WP 5
Marine Domain

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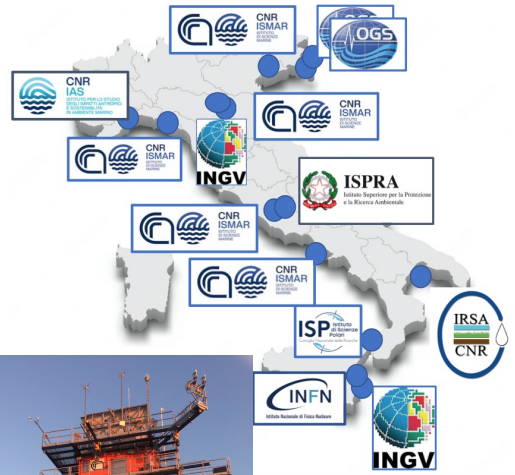
IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
(D.D. n. 130/2022 - CUP B53C22002150006) Funded by EU - Next Generation EU PNRR-Mission 4 “Education and Research” - Component 2: “From research to business” - Investment 3.1: “Fund for the realisation of an integrated system of research and innovation infrastructures”

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani

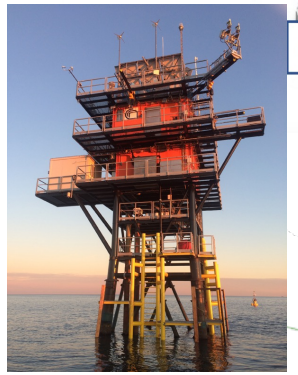
ITINERIS – Marine Domain

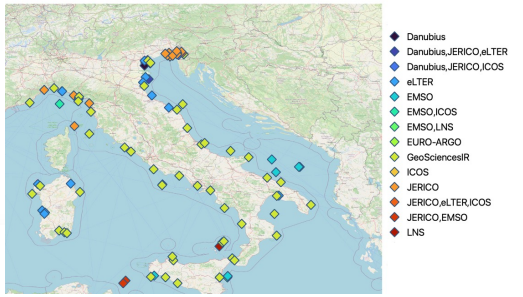
Aims:

- **to harmonize and integrate all Italian nodes of marine RIs** to guarantee **access to Italian facilities, services and marine data and to ensure long term monitoring of EOVs, EBVs and ECVs.**
- **to establish the "Italian Integrated Ocean Observing System"** able to contribute to **European and International** effort on **ocean observations (GOOS & EOOS)**
- Implementation of **the Italian Marine Data Store**

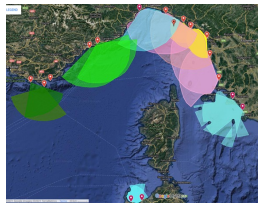


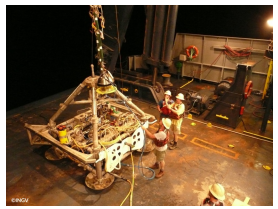
Italian Nodes of Marine RIs

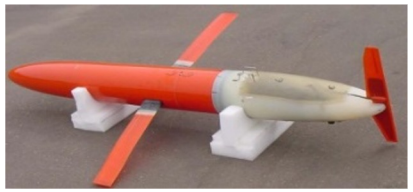


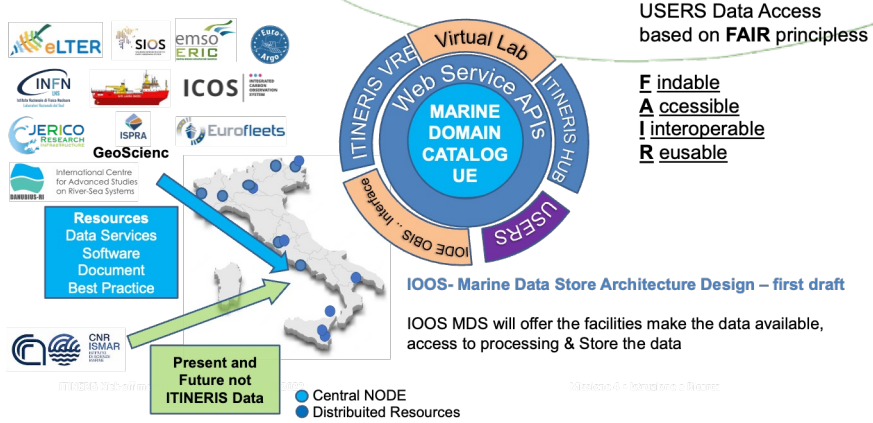


The Italian Marine Data Store









WP5: Participants in the WP per RIs

WP Leader:
Rosalia Santoleri

***Elena Mauri** (OGS), Giulio Notarstefano (OGS), Emanuele Organelli (CNR-ISMAR)*

***Laura Beranzoli**, Davide Embriaco,(INGV), Roberto Bozzano (CNR-IAS), Vanessa Cardin (OGS)*

***Katrin Schroeder**, Anna Vetrano (CNR-ISMAR)*
Franco Coren (OGS)

***Caterina Bergami** (CNR-ISMAR), Antonella Petrocelli (CNR-IRSA)*

***Francesca De Pascalis,** Debora Bellafiore, Georg Umgiesser (CNR-ISMAR), Donata Canu (OGS), Georg Umgiesser*

***Giorgio Riccobene**, Emidio Giorgio, Salvatore Viola (INFN-LNS)*

***Maurizio Azzaro**, Federico Giglio, Francesco Filiciotto, Stefano Miserocchi (CNR-ISP)*

***Michele Giani**, Giuseppe Civitarese (OGS), Carolina Cantoni (CNR-ISMAR)*

***Marcello Magaldi**, Mauro Caccavale, (CNR-ISMAR), Fabio Brunetti (OGS), Cosimo Solidoro (OGS)*

***Franco Coren** (OGS)*

***Giordano Giorgi** (ISPRA)*

WP5: Marine Domain – International Context

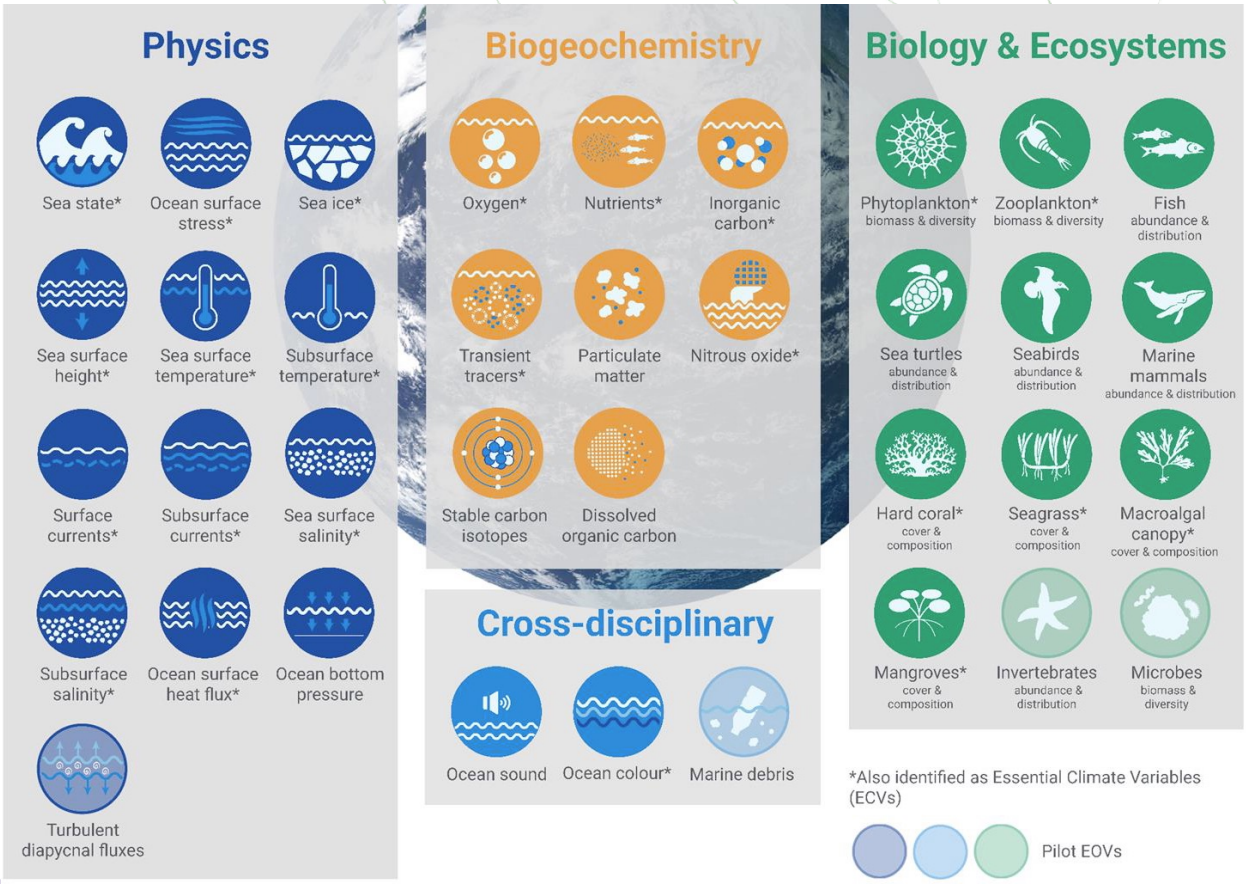
Global Ocean Observing System

Observing the ocean is essential to quantify the changes that have occurred in the recent past and to monitor current changes and predict the future

GOOS EOVs:

- 36 EOVs
- 19 EOVs are also ECVs

Ocean Essential Variable (EOV)



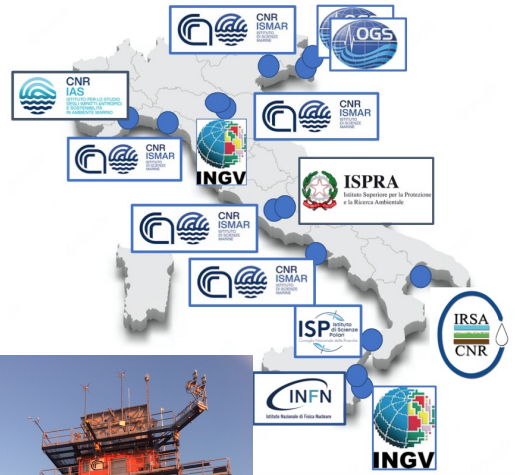
ITINERIS – Marine Domain:

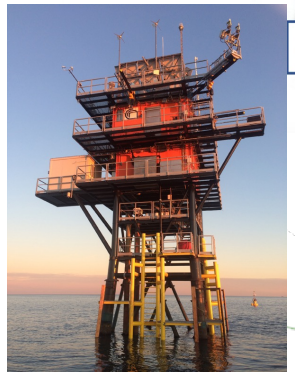
OBJ1- Integration and harmonization of Marine Domain RIs towards Italian Integrated Ocean Observing System (IT-IOOS)

OBJ2 - Fill the gaps the gaps in biological and ecosystem observations

OBJ3 - Expand capability of NRT ship-based ocean observations

OBJ4 - Develop Pilot services to tackle overarching marine issues





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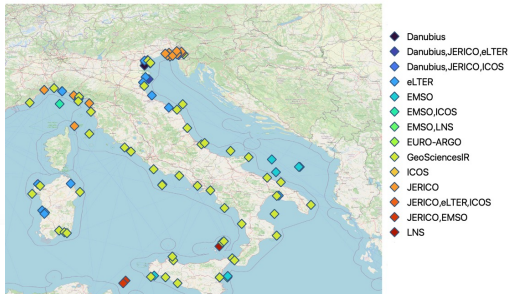
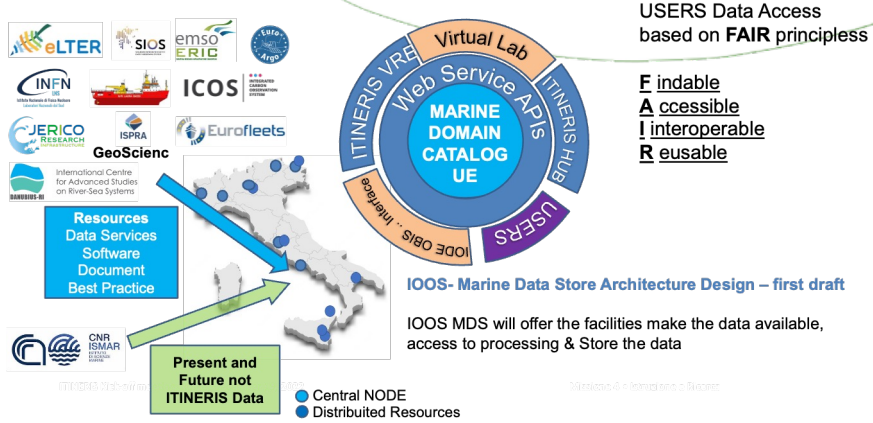
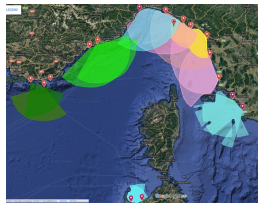


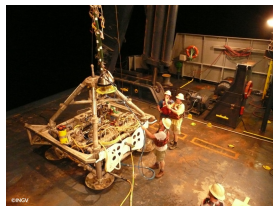
The Italian Marine Data Store

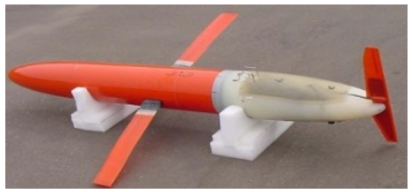


USERS Data Access based on **FAIR** principless

F indable
A ccessible
I nteroperable
R eusable







Objective 1 - Integration and harmonization of Marine Domain RIs towards IT-IOOS - Italian Integrated Ocean Observing System, Contributing RIs: all

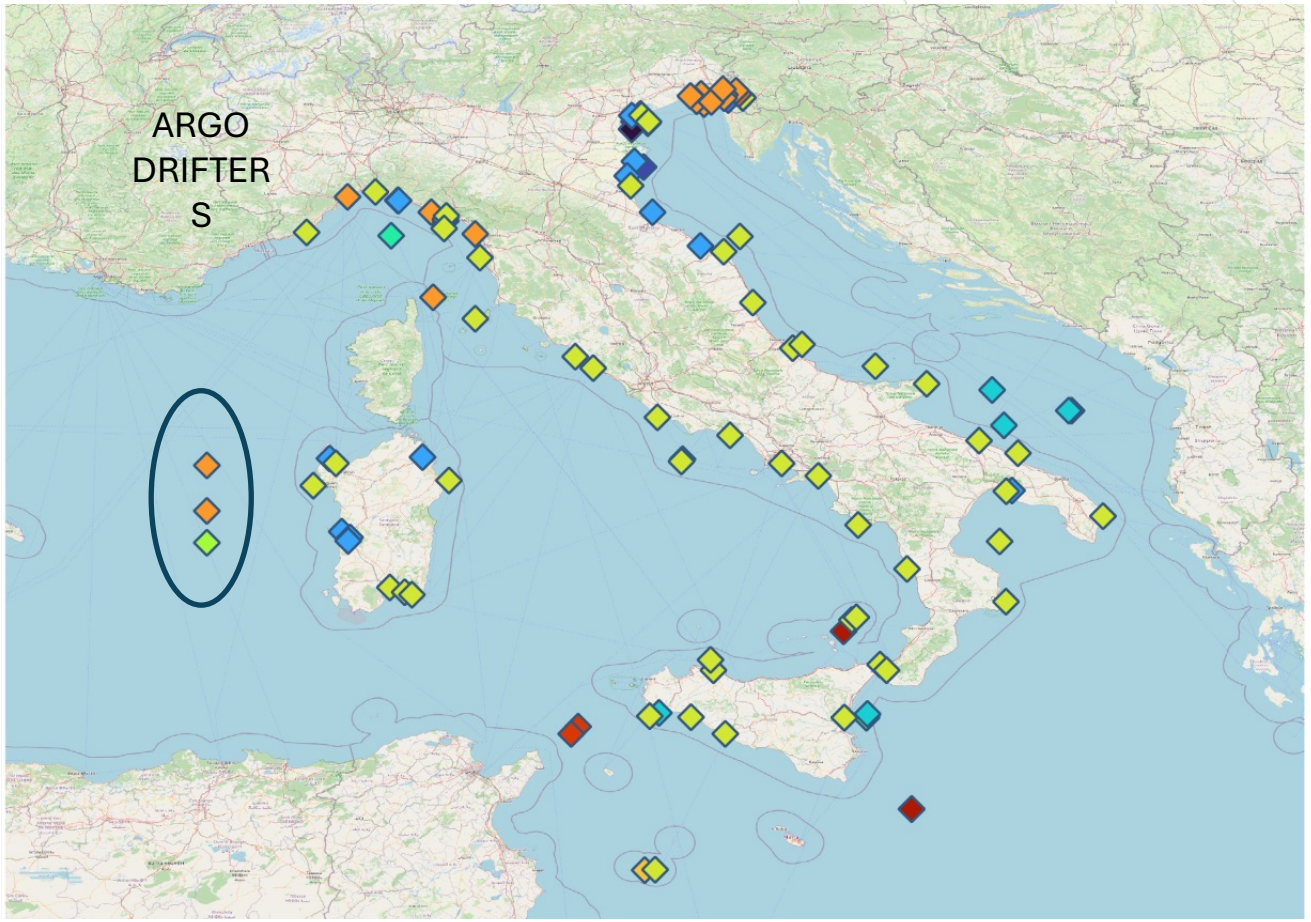
How:

- **Integration and harmonization** of Marine Domain RIs
- **Design and implementation of IOOS**

Location of national facilities of ITINERIS - Marine Domain

+ Arctic Facilities at the Svalbard - SIOS RI

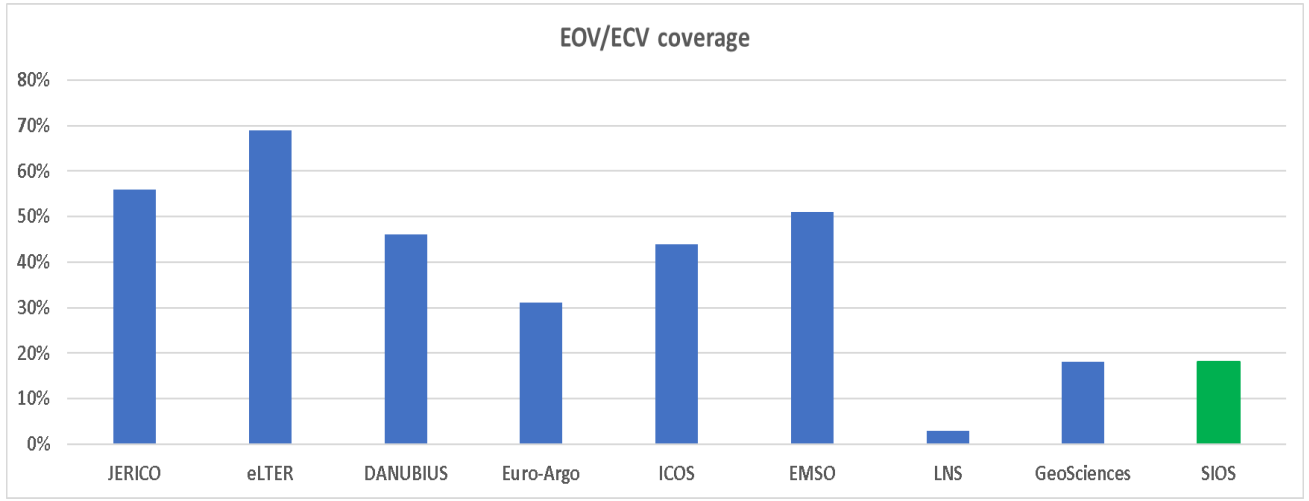
RV vessels are not included in this image

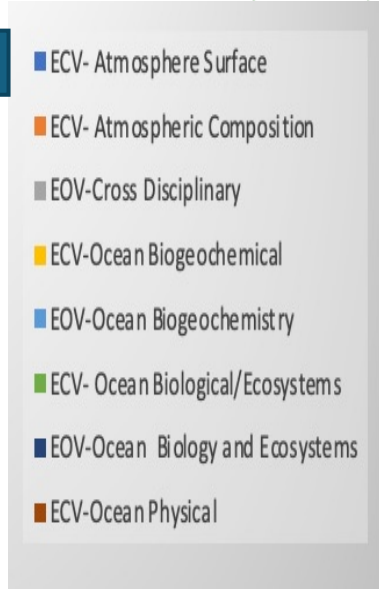


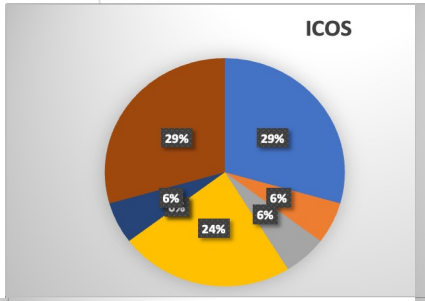
- Danubius
- Danubius,JERICO,eLTER
- Danubius,JERICO,ICOS
- eLTER
- EMSO
- EMSO,ICOS
- EMSO,LNS
- EURO-ARGO
- GeoSciencesIR
- ICOS
- JERICO
- JERICO,eLTER,ICOS
- JERICO,EMSO
- LNS

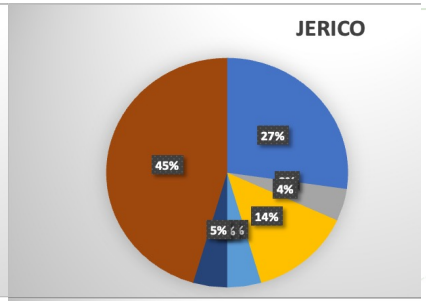
Gap analysis:
State of the art of EOVs & ECVs observations

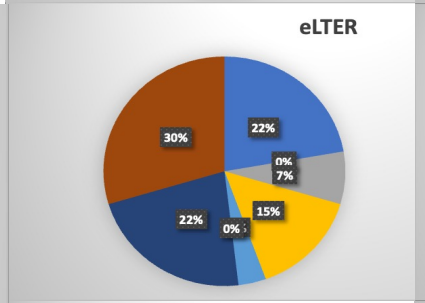
Percentage of EOVs/ECVs measured by each RI on the 39 EOVs/ECVs considered.

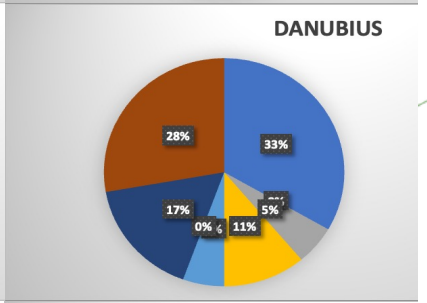


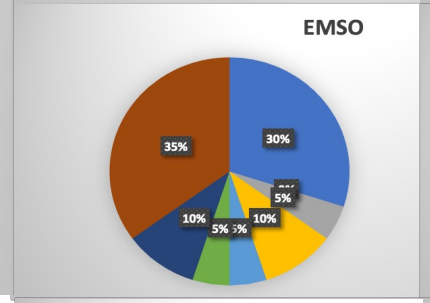


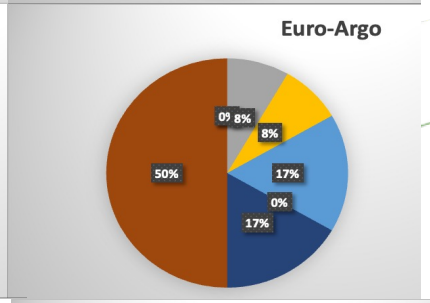


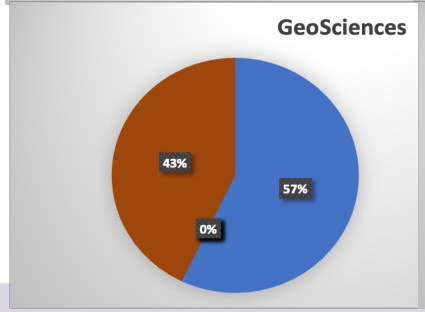


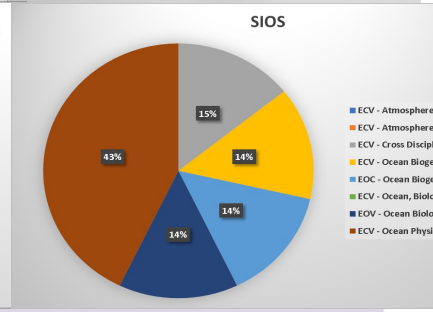






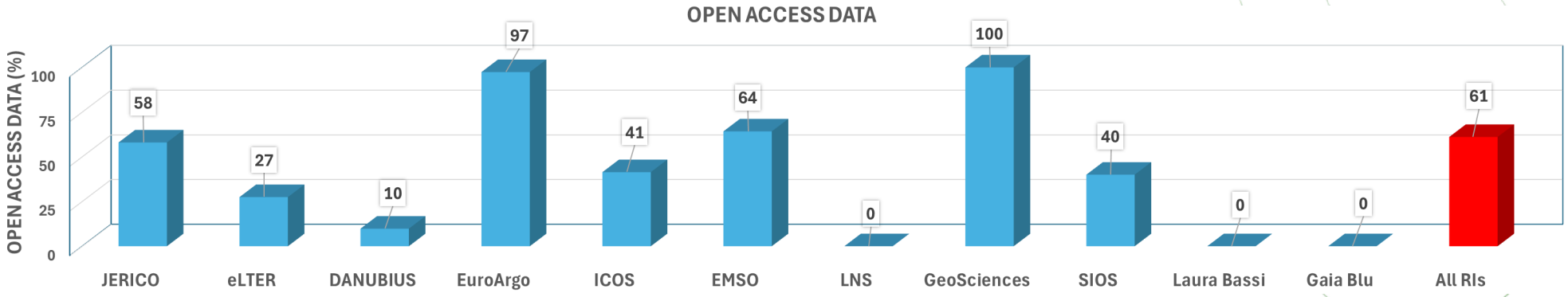


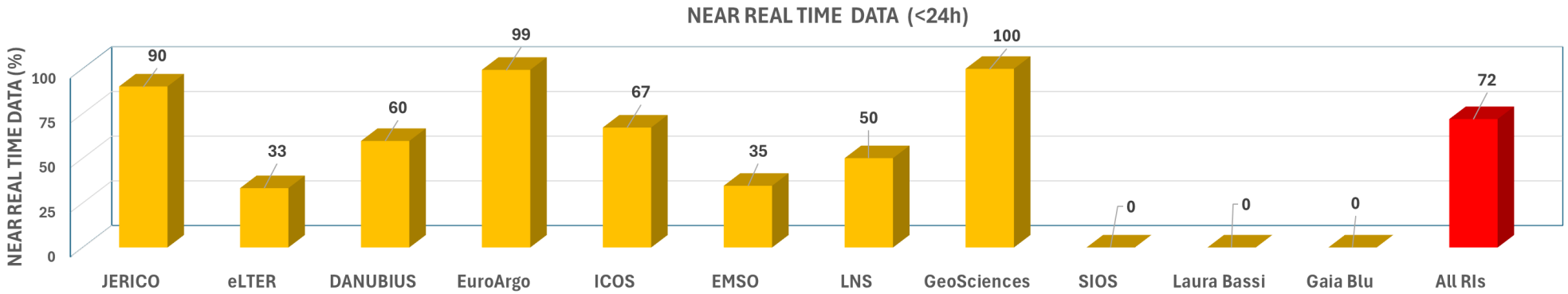




Present State Measured EOVs/ECVs	JERICO	eLTER	DANUBIUS	Euro-Argo	ICOS	EMSO	LNS	GeoSciences	SIOS
TOTAL EOVs/ECVs = 39	22	27	18	12	17	20	1	7	7
Relative RI EOVs/ECVs coverage	56%	69%	46%	31%	44%	51%	3%	18%	18%

Gap analysis:
State of the art of Data Access and Time release



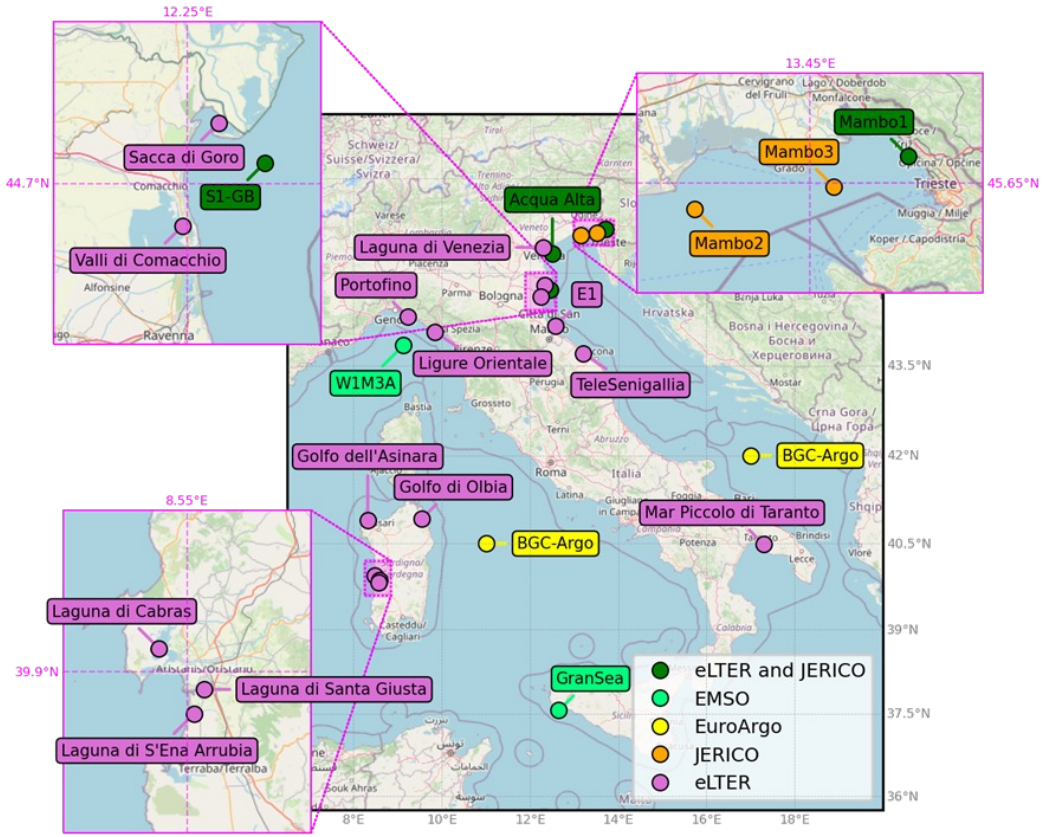


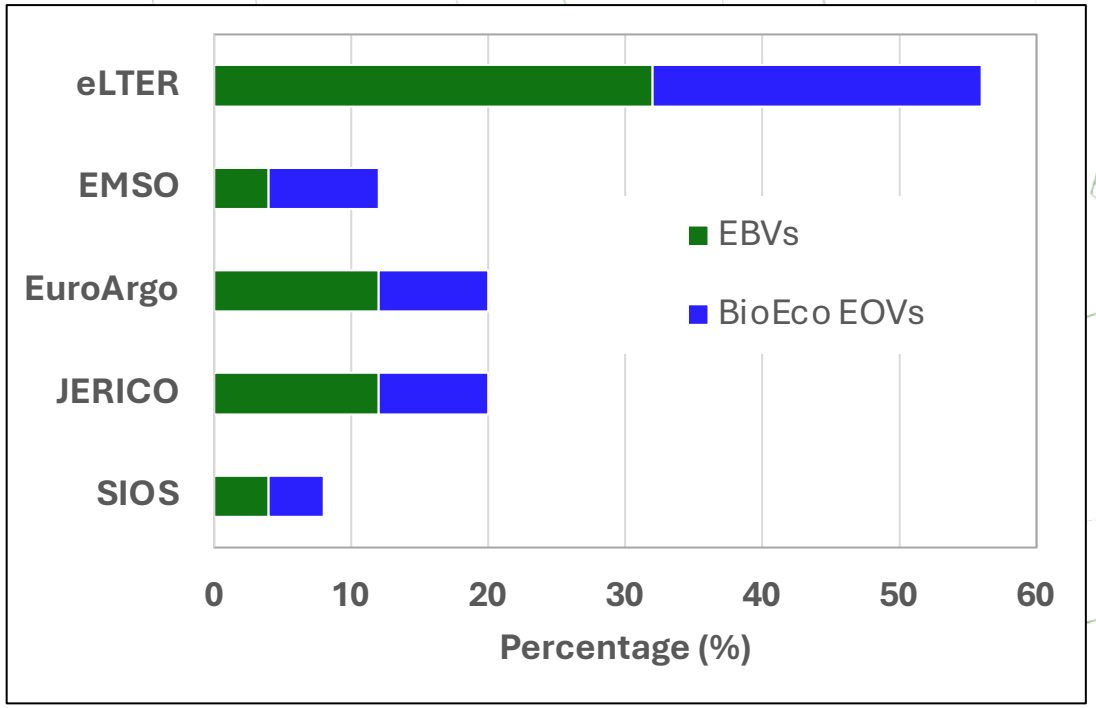
Total number of current datasets: 1412!

Method of delivery of the product	Datasets (%)
Upon request to the data owner/manager	14
Accessible on database (by link}	9
Accessible on international database (NOT OPEN)	14
Accessible on international database (OPEN)	61
Accessibile on any other national database (NOT OPEN)	1

Data release time	Datasets (%)
Real time (< 2h)	54
<24 h	18
<7 days	1
<30 days	12
<365 days	15
never	1

Gap analysis based on the state of the art in Bio EOVs & EBVs observations: All the 4 eco-RIs





Present State Measured BioEco EOVs/EBVs	eLTER	EMSo	EuroArgo	JERICO	SIOS
Total BioEco EOVs/EBV=25	14	3	5	5	2

Gap analysis outcomes & ITINERIS WP5 solutions

Gaps	ITINERIS' Solutions
Uneven distribution/Lack of observations in key oceanographic areas	**Increase of observations sites**
- Key areas for the Italian Seas are completely uncovered: coastal and offshore waters of Central Adriatic, main straits (Otranto, Sicily, Messina), coastal waters of the Tyrrhenian Sea, offshore waters of the Ionian Sea.	
- BioEco EOV and EBV, observations are located either in small gulfs and embayment or in wetlands and lagoons: lack of coverage in offshore areas.	
Poor coverage/absence of BioEco EOVs and EBVs in respect to EOV/ECV	**New acquisition and installation of BioEco instrumentation**
- Biological and ecological variables display a poorer, with a strong unbalance among RIs (dominated by the eLTER)	
- Lack of automatic observation for key biological variables (phytoplankton and zooplankton distribution and abundance).	
- Need for increasing the number of measurements for BioEco EOVs and EBVs. Specific focus needed on EOV - Biology and Ecosystems: Seagrass Coverage and Composition	
Lack of Quality Checked data	**Quality Check developed and applied to all marine dataset**
- Many dataset are not checked for quality control. Need for applying quality check on all measured EOV/ECV/EBV.	
Inhomogeneity in sampling procedures and standards	**Data and products intercalibration and intercomparison**
- Many EOV/ECV/EBV are investigated by using a wide range of different sensors, sampling procedures and analytical methods. Need for appropriate harmonization.	
- Need for an organized and near real time approach for producing FAIR data.	
Lack of automatic transmission of data	**Public availability of all marine data from a single access point**
- Need for an update through new generation sensors, allowing continuity in the data collection but increasing accuracy and reliability.	
- Need for a thorough quality check on measured EOV/ECV.	
- Specifically, data from remotely located moorings (poles, offshores areas) are collected manually and during monitoring surveys	
Lack of FAIR data	**Public availability of all marine data from a single access point**
Many data are not promptly formatted, stored and made available. Need for a common and interoperable way to access the highest amount of available data.	
Need for an organized and near real time approach for producing FAIR data.	
Time limited coverage of observations	**Ensuring continuity of observation after ITINERIS**
- A certain EOV/ECV/EBV can be investigated in limited temporal periods, lacking in continuity. Need for continuous measurements in time.	

IT-IOOS General Requirements

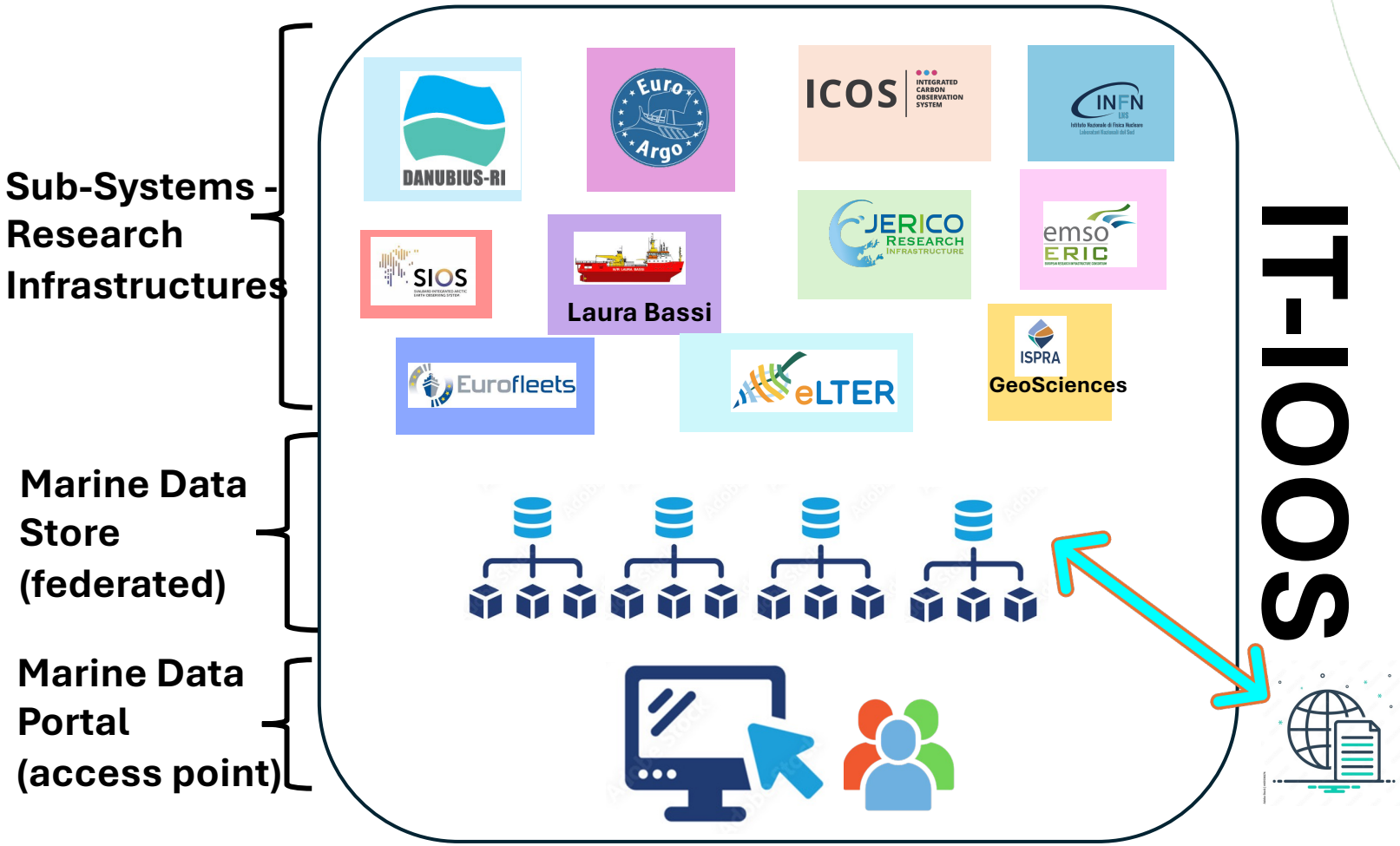
IT-IOOS design needs to be address:

- building up an integrated system of systems able to ensure continuity of data and services and to respond to user needs
- requirements regarding quality and interoperability of ocean data
- to meet the societal needs for access to ocean information
- contribute to the global ocean observation efforts
- enable Italy to better adapt to changing requirements and a changing environment
- Integrate the data collected by the Marine Domain RIs and their progressive harmonization and updates.
- Large variety of Dataset acquired from marine RIs, different platforms/systems
- Interface with ITINERIS HUB

General requirements of IT-IOOS

- Provide a **single access point** for the users to access to the entire ocean database and RIs' services
- IT-IOOS data includes **all available datasets** from: 11 RIs, ITINERIS integrated marine products, able to host additional products
- Designed as a **modular system configurable** either at system and sub-system levels
- Designed to allow any **upgrade and integration of additional sub-systems** without requiring any change of the overall system architecture.
- Apply system architecture standards

Italian Integrated Ocean Observing System (IT-IOOS): Architecture design



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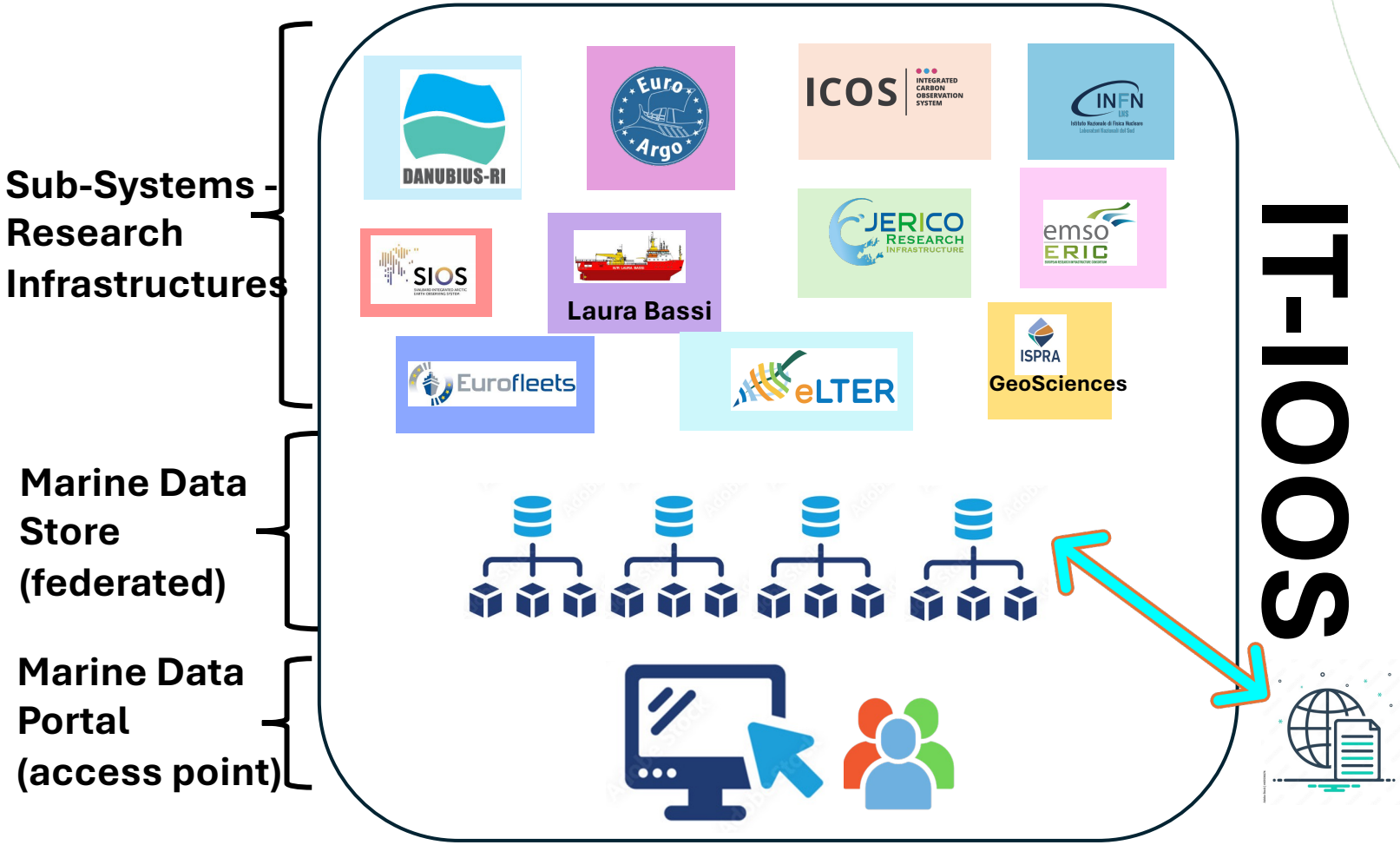


IT-IOOS key Architecture concepts

Sub-System (SS)

Building block of the system with general functions coherent with specific mission of the SS

13 sub-system: 11 SS-Research Infrastructures (PNIR) + 2 to archive (Marine Data Store) and access to data and services (Marine Data Portal)

Component

part of the sub-system, with specific modules responding to requirement of the sub-system.

Have also coordinating functions for the production units

Production unit

It is the segment of the component or of the SS responsible for the data production and management (acquisition data, data processing, quality, etc.)

Internal interfaces

Nodes connecting two or more ITINERIS Marine Domain SS.

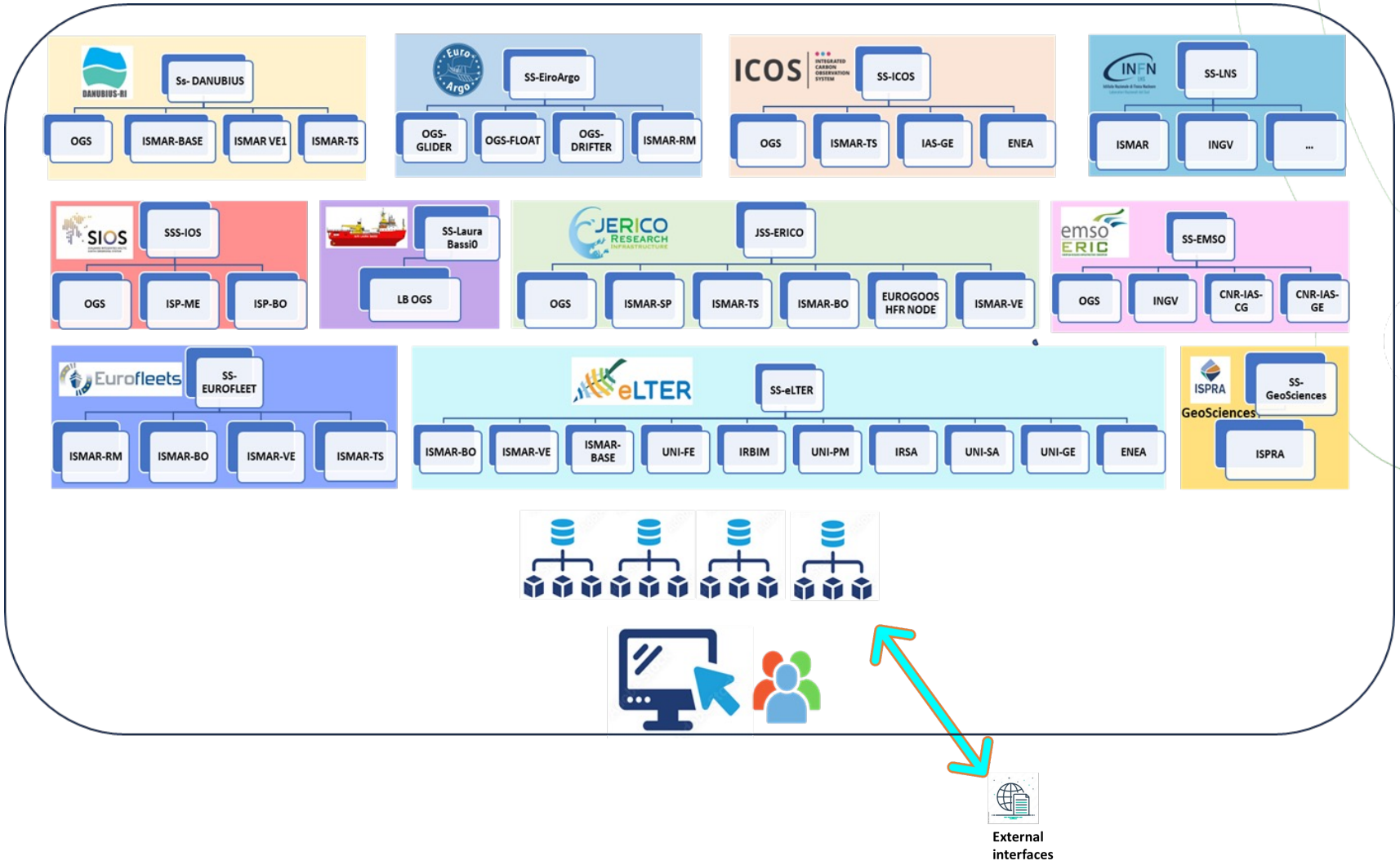
External interfaces

External the source of data (not part of ITINERIS) used by the SS for its operations.

Federeted archive

IT-IOOS marine data and services are stored in geographically widespread and federated archives belonging to the Ris.

IT-IOOS: Sub-Systems architecture



IT-IOOS Sub-System requirements

Every sub-system has to satisfy specific requirements about the data information, acquisition, management and storage.

- Providing and updating **info about the data and metadata** (SSR-01, SSR-09)
- **Acquiring data** (manually or automatically, SSR-02)
- Performing **processing** and **quality control** of data, metadata and files format (SSR-03, SSR-04, SSR-06)
- **Archiving and back-uping data** for at least 10 years
- Providing an **end-point** for a data harvesting form the Marine Data Store (SSR-08)

IT-IOOS Architecture: SS & Components & PUs

IT-IOOS key concepts

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IT-IOOS key numbers

N° Sub-Systems:	11+2
N° Components:	32
N° PUs:	51
N° Internal Interfaces:	5
N° External Interfaces:	6
N° Archives (federated):	14+1
N° Datasets to integrate:	1412

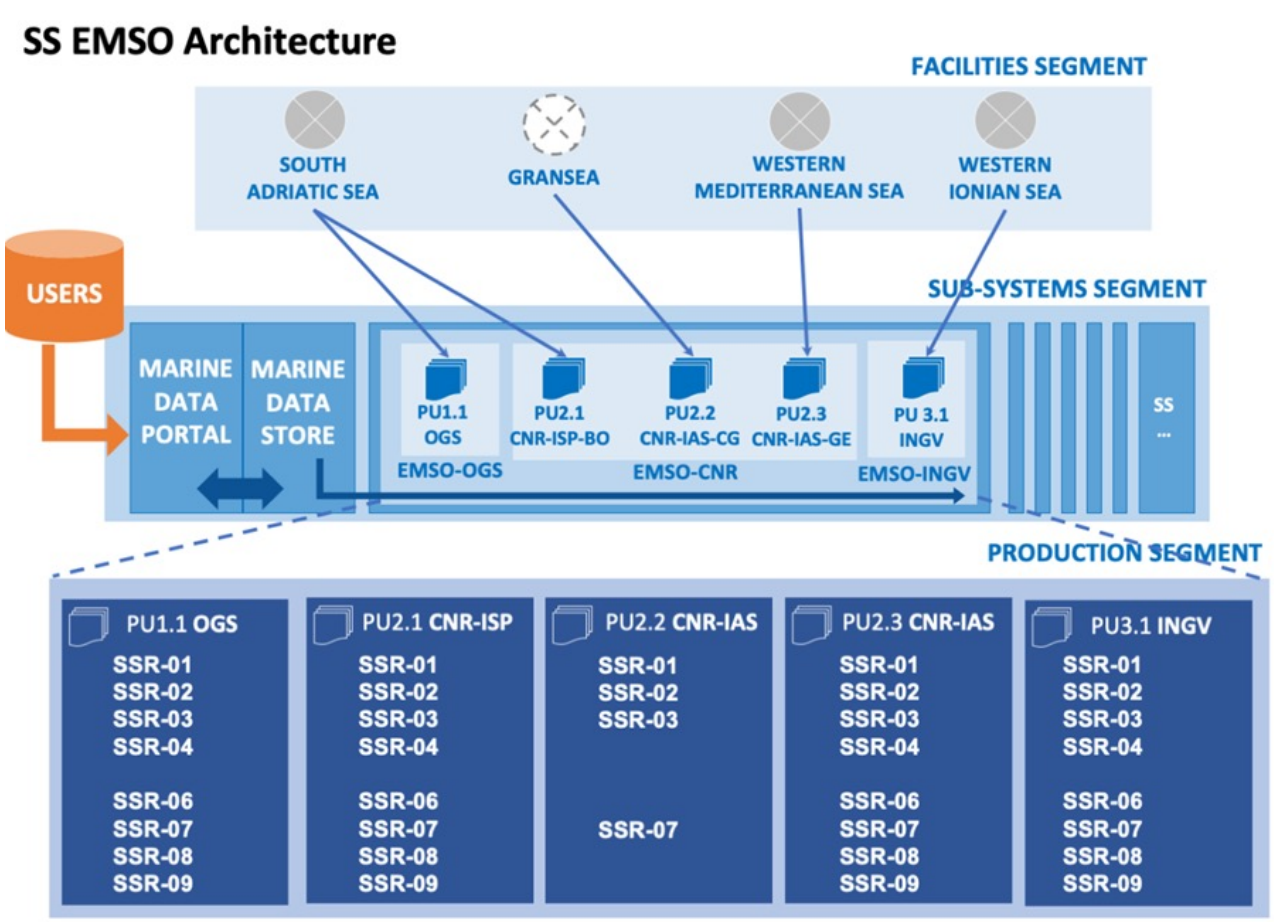
Federated Archives
LNS
IADC
OGS NODC
CNR ISMAR RM
CNR IAS
INGV
ISP BO
ISMAR
OGS NODC
ISPRA
IRBIM
UNI-GE
UNI-FE
ENEA
N° Fed Arch
14

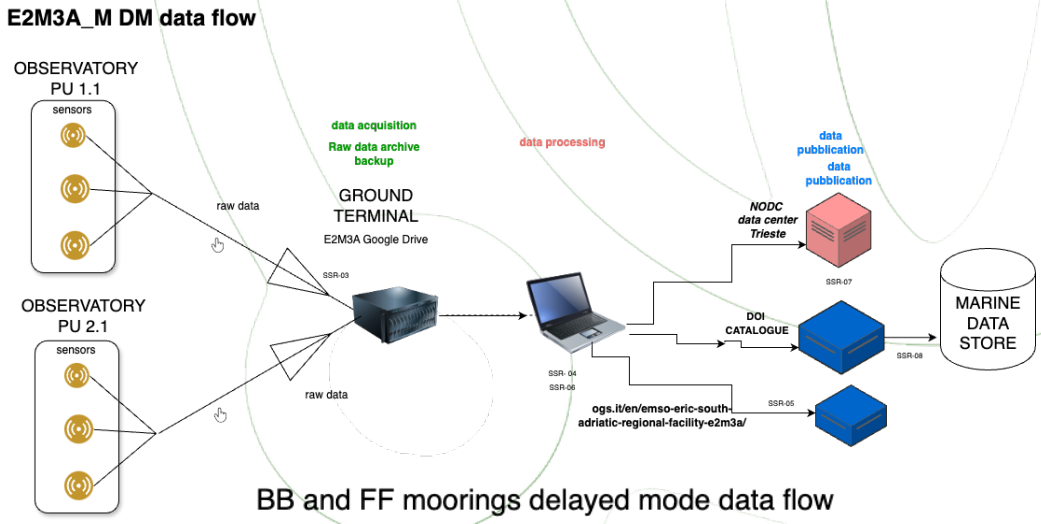
External Interfaces
ICOS CARBON PORTAL
GDAC IFREMER
CORILA
EMODNET
COPERNICUS MARINE
SEADATANET
N° Ext Interf
6

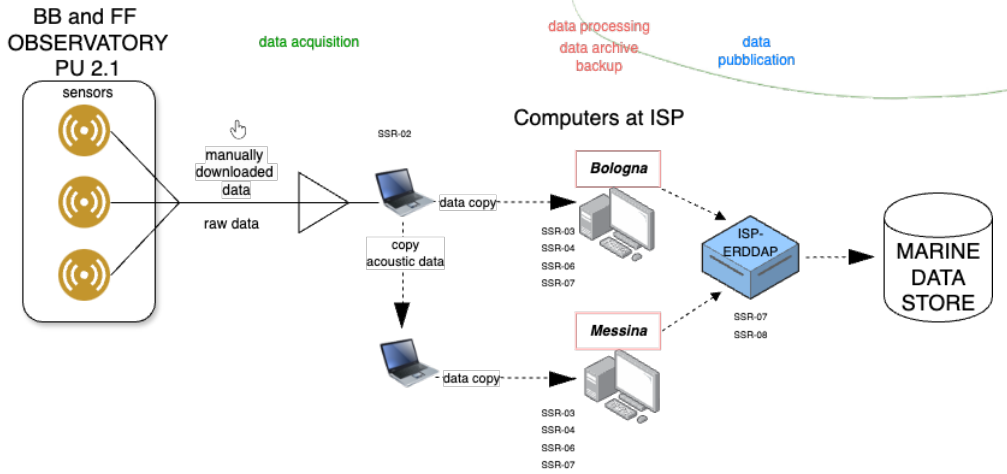
Internal Interfaces
LNS-EUROFLEET
LNS-EMSO
DANUBIUS-eLTER
DANUBIUS-JERICO
JERICO-e-LTER
N° Int Interf
5

SS	Coordinator	Components	PU/ Component	N° Comp	N° PU
DANUBIUS	CNR-ISMAR	DANUBIUS-ISMAR	ISMAR-VE1	3	5
			ISMAR-BASE		
			ISMAR-BO		
			ISMAR-TS		
		DANUBIUS-OGS	DANUBIUS-OGS		
		ARCHIVE-ISMAR NA			
eLTER	CNR-CNR-ISMAR	eLTER-ISMAR	ISMAR-VE	9	11
			ISMAR-BASE		
			ISMAR-BO		
		eLTER-ENEA	eLTER-ENEA		
		eLTER-CNR-IRBIM	eLTER-CNR-IRBIM		
		eLTER-CNR-IRSA	eLTER-CNR-IRSA		
		eLTER-UNI-GE	eLTER-UNI-GE		
		eLTER-UNI-SA	eLTER-UNI-SA		
		eLTER-UNI-PM	eLTER-UNI-PM		
		eLTER-UNI-FE	ParcoPo		
		eLTER-UNI-FE	eLTER-UNI-FE		
EMSO	INGV	EMSO-CNR	IAS-GE	3	5
			IAS-CG		
			ISP-BO		
		EMSO-OGS	OGS		
		EMSO-INGV	INGV		
EuroArgo	OGS	EuroArgo-OGS	OGS-FLOAT	2	4
			OGS-GLIDER		
			OGS-DRIFTER		
		EuroArgo-Ismar-RM	ISMAR-RM		
EUROFLEET	CNR-ISMAR	GAIA BLU ACQUISITION HOST	GAIA BLU ACQUISITION HOST	3	6
		EUROFLEET-ISMAR ARCHIVE	EUROFLEET-ISMAR ARCHIVE		
		EUROFLEET-PRODUCTION	ISMAR-TS		
			ISMAR-BO		
			ISMAR-RM		
			ISMAR-VE		
GEOSCIENCES	ISPRA	ISPRA	ISPRA	1	1
ICOS	OGS	ICOS-CNR	ISMAR-TS	3	4
			IAS-GE		
		ICOS-OGS	OGS		
		ICOS-ENEA	LAMPEDUSA		
JERICO	CNR-ISMAR	EUROGOOS HFR NODE	EUROGOOS HFR NODE	3	7
		JERICO-ISMAR	ISMAR-SP		
			ISMAR-BO		
			ISMAR-TS		
			ISMAR-VE		
			ISMAR-RM		
		JERICO-OGS	JERICO-OGS		
LAURA BASSI	OGS	LAURABASSI-RV	LAURABASSI-RV	2	2
		LAURABASSI-OGS	LAURABASSI-OGS		
LNS	INFN	LNS-INFN	INF-CA	1	1
SIOS	CNR-ISP	SIOS-PRODUCTION	CNR-ISP-BO	2	5
			CNR-ISP-ME		
			OGS		
		SIOS-ARCHIVE	CNR-ISP-BO		
			CNR-ISP-ME		
N° SS				N° Comp	N° PU
11				32	51

Example of an operational Sub-System: EMSO

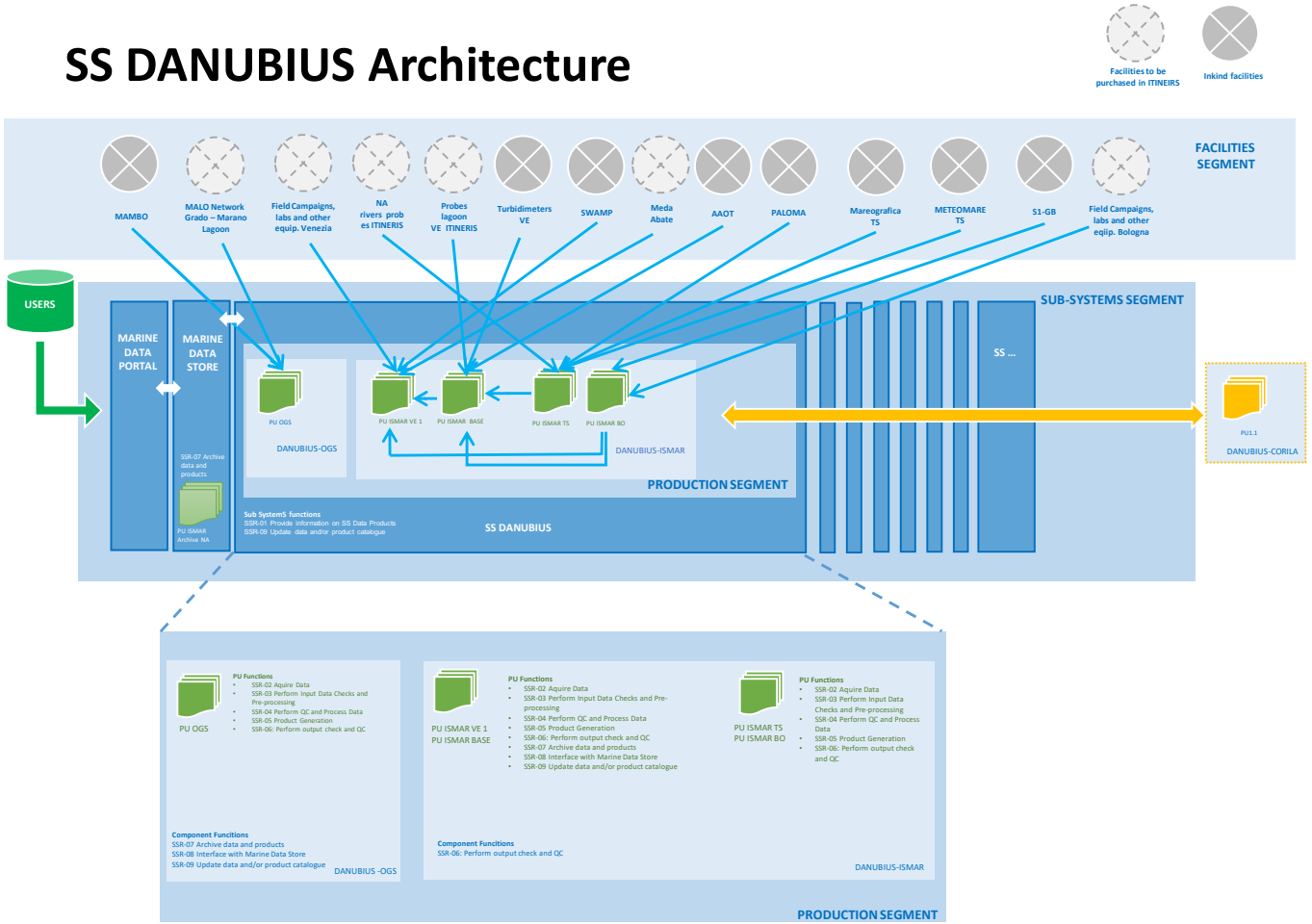


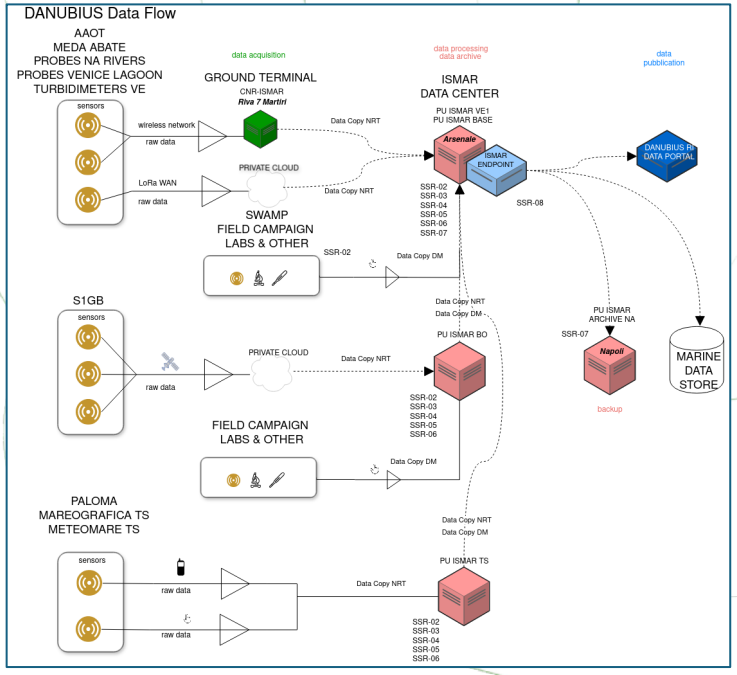


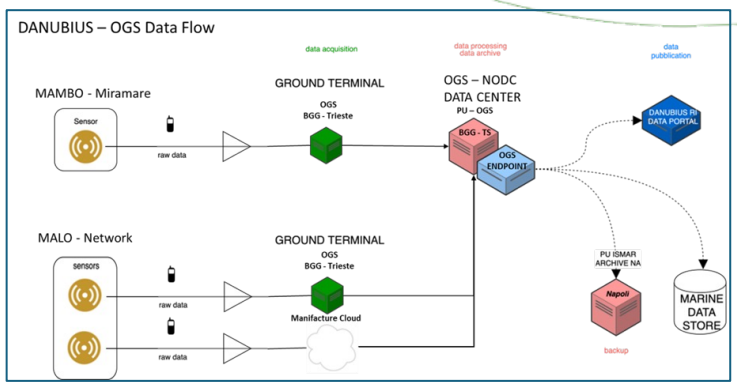


Example of a Sub-System under development : DANUBIUS

SS DANUBIUS Architecture

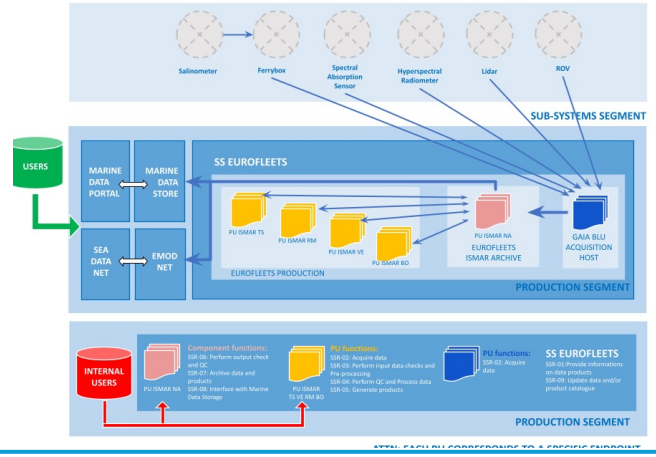


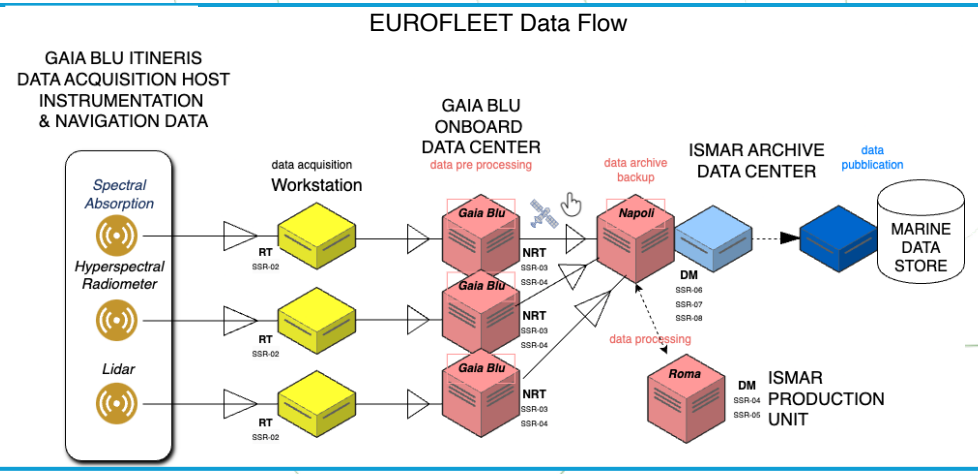




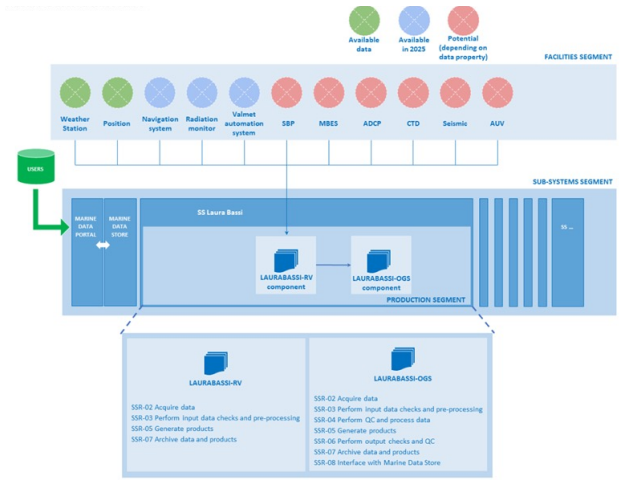
Research vessels SS: Gaia Blu and Laura Bassi

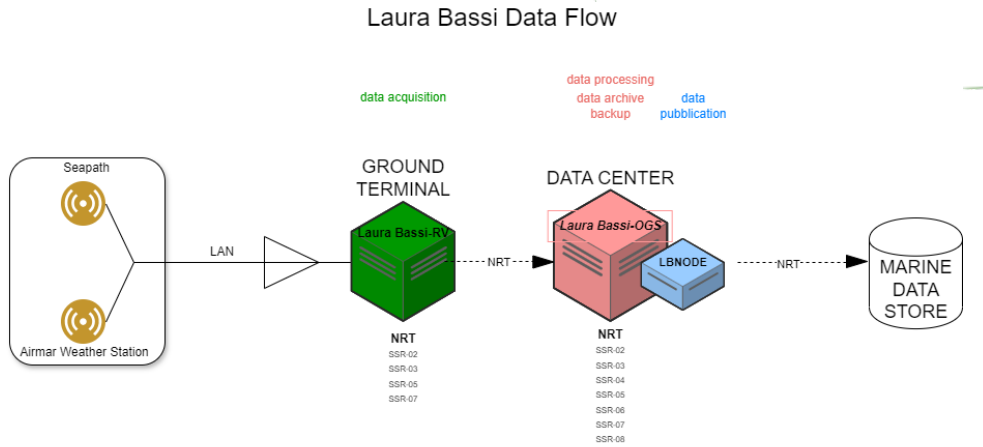
Architercture desing of SS EUROFLEET (Gaia Blu)





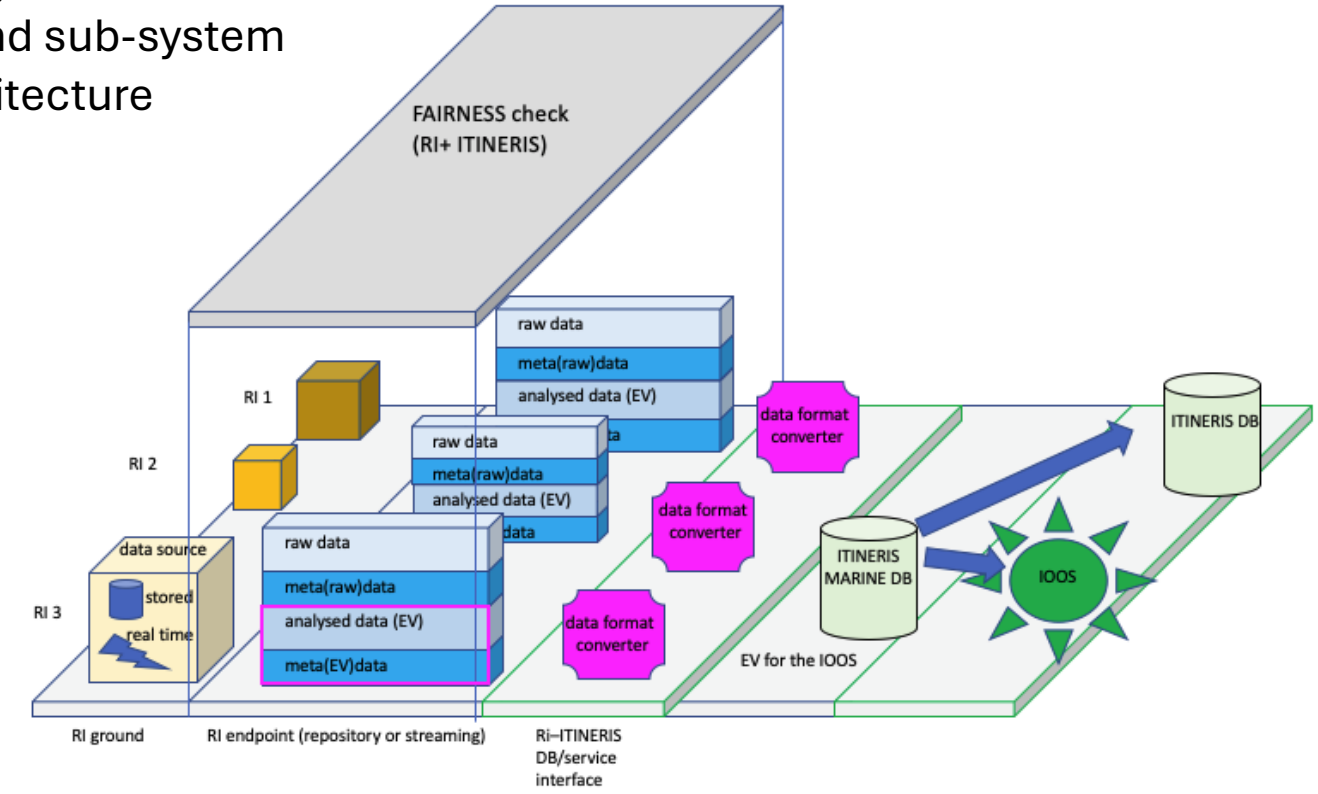
Architercture desing of SS Laura Bassi



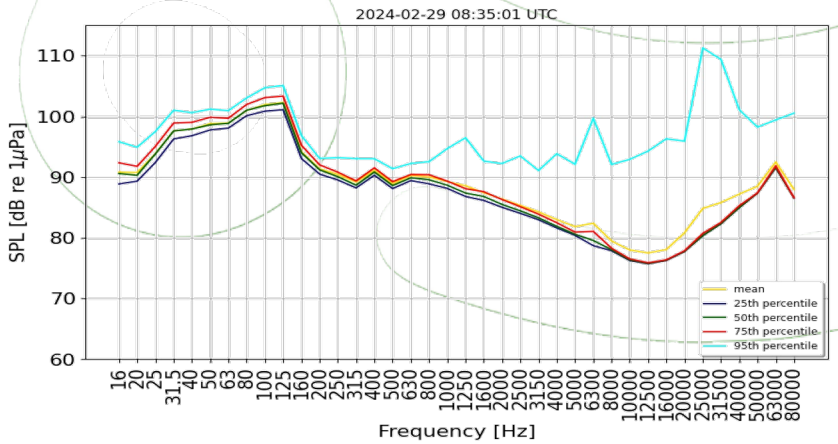


Acoustic SS designed for the first time by ITINERIS

Integrated EOV Ocean Sound sub-system architecture

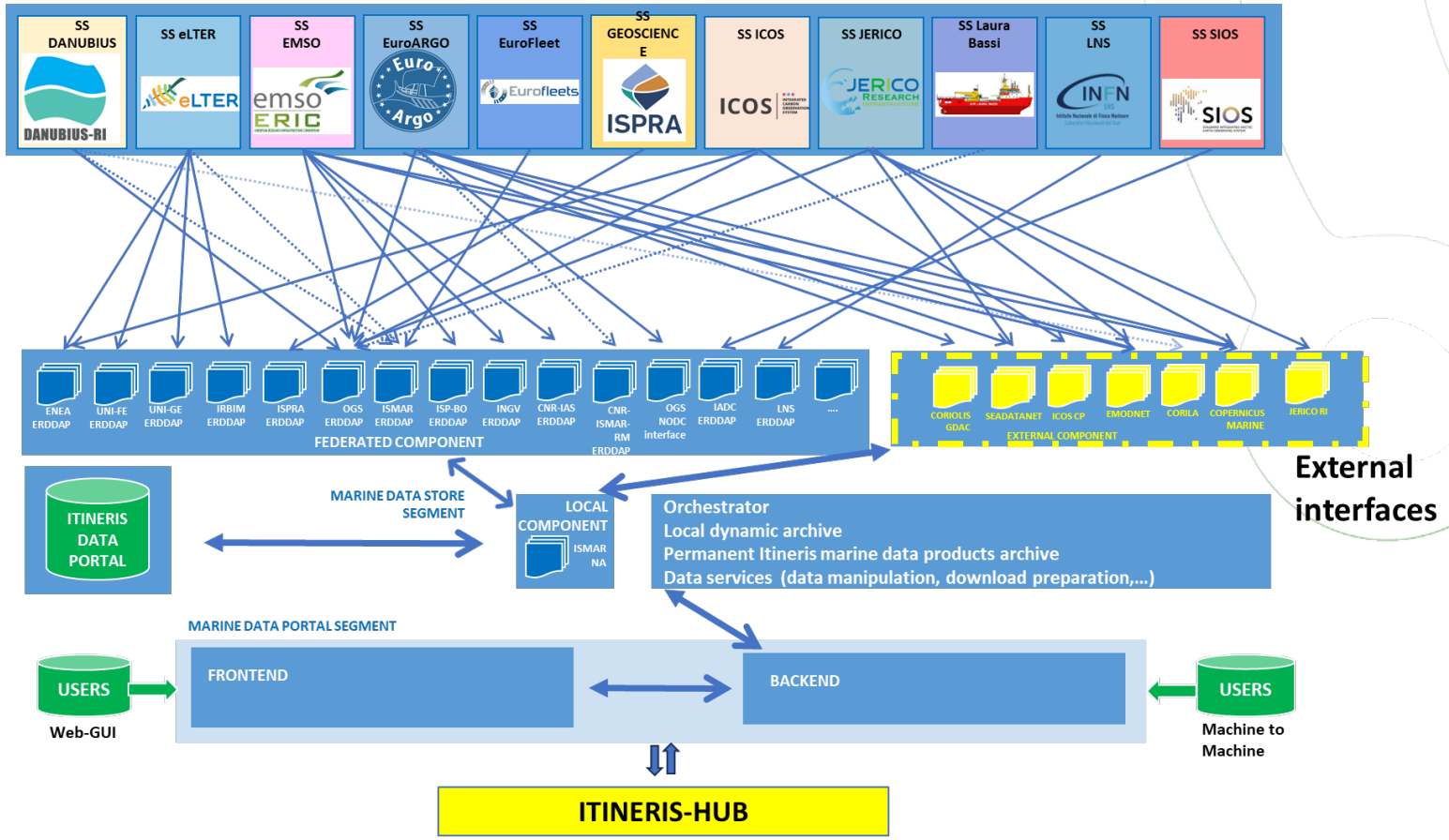


Harmonize ocean sound data and products of the different RIs and build SS
Development of the subsystem for the measurement of the Sound Pressure Level in the open sea.



Example of data production with hydrophones at 3500m at Capo Passero: Sound Pressure Level (SPL)

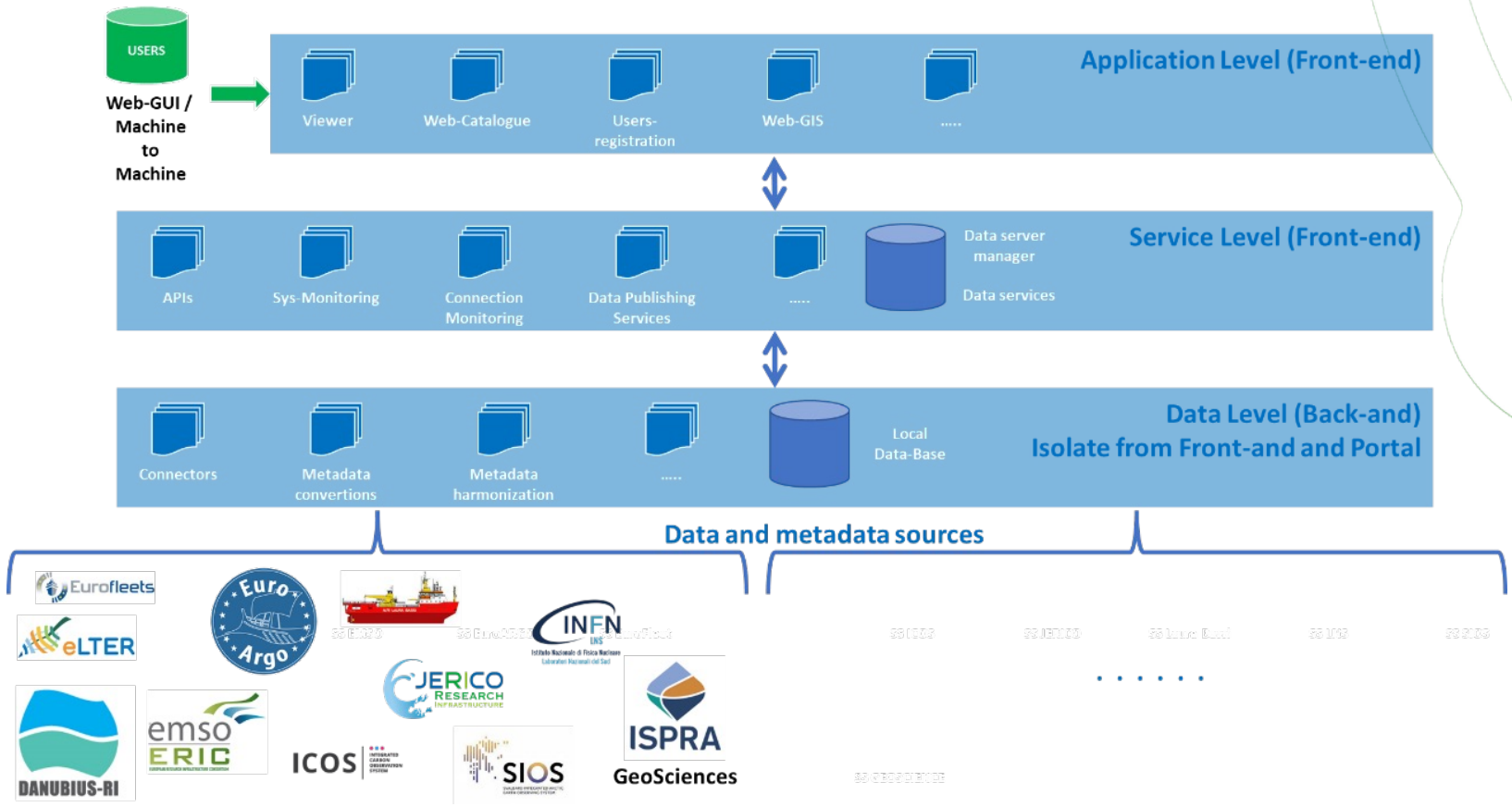
Marine Data Store Architecture



Key requirements of Marine Data Store

- Physically storing data and metadata.
- Connecting to a federated system.
- Providing data and metadata to WebGUI through backend operations.
- Cataloguing data from other data stores for access and distribution.
- Providing tools to buildup statistics

Marine Data Portal



Key requirements of Marine Data Portal

- User registratiom & support
- Provide e Project & product information
- Display product catalogue
- Search for data/products & services
- Visualization/sub-setting & download of data & products
- Display statistical information on user access search and downloads

IT-IOOS metadata catalogue for data and facilities

- The Marine Data Portal will use **CKAN** to publish, share and use ITINERIS data.
- CKAN is an **open-source data management system** for powering data hubs and data portals.
- One **CKAN dataset** will contain all measurements acquired (in situ data) or produced (in generated) by Marine Domain within each IT-IOOS Sub-system produced in real-time or in delayed mode (new data and old data series).

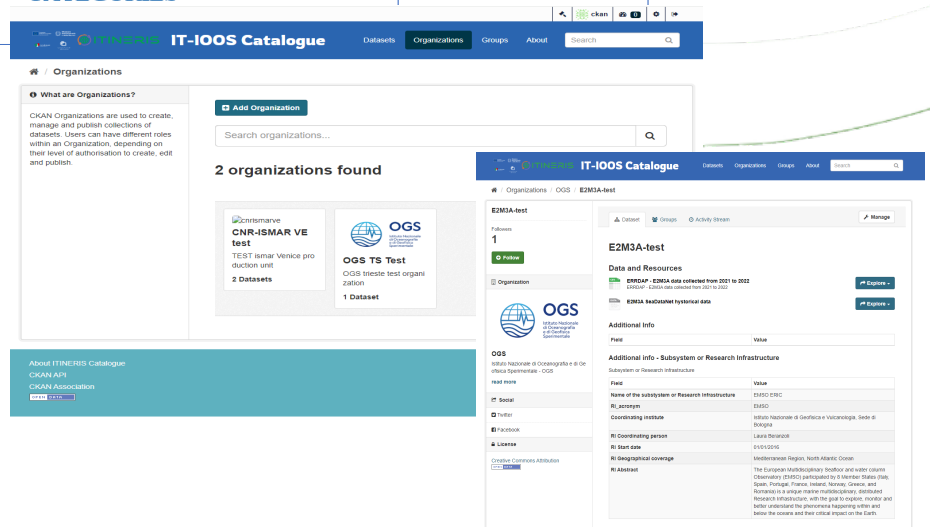
Metadata related to the Sub-system

ITINERIS Metadata	*Description or SeaDataNet reference (EDIOS & vocabs)*	*Mandatory / Optional*
Name	Name of the Subsystem or Research Infrastructure	M
RI_acronym		M
RI Coordinating institute	Coordinating institute, EDMO reference	M
RI Coordinating person	Principal Investigator (Name/Names, free text)	O
RI Start date	Program Start date	M
RI Geographical coverage	Sea-areas C19 - SEAVOX SALT AND FRESH WATER BODY GAZETTEER	M
RI Abstract	Abstract	O

Metadata related to the Facility or Observation Platform:

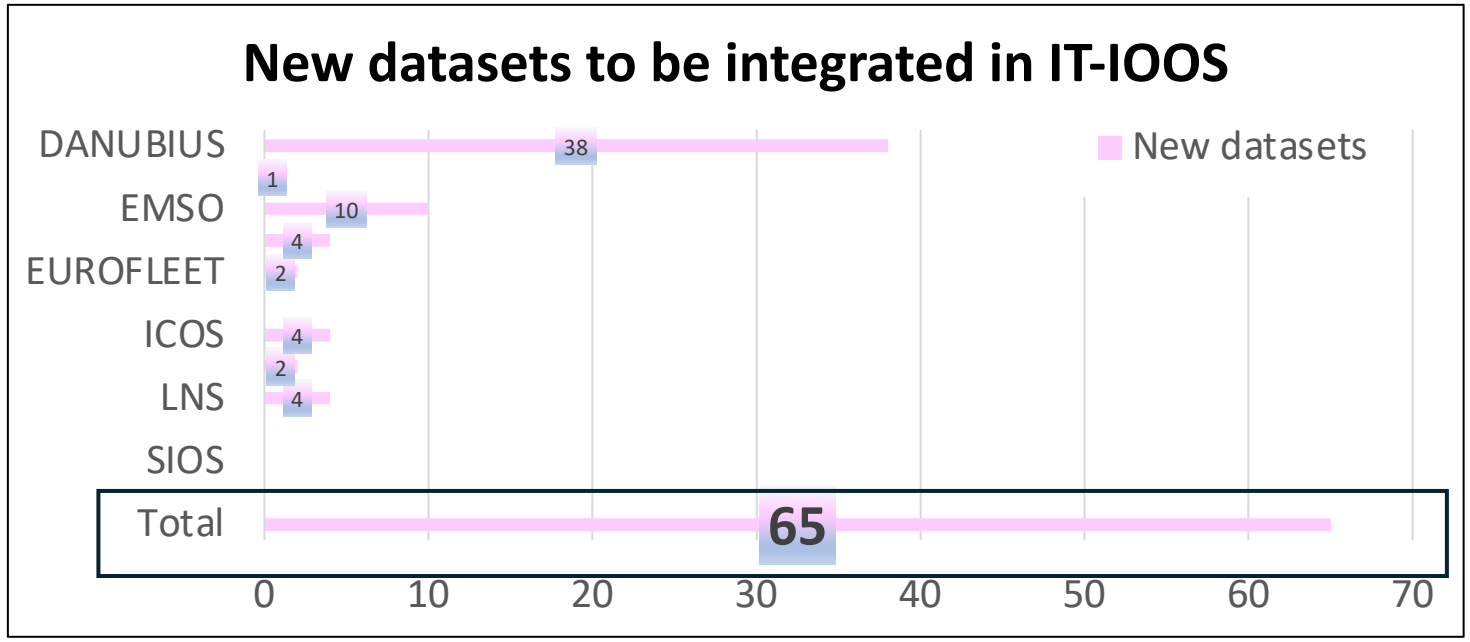
ITINERIS Metadata	*Description or SeaDataNet reference (EDIOS & vocabs)*	*Mandatory / Optional*
Operating facility name	Platform Name, free text	O
Type of platform (RV, float, offshore structure, fixed benthic node, …)	Platform class L06 - SEAVOX PLATFORM CATEGORIES	M

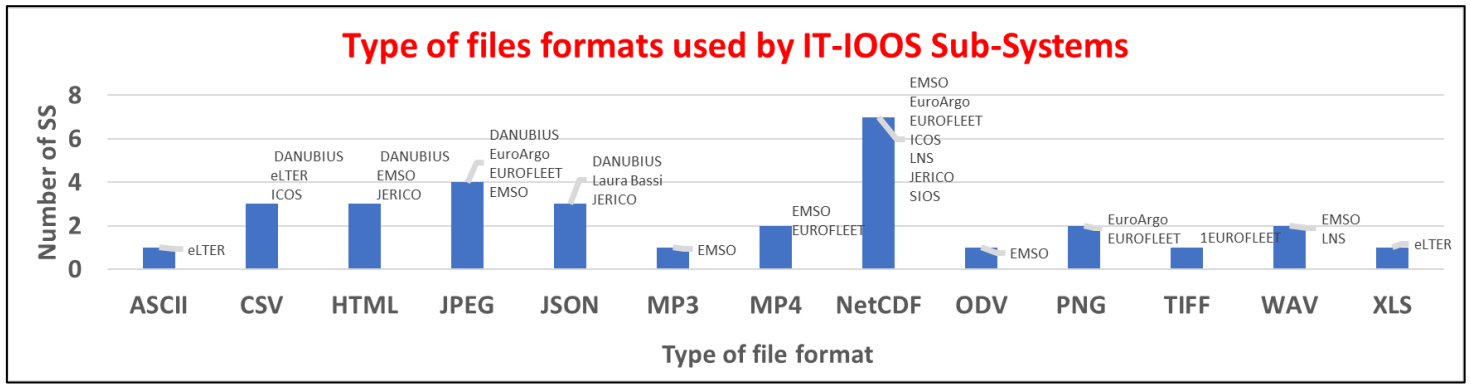
Test enriroment to develop of the IT-IOOS Catalogue has been started



Metadata of the Dataset

IT-IOOS Catalogue





Subsystem or Research Infrastructure		
ITINERIS Metadata	Description or SeaDataNet reference (EDIOS & vocabs)	Mandatory / Optional
Name	Name of the Subsystem or Research Infrastructure	M
RI_acronym		M
RI Coordinating institute	Coordinating institute, EDMO reference	M
RI Coordinating person	Principal Investigator (Name/Names, free text)	O
RI Start date	Program Start date	M
RI Geographical coverage	Sea-areas C19 - SEAVOX SALT AND FRESH WATER BODY GAZETTEER	M
RI Abstract	Abstract	O
Facility or Observing platform:		
Operating facility name	Platform Name, free text	O
Type of platform (RV, float, offshore structure, fixed benthic node, …)	Platform class L06 - SEAVOX PLATFORM CATEGORIES	M
Dataset		
Dataset Name or **Resource title**	Original title of the dataset, free text	**M**
Dataset originator or **Organization**	EDMO reference	**M**
Dataset originator, person	Free text	O
Type of device (meteorological packages, sediment traps, Ocean models, …)	Instrument class L05 - SEADATANET DEVICE CATEGORIES	M
Instrument (RM Young 32500, Sea-Bird SBE 911 CTD…)	Instrument code L22 - SEAVOX DEVICE CATALOGUE	O
Discipline	P08 - SeaDataNet Parameter Disciplines	M
Parameters group	P03 - SeaDataNet Agreed Parameter Groups	M
Discovery parameter	List of variables, P02 - SEADATANET PARAMETER DISCOVERY VOCABULARY	M
Temporal extent	Dataset Date and Time or time domain - Start date	M
Data type (NRT/DMT)		M
Spatial extent	Dataset Latitude, longitude or spatial domain - Geographic coverage (bounding box)	M
Coordinate reference system	Coordinate reference system	M

Objective 3 - Expand capability of NRT ship-based ocean observations
Contributing RIs: EUROFLEETS, Laura Bassi

The aim is to expand the Italian capacity to acquire and make available in near real time (NRT) physical, biogeochemical and geological ocean variables providing highest accuracy measurements obtainable only with research ships.

How:

- **Design the Italian contribution** to the international **research fleets** effort **on full-depth, NRT continous measurements from coast-to-coast ;**
- **Acquisition & installation of autonomous systems** on board of Italian research ships: Laura Bassi & Gaia Blu;
- **Development of systems for NRT data quality control and data transmission from RV to the Italian IOOS Marine Data Store;**
- Definition of the procedures for **data policy and access to fleets NRT observations;**
- **Adaptation of the procedures in order to guarantee FAIR data release.**

On-board location

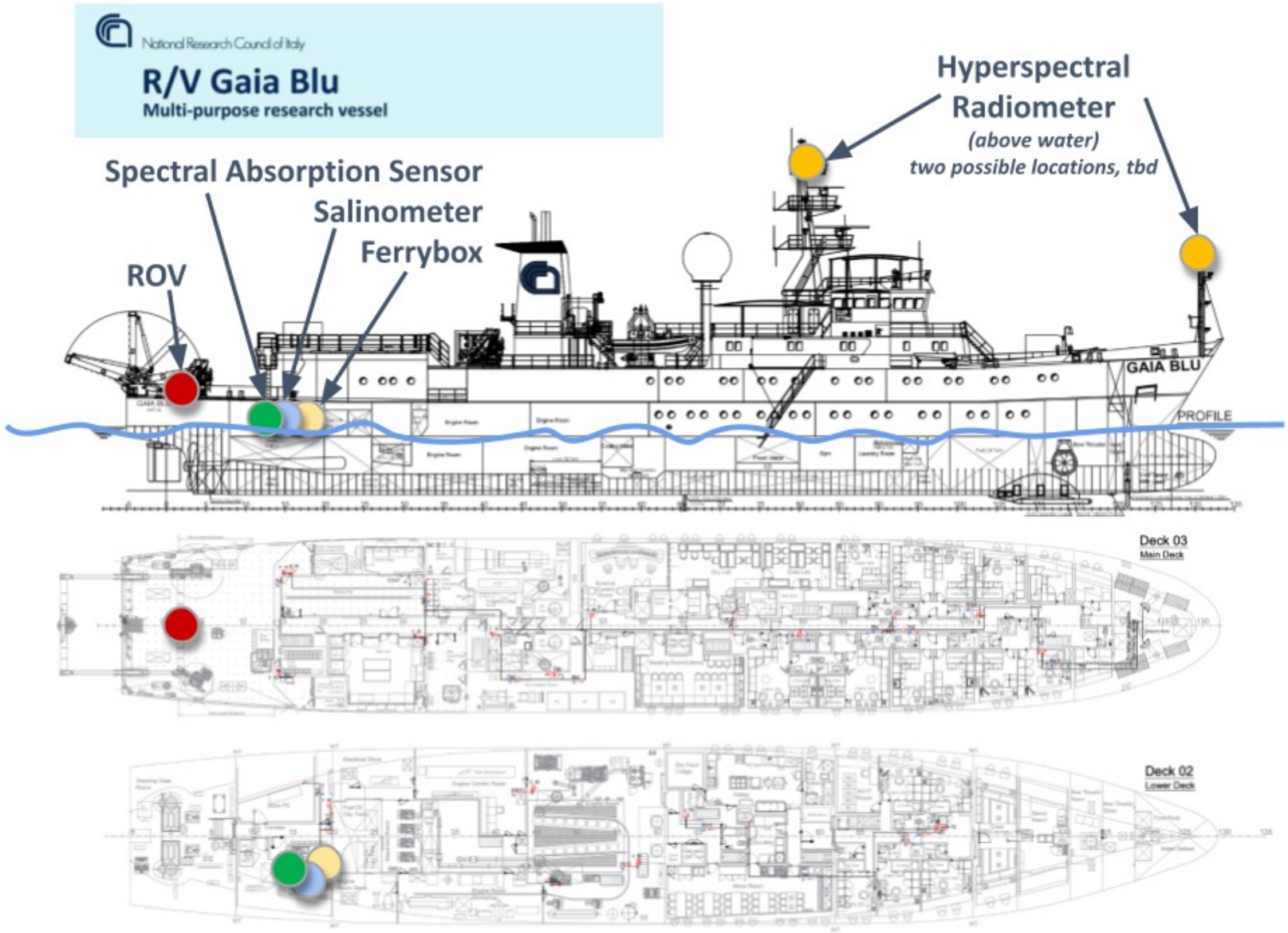
Contract Negotiation Phase: June 2024 - September 2024

Definition of Delivery Timelines: December 2024

Installation Phase: January 2025 – March 2025

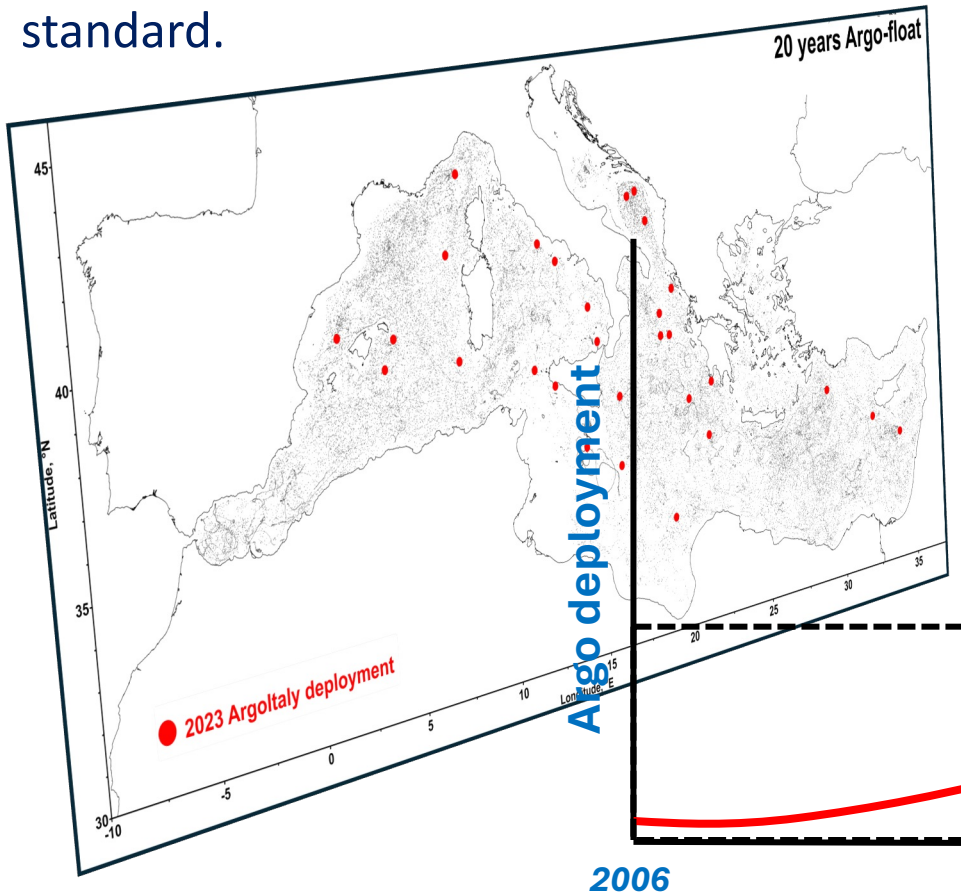
Compliance Verification: March 2025

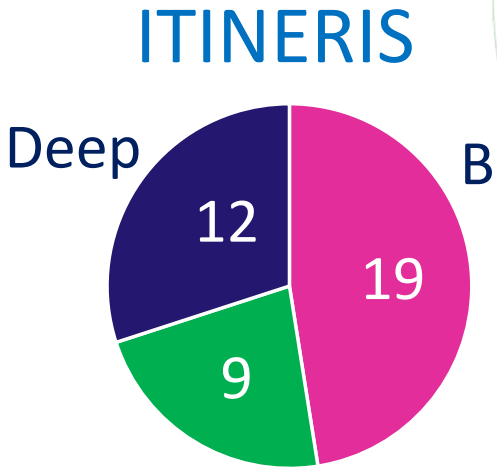
Staff Training Program: April 2025

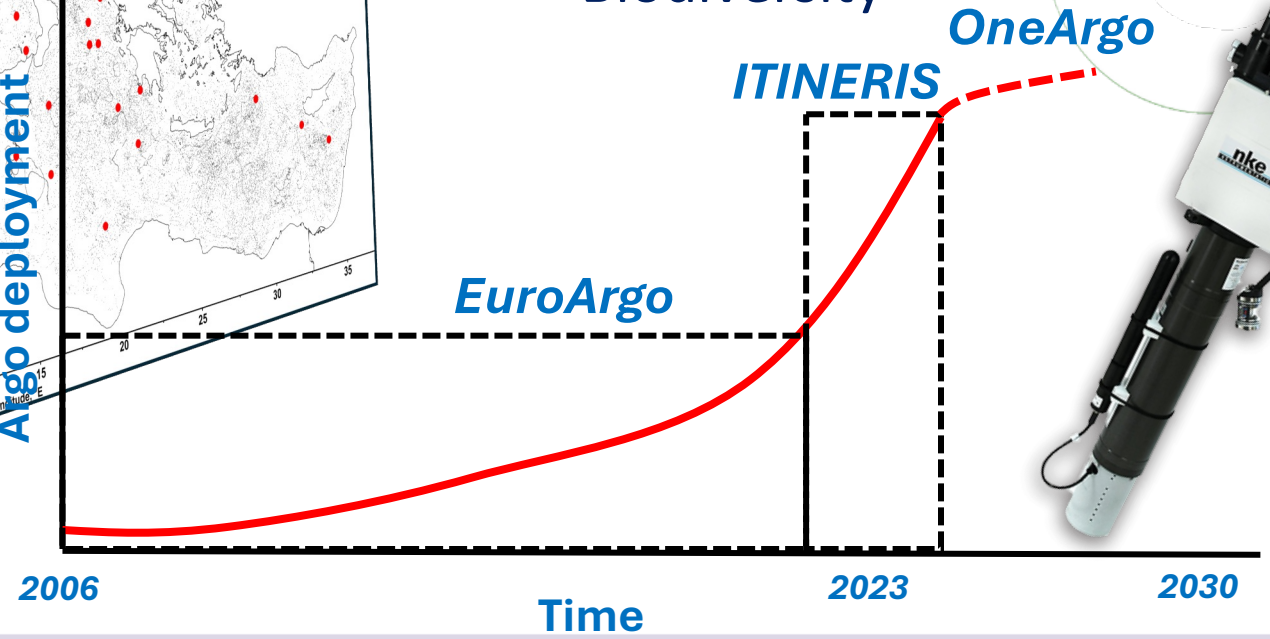


ITINERIS' contribution to EuroArgo improvemen

ITINERIS increased the number of **Argo floats** in the **Mediterranean Sea,** laying the settings for **getting** to the **OneArgo** world standard.







Argo values

- fundamental ocean research;
- new dimensions of climate assessment;
- educational engagement;
- improved long and short-term ocean, climate and ecosystem state estimates and forecasts.

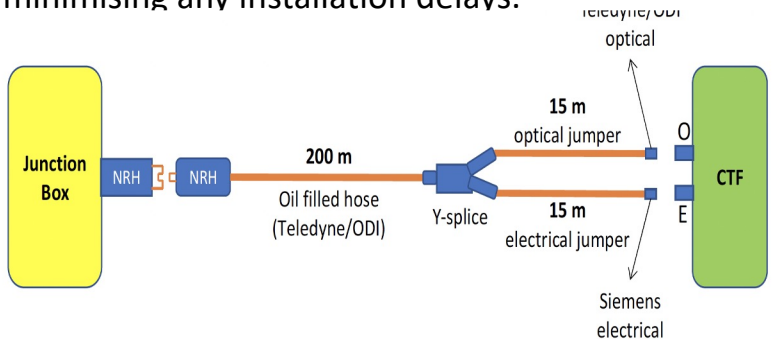
Technological Innovations:

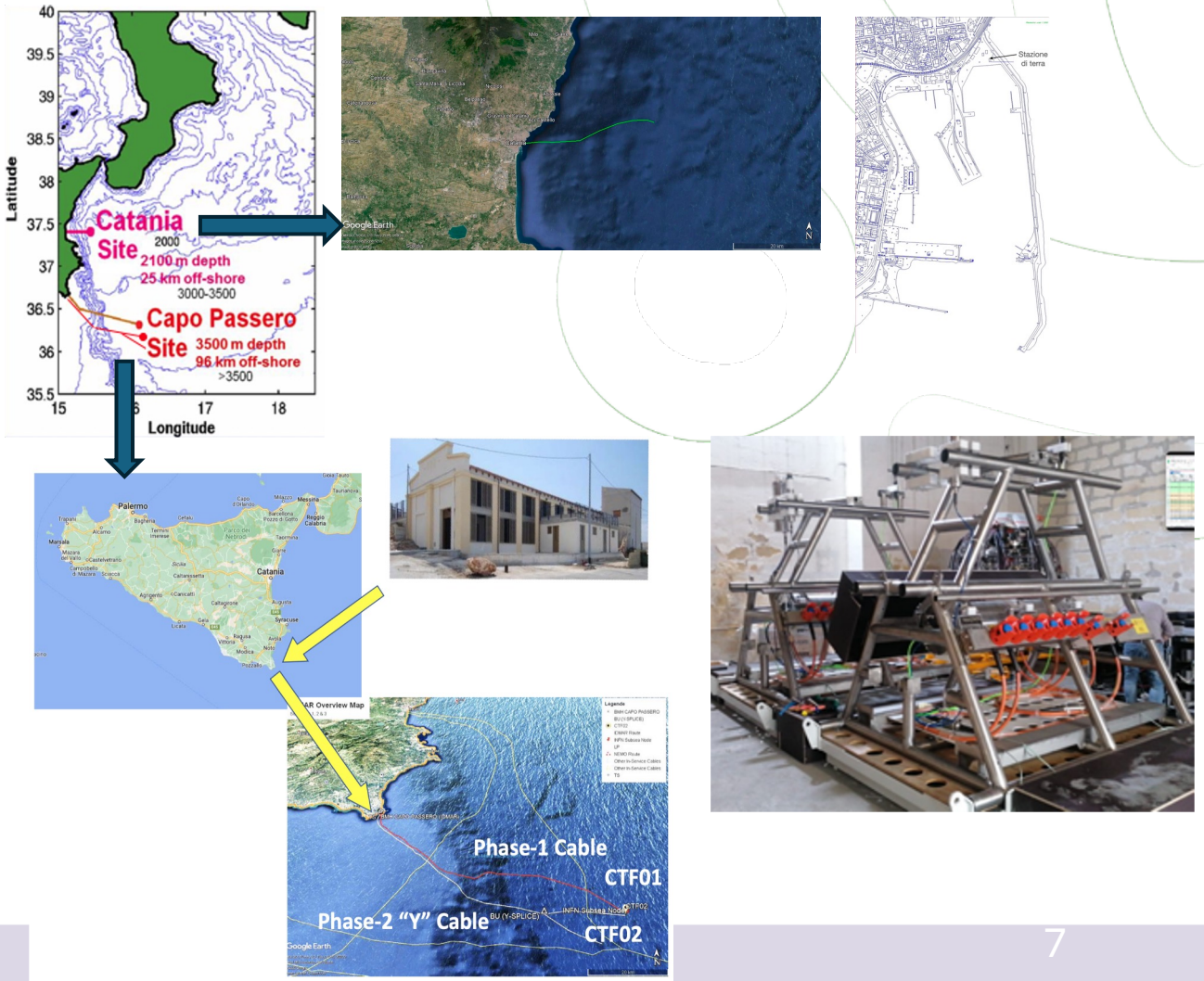
Improving float lifetimes;
New sensors:
Nitrate (sensor testing);
Hyperspectral radiometry;
Underwater vision profiler;
Passive acoustic driven mission.

Design of Submarine Junction Box installation and procurement

Design, construction and testing of a new submarine Junction Box (JB) that will be installed at a depth of about 3500 m off Capo Passero

- Identifying the optimal route for the submarine electro-optical cable system, the optimal site for the landing point.
- Power distribution and optical links to new observation stations of the underwater environment.
- Ground connection with two electro-optical cables (MEOC) of almost 100 km that allow power and data to be distributed to different instruments and sensors.
- Key criteria for selection: safety, economy, and minimising any installation delays.





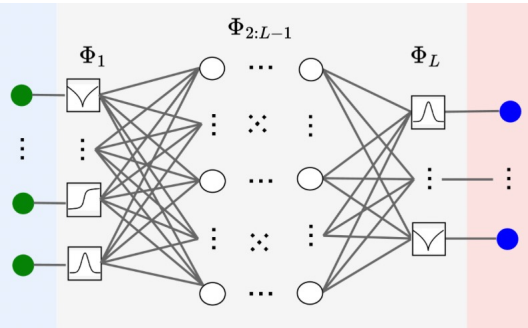
Prototype models for data-driven reconstruction of the ocean state

Reconstruction of vertical profiles from surface data with innovative AI-tools

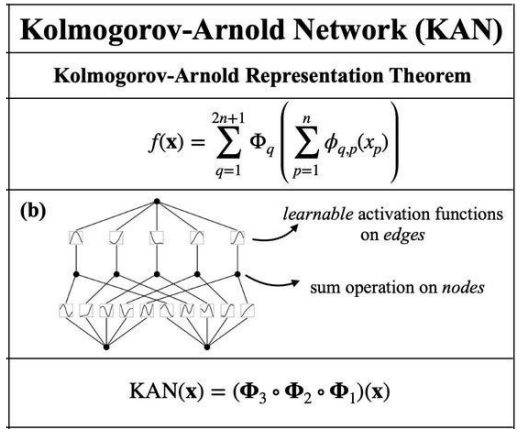
***Della Cioppa**, Sammartino, Buongiorno Nardelli*

- training/validation/test dataset prepared within ESA-4DMED project starting from available i data
- **ITINERIS: implemented completely new algorithm based on *Kolmogorov-Arnold Netwo***

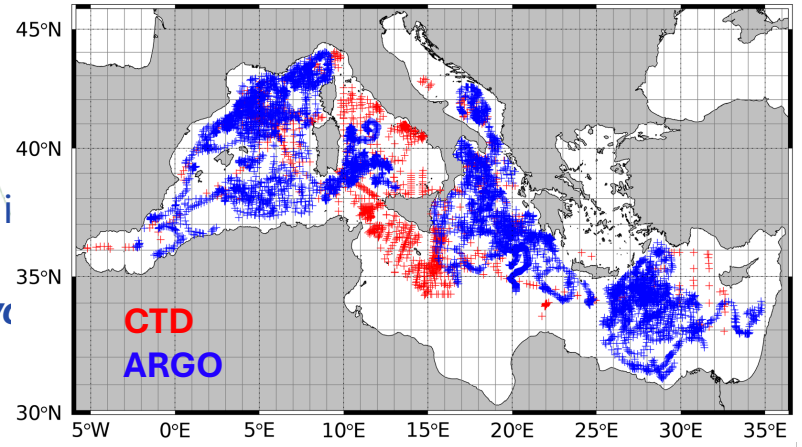
Predictors
• Day of year (sin,cos)
• Latitude
• Longitude
• SSS/S(0)
• SST/T(0)
• CHL/OWP
• ADT
• Ugos
• Vgos

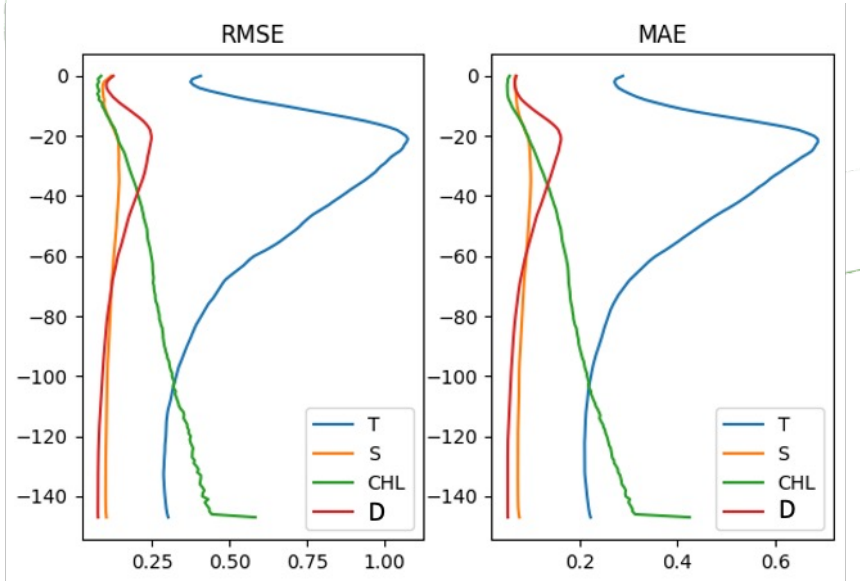


Target
• Temperature Profile
• Salinity profile
• Density profile
• Chlorophyll profile



→Objective to reconstruct full 4D timeseries starting from improved 2D data





Liu, Z. *et al.* (2024), https://doi.org/10.48550/arXiv.2404.19756

Project achievements in numbers at Bimester 9

- Total number of hired personnel: **42**
- Contractualized purchases: **13.093.825 €**
- Reported purchases: **2.765.097 €**
- Number of deliberable released: **10**
- Number of pubblications: **1**
- Number participation to conferences/congresses/workshops: **8**
- Number of outreach activities: **2**

Conclusions

- The gap analysis has been completed and allowed us for the first time to have a complete picture of the observations prodived by the 11 RIs participating to the marine domain

- The design of the system architecture of the Italian Integrated Ocean Observing System has been completed. For each RI sub-system the detailed architecture and the data flow have been defined.

- The requirements and the design of the IT-IOOS Marine Data Store, Marine Data Portal and Data Catalogue have been completed and texts on the Catalogue integration has been started

- More than 70% of the puchases have been started and we plan to have all the instrumentation available for installation in the next 9 months

Next steps (12 months) and Risks

- Installation of the IT-IOOS Marine Data Portal to provide single access point to all marine data products and services
- Progressive integration of RI sub-systems into IT-IOOS and tests of their data flow from facilities to the IT-IOOS Marine Data Center.
- Installation of the acquired instruments on the RIs facilities and tests of the data flow and development of QC
- Develop of prototypes and pilot services for the integration of cross infrastructural data and products for to tackle overarching marine issues in open and coastal sea environments

RISKS

1. **DELAY OF INSTRUMENTATIONS' DELIVERY**

   IMPACTS: The number of the planned upgrade of the Ris; the number of EOVs, ECVs and EBVs available on Marine Data Portal.

   MITIGATION: Contact the instruments distrubutors to ensure that the instrument arrival will occur at least 6 months before the end of the project contract.

2. **ADDITIONAL DELAY IN CIVIL INFRASTRUCTURS BIDS AND DELAY IN THE REALIZATION OF OF CIVIL INFRASTRUCTURES WORK .**

   IMPACT: Additional delay in civil infrastructure realization work at the ISMAR-Naples will impact the installation of the computing and archiving facilities dedicated to the Marine Data Store at ISMAR Naples.

   MITIGATION: Push the administration to open the bid, include in the bid a deadline to complete the works within 3 months before the end of the project. Develop the Marine Data Store and Marine Data Portal using other computing facilities & to transfer the MDS immediately after installation on new facilities and before the end of the project. IMPACT: Delay in the pubblication of the Civil Infrastructure work on to expand the electricity power capacity at Acqua Alta Tower (AOOT) will threat the possibility to use all the instruments acquired by ITINERIS

   MITIGATION: Use the instrumentation on turn to avoid overloading of the power capacity

THANKS!

IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
(D.D. n. 130/2022 - CUP B53C22002150006) Funded by EU - Next Generation EU PNRR-Mission 4 “Education and Research” - Component 2: “From research to business” - Investment 3.1: “Fund for the realisation of an integrated system of research and innovation infrastructures”

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
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