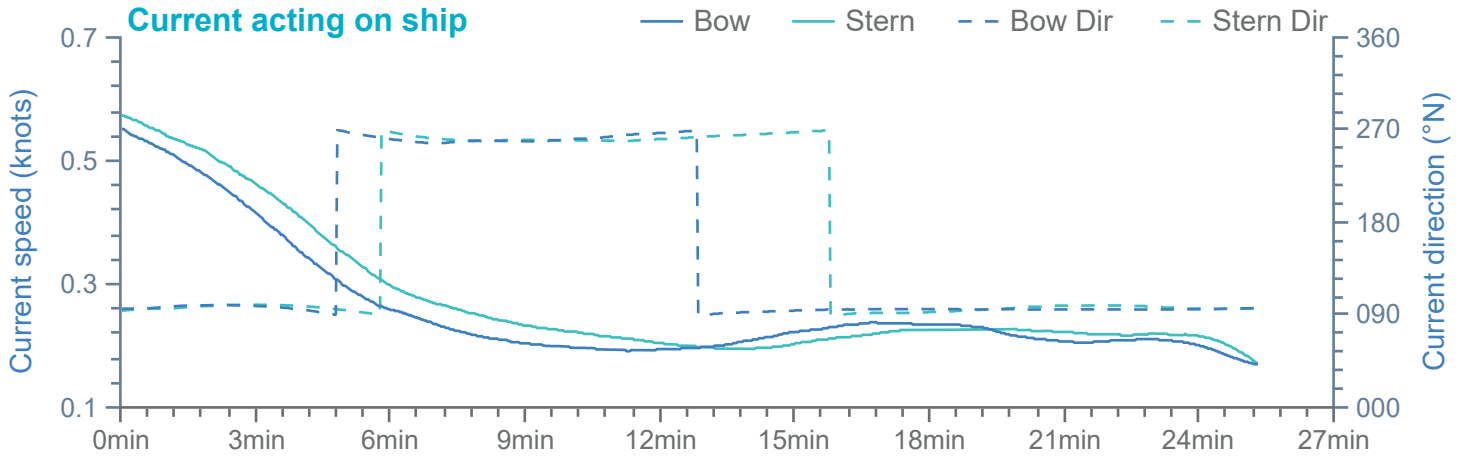
Ships plotted every 1 mins, highlight every 5 mins

Berthing



Ships plotted every 1 mins, highlight every 5 mins





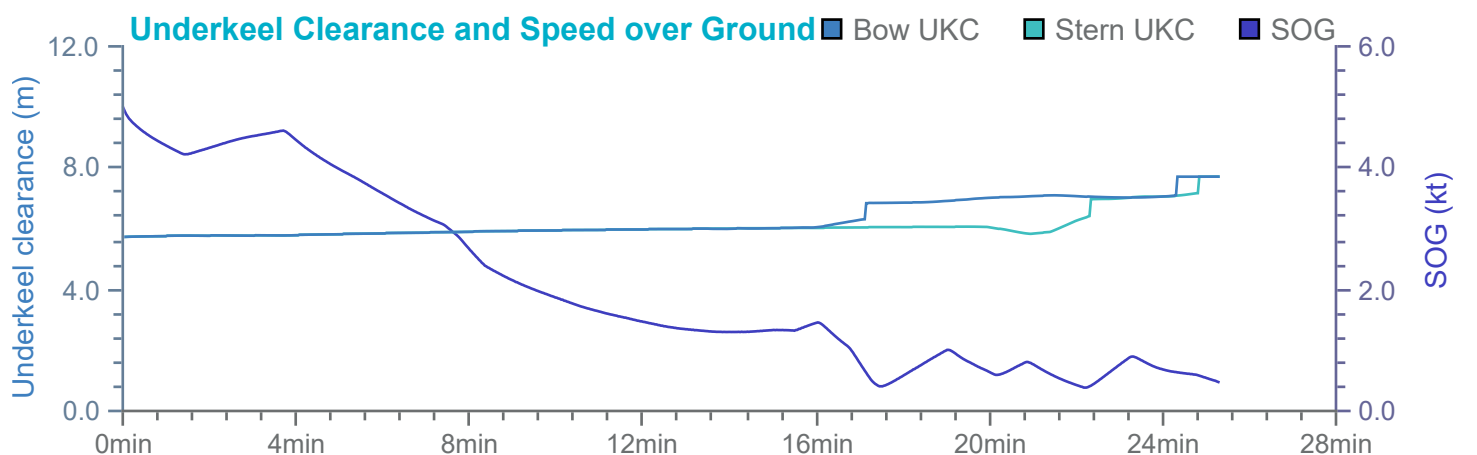
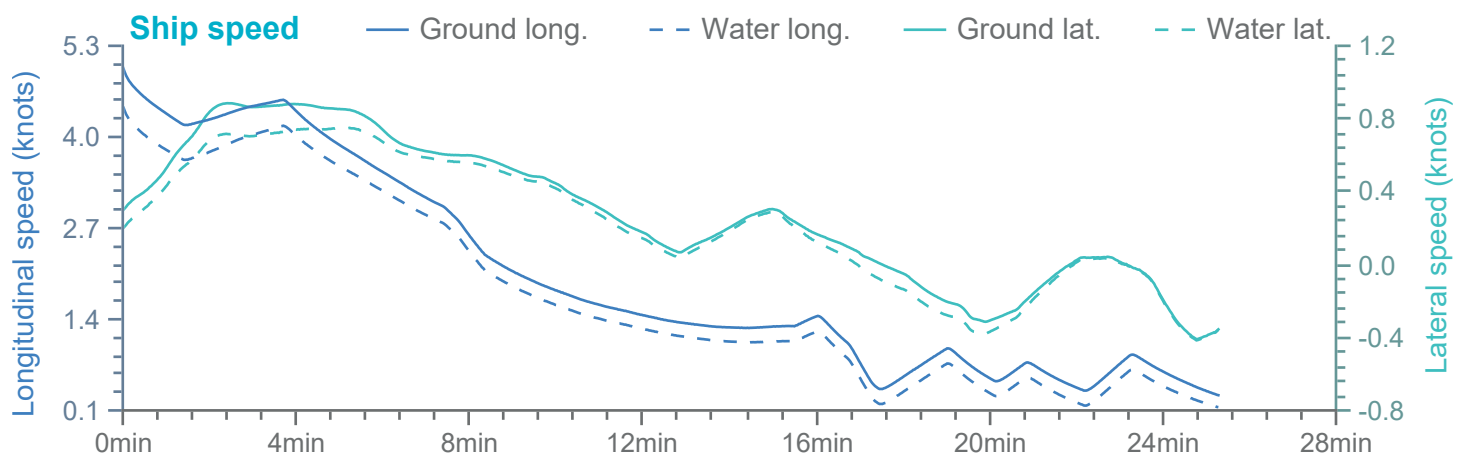
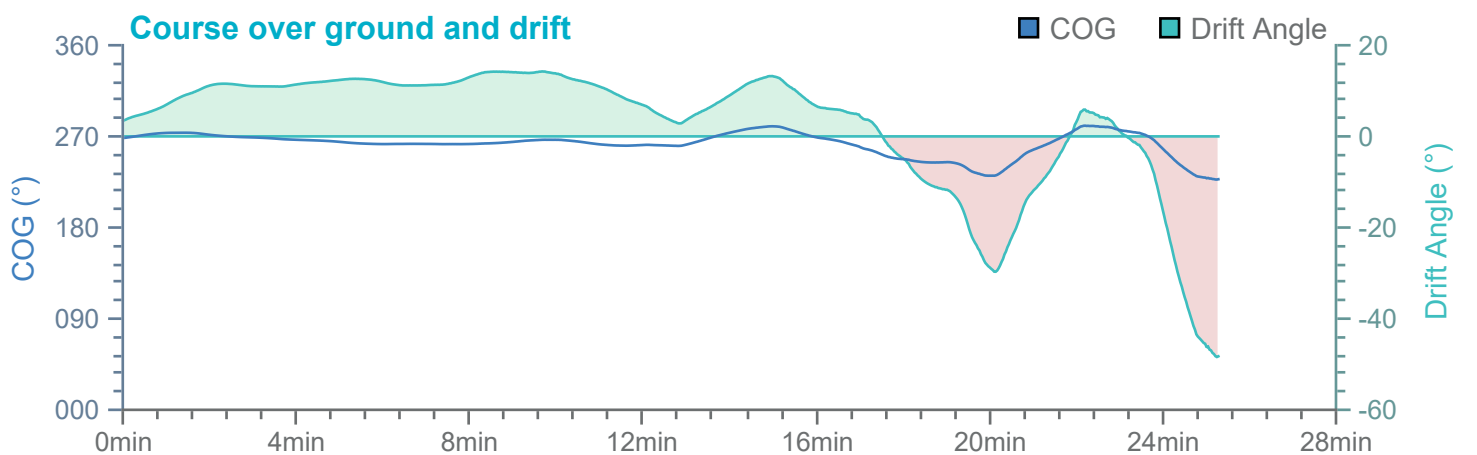
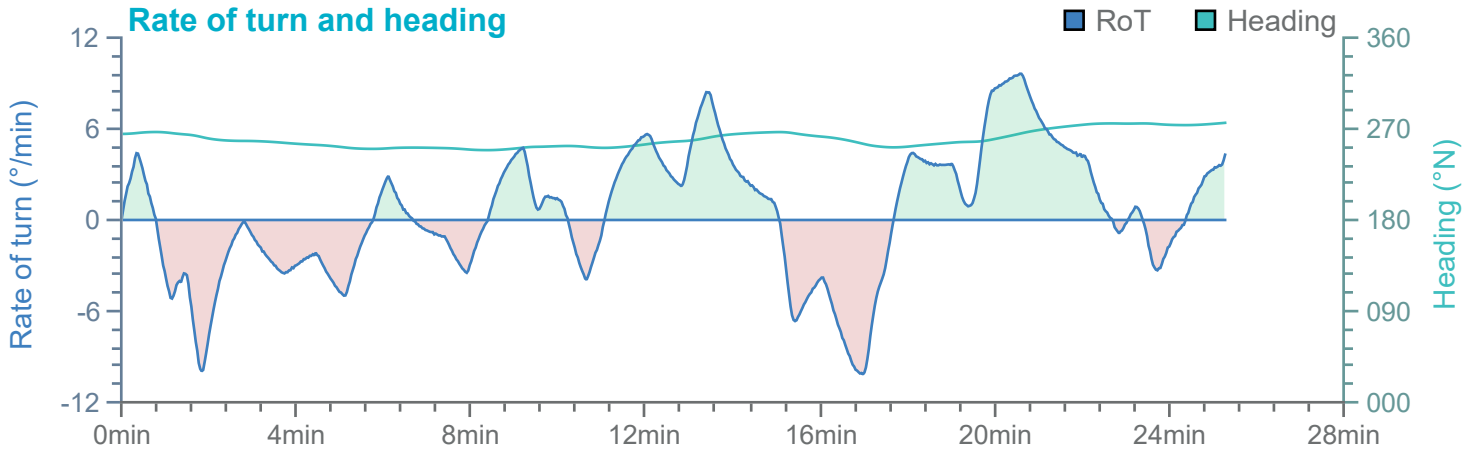
Overview

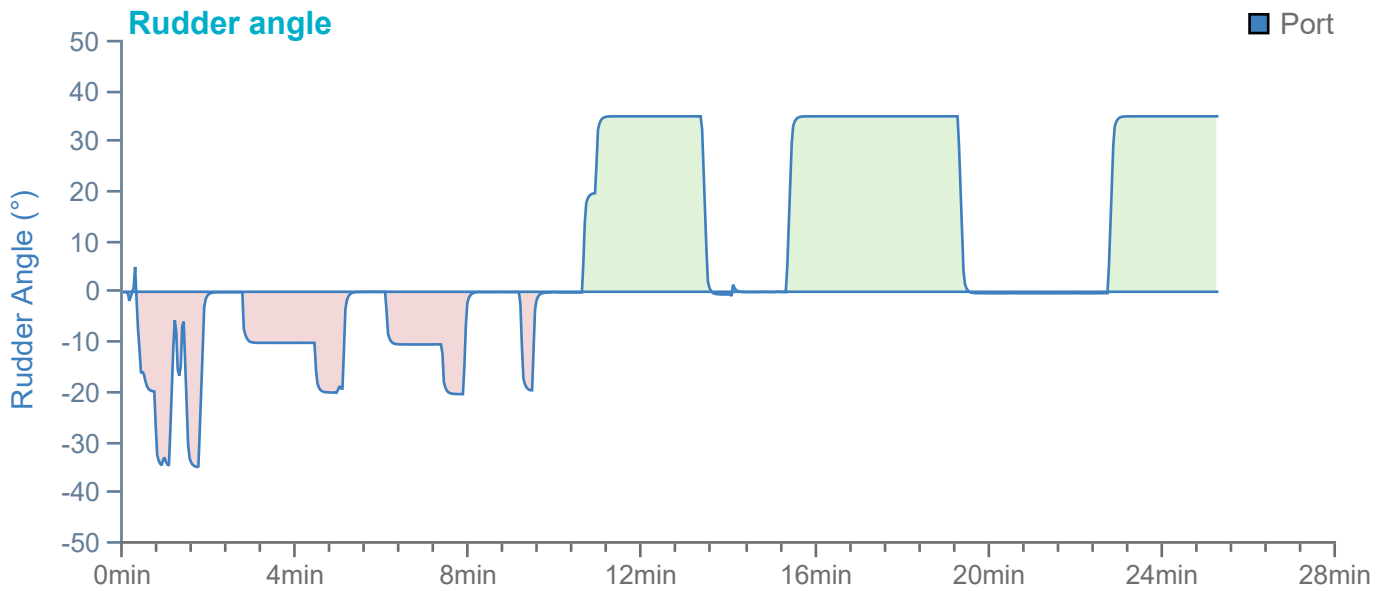
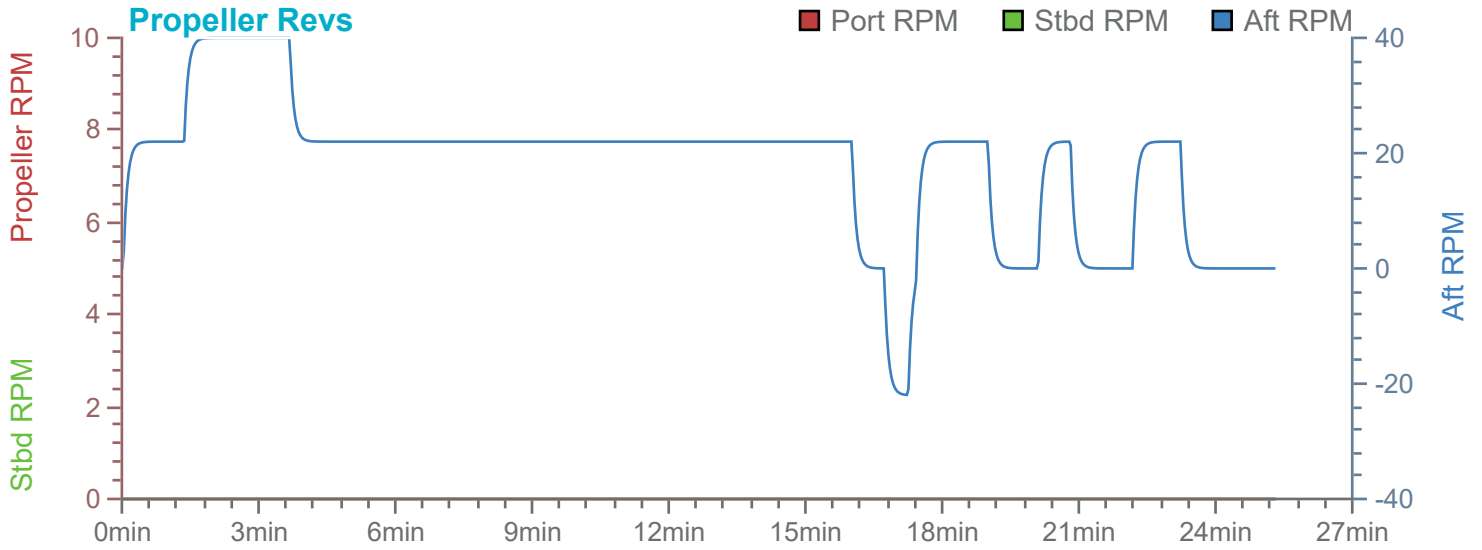
Environment

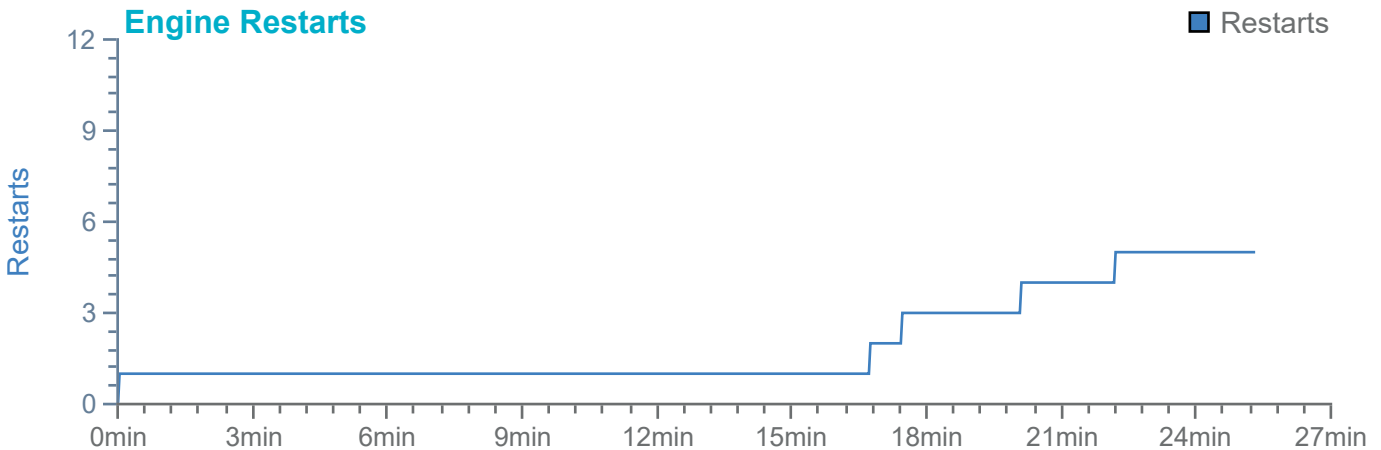
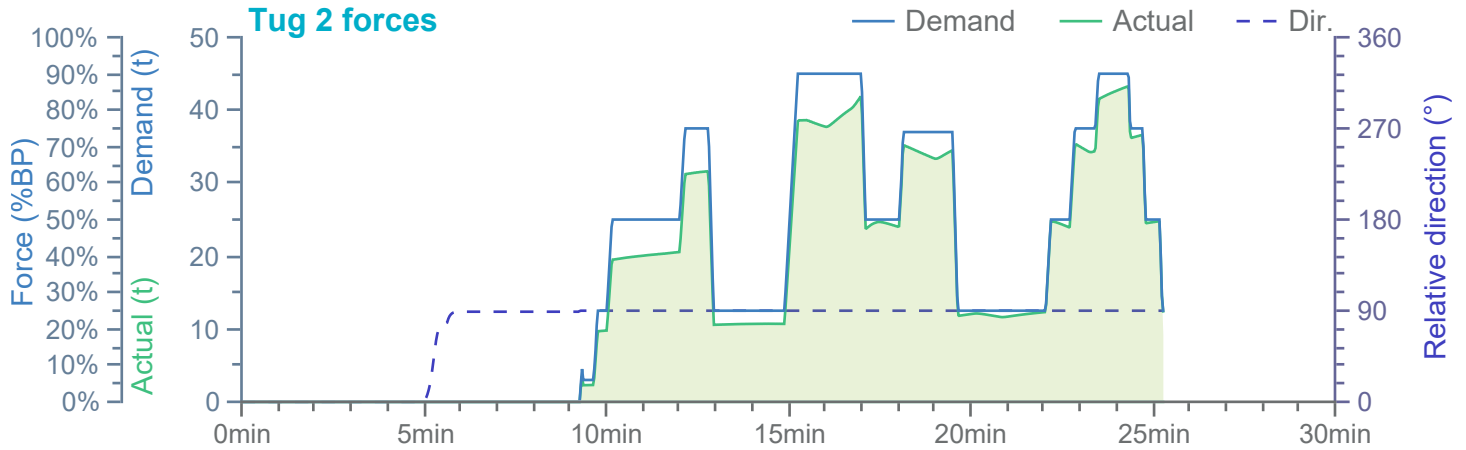
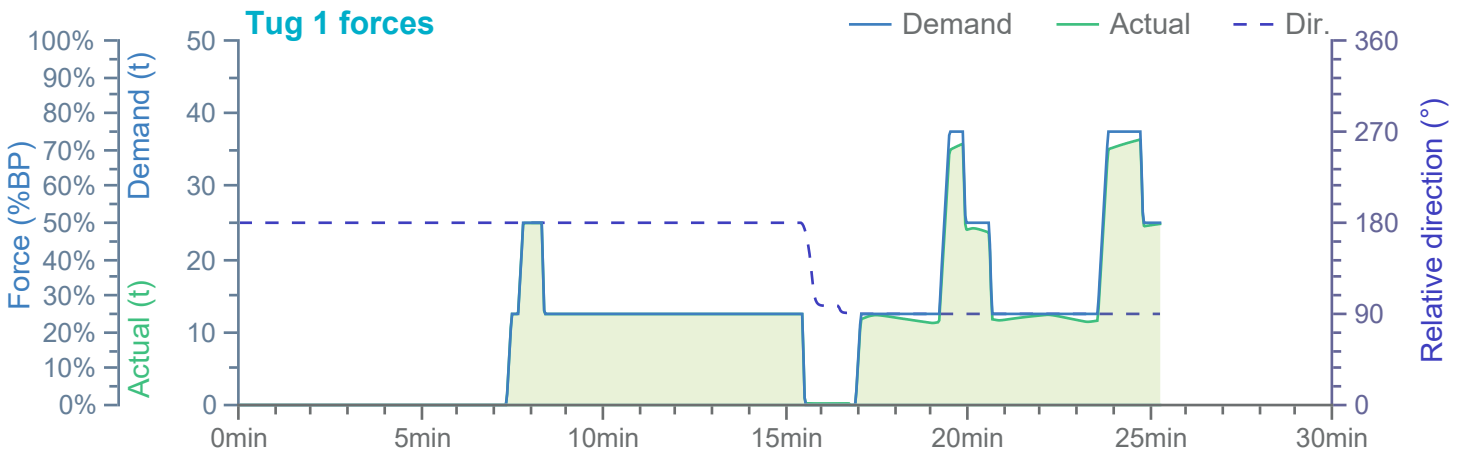
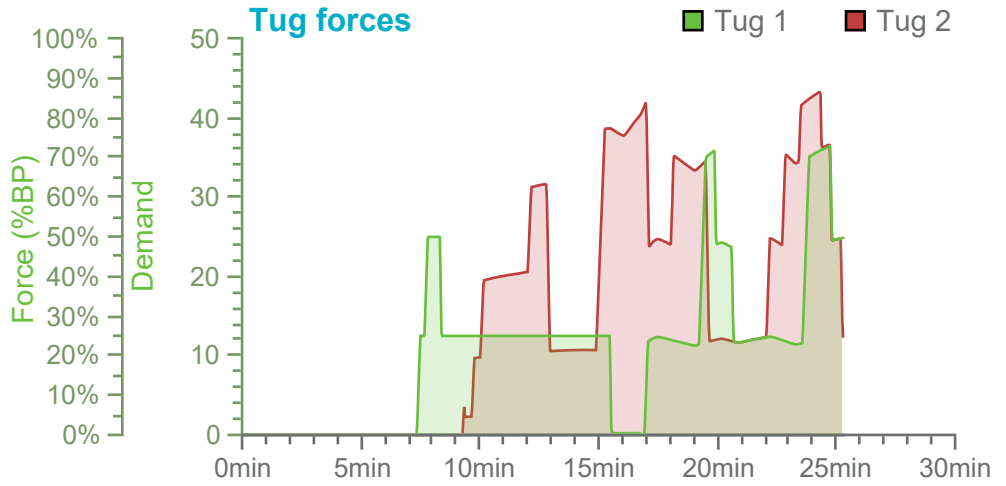
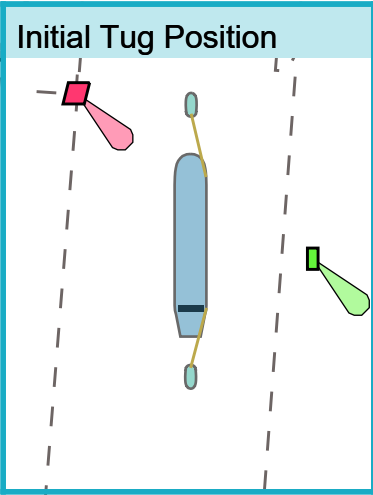
185m x 32m Bulker Ballast

Thruster and engine use

Tug use

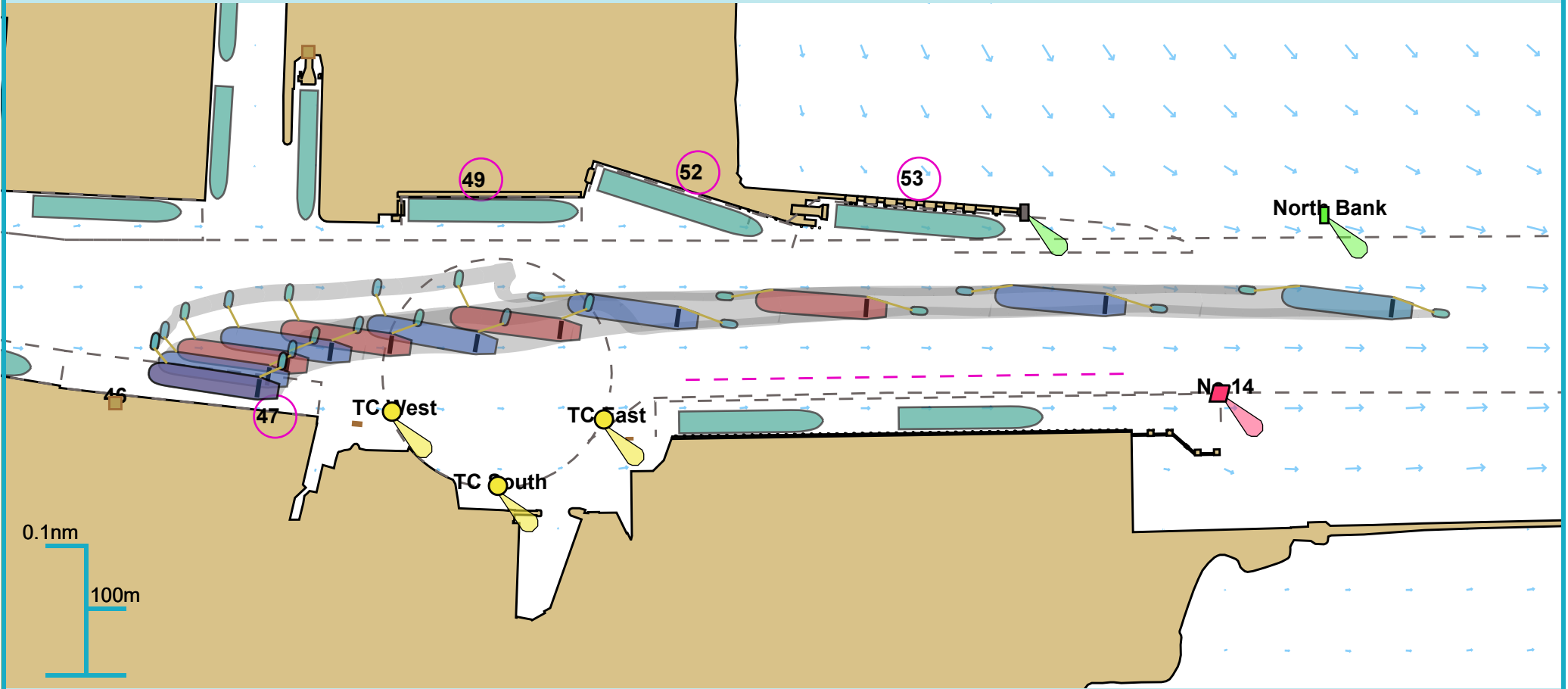






Full Run Overview

53° 20.293 N, 006° 12.276 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:20 minutes

Manoeuvre:Other

Ownship(s):185m x 32m Bulker Ballast

Comments:

Overview

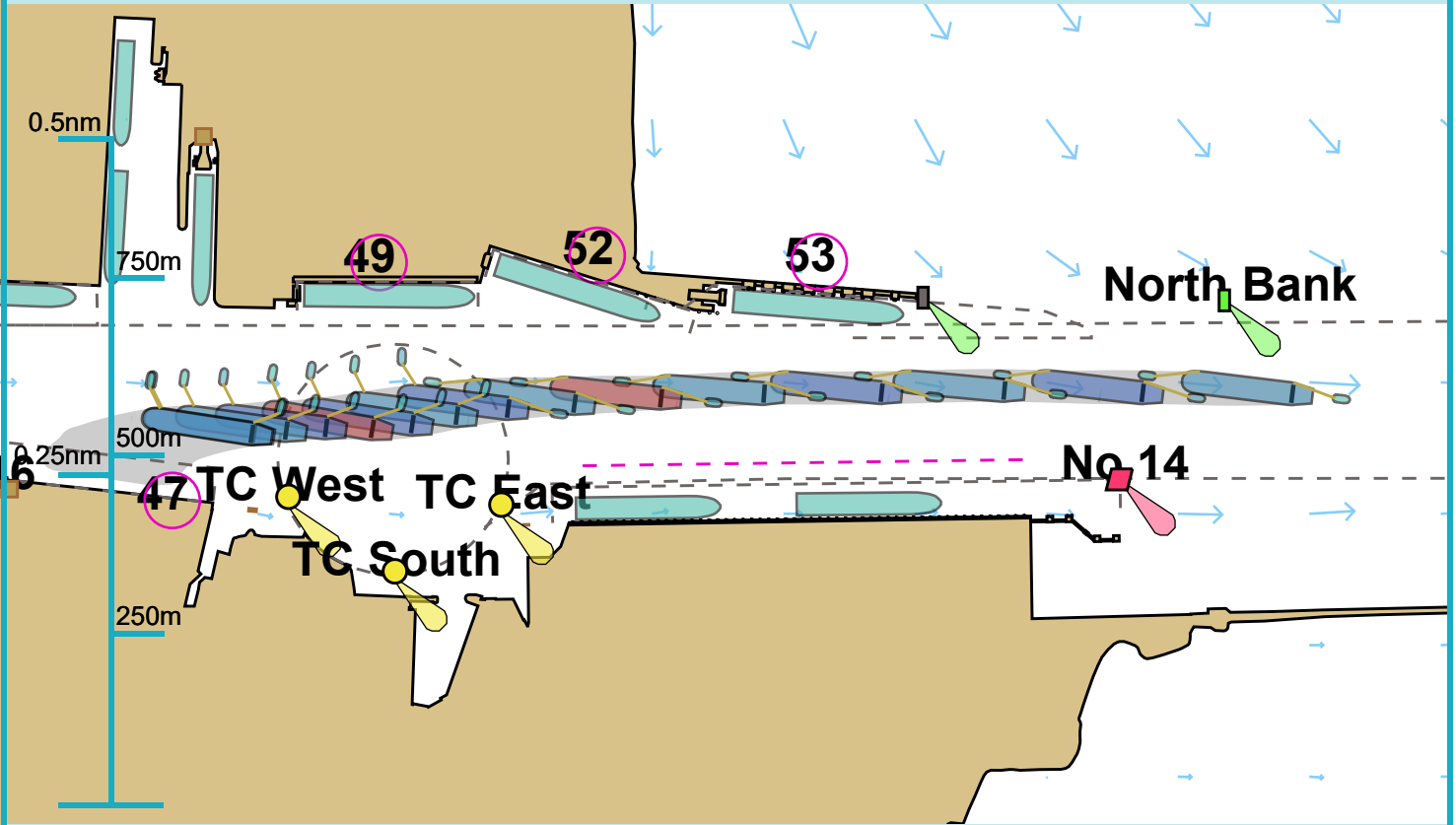
Environment

185m x 32m Bulker Ballast

Thruster and engine use

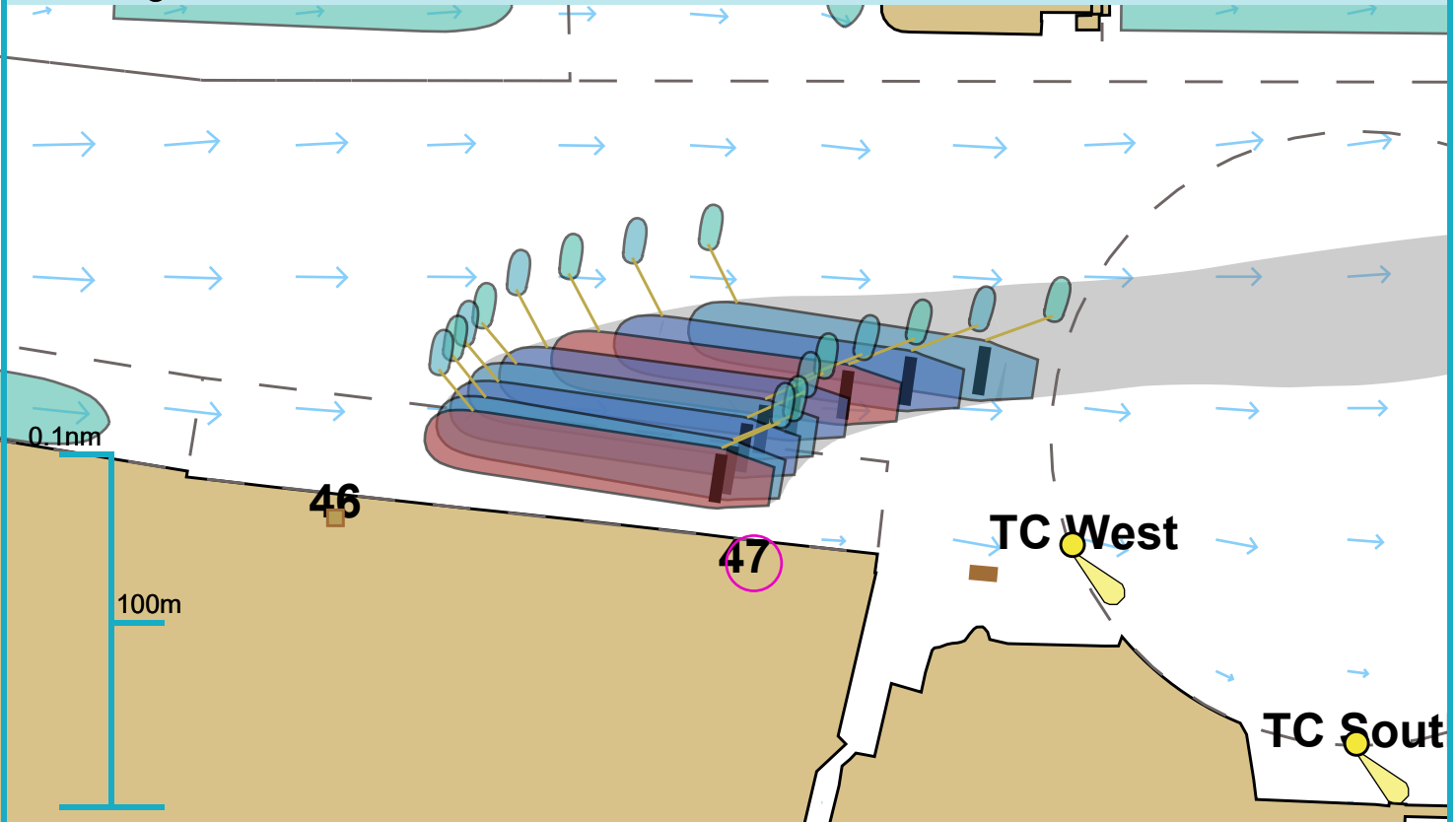
Tug use

Approach

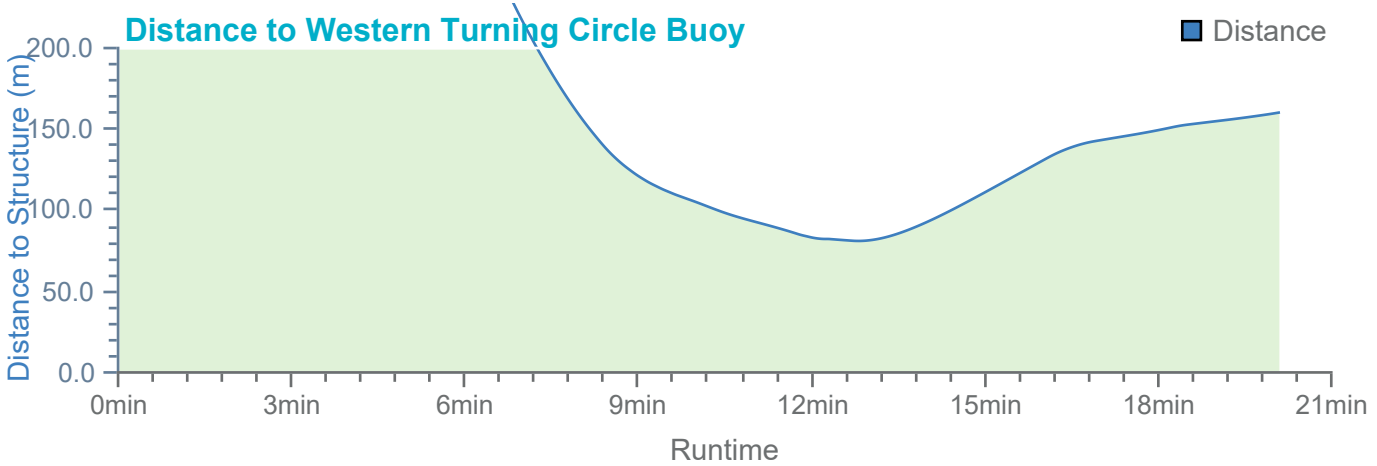
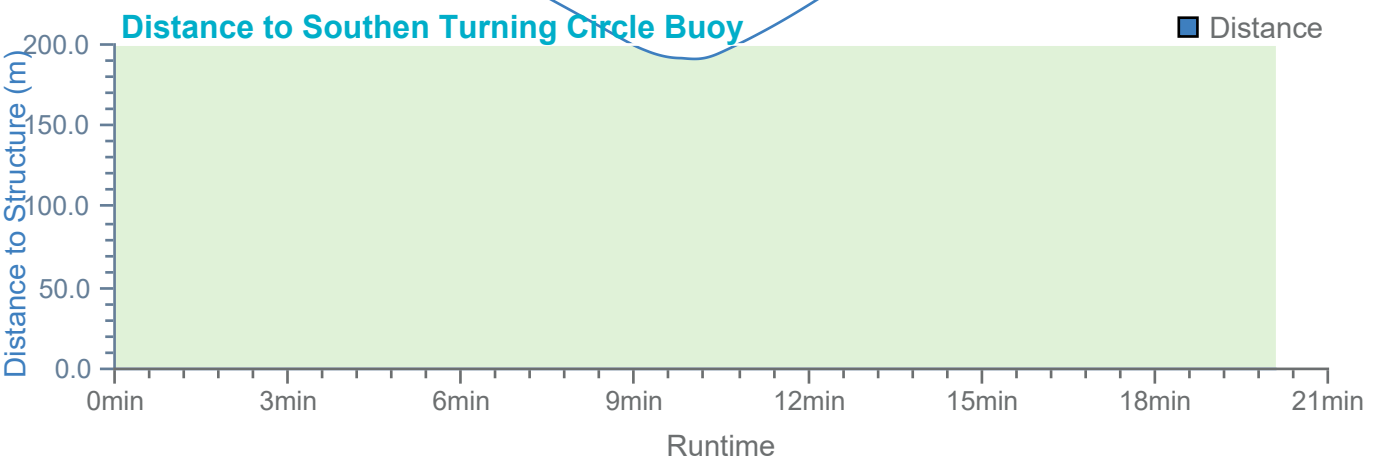
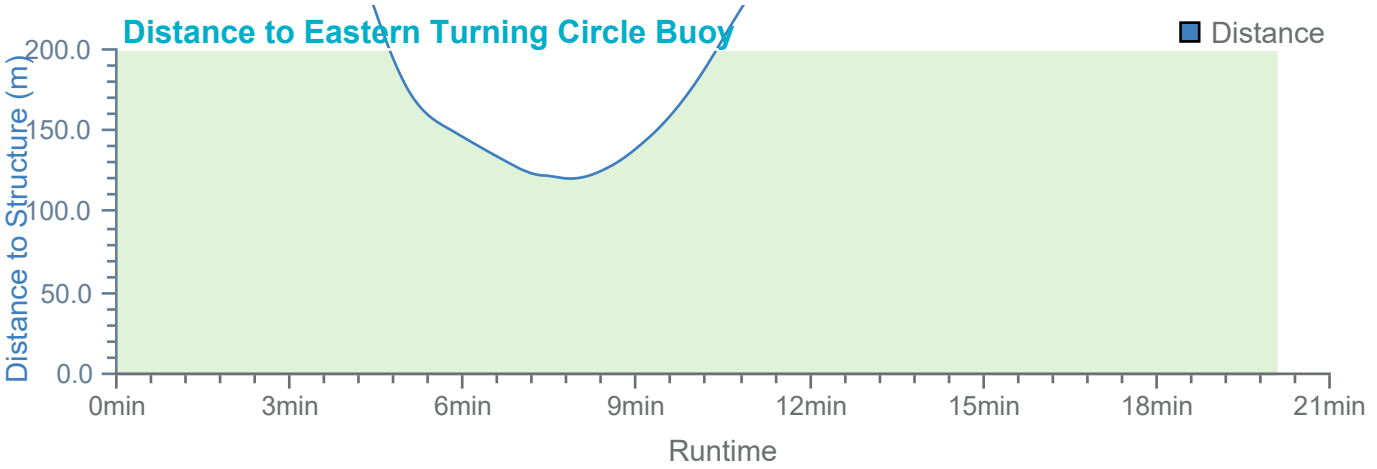
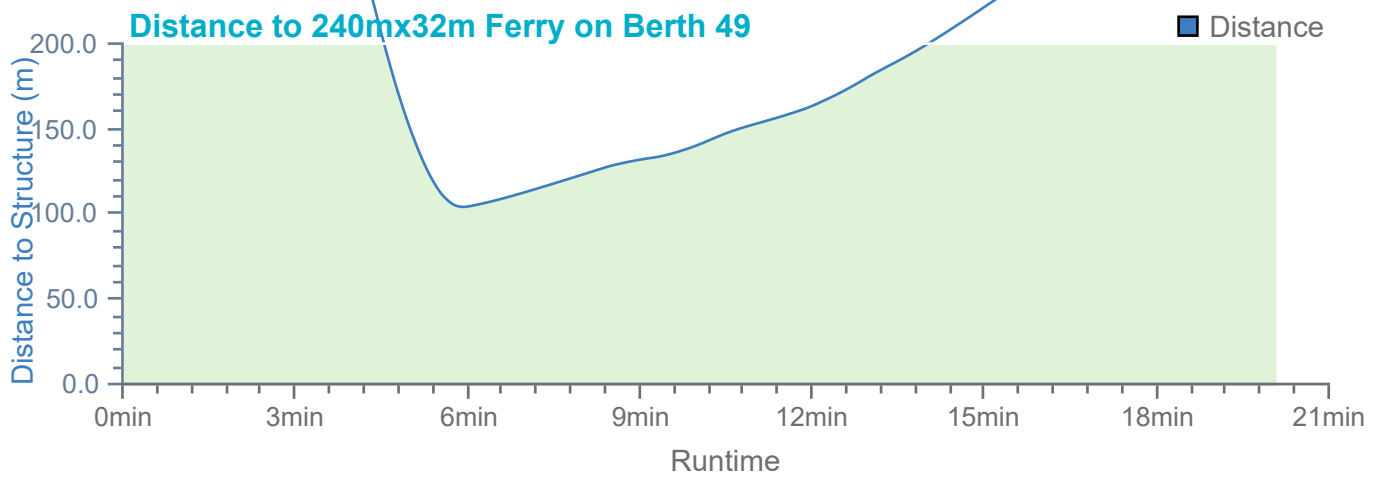


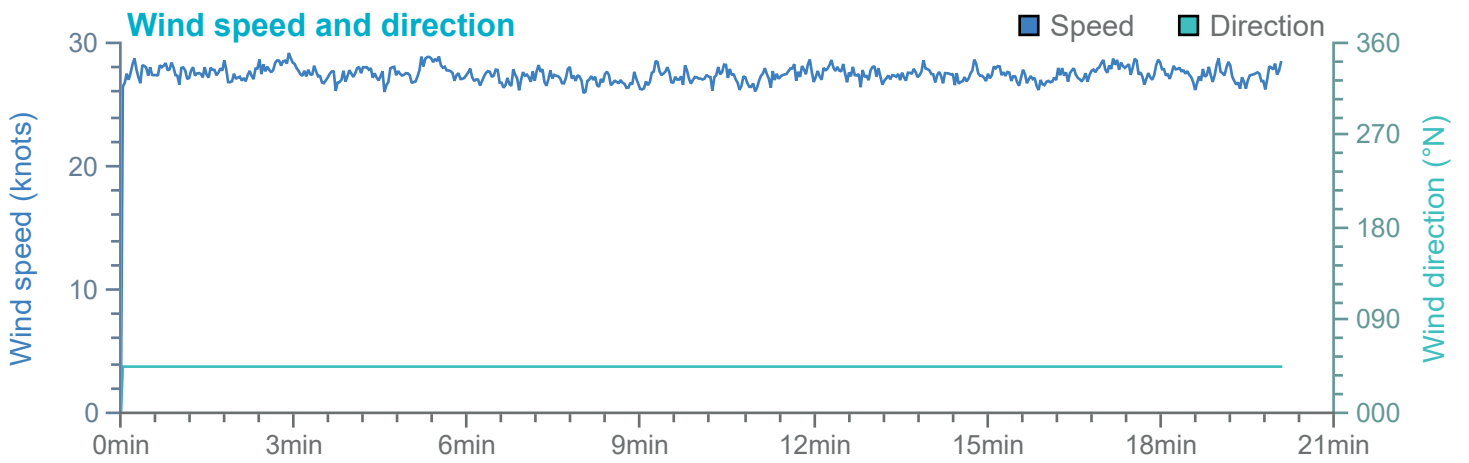
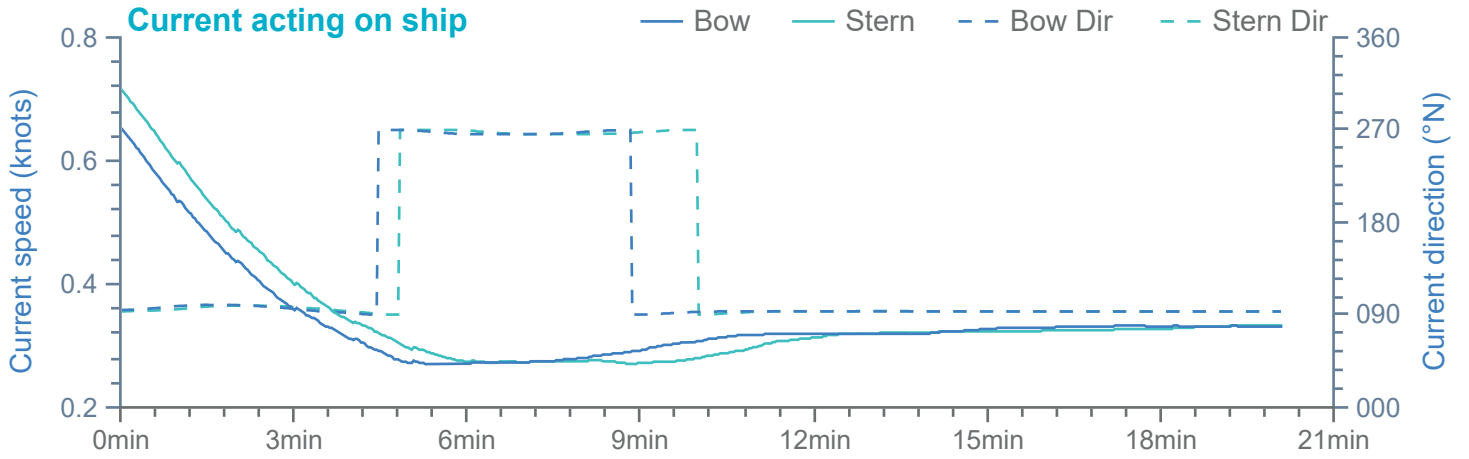
Ships plotted every 1 mins, highlight every 5 mins

Berthing



Ships plotted every 1 mins, highlight every 5 mins





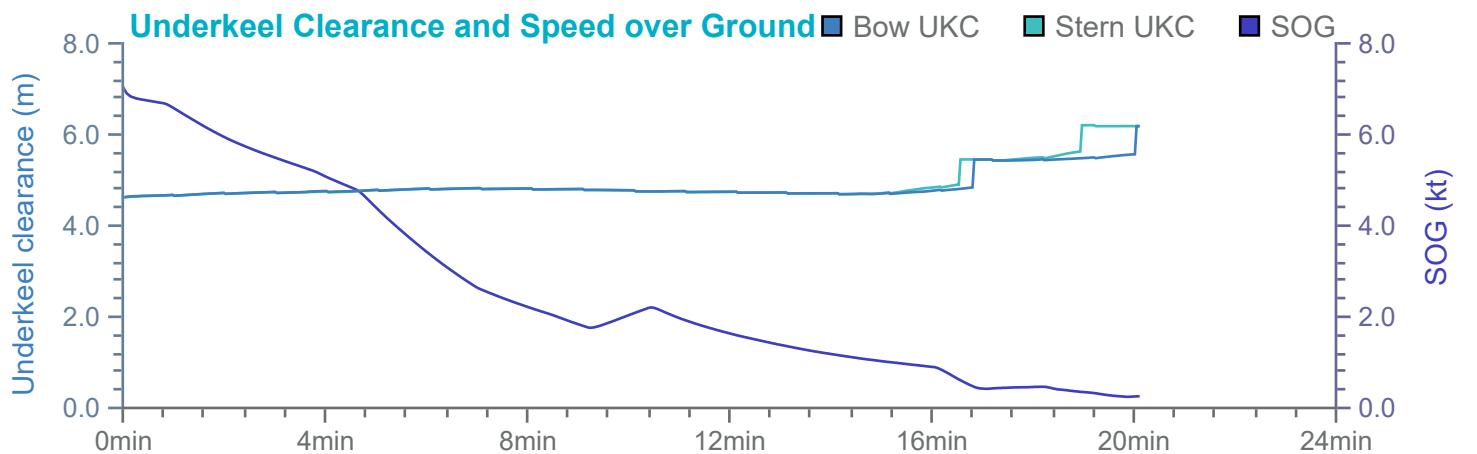
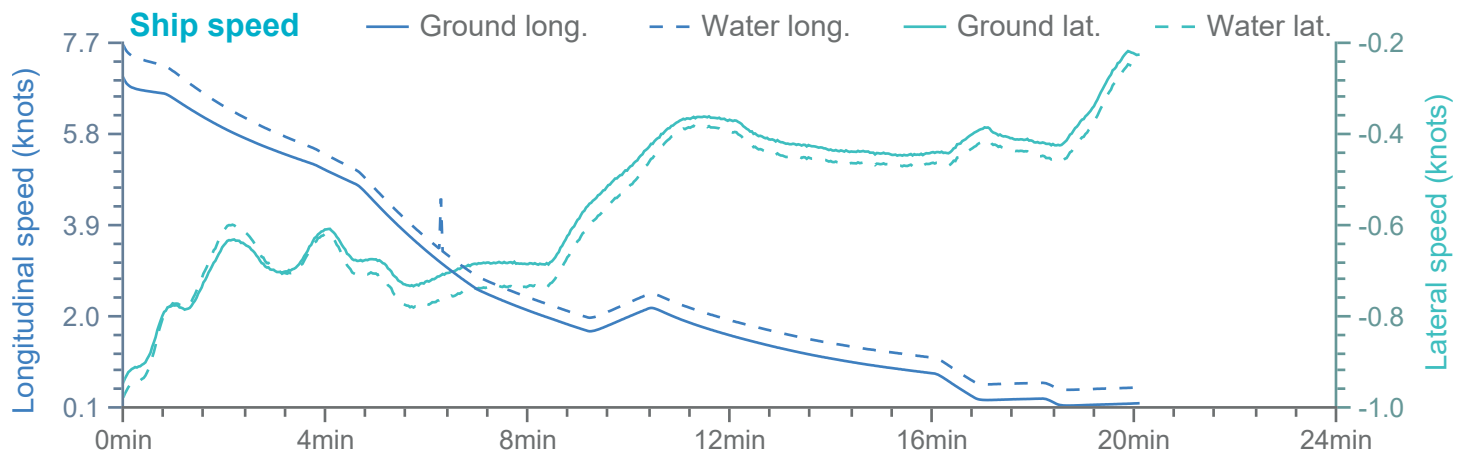
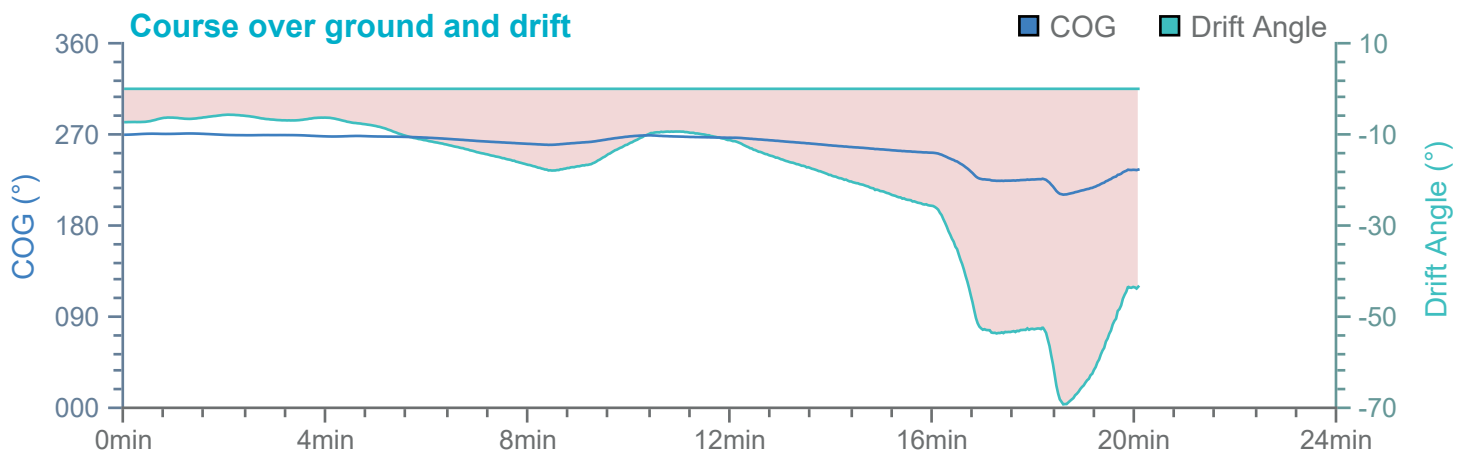
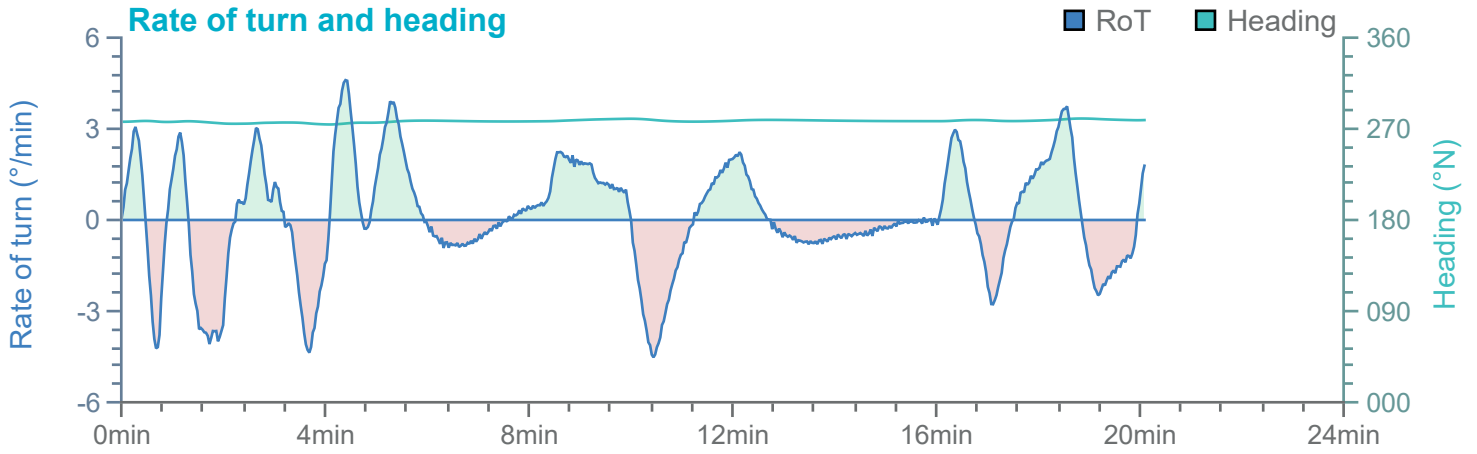
Overview

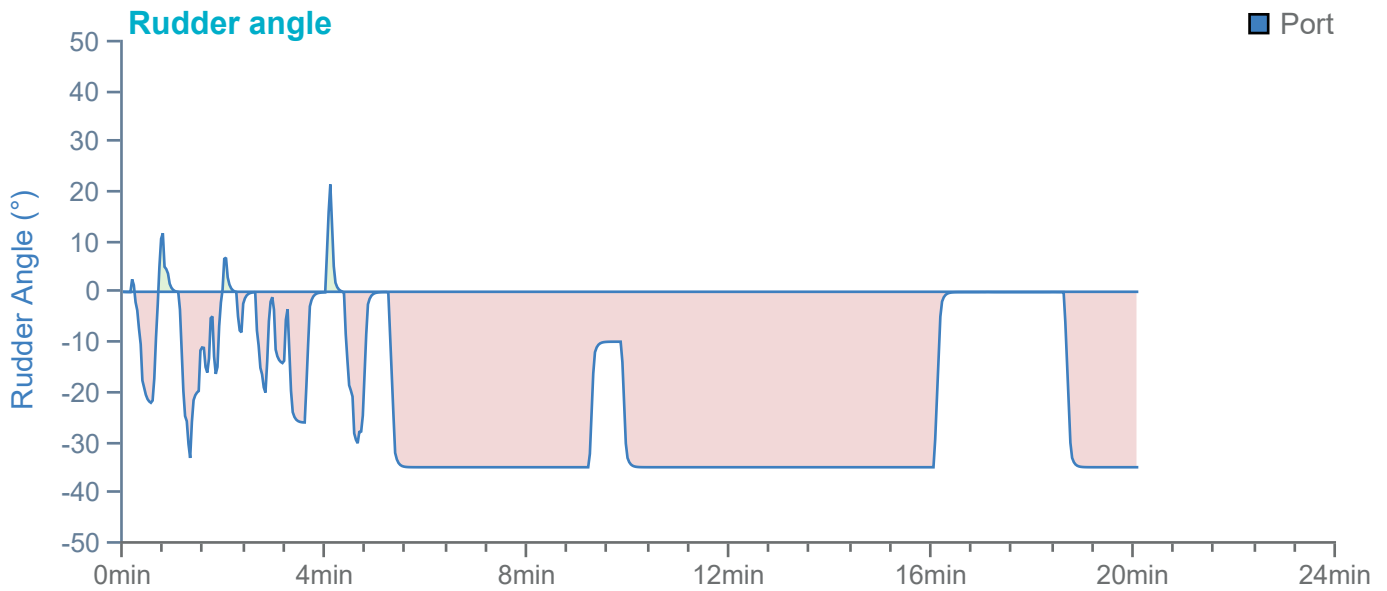
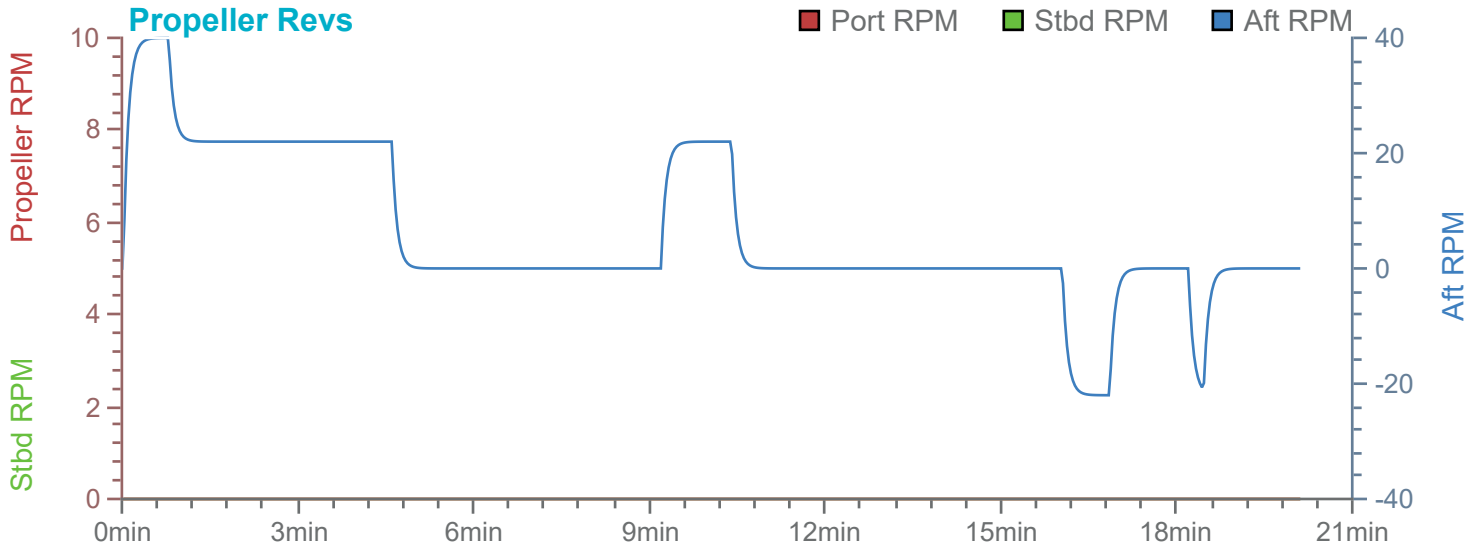
Environment

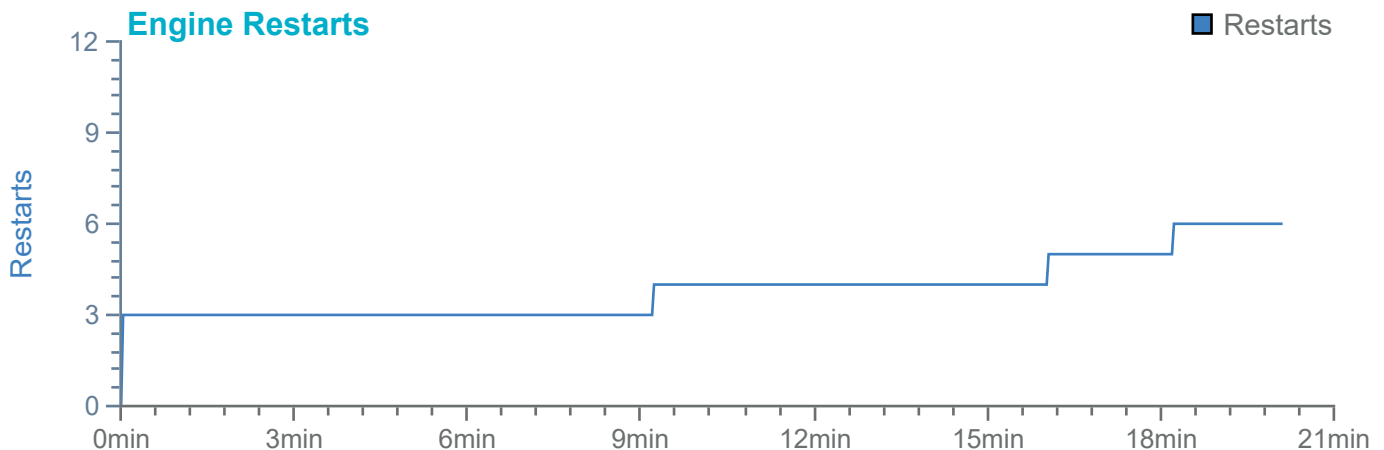
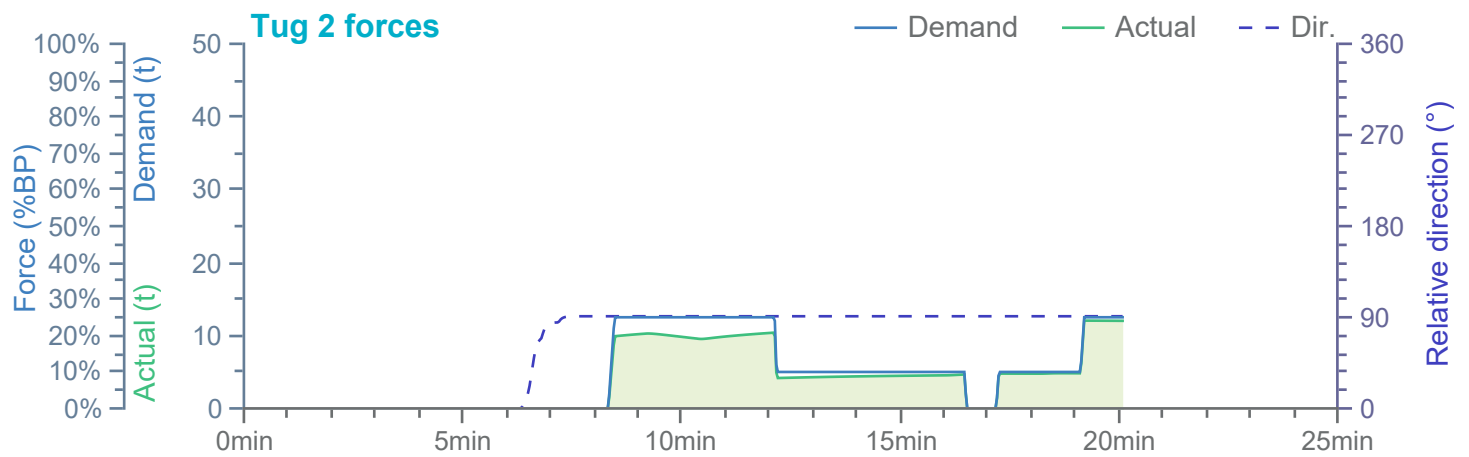
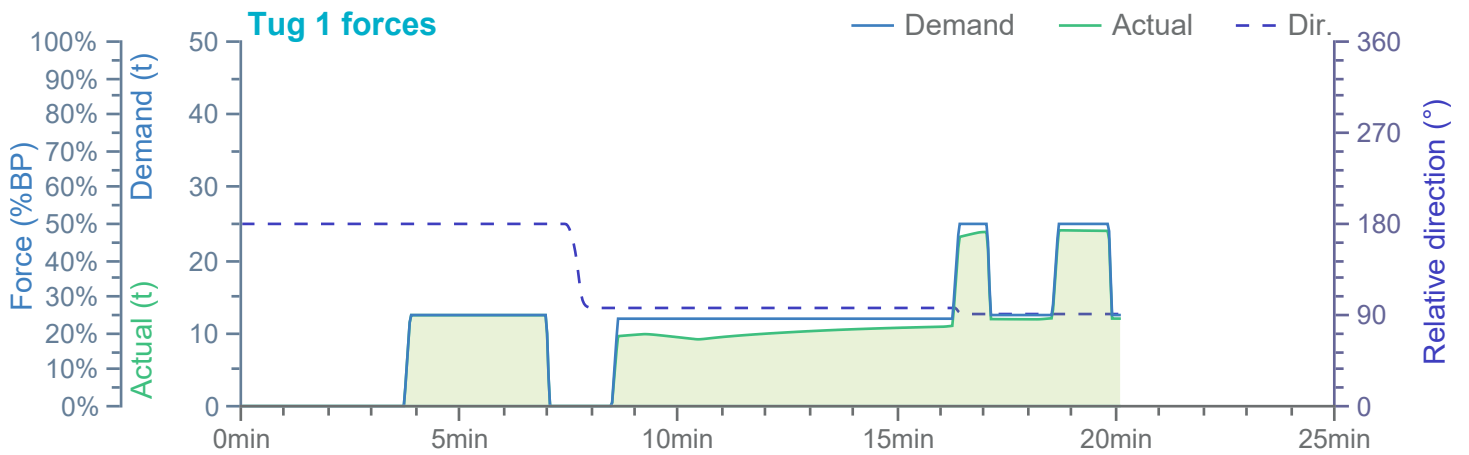
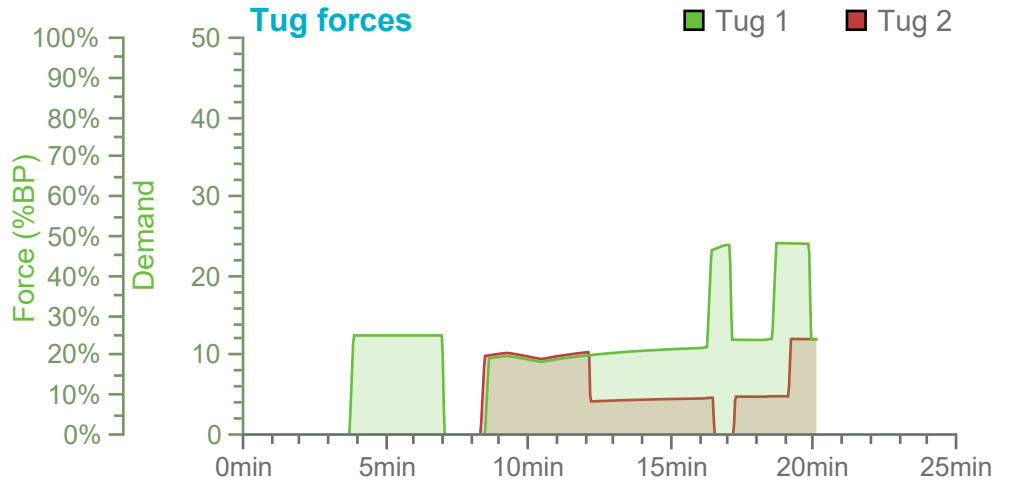
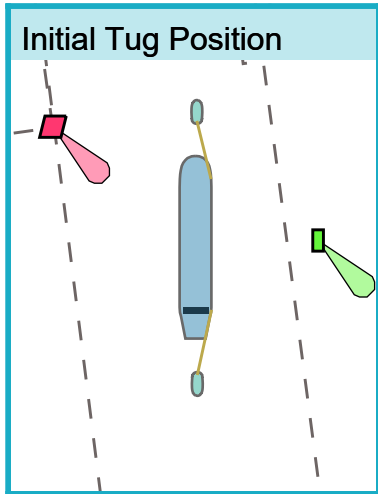
185m x 32m Bulker Ballast

Thruster and engine use

Tug use

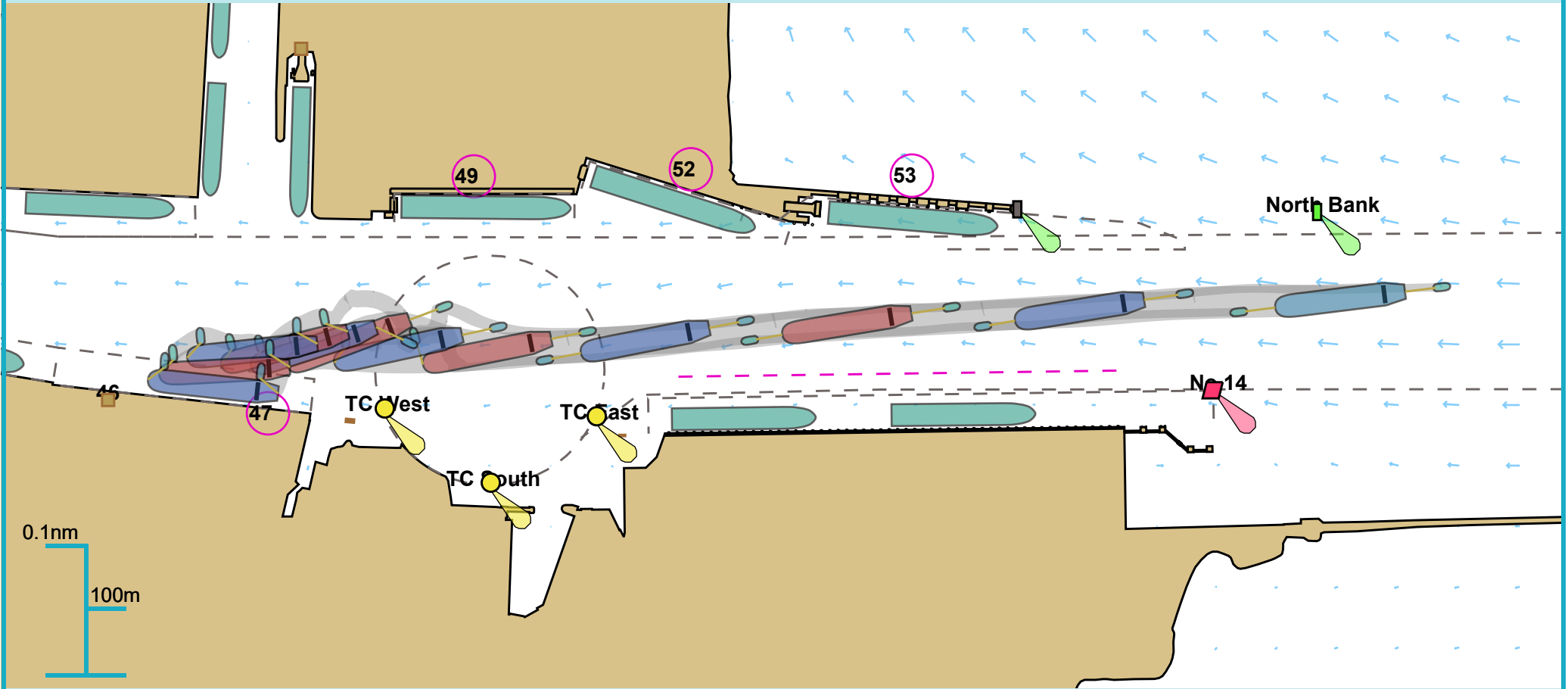






Full Run Overview

53° 20.291 N, 006° 12.267 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:22 minutes

Manoeuvre:Other

Ownship(s):185m x 32.2m x 11m Bulker L

Comments:

Overview

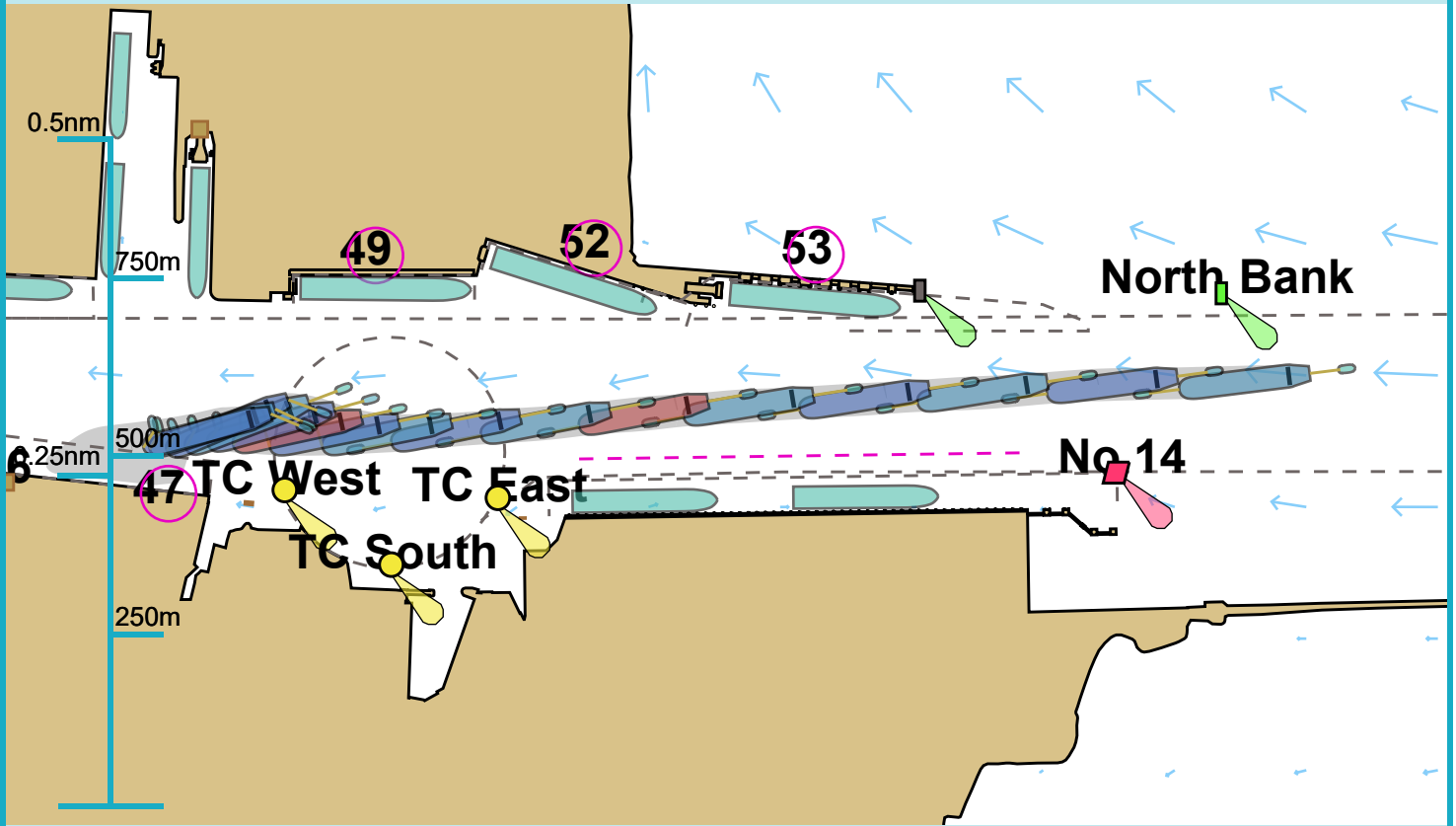
Environment

185m x 32.2m x 11m Bulker L

Thruster and engine use

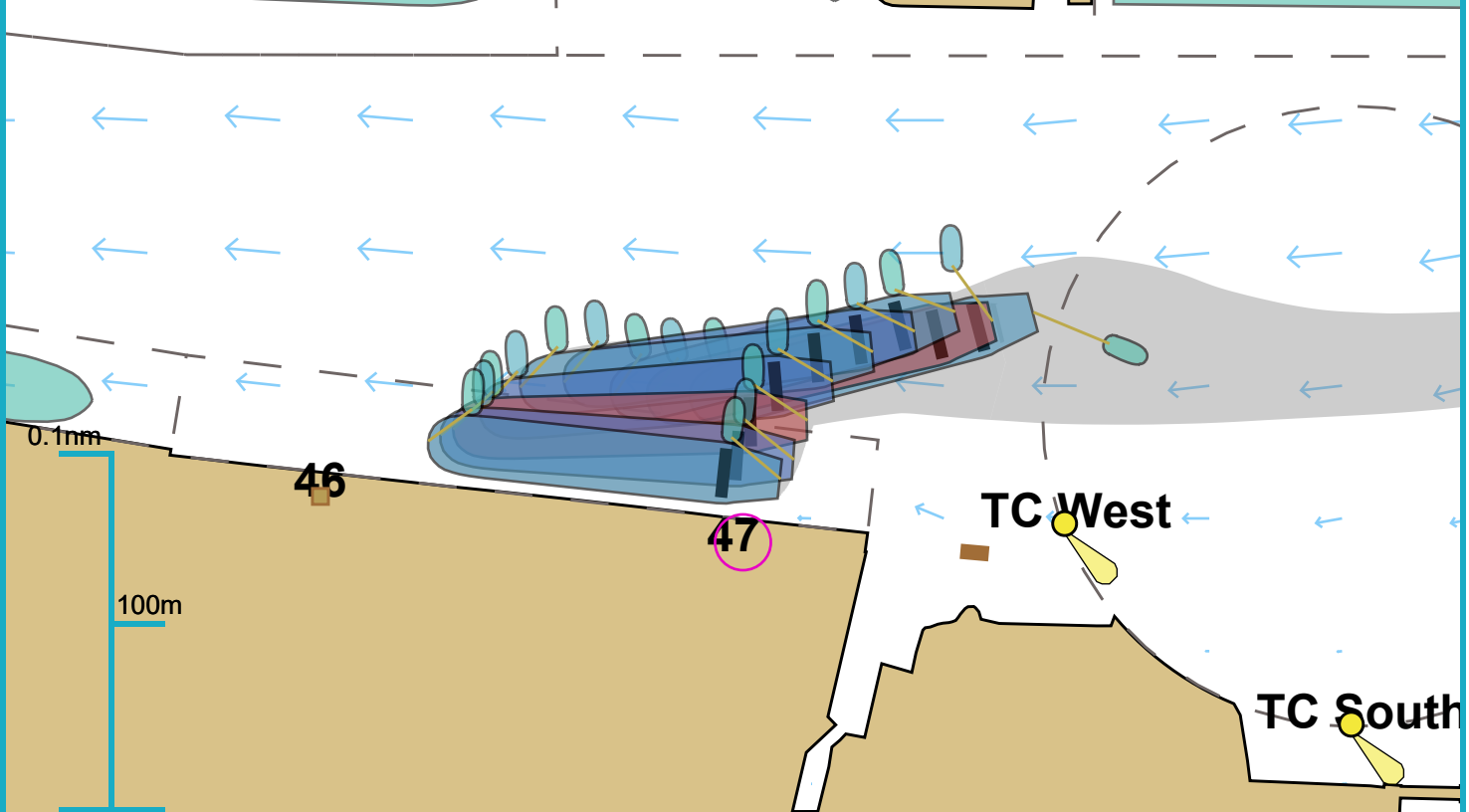
Tug use

Approach

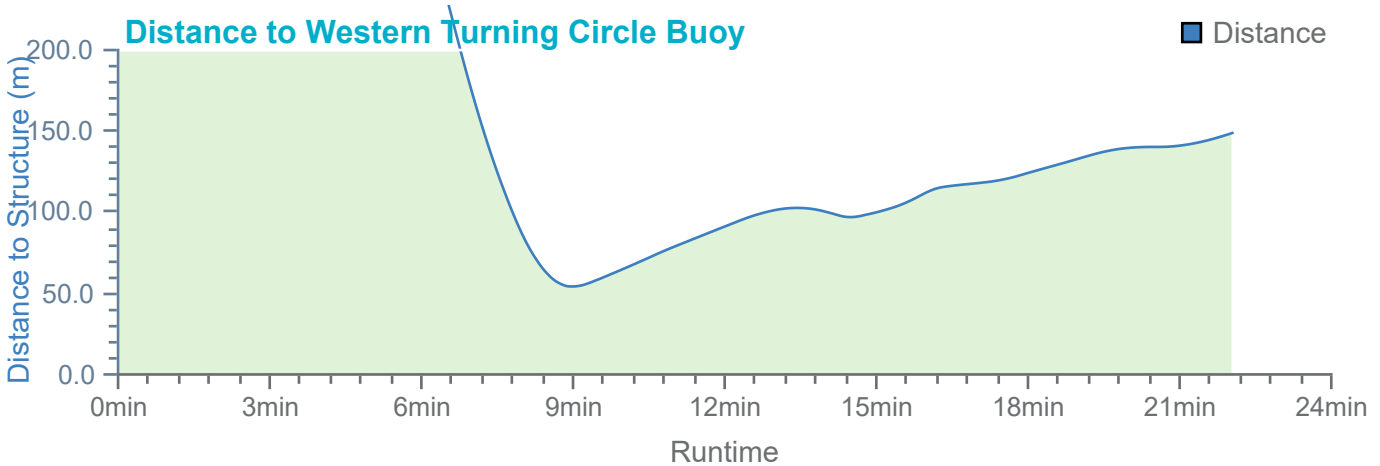
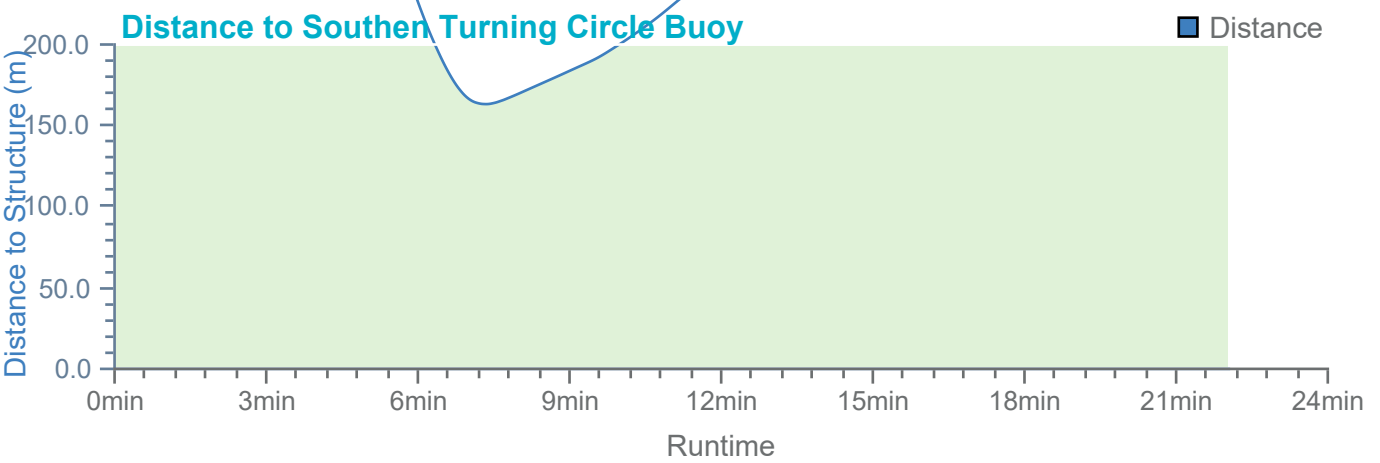
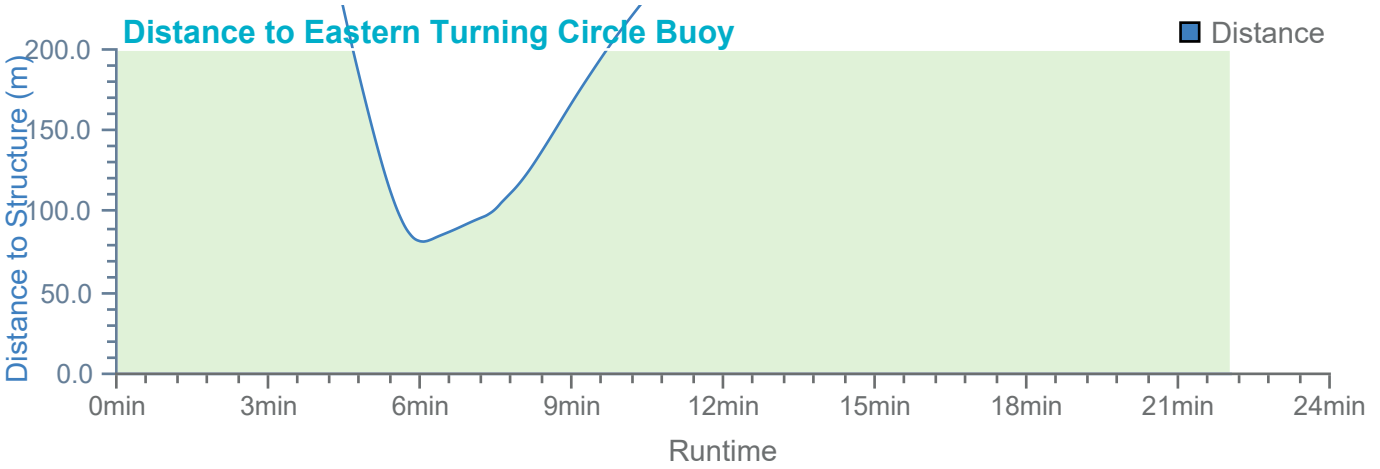
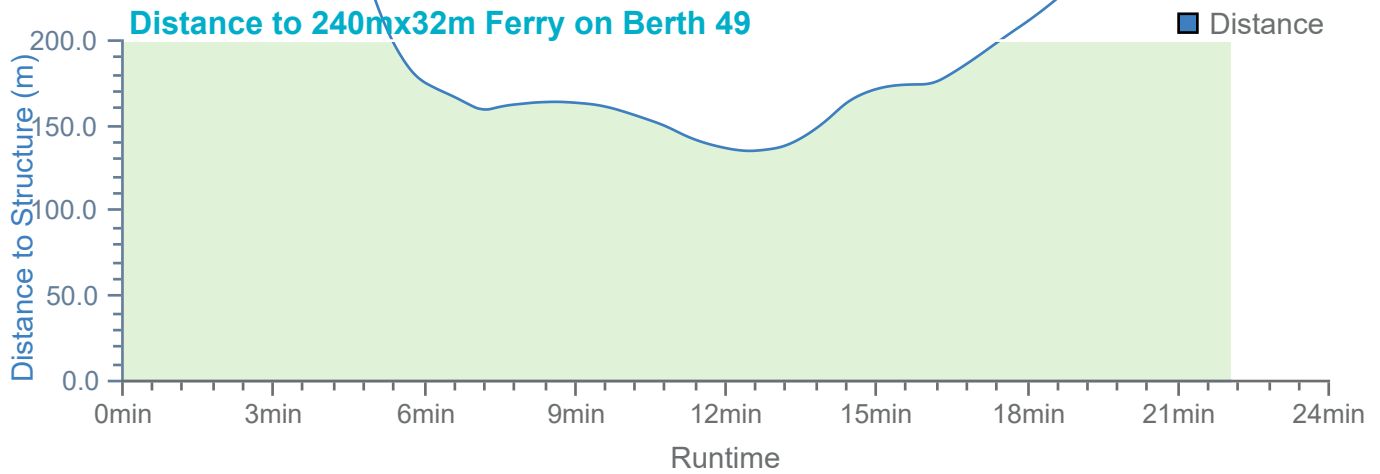


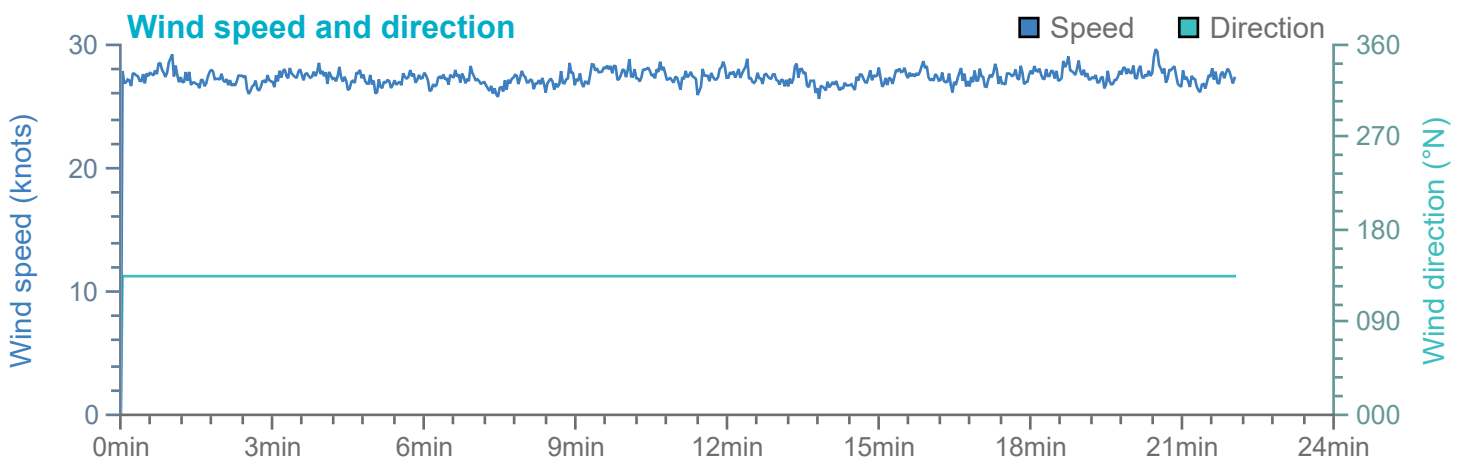
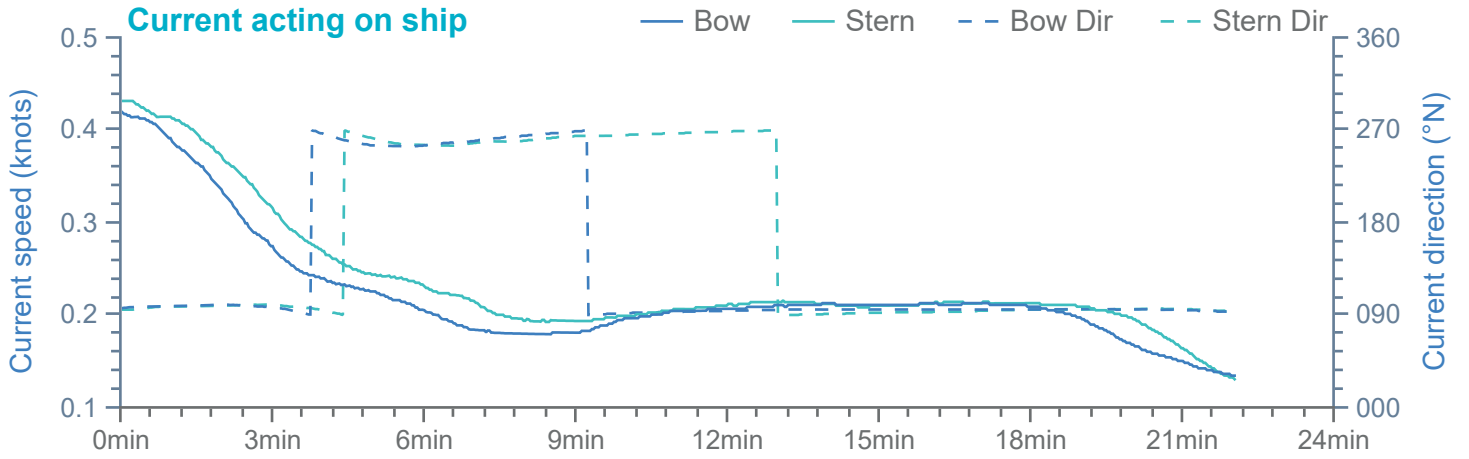
Ships plotted every 1 mins, highlight every 5 mins

Berthing



Ships plotted every 1 mins, highlight every 5 mins





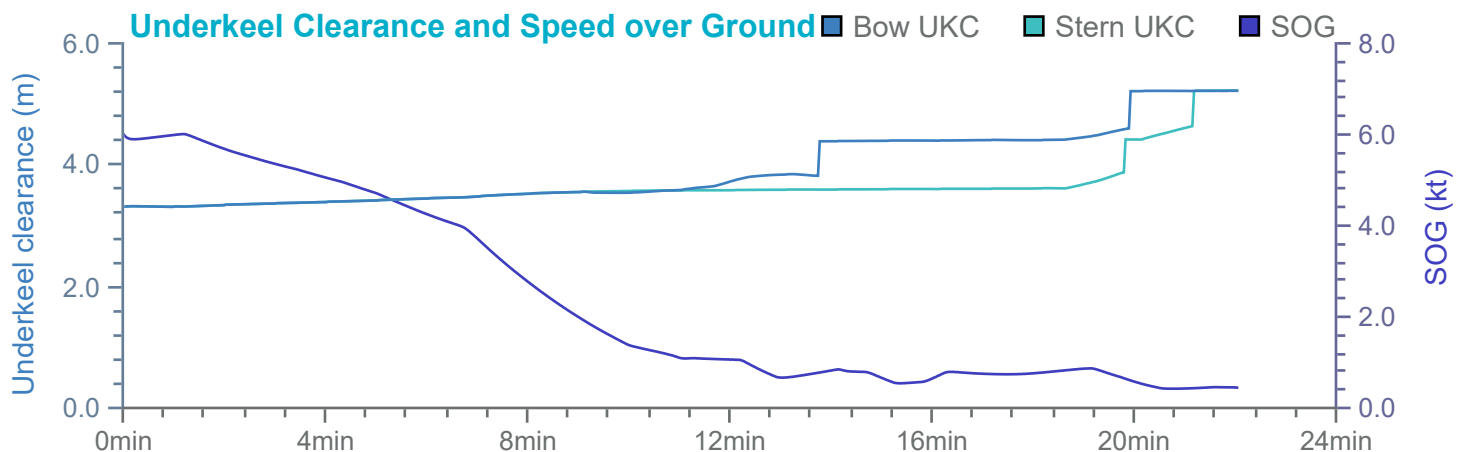
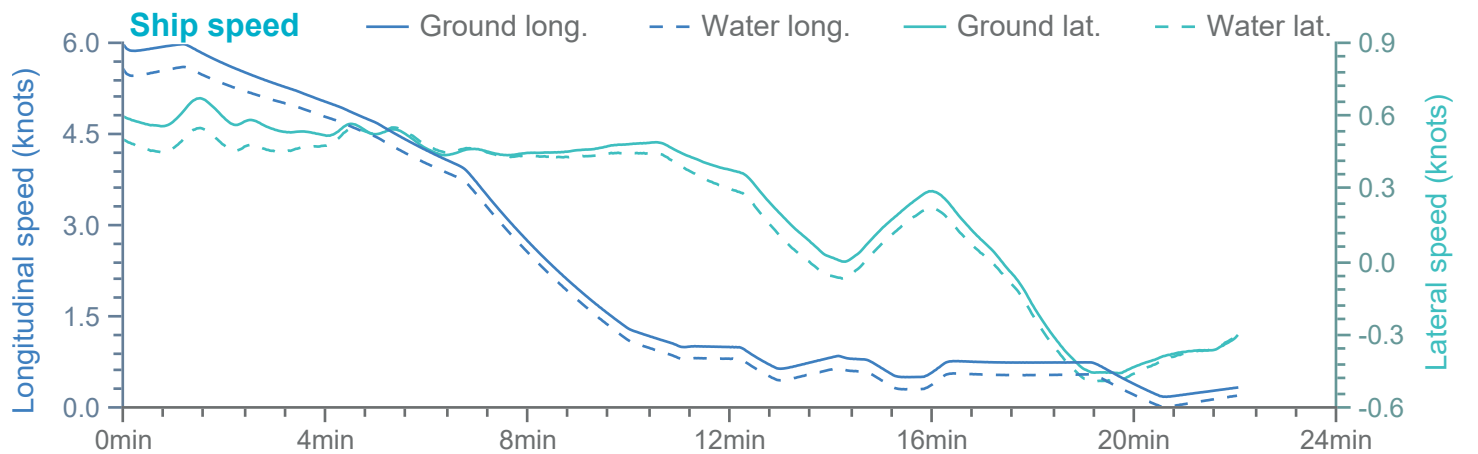
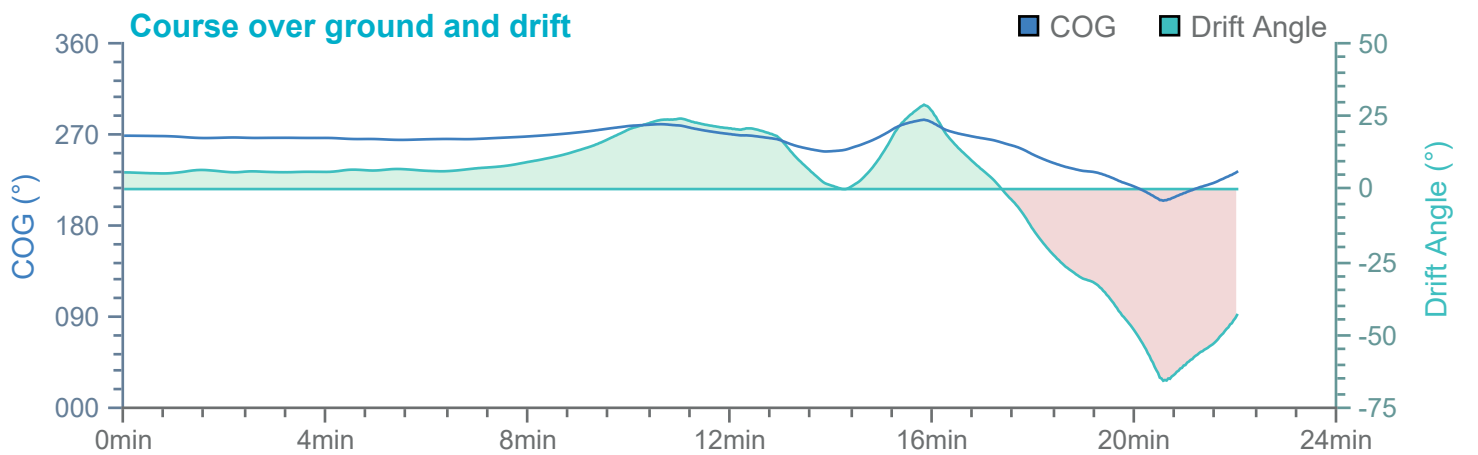
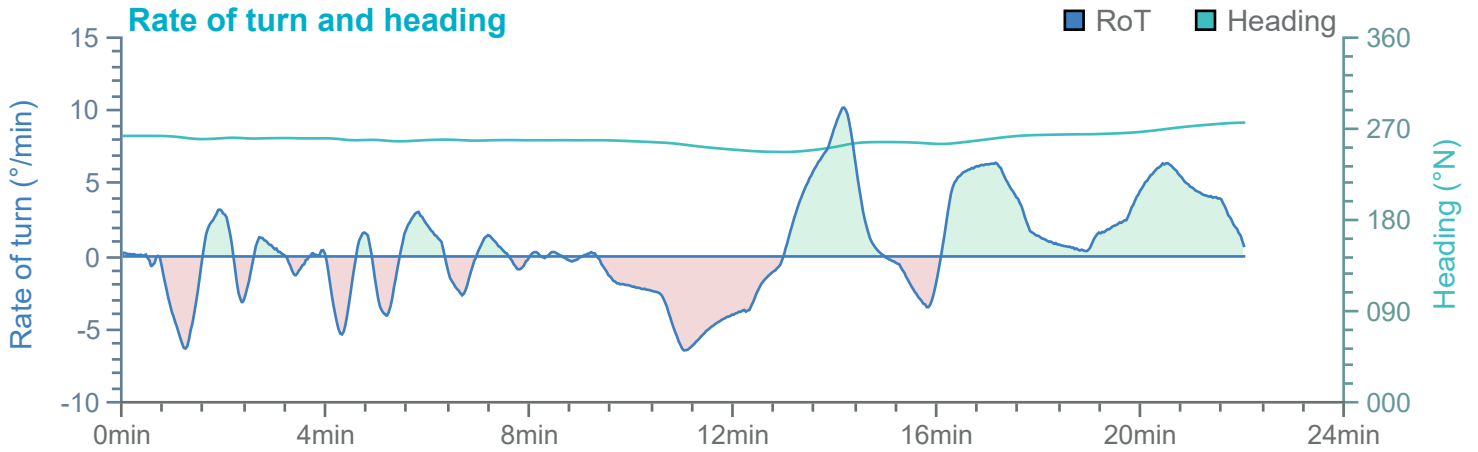
Overview

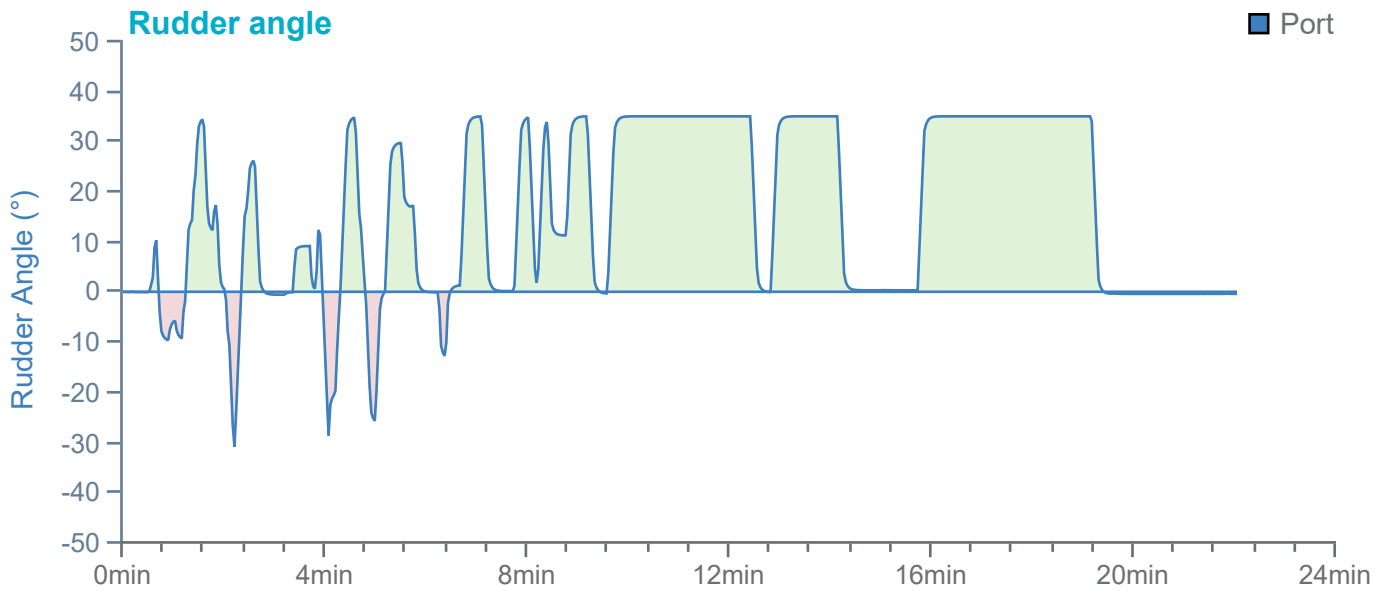
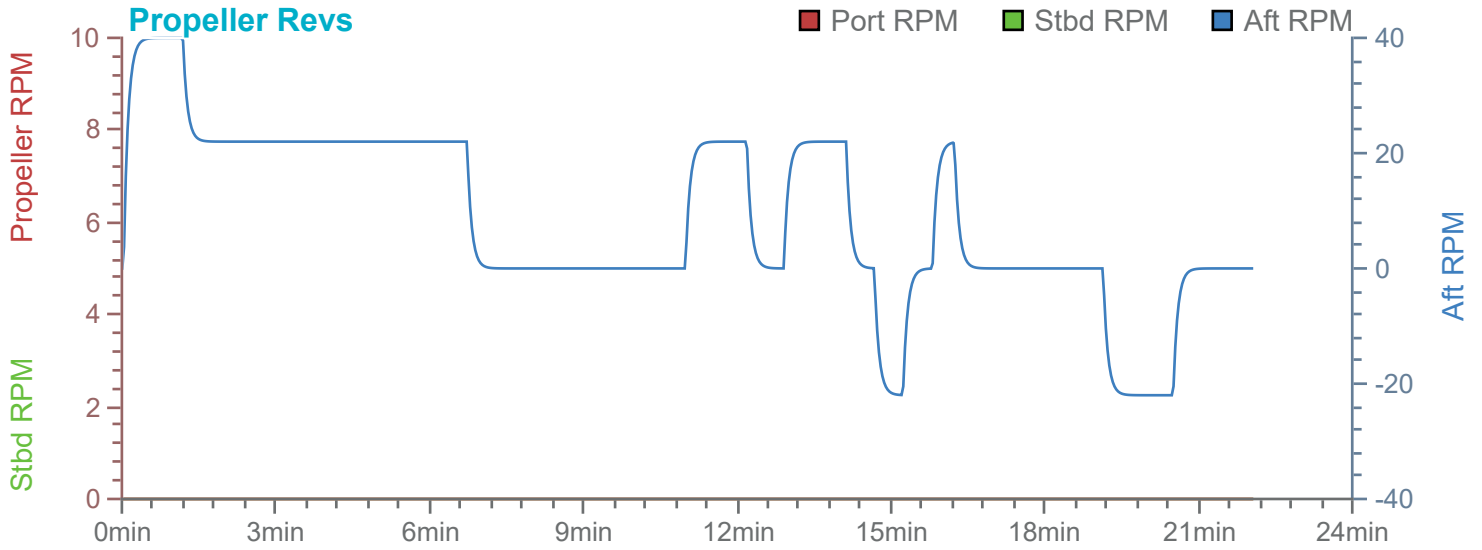
Environment

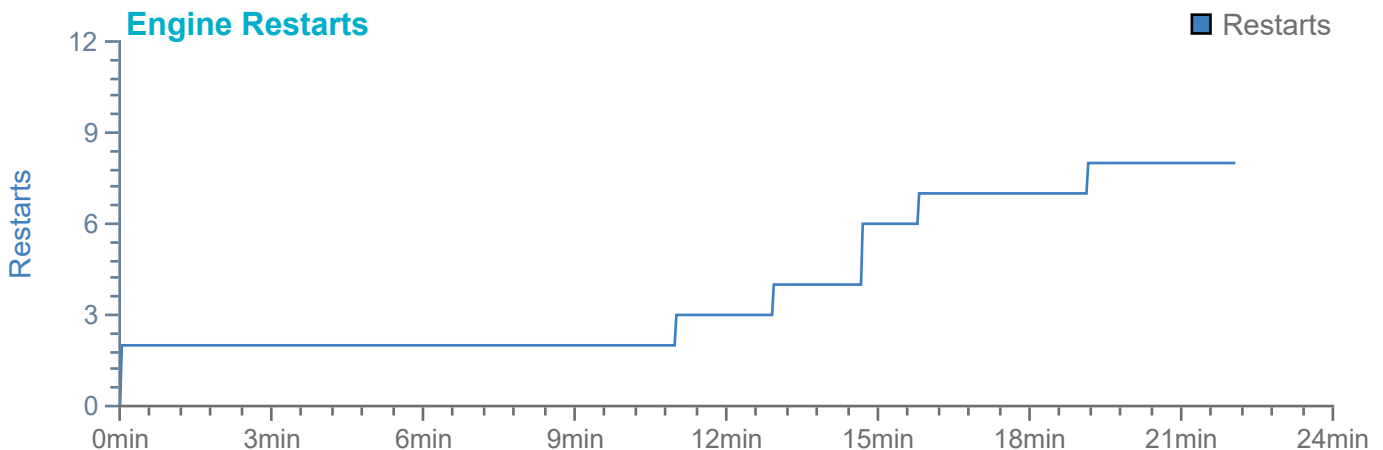
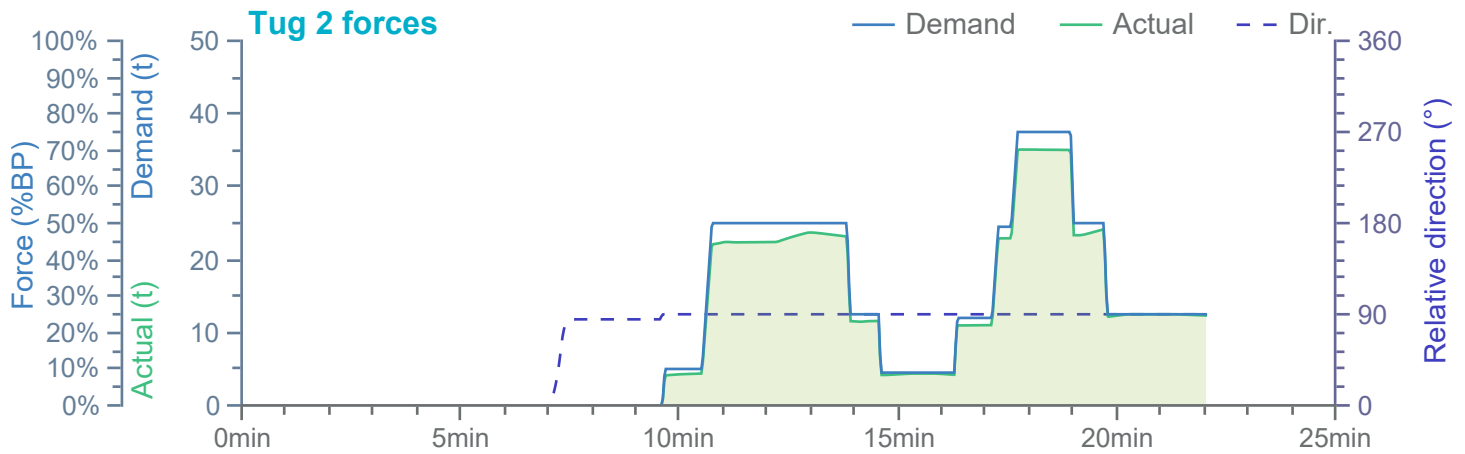
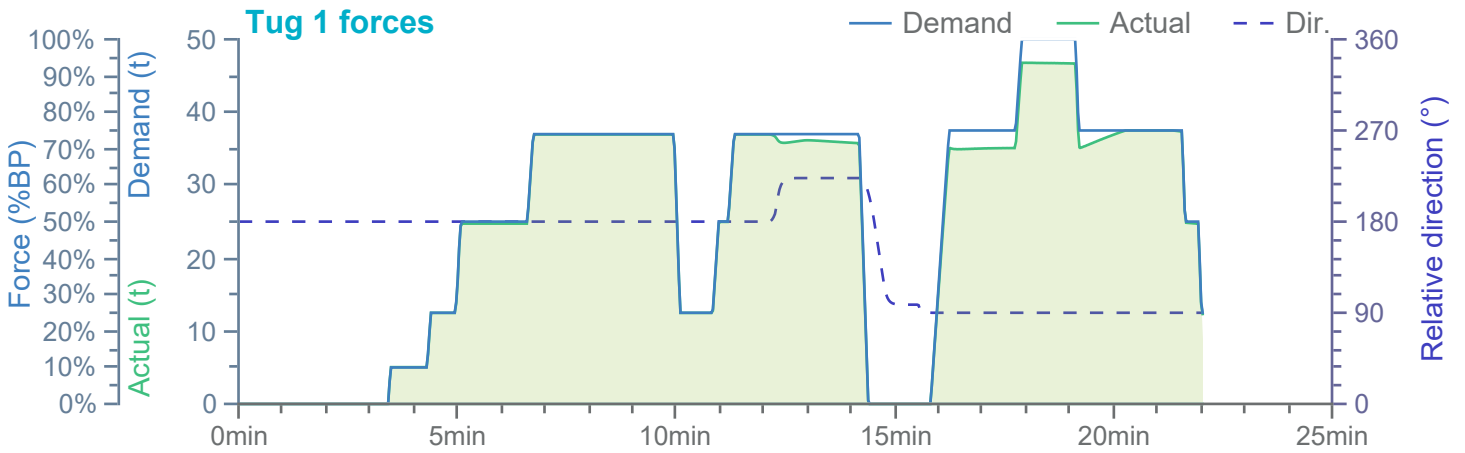
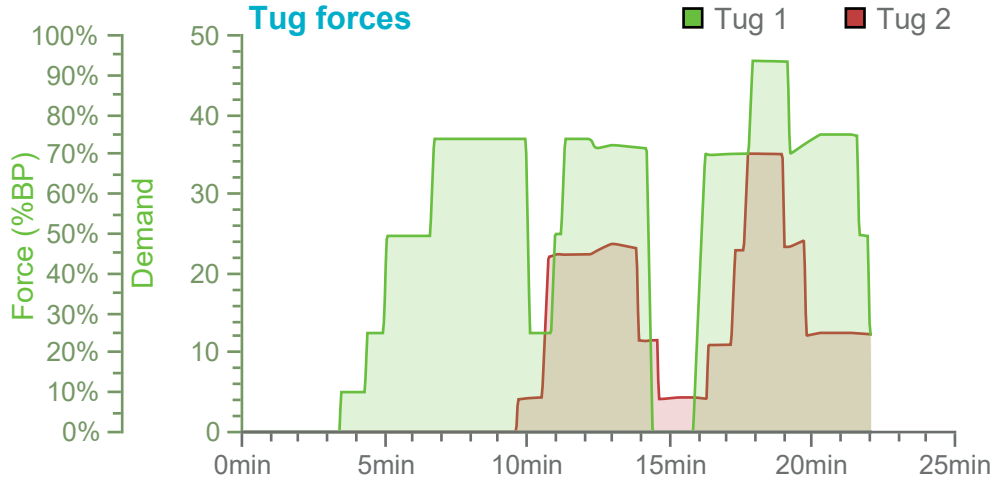
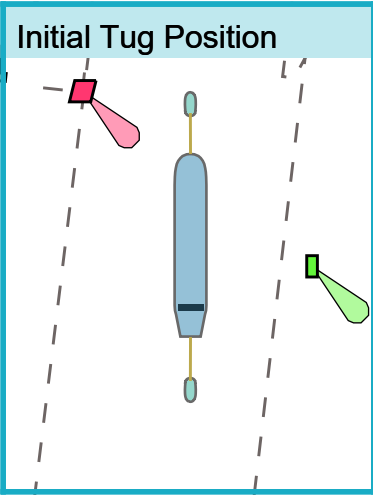
185m x 32.2m x 11m Bulker L

Thruster and engine use

Tug use

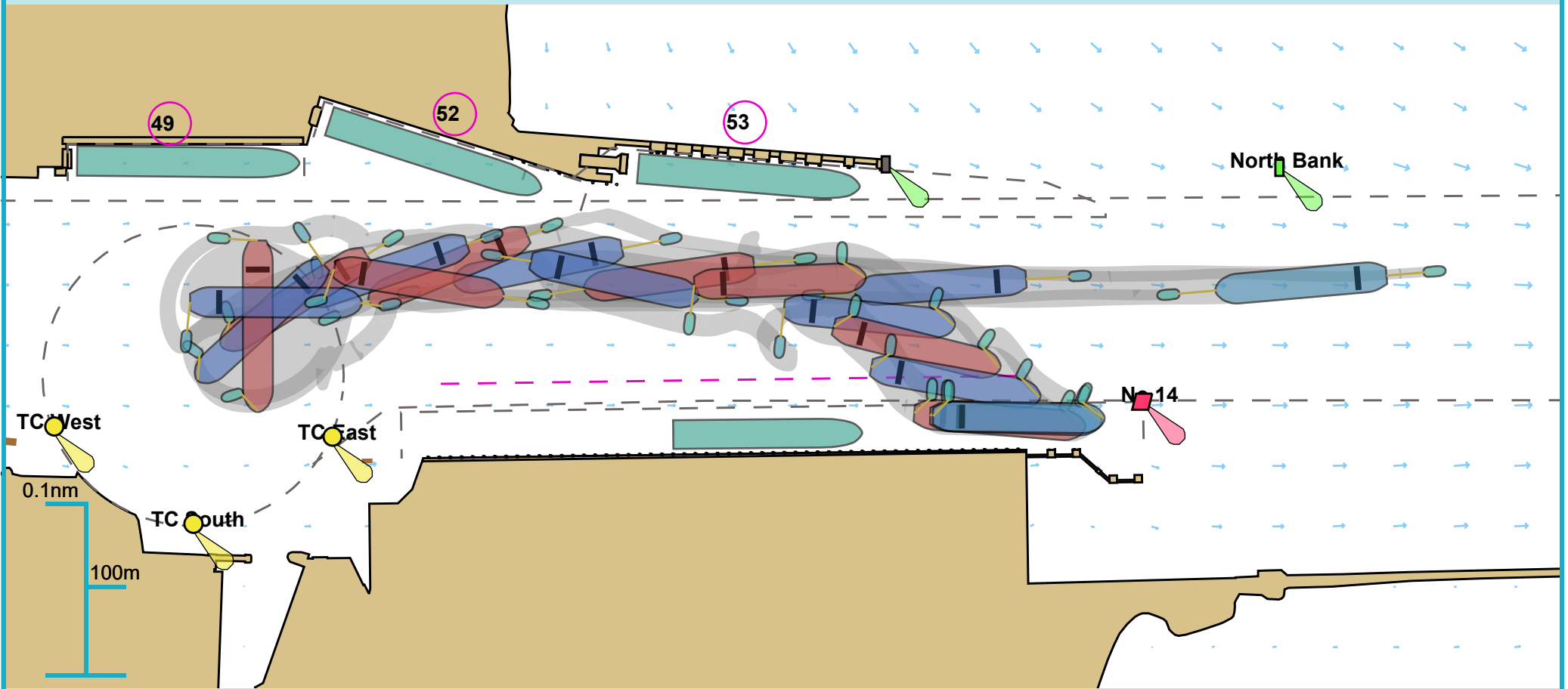






Full Run Overview

53° 20.360 N, 006° 11.831 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

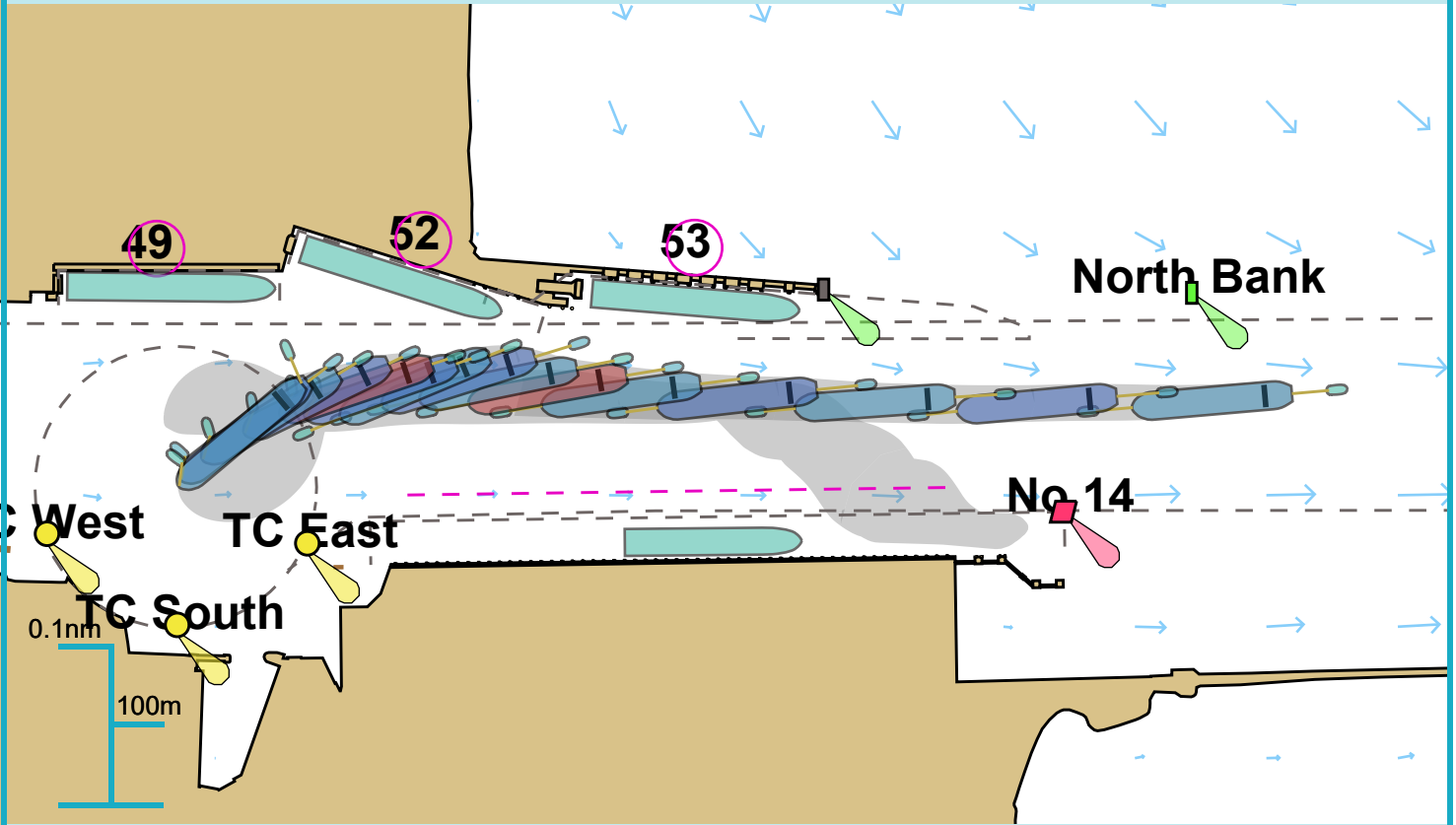
Run length:34 minutes

Manoeuvre:Other

Ownship(s):185m Product Tanker

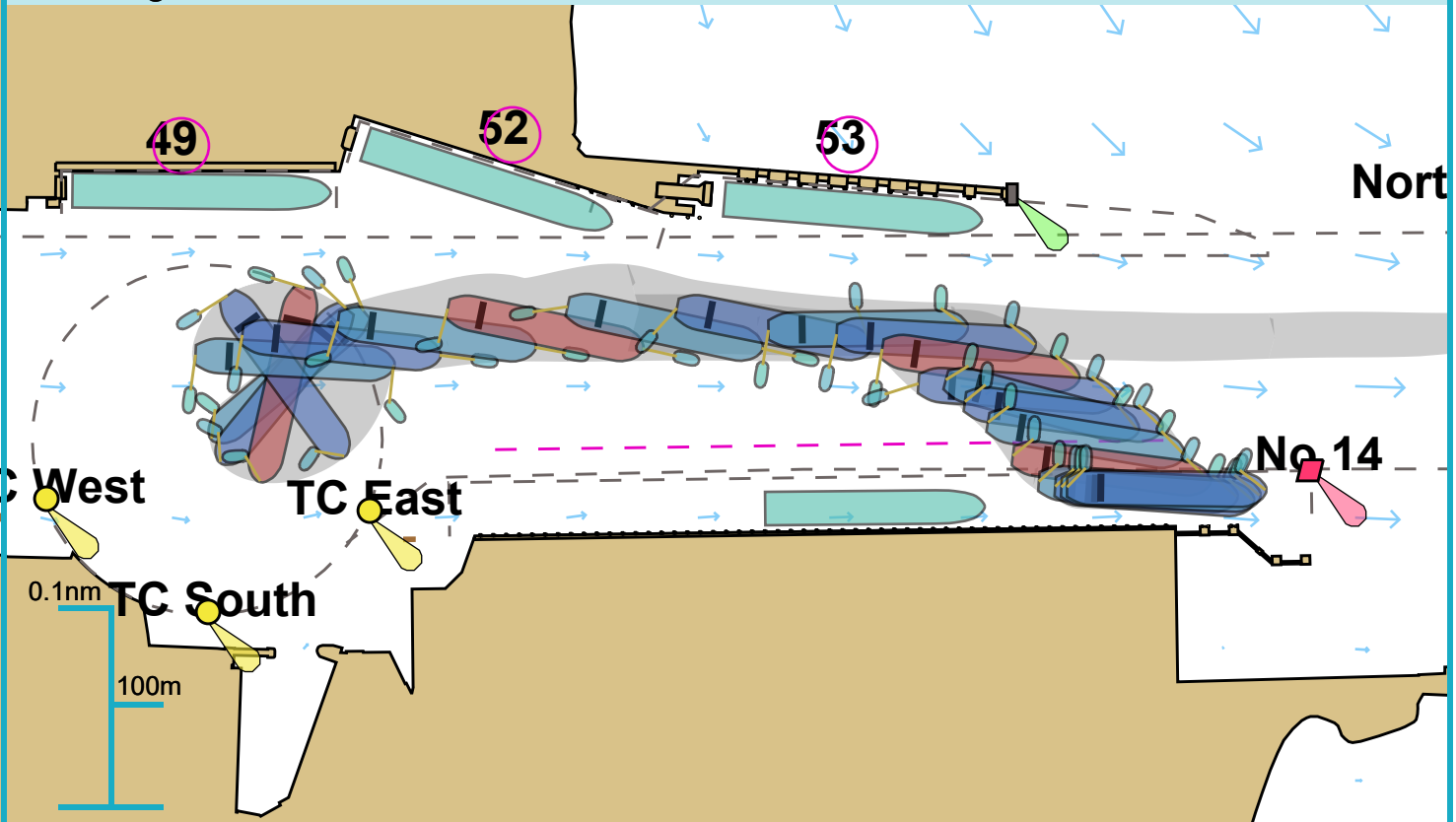
Comments:

Approach



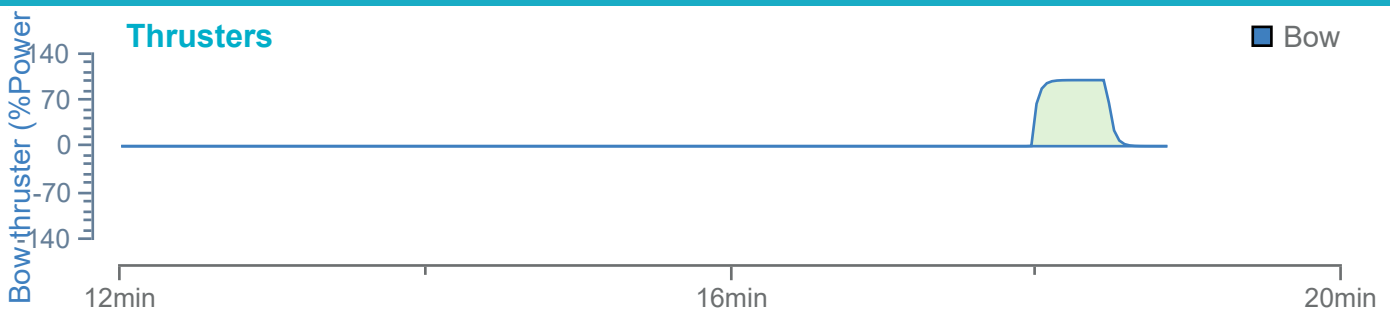
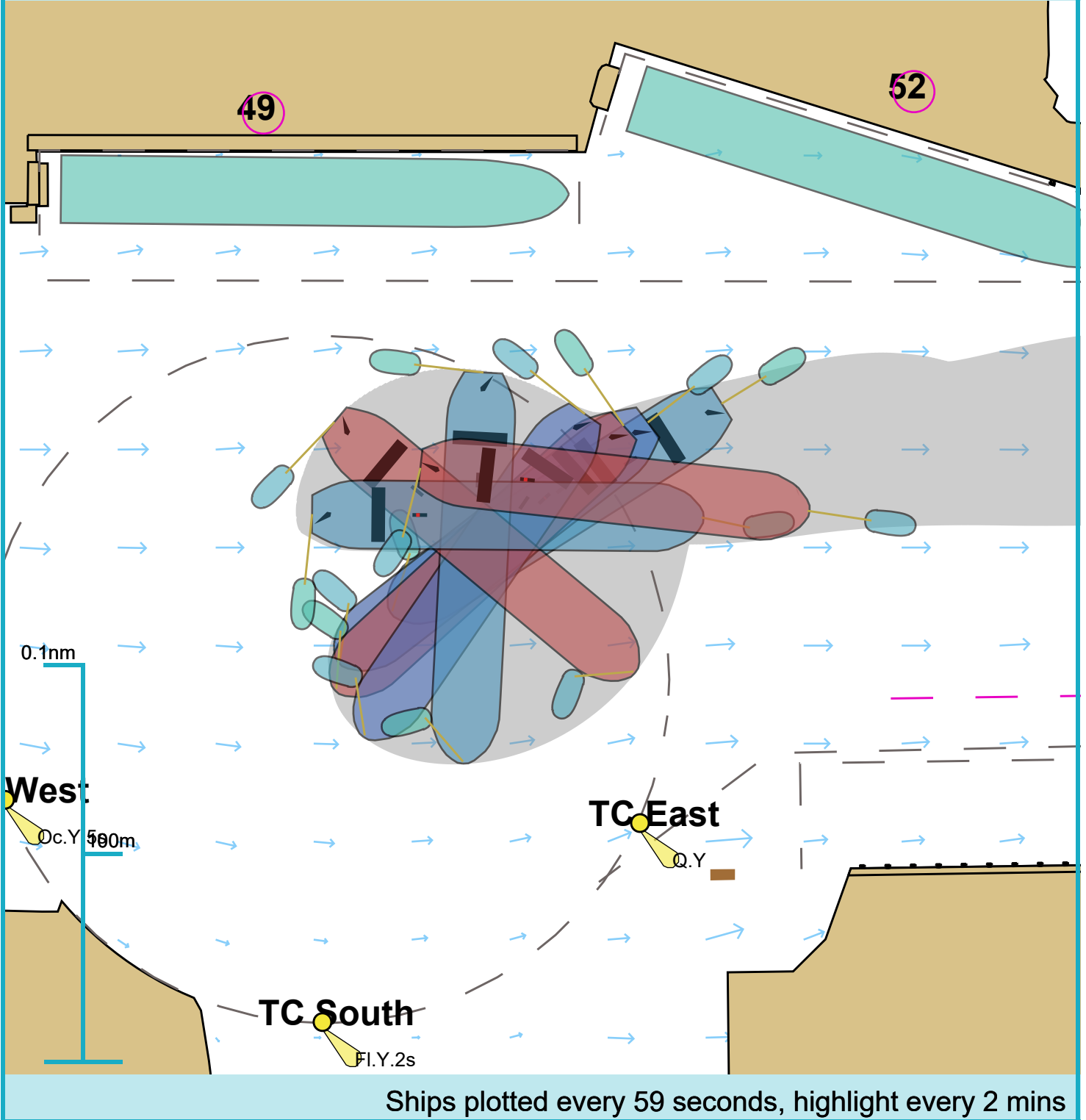
Ships plotted every 1 mins, highlight every 5 mins

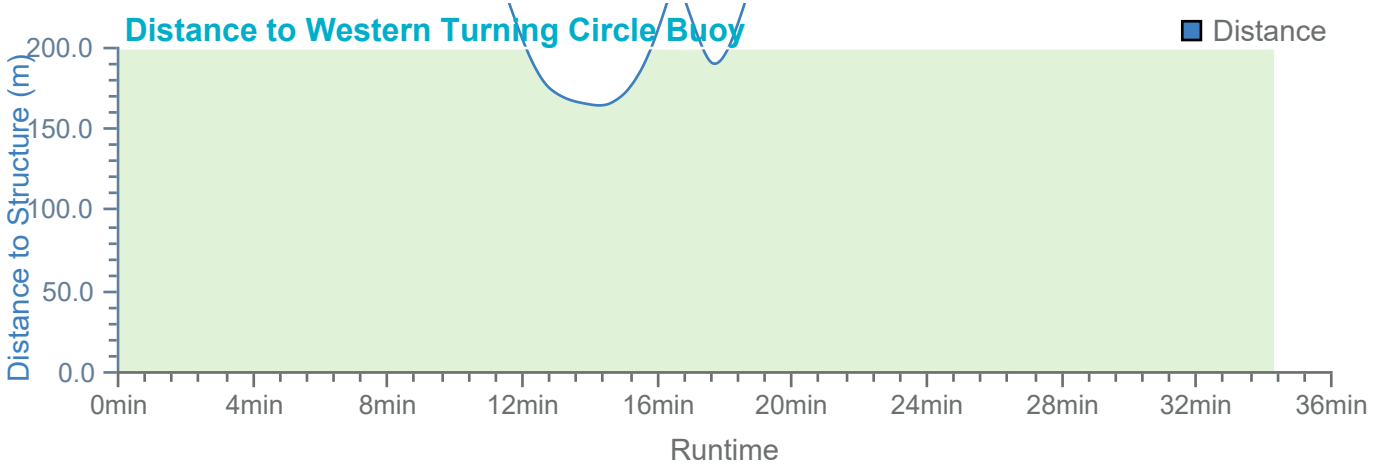
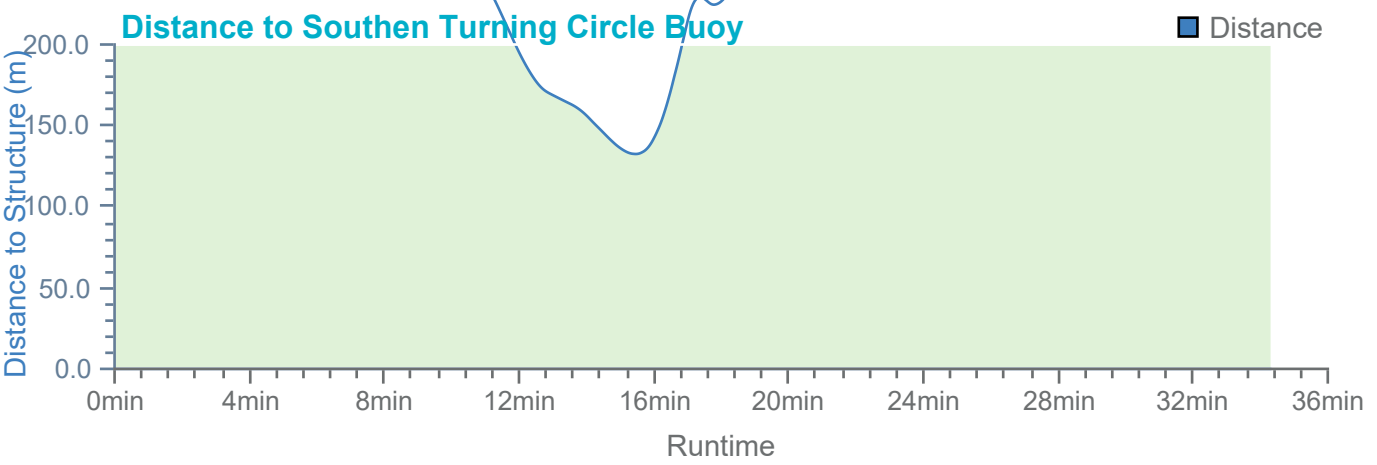
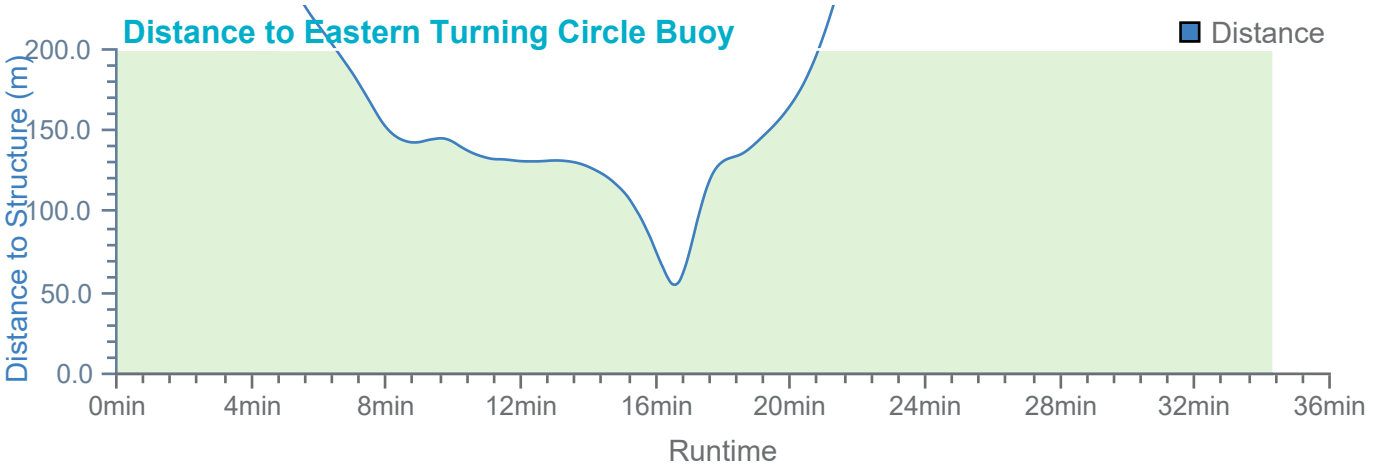
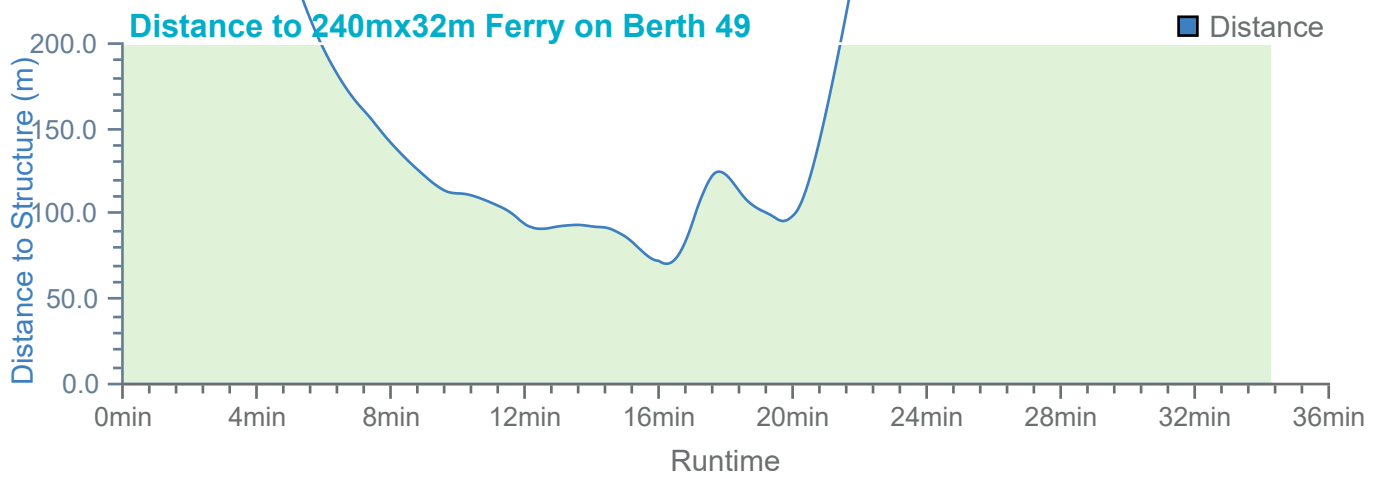
Berthing

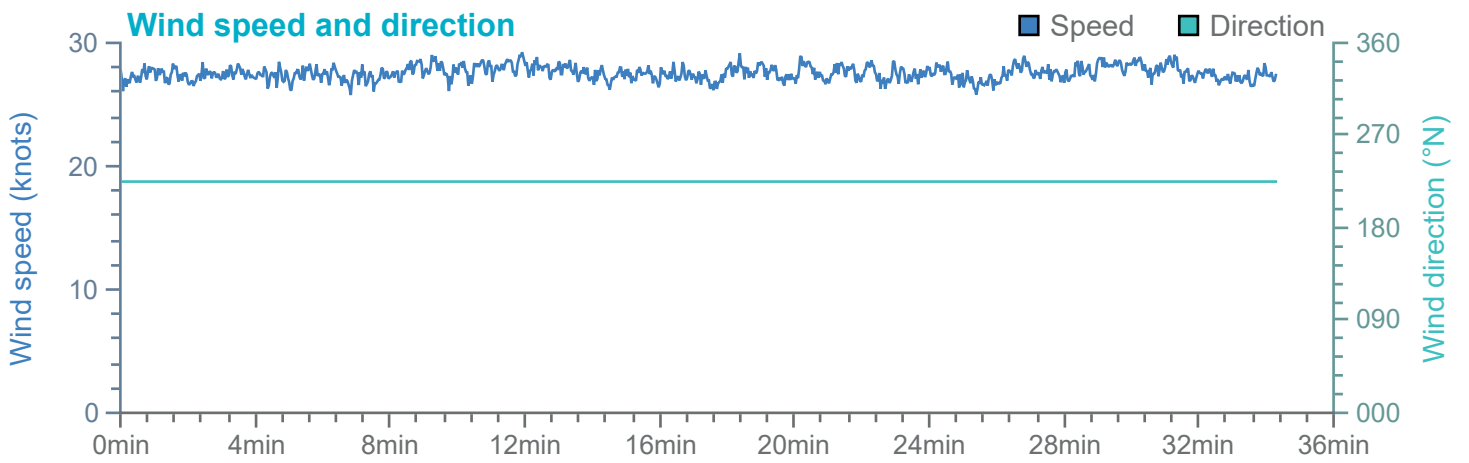
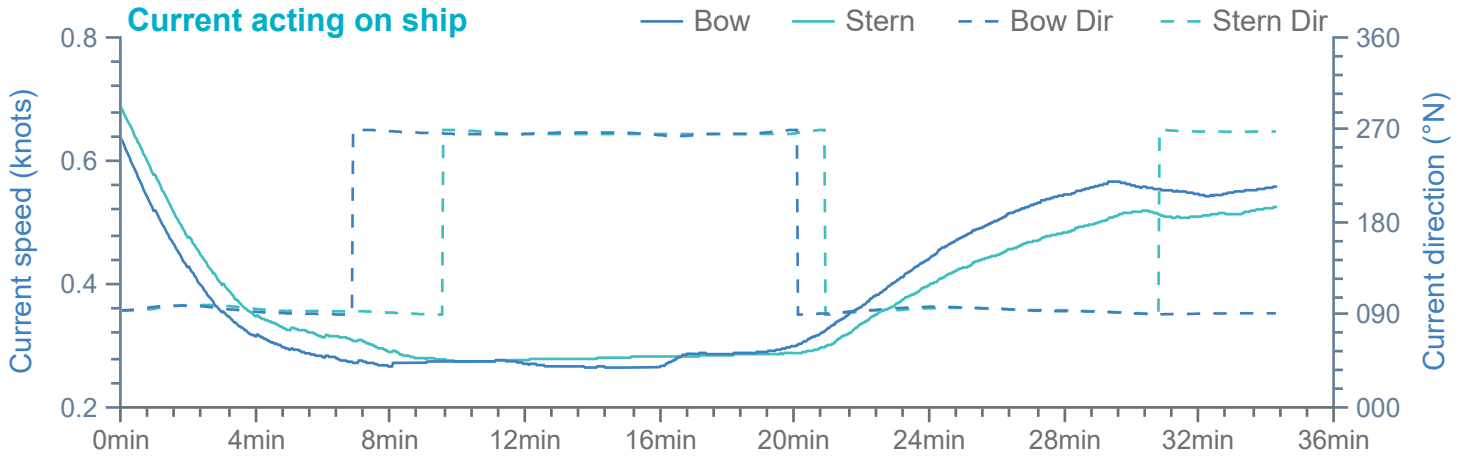


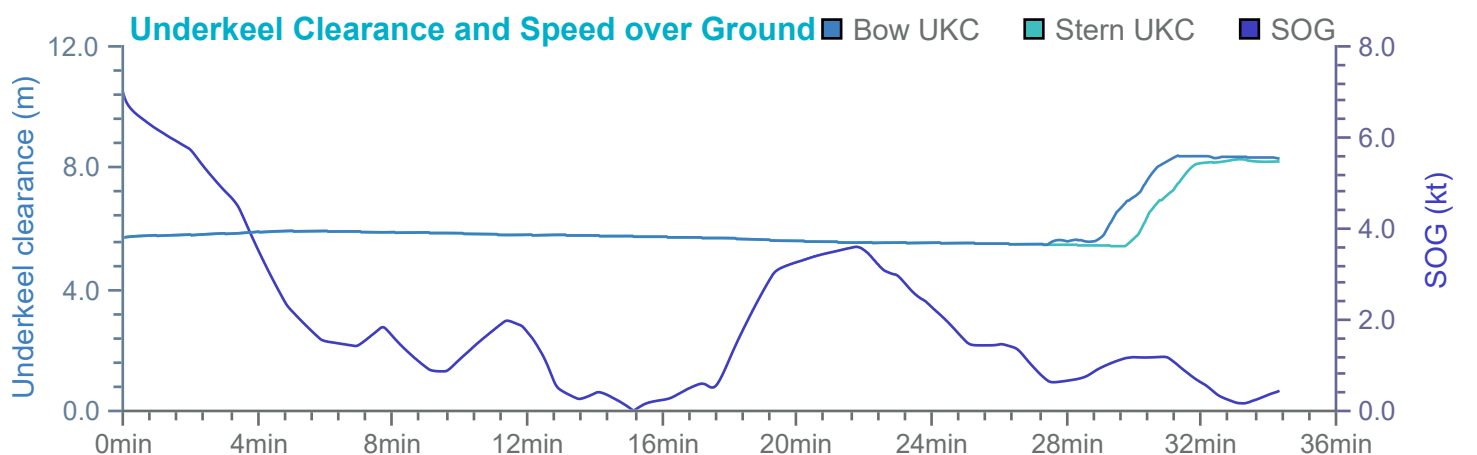
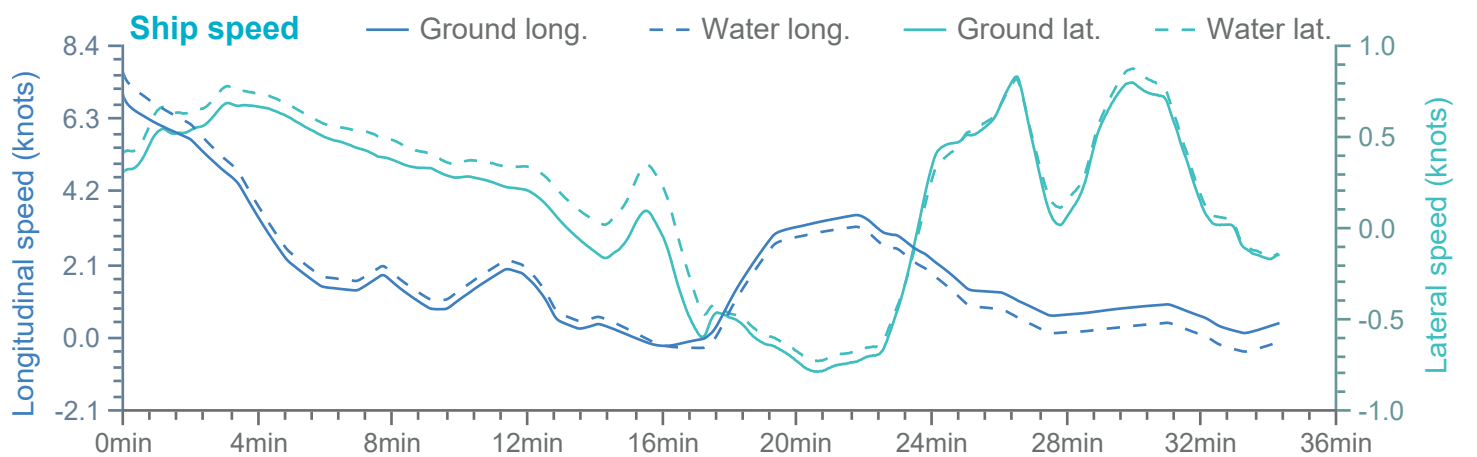
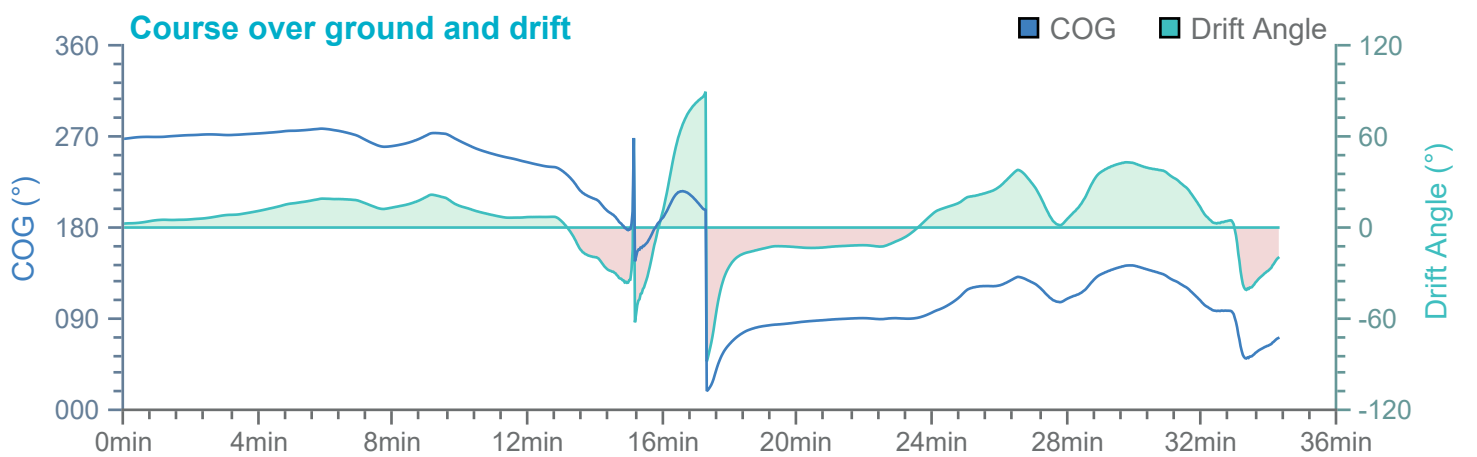
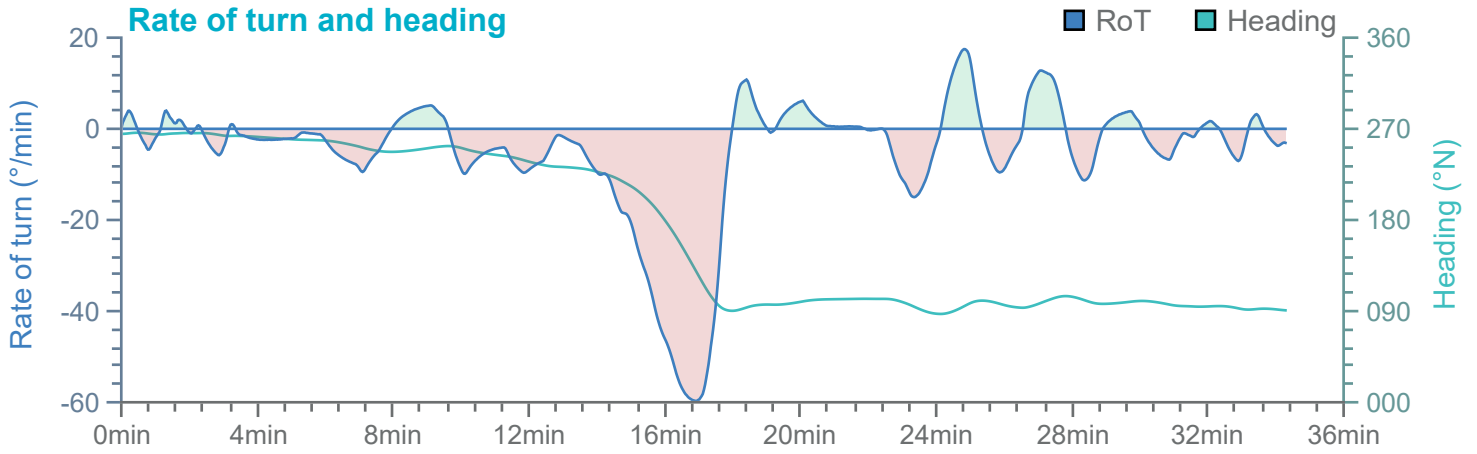
Ships plotted every 1 mins, highlight every 5 mins

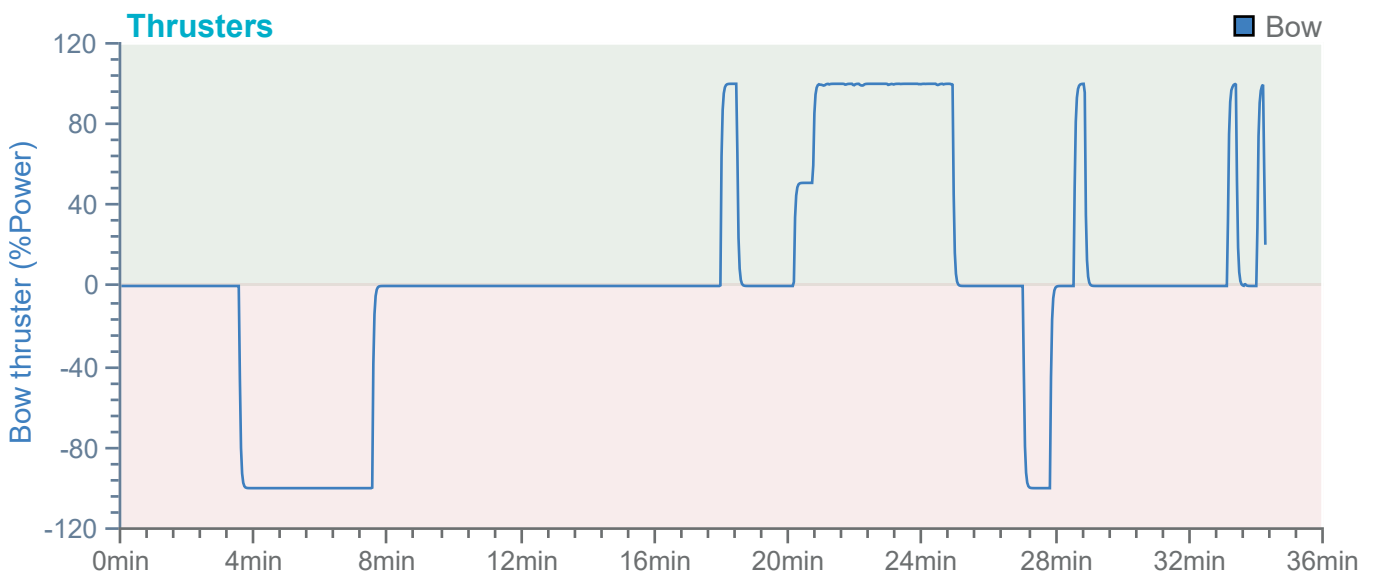
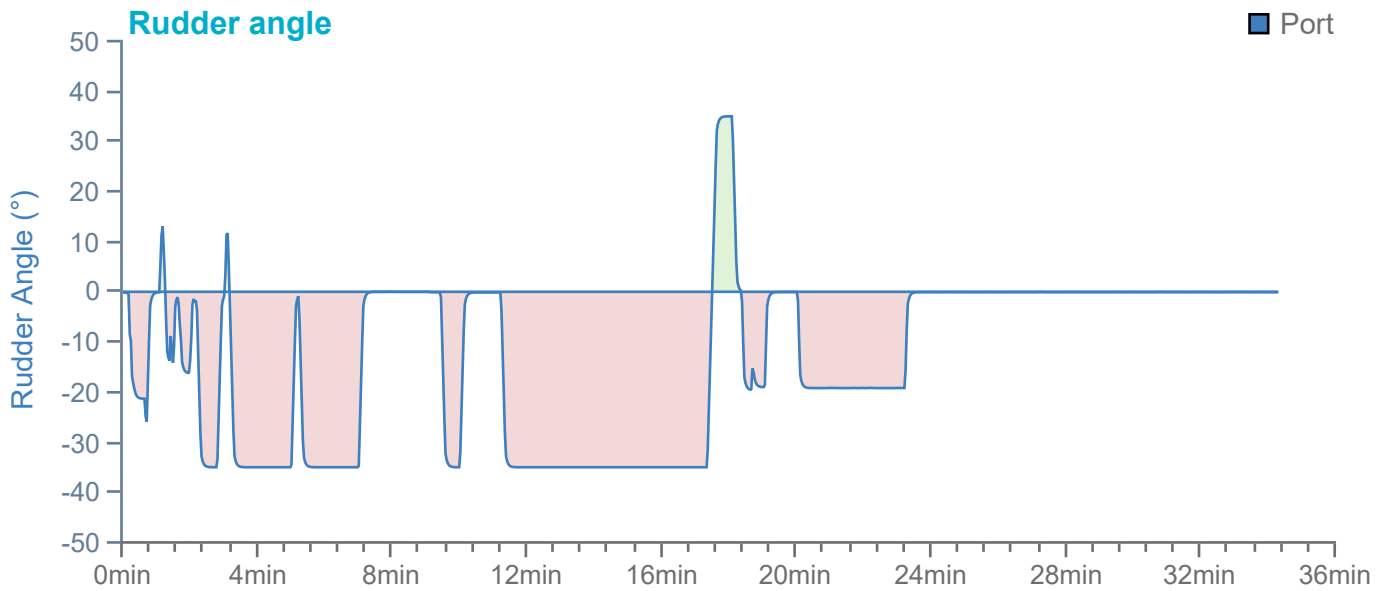
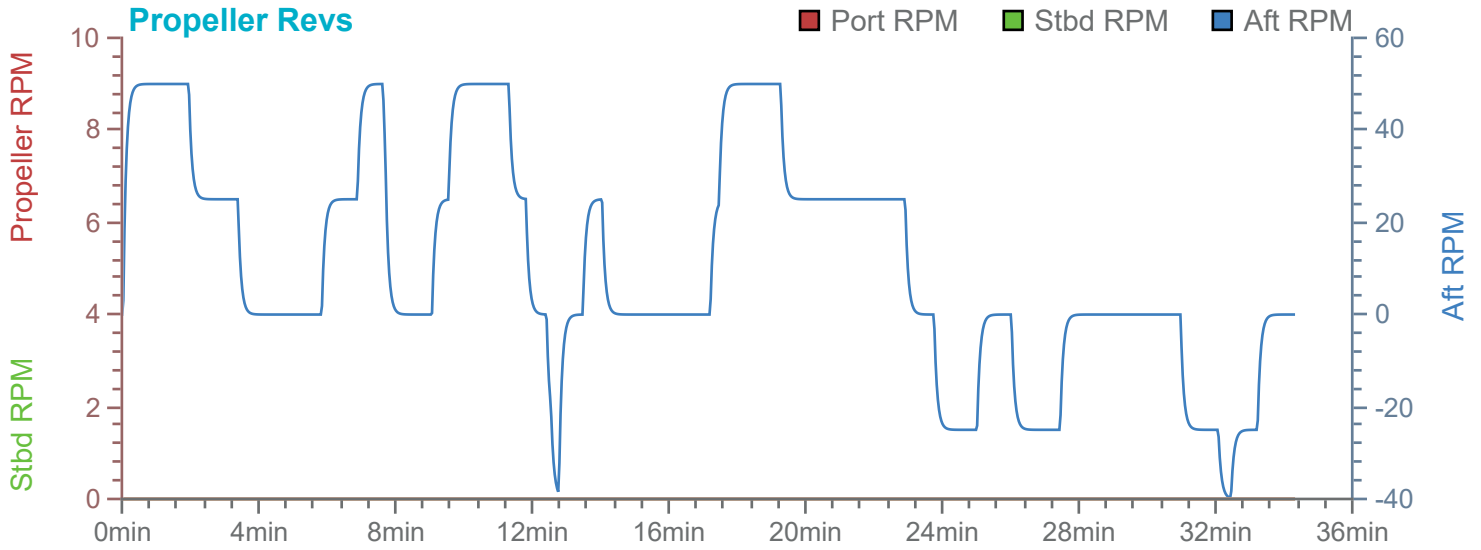
Swing

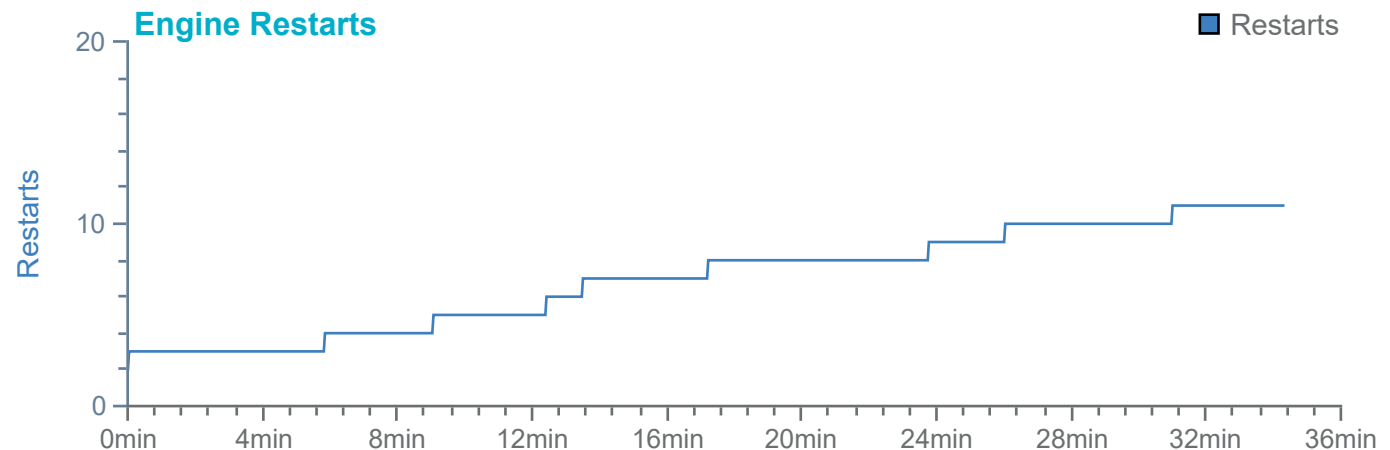
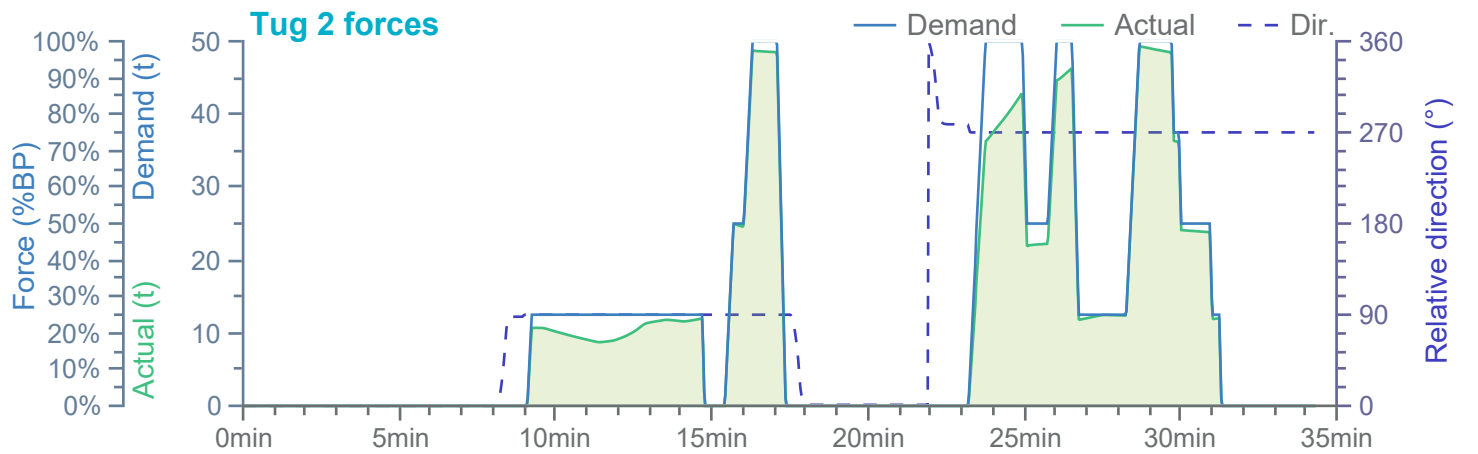
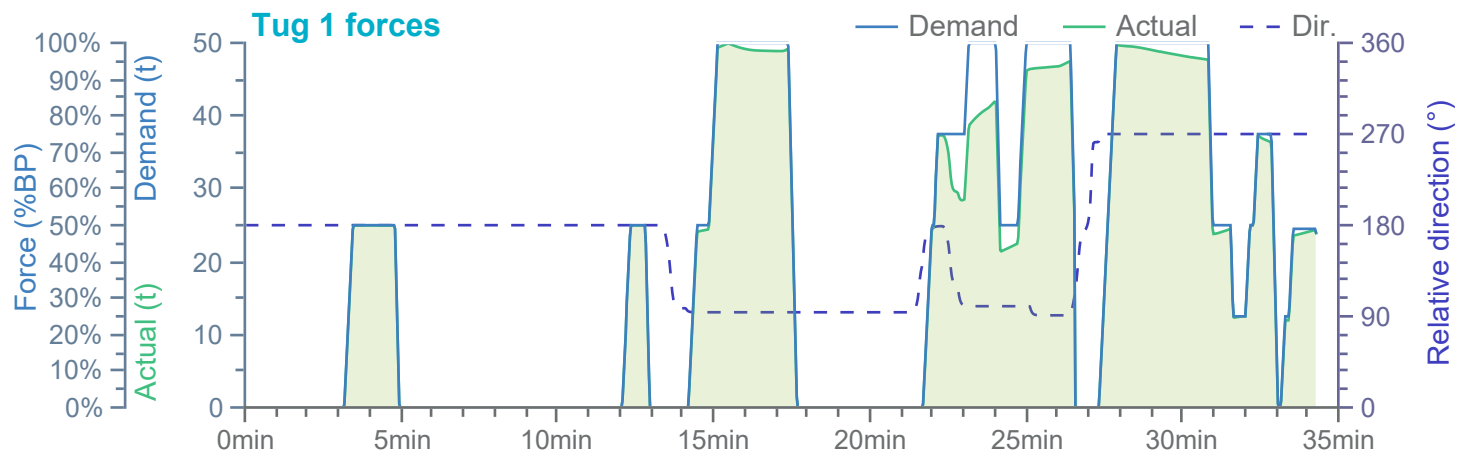
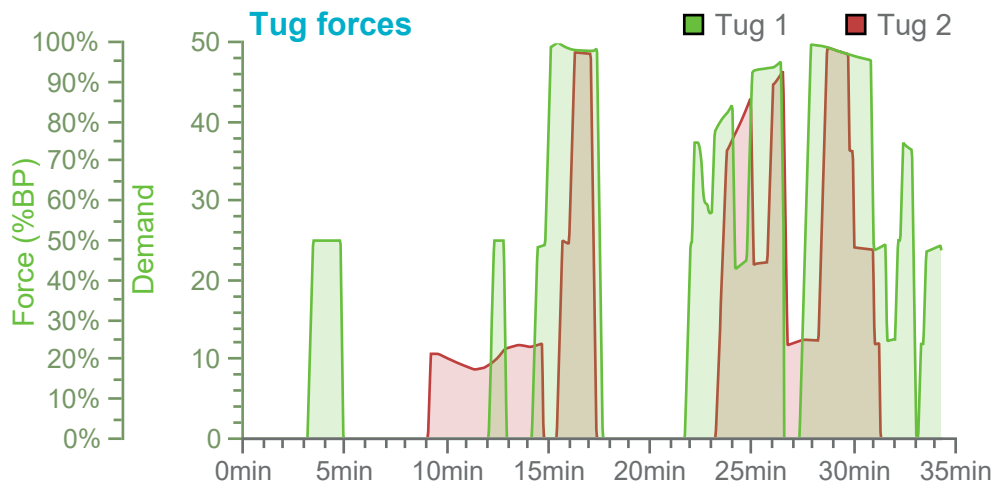
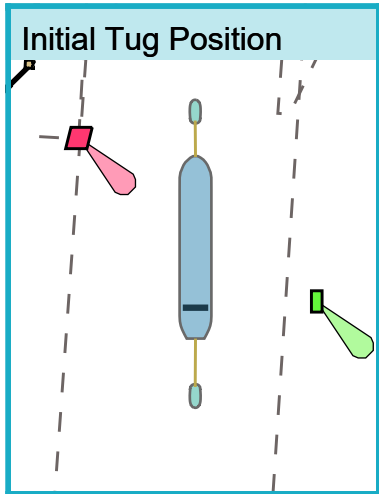






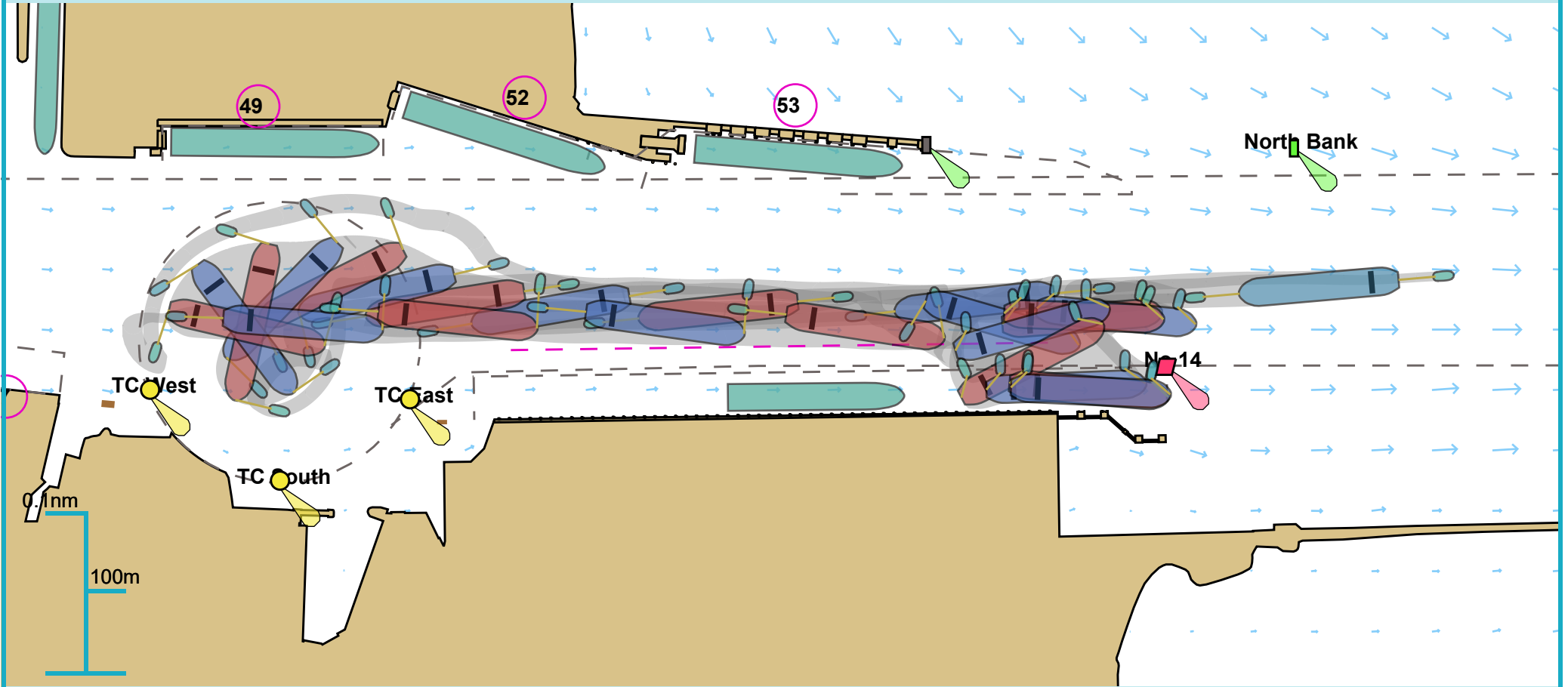






Full Run Overview

53° 20.326 N, 006° 11.934 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD

Run length: 45 minutes

Manoeuvre: Other

Ownship(s): 185m Product Tanker

Comments:

Overview

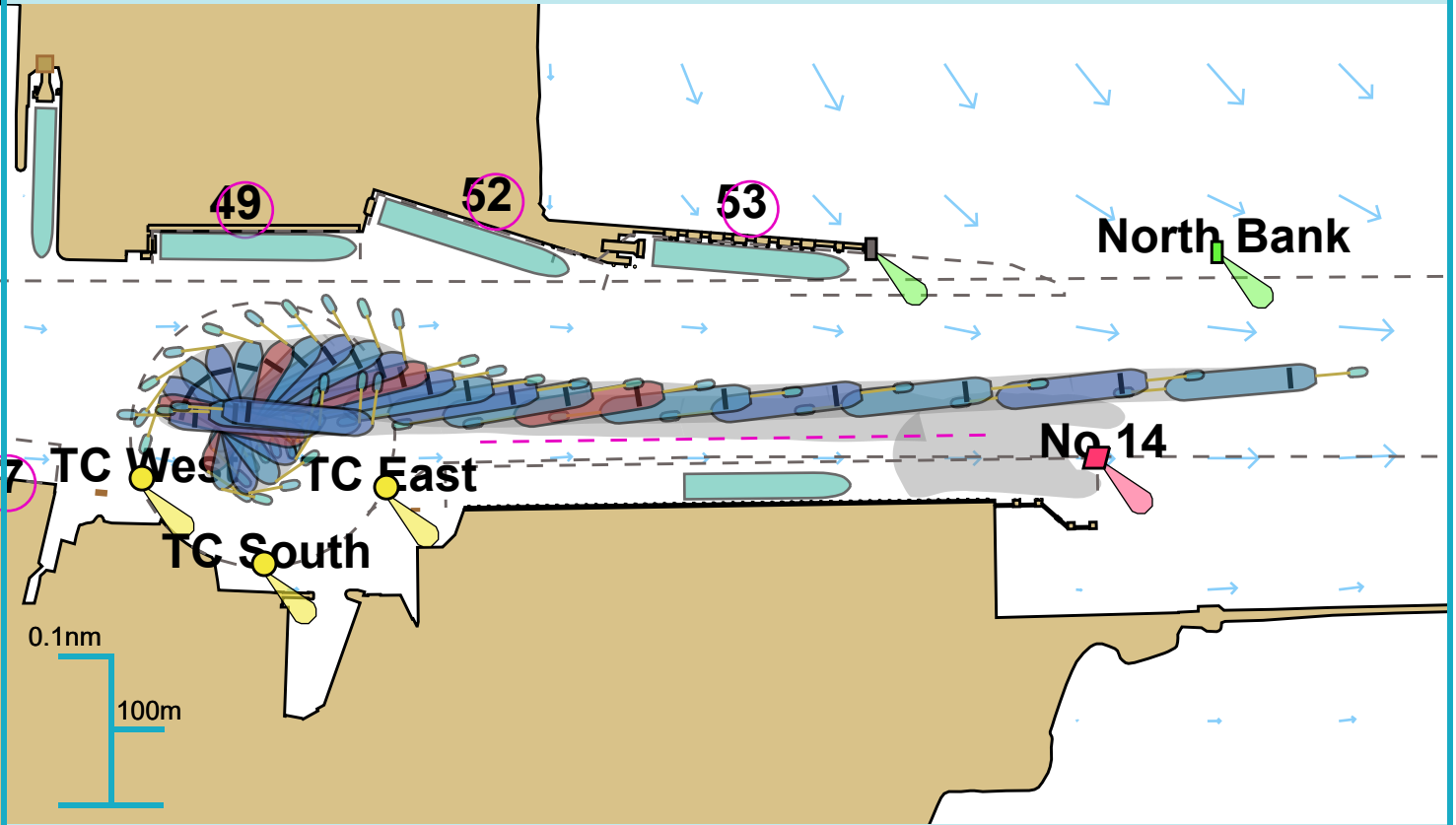
Environment

185m Product Tanker

Thruster and engine use

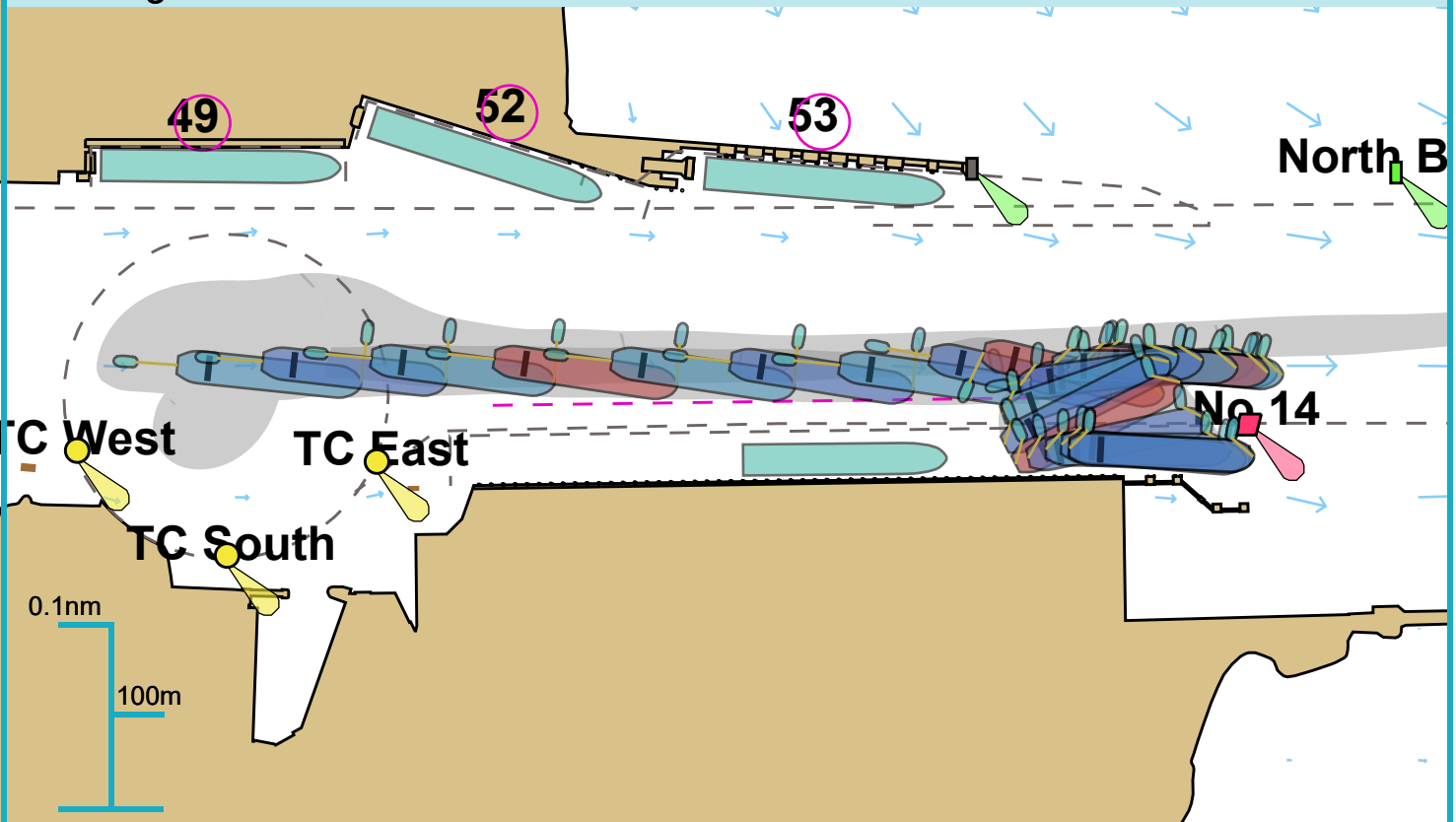
Tug use

Approach



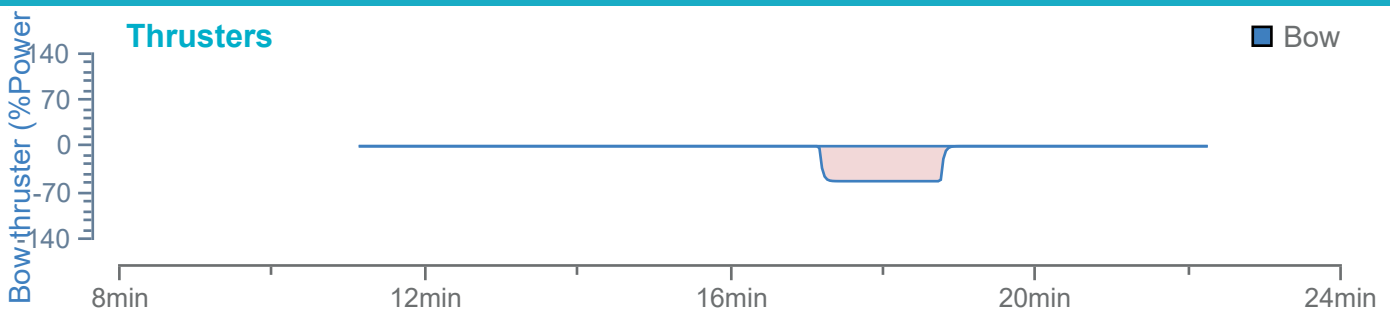
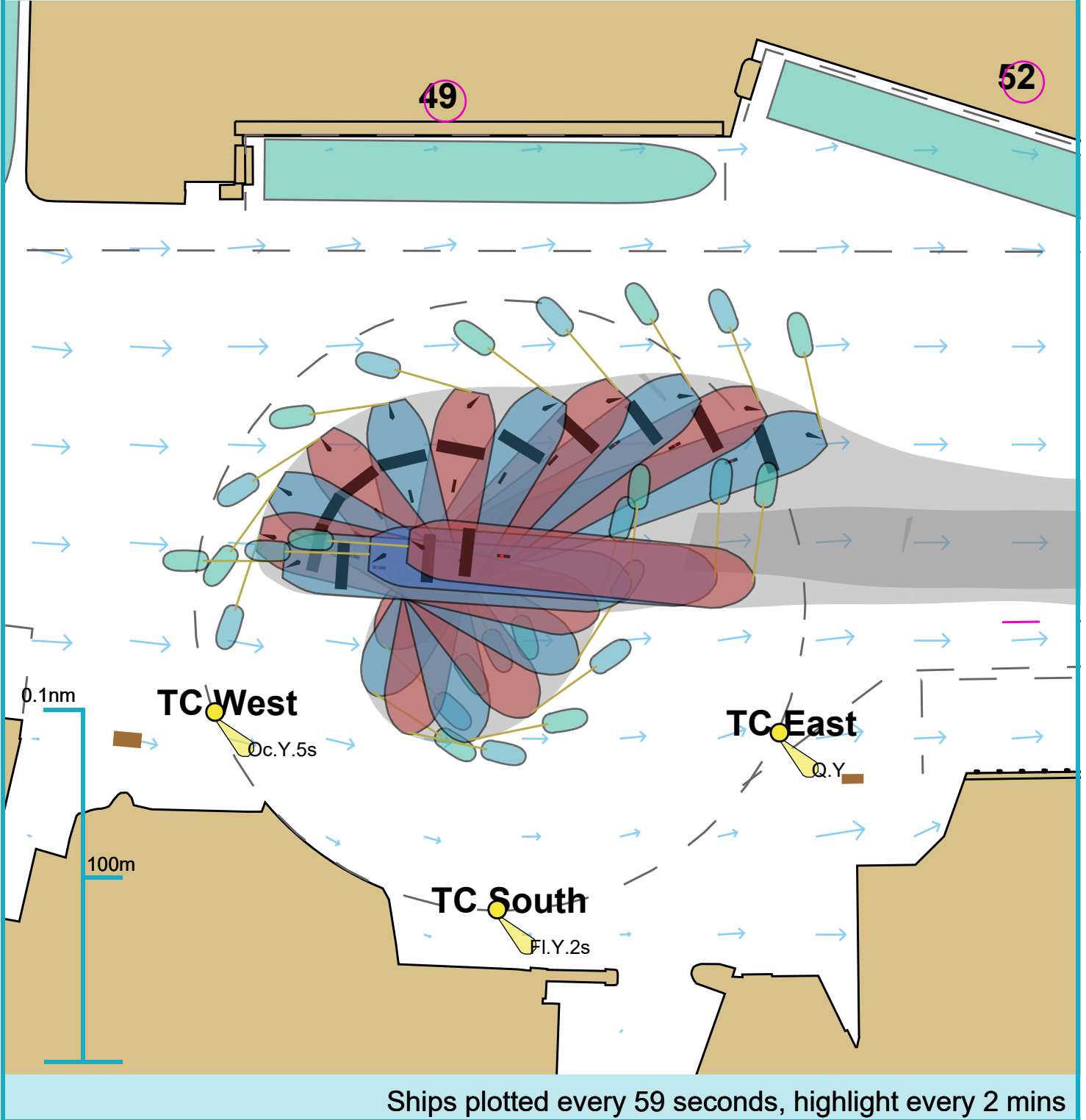
Ships plotted every 1 mins, highlight every 5 mins

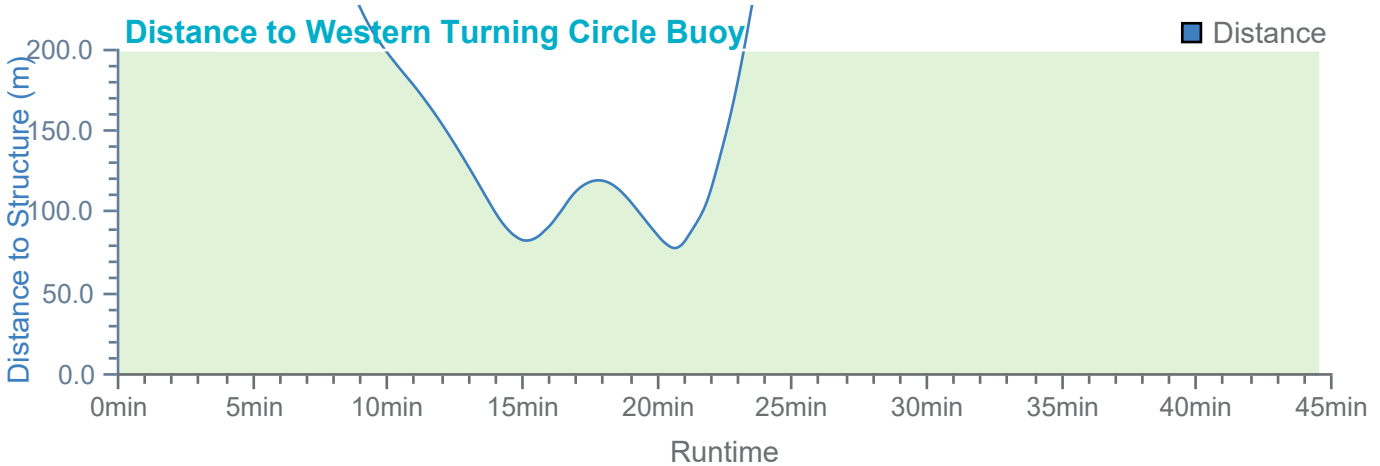
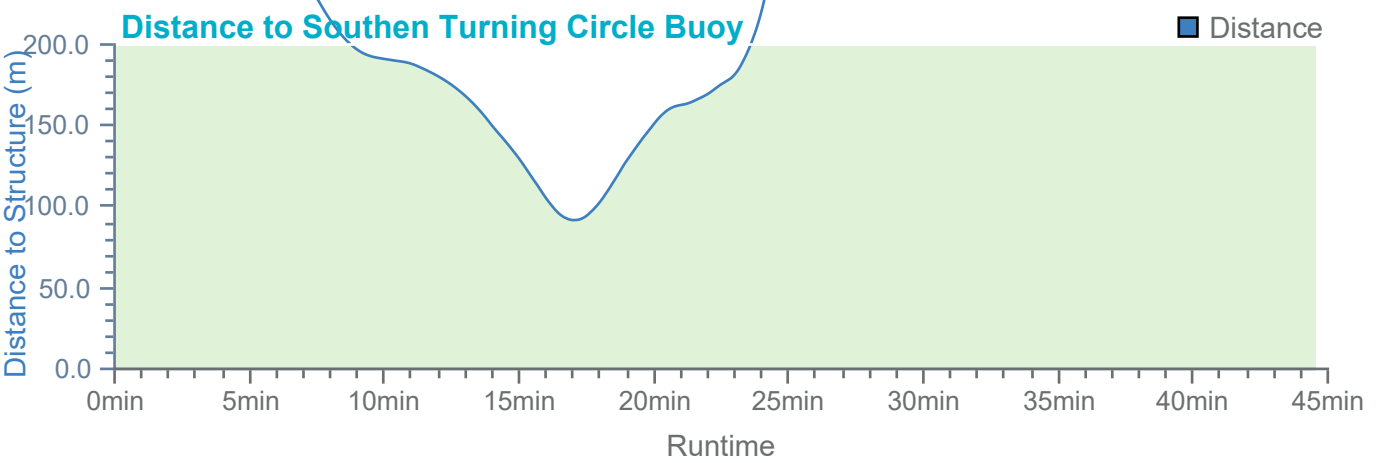
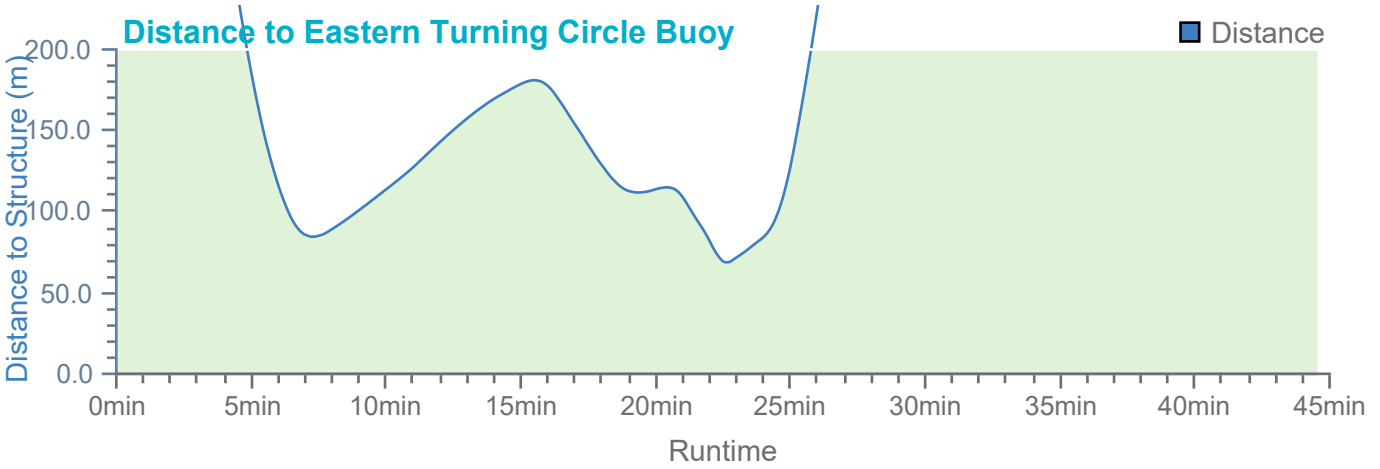
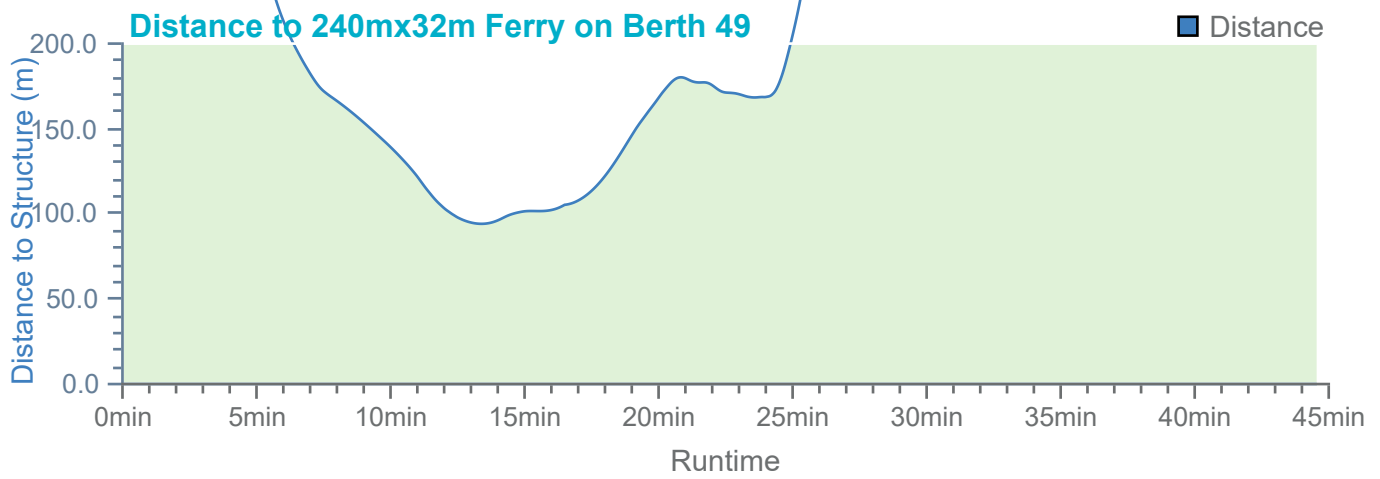
Berthing

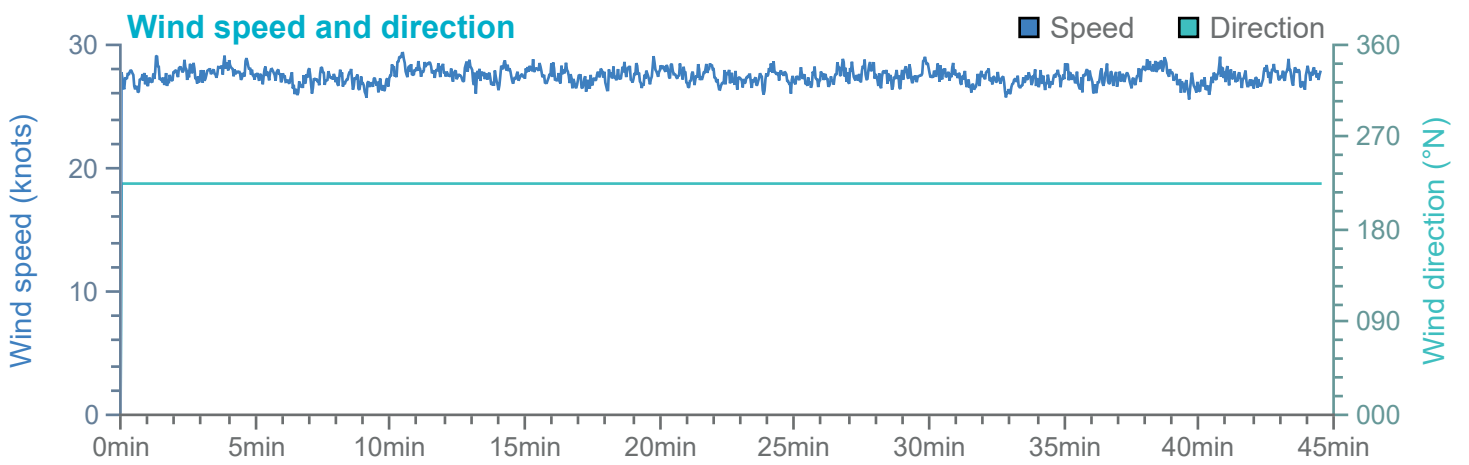
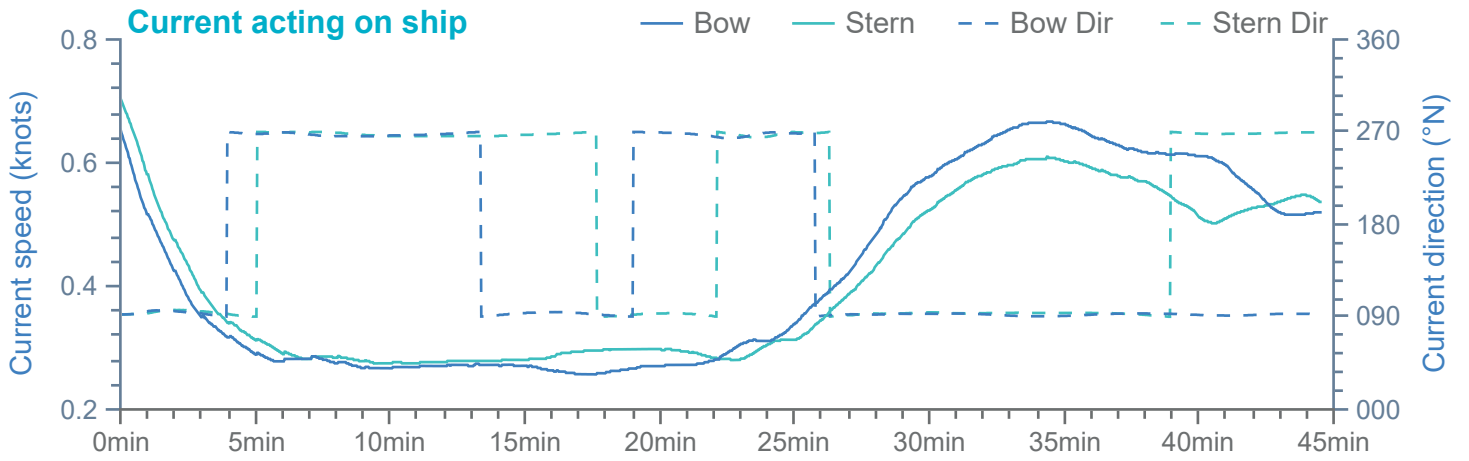


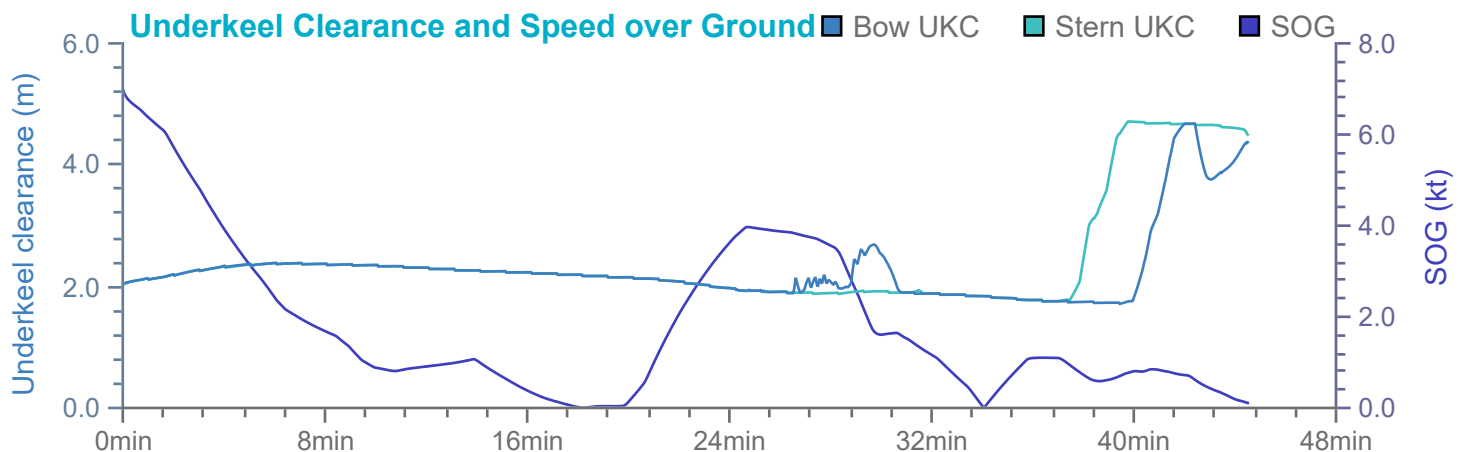
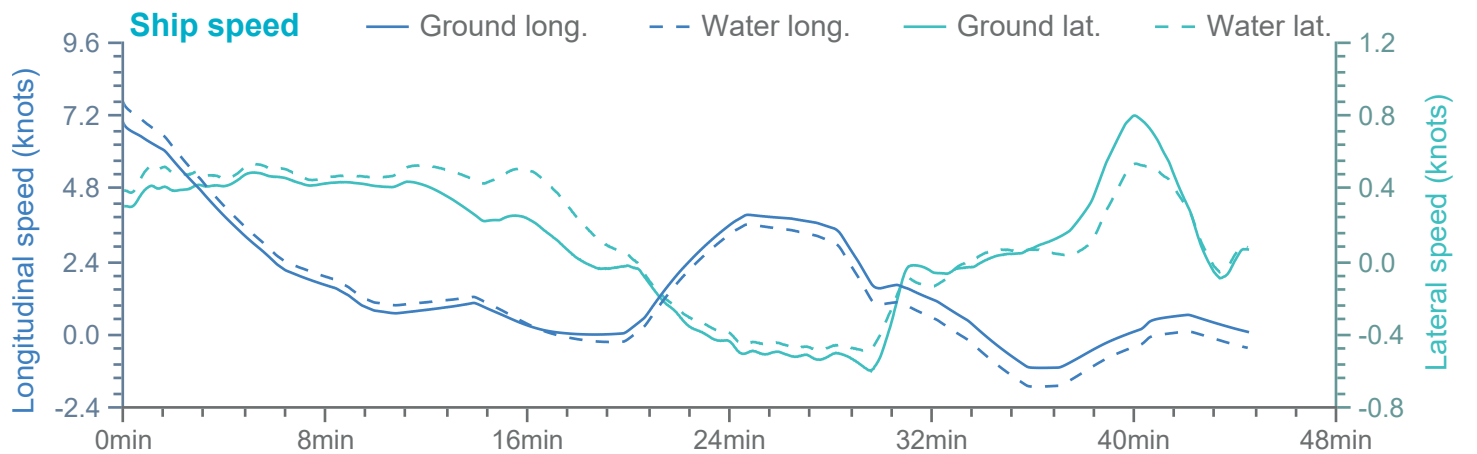
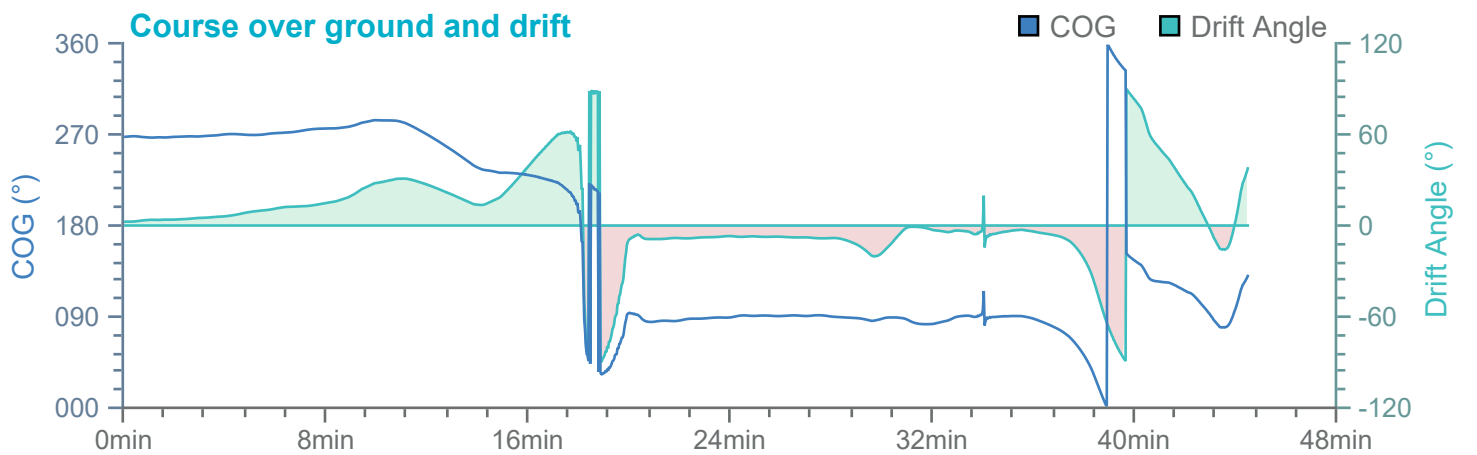
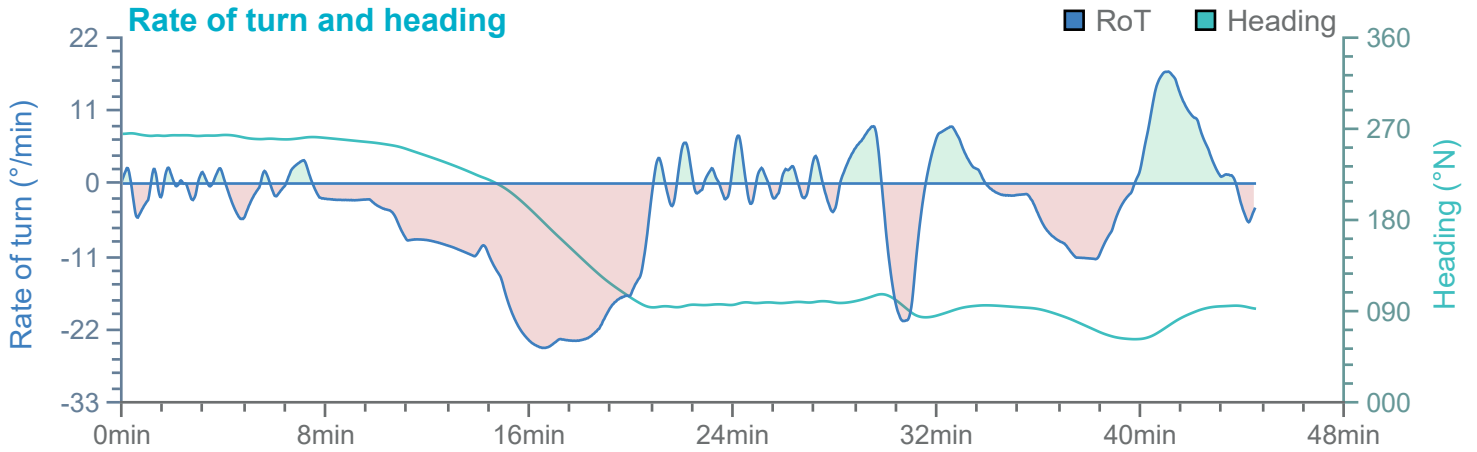
Ships plotted every 1 mins, highlight every 5 mins

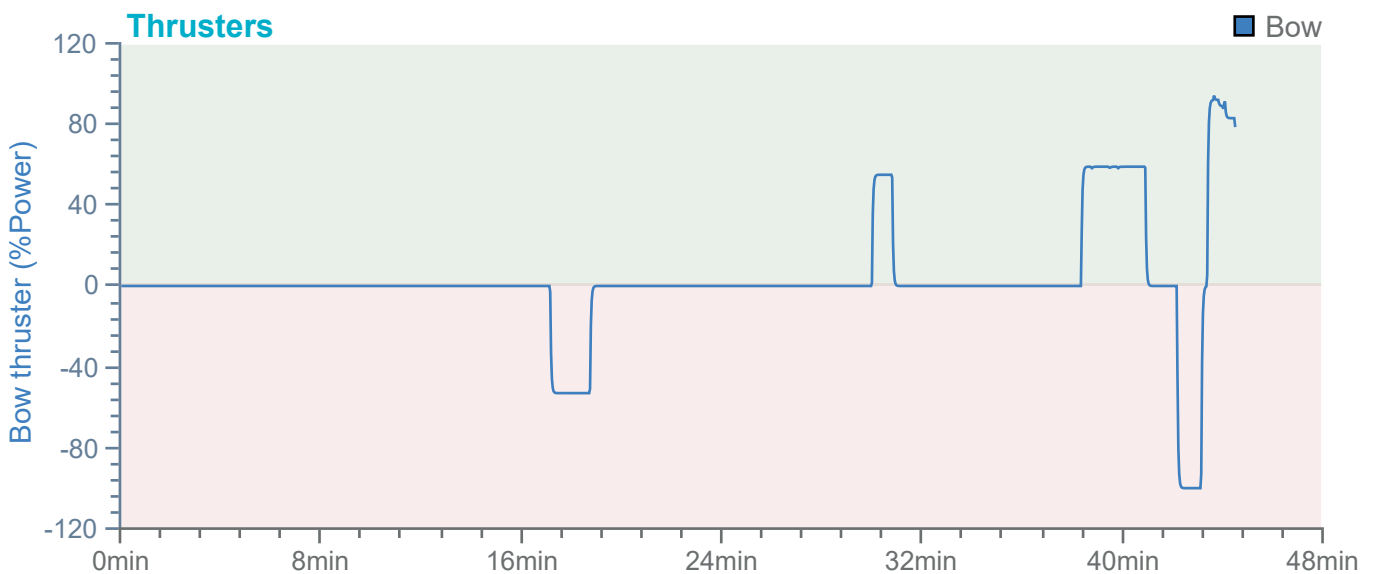
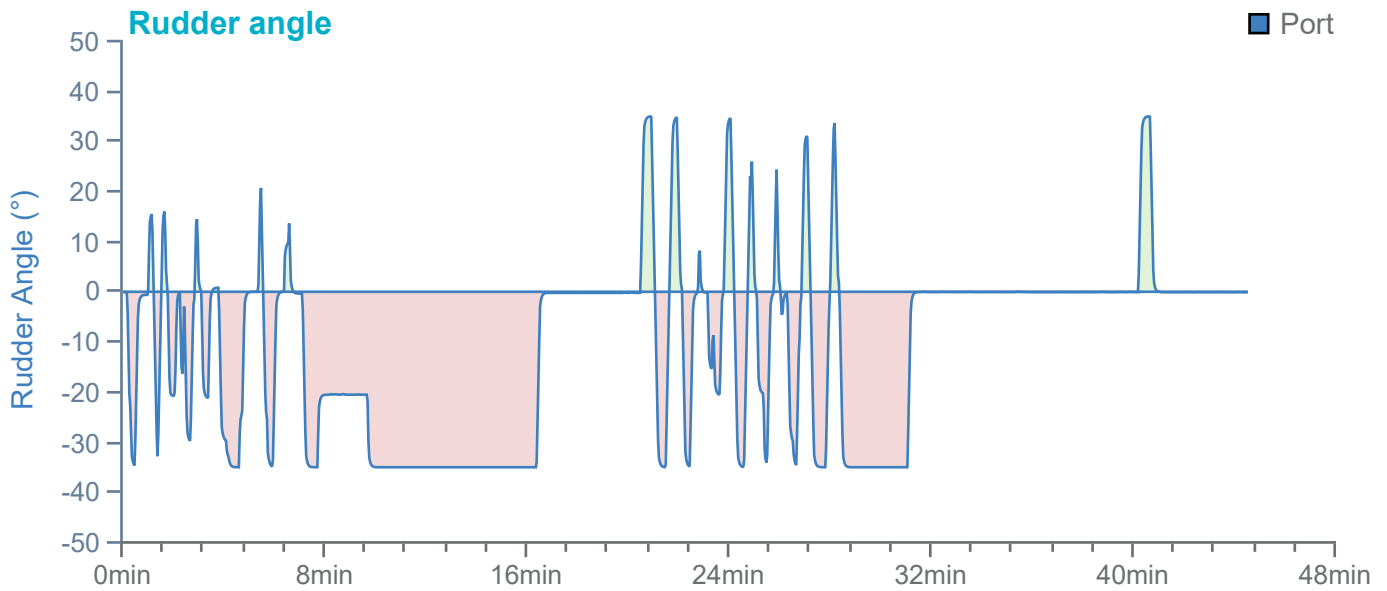
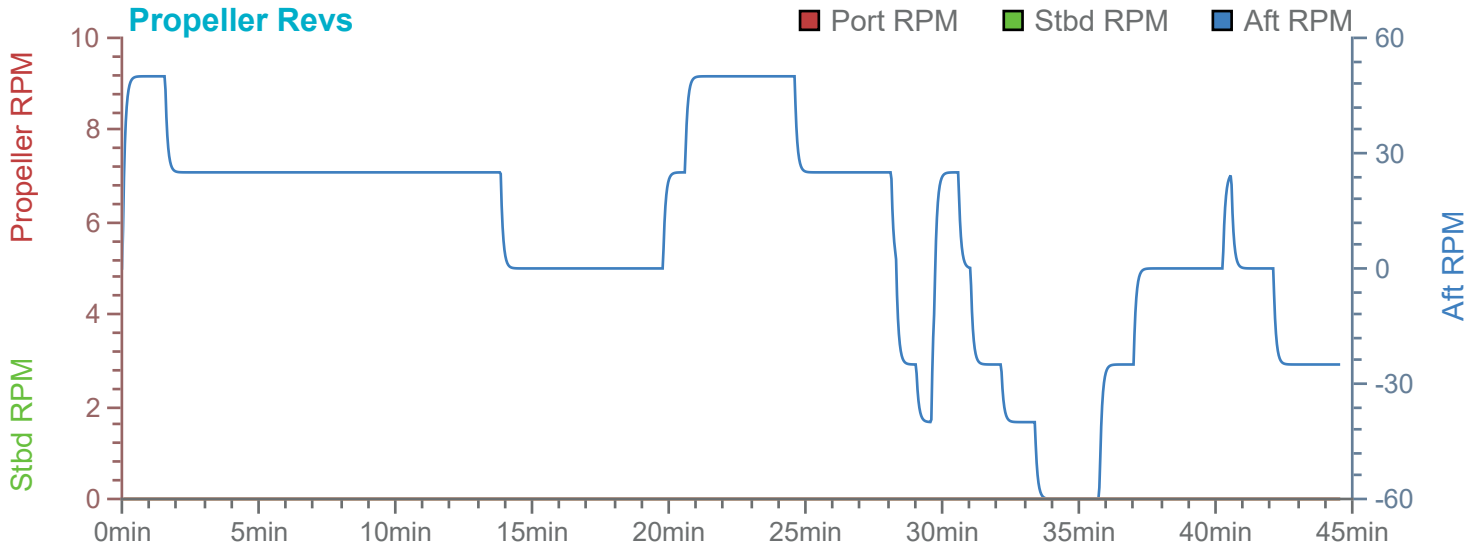
Swing

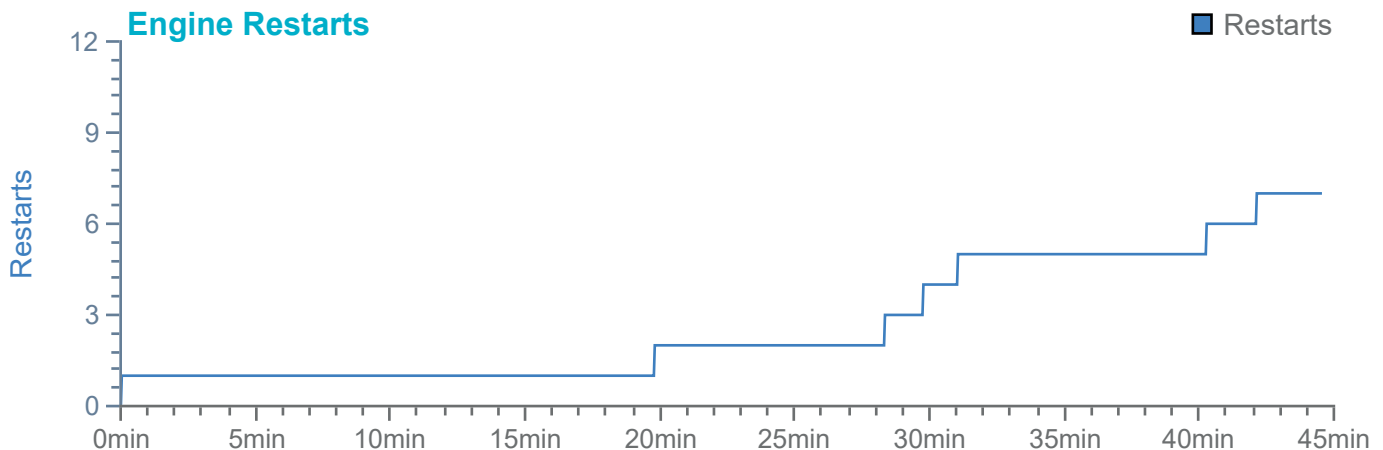
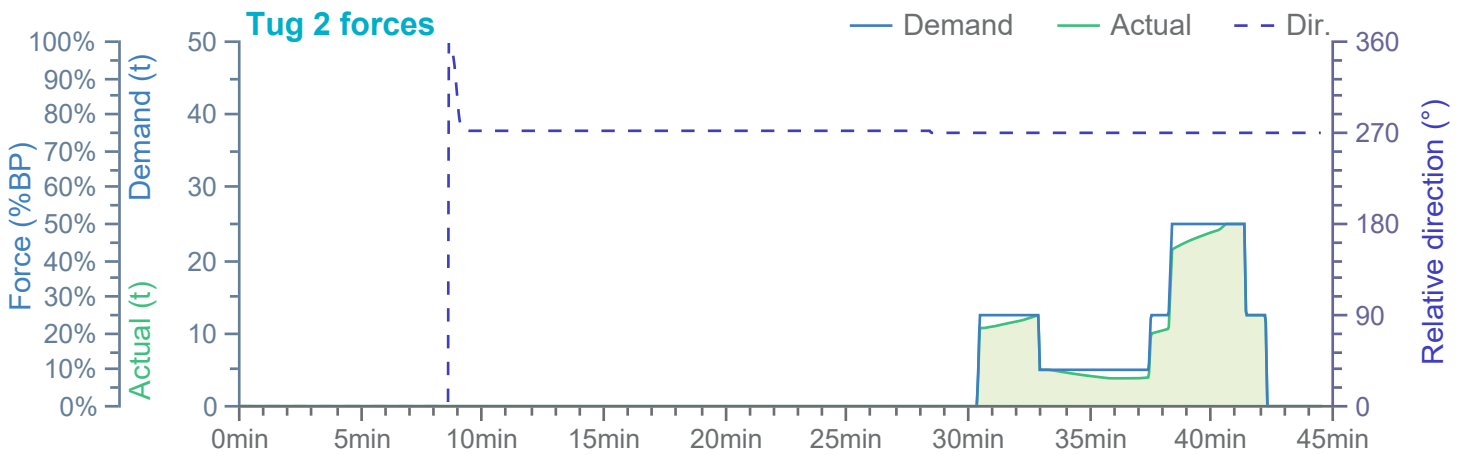
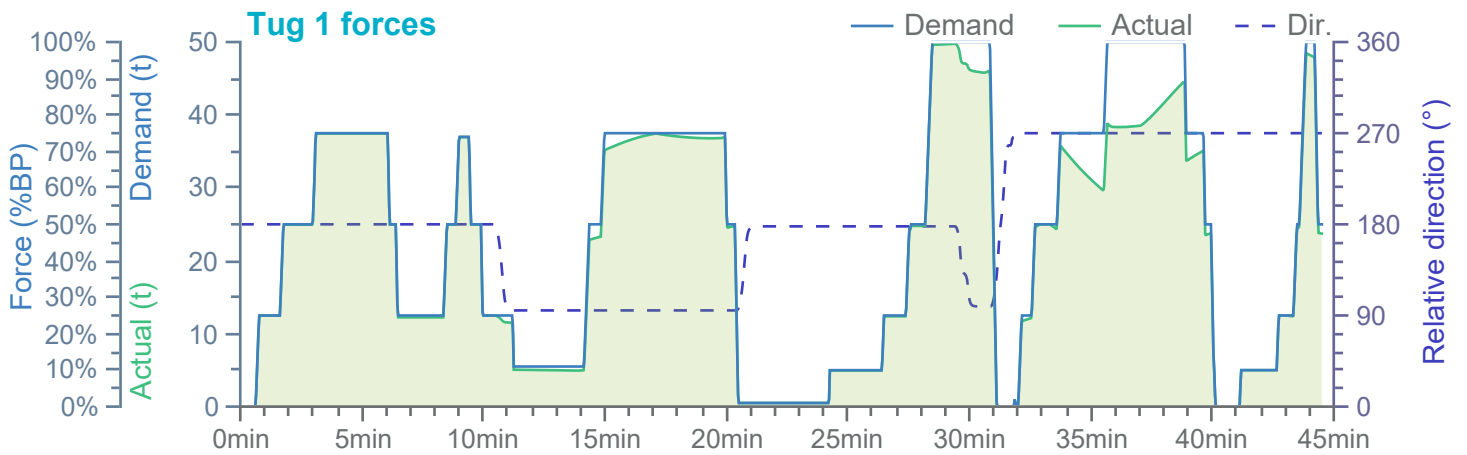
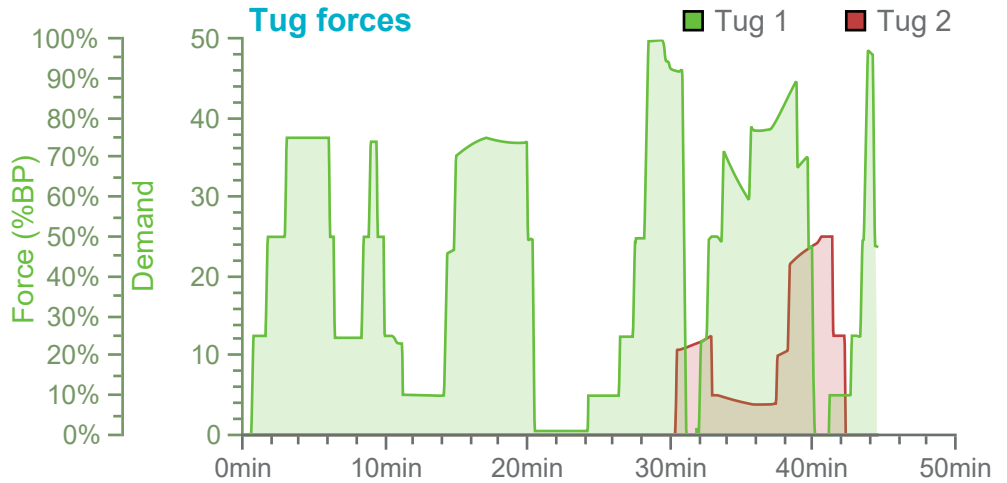
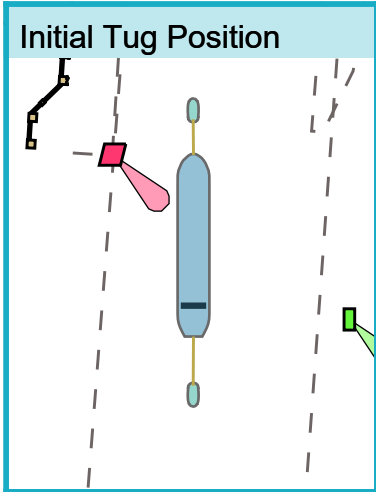






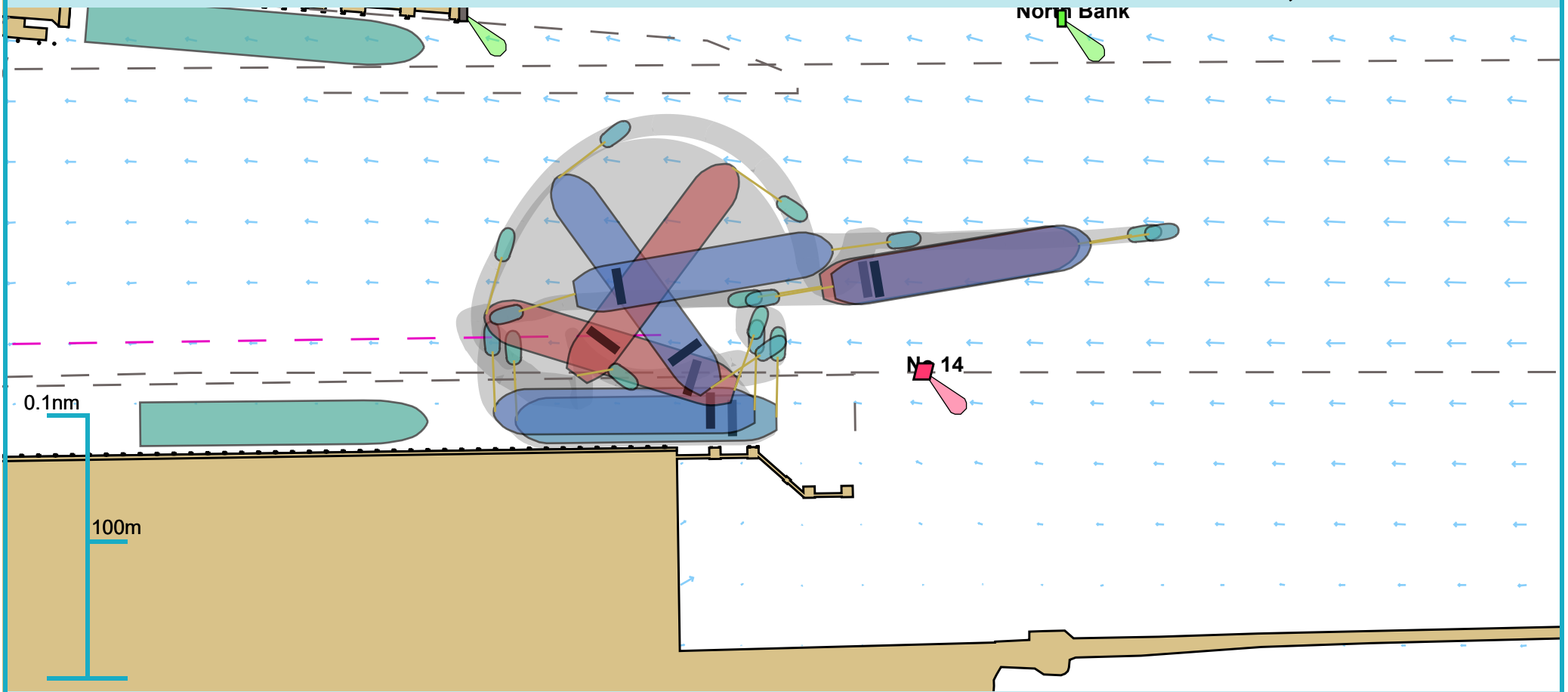






Full Run Overview

53° 20.416 N, 006° 11.266 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

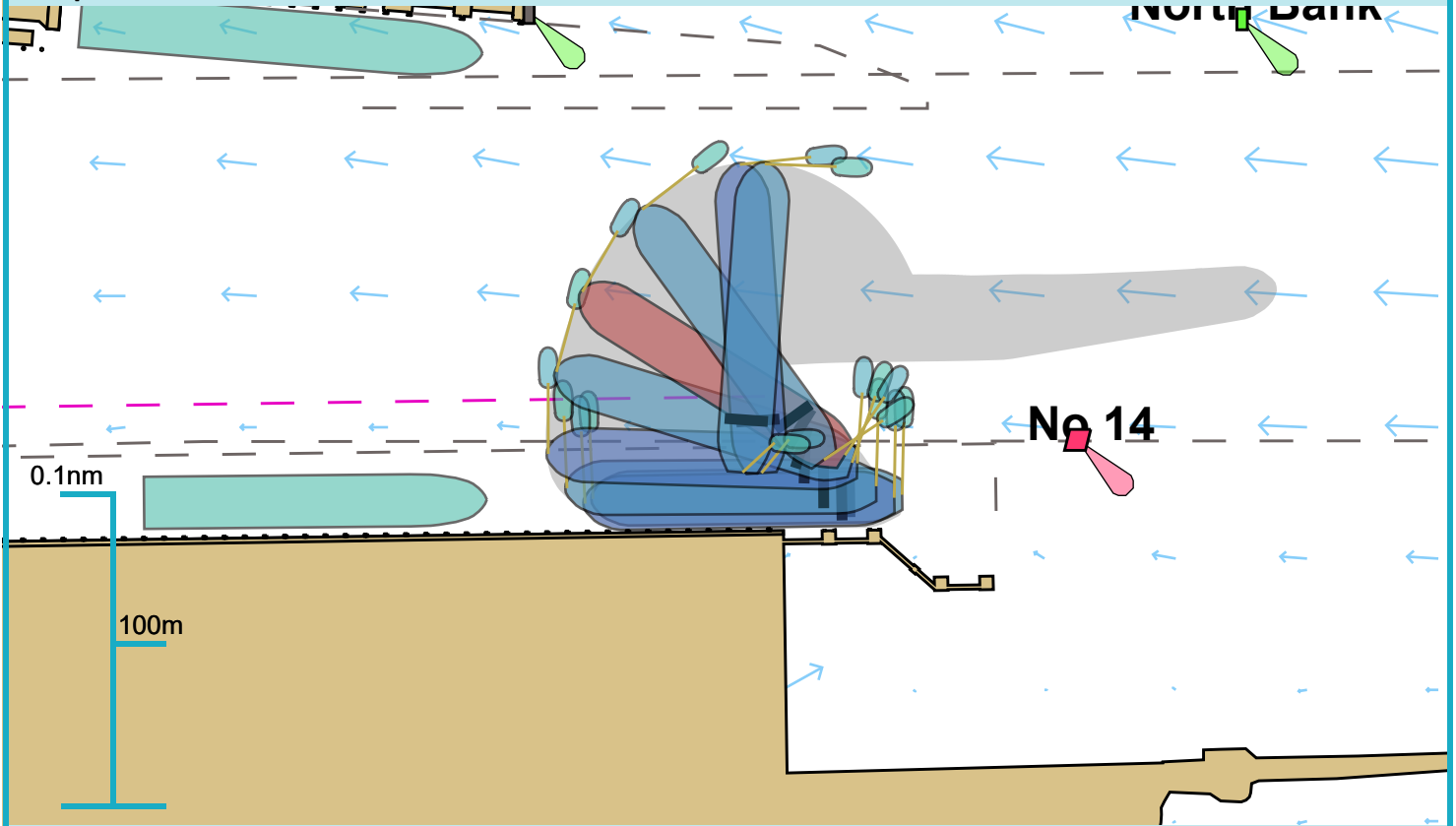
Run length:12 minutes

Manoeuvre:Other

Ownship(s):185m Product Tanker

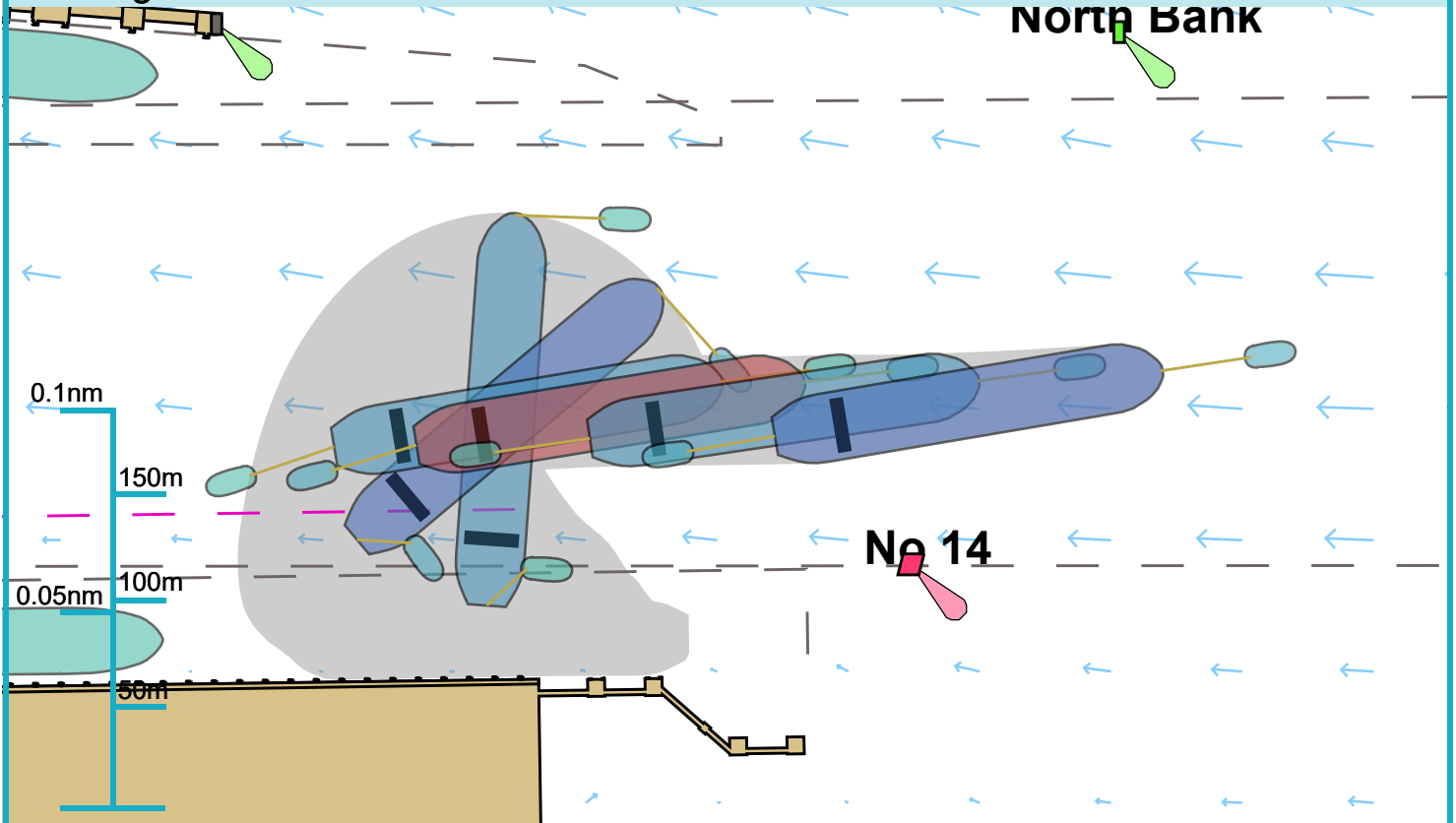
Comments:

Departure



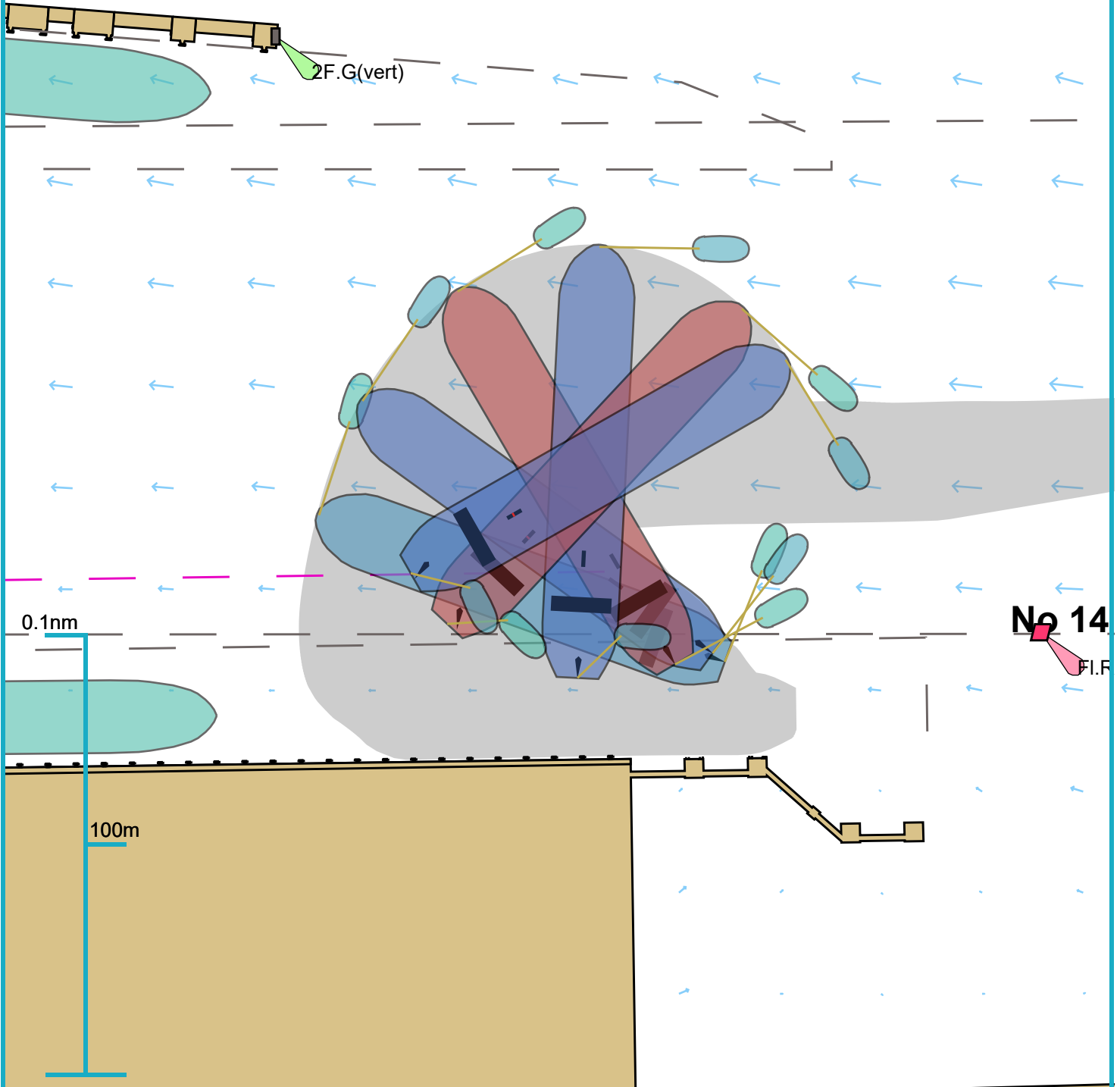
Ships plotted every 1 mins, highlight every 5 mins

Passage

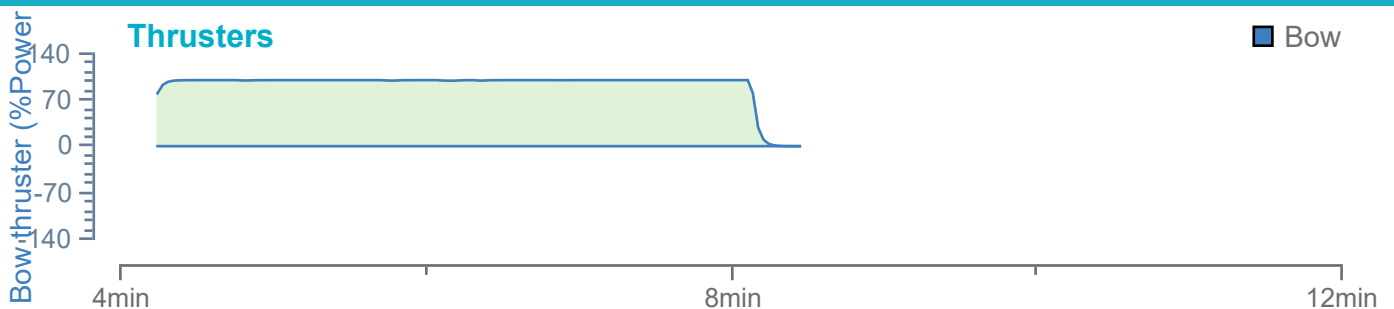


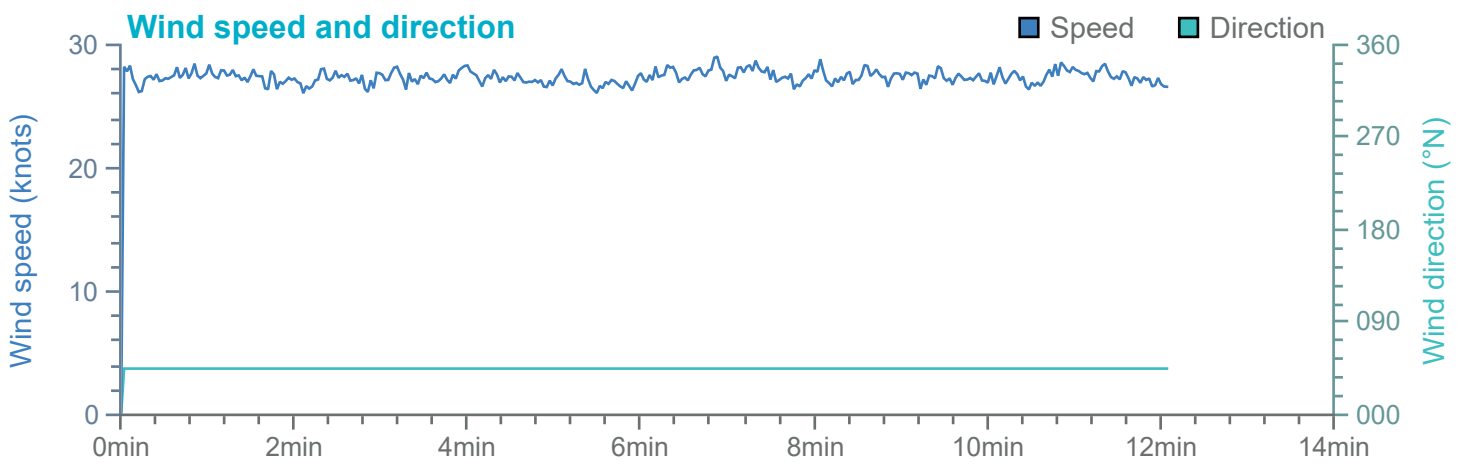
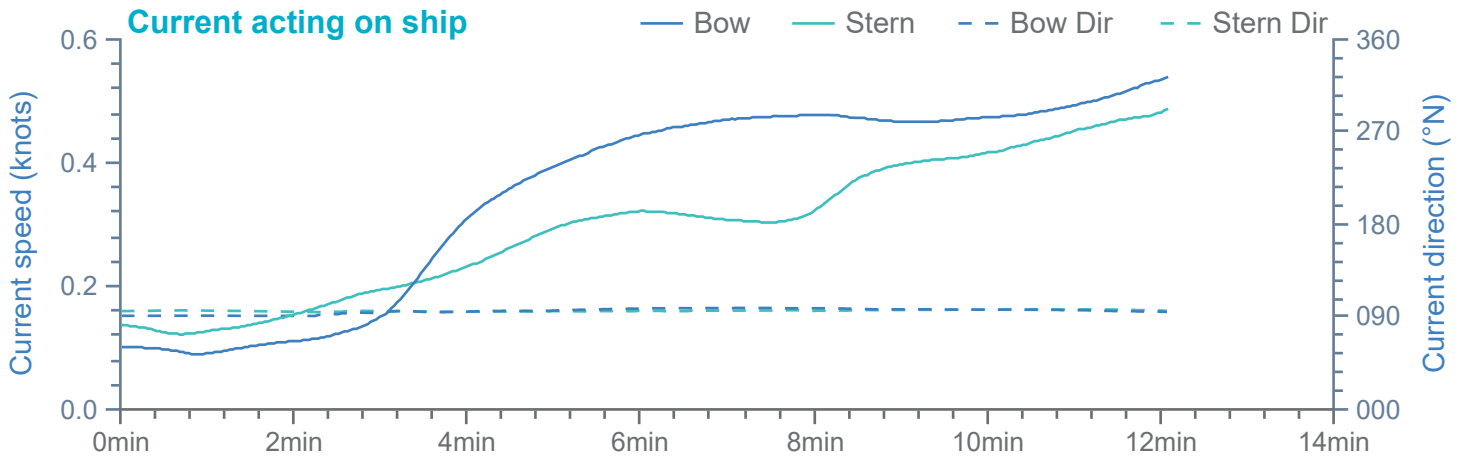
Ships plotted every 1 mins, highlight every 5 mins

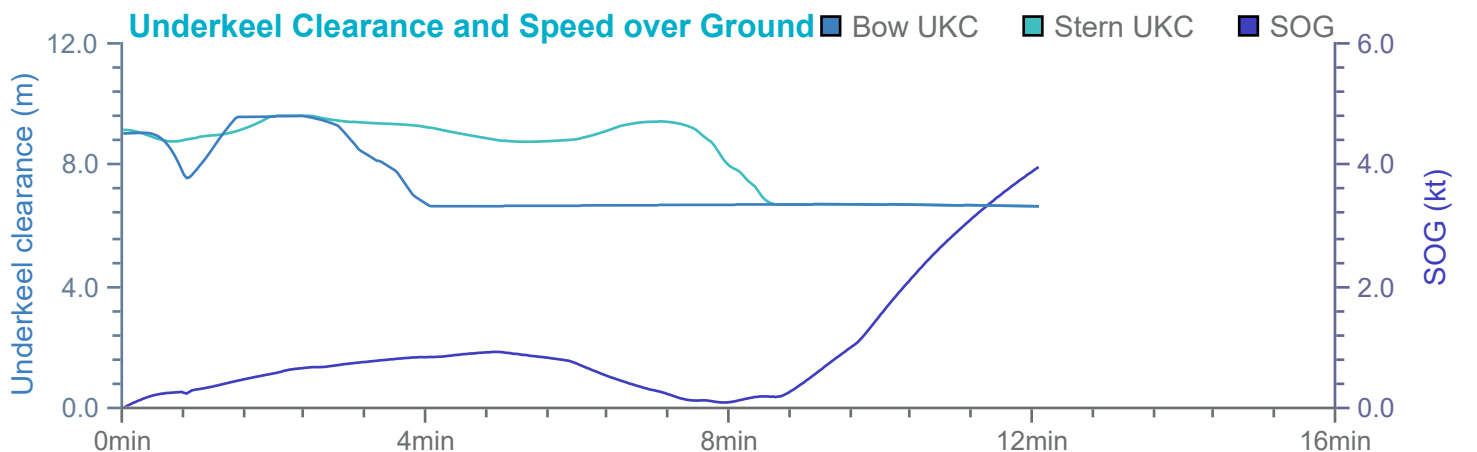
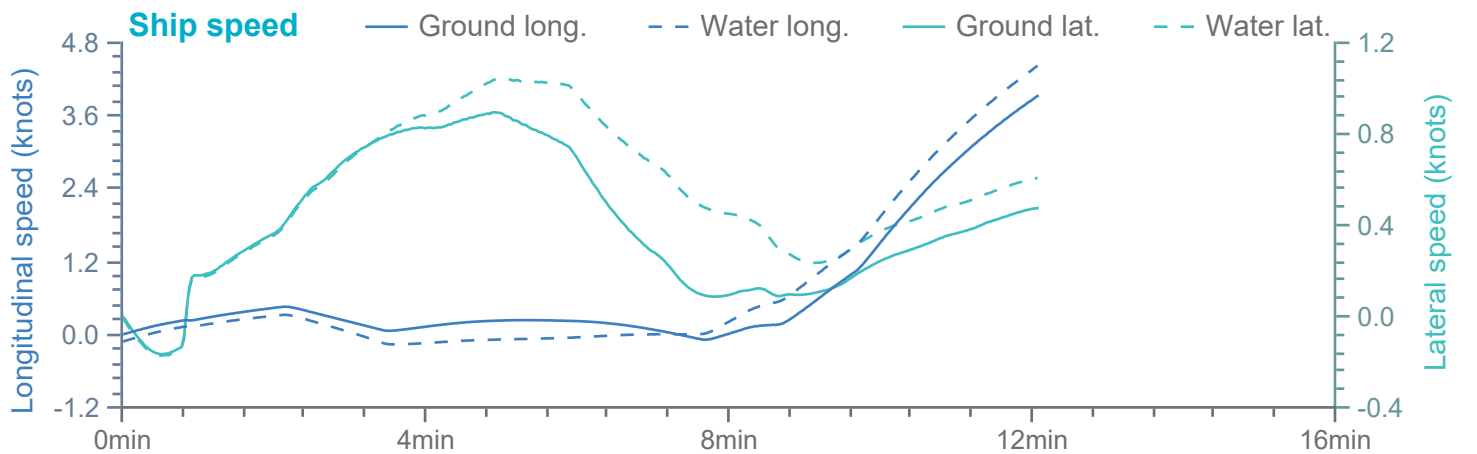
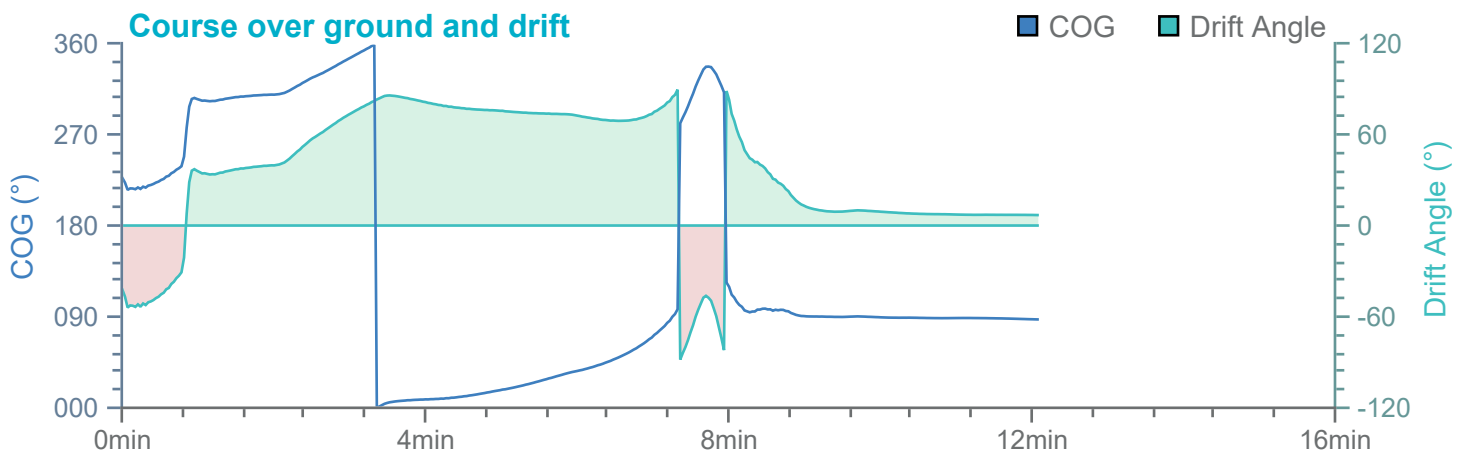
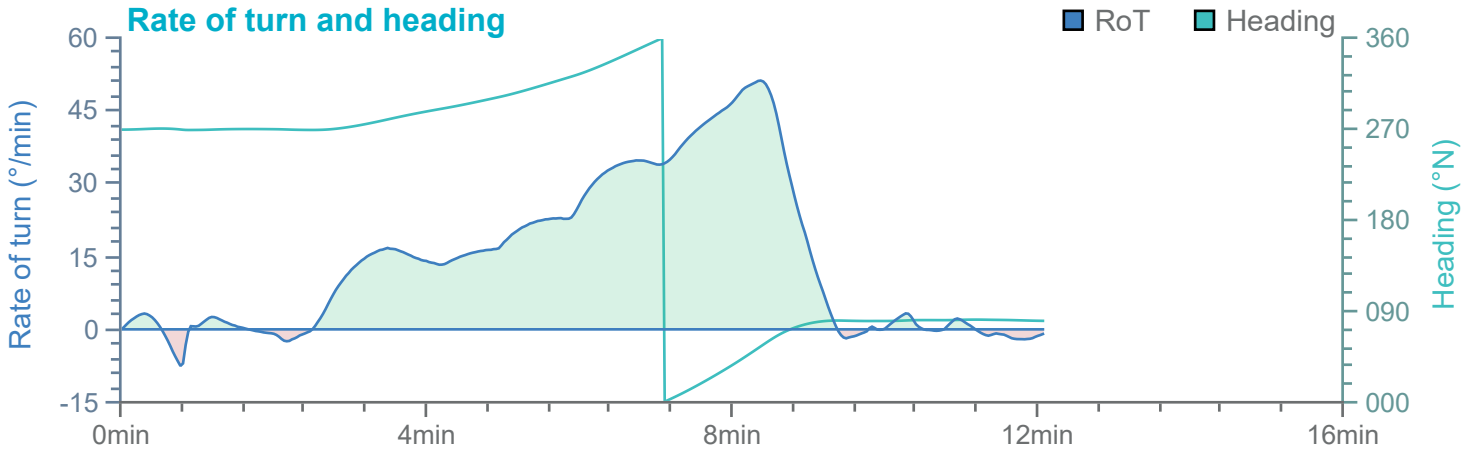
Swing

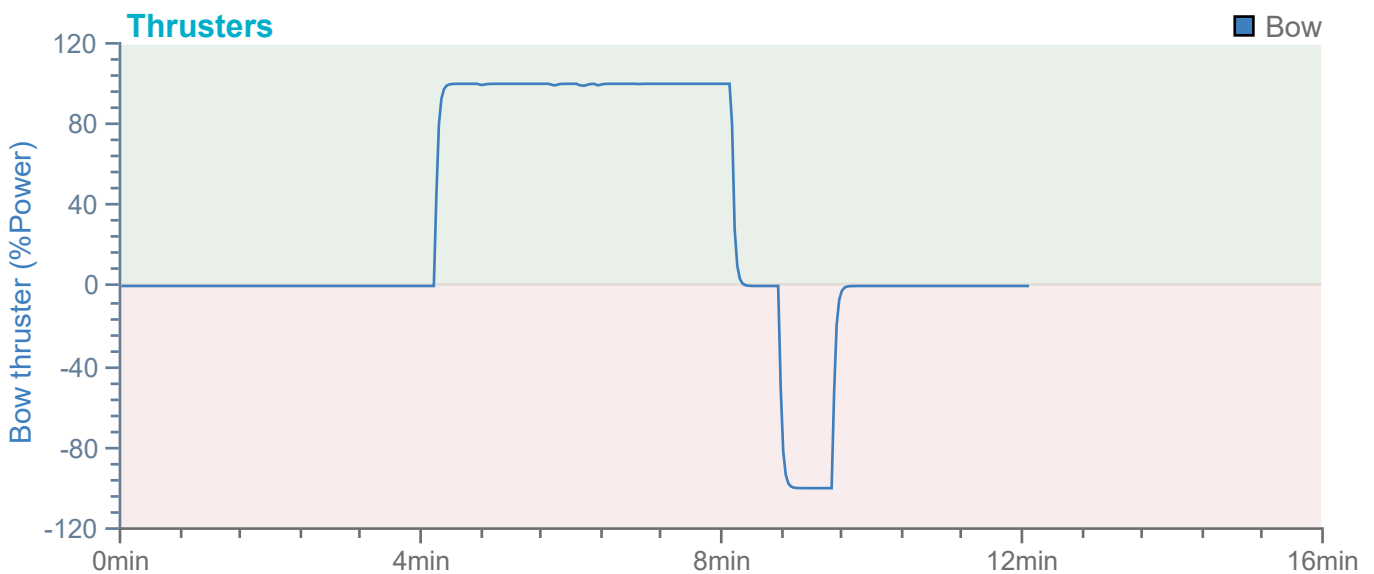
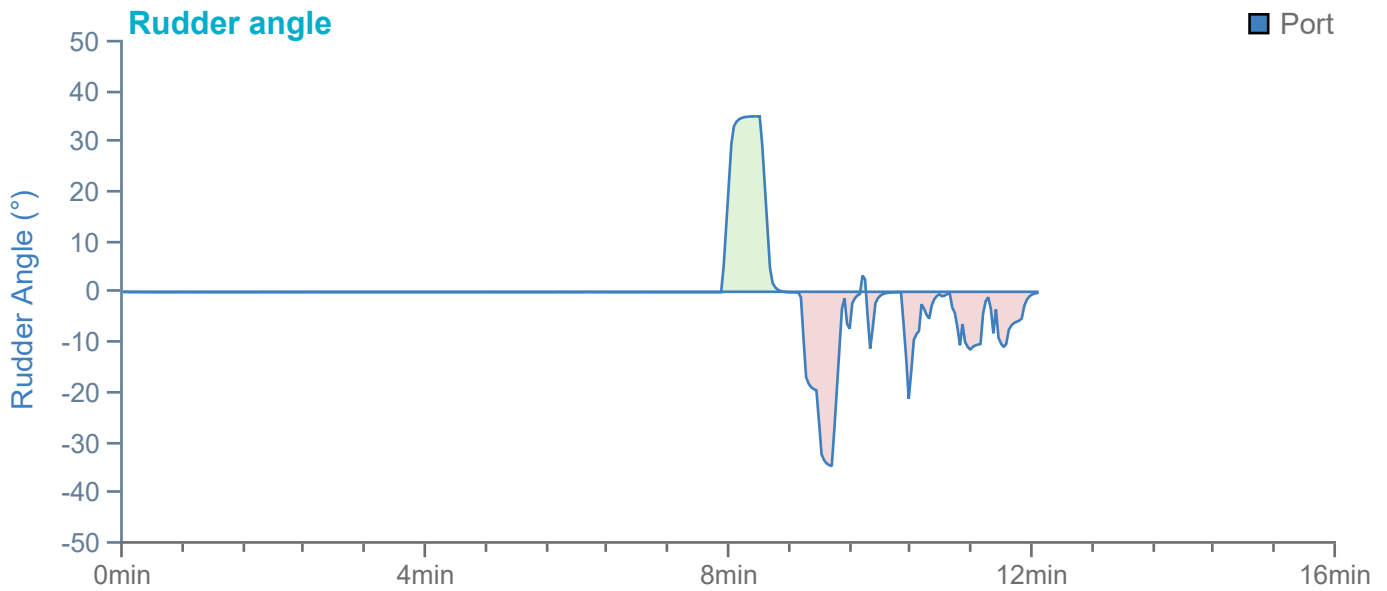
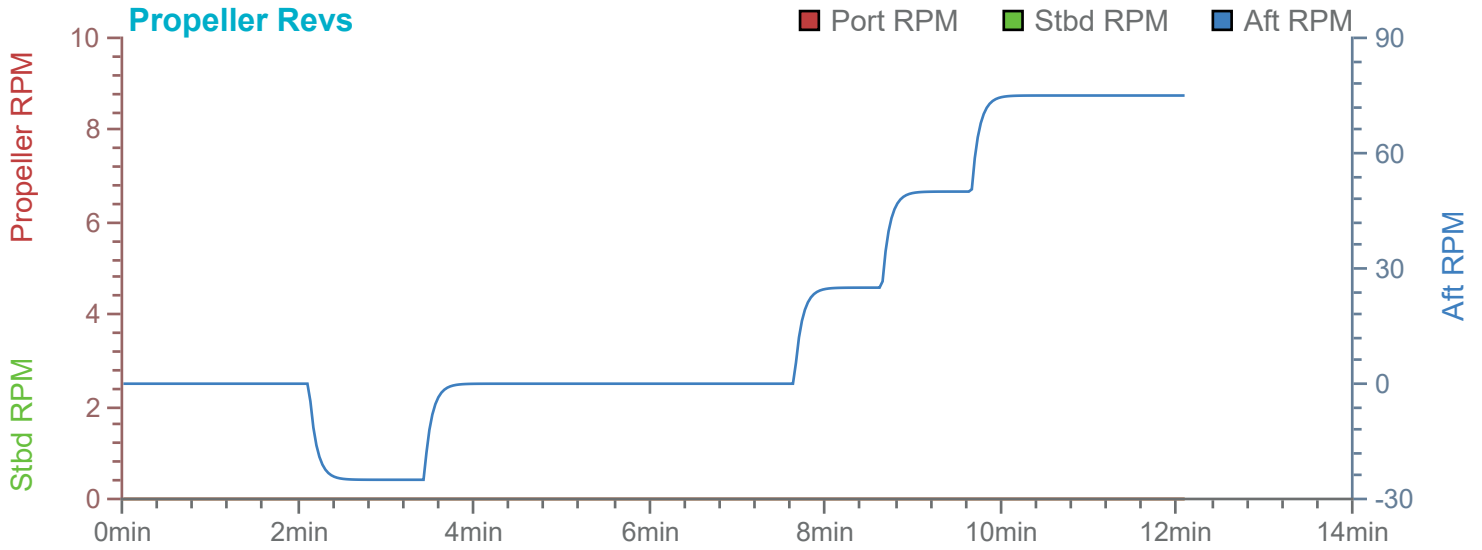


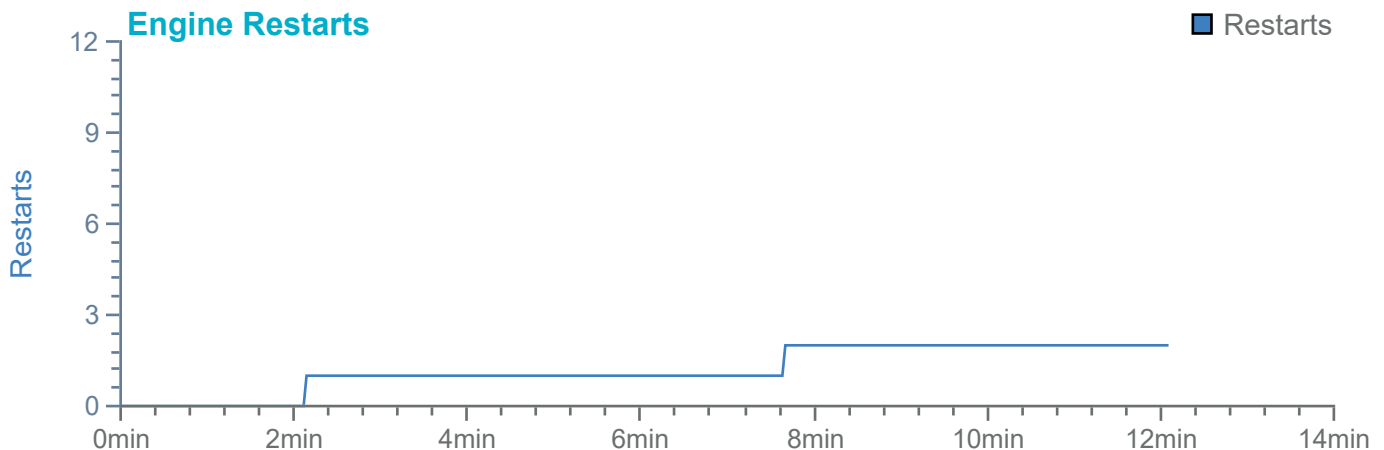
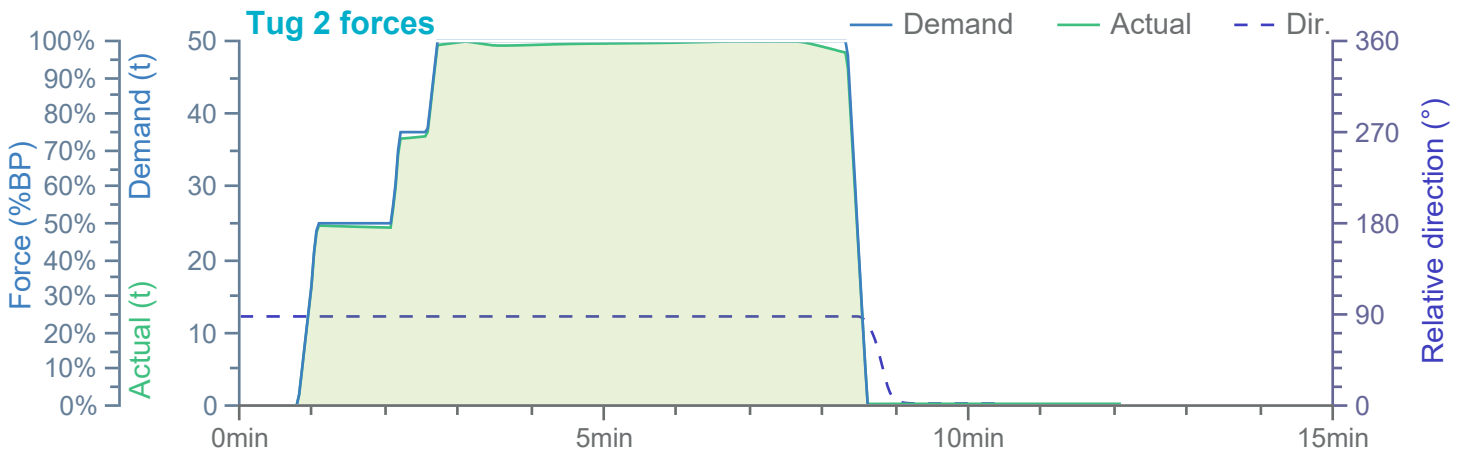
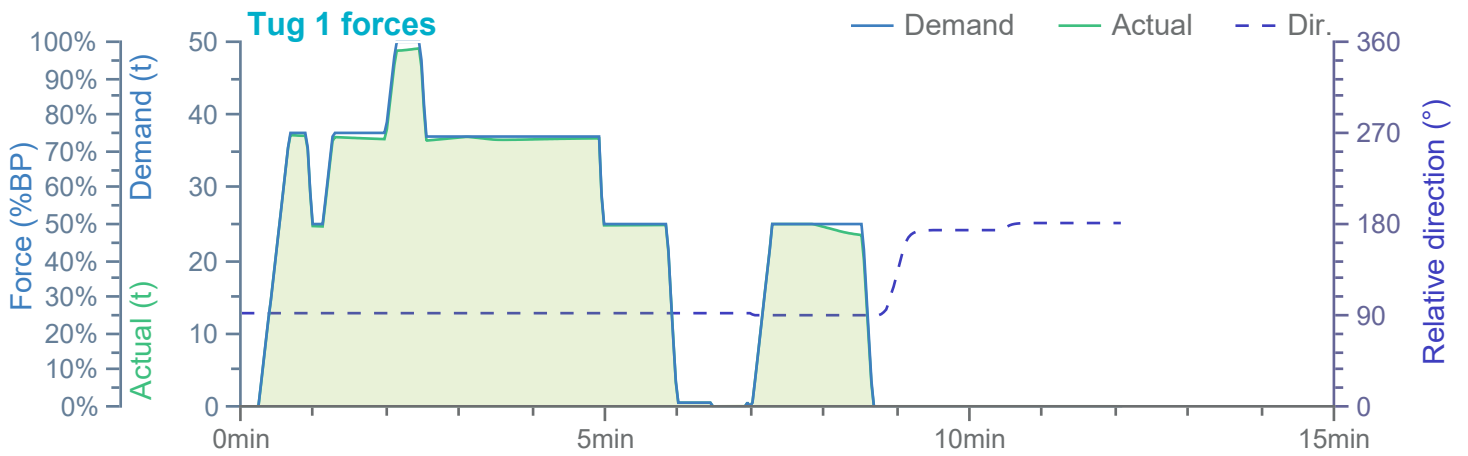
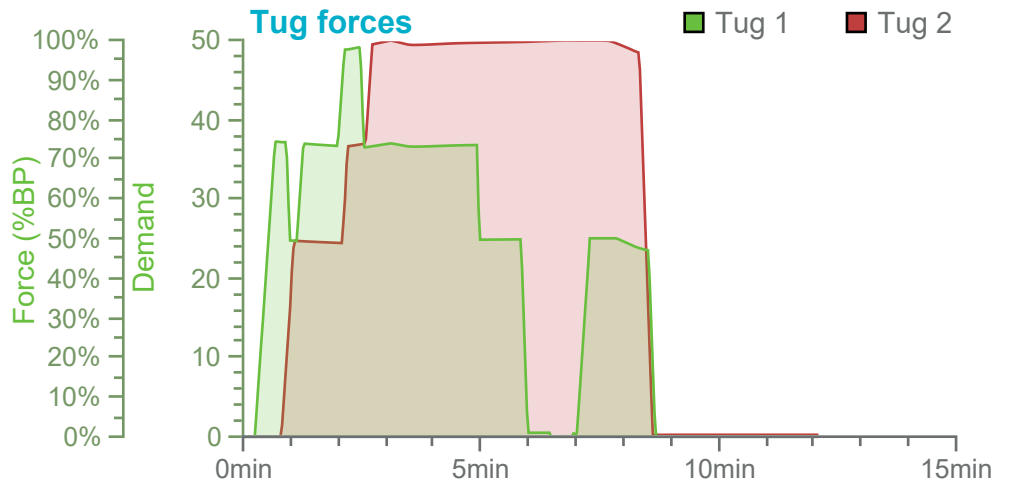
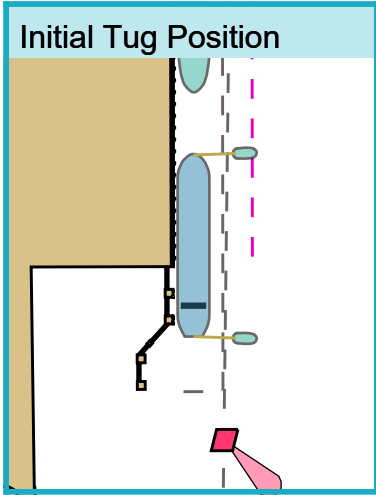
Ships plotted every 59 seconds, highlight every 2 mins





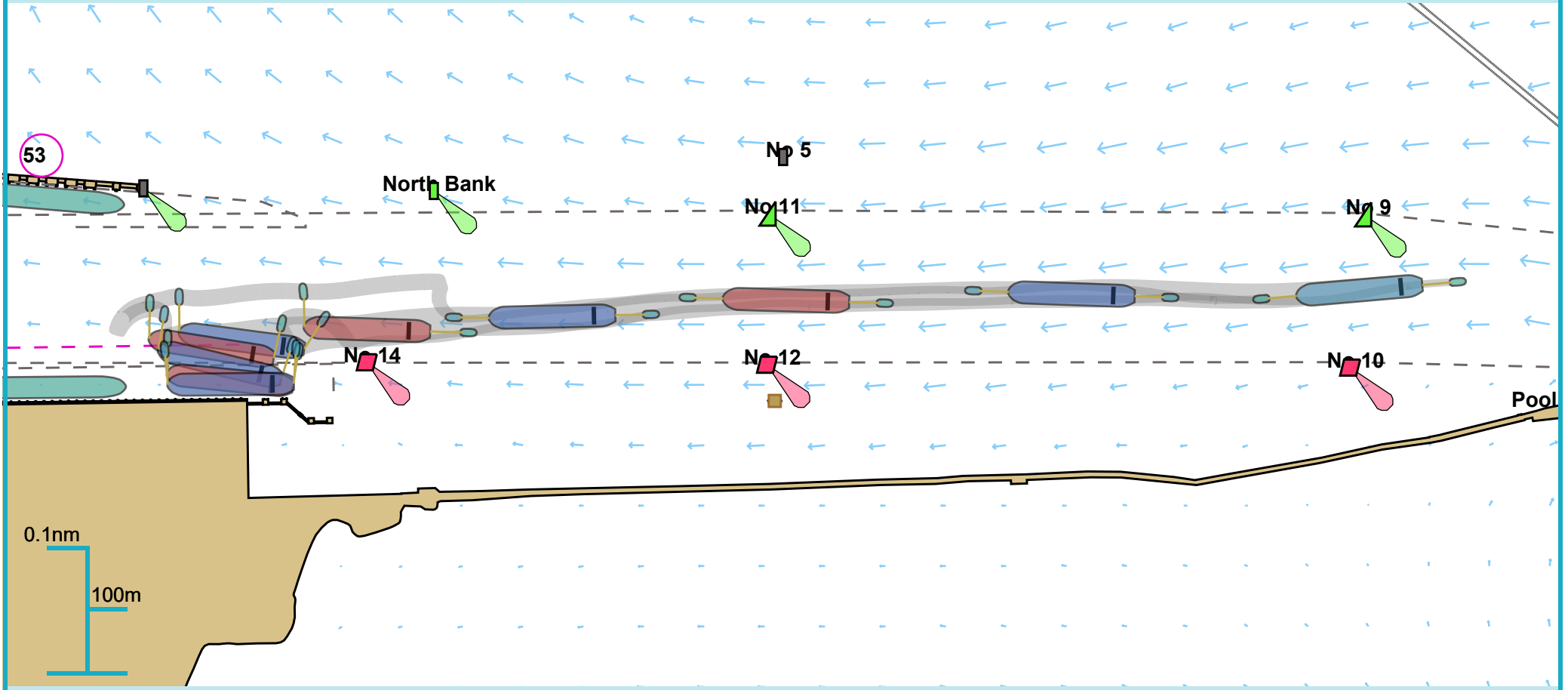






Full Run Overview

53° 20.263 N, 006° 11.157 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:17 minutes

Manoeuvre:Other

Ownship(s):185m Product Tanker

Comments:

Overview

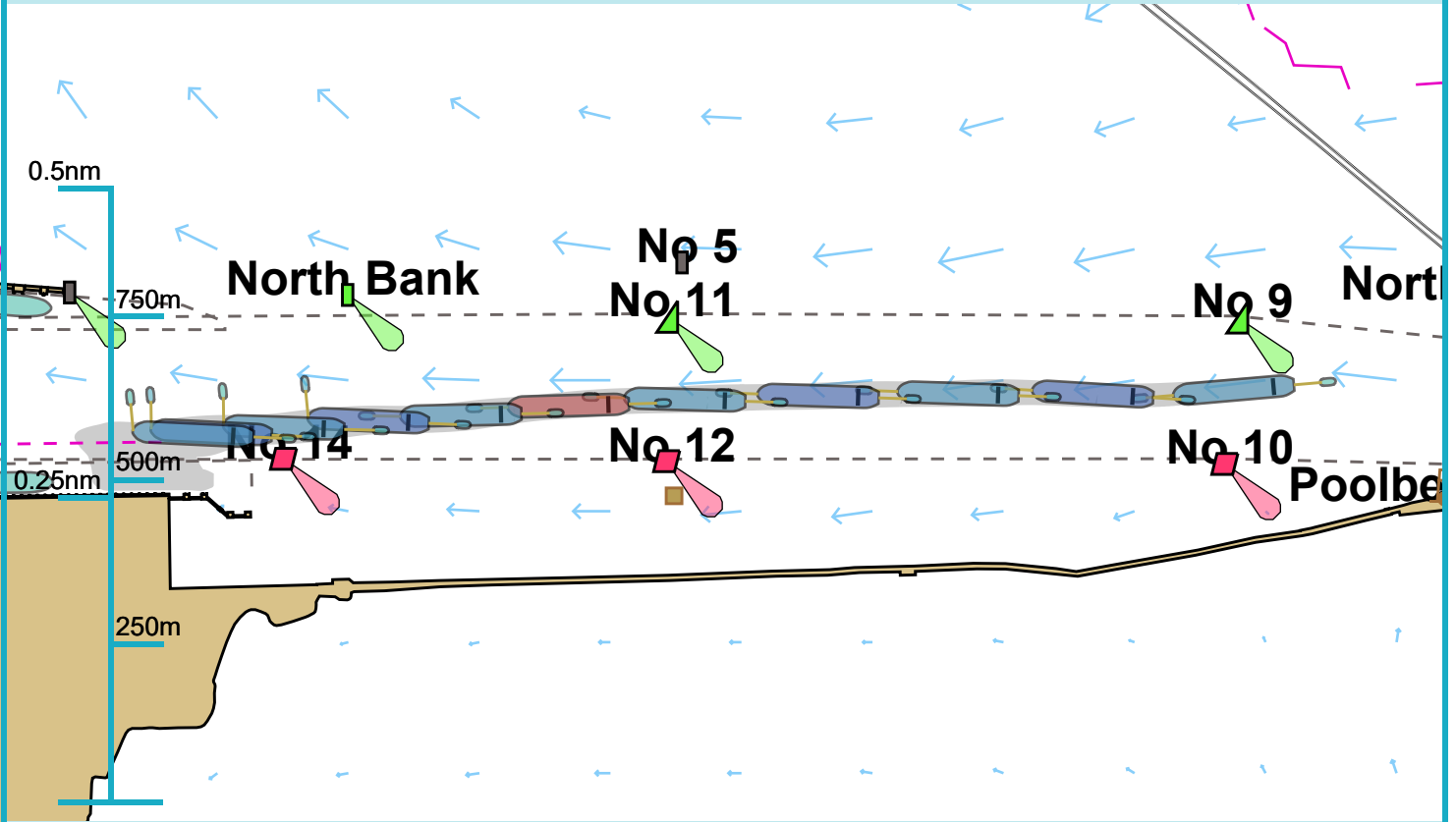
Environment

185m Product Tanker

Thruster and engine use

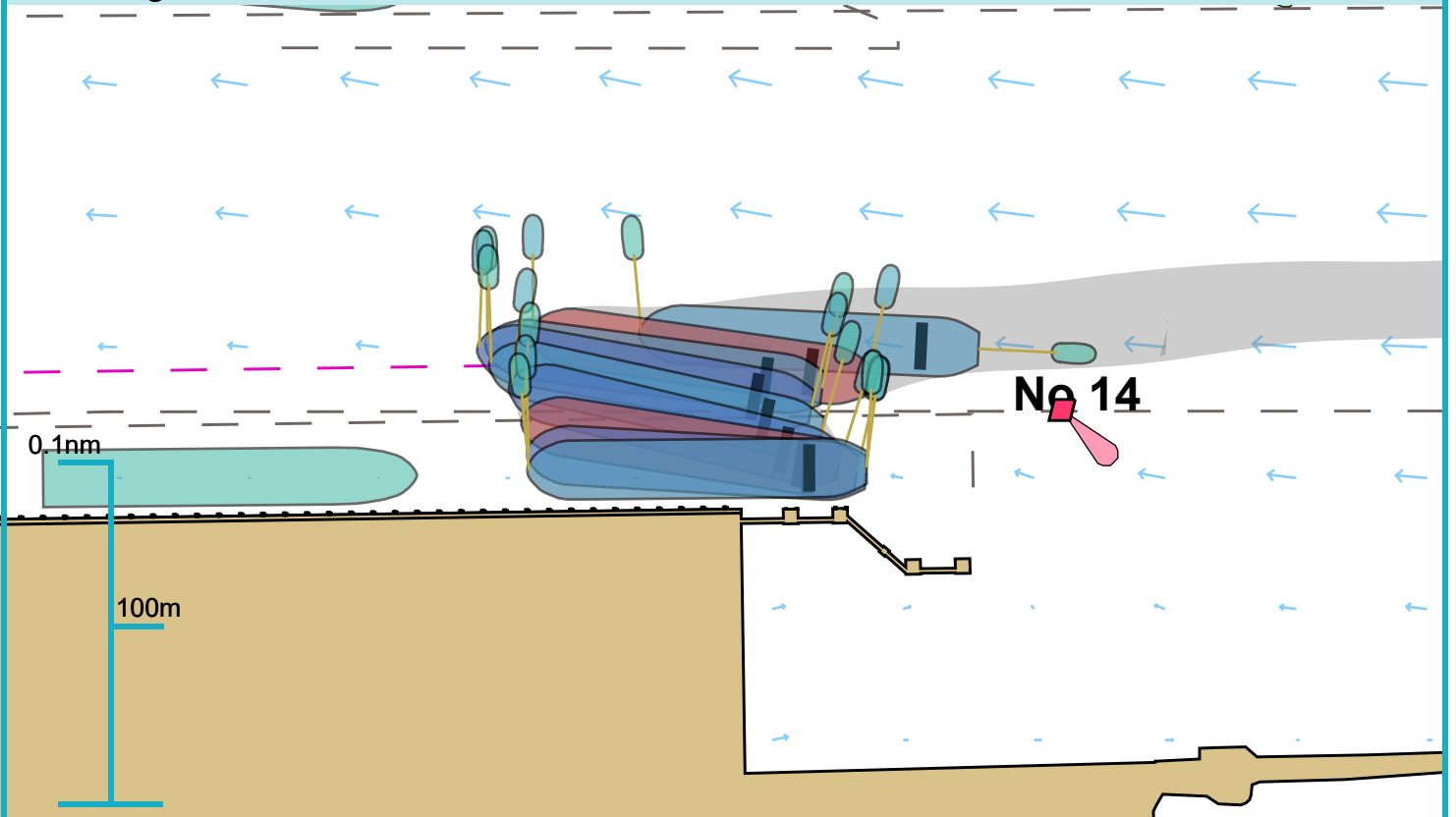
Tug use

Approach

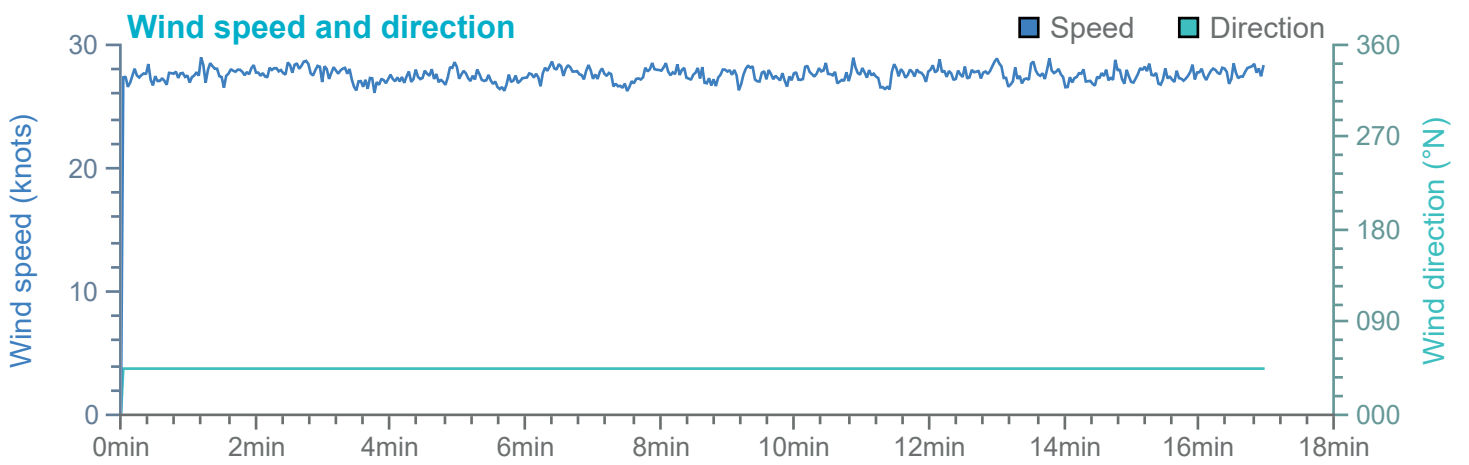
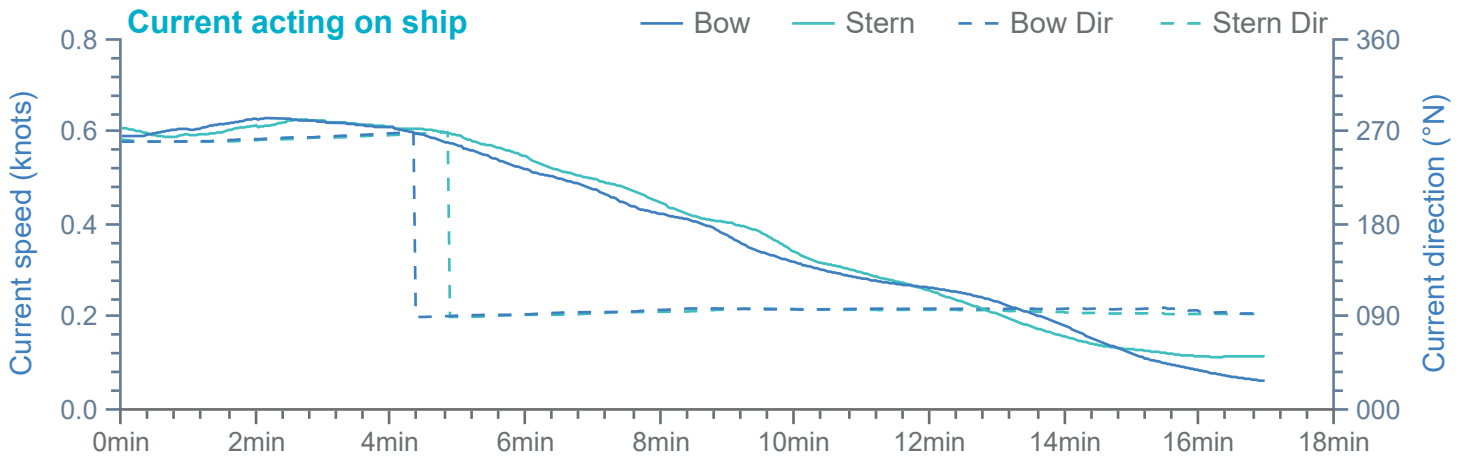


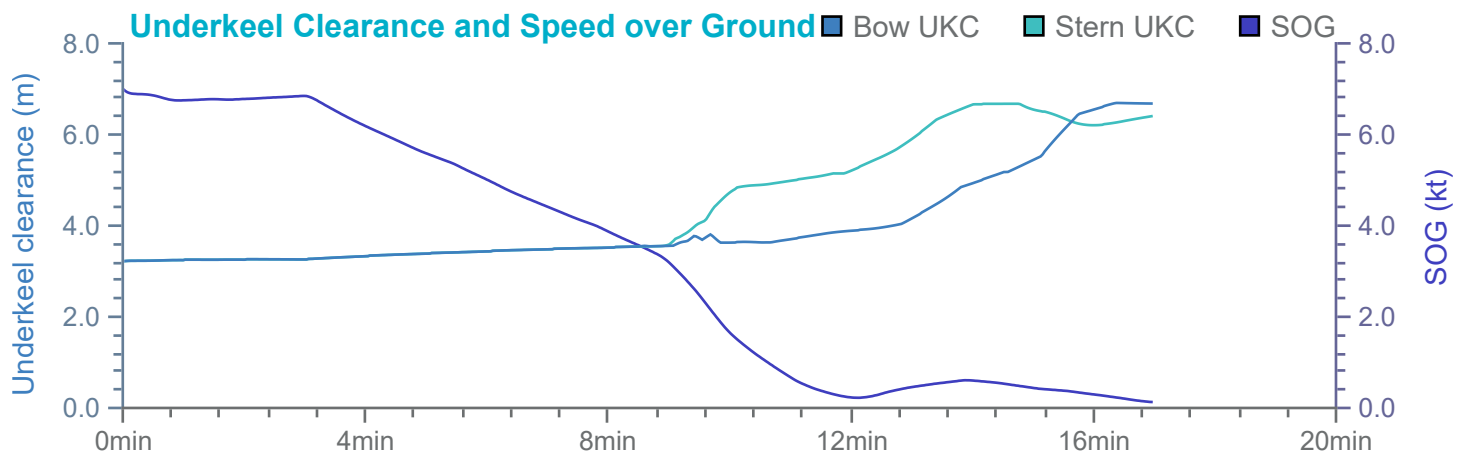
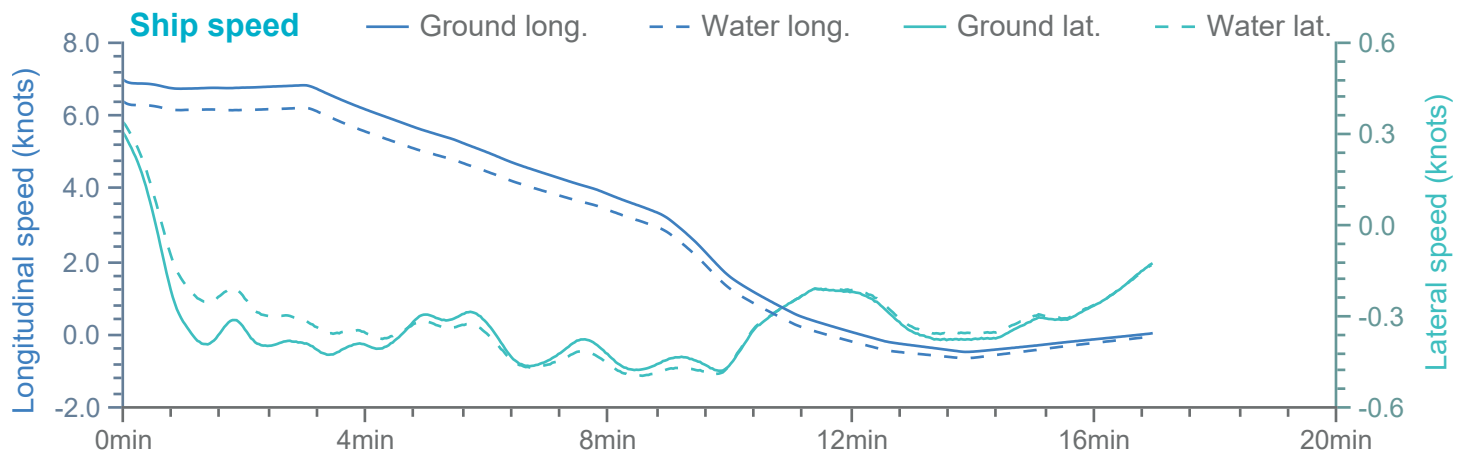
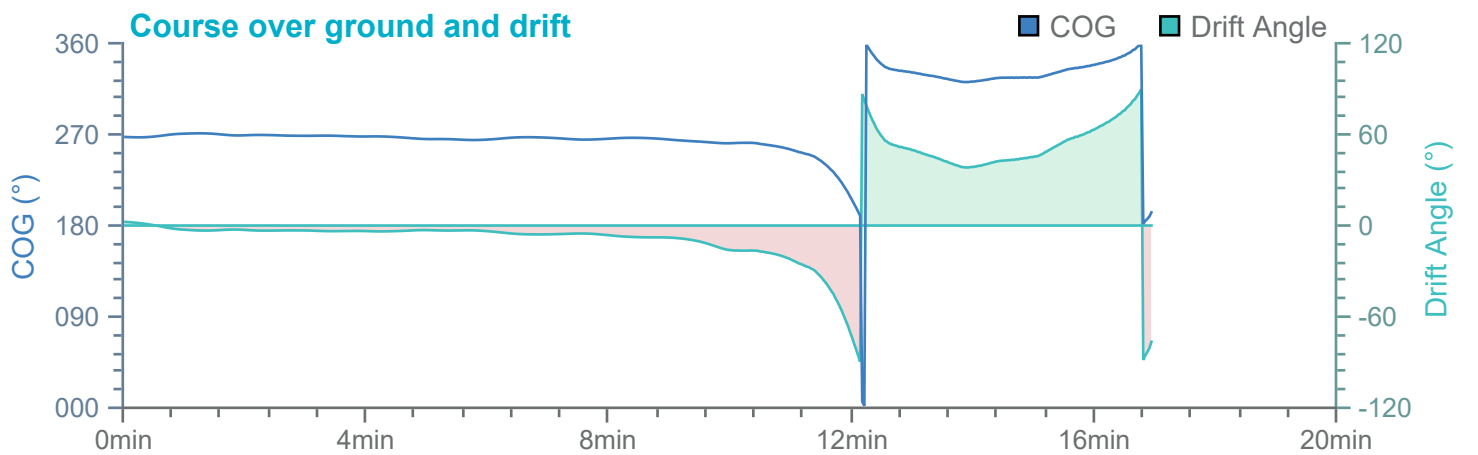
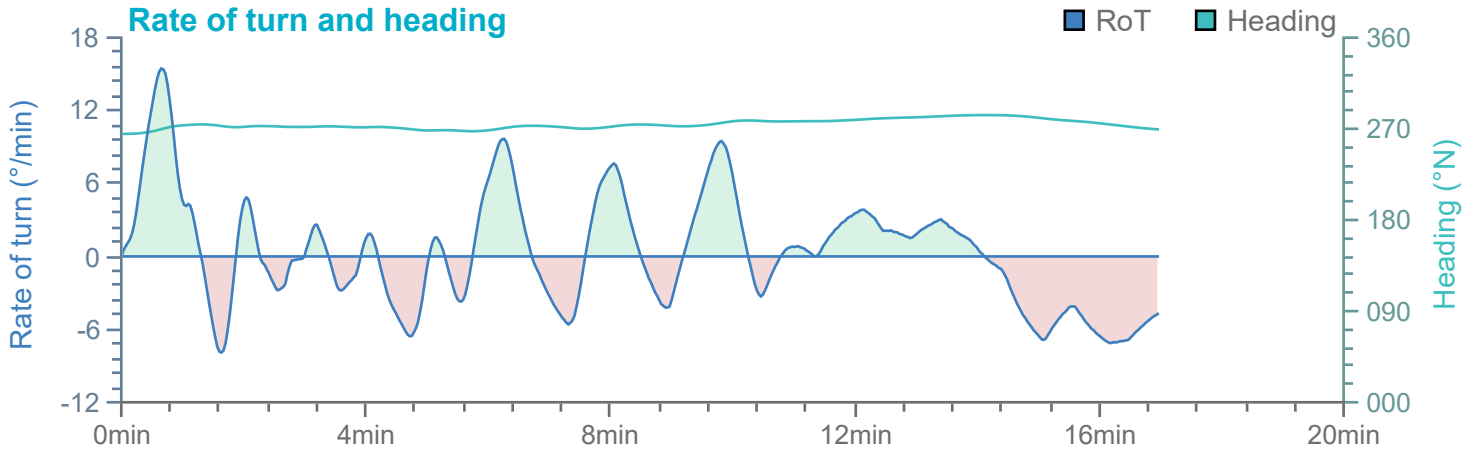
Ships plotted every 1 mins, highlight every 5 mins

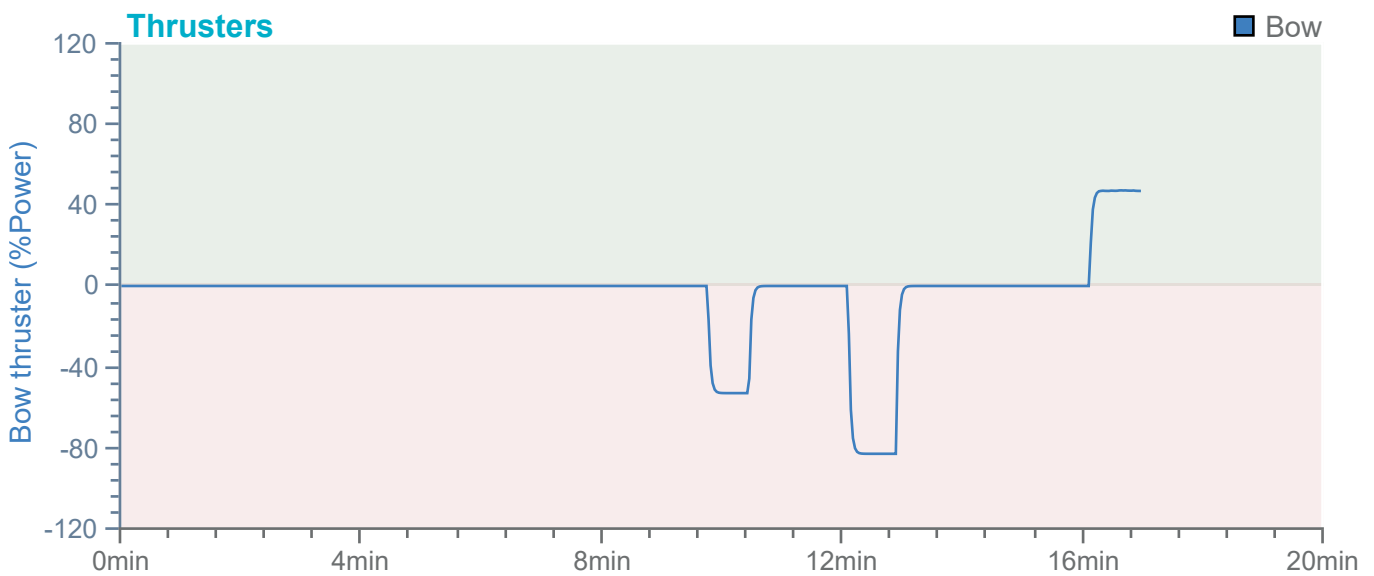
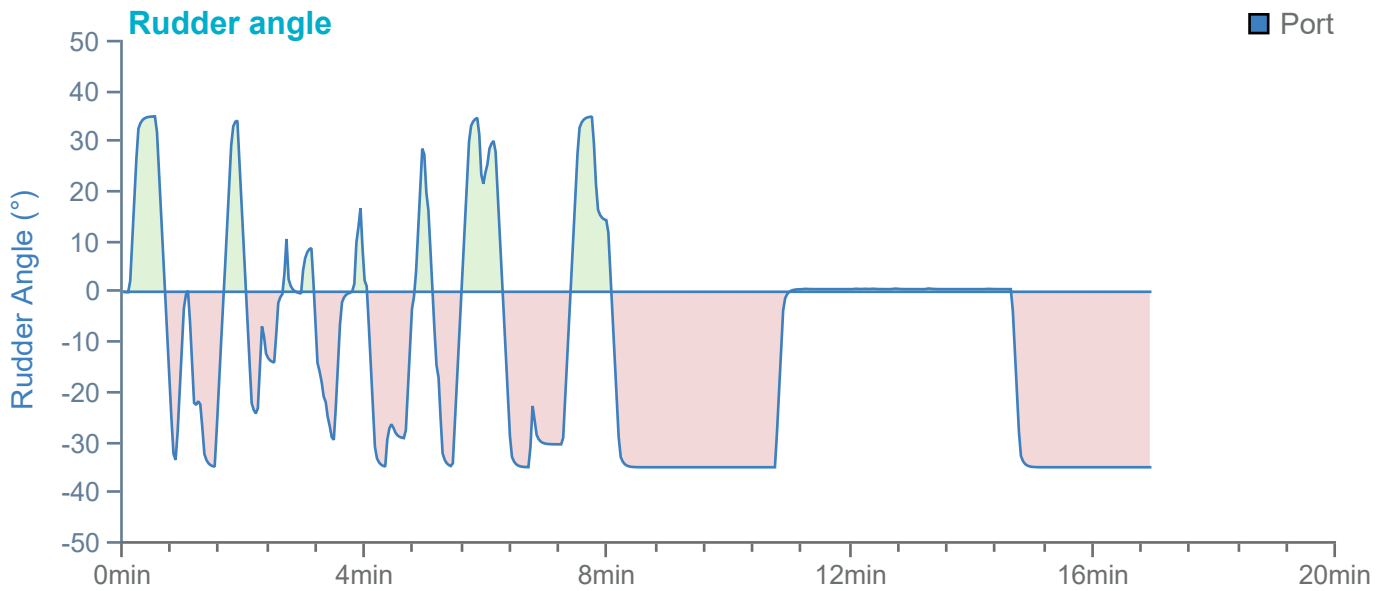
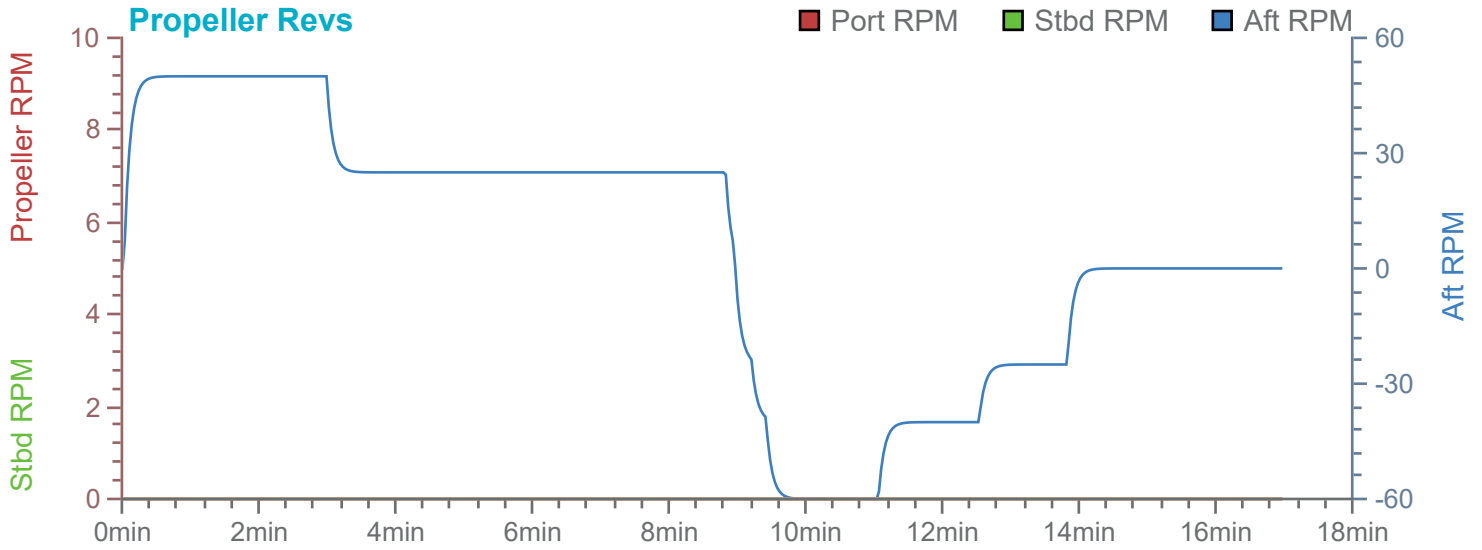
Berthing

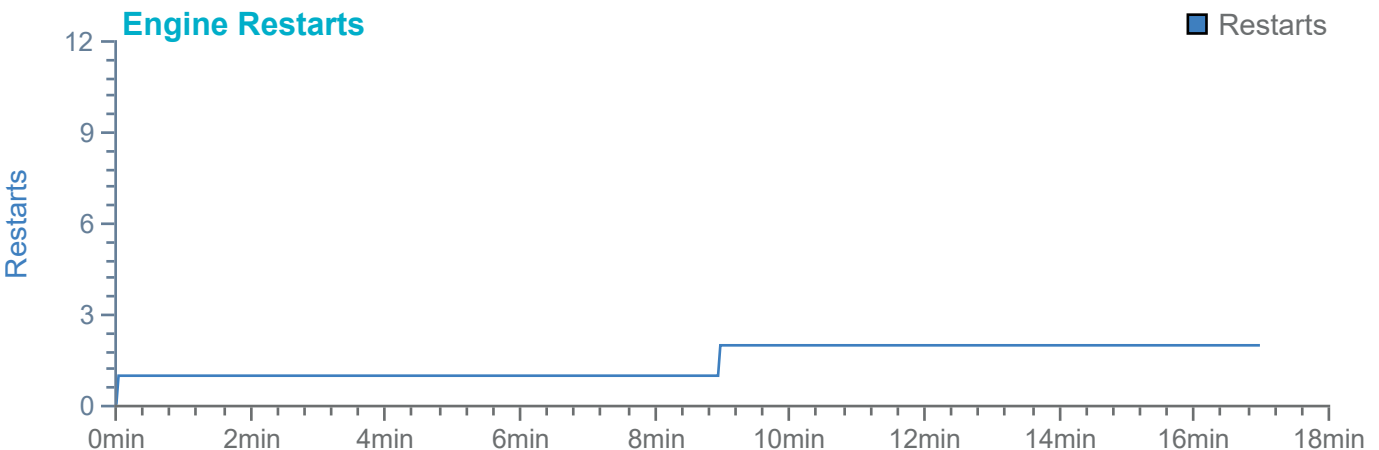
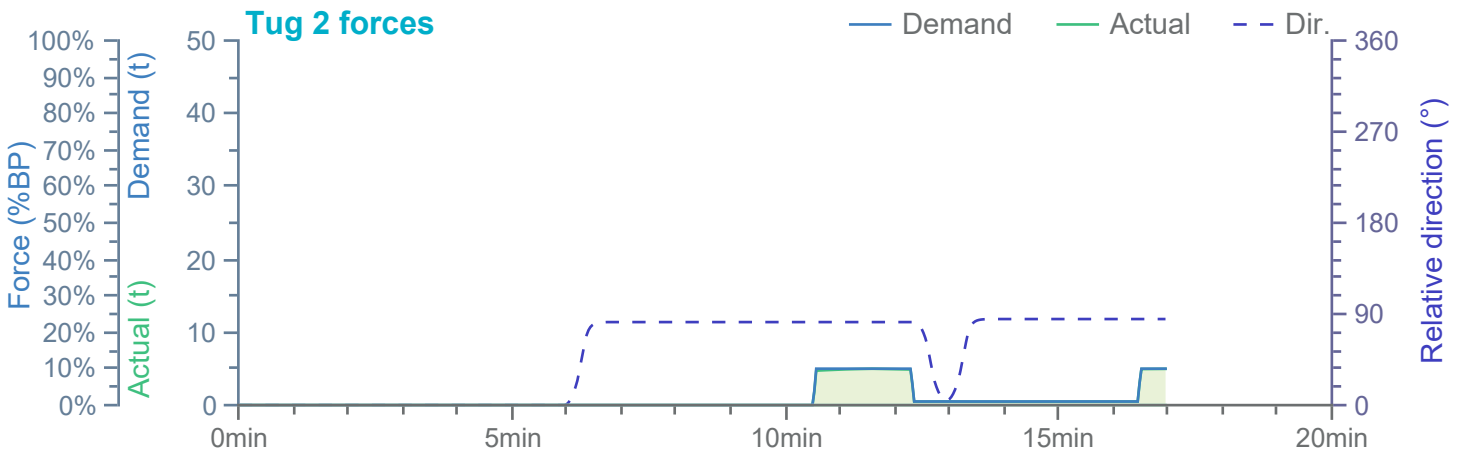
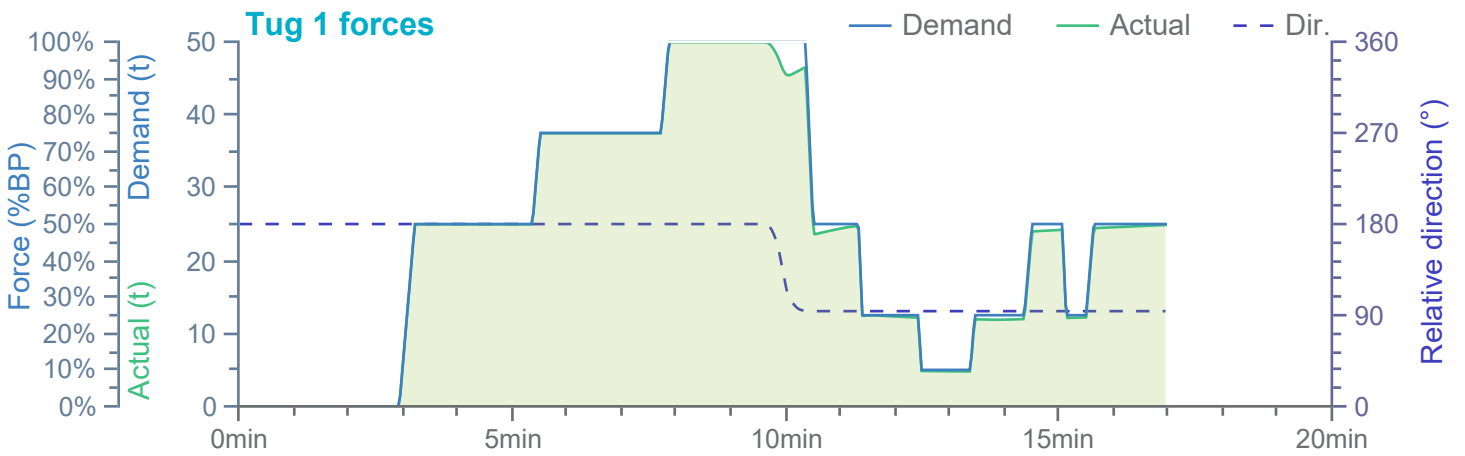
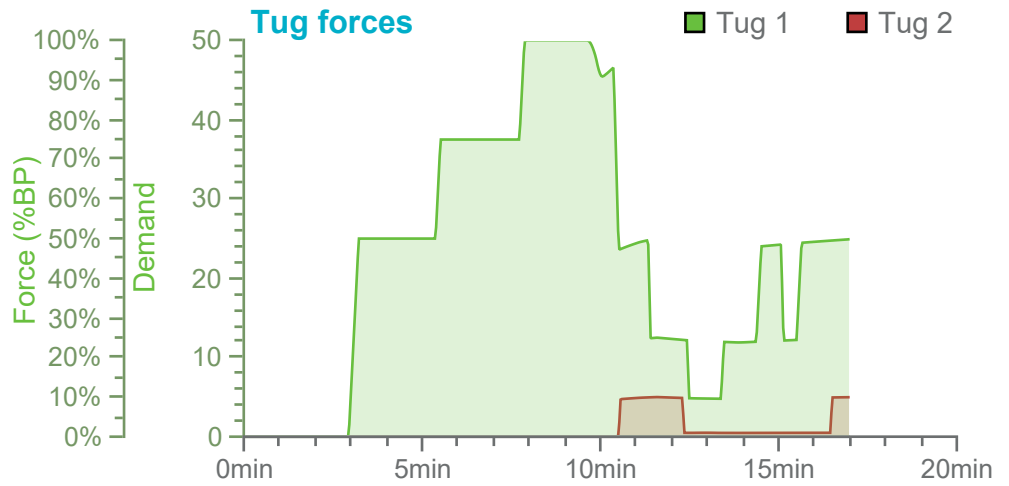
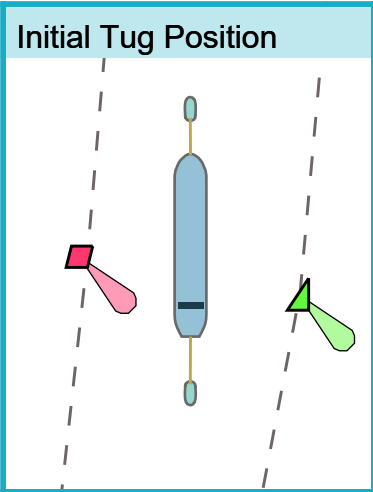


Ships plotted every 1 mins, highlight every 5 mins



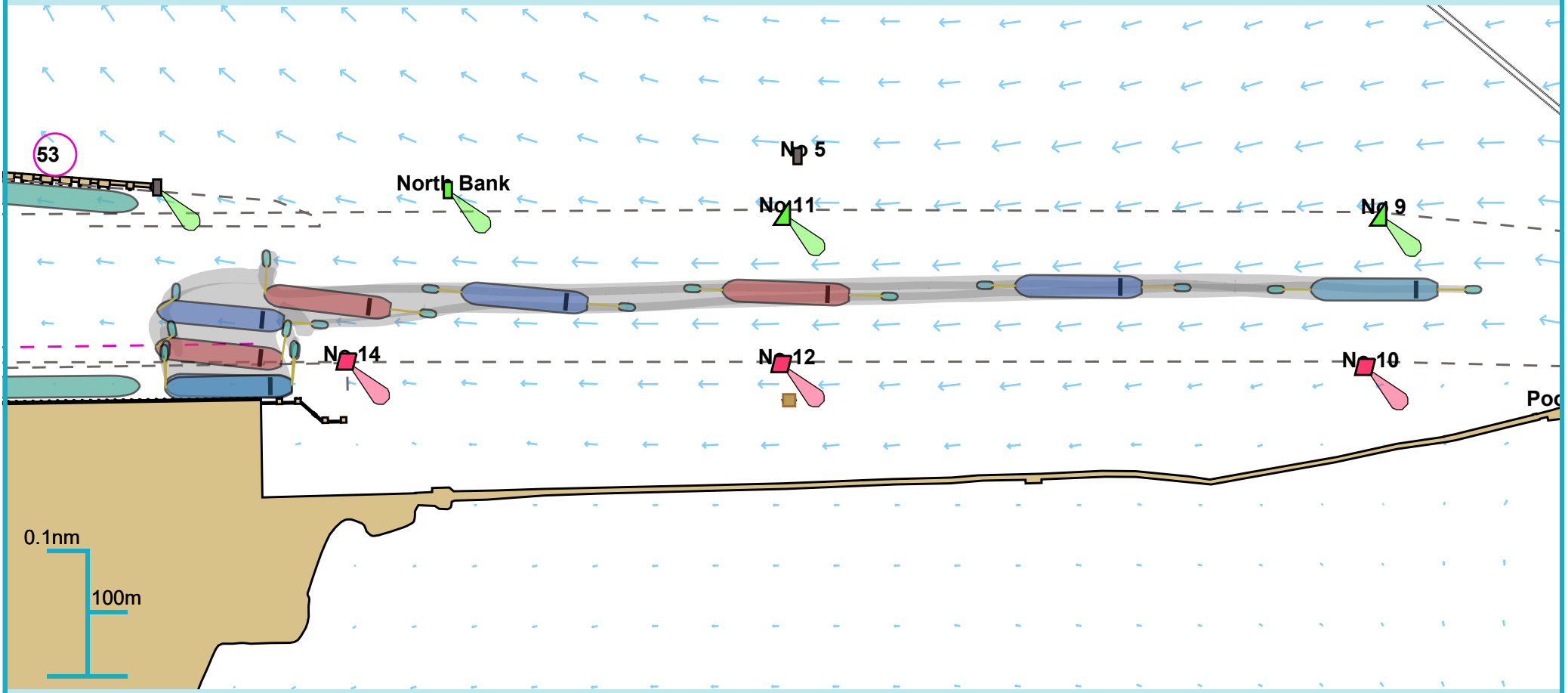






Full Run Overview

53° 20.260 N, 006° 11.175 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD

Run length: 14 minutes

Manoeuvre: Other

Ownship(s): 185m Product Tanker

Comments:

Overview

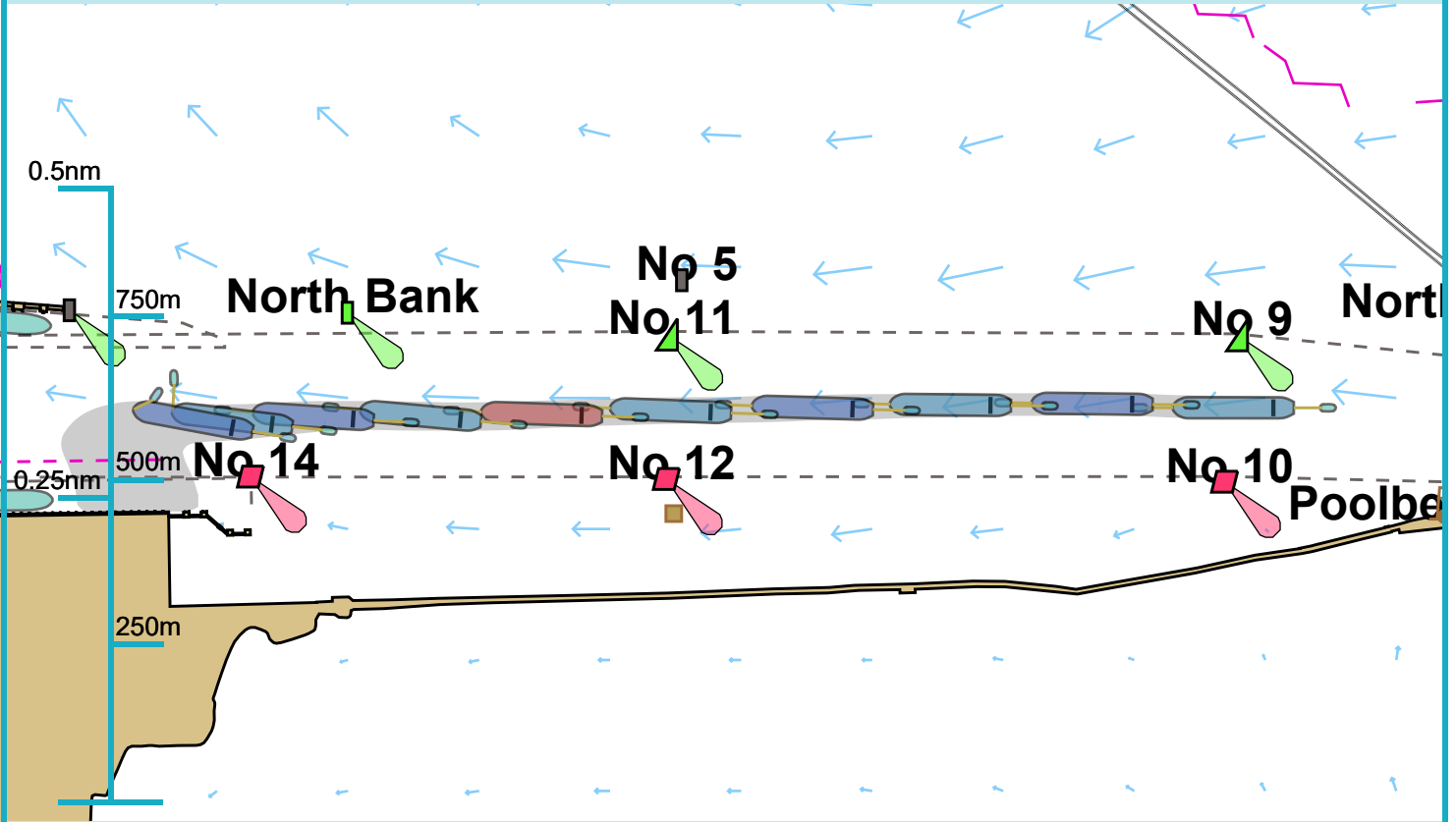
Environment

185m Product Tanker

Thruster and engine use

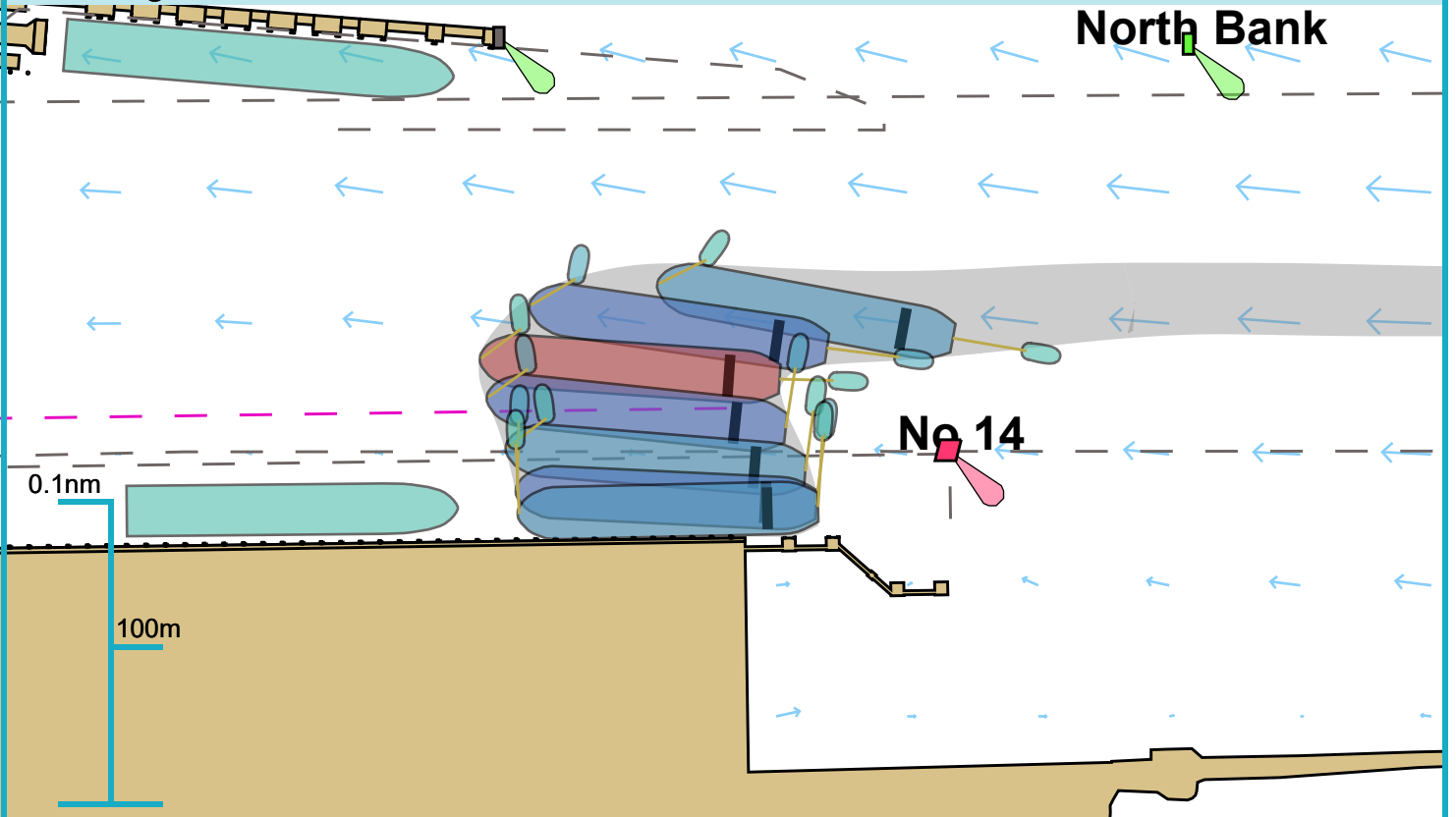
Tug use

Approach

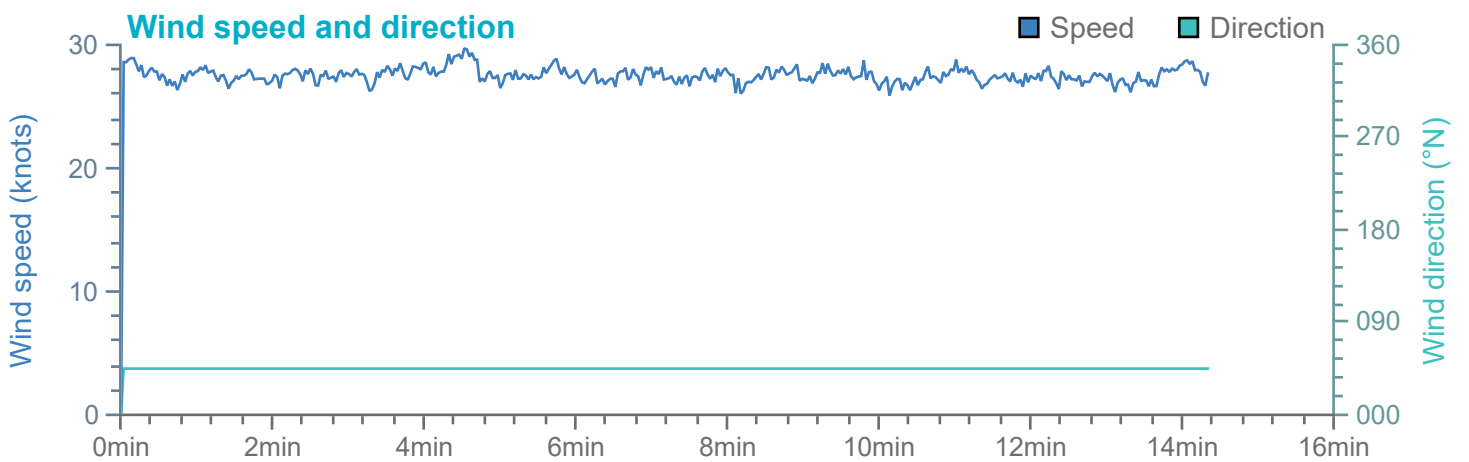
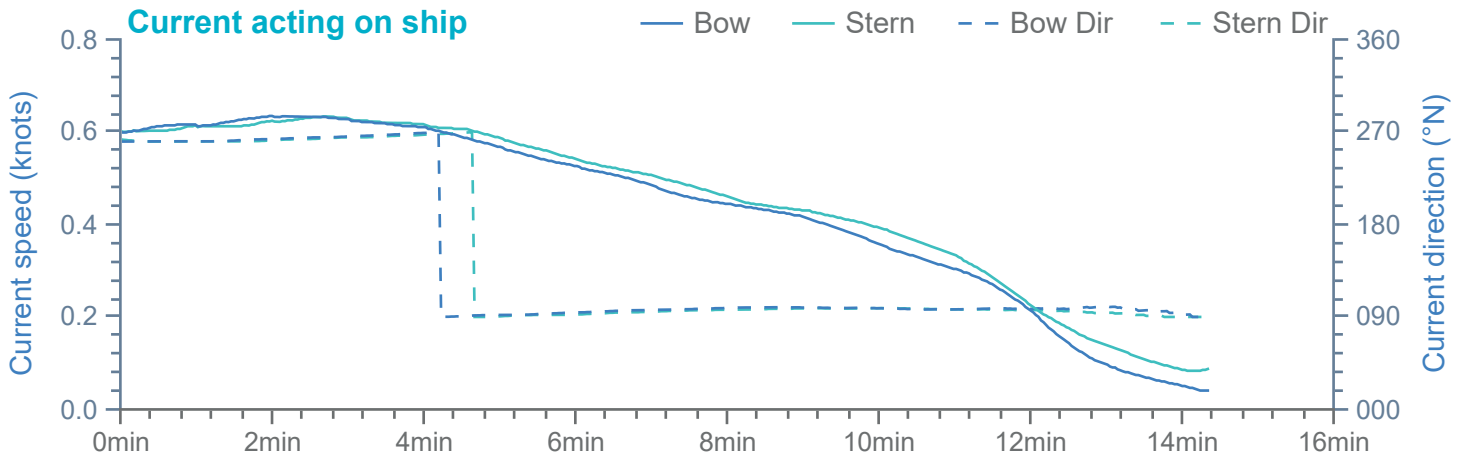


Ships plotted every 1 mins, highlight every 5 mins

Berthing



Ships plotted every 1 mins, highlight every 5 mins



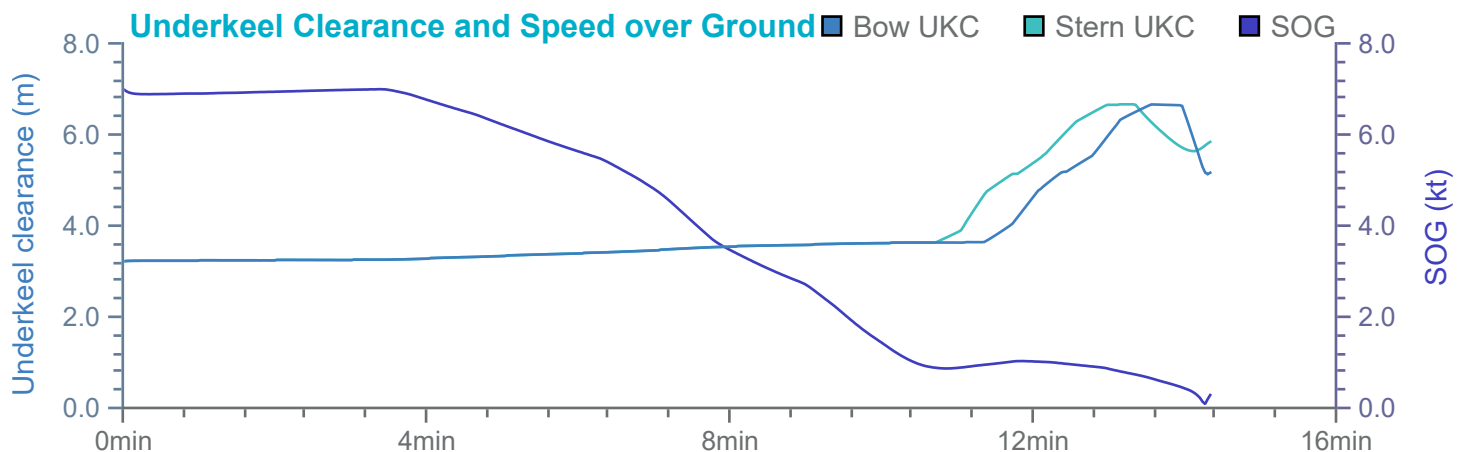
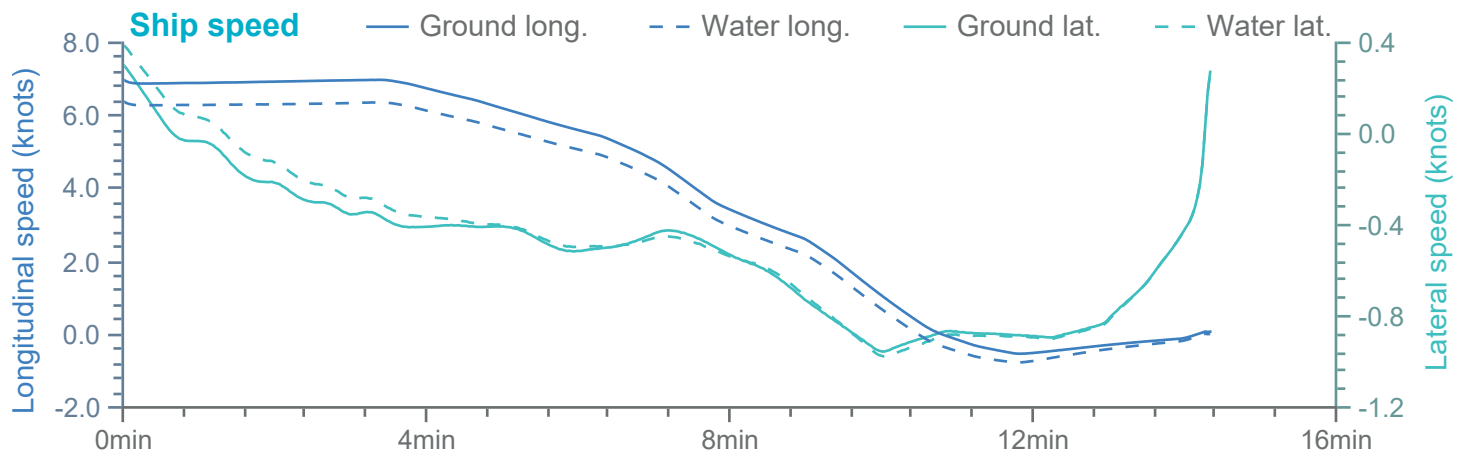
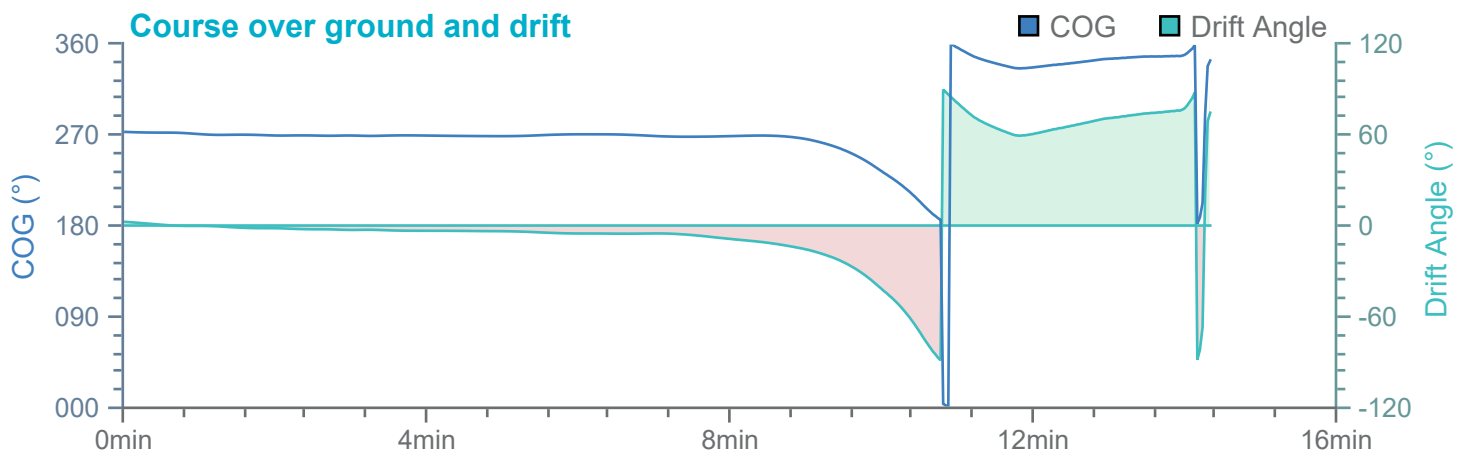
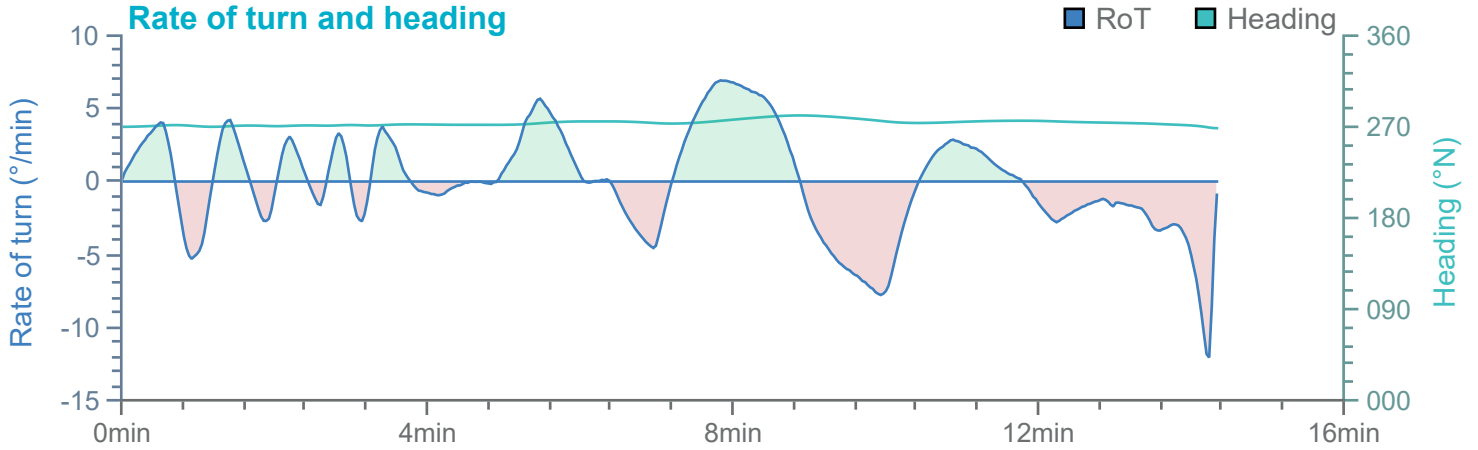
Overview

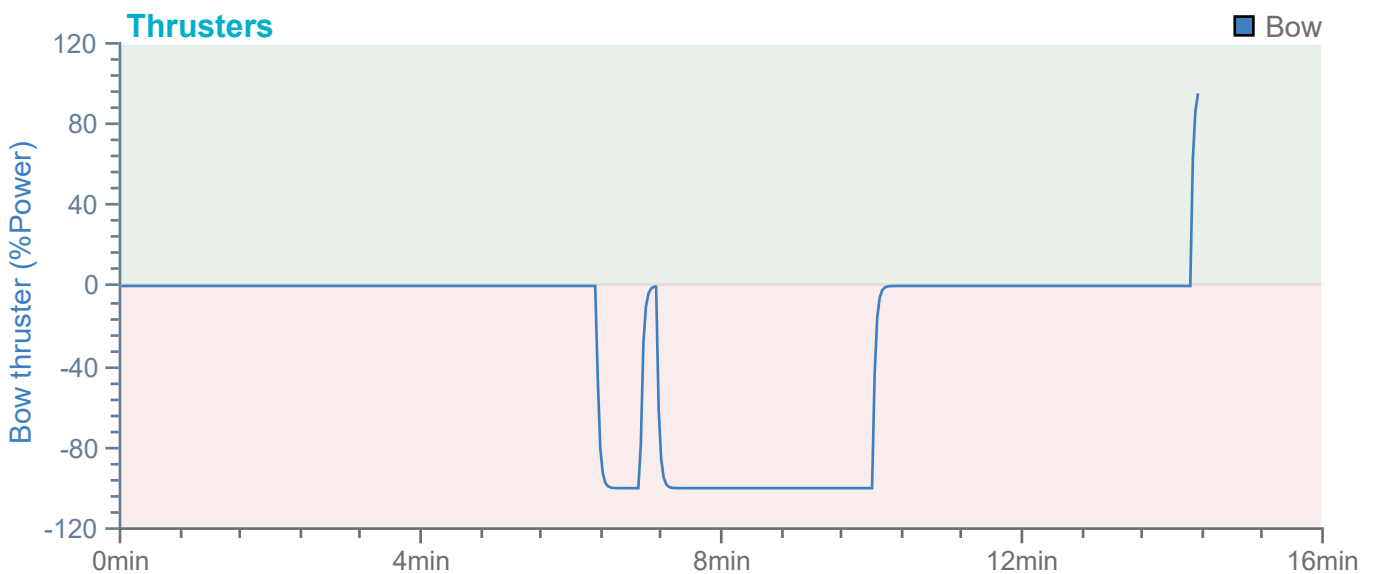
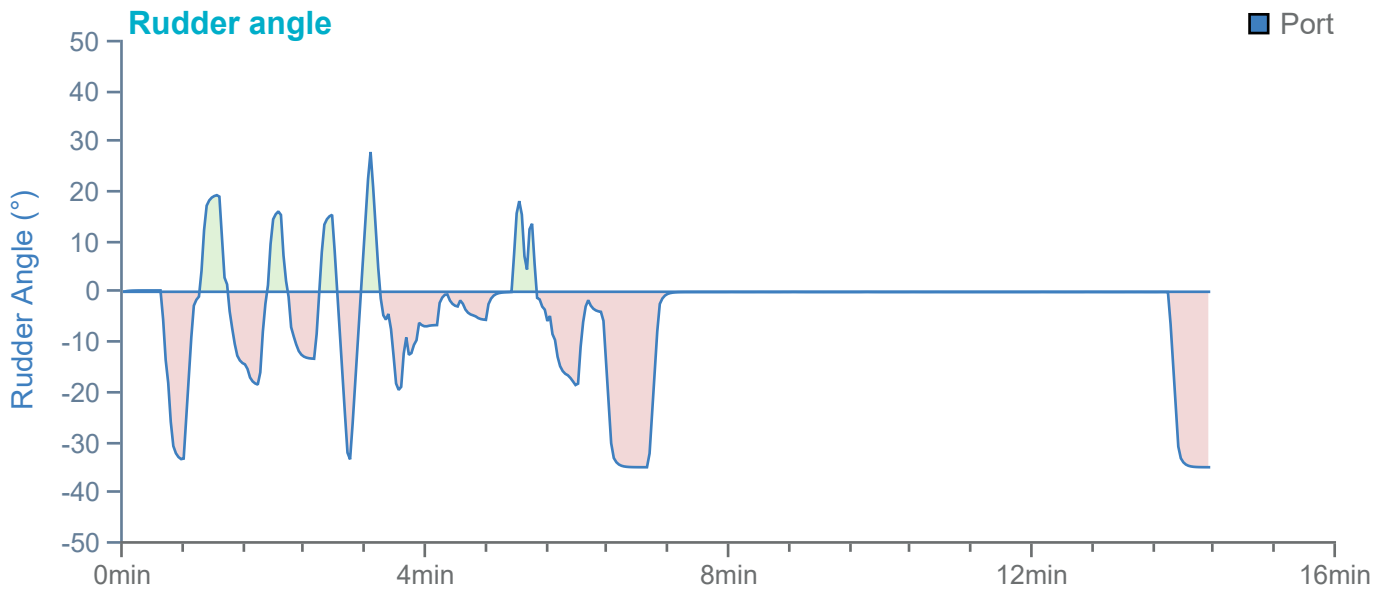
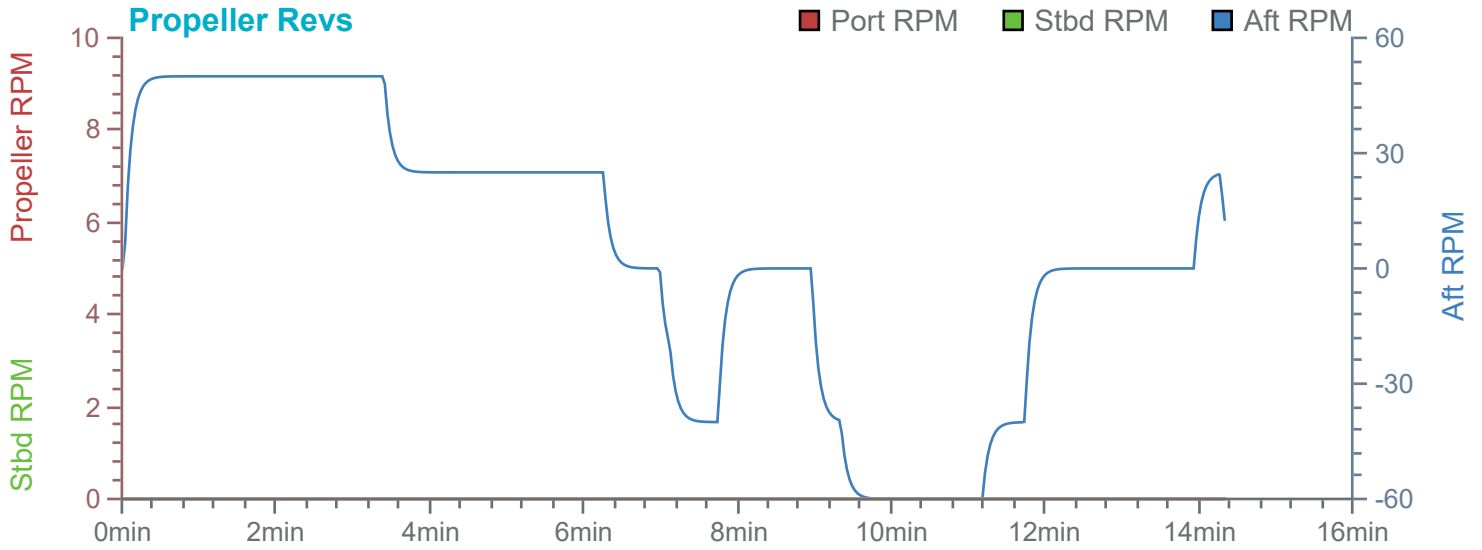
Environment

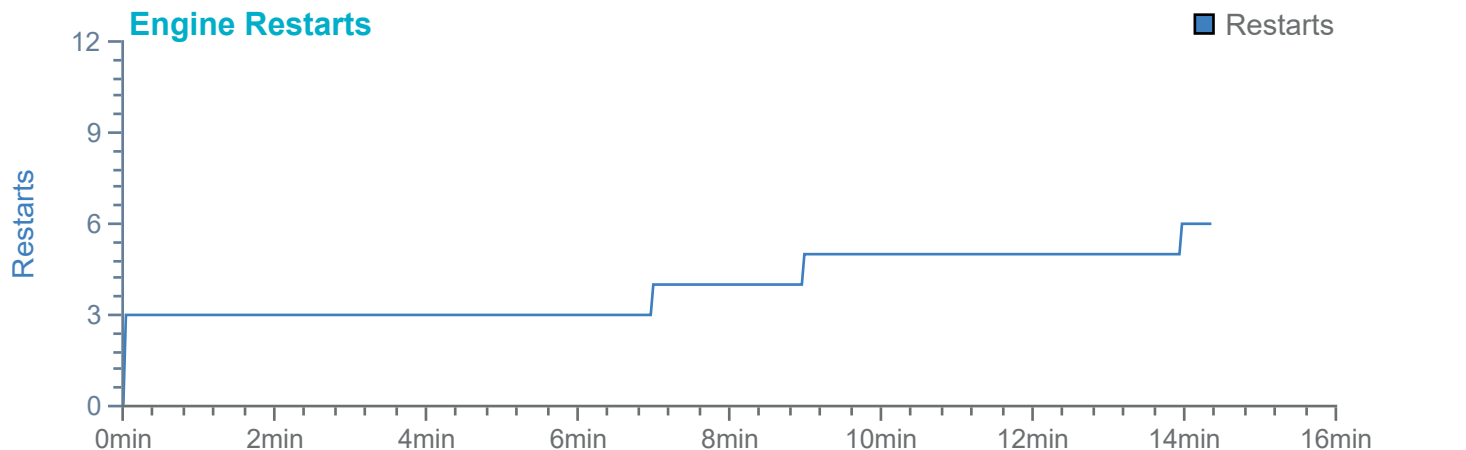
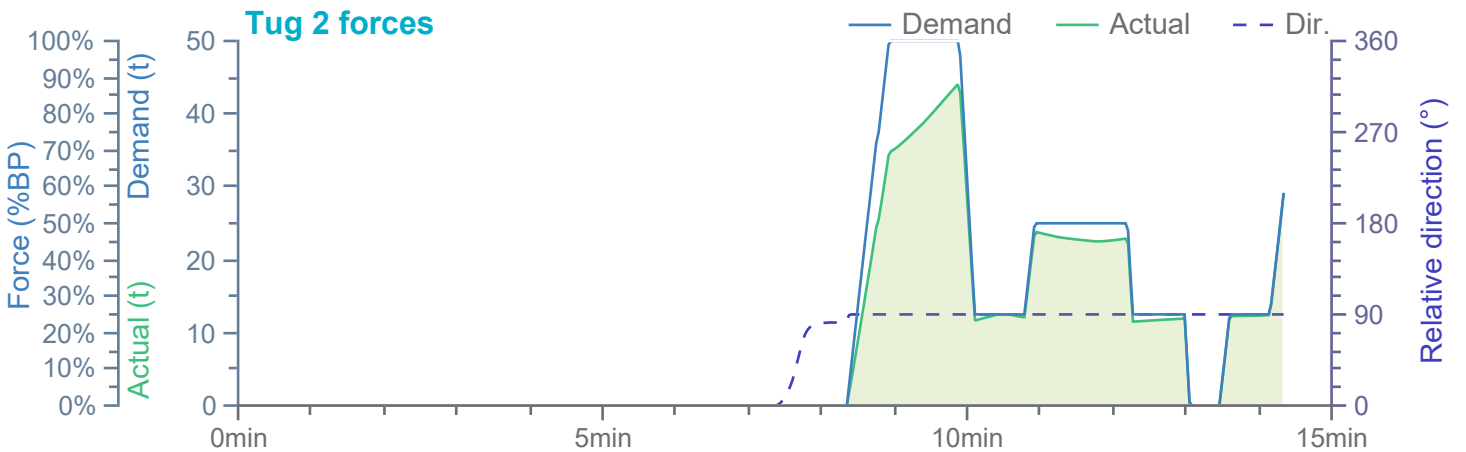
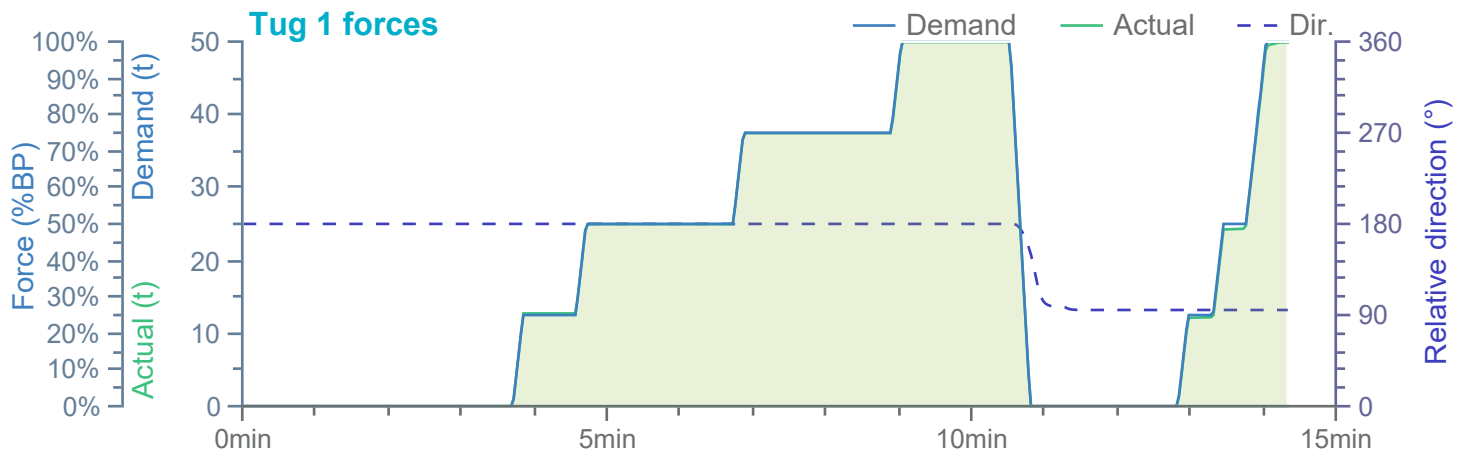
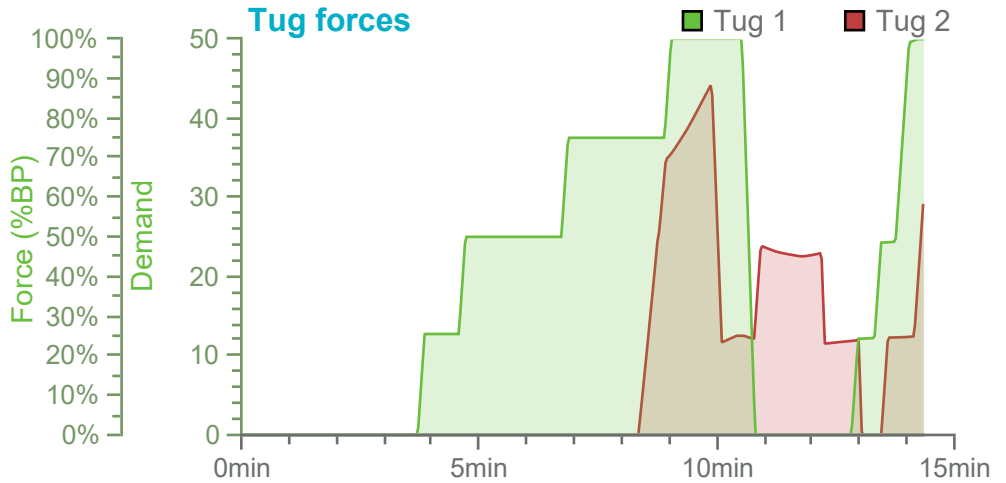
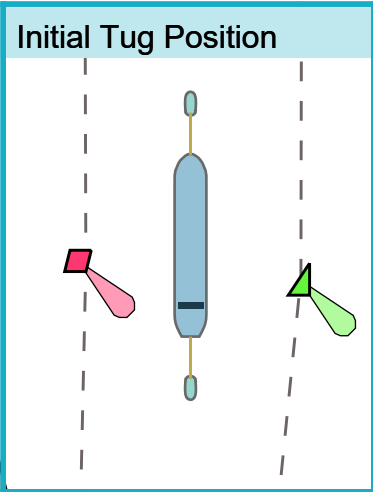
185m Product Tanker

Thruster and engine use

Tug use

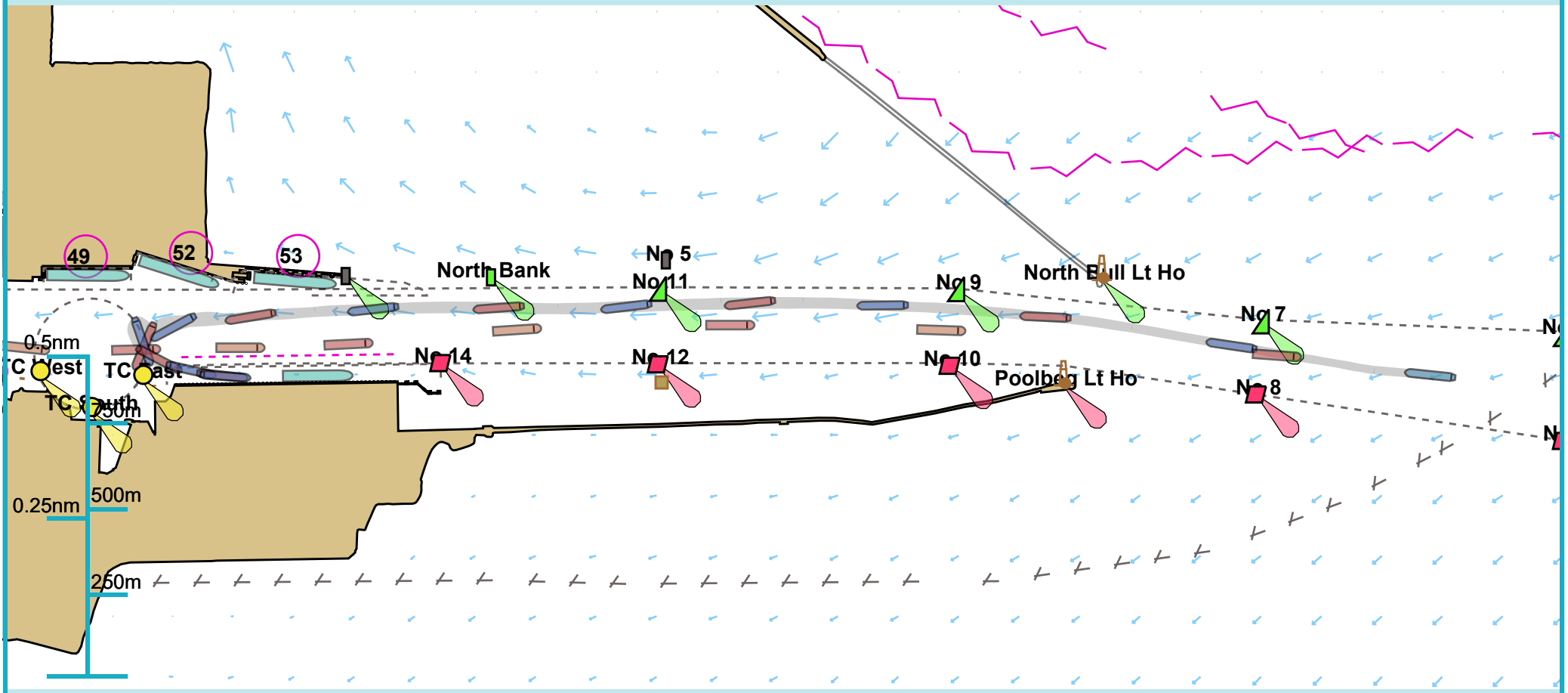






Full Run Overview

53° 19.965 N, 006° 11.873 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: MM&IL

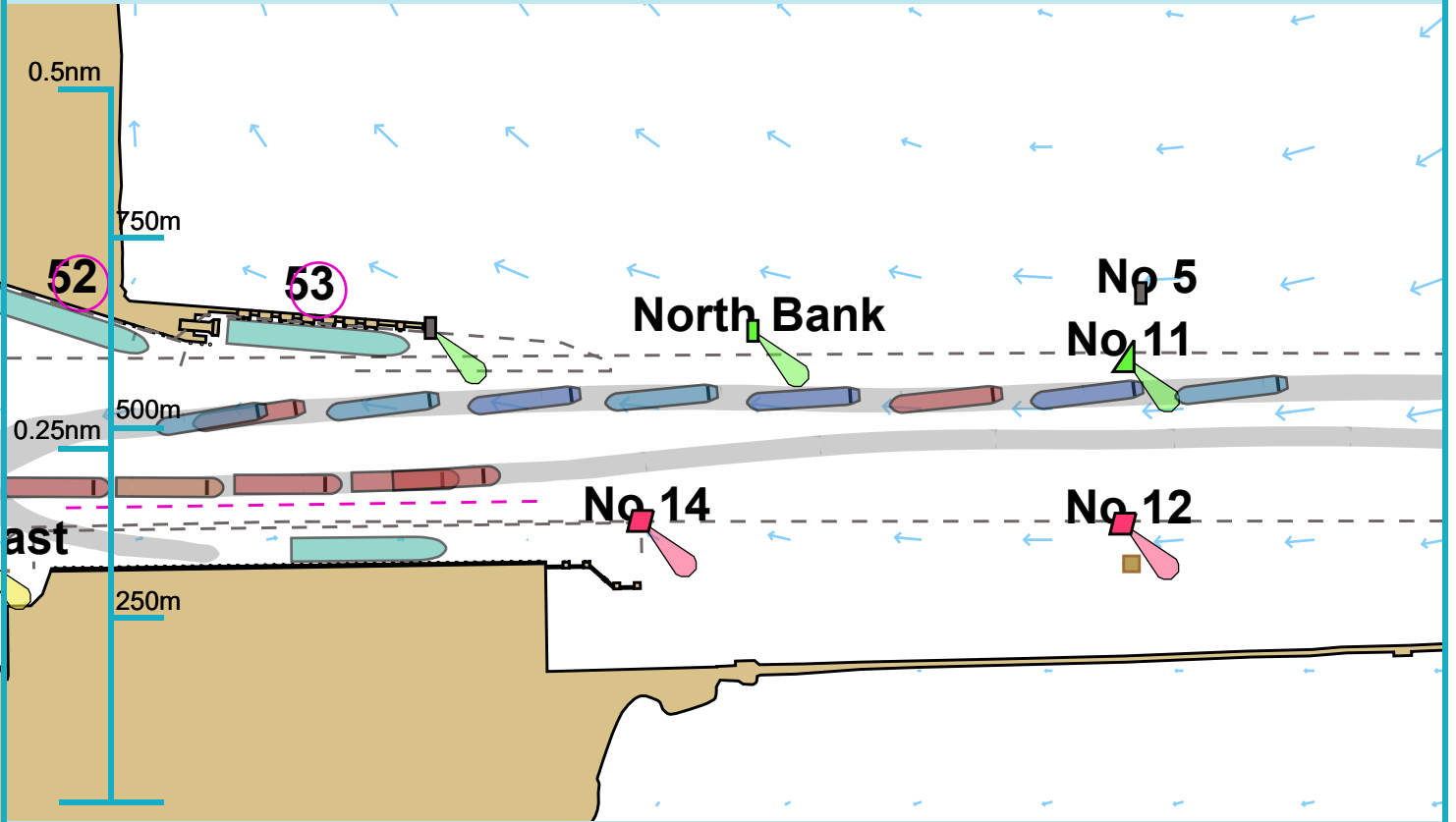
Run length: 29 minutes

Manoeuvre: Other

Ownship(s): 148m Container, Seatruck Power

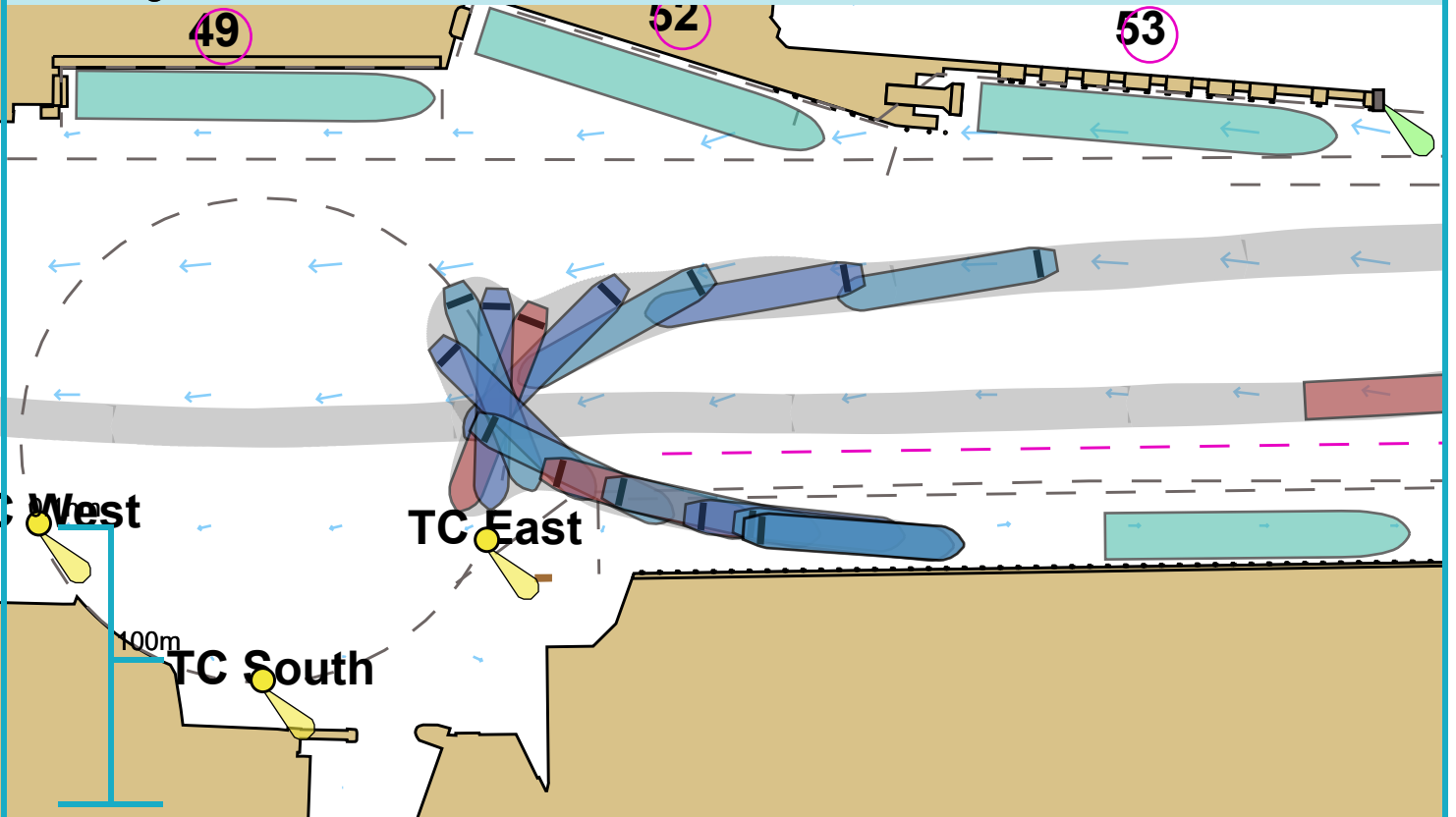
Comments:

Approach



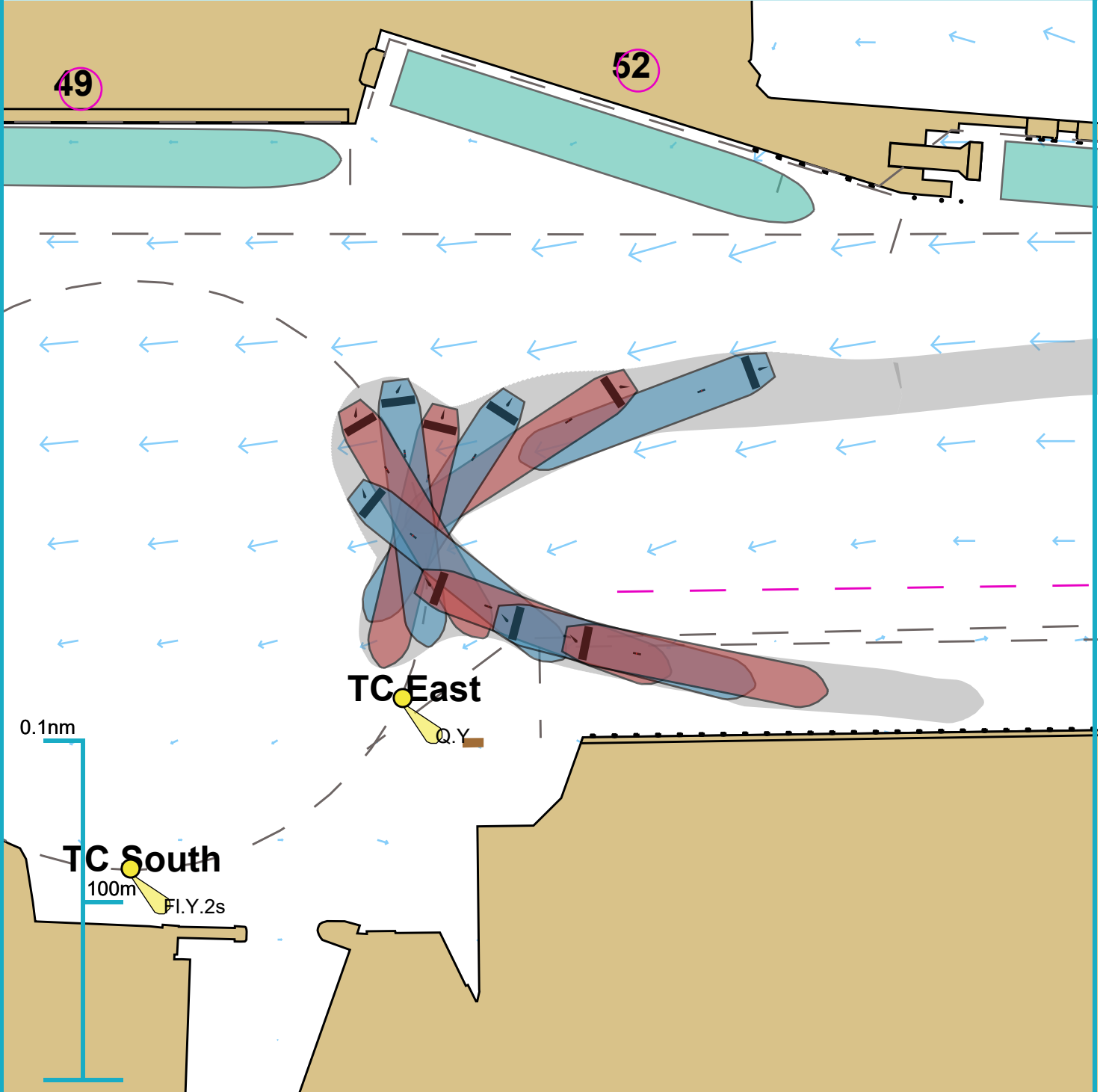
Ships plotted every 1 mins, highlight every 5 mins

Berthing

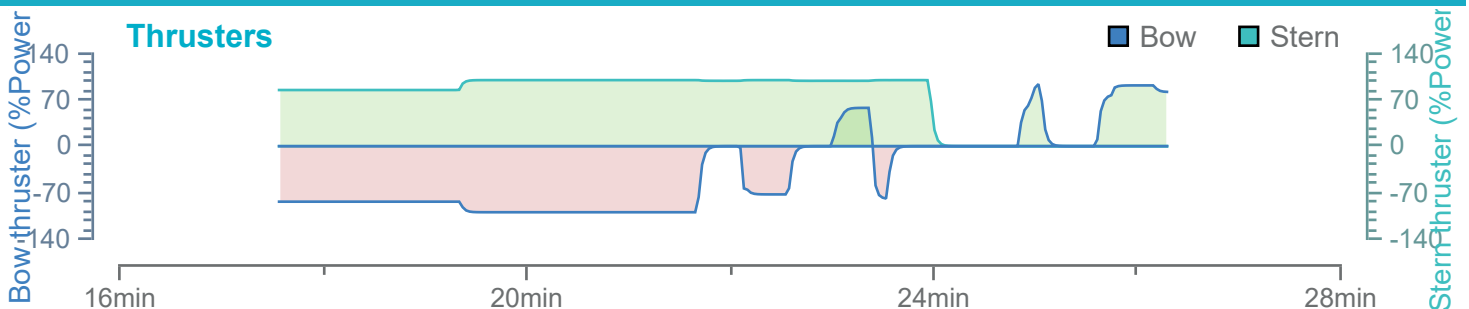


Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins

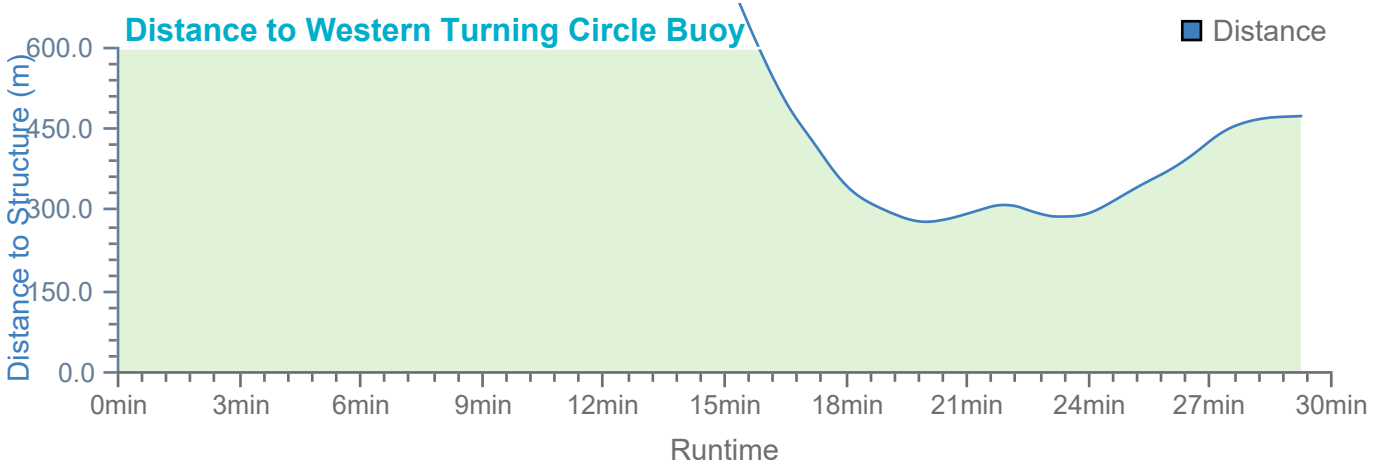
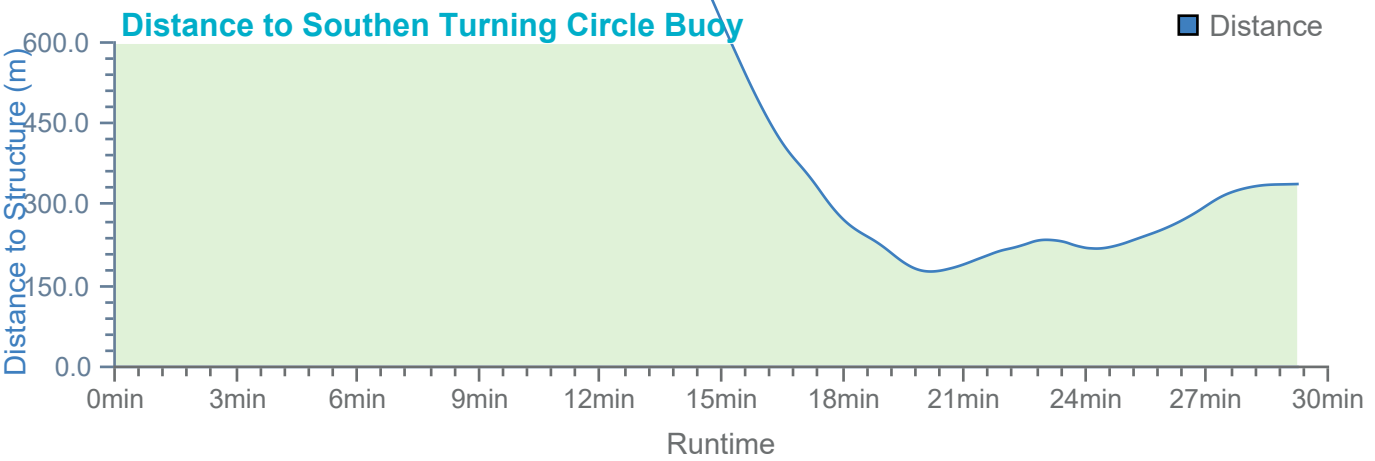
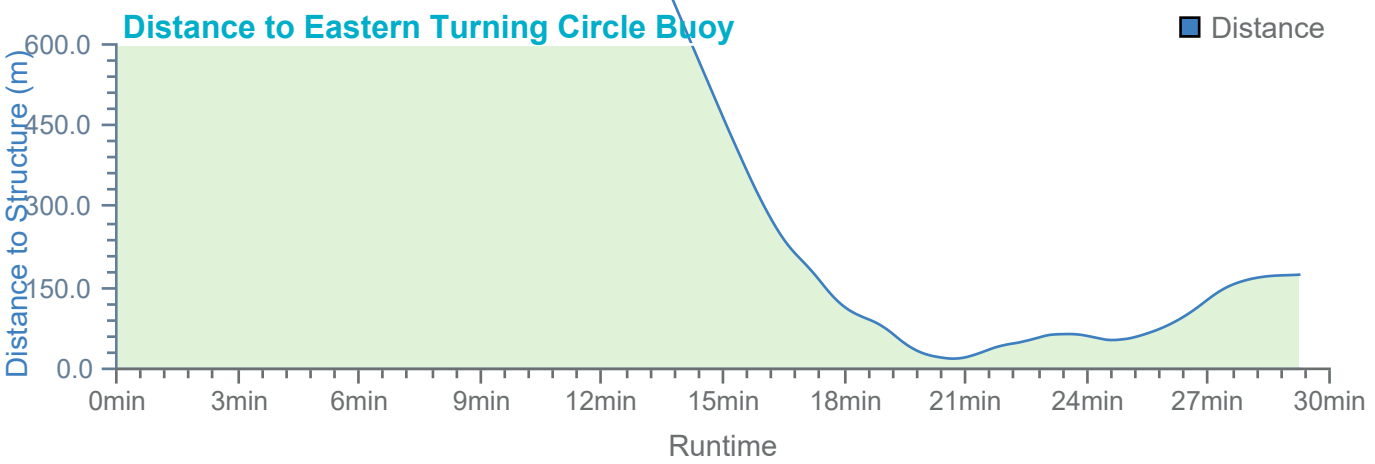
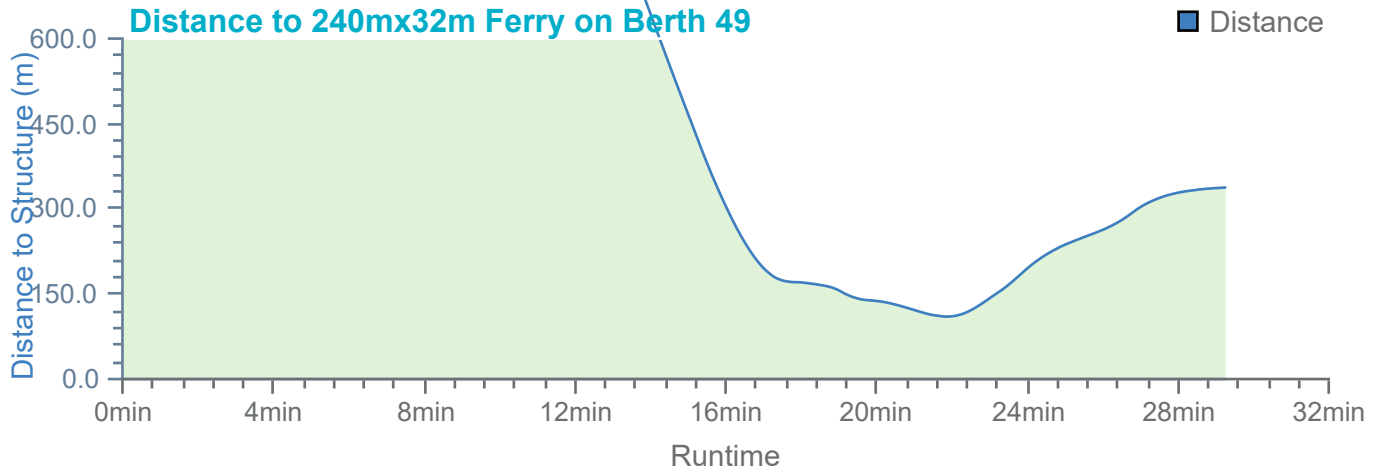


Overview

Environment

148m Container

Thruster and engine use

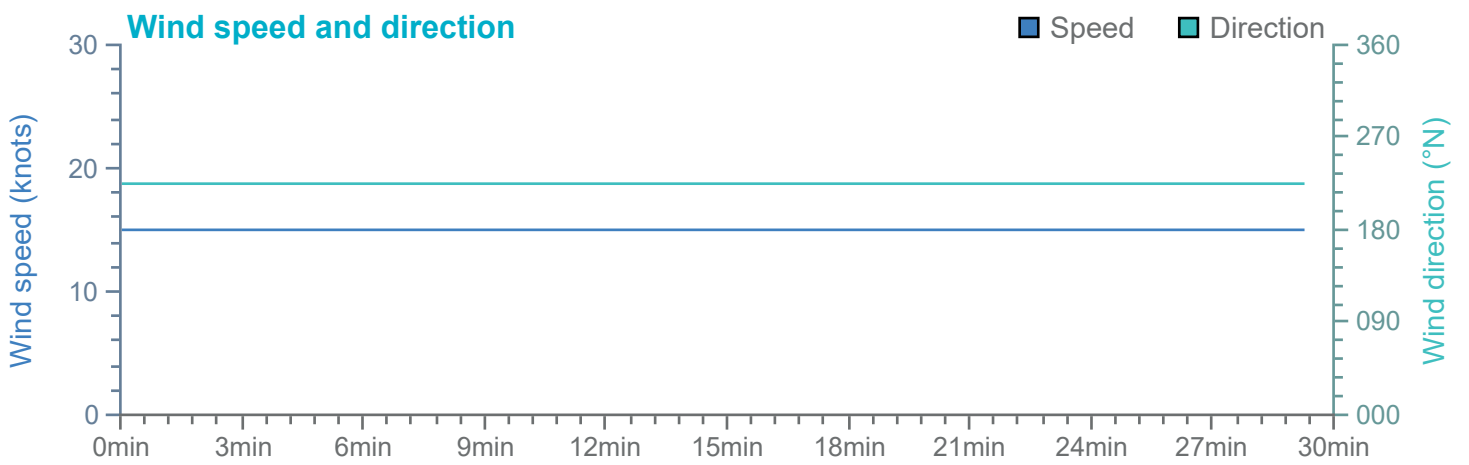
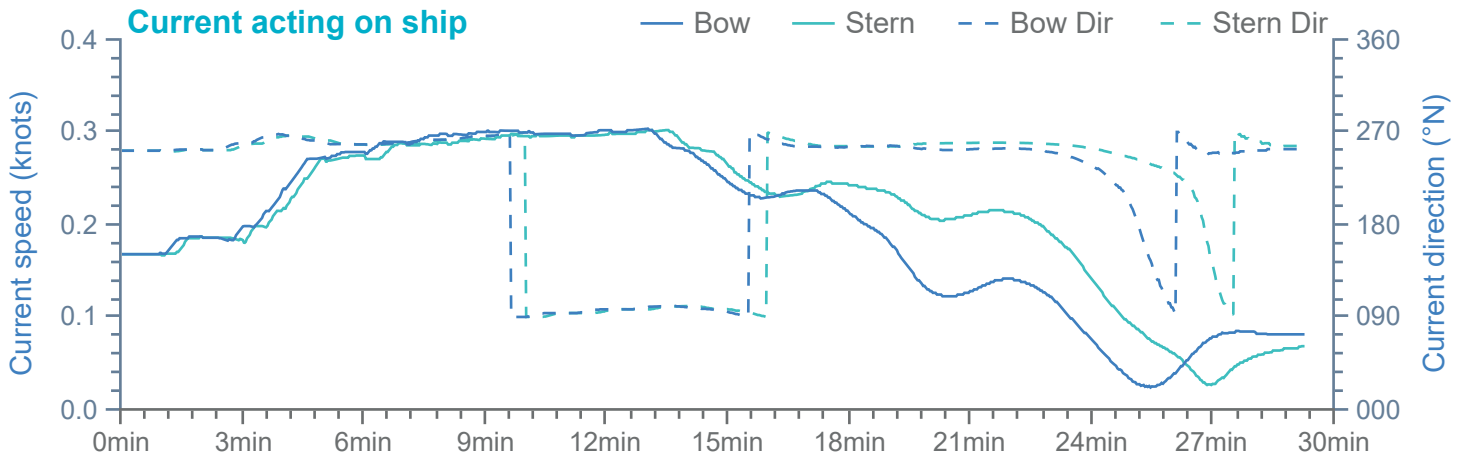


Overview

Environment

148m Container

Thruster and engine use

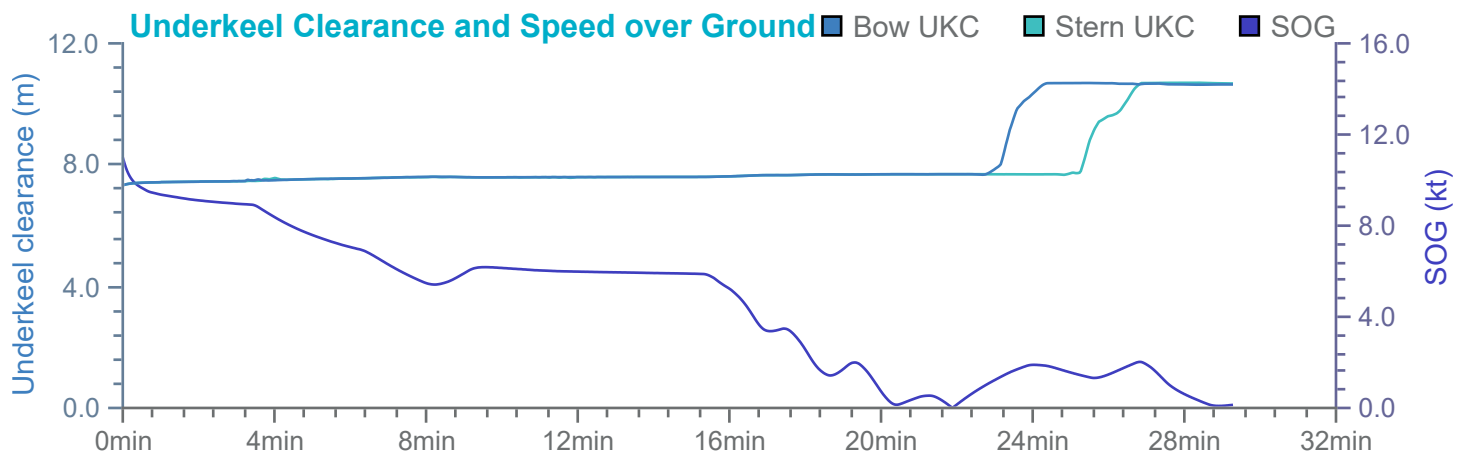
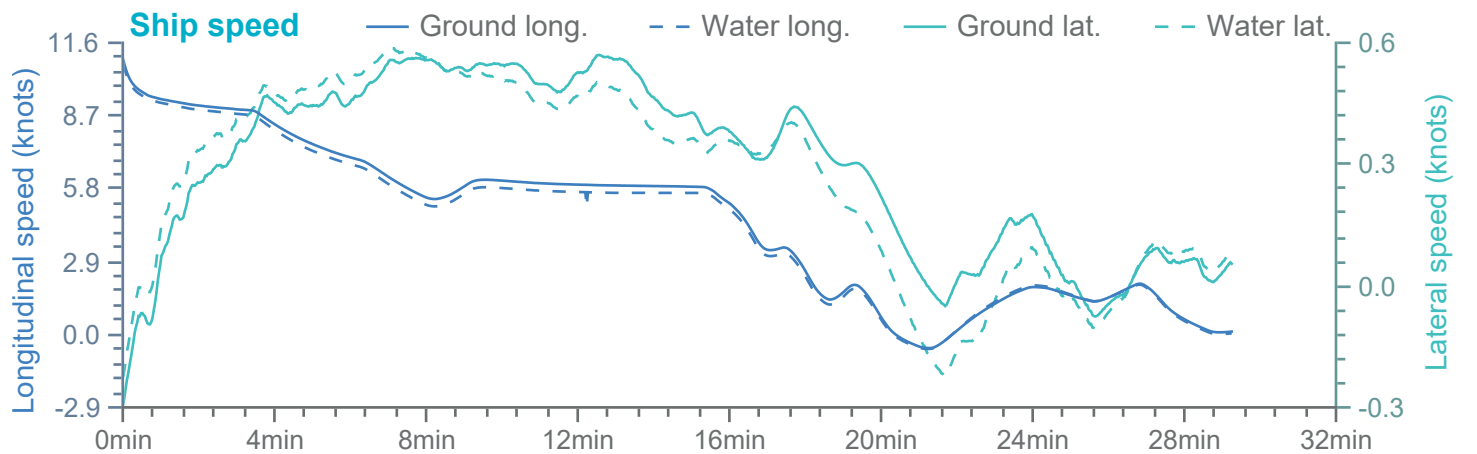
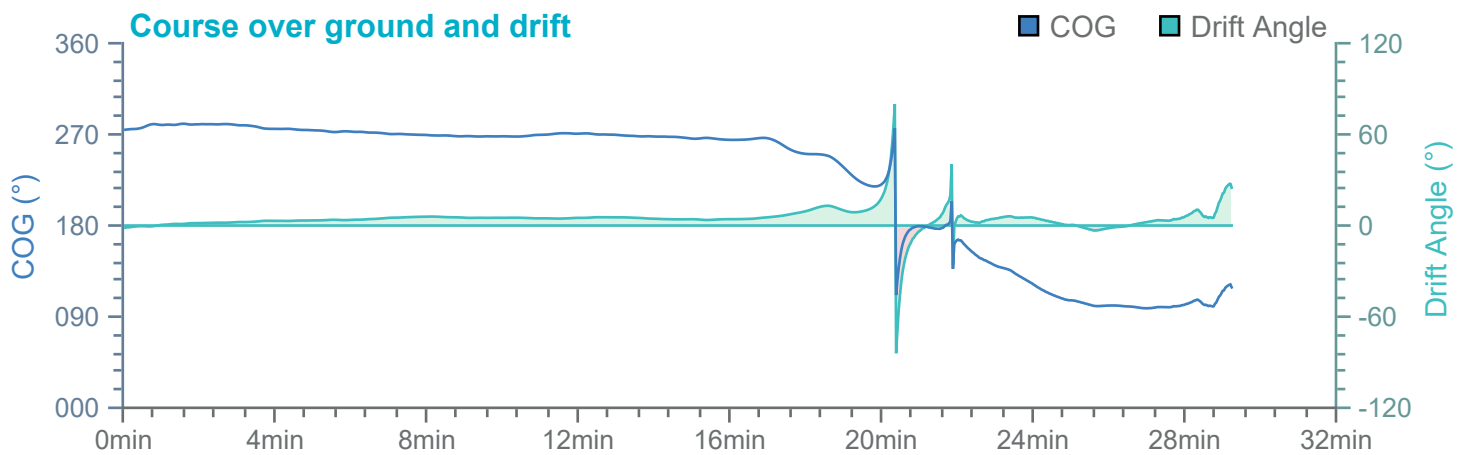
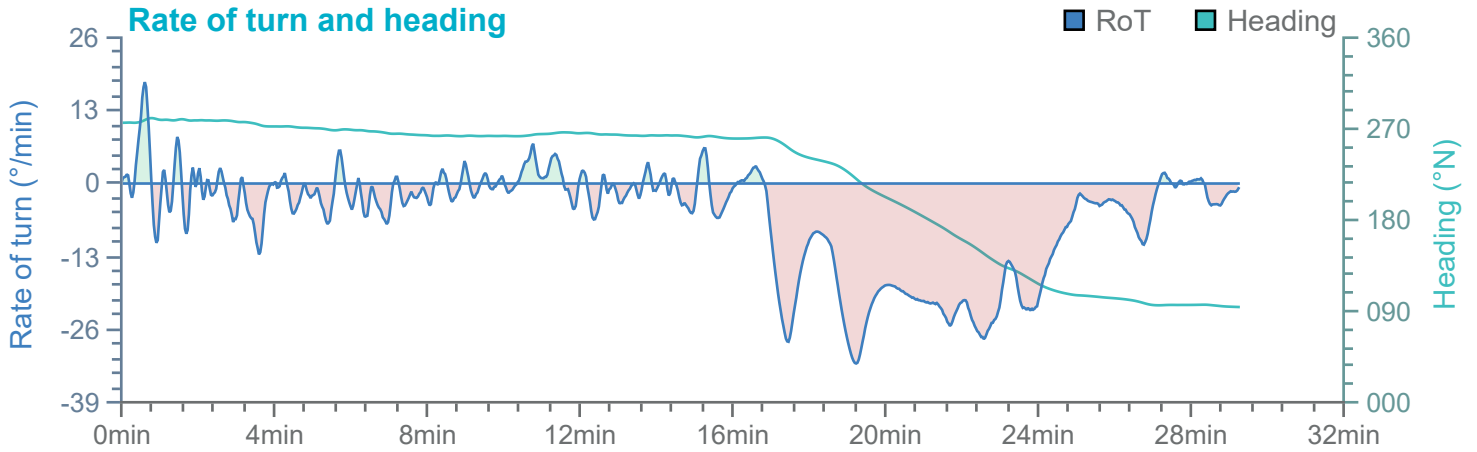


Overview

Environment

148m Container

Thruster and engine use

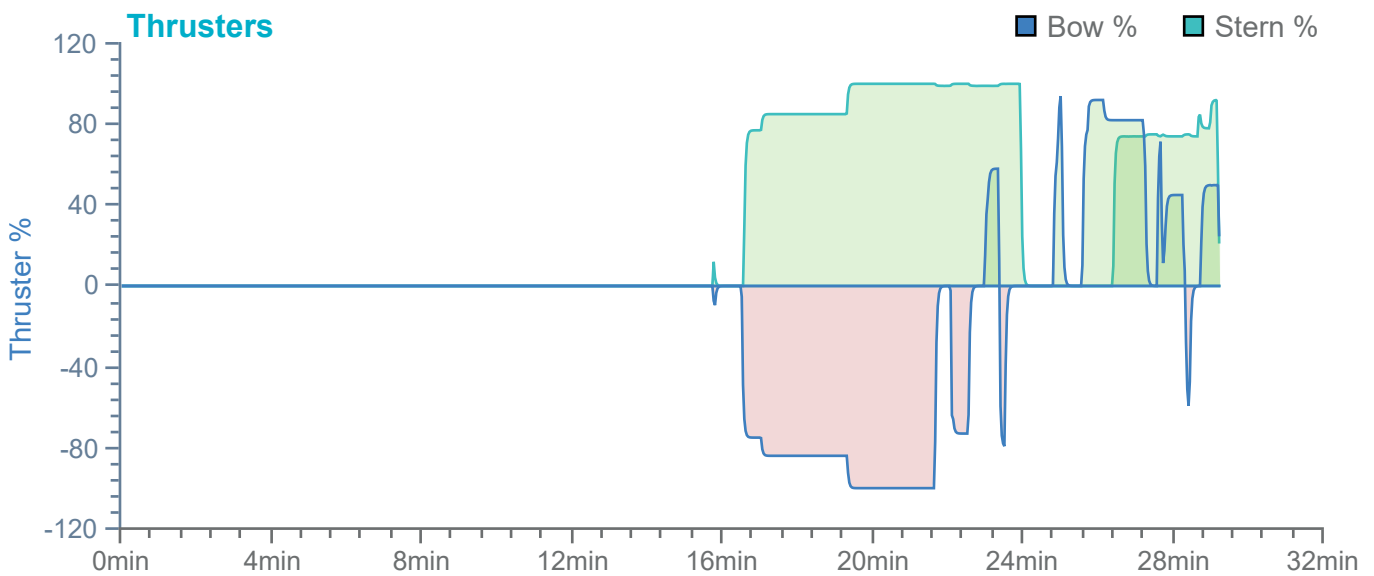
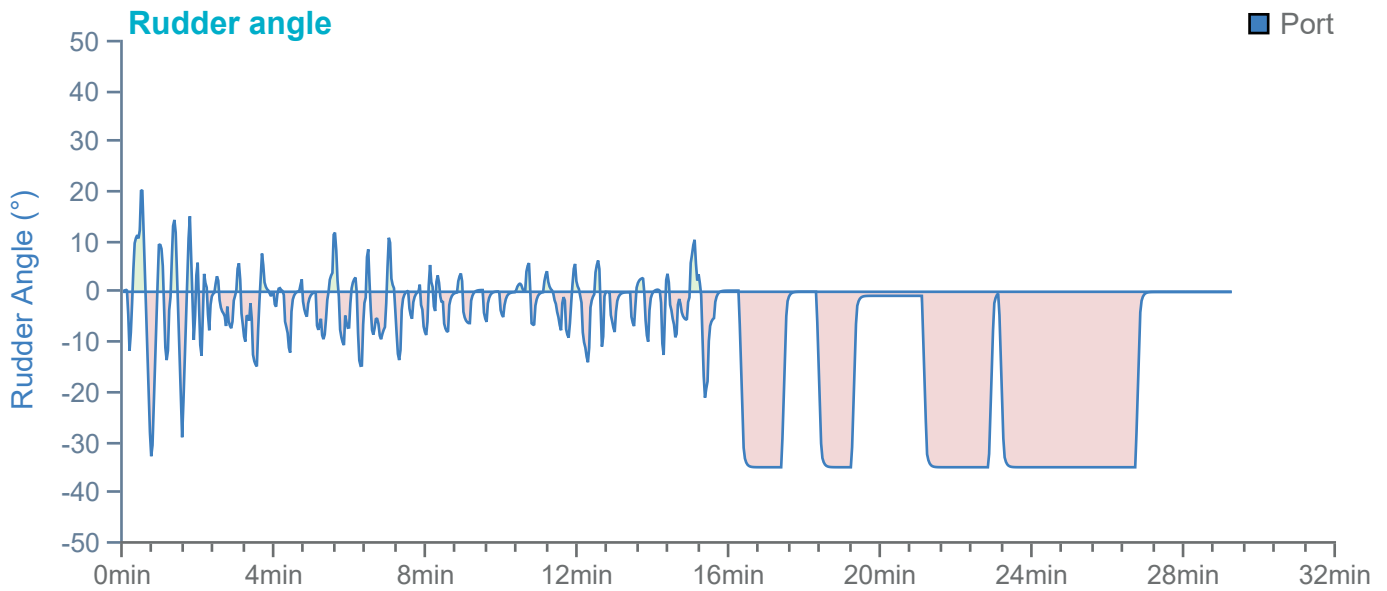
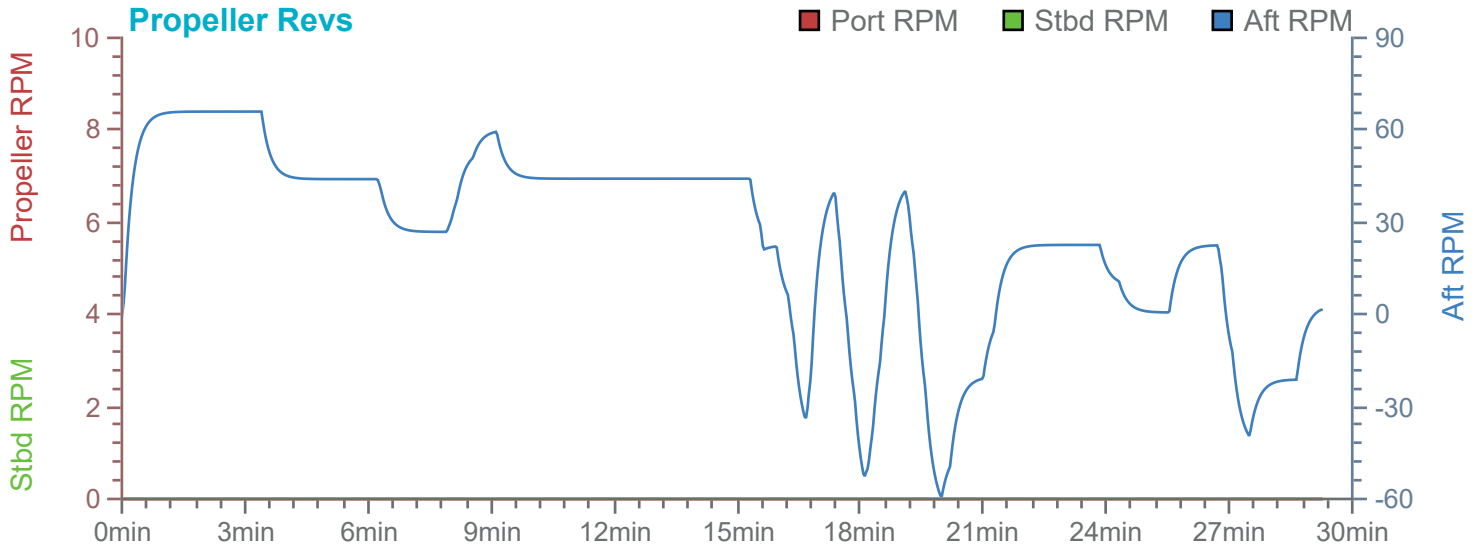


Overview

Environment

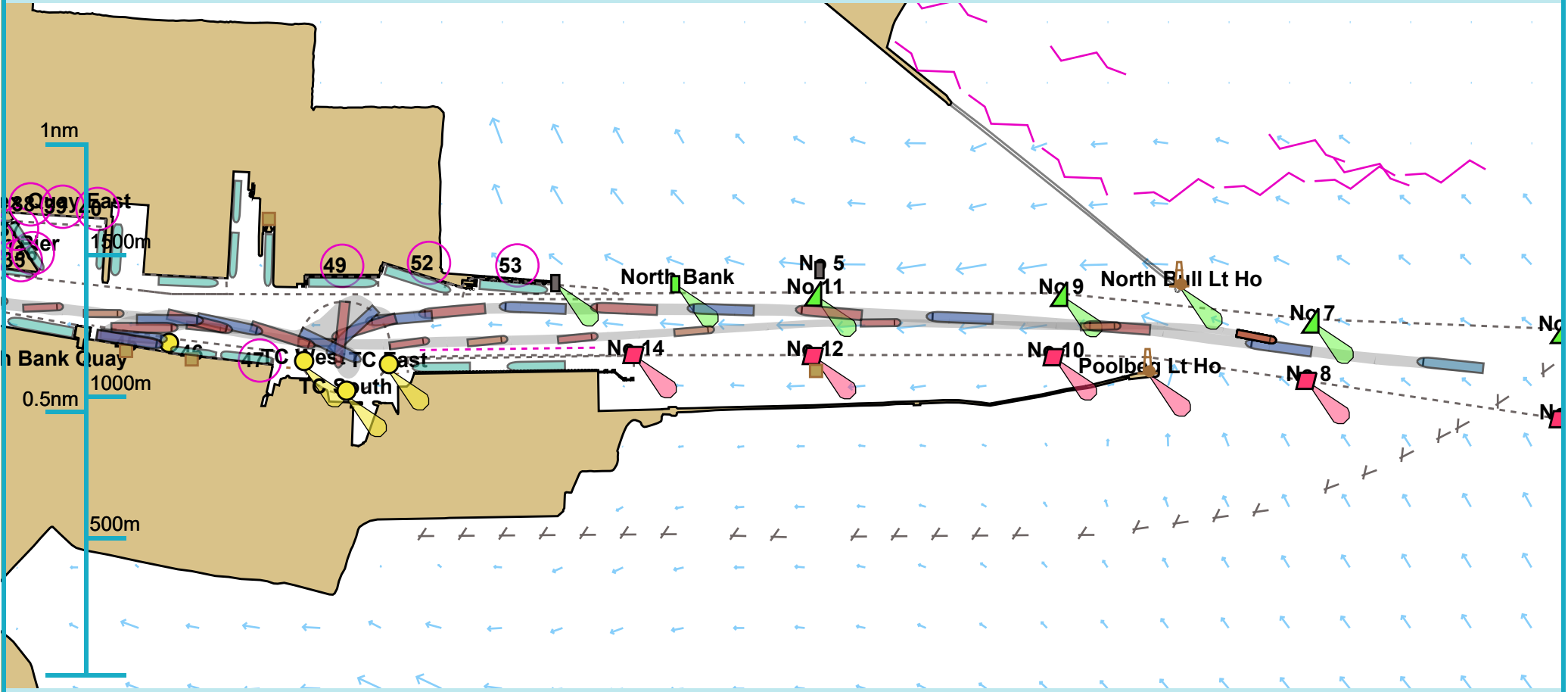
148m Container

Thruster and engine use



Full Run Overview

53° 19.825 N, 006° 12.738 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM&IL

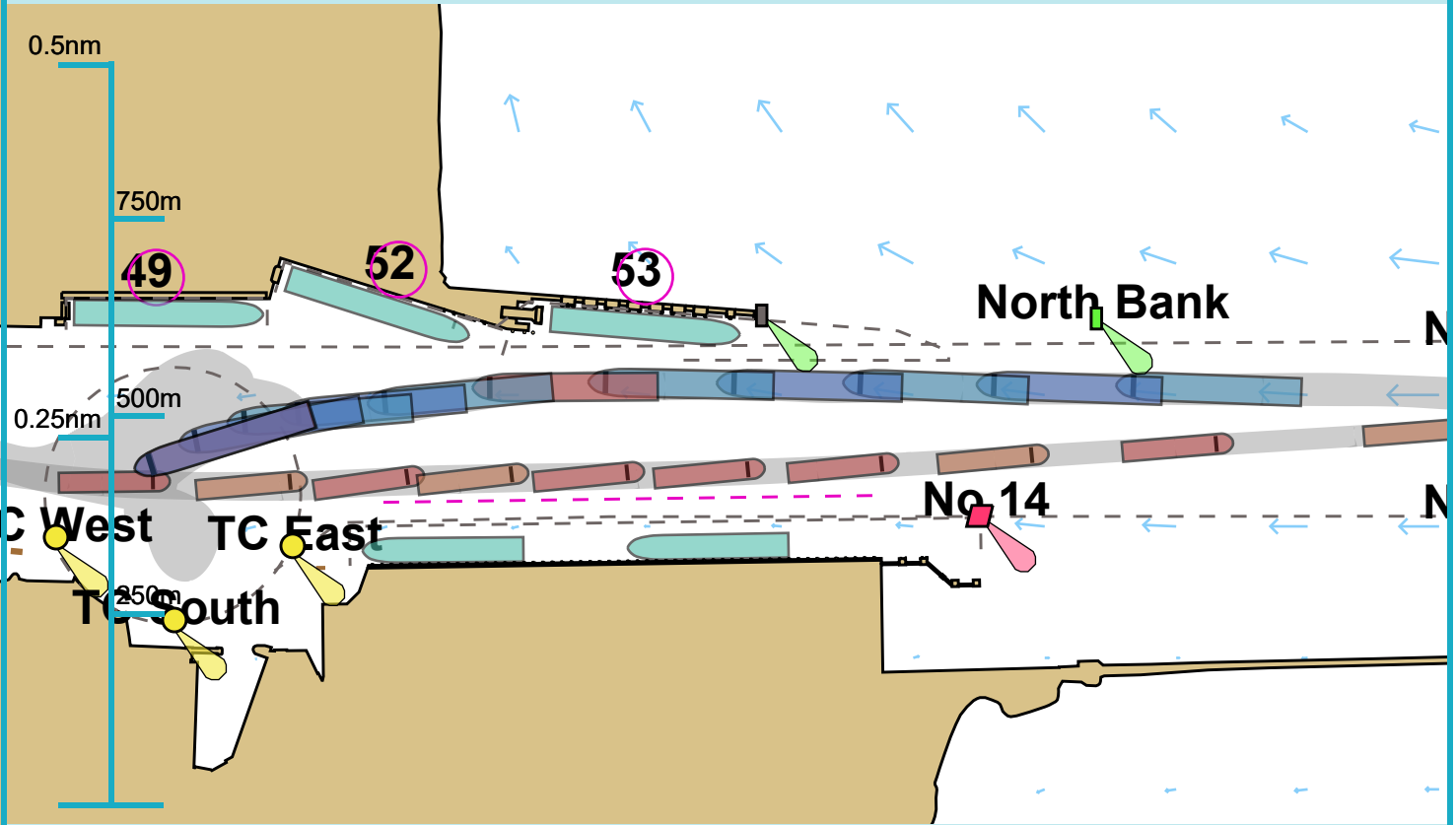
Run length:40 minutes

Manouvre:Other

Ownship(s):MV Celine, Seatruck Power

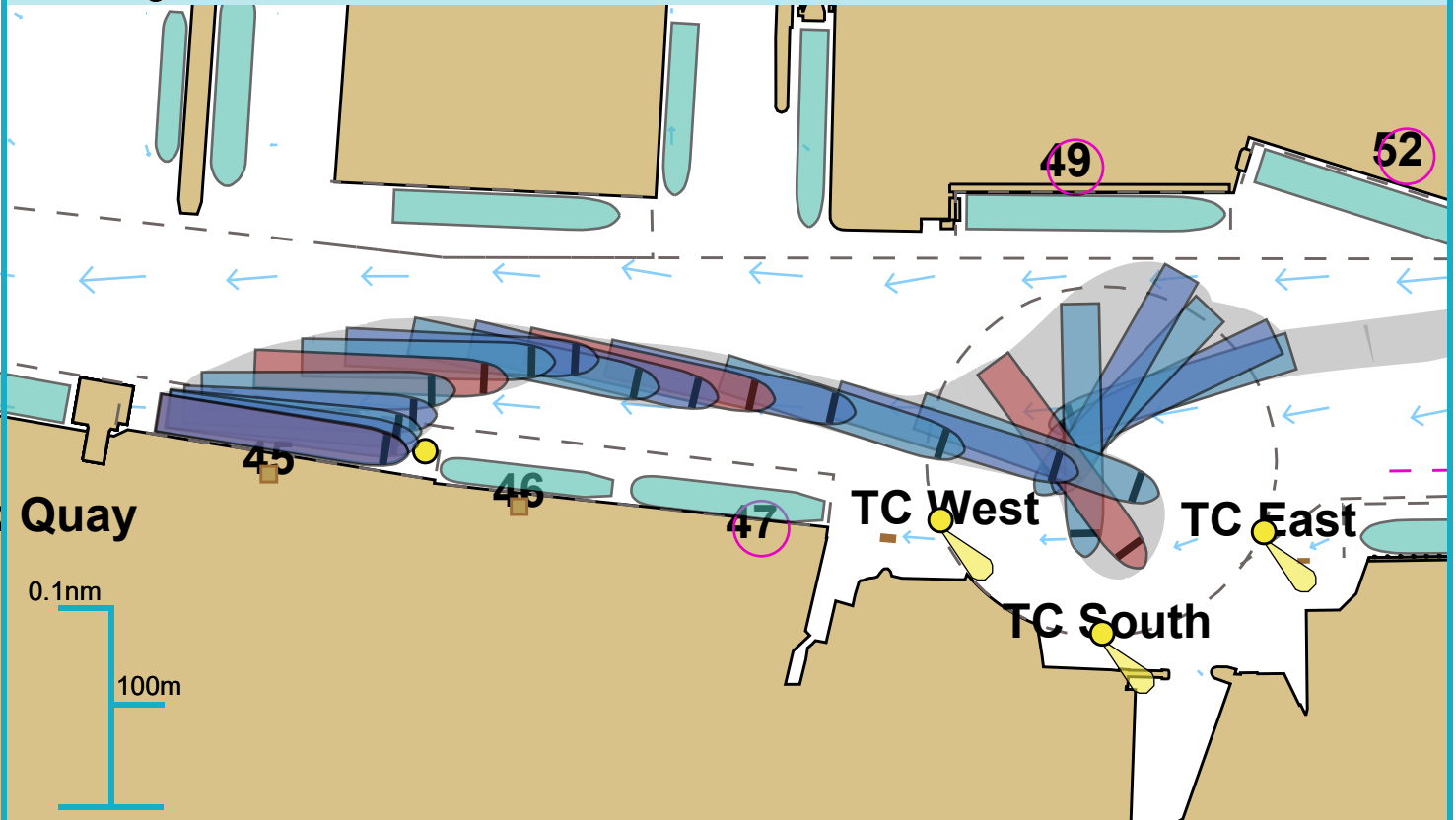
Comments:

Approach



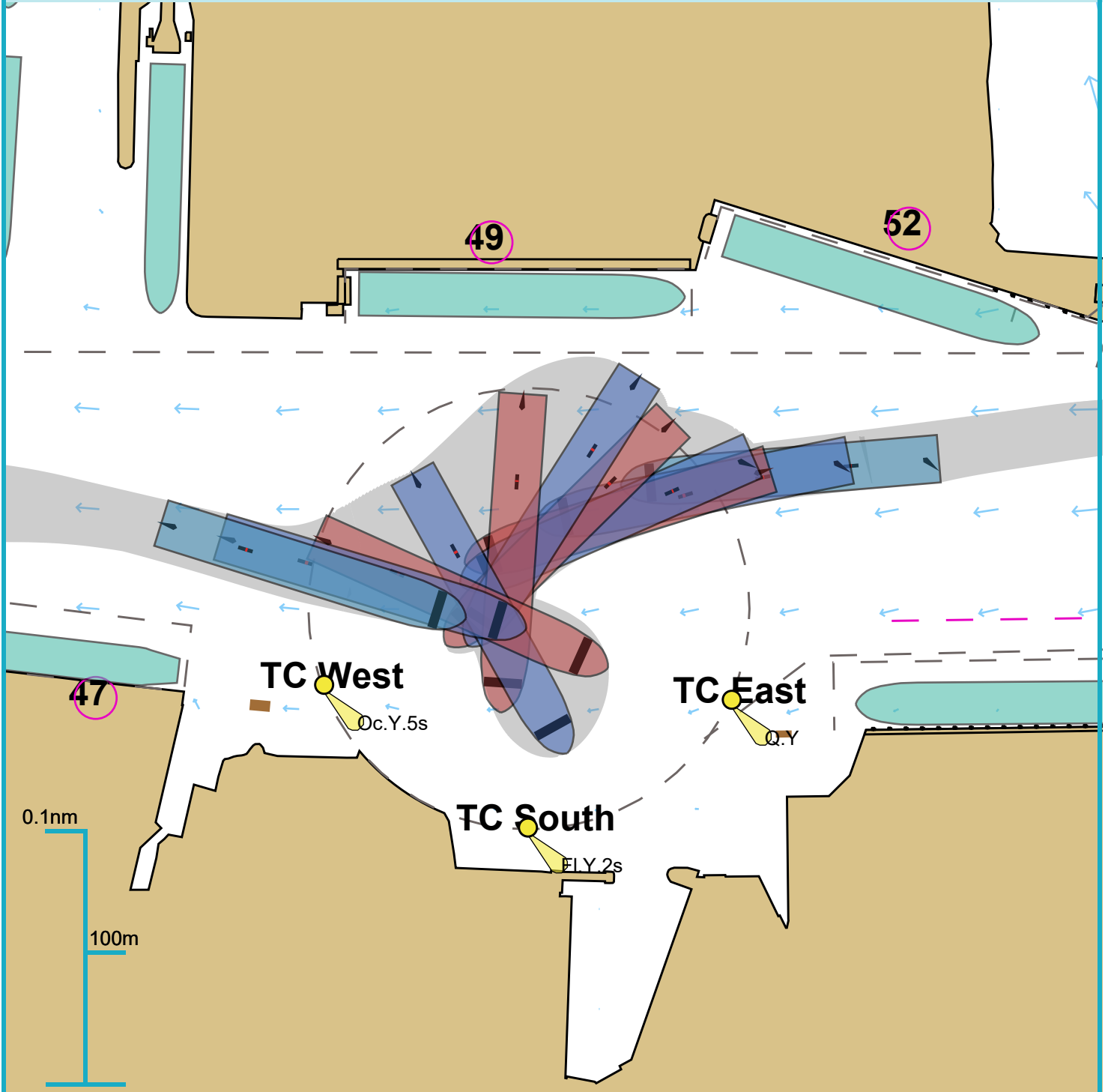
Ships plotted every 1 mins, highlight every 5 mins

Berthing

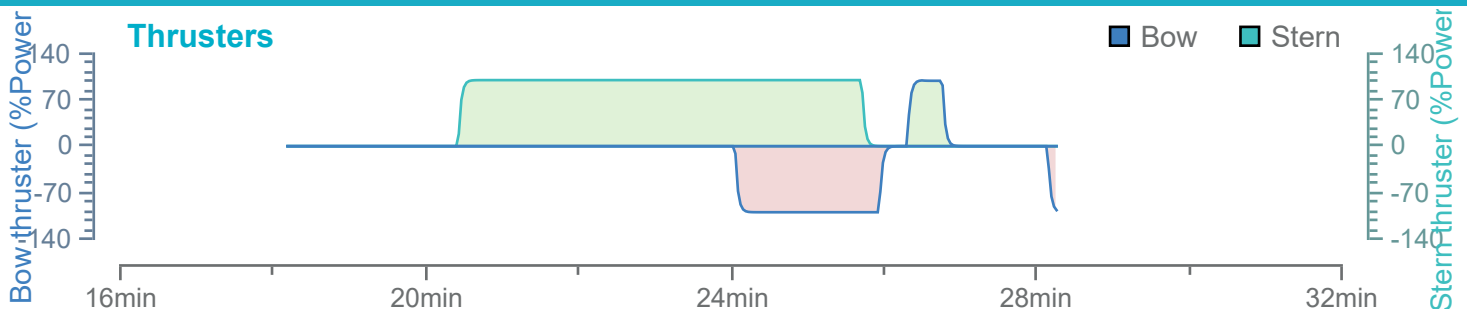


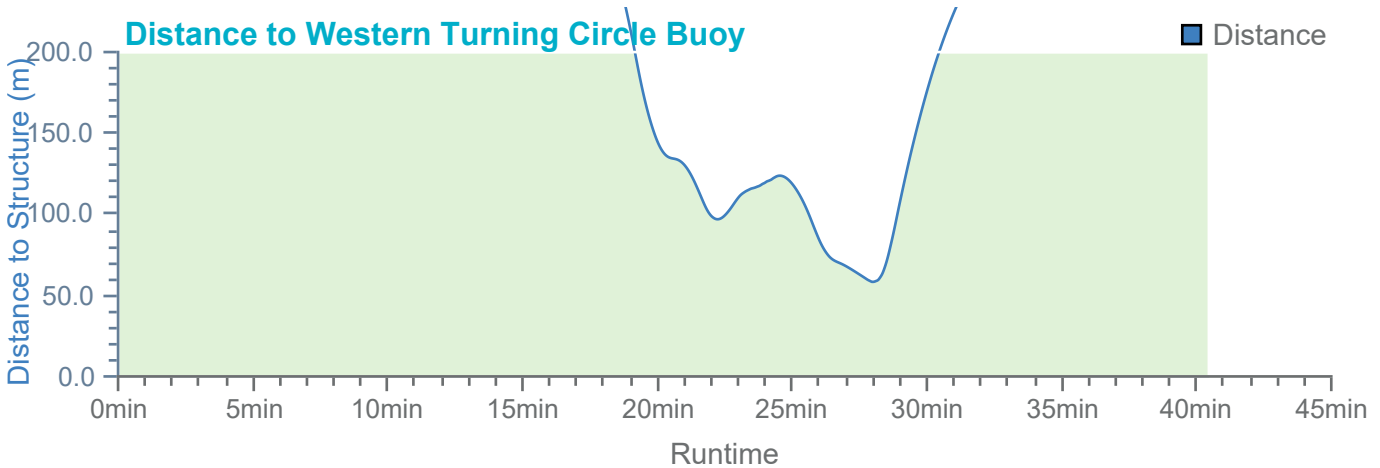
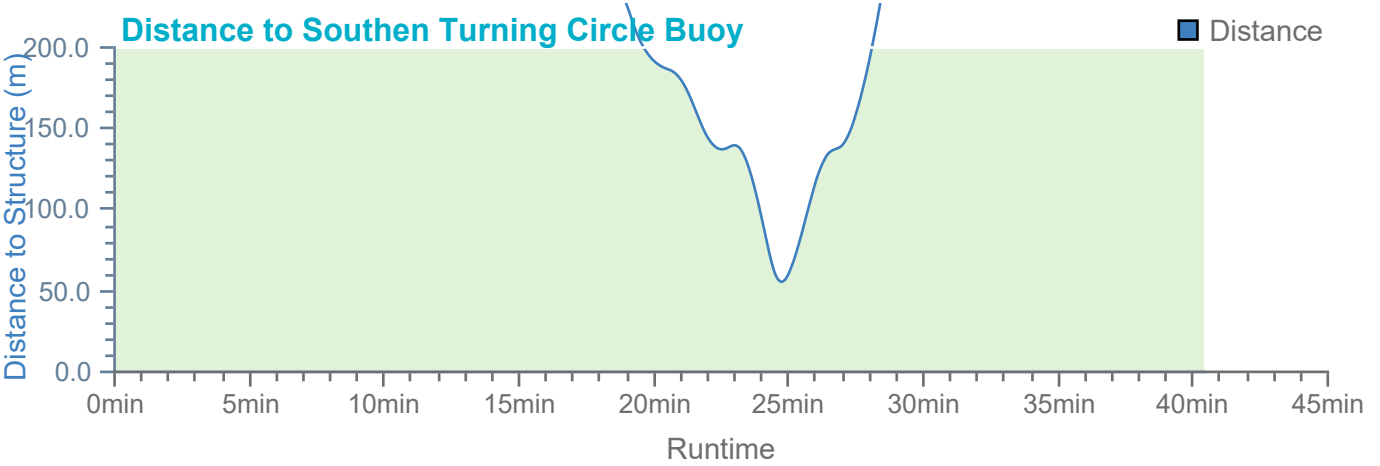
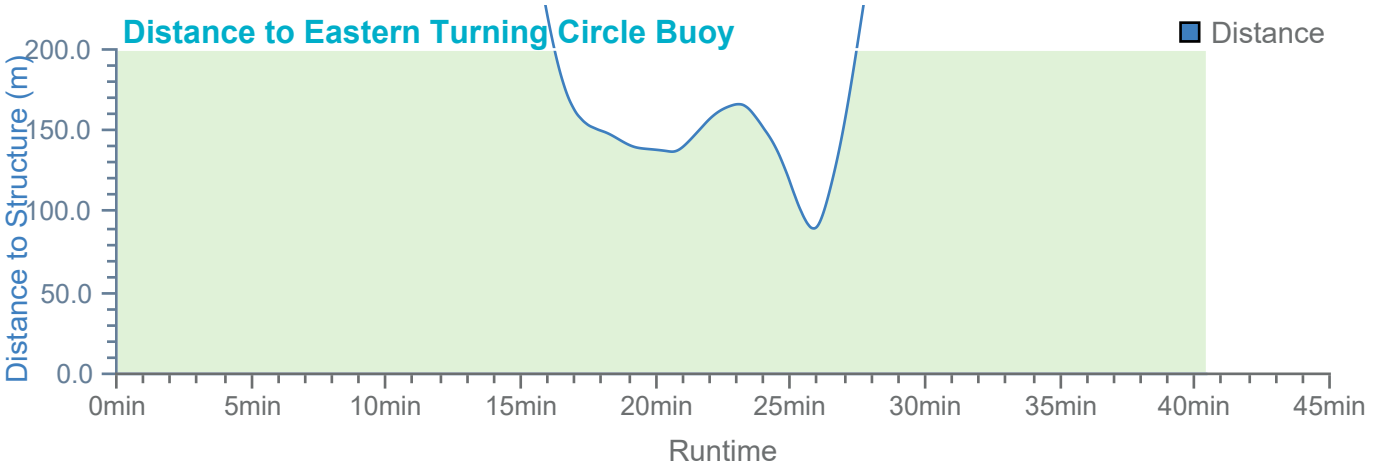
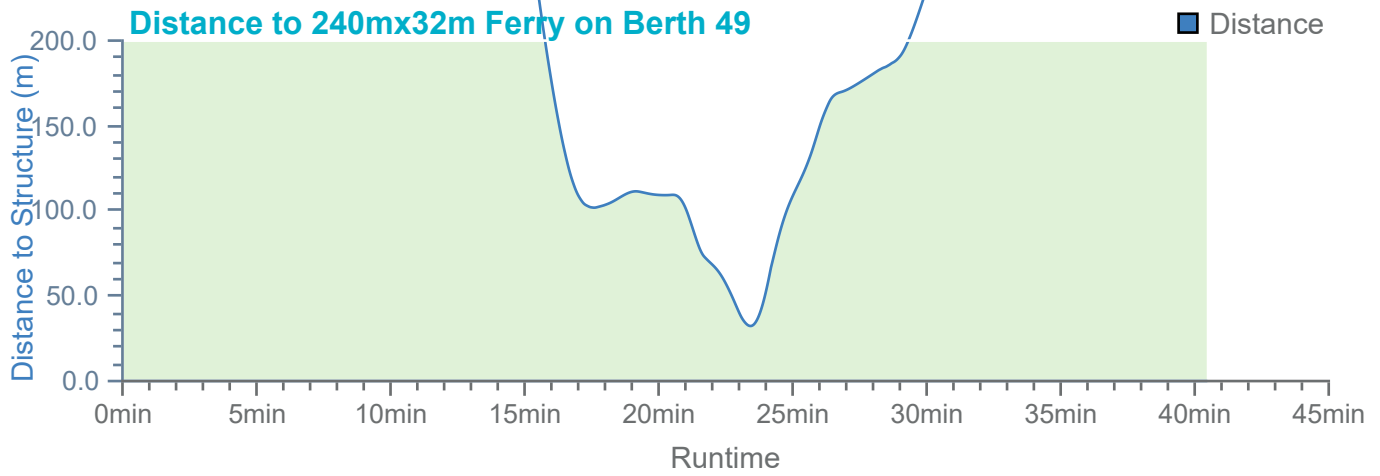
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



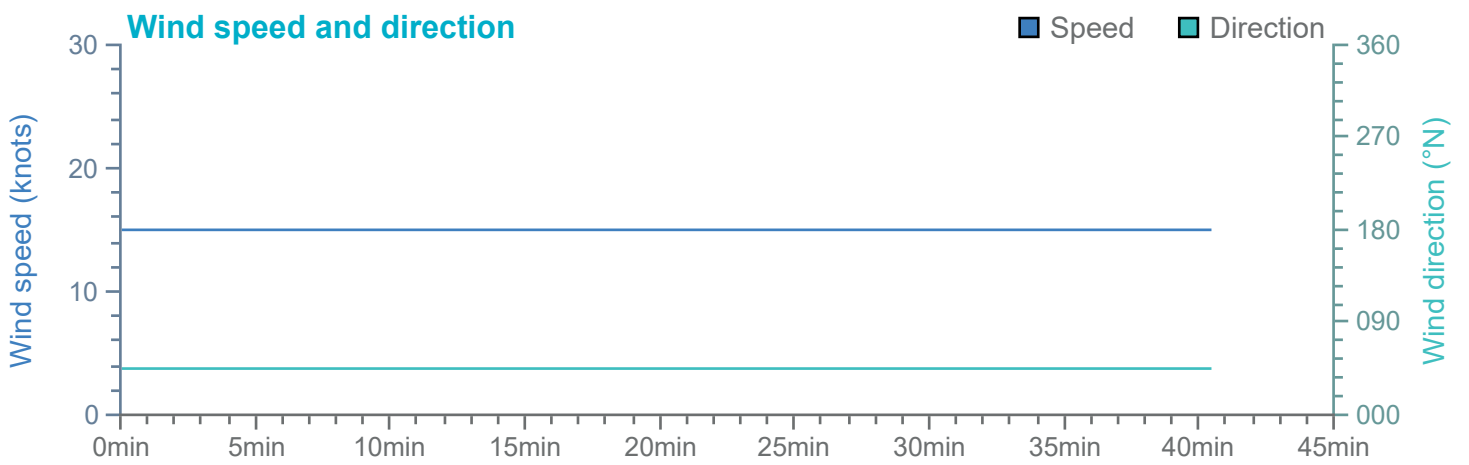
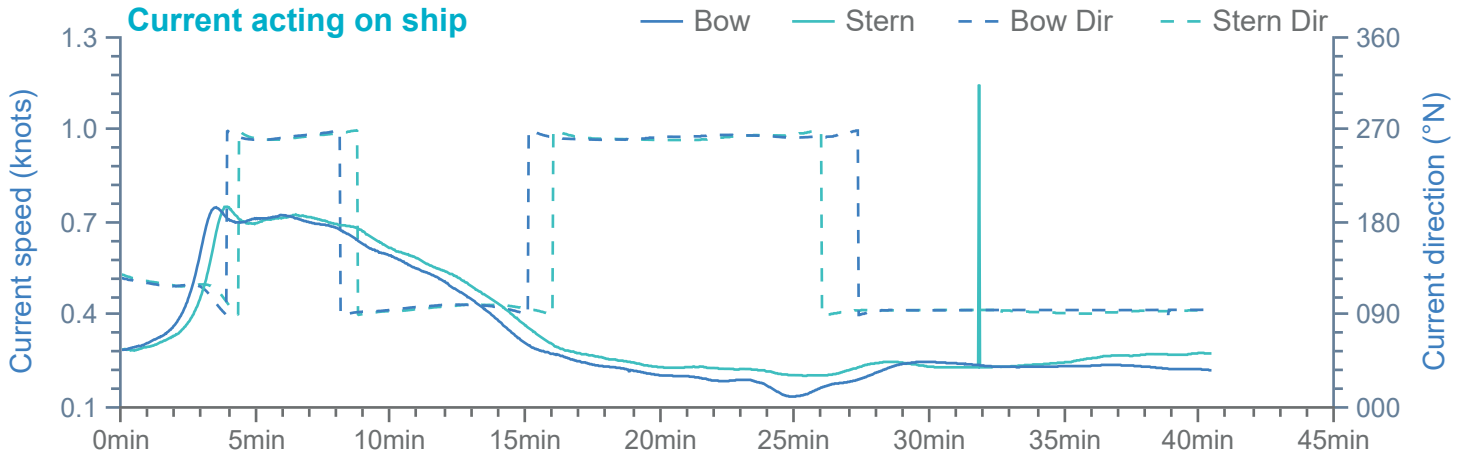


Overview

Environment

MV Celine

Thruster and engine use

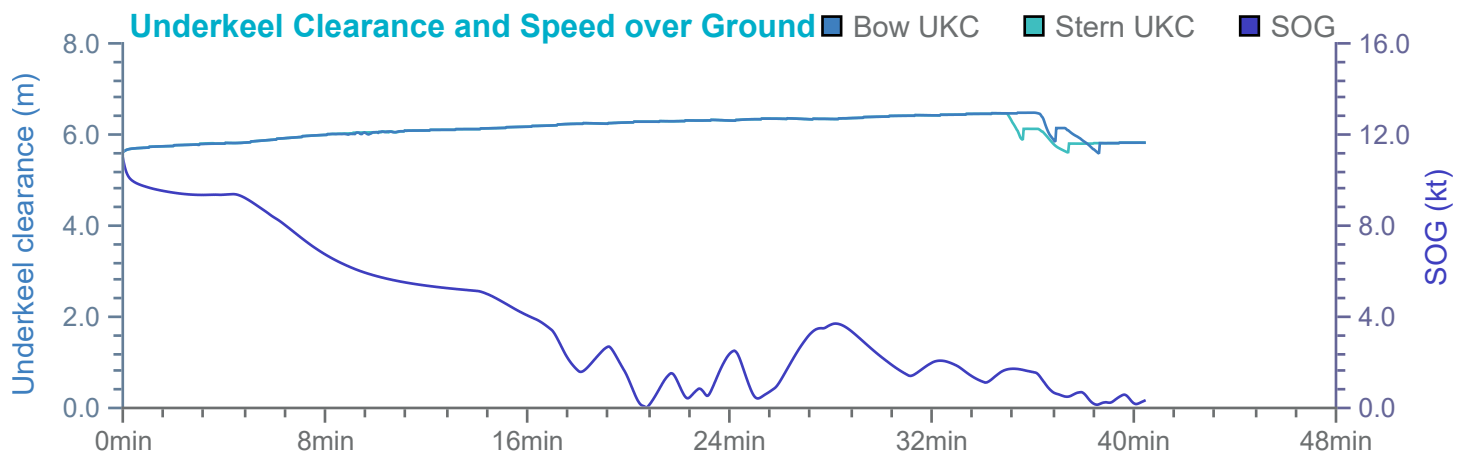
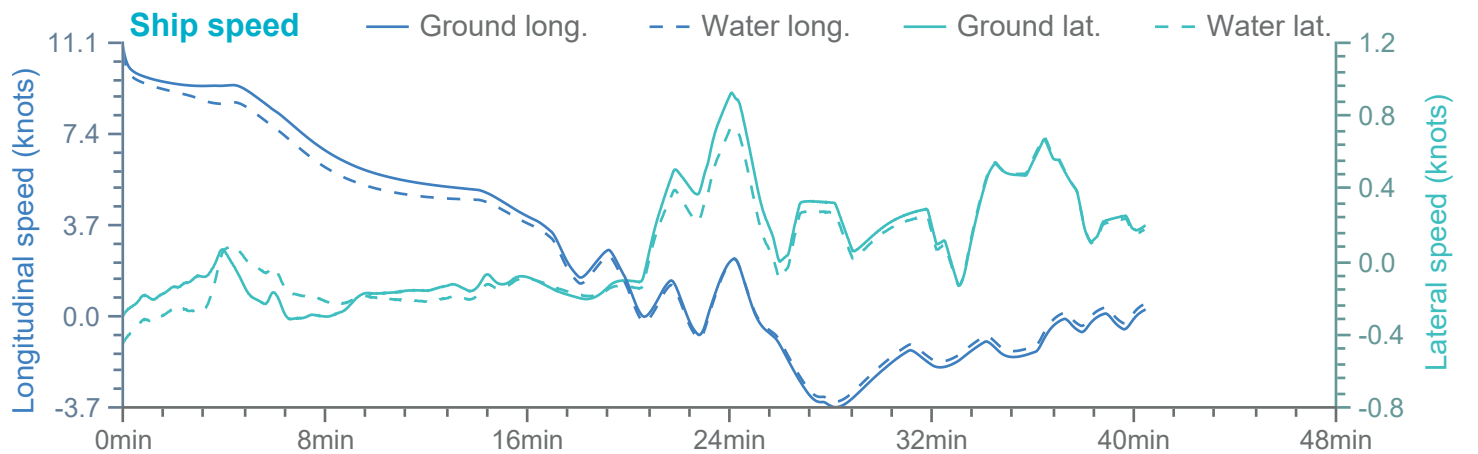
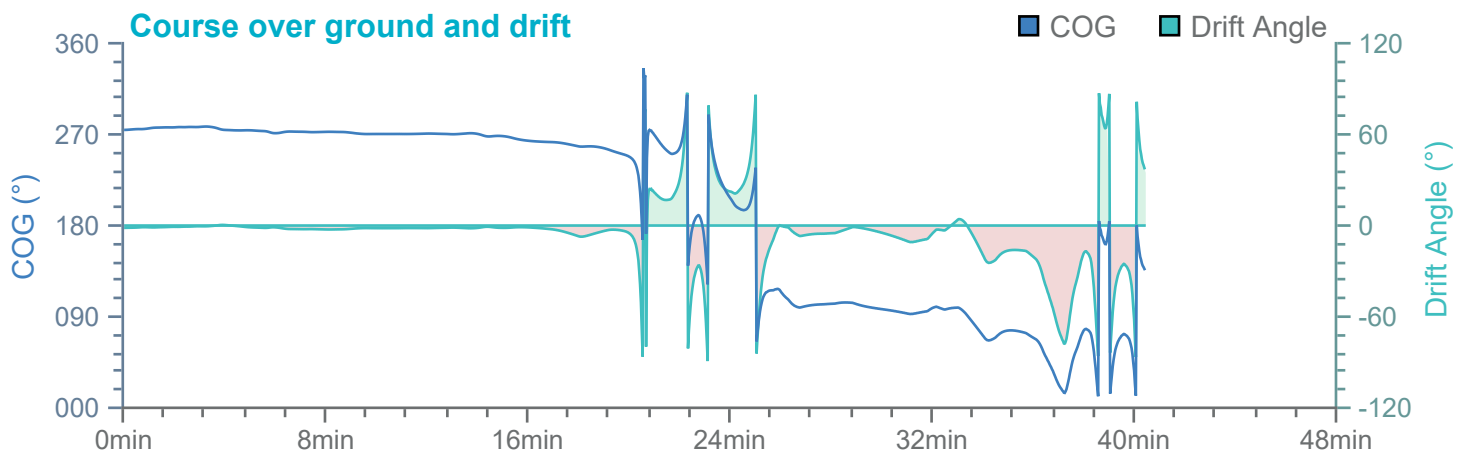
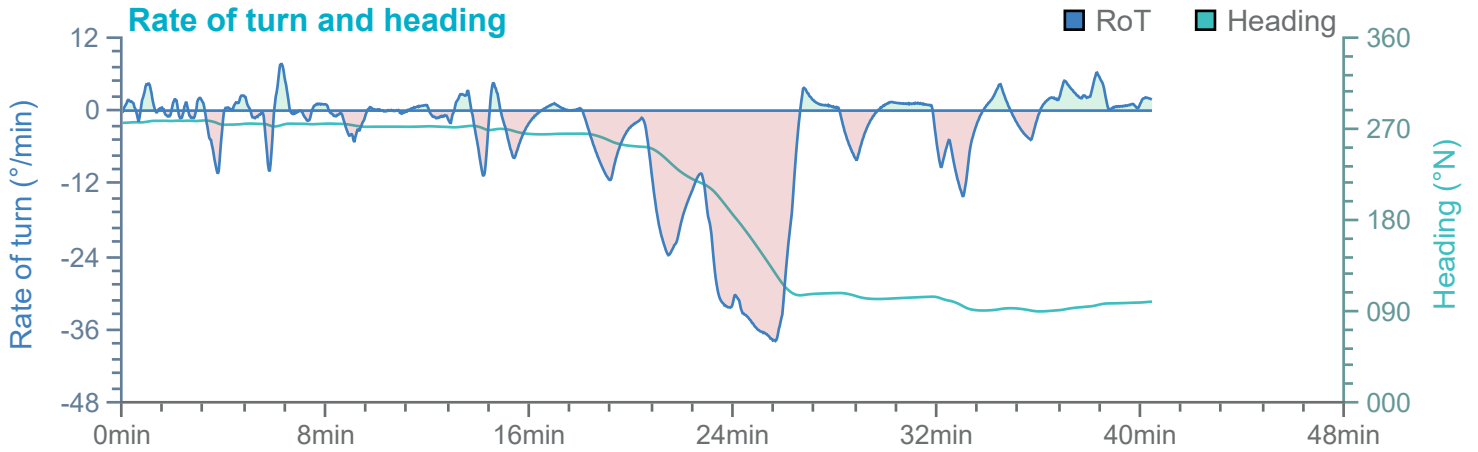


Overview

Environment

MV Celine

Thruster and engine use

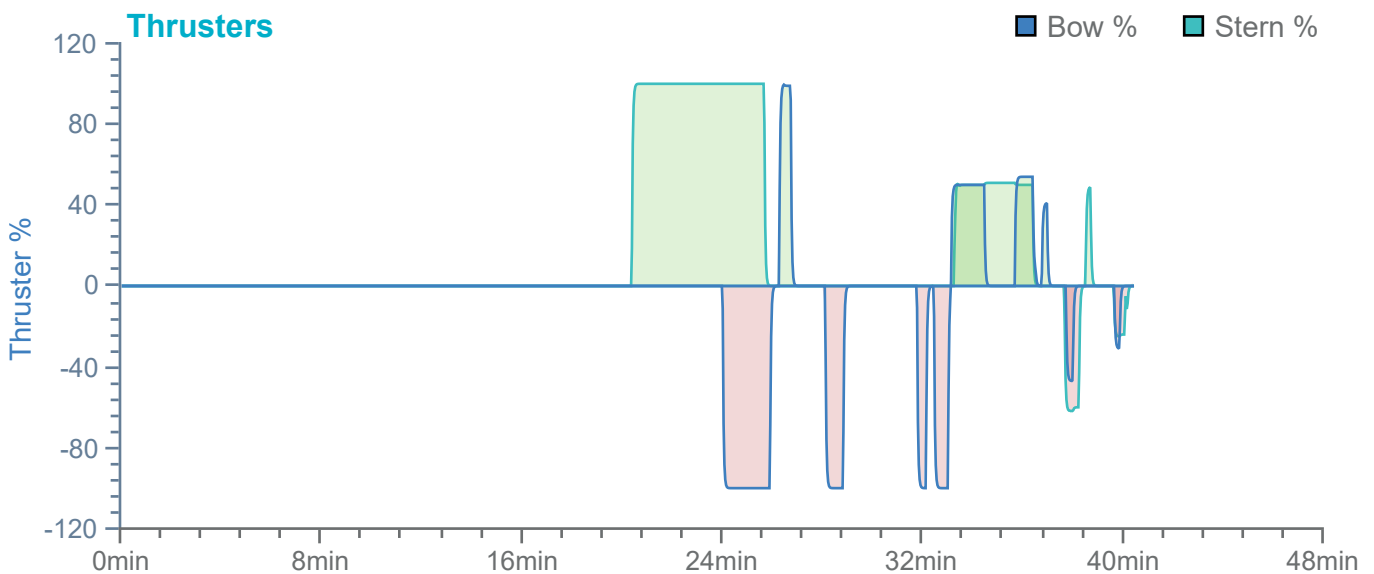
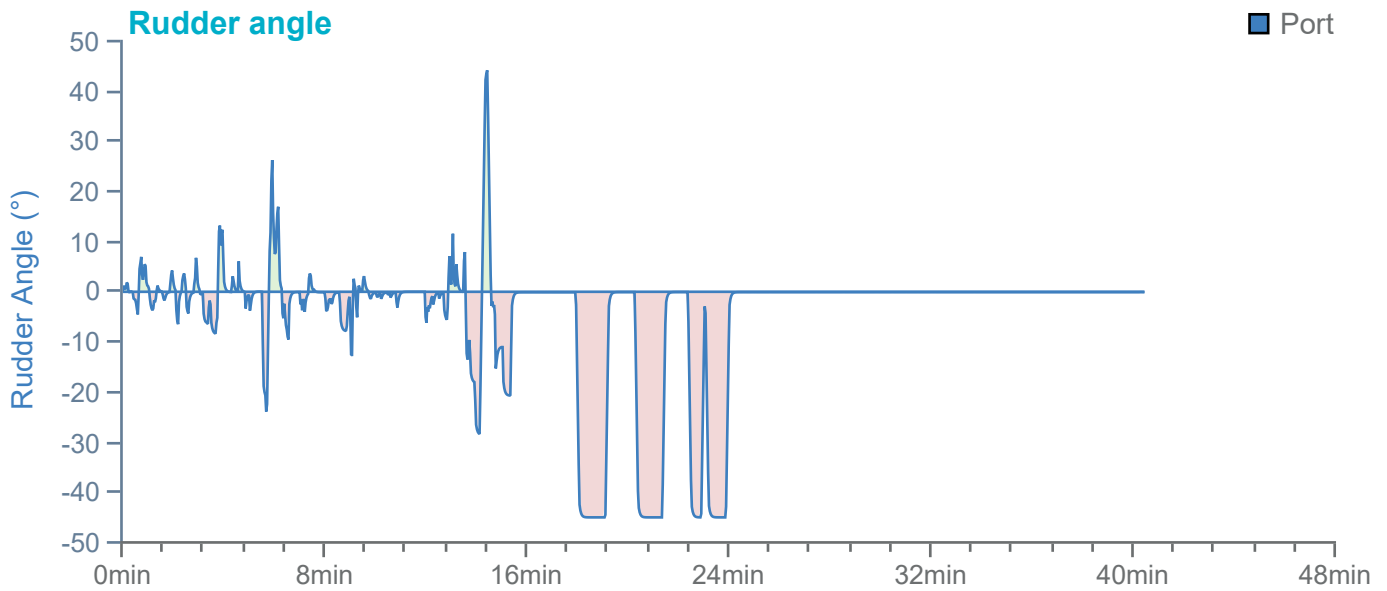
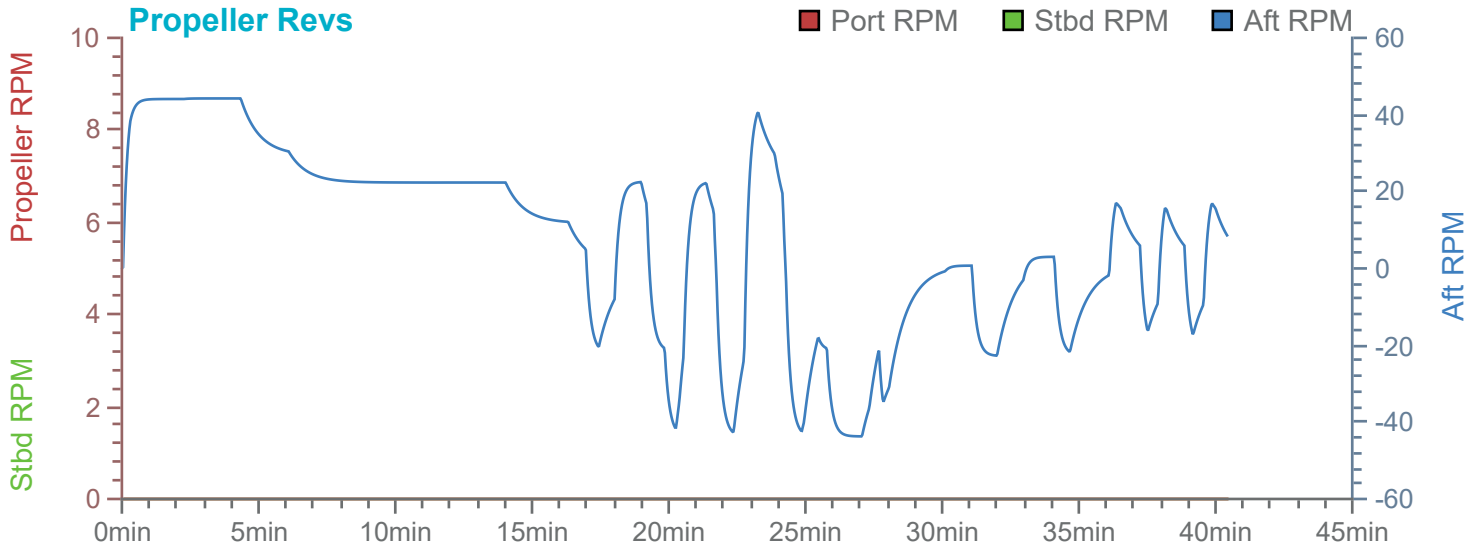


Overview

Environment

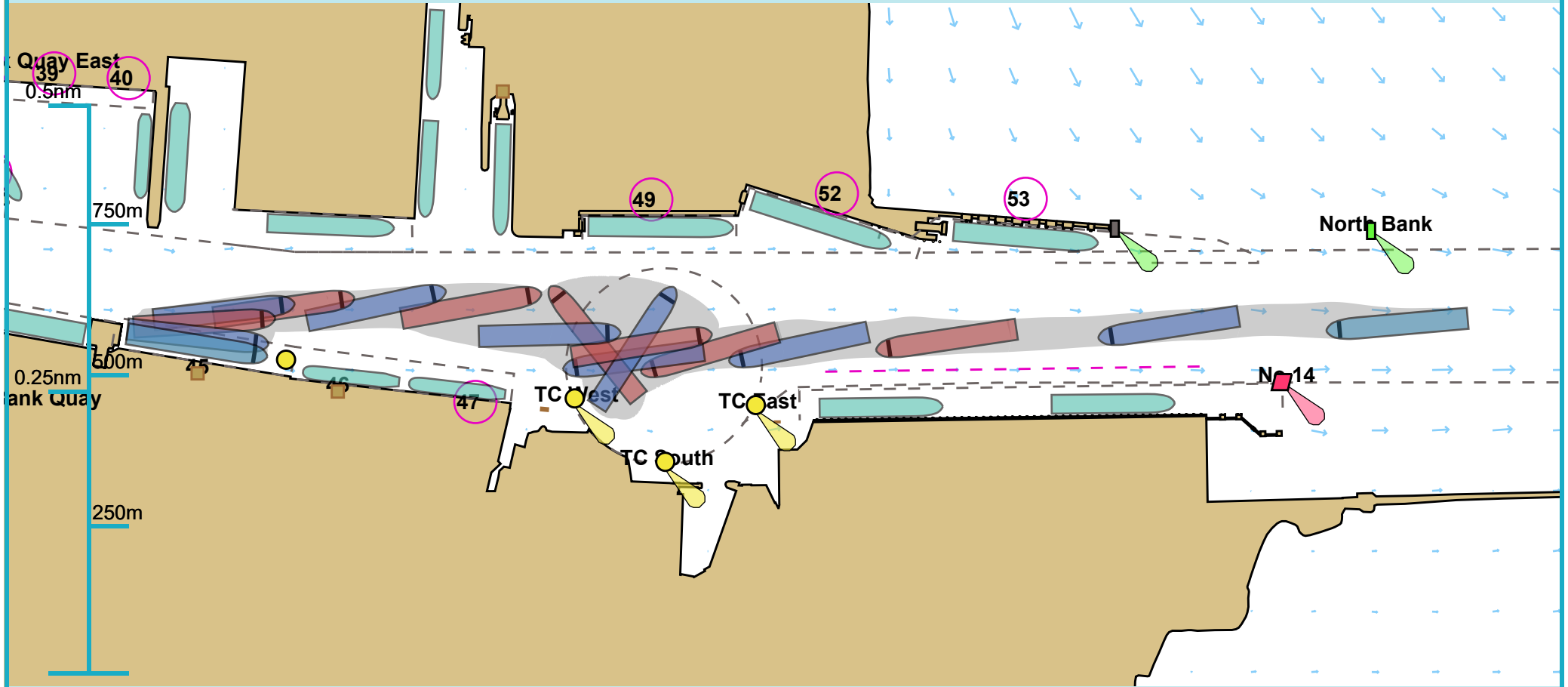
MV Celine

Thruster and engine use



Full Run Overview

53° 20.241 N, 006° 12.629 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:31 minutes

Manoeuvre:Other

Ownship(s):MV Celine

Comments:

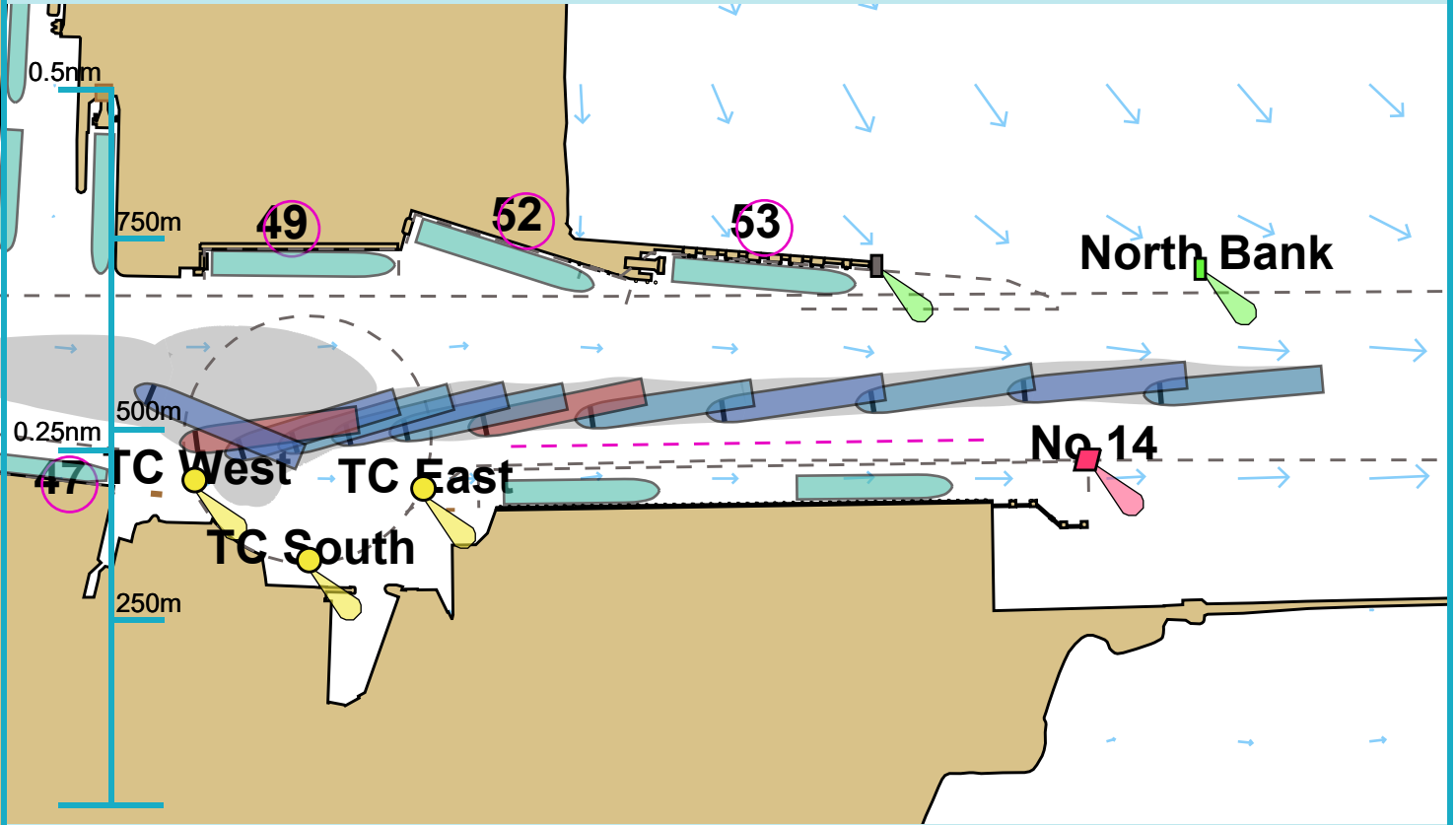
Overview

Environment

MV Celine

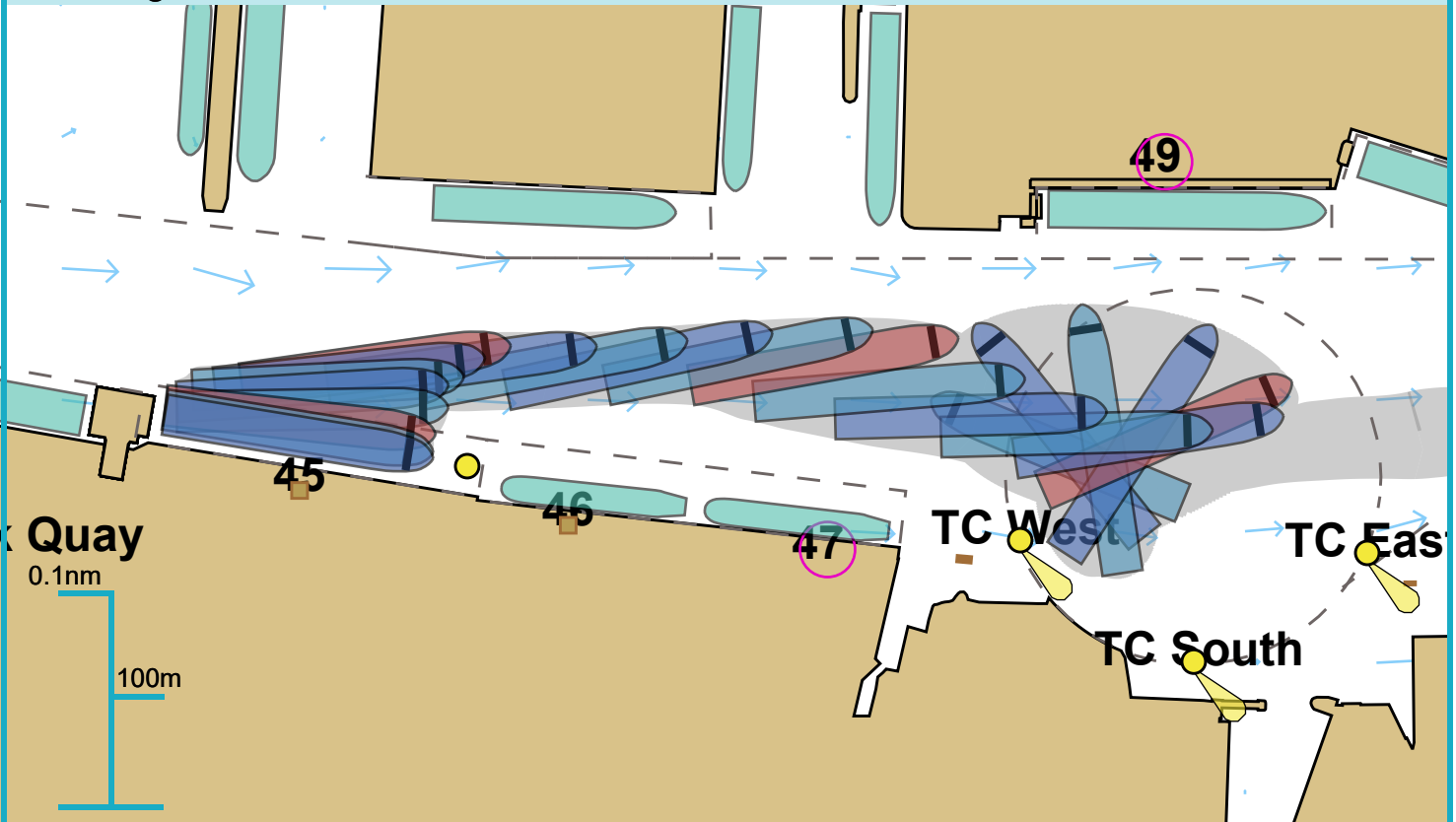
Thruster and engine use

Approach



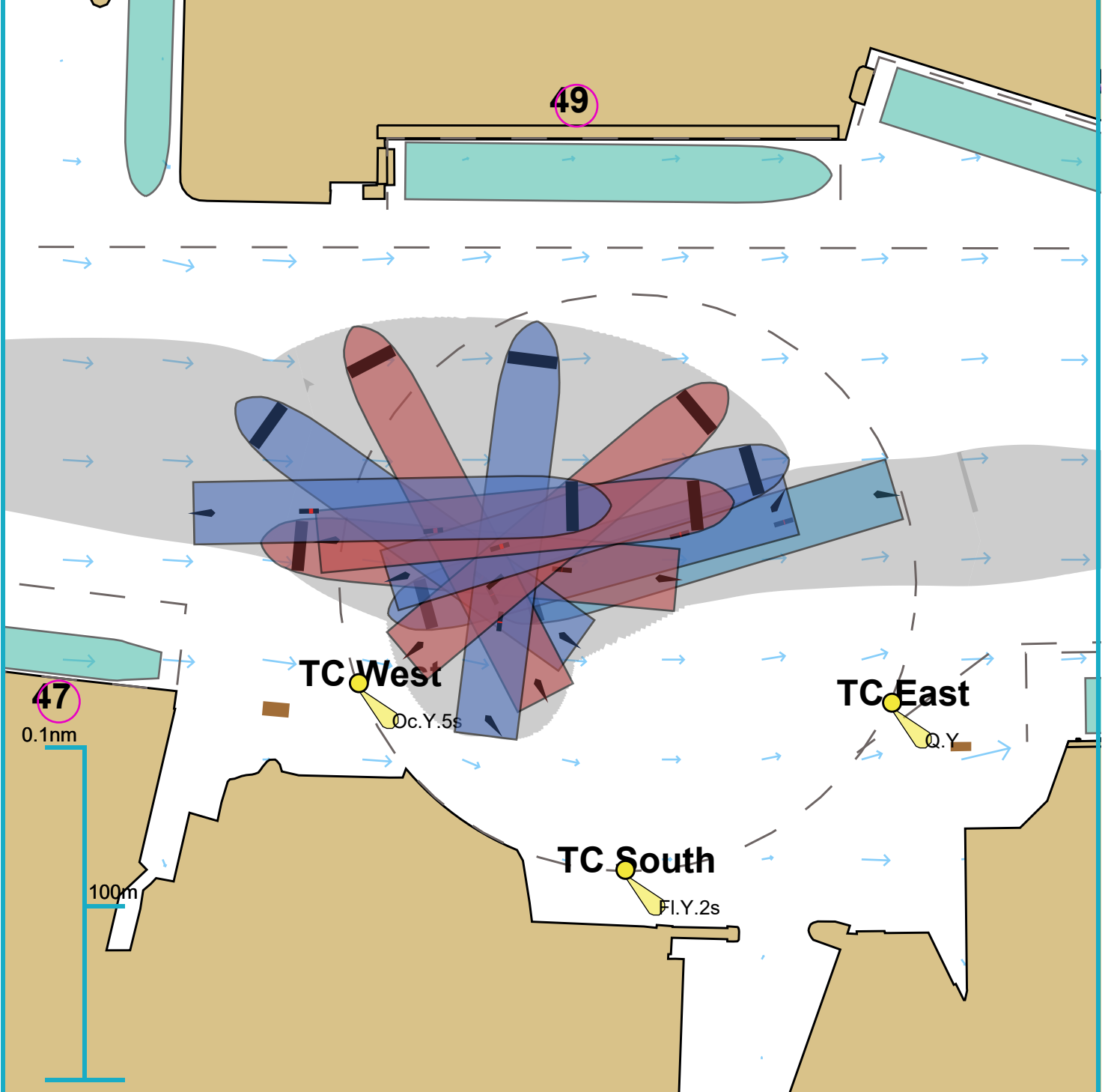
Ships plotted every 1 mins, highlight every 5 mins

Berthing

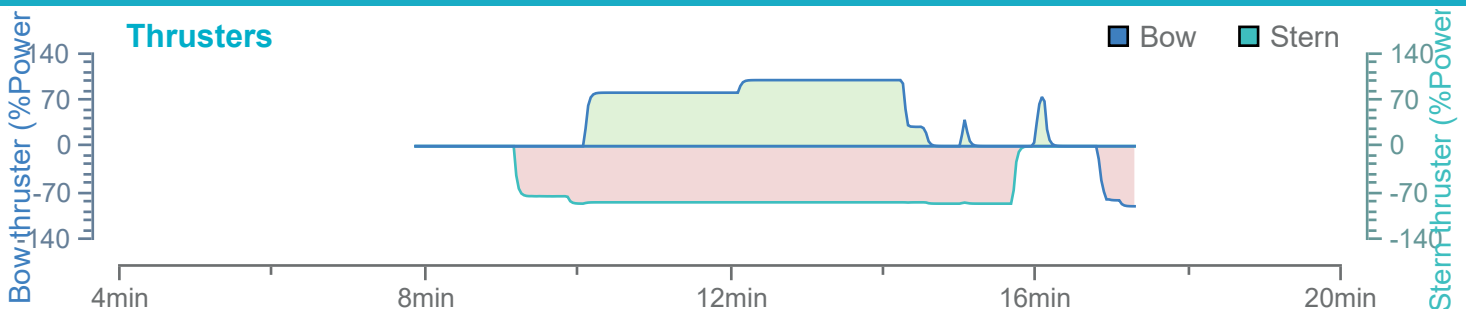


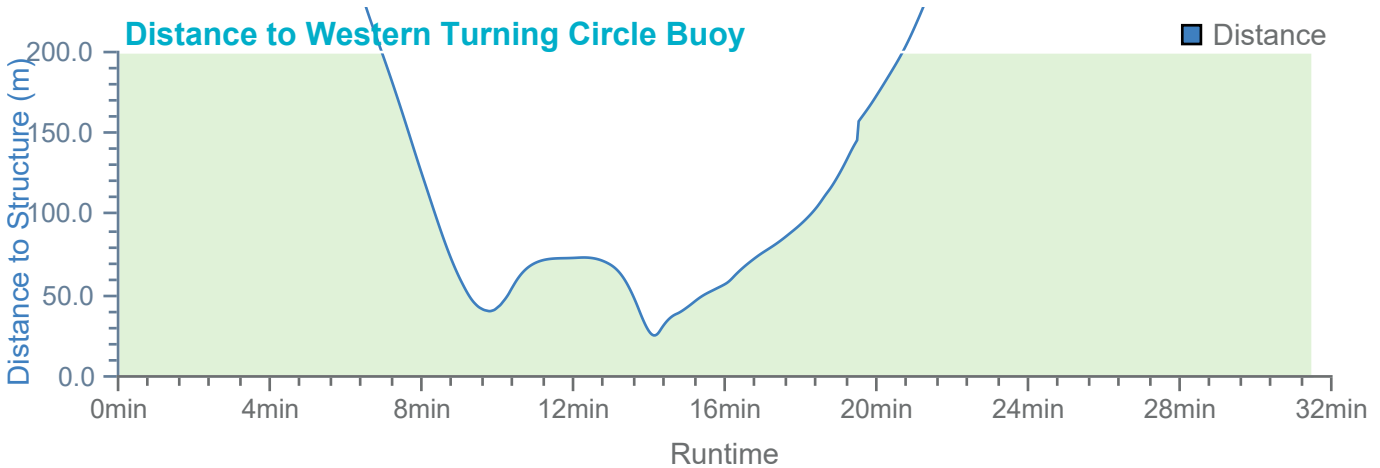
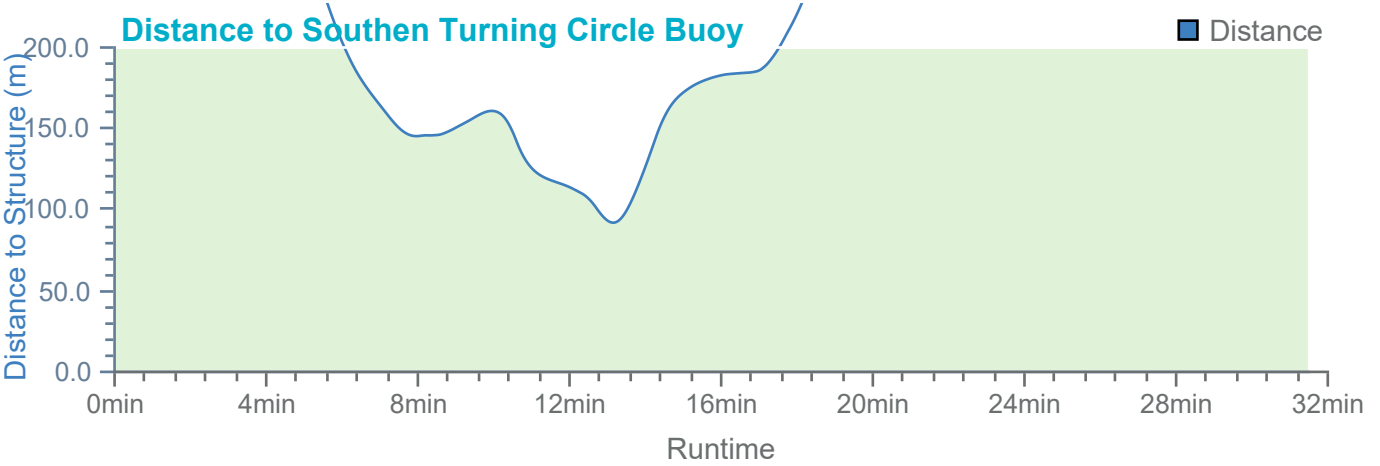
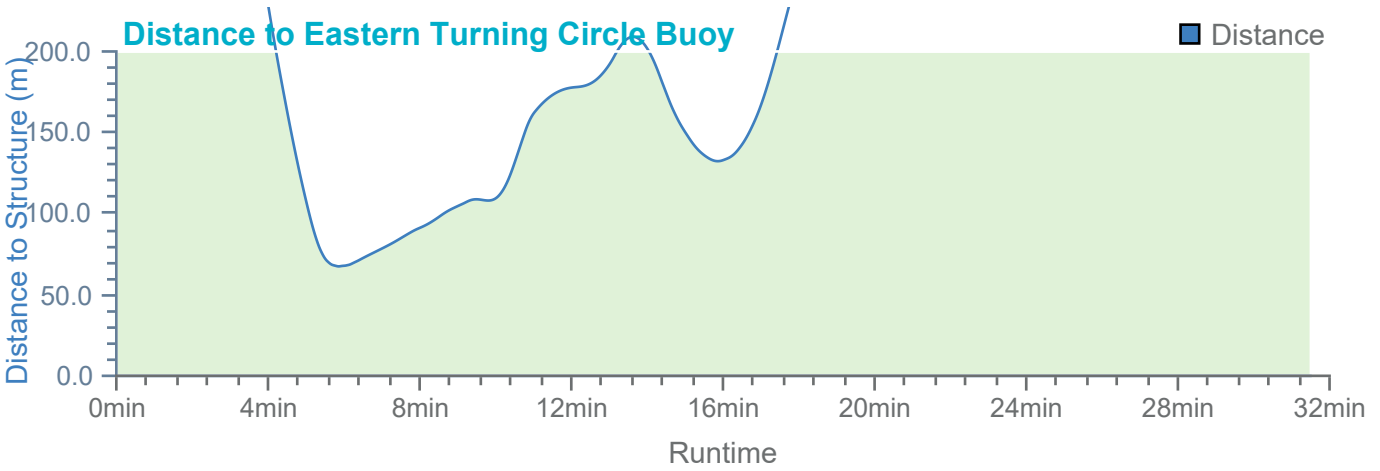
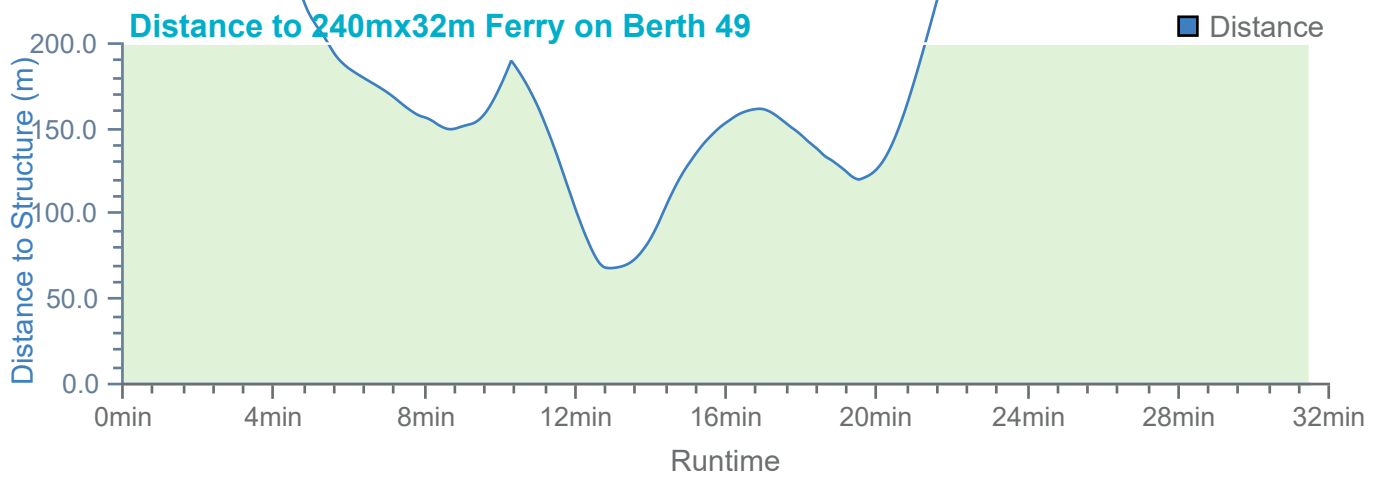
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



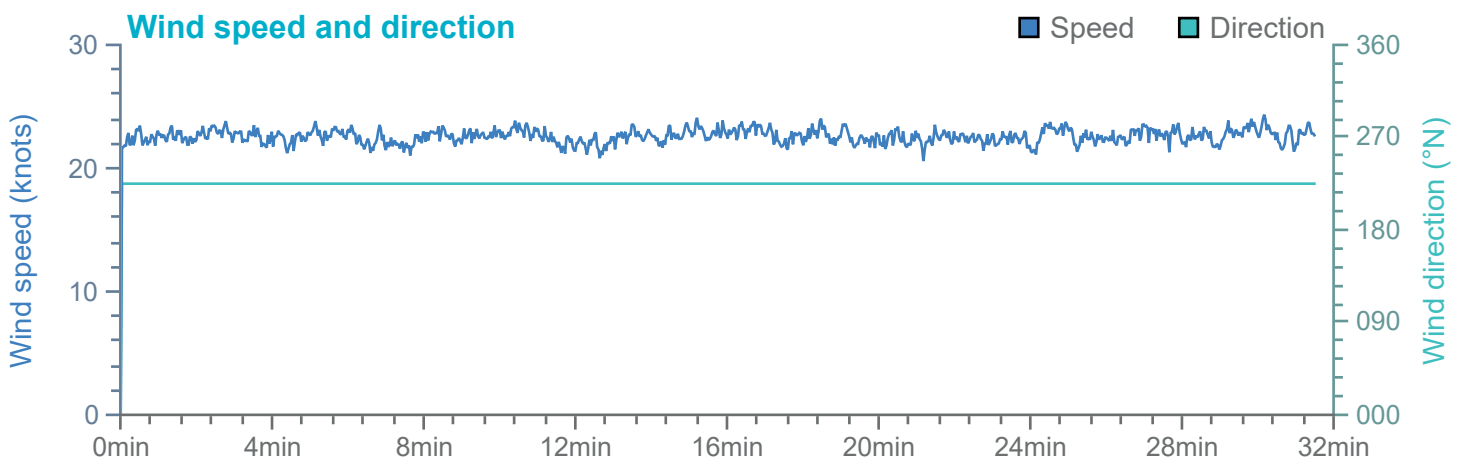
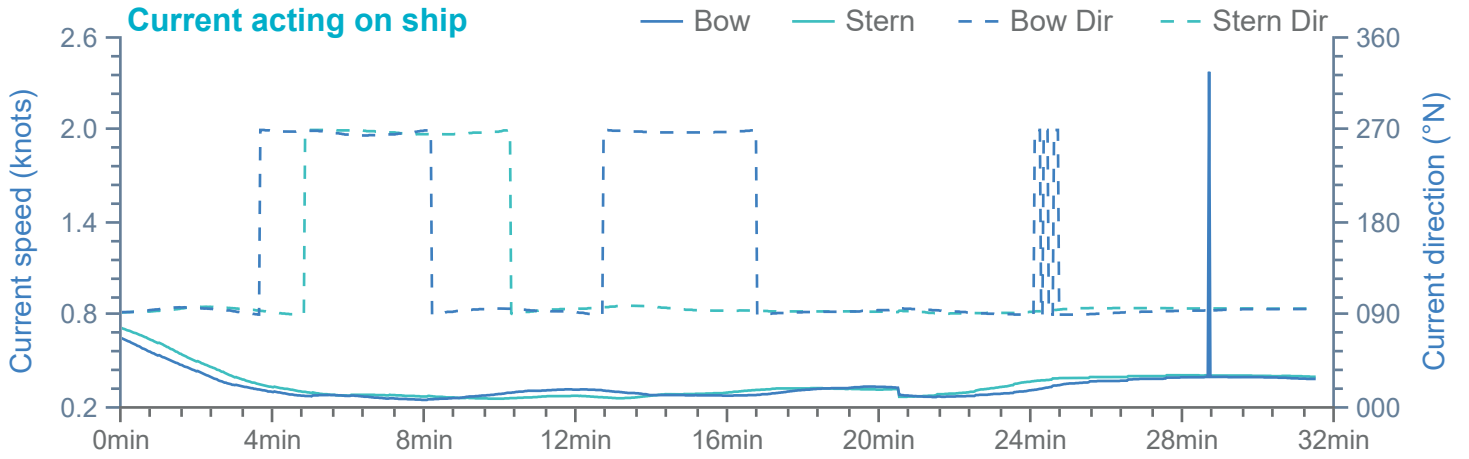


Overview

Environment

MV Celine

Thruster and engine use

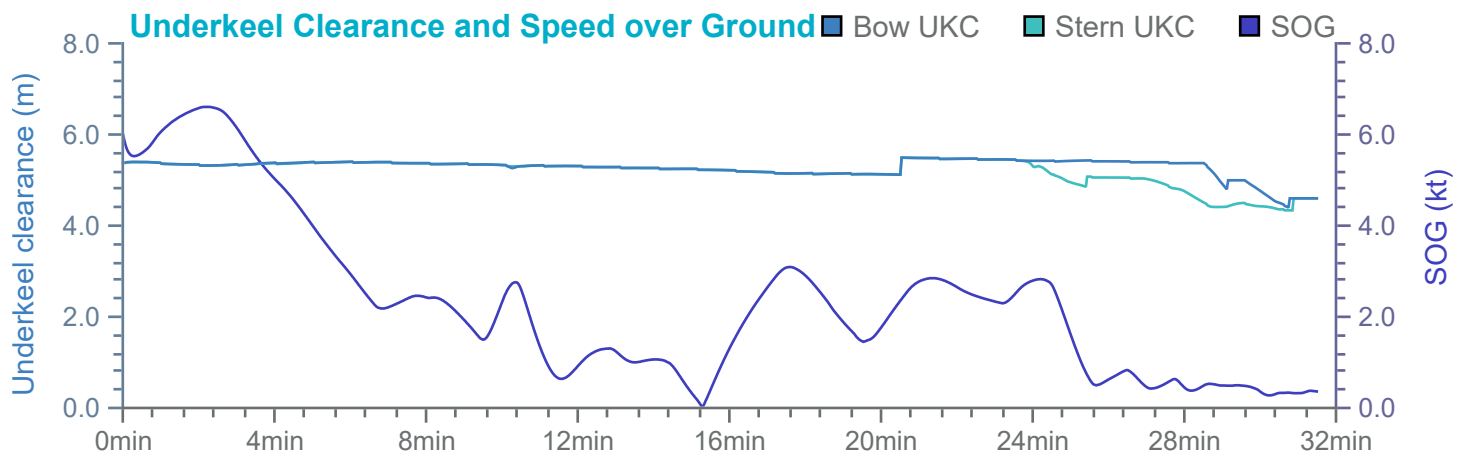
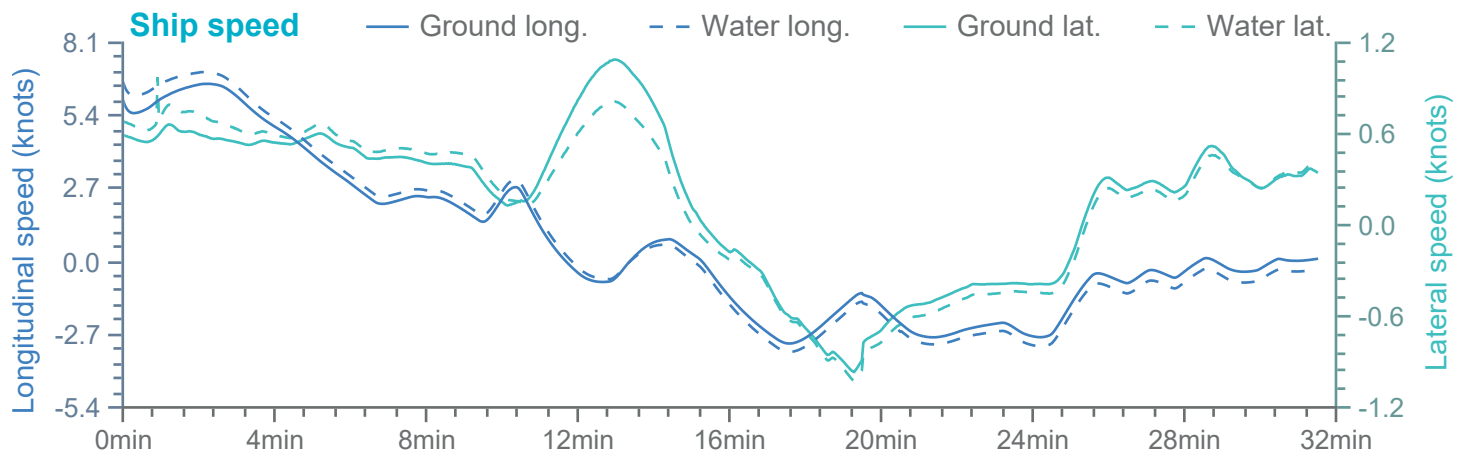
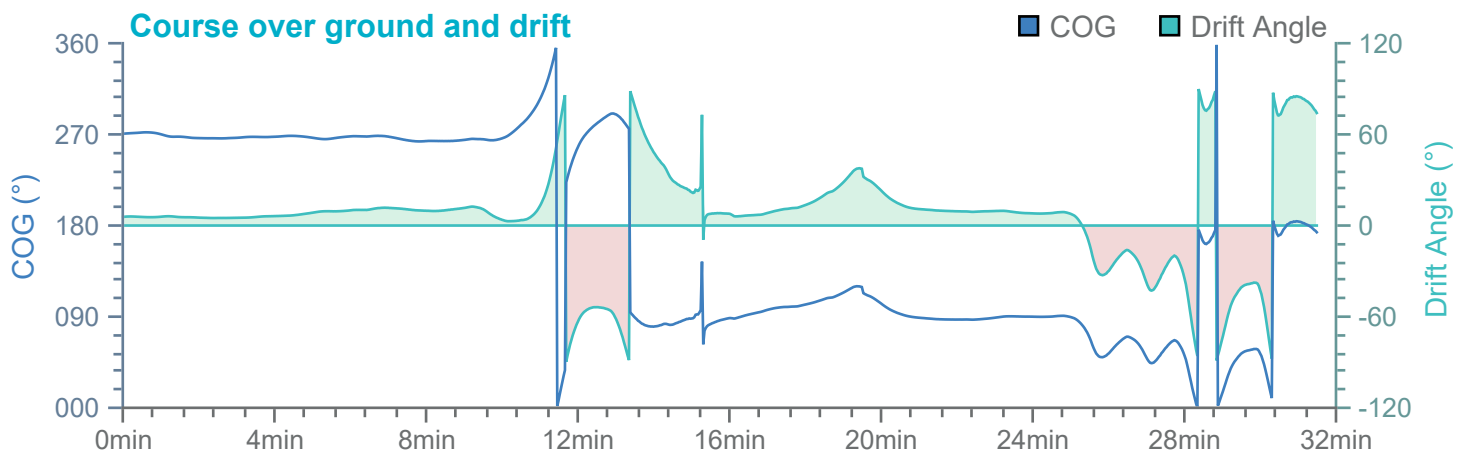
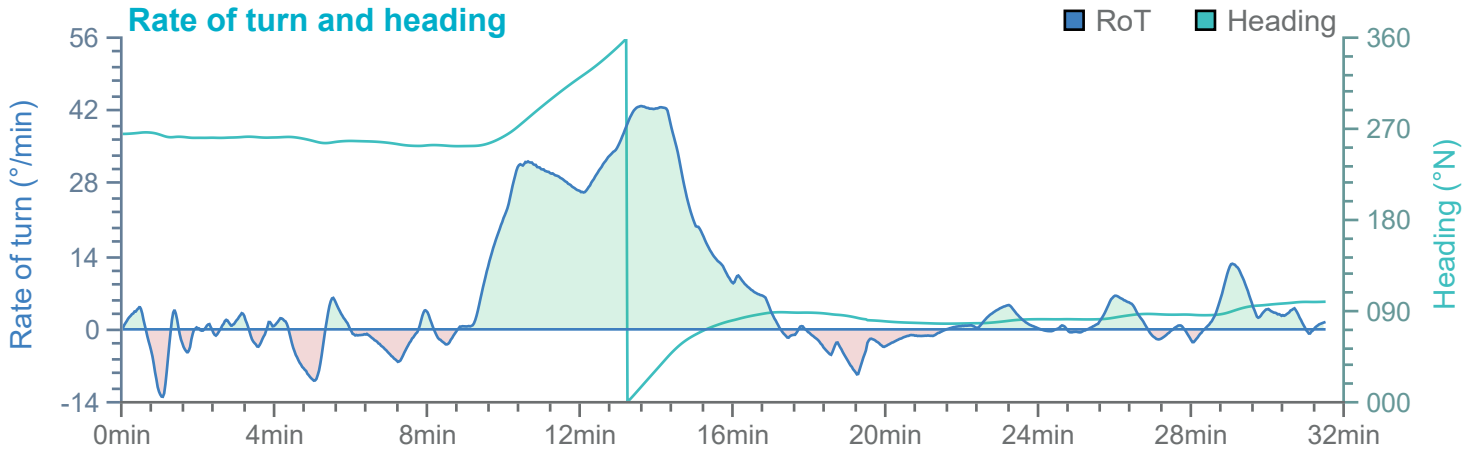


Overview

Environment

MV Celine

Thruster and engine use

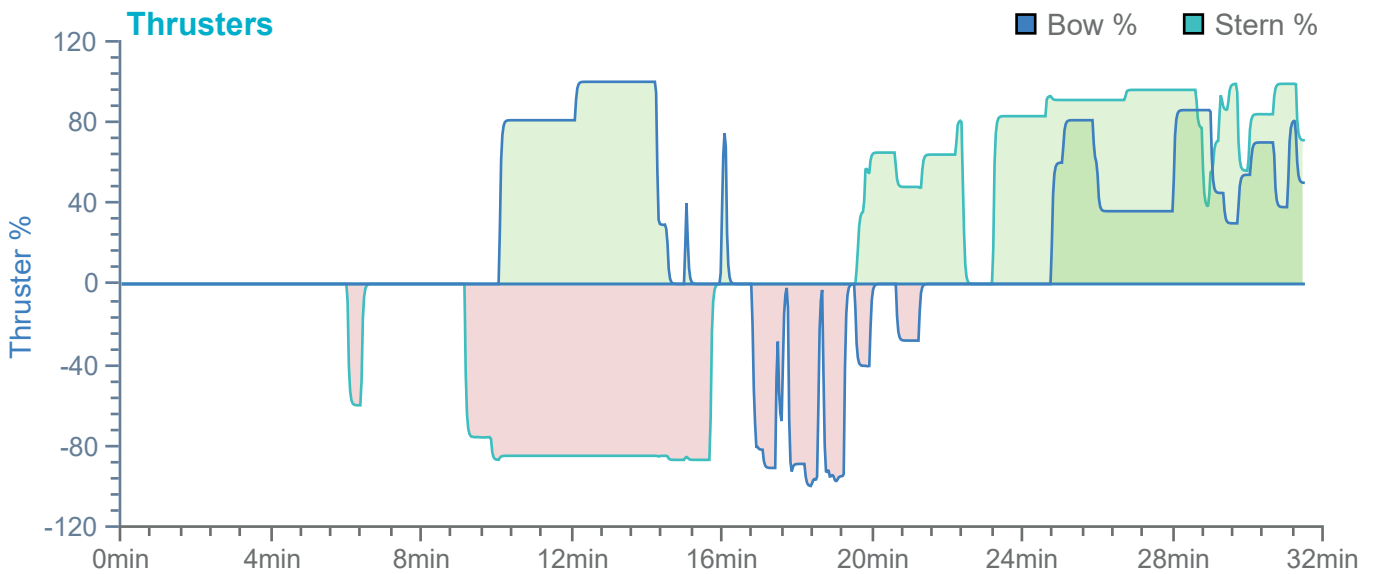
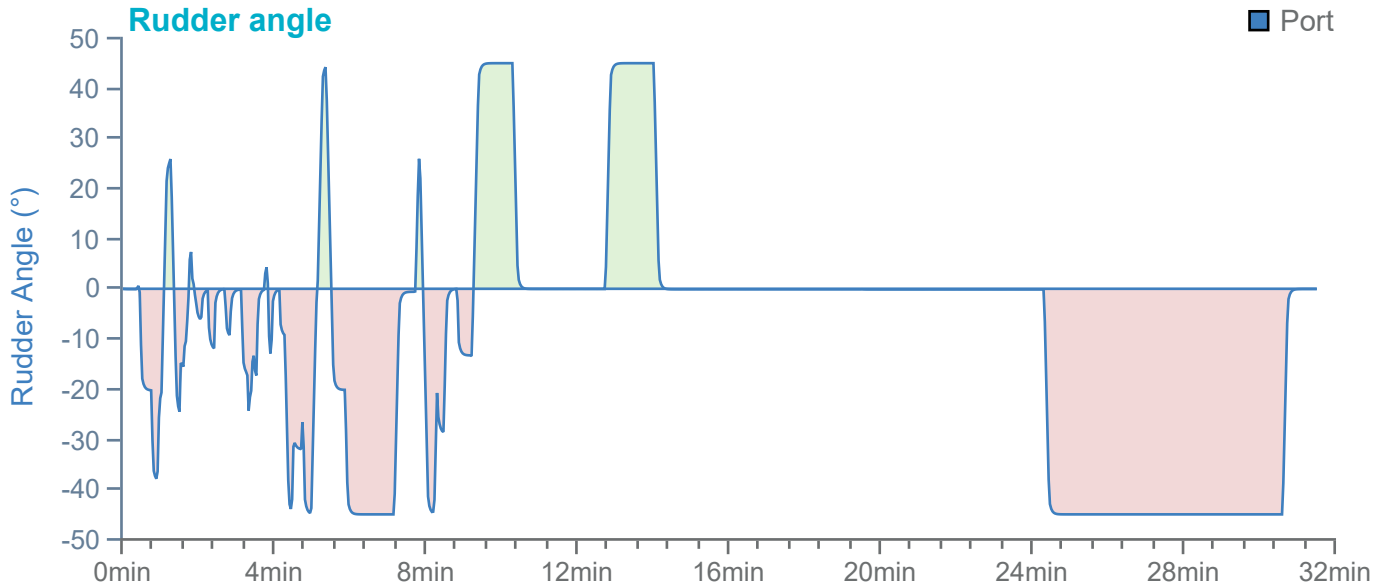
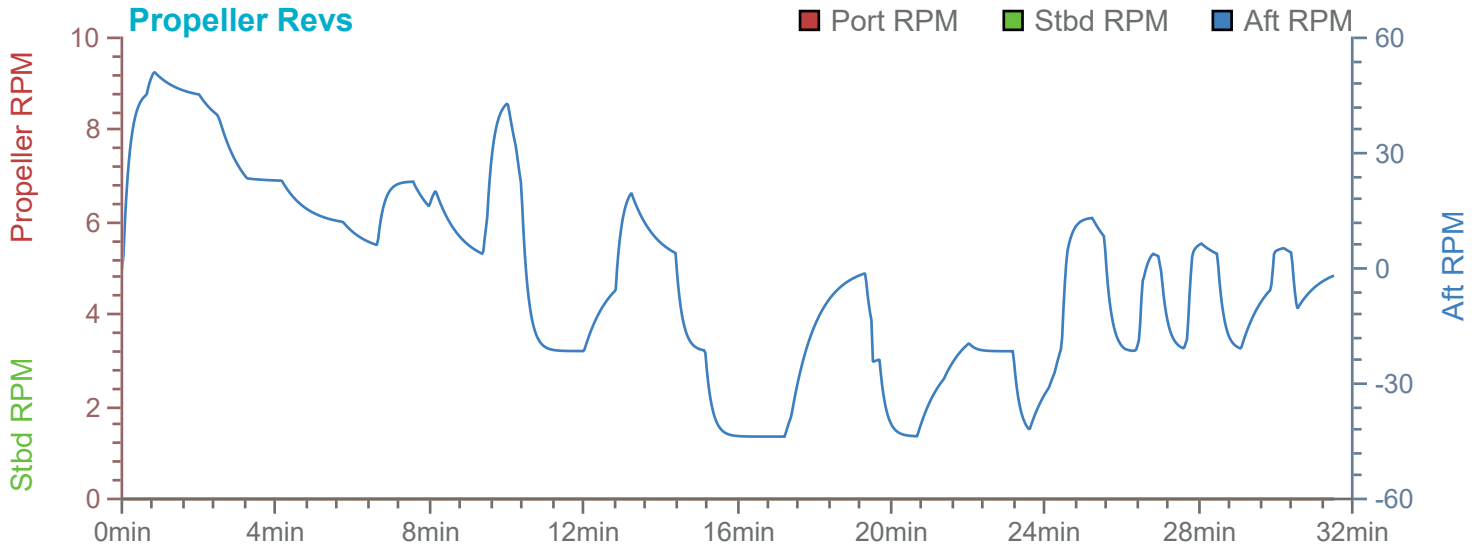


Overview

Environment

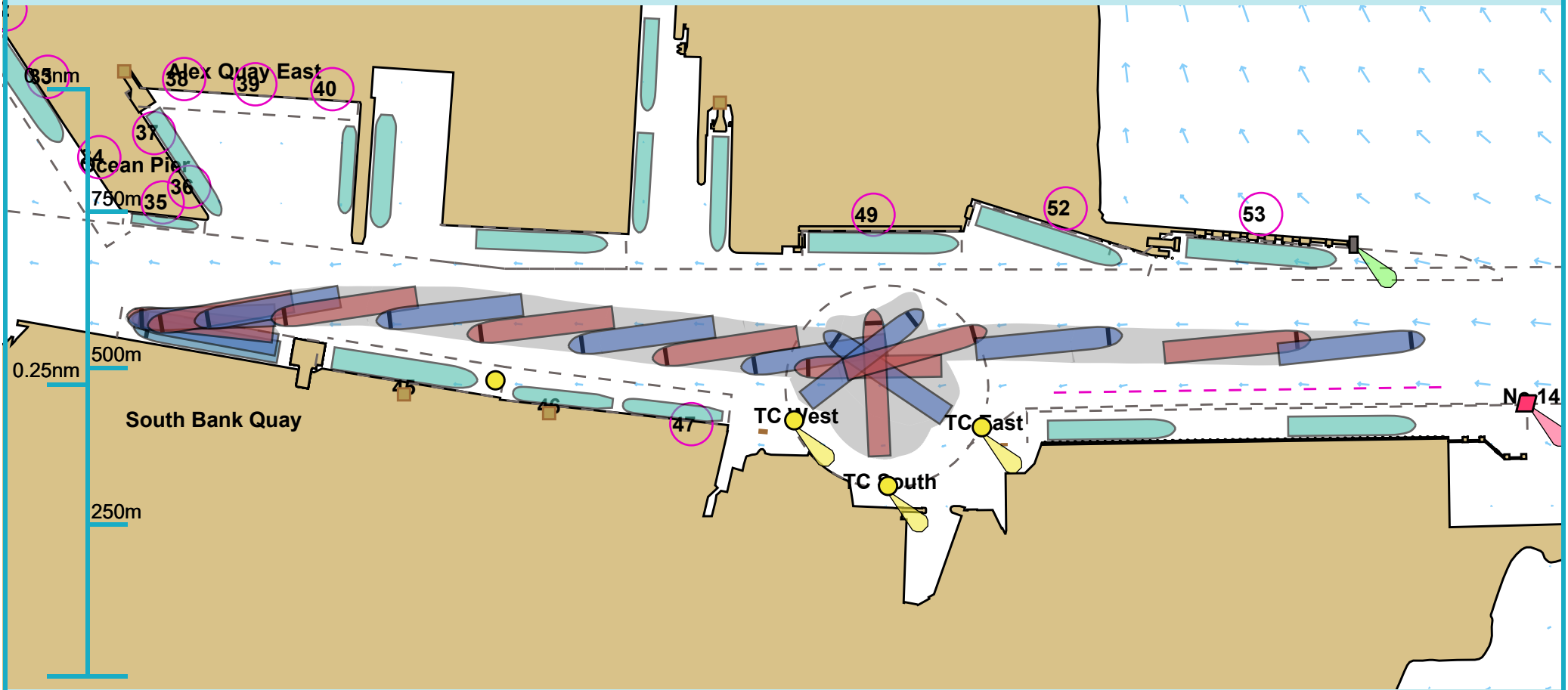
MV Celine

Thruster and engine use



Full Run Overview

53° 20.267 N, 006° 12.918 W



Ships plotted every 2 mins, highlight every 4 mins

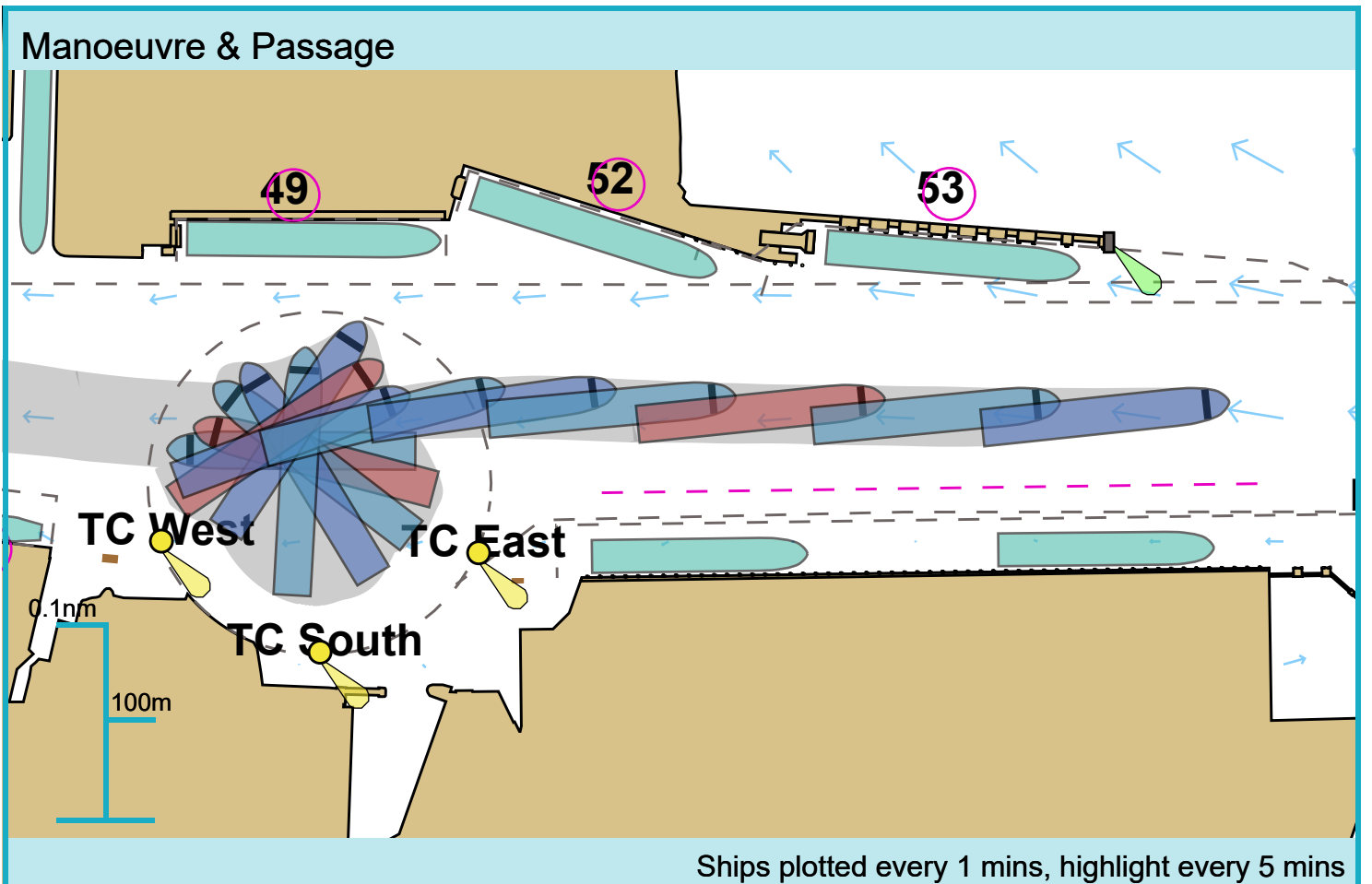
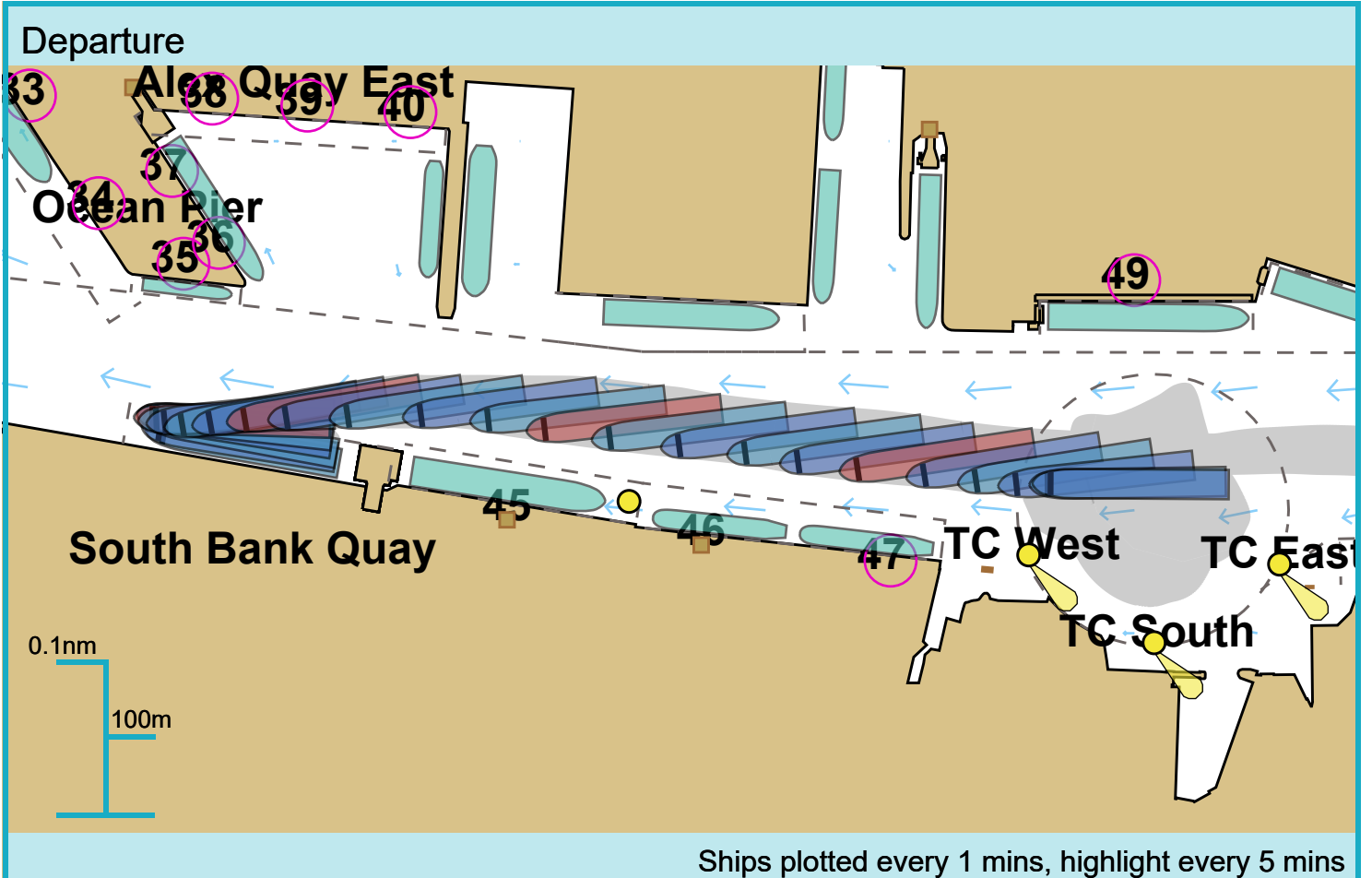
Pilot: IL

Run length: 37 minutes

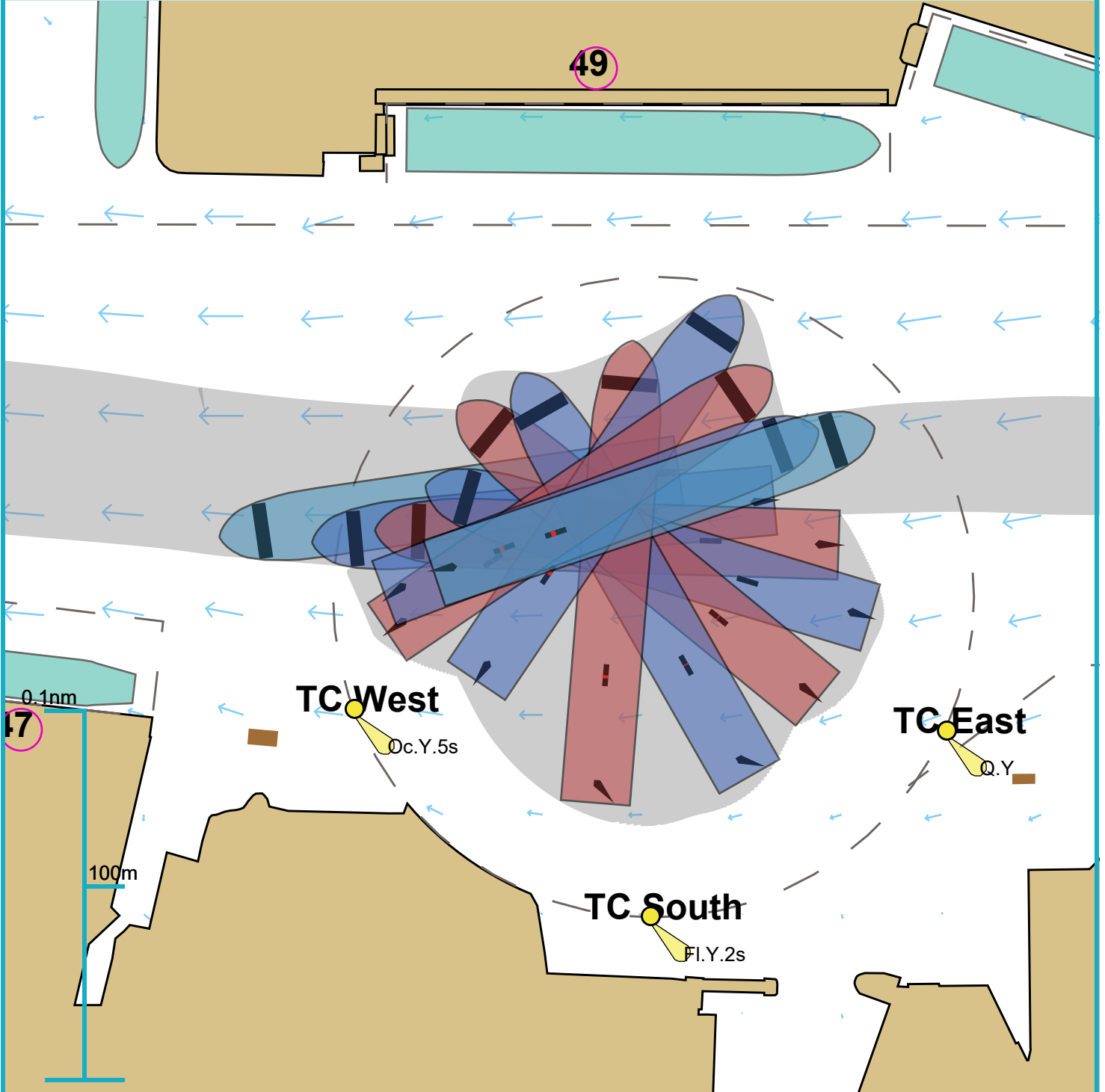
Manoeuvre: Other

Ownship(s): MV Celine

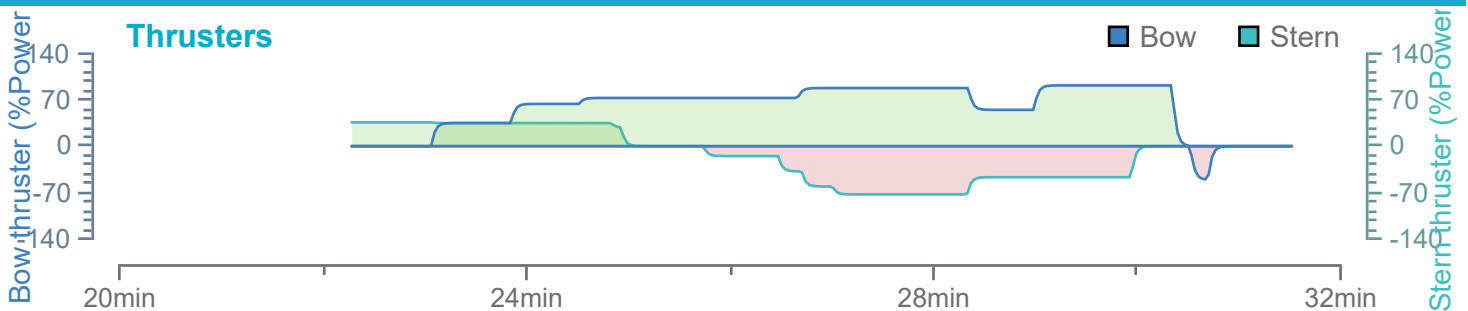
Comments:



Swing



Ships plotted every 59 seconds, highlight every 2 mins

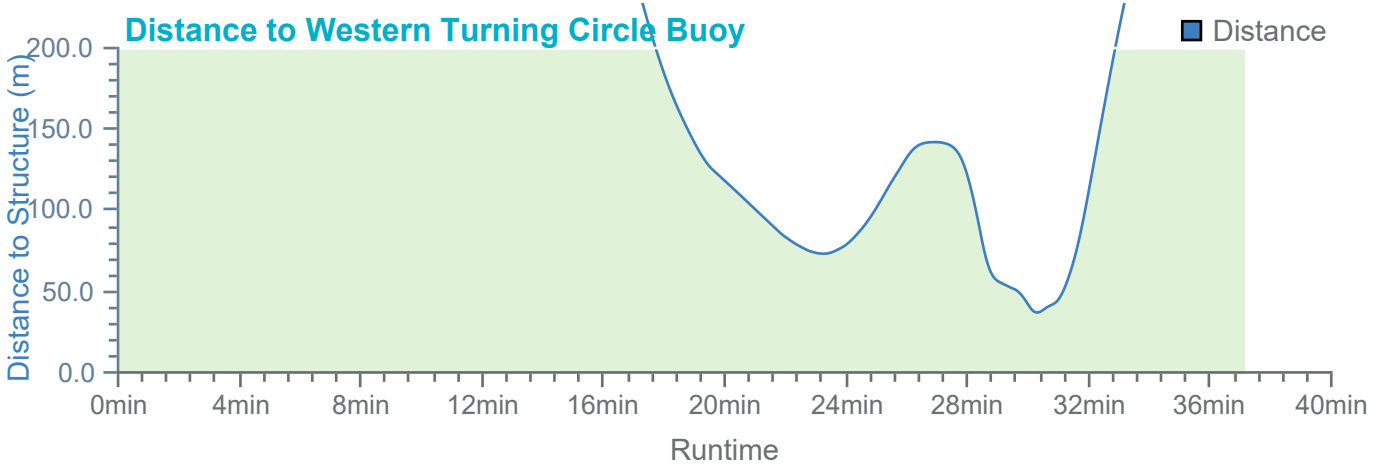
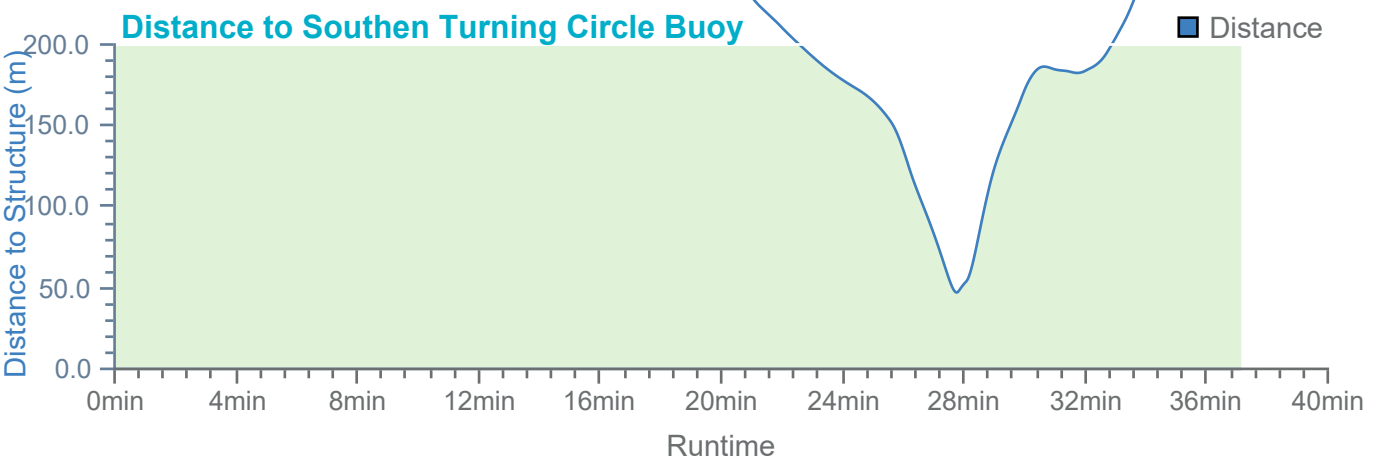
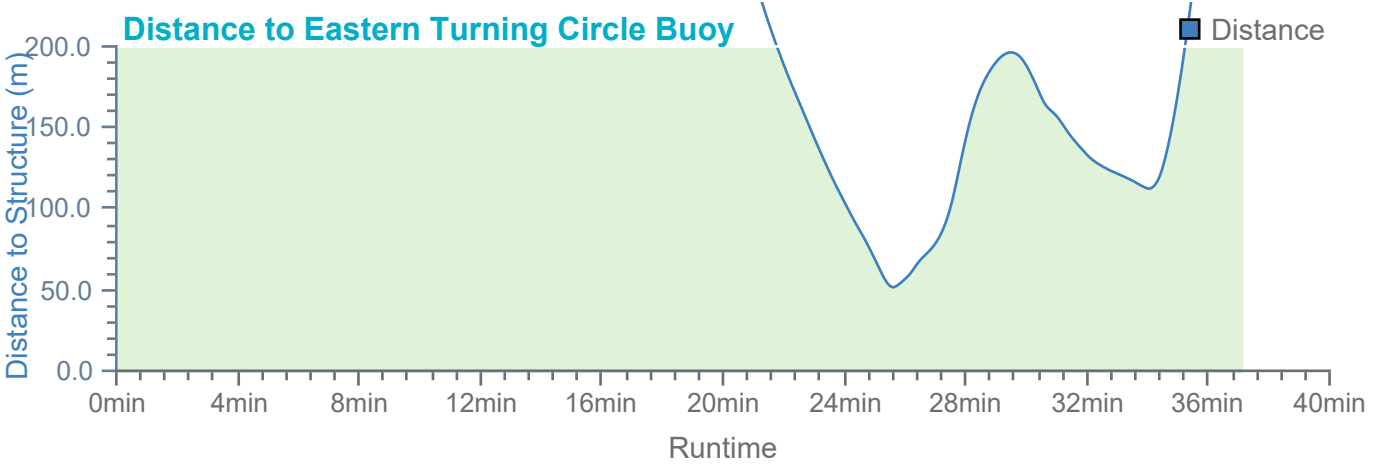
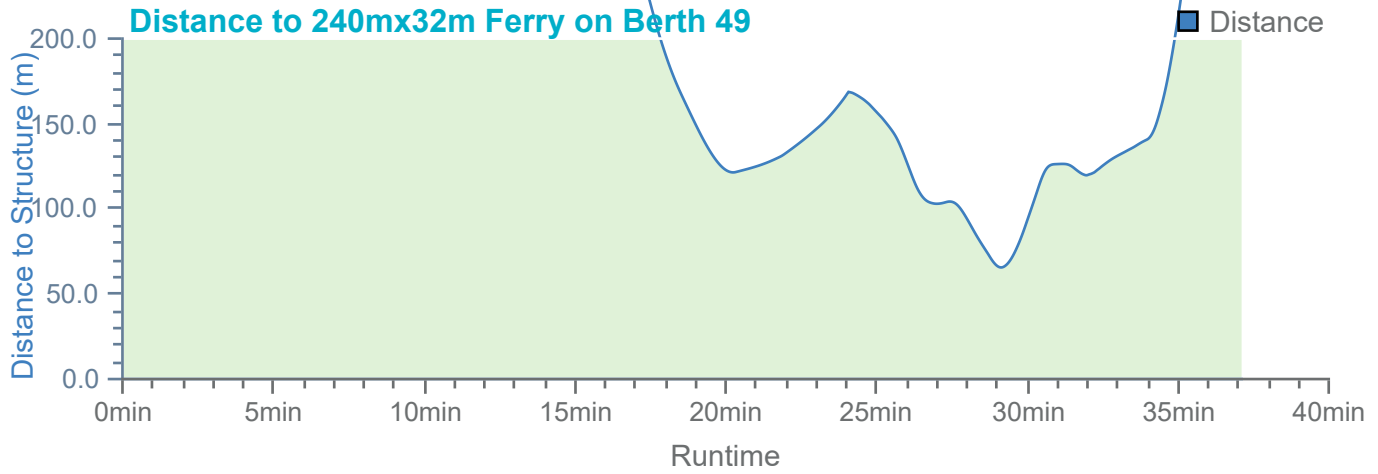


Overview

Environment

MV Celine

Thruster and engine use

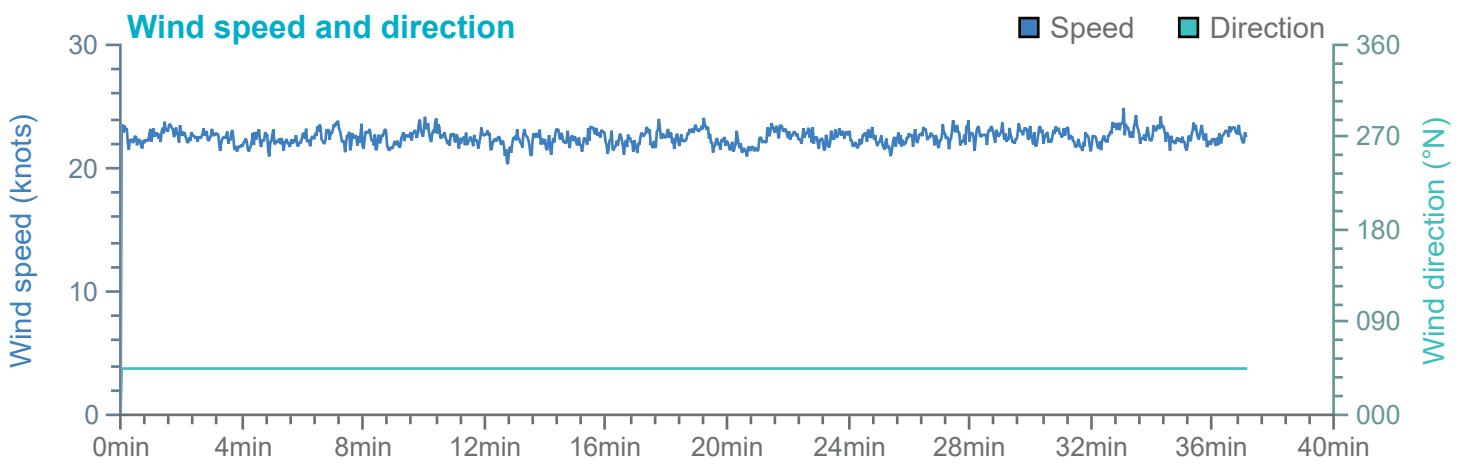
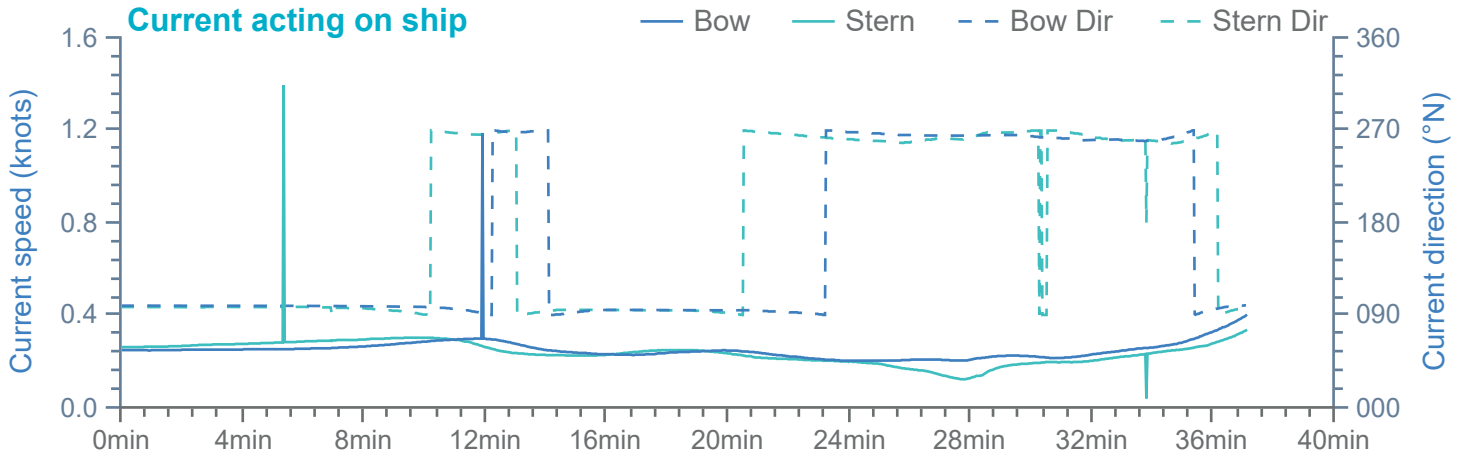


Overview

Environment

MV Celine

Thruster and engine use

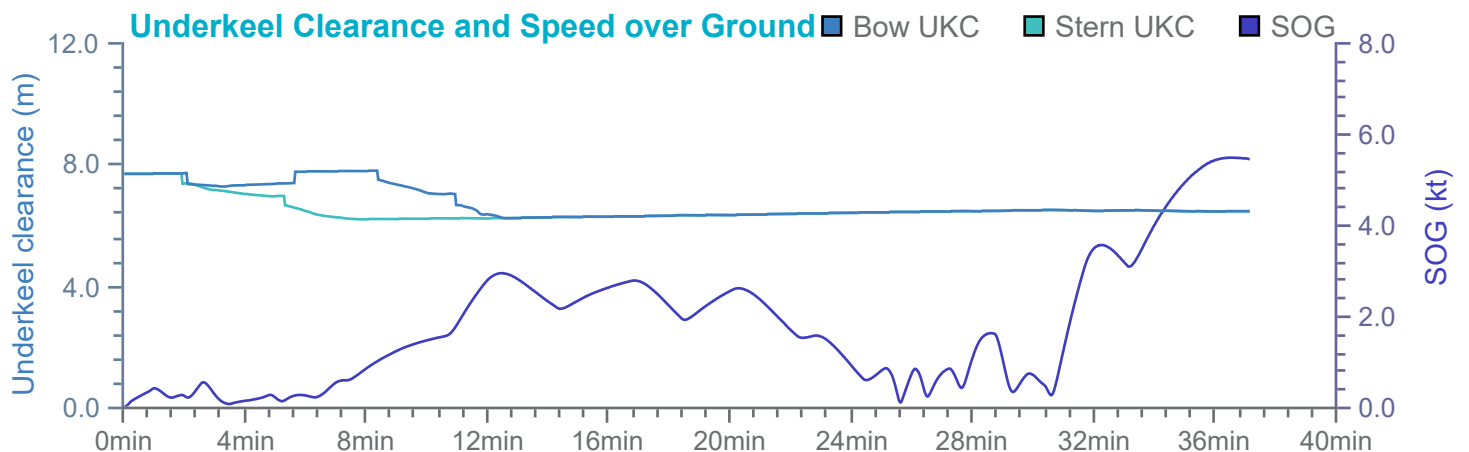
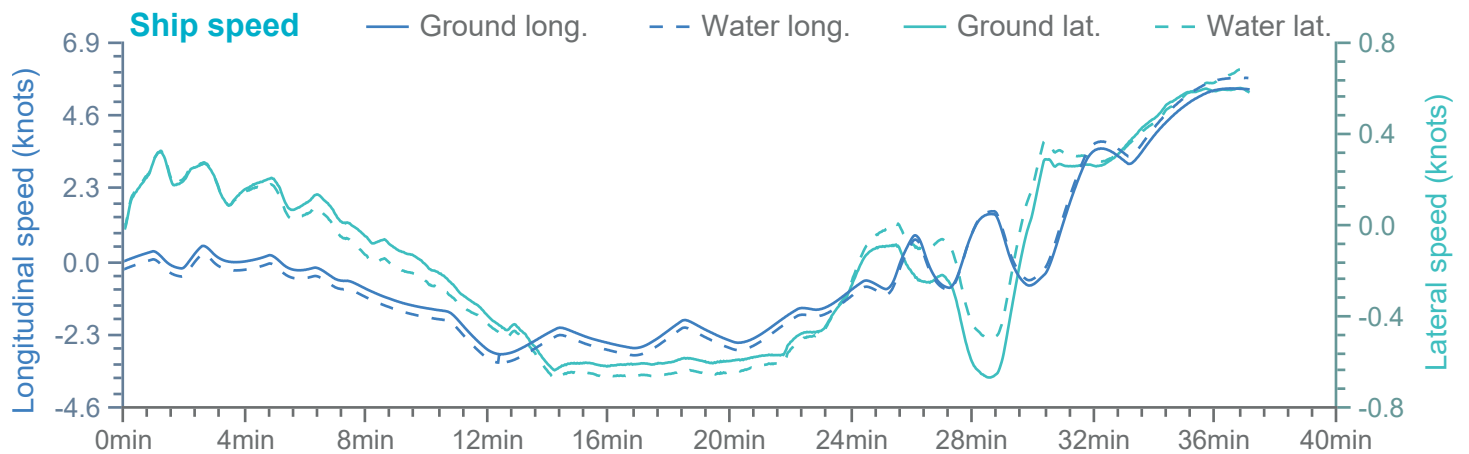
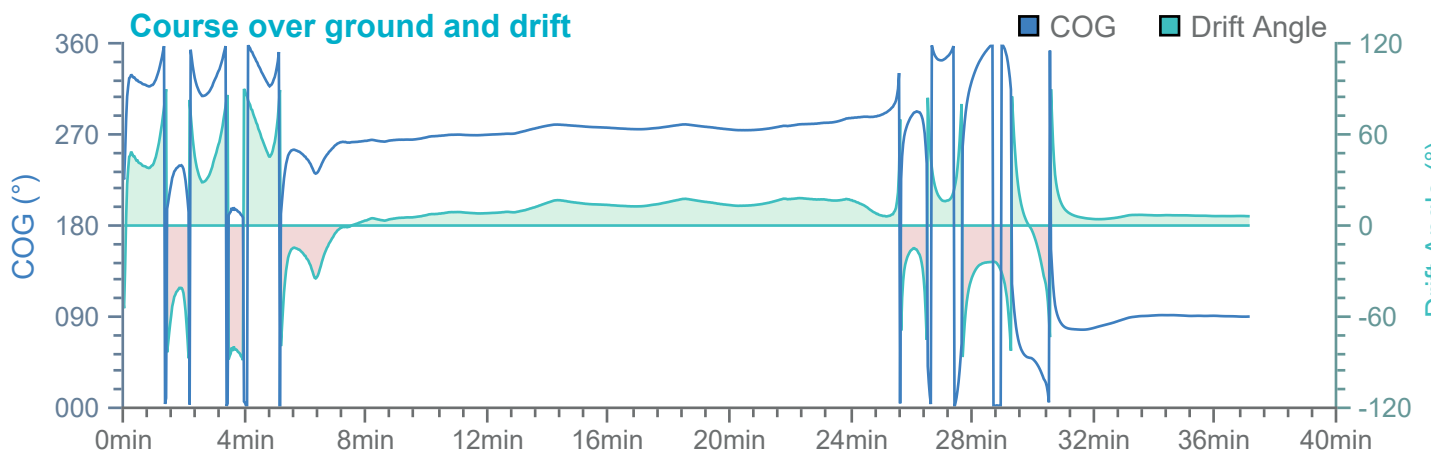
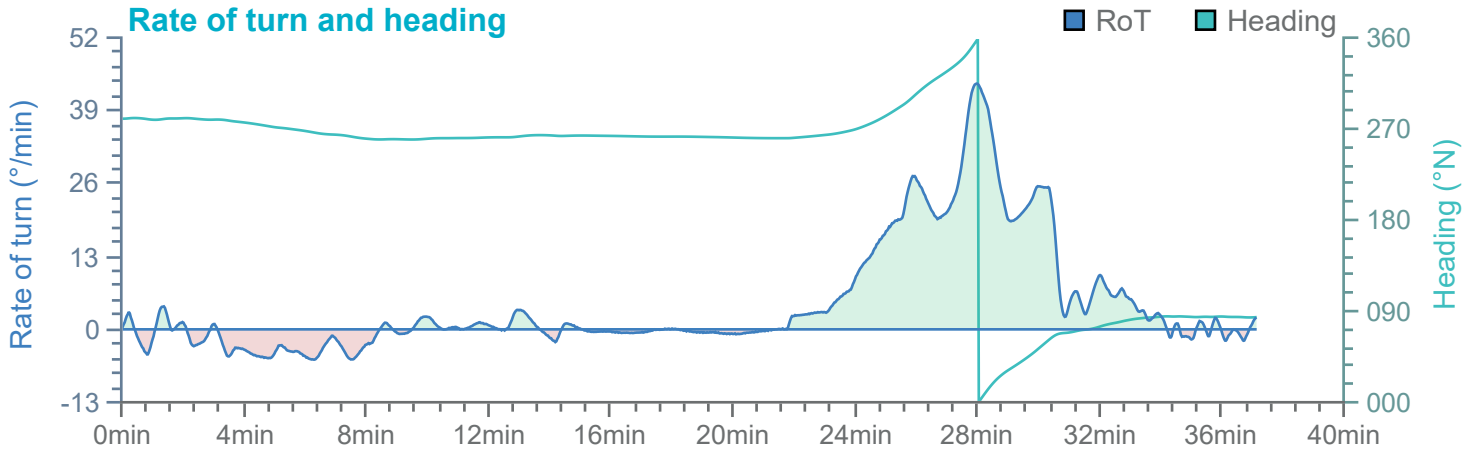


Overview

Environment

MV Celine

Thruster and engine use

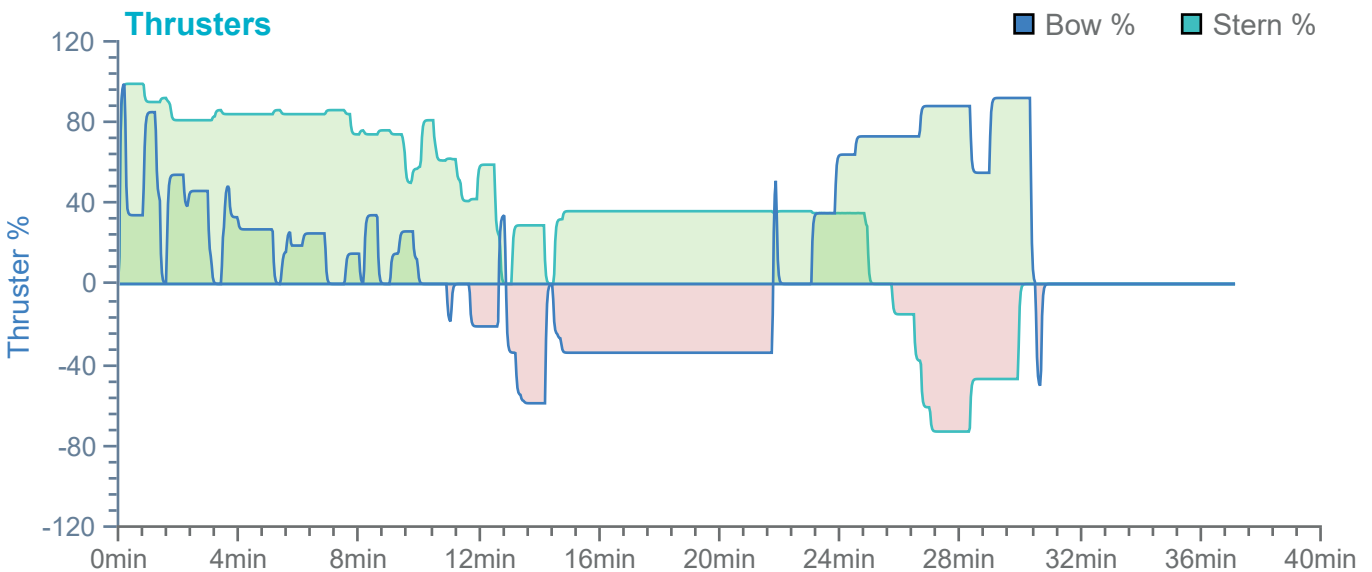
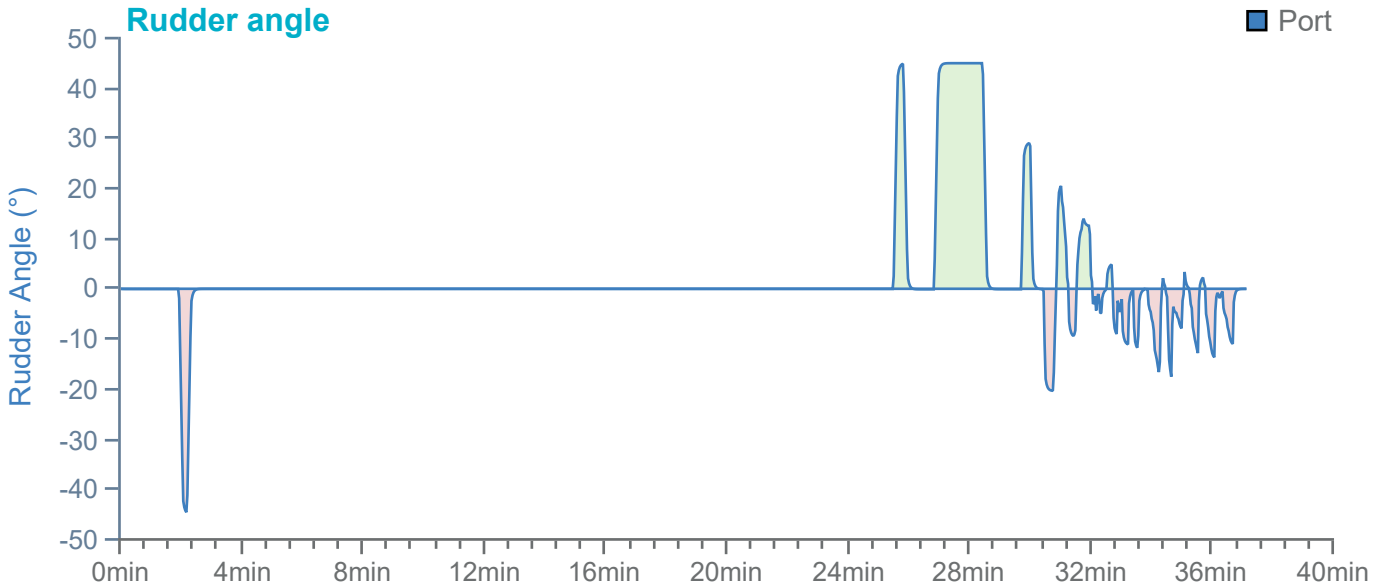
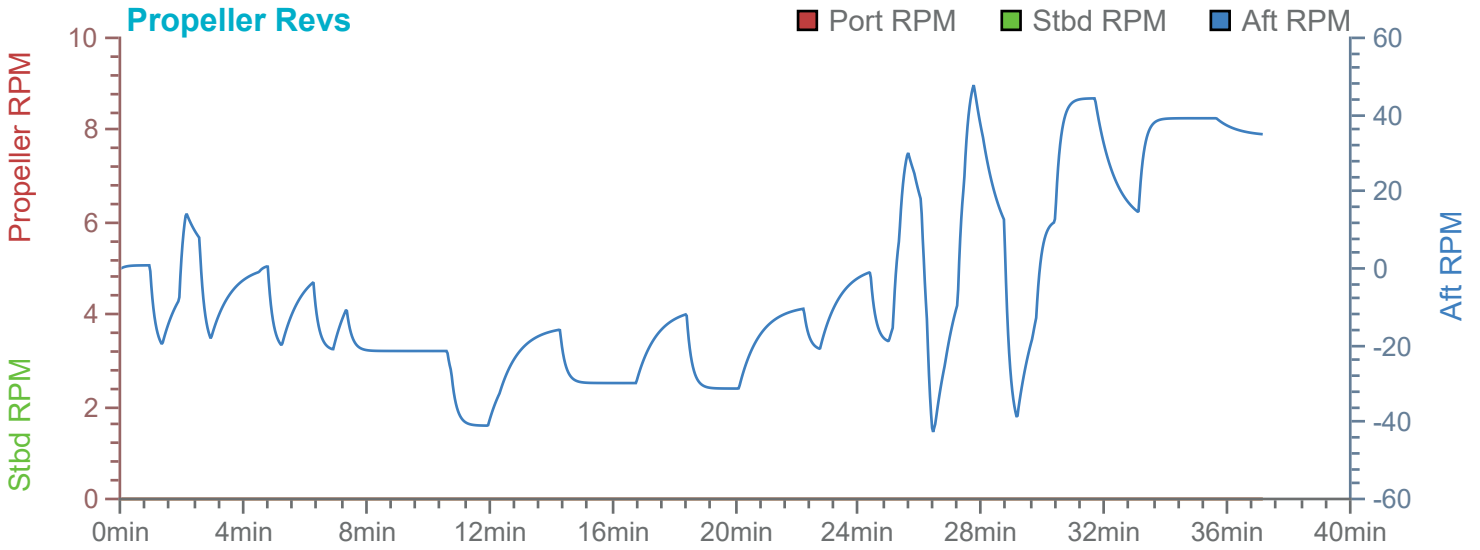


Overview

Environment

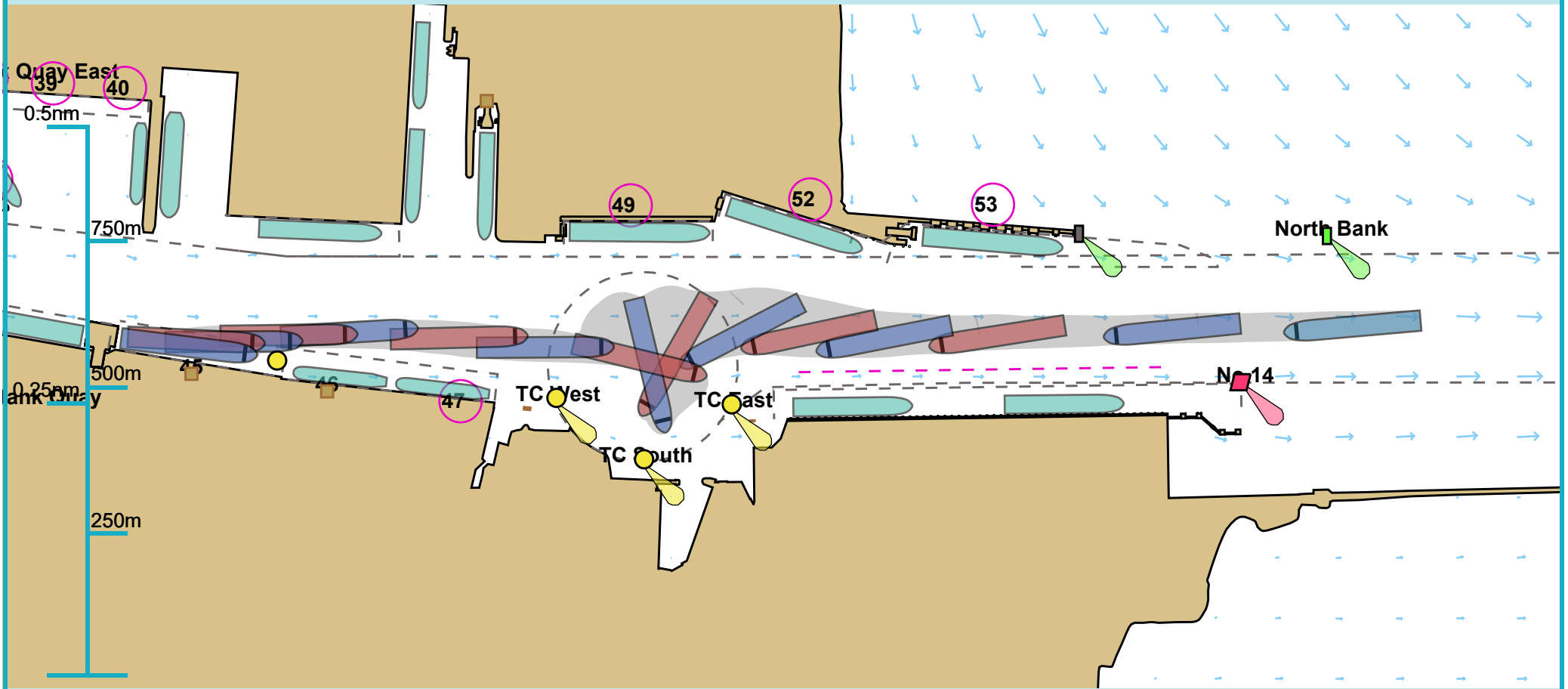
MV Celine

Thruster and engine use



Full Run Overview

53° 20.229 N, 006° 12.631 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

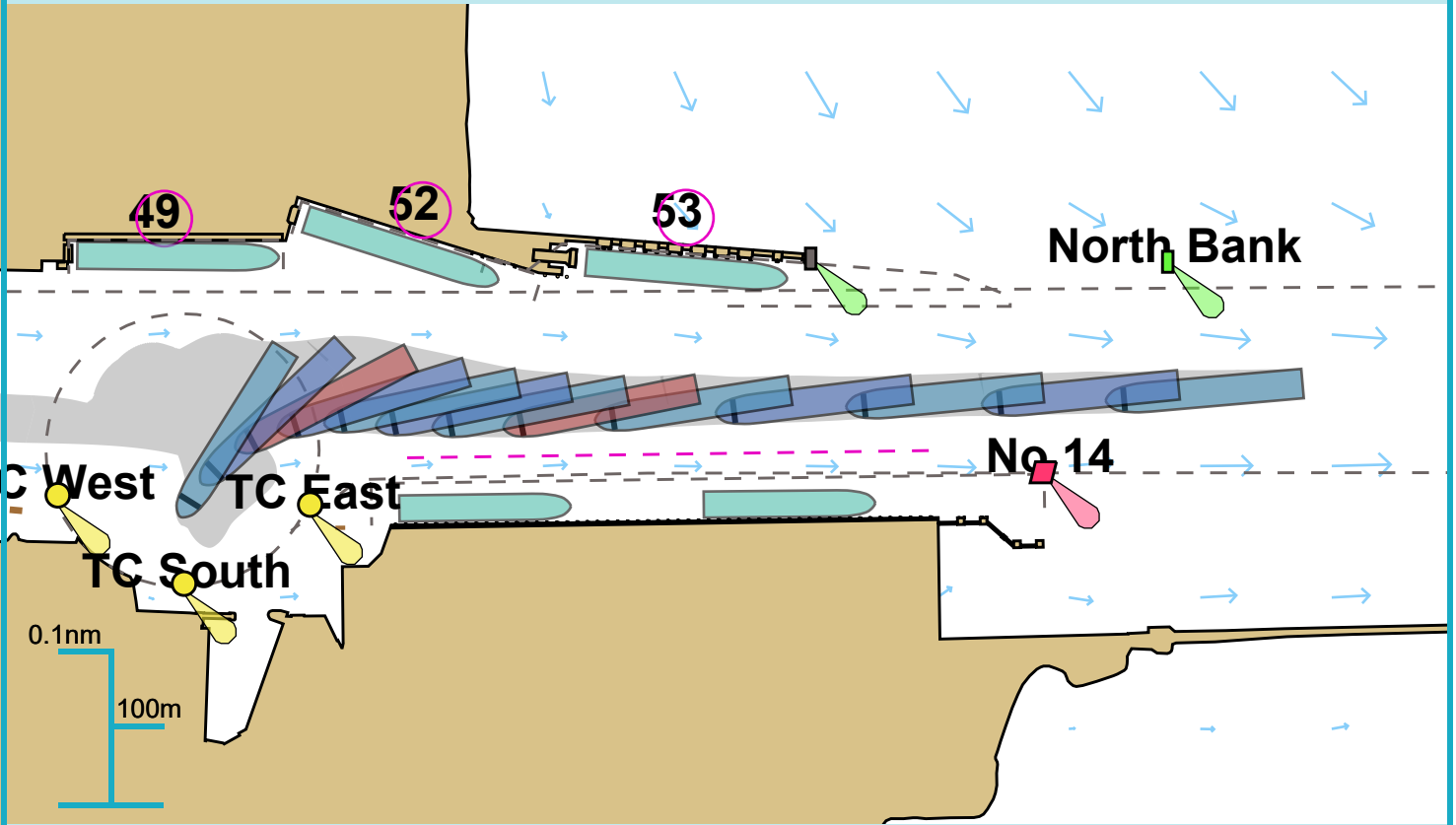
Run length:30 minutes

Manoeuvre:Other

Ownship(s):MV Celine

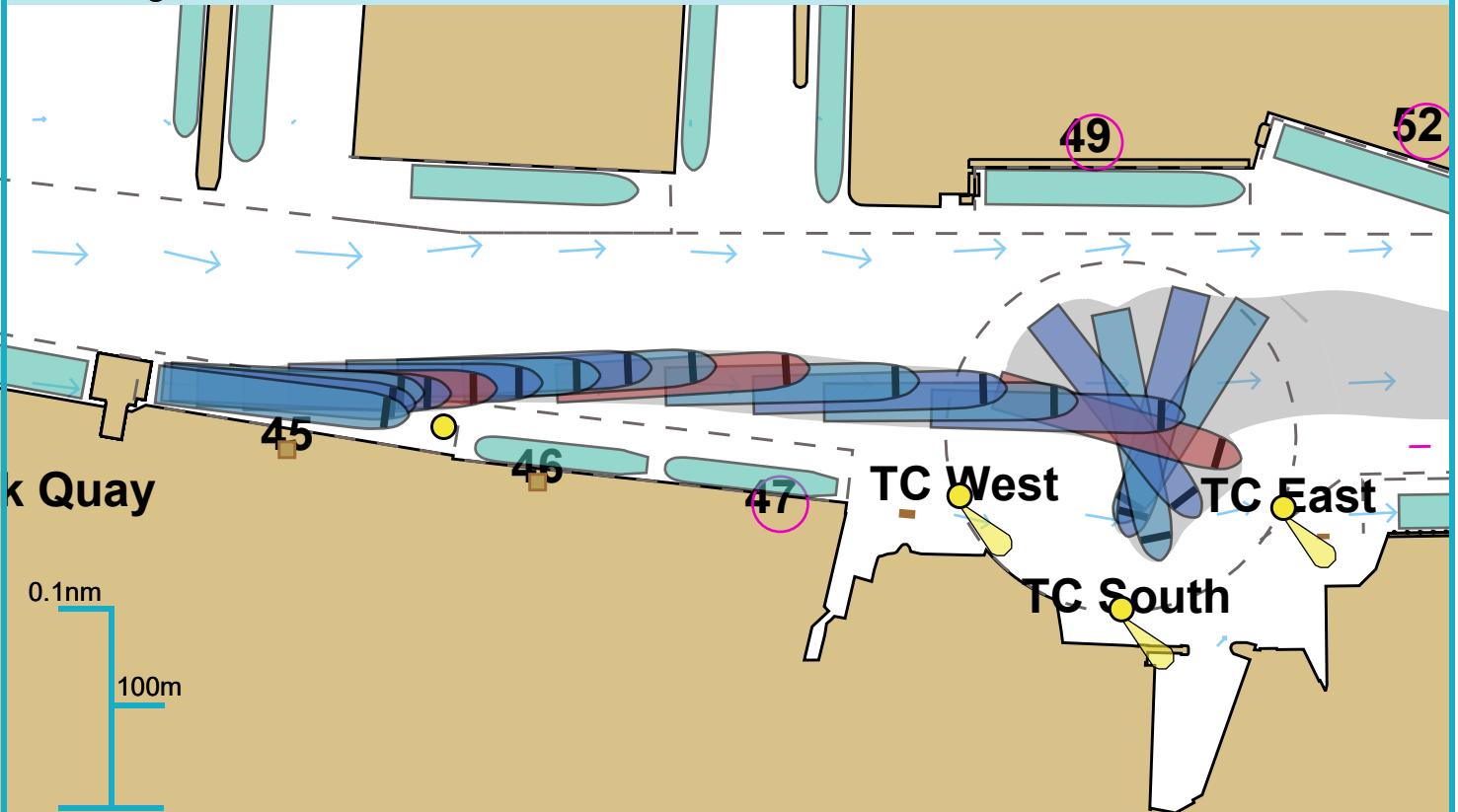
Comments:

Approach



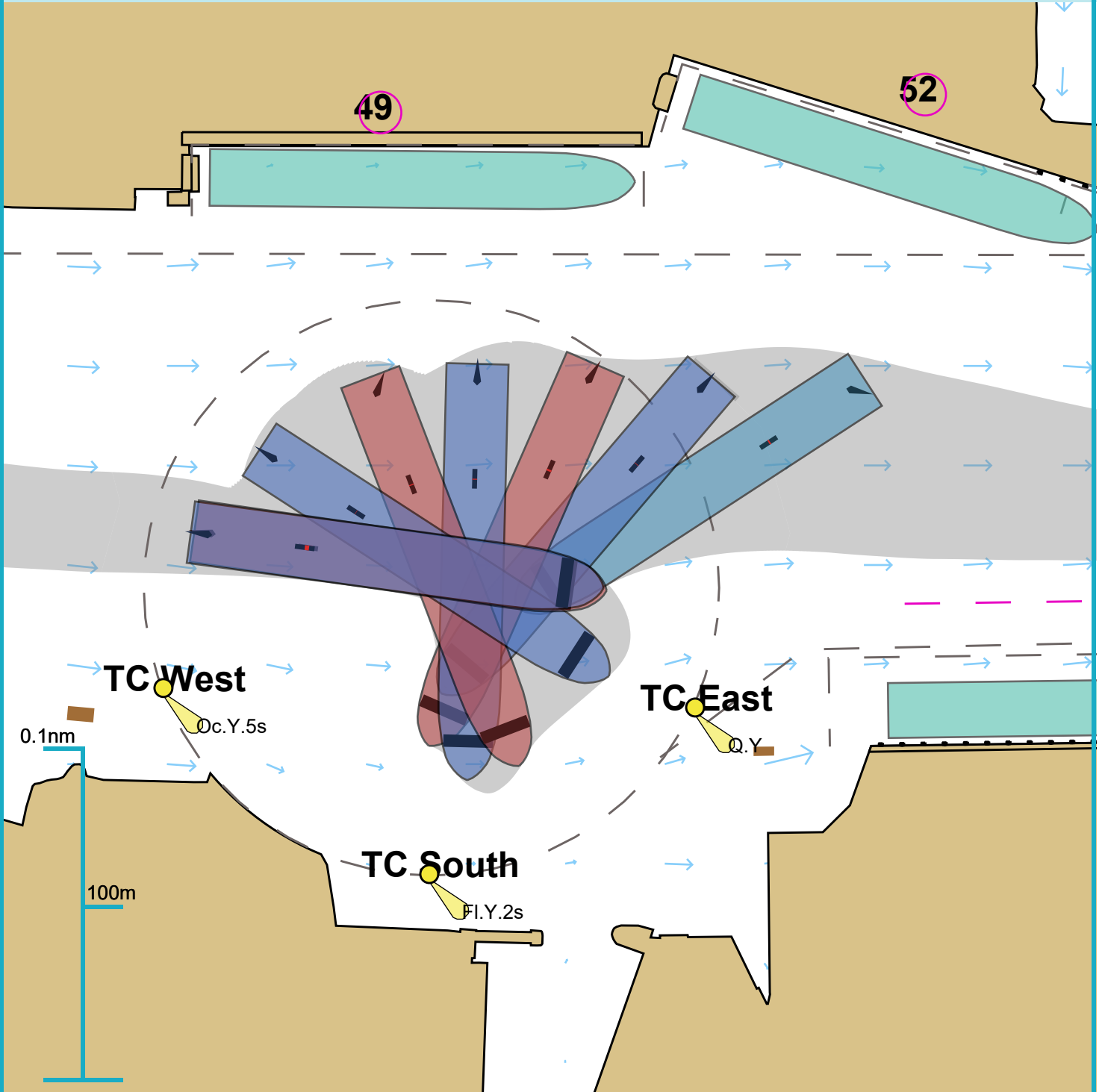
Ships plotted every 1 mins, highlight every 5 mins

Berthing

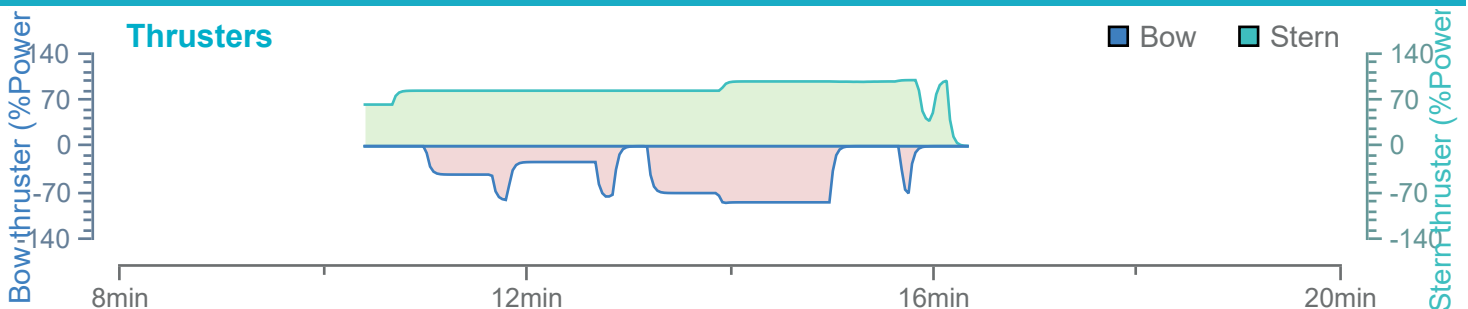


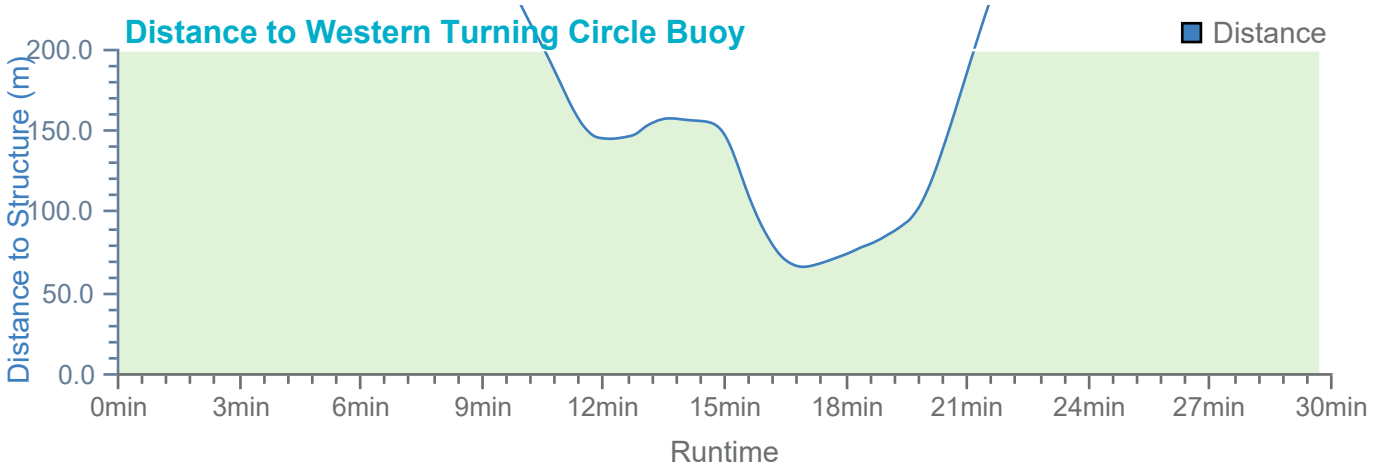
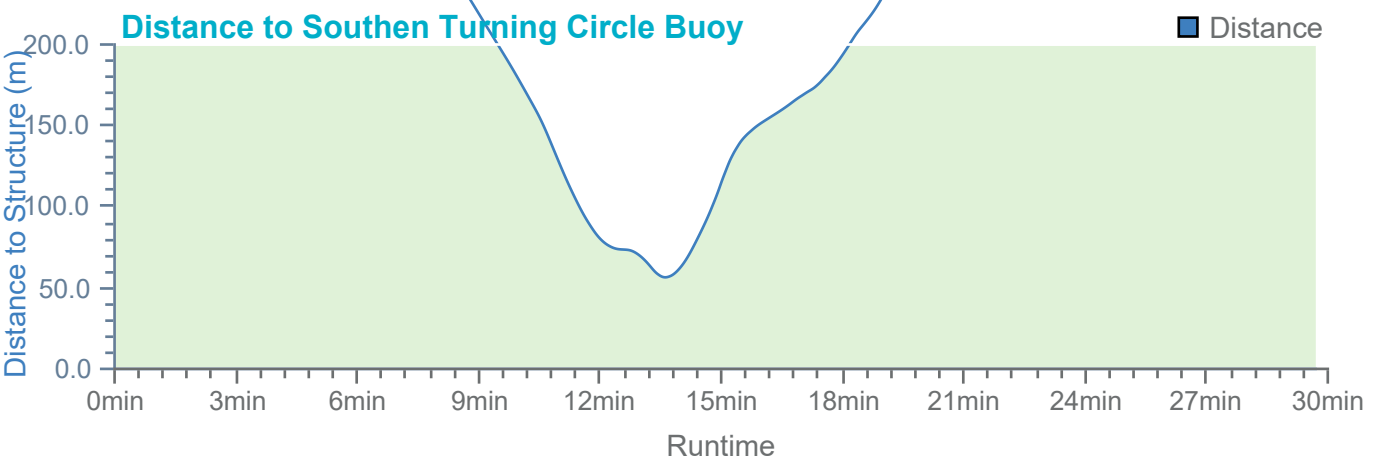
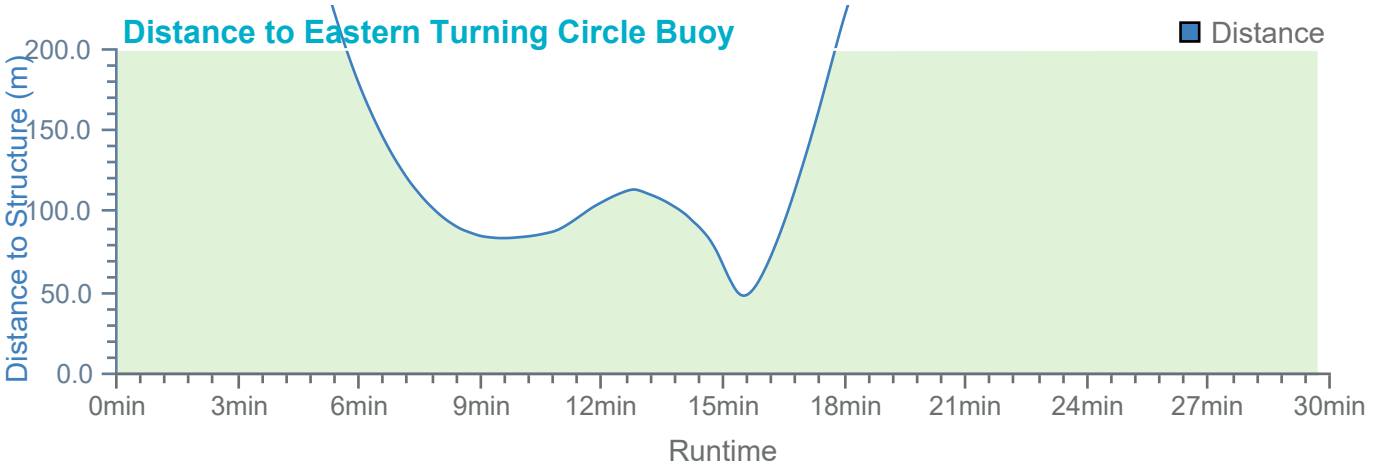
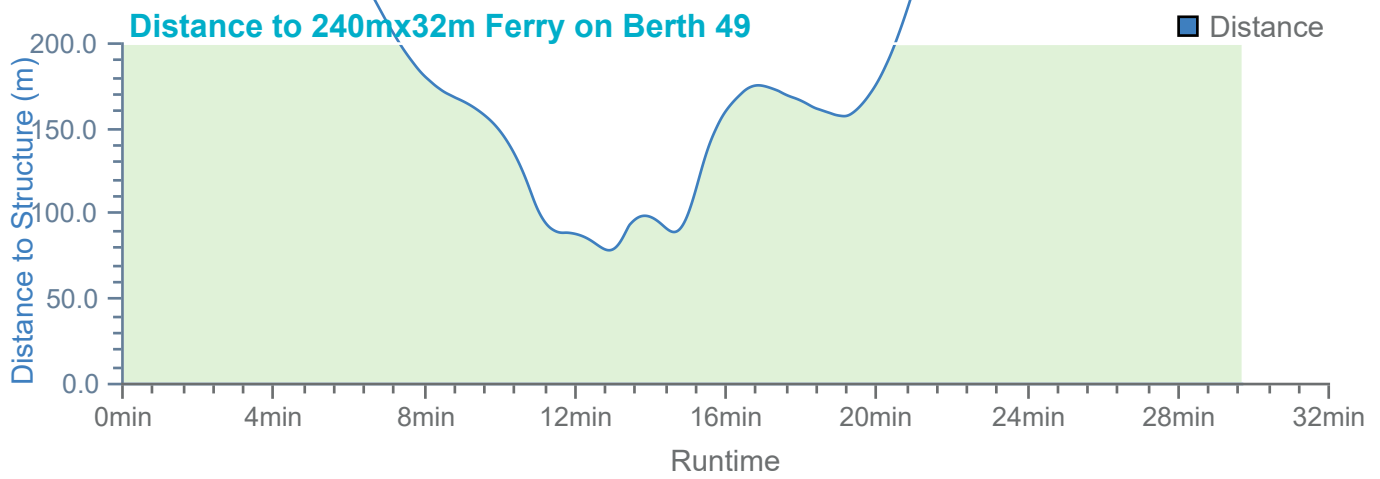
Ships plotted every 1 mins, highlight every 5 mins

Swing



Ships plotted every 59 seconds, highlight every 2 mins



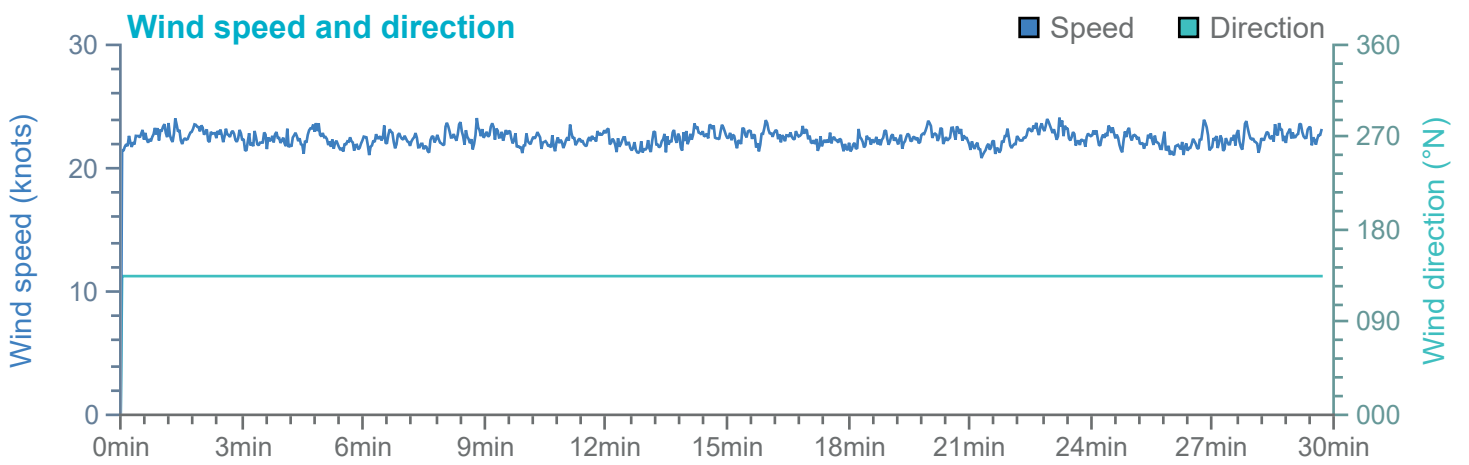
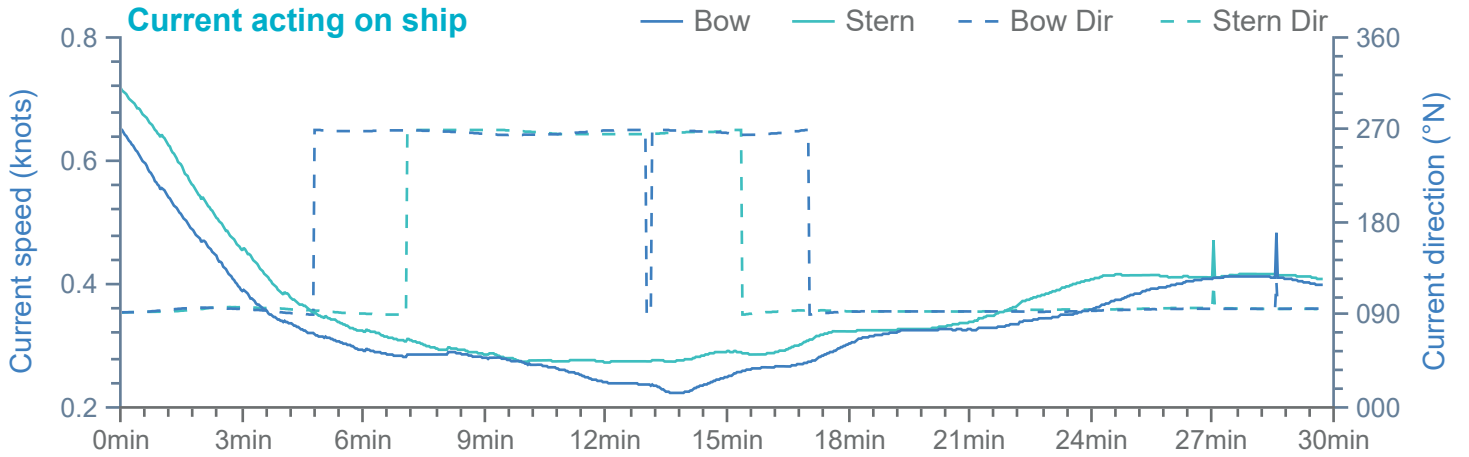


Overview

Environment

MV Celine

Thruster and engine use

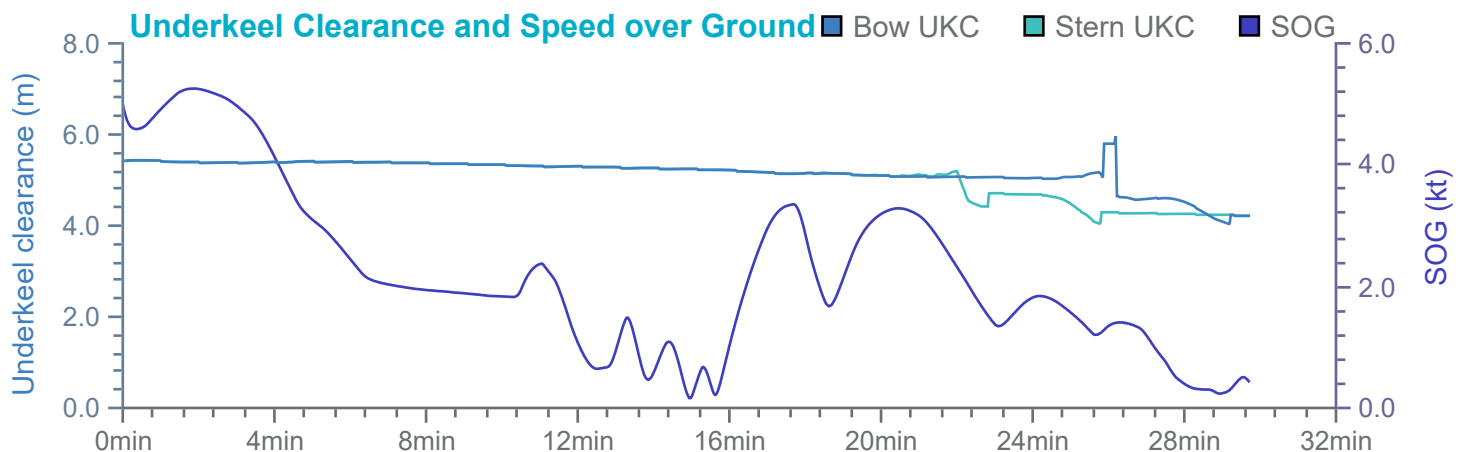
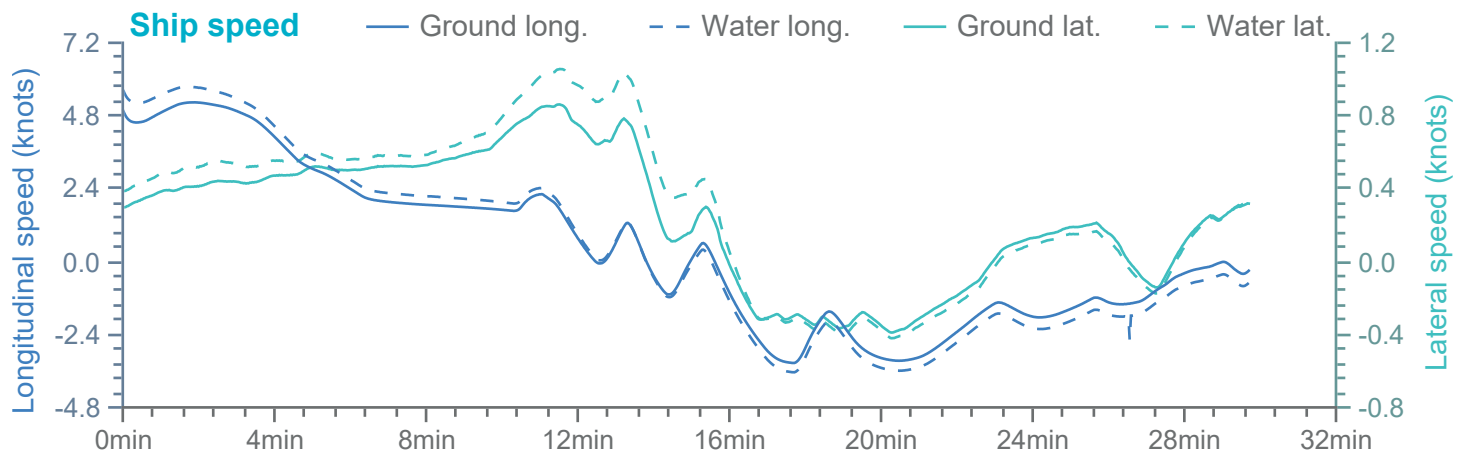
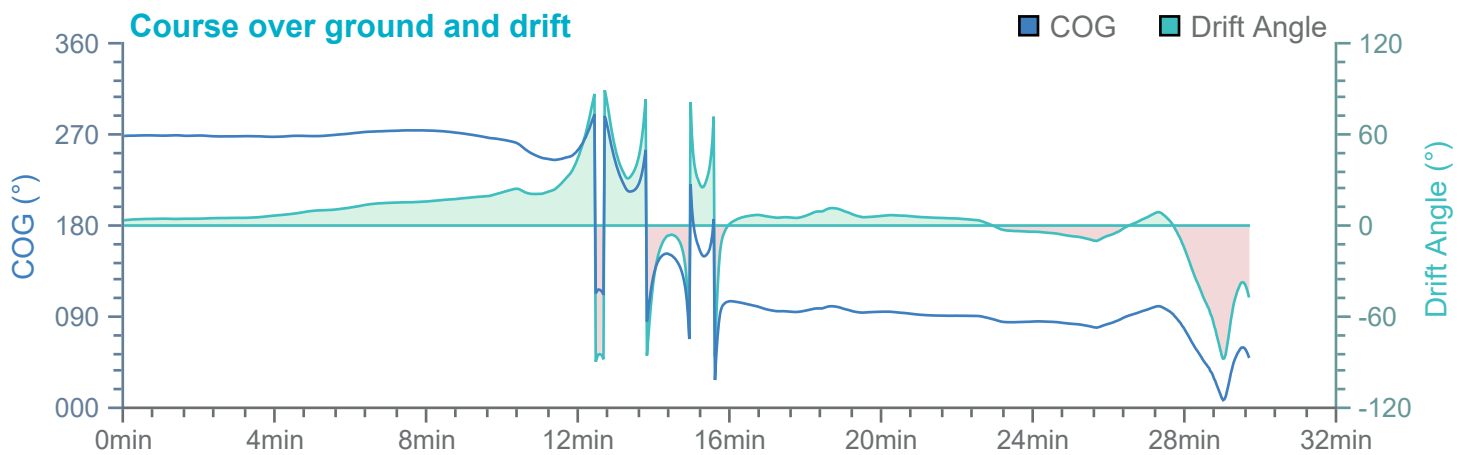
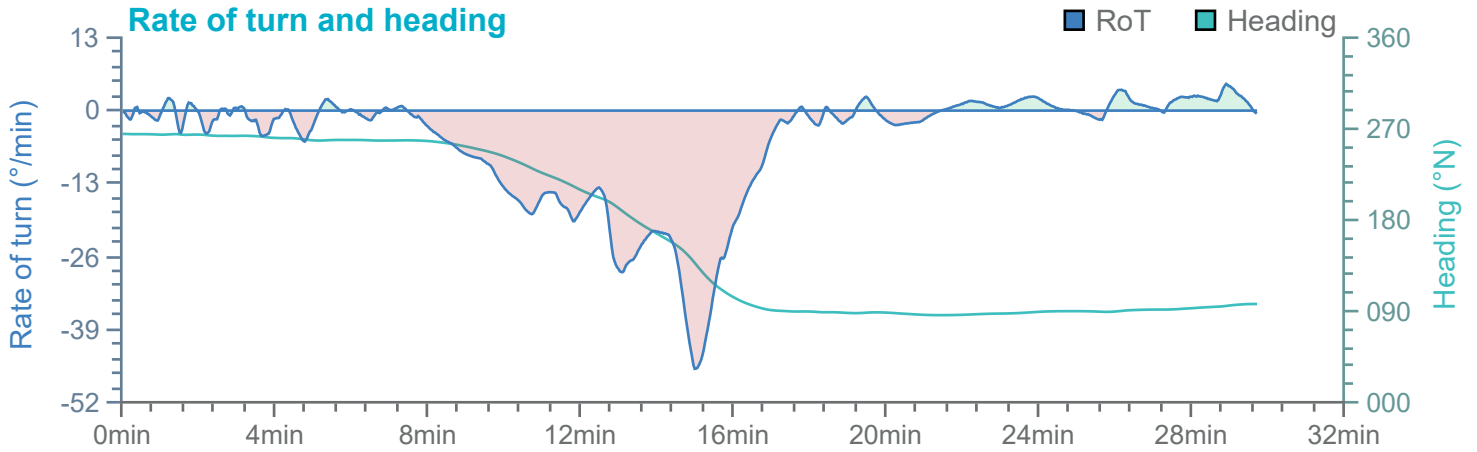


Overview

Environment

MV Celine

Thruster and engine use

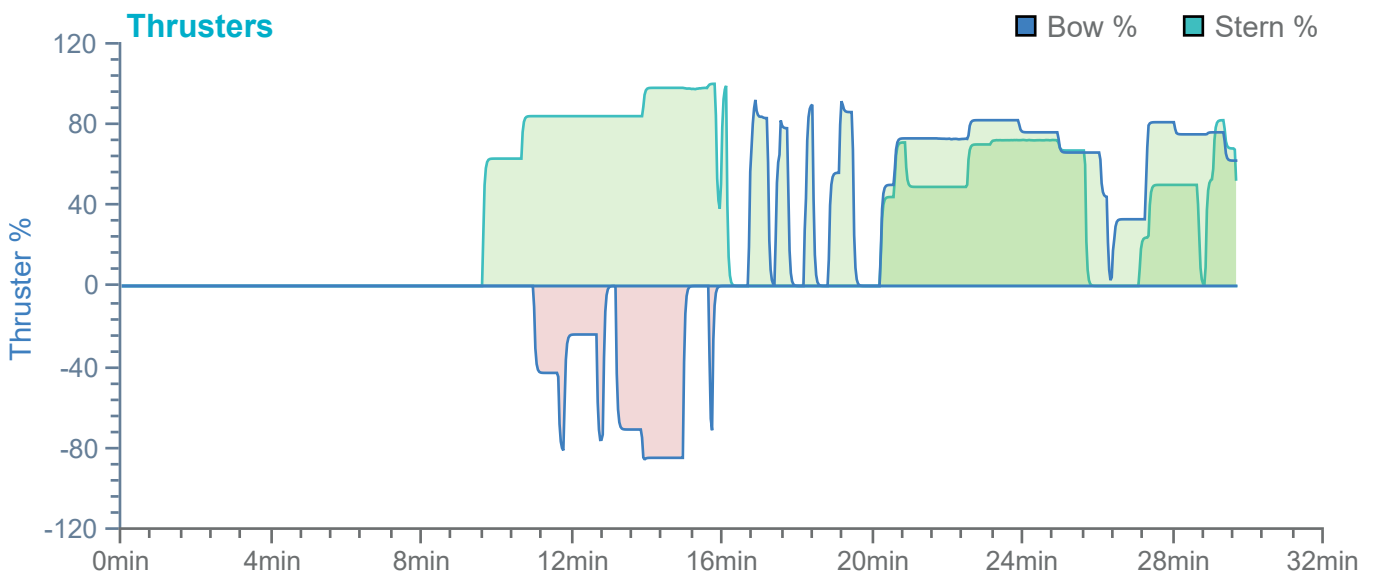
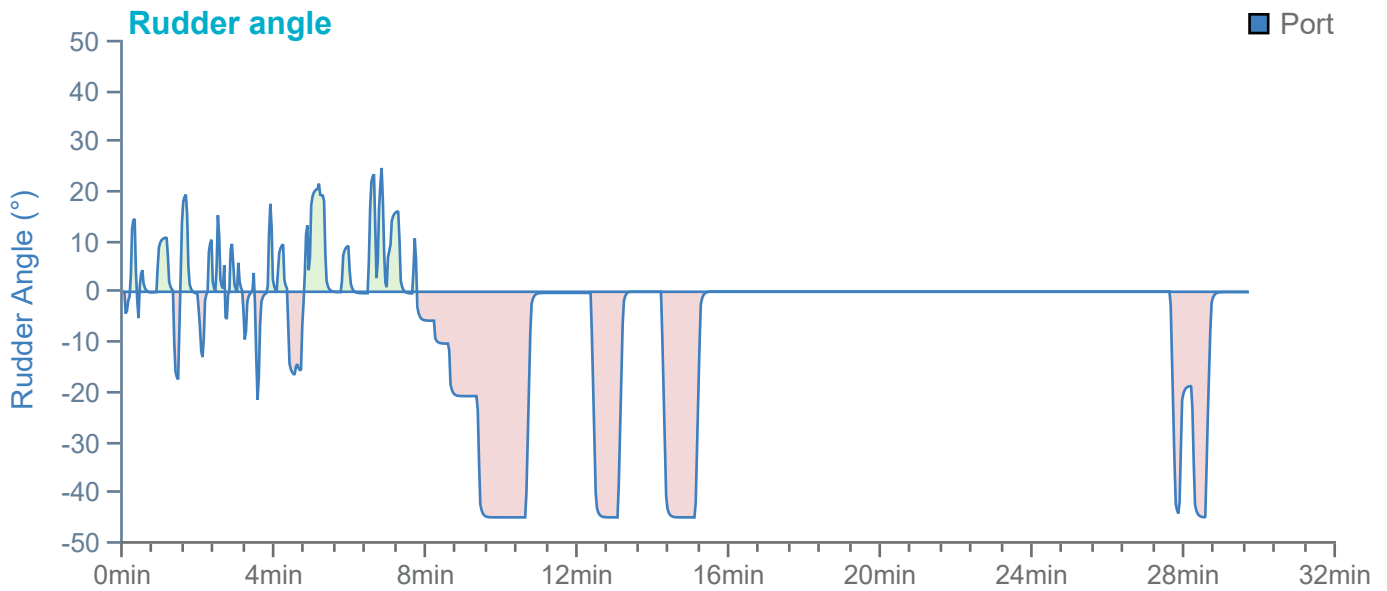
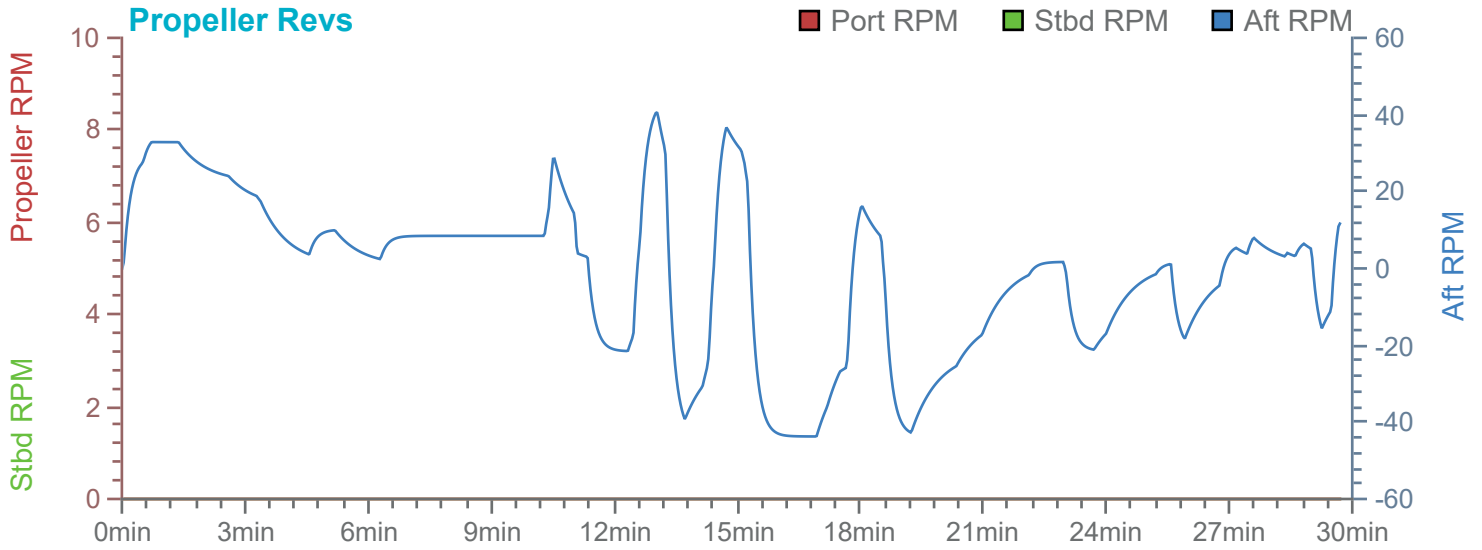


Overview

Environment

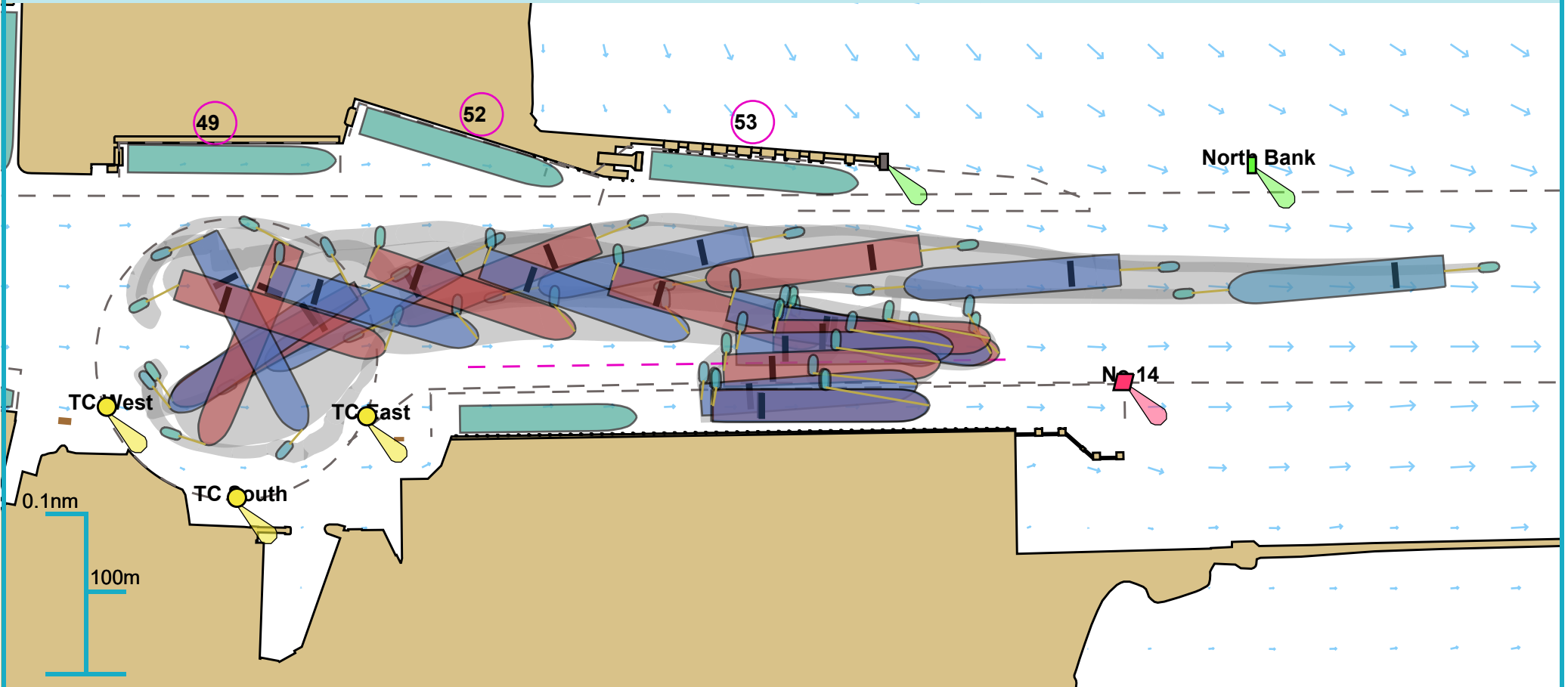
MV Celine

Thruster and engine use



Full Run Overview

53° 20.336 N, 006° 11.889 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD

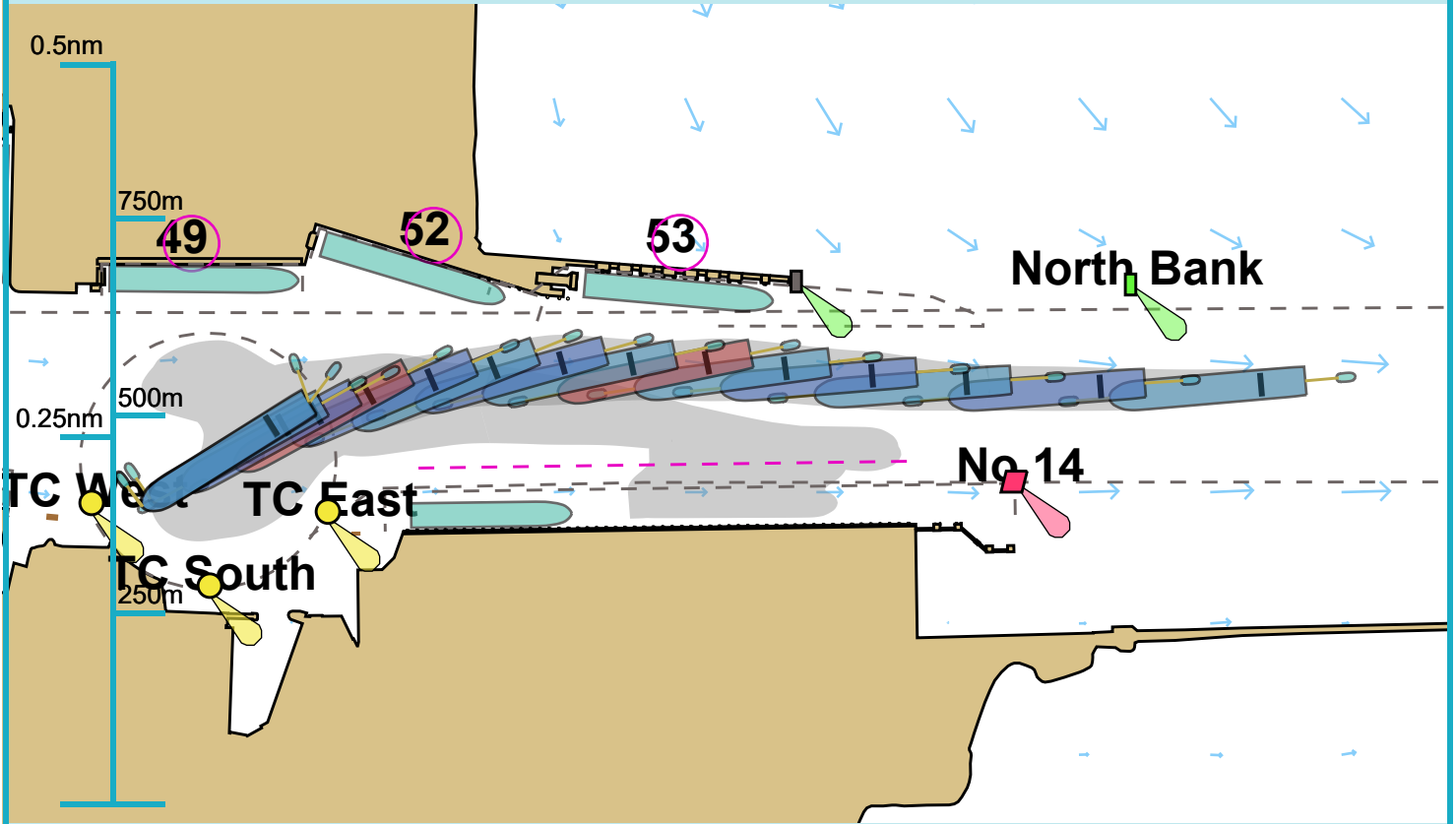
Run length: 44 minutes

Manoeuvre: Other

Ownship(s): 250m Container

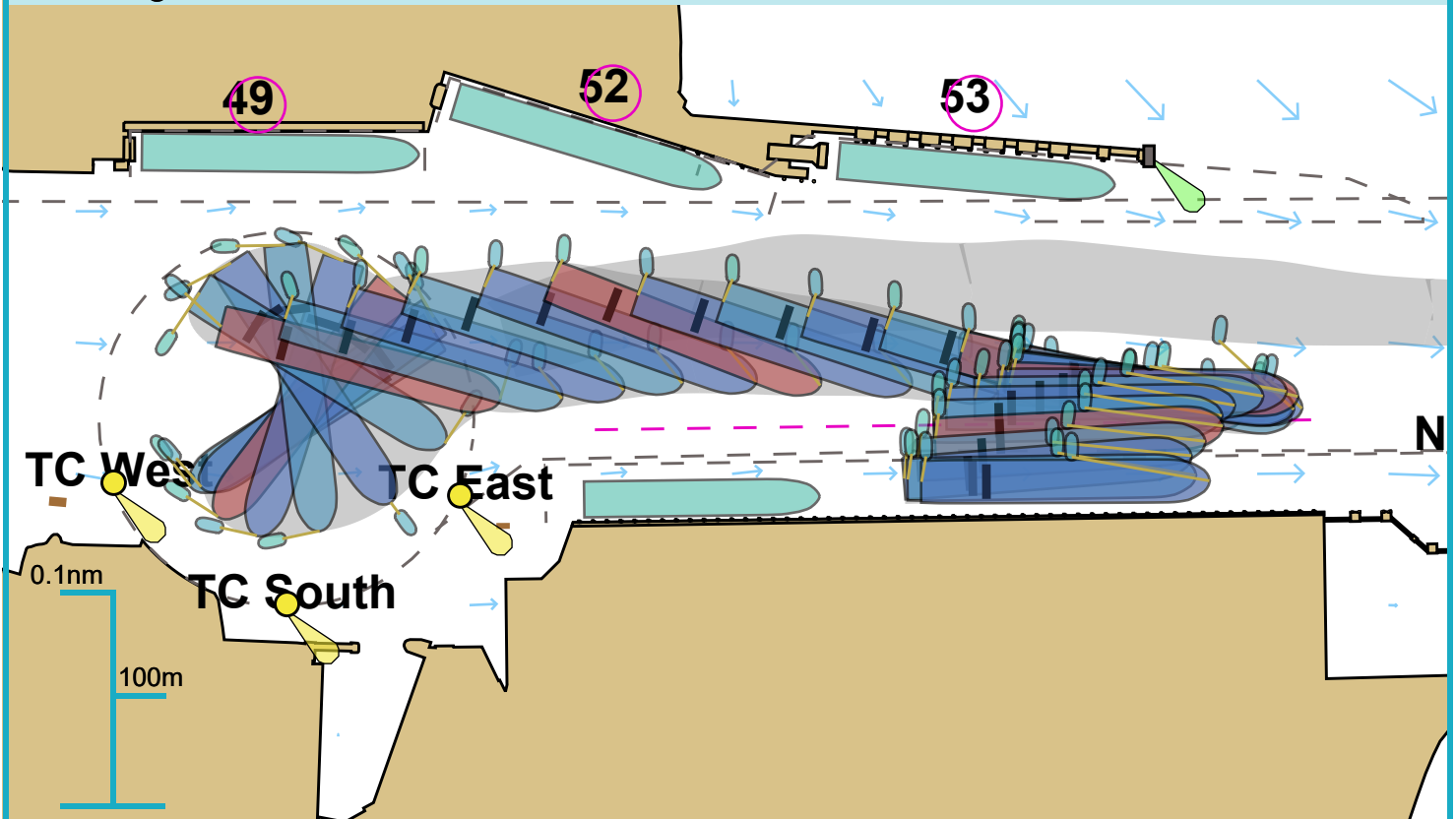
Comments:

Approach



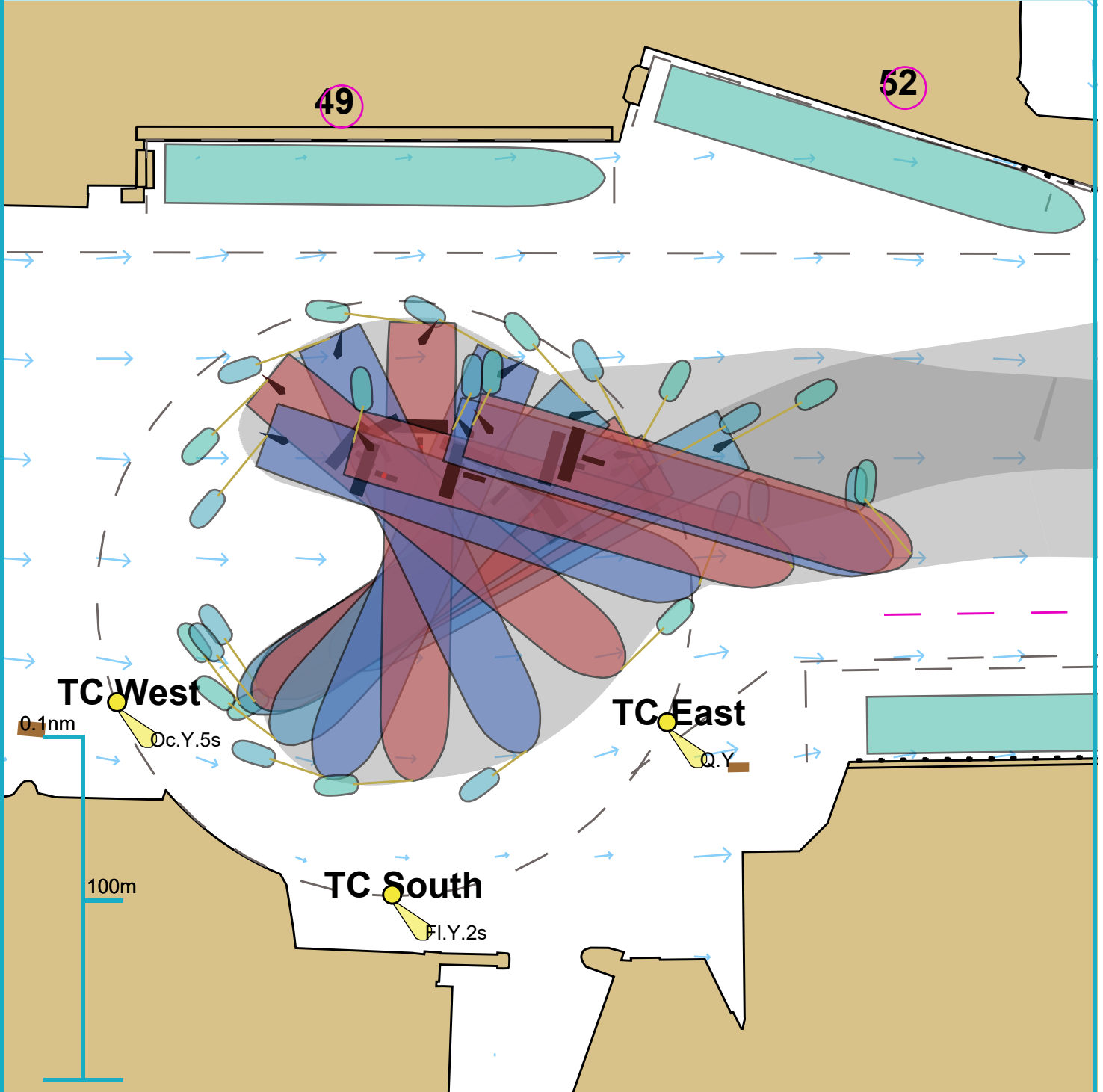
Ships plotted every 1 mins, highlight every 5 mins

Berthing

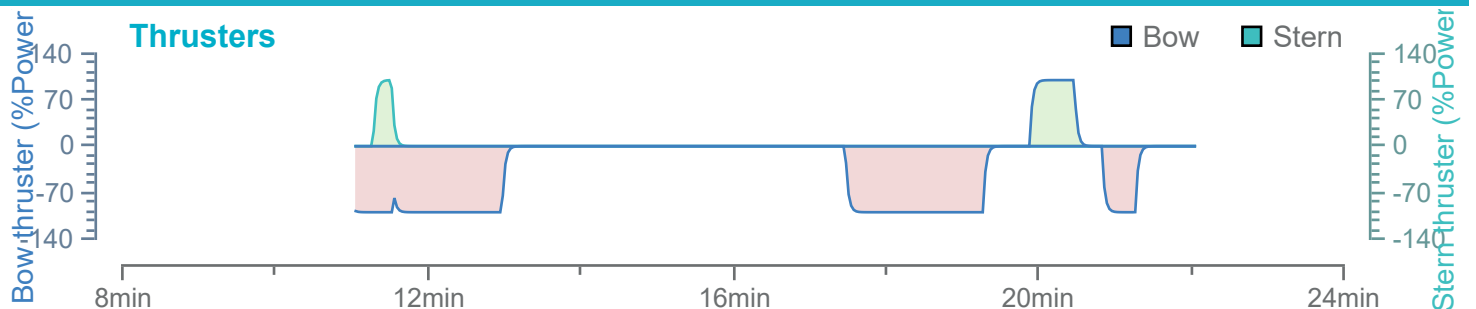


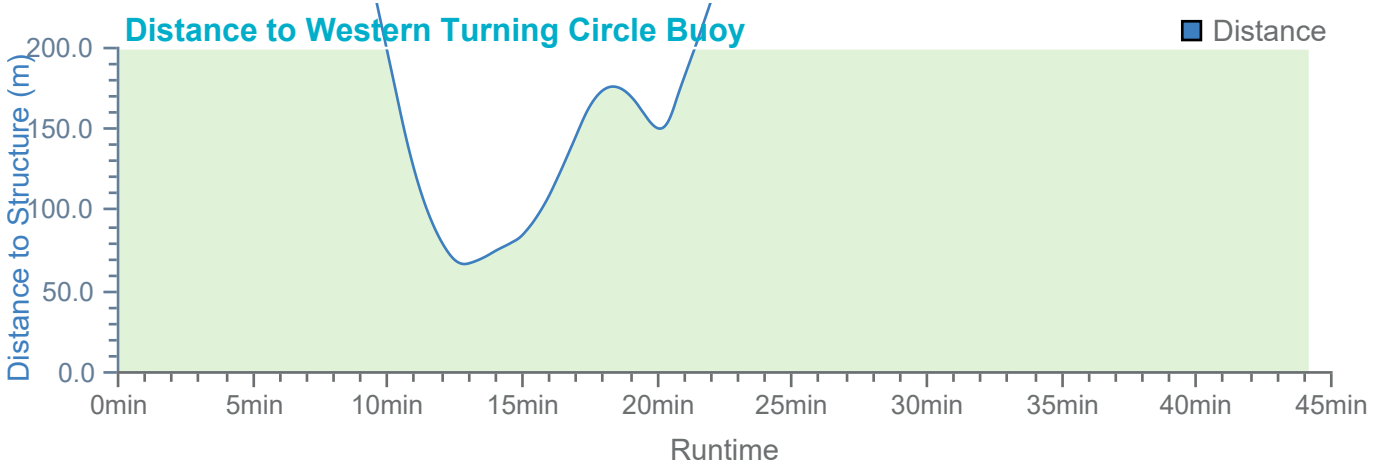
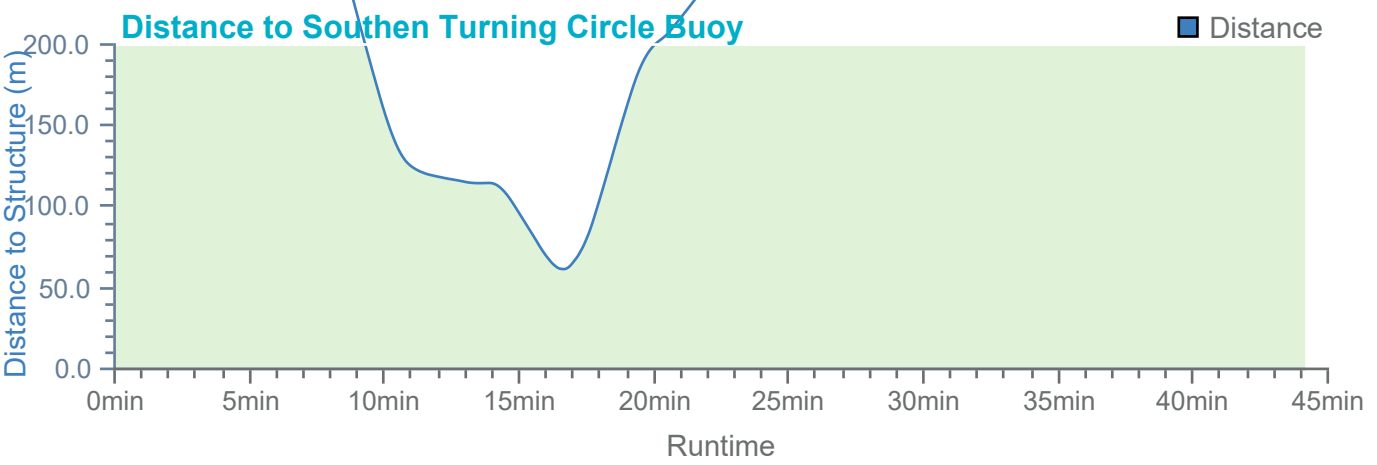
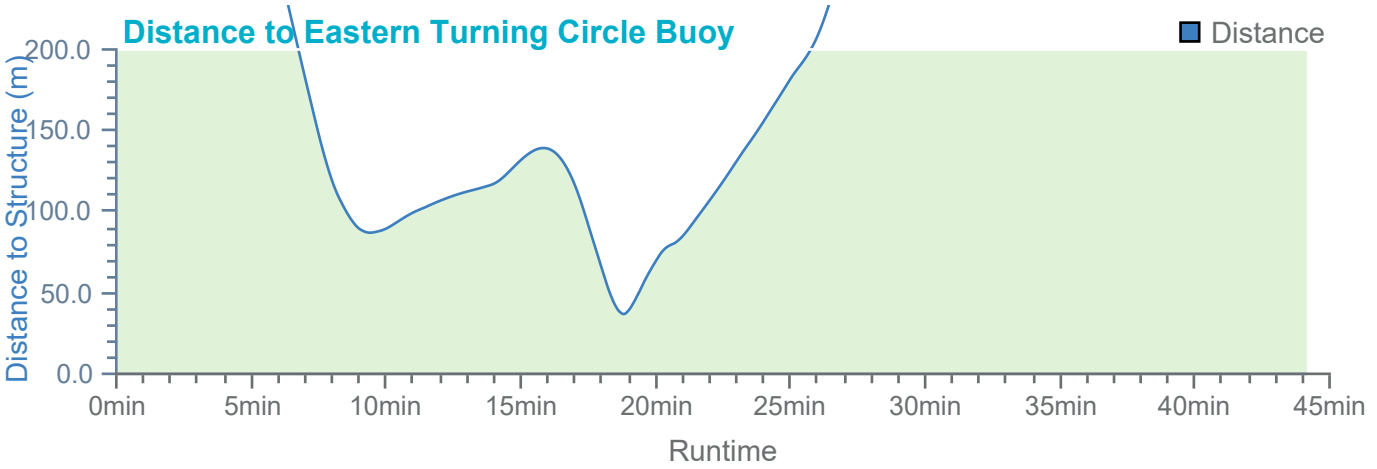
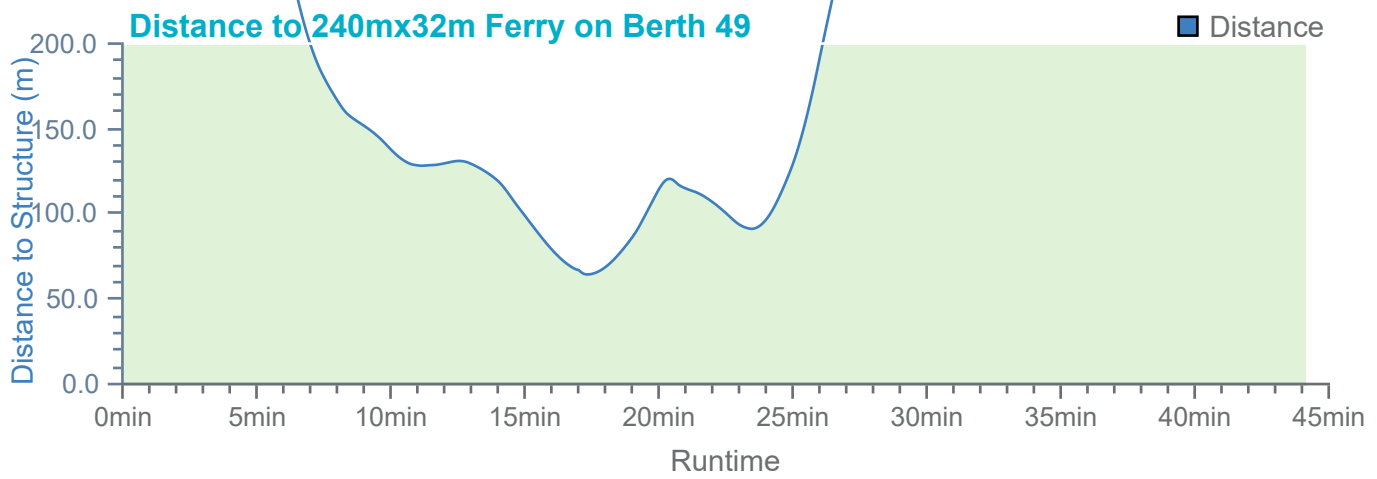
Ships plotted every 1 mins, highlight every 5 mins

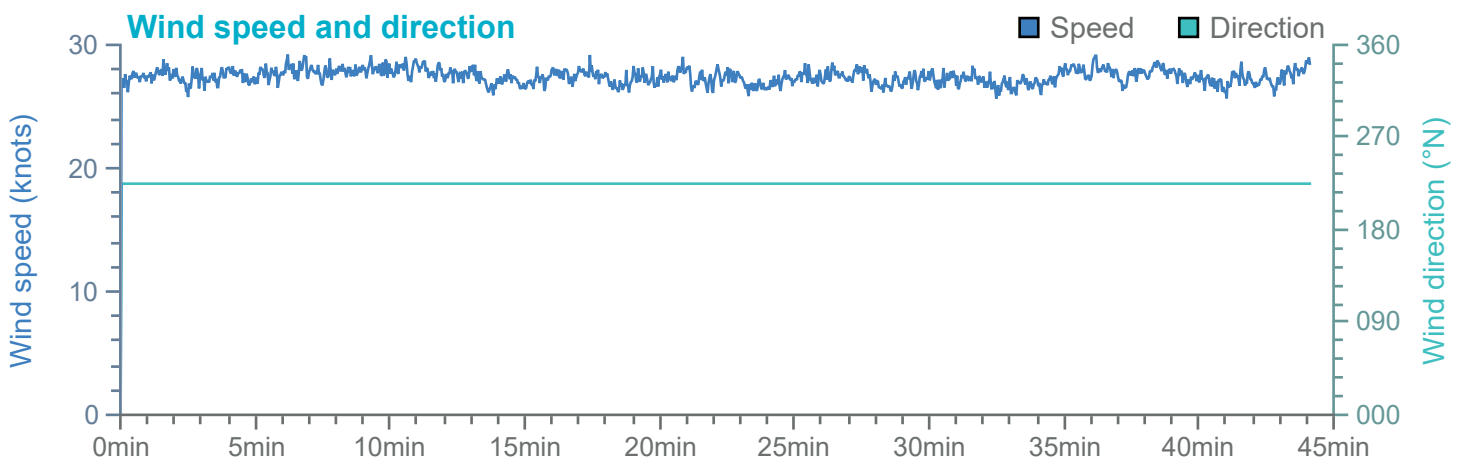
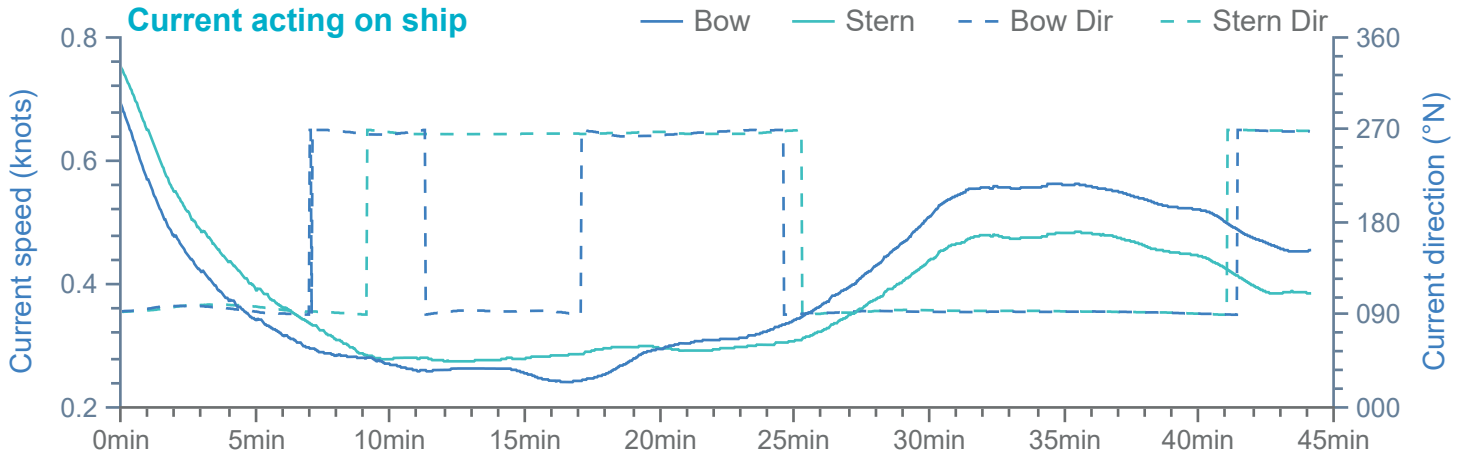
Swing

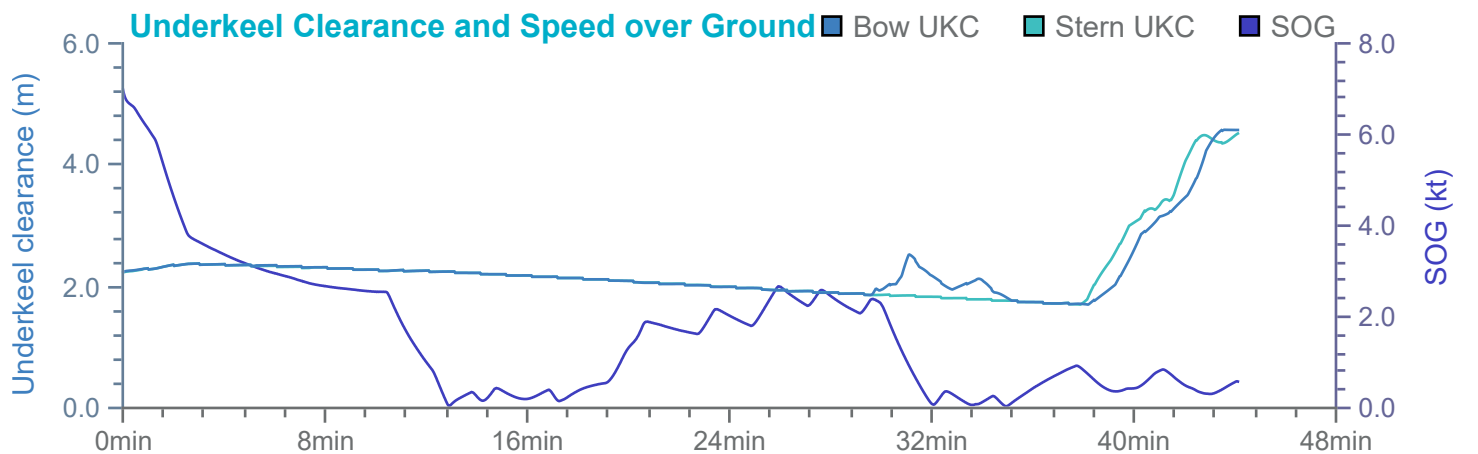
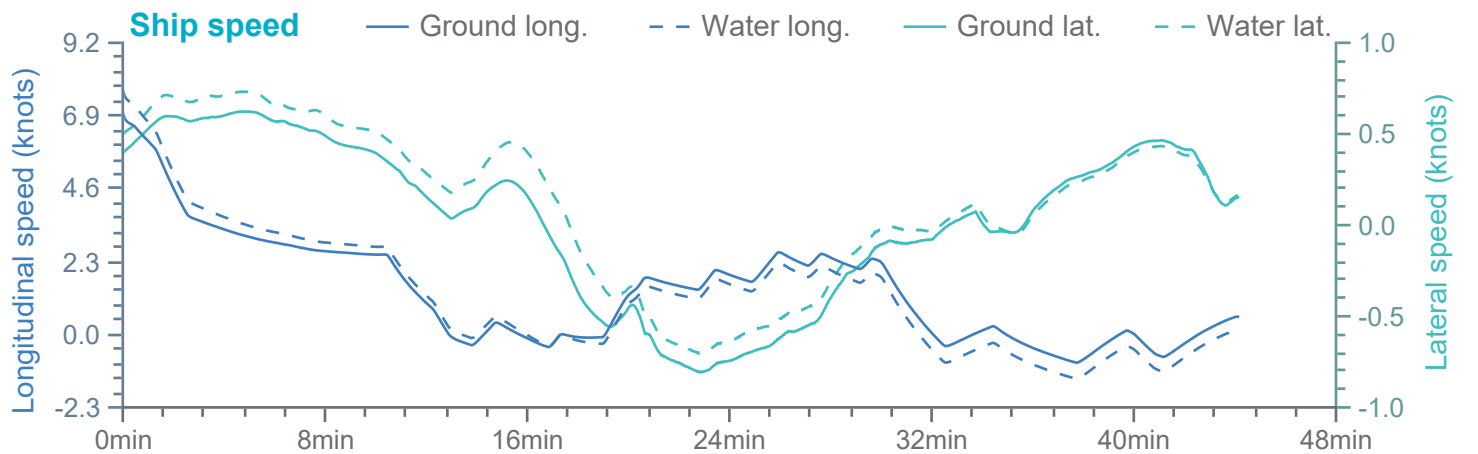
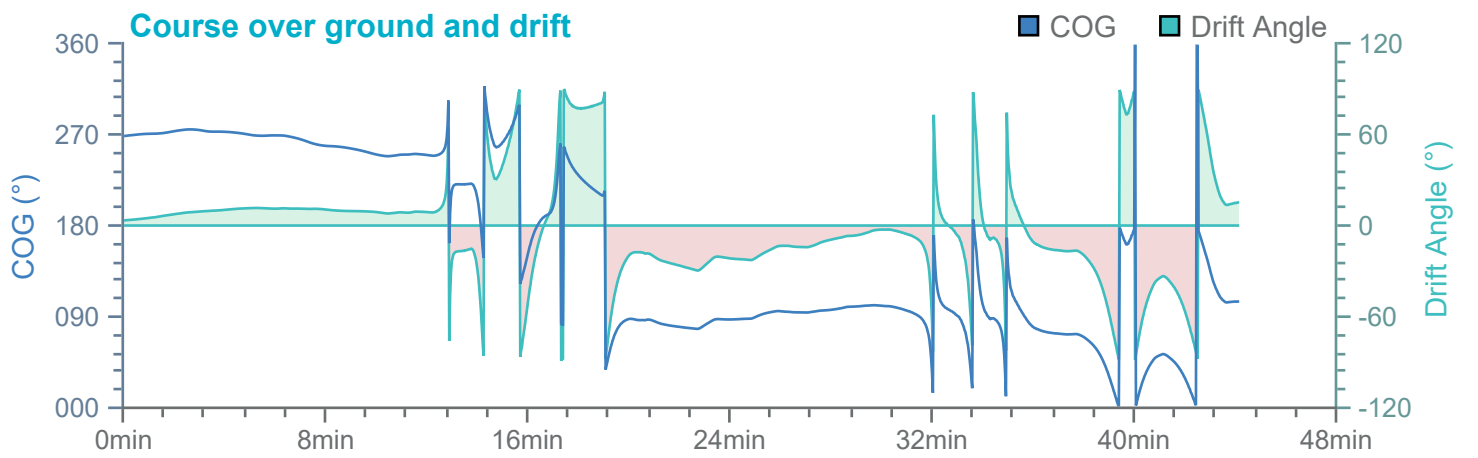
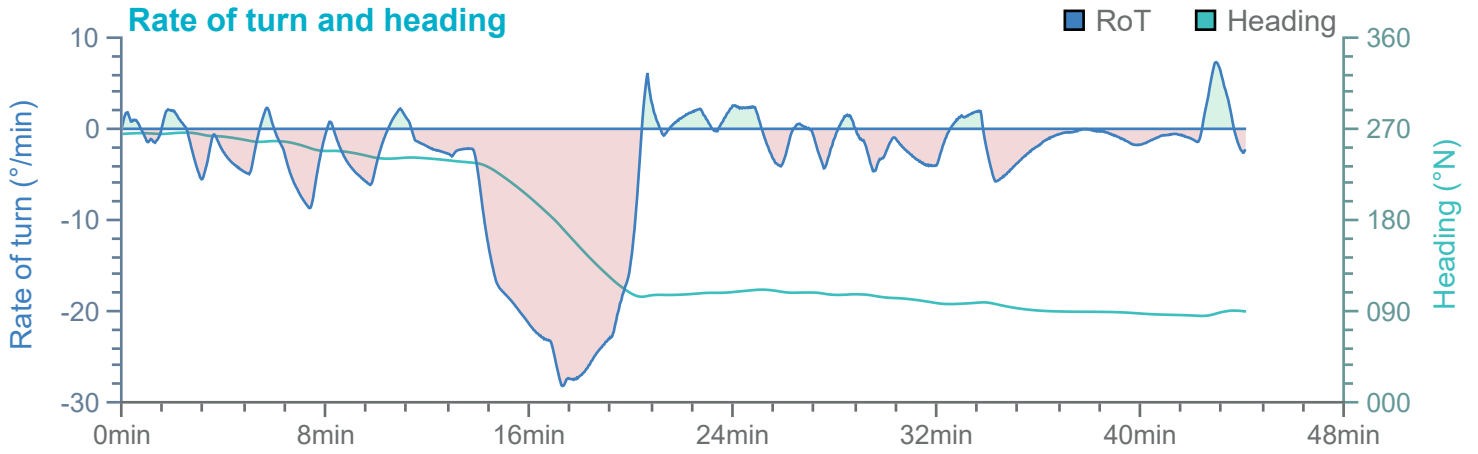


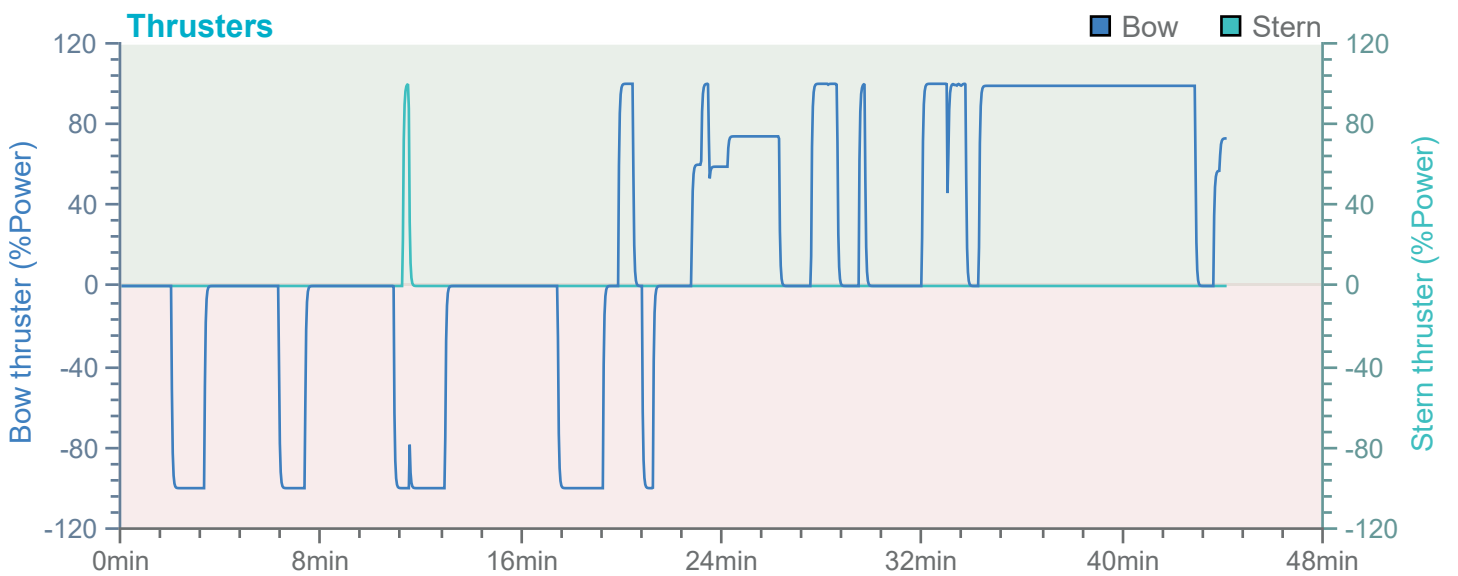
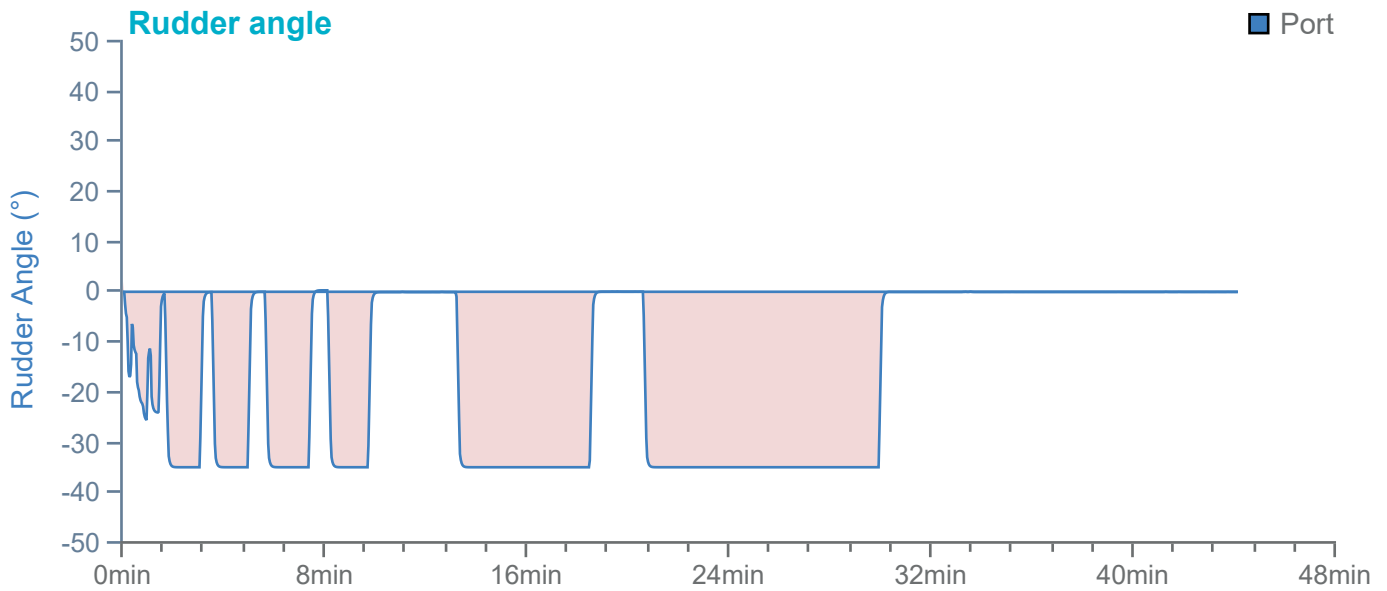
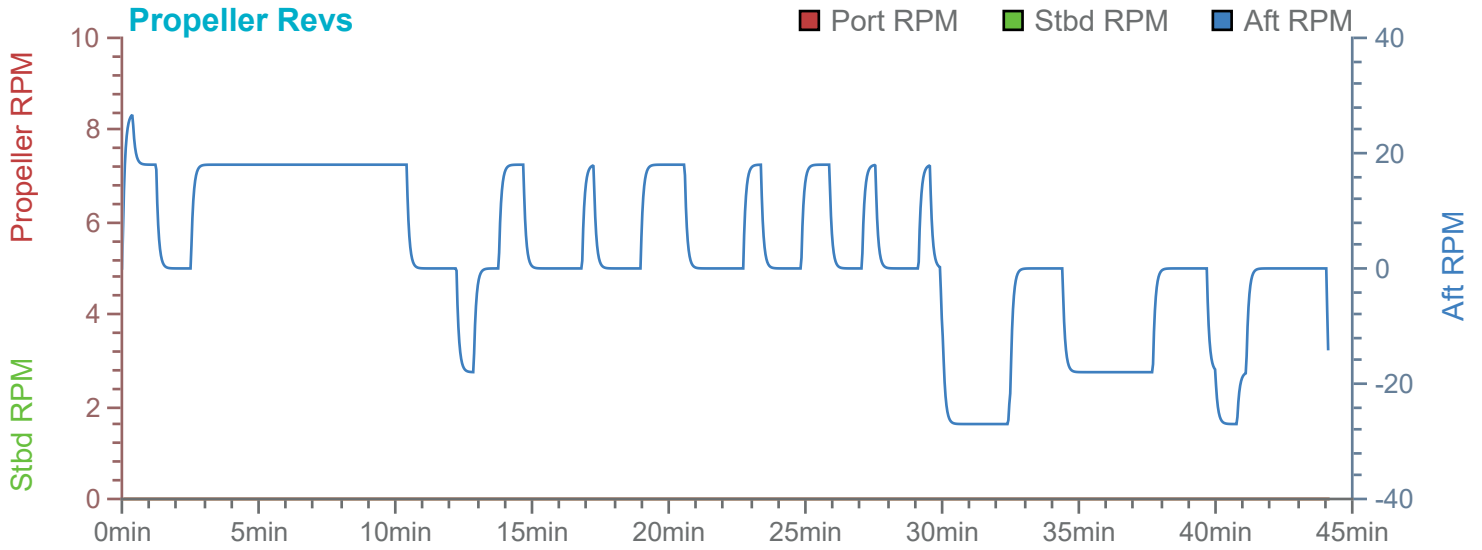
Ships plotted every 59 seconds, highlight every 2 mins

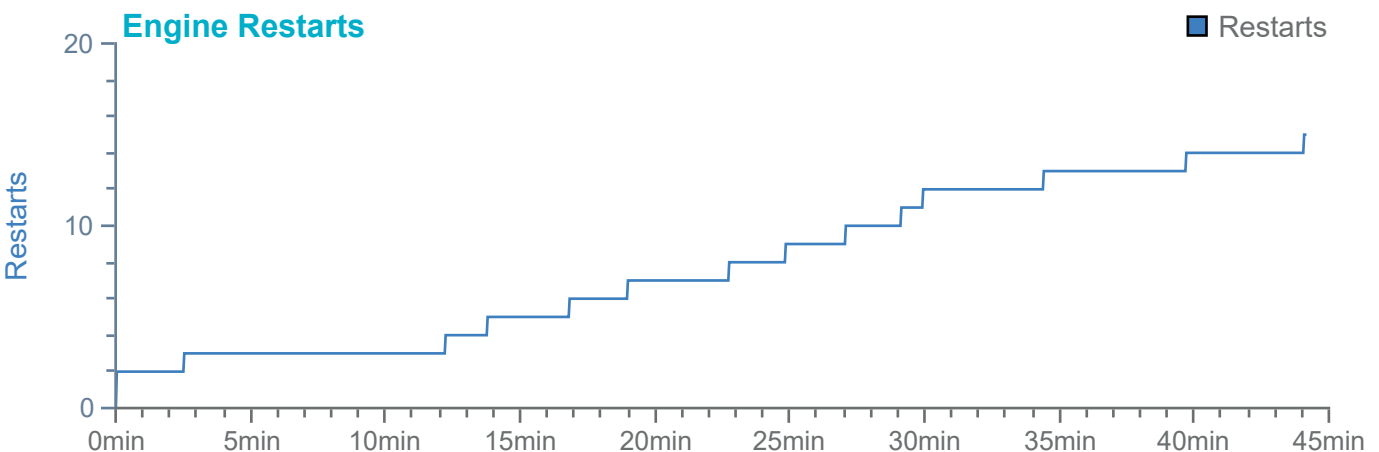
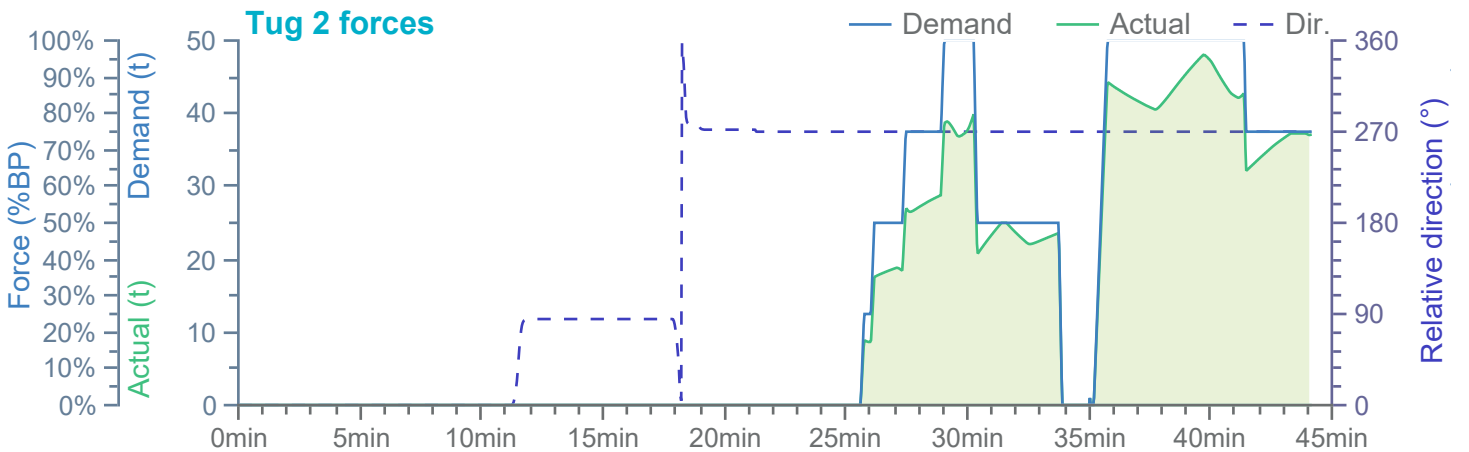
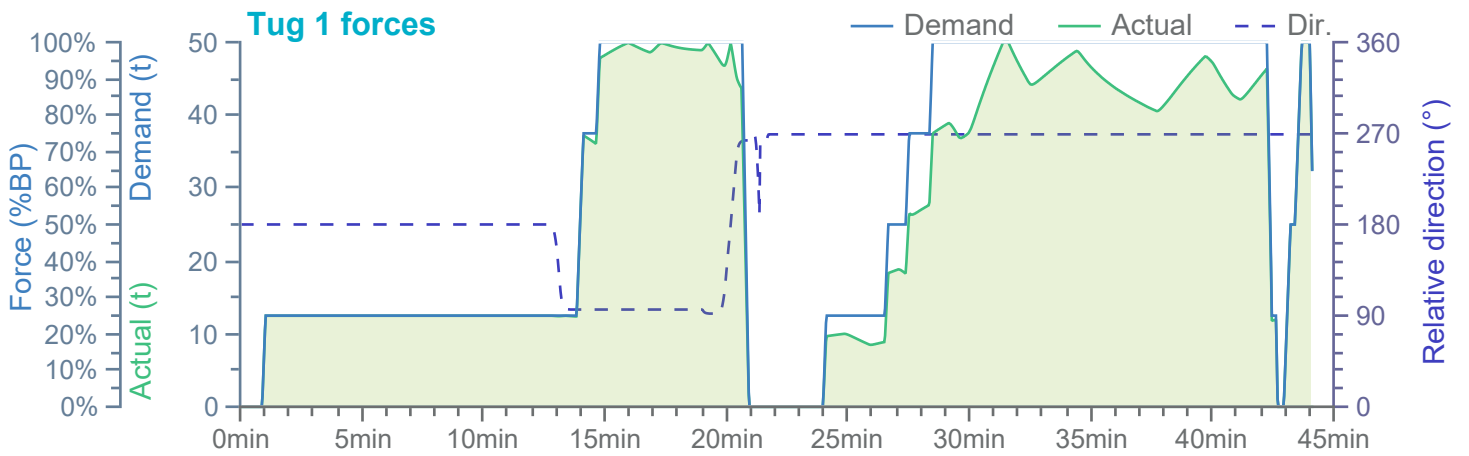
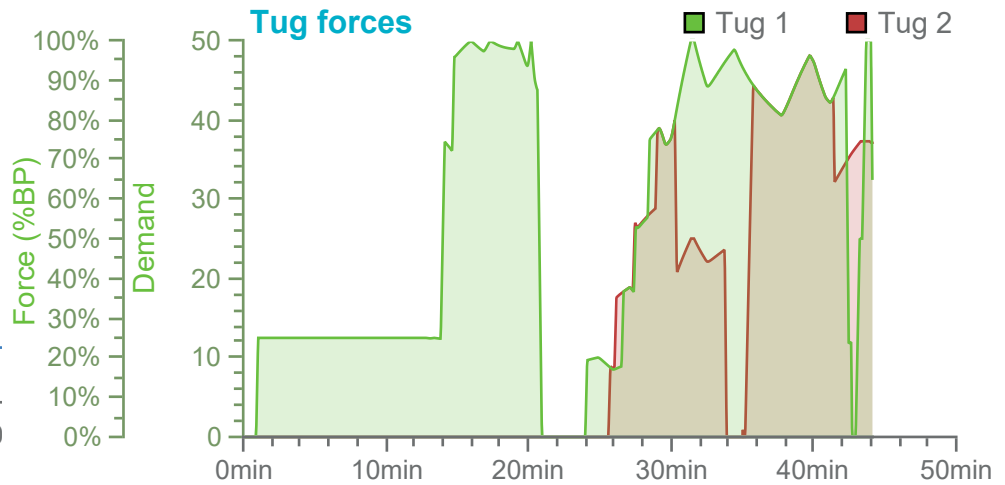
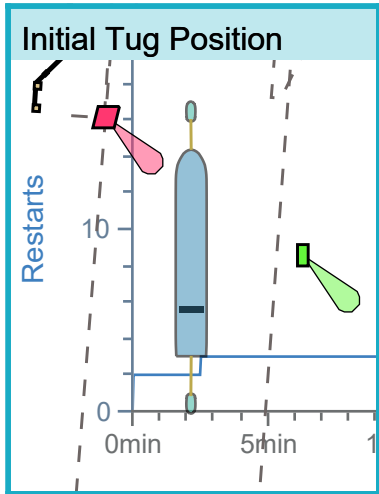






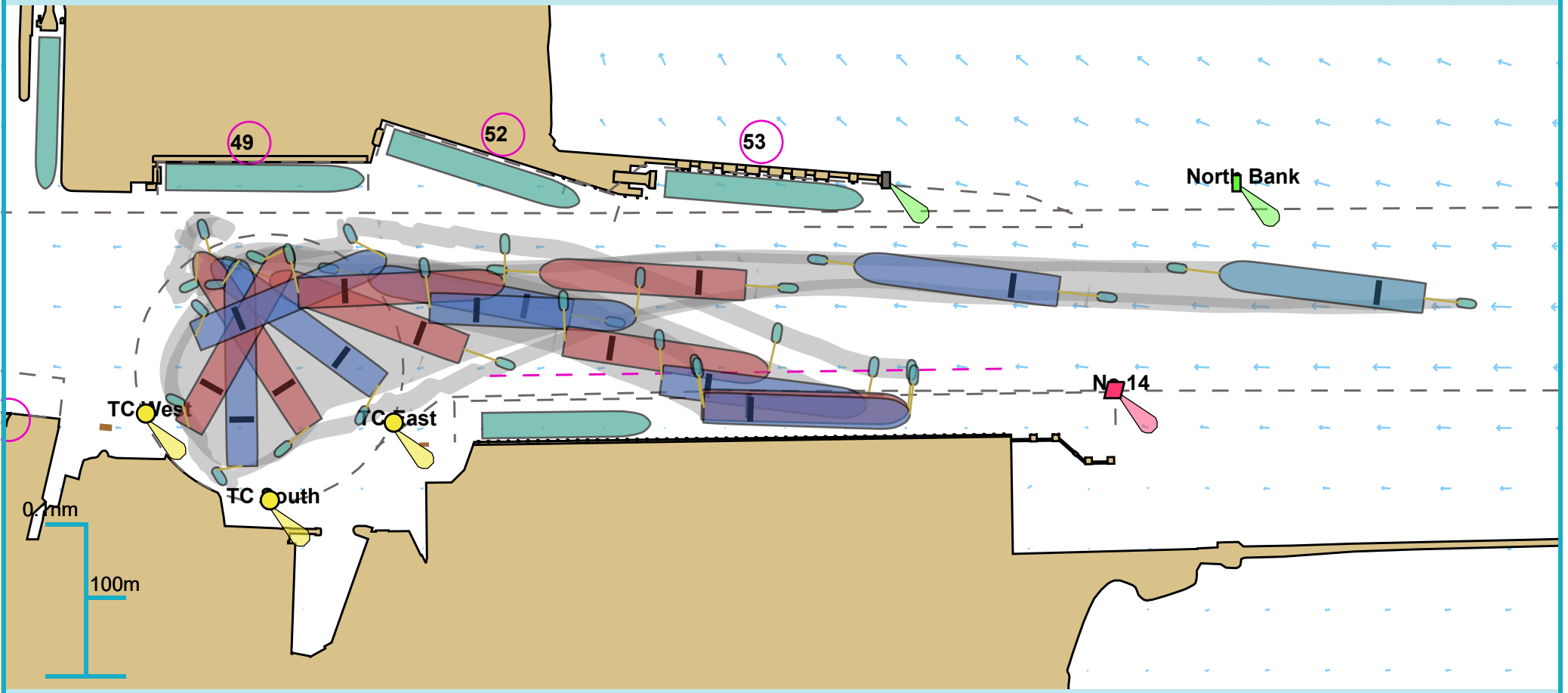






Full Run Overview

53° 20.329 N, 006° 11.937 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

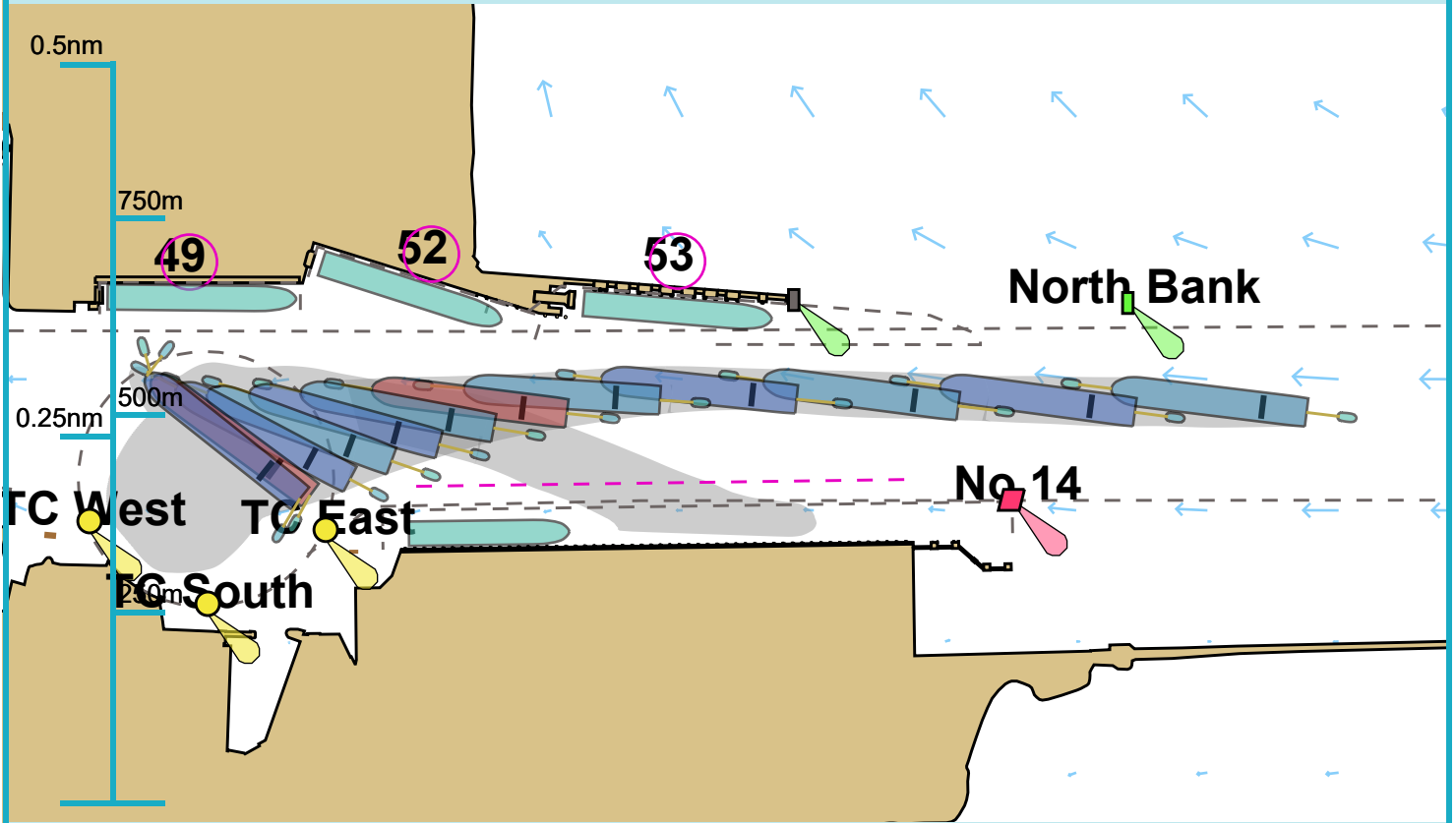
Run length:29 minutes

Manoeuvre:Other

Ownship(s):250m Container

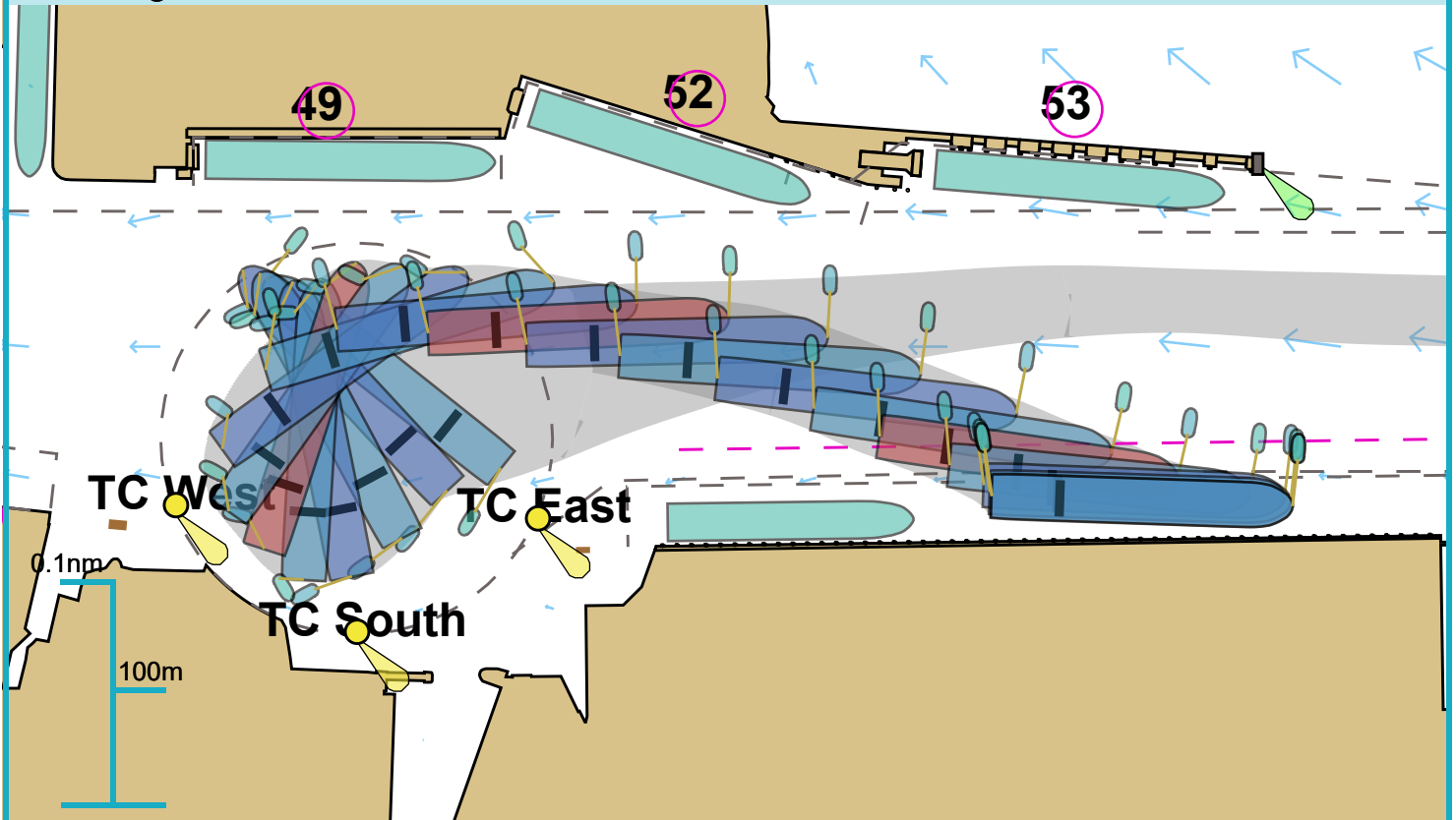
Comments:

Approach



Ships plotted every 1 mins, highlight every 5 mins

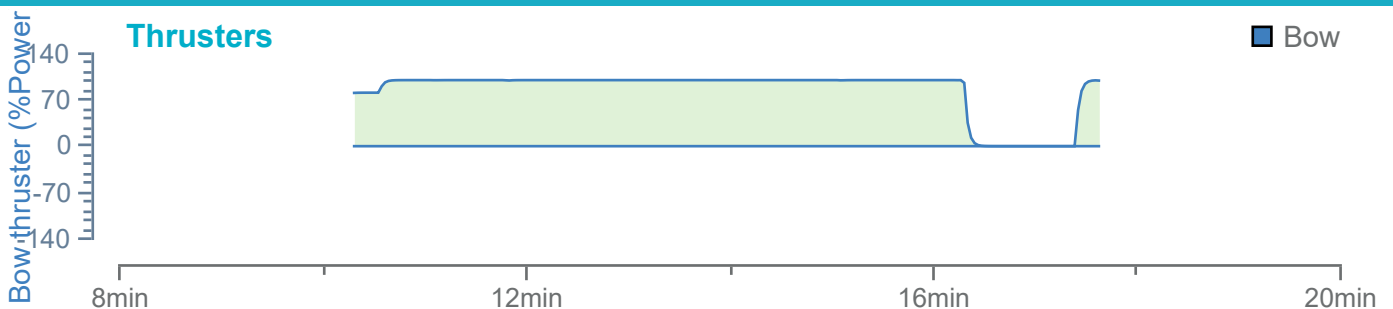
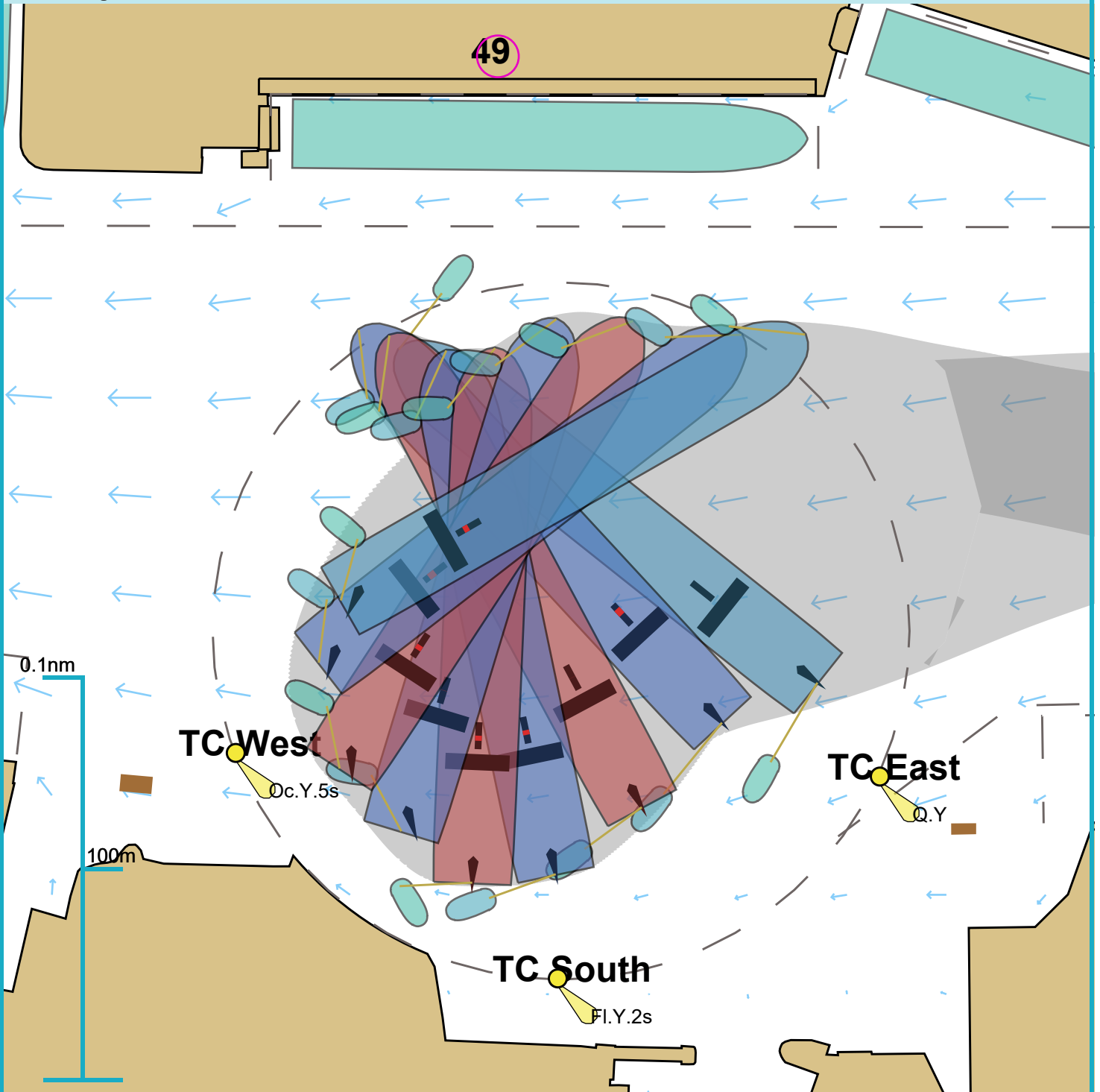
Berthing

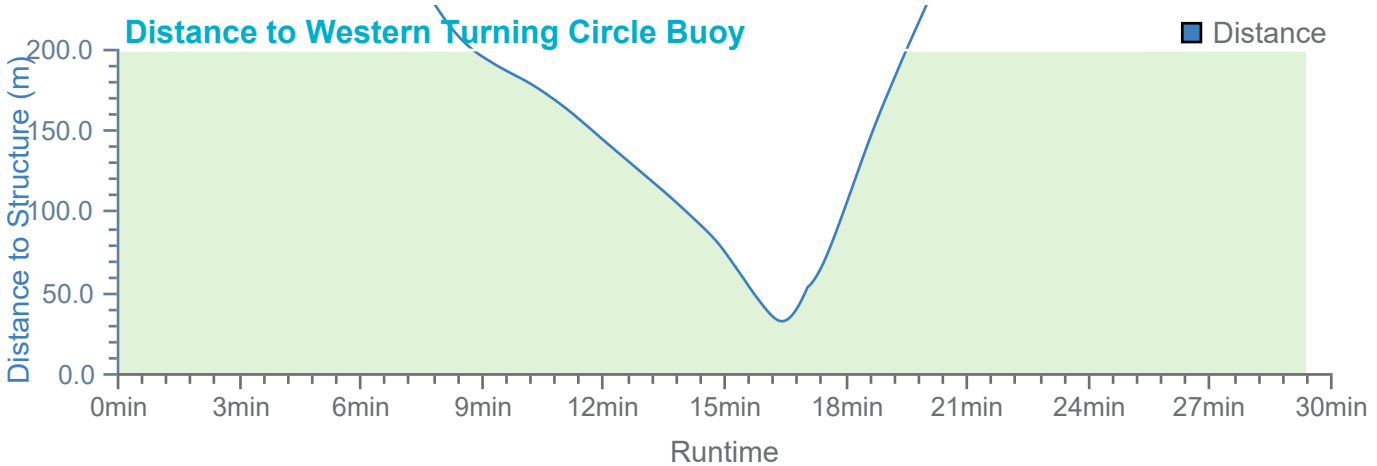
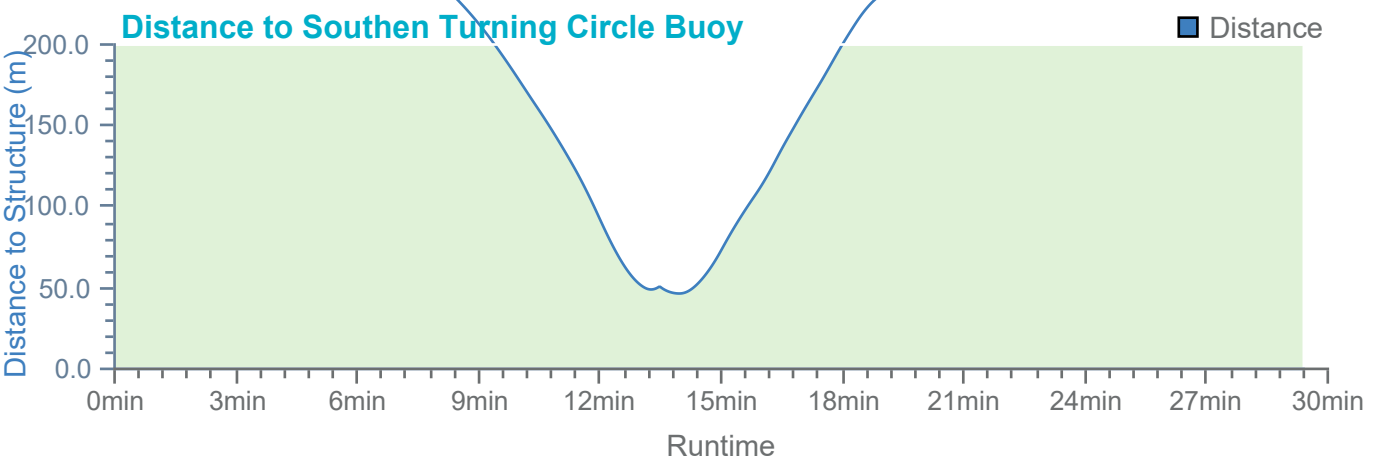
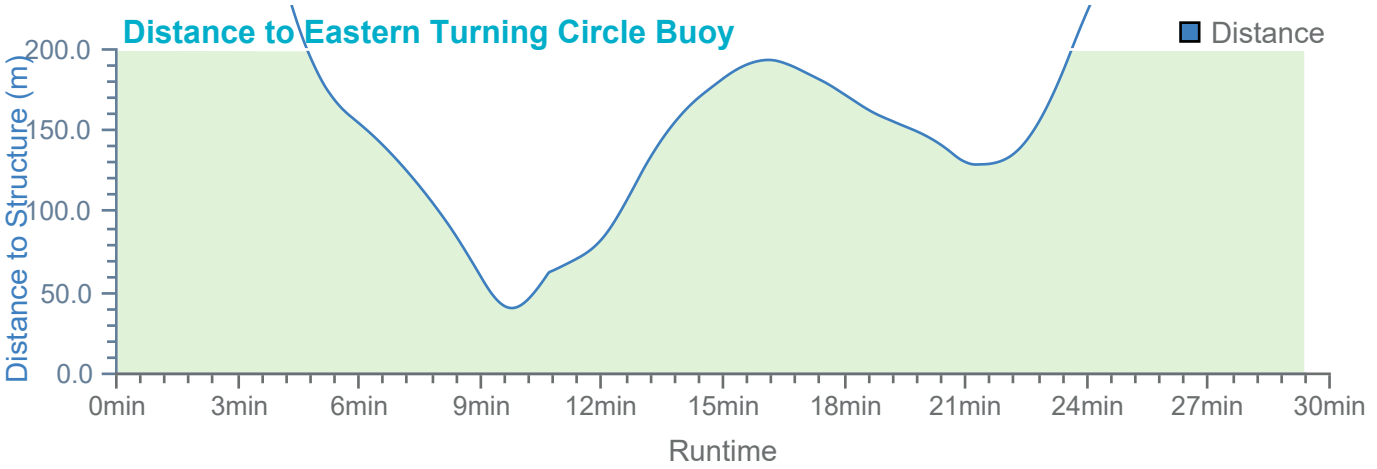
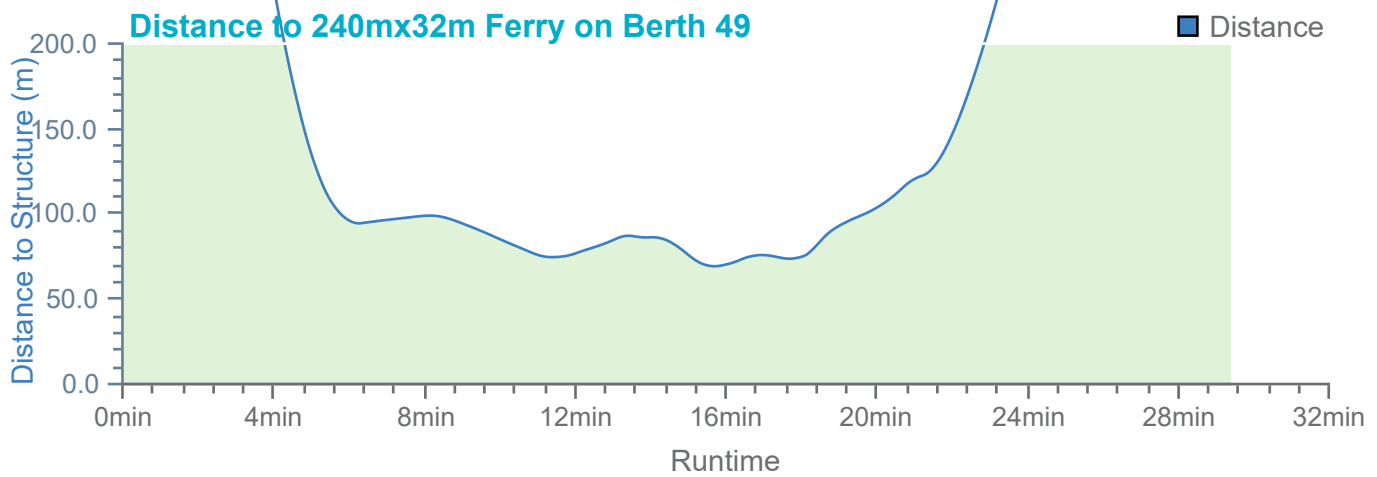


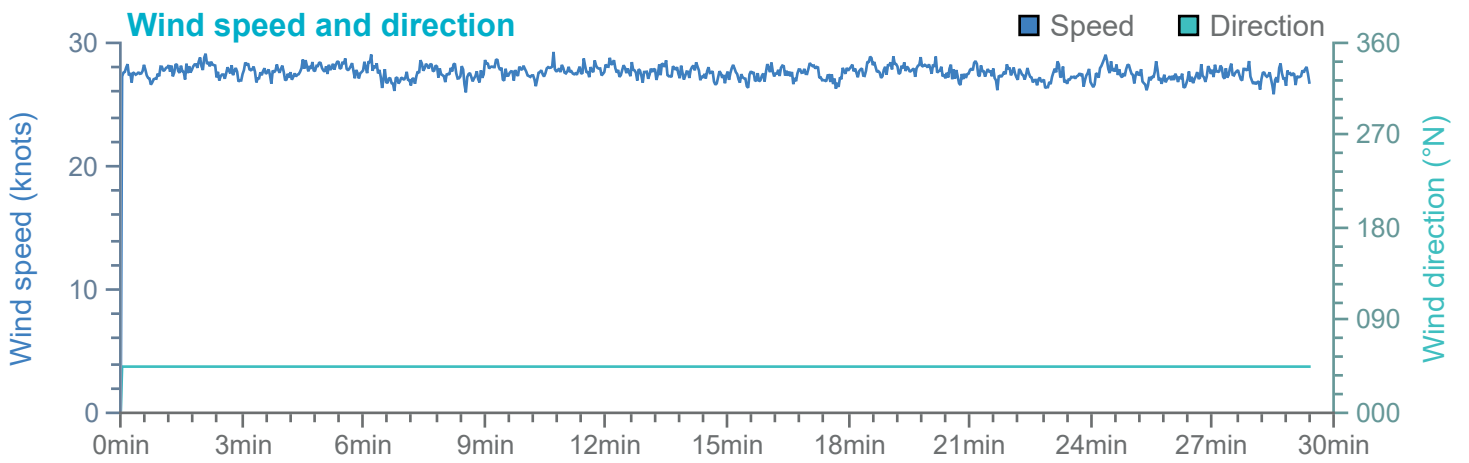
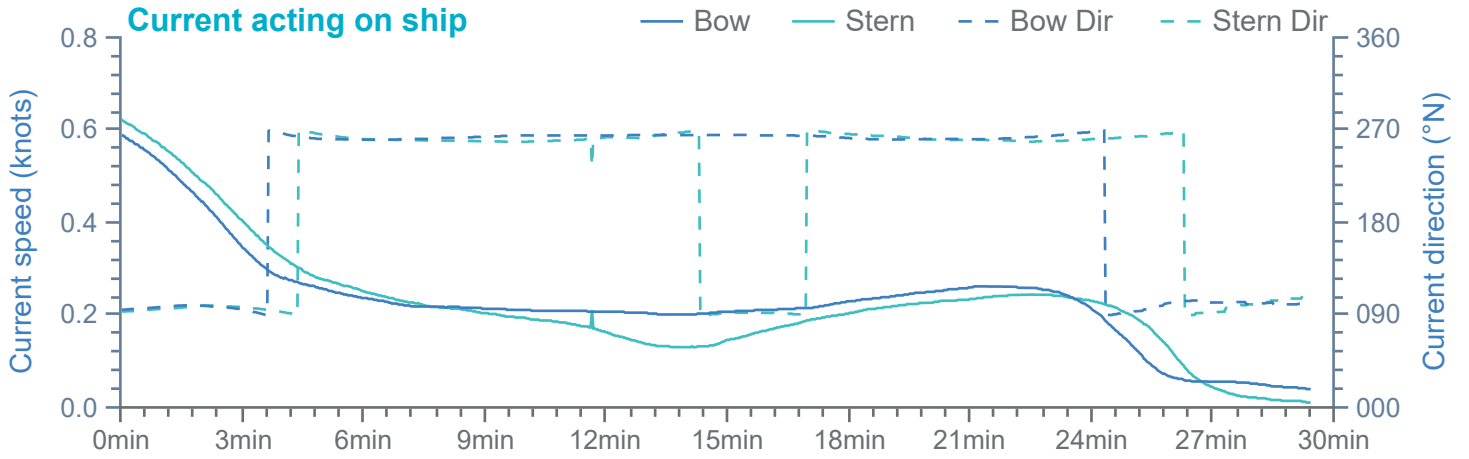
Ships plotted every 1 mins, highlight every 5 mins

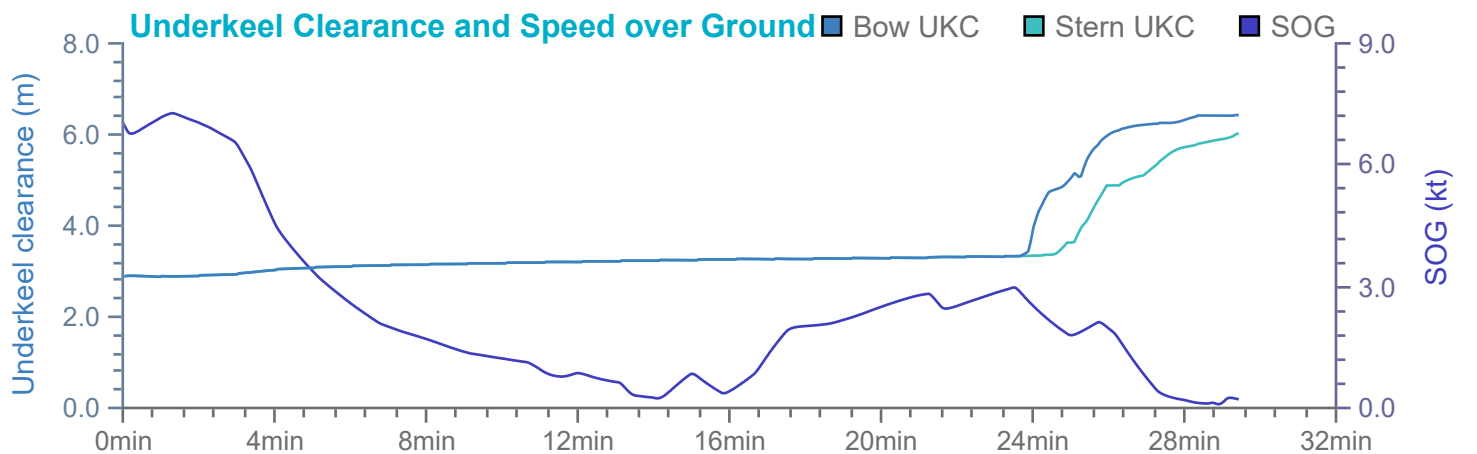
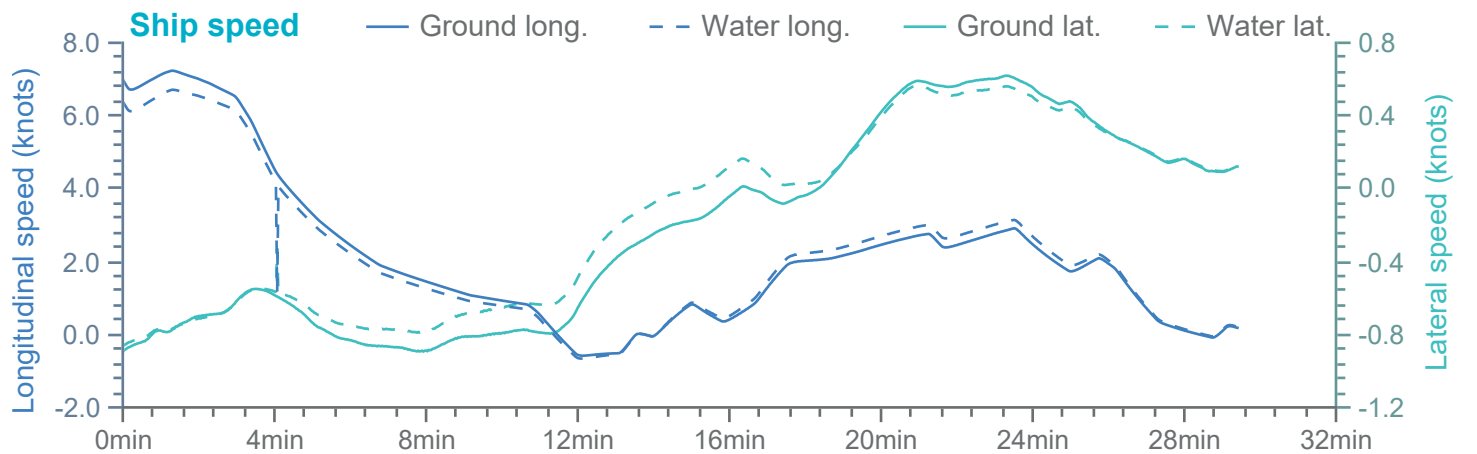
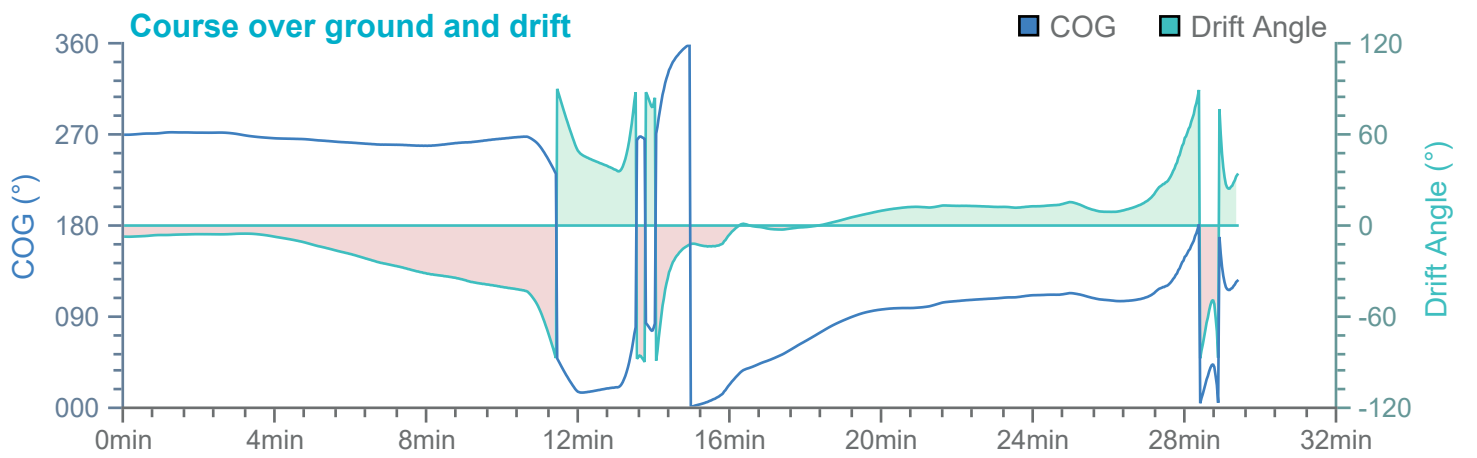
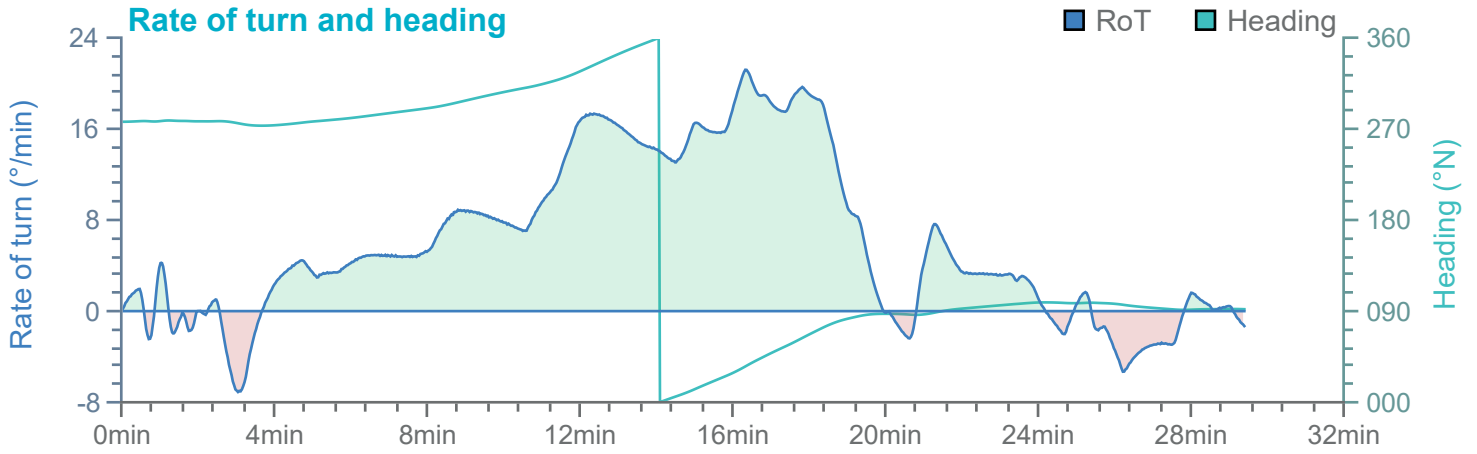
Swing

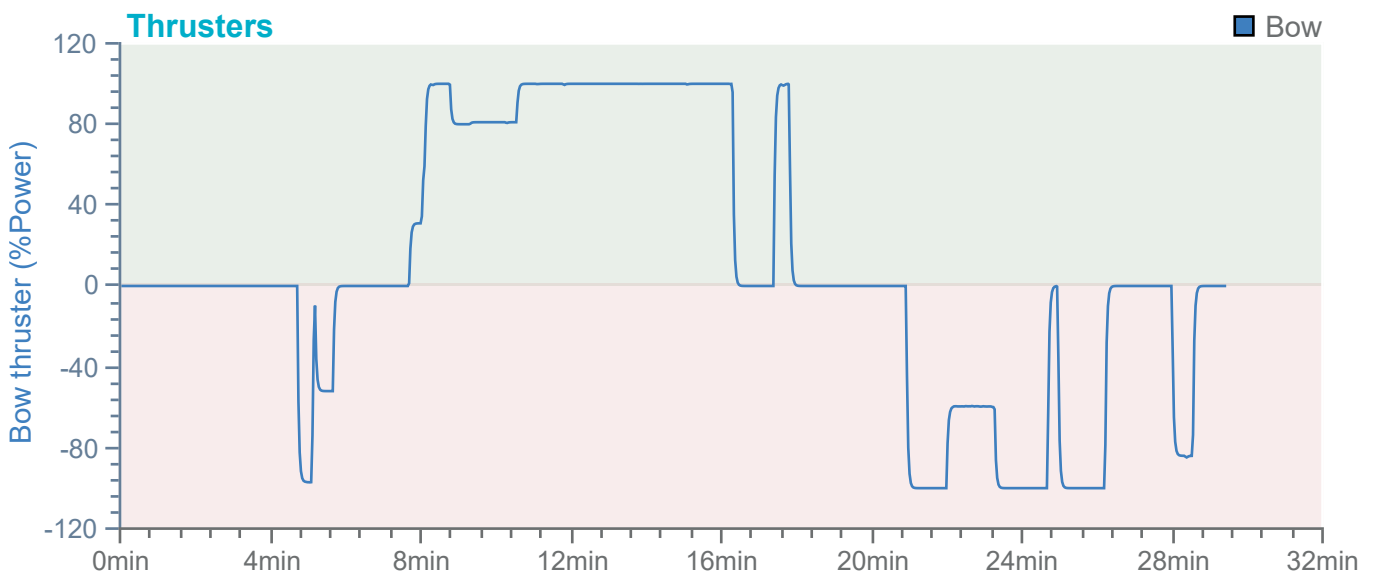
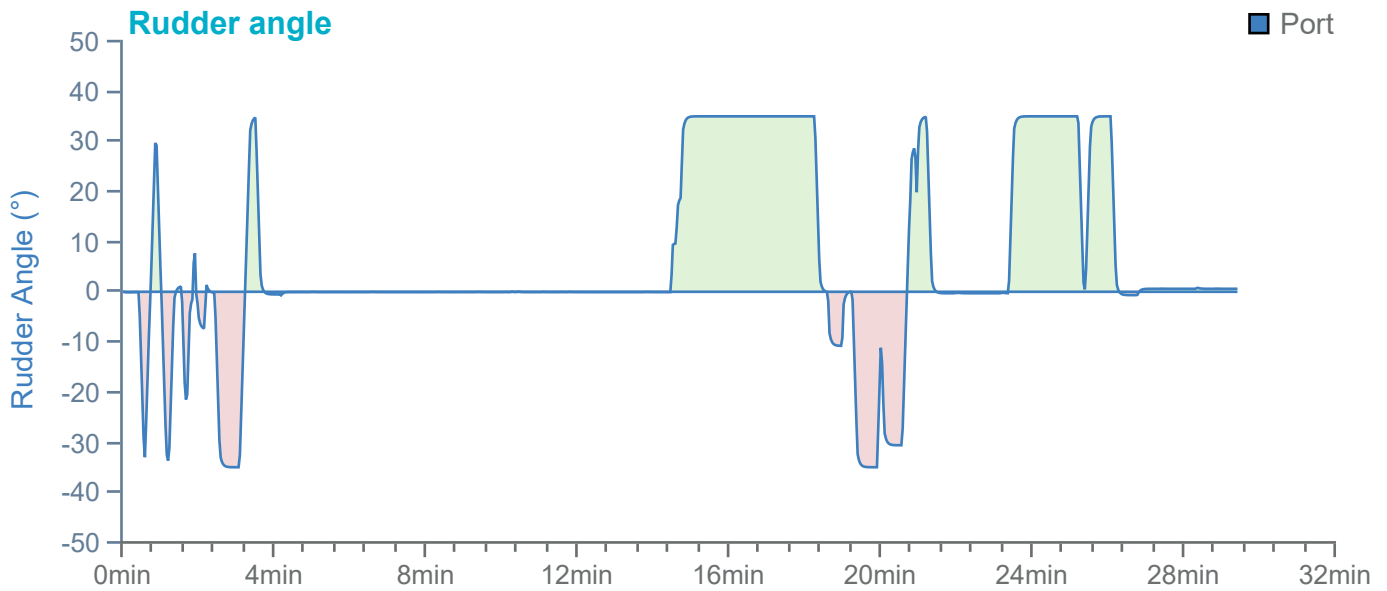
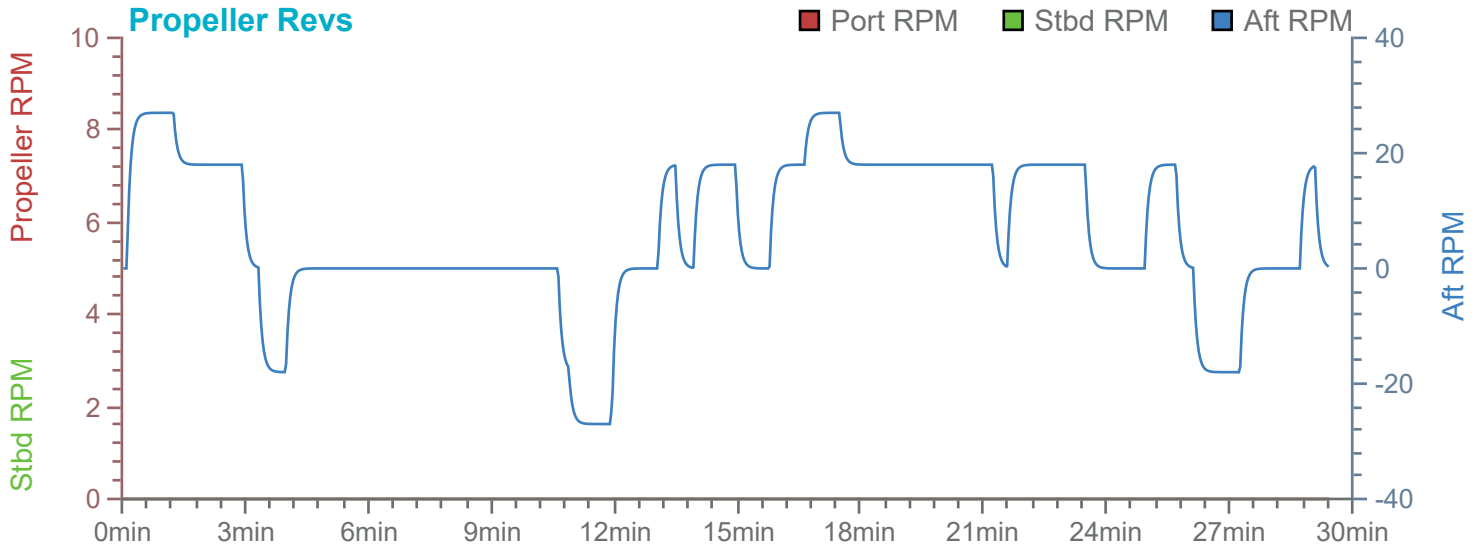
49

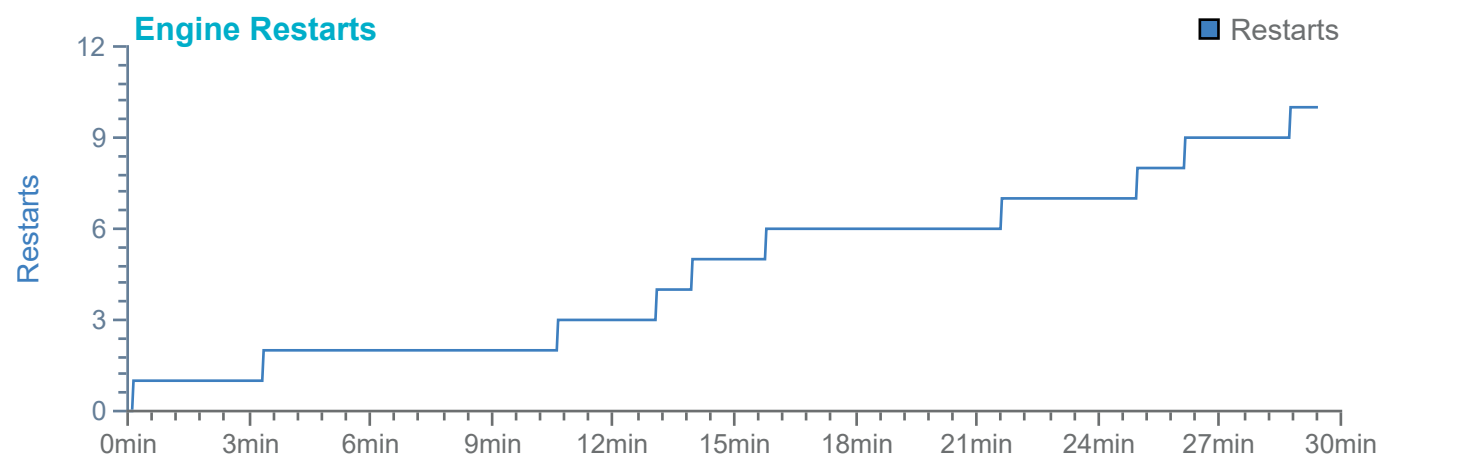
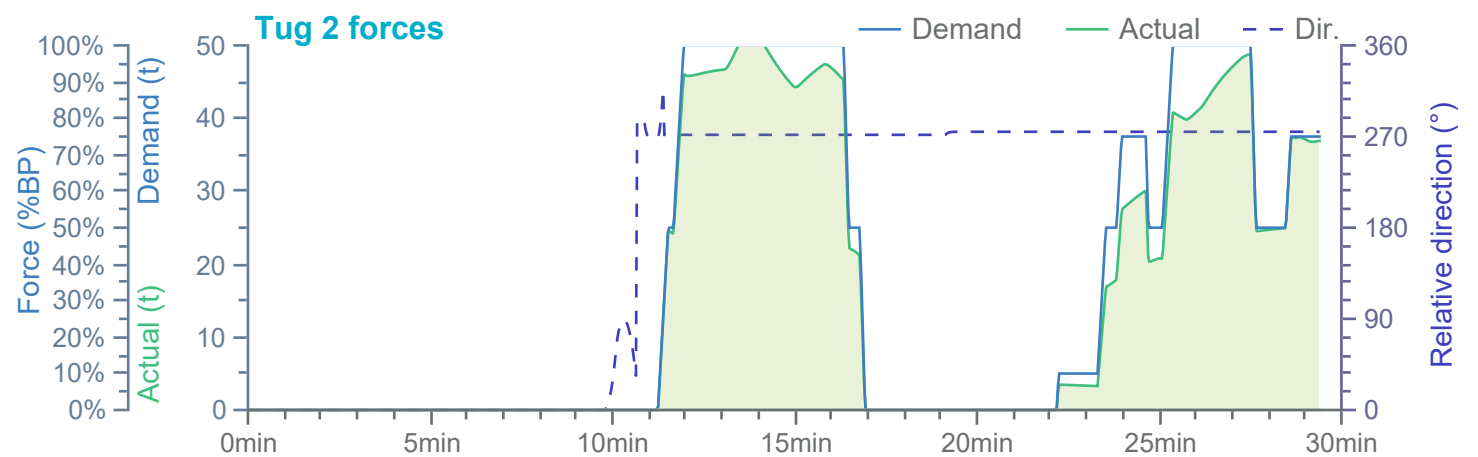
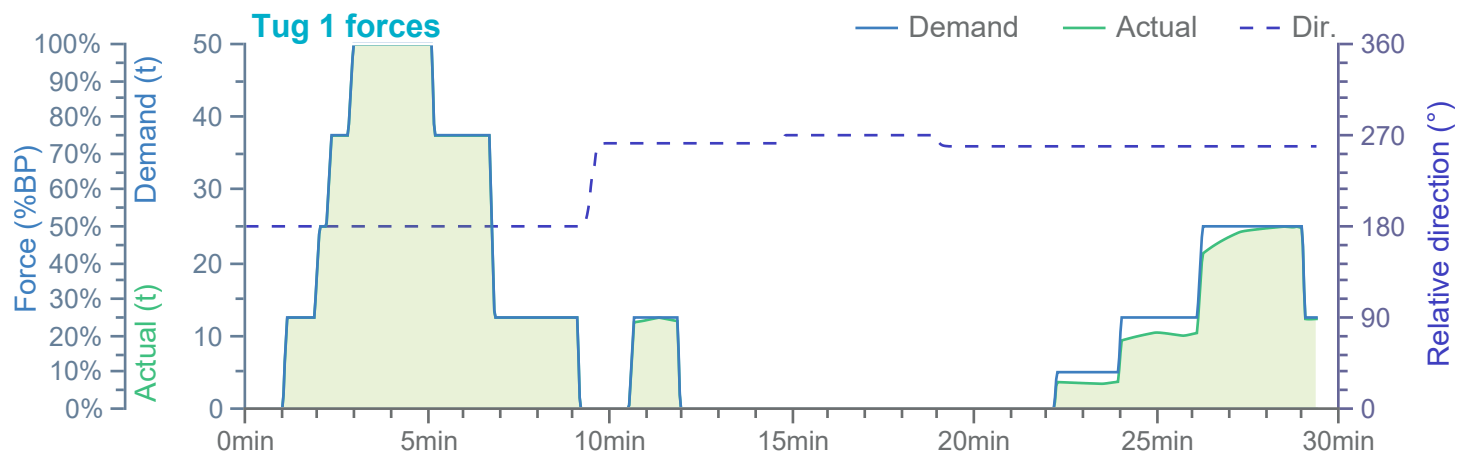
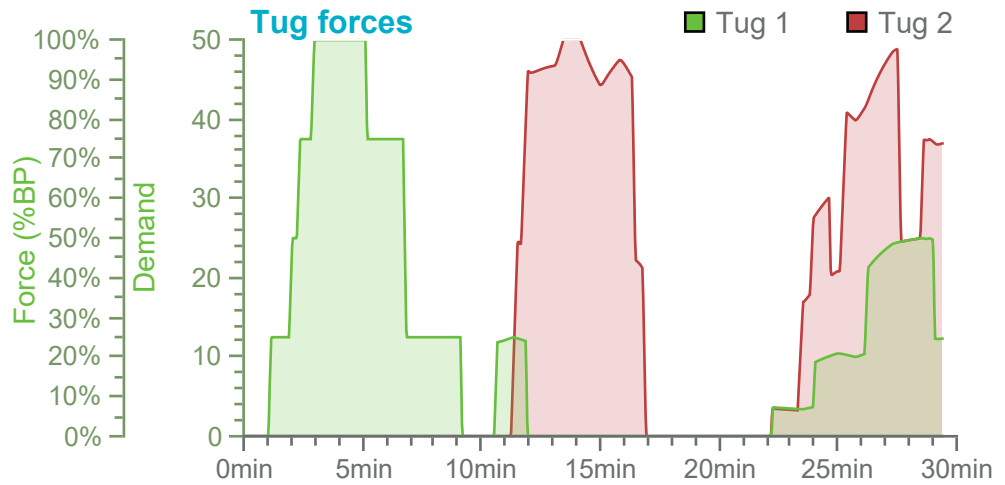
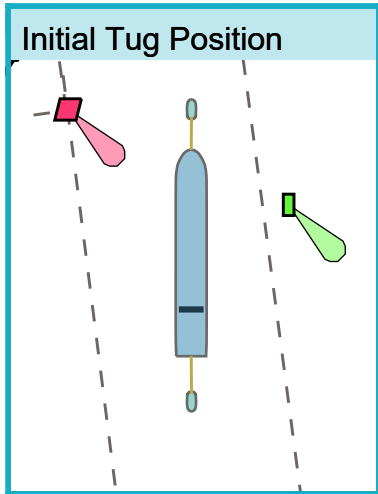






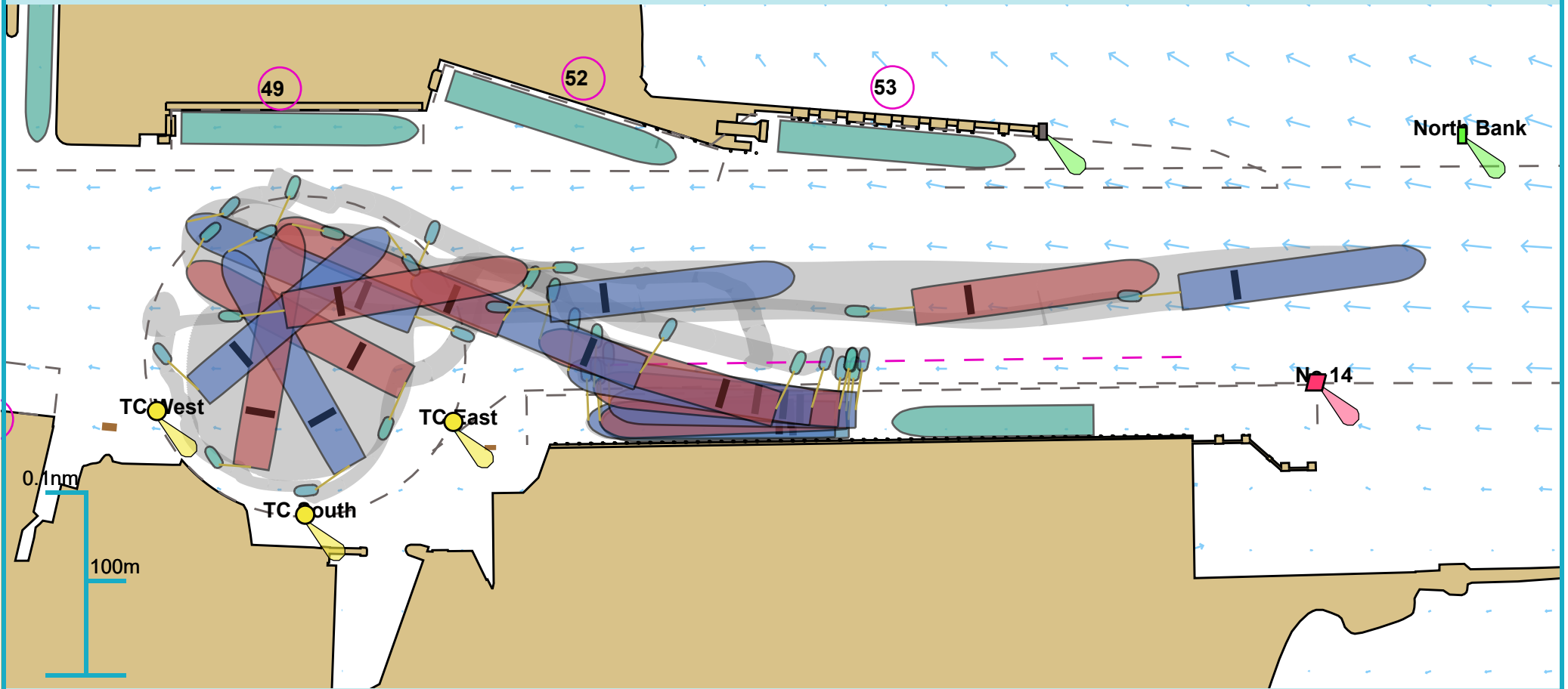






Full Run Overview

53° 20.363 N, 006° 11.921 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD

Run length: 34 minutes

Manoeuvre: Other

Ownship(s): 250m Container

Comments:

Overview

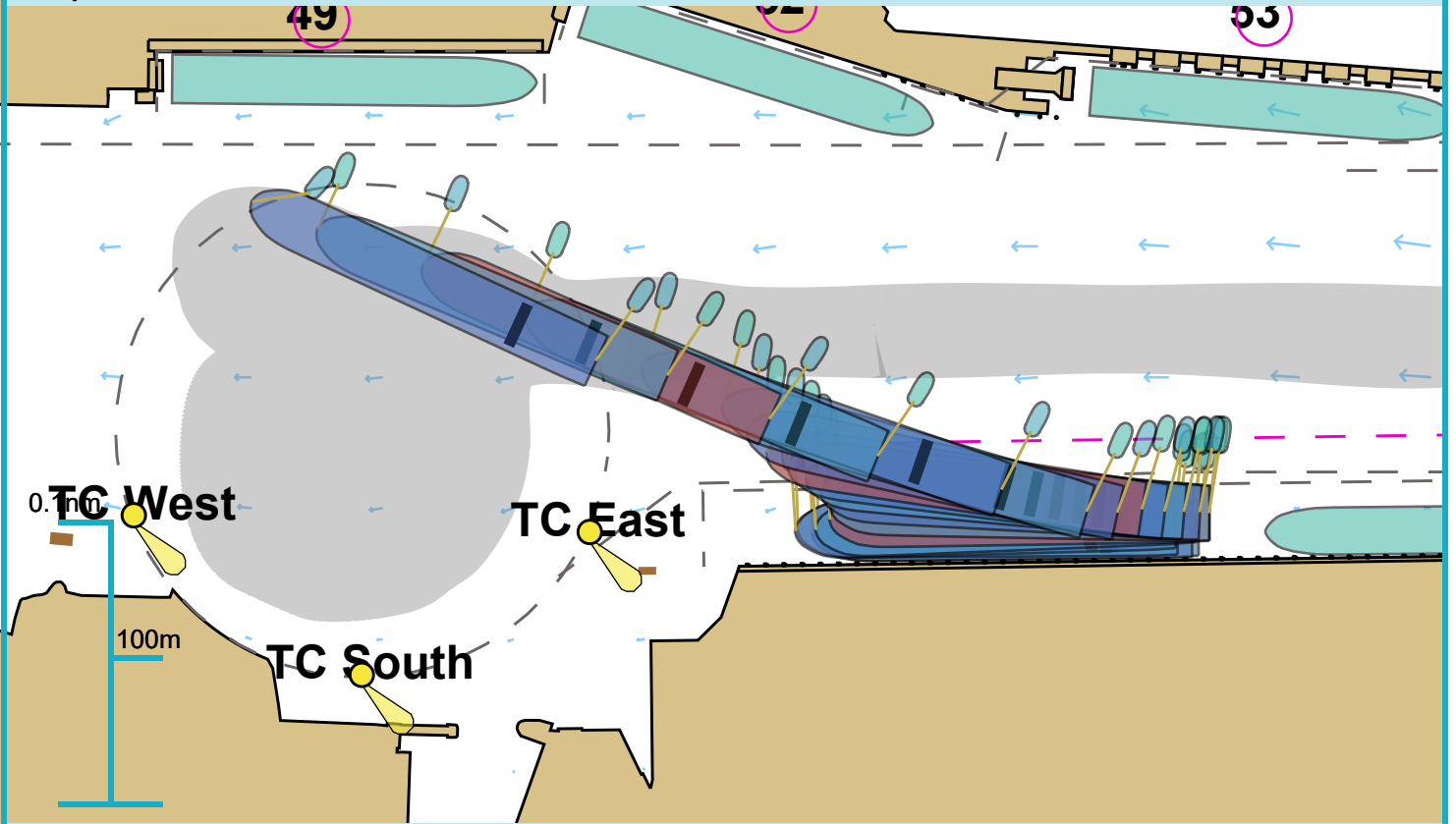
Environment

250m Container

Thruster and engine use

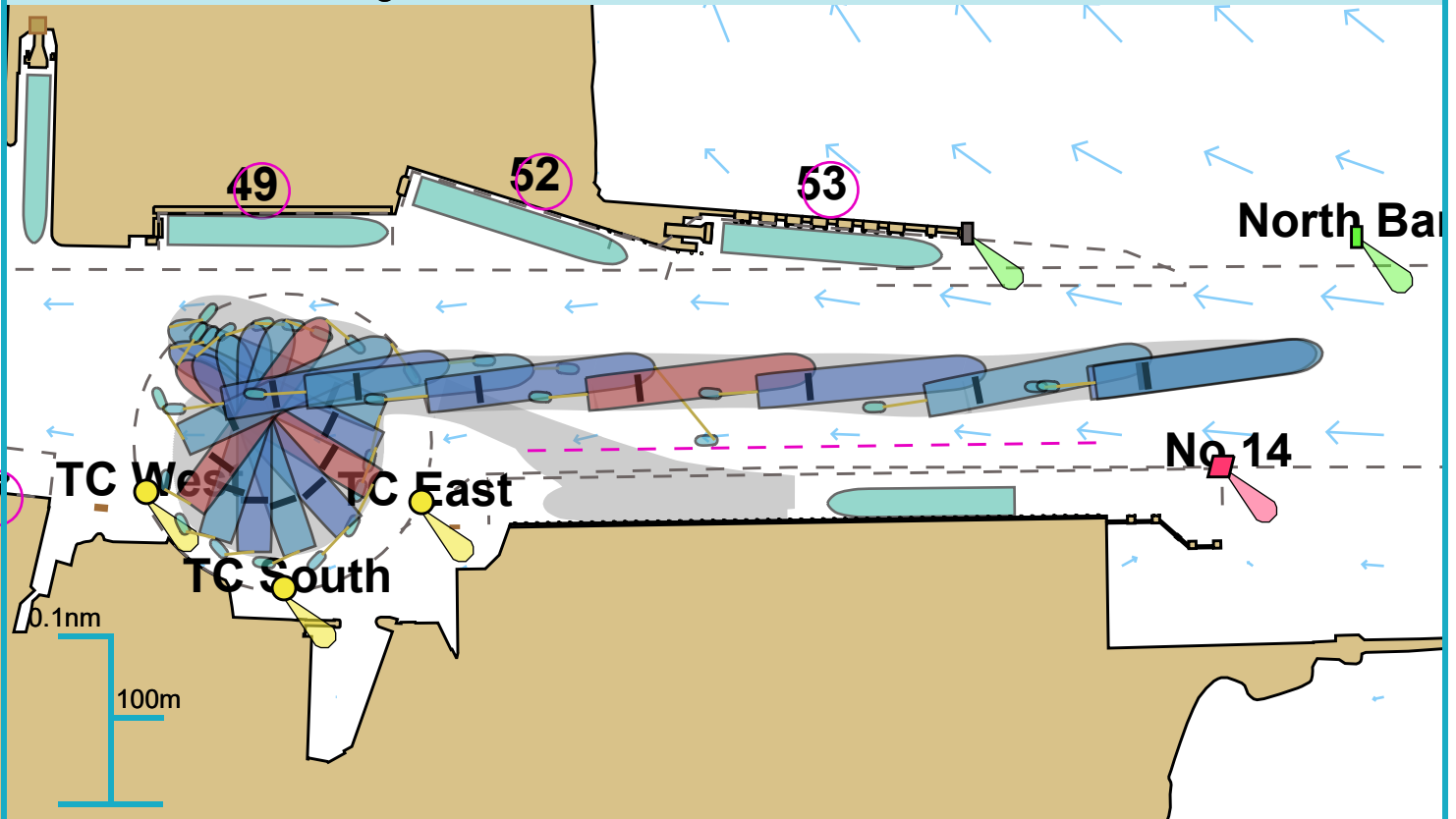
Tug use

Departure



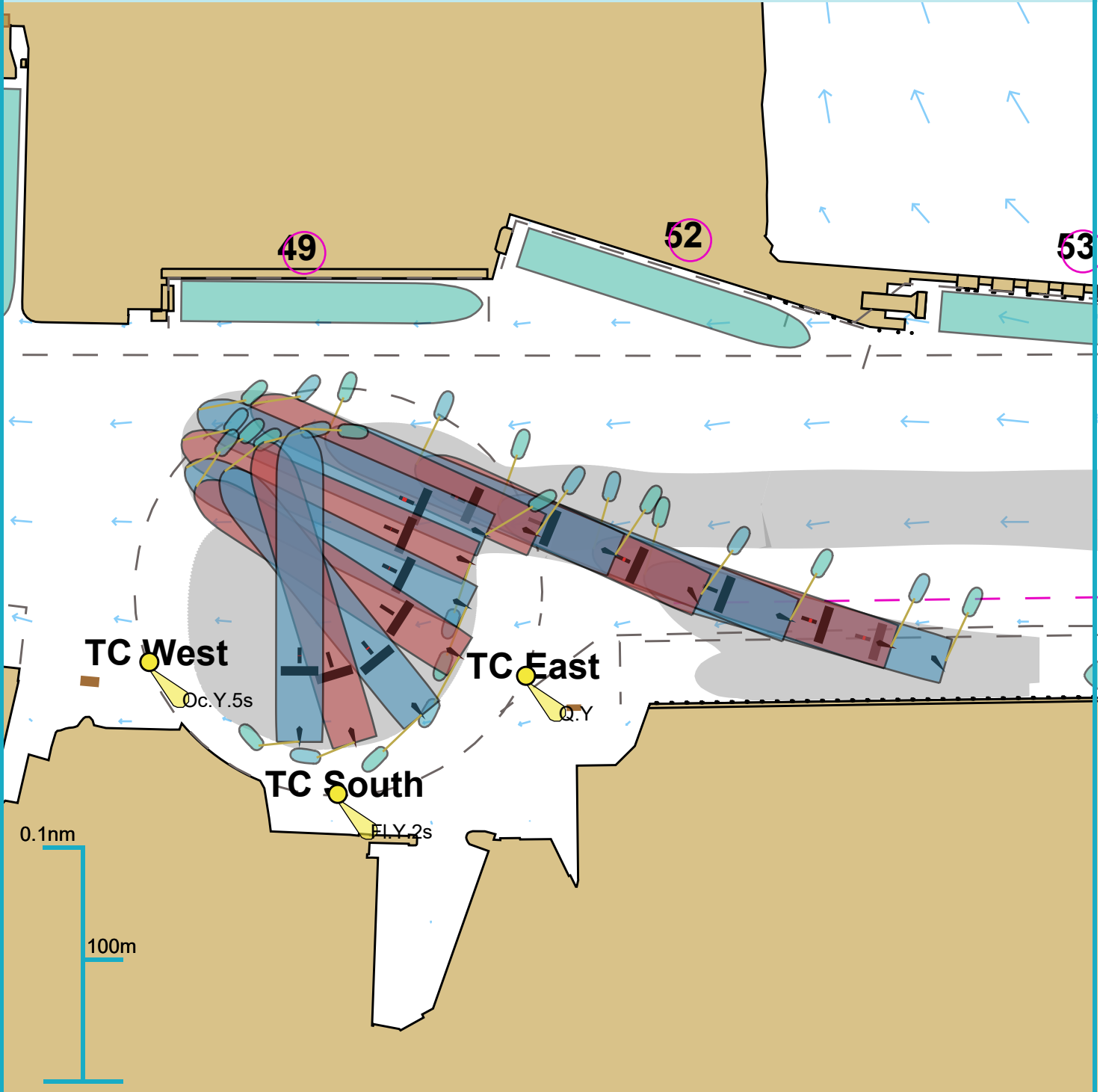
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

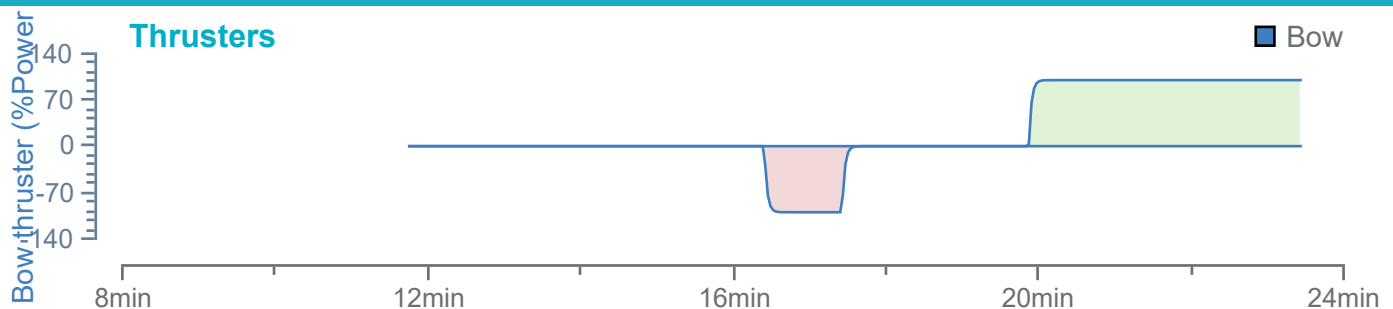


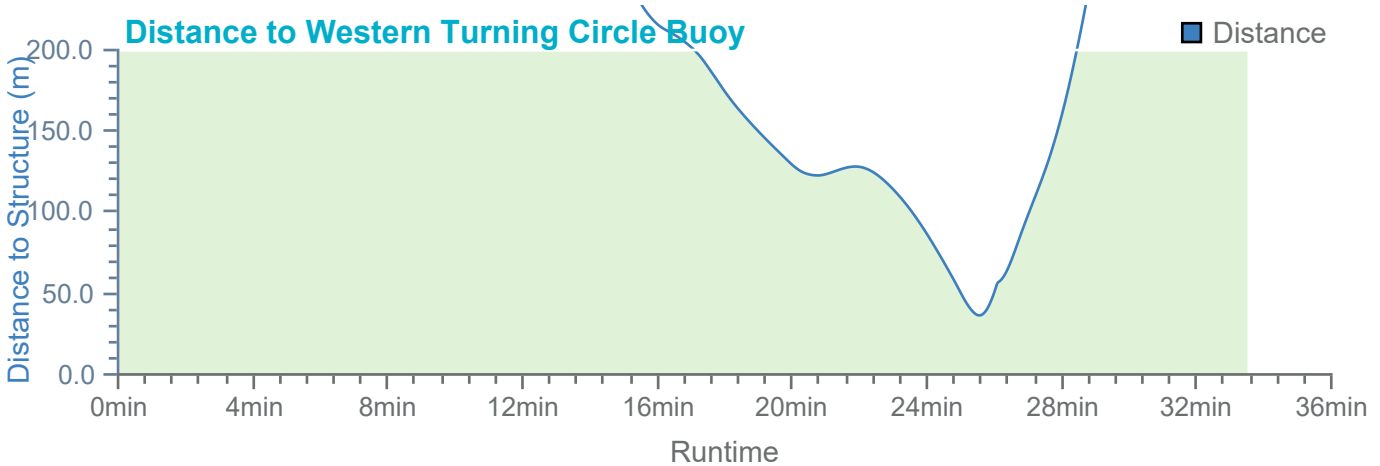
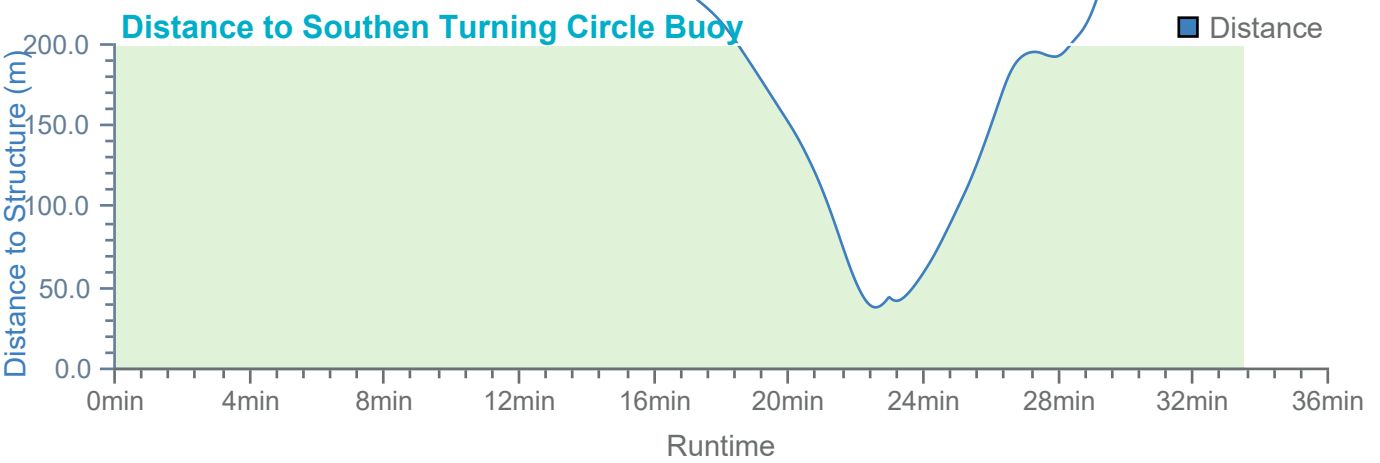
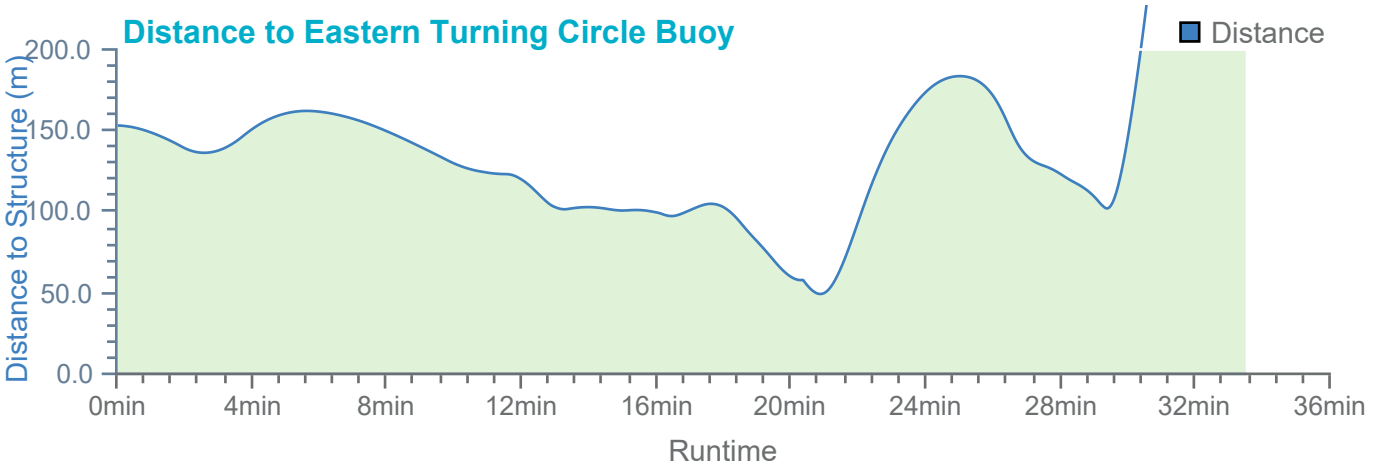
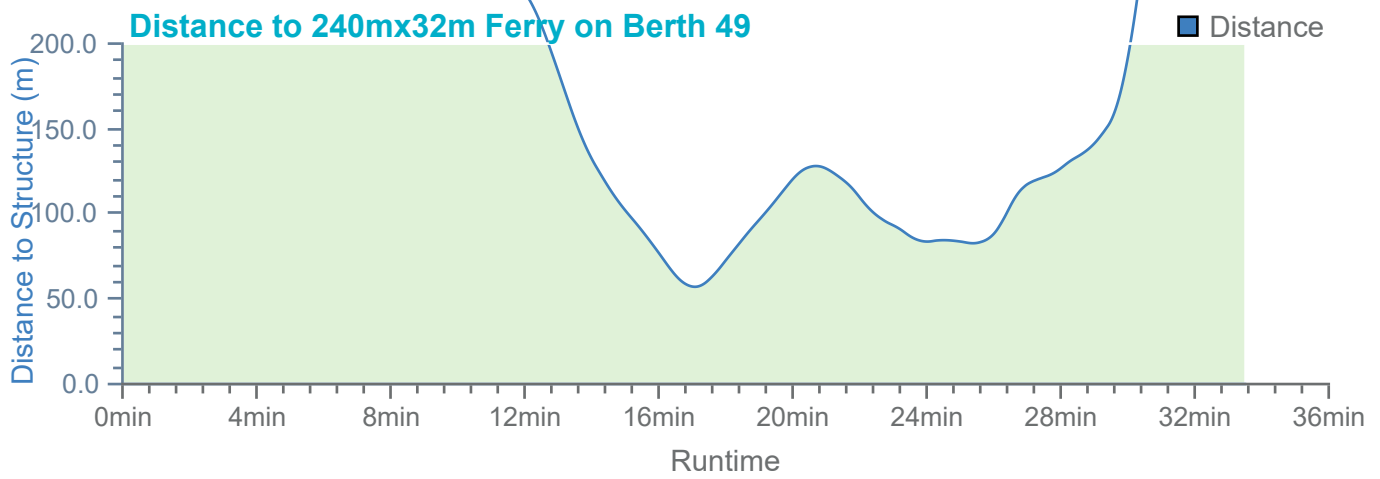
Ships plotted every 1 mins, highlight every 5 mins

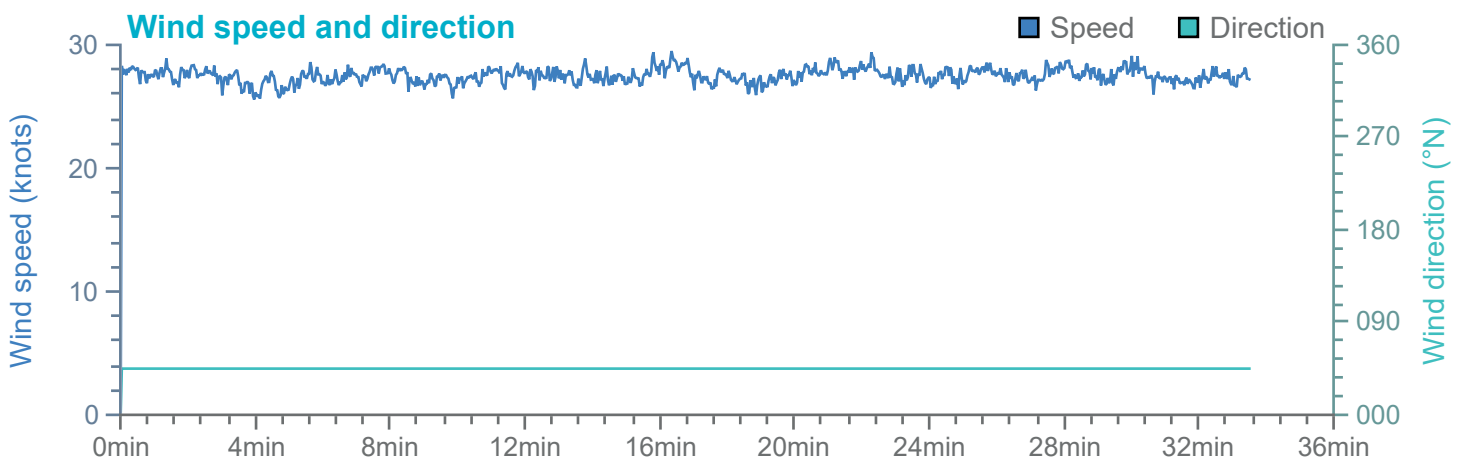
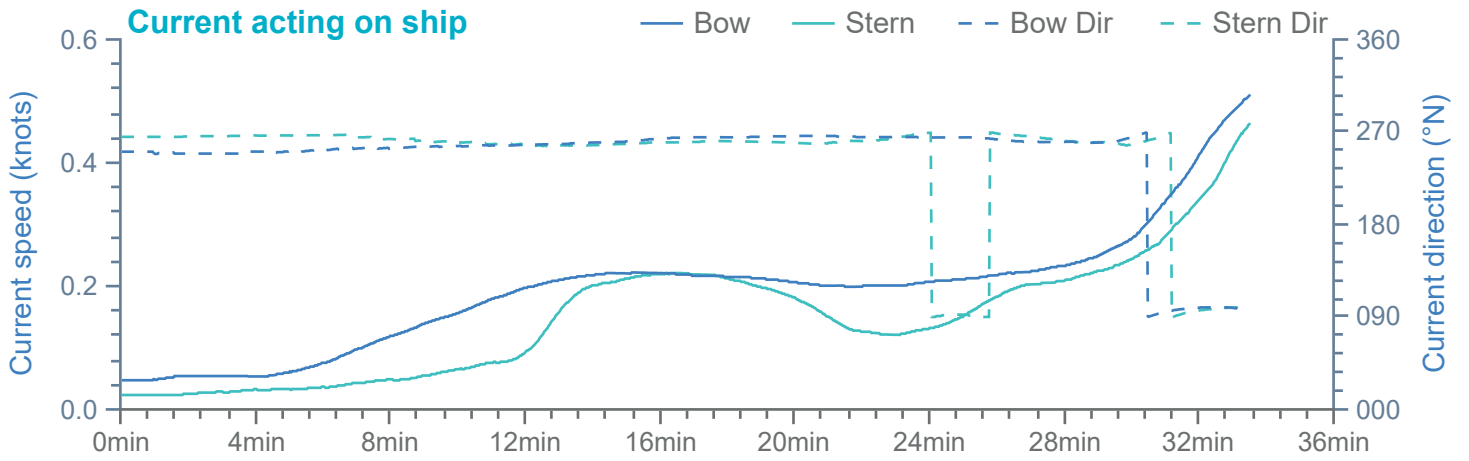
Swing

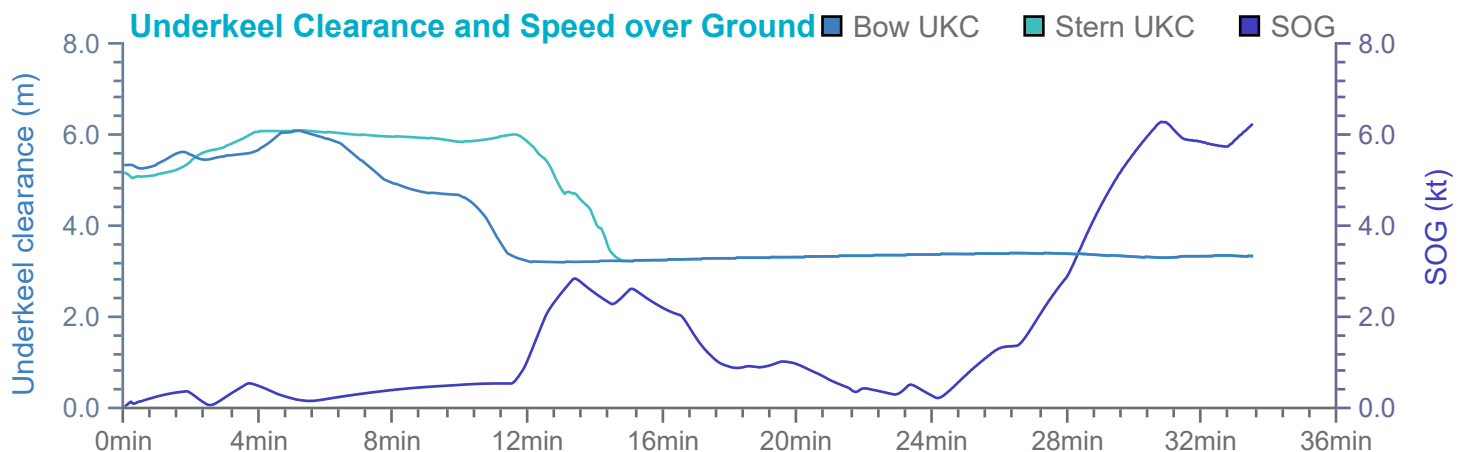
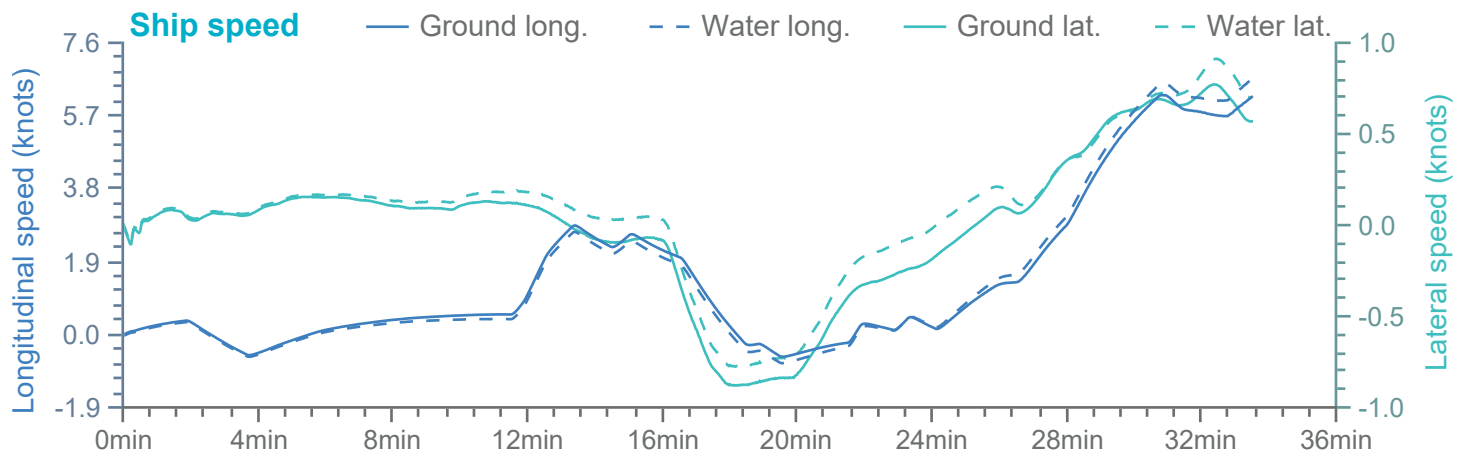
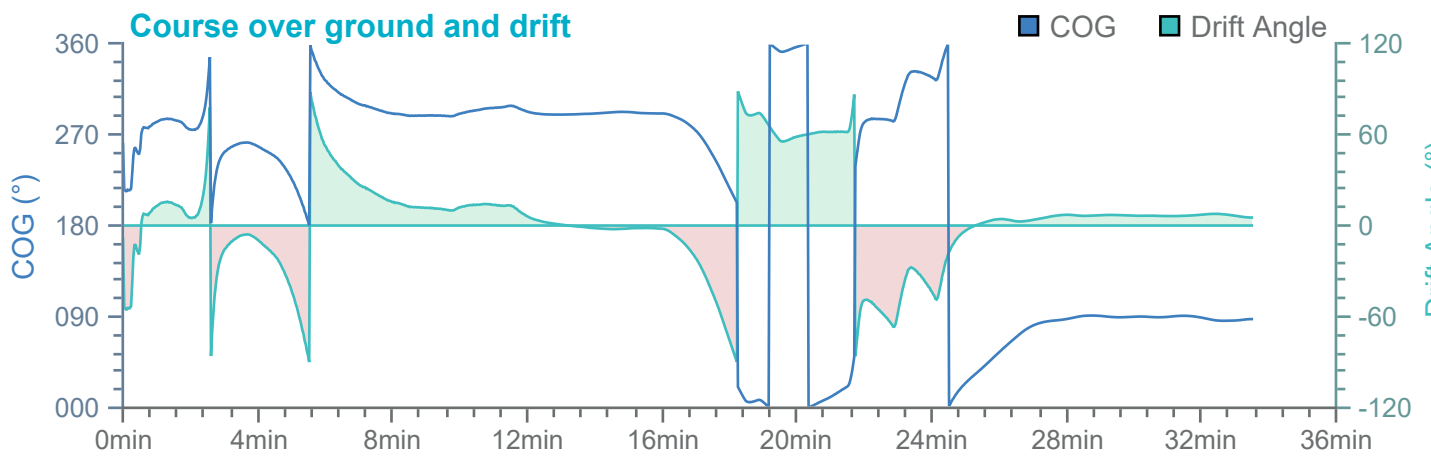
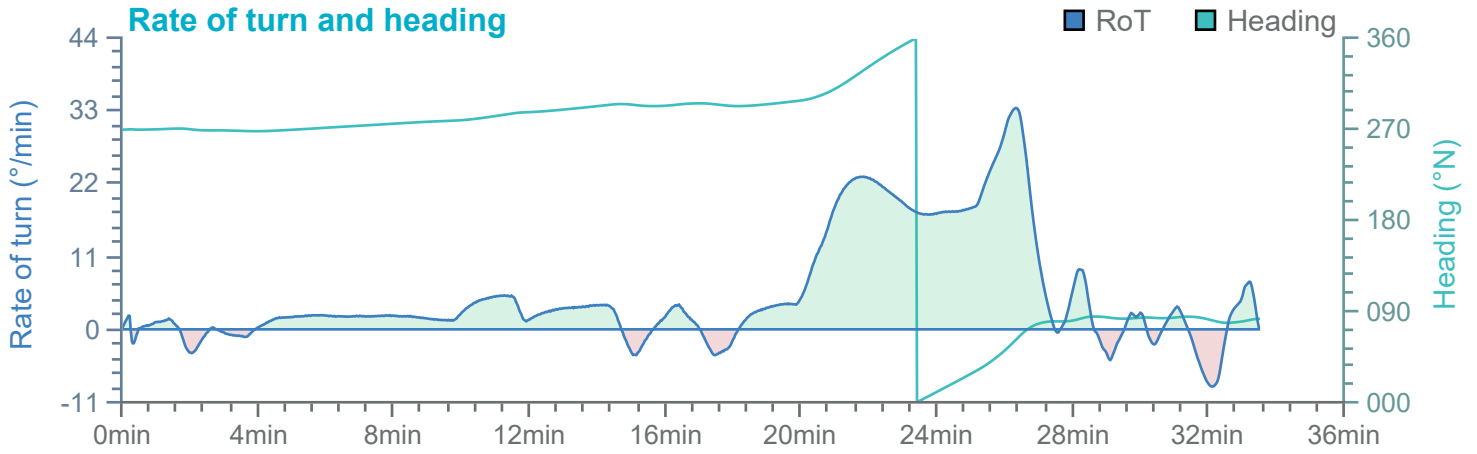


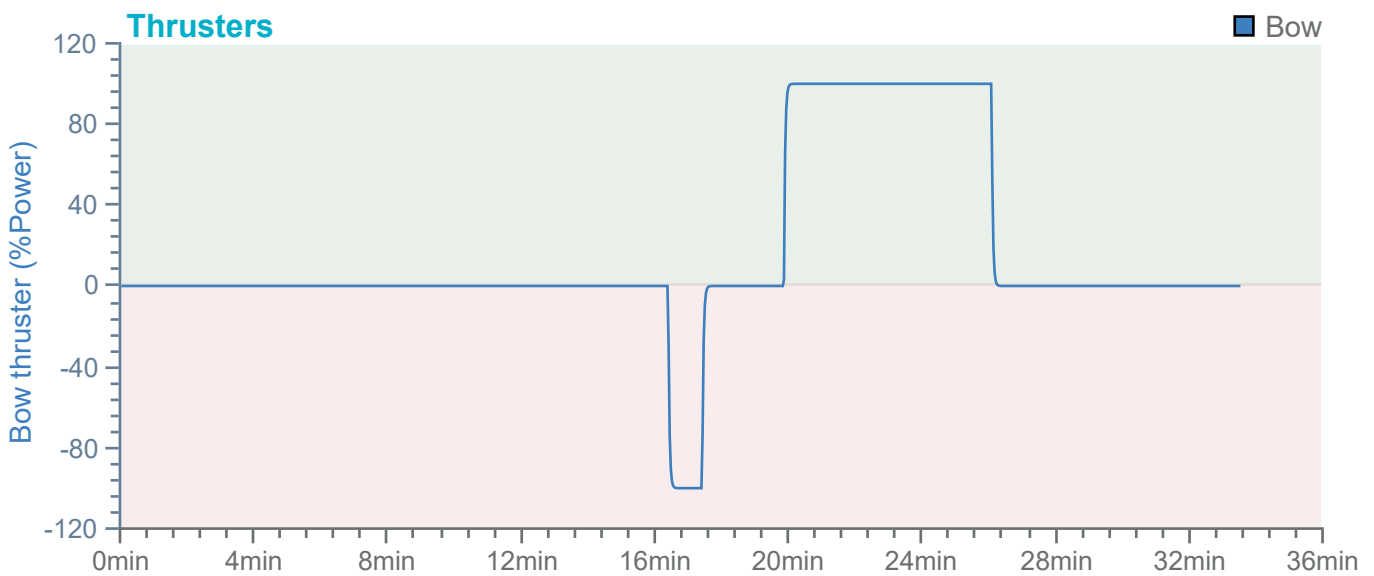
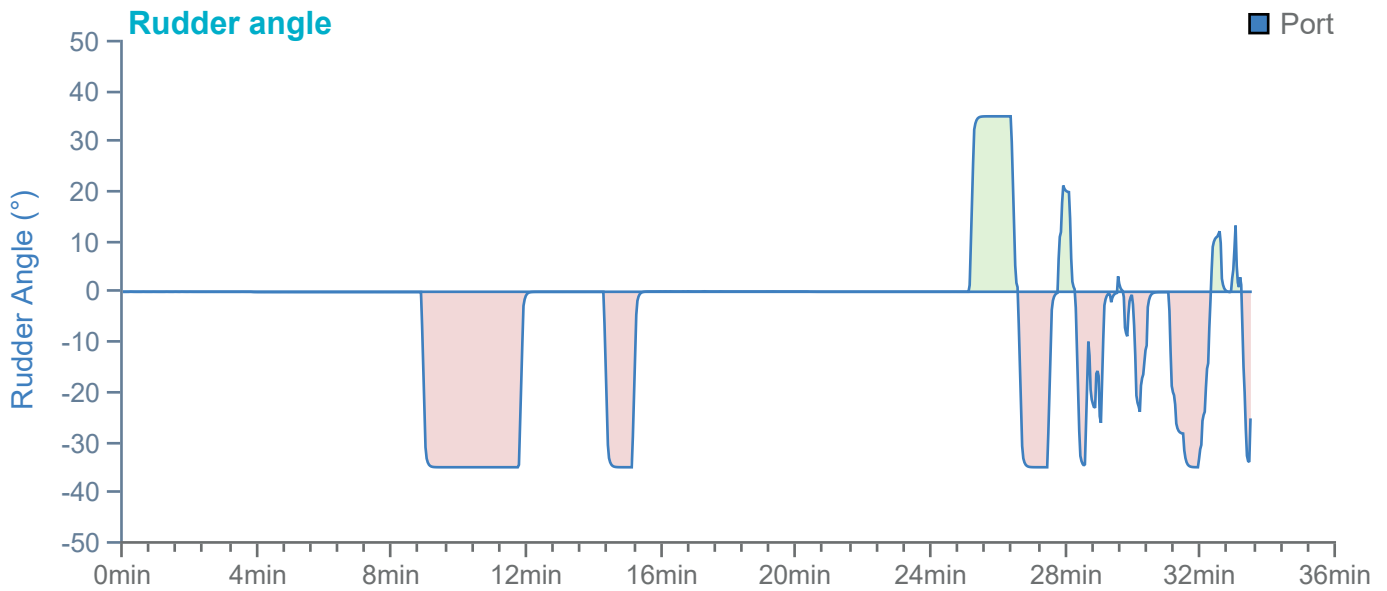
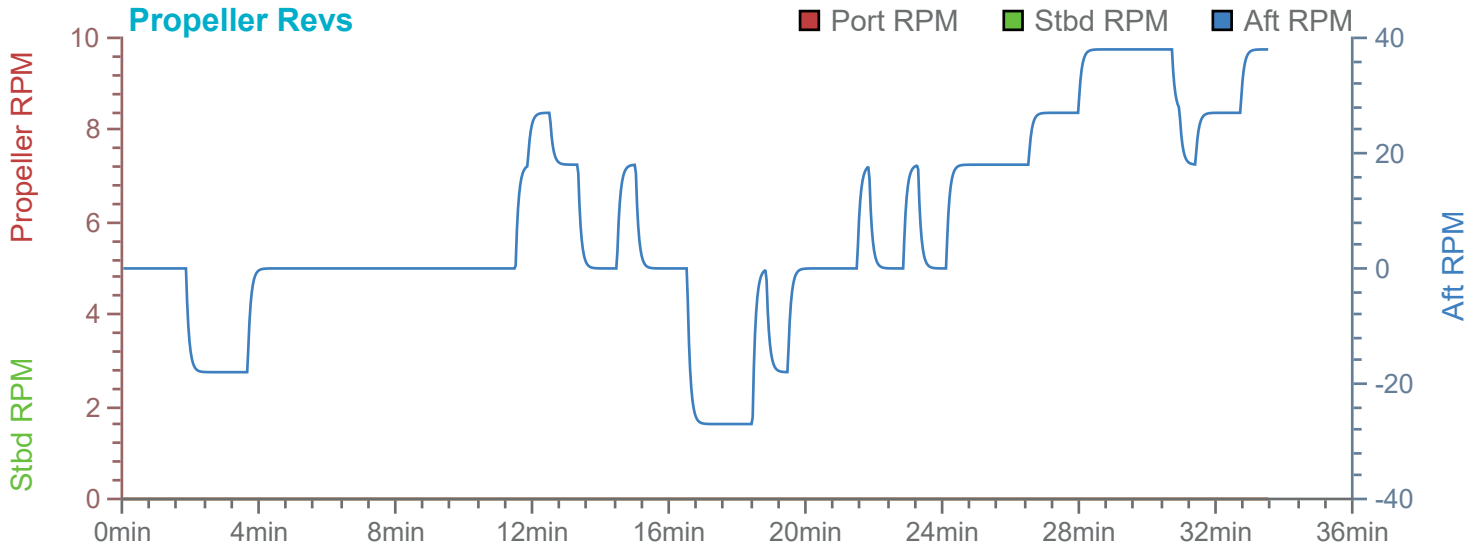
Ships plotted every 59 seconds, highlight every 2 mins

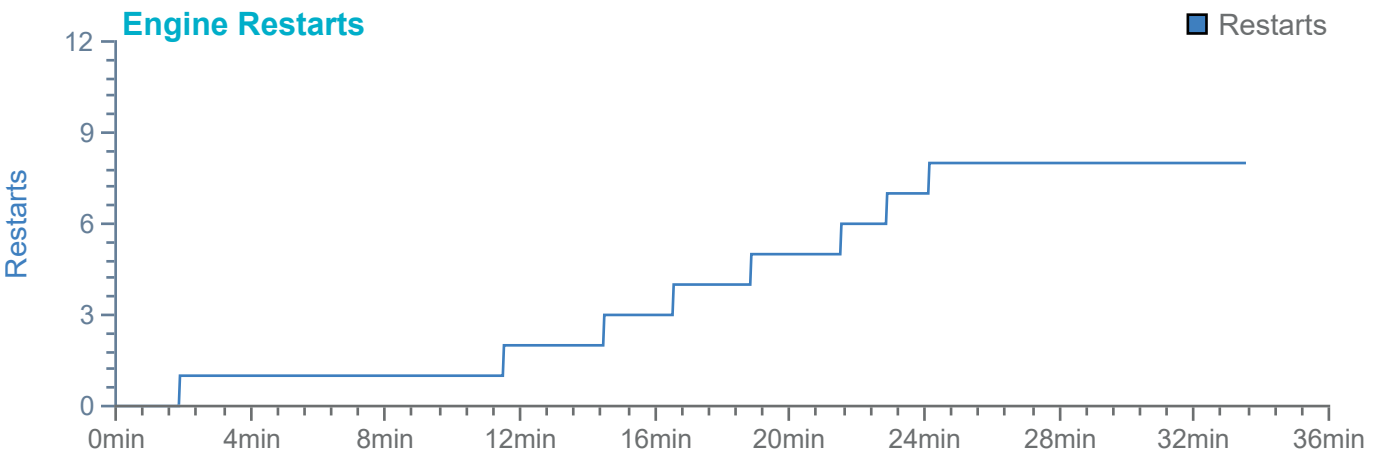
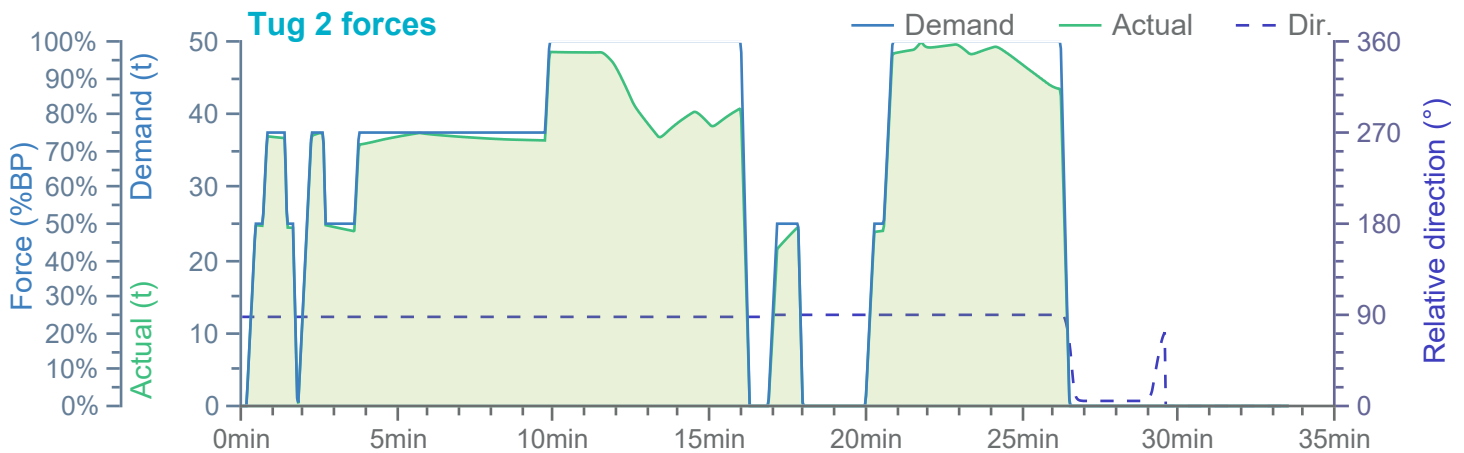
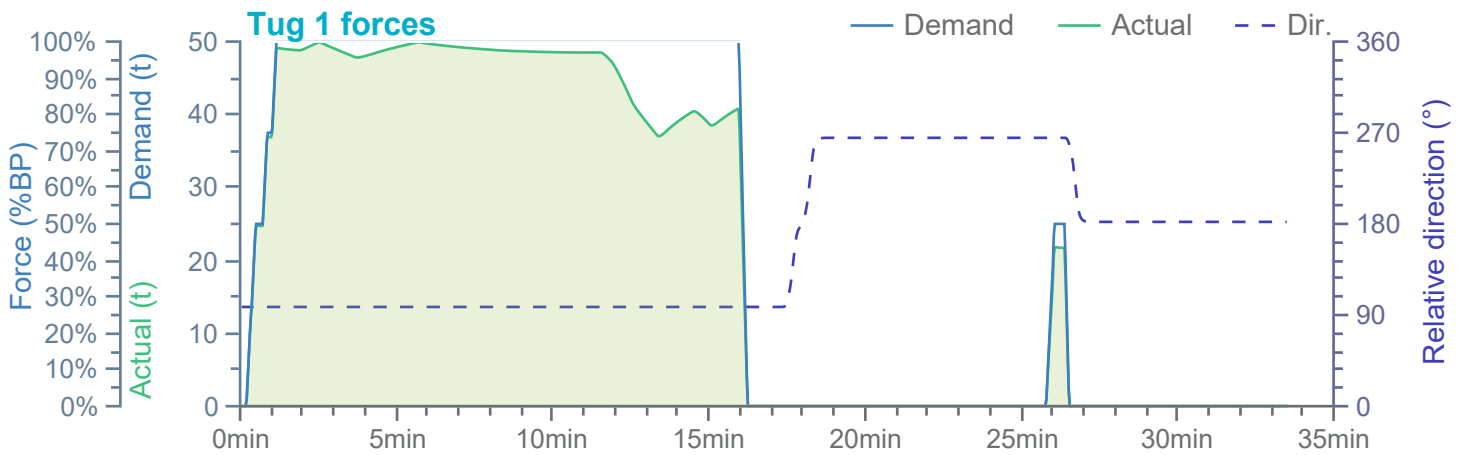
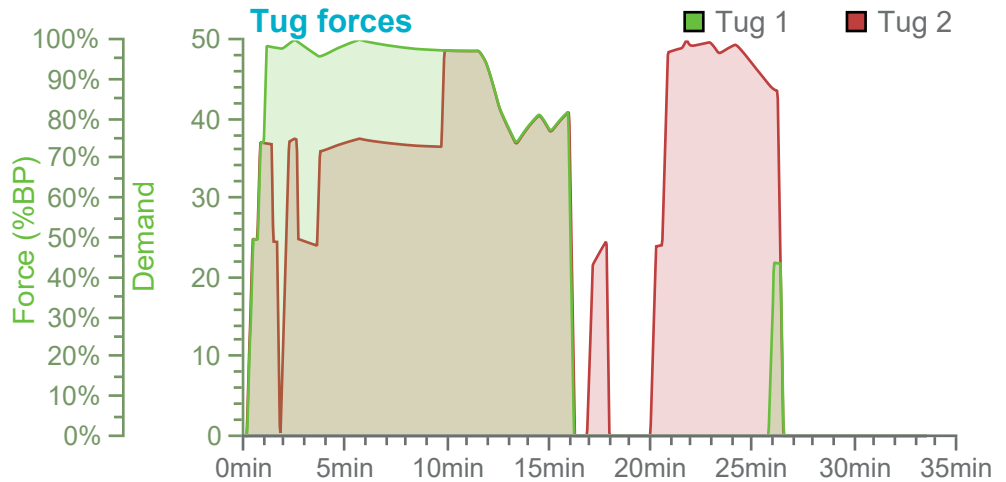
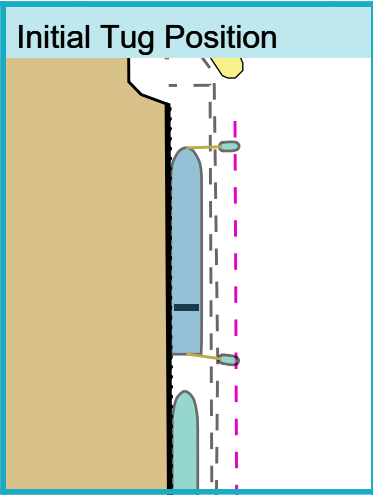






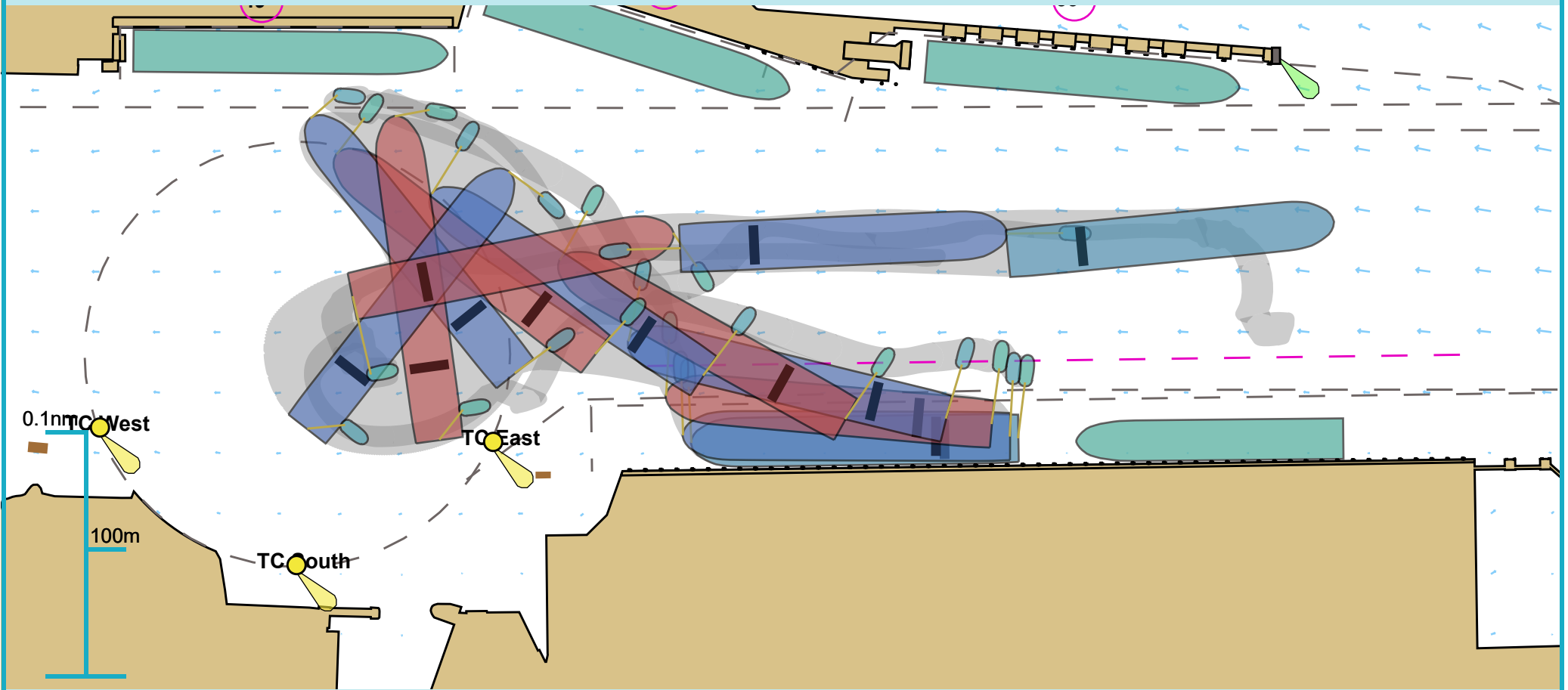






Full Run Overview

53° 20.413 N, 006° 11.848 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD
Run length: 24 minutes
Manoeuvre: Other
Ownship(s): 250m Container

Comments:

Overview

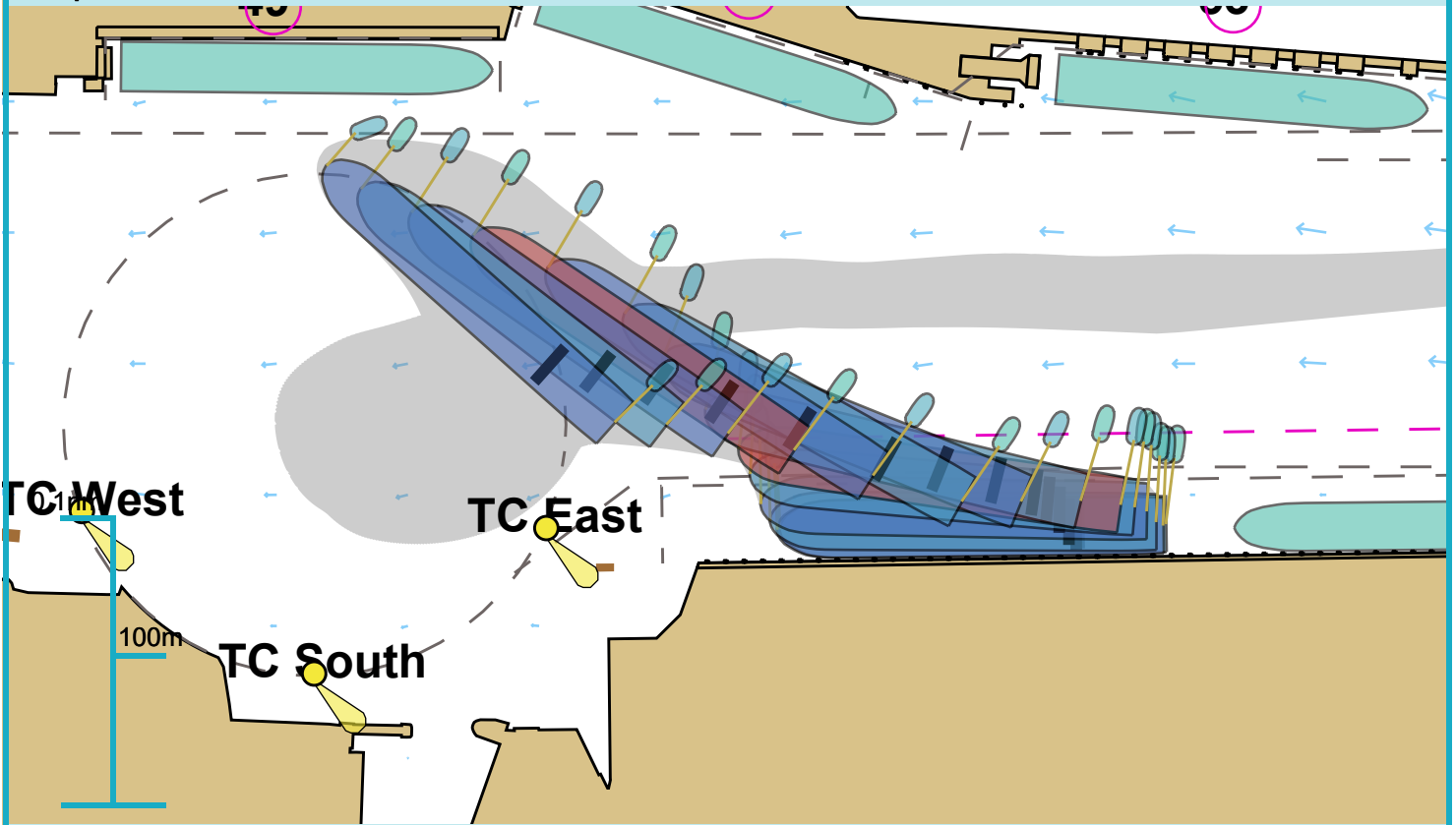
Environment

250m Container

Thruster and engine use

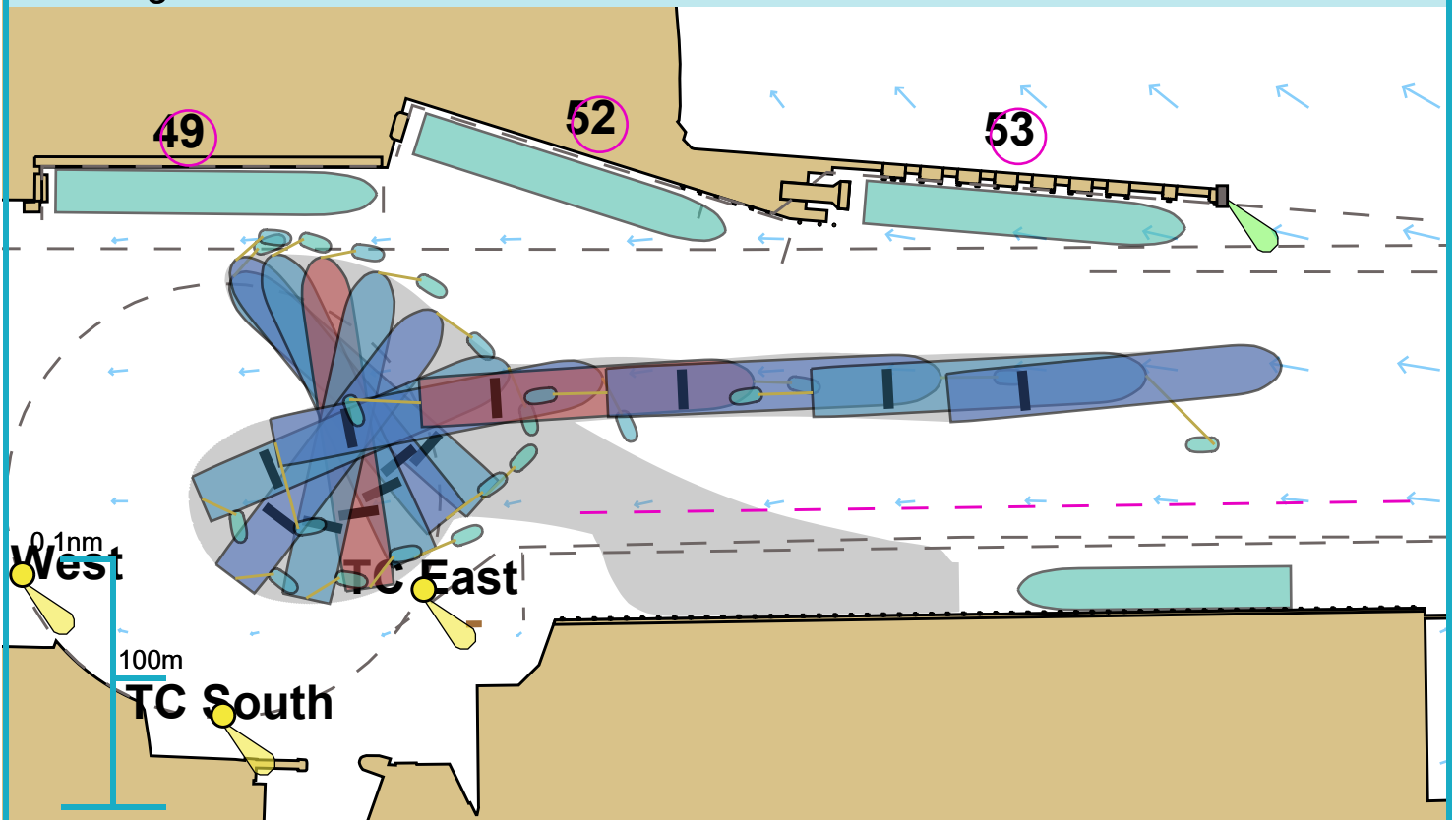
Tug use

Departure



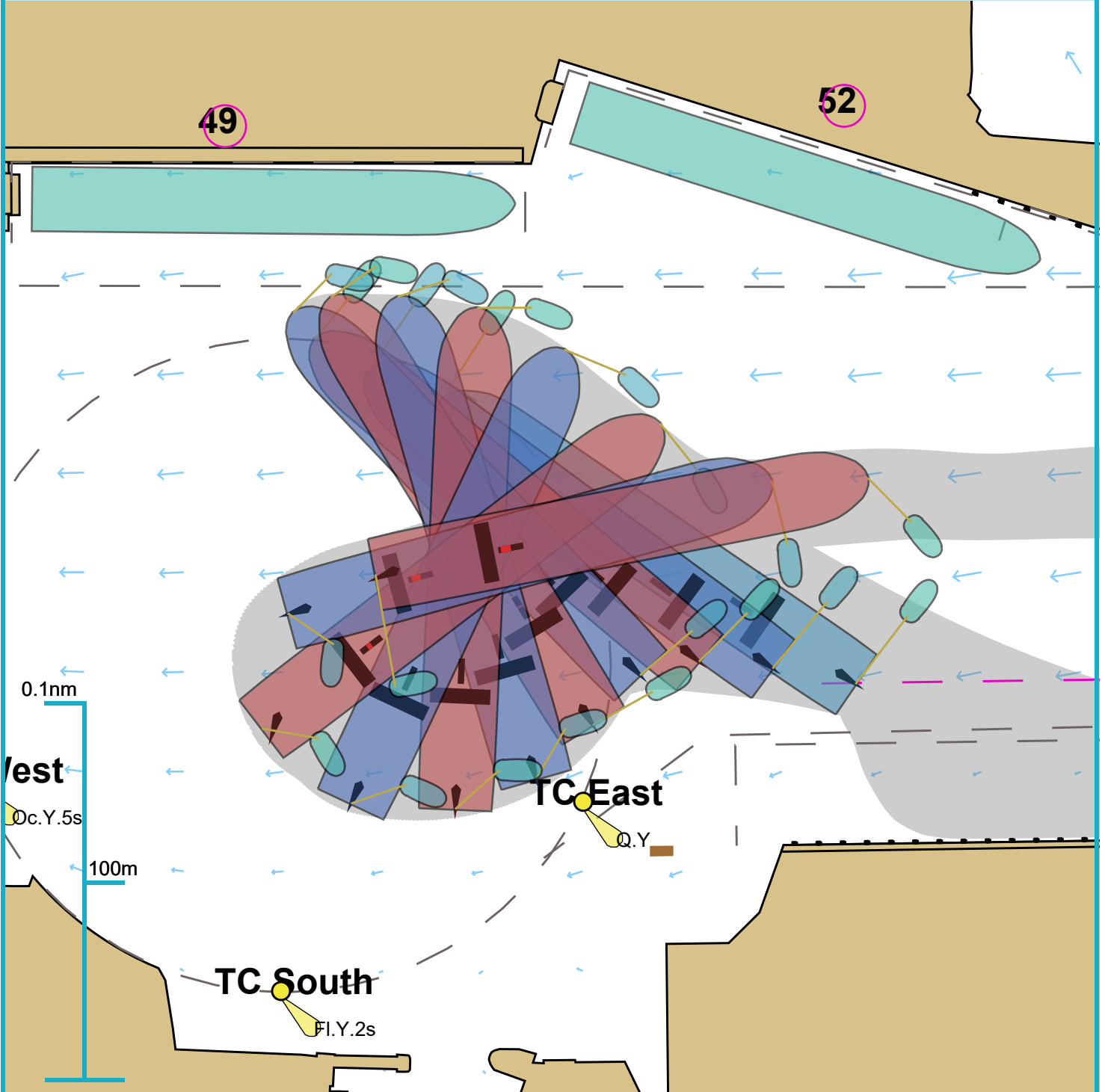
Ships plotted every 1 mins, highlight every 5 mins

Berthing

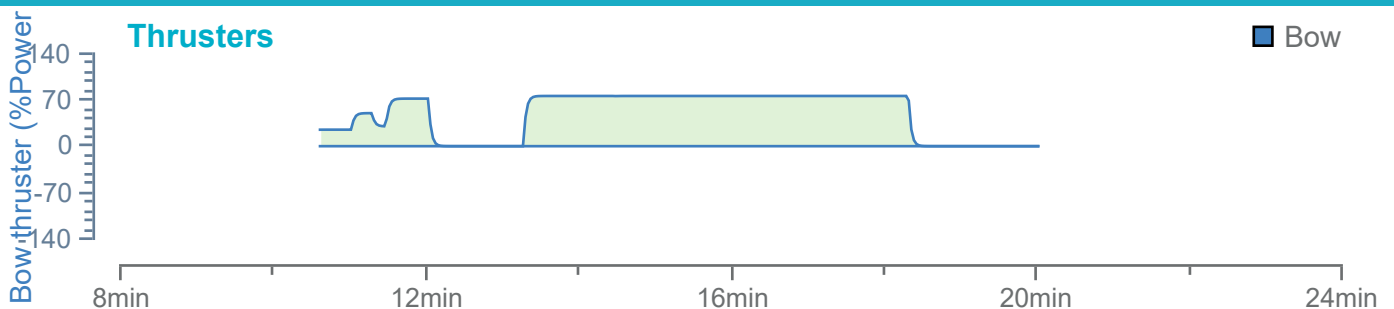


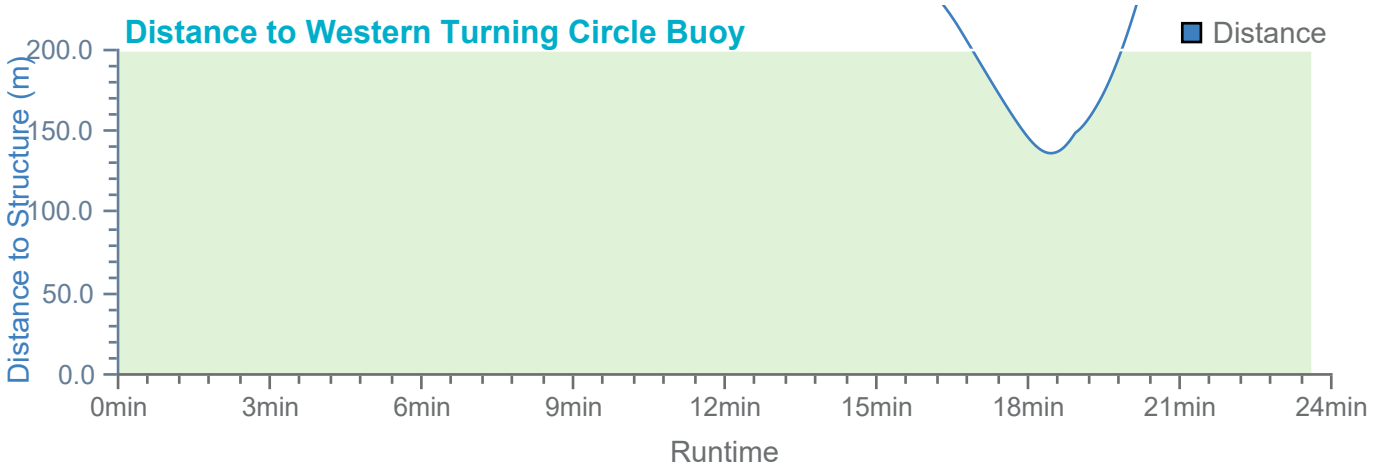
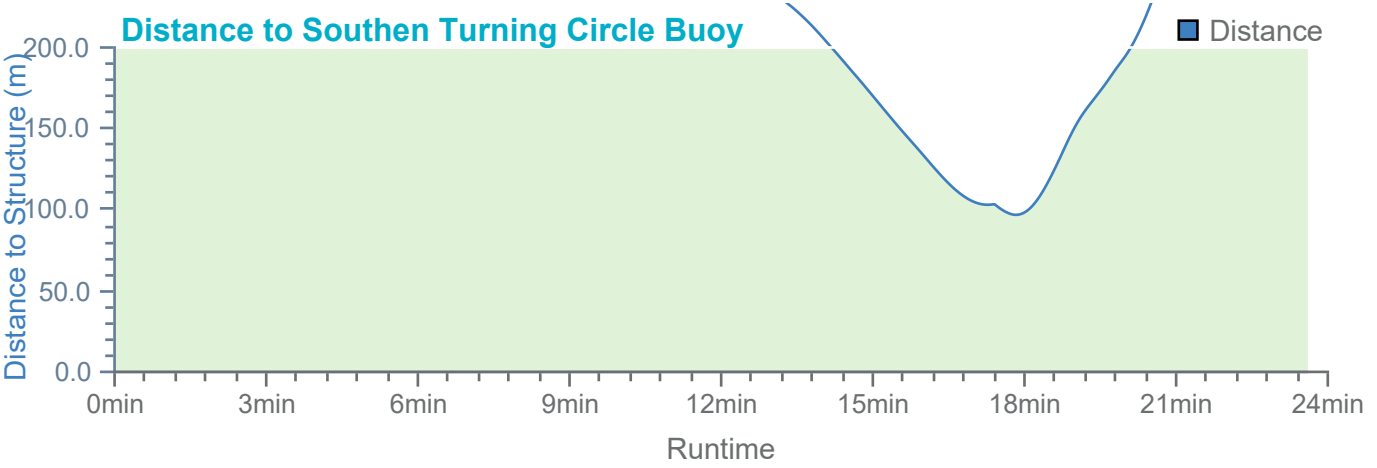
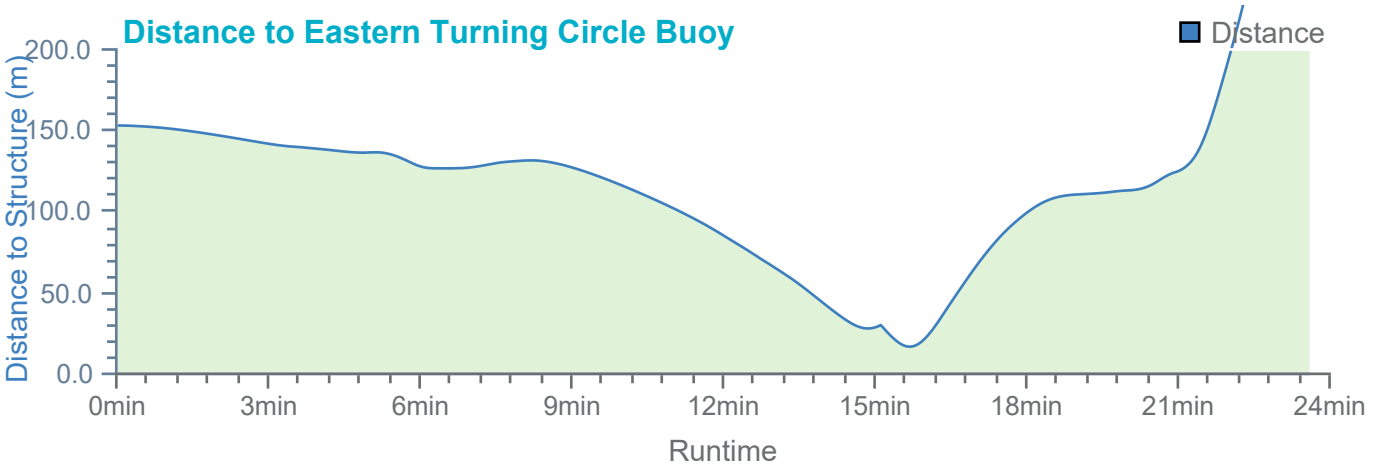
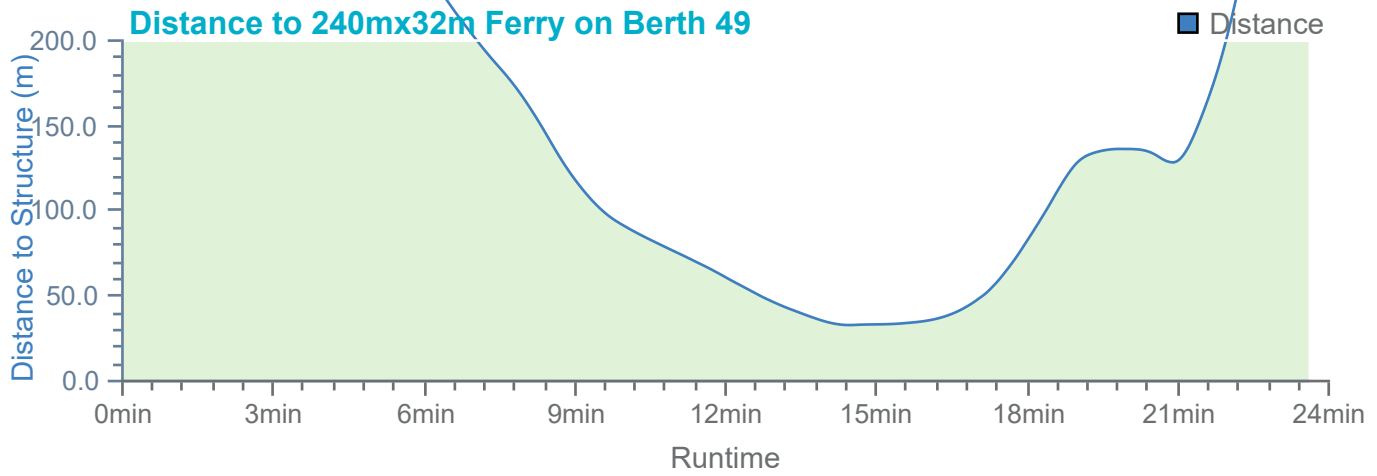
Ships plotted every 1 mins, highlight every 5 mins

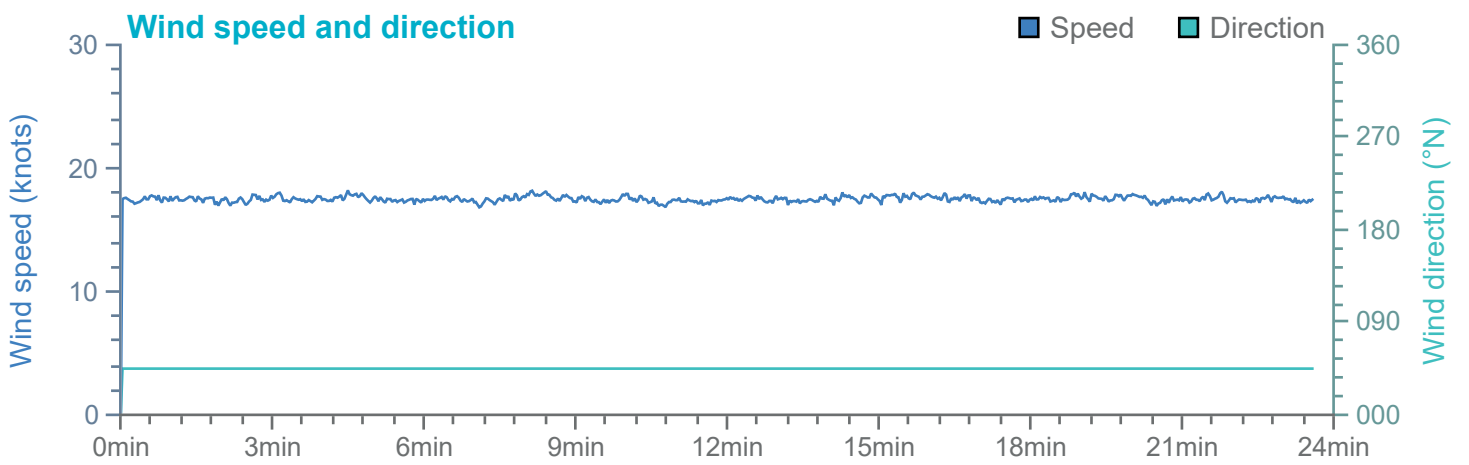
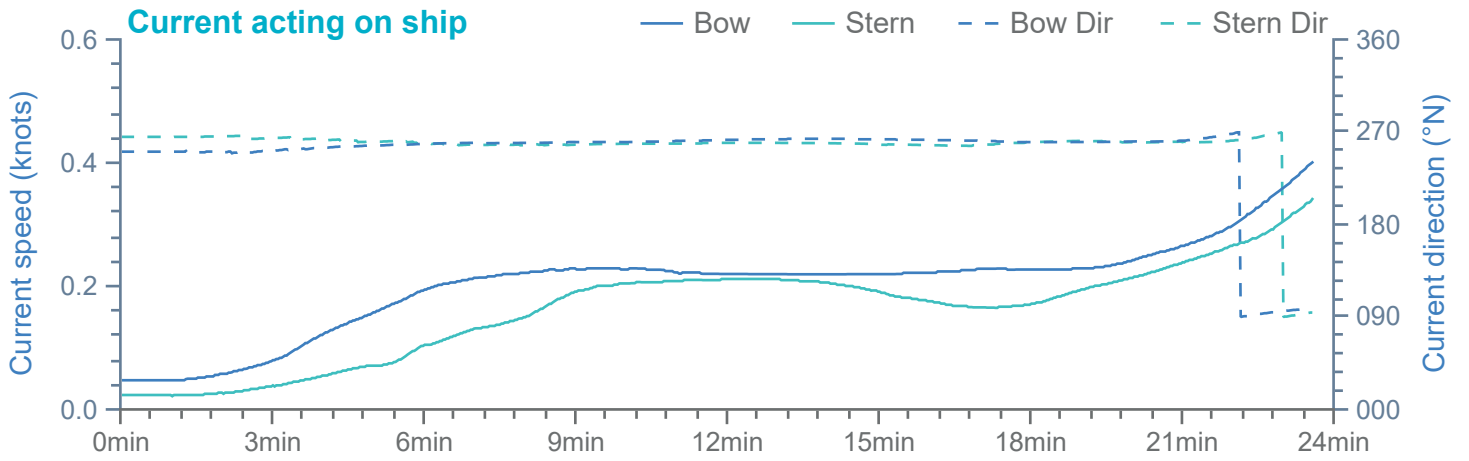
Swing



Ships plotted every 59 seconds, highlight every 2 mins







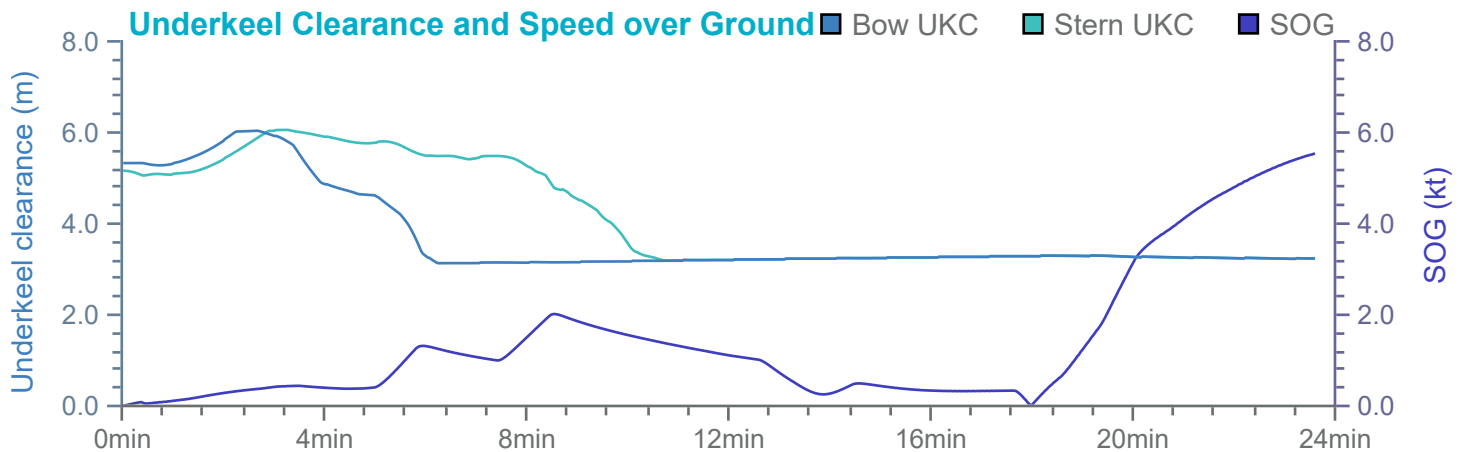
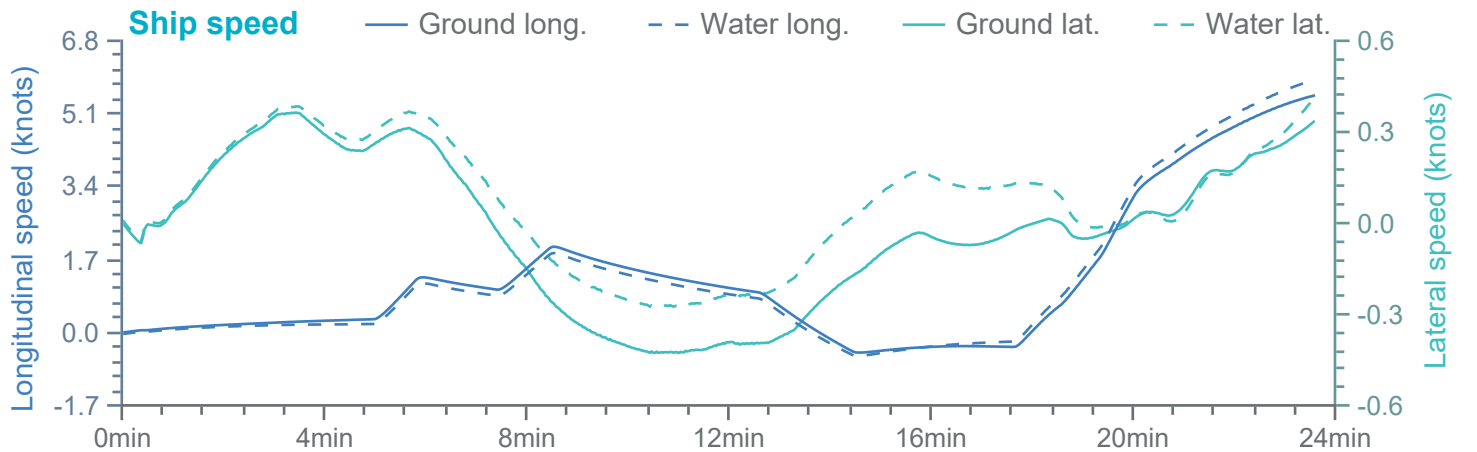
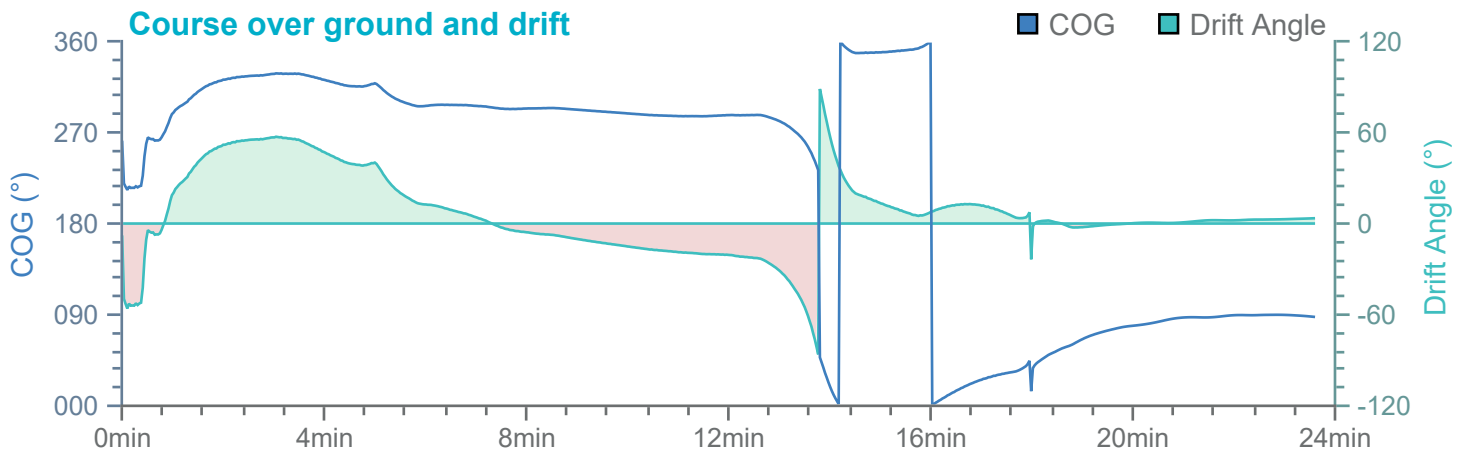
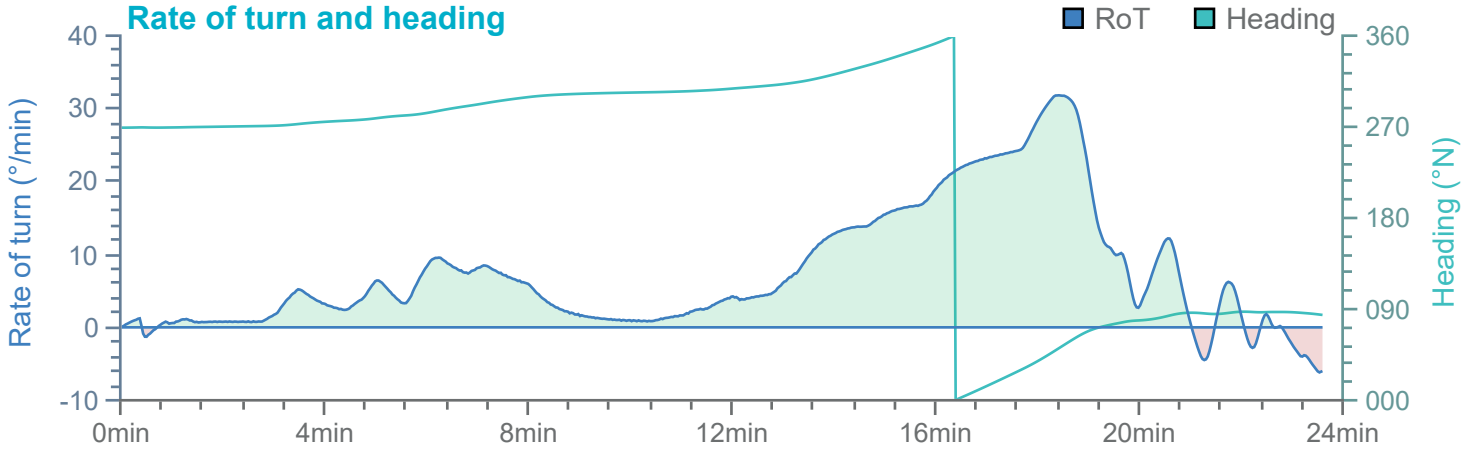
Overview

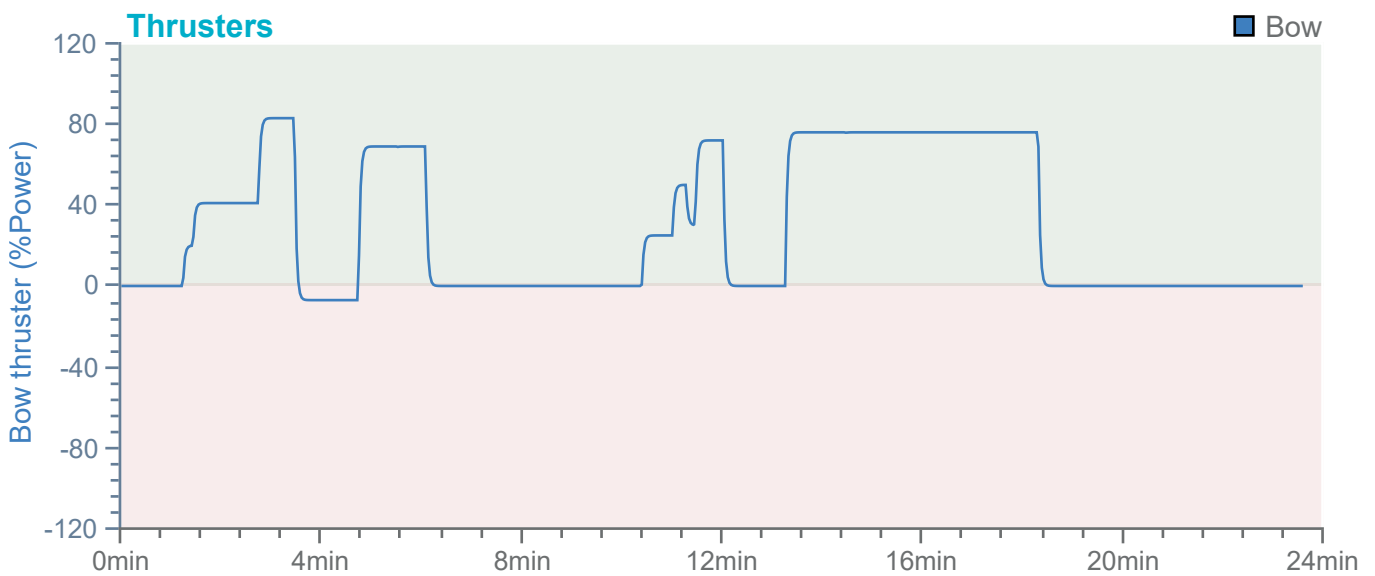
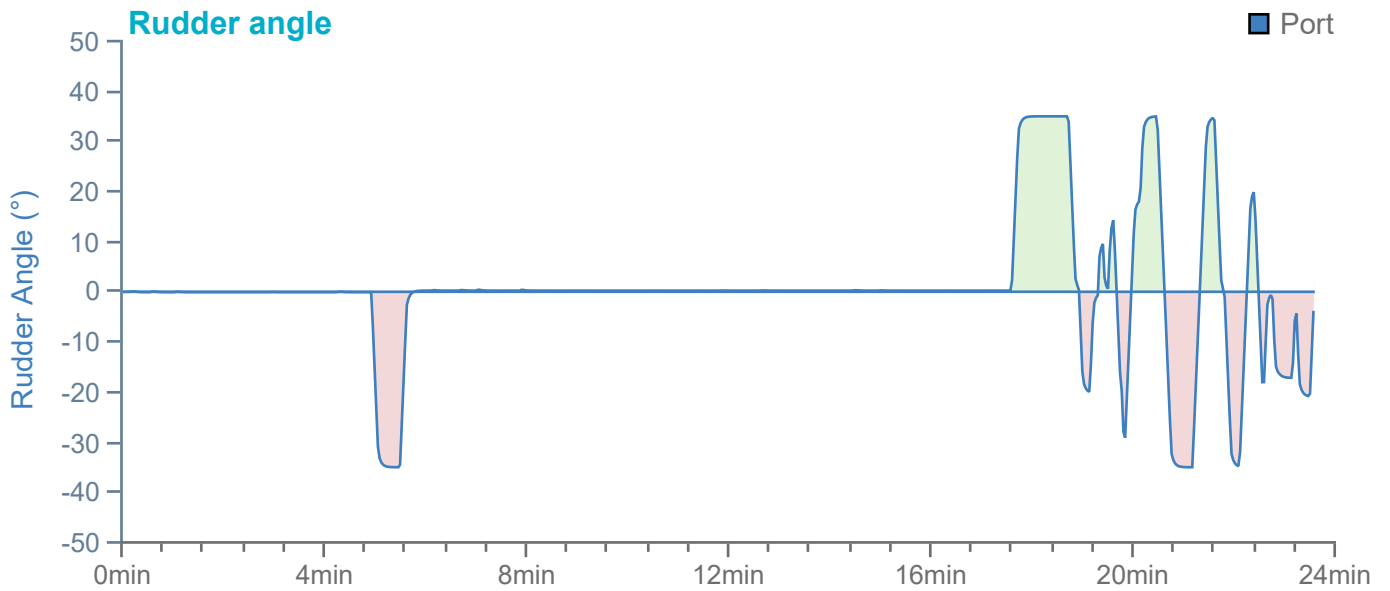
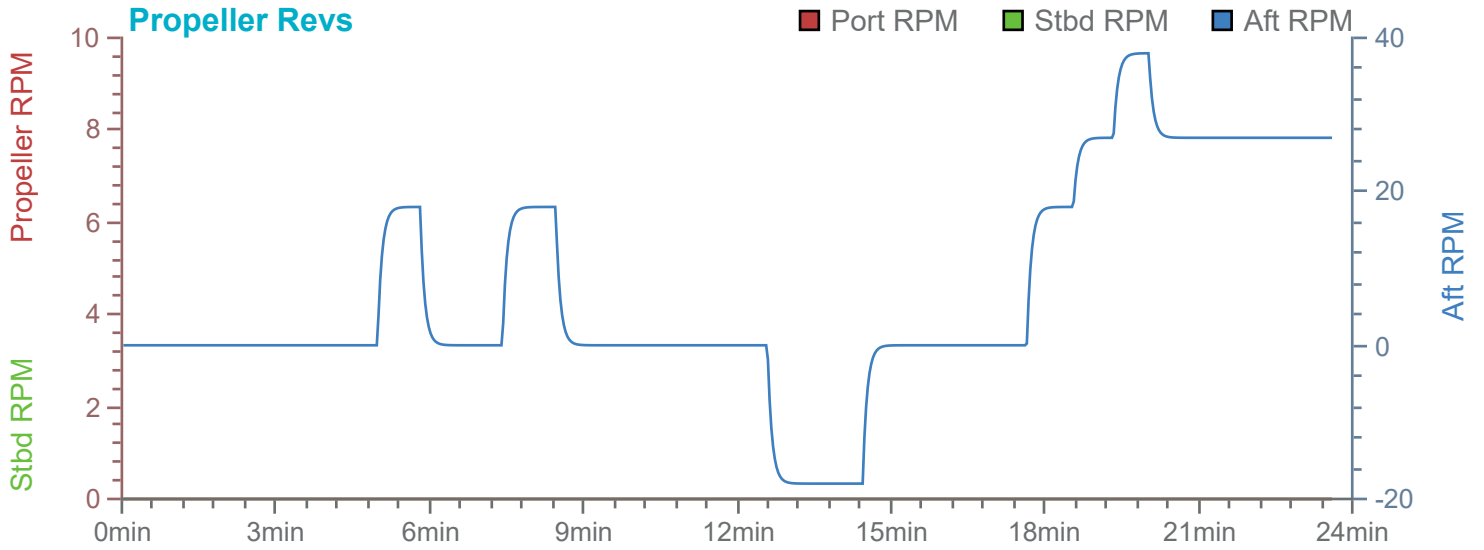
Environment

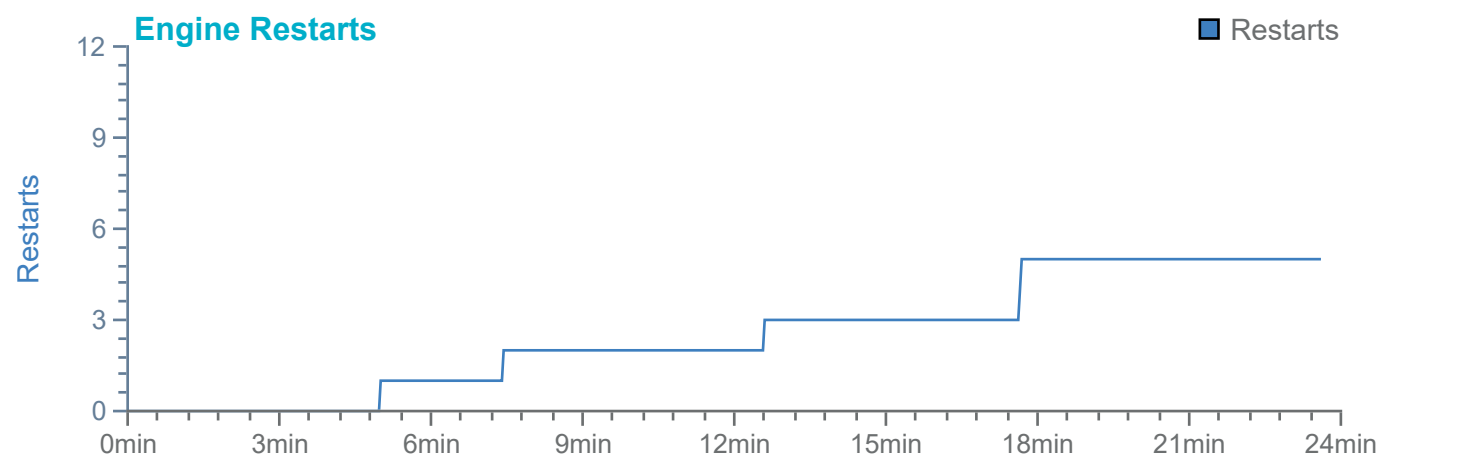
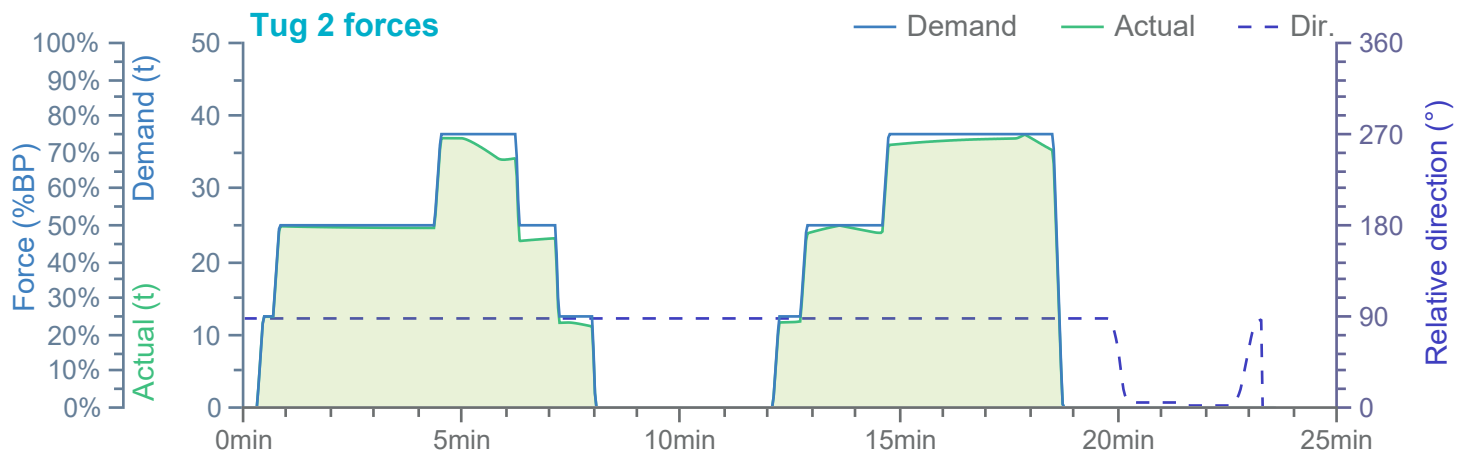
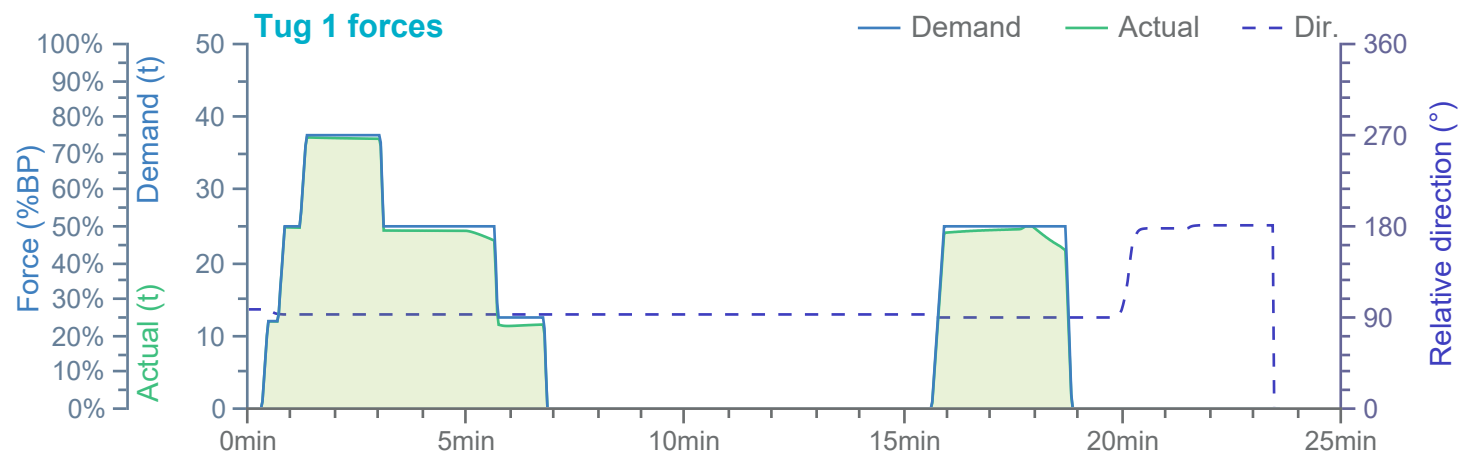
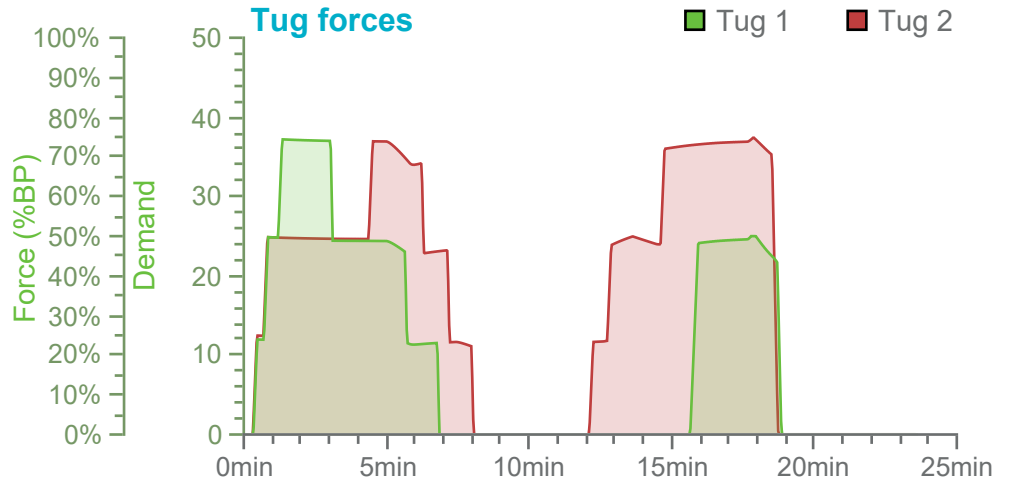
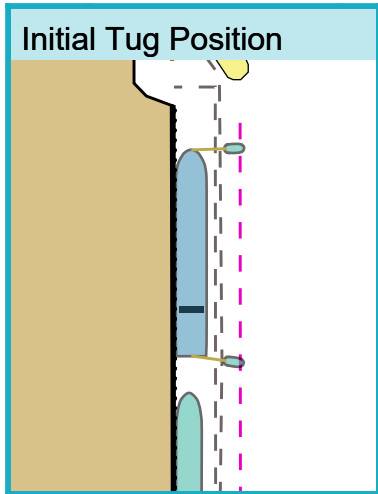
250m Container

Thruster and engine use

Tug use

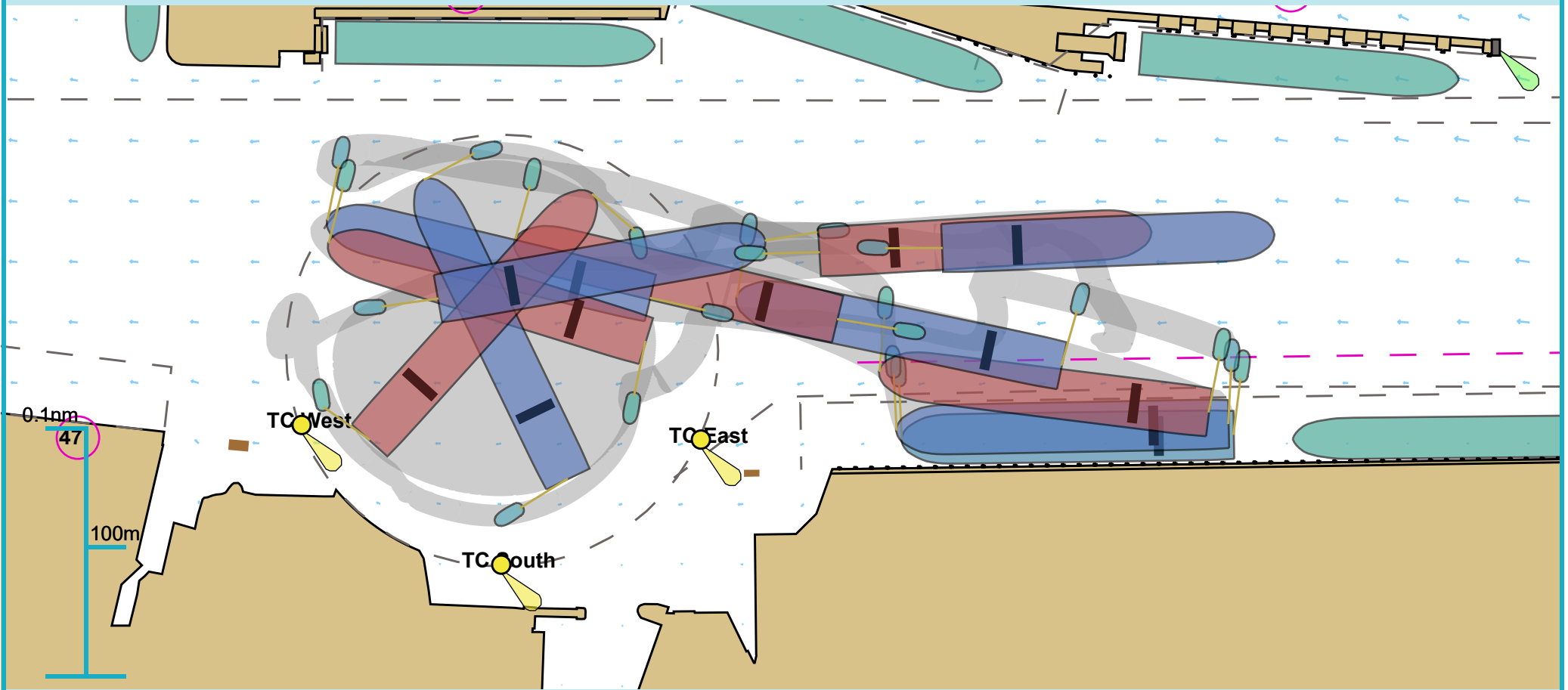






Full Run Overview

53° 20.414 N, 006° 11.983 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:21 minutes

Manoeuvre:Other

Ownship(s):250m Container

Comments:

Overview

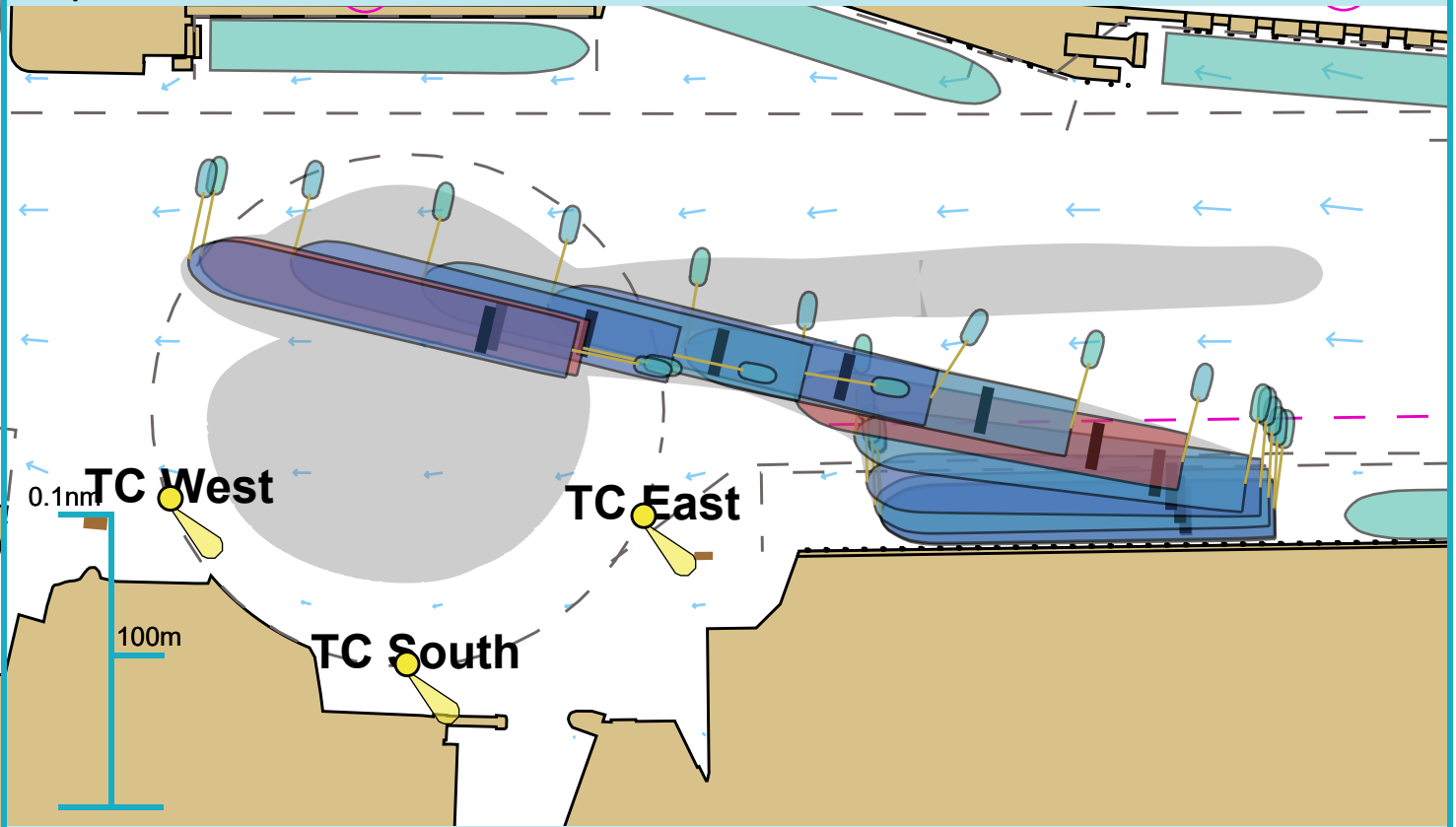
Environment

250m Container

Thruster and engine use

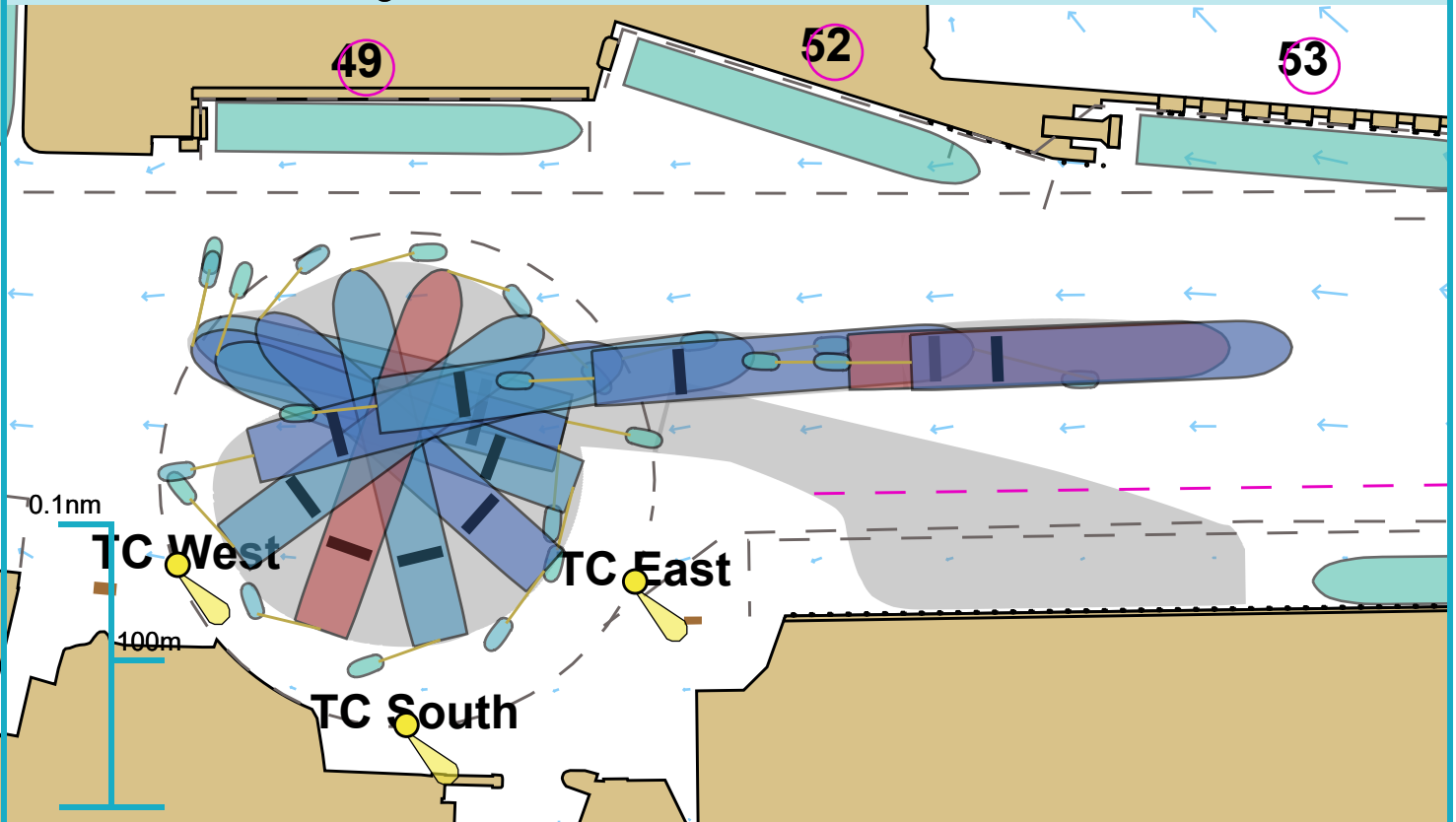
Tug use

Departure



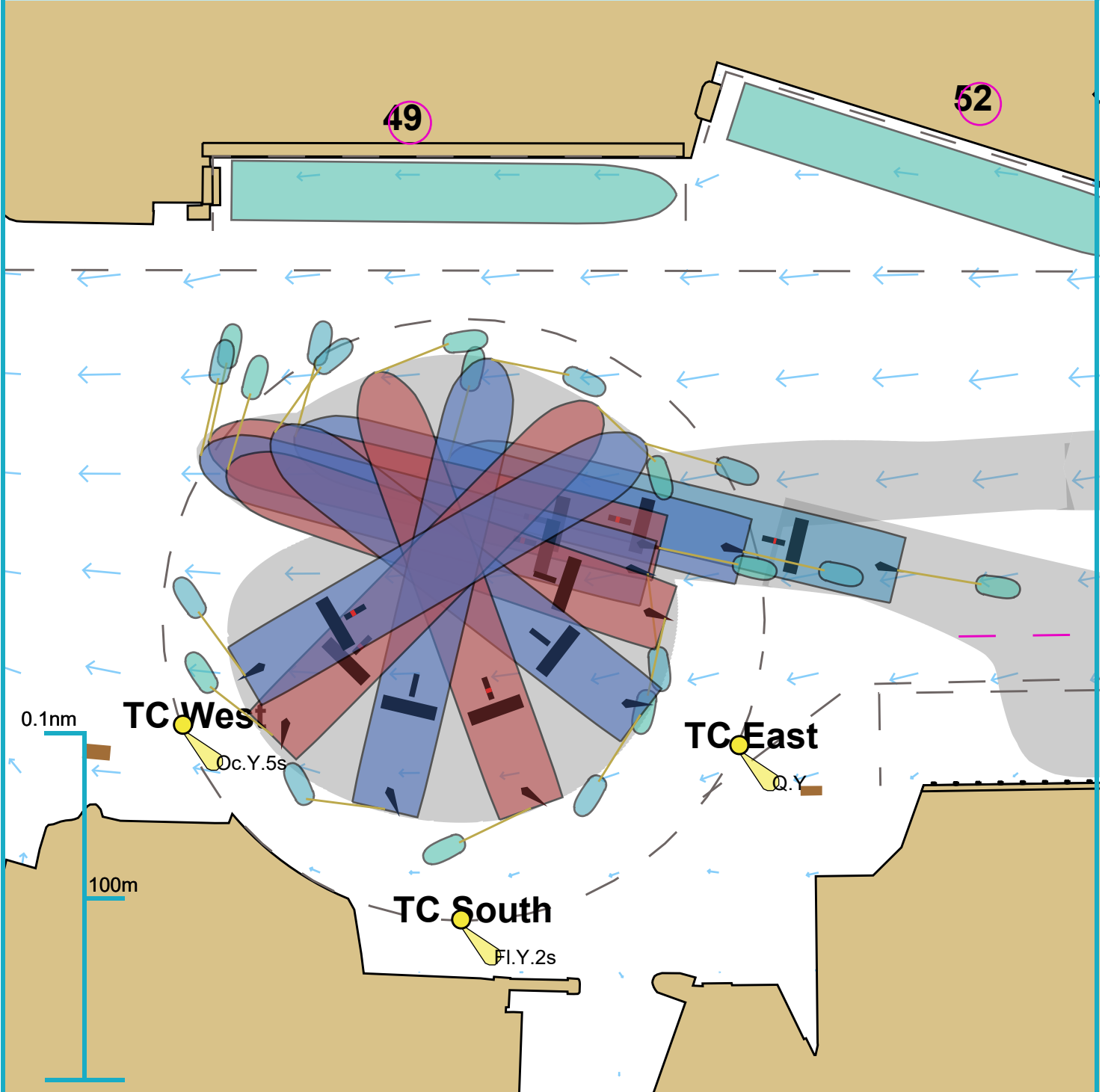
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

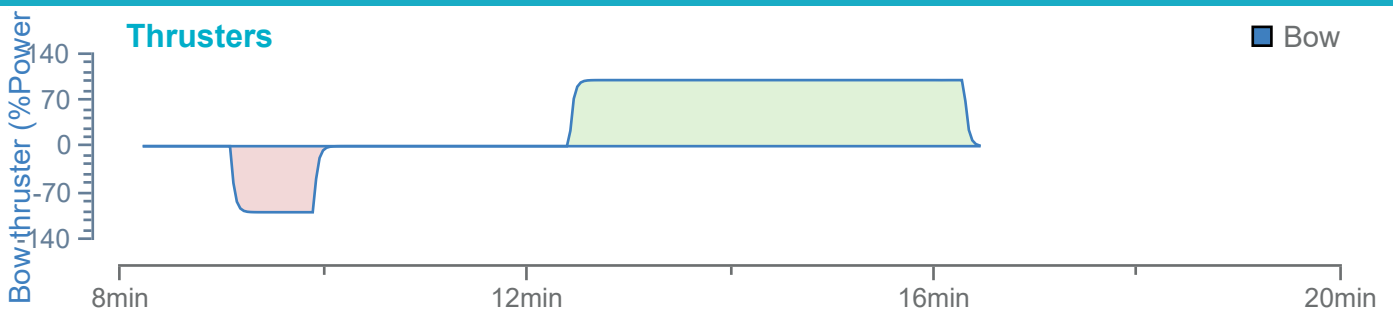


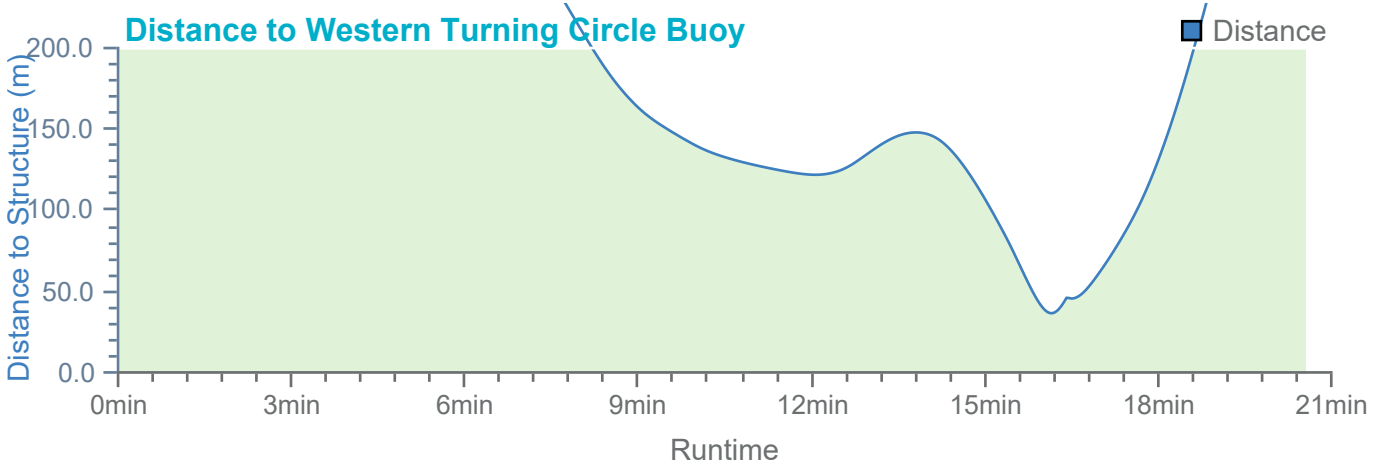
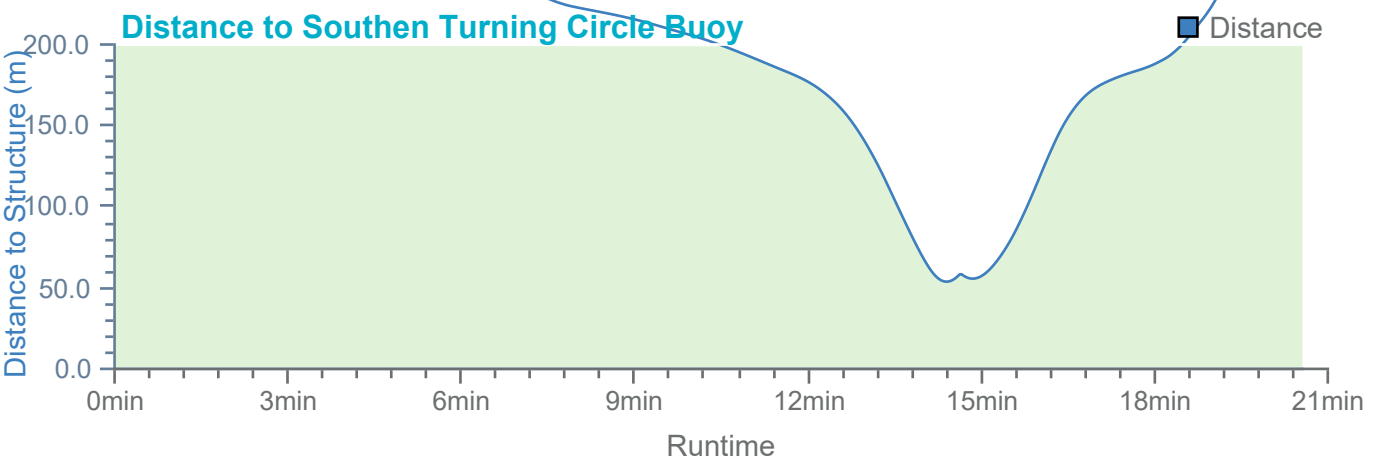
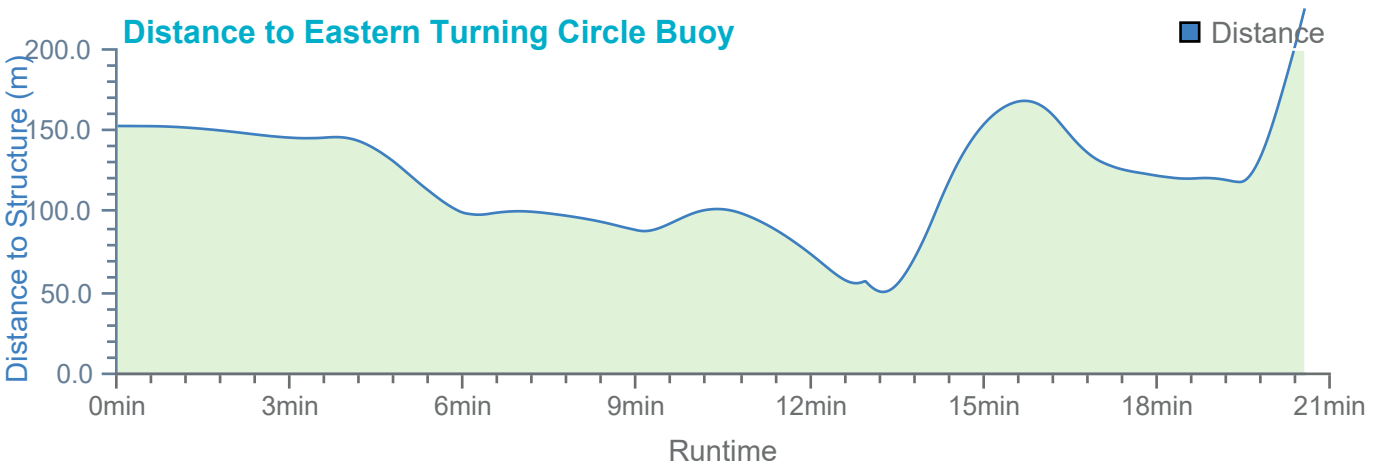
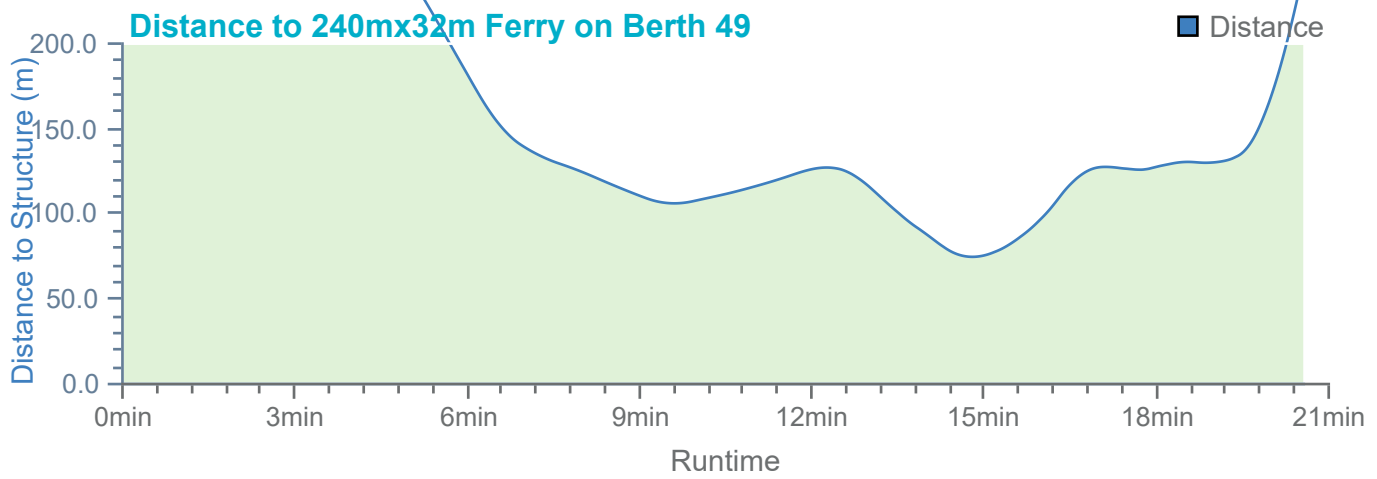
Ships plotted every 1 mins, highlight every 5 mins

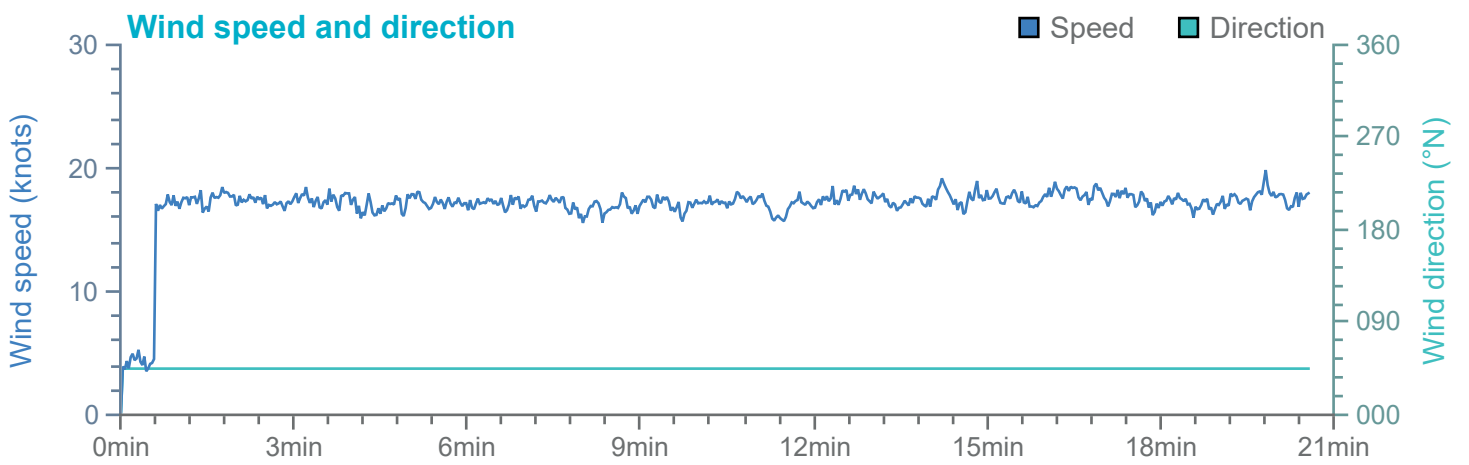
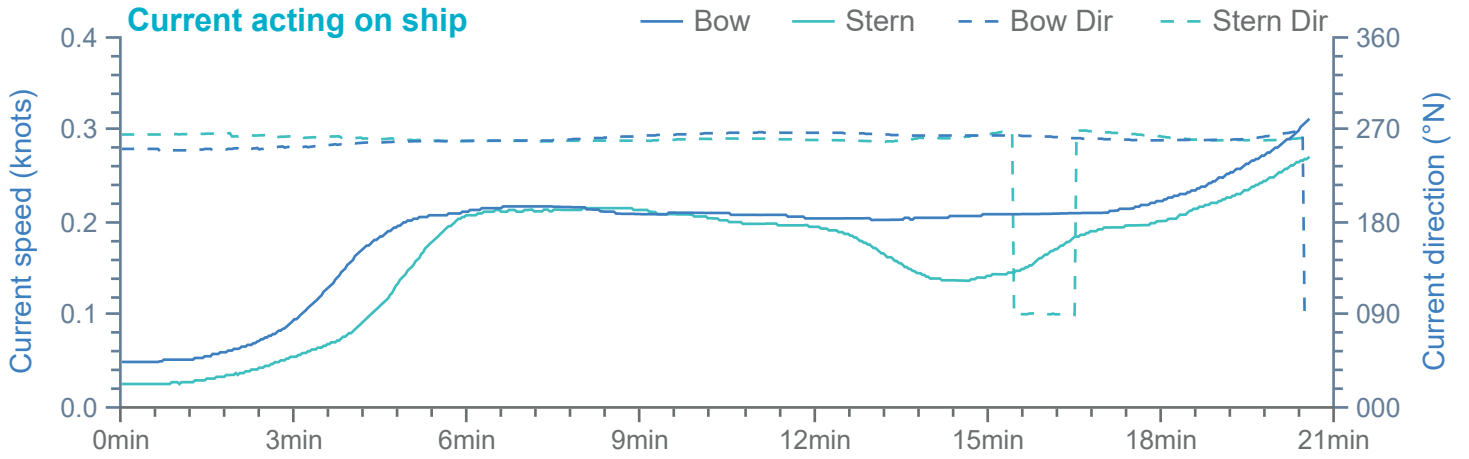
Swing

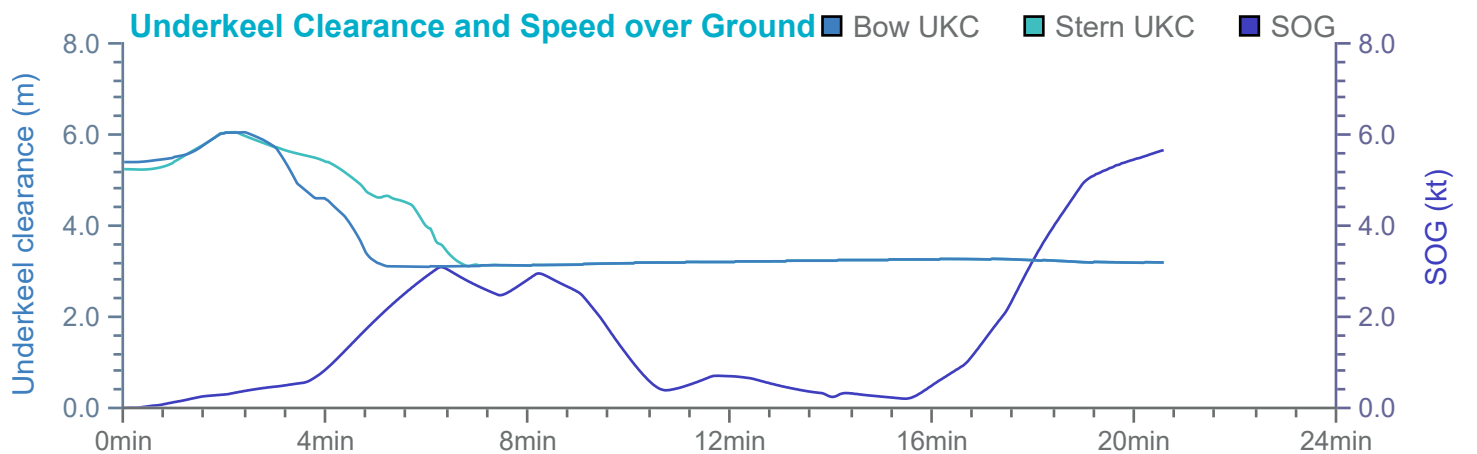
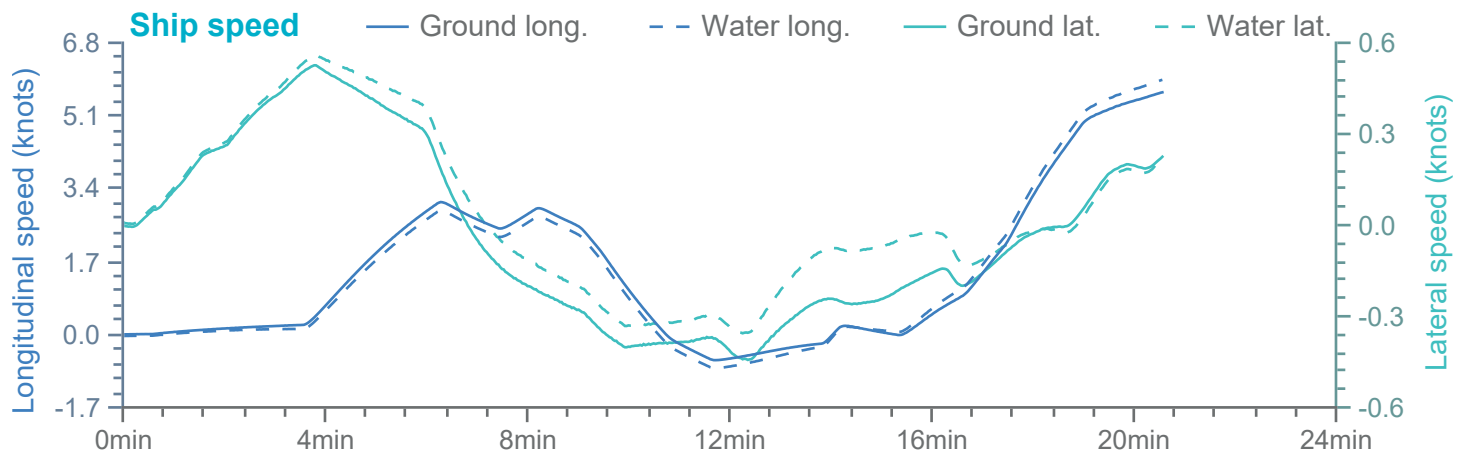
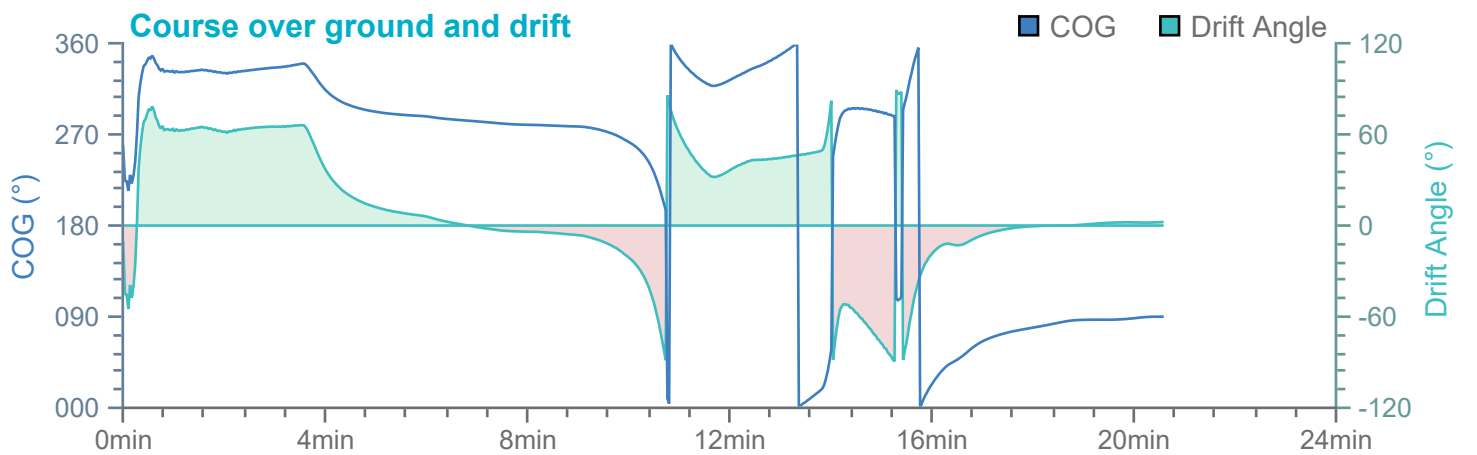
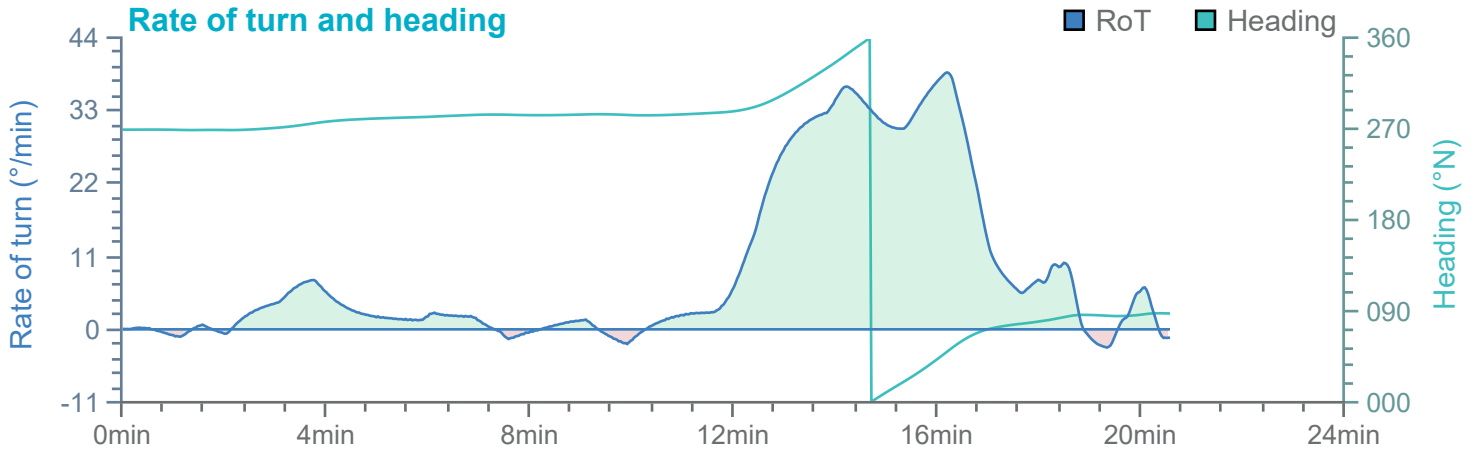


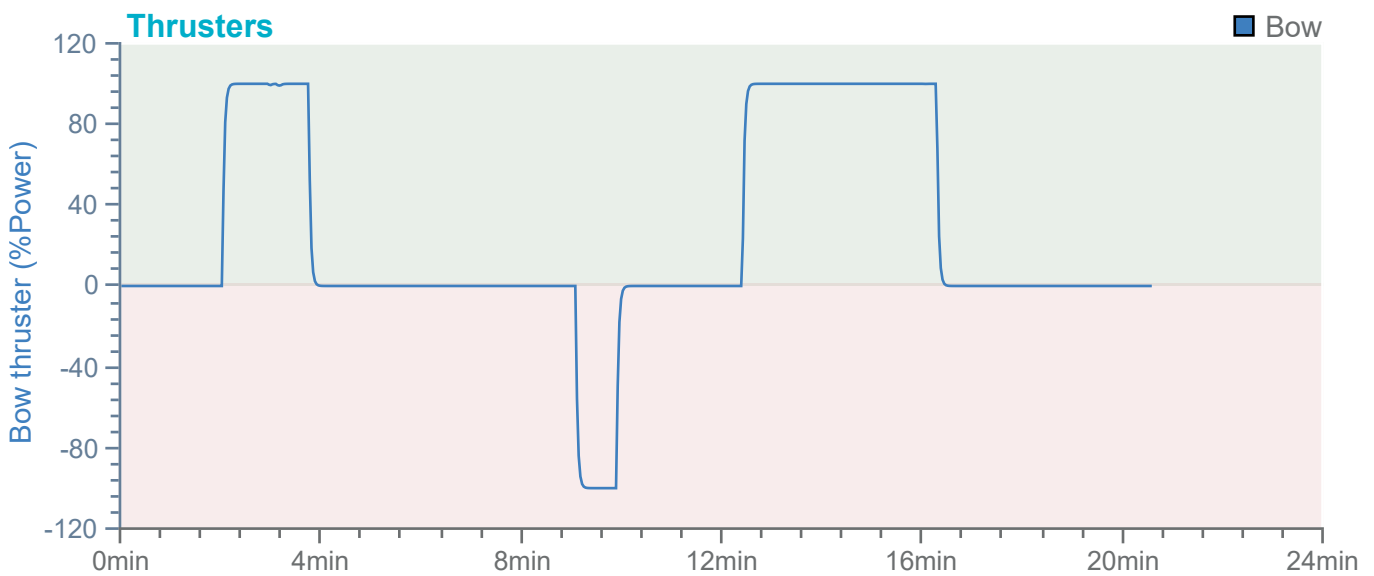
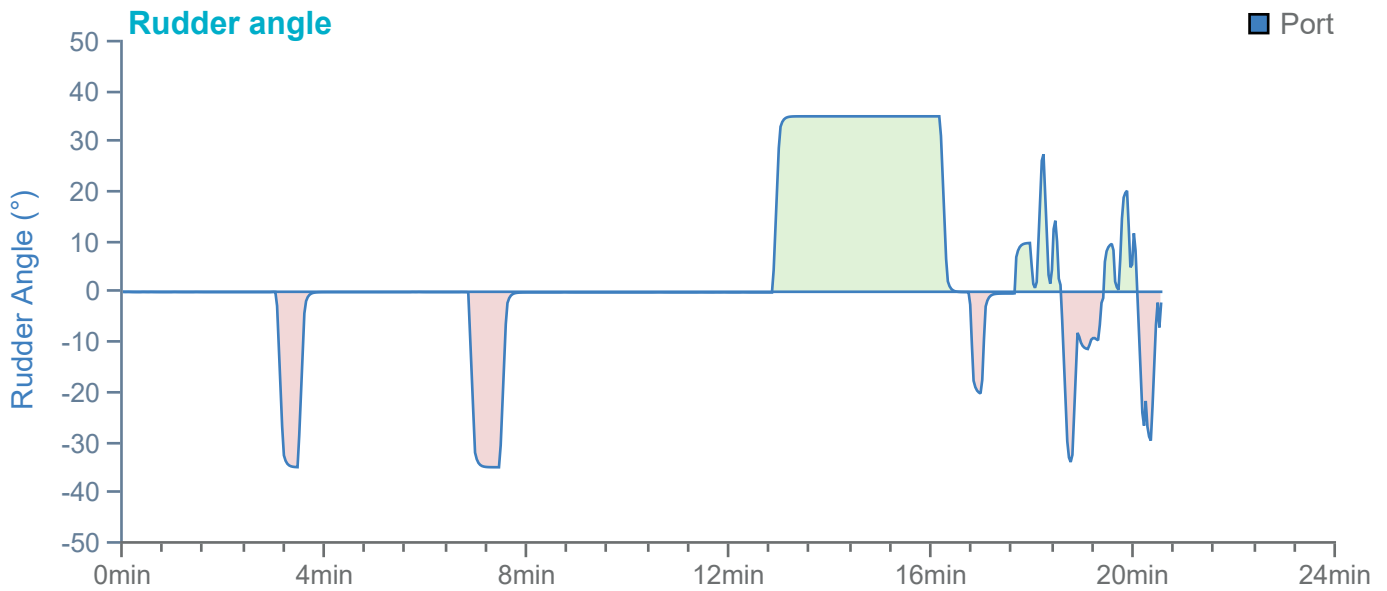
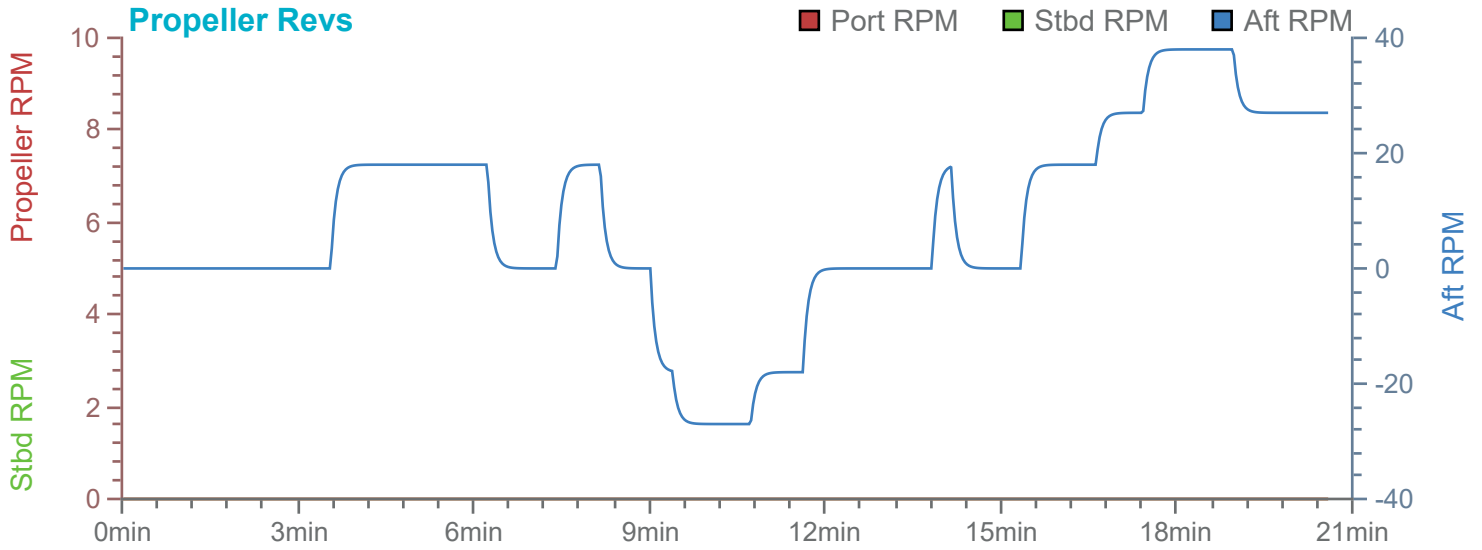
Ships plotted every 59 seconds, highlight every 2 mins

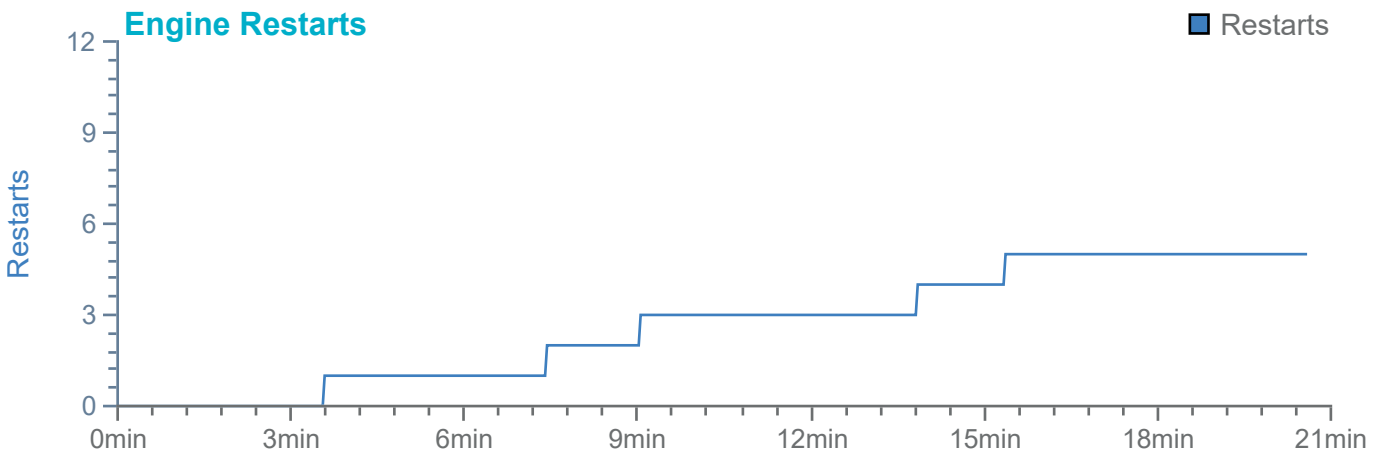
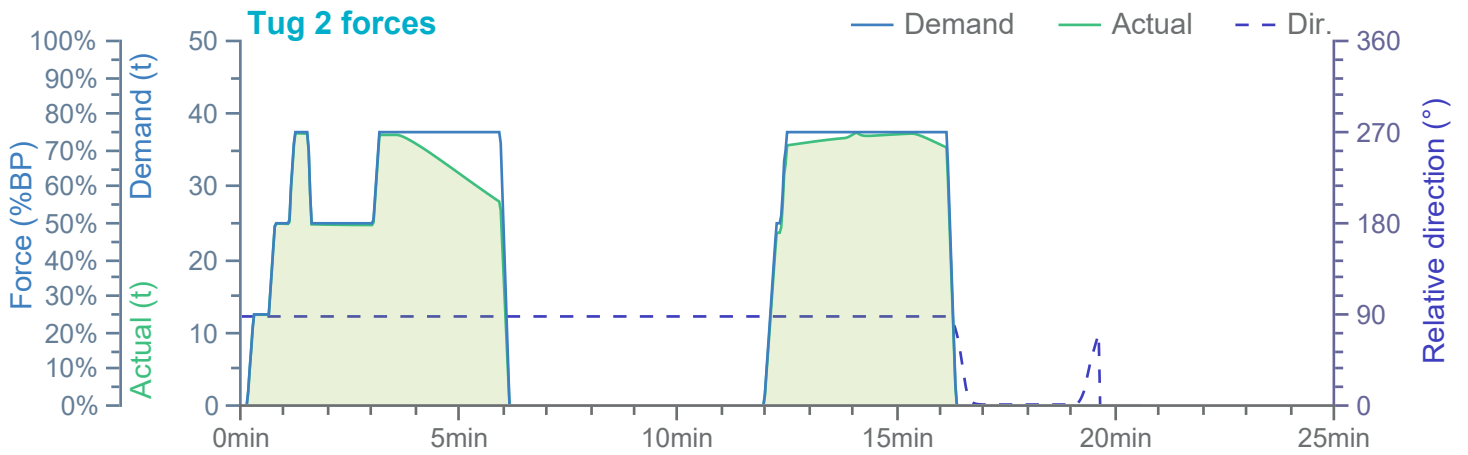
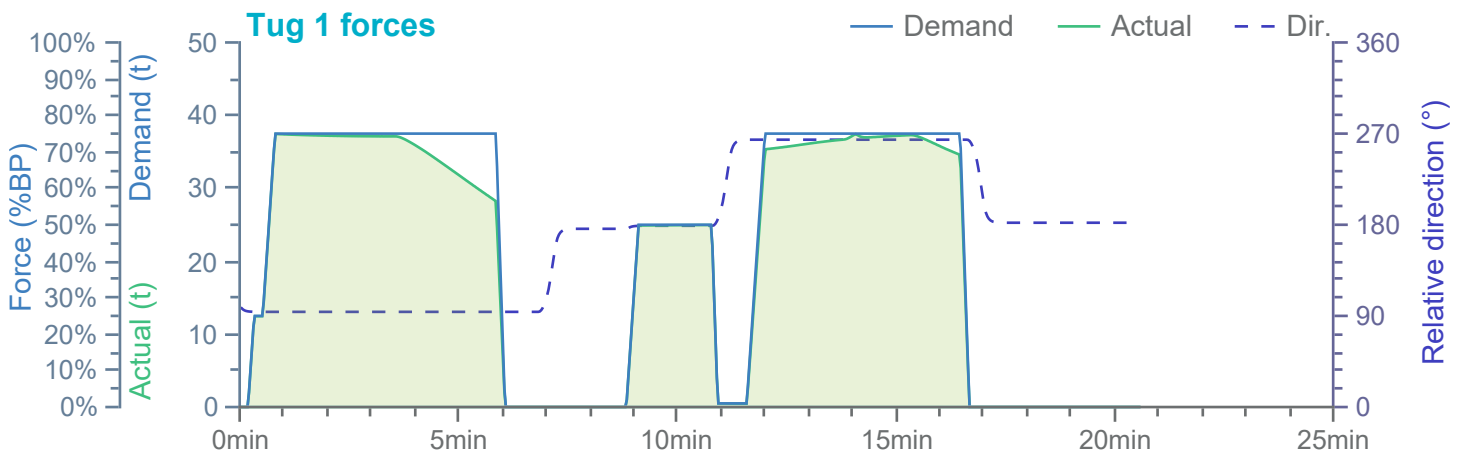
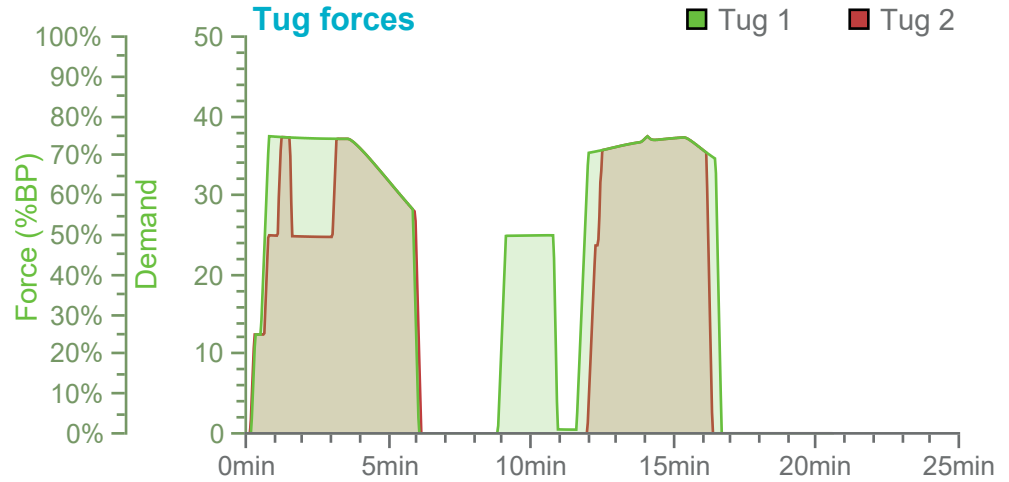
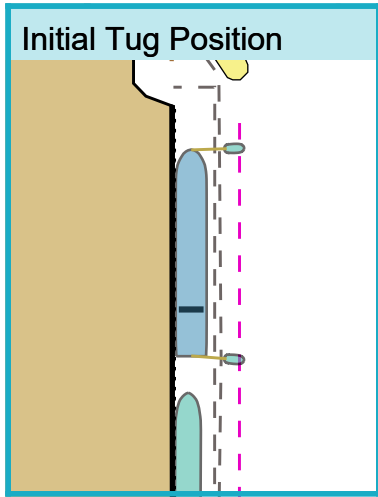






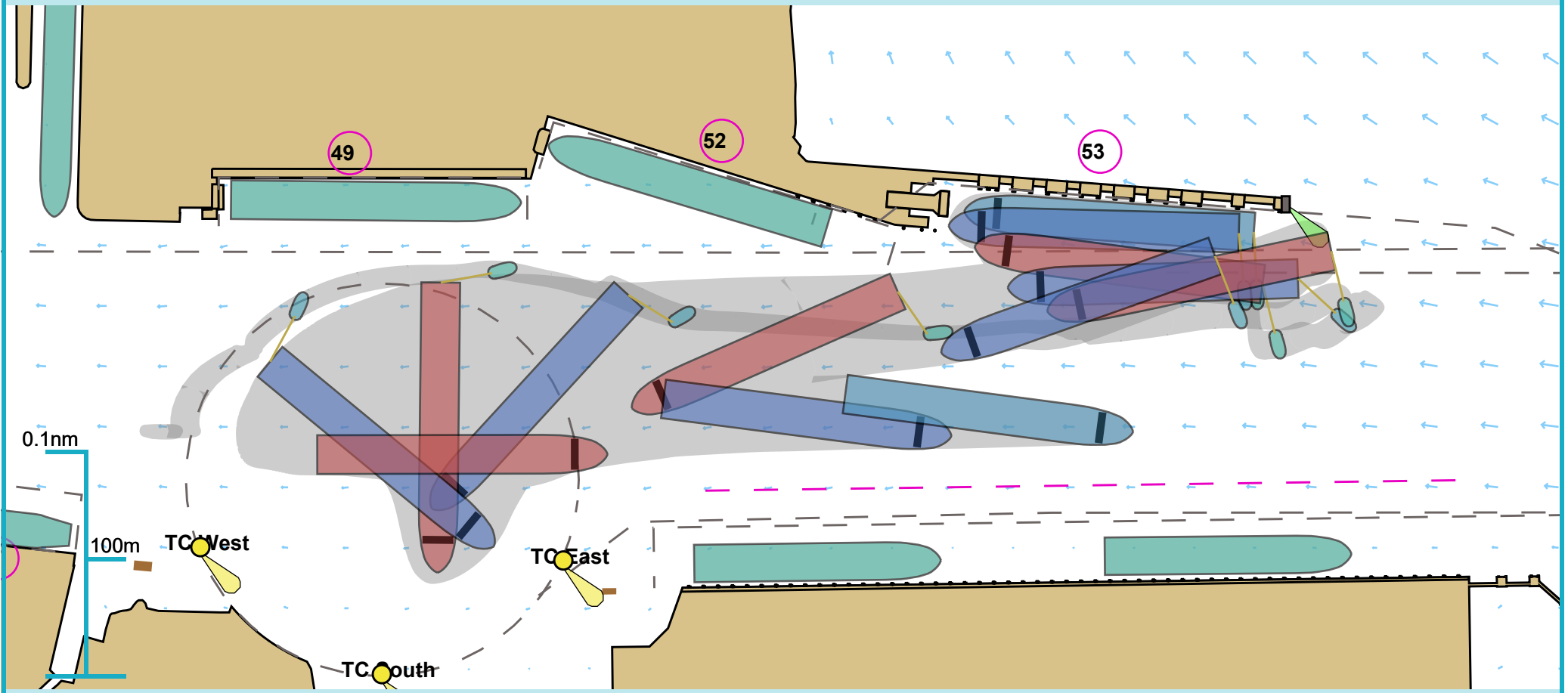






Full Run Overview

53° 20.456 N, 006° 11.928 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot:MM

Run length:23 minutes

Manoeuvre:Other

Ownship(s):240m x 32m RoPax Ferry

Comments:

Overview

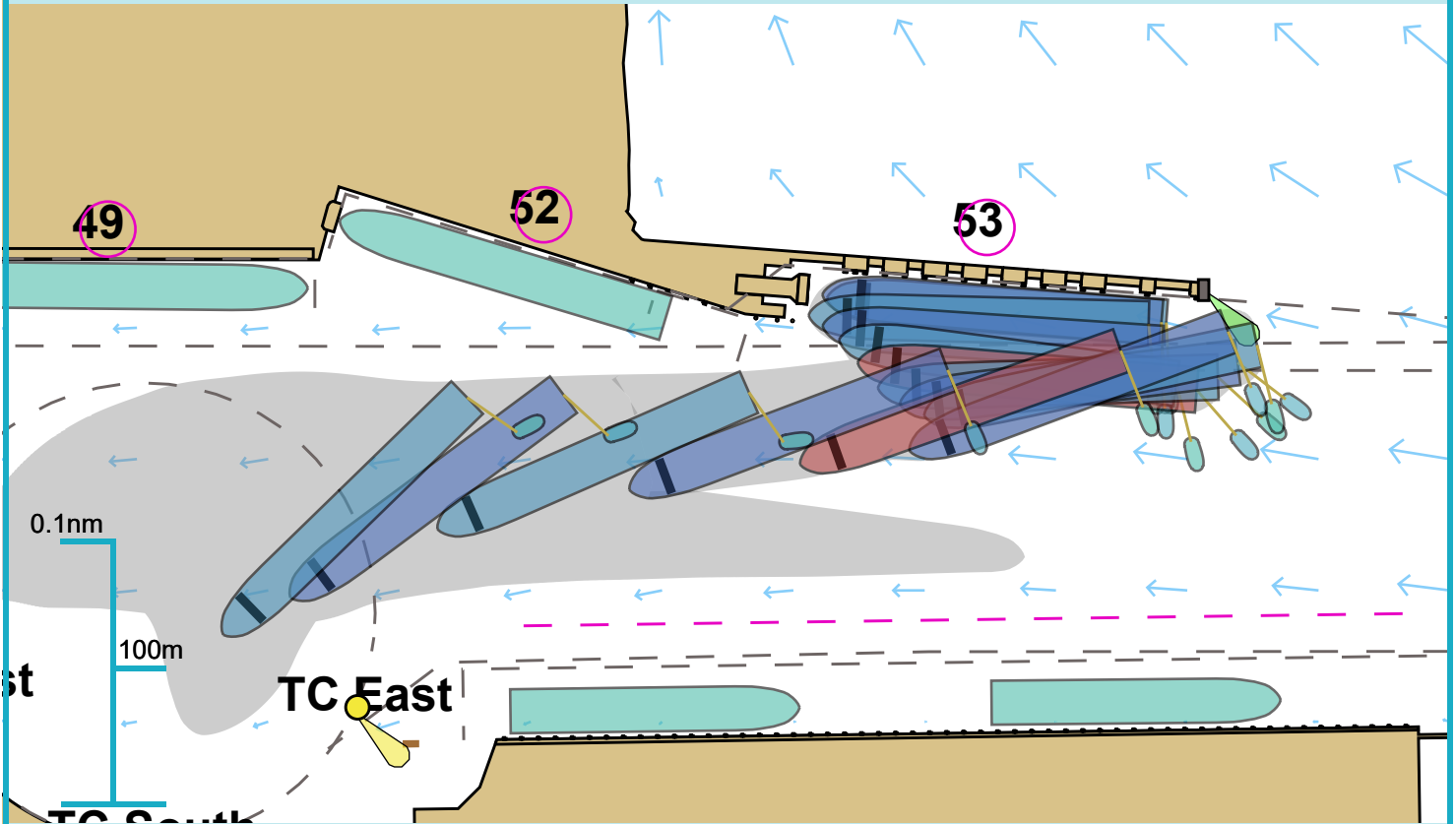
Environment

240m x 32m RoPax Ferry

Thruster and engine use

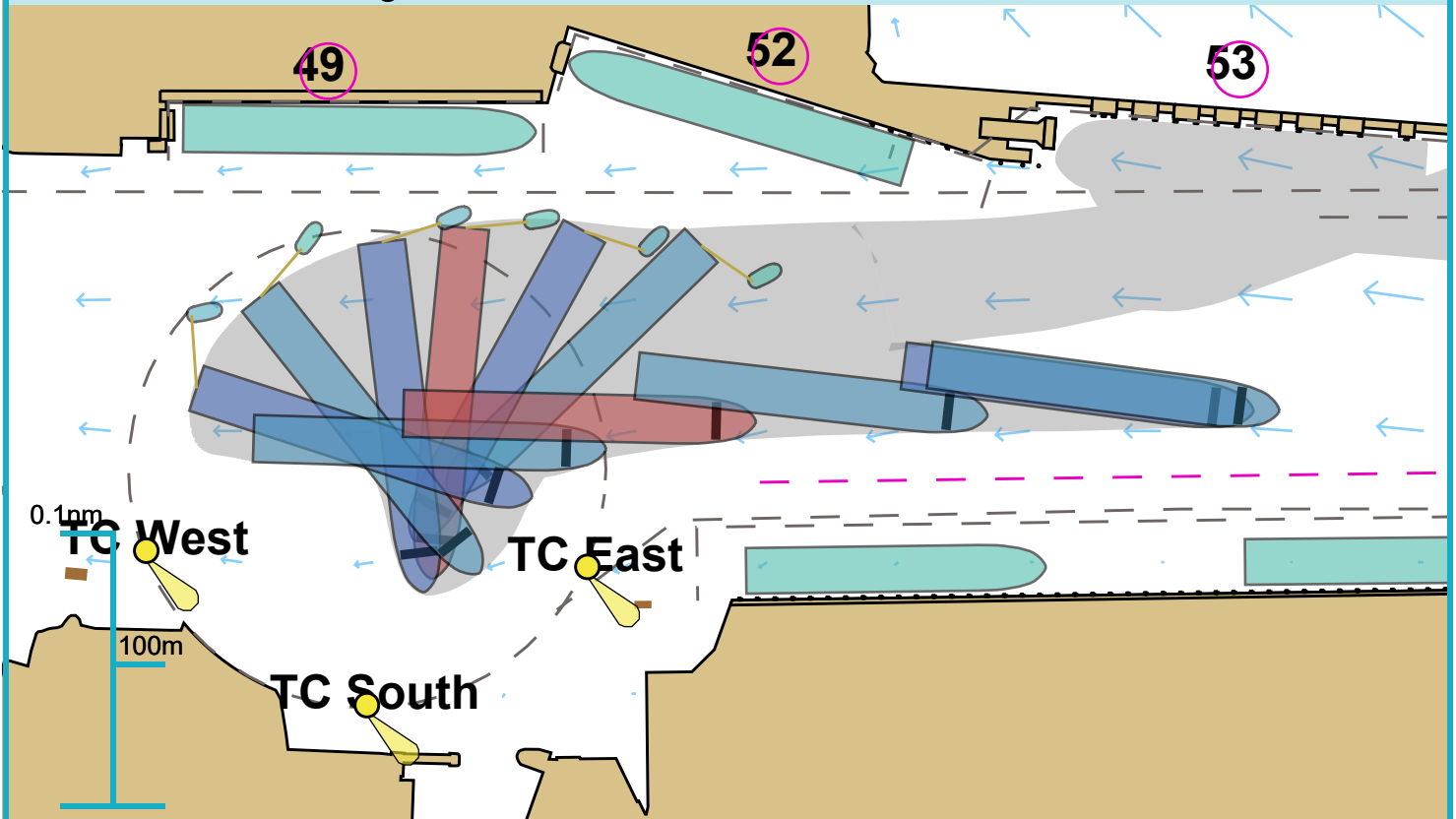
Tug use

Departure



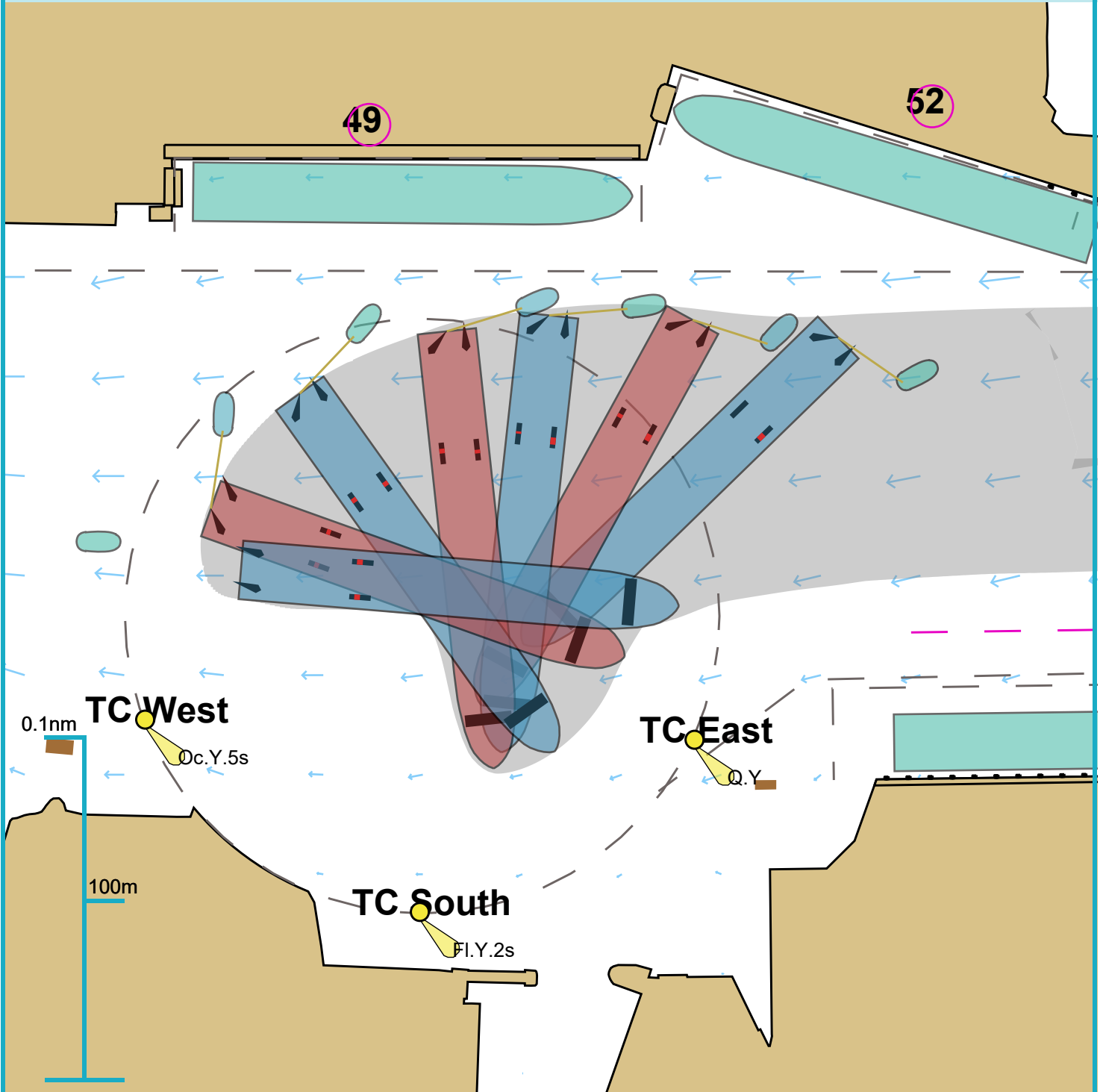
Ships plotted every 1 mins, highlight every 5 mins

Manoeuvre & Passage

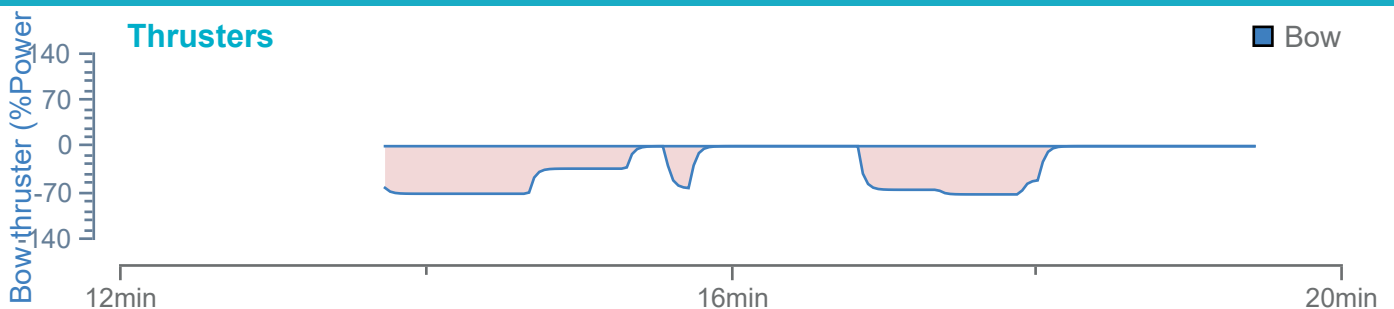


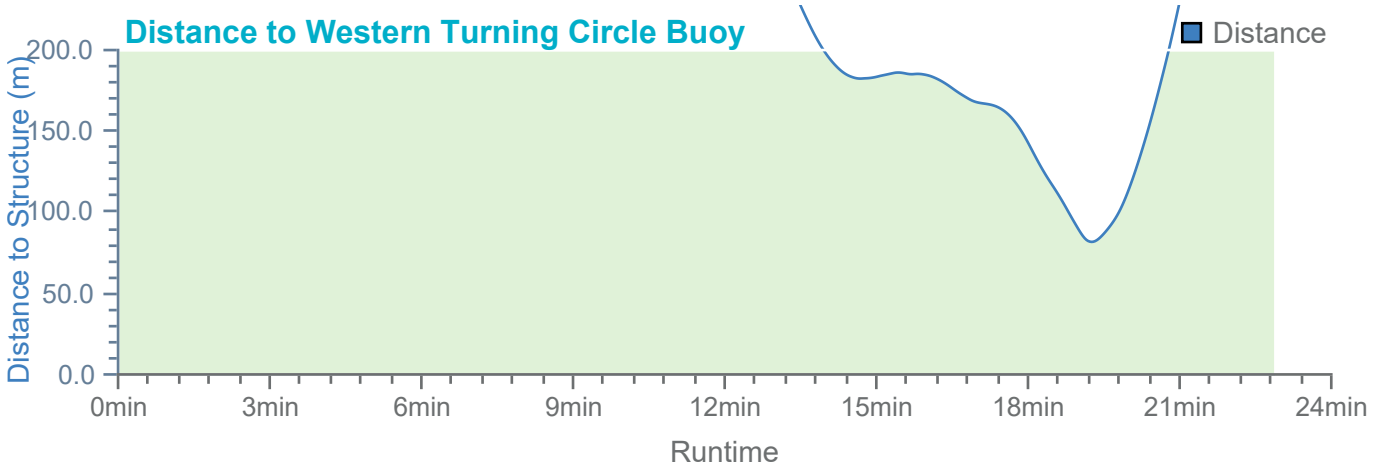
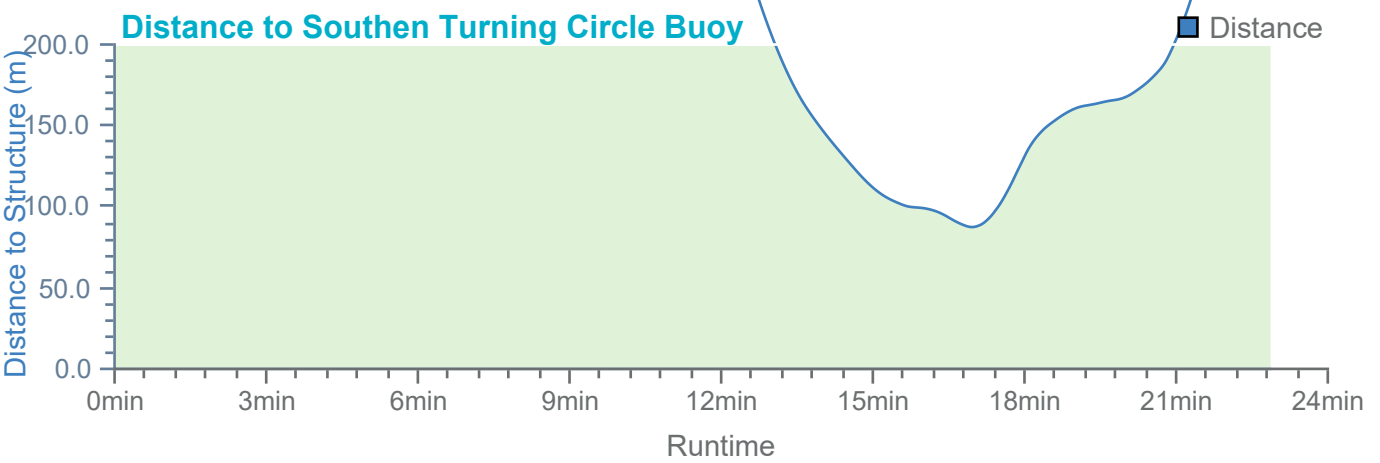
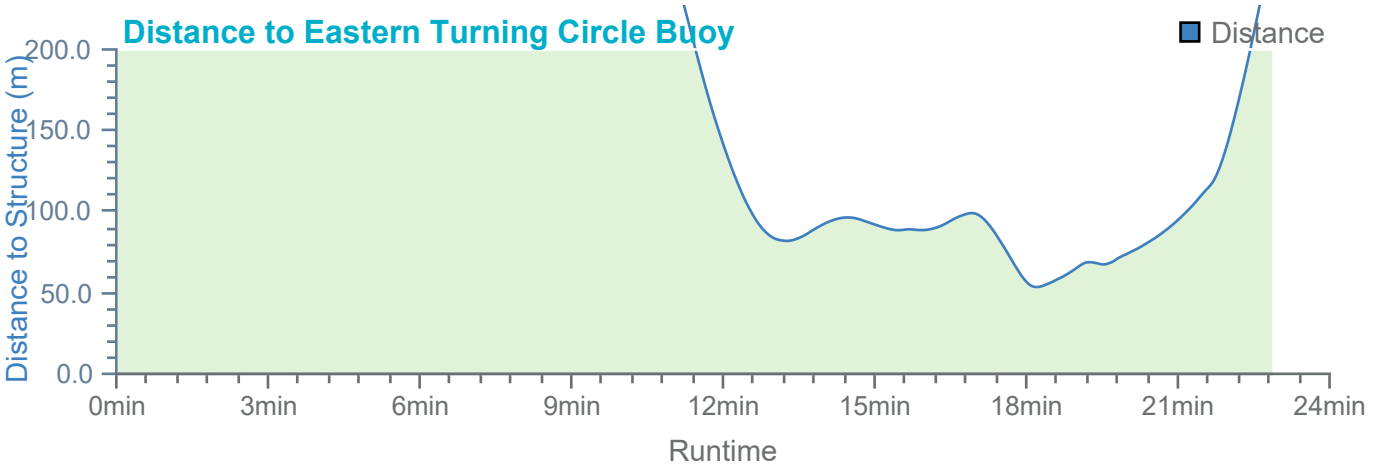
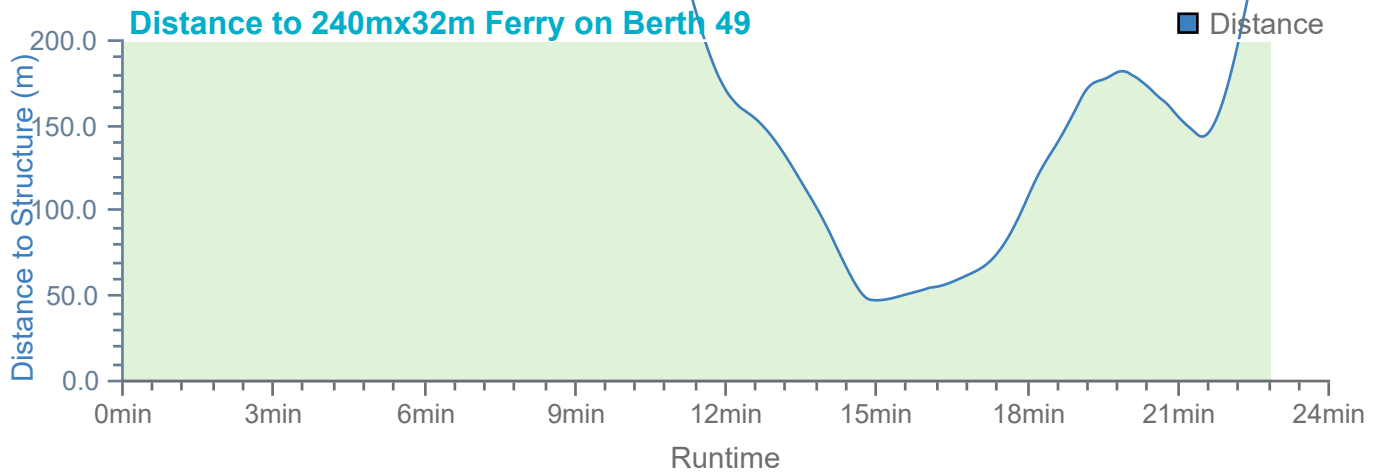
Ships plotted every 1 mins, highlight every 5 mins

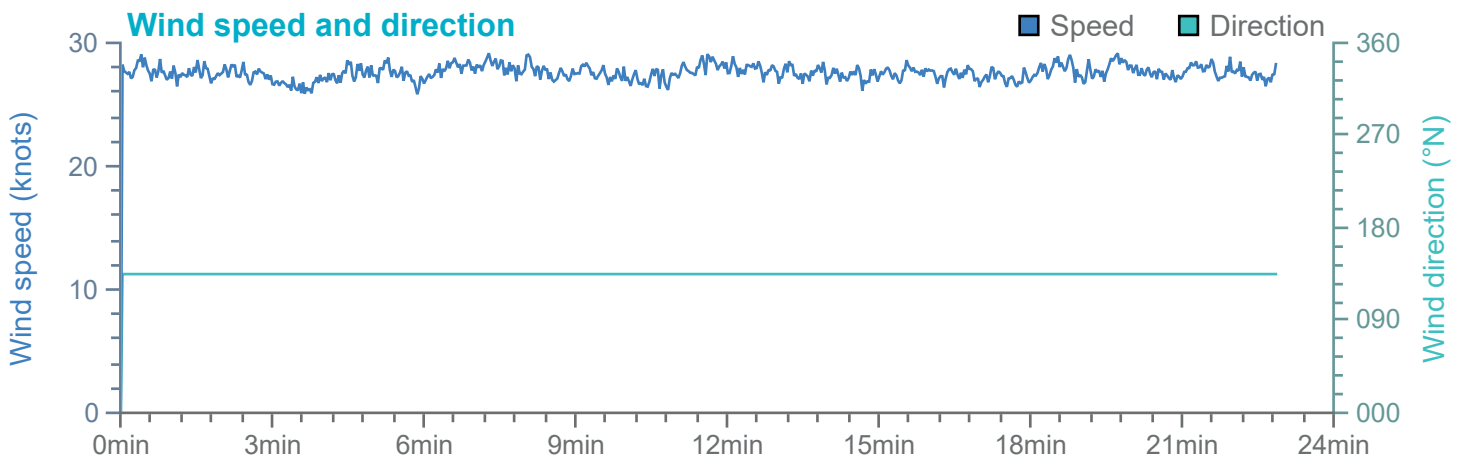
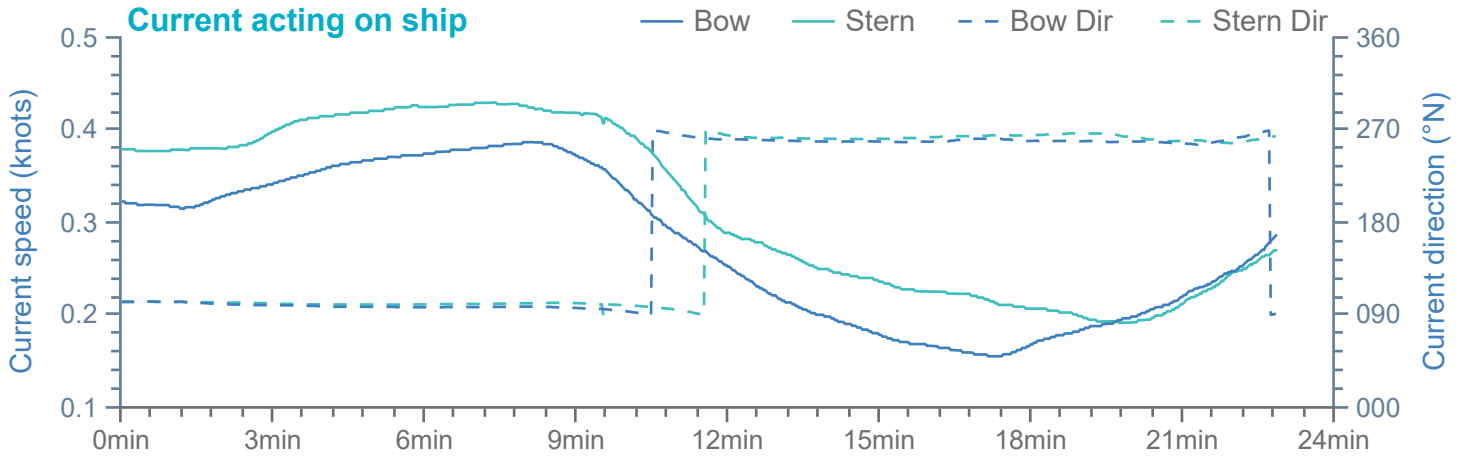
Swing



Ships plotted every 59 seconds, highlight every 2 mins







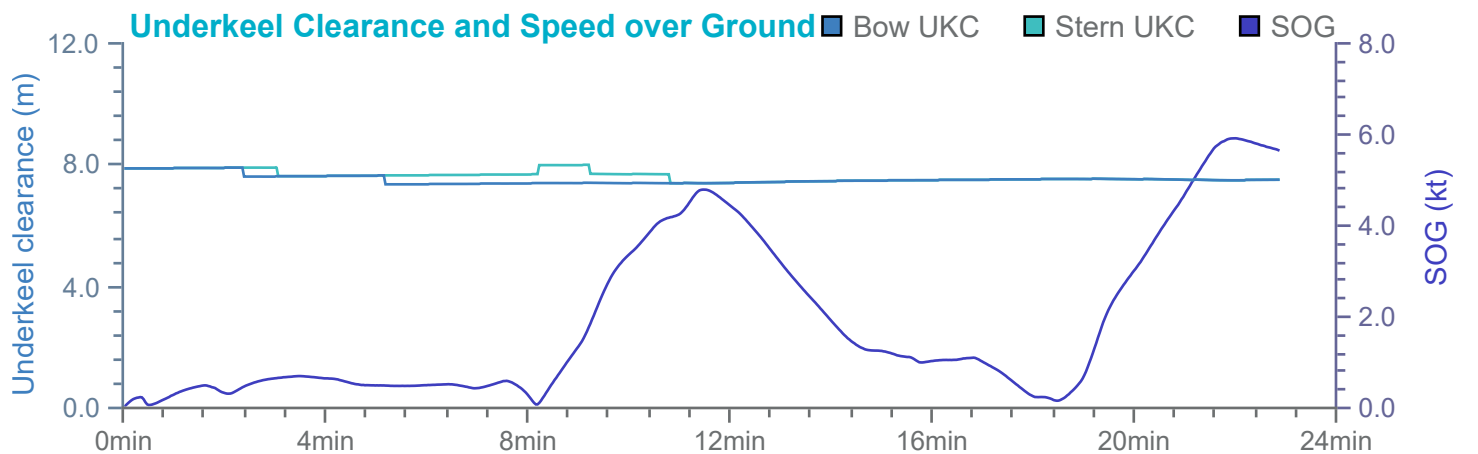
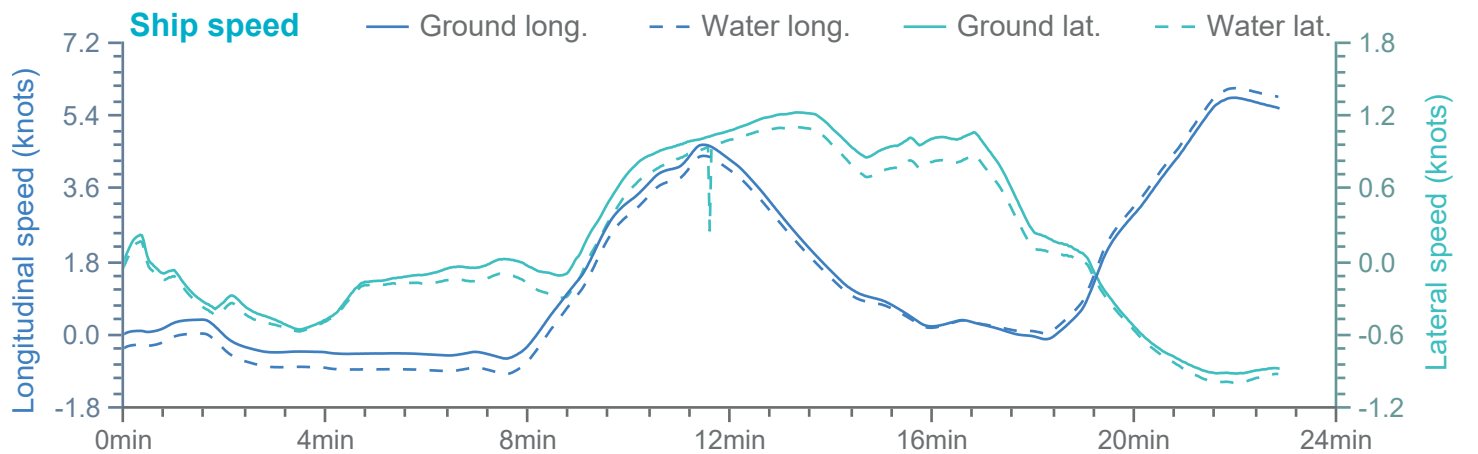
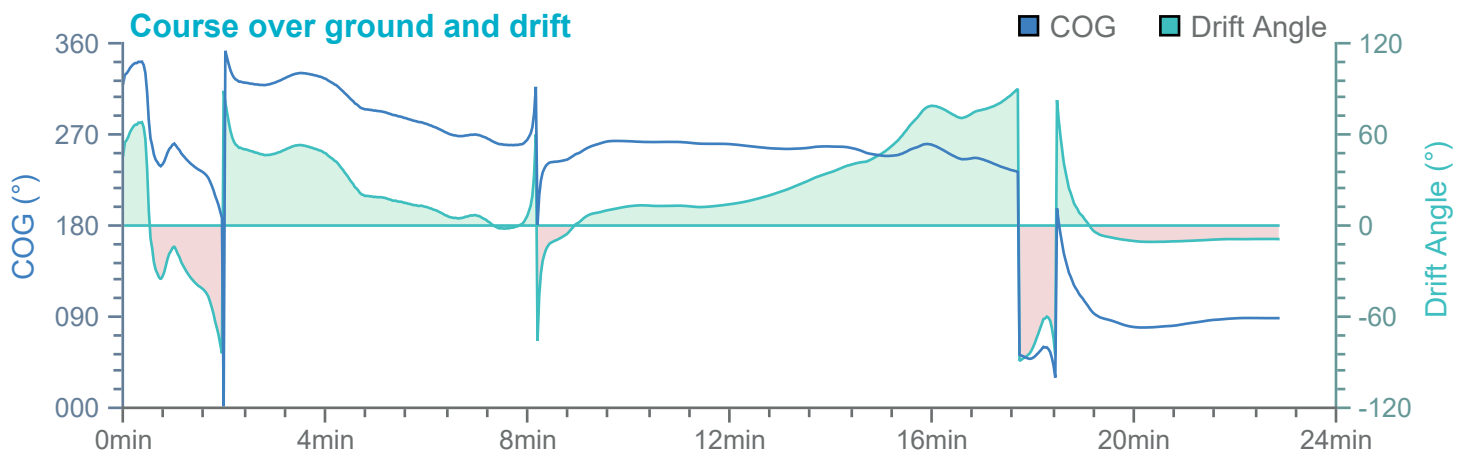
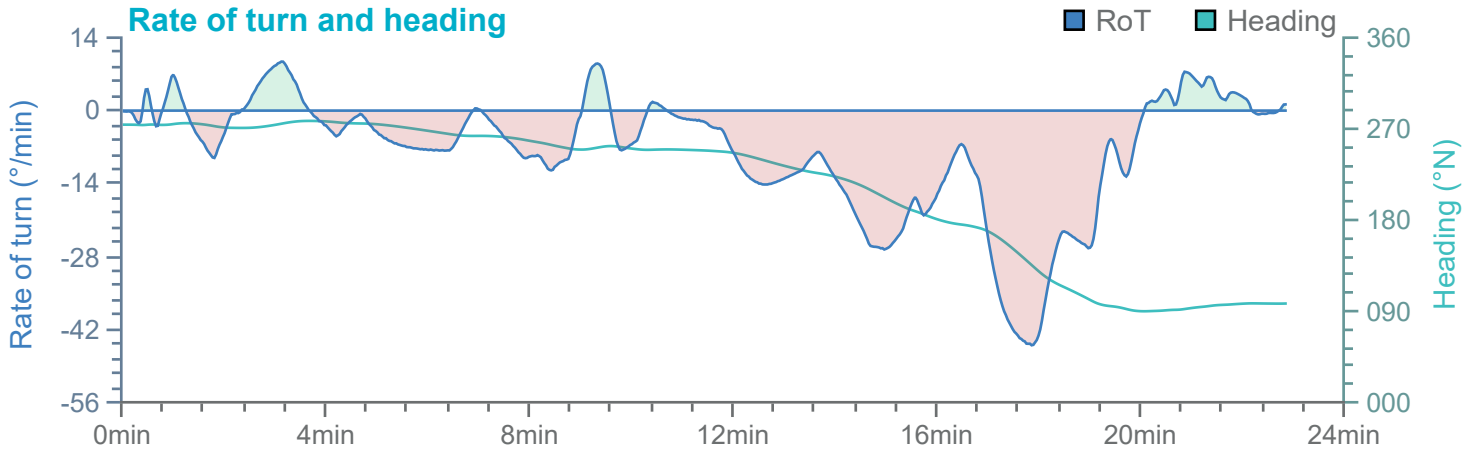
Overview

Environment

240m x 32m RoPax Ferry

Thruster and engine use

Tug use



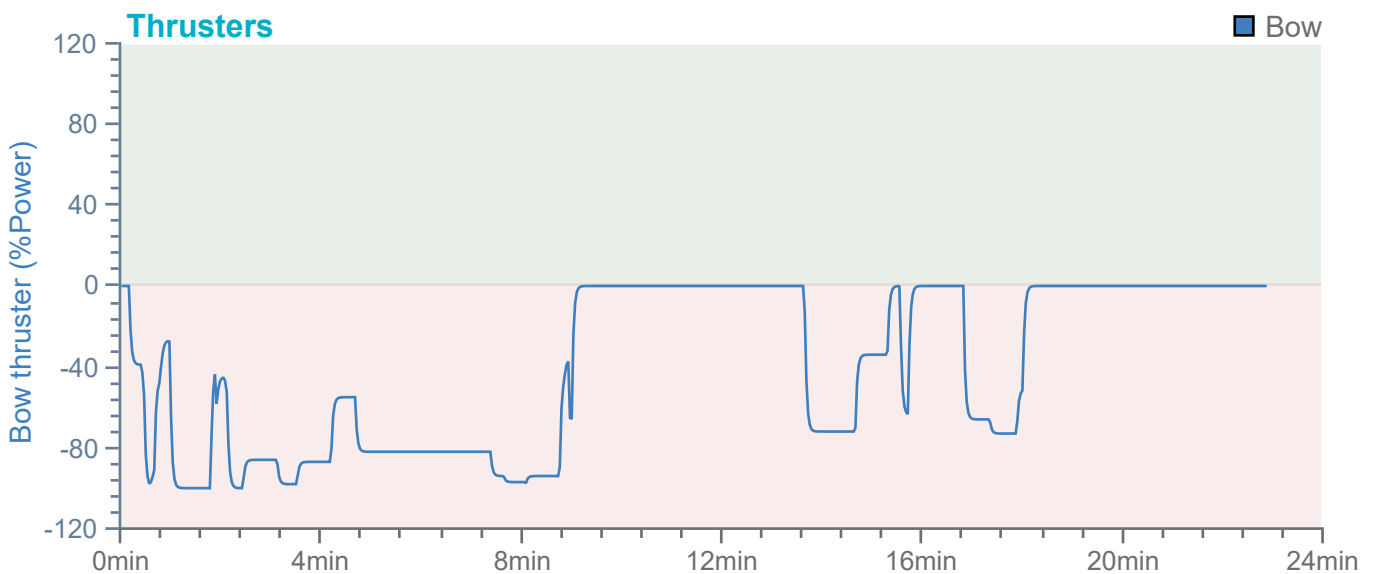
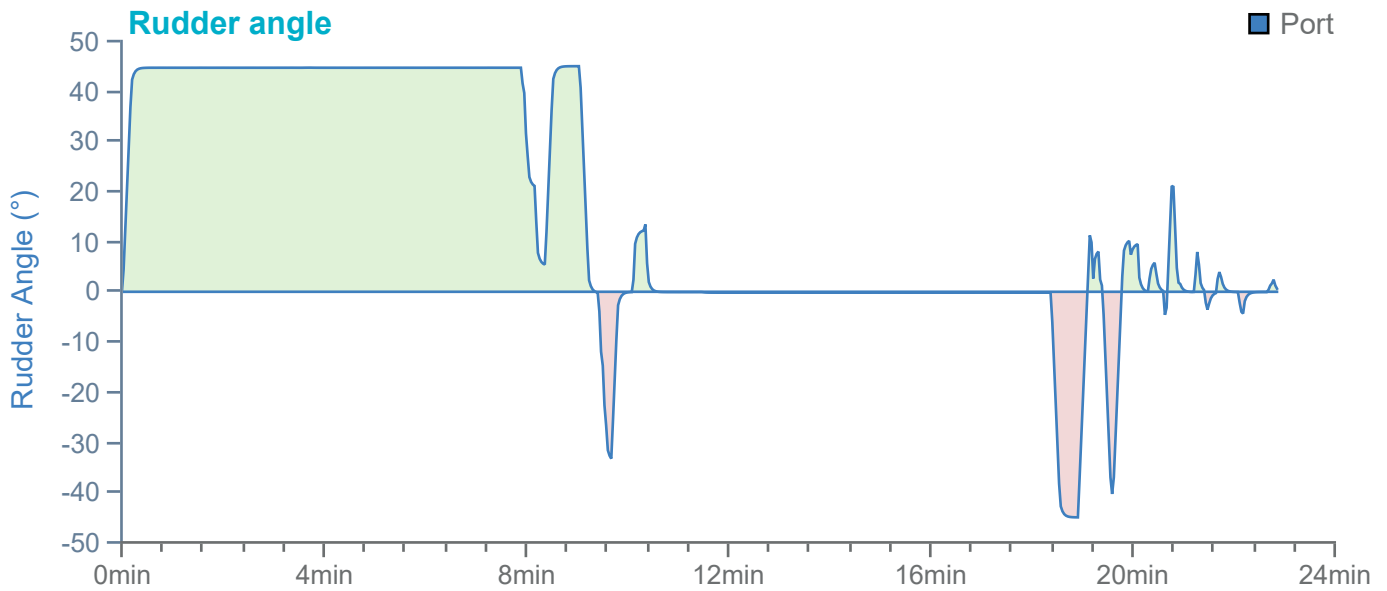
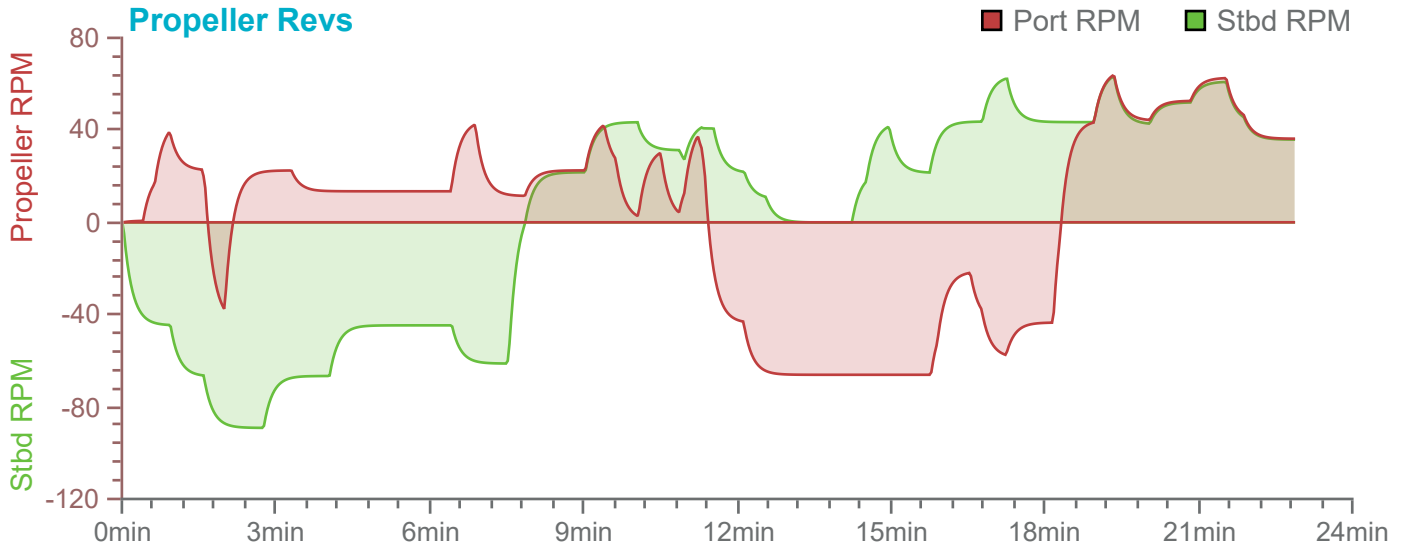
Overview

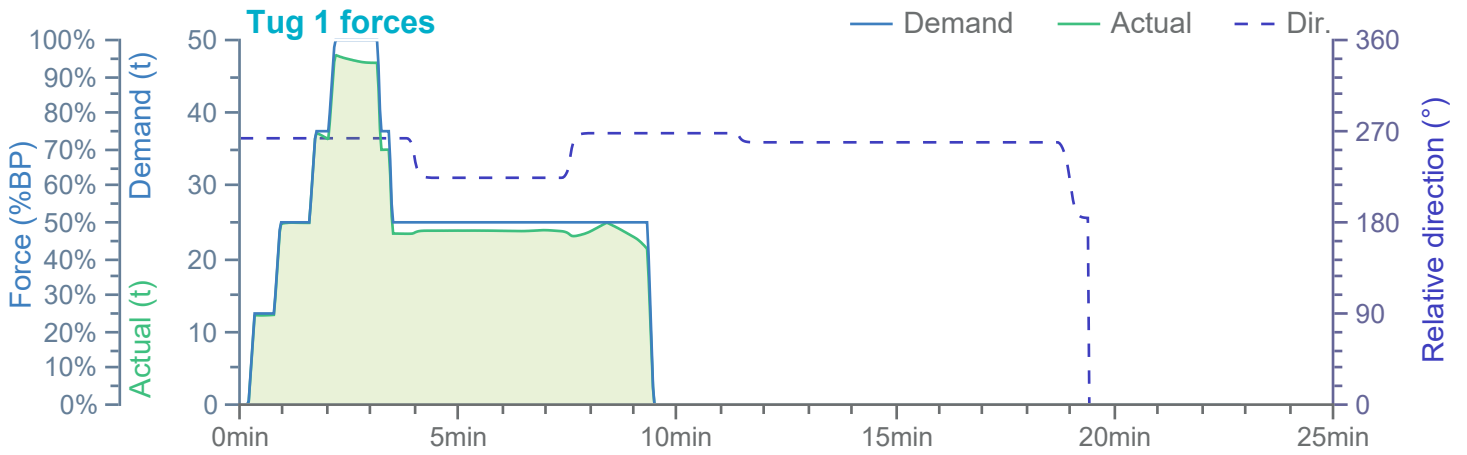
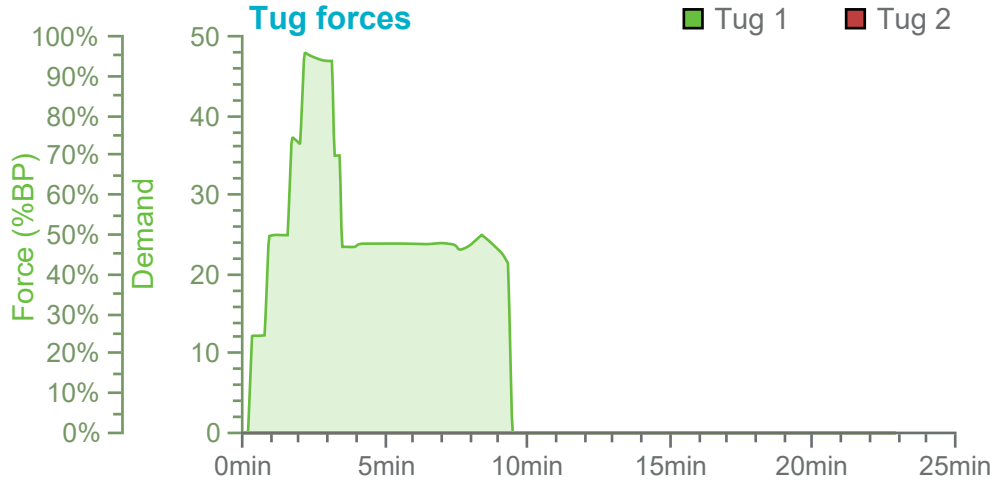
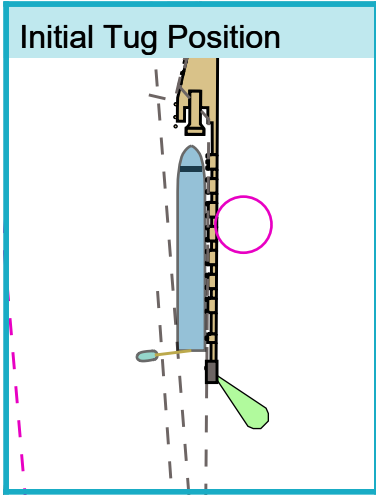
Environment

240m x 32m RoPax Ferry

Thruster and engine use

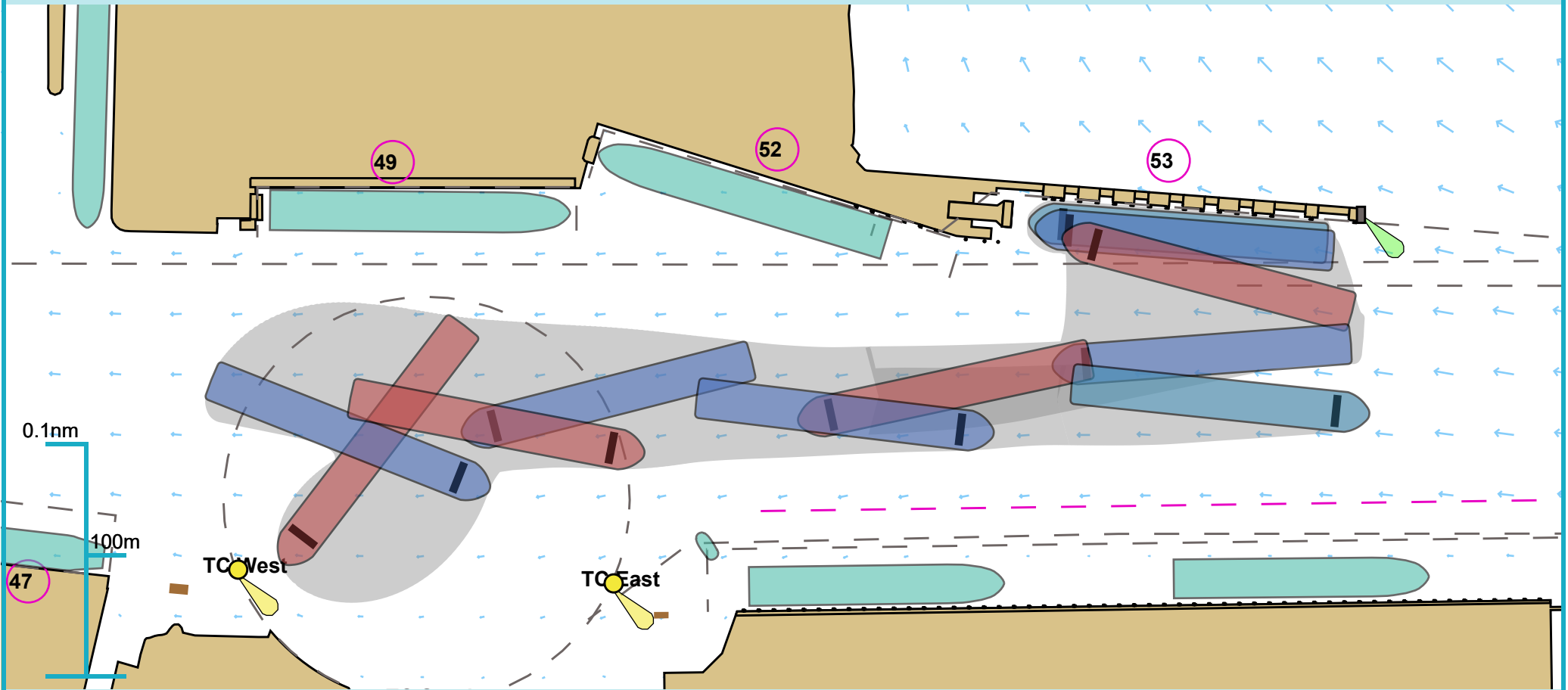
Tug use





Full Run Overview

53° 20.468 N, 006° 11.950 W



Ships plotted every 2 mins, highlight every 4 mins

Pilot: LD

Run length: 20 minutes

Manoeuvre: Other

Ownship(s): 240m x 32m RoPax

Comments:

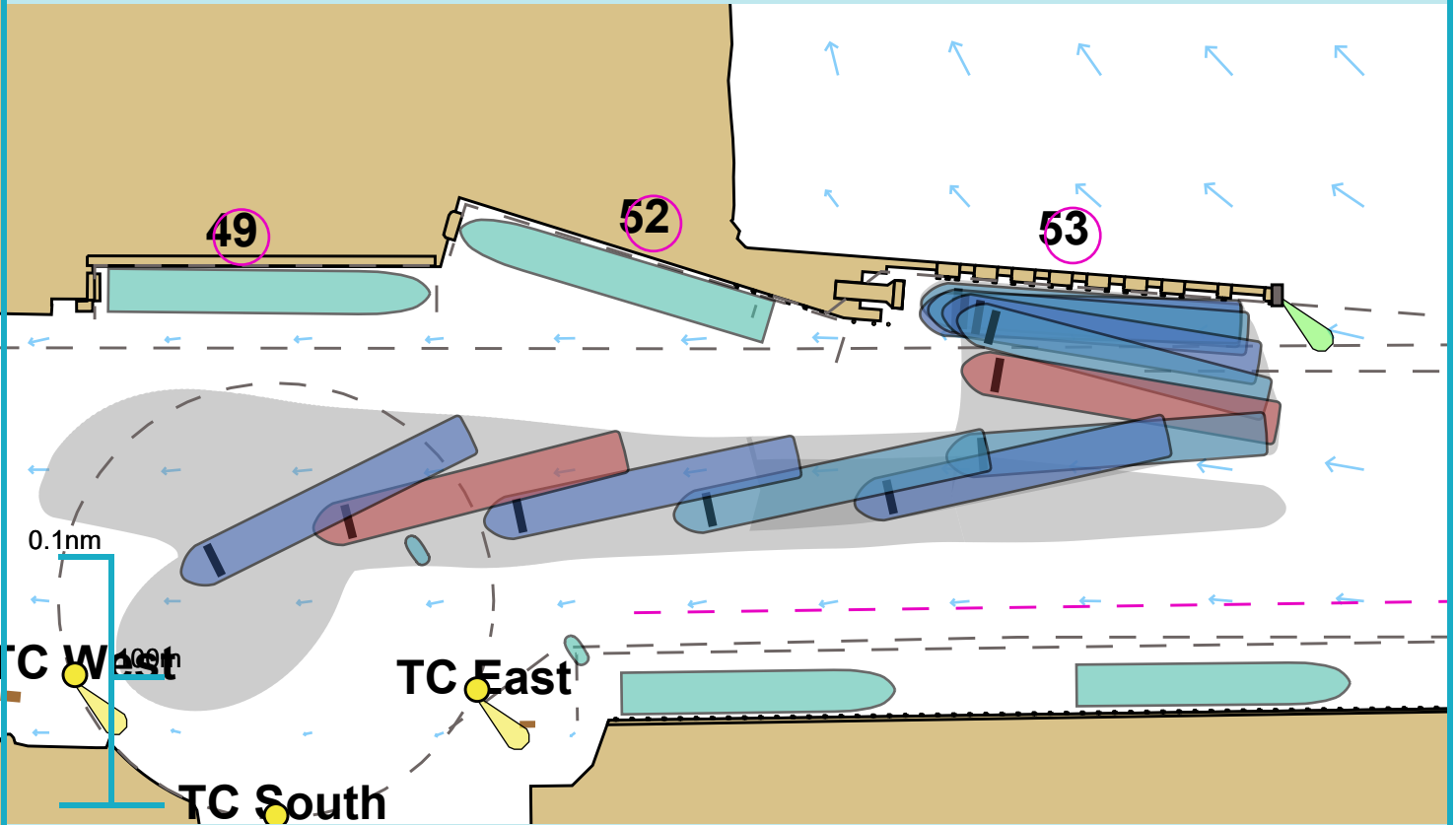
Overview

Environment

240m x 32m RoPax

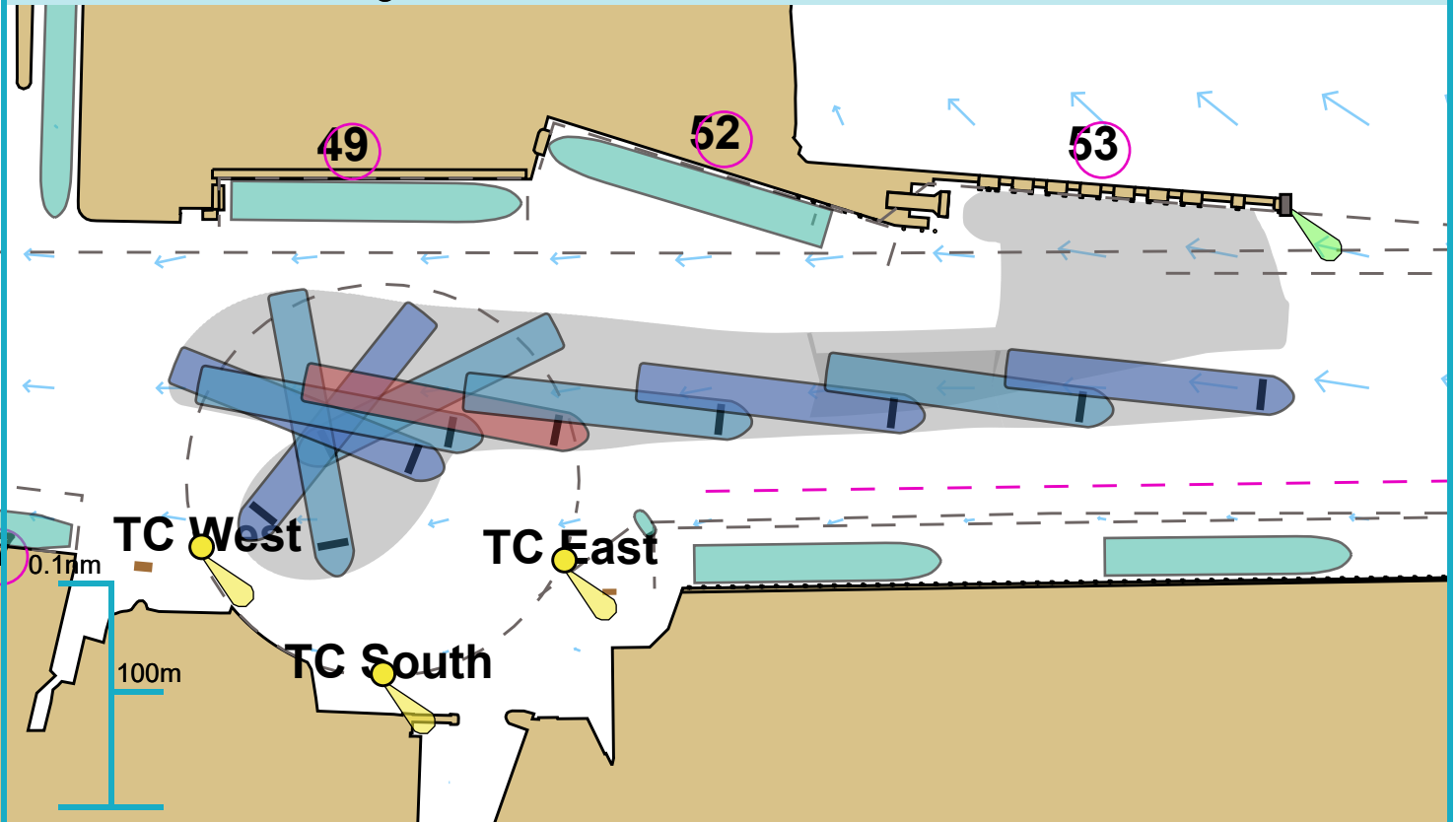
Thruster and engine use

Departure



Ships plotted every 1 mins, highlight every 5 mins

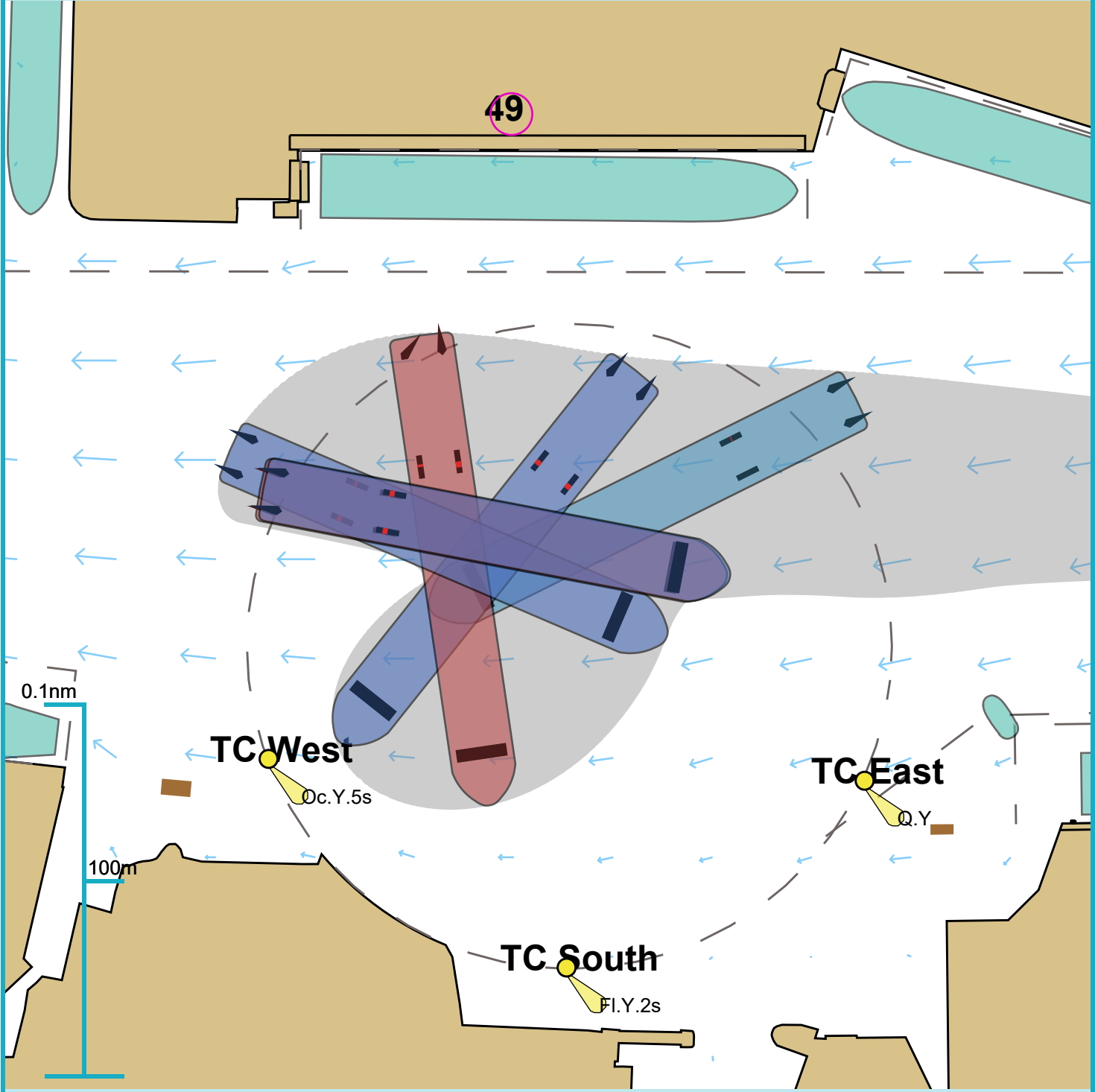
Manoeuvre & Passage



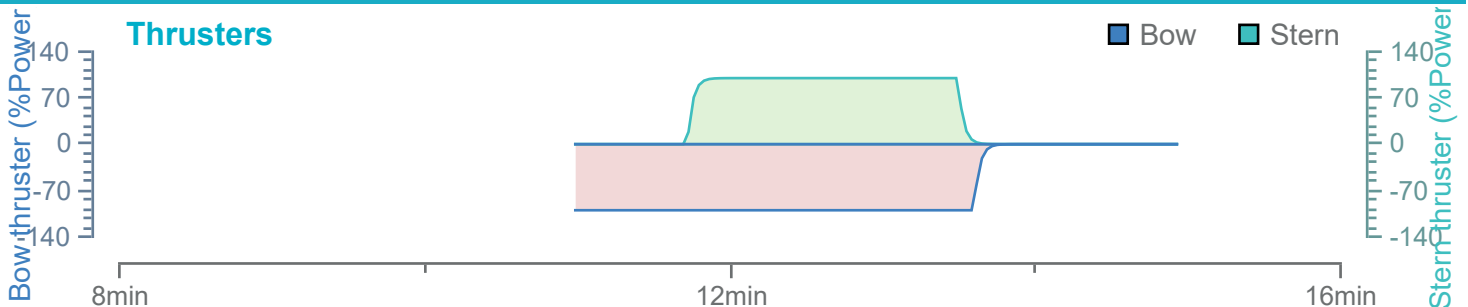
Ships plotted every 1 mins, highlight every 5 mins

Swing

49



Ships plotted every 59 seconds, highlight every 2 mins

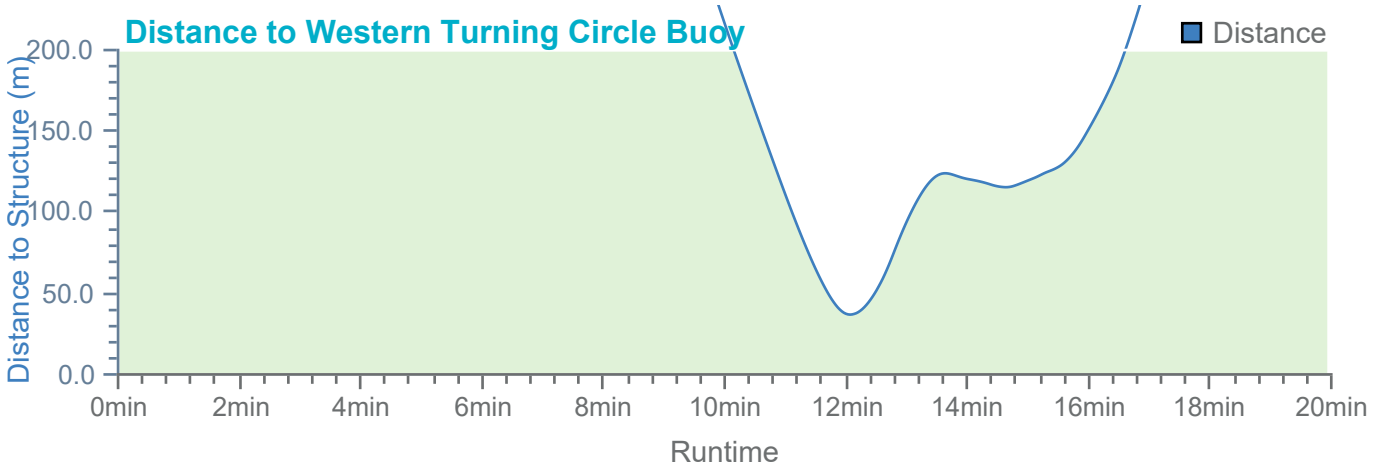
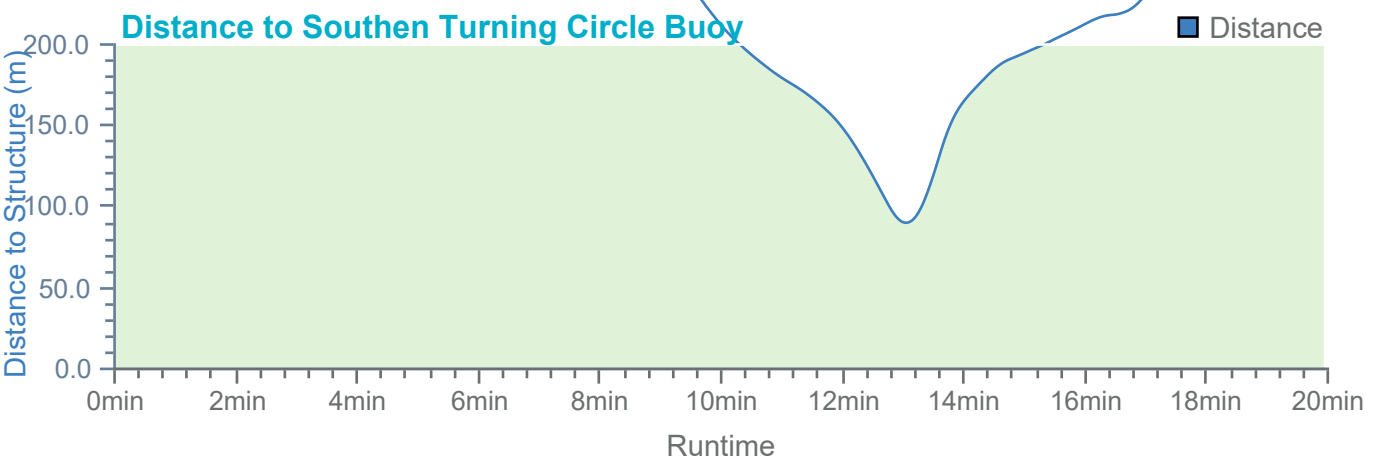
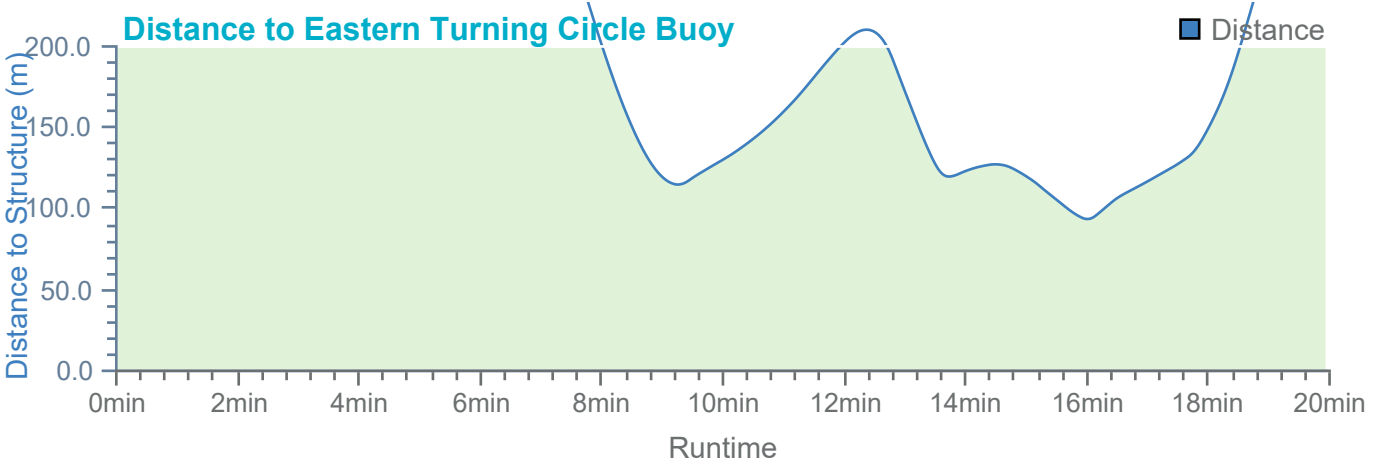
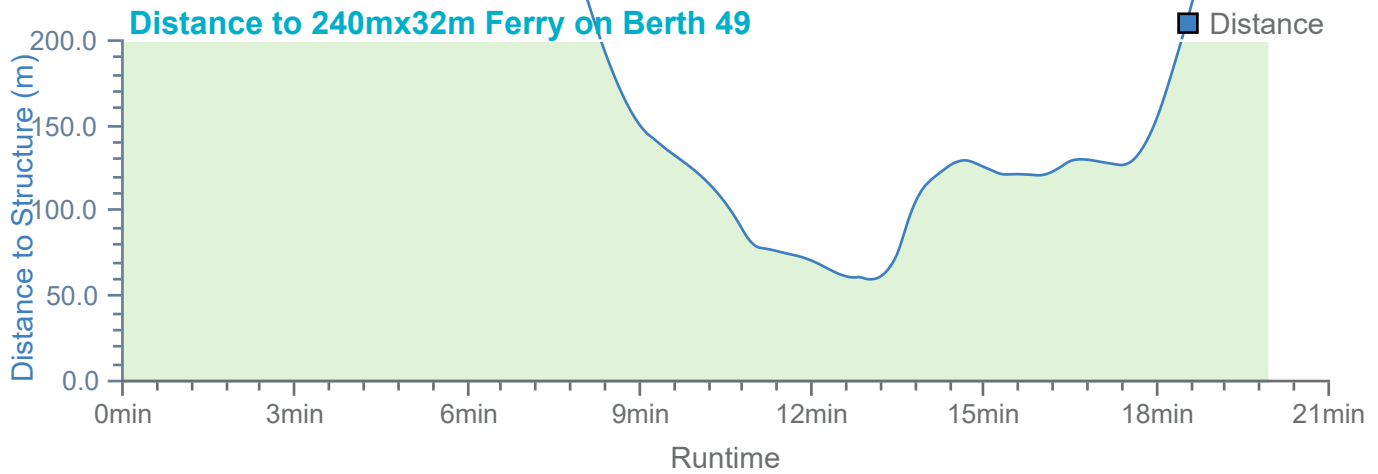


Overview

Environment

240m x 32m RoPax

Thruster and engine use

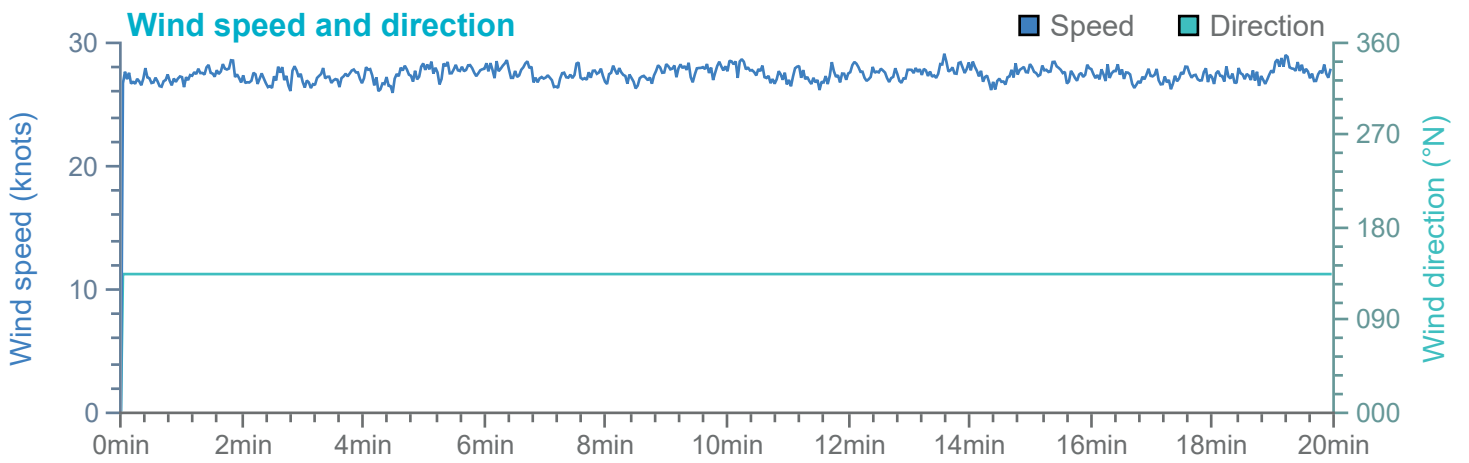
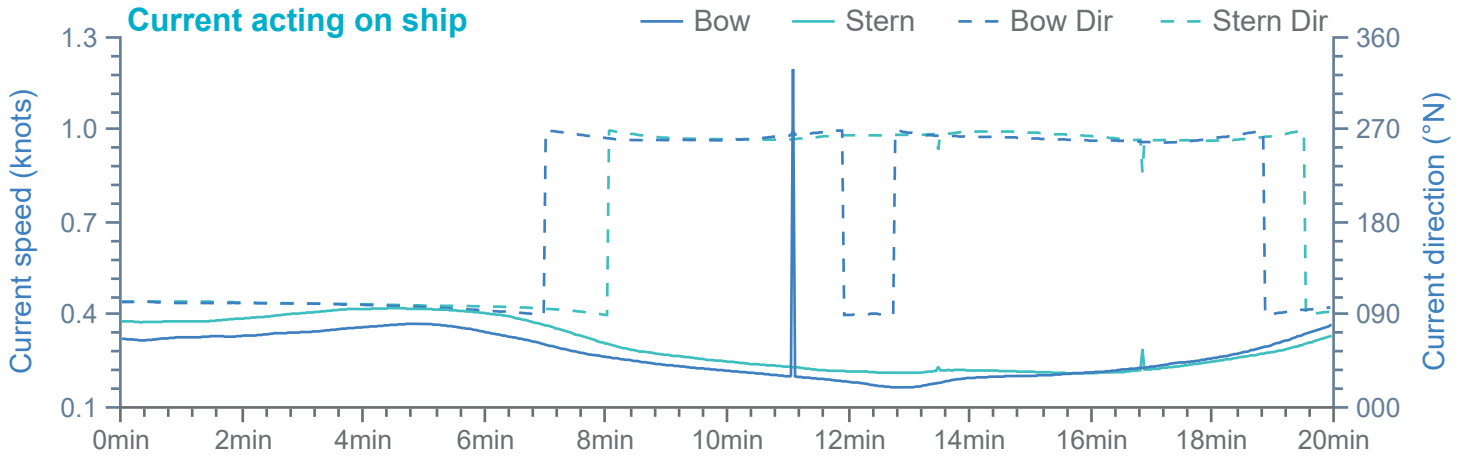


Overview

Environment

240m x 32m RoPax

Thruster and engine use

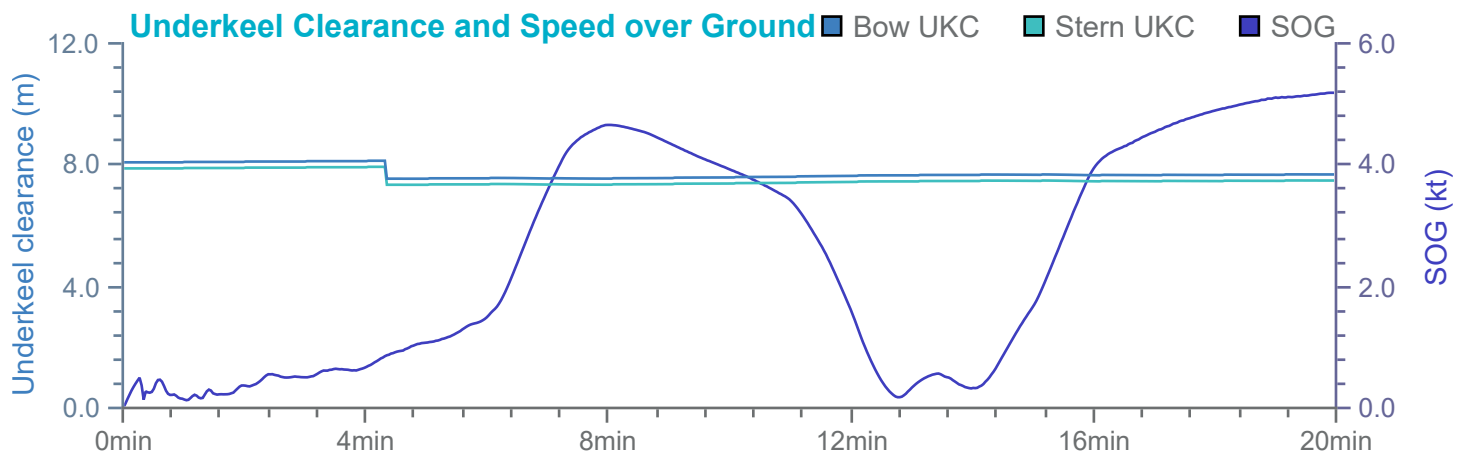
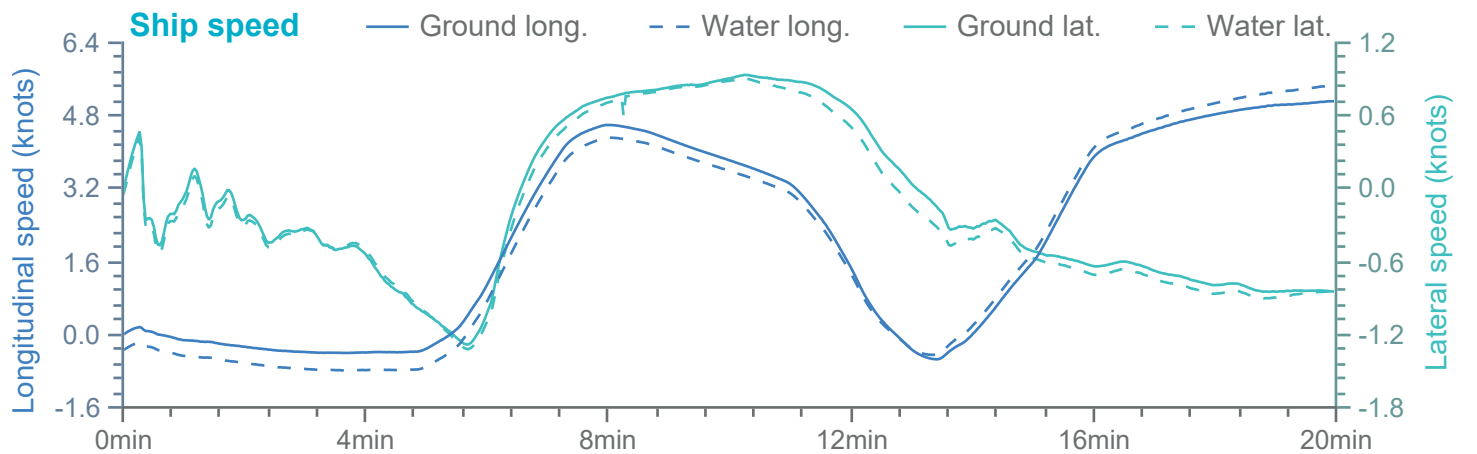
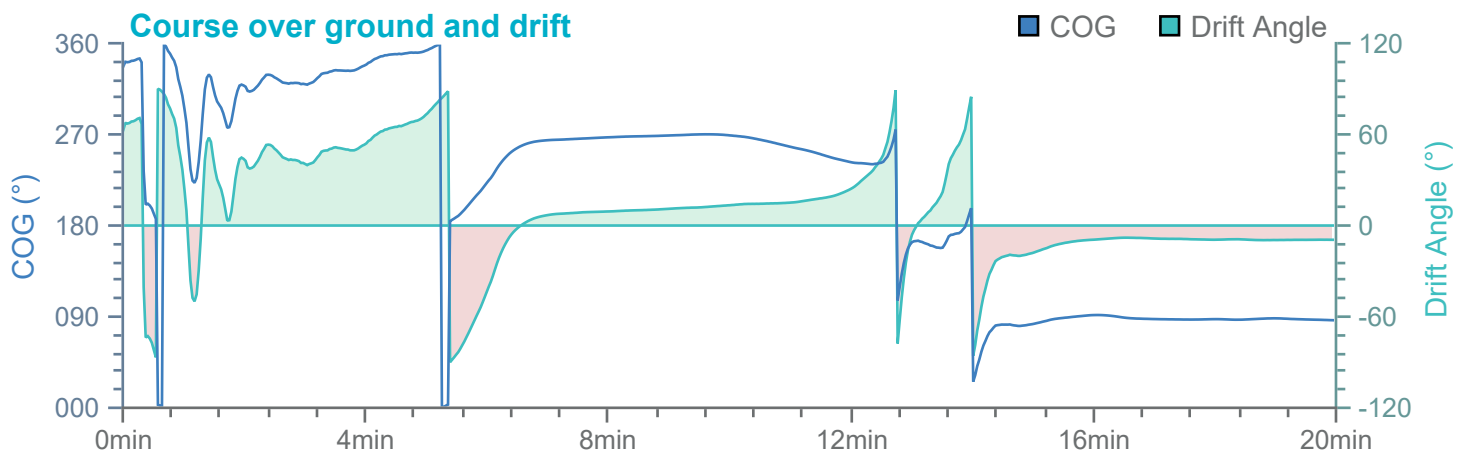
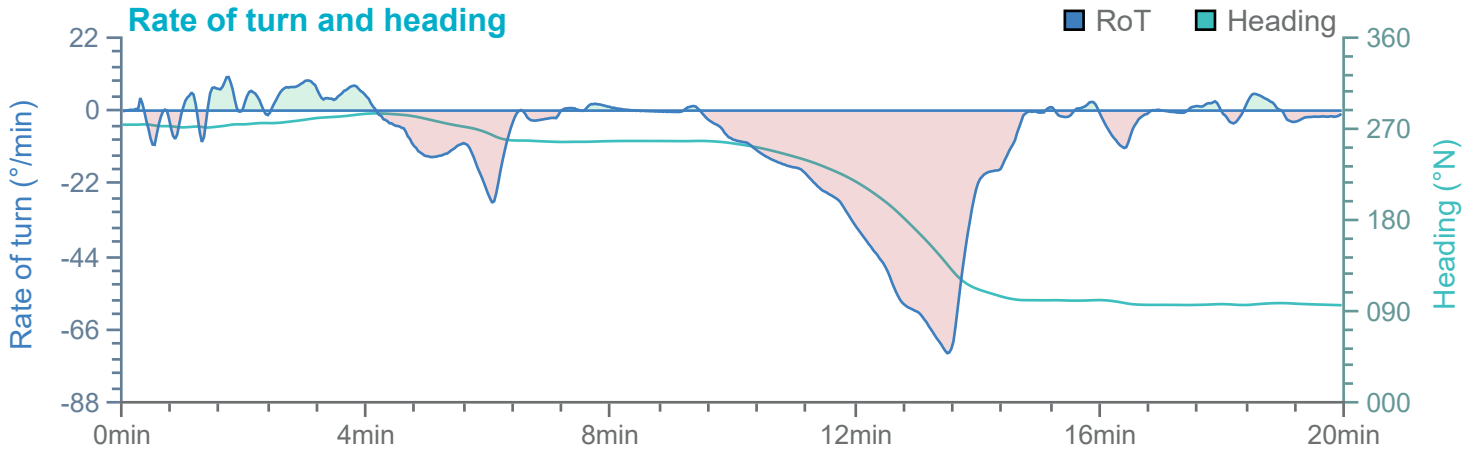


Overview

Environment

240m x 32m RoPax

Thruster and engine use

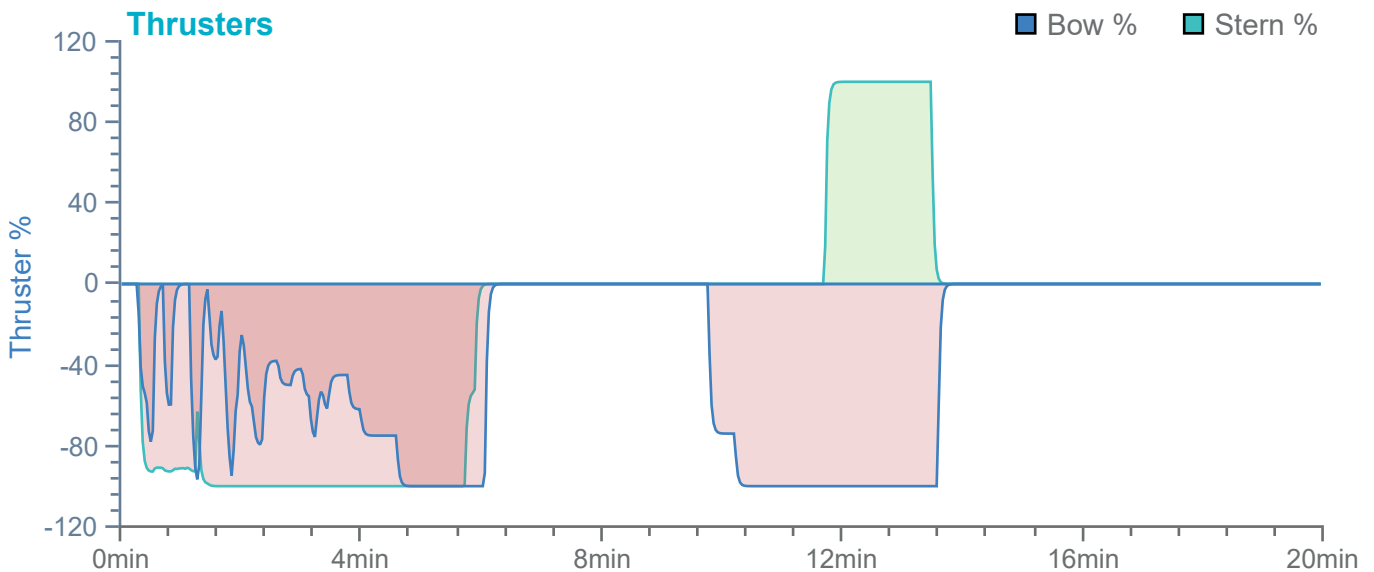
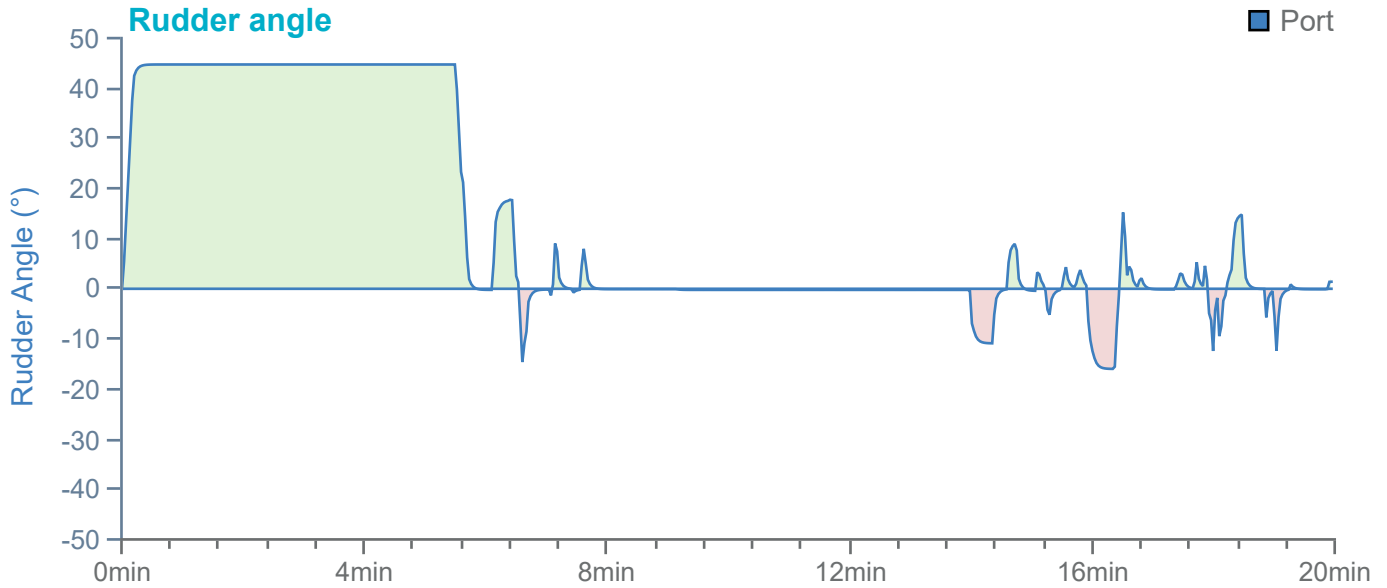
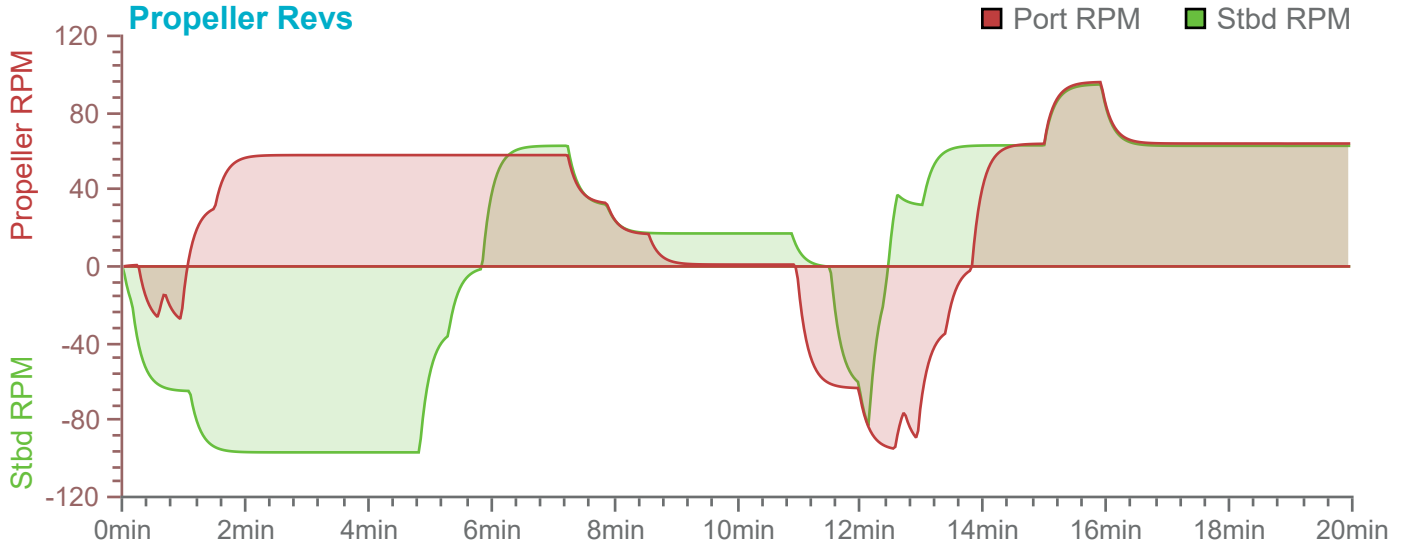


Overview

Environment

240m x 32m RoPax

Thruster and engine use



We design smarter, more resilient solutions across both the natural and built environment to help everyone live and work more sustainably with water.

HR Wallingford
Howbery Park
Wallingford
Oxfordshire OX10 8BA
United Kingdom

+44 (0)1491 835381

info@hrwallingford.com

www.hrwallingford.com