Using on-demand services to build reliable coastal forecasts
The CONNECT service as a demo

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Ocean Circulation Predictions from Global to Coastal scale. Session 1, OBPS Workshop VIII, 17 October 2024
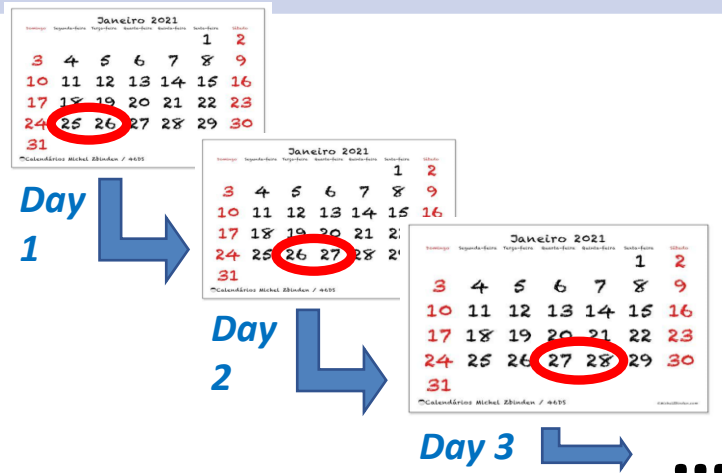
Forecast systems: predicting coastal zones dynamics for the next (few) days

Forcings → **Prediction simulations** → **Post-processing, archiving and visualization** → **Comparison with real time data**

Day 1

Day 2

Day 3 ...

- High-resolution information in space and time
- Ability to address "what-if", CC and management scenarios
- Very accurate and reliable tools

Societal value of forecast systems

- Anticipate contamination events and support emergency actions

- Support water economy daily tasks and leisure & recreation

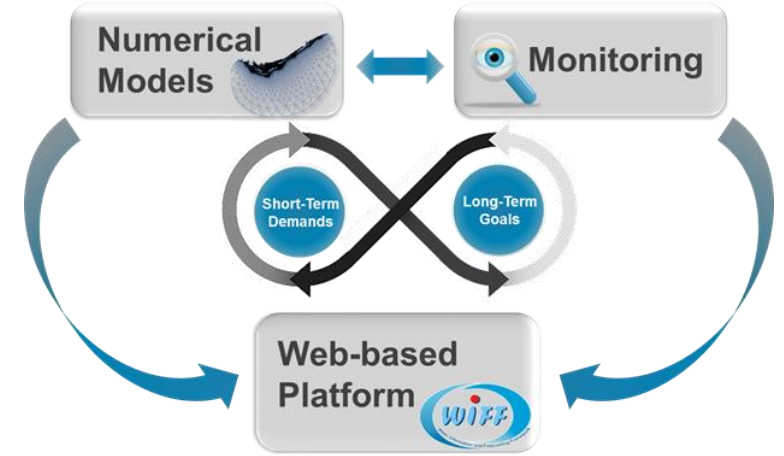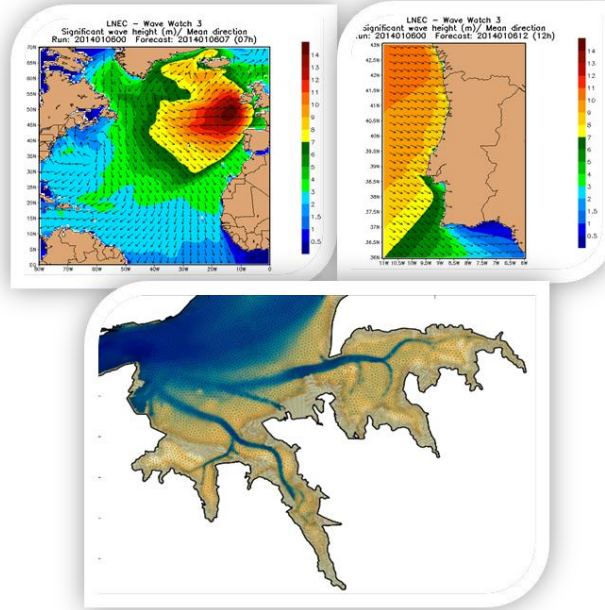- Guide management to minimize risks and address conflicting uses in coastal areas

Coastal Digital Twins:
user-centered, on-demand framework for decentralized ocean-to-coast knowledge creation through modeling, **forecasting**, data analysis and **service provisioning**

Methodology to create and operate a coastal forecast system

- Identified the relevant physical processes
- Evolution to more complex stages (water quality,…) built on accurate physics

- Identify the adequate spatial and temporal scales
- Implement models that solve processes and handle scales.
- Validate with (historical) data across environmental conditions

- Implement robust and accurate forecast system that runs automatically everyday
- Make results available in friendly and tailored way

Limitations and challenges in forecast systems

- Traditionally built individually – difficult to replicate and evolve with better tools

- Requires huge IT resources to build and maintain

- Quality control difficult: different models, different inputs, seldom automatic performance assessment

- *Build forecast frameworks through building blocks*

Relocatable on-demand forecast tools

Modeling and prediction for all systems

Flexibility, replicability and high accuracy

Facilitate good quality deployment and help non-experts to build their systems

Provide replicability for realiability and trustwordiness
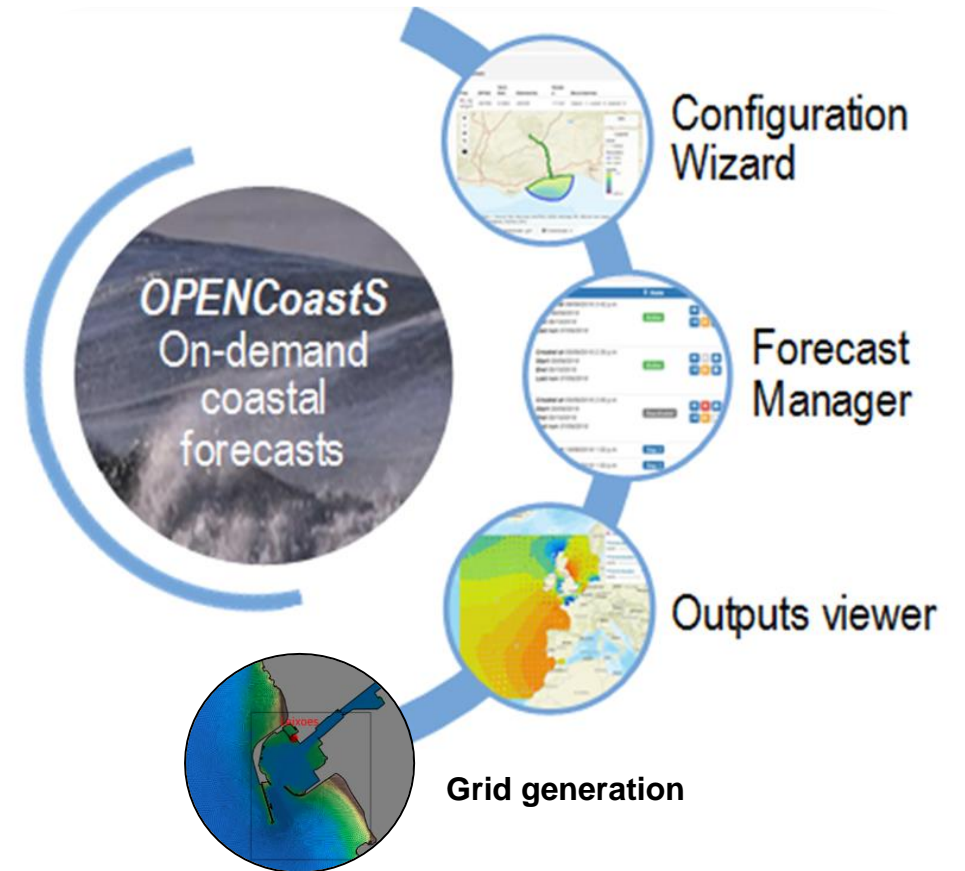
Forecast systems as services
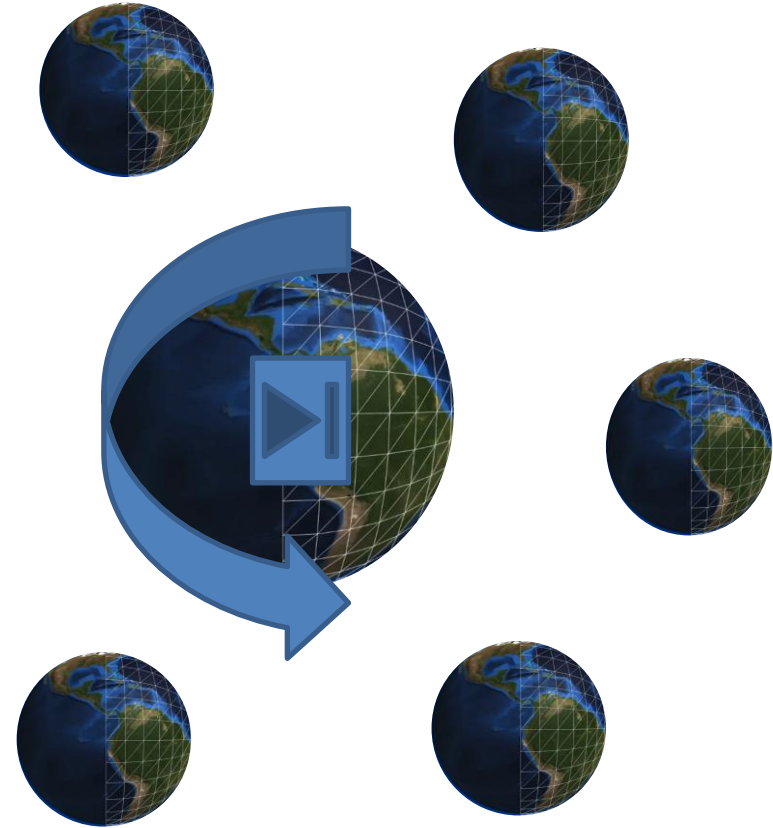
Generic model and prediction tools

- Forecast systems quickly

- Create and share good pratices

- OPENCoastS stands out for simple usage and hiding computational complexity and need for computer resources

Platform	Country	Access	Not available	Applicable	Web Platform	Notes
Delft-FEWS (GLOSSIS/GLO FFIS)	Netherlands	Free	Not available	Generic	Yes	New models
Saturn	USA	Free	Partially open	Several generic tools	Yes	Scenarios +predictions
SOCIB	Spain	Free	Partially open	Several generic tools	Yes	FAIR data, assimilation
Web MARine Virtual Laboratory	Australia	Closed	Open	Generic	Yes	Modeling and pre-operational
RELOcatable ocean nowcast/forecast system	USA	Closed	Not available	Generic	Yes	Ocean scale + ADCIRC at the coast
SURF: Structured and unstructured infrastructure	Italy	Free	Open	Generic	On-going	Downscaling automatic from regional to local scales
OPENCoastS	Portugal (Spain+ France)	Free	Open	Generic	Sim	Friendly interface for on-demand. Hydrodynamics + WQ

OPENCoastS computational service

- Create and maintain an operational forecast for the user selected coastal area
  - Interaction with a simple Web interface
  - Allow choice of forcings, parameters and data sources
  - Integrate with external forecasts (e.g., AI river flow)
  - Easy replication of deployments for fast calibration

- Whole forecast cycle: create grid, configure, manage, outputs viewer

- Flexible IT architecture that can grow to additional processes

- Take advantage of the EOSC infrastructure

OPENCoastS On-demand coastal forecasts

Configuration Wizard

Forecast Manager

Outputs viewer

Grid generation
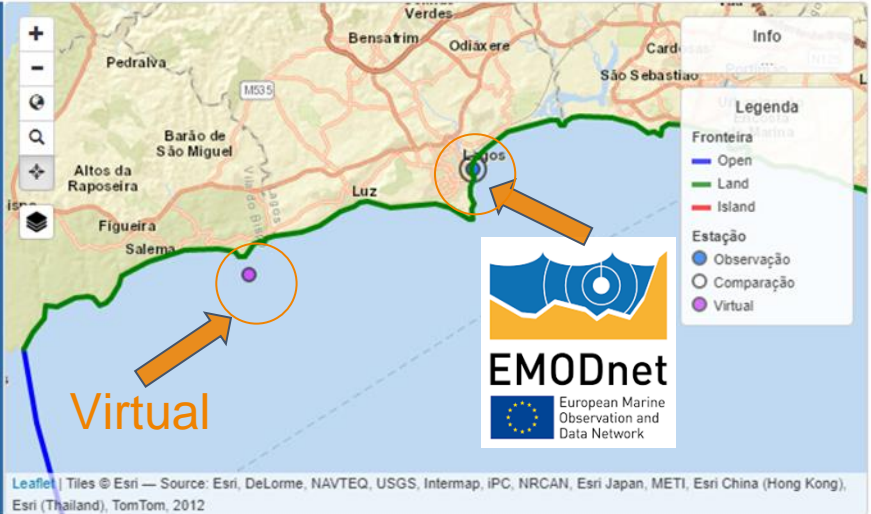
Build a forecast system on demand

Automatic (EMODNET)

Virtual sensor (user)

Fast management of deployments and visualization of results

Manager

Viewer

Coastal observatories: Dedicated web portals
Example: the CONNECT project

CONNECT project: Observatory co-designed with users

- Address user's requirements and feedback on the coastal service through inquiries and interviews

- Dedicated actions with users for portal dissemination with improvement and future actions goals

CONNECT forecast system: baroclinic circulation with wave and current interaction forecast at the Mondego estuary
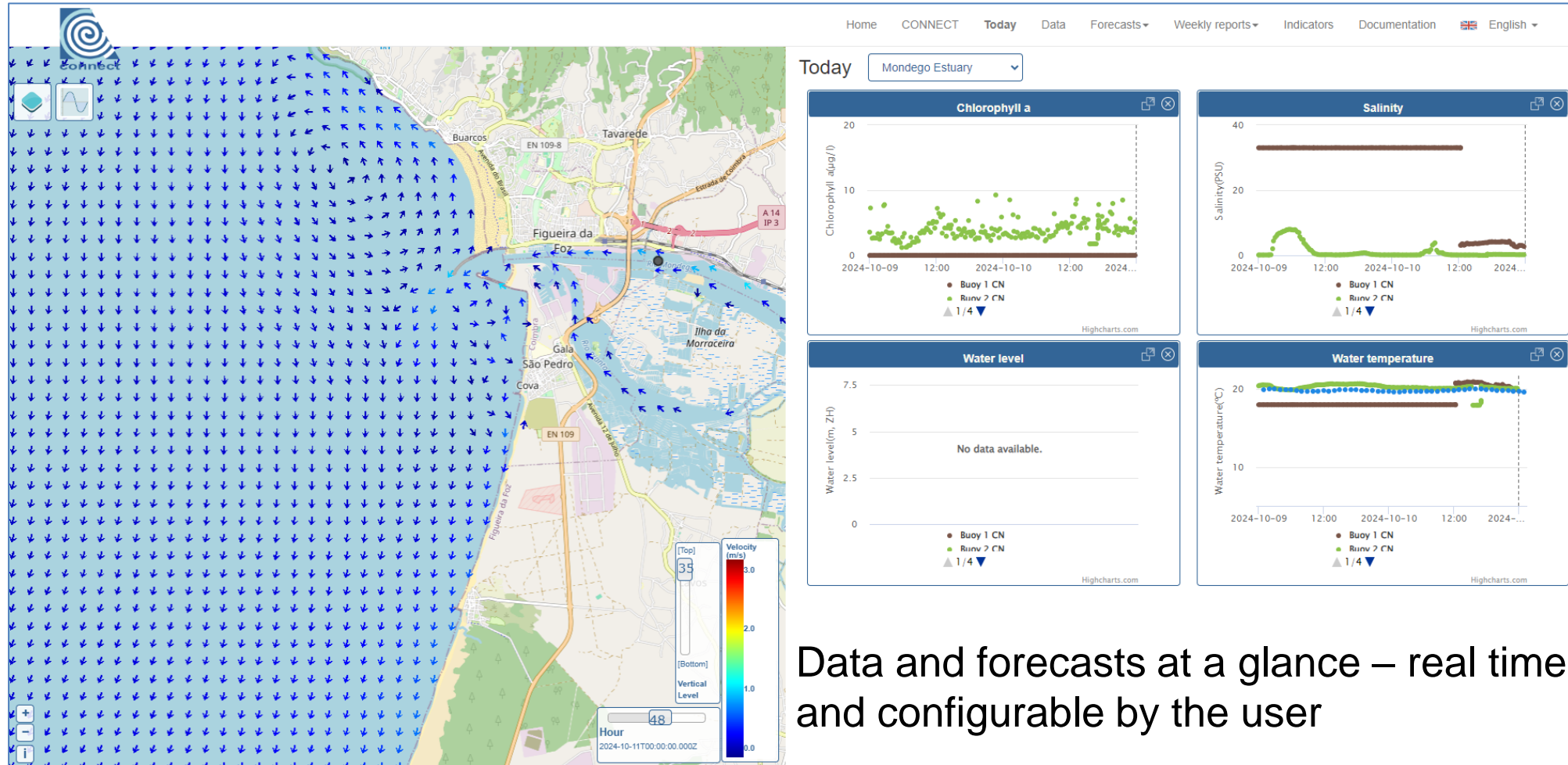
3D forecast
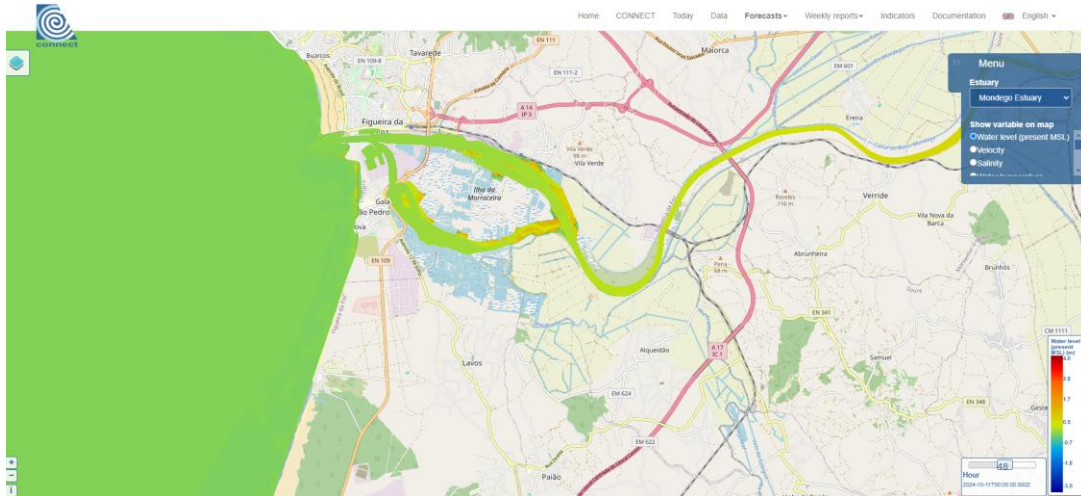
- *For navigation, estuarine inundation and water mass characterization*

- Developed using OPENCoastS

- Simulates water levels, velocity, waves, salinity and temperature

- forcings: water levels, velocity, salinity and temperature (CMEMS-IBI), waves (WW3-LNEC for spectra), wind, pressure, temperature, solar radiation (MeteoGalicia), river flow (national water resources database SNIRH)

- Horizontal resolution: 5 – 2000 m (10-40 m inside the estuary)
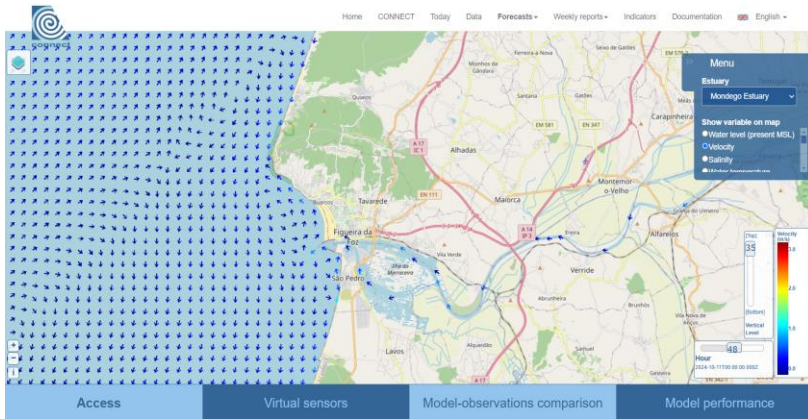
- In the vertical: 11 S levels plus 24 Z levels

CONNECT project: tailored platforms for users

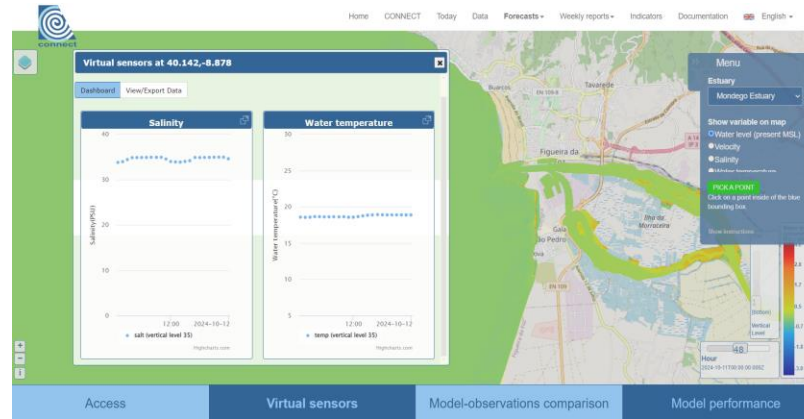**Dedicated WebGIS portal -** connect-portal.lnec.pt/connect/

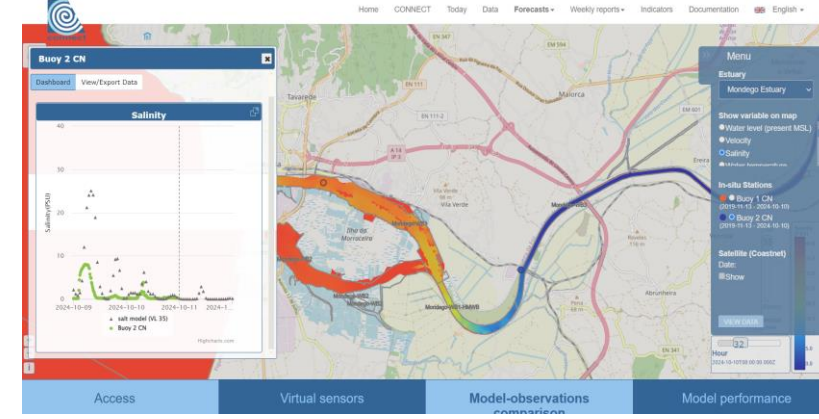Data and forecasts at a glance – real time and configurable by the user

CONNECT observatory: selected products
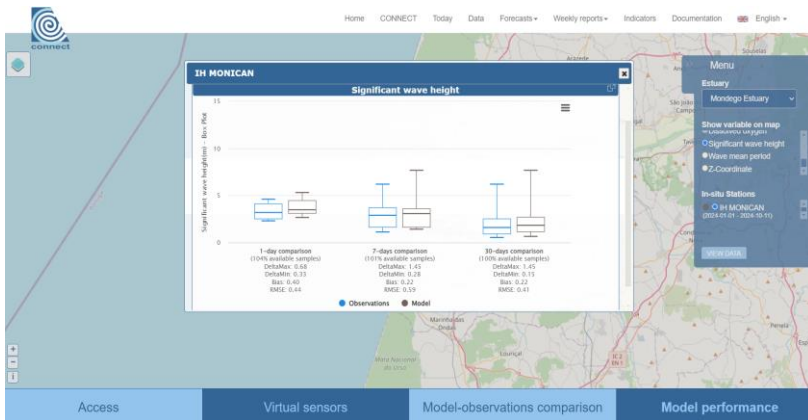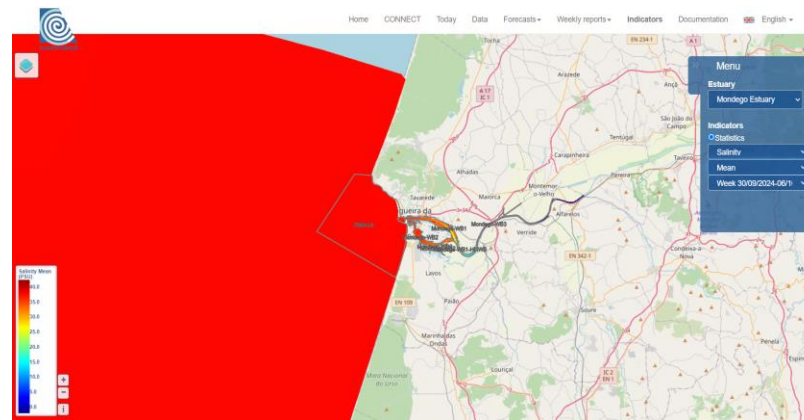

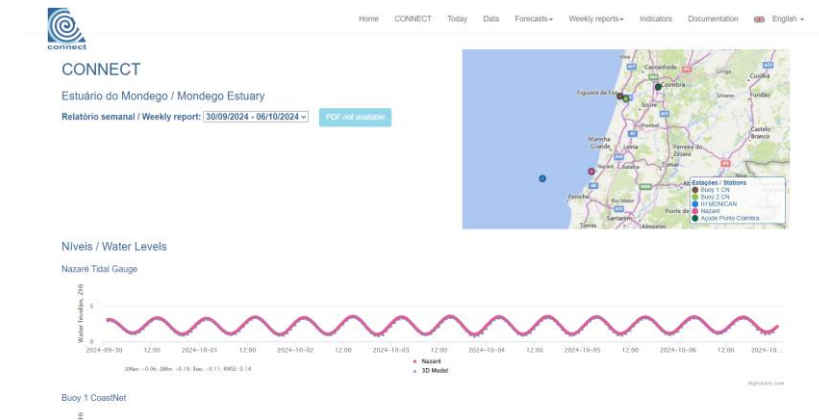48-hour forecasts

Virtual sensors

Data / model comparison
(in-situ & satellite)

Model performance & quality

Indicators for EU Directives

Weekly reports

Conclusions and take-home messages

- The complexity of coastal dynamics, the multiple tools available for modeling and the need for computational resources are challenging for users to setup good quality forecast systems

- High resolution models are freely available along with (near) real time data sources to support good quality forecasts, but IT implementation brings additional challenges

- Reliable and accurate forcing conditions providers (such as CMEMs) contribute to good quality of coastal forecasts

- OPENCoastS computational service - example of helpful tools to build reliable and robust forecast systems for the coast

- AI will play a major role at coastal scale: to handle land inputs (rivers, city) and to build faster predictors based on process-based simulations

- The human-in-the-loop: forecast systems (in DT) need to address end-users needs