
NAVOZYME™
Transforming Maritime Ahead of Time
JIT Bunkering via DeepTech, The Nautical Institute - Iberia Branch, 22nd May 2024

Decarbonisation
...the priority for maritime

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IMO GHG STRATEGY
NET ZERO GHG EMISSIONS
BY 2050

EU GREEN DEAL

EU EMISSIONS TRADING SYSTEM (ETS)
ENTERED IN FORCE IN 2024

The Bunkering Industry

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400K Bunkering operations globally

Valued at US$ 225 Billion+

Global bunker volume 300M tns [Ship&Bunker], avg 300tns/lift, est. # annual bunker operations 1M.
VLSFO, average price of US$750/tn [Ship&Bunker], est. value US$ 225B.

JIT Bunkering: The Challenges

Port Authorities

Bunker Suppliers

Barges

Masters &

Chief Engineers

PSC Inspectors

Surveyors

Pilots

Ship Agents

Laboratories

Shipowners

FRICTION = WAIT TIME = WASTED FUEL BURN

Difficulty to co-ordinate diverse actors.

Lack of real-time data.

Risk of Oil Spills!

>2.8Million Hours Lost

>2 Million mT GHG Emissions

MARITIME DECARBONISATION

The Impact

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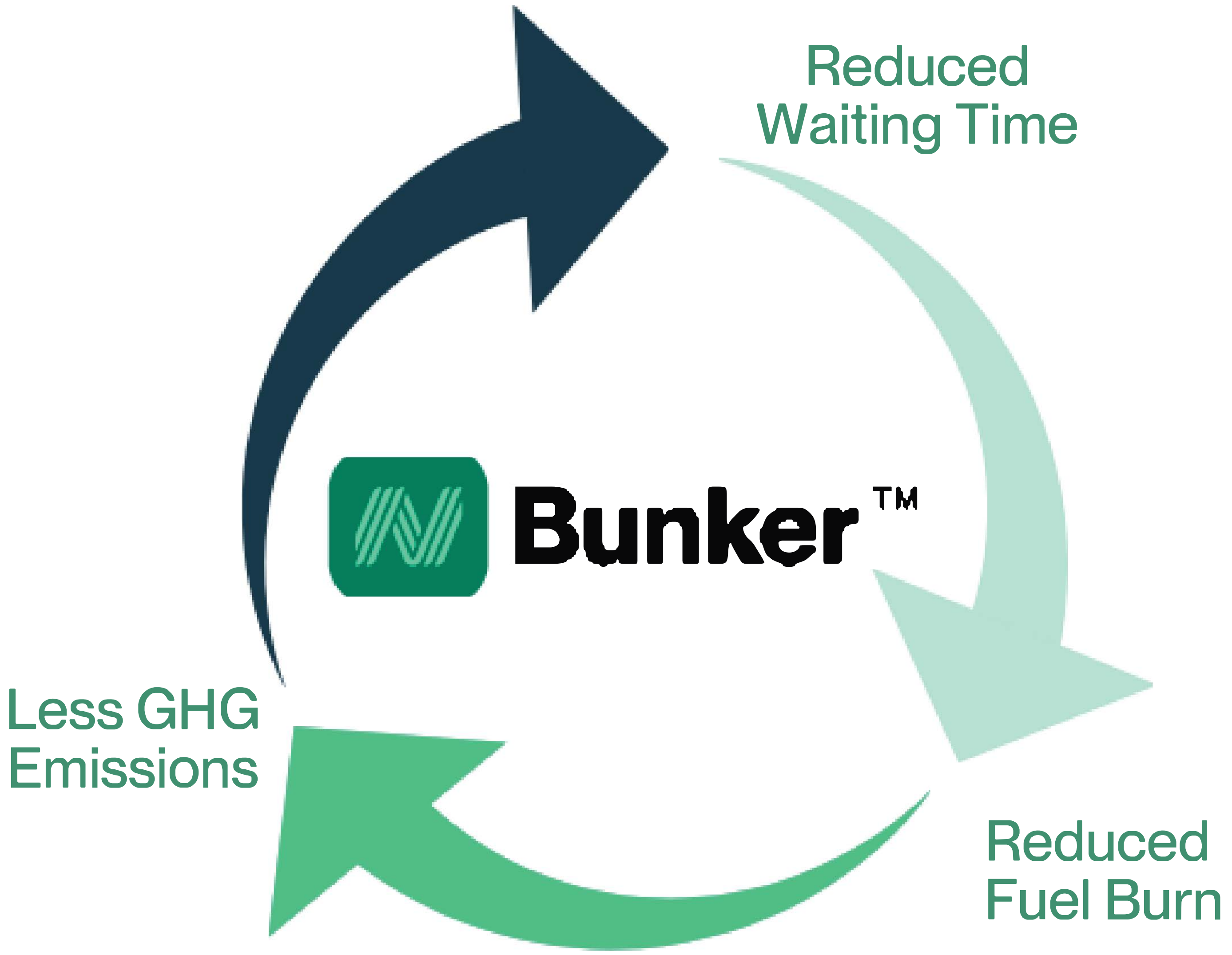

ANNUAL POTENTIAL GLOBAL SAVINGS

- **GHG** — **2M tns**
- **Money** — **US$ 4B**
- **Wait Time** — **2.8M hrs**

Avg idle of 1.85h [*Lind, M., et all, 2018, Ships and Port Idle Time: Who are the Culprits?]
Avg 5.3 tns MDO burn/day at anchor, Aframax Tanker MT Berica (114000GT).
Global bunker volume 300M tns [Ship&Bunker], avg 300tns/lift, est. # annual bunker operations 1M.
Avg operating cost US$1,400/h/vessel, [Netherlands Institute of Transport Analysis, 2020]
Emission factors for CO_2 (3.15tn CO_2/tn of MDO), NO_x (0.057 tn NO_x/tn MDO), SO_x (0.001 tn SO_x/tn MDO), 4th IMO GHG Study (2020).

The Solution

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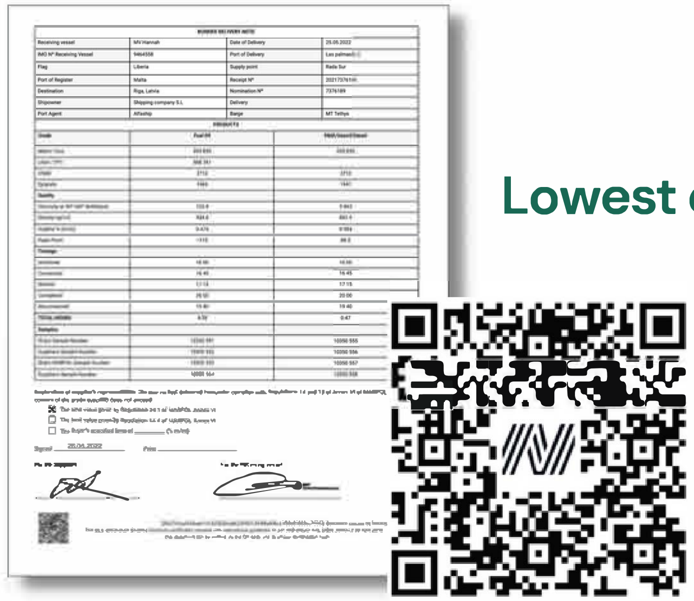
Just-In-Time Bunkering enabled via DeepTech.

DLT enabled Digital Platform

Real-time data from the source.
Regulatory checklists digitalised.

REDUCED RISK & COMPLEXITY



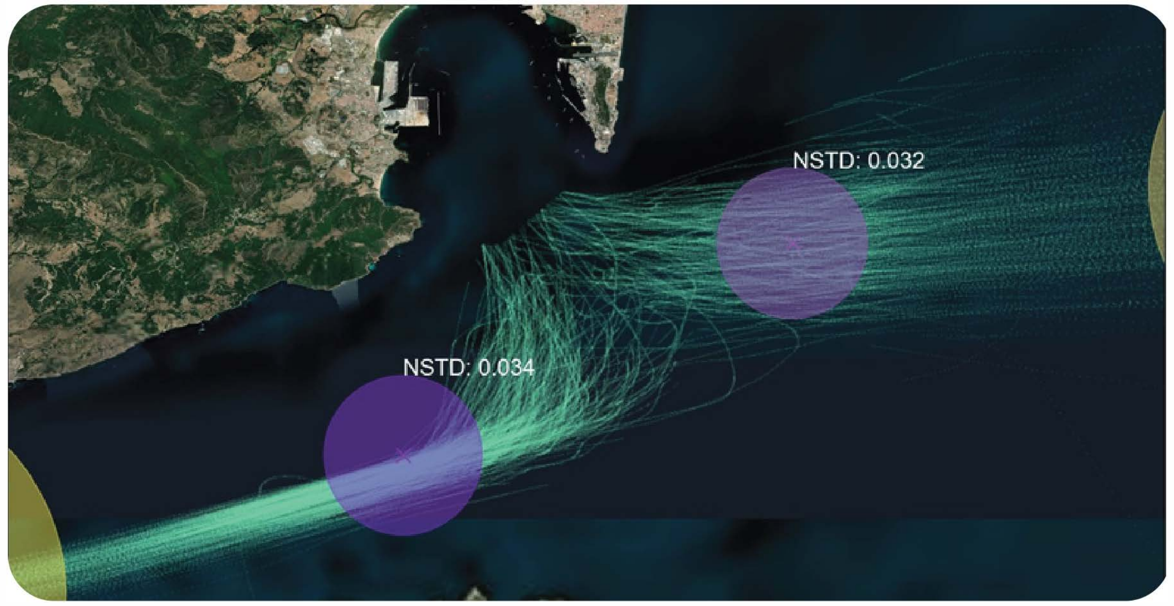
Lowest carbon footprint

DFINITY

AI-ML Optimisation Algorithm

Optimised Vessel ETA.
Bunker Barge schedules.

REDUCED WAITING TIME



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Strong support from bunker ecosystem.

Puerto Bahía de Algeciras
Autoridad Portuaria de la Bahía de Algeciras

HAFNIA
Member of BW Group

DELTA
independent surveyors

AmSpec

ORYX ENERGIES

bcam
basque center for applied mathematics

Puertos de Las Palmas
Autoridad Portuaria de Las Palmas

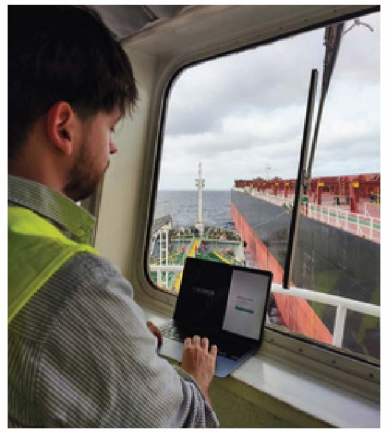
Port de Barcelona

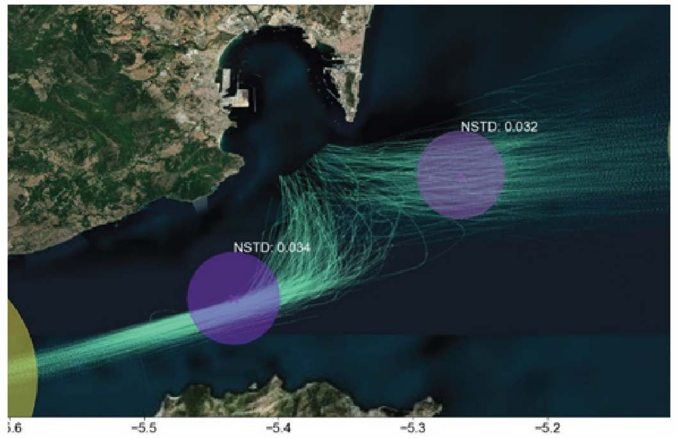
Puerto de Huelva
Autoridad Portuaria de Huelva

valenciaport
Autoridad Portuaria de Valencia

Autoridad Portuaria de Ceuta

alfaship





MARITIME DECARBONISATION

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Awards & Recognitions

Commended by prestigious organisations.

INTERNATIONAL MARITIME ORGANIZATION

TRIBE ACCELERATOR

aws activate

AIPLAN 4EU

PORTS 4.0
Ports of Spain Tradetech Fund

DIGICIRC

ATLANTIC SMART PORTS
BLUE ACCELERATION NETWORK

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873468.

Introduction

NAVOZYME™
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ZERUA TECH S.L.
www.zerua.tech

Artificial Intelligence | Machine Learning | Optimization | Evolutionary Computations

Developing cutting-edge algorithms, software and applications, involving artificial intelligence tools such as machine learning and optimization for engineering problems in variety of science and engineering sectors such as space engineering and maritime industry.

Artificial Intelligence and Machine Learning

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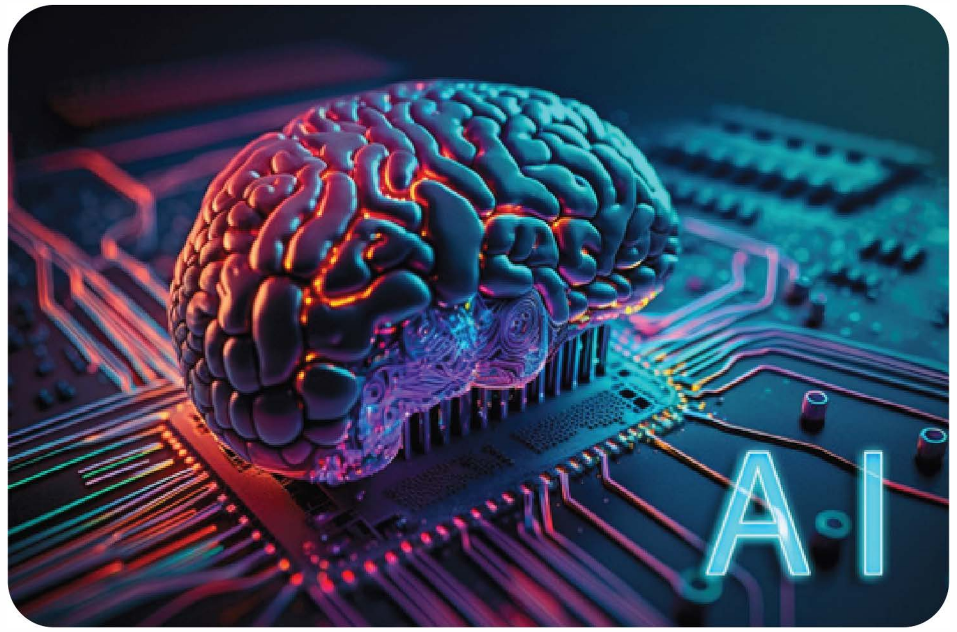
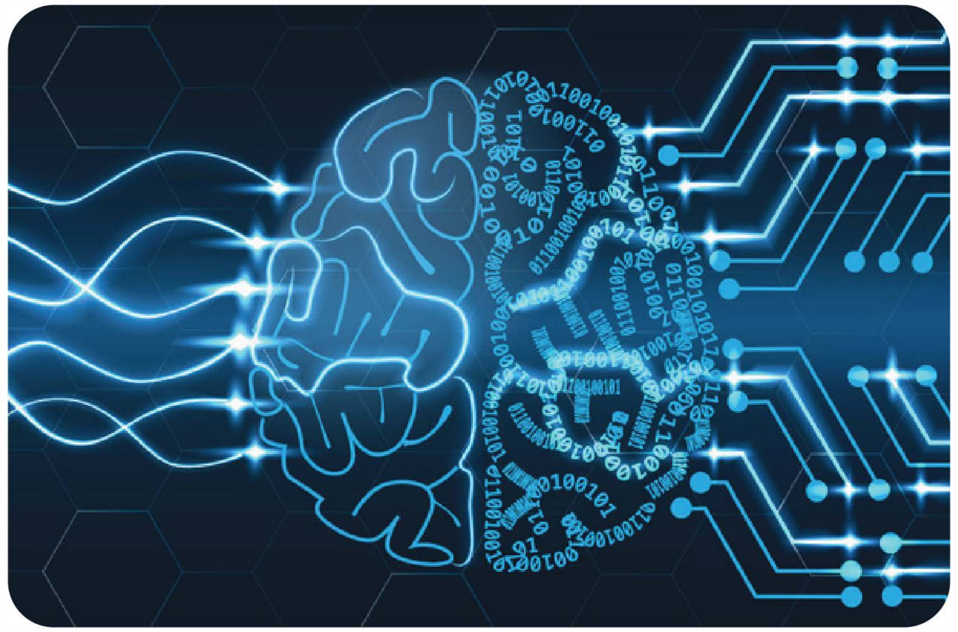


AI

Artificial Intelligence refers to the simulation of human intelligence processes by machines, such as learning, reasoning, and self-correction.

ML

Machine learning is a subfield of artificial intelligence (AI) that focuses on the development of algorithms and models that enable computers to learn and make predictions or decisions without being explicitly programmed.



AI and ML in NBunker

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Objective

- To suggest an Optimised Arrival Time to incoming vessels so they can arrive at anchorage maintaining the optimal speed and at arrival pilotage services and bunkering services are taking place.
- The overall target is to minimize the overall waiting/idle time.

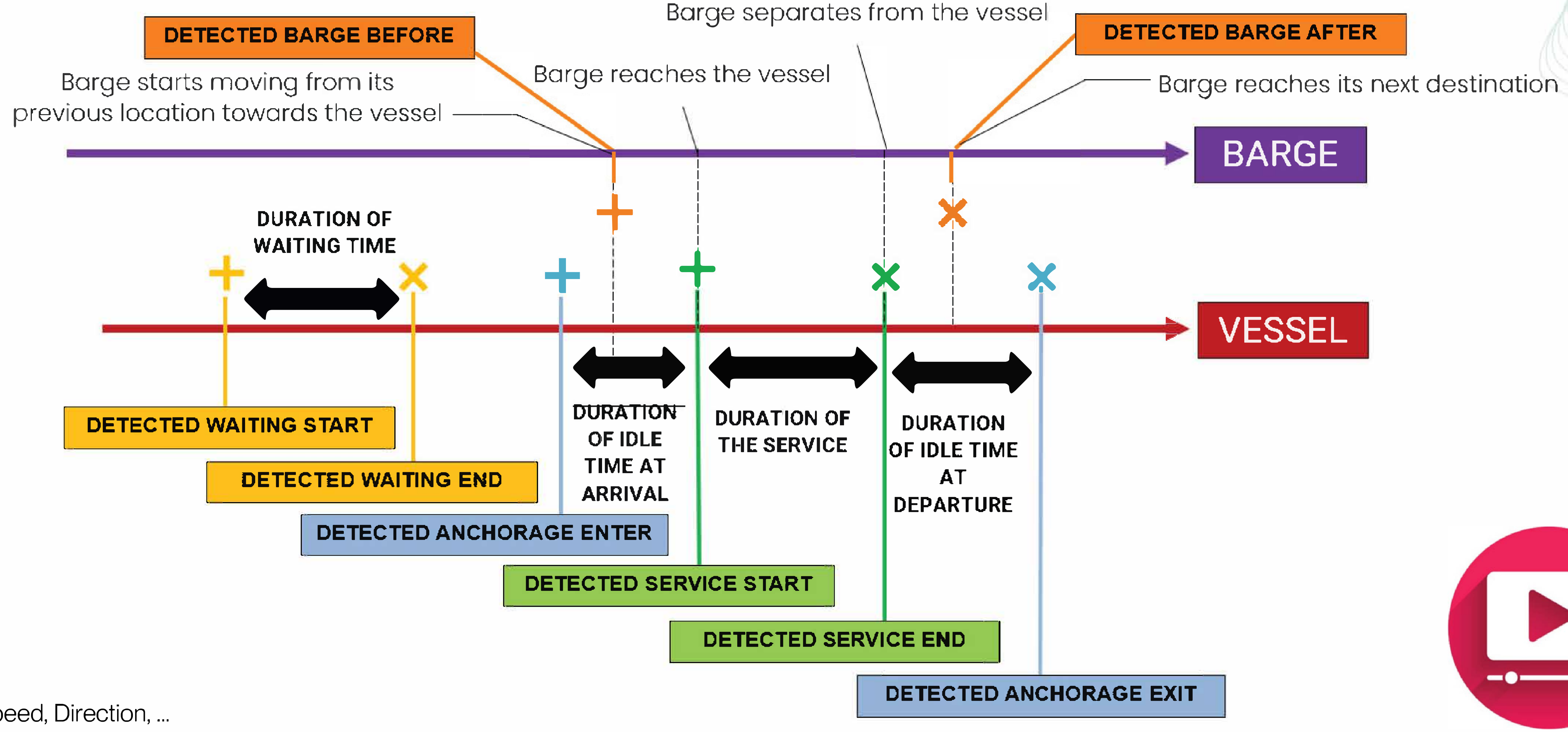
Main Tasks

- In-depth analysis of the bunkering operations
- Estimation of time of arrival
- Optimization of the bunkering scheduling
- Online implementation of the data preprocessing
- Real-time estimation of time of arrival
- Online optimization for recommended time of arrival

IN PROGRESS

In-depth analysis of the bunkering operations

Timestamps



AIS Data:

Name, MMSI, Coordinates, Speed, Direction, ...

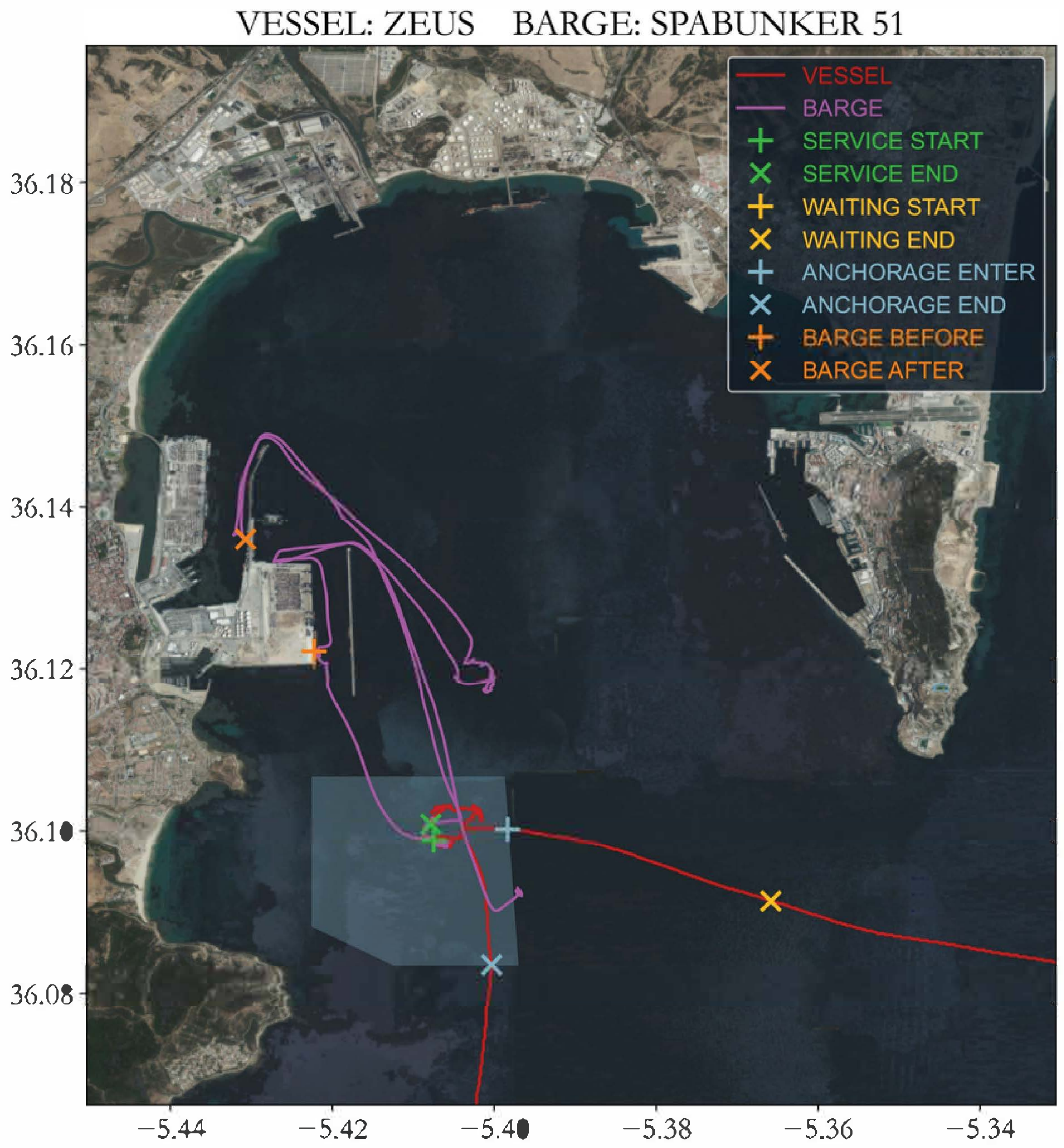
In-depth analysis of the bunkering operations

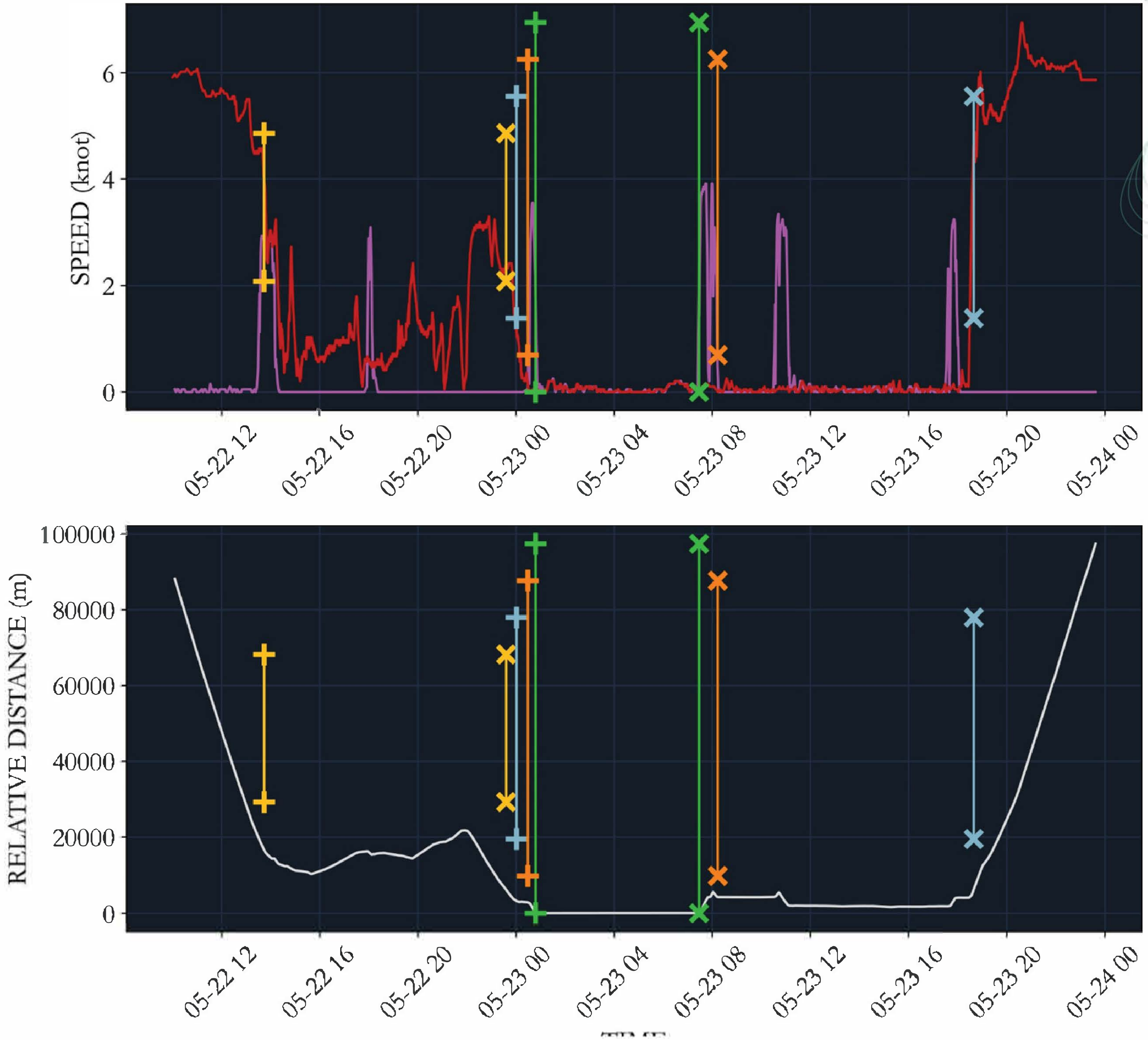
Output of the software

IDENTIFIER:	05_042
VESSEL:	ZEUS,636017523,70
ATA:	2021-05-23 02:17:15
MOORING:	2021-05-23 03:15:00
UNMOORING:	2021-05-23 09:00:00
ATD:	2021-05-23 20:26:34
DETECTED BARGE:	SPABUNKER 51,224322240,Carmen Jimenez,VERENIGDE TANKREDERIJ SPAIN SA,CEPSA
IS SERVICE INSIDE ANCHORAGE AREA D:	True
AMOUNT OF FUEL (TM):	700.0
DETECTED VESSEL ORIGIN:	OUTSIDE OF THE PORT
DETECTED VESSEL INITIAL LOCATION:	OUTSIDE OF THE PORT
DETECTED WAITING START:	2021-05-22 13:44:11,-5.221,36.10567
DETECTED WAITING END:	2021-05-22 23:35:50,-5.36583,36.09133
DETECTED ANCHORAGE ENTER:	2021-05-23 00:01:00,-5.39833,36.10017
DETECTED ANCHORAGE EXIT:	2021-05-23 18:39:11,-5.40033,36.0835
DETECTED SERVICE START:	2021-05-23 00:47:44,-5.4075,36.09883
DETECTED SERVICE END:	2021-05-23 07:27:30,-5.40783,36.10083
DETECTED BARGE ACTIVITY BEFORE:	2021-05-23 00:28:41,-5.42223,36.12217
DETECTED BARGE ACTIVITY AFTER:	2021-05-23 08:13:15,-5.4307,36.13598
DETECTED BARGE LOCATION BEFORE:	VOPAK DOCK
DETECTED BARGE LOCATION AFTER:	CLH TERMINAL

In-depth analysis of the bunkering operations

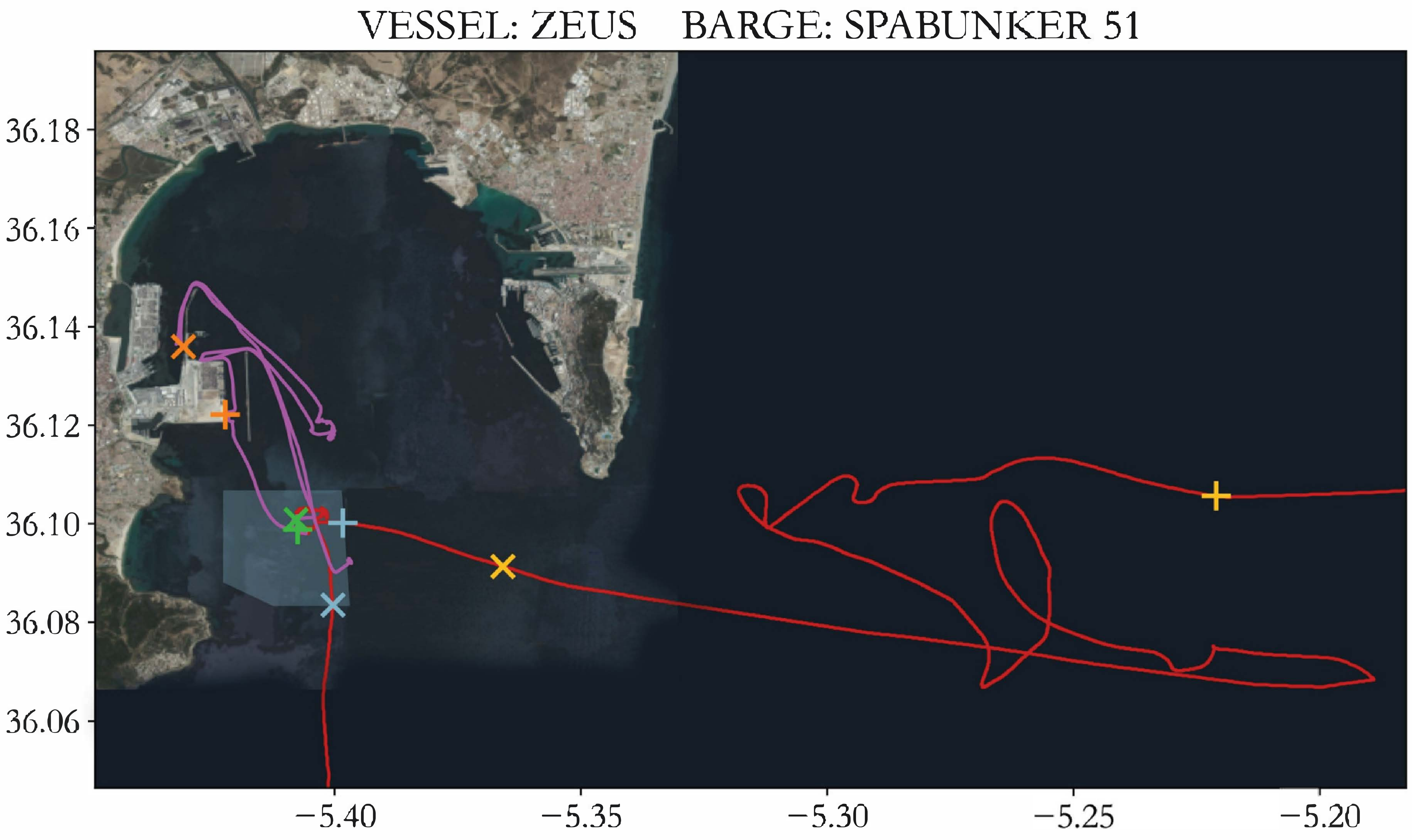
Output of the software





In-depth analysis of the bunkering operations

Output of the software



In-depth analysis of the bunkering operations

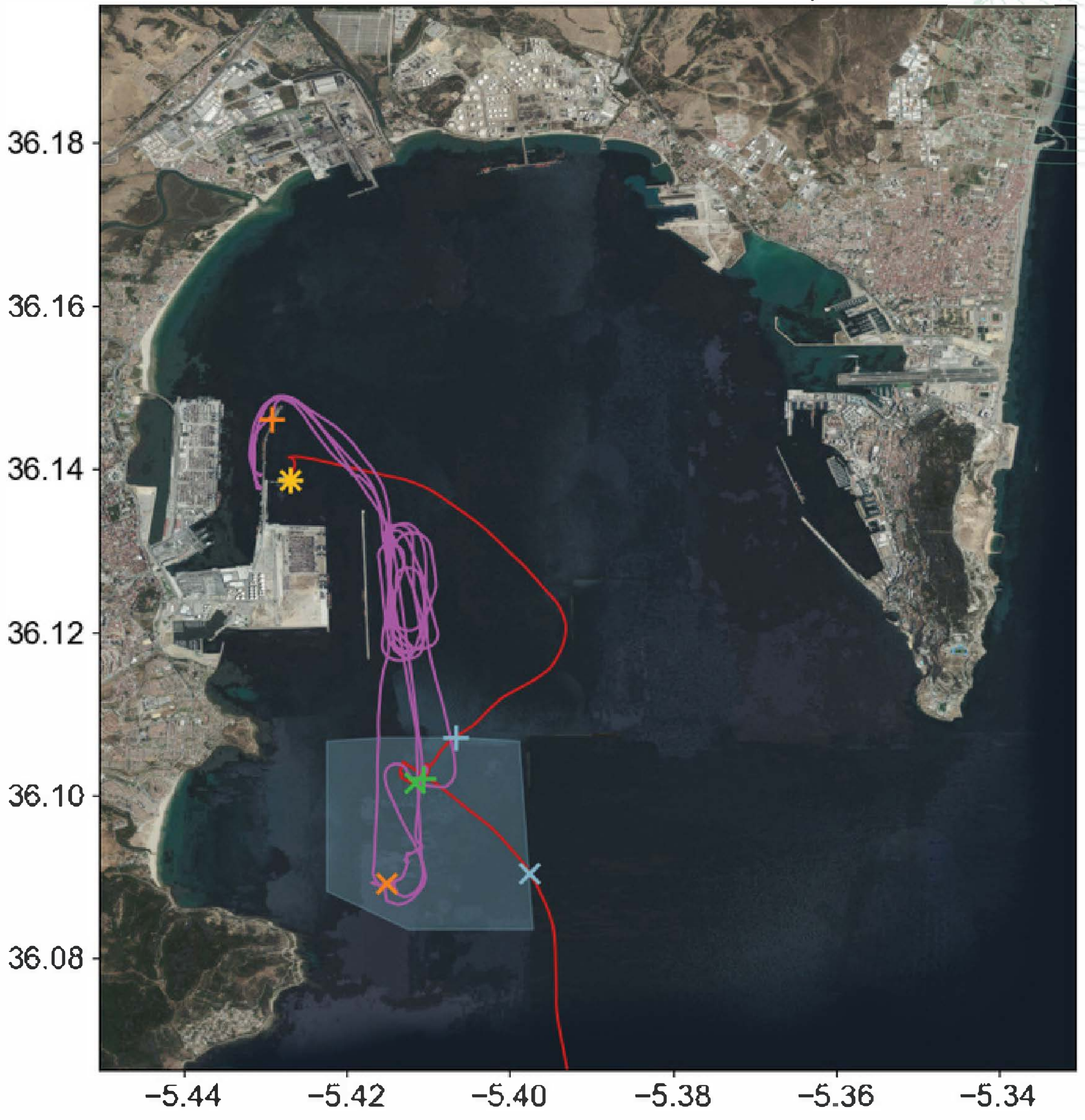
Output:

- Distribution of bunkering services as per barge, per supplier, per anchorage area
- Distribution of service times and transferred fuel
- Distribution of waiting times, idle times, and pumping rates
- Occupancy rates of the anchorage areas
- Barge activities before and after the process
- ....

Notable take aways:

- Average service time of XX h XX m
- Average waiting time of XX h XX m
- Summation of Idle Times at Arrival: XX months XX days XX hours XX minutes
- Summation of Idle Times at Departure: XX months XX days XX hour XX minutes
- ...

VESSEL: QUARTZ   BARGE: Bunker Bay - NST LEONI



Estimation of Time of Arrival

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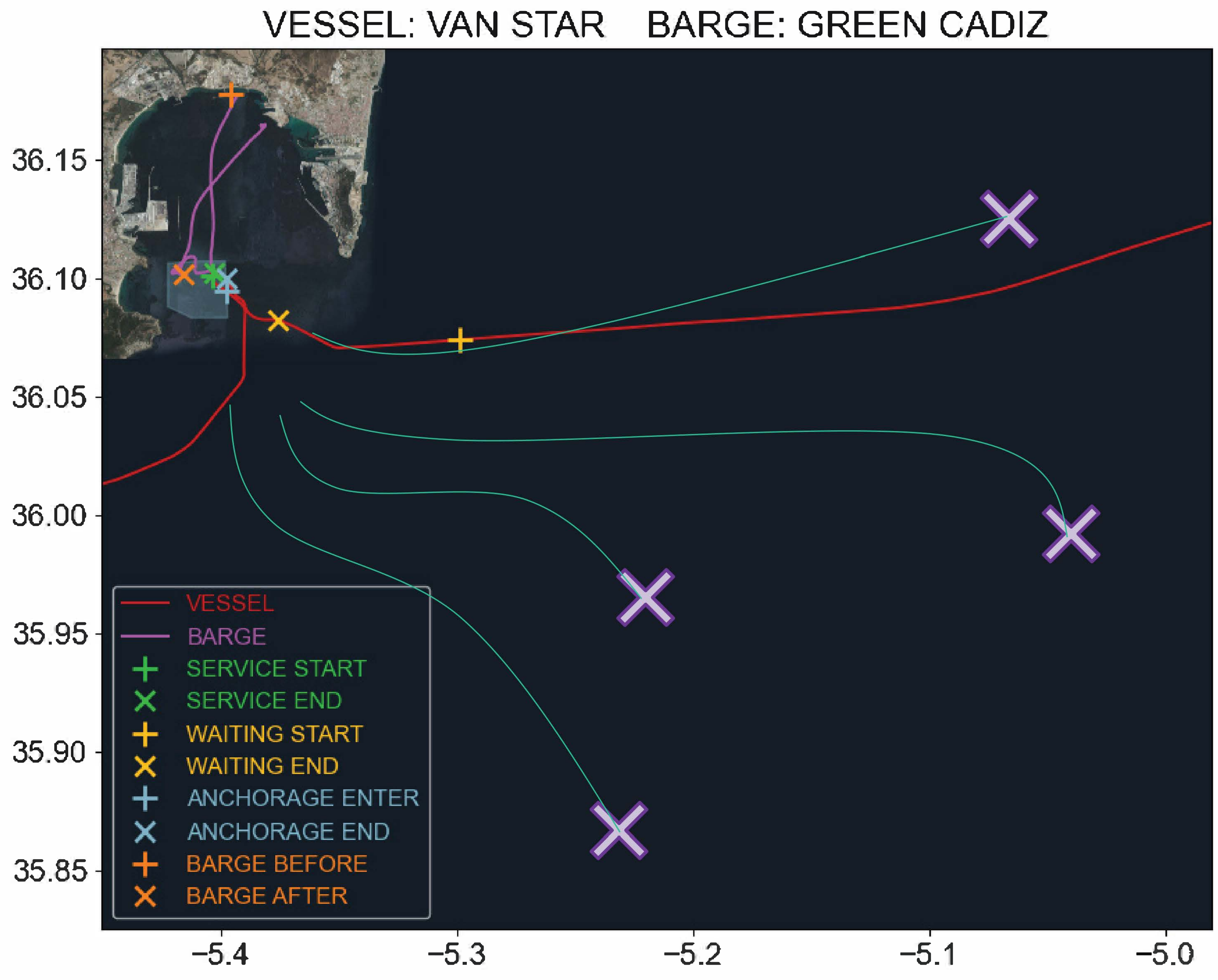
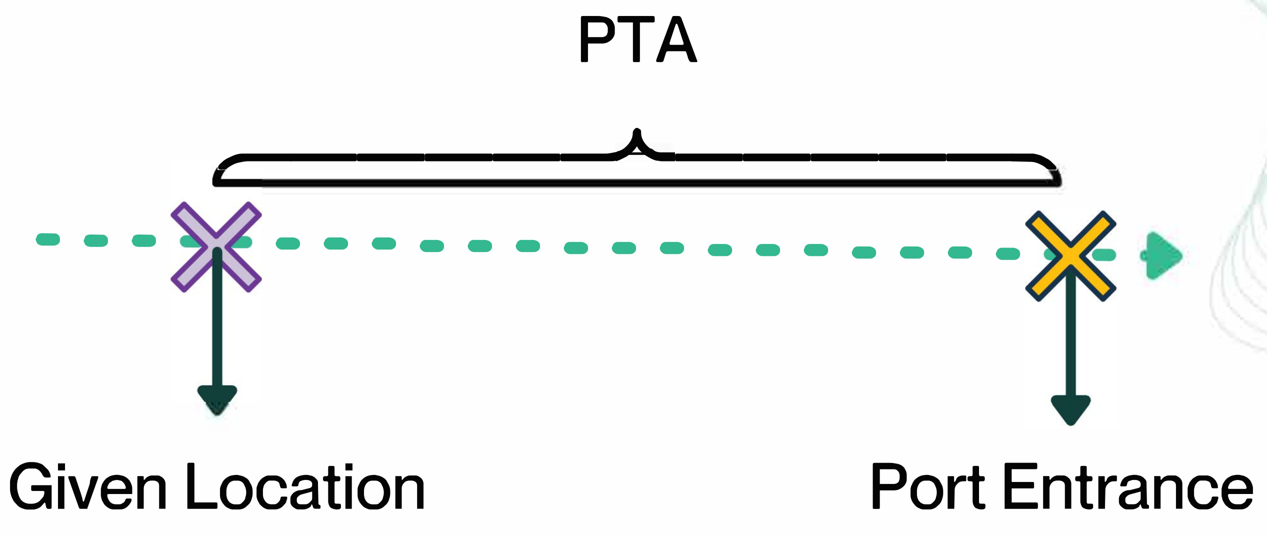




POSSIBLE TIME OF ARRIVAL (PTA)

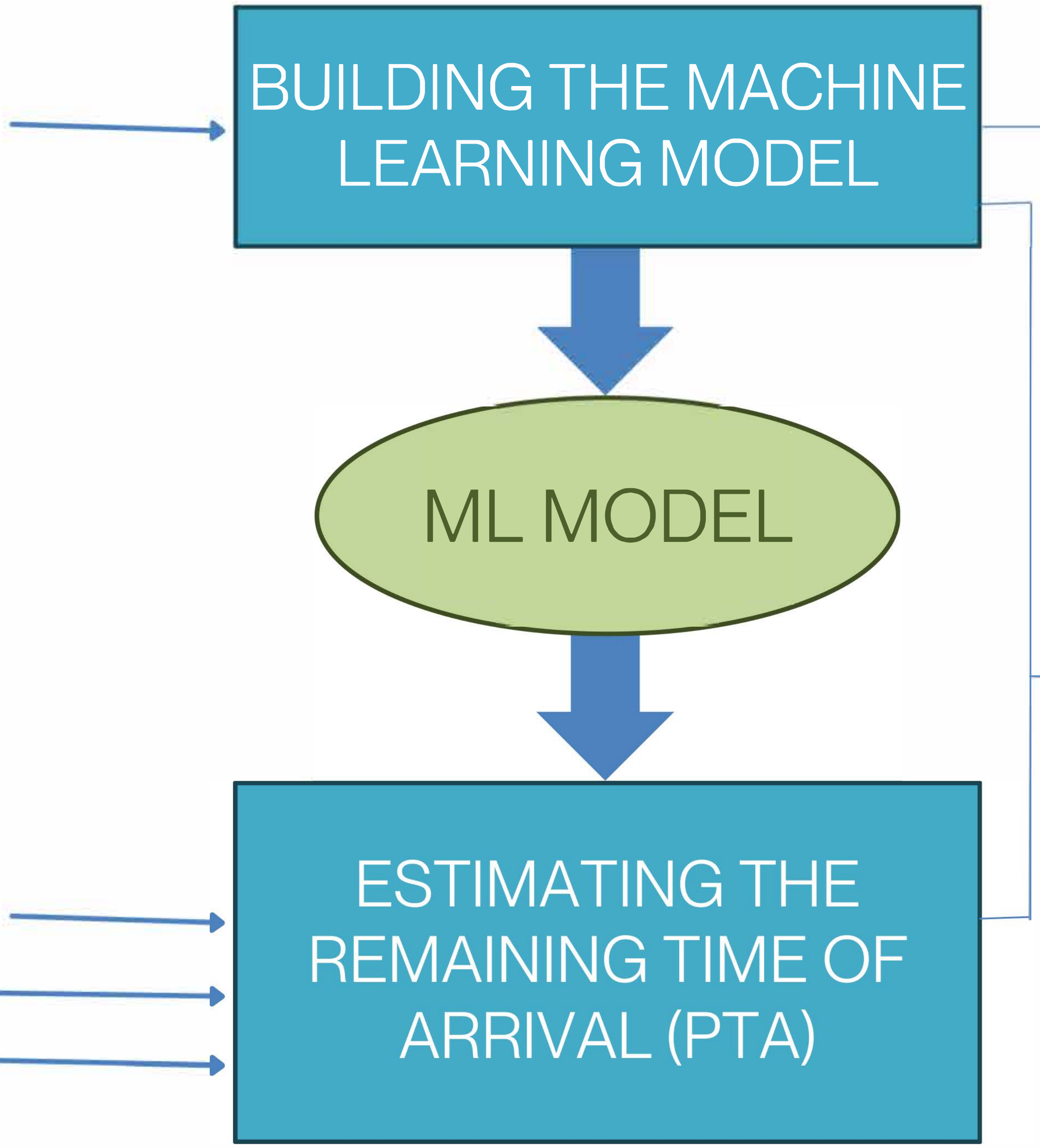
Definition:

- The earliest time in which the vessel is able to reach the port, disregarding the intended operation
- It is associated with the imaginary trajectory which the vessel travels at its cruise speed
- It is technically impossible for vessel to reach the port sooner than this time

Estimation of Time of Arrival

Workflow and Process

Analyzed cases



- Given point to estimate (required)
- Given time (optional)
- Given vessel type (optional)

REQUIRED ALGORITHMS

Cruise Detector

Detects and extracts the cruise trajectory from AIS data of the vessel

Weather Predictor

Predict the weather condition from the given time and location

Problem Formulation

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Earliest Possible Time of Arrival (EPTA) → **OPTIMIZATION** → Recommended Time of Arrival (RTA)

Definition

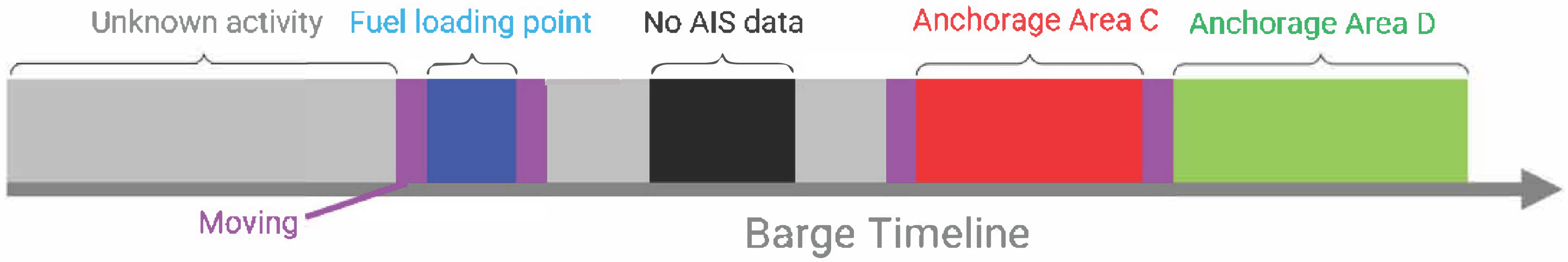
Given the current time and list of upcoming vessels, what is the optimized scenario of the bunkering operation for each barge for a given time period?

Programming the bunkering process

Objective Function
- Summation of waiting times of the upcoming vessels
- Summation of idle times of the barges
- ....

Decision Variables
- Arrival time of the upcoming vessels
- The choice of the serving barge for the upcoming vessels
- ...

Constraints
- Availability of the barge
- Availability of the Anchorage Area
- ...



Achievements

An optimization framework for providing the recommended time of arrival of the upcoming vessels

- Port authorities
- Suppliers
- Ship owners
- ...

Ongoing improvements:

- Considering the priority of specific vessels in the optimization
- Considering the involvement of pilots within the bunkering operations
- Optimizing the choice of the barge from the supplier's available barges
- Improving the simulation to show the result in case some vessels do not follow the RTA

NAVOZYME ™

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Our guiding compass

To enhance lives & to facilitate decarbonisation via innovative technology solutions that promote circularity, and raise the safety, productivity & reputation of the global maritime industry.

https://navozyme.com/

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