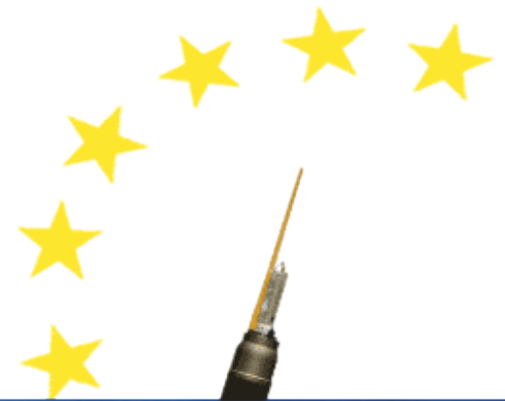




Euro-Argo: a long term contribution of Europe to Argo

S. Pouliquen, P.Y. Le Traon and Euro-Argo RI partners

5th Euro-Argo User Workshop





The Euro-Argo European Research Infrastructure

- Ø Objective: ensure a long term European contribution to Argo
- Ø The goal: Europe establishes an infrastructure for $\frac{1}{4}$ of the global array
 - ü Deploy about 250 floats per year to contribute to the Argo core mission including regional enhancements (Nordic seas, Mediterranean&Black seas) (maintain an array of 800 floats).
 - ü Prepare and contribute to the extension of Argo (e.g. marginal seas, biogeochemistry, deep ocean, polar regions)
 - ü Dual use: ocean and climate research and operational oceanography (GMES/Copernicus)
- Ø The tool : Set up a new European legal structure (Euro-Argo ERIC) that will allow European countries to consolidate and improve their contribution to Argo international.





History of the Euro-Argo Research Infrastructure development

- Ø Discussion/preparation Euro-Argo proposal for the ESFRI roadmap : 2004/2005
- Ø Part of the first ESFRI roadmap – 2006.
- Ø FP7 Euro-Argo preparatory phase: 2008-2011
- Ø Interim Phase (consortium agreement): 2011-2013
- Ø May 2014. Creation of the Euro-Argo ERIC.

Three FP7 projects: Euro-Argo PP (2008-2011), SIDERI (2011-2012) and E-AIMS (2013-2015)





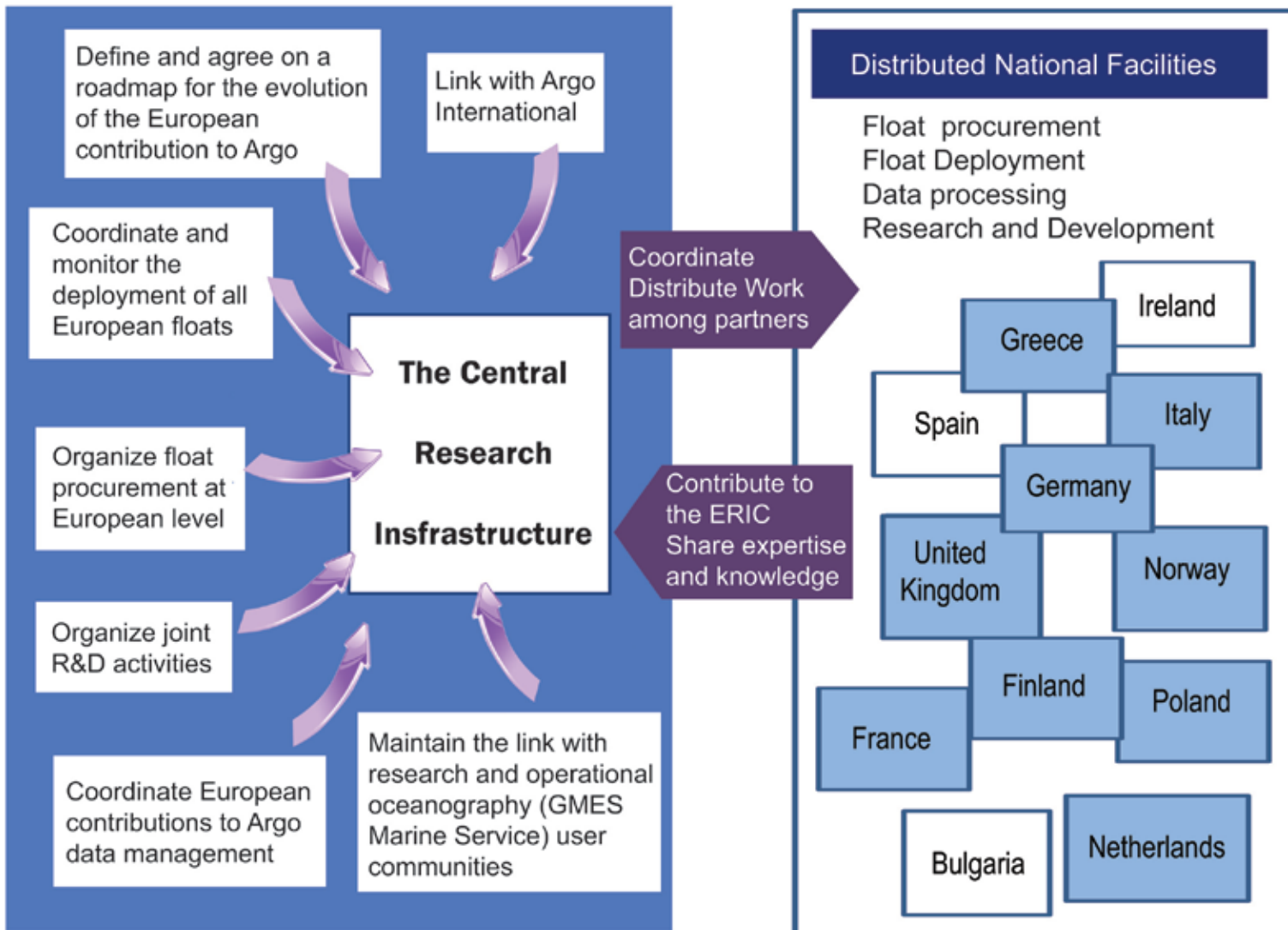
Long term organization of the Euro-Argo research infrastructure

*Objectives: Improve, Strengthen and Sustain
European contributions to Argo*



Organisation of the Euro-Argo RI

A central facility and distributed national facilities





The Governance of the Euro-Argo ERIC

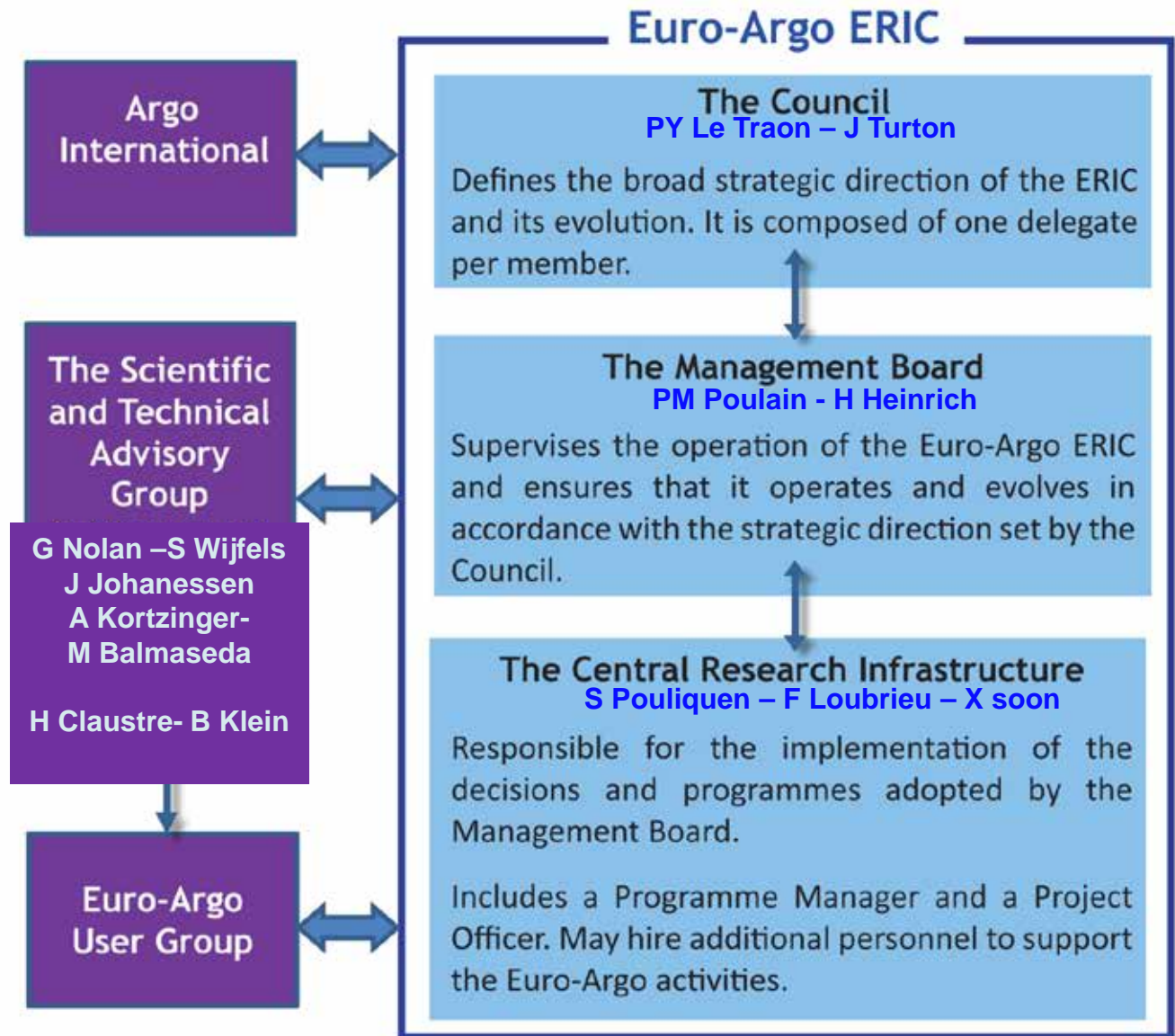
Local Host for Euro-Argo ERIC

France (Ifremer, Brest)

Members: Finland,
France,
Germany, Greece,
Italy, Netherlands,
United Kingdom

Observers: Norway,
Poland

Candidate Members:
Spain, Ireland, Bulgaria
(Portugal?)





How the Central-RI works with the Council, Mgt board and STAG

- Management board meets 3 times a year:
 - Main activities : float deployment coordination, organize data system, improve the service to the research and OO communities, develop user communities, consolidate European contribution to Argo and prepare the extension of Argo in Europe,
 - October to prepare activity report, work plan and budget for the year to come
 - March to monitor activities, agree on deployment plans, prepare the European contributions to the Argo International Steering team.
 - June to analyse the Council and STAG recommendations and take appropriate actions.
- Council meets twice a year
 - Validate long term strategy incl. implementation/budget issues (ministry representatives or delegated bodies)
 - March-April : validation of the previous year activity and account reports
 - November-December: annual work plan and budget validation
- STAG. Provide feedbacks to the Council on activity report and strategy. To be organized in 2015.



2015 ERIC C-RI Main activities



- ERIC C-RI plans to work in 2015 along six main activities:
 - Set up and management of the Euro-Argo ERIC
 - Enhance communication and outreach (incl. scientific community)
 - Coordination of Euro-Argo float deployment and float monitoring activities
 - Development of a long term roadmap for Euro-Argo incl. implementation issues
 - Organize the work of the ERIC for new EU projects
 - Continue seeking for long term funding with EC



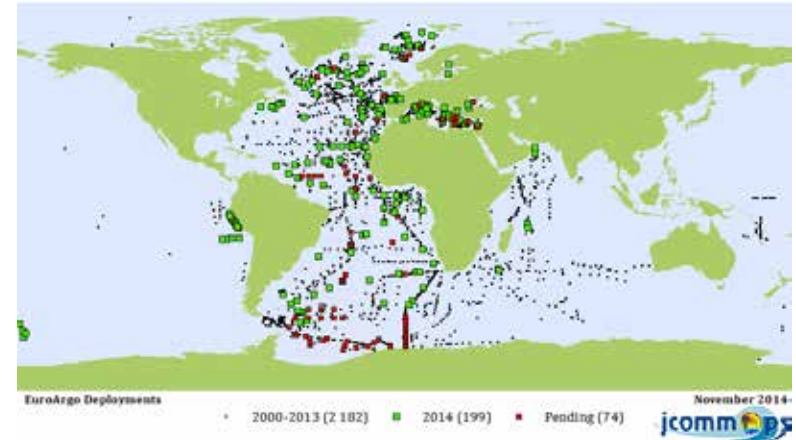
Status of Euro-Argo Contribution to Argo



Euro-Argo ERIC countries Argo

contributes to all aspects of

- Float technology developments
- Float procurement/deployment
- At-sea monitoring of the European Argo fleet
- Argo data system :
 - 2 DACs (real time)
 - 4 DM Operators and coordination of 2 ARCs (delayed mode)
 - 1 GDAC (service to the operational and research communities)
- R&D with Argo (25% of Argo Publication)
- Operational use with Copernicus Marine Service

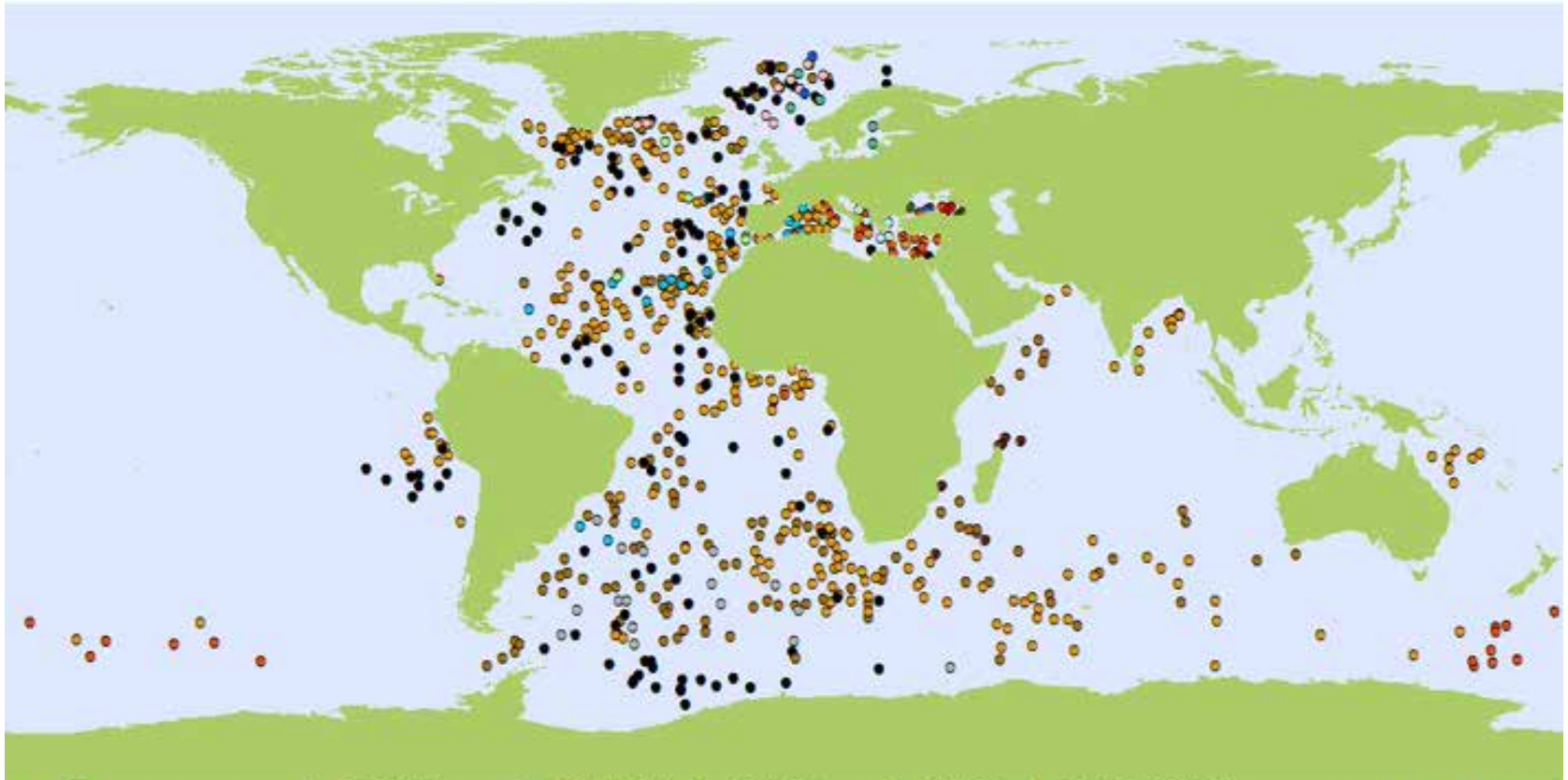




Euro-Argo floats as in January 2015



- Between 150 to 200 floats are now deployed per year and the Euro-Argo array has reached a number of about 700 active floats
- This is still below our initial target (250 floats/year and 800 floats) but has increase in recent years . It will be reached when a long-term direct EU co-funding is set up.



693 Floats

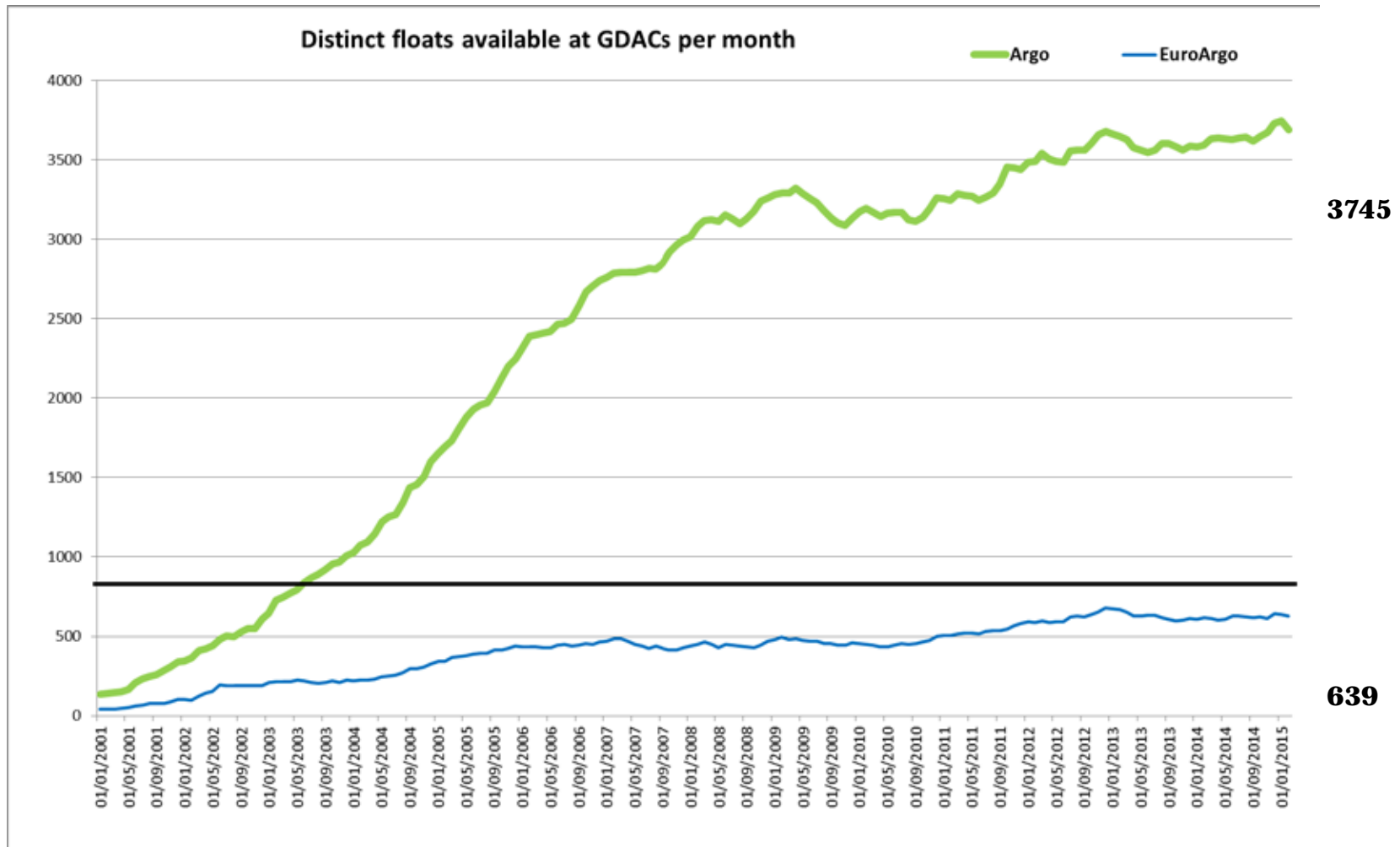
● BULGARIA (3)	● GERMANY (129)	○ LEBANON (0)	○ POLAND (0)	● UNITED KINGDOM (153)
● EUROPEAN UNION (5)	○ GREECE (5)	● MAURITIUS (7)	● SPAIN (20)	
● FINLAND (5)	● IRELAND (8)	○ NETHERLANDS (16)	● SWEDEN (0)	
● FRANCE (286)	● ITALY (45)	○ NORWAY (9)	● TURKEY (4)	

January 2015





Euro-Argo active floats (at GDAC) versus Argo floats



Euro-Argo regressing towards the initial target of 800 active floats about 700 floats



	<i>2011 deployed</i>	<i>2011 Argo extension</i>	<i>2012 deployed</i>	<i>2012 Argo extension</i>	<i>2013 deployed</i>	<i>2013 Argo extension</i>	<i>2014 deployed</i>	<i>2014 Argo extension</i>	<i>2015</i>	<i>2016-2020 plans (per year)</i>
Bulgaria		3				1	0	0	3	3
European Union					2	2		9		
Finland		2		3		4		5	3	3
France	53		82		65	16	85	15	80	80
Germany	48		72		31	7	48	18	52	40
Greece						2		5	5	5
Ireland	3		2		1		2		3	3
Italy		4	2	17		12		22	25	25
Netherlands	7		7		4		8		7	7
Norway						1	2	4	3	3
Poland			1			2			3	3
Spain	17		6		4		2		3	3
Turkey						4		2		
UK (Mauritius)	41 (4)		25	13	30 (2)	2	45(2)	2	50	40
Total	173	9	197	33	139	53	194	82		
	182		230		192		276		237	215

Foe 2015-2019 : It does not include the European floats :

- **14 Extension of Argo within AtlantOS (2015-2016)**
- **50+100 Core Argo within Dg-Mare (2015-2016)**



Euro-Argo – deployed floats (from Argo Information Center)



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 estimated	2016-2020 plans (per year)
European Union	70	4	15	7	3	8						4	9	3	3
Bulgaria										3		1		0	0
Finland									2	2	3	4	5	3	3
France	7	34	85	89	51	36	90	35	55	53	82	81	100	80	80
Germany	14	25	45	75	36	35	71	33	41	48	72	38	66	52	40
Greece									1			2	5	5	5
Ireland		2	0	0			4	4	3	3	2	1	2	3	3
Italy									1	4	19	12	22	25	25
Netherlands			3	4	4	4	13	4	9	7	7	4	8	7	7
Norway	3	6	0	0	2				4			1	6	3	3
Poland								2			1	2		3	3
Spain		7	2	4	1				10	17	6	4	2	3	3
Turkey												4	2	0	0
UK (Mauritius)	38	38	47	28	26	31	29	20	25	45	38	34	49	50	40
Total	132	116	197	207	123	114	207	98	151	182	230	192	276	237	215

- **2015 plans already include evolution of Argo core mission : about 160 core Argo floats, 30 marginal seas, 30 high latitudes, 20 Bio-Argo**
- **At the member level, plans for 2016-2020 are similar to 2015 plans**
- ***With the EC contribution (2015-2016) we will reach our target of 250 floats /year target for the core Argo program in 2016 and continue to progress on the extensions of Argo.***



Euro-Argo needs to meet requirements from the research and operational (Copernicus Marine Service) oceanography community in Europe.

- Priority 1 : maintain the global array.
 - Increase European contribution from 150-200 floats to 250 floats/year and consolidate the data processing system
 - Strong European requirement for marginal seas
 - Important European research activities in high latitudes: Nordic Seas, Arctic
- Priority 2: evolution of Argo to address new scientific and operational challenges.
 - Strong interest (and good maturity) of the European research community and/Copernicus (operational oceanography) for extension to biogeochemical variables : Oxygen, Chl-a. Several pilot experiments ongoing or planned (e.g. Remocean, NAOS, E-AIMS, Atlantos).
 - Improved resolution at the surface (SST, SSS) needed (on going)
 - Deeper measurements needed. Pilot experiments on going (NAOS, E-AIMS, Atlantos).



European projects contributing to Euro-Argo



E-AIMS -(2013-2015)

E-AIMS organizes an end-to-end evaluation of new Argo floats from float design down to the use by Copernicus.

Observing System Evaluations and Sensitivity Experiments have been conducted to provide robust recommendations for the next phase of Argo that take into account Copernicus Marine Service, seasonal/decadal climate forecasting and satellite validation requirements.

E-AIMS is demonstrating the capability of the Euro-Argo infrastructure to conduct R&D driven by Copernicus needs and demonstrate that procurement, deployment and processing of floats for Copernicus can be organized at European level.

These are key aspects for the long term sustainability of Copernicus *in-situ* component.



Main findings/results of E-AIMS project for its first two years

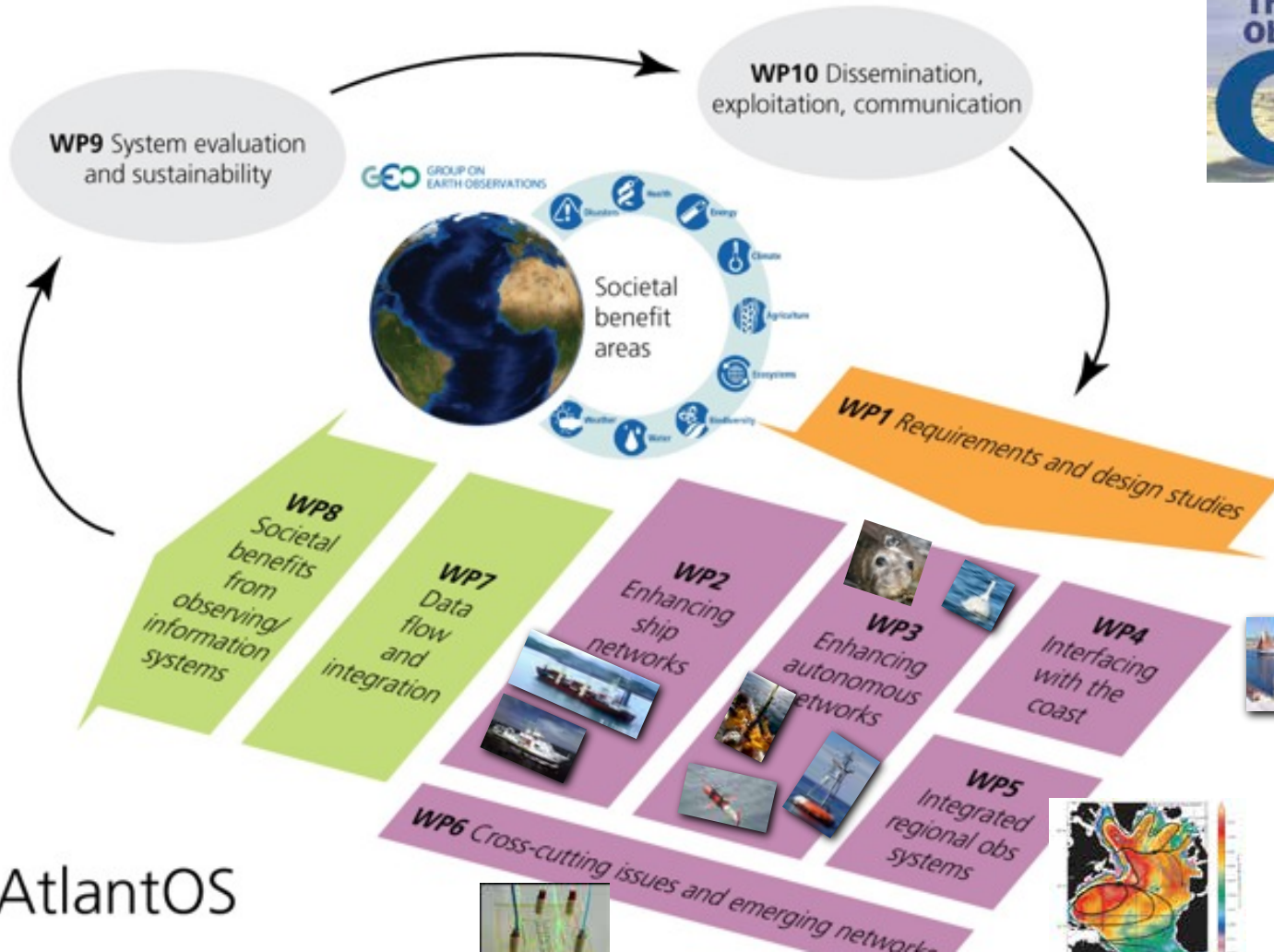
- The feasibility and readiness for pre-operational monitoring of the new Argo floats (deep Argo, O₂, Bio-Argo, two way telecommunication) (18 floats tested at sea). (see Sagot and Bittig posters)
- Improvements of the Argo data system (European DACs and GDAC) incl. real time/delayed mode QC to handle new types of Argo floats. (see Poster C Schmechtig)
- Interfaces with the Copernicus Marine Service monitoring and forecasting centres (global and regional).
- Major impact of past and future Argo data for satellite validation activities (ocean colour, altimetry, SST, SSS) (See Mangin and Organelli posters) and for the Copernicus Marine Service (data assimilation, validation).
 - Improvements of Argo (Deep, Bio) are expected to have a large impact on the Copernicus Marine Service. (See Drévilion & al talk)
 - Design recommendations to be developed in 2015.
- Post E-AIMS (from 2016). Agree on and start implementing Argo extension in Europe (Euro-Argo ERIC). o



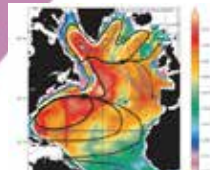
AtlantOS

The challenge is to conduct the Research and Innovation activities necessary to Optimizing and Enhancing the **Integrated Atlantic Ocean Observing System** building on existing capacities **on both side of the Atlantic.**

WP11 Management



AtlantOS





Euro-Argo in Atlantos



One Task led by the Euro-Argo ERIC with contributions from Ifremer, LOV, GEOMAR and Euro-Argo ERIC partners

Objective : contribute to the progressive extension of the Argo core mission towards the deep ocean and biogeochemistry. Develop long-term plans.

- Deep-Argo float deployment. 7 deep -Oxygen Argo floats (complementing 30 floats already funded at national or European level) in the North Atlantic.
- Bio-Argo float deployment: 7 Bio-Argo floats (complementing 60 floats and 60 O₂-floats funded at national level) in the North-Atlantic to enhance this network in various biogeochemical provinces of the Atlantic.
- Improving Bio-Argo float capabilities (adapt novel optode-based sensors for CO₂ and O₂ partial pressure and new pH sensors)
- Data Management Real time/delayed mode data processing. Refine delayed mode QC and deliver a consistent Argo and Bio-Argo dataset for the Atlantic.
- Sustainability issues: work on the long-term sustainability issues for Bio-Argo and Deep Argo after the AtlantOs pilot project. Long-term targets for Europe will be defined and the Euro-Argo ERIC will seek agreements at ministerial level and with the EU for their implementation. To be done with international partners.



- The ERIC received an invitation to submit, for the 20th April 2015, an application for a grant for the implementation of the action Monitoring the Oceans of the European Maritime and Fisheries Fund (EMFF) programme 2015
 - Funding for purchasing 50+100 T&S floats , their deployment in 2015-2016 including at sea monitoring , and their processing (2015-2019) in real time and delayed mode
 - Project at 5M€ : 4M€ from EC and 1M€ from the Euro-Argo RI
- The ERIC will have to demonstrate its capacity to manage such activity .
- The ERIC will continue to work with EC to sustain such contribution in the future

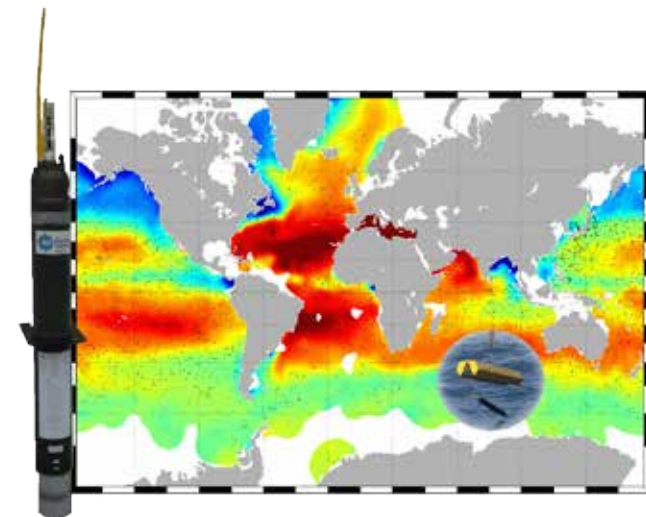
Conclusion



The objective of Euro-Argo is to ensure a long term contribution of Europe to Argo

European level is needed : improved efficiency in all implementation aspects

- q We have defined, agreed and set up a new European legal structure and organization.
- q This will allow EU member states to better coordinate, consolidate and improve their contribution to Argo international.
- q Euro-Argo ERIC is in place since May 2014.
- q There is common understanding that long term EU funding is required for such a global infrastructure
- q First EU projects contributing to Argo and managed by the ERIC are starting to demonstrate the importance of the EC contribution to Argo



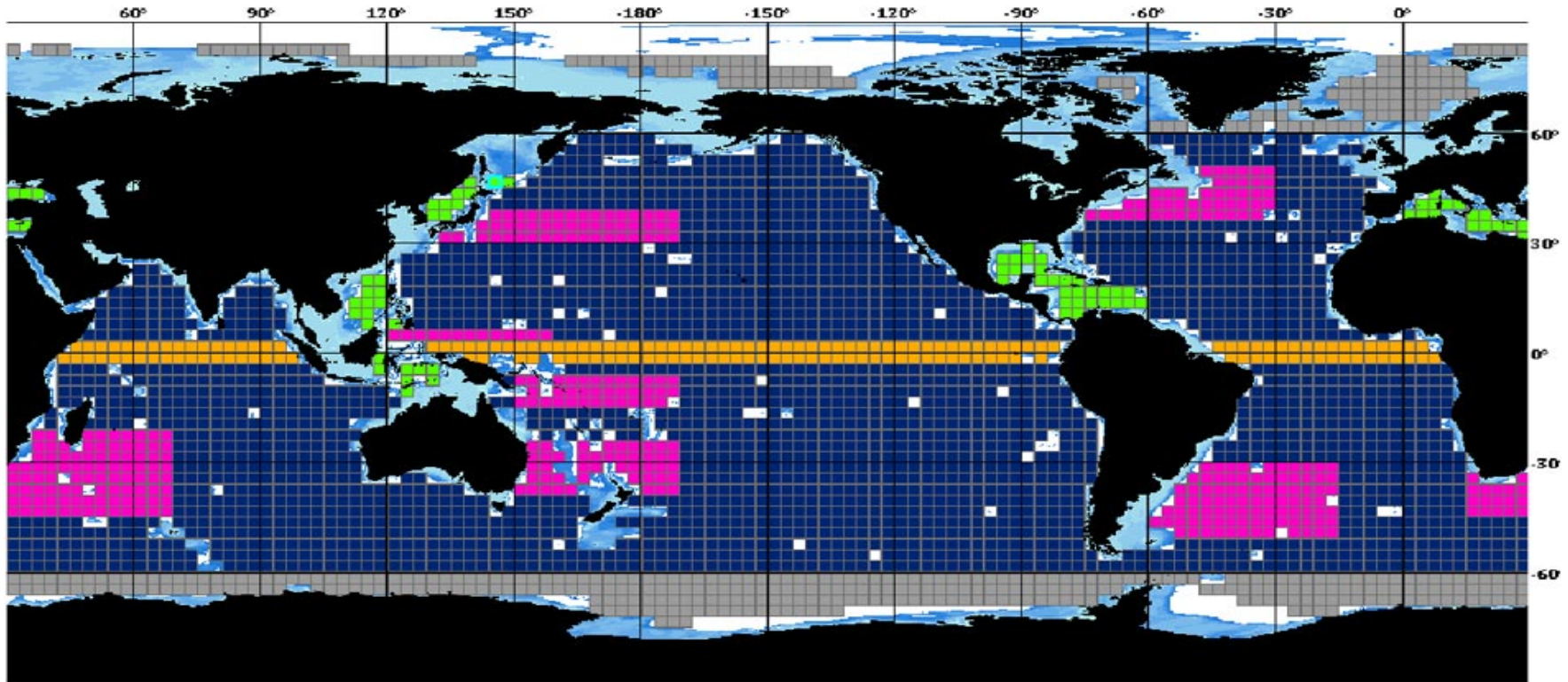




Extra



A new Design for Global (core) Argo?



Global Argo

Target = ~4135



Equatorial (x1.5)



WBC (x2.25)



High Latitudes (x1)



Marginal Seas (x2)



- Same mission – tracking the slow manifold - more spatially complete and better signal to noise
- Double sampling in WBCs and equatorial regions **~4200 float array**
- Marginal Seas: enhanced sampling - determined by regional partnerships
- Seasonal Ice zone: normal sampling [Fast ice zone requires different technology]



New Missions : Bio-Argo

Bio-Argo Science : global, climate change

- Ocean acidification
- Ocean deoxygenation
- Carbon sequestration

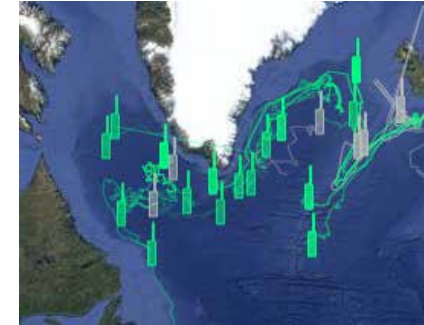
Bio-Argo integration: a component of future observing and forecasting systems

- Link with ocean colour remote sensing
- Link with biogeochemical & ecosystem models

Implementation : we first target regional hotspots

- Oxygen Minimum zones
- North Atlantic sub-polar gyre
- Mediterranean Sea

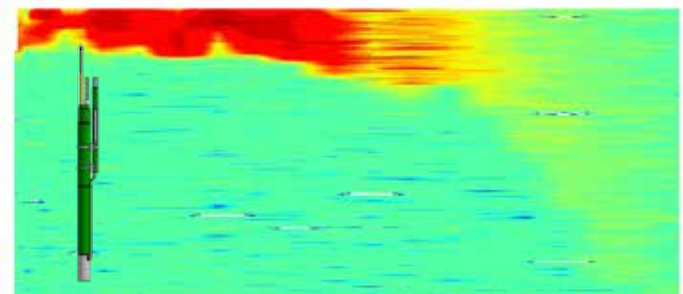
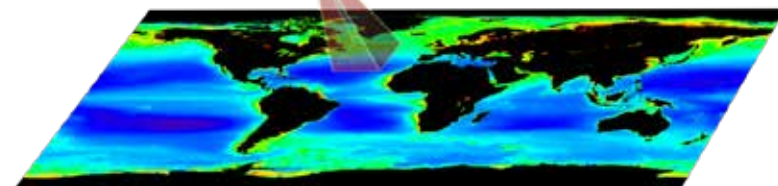
Target: 25% of the array equipped with biogeochemical sensors



FP7 ERC remOcean (2010-2016) Bio-Argo pilot experiment in the North Atlantic (PI: H. Claustre)



Satellite: Global scale



Bio-Argo profiling float: Vertical dimension



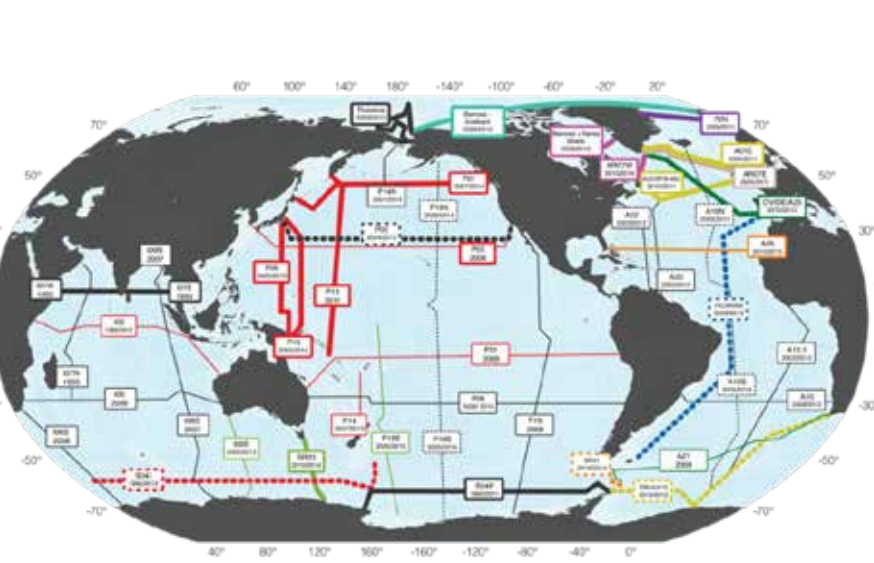
New Missions : Deep Argo



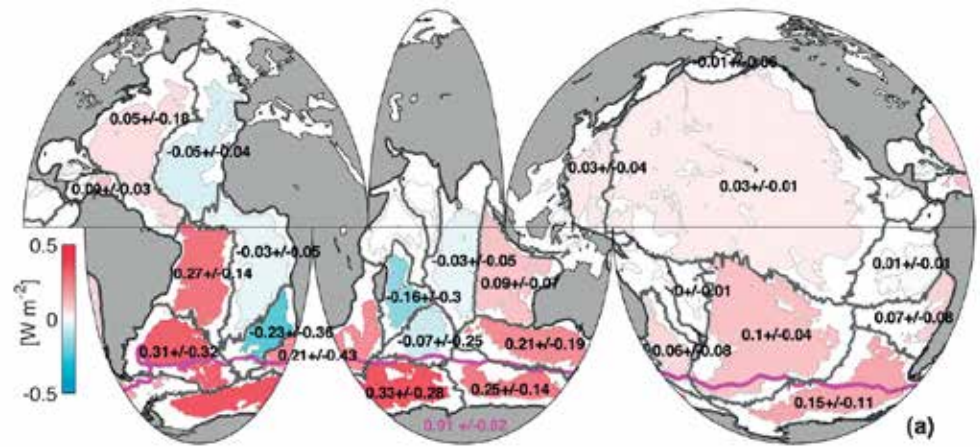
Requirements

- closure of the sea level, ocean mass, and energy budgets on regional and global scales
- provide new information on ocean circulation and water mass formation and properties
- mitigate the lack of observations below 2000 m for ocean data assimilation modeling

Design issues : technological developments are progressing well, pilot experiments are on going or planned, design of a Deep Argo array is under discussion (global vs regional sampling, time/space sampling, number of floats, 4000/6000m, etc)



— Decadal Survey — USA — Australia — Germany — Norway — France — Netherlands
 — High-Frequency Lines — Japan — Canada — UK — Spain — Sweden — Plans Pending



Bottom Water warming from 1990's to 2000's
 Purkey and Johnson (2010)



Some of our priorities for the coming years

- q Organize the functioning of the ERIC. New members/observers.
- q Work with DG MARE to set up a long term EU contribution to Euro-Argo.
- q Contribute to the global array and sampling of European regional seas.
- q Consolidate the Argo data system (real time and delayed mode/climate).
- q Continue working with user communities and expand our user base (e.g. scientific conferences, user training, user meetings). Maintain strong links with Copernicus and Emodnet.
- q Prepare the implementation of the new phase of Argo at European level: deep ocean, biogeochemistry and Arctic.
- q Integration of Euro-Argo with other marine research infrastructures: towards an European Ocean Observing System (EOOS).