

Improvements in flood forecast

Juan Taboada

MeteoGalicia - Subdirección Xeral de Meteoroloxía e Cambio Climático

Dirección Xeral de Calidade Ambiental e Cambio Climático

ConSELLERÍA DE MEDIO AMBIENTE, TERITORIO E VIVENDA

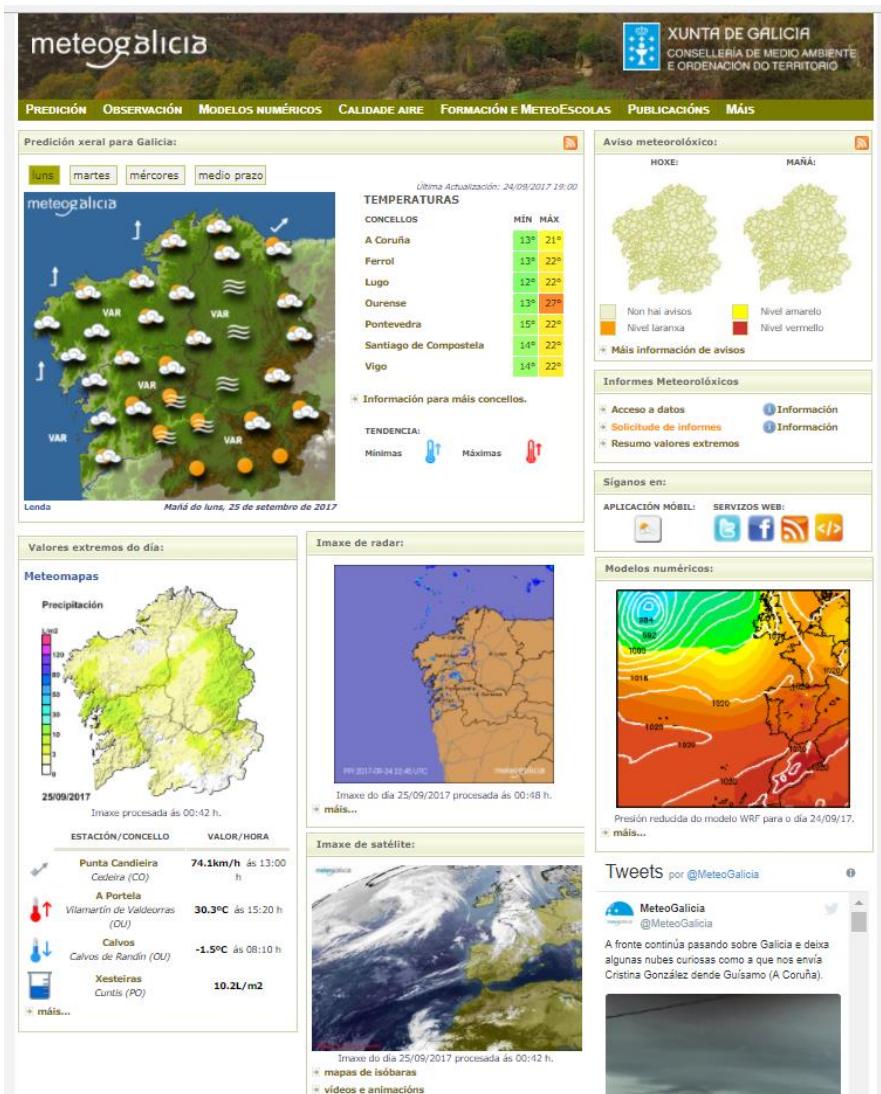
Xunta de Galicia



XUNTA DE GALICIA

CONSELLERÍA DE MEDIO AMBIENTE,
TERRITORIO E VIVENDA

MeteoGalicia

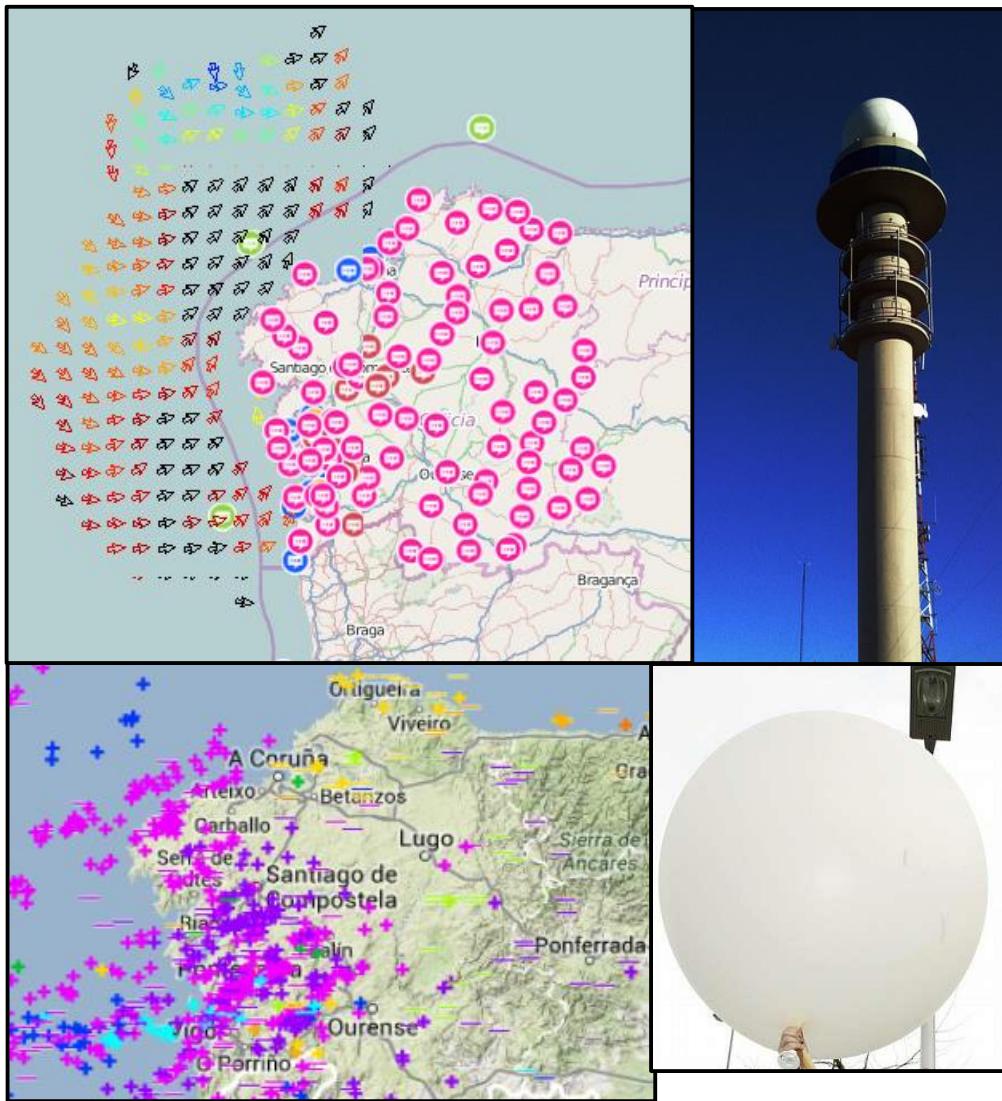


Serving the society since 2000

- Weather forecast
- Observation & Climate
- Numerical models
- Services to end users
- Air Quality
- Participation in research projects

<http://www.meteogalicia.es>

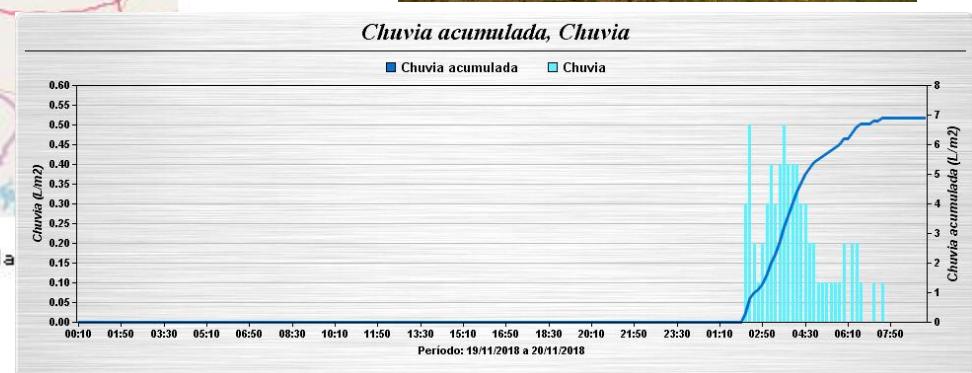
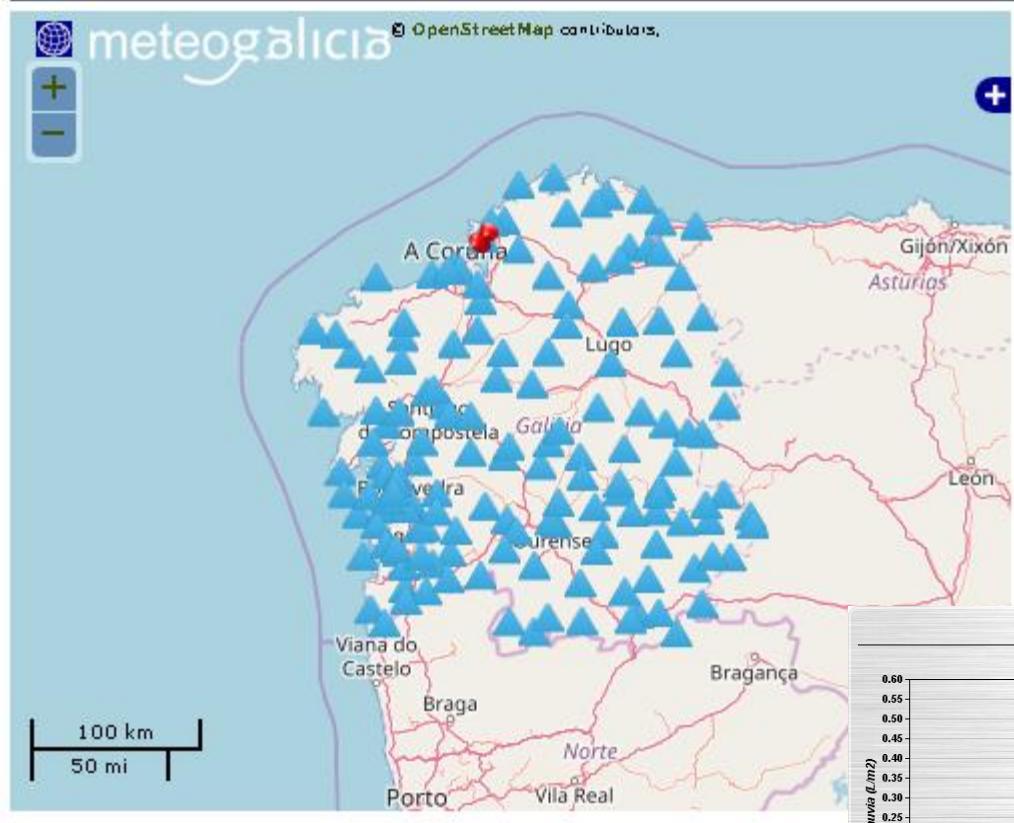
Observation



Monitoring system:

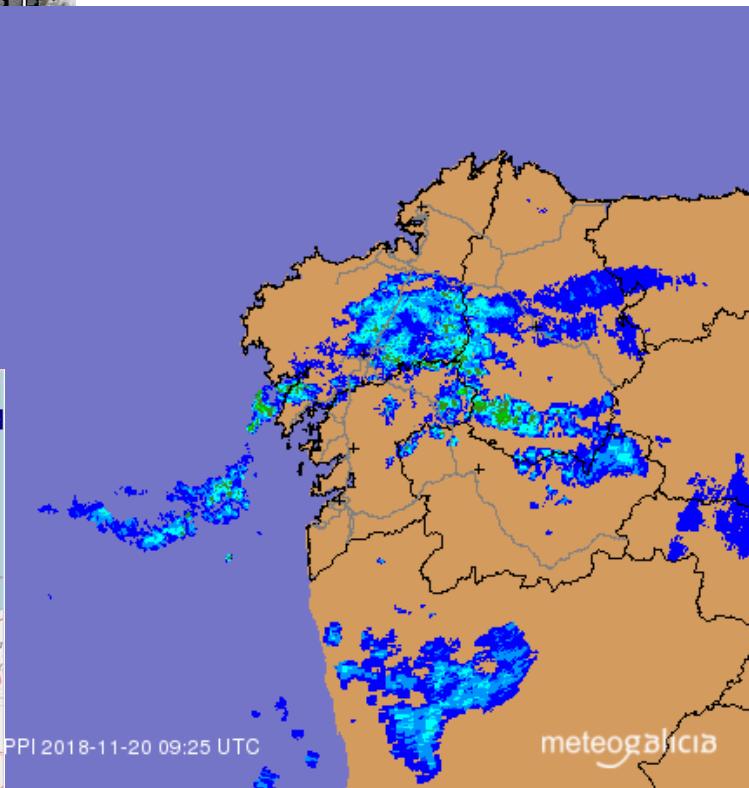
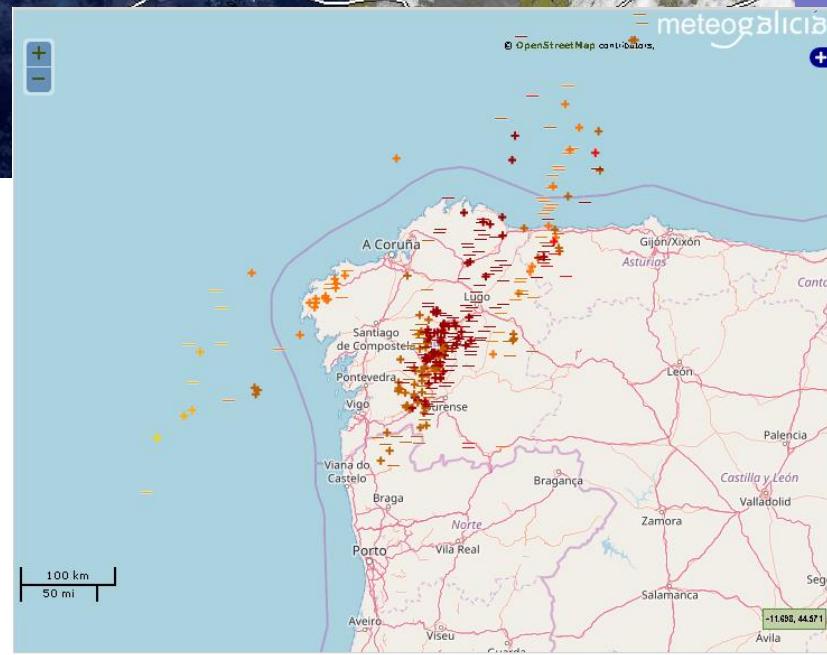
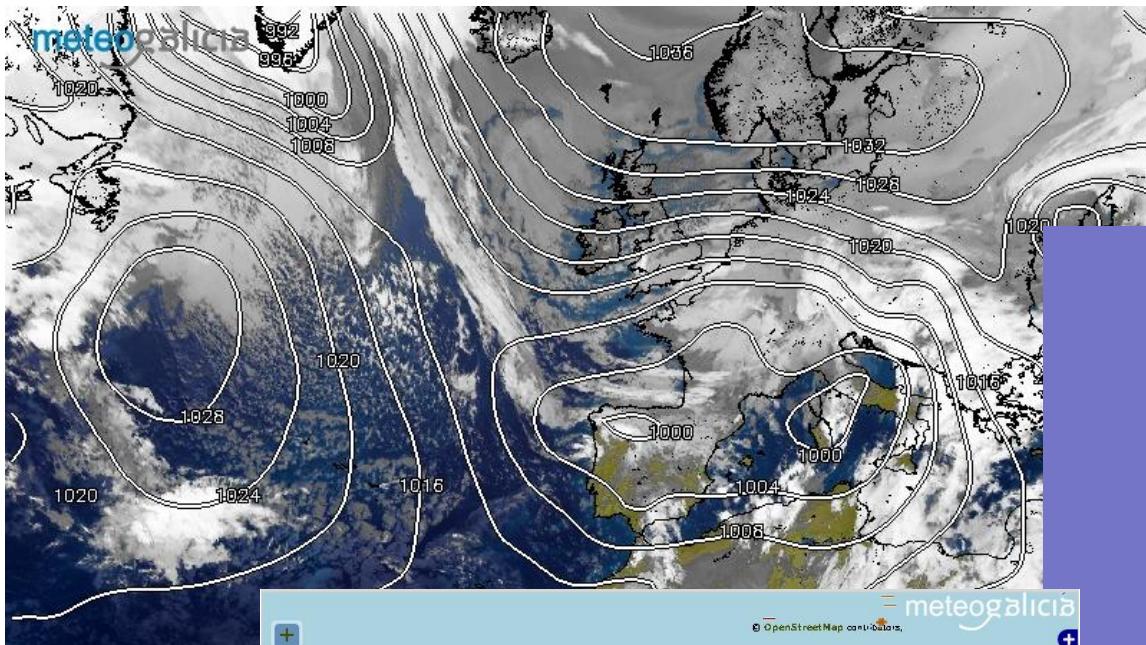
- Weather stations
- Oceanographic buoys
- Radar
- Radiosonde
- Lighting detection
- Satellite

Observation: Weather stations



More than 150 automatic weather stations distributed all over the territory

Observation: Satellite, radar, lightning

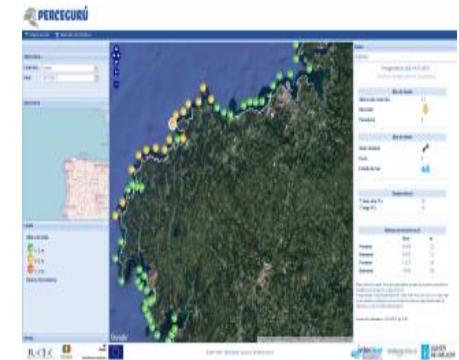
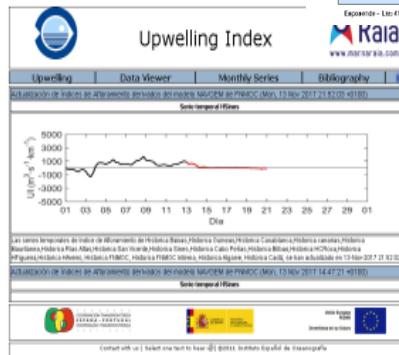
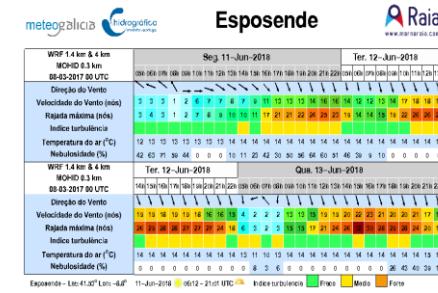
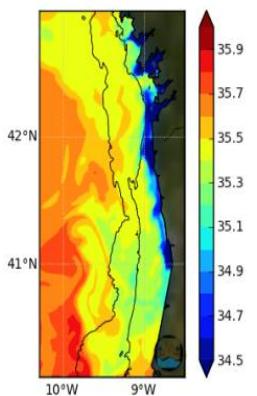
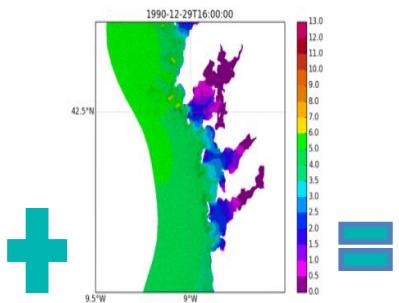
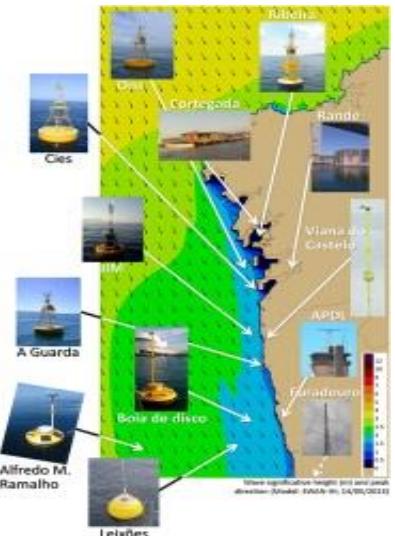


Monitoring: RAIA Oceanographic Observatory

- The RAIA Observatory started with the RAIA project (2009–2011) and was maintained and further developed in the RAIA.co (2012–2015) and RAIA tec (2013–2015) follow-up projects
- The observatory has been adopted as the basis for MarRisk, the new project financed by Interreg V-a (Poctep)
- .



Monitoring: RAIA Oceanographic Observatory



Observations + Models = Services

Integration



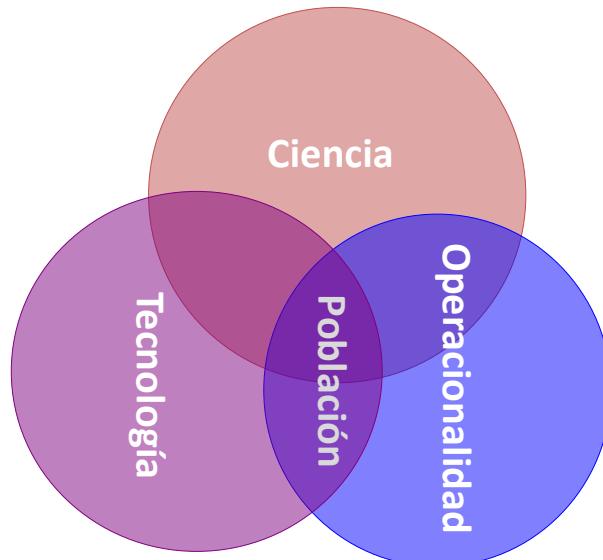
Observación



**Modelización
Numérica
Atmosfera/Océano**



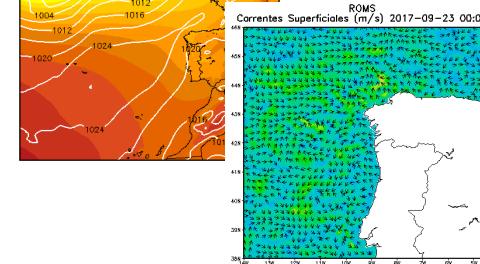
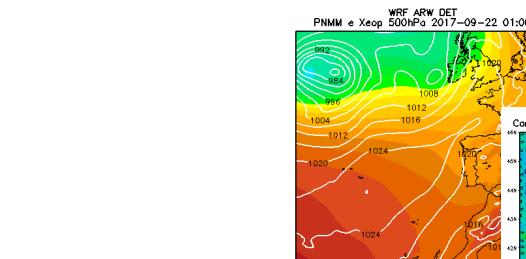
**Implementación
Operacional**



Usuarios Finales

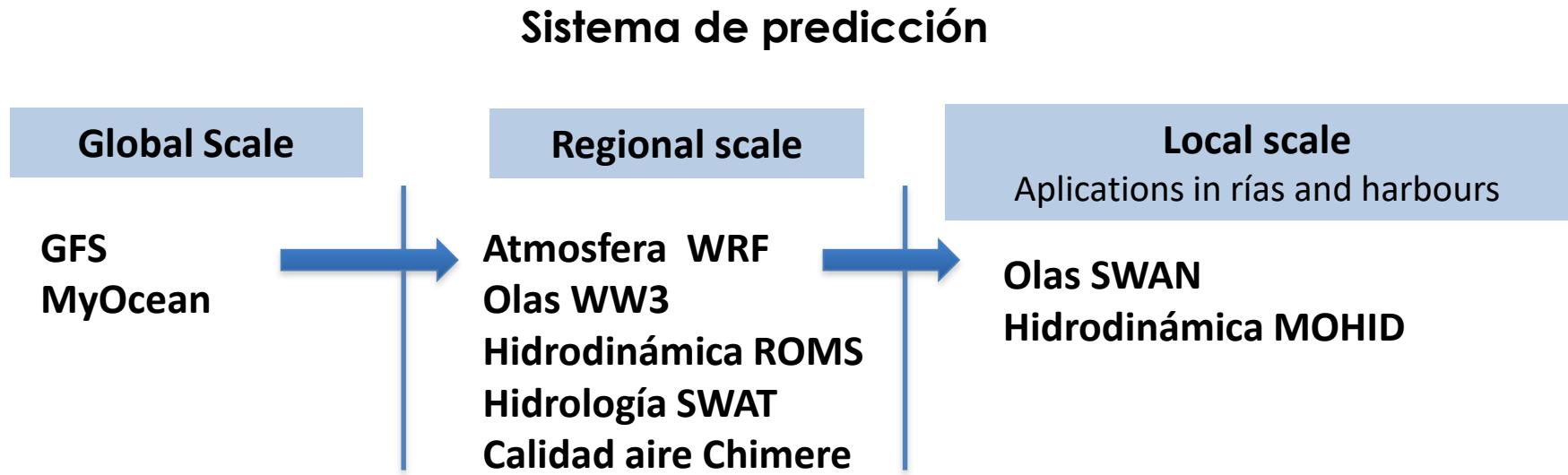


Distribución



Productos y Servicios

Operational models

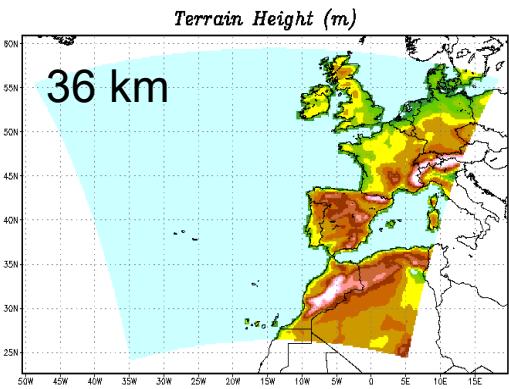


For an adequate response:

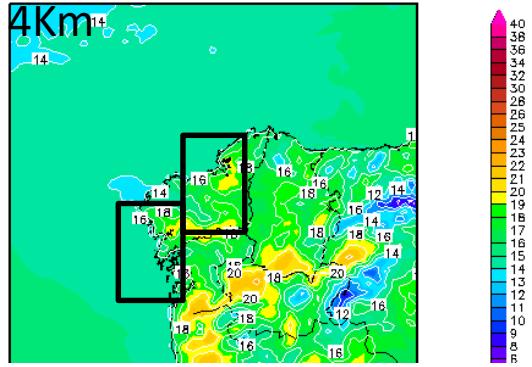
- More precise predictions, several models are used at different scales: regional and local
- They are run daily providing predictions of atmospheric and oceanic variables for the Galician coast and for the rias and harbours of greatest interest
- The demand for resources is great. The processing capacity available at CESGA allows us the possibility of improving the accuracy of our predictions, as well as increasing areas of modeling of interest at a higher spatial resolution

Atmosphere

GFS 0.25°



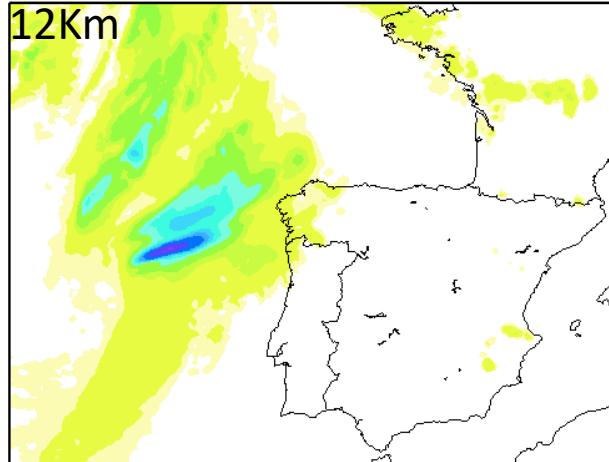
wrf_arw - Temperatura a 2m (C) 2011-06-09 14:00Z



**Model:
WRF – ARW**

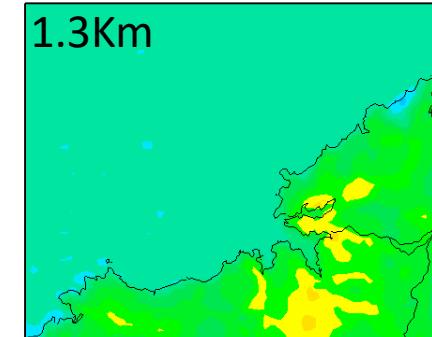
- deterministic
- forecast: 4 days
- 2X/day 00Z,12Z
- 24 procs

wrf_arw - Precipitacion 6h (mm) 2012-06-20 18:00Z

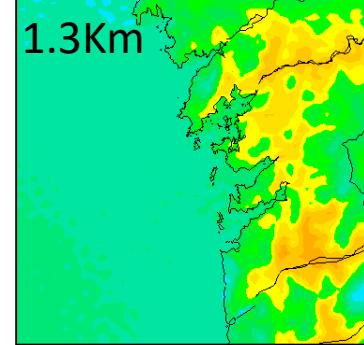
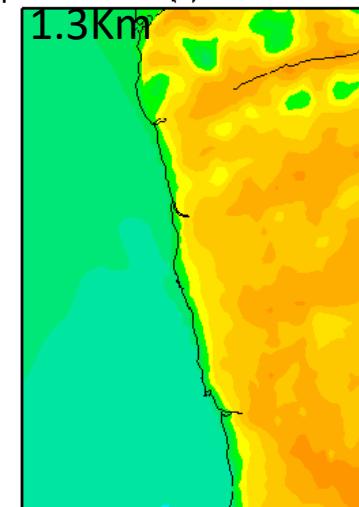


MeteoGalicia – Consellería de Medio Ambiente – Xunta de Galicia

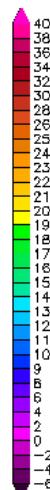
wrf_arw - Temperatura a 2m (C) 2011-06-09 14:00Z



WRF ARW DET 1KM
Temperatura a 2m (C) 2017-09-24 12:00Z

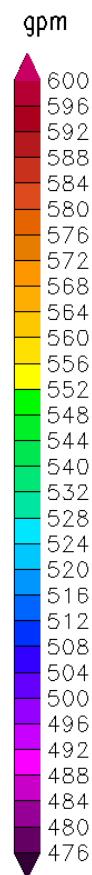
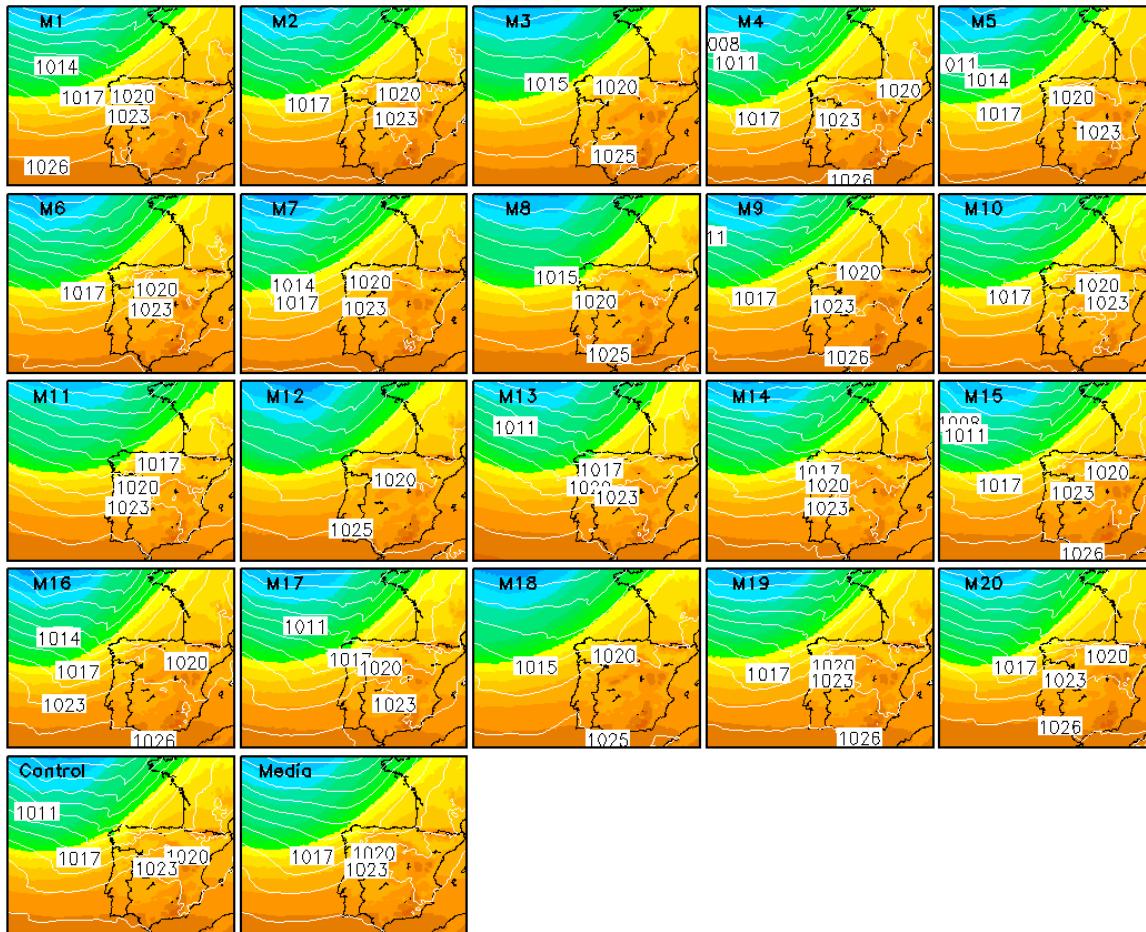


MeteoGalicia – Consellería de Medio Ambiente – Xunta de Galicia



GEFS

Conx. (WRF) 2016-03-26 12:00Z. A. xeop. a 500HPa + Pr. reducida (mb)



Model: WRF – ARW

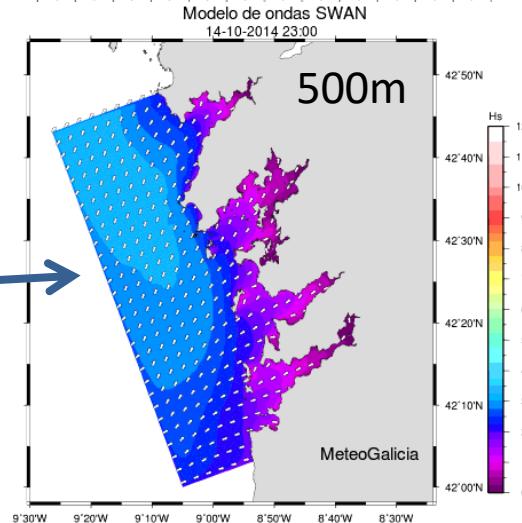
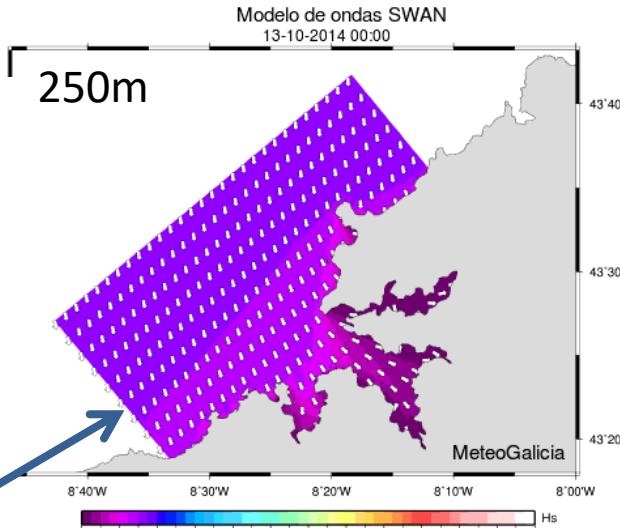
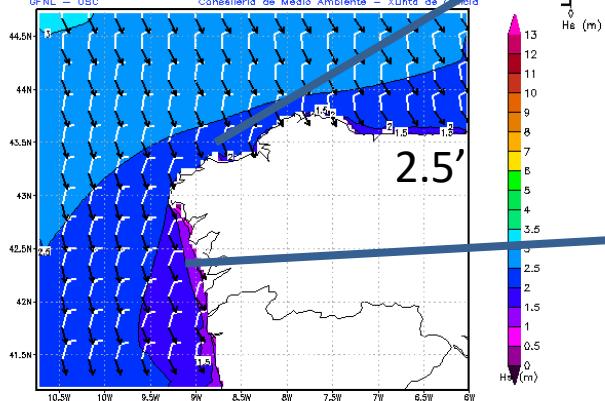
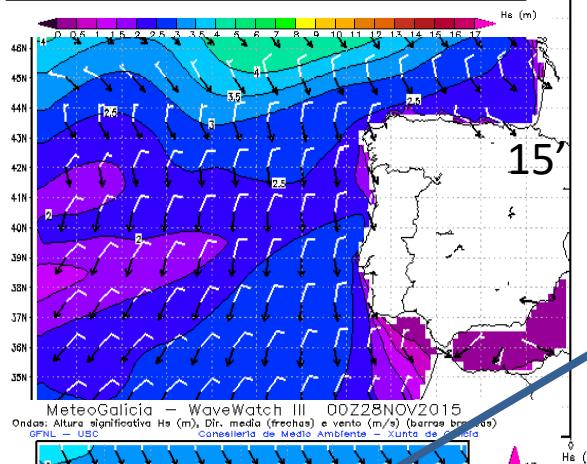
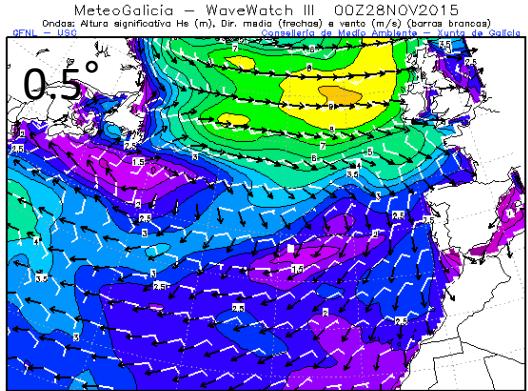
- Ensemble: 21 miembros

- 3 mallas: 36,12,4 km

- forecast :
curto plazo - 4 días
largo plazo - 9 días

- 21 nodos
1 miembro \ 1 nodo

Oleaje

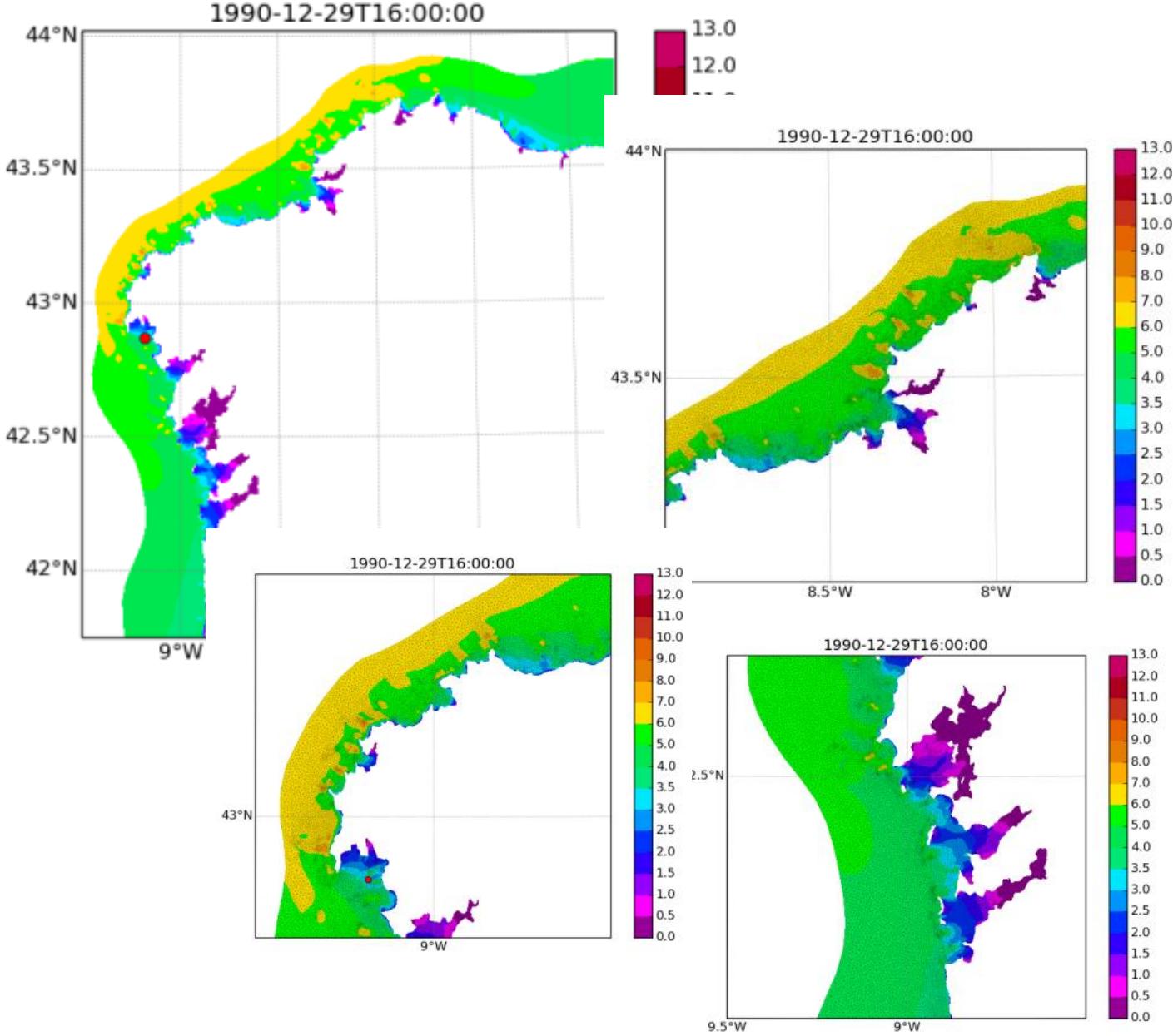


Modelo (Regional): WaveWatch III

- forecast: 4 días
- 2X/día 00Z,12Z
- 1 proc

Modelo (Local): SWAN

- forecast: 4 días
- OpenMP



Modelo: SWAN

- malla: no estructurada
- forecast: 4 días
- 12 Procs

Hydrodinamic

WRF 12 & 4 Km

Atmospheric model

4 forecast days

wind

temperature

precipitation

radiation

Humidity

ROMS 2 km & MOHID 0.3 Km

Hydrodynamic model

4 – 3 forecast days

3D U,V

temperature

salinity

SWAT

Hydrological model

4 forecast days

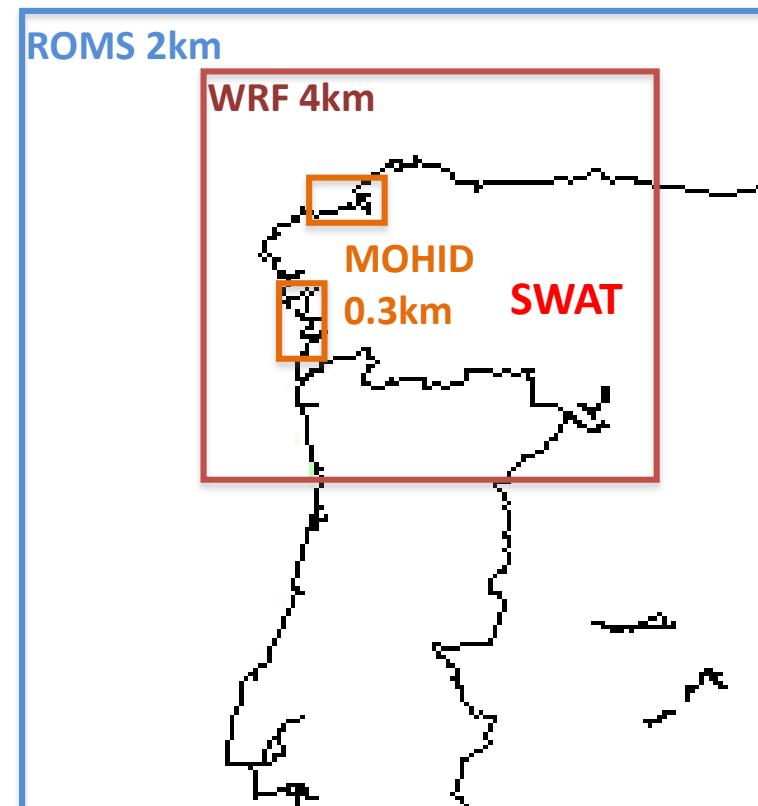
WRF 12km

ROMS 2km

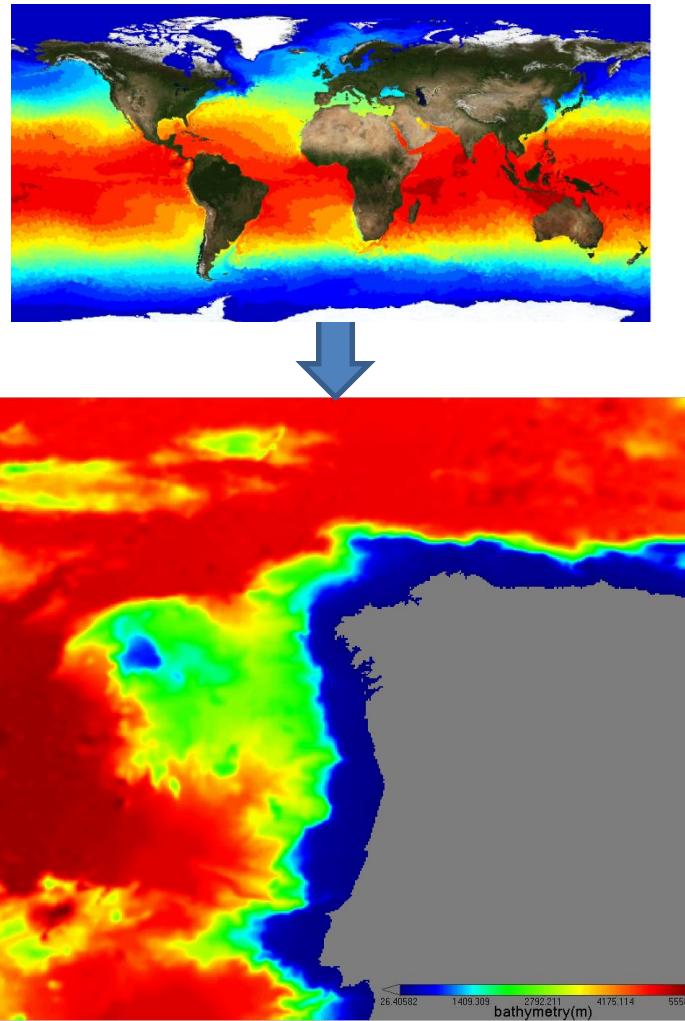
WRF 4km

MOHID
0.3km

SWAT

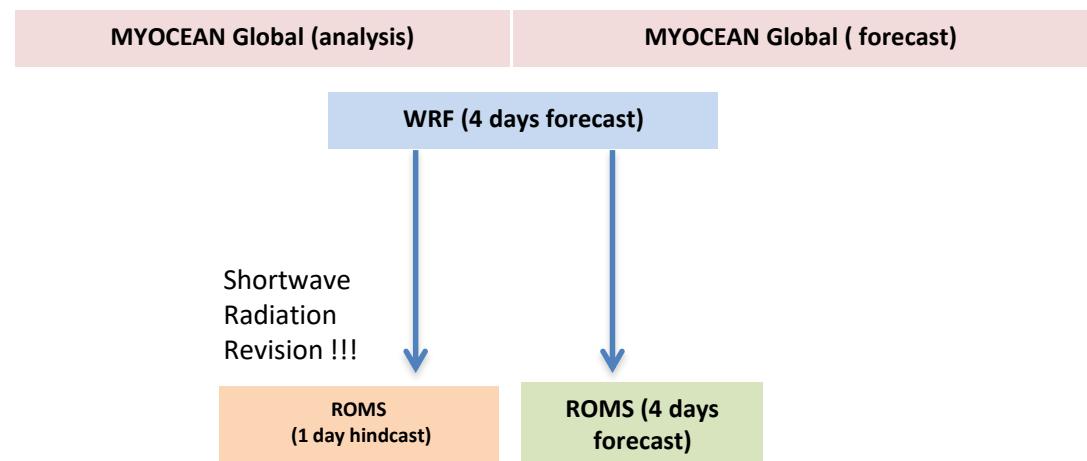


MyOceanGlobal 1/12

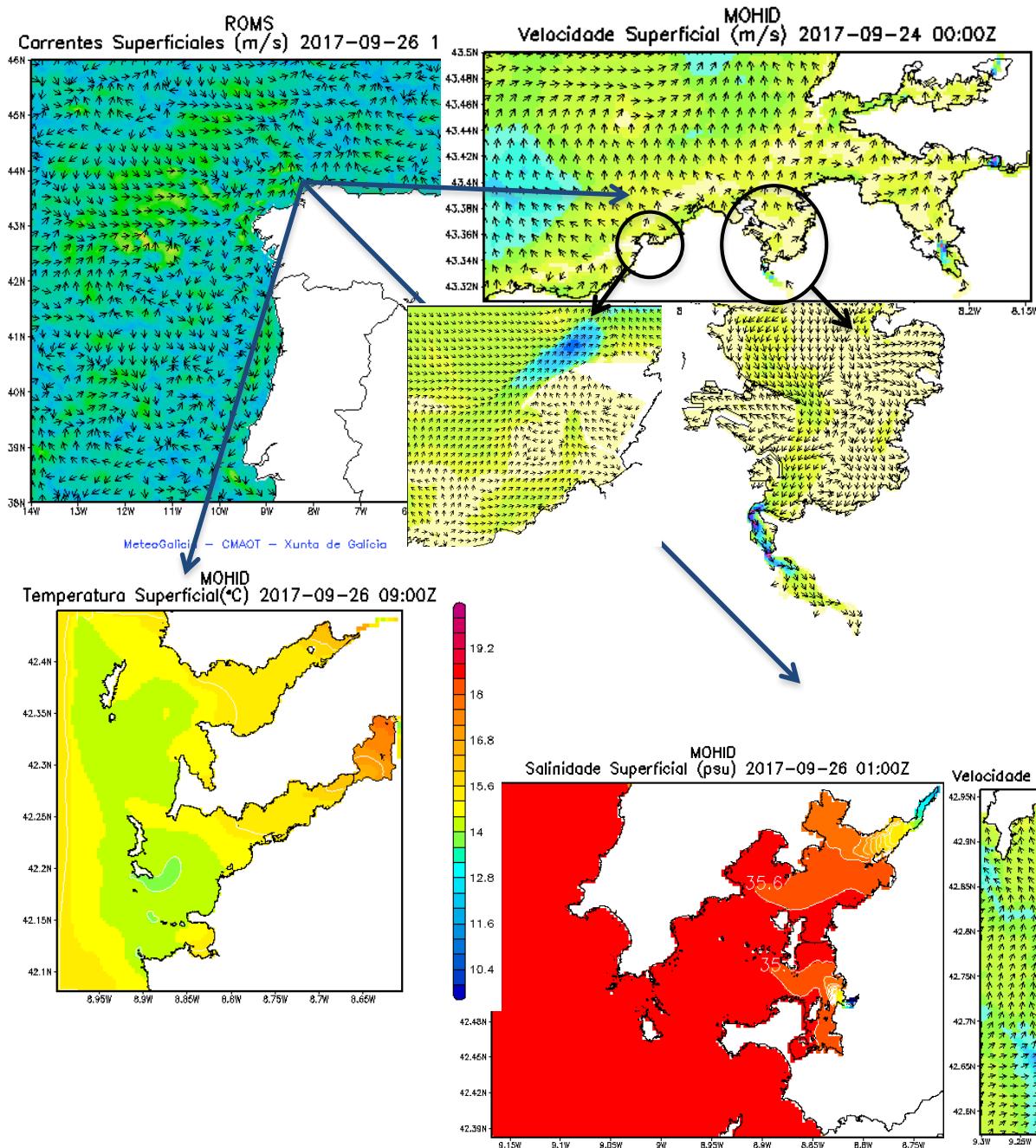


Modelo (Regional): ROMS

- forecast: 4 días
- malla 2km
- Norte Península Ibérica
- 24 procs



- $Dx = 2\text{km} / DT = 60 \text{ s}$
- $Nx = 400, Ny = 475, Nz = 41$
- Ocean forcing - $1/12^\circ$
- Meteo Forcing - WRF 12km
- Tidal - OSU Topex/Poseidon
- Rivers – SWAT model



Modelo (Local): MOHID

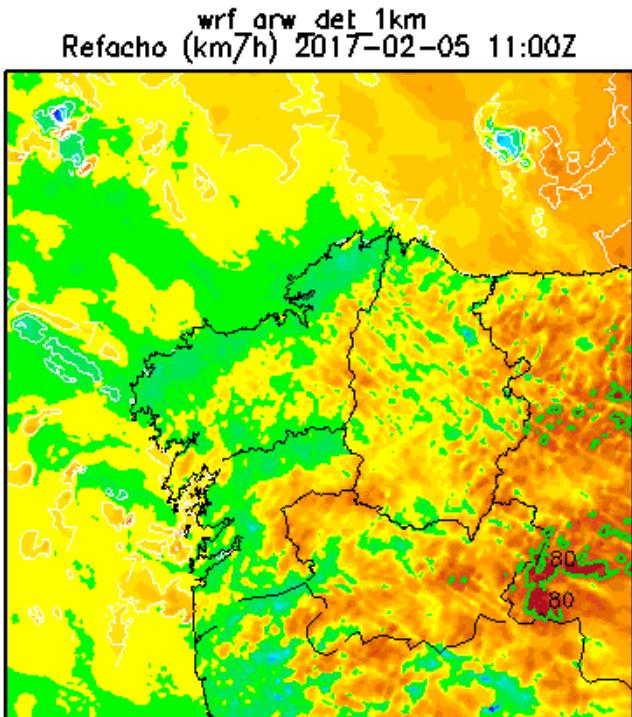
- forecast: 3 días
- 4 mallas 300m+2malla 50m
- Artabro, Noia_Muros, Arousa,
Vigo/Pontevedra y
Puertos: Langosteira y Coruna
- OpenMp

- $Dx = 300\text{m}/ DT = 30\text{s}$
- $Dx = 50\text{m}, DT= 15$
- Ocean forcing – Roms 2km/DT=900s
- Meteo Forcing – WRF 4km
- Rivers – SWAT model

Coming very soon:

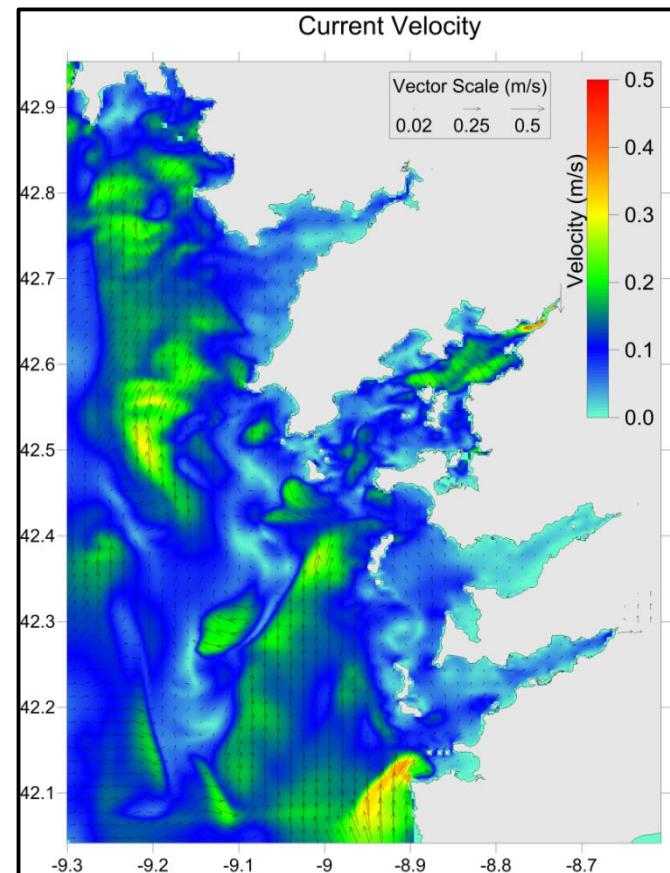
WRF :

- malla 1km para Galicia
- determinista
- forecast: 4 días
- 2X / día 00Z,12Z
- **41 nodos**



MOHID :

- mallas:
- Riasbaixas & Arco Artábro
- forecast: 3 días
- **24 procs**



Data distribution

Datos de modelos y observaciones son distribuidos a través: WEB based access y servidor THREDDS



Catalog <http://mando.meteogalicia.es/thredds/catalog/modelos/mohid/baroclinaNX/arousa/20110308/catalog.html>

Dataset: Saída do 08 do 03 de 2011/Malla de Arousa - Saída do 08 do 03 de 2011 -D+2

- Data type: GRID
- ID: MOHID_AROUSA/20110308/20110308Arousa_d2_linux.nc

Access:

1. OPENDAP: /thredds/dodsC/modelos/mohid/baroclinaNX/arousa/20110308/20110308Arousa_d2_linux.nc
2. HTTPServer: /thredds/fileServer/modelos/mohid/baroclinaNX/arousa/20110308/20110308Arousa_d2_linux.nc
3. NetCDFSubset: /thredds/ncss/grid/modelos/mohid/baroclinaNX/arousa/20110308/20110308Arousa_d2_linux.nc
4. WMS: /thredds/wms/modelos/mohid/baroclinaNX/arousa/20110308/20110308Arousa_d2_linux.nc
5. WCS: /thredds/wcs/modelos/mohid/baroclinaNX/arousa/20110308/20110308Arousa_d2_linux.nc

Dates:

- 2011-03-09 06:14:12Z (modified)

Viewers:

- Integrated Data Viewer
- NetCDF-Java
- Google Earth

Different kind of protocols are available!

meteogalicia.es/web/modelos/threddsIndex.action

Castellano | Galego

XUNTA DE GALICIA
CONSELLERÍA DE MEDIO AMBIENTE,
TERRITORIO E INFRAESTRUTURAS

PREDICIÓN | OBSERVACIÓN | CLIMA | MODELOS NUMÉRICOS | MAIS | METEOGALICIA

Galicia | Localidades | Medio prazo | Marítima | Mareas e lúas | Camiños de Santiago | Cortes voz | Adversos | Orto e ocasional | Ultravioleta

Servidor THREDDS - MeteoGalicia

Que é THREDDS?

O servidor THREDDS (Thematic Realtime Environmental Distributed Data Service) é unha ferramenta de conectividade entre proveedores de datos científicos e posibles usuarios finais.

O servidor baséase na xeración dinámica de catálogos en formato XML a través dos cales proporcionanse ligazóns de acceso mediante diferentes protocolos ás diferentes coleccións e conxuntos de datos. Así pois, a través de esta ferramenta permítese o acceso público aos datos de predición numérica que se xeran operativamente en MeteoGalicia.

Actualizacións do Thredds
24/10/2011
Subscrpción á lista de correo do Thredds
Para manterse informado dos cambios que se produzan no Thredds de MeteoGalicia, pode subscribirse a esta lista. É un servizo, polo momento, en probas.

Subscripción en lista de correo

A través desta lista de correo, informarase dos cambios que se produzcan no Thredds de MeteoGalicia. É un servizo, polo momento, en probas.

Nome:

Organización:

Email: *

Confirme email: *

*Campos obligatorios

Datos disponibles no servidor THREDDS

1. MeteoGalicia

Modelo WRF (Weather Research Forecast)

NetCDF files with surface variables from WRF model. Model WRF runs operationally twice a day initialized at 00UTC and 12UTC, the former runs for 96hours and the latter for 84 hours. Three nested domains are configured for 36Km, 12Km and 4km resolution.
Surface level model variables.
Consultar o catálogo

Modelo WRF 3D

Grib files (NCEP standard) with forecasted surface and vertical variables. Model WRF runs operationally twice a day initialized at 00UTC and 12UTC, the former runs for 96hours and the latter for 84 hours. Three nested domains are configured for 36Km, 12Km and 4km resolution.
Surface and 3D diagnostic model variables.

FoxyProxy: Deshabilitado

<http://www.meteogalicia.es/>
<http://www.marnaraia.org>

Access:

1. OPENDAP: </thredds/dodsC/>
2. HTTPServer: </thredds/fileServer>
3. WCS: /thredds/wcs/wrf_2d
4. NetcdfSubset: </thredds/ncs>
5. WMS: /thredds/wms/wrf_2d

GeoRSS

Mañá

Medio prazo

A Coruña

Ferrol

Lugo

Ourense

Pontevedra

Santiago de Compostela

Vigo

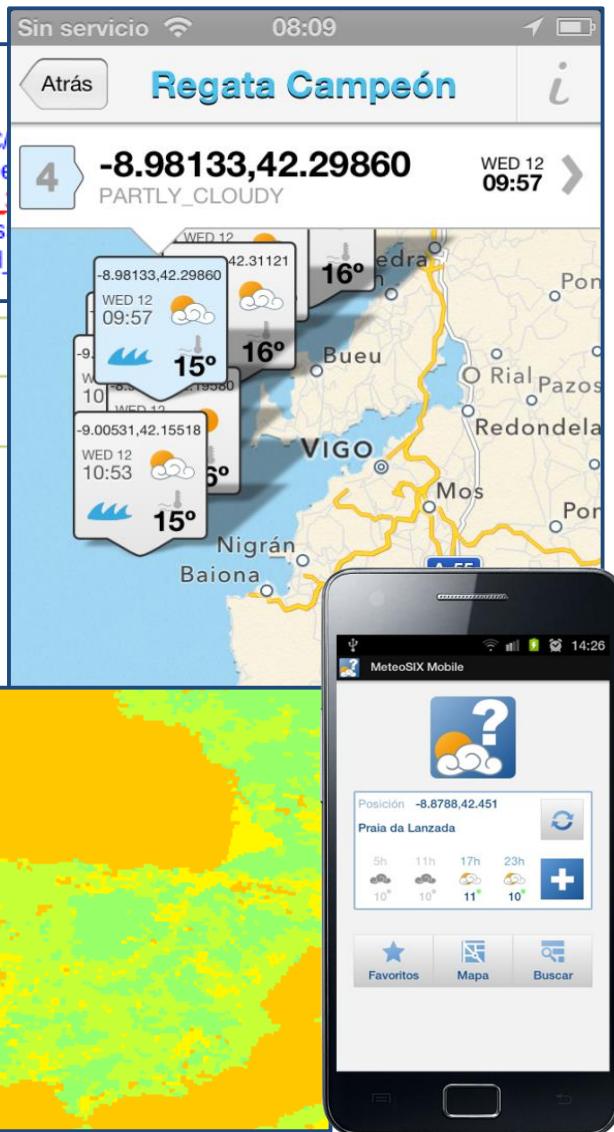
Costa Cantábrica

Ferrol-Bares

Ártabro

Costa da Morte

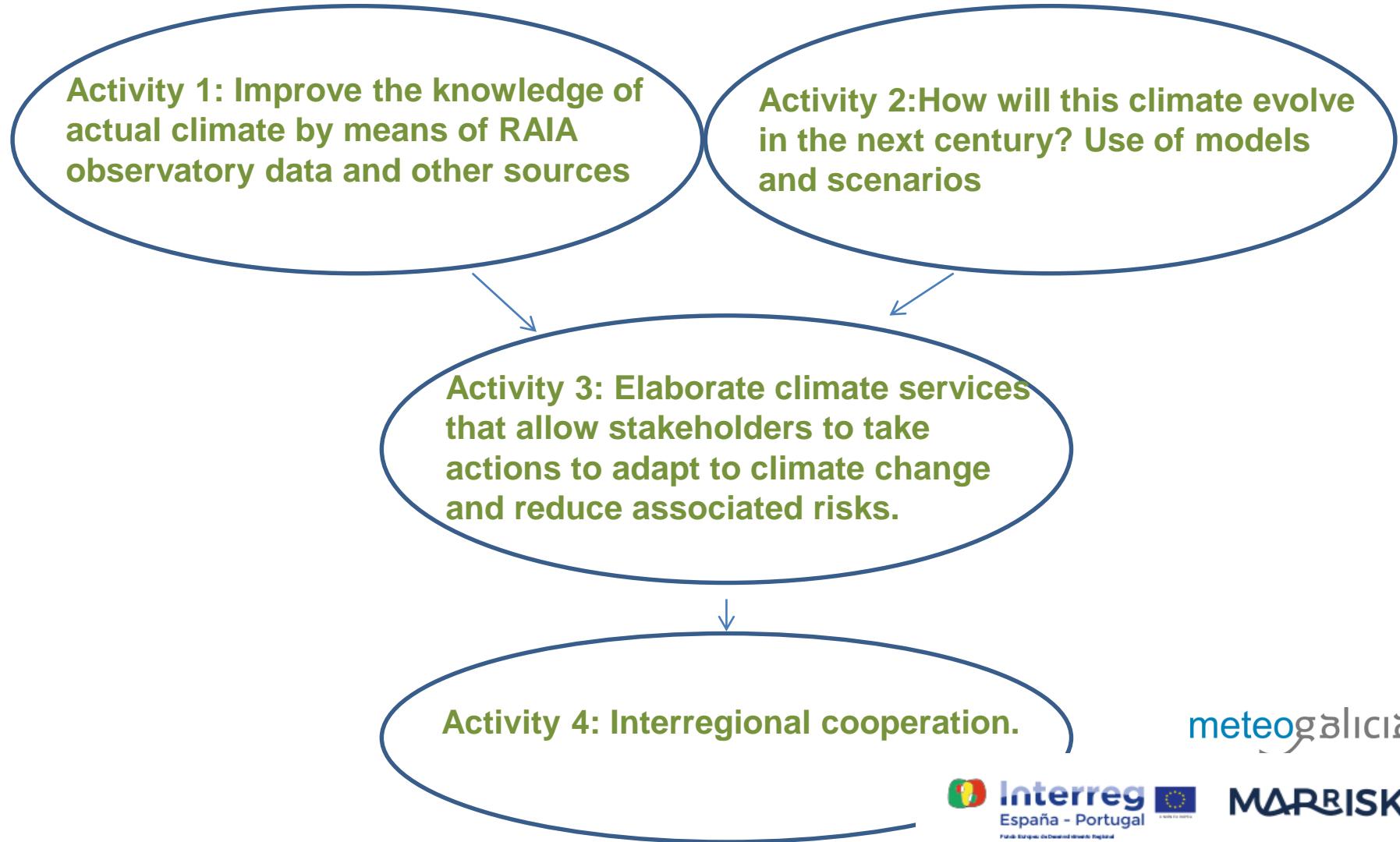
Rías Baixas



Several formats and standard services are used for the diffusion of products:

- **Previsiones Operacionales:**
RSS, XML, CSV
- **Observación**
SOS, XML, CSV
- **Modelos/Thredds Servidor:**
OpenDAP, WMS, WCS
- **API y Móviles Apps:**
Meteosix & MeteoRoute

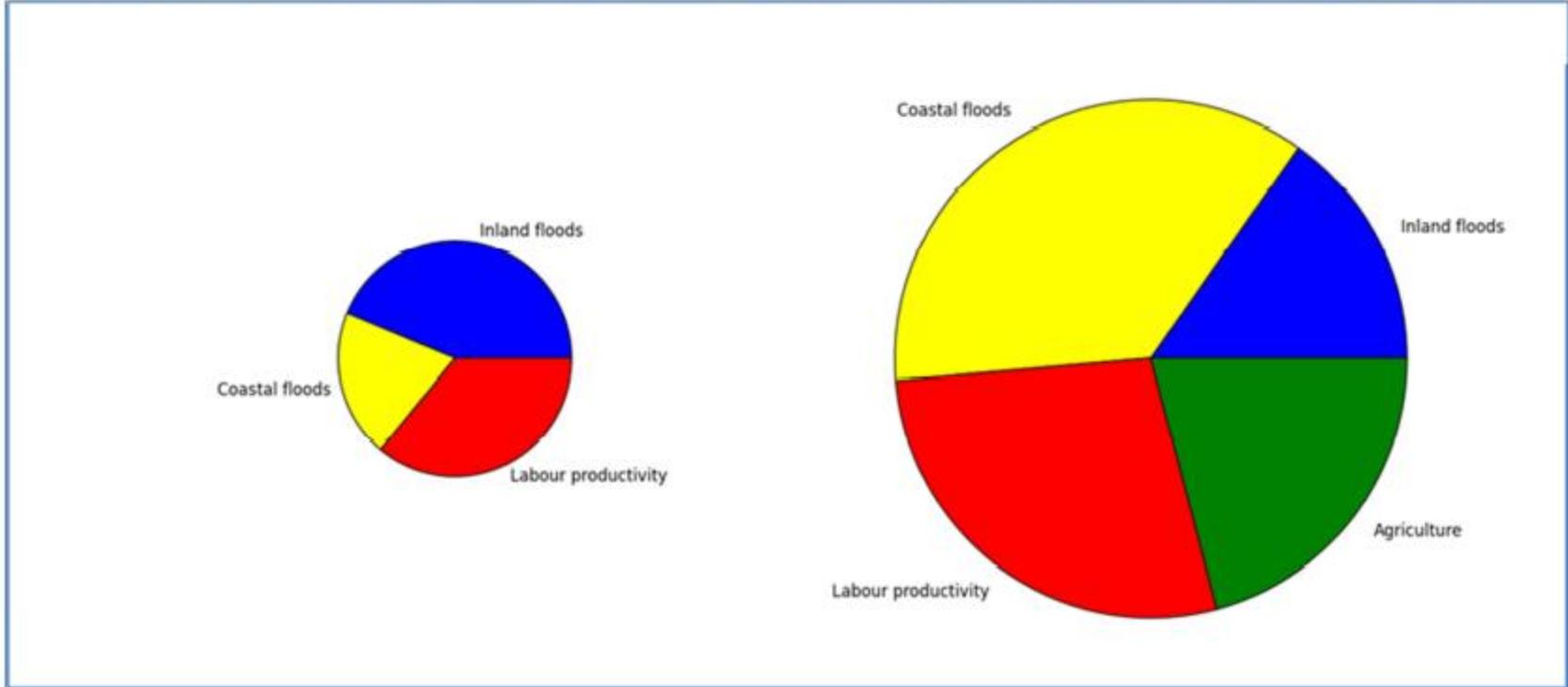
MarRisk Project



meteogalicia

Coastal flooding will be one of the main effects of climate change in Europe

Figure 26. Distribution of climate impacts (without health) under the 2°C scenario (left) and high warming scenario (right)



- Resultados del proyecto PESETA III (Projection of Economic impacts of climate change in Sectors of the EU based on bottom-up Analysys) del Joint Research Center (JRC) de la Unión Europea

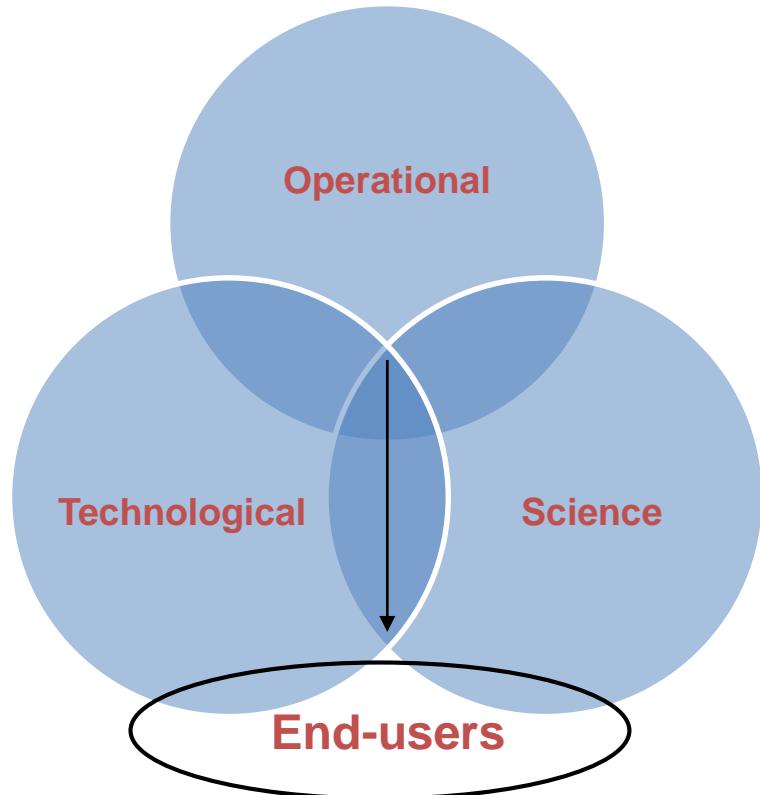
13 Partners

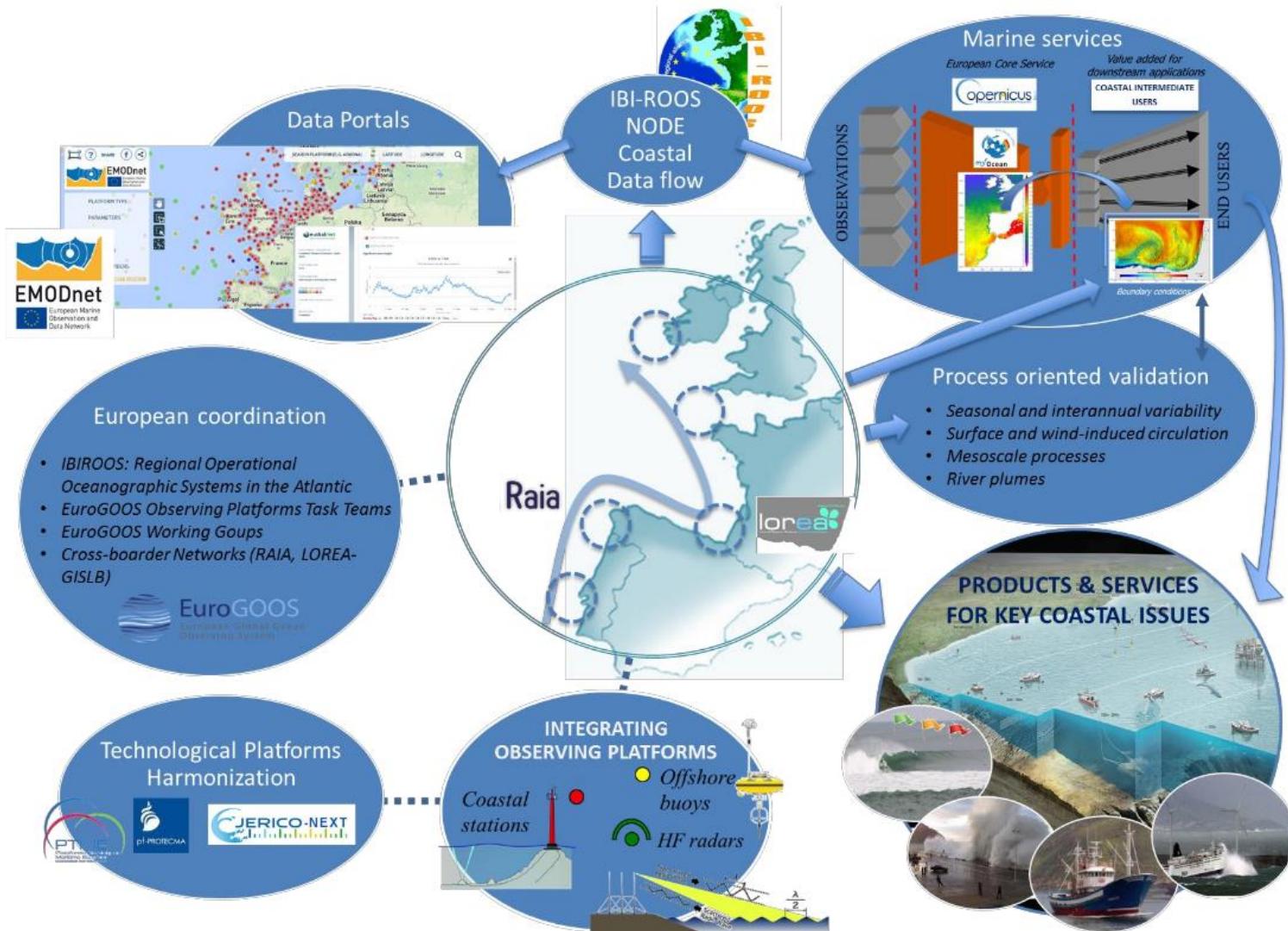
- **Portugal**

- Instituto Hidrográfico (IH)
- INESC-TEC,
- Universidade de Aveiro (UA)
- CIIMAR (Porto)
- Uminho
- IPMA (Instituto Meteorológico de Portugal)
- APA (Agencia Portuguesa do Ambiente)

- **Galicia**

- Instituto Español de Oceanografía (IEO)
- Universidade de Vigo (UVigo)
- Intecmar
- CETMAR
- Instituto de Investigaciones Mariñas (IIM-CSIC)
- Consellería de Medio Ambiente. MeteoGalicia. **(Lead partner)**





Products for Users

Who are the potential beneficiaries of these systems?

- Detailed weather forecast for 3 days
- Probabilistic weather forecast for 4 to 10 days
- **Meteorological warnings**
- Weather forecast for every council
- Weather forecast for seas. Weather forecast for beaches.
- Tides, ortho, sunset, lunar phases
- Ultraviolet
- Forecasts for fishermen's associations
- Heatwave forecast



Weather Warnings

• NIVELES DE AVISO	
• Nivel verde	• No existe ningún riesgo meteorológico.
• Nivel amarillo	• No existe riesgo para la población en general aunque sí para alguna actividad concreta. Este nivel no dará lugar a un texto específico de aviso sino que llamará la atención y remitirá a la predicción en vigor para la zona.
• Nivel naranja	• Existe un riesgo meteorológico importante.
• Nivel rojo	El riesgo meteorológico es extremo.

Structure of a weather Warning

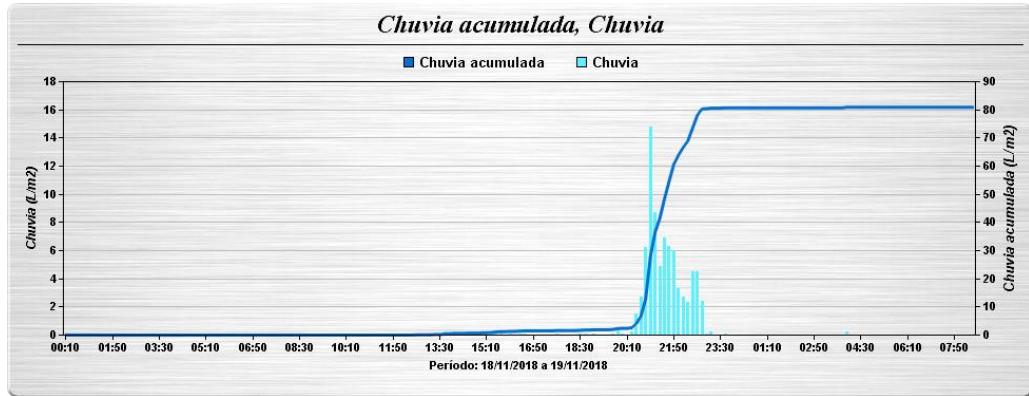
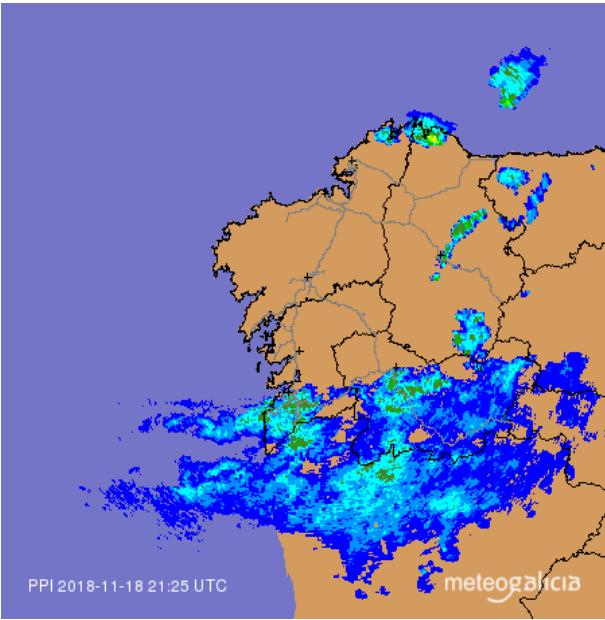
Meteoro	Área	Período horario												
		0-3 horas	3-6 horas	6-9 horas	9-12 horas	12-15 horas	15-18 horas	18-21 horas	21-24 horas					
Chuvia	Litoral de Pontevedra	40 mm en 12 horas												
	Resto Litoral Atlántico			15 mm em 1 hora										
Vento	Litoral e zonas altas			Refachos puntuais por riba dos 100 km/h										
Neve	Montaña Lugo e Ourense	Acumulación de más de 20 cm en 24 horas												
	Resto de Galicia	Acumulación de más de 5 cm en 24 horas												
Mar de vento	Litoral Atlántico	Vento de forza 8 con refachos de forza 9												
Mar de fondo	Todo o litoral							Ondas por riba dos 4 m con dirección NW						

Paradigm shift: From the meteorological warning to the risk for the population



MeteoGalicia as Stakeholder in Anywhere project

Example: Floods in Viveiro Nov-2018



Possible contribution of Hazrunoff project:

- Improvements in models
- Improvements in ability to act
- Focus on risks

Fin!

GRACIAS POR VUESTRA ATENCIÓN!

The End!

THANKS FOR YOUR ATTENTION!