MOHIDing 26th June 2025

Operational MOHID-SWAN coupling

CoLAB
+ATLANTIC

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CONTENTS

OVERVIEW

Upgrade the coastal dimension of CMEMS to achieve a seamless **monitoring and forecasting** of the ocean **from global to regional and coastal scales**, by applying and improving state-of-the-art methods and through the development of new coastal products to better serve coastal users and Member States.

STUDY AREA

Tagus estuary domain

COUPLING METHODOLOGY

MOHID

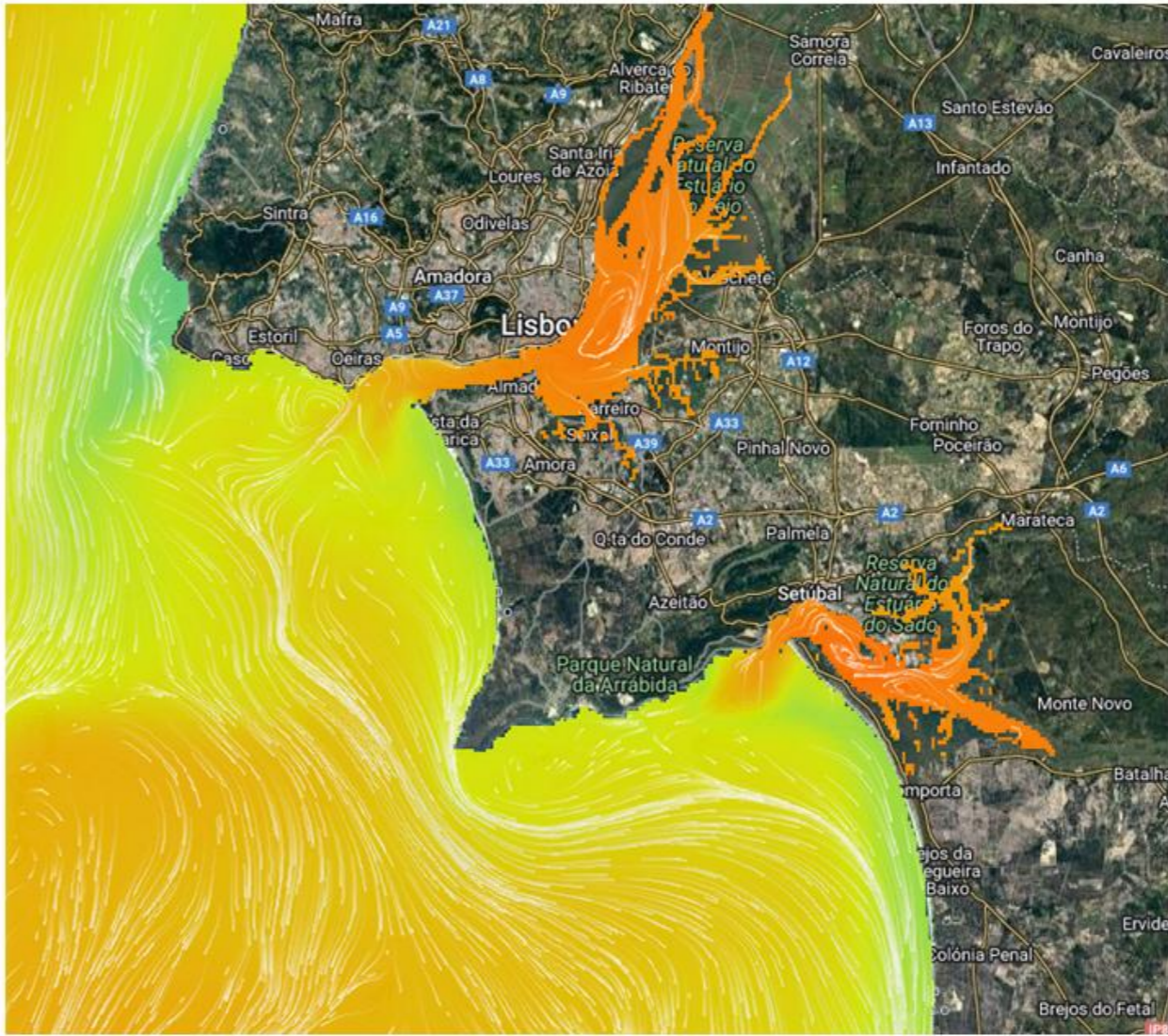**SWAN**
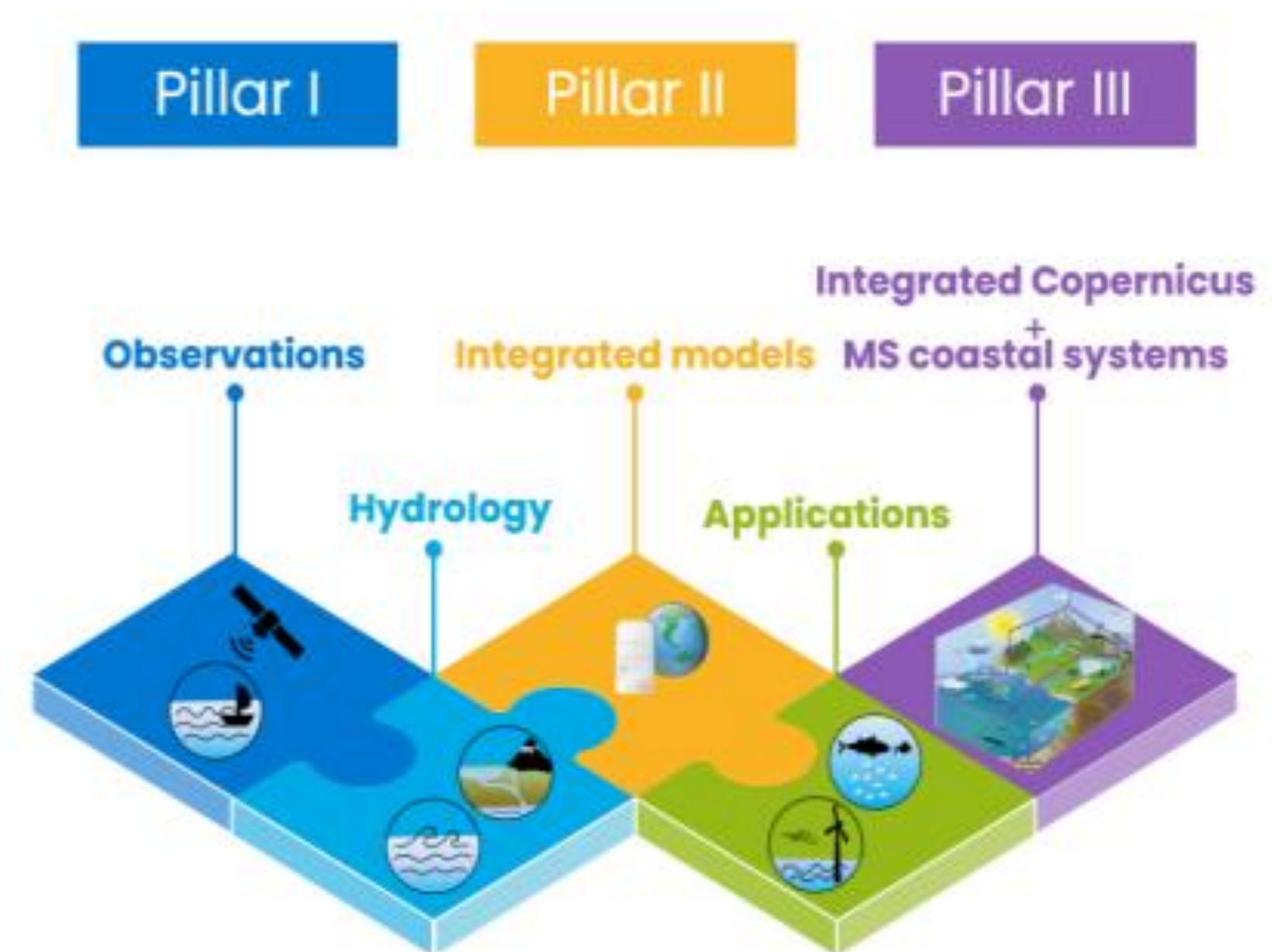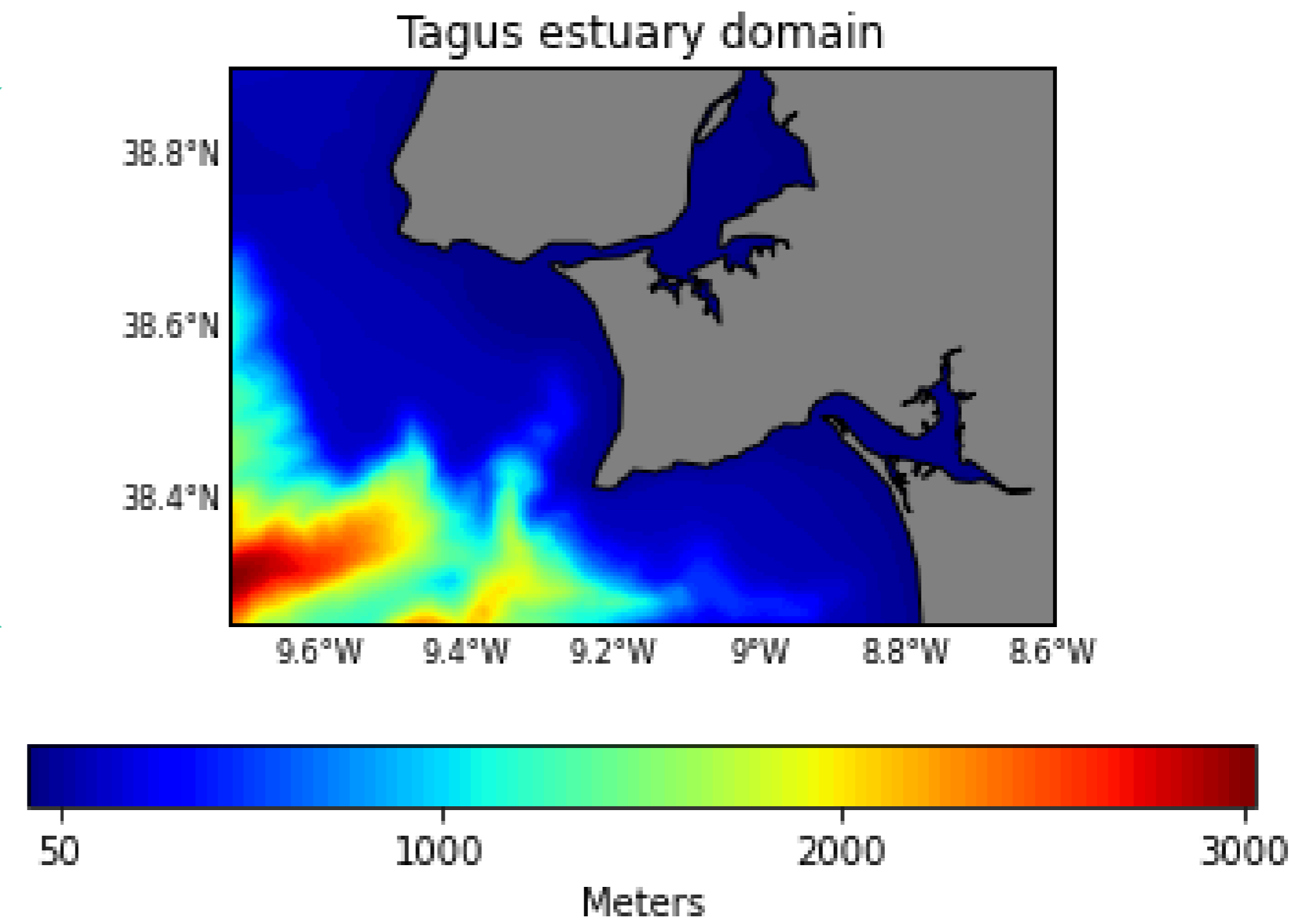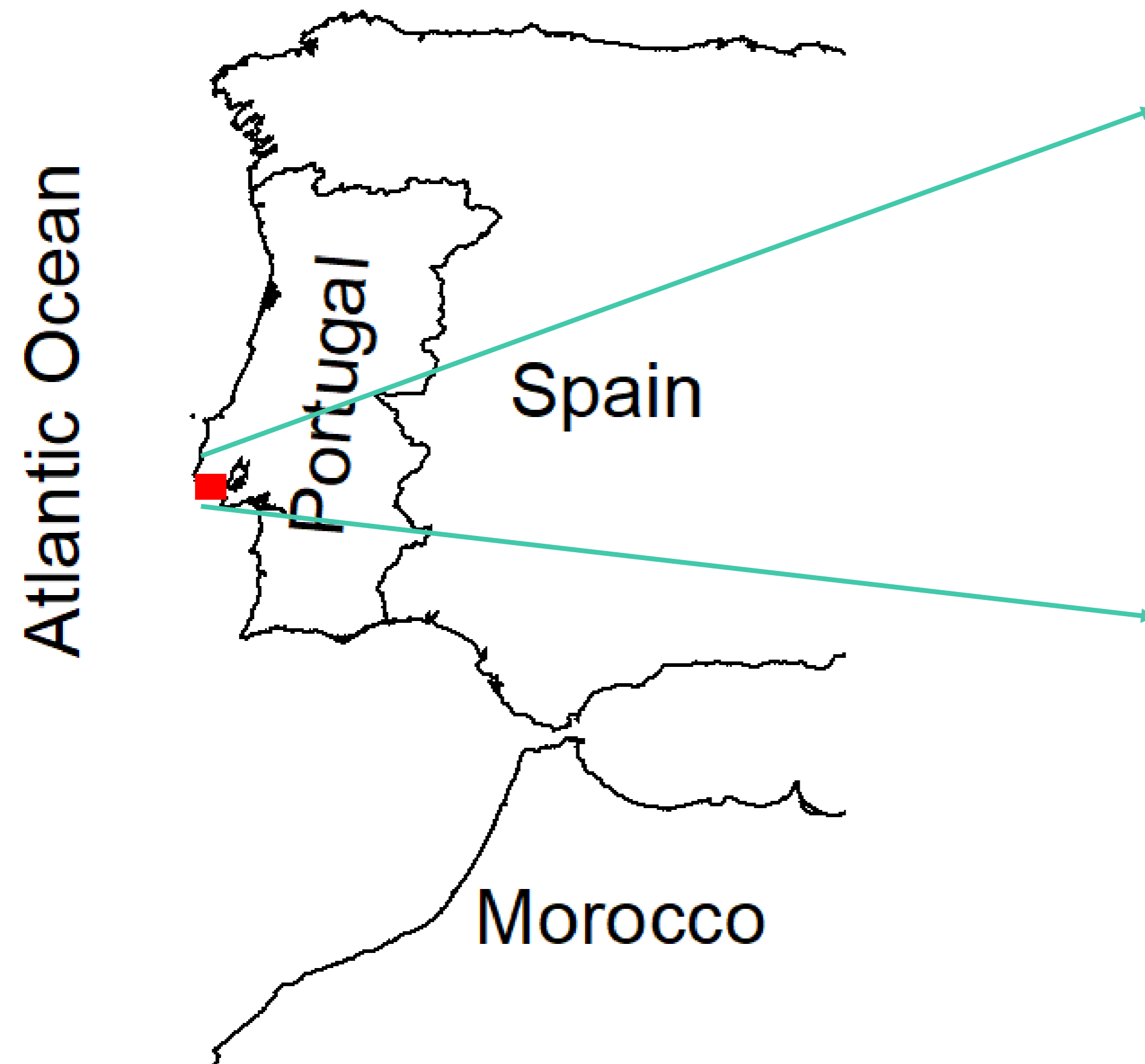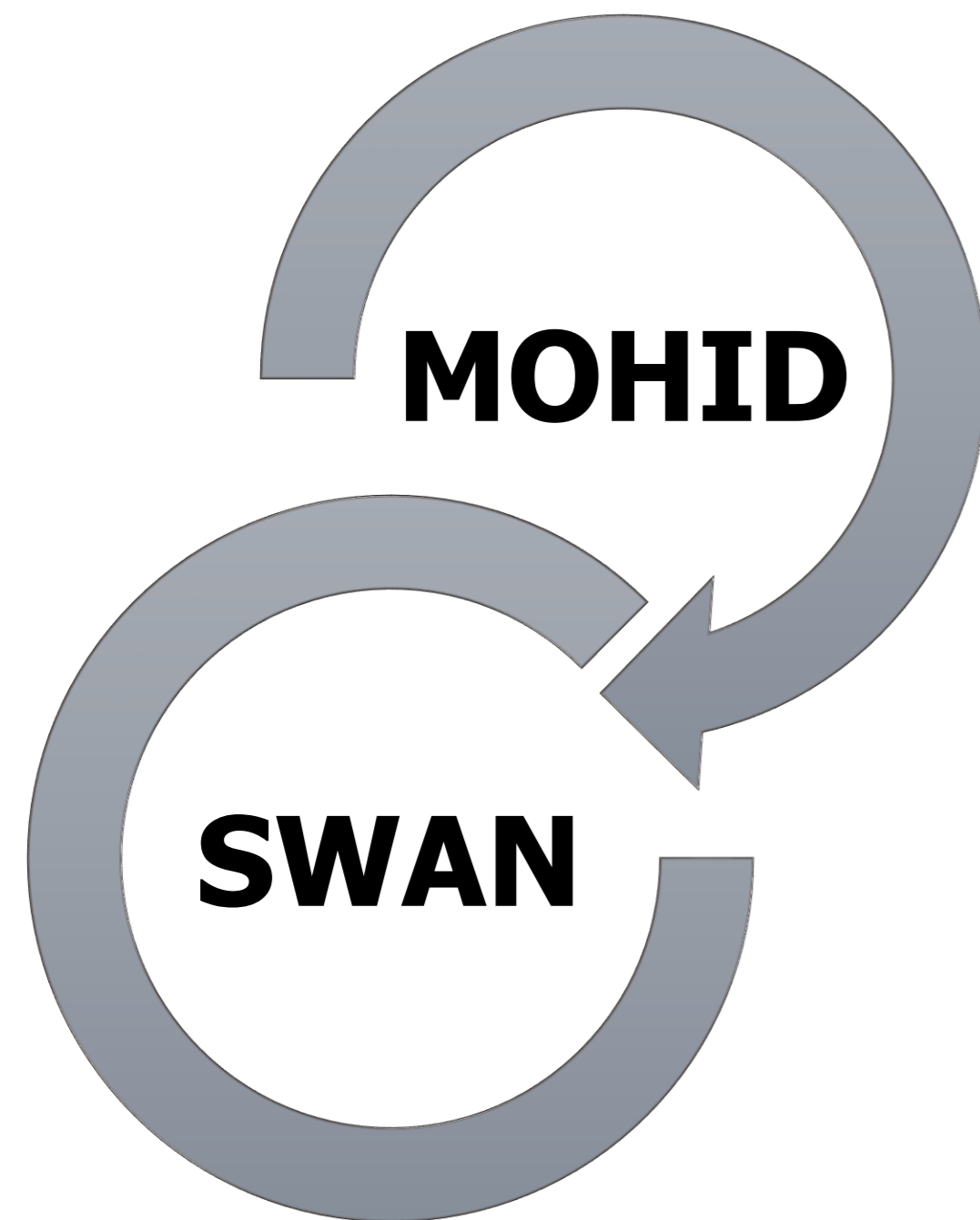
CIRCULATION MODEL
o Water Level
o Velocity

WAVE MODEL
o Significant Wave Height
o Mean Wave direction
o Wave lenght
o Mean Wave Period
o Orbital velocity
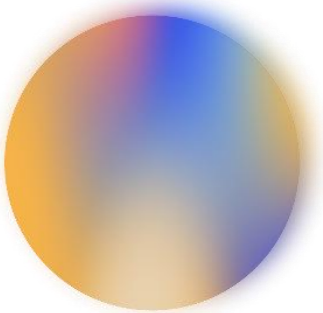o Radiation Stress

COUPLING METHODOLOGY

LISOCEAN MODEL

- ✓ 3D Hydrodynamic model
- ✓ 280 m spatial resolution
- ✓ Operational (3 days forecast)
- ✓ Hourly outputs (WL, T, S, velocity components)

http://pipeline-dito-platform.colabatlantic.com/

Tagus Estuary
- Tide Gauge
- Buoy

Nível em Cascais — TGCascais — MOHID
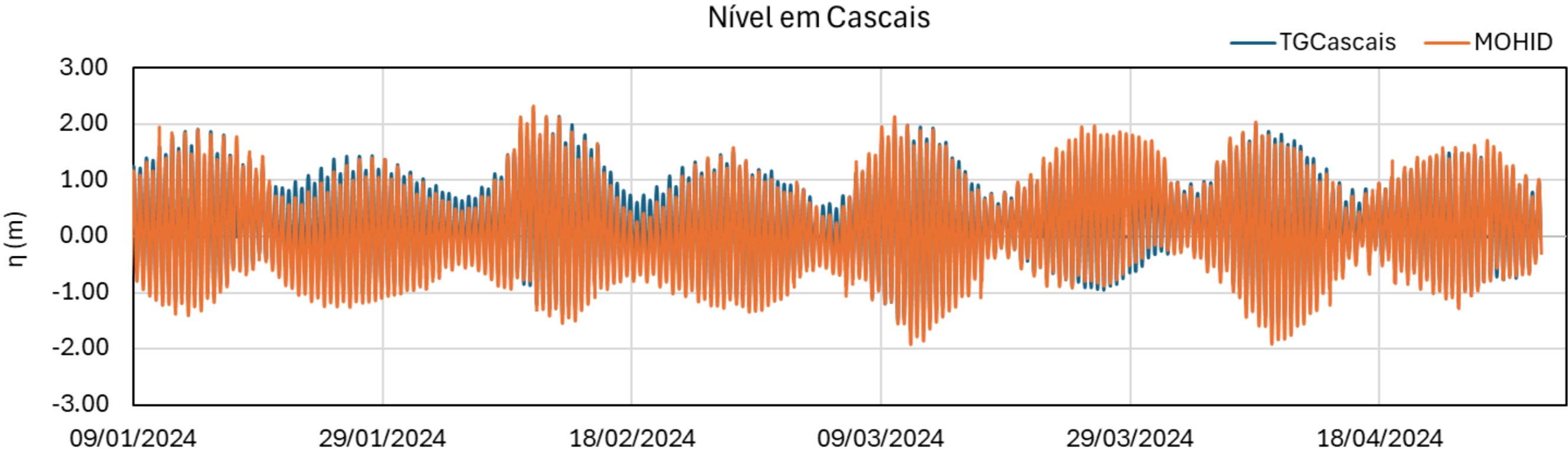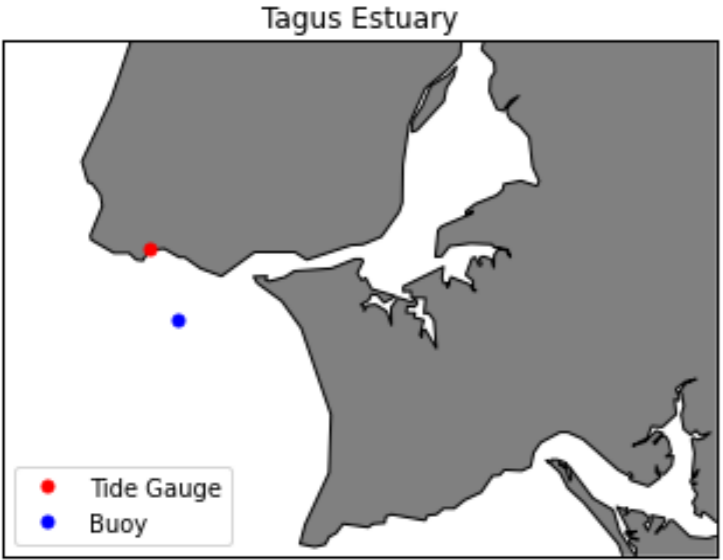
COUPLING METHODOLOGY

LISOCEAN MODEL

Astronomical tide (FES) General circulation (CMEMS)
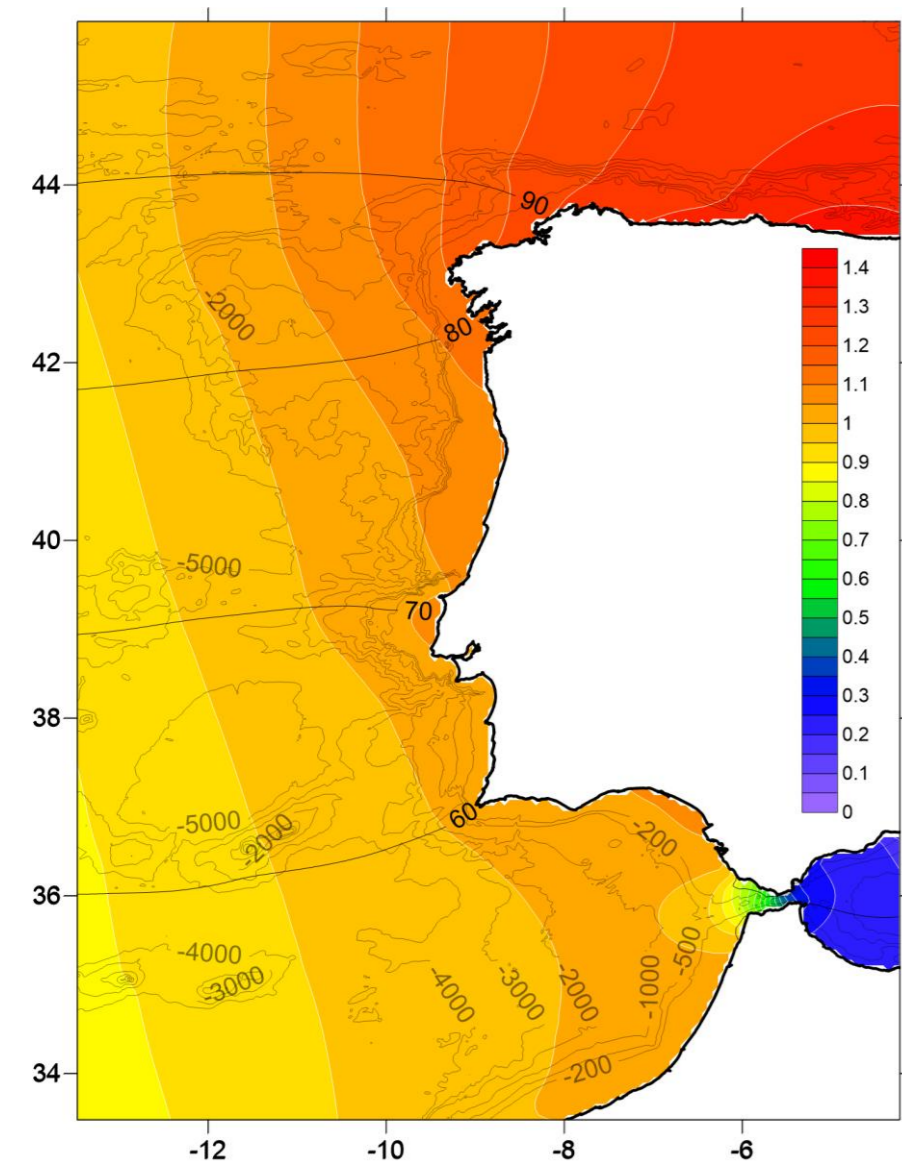
3D high-resolution bathymetry (EMODNet, IH)
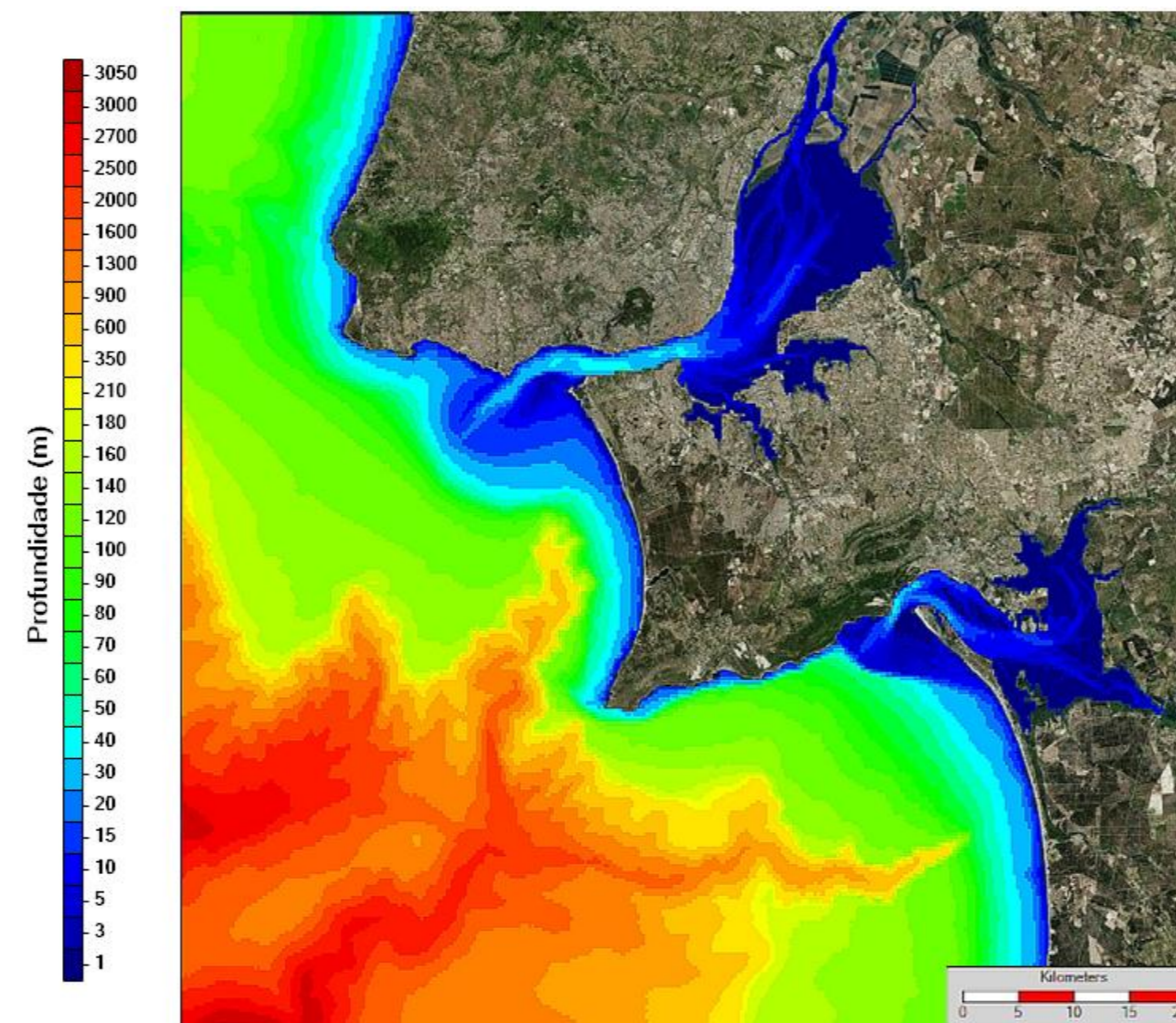
Atmospheric inputs (AROME, GFS)

River flow

OPERATIONAL COUPLING METHODOLOGY

Automatic Running Tool (**ART**)
Tools based on PYTHON

PRE-PROCESSING

- ✓ Copy restart files

- ✓ Copy and conversion of WL and velocities files

- ✓ Modify SWAN input file

- ✓ Run SWAN

POST-PROCESSING

- ✓ Convert to HDF

- ✓ Copy outputs to results folder

PERFORMANCE TESTS

✓ Using diferent boundary conditions

✓ Coupling including only water level

✓ Coupling including water level and velocities

✓ Restart/No restart

✓ Wind/ no wind (*ongoing*)

✓ Testing diferent number of cores

LISOCEAN WAVES OPERATIONAL MODEL

CMEMS IBI WAVES

+

15 min temporal resolution data (WL and velocities) from **MOHID LISOCEAN**

3D one-way coupled wave model

280 m spatial resolution

Operational (3 days forecast)

Hourly outputs (Hs, Dir, Tm, L, Ubot, SXX, SXY, SYY)

HDF format outputs
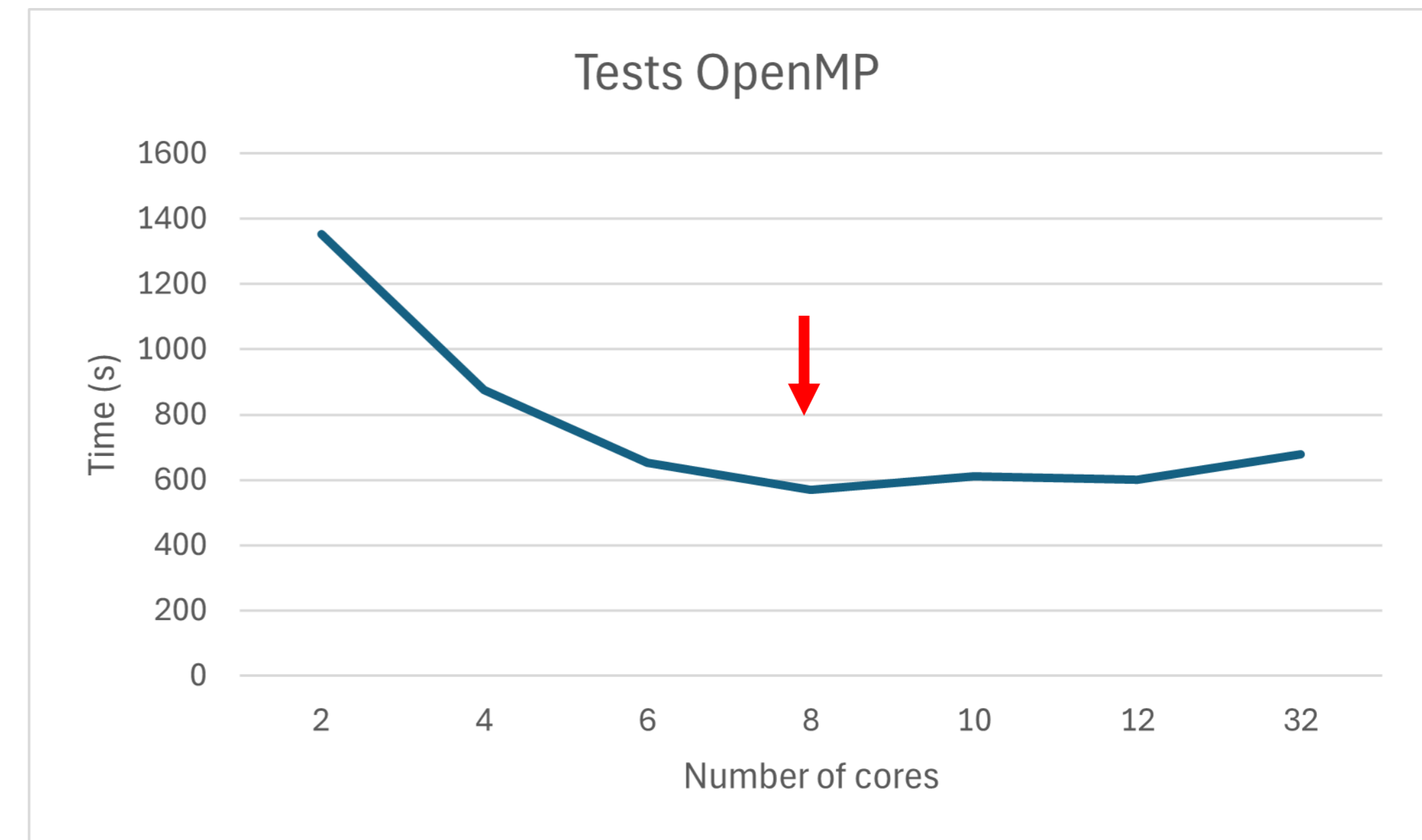
Running since 01/01/2025 – Up to date

RESULTS AND DISCUSSION

Tagus Estuary

SWAN IBI vs Lisbon Port Buoy - Hs

SWAN-MOHID:
r = 0.95 | MAE = 0.13 | RMSE = 0.17 | R² = 0.88 | Bias = -0.05

SWAN no currents:
r = 0.95 | MAE = 0.14 | RMSE = 0.18 | R² = 0.87 | Bias = -0.10

SWAN no currents no level:
r = 0.95 | MAE = 0.14 | RMSE = 0.18 | R² = 0.87 | Bias = -0.10
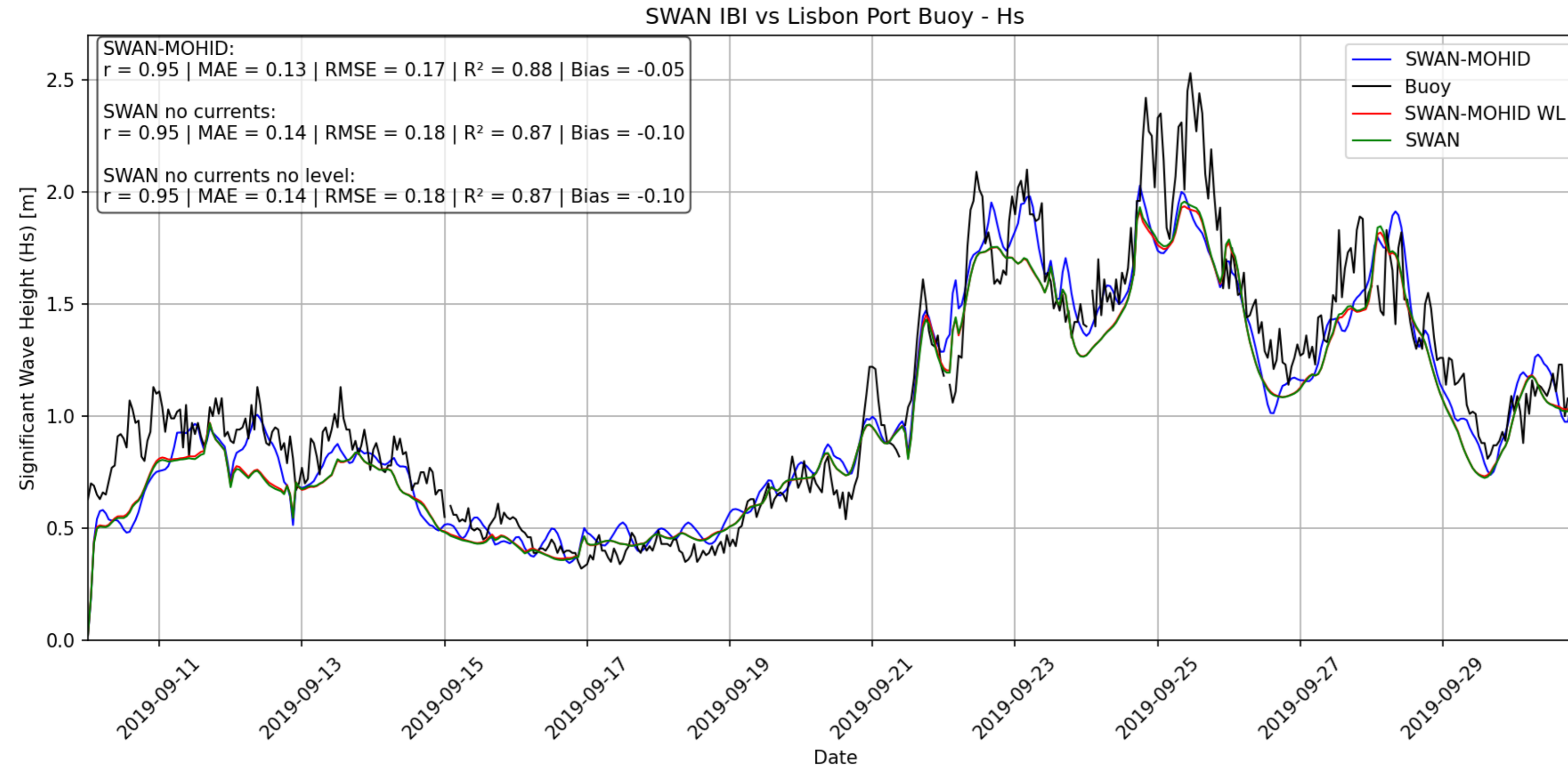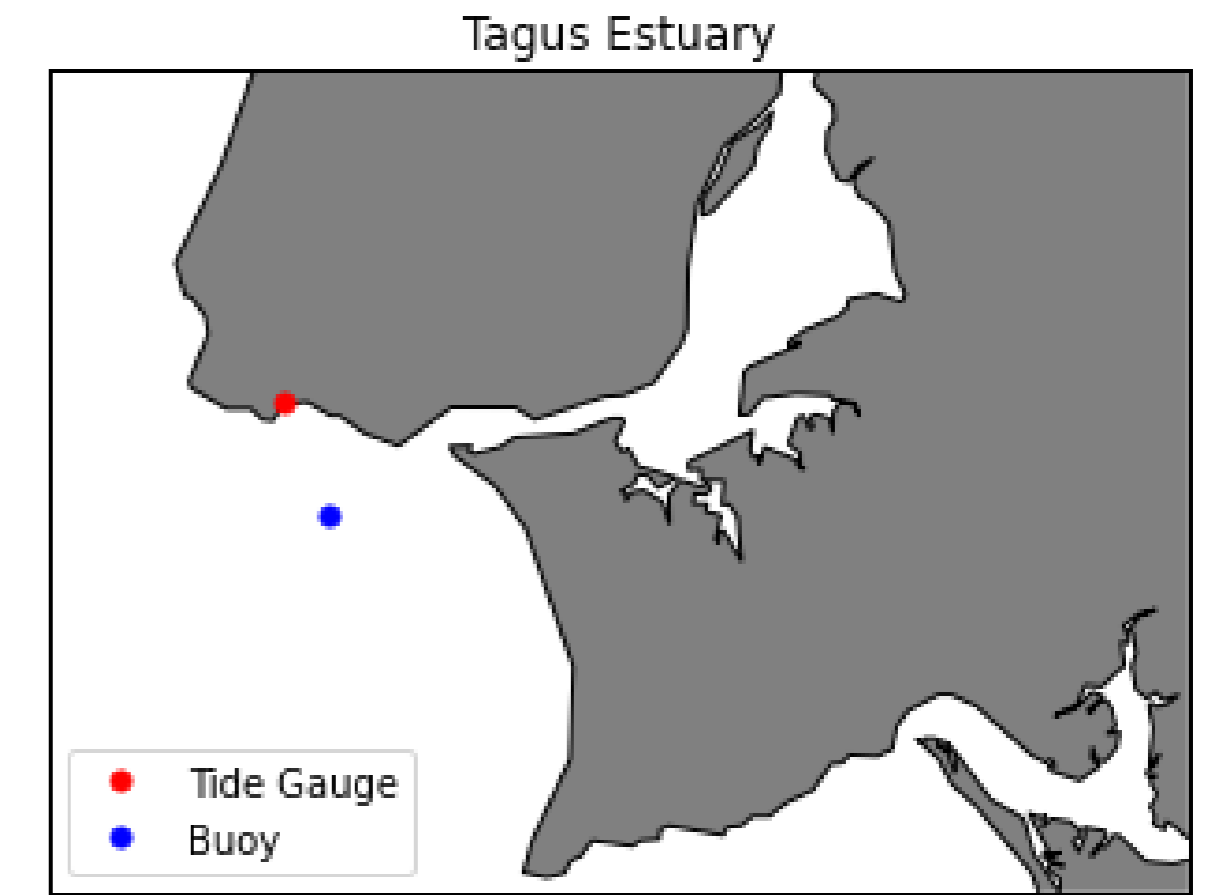
RESULTS AND DISCUSSION
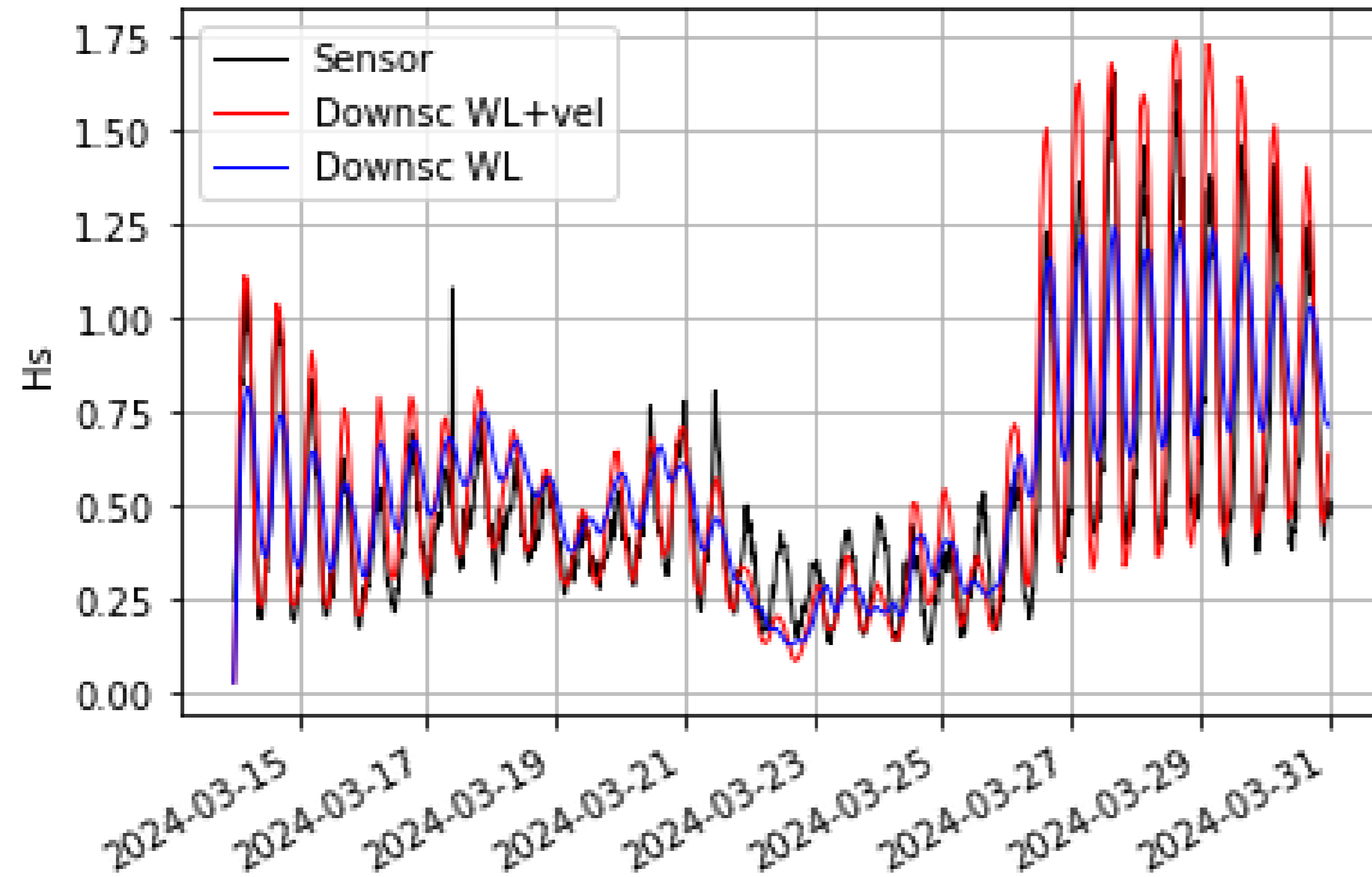
	Water Level	WL + Velocities
RMSE	0.18	0.14
r^2	0.82	0.96

FINAL REMARKS

- ✓ The proposed methodology has proven **effective for improving wave forecasting** in coastal areas.

- ✓ The model **reproduces** observed wave heights behavior, capturing the main variability patterns.

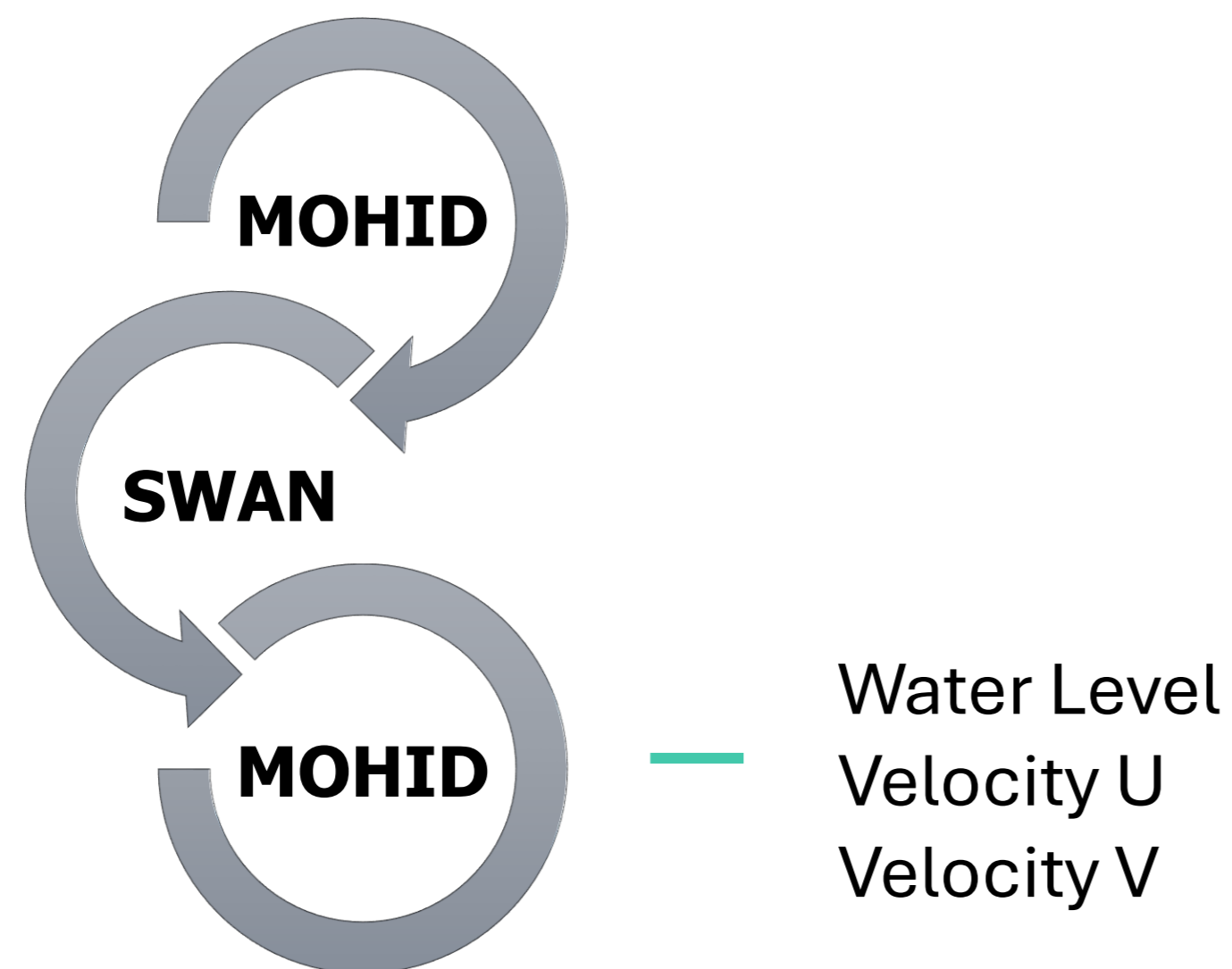- ✓ Coupling with hydrodynamic fields (water level and currents) leads to a **reduction in bias** and slight improvements in statistical indicators (RMSE and R^2).

- ✓ A **consistent improvement** is observed even over a short simulation period.

- ✓ These results **highlight the value of model coupling** for enhancing forecast accuracy in complex coastal environments.

NEXT STEPS/FUTURE WORK

✓ Include wind in the operational waves simulation

✓ Use wave spectra from WW3 as wave forcing

✓ Enhance two-way coupling between MOHID and SWAN, and integrate it into the operational system:

MOHID

SWAN

MOHID — Water Level
Velocity U
Velocity V

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PRR — Plano de Recuperação e Resiliência   REPÚBLICA PORTUGUESA   Financiado pela União Europeia NextGenerationEU   MI' MISSÃO INTERFACE   ANI' AGÊNCIA NACIONAL DE INOVAÇÃO