Seasonal physics and biogeochemistry Forecasts for Coastal Water Quality Services

MOHIDing

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Agenda

- Context
- Implementation
- Meteo Input Quality
- Validation
- Improvements
- Results
- Next Steps
- Final Remarks

Context

ClimForCE
Climate-based Predictive Analytics for Coastal Ecosystems

Objective:

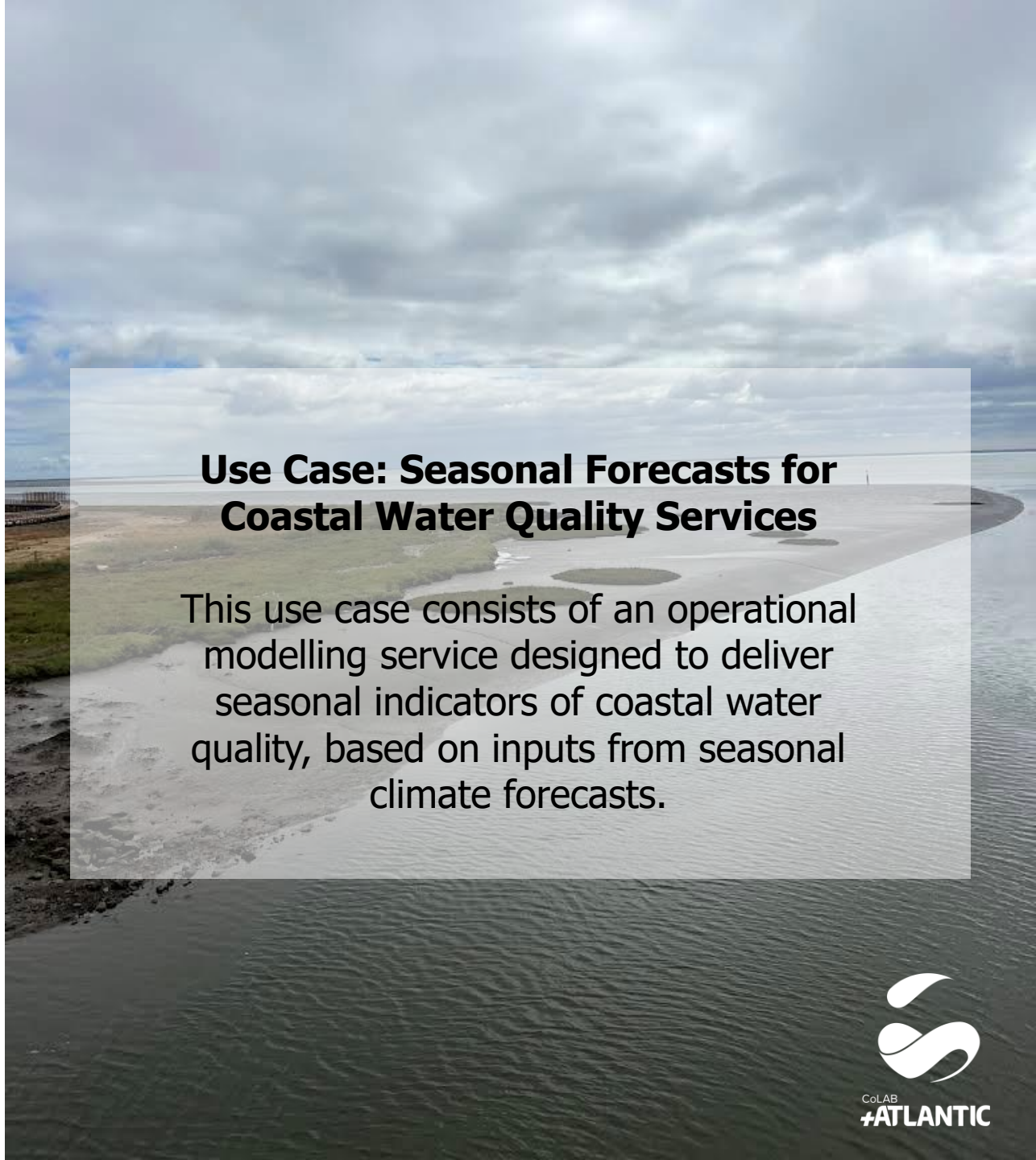
Develop and implement a use case to support the implementation of European Union policies and directives in mainland Portugal, using state-of-the-art operational numerical models and Earth Observation-derived applications.

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

Copernicus Marine Service

Implemented by MERCATOR OCEAN INTERNATIONAL



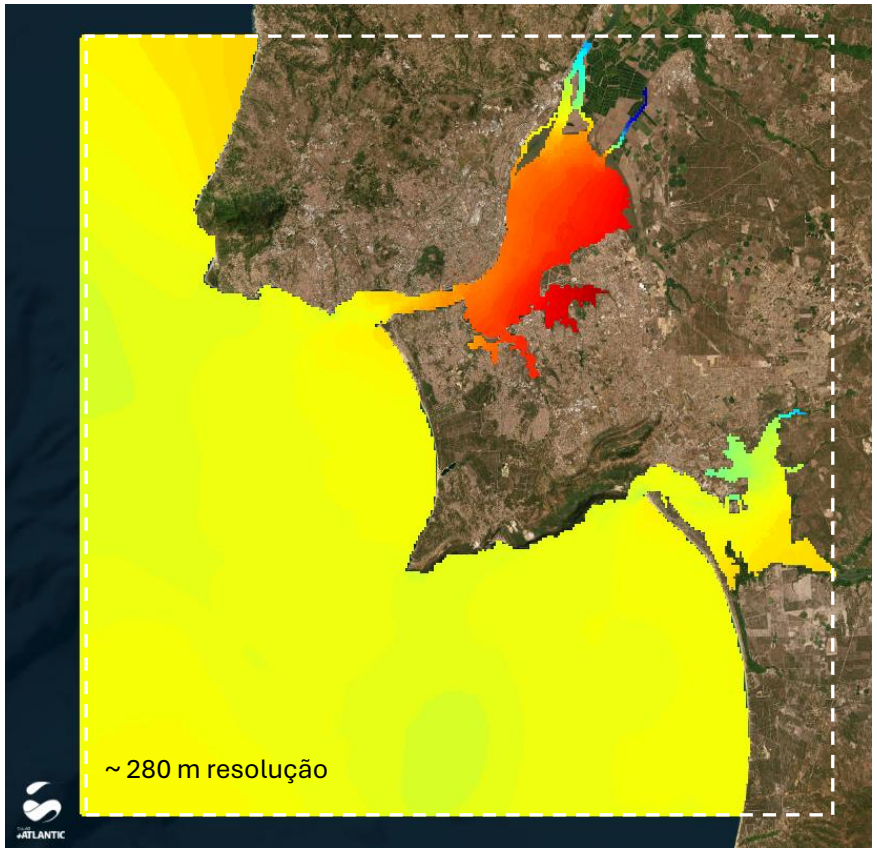
Use Case: Seasonal Forecasts for Coastal Water Quality Services

This use case consists of an operational modelling service designed to deliver seasonal indicators of coastal water quality, based on inputs from seasonal climate forecasts.

CoLAB +ATLANTIC

Implementation

- Model
  - Numerical model MOHID
  - Physical-biogeochemical processes
- Temporal and spatial scale
  - 280 m spatial resolution
  - 2D model
  - Hourly outputs
- Boundary conditions
  - Ocean
  - River
  - Meteo



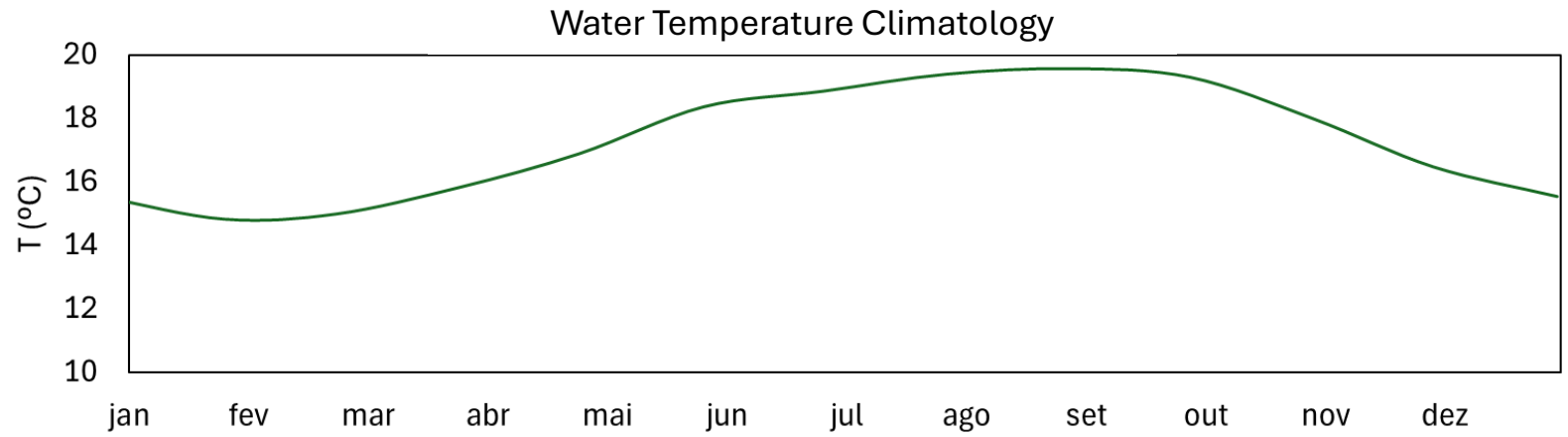
WHAT WE PREDICT:
(Ocean physics
&
Water Quality)

sea level | currents | temperature | salinity | river discharge | water quality

Implementation – Boundary Conditions

How do we make forecasts up to 6 months ahead?

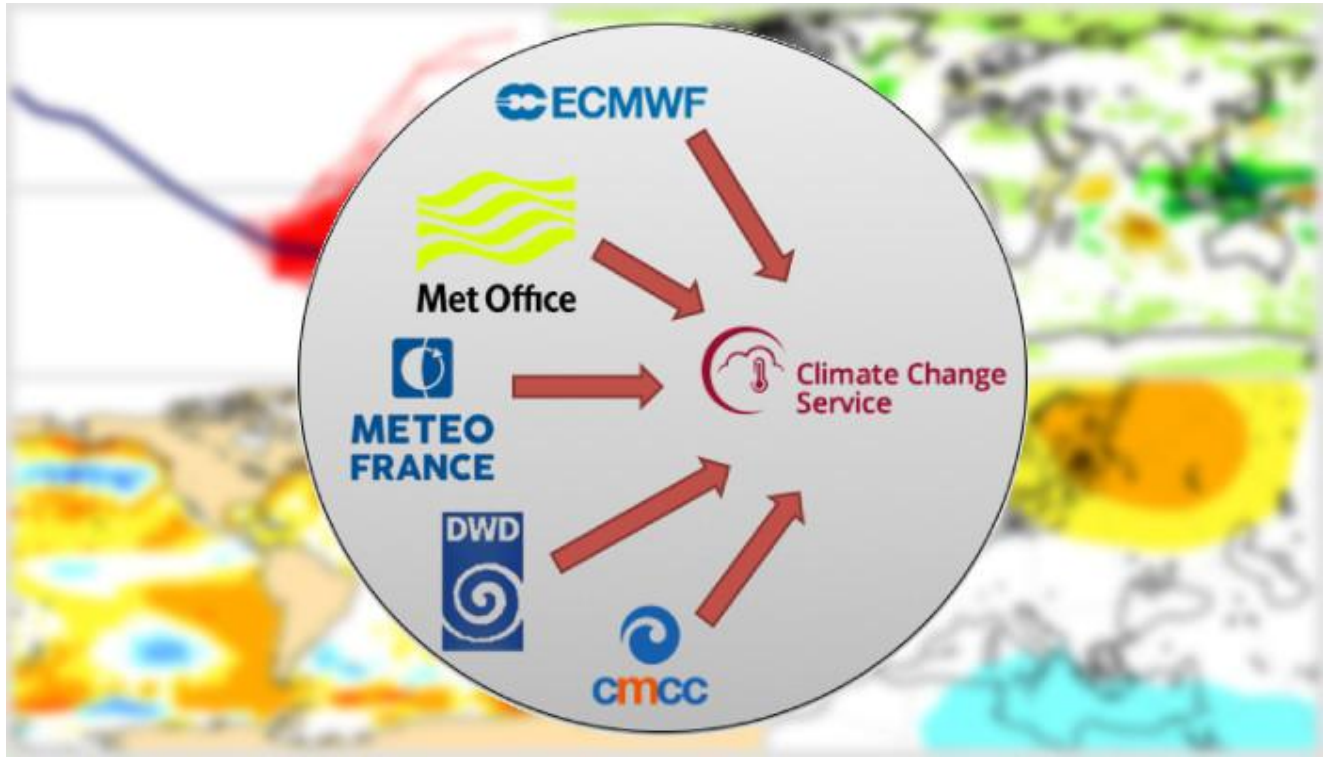
- Ocean
  - Copernicus multiyear climatology
- River
  - River flow climatology
  - Water quality climatology (OSPAR)



Implementation – Boundary Conditions

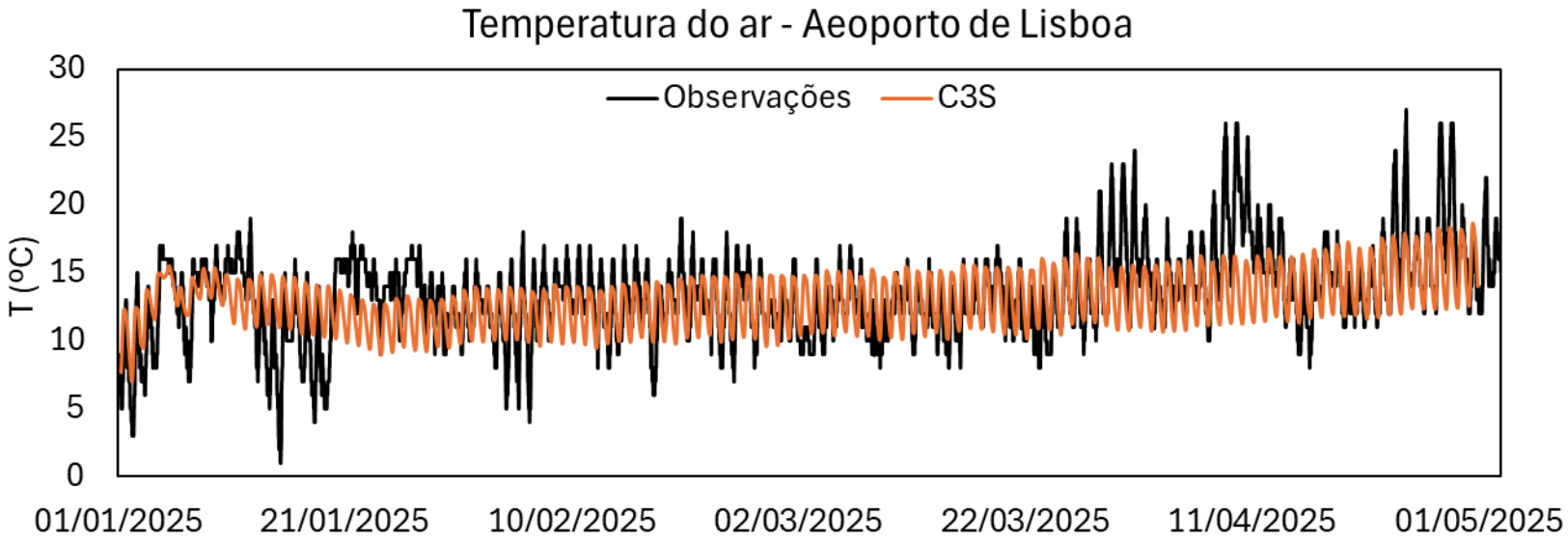
How do we make forecasts up to 6 months ahead?

- Meteo
  - Seasonal forecasts from multiple European climate models
  - Spatial resolution: 1º
  - Temporal resolution:
    Daily or 6-hourly
  - Updated monthly
  - Variables:
    Wind
    Temperature



Meteo Input Quality

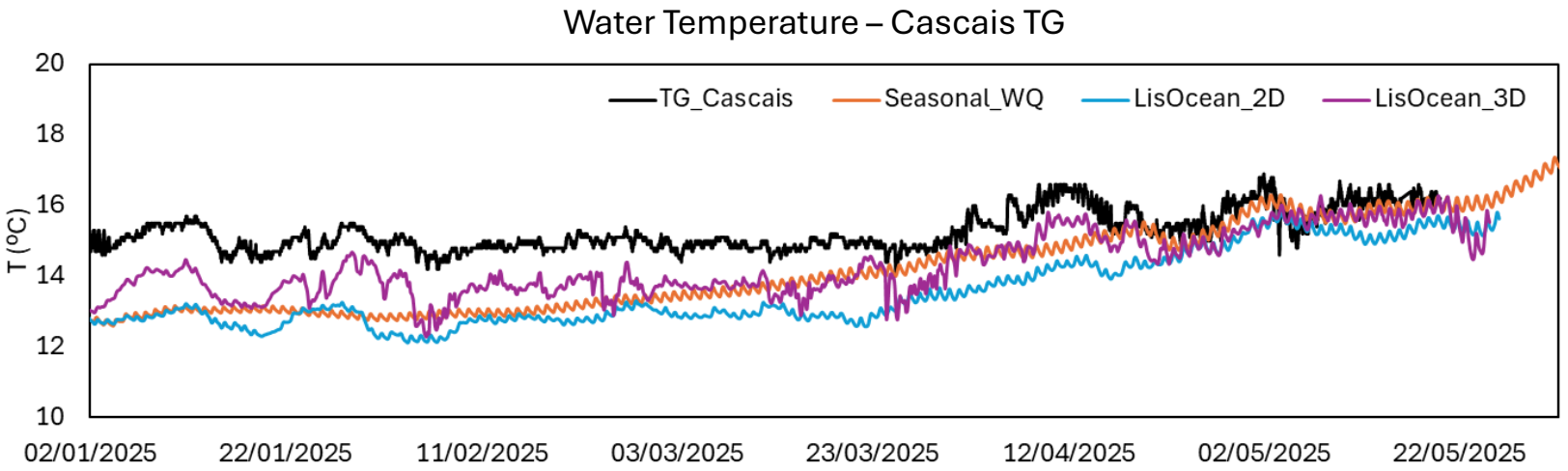
Comparison of C3S air temperature with observations from Lisbon airport



C3S air temperature can predict the general temperature pattern

Validation

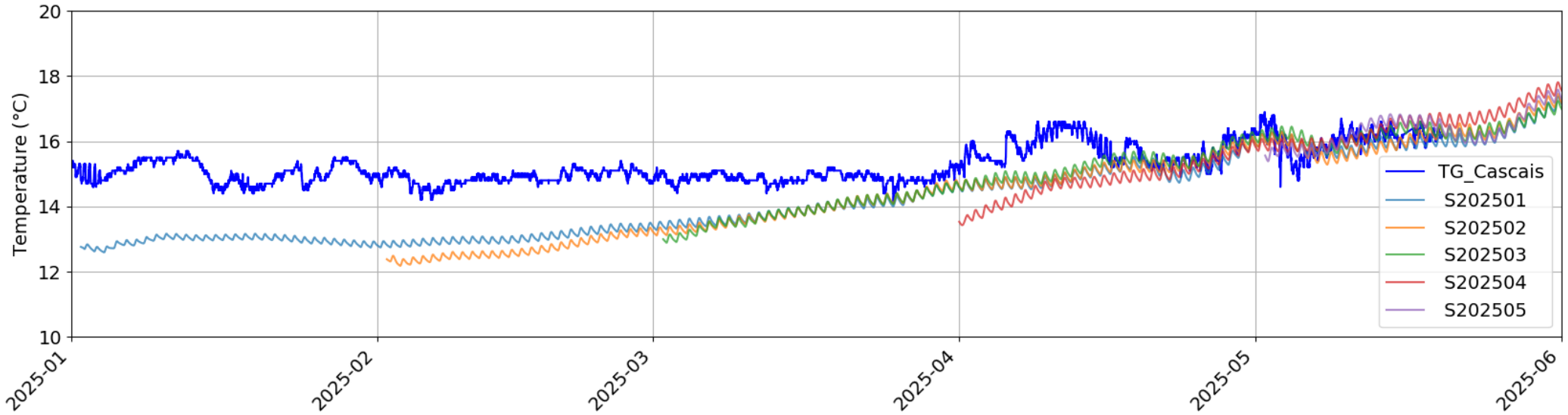
Comparison of the Seasonal, LisOcean_2D and LisOcean_3D with observations



TG_Cascais x Seasonal_WQ	
BIAS	-1.23
RMSE	1.45
r	0.74
r^2	0.55

Validation

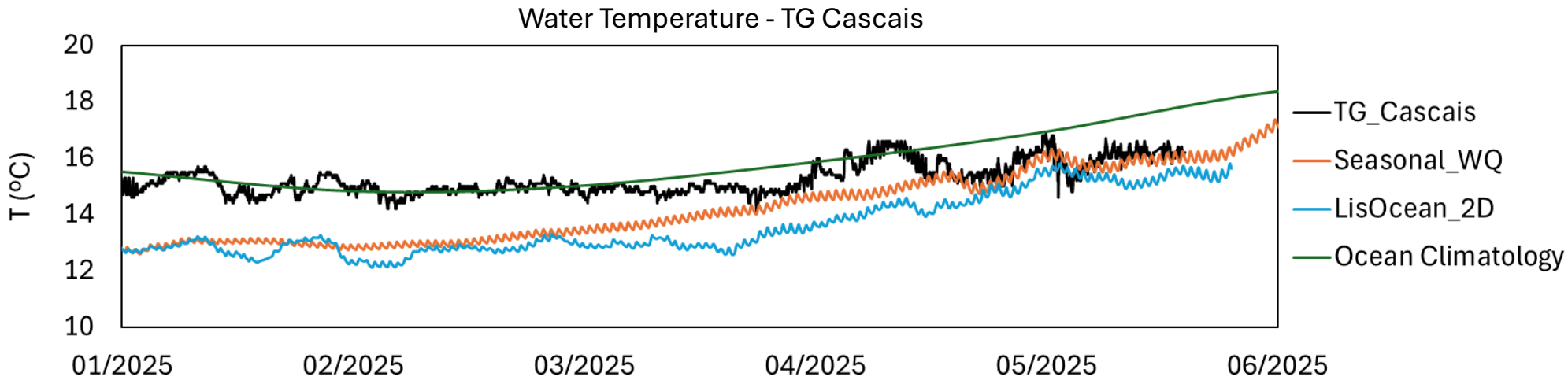
Comparison of the monthly forecasts published by C3S with observations from the Cascais tide gauge



The model results for the various forecast solutions begin to converge from mid-April onwards

Improvements

Comparison of the ocean climatology with observations, and models



Seasonal model starts with operational 2D model (LisOcean_2D)
Results are similar at the beginning

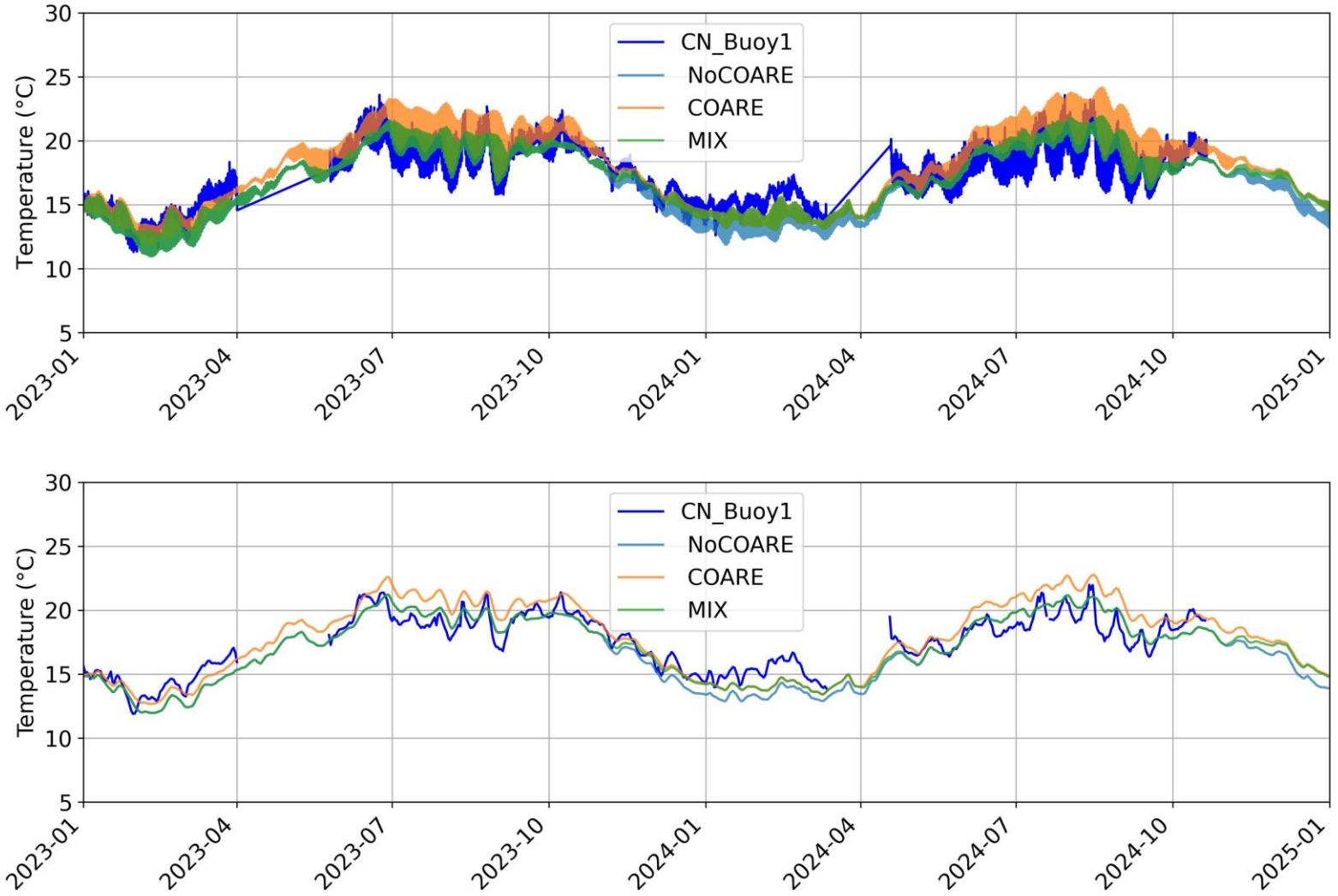
Ocean Climatology are coherent with observations (TG_Cascais)

Improvements

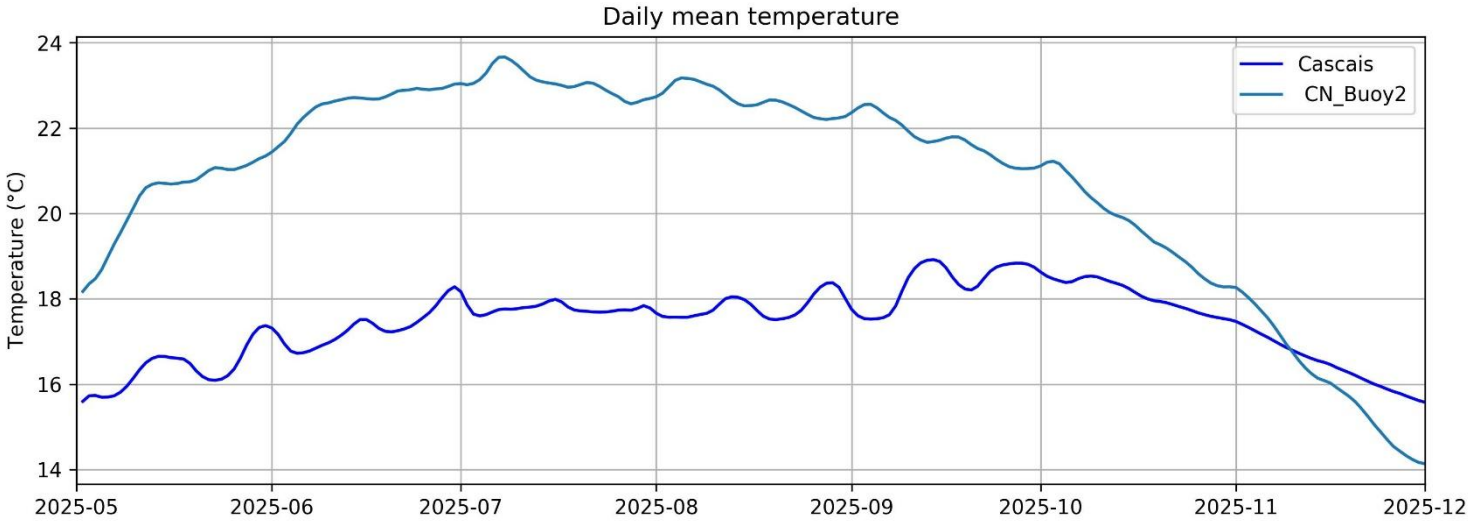
Test COARE algorithm

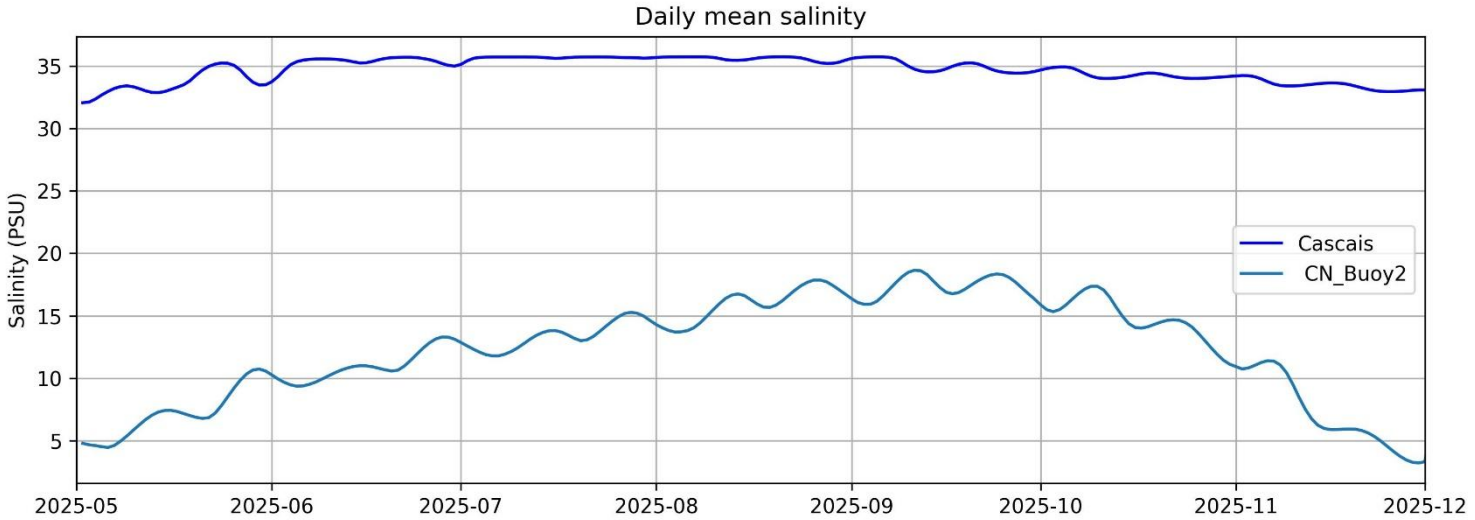
Comparison between
- NoCOARE
- COARE
- MIX:
  - COARE
    - Winter (Nov - Mar)
  - NoCOARE
    - Summer (Apr - Oct)

	NoCOARE	COARE	MIX
BIAS	-0.42	0.58	-0.27
RMSE	1.12	1.37	0.97
r	0.93	0.93	0.94
r^2	0.87	0.87	0.88



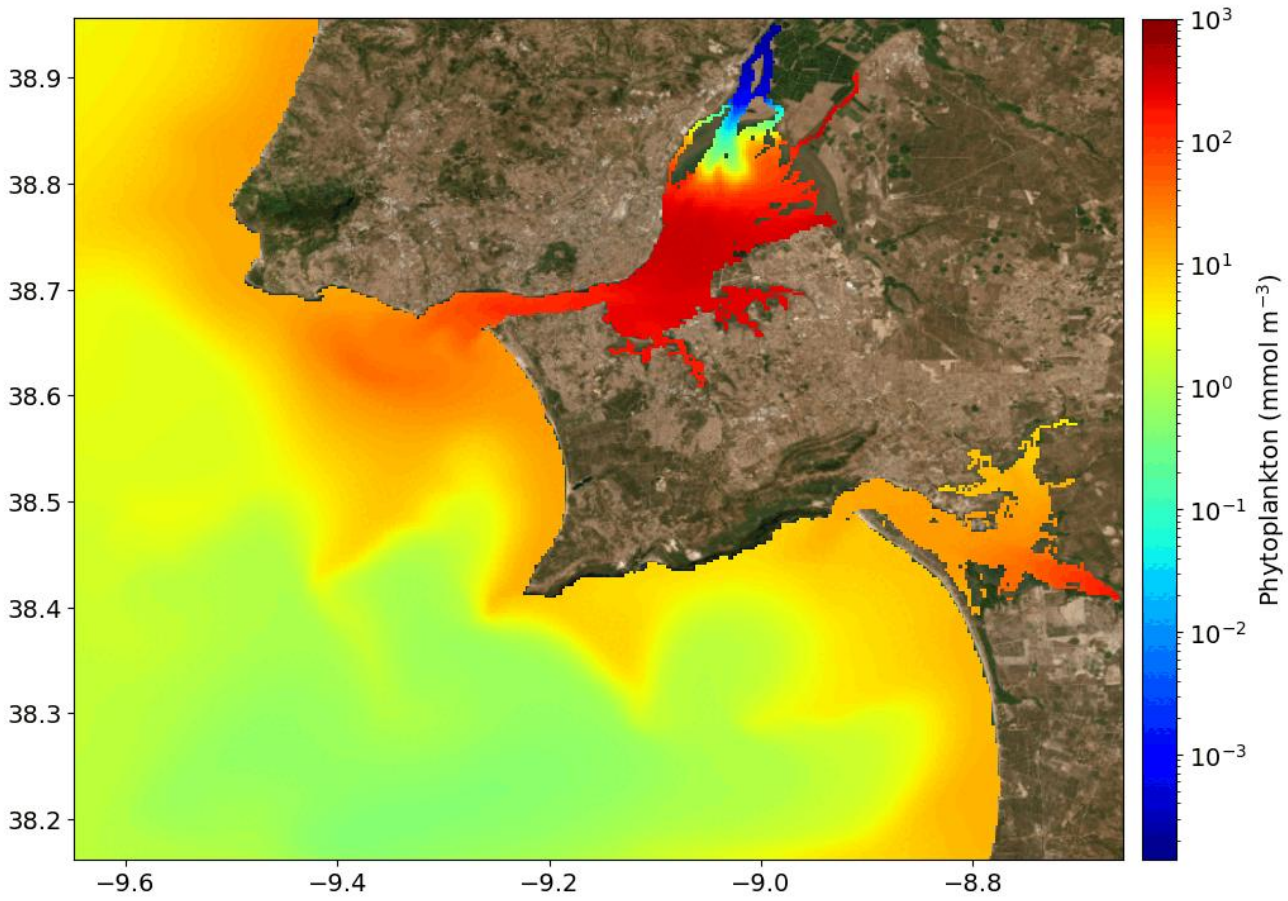
Results





- Daily average temperature and salinity forecasts up to December 2025, based on the solution provided in May
- Seasonal variability is well represented by the model

Next Steps



Proper validation of water quality parameters

Available physical parameters:

- Current velocity U e V
- ✓ Sea Surface Height

Available biogeochemical parameters

- ✓ Temperature
- Salinity
- Nitrates
- Dissolved Oxygen
- Ammonia
- Suspended Sediments
- Phytoplankton
- Zooplankton

ATLANTIC PLATFORM

https://atlanticsense.com/

ATLANTIC
SENSE

Geospatial Tool for Climate Resilience and Environmental Monitoring

Atlantic SENSE by +ATLANTIC is a geospatial platform designed to support climate resilience and environmental monitoring across the Atlantic Basin. It offers access to data from four key Earth domains: **ocean**, **land**, **air**, and **coastal areas**.

By transforming complex data into actionable insights, Atlantic SENSE helps various types of users understand and address the **impacts of climate change and environmental risks**, with a **focus on protecting vulnerable ecosystems and communities.**

EXPLORE OUR PLATFORM

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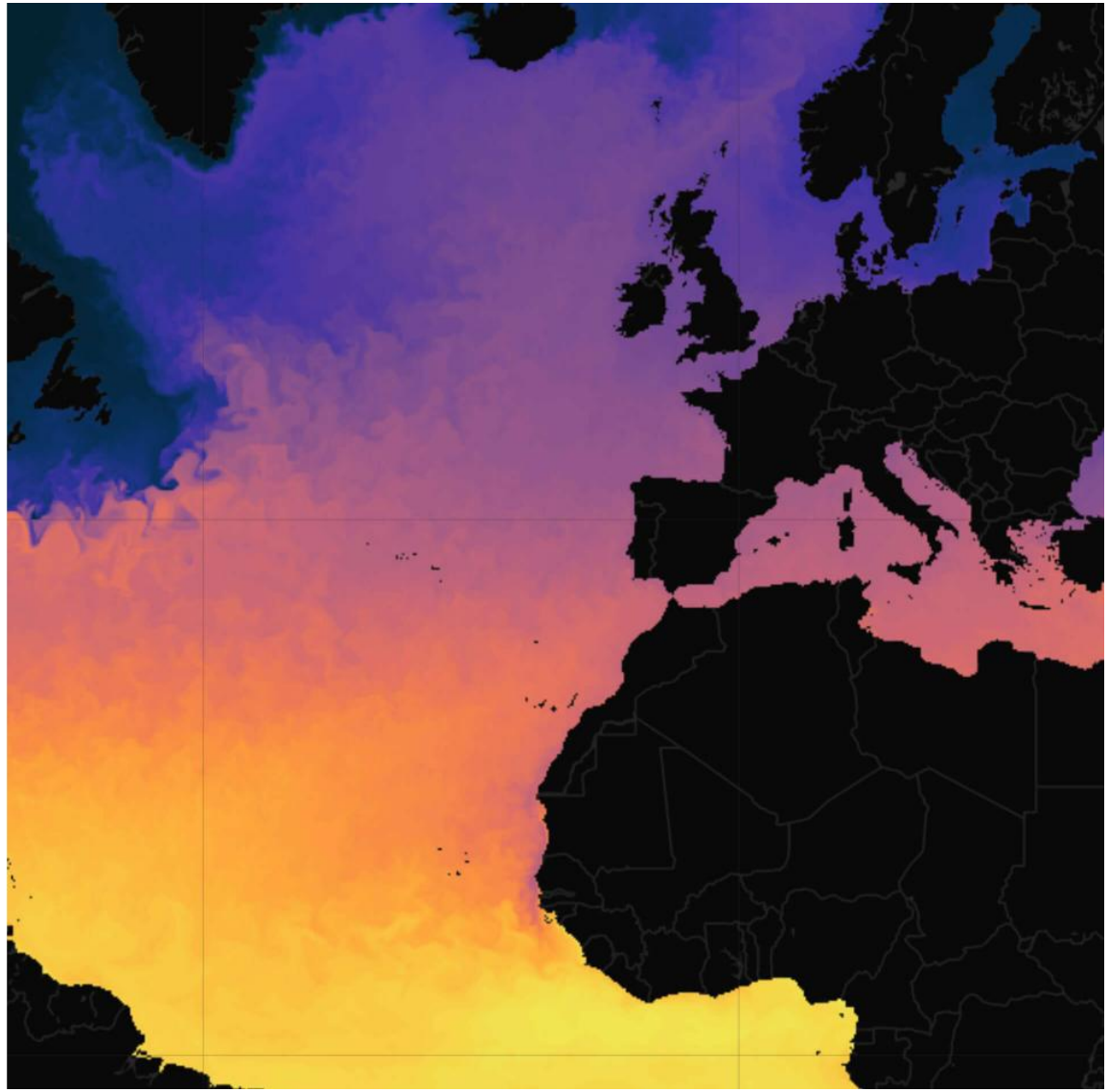
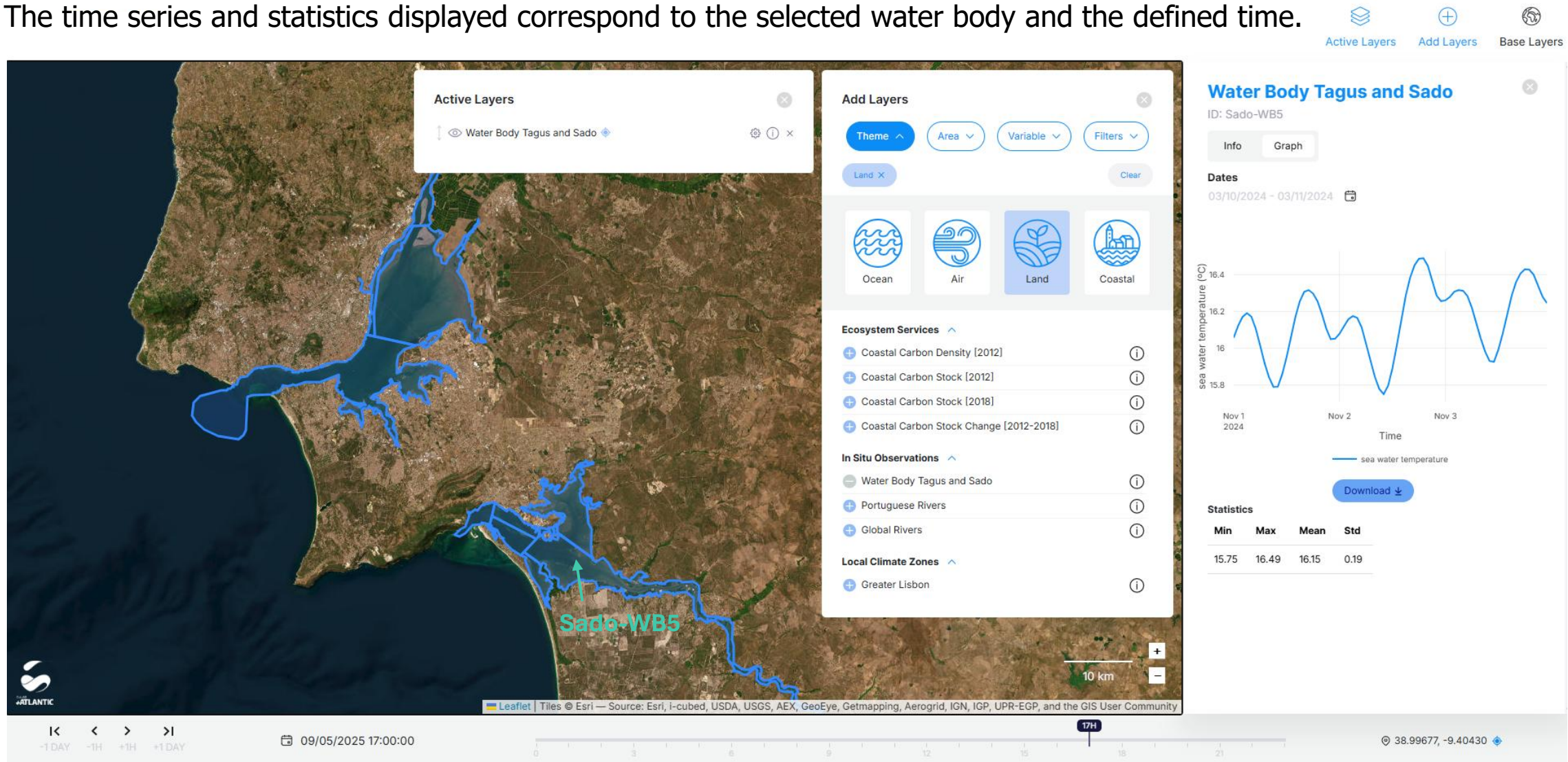


The results will be published in the ATLANTIC SENSE Platform

ATLANTIC PLATFORM

https://atlanticsense.com/

Results visualisation on the platform for the water bodies defined under the Water Framework Directive.
The time series and statistics displayed correspond to the selected water body and the defined time.



Final Remarks

- The seasonal model can provide six-month water quality forecasts for optimised management
- The model can predict the general patterns
- Improvements in model solutions testing COARE algorithm
- Validation of water quality parameters
- Access and visualisation of numerical model results through a web platform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