





# Coastal dynamics on-demand forecast

## Coastal dynamics on-demand forecast platform

# **Users Manual**

(version 5.5)





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### **Overview**

OPENCoastS<sup>+</sup> is an online service that assembles on-demand coastal dynamics forecast systems for selected areas and keeps them running operationally for a period defined by the user. This service generates daily forecasts of water dynamics circulation variables (water levels, velocities, temperature, salinity, wave parameters) and water quality variables (Escherichia coli - E. coli and enterococcus; or a user specified generic tracer) over the region of interest for 48 hours, based on numerical simulations of all relevant physical processes. This service was built from the circulation service OPENCoastS, developed in the scope of the H2020 EOSC-hub project, jointly developed and maintained by LNEC - Laboratório Nacional de Engenharia Civil (LNEC - http://www.lnec.pt), LIP - Laboratório de Instrumentação e Física Experimental de Partículas (LIP - https://www.lip.pt), CNRS-LIENSs - Centre National de la Recherche Scientifique - LIttoral ENvironnement et Sociétés (CNRS-LIENSs - https://lienss.univ-larochelle.fr) and Universidad de Cantabria (UC - https://web.unican.es). Presently, all forecasts are made with the model SCHISM (<u>http://ccrm.vims.edu/schismweb/</u>), version 5.8.

The conceptual vision of OPENCoastS and its implementation rationale along with several use cases are described in the following papers:

- Oliveira, A., A.B. Fortunato, M. Rodrigues, A. Azevedo, J. Rogeiro, S. Bernardo, L. Lavaud, X. • Bertin, A. Nahon, G. de Jesus, M. Rocha, P. Lopes, 2021. Forecasting contrasting coastal and estuarine hydrodynamics with OPENCoastS, Environmental Modelling & Software, 143: 105132, https://doi.org/10.1016/j.envsoft.2021.105132.
- Oliveira, A., A.B. Fortunato, J. Rogeiro, J. Teixeira, A. Azevedo, L. Lavaud, X. Bertin, J. Gomes, M. • David, J. Pina, M. Rodrigues, P. Lopes, 2020. OPENCoastS: An open-access service for the automatic generation of coastal forecast systems, Environmental Modelling & Software, 124: 104585, https://doi.org/10.1016/j.envsoft.2019.104585.

The service is accessible at <u>https://opencoasts.ncg.ingrid.pt/</u> supported by computational resources from INCD - Infraestrutura Nacional de Computação Distribuída (https://www.incd.pt), a node of the EGI



- European Grid Infrastructure (<u>https://www.egi.eu</u>), and from IFCA - Institute of Physics of Cantabria (<u>https://ifca.unican.es</u>).

Access to the service is granted through a registration procedure, and is obtained after acceptance of the registration by the OPENCoastS<sup>+</sup> user support team.

Four types of circulation forecast systems are available, depending on the physical processes being solved:

1) 2D barotropic simulations without short waves - these simulations are fast and provide water levels and depth-averaged velocities as outputs. Forcings include tides, wind, atmospheric pressure and river flow. They can be applied anywhere in the world. This is the recommended option for a first deployment at a site.

2) 2D barotropic simulations with wave-current interaction - these simulations provide wave parameters besides the ones in the option above. Wave-current interactions are simulated and forcings include short waves besides the ones above. The region where this option can be used is limited to the North Atlantic area, as the wave boundary conditions are limited to this area. This option should only be selected at sites where short waves are relevant as computational costs are considerably larger than option 1. A prior deployment with option 1 is recommended.

3) 3D baroclinic simulations - these simulations provide 3D fields of velocity, salinity and temperature, besides water levels. They can be forced by tides, river flow and temperature and salinity at all the boundaries, besides the atmospheric forcing (wind, air temperature, pressure, humidity, solar radiation and downwelling longwave radiation) at the surface. These forecasts can be generated anywhere in the world. The full baroclinic equations are used. Thus, they are quite demanding computationally and more complex to set-up with success. Unlike the previous options, that are freely available to all, access to these simulations is granted on request (send an email to <u>aoliveira@lnec.pt</u> for access).

4) 3D baroclinic simulations with wave-current interactions. This option combines options 2 and3.



Finally, OPENCoastS<sup>+</sup> also allows for predicting some water quality dynamics. In the present version of the service, two options are available, forced by any combination of the circulation options defined previously:

- 1) Fecal contamination these simulations account for both *E. coli* and enterococcus dynamics, in accordance with the Bathing Water Directive. Several formulations are available to evaluate the indicator decay rate due to mortality, as well as aggregation to sediments.
- 2) Generic tracer these simulations allow the user to configure a user-specific decay process for a scalar of choice. This option aims at circumventing the current limitations on water quality processes and to give the user the flexibility to configure and test several water quality processes.

This manual presents a detailed guide for the use of the OPENCoastS<sup>+</sup> service under these several options. In particular, it helps the user to take advantage of the service's three main features:

**Configuration Assistant**: this feature guides the user in the process of creating a new forecast system at the user's region of interest, following 7-8 simple steps. It only requires the availability of a computational 2D unstructured grid in the SCHISM/ADCIRC/SELFE format (<u>SCHISM v5.8 manual</u>, pages 59-61). For 3D baroclinic runs the user must also provide a vertical grid file pages 61-63).



Figure 1 - Configuration Assistant page preview

Forecast Systems: this feature allows users to manage their forecast systems, through a number of tasks that can be done on a forecast system, e.g.: edit the systems' configurations at any time before





submission, delete it, clone it, generate a print-preview, activate (submit) / deactivate it or request an extension of the forecast's duration.

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Forecast Systems		Extensio	n requests ON	ew System
recast <mark>s management</mark>				٥
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56:41 SCHISM, v5.4.0 (48h)	La Rochelle large grid - FES2014	Created at 11/07/2018 5:18 p.m. Start 11/07/2018 End 12/08/2018 Last run 07/08/2018	Active Expiring	◎ × ů × I ii
reated by laura.lavaud@univ-lr.fr		Created at 11/07/2018 5:06 n m		
55:24 SCHISM, v5.4.0 (48h)	aveiro do forecast atual - FES2014	Start 11/07/2018 End 12/08/2018	Deactivated	× • •
EOSChub		LADORITHE INCOME		© LNEC/LIP

Figure 2 - Forecast System Manager page preview

**Outputs Viewer:** this feature allows the user to visualize the daily predictions for each forecast and to compare model predictions with observations from available EMODnet monitoring stations.



Figure 3 - Output Viewer page preview

## **Registration and Login**

To be able to start using the service, a new user must first register:

A https://operceasts.reg.ingrid.pt/register/		
OPENCOASTS TARGET AUDENCE FEATURES	REGISTER LOGIN	
e	OPENCoastS	
North Atlantic	coastal circulation on-demand forecast	
The second s		
Regist Amuseo (): Amuseo Cou First name: Lan name: Baal (): Passeo () Confirmation ()	eer riter (1) Terr the taxe passed as balan, for with rank. Terr the taxe passed as balan, for with rank.	
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Figure 4 - Preview of OPENCoastS register page

As an alternative, users can register through the EGI check-in service using their affiliation entity identification:





1.0		
	A. T. Still University	^
	AAF Virtual Home	
	AAI@EduHr Single Sign-On Service	
	Aalborg University	
	Aalto University	
	Aarhus School of Marine and Technical Engineering	
	Aarhus University	
	Abertay University	
	Aberystwyth University	
	Aberystwyth University IdP 3.1 Test	
	ABES - French Bibliographic Agency for Higher Education	
	Abingdon and Witney College	
	Absalon University College	
	Academic Analytics	
	Academic Scientific Research Computer Network of Armenia (ASNET-AM)	
	Academisch Ziekenhuis Maastricht	
	Academy of Arts, Architecture and Design in Prague	
	Academy of Performing Arts in Prague	-
	or	
		-
	COT LOG-IN B2ACCESS Facebook Google IGTF	

Figure 5 - Preview of the EGI Check-in service



Register Registration successful! You will receive an email to confirm your registration. As soon as your process is confirmed and validated successfully you will get an activation confirmation by email.

Figure 6 - OPENCoastS+ message on new user registration

After registering, a confirmation is issued at the site and a confirmation email is sent to the user:





webmaster@inec	c.pt
to me 🖃	
OPENCoastS - R	egister
Confirm your regis	stration by clicking the link below and once it is successfully validated you will receive an activation account notification
Affiliation	Laboratório Nacional de Engenharia Civil
Affiliation Count	try PT
Name	Anabela Pacheco de Oliveira
Email	anabela.pacheco.oliveira@gmail.com
DateHour	7 Aug 2018, 5:29 p.m.

#### Figure 7 - OPENCoastS email text sent on new user registration

<u>The user must then confirm the registration</u> through the link provided in the registration acknowledgement email.

Note: If the registration is made via EGI, no confirmation is required.

With this confirmation, a validation request is launched and as soon as this request is validated and accepted, an email is sent confirming the access to the service. From that point onward, the user can login and start using the OPENCoastS+ service.

OPENCoastS	TARGET AUDIENCE FE	ATURES			REGISTER	LOGIN	PT EN
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	North	Atlantic co	astal circulatior	on-demand fore	cast		in
		Login					
		Email: Password:	anabela.pacheco.oliveira@	}gmail.com			
		Forgot my password		Register Login			
			Or login through federate	d ID			

Figure 8 - Preview of OPENCoastS login page

<u>Note</u>: Users can at any time request a new password, in case they have forgotten it, by clicking on the "Forgot my password" link and providing their user email.

After login in for the first time, the user is prompted to accept the Terms and Conditions. This acceptance is necessary to be able to use the service.







Figure 9 - Preview of the Terms and Conditions of the service usage

After accepting these terms, the user is ready to start deploying forecasts and is automatically taken to the Configuration Assistant.

### **Configuration Assistant**

### First time usage

The first time a user enters the Configuration Assistant, a guided tour of the assistant is proposed. The user can skip it by hitting the "close" button at any time or can follow it back and forth through the guide's steps. All steps have a <sup>3</sup> button that opens this guide with tips on how to use each step.



OPENCOastS Coastal dynamics on-demand forecast User Manual



Figure 10 - Previews of the Configuration Assistant Guide

Next to the 1 button all steps also have the 2 button that opens a collapsible panel with a more detailed description of each step.

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
0						
Model	Domain	Boundaries	Stations	Parameters	Additional Data	Submission More info
Select Model						0
In this configuration Note that some for The modeling sys The OPENCoastS simulates thus wa	on step the user selects t recasts that provide BCs tem SCHISM simulates a platform uses the circul ter levels and velocities (	he model version to use in the i are not available for 72 hours, vast range of processes in walt ation model SCHISM (Zhang et due to tides, wind, atmospheric	forecasts, as well as the fo so the choice of this range er bodies. SCHISM is a cor al., 2016), that solves the pressure and river flow.	recast range(48h or 72h). e of prediction may limit other c mmunity model, based on unstr shallow water equations, in 2D	hoices ahead. ructured grids and fully pai mode (vertically integrated	rallelized. 1). SCHISM
In a near future the spectral model the and to receive wa	e systems will be update at simulates the generati ter levels and velocities	d to coupled circulation waves- on and propagation of short waves hat affect wave propagation.	currents by activating the r ves. It is coupled to the SC	model WWM (Roland et al., 20 HISM model in order to provide	12). The short wave model e radiation stresses that af	WWM is a fect circulation,

Figure 11 - Detail of a step's detailed description collapsible panel

The Header indicates in which step the user is at the Configuration Assistant and can also be used to navigate between available steps. Most steps require users to fill out forms with mandatory fields. They can then move to the next step by clicking the "**Complete step**" button which will validate the user's choices. Users can also move back and forth through the steps by clicking on the "**Previous**" and "**Next**"



buttons or reset the current step by clicking the "**Restart step**" button. **Note** that <u>resetting a step implies</u> <u>also resetting the steps ahead already completed</u> for they depend sequentially on one another.

Users should save the forecast system at an early stage and along the process in order to avoid loss of information, by using the "**Save**" button (top right of the screen) and providing a name for the system on the first time it is saved. The service will assign a forecast ID number to each forecast system. Users can then access each forecast deployment using the "Forecast Systems" page and re-open it on the Configuration Assistant, if the system is still under configuration.

Next to the "Save" button is the "**New System**" button that resets the Configuration Assistant. Note that in order to not lose work already done on a system's configuration, the user must first save it.

**Attention**: changes to a step already completed require the user to click the step's **"Save changes"** button, located at the bottom of the page, in order to re-validate the step and save the changes.

### Creating a new forecast system

The creation of a new forecast system requires following 7 or 8 steps, depending whether it is a circulation only or circulation+water quality forecast:

**Step1**: In this step the user will configure the run type (2D/3D, with / without waves, with/without water quality), the model to use and the daily forecast range. Presently, only version 5.8 of the <u>SCHISM model</u> is available and each daily forecast simulation is limited to 48 hours.

**Step2:** In this step, the user has to provide computational grids for the forecast in the format adequate for the model chosen in the previous step. These grids will represent the geographical domain of study. For the 2D options modes, only an horizontal grid is necessary, along with the indication of the horizontal and vertical Coordinate Reference System of the grid. For the 2D Waves & currents mode, the grid must be in cartesian coordinates. For the 3D baroclinic mode, the user also needs to upload a vertical grid.

**Step3**: In this step the user must define the forcing sources for the ocean, river and atmospheric boundaries from the available options. Several options are available and the user must check whether the selected sources are available at the grid domain.



**Step 4**: In this step the user selects the stations in which time series are extracted with the model output temporal resolution. These stations can be locations where real-time data are available (predefined comparison stations) or other places of interest (virtual stations).

**Step 5**: For the selected model it is necessary to define all the physical and numerical parameters for the simulation. In this step the user will start from predefined parameter files and can change some of their parameters, if needed.

**Step 6:** In this step the user can define additional parameters of the model, by specifying constant values or uploading files with spatially variable values. For the water quality runs, the user defines here the decay rate for the tracers, the FIB aggregation to sediments (for fecal contamination runs) and the tracers' initial conditions.

**Step 7**: (Optional) Only used for water quality runs: in the first sub-step, the user defines the boundary conditions for the tracers. If sources are also present (user choice), then a second-substep is activated for definition of the sources locations and inputs. For circulation-only runs, step 7 is skipped.

Step 8: Confirms the selected configurations and activates the forecast system.

### Building a forecast system step by step

### Step 1 - Model

In this configuration step, the user selects the run characteristics (2D/3D, with/without waves and with/without water quality), the model version to use in the forecasts, as well as the forecast range (in the present version '48h' is the only available option). The run type circulations options are between: 2D Barotropic, 3D Baroclinic (available only to users with advanced permissions) and 2D waves & currents. The water quality options include a generic tracer and fecal contamination indicators: *E. coli* and enterococcus.





OPE	ENCoastS	Manual 🛓	FAQ 😧 Step 3				💄 aoli	iveira@Inec.pt	*	PT EN
Mo	odel	Domain	Boundaries	s Stations	Hydrodinamic Parameters	cAldditional Da	ita	Water Quality	Sul	omission
Sele	ct Model								I	96
This ( run ty	Configuration /pe, the mode	Assistant aims I to use and th	to set up a forecas e daily forecast rang	t system on dem ge. 3D run types	and in an area o are only availat	chosen by the u ble to users with	iser. In th advance	is step the user ed permissions.	will choo	ose the
elect	run type									
Baroci	linic Simulati	on:								
<ul><li>N</li></ul>	No									
0 1	res (3D)									
Waves	:									
ON	No									
Image: N	/es									
Water	Quality:									
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OF	<sup>=</sup> ecal Contami	nation								
Select	a model (*):	SCHISM-5.	8 ~							
Select	a period (*):	48h ~	]							
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OPENCoastS	Manual 🛓	FAQ 😧			1	aoliveira@Inec.pt	► PT EN
Configu	iration A	ssistant				• New System	🗎 Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
0							
Model	Domain	Boundaries	Stations	Hydrodinami	ofkiditional Data	Water Quality	Submission
woder	Domain	Boundaries	Stations	Parameters	CAUCITIONAL Data	water quality	aubilitssion
Select Model							00
This Configuration	n Assistant aims t	o set up a forecast sys	tem on dema	and in an area	chosen by the user. I	n this step the user w	ill choose the
run type, the mod	el to use and the	daily forecast range. 3	D run types	are only availa	ble to users with adva	inced permissions.	
elect run type							
Baroclinic Simula	tion						
O No							
Yes (3D)							
Waves:							
O Yes							
Water Quality:							
O No							
O Generic Trac	er						
Fecal Contan	nination						
Select a model (*)	SCHISM-5.8	~					
Select a period (*	): 48h ~						
						Co	mplete step 🔶
EOSC-hub							© LNEC/LIP 2018

Figure 12 - Preview of Step 1 - Model: a) 2D with waves; b) 3D with fecal contamination

The OPENCoastS platform uses the circulation model SCHISM (Zhang et al., 2016), that solves the shallow water equations. <u>SCHISM</u> is a community model, based on unstructured grids and fully parallelized, that simulates a vast range of processes in water bodies. <u>SCHISM</u> simulates water levels and velocities due to tides, wind, atmospheric pressure and river flow, in 3D or 2D depth-averaged mode. Presently, only version 5.8 of the <u>SCHISM model</u> is available in this service.

For 3D Baroclinic runs the SCHISM model simulates other variables, such as temperature and salinity, along with the baroclinic processes.

For the 2D waves & currents option, the model WWM (Roland et al., 2012) will be activated within SCHISM. WWM is a spectral wave model that simulates the generation and propagation of short waves.



It is coupled to the SCHISM model in order to provide wave forces that affect circulation, and to receive water levels and velocities.

The water quality modules included in OPENCoastS simulate fecal contamination (Rodrigues et al., 2011), through *E. coli* and enterococcus concentrations, or a generic tracer.

The processes affecting the fecal contamination tracers are the advection-dispersion, the first-order decay of the bacteria due to mortality and the settling of the bacteria attached to the sediments. For the first-order decay of the bacteria due to mortality, the user can specify a constant decay rate or select one of the predefined equations: Canteras et al., 1995, Servais et al., 2007 or Chapra, 1997. The approach used to simulate the settling of the microorganisms is similar to the one proposed by Steets and Holden (2003), which considers that a fraction of the fecal bacteria is attached to the sediments in the water column (e.g. defined based on Bai and Lung, 2005) and settles at a user-specified velocity.

For the generic tracer, the processes affecting its dynamics are the advection-dispersion and the first-order decay, for which the user can specify a constant decay rate.

After filling in the required fields, the user can move to the next step pressing the "complete step" button.

### References and links useful for this step:

- Zhang, Y.J.; Ye F.; Stanev, E.V.; Grashorn, S., 2016 Seamless Cross-scale Modeling with Schism. Ocean Modelling, 102: 64-81.
- Roland, A., Zhang, Y., Wang, H.V., Meng, Y., Teng, Y., Maderich, V., Brovchenko, I., Dutour-Sikiric, M. and Zanke, U. (2012) A fully coupled wave-current model on unstructured grids, Journal of Geophysical Research-Oceans, 117, C00J33, doi:10.1029/2012JC007952.
- Rodrigues, M.; Oliveira, A.; Guerreiro, M.; Fortunato, A.B.; Menaia, J.; David, L.M.; Cravo, A. (2011) Modeling fecal contamination in the Aljezur coastal stream (Portugal). Ocean Dynamics. 61(6), 841-856. doi:10.1016/0043-1354(95)00021-C
- SCHISM URL: <u>http://ccrm.vims.edu/schismweb/</u>
- Canteras JC, Juanes JA, Pérez L, Koev KN (1995) Modelling the coliforms inactivation rates in the Cantabrian Sea (Bay of Biscay) from in situ and laboratory determinations of T90. Wat Sc Tech 32:37–44. doi:10.1016/0273-1223(95)00567-7
- Servais P, Garcia-Armisen T, George I, Billen G (2007) Fecal bacteria in the rivers of the Seine drainage network (France): sources, fate and modelling. Sci Total Environ 375(1–3):152–167. doi:10.1016/j.scitotenv.2006.12.010
- Chapra, S (1997) Surface Water Quality Modeling. McGraw-Hill, New York.
- Steets BM, Holden PA (2003) A mechanistic model of runoff-associated fecal coliform fate and a transport trough a coastal lagoon. Water Res 37:589–608. doi:10.1016/S0043-1354(02)00312-3
- Bai S, Lung WS (2005) Modeling sediment impact on the transport of fecal bacteria. Water Res 39:5232–5240. doi:10.1016/j. watres.2005.10.013



### Step 2 - Domain

In this step the user must upload a simulation grid ("**horizontal grid**") in a format compatible with the model chosen in the previous step. For the SCHISM model the grid should be in the "hgrid.gr3" or "hgrid.ll" format (see <u>SCHISM manual</u>). This format is also used in other coastal models, such as ADCIRC, ELCIRC or SELFE. These grids can be built with grid generators such as XMGREDIT or <u>SMS</u>, among other tools.

Note that although SCHISM allows the use of hybrid grids, composed of triangles and quadrangles, the OPENCoastS service <u>only works with triangular grids</u>. The service also <u>limits the size of uploaded files</u> (10 MB) and the <u>maximum number of nodes in the grid</u> (175 000 nodes), in order to allow access to more users and a sustainable usage of the infrastructure.

For 3D Baroclinic runs the user must also provide a vertical grid file as input. For format, see <u>SCHISM</u> <u>manual</u>.

The user must also indicate the "**Coordinate Reference System**" of the grid, from a list of predefined systems available or in alternative specifying an EPSG code (more info on <u>codes EPSG</u>) and provide the "**Vertical reference**" of the grid to allow a correct comparison with real-time data available at the region of study and a correct specification of boundary conditions. The user can select from the Hydrographic Zero or Cascais height, or establish his own vertical displacement relative to Mean Sea Level. When this reference is unknown, the user can enter the value 0 as reference. Note that in the 2D waves & currents option, a cartesian coordinate system must be selected in this version.





	Manual 🛓	FAQ \varTheta		1	aoliveira@Inec.pt	Y PT EN
Config	uration A	ssistant			O New System	🍽 Save
Step 1	Step 2	Step 3	Step 4 Step 5	Step 6	Step 7	Step 8
<b>—</b>	0					
Model	Domain	Boundaries	Stations Hydrodin Paramete	amicAldditional Data rs	Water Quality	Submission
Upload Grid						00
In this step the u	iser has to provide	the computational grid	for the forecast in the	ormat adequate to the	model chosen in the pr	evious step.
This grid will rep grid.	resent the geogra	phical domain of study.	The user must also ind	cate the horizontal and	vertical coordinate sys	stem of the
In the present ve using an approp	ersion of OPENCoa priate co	astS, in deployments wi	th waves, only grids in (	Cartesian coordinates c	an be used. Please sul	bmit a grid
	In the p only gr	oresent version of ids in Cartesian co	OPENCoastS, in de oordinates can be	ployments with w used. Please subm	aves, it a grid	
Select a horizon	tal grid using a	in appropriate coo	rdinate system.			
Coordinate Refe	erence				er an EF	SG code (*):
Vertical reference	e of the grid: g	or enter a vertical dis	placement in meters	(*)•		
		٢		( ).		
Calculate a sugg	jestion for the tir	mestep (dt): 🔲 It n	nay increase significantly	the processing time.		
Obtain satellite i	mages for the de	efined grid: 🗂 The	satellite images will only	be available at the end of	today.	
+ Previous					Co	mplete step 🔸
Frevious						
- + Previous						
Themody						
Thereads						

Figure 13 - Warning to the user for the need to use a cartesian grid for options with waves.

Optionally, the service also allows the estimation of an adequate "**time step**", based on the analysis of the depth and the grid resolution, i.e., the dimension of its elements. It searches for a maximum Courant number below 100.

Finally, the user also selects whether a comparison with satellite images is active (Figure ??). The water/land interface is identified by processing images from the Sentinel missions Sentinel-2A and Sentinel-2B, with a temporal resolution of five days. Level-2A images were used for the calculation of the NDWI (normalized difference water index), using the green (B3—560 nm) and NIR (B8—842 nm) bands, both with 10 m pixel resolution. The image retrieval is automatic and starts with the last image prior to the first forecast day.



OPENCoastS	Manual 🛓 🛛 FAQ 😧					1 aoliveira@Inec.pt	PT EN
Configu	ration Assist	tant				O New System	💾 Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Model	Domain	Boundaries	Stations	Hydrodinamical Parameters	Additional Data	Water Quality	Submission
Upload Grid							06
In this step the us geographical dom In the present ver system.	er has to provide the com lain of study. The user mu sion of OPENCoastS, in d al grid (*): Browse	putational grid for the foreca st also indicate the horizonta eployments with waves, only eixoes_utm_hgrid.gr3	ast in the forma al and vertical grids in Carte	at adequate to the n coordinate system o esian coordinates ca	nodel chosen in the previc of the grid. In be used. Please submit	us step. This grid will repr	esent the te coordinate
Coordinate Refer	ence System for the gr	d:			or enter an EPSG	code (*):	
Vertical reference	e of the grid: or enter	a vertical displacement in	meters (*):				
Calculate a sugge	stion for the time step	(dt): 📋 It may increase sig	gnificantly the p	processing time.			
Obtain satellite in	nages for the defined g	rid: 🔲 The satellite images	s will only be av	vailable at the end of to	oday.		
← Previous						C	Complete step →
EOSC-hub							© LNEC/LIP 2018



OPENCoastS	Manual 🛓 🛛 FAQ 😧					1 aoliveira@Inec.p	t 💙 🛛 PT EN
Configu	ration Assist	ant				• New System	H Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Model	Domain	Boundaries	Stations	Hydrodinamical Parameters	Additional Data	Water Quality	Submission
Upload Grid							00
in this step the use geographical doma For 3D run types the Select a horizontal Select a vertical g	r nas to provide the comp ain of study. The user mus he user must additionally i I grid (*): Browse gu rid (*): Browse vgrid	utational grid for the forec: it also indicate the horizont load a vertical grid file. Jadiana (1).II I_guadiana in	ast in the forma	at adequate to the r coordinate system	nodei chosen in the previo of the grid.	us step. This grid will rep	resent the
Coordinate Refere	ence System for the grid	d:			or enter an EPSG	code (*):	
Vertical reference	of the grid: or enter a v 0 stion for the time step (	vertical displacement in	n meters (*): gnificantly the p	rocessing time.	4020		
Obtain satellite im	ages for the defined gr	id: 🔲 The satellite image	s will only be ava	ailable at the end of t	oday.		
+ Previous							Complete step 🔶
EOSC-hub					LARDANDR D MAXIMAL DE DELEVINA NA COL	Consume terrainessign trice personales, is services	© LNEC/LIP 201

Figure 13 - a) Preview of Step 2 - Domain for a 2D deployment; b) Preview of Step 2 - Domain for a 3D deployment

The completion of this step validates the uploaded grid and the EPSG choice. If the file is not valid, the user gets an error message. If validation fails to apply a coordinate conversion, the user is prompted to select a different coordinate reference system (EPSG). If the file is valid and the selected EPSG is applicable, the user is redirected to an intermediate step where he/she can confirm visually on the map if the processing of the computational domain and its bathymetry is correct.





Figure 14 - Details on Step 2 validation (1: coordinate conversion prompt message example; 2: incorrect EPSG selection example)

If this is not the case the user must click on the "**Restart step**" button in order to upload a new grid file or choose a different EPSG code.



Figure 15 - Details on Step 2 - restarting / resetting step

If all is in order the user just has to click "Next".





Figure 16 - Details on Step 2 - grid valid and ready for next step

### Step 3 - Boundaries

This step allows users to select the type of forcing to be used at each open boundary of the simulation grid (ocean or river) and over the domain (atmospheric).

Regarding the open boundaries of the model, the present version of OPENCoastS service allows the following options for ocean boundaries:

- 1. Water levels
- FES2014 last (2014) version of the FES (Finite Element Solution) global tide model
- 2. Temperature and salinity
- CMEMs global global 3D circulation model
- CMEMs IBI Iberian shelf 3D circulation
- 3. Short waves:
  - North Atlantic WW3

<u>FES2014</u> is the latest version of the FES (Finite Element Solution) tide model developed in 2014-2016. It is the improved version of the FES2012 model. This new FES2014 model has been developed, implemented and validated by the LEGOS, NOVELTIS and CLS, within a CNES funded project. FES2014



takes advantage of longer altimeter time series and better altimeter standards, improved modeling and data assimilation techniques, a more accurate ocean bathymetry and a refined mesh in most shallow water regions. Special efforts have been dedicated to address the major non-linear tides issue and to the determination of accurate tidal currents. FES2014 is based on the resolution of the tidal barotropic equations (T-UGO model) in a spectral configuration. A new global finite element grid (~2.9 million nodes, 50% more than FES2012) is used and model physic has been improved, leading to a nearly twice more accurate 'free' solution (independent of in situ and remote-sensing data) than the previous FES2012 version. Then the accuracy of this 'free' solution was improved by assimilating long-term altimetry data (Topex/ Poseidon, Jason-1, Jason-2, TPN-J1N, and ERS-1, ERS-2, ENVISAT) and tidal gauges through an improved represented assimilation method. Details are presented in Carrere et al (2016). Note that if FES2014 is selected, and atmospheric forcings are imposed, then an inverse barometer effect is imposed at the ocean boundaries, superimposed on the tidal elevation signal. In addition, if FES2014 is imposing both elevations and (tidal) depth-averaged velocities are imposed at the ocean boundary. Imposing both elevations and velocities leads to more robust solutions than imposing elevations alone, as is done when the model is forced with CMEMS forecasts.

The Copernicus Marine Service (CMEMS) provides observation-based and forecast-based information about the state of the and regional seas. Two products from CMEMS are available in OpenCoastS: i) the global ocean analysis and forecast (GLOBAL ANALYSIS FORECAST PHY 001 024; system https://resources.marine.copernicus.eu/?option=com csw&task=results?option=com csw&view=detail s&product\_id=GLOBAL\_ANALYSIS\_FORECAST\_PHY\_001\_024) and ii) the IBI (Iberian Biscay Irish) ocean analysis and forecasting system (IBI\_ANALYSIS\_FORECAST\_PHYS\_005\_001; https://resources.marine.copernicus.eu/?option=com csw&task=results?option=com csw&view=detail s&product id=GLOBAL ANALYSIS FORECAST PHY 001 024).

The Operational Mercator global ocean analysis and forecast system provides 10 days forecasts of 3D global hydrodynamic conditions and is updated daily. The global ocean information is available with a 1/12<sup>o</sup> horizontal resolution with regular longitude/latitude equirectangular projection. Regarding the vertical grid, 50 vertical levels ranging from 0 to 5500 meters are available. This product includes, among others, daily mean fields of temperature and salinity and hourly mean surface fields for sea level height, which are used in the OPENCoastS service. Further information about the product is available in Chune et al. (2019) - https://resources.marine.copernicus.eu/documents/PUM/CMEMS-GLO-PUM-001-024.pdf



- and Lellouche et al. (2019) - https://resources.marine.copernicus.eu/documents/QUID/CMEMS-GLO-QUID-001-024.pdf.

The operational IBI (Iberian Biscay Irish) ocean analysis and forecasting system is a regional application that provides 5-day hydrodynamic forecasts and is updated daily. The system is based on an application of the NEMO model using a horizontal grid with 1/36<sup>o</sup> resolution. Regarding the vertical grid, 50 vertical levels ranging from 0 to 5500 meters are available. This product includes 6 different datasets, among which 3D daily mean fields of temperature, salinity and hourly mean sea surface height, which are used in the OPENCoastS service. Further information about the product is available in Amo et al. (2019) - https://resources.marine.copernicus.eu/documents/PUM/CMEMS-IBI-PUM-005-001.pdf - and Sotillo et al. (2019) - https://resources.marine.copernicus.eu/documents/QUID/CMEMS-IBI-QUID-005-001.pdf.

Wave boundary conditions are provided within OPENCoastS+ for the North Atlantic Ocean through daily forecasts made with the model WaveWatchIII, version 5.16. The simulation domain of WaveWatchIII covers the North Atlantic from the equator to latitude 70° N and is discretized with an unstructured grid with higher resolution along the European coast. The wave spectra are discretized using 24 directions and 24 frequencies. The model is forced by wind forecasts from NCEP. Further details on this application are provided in Oliveira et al. (2021).





In this step the user has to define the forcing sources for the ocean, river and atmospheric boundaries, from the available options.  Sector or o	Define Boundary Conditions	0
Select one or more boundaries and define their type and forcing condition          Image: Definition of the selection of	In this step the user has to define the forcing sources for	r the ocean, river and atmospheric boundaries, from the available options.
D       Type       Forcing         @ open.2       Ceffice type and forcing condition       Ligend         Image: Second S	Select one or more boundaries and define their type ar	In forcing condition
Forcings for Circulation to apply to all oceans boundaries:   Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans boundaries:  Forcings for Temperature and Salinity to apply to all oceans for Temperature and Salinity to apply to all oceans for Temperature and Salinity to apply to all oceans for Temperature and Salinity to apply to al	ID     Type     Forcing       open-1     open-2   Define type and forcing condition	Leffet   Tiles @ Esri — Source: Esri, DeLorme, NAVTEO, USGS, Internap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong). Esri (Thailand), TomTom, 2012
Forcings for Temperature and Salinity to apply to all oceans boundaries:	Forcings for Circulation to apply to all oceans bounda	ries:
Boundary conditions: ' open-1' × Select the type of boundary: <ul> <li>Ocean</li> </ul>	Forcings for Temperature and Salinity to apply to all o	ceans boundaries:
Boundary conditions: ' open-1' × Select the type of boundary: <ul> <li>Ocean</li> </ul>		~
Ocean	Boundary condition Select the type of bound	ary:
	Ocean	I

### Figure 17 - Preview of Step 3 – Boundaries and detail of the Popup form

Close

Define

To specify the required boundary conditions, the user must select each boundary by ticking its corresponding checkbox in the table (on the left) and then click on the "Define type and forcing



Il oceans boundaries:

ty to apply to all oceans boundaries:

## OPENCOastS Coastal dynamics on-demand forecast User Manual

**condition**" button. This will open a popup form where the user must choose between an ocean and a river boundary. If several boundaries are selected at the same time, then the specified values will be applied equally to all of them.

For the ocean boundaries the users must still <u>select a forcing source to apply to all ocean boundaries</u>. The several options are available in a pull-down below, for water levels and for salinity and temperature in the 3D version.

Define type and forcing condition	Porto Porto Afeiro Aveiro Aveiro Viesu Viesu Quarda Straro
	Leaflet   Tiles © Esri — Source: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012
Forcings for Circulation to apply to all oceans boundaries:	
FES2014 - Finite Element Solution	
North Atlantic WW3	~
Atmosphere Forcing:	
Météo-France   ARPEGE Europe-Atlantique	~
← Previous Restart step	Save changes Next →

#### Figure 18 – Selection of the source of ocean boundary conditions

For the river boundaries the users must define manually, from the popup form (Figure 19), the monthly average river flow in m<sup>3</sup>/s (climatology) of each river boundary or a fixed value for the whole simulation. The same applies to temperature and salinity for the 3D runs. Positive river flows values are considered as incoming water fluxes and negative values as outgoing water fluxes.

For the river boundaries where flow predictions are available, the user can upload a permanent link where the prediction of river flow can be obtained by OPENCoastS. The format is an ASCII format, following the indication in page 65 of SCHISM's manual: <u>http://ccrm.vims.edu/schismweb/SCHISM\_v5.3.1-Manual.pdf</u> (4.3.1 Optional inputs: .tc (ASCII)). Another alternative is to set the river flow as a percentage of another river flow boundary.



Boundary conditions: ' open-2'	×
Select the type of boundary: O Ocean River	
V Note: positive values mean incoming water fluxes; negative values mean outgoing water fluxes O Source of flow forecasts:	•
/= UL http://	11
Url for flow forecast data collection (accepts dynamic urls) ○ Percentage: 96 of:	
Attention: the selected boundary will also have to be defined as river Close Defin	ne

Figure 19 - Detail of the Popup Form to define river boundaries forcing conditions for URL or percentage options.

The user must finally <u>select source of the atmospheric forcing</u> for the forecast system (or select not to use atmospheric forcings). Several options are available:

- GFS from NOAA at ?? resolution
- ARPEGE from MeteoFrance at ?? resolution

-

Currently, the NOAA and Arpege atmospheric forecasts are available for the 2D deployments but for 3D forecasts, only NOAA's outputs can be used, as it is the only provider that has all necessary input variables for the 3D run. Also, the Arpege forecasts only cover the European coasts.





in this step	une user na	s to define the	Ioreni	y sources for t	ne oc	ean, nver and a	atinos	phene boundar	les nom t	ne avanable	options.
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ID	Туре									64	COLUMN TRANS
🔲 open-1	Ocean	Select the ty	/pe o	f boundary:	0 00	cean 🧿 Riv	ver				INTO
	00000000000	Monthly val	ues:							Ser.	Lenend
		Jan (m3/s)		Feb (m3/s)		Mar (m3/s)		Apr (m3/s)		12	Area
✓ open-2	River	May (m3/s)		Jun (m3/s)	(A) V	Jul (m3/s)		Aug (m3/s)			Boundary
		Sep (m3/s)	4	Oct (m3/s)	*	Nov (m3/s)		Dec (m3/s)		and the second s	- Open
🔽 open-3	River	Note: positive v	alues	mean incoming w	ater flu	xes; negative val	ues me	ean outgoing <mark>w</mark> ate	r fluxes		
								Clos	e Def	fine	all.
🔽 open-4	River	May: 28.7, J Jul: 28.7, Au	un: 28 g. 28.	1.7, 7, <del>*</del>			1	Xn	1X	-351	17
Define type	and forcing c	ondition		Le	estlet   1 ETI, Est	liles © Esri — Sou i China (Hong Ko	rce: Es ng), Es	ri, DeLorme, NAV ri (Thailand), Tom	'EQ, USGS, Tom, 2012	Intermap, iPC	NRCAN, Esri Japai

Figure 19 - Detail of the Popup Form to define river boundaries forcing conditions











Conf	figurat	ion Ass	istant 10:54:47			• New System	H Save
Step 1		Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
-			<b></b> _	<b>—</b>	<b>—</b> —	<b>—</b>	- 0
Model		Domain	Boundaries	Stations	Parameters	Additional Data	Submission
Define Bou	Indary Cond	litions					00
In this step t	he user has	to define the for	cing sources for the ocean, river a	nd atmospheric boundaries, f	rom the available options.		
Select one or	r more bou	ndaries and de	fine their type and forcing con	dition			
ID	Туре	Forcing		Davis Strait		A Gurger	Info
open-1	Ocean	Waves: Nort Circulation: I Solution	h Atlantic WW3 FES2014 - Finite Element			NORWAY	Legend
open-2	Ocean	Waves: Nort Circulation: I Solution	h Atlantic WW3 FES2014 - Finite Element				a ov na-ww3 cmems-ibi
open-3	Ocean	Waves: Nort Circulation: I Solution	h Atlantic WW3 FES2014 - Finite Element	24		Palis arp	meteofr- ege_ea prism2017
Define type a	and forcing c	ondition	o Vew	York	1 1 5	Madrid FALY Bo	undary Open stanbul
						a the	B
			5	Atlantio Ocean		ALGERIA LIBYA	Cairo
			Lea	flet   Tiles © Esri — Source: Esri, ng Kong), Esri (Thailand), TomTom	DeLorme, NAVTEQ, USGS, Inter	map, iPC, NRCAN, Esri Japan, M	ETI, Esri China
Forcings for	Circulation	to apply to all	oceans boundaries:	······		MALL MGER	autorial Artis
FES2014 - F	inite Element	Solution					~
Forcings for	Waves to a	upply to all oce	ans boundaries:				
North Atlanti	ic WW3						~
Ocean bounds	aries outside f	the forcing area	vill not be considered.				
Atmospheri	c forcing:						
GFS - Globa	I Forecast Sy	ystem NOAA/NC	EP				$\sim$
+ Previous	Resta	rt step				Save chang	es Next →

Figure 20 - Preview of Step 3 – Boundaries, all filled out for a) a 2D run and b) a 2D W&C runs.

References and links useful for this step:

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### Step 4 - Stations

This step allows establishing locations where to extract model time series with the model output resolution, for automatic comparison of predictions with real-time stations, or to get time series at user-selected locations (virtual sensors). The system automatically identifies the available real-time stations available in the computational domain of the grid (observation stations from those available at EMODnet) and proposes them in a table (limited to 5 stations). This step is optional and if the user does not want these predefined outputs he/she only has to complete the step without interaction.





Configu	ration	Assist	ant			• New System	H Save
Step 1	Step 2		Step 3	Step 4	Step 5	Step 6	Step 7
Model	Domain		Boundaries	Stations	Parameters	Additional Data	Submission
Define Stations							00
In this step the use available, (predefin Select/Deselect des	r selects the s ned comparison	tations (virtual n stations) or o <b>s. You can ad</b>	sensors) in which tir ther places of intere in new ones by sel	ne series are extracted with full ist (virtual stations).	model resolution. These can	be locations where real time	data is
Name	Latitude	Longitude	Comparison		· · · · · · · · · · · · · · · · · · ·	ennes	Info
LaRochelleTG	46.15067	-1.23318	LaRochelleTG (46.15067, -1.23318)	-	ل المتر ال	lantes	Legend
PortBlocTG	45.57033	-1.06878	PortBlocTG (45.57033, -1.06878)	a *		FRA	Area
SocoaTG	43.40009	-1.68010	SocoaTG (43.40009, -1.68010)	•	Bay of B scay	B ordeaux	Open     Land     Island Station     Observation     Comparison     Virtual
				Leaflet   Tiles © Esri — Source: Esri, I (Thailand), TomTom, 2012	viedo Bha Vitoria Gastas DeLorme, NAVTEQ, USGS, Intermap, PU	C, NRCAN, Esri Japan, METI, Esri Chin	e na (Hong Kong), Esri
← Previous R	estart step						Complete step →

### Figure 21 - Preview of Step 4 - Stations

The user can add new stations by clicking the button "**New Station**" or by clicking directly on the map. These actions will open a popup form with the difference being that the station's coordinates are already pre-filled if the user clicks on the map. Note that the new station's position must be placed inside the domain (grid) area. From the form, the user must choose between "Comparison" and "Virtual" type of station and fill out the mandatory fields.

The <u>Comparison Station</u> will use data from observation stations as a reference of comparison with the new station's values. The chosen observation station may be located outside of the domain. If the distance between points is above a recommended threshold (100 meters) the user will be notified in the form. However, it can still be created; this notification is only a warning.

If the location of the comparison station does not match the exact location of the observation station, a line will be created linking both visually.

The <u>Virtual Station</u> requires the user only to fill in a name describing the station. In this case no comparison is made to the extracted time series data at the specified location.



		or	New Station	sorios aro ovtro	isted with full model secolution. These can be le	×	
		ac de	Latitude (*): 43.4788	317 🖨 Long	jitude (*): -3.77758 💮		
		5	Name (*):			6.2	
			Santander				
		8	Select the type of s	tation:    C	Comparison O Virtual		
			Compare with static	on (latitude, lo	ngitude) (*):		
		2	SantanderTG (43.46	256, -3.79829)		~ mo	
			Note: this station is loc	ated at 2462m. F	Recommended maximum distance is 100m.		
					Order by dis	tance	
					Close Ad	ibai al-ħ	
		1)			1 1 1 1 1	Entrami	
Name	Latitude	Longitude	Comparison				
Hume	Lutitude	Longhade	LaRochelleTG	+			Info
LaRochelleTG	46.15067	-1.23318	(46.15067,	-			
			-1.23318)	0			Legend
_			PortBlocTG	Q			Area
PortBlocTG	45.57033	-1.06878	(45.57033,	*			C _ Global
			SocoaTG				— Open
✓ SocoaTG	43.40009	-1.68010	(43.40009,			north Santona $^{\times}$	- Land
			-1.68010)				- Island
			SantanderTG			Remove	Station Observation
Santander	43.493746	-3.77037	(43.46256,	and the second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	•	O Comparison
	40 400700	0.440560	-3.79629)	-	Santandor	Samoña	Virtual
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				(Thailand), T	FomTom, 2012	ternap, a o, moran, can Japan, m	
Define	Ctations						
Define	Stations						0 0

In this step the user defines the stations (virtual sensors) in which time series are extracted with full model resolution. These can be locations where real time data is available, (predefined comparison stations) or other places of interest (virtual stations).

Select/Deselect desired stations. You can add new stations by selecting a location on the map or using the button New Station. Note: If the list is empty at startup this means that there are no observation stations located within the grid domain.



3)

2)





## Figure 22 - Details of Step 4 (1: the New Station Popup Form; 2: after adding new comparison and virtual stations, 3 - wave and current simulation)

The user can remove added stations permanently by clicking on them on the map and on the button "**Remove**" or just deselect them, in this case they remain in the table and can be selected at any time whilst the forecast system is still in the configuration stage.

### Step 5 - Parameters

In this step the user can choose to use the predefined parameters proposed by the OPENCoastS+ service used in model SCHISM or configure the parameters available for edition. In this current version only a few parameters are available for edition, e.g., the time step (dt) or the model ramp period (dramp). For the 3D baroclinic option, more parameters can be specified by the user.

Based on the parameters defined here, the SCHISM parameter file (param.nml) is automatically created for use in the SCHISM model (for more information see SCHISM's user manual - http://ccrm.vims.edu/schismweb/SCHISM\_v5.8-Manual.pdf). Future versions of the service will allow the user to upload directly a param.nml file, fully edited and created by the user.

Config	uration Ass	istant ma			O New System	H Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Save completed steps
-	_			. 0		
Model	Domain	Boundaries	Stations	Parameters	Additional Data	Submission
Define input pa	rameters					00
For the selected parameters.	model it is necessary to	define all parameters for the s	imulation. In this step the	user will start from a predefi	ned parameter file and can	alter some of its
slect one of the	options: O Predetine	ed parameters	igurations:			
Run time and ran	np	51				
amp-up option (I	nramp): 🍥 on 🖱	off				
amp-up period [	day] (dramp): 1					
ime step [sec] (d	t): 100 🚖					
The second se	-					and country of second second





elect	one of the options: <ul> <li>Predefined particular</li> </ul>	rameters 💿 Customize parameters	
5 🕶	records		Search
Paran	neter	Description	Value
Node	l configuration parameters		
CS		Coordinate option	2   Ion/lat
ncor		Coriolis	1
pre		Pre-processor flag	0
hot		Hotstart option	0   cold start
nydra	ulics	Hydraulic model option	0
oint	sources/sinks		
f_sou	rce	Point sources/sinks option	0
ramp	_\$\$	Ramp-up flag for source/sinks	1
Iramp	_ss	Ramp-up period for source/sinks [day]	2
upwin	d_mom	Method for momentum advection	0   ELM
ndvel		Method for computing velocity at nodes	0   conformal linear shape function
Stabil	ization methods		
horco	n	Horizontal viscosity option	0   no viscosity
vis_c	oef0	Const. diffusion	0.025
shapi	0	Shapiro filter flag	1
shapir	o	Shapiro filter strength	0.5
		Horizontal diffusivity option	0





Define input parameters	00
For the selected model it is necessary to define all parameters for the simulation. In this step the user will start from a predefined parameter file and can customize a parameters.	some of its
Select one of the options:	
Predefined parameters	
O Customize parameters	
10 V lines Search	IT
Coordinate option: 1: Cartesian; 2: Ion/lat (hgrid.gr3=hgrid.ll in this case, and orientation of element is outward of earth)	
ics = 1 Coordinate option	
Pre-processing option. Useful for checking grid violations.	
ipre = 0 Pre-processor flag (1: on; 0: off)	
Equation of State type used ieos_type=0: UNICEF (nonlinear); =1: linear function of T ONLY, i.e. Vrho=eos_b+eos_a*T, where eos_a<=0 in kg/m^3/C	
ieos_type = 0	
ieos_pres = 0 used only if ieos_type=0. 0: without pressure effects	
If WWM is used, set coupling/decoupling flag. Not used if USE_WWM is distabled in Makefile 0: decoupled so 2 models will run independently; 1: full coupled (elevation, vel, and wind are all passed to WWM); 2: elevation and currents in wwm, no wave force in selfe; 3: no elevation and no currents in wwm, wave force in selfe; 4: elevation but no currents in wwm, wave force in selfe; 5: elevation but no currents in wwm, no wave force in selfe; 6: no elevation but currents in wwm, no wave force in selfe; 7: no elevation but currents in wwm, no wave force in selfe; Note that all these parameters must be present in this file (even though not used).	
icou_elfe_wwm = 0	
nstep_wwm = 1 call WWM every this many time steps. If /=1, consider using quasi-steady mode in WWM	
iwbl = 0 1: modified Grant-Madsen formulation for wave boundary layer, used only if icou_elfe_wwm/=0; if icou_elfe_wwm=0, set iwbl=0	
msc2 = 24 same as MSC in .nml for consitency check between SCHISM and WWM-II	
mdc2 = 30 same as MDC in .nml	
hmin_radstress = 1.       min. total water depth used only in radiation stress calculation [m]         <<	
← Previous Restart step	Complete step 🔶





Define input parameters	00
For the selected model it is necessary to define all parameters for the simulation. In this parameters. For Wave and currents runs is is also necessary to define the parameters	step the user will start from a predefined parameter file and can customize some of its for the 'wwminput.nml' file.
Circulation (param.in)	Waves (wwminput.nml)
Select one of the options: O Predefined parameters O Customize parameters	
This option allows to alter/customize the following predefined configurations:	
Run time and ramp	
Ramp option flag (nramp): <ul> <li>on</li> </ul>	
○ off	
Ramp-up period [day] (dramp):	
Time step [sec] (dt): 100	
WWM	
Steps to call WWM (nstep_wwm): 3 🔷 Will match 'wwm_input.nml':Pf	ROC_DELTC / 'param.in':dt (must be integer)
← Previous Restart step	Save changes Next →

### Figure 23 - Preview of details on Step 5 – a) Parameters for a 2D run; b) Parameters for a 3D run; c) Parameters for 2D Waves & Currents

When waves are switched on, SCHISM is run coupled to its wave module WWM, which requires an additional parameter input file (wwminput.nml). An additional tab entitled "Waves (wwminput.nml)" is provided (Figure 23c) to help the user specify additional parameters. Again, most parameters are fixed, and the user can only specify a few (e.g., the time step for WWM and the wave breaking coefficient). OPENCoastS+ provides default values that are usually adequate.

### Step 6 - Additional Data

This step allows the user to define the additional parameters not defined in param.nml.

### 2D deployments

In the current version, only the Manning coefficient is available for the 2D deployments (with or without waves). This coefficient is used by the SCHISM model in 2D mode to determine bottom friction based on local characteristics. The user can specify a constant value or, in alternative, upload a file with the spatial variation of this value (grid format - .gr3). The Manning coefficient is defined in  $m^{1/3}/s$ .





### **3D deployments**

For the 3D deployments several parameters need to be defined, within predefined ranges.





Config	uration Assi	istant 📠			O New System	H Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Model	Domain	Boundaries	Stations	Parameters	Additional Data	Submission
Additional info	)					00
In this step the	user can select some add	litional parameters of the mod	el, by specifying values or	uploading a file for spatial va	riability of the values.	
elect one of the	e options: <ul> <li>Customiz</li> </ul>	ze value 🛛 🔿 Upload file				
	0.025					
efine a Constan	II. 0.025					
efine a Constan	Restart step					Complete step 🔶





Additional info
In this step the user can select some additional parameters of the model, by specifying values or uploading a file for spatial variability of the values.
Drag coefficient
Select one of the options:
Customize value
O Upload file
Constant: 0.002
Albedo
Select one of the options:
Customize value
O Upload file
Constant: [0.0-1.0]
Water type - integer between 1 and 7
Select one of the options:
Customize value
O Upload file
Constant: 7
Temperature [°C] - Initial conditions
Select one of the options:
Customize value
O Upload file
Constant: [0.0-40.0]
Salinity [PSU] - Initial conditions
Select one of the options:
Customize value
O Upload file



Minimum diffusivity (Not available)	
Select one of the options:	
Customize value	
O Upload file	
Constant: 1e-06	
Maximum diffusivity (Not available)	
Select one of the options:	
Customize value	
O Upload file	
Constant: 0.01	
← Previous Restart step	

Figure 24 - Preview of Step 6 - Additional Data a) 2D run; b) 3D run

### Water quality

In addition to the previous parameters for 3D deployments, several others need to be defined for water quality simulations:

- For fecal contamination the decay formulation (see description about the available options in Step 1), the fraction of fecal indicator bacteria (FIB) aggregated to the sediments [between 0 and 1], the sedimentation rate of the FIB aggregated to sediments [m/s] and the initial conditions for Escherichia coli and enterococcus [UFC/100ml or MPN/100ml] - Figure 25.
- For a generic tracer the decay rate [day<sup>-1</sup>] and the initial conditions for the tracer [concentration in units defined by the user, -/m<sup>3</sup>].

Decay formula [-]	1	
Select one of the	options:	Chapra et al. 2004 🗸
E-coli constant:		 Constant [/day] Canteras et al. 1995
Enterococcus co	nstant:	Servais et al. 2007 Chapra et al. 2004

#### Figure 25 - Preview of Step 6 - Additional Data for water quality simulations



### Step 7 – Water quality (optional)

This step is only active for water quality simulations. This step allows users to select the type of forcing for water quality tracers to be used at each open boundary of the simulation grid and also to include additional sources.

For the open boundaries the users must define manually, from the popup form (Figure 26), the type of forcing for each boundary. The following are available:

- constant concentration for the whole simulation; •
- monthly average water quality tracer's concentration; •
- the user can upload a permanent link where the prediction of water quality tracers' • concentration can be obtained by OPENCoastS. The format is an ASCII format, following the indication in SCHISM's v5.8 manual: http://ccrm.vims.edu/schismweb/SCHISM\_v5.8-Manual.pdf (4.3.2 .th (ASCII), pp. 78).

The units are in UFC/100 ml or MPN/100 ml for Escherichia coli and enterococcus, and defined by the user [-/m<sup>3</sup>] for a generic tracer

✓ open-1 Ocean		Info 
Define water quality conditions	Conditions for Water Quality: ' open-1'	Caption
	Select water quality conditions for boundaries:	cmems-ibi
	E-coli Enterococcus	Boundary Open
	Average annual contamination by E-coli: [UFC/100ml]	
	Average monthly contamination by E-coli:	
	Jan [UFC/10C Feb [UFC/10L Mar [UFC/10L Apr [UFC/10C May [UFC/10	
	Jun [UFC/100] Jul [UFC/100] Aug [UFC/101] Sep [UFC/101] Oct [UFC/100]	
	Nov [UFC/10] Dc [UFC/100]	
	Note: positive values mean incoming water fluxes; negative values mean outgoing water fluxes	Esri China (Hong Kong)
	Source of water quality variables forecasts:	
Source type for water quality cond	dition: http://	
	Url for flow forecast data collection (accepts dynamic urls)	
	Close Define	
+ Previous Restart step		Complete step ->

Figure 26 - Detail of the Popup Form to define water quality forcing conditions at the boundaries



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In this step the users can also define additional point sources using the field "Source type for water quality conditions" (Figure 27). The users can add new sources by defining the new source in the map or through coordinates. Note that the new point source's position must be placed inside the domain (grid) area.

The users can add new sources by clicking the button "**New Source**" or by clicking directly on the map. These actions will open a popup form with the difference being that the point source's coordinates are already pre-filled if the user clicks on the map. In this popup the user must provide information about the flow, water temperature, salinity and water quality tracers' concentration for that source (Figure 28). The options available are similar to those described above to define water quality at the open boundaries and for river boundaries (Step 3).



Figure 27 - Detail of the options available to define point sources for water quality simulations





Name	Latitude	Longitude F	Latitude (*):	Info
lew Source			Name (*):	
				Ayamon Caption
			Select water quality conditions for sources:	Boundary Open
			Flow Temperature Salinity E-coli Enterococcus	- Land
			Average annual flow: [m3/s]	Source
			Average monthly flow:	1
			Jan [m3/s] Feb [m3/s] Mar [m3/s] Apr [m3/s] May [m3/s]	
			Jun [m3/s] Jul [m3/s] Aug [m3/s] Sep [m3/s] Oct [m3/s]	
			Nov [m3/s] Dc [m3/s]	
			Note: positive values mean incoming water fluxes; negative values mean outgoing water fluxes	
			<ul> <li>Source of water quality variables forecasts:</li> </ul>	anan METL Esri China (Hong Kong)
			http://	apan, wie n, ean onna (nong tong),
	Restart ster		Url for flow forecast data collection (accepts dynamic urls)	

Figure 28 - Detail of the Popup Form to define the forcing conditions at the point sources

### Step 8 – Submission

In this step the user can review a summary of all configured steps as well as submit / activate the forecast system. The activation of the system will launch the forecast system in the computational infrastructures available. Currently, the simulations will be carried out using the INCD – Portugal's National Infrastructure for Distributed Computing and IFCA (Spain) facilities.



Config	uration Ass	istant 🔤			O New System	H Save
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Save completed steps
						- 0
Model	Domain	Boundaries	Stations	Parameters	Additional Data	Submission
Submit Forecas	st System					00
Confirm the selec	cted configurations and a	activate the forecast system.				
Summary				Submit		
1 Model				Name (*):		
2 Domain				manual test using a sample grid		
Boundar	ries			Description:		
Stations						
5 Paramet	ters			I Accept Terms a	nd conditions of use	
6 Addition	al Data				() Acti	vate System

Figure 25 - Preview of Step 7 - Submission

By selecting a Step on the left panel, a summary of that step unfolds revealing the user's selections along the configuration stage. Some steps provide additional functions, e.g. the Domain and Parameters steps allow users to download the domain grid and the param.nml files, respectively.

<u>Note</u>: if the uploaded horizontal grid on Step 2 contained projected coordinates, the user can download the original uploaded file (.gr3) and also the grid file converted to geographic coordinates WGS84 (.II).

Users can save the configured forecast system (press the "**Save**" button on the top right screen) and submit later on at any time.

To submit and launch the forecast system, the user must first accept the Terms and Conditions of Use, provide a "<u>Name</u>" for the system (if not done previously) and optionally add a brief "<u>Description</u>" to it and finally press the "**Activate System**" button.



1 Model			Name (*):		
2 Domain			Description	n:	
Vert. File EPSG Ref.	Elements	Node s Boundaries	_		
66_hg nd gr3 20790 0.000	m 20448	1112 Open: 1; Land; 3; Island; 0		t Terms and conditions of	O Activate System
(Hong Kong), Esri (Thailand), To	: Esri, DeLorme, NAVTEQ, I omTom, 2012	USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri Chin	Bar		
(Hong Kong), Esri (Thailand), Tr Open .gr3	: Esri, DeLorme, NAVTEQ, omTom, 2012 ownload .gr3	USOS, Internep, PC, NRCAN, Esri Japan, METI, Esri Chin Download .II	Sur La a		
(riorg Kong), Esri (Thaliand), Th	: Earl, DeLorme, NAVTEQ, l omTorn, 2012 ownload .gr3 Submit Name (	USOS, kternep, PC, NRCAN, Earl Japan, METI, Earl Chin Download .II			
(Heng Kong), Earl (Thalland), Tr Open. gr3 © D	Earl Decome, NAVED, wintern, 2012 Submitt Name ( my grid	USOS, Internep, PC, NRCAN, Earl Japan, METI, Earl Chin Download .II			
(Hong Kong), Earl (Thailand), Th Open gr3 0 Du	Earl Detarme, INATEO, emfan, 2012 Submit Name ( My grid Descrij	USOS, Interneo, PC, NRCAN, Earl Japan, METI, Earl Chin Download .II  *): ption:			
(Hong Kong), Esri (Thaliand), Tr Open.gr3 ① D	Earl Decome, INATEO, ownload.gr3 Submit Name ( Manual Manual	usos, kternep, PC, NRCAN, Earl Japan, METI, Earl Chin Download .II *): ption: I test using a sample grid			
(Hong Kong), Esri (Thaliand), Tr Open. gr3 ④ Dr	Earl, Decome, IKAYTEO, emfern, 2012 Submit Name ( My grid Descrip Manual V I Ac	<pre>usos, internee, PC, NRCAN, Earl Japan, METI, Earl Chin Download .II *): ption: I test using a sample grid cept Terms and conditions of</pre>	USe		

This action will redirect the user to the "**Forecast Systems**" page where the system in question will switch from the "<u>Configured</u>" to the "<u>Active</u>" status. An active forecast system can also be referred to as a deployment. The first simulations will start on the following day.



Forecasts man	agement				0
IFID IM	odel	\$ Name	\$ Dates	1 State	
66 SCH	SM, v5.4.0 (48h)	manual test using a sample grid	Created at 08/08/2018 6:15 p.m. Start 09/08/2018 End 10/09/2018	Active	
Created by aol my test	iveira@Inec.pt				
65 SCH	SM, v5.4.0 (48h)	arade_quads	Created at 07/08/2018 3:55 p.m. Start 07/08/2018 End 08/09/2018 Last run 09/08/2018	Deactivated	0 X 8 X 1
Created by afo	rtunato@Inec.pt s with mix tri- quads grid				
64:56 SCH	SM, v5.4.0 (48h) F	orecast System ID:66 activated succe esults will be generated, you can cons	ssfully. As of tomorrow the first ult them by accessing the	Deactivated	
Created by aol	iveira@Inec.pt	Support of the menu.			

Figure 27 - Details on Step 7 - Submission; after activating a forecast system

## **Forecast Systems**

### Monitoring my forecasts

The Forecast Systems page allows users to monitor and manage their forecast systems. It provides an overview of their state and helps to anticipate the need for time extensions and to remove unwanted systems or deployments (submitted systems) that are not well configured or already expired.

OPENC	CoastS		1	afortunato@Inec.pt 🗸 🛛 🏱
Fo	recast Systems		🗮 Extensio	n requests O New System
orecas	sts management			•
l₹ ID	1 Model	1 Name	1 Dates	1 State
65	SCHISM, v5.4.0 (48h)	arade_quads	<b>Created at</b> 07/08/2018 3:55 p.m. <b>Start</b> 07/08/2018 <b>End</b> 08/09/2018 <b>Last run</b> 09/08/2018	Deactivated
est op	encoasts with mix tri- quads grid			
61	SCHISM, v5.4.0 (48h)	Tejo-APL07	<b>Created at</b> 31/07/2018 3:09 p.m. <b>Start</b> 31/07/2018 <b>End</b> 01/09/2018 <b>Last run</b> 09/08/2018	Active
60	SCHISM, v5.4.0 (48h)	Arade	<b>Created at</b> 31/07/2018 3:03 p.m. <b>Start</b> 31/07/2018 <b>End</b> 01/09/2018 <b>Last run</b> 09/08/2018	Active
Arade e	estuary			
20	SCHISM, v5.4.0 (48h)	Leixões-PRISM	<b>Created at</b> 06/04/2018 4:26 p.m. <b>Start</b> 06/04/2018 <b>End</b> 06/07/2018 <b>Last run</b> 06/07/2018	Expired X

Figure 28 - Preview of the Forecast Systems page





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Each user will only be able to see their own deployments. Only people assigned with "Administrator" permission are allowed to see other deployments.

### Managing forecast systems

### **Configuration mode**

Once a forecast system is created and saved, the user can logout and continue the configuration later on. The "<u>Open System</u>" tool allows the user to continue this task at his own pace. Until the system is launched, the configuration is open for changes.



#### Figure 29 - Opening a system on the Configuration Assistant

After clicking on this tool, the Configuration Assistant opens, loads the selected system and allows the user to continue to set up the selected system under configuration.

### Deleting a forecast system

If a forecast system is not necessary any longer, the user can eliminate it (saving resources and allowing for the setup of a new system if their system's quota has been reached).

By clicking on the "<u>Delete System</u>" tool the system is erased. Note that access to results will be lost and this forecast cannot be recovered. Also, the delete tool is not available for deployments in the "Active" state. Deployments must be deactivated before they can be deleted.

As for other actions, an acknowledgement of the deletion is provided.

26	SCHISM, v5.4.0 (48h)	teste La Rochelle	Created at 02/05/2018 2:54 p.m. Start 02/05/2018 End 03/06/2018	Expired	▼ ★ ↓
Created	by aoliveira@Inec.pt				
Teste e	nviado pela Laura em 2/5/2018				





31	SCHISM, v5.4.0 (48h)	La Rochelle	Start 04/05/2018	Active	
Created	<b>d by</b> jrogeiro@inec.pt	Delete System	×		
	nviado pela Laura em 2/5/201	If you delete the system you will not be able to reco	ver it.		
26	SCHISM, v5.4.0 (48h)	Do you want to continue with this action?		Expired	24 1 1
Created	d by aoliveira@inec.pt				
	nviado pela Laura em 2/5/201		No Yes		
25	SCHISM v5.4.0 (48b)	obidos estudo ds	Start 27/04/2018	Active	

Figure 30 – Details on deleting a system

### Print preview

By pressing the "<u>Print Configuration</u>" tool the user opens a report of the forecast system's configuration summary on a new page for printing purposes. This option is available as soon as the system is configured.

62:57 SCHISM, v5.4.0 (48h)	aveiro do forecast atual - FES2014	Created at 02/08/2018 5:06 p.m.	Configured	¢ 🗙 🖨
Created by aoliveira@Inec.pt				
igual ao aveiro original mas agora com fes				
igual ao aveiro original mas agora com fes				

#### Figure 31 - Printing a system's report

### Reviewing a deployment's configuration

Activated/submitted forecast systems present a different toolbar from those still in configuration. When the system is activated, it can no longer be configured, so, the "Open System" is replaced with the "<u>View Configuration</u>" tool which opens a modal panel presenting the forecast system's configuration summary for reviewing purposes, along with its tools.



66	SCHISM, v5.4.0 (48h)	manu	ial test using a sample grid	Created at 08/08/2018 6:15 p.m. Start 09/08/2018 End 10/09/2018 Last run 23/08/2018	Active	♥ × ₽ × ■ ■
Created my test	d by aoliveira@Inec.pt					
OP	Forecast ID:66					X PT E
Crea	1 Model					
72:5	2 Domain					
Crea	<b>3</b> Boundaries					
leste	Boundary	Туре	Forcing			
71:5	open-1	Ocean	FES2014 - Finite E	lement Solution		
Gran	Atmospheric Forcing: No	forcing				
teste	4 Stations					
70:6	5 Parameters					
Crea	6 Additional Data					
66						Close

Figure 32 - View deployment's configuration summary

### **Cloning a forecast deployment**

This tool was developed to facilitate the creation of new deployments that only have marginal changes relative to operating ones. If the user presses the "<u>Clone System</u>" tool the service duplicates the deployed forecast system in question into a new system, still in the configuration stage.

Cloned systems are issued an ID number that refers to the number of the one from which they were created, i.e., the original deployment; e.g. "62:57" where 62 is the ID of the new system and 57 the ID of the original deployment.

44	SCHISM, v5.4.0 (48h)	BahiaTest3	Created at 04/06/2018 4:12 p.m. Start 04/06/2018 End 06/07/2018	[Expired]	<ul> <li>≥</li> <li>≥</li></ul>
Create	d by admin				





### Figure 33 - Details on cloning a deployment

Once the clone is created, the user can press its "Open" tool, being redirected to the Configuration Assistant. Then navigate to the step(s) needing adjustments (after step 1), execute the changes and press the "**Change step**" button which will <u>re-validate the step and, if valid, save the changes to the step</u>.

After all modifications are done, the user should navigate to Step 7, confirm the changes were applied and launch the new deployment by pressing the "Activate System" button.

### Deactivating / activating a deployment

**OPENCoastS** 

If a deployment is temporarily not necessary, the user can pause it (saving resources and allowing for the setup of a new deployment if the forecast system's quota has been reached). By clicking on the "Deactivate System" tool, the deployment is paused. Note that access to results will stop.

The system can be restarted by clicking on its "<u>Activate System</u>" button. Note that if the pause is larger than 48 hours, a gap in the prediction stream for that deployment will occur, because the model must be launched in a cold-start mode.







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Figure 34 - Details on deactivating / activating a deployment

### **Extension request**

**OPENCoastS** 

By default, all deployments are set up for one month of operation. If the user wants to extend this period, he/she can click on the "<u>Extend Period</u>" button which will open a form requesting the extension. The request is then evaluated and the user is informed of the decision.

	Expiring	× 11 1
Created by aoliveira@Inec.pt		
igual ao aveiro original mas agora com fes		

### Figure 35 - Extending a deployment's operation period

Note that the OPENCoastS service adds an "Expiring" label on the Forecast Systems page when a deployment's operation time is ending, so the user can anticipate the expiration and avoid service interruption. This label is issued one week before expiring.

If the "Expiring" label is red that means it has already entered the 48-hour period and it is no longer possible to continue the deployment without a cold-start on the model. Therefore, the "Extend Period" button is disabled.

Regarding the request form, the user must provide a new limit date as well as the reason supporting this request (as computational resources are limited, a priority must be assigned to deployment extensions).

The request will be acknowledged. Multiple requests to the same deployment are not permitted:

and the second sec	Created at 31/07/2018 3:09	o.m.	he management	
61 SCHISM, v5.4.0 (48h)	System extension request ID:57	×	Active	
Created by afortunato@Inec.pt	Extend until: 07/09/2018			
60 SCHISM, v5.4.0 (48h)	Motive:		Active	<ul> <li>∞ × ₽</li> <li>× ■</li> </ul>
Created by afortunato@Inec.pt Arade estuary				
57:55 SCHISM, v5.4.0 (48h)	Close	8	Active Expiring	● × ₽ × ■ ■
Created by aoliveira@Inec.pt	an fac	_		





Figure 36 - Details on extending a deployment's operation period

## Outputs viewer

The outputs viewer is a simple interface to preview forecast maps and time series at deployment's comparison and virtual stations. Also, it allows downloading the model results. It provides access to the predictions for each user's active deployment, under three features: <u>Maps, Stations and Files</u>. While the maps and the stations are available for the latest predictions, the deployment's files are available for download from the beginning of its activation. Other model output files, such as error logs, are also available for download.





Figure 37 – Viewer feature choice. In the example, the wave peak period is shown in colour and the wave direction in arrows colored with the magnitude of the significant wave height.

The viewer is divided into <u>3 main panels</u>: on the <u>left</u>, a resizable and collapsible menu panel shows the user's active deployments and respective tools; on the <u>right</u>, there is a map where user can preview model output (elevations, velocities and other variables) among other tools; in between is a <u>center</u> panel, also resizable and collapsible, where the user can load charts with station time series.

### Maps of model predictions

OPENCoastS

Access to maps of predicted variables is available by selecting the "**Maps**" button/tab and clicking on the corresponding output map checkboxes. The user can rearrange the order in which the output maps are rendered by dragging their corresponding panel on the Legend Panel (top right screen) and can also change the opacity of each layer and uncover the map's legend image by clicking on their corresponding label. The following variables can be available, depending on the selected model: **Elevation, Velocities** (all models), Significant wave height / wave direction, peak period (2D waves & currents model), salinity and temperature (3D baroclinic model), e-coli, enterococcus or a generic tracer concentration.





Figure 38 - Preview of the Outputs Viewer: Maps Feature with layer selection and legend unfolding

On the map's top left panel is a toolbar that includes multiple functions: to zoom in and out; zoom out to the map's full overview; a toggle tool that allows users to add new output probing stations (that can be seen in time series part of the viewer); a Bookmark menu that allows users to save map bookmarks locally on his/her browser and a Basemap toggle menu from which users can change the map's basemap. At the bottom of the map, a time slider is also available that allows users to move between the time steps; it also includes a play/pause button to view steps in an animated fashion. Finally, three options are available for the background layer: ESRI World Street Map, ESRI World Grey Canvas, and ESRI World Imagery.



OPENCoastS



### Figure 39 - Maps Feature: functions

**Note:** the viewer is still under development and may present an erroneous, "inconsistent tiled" behavior. The development team is making the best efforts to overcome these limitations.

### Real and Virtual Stations and Charts

The intermediate panel "Charts" presents the time series of all comparison and virtual stations created by the user during the deployment's configuration stage. To load charts, the user must first select the "Charts" button/tab and click on the available stations checkboxes. This will load the time series of the corresponding station. Once on the chart, users can hide/show a station's time series by clicking on its



label on the chart's legend. Also each chart has a menu button  $\equiv$  (top right chart) with tools such as "Print chart" or download the chart's data to formats: CSV or XLS.



Figure 40 - Preview of the Outputs Viewer; focusing on the Stations Feature

Lines are used for elevation and velocity magnitudes, while arrows with velocity direction are shown on the velocity chart using the color of the corresponding line.

Note that the map and the charts are linked, so changing the time stamp on the map will update the time reference on the charts (represented by a vertical line on the time series). Also selecting a specific time on the chart will update the time slider positioned at the bottom of the map and all of the elevation and velocity maps loaded to the map. By moving the mouse over the time series curves, the values for all lines at that time are displayed.





Figure 41 - Preview of the Outputs Viewer; examples of charts

On loading comparison stations to the chart, the viewer will attempt to load the EMODnet's observation elevation data for the corresponding station. If the monitoring station has published data inside the deployment's time range, a second time series with that data will also be loaded onto the chart, from which the user can infer about the quality of the model's output results.

Note that there can be a vertical offset between observation and modelled elevations. This is caused by vertical reference differences between the deployment's domain and the monitoring stations.

Another useful feature of the Outputs Viewer is the "Add point to chart" tool on the map's top left toolbar. On activating this tool, the user can click on a point of an elevation and/or velocity map, loaded on the map, and the charts panel will add a time series of that position to the corresponding chart.





*Figure 42 - Detail of the Outputs Viewer; Adding point to chart tool* 

### **Model Output Files**

The user can see all available files, generated by the model, for all simulated days in a list by selecting the "**Files**" button/tab. As the list may be long, a search mechanism is implemented to facilitate the download. The download of each file can be done by clicking on the file name and just saving it to the user's Downloads folder.



Figure 43 - Preview of the Outputs Viewer; focusing on the Files Feature

### **Online Demo**

A live hands-on demo on the use of the 3 main features of OPENCoastS will be available soon.



OPENCOastS Coastal dynamics on-demand forecast User Manual

### Rating the service

Under the main menu (top right screen), a link to rate the OPENCoastS service is available. Users can grant up to 5 stars (1-bad to 5-excellent) and leave comments on their experience and suggestions to the development team. This feature aims to infer about users' experience in order to improve the platform's usability and functionality; also to receive feedback from users about their models' outputs to infer about their quality. Therefore, the platform inquires users automatically one week after having their first deployment up and running. User's ratings are saved and presented on this page.

OPENCoastS	1
North Atlantic coastal circulation on-demand for	ecast
Rate this service	
…	
Leave your comment here:	
Thank you, your feedback is important to us.	
Previous ratings	
Excelent 9 Aug 2018, 6:18 p.m. A breakthrough in coastal forecast! Nice interface, easy to follow. I am planning to use it a lot.	

### Figure 44 - OPENCoastS service Rating feature

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