MOHID Applications by CIMA Around the World

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UAlg CIMA

UNIVERSIDADE DO ALGARVE

CENTRO DE INVESTIGAÇÃO MARINHA E AMBIENTAL

Summary

- The CIMA Research Centre
- Training Activities
- Coastal and Ocean Dynamics
  - The Fly River Turbid Plume (Australia)
  - Hypersaline Density-driven Circulation (Australia)
  - OCASO (SW Iberia Environmental Observatory)
- Oil Spills
  - The ARGOMARINE system (Tyrrhenian Sea)
  - Cooperation with Portuguese Navy / AMN (Portuguese Coast)
  - Hazard in the Atlantic (Atlantic Ocean)
- Water Quality
  - WWTP management by AdA (Ria Formosa)
  - Integral Management of Cartagena Bay (Colombia)

O CIMA

Multidisciplinary centre with the **mission** of promoting knowledge and innovation in environmental and marine sciences.

Activities:

i. Research
ii. Training
iii. Environmental Monitoring
iv. Knowledge Transfer




CIMA Key Areas

Climate Change

Ocean Observation

Transitional Systems

Coastal Dynamics and Risks

Environmental Quality and Remediation

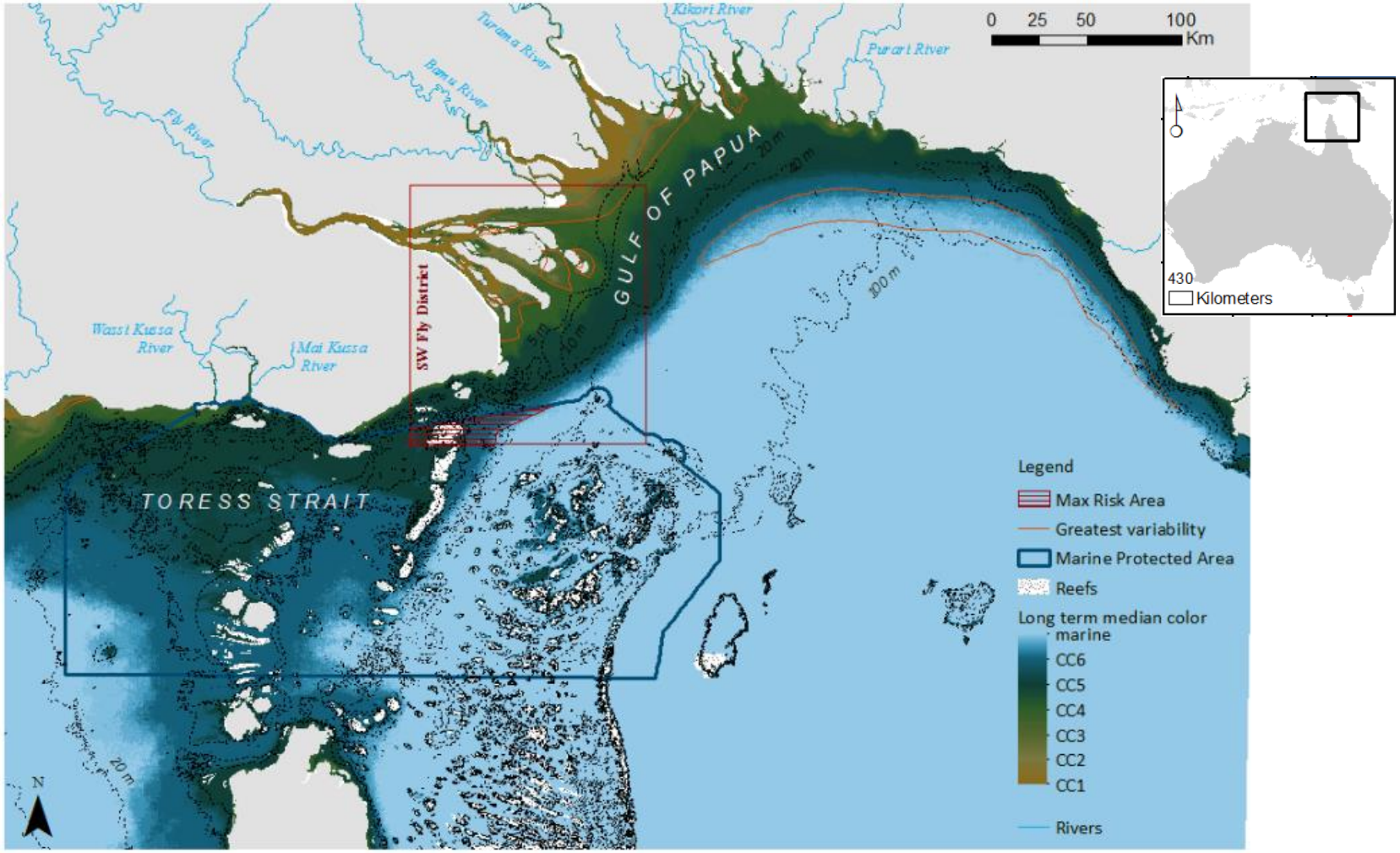
Energy and Resources

MOHID
Training Activities

- Erasmus Mundus Master in Water and Coastal Management
- Mestrado em Estudos Marinhos e Costeiros (UAlg)
- Master in Marine and Coastal Systems (UAlg)
- Master in Urban Water Cycle (UAlg)
- Mestrado em Engenharia Mecânica (UAlg)
- Pós-graduação em Proteção Costeira e Fluvial (UAlg)
- Master in Water Science and Engineering (IHE-Delft)

Coastal and Ocean Dynamics

The Fly River Turbid Plume (Australia)



Coastal and Ocean Dynamics

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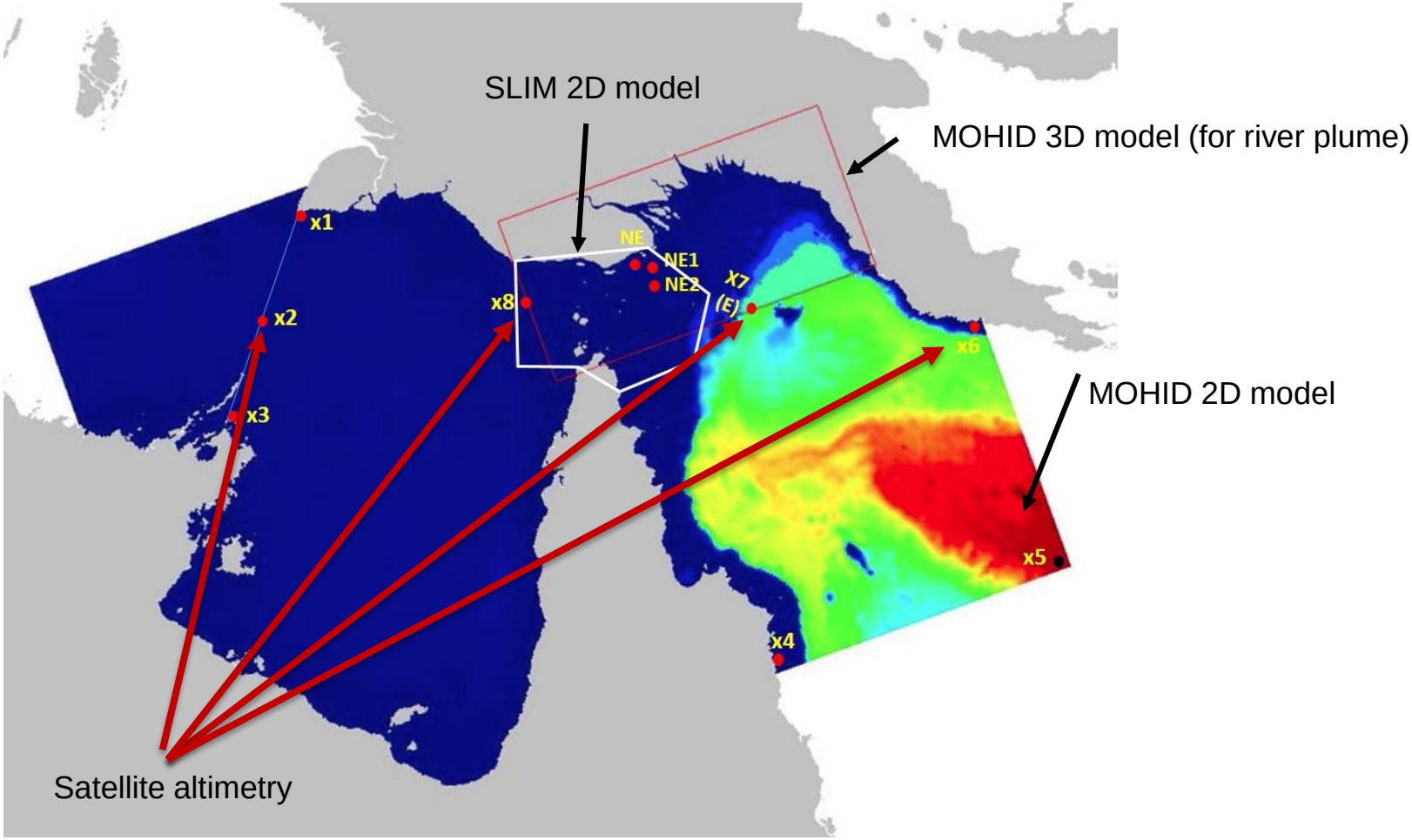
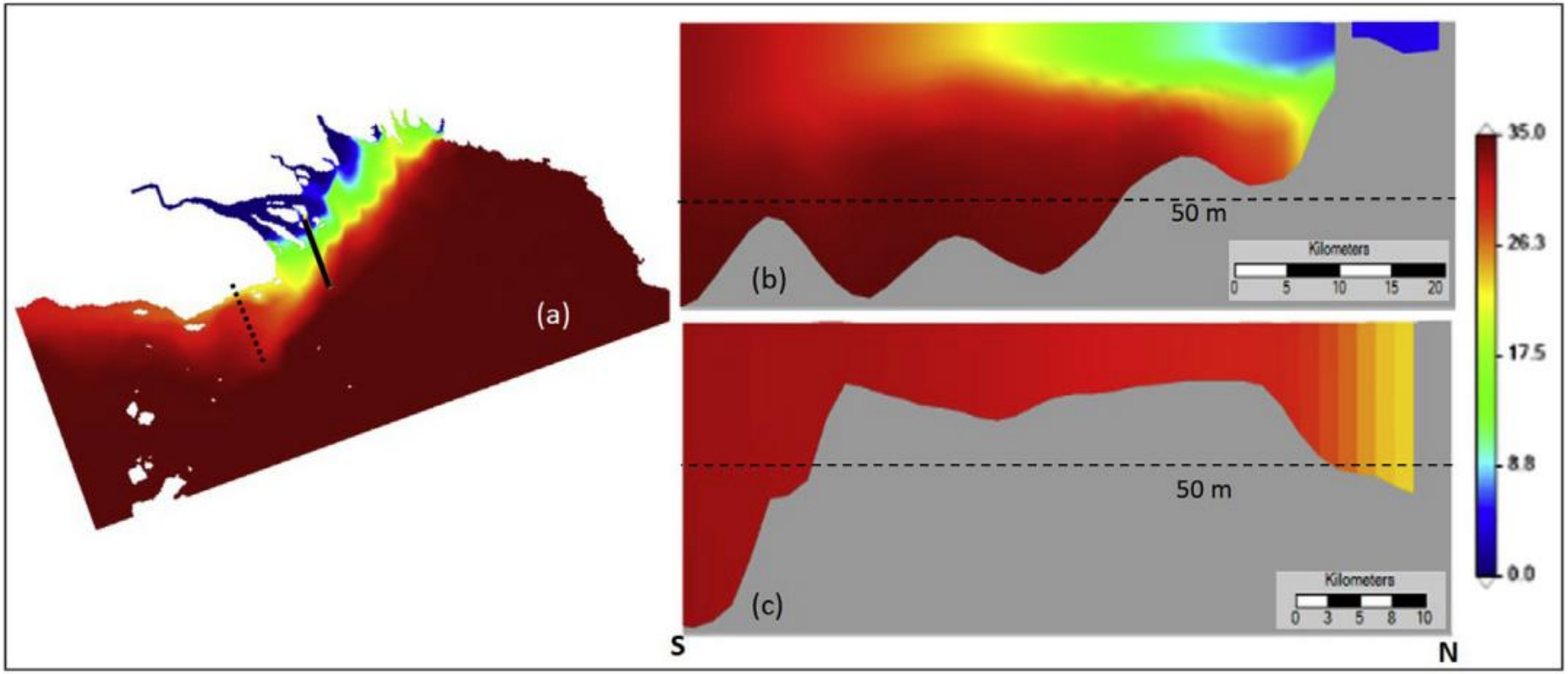


Coastal and Ocean Dynamics

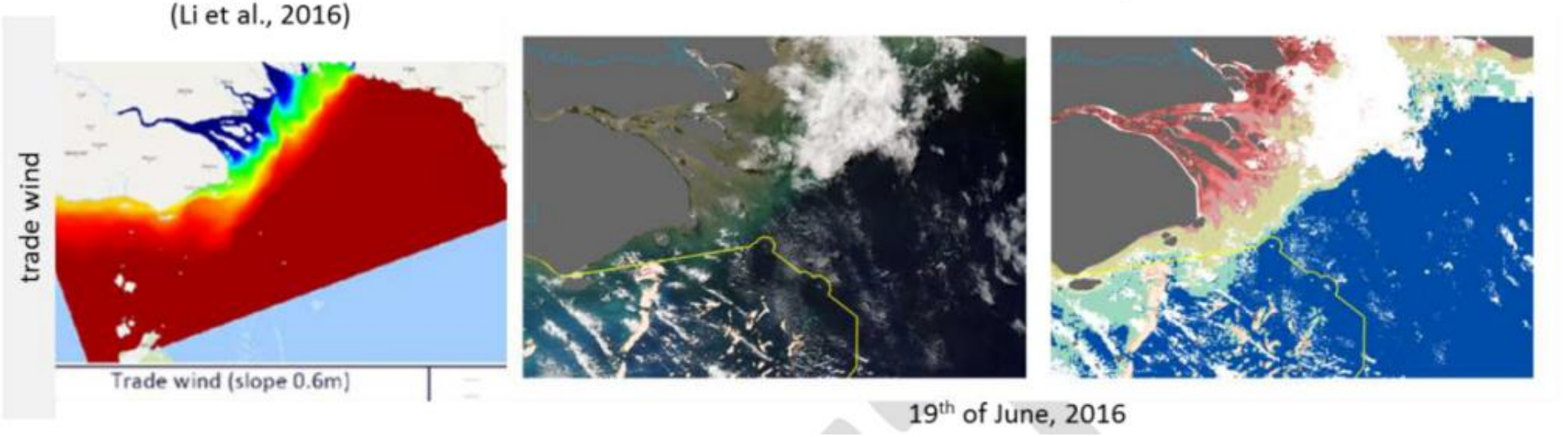
The Fly River Turbid Plume (Australia)



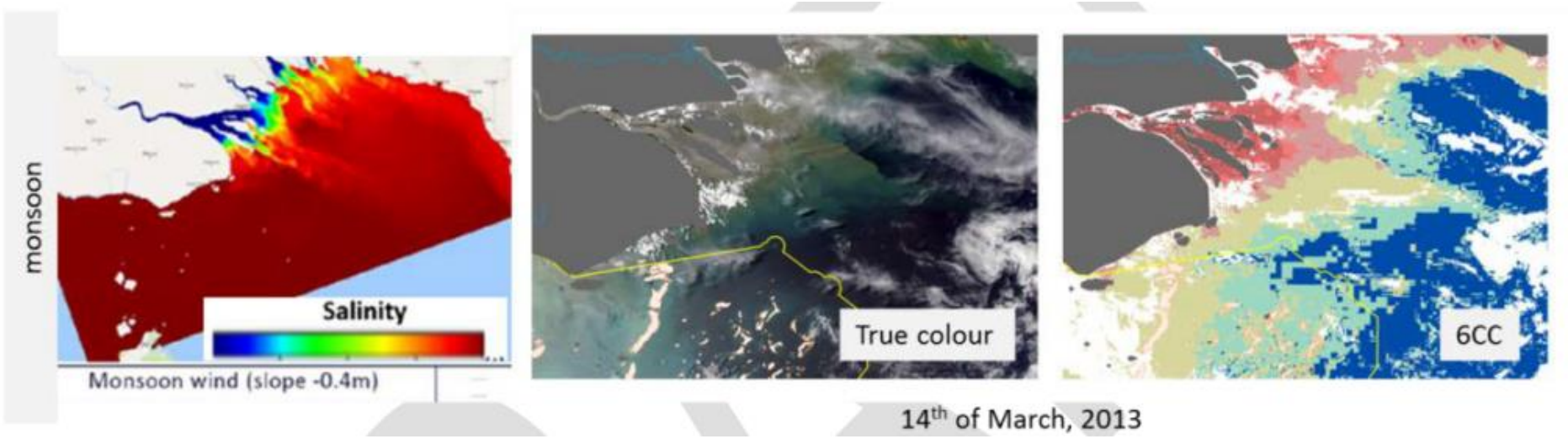
Coastal and Ocean Dynamics
The Fly River Turbid Plume (Australia)

Oceanographic model
(Li et al., 2016)

MODIS examples



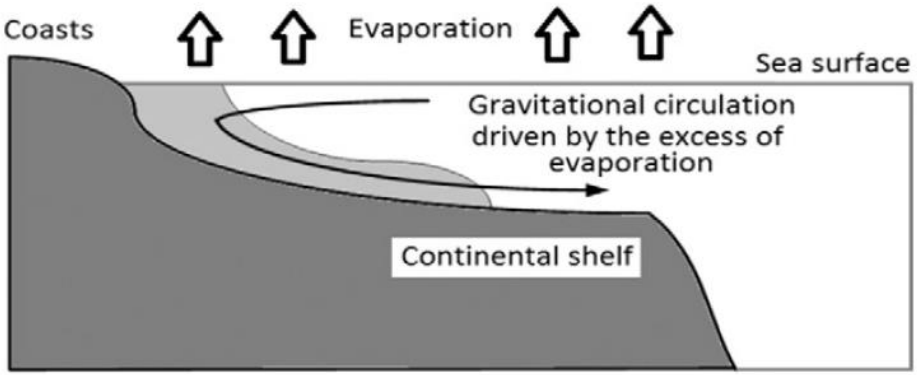
Coastal and Ocean Dynamics
The Fly River Turbid Plume (Australia)

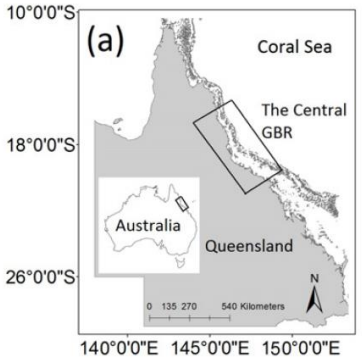


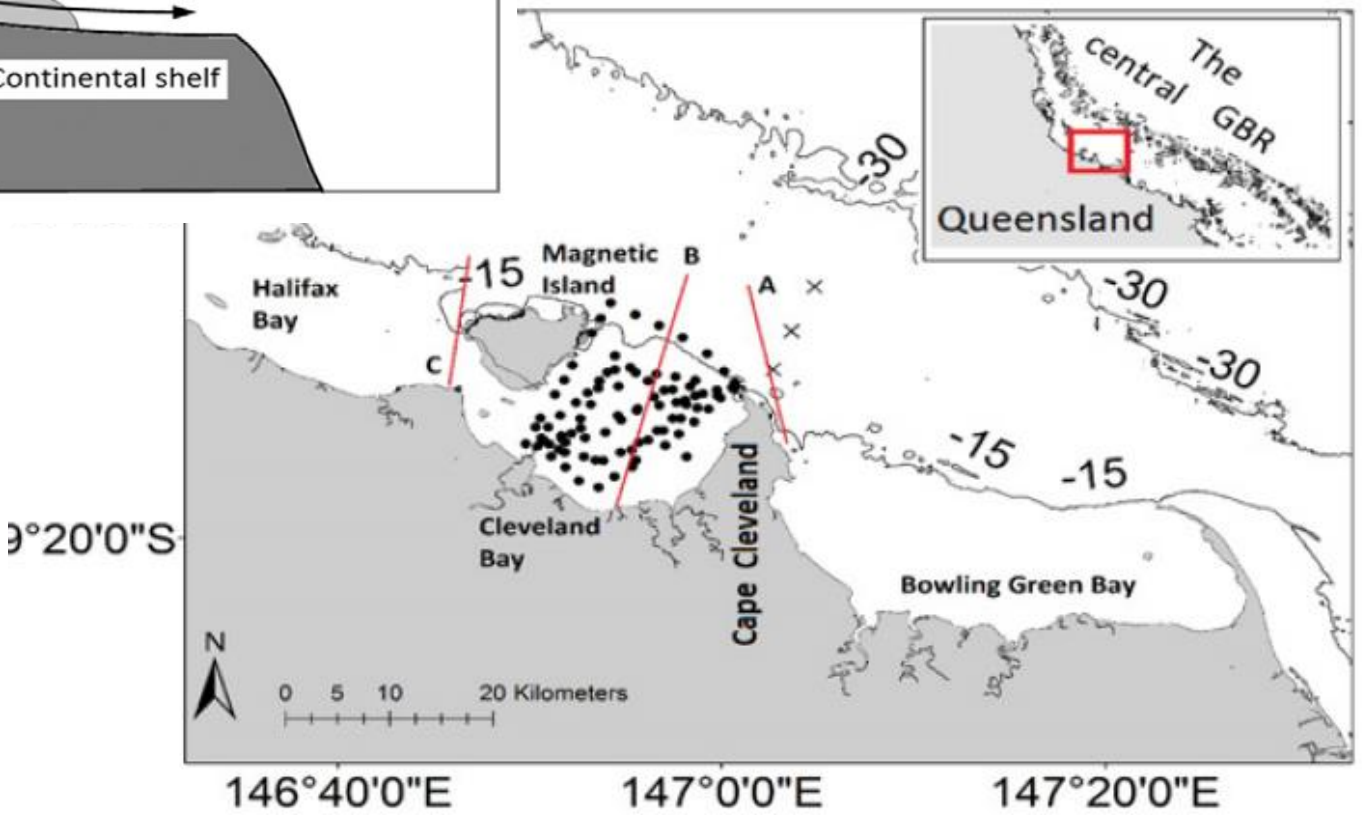
Li, Y., Martins, F. and Wolanski, E., 2017. Sensitivity analysis of the physical dynamics of the Fly River plume in Torres Strait. Estuarine, Coastal and Shelf Science, 194:84-91.

Coastal and Ocean Dynamics

Hypersaline Density-driven Circulation (Australia)







Coastal and Ocean Dynamics

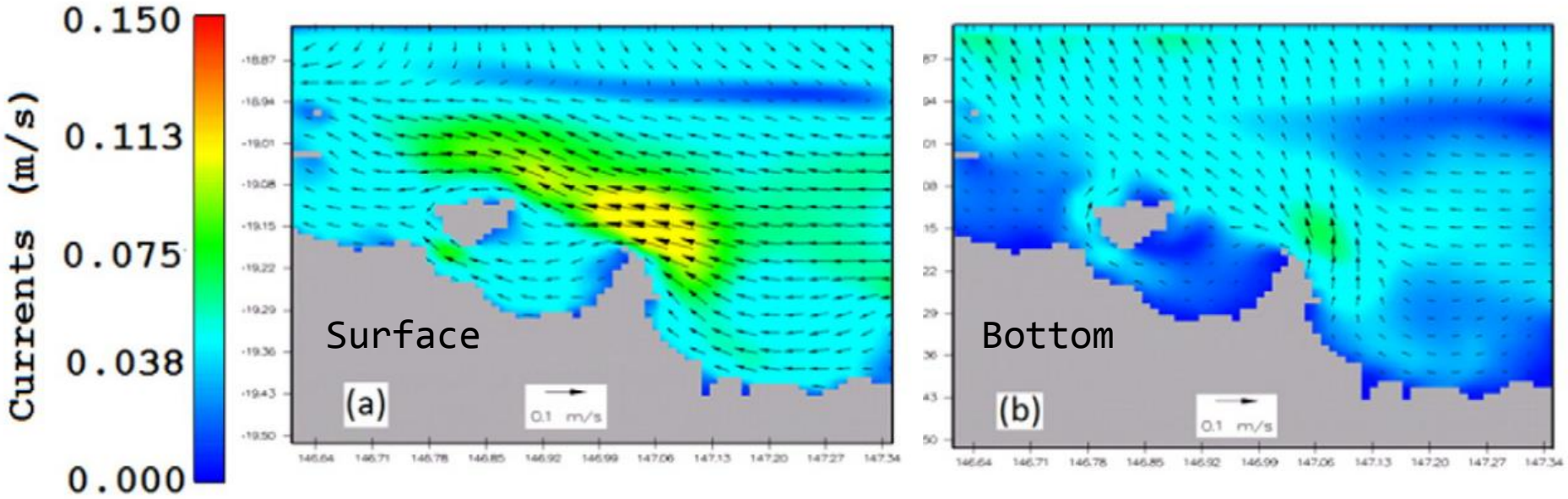
Hypersaline Density-driven Circulation (Australia)

Geometry:20 Cartesian layers; DX=DY= 100 m (Deepreef Project)

Wind and Evaporation from Atmospheric data (BOM)

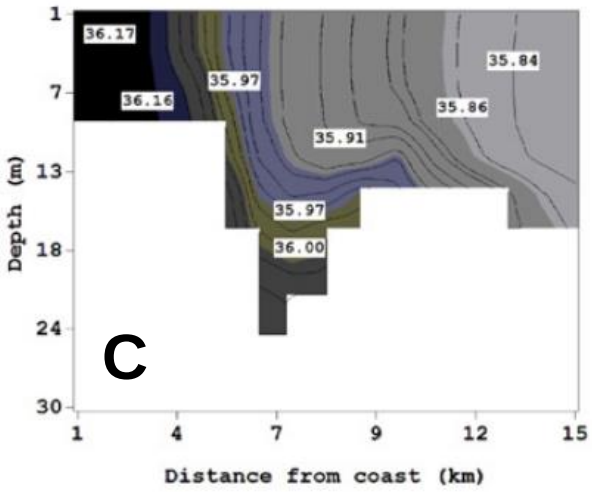
Initial and boundary data from measurements

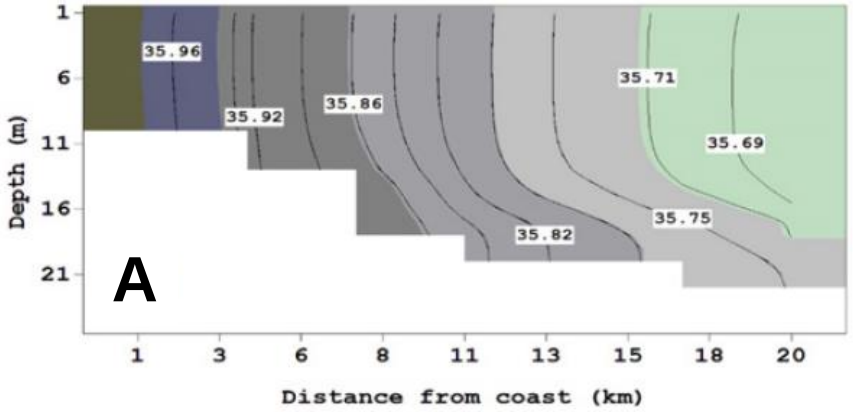
Residual Currents August 1st. to October 31st.

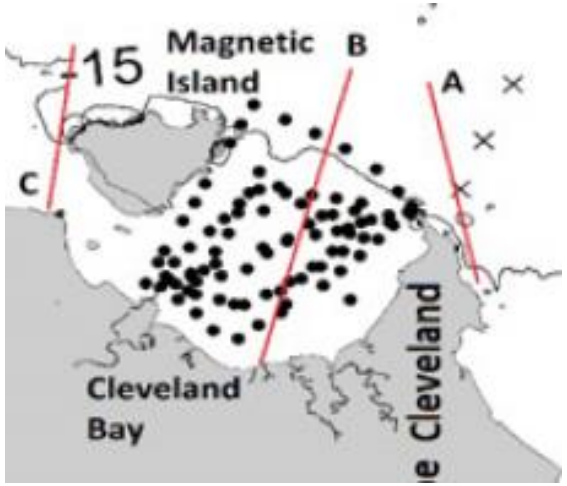


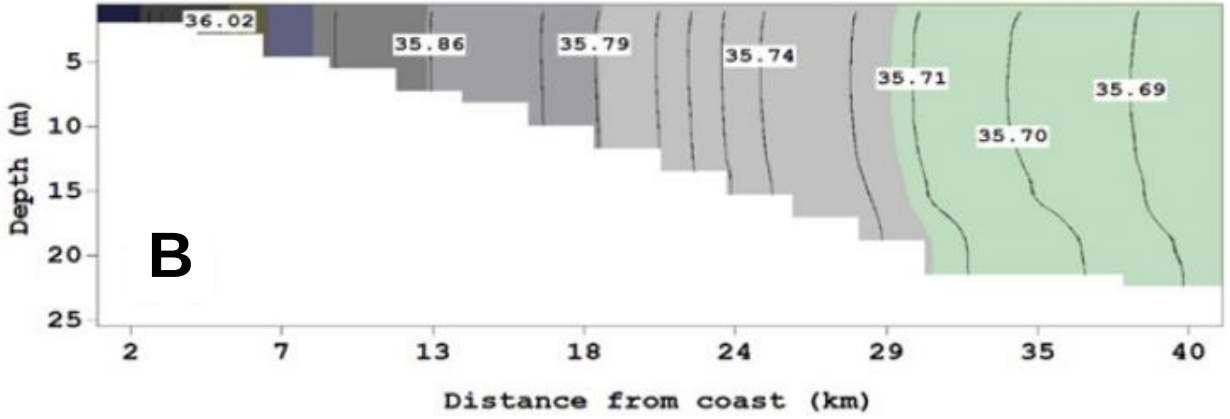
Coastal and Ocean Dynamics

Hypersaline Density-driven Circulation (Australia)



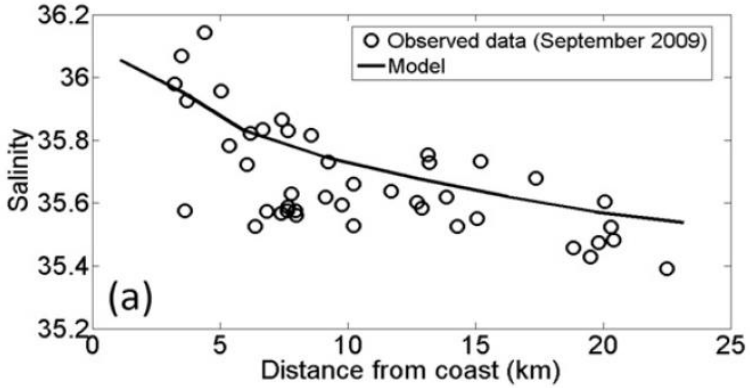


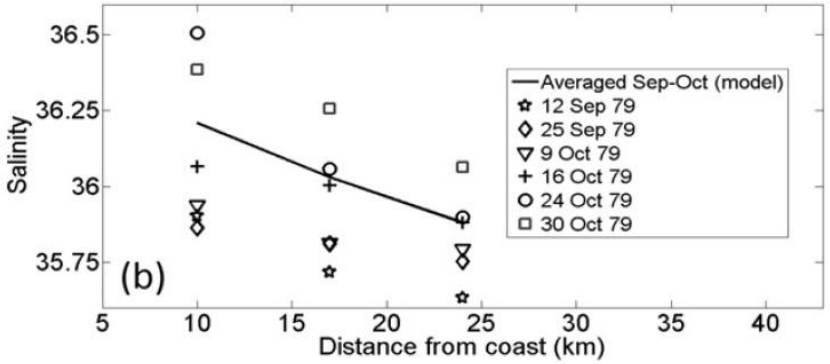


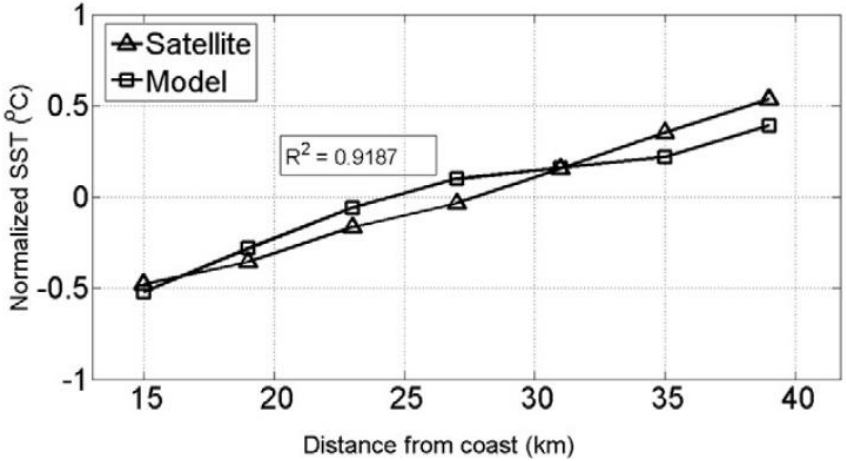


Coastal and Ocean Dynamics

Hypersaline Density-driven Circulation (Australia)







Salamena, G.G., Martins, F., Ridd, P.V., 2016. The density-driven circulation of the coastal hypersaline system of the Great Barrier Reef, Australia. Marine Pollution Bulletin, 105:277-285

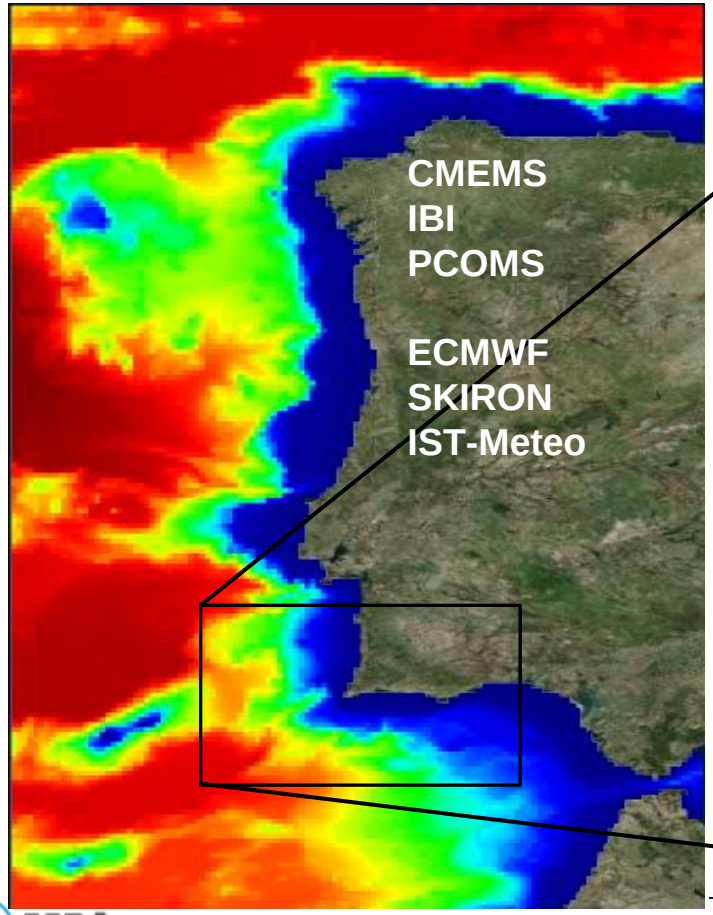
Coastal and Ocean Dynamics

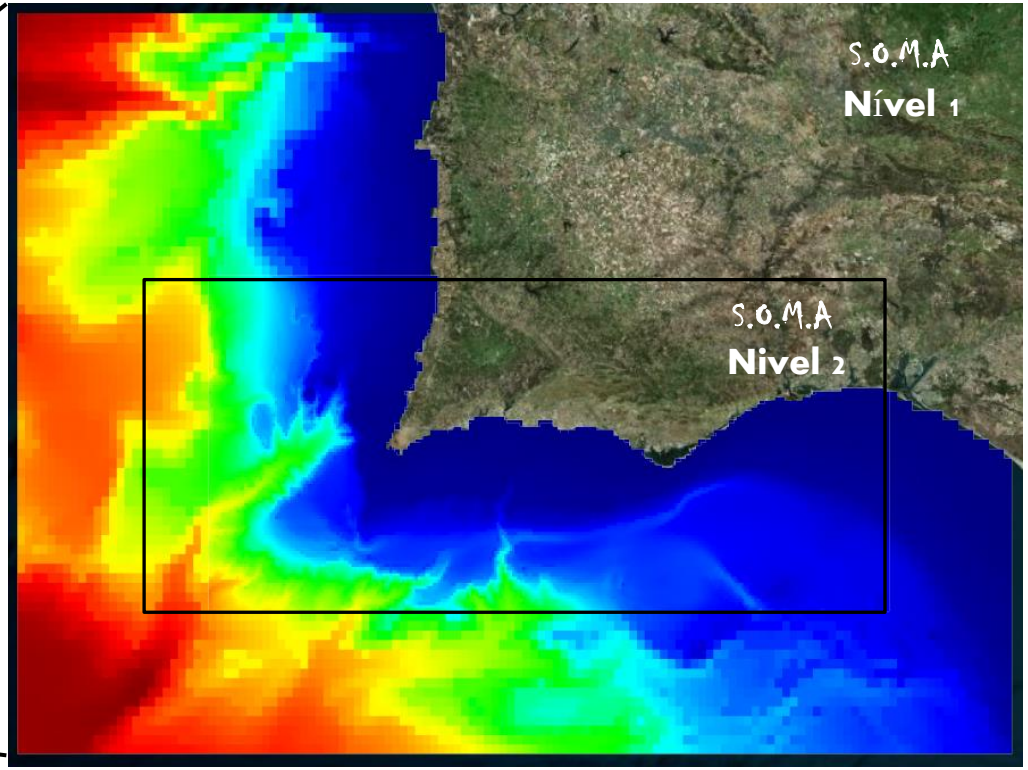
OCASO (SW Iberia Environmental Observatory)

Budget: **€ 1.3 Mio. for 3 years (2017 - 2019)**
Partners: **5 (UCA, UAlg, IH, IOE, Puertos del Estado).**

Interreg Europe
European Union | European Regional Development Fund

PROGRAMA COOPERACIÓN TRANSFRONTERIZA ESPAÑA - PORTUGAL





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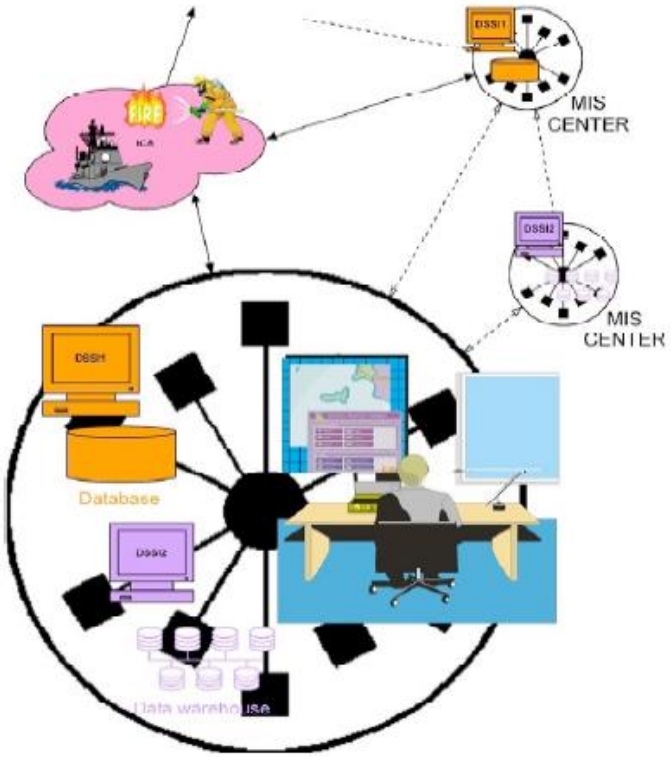
Oil Spills

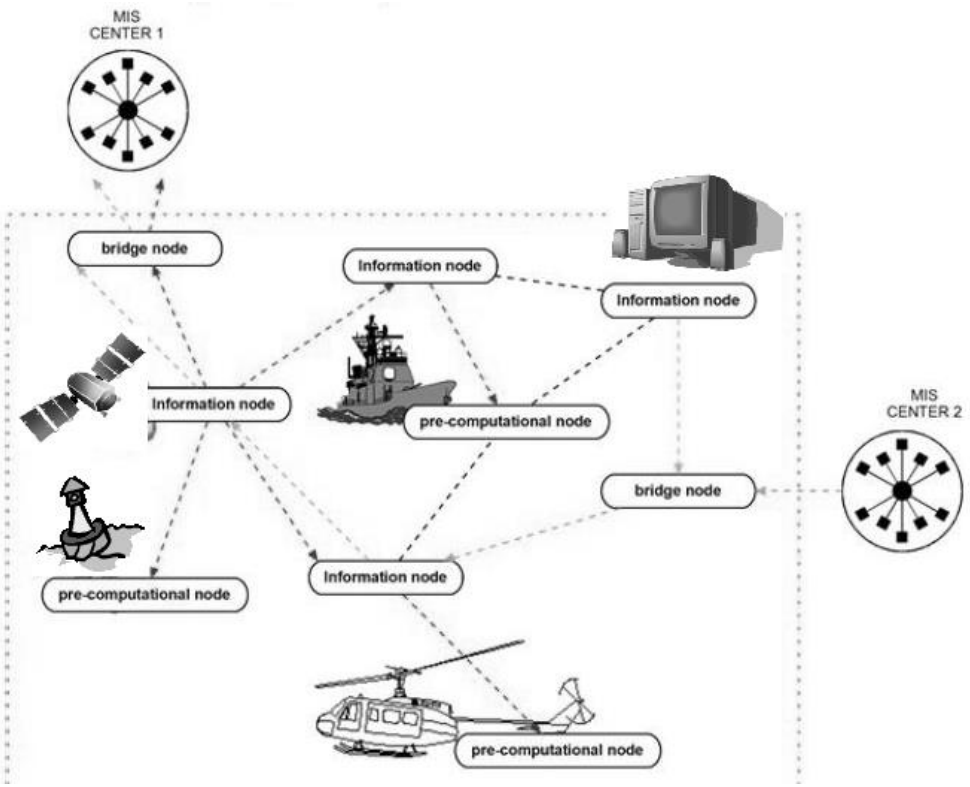
The ARGOMARINE system (Tyrrhenian Sea)

Marine Information System (MIS)



Network of systems for data storage, data mining and analysis, decision-support and data warehouses.

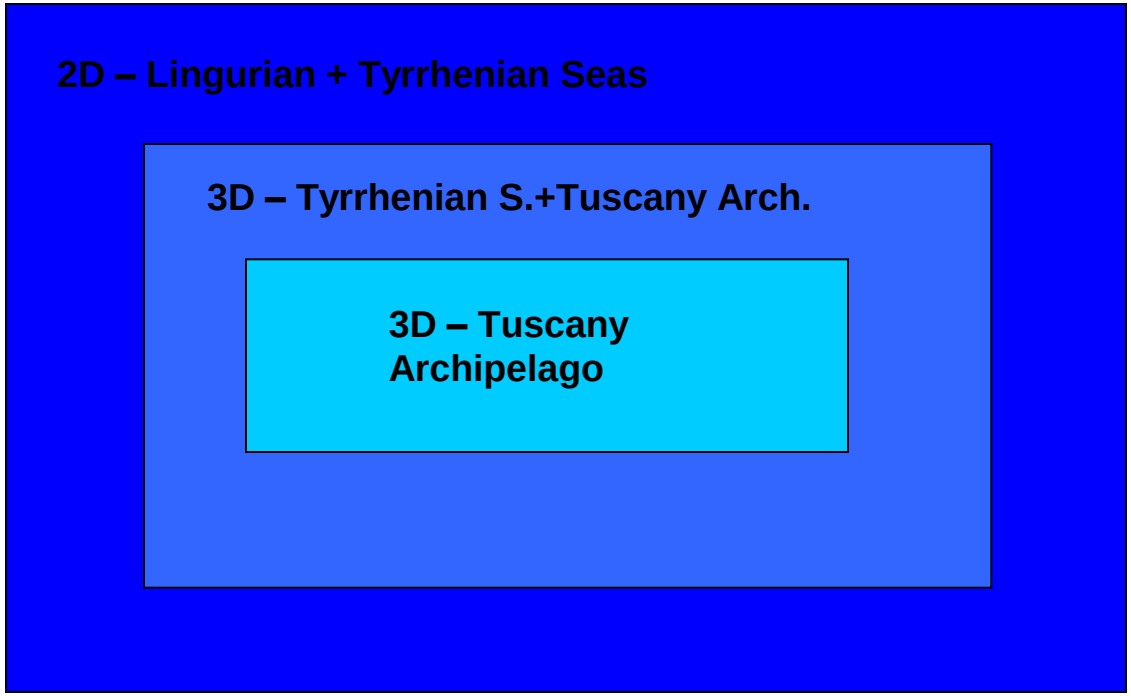
Integrated Communication System (ICS)



Ensures reliable and efficient data transmission from different types of sensors to the MIS, providing accurate geopositioning of every data item.

Oil Spills
The ARGOMARINE system (Tyrrhenian Sea)

3 Grids system

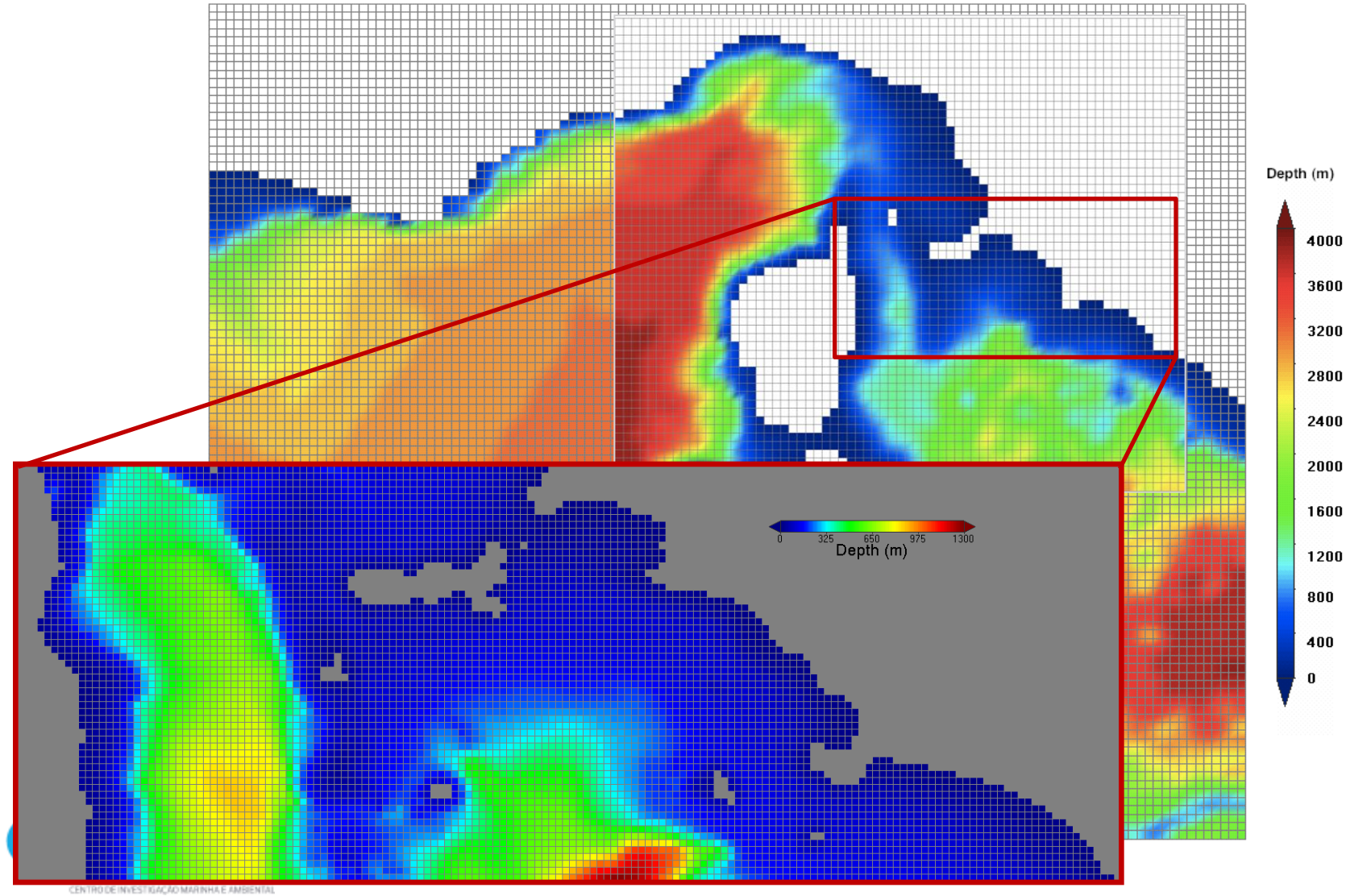


Open Boundary Conditions

- 1 Way Nesting
- Sea Level: (Blumberg and Kantha, 1985)
- Velocity & Water Properties: Flow Relaxation Scheme (Martinsen and Engedahl, 1987)
- Spounge Layer

Oil Spills

The ARGOMARINE system (Tyrrhenian Sea)



Oil Spills
The ARGOMARINE system (Tyrrhenian Sea)

Bathymetry : GEBCO 30'

Wind : SKIRON (hourly 5.5km)

Atmosferic fluxes : MFS (daily 6.9km)

Tide : FES '04 (13.9 km)

Boundaries T,S,u,v: MFS (daily 6.9km)

3D Baroclinic models

2D Barotropic model

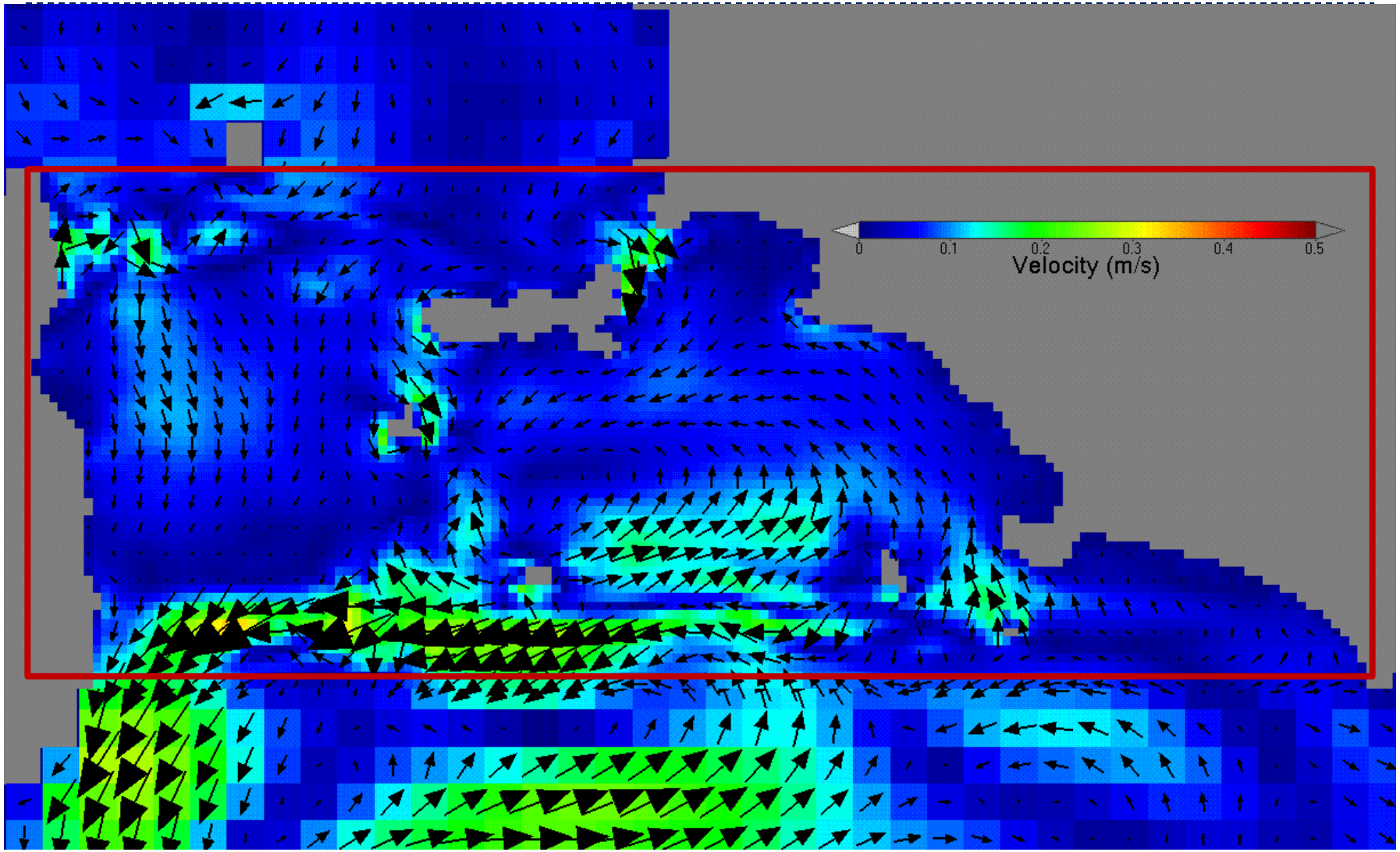
Climatology: Medatlas (monthly 22.2km)

Other model: Mercator (daily 9.3km)

In situ data - buoys: IDROMARE

Oil Spills

The ARGOMARINE system (Tyrrhenian Sea)



Oil Spills

The ARGOMARINE system (Tyrrhenian Sea)

Oil Spills

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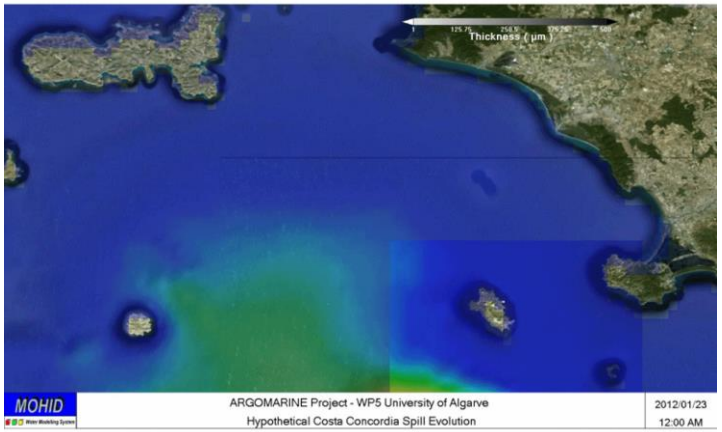
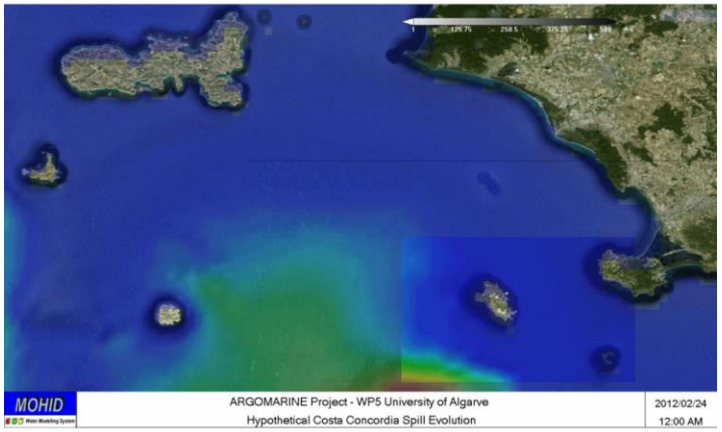
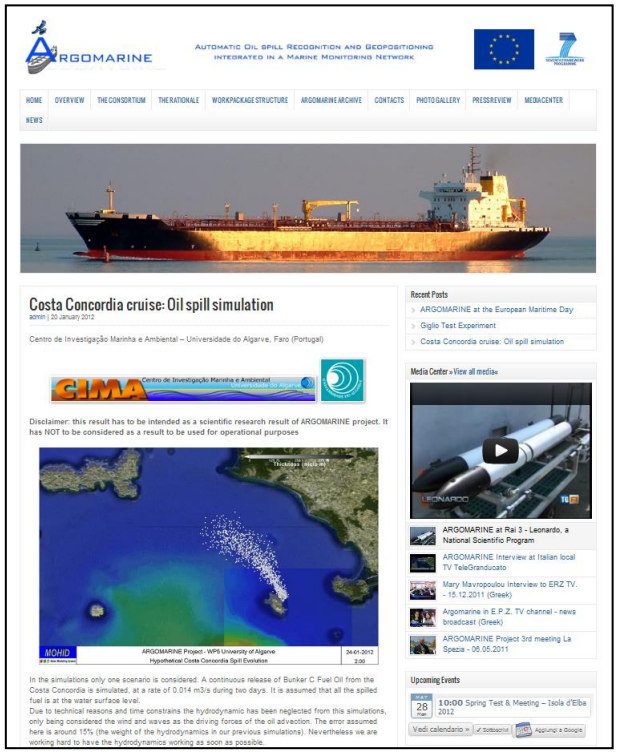






Janeiro, J., Zacharioudaki, A., Sarhadi, E., Neves, A. & Martins, F., 2014, Enhancing the management response to oil spills in the Tuscany Archipelago through Operational modelling, Marine Pollution Bulletin, 85:574–589.

De Dominicis, M., Falchetti, S., Trotta, F., Pinardi, N., Giacomelli, L., Napolitano, E., Fazioli, L., Sorgente, R., Haley Jr., P.J., Lermusiaux, P.F.J., Martins, F. & Cocco, M., 2014. A Relocatable Ocean Model in support of environmental emergencies - The Costa Concordia emergency case, Ocean Dynamics 64-5:667-688.

Oil Spills

Cooperation with PT Navy / AMN (Portuguese Coast)

COOPERATION WITH AMN

- **Ria Formosa Exercise (2014)**
- **Cascais International Exercise (2015)**
- **Atlantic POLEX.PT16 International Exercise (Portimão, 2016)**
- **Atlantic POLEX.PT17 International Exercise (V. R. Sto. António, 2017)**

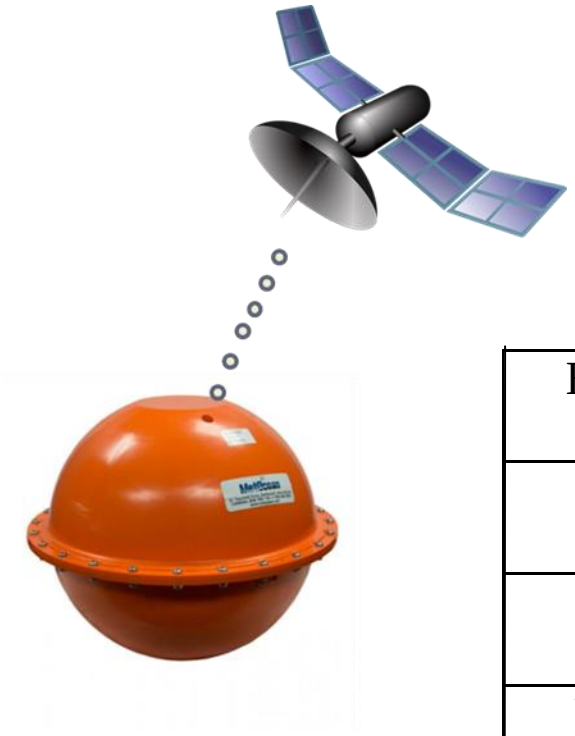
Oil Spills

Cooperation with PT Navy / AMN (Portuguese Coast)

POLEX.PT17 Exercise

Oil Spills

Cooperation with PT Navy / AMN (Portuguese Coast)



POLEX.PT17 Exercise

	"IBI" Runs	**"SOMA" Runs**
Hydrodynamic Model	CMEMS-IBI	SOMA
Horizontal Resolution	1/36° (2.3 km)	1 km
Vertical Resolution	50 z-layers (up to 1m @ surface)	
Wind Forcing	ECMWF	"meteoTecnico"
Wind Resolution	9 km	
Wind drag on particles	"meteoTecnico"	

Oil Spills

Cooperation with PT Navy / AMN (Portuguese Coast)

MARPOCS

Home | Maps | Charts | Dashboard | Simul

Layers

Vulnerability Index i

- None
- Socio-Economic
- Ecological
- Environmental

Risk Index

- Vessel Accident Risk
- Shoreline Contamination Risk (non-modelled)

User Simulation Layers

- Zoom to Emission Point

POLEX_SOMA@17/10_15:00

Property

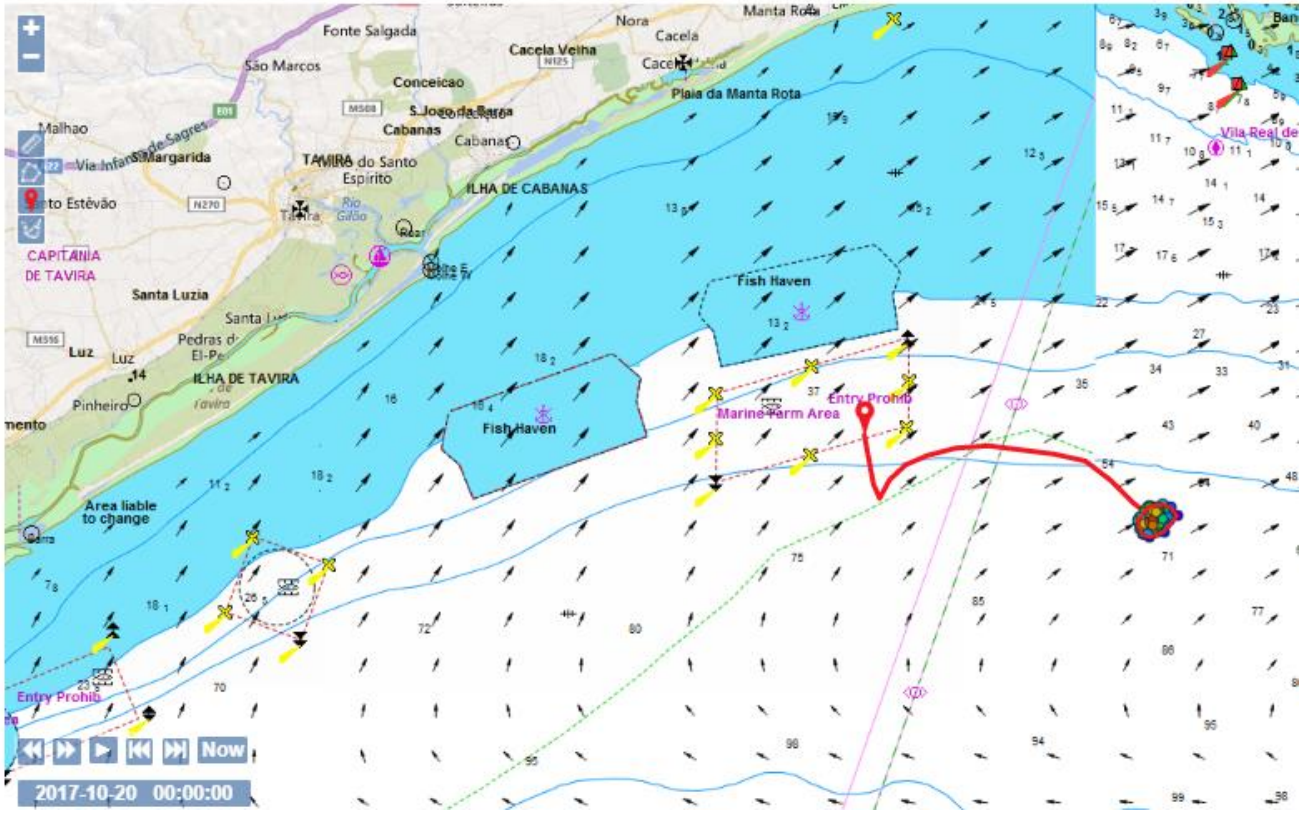
Thickness [um]

- Barrier
- Plume Envelope
- Plume Center Trajectory

General Options

- Tooltip on Mouse Stop

Map



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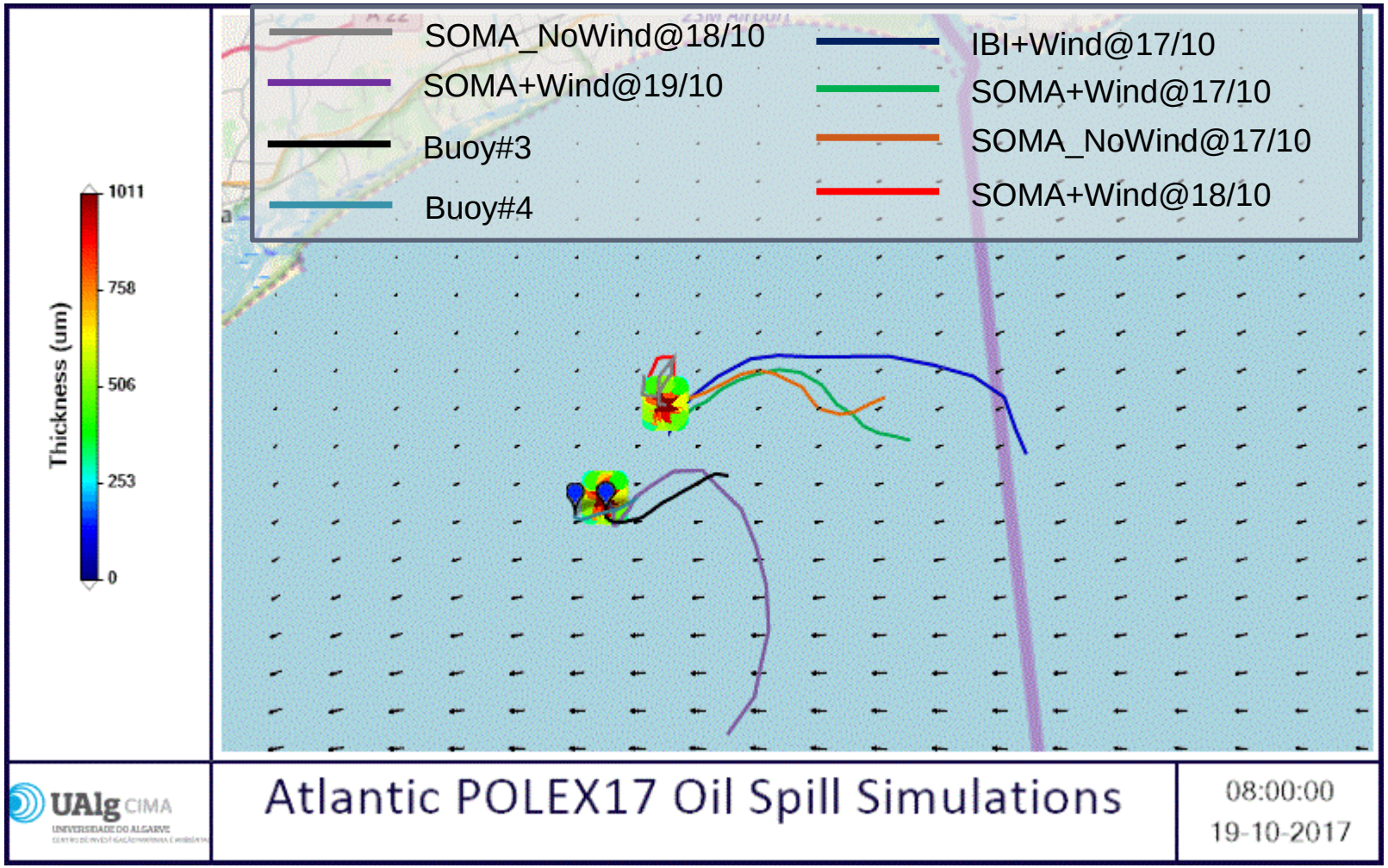
Oil Spills

Cooperation with PT Navy / AMN (Portuguese Coast)



Oil Spills

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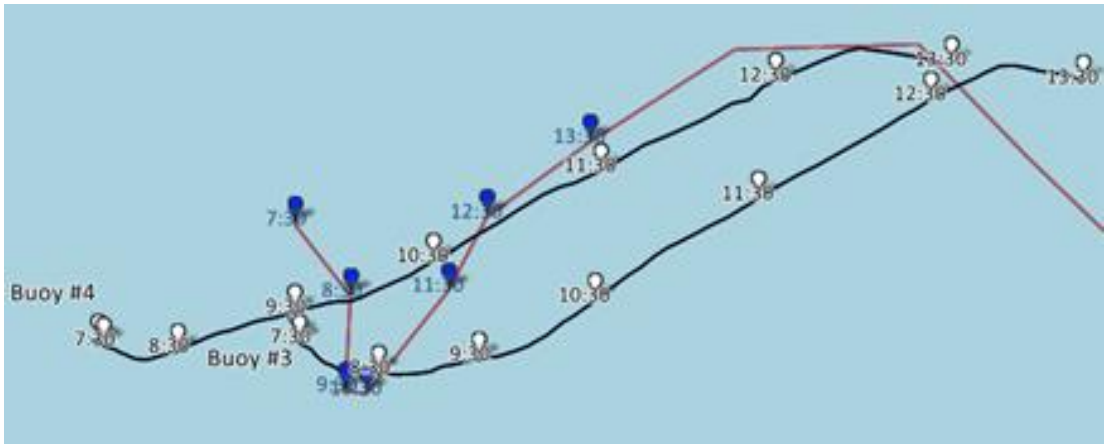


$$S = \sum_{i=1}^{N} d_i \Big/ \sum_{i=1}^{N} l_i$$

Martins, F., Janeiro, J., 2018. The role of high-resolution oil spill response models in emergency scenarios, The ATLANTIC POLEX.PT 2017 example. 5as Jornadas de Engenharia Hidrográfica, 19-21 junho, Lisboa.

Table III. Distances and errors between model and buoys.

Time	d #3 (m)	S #3	d #4 (m)	S #4
07:30	560	-	1085	-
08:30	390	0.88	856	2.38
09:30	647	0.76	439	1.00
10:30	1160	0.76	727	0.69
11:30	1509	0.70	907	0.54
12:30	2139	0.68	1482	0.50
13:30	2316	0.64	1743	0.47

Oil Spills

Hazard in the Atlantic (Atlantic Ocean)

AtlantOS

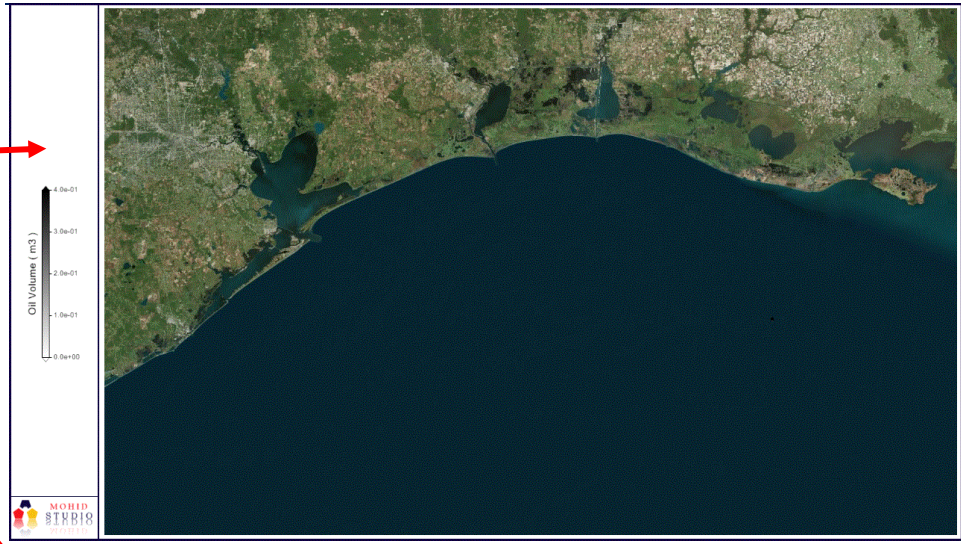
Optimizing and Enhancing the Integrated Atlantic Ocean Observing System

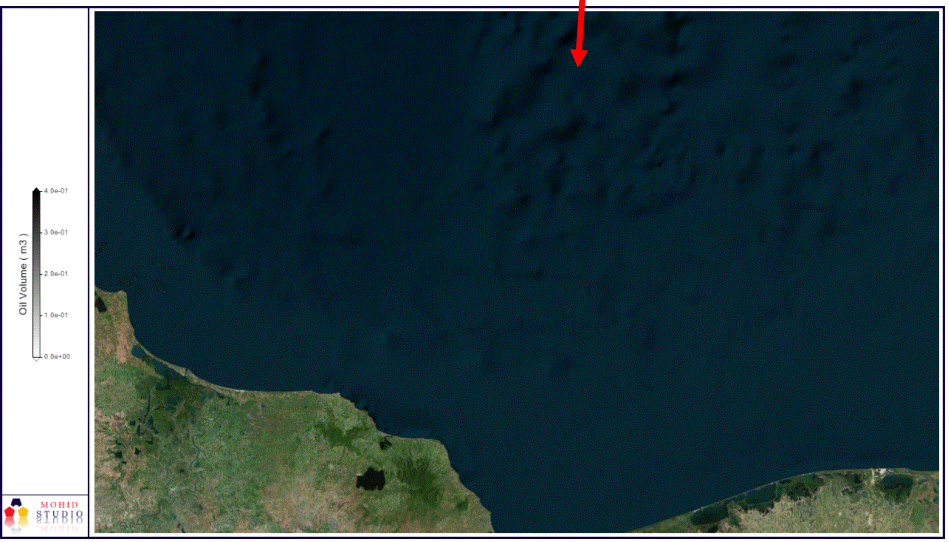
GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

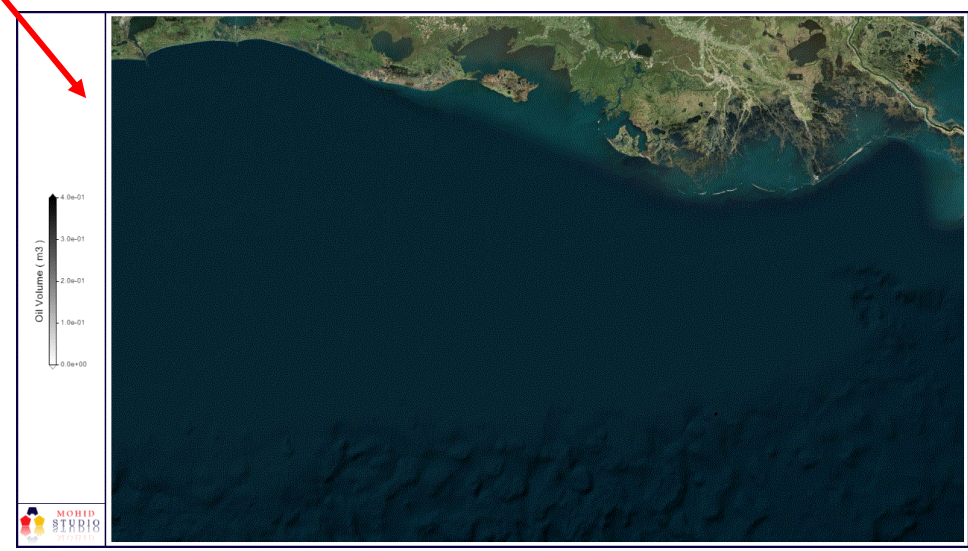
Budget: **€ 20.65 Mio. for 4 years (April 2015 - July 2019)**
Partners: **62 (research institutes, universities, marine service providers, multi-institutional organizations, international partners, private sector) from 18 countries (13 EU & 5 non-EU) plus supporters.**

Oil Spills

Hazard in the Atlantic (Atlantic Ocean)







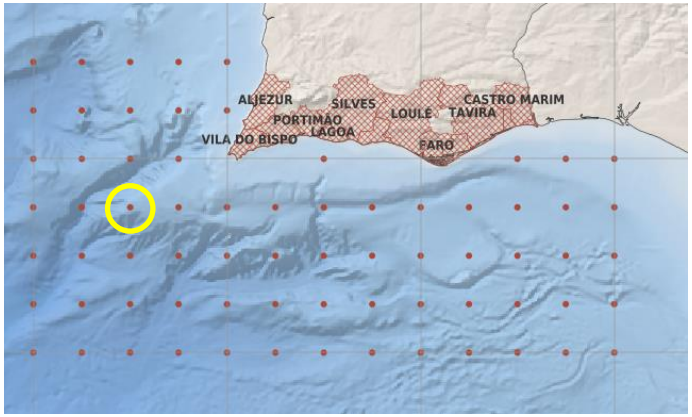
Oil Spills

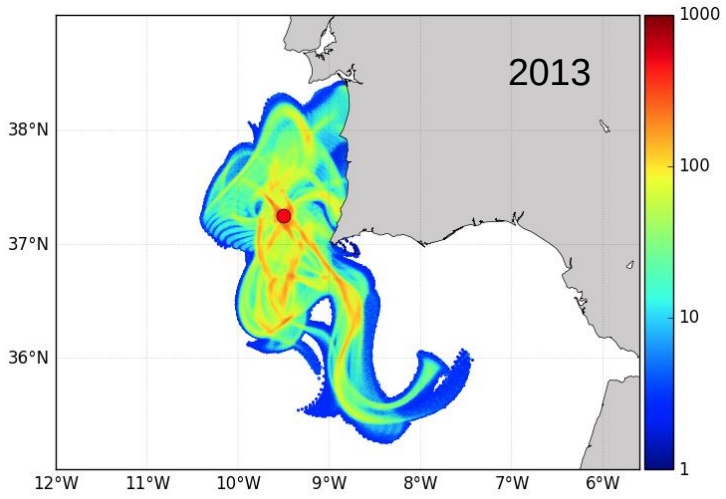
Hazard in the Atlantic (Atlantic Ocean)

Origins: 9000

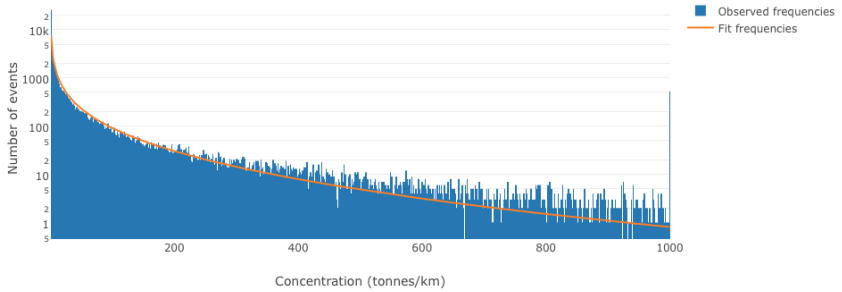
Simulations: >1.000.000

Estimated Time (100 CPU's): 2 month





Cumulative trajectories

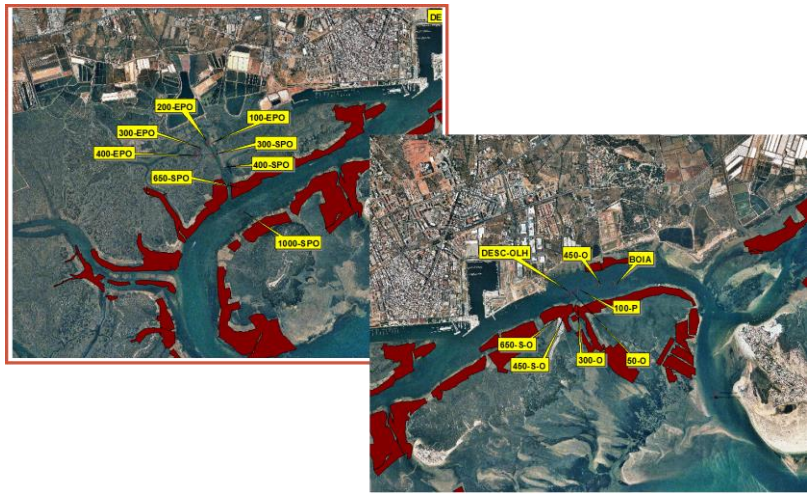


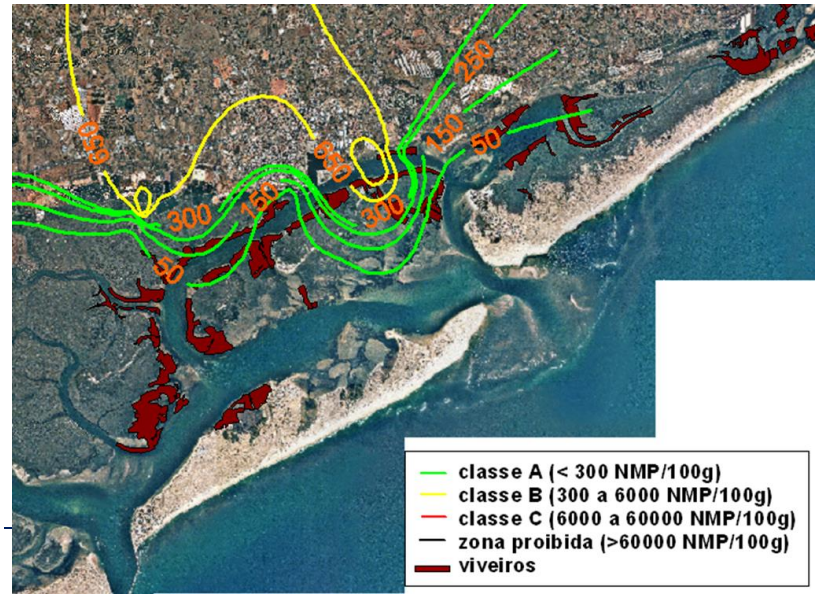
Janeiro, J., Neves, A., Martins, F. and Relvas, P., 2017. Integrating technologies for oil spill response in the SW Iberian coast. Journal of Marine Systems, 173:31-42

Neves, A., Pinardi, N., Martins, F., Janeiro, J., Samaras, A., Zodiatis, G., De Dominicis, M., 2015. Towards a common oil spill risk assessment framework – Adapting ISO 31000 and addressing uncertainties, Journal of Environmental Management, 159:158-168

Water Quality
WWTP management by AdA (Ria Formosa)

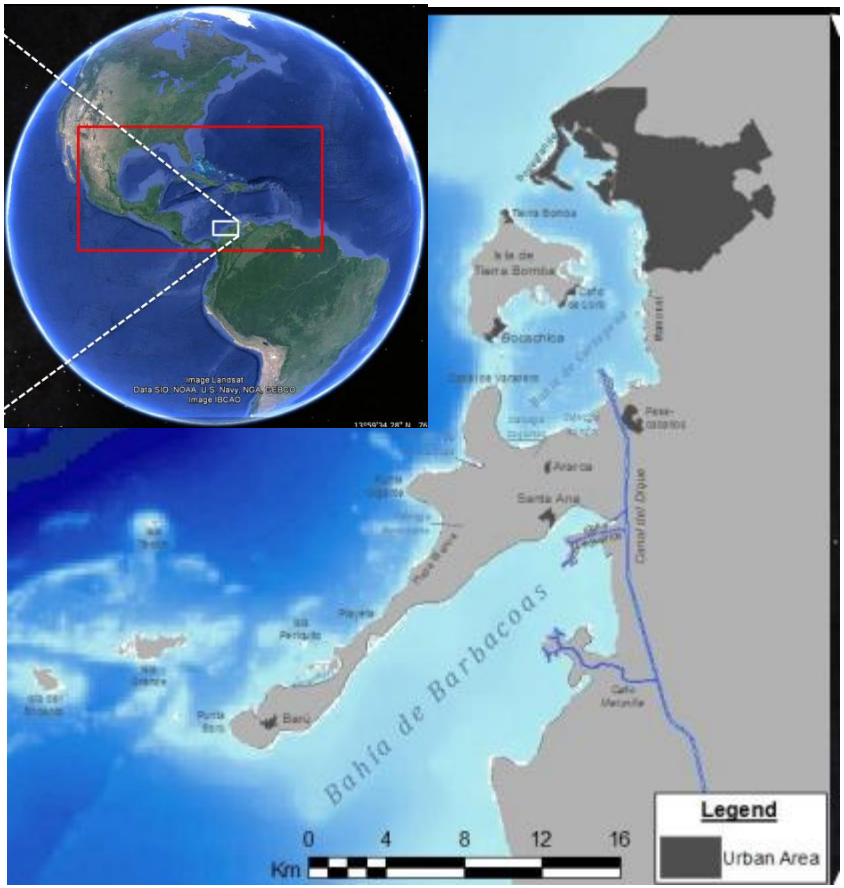
- 2004 Evaluation of the effect of WWTP discharges on the bivalve quality of Ria Formosa (CCDR/ARH)
- 2005-2006 Monitoring the receiving waters or urban WWTPs of Algarve (AdA)
- 2008-2011 Whole-system metabolism and CO2 fluxes in a coastal lagoon dominated by saltmarsh and seagrass meadows (FCT)
- 2010 Technical Study of the Receiving Waters of Faro and Olhão WWTP (AdA)
- 2014 Technical Study on support of Environmental Impact Assessment of Faro WWTP (AdA)

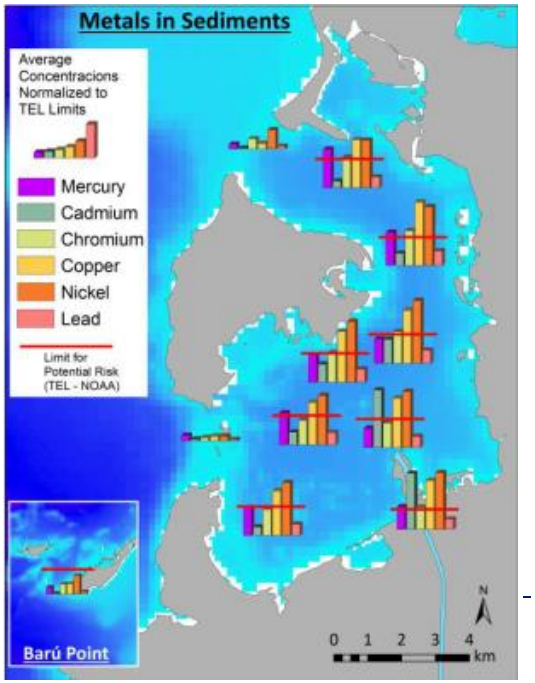




Water Quality

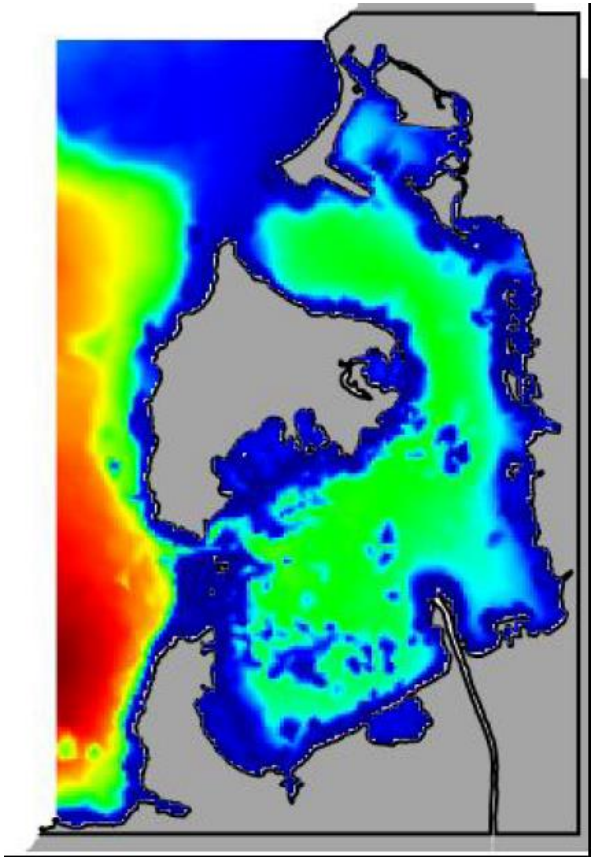
Integral Management of Cartagena Bay (Colombia))



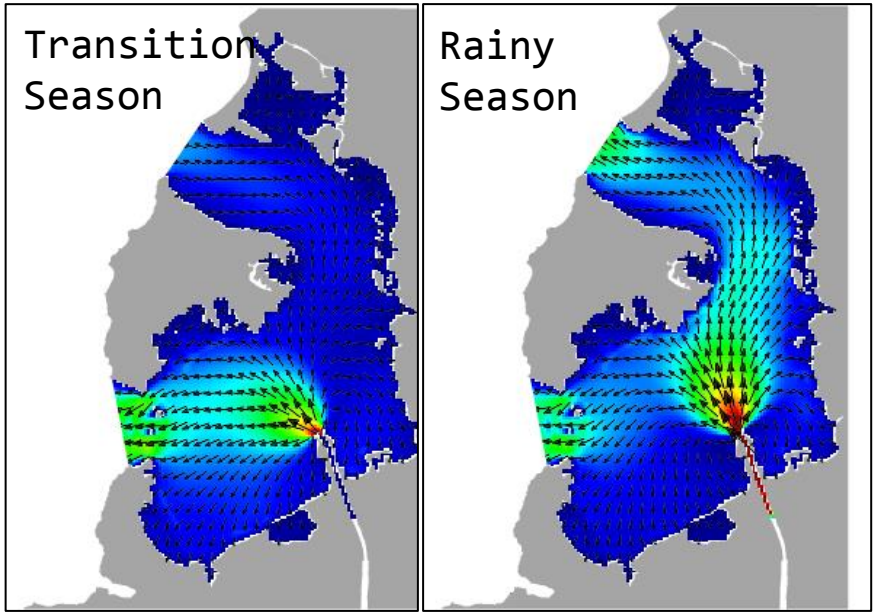


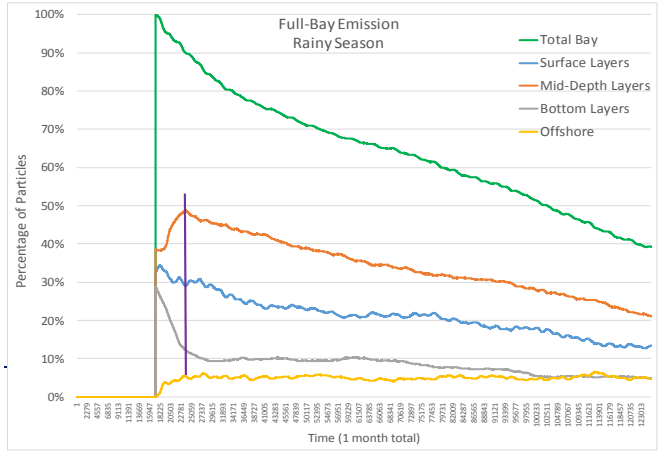
Water Quality

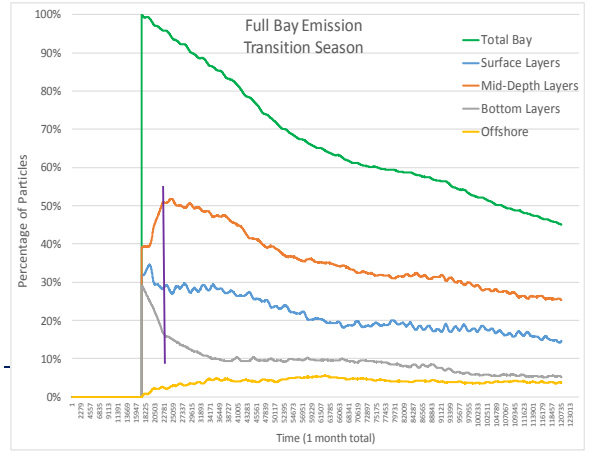
Integral Management of Cartagena Bay (Colombia))



Residual Currents







Especial Requests
For Future MOHID

WISH LIST:

- An efficient (fast) Lagrangian model;
- An efficient (fast) parallelization;
- A proper assimilation scheme;

Thank You

This project has received funding from the European Union's Horizon 2020 research and innovation program AtlantOS under grant agreement No 633211.

This project has received funding from the European Union's INTERREG/POCTEP program OCASO under grant agreement No GA 0223_OCASO_5_E.

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