9th EuroGOOS International Conference: Advances in Operational Oceanography
Expanding Europe's Ocean Observing and Forecasting Capacity

EuroGOOS
European Global Ocean Observing System

New Climate services to coastal communities in Galicia (NW Spain)

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galicia · Xacobeo 2021 · meteogalicia · XUNTA DE GALICIA · Interreg España - Portugal · MARRISK

MarRisk: 13 partners from Galicia (NW Spain and Portugal)

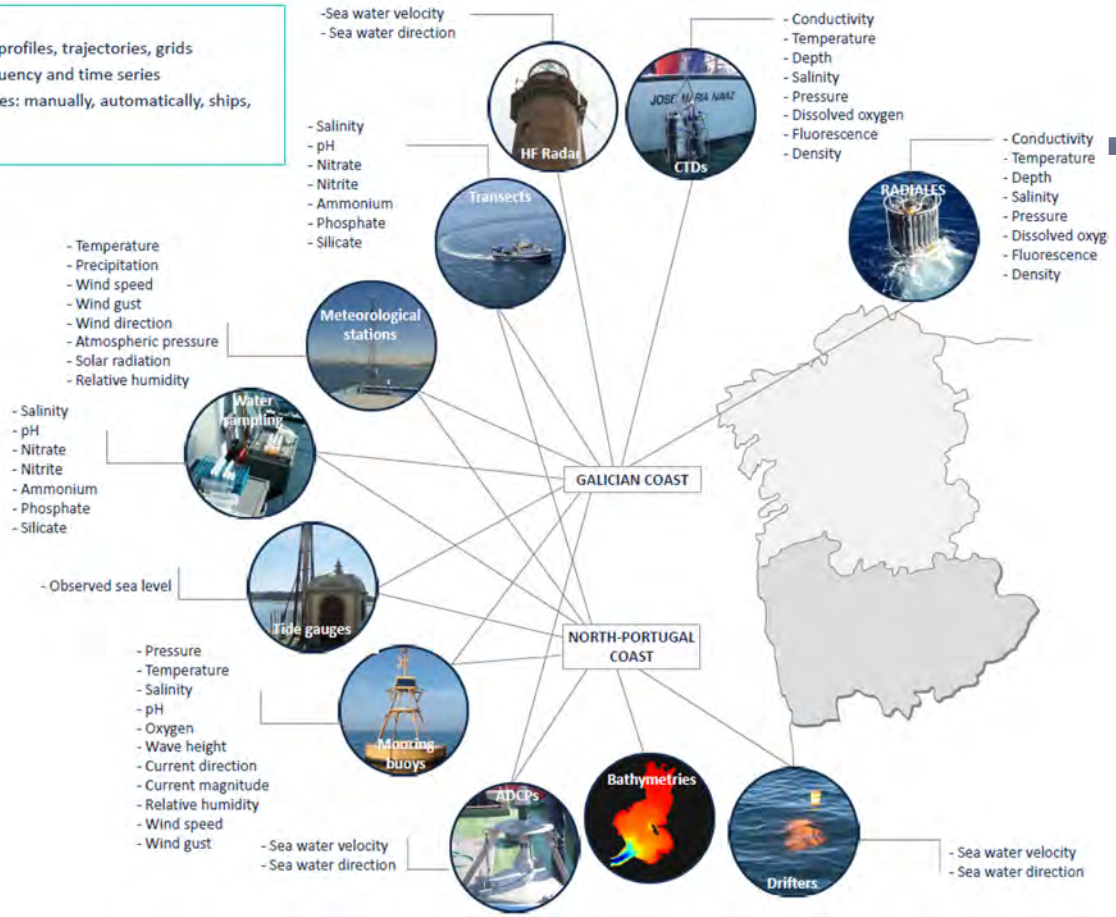
- ❑Dirección Xeral de Calidade Ambiental e Cambio Climático – Xunta de Galicia (MeteoGalicia)
- ❑Centro Tecnológico del mar (CETMAR)
- ❑ Instituto Tecnolóxico para o control do medio Mariño (INTECMAR)
- ❑Instituto de Investigacións Mariñas (IIM-CSIC)
- ❑ Instituto Português do Mar e da Atmosfera (IPMA)
- ❑Ephyslab, Geoma, Grupo Rede, Divulgare (Uvigo)
- ❑Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR)
- ❑Universidade do Minho (Uminho)
- ❑ Instituto Español de Oceanografía (IEO)
- ❑Universidade de Aveiro (UA)
- ❑Agência Portuguesa do Ambiente, I.P. (APA, I.P.)
- ❑Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)
- ❑ Instituto Hidrográfico (IH)

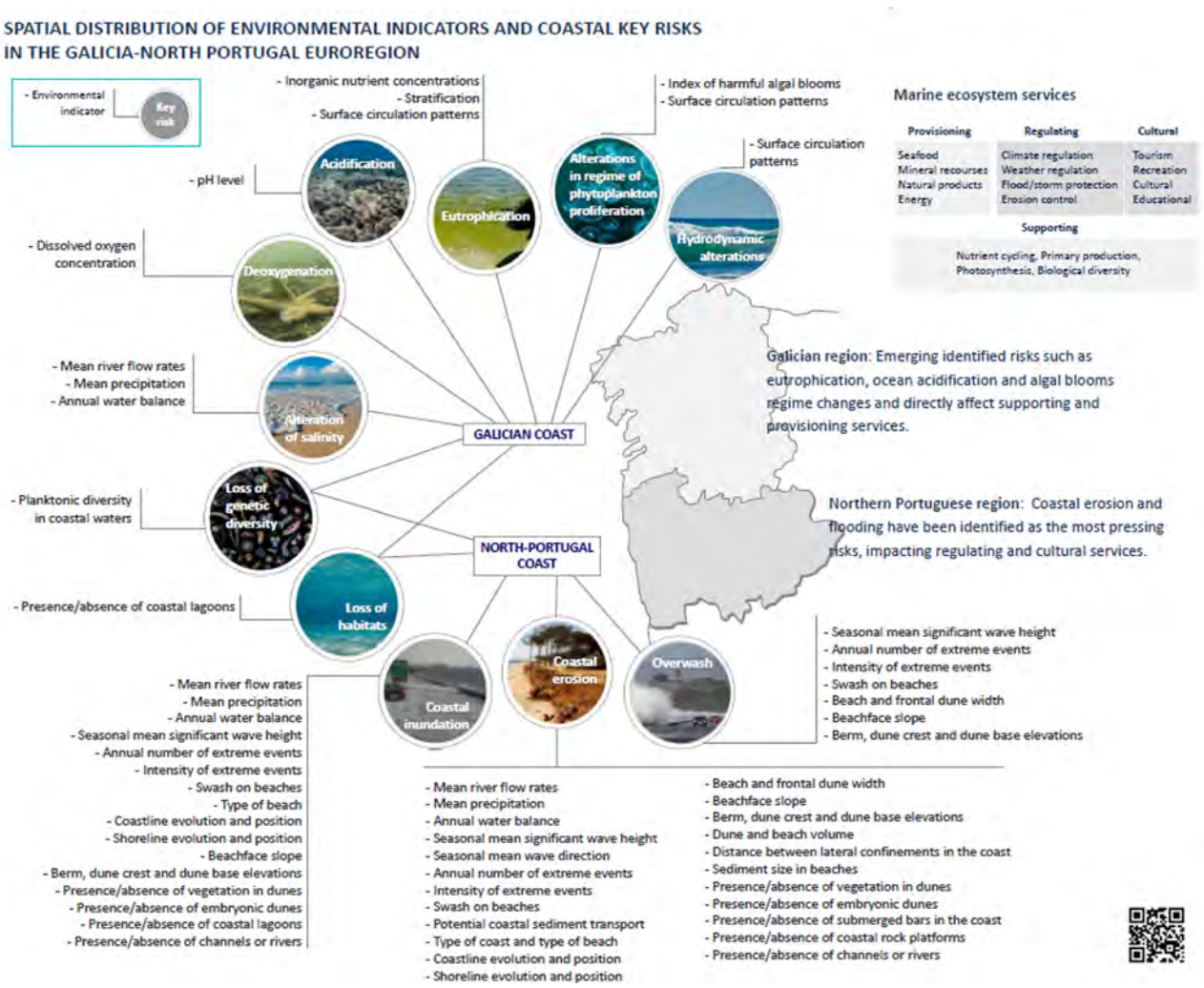
Activity 1: Data infrastructure and Indicators

CHALLENGES:

- Spatial distributions: sites, profiles, trajectories, grids
- Temporal distribution, frequency and time series
- Diverse sampling approaches: manually, automatically, ships, platforms, etc.
- Quality control of data

Action 1.1: Consolidation of observational data series of the RAIA Observatory

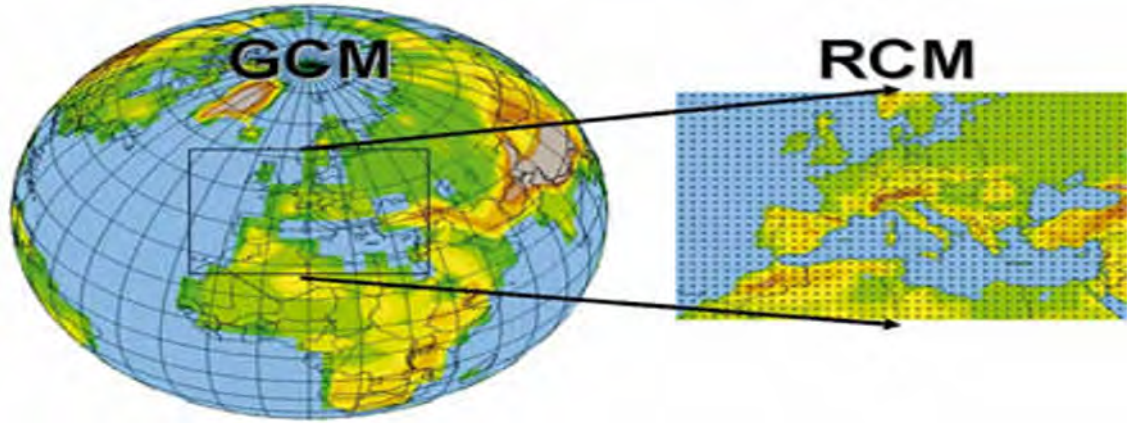


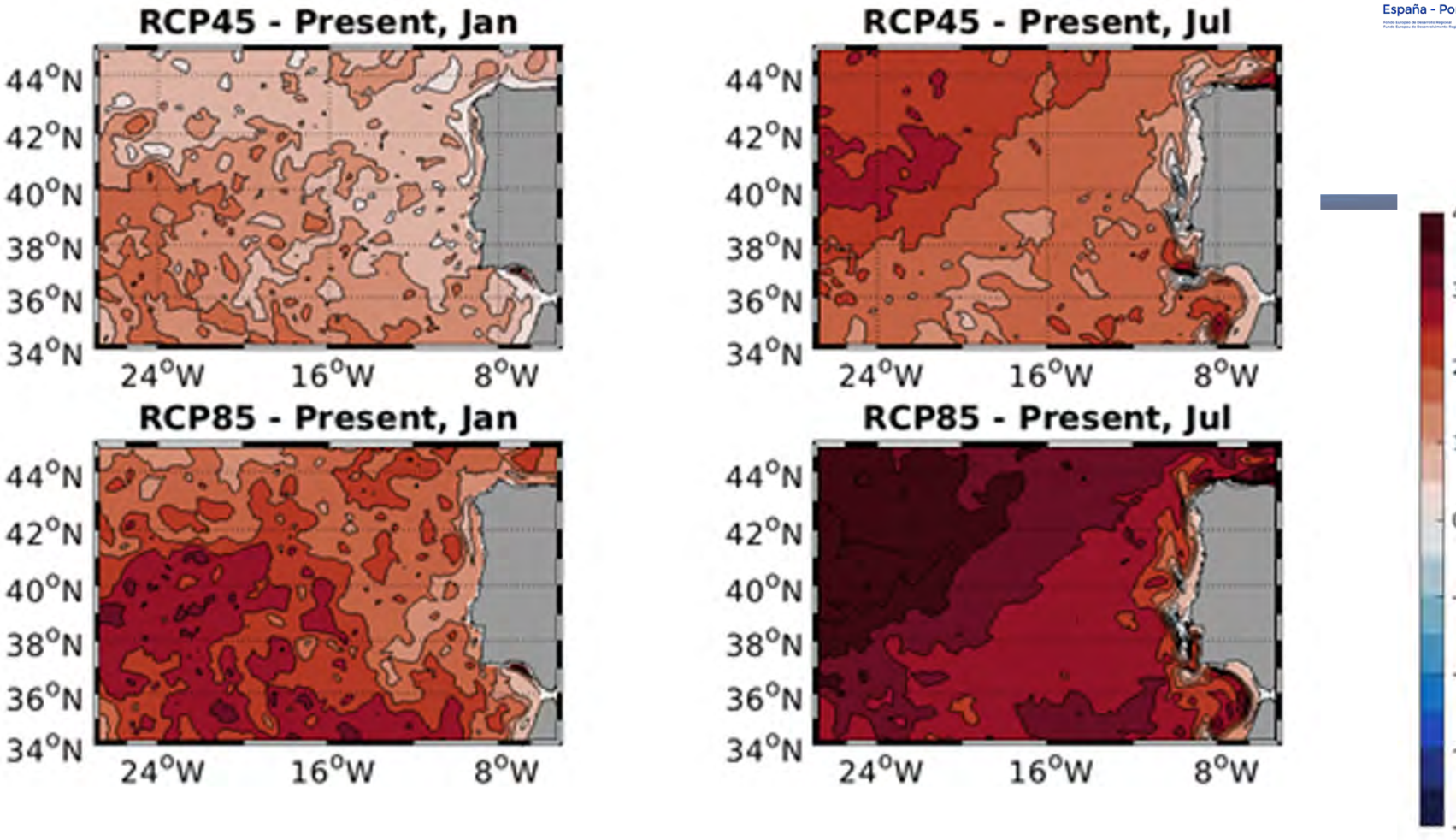


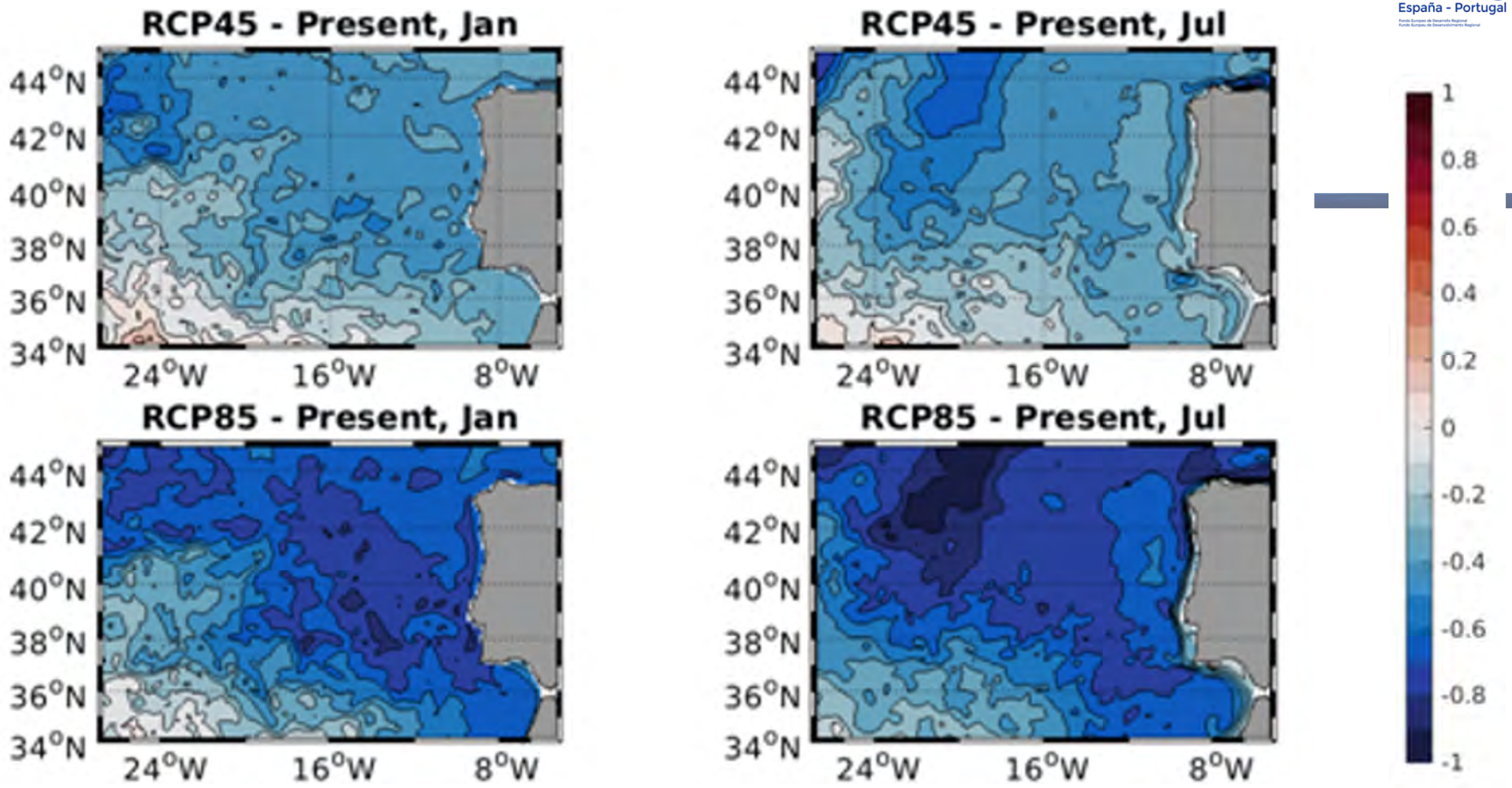
Action 1.2: Identification of environmental indicators to assess potential coastal risks in the Euroregion

Activity 2: Scenarios using dynamical downscalling

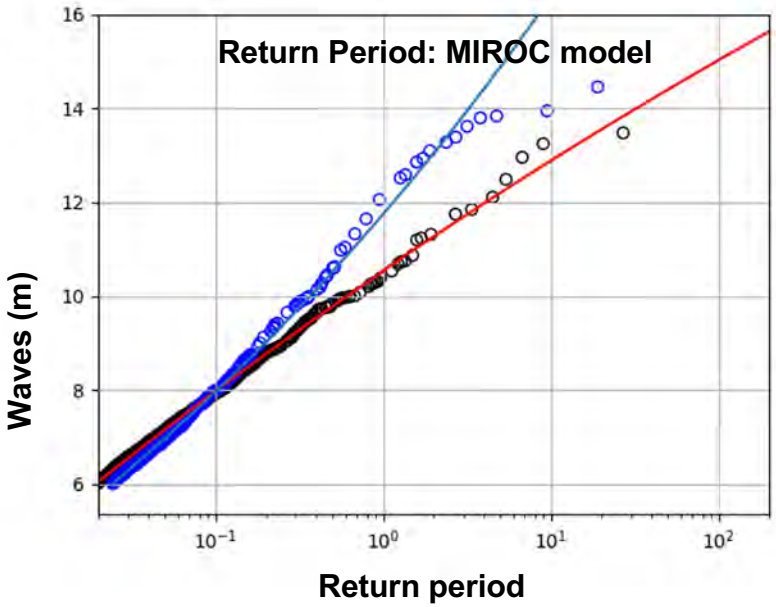
- Application of regional models to assess the variation of sea level, swell, temperature and biogeochemical variables in two RCP (Representative Concentration Pathway) scenarios and three different time horizons (2030, 2050 and 2090)

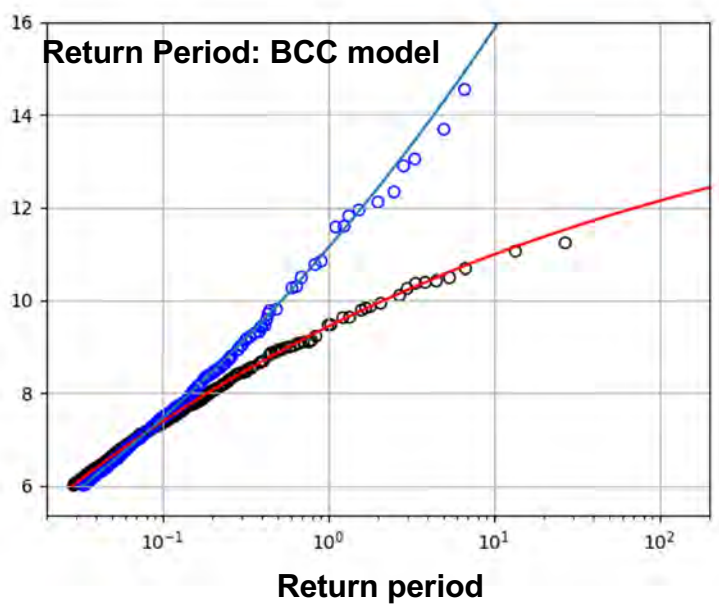



RCP45 - Present, Jan
RCP45 - Present, Jul
RCP85 - Present, Jan
RCP85 - Present, Jul
44°N
42°N
40°N
38°N
36°N
34°N
24°W
16°W
8°W
4
3
2
1
0
-1
-2
-3
-4


RCP45 - Present, Jan
RCP45 - Present, Jul
RCP85 - Present, Jan
RCP85 - Present, Jul
44°N
42°N
40°N
38°N
36°N
34°N
24°W
16°W
8°W
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1

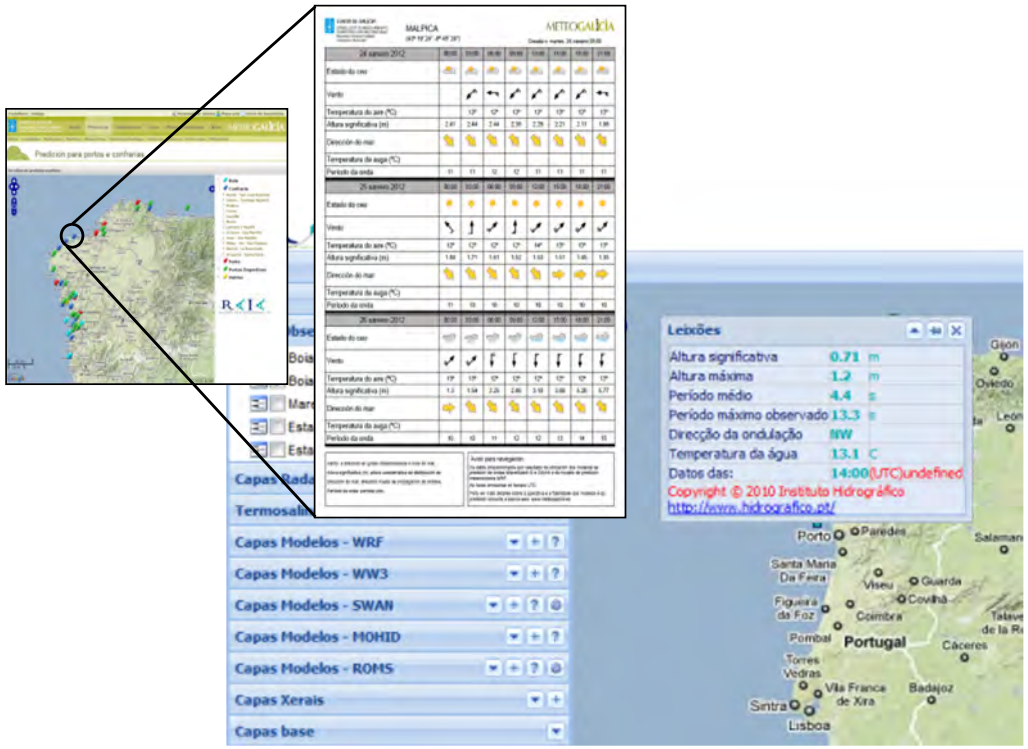
Return period for different wave heights in RCP8.5 scenario
Red: Actual climate Blue: Future Climate





Activity 3: Cimate Services

- Calculation of overflows and damages in coastal infrastructures.
- Estimation of vulnerability and risk of coastal erosion and flood.
- Early warning system of longwave resonance in harbours
- Prediction of harmful algae toxic episodes.
- Resilience index



Activity 4: Interaction with Stakeholders

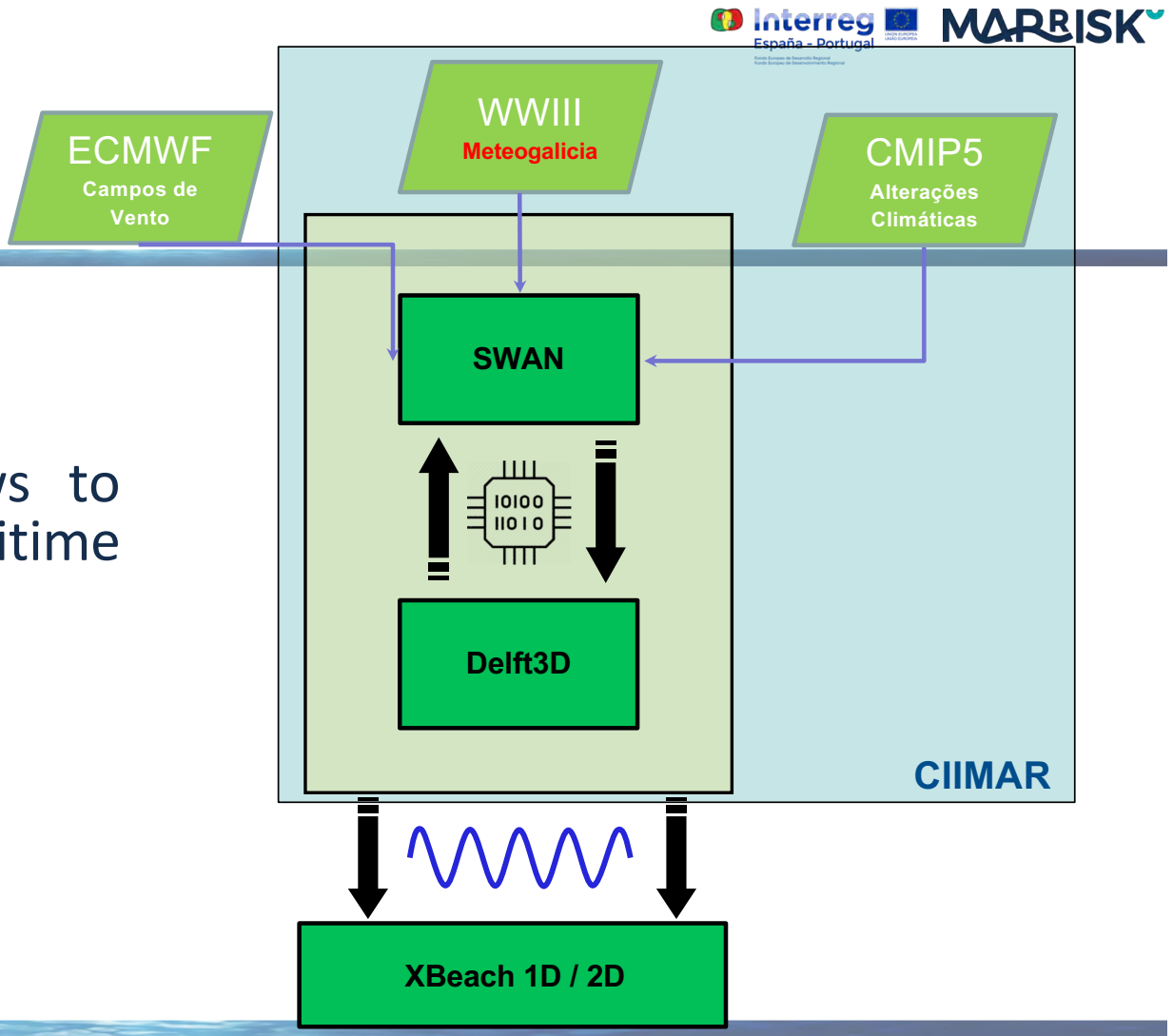
- Involvement of users in the process of development of services.

  Training workshops for users of the services offered by MarRISK.

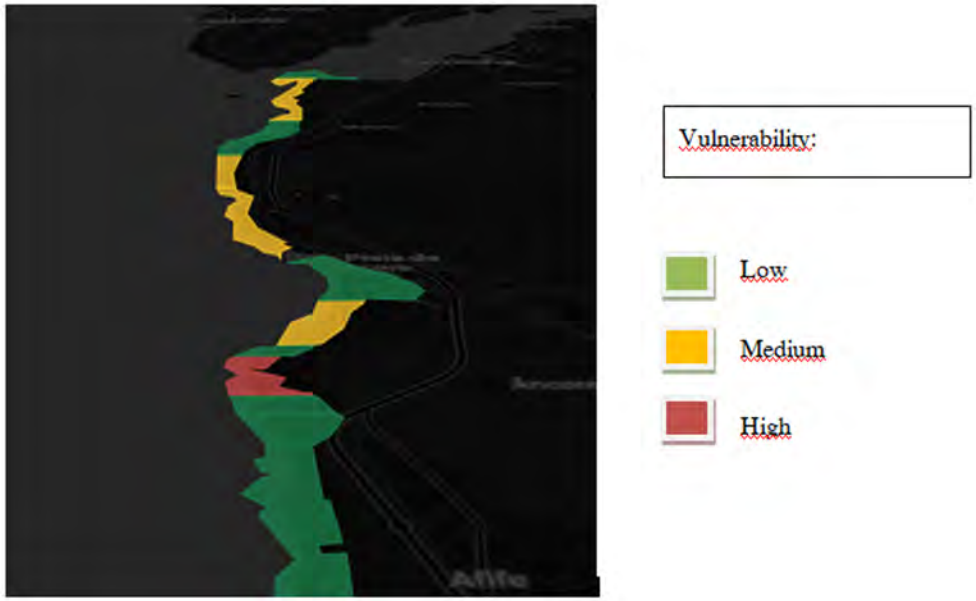
  Dissemination and awareness of the potential risks of Climate Change among schoolchildren.

Risk of Flooding and Erosion

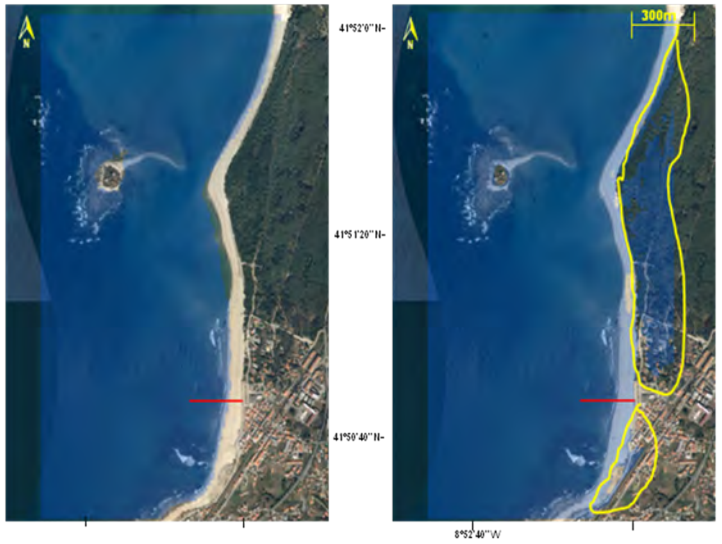
- Integrated modeling that allows to know the regime of maritime agitation and coastal currents



Risk of Flooding and Erosion



Map of erosion vulnerability in a section of north Portugal coast



Example of flooded area taking into account a wave storm in 2050 in RCP4.5 scenario

- Strategies for adaptation to climatic changes
  - Defense
  - Accommodation
  - Relocation

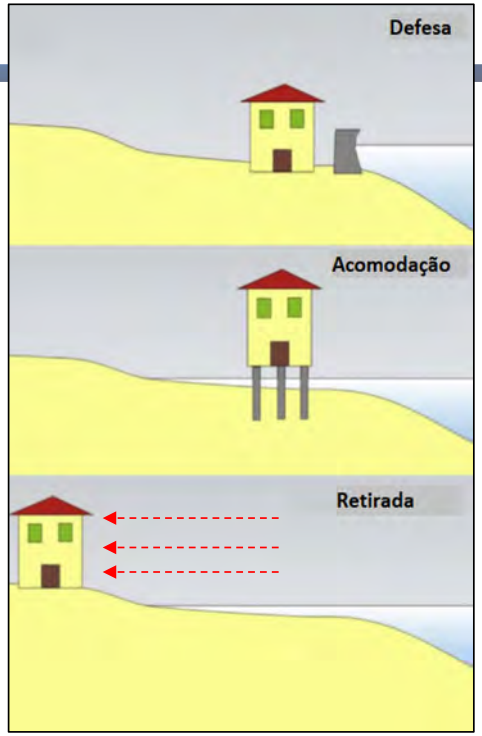


Figura 1 – Estratégias de Adaptação às alterações climáticas (Defesa, Acomodação e Retirada).
Fonte: Adaptado de Williams et al (2017).

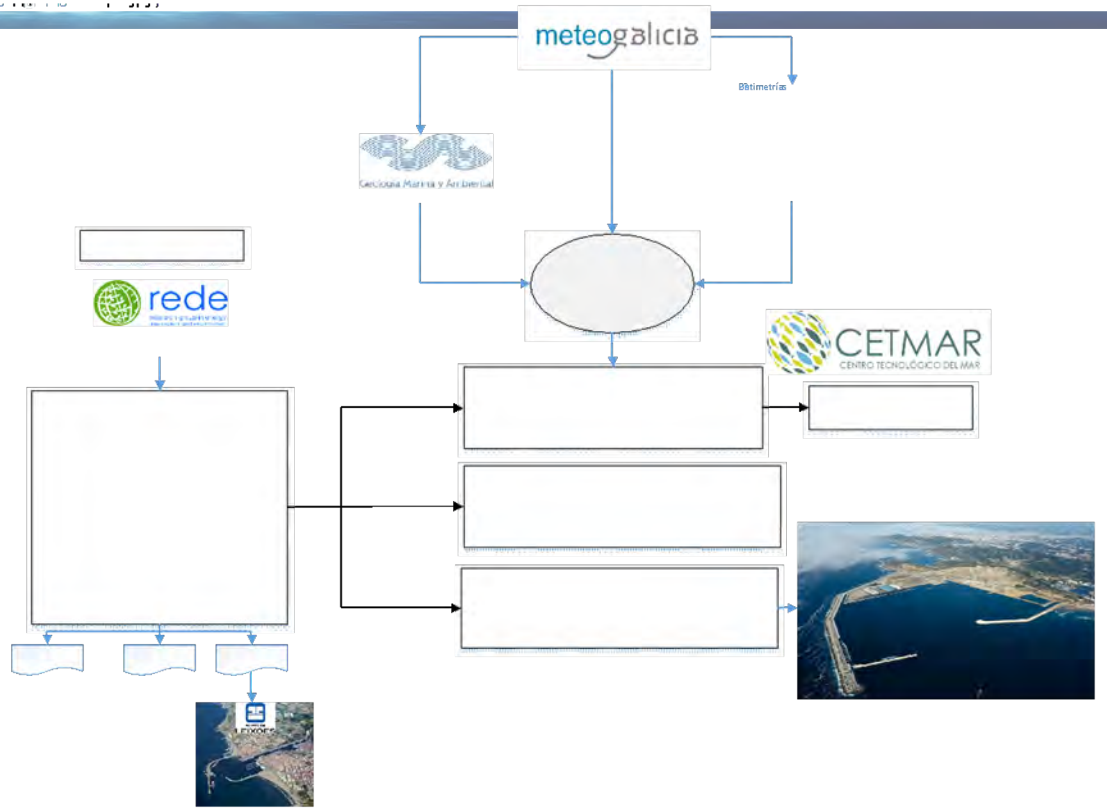
Benefits Analysis

Average of the benefits index carried out by the specialists

Defense	Accomodation	Relocation
22%	25%	53%

Resilience index for harbours

- Creation of a tool to improve resilience. Case study: Port of Punta Langosteira (A Coruña)



Resilience index for harbours

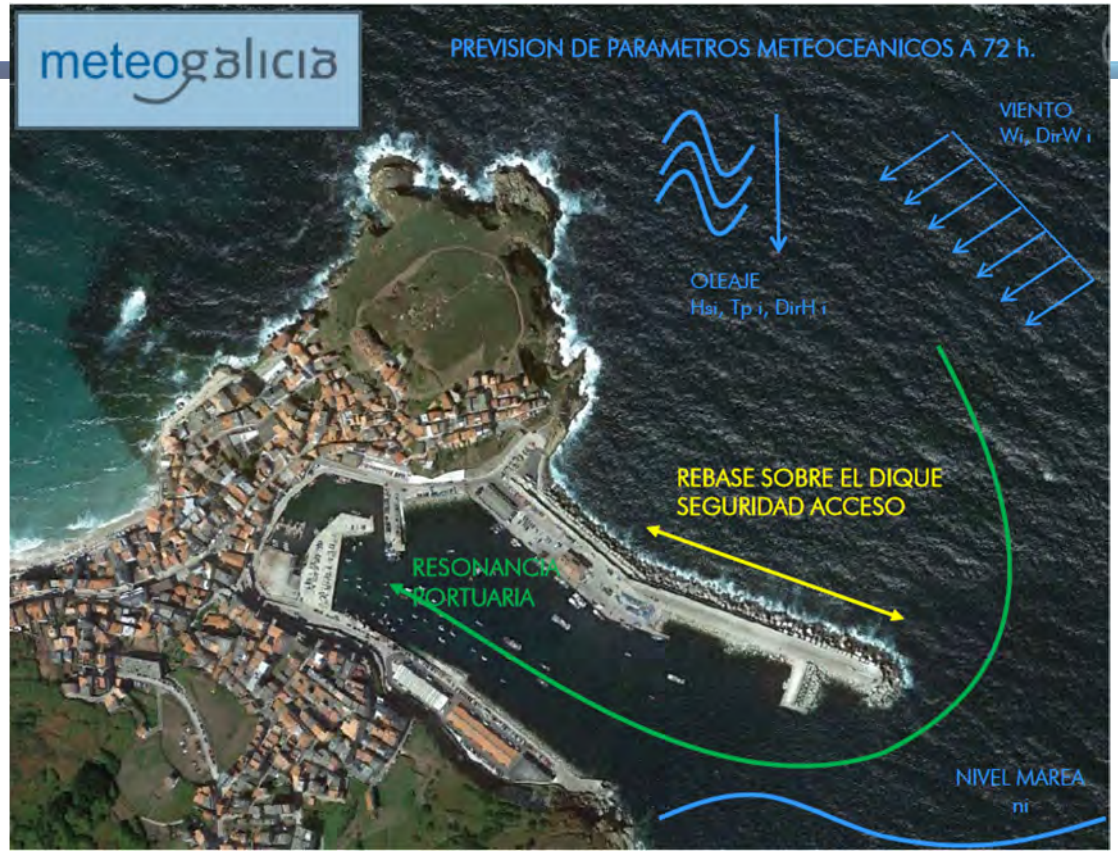
- First step: A group of experts evaluates the connection of different physical parameters (waves, wind, rain ...) with different aspects of harbour operations
- Second step: Another group studied the relationship of these risk scenarios with different adaptation factors

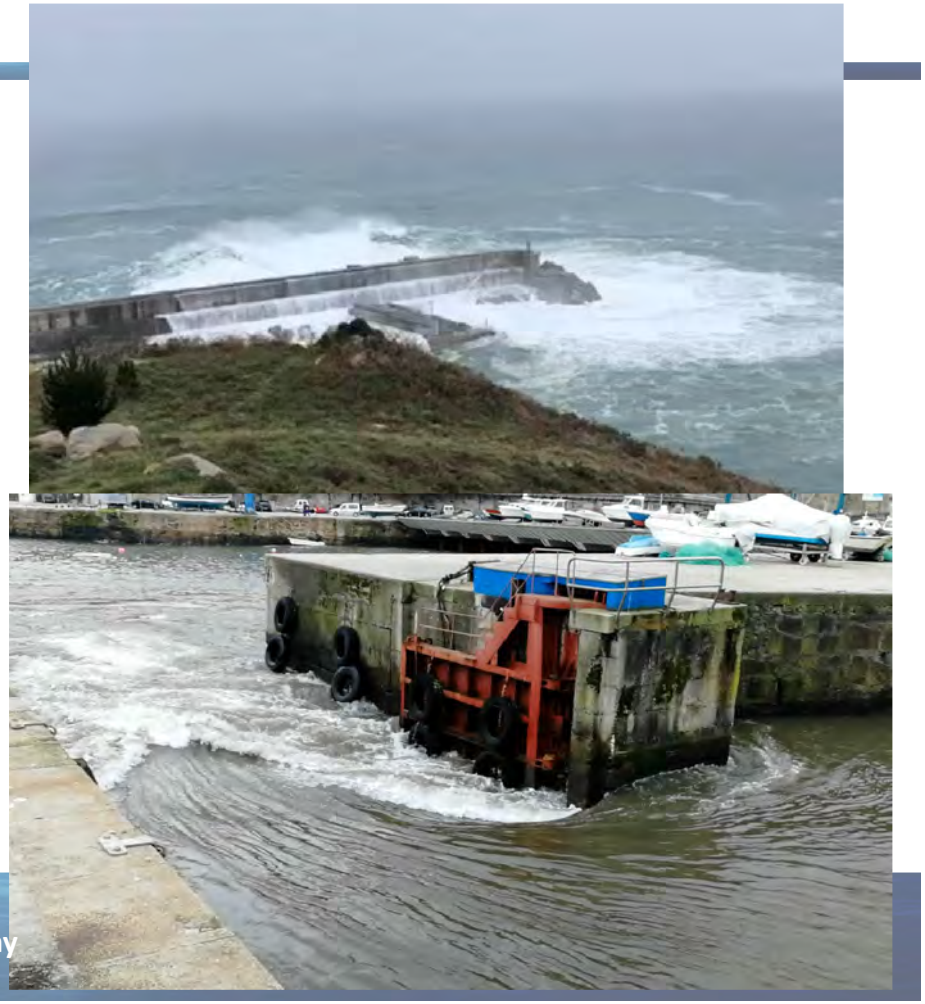
1. Gobernance | **2. Colaboration and comunicación** | **3. Infraestructures and equipment** | **4. Adaptation Capacity** | **5. Risk Management**

Plans for adaptation to climate change

1. Development of more efficient prediction models
2. Digital transformation of the harbour and innovation in business models
3. Planning of the construction / acquisition of new infrastructures / equipment, as well as for the sustainability and adaptability of the existing ones
4. Adaptation to the normative / regulatory framework of climate change in the port environment
5. Collaboration with other port entities in matters of Climate Change

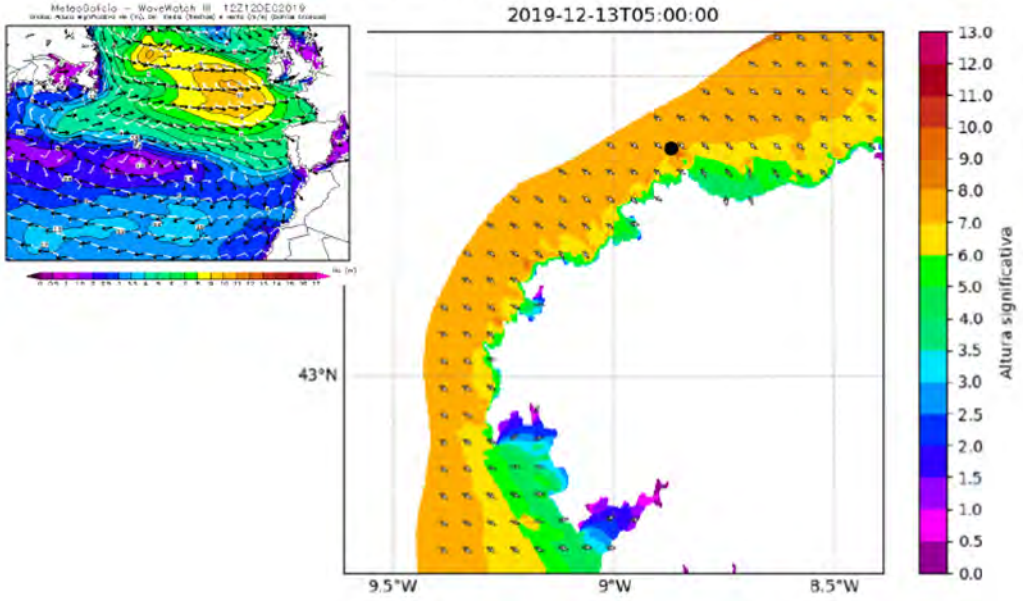
Long-wave resonance



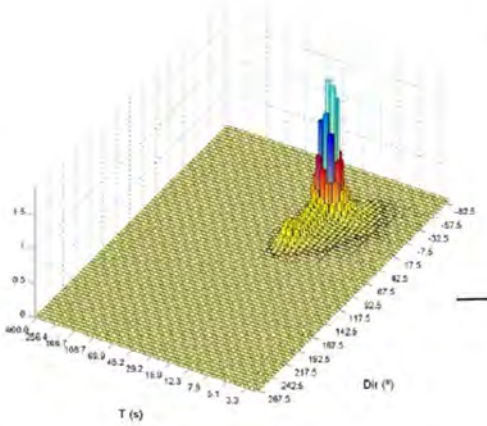


Methods

1) PREVISION METEOGALICIA
ESPECTROS OLEAJE A 72 h
NIVEL DEL MAR

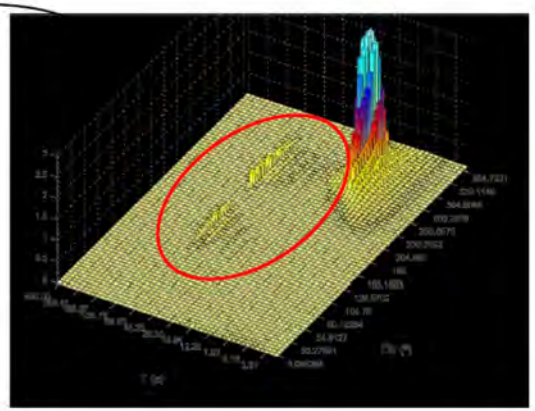


2) GENERACIÓN ESPECTROS
DE ONDA LARGA

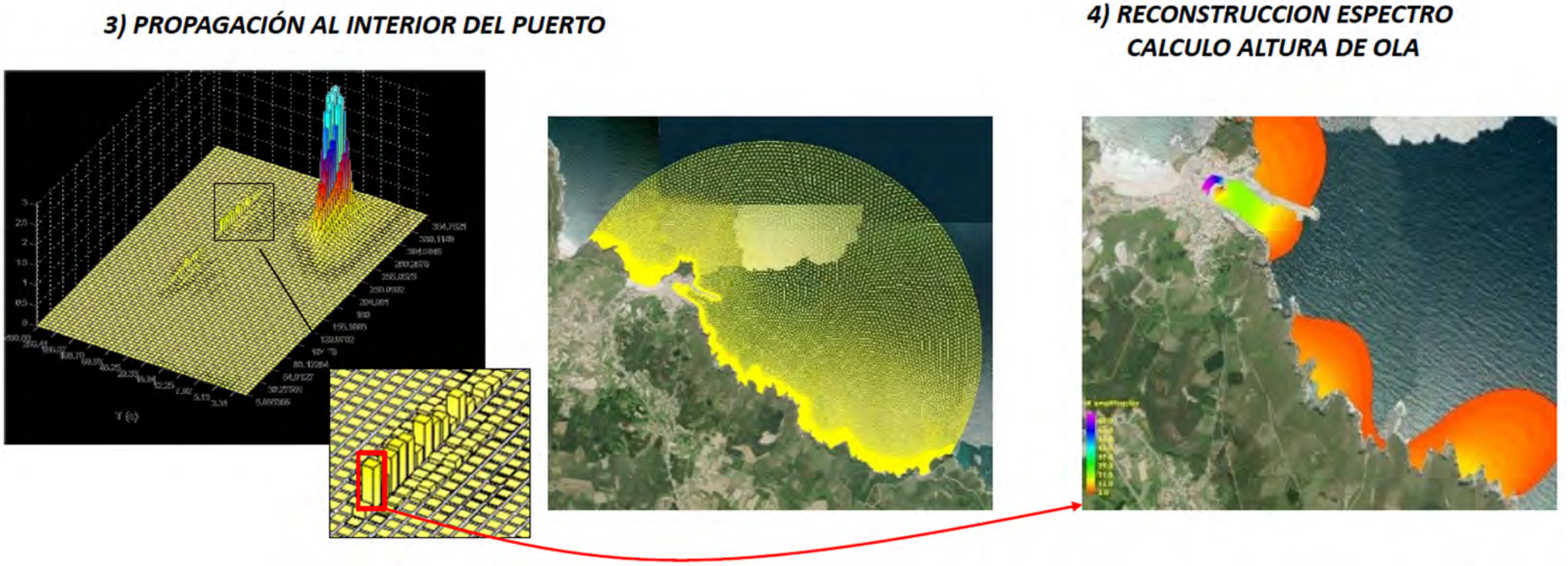


$$\eta(\omega_j) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty}\sum_{q=1}^{n\theta}\sum_{r=1}^{n\theta} C_e \cdot A_{n,q} \cdot A_{m,r}$$

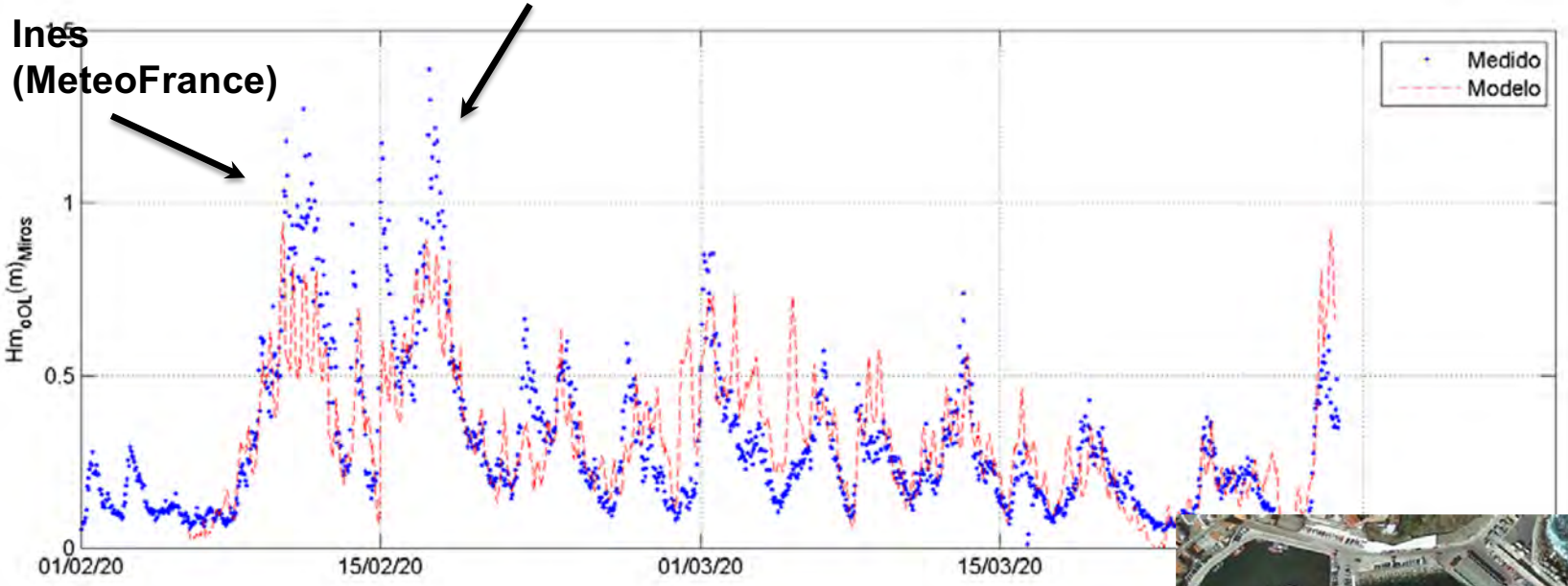
Okihiro (1992)

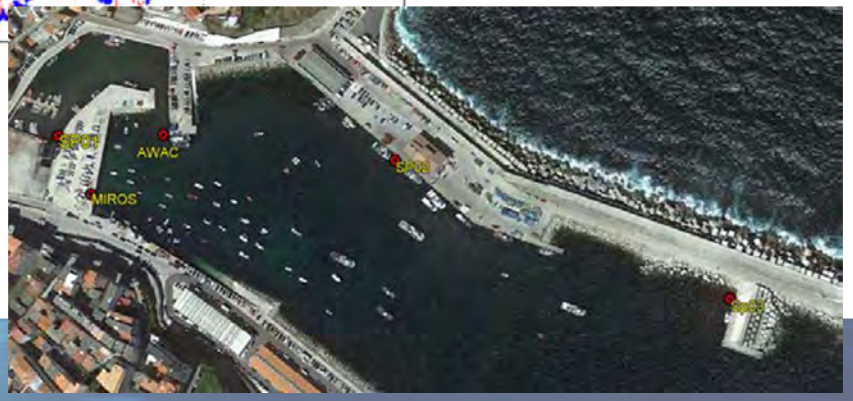


Methods


3) PROPAGACIÓN AL INTERIOR DEL PUERTO
4) RECONSTRUCCION ESPECTRO
CALCULO ALTURA DE OLA

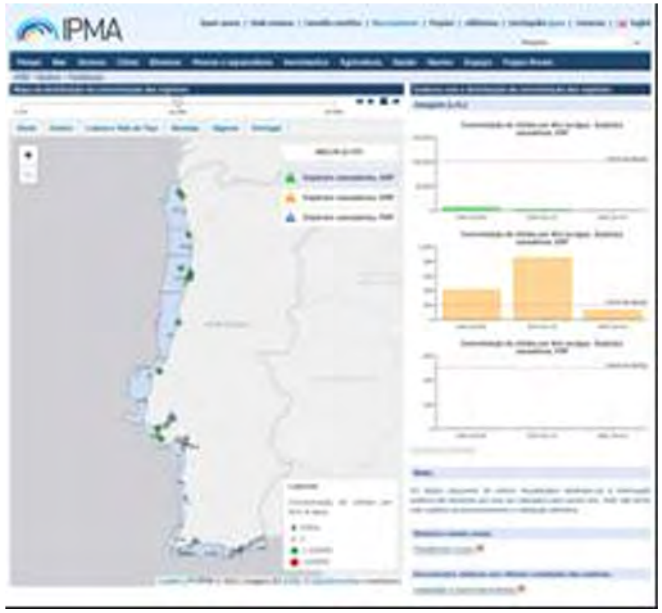
Results

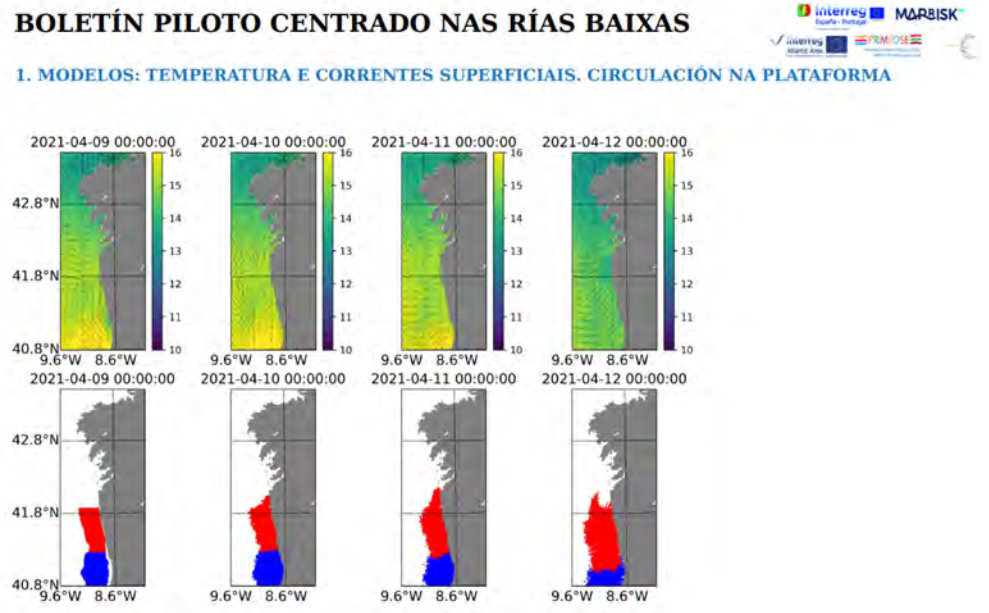

Dennis (920 mb)
Ines
(MeteoFrance)
Medido
Modelo
$Hm_{0OL}(m)_{Miros}$
0
0.5
1
01/02/20
15/02/20
01/03/20
15/03/20


SPOT
AWAC
MIROS

Coastal risks for aquaculture in the Eurorregion (Galicia – North Portugal)

- The early warning developments in Marrisk rely on the use of Marrisk hydrodynamic models that predict the possible transport of HAB causing advection of phytoplankton species, combined with satellite data and in-situ HAB data from the monitoring of Marrisk partners in Galicia (INTECMAR) and Portugal (IPMA)





An example of the Marrisk HAB services in Portugal and Galicia for supporting coastal communities. On the left, the IPMA web page showing HAB phytoplankton species distribution in bivalve production areas (https://www.ipma.pt/pt/bivalves/fito/index-map-dia-chart.jsp). On the right, an example of the model forecasts in the Galician risk assessment pilot bulletin.

Conclusions

1) Need to continue generating knowledge: Data and models to elaborate realistic scenarios
2) Implication of stakeholders in strategies (co-creation of climate services)
3) Combining early warning systems for phenomena such as coastal flooding,wave overtopping, longwave resonance with other long-term strategies
4) Need for a good identification of problems