"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

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ITINERIS – Italian Integrated Environmental Research Infrastructures System

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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"

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Ministero dell'Università e della Ricerca

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ITINERIS

Tue, May 6th

11:00 AM - 12:00 PM

ITINERIS - Italian Integrated Environmental Research Infrastructures System
Gelsomina Pappalardo - Scientific Coordinator
Giuseppe Gargano - Research Infrastructure Manager
Antonello Provenzale - WP Leader for Virtual Research Environments

12:00 PM - 1:00 PM

ACTRIS Aerosol, Clouds and Trace Gases Research Infrastructure
Lucia Mona - Italian National Coordinator

EIRENE Environmental Exposure Assessment Research Infrastructure
Nicola Pirrone - Management Board of the EIRENE Project

3:00 PM - 4:00 PM

ICOS Integrated Carbon Observation System
Sindu Raj Parampil - Science Integration Officer, ICOS Head Office

DANUBIUS International Centre for Advanced Studies on River-Sea Systems
Francesca De Pascalis - Italian National Coordinator

Wed, May 7th

3:00 PM - 4:00 PM

e-LTER Integrated EU Long-Term Ecosystem, critical zone and socio-ecological Research
Michael Mirtl - eLTER Coordinator

ANAEE Analysis and Experimentation on Ecosystems
Elena Paoletti - Italian National Coordinator

Thu, May 8th

11:00 AM - 12:00 PM

EMSO European Multidisciplinary Seafloor and water column Observatory
Ingrid Puillat - Director General of EMSO-ERIC

Euro-Argo European contribution to the Argo programme
Elena Mauri - Vice Chair of Euro-Argo Council

3:00 PM - 4:00 PM

LifeWatch European e-Science Infrastructure for biodiversity and ecosystem research
Alberto Basset - Director of Lifewatch Service Centre

DISSCo Distributed System of Scientific Collections
Vanni Moggi Cecchi - Italian National Node

@ITINERIS-RI @ITINERIS_RI

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PIANO NAZIONALE DI RIPRESA E RESILIENZA

Outline

- What is ITINERIS?
  - European Research Infrastructures
  - ESFRI RIs Landscape and analysis of the ENV domain
  - Environmental RIs in Italy
  - ITINERIS - the project/objectives/expected impact
- A focus on the ITINERIS HUB (Ermann Ripepi - CNR)
- A focus on the ITINERIS Virtual Research Environments (Antonello Provenzale – CNR)
- Q&A

European Research Infrastructures

Research infrastructures are facilities that provide resources and services for the research communities to conduct top-level research and foster innovation in their fields.

They may be single-sited, distributed or virtual.

A BROAD CONCEPT

- Great scientific equipment or set of instruments.
- Scientific collections, archives and structured information.
- Electronic infrastructures (e-infrastructures).
- Any other entity of a unique nature necessary for research.

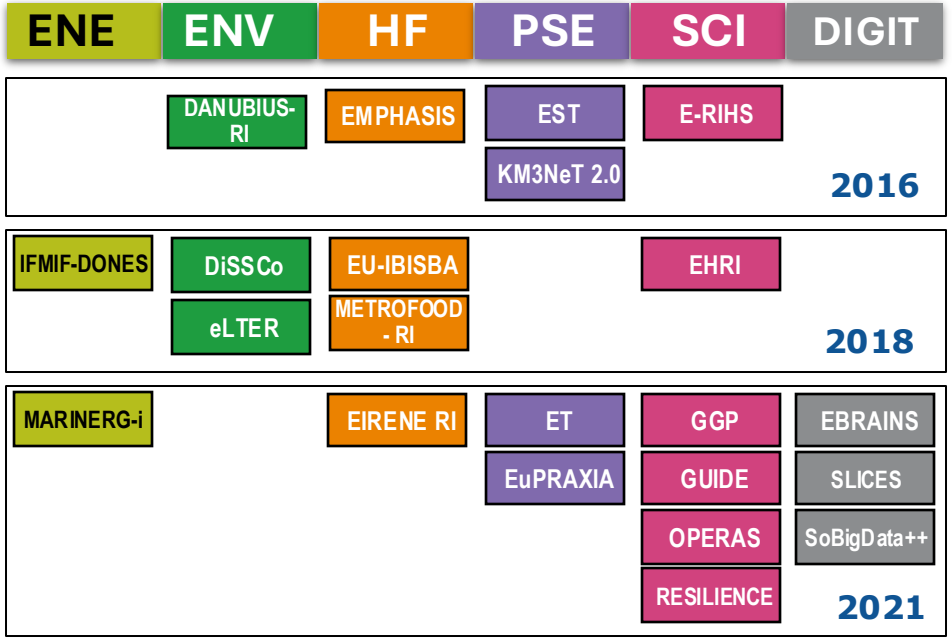
ACCESS

Physical, Remote, Virtual

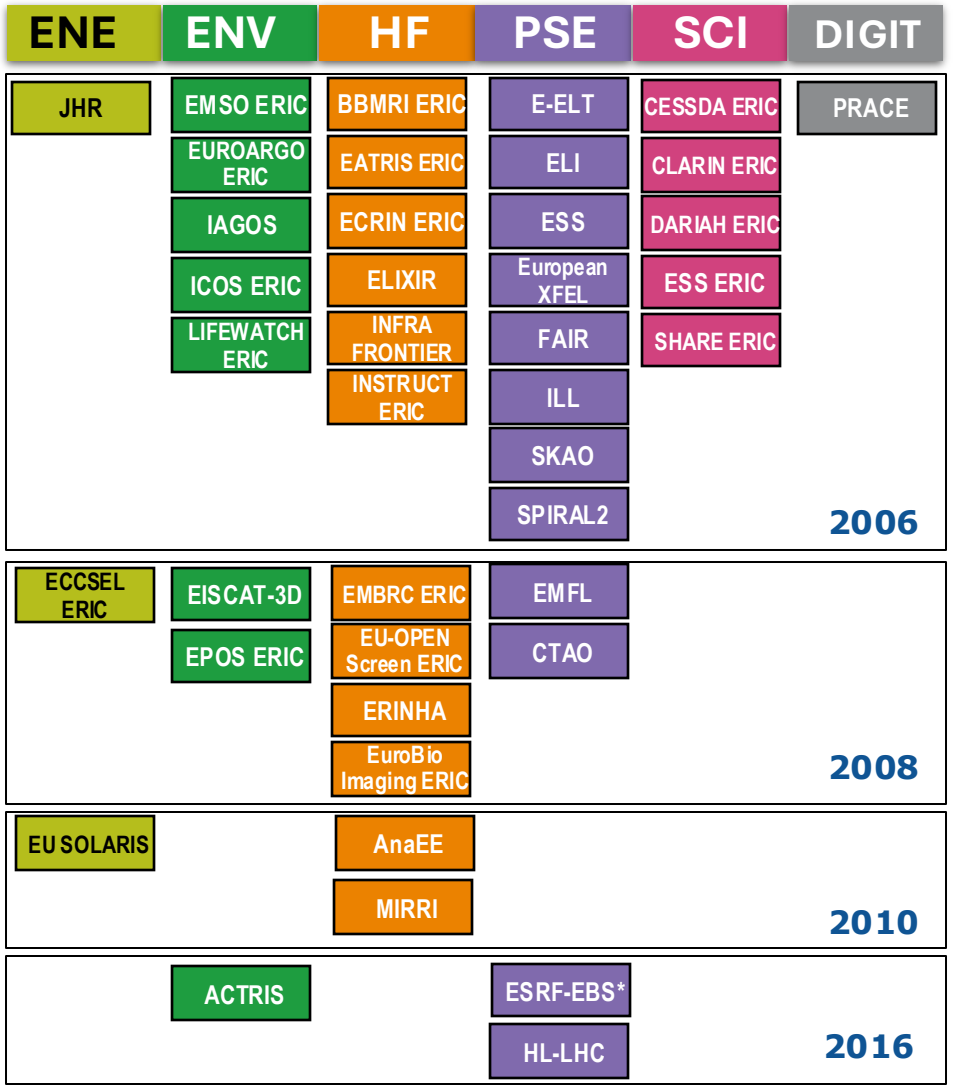
ESFRI Strategic Report on RIs in Europe

ITINERIS

22 ESFRI Projects (11 new)



41 ESFRI Landmarks (4 new)



** The ESFRI Roadmap 2026 is under way*

https://roadmap2021.esfri.eu/

ESFRI

European Strategy Forum on Research Infrastructures

ESFRI Landscape Analysis 2024

The Landscape Analysis provides an overview of the European RI ecosystem by identifying the main RIs operating transnational access in Europe, in all fields of research, and major new or ongoing projects.

The Landscape Analysis also provides an opportunity to help identify potentially critical gaps in the current landscape and includes trend analysis and the first examples of RIs services and their impacts in specific areas.

https://landscape2024.esfri.eu/

ESFRI European Strategy Forum on Research Infrastructures

** To underline the strategic relevance of the Landscape Analysis, ESFRI has decided to de-couple it from the Roadmap. The LA 2024 is a stand-alone document*

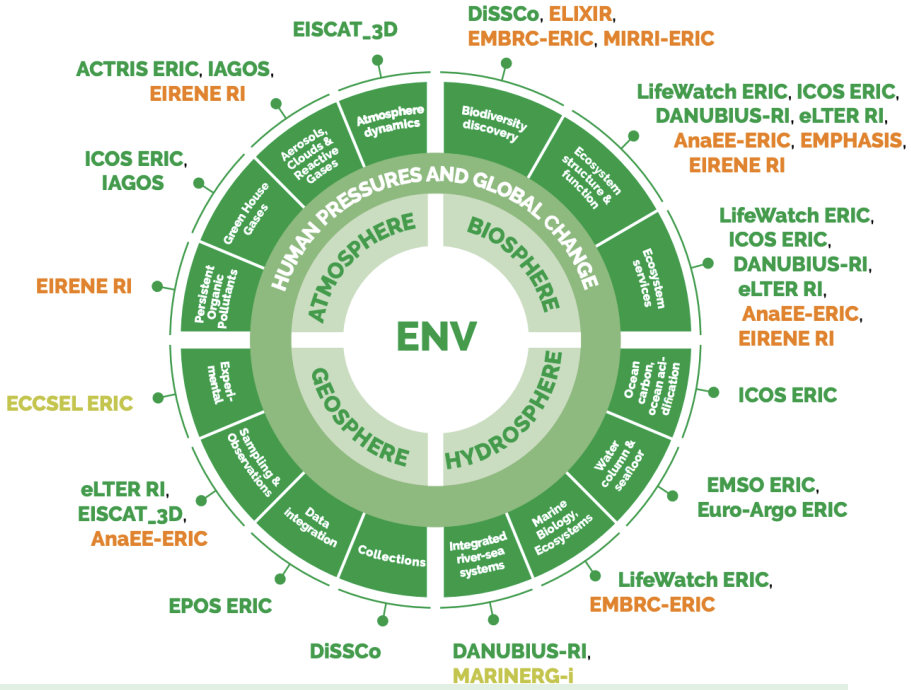
Landscape Analysis - Environment domain

CURRENT STATUS / SERVICES IN THE DOMAIN

Environmental research is aimed at understanding the functioning of the Earth system at various spatial and temporal scales. ENV RIs are key to providing systematic and coherent datasets needed for research that addresses major issues but also societal challenges such as climate, natural resources, health, food security, biodiversity and sustainable use of the sea, fresh water and soil.

8 Landmarks (ACTRIS ERIC, EPOS ERIC, EISCAT_3D, IAGOS, ICOS ERIC, EMSO ERIC, LifeWatch ERIC and Euro-Argo ERIC), and 3 Projects (DiSSCo, eLTER RI, DANUBIUS-RI) across ENV sub-domains:

- GEOSPHERE
- HYDROSPHERE
- ATMOSPHERE: FROM NEAR TO THE GROUND TO THE NEAR SPACE
- BIOSPHERE: BIODIVERSITY AND ECOSYSTEMS



*"**ITINERIS** and Data Terra exemplify national instances that can serve as models for the implementation of RIs at the European level."*

ESFRI European Strategy Forum on Research Infrastructures

Landscape Analysis - Environment domain

IMPACT, GAPS AND NEEDS

- RIs contribute to understanding environmental challenges
- ENV RIs contribute to the Sustainable Development Goals
- Multiple European policies benefit from ENV RIs

TRENDS IN THE DOMAIN

- ENV RIs are 'bridging' while undergoing similar developments that can boost their impact
- Increased IT capabilities (joint work on fair data, AI applications, digital twin)
- Challenge-driven service provision for wider user communities
- Enabled participation in global frameworks
- Socio-technological advances enabling enhanced impacts

CROSS-DOMAIN ASPECTS AND FUTURE NEEDS

- Interdisciplinary collaboration within the ENV sciences and also at cross-domains interfaces

- link with life sciences [ANAEE, EMPHASIS, EU-IBISBA, EIRENE, EMBRC, ….] (H&F);
- the environment's role in energy systems (ENE);
- process studies and technological developments (PSE);
- the environment in interaction with human society (SSH);
- large distributed volume of data - strong digital component - (DIGIT)

Enviromental RIs in Italy

- Italy contributes to almost all ENV ESFRI RIs: ACTRIS, DANUBIUS, DiSSCo, eLTER RI, EMSO, EPOS, EURO-ARGO, ICOS, LIFEWATCH.
- Relevant role in ESFRI Landmarks:
  - Hosting the EMSO and EPOS ERICs
  - Hosting the Service Center of LifeWatch ERIC
  - Hosting the ACTRIS ERIC SAMU, CARS, CAIS and Aerosol Remote Sensing Data Center
  - Hosting the ICOS Ecosystem Thematic Centre
  - Coordinating the Mediterranean and Black Sea Argo Regional Centre in Euro-Argo
- Participation in other non ESFRI ENV RIs (EUFAR, EuroFleet, Jerico, SIOS, ECORD)
- Other ENV RIs at national level as reported in the PNIR (ATLaS, CeTrA, R/V Laura Bassi, SMINO)

A Hub for environmental research

- The active participation in ESFRI and other European ENV RIs testifies to the importance that Italy places in environmental research.
- A fragile country from an environmental point of view with a strong and multidisciplinary scientific community working in this sector for many years.
- Coordinated actions are crucial to address key challenges in accessibility, interoperability, and service gaps within the national RI landscape.

- X Atmosphere, marine, terrestrial, and geosphere data lack integration
- X Disjointed systems hinder discovery/interoperability & duplicate efforts
- X Inconsistent standards and adoption of FAIR principles limits data reuse
- X Complex, non-standardized procedures for physical/remote RI access
- X Limited analytical tools to support cross-domain, multi-scale analysis

NRRP actions for RIs in Italy

The Ministry of University notice 3264/2021 provided a budget of €1,080 million divided according to the 6 thematic areas of ESFRI and based on the priorities identified in the National Plan for RIs 2021-2027 (PNIR).

i. RI enhancement – for high priority RIs;

ii. New RIs – for medium- high priority RIs;

iii. Thematic or multidisciplinary RI networks related to one of the ESFRI area - for medium- high priority Ris

Opportunities….with conditionaliities!

- 40% of the investment to be located in the Southern Italy regions
- Gender equal opportunities;
- Do Not Significantly Harm
- Envronmental and digital tagging objectives
- Open science and fair data
- Long-term sustainability: at least for the 10 years period after the completion of the project

ITINERIS: Empowering Italy's Environmental Future

ITINERIS builds the Italian thematic network of Environmental Research Infrastructure

for the observation and study of environmental processes in the atmosphere, marine domain, terrestrial biosphere, and geosphere.

Foster a systemic and multi-disciplinary approach for a deeper understanding of environmental processes and for the creation of effective strategies.

Promote the adoption of common standards and FAIR-enabling practices, to harmonize RIs development and enhance interoperability.

Establish a national access framework to ensure integrated and multifunctional access to Italian Env Ris, and promote sharing of data and research results.

The project at a glance

ITINERIS -Italian Integrated Environmental Research Infrastructures System is a project 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”.

The project is coordinated by the CNR (National Research Council). It started in November 2022, and during 36 months.

PROJECT AT A GLANCE

155 M€ INVESTMENT

7 PARTNERS

39 OPERATING UNITS

175 FIXED-TERM HIRED

43 PHDs SPONSORED

~500 PERMANENT STAFF

75 INTERMEDIATE OBJECTIVES

208 DELIVERABLES

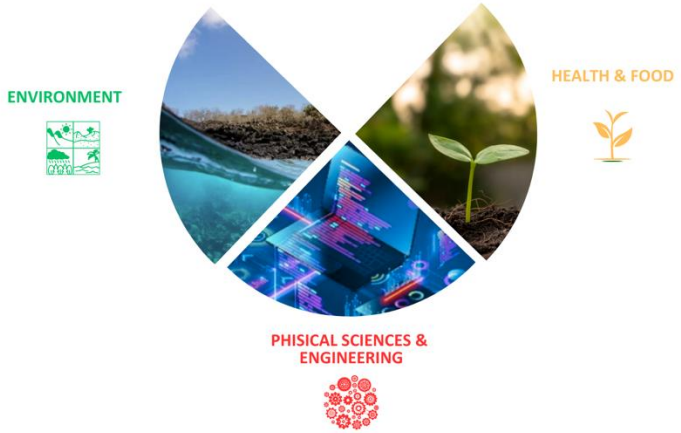
8 WORK PACKAGES

89 ACTIVITIES

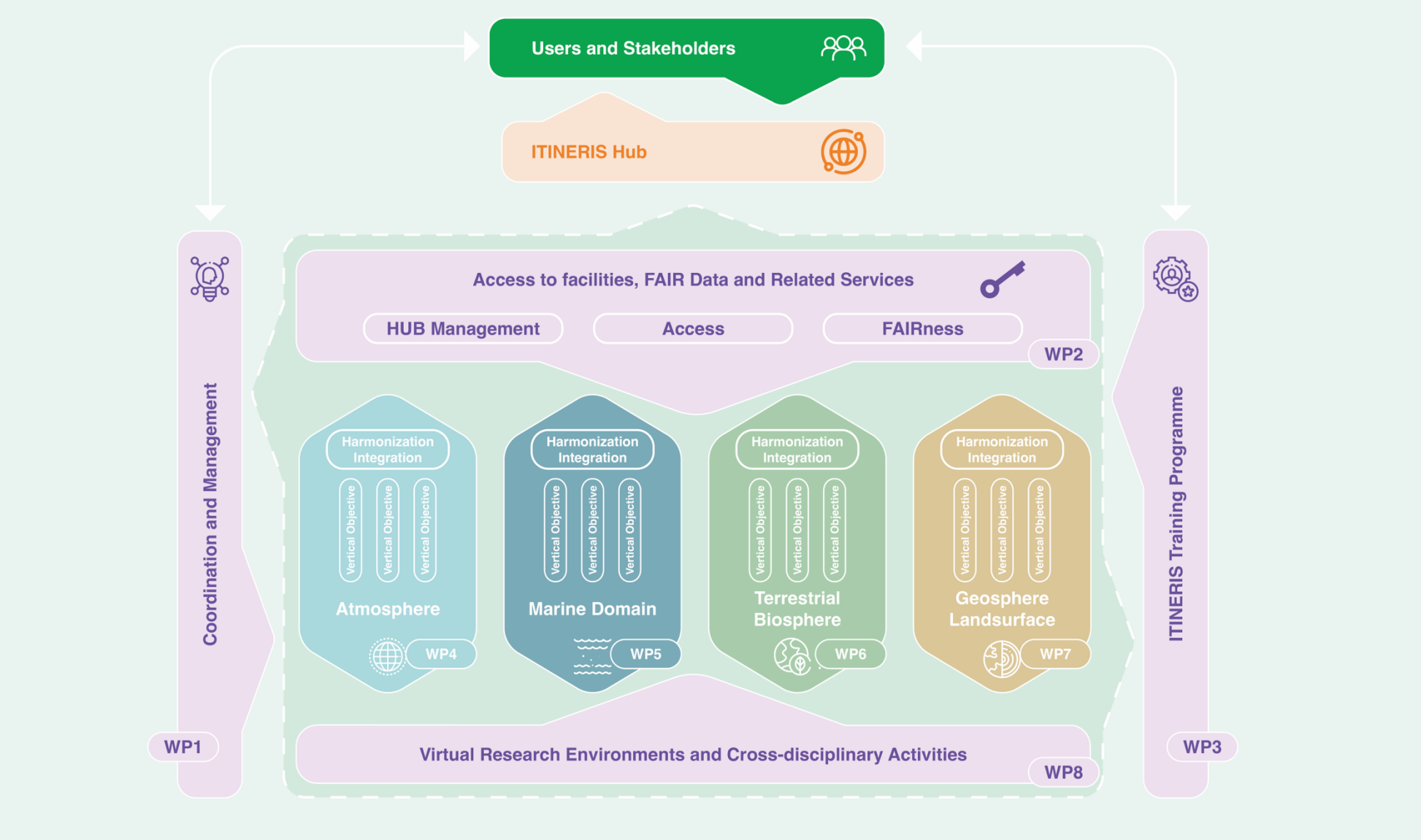
A network of excellence

ITINERIS coordinates the national nodes from 22 RIs belonging to or relevant for the ENV domain.

ESFRI Landmarks ACTRIS, EMSO, Euro-Argo, ICOS and LIFEWATCH, and ANAEE; **ESFRI projects** DANUBIUS, DISSCO, e-LTER, and EMPHASIS and EU-IBISBA; the **EU RIs** ECORD, EUFAR, Eurofleets, JERICO and SIOS; and the **national RIs** ATLaS, CeTrA, R/V Laura Bassi, and SMINO, and Geosciences and LNS.



Work Packages and interconnections



Click to view details for each WP →

The ITINERIS HUB

ITINERIS Catalogue

ITINERIS Access Platform

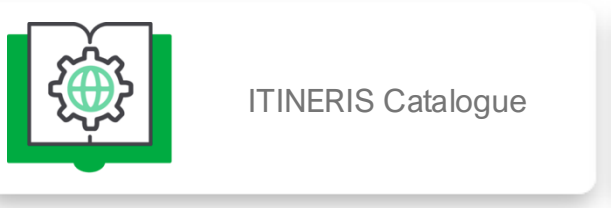
ITINERIS Virtual Research Environment (VRE)

ITINERIS Training Centre

The ITINERIS HUB fulfills the core objective of the project serving as the **centralized gateway to Italian ENV Ris**, consolidating access to dispersed resources and eliminating the need to navigate multiple entry points.

Moving beyond simple resource aggregation, the ITINERIS HUB provides a truly integrated digital ecosystem offering user-friendly interfaces, advanced capabilities, and integrated tools designed to enhance impact on research, collaborative potential, and user experience.

ITINERIS Catalogue

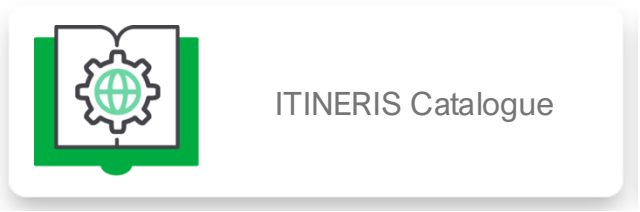


At the HUB core, the metadata Catalogue serves as the comprehensive online registry with a user-friendly interface and advanced search capabilities empowering users with easy discovery and access to data, tools, and services provided by the network of ENV RIs.

This is enabled by essential services that bridge technical and operational disparities between the different RIs and ensure a rigorous implementation of FAIR data management and integration framework.

More on this next!

ITINERIS Catalogue



- Over 500,000 environmental datasets from Italian ENV RIs.
- Facilities, observatories, specialized labs, advanced instrumentation, research vessels, etc.
- Analytical and validation services to enhance data processing and research outcomes.
- FAIR-enabling services: metadata, persistent identifiers (DOI), terminology services, etc.
- Digital infrastructures and computational resources.
- Geospatial visualization tools for intuitive exploration and analysis of data coverage.
- Technology transfer services facilitating the application of research findings.
- Complementary resources such as modeling tools and high-performance computing to expand research capabilities.
- Linkage services facilitating connections and collaborations with RIs in other domains to support holistic research endeavors.
- ….and more!

Access platform

ITINERIS

ITINERIS Catalogue

ITINERIS Access Platform

ITINERIS Virtual Research Environment (VRE)

ITINERIS Training Centre

A single platform enhancing access to data and services from the RIs through physical, remote, virtual, and hybrid access types – accommodating diverse user needs within a standardized operational framework.

Data Management Plan

Access Policy

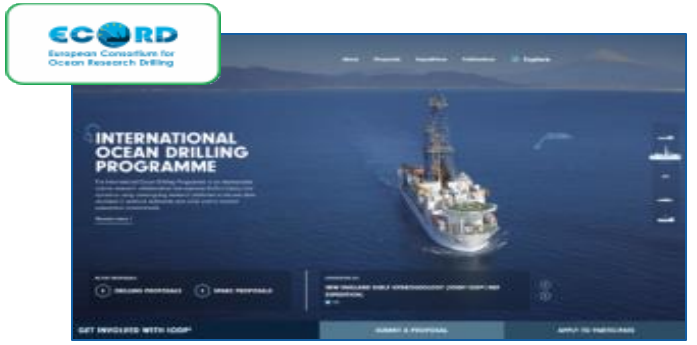
Access Management Plan

ONGOING PILOT INITIATIVES

118 users

30% from EU/Int'l to Italy

IT **70%** from Italy to EU / Italy



15 members of science parties

IT **10** Berths

IT **5** Shore-based

ITINERIS Virtual Research Environment (VRE)

ITINERIS Catalogue

ITINERIS Access Platform

ITINERIS Virtual Research Environment (VRE)

ITINERIS Training Centre

Advanced digital platforms designed to empower users with cutting-edge tools for cross-disciplinary environmental analysis. ITINERIS VREs integrate data, models, and computational resources from multiple RIs, enabling researchers, policymakers, and stakeholders to address complex environmental challenges through collaborative and innovative approaches.

Thematic VREs

More on This Next!

- Critical Zone Services
- Aquatic Biomass Services
- Crops, Plants, and Pests
- Essential variables
- Aerosol-Biosphere
- Carbon Cycle Services
- Climate Change Indicators and Impacts
- Downstream Effects
- Isotope Database

ITINERIS Training Centre

ITINERIS

ITINERIS Catalogue

ITINERIS Access Platform

ITINERIS Virtual Research Environment (VRE)

ITINERIS Training Centre

A dedicated platform offering courses, hands-on training, workshops and educational resources to enhance researchers', technicians', and stakeholders' skills in utilizing data, tools, and VREs developed from environmental RIs.

ONGOING ACTIONS

~600 Users on the training platform (PhD, researchers, technicians, faculty, and communication staff)

32 training courses delivered / **~600** participants

New training opportunities await! **46 new courses coming by summer!**

Visit the ITINERIS HUB hub.itineris.cnr.it and register to the Training Centre while spots are still open!

Main expected impacts

- A unified national system of ENV RIs, enabling seamless flow of data, information, and knowledge across ENV sub-domains.
- New knowledge on environmental processes through a whole-system approach, emphasizing interconnections often missed by individual RIs.
- Cross-disciplinary links with other research areas.
- Evidence-based insights to support and inform policy-making.
- Wider scientific, economic, and societal effects: (a) promotion of scientific excellence and creation of knowledge and innovation; (b) attraction of new researchers from other territories; (c) attraction of capital and investments in the territory; (d) impact on the competitiveness of enterprises, and more generally in terms of spin-off effect on the territory.

National, European and international context

- Synergies with other PNRR actions: other RIs (EPOS, GeoScienceIR and EMBRC upgrades), National Centres (National Biodiversity Future Centre, Agritech Center , National Centre for HPC, Big Data and Quantum Computing), Ecosystem (TECH4You)
- Link to other national initiatives (PRIN, regional projects, private sector, etc.)
- Synergy with the European RI framework supporting, at national level, the participation of Italian scientists in pan-European initiatives (ENVRI, ENVRIFAIR, EOSC) and in HE (Pillar 1, Mission, Partnership, Clusters).
- Collaboration with European and international global communities and organizations.
  - Copernicus: CAMS (Copernicus Atmosphere Service), C3S (Copernicus Climate Change Service) and CMS (Copernicus Marine Service)
  - EU programmes: Destination Earth, Digital Twin Ocean, EOSC Italian node;
  - Space agencies: ASI, ESA, EUMETSAT, NASA, JAXA;
  - Int.l organizations: WMO, WCRP, GEO, GAW, GCOS, GOOS, GSO, FAO, Belmont Forum, EUCENTRE, EUREF, AUSCOPE;

A long-term strategy in the national and European context

- National nodes of EU RIs with long-term commitment
- Partners commitment
- ENV RIs scientific community has been working together in Europe for many years now
- Capacity to serve a larger community with new services will have a positive impact at both national and EU level
- Improved access management and governance will also have a positive impact

A vision for the future

ITINERIS is poised to become an international benchmark and position Italy as a global leader in environmental research, by harnessing the power of interdisciplinary research and leveraging cutting-edge technologies and innovative solutions, sustained by the main Italian environmental scientists involved in European RIs.

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ITINERIS Integration Framework

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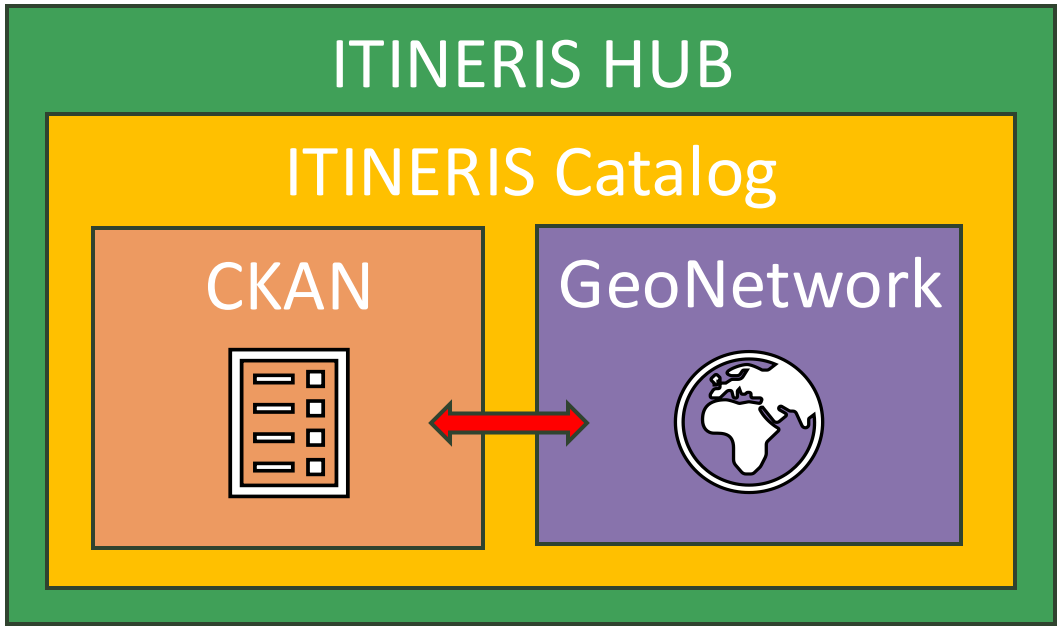
ITINERIS HUB implementation choices

- Architecture based on CSW-OGC Server:
  - **CKAN and GeoNetwork**: metadata profiles of
    - services
    - data sources
    - research products
    - training resources
    - VREs



- Metadata schema
  - EOSC Metadata Schema
  - ISO 19139 for geographical/geospatial metadata
  - Ecological Metadata Language (EML)

- Data Policy: CC-BY 4.0 International compliant with FAIR and OpenData principles

Why this choice?

- Choice based on ITINERIS RIs data portal mapping
  - ISO 19139 (19115) and EML: used by most of mapped RIs
  - CKAN and GeoNetwork: widely used in the international context and by many of ITINERIS RIs

- Possibility to integrate (meta)data from various environmental domains and RIs
  - Federation of CKAN endpoints
  - Harvesting from GeoNetwork endpoints

ITINERIS HUB OGC CSW compliant status

16 of 22 ITINERIS RIs data portal compliant with OGC CSW standard

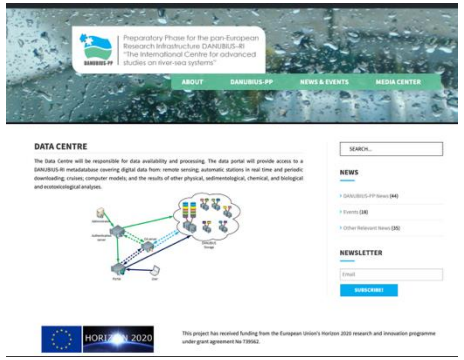
WP4: ATMOSPHERE

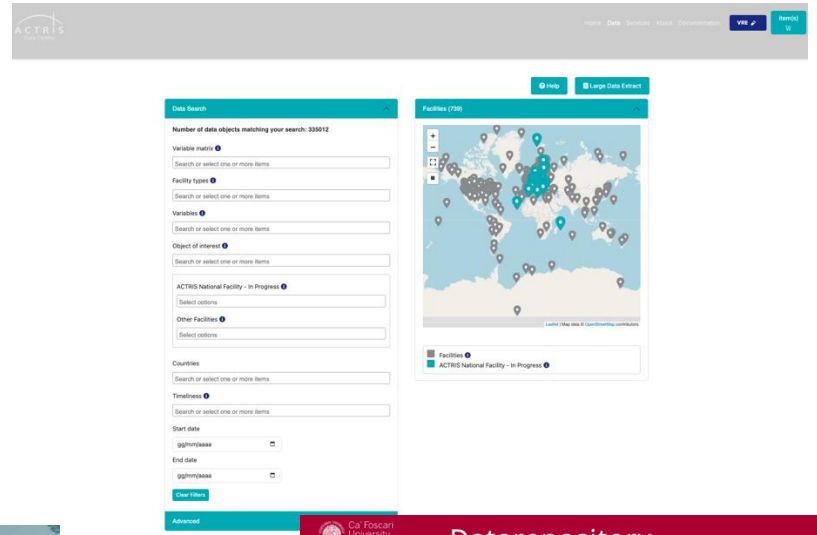
WP5: MARINE (Marine HUB)

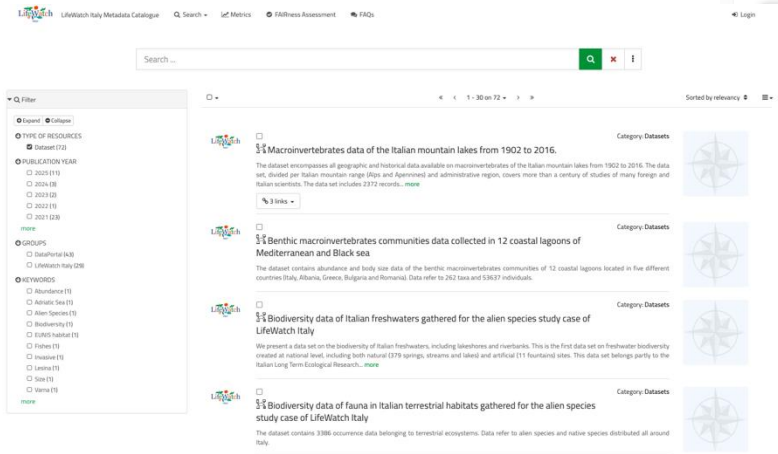
WP6: TERRESTRIAL BIOSPHERE

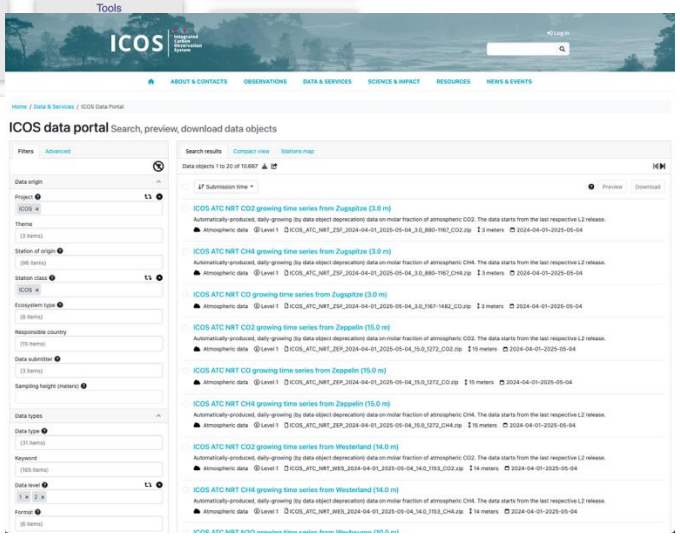
WP7: GEOSPHERE LANDSURFACE

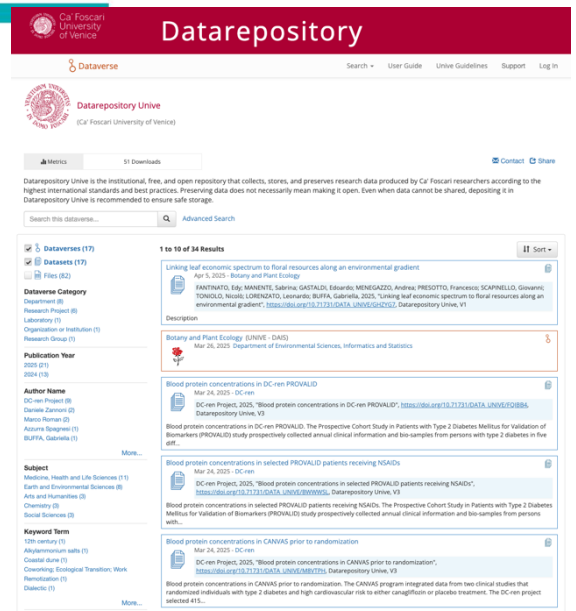
Yet another HUB in addition on existing ones?!











Yet another HUB? The answer is NO!

- ITINERIS will not duplicate existing data provided by RIs' data portal
- ITINERIS will be a single point of access for discovery metadata and services of the RIs
- ITINERIS could provide access also to other digital resources of interest for environmental investigation at national and international level (e.g. projects and Copernicus framework)
- Dissemination activities to promote links with other international initiatives

What have we learnt? 1/2

During the harvesting activities, we learned that it is difficult to integrate data portals that do not expose metadata in the CSW standard, some examples:

- Data portal compliant with CSW harvesting
  - SIOS – IADC: GeoNetwork
  - CeTrA (Dataverse): OAI/PMH
  - WP5: Marine HUB, GeoNetwork and CKAN (under implementation)

- Data portal not compliant with CSW harvesting
  - ACTRIS (REST-API): dedicated code for metadata harvesting by API
  - ICOS (SparQL): dedicated code for metadata ingestion (under implementation)

Open Geospatial Consortium

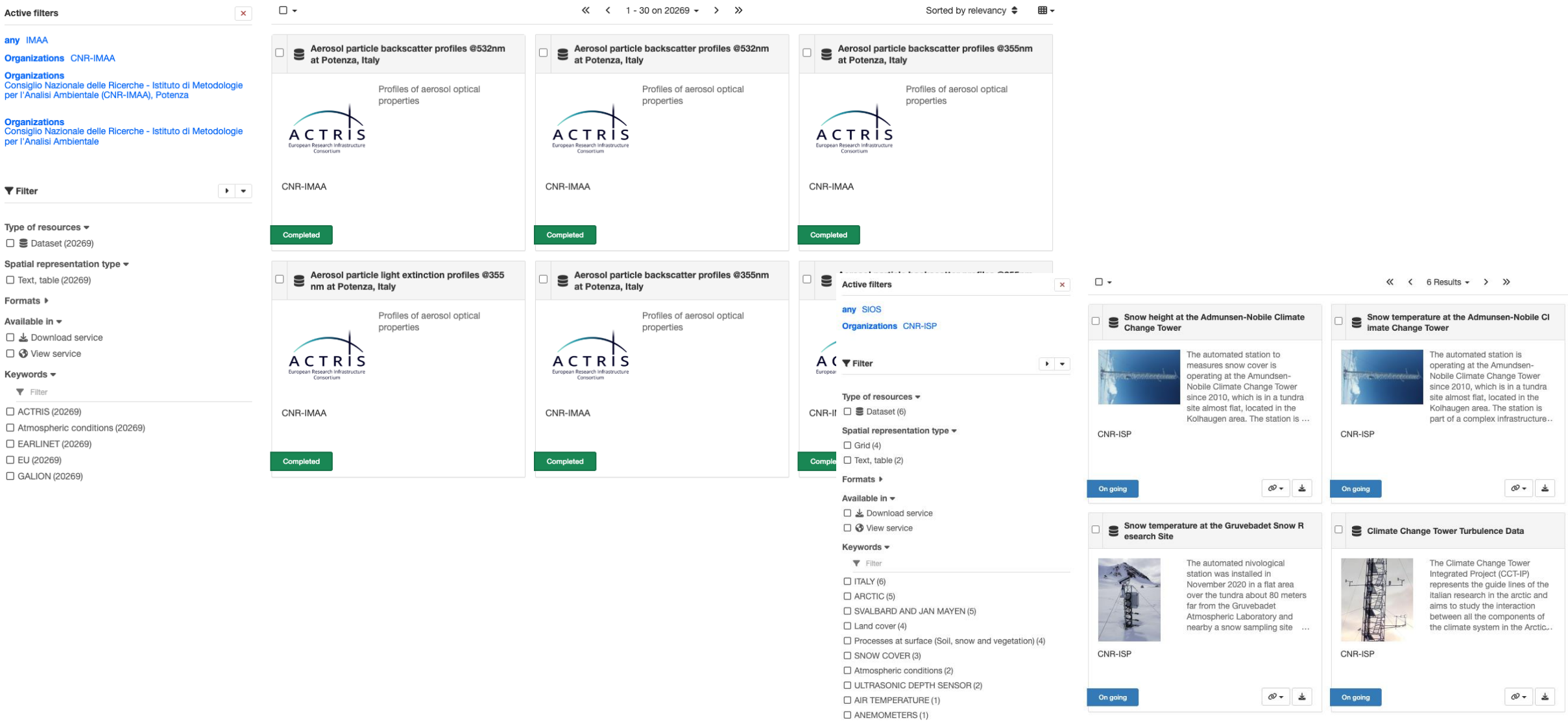
Catalog Service for the Web

What have we learnt? 2/2

- A customized solution for each entity is not reasonable
- Guidelines (distributed)
  - CSW Server: e.g. CKAN/ GeoNetwork
  - Metadata service: CSW
  - Metadata format: EOSC, ISO19139 and EML

Example of metadata available on the ITINERIS HUB:

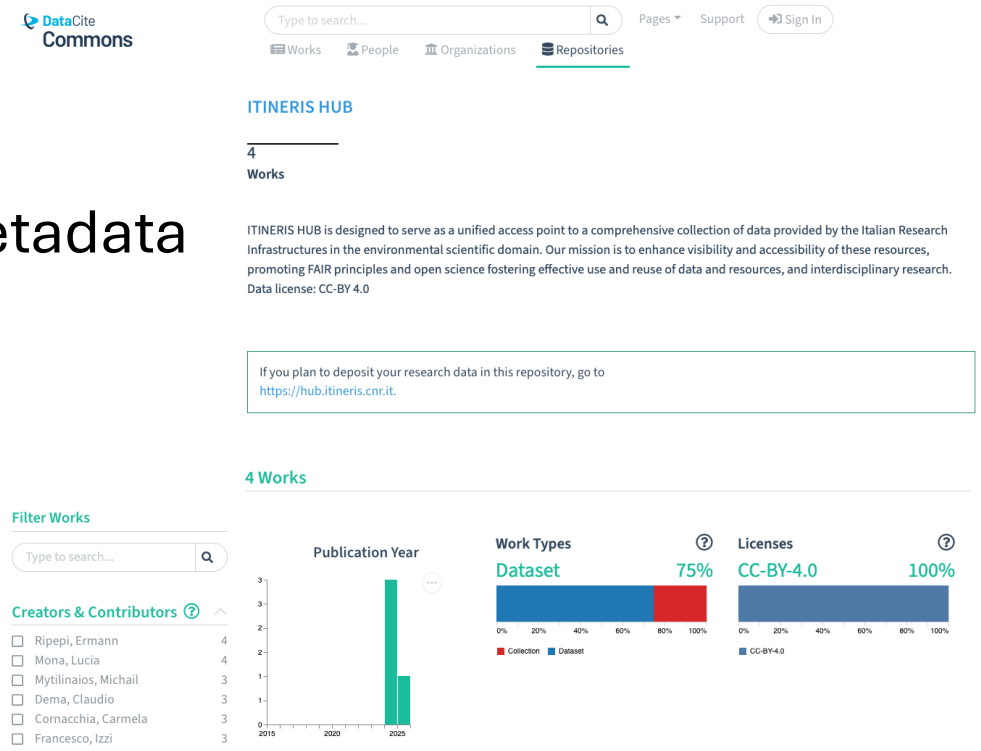
https://geonetwork.itineris.cnr.it/geonetwork



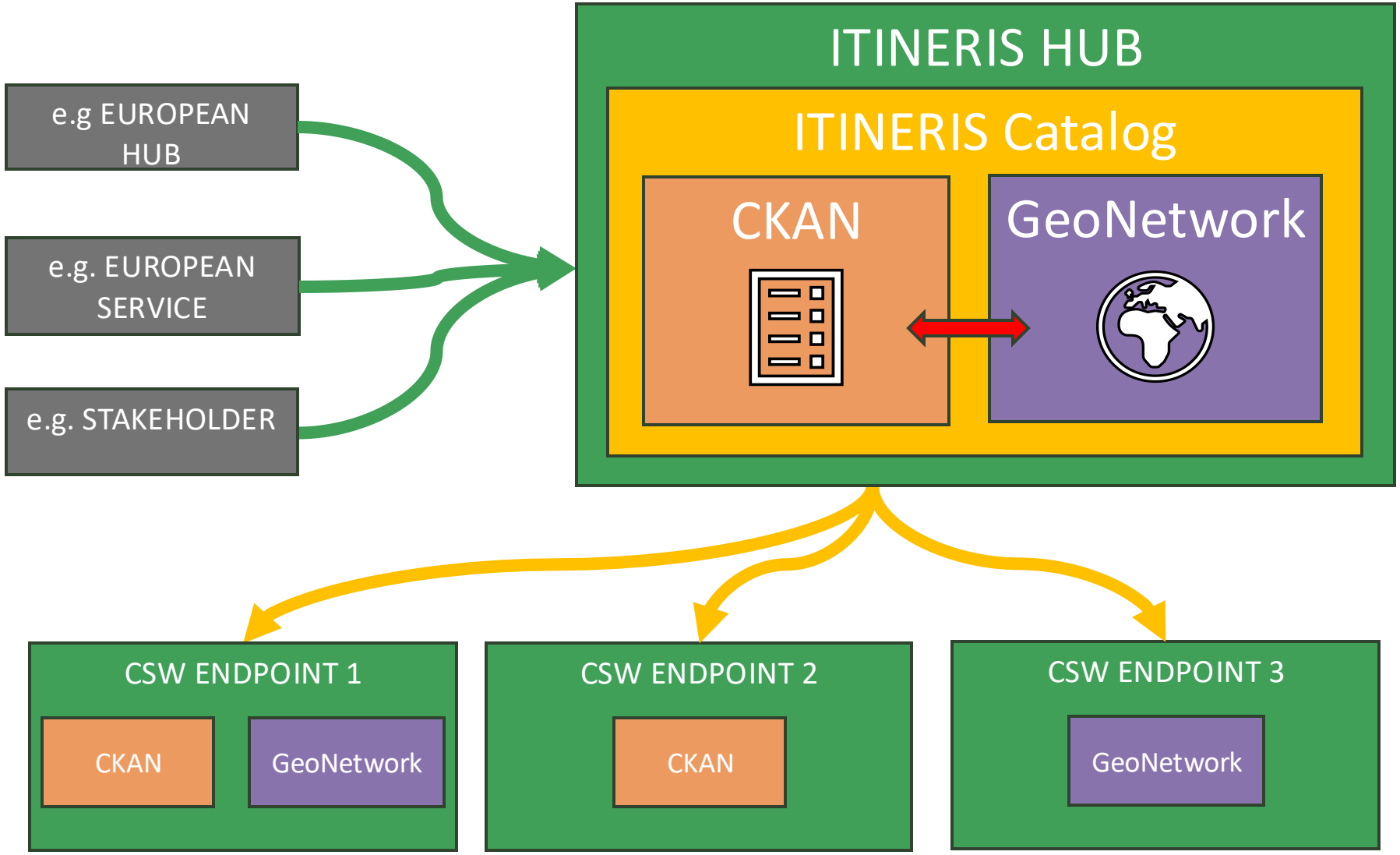
DOI ASSIGNMENT

- DOI provision for dataset and software:
  - DataCite DOI prefix assigned to ITINERIS HUB repository https://doi.org/10.57837
  - https://commons.datacite.org/repositories/g69ce4n

- CKAN/GeoNetwork plugin integration
  - Automatic generation of DOIs starting from metadata



Conceptual figure of the ITINERIS HUB



ITINERIS HUB: a single point of access from other HUBs and resources
(e.g. ENVRI, Copernicus/CAMS)

ITINERIS HUB… WORK IN PROGRESS

- Currently, the HUB is still under development, and metadata harvesting is ongoing.

- This activity will continue even beyond the end of the project.

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Virtual Research Environments

Antonello Provenzale, CNR-IGG
Eugenio Trumpy, CNR-IGG

von Humboltd and Bonpland, Naturgemalde

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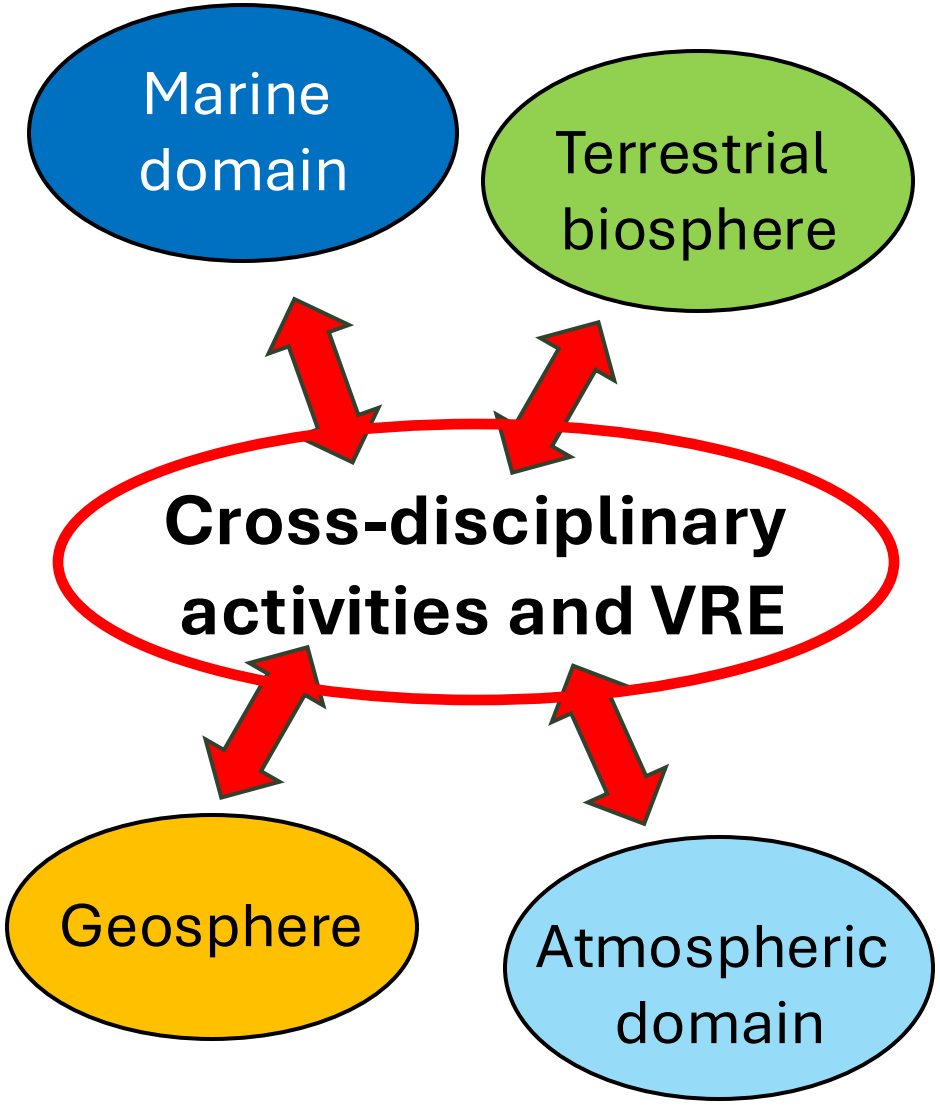


We use data, information and knowledge generated by the individual RI to create **a suite of Virtual Research Environments (VRE)**, providing **services where RIs from different domains are harmonized to deal with scientifically and societally relevant topics**.

This **systemic approach** will support addressing complex, multi-disciplinary challenges with a broad perspective.

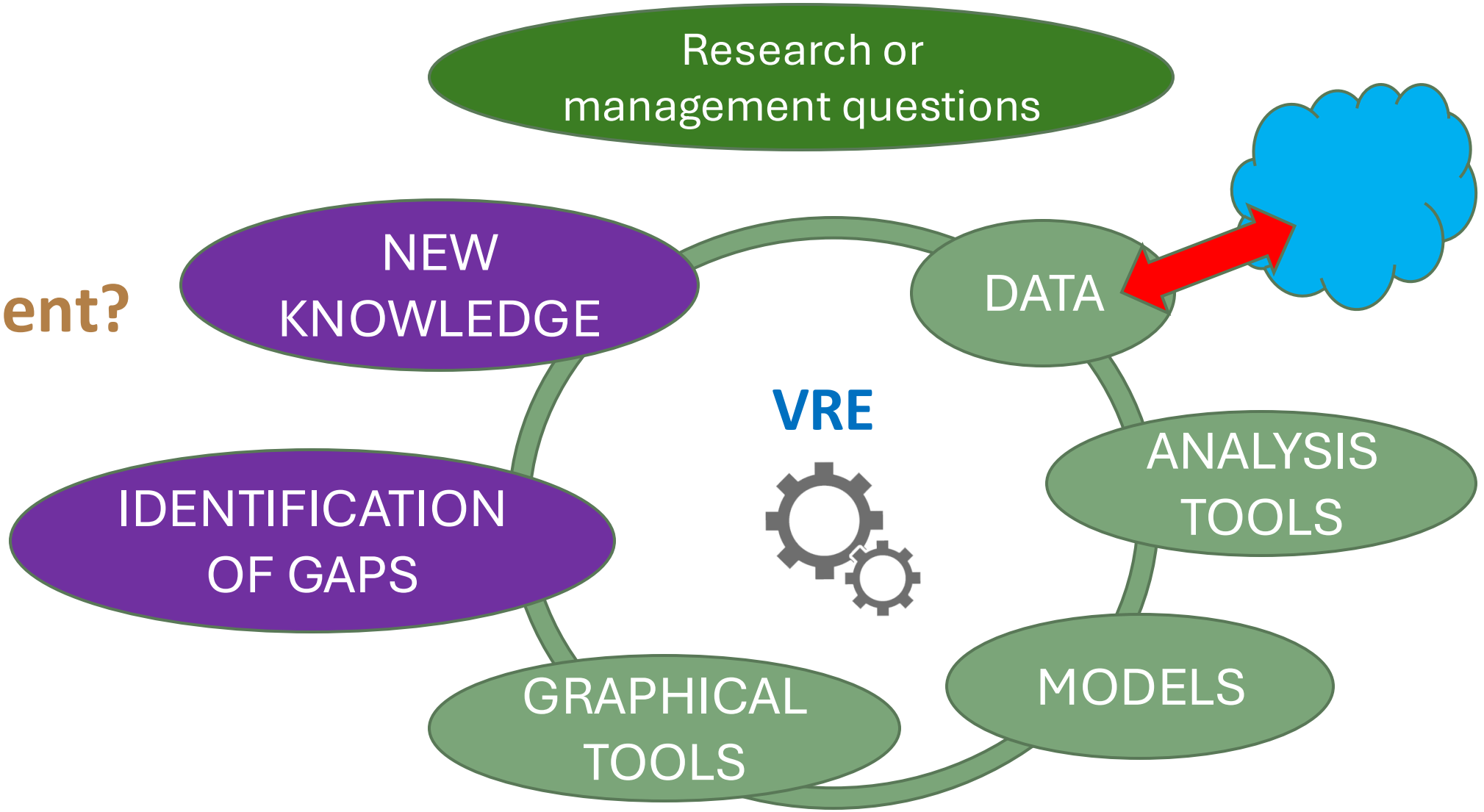
What is a Virtual Research Environment?

VRE

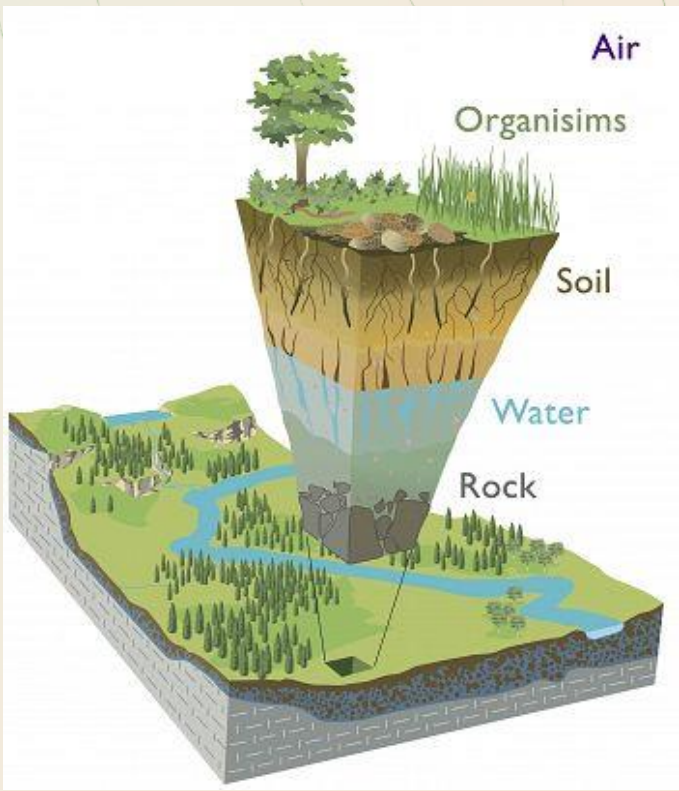
An e-Science online environment favouring collaborations and shared solutions **to answer specific scientific and/or management questions** that require an ensemble of data, analysis tools, modelling solutions and graphical tools, in the spirit of the **open science principles**.

Researchers can upload/download and share knowledge, contributing to the construction of the VRE. **Users** can access to a simplified version of the VRE to tackle specific issues.

What is a Virtual Research Environment?



Critical Zone VRE



Marta S., Gennaro S., Bove P., Caparrini F., Baneschi I., Coro G., Costanza L., D'Incecco S., Donato A., Forni P., Giamberini M. S., Menichini M., Pennisi M., Raco B., Vivaldo G. & Provenzale A.

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

Data management

Data Collections

The Metadata counterparts

A tool to visualize these datasets

Applications and methods

Applications for processing datasets and performing experiments

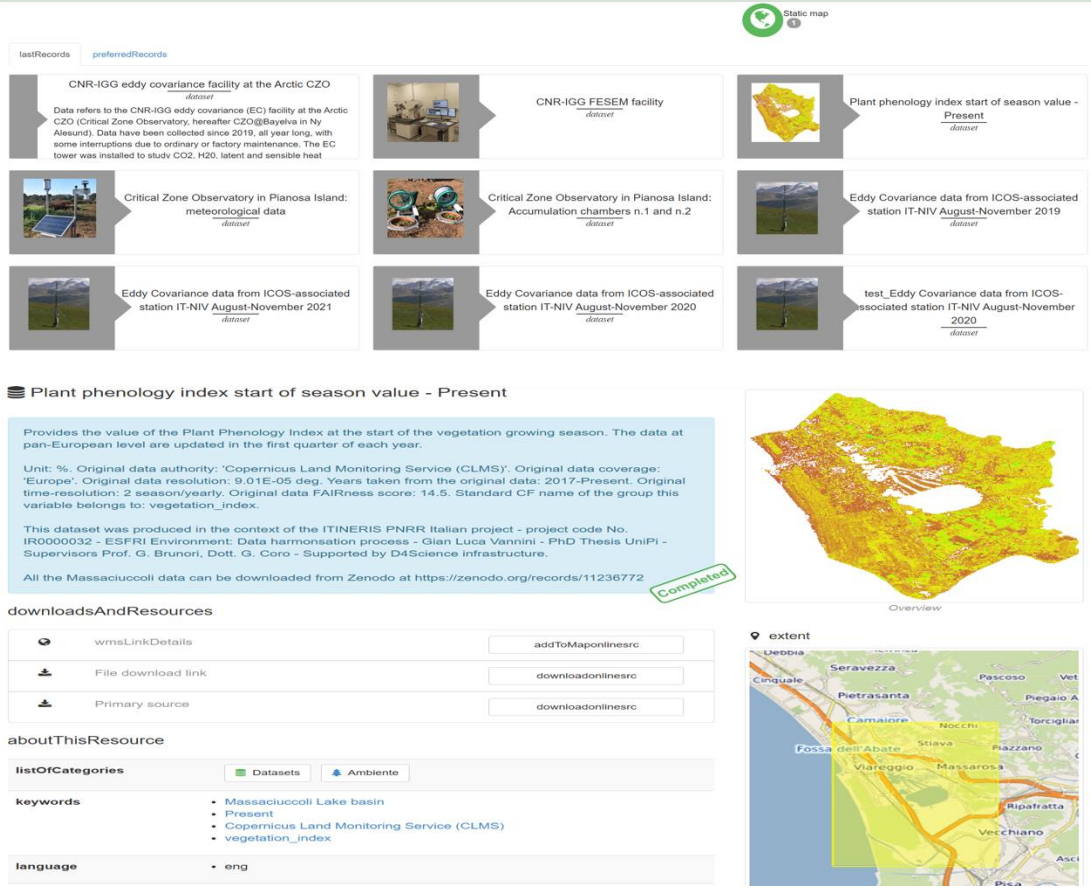
One or more platforms to use these applications

Social and cooperative Environment

A social platform to support cooperation between users

A framework for conducting cooperative experiments

Environment	*Site*	*Instrument*	*Data type*	*N records*
Arctic	**Ny Ålesund**	Portable chamber	CO_2 flux, vegetation class, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, irradiance, green fractional cover	496 (248 paired)
Semi-arid	**Pianosa**	Automated chamber	CO_2 flux, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, wind direction, wind speed, rain gauge	29,768
Mountain	**Lauson**	Portable chamber	CO_2 flux, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, irradiance	168
Mountain	**Forni**	Portable chamber	CO_2 flux, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, irradiance	97
Mountain	**Nivolet**	Portable chamber	CO_2 flux, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, irradiance	7,180 (3,590 paired)
Mountain	**Nivolet**	Automated chamber	CO_2 flux, H_2O flux, pressure, soil volumetric water content, soil temperature, air temperature	3,550
Mountain	**Nivolet**	Eddy covariance	CO_2 flux, air temperature, air relative humidity, wind direction, wind speed, maximum wind speed	2,008
Mountain	**Lavassey**	Portable chamber	CO_2 flux, pressure, soil volumetric water content, soil temperature, air temperature, air relative humidity, irradiance	79



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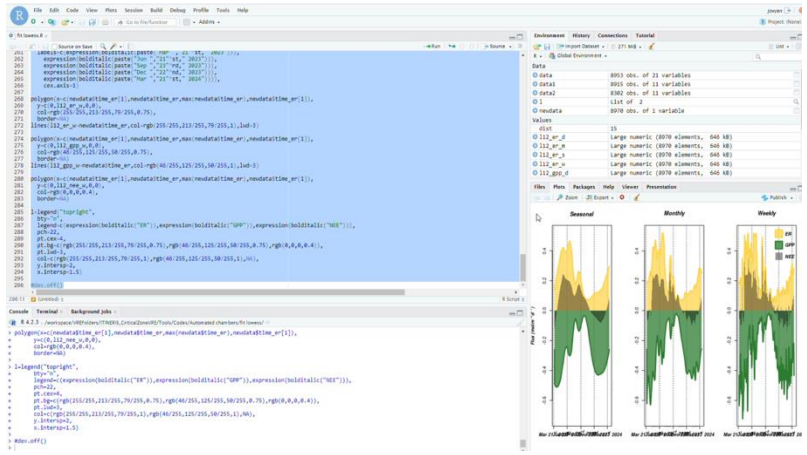
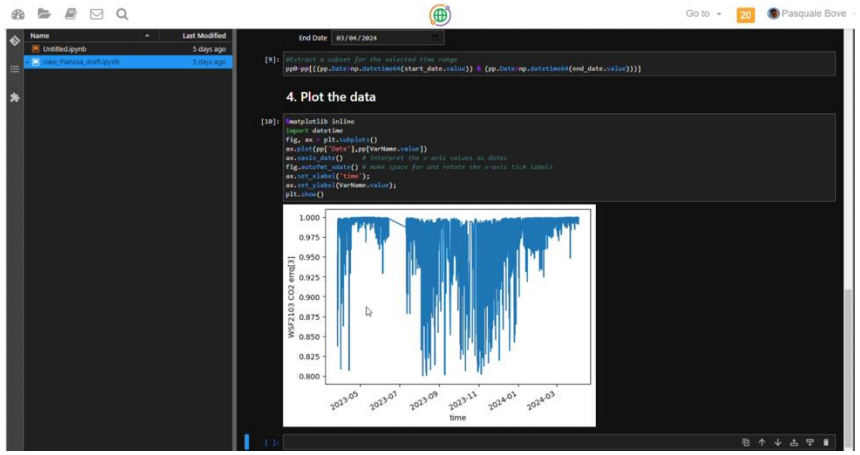
RStudio

demo application: Smoothing timeseries of CO2 fluxes from automated chambers data



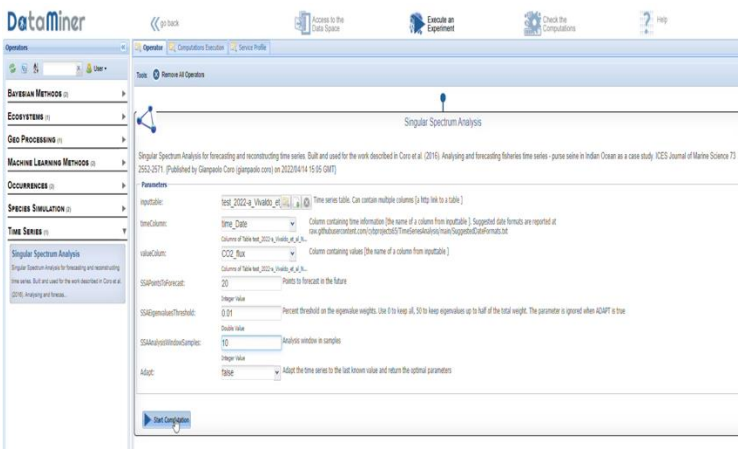
Jupiter NoteBook

demo application: visualization of data from the CZO in Pianosa island CO2 accumulation chambers



DataMiner

demo application: Singular Spectrum Analysis, MaxEnt Ecological Niche Model



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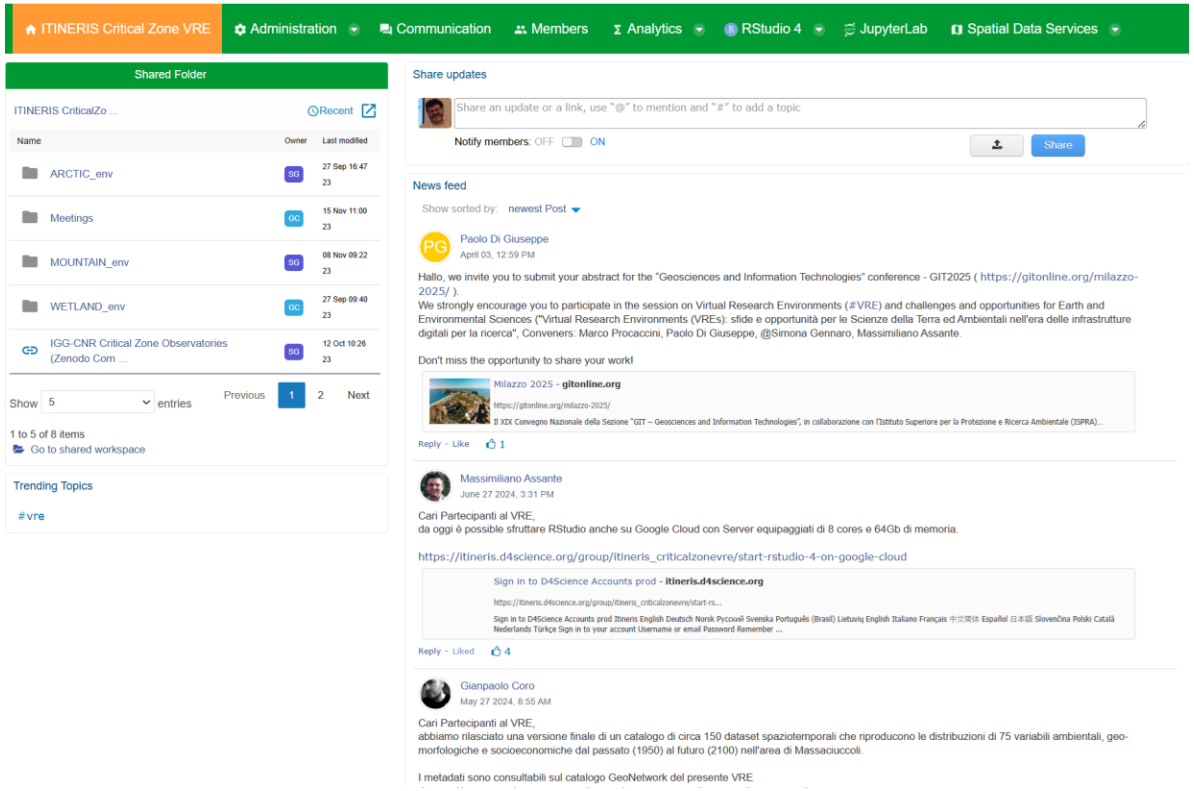
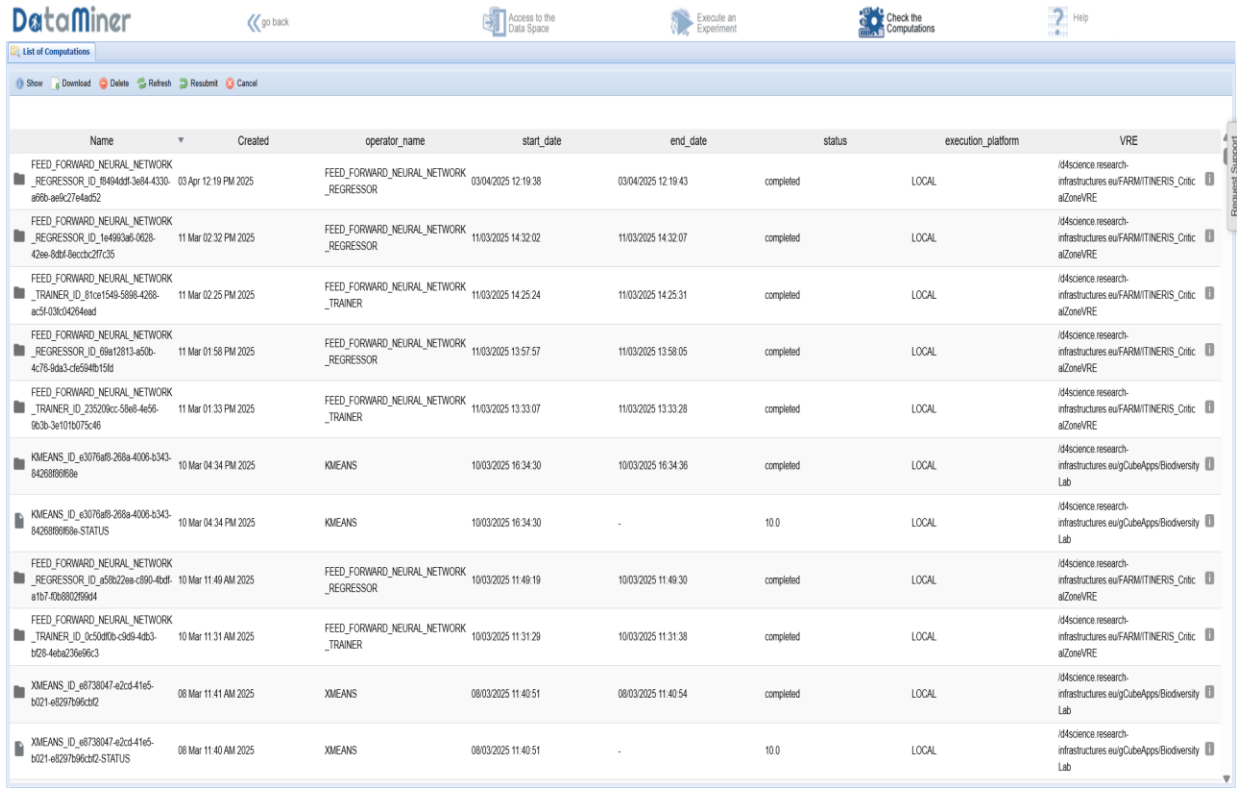




LifeWatch ERIC High Mountains Working Group

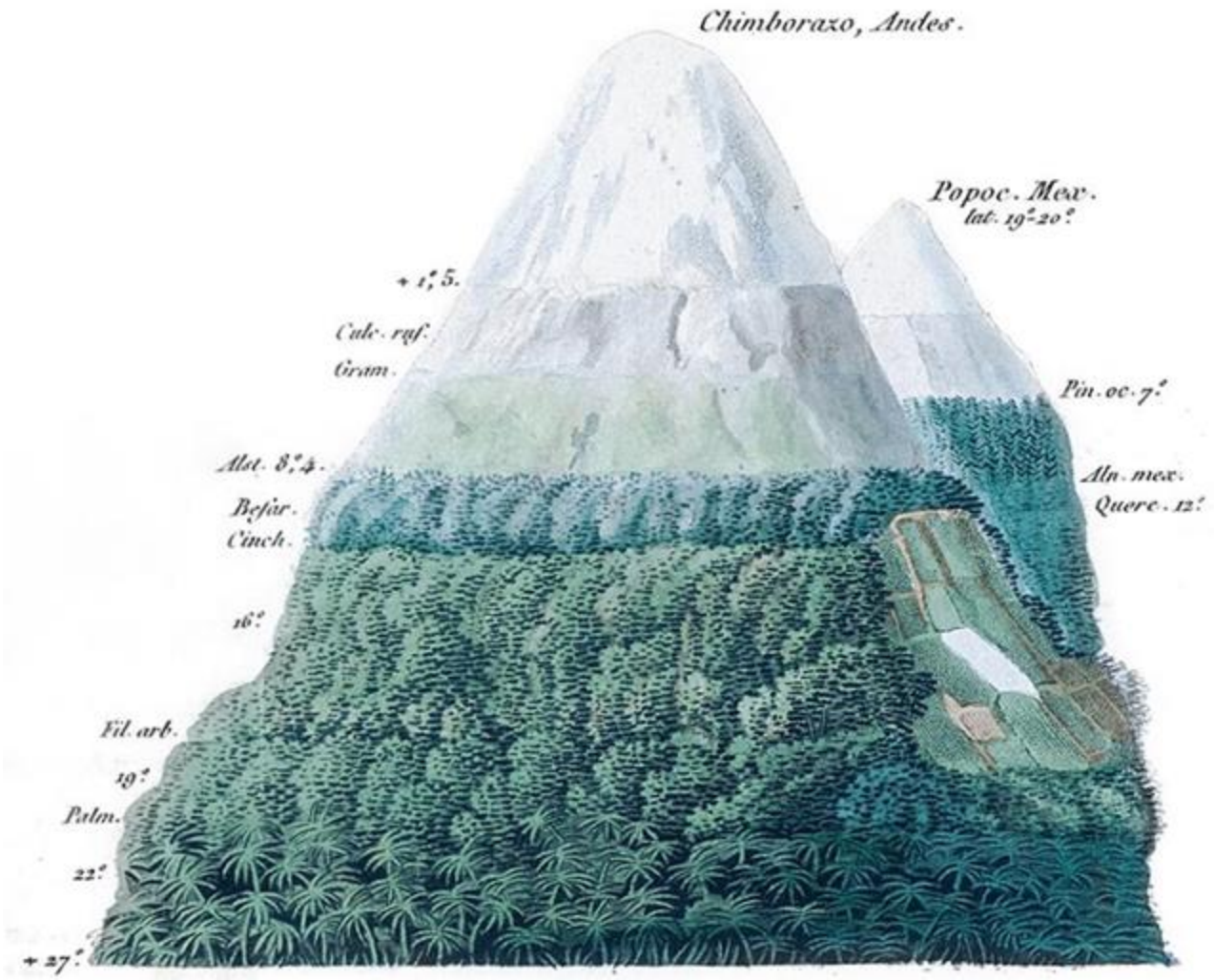


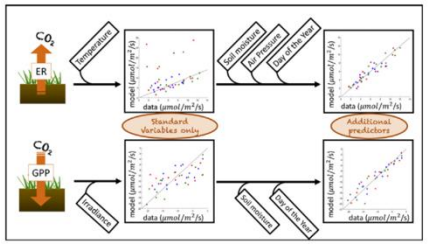
ILLUSTRATION: ALEXANDER VON HUMBOLDT/LIBRARY OF CONGRESS

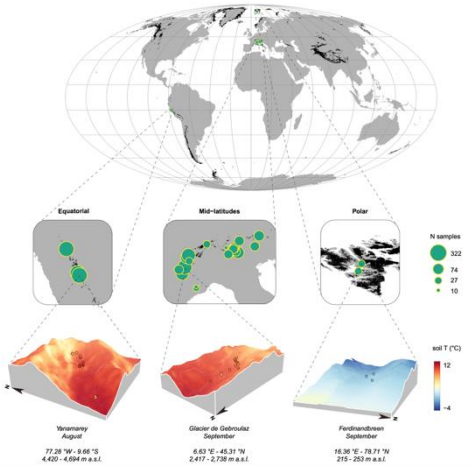
EuroGEO Action Group «Biodiversity, Ecosystems and Geodiversity»

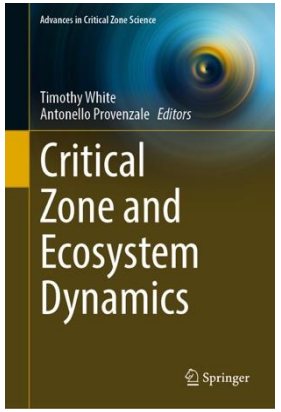
LifeWatch ERIC supporting mountain research: Tools and services for the changing Mountain Critical Zone

Data, analysis methods and models for assessing changes in the Mountain CZ

LifeWatch ERIC supports a full Virtual Research Environment on the mountain Critical Zone and its changes, linking to existing information, implementing data analysis and visualization tools and developing new modelling methods, from correlation-based models to process-based approaches, and providing the knowledge framework for implementing digital twins of specific mountain environments.

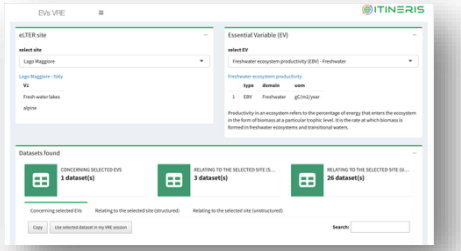




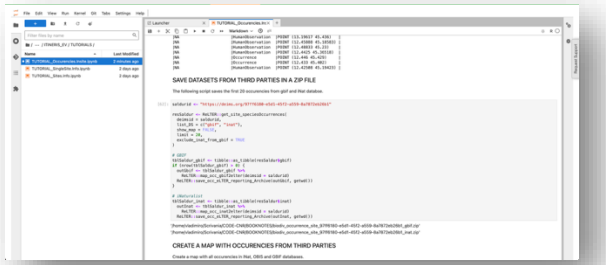


Objectives of the Essential Variables VRE

- To ease EV-dataset-related activities for VRE members by means of an **interactive R Shiny web app.** Different users can find, select, visualize and share datasets related to Essential Variables (EVs).



- To constitute a place where **executable and documented scripts of analysis of EV data** can be collected, written, shared and reused.



EV VRE components

ITINERIS

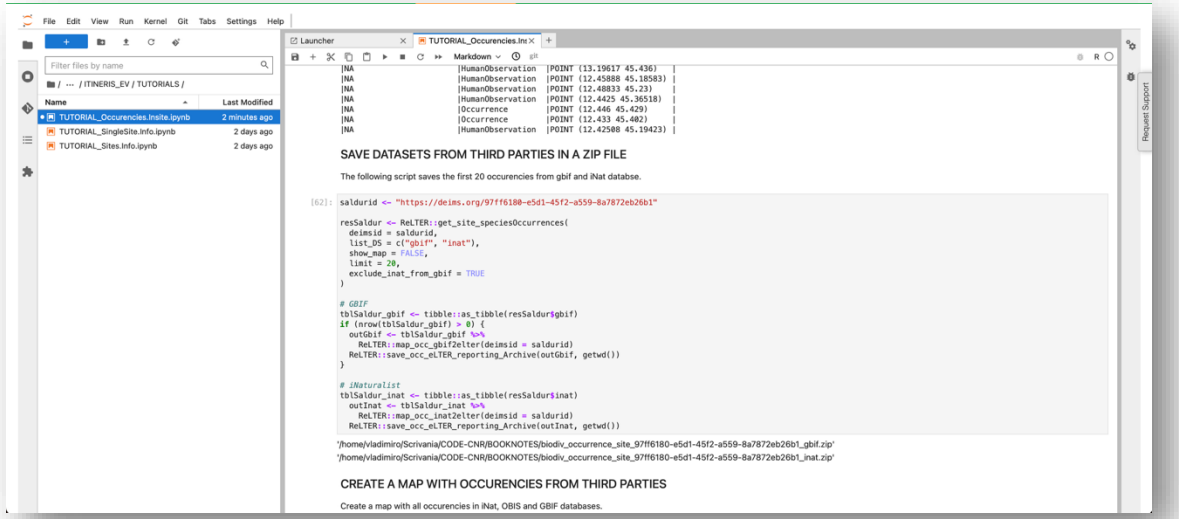
ITINERIS

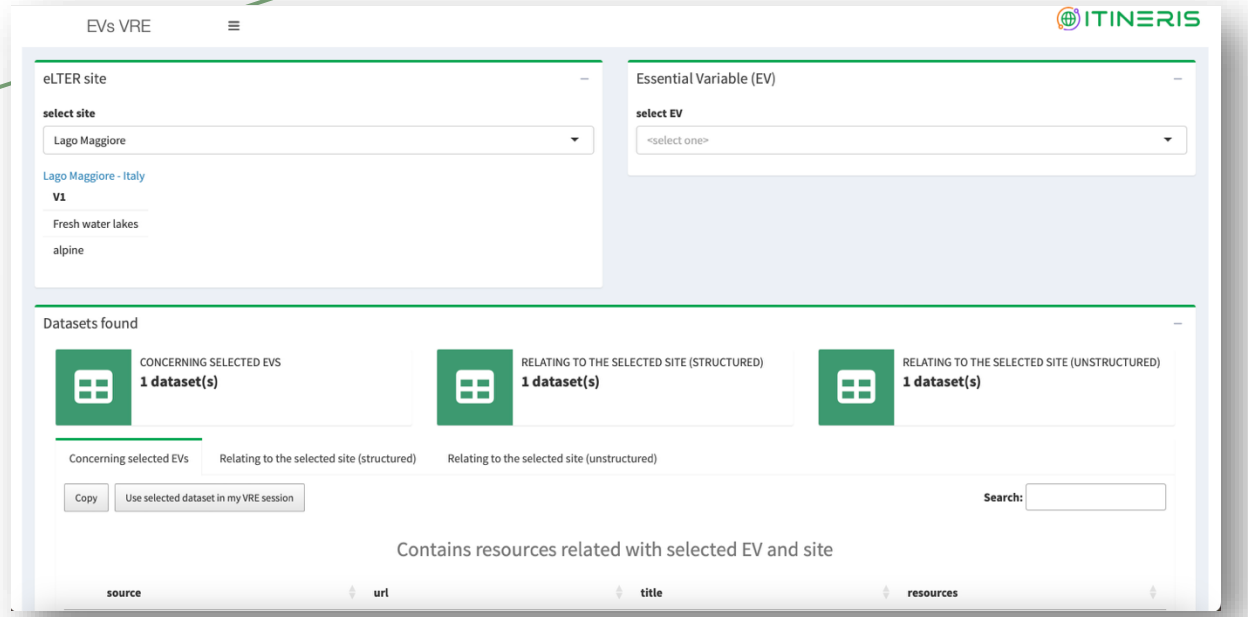
Go to 1 Alessandro Oggioni

ITINERIS EVs | Administration | Communication | Members | JupyterLab | RStudio | Spatial Data Services | How-tos

create an executable and documented script

share or reuse this analysis or data product

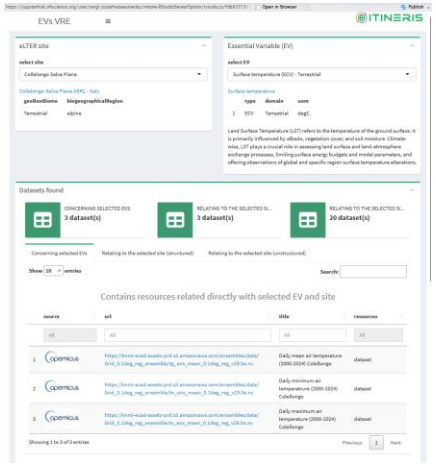




retrieval of datasets

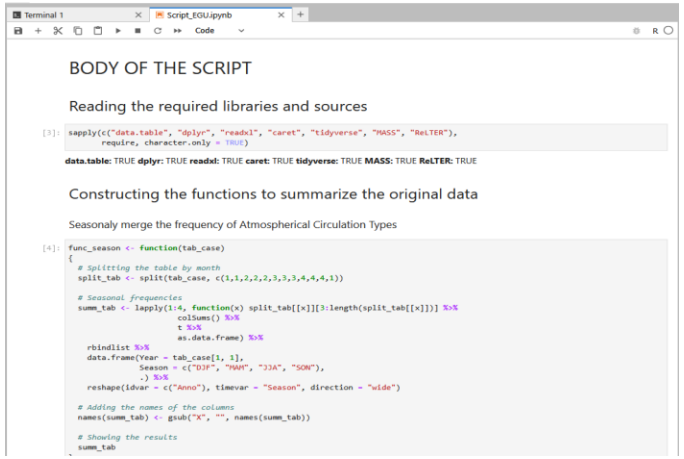
usage in analysis

Jupyter notebooks - real life workflow (eLTER Collelongo site)

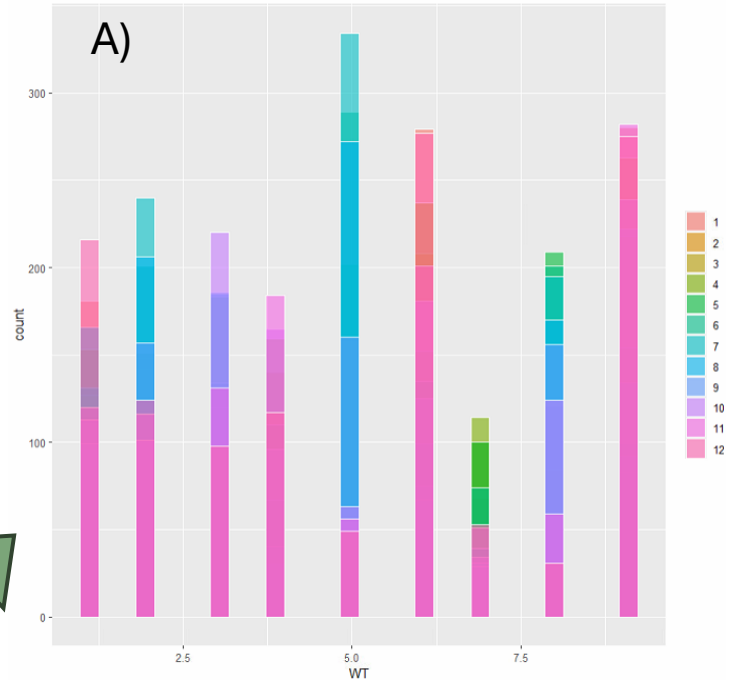


Download data from Shiny App

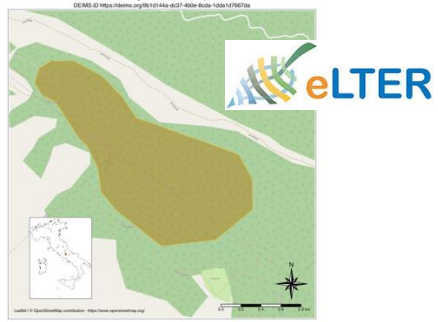
Include these in the VRE



Jupyter notebook



Result



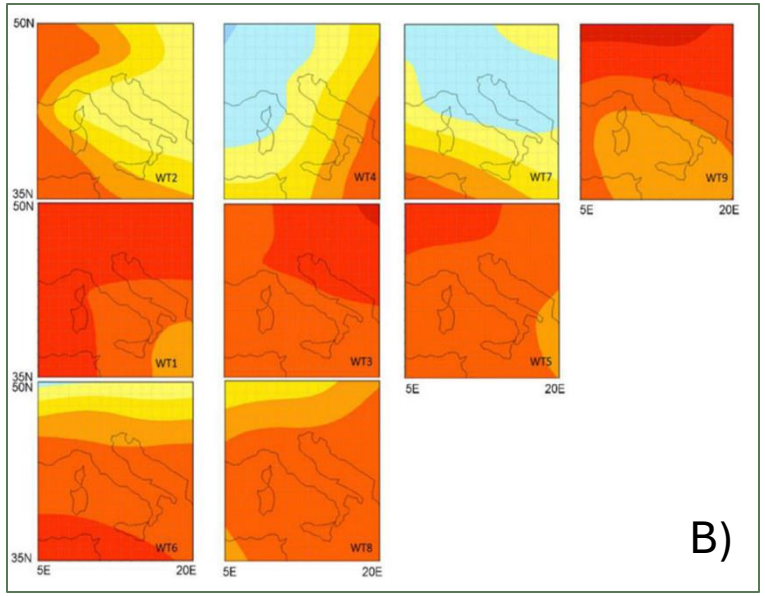


Figure 3. A) Monthly distribution of the Atmospheric Circulation types and B) Circulation type classification for Italy based on principal component methods(PCT) for precipitation.

VRE CARBON

IRET Montelibretti: Gaia Vaglio Laurin, Alessandro Sebastiani, Paolo Sconocchia
IRET Porano: Francesca Chiocchini, Gabriele Guidolotti, Irene Tunno
IRET Lecce: Flavio Monti, Teodoro Semeraro, Jessica Titocci, Lorenzo Liberatore

The VRE Carbon is the first digital environment dedicated to the Italian carbon balance and cycle.

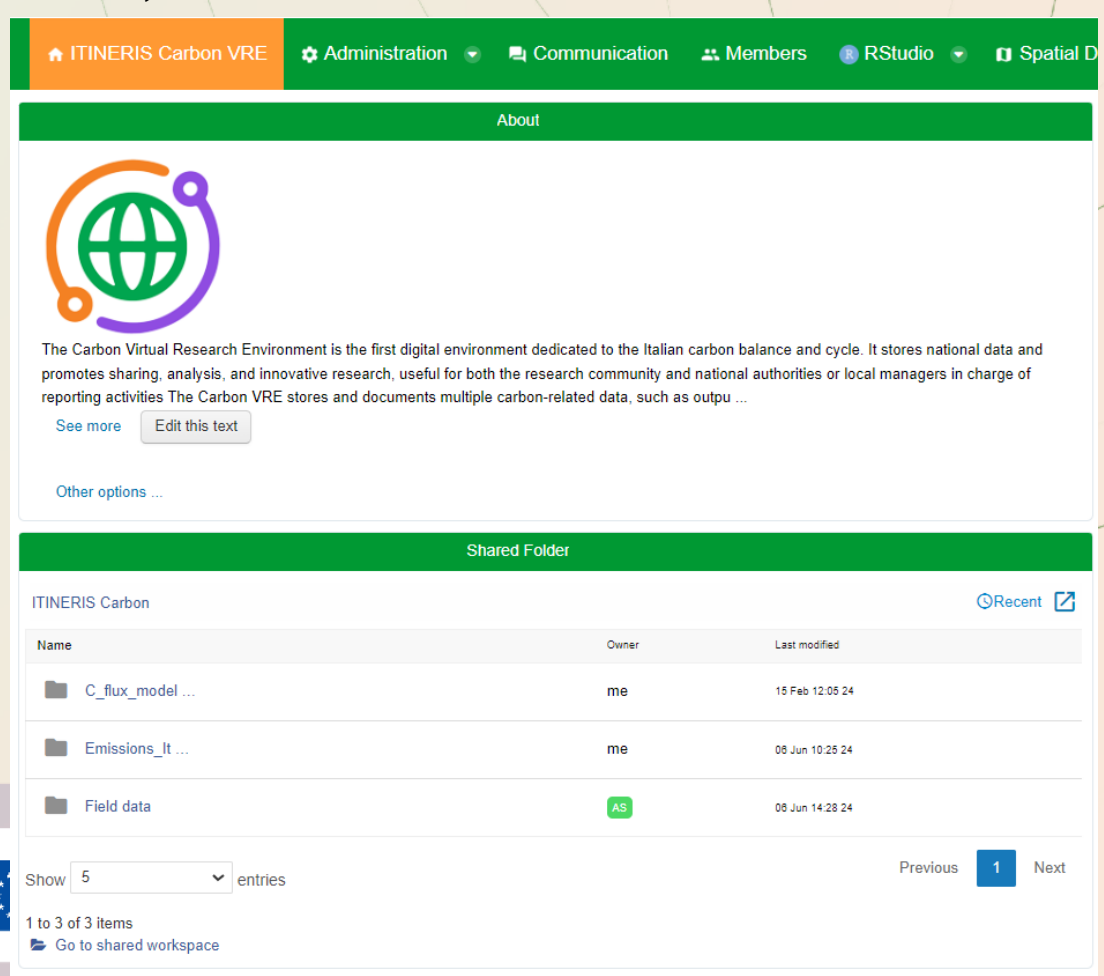
- Stores datasets and promotes sharing, analysis, innovative research, and facilitates reporting activities.
- Stores and documents spatially explicit C-related data:

- variables from large-scale models
- ground observations
- experimental modelling results

- Provides tools for on-demand geospatial analyses

The Carbon VRE integrates:

- a Geoserver to visualize and explore data;
- a Geonetwork reporting infographic and metadata
- analysis tools allowing user-specific processing, with links to RStudio and code.



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VRE CARBON

GPP, NEE, Ra for Italy

Data for Italy are derived by main modeling families:

- dataset at spatial resolution > 0.05°, in agreement with Italian landscape fragmentation
- monthly aggregated datasets for different years

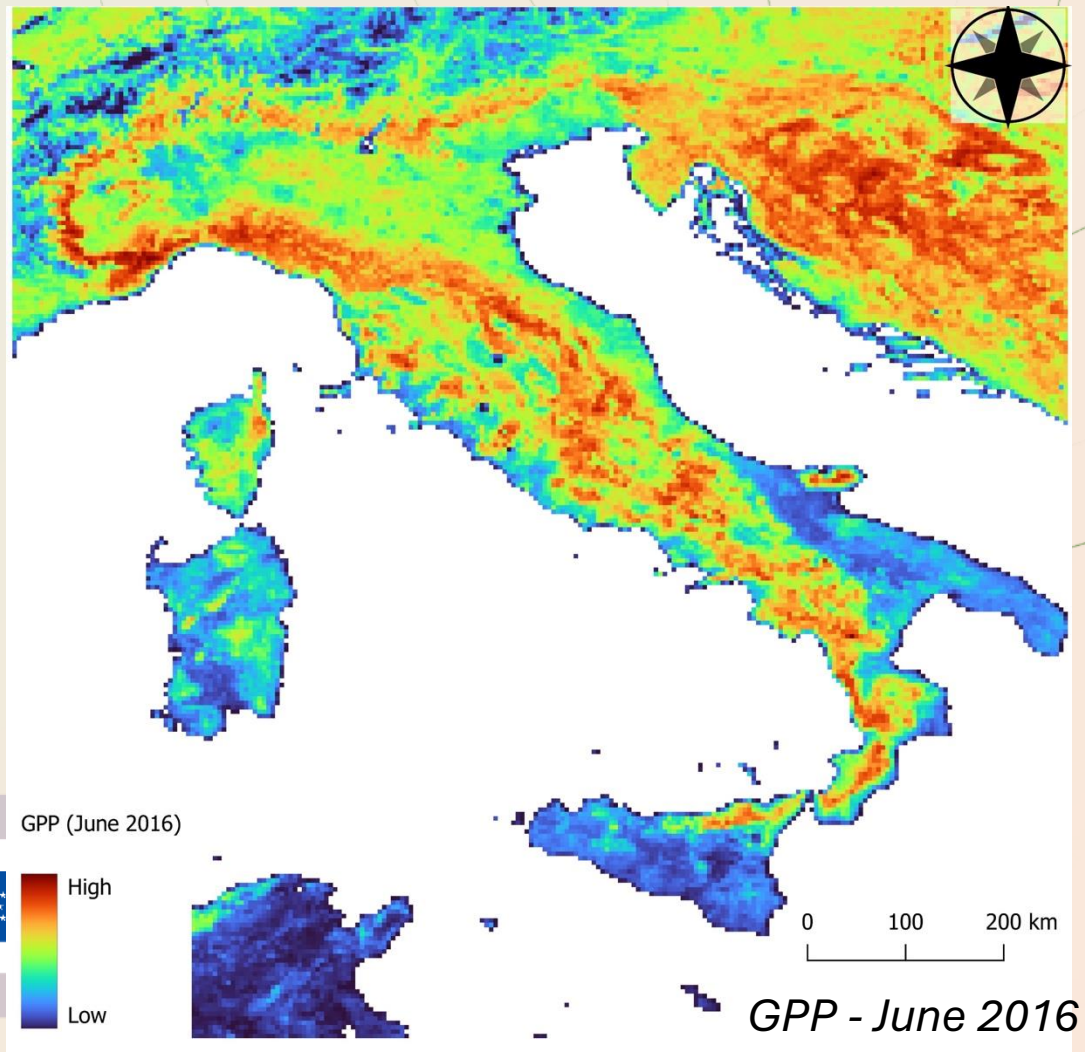
Now including 3 families and 144 monthly products:

- Fluxnet Ensamble Modeling products
- Vegetation Photosynthesis and Respiration Model
- Vegetation Photosynthesis model

Shared Folder

ITINERIS Carbon / C_flux_models_Italy

Name	Owner
FLUXCOM ensamble products	AS
Vegetation Photosynthesis and Respiration Model	me
Vegetation Photosynthesis Model	AS



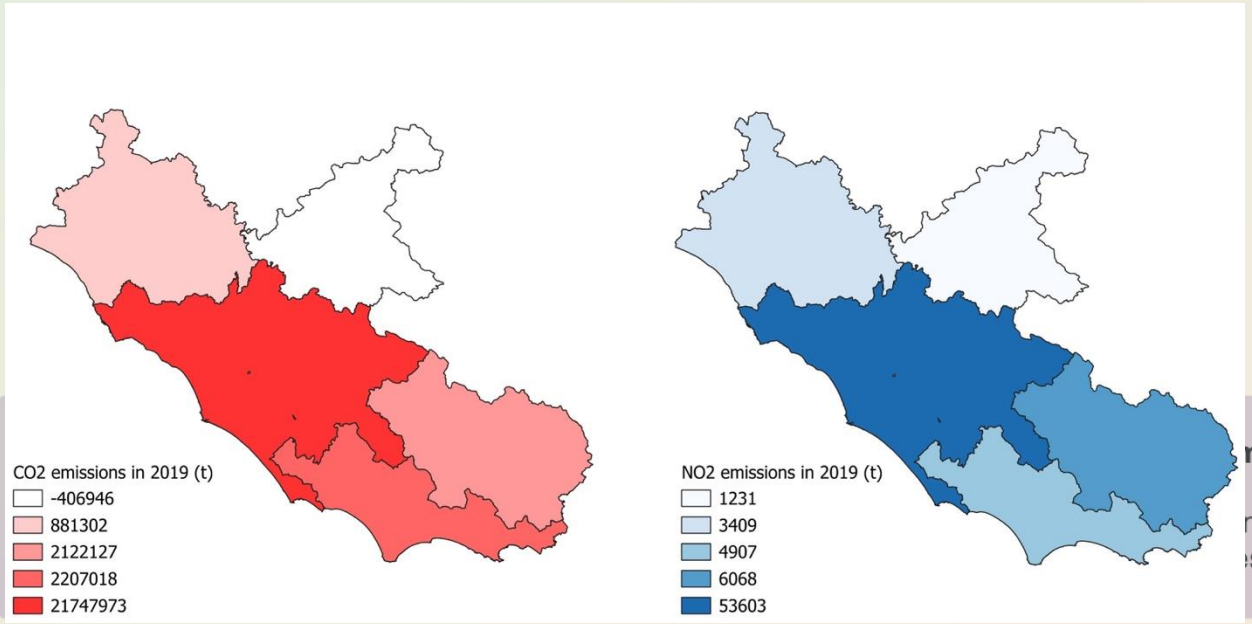
GPP - June 2016

VRE CARBON

Emissions

Data for Italy are derived by ISPRA

- spatialization of main GHG (NO+N2O, CO2, CO, CH4) at Province level with source characterization and grouped by temporal intervals since 1990



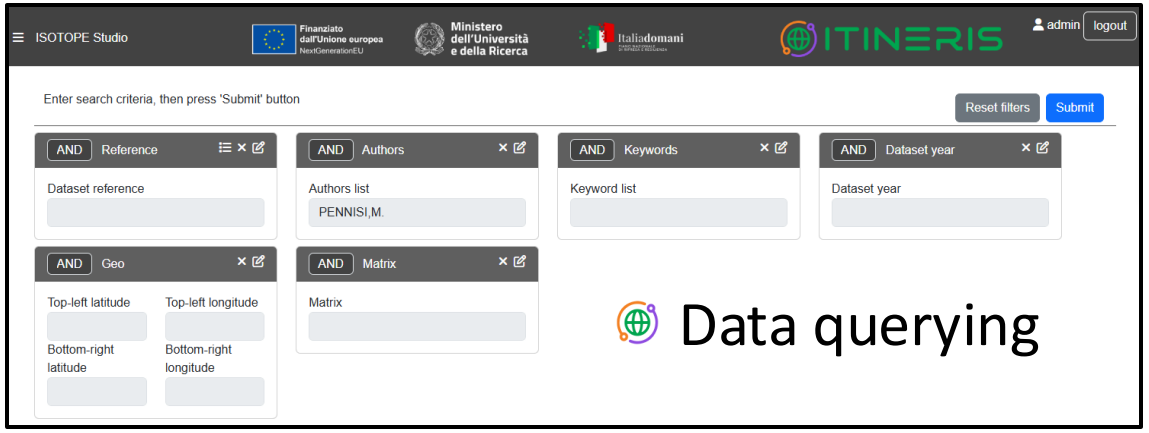
Ground data

Collaboration among IRET groups to collect new data for calibration and validation of experimental C aboveground biomass models based on SAR + optical remote sensing and machine learning in grasslands

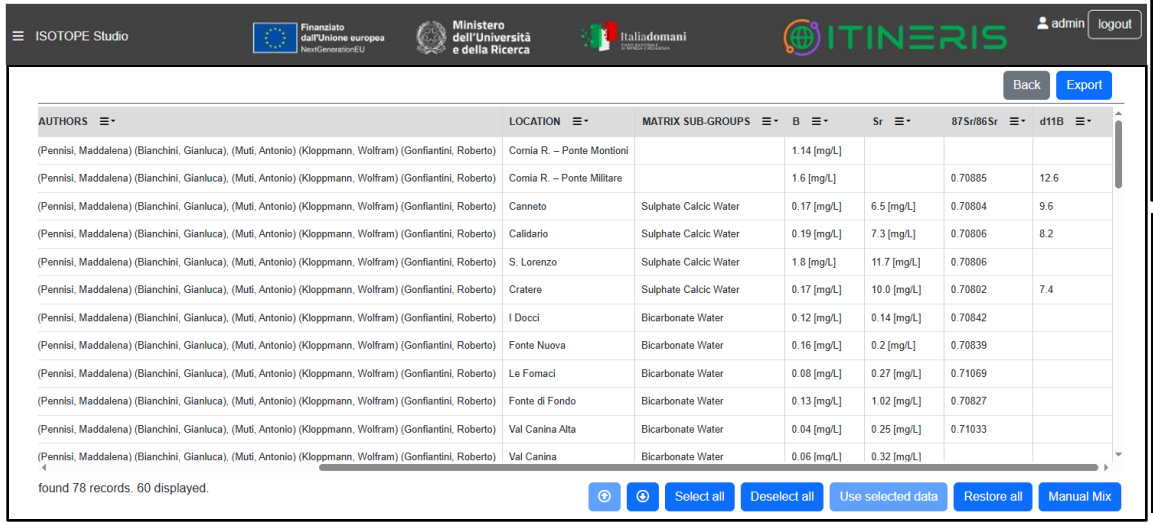
Finanziato dall'Unione europ
NextGenerationEU

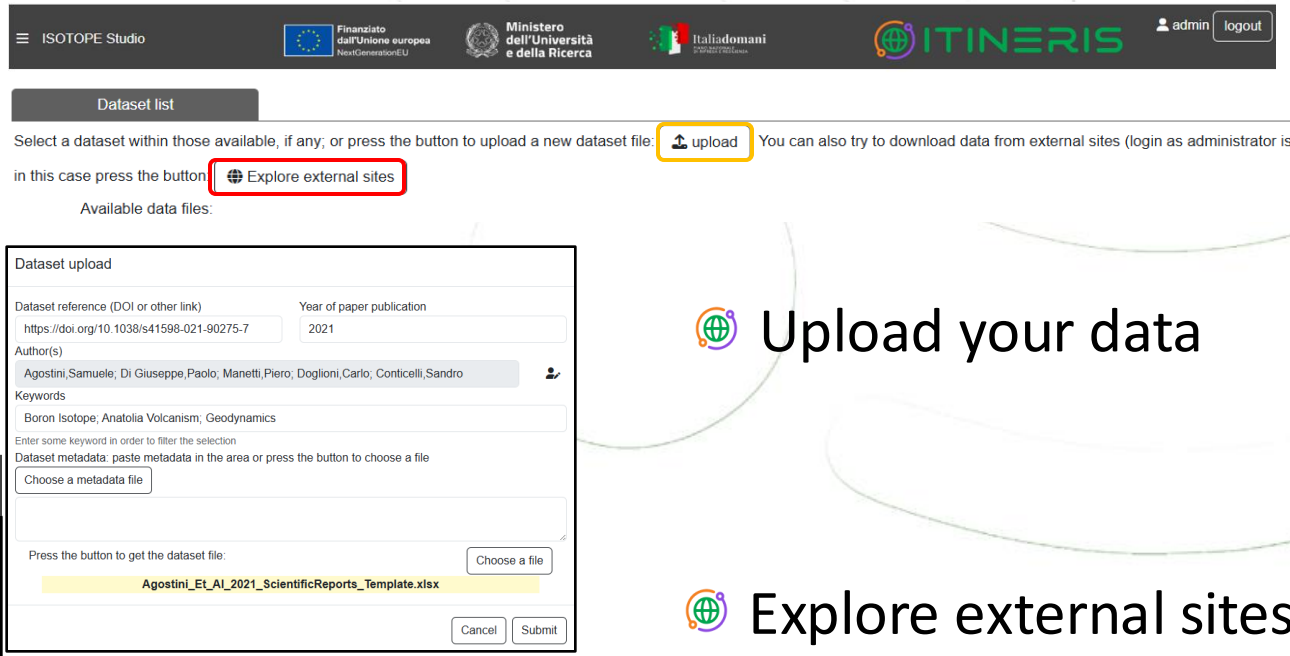
Isotope VRE

- ISOTOPE STUDIO is a web application implemented on the VRE and provides a REST API to enable interoperability with external applications



Data querying



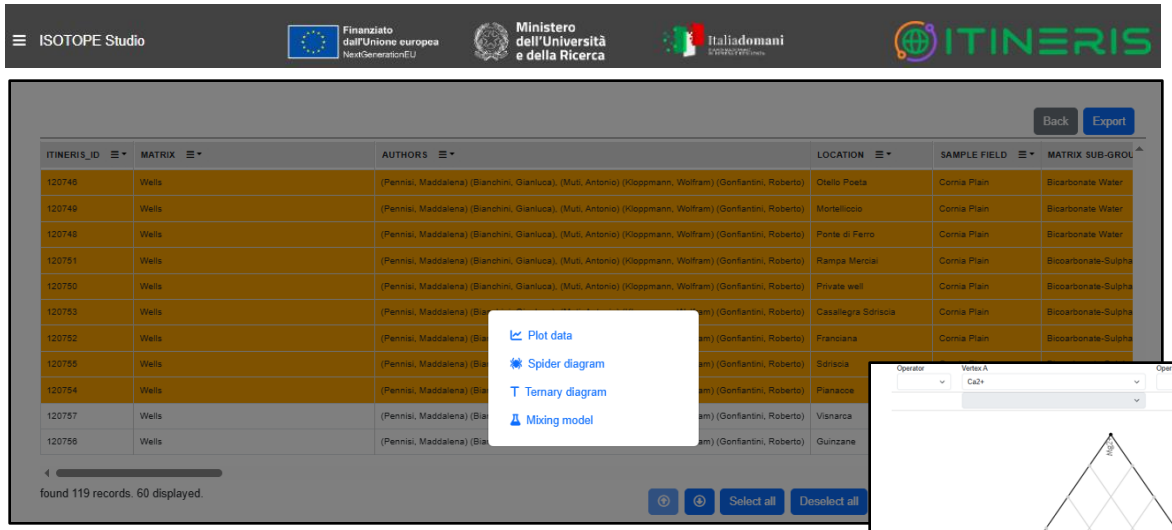


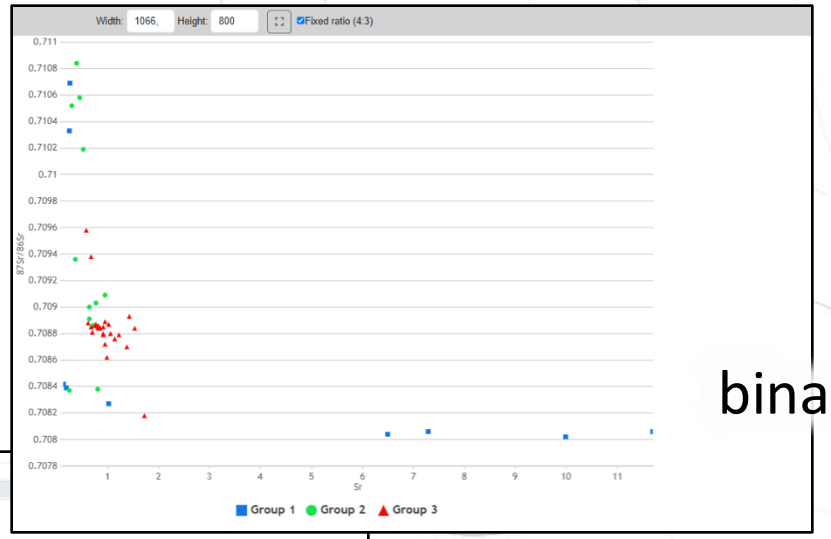
Upload your data

Explore external sites

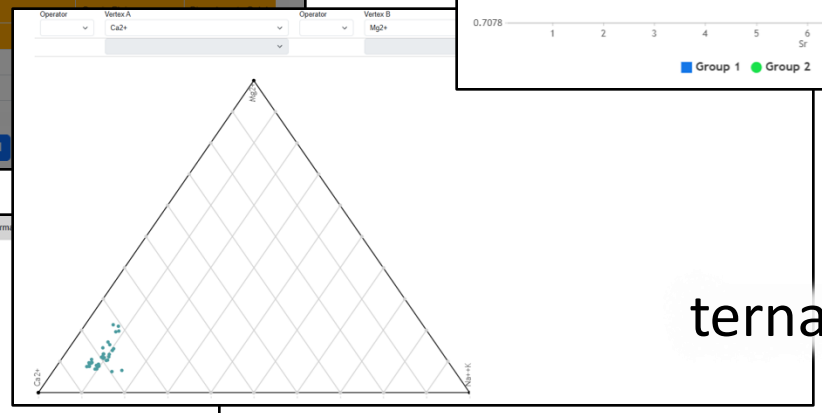
Isotope VRE

Select your data

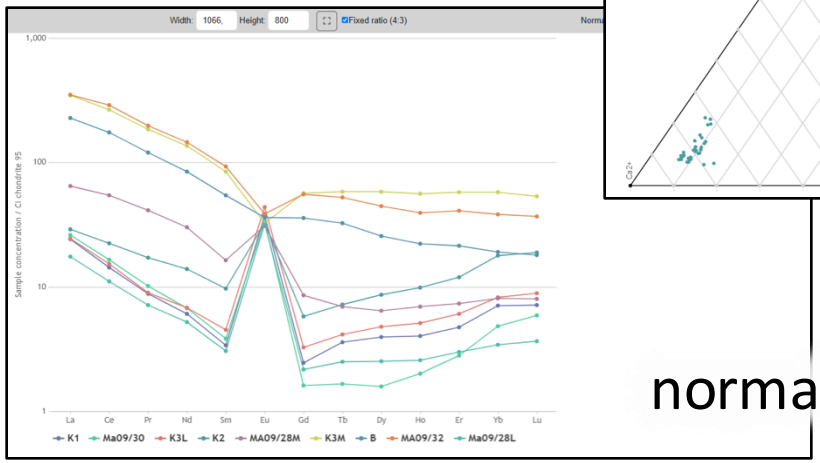




binary diagrams



ternary diagrams



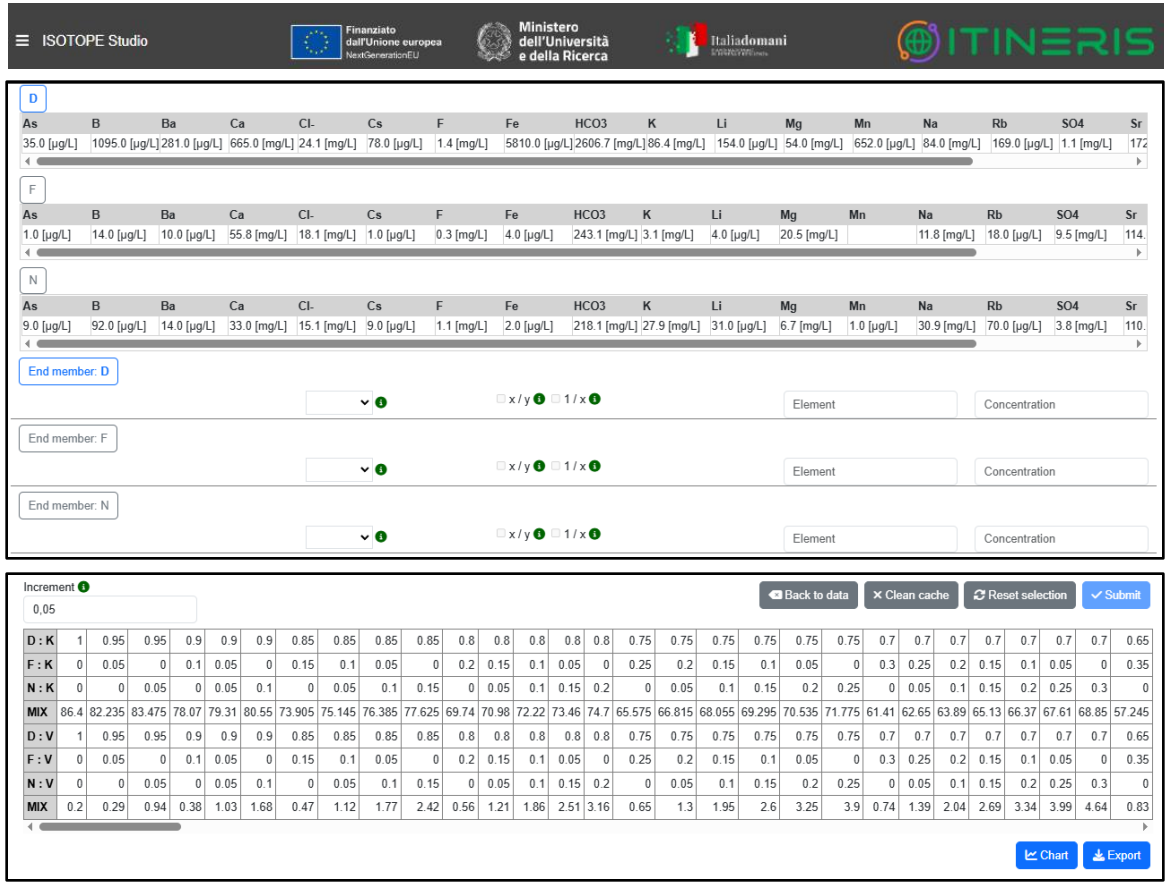
normalised diagrams

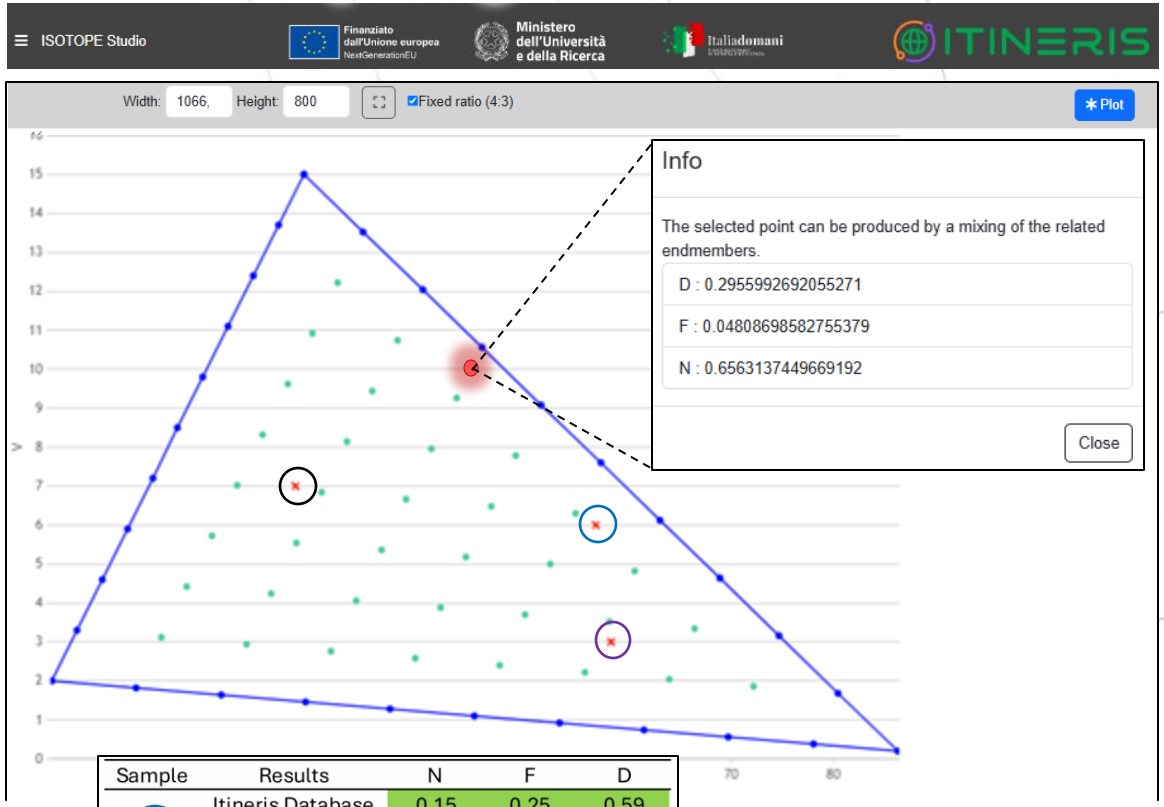
…and model your data!

Isotope VRE

Model your data!

ternary mixing





Sample	Results	N	F	D
#25	Itineris Database	0.15	0.25	0.59
	Cuoco Et al. (2021)	0.16	0.24	0.60
	EMMA	0.16	0.24	0.58
#17	Itineris Database	0.43	0.41	0.16
	Cuoco Et al. (2021)	0.44	0.41	0.15
	EMMA	0.44	0.41	0.15
#26	Itineris Database	0.38	0.09	0.53
	Cuoco Et al. (2021)	0.41	0.08	0.51
	EMMA	0.41	0.05	0.53

CLIMA VRE

Lagomarsino-Oneto D.[1], Lira-Loarca A.[2], Sciascia R.[1], Corgnati L.P.[1], Mantovani C.[1], Besio G.[2], Magaldi M.G.[1]

[1]National Research Council (CNR) – Institute of Marine Sciences (ISMAR), La Spezia, Italy,
[2]University of Genoa (UNIGE), Department of Civil, Chemical and Environmental Engineering (DICCA), Genoa, Italy

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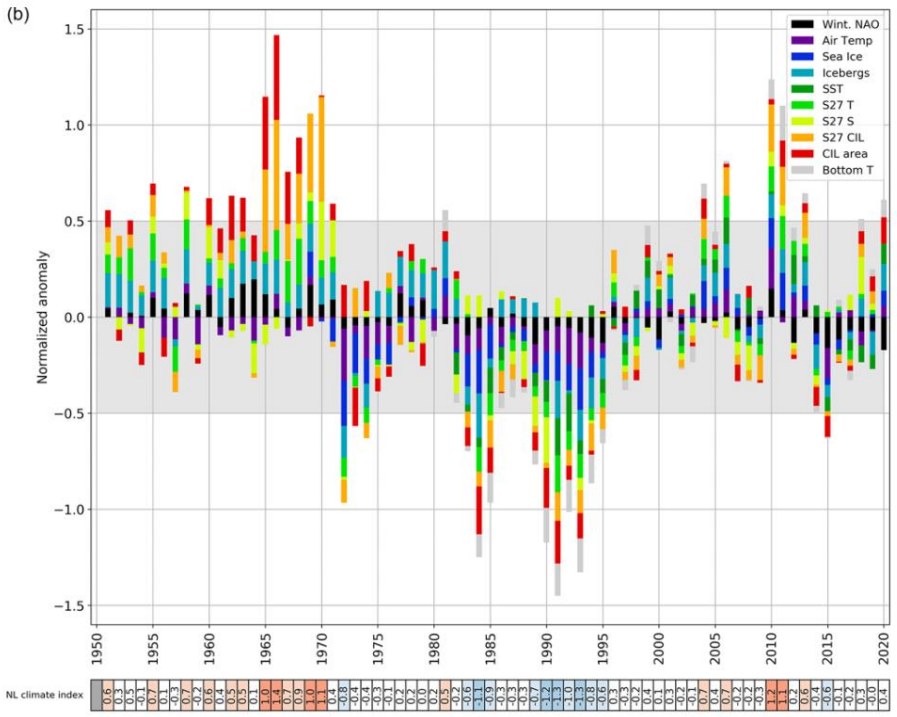
Ministero dell'Università e della Ricerca
Italiadomani

CLIMA VRE

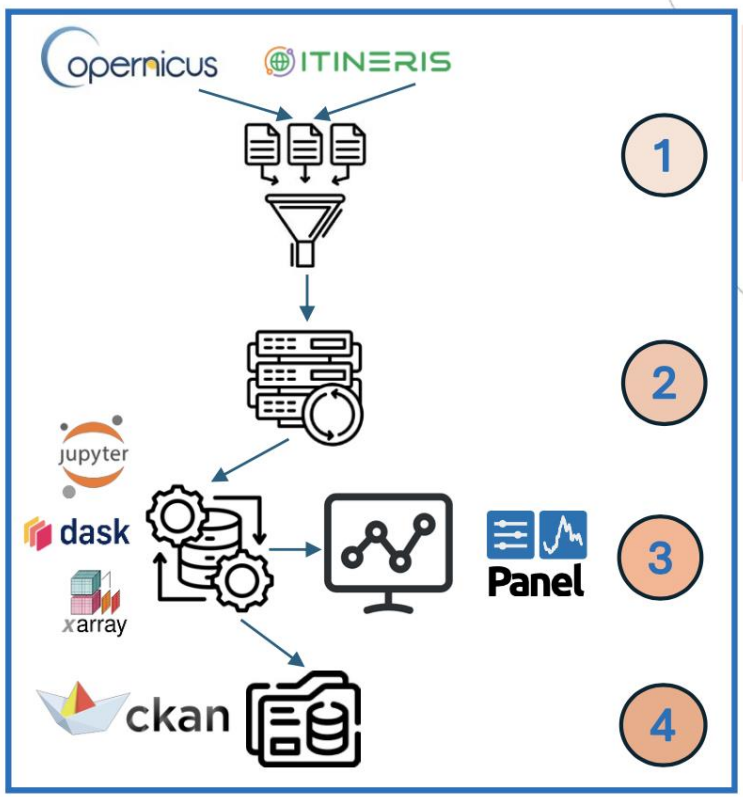
In CLIMA VRE we exploit Big Data and Cloud Technologies to investigate climatic variables and develop **climatic indices**

Variables can be combined together to produce an indicator for climatic changes of an area of interest



An example from *Cyr e Galbrath, 2021*
Newfoundland and Labrador area

A Typical dataflow



1. **DATA HARVESTING**:
   - Data from **COPERNICUS (+ ITINERIS** in near future)
   - **HUGE DATASETS** will be peculiar of CLIMA VRE

2. **DATA HARMONIZATION** (format, variable names, spatio-temporal alignment)

3. **DATA PROCESSING AND VISUALIZATION with interactive web application**:
   - We use python packages (xarray, dask) suited for **DISTRIBUTED CALCULUS** and **BIG DATA.**
   - Interactive GUI developed

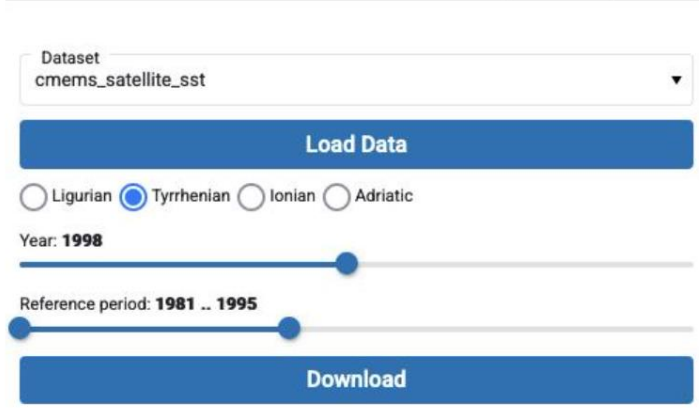
4. Publish in catalogue

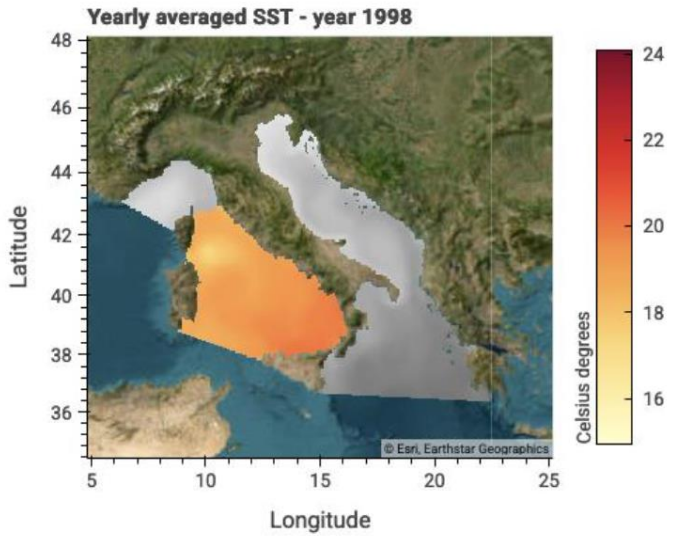
CLIMA VRE: Interactive Analysis of Italian Seas SST Anomaly

Users interact with data through a panel of controllers to produce their customized analysis of Sea Surface Temperature (SST) across Italian Seas

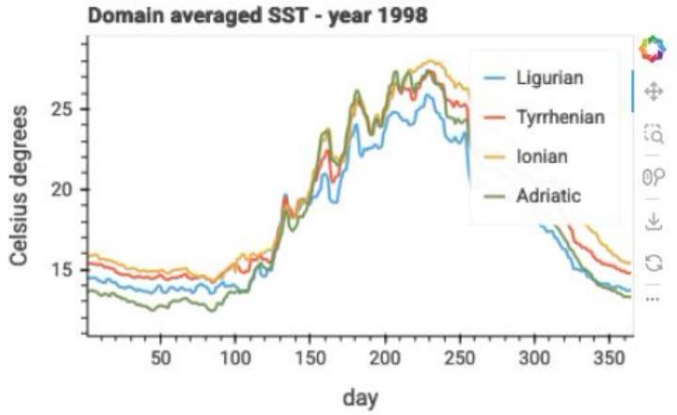
Customizable:

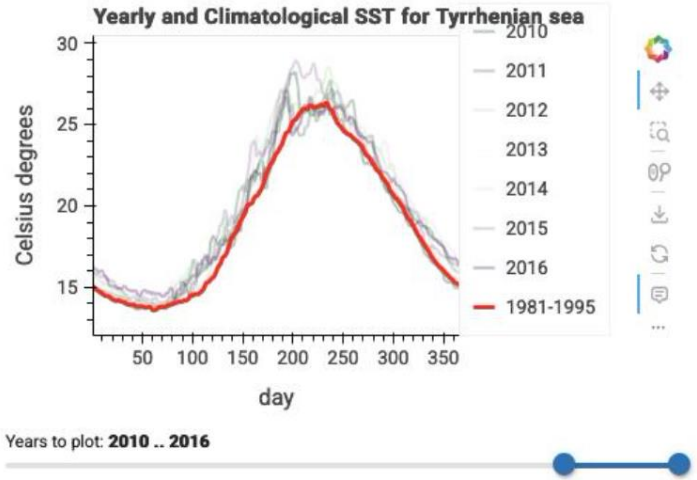
- Basin of interest
- Year for plotting
- Reference period for Climatology





Basin-averaged SST time series can be visualized and compared with a custom climatological average

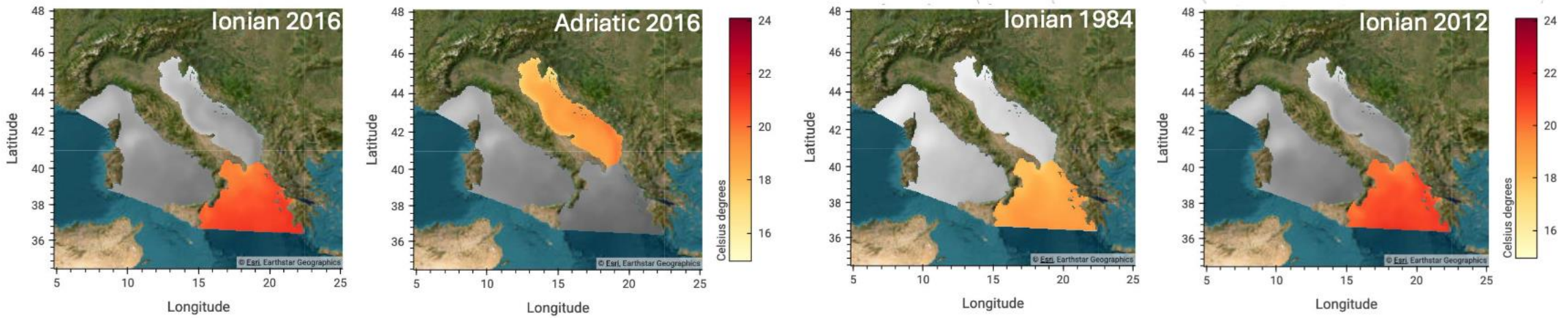




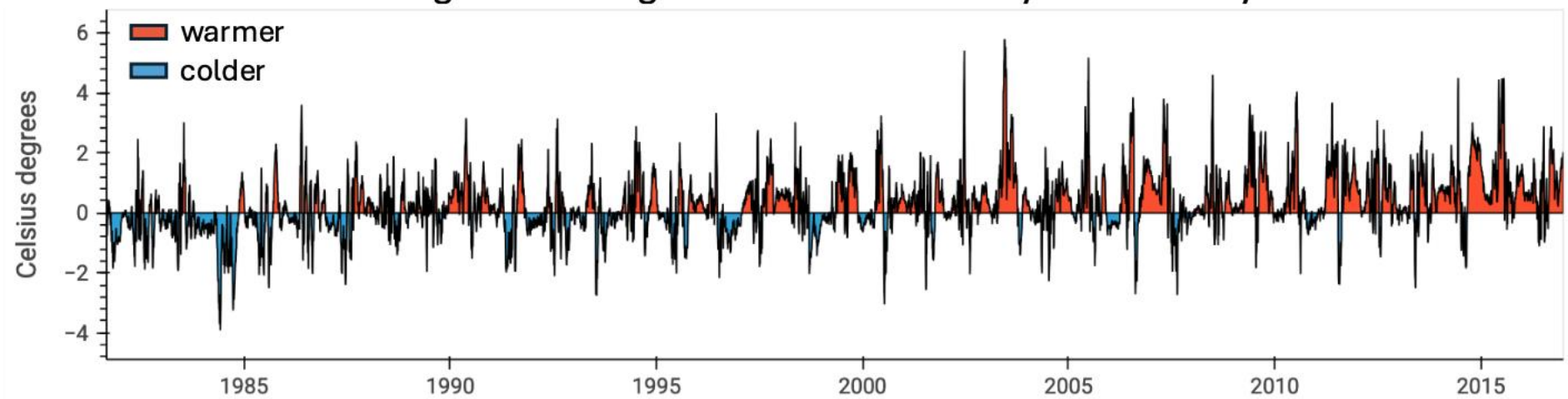
CLIMA VRE: Interactive Analysis of Italian Seas SST Anomaly

Example analysis

cross-basin/cross-year comparison



warming trend on Ligurian Sea as showed by SST Anomaly



Downstream VRE

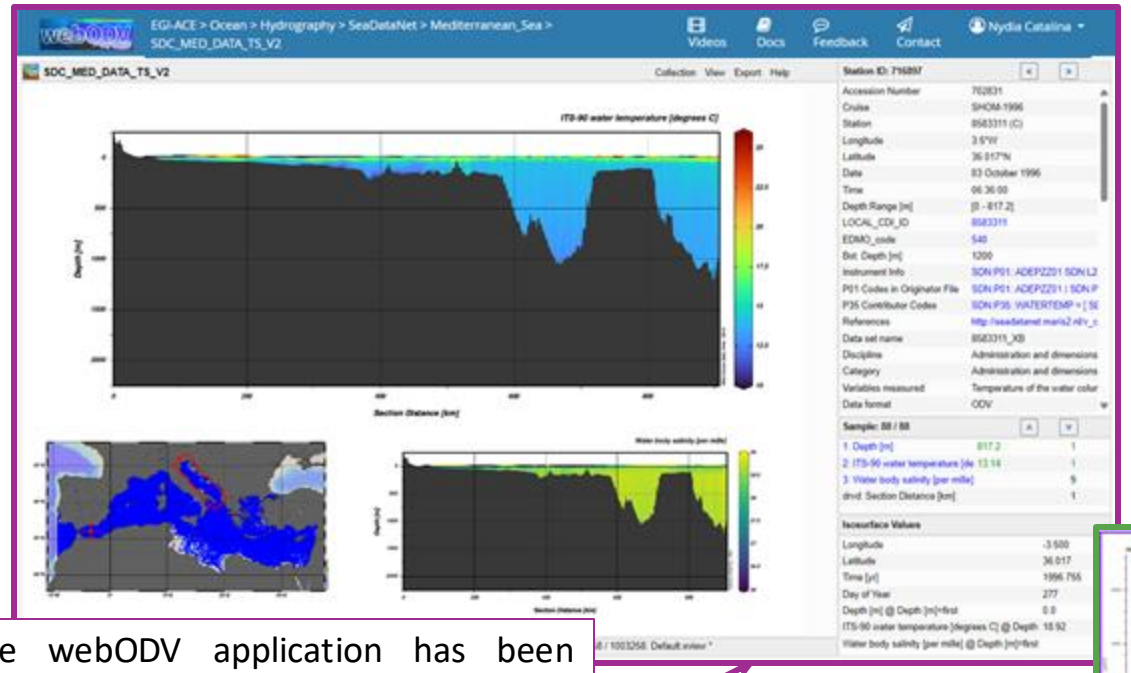
https://itineris.d4science.org/group/itineris_downstream_vre

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”

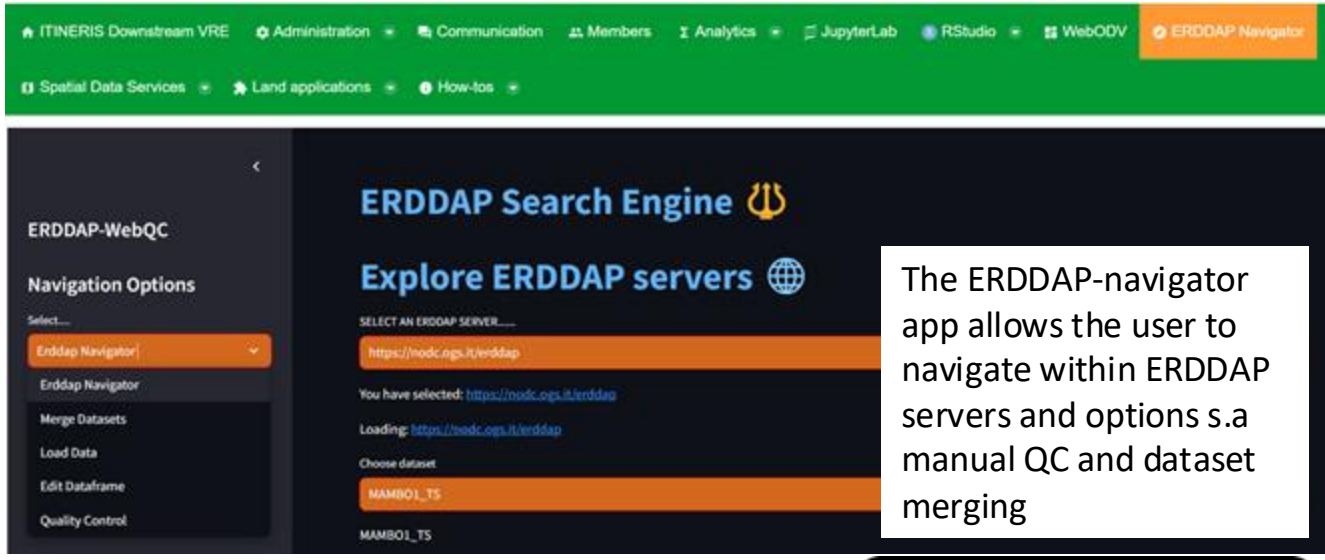
Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani

Marine Domain

The marine domain toolbox focalizes in carbon cycling and acidification data available in the North Adriatic Sea mainly pH, pCO2, fCO2, temperature and salinity within the different Ris in the ITINERIS project.

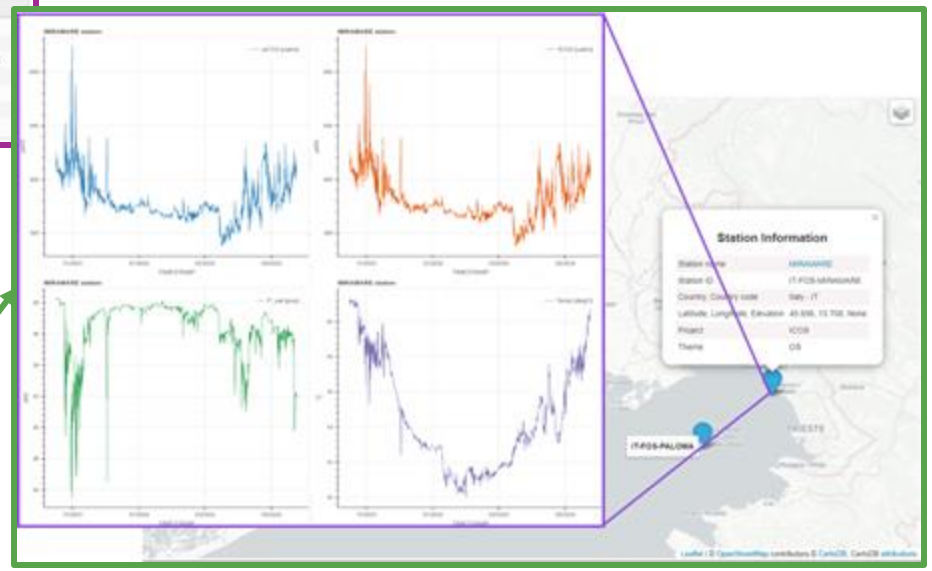


The webODV application has been linked to the Downstream VRE for data extraction, analysis, exploration and visualization restricted for Argo (TS & BGC) and SeaDataNet (TS) products.



The ERDDAP-navigator app allows the user to navigate within ERDDAP servers and options s.a manual QC and dataset merging

Implementing the ICOScp python library in the VRE by means of jupyter notebooks allows the user to explore ICOS data. ICOScp shows OGS station (IT-FOS-MIRAMARE) use case.



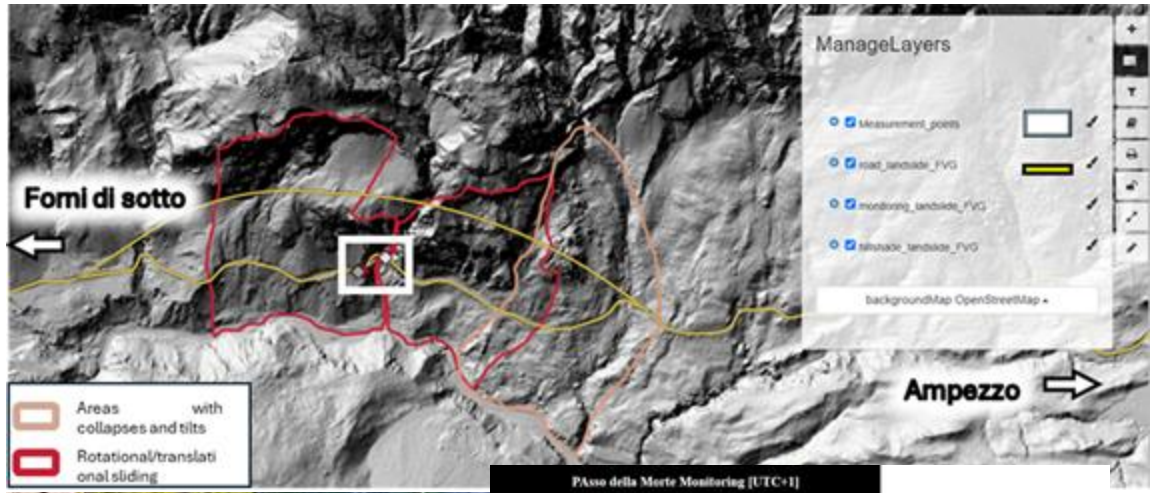
TRY ME

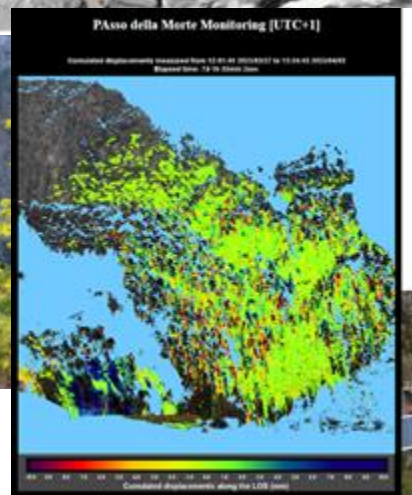
https://itineris.d4science.org/group/itineris_downstream_vre

Land Domain

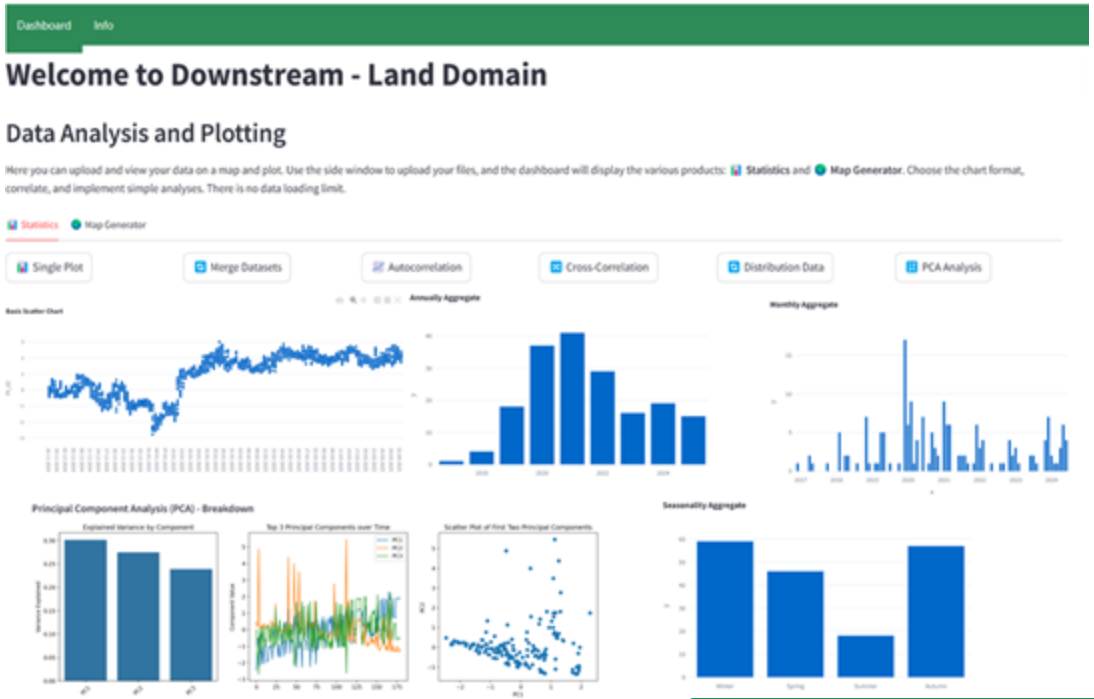
Geoserver, Geonetwork and monitoring systems

A geoserver and geonetwork have been implemented hosting regional and local scale. By means of Downstream VRE it is possible to see currently monitoring systems which have been installed at Passo della Morte close to Forni di Sotto (UD) to delineate possible ground instabilities.





Land instability application



To quickly analyze time series, an application was created with the help of Streamlit with python language. The application allows you to create graphs, make analyses (merge datasets, auto-correlation, cross-correlation, seasonality, PCA) and map the data in csv, txt and xlsx format.

- Expeditious analysis
- Upload one or more data
- Analyze data by means of Statistics or Map Generator
- Different analysis can be chosen
- Downloable data plot

https://itineris.d4science.org/group/itineris_downstream_vre

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

European Union

Lucia Mona – CNR-IMAA

ACTRIS Italian National Contact Point

ACTRIS ARES (Aerosol Remote Sensing) DC unit

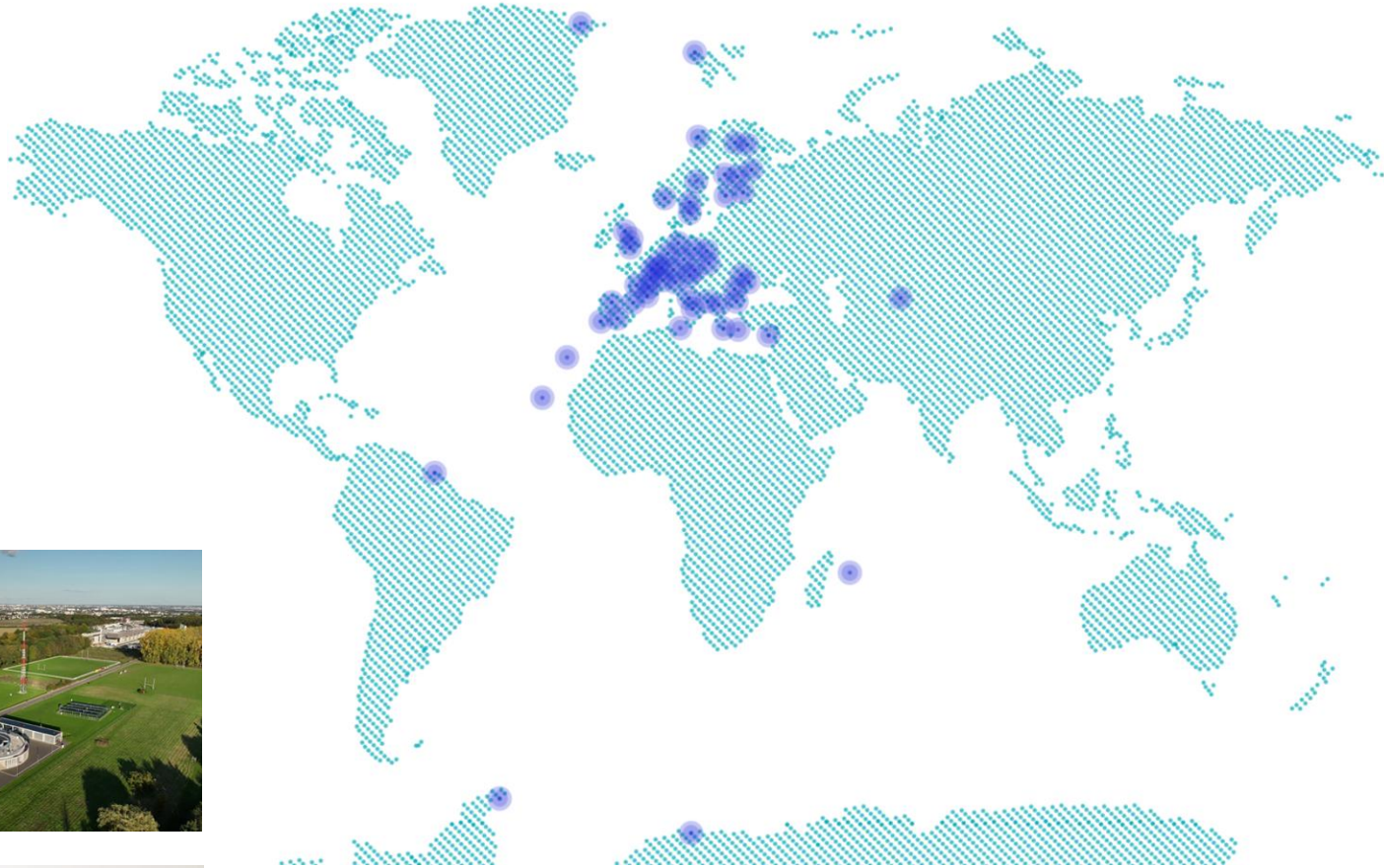
Click to edit Master title style

The Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS) is a pan-European research infrastructure having the goal to produce high-quality integrated datasets in the field of atmospheric sciences.
ACTRIS provides different services, including access to instrumented platforms, tailored for scientific and technological usage.

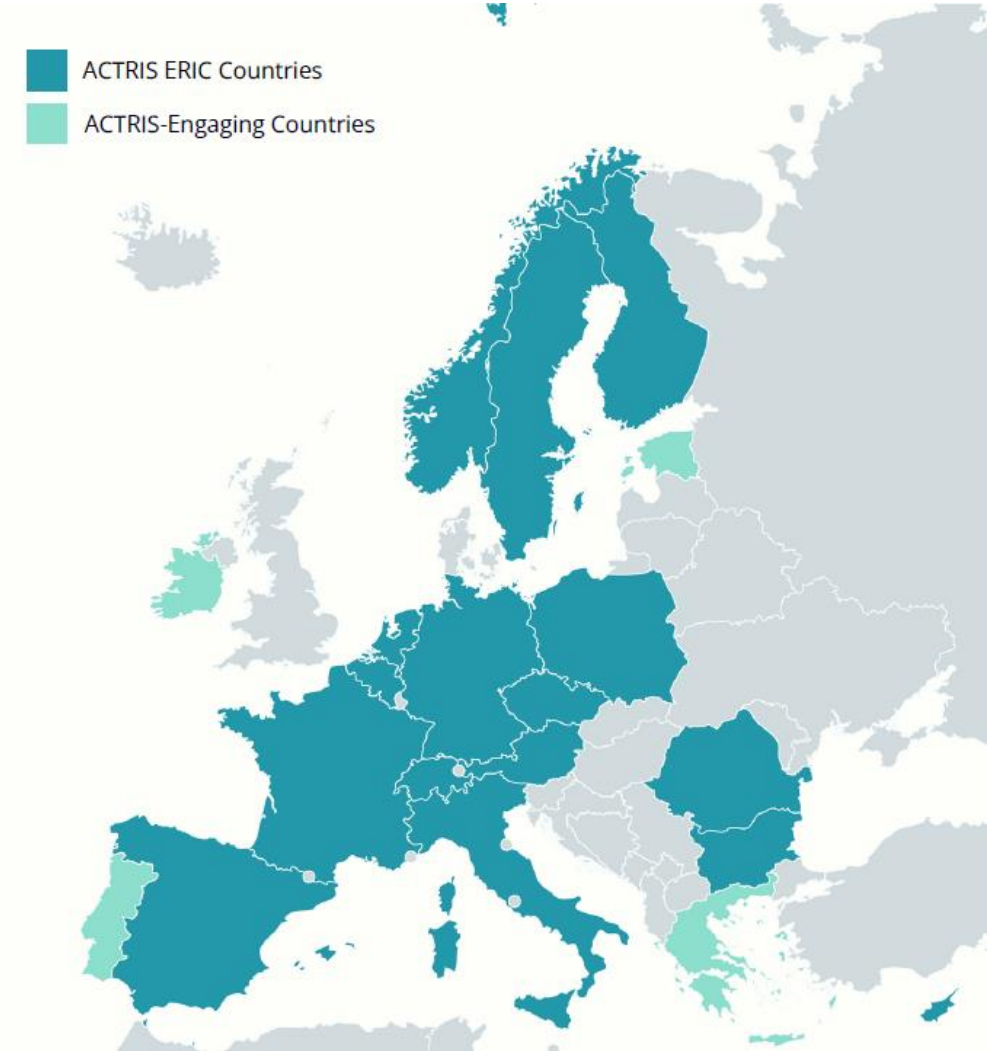
	In Situ	Remote Sensing
Aerosol		
Clouds		
Trace Gases		

ACTRIS at a Glance

- **A**erosol, **C**louds, and **T**race Gases **RIS**
- Consortium of 17 EU countries
- 100+ atmospheric facilities
- Observatory and Exploratory Platforms
- In Situ and Remote Sensing techniques



ACTRIS ERIC established on 25th April 2023



16 member countries: Austria Belgium Bulgaria Czechia Cyprus Denmark Finland France Germany Italy Netherlands Norway Poland Romania Spain Sweden

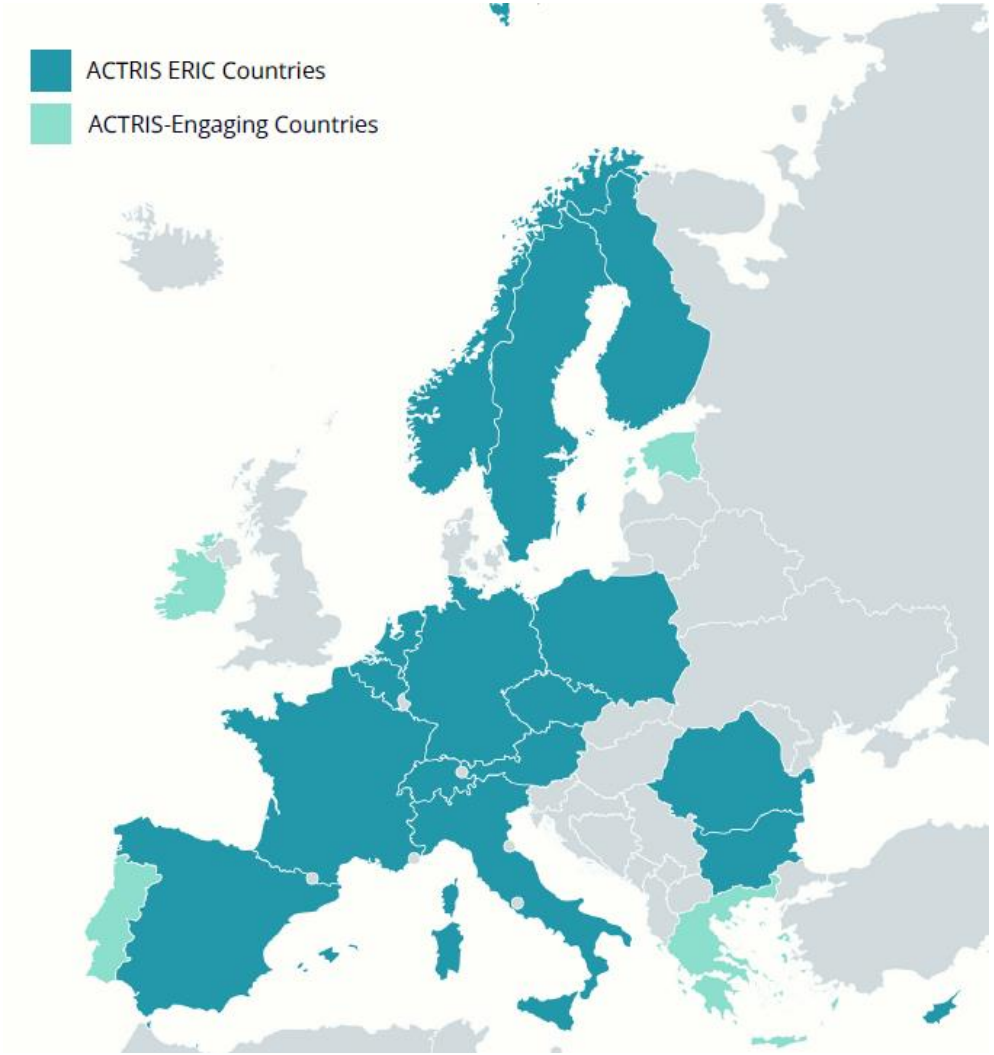
One permanent observer:
Switzerland

One in membership process:
Greece

Three in negotiation process:
Estonia Ireland Portugal

ACTRIS Countries

ACTRIS Community Handbook 2025.
A Collaborative Network.



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Switzerland

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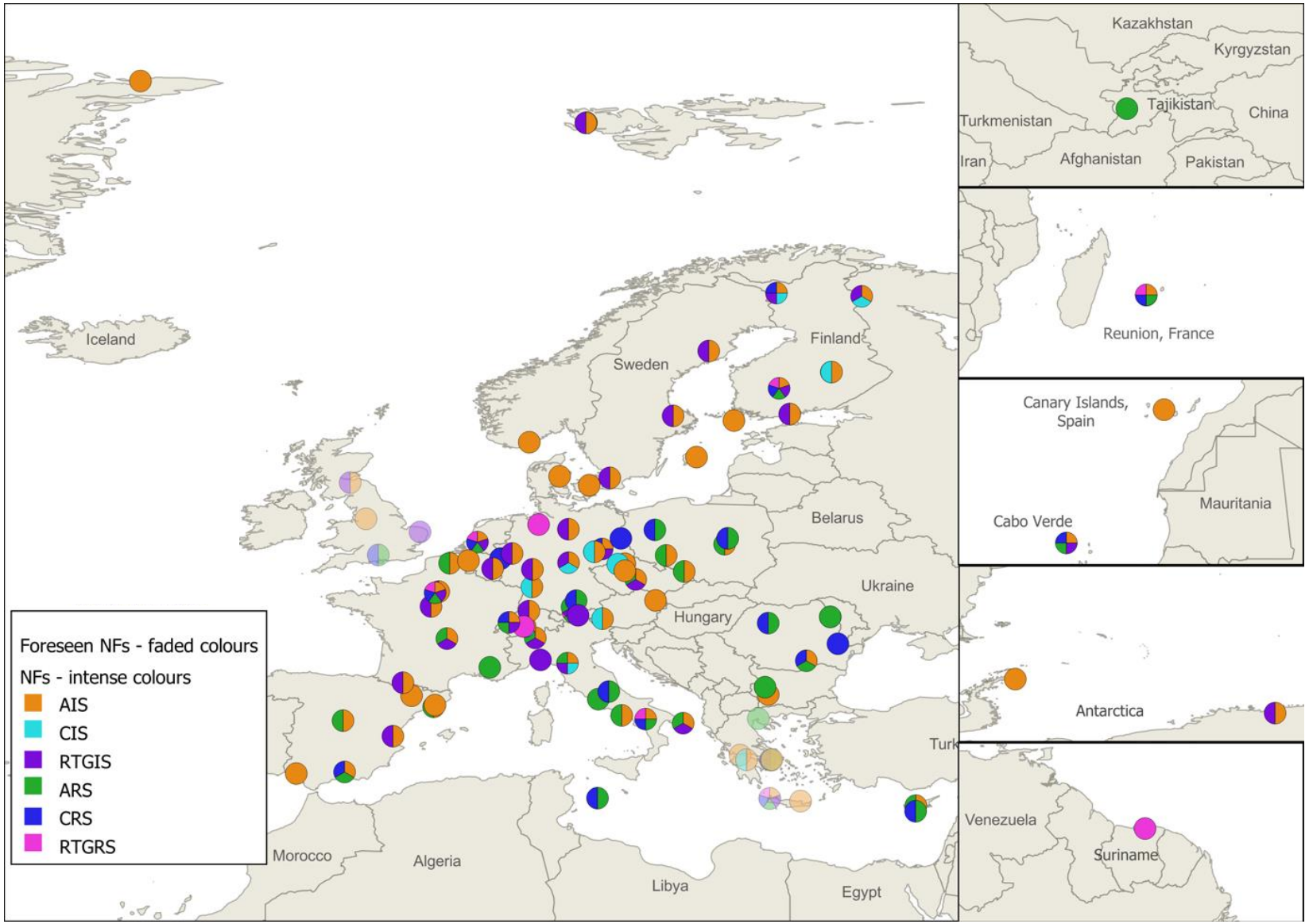
Estonia Ireland Portugal

ACTRIS NATIONAL FACILITIES – THE BACKBONE OF THE RI



80 **Observatory Platforms**

Fixed ground-based stations delivering long-term high-quality data on aerosol, clouds and trace gases via remote-sensing and in situ measurement techniques.

ACTRIS NATIONAL FACILITIES – THE BACKBONE OF THE RI

30+ Exploratory Platforms

Atmospheric simulation chambers, **laboratories** and **mobile platforms** that perform dedicated experiments and campaigns.

ACTRIS Multi-dimension operational structure and workflows

Harmonized methods → Calibrated Instruments → Provision of data → Qualified data production → Curation of data → Access to users

ACTRIS Topical Centres

ACTRIS National Facilities

Exploratory

20 Simulation chambers

Observational

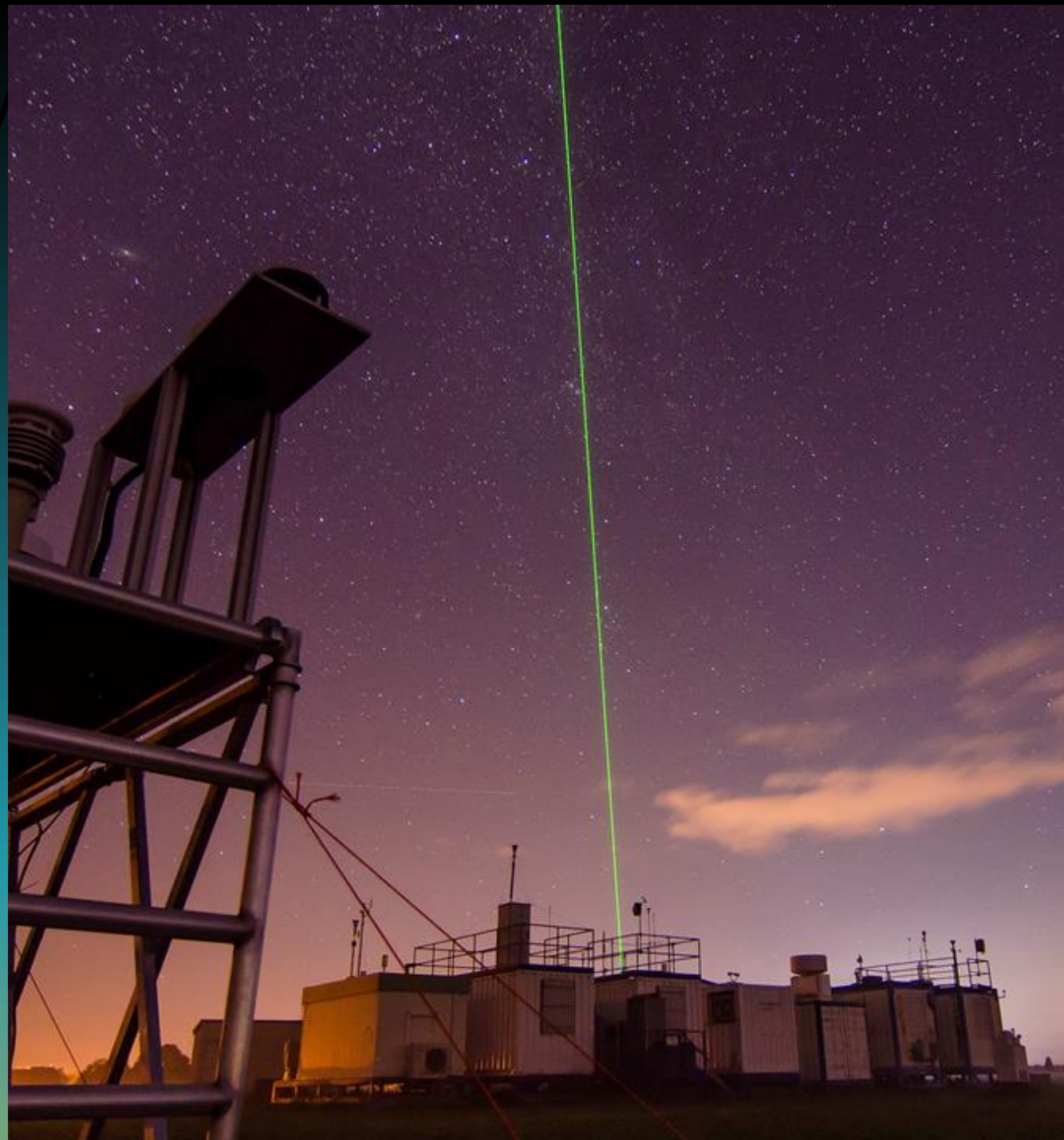
80 Facilities

Remote-Sensing

In-situ

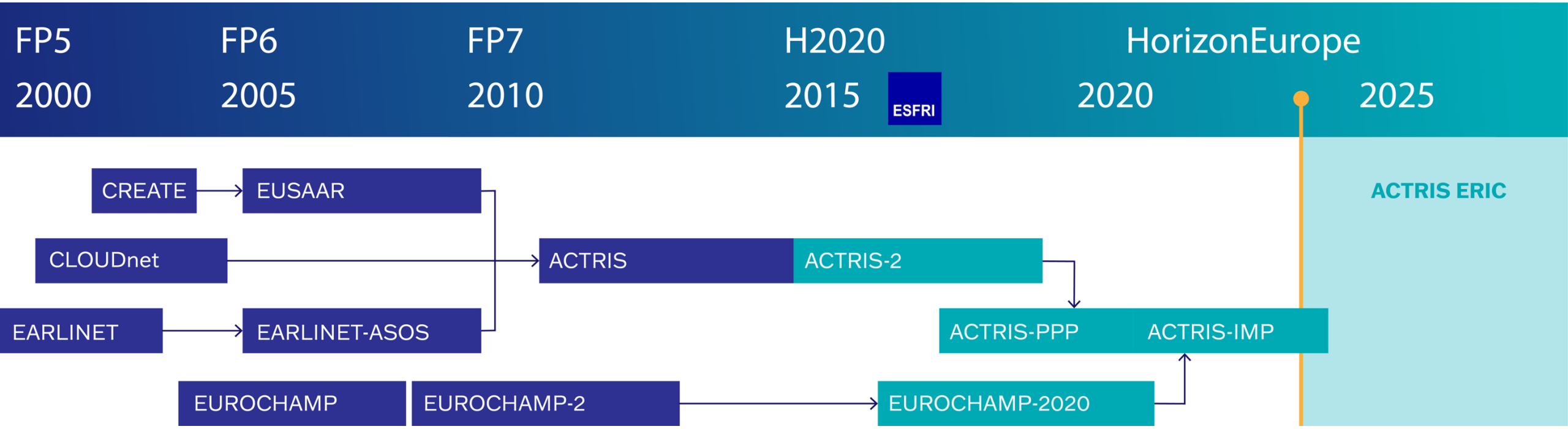
ACTRIS Data Centre

Click to edit Master title sty



The development of ACTRIS

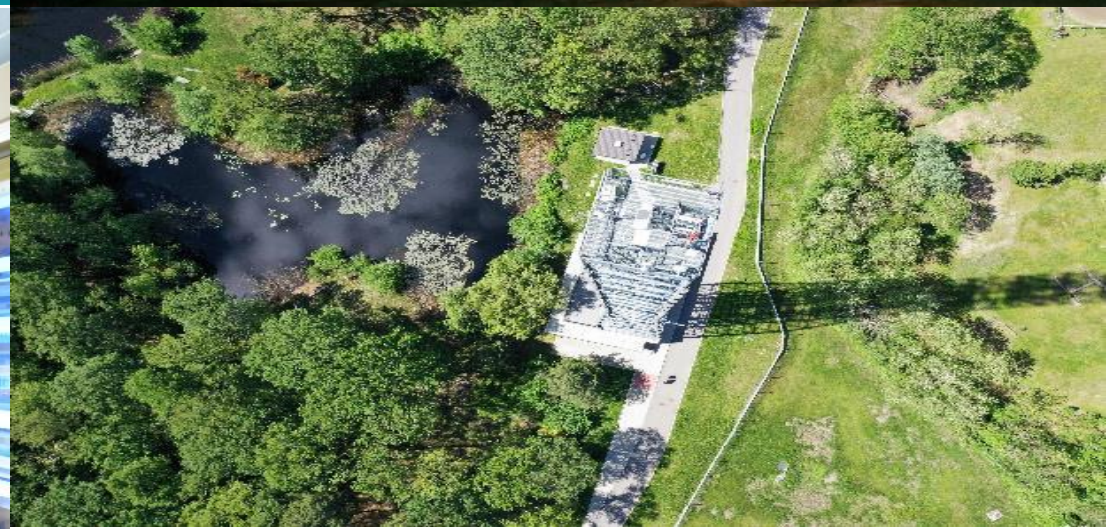
- From scientific projects to an operational Research Infrastructure
- Streamlining the activities and community



EARLINET EUSAAR Cloudnet EUROCHAMP 2020

Implementation timeline

- 2028-2032 2nd Five-year period
- 2026 Operational Phase
- 2023 ACTRIS ERIC
- 2021 ACTRIS as ESFRI Landmark
- 2021 - 2025 Implementation Phase
- 2017 - 2019 Preparatory phase
- 2016 ACTRIS in ESFRI Roadmap



Atmospheric observations for societal needs

Climate change

Quantifying the radiation balance of the Earth requires four-dimensional observations short-lived atmospheric constituents

Emissions in industrial hotspots

Monitoring and reducing industrial emissions requires enhanced observations and technological research

Air quality in urban areas

Understanding the impact of air pollution on public health requires knowledge on harmful short-lived constituents

Atmospheric hazards

Reducing societal vulnerability to atmospheric hazards requires actions from hazard identification to emergency management

Validation of Earth observations from space

Applying space-borne sensors for Earth observations requires fiducial reference measurements from ground

Evaluation of models and data assimilation

Predicting weather and climate requires observations with a high level of precision, coherence and integration

Data Services & Digital Tools

Access Services

Technical Services

Innovation Services

Trainings and Expertise

Outreach and Networking

ACTRIS Services for Science

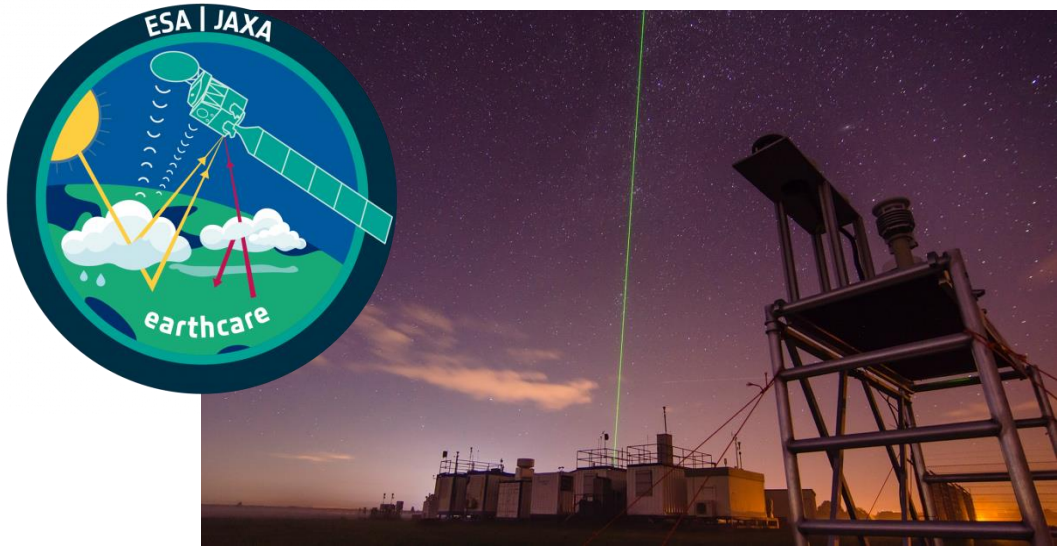
ACTRIS fuels fundamental and applied research in atmospheric sciences

- Comprehensive, long-term FAIR data
- Access to advanced instrumentation

Application: Using ACTRIS data to calibrate satellite missions

- ACTRIS ground-based observations support validation of satellite retrievals
- ACTRIS scientists co-develop algorithms and provide reference data.

Success Story | Enhancing EarthCARE Data for Climate Research



- Over 50 ACTRIS Observational Platforms (mainly radar and lidars) are involved in the calibration and validation of EarthCARE's data.
- Preliminary rehearsal campaigns were implemented within the framework of the ATMO-ACCESS project under a pilot call dedicated to access for international stakeholders.

ATMO ACCESS
Access to Atmospheric Research Facilities

ACTRIS Services for Society

ACTRIS supports policy-making and public health through air quality monitoring and early warning systems.

Application: ACTRIS data for near-real-time air quality services

- Integration in Copernicus Atmosphere Monitoring Service (CAMS)
- Supporting national agencies with particulate matter (PM) measurements and forecasts

Success Story | Improving Air Quality Monitoring in Europe

As part of the European Green Deal, the EU has been revising current air pollution standards to align them more closely with the recommendations of the World Health Organization.

- ACTRIS has significantly influenced the revision of the European Air Quality Directive, aligning it with WHO standards and introducing advanced monitoring for pollutants like ultrafine particles and black carbon.

- ACTRIS has also published 20 advanced service tools to assess air quality within urban areas (e.g., protocols for the measurement of novel air quality parameters, methodologies for urban mapping of novel air quality parameters and for evaluating the health effects of novel air quality parameters).

ACTRIS Services for Innovation

ACTRIS provides an innovation ecosystem supporting SMEs, start-ups, and developers.

Applications: Instrument manufacturers testing their prototypes at ACTRIS Exploratory Platforms.

- Real-world validation of novel sensor technology
- ACTRIS Access services support instrument validation under harmonized protocols.

Success Story | Pre-market validation of Green City Solutions' City Tree

Green City Solutions' City Tree : a pollution absorbing vertical plant filter for mitigating air pollution and heat in cities.

greencity solutions

Combination of mosses, which are naturally powerful in absorbing pollution and particulates, and plants, which provide the shade that mosses need to thrive in an urban environment.

The CityTree also has built-in watering and IoT monitoring, which maintains and measures the performance of the living structure.

ACTRIS Centre for Aerosol in Situ measurements collaborated in the development of the City Tree providing the facilities for testing absorption efficiency.

ACTRIS Core Services – Producing and providing high-quality standardized data

- Standard operation procedures developed for all ACTRIS techniques and variables
- Standards for harmonised measurement and data processing protocols and quality control
- Certification of National Facility measurements
- All data available for free via the ACTRIS Data Portal
- Virtual tools for processing data online
- Over 100 variables

ACTRIS Core Services - Providing access to highly equipped facilities in Europe

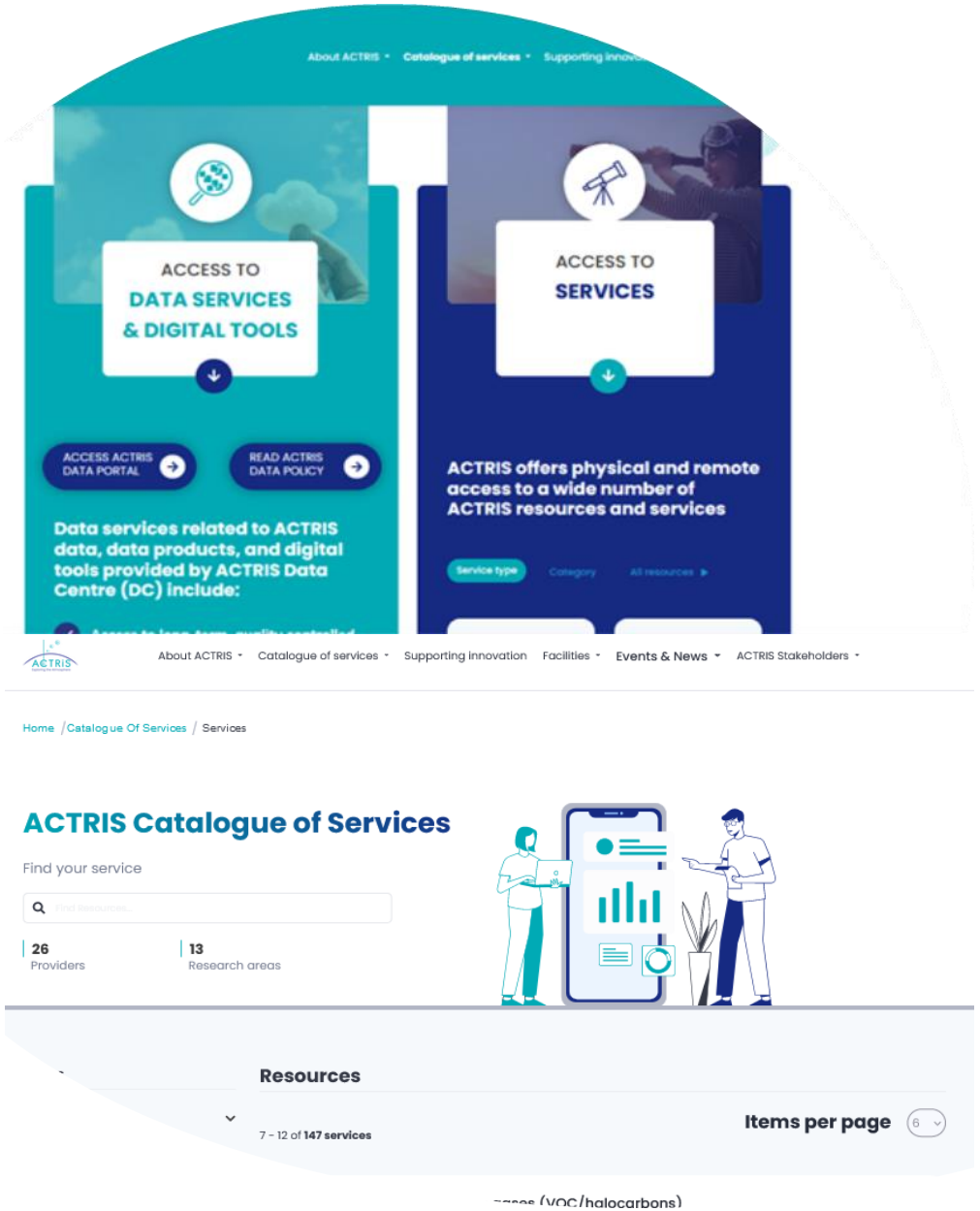
ACTRIS provides physical, remote and hybrid access to various user groups

Access can be for:

- Instrument testing in different environments and weather conditions (usage)
- Field / experimental campaigns
- Deployment side-by-side with regular ACTRIS instruments

The access to ACTRIS facilities is provided mainly free of charge thanks to the Trans-National Access (TNA) programmes

→ Selection via a competitive selection process



ACTRIS

www.actris.eu

Explore
ACTRIS Data!

Help | Large Data Extract

Data Search

Number of data objects matching your search: 24585

Variable matrix
Search or select one or more items

Facility types
Search or select one or more items

Variables
Search or select one or more items

Object of interest
Search or select one or more items

ACTRIS National Facility - In Progress
Select options

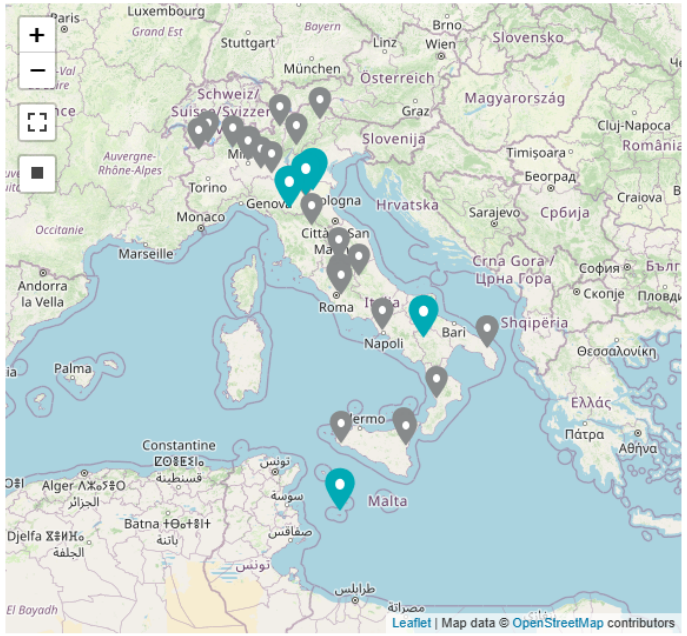
Other Facilities
Select options

Countries
× Italy

Timeliness
Search or select one or more items

Start date
dd/mm/yyyy

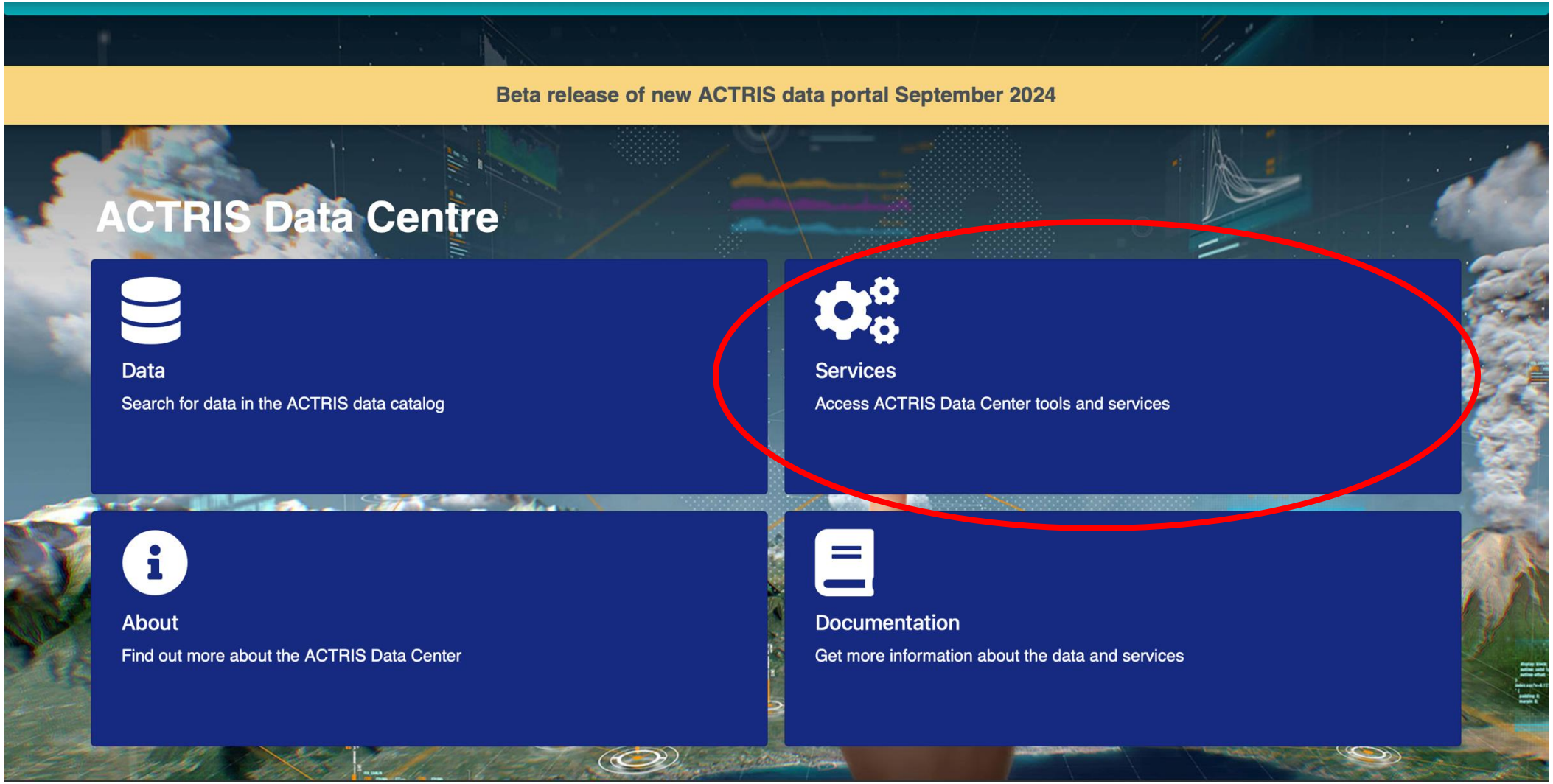
Facilities (31)



Facilities
ACTRIS National Facility - In Progress

ACTRIS Data Centre Services

www.actris.eu



ACTRIS Data Centre Services

data.actris.eu/services

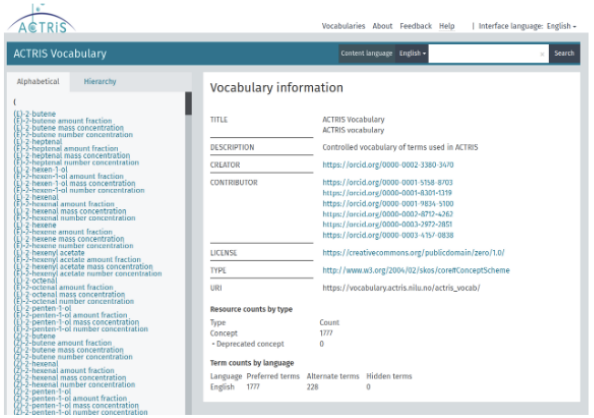
Different categories of Tools and Services

- Services
- Visualization tools
- APIs
- Data products
- Softwares

ACTRIS Data Centre Services

data.actris.eu/services

Services: offered by ACTRIS DC as services opened to all, can be offered by the ACTRIS DC as a whole or from 1 unit.



ACTRIS Vocabulary

The ACTRIS vocabulary server documents the vocabulary and controlled lists of terms used by the Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS). As grammar for observed variables, the ACTRIS vocabulary takes into use the InteroperAble Descriptions of Observable Property Terminology (I-ADOPT) concept for atomizing the variable names into parts of themselves controlled lists of terms. The vocabulary tries to refer to link to external vocabularies wherever possible.

Access

Access Rights

Open

Product Type

Service

Services developed for and within the whole DC for the whole ACTRIS community and beyond

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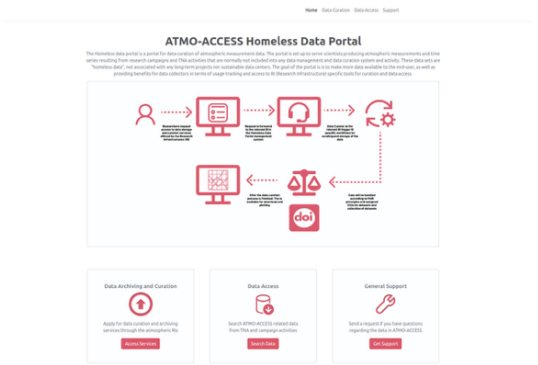


ATMO-ACCESS Homeless Data Portal

The Homeless data portal is set up to serve scientists producing atmospheric measurements and time series resulting from research campaigns and TNA activities that are normally not included into any data management and data curation system and activity. These data sets are “homeless data”, not associated with any long-term projects nor sustainable data centers. The objective of this portal is to provided access to relevant services and tools facilitating access to TNA data and campaign data for future use through long term, sustainable data centers. The goal of the tool is to make more data available to the end-user, as well as providing benefits for data collectors in terms of usage tracking and access to RI (Research Infrastructure) specific tools for curation and data access.

Access

Access Rights
Open

Product Type
Service

Services developed within a project

ATMO ACCESS
Access to Atmospheric Research Facilities

ACTRIS Data Centre Services

data.actris.eu/services

Services: offered by ACTRIS DC as services opened to all, can be offered by the ACTRIS DC as a whole or from 1 unit.

Aerosol Remote Sensing Single Calculus Chain (SCC)
The ACTRIS EARLINET Single Calculus Chain (SCC) is a centralized tool for the automatic analysis of aerosol lidar measurements. The development of this tool started in the framework of EARLINET-ASOS (European Aerosol Research Lidar Network – Advanced Sustainable Observation System), it was extended and still on going under the ACTRIS (Aerosol, Clouds and Trace gases Research InfraStructure Network) umbrella. The SCC is a major component of the ACTRIS Aeorosol Remote Sensing Node (ARES) responsible for the curation and the processing of the ACTRIS aerosol remote sensing data.

Access

Access Rights
Open

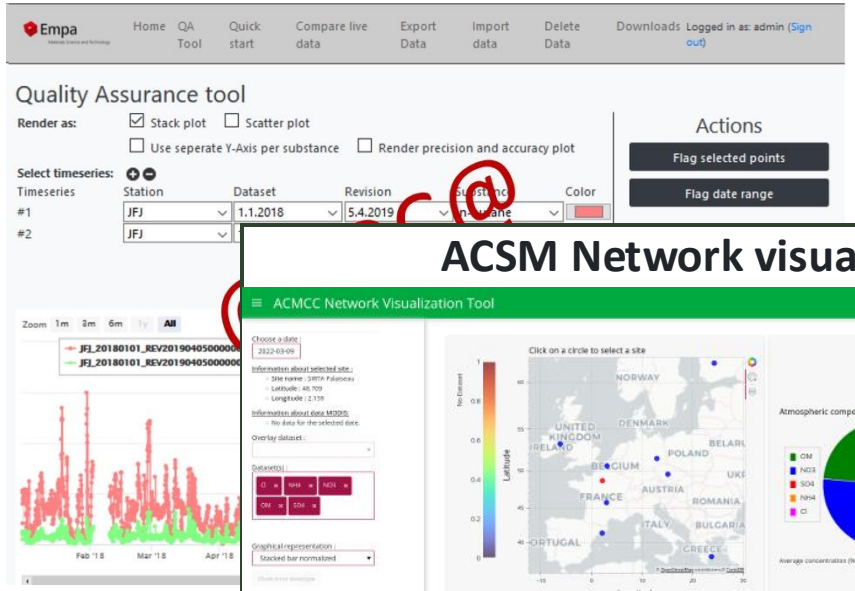
Product Type
Service

Thematic Data Centre unit's service

ACTRIS Data Centre Services

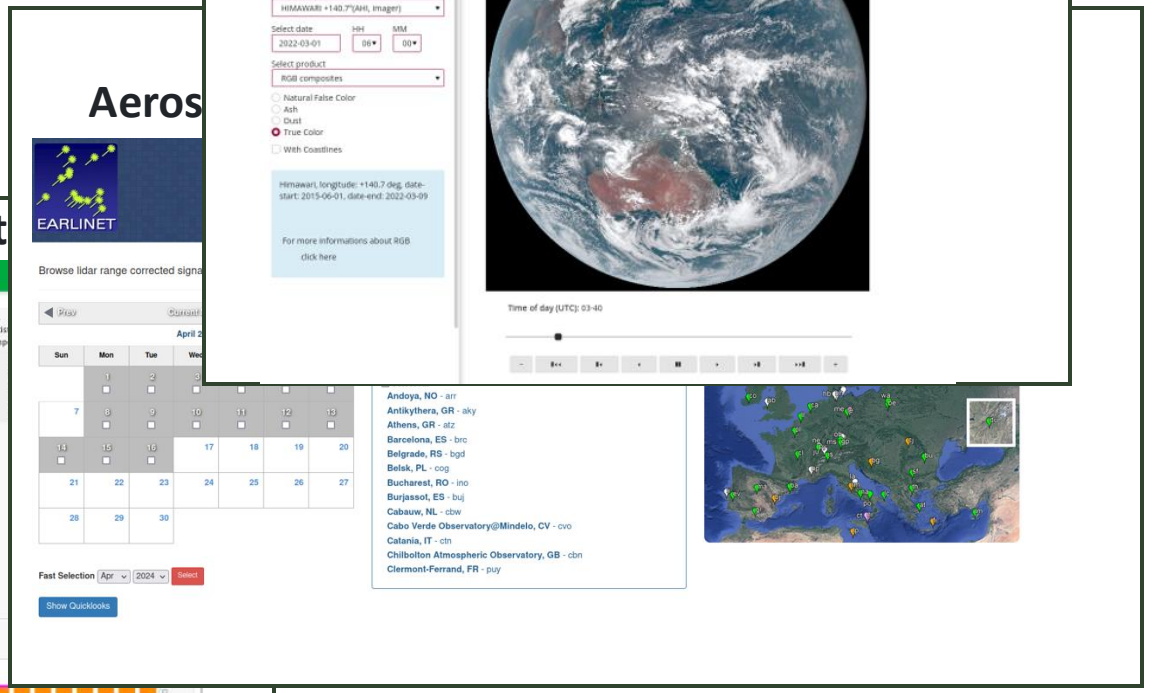
Visualization tools

Web-based tool checking for VOC data



ACSM Network visualization t

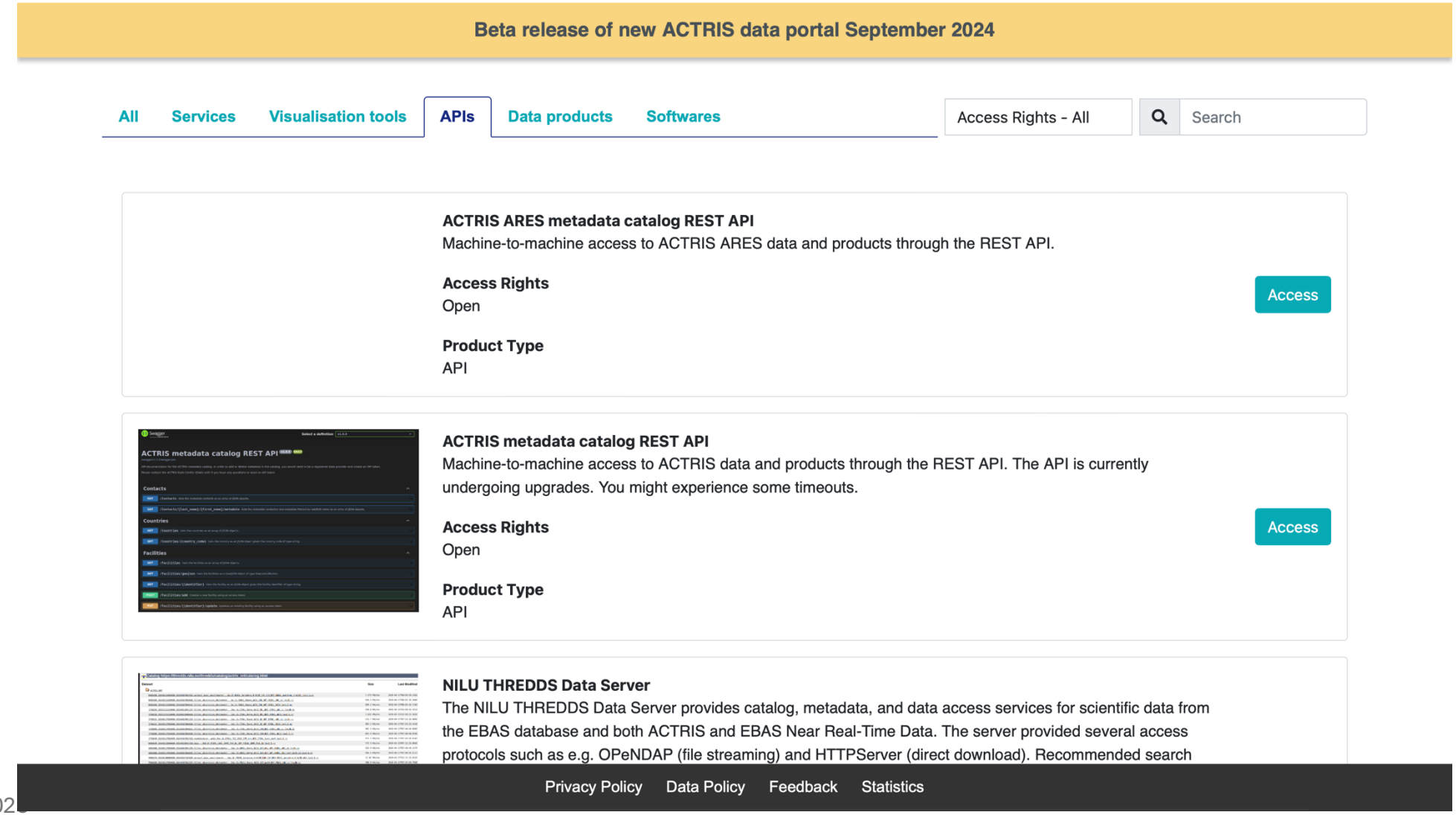
Aeros



Geostationary data viewer

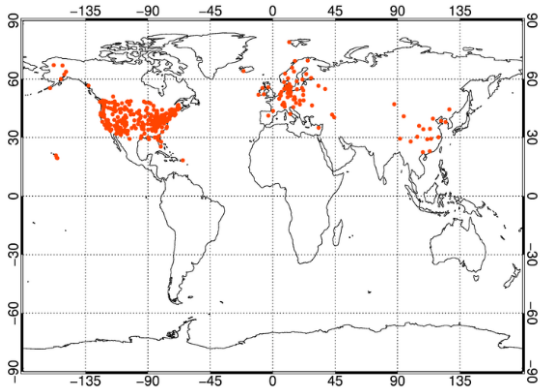
ACTRIS Data Centre Services

APIs



ACTRIS Data Centre Services

Data products: trans-components, single component, or even including models. ACTRIS time, but even legacy



Measured and modeled surface concentrations of aerosols from 'Concentrations and radiative forcing of anthropogenic aerosols from 1750-2014 simulated with the OsloCTM3 and CEDS emission inventory'

By Marianne Tronstad Lund*, Gunnar Myhre et al. https://doi.org/10.21336/gen.3

Access Rights

Open

Product Type

Data product

Access

ACTRIS Data Centre Services

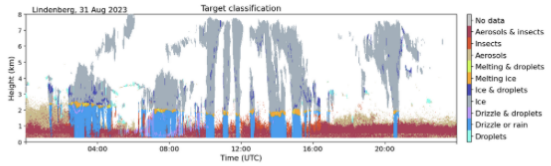
Softwares: available packages useful for researchers

CloudnetPy

CloudnetPy is Python software designed for producing vertical profiles of cloud properties from ground-based remote sensing measurements. The Cloudnet processing combines data from cloud radar, optical lidar, microwave radiometer, and numerical weather prediction models. Measurements and model data are brought into a common grid and classified as ice, liquid, aerosol, insects, and so on. Subsequently, geophysical products such as ice water content can be retrieved in further processing steps. See Illingworth et al. (2007) for more details about the concept.

CloudnetPy is a rewritten version of the original Cloudnet Matlab code. It features several revised methods, extensive documentation, and more.

- CloudnetPy documentation: https://actris-cloudnet.github.io/cloudnetpy/
- Cloudnet data portal: https://cloudnet.fmi.fi



Cloud remote sensing data processing

Cloudnetpy is a Python package for processing Cloud Remote Sensing data.

Access Rights

Open

Product Type

Software

Access

ACTRIS Data Centre Services

Currently the followings are mapped

- Services # 14
- Visualization tools #6
- APIs #3
- Data products #19
- Softwares #5

ACTRIS

www.actris.eu

Explore
ACTRIS Data!

Help | Large Data Extract

Data Search

Number of data objects matching your search: 24585

Variable matrix
Search or select one or more items

Facility types
Search or select one or more items

Variables
Search or select one or more items

Object of interest
Search or select one or more items

ACTRIS National Facility - In Progress
Select options

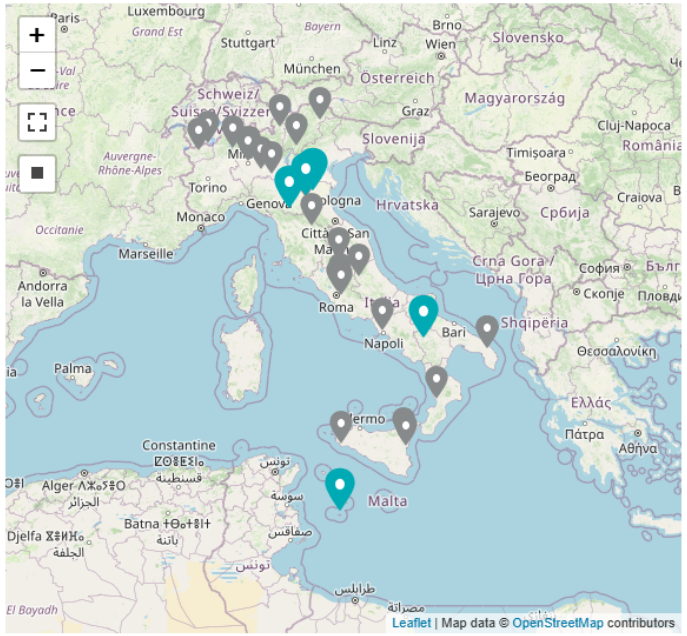
Other Facilities
Select options

Countries
× Italy

Timeliness
Search or select one or more items

Start date
dd/mm/yyyy

Facilities (31)



Facilities
ACTRIS National Facility - In Progress

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

European Union

ACTRIS | Italy

www.actris.it

ACTRIS-IT Joint Research Unit (JRU) was established in 2017

8 partners

Italy was among the funding Countries of ACTRIS, coordinating the first 2 projects related to the establishment of ACTRIS starting from European networks in the field.

Key role of Italy in ACTRIS

Partecipation in Central Facilities

- **Head Office** - Service and Access Management Unit (SAMU)
- **Data Centre-** Aerosol remote sensing data centre unit (ARES)
- **Centre for Aerosol Remote Sensing** - Aerosol high-power lidar (CARS-AHL-CNR)
- **Centre for Aerosol In Situ Measurements** - Elemental Mass Composition Centre (EMC2)

ACTRIS | Italy

www.actris.it

7 ACTRIS Observational Platforms for atmospheric measurements (Mt Cimone, L'Aquila, Rome, Naples, Potenza, Lecce, Lampedusa),

+

3 ACTRIS Exploratory platforms, including 1 chamber for measurements in a controlled environment (Genoa) and 2 transportable systems for atmospheric measurements (operated by the sites in Potenza and Lecce).

ACTRIS | Italy

Aerosol in situ

- Monte Cimone – Bologna – CNR ISAC
- Rome – CNR ISAC
- Potenza – CNR IMAA
- Lecce – CNR ISAC
- *Ispra – Varese – JRC*

Planned:

- *Naples -UNINA*

ACTRIS | Italy

Aerosol remote sensing

- Rome – CNR ISAC
- L'Aquila – UniLA
- Naples –UNINA
- Potenza – CNR IMAA
- Lecce – UniSalento
- *Ispra – Varese – JRC*

Planned:

- *Monte Cimone – Bologna – CNR ISAC*
- *Lampedusa – Agrigento - ENEA*

ACTRIS | Italy

Clouds remote sensing

- Potenza – CNR IMAA
- Lampedusa – Agrigento - ENEA

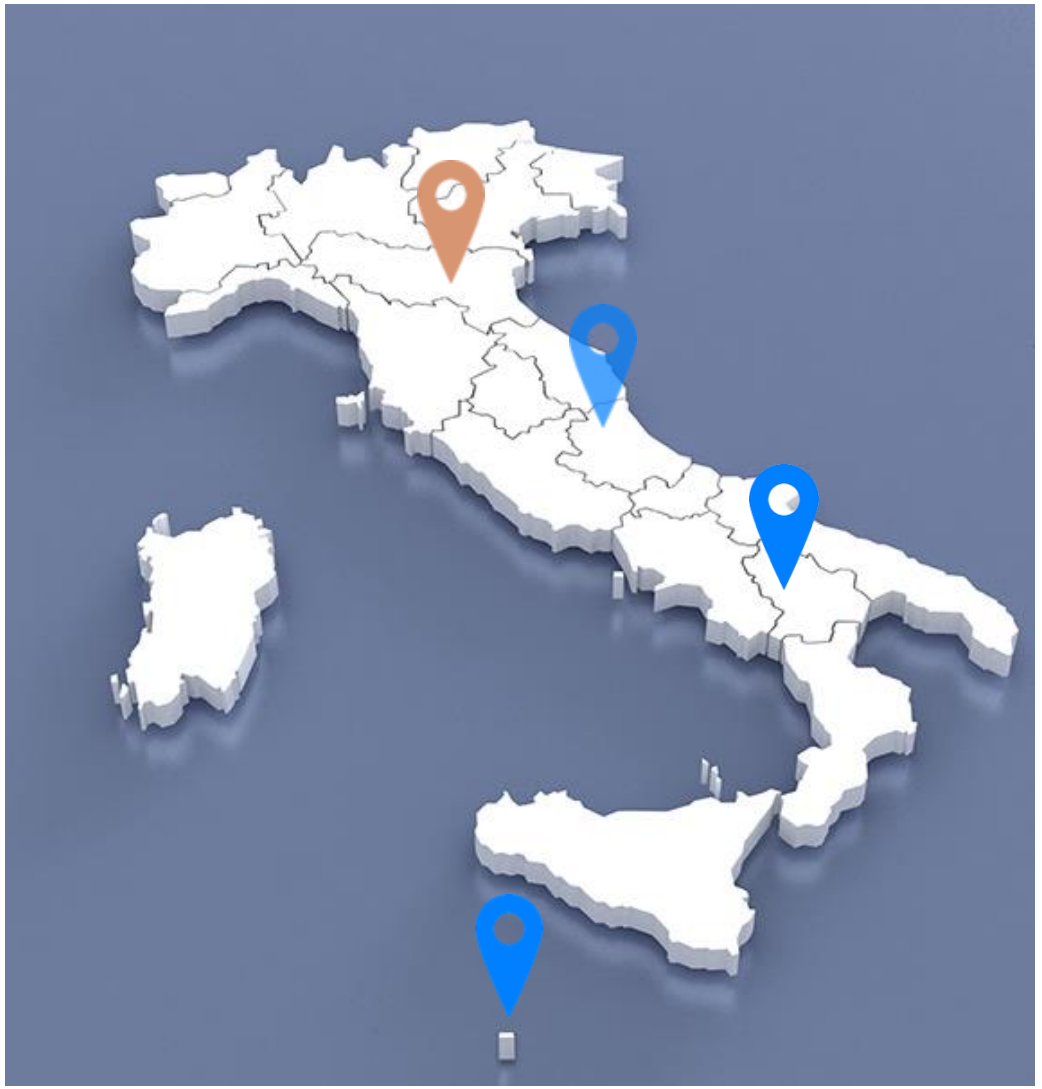
Planned:

- *L'Aquila – UniLA*

Clouds in-situ (green)

Planned:

- *Monte Cimone – Bologna – CNR ISAC*



ACTRIS | Italy

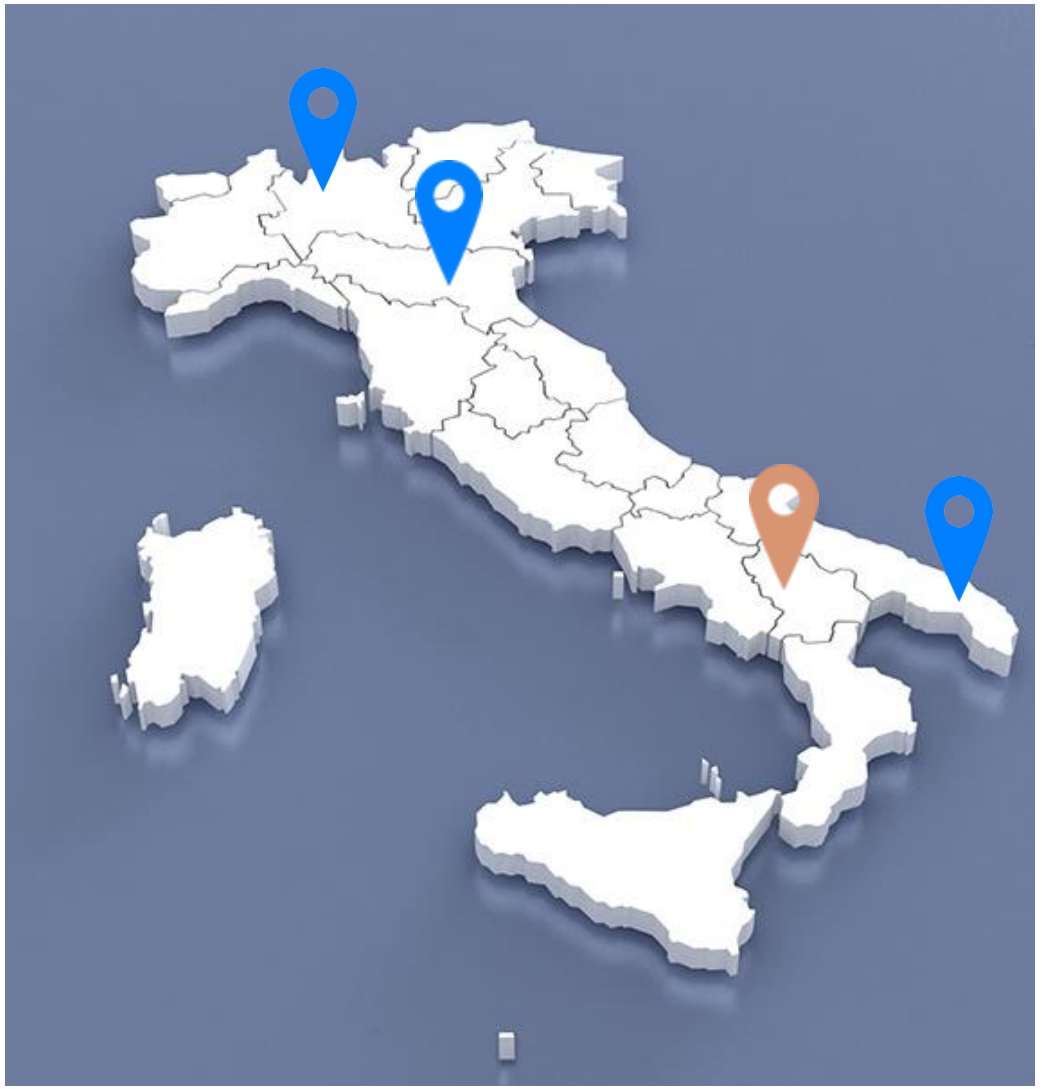
Trace gases In-situ

- Monte Cimone – Bologna – CNR ISAC
- Lecce – UniSalento
- *Ispra – Varese – JRC*

Trace gases remote sensing (green)

Planned:

- *Potenza – CNR IMAA*



ACTRIS | Italy

Thanks to ITINERIS, additional data are available from ACTRIS Data Centre related to associated stations and campaigns over Italy

Further data can be added in the near future to the ACTRIS DC

Wide community (around 120 people) with advanced expertise and opened for discussion and new challenges

The Italian Node of EIRENE RI

"The Earth Talks"

GLOBAL FORUM ROME, Italy **5-9 MAY, 2025**

Presented at the side event of ITINERIS Booth

May 6th – 12.00 CEST

Nicola Pirrone

- EIRENE – ITALY national node coordinator
- Research Director of CNR

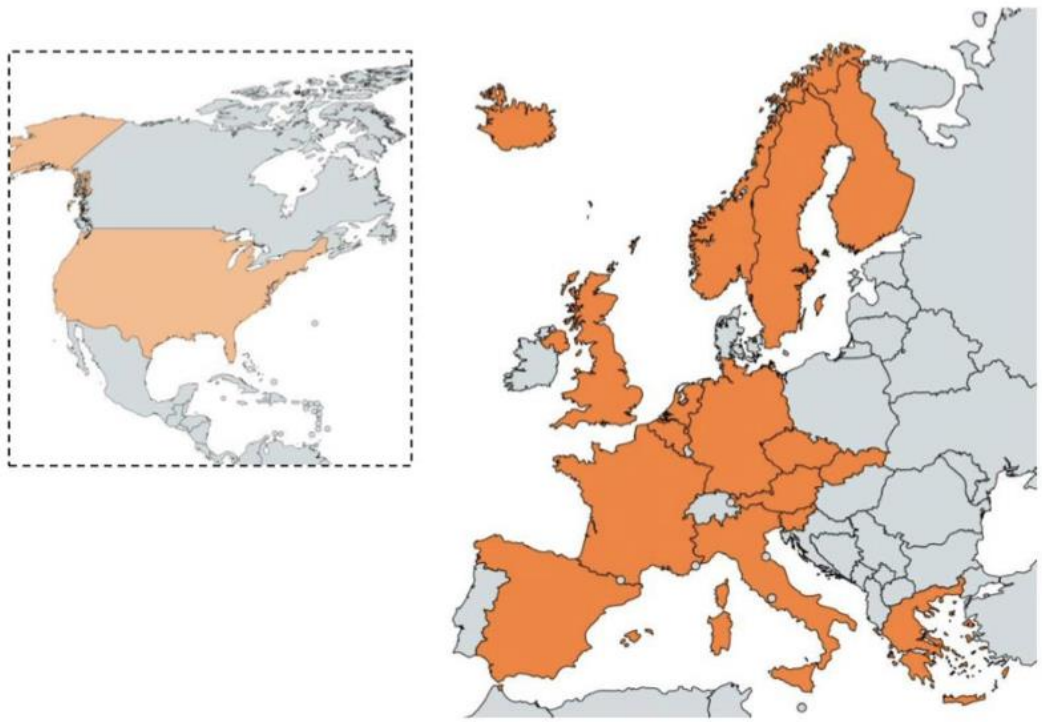
HOSTED BY

CO-SPONSORED BY

Environmental Exposure Assessment Research Infrastructure (EIRENE RI)

GLOBAL FORUM "The Earth Talks"

21 national hubs, 50+ individual partners



Member States:

Austria
Belgium
Czech Republic (coordinator)
Finland
France
Germany
Greece
Iceland
Cyprus
Portugal
Italy
Netherlands
Denmark
Luxembourg
Norway
Slovakia
Slovenia
Spain
Sweden
UK
USA

EIRENE RI is open for new members

EIRENE RI is part of the national ESFRI roadmap since 2021 - it is considered among the high-priority national RIs (PNIR 2021-2027 report).

EIRENE RI

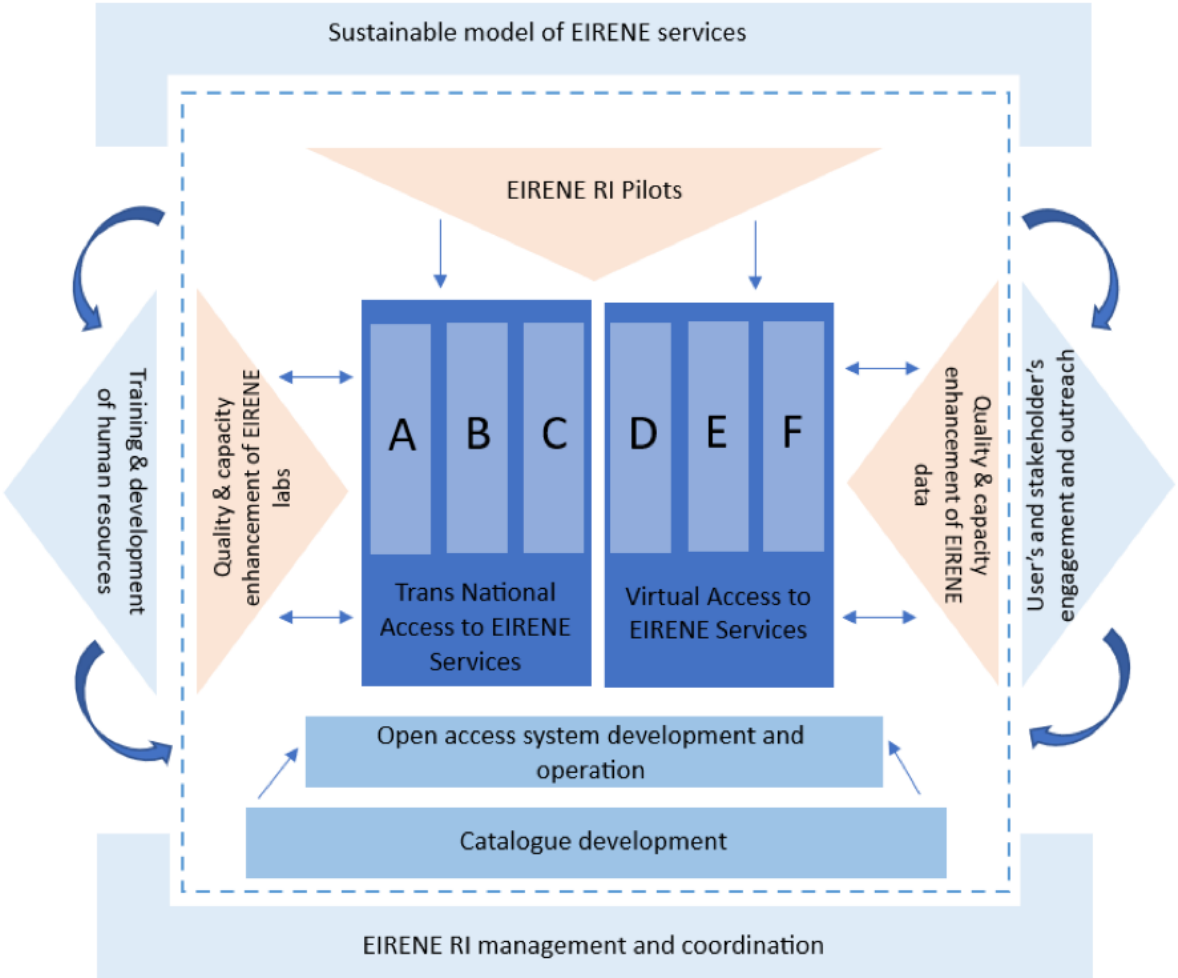
EIRENE RI's Mission

GLOBAL FORUM "The Earth Talks"

To establish a sustainable RI enabling the advancement of exposome research in Europe by integrating the complementary capacities of European Member States, harmonizing and upgrading them to effectively address current scientific and societal challenges in the areas of chemical exposures and population health.

EIRENE RI

The EIRENE RI pillar structure



Trans National services are comprised of chemical, toxicological and biological profiling. These services can either require a physical infrastructure, typically measurements in a laboratory, or remote access.

Virtual services are comprised of environmental data, human data and tools and require a virtual infrastructure, typically online tools, platforms and data storage system and repositories.

https://www.eirene-ri.eu

EIRENE RI

EIRENE-ITALY national node

GLOBAL FORUM "The Earth Talks"

The contribution of Italy to EIRENE RI is through a Joint Research Unit (JRU) established in 2024 between:

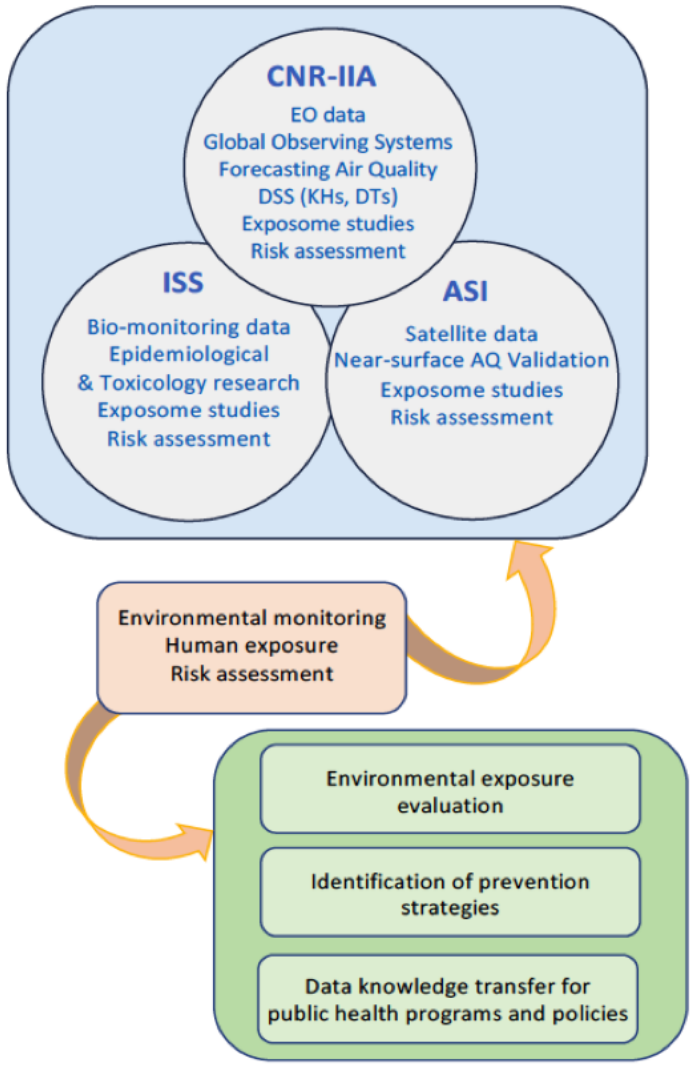
- ✓ National Research Council of Italy (CNR)
- ✓ Italian Space Agency (ASI)
- ✓ Italian National Institute of Health (ISS)

Agenzia Spaziale Italiana

EIRENE RI ITALY is open for new members

EIRENE IT

EIRENE-ITALY
Competences & Research Focus



CNR - Institute of Atmospheric Pollution Research (CNR-IIA)

- Air quality and atmospheric emissions from industrial plants
- In-situ monitoring systems (i.e., GMOS, GOS4M, Reti Speciali)
- EO data & multi-media models interoperability (i.e., GEO-DAB, HERMES)
- Decision Supporting Systems (i.e., Knowledge Hubs, Digital Twins)
- Design of exposome studies & risk assessment
- Support to policy makers and public administrations

Italian Space Agency (ASI)

- Satellite missions & data access
- Air Quality studies through down-scaling of satellite data vs in-situ observations
- Data analytics and modeling
- Design of exposome studies & risk assessment

National Institute of Health (ISS)

- Identification and validation of adequate exposure biomarkers.
- In vitro studies of toxicokinetic processes.
- In vitro and in silico predictive models, gene-environment interactions, epigenetics in the identification of groups at risk.
- Mechanisms of carcinogenesis, response to DNA damage and of genome stability.
- Human exposure and health impact assessment.

EIRENE IT

EIRENE-ITALY Overarching Goals

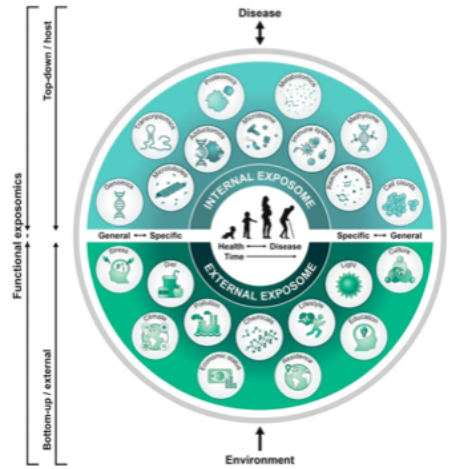
GLOBAL FORUM "The Earth Talks"

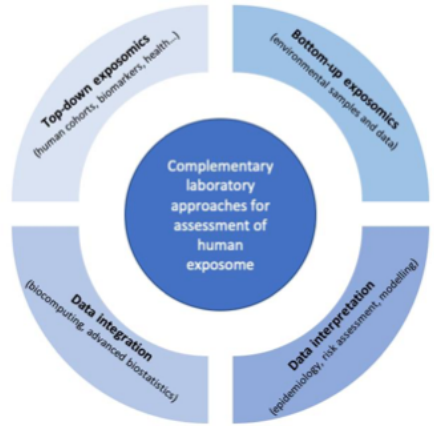
- **To mediate an open access to RIs** supporting a world-class research addressed to expand the scientific knowledge in the area of human exposome.

- **To provide a physical and/or virtual open access to RIs** (i.e., laboratories, observatories, and environmental networks) as well as to harmonized data and tools (knowledge Hub Platforms) according to FAIR principles for advancing exposome research in Italy.

- **To launch demonstrators on data analysis** for understanding exposome research (environmental pollution & health) using Earth Observation data.

- **To promote exposome studies** in the areas of **chemical exposures** and population health with a special emphasis to **urban and industrial areas** and future implementation of **the new EU Air Quality Directives**.





EIRENE IT

EIRENE-ITALY Overarching Goals

- **Foster the cooperation with international programs & conventions** aiming to face the global challenge of environmental pollution i.e., Copernicus, UNEP, GEO, intern. conv. i.e., LRTAP, Minamata, Stockholm.
- **To support the transfer of knowledge** from research projects to Public Administrations via public-private (industry, spin-offs) or public-public (policy-making) partnerships.
- **To enhance the development of interoperable tools** jointly co-designed with stakeholders and policy makers capable to elaborate data-based solutions of cost-effective mitigation measures.

EIRENE-ITALY: SERVICES

GLOBAL FORUM "The Earth Talks"

CNR-IIA

- Trace Lab
- Mercury Lab
- Environmental & Health Lab
- GOS4M Knowledge Hub
- Environmental Observatory
- Regional & Global Networks

ISS

- Trace Lab Organics
- Trace Lab Metals
- Human/HBM samples

ASI

- The Multimission Access Data System (MADS) is a platform that will support the individual Ground Segments by providing to users a cloud-based access to products
- The NPM (Network for Particulate Measurement) is a component of the MAIA mission and it is made of surface monitors located inside the Italian target.
- HYPERHEALTH Knowledge Hub
- PRIMARY Knowledge Hub

EIRENE IT

SERVICES provided in ENVI domain

GLOBAL FORUM "The Earth Talks"

Access to Environmental Networks

- **Atmospheric Observatory "Monte Curcio"** (MCU) – Environmental-Climate Observatory and part of GAW;
- **Italian National Network "Rete MerPAS"** measuring Hg concentrations in ambient air to support the Minamata Convention; possibilities to provide on-site training to technicians and scientists.
- **Global Mercury Observation System GMOS/GOS4M network** with over 40 sites in both southern and northern hemispheres. Access to the GOS4M platform for data handling/automated QA/QC and storage of raw data.

EIRENE IT

Access to environmental networks

Agenzia Spaziale Italiana

* **Multimission Access Data System (MADS) platform** that will support the individual Ground Segments by providing to users a cloud-based, unique point of access to products from different missions with possibilities to browse catalogs, to plan new acquisitions, to access data through standard M2M Interfaces, to run their applications on the cloud (users to the data).

* **ASI-sponsored NPM (Network for Particulate Measurement)** is a component of the MAIA mission and is made of surface monitors located inside the Italian target areas, periodically observed during the MAIA mission, measuring PM2.5 sulfate, nitrate, elemental carbon, organic carbon, and dust (calculated using concentrations of Fe, Al, Ca, Si, and Ti). The network is jointly developed by ASI, CNR and the Regional Enviromental Agencies (ARPAs) and is based on the already available surfaces monitors operated by CNR and the ARPAs whose territory is within the MAIA Target Areas.

SERVICES provided in ENVI domain

GLOBAL FORUM "The Earth Talks"

Access to Environmental Data

- **User-friendly platform** to access to **online data** from the **Monte Curcio GAW** site - Environmental-Climate Observatory;
- **User-friendly platform** to access to **online data from "Reti Speciali" and "MerPAS"** national networks;
- **Access to Global Mercury Observation System GMOS-GOS4M** / platform that allows to access to historical data since 2012 from satellite, off-shore and in-situ monitoring platforms;
- **Online catalog (metadata) for available datasets** on mercury in the atmosphere, oceans and marine biota, as well as ancillary parameters, tool for discovery and download datasets.

EIRENE IT

SERVICES provided in ENVI domain

Access to environmental data

- ✓ **MADS Online catalog** (metadata) for available standard products from Italian national satellite missions, tool for discovery and download (upon registration) datasets. The development of MADS provides one user interface to discover and access all data of present and future ASI missions;
- ✓ **ASI-NPM** access to data from the ASI-sponsored NPM;
- ✓ **Platform to MAIA mission Standard products** over the Italian Target Areas: L1 imagery product, L2 Aerosol product, L2 and L4 PM Products (PM10 & PM2,5).
- ✓ **ASI-Air Quality and Health Knowledge Hub** Under development, to provide access to ASI-sponsored projects and investigations on Air Quality monitoring, forecasting and associated effects and risks on population health.

SERVICES provided in ENVI domain

GLOBAL FORUM "The Earth Talks"

Agenzia Spaziale Italiana

Access to environmental data

- ✓ **HYPERHEALTH Knowledge Hub**: HYPERHEALTH is a project (2022-2024) being developed through a partnership that includes ASI, University of Pisa, CNR, and SiHealth Photonics S.r.l Company centered on the use of PRISMA Hyperspectral data. The overall goal is to develop and validate the HyperHealth prototype service (mobile app) providing a PRISMA-based assessment of environmental health risk connected with pollen maps, health-relevant atmospheric components (e.g. CO2, CWV) and solar UV radiation.

- ✓ **PRIMARY Knowledge Hub**: PRIMARY is a project being developed through a partnership that includes ASI, University of Tor Vergata (Rome), CNR, University of L'Aquila, and SERCO Company. It is centered on the use of PRISMA Hyperspectral data and neural algorithms for the generation of the products of interest for the Rome urban area (test area). Expected main product is the abundance of chemical species in the aerosol, such as inorganic and organic particulate, Black carbon, mineral dust, marine salt and the mixing ratio (ppm) of the above. The project will also made available a full wealth of ground and airborne measurements, used for the calibration and validation of the satellite-derived products.

EIRENE IT

SERVICES provided in ENVI domain

DATA PROCESSING, INTEGRATION and MODELING….

- **On-line QA/QC:** The following flow is adopted in the VA: Data acquisition, L0 (raw) data storage, data QA/QC, L1 data storage, metadata preparation, service publication; Knowledge Hub available to provided workflow on adopted processes and open science

- **Statistical Online Emulator for CTMs** to test chemical reduction scenarios in the environment and endpoints;

- **Regional and global Chemical Transport Models (CTMs)** to simulate fate and transport of persistent pollutants in the atmosphere. Biogeochemical simplified model and trophic model coupled with CTMs.

SERVICES provided by CNR-LABS

Access to laboratory services/capacities

Trace-Lab

- ✓ Quantification of heavy metal and ionic species; Determination of carbonaceous aerosol fractions in particulate matter for classifying Organic (OC) and Elemental (EC) Carbon;

Mercury-Lab

- ✓ Quantification of total and speciated Hg in environmental (air, water, soil, biota, waste) and biological (urine, hair, human breast milk) matrices;

Environmental & Health Lab

- ✓ Amplification of relevant genes or biomarkers of genetic susceptibility.

SERVICES provided by CNR-LABS

Methodology Development

Trace-Lab

- ✓ Ion chromatography (IC); Inductively Coupled Plasma-tandem Mass Spectrometry (ICP-MS/MS); Ion Chromatography followed by Inductively Coupled Plasma-tandem Mass Spectrometry (IC-ICP-MS/MS); TD-AAS; Thermal-Optical Trasmittance (TOT) methods.

Mercury-Lab

- ✓ Direct Thermal Decomposition – Gold Amalgamation – Cold Vapor Atomic Absorption Spectroscopy (CVAAS); Cold Vapor Atomic Florescence Spectrometry (CVAFS).

Environmental & Health Lab

- ✓ Polymerase Chain Reaction (PCR).

SERVICES provided by ISS-LABS

Methodology Development

Trace-Lab Organics

- **High-resolution gas chromatography** coupled with high resolution mass spectrometry (HRGC-HRMS);
- **Liquid chromatography** coupled with tandem mass spectrometry (LC-MS/MS);
- **Ultra performance liquid chromatography** coupled with tandem mass spectrometry (UPLC-MS/MS);
- **Non target screening (NTS)** with high resolution mass spectrometry coupled to GC and LC modules.

SERVICES provided by ISS-LABS

GLOBAL FORUM "The Earth Talks"

Methodology Development

Trace-Lab Metals

- ✓ Inductively coupled plasma-mass spectrometry (**ICP-MS**, both ICAp-Q ICP-MS and SF-ICP-MS);
- ✓ Field-flow fractionation with multi angle light scattering coupled to inductively plasma mass spectrometry (**FFF-MALS-ICP-MS**) and Single Particle ICP-MS;
- ✓ High performance liquid chromatography coupled to inductively plasma mass spectrometry (**HPLC-ICP-MS**);
- ✓ Ion chromatography coupled to inductively coupled plasma mass spectrometry (**IC-ICP-MS**);
- ✓ Multicollector coupled to inductively plasma mass spectrometry (**MC-ICP-MS**);
- ✓ Direct mercury analyzer (**DMA-80**).

EIRENE IT

SERVICES provided by ISS-LABS

GLOBAL FORUM "The Earth Talks"

Access to laboratory services / capacities

Trace-Lab Organics

- ✓ **Determination of** PCDDs, PCDFs, PCBs, pesticides, PBDEs, HBCDs, PFAS, PAHs and their metabolites; NTS;

Trace Lab Metals

- ✓ **Determination of metals** including Hg, nanoparticles of metals, species of metals.

Access to environmental data & samples

- ✓ **Analysis of environmental matrices** (sediment, soil, air, waste, biota, water) for organic pollutans including POPs
- ✓ **Data are available on-line** for further modeling / statistical analysis.

EIRENE IT

SERVICES provided in HEALTH domain

GLOBAL FORUM "The Earth Talks"

Access to human/HBM samples

Trace-Lab Organics

- ✓ **Analysis of human samples** (blood, urine and breast milk) for organic pollutants including POPs.
- ✓ **Analysis of human samples** (serum, urine, blood, exhaled breath condensate, hair, dermal wipes) for metals including Hg, nanoparticles of metals, species of metals

EIRENE IT

Political Support from Ministries

EIRENE-IT has been receiving political support from the Italian **Ministry of the Environment and Energy Safety** (**MASE**) through a supporting letter to EIRENE RI (16/04/2020).

The **Ministry of University and Research (MUR)** also confirmed its support including EIRENE RI in the IR of High Strategic Priority at national level (PNIR 2021-2027).

EIRENE-IT is fully aligned not only with EIRENE at the pan-European level but also with the innovation strategy of the Italian government (Agenda 2030), and this significantly enhances the relevance of such a dedicated infrastructure.

Financial Support

The operational costs of EIRENE-IT are covered by National, European and International projects and programs (i.e., HORIZON EUROPE, NSF, UNEP-GEF etc.). **EIRENE IT funding** is derived from **three primary sources**:

- **Internal funding** is secured from the participating institutions, allocating resources such as two postdoctoral researchers for the preparatory phase (2023-2025) as an in-kind contribution.

- **External funding** is obtained through European projects, including EIRENE PPP (GA-101079789; €140k, 2022-2025) and EUROGEOSec (GA-101134335; €234k, 2023-2025). Furthermore, national funding is received from the **APEMAIA project** funded by ASI (€300k) and the Reti Speciali project under the Ministry of Environment (MASE) for the National Network (€220k, 24 months).

- **User fees** for EC/OC, IC, and ICP-MS-MS analyses, extending services to external programs, networks, and projects. In the operational phase, there is a strategic plan to significantly expand this funding channel by offering 'Open Access' to users from academia and, to a limited extent, industry.

Stakeholders

Internal

- ✓ Consortium members of the Italian National Node and their teams;
- ✓ Bodies (financial and research departments) from respective contributing institutions;
- ✓ Management Board of EIRENE PPP;
- ✓ European EIRENE-PPP Consortium;

External

- ✓ The Italian Ministry of the Environment and Energy Safety (MASE);
- ✓ Italian Ministry of Agricultural, Food and Forestry Policies (MASAF);
- ✓ Italian state Agencies;
- ✓ Private and public Research Institutions;
- ✓ Industry.

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

European Union

ICOS | INTEGRATED CARBON OBSERVATION SYSTEM

THE INTEGRATED CARBON OBSERVATION SYSTEM

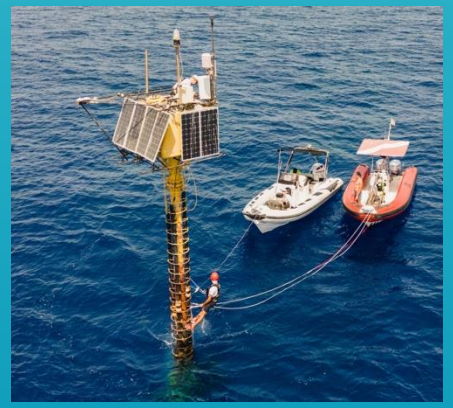
Dr. Sindu Raj Parampil

On behalf of ICOS community

GEO Global Forum 2025

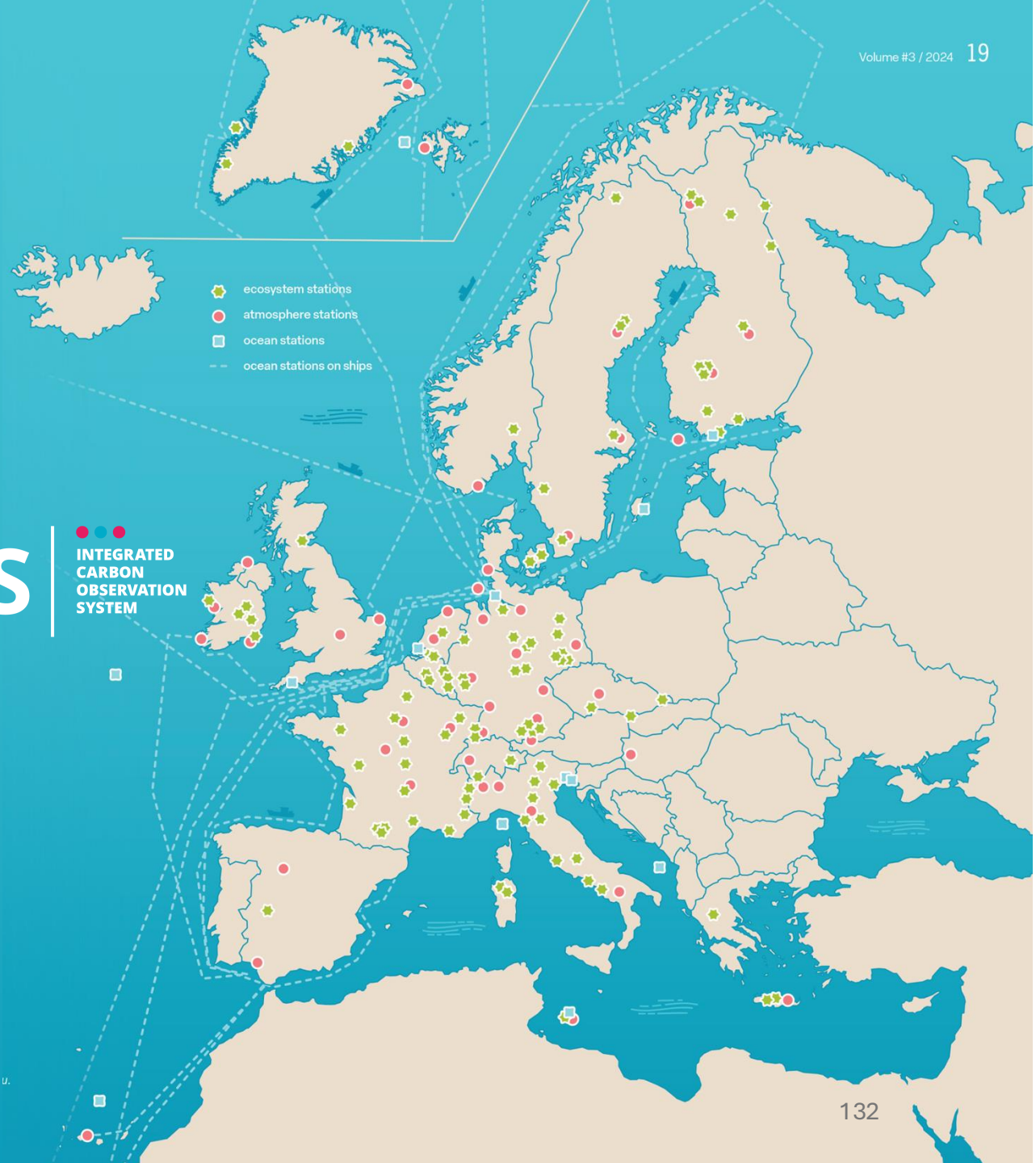
Atmosphere

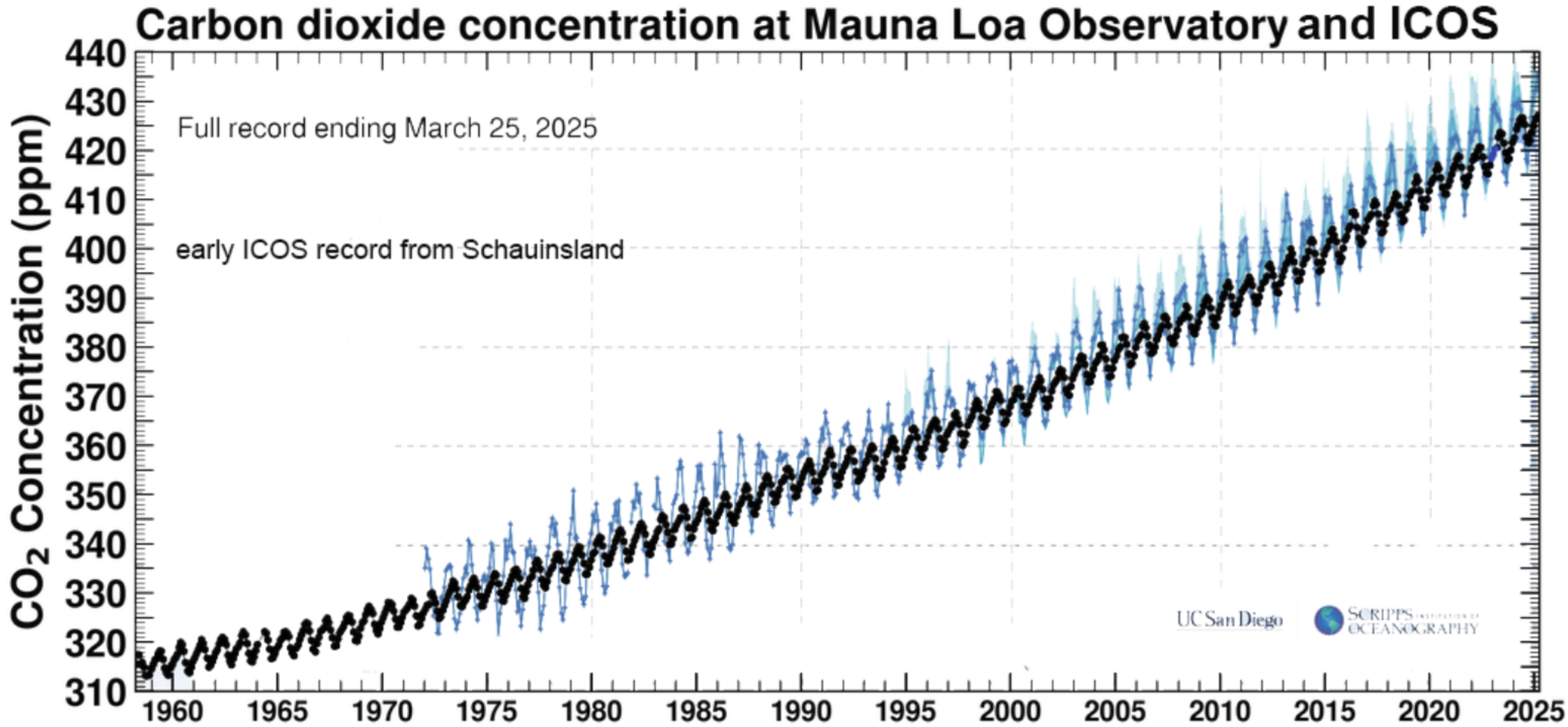
Land ecosystems

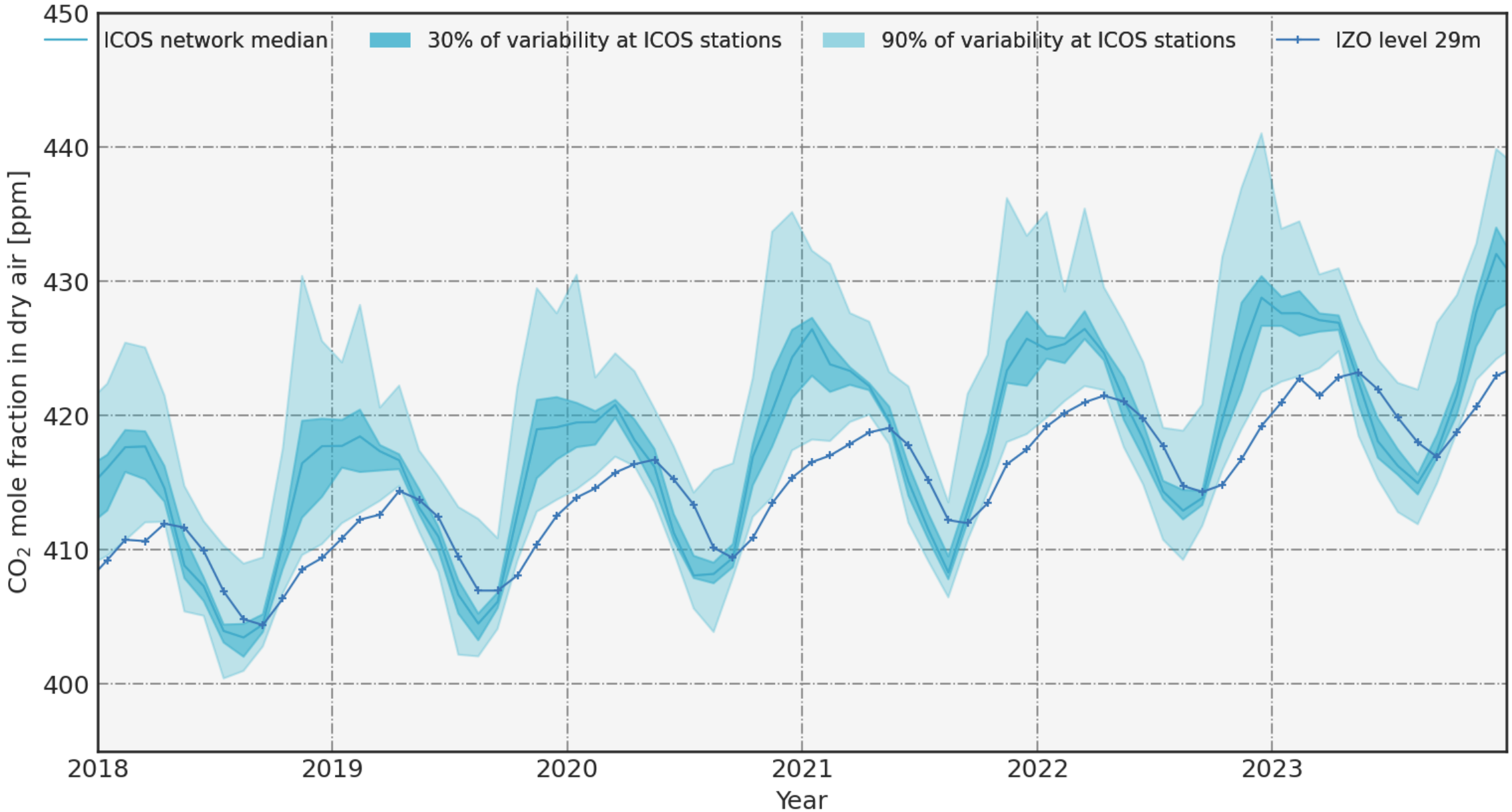


Oceans

ICOS
INTEGRATED CARBON OBSERVATION SYSTEM




Carbon dioxide concentration at Mauna Loa Observatory and ICOS
Full record ending March 25, 2025
early ICOS record from Schauinsland
CO_2 Concentration (ppm)
440
430
420
410
400
390
380
370
360
350
340
330
320
310
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
UC San Diego
SCRIPPS INSTITUTION OF OCEANOGRAPHY


ICOS network median
30% of variability at ICOS stations
90% of variability at ICOS stations
IZO level 29m
CO_2 mole fraction in dry air [ppm]
450
440
430
420
410
400
2018
2019
2020
2021
2022
2023
Year

The pathway towards an operational research infrastructure

Roadmap | ICOS Prep Phase Project | Interim | ICOS ERIC 1st 5y period | ICOS ERIC 2nd 5y period | ICOS ERIC 3rd 5y period

Design

PPP

- Define the parameters
- Standardise methods
- Set governance model
- Financial resourcing

Implementation

RINGO

- Establish the observational networks
- Ensure the compliance with standards
- Establish data life cycle
- Develop strategy

Operational

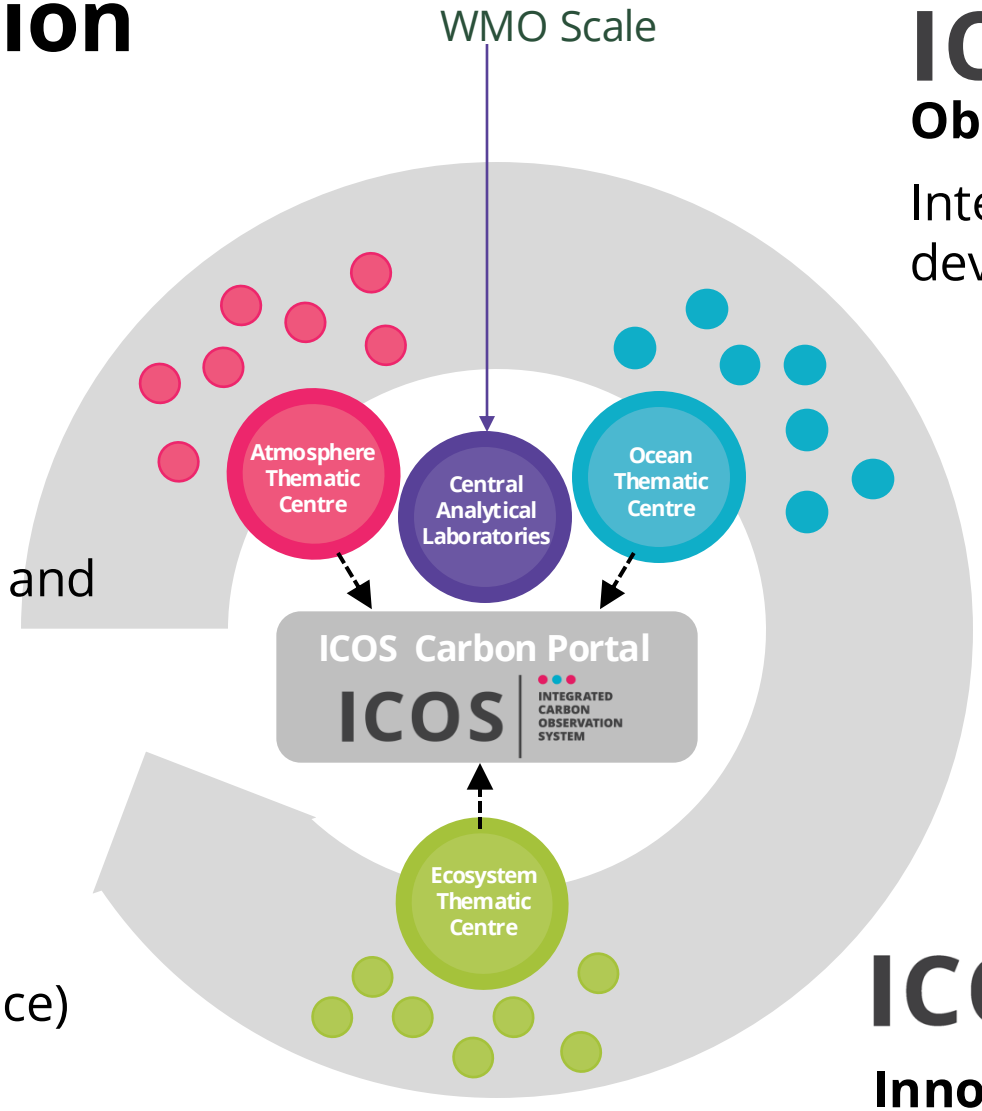
NUBICOS

- Support science by ensuring data usage
- Develop services for scientific or societal users
- Generate societal impact
- Technical innovation

Supported by a strategic project portfolio.

Internal integration

- Multi-country entity
- Statutes and internal legal agreements
- Central laboratories for calibration and analyses
- Standardisation
- Centralized data processing and QC
- Cross-domain learning
- Common data policies
- Integration of scientific community (by common initiatives, Science Conference)
- Common user base beyond science (modelling, verification, satellite cal/val)



ICOS Cities

Observations are scalable

Integrated city observatories are developed

This project has received funding from the European Union's Horizon 2020 under grant agreement No 101037319

KADI

Knowledge and climate services from an African observation and Data research Infrastructure

Knowledge is transferable

Concept for climate service-based observations in Africa

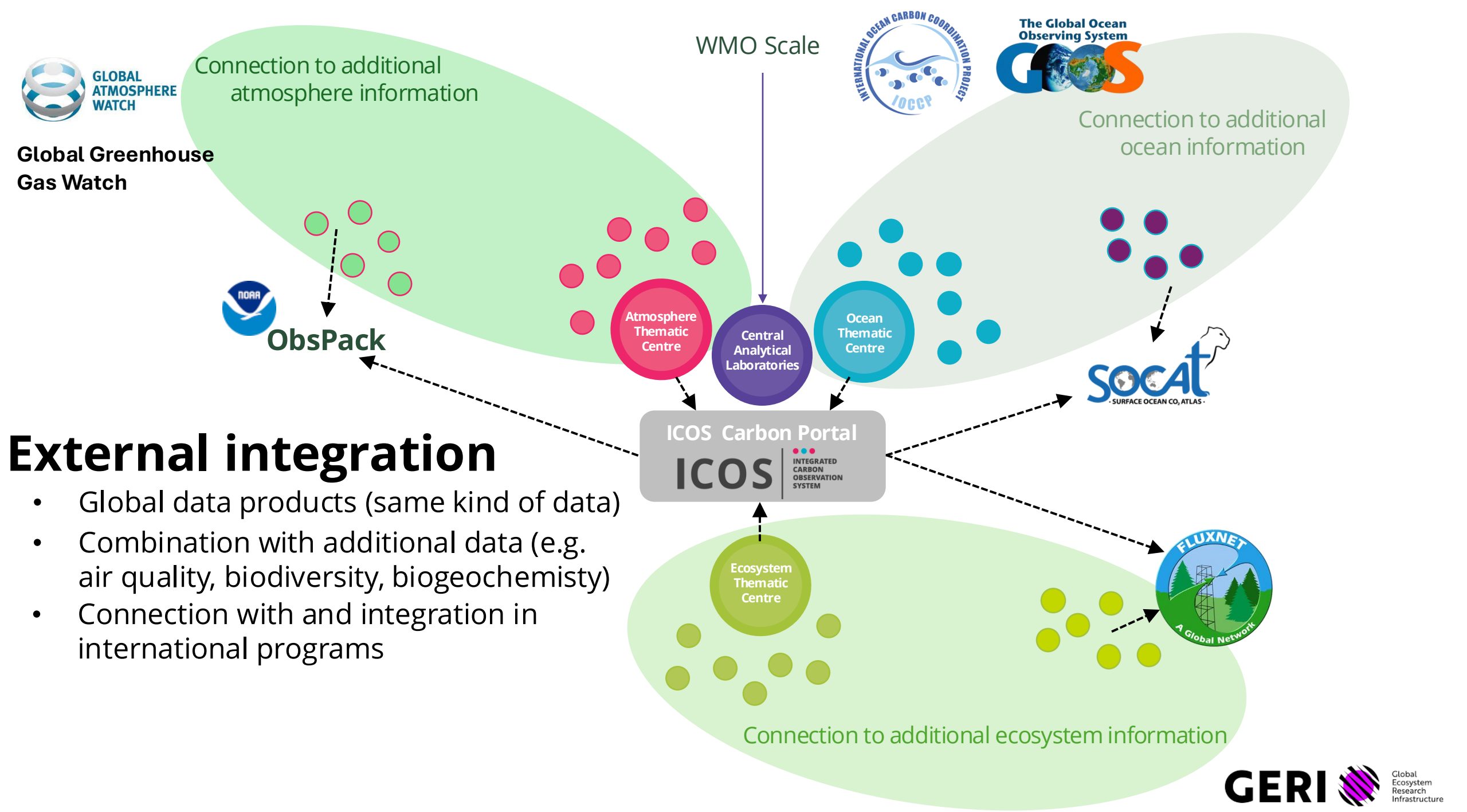
This project has received funding from the European Union's Horizon Europe under grant agreement No 1010585

ICOS NUBICOS

Innovation is indispensable

Improving ICOS data and strengthening the ICOS community

This project has received funding from the European Union's Horizon Europe under grant agreement No 101130676



External integration

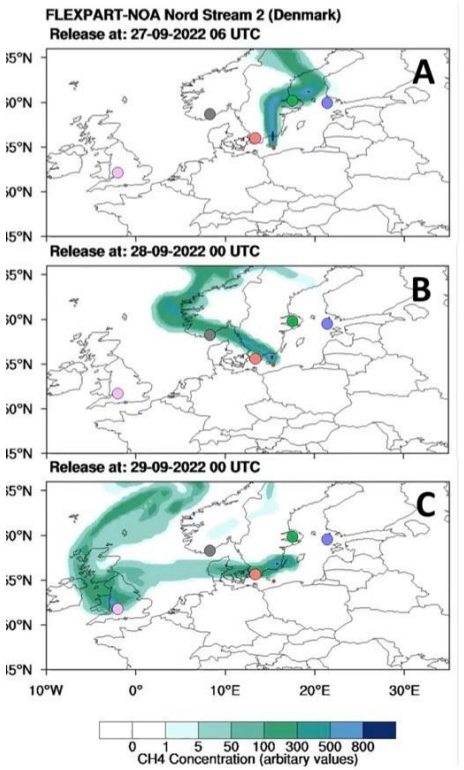
- Global data products (same kind of data)
- Combination with additional data (e.g. air quality, biodiversity, biogeochemisty)
- Connection with and integration in international programs

GERI Global Ecosystem Research Infrastructure

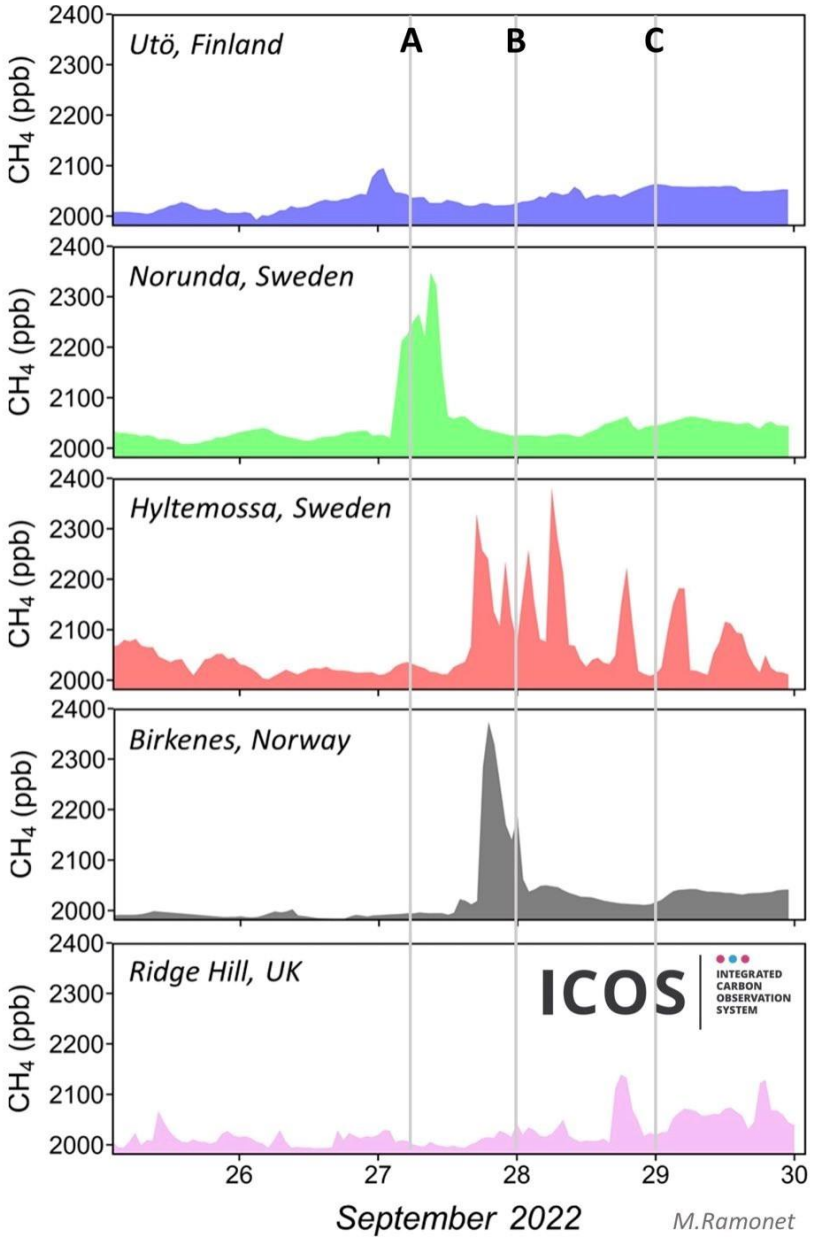
Data

- Helped quantify methane emissions from Nord Stream pipeline leaks (2022)
- Stations detected methane plumes in real time
- Satellites had limited view of the event due to clouds
- In situ data are complementary to satellite

Methane emissions from the Nord Stream subsea pipeline leaks. Harris et al., Nature (2025).



I.Binietoglou



M.Ramonet

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Communication

International cooperation

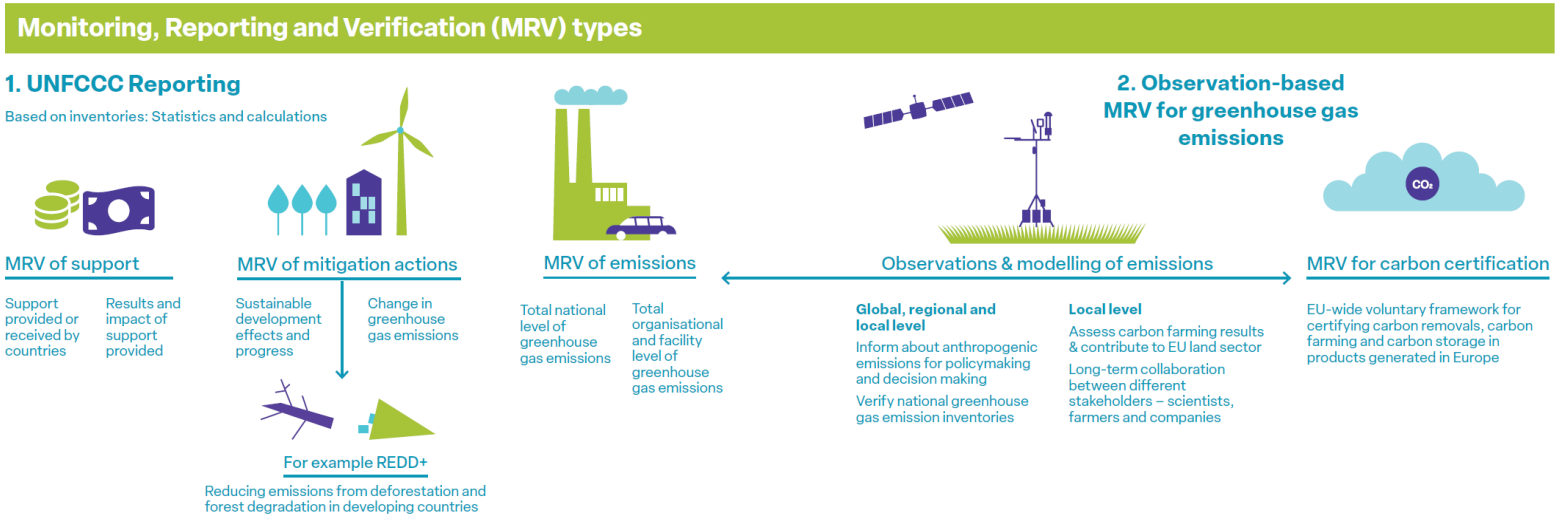
New developments

→ Impact creation

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Communication for impact

- Annual bulletin, FLUXES → policy-makers
  2025 volume to be published in early Nov 2025
  2024: ICOS data has the ability to support MRV systems



http://fluxes.science

International cooperation for impact

- Contributions to COP and SBSTA

  ICOS is an admitted intergovernmental organisation (IGO) at UNFCCC

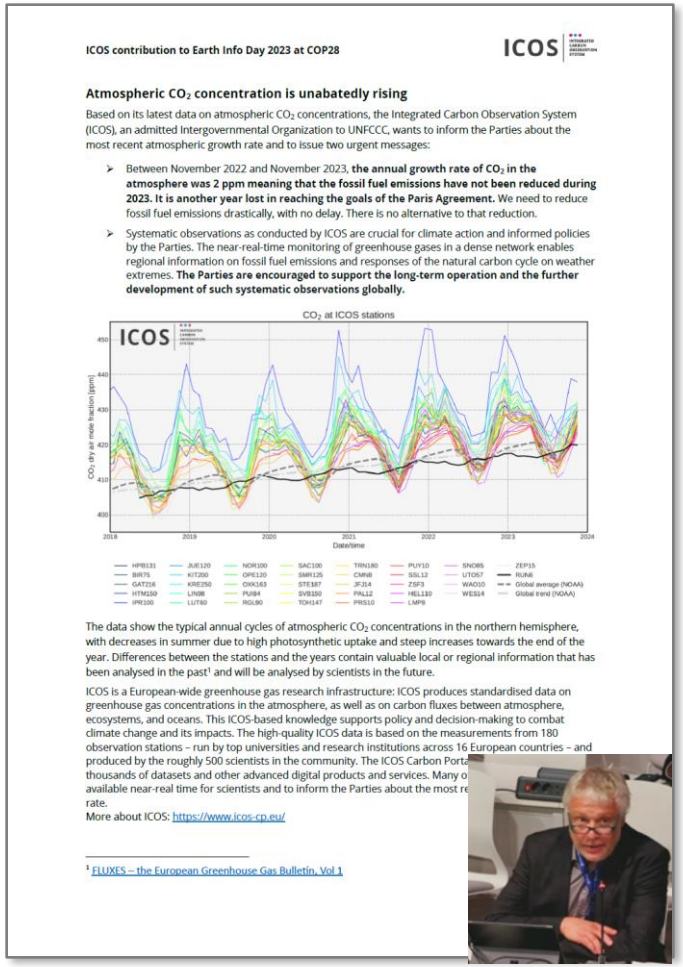
  Statements, side-events, networking…

- Contributions to GEO and its regional networks

  ICOS has been a partic 6

  Side-events, networkir

KADI at AfriGEO



ICOS contribution to Earth Info Day 2023 at COP28

ICOS

Atmospheric CO_2 concentration is unabatedly rising

Based on its latest data on atmospheric CO_2 concentrations, the Integrated Carbon Observation System (ICOS), an admitted Intergovernmental Organization to UNFCCC, wants to inform the Parties about the most recent atmospheric growth rate and to issue two urgent messages:

- Between November 2022 and November 2023, **the annual growth rate of CO_2 in the atmosphere was 2 ppm meaning that the fossil fuel emissions have not been reduced during 2023. It is another year lost in reaching the goals of the Paris Agreement.** We need to reduce fossil fuel emissions drastically, with no delay. There is no alternative to that reduction.
- Systematic observations as conducted by ICOS are crucial for climate action and informed policies by the Parties. The near-real-time monitoring of greenhouse gases in a dense network enables regional information on fossil fuel emissions and responses of the natural carbon cycle on weather extremes. **The Parties are encouraged to support the long-term operation and the further development of such systematic observations globally.**

CO_2 at ICOS stations

The data show the typical annual cycles of atmospheric CO_2 concentrations in the northern hemisphere, with decreases in summer due to high photosynthetic uptake and steep increases towards the end of the year. Differences between the stations and the years contain valuable local or regional information that has been analysed in the past[1] and will be analysed by scientists in the future.

ICOS is a European-wide greenhouse gas research infrastructure: ICOS produces standardised data on greenhouse gas concentrations in the atmosphere, as well as on carbon fluxes between atmosphere, ecosystems, and oceans. This ICOS-based knowledge supports policy and decision-making to combat climate change and its impacts. The high-quality ICOS data is based on the measurements from 180 observation stations – run by top universities and research institutions across 16 European countries – and produced by the roughly 500 scientists in the community. The ICOS Carbon Porta thousands of datasets and other advanced digital products and services. Many o available near-real time for scientists and to inform the Parties about the most re rate.

More about ICOS: https://www.icos-cp.eu/

[1] FLUXES – the European Greenhouse Gas Bulletin, Vol 1

Earth Information Day 2023

New developments for impact

- **ICOS Cities** develops and tests methods to estimate fossil fuel emissions from cities, in relation to inventories.

  → **www.icos-cities.eu**

- **GEORGE** develops future autonomous vehicles and enhances collaboration between three major marine Research Infrastructures, EMSO, Euro-Argo and the ocean component of ICOS

  → **www.george-project.eu**

Key take aways

- ICOS provides valuable greenhouse gas data and services to support science and societies.
- ICOS data are highly complementary to satellite observations; each has its strengths
- ICOS seeks closer ties with GEO and satellite community
- Within the NUBICOS project, ICOS explores new utilisation of our data through tighter collaboration with the remote sensing community (in the next slides)

NUBICOS project received funding from the European Union's Horizon Europe programme under grant agreement no. 101130676

Thank you for your attention!

NUBICOS project received funding from the European Union's Horizon Europe programme under grant agreement no. 101130676

ICOS | NUBICOS

Funded by the European Union

ICOS ECOSYSTEM STATION NETWORK

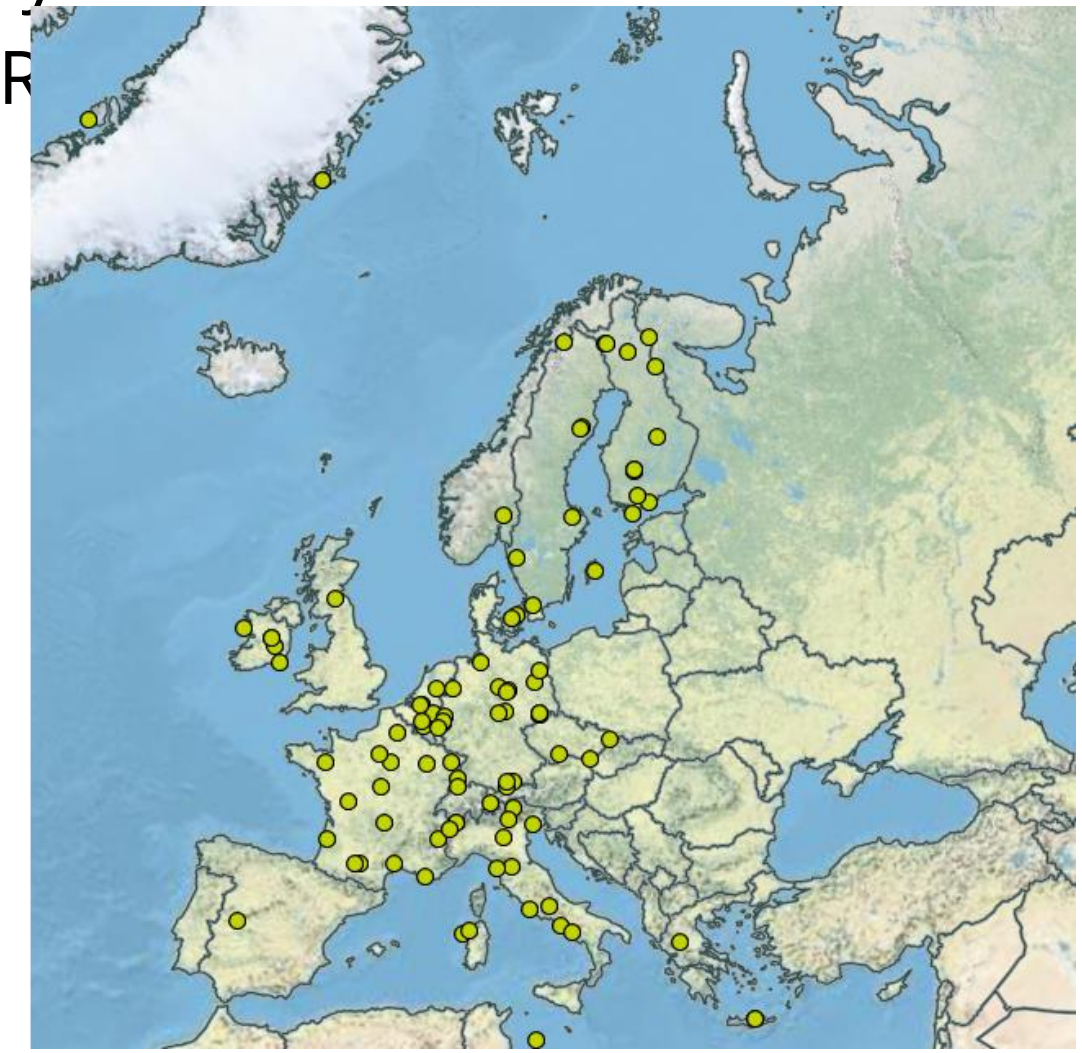
Dr. Simone Sabbatini

cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici

- Long-term GHG monitoring over ecosystems
- High-precision, standardized, (near-) R
  Time observations
- Open-source, FAIR data policy, PIDs

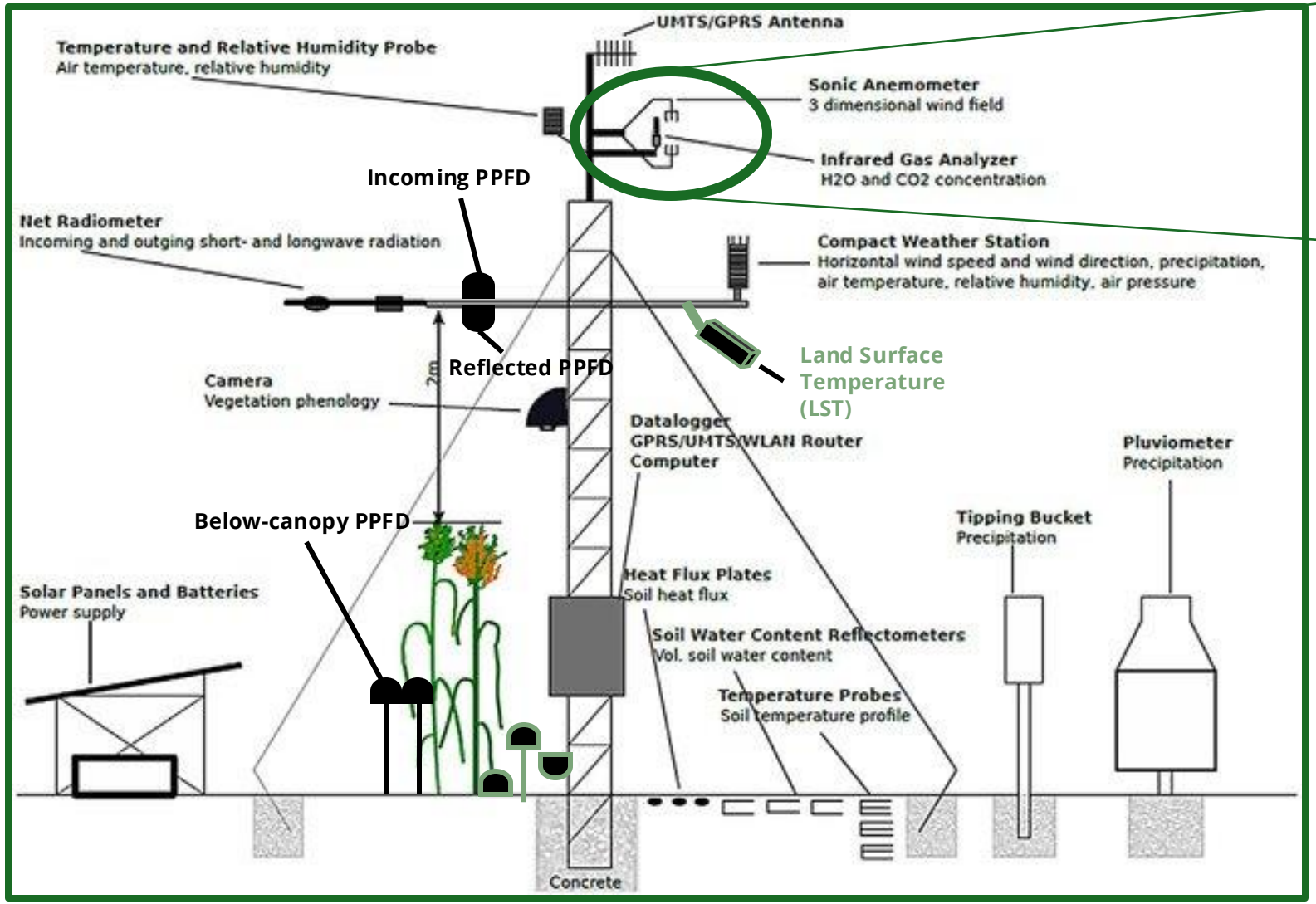
ICOS Ecosystem stations

16 Class 1 stations
29 Class 2 stations
58 Associated stations
20 stations not yet labelled



https://data.icos-cp.eu/portal/

Continuous measurements



Adapted from Bliefernicht_et_al_2018

Based on “Instructions” for standardisation (sensors’ requirements, setup, units, var. names, file format, etc.)

Upcoming:

- **New setup for PPFD_BC in forests (LAI; fAPAR for CAL/VAL)**
- **LST**

Complete list: https://www.icos-etc.eu/icos/documents/Variables

NUBICOS – New Users for a Better ICOS

- Cooperation between ICOS and RS & Global cooperation of ICOS

- Use of ICOS ecosystem data in satellite data calibration and validation
- How the ICOS measurements can be made compliant
- Pilot to measure additional essential climate variables (ECV's)
- Validation of the Sentinel-2 and 3 products wi

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Universiteit Antwerpen

ICOS | NUBICOS

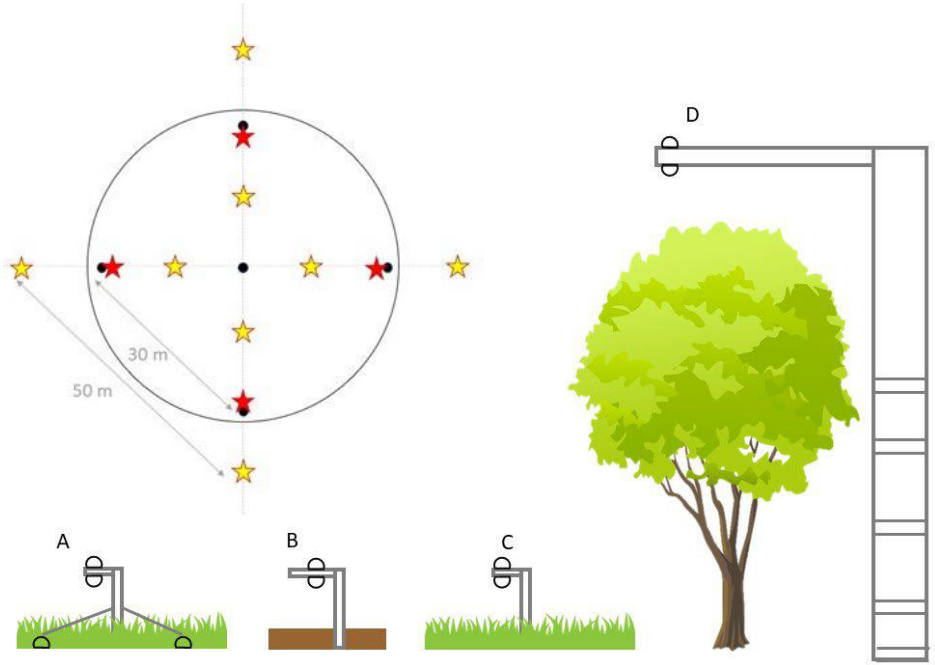
Funded by the European Union

NUBICOS new variables

fAPAR from PPFD_BC

Universiteit Antwerpen

- Pilots at subset of 4 sites
- Consistent withFRM4VEG
- Evaluate spatial sampling design to optimse numberof sensors (38)



LST

- Pilot study at 5 stations
- Compliant with FRM4STS and CEOS LPV

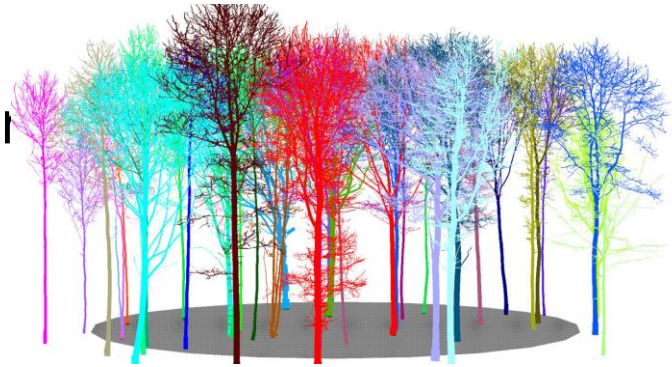
UNIVERSITY OF LEICESTER

TLS

- Pilot at seven ICOS forest stations
- Standardised operator, sensor & processing
- Site-specific allometric r
- AGB ←→EC fluxes

UNIVERSITEIT GENT

UFZ



Sparse plots (20)

700 m^2

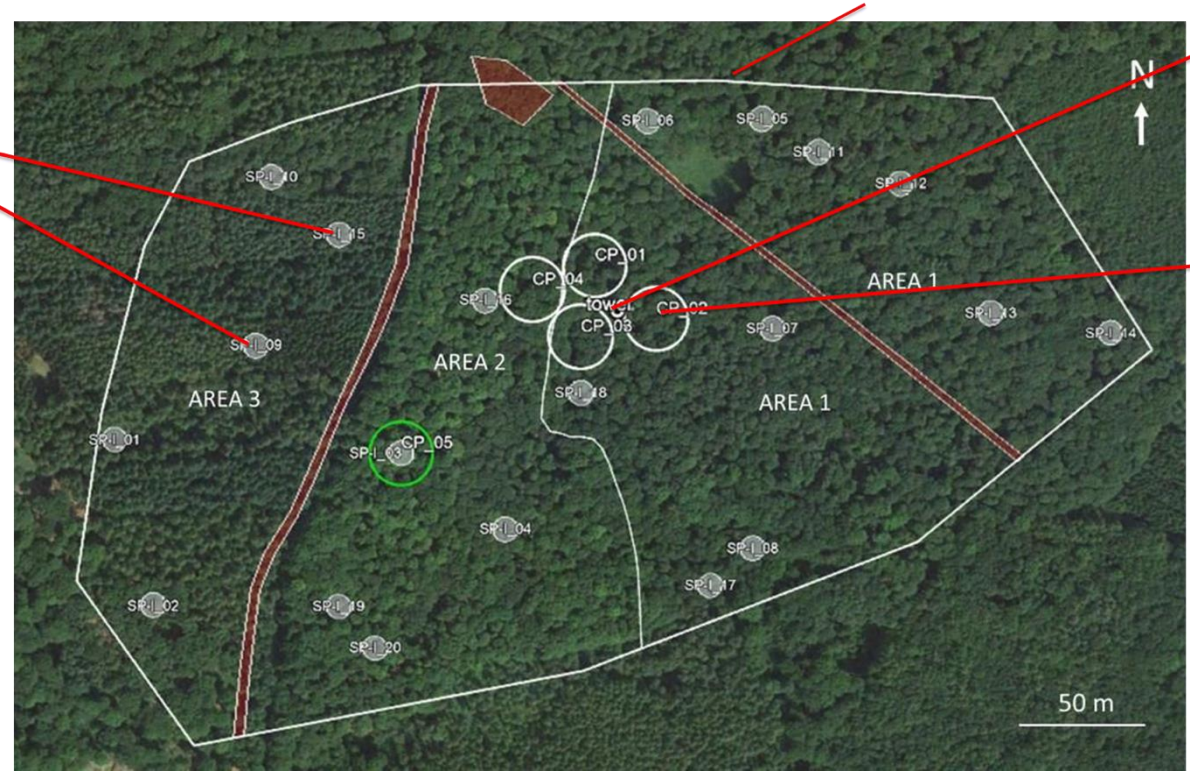
Every 5-10 years

- Tree DBH/height
- Tree spp/health
- GAI
- Soil C and N

Spatial var.

Target area

EC tower and air meteo



Temporal var.

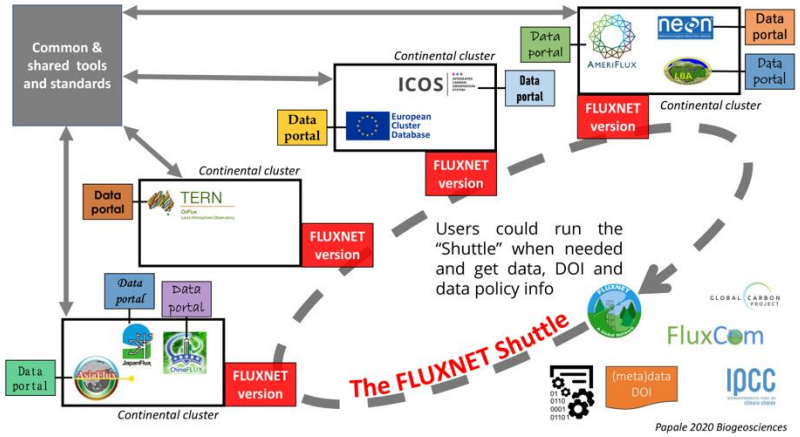
Continuous plots (2–5)

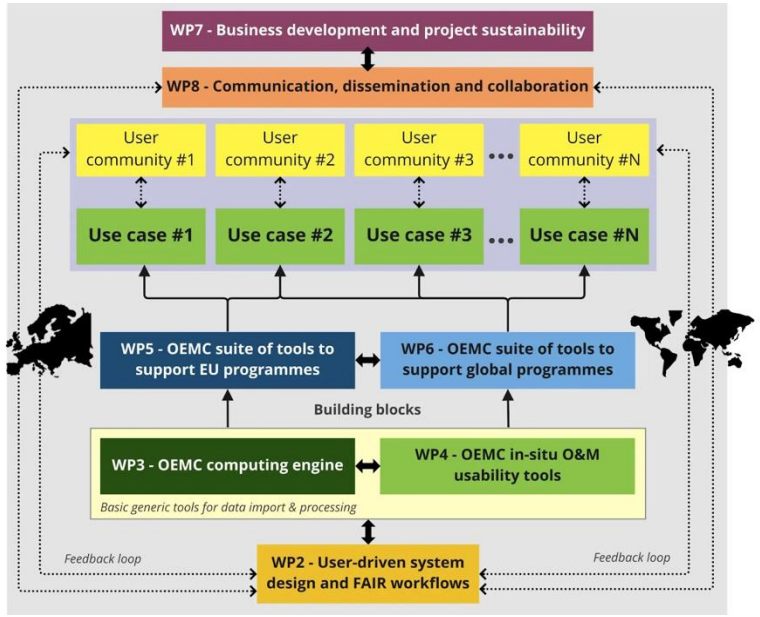
2.000 m^2

Multiple times per year*

- Tree DBH/height
- Tree spp/health
- GAI
- Leaves nutrients
- Litter production

**also soil & tree CBH continuous*





ITINERIS

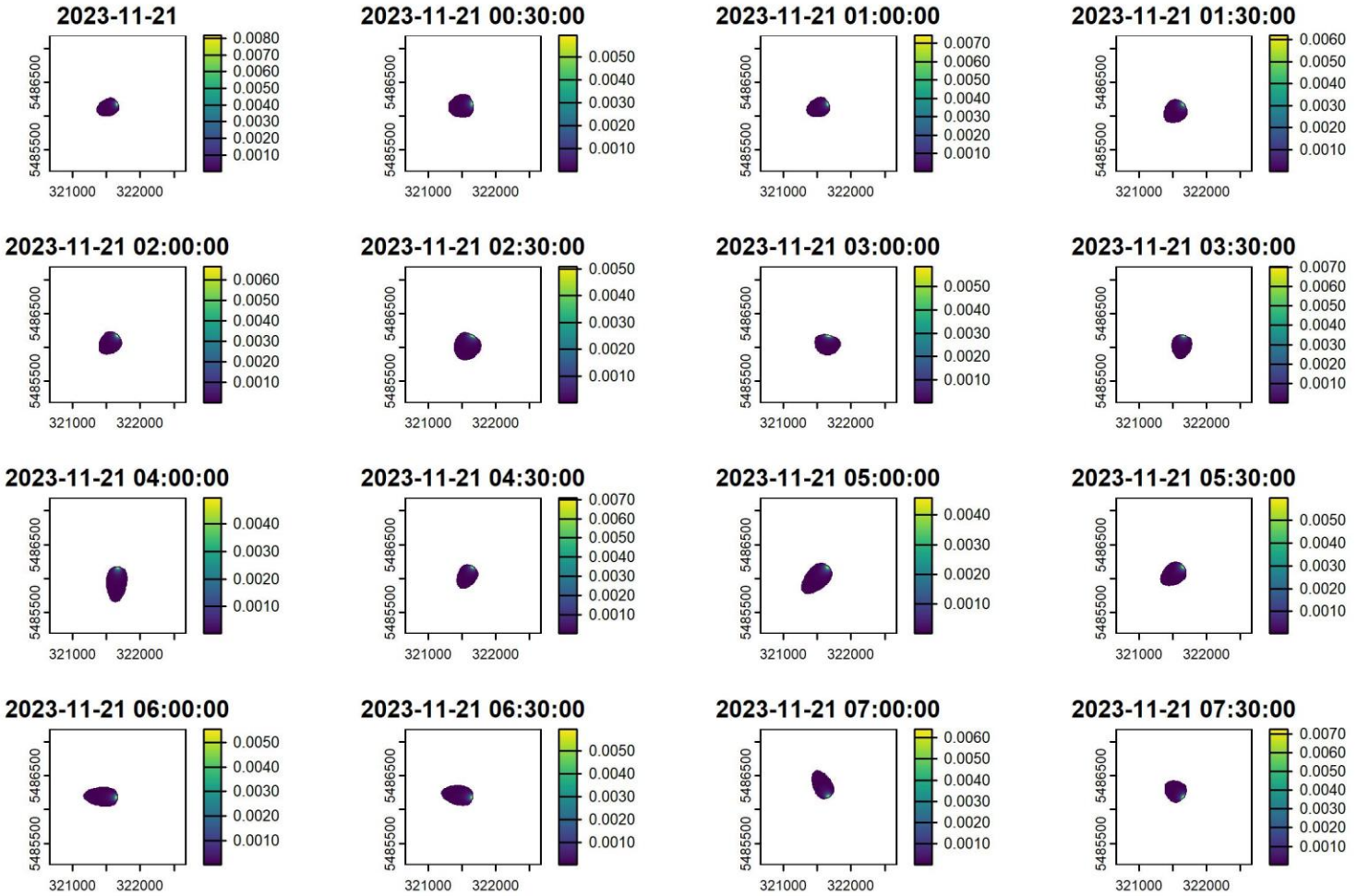
Italian integrated system of RIs in the env. domain, facilitating observation of processes in the atmosphere, marine domain, terrestrial biosphere, and geosphere

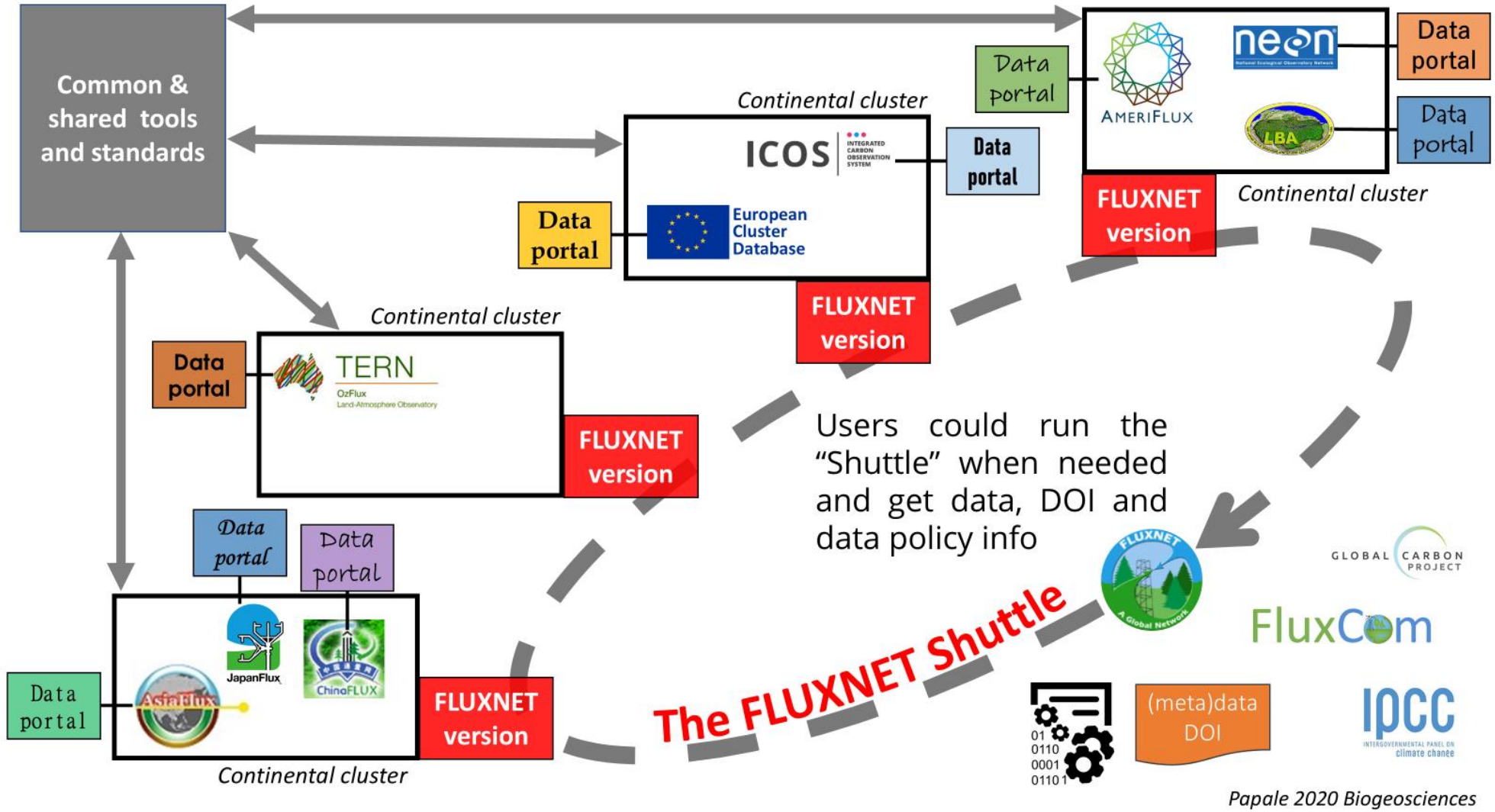
OPEN EARTH MONITOR

Funded by the European Union

- Inter-connections, new perspectives
- New high-temporal resolution footprint predictions
- Centralisation of raw data processing (ETC) → extend to Associated ICOS stations, and pre-labelling data
- FLUXNET Data System: continually updated, open-access. https://fluxnet.org/fluxnet-data-system/
- FLUXNET Shuttle: query-based tool for accessing any dataset of any regional network part of it (ICOS, AMERIFLUX, OZFLUX, other) in the same format and continuously updated (pace of regional net.)

- NetCDF daily file, 30 min resolution
- Contribution to the measured flux of each “pixel” (1x1 m, selectable)
- ATMODAT (Atmospheric Model Data) and CF (Climate and Forecast) standards

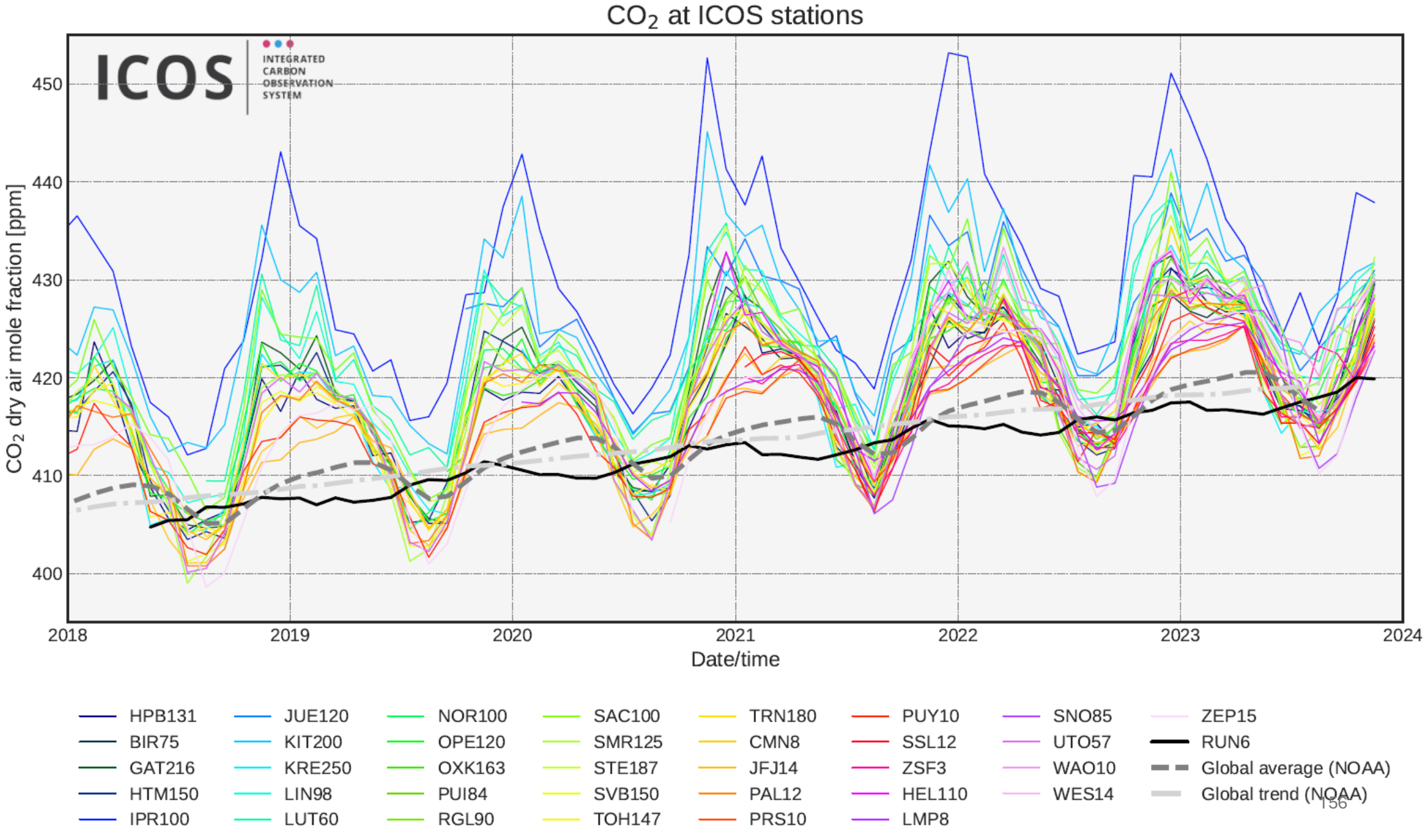




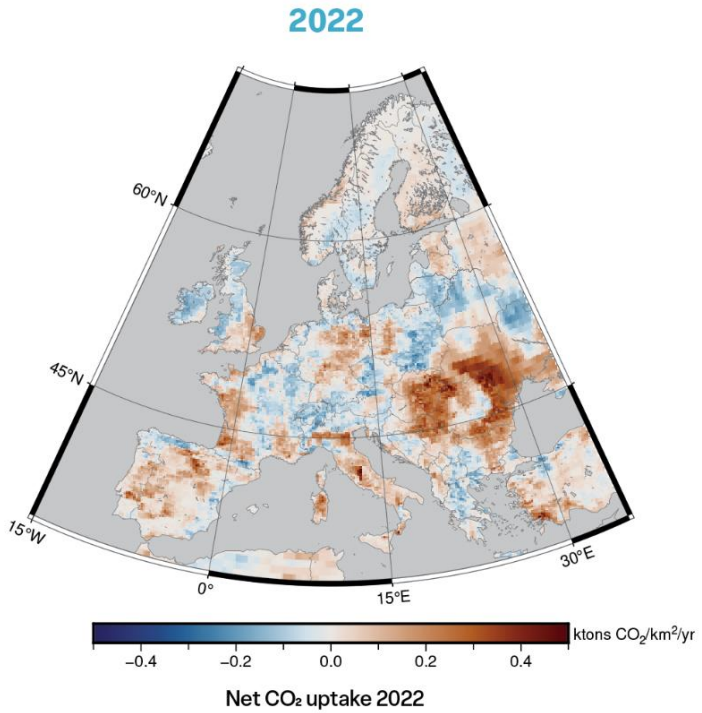
Papale 2020 Biogeosciences

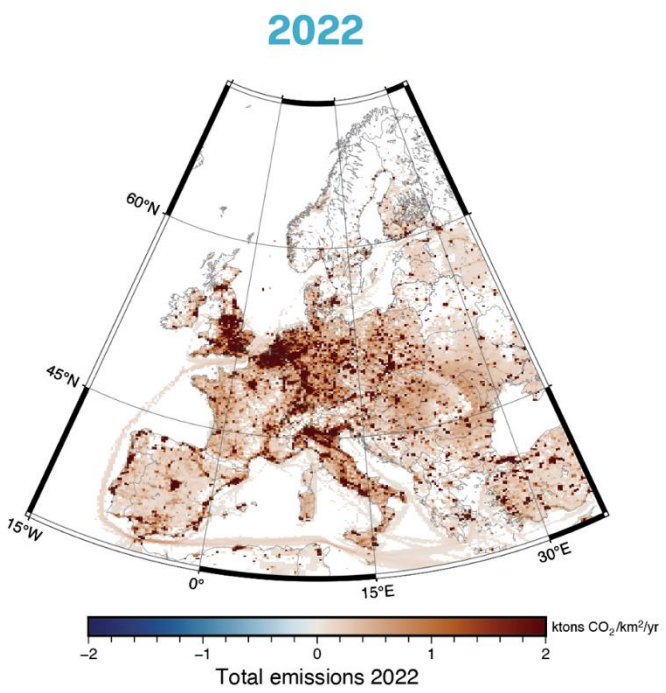
Thank you

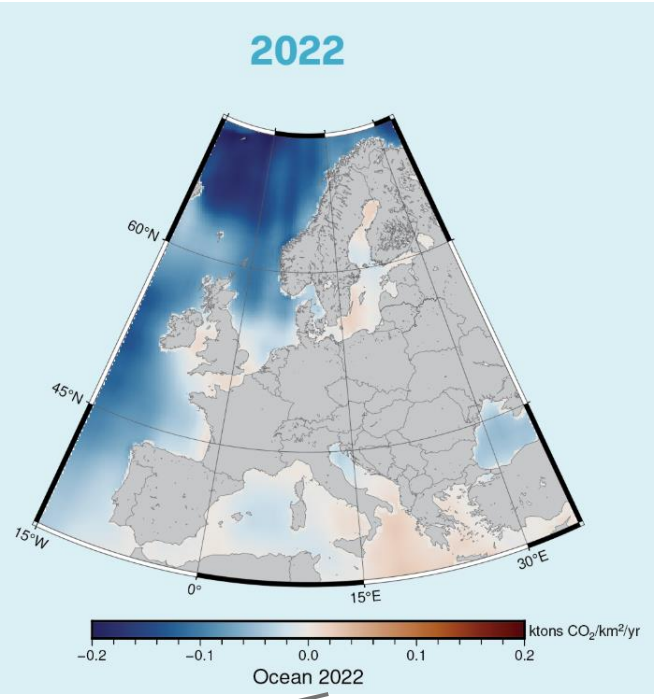
ICOS
INTEGRATED CARBON OBSERVATION SYSTEM


CO_2 at ICOS stations
ICOS
INTEGRATED CARBON OBSERVATION SYSTEM
CO_2 dry air mole fraction [ppm]
450
440
430
420
410
400
2018
2019
2020
2021
2022
2023
2024
Date/time
HPB131
BIR75
GAT216
HTM150
IPR100
JUE120
KIT200
KRE250
LIN98
LUT60
NOR100
OPE120
OXK163
PUI84
RGL90
SAC100
SMR125
STE187
SVB150
TOH147
TRN180
CMN8
JFJ14
PAL12
PRS10
PUY10
SSL12
ZSF3
HEL110
LMP8
SNO85
UTO57
WAO10
WES14
ZEP15
RUN6
Global average (NOAA)
Global trend (NOAA)

Data







Priors for inverse modelling using ICOS atmosphere data

https://www.icos-cp.eu/fluxes

GLOBAL FORUM
"The Earth Talks"
ROME, Italy 5-9 MAY, 2025

DANUBIUS-RI

Advancing Global River-Sea System Science for a Resilient Planet

Francesca De Pascalis

CNR-ISMAR

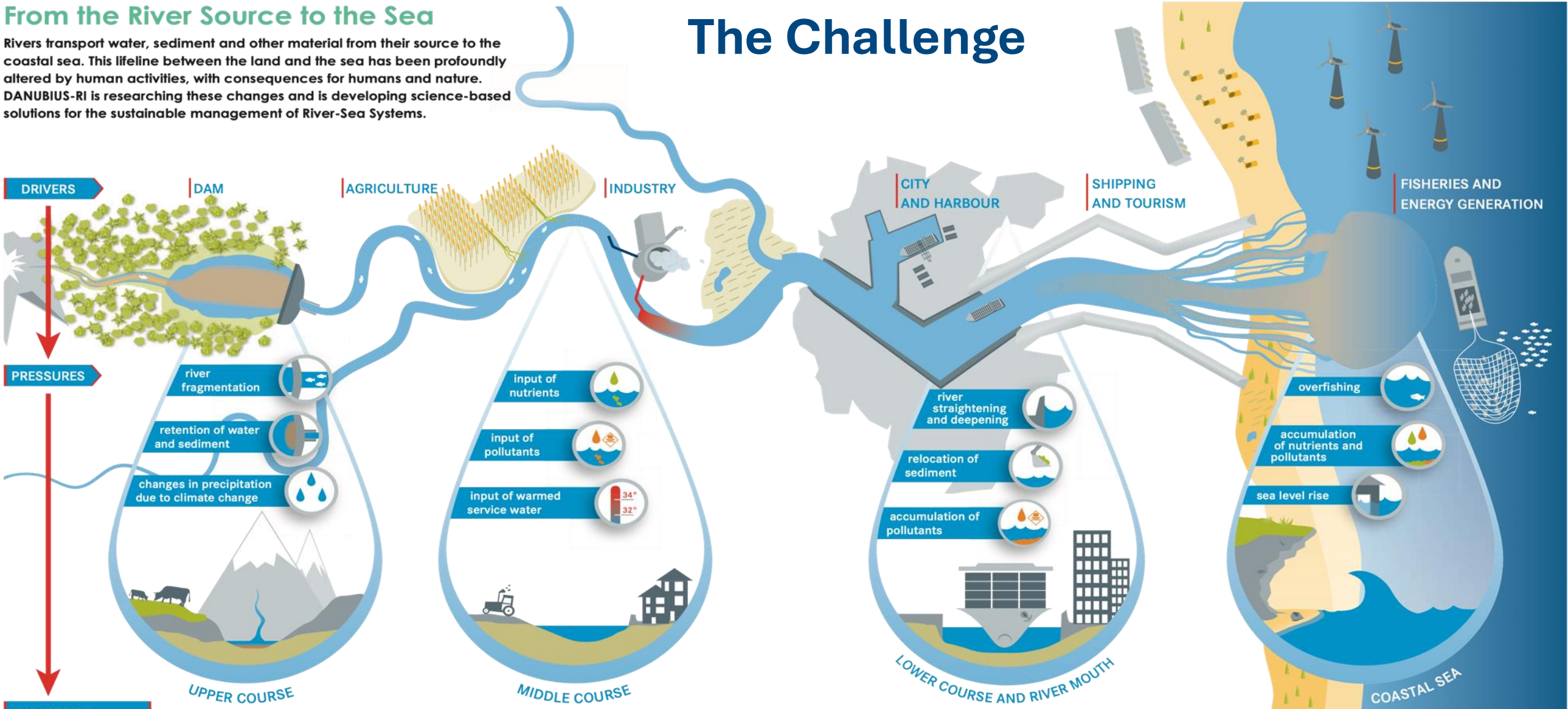
francesca.depascalis@cnr.it

Image: The Danube Delta

From the River Source to the Sea

Rivers transport water, sediment and other material from their source to the coastal sea. This lifeline between the land and the sea has been profoundly altered by human activities, with consequences for humans and nature. DANUBIUS-RI is researching these changes and is developing science-based solutions for the sustainable management of River-Sea Systems.

The Challenge



IMPACTS ON RIVER AND SEA

Human activities have multiple and often compounding effects, propagating through the River Sea System and with impacts that are sometimes visible at points far from the point of origin.

temperature stress for native species
habitat loss
spread of invasive species
land subsidence
decline of fish stock
hydropeaking
extreme floods/low waters
impaired fish migration
insufficient floodplains
decrease in self-purification capacity
bank and coastal erosion
sediment starvation on coasts and in deltas
altered hydrological conditions
surplus algae growth in the rivers and seas
decrease in water and sediment quality
low-oxygen zones
groundwater salinisation
biodiversity loss
accumulation of pollutants in organisms and damage

What is DANUBIUS-RI ?

Image: Venice Grand Canal

Our Vision

to achieve **healthy River-Sea Systems** and to advance their **sustainable use,** in order to live within the planet's ecological limits by 2050.

Our Mission

- to provide **state-of-the art research infrastructure** from river source to sea;
- to facilitate **excellent interdisciplinary science**;
- to offer **integrated knowledge** to manage and protect River-Sea Systems.

Our Goals

- **to overcome the current fragmentation of science, knowledge, data & management** in rivers and seas by integrating spatial, temporal, disciplinary and sectorial thinking;
- **to provide scientific solutions to environmental and societal risks** from climate change;
- **to resolve problems** arising from human impacts on River-Sea Systems by using an **interdisciplinary perspective**, from source to sea.

DANUBIUS-RI

Image: Hamburg Port

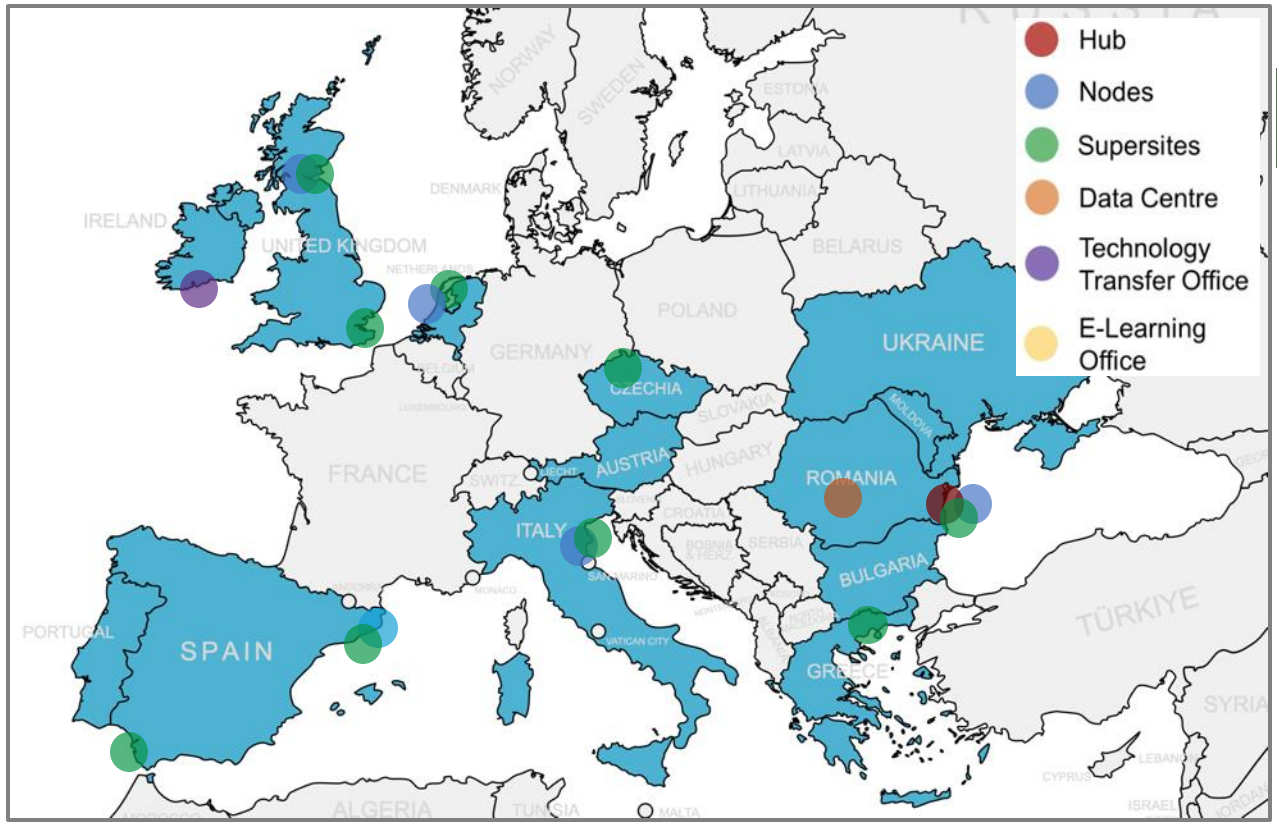
Global Impact through Science

- Interdisciplinary, distributed Research Infrastructure
- Addressing the conflicts between society's demands and environmental change
- Facilitates knowledge exchange
- Attracts young people to science
- Components across Europe

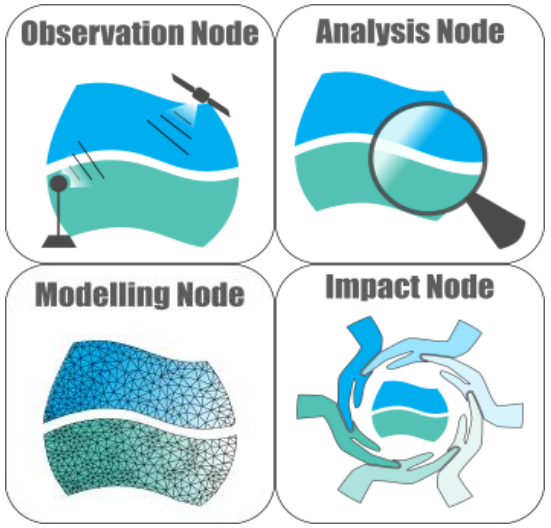
How ? DANUBIUS-RI Architecture

DANUBIUS-RI

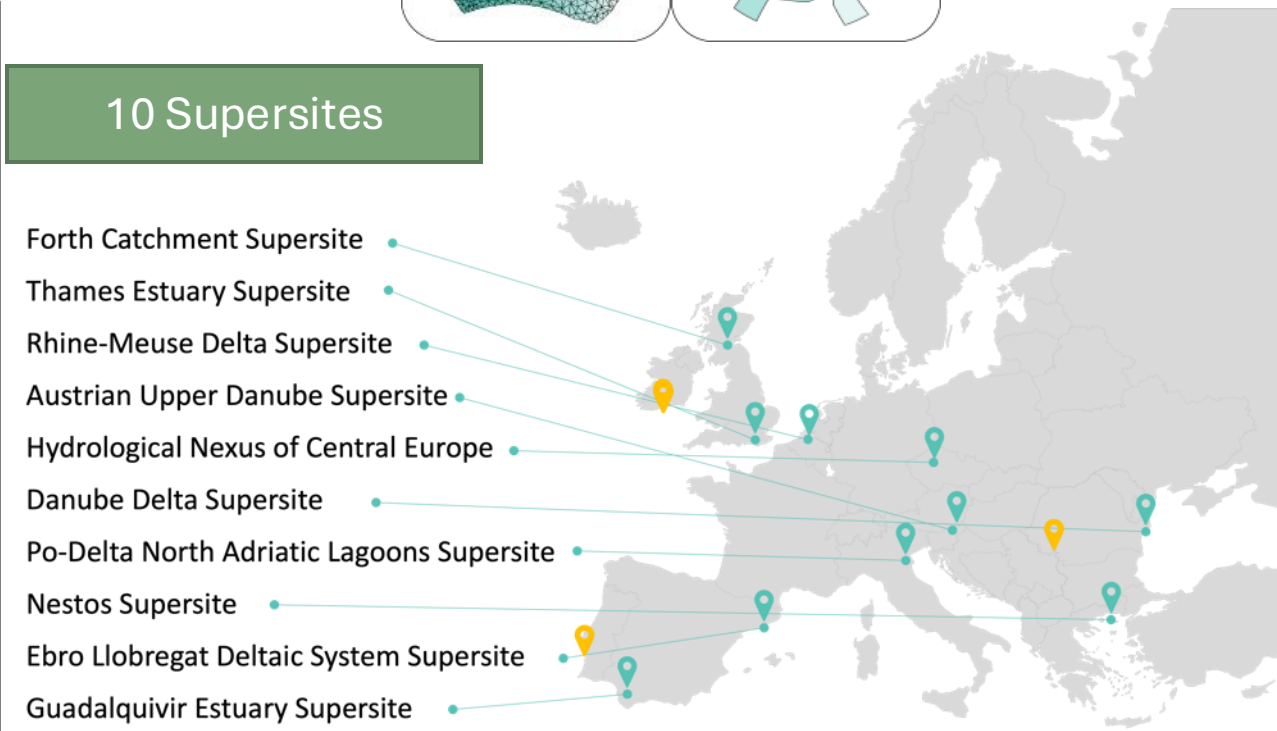
All Components



4 Thematic Nodes



10 Supersites



New Supersite offers from IE, PT, RO, presented in Nov. 2023

Nodes

Observation (UK)

Real time observation tools and instruments, new sensors, satellites, automated data processing, quality control and visualization

Analysis (Romania)

laboratories, instrumentation and highly innovative methodologies for samples analysis.

Modelling (Italy)

Development of new modelling tools in terms of new algorithm, data-models interaction, interfaces, link with socio-economic modelling.

Impact (Netherlands)

interface between natural and social sciences developing methodologies and tools that will help to solve problems in highly complex dynamic RS systems

Tay river

Research infrastructure and testbed for evaluating and de-risking novel monitoring technologies

Transfer, upscale and export **technologies**

Digital observatory combining data from sensors, satellites and models

Comparison among the 10 Supersites

Natural laboratories for observation, research, modelling and innovation at locations of high scientific importance and opportunity

Supersite Concept

DANUBIUS-RI

DANUBIUS-RI

Services to the GEO Community

Unique Capabilities

- Combines natural and social sciences
- Mobile laboratories and observatories
- Harmonized research methods across locations
- Standardized data protocols on Supersites (DANUBIUS Commons)

Valuable Data Resources

- Long-term, multi-disciplinary observation
- Multi-source integrated products
- FAIR-compliant
- Real-time and Delay mode/historical datasets

Access to:

- Supersites and infrastructure,
- State-of-the-art analytical tools,
- Trained research teams

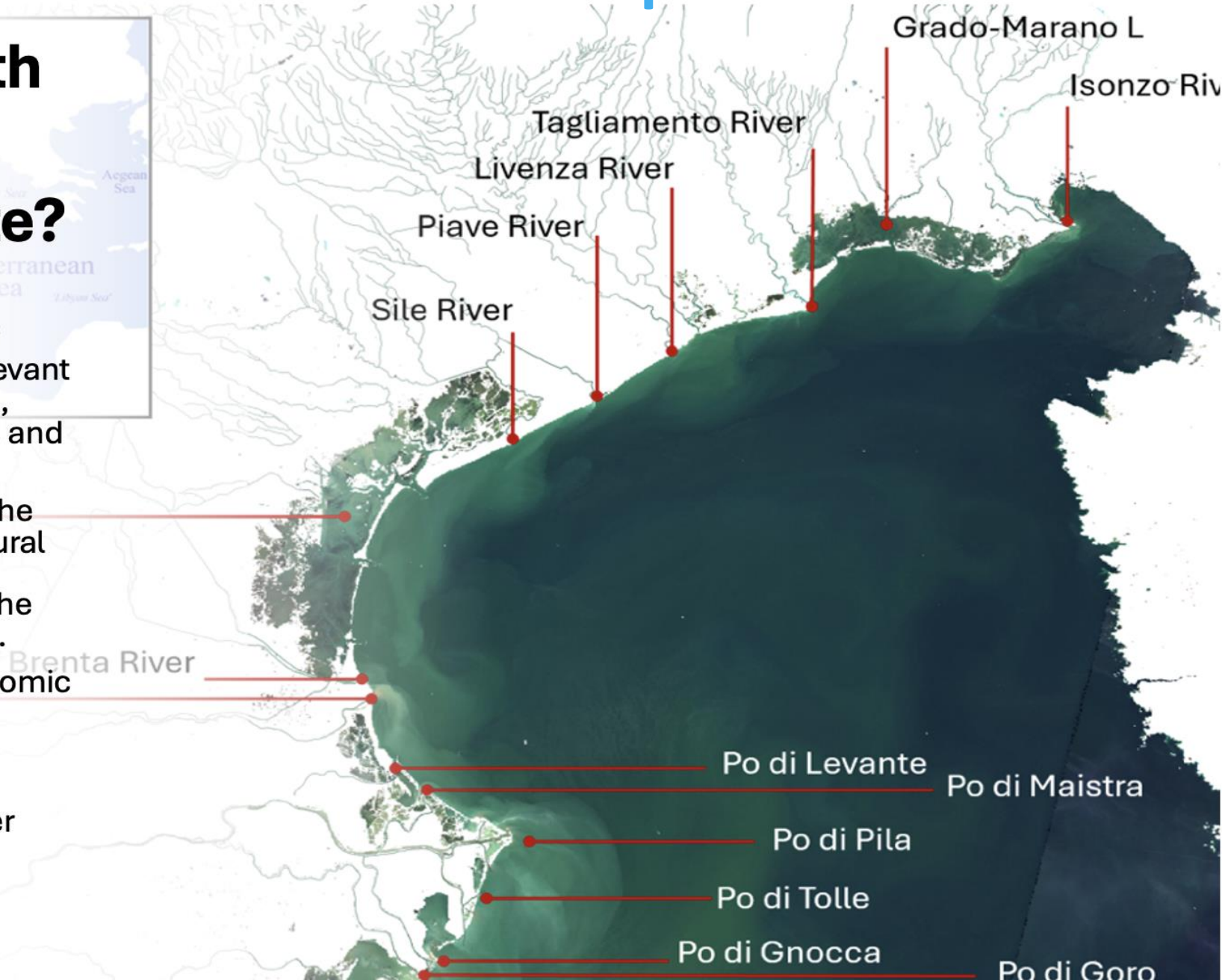
Support for: Scenario modeling and assessments, Stakeholder co-design of studies

The Italian example

DANUBIUS-RI

Po Delta and North Adriatic Lagoons Why this supersite?

- It is a natural laboratory for the study of transitional environments. It plays a relevant role to investigate land-sea interactions, given its peculiar geographical, climatic and ecologic characteristics
- It represents an important example of the coexistence of anthropic uses and cultural and social values, being n hot spot for climate change. It allows investigating the consequences of adaptation measures.
- The supersite comprises multiple economic systems covering different sectors and being open to innovation
- It is characterized by several science/societal themes (from saltwater intrusion, to coastal erosion, SLR, ...)



Po Delta & North Adriatic Lagoons: The digital observatory

DANUBIUS-RI

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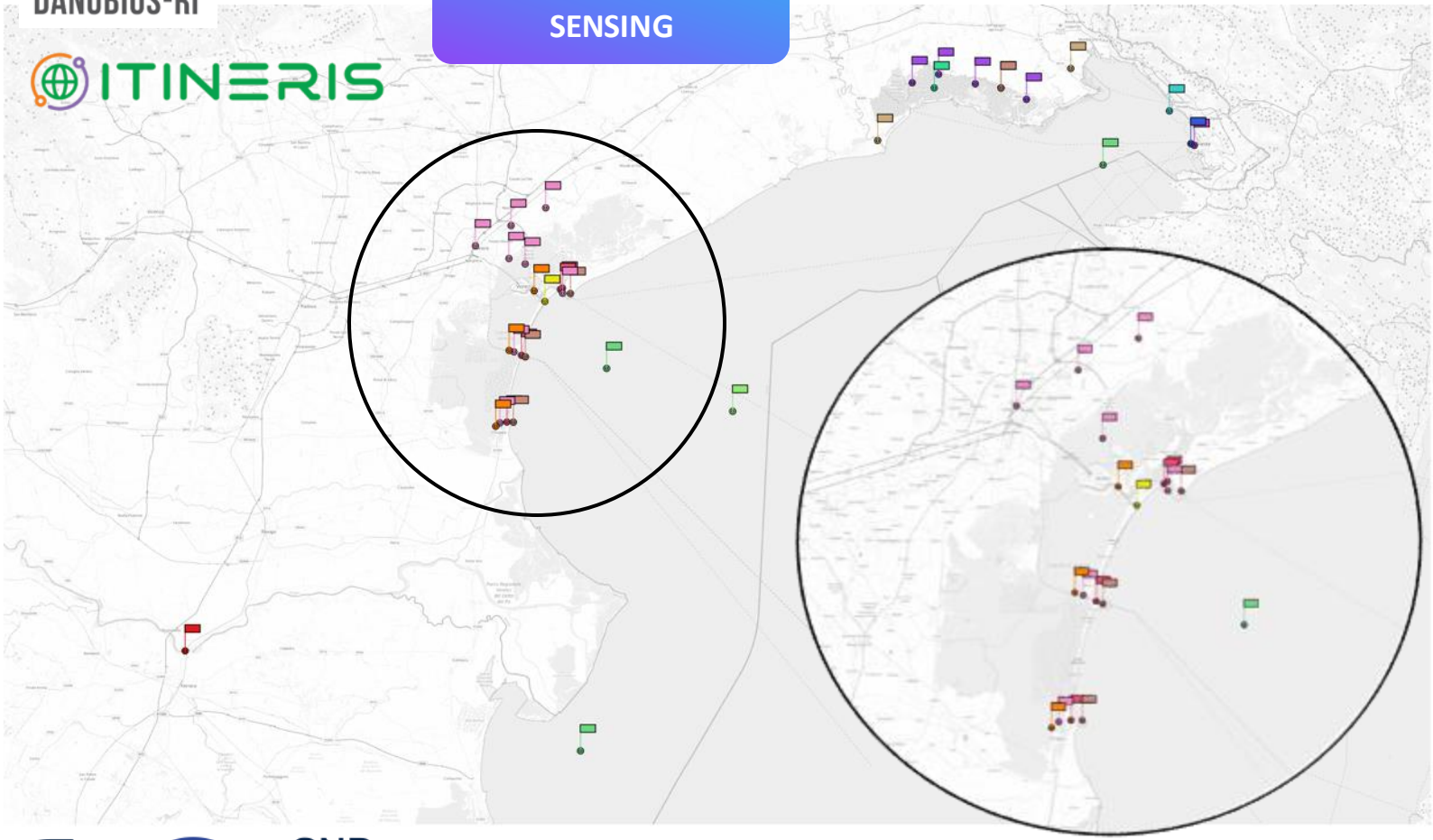
ENVIRONMENTAL SENSING

Data Centre



- Air _Temperature, Wind_Speed_and_Direction,_water _Subsurface_Temperature
- Coast_line_webcam
- Nutrient_automatic_analyzer _(Nitrates)
- Ocean_Sound
- Pressure-Temperature-Conductivity-Dissolved_ Oxigen-pH
- Pressure-Temperature-Conductivity-Dissolved_ Oxigen-Turbidity-pH-Chla
- Pressure-Temperature-Conductivity-Dissolved_ Oxigen-Turbidity-pH-Chla-(Nitrates)
- Reflectance
- Surface_Sea_Level_Pressure
- Temperature_ Conductivity
- Turbidity
- Various_parameters
- water __level-Temperature-Conductivity-Dissolved_ Oxigen-Turbidity-pH-Chla
- Water _ Currents

River-Sea ecosystems Interactions

Enhancing digitalization of EOV and ECV.

Lateral source quantification for water, sediment, and nutrient loads.

ROFI coastal area analysis.

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OGS

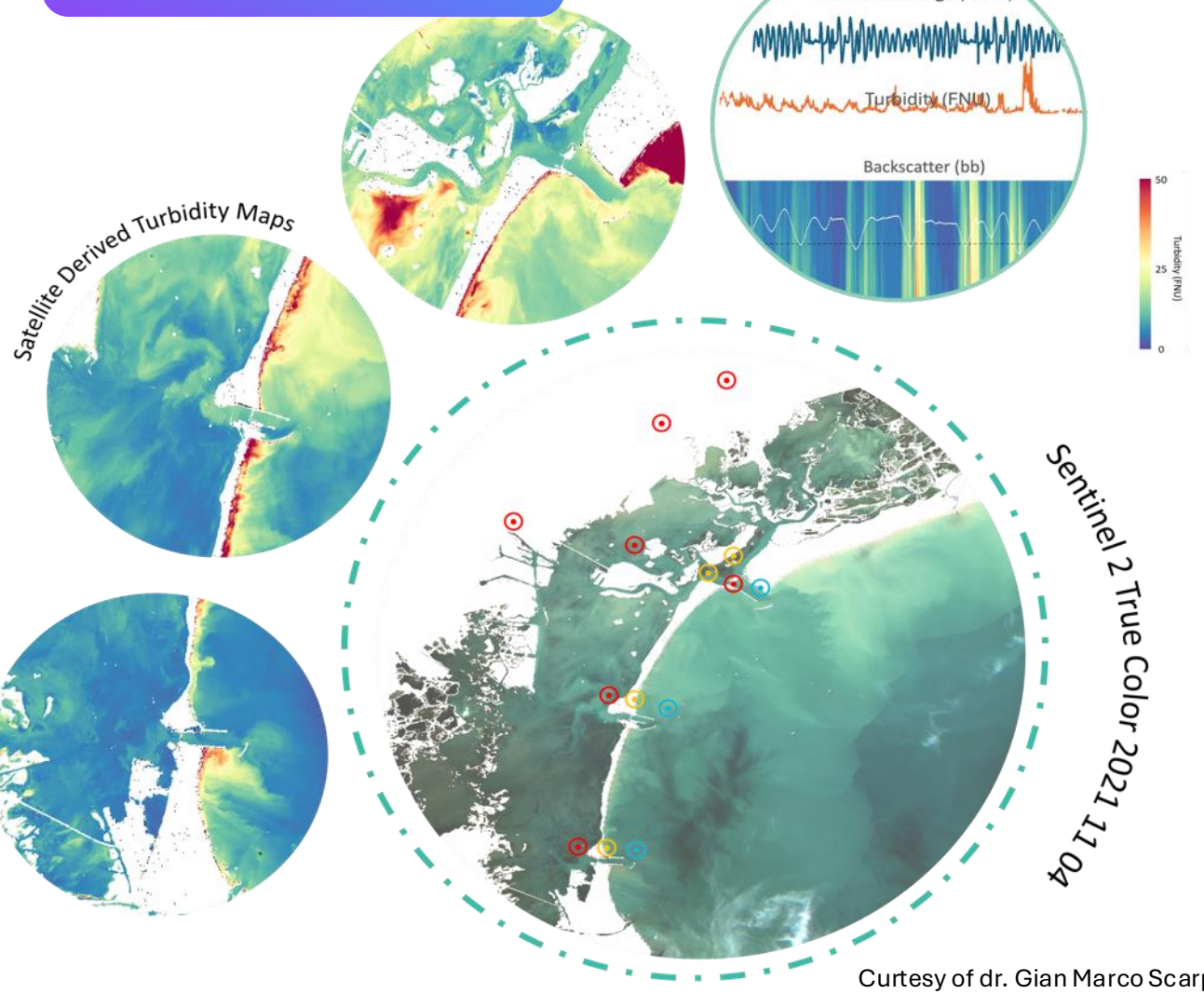
Po Delta & North Adriatic Lagoons: The digital observatory

DANUBIUS-RI

Data Centre

- River-Sea ecosystems Interactions
- Water Quality
- Coastal Morphology
- Sediment Dynamic
- Integrated products with Numerical Models
- Satellite Products validation

SATELLITE
+
ENVIRONMENTAL SENSING



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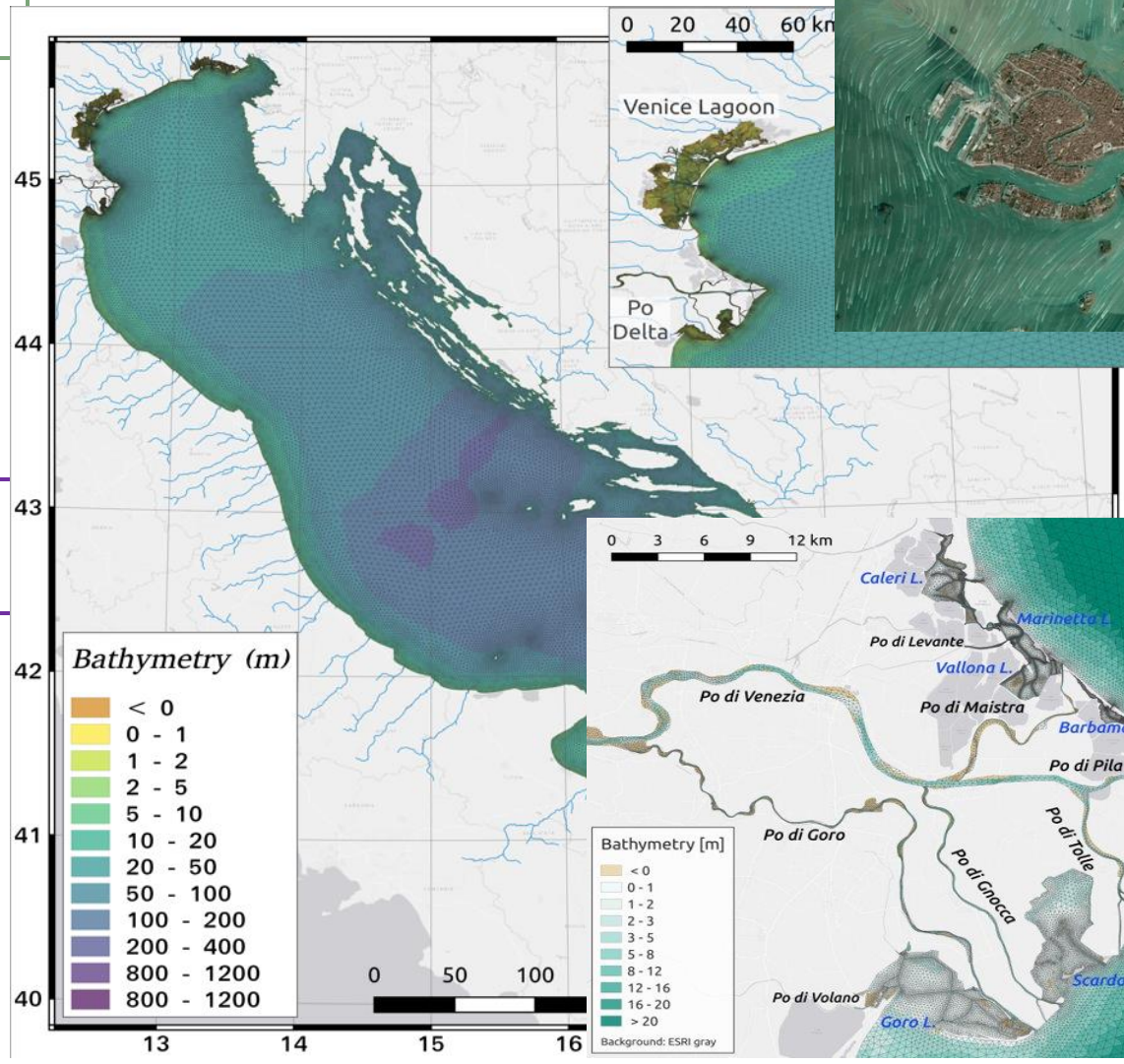
Curtesy of dr. Gian Marco Scarpa

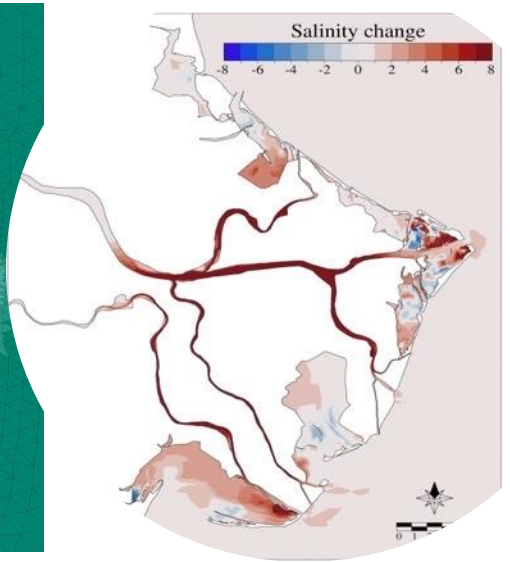
Po Delta & North Adriatic Lagoons: The digital observatory

DANUBIUS-RI

ENVIRONMENTAL SENSING
+
NUMERICAL MODELS

- River-Sea ecosystems Interactions
- Water Quality
- Coastal Morphology
- Sediment Dynamic
- Climate change
- Extreme events
  (e.g floods, droughts, storm surge)
- Salt intrusion
- Water resource management
- What if scenarios





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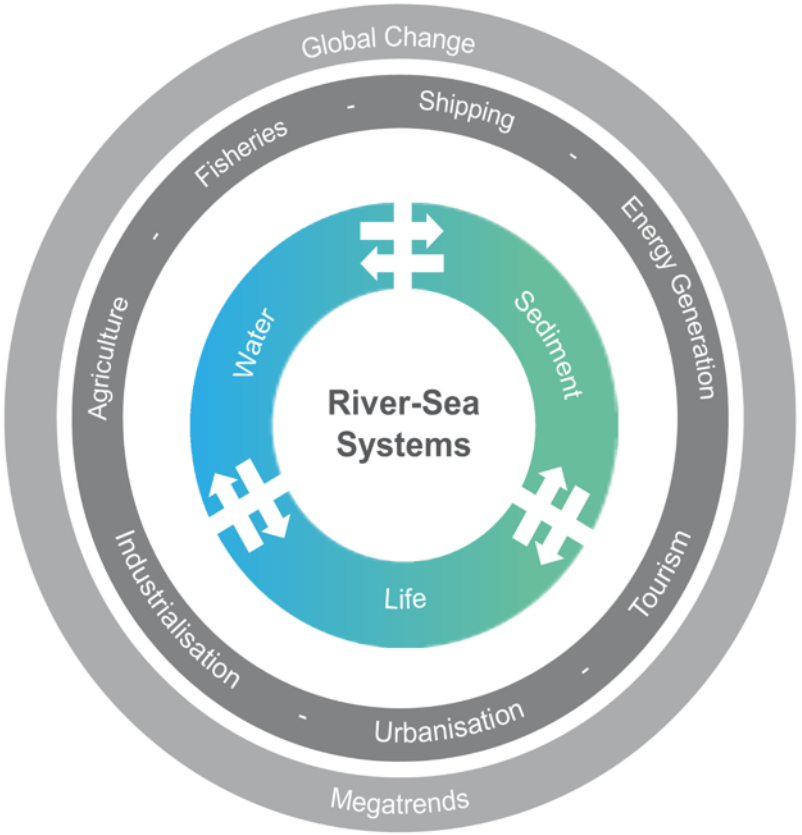
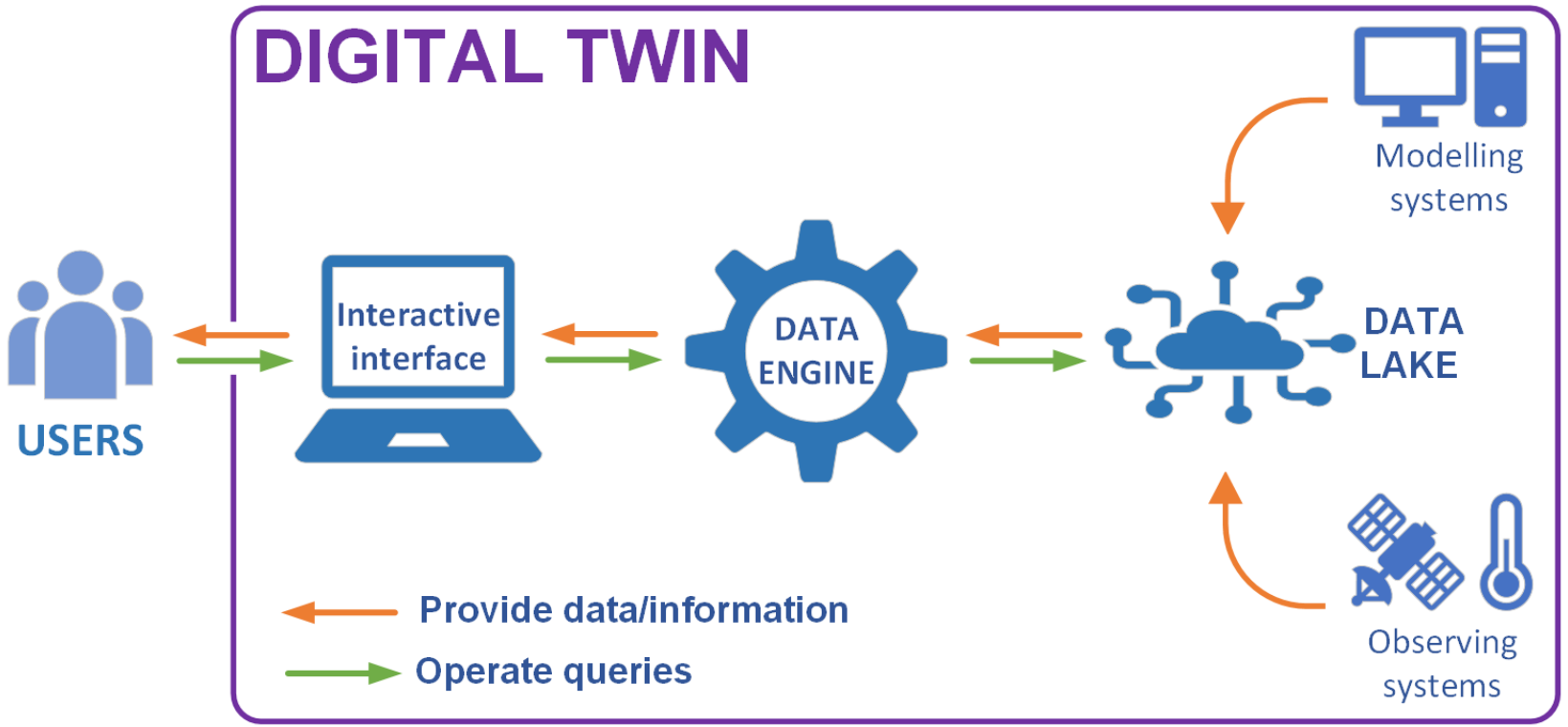
DANUBIUS-RI

Po Delta & North Adriatic Lagoons: Digital Twin

ENVIRONMENTAL SENSING
+
SATELLITE
+
NUMERICAL MODELS



Integrated product and components to support digital twins of the River-Sea Systems



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Global

International initiatives

WMO, GCOS, WWAP, UNESCO, UNEP and the United Nations Ocean Decade initiatives) as well as other networks such as International Union for Conservation of Nature and Wetlands International.

International river basin and regional seas commissions

International Commission for the Protection of the Rhine (ICPR), International Commission for the Protection of the Danube River (ICPDR), Black Sea Commission, Inter-Mediterranean Commission and OSPAR Commission for the North-East Atlantic.

National / Local

Funded Projects and collaborations

Regional Authorities, Regional Environmental Protection Agencies, Universities, Basin District Authorities and Civil Protection.

European Regional

Research projects

H2020, HORIZON, LIFE, Interreg, COST (e.g. DOORS, BRIDGE, LandSeaLot, InnovaMare; I-Storms; PortoDiMare; ChangeWeCare; HATCH; WaterCare, STREAM).

EU Programmes and Initiatives

Copernicus programme EUMETSAT, SeaDataNet, EMODnet.

Partnerships

Sustainable Blue Economy Partnership, Water4all.

ENVRI / ESFRI

EMSO ERIC, EURO ARGO ERIC, LifeWatch ERIC, eLTER, ANAEE ERIC, JERICO, EPOS ERIC, EMBRC ERIC, ICOS ERIC, AQUACOSM, ACTRIS ERIC, IAGOS.

Joint Programming Initiatives

JPI Water, JPI Ocean and JPI Climate.

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

European Union

Anaee-eric
Analysis and experimentati
on ecosystems

ELENA PAOLETTI, IRET-CNR, ANAEE NN FOCAL POINT FOR ITALY

GEO GLOBAL FORUM (7 MAY 2025)

AnaEE ERIC
Created 24/02/2022


EMPOWERING
ENVIRONMENTAL
SCIENCE
AnaEE
ERIC
RESEARCH SERVICES FOR A RESILIENT PLANET

A EUROPEAN COLLABORATIVE ORGANISATION AND RESEARCH NETWORK


WE INVESTIGATE HOW ECOSYSTEMS RESPOND TO VARIOUS PRESSURES - FROM CLIMATE CHANGE TO POLLUTION – AND THE BEST WAYS TO MITIGATE THE RISKS

WHETHER YOU'RE DEVELOPING ENVIRONMENTAL POLICIES...


...NATURE-BASED SOLUTIONS AND
GREEN TECHNOLOGIES...

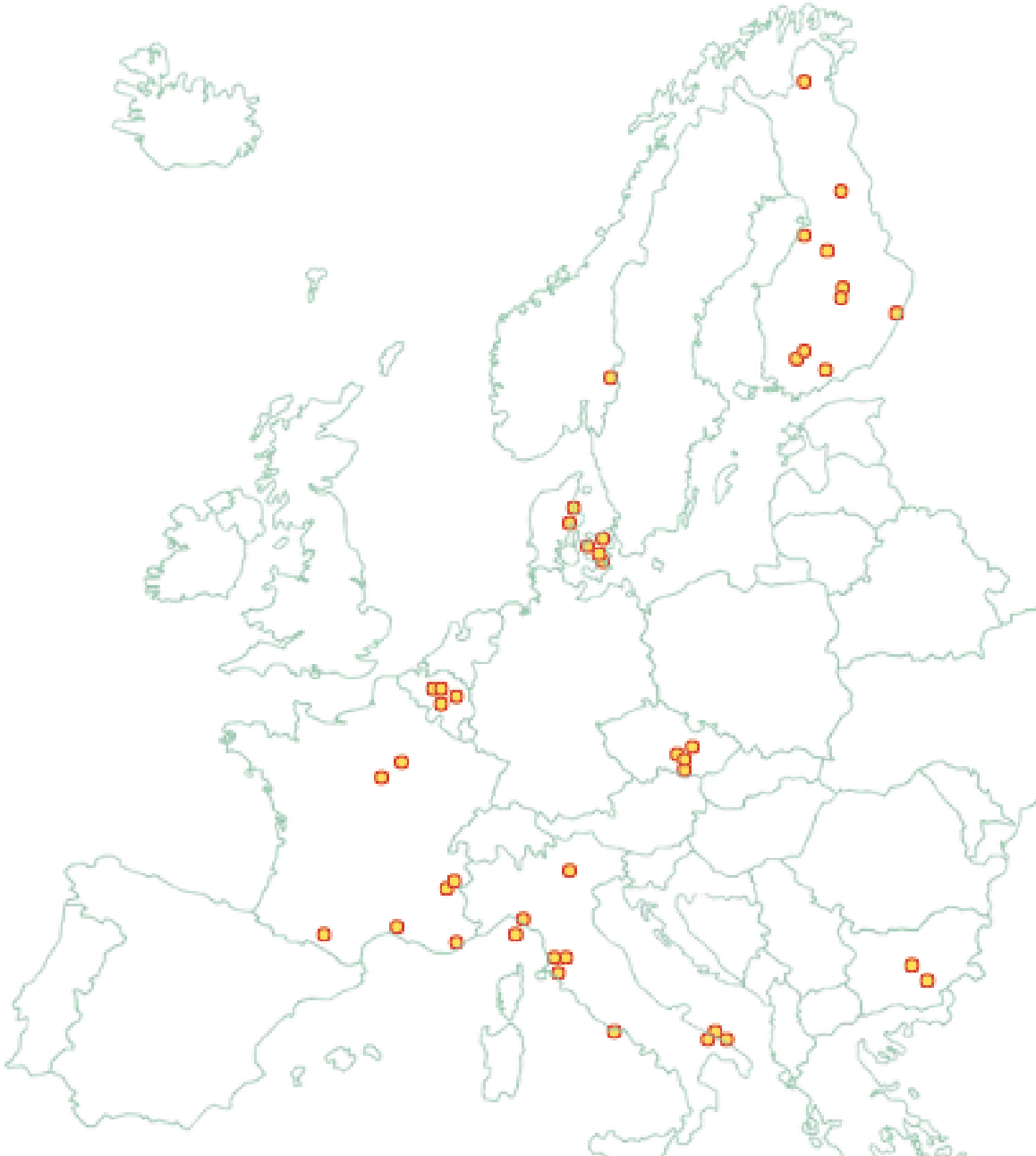

...OR EDUCATING THE NEXT GENERATION,
ANAEE-ERIC CAN PROVIDE VALUABLE TOOLS
AND EXPERTISE

Forecasting the climate of the future

With the help of our facilities researchers can forecast how ecosystems will react under the pressures humans are causing.

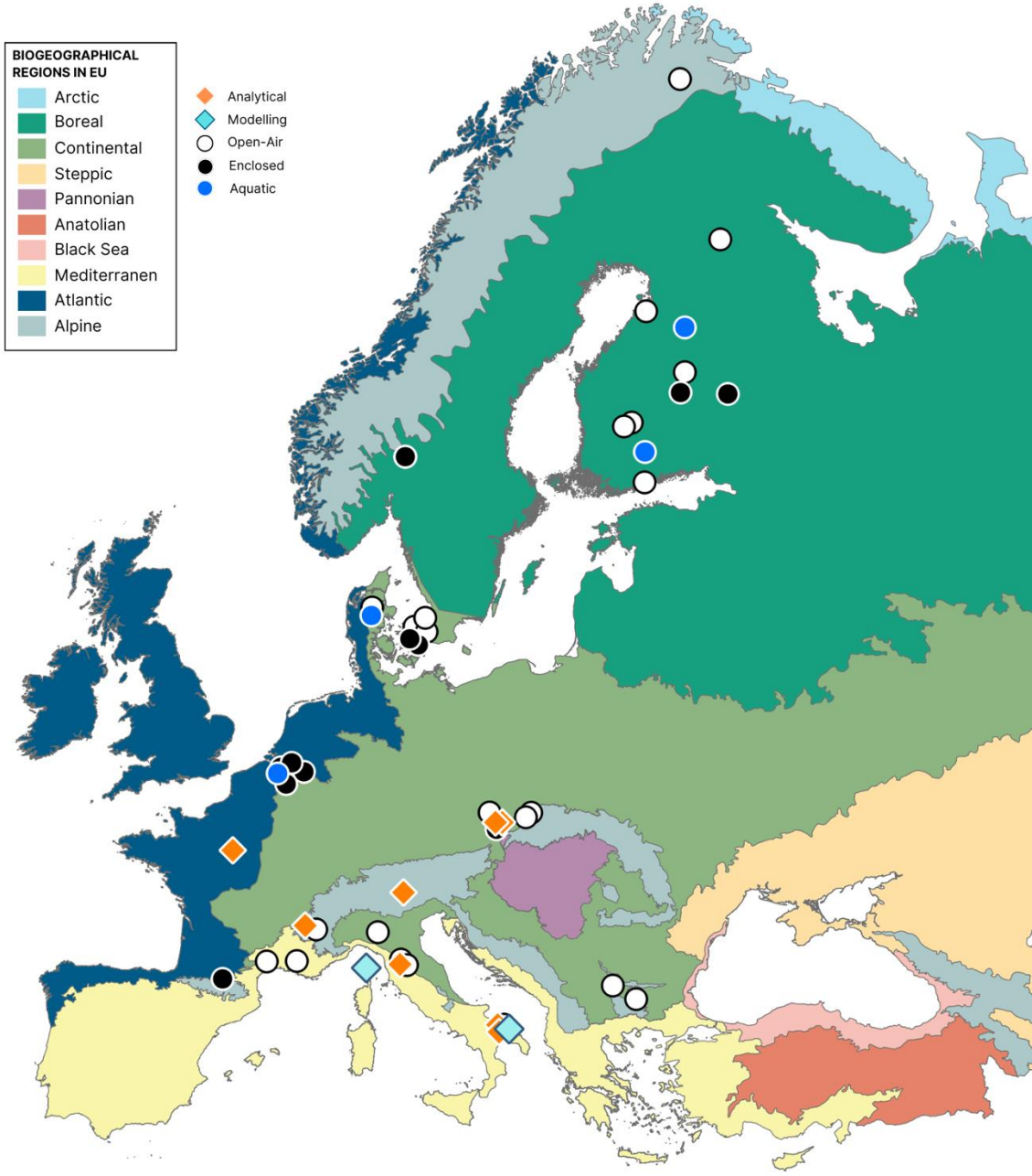
Manipulation of the environment:

- Climate extremes (intense droughts, heat waves, flooding),
- Pollution (ozone, nitrogen)
- GHGs concentrations (CO_2, CH_4, N_2O)
- Methods (monitoring and assessment of soil, plant and water status opportunity for studying plant-soil-microbe-interactions and others).



Anaee RI covers all european climates

- All types of ecosystems: terrestrial and aquatic.
- From the sub-arctic to the Mediterranean
- Managed as well as unmanaged land = Agro-ecosystems vs. grasslands, peatlands or forests.



Geographical location of AnaEE's facilities, within the various biogeographical zones in Europe.

(Base layer: EU Environmental Agency)

4 types of facilities

Our facilities have advanced equipment that can **simulate future environmental conditions**, such as soil composition, drought and CO_2 levels, and observe how plants, animals, and entire ecosystems react, in **all European climatic zones.**

- **4 TYPES:**
  - Open-air
  - Enclosed
  - Modelling
  - Analytical

OPEN-AIR

OPEN-AIR ECOSYSTEMS

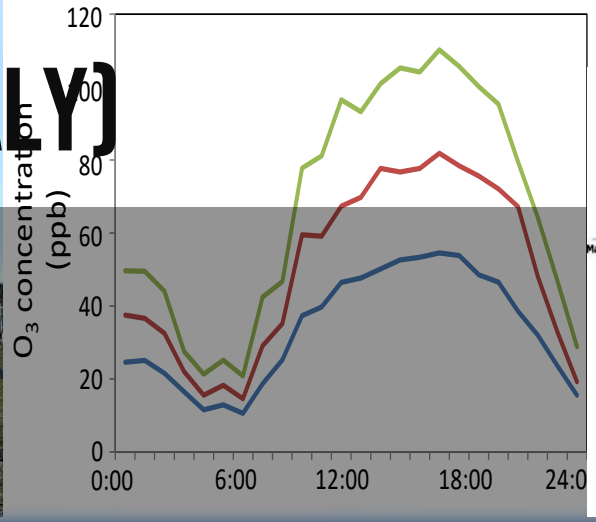
- Several drivers and manipulations
- Diversity of ecosystems
- Long-term experiments
- Terrestrial and Freshwater ecosystems

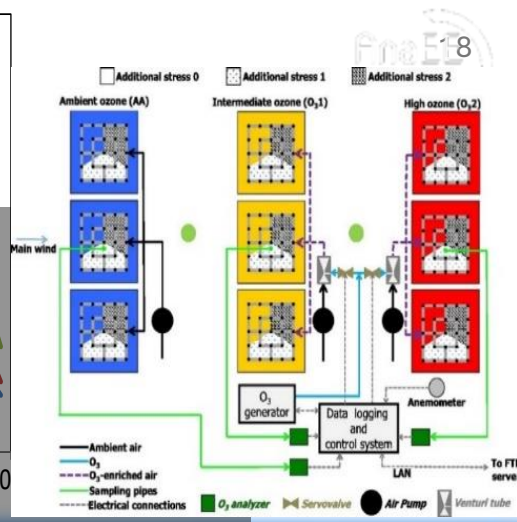
OPERATIONS

- Standalone experimental facilities
- Networks of sites

    - Physical access
    - Remote access for samples already existing

AN EXAMPLE: FO3X (OZONE FACE IN ITALY)





MANIPULATION OPTIONS ARE:

- Three levels of ozone in open air
- Fertilization
- Pests-pathogens
- Drought
- Heat

Platform for exposing vegetation to elevated ozone (O3) pollution in open air
One of the 7 running ozone FACEs in the world
Fully replicated, operated continuously since 2015

7.5 person months per year, 54 peer reviewed papers

NEC Directive, Forest monitoring, Guidelines for urban forestry

ENCLOSED

HIGHLY CONTROLLED CONDITIONS

At Least 12 Individual Units and 3 Replicates

- High CO_2 concentrations and other gas
- Solar irradiance
- Warming / rainfall

ECOTRON

- Short to medium term exposure
- Whole pieces of ecosystems in fully controlled chambers
- Can be linked with an open-air facilities

AN EXAMPLE: TERRA-ECOTRON, BELGIUM

STUDIES AGRO-ECOSYSTEMS

Controllable climatic variables:

- Radiation
- Air temperature
- Humidity
- Precipitation
- CO2 & O3 concentration

Lysimeters are 1.5 m deep. Soil temperature and water potential are conditioned at the bottom of the lysimeter. Greenhouse gas fluxes (CO_2, H_2O, N2O, O_3) and sensible energy from the ecosystem, soil temperature, water content and matric potential vertical profiles, as well as water leachate amounts are all measured automatically.

ANALYTICAL (LABS)

PROVIDES ADDITIONAL MEASUREMENTS FOR THE ECOSYSTEM EXPERIMENTS

- Services to the whole AnaEE community
- Standardization of procedures

Many of these facilities are resource centres in genomics, plant physiology, soils, remote/proximal sensing, etc.

- Molecular biology and genetics
- Mobile BVOC and plant physiology labs
- Airborne labs
- Plant and soil analytical labs, metabolomics, isotopes
- Soil + (micro)biology, chemistry, genetics
- NMR and MRI imaging of plant and animal tissues

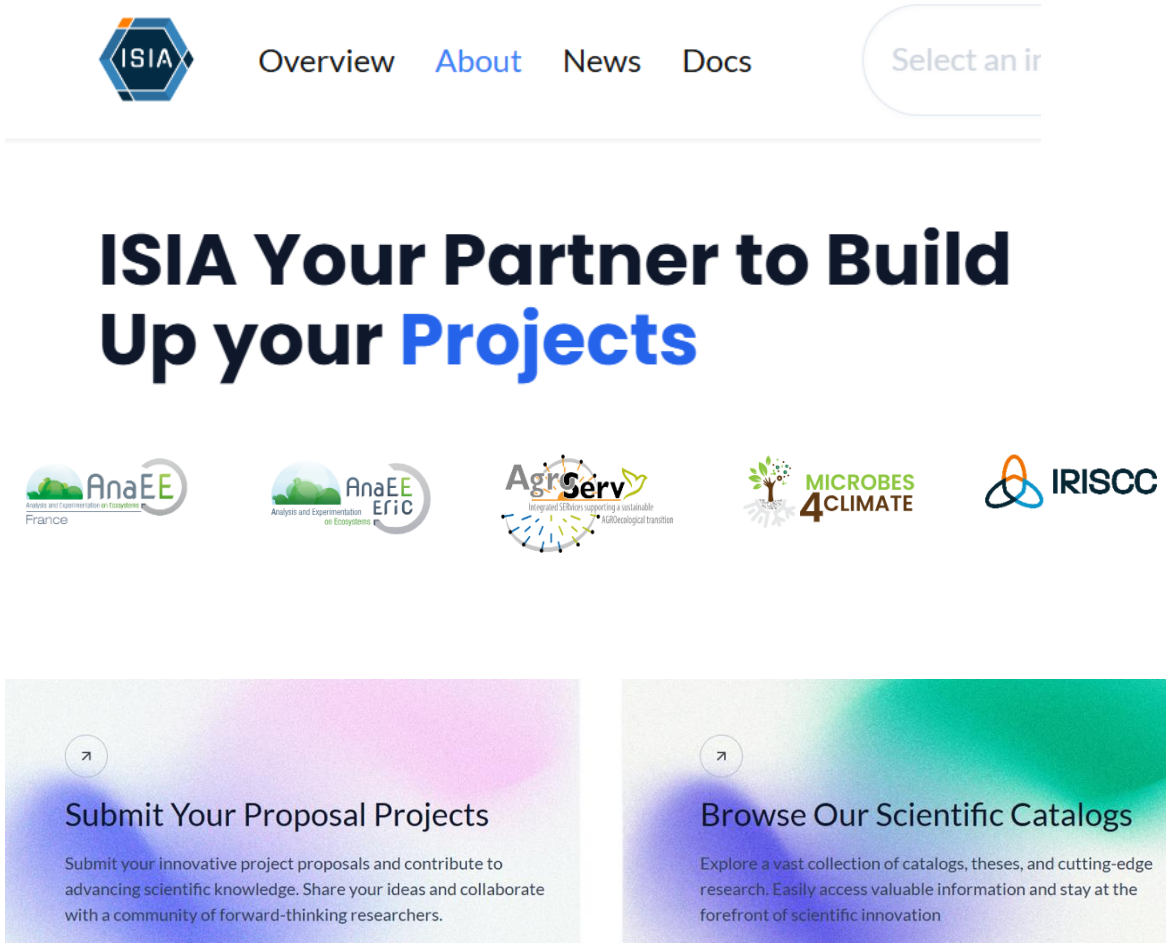
MODELLING

MODELLING IS EMBEDDED IN ANAEE-ERIC

- Statistical and biophysical modelling of environmental systems
- Close the experimental loop
  Hypotheses > Predictions > Experiment > Model > New predictions
  Detection of anomalies in data
- Forecasting
  Trends, impact of management practices
  Generalizations of experimental results and in turn recommendations (for policymakers, agriculture, managers, industry)

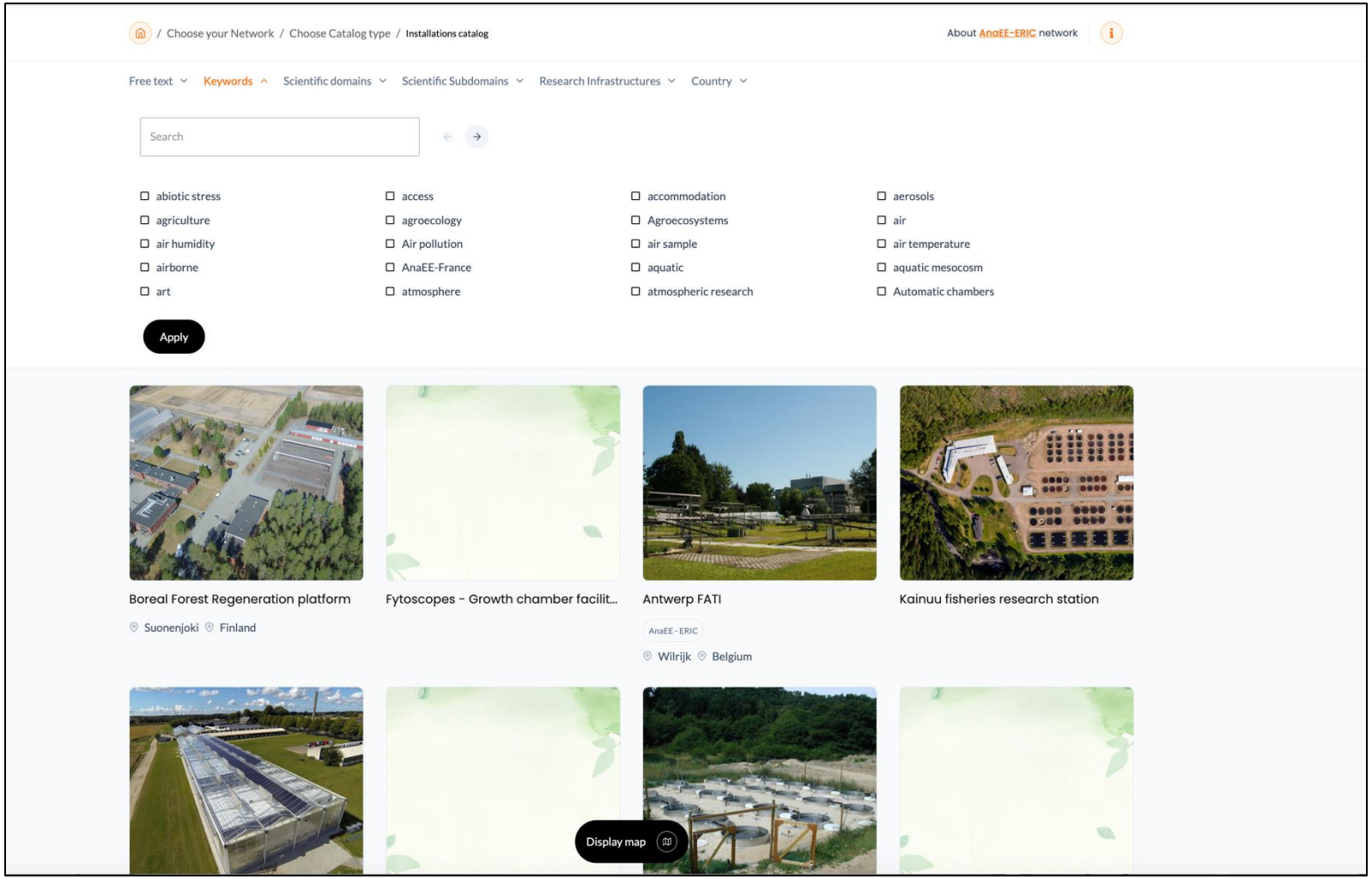
HOW to USE ANAEE SERVICES ?

- Through our EU projects (AgroServ, M4C, IRISCC)
- Integrated catalogue of services - https://catalog.isia.cnrs.fr/
- Embedded capacity to interpret experiments, and predict evolution of ecosystem processes
- Direct services will be open on 2nd June 2025
- TNA and VA



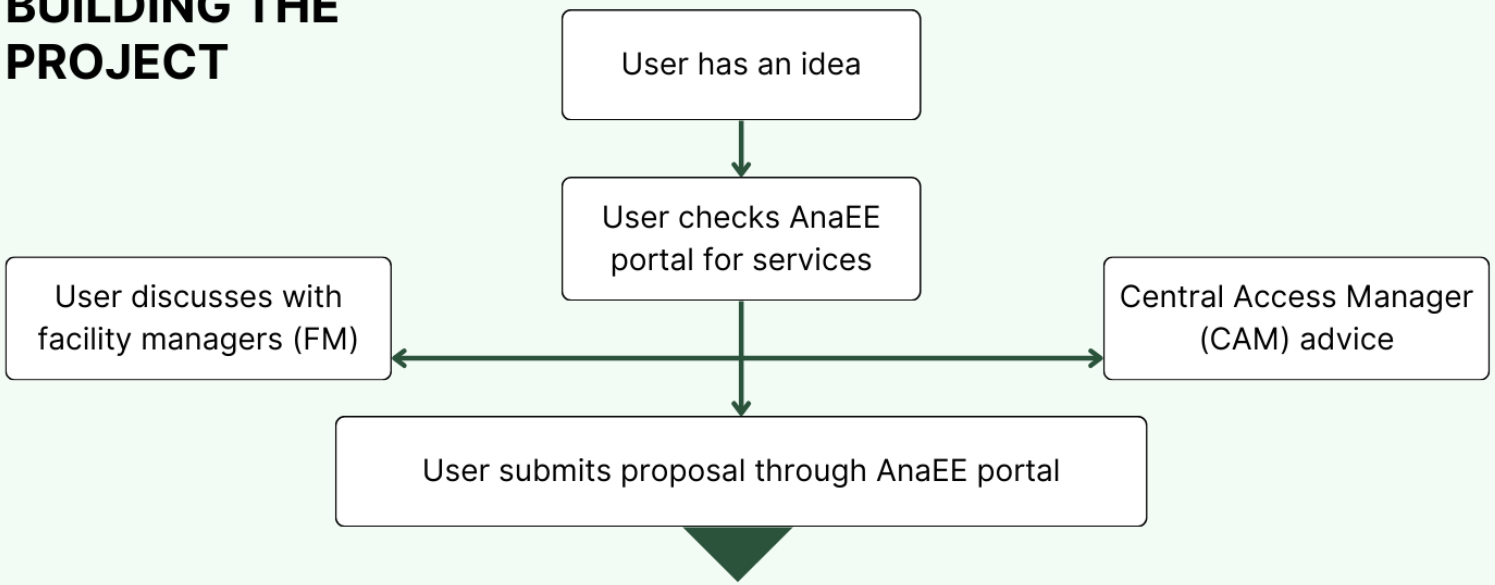
- **1. Discover & Explore**
- Attend AnaEE-ERIC webinars, workshops, and conferences to learn about our capabilities. Browse our comprehensive service catalogue on the AnaEE-ERIC portal to identify facilities that match your research needs.
- **2. Connect & Plan**
- Reach out to facility managers to discuss your project concept and refine your approach. Our Central Access Manager (CAM) is also available to provide guidance and help match your research goals with our infrastructure network.
- **3. Apply & Secure Funding**
- Submit your application with attention to eligibility criteria and feasibility requirements. After scientific evaluation and acceptance, we'll provide a preliminary acceptance report and assist with identifying funding opportunities through INFRA projects and Horizon Europe channels.
- **4. Execute & Share**
- Conduct your research at our facilities with ongoing support. Remember to acknowledge AnaEE-ERIC in your publications and share your results through open access channels. After a brief embargo period, your data will contribute to our growing knowledge ecosystem, furthering environmental science globally.

Apply through the isia catalogue of services

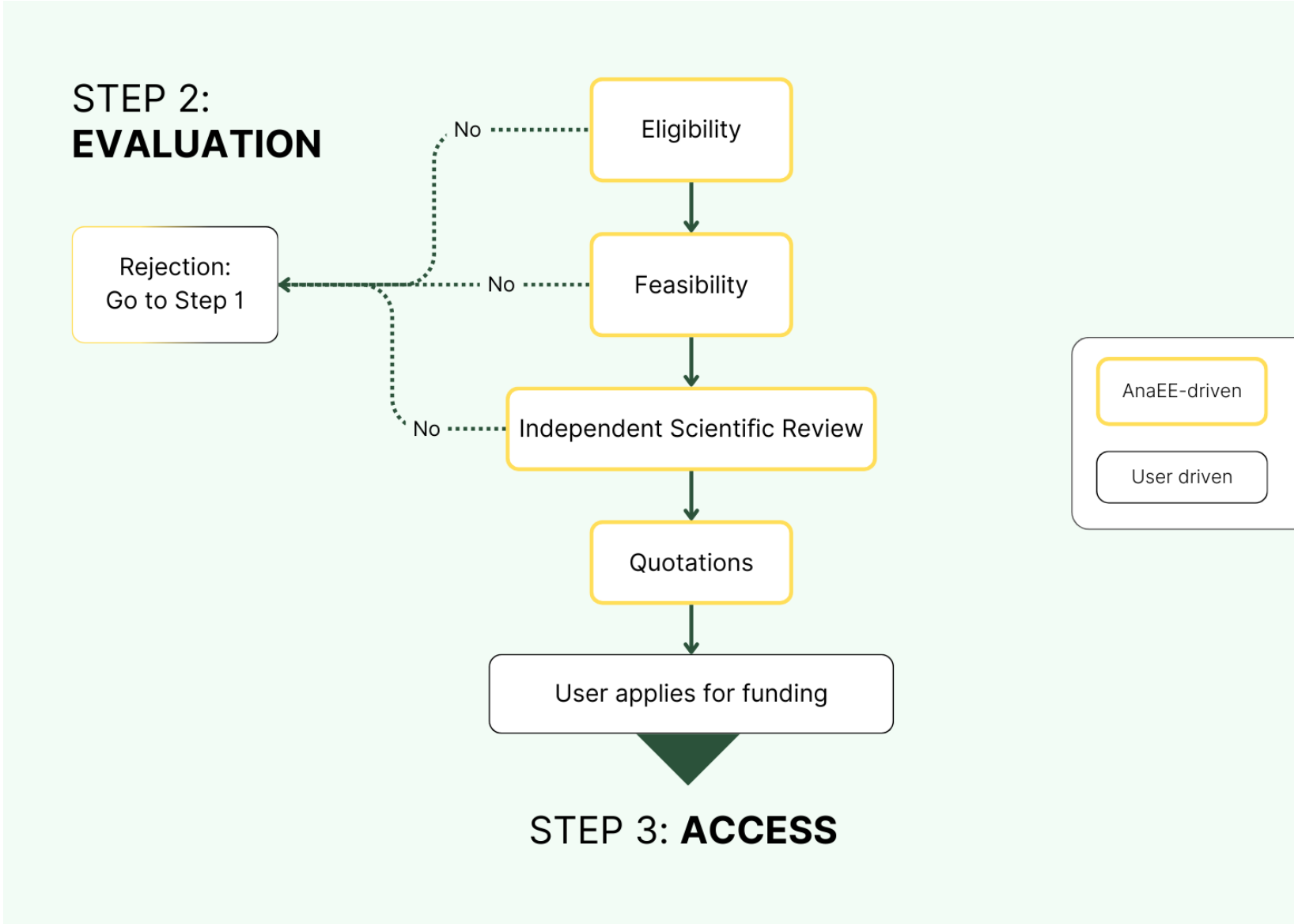


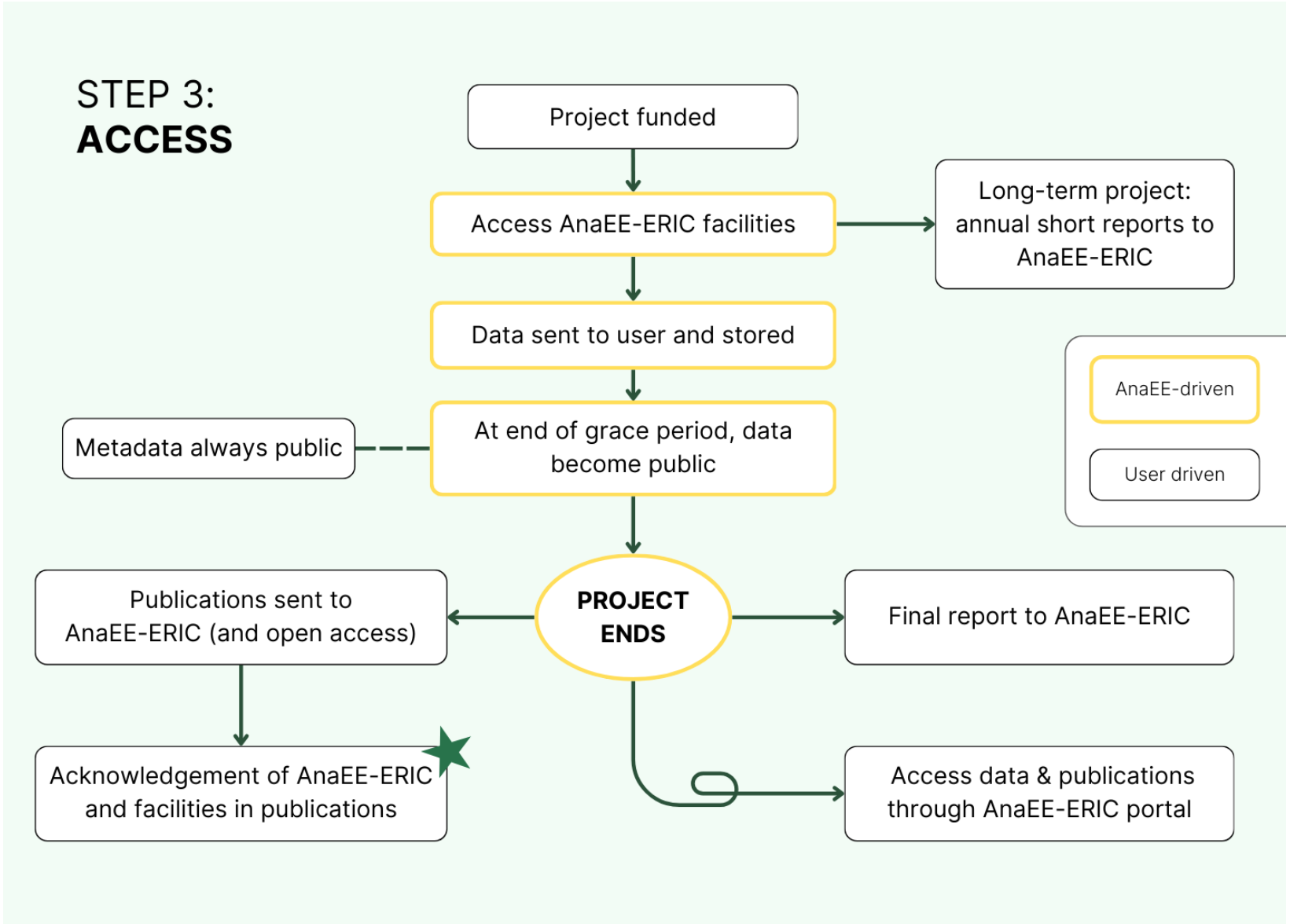
ANAEE-ERIC PROJECT EVOLUTION IN 3 STEPS

STEP 1: **BUILDING THE PROJECT**

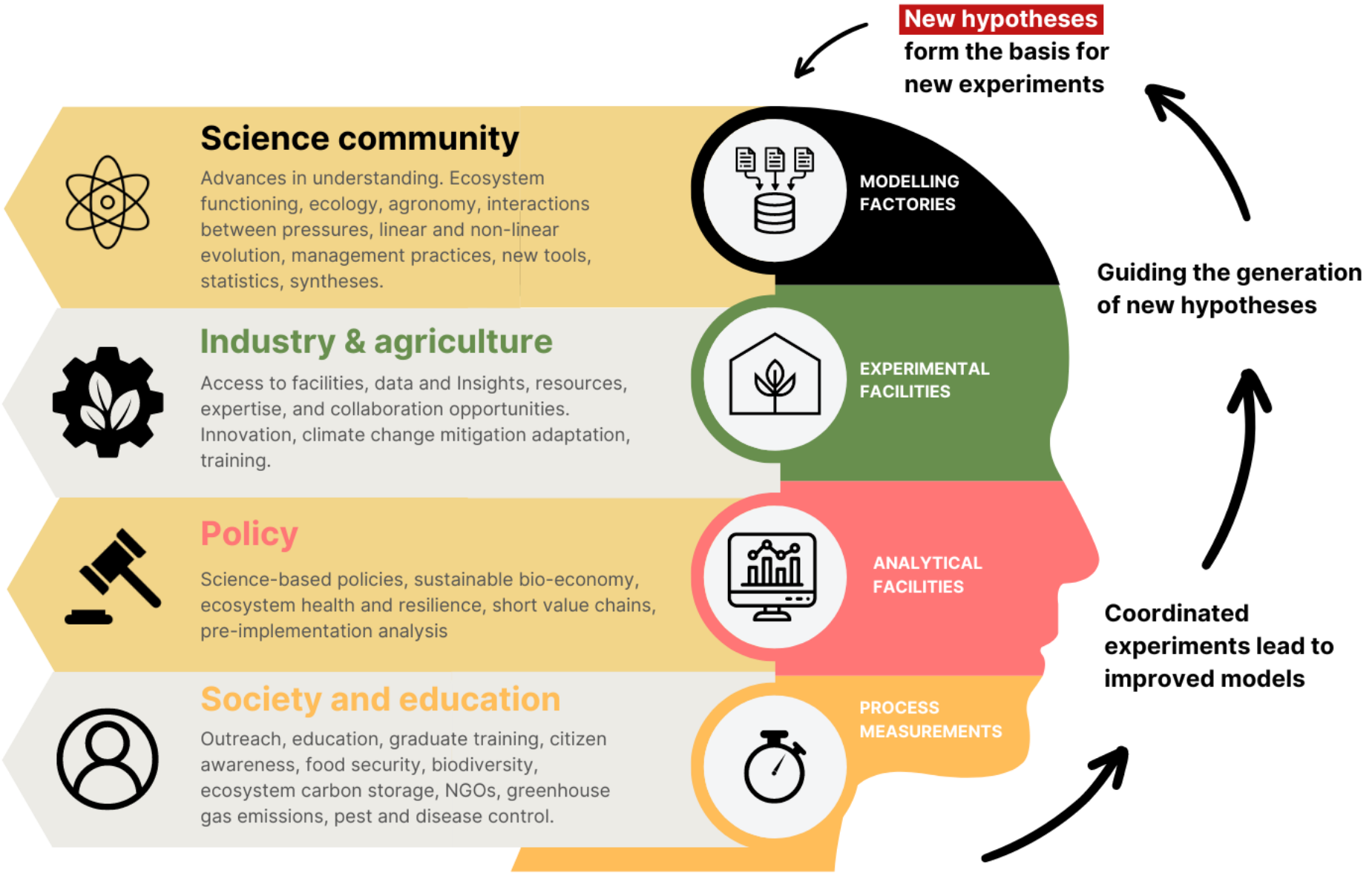


STEP 2: **EVALUATION**


STEP 2:
EVALUATION
Eligibility
No
Feasibility
No
Rejection:
Go to Step 1
Independent Scientific Review
No
Quotations
User applies for funding
STEP 3: ACCESS
AnaEE-driven
User driven


STEP 3:
ACCESS
Project funded
Access AnaEE-ERIC facilities
Long-term project: annual short reports to AnaEE-ERIC
Data sent to user and stored
At end of grace period, data become public
Metadata always public
AnaEE-driven
User driven
PROJECT ENDS
Publications sent to AnaEE-ERIC (and open access)
Final report to AnaEE-ERIC
Acknowledgement of AnaEE-ERIC and facilities in publications
Access data & publications through AnaEE-ERIC portal

Anace che benefits the whole community



MULTIPLE POSSIBILITIES for JOINT DATA WITH OTHER RIS

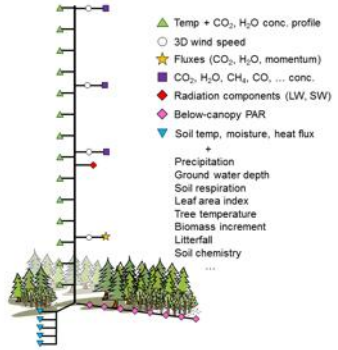
1. AnaEE-O3HP open-air facility with rainfall regime manipulations in pubescent oak mediterranean forest, featuring ecosystem exchange 'eddyflux', CO_2 & H_2O trace gases experiment.

-20 to 15 m

2. AtmoSud regional air quality monitoring network

4 m

3. ICOS – greenhouse gas monitoring at the regional scale



100 m – 7 km

4. ACTRIS – Geophysical station – tropospheric and stratospheric aerosols, ozone, water and GHG monitoring.

13-80 km

Anaee-eric – an attractive partner in european projects

Ongoing projects:

- PHENET (1/01/2023 - 31/12/2027)
- **AgroServ, AnaEE-ERIC as coordinator (1/09/2022 - 31/08/2027)**
- **Microbes-4-Climate (1/02/2024, 31/01/2029)**
- AquaServ (1/04/2024 - 31/03/2029)
- **IRISCC (1/04/2024 - 30/09/2028)**
- ERIC Forum 2 (1/09/2023, 31/08/2026)
- FHERITALE (1/01/2024, 31/12/2026)
- **ITINERIS (01/11/2022 – 30/10/2025)**

AgroServ
Integrated SERvices supporting a sustainable AGROecological transition

ITINERIS

What is AgroServ?
An example of synergies among RIs

A large project

- 5yrs (started 04/2022)
- 15M€ EU funded (HE)
- 11 pan-European Research Infrastructures
- 73 beneficiaries
- Coordination AnaEE-ERIC

Large offer of services for research

- 143 transnational and virtual services
- From the molecule and micro-organism to the ecosystem and field, to the society and economy
- AgroServ / EU supports access costs, travel and subsistence

What is AgroServ?
An example of synergies among RIs

Interdisciplinarity

- We require that proposals request services from at least 2 Research Infrastructures

Transdisciplinarity

- 5 living-labs Mediterranean (IT, FR, PT), Central Europe (CZ), Northern Europe (FI)
  - These living-labs will feed the demand of services and the offer of services
- Proposal involving non-academic partners are welcomed

- AnaEE-ERIC is at the interface between Life and Environmental sciences
- Through projects such as AgroServ (future food system) but also M4C (role of microbiomes for soils and plants) and IRISCC (vulnerability to climate change risk), many questions can be addressed, beyond the sole perimeter of the participating RIs
- ESFRI has identified some gaps: they can be filled with new facilities, possibly in new countries

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

European Union

Taking the Pulse of the Ocean:
Insights from the European Research Infrastructure EMSO ERIC

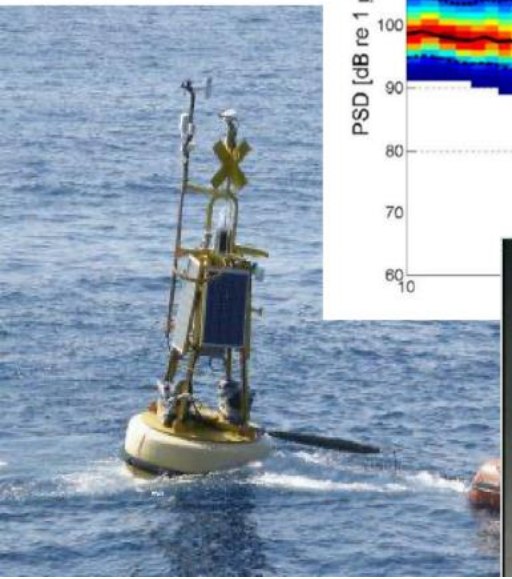
European Multidisciplinary Seafloor and water column Observatory
European Research Infrastructure Consortium

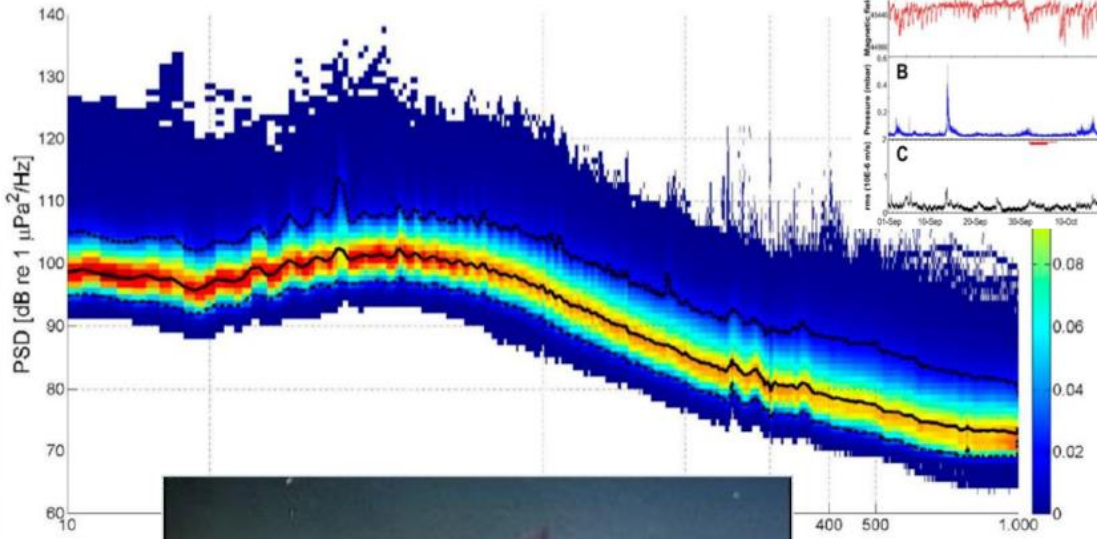
Ingrid Puillat, Director General
Ingrid.puillat@emso-ri.eu
www.emso.eu

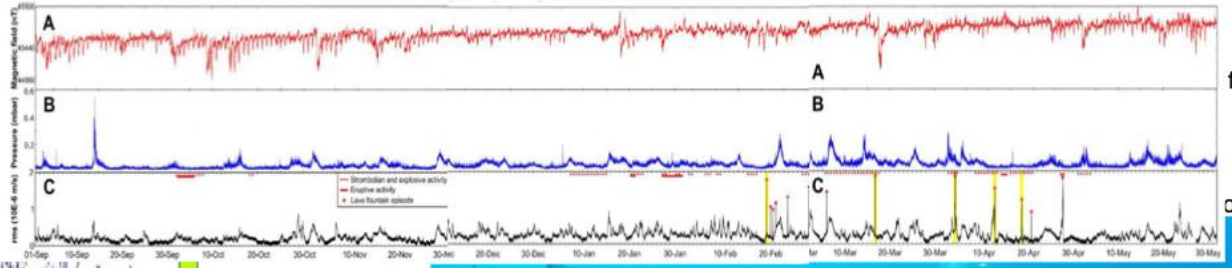
Table of contents

emso® ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

I.
What's EMSO about?







field

ound velocity

EMSO ERIC: What's about?

EMSO Mission

EMSO Mission: A draft statement

As a European marine research infrastructure,

*EMSO ERIC aims at the advance in the knowledge of deep ocean and water column processes in key oceanic **regions** in the context of **global change.***

*The **operational** scope of EMSO is the provision of **services,** for both the **long-term** repeated **observations** and **analysis** of Essential Ocean Variables, as well as other physical and environmental variables retrieved by deep-sea observatories.*

EMSO delivers Findable, Accessible, Interoperable and Reusable data.

EMSO ERIC has to render them Visible, Sustainable and Inspiring thanks to dedicated tools and products for the research community and the society.

EMSO ERIC: What's about?

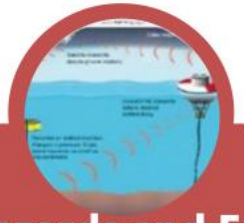
A Science and society driven strategy

Socio Economic Challenges

EMSO Science and Societal Challenge

Impacts of Climate Change

Open ocean temporal variability across spatial scales

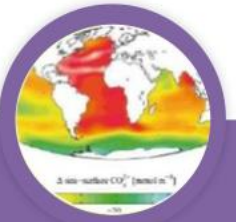


Geohazards and Early warning for earthquakes & tsunamis

Spatiotemporal process variability and natural hazards

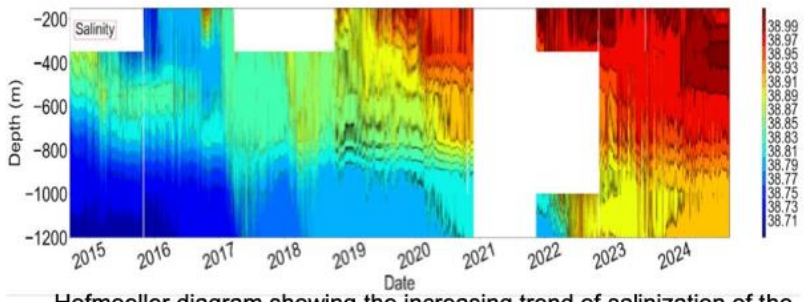
Biodiversity and Sustainability of Marine Resources

Assessing baseline and potential changes of open ocean benthic and pelagic ecosystems

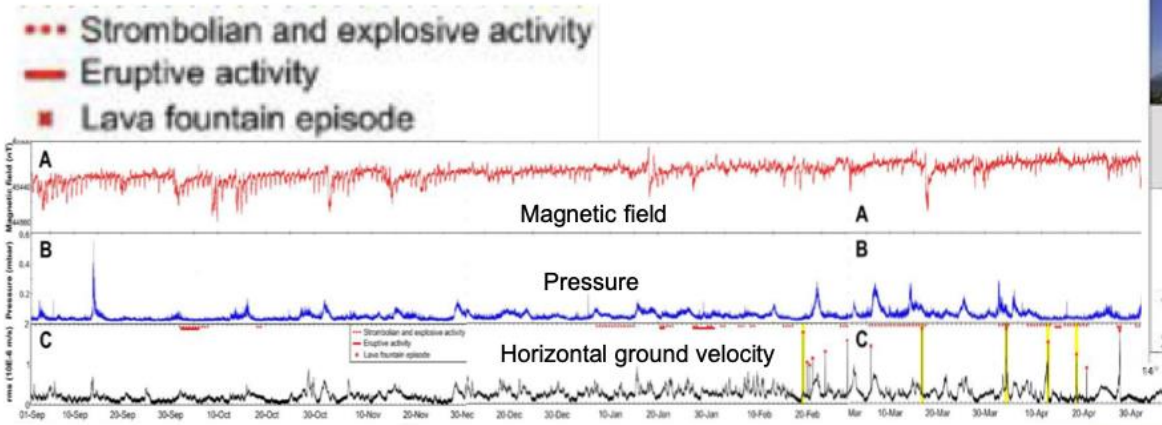


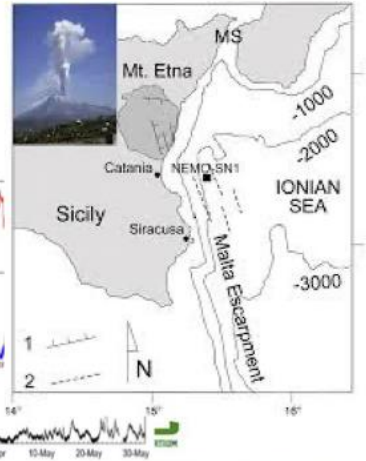
Global Ocean Warming and Ocean Acidification

Geophysical events, climatic & anthropogenic changes and deep carbon storage



Hofmoeller diagram showing the increasing trend of salinization of the intermediate and deep layers at EMSO-SA (E2M3A-M) in 2012 - 2024.





EMSO ERIC: What's about?

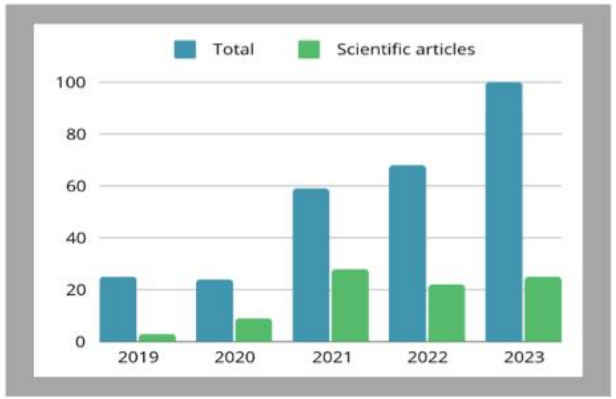
A Legal Entity

8 Country Members : Italy (host), France, Greece, Ireland, Portugal, Romania, Spain, Norway

2016, September: ERIC legal entity

14 Regional facilities

> 25 Institutions involved

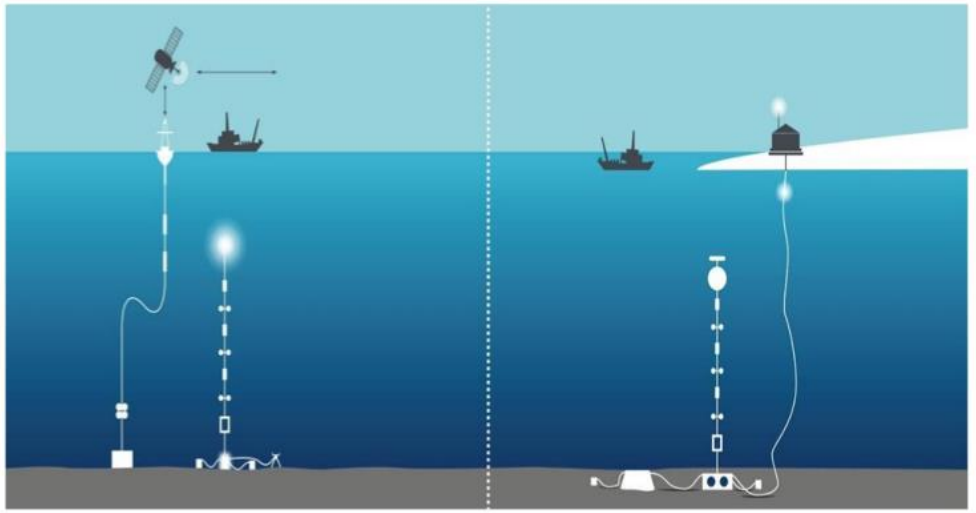


EMSO ERIC: What's about?

Regional facilities and deployed technologies

11 cable and stand-alone observatories (including 19 deep sites)

3 test sites (shallow water)

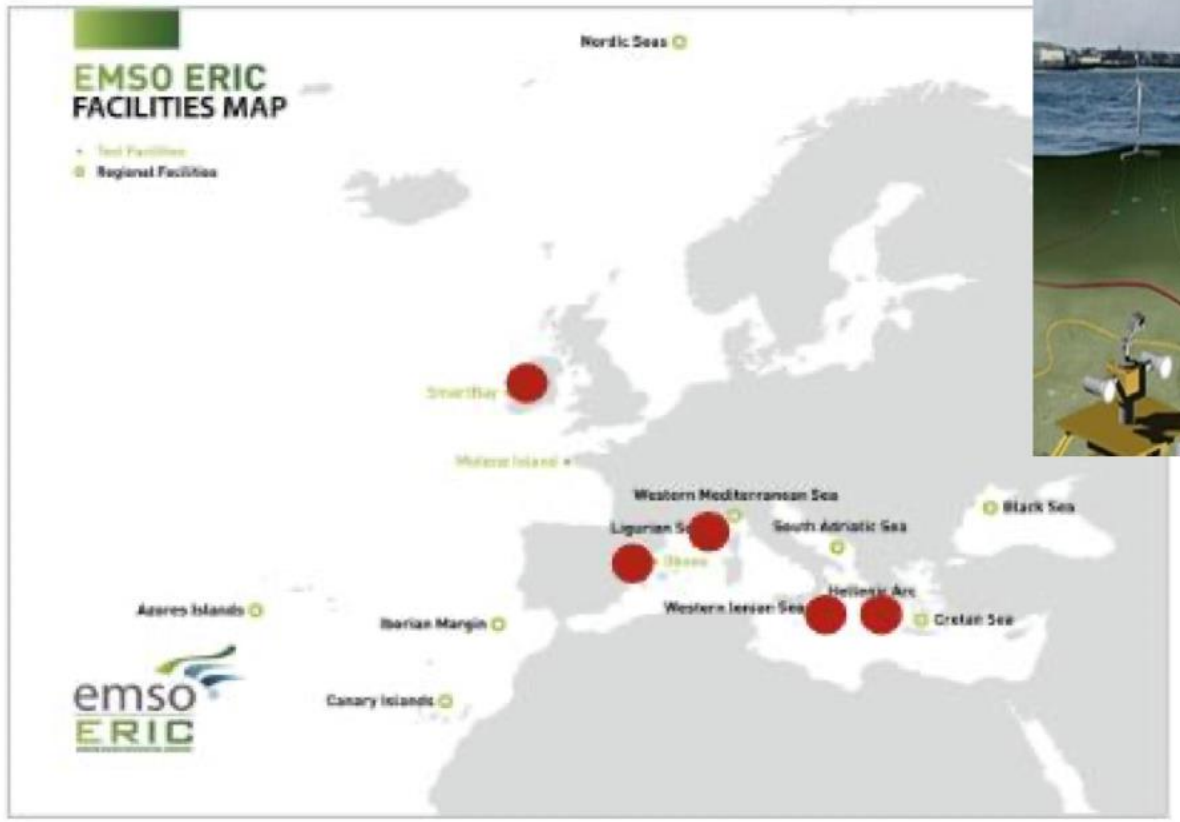


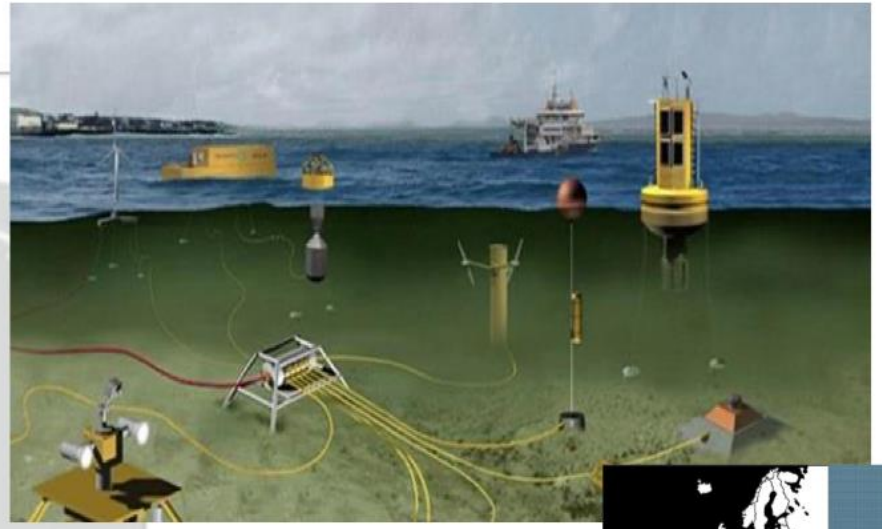
- 19 deep sea sites: 5 in the Nordic Seas Regional Facility, 3 in the South Adriatic, 4 in the Ligurian, 4 in the Ionian basin, 1 in the Black Sea, 2 in the north-east Atlantic.
- 4 deep sea platforms are cabled to shore (Ligurian Ouest, Nice, Western Ionian Sea, Hellenic Arc).

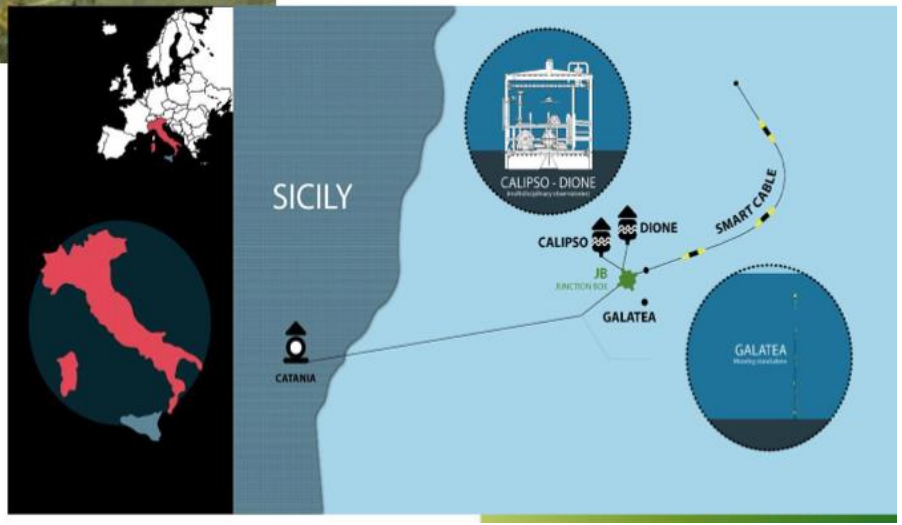
EMSO ERIC: What's about?

Regional facilities and deployed technologies

Cutting edge technologies in submarine cables: SMART and sensing systems (DAS and SOP)





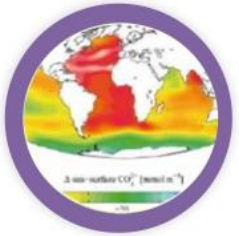


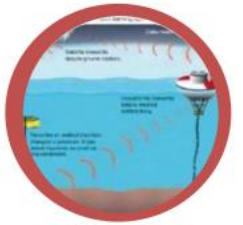
II.
Fundamental observational service

The « Upstream service »
stands in the regional observations

Fundamental Observational Service - Upstream

Federated Observational Service for Data Generation



EMSO Strengths:

- **Long term times series of repeated in situ observations in fixed regions**

- **Acquisition of and expertise on Marine Environmental Variables:**
  - Essential Oceanic variables (EOVs), Temperature, Salinity, Oxygen, pH
  - Geosciences (seismology, hazards) :
  - Ocean sounds :
  - Ecosystem and Biodiversity

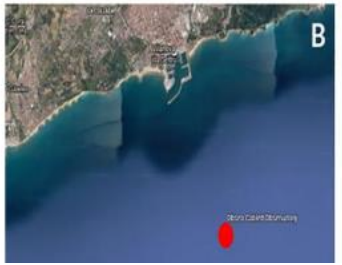
- **Enhancing observation capabilities using new technologies** (Images, videos…)

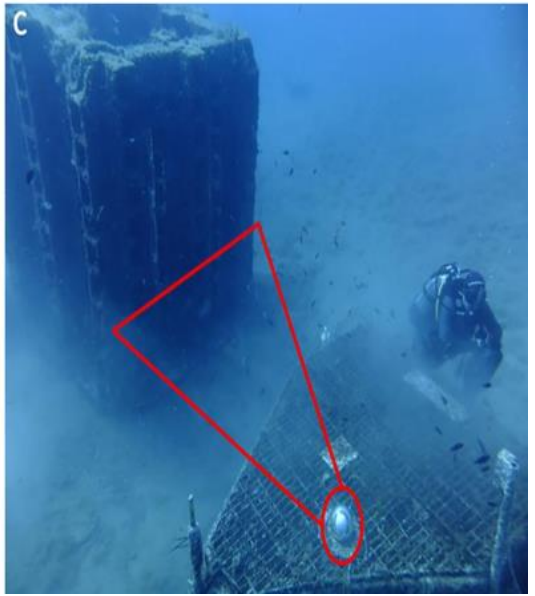
=> Identification of species

iMagine

UPC

SARTI



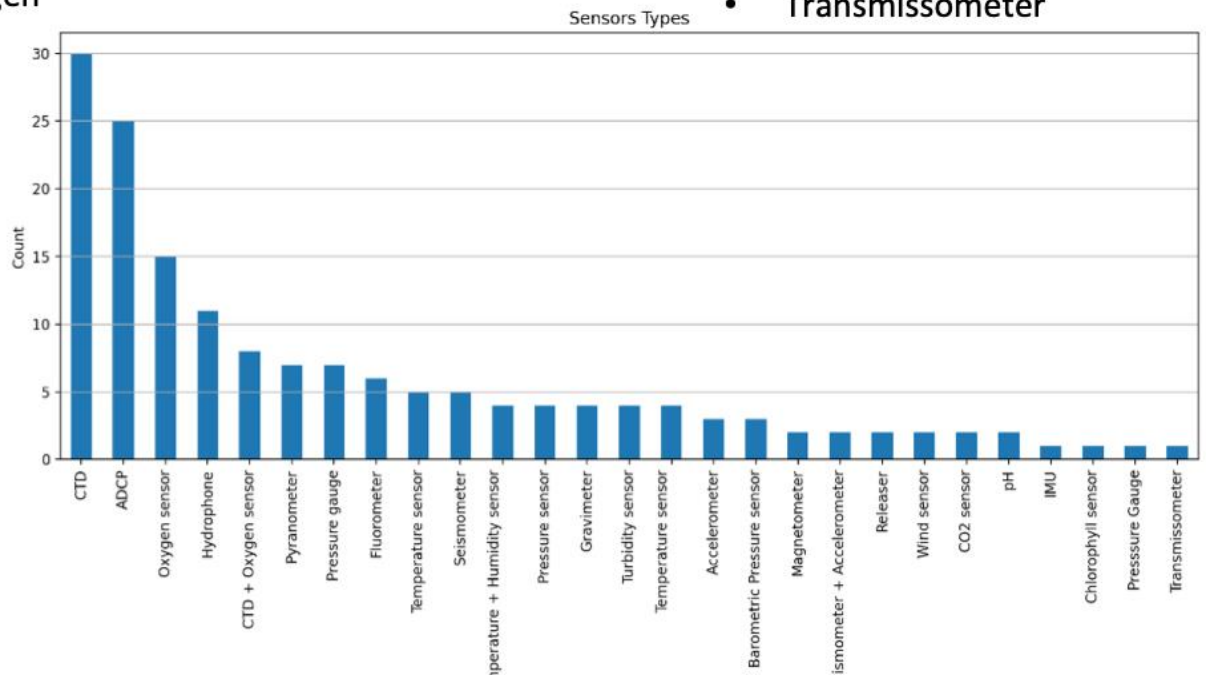


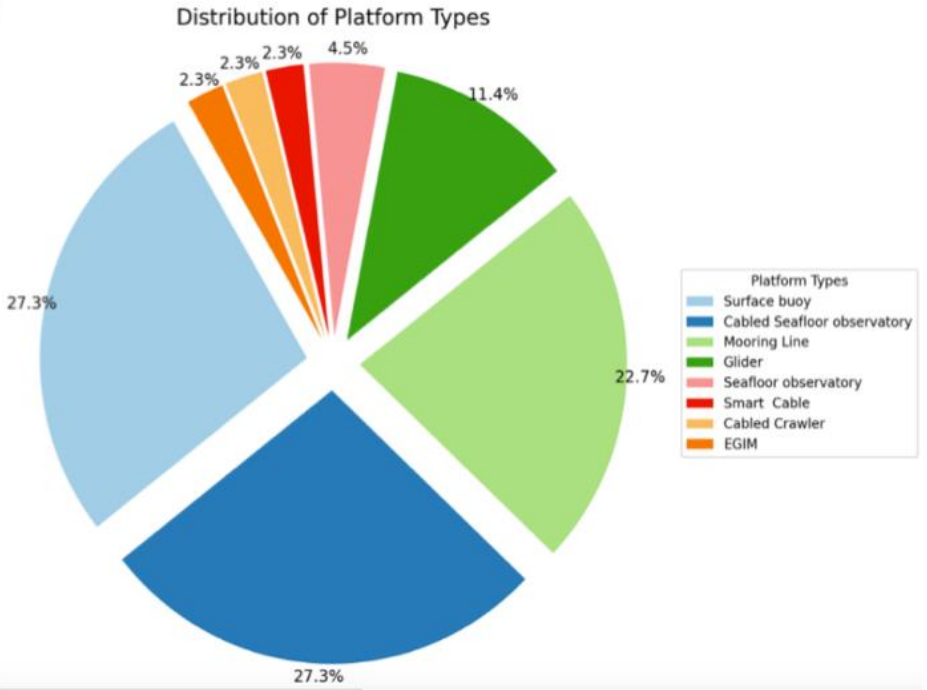
Upstream Servi

Federated Observational Service for Data Generation

List of sensors operating on EMSO platforms

- Accelerometer - IMU
- Magnetometer
- Seismometer
- Gravimeter
- Pressure Gauge
- CTD - Conductivity + Temperature + Depth
- Temperature
- ADCP - Acoustic Doppler Current Profiler
- AWAC - Acoustic Wave and Current profiler
- Oxygen
- pH
- CO2
- Chlorophyll
- Fluorometer
- Turbidity
- Hydrophone
- Camera
- CytoSub
- Weather Station
- Wind
- Humidity
- Pyranometer
- Transmissometer





- EMSO Ligurian Sea
- EMSO Western Ionian Sea
- EMSO Azores
- EMSO Iberian Margin
- Mòlene
- EMSO Canarias
- EMSO Hellenic Arc
- EMSO Black Sea
- EMSO South Adriatic Sea
- EMSO Cretan Sea
- EMSO Nordic Sea
- EMSO Smart Bay
- OBSEA
- EMSO Mediterranean Sea

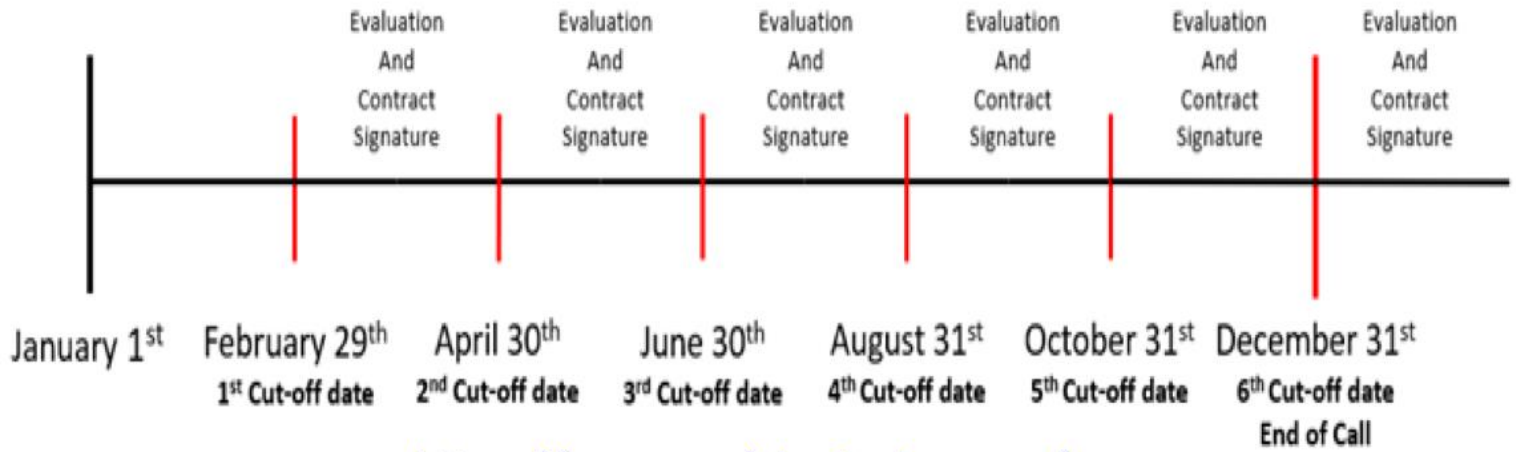
Acquisition of about 128 in situ observation marine variables by platforms in deep and open ocean of the European

III.
Some downstream services

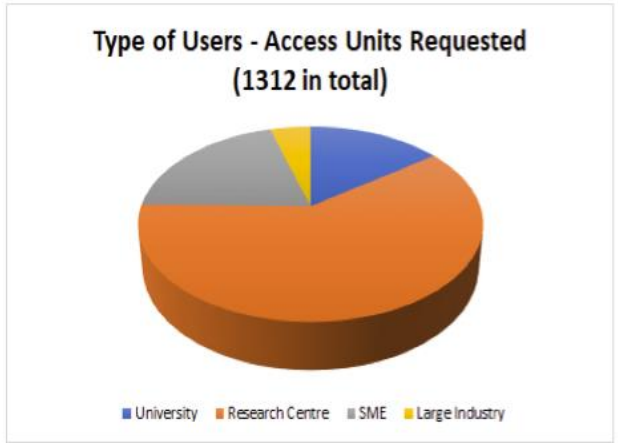
- **Service for Physical Access**
- **Service for the federation of harmonised data flows**

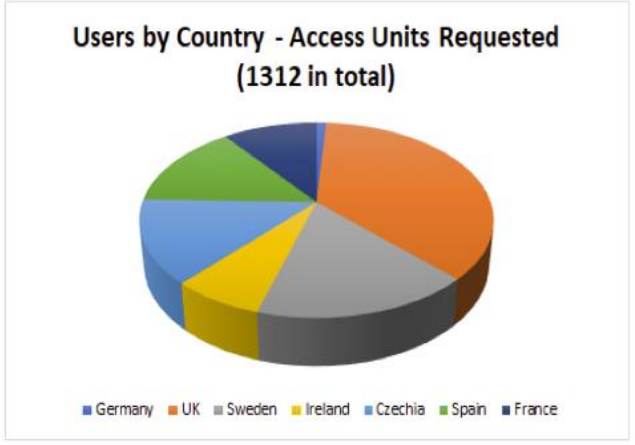
Downstream Services

Service for Physical Access



https://emso.eu/physical-access/



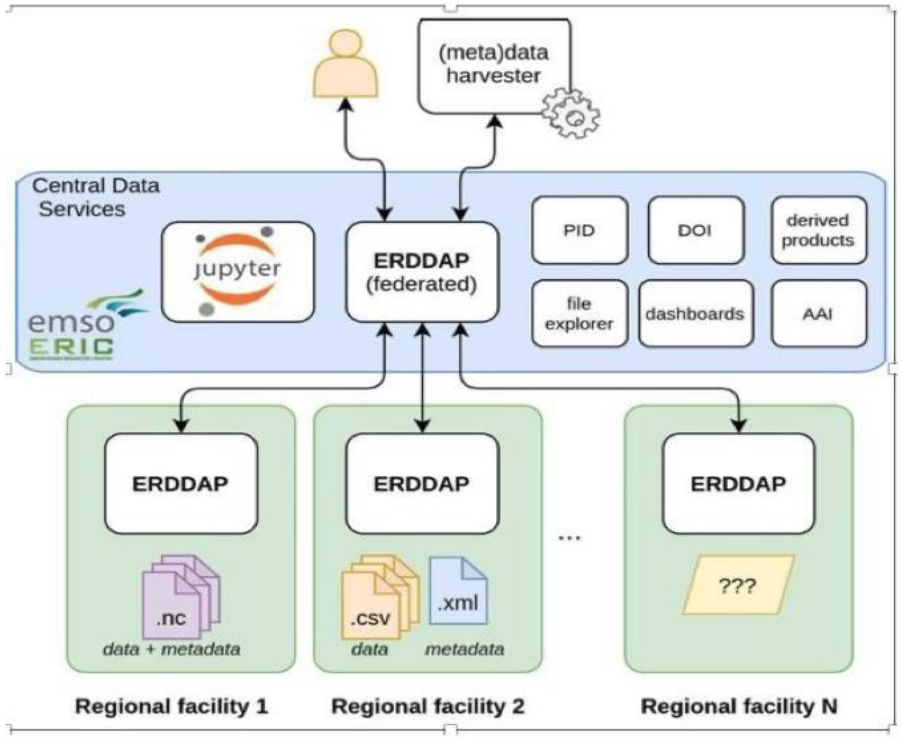


Key features:

- Access to high-quality, instrumented platforms for open-ocean activities.
- New technologies, new procedures/experiments can be tested/take place.
- Training and co-development opportunities with experienced engineers and scientists.
- Tailored data collection services.
- Continuous availability with cut-offs for proposals evaluation every 2 months.

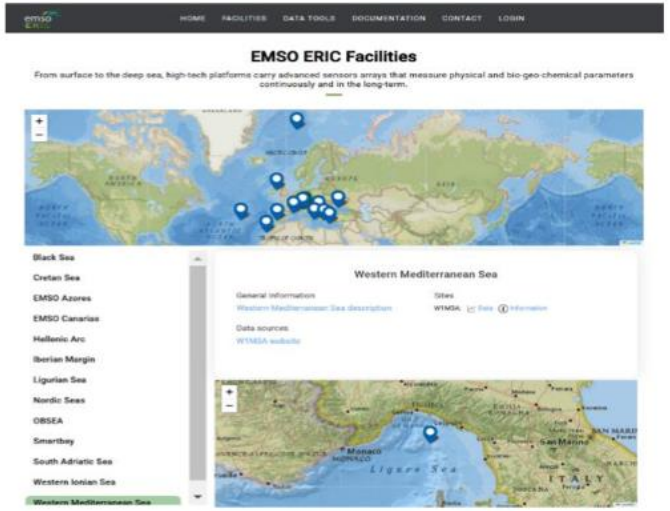
Downstream Services

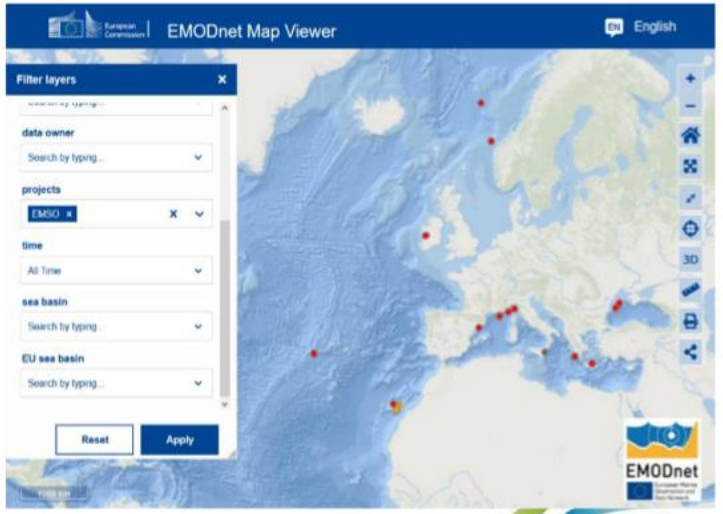
Service for the federation of harmonised data flows



Key features

- The federated ERDDAP infrastructure provides access to all data through a single-entry point.
- Flexible data download options supporting multiple formats, including CSV, NetCDF, and JSON.
- Shared with the EMODnet platform, ensuring broader accessibility and integration.





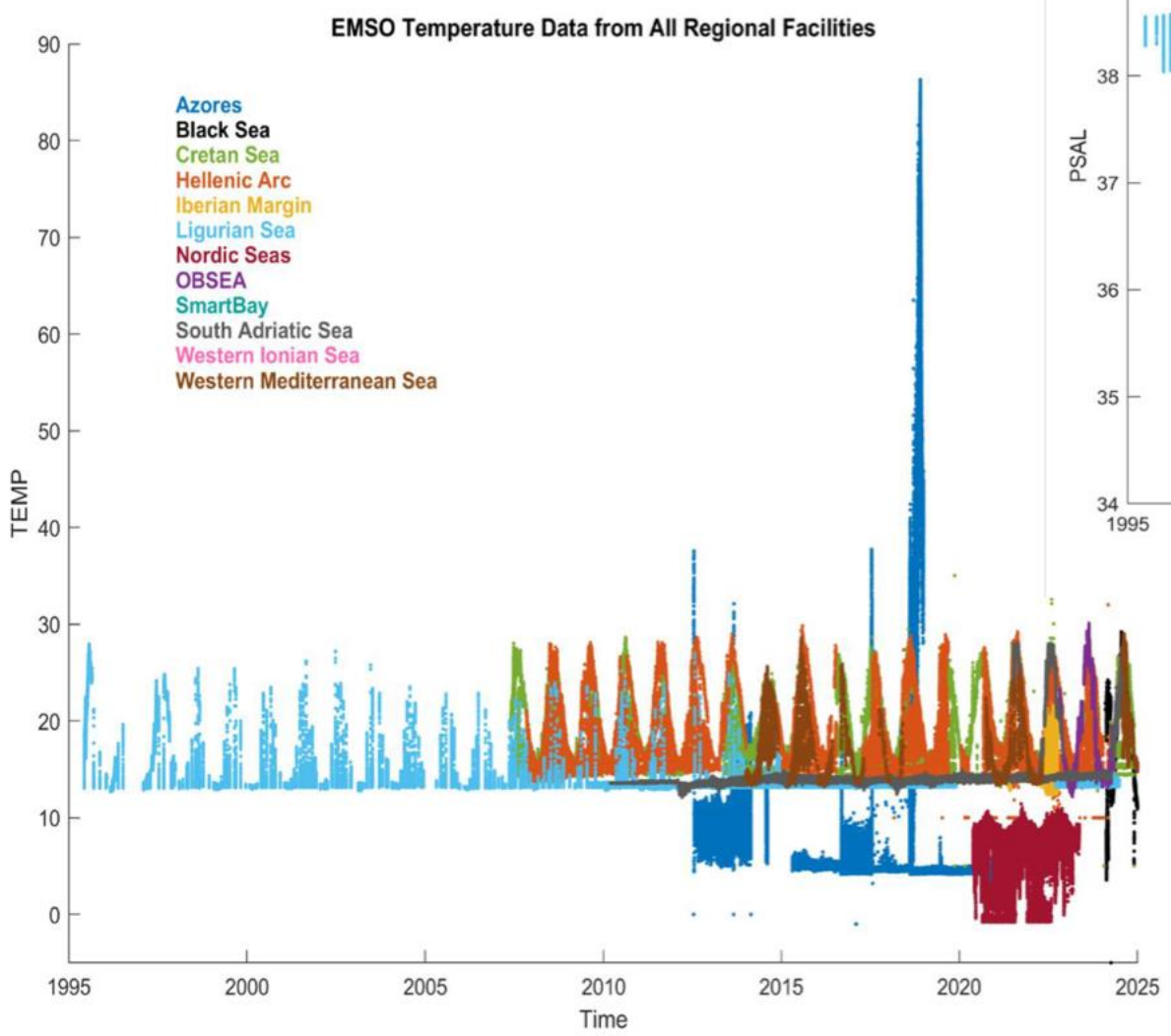
- EMSO has developed tools and expertise to collect data, qualify data and making them available within the FAIR principles.

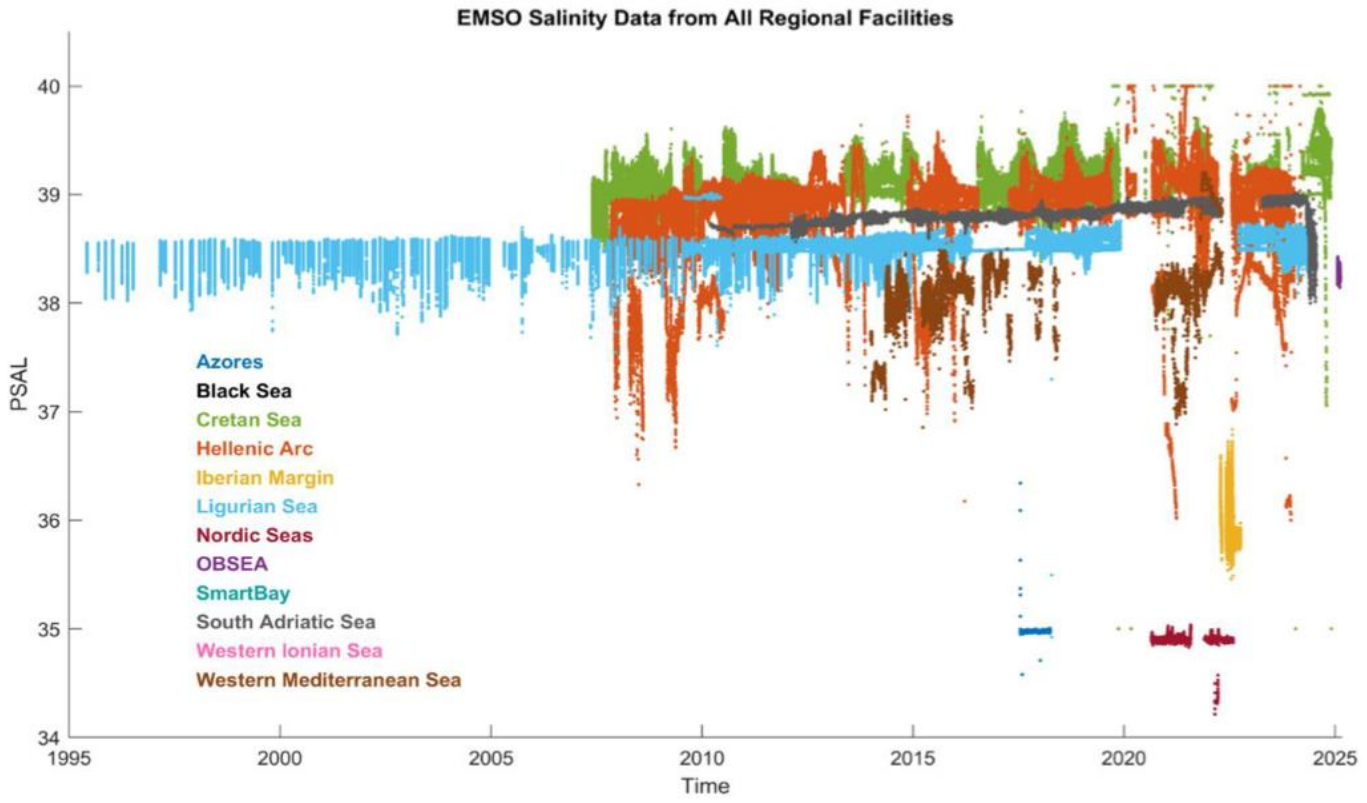
Findable
Accessible
Interoperable
Reusable

emso ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

Downstream Services

Service for the federation of harmonised data flows



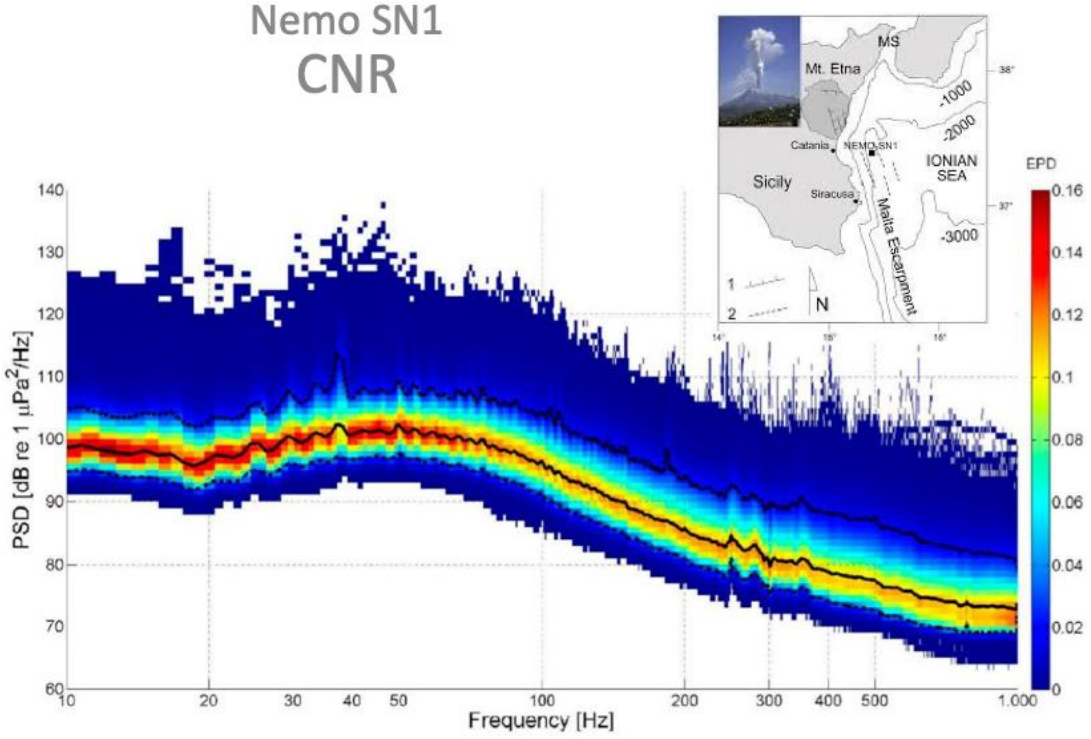


Downstream Services

Service for the federation of harmonised data flows

OCEAN NOISE: EX ETNA

Nemo SN1
CNR



BIODIVERSITY & ECOSYSTEM

EMSO AZORES – EMSO LO
Ifremer - CNRS

https://ocean-spy.ifremer.fr
Citizen Science

emso ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

Downstream Services

Public Engagement and EMSO Academy

Public Engagement

- EMSO leverages several channels, from website to social media platforms, Zenodo and Newsletter to share updates, research highlights, and multimedia content with a wider audience.
- Main events in marine domain and booth organization

EMSO increases public awareness of ocean science and inspires future generations of scientists

emso ACADEMY

Training and tutorial to assist users in accessing and utilising data

- **API Tutorial**: A guide on programmatic access to EMSO ERIC's (meta)data via their Application Programming Interface (API).
- *Video Tutorials*: Visual demonstrations covering various data tools and access methods.

Expertise sharing

- **Training and co-development** to users interested in learning specialised techniques/methodologies and developing new products, taking advantage of years of experience gathered at EMSO Facilities' labs.
- **Internships to train young researchers** on research and management topics of EMSO activities.

emso ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

IV.
Take home messages

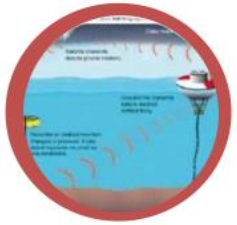
Take Home messages

EMSO Specificities

Climate Change

Open ocean temporal variability across spatial scales

> 10 years of in situ data



GeoSciences & GeoHazards

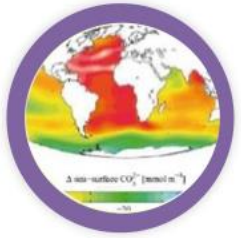
Spatiotemporal process variability and natural hazards

Near real time

Biodiversity

Assessing baseline and potential changes of open ocean benthic and pelagic ecosystems

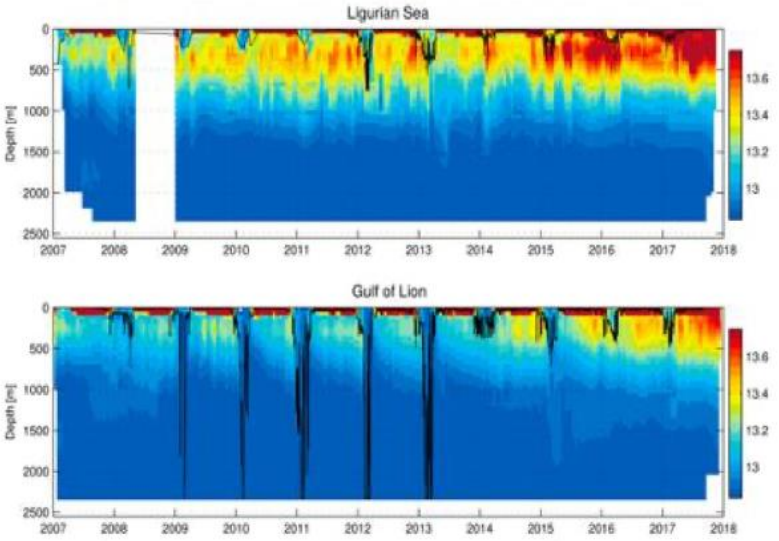
Seafloor & Water column

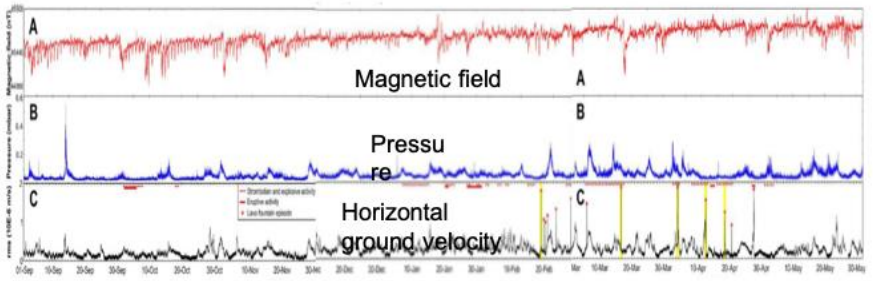


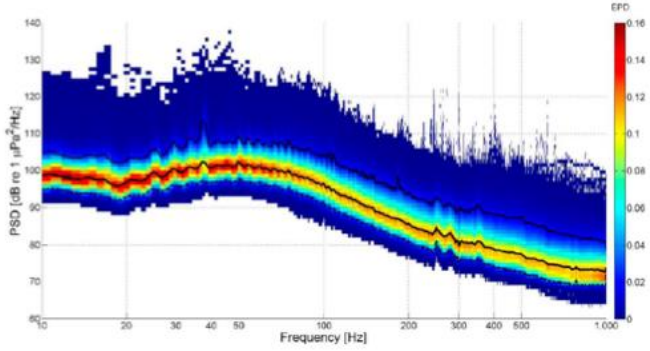
Global ocean warming and acidification

Geophysical events, climatic and anthropogenic changes and deep carbon storage

Integrated & multidisciplinary







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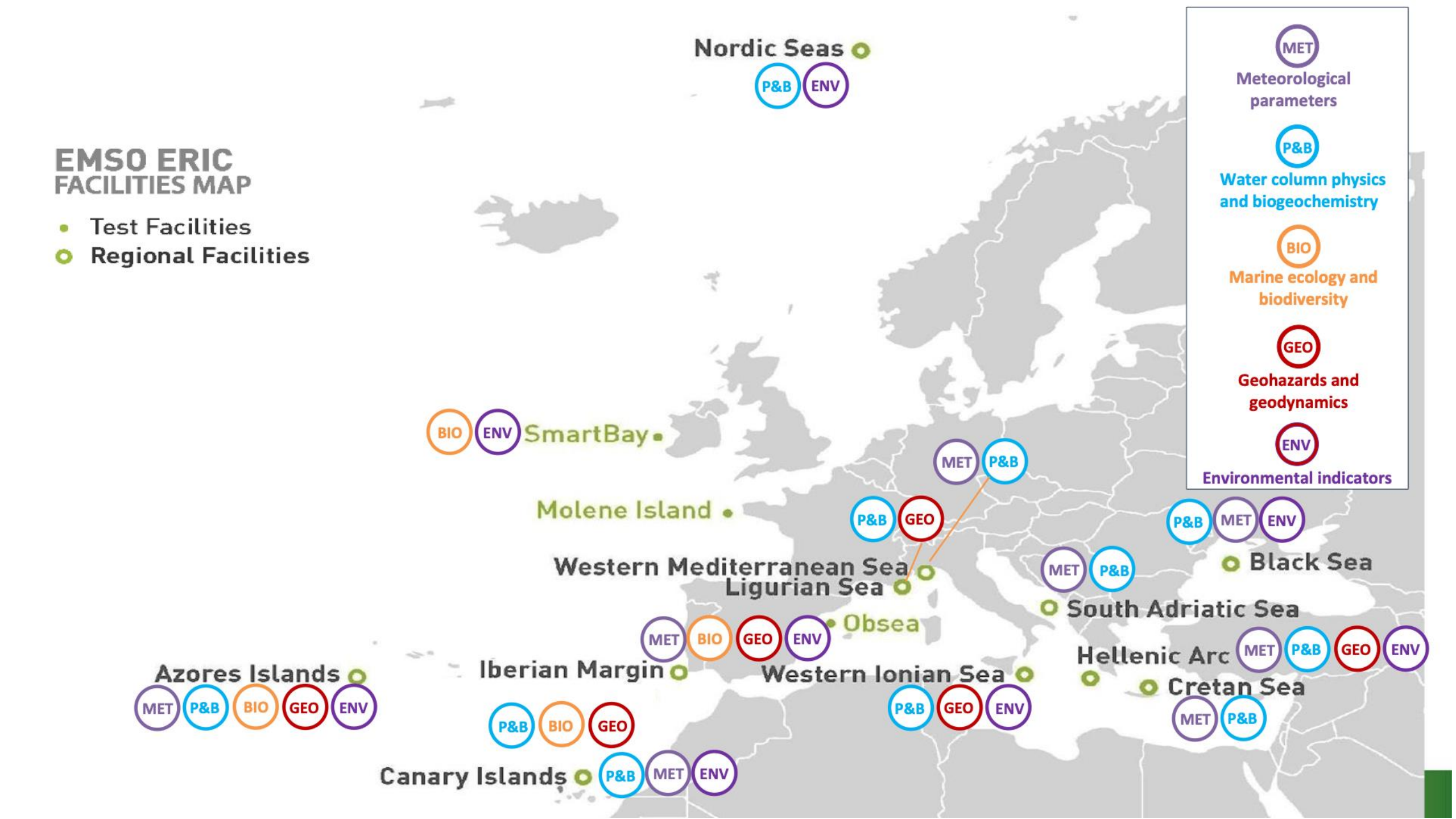

EMSO ERIC
FACILITIES MAP
Test Facilities
Regional Facilities
MET
Meteorological parameters
P&B
Water column physics and biogeochemistry
BIO
Marine ecology and biodiversity
GEO
Geohazards and geodynamics
ENV
Environmental indicators
Nordic Seas
P&B ENV
BIO ENV SmartBay
Molene Island
MET P&B
P&B GEO
Western Mediterranean Sea
Ligurian Sea
P&B MET ENV
Black Sea
MET P&B
South Adriatic Sea
Obsea
MET BIO GEO ENV
Iberian Margin
Western Ionian Sea
Hellenic Arc
MET P&B GEO ENV
Cretan Sea
Azores Islands
MET P&B BIO GEO ENV
P&B BIO GEO
P&B GEO ENV
MET P&B
Canary Islands
P&B MET ENV

Take Home messages

UN Decade endorsed Deep Sea Observation

Summary

The deep ocean remains the **last unexplored frontier of our planet**. A place that **holds secrets about the origin of life and could provide ecosystem goods and services for the sustainable development of humankind.** On the other hand, serious threats to coastal communities and infrastructures from **earthquakes and tsunamis are often associated with volcanism occurred on the seafloor and volcanic islands.** High-tech devices and expertise from multiple scientific areas are necessary **to further to our understanding of how to mitigate these coast-abyss interactive threats.** To do this, we propose a **step-change in deep-sea science through connecting inter-multidisciplinary observatories and surveying technologies** at various site at the global ocean. This coordination will contribute to **integrating knowledge** on **deep-sea ecosystems functioning under global changes, to advancing hazard mitigation from natural hazards and to engaging citizens with the deep ocean** that faces a growing pressure from human activities

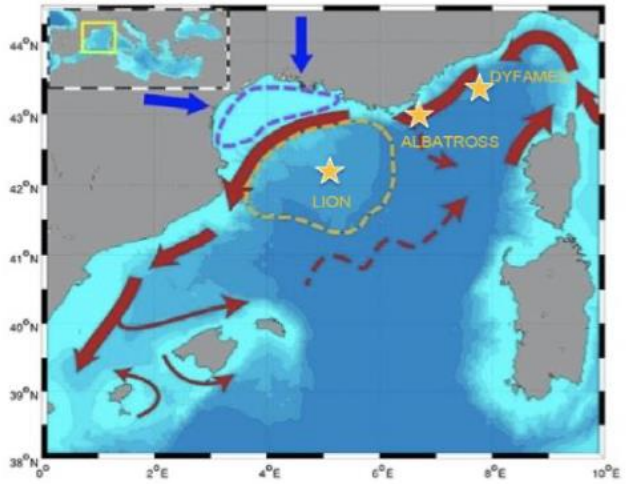
Key partners:
IFREMER, EMSO ERIC, ONC, JAMSTEC

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

emso ERIC
EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

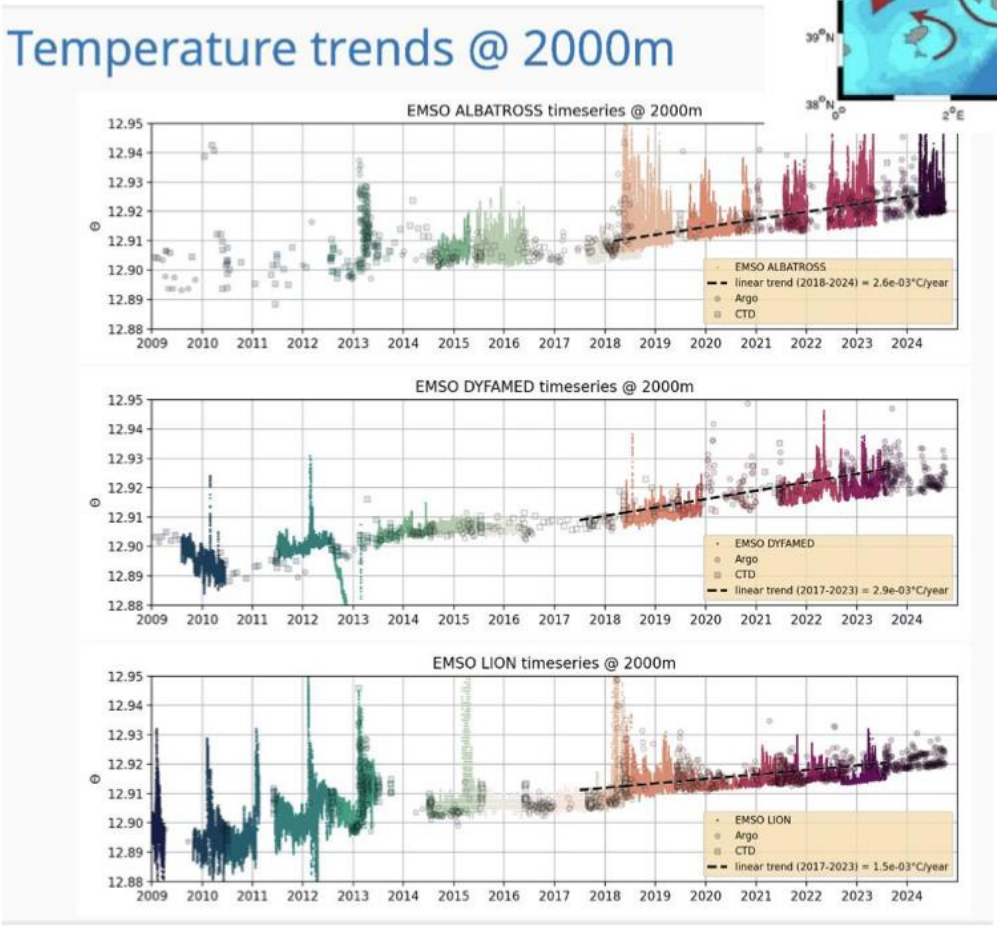
Take Home messages

2035 Vision of EMSO ERIC



*"The sustainability of our ocean stands in our **integrative** capacity to observe, study, understand and advocate it from its deepest part to the upper water column on long terms.*

*In that context, by 2035, EMSO will be recognised as the European reference for the **long-term observation and analysis** of the marine environment **variability** and marine geohazards from the seabed to the water column, in key marine **regions**."*



2009 **2025**

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

HOSTED BY

Agenzia Spaziale Italiana

CO-SPONSORED BY

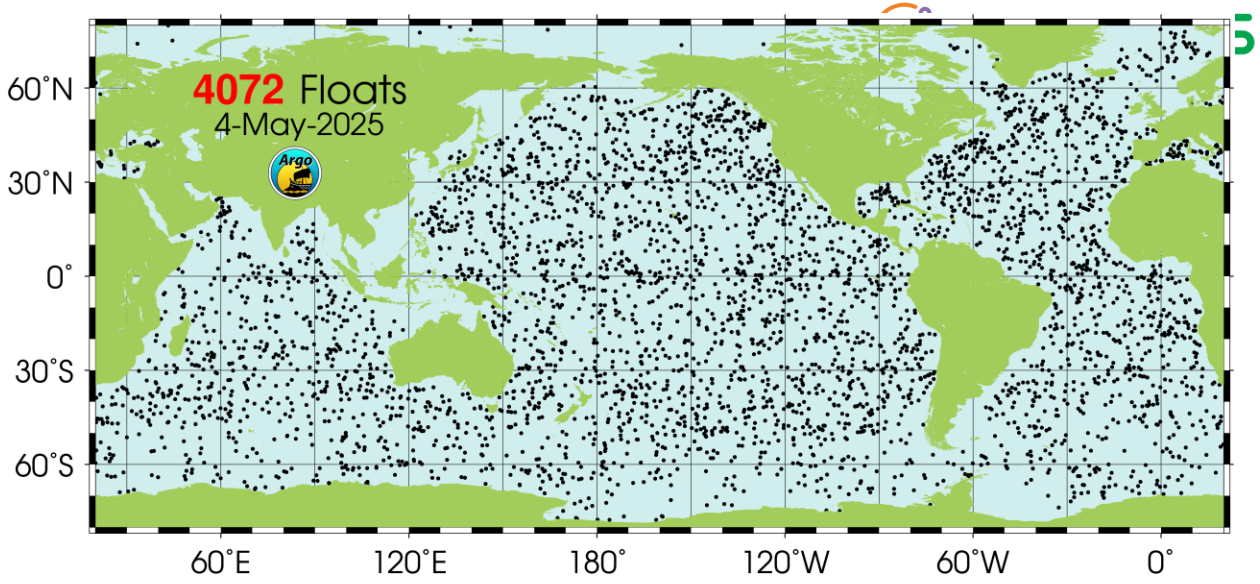
European Union

Euro-Argo: the European Contribution to the Global Argo Programme

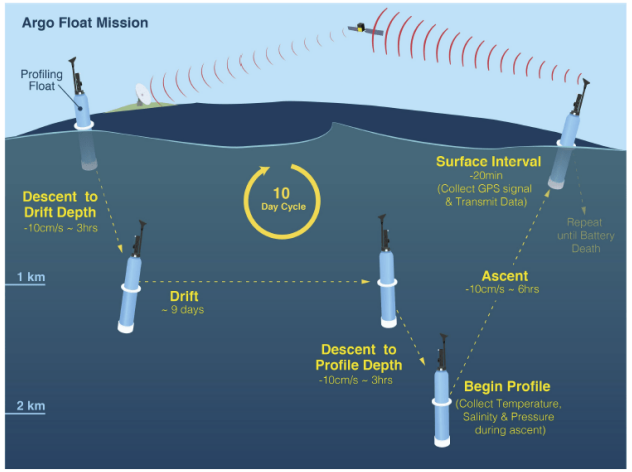
- Elena Mauri
- National Istitute of Oceanography and Applied Geophysics (OGS)

GEO Global Forum – Rome, Italy 5-9 May 2025

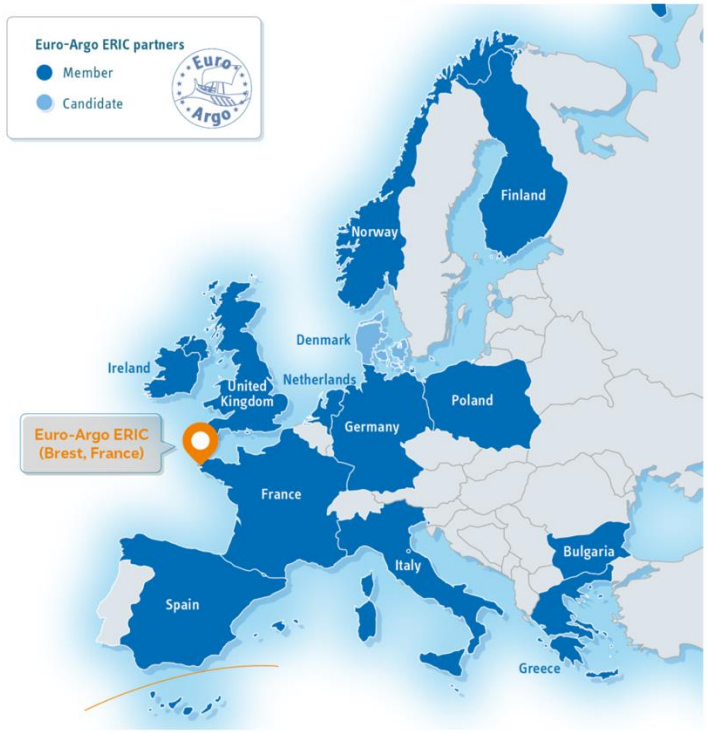
Global Argo Programme



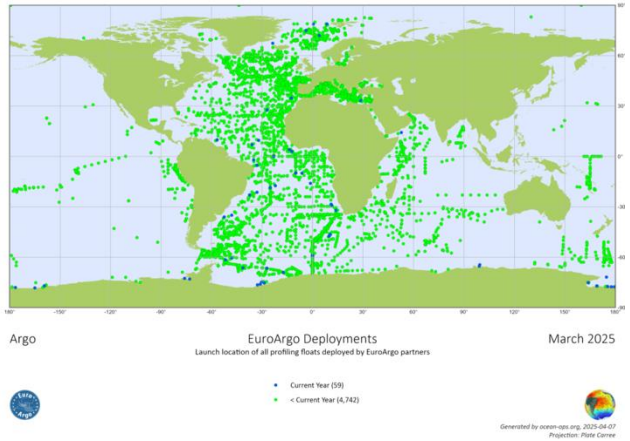
- Argo: first-ever **global ocean observation system** with autonomous profiling floats developed to **quantify ocean-climate interactions**.
- **1998:** proposed as a global initiative **2000:** deployment of the first floats begins.
- Currently, around 30 countries (23 nations have national funding) actively participate in the Argo program, contributing through :
  - **deployment and maintenance of Argo profiling floats,**
  - **data processing and sharing,**
  - **development of advanced technologies and new missions (such as Deep Argo and BGC Argo).**



Members' list



The Euro-Argo ERIC National Members.



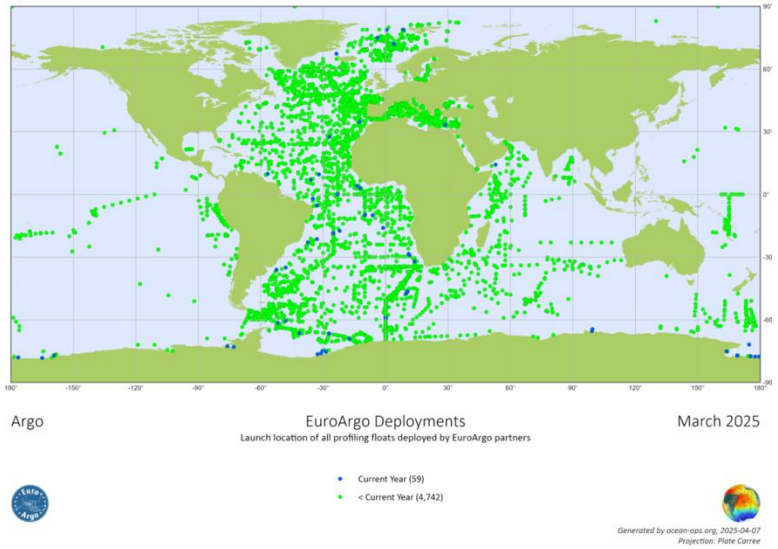
Euro-Argo ERIC

- **In 2006** **Roadmap ESFRI** Euro-Argo
- 2008-2012 **Preparatory phase** in which **FAIR principles were adopted (data and metadata),** data acquisition and processing network improved, and personnel trained.
- 2012-2014 **Implementation phase**, strategic objectives were defined to collect and distribute data.
- **In 2014** **Euro-Argo ERIC** Statute was defined, outlining **governance**, role of member states, **objectives** of

  maintaining 25% of the global float array, cover European seas, improve float technology and enhance data quality control.
- In 2016 Euro-Argo is recognized as **"ESFRI Landmark"**
- **In 2024** ESFRI Landscape Analysis Euro-Argo ERIC is recognized as one of the eight **landmark** environmental research infrastructures in Europe.

Members' list

The Euro-Argo ERIC National Members.

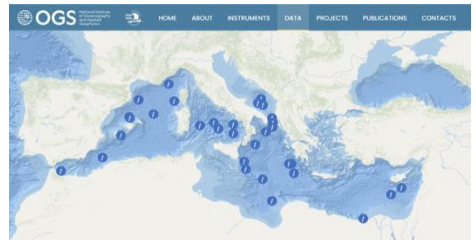


Euro-Argo ERIC

- Euro-Argo ERIC: coordinates and strengthens **European participation** in Argo of **12 countries**.
- Since 2020, have been evolving to expand temperature and salinity measurements (**Core Argo mission, up to 2000 m depth**)
  - to the full water column (**Deep Argo mission, up to 6000 m**) and
  - to biogeochemical measurements (**BGC Argo mission**),
  - in order to increase coverage in **polar oceans, marginal seas, and the most dynamic zones**.

- Euro-Argo is also developing by providing **new services** to its Members: organizing joint purchases of profilers, monitoring the European fleet, and training scientific and technical staff.

Argo Italy



Since 2014 Italy, is a founding member of Euro-Argo ERIC and responsible for **MedArgo**, coordinating activities in the **Mediterranean and Black Seas**.

Since 2022, the **ITINERIS-PNRR** project has enabled the Italian comunity to align with this evolution by expanding the fleet in the Mediterranean to **include**

Deep (>2000 m) and

BGC Argo missions.

Near future

The new data will provide information on

deep ocean circulation, ecosystems, and **biogeochemical cycles** in our seas, supporting the Italian physical and biogeochemical **operational modeling** center at CMCC and OGS—the only one in the world to operationally assimilate BGC Argo data.

1

These data and **model forecasts** will help assess the "**health status**" of our seas and provide essential **tools for proper marine resource management and planning for climate change adaptation**.

2

With **ITINERIS**, in collaboration with European and international companies, the testing of **more affordable and higher-performance sensors** that enhance competition in the BGC Argo sensor market. The expected result is improved **resilience and sustainability** of the Euro-Argo infrastructure and the entire global Argo program.

Core Activities and Distinctive Capabilities

- Thanks to the synergy among 22 countries. Europe contributes to the **DEPLOYMENT and OPERATION of ~800 active floats** with an annual renewal: **~250 new floats per year**. That is the contribution of 25% to the active 4000 Argo float word wide array.

- Besides float deployment, Argo has worked hard to develop **two separate PROCESSING DATA streams**: real time and delayed mode.

  A **real time data delivery and quality control system (RTQC)** has been established that delivers 90% of profiles to users via two global data centers (GDACs) within 12 hours and 80% arriving within 6 hours.

  A **delayed mode quality control system (DMQC)** has been established and 75% of all eligible profiles have had DMQC applied.

Provides FAIR data in real-time (RTQC) following EOSC

Core Activities and Distinctive Capabilities

Argo FAIR data distribution

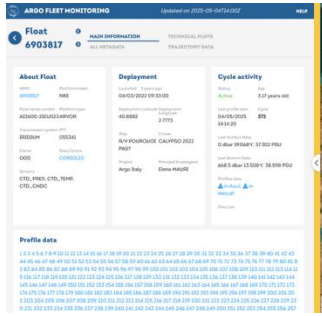
- ftp → ftp://ftp.ifremer.fr/ifremer/argo
- https → https://data-argo.ifremer.fr
- erddap → https://erddap.ifremer.fr
- Euro-Argo is developing a “cloud” version of the dataset
- Italian Argo floats in the Itineris dataserver

- to **operational centers** through the **Global Telecommunication System (GTS)**, which is the worldwide coordinated system for the acquisition, exchange, and rapid distribution of observations within the framework of the **World Weather Watch**.
- to **Copernicus Marine Environment Monitoring Service (CMEMS)**
- To **European Marine Observation and Data Network (EMODnet)**

database.

ChatGPT ha detto:
There are also several interfaces that facilitate access to the database.

Core Activities and Distinctive Capabilities



There are also several **interfaces** that facilitate access to the database:

- https://fleetmonitoring.euro-argo.eu
- https://dataselection.euro-argo.eu

Libraries accessible to everyone e.g., ArgoPy, https://argopy.readthedocs.io
to access and select portions of the Argo dataset

The Argo database has also been integrated into the oceanographic data visualization and analysis software "**Ocean Data View**"
webODV, https://webodv-egi-ace.cloud.ba.infn.it
enabled its use by Italian high school students.

Adopt a float program for schools

Global Impact and Examples of Applications

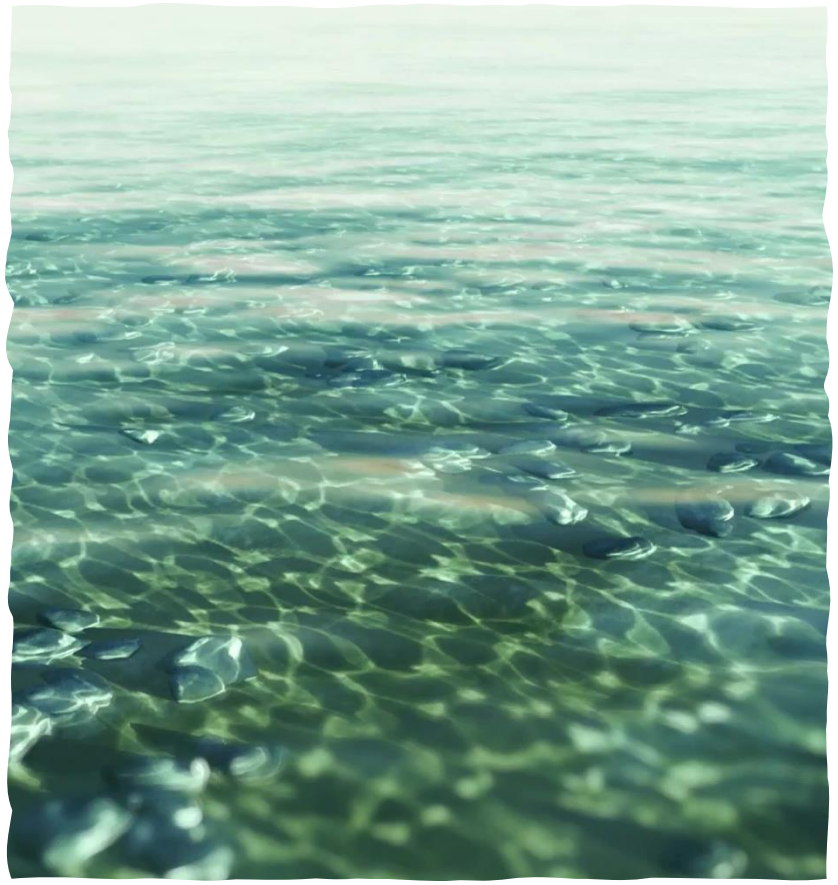
Significant examples include global ocean monitoring, **improved climate forecasting**, and **enhanced understanding of ocean circulation, hydrological and BGC cycle** and its impact on the Earth's climate system

- Quantification of **ocean heat uptake**: Argo has significantly reduced uncertainty in estimates of ocean heat storage, which accounts for 90% of global warming.
- Quantification of **sea level rise** due to thermal expansion.
- Study of **thermohaline circulation** (Atlantic Meridional Overturning Circulation) and its variability, which are critical for European climate. Improve the **accuracy of global weather and climate prediction models**.
- Quantification of **changes in the hydrological cycle** (through salinity measurements) caused by global warming.

Global Impact and Examples of Applications

- Global estimation of **deep ocean current velocities and thermoaline properties change**.
- Improved **understanding of the carbon cycle** thanks to the BGC Argo mission.
- Detection of **extreme events**: anomalous variations in temperature and salinity associated with extreme events, such as marine heatwaves, crucial for understanding impacts on fisheries and biodiversity.
- **Synergy with satellite observations**: data collected by Argo floats are used in conjunction with satellite measurements, enhancing the understanding of ocean dynamics.

Direct Benefits to the GEO Global Community



- Argo has measured the physical parameters on more than **5 times as many profiles as the entire history of ocean observing**. For the BGC parameters, even the pilot arrays make more profile measurements each year than the entire global research ship fleet.

- **Researchers:** access to **unparalleled global QC ocean datasets in real time (FAIR)**.
- **Policymakers: evidence-based decisions** using **accurate global weather and climate prediction models**, supporting sustainable marine resource management, safe navigation, and climate change adaptation strategies which are critical for European climate.
- **Technology users**: testing new **instrumentation** (Deep Argo, BGC Argo).
- **Industry**: enabling **blue economy innovation**.

Future Perspectives

Expansion of BGC Argo and Deep Argo arrays, set up RTQC and DMQC data stream in line with EOSC principles. Useful to operational physical and BGC models to provide essential **tools for proper marine resource management and planning for climate change adaptation**

Thematic collaborations and joint projects continue to participate in European projects (e.g., Horizon Europe, Copernicus, Digital Europe) on shared themes such as **environmental monitoring, the green transition, health and artificial intelligence applied to data**.

Infrastructure forums and clusters continue to take part in common platforms such as the ESFRI Forum, the ENVRI community (for environmental infrastructures), and other sector-specific clusters to exchange best practices, strategic synergies, and roadmaps.

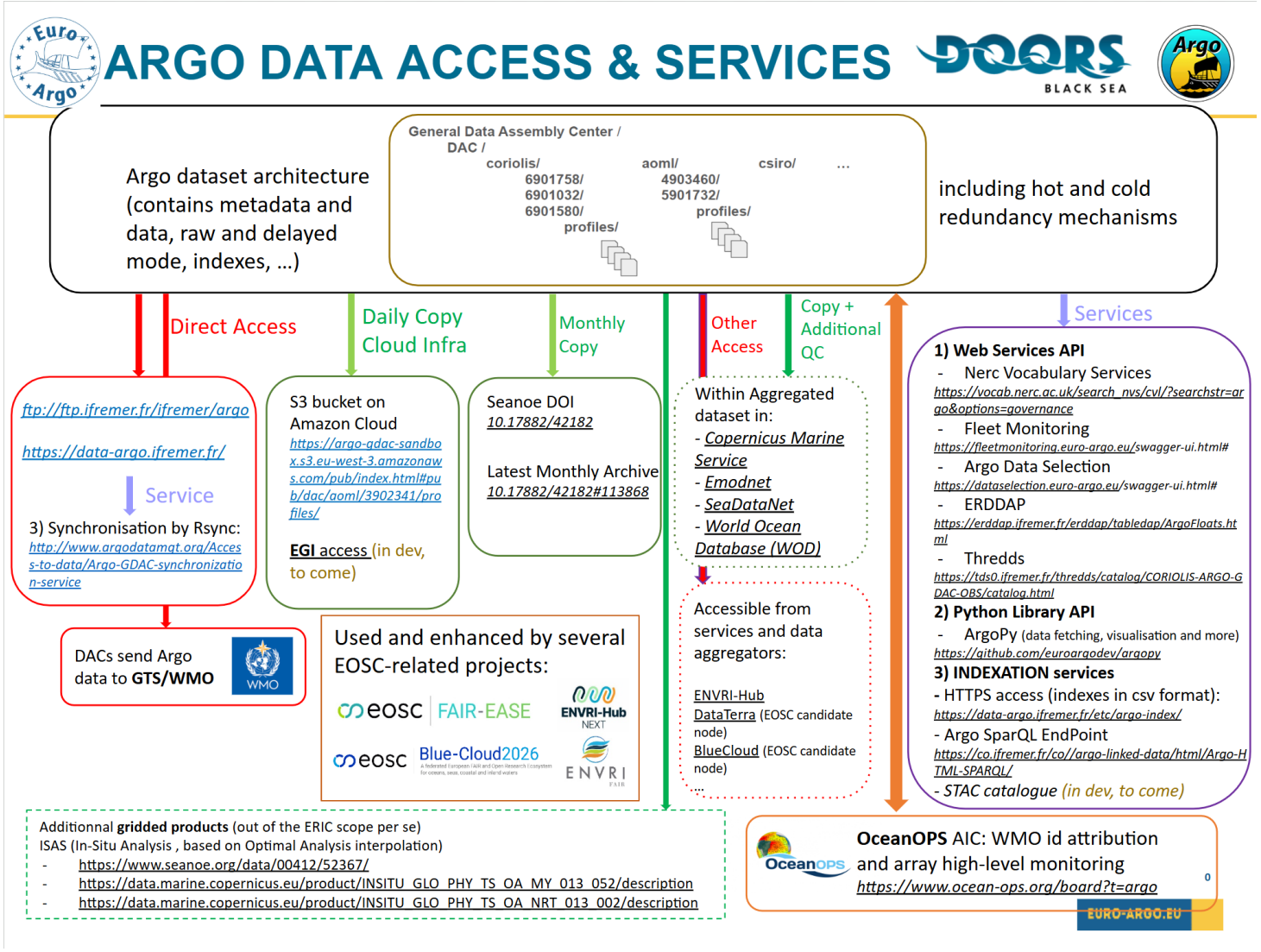
Conclusion

•Euro-Argo ERIC and Argo has **transformed ocean observing**, providing global year-round measurements of the subsurface ocean.

•A **coordinated, comprehensive, and sustained Earth observations** taking into account different RI are necessary for a **global understanding of the ocean** for future generations and help to take decision for **sustainable development**.

International Collaboration and Knowledge Exchange

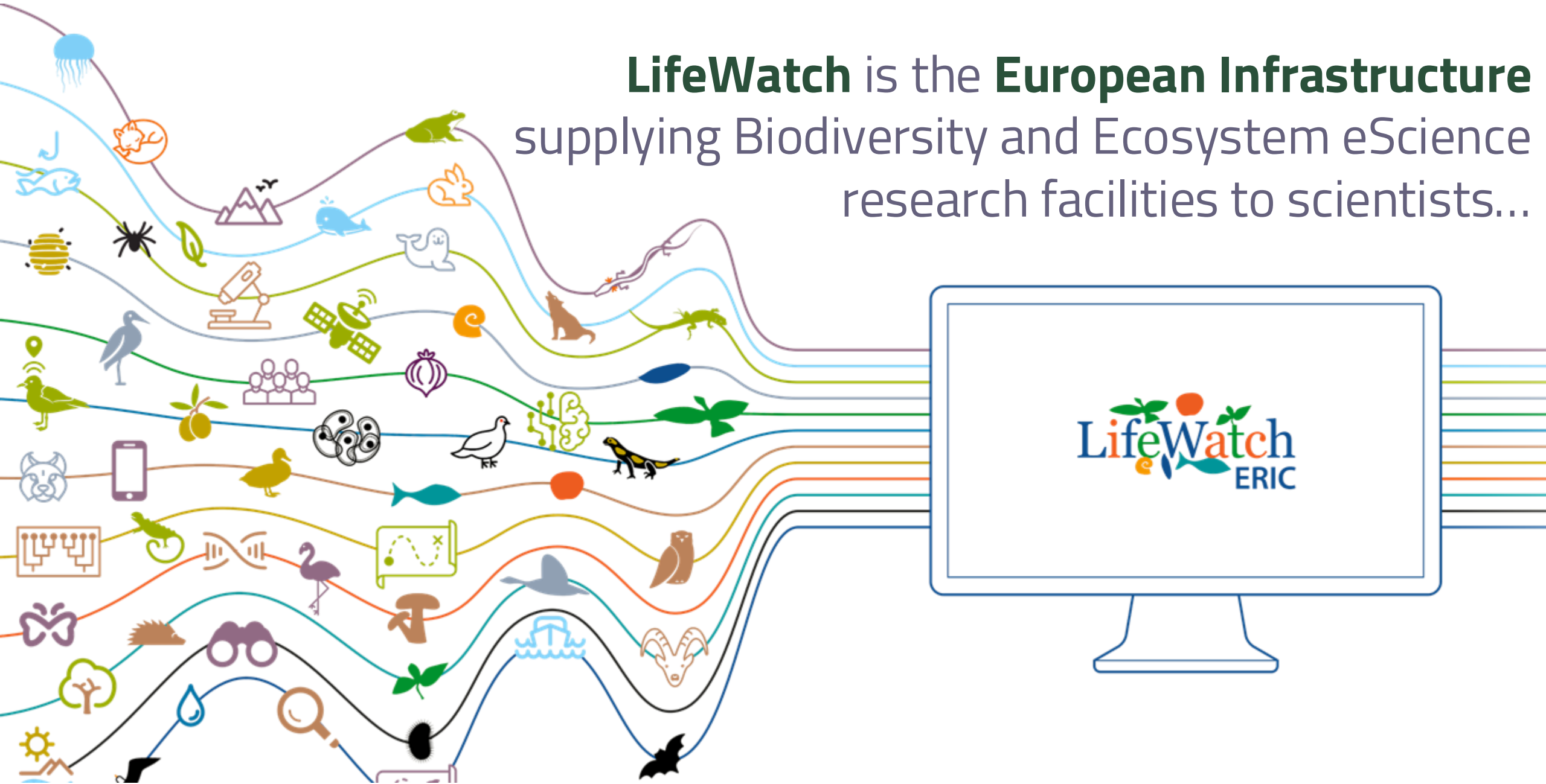
- **Partnerships**: EuroSea, OceanOPS, GOOS, Copernicus, EOSC.
  Training programs, technical workshops, capacity-building activities.
  Data sharing platforms: GDACs (Coriolis, USGODAE).



LifeWatch ERIC in a nutshell

What is LifeWatch ERIC

LifeWatch is the **European Infrastructure** supplying Biodiversity and Ecosystem eScience research facilities to scientists…



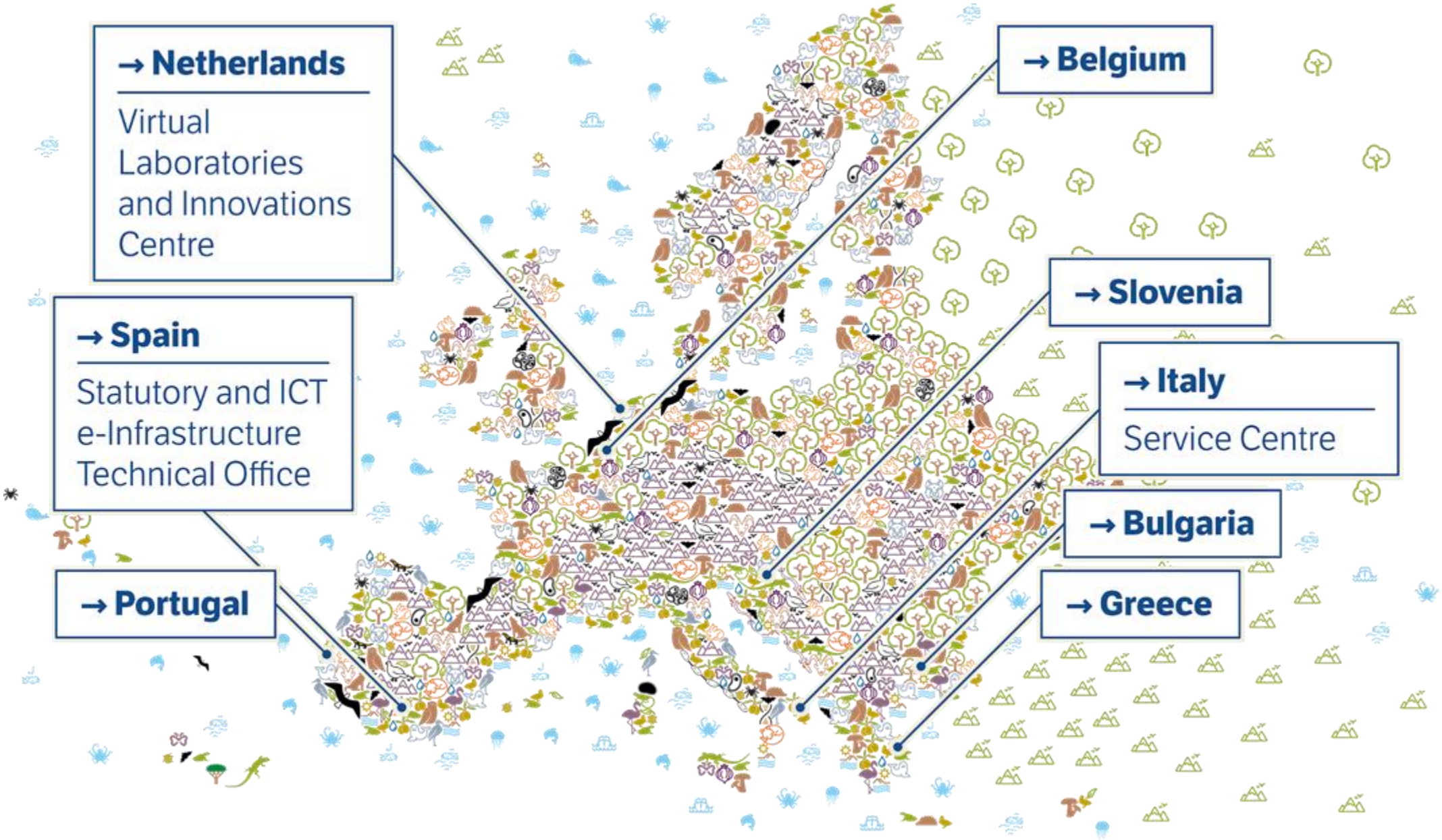
What is LifeWatch ERIC

LifeWatch ERIC's vision is to Become the Research Infrastructure providing access to the world's biodiversity content, services and communities in one click.

LifeWatch ERIC's mission is to accelerate the research efforts of the scientific community by delivering a European state-of-the-art e-Science Research Infrastructure on biodiversity and ecosystems.

The **goal** of the **LifeWatch ERIC infrastructure** is the construction of virtual “workbenches” with e-services that allow its user communities to analyse patterns and trends in biodiversity in space and time, its (natural or man-made) drivers and the impacts on ecosystems.

LifeWatch ERIC Common Facilities & Members



Main communities served

Scientists in LW ERIC Member States
EU and International Scientists
Early Career Scientists

USERS

STAKEHOLDERS

Policy Makers
Governmental Organisations
Other EU RIs
Private Actors

Educational System
Citizen Scientists

GENERAL PUBLIC

With LifeWatch ERIC you can

01 Find, access and reuse Data and Metadata

02 Work with interoperable data

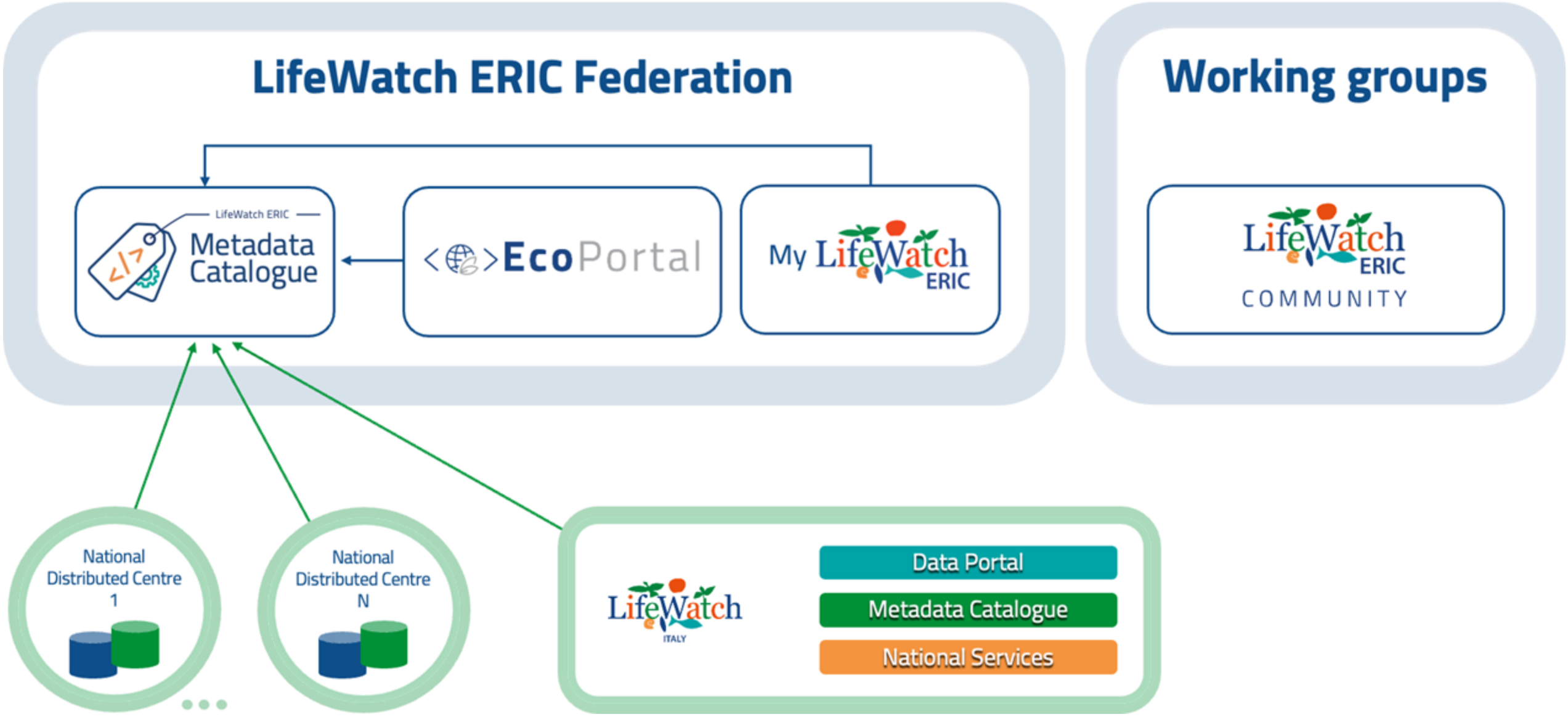
03 Share and search your semantic resources

04 Process and Analyse data in VREs

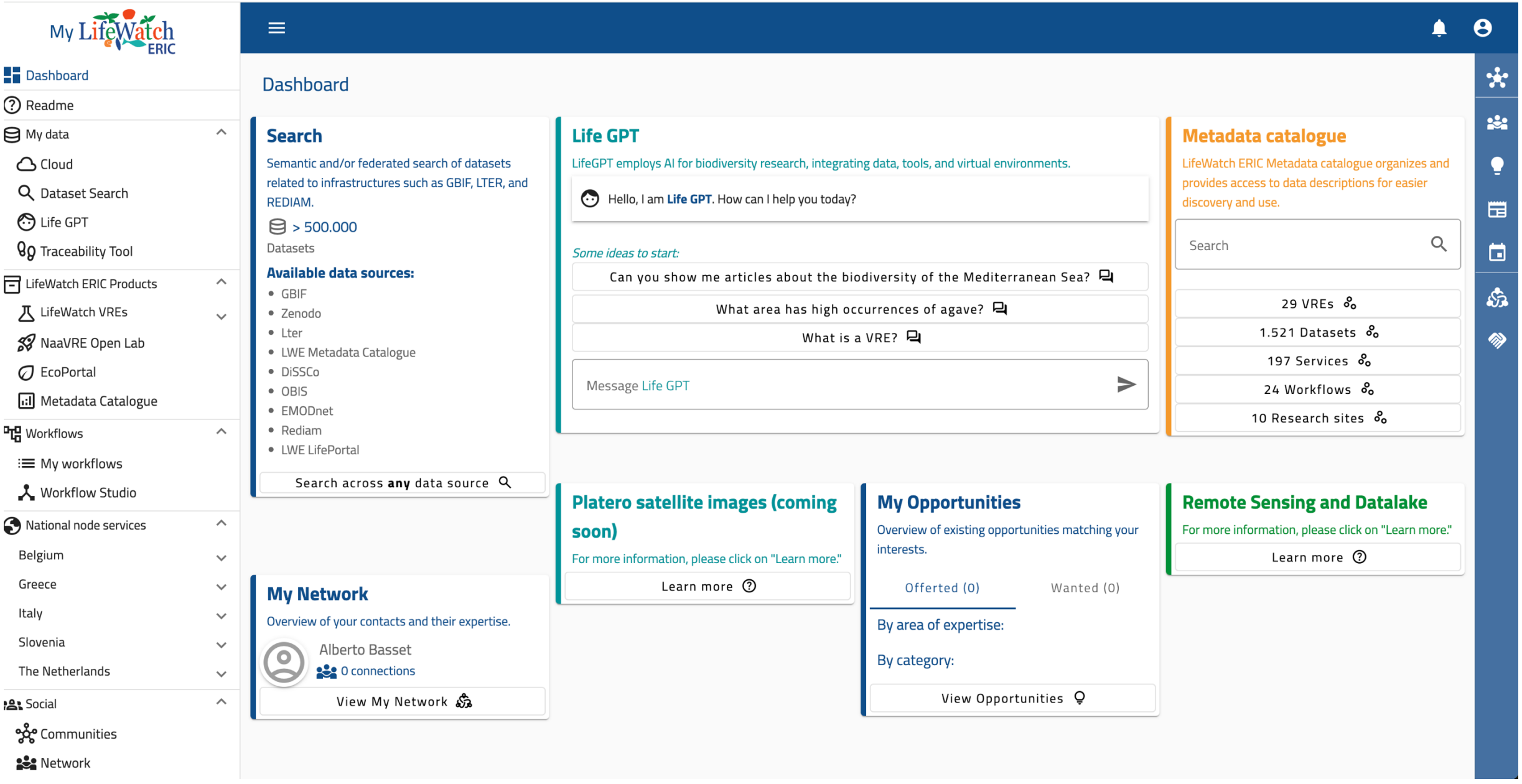
05 Get trained & Receive support

06 Discover our web services

LifeWatch ERIC Federation



LifeWatch ERIC Federation



LifeWatch ERIC Federation

Workflows

Home | Internal Joint Initiative | **Workflows**

The Internal Joint Initiative (IJI) was instigated by **LifeWatch ERIC** in 2019 to build the next generation of Virtual Research Environments (VREs). Informaticians at the ICT-Core in Spain and the Service Centre in Italy worked extensively with scientists from biodiversity & ecosystem communities across Europe to develop new platforms and tools that those researchers required to take their investigations to the next level.

This page gives an overview of the five validation cases on Non-indigenous & Invasive Species (NIS) and allows access to the corresponding workflows. Choose whichever is most relevant and click 'Go to the workflow'. You will find a login page, where even without LWOS credentials, (the LifeWatch operating system - a lifewatch.eu email address), access is available through your: ORCID ID, the persistent digital identifier for researchers; Google account - a gmail.com address and password; or EGI, the federation of computing and storage resources providers.

Watch this space for forthcoming training support in navigation within the workflows and Help Desk services.

Internal Joint Initiative

- ABOUT
- PUBLICATIONS
- FRAMEWORK AND KNOWLEDGE MAP
- VALIDATION CASES
- COMMUNICATION MATERIALS
- NEWS & EVENTS
- WORKFLOWS

Ailanthus altissima

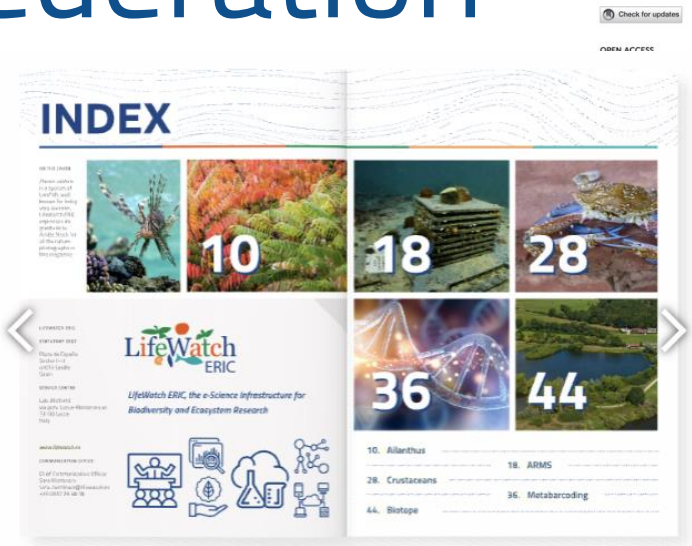
It is a data chaining pipeline that uses both community composition and community metabarcoding data produced by a network of Autonomous Reef Monitoring Structures (ARMS).

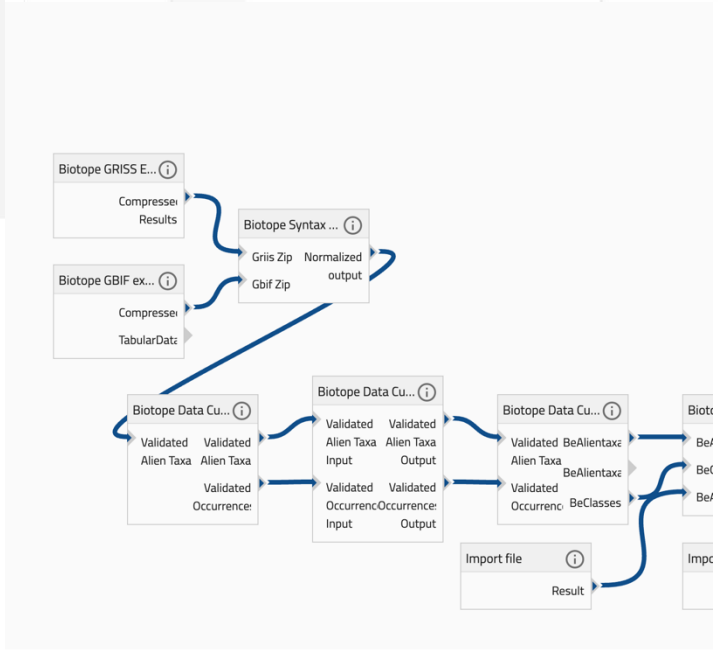
Go to the workflow!

Biotope

Crustaceans

Metabarcoding





frontiers | Frontiers in Environmental Science

TYPE Methods
PUBLISHED 04 January 2023
DOI 10.3389/fenvs.2022.1038635

Check for updates

OPEN ACCESS

The validation case on invasive crustaceans of the LifeWatch ERIC Internal Joint Initiative: State of the art and next steps forward

Cristina Di Muri[1,2]*, Christos Arvanitidis[3], Alberto Basset[1,2,4], Raffaele De Giorgi[2], Ilaria Rosati[1,5], Lucia Vaira[2] and Giorgio Mancinelli[4,6,7]*

[1]Italian National Research Council, Institute of Research on Terrestrial Ecosystems–CNR-IRET, University of Salento, SP Lecce–Monteroni, Lecce, Italy, [2]LifeWatch ERIC, Service Centre, Ecotekne, SP Lecce–Monteroni, Lecce, Italy, [3]LifeWatch ERIC, Plaza España SN, SECTOR II-III, Seville, Spain, [4]Department of Biological and Environmental Sciences and Technologies–DiSTeBA, University of Salento, SP Lecce–Monteroni, Lecce, Italy, [5]LifeWatch Italy, University of Salento, SP Lecce–Monteroni, Lecce, Italy, [6]National Inter-University Consortium for Marine Sciences–CoNISMa, Piazzale Flaminio 9, Roma, Italy, [7]National Research Council, Institute of Marine Biological Resources and Biotechnologies–CNR-IRBIM, Lesina, Italy

LifeWatch ERIC Federation

LifeWatch ERIC COMMUNITY

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- BOARD OF OPPORTUNITIES
- EVENTS
- CONFERENCES
- WORKING GROUPS
- SCIENTIFIC SKILLS
- FAQS
- LIFEWATCH.EU

CALLS	OPPORTUNITIES	EVENTS	WORKING GROUPS	SCIENTIFIC SKILLS	MEMBERS
45	104	59	13	90	322

LifeWatch ERIC Federation

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Welcome to the LifeWatch ERIC Training Platform!

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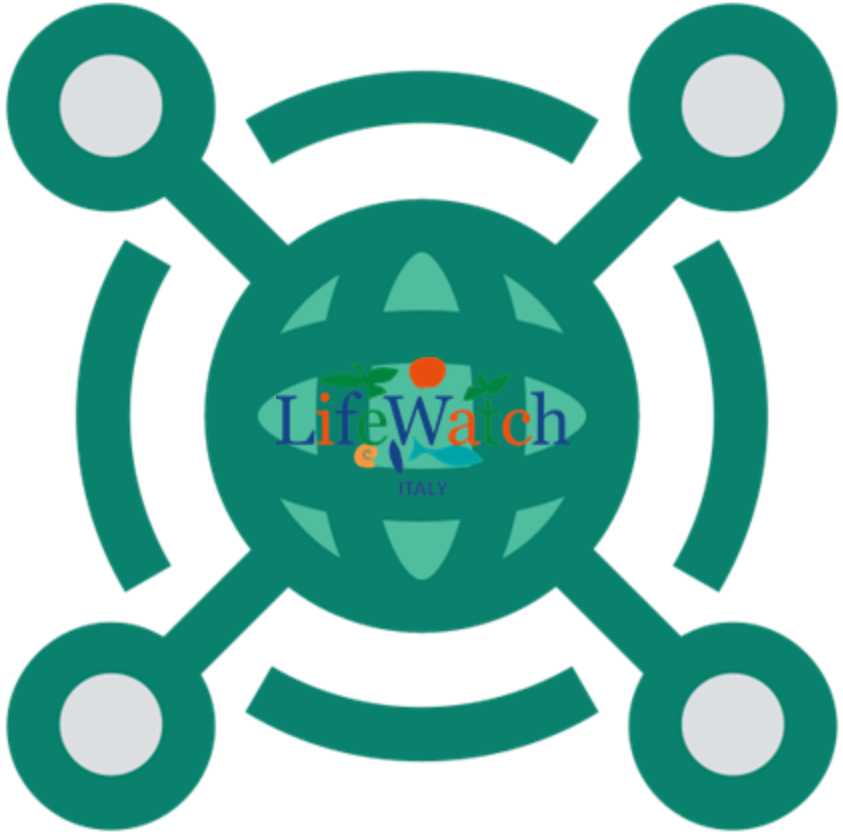
Webinars and Conferences

International Projects

Data Portal: the case of LifeWatch Italy

Prerequisites for development



National Hub for biodiversity and ecosystem research and knowledge

- Main point access to **FAIR** and **Open data** and other **research products**
- **e-Science services** and **platforms** for supporting a **FAIR** and **Open** research lifecycle

Prerequisites for development

FAIR Principles

Image: Illustrations from the Turing Way book dashes. Zenodo. http://doi.org/10.5281/zenodo.3695300

Image: Icons by Freepik from www.flaticon.com and ARDC https://conference.eresearch.edu.au/fair-go-new-resources-to-support-fair-data/

Prerequisites for development

Open Science Principles

Data and other research outputs are available in the public domain or under copyright and licensed under an open licence that allows access, re-use, repurpose, adaptation and distribution under specific conditions.

UNESCO Recommendation on Open Science 2022 version 1.
https://doi.org/10.54677/UTCD9302

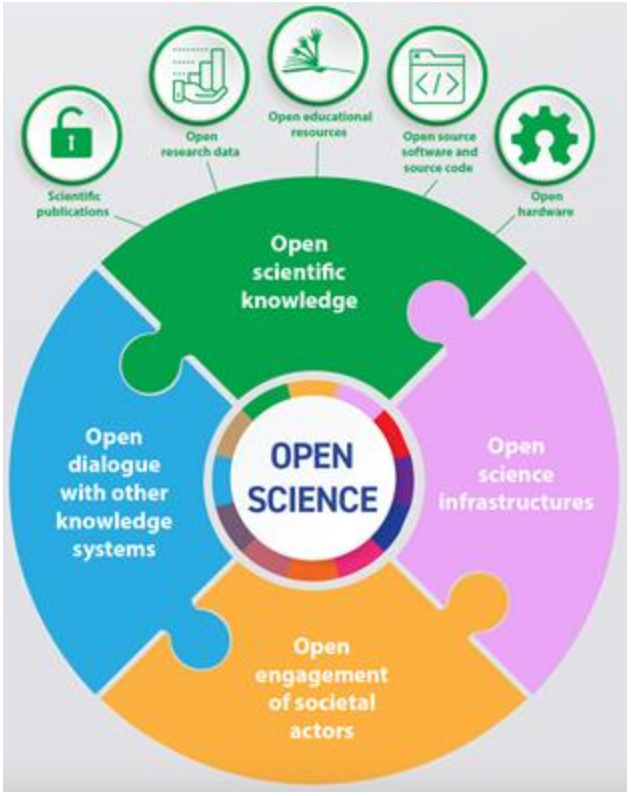


Image: UNESCO Open Science brochure

Prerequisites for development

Open & FAIR Research Lifecycle

- Findable
- Accessible
- Interoperable
- Reusable
- Open

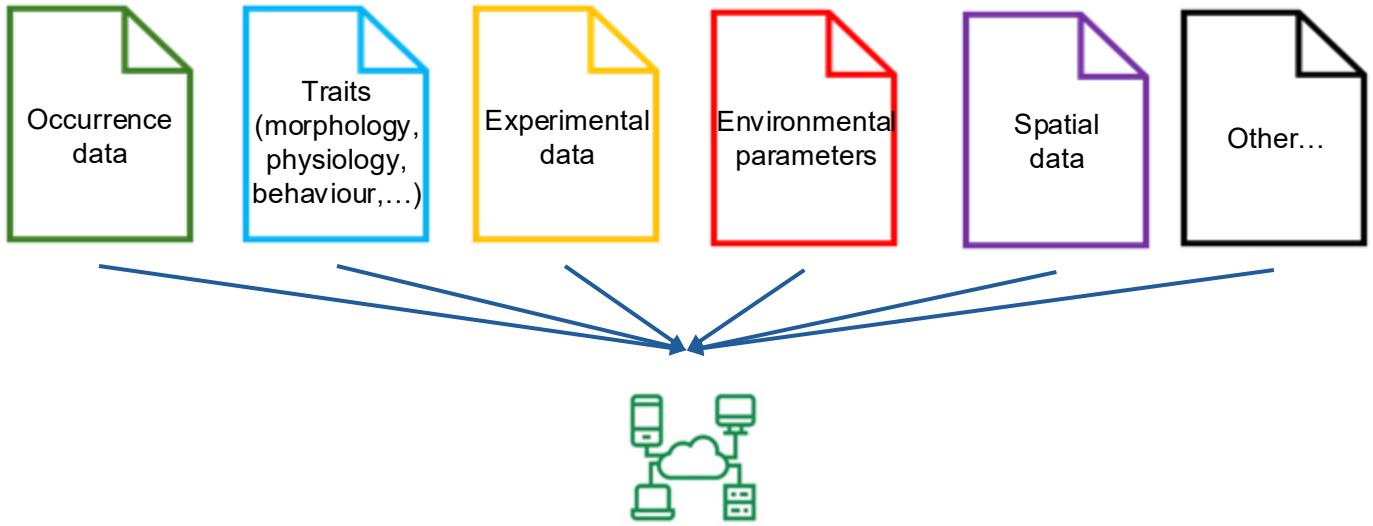
Platforms & Services

- **Data Portal**
- **Metadata Catalogue**
- **Semantic Platform**
- **EcoPortal**
- **DataLabs**
- **BioAcustics**
- **Citizen Science**

Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal

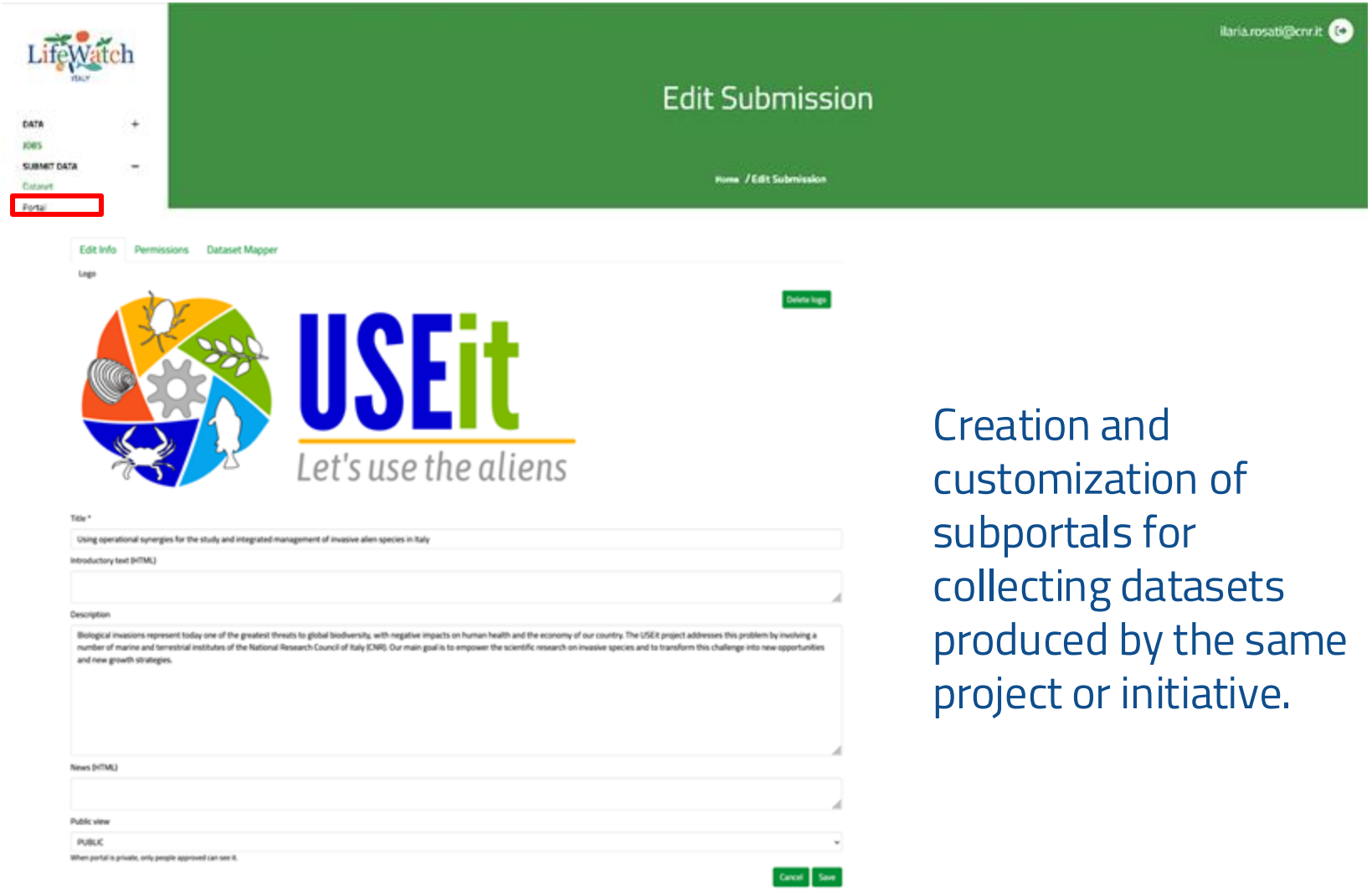


Open data formats can be uploaded: csv, tiff, json, png, etc.

Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal

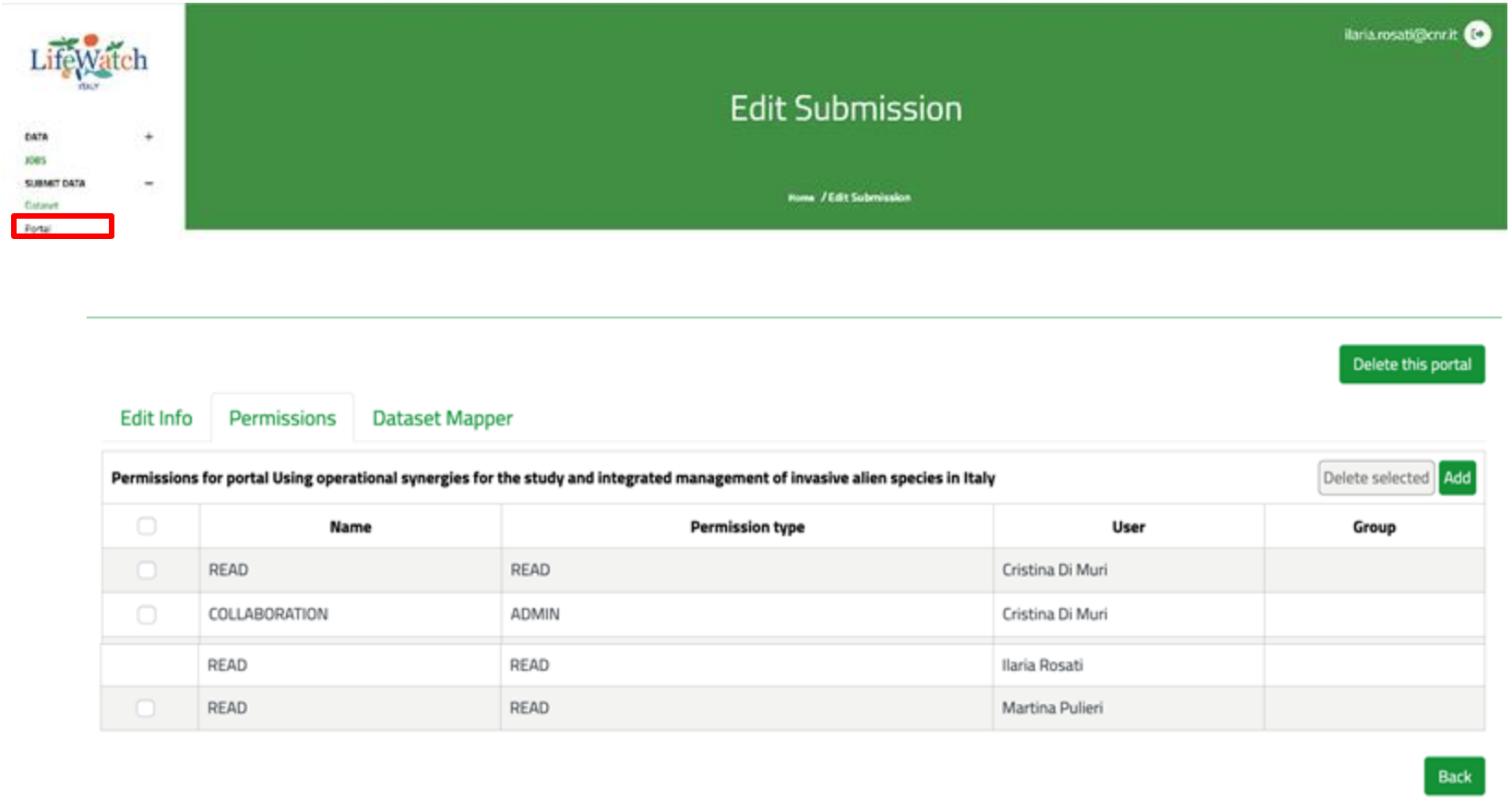


Creation and customization of subportals for collecting datasets produced by the same project or initiative.

Data Basis, Data Flow, Data Providers

Researcher

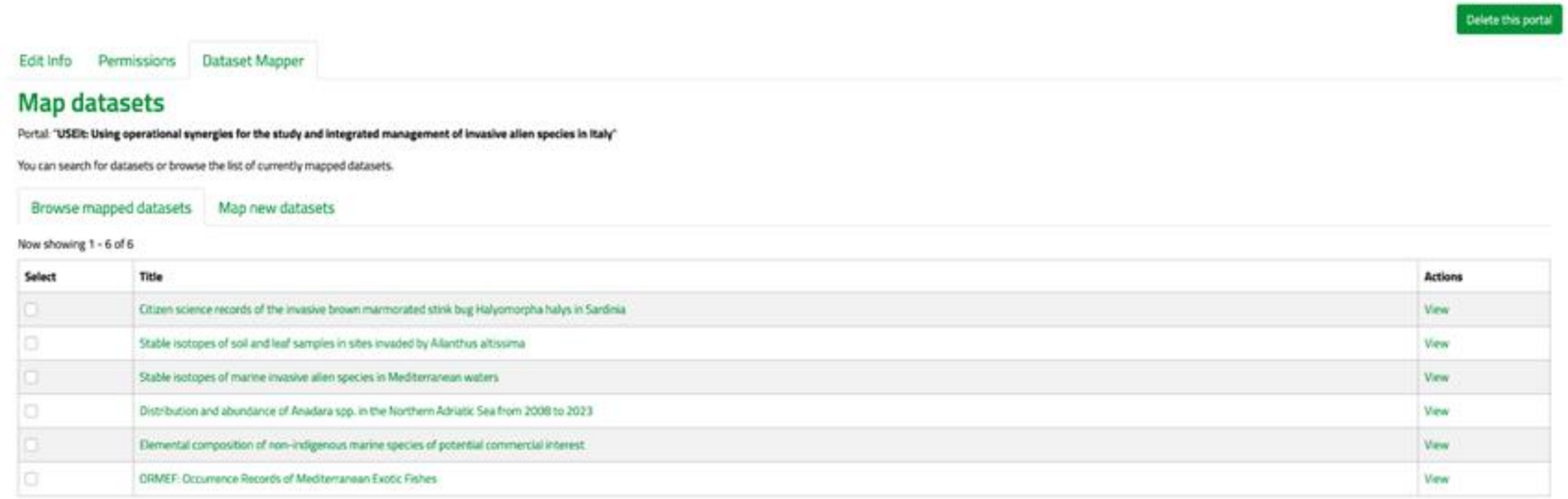
LifeWatch Italy Data Portal



Data Basis, Data Flow, Data Providers

Researcher

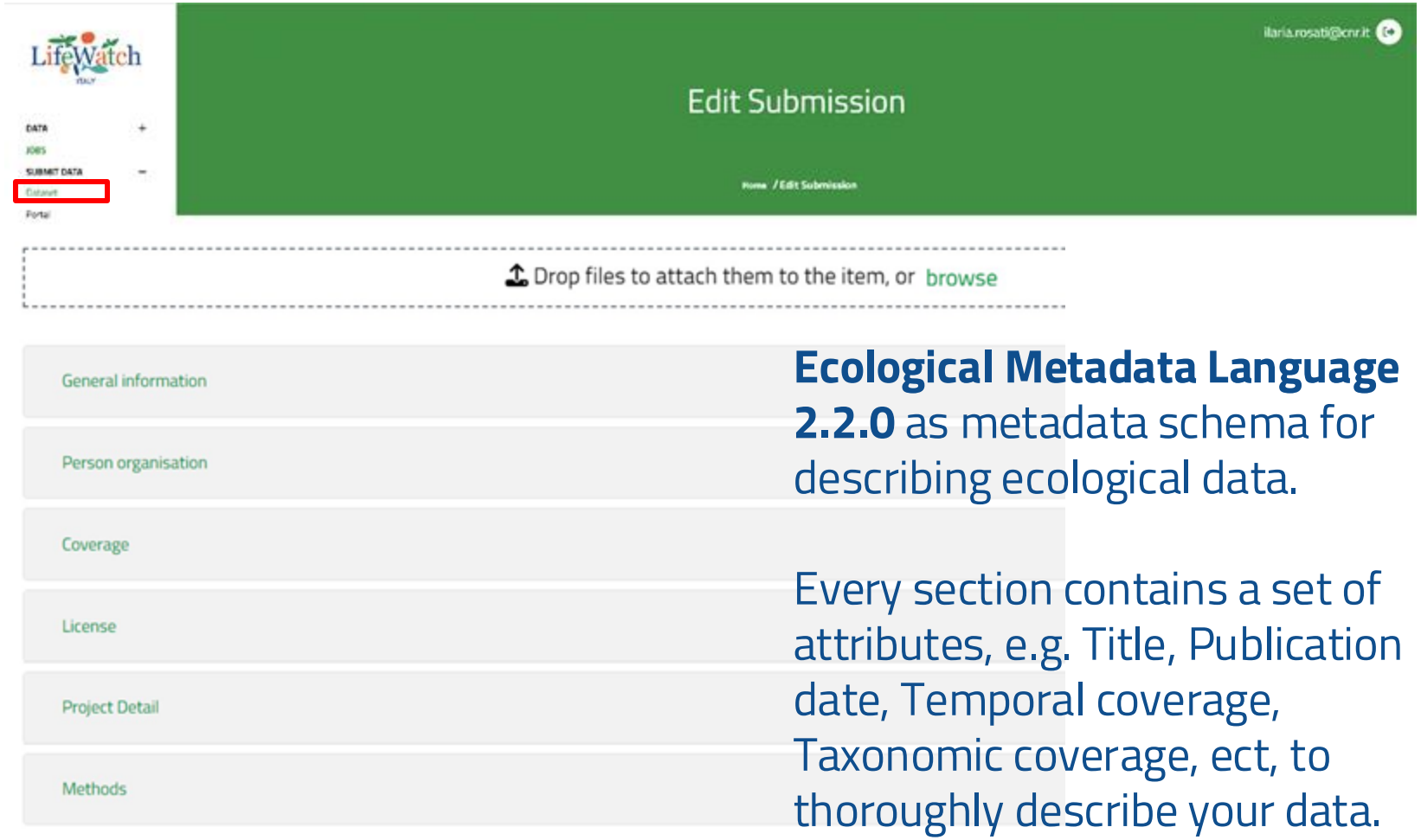
LifeWatch Italy Data Portal



Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal



Ecological Metadata Language 2.2.0 as metadata schema for describing ecological data.

Every section contains a set of attributes, e.g. Title, Publication date, Temporal coverage, Taxonomic coverage, ect, to thoroughly describe your data.

https://eml.ecoinformatics.org/eml-schema

Data Basis, Data Flow, Data Providers

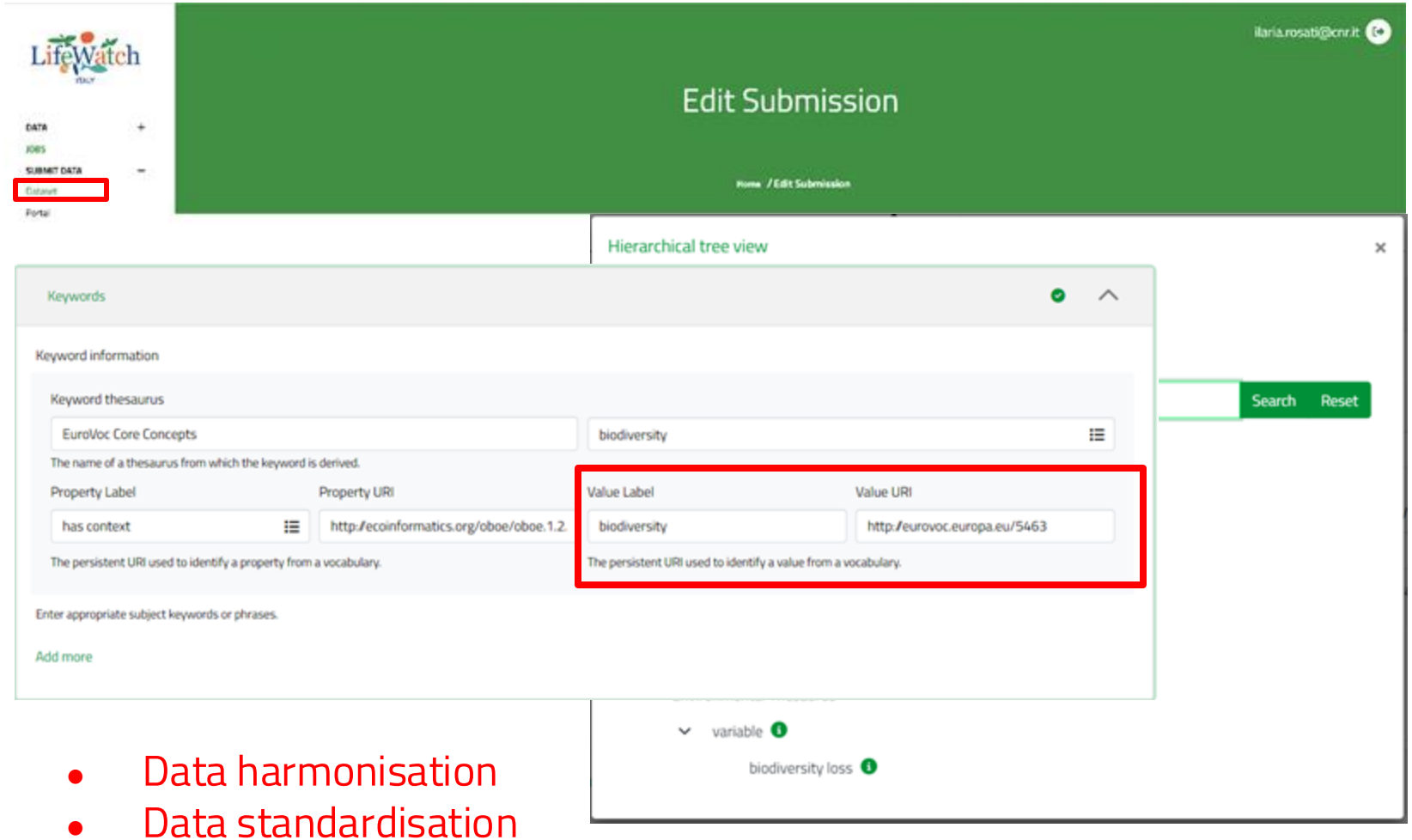
Researcher

EcoPortal

https://ecoportal.lifewatch.eu

Semantic Annotation

LifeWatch Italy Data Portal



- Data harmonisation
- Data standardisation
- Data reuse

Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal

Metadata Validation

The xml file is checked against the EML schema validator (.xsd file)

Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal

Data Curation and Validation

Drop files to attach them to the item, or browse

CSV **LW-ITA Data Schema based on DarwinCore and controlled vocabularies**

scientificName	samplingProtocol	bodyLenght
Idotea balthica	hand operated ekman grab	4.5

scientificName
Idotea balthica

Validated data CSV

Taxonomic check

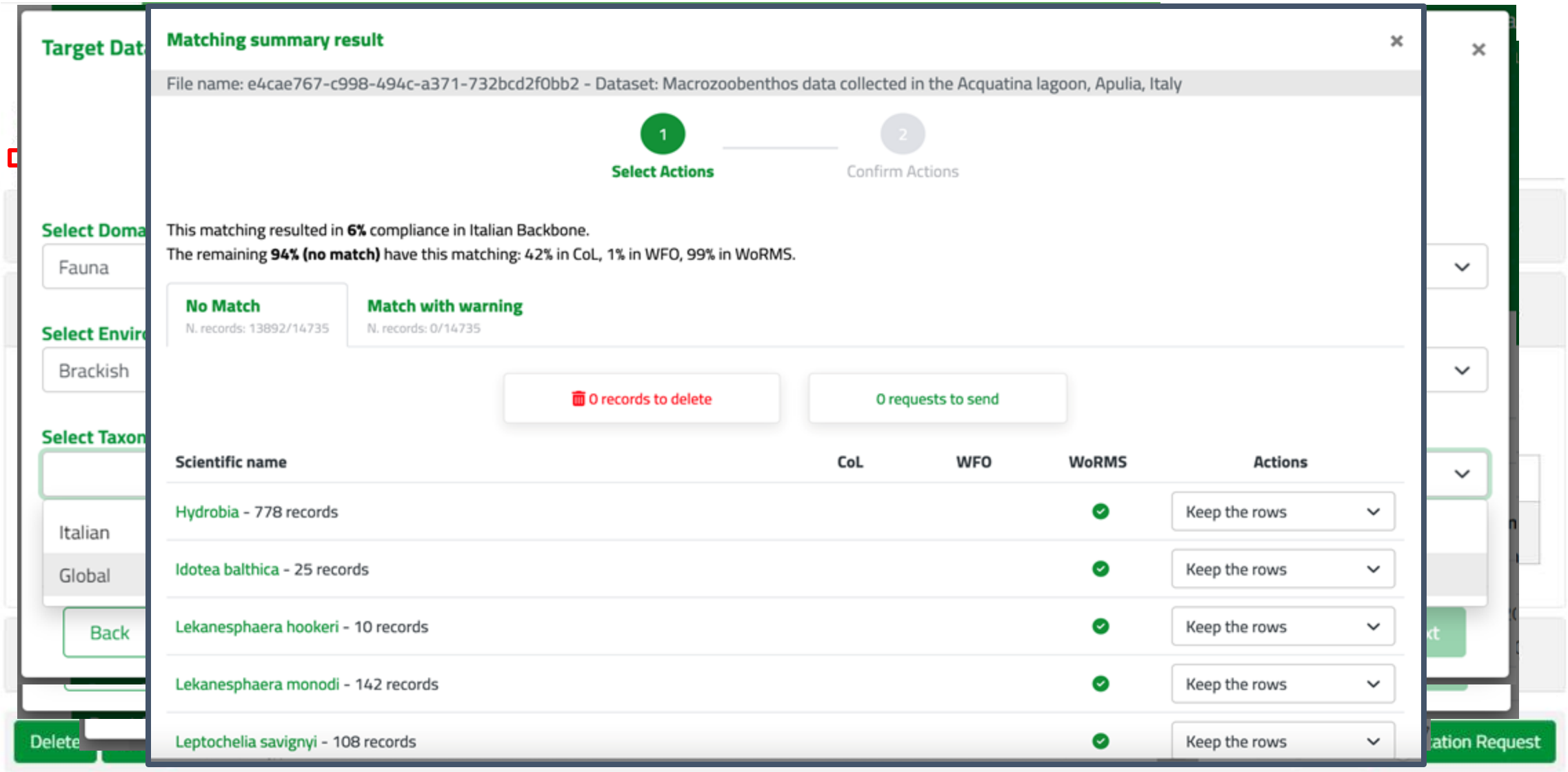
WoRMS World Register of Marine Species

Catalogue of Life

LifeWatch Italian Taxonomic Backbone

Data Basis, Data Flow, Data Providers

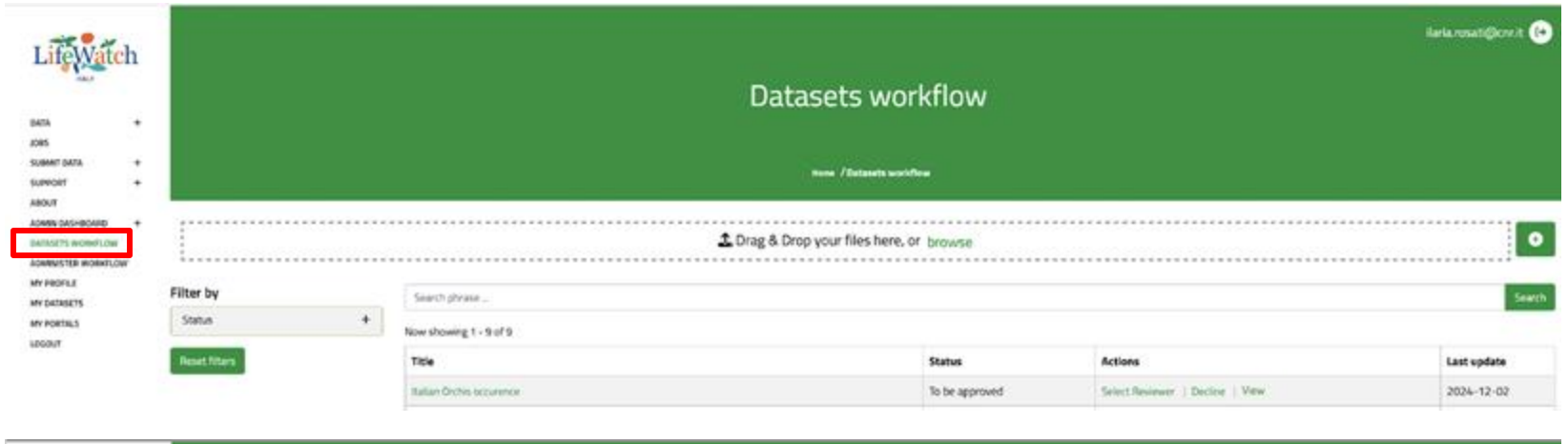
Data Curation and Validation

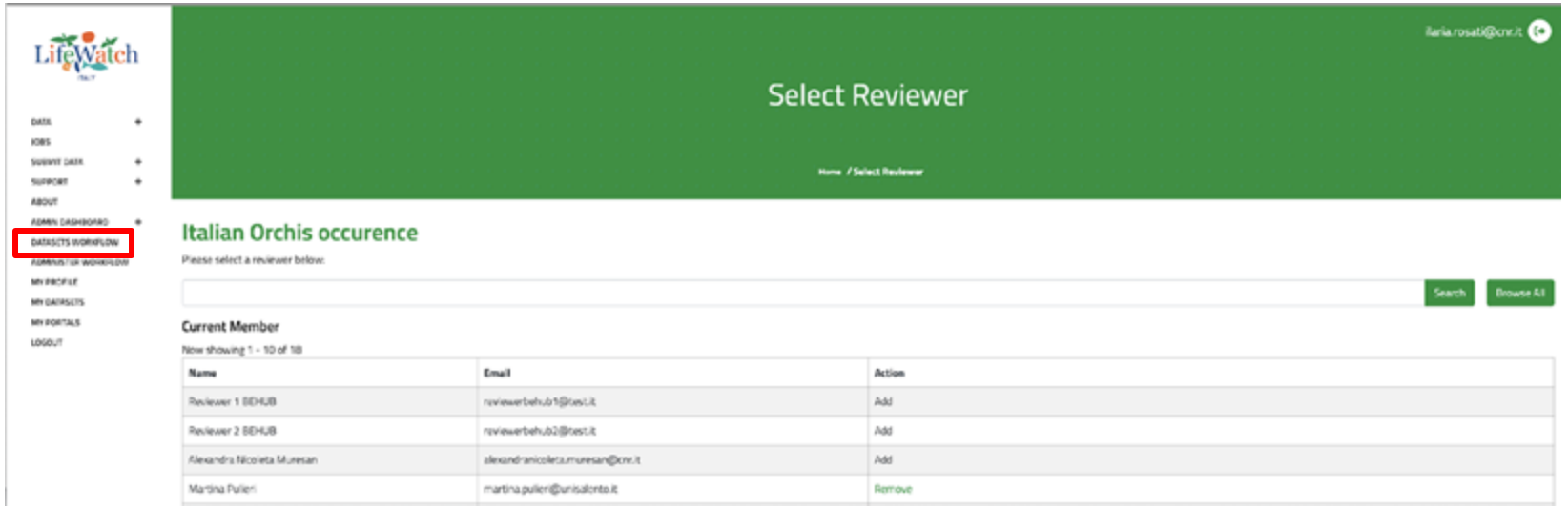


Data Basis, Data Flow, Data Providers

Administrator
Reviewer

Data and Metadata Validation by Reviewer

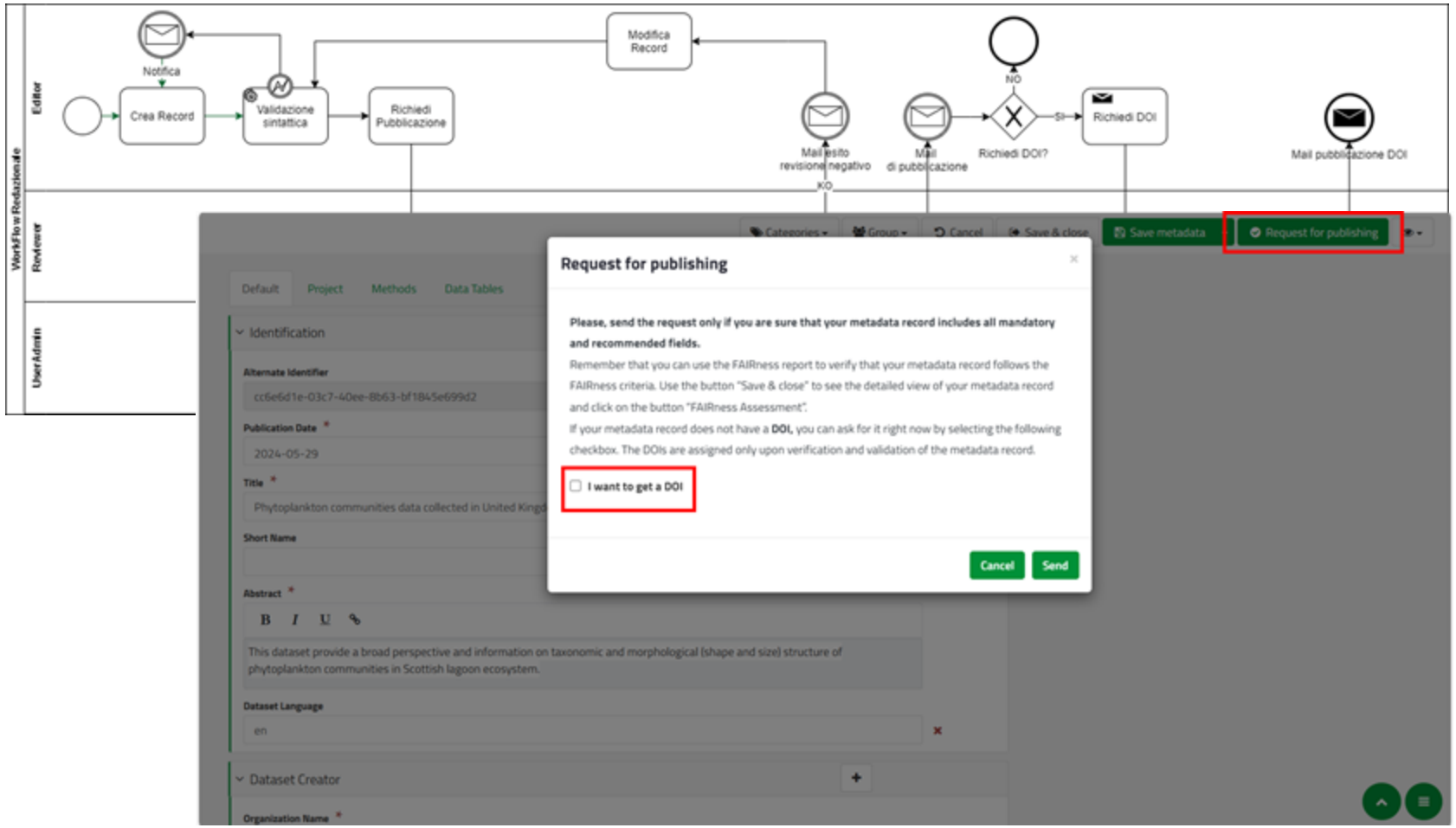




Data Basis, Data Flow, Data Providers

Administrator
Editor
Reviewer

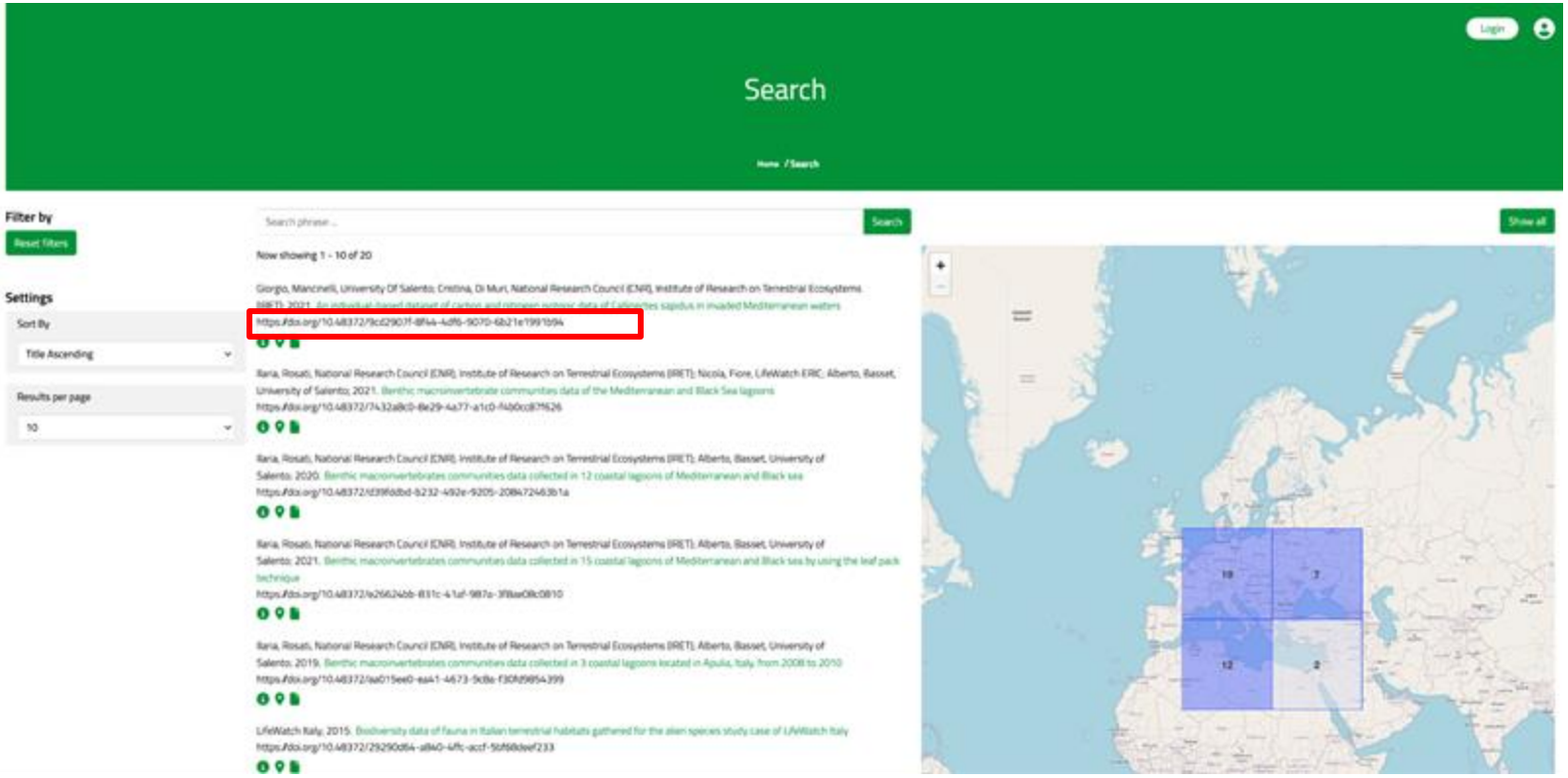
Data & Metadata Publication and DOI assignment



Data Basis, Data Flow, Data Providers

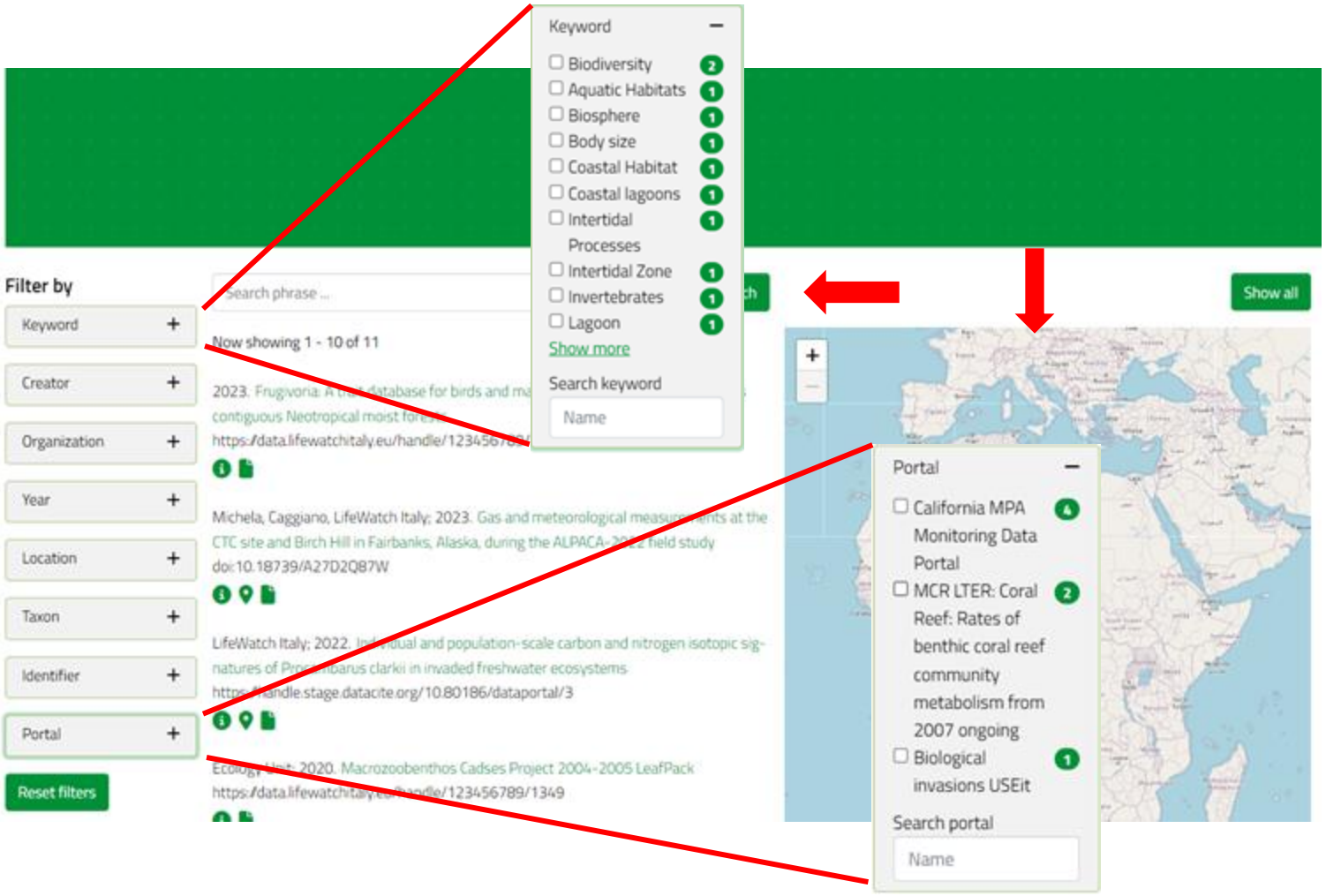
Researcher

LifeWatch Italy Data Portal



Data Basis, Data Flow, Data Providers

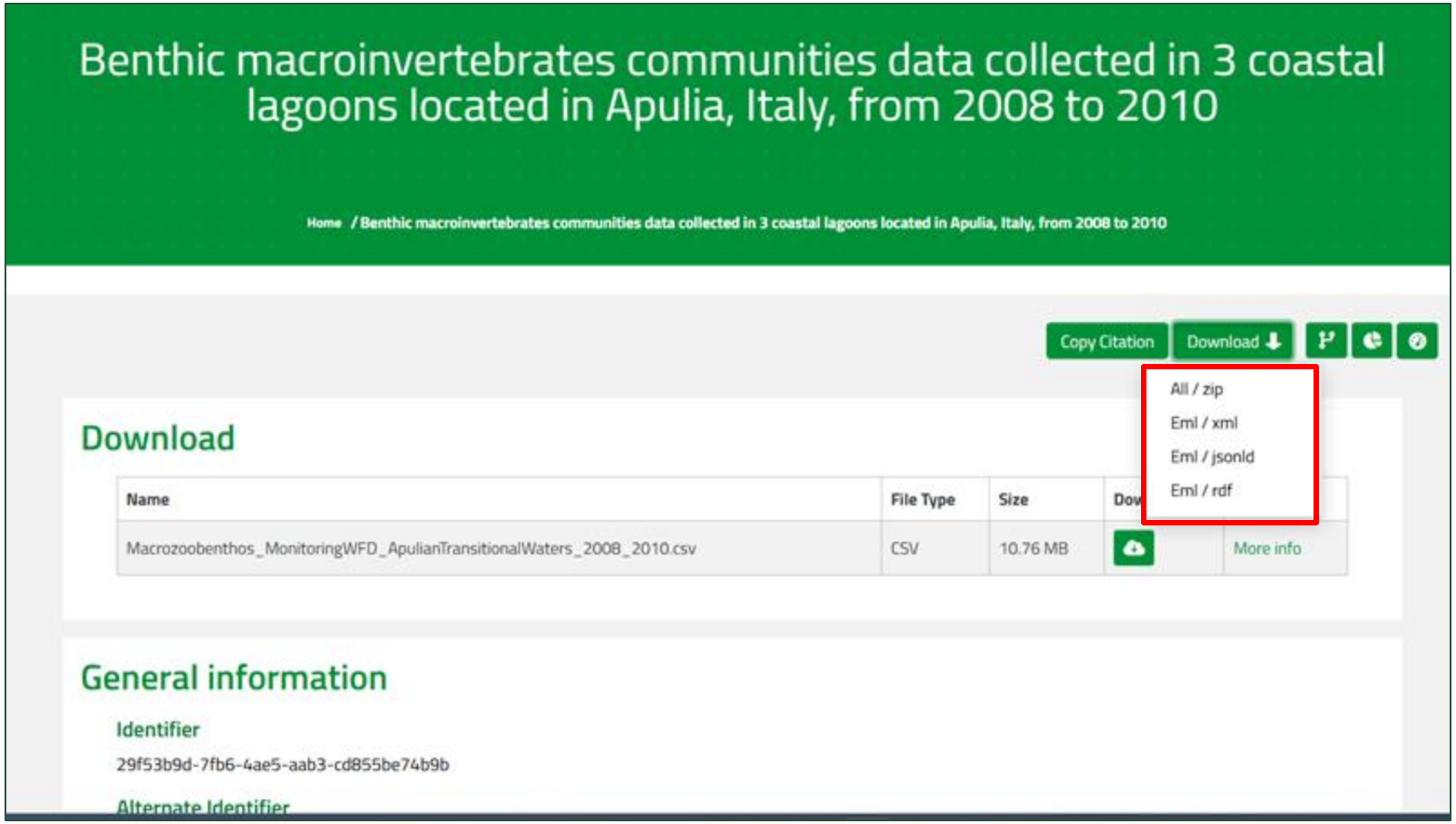
Researcher



Data Basis, Data Flow, Data Providers

Researcher

LifeWatch Italy Data Portal



Data Basis, Data Flow, Data Providers

Researcher

LifeWatch ITALIA
Data Portal

↓

LifeWatch ITALIA
Metadata Catalogue

↓

LifeWatch ERIC
Metadata Catalogue

↓

eosc

Metadata are harvested in the Metadata Catalogue of LifeWatch Italy and to LifeWatch ERIC one.

The metadata catalogue of LifeWatch ERIC is already a node of EOSC and data will be findable, accessible and discoverable by a wider community.

"The Earth Talks"

GEO GLOBAL FORUM

ROME, Italy **5-9 MAY, 2025**

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The DiSSco – RI project: capabilities, data, and services

Vanni Moggi Cecchi, Lorenzo Cecchi & Gianna Innocenti

University of Florence - Museum System

Curators, National node representatives

UNIVERSITÀ DEGLI STUDI FIRENZE | Sistema Museale di Ateneo

General Overview

DiSSco (Distributed System of Scientific Collections) is a new world-class Research Infrastructure (RI) for Natural Science Collections.

It aims to create a new business model for one European collection that digitally unifies all European natural science assets, sharing common access, curation, policies and practices across countries while ensuring that all the data complies with the FAIR principles (Findable, Accessible, Interoperable and Reusable data).

DiSSCo enters in 2024 its Transitional Phase, an exciting 18-month prelude to the final Construction stage that will culminate with DiSSCo becoming an ERIC (European Research Infrastructure Consortium).

General Overview

From here, DiSSCo aspires to:

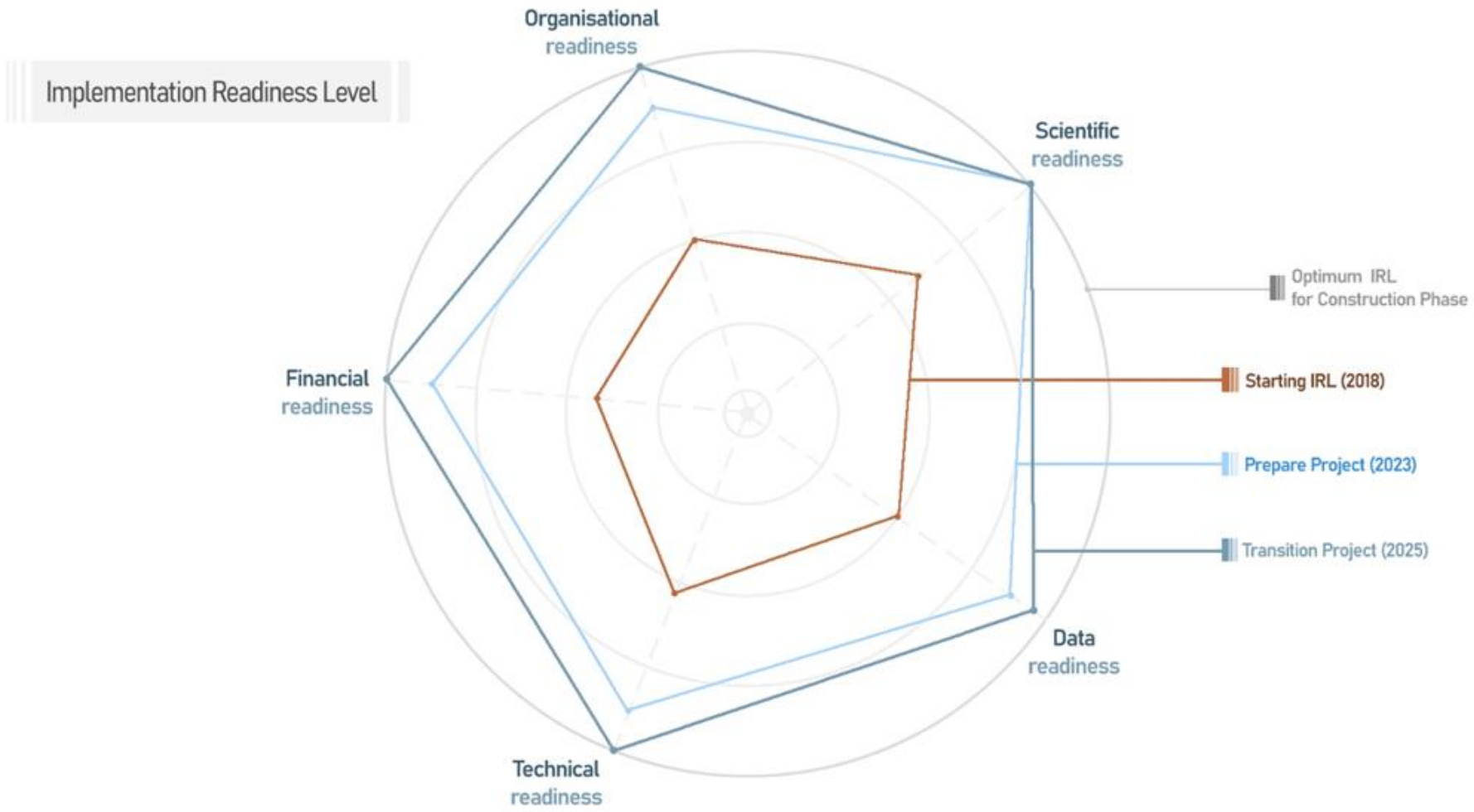
- ***Create a one-stop e-science infrastructure providing discovery, access, interpretation, and analysis of complex linked data.***
- ***Provide end-user services such as digitisation on demand, research support and training activities to address current community limitations.***
- ***Optimise collection access, curation and management practices in individual institutions, enabling strategies under a common research agenda.***
- ***Accelerate digitisation, taking the current workflows to an industrial scale.***
- ***Permanently link representations of digital specimens to their attributes across distributed digital resources, thus ensuring robust science.***
- ***Reduce the global carbon footprint with digital collections access that will reduce international trips and global shipments of specimens.***
- ***Improve efficiency, facilitate economies of scale, make natural science research more responsive and resilient to urgent needs and accelerate biodiversity discovery.***

General Overview

Other aims of the project:

- Support and improve both physical and digital access to European Natural Scientific Collections (NSCs)
- Enable and support industrial scale digitisation of the collections
- Provide enhanced interpretation, curation, annotation and use of specimen data by novel, machine-actionable mechanisms

The DiSSco development:



The DiSSco development:

General Overview

The present project:
DiSSCo Transition consists of five targeted Work Packages (WP) covering all the project's dimensions. Each WP will generate a varied output of milestones and deliverables (reports, analyses and actionable recommendations). These deliverables will become living documents reflecting DiSSCo's continuous planning and stewardship.

General Overview

The 5 work packages:

- WP1: ERIC Roadmap and Policy Framework
- WP2: National Nodes Engagement and Inclusion
- WP3: Data Infrastructure and Core Services
- WP4: International Collaboration on (Data) Standards
- WP5: Management, Communication and Outreach

General Overview

The 5 work packages:

- WP1: ERIC Roadmap and Policy Framework: 5 implementation rules (GA RoP, EB ToR, NC RoP, SETAB RoP), 5 policies (Data, Access, IPRs, Emplyment & Procurement)
- WP2: National Nodes Engagement and Inclusion: starting from 8 countries aims to reach all 23 countries.
- WP3: Data Infrastructure and Core Services: authorization management (AAI, Authorization and Authentication Infrastructure). A prototype for massive quantitative analysys inside MAS (Machine Annotation System) Digital specimen architecture.
- WP4: International Collaboration on (Data) Standards
- WP5: Management, Communication and Outreach

Challenges and opportunities in utilizing DiSSco

Up to date existing documents and tools:

- AAI (The Authorisation and Authentication Infrastructure)
- CDD (Collection Descriptions Dashboard): make European natural history collections visible and discoverable and to highlight the institutional contributions
- DiSSCo Labs e-service (https://dissco.tech/labs/)
- ELViS (loans): a one-stop shop for access to the collections in Europe to request visits, loans and virtual access
- Modelling Framework
- Policy Self-assessment tool
- SDR (Specimen Data Refinery, for loans) combining technologies to harvest, organise, analyse and enhance information from other sources in a cloud-based platform for processing specimen images and their labels in order to extract essential data

Challenges and opportunities in utilizing DiSSco

Potential users:

- ***Small museums,***
- ***Researchers***
- ***Amateur scientists***
- ***General Public***

Policy-makers: CNR/MUR

Challenges and opportunities in utilizing DiSSco

A complete and wide overview of the project on the web:

https://www.dissco.eu/services/
https://www.dissco.eu/dissco-transition/project-outcomes/
https://know.dissco.eu/handle/123456789/7
https://www.dissco.eu/knowledge-area/
https://www.dissco.eu/dissco-transition/

DiSSCo - A New Frontier for Biodiversity Research - YouTube

National Node Overview

A wide and heterogeneous landscape

- 500+ owners (public/private)
  - Universities (38)
  - Municipalities (150+)
  - Schools (90)
  - Others (local institutions, libraries, religious institutions, associations, NGOs, NPs, private owners…)
- 750 headquarters
- 1300 macro-collections
- 30+ Mln specimens

National Node Overview

2018

Maximum representativeness…

The Italian Consortium

1. **UNIFI-SMA**, Sistema Museale dell'Università di Firenze - Leader
2. **CNR**, Consiglio Nazionale delle Ricerche
3. **AXL**, Accademia Nazionale delle Scienze detta dei XL
4. **ANIE**, Accademia Nazionale Italiana di Entomologia
5. **ANMS**, Associazione Nazionale Musei Scientifici
6. **SBI**, Società Botanica Italiana
7. **SIB**, Società Italiana di Biogeografia
8. **SGI**, Società Geologica Italiana
9. **SPI**, Società Paleontologica Italiana

National Node Overview

2025

… vs maximum effectiveness!

The DiSSCo-IT Joint Research Unit

1. **UNIFI-SMA**, Sistema Museale dell'Università di Firenze - Leader
2. **CNR**, Consiglio Nazionale delle Ricerche
3. **MUSE**, Science Museum of Trento
4. **UNIBO**, University of Bologna
5. **UNICAM**, University of Camerino
6. **UNIROMA1**, University of Rome (Sapienza)
7. **UNINA**, University of Naples
8. **UNITS**, University of Trieste

\+ ***Many others in the future…***

National Node Integration

- DiSSCO included in PNIR
  (National Plan for Research Infrastructures)
- Timeframe: 2021-2027
- No funds in 2025
- Joining the DiSSCo ERIC in 2026
- Italy temporarily excluded but a MoU will be signed to include Italy in 2026

Digitisation Progress

Overall funding 2022-2025

10-15 Mln €

- 200 k€ collection survey update
- 2-3 Mln € equipment
- 8-10 Mln imaging & databasing
- New acquisitions + mapping of old data
- 5+ Mln digitized specimens (~16%)

Digitisation Progress

Next Generation EU - PNRR

NBFC

National Biodiversity Future Center

- 30 institutions
- Research & conservation
- 10+ years
- “Digitization” under “Spoke 7 - Outreach”

Digitisation Progress

Next Generation EU - PNRR

ITINERIS

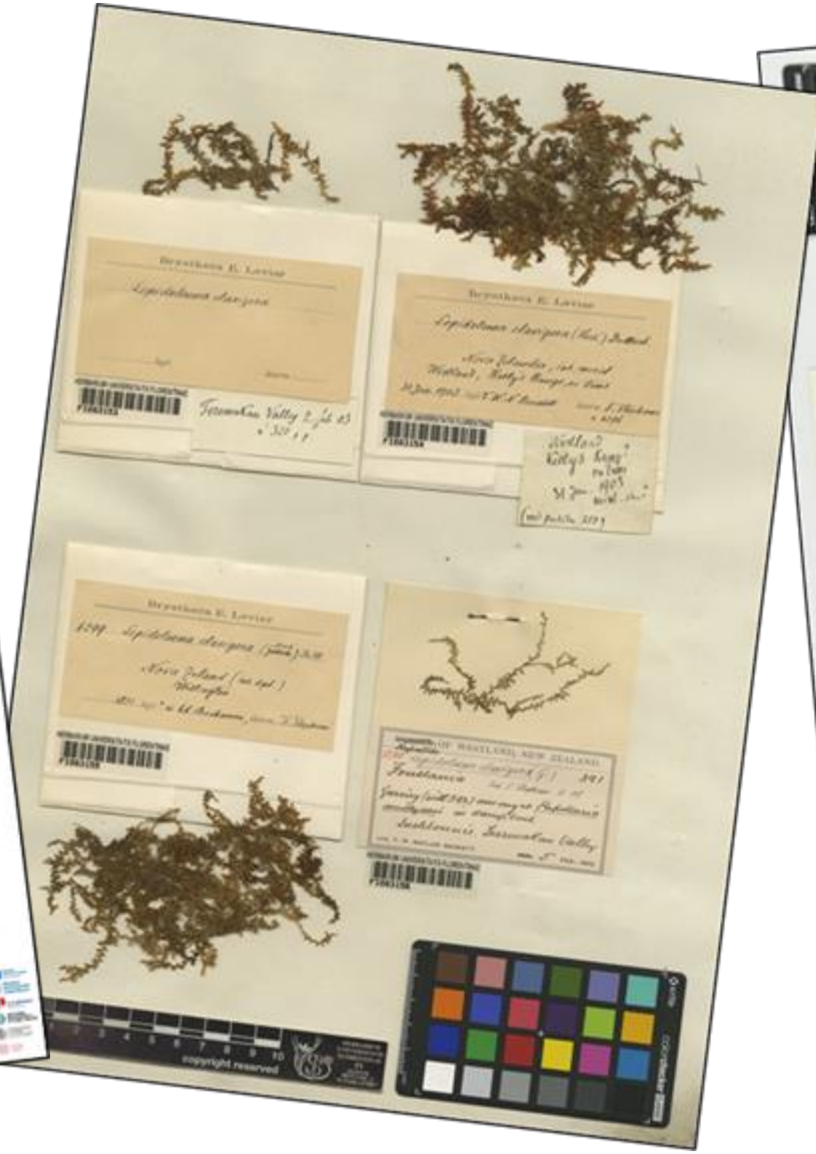
ITalian INtegrated Environmental Research Infrastructures System

- Environmental RIs networking
- Digitization from 3 DiSSCo Operational Units (UNIFI + CNR)
- Climate-related prioritization
- DiSSCo-IT formally recognised
- 80% funds for equipment

Digitisation Progress

Digitization training course

- 5 cities (Padua, Turin, Florence, Naples and Palermo)
- 145 attendees
- 3.500 MIDS2 specimens
- Datapaper under construction…

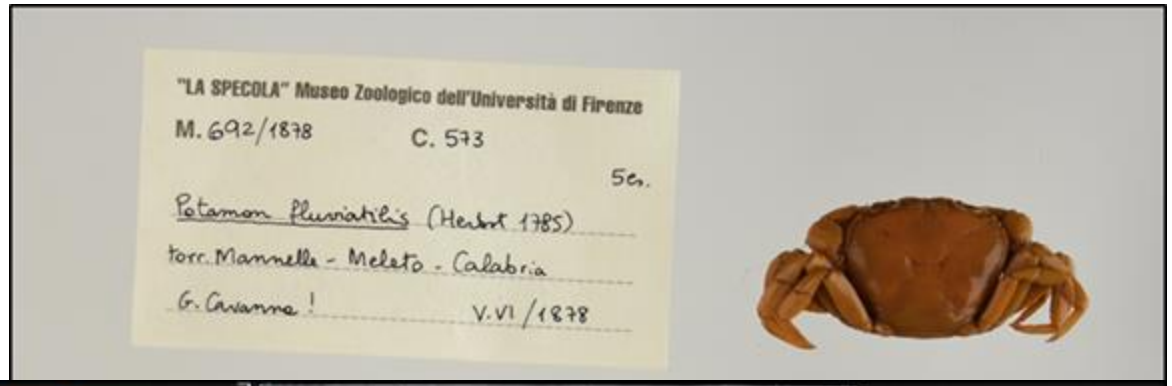

Platanthera bifolia Rich.
TOSCANA

Bryotheca E. Levier
copyright reserved

copyright reserved


UNIVERSITÀ DEGLI STUDI FIRENZE
MZUF-VER
Sistema Museale di Ateneo
Museo di Storia Naturale
Coll. R.Verity-Entomologia
0 1 2 3 4 5
cm
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione R. Verity – Entomologia
MZUF-VER-B0082


12435
12436
12438
12437
"La Specola" - Museo Zoologico dell'Università di Firenze
M. 1042
C. 12435-12438
Chondrostoma genei (Bp.)
Fiume Panaro (Modena), IV-18
viaggio del prof. E.H. Giglioli. Ju
comunic. dal Mus. Zool. R. Univ. Moden
P.G. Bianco det. XII - 1985
colorchecker CLASSIC
UNIVERSITÀ DI FIRENZE - MUSEO ZOOLOGICO DELLA SPECOLA
1506
1519
1520
1521
1522
1523
"LA SPECOLA" Museo Zoologico dell'Università di Firenze
UNIVERSITÀ DEGLI STUDI FIRENZE
MZUF-AMP
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione batracologica
0 1 2 3 4 5
cm
UNIVERSITÀ DI FIRENZE - MUSEO ZOOLOGICO DELLA SPECOLA
Coll. 6007
Charadrius alexandrinus alexandrinus dimorph
Nizza, Provence, FRANCIA
Leg. Acq. dei Fratelli Gal
UNIVERSITÀ DEGLI STUDI FIRENZE
MZUF-AVE
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione ornitologica
0 1 2 3 4 5
cm

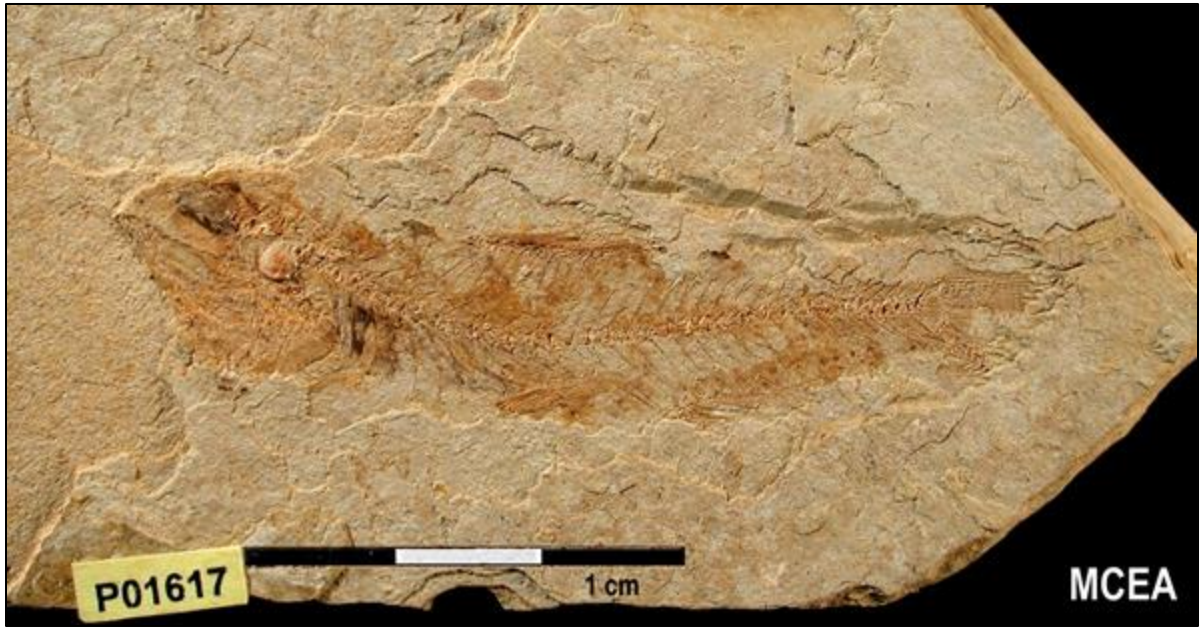

UNIVERSITÀ DEGLI STUDI FIRENZE
MZUF-GC
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione malacologica
0 1 2 3 4 5
cm
Museo Zoologico "La Specola" - Università di Firenze
M. 1/1898
C. 1645
Echinia vermiculata (Müller, 1774)
N. cm. 5.: 4
COTE D'AZUR: CAPO MARTIN - FRANCIA
Legit BONFILS, II/ 1887
GIANFANELLI S. DIST. 2004
dono PAULUCCI M.
Riviera del Capo Martin 9 me N. M.a Bon fils, Febbraio 1887
calibrite
colorchecker CLASSIC
12/22
mm


"LA SPECOLA" Museo Zoologico dell'Università di Firenze
M. 692/1878
C. 573
5es.
Potamon fluviatilis (Herbst 1785)
torr. Mannella - Melato - Calabria
G. Cavanna !
V.VI /1878


UNIVERSITÀ DEGLI STUDI FIRENZE
MZUF-AN
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione Anellidi
12/22
mm
MZUF AN 2336


calibrite
colorchecker CLASSIC
12/22
mm
"LA SPECOLA" Museo Zoologico dell'Università di Firenze
M.
C. 371
Ophiolepis superba (H.L.Cl) 1es.
Mogadishu, Somalia
S.B.S.!
XII 1976
Ophiolepis
Superba H.L.Cl.
Mogadishu
det. E. Tortonese


3321-I
UNIVERSITÀ DEGLI STUDI FIRENZE
MSN-MIN
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione Mineralogica
0 1 2 3 4 5
cm


P01617
1 cm
MCEA


10 cm
Museo Civico D. Dal Lago
N. CDL 2
Paronuter cupuliformis Abbagni
Età Cretacico superiore
Località Novale (Valdagno, VI)
Collezione D. Dal Lago


3325-I
UNIVERSITÀ DEGLI STUDI FIRENZE
MSN-MIN
Sistema Museale di Ateneo
Museo di Storia Naturale
Collezione Mineralogica
0 1 2 3 4 5
cm

Digitisation Progress

Expected outcomes

5+ Mln digitized specimens

- 40+ institutions involved
- 4.350.000 specimens imaged + MIDS2
- 200.000 imaged + MIDS1
- ? 500.000 data from pre-existing DBs

Collaboration with National Authorities & Next steps

- CNR/MUR in the FF
- Strengthening the CNR-MUR contact toward the ERIC process step 2
- First DiSSCo-JRU assembly held in April 2025
- Joining GBIF as a Country

Lessons learned so far

The knowledge base…

1. Accept the limits:
   Digitizing ≠ Replacing
1. You cannot had the best, if you do not know the minimum:
   Institutions > Collections > Specimens
1. Just a box can be better than nothing…

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