

OPENCoastS⁺: on-demand forecast of circulation and water quality in coastal regions

Demonstration course and hands-on training



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Course Brief Outline

- Introduction to OPENCoastS⁺: motivation, concept and general overview
 - 2D wave and current forecasts: relevance and OPENCoastS⁺ setup
 - 3D baroclinic and water quality: relevance and OPENCoastS⁺ setup
- 15 min break to organize participants in groups and guarantee platform registration of at least one user per group
- Demo on how to setup forecasts in OPENCoastS⁺: hands-on
 - Conclusions and Q&A

Introduction to OPENCoastS⁺: motivation, concept and general overview

Forecast systems: predicting coastal zones water dynamics for the next (few) days

Forcings

Prediction
simulations

Post-processing,
archiving and
visualization

Comparison with
real time data

January 2021

						1	2
3	4	5	6	7	8	9	
10	11	12	13	14	15	16	
17	18	19	20	21	22	23	
24	25	26	27	28	29	30	
31							

Calendar: Michel Borden / 4455

Day
1

January 2021

						1	2
3	4	5	6	7	8	9	
10	11	12	13	14	15	16	
17	18	19	20	21	22		
24	25	26	27	28	29		
31							

Calendar: Michel Borden / 4455

Day
2

January 2021

						1	2
3	4	5	6	7	8	9	
10	11	12	13	14	15	16	
17	18	19	20	21	22	23	
24	25	26	27	28	29	30	
31							

Calendar: Michel Borden / 4455

Day 3

...

Societal needs

- 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



The role of relocatable (applicable anywhere) forecast systems in CDT

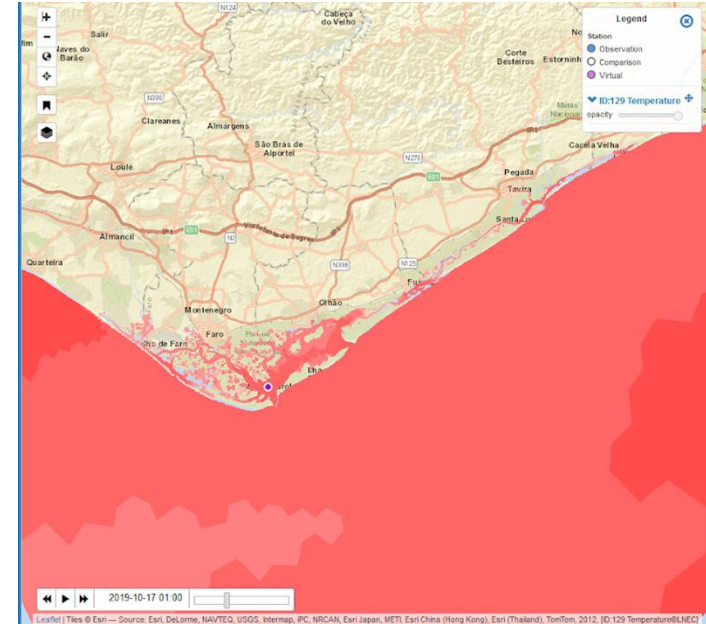
- Capacity to anticipate coastal system dynamics for circulation, sediment dynamics, water quality, biogeochemistry
- High resolution information in space and time
- Facility to address “what-if”, CC and management scenarios
- Continuous increase in coastal knowledge, numerical modeling and computational resources has produced very accurate and reliable tools

However:

- Forecast systems are complex to maintain and improve
- Concept of on-demand forecasting as a service - **OPENCoastS**
 - to centralize development, execution and maintenance of forecast systems
 - make forecast system building available to all - on-demand service

in a nutshell

- Web portal to assemble on-demand coastal forecast systems for selected coastal areas
- Generates daily forecasts of water levels, wave parameters, 2D and 3D velocities, and 3D salinities, temperatures and water quality variables over the region of interest for 48 hours
- Based on numerical simulations of all relevant physical and biogeochemical processes

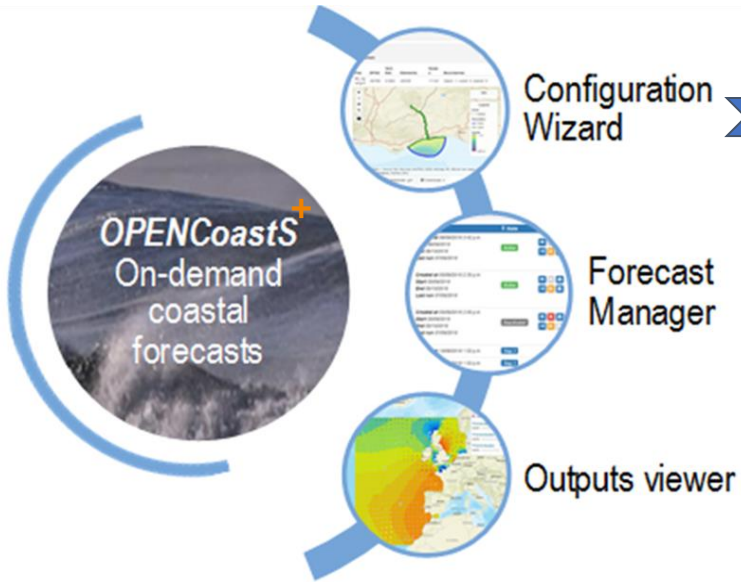


a new paradigm in coastal forecasting to empower users

A service to:

- Make the implementation of coastal forecasts fast and easy:
build forecast systems for a location chosen by the user, using a browser-based user-friendly, interface
- Make the service flexible in its configuration:
forcings, processes and model parameters
- Flexible IT architecture that can grow to additional processes
- Take advantage of the EOSC infrastructure and core-services to provide the required computational resources

Navigating in the 3 pillars: user-centered approach



Configuration Assistant

ID:26:19
New System
Save

Step 1
Step 2
Step 3
Step 4
Step 5
Step 6
Step 7
Step 8

Model
Domain
Boundaries
Stations
Hydrodynamic Parameters
Additional Data
Water Quality
Submission

Select Model

This Configuration Assistant aims to set up a forecast system on demand in an area chosen by the user. In this step the user will choose the run type, the model to use and the daily forecast range. 3D run types are only available to users with advanced permissions.

Select run type

Baroclinic Simulation:

☒ No
☐ Yes (3D)

Waves:

☒ No
☐ Yes

Water Quality:

☒ No
☐ Generic Tracer
☐ Fecal Contamination

Select a model (*):

Select a period (*):

2D/3D baroclinic flow

2D/3D/ W&C/quality

With/without wave & current interaction

With/without water quality (fecal, generic tracer)



- Step 1: define type of run
- Optional choices on every step

Configuration assistant: domain

Configuration Assistant

ID:26:19

New System



Upload Grid

In this step the user has to provide the computational grid for the forecast in the format adequate to the model chosen in the previous step. This grid will represent the geographical domain of study. The user must also indicate the horizontal and vertical coordinate system of the grid.

Select a horizontal grid (*): 23_guad_20790_hgrid.gr3

Coordinate Reference System for the grid:

EPSG:20790 | Lisbon / Portuguese National Grid

or enter an EPSG code (*):

20790

Vertical reference of the grid: or enter a vertical displacement in meters (*):

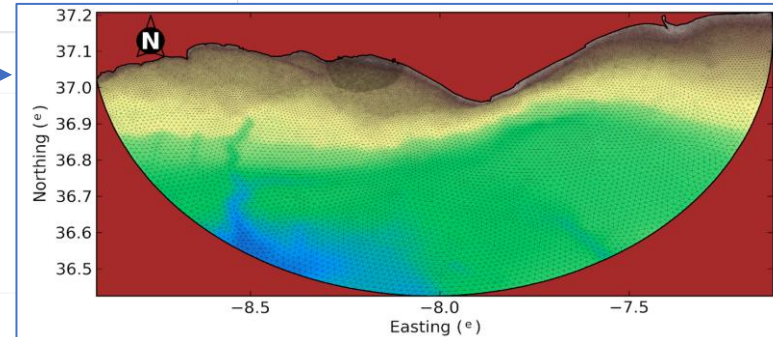
Calculate a suggestion for the time step (dt): ☐ It may increase significantly the processing time.

Obtain satellite images for the defined grid: ☒ The satellite images will only be available at the end of today.

Previous



LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL



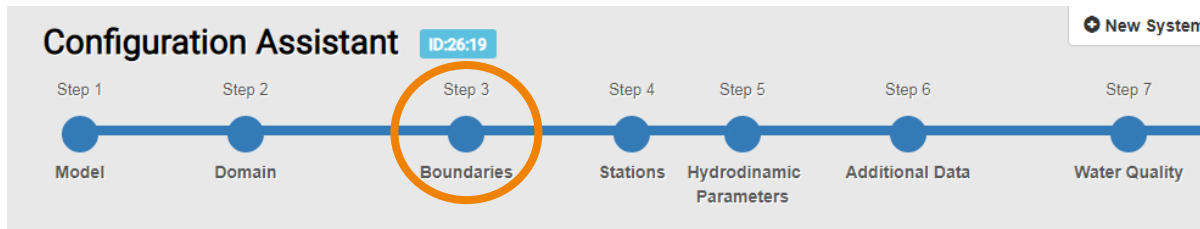
Step 2: Upload horizontal (and vertical) grids

- Format SCHISM/SELFE/ADCIRC
- Vertical reference: mean sea level

Still Step 2, to guarantee simulation quality

Configuration assistant: boundaries

Step 3: define b.c.

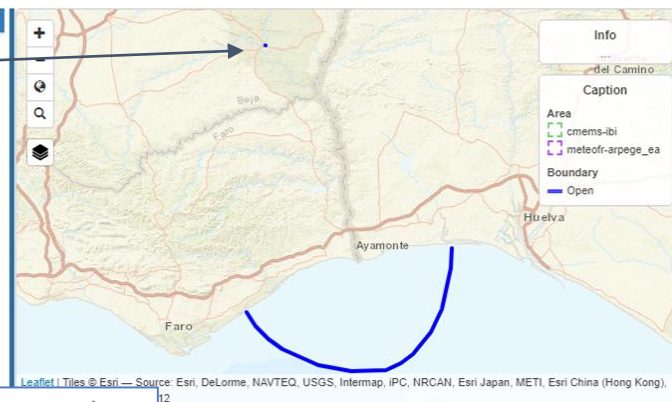


In this step the user has to define the forcing sources for the ocean, river and atmospheric boundaries, from the available options.

Select one or more boundaries and define their type and forcing condition

ID	Type	Forcing
☐ open-1	Ocean	FES2014 - Finite Element Solution
☐ open-2	River	annual=10

Define type and forcing condition



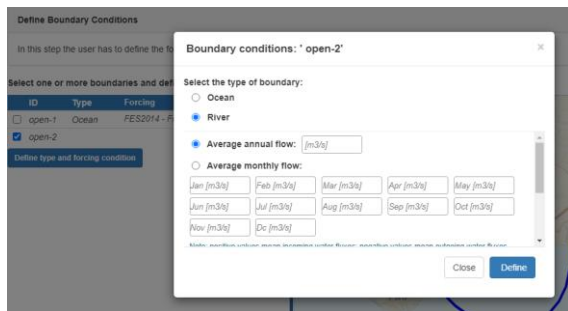
Forcings for Circulation to apply to all oceans boundaries:

FES2014 - Finite Element Solution

Atmosphere Forcing:

Météo-France | ARPEGE Europe-Atlantique

meteo galicia



Several options for river forecast including other forecast system

FES2014 TIDE



WAVEWATCH III



Configuration assistant: Stations

Step 4: comparison with data stations and creation of virtual stations

Automatic

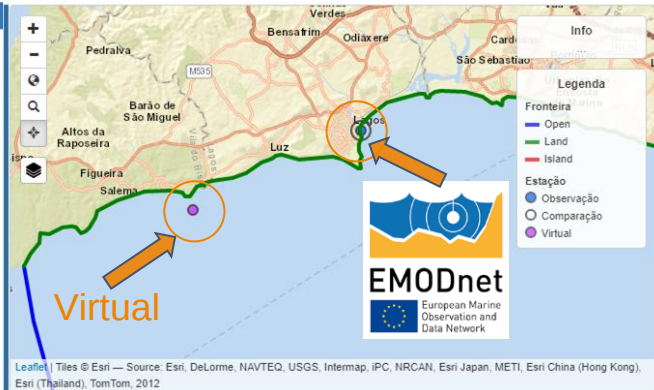
Defined by the user

Configuration Assistant ID:26:19 New System

Step 1 Model Step 2 Domain Step 3 Boundaries **Step 4 Stations** Step 5 Hydrodynamic Parameters Step 6 Additional Data Step 7 Water Quality

Name	Latitude	Longitude	Comparison
☒ LagosTG	37.10000	-8.66670	LagosTG (37.10000, -8.66670)
☒ teste	37.055254	-8.786659	

New Station

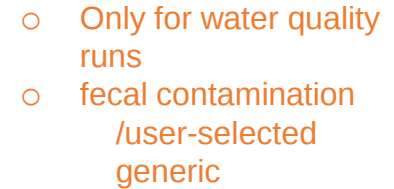


Virtual

EMODnet
European Marine Observation and Data Network

Leaflet | Tiles © Esri — Source: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

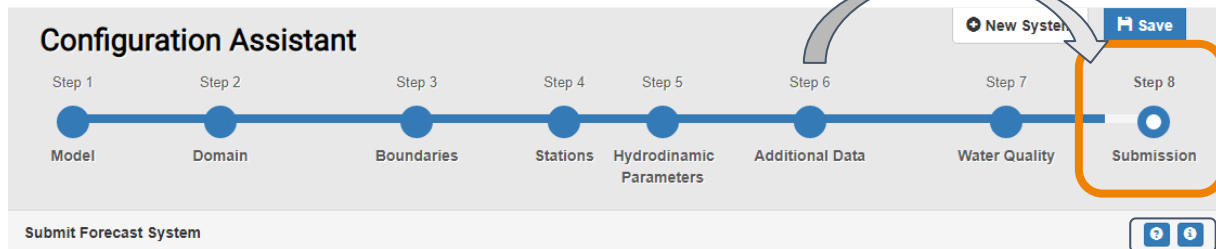
- Automatic detection of stations inside domain
- Setup of virtual stations



- Template files based on the specific run
- Encapsulate our best knowledge on the processes and their numerical representation

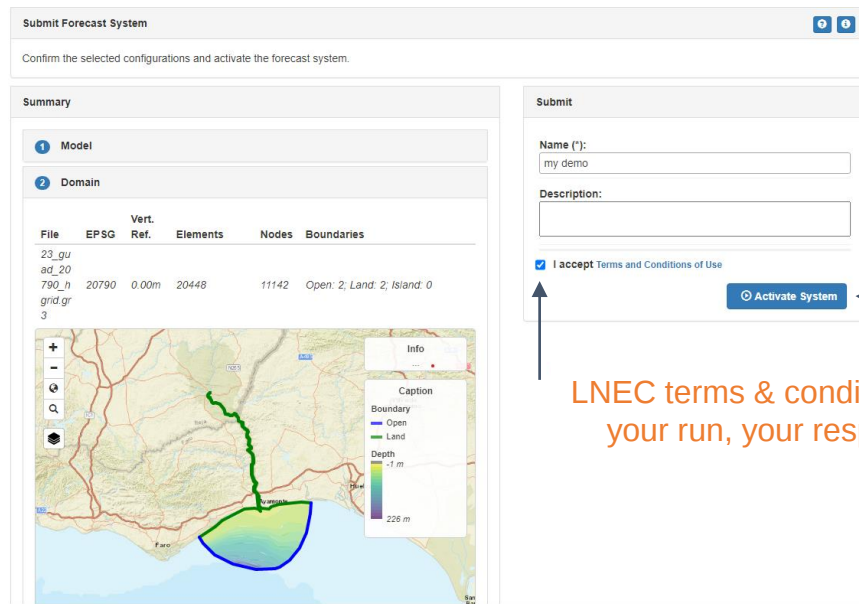
14

Configuration assistant: launching deployment



Step7: check everything and launch run

Online help (content, navigation)



Submit Forecast System

Confirm the selected configurations and activate the forecast system.

Summary

1 Model

2 Domain

File	EPSG	Vert. Ref.	Elements	Nodes	Boundaries
23_gu					
ad_20					
790_h	20790	0.00m	20448	11142	Open: 2; Land: 2; Island: 0
grid.gr					
3					

Info

Caption

Boundary

Open

Land

Depth

-1 m

226 m

Submit

Name (*):

my demo

Description:

☒ I accept Terms and Conditions of Use

Activate System

Results in 24 hours

LNEC terms & conditions:
your run, your responsibility

Navigating in the 3 pillars: Forecast manager

OPENCoasts User Manual [anabela.pacheco.oliveira@gmail.com](#) PT EN

Forecast Systems

Extension requests New System

Forecasts management

ID	Model	Name	Dates	State
79	SCHISM, v5.4.0 (48h)	my youtube forecast	Created at 06/09/2018 3:42 p.m. Start 06/09/2018 End 06/10/2018 Last run 07/09/2018	Active
this is the forecast I created for the demo.				
77	SCHISM, v5.4.0 (48h)	teste_prep_imum2	Created at 05/09/2018 2:35 p.m. Start 05/09/2018 End 05/10/2018 Last run 07/09/2018	Active
tejo fes+gfs				
76	SCHISM, v5.4.0 (48h)	teste_prep_imum	Created at 05/09/2018 2:00 p.m. Start 05/09/2018 End 05/10/2018 Last run 07/09/2018	Deactivated
obidos com prism+gfs				
58	SCHISM, v5.4.0 (48h)	teste de carga2	Created at 10/08/2018 1:53 p.m.	Step 3
57	SCHISM, v5.4.0 (48h)	teste de carga1	Created at 10/08/2018 1:59 p.m.	Step 3

Checking the status and the settings of my runs

Clone it – duplicate to change: b.c., parameters, outputs

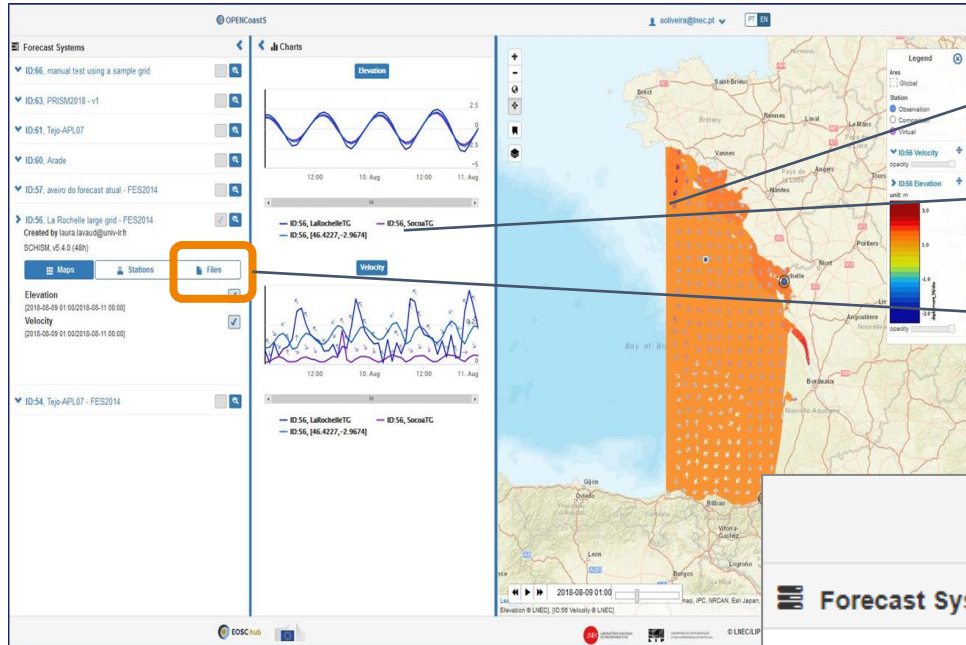
Re-activate a deactivated system or eliminate it

Many states are possible:

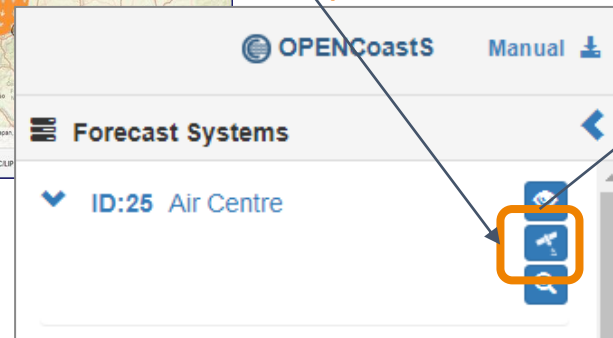
- “step k” – in construction, we can continue later or just eliminate it
- Active – we can deactivate, clone it, check it,...
- Deactivated – we can activate it again or eliminate it

Return to Conf. Assist. to continue to setup my forecast

Navigating in the 3 pillars: Viewer



- Hydrodynamic and water quality maps
- Time series (pre-defined stations or stations defined on-the-fly)
- Download inputs and outputs
- View remote sensing water limits on top of predictions



WORSICA
backend:
Remote
sensing:
Sentinel 2

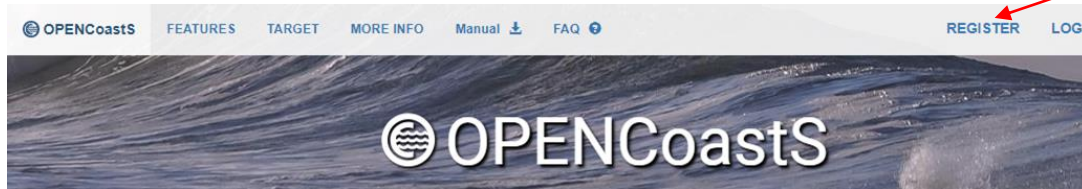
**2D wave and current forecasts: relevance and
OPENCoastS+ setup**

**3D baroclinic and water quality: relevance and
OPENCoastS+ setup**

15 min Break to organize Hands-on

Don't leave the room until your group is ready for the demo!!!

- Organize yourselves in up to 5 people teams
- Make sure that at least one of your team elements has registered at opencoasts beforehand
- IF NOT, call one of the trainers for help or try the procedure below:
- Procedure to register (if you have not done it before):
 - Goto <https://opencoasts.ncg.ingrid.pt/>



- Goto to your email and confirm the registration
- Wait for our approval and then login with the email and selected password
- **Done!!**

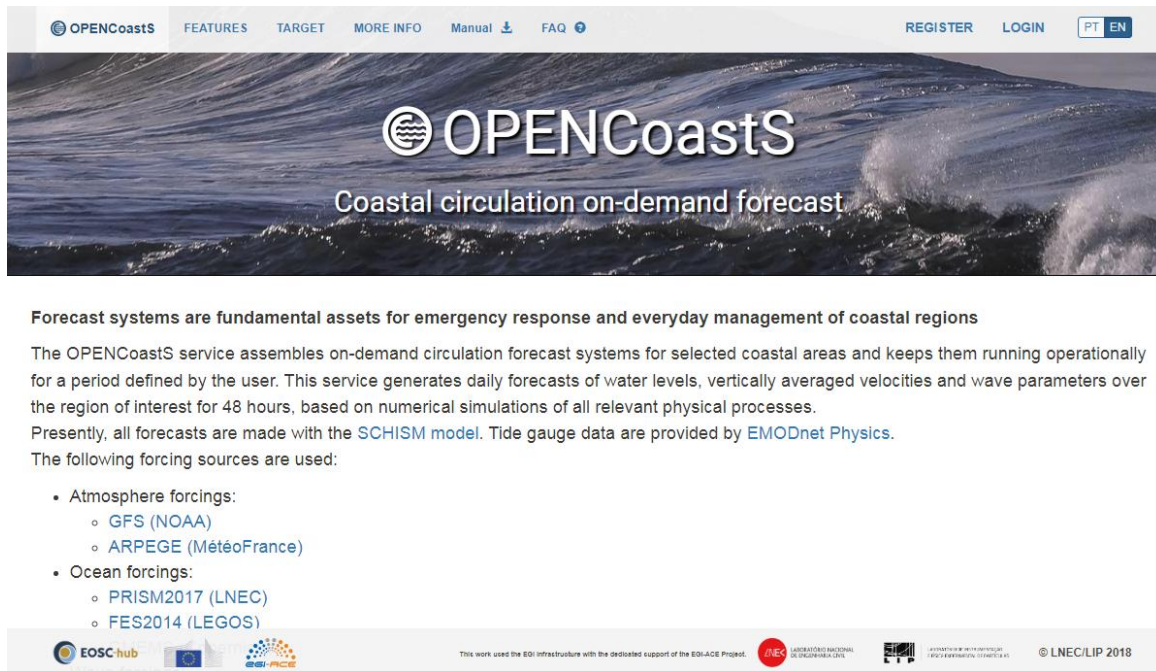
Demo on how to setup forecasts
in OPENCOastS+

Download grid:
<https://shortest.link/8Lp->

OPENCOastS⁺ : hands-on

OPENCoastS PLATFORM

<https://opencoasts.ncg.ingrid.pt/>



The screenshot shows the OPENCoastS website interface. The header includes navigation links: OPENCoastS, FEATURES, TARGET, MORE INFO, Manual (with a download icon), and FAQ (with a plus icon). On the right, there are links for REGISTER and LOGIN, and language selectors for PT and EN. The main banner features a background image of ocean waves with the OPENCoastS logo and the text "Coastal circulation on-demand forecast". Below the banner, a paragraph states: "Forecast systems are fundamental assets for emergency response and everyday management of coastal regions". This is followed by a detailed description of the service: "The OPENCoastS service assembles on-demand circulation forecast systems for selected coastal areas and keeps them running operationally for a period defined by the user. This service generates daily forecasts of water levels, vertically averaged velocities and wave parameters over the region of interest for 48 hours, based on numerical simulations of all relevant physical processes. Presently, all forecasts are made with the SCHISM model. Tide gauge data are provided by EMODnet Physics. The following forcing sources are used:". A bulleted list follows: "Atmosphere forcings: GFS (NOAA), ARPEGE (MétéoFrance); Ocean forcings: PRISM2017 (LNEC), FES2014 (LEGOS)". The footer contains logos for EOSC hub, the European Union flag, EGI-ACE, LNEC, and LIP, along with the text "This work used the EGI infrastructure with the dedicated support of the EGI-ACE Project." and "© LNEC/LIP 2018".

OPENCoastS
Coastal circulation on-demand forecast

Forecast systems are fundamental assets for emergency response and everyday management of coastal regions

The OPENCoastS service assembles on-demand circulation forecast systems for selected coastal areas and keeps them running operationally for a period defined by the user. This service generates daily forecasts of water levels, vertically averaged velocities and wave parameters over the region of interest for 48 hours, based on numerical simulations of all relevant physical processes. Presently, all forecasts are made with the [SCHISM model](#). Tide gauge data are provided by [EMODnet Physics](#). The following forcing sources are used:

- Atmosphere forcings:
 - GFS (NOAA)
 - ARPEGE (MétéoFrance)
- Ocean forcings:
 - PRISM2017 (LNEC)
 - FES2014 (LEGOS)

EOSC hub | European Union | EGI-ACE | LNEC | LIP | This work used the EGI infrastructure with the dedicated support of the EGI-ACE Project. | © LNEC/LIP 2018

Questions & Answers / Final remarks

Useful links

OPENCoastS PLATFORM	https://opencoasts.ncg.ingrid.pt/
Users Manual	http://opencoasts.lnec.pt/pdfs/Manual_opencoasts_v11.docx.pdf
Link to previous training events	http://opencoasts.lnec.pt/
Source code	https://gitlab.com/opencoasts/eosc-hub

Contact: aoliveira@lnec.pt

Evaluation: <https://shortest.link/9b9w>