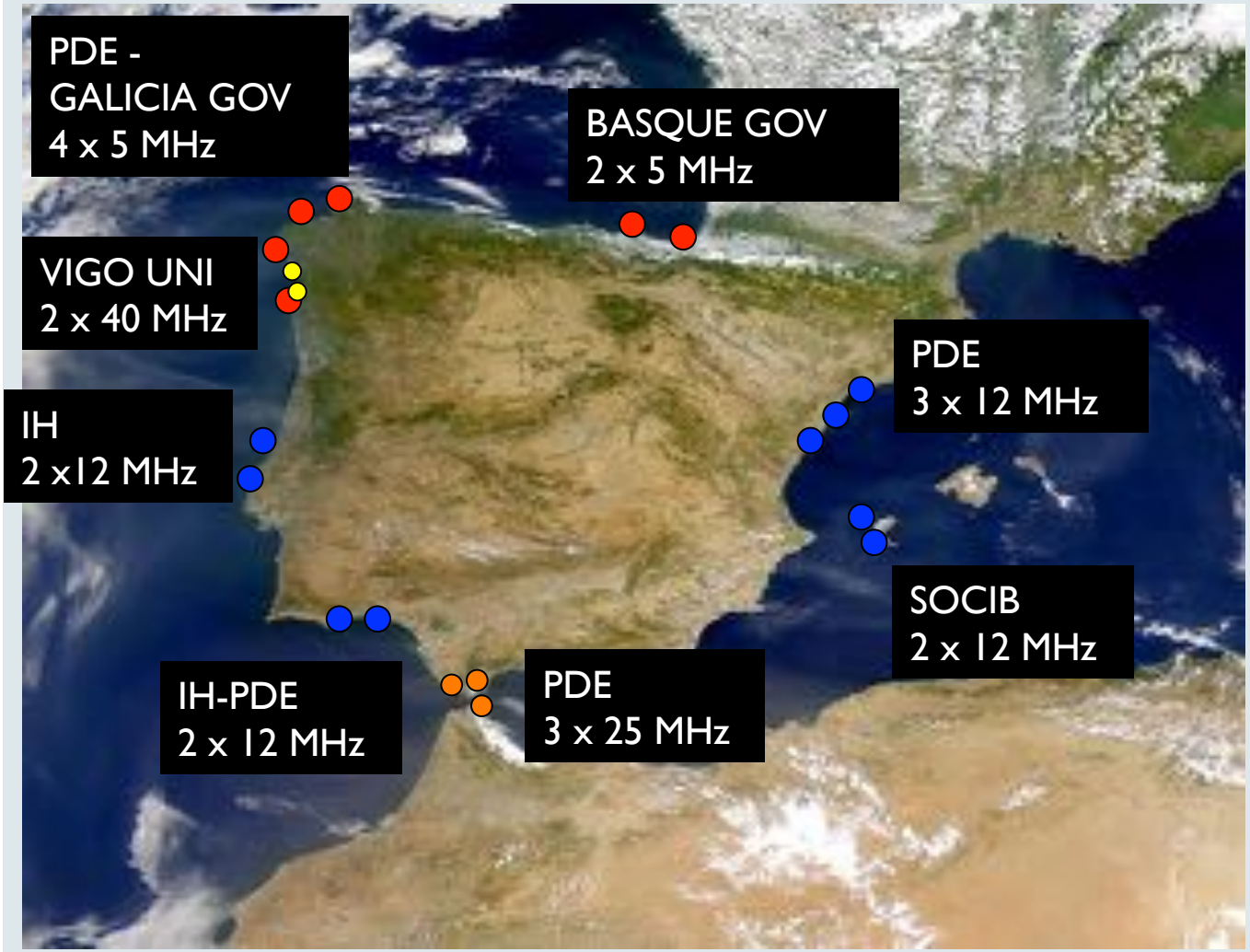
The Iberian Peninsula HF Radar network

Enrique Alvarez Fanjul and the Iberored team

HF radars at the Iberian Peninsula



- Galicia Govt.: 2 stations
- Vasque country Govt: 2 stations
- IH Portugal: 3 stations
- SOCIB: 2 stations
- Puertos del Estado: 9 Stations

- **Total: 18 stations**

Why IberoRED-HF?

- Spain and Portugal are leading areas in implementation of HF radar in Europe.
- Exchange of accumulated experience
  - QC
  - Maintenance
  - R&D
  - Callibration
  - Downstream applications
- Exchange of data
- Searching for new funding possibilities

Objective of the group

The HF radars working group of in the Iberian Peninsula is an inter-institutional network created with the objective of improving the visibility and exploitation of data generated by HF radars on our shores.

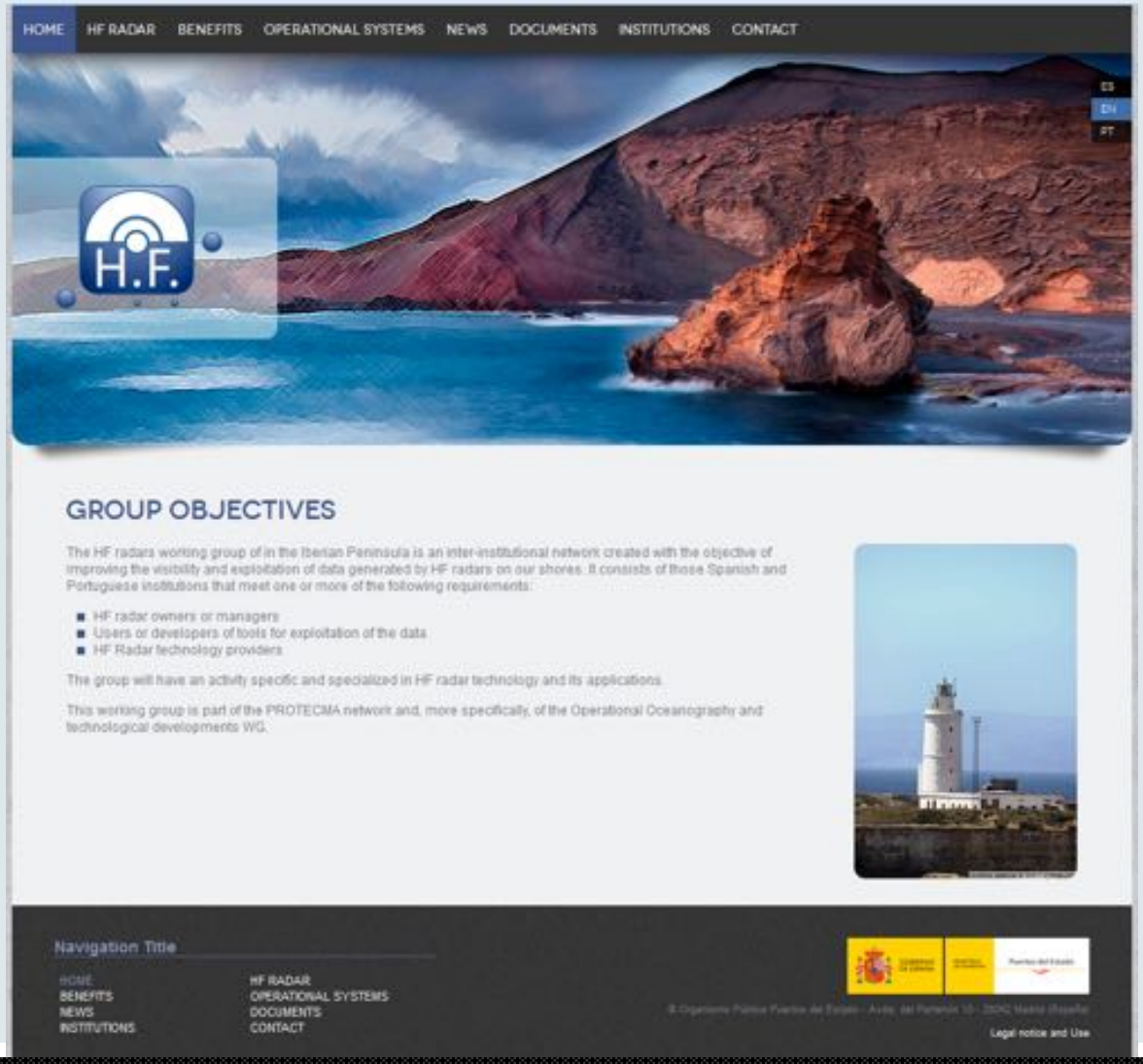
Who is in?

- HF radar owners or managers
- Users or developers of tools for exploitation of the data
- HF Radar technology providers

Institutions participating

- AZTI – Tecnalia
- Euskalmet
- Cetmar - Centro Tecnológico del mar
- Intecmar - Instituto Tecnolóxico para o control do medio mariño de Galica
- IH - Instituto Hidrográfico
- IH Cantabria - Instituto de Hidráulica Ambiental
- Qualitas REMOS - Qualitas REMOS
- MG - MeteoGalicia
- PdE - Puertos del Estado
- SASEMAR - Salvamento Marítimo
- SOCIB - Sistema d'observació i predicció costaner de les Illes Balears
- UCA - Universidad de Cádiz
- U. Vigo - Universidad de Vigo

The web page: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HF RADAR
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H.F.
GROUP OBJECTIVES
The HF radars working group of in the Iberian Peninsula is an inter-institutional network created with the objective of improving the visibility and exploitation of data generated by HF radars on our shores. It consists of those Spanish and Portuguese institutions that meet one or more of the following requirements:
HF radar owners or managers
Users or developers of tools for exploitation of the data
HF Radar technology providers
The group will have an activity specific and specialized in HF radar technology and its applications.
This working group is part of the PROTECMA network and, more specifically, of the Operational Oceanography and technological developments WG.
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Legal notice and Use

Working structure

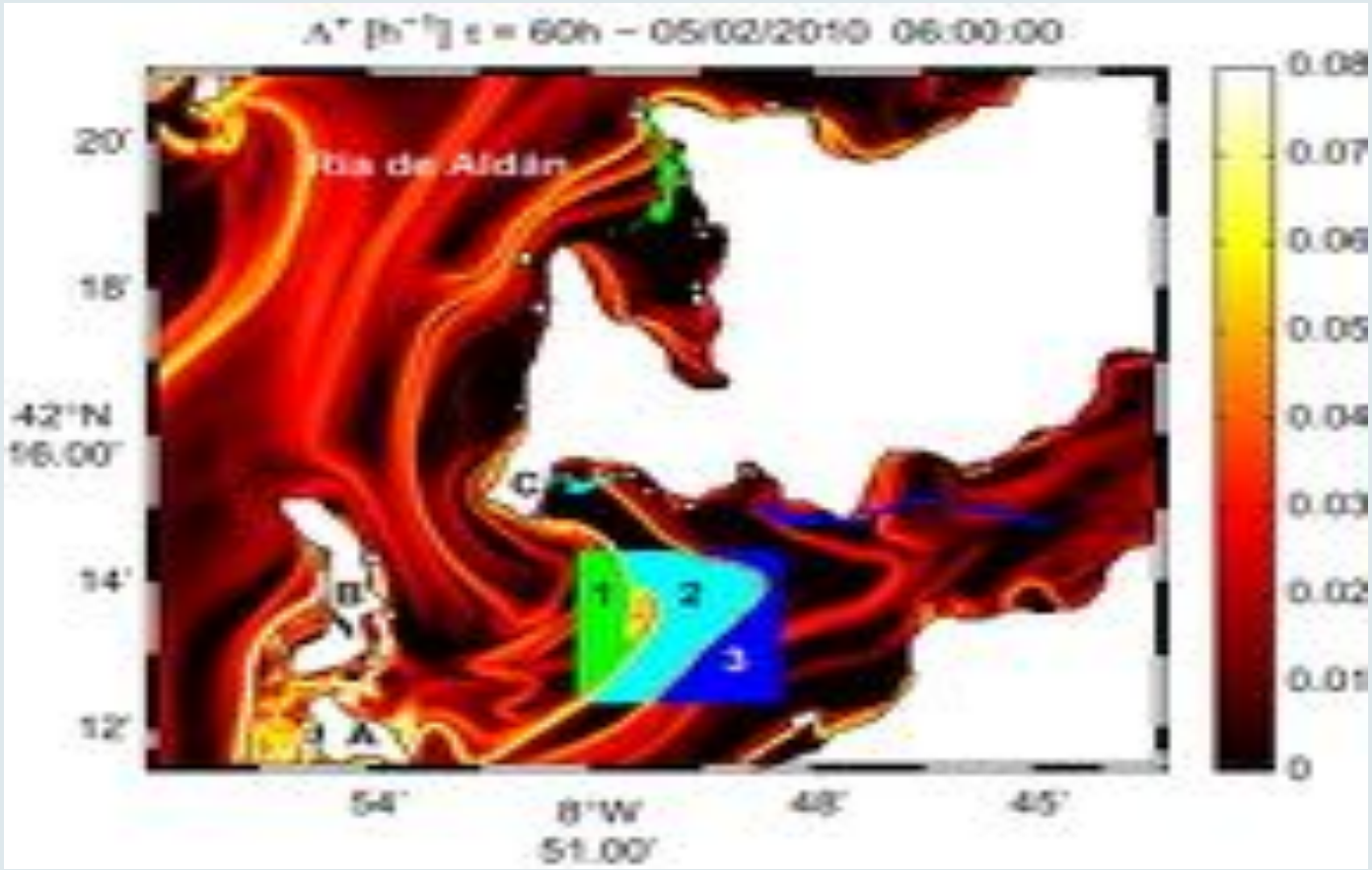
- One meeting every two years
- Working groups stablished in last meeting:
  - Maintenance
  - R&D and downstream
  - QA/QC
  - Data flow and dissemination
- Data from these groups to be compiled in a special publication by the end of the present year

R&D and downstream WG

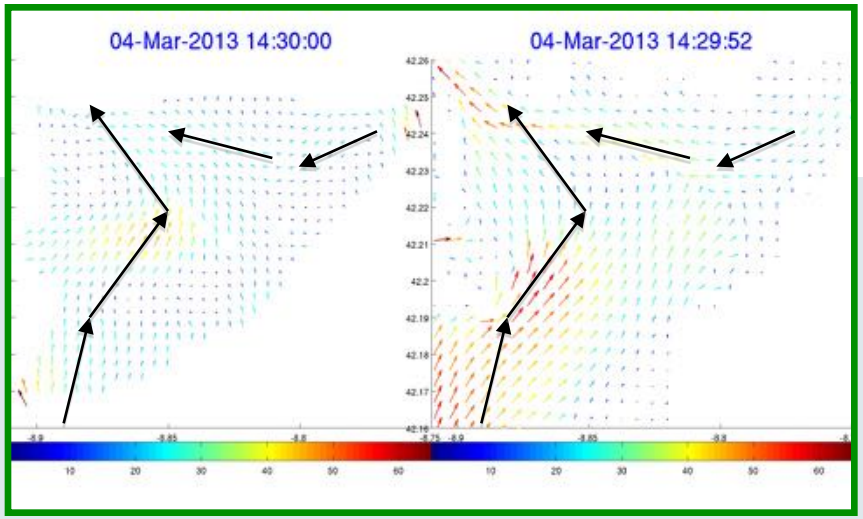
Examples

Zonas de retención y barreras oceanográficas

- Use of models and radars to locate converge areas and planify barriers (FLTE)

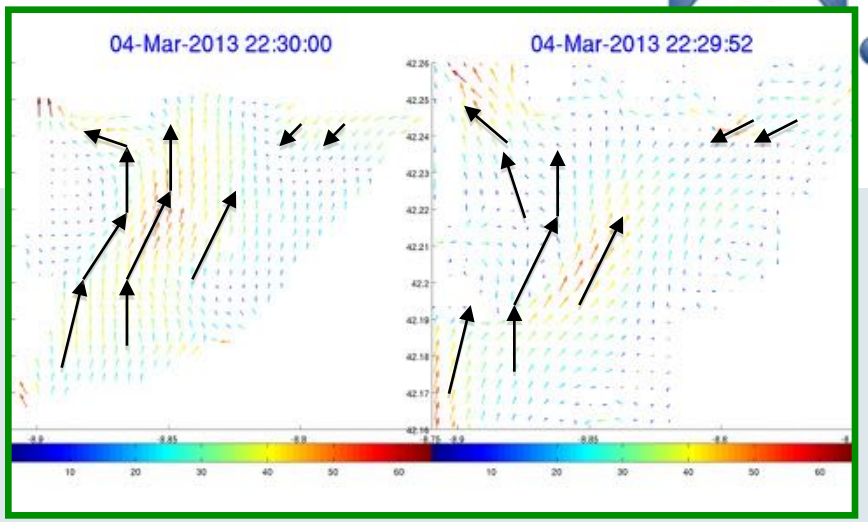


HF Radar



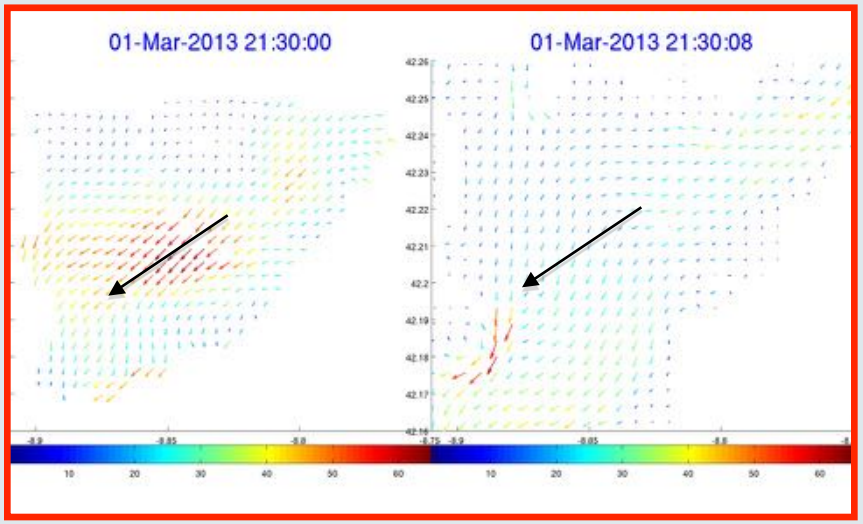
Modelo ROMS

HF Radar



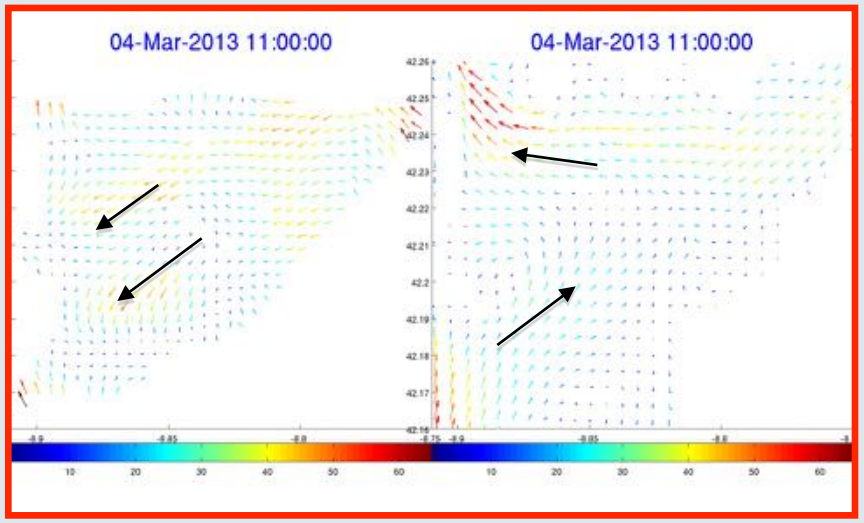
Modelo ROMS

HF Radar



Modelo ROMS

HF Radar

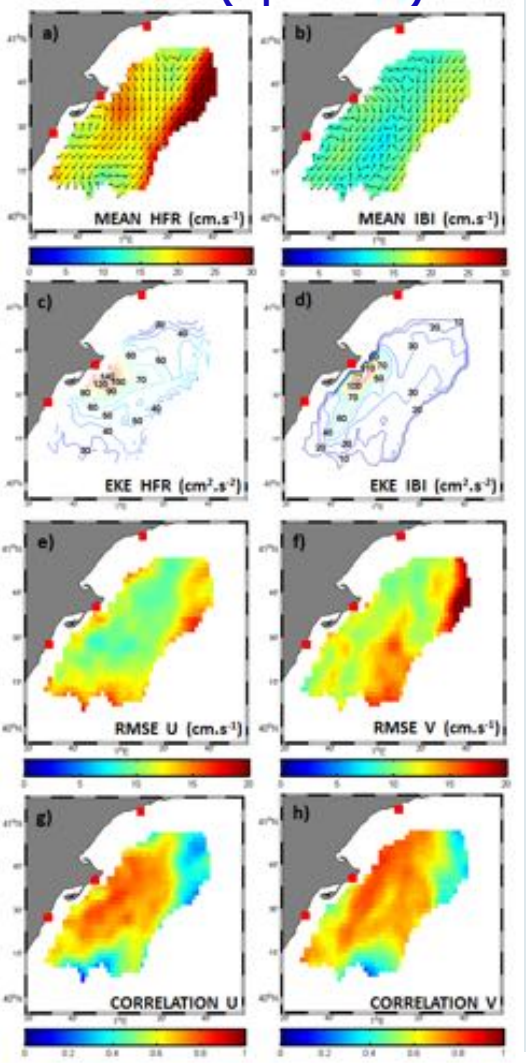


Modelo ROMS

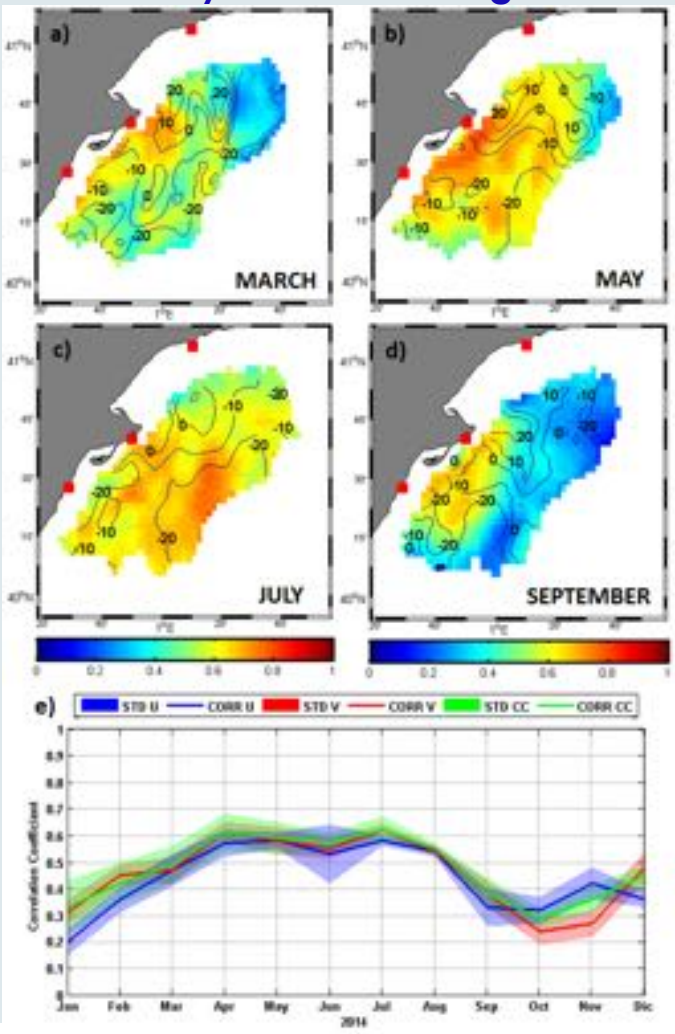
Model data comparisson in the Ria de Vigo

Model and HF radar current characterization the EBRO delta region

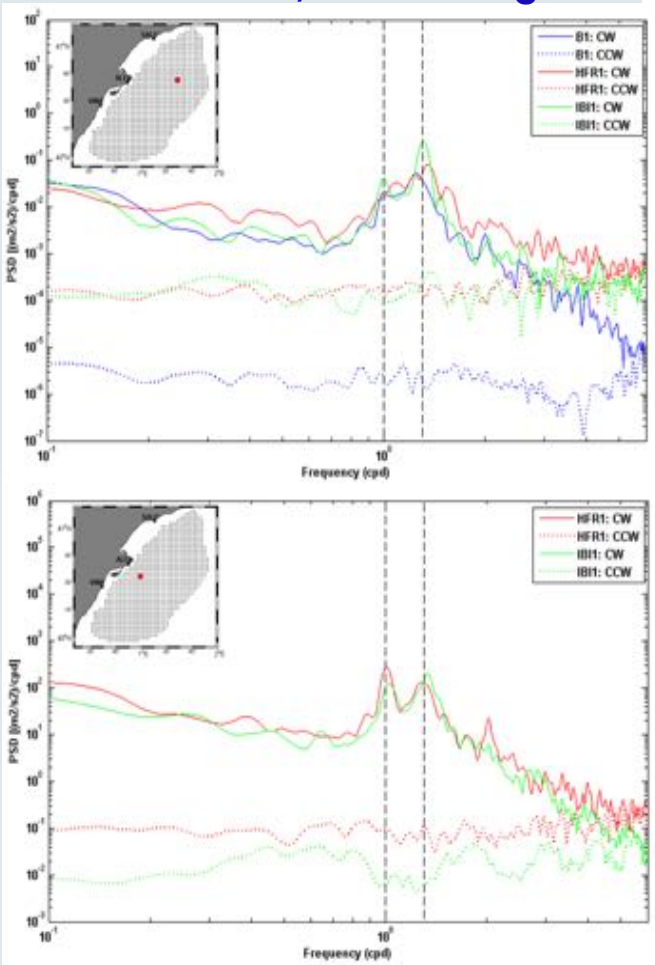
Mean patterns + scalar metrics (April 2014)



Maps of Complex Correlation HFR-IBI. Monthly evolution along 2014

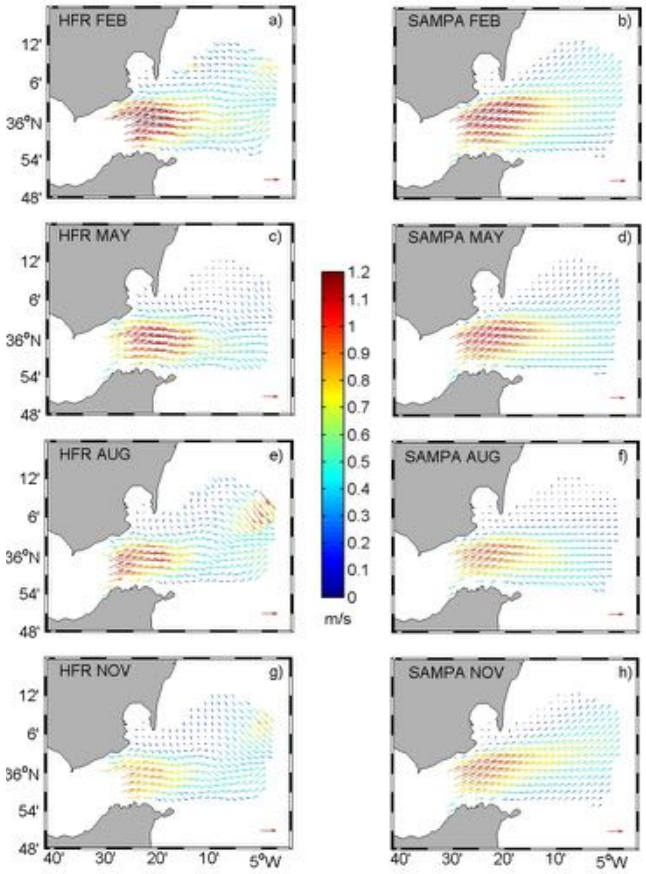


Spectral analysis: variations near-shore / offshore regions

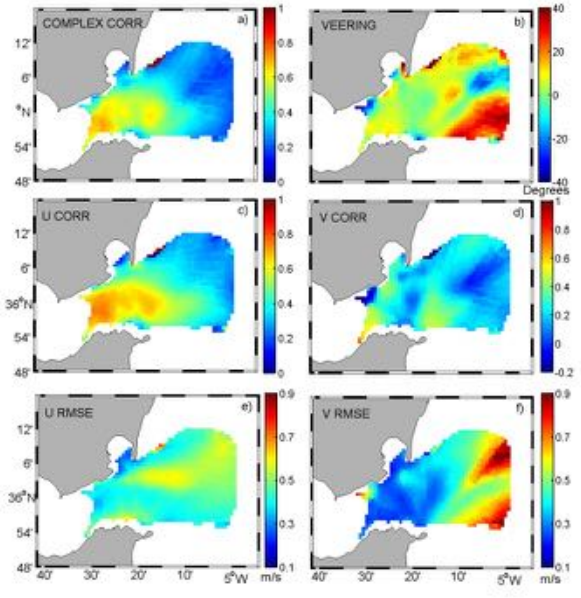


Monitoring the surface circulation in the Strait of Gibraltar: a combined study from HF radar and high resolution model data (SAMPA).

Monthly Mean Patterns



Statistic comparison

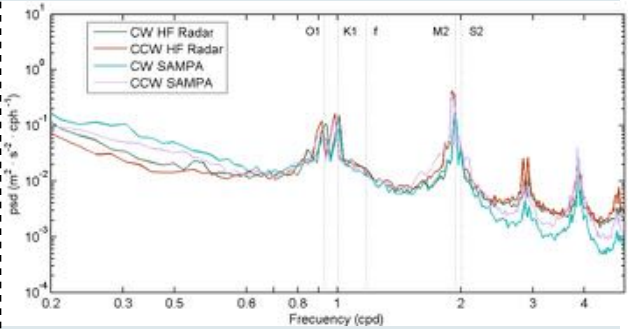


Low correlation for the meridional component

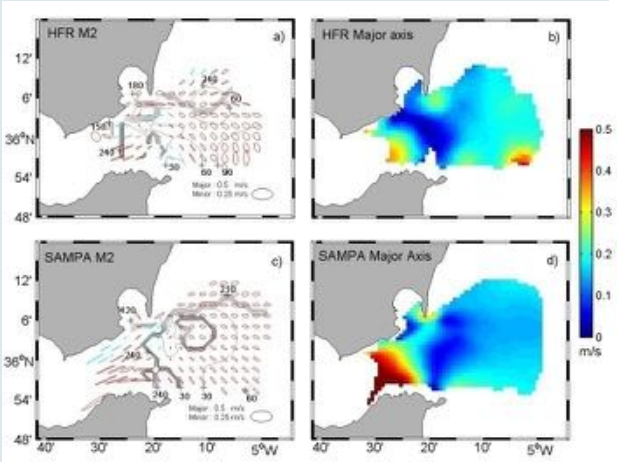
↓

Low resolution of the wind forcing and too deep surface level (2.5 m) in the model

Rotary spectral density



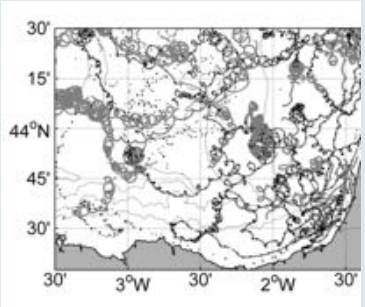
M2 Tide Ellipses



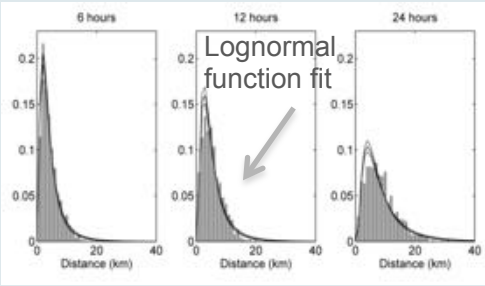
HFR País vasco I+D+i

LAGRANGIAN PARTICLE-TRACKING MODEL

(every 5 h at the position of the real drifters and advected 48 h).



Drifters (Charria et al. 2013) May - Sep 2009 (gray) and starting points for simulations (black)



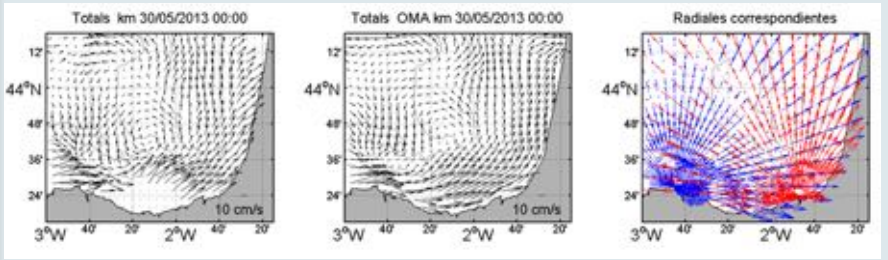
Probability density distributions of the distances between real and simulated trajectories

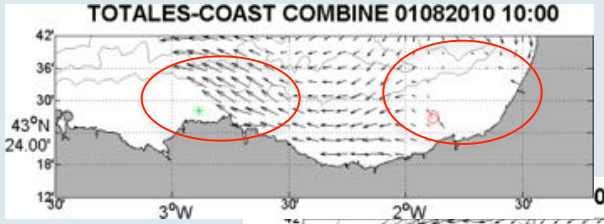
Statistical Parameters For The Log-normally Distributed Distances Between Real And Simulated Trajectories

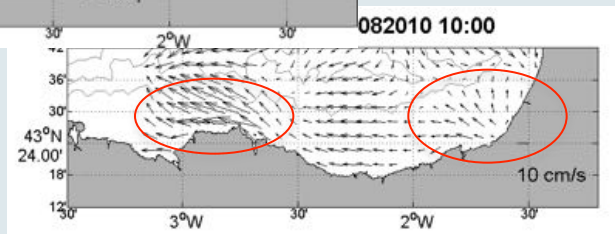
Time (hours)	Main statistical parameters (in km)		
	Mode	*Mean*	*Standard deviation*
6	2.30 [2.30, 2.30]	4.61 [4.35, 4.89]	3.60 [3.24, 4.02]
12	3.07 [3.07, 3.07]	5.73 [5.42, 6.08]	4.38 [3.95, 4.89]
24	5.14 [5.14,5.14]	8.93 [8.43,9.48]	6.96 [6.25,7.79]

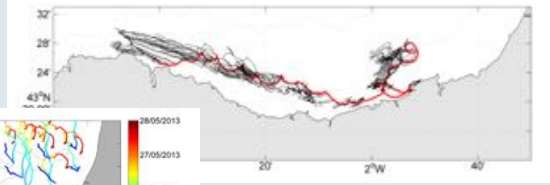
TRAJ_2D.exe: HF Radar data (Netcdf format) via OPENDAP, positions (dates + url); Future iImprovements: Integrated in a web service, multiplatform

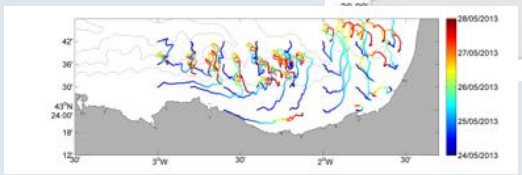
OMA CURRENTS – COASTAL COVERAGE



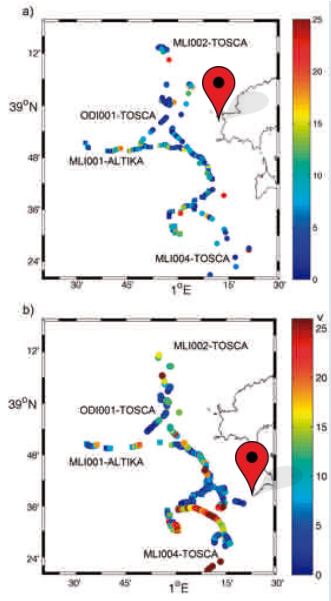








HF Radar – in situ validation



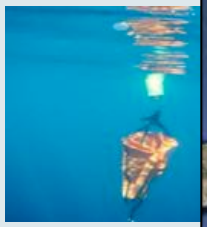
ALTIKA (2013) and TOSCA (2012) drifters were use for validation: radials derived data were used to HF Radar validation

Maps showing differences between both measurements are useful to have a correct identification of spatial areas where there is a higher agreement between the HF Radar radial data and surface drifters velocities. The differences are very low for Ibiza Radar station, where the values are generally below 10 cm/s for the four drifters considered. For the Formentera Radar station the difference is still generally low, however there are certain areas with larger values, mainly due to the scarcity of radial data in the area.

HF Radar experiment (2014) 13 drifters (different drogues and windage) were launched in the Radar HF area at 4 different points in September.

Mdi

CODEi

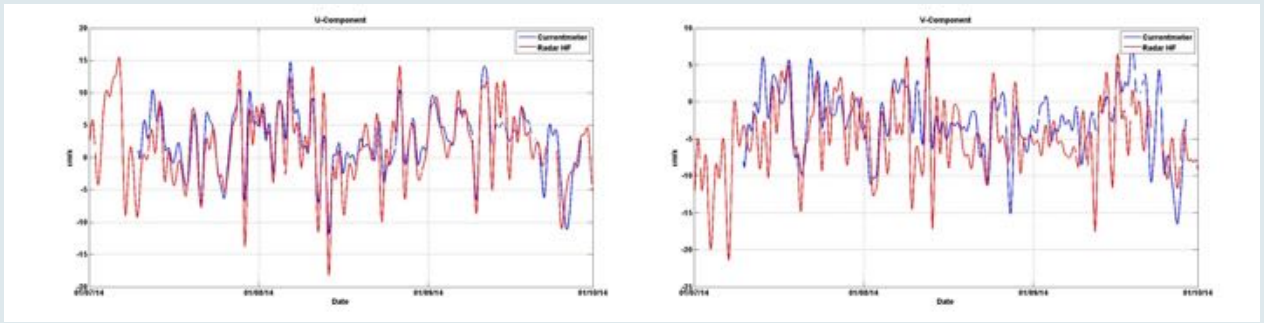


ODi

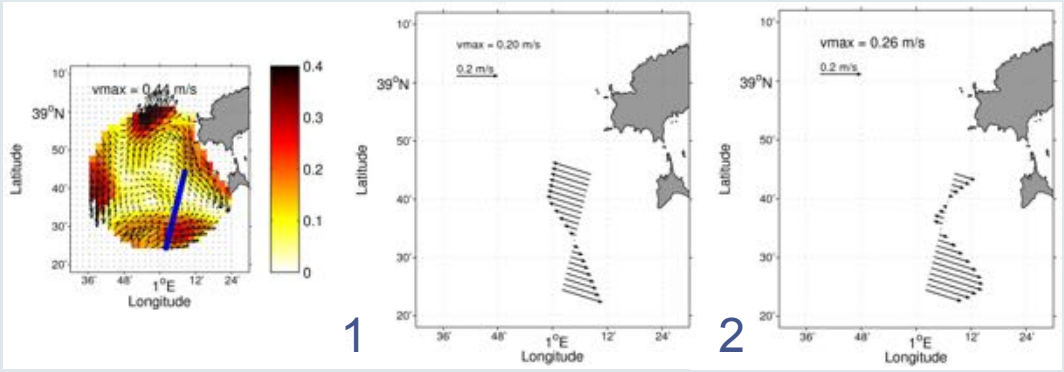
	GALF			FORM		
	N	RMSbias	CORR	N	RMSbias	CORR
CODE1001	137	-0.02	0.62	47	-0.002	0.41
CODE1002	121	-0.05	0.64	66	-0.01	0.57
CODE1003	167	-0.01	0.79	192	0.006	0.66
CODE1004	186	-0.01	0.85	261	-0.009	0.78
ODI017	196	0.005	0.67	130	0.01	0.86
ODI018	195	-0.01	0.72	143	0.006	0.80
ODI004	180	-0.05	0.55	173	0.002	0.56
ODI006	126	-0.03	0.79	236	-0.01	0.78
MD031003	211	-0.03	0.80	127	-0.01	0.82
MD031004	206	-0.01	0.81	256	0.007	0.66
MD031005	166	-0.01	0.85	257	-0.005	0.77
MD031002	148	0.04	0.76	64	0.01	0.58
MD031001	145	0.06	0.47	31	0.05	0.37

HF Radar – in situ validation

Mooring:

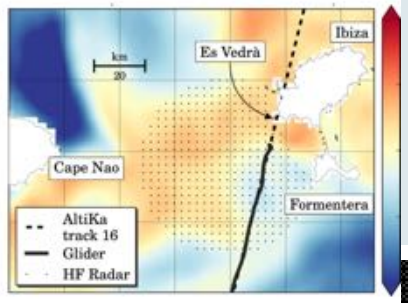


Additional results:



1. Absolute geostrophic velocities perpendicular to the track derived from SARAL/AltiKa data;
2. surface HF radar velocities perpendicular to the SARAL/track interpolated from the HF radar data.

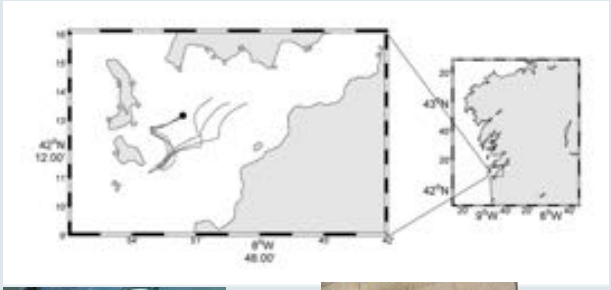
Pascual et al. 2015.
Accepted at Marine Geodesy



Troupin et al. 2015.
Advance in Space Research

CALIBRACIÓN Y VALIDACIÓN TESEO PREDICCIÓN/BACKTRACKING

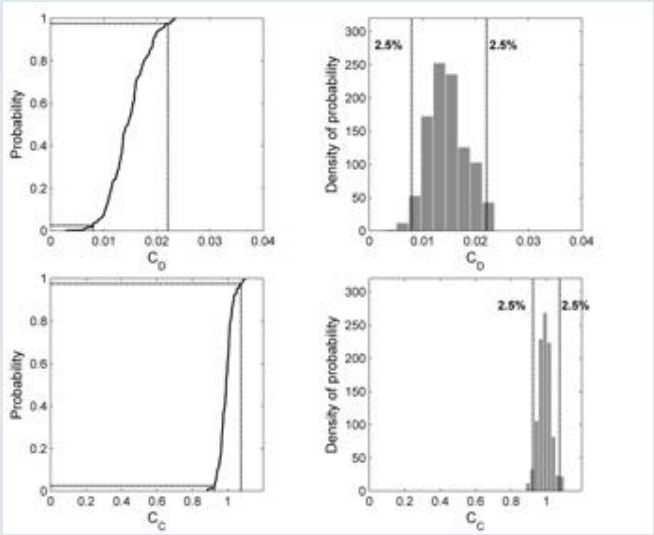
Proyecto DRIFTER
Proyecto PROMARES/OCTOPOS (MICIN, 2009-2011)



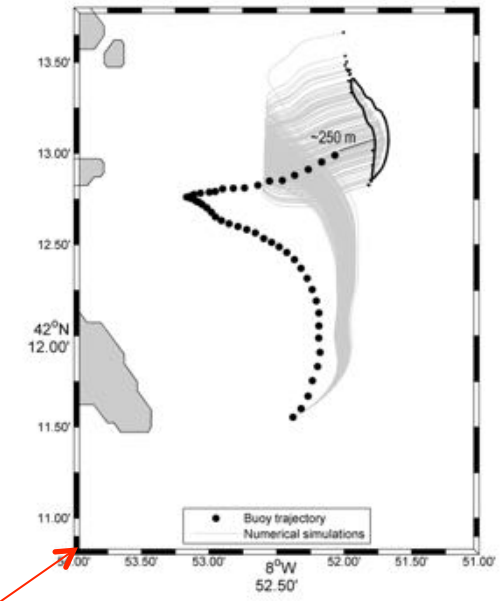
PUBLICACIONES

Abascal, A. J., Castanedo, S., Fernández, V., Medina, R., 2012. **Backtracking drifting objects using surface currents from High-Frequency (HF) radar technology** , Ocean Dynamics, 62(7), 1073-1089(DOI: 10.1007/s10236-012-0546-49)

Calibración: función de distribución de los coeficientes del modelo

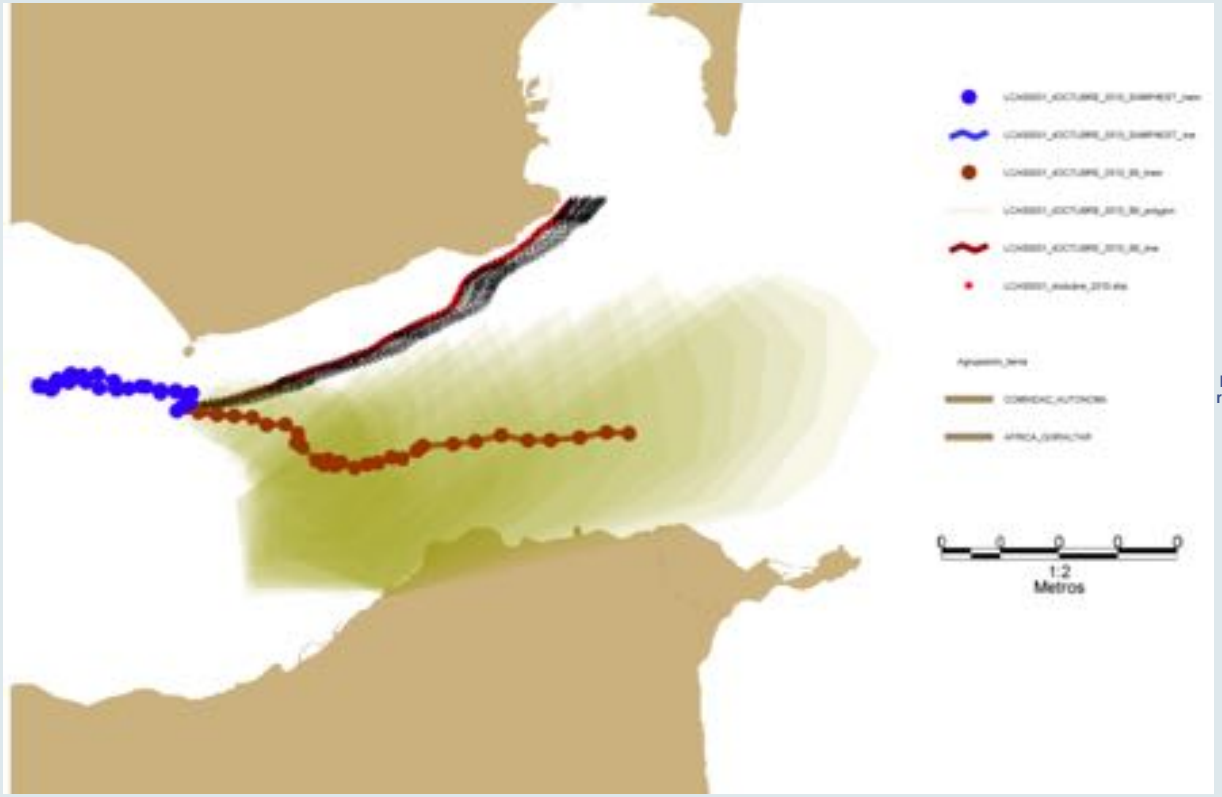


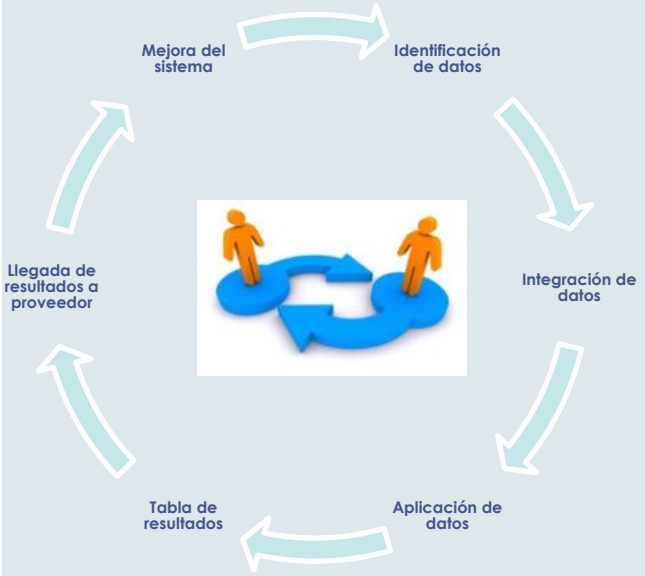
backtracking



Validación: Boya (puntos negros) vs. modelo (trayectorias grises)
Distancia final (boya vs. modelo aprox. 200 m)

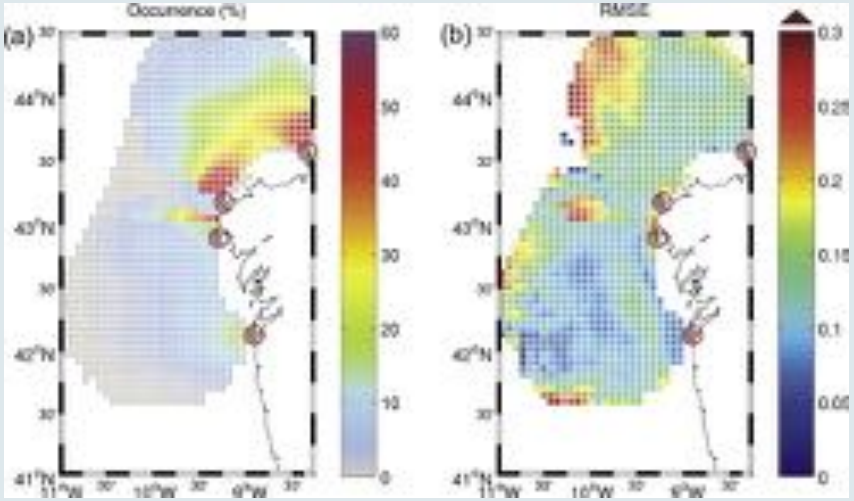
Feedback


1:2
Metros

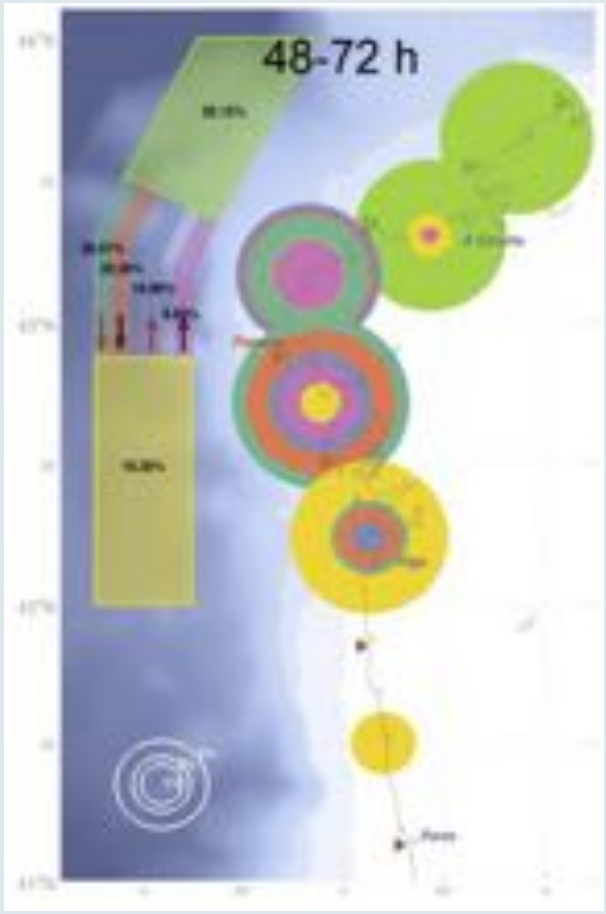

Mejora del sistema
Identificación de datos
Integración de datos
Aplicación de datos
Tabla de resultados
Llegada de resultados a proveedor

Galicia Contingency plan

- Support for mapping risks



Validación de los modelos del análisis usando Radar HF

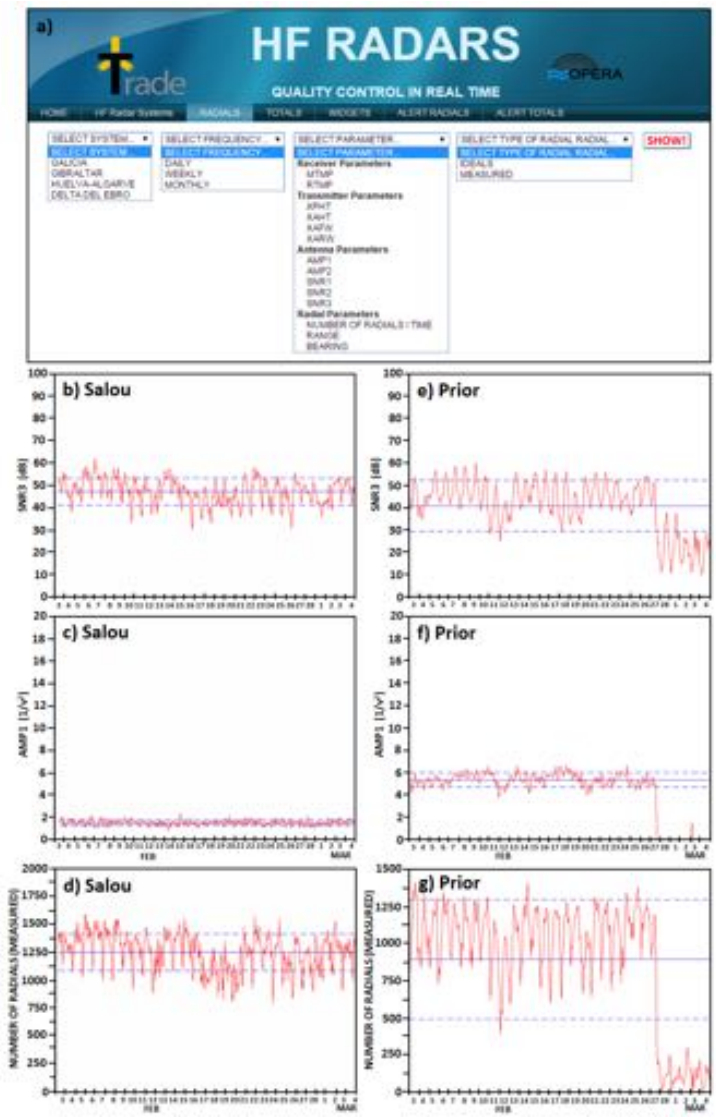


Ocurrencia de impacto según el origen en 48-72 horas

QA/QC WG

Examples

Web page for daily control of HF radars



- Unified procedures **for quality assurance-quality control (QA-QC)** of radar data in real-time.

- A dedicated **online website** developed to operationally **monitor radar system health in real time**.

- This automated quality control application analyze **nonvelocity-based diagnose parameters** to obtain estimates of their standard ranges and evaluate radar site performance according to them.

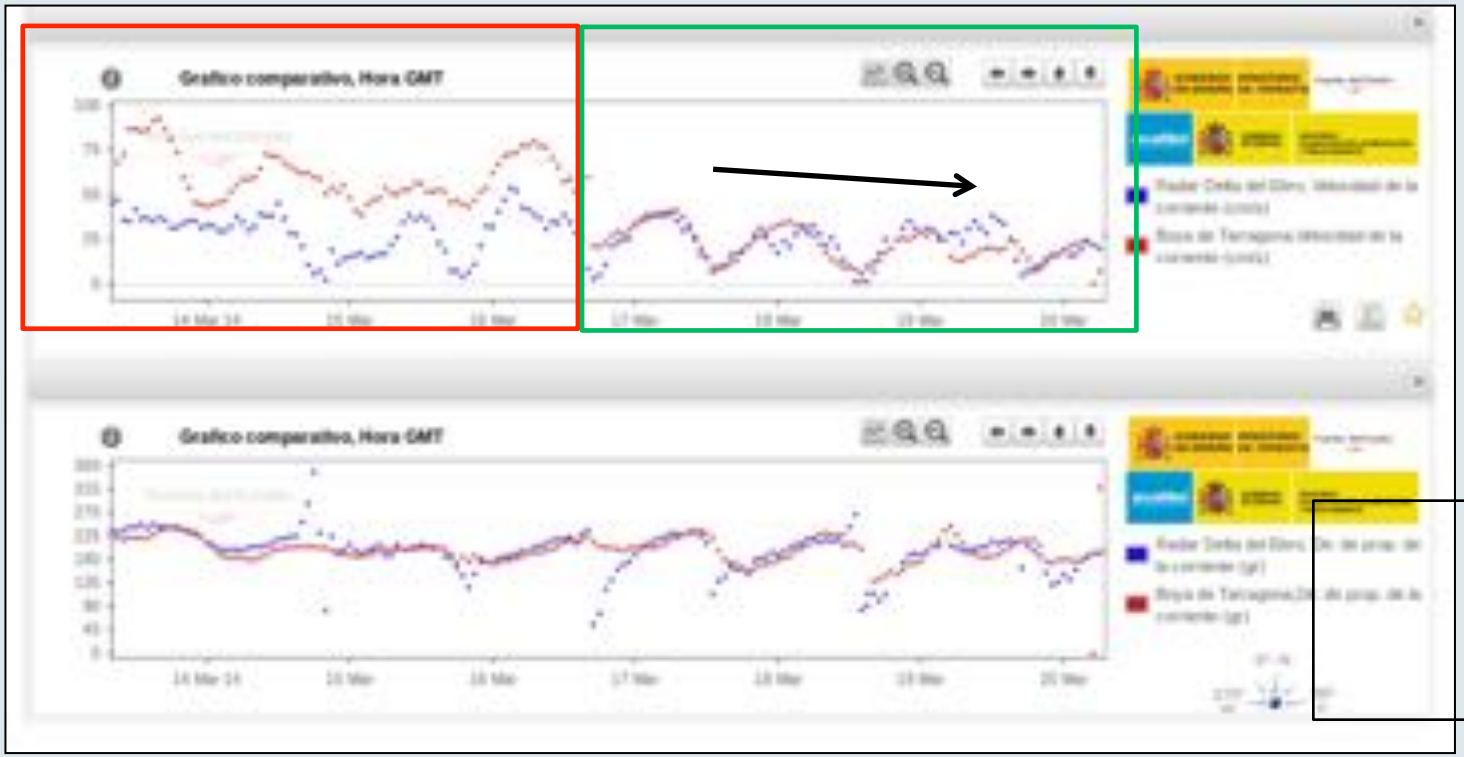
- Abrupt changes, gradual degradation and/ or failure problems can be easily detected, **triggering alerts for troubleshooting.**

QA/QC

Real time validation with Buoys

KO!

OK!



Quality Control Procedures

the real-time HF Radar data requires constant quality control. The many factors that can affect the radar signal require continuous oversight.

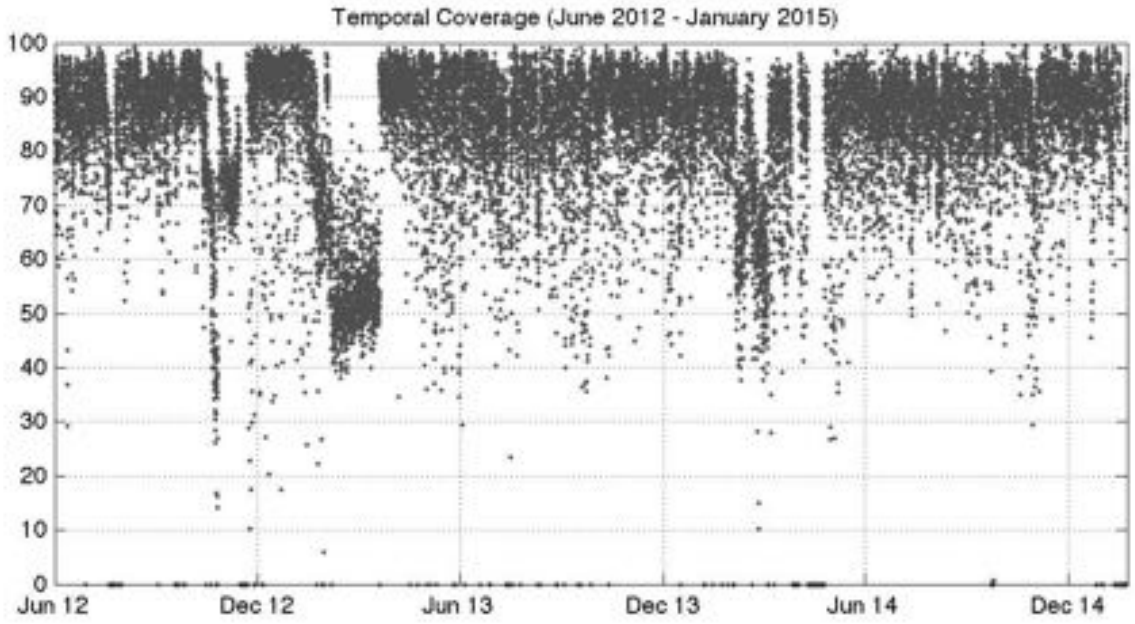
Additionally to CODAR QC procedures, all radial and total data which enters in **SOCIB Data Center** are associated to a **quality flag** to ensure the data being produced are of the highest quality.

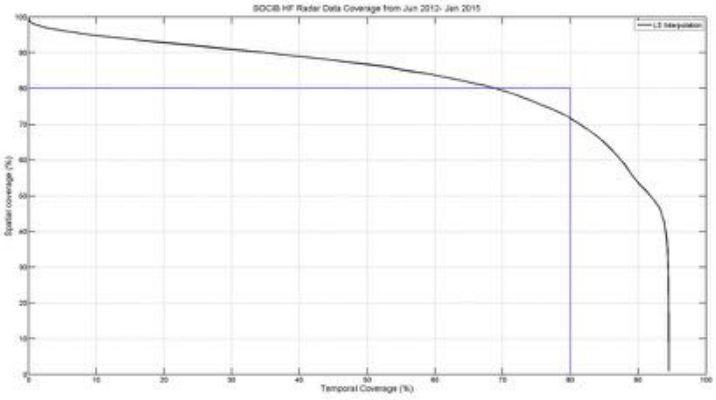
Code	Meaning
0	No QC was performed
1	Good data
2	Probably good data
3	Probably bad data
4	Bad data
6	Spike
8	Interpolated data
9	Missing data

SOCIB Quality Flags

- **QC Flags** for radials and totals based on:
  - System functioning Diagnostics (S2N, bearing, etc…)
  - Battery of tests for individual total vectors (spikes, range, ouliers, etc..)

System Performance





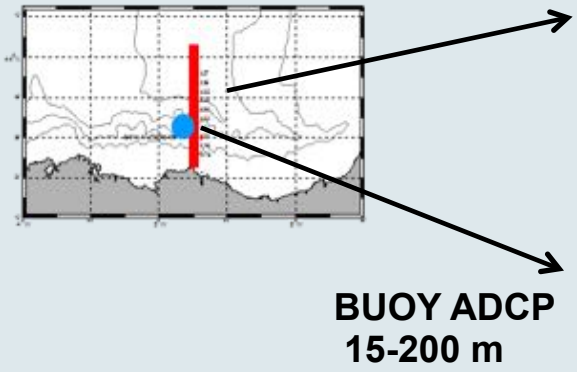
Total coverage metrics

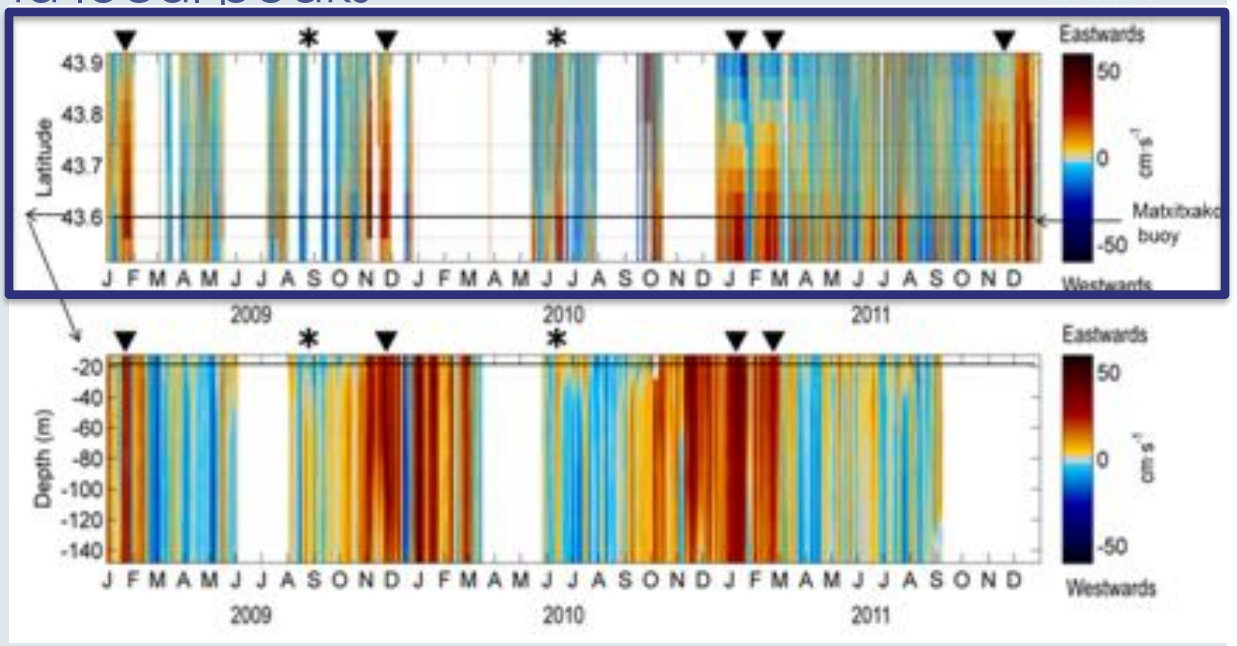
5 % of time with NO DATA: episodic electric shutdowns, turn off, problems with the computer…

Decrease in coverage: Radiolectric interference at radial stations, antenna malfunctioning (gaps),…

HFR País vasco – QA/QC

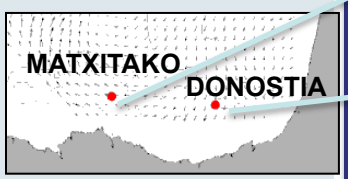
Along slope circulation and local peaks

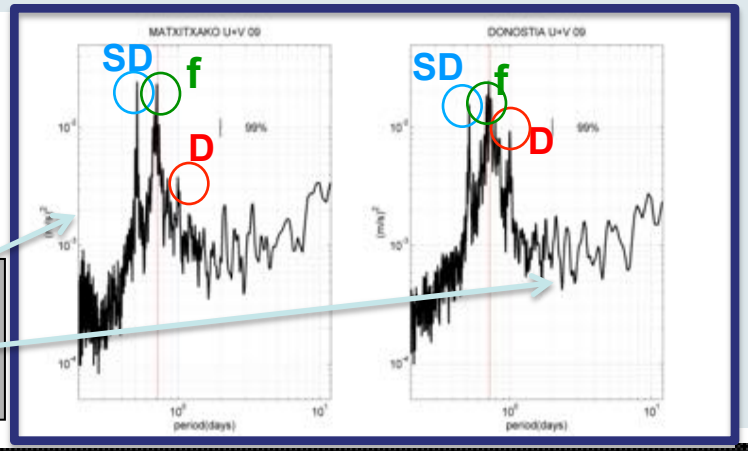


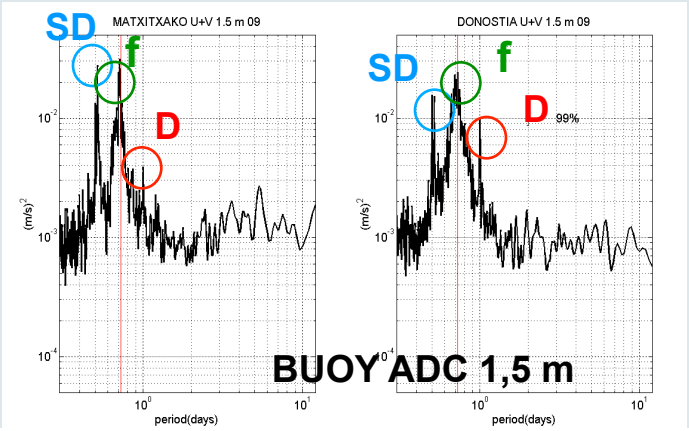


MAIN LOCAL PEAKS

- **D**: diurnal
- **SD**: semidiurnal
- **f**: inertial







Maintenance WG

Examples

ANÁLISIS INCIDENCIAS

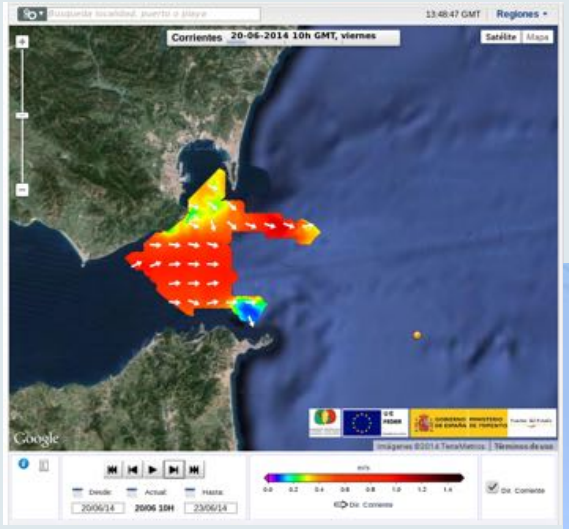
		TYPE OF INCIDENCE								
SYSTEM	STATION	COMMUNICATIONS	ENERGY	ANTENNA	ELECTRONICS	SOFTWARE	GPS	CABLING	COMPUTER	OTHERS
GALICIA	SILL	5	1				1			
	FIST	2			1		1			1
	COMB	1								
GIBRALTAR	TARI	1				1				
	CARN	4	1			1				1
	CEUTA	1								
	COMB	1				1				
PAÍS VASCO	HIGE		2			2		1		
	MATX	2	2		2	1		1	1	1
	COMB					1				
TRADE	MAZA	2								
	COMB									1
		19	6	0	3	7	2	2	1	4
	%	43,18%	13,64%	0,00%	6,82%	15,91%	4,55%	4,55%	2,27%	9,09%

Puertos del Estado

EUSKO JAURLARITZA GOBIERNO VASCO

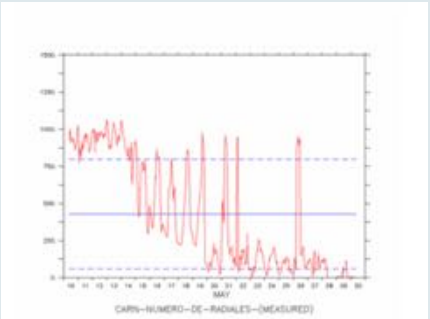
Mantenimiento (IV)

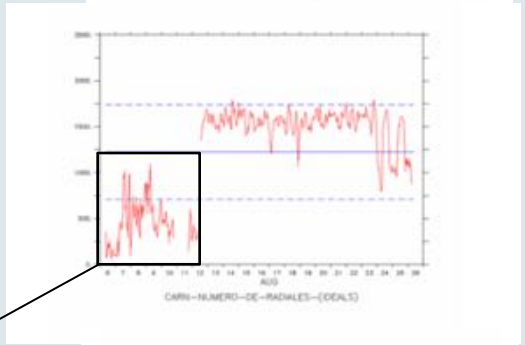
Example of a problem:
intereferences near the station

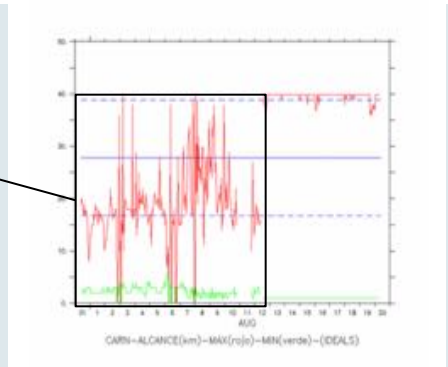


Fallo

Operarios instalando protecciones en los cables y torreta



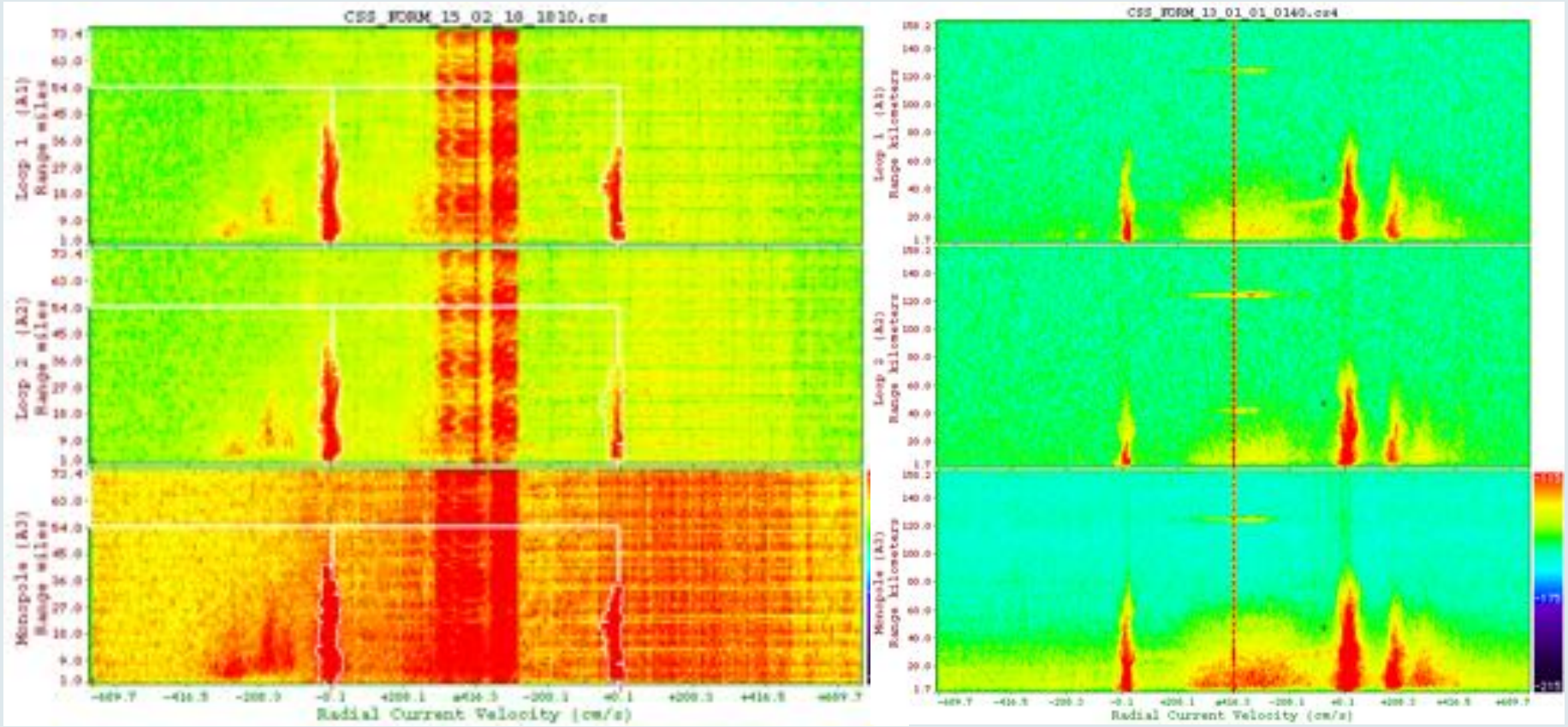




PRINCIPALES PROBLEMAS

- Maintenance by SOCIB

PRINCIPALES PROBLEMAS



Interferences- ???

Data Handling and dissemination

Examples

Vigo data

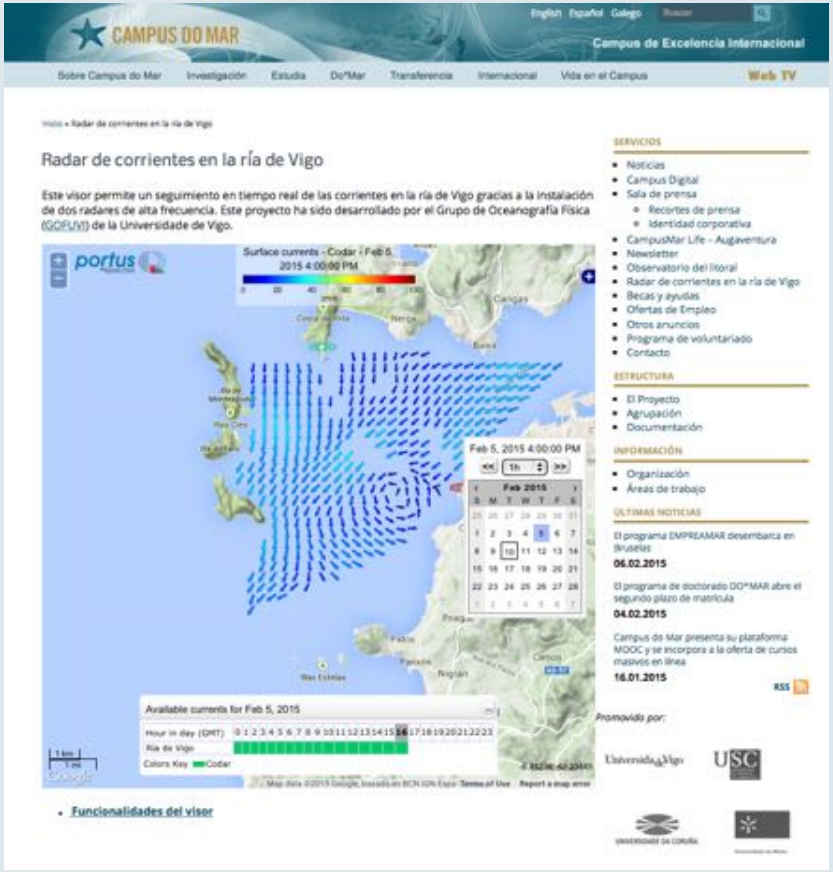
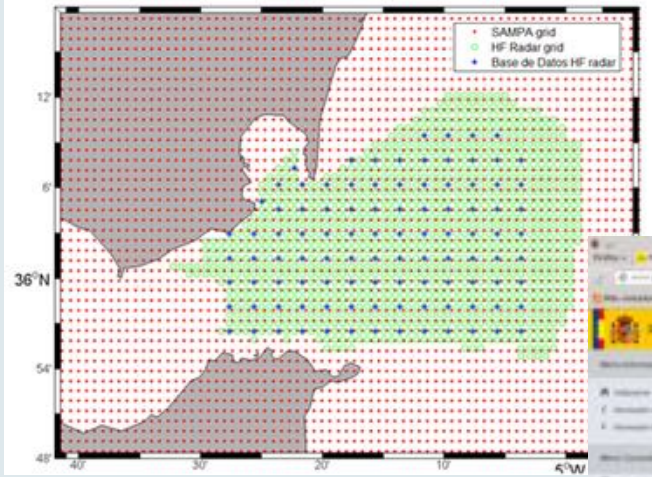


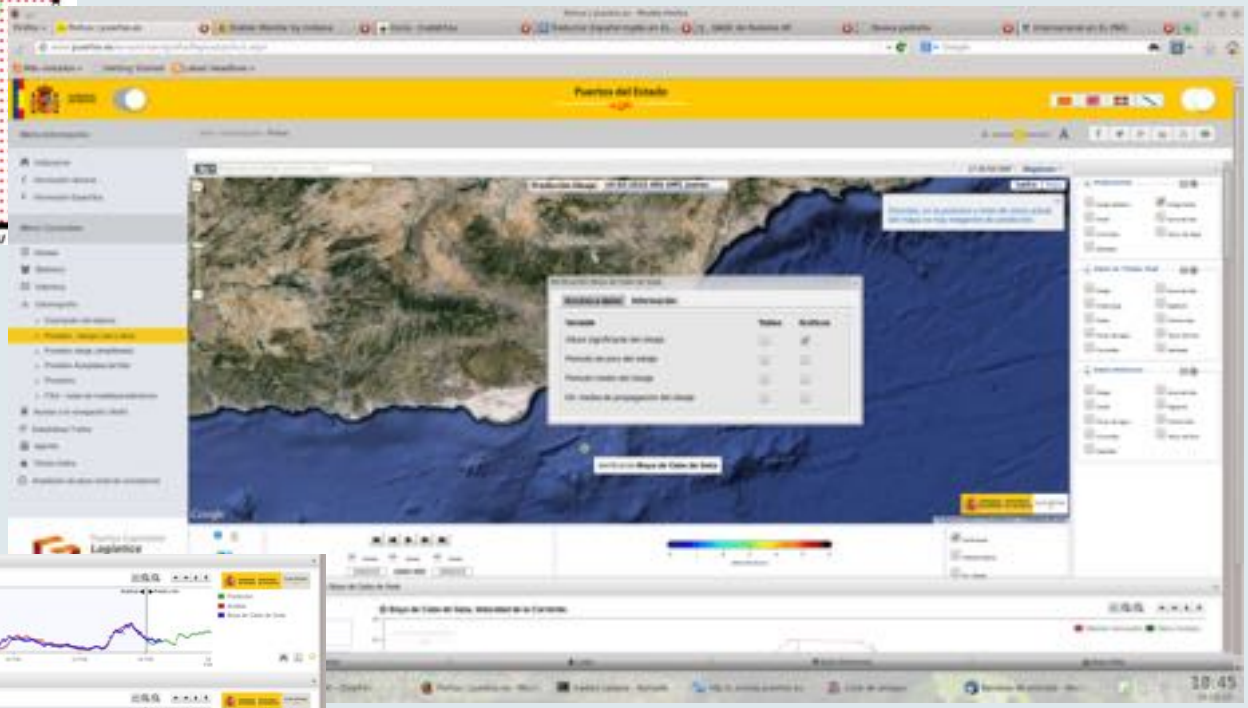
Figura 1. Web de Campus do Mar

http://campusdomar.es/radar-de-corrientes-en-la-ria-de-vigo/?lang=es

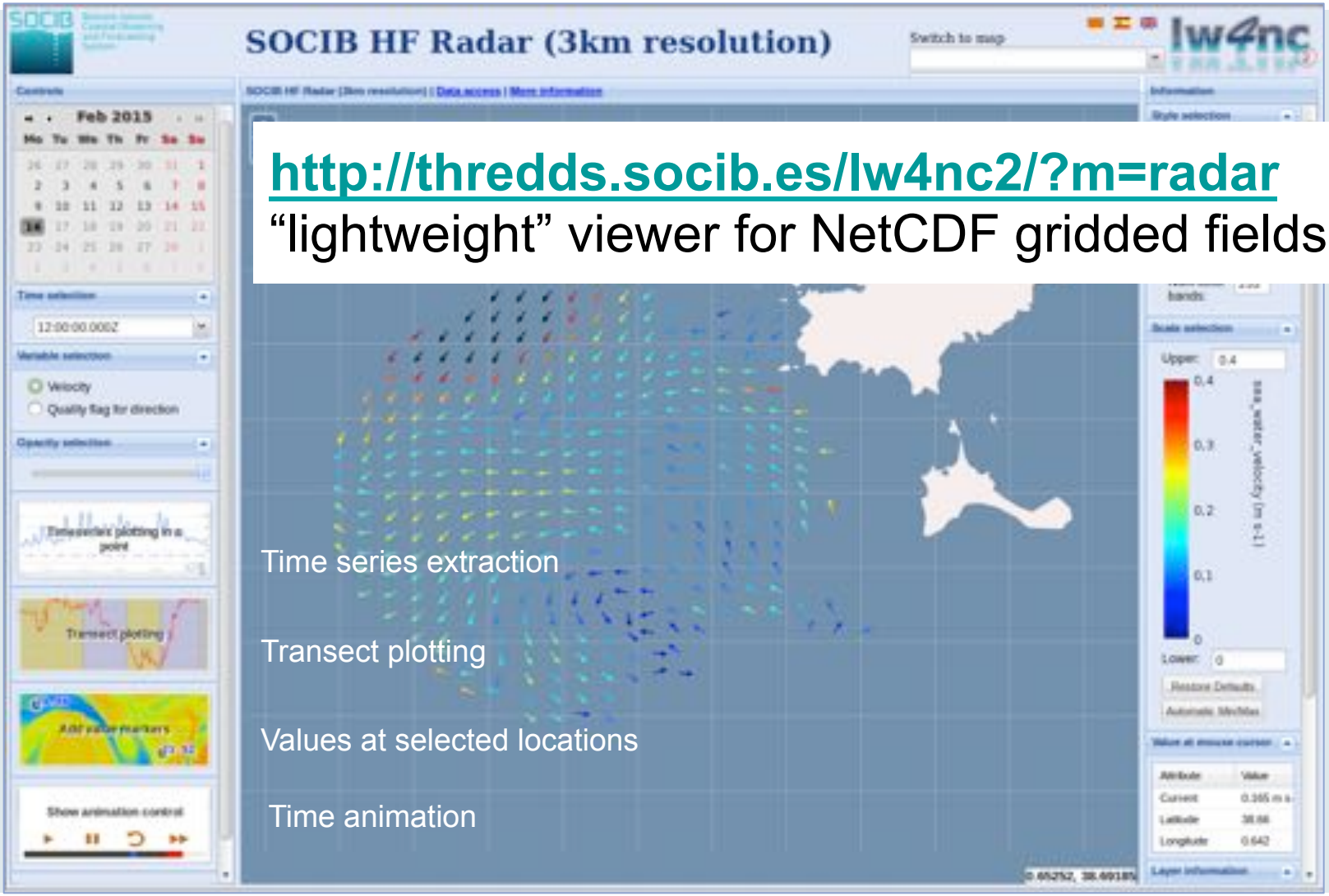
Gestión de datos (IV)



- Puertos web and Thredds available



SOCIB HF Radar Facility



http://thredds.socib.es/lw4nc2/?m=radar

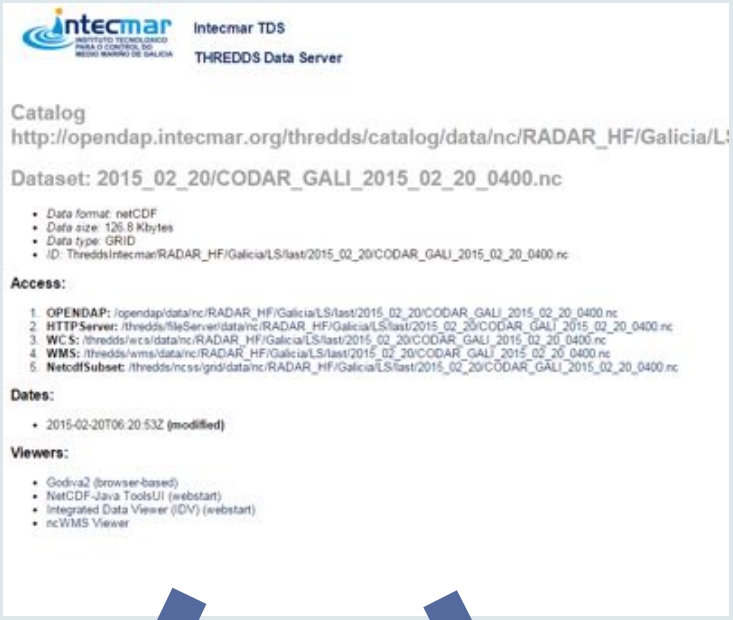
"lightweight" viewer for NetCDF gridded fields

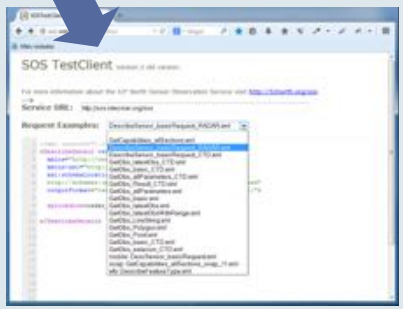
HFR País vasco – gestión de datos

ESTANDARIZACIóN HFNT EMODNET :
Metadatos
Estructura del catálogo Thredds
Netcdf :variables y atributos

Intecmar data handling

- INTECMAR and Puertos fully cooridnated
- Data via THREDDS:



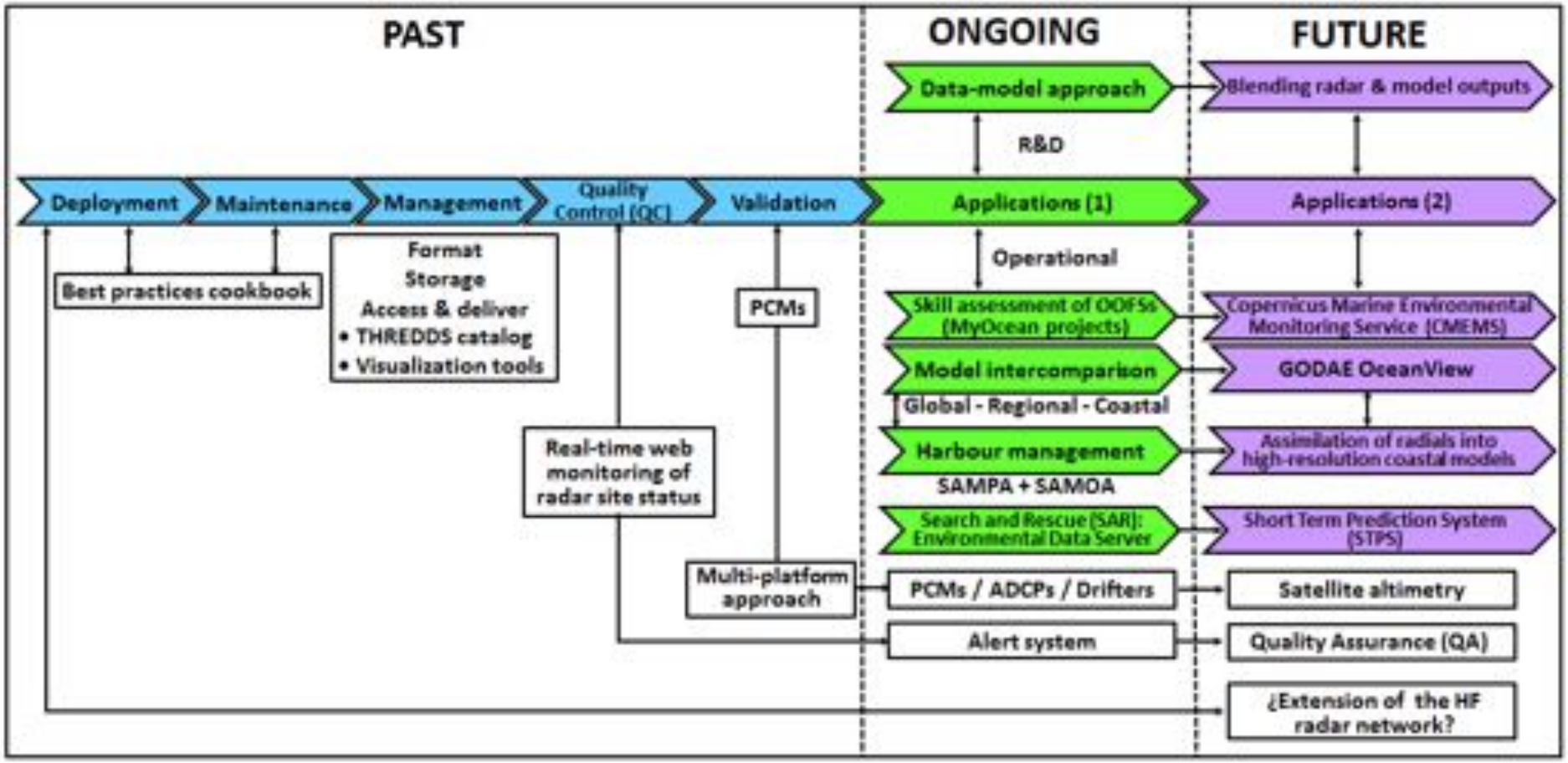


  - http://opendap.intecmar.org/thredds

EMODNET physics

Intecmar coordinating distribution of HF radar to EMODNET via Thredds (coordinated with EuroGOOS HF radar TT.

Conclusions (1/2): the long road…



Conclusions (2/2)

- The IberoRed Team is one of the leading forces for implementing HF radar technology at Europe.
- It constitute a forum for exchange of experience, data interchange and search of collaborations and funding.
- The different WG are working on a joint publication of HF radar activity in Iberian peninsula (by the end of the year)