An overview into HF radar activity in Europe

Outline

1. Contex:
   - The HFR Taks Team and Emodnet iniciatives
   - Sea Data Net
2. JERICO_NEXT
3. INCREASE project - CMEMS Service Evolution
4. The HFR inventory
5. Standards for data and metadata

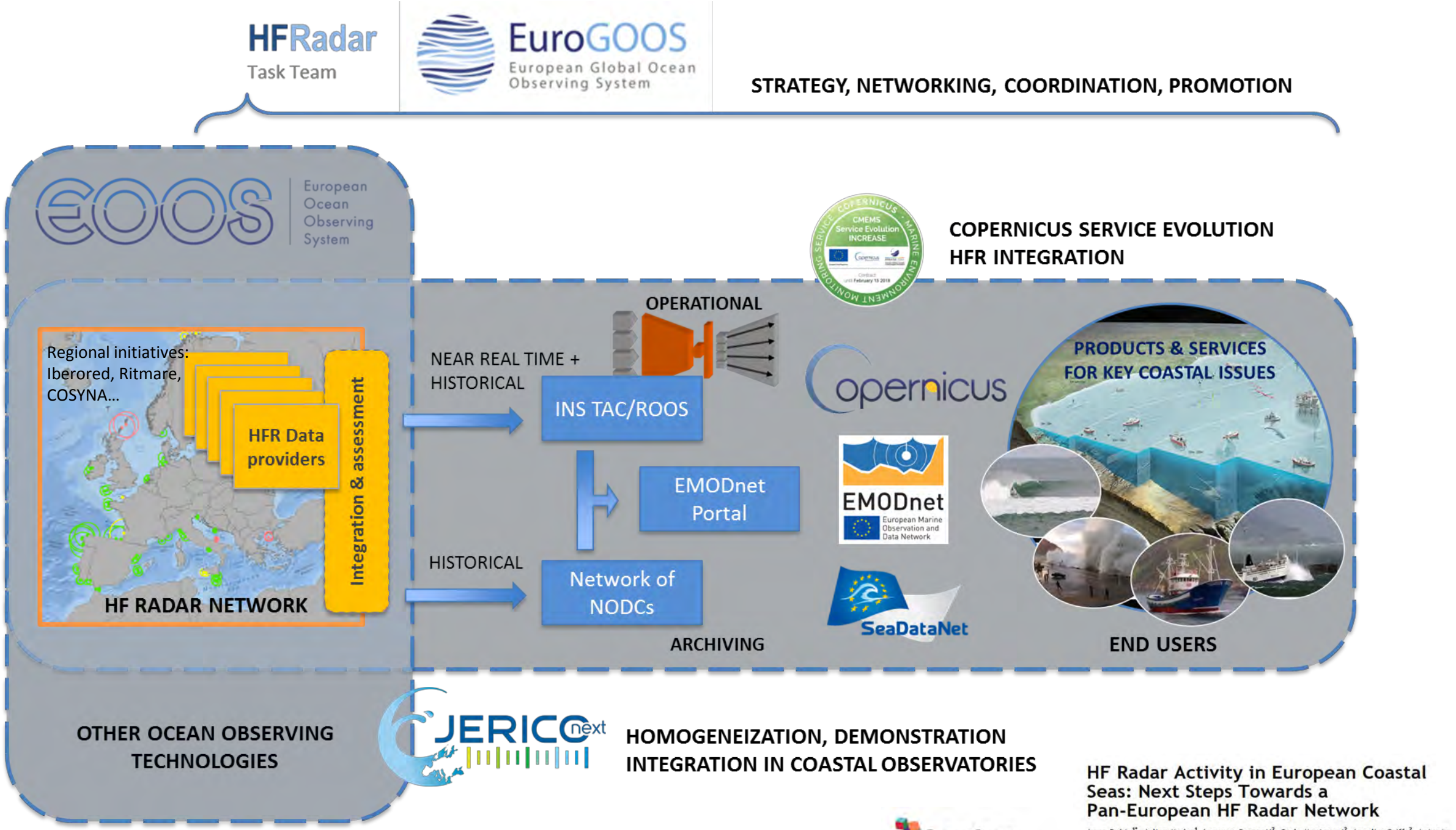


Figure from Rubio et al. 2016 (accepted)

frontiers

HF Radar Activity in European Coastal Seas: Next Steps Towards a Pan-European HF Radar Network

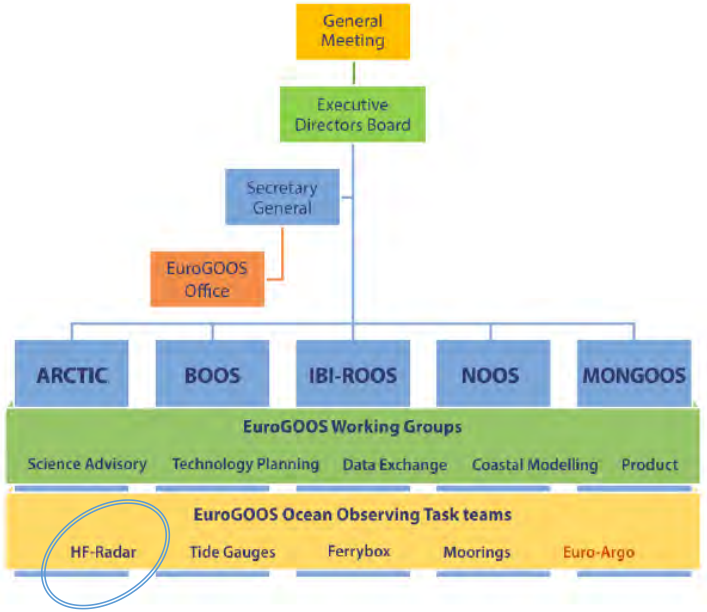
Anna Rubio[1*], Julien Mader[1], Lorenzo Corgnati[2], Carlo Mantovani[2], Annalisa Griffa[2], Antonio Novellino[3], Céline Quentin[4], Lucy Wyatt[5], Johannes Schulz-Stellenfleth[6], Jochen Horstmann[6], Pablo Lorente[7], Enrico Zambianchi[8], Michael Hartnett[9], Carlos Fernandes[10], Vassilis Zervakis[11], Patrick Gorringe[12], Angélique Melet[13], Ingrid Puillat[14]

Context: the European HFR community

The HF radar Task Team

HFRadar Task Team

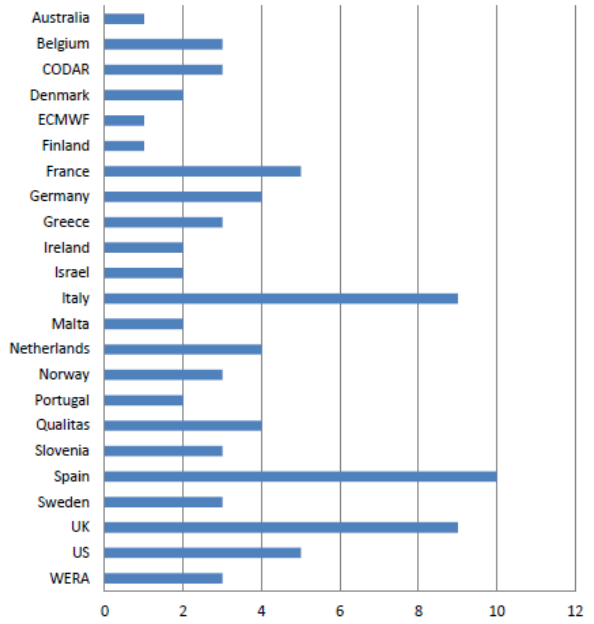
EuroGOOS European Global Ocean Observing System



HFR TASK TEAM
Chair: Julien Mader (AZTI)
Core group (**2013**): Antonio Novellino (ETT), Annalisa Griffa (CNR-ISMAR), Johannes Schulz-Stellenfleth (HZG), Maribel Ruiz (Puertos del Estado), Lucy Wyatt (Univ. Sheffield), Céline Quentin (MIO-Toulon), Anna Rubio (AZTI)…

EuroGOOS Task Teams are operational networks of observing platforms. They promote scientific synergy and technological collaboration among European observing infrastructures. Task Team members exchange open source tools, collaborate in areas of common interest, and jointly make European data available to the EuroGOOS ROOS regional data portals, which in turn are feeding data to EMODnet and Copernicus Marine Service, CMEMS.

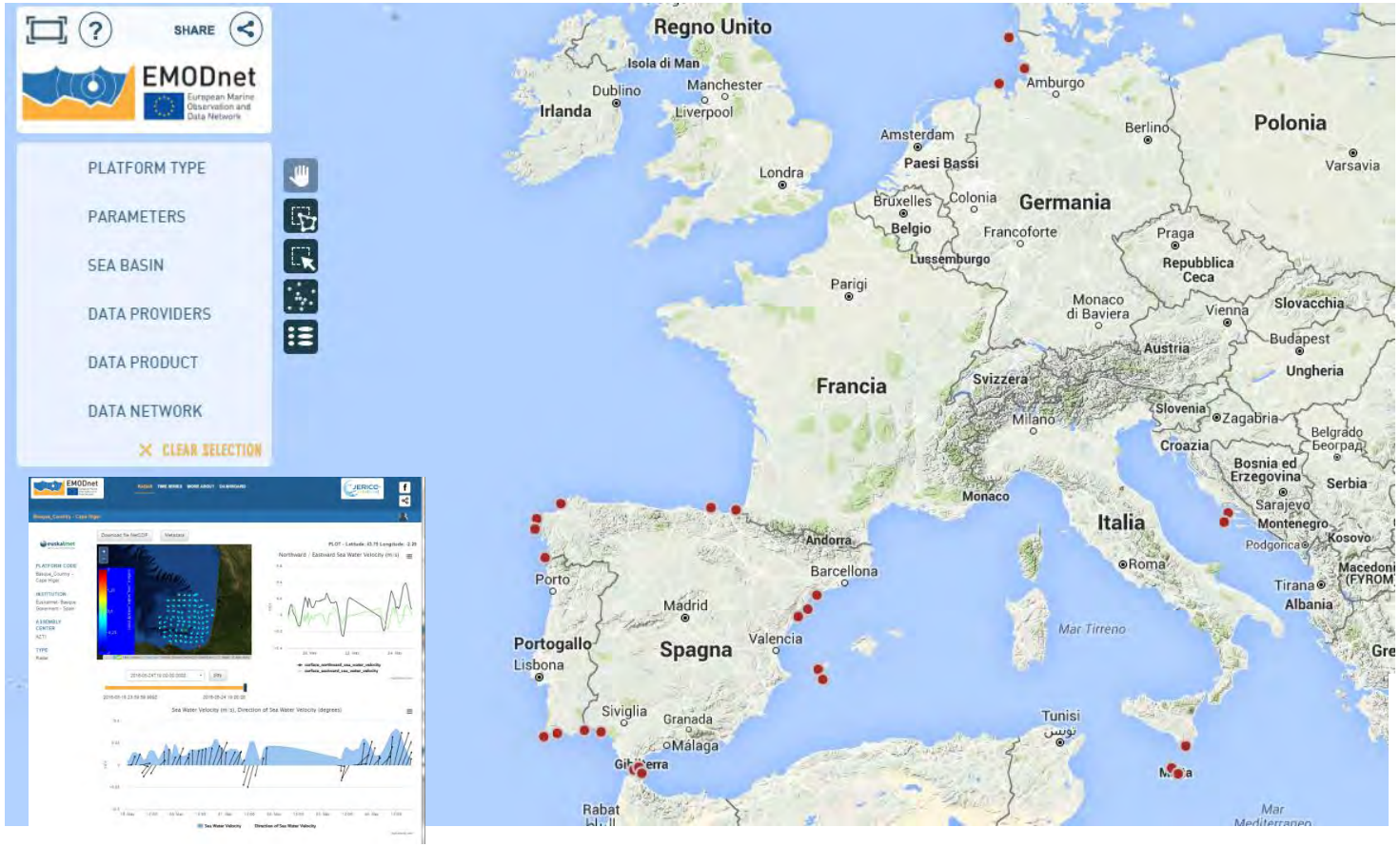
Number of Individuals on HFR TT Mailing List By Country/Organization/Company



84 individuals from 23 countries represented on the mailing List

Context: the European HFR community

Successful pilot action for connecting HFR systems with a homogenized THREDDS catalogue (EMODnet Physics framework)



Context: the European HFR community

Sea Data Net – Sea Data Cloud

HFR SeaDataCloud subtask

Integration of the HFR historical data into the SeaDataNet architecture:

- definition of standard interoperable data and CDI derived metadata formats for historical radial and total velocity data

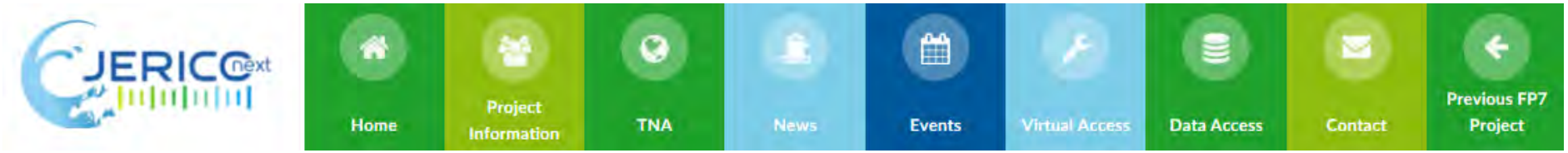
- definition of QC standard procedures for historical radial and total velocity data, with particular focus on data versioning

- design and implementation of an open tool (to be run on the cloud architecture) for the conversion of native HF radar data (both radial and total velocity data) into the standard data and metadata formats and for the production of related CDIs

- implementation of prototype data access services for HF radar (e.g. OGC) in coordination with CMEMS

Task to be performed by the joint collaboration CNR-ISMAR and CNR-ISAC

HF RADAR ACTIVITIES in JERICO_NEXT



HF Radar activities

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3: Harmonizing new network systems

Objective: *Integrating HF-radar systems and cabled coastal observatories*

WP3. JRA1- Innovations in Technology and Methodology

Objective: *To improve the quality of current estimates and to integrate the surface information from HF radar with vertical information from the other components of the coastal observing system to improve 4D transport estimates.*

Task 3.2 Developments on current observations from HF radars

WP4. JRA2- JERICO Valorisation through applied joint research

Task 4.4: JRAP #4 (hydrography): 4D characterization of trans-boundary hydrography and transport

WP5: Data management

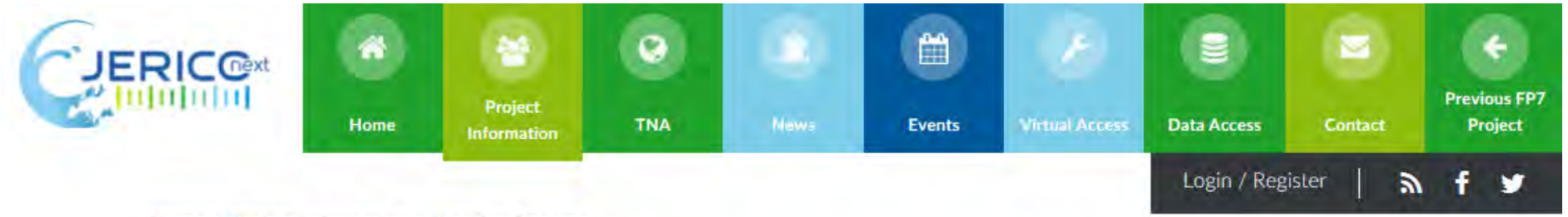
Task 5.5: Coordinated implementation of Quality Assessment and Quality Control procedures for HF Radar data access

WP6: Virtual access

Objective: *To provide free of charge "virtual access" to data and information that will enable scientists to carry out high quality research using data from a variety of coastal observation systems*

HF RADAR ACTIVITIES in JERICO_NEXT

Milestones and Deliverables



Home > Project Information > Meeting Reports

Meeting Reports

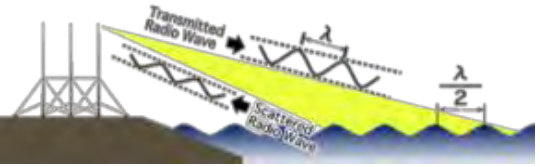
Year	WP	Title of meeting	Date and Place	File	Date of upload
2016	2, 3, 5	7th Ferrybox Workshop Jerico-Next meeting	06/04, Heraklion, Greece	Report-Jerico-Next-FerryBox-Workshop Side-Meeting-V1.0&slides-4aug16 (4.4 MiB)	05/08/2016
2016	2, 3, 4, 5, 6	JERICO NEXT HF RADAR meeting	April, AZTI San Sebastian, Spain	Jerico Next HFR Workshop - Minutes (595.2 KiB) JERICO NEXT HF RADAR Meeting Day 1 (22.4 MiB) JERICO NEXT HF RADAR Meeting Day 2 (6.0 MiB) JERICO NEXT HF RADAR Meeting Day 3 (7.6 MiB)	06/05/2016

Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories - **JERICO-NEXT**

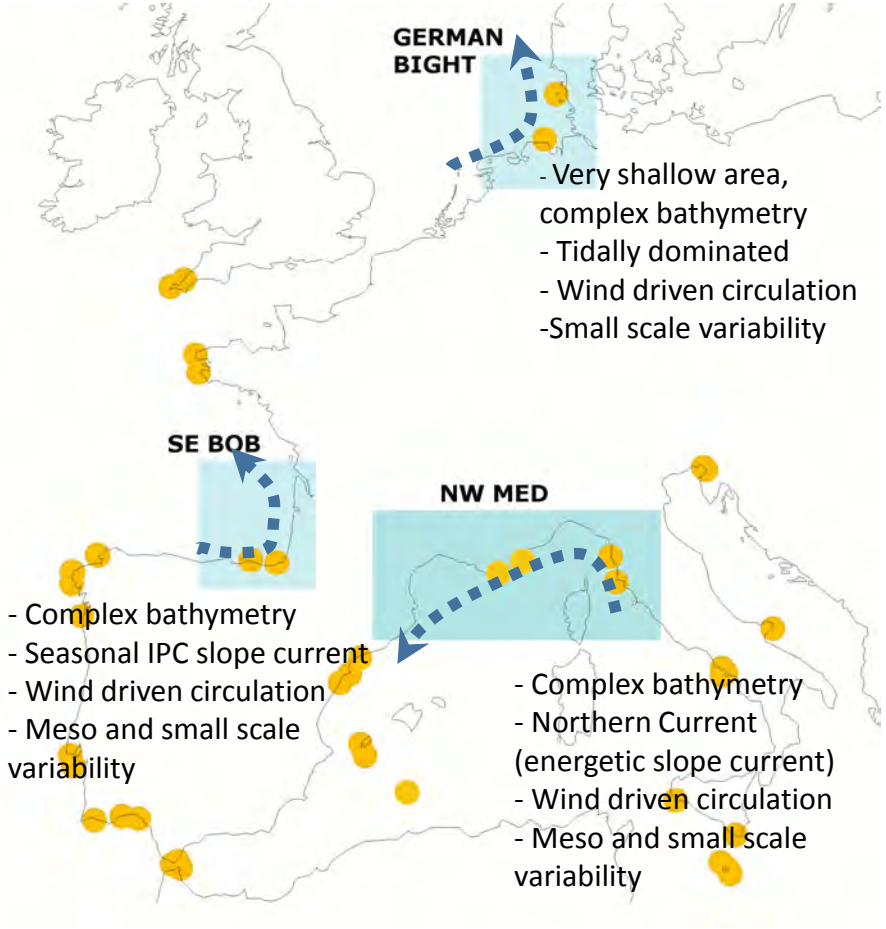
Deliverable title	Report on the status of HF-radar systems and cabled coastal observatories
Work Package Title	**WP2 - Harmonization of technologies and methodologies - technical strategy**
Deliverable number	D2.1

HF RADAR ACTIVITIES in JERICO_NEXT

JRAP4 activities

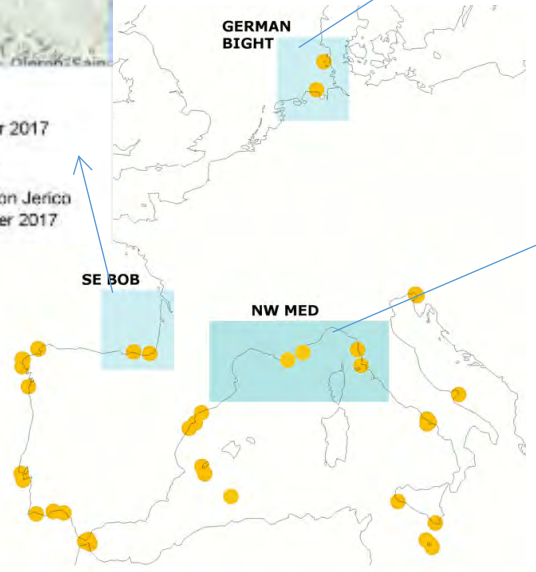


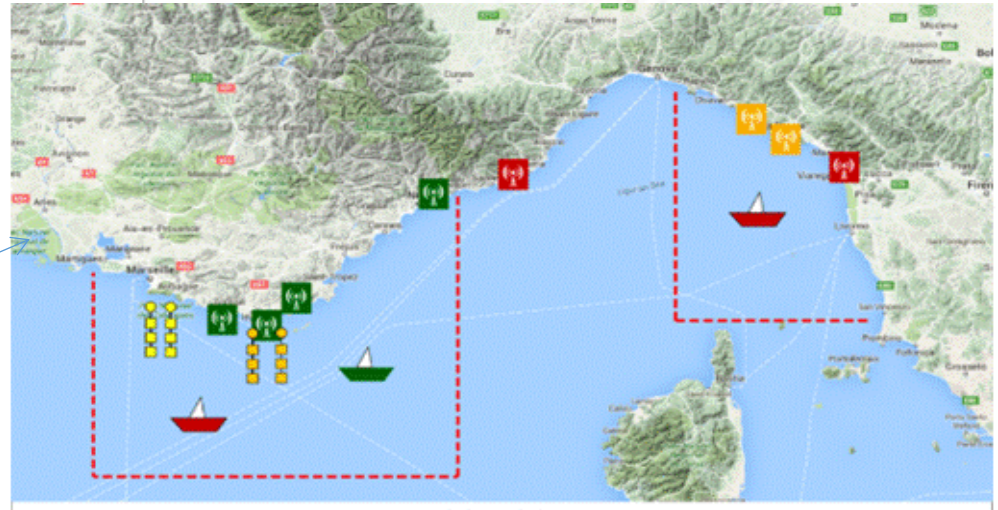
- demonstrate the potential of coastal observatories (HF Radar) for the understanding and monitoring coastal circulation;
- expand the very surface information from HF radars to the interior ocean through moored instruments, gliders, drifters and high-resolution models;
- quantify the impact of ocean transport on the distribution of floating and dissolved matter
- short time prediction using data or combination of data and models.



HF RADAR ACTIVITIES in JERICO_NEXT

JRAP4 activities





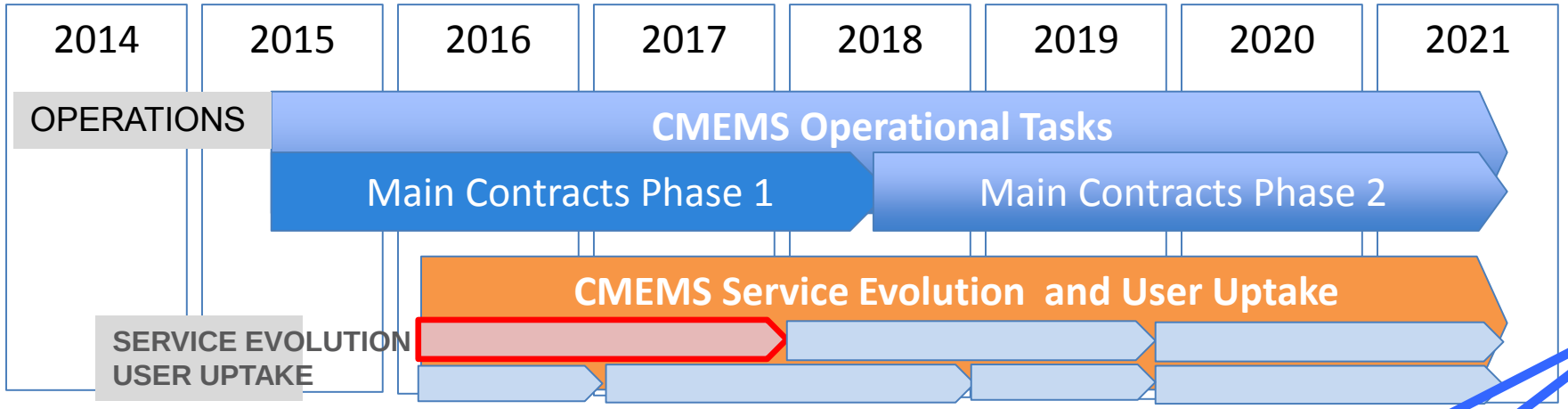
HF radar already operating
HF radar expected: beginning of 2016
HF radar expected: beginning of 2017
or
Mastodon Mooring expected: end of 2017
Completed oceanographic campaign
Oceanographic campaign expected (non Jerico fundings, submitted proposals): end 2016-2017

INCREASE project

CMEMS Service Evolution

INCREASE
HF Radar Experts Workshop

13th-15th September 2016



Operational products delivered to users (Production Units)

⇒ Support leading edge R&D activities required for the CMEMS service evolution :

- Consolidating the scientific tools and methods underpinning the production of the best possible ocean information by CMEMS production units;
- Supporting new developments to consolidate the CMEMS catalogue, as requested by users or motivated by downstream service providers ;
- Enhancing integration of the scientific innovation effort across CMEMS partners and fostering the exchange of know-how and expertise between the consortium members ;
- Preparing the next generation of operational systems needed to ensure long-term competitiveness of the CMEMS.

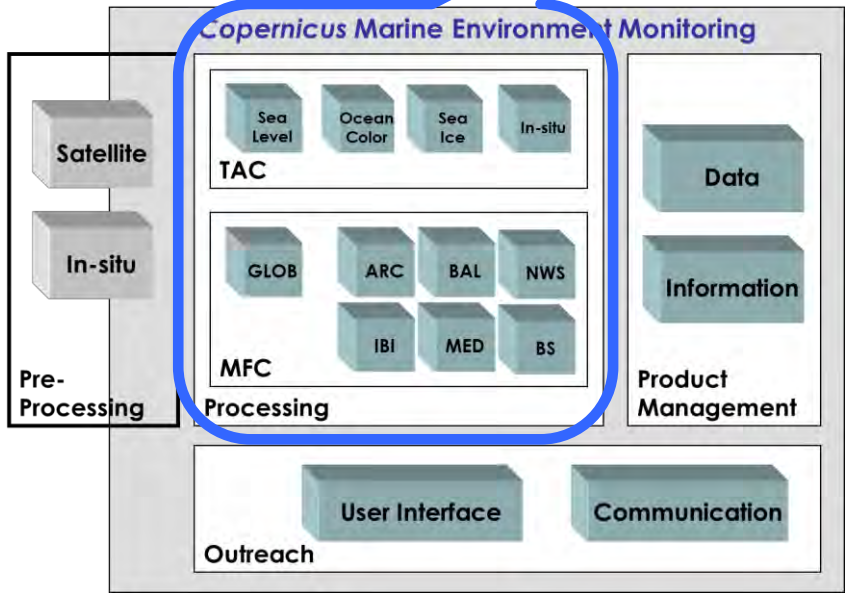


Figure 1: System overview of *Copernicus* Marine Environment monitoring service chain as presented by the European Commission to the GMES/Copernicus User Forum.

INCREASE project

Mar2016-Feb2018 (CMEMS service Evolution Lot5)

Innovation and Networking for the integration of Coastal Radars into European mArine SErvices

INCREASE aims to set the necessary developments for the integration of the existing European HFR operational systems into the CMEMS, following four main objectives:

- Provide **HFR quality controlled real-time surface current data for direct use and through key derived products** (gap-filled data, filtered data, short-term prediction and derived Lagrangian products)
- Set the **basis for the management of historical data and methodologies for reprocessing existing data sets**, using advanced delayed mode quality-control techniques, to obtain the best possible continuous surface coastal ocean observations
- **Boost the use of HFR data for improving CMEMS numerical modeling systems**, through validation, model-data blending and data assimilation.
- **Enable an HFR European operational node to ensure the operational availability of HFR data** and data products and the link with operational CMEMS

INCREASE project

Main Work Lines and Milestones

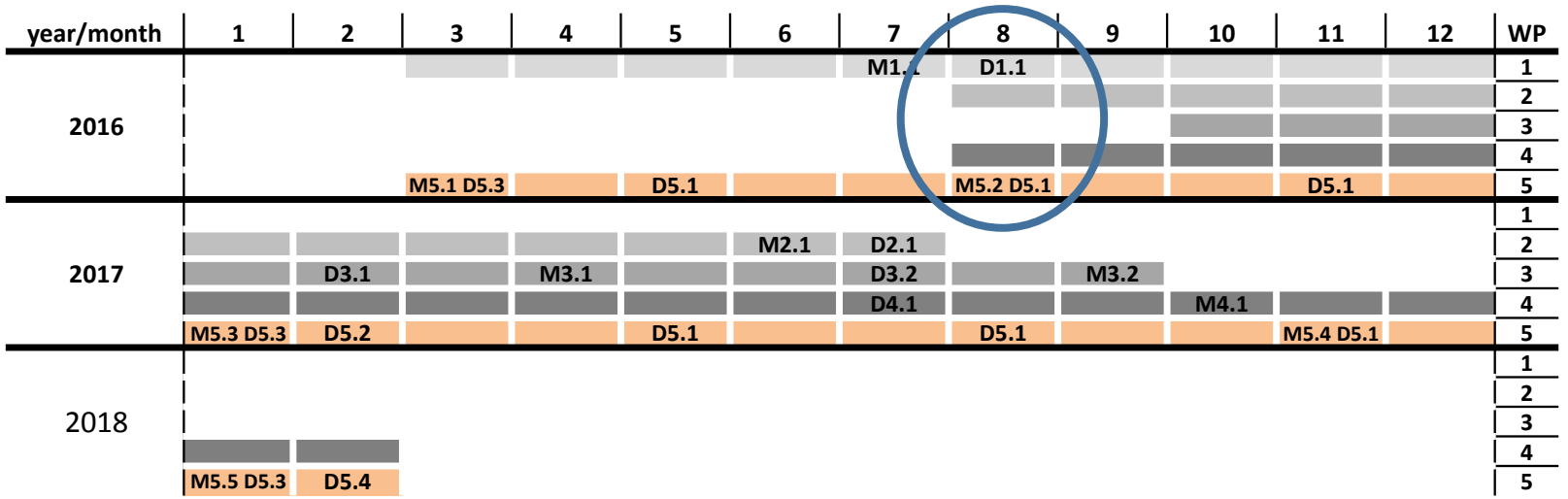
WP1: Towards the integration of HFR observing technology into CMEMS M1.1; **D1.1: Report on European HFR systems development and roadmap for HFR products evolutions in compliance with CMEMS needs**

WP2: Basis for HFR data assimilation into CMEMS models; M2.1; D2.1 :Guidelines towards increasing HFR data assimilation capacities into CMEMS

WP3: HFR Products development; M3.1-2: Basic and advanced products v0 are ready;D3.1: Protocols on QA best practices, QC for radial and total data ; D3.2: Tool for interoperable radial and total data production, tool for combination of radial data with different spatial resolutions

WP4: HFR Node; M4.1: HFR Node working infrastructure; D4.1: Recommendation and guideline to set up the hardware and software tools to provide HFR data to the HFR Node

WP5: Coordination;M5.1:Online KOM; M5.2: HFR expert WS; M5.3+5: Mid-term /final review meeting CMEMS (MFC+TAC);M5.4: Implementation expert users WS (CMEMS users);D5.1-4 :Reports, minutes



INCREASE HFR EXPERTS WORKSHOP

4. Workshop objectives

INCREASE
HF Radar Experts Workshop

13th-15th September 2016

INCREASE HF Radar Experts Workshop
Sep 13-15, La Spezia

Objectives :

To report on European HFR systems development and roadmap for HFR products evolution in compliance with CMEMS needs:

- To make a diagnostic of the present development of European HFR systems (existing systems, operators, existing products)
- To review and set methodologies for basic and advanced HFR derived products
- To review CMEMS needs and objectives and how HF Radars can fit into them
- To design a roadmap for the establishment of a European HFR network

https://azti.box.com/v/EuroGOOSHFRTTINCREASEexpWS

47 people

NAME	INSTITUTION
Simone Cosoli	ACORN (Australian COastal Radar Network)
Julien Mader	AZTI
Anna Rubio	AZTI
Jose Luis Asensio	AZTI
Angélique Melet	CMEMS / Mercator Océan
Bruno Levier	CMEMS / Mercator Océan
Loic Petit De La Villeon	CMEMS instac / IFREMER
Stéphane Tarot	CMEMS instac / IFREMER
Carlo Brandini	CNR Ibimet & LaMMA Consortium
Carlo Mantovani	CNR-ISMAR
Lorenzo Corgnati	CNR-ISMAR
Annalisa Griffa	CNR-ISMAR
Maristella Berta	CNR-ISMAR
Marcello Magaldi	CNR-ISMAR
Roberta Sciascia	CNR-ISMAR
Laura Barbieri	CNR-ISMAR
Stefano Taddei	Consorzio LaMMA - Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile
Lohitzune Solabarrieta	DeustoTech
Enrico Zambianchi	DiST, Università Parthenope and CoNISMa
Pierpaolo Falco	Dpt. Science and Technology, University of Naples "Parthenope
Marco Uttieri	Dpt. Science and Technology, University of Naples "Parthenope"
Antonio Novellino	ETT
Marco Alba	ETT
Patrick Gorringe	EuroGOOS
Leif Petersen	Helzel/WERA
Johannes Schultz-stellenfleth	HZG
Jochen Horstmann	HZG
Alejandro Orfila	IMEDEA
Carlos Fernandes	Insituto Hidrografico
Maurizio Demarte	Italian Hydrographic Office
Marta Pratellesi	Italian Hydrographic Office
Cosmo Peluso	Italian Hydrographic Office
Céline Quentin	MIO
Michael Hartnett	National University of Ireland
Vlado Malacic	NIB
Branko Cermelj	NIB
Pablo Lorente	Puertos del Estado
Andrés Alonso-Martirena	Qualitas/CODAR
Jorge Sánchez	Qualitas/CODAR
Pia Andersson	SMHI
Emma Reyes	SOCIB
Adam Gauci	University of Malta (CALYPSO)
Giuseppe Ciraolo	University of Palermo (CALYPSO)
Fulvio Capodici	University of Palermo (CALYPSO)
Lucy Wyatt	University of Sheffield
Jeff Paduan	USA/IOOS, NPS
Mark Otero	USA/IOOS, Scripps

THE EUROPEAN HFR SURVEY

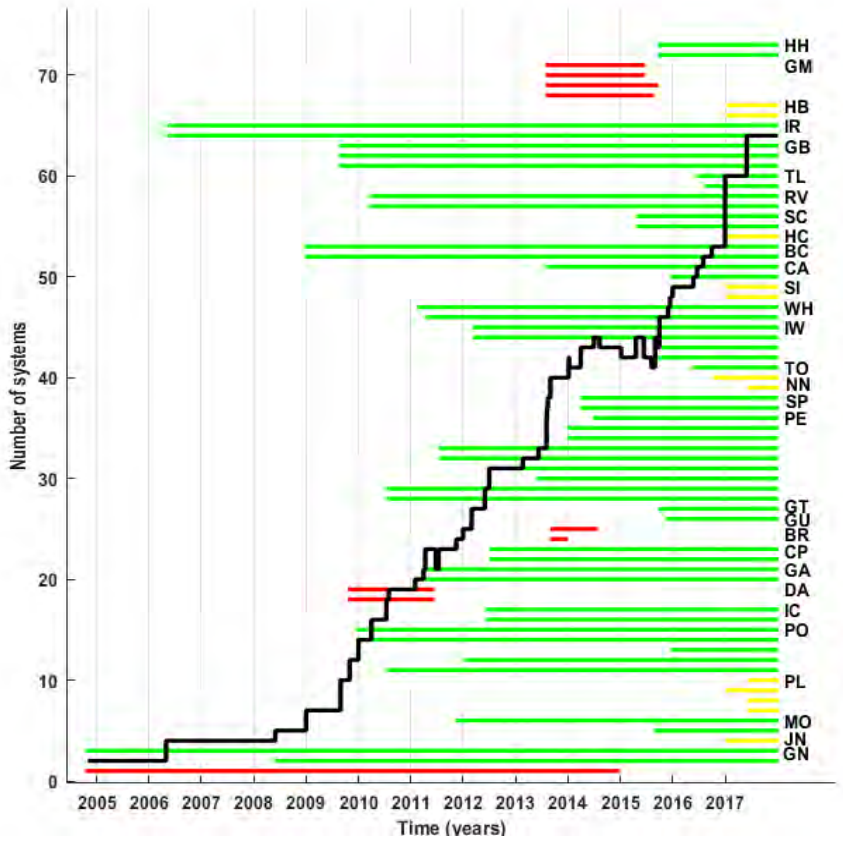
- ✓ 46 questions on four axes: Contact people; Technical information on the network; Technical information about the data formats, sharing protocols and policies, QA/QC and processing ; Areas of application of the data and identified users
- ✓ Launched in June 17th and closed July 27th, gathering responses from 28 EU institutions and more than 70 HFR systems.

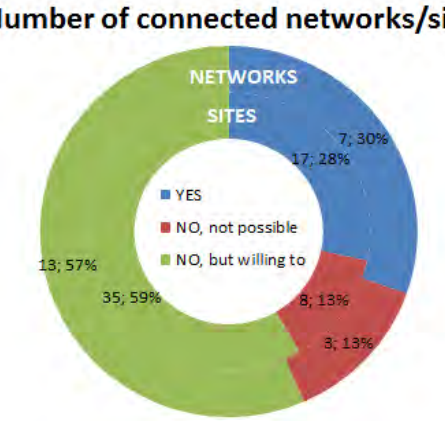
HFR NETWORK	Hook of Holland	German Bight	Gulf of Naples	TirLig	Gulf of Manfredonia	SICOMAR	Calypso	Joe Doe	CALYPSO	SPLIT
COUNTRY	*THE NETHERLANDS*	*GERMANY*	*ITALY*					SLOVENIA	MALTA	*CROATIA*
OPERATOR	Rijkswaterstaat	Helmholtz-Zentrum Geesthacht	University of Naples		CNR-ISMAR	Consorzio LaMMA - CNR	University of Palermo	National Institute of Biology	University of Malta	Institute of Oceanography and Fisheries
Numbser of SITES	2									
Name of sites	Ter Heijde	Ouddorp								
Sites lat , lon coordinates	52,03	51,82								
	4,17	3,88								
Date of 1st deployment	01/10/2015									
Status	Ongoing									
Permanent installation?	yes									
Manufacturer	WERA*									
Type of radar	PA									
Temporal resolution (minutes)										
Spatial resolution of total velocity grid (m)										
Tansmit Fequency (MHz)	16,1									
Tansmit Bandwidth (KHz)	150									

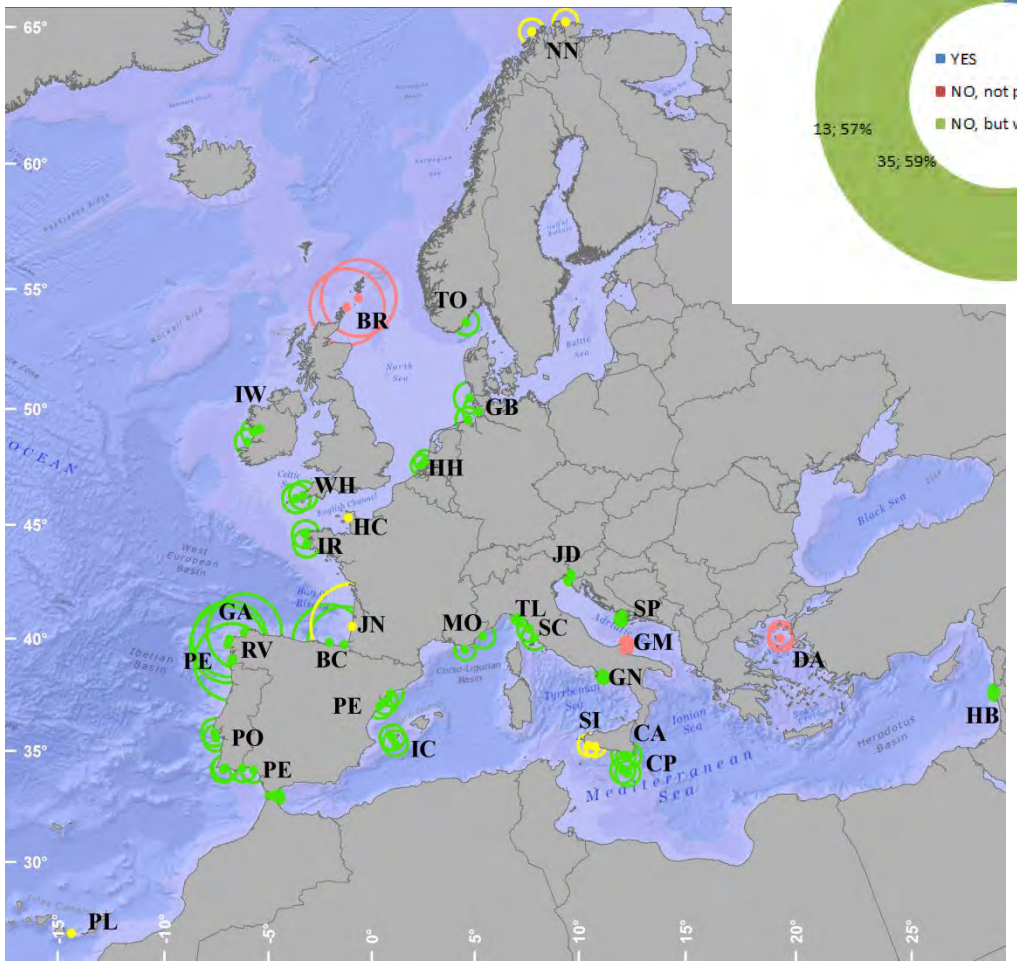
HFR NETWORK	IBIZA CHANEL	DELTA DEL EBRO	ESTRECHO DE GIBRALTAR	GOLFO DE CÁDIZ	GALICIA	Ria de Vigo	Basque Country	National HF Network
COUNTRY	*SPAIN*							*PORTUGAL*
OPERATOR	SOCIB		Puertos del Estado		INTECMAR	University	AZTI	Instituto Hidrografico
Numbser of SITES	2							
Name of sites	FORM	GALF	SALOU	ALF				
Sites lat , lon coordinates	38,67	38,95	41,06	4				
	1,39	1,22	1,17					
Date of 1st deployment	01/06/2012		01/07/2014					
Status	Ongoing			Ong				
Permanent installation?	yes			y				
Manufacturer	CODAR			CO				
Type of radar	DF			D				
Temporal resolution (minutes)	60			6				
Spatial resolution of total velocity grid (m)	3000			30				
Tansmit Fequency (MHz)	13,5		13,5					
Tansmit Bandwidth (KHz)	90,069		90					

HFR NETWORK	MOOSE HF radar			Iroise		Torungen	Wave Hub HF Radar		BRAHAN		Ireland West Coast_Radars			
COUNTRY	*FRANCE*					*NORWAY*	*UK*				IRELAND			
OPERATOR	MIO, AMU-CNRS-IRD-UTLN			SHOM		Norwegian Meteorological Institute	Plymouth University		Marine Scotland Science		National University of Ireland			
Numbser of SITES	3			2		1	2		2		4			
Name of sites	Vila real de Santo António	ANTARES	DYFAMED	Pointe de Garchine	Pointe de Brézellec	Torungen	Pendeen	Perranporth	SUMB	NRON	Mutton Island	Spiddle	Inish Oirr	Loop Head
Sites lat , lon coordinates	37,18	42,95	43,50	48,50	48,07	58,40	50,16	50,34	59,85	59,39	53,25	53,24	53,06	52,56
	-7,44	6,00	7,25	-4,78	-4,66	8,79	-5,67	-5,18	-1,28	-2,38	9,05	9,30	9,52	9,92
Date of 1st deployment	01/08/2010	15/11/2011	01/09/2015	01/05/2006		25/05/2016	01/02/2011 and 01/04/2011		01/09/2013		01/03/2012		01/09/2015	
Status	Ongoing	Ongoing	Ongoing	Ongoing		Ongoing	Ongoing		Ended on 09/08/2014	Ended on 09/01/2014	Ongoing			
Permanent installation?	yes	yes	yes	yes		yes	no		no		yes			
Manufacturer	CODAR	WERA*	CODAR	WERA		CODAR	WERA*		CODAR		CODAR			
Type of radar	DF	DF on 8 receiving antenna	DF	PA		DF	PA		DF		DF			
Temporal resolution (minutes)	60	60	90	10		60	60		60		60			
Spatial resolution of total velocity grid (m)	1500	3000	0	2000			1000		5000		300		2000	
Tansmit Fequency (MHz)	12,4698	16,175	13,45	12,4		13,5	12		4,5		25		13,5	
Tansmit Bandwidth (KHz)	99,259	50	50	100		75	350	375	36,8		500		49,6	

THE EUROPEAN HFR SURVEY







REFERENCES:

- Mader et al. (2016). The European HF Radar Inventory, EuroGOOS publications (Available at http://eurogoos.eu/download/publications/EU_HFRadar_inventory.pdf)
- Rubio et al. (ACCEPTED) **HF Radar Activity in European Coastal Seas: Next Steps Towards a Pan-European HF Radar Network. Frontiers in Marine Science**
- Joint Efforts Towards European HF Radar Integration-https://agu.confex.com/agu/fm16/meetingapp.cgi/Paper/174583

DATA INTEROPERABILITY: STANDARD FOR DATA AND METADATA (L. Corgnati CNR-ISMAR)

DATA FORMAT

Double production:
- **netCDF 4** as standard
- **netCDF 3** for CMEMS real-time data ingestion

METADATA STRUCTURE

- **CF-1.6** compliancy (mandatory)
- **OceanSites** compliancy for CMEMS real-time data ingestion (mandatory)
- **INSPIRE** compliancy (recommended)

QC FLAGGING SCHEME

- **IODE** scheme

QC TESTS

Radial data:
- **Syntax**
- **Over water**
- **Variance threshold**
- **Velocity threshold**

Total data:
- **Data density threshold**
- **Balanced contributing radials**
- **GDOP threshold**
- **Variance threshold**

	Mar 2016	Jun 2016	Sep 2016	Dec 2016	Mar 2017	June 2017
Data format						
Metadata structure						
QC flagging scheme						
QC tests						

Ritmare HFRadar Task Team EuroGOOS European Global Ocean Observing System JERICO next EMODnet European Marine Observation and Data Network Copernicus Europe's eyes on Earth