



Coastal Lagoon Restoration
Life SERESTO final conference
11th April 2018



LAGOONS EU Project - Modelling the processes associated with intertidal seagrass communities in Ria de Aveiro

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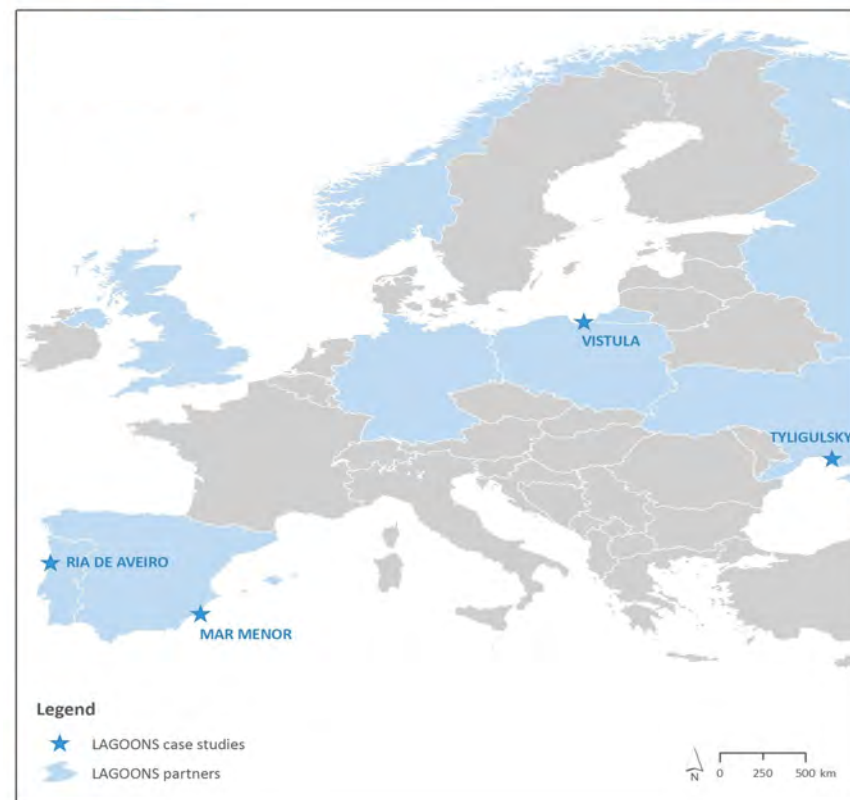
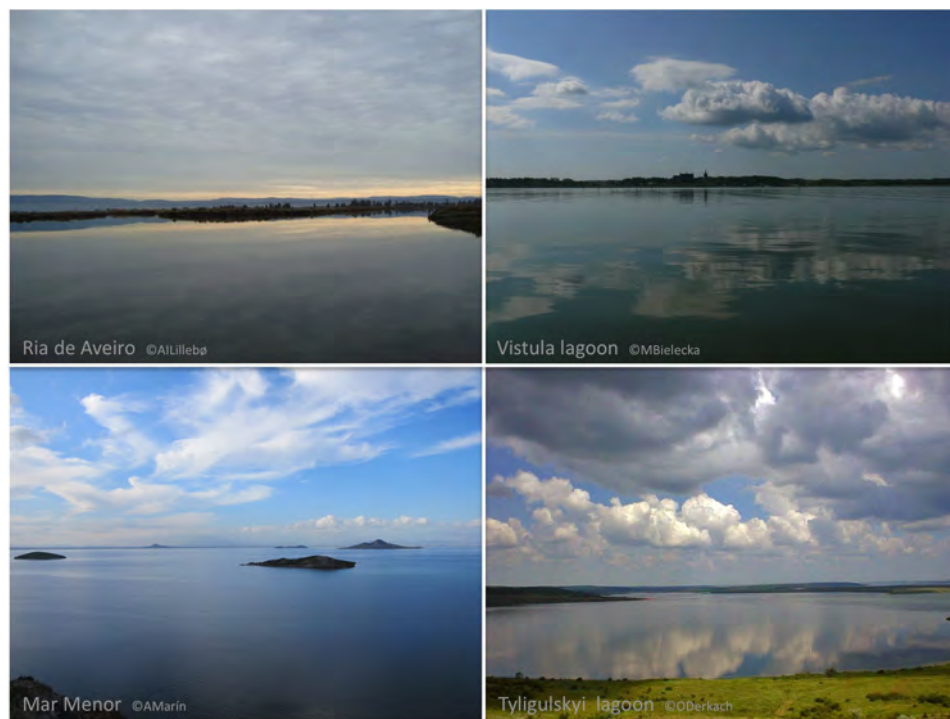


lagoons.web.ua.pt



- **LAGOONS EU Project** - Integrated water resources and coastal zone management in European lagoons in the context of climate change
- **Modelling the processes associated with intertidal seagrass communities in Ria de Aveiro**

LAGOONS - Integrated water resources and coastal zone management in European lagoons in the context of climate change



OBJECTIVES



The main objective of the LAGOONS project was to develop science-based strategies and a decision support framework for the integrated management of coastal lagoons and their catchments and, in this context, to enhance connectivity between research and policymaking

In this presentation our main objective is to share the lessons learned from the innovative methodology used throughout the project



Our main hypothesis is that successful management of coastal lagoons is dependent not only on multidisciplinary scientific information but also on the governance systems in which this knowledge is used, and the interface between science, policy and stakeholders (including the citizens)

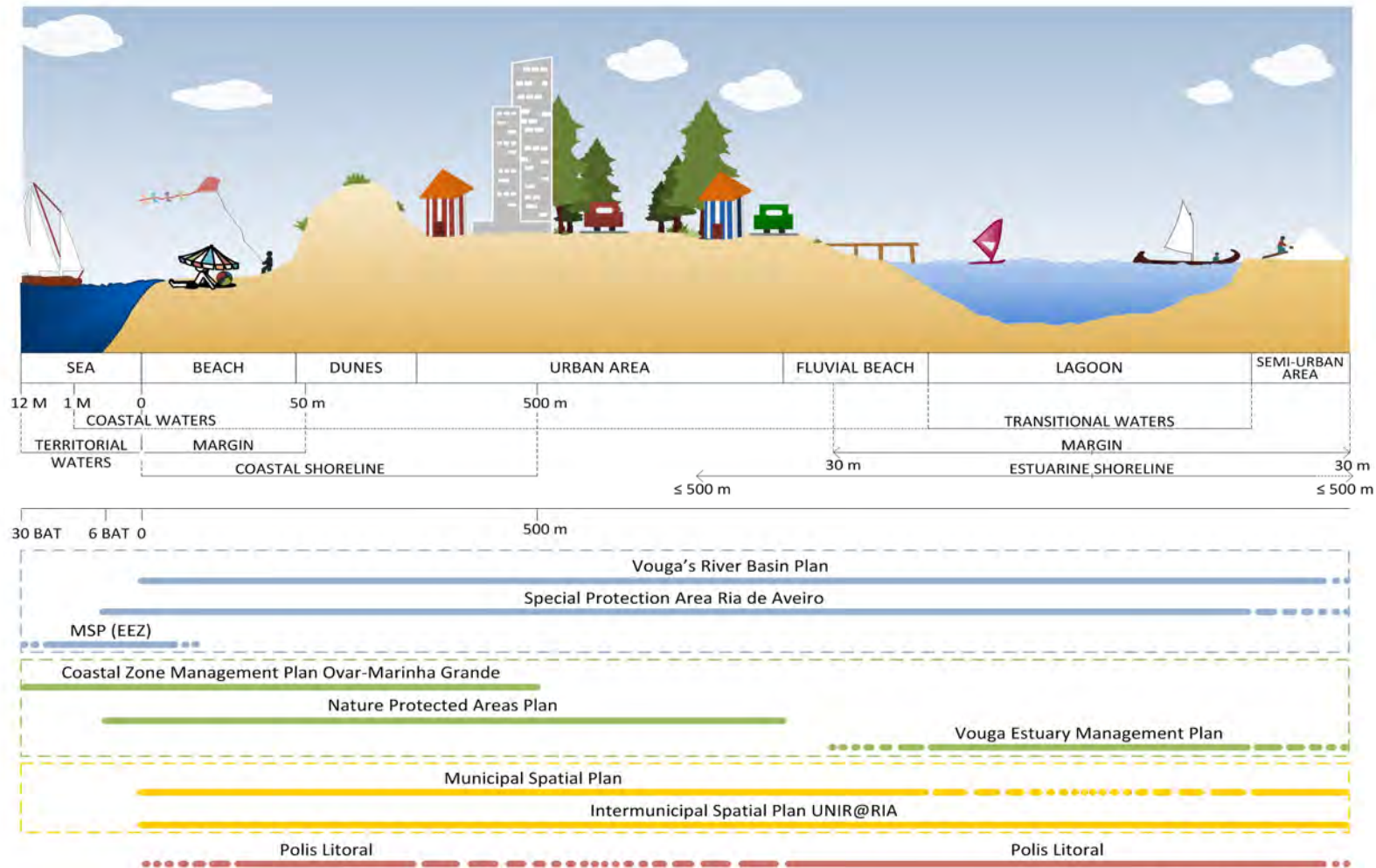
Knowledge base & gap analysis



Knowledge base – Gap analysis

	VISTULA	TYLIGULSKYI	RIA DE AVEIRO	MAR MENOR
HYDROLOGICAL	Hydrological monitoring is not sufficient for modelling	Lack of hydrological and hydro-chemical data	Need to identify the impacts resulting from the changes in the system's tidal prism and water velocity	Hydrological monitoring is not sufficient for modelling
ENVIRONMENTAL	Environmental monitoring is not sufficient for modelling; lack of sediment/water interactions studies	Hydroecological observations were sporadic	The protection of Ria de Aveiro's natural and cultural capital is considered insufficient	A better understanding of the interactions between changes in the watershed and their consequences on the lagoon
ECOSYSTEM SERVICES	Need to enhance a more holistic approach regarding eutrophication, fisheries and natural protection	Need to enhance model's ability to describe the lagoon ecosystem under natural and anthropogenic forcing	Need to enhance the collaborative research in order to identify and value the provided ecosystem services	The consequences of CC in the area and the possibility of aggravated eutrophication needs to be addressed
SOCIAL	Solutions to unemployment and outflow of young people problems	Unconscious and uninformed in respect of environmental protection and conservation	Increase the knowledge about the evolution of the lagoon as a social-ecological system	Seasonal increase of the tourist population
MANAGEMENT	Effective methods for local and cross border environmental management	Modern environmental management systems are lacking	Need to integrate on the lagoon management system its resilience and adaptability to human and natural change	Need to integrate on the lagoon management system its resilience and adaptability to human and natural change.
STAKEHOLDERS INVOLVEMENT	Application of mechanisms for active participation of stakeholders	The location of the lagoon in the territories of two administrative units (Odessa and Mykolaiv regions)	Application of mechanisms for active participation of stakeholders in the decision-making process	Application of mechanisms for active participation of stakeholders in the decision-making process
EQUIPMENT & DATA	Knowledge gaps in soils properties; CLC database does not cover Russian territory; data gaps regarding the catchment area and the lagoon	There are no stationary hydrometeorological stations or monitoring sites. The census data are old.	There are data gaps regarding the catchment area and the lagoon; No stationary hydroecological stations	Insufficient number of stationary hydroecological monitoring stations in the main wadis.

Ria de Aveiro, Portugal

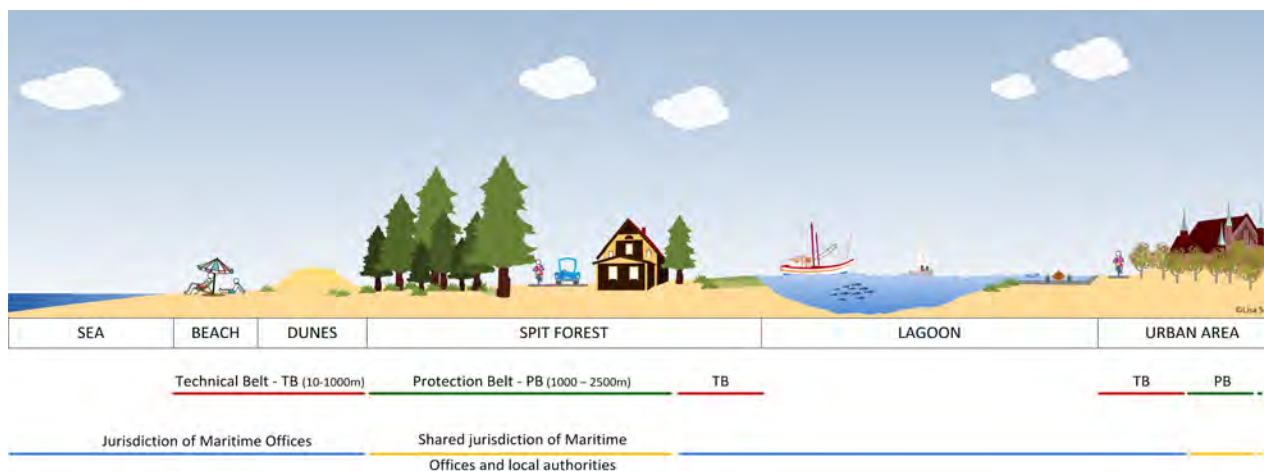
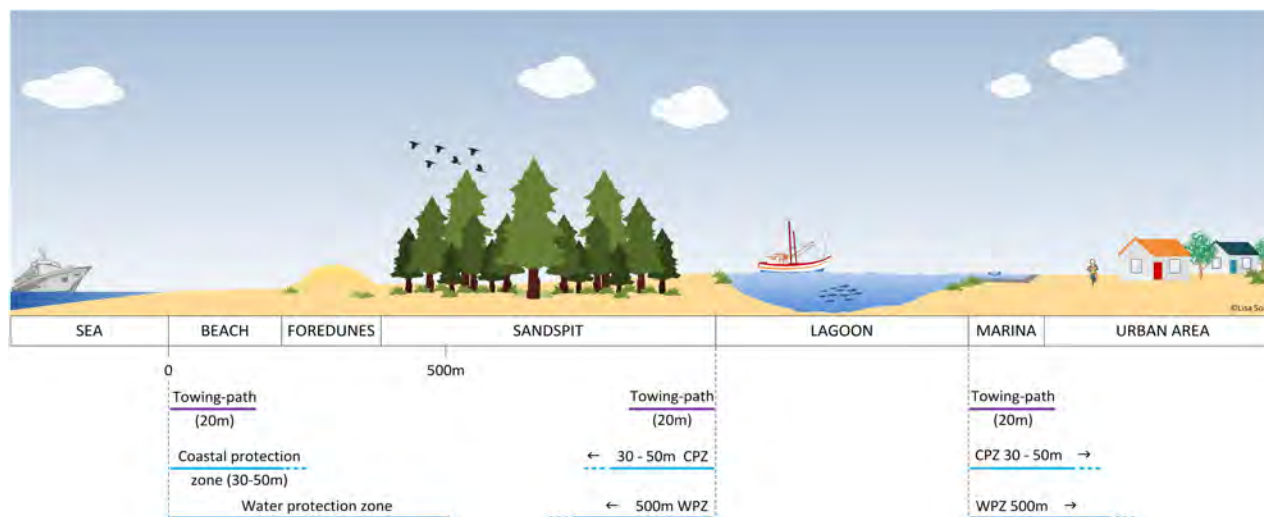


Hydrological domain

Territorial management tools

Source: Sousa *et al.*, 2011

Vistula lagoon, Russia/Poland

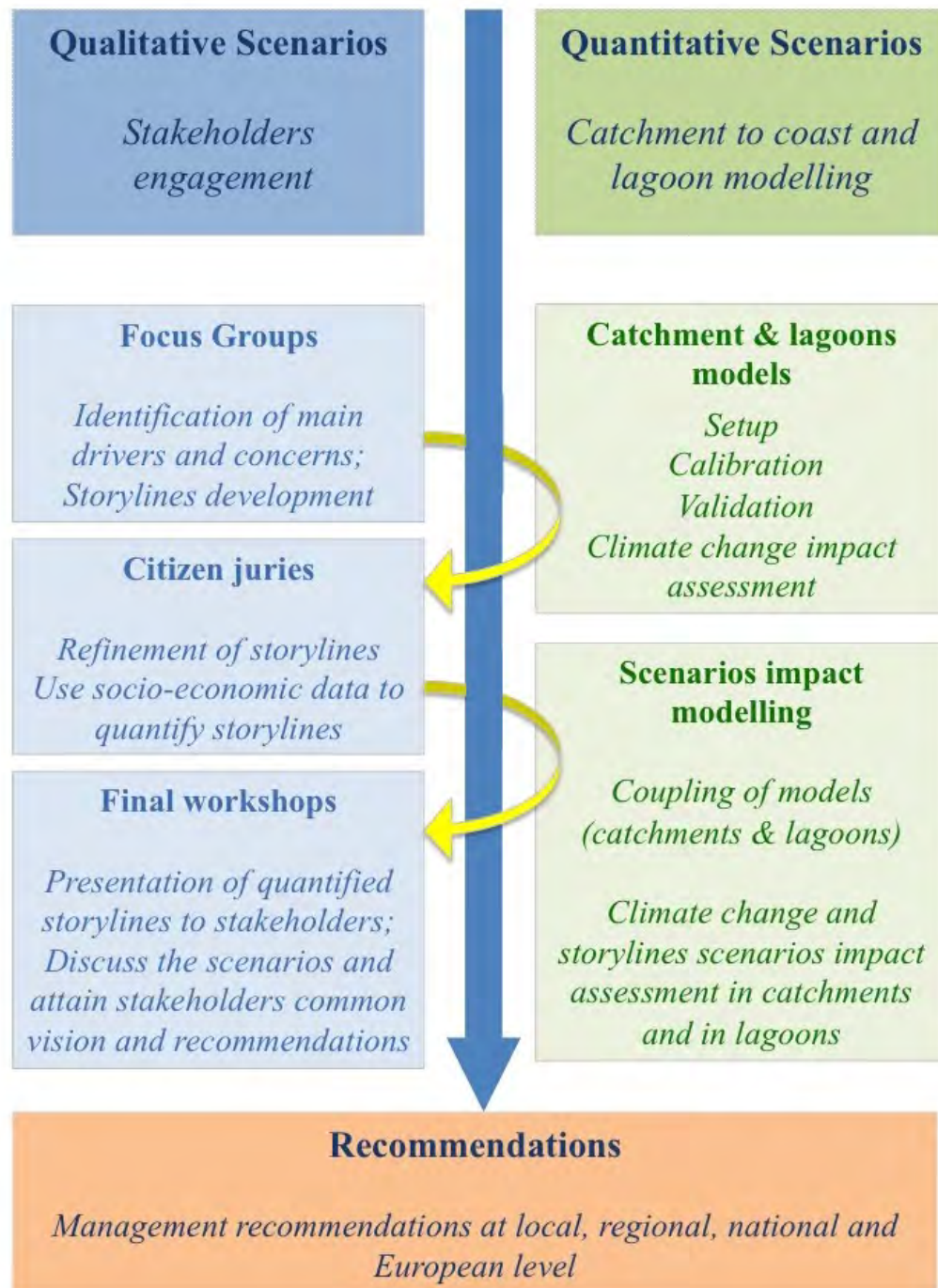
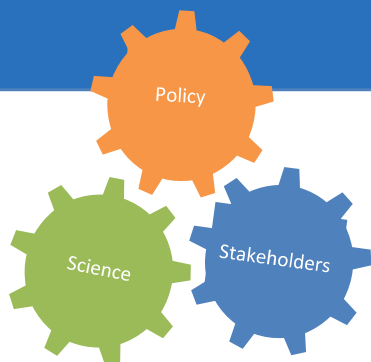


LAGOONS - Integrated water resources and coastal zone management in European lagoons in the context of climate change



Europe's lagoons: vulnerable ecosystems under threat

<https://vimeo.com/147599349>



Stakeholders, FG

Driving forces				
Lagoon	Vistula Lagoon	Ria de Aveiro	Tyligulskiy Liman	Mar Menor
Climate Change	Economical crisis			
	Uncoordinated Management			
	Population, tourism and related activities	Population, tourism and related activities	Population, tourism and related activities	Population, tourism and related activities
	Agriculture and livestock	Aquaculture, agriculture and livestock	Agriculture	Agriculture and livestock
	Harbour, port and maritime transport	Harbour, port and maritime transport	Artificial channel (connection with the sea)	Harbour, port and maritime transport
	Fish catches	Fish, shellfish and bait catches	n.a.	Fish catches
	n.a.	Industry (historical contamination)	n.a.	Historical mining

Stakeholders, CJ

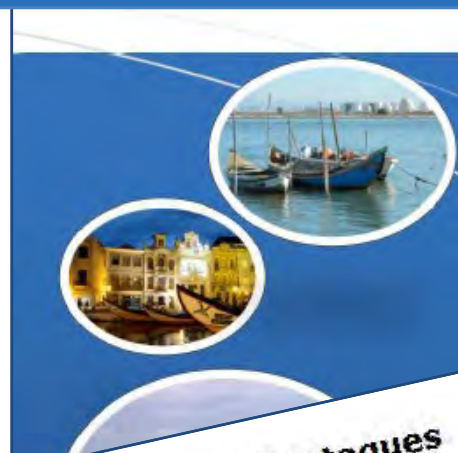


The CJs allowed us to identify how the information and recommendations could further contribute to and be expanded on the information already received

Relevant examples of socio-economic recommendations from the FGs and CJs participatory processes, common for all case study lagoons are:

- to promote an integrated and coordinated management, including transboundary cooperation
- the enhancement of sustainable tourism activity





LAGOONS: Destaques

Gestão integrada de lagunas costeiras europeias no contexto das alterações climáticas

Edição Nº B4.1 P1



Grupos de Discussão

Ria de Aveiro, Portugal

7 de Abril

Biuletyn Projektu LAGOONS:

Zintegrowane zarządzanie zasobami wodnymi oraz strefą przegową lagun europejskich w kontekście zmian klimatycznych

Nr. B4.1PL



Grupy Fokusowe

Zalew Wiślany, Polska

LAGOONS



OFICINA DE TRABALHO

22 de Maio de 2014

(14h00 – 17h00)

Reitoria da Universidade de Aveiro

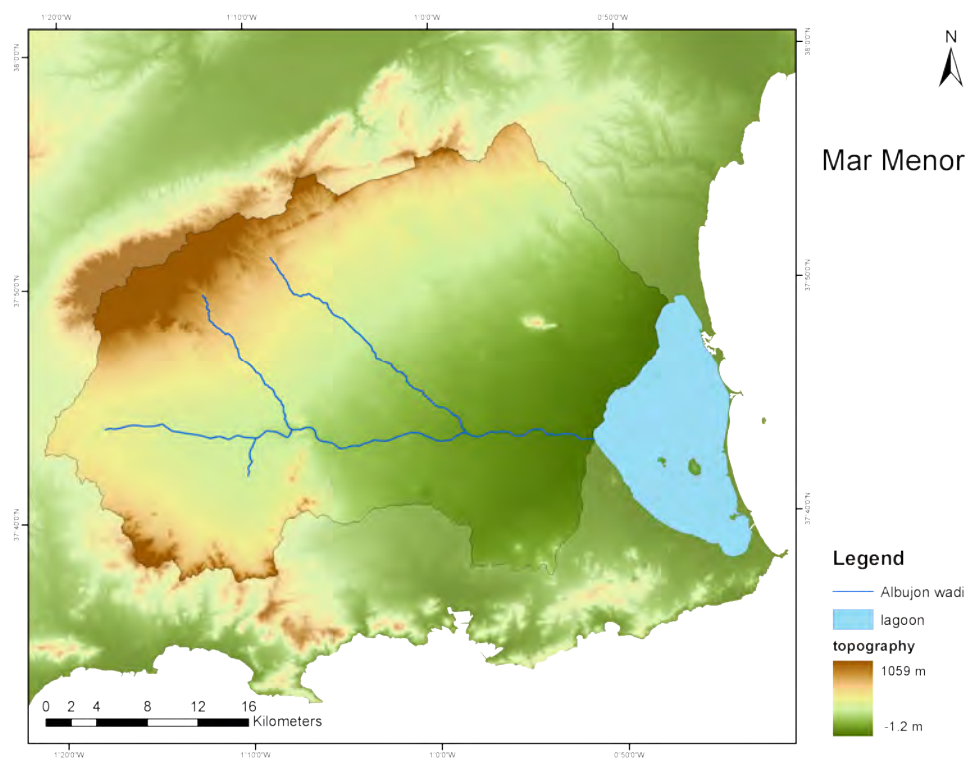
- <http://lagoons.web.ua.pt> -



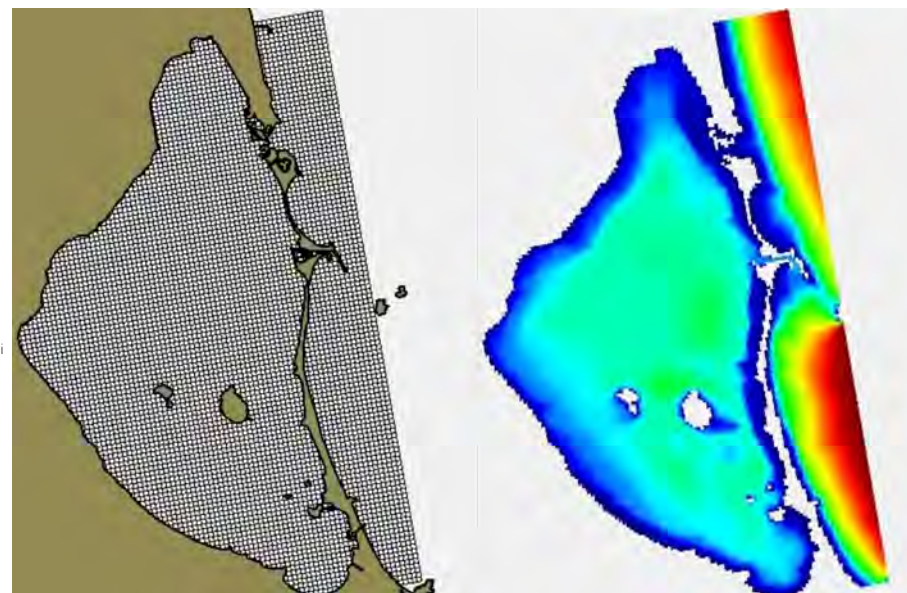
LAGOONS

Land-Sea processes – Mar Menor, Spain

Albujón catchment: SWIM model

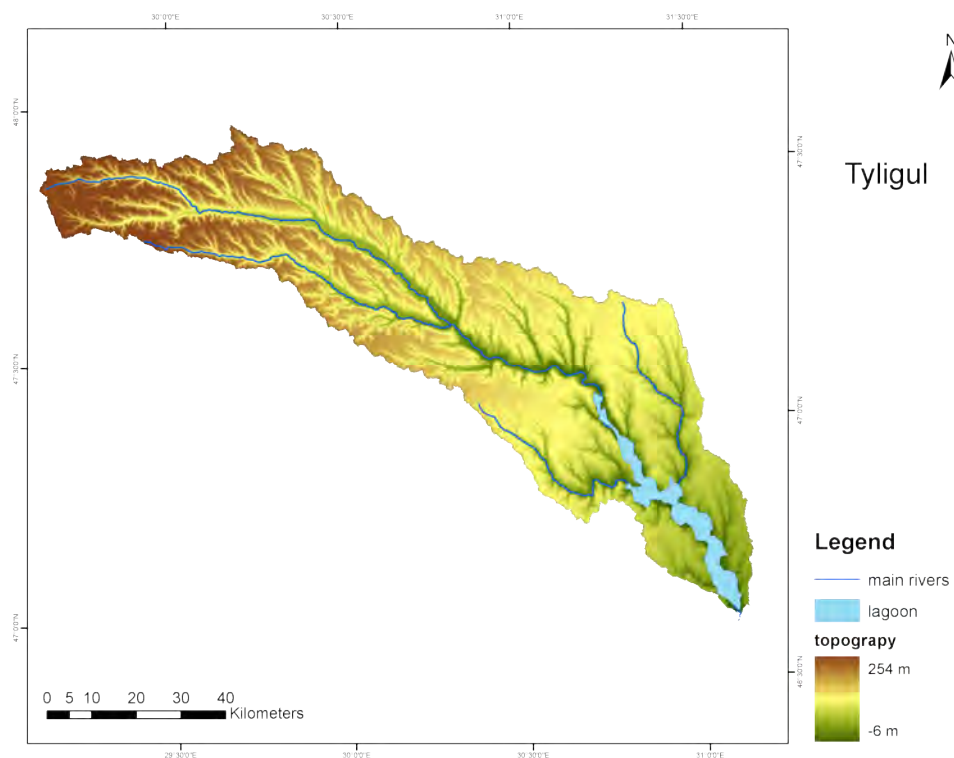


MOHID water modelling system

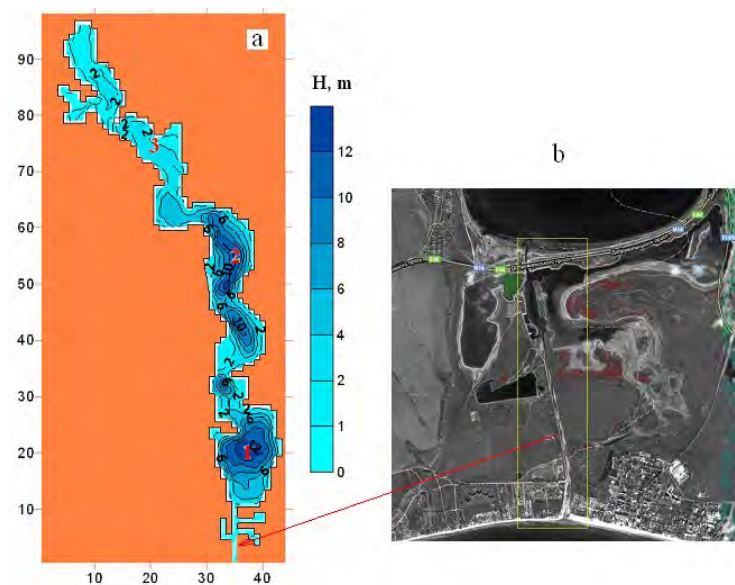


Land-Sea processes – Tyligulskyi, Ukraine

Tyligul catchment: SWIM model



MECCA three-dimensional numerical non-stationary hydrothermodynamic model



FG
CJ



Use socio-economic
data to quantify
storylines

Eurostate data

Land-Sea processes

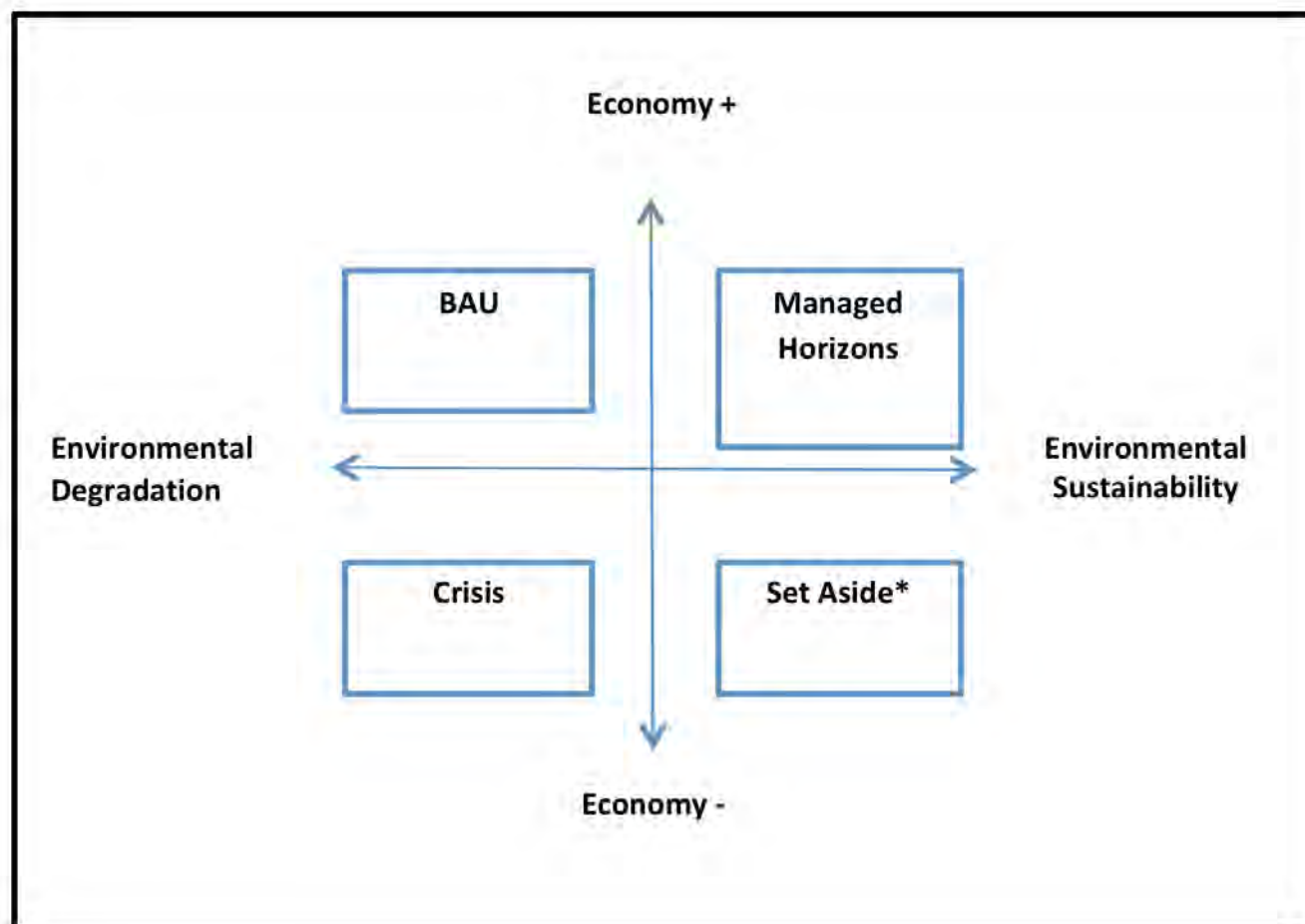
FW

Combine socio-
economic and water
quality and quantity
data in numerical
models

Use results to present
quantified storylines
in final workshops

Vision for 2030

Lagoons



*Set Aside – could also provide an indirect economy through ES

Common Main Drivers

Ria de Aveiro: BAU



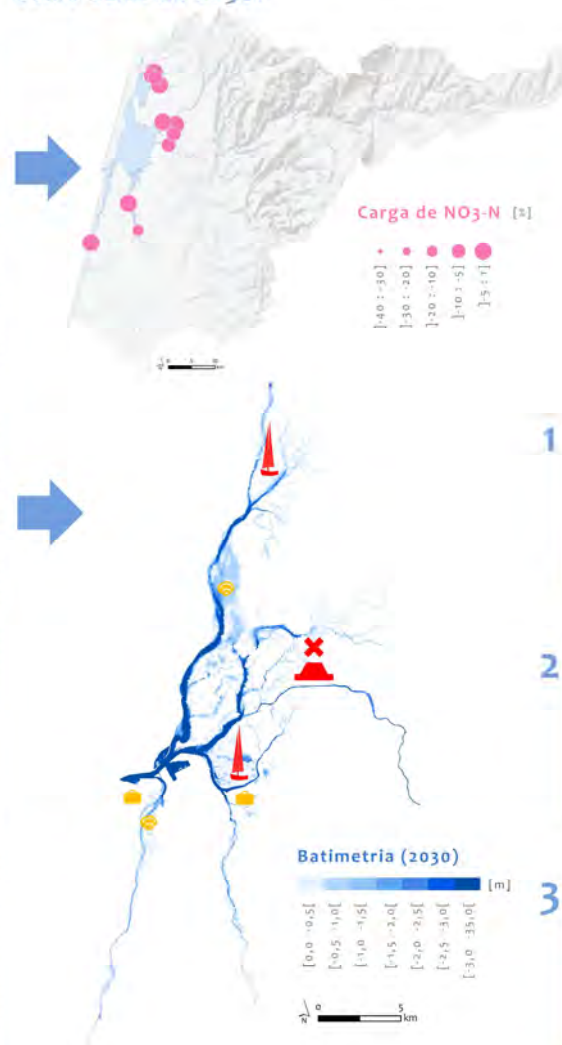
TENDÊNCIA ATUAL



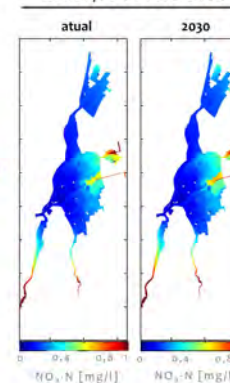
PRESSUPOSTOS:



COMO SERÁ EM 2030?



Condição de referência



1 Dique do Baixo Vouga Lagunar incompleto



2 Alterações na hidrodinâmica (velocidade água, amplitude de maré)



3 Fiscaliação inadequada e gestão descoordenada?



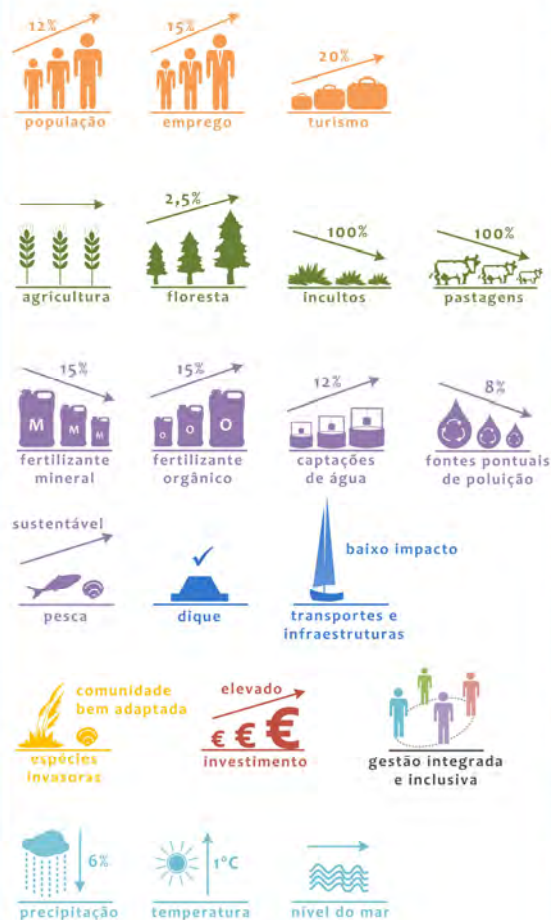
Ria de Aveiro: Managed Horizons



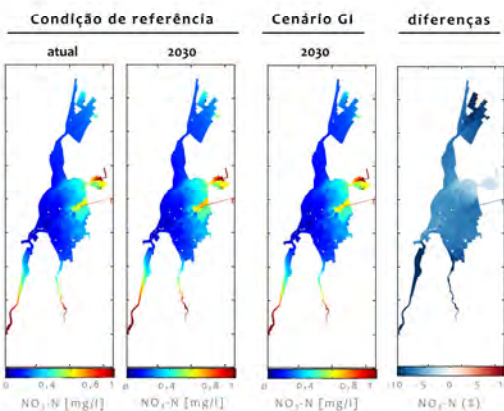
GESTÃO INTEGRADA



PRESSUPOSTOS:



COMO SERÁ EM 2030?



1 Dique do Baixo Vouga Lagunar terminado



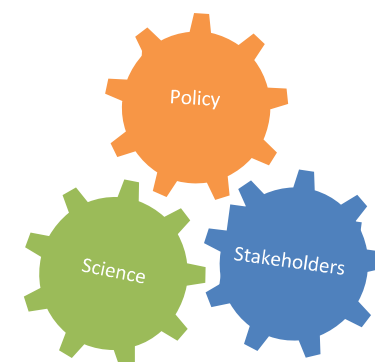
2 Hidrodinâmica



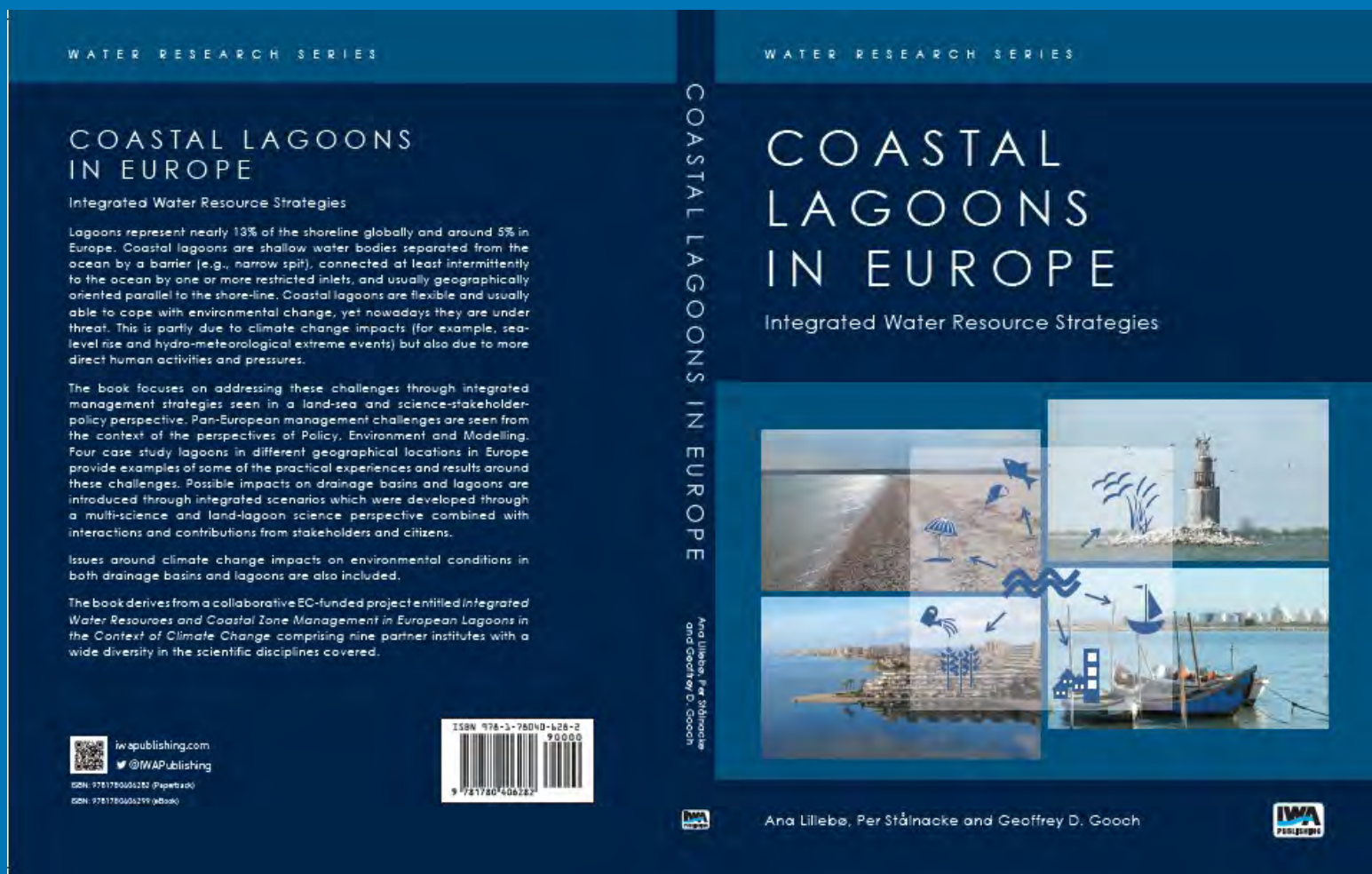
3 Gestão integrada e inclusiva



Main environmental recommendations from stakeholders	Main recommendations of the project	Main target policy (regional, national or European level)
Sustainable use of water resources; Agriculture based on modern technologies and practices; Diversified agriculture with crops adapted to the local conditions.	Sustainable use of water resources; best agricultural practices;	Regional – River basin management plans; National - water law (water uses regulation and surveillance) EU level – WFD (chemical and biological indicators); Nitrates Directive; CAP (2014); Habitats Directive; Biodiversity 2020
Maintenance of natural habitats and endemic species and establishment of means and ways of nature conservation to sustain traditional and other uses of lagoons ecosystem.	Assessment of ecosystem services and their beneficiaries; Spatial planning of activities taking into account natural habitats and enabling the local traditional activities and livelihood's; Elaboration of a best practices guide for the natural and human capital balance.	Regional - improvement of ecological attractiveness National – water law (water uses regulation and surveillance); national nature strategies EU level – WFD; MSFD; EIA; Habitats Directive (Natura 2000); Biodiversity 2020
Increase RTD, namely related to flood threats, nutrient inputs from the catchment, hydrology, impact of climate change on water resources and ecological conditions	RTD on flood risk; adaptation to climate change; eco-hydrology	Regional - River basin management plans; National – water law (water uses regulation and surveillance); national nature strategies EU level – Floods Directive; EU strategy on adaptation to climate change



Coastal Lagoons in Europe: Integrated Water Resource Strategies (2015) Lillebø A.I., P Stålnacke and G.D. Gooch (Eds). IWA publishing; International Water Association (IWA), UK, 254pp





This study was supported by the European Commission, under the 7th Framework Programme, through the collaborative research project LAGOONS (contract no. 283157)





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João Lencart e Silva (Longline Environment, UK)

Scope within LAGOONS



Hydrological, Environmental, Ecosystem Services – Multidisciplinary scientific information

RIA DE AVEIRO	
HYDROLOGICAL	Need to identify the impacts resulting from the changes in the system's tidal prism and water velocity
ENVIRONMENTAL	The protection of Ria de Aveiro's natural and cultural capital is considered insufficient
ECOSYSTEM SERVICES	Need to enhance the collaborative research in order to identify and value the provided ecosystem services



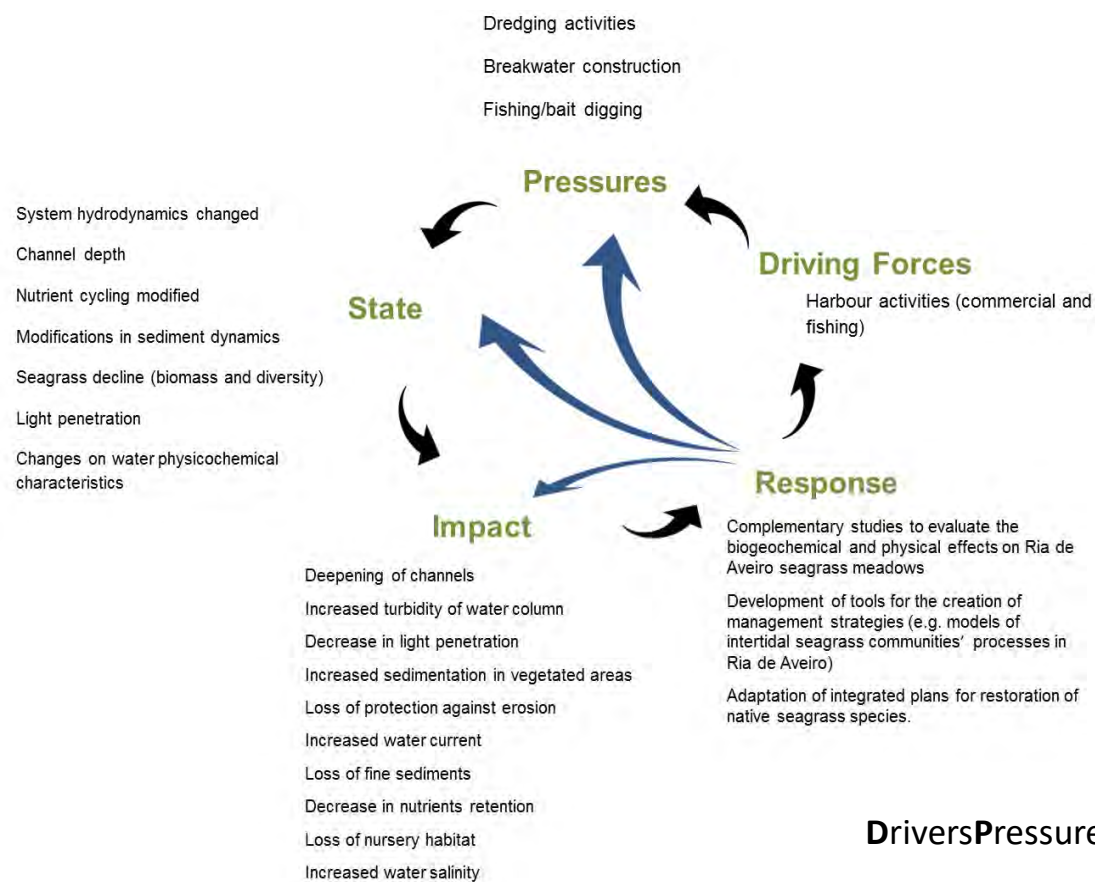
Ria de Aveiro ©AIIllleba



● Freshwater inputs

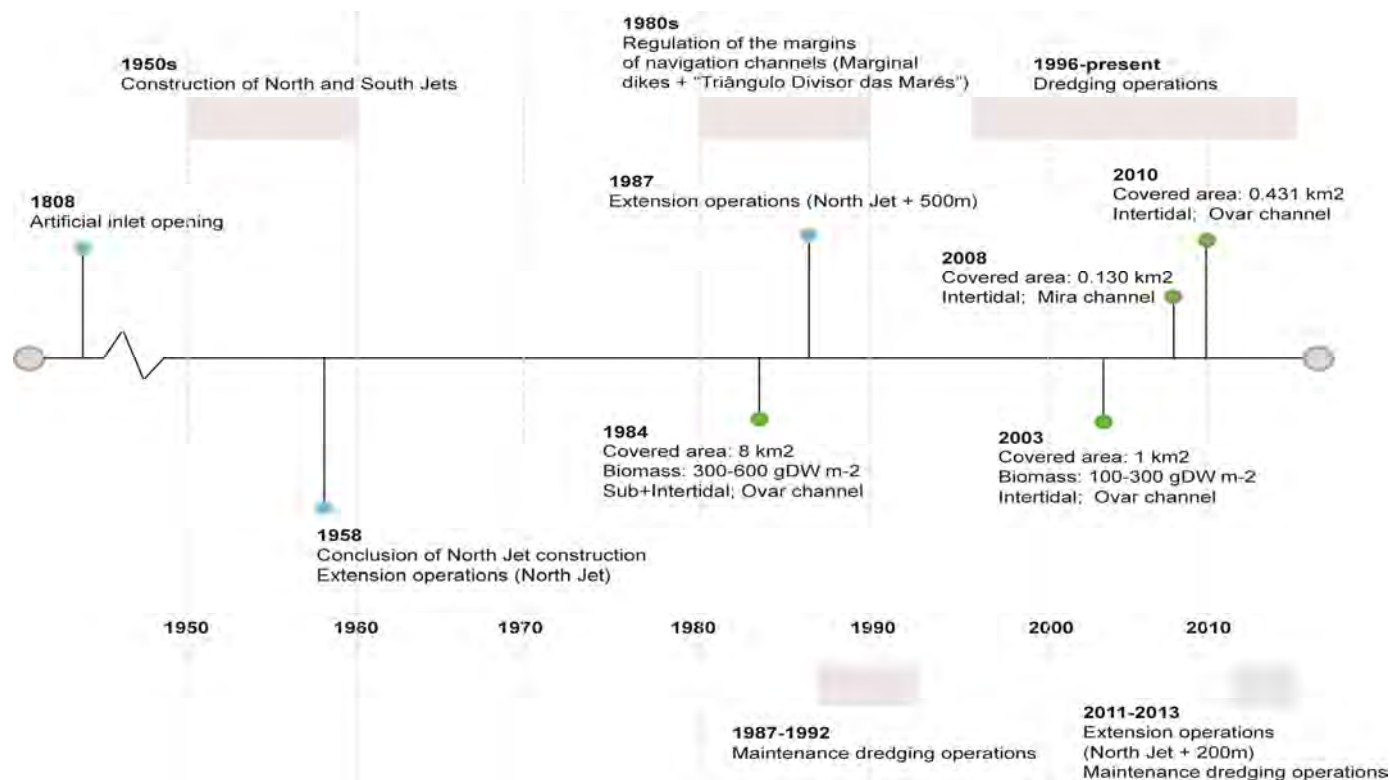


Case Study - Seagrass Meadows in Ria de Aveiro Lagoon



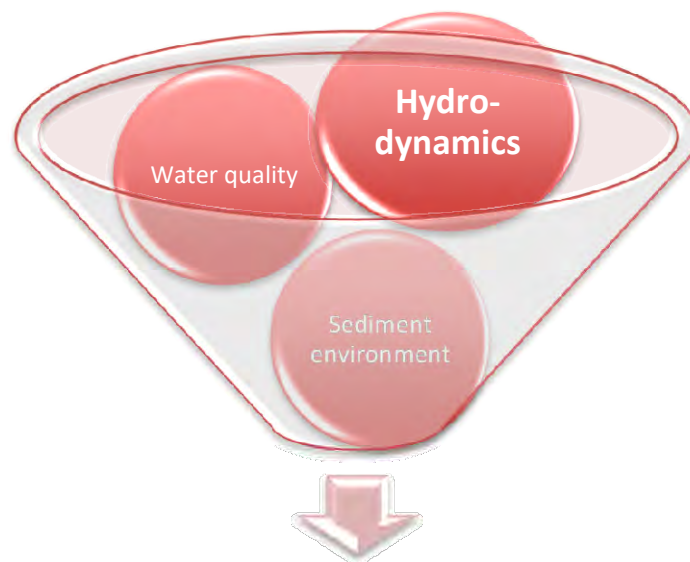
DriversPressuresStateImpactsResponse

Drivers of Seagrass Decline in Ria de Aveiro Lagoon



Time-extended anthropogenic operations ● Punctual anthropogenic operations ● Ground-surveyed seagrass data

Drivers of Seagrass Decline in Ria de Aveiro Lagoon



Decline of Seagrass Biodiversity in Ria de Aveiro lagoon



Currently restricted to **intertidal** and **monospecific** meadows of *Zostera noltei*

Proposed Responses

- Complementary studies to evaluate the biogeochemical and physical effects on the seagrass meadows of Ria de Aveiro lagoon
- Development of tools for the creation of management strategies (e.g. **numerical models – Delft3D Flow and Delft3D WAQ**)



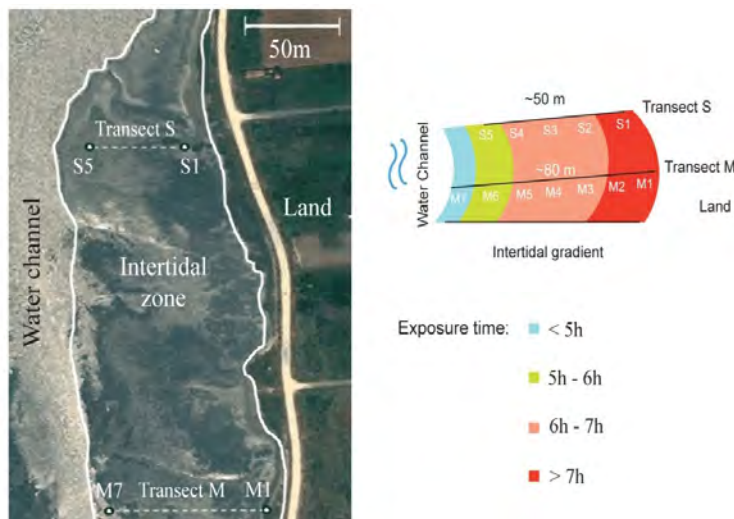
Use model outputs as supportive tools

- Adaptation of integrated management plan for restoration of native seagrass species

Improvement of Current Seagrass Numerical Models – Desiccation Module

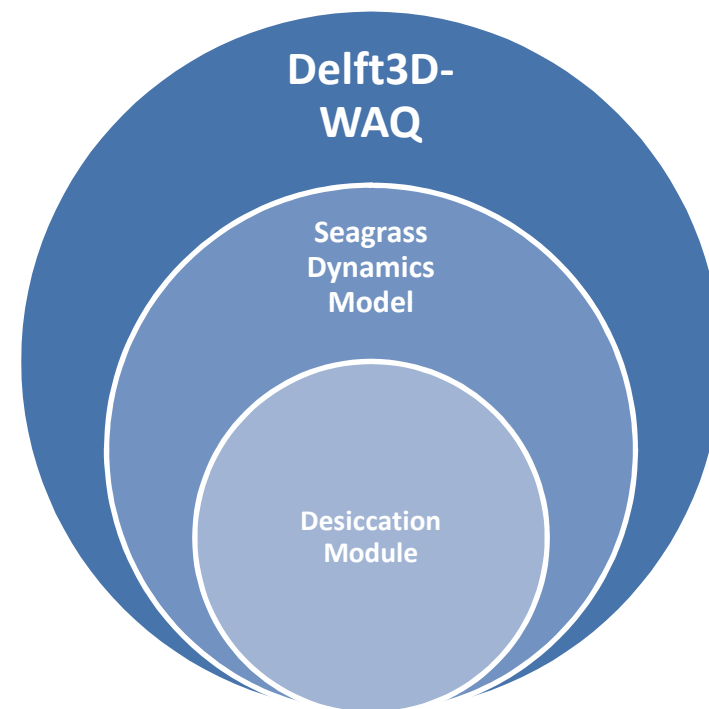
Integration of Seagrass Model + Desiccation Module in Delft3D WAQ

Ground-surveyed experiments



Desiccation dynamics suggested that relative importance of **sediment** characteristic is **more effective** in **conditioning** the **RWC of seagrasses over a tidal cycle**, than air exposure time.

Seagrass leaves of colonised finer grain size sediments presented less relative water loss.



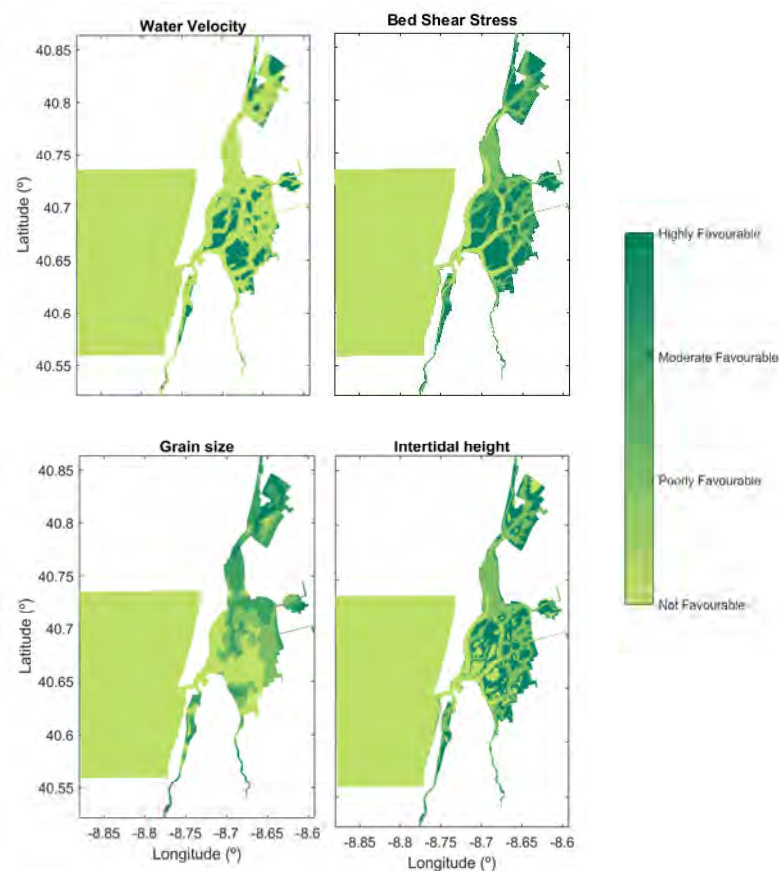
Numerical modelling - Outputs



Reference Condition

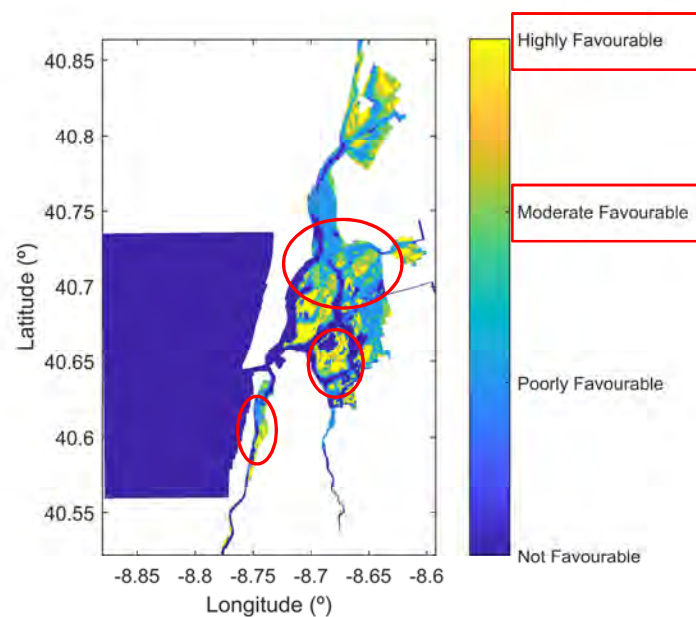
Layers of Information for Mapping Potential Favourable Areas for Seagrass Restoration

LAYER	DESCRIPTOR
HYDRODYNAMICS	<ul style="list-style-type: none"> Water velocity
SEDIMENT	<ul style="list-style-type: none"> Grain size
WATER QUALITY	<ul style="list-style-type: none"> Limiting functions of seagrass growth (i.e. light, space, air/water temperature) Salinity
OTHER	<ul style="list-style-type: none"> Bottom shear stress Intertidal height Relative Water Content



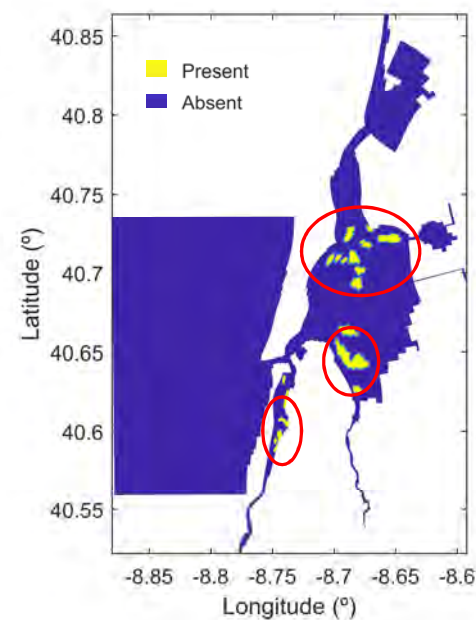
Mapping the Potential Most-Favourable Areas for Seagrass Restoration

- Combining the layers...



Comparing to...

Ground-Surveyed Data of Current Spatial Distribution of *Z. noltei* in Ria de Aveiro Lagoon

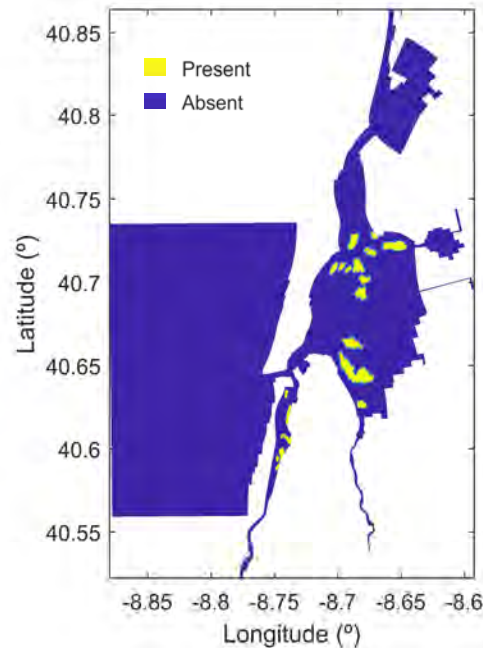


Mapping the Potential Most-Favourable Areas for Seagrass Restoration

- Climate change impacts

- River Forcing: Climatology from SWIM
- Atmospheric and Ocean Forcing: Regional and Global Circulation Models
- Climate change scenarios: **Representative Concentration Pathways (RCP)**, IPCC 5th Assessment Report – RCP 8.5

Present Spatial Distribution



RCP 8.5 with Sea Level Rise (0.63m)



Take-Home Message

- Numerical model gives a fairly idea of potential favourable areas for seagrass restoration
- Simulations with Climate Change projections pointed out for a narrower restriction of seagrass spatial distribution in Ria de Aveiro
- Ongoing and future improvements of the modelling formulation
 - Inclusion of the sediment processes and interactions; Seagrass Internal Nutrient Dynamics
 - Spatial distributed model – enhancing modelling ability to simulate other coastal systems
 - Multiple stressors scenarios



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Thank you for your attention!



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