

ODYSSEA - HYDRODYNAMIC MODELING RESULTS ALONG THE MOROCCAN COASTS

ATELIER DE VALIDATION DE LA PLATEFORME DE DONNEES PAR LES UTILISATEURS ET DE
FORMATION A L'OCEANOGRAPHIE OPERATIONNELLE

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Overview






- Odyssea coastal model rational;
- What is downscaling?
- Questions that downscaling can answer;
- Implementation of coastal model in forecast mode (Morocco Observatory example).

Rational

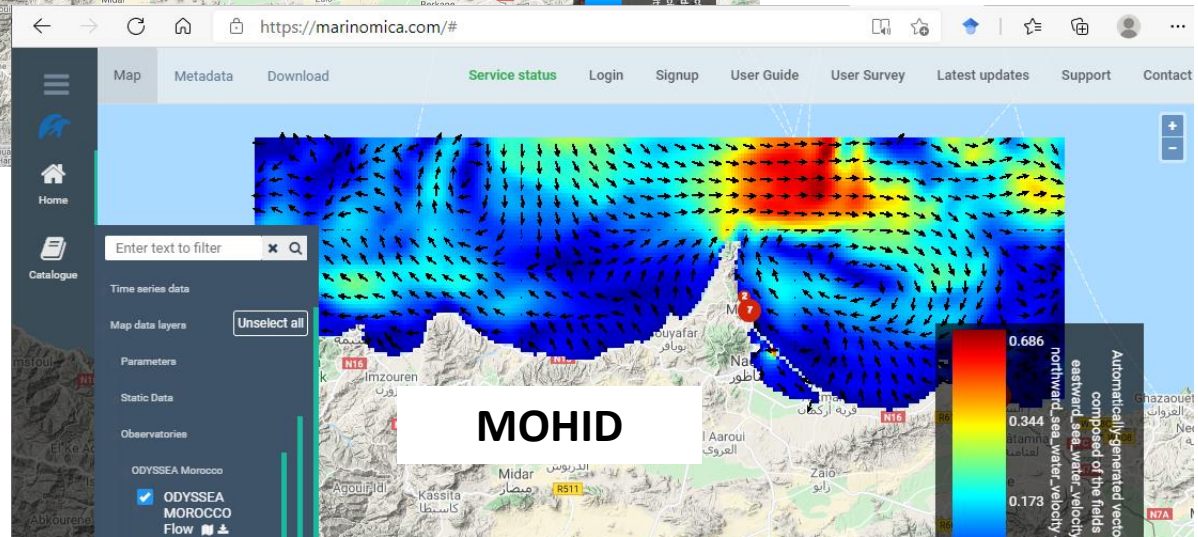
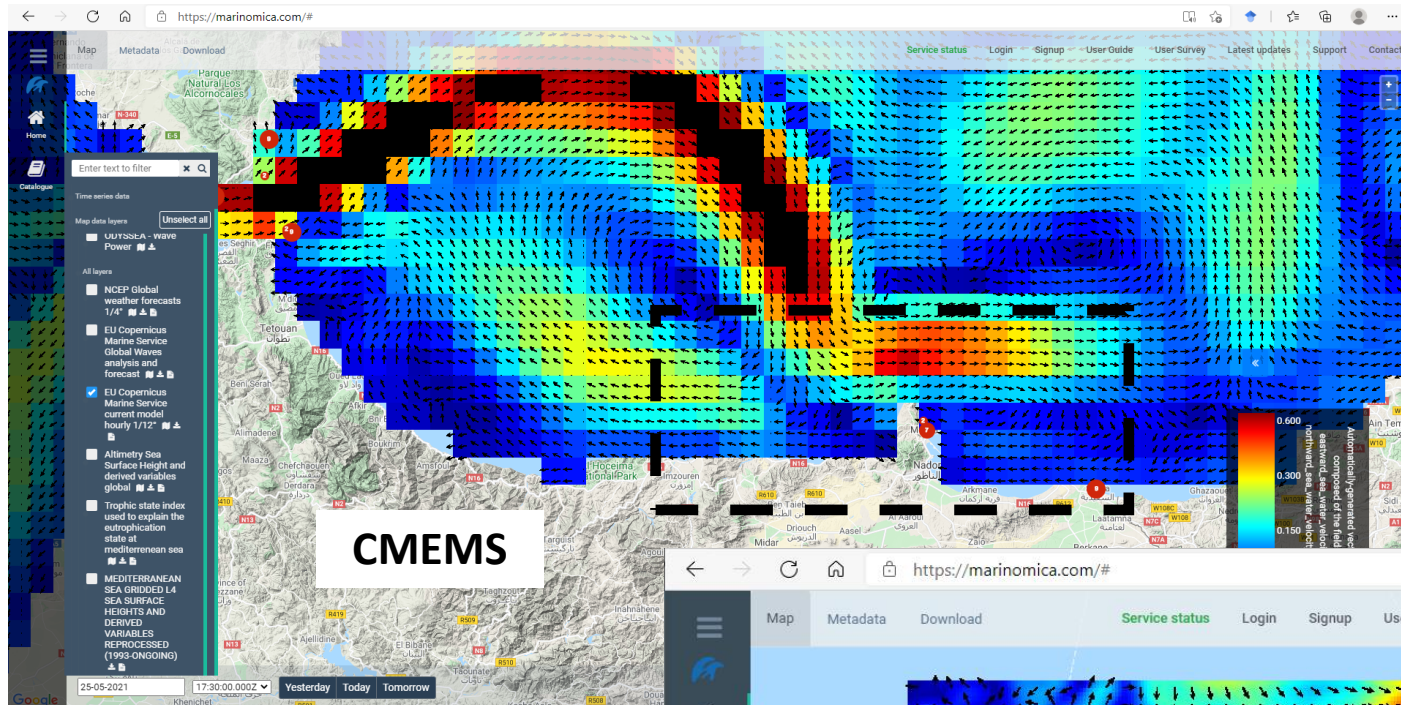
- Datasets, data sources, models and algorithms under consideration for each observatory



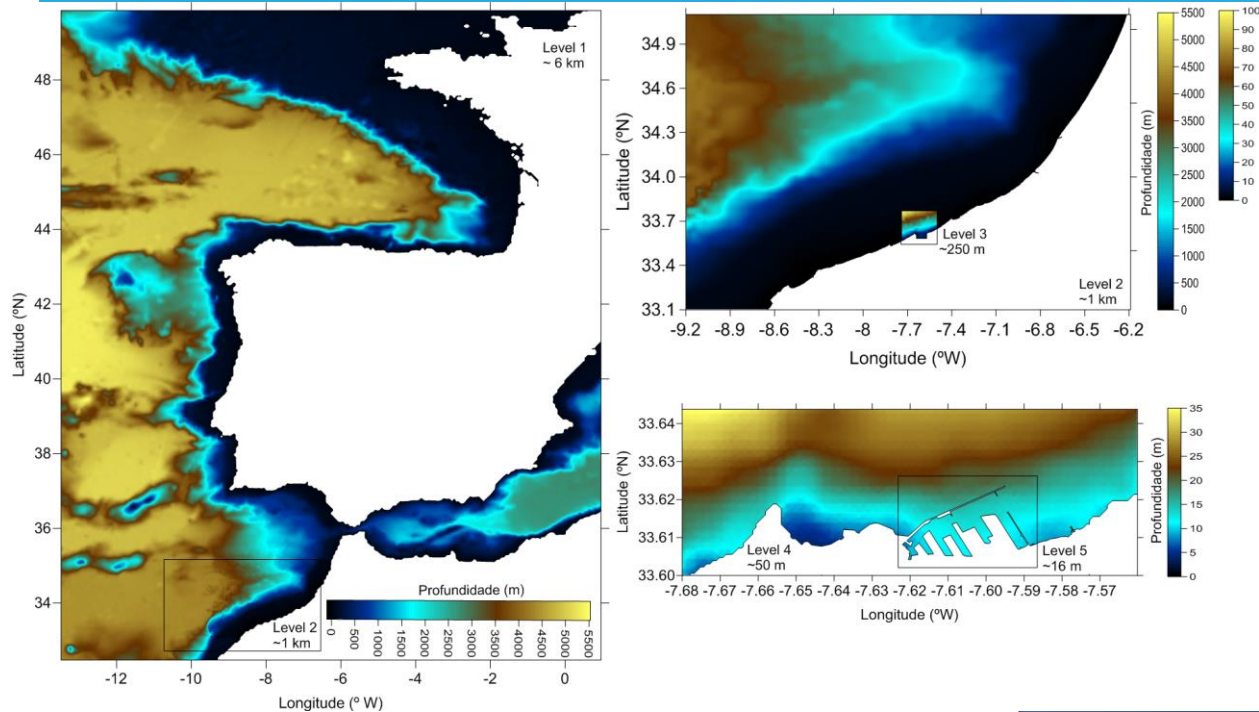
Downscaling

	 In-situ measurements	 Coastal models	 External Earth Observation datasets	 Citizen Science	 Algorithms
DESCRIPTION	At the ODYSSEA Observatories new in-situ monitoring devices (fixed bottom and surface sensors, and gliders) are deployed measuring standard physical and biogeochemical variables, as well as novel measurements (e.g. microplastics, acoustic signal, etc.)	At the ODYSSEA Observatories high-resolution three-dimensional coastal models are setup to simulate hydrodynamics, wave conditions, water quality, oil spill (in selected observatories), jellyfish (in selected observatories), and ecosystem composition	Covering the entire Mediterranean Sea basin ODYSSEA collects and provides easy access to external databases containing in-situ measurements, satellite data, and model outputs	ODYSSEA collects and makes use (e.g. visualizes) of data provided by citizens through social media and dedicated citizen science apps	Using algorithms to merge, fuse, and transform the primary data products, ODYSSEA generates secondary variables that are not provided by any other data sources
OBSERVING/MODELLING PLATFORM	<ul style="list-style-type: none"> - Develogic Modular Surface Sensor (fluorometer + hydrophone + submerged camera + microplastics sensor) - Develogic Deep Water Sea Lander - Alseamar SeaExplorer glider: <ul style="list-style-type: none"> • Payload 1: GPS, CTD, DO, Phyto, CDOM, Turbidity, • Payload 2: Passive Acoustic Monitoring (hydrophone), • Payload 3: CTD and microplastics 	<ul style="list-style-type: none"> - Hydrodynamic model: Delft3D-FLOW, MOHID - Wave model: Delft3D-WAVE, SWAN - Biogeochemical model: Delft3D-WAQ, MOHID - Oil spill model: MEDSLIK-II - Mussel farm model - Ecosystem model: ECOPATH - Jellyfish model: Delft3D-PART, OpenDrift 	<ul style="list-style-type: none"> - CMEMS - GEOSS - EMODnet - NOAA - ECMWF - GOOS - MonGOOS - SeaDataNet - UNEP-WCMC 	<ul style="list-style-type: none"> - Twitter - Marine LitterWatch App - Pangaea 	<ul style="list-style-type: none"> - Algorithm for Eutrophication Index in sea water - Algorithm for TRophic Index in sea water - Algorithm for UNscaled TRophic Index in sea water - Algorithm for Efficiency Coefficient in sea water - Algorithm for wave power

Downscaling – Morocco observatory



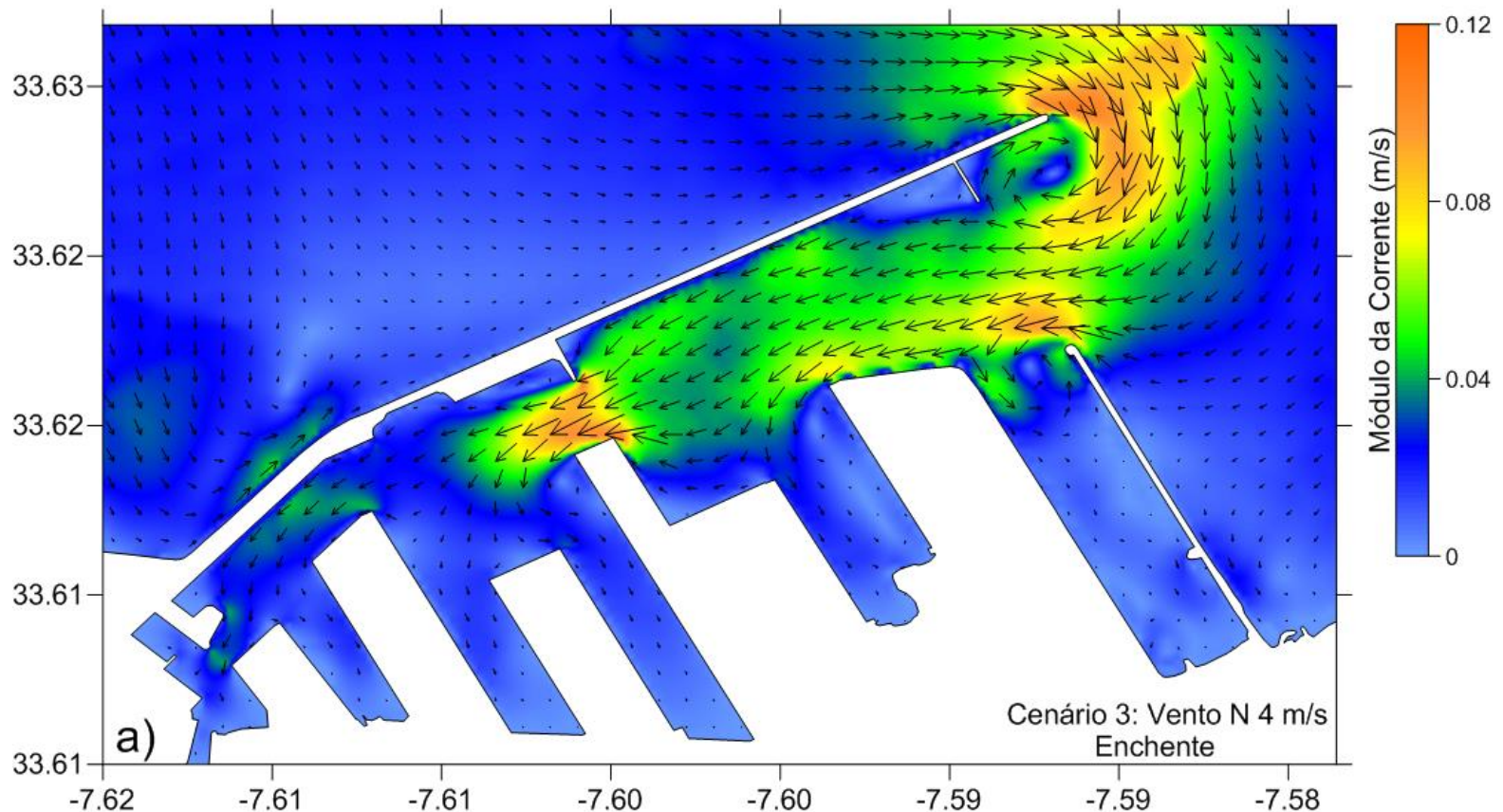
Downscale to local scale Casablanca



Downscale to local scale

Casablanca

- Spring tide, flood – North wind 4 m/s;



Questions that downscaling can help

- Usually users are interested in the local scale;
- You need to define the model purpose?
- Downscaling can be useful for:
 - Support operations: ports, aquaculture,...;
 - Emergence response: Oil spill, search and rescue;
 - Bathing water quality forecast;
 - Storm surge forecast;
 - Consultancy;
 - Litter trajectory;
 - ...

Ports operation



ODYSSEA

- Aveiro/Portugal



RELATÓRIO DE PREVISÕES
PORTO DE AVEIRO

18-04-2019 09:00

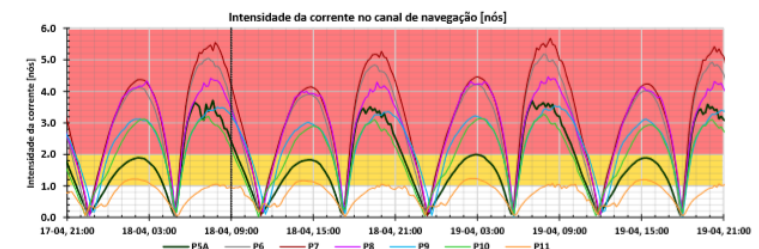
7. CORRENTES | Previsões do modelo MOHID (50 m)

Data/hora		quinta-feira, 18-04-2019																																															
Hora	08h	08h				09h				10h				11h				12h				13h				14h				15h				16h															
minutos	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45									
hora à PM	08:00	08:15	08:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00								
PSA	Int (nós)	3,2	3,2	2,8	2,7	2,4	2,1	1,9	1,6	1,4	1,1	0,8	0,5	0,3	0,1	0,3	0,5	0,6	0,8	1,0	1,2	1,3	1,5	1,6	1,7	1,8	1,8	1,8	1,8	1,7	1,5	1,4	1,3	1,2	1,1	1,0	0,8	0,6	0,5	0,4	0,3								
P6	Int (nós)	4,8	4,6	4,3	4,0	3,6	3,2	2,8	2,4	2,0	1,6	1,2	0,7	0,2	0,3	0,8	1,3	1,6	2,0	2,4	2,7	3,0	3,2	3,5	3,6	3,8	3,9	3,9	3,8	3,6	3,3	2,9	2,5	2,1	1,7	1,4	1,1	0,9	0,7	0,5									
P7	Int (nós)	5,5	5,2	4,9	4,6	4,2	3,8	3,4	3,0	2,6	2,1	1,6	1,1	0,5	0,2	0,7	1,2	1,6	2,0	2,4	2,7	3,0	3,3	3,6	3,8	3,9	4,0	4,1	4,1	4,0	3,9	3,6	3,3	2,9	2,5	2,1	1,7	1,4	1,1	0,9	0,7								
P8	Int (nós)	4,3	4,2	3,9	3,7	3,4	3,1	2,9	2,6	2,3	1,9	1,6	1,1	0,6	0,2	0,6	1,0	1,5	1,9	2,3	2,7	3,0	3,3	3,6	3,8	3,9	4,0	4,0	3,9	3,9	3,9	3,7	3,3	2,9	2,5	2,1	1,7	1,4	1,1	0,9	0,7								
P9	Int (nós)	3,5	3,5	3,5	3,4	3,2	3,0	2,9	2,6	2,4	2,1	1,8	1,5	1,1	0,6	0,1	0,4	0,9	1,3	1,8	2,1	2,3	2,5	2,7	2,8	2,9	2,9	3,0	3,0	2,9	2,9	2,8	2,7	2,5	2,1	1,7	1,4	1,1	0,9	0,7									
P10	Int (nós)	2,9	2,8	2,7	2,4	2,2	1,9	1,7	1,4	1,2	0,9	0,6	0,3	0,0	0,4	0,8	0,9	1,1	1,2	1,4	1,6	1,8	2,0	2,3	2,5	2,6	2,7	2,8	2,9	2,9	2,8	2,6	2,4	2,1	1,7	1,4	1,1	0,9	0,7										
P11	Int (nós)	1,1	1,0	1,0	0,9	0,8	0,9	0,9	0,9	0,7	0,6	0,5	0,4	0,2	0,3	0,4	0,4	0,4	0,4	0,5	0,7	0,9	1,0	1,1	1,2	1,2	1,2	1,1	1,1	1,0	1,0	0,8	0,6	0,4	0,3	0,2	0,1	0,1	0,0										

Data/hora		quinta-feira, 18-04-2019																																															
Hora		16h				17h				18h				19h				20h				21h				22h				23h				00h															
minutos		00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45				
hora & PM		06:00	06:15	06:30	06:45	06:00	06:15	06:30	06:45	07:00	07:15	07:30	07:45	08:00	08:15	08:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45				
P5A	Int (nós)	1,1	0,9	0,6	0,2	0,3	0,9	1,8	2,6	3,1	3,4	3,4	3,4	3,5	3,3	3,2	3,2	2,8	2,5	2,3	2,0	1,7	1,5	1,2	0,9	0,6	0,4	0,2	0,2	0,4	0,6	0,7	0,8	0,9	0,9	0,8	0,7												
P6	Int (nós)	2,5	1,9	1,3	0,5	0,4	1,4	2,4	3,3	3,9	4,3	4,5	4,7	4,8	4,8	4,7	4,6	4,6	4,4	4,1	3,7	3,4	3,0	2,6	2,1	1,7	1,4	0,9	0,5	0,2	0,5	1,0	1,5	1,9	2,3														
P7	Int (nós)	2,9	2,4	1,8	1,0	0,4	1,3	2,5	3,4	4,0	4,5	4,8	5,0	5,1	5,2	5,1	5,3	5,1	4,9	4,6	4,3	4,0	3,6	3,2	2,7	2,2	1,8	1,3	0,8	0,4	0,9	1,4	1,9	2,3	2,7														
P8	Int (nós)	3,0	2,5	1,9	1,1	0,4	1,3	2,0	2,7	3,2	3,5	3,7	3,8	4,0	4,0	4,2	4,1	4,1	4,0	3,7	3,5	3,2	3,0	2,7	2,3	2,0	1,7	1,3	0,9	0,4	0,7	1,3	1,7	2,1	2,5														
P9	Int (nós)	2,2	1,8	1,4	0,8	0,3	0,7	1,4	2,0	2,4	2,7	2,9	3,0	3,1	3,3	3,2	3,3	3,4	3,3	3,2	3,1	2,9	2,7	2,4	2,2	1,9	1,6	1,3	0,9	0,4	0,2	0,7	1,1	1,5	1,9														
P10	Int (nós)	2,1	1,8	1,3	0,7	0,3	0,8	1,5	2,1	2,5	2,7	2,9	3,0	3,0	3,1	2,9	2,7	2,8	2,6	2,5	2,2	2,0	1,8	1,5	1,2	1,0	0,7	0,5	0,3	0,2	0,5	0,8	1,0	1,2															
P11	Int (nós)	0,7	0,6	0,4	0,3	0,1	0,1	0,3	0,5	0,6	0,7	0,8	0,9	0,9	0,9	1,0	1,1	1,0	1,0	0,9	0,9	1,0	1,0	0,7	0,7	0,6	0,4	0,3	0,2	0,4	0,4	0,3	0,4	0,4	0,3	0,4													

Data/hora		sexta-feira, 19-04-2019																								sábado, 20-04-2019																															
hora		00h	01h	02h	03h	04h	05h	06h	07h	08h	09h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	00h	01h	02h	03h	04h	05h	06h	07h	08h	09h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h								
hora à PM		00h	05h	10h	15h	20h	25h	30h	35h	40h	45h	50h	55h	00h	05h	10h	15h	20h	25h	30h	35h	40h	45h	50h	55h	00h	05h	10h	15h	20h	25h	30h	35h	40h	45h	50h	55h	00h	05h	10h	15h	20h	25h	30h	35h	40h	45h	50h	55h								
P5A	Int (nós)	0,6	1,3	1,8	2,0	1,7	0,8	1,4	3,7	3,5	3,2	2,1	1,0	0,1	0,9	1,5	1,9	1,8	1,1	0,3	3,2	3,4	3,1	2,2	1,1	0,1	0,7	1,5	1,8	1,9	1,4	0,3	2,7	3,4	3,7	3,4	3,1	2,2	1,1	0,1	0,7	1,5	1,8	1,9	1,4	0,3	2,7	3,4	3,7	3,4	3,1	2,2	1,1	0,1			
P6	Int (nós)	1,5	2,9	3,9	4,2	3,8	1,8	1,9	4,6	5,2	4,5	3,2	1,5	0,4	2,1	3,3	4,0	3,8	2,4	0,6	4,0	4,9	4,6	3,4	1,7	0,1	1,8	3,2	3,9	4,1	3,1	0,7	3,3	4,9	5,2	4,5	3,2	1,5	0,4	2,1	3,3	4,0	3,8	2,4	0,6	4,0	4,9	4,6	3,4	1,7	0,1	1,8	3,2	3,9	4,1	3,1	0,7
P7	Int (nós)	1,4	2,9	4,0	4,5	4,0	2,3	2,0	4,9	5,4	5,0	3,8	2,0	0,3	2,1	3,4	4,2	4,0	2,8	0,3	4,2	5,2	5,1	3,8	2,1	0,1	1,8	3,3	4,1	4,4	3,5	1,2	3,5	5,2	5,5	4,8	3,5	2,0	0,3	2,1	3,4	4,2	4,0	2,8	0,3	4,2	5,2	5,1	3,8	2,1	0,1	1,8	3,3	4,1	4,4	3,5	1,2
P8	Int (nós)	1,3	2,9	4,0	4,2	4,0	2,4	1,7	3,7	4,1	4,1	3,1	1,8	0,1	2,0	3,4	4,1	3,9	2,9	0,2	3,3	4,0	4,1	3,2	1,9	0,3	1,7	3,2	4,1	4,2	3,5	1,3	2,7	3,9	4,2	4,1	3,2	1,9	0,3	1,7	3,2	4,1	4,2	3,5	1,3	2,7	3,9	4,2	4,1	3,2	1,9	0,3	1,7				
P9	Int (nós)	0,7	2,3	2,9	3,2	2,9	1,7	1,1	2,9	3,5	3,5	3,0	2,0	0,5	1,5	2,6	3,0	2,9	2,1	0,0	2,5	3,2	3,4	3,0	2,2	0,8	1,1	2,5	3,0	3,1	2,5	1,0	2,0	3,0	3,2	3,1	2,5	1,0	0,8	1,1	2,5	3,0	3,1	2,5	1,0	0,8	1,1	2,5	3,0	3,1	2,5	1,0	0,8				
P10	Int (nós)	1,0	1,7	2,6	3,1	2,9	1,7	1,2	2,9	3,2	2,8	1,9	0,8	0,5	1,3	2,1	2,8	2,9	2,1	0,2	2,8	3,1	2,8	1,9	1,0	0,3	1,1	2,8	2,7	3,1	2,5	0,9	2,1	3,0	3,2	3,1	2,5	0,9	1,0	0,3	1,1	2,8	2,7	3,1	2,5	0,9	1,0	0,3	1,1	2,8	2,7	3,1	2,5	0,9			
P11	Int (nós)	0,3	0,6	1,2	1,2	1,0	0,6	0,2	0,7	1,0	1,0	1,0	0,5	0,3	0,5	0,9	1,2	1,1	0,7	0,1	0,8	0,9	1,0	1,0	0,6	0,1	0,4	0,8	1,2	1,2	0,8	0,3	0,5	0,8	0,9	1,0	1,0	0,6	0,1	0,4	0,8	1,2	1,2	0,8	0,3	0,5	0,8	0,9	1,0	1,0	0,6	0,1	0,4				
Previsões para a intensidade da corrente (Int) do modelo MCHMD (10,0 m de resolução) em nós P5, P6, P7, P8, P9, P10 e P11.																																																									

Previsões para a intensidade da corrente [Int] do modelo MOHID (200 m de resolução) em P5, P6, P7, P8, P9, P10 e P11.

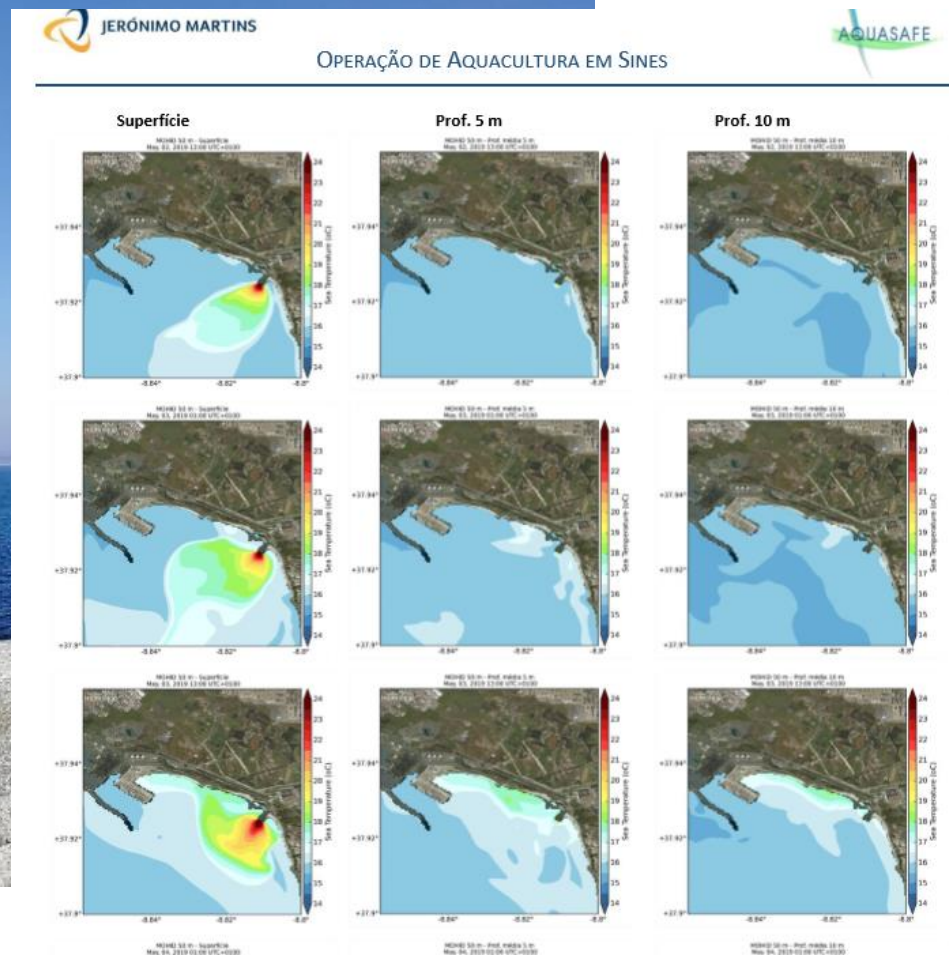
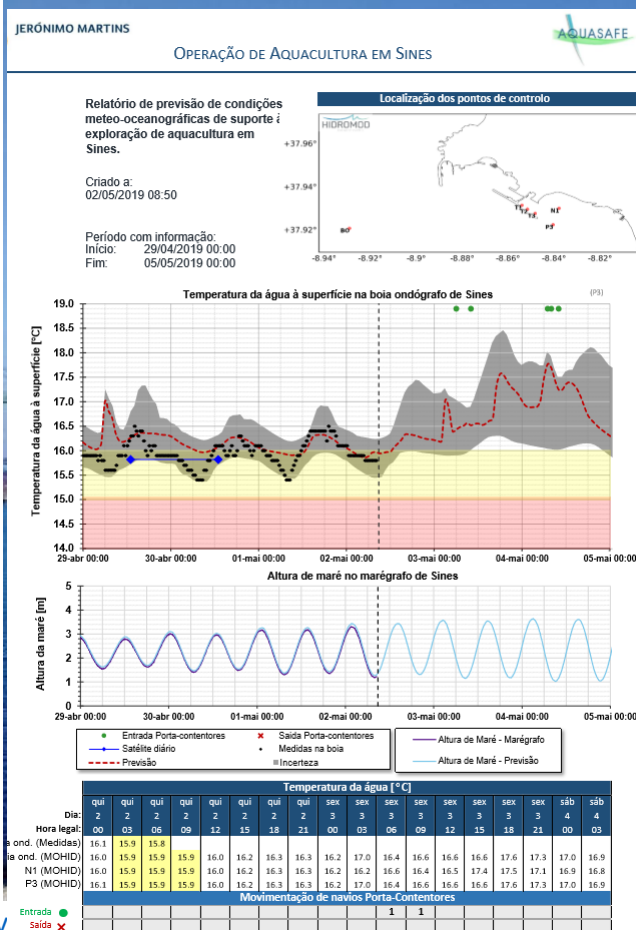


Aquaculture operation



ODYSSEA

- Sines/Portugal – fish feeding optimization



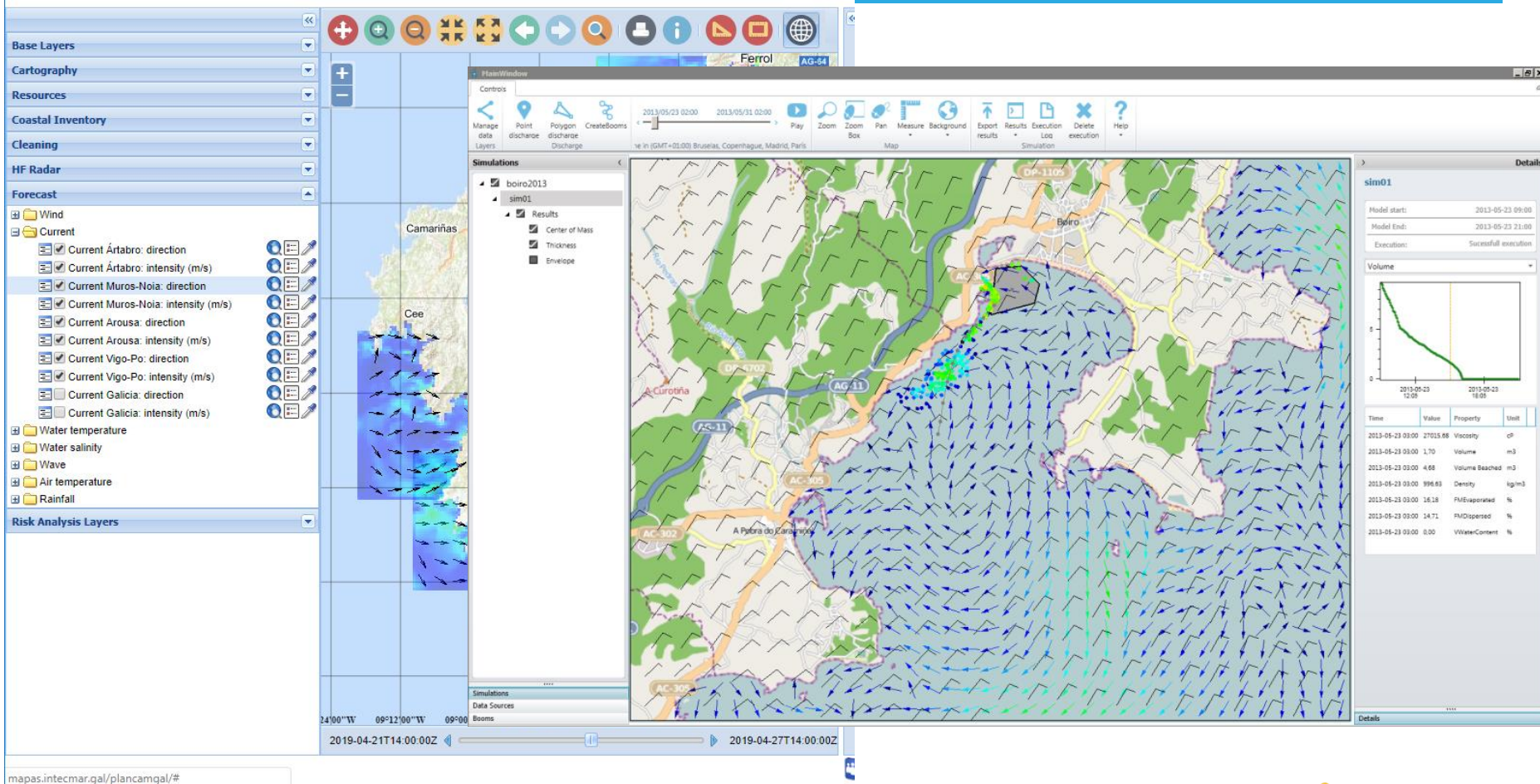
Emergency response – Oil spill



ODYSSEA

Plan CAMGAL

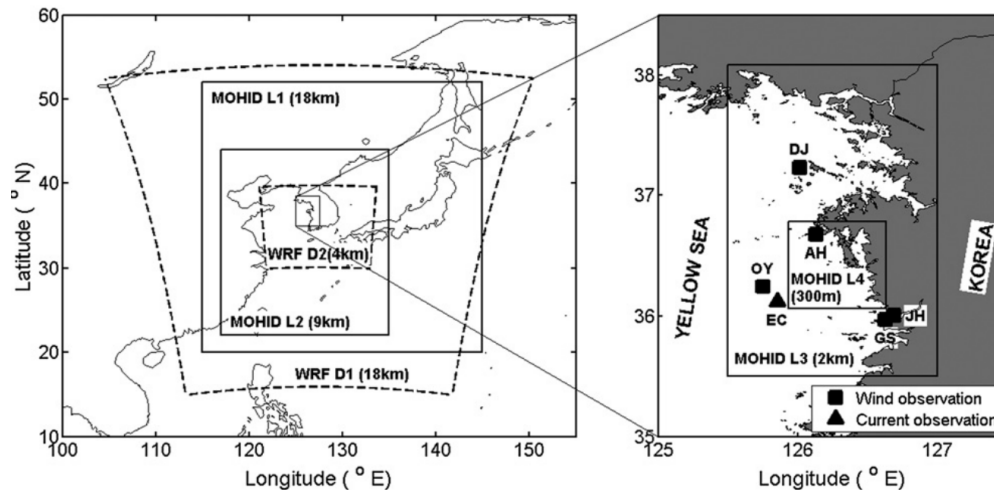
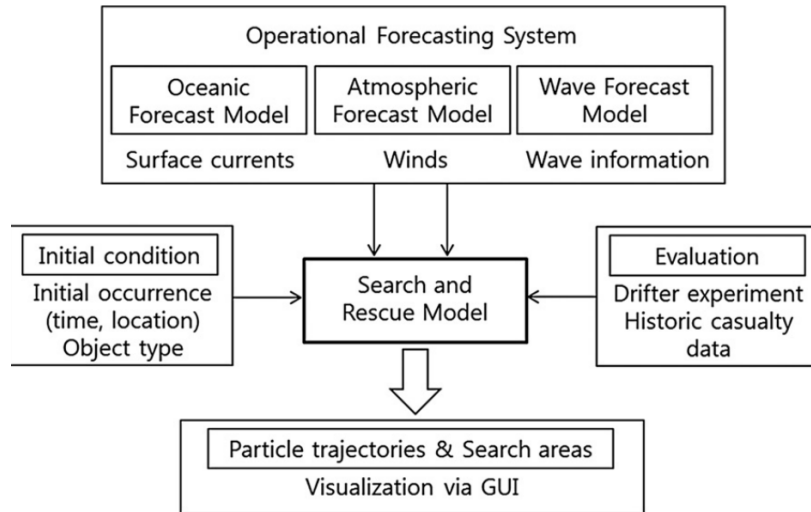
XUNTA DE GALICIA
CONSELLERÍA DO MAR



KIOST (Korea) Emergence response – search and rescue



Cho K-H, Li Y, Wang H, Park K-S, Choi J-Y, Shin K-I, Kwon J-I. Development and validation of an operational search and rescue modeling system for the Yellow Sea and the East and South China Seas. **Journal of Atmospheric and Oceanic Technology**. 2014; 31: 197–215



Bathing water quality forecast



ODYSSEA

- Santos/Brazil – Water utility – Faecal contamination

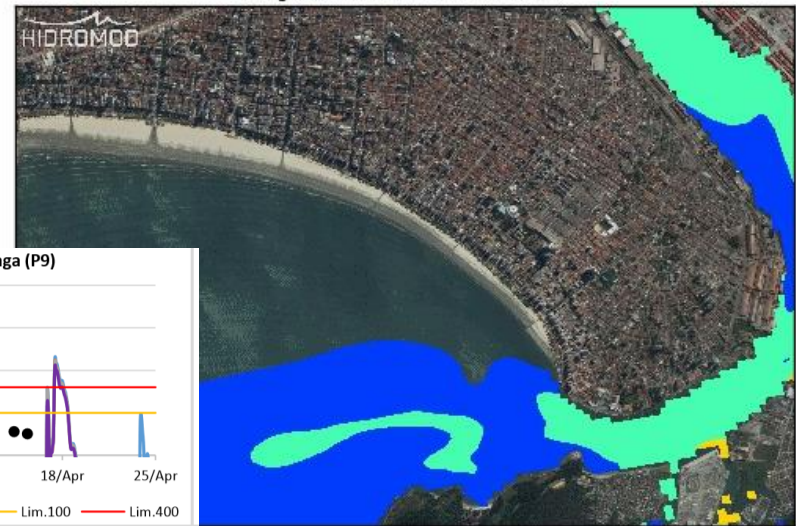


Concentração de Enterococos
Previsão 4/25/2019

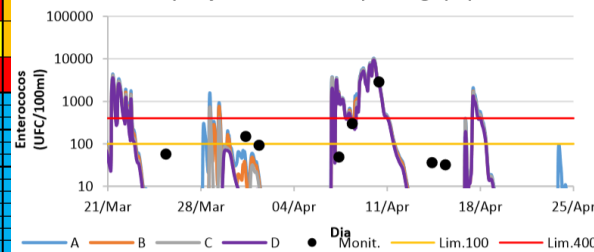


UFC/ 100ml	Classificação
<25	Excelente
25-50	Muito boa
50-100	Satisfatória
100-400	Ruim
>400	Péssima

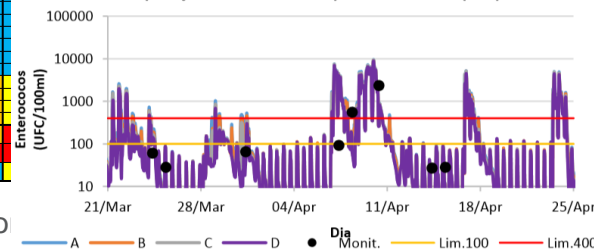
Concentração de Enterococcus
Aug. 20, 2017 07:00 UTC+0000



Comparação dado x modelo | Gonzaga (P9)



Comparação dado x modelo | Ponta da Praia (P13)



Ponto	Nome	Cenário	Previsão: máxima concentração de enterococos (UFC/100ml)								
			25/04 (Thu.)			26/04 (Fri.)			27/04 (Sat.)		
			Manhã	Tarde	Noite	Manhã	Tarde	Noite	Manhã	Tarde	Noite
Cidade	1 Prainha	-	188	184	18	111	119	29	196	156	131
	2 Gonzaguinha	-	358	347	32	254	285	70	55	242	156
	3 Milionários	-	203	228	15	14	125	16	95	83	100
	4 Ilha Porchat	-	12	7	21	51	54	323	172	38	36
	5 Itararé	-	101	167	442	112	453	206	8	13	22
	6 Divisa	-	20	6	1	0	0	0	0	0	0
S. Vicente	REIS	-	696	377	384	769	477	127	236	497	405
	SV1 Canal de São Vicente 1	-	1957	2381	284	135	337	259	158	437	
	SV2 Canal de São Vicente 2	-	573	471	378	175	327	410	65	77	
	SV3 Canal de São Vicente 3	-	2976	1992	3863	2766	2591	2476	4509	3543	
Santos	7 José Menino (R. Frederico Ozanan)	A	0	0	0	0	0	0	0	0	0
		B	0	0	0	0	0	0	0	0	0
		C	0	0	0	0	0	0	0	0	0
		D	0	0	0	0	0	0	0	0	0
	8 José Menino (R. Olavo Bilac)	A	0	0	0	0	0	0	0	0	0
		B	0	0	0	0	0	0	0	0	0
		C	0	0	0	0	0	0	0	0	0
		D	0	0	0	0	0	0	0	0	0
	9 Gonzaga	A	0	0	0	0	0	0	0	0	0
		B	0	0	0	0	0	0	0	0	0
		C	0	0	0	0	0	0	0	0	0
		D	0	0	0	0	0	0	0	0	0
	10 Boqueirão	A	3	2	1	0	0	0	1	0	0
		B	0	0	0	0	0	0	0	1	0
		C	0	0	0	0	0	0	0	1	0
		D	0	0	0	0	0	0	0	1	0
	11 Embaré	A	5	2	1	1	1	0	1	1	1
		B	0	0	0	0	0	0	1	1	1
		C	0	0	0	0	0	0	1	1	1
		D	0	0	0	0	0	0	1	1	1
	12 Aparecida	A	4	1	1	1	1	2	3	19	20
		B	1	1	1	1	1	2	3	19	20
		C	1	1	1	1	1	2	3	19	20
		D	1	1	1	1	1	2	3	19	20
	13 Ponta da Praia	A	72	8	39	25	12	12	42	116	116
		B	72	8	31	68	13	13	45	120	120
		C	72	7	32	64	12	12	42	125	125
		D	72	7	32	64	12	12	42	126	126
	ST1 Canal de Santos 1	-	1480	1674	1282	3449	2219	1558	1813	273	
	ST2 Canal de Santos 2	-	7448	1517	5586	5114	3824	5018	3567	3996	
	ST3 Canal de Santos 3	-	23	79	80	13	2	51	4	1	

Bathing water quality forecast France – Since 2008




ODYSSEA



JGR Oceans

Research Article | [Free Access](#)

Effects of waves on coastal water dispersion in a small estuarine bay

M. T. Delpéy , F. Ardhuin, P. Otheguy, A. Jouon

First published: 13 December 2013 | <https://doi.org/10.1002/2013JC009466> | Citations: 24



International Journal of Hygiene and
Environmental Health
Volume 222, Issue 4, May 2019, Pages 695-704



Differential decay and prediction of persistence of
Enterococcus spp. and *Escherichia coli* culturable
cells and molecular markers in freshwater and
seawater environments

Maïalen Sagarduy ^{a, B}, Sophie Courtois ^B, Andrea Del Campo ^S, Joxe Mikel Garmendia ^S, Agnès Petrau ^a

- ^a Rivages Pro Tech, 2, Allée Théodore Monod, 64210, Bidart, France
- ^b Suez, CIRSEE, 38 rue du président Wilson, 78230, Le Pecq, France
- ^c AZTI Tecnalia, Herrera Kaia – Portualdea z/g, E-20110, Pasaia, Spain

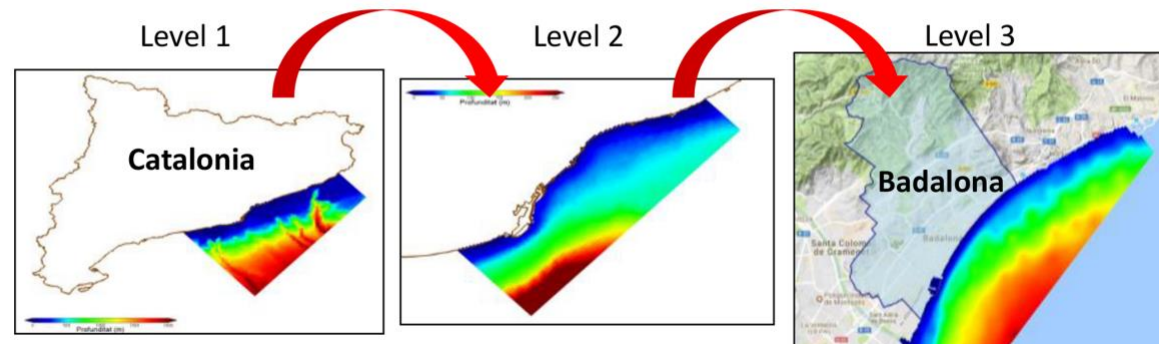
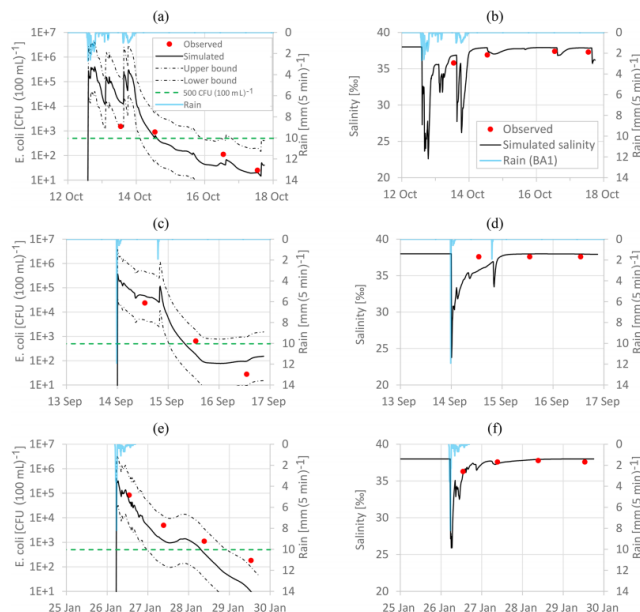


Bathing water quality forecast Spain/Barcelona since 2007



L. Locatelli et al.: Modeling of *E. coli* distribution for hazard assessment of bathing waters

Locatelli et al.: Modeling of *E. coli* distribution for hazard assessment of bathing waters



Nat. Hazards Earth Syst. Sci., 20, 1219–1232, 2020
<https://doi.org/10.5194/nhess-20-1219-2020>
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Natural Hazards
 and Earth System
 Sciences



**Modeling of *E. coli* distribution for hazard assessment of bathing
 waters affected by combined sewer overflows**

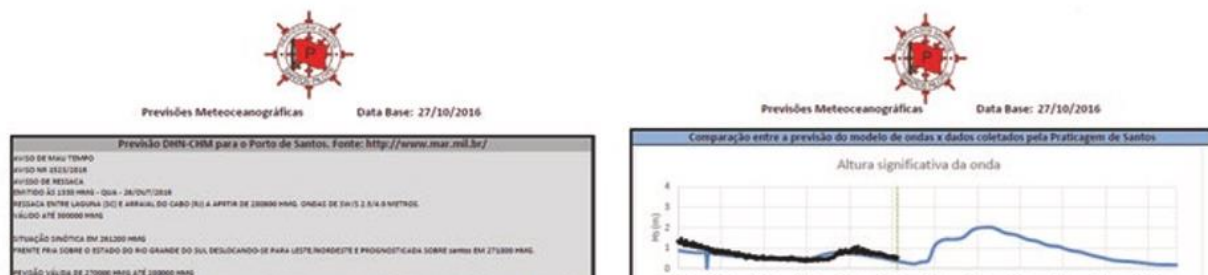
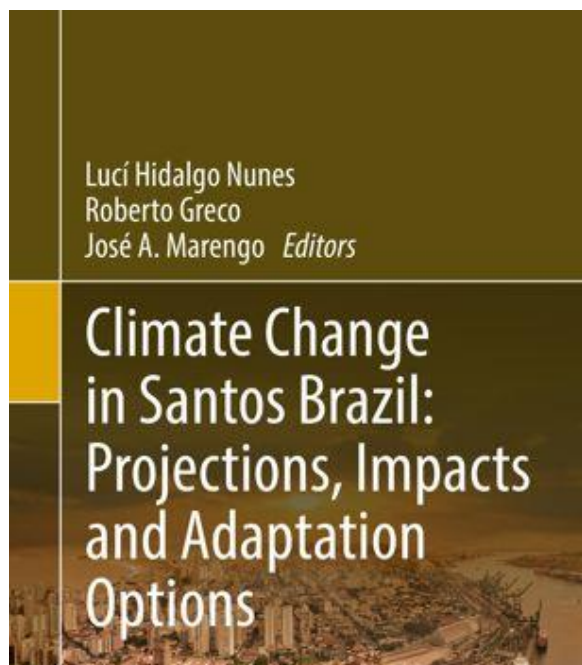
Luca Locatelli¹, Beniamino Russo^{1,2}, Alejandro Acero Oliete², Juan Carlos Sánchez Catalán²,
 Eduardo Martínez-Gomariz³, and Montse Martínez¹

¹AQUATEC – Suez Advanced Solutions, Ps. Zona Franca 46-48, 08038, Barcelona, Spain

²Group of Hydraulic and Environmental Engineering (GIHA), Technical College of La Almunia (EUPLA),
 University of Zaragoza, Mayor St. 5, 50100, Zaragoza, Spain

³Cetaqua, Water Technology Centre, Environment, Society and Economics Department,
 Cornellà de Llobregat, 08940, Spain

Storm surge forecast



Efeitos de ressaca 'prevista' são minimizados

Trabalho preventivo é exaltado em Santos

SANDRO THADEU
DA REDAÇÃO

O trabalho integrado de previsão das ressacas e as ações de prevenção de transtornos à população, promovidos pela Defesa Civil de Santos e o Núcleo de Pesquisas Hidrodinâmicas (NPH) da Universidade Santa Cecília (Unisant), foram considerados positivos.

O fenômeno registrado por volta das 14 horas de ontem ocorreu um pouco acima do esperado (2,03 metros contra 1,85 metro). A água tomou pra-

chance para fazer uma selfie e estava convencido de que as fortes ondas do último dia 21 não ocorreriam novamente.

Moradora de Guarujá, a professora Eunice Pinheiro tinha uma consulta médica marcada, mas chegou com antecedência, na esperança de ser atendida mais cedo, com medo das ondas na hora de ir embora do consultório. "Estou com medo que as ondas estejam fortes, porque elas podem atrapalhar meu retorno para casa".



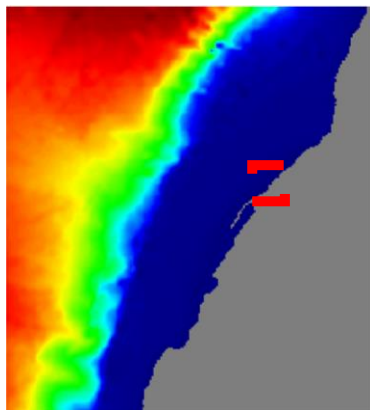
Prefeitura e Núcleo de Pesquisas Hidrodinâmicas, da Unisant, ressaltam o trabalho integrado; ondas chegaram a 2,03 metros

Fig. 7.19 Page in the local newspaper showing an article praising the preventative work in Santos. Source: Jornal A Tribuna from 16 September 2016)

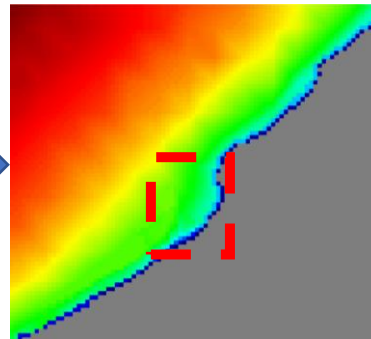
Improvement of an Operational Forecasting System for Extreme Tidal Events in Santos Estuary (Brazil)

Joana Mendes ¹, Paulo Leitão ², José Chambel Leitão ², Sofia Bartolomeu ², João Rodrigues ² and João Miguel Dias ^{1,*}

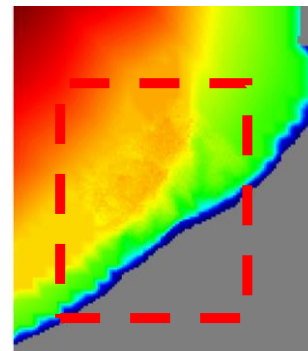
¹ CESAM, Departamento de Física, Universidade de Aveiro, 3810-193 Aveiro, Portugal; joanaamendes@ua.pt.
² Hidromod, Rua Rui Teles Palhinha, n.º 4, 1.º, 2740-278 Porto Salvo, Portugal; paulo.chambel@hidromod.com (P.L.); jcleitao@hidromod.com (J.C.L.); sofia.bartolomeu@hidromod.com (S.B.); joao.rodrigues@hidromod.com (J.R.)



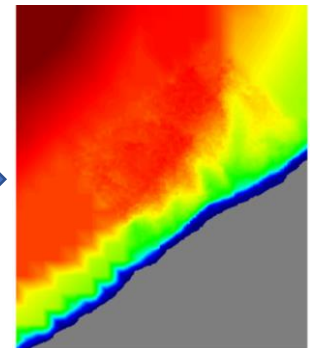
$dx \sim 2 \text{ km}$



$dx \sim 250 \text{ m}$

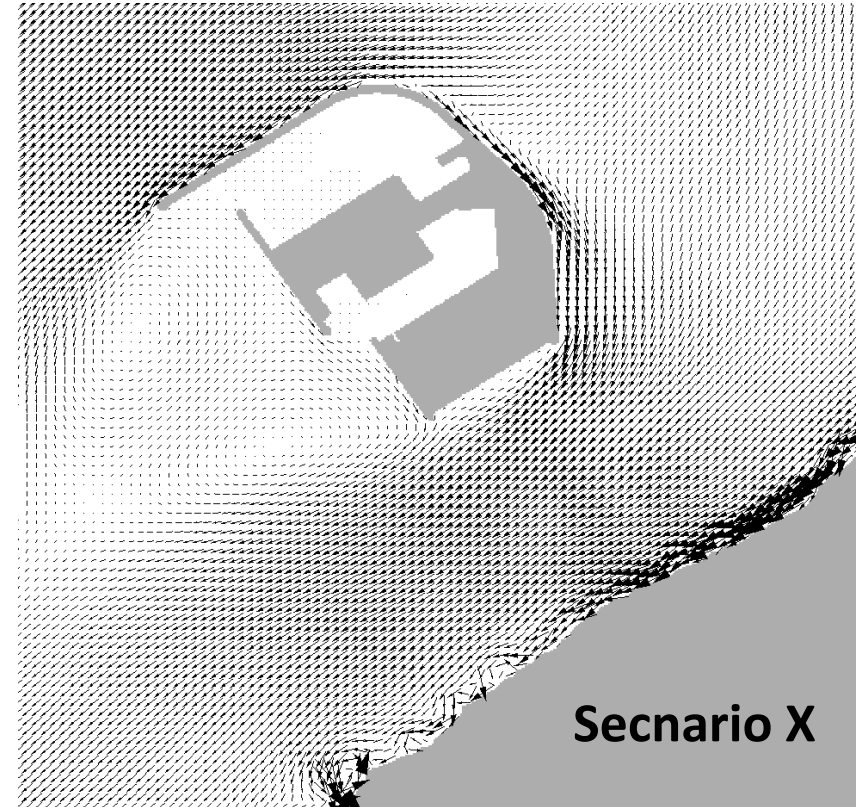
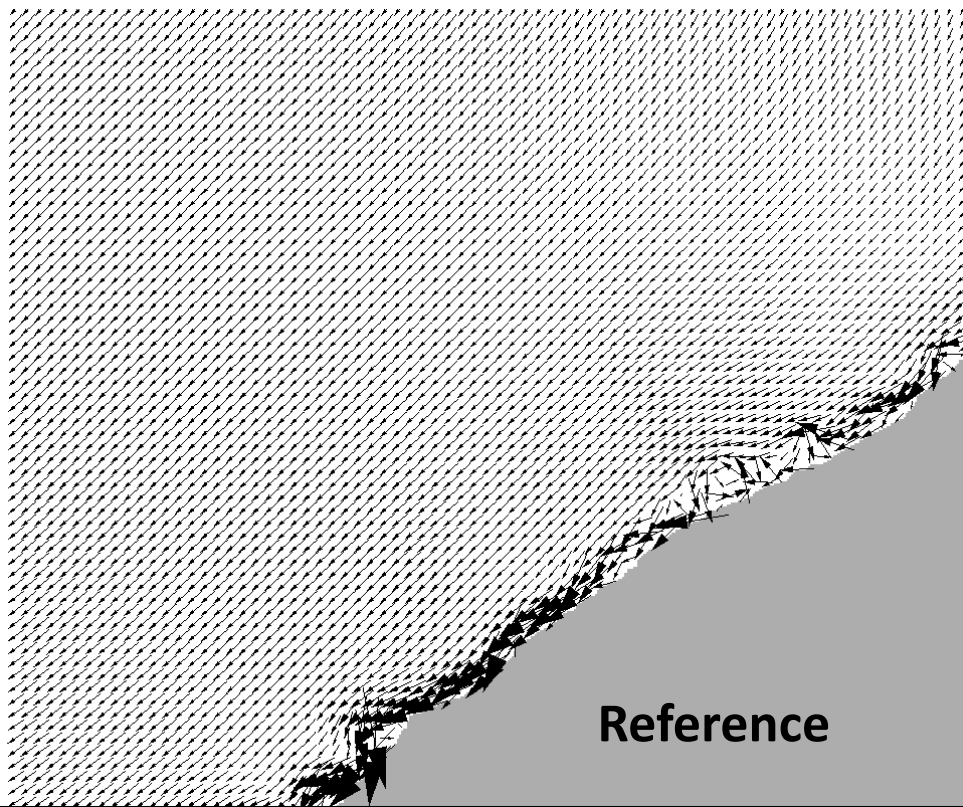


$dx \sim 50 \text{ m}$



$dx \sim 10 \text{ m}$

Downscale to local scale Dakhla – port scenarios



Implementation of coastal hydrodynamic model in forecast mode

Morocco Observatory



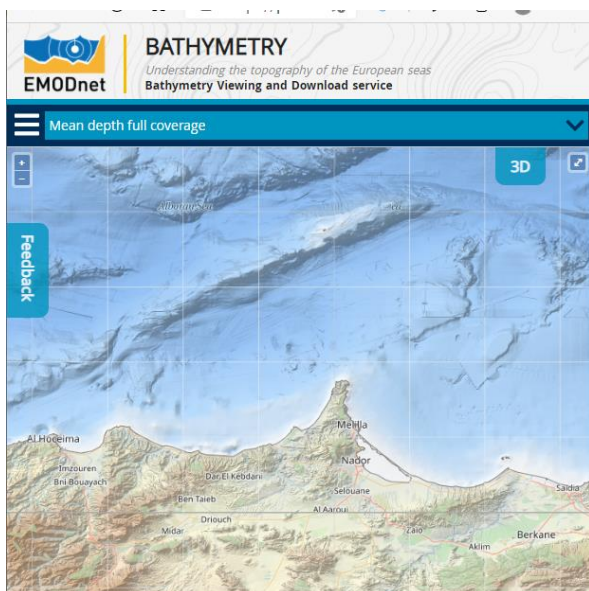
ODYSSEA

- Initial and boundary conditions:
 - Earth Observation datasets;
- Spatial discretization;
- Outputs (Marinomica platform);
- Validation.

External Earth Observation datasets

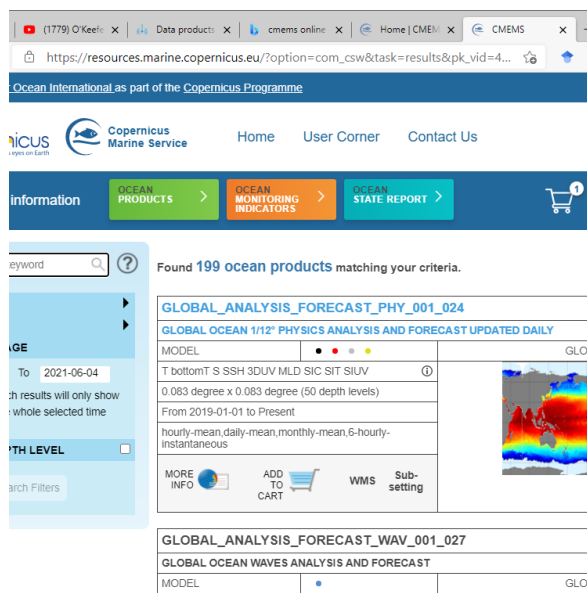


ODYSSEA



Emodnet

Bathymetry



CMEMS + FES2014

Large scale
hydrodynamics
forecast



ICON

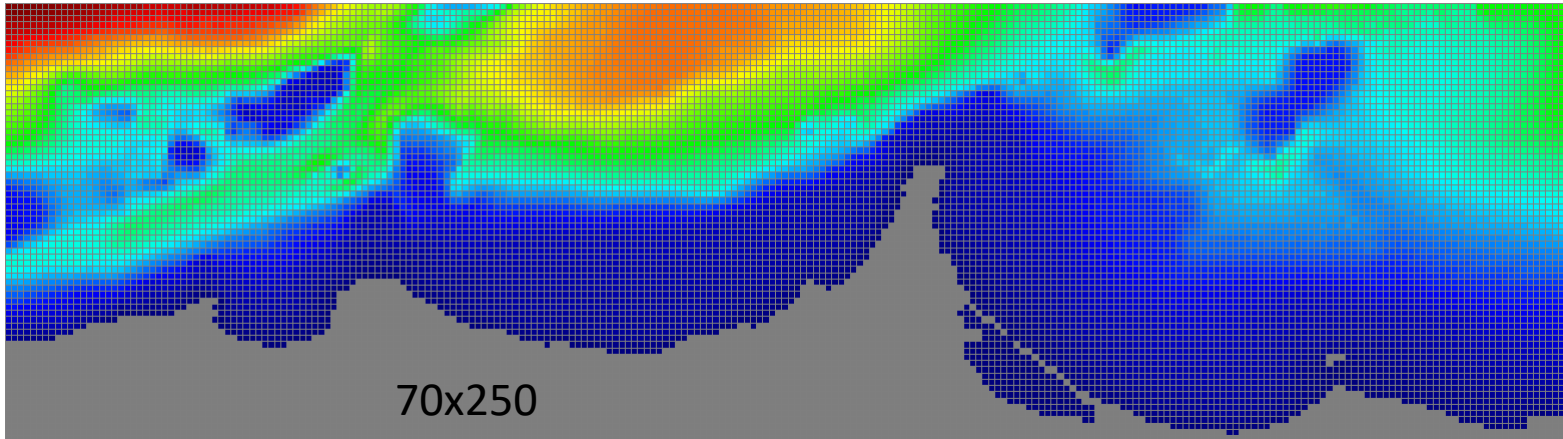
Weather forecast
model

Spatial discretization & running cycle

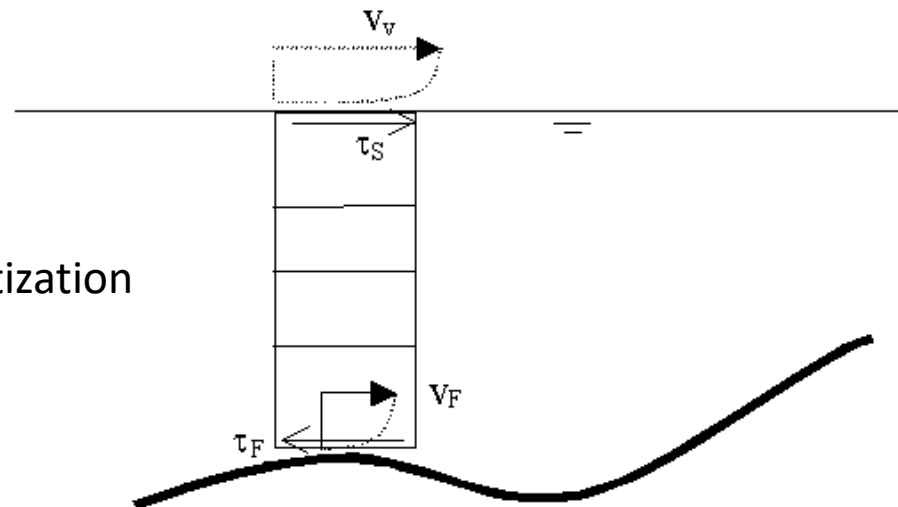
Morocco Observatory



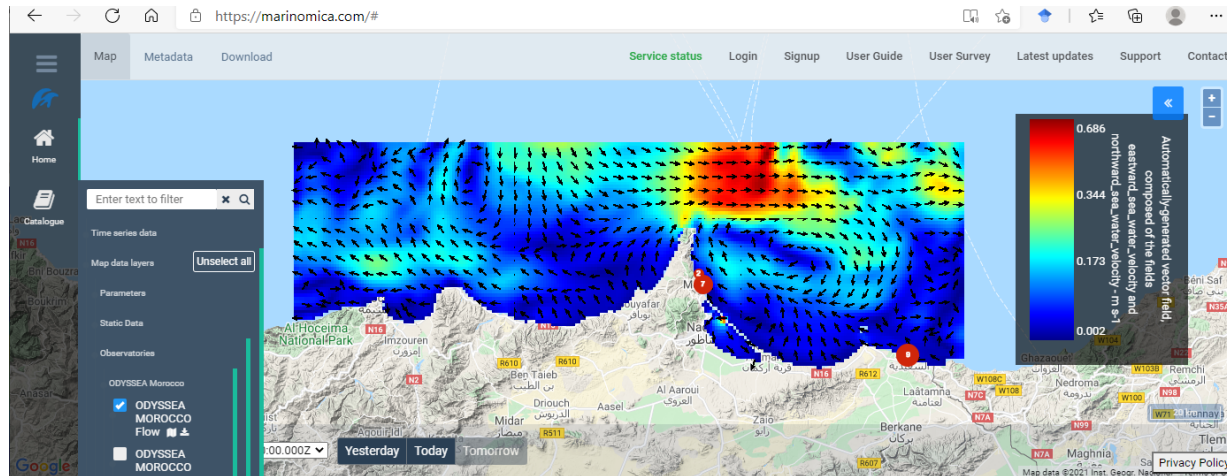
ODYSSEA



75 layers - Z level vertical discretization



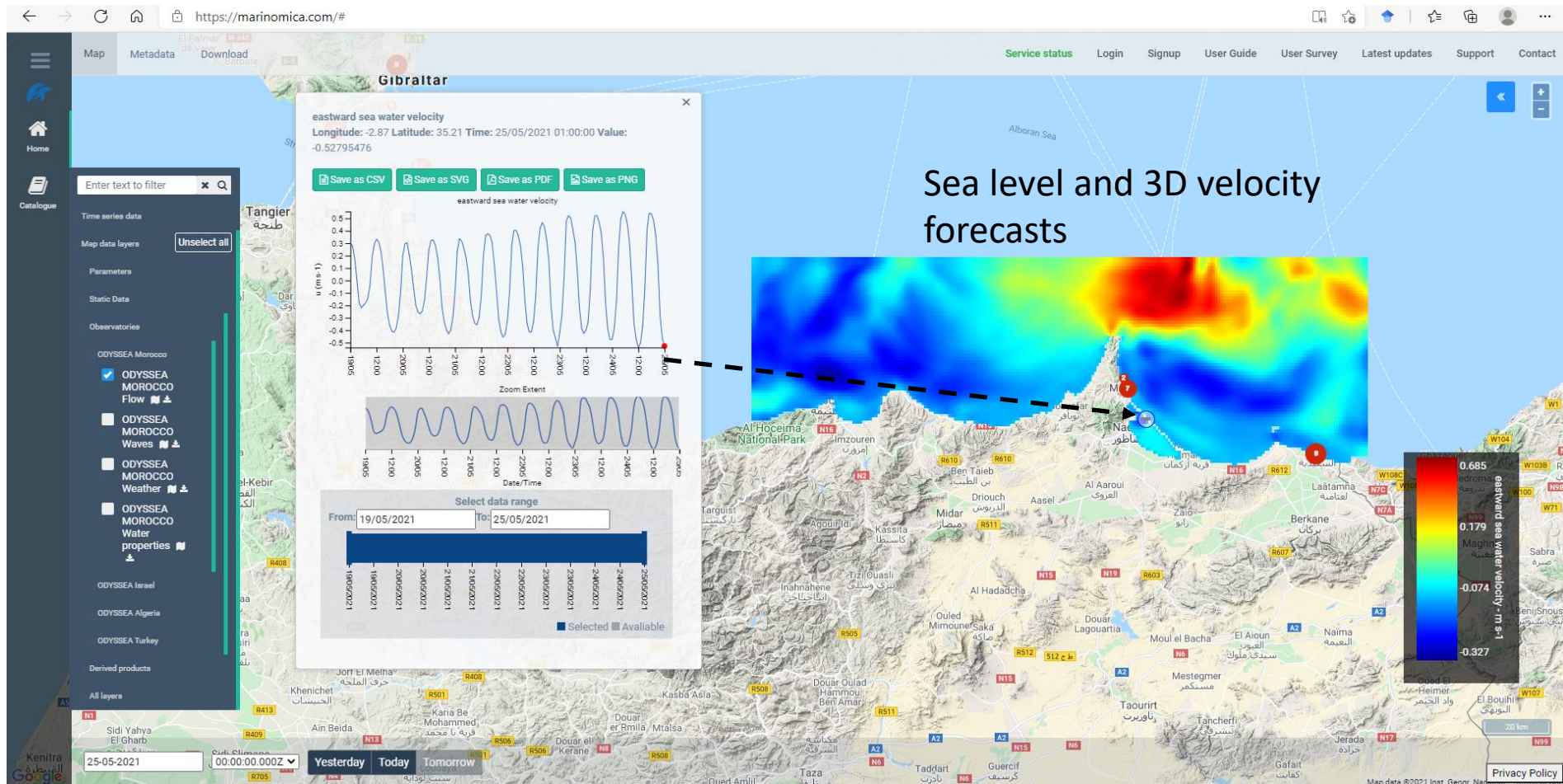
Morocco Observatory – Output



- Biogeochemical model: Delft3D-WAQ
- Oil spill model: MEDSLIK-II
- Mussel farm model
- Ecosystem model: ECOPATH
- Jellyfish model: Delft3D-PART, OpenDrift

- Local scale high-resolution hydrodynamic models to support services

Morocco Observatory – Output

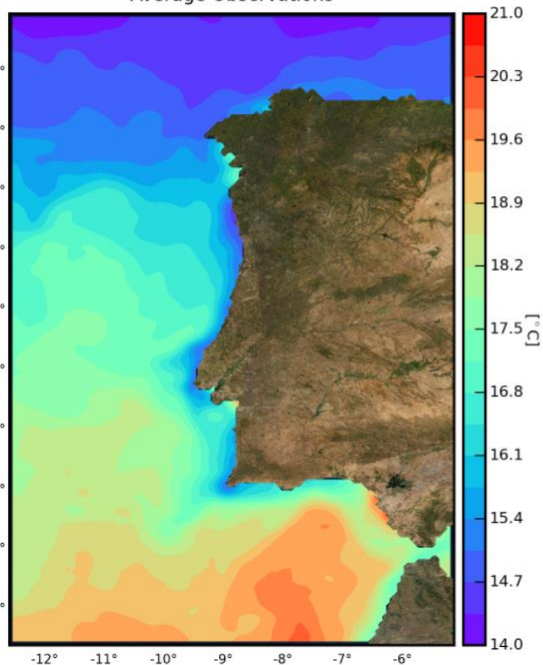


Validation

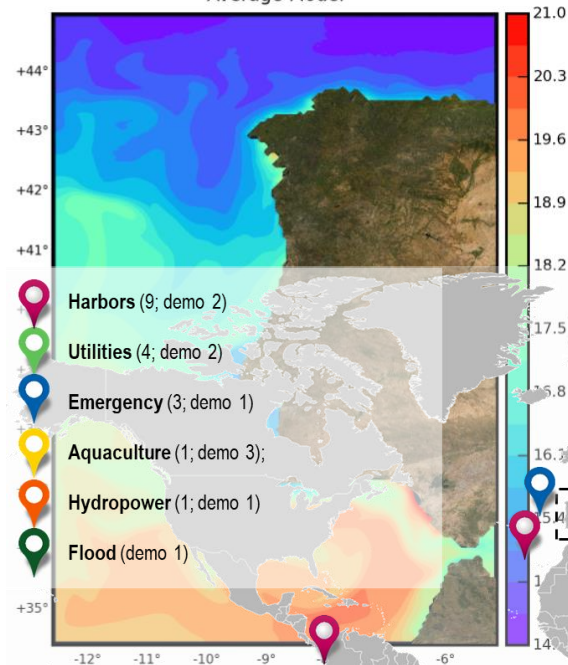
- Validation is a critical task in running models in forecast mode to support activities;
- Users want to know the uncertainty of forecasts;
- Implement a coastal model run in forecast mode without validation can take a couple of days. However, a good **validation can take years**;
- Validation is complex process because:
 - The present volume of observations (satellite & in situ) is quite large;
 - Number of observations grows continuously due to new satellite missions and the deploy of new in situ platforms;
 - Models have several calibration parameters that need to be tuned (e.g. bottom drag coefficient, surface drag coefficient, parameters of the horizontal and vertical turbulence models, etc.);
 - Models are always being improved for each relevant new version a new implementation need to be done and the validation procedure need to be repeated;
 - End users looking to the forecasts in a daily base find regulary new deficiencies that need to be tackle;
 - It is a non stopping procedure and very time consuming;

Validation

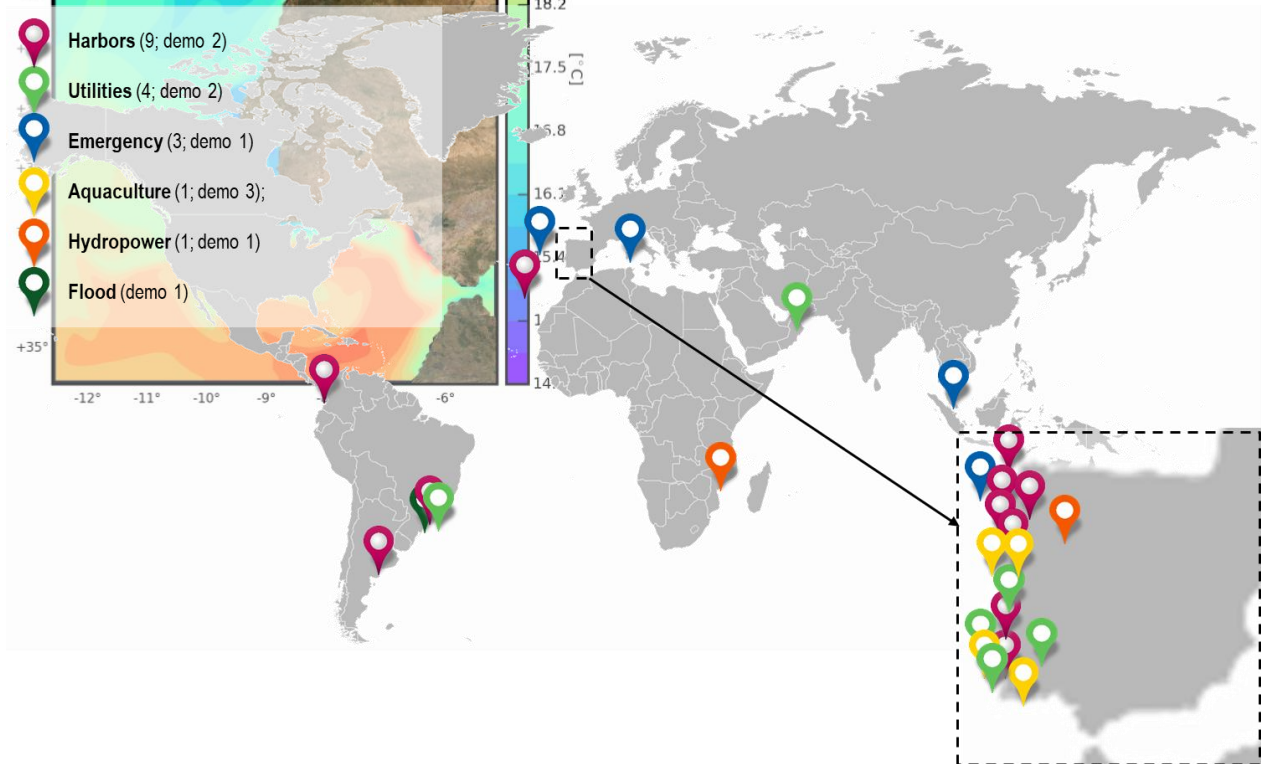
Average Observations May. 22, 2021 12:00 - May. 29, 2021 12:00 UTC



Average Model

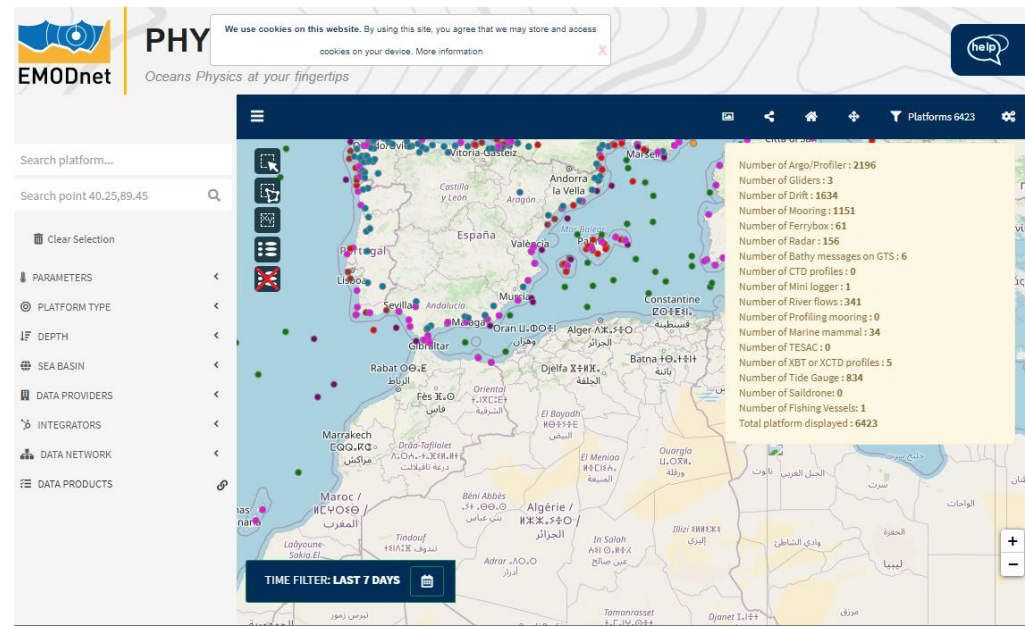


- Harbors (9; demo 2)
- Utilities (4; demo 2)
- Emergency (3; demo 1)
- Aquaculture (1; demo 3);
- Hydropower (1; demo 1)
- Flood (demo 1)



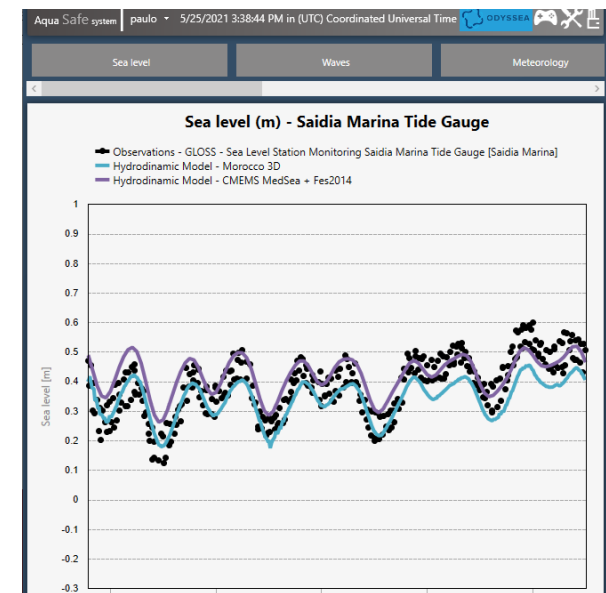
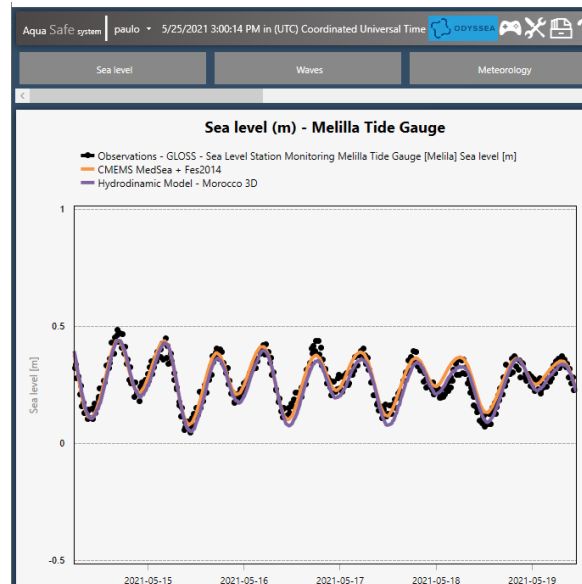
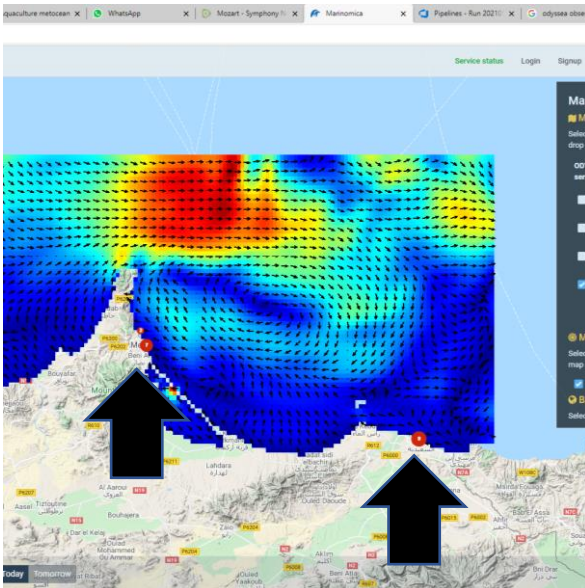
Validation – coastal models

- sea level - **Tidal gauges**,...;
- temperature – **Satellite**, buoys, gliders, ... ;
- currents – **ADCP, HF-Radar, drifters**,...;
- salinity – buoys, gliders, ...;
- ...



Tidal gauge – Morocco Obs.

Preliminary validation – March-May 2021



Sea level
Tidal gauges

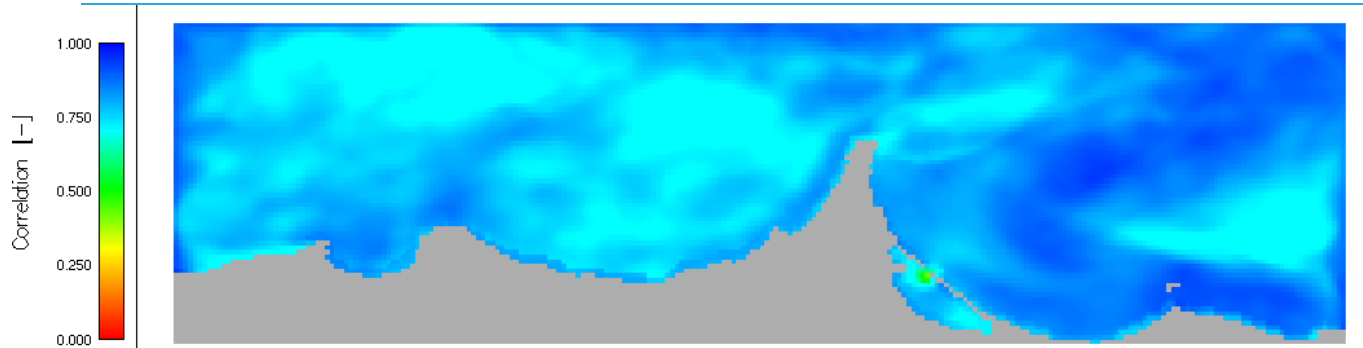
Melilla

Saidia Marina

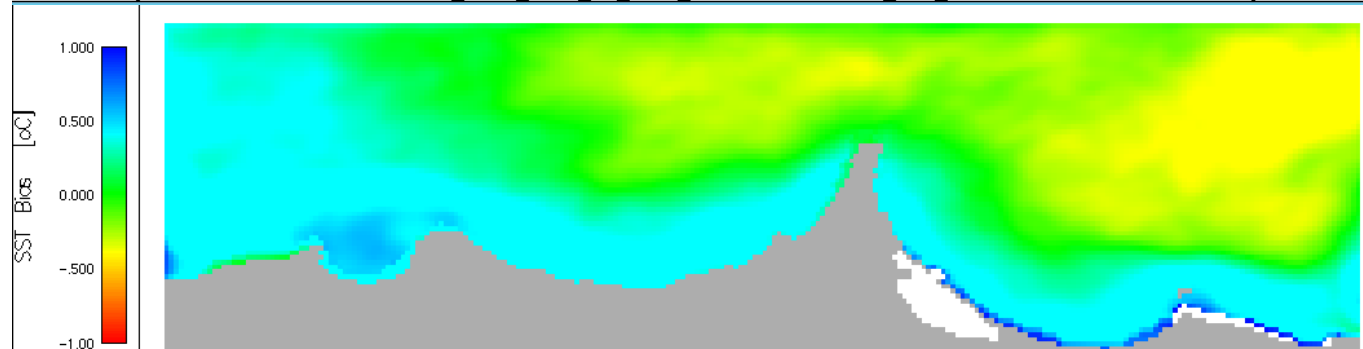
BIAS [m]	0.01
RMSE [m]	0.07
Normalise RMSE [%]	14
Unbias RMSE [m]	0.07
Normalise unbias RMSE[%]	14
R	0.83

Satellite – temperature – Morocco Obs.

Preliminary validation – May 2021



MOHID Water Modeling System
SST - Correlation
SST_MED_SST_L4_NRT_OBSERVATIONS_010_004



MOHID Water Modeling System
SST - Bias
SST_MED_SST_L4_NRT_OBSERVATIONS_010_004

SST_MED_SST_L4_NRT_OBSERVATIONS_010_004

MEDITERRANEAN SEA HIGH RESOLUTION AND ULTRA HIGH RESOLUTION SEA SURFACE TEMPERATURE ANALYSIS

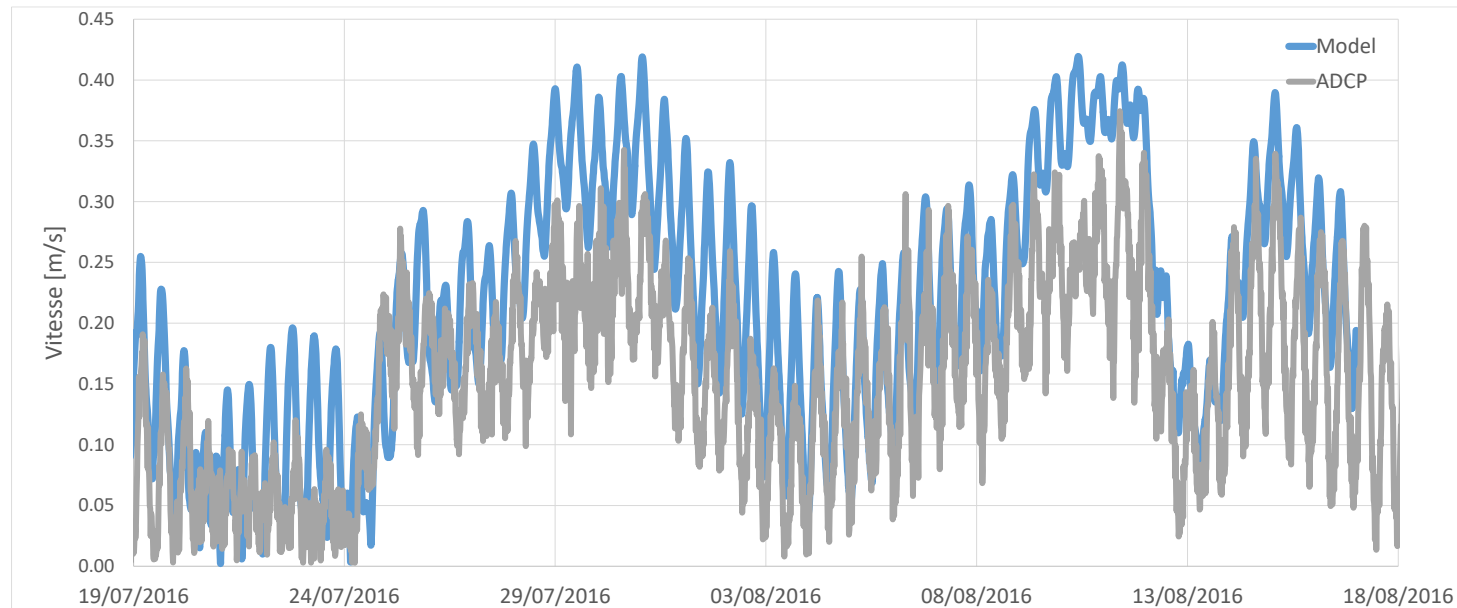
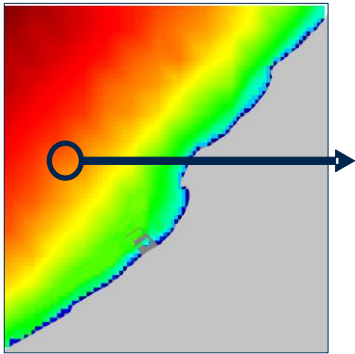
OBSERVATION	L4	MED
SST	①	
0.01 degree x 0.01 degree (Surface only)		
From 2008-01-01 to Present		
daily-mean		

MORE INFO ADD TO CART WMS Sub-setting



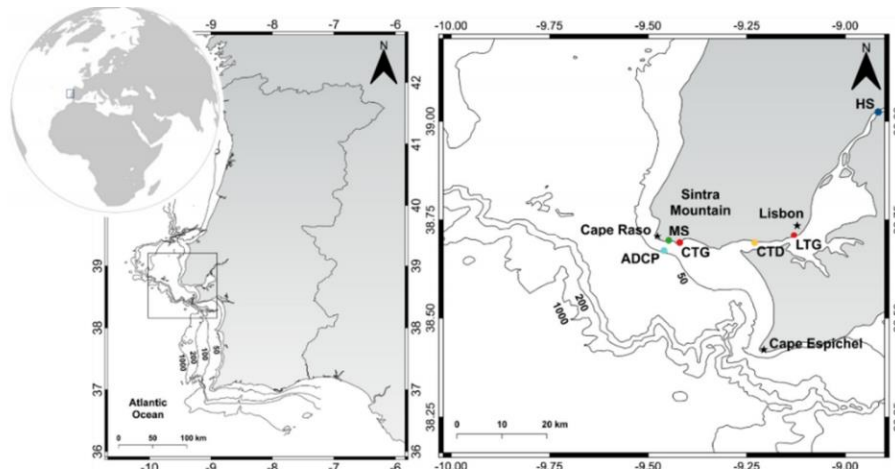
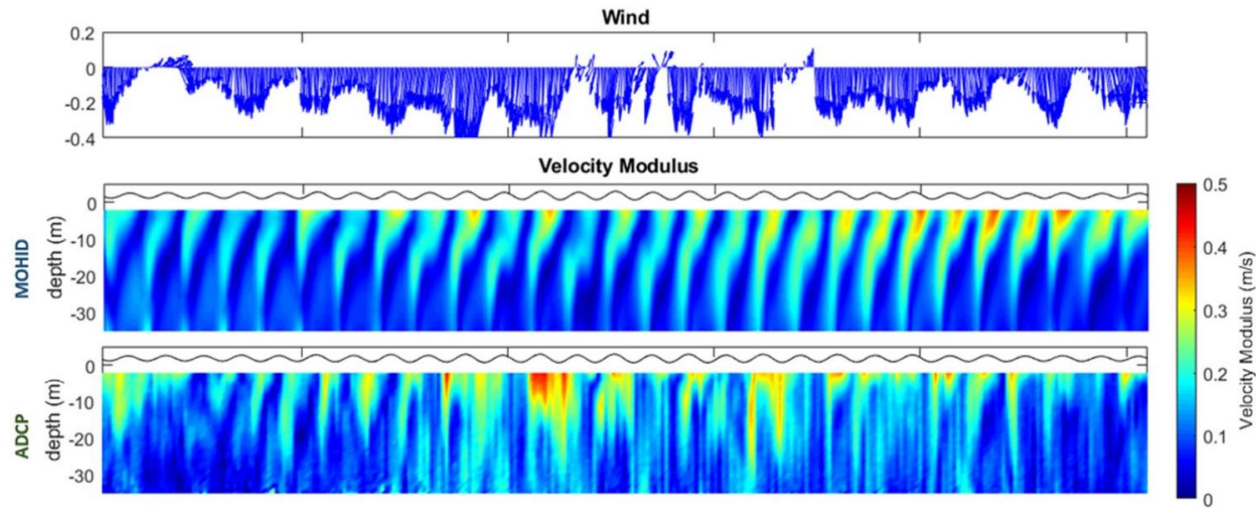
Validation - ADCP

Dakhla/Morocco



Validation - ADCP

Lisbon/Portugal



Validation – Drifters Korea



Hindawi
Discrete Dynamics in Nature and Society
Volume 2018, Article ID 6848745, 15 pages
<https://doi.org/10.1155/2018/6848745>



Research Article
**Prediction of Drifter Trajectory Using
Evolutionary Computation**

Yong-Wook Nam and Yong-Hyuk Kim 

Department of Computer Science, Kwangju University, 20 Kwangju-ro, Nowon-gu, Seoul 01897, Republic of Korea

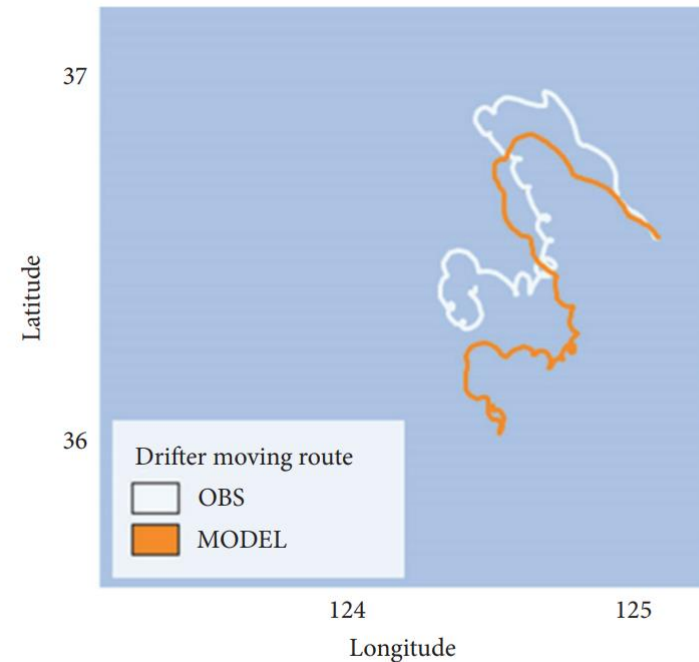
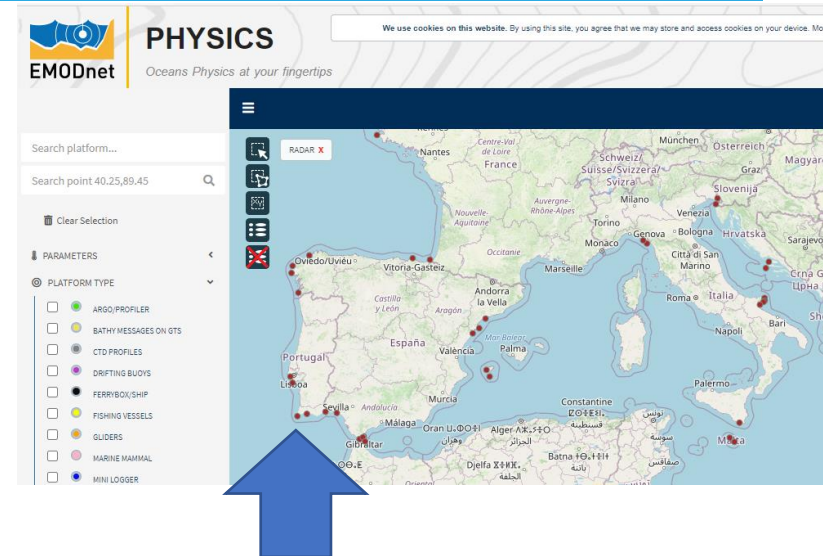
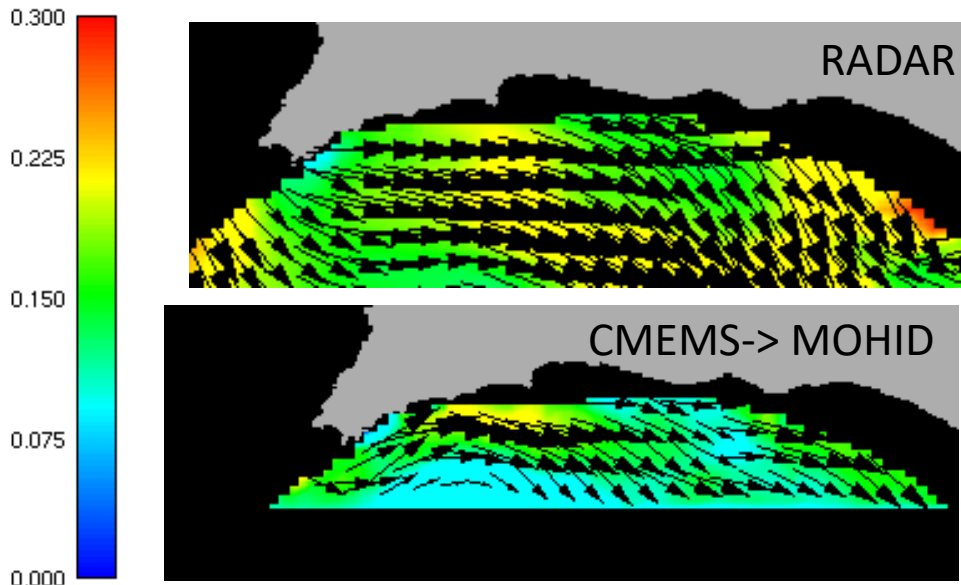


FIGURE 3: Observed trajectory of drifter (OBS) and predicted one of MOHID model to be compared with our predicted models (Case 1).

Validation – HF-Radar Algarve/Portugal

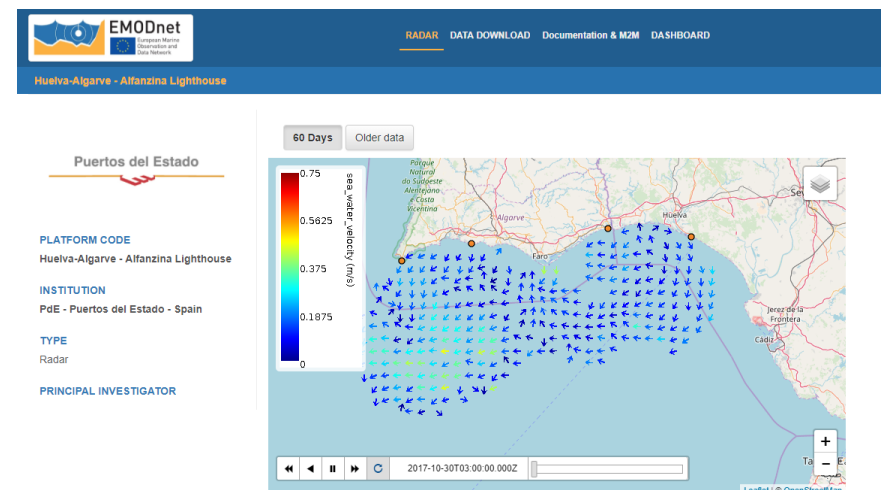


Lisboa, 19, 20 e 21 de junho de 2018

Downscaling CMEMS IBI 3D hourly solution

Leitão P. (1), A. Silva (1), J. Rodrigues (1), S. Bartolomeu (1) and J. Leitão (1)

(1) HIDROMOD, R. Rui Teles Palhinha, Nº4, 1º, 2740-278, Porto Salvo. E-mail: paulo.chambel@hidromod.com



Conclusions



ODYSSEA

- CMEMS forecasts can be downscale to support services at the local scale;
- Before implementing a complex downscale process it is necessary to **define the question to answer**;
- Validation is a critical component of any service. The end user needs to know the forecasts uncertainty.



ODYSSEA

**Creating products and knowledge
for the Mediterranean**

THANK-YOU

Paulo Leitão

HIDROMOD

paulo.chambel@hidromod.com



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727277