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ITINERIS

Italian Integrated Environmental Research Infrastructures System

2nd ITINERIS General Meeting

POSTER SESSION

Rome 10 July 2024

We are pleased to present this collection of 108 posters, the result of the work by researchers, technologists and collaboratorsof the ITINERIS project. These posters provide an overview of the activities and results achieved so far, representing an opportunity for sharing and discussion.

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Analysis of the Mediterranean outflow in the eastern North Atlantic basin using Argo float data

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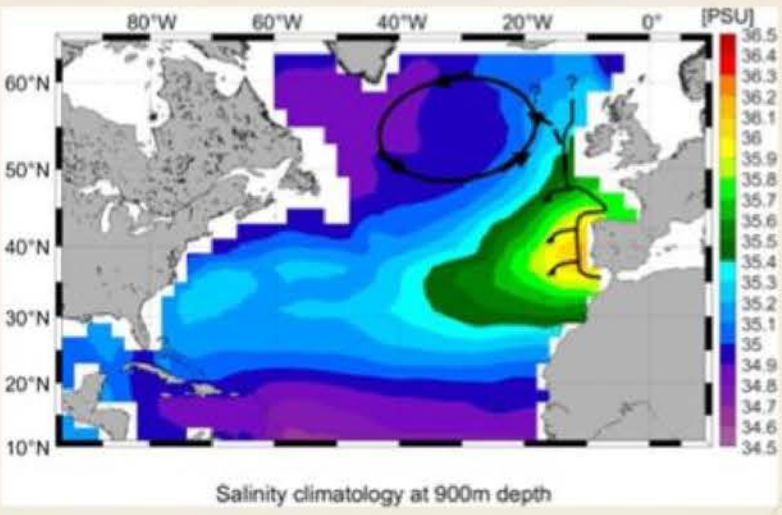

Figure 1: Schematic MOW circulation, superimposed on a map of the mid-depth climatological salinity field (source: Sea Data Net).

INTRODUCTION:

The Mediterranean Outflow Water (MOW) is a warm, saline water mass formed by the mixing of the North Atlantic Central Water with the Mediterranean overflow water. Its northward penetration into the eastern North Atlantic basin has drawn interest due to the hypothesis that it is a source of heat and salt for high-latitude waters. Previous studies suggest that the intrusion of this water mass into the subpolar gyre and its subsequent spreading toward the northern regions of the Atlantic basin is influenced by the position of the polar front, which fluctuates with the North Atlantic Oscillation (NAO).

In this work, we use Argo float-derived salinity data as an indicator of the MOW pathway in 2018, which is characterized by a positive NAO index, and 2019, which is characterized by a positive NAO index.

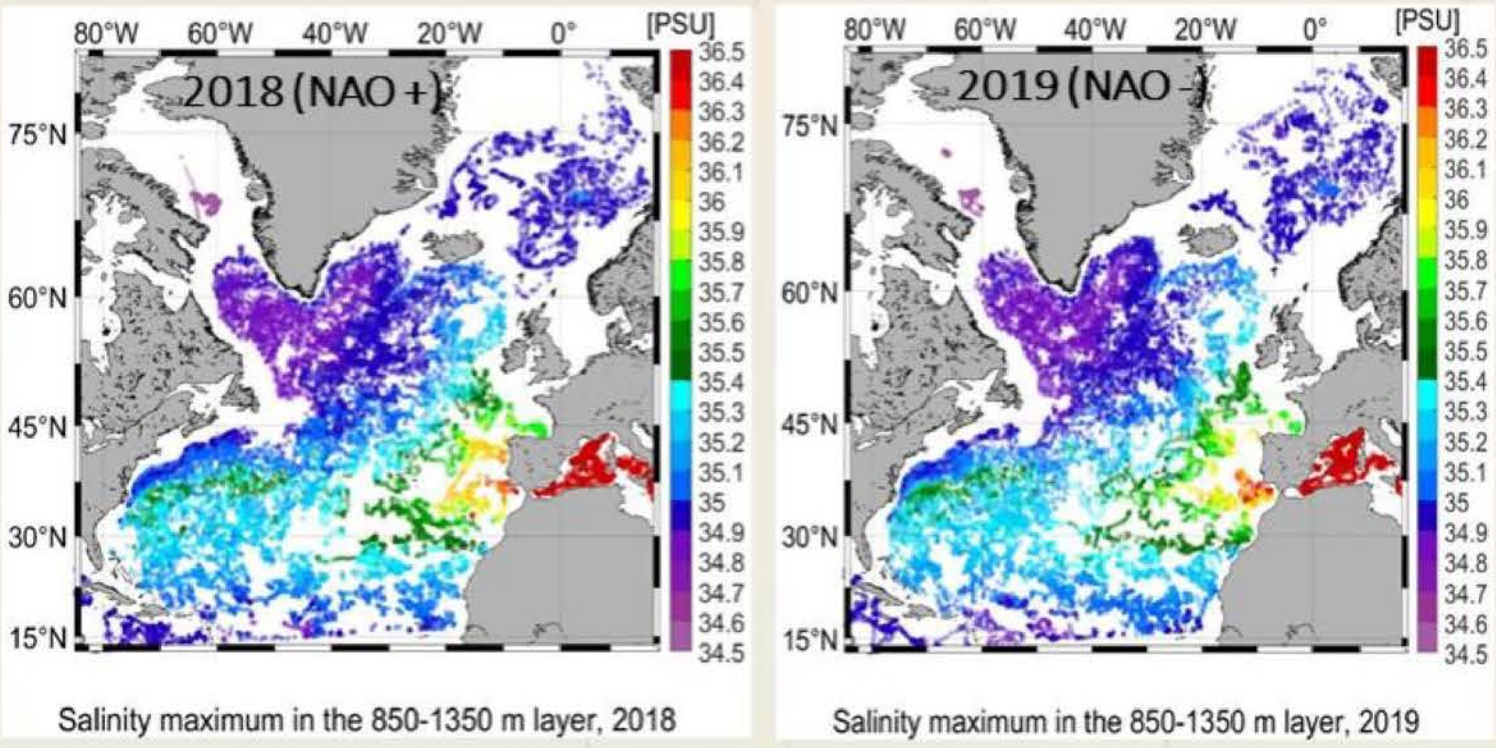

Figure 2: Horizontal scatter plot of the salinity maximum, derived from Argo float profiles in the 850-1350 m layer (2018 and 2019).

RESULTS:

Salinity maximum NAO+:

- Reduced northward extension along the eastern boundary of the North Atlantic (Figure 2 left panel)
- Lower values in the region south of Iceland
- Detected at shallower depths (Figure 3, left panel)

This suggests that the northward flow of MOW might have been blocked by the eastward shift of the polar front, associated with NAO + .

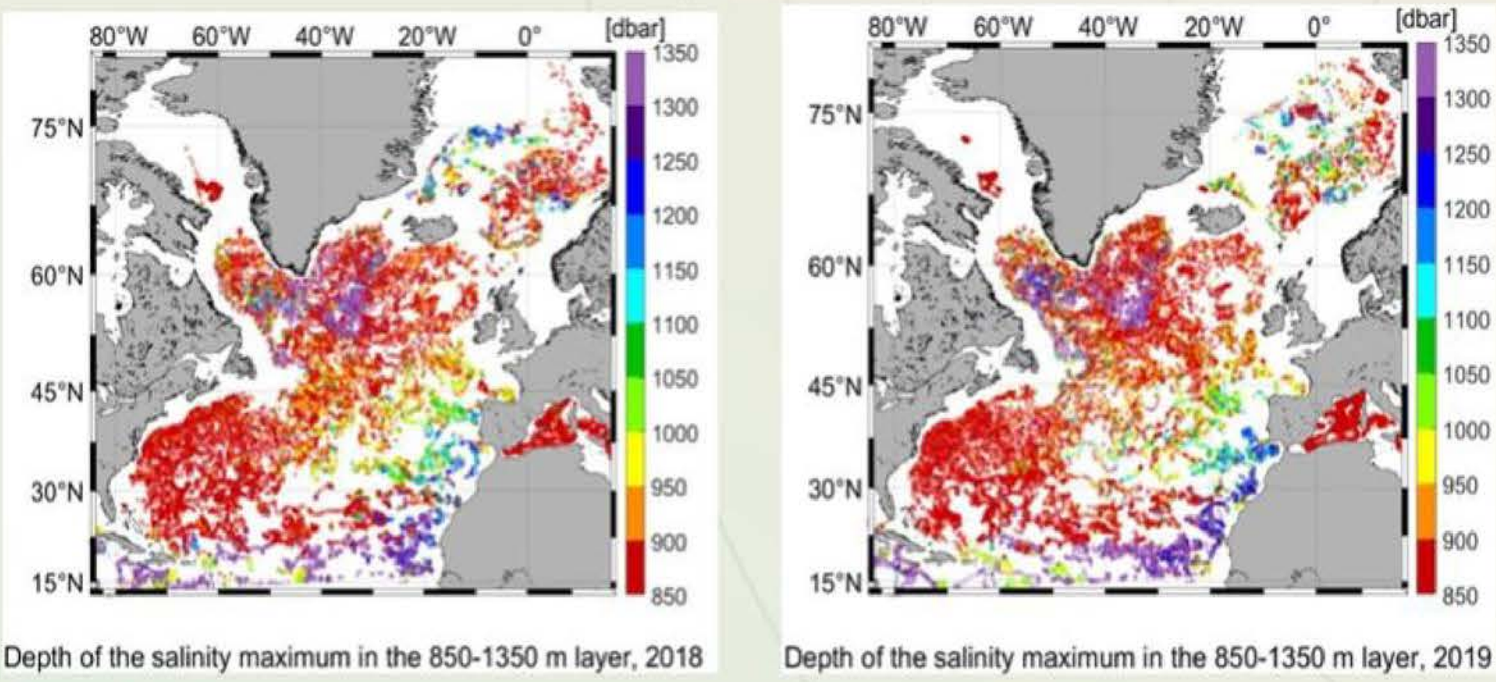

Figure 3: Horizontal scatter plot of the depth of the salinity maximum, derived from Argo float profiles in the 850-1350 m layer (2018 and 2019).

Salinity maximum NAO-:

- Larger northward extension along the eastern boundary of the basin
- Higher values in the region south of Iceland
- Detected at greater depths (Figure 3, right panel)

This suggests that the westward shift of the polar front, associated with NAO-, likely allowed a greater northward penetration of MOW.

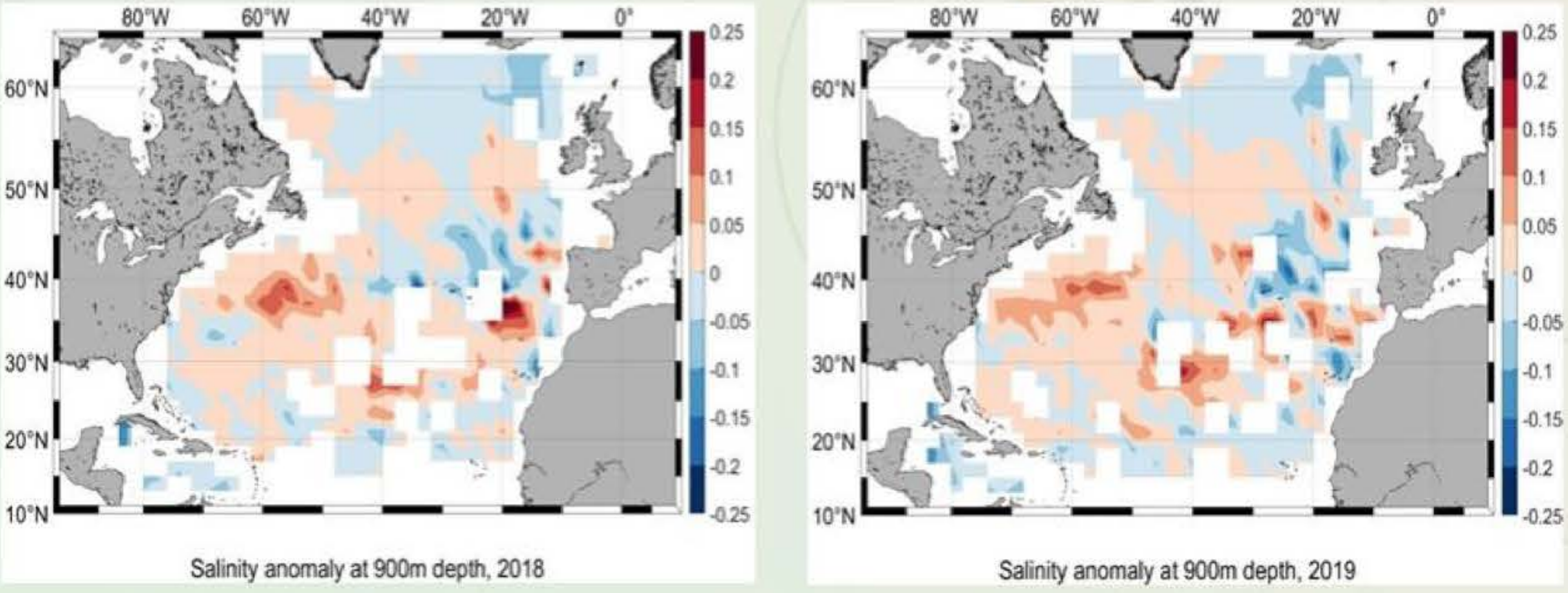

Figure 4: surface plot of the salinity anomalies at mid-depths (2018 and 2019).

Salinity anomaly in 2018 (NAO+):

- The Labrador Sea exhibits mostly positive salinity anomalies
- Greater positive anomalies are observed in the subtropical region of the North Atlantic basin

Salinity anomaly in 2019 (NAO-):

- The Labrador Sea is mainly characterized by negative salinity anomalies
- The positive anomalies are spread further north

FUTURE STEPS:

further analysis will be extended to the entire dataset of Argo float profiles available for the North Atlantic basin, from 2001 to 2020, to establish the potential role of MOW on the convective processes in the Labrador and Irminger Seas.

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Improving Copernicus L4 SST regional products with CIMR observations

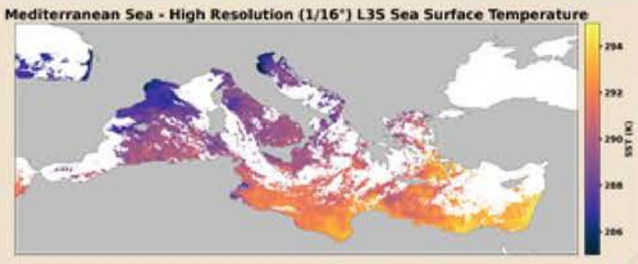
Mattia Sabatini[1,2], Andrea Pisano[2], Claudia Fanelli[2], Bruno Buongiorno Nardelli[2], Gian Luigi Liberti[2], Rosalia Santoleri[2], and Daniele Ciani[2]

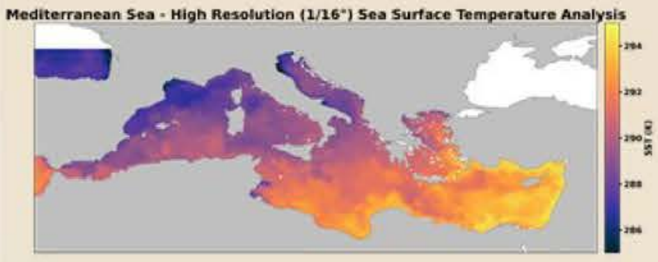
1 - Università di Napoli « Parthenope », Italy

2 - Consiglio Nazionale delle Ricerche - Istituto di Scienze Marine (CNR-ISMAR), Italy

COPERNICUS MEDITERRANEAN SST PRODUCTS

The National Research Council (CNR) provides daily maps of merged, multi-sensor (L3S) and gap-free (L4) SST over the Mediterranean Sea at 1/16° and 1/100° spatial resolution.



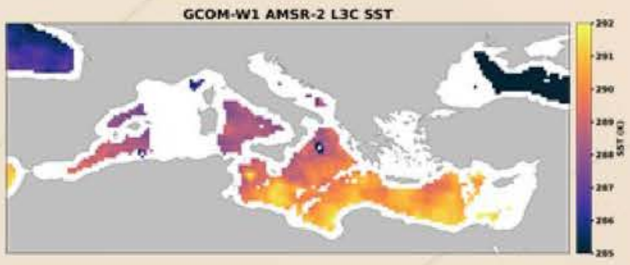


These products are based on data from IR sensors only.

INFRARED VS MICROWAVE SST RETRIEVAL

INFRARED

- ✓ High resolution (~1 km)
- x No retrieval with clouds



MICROWAVE

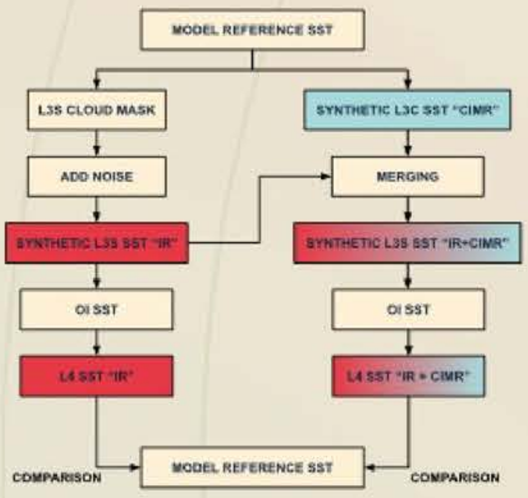
- ✓ Nearly all-weather
- x Low resolution (~25 km)

The Copernicus Imaging Microwave Radiometer (CIMR) will provide near-all-weather SST with spatial resolution 10-15 km
How the Copernicus Marine Service SST processing chain can benefit from this?

NUMERICAL STUDY BASED ON MODEL OUTPUTS: OBSERVING SYSTEM SIMULATION EXPERIMENT

Model data: one year (2017) of daily SST from the Copernicus Mediterranean Sea Physical Analysis and Forecast model (1/24°)

Synthetic IR L3S SST
We simulate the multi-sensor IR SST applying Copernicus L3S cloud mask and radiometric noise to the model SST

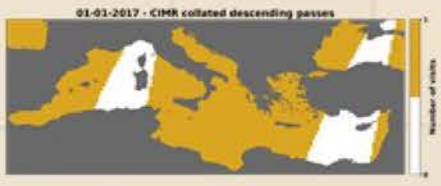


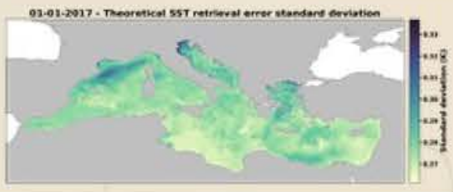
Merging IR and CIMR
CIMR SST is first remapped to the model grid, leaving gaps every 2 pixels

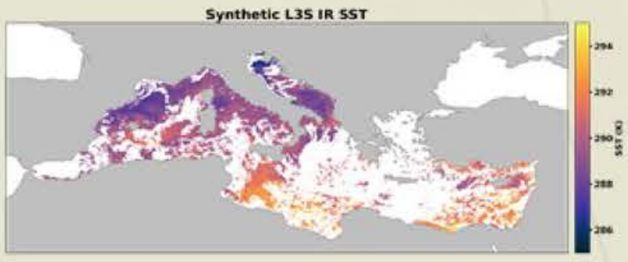
Optimal interpolation (OI) algorithm from CNR processing chains

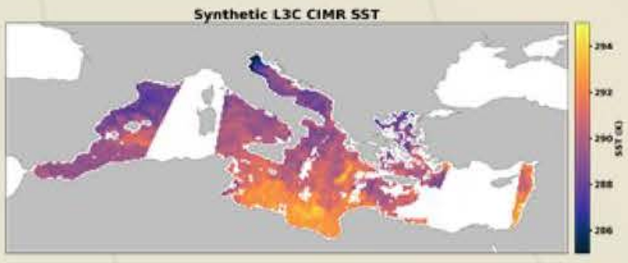
Synthetic CIMR L3C SST

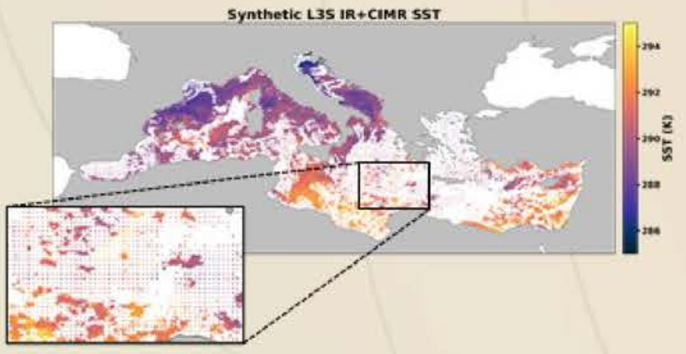
- CIMR coverage data computed with ESA tool "RevisitTime", descending passes only
- Half-hourly precipitation rate from Integrated Multi-satellitE Retrievals for GPM (IMERG) dataset
- Theoretical SST retrieval error from Kilic et al., 2018







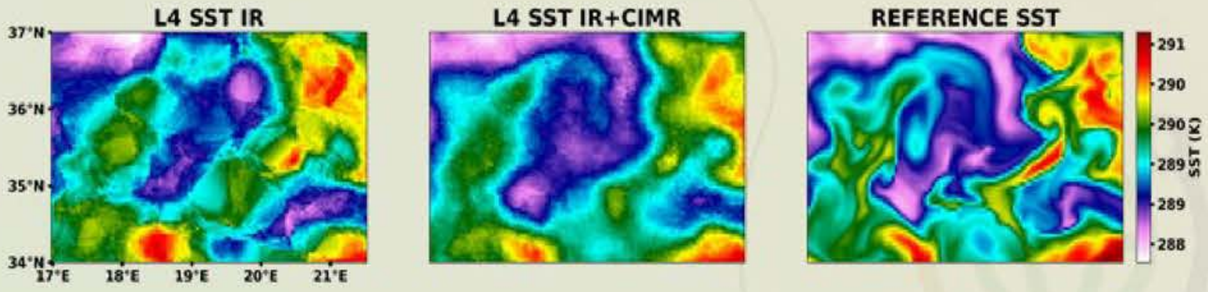




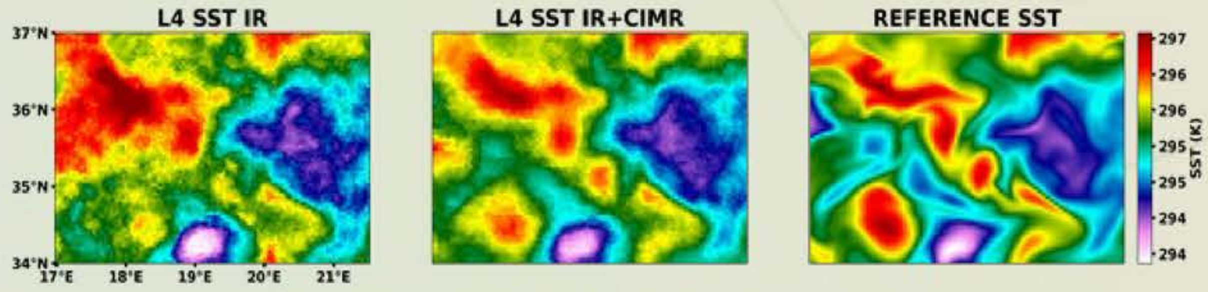
PRELIMINARY RESULTS

Detail of the comparison between daily SST analysis and reference SST

22/01/2017



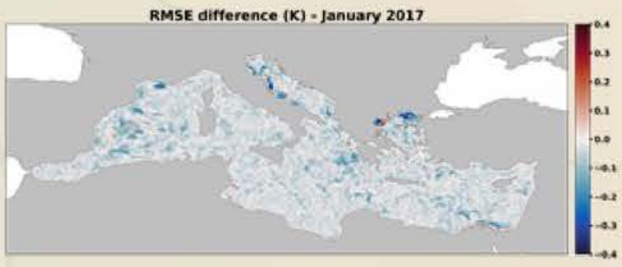
06/06/2017

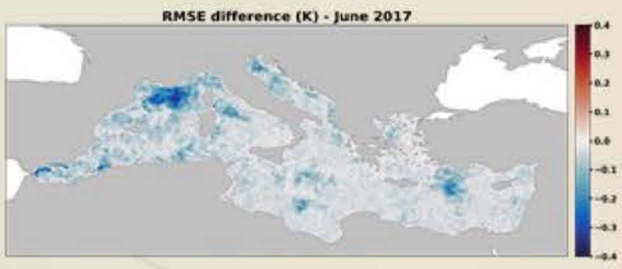


Greater consistency with reference SST when CIMR is included in the OI algorithm

Variation of RMSE in January when CIMR is added

Blue = improvement due to CIMR





Future works:

- Analysis of improvements as function of coast distance and cloud coverage
- Sensitivity studies
- SST gradients analysis

REFERENCES:

Buongiorno Nardelli, Bruno, et al. "High and Ultra-High resolution processing of satellite Sea Surface Temperature data over Southern European Seas in the framework of MyOcean project." Remote Sensing of Environment 129 (2013): 1-16.

Kilic, Lise, et al. "Expected performances of the Copernicus Imaging Microwave Radiometer (CIMR) for an all-weather and high spatial resolution estimation of ocean and sea ice parameters." Journal of Geophysical Research: Oceans 123.10 (2018): 7564-7580.

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Ecological and evolutionary approaches to the study of cancer cell populations: a first assessment of the state-of-the-art

Alessandro Fiore[1], Grazia Bramato[1], Giulia Girolimetti[1], Cecilia Bucci[2] & Alberto Basset[1,3]

[1]Department of Biological and Environmental Sciences and Technologies (DiSTeBA), University of Salento, Lecce, Italy;
[2]Department of Experimental Medicine (DiMeS), University of Salento, Lecce, Italy;
[3]Italian National Research Council (CNR), Institute for Research on Terrestrial Ecosystems (IRET), Lecce, Italy

Introduction

Human tumor cell populations are comparable to communities of individuals within an ecological system, allowing for the application of ecological theories in cancer research [9]. The exploration of group phenotypic composition in cancer - hallmarks of cancers - has highlighted the impact of individual cell traits on the fitness of both the cell and the population, to understand new perspectives on tumor progression and metastasis (Figure 1A) [5,11]. Here, we want to illustrate how certain ecological theories can be applied to study some characteristics of tumor cell populations, in particular metabolism and the tumor microenvironment (TME).

Metabolic Theory of Ecology

Metabolic Theory of Ecology (MTE) proposes that an organism's metabolic rate is the fundamental biological rate that influences ecological patterns [3].

In cancer, this theory aligns with the Warburg effect — a phenomenon where cancer cells exhibit altered metabolism, favouring rapid growth even in hypoxic environments [1,13].

Similarly, allometry in mammals demonstrates how traits like heart rate and brain size scale with body size [2]. This reflects the pivotal role of metabolism in biological and ecological processes where resource availability drives population dynamics (Figure 1B) [4].

Niche Construction Theory

Niche Construction Theory (NCT) suggests that organisms modify their own and each other's niches, which in turn affects the selection pressures they experience [10].

Cancer cells play a crucial role in the human organism analogous to keystone species in ecosystems (i.e. beavers acting as ecosystem engineers by building dams) (Figure 1C) [8].

They engage in niche construction by modifying the tumor microenvironment (TME), promoting angiogenesis, and evading immune improving survival and reproduction chances [7,12].

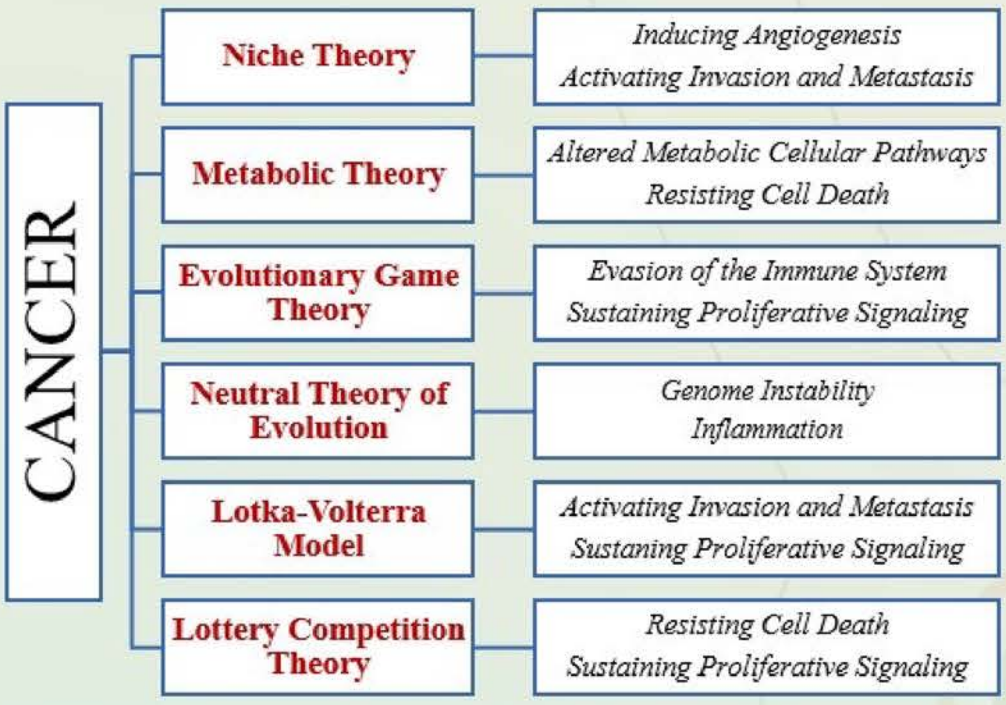

Figure 2. Cancer cell phenotypes (cursive) seen through the lens of ecological and evolutionary theories (red).

Conclusions and future perspectives

The tumor could be compared to a new species that modifies the surrounding environment to satisfy its needs, using the resources and nutrients provided by the host. Analysing the evolutionary dynamics and ecological interactions of tumor cells with the microenvironment can lead to better understand the tumorigenesis: this could potentially bring development of new therapeutic approaches. To this end, we will use cell cultures of various types of tumors, each with different genetic and phenotypic characteristics and we will apply cellular and molecular biology techniques, and ecological models.

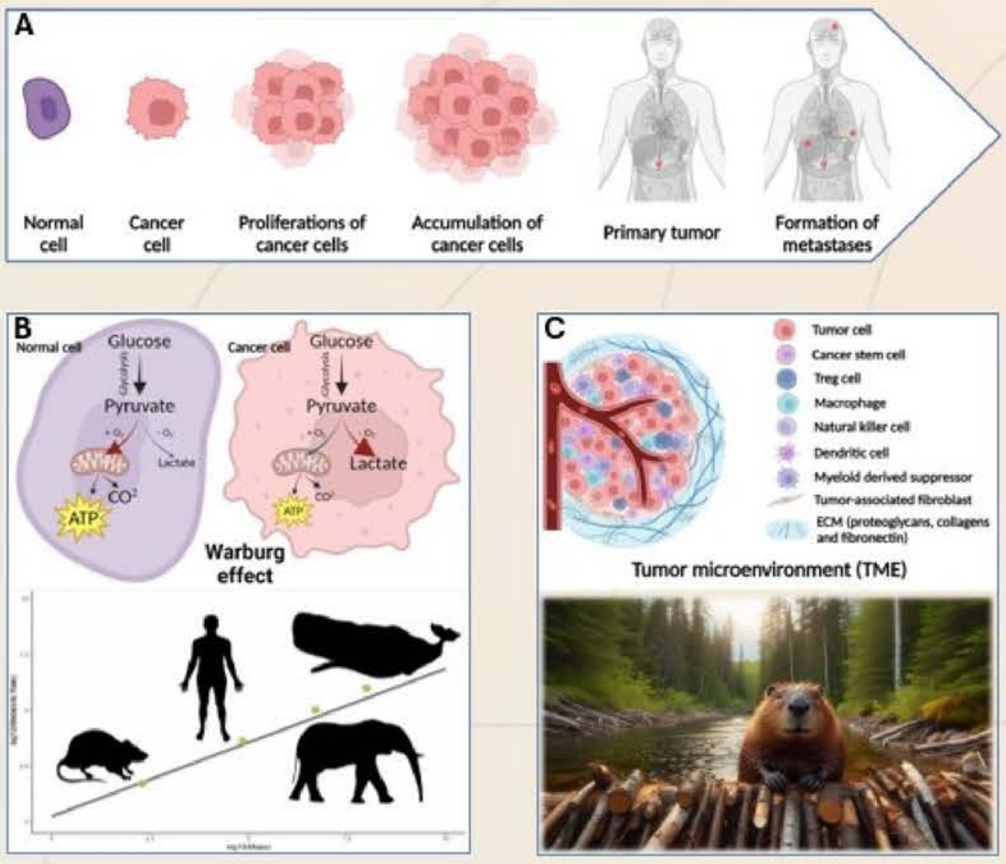

Figure 1. (A) The stages of cancer cell development, (B) parallelisms between Warburg effect in cancer cells and allometry in multiple mammal species, (C) comparison between the TME modified by cancer cells and the environment shaped by beavers.

Hallmarks of Cancer

The concept of hallmarks of cancer, proposed by Hanahan and Weinberg in 2000, serves as a heuristic tool to comprehend the vast complexity of cancer phenotypes and genotypes into a provisional set of underlying principles [5,6]. These hallmarks align with various theories (Figure 2):

Niche Theory: Cancer cells foster angiogenesis and modify their microenvironment to support invasion and metastasis.

Metabolic Theory: Cancer cells adapt their metabolism for growth and evade apoptosis.

Evolutionary Game Theory: Cancer cells employ immune evasion and proliferative strategies reminiscent of game theory.

Neutral Theory of Evolution: Genetic diversity in tumors arises from neutral mutations affecting genome stability and inflammation.

Lotka-Volterra Model: Describes cancer cell population dynamics during invasion and competition for growth resources.

Lottery Competition Theory: Cells resisting apoptosis or sustaining growth signals outcompete others, akin to winning a survival lottery.

Bibliography

1. Adler, F. R., Amend, S. R., Baratchart, E., & Whelan, C. J. (2022). From Ecology to Cancer Biology and Back Again. *Frontiers in Ecology and Evolution, 10*, 840375.
2. Brummer, A. B., & Savage, V. M. (2021). Cancer as a model system for testing metabolic scaling theory. *Frontiers in Ecology and Evolution, 9*, 691830.
3. Brown, J. H., Gillooly, J. F., Allen, A. P., Savage, V. M., & West, G. B. (2004). Toward a metabolic theory of ecology. *Ecology, 85*(7), 1771-1789.
4. Demetrius, L. A., Coy, J. F., & Tuszynski, J. A. (2010). Cancer proliferation and therapy: the Warburg effect and quantum metabolism. *Theoretical Biology and Medical Modelling, 7*, 1-18.
5. Hanahan, D. (2022). Hallmarks of cancer: new dimensions. *Cancer discovery, 12*(1), 31-46.
6. Hanahan, D., & Weinberg, R. A. (2000). The hallmarks of cancer. *cell, 100*(1), 57-70.
7. Ibrahim-Hashim, A., Gillies, R. J., Brown, J. S., & Gatenby, R. A. (2017). Coevolution of tumor cells and their microenvironment:"niche construction in cancer". *In Ecology and evolution of cancer* (pp. 111-117). Academic Press.
8. Kareva, I. (2015). Cancer ecology: Niche construction, keystone species, ecological succession, and ergodic theory. *Biological Theory, 10*(4), 283-288.
9. Kotler, B. P., & Brown, J. S. (2020). Cancer community ecology. *Cancer Control, 27*(1), 1073274820951776.
10. Laland, K., Matthews, B., & Feldman, M. W. (2016). An introduction to niche construction theory. *Evolutionary ecology, 30*, 191-202.
11. Mazingi, D., & Lakhoo, K. (2023). Cancer Development and Progression and the "Hallmarks of Cancer". In *Pediatric Surgical Oncology* (pp. 1-15). Cham: Springer International Publishing
12. Qian, J. J., & Akçay, E. (2018). Competition and niche construction in a model of cancer metastasis. *PloS one, 13*(5), e0198163.
13. Shan, M., Dai, D., Vudem, A., Varner, J. D., & Stroock, A. D. (2018). Multi-scale computational study of the Warburg effect, reverse Warburg effect and glutamine addiction in solid tumors. *PLoS computational biology, 14*(12), e1006584.

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Evaluation of the CO_2 sequestration capacity of different land uses in the Alps, with a focus on mountain pasture encroachment by woody species.

Daria Ferraris [1)2)], Marta Galvagno [2)], Dario Papale [3)4)]
1) Università della Tuscia, 2) ARPA Valle d'Aosta, 3) CNR IRET

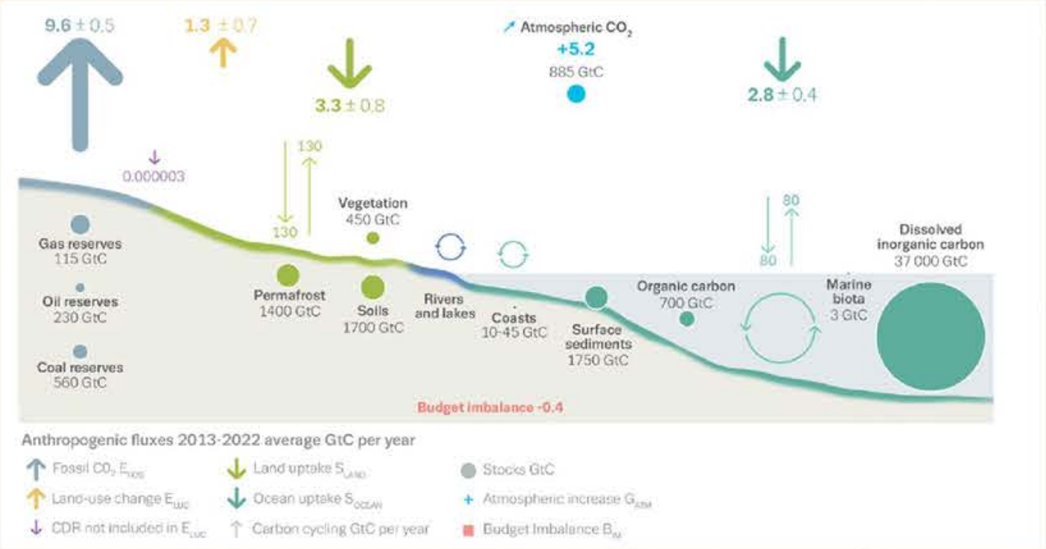


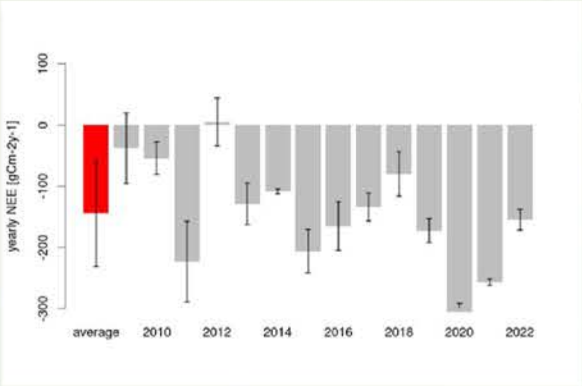
Figure: global carbon budget 2013-2022 [Lal R.]

Introduction: carbon sinks and carbon sources. Anthropogenic GHG emissions are increasing the concentration of CO2 in the atmosphere, leading to a rapid increase in Earth's surface temperature. Vegetation plays a crucial role in mitigating this effect by absorbing the excess CO2 from the atmosphere. Different ecosystem have different potential of carbon sequestration and land use change can influence this process. In particular, warming in the Alps is occurring twice as fast as in other regions of the planet and socio-economic changes have led to partial land abandonment, with effects on the C cycle.

Aim of the project: The aims of the PhD activity will be the comparison of CO2 sequestration in different ecosystems in the Alps.

Measurements data from alpine stations will be analysed and used to interpret the divergent ecosystem responses to meteorological variables. Concerning in particular the risk of transition of the role of Alpine ecosystems from carbon sink to carbon source.

Materials and methods: The Eddy covariance (EC) method will be used to measure carbon fluxes between the ecosystem and the atmosphere at three ecosystems: an abandoned pasture, a larch forest and an encraoched area. In June 2024 we started to install the new Eddy Covariance station on an abandoned pastureland under the encroachment by larch and shrubs (upper figure).



Net ecosystem Carbon Exchange (NEE) measurement from Torgnon pasture station showing large interannual variability (2008-2022).

Eddy covariance ARPA stations in Torgnon, Aosta Valley are settled in a pasture (ICOS IT-Tor) and in a forest (ICOS IT-TrF).

Conclusions: In recent decades in the Alps many pastures have been abandoned, so especially in our region it is important to study a phenomenon that could demonstrate a substantial influence on the carbon balance.

Lal R., 2017. Digging deeper: A holistic perspective of factors affecting soil organic carbon sequestration in agroecosystems.

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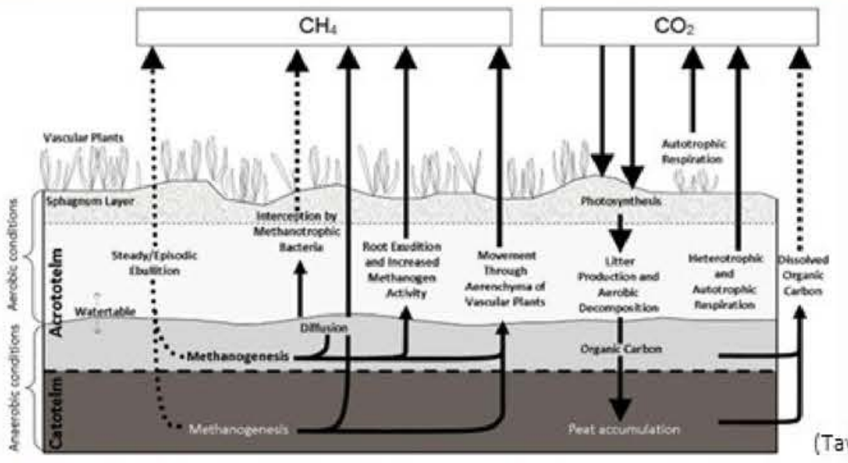
Experimental study of GHG flux dynamics at "Le Viote" alpine peatland (Italy), in a climate change view.

Laura Rubriante[1,2*], Damiano Gianelle[1], Dario Papale[3], Luca Belelli Marchesini[1]

[1]Forest Ecology Unit, Research and Innovation Centre, Edmund Mach Foundation, San Michele all'Adige (Italy)
[2]Department of Innovation in Biological, Agri–Food and Forestry Systems (DIBAF), University of Tuscia, Viterbo (Italy)
[3]Iret–Cnr (The Institute of Research on Terrestrial Ecosystems of the National Research Council)
* laura.rubriante@fmach.it

Why Study Peatlands?

- Peatlands are ecosystems whose soil is composed of peat (partially decomposed plant material due to the conditions of water-saturated soil) that are particularly threatened by climate change and anthropogenic activities
- Peatlands are important carbon stocks (about 30% of Earth's carbon), and sources or sinks of greenhouse gases (GHGs) like methane (CH_4) and carbon dioxide (CO_2)
- Climate change can alter fluctuations in space and time of peatland environmental drivers (temperature, soil moisture, water-table depth) and can make peatlands possible hot spots of GHGs emissions in the coming years
- Worldwide, around 12% of current peatlands are degraded and drained for human activities (like agriculture, forestry, mining), contributing to at least 4% of annual global human-induced emissions



(Taylor, 2014)

Variable	Mean ± std.dev	Unit	Year
NEE (Net Ecosystem Exchange)	180.7 ± 65.2	gC-CO_2 $m^{-2}yr^{-1}$	2012-2014
GPP (Gross Primary Production)	1191.0 ± 42.9	gC-CO_2 $m^{-2}yr^{-1}$	2012-2014
Reco (Ecosystem Respiration)	1307.7 ± 25.4	gC-CO_2 $m^{-2}yr^{-1}$	2012-2014
CH_4 (Methane flux)	3.2	gC-CH_4 $m^{-2}yr^{-1}$	2014
DOC (Dissolved Organic Carbon) export fluxes	10.9 ± 4.1	gC $m^{-2}yr^{-1}$	2014-2015
NECB *	**-194,8 ± 46,19**	gC $m^{-2}yr^{-1}$	
GHG budget **	**-281.2 ± 46,19**	gC-CO_2eq $m^{-2}yr^{-1}$	

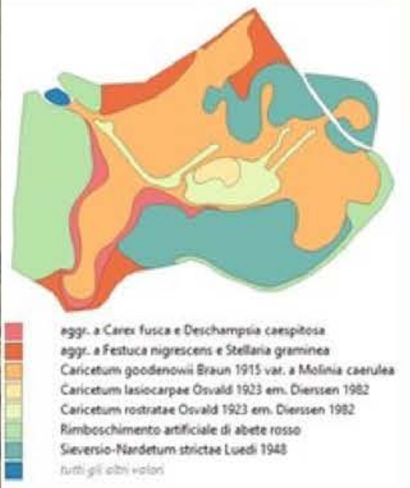
* NECB=-NEE-CH_4-DOC
** 100 yrs GWP CH_4 (IPCC, AR6)
*** CH_4 flux uncertainty not included in cumulative uncertainty

Research Goals

- To monitor the spatial and temporal dynamics of greenhouse gas (GHG) exchanges, namely of methane (CH_4) and carbon dioxide (CO_2), between the "Le Viote" peatland ecosystem and the atmosphere
- To analyze the response of GHG fluxes to water table depth variations and climate warming
- To produce an updated GHG budget assessment of the peatland site

Materials and Methods

- Area of interest: the alpine peatland "Le Viote" (46°01'07" N, 11°02'34" E), located in the middle of a plateau in the Mt. Bondone area, in the eastern Alps (Italy)
- The area is close to the ICOS Site IT-Mbo, an alpine grassland (~0.5 km)
- GHG fluxes measured through chamber based and micrometeorological techniques
- Climate variables measured by the meteorological tower in the middle of the peatland



- Taylor E.S. (2014). The Impact of Fire on Blanket Bogs: Implications for Vegetation and the Carbon Cycle.
- Pullens J.W.M. (2017). Measurements of the carbon, energy and water balance in an Italian alpine peatland and simulating the vegetation and carbon dynamics in three different peatlands. https://hdl.handle.net/10468/6482
- Carbognani M., Tomaselli M. & Petraglia A. (2023). Interactions and Covariation of Ecological Drivers Control CO_2 Fluxes in an Alpine Peatland. Wetlands, 43(5). https://doi.org/10.1007/s13157-023-01692-5

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Biodiversity and Ecological Resilience of *Quercus robur* (L.) in the Castelporziano Presidential Estate (Roma, Italy): Past, Present and Future

Nour Zaher, Elena Kuzminsky, Dario Papale, Paolo De Angelis

Science Technology and Biotechnology for Sustainability, 39th Cycle. University of Tuscia, Italy

Introduction

- Biodiversity and ecological resilience are vital for the sustainability of forest ecosystems, especially in the context of climate change and environmental stressors.

- This research leverages innovative biotechnology, advanced remote sensing technology, and comprehensive historical data analysis to enhance the understanding and monitoring of biodiversity.
- By examining the past, present, and future of *Q. robur*, this study provides a robust framework for future biodiversity preservation efforts and informs effective conservation strategies for sustainability.

General Objectives

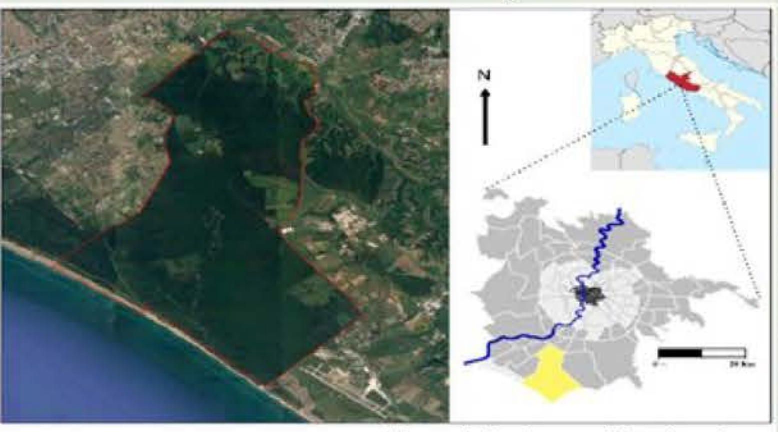
- Enhance the understanding of biodiversity and resilience of the most drought vulnerable oak species (*Q. robur*) in the Castelporziano Presidential Estate, to provide insights for future conservation strategies.
- Monitoring of biodiversity and analysing the *Q. robur* in the Castelporziano Presidential Estate using historical data and advanced Remote Sensing techniques.
- Develop effective vegetative propagation techniques to support the selection of specimens of *Q. robur* tolerant to environmental stresses.

Materials and Methods

Study Area

The Presidential Estate of Castelporziano (Roma, Italy)

- It is a state nature reserve listed among protected areas, is located 25 km from the center of Rome, Italy. Covering approximately (6000 ha), It is a unique reserve, ecologically and historically significant site, incredibly rich natural environment and varied cultural heritage.




(Recanatesi *et al.* 2020) Figure 1 - Study area of Castelporziano

- Castelporziano encompasses most of the coastal ecosystems typical of the Mediterranean environment region, making it a unique conservation area with a diverse array of flora.
- **Castelporziano is a hot spot for biodiversity.**
- The Mediterranean forest of Castelporziano is dominated by oak species, forming the backbone of the woodland ecosystem.

Figure 2 - Castelporziano oak forest

Methods

•Vegetative Propagation:

Techniques for epicormic shoot emergence and rooting.

•Micropropagation:

Forced flushing of branch segments for reactive explants.

•Historical Analysis:

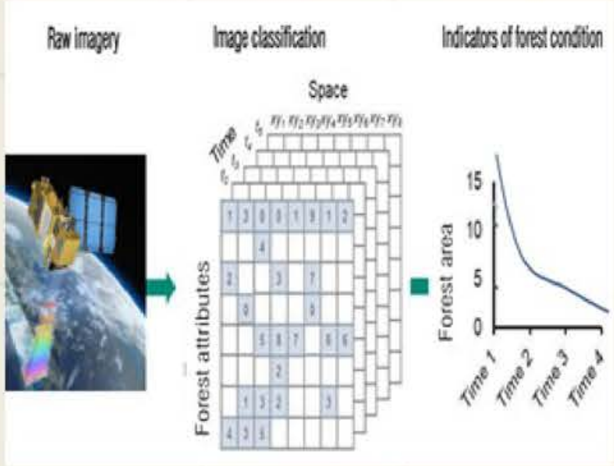
Utilization of satellite data to track historical conditions and identify *Q. robur* trees.

•Remote Sensing:

•Data sources, Image classification techniques, Mapping oak forests, change detection.

•Advanced technologies for monitoring biodiversity and detecting health decline rates.

•Assessment of the usefulness and value of remote sensing imagery products for monitoring applications.

•Characterization:

Monitoring biodiversity and tree health and morpho-physiological analysis.

•Propagation:

Re-experimentation based on monitoring results.

Research Infrastructures

- Remote Sensing techniques
- Field Surveys
- Biotechnology Laboratories
- Data Analysis

Conclusion

- This research not only contributes to the preservation of a critical species but also sets a precedent for integrating technological advancements with conservation methods.
- The findings will provide a robust framework for biodiversity preservation and inform strategies to ensure the long-term sustainability of oak woodlands.
- This holistic approach will be instrumental in shaping future biodiversity conservation efforts and promoting ecological sustainability in Mediterranean climate regions.

Acknowledgments

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Characterization of combustion-released SOA using an atmospheric-aging reactor, focusing on nucleation processess and anthropogenic-biogenic interactions

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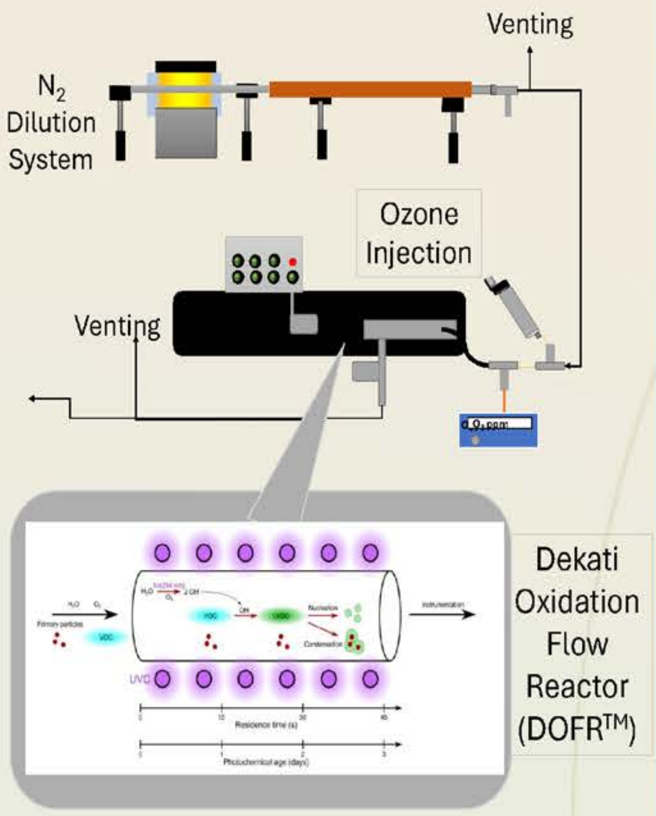
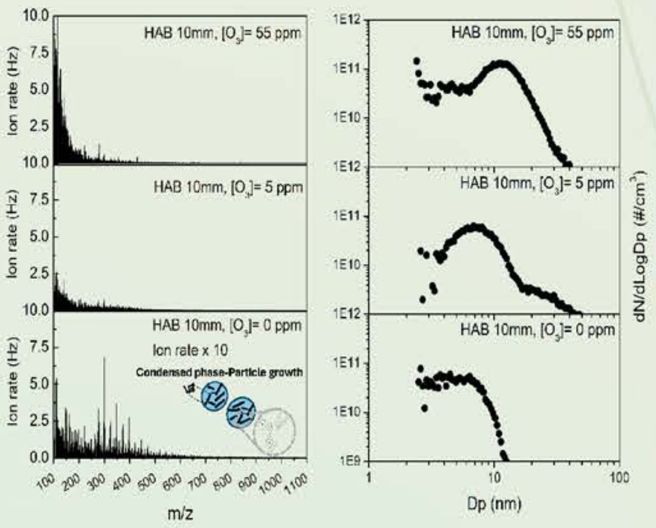
Combustion released aerosols represent one of the major sources of atmospheric pollution[1]. The characterization of flame-generated particles (Primary Aerosol- PA-) and the investigation of their evolution in the atmosphere (Secondary Aerosol-SA-) represent a crucial goal to reduce the anthropogenic impact on our planet as on our health[2].
For this purpose, different experimental setups were adopted. For each analysed condition, the morphological, chemical and optical characterization of the aerosol was performed by using HR-ToF-AMS, TSI-SMPS, DBAP5, Raman Spectroscopy and AFM.

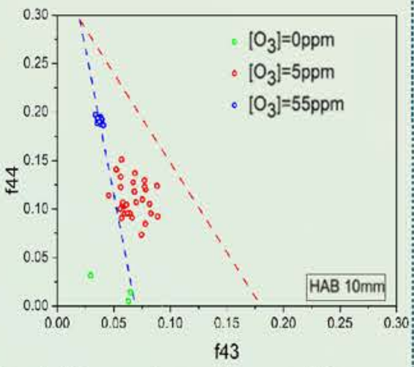
Undoped Laminar Premixed Flame



An ethylene/air flame with C/O=0.67 is characterized through mass spectra analysis and particle size distribution functions investigation.
An example of particles collected at 10mm from the burner (HAB) is reported below.



VK diagrams show that increasing HAB, oxidation is more evident. The same result can be noticed also in the triangular plots.

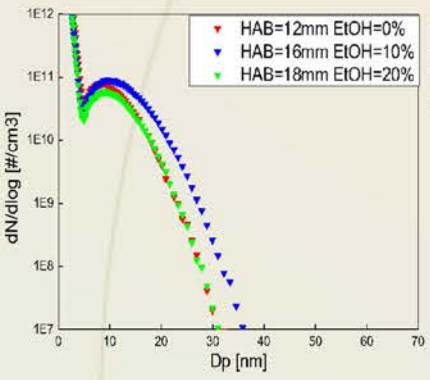


Additional info about this work can be read in: Sasso F., Picca F., Pignatelli A., Commodo M., Minutolo P., D'Anna A., *A laboratory study of secondary organic aerosol formation in an oxidation flow reactor*, Fuel, Volume 367, 2024, 131491, ISSN 0016-2361.

Doped Laminar Premixed Flame

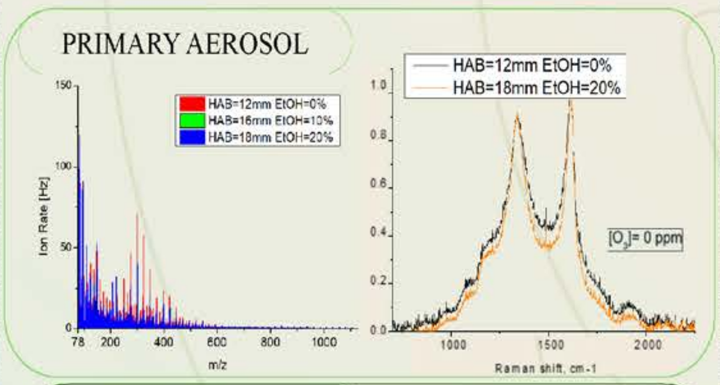
An experimental setup equal to the one adopted for the undoped flame, is implemented to obtain a 0, 10 and 20% bio-ethanol blended flame.

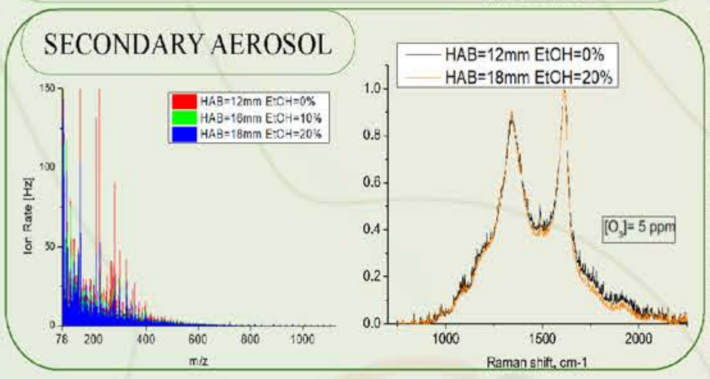
Φ	Air [L/min]	Ethylene [L/min]	Ethanol [L/min]	Ethanol [%]
2.010	14.570	2.051	-	-
2.010	14.570	1.846	0.205	10%
2.010	14.570	1.641	0.410	20%



A first comparison of the PSDs, highlighted the presence of some overlapping conditions characterized by morphologically similar particles.

Their evolution and aging in the atmoshere is simulated in the DOFR™.



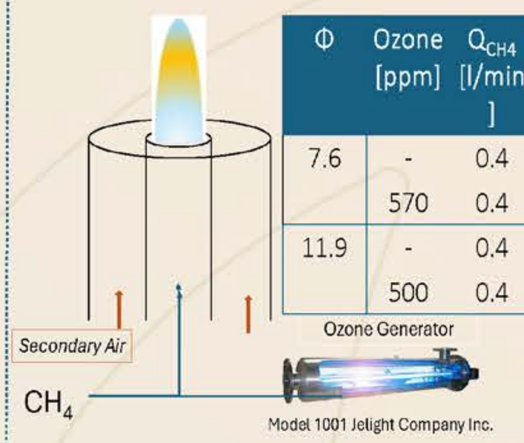


Moreover, the effects of ethanol addition on a co-flow diffusion flame are also investigated through a Mini Inverter Soot Generator. A direct correlation between EtOH blending and aromatic structures in the generated soot is noticed.

Conclusions and Further Steps:

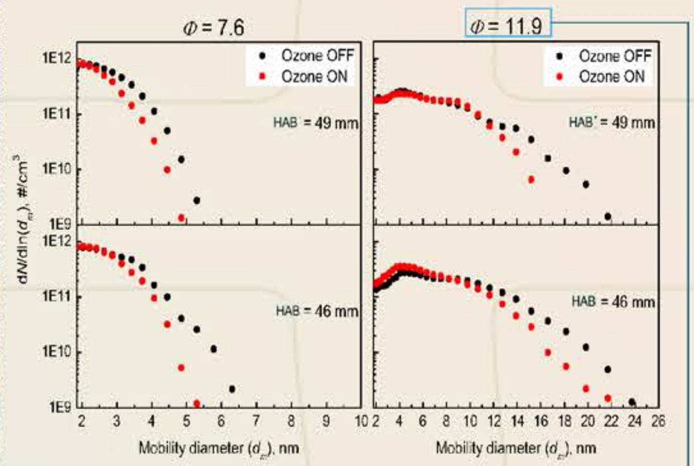
- Investigation of the toxicological potential of the flame-generated soot particles;
- Better identification of the effects of the oxygen molecule on secondary aerosol;
- Focus on the nucleation potentials of the combustion released particles in the atmosphere.

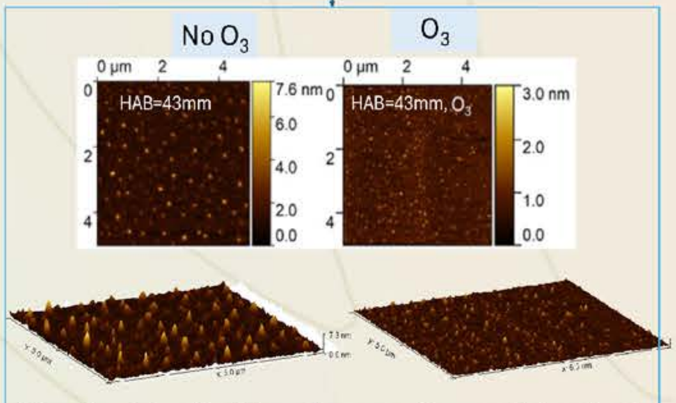
Ozone Doped Diffusion Flame



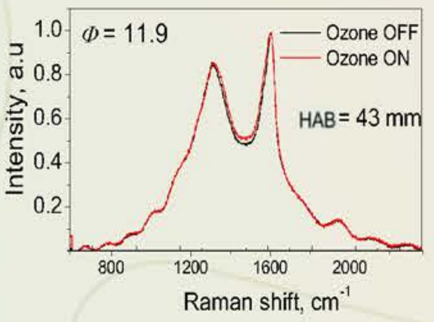
Φ	Ozone [ppm]	Q_{CH4} [l/min]	Q_{PA} [l/min]	Q_{SA} [Nl/h]
7.6	-	0.4	0.5	4000
	570	0.4	0.5	4000
11.9	-	0.4	0.32	4000
	500	0.4	0.32	4000

Ozone is an active molecule with a huge potential in compromising the production of harmful compounds by altering the flame chemistry [3].





After the introduction of ozone, the particles look flatter, indicating a lower level of cross-linking in the aromatic network.



Differences in the D/G intensity can be associated to the growth of the aromatic domain induced by O_3 molecules.

Further info about this work will be available on *Fuel* in few months : Basta L., Pignatelli A., Sasso F., Picca F., Commodo M., Minutolo P., Martin J.W., D'Anna A., *The effect of ozone on soot formation in partially premixed laminar methane/air flames*

REFERENCES
1. Butt E.W. *et al* (2016) *ACP* **16**, 873-905;
2. Gentner, D. R. *et al* (2017) *Environ. Sci. Technol.* **51**, 1074-1093;
3. Sun W. et al (2019) Prog. Energy Combust. Sci. 73, 1-25.

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Università degli Studi di Napoli Federico II - Dipartimento di Fisica "Ettore Pancini"

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Investment 3.1: "Fund for the realisation of an integrated system of research and innovation infrastructures"

Characterization of the Planetary Boundary Layer (PBL) over the ACTRIS Neapolitan Station by Active Remote Sensing Techniques

Zeeshan Ali

Tutors: Salvatore Amoruso, Alessia Sannino

PhD PROJECT DESCRIPTION

- In the frame of ITNERIS Project my main focus is on the study of the Planetary Boundary Layer (PBL) with Remote sensing techniques.
- The PBLH determines the dispersion volume of aerosols and pollutants, and serves as a scaling parameter for vertical profiles of wind and turbulence.
- The accuracy of PBLH is crucial for climate change research, meteorology, and air pollution forecasting.

METHODOLOGY

- To determine the PBLH, gradient-based methods **(GM, IPM, LGM, CRGM)** are employed on the range-corrected signal (RCS) of Lidar (MALIA) at two different wavelengths **(355nm, 532nm)**.
- The Variance of Radial Wind speed Method is Employed To determine the PBLH value from the data of the Wind Profile Lidar.

INSTRUMENTATION

The ACTRIS Station at University of Naples Federico II is equipped with a multi-wavelength Raman lidar as well as a Wind Lidar.

MALIA

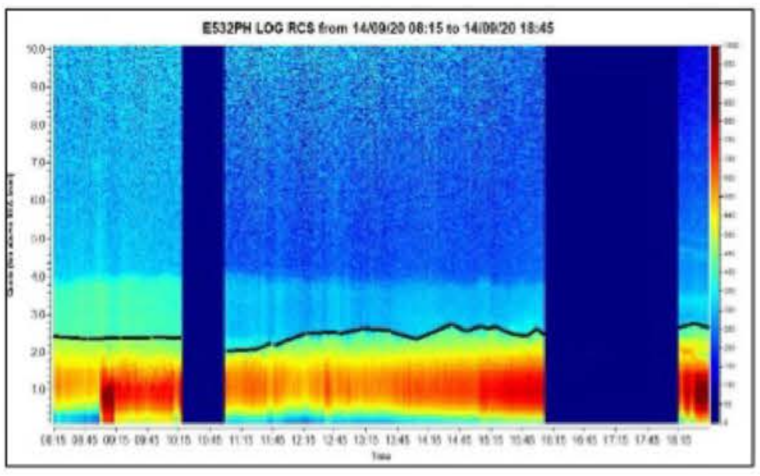
MALIA is an advanced lidar capable to retrieve three backscattering coefficients **(3β)**, two extinction coefficients **(2α)**, and two depolarization ratios **(2δ)**.

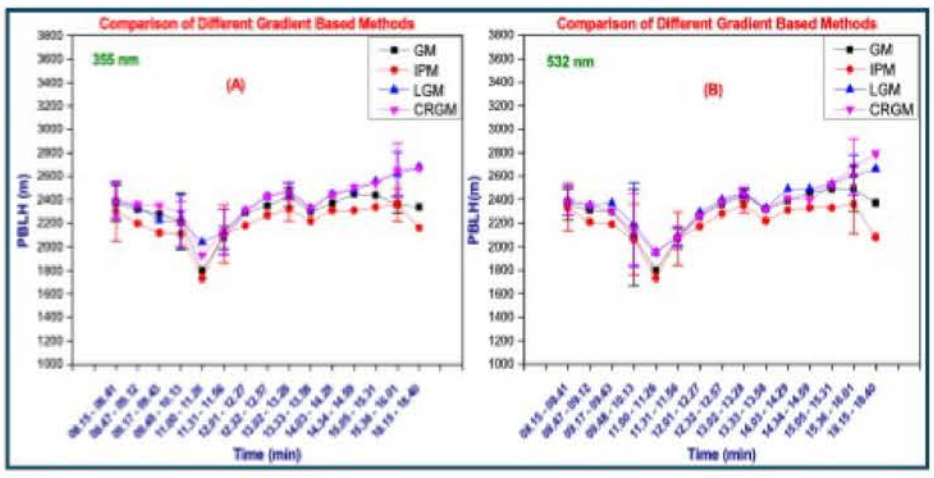
Wind Lidar

This is a high-resolution ground-based Doppler lidar (Leosphere WindCube 100S). It has the ability to continuously sample the planetary boundary layer (PBL) with high temporal and spatial resolutions in all **scanning modes**.

RESULTS

Lidar data : Comparison of (GM,IPM,LGM,CRGM)

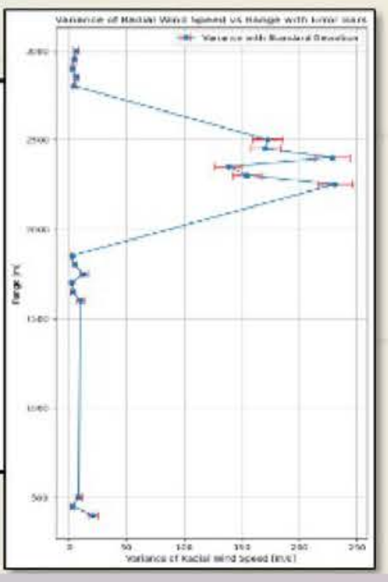




When comparing PBLH values from different gradient based methods for wavelengths **355 nm** and **532 nm**, first and second order gradient methods yields similar results, as do the logarithm and cubic root methods. Slight differences in PBLH values are due to the wavelength dependent backscattering properties of aerosols, resulting in variations in how the lidar laser beams interact with aerosols.

Wind Lidar : Variance of Radial Wind Speed (Preliminary Results)

From the preliminary work on the variance of Radial Wind Speed over 15 min time segment, it is observed that we have low variance up to 1900 m altitude range, indicating a region with less turbulent and stable air. Above that height, the variance of the vertical wind speed increases, indicating the PBL region with strong turbulence and mixing due to aerosols particles.



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Optical and microphysical characterization of atmospheric particulate matter in an urban environment

Matteo Manzo

matteo.manzo@unina.it

Tutors: Salvatore Amoruso, Antonella Boselli

PhD project

The aim of my thesis project is to characterize urban aerosol using remote sensing and in situ instruments. The Naples urban area is particularly interesting because of its centrality in the mediterranean basin, making it the crossroads of a very high aerosol content of both natural and anthropogenic origin.

Instrumentation

Our National Facility is equipped with two lidars (MALIA and TWCA) and a sun-sky lunar photometer.

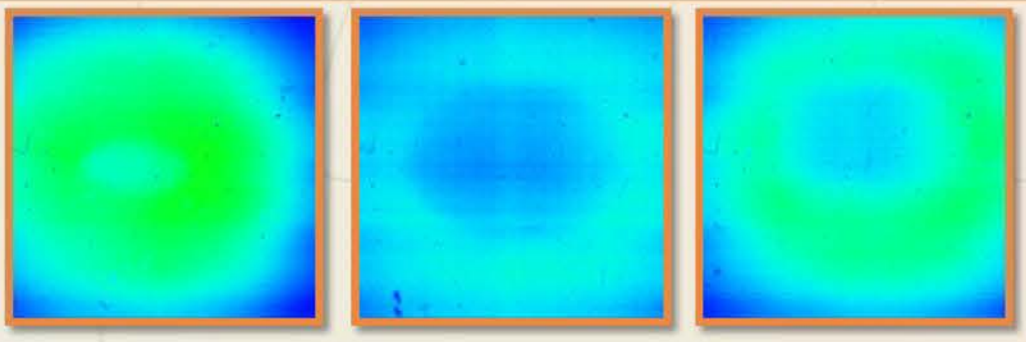
MALIA

TWCA

PHOTOMETER

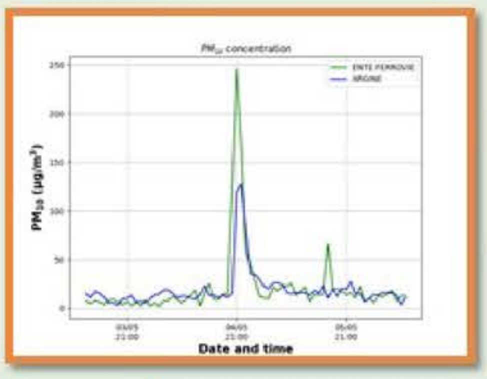
Results

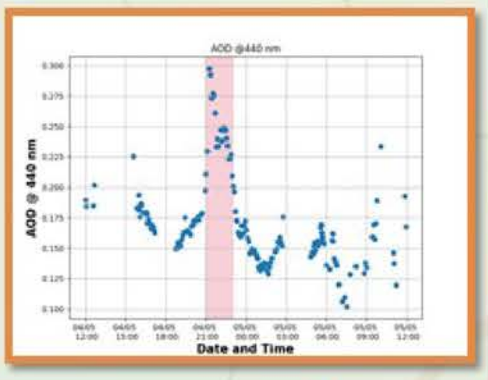
I participated in the set-up and calibration of different lidar systems through laboratory tests and experimental measurements.

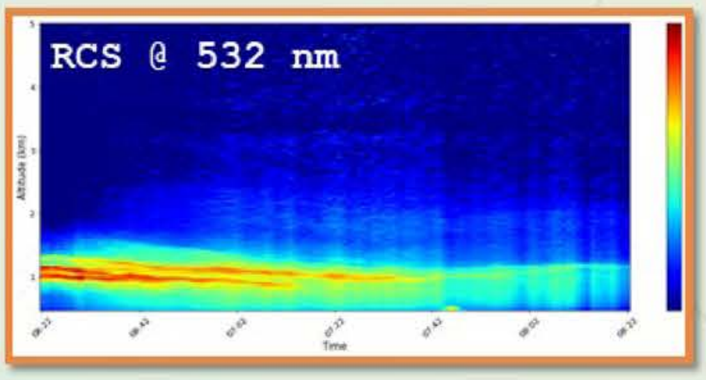


Camera-check of the beam alignment inside the receiver box for the 355, 532 and 407 channels.

The MALIA Lidar has been used, among other instruments, to study the effects of a massive fireworks event that invested the city, following Napoli's championship victory.





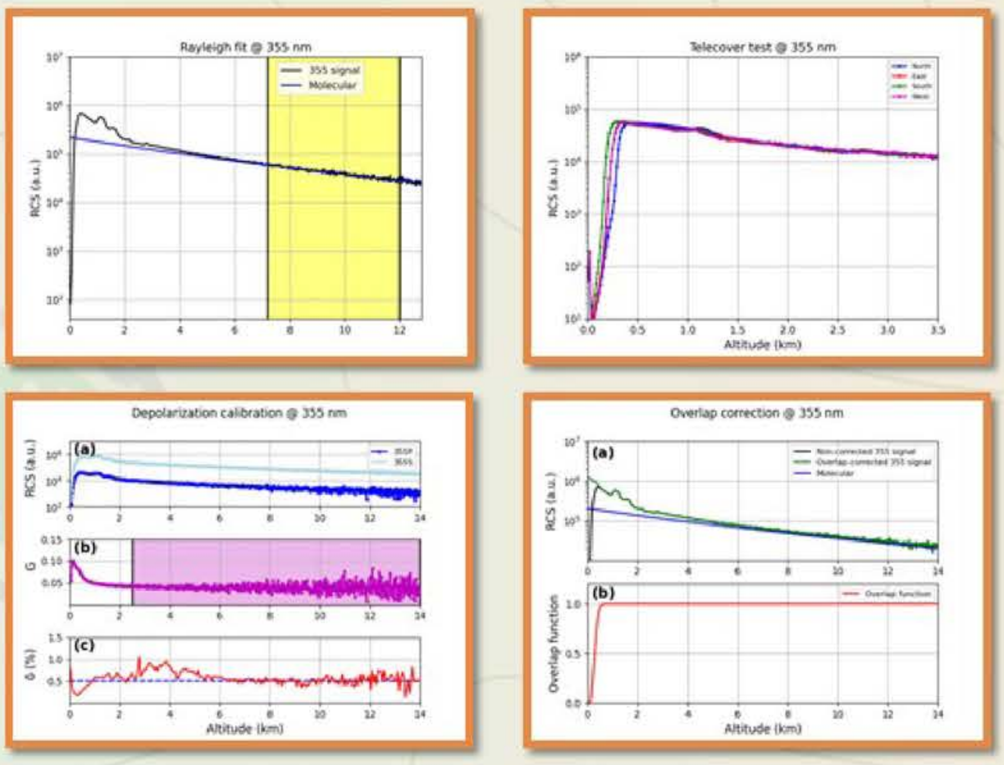


These results have been presented on two different poster sessions and a paper is under preparation.

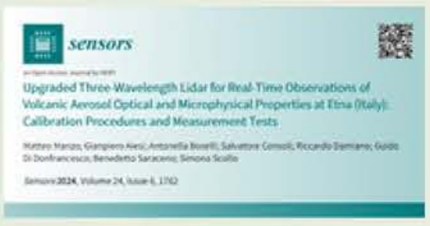
ACTRIS Best student poster award

PM2024 Honourable mention Poster award

Calibration procedures following the ACTRIS protocol have been performed on a transportable 3β+2α+2δ lidar system (AMPLE) in EARLINET since 2013.



These results have been part of a paper published on march, 2024.


Upgraded Three-Wavelength Lidar for Real-Time Observations of Volcanic Aerosol Optical and Microphysical Properties at Etna (Italy): Calibration Procedures and Measurement Tests

Published manuscript: MDPI Sensors on 05/03/24

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Gap filling and forecasting on groundwater levels data using machine and deep learning models: a case study on the Pianosa Island aquifer system (Tuscan Archipelago, Italy)

Marco Chimenti[1,2], Matia Menichini[1], Marco Doveri[2], Roberto Giannecchini[2]

[1] Institute of Geosciences and Earth Resources (IGG-CNR) of Pisa.

[2] Department Of Earth Sciences of University of Pisa.

INTRODUCTION AND AIM OF THE RESEARCH

The current state of knowledge about the CZ in Italy is marked by fragmentation and data heterogeneity. My PhD research involves mathematical modeling using machine and deep learning techniques focusing on specific CZs, such as the Pianosa Island, with the aim to fill the data gaps, understand and predict their response to short-long term due to climate change.

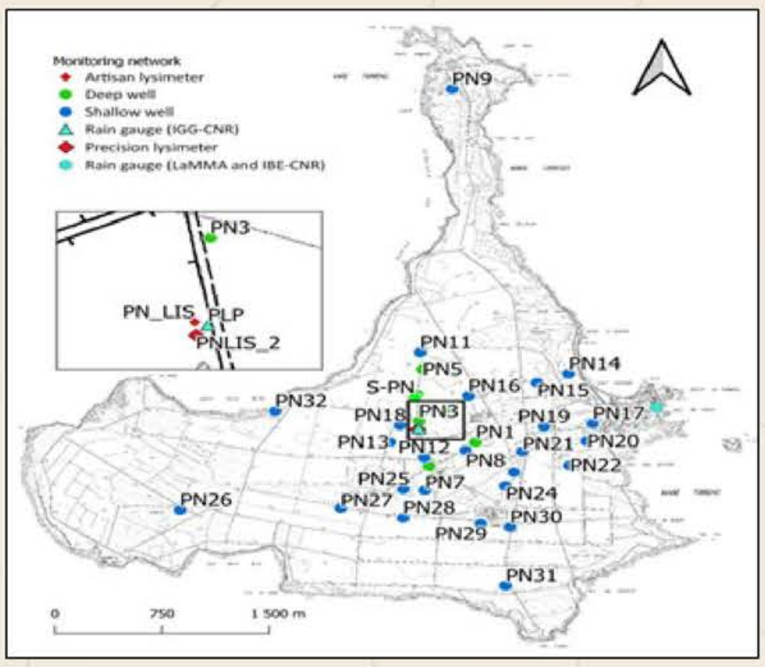
STUDY AREA AND DATASETS

Two aquifers:

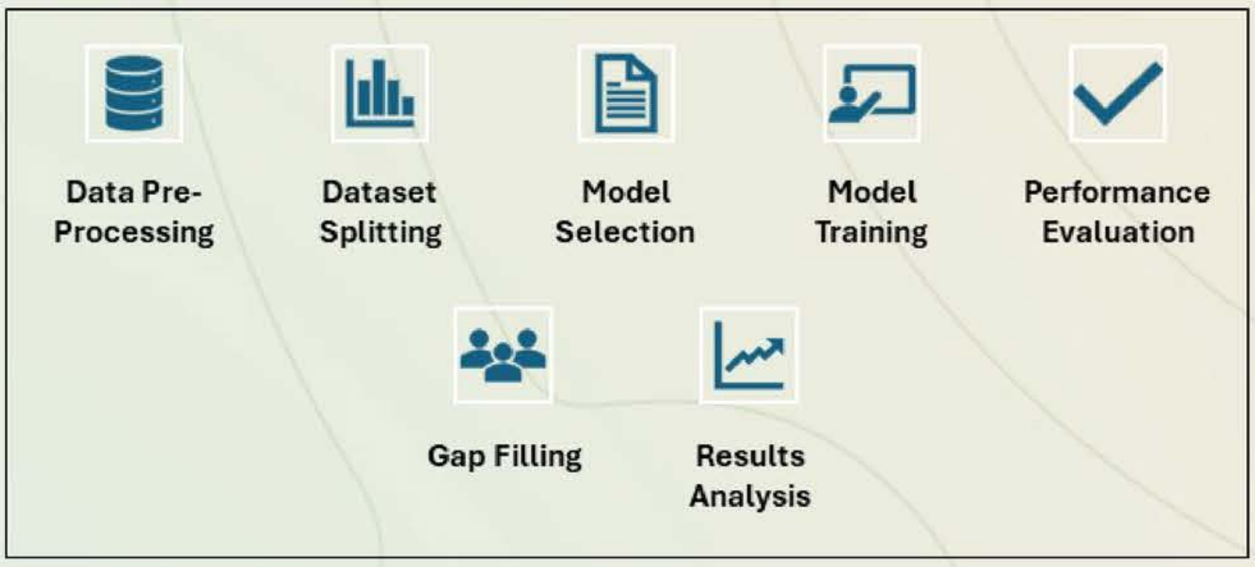
- Phreatic aquifer (Pianosa Fm.).
- Confined/semi-confined aquifer (Golfo della Botte Fm.).

Datasets:

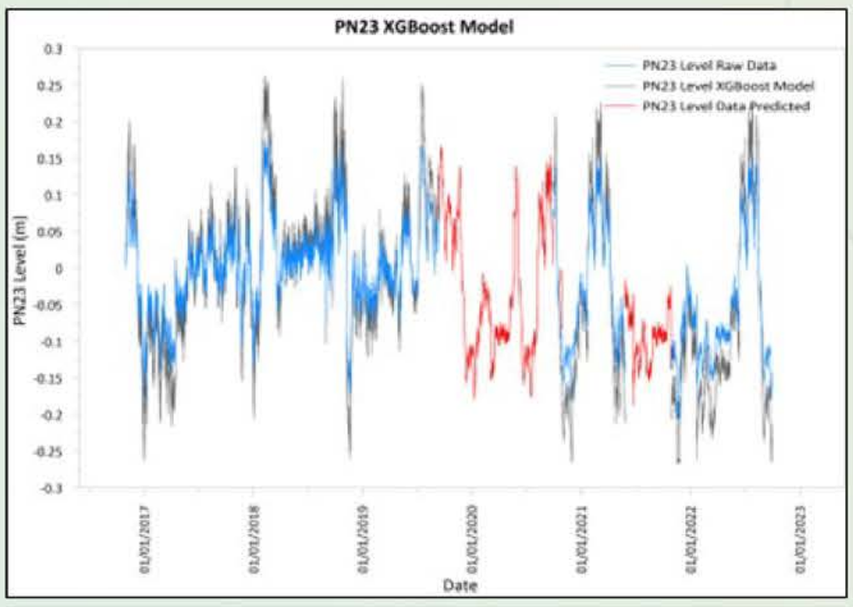
- 3 wells (PN4, PN17, PN23).
- 1 meteorological station (LAMMA - CNR IBE).
- 1 tide gauge (Marina di Campo - ISPRA).

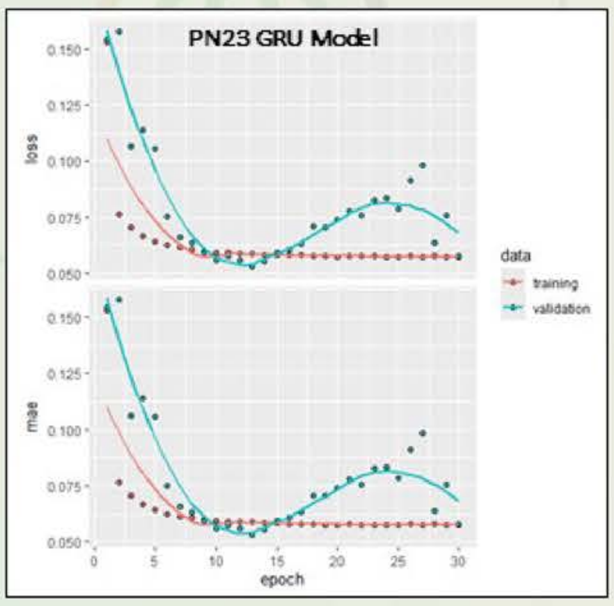


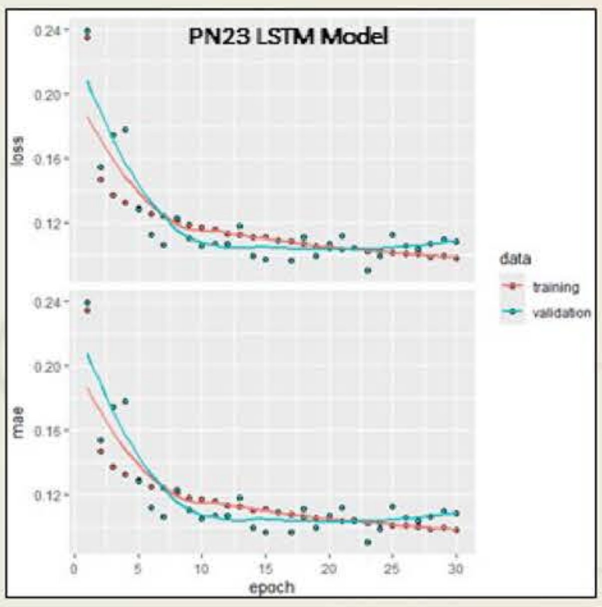
METHODOLOGY



RESULTS







Time Interval	RMSE	MAE	Adjusted R-squared
PN23_34241	0.03	0.04	0.72
PN23_34957	0.01	0.01	0.92
PN23_51840	0.02	0.01	0.93

PN23	LOSS	MAE
GRU_MODEL_TRAIN	0.0575	0.0575
GRU_MODEL_VALIDATION	0.0580	0.0580
GRU_MODEL_TEST	0.0554	0.0554

PN23	LOSS	MAE
LSTM_MODEL_TRAIN	0.0979	0.0979
LSTM_MODEL_VALIDATION	0.0979	0.1079
LSTM_MODEL_TEST	0.0794	0.0794

Annual meeting - Roma - 9-10/07/2024

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Finanziato dall'Unione europea NextGenerationEU
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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

LITHIUM-RICH WATERS IN THE FOREDEEP-TECTONIC WEDGE ZONE OF THE NORTHERN APENNINES: ORIGIN AND EVOLUTION OF A POTENTIAL UNCONVENTIONAL LITHIUM RESOURCE

Candidate: Matteo Salvadori
Supervisor: Dr. Maddalena Pennisi
Co-supervisor: Dr. Andrea Dini; Prof. Massimo D'Orazio
matteo.salvadori@phd.unipi.it

INTRODUCTION AND AIM OF THE PROJECT

The exponential **increase in demand for lithium** in the context of the energy transition necessitates an increase in actual extraction activity (FIG.1), making essential the research for **new sources and extraction methods**. In Italy, although there are no economically significant conventional lithium sources (hard rock ores, salars), some promising scenarios derive from lithium extraction from fluids.

Lithium-rich waters have been identified in volcanic/geothermal peri-Tyrrhenian zone and along the **Apennines foredeep** (FIG.2). Despite the high scientific and economic potential, the knowledge on these systems in terms of chemical and isotopic data is limited, and related researches on Li enrichment are currently lacking.

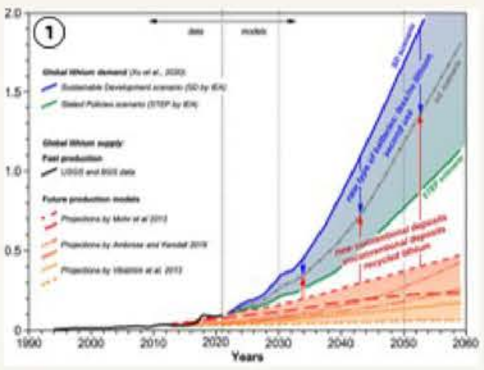


FIG.1- Projections for lithium production and demand[1]

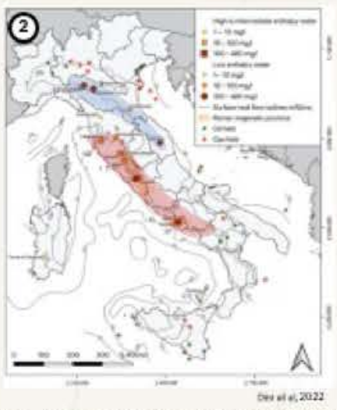


FIG.2- Areas of interest for Li extraction from fluids. Low enthalpy (blue) and High enthalpy (red)[2]

This PhD project aims to fill this data shortage to understand the **origin, distribution and behavior of lithium in deep saline waters hosted by sedimentary formations along the Apennine foredeep** in Emilia Romagna.

STUDY AREA AND SAMPLING

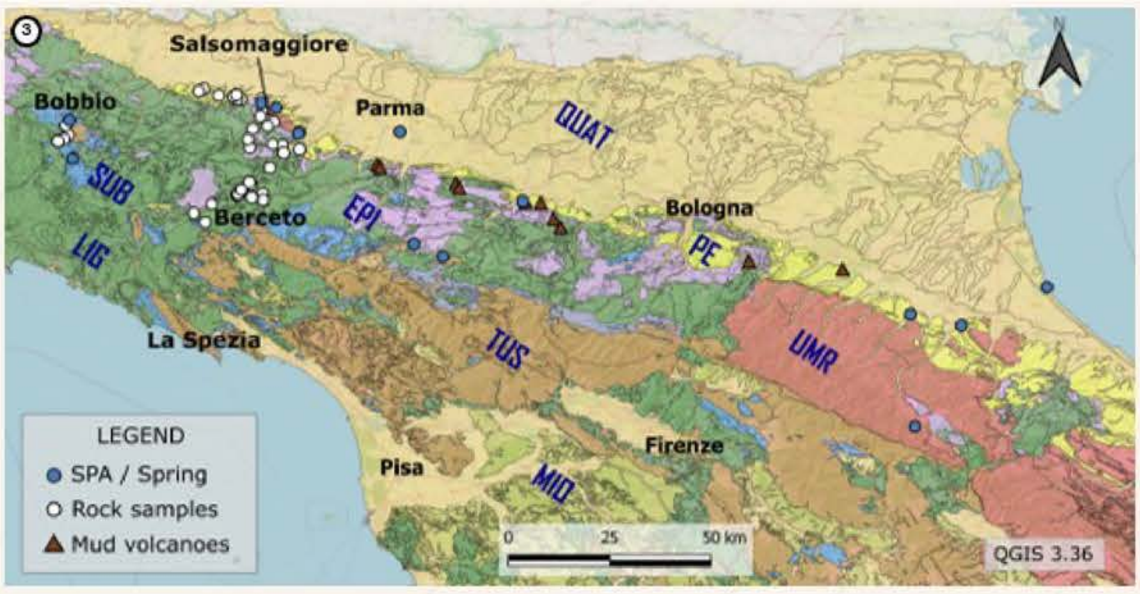


FIG.3- Study area divided in the main geologic domains with location of the rock, water and mud samples. QUAT=Quaternary; PE=Post Evaporitic; EPI=Epiligurids; LIG=Ligurids; SUB=Subligurids; TUS=Tuscan; UMR=Umbro-Marchigian (Salsomaggiore unit).

FIG.4 – Sampling campaigns (Sept 23 – Jul 24). **48** rock samples, **10** mud volcanoes, **17** SPA wells, **4** natural spring

Rock samples: major and trace element (ICP-MS, PGNA), Sr, B, Li isotope;
Waters: major and trace element (IC, ICP-MS), O, H, Sr, B, Li isotope

METHODS AND ACTIVITIES

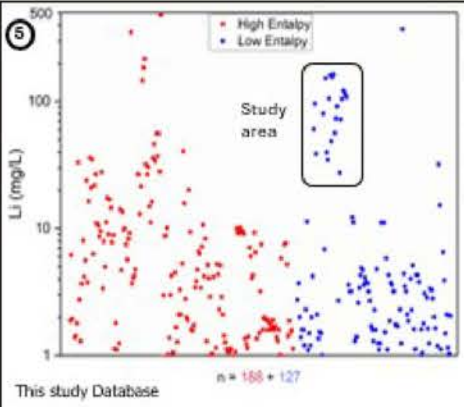
An integrated geoscience approach involving geology, petrography, geochemistry and isotope geochemistry on different geological matrices (rock, sediments, water) has been adopted.

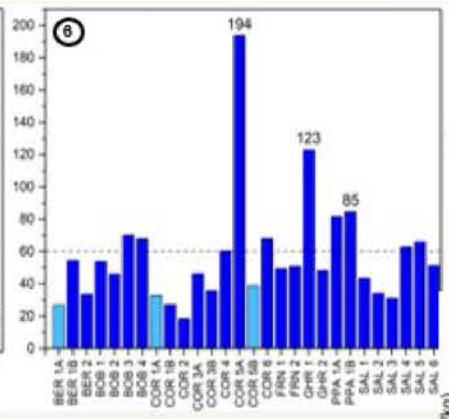
- A **chemical-isotopic database** (FIG.5) with data from 72 papers (over 20.000 data) has been created (and constantly updated) for rock, mud and waters from Italy. It permits to individuate the most enriched springs and wells and also will serves for future comparisons with the project study area.
- Currently 48 **rock samples** ware taken, representative of 35 formations of Apennine Units (7 geological domains). Samples of 10 **mud volcanoes** (mud+water) were also taken as a deep sedimentary formation proxy. Samples were pulverised and composition analized via ICP-MS for trace elements and PGNA for boron concentration.
- 21 **Thermal waters** from natural spring and SPA wells were sampled along the Apennine margin. Samples will be analysed via ICP-MS and IC for chemical composition
- Samples **mineralogy** was determied via XRD analyses, and the results guided the SEM mapping detailed analysis. Mineralogical zonation observed has been deepened with LA-ICP-MS to trace the variation of Li concentration across sample layers.
- The set up of an analytic method using a MC-ICP-MS[3;4] permitted to obtain accurate and reproducible **lithium isotope** analyses on Li-SVEC international standard[5] at different concentration (10-250 ppb; SD=0.16‰). In-house lithium carbonate standard (LiPI) and enriched aqueous solutions were also measured (FIG.9). Chemical Li purification procedure for natural complex matrices is in progress, and first tests on columns calibration were done.
- Several **leaching experiments** (FIG.10) to measure the degree of Li release from rocks to water (at natural conditions, different pH, T, and chemical composition [6]) have been taken.

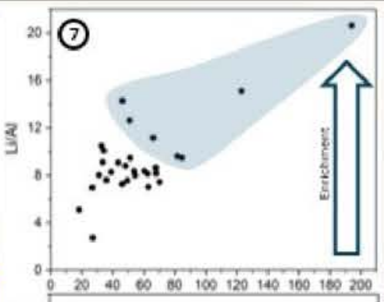
NEXT STEPS

- Complete the set up of a chemical purification procedure for lithium water and rock samples in cleanroom.
- Complete the chemical analysis of major, minor and trace element of rock and water samples and isotope analyses (O, H, Li, B, Sr) on selected samples of rock, sediments and water to evaluate element origin and w/r interactions processes.
- Develop a conceptual model for lithium mobilization during water-rock interaction in foredeep-tectonic wedge settings.

FIRST RESULTS







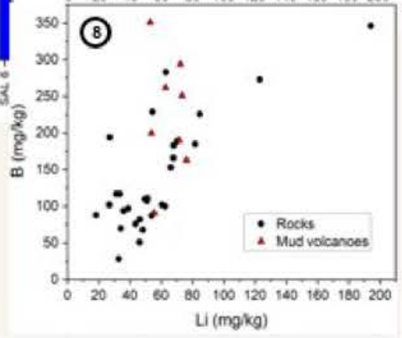


FIG.5- Data available in literature for Li concentration in water (springs, wells) in Italy. FIG.6- Lithium concentration in sampled rocks. The dotted line represents the average concentration for shale rocks globally [7]. FIG.7- Lithium enrichment compared to aluminium content (proxy for clay mineral abundance). FIG.8 – Li vs B correlation for rock and mud samples.

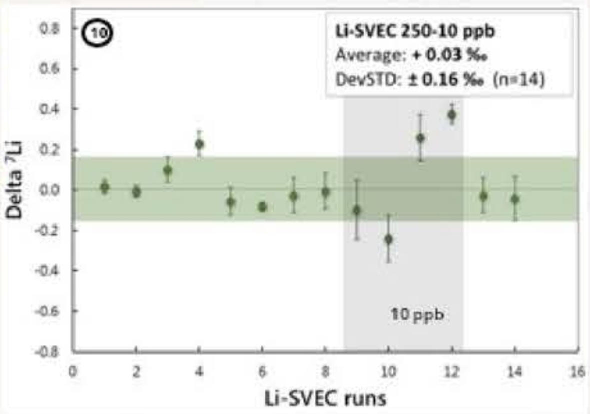
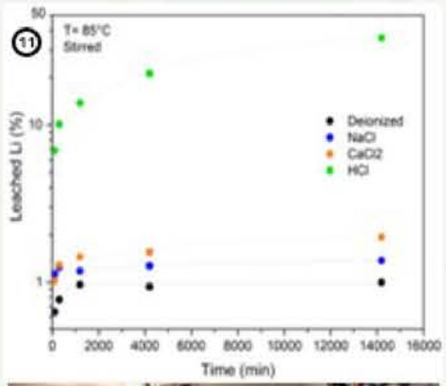


FIG.9 - a) Cleanroom class 100 at IGG-CNR, with chromatographic columns for Li sample purification and concentration. b) MC-ICP-MS Neptune Plus™ at Neptune/TIMS Laboratory.
Fig.10 - Lithium isotope analyses of NIST SRM 8545 L-SVEC international reference material.



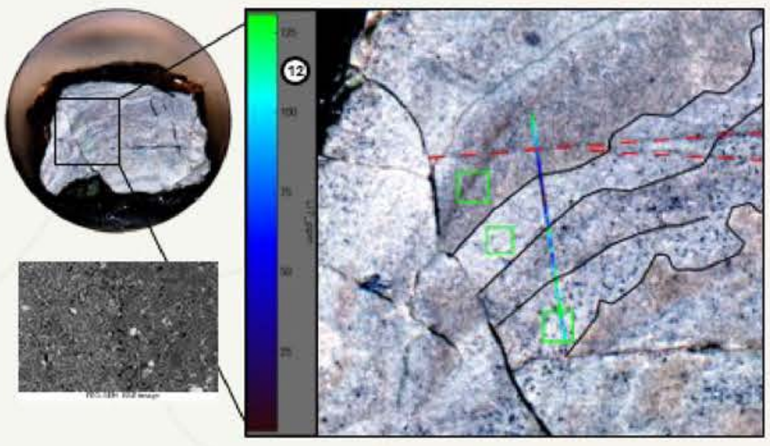


Fig.11 - Leaching experiment on powdered samples. Mixture was stirred and maintained at 85 °C with IR lamps. Experiment uses different solutions (Deionised water, NaCl, CaCl2, HCl) to simulate natural conditions.
Fig.12 Detailed analyses on polished mounts to determine textural/mineralogical distribution (Scanning Electron Microscope) and chemical distribution (Laser Ablation ICP-MS; focus on Li)

BIBLIOGRAPHY

[1] Dini A. (2023). Litio: dal Big Bang alla transizione energetica. In Sapere, n. 4, agosto 2023 – pp. 10-15, DOI: 10.12919/sapere.2023.04.1; [2] Dini, A., Lattanzi, P., Ruggieri, G., & Trumpy, E. (2022). Lithium Occurrence in Italy—An Overview. Minerals, 12(8); [3] Bohlin, M. S., Misra, S., Lloyd, N., Elderfield, H., & Bickle, M. J. (2018). High-precision determination of lithium and magnesium isotopes utilising single column separation and multi-collector inductively coupled plasma mass spectrometry. Rapid Communications in Mass Spectrometry, 32(2), 93–104.; [4] Zhang, W., Tanaka, R., Kitagawa, H., Bohlin, M., & Nakamura, E. (2022). A rapid method of simultaneous chromatographic purification of Li and Mg for isotopic analyses using MC-ICP-MS. International Journal of Mass Spectrometry, 480, 116893.; [5] Flesch, G. D., Anderson, A. R., & Svec, H. J. (1973). A secondary isotopic standard for $^6Li/^7Li$ determinations. International Journal of Mass Spectrometry and Ion Physics, 12(3), 265–272.; [6] Lee, K. J., You, J., Gao, Y., & Terlier, T. (2024). Release, Transport, and accumulation of lithium in shale brines. Fuel, 356, 129629.; [7] Yuan-Hui, L. (1991). Distribution patterns of the elements in the ocean: A synthesis. Geochimica et Cosmochimica Acta, 55(11), 3223–3240.

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Energetic requirements and individual life history along a resource availability gradient:

a laboratory experiment on intrapoupulation variability on a model aquatic macroinvertebrate species

L. Lezzi⁺, M. Shokri, A. Basset
⁺ludovico.lezzi@unisalento.it

Context

Individual life history depends on both:

- the amount of **energy available** in the environment;
- how each **individual uses** it[1 2].

Within the same population, different individuals may have different energy allocation strategies[3 4].
This ability to adapt and respond to the environment plays an important role in enhancing population stability.
However, the extent to which resource availability could affect individual pace of life, especially current changing ecosystems, still requires additional exploitation[5].
With this in mind, this work aimed to investigate how **individual pace of life**[6], expressed as:

- metabolic rate,
- growth rate,
- maturity rate,

and the overall population-level energy budget, are influenced by changes in **individual resource availability**[5].

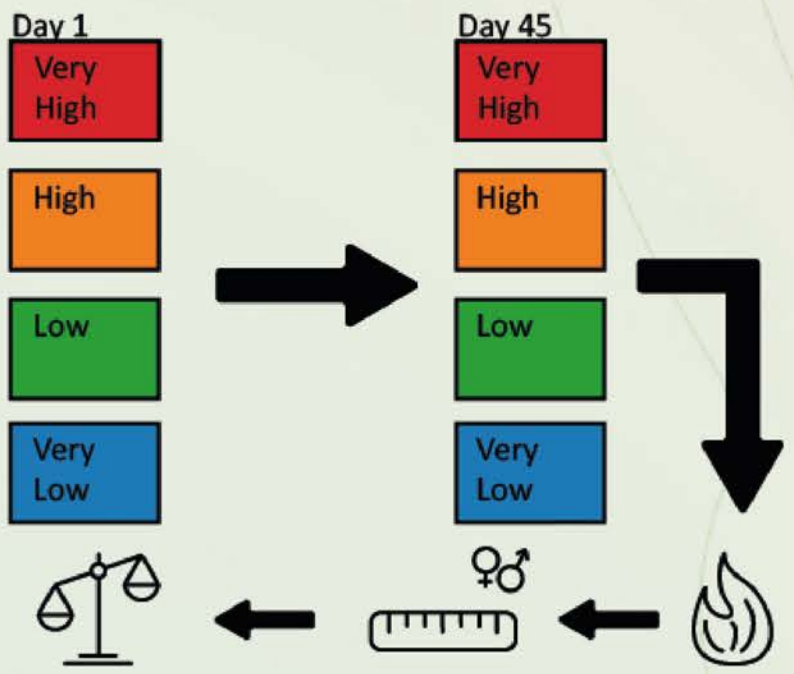
Materials and Methods

Cohorts with different population densities of the species model *G. Insensibilis* were maintained for 45 days with conditioned *P. australis*.
Every 15 days:
1. The resources were renewed[7];
2. The overall health condition of the populations was checked.

Individual traits such as:

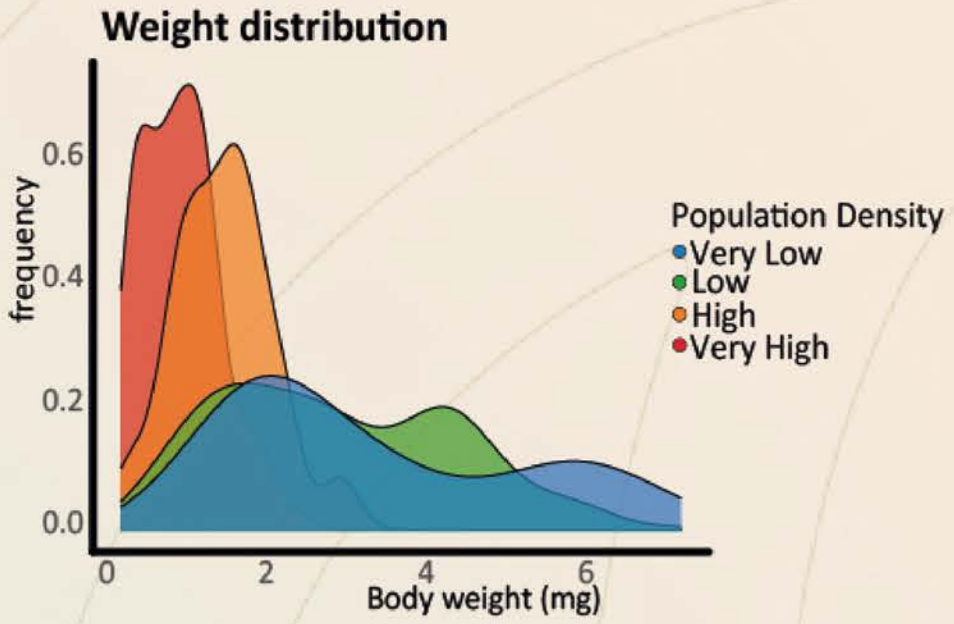
- Metabolic rate;
- Body weight;
- Body length;
- Sex

were meauserd individually

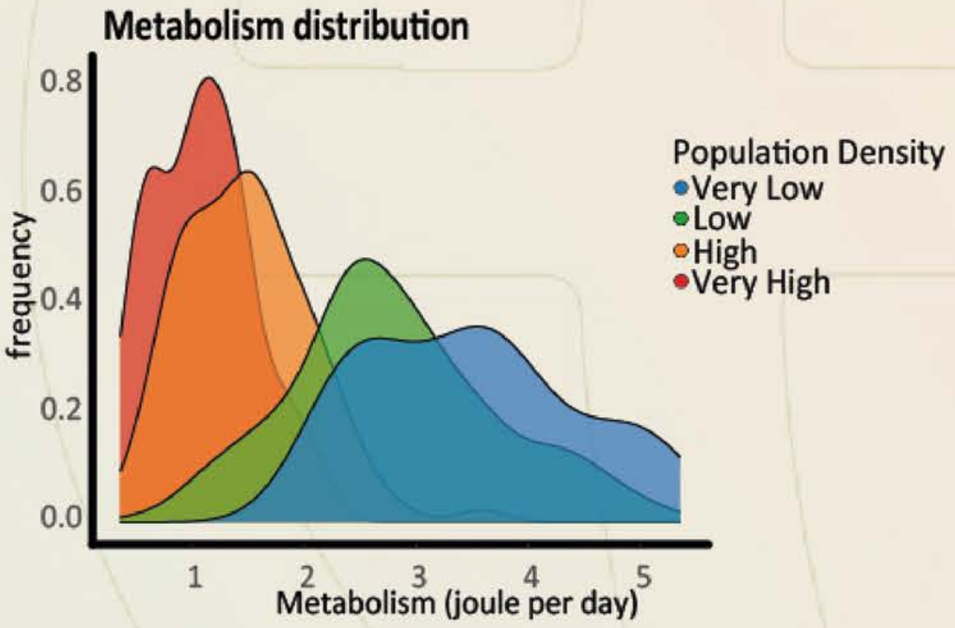


Results

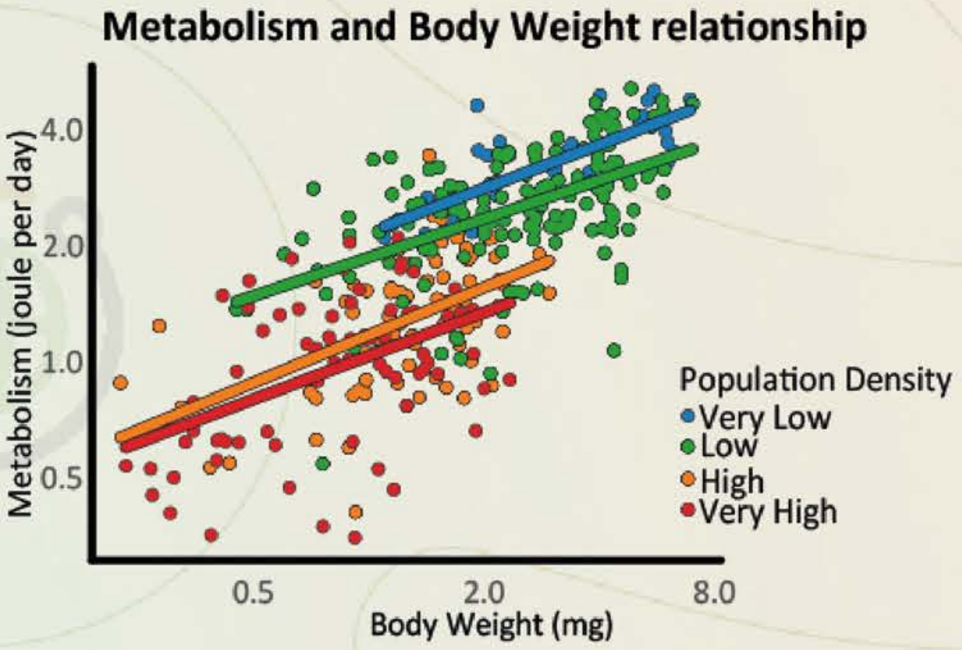
Individuals reared in conditions with a higher density grew faster than individuals reared in conditions with a lower density.



The individual energetic requirement negatively scaled with population density.



Overall, a **higher population density** was related to animals with **larger dimensions** and **higher energetic requirements.** The relationship between body weightand metabolism follows the allometric law and is not significantly influenced by the amount of resources provided.



Conclusions

This study highlights how **population density**, by altering individual's resource availability, **influences** the rates in aquatic macroinvertebrates influencing their **pace of life**.
These findings highlighted how environmental factors and individuals traits are tightly connected.

References

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The Patch Concept in Ecology: a literature review of methodologies and experimental designs to assess space-use behavior

M. Elia* ; A. Basset ; M. Apollonio
*marco.elia@unisalento.it

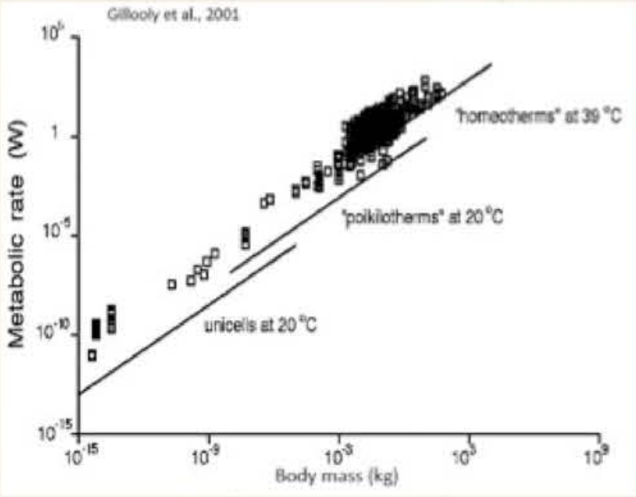
Theoretical background

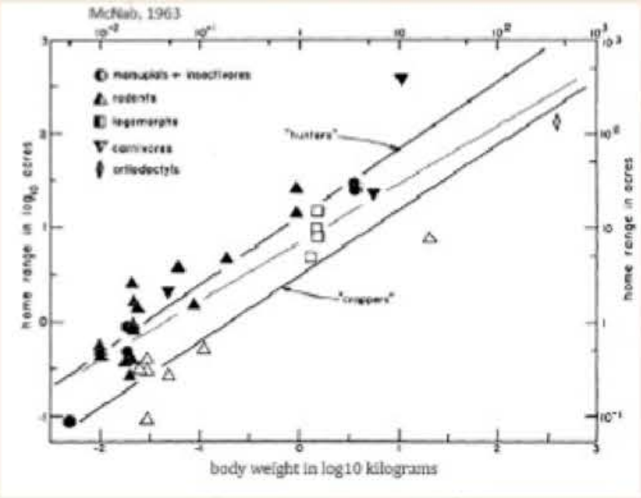
Animal feeding activity play a key role on the evaluation of the optimal space-use behavior from individuals. The resources allocation in the environment is a function of individual resources availability perception. In other words, the same quantity of a single type of resource is perceived differently among individuals belonging to the same gild.

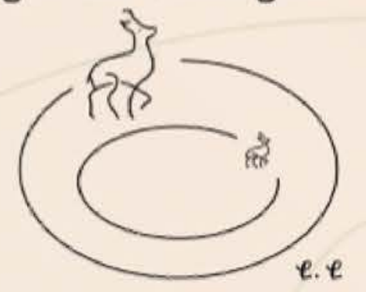
Body size

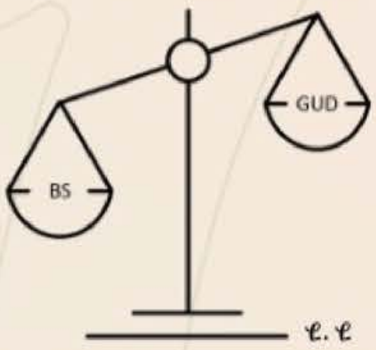
Resources

Space-use behavior









Metabolism | Coexistence | OFT | MVT | GUT & GUD

Objective

Provide insight on the behavioral ecology of coexisting species at inter- and intraspecific level.

Under a climate change scenario, it is crucial to predict species' habitat choices in response to significant variations. Leveraging observed intraseasonal choices is instrumental in modeling future adaptations and providing a mechanistic explanation for variations in space-use behavior due to climate changes.

At the individual level, the allometric scaling principle of space-use with body size will be tested.

To achieve this objective, we explore the area of interest by a **literature review**, a **data review**, **field observation** and **experiments** carried out during different seasons.

Literature review

An intensive bibliographic research on different methodologies for measuring space-use by individuals and/or populations, in different type of habitats.

A specific focus of this bibliographic research is about the use of the **patch concept** in terms of habitat patch (large-grain) or resources patch (fine-grain).

This literature review follows the **PRISMA checklist** criteria for extracting information from papers.

Experimental design

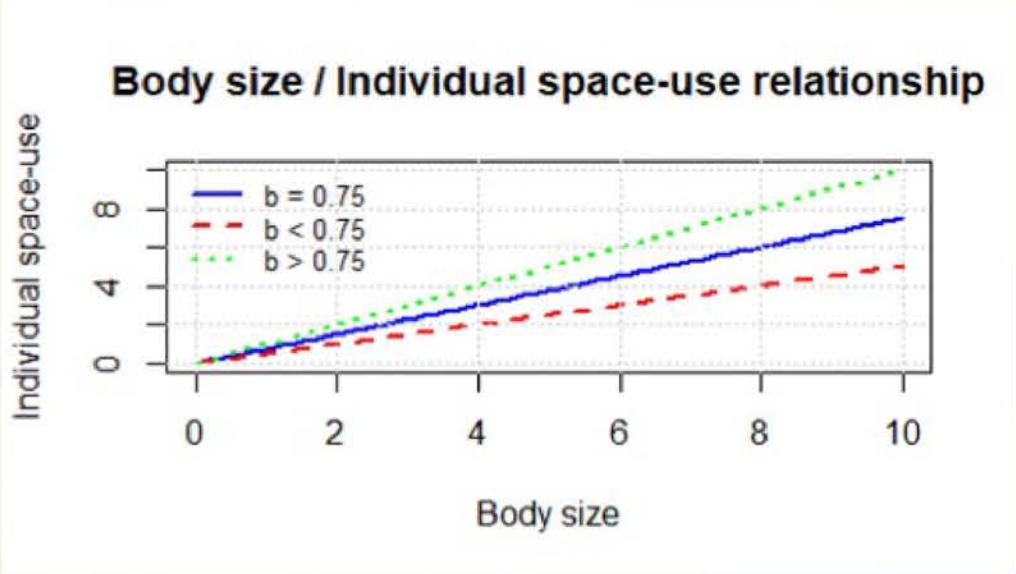
Test the theoretical prediction of individual space-use and body size relationship between coexisting individuals, sharing resources (a % of their diet) on the same habitat.

H0. The relationship between space-use and body size scale positively with $b = 0.75$.

H1. The relationship between space-use and body size scale positively with $b \neq 0.75$.

H1a. The relationship between space-use and body size scale positively with b > 0. 75.

H1b. The relationship between space-use and body size scale positively with b < 0. 75.

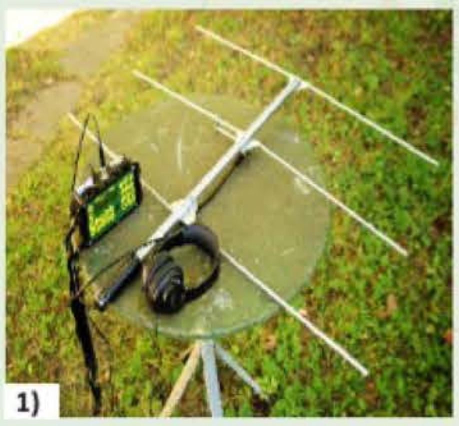


Methodologies

1) A **radiotelemetry** system to obtain animal locations in the space and estimate the daily and seasonal home-range.

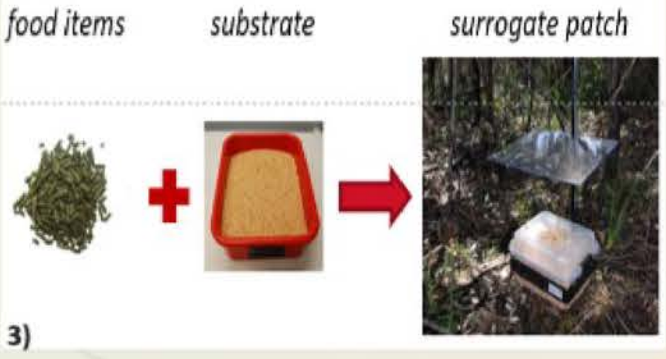
2) Foto and video traps and direct observation on field.

3) Artificial food trials to measure the GUD and GUT.


1)


2)

GUD = H ≈ *C + P + MOC*



3)

Conclusion

This work will support researchers studying animal space-use behavior, by offering insights into the concepts of resources and habitat patch. Additionally, it provides an optimized methodology for utilizing animal location data in a heterogeneously distributed resources environments.

Bibliography:

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Decoding Body Size-Mediated Competitive Coexistence Mechanism Using Spatially Explicit Individual-Based Modeling

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[1]Department of Biological and Environmental Sciences and Technologies (DiSTeBA), University of Salento, Lecce, Italy
[2]Department of Mathematics and Physics, University of Salento, Lecce, Italy

Background

Competitive coexistence remains a mysterious concept with major gaps in our understanding of the mechanisms contributing to biodiversity. Traditional theories such as competitive exclusion principle, niche partitioning, neutral and lottery competition theories rely on niche differentiation. However, observations of complete niche overlap challenge these theories, suggesting species should be excluded [1]. Contrarily, some evidence have shown that species can coexist when size differences among competitors facilitate coexistence through niche inclusion. The theory of "body size-mediated coexistence," introduced by Basset in 1995, demonstrates that species with sufficiently different physiological sizes can coexist despite overlaps in diet and home range [1,2,3].

Research Objectives

This research aims to empirically validate the body size-mediated coexistence theory and integrate it into predictive models for biodiversity conservation and ecosystem management. This research also explores how metabolic constraints on foraging behavior affect coexistence based on resource turnover rates, body size ratios, and exploitation efficiency.

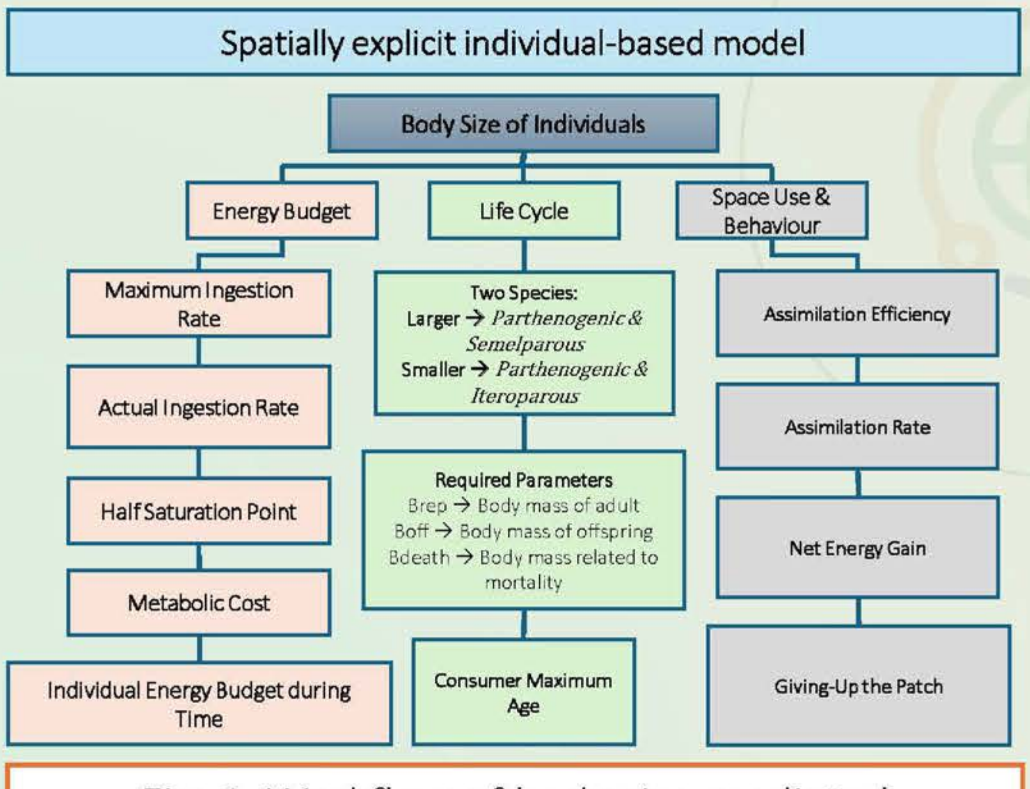

Fig. 1: Workflow of body size-mediated coexistence modeling

Methods

A spatially explicit individual-based (IBM) approach will be used to model the consumer-resource dynamics of two vagile animal species with varying body sizes that are using the same resource in the home range space of an individual of the larger species. This approach takes into account the most significant aspects of the energy budget, life cycle, and spatial behaviour of individual animals, respectively. Maximum and actual ingestion rate, half saturation point in each cell and metabolic cost are given by resource dynamics and consumer behaviour and energetics. The larger consumer will be assumed parthenogenic and semelparous, while the smaller consumer would be iteroparous. Net energy gain (assimilation rate/metabolic cost) is used to achieve allometric variation in space use by two species (Fig. 1).

Expected Outcomes

This proposed metabolic theory is expected to predict and enhance body size-mediated coexistence across ecosystems. It is also expected that larger species' superiority, through resource density control, facilitate stable coexistence independently of resource partitioning. This mechanism is attributed to the superiority of larger species, as body size influences ecological roles and competitive advantages [3].

Conclusion

This study will deepen our understanding of competitive coexistence by incorporating energetic and spatiotemporal constraints into existing theories.

References

[1] Basset, A., (1995). Ecology, 76(4): 1027-1035.
[2] Basset, A., (1997). Oikos, 78(1): 31-36.
[3] Basset, A., & DeAngelis, D.L., (2007). Oikos, 151: 245-260.

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Università degli Studi della Tuscia – Dipartimento per la Innovazione nei Sistemi Biologici Agroalimentari e Forestali

IMPROVING ACCESS TO ENVIRONMENTAL RESEARCH INFRASTRUCTURES TO ADDRESS THE CHALLENGES OF EXTREME CLIMATIC CONDITION ON GLOBAL FOREST HEALTH AND BIODIVERSITY

Author: EKO O. D. / Reviews: CARBONE F. (Ph.D. Supervisor), BARBERIS M. (Internship Supervisor)

Topic

- This is an exploratory study on the policy side.
- It will feed a research dissertation on:

"Socio-economic impact assessment and Integration of Italian integrated environmental research infrastructures to address European and global environment questions"

Relevance

- There is growing policy interest in science-based approaches to tackle interconnected realities of global environmental issues.
- This requires ***multidisciplinary collaboration***, ***open science approach*** and ***equitable access*** to research infrastructures.

Objectives of the study

General objective: To analyse access conditions to and integration of environmental research infrastructure data services to address the challenges of extreme climatic conditions on *global forest health and biodiversity.*

The following are the ***specific objectives*** of the study:

- To identify the enabling factors influencing the successful integration and management of environmental research infrastructures data services.
- To identify the barriers and challenges that could limit the accessibility of environmental RIs in line with the European open science policy.
- To analyse how the integration of environmental RIs, including common data access can improve and support studies to address global forest health and biodiversity.
- To determine the contribution and advantages of openness (FAIRness) in environmental RIs landscape.
- To generate policy recommendations based on empirical evidence and stakeholder perspectives to support the accessibility and integration of environmental research.

Data and Methods

Data collection techniques includes:

- Analysis of secondary data from relevant policy documents (ESFRI, RIs annual reports, EU policy documents, etc.).
- Semi-structures online interviews (guiding questions were designed targeting RI stakeholders such as RI staff, RI managers, scientists, industrial users and policy makers).

Methods of analysis:

- Qualitative analysis, including policy and content analysis based on the data collected.

BOX. Interview design

The structure of the interview design:

1. ***Access:*** *type of data produced, types of users and their specific needs, barriers to access data.*
2. ***Integration:*** *enablers and good practices of integrating different RIs as well as barriers.*
3. ***Impact on SDGs:*** *the way the access and research performed at RIs accelerated the achievement of the SDGs? compared to the operation of individual RIs?*

Preliminary findings

Some keywords emerging from the interviews process are:

- ***Standard of operations:*** RIs should adopt similar standards of operation, measurements and metadata system.
- ***Openness:*** Data access is open but physical access is very restricted to avoid disturbances on the ecosystem.
- ***Financing:*** To ensure continuous provision and free access to the data.
- ***Co-location:*** Locating the research stations of 2 or more RIs at the same place with minimal disturbance.
- ***Findability:*** Access is open, some scientists still find it difficult to find.

- The national level is perceived as the most important level of integration and synergy.
- Next step of the study is to assess the integration of RIs from the end users perspectives.
- Finally, policy recommendations will be drafted based on these results.

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In silico analytical pipeline creation for engineered protein/peptide production in plant systems

Luciani L; Biscarini F; Pedrazzini E.

ABSTRACT

This PhD project focuses on implementing the design phase of engineered proteins to be produced in plant systems using an *in silico* analytical pipeline (digital twin), and is ongoing at IBBA CNR, which is a partner of the European Infrastructure EU IBISBA participating in ITINERIS. Algorithms to predict structure, co-translational and post-translational modification, intracellular destiny and stability of recombinant proteins are available.

However, whether some of these prediction tools are robust, others still suffer from limited experimental knowledges on *in vivo* regulation mechanisms (e.g. chaperone interactions and protein quality control). Furthermore, plant-specific features, such as sorting to vacuoles, protein bodies formation, N-glycan processing, are still very difficult to be predict in silico.

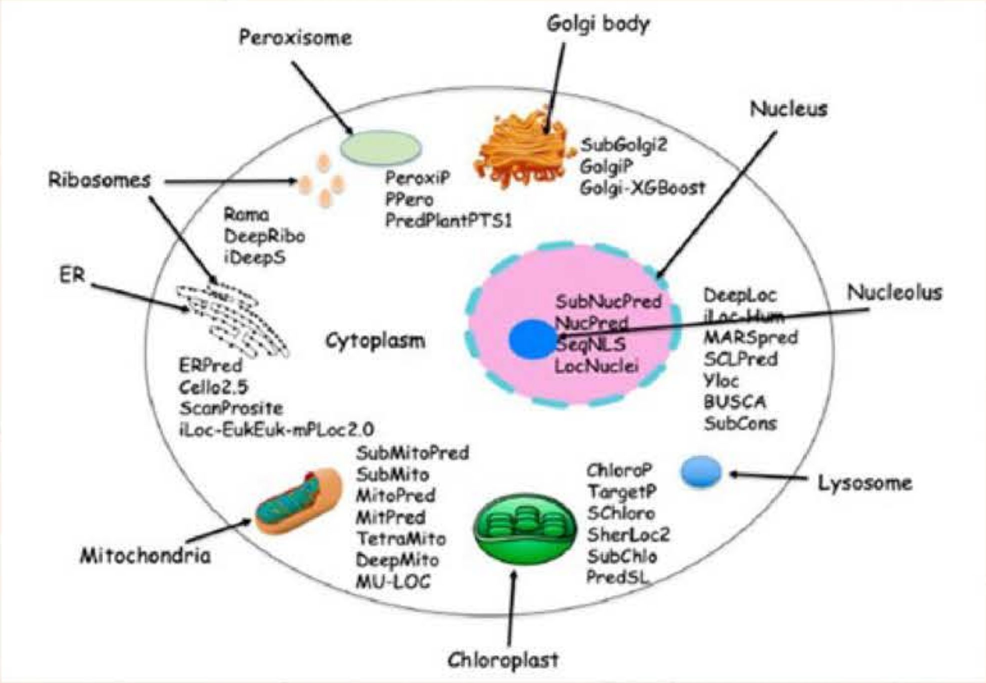

Fig.1 A schematic cell with the possible intracellular protein localizations with the available prediction tools

AIM

Creating an *in silico* analytical pipeline (digital twin) by connecting the already available prediction tools.
The pipeline is useful in planning successful protein engineering strategies for recombinant protein/peptide production in plant systems

WORKFLOW

To create the pipeline, we used a decision tree where each decision node represents an algorithm, and the output of each algorithm can either become the input of the next decision step or be a final node.
We first focused on studying and choosing the currently public available prediction algorithms for in-silico protein analysis, dividing them according to the kind of prediction. Then, based on a cell biology approach, we have established a hierarchy of the prediction algorithms

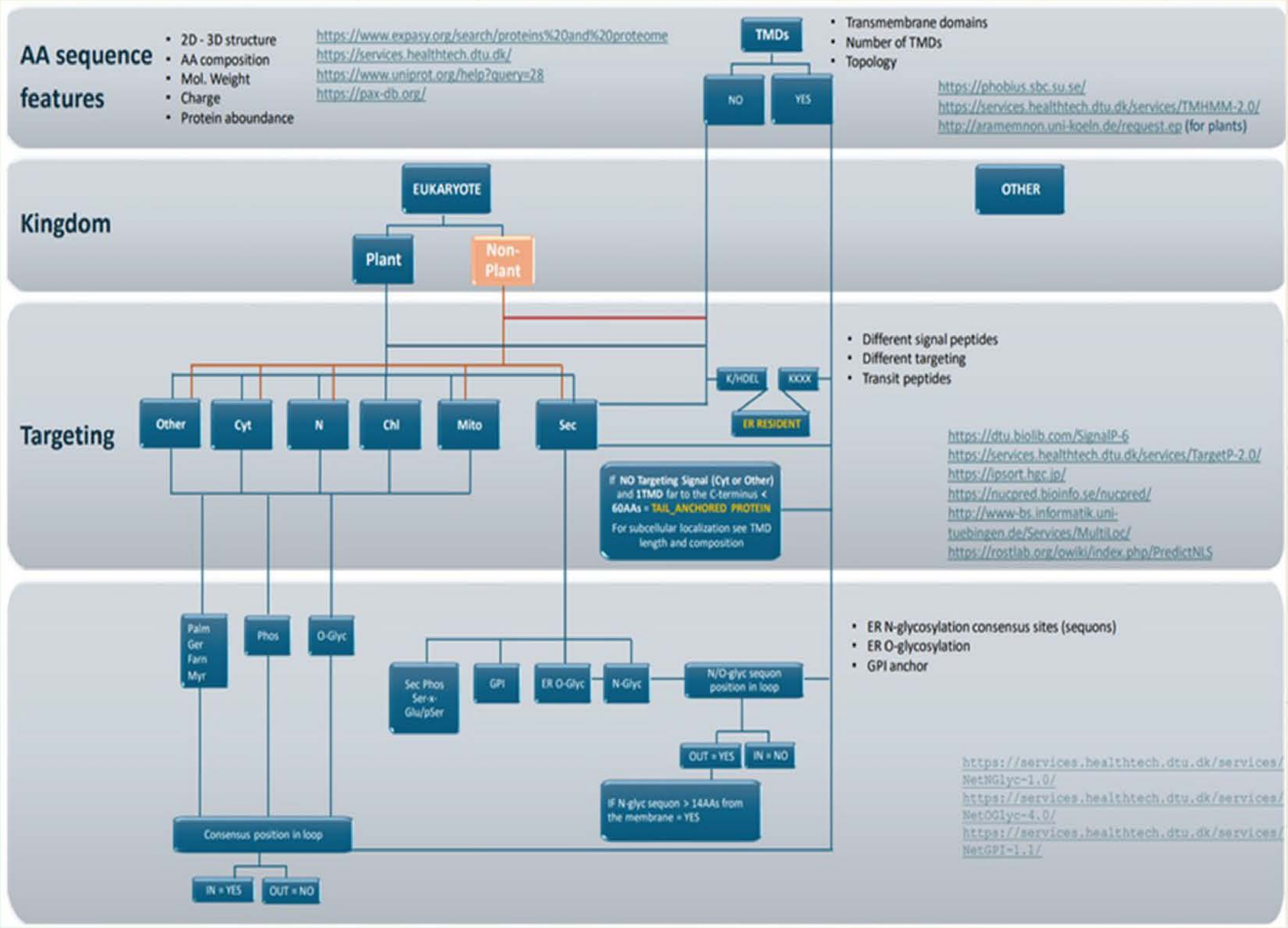

Fig.3 Hierarchy of the algorithms in the pipeline for protein analysis

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CHARACTERIZATION OF NATURAL AEROSOL IN MEDITERRANEAN AREA BY REMOTE SENSING INSTRUMENTS

Spinosa Salvatore

Tutor: Amoruso Salvatore, Boselli Antonella

PHD PROJECT

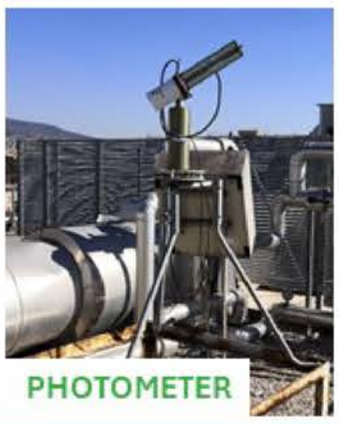
My thesis project aims at monitoring natural aerosol like: volcanic plume, forest fire or saharan dust with active and passive remote sensing techniques.

In particular, during the first year I focused my attention on:

- Application of a Superconductor Detector (SNSPD) for infrared atmospheric lidar measurements;
- LiDAR Measurement of Ash Concentration During the Mount Etna Volcanic Emission of February 21, 2019;
- Multi year sun-photometer measurements for aerosol characterization in Italy.

INSTRUMENTS & METHODS

- Sun-sky-lunar photometer;
- Transportable lidar (TWCA);
- Bistatic lidar (MALIA);
- Bistatic lidar (VAMOS).

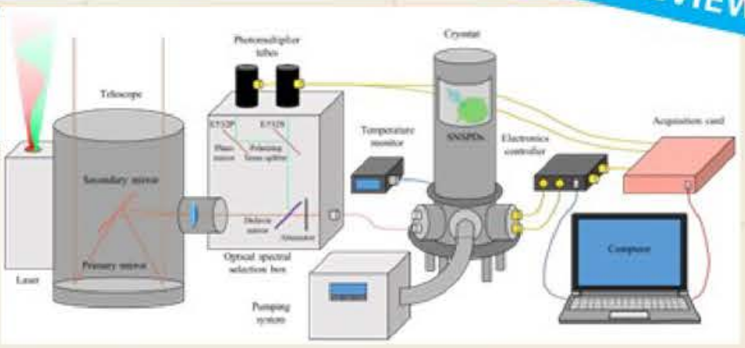


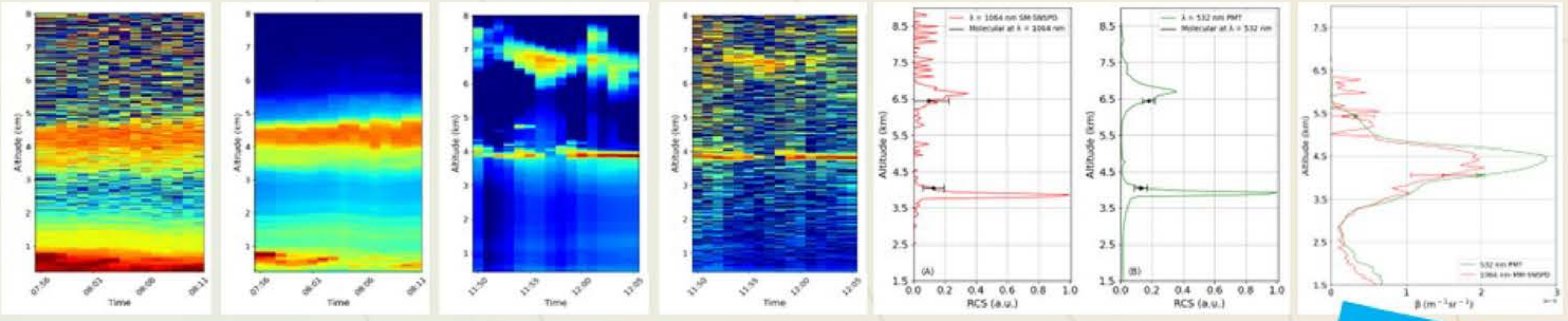
EXPERIMENTS AND DATA ANALYSIS

UNDER REVIEW

Application of a Superconductor Detector (SNSPD) for infrared atmospheric lidar measurements

We use a SNSPDs for atmospheric lidar observations at 1064 nm and compare the results with those obtained simultaneously at 532 nm using a photomultiplier (PMT) as detector. Our experimental findings show the potentiality of SNSPDs for future lidar applications in the infrared domain.



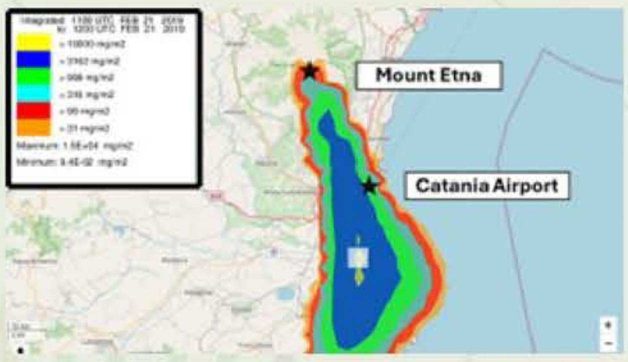


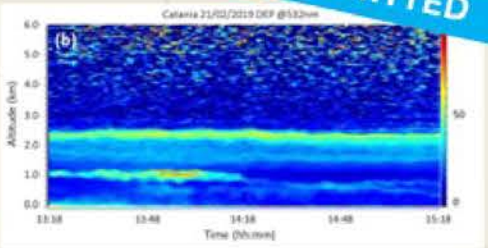
SUBMITTED

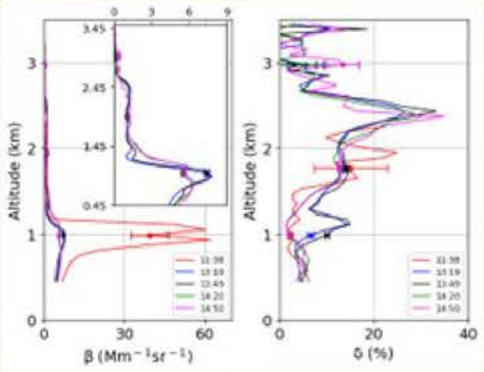
LiDAR Measurement of Ash Concentration During the Mount Etna Volcanic Emission of February 21, 2019

The volcanic ash emissions that took place on 21st February 2019 from the Northeast Crater, one of the summit craters of Mt. Etna, in Italy, was characterized.

Volcanic ash was dispersed by winds several kilometers away from the eruptive crater, mainly toward the west, south and south-east directions, also leading to the temporary closure of the International Airport in Catania. This activity was analyzed using a dual depolarization LiDAR.





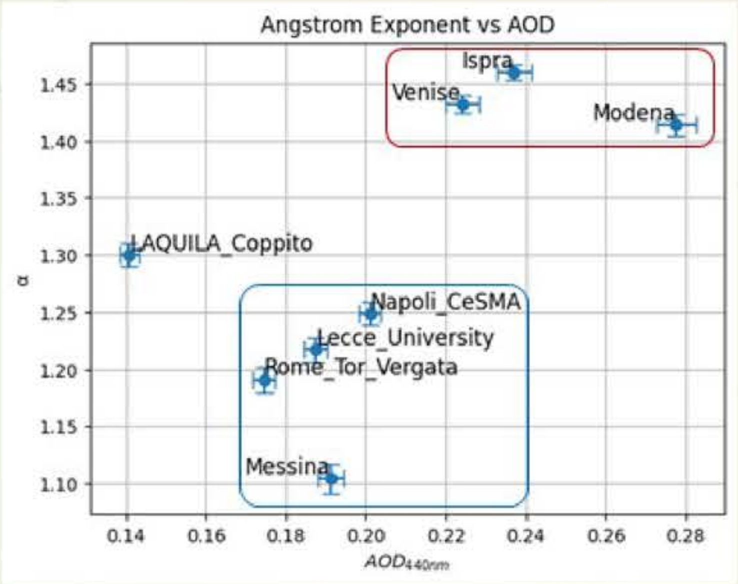


Multi year sun-photometer measurements for aerosol characterization in Italian sites

We analysed the correlation between aerosol characterized at different AERONET stations in terms of AOD, Angstrom Exponent, SSA and Refractive Index, using 8 years of measurements from 01/2016 to 12/2023.

The analysis looks quite promising and is currently in its late stage.

Thanks to these data I performed the exam "Statistical Method For Data Analysis".



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Characterization of source and sinks of O_3, NO_x and CO_2 in lowland deciduous forest

Davide Plebani[1], Angelo Finco[1], Riccardo Marzuoli[1], and Giacomo Gerosa[1]

[1]Dipartimento di Matematica e Fisica, Università Cattolica del S. C., Brescia, Italy

Figure 1: Bosco Fontana tower (ICOS IT-BFt site), is situated within a forest of hornbeams and oaks near the city of Mantua (Italy), in the middle of the Po Valley.

INTRODUCTION

Tropospheric ozone is one of the most dangerous pollutants for plants, being responsible for a series of negative effects leading to reductions of plants photosynthetic performance and growth rate (Marzuoli et al., 2019; Emberson, 2020). Ozone formation is closely linked to NOx and VOCs, its precursors. Uncertainties persist regarding ozone dynamics within forest canopies, such as, for example, its interaction with NO emissions from forest soil (Finco et al., 2018). For these reasons, accurately estimating ozone uptake by stomata (stomatal fraction) versus non-stomatal uptake remains challenging. Therefore, the objective is to conduct long-term campaigns measuring ground-level fluxes of O_3, NOx, and CO_2. These measurements, combined with other data such as above and below canopy fluxes, aim to enhance our understanding of the chemical and physical dynamics within the canopy. Ultimately, this research aims to elucidate how ozone flux influences CO_2 absorption capacity. Here, we describe the infrastructure utilized and present preliminary measurements, focusing particularly on ground-level fluxes of O_3, NOx, and CO_2 measured using an automated dynamic chambers system. Additionally, the measurement of ground-level NO and NO_2 fluxes provides insights into the nitrogen status of the forest. These measurements are crucial given that our measurement site, ICOS IT-BFt, is in the middle of the Po Valley, a hotspot for nitrogen deposition.

MATERIALS AND METHODS

Measurements were performed at the ICOS site IT-BFt in Bosco Fontana, located in Marmirolo near Mantua, Italy. The natural reserve is a mature mixed oak–hornbeam forest. Since 2012, a 40-meter-tall tower has been used for monitoring gas exchanges between the ecosystem and the atmosphere using eddy covariance techniques. Currently, fluxes of O_3, CO_2, and H_2O are measured both above and below the canopy by two eddy covariance stations. Concentration profiles for O_3, NOx, and CO_2 are also measured at four different heights (2, 8, 32, and 42 meters) along the tower. At ground level, a dynamic chambers system, like those described by Butterbach-Bahl et al. (2002) and Fumagalli et al. (2016), is installed to measure soil fluxes of O_3, NO_x, and CO_2.

Figure 2: Automatic dynamic chamber system, constructed following the Butterbach-Bahl et al. (2002) design. This system measures surface fluxes of O_3, NO, NO_2, and CO_2 and it includes 5 measurement chambers and 1 blank chamber.

RESULTS

Here, data collected from early March to mid-May 2024 are presented. Figure 3 shows the average daily soil fluxes of O_3, NO_2, and NO measured by the dynamic chambers system. These average values were recorded:

- O_3 deposition = -0.50 ± 0.06 *n*mol m^{-2} s^{-1}
- NO_2 deposition = -0.17 ± 0.01 *n*mol m^{-2} s^{-1}
- NO emission = 0.30 ± 0.01 *n*mol m^{-2} s^{-1}

Overall, the soil at Bosco Fontana is a net source of NOx, emitting an average of 6.6 ± 0.1 μg N m^{-2} h^{-1}. NO emissions fluctuate between 0.25 and 0.5 *n*mol m^{-2} s^{-1} during the day (Figure 3) and peak in the early afternoon, between 12 AM and 3 PM, following the soil temperature trend (Figure 5).The average respiration rate is 4.1 ± 0.2 μmol m^{-2} s^{-1}, with the daily pattern shown in Figure 5, peaking in the early afternoon. Figure 4 shows the temporal trend of CO_2 emissions, displaying the average daily values. During the measurement period, respiration increased and showed a strong correlation with air temperature.

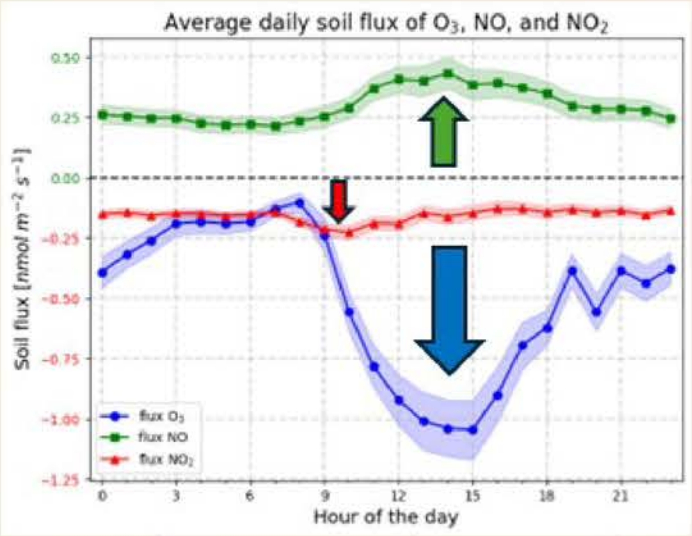

Figure 3: Daily average soil fluxes of O_3 (blue), NO (green), and NO_2 (red), with the lighter shaded area representing the standard error. Data collected using the dynamic chambers system in Bosco Fontana forest (ICOS IT-BFt site) since March to May 2024.

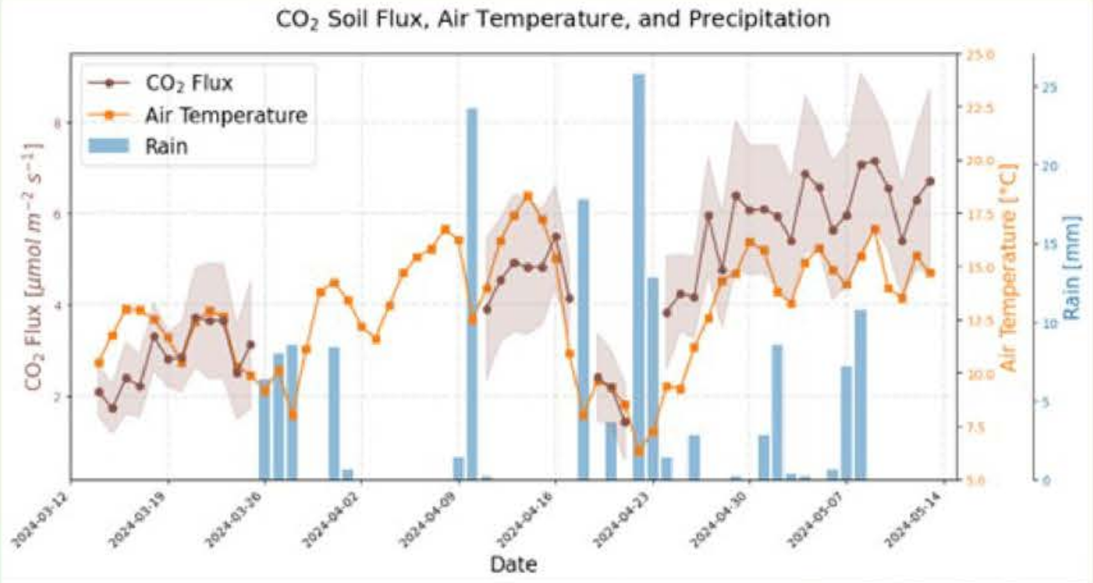

Figure 4: Average daily values from early March to mid-May 2024, showing CO_2 soil fluxes (brown) with standard error (light brown), air temperature at a height of 20 cm (orange), and precipitation (blue). CO_2 fluxes and temperature represent daily averages, while precipitation represents the daily cumulative rainfall.

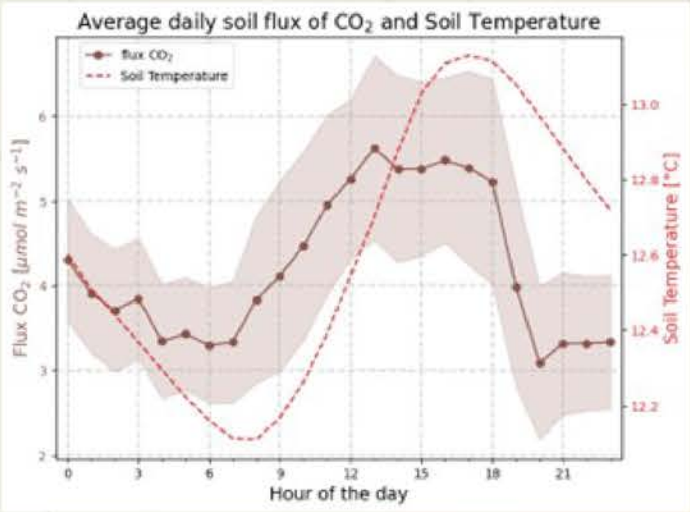

Figure 5: Daily average soil flux of CO_2 (brown), with the lighter brown shaded area representing the standard error. Also shown is the daily average soil temperature at a depth of 10 cm. Data collected using the dynamic chambers system in Bosco Fontana forest (ICOS IT-BFt site) since March to May 2024.

CONCLUSION AND PERSPECTIVES

The first measurements performed with the dynamic chambers system look promising, and, with additional data, the aim is to link NO and CO_2 emissions with environmental parameters, such as air and soil temperature, soil moisture, and precipitation events.

Soil fluxes, as well as flux measurements above and below canopy, will be useful to improve the knowledge about intra-canopy dynamics.

Looking ahead, for the 2025 field campaign, we are attempting to organize measurements of N_2O fluxes too at the soil level to further investigate nitrification and denitrification processes, along with above canopy ammonia and NO fluxes in order to better estimate the nitrogen load of this ecosystem, given its unique position in the middle of the Po valley.

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REFERENCES

[1] **Butterbach-Bahl, K., Breuer, L., Gasche, R., Willibald, G., Papen, H., 2002.** Exchangeof trace gases between soils and the atmosphere in Scots pine forestecosystems of the northeastern German lowlands: 1. Fluxes of N2O, NO/NO2and CH4 at forest sites with different N-deposition. For. Ecol. Manage. 167 (1),123–134.

[2] **Fumagalli I; Gruening C; Marzuoli R; Cieslik S; Gerosa G. 2016.** Long-term measurements of NOx and O3 soil fluxes in a temperate deciduous forest. AGRICULTURAL AND FOREST METEOROLOGY 228-229; p. 205-216. JRC100639.

[3] **Marzuoli, R, Gerosa, G, Bussotti, F, Pollastrini, M. 2019.** Assessing the impact of ozone on forest treesin an integrative perspective: Are foliar visible symptomssuitable predictors for growth reduction? A critical review. Forests 10: 1144.

[4] **Emberson, L. 2020.** Effects of ozone on agriculture, forests and grasslands. Philosophical Transactions of the Royal Society A 378(2183): 20190327. DOI: http://dx.doi.org/10.1098/rsta.2019.0327.

[5] **Finco, A., Coyle, M., Nemitz, E., Marzuoli, R., Chiesa, M., Loubet, B., Fares, S., Diaz-Pines, E., Gasche, R., and Gerosa, G.** 2018: Characterization of ozone deposition to a mixed oak–hornbeam forest – flux measurements at five levels above and inside the canopy and their interactions with nitric oxide, Atmos. Chem. Phys., 18, 17945–17961, https://doi.org/10.5194/acp-18-17945-2018.

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The potential of the ICOS network for assessing climate-smart forestry options: preliminary modelling results from a sub-alpine forest

[1]Sherry Kyamagero, [1]Leonardo Montagnani, [2]Daniela Dalmonech, [2]Alessio Collalti, [1]Enrico Tomelleri

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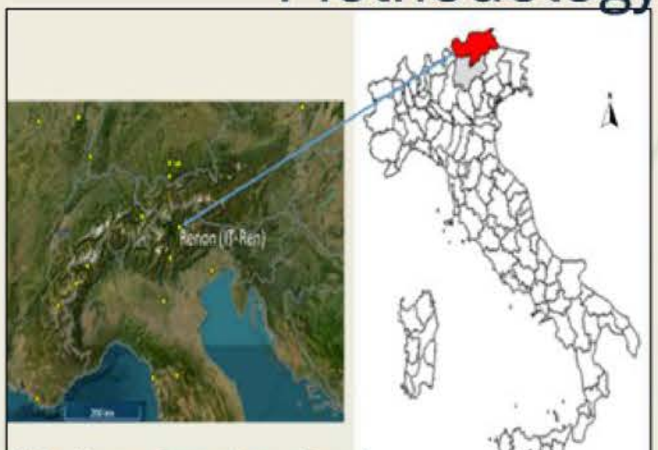
Introduction

- Accurate assessment of carbon dynamics in managed forests is crucial for effective carbon accounting and climate mitigation strategies.
- The study aims to evaluate and improve the model predictions with observations for assessing the impact of management on carbon dynamics and support the development of large-scale climate-smart forestry strategies.

Methodology



http://www.icos-etc.eu/icos/

- Renon forest is in the Italian Alps
- Norway spruce (ca. 85%)
- LAI of 5.1
- Max height ca. 30 m
- Equipped with eddy covariance (EC) flux tower since 1997

- The study employed a process-based model (3D-CMCCFEM_V5.6) https://www.forest-modelling-lab.com/the-3d-cmcc-model
- Model performance was tested against the ICOS Warm Winter 2020 EC flux data for IT-Ren (2010-2020).

Sensitivity analysis

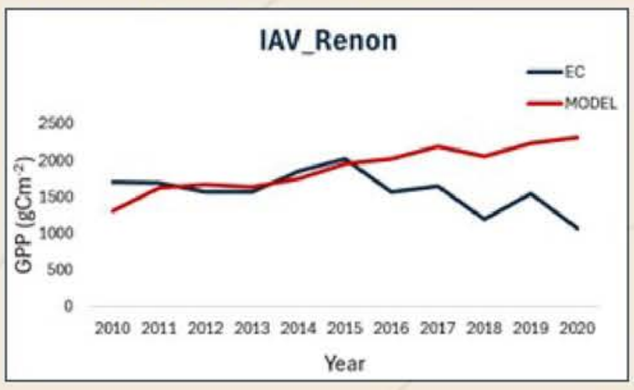
- Sensitivity analysis was conducted using the One-Factor-at-a-Time (OAT) method.
- Parameters were perturbed by ±10% of their default values.
- Parameters were selected based on previous sensitivity study (Collalti et al., 2019).

Ten parameters used in the sensitivity analysis

Process	Parameter	Default value	Description
Light interception	K	0.54	Extinction coefficient for absorption of PAR by canopy
Stomatal conductance Mortality	MAXAGE (yr)	400	Determines rate of physiological decline of forest
Photosynthesis Stomatal conductance	GROWTHTMAX (°C)	35	Maximum temperature for assimilation /conductance
Partitioning and allocation	LIVE_TOTAL_WOOD	0.076	Live C : total wood
Partitioning and allocation Autotrophic respiration	CN_LIVEWOOD (Kg C/kg N)	50	C:N of live wood
Autotrophic respiration	LIVE_WOOD_TURNOVER (yr^{-1})	0.02	Annual live wood turnover
Plant structural trait Light interception	SAP_A	0.851	Scaling coefficient in sapwood area vs. DBH relationship
Plant structural trait Light interception	SAP_B	1.684	Scaling exponent in sapwood area vs. DBH relationship
Plant structural trait	STEMCONST_P	0.127	scaling coefficient in stem mass vs. DBH relationship
Plant structural trait	STEMPOWER_P	2.3	Scaling exponent in stem mass vs. DBH relationship

Results

Model performance



The predicted inter-annual variability (IAV) of Gross Primary Production (GPP) is partially consistent with observations.

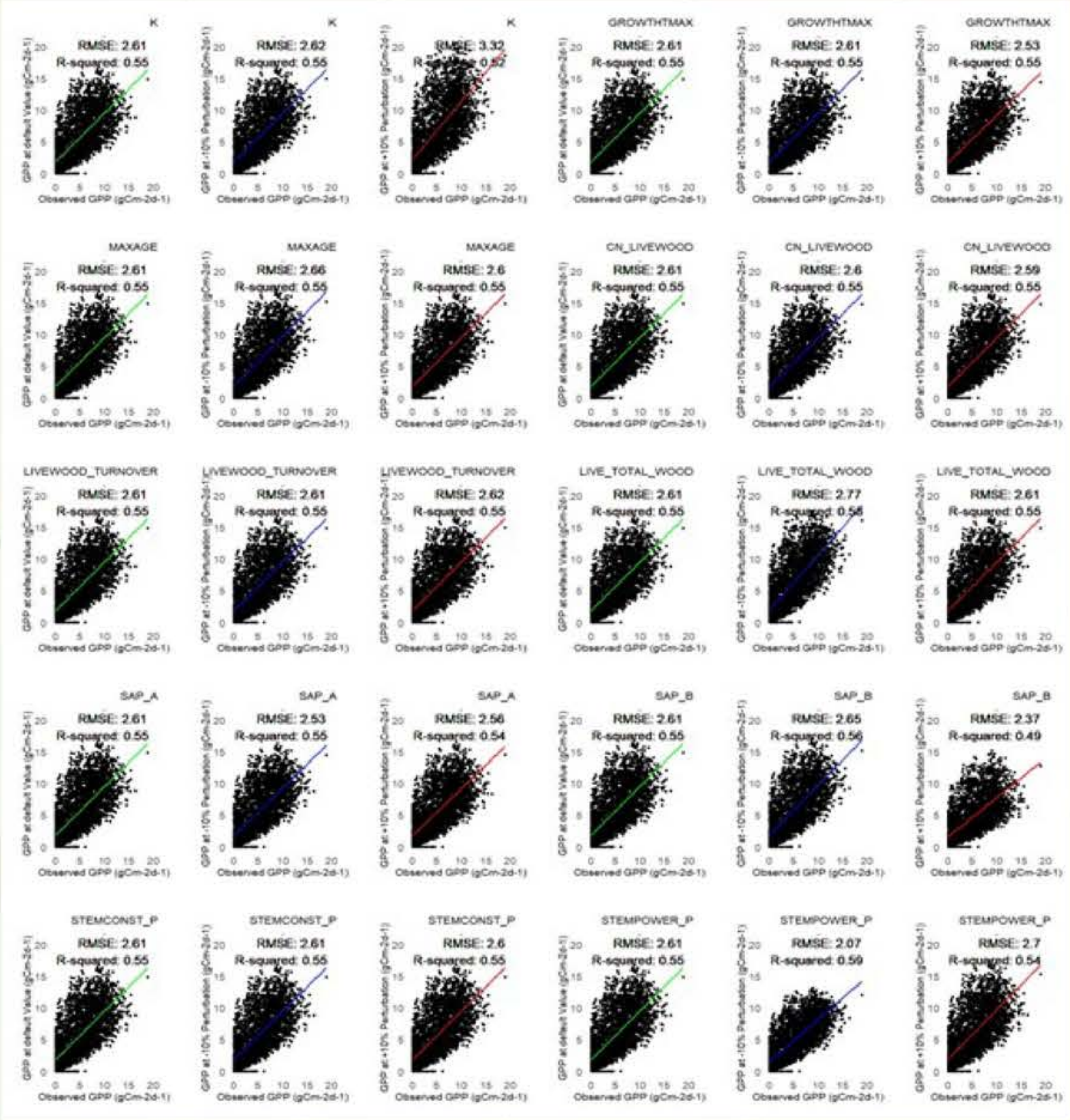
Performance statistics				Long-term average of annual GPP values (gC m−2 year−1)	
MAE	MABstd	NRMSE	R_squared	EC	MODEL
419.825	1.0655	0.00036	0.928	1585.179	1888.321

Response to climate variability

	Coefficients	Standard Error	P-value	F	Significance F	R Squared
Intercept	836.4157	437.3269	0.0922	5.5694	0.0305	0.582
Temperature	215.9566	67.4123	0.01255*			
Precipitation	-18.3138	140.1652	0.8993			

- Approximately 58.2% of the yearly fluctuations in gross primary productivity (GPP) were accounted for, indicating the potential influence of other factors.
- We could confirm that the model responds significantly to temperature.

Parameter sensitivity for GPP



- The GPP simulated by 3D-CMCCFEM is highly sensitive to parameters SAP_B and STEMPOWER_P : Calibration needed.
- Not sensitive to parameters LIVE_WOOD_TURNOVER, STEMCONST_P, CN_LIVEWOOD, T_MAX, and MAXAGE: Need for analysis with wider perturbation ranges to thoroughly evaluate model robustness.
- Some parameters impact model performance when increased (SAP_A and K) or decreased (LIVE_TOTAL_WOOD) but exhibit no effect when perturbed in the opposite direction: Further Investigation needed.

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The urban energy and carbon balance evaluation for defining the impact of anthropogenic emissions

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CONTEXT

In the course of the last decades, we have assisted a slow and steady modification of the energy balance in urban environments, causing an alteration of the energy partitioning in cities that emerges from the complex nature of urban environments. Such changes include increases in heat and greenhouse gas emissions and fluxes, which are directly dependent on the growing world population and the constant increase of energy demand and consumption. The energy partitioning depends on the surface geometry of roughness elements, the type of climate, the local weather conditions and the surrounding rural landscape. Exchanges and interactions at the land-atmosphere interface in cities play a major role in accurately depicting the partitioning of energy, heat and GHG fluxes, the influence on weather conditions, rainfall events, heat waves, air turbulence conditioned by surface morphology, urban carbon fluxes and so on. The research takes place within the EU Horizon 2020 programme, funding PAUL and ICOS Cities projects, dealing with innovative approaches to GHG emissions assessments to support cities in adopting climate action plans, through the delivery of data on fossil fuel emissions from urban areas.

OBJECTIVE

To accurately estimate and close the urban energy balance, it is essential to study the residual terms, with a focus on the anthropogenic contribution in all its forms, as it significantly influences the energy balance of a city.

METHODOLOGY

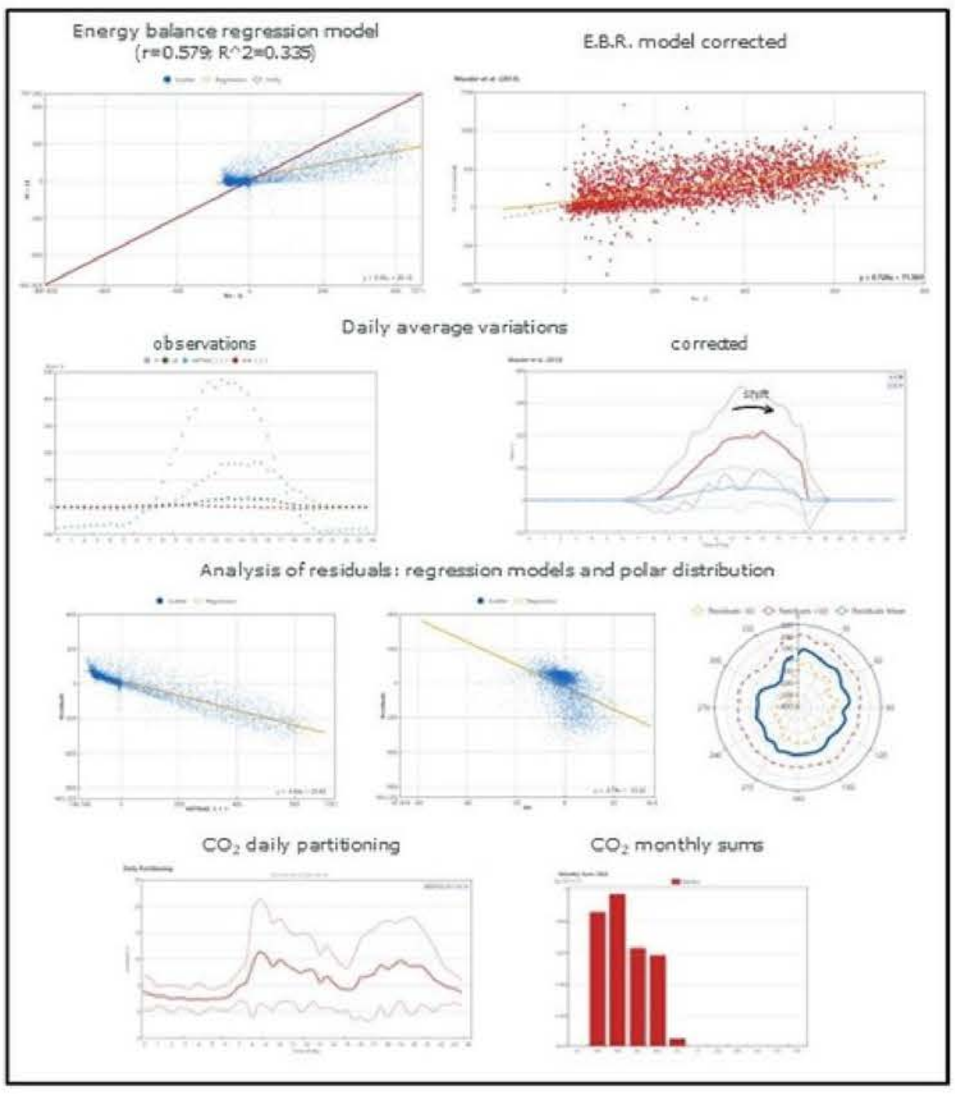
The Eddy Covariance approach for environmental studies is a powerful technique that is used in many applications in the study of urban ecosystems and fluxes. The post-processing steps of flux data included flux footprint climatology and energy and carbon budgets calculations at the urban EC site 'ITSas', which were realized using tools such as the online tool 'Flux Footprint Prediction' and the post-processing 'Tovi' (from LI-COR®) software.

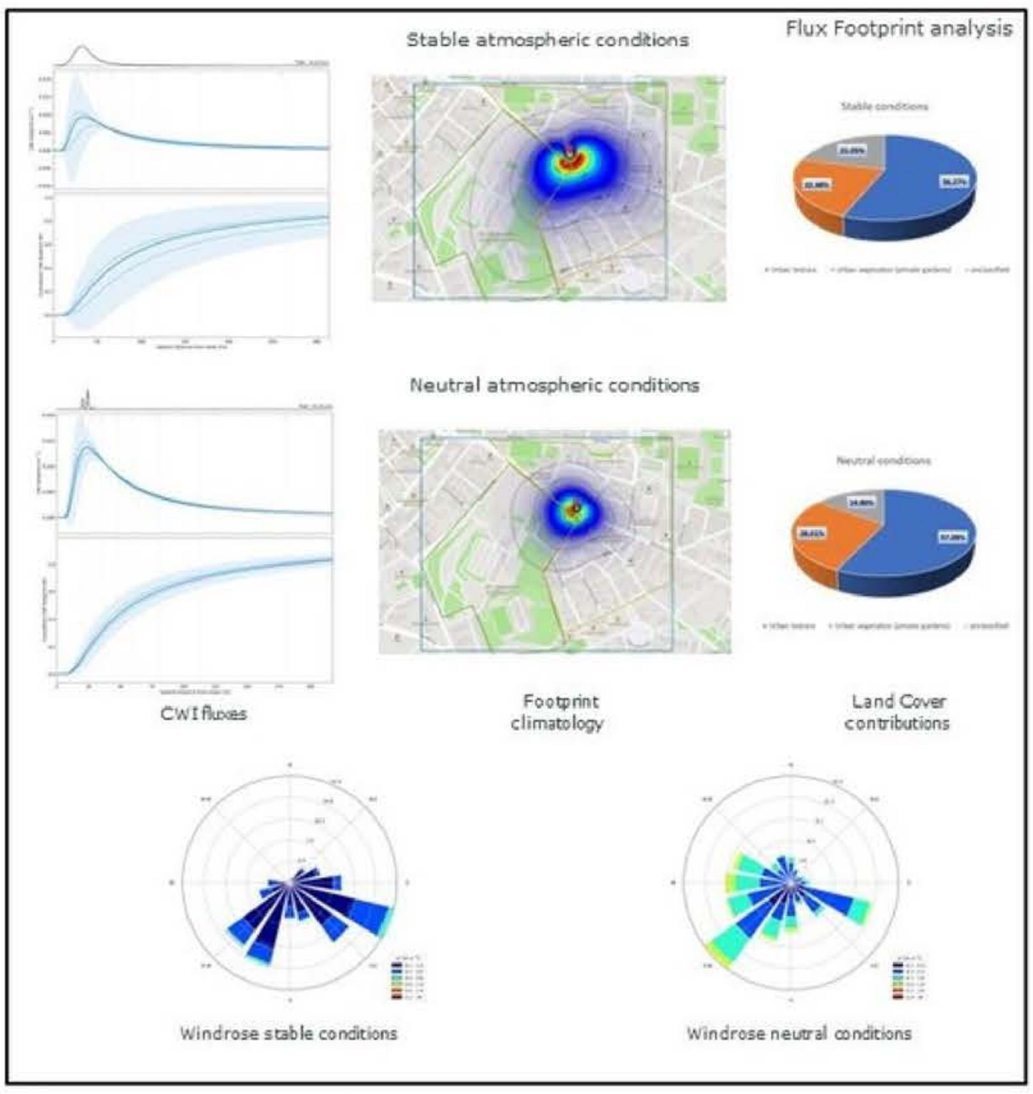
EXPERIMENTAL SETUP

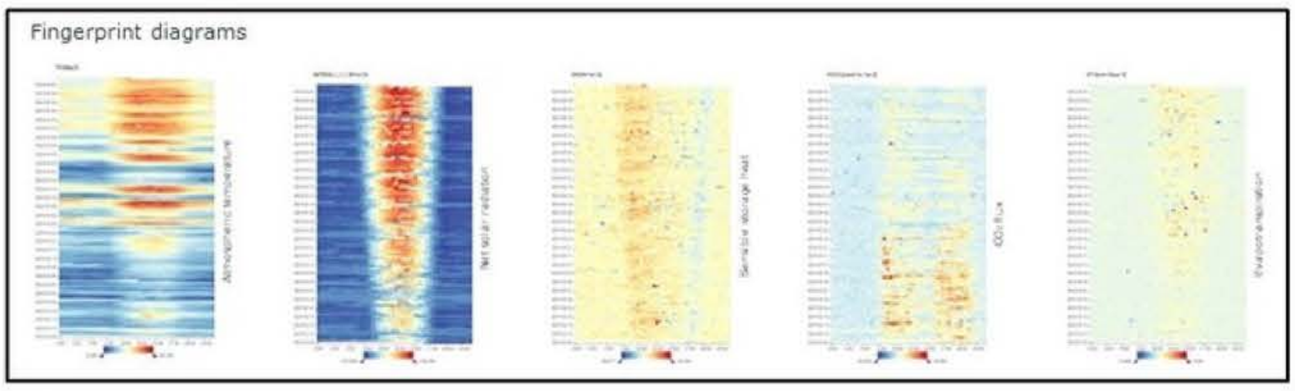
The EC station is located on the roof of a building in Sassari (Sardinia, Italy N 40° 43' 0.4836 E 8° 34' 32.88, 254 m asl). Measurement height is fixed at 23 m from ground. Instruments include a Gill HS-50 sonic anemometer, with a north off-set of 314.0°, and a closed-path LI-7200 gas analyzer, with ID AIU-0870, for H2O and CO_2 fluxes.

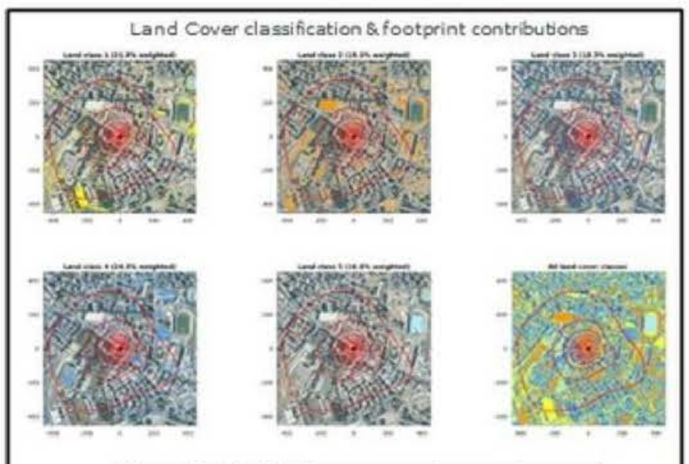
RESULTS

Here are presented products that show an ensemble analysis of fluxes data for the overall timeline Feb 6th - Jun 4th 2024.









FFP FOOTPRINT classification	Site: 202406152129311299				
Area	Class=1 within footprint	Class=2 within footprint	Class=3 within footprint	Class=4 within footprint	Class=5 within footprint
10%	0.308	0.117	0.242	0.128	0.206
20%	0.275	0.090	0.261	0.151	0.222
30%	0.279	0.078	0.258	0.149	0.235
40%	0.268	0.115	0.233	0.146	0.239
50%	0.247	0.168	0.198	0.156	0.233
60%	0.256	0.202	0.162	0.158	0.222
70%	0.255	0.225	0.158	0.169	0.195
80%	0.245	0.232	0.151	0.182	0.190
90%	0.251	0.203	0.170	0.174	0.201
Domain	0.256	0.199	0.160	0.187	0.199

DISCUSSION

The energy balance regression model reveals a state of non-closure with a poor correlation. The application of the correction method of Mauder et al. (2013) helps achieve a near-closure balance, with few residuals left. By comparing the daily variation of budget components, the correction reveals the action of CO_2 and H_2O that delay heat fluxes, enhanced probably by advection effects and winds. Energy residuals seem to correlate well with energy availability and storage, hinting at inputs from anthropogenic heat fluxes, like fossil fuel consumption and urban metabolism. The range of variations remains uniform, with only little deviations falling along main wind directions (e.g. NW winds). The CO_2 balance analysis corroborates the effective contribution of CO_2 from fossil fuels due to enrichment by urban traffic peaks at rush hours. The CO_2 gas appears to be more abundant during the cold season than milder periods due to its solubility and stronger household emissions. Fingerprint diagrams have shown that the heat storage reaches maxima during the morning while drops out during the evening, that LE, ET and H_2O flux vary the same and increase with high air temperatures and strong radiation, that the CO_2 flux varies inversely with TA and manifests two main high-value peaks. The flux footprint processing, based on the work of Kljun et al. (2015), demonstrates the urban nature of the flux data since the major contributions (about 60%) to footprint climatology come from urban areas, while a minor input is from vegetated surfaces. The footprint profiles seem to roughly reflect in shape the prevailing wind directions, i.e. SW and SE, in atmospherically stable and neutral conditions that best characterize the tower site, as can be deduced by fingerprint diagrams of the main atmospheric descriptors. Finally, the k-means land cover classification responds to the patchy typology of the terrain around the site by partitioning flux contributions with little differences between the five classes and for each cumulative areal step so that fractions of land surface types do not differ significantly and fall in a relatively short range. However, this kind of classification sometimes lacks in accuracy or it is excessively detailed for the scope of the study, as in this case.

REFERENCES

Kljun N, Calanca P, Rotach MW, Schmid HP. 2015. A simple two-dimensional parameterisation for Flux Footprint Prediction (FFP). Geoscientific Model Development, 8(11):3695-3713. doi:10.5194/gmd-8-3695-2015.

Mauder M, Cuntz M, Drüe C, Graf A, Rebmann C, Schmid HP, Schmidt M, Steinbrecher R. 2013. A strategy for quality and uncertainty assessment of long-term eddy-covariance measurements. Agricultural and Forest Meteorology, 169:122-135. doi:10.1016/j.agrformet.2012.09.006.

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Assessment of ozone impact on stem radial growth in Italian forests: a preliminary analysis and research perspectives

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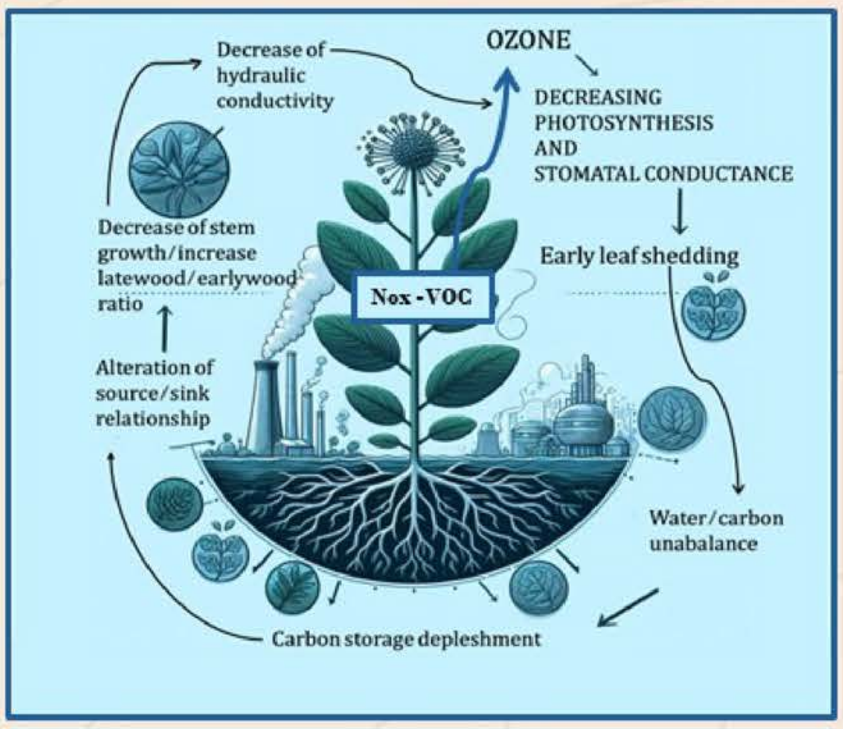
Background and Hypothesis

Ozone and plant carbon sequestration are the focus of scientific studies on O_3 phytotoxicity and tree physiological responses. O_3 enters plants through stomatal openings. Assessing O_3 flux using the Phytotoxic Ozone Dose (POD) equation helps estimate vegetation damage risk, considering factors such as vapor pressure deficit and soil water content, especially pertinent in Mediterranean regions. In the troposphere, O_3, primarily from human activities, poses significant harm to both humans and plants due to its stability and low molecular weight, enabling extensive dispersion from emission sources. Plants are highly sensitive to environmental changes that can restrict growth. Forests play a critical role in climate regulation but are susceptible to stressors like climate change, pollution, and ozone, which induces phytotoxic damage. The European Community estimates that over 50% of forests have been exposed to high ozone levels.Ozone levels in natural environments may act as stress cofactors at the leaf level, influencing stem water relationships during growing seasons, thereby limiting radial growth. This hypothesis originates from ozone's impact on leaf biology and physiology, triggering cascading negative effects at the stem level.



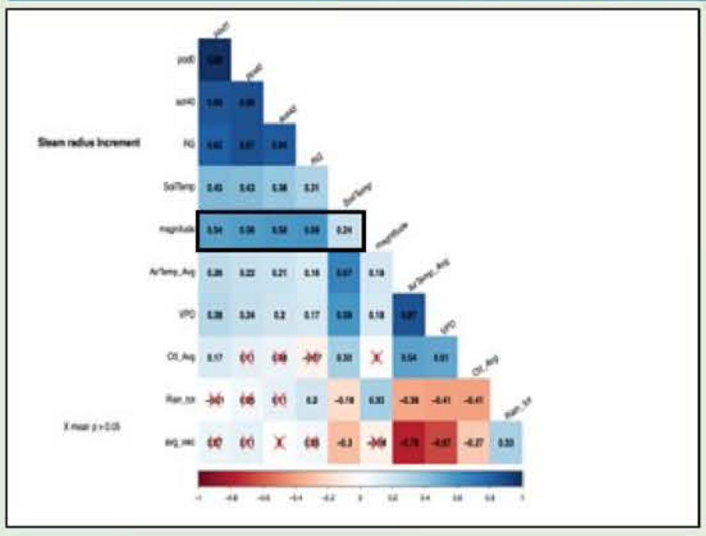
Aim

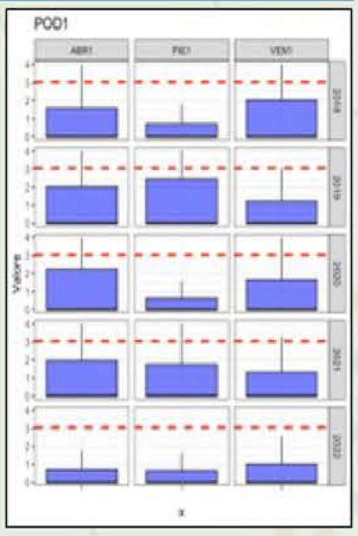
The study aims to assess the impact of tropospheric ozone on forest ecosystems, focusing on tree radial growth. It seeks to provide reliable measurements, establish cause-and-effect relationships between ozone levels and tree growth, and develop analytical protocols for large datasets and environmental correlations.

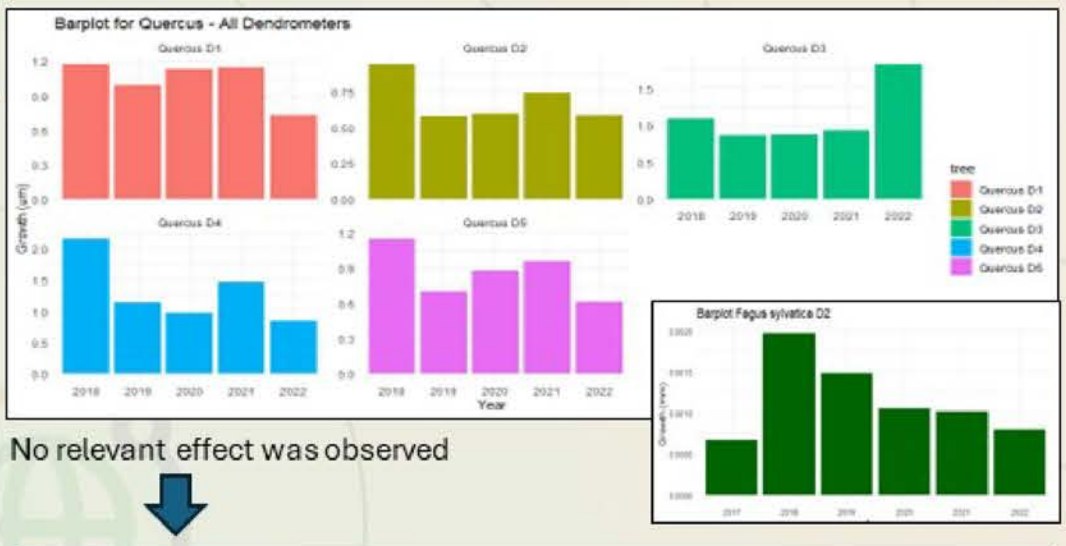
Materials and Methods

The study spans **6 forest sites in Italy**, each with 5 coeval trees equipped with environmental monitors. Radial stem growth is tracked using **5 point dendrometers** per site, and sap flow is measured with **Treetalkers** on each tree. Dendrometric signals, detected by potentiometers on the stem, reflect water dynamics in cortical tissues as cycles of shrinkage (S), expansion (E), and increment (I). Automated analysis of point dendrometer time series (DTS) is essential for studying tree growth, despite noise that needs distinguishing from biological responses and irregular fluctuations. Data analysis, including both dendrometric and environmental data, is managed using R software with scripted workflows for comprehensive analysis.

Preliminary results







No relevant effect was observed

- Is the survey period too short?
- Are there effects of ozone from the previous year on the current growth patterns?
- Are traditional qualitative and quantitative statistical methods too weak to model such complex physiological effects?

Main conclusions

To address these challenges, we will implement algorithms and models to remove environmental noise and a two-module software component: the Embedding module, which uses key Machine Learning algorithms, and the Voter module, which consolidates results. Additionally, we will estimate stomatal conductance using sap flow data and employ moving window cross-validation.

In summary, these future perspectives will underscore the significance of our software framework in studying the effects of ozone on tree growth, paving the way for advancements in environmental analysis and modeling.

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Understanding Ozone Dynamics in Periurban Mediterranean Forests: Insights from Multiannual Flux Measurements

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(1) Institute of bioeconomy (IBE-CNR) , (2) Institute for Sustainable Plant Protection (IPSP-CNR), (3) Council for Agricultural Research and Economics (CREA), (2) Research Centre for Forestry and Wood, (4) Institute for Agriculture and Forestry Systems in the Mediterranean (ISAFoM-CNR).

Introduction

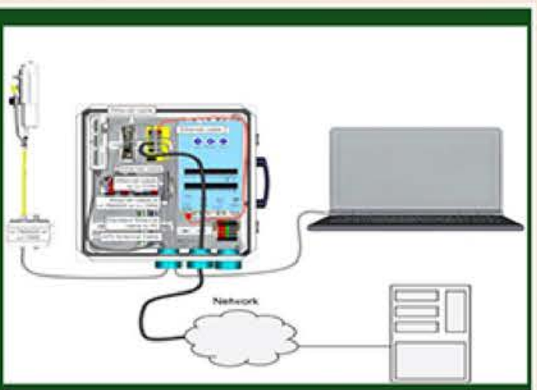
- Tropospheric ozone (O_3) is harmful to plants, causing leaf damage, reduced photosynthesis rates, and inhibited growth.
- Urban areas, abundant with anthropogenic O_3 precursors, significantly contribute to O_3 formation, posing a particular risk to periurban Mediterranean forests.
- This study investigates the seasonal patterns in ozone stomatal fluxes and the climatic factors influencing their fluctuations. It will also examine the year-to-year variability of ozone fluxes based on climatic conditions.

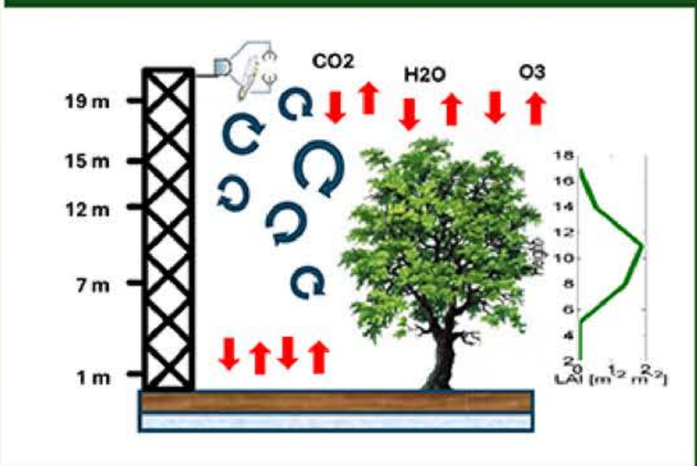
Study site

- The study site, "Grotta di Piastra" (IT-Cp2) (41°42' N, 12°21'E), located within the Castelporziano Estate, 25 km southwest of central Rome, Italy, is designated as an ICOS Class 1 site.
- The site is a periurban Mediterranean ecosystem, consisting of an even-aged holm oak (Quercus ilex L.) forest, characterized by dry summers with minimal precipitation.

Materials and Methods

- The Eddy Covariance technique is employed to evaluate bidirectional fluxes and the role of the forest in the exchange of air pollutants.
- This method measures CO_2, H_2O, and O_3 fluxes on a 30 minutes interval year-round to capture seasonal dynamics.



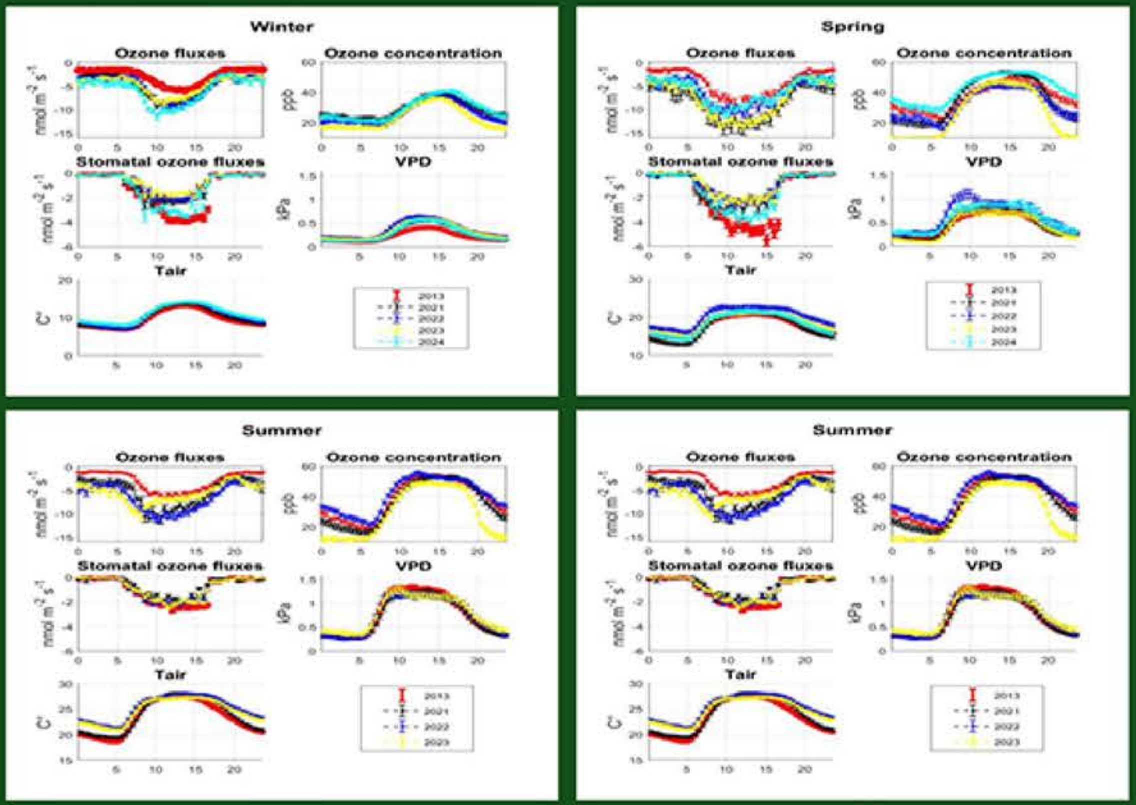


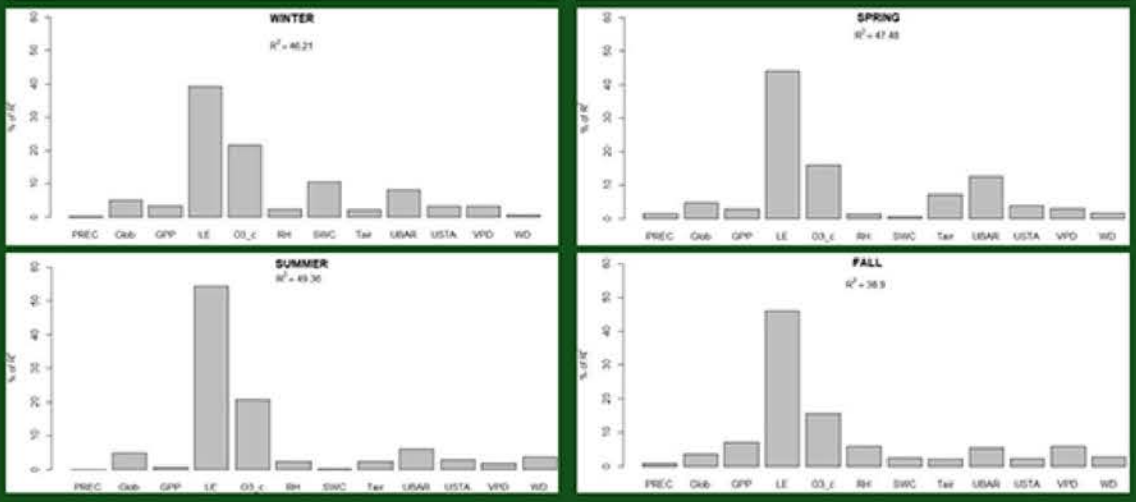
- Air temperature and relative humidity are measured at multiple heights using thermohygrometers on a scaffold tower. Additionally, we measure precipitation, PAR, soil water content, and other environmental parameters.
- Ozone fluxes are quantified using a UV photometric ozone analyzer and a FAST ozone analyzer.

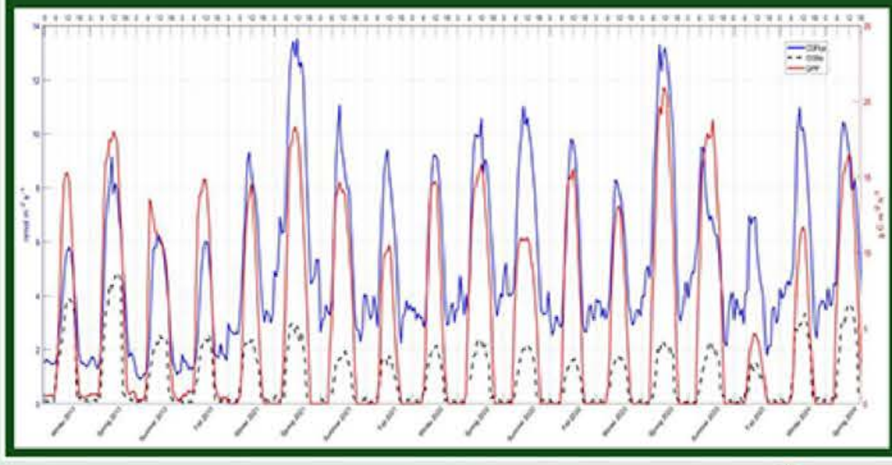
Wind Direction and Sonic Temperature	Gill HS-50
CO_2 and H_2O	LI-7200, LI-COR
Fast O_3 analyzer	FOS-sensor, Sextant technology Ltd
O_3	49i Thermo Scientific

Dependence of Ozone Fluxes on Environmental Parameters

- Differences in the stomatal component of ozone flux between seasons are more pronounced in years with greater seasonal variations in VPD.
- Summers marked a strong reduction of precipitation, while temperature still increased: stomatal conductance decreased to prevent excessive water loss by transpiration, leading to a decline in photosynthesis rate.
- Seasonal hourly averages show that years with higher water availability exhibit higher levels of GPP and ozone fluxes.
- Higher water availability corresponds to a greater stomatal component of ozone fluxes (calculated using the evaporative/resistance method).
- A stepwise analysis on daily ozone fluxes shows that approximately 50% of the variability in stomatal ozone fluxes is explained by environmental variables, particularly the latent heat flux (LE) and the ozone concentration (O_3_c).
- From the histogram, we observe that parameters related to atmospheric turbulence, such as horizontal wind speed (UBAR), also contribute to the variability of stomatal ozone fluxes.







- Despite GPP accounting for only a minor portion of the variability in stomatal ozone fluxes, it exhibits a seasonal variability consistent with these fluxes due to its dependence on stomatal regulation.

We want to thank: The Directorate of Castelporziano Estate. Research was possible thanks to MULTIFOR project and National Biodiversity Future Center.

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Interplay of Climate, Fishing, and Biodiversity: Risk Assessment in the Mediterranean Sea

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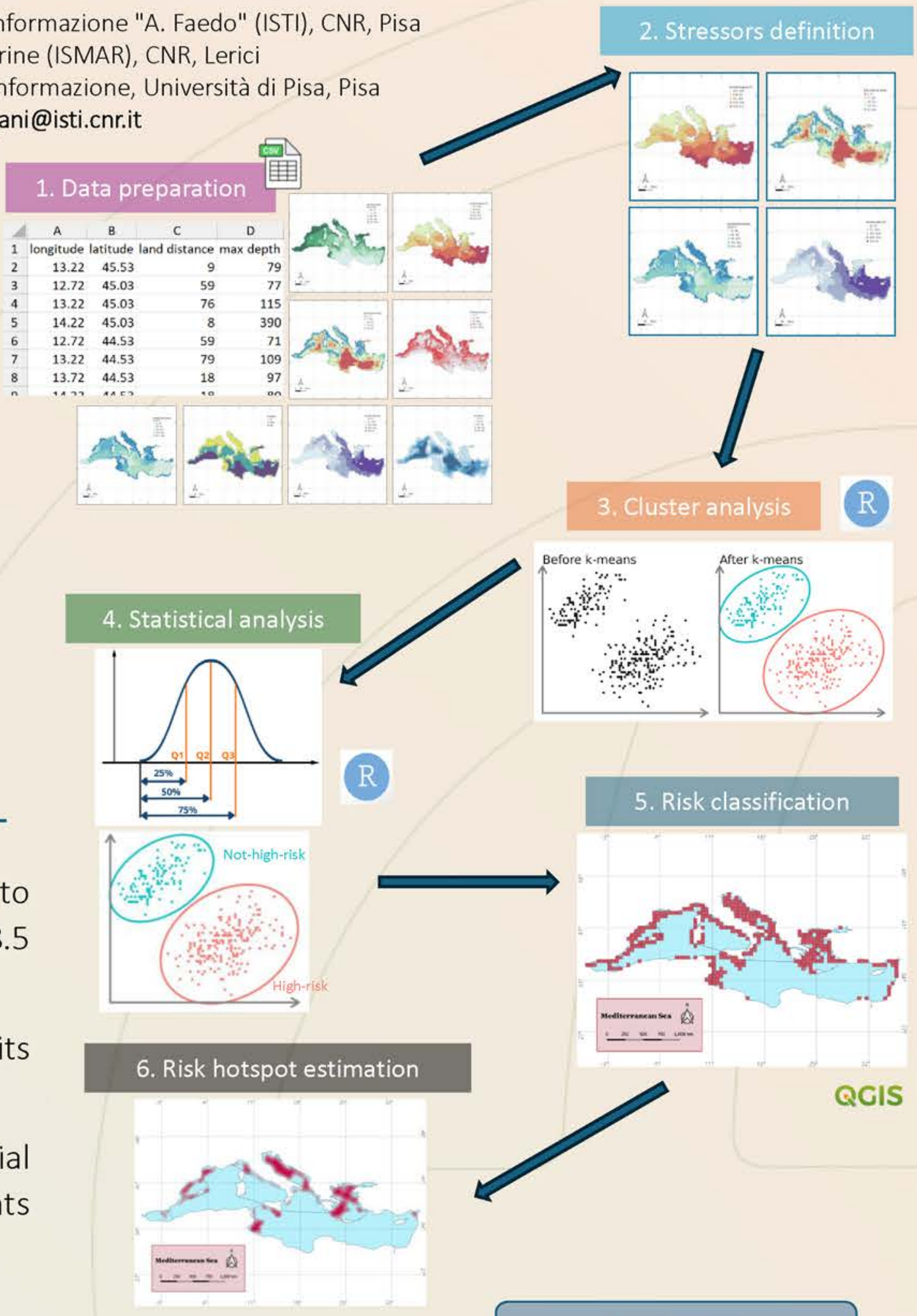
INTRODUCTION

Marine ecosystems provide essential goods and services for both the environment and the economy. However, increased human activities are having several negative impacts on these ecosystems and climate change is intensifying these effects.

Risk assessments for ecosystems quantify the probability and consequences of undesirable events.

The current study presents a methodology that automatically identifies high-risk hotspots in the Mediterranean Sea, where environmental parameters, fishing activity, and species richness stressors overlap.



METHODOLOGY

The dataset includes open geospatial data from 2017 to 2021 and data projections to 2050 under the RCP 8.5 scenario.

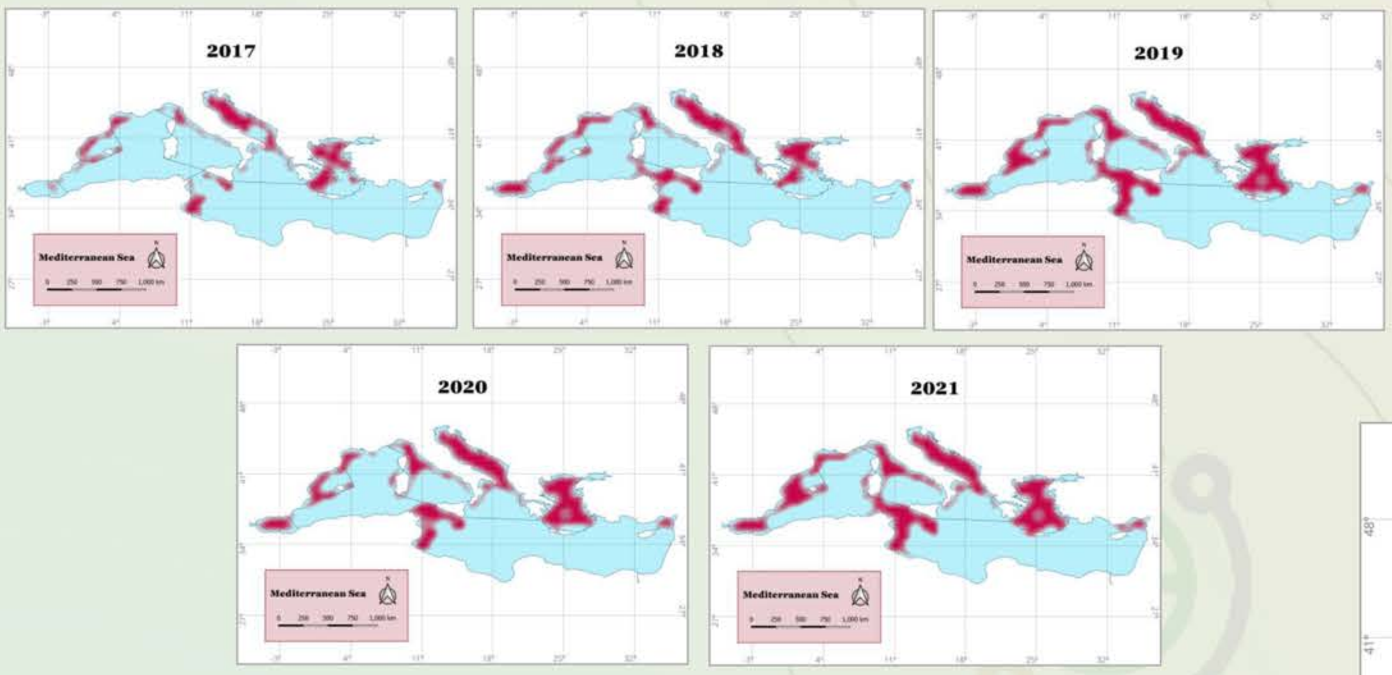
Our methodology is statistical and based on big data, its scope is to produce macro patterns of risk.

The workflow can produce a temporal sequence of spatial perspectives over a reference time frame, which highlights the dynamic evolution of the stressors' concurrency.

RESULTS

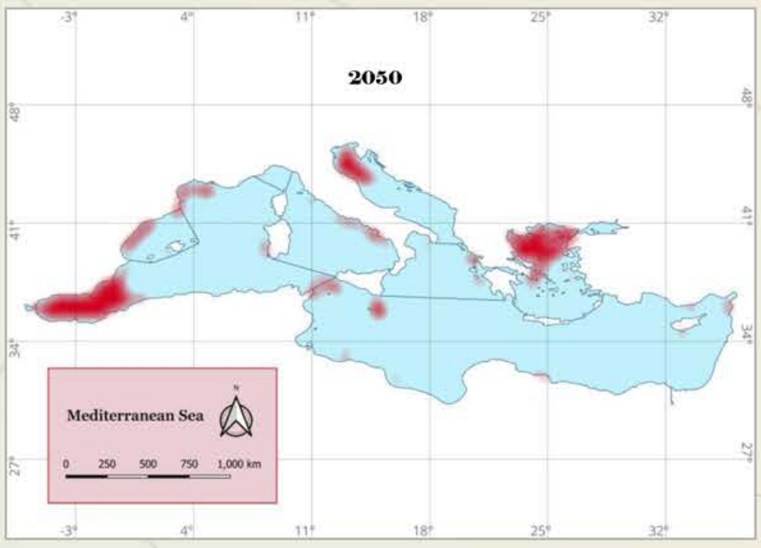
The results obtained by overlapping different features via multi-K-Means cluster analysis revealed "high risk" areas (red areas).

In these areas, a combination of stressors such as overexploitation of fisheries resources, excessive fishing hours, biodiversity, geographical and environmental conditions create a particularly risky for biodiversity and, consequently, for stock richness.



Fishing activity pressure on species and stock richness in peculiar environmental conditions. From 2017 to 2021

Hotspots of climate change 2050



CONCLUSIONS

Understanding the interplay of environmental, human, social, and economic factors, and how they will evolve with climate change, is crucial for prioritizing management interventions.

Using FAIR and big data within an Open Science-oriented approach benefits ecosystem sustainability and conservation.

Our maps can provide prior information to Bayesian models for ecosystem modelling and spatial planning.

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ITINERIS

Wetland Geospatial data Harmonization: an Open Catalogue for the Massaciuccoli Lake Basin

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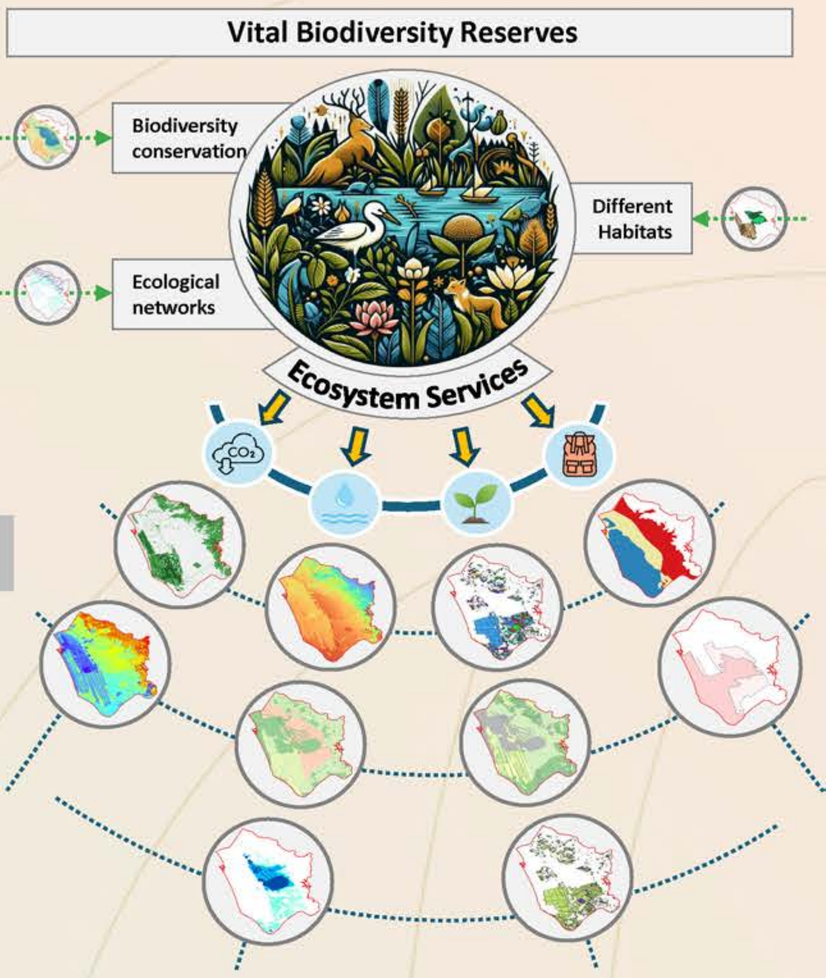
Context

Wetlands are important biodiversity reserves and represent **critical ecosystems**. These environments include an extraordinary diversity of plants, animals and aquatic species. They contribute substantially to the **preservation of biological diversity** and provide a **wide range of habitats**. These areas also acts as vital connectors within larger **ecological networks**.

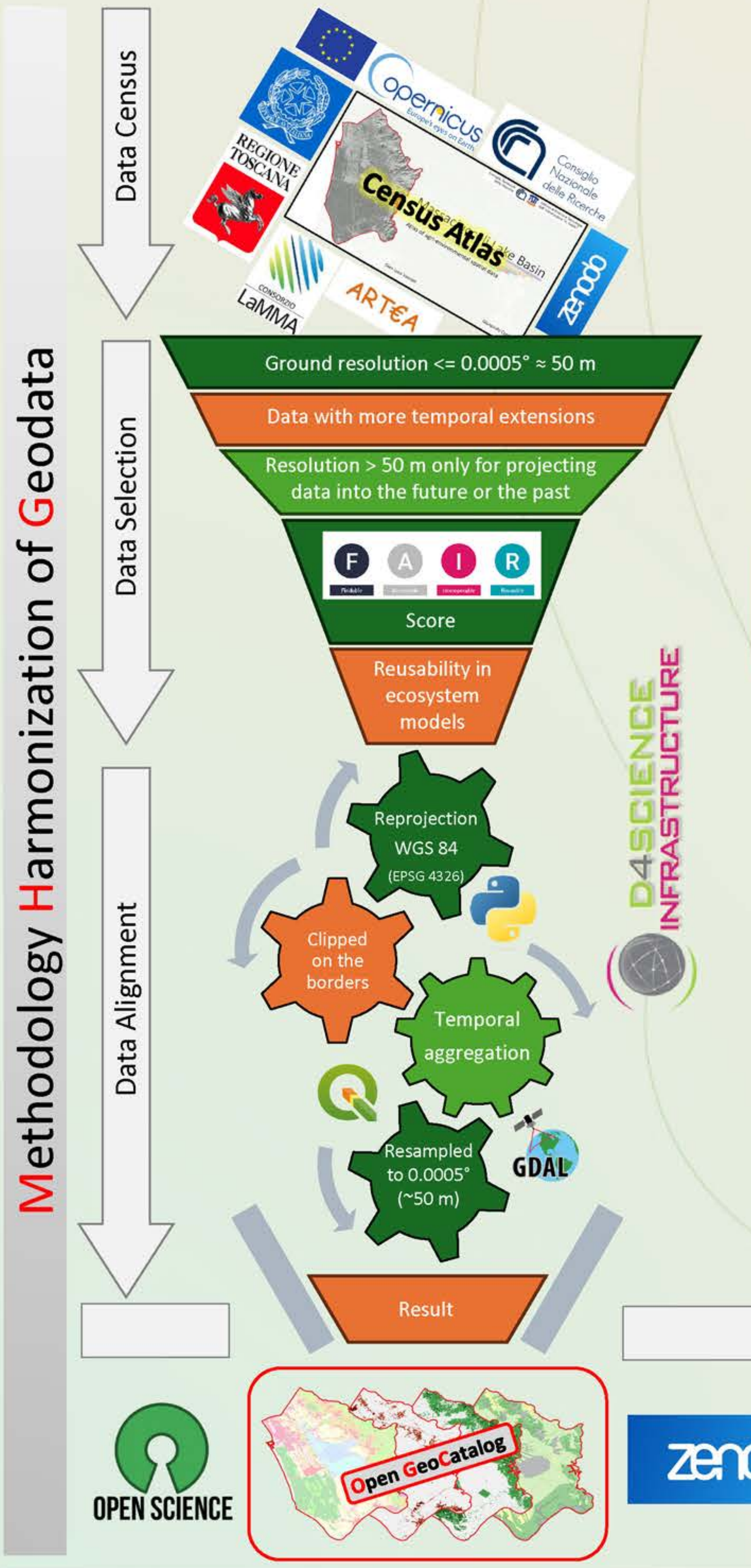
They influence the surrounding areas and enrich the overall biodiversity of entire ecosystems. Additionally, wetlands **provide** many **ecosystem services**, from climate regulation to water purification, carbon sequestration, food supply, tourism and recreation. It is essential to develop **ecosystem models** that predict the evolution of the area **starting from a cognitive reference framework**.



Case Study

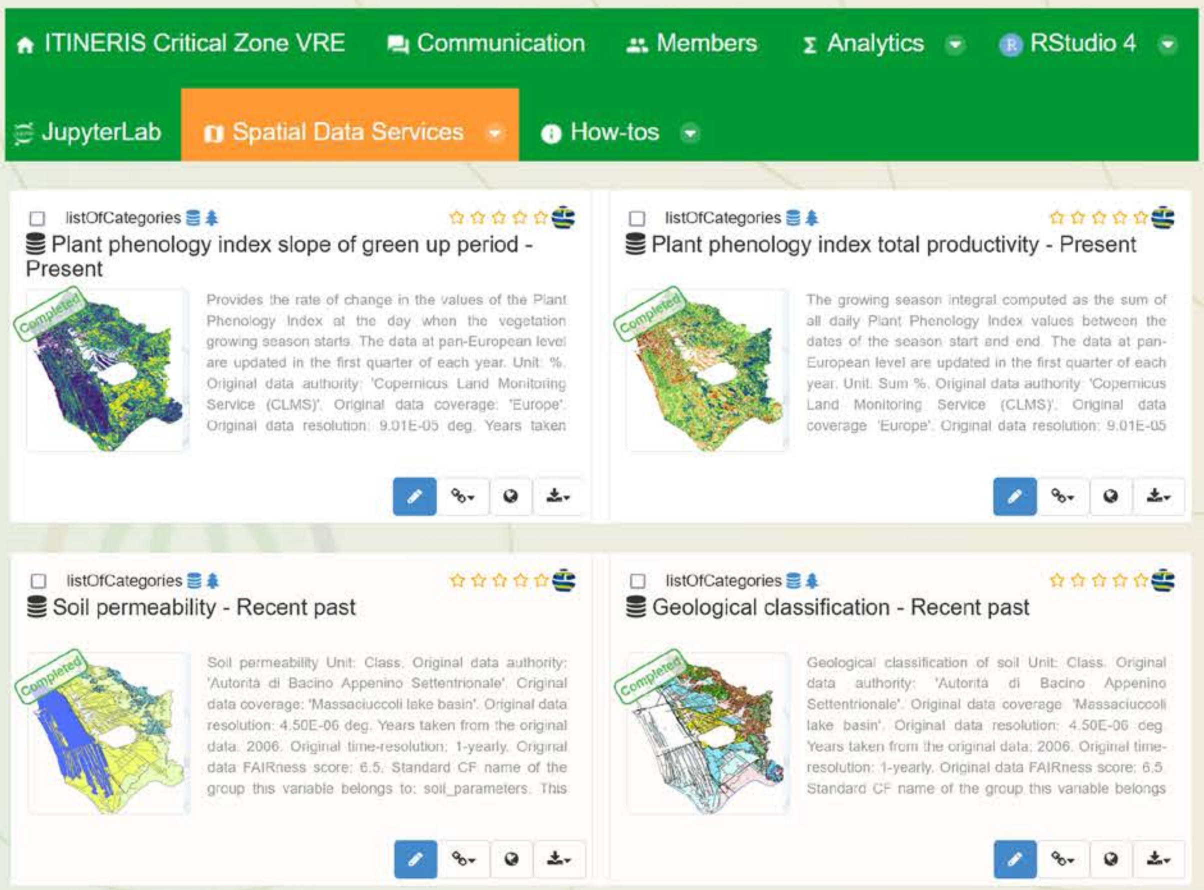
The Massaciuccoli Lake Basin is a **RAMSAR wetland** located in the Versilia Plain, a particular **transition area** between the Apuan **Alps** and the Tyrrhenian **Sea**. This area is an important natural attraction in Tuscany. Thanks to its hydrogeological, environmental and chemical characteristics, the area is **home** to **native** and **rare species**. The lake area is also an important hub for the **migratory routes** of many birds but at the same time, these characteristics also influence the **presence of invasive alien species** introduced by humans.

Cognitive Framework



To **spatially characterize** the wetlands and describe the main **variables** related to **ecosystem services**, a semi-automatic workflow was defined. **148 datasets** representing **75 environmental, geomorphological and socio-economic variables** associated with the Lake Massaciuccoli Basin were collected. The data cover **five temporal snapshots**: **remote past** (1950-1980), **near past** (1981-2015), **present** (2016-2024), **near future** (2050 according to RCP2.6, RCP4.5 and 8.5) and **far future** (2100 according to RCP2.6, RCP4.5 and 8.5). The raster **data** were **harmonized** and **resampled** to a resolution of **0.0005° (~50 m)**. The vector data were aligned and cropped to the basin boundaries. The **metadata**, compliant with the **INSPIRE** directive, contains descriptions of the data contents, **primary sources** and their **levels of FAIRness**.

Open GeoCatalogue



Data Publication

zenodo
GeoServer
GeoNetwork opensource
INSPIRE - Infrastructure for Spatial Information in Europe

Link https://zenodo.org/records/11243783 https://services.d4science.org/group/itineris_criticalzonevre/geonetwork

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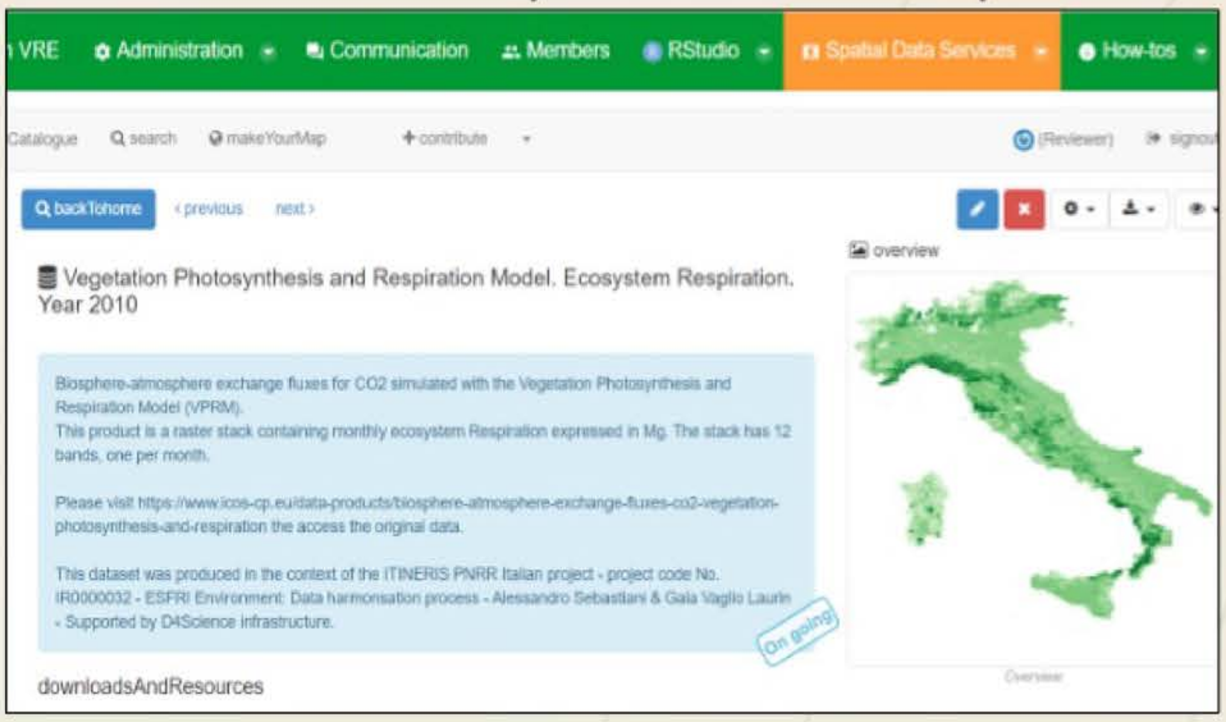
Carbon VRE: the first Italian portal for Carbon data

Gaia Vaglio Laurin, Alessandro Sebastiani, Paolo Sconocchia – IRET - CNR Montelibretti

The Carbon VRE provides:

- Harmonized and georeferenced data on ecosystems carbon dynamics
- Re-elaborated emission data
- Tools and facilities for independent analyses
- Field data
- Modelling

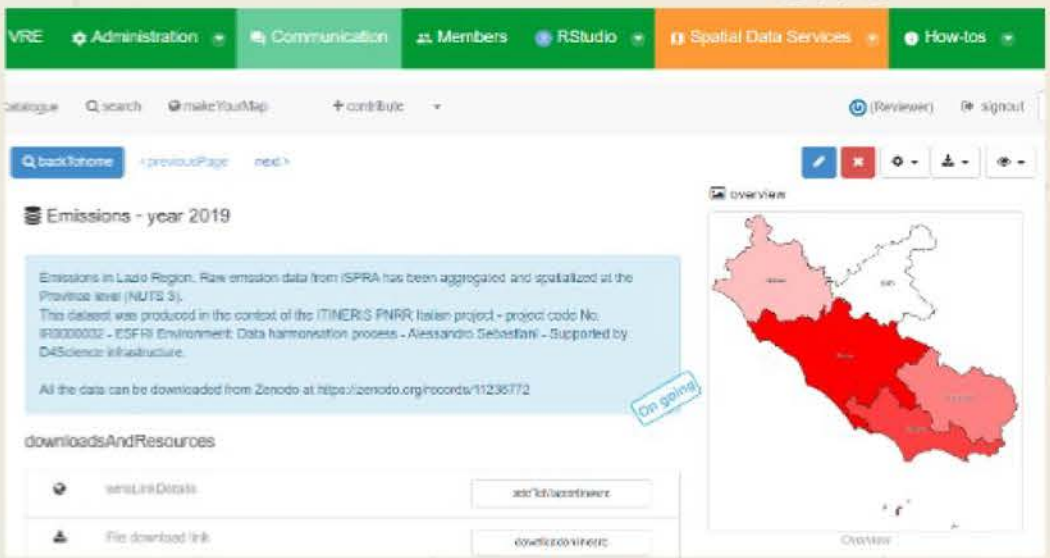
Harmonized Ecosystems Carbon Dynamics



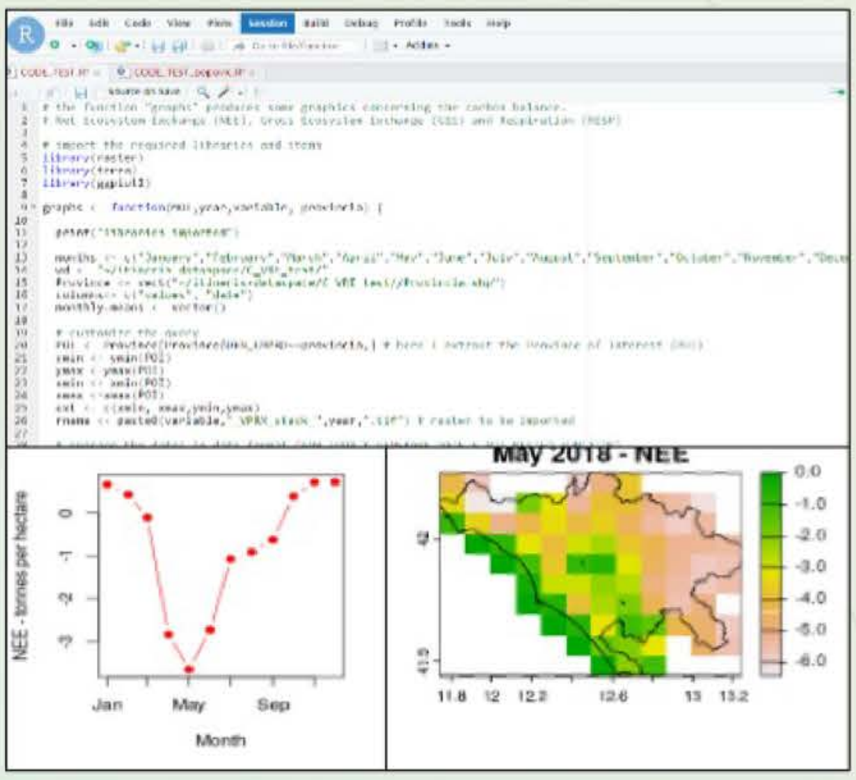
The harmonization process produced C exchange maps based on different models, such as FLUXCOM, Vegetation Photosynthesis and Respiration Model, LPJ-GUESS, among others. Variables include GPP, NEE, RA.

GHG

Includes the aggregation of Italian national emission data for main gases, with sources information. Spatialization customized examples are provided, with facilities to further process data to extract the desired information.



Tools and facilities



R code for maps and graphs of Net Ecosystem Exchange, Gross Primary Productivity and Respiration dynamics, at the province (NUT3) level

Field data

IRET groups (Lecce, Porano, Montelibretti) are collecting grassland field data for calibration and validation of aboveground biomass models, based on SAR and optical remote sensing satellite imagery.

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The Isotope Virtual Research Environment of ITINERIS Project: example of mixing modeling and data plotting

Erico Perrone[1], Paolo Di Giuseppe[1], Simona Gennaro[1], Eugenio Trumpy[1], Samuele Agostini[1], Ilaria Baneschi[1], Chiara Boschi[1], Irene Cornacchia[2], Maddalena Pennisi[1], Eleonora Regattieri[1], Andrea Rielli[1], Simone Vezzoni[1], Matteo Salvadori[1,3], Alberto Zanetti[4], Antonello Provenzale[1]

[1]Italian National Research Council, Institute of Geosciences and Earth Resources (CNR-IGG), Pisa, Italy; [2]Italian National Research Council, Institute of Environmental Geology and Geoengineering (CNR-IGAG), at Department of Earth Sciences, University of Rome "Sapienza", Rome, Italy; [3]University of Pisa, Department of Earth Science, Pisa, Italy; [4]Italian National Research Council, Institute of Geosciences and Earth Resources (CNR-IGG), Pavia, Italy

Introduction

Isotope Geochemistry has become a fundamental tool in the study of natural processes, and numerous applications have proved valuable in a diversity of research fields, mainly Environmental Science, in which sources and transport of pollutants, the impact of climate change, and the behaviour of contaminants in soil, atmosphere, and waters remain open questions to be answered with the fundamental tools of isotopes, as well as any discipline belonging to Earth System Sciences, such as Geology, Biology, Agronomy, Ecology, and food authenticity and traceability.

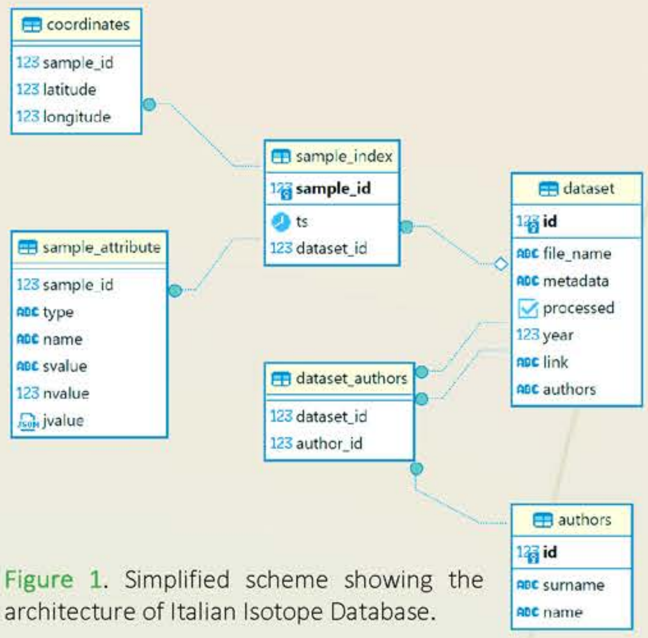


Figure 1. Simplified scheme showing the architecture of Italian Isotope Database.

Materials and Methods

The Italian Isotope Database (Figs. 1 and 2) is designed to collect geochemical data which include stable, non-conventional, and radiogenic isotopes and providing to the scientific community isotopic data sharing set in a Virtual Research Environment (VRE) with a set of powerful tools to understand and interpret environmental processes.

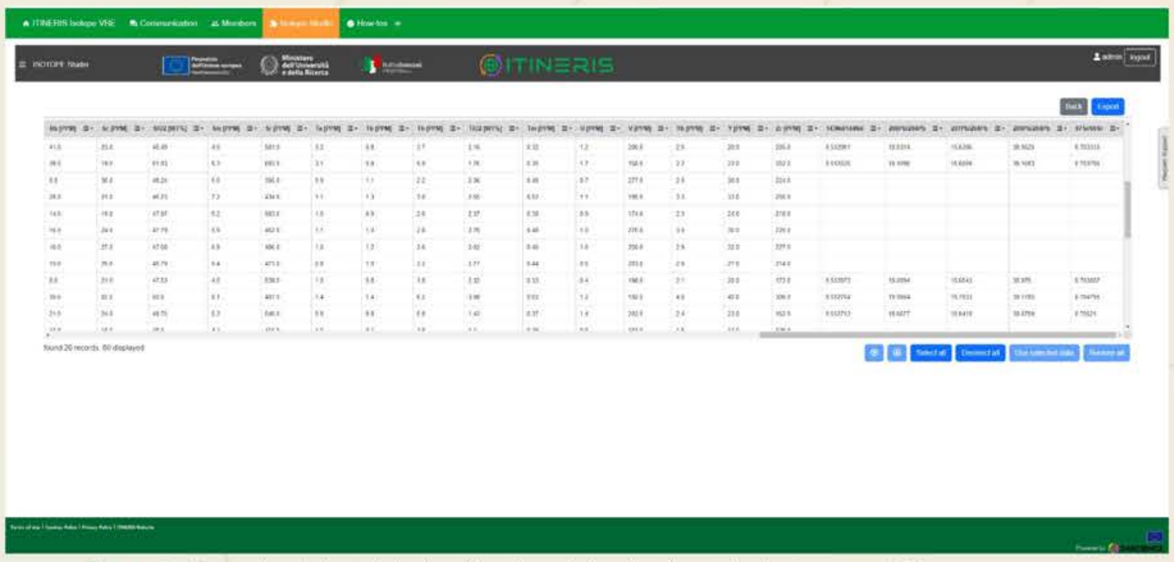


Figure 2. Example of the table visualization of the database in the Isotope VRE.

Preliminary results

Isotope Studio is designed and implemented as a web application deployed in a dedicated D4science VRE.

The tools now available in the ISOTOPE VRE allow to build binary and ternary plots, as well as normalized diagrams with the data collected in the Italian Isotope Database (Fig. 3).

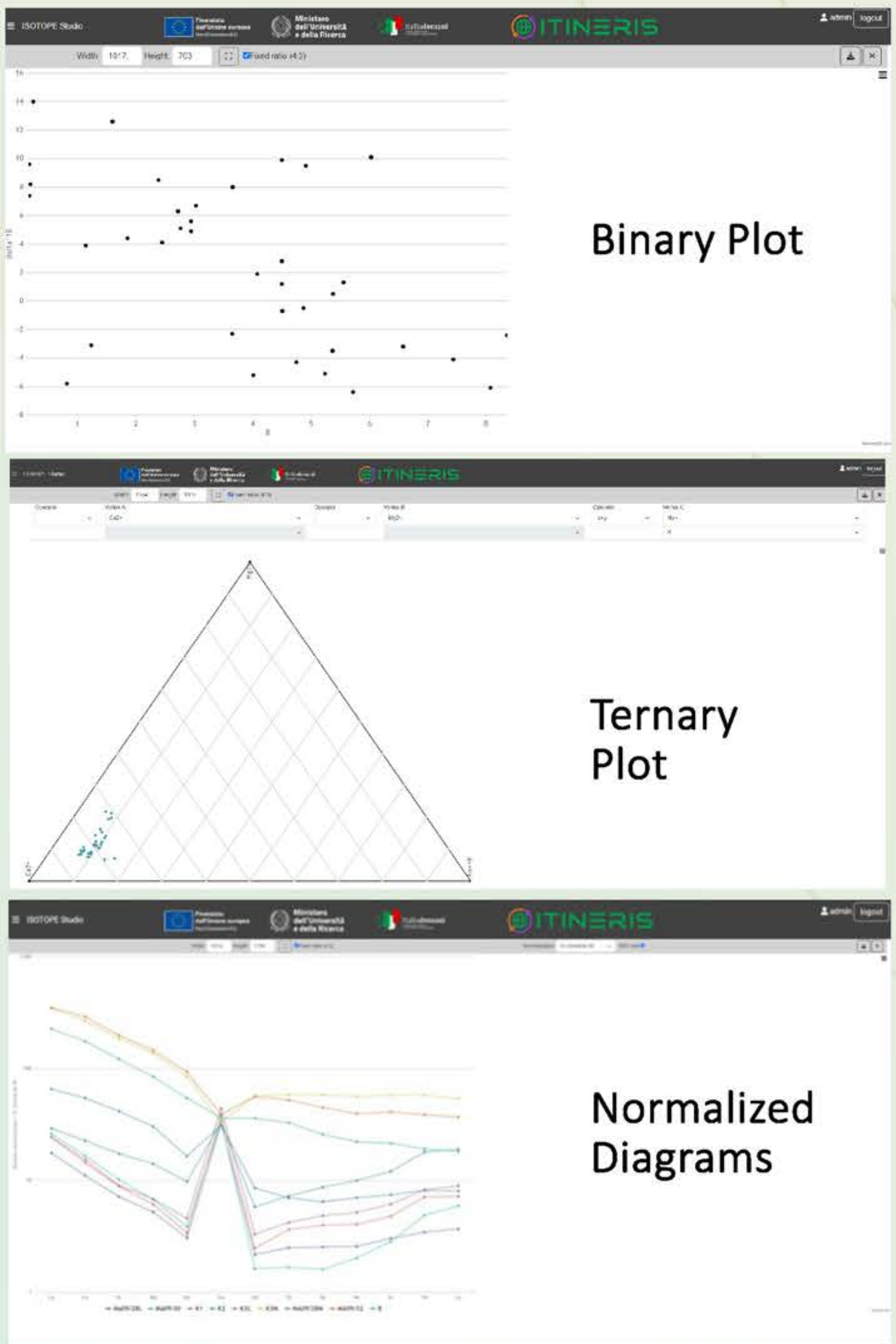
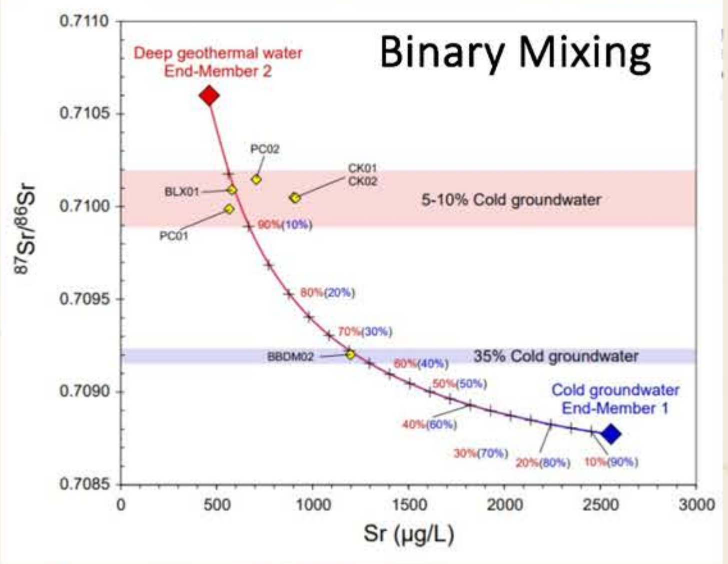


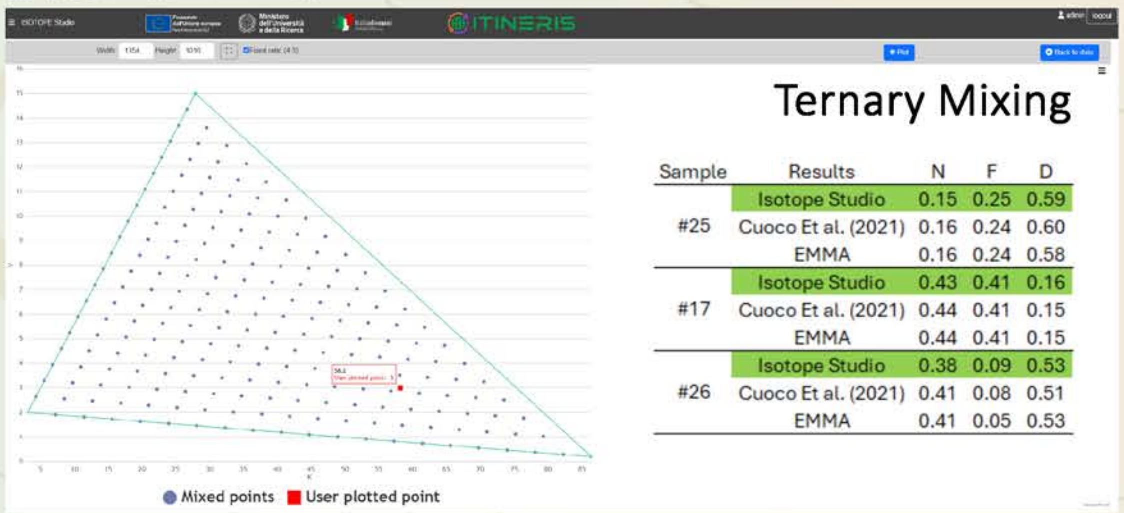
Figure 3. Example of the different plots and diagrams created in the framework of the ISOTOPE VRE.

In addition, the ISOTOPE VRE allows to create binary (Fig. 4) and ternary (Fig. 5) mixing models using major and trace elements, as well as isotope compositions of selected samples.

Figure 4. Binary mixing modeling redraw from calculations performed by ISOTOPE VRE

SR	87SR86/SR	BBDM01: 87SR/86SR	Average PC04-PC05: 87SR/86SR
456	0.710005	0.000	1.000
561	0.709609	0.050	0.950
666	0.709339	0.100	0.900
771	0.709142	0.150	0.850
877	0.708992	0.200	0.800
982	0.708874	0.250	0.750
1087	0.708780	0.300	0.700
1192	0.708701	0.350	0.650
1297	0.708636	0.400	0.600
1402	0.708580	0.450	0.550
1508	0.708532	0.500	0.500
1613	0.708491	0.550	0.450
1718	0.708454	0.600	0.400
1823	0.708422	0.650	0.350
1928	0.708393	0.700	0.300
2033	0.708367	0.750	0.250
2138	0.708344	0.800	0.200
2244	0.708323	0.850	0.150
2349	0.708304	0.900	0.100
2454	0.708286	0.950	0.050
2559	0.708270	1.000	0.000





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

Figure 5. Ternary mixing modeling. Table indicates the comparison between calculations performed by ISOTOPE VRE and literature data (Cuoco et al., 2021_Hydrological Processes; https://doi.org/10.1002/hyp.14409)

Future perspectives

Data collection to populate the database, as well as the implementation of ISOTOPE VRE with other types of geochemical models are scheduled, with the aim to become a meeting point between National Institutions, Universities, and Private Entities.

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Essential Variables (EVs): a multi-purpose tool for exploring ECVs and EBVs across multiple ecodomains studied by LTER Italy network

Alessandro Oggioni[1], Paolo Tagliolato[1], Vladimiro Boselli[1] and Giorgio Matteucci[2]

[1] Institute of Electromagnetic Sensing of the Environment (IREA-CNR), Via Alfonso Corti, 12 – 20133 Milan (Italy)

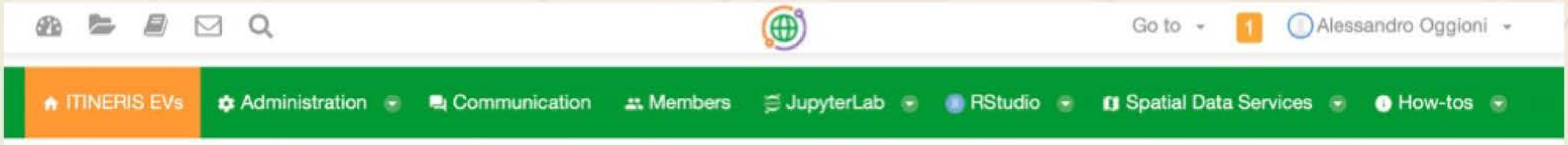
[2] Institute of BioEconomy (IBE-CNR), Via Giovanni Caproni 8 – 50145 Firenze (Italy)

Consiglio Nazionale delle Ricerche Istituto per la BioEconomia

Objectives

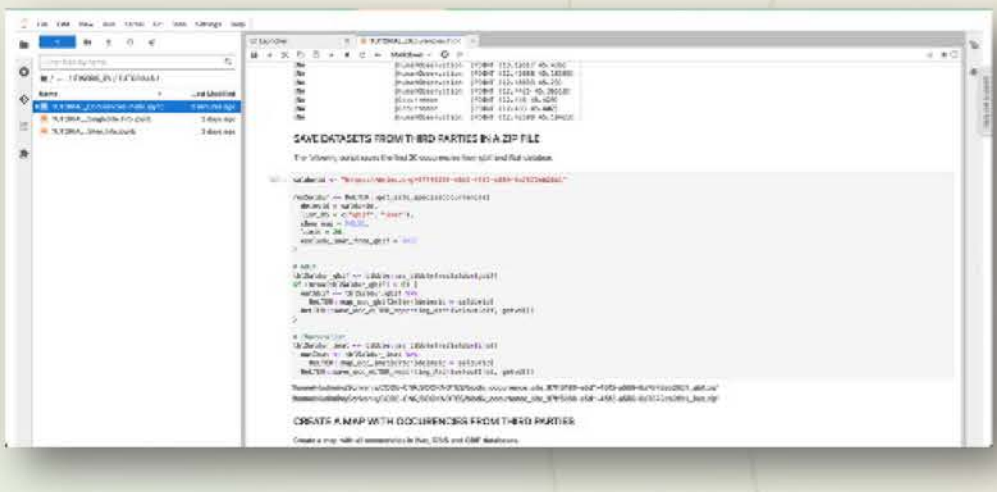
To ease EV-dataset-related activities for VRE members by means of an **interactive R Shiny web app.** Different users can find, select, visualize and share datasets related to Essential Variables (EVs).

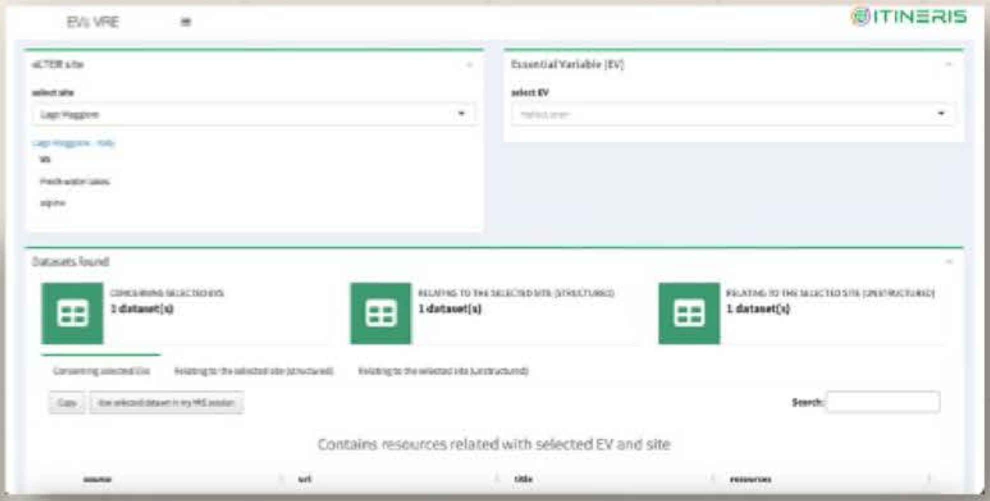
To constitute a place where **executable and documented scripts of analysis of EV data** can be collected, written, shared and reused



create an executable and documented script

share or reuse this analysis or data product





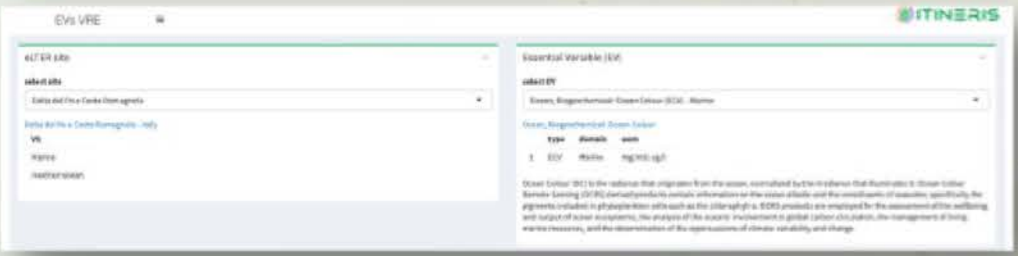
retrieval of datasets

usage in analysis

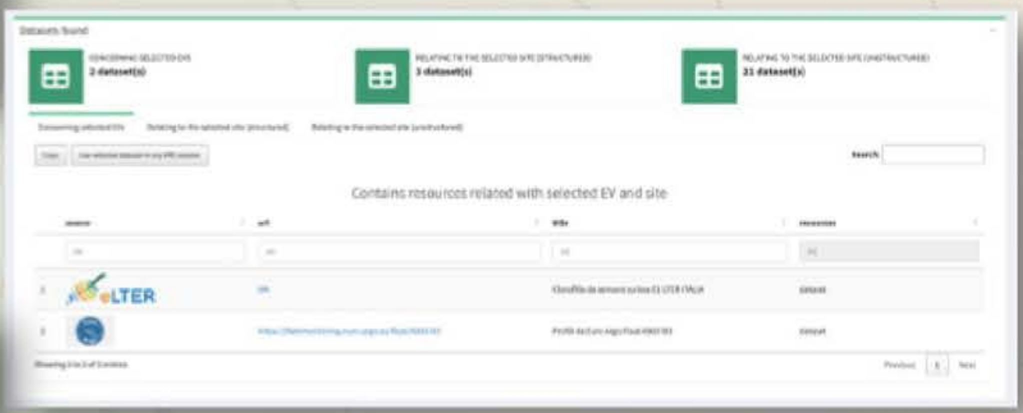
a single user profile

multi-user responses in the ShinyApp

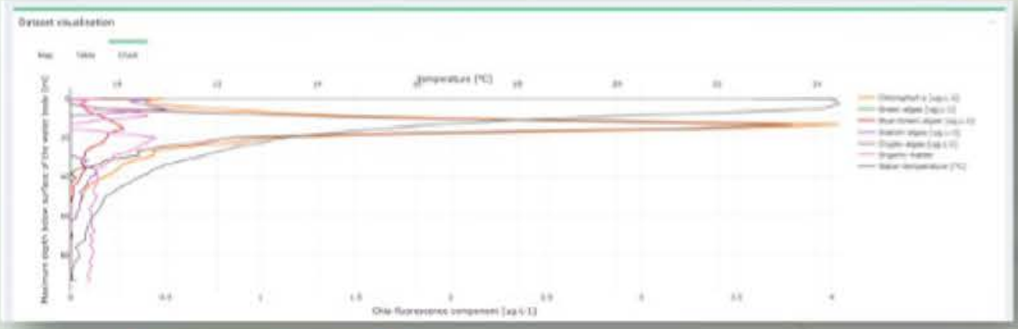
scripts for people of different backgrounds



Selection and base information on eLTER site and EVs



Activate a meta-search of appropriate data resources



Custom visualization based on recognised data type

Next steps

Enhance Shiny App Development:

- Add new repositories and implement additional functions for data harmonisation.
- Develop and document new executable analysis scripts.
- Involve colleagues from the eLTER infrastructure and other RI.

Local and remote Integration:

- Align the local version of the Shiny App with the version in the Virtual Research Environment (VRE).
- Establish connections with data catalogues (GeoServer) and metadata systems (GeoNetwork) present in the VRE.

Deliverable Preparation:

- Draft the deliverable, ensuring it comprehensively covers the progress and integration steps.

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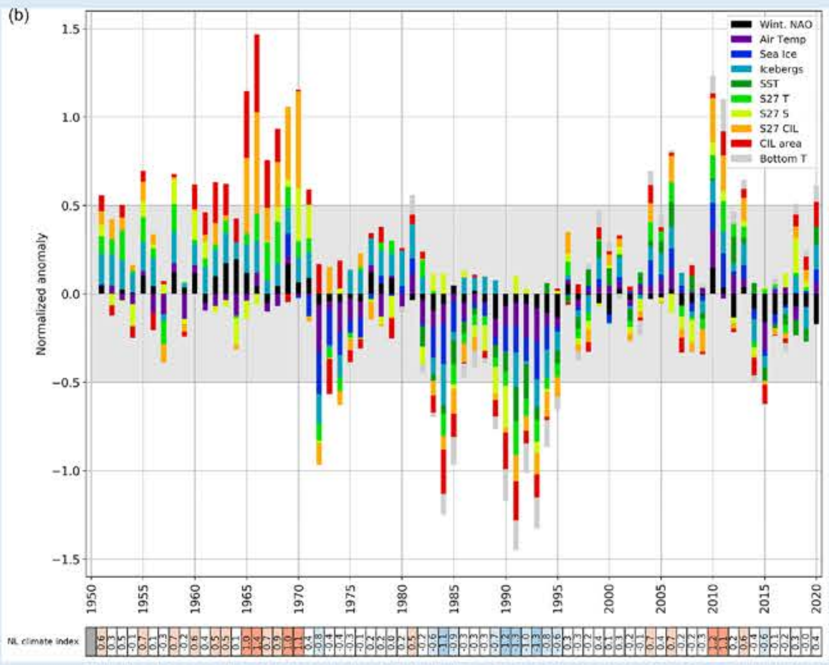
CLIMA VRE: a first demonstrator, challenges and perspectives

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]

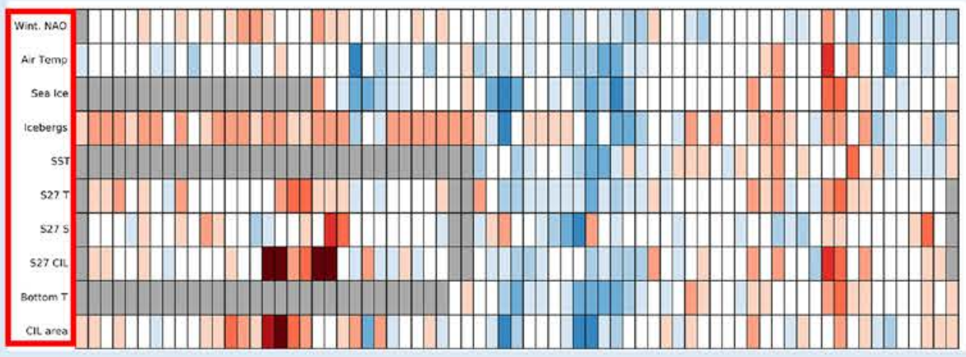
[1]National Research Council (CNR) – Institute of Marine Sciences (ISMAR), La Spezia, Italy,

[2]University of Genoa (UNIGE), Department of Civil, Chemical and Environmental Engineering (DICCA), Genoa, Italy

CLIMATE CHANGE studies involve evaluating many environmental and biological observables on a wide range of spatio-temporal scales. A **CLIMATE INDICATOR** is built on one or more of these variables and aims at representing variations of the climate state. Here is a nice example taken from *Cyr e Galbrath, 2021 Earth System Science Data:* **Climate indicator for the Newfoundland and Labrador (NL) area**



The NL climate index combines **ten normalized anomalies** derived annually



Colour-coded according to their value (blue negative, red positive, white neutral). The sign of some variables or indices (NAO, ice, icebergs, salinity and CIL volume) has been reversed when positive anomalies are generally indicative of colder conditions. Grey cells indicate the absence of data.

The **NL Indicator** shows to have a strong link with **ecosystem studies, stock assessments** and **models of marine resources!**

STRUCTURE AND GOALS OF CLIMA VRE

WORKSPACE area: where users can organize and share digital materials like datasets, notebooks, codes

SOCIAL NETWORKING area: where users can discuss and exchange information through usual social networking concepts like threads, posts, hashtags, mentions, etc

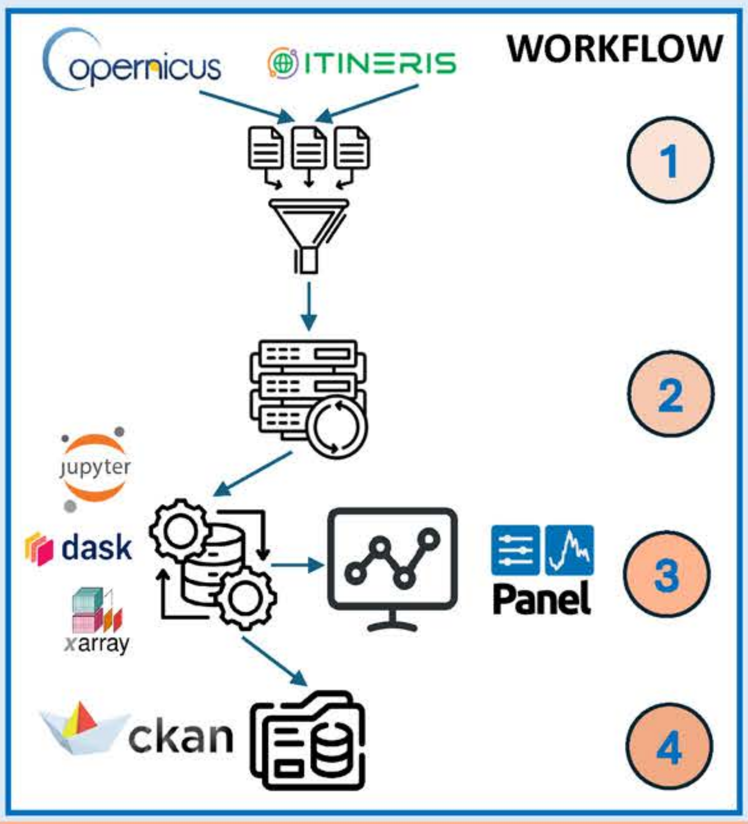
CLIMA VRE ITINERIS

A **SHARE POINT** for scientists (code, recent advances Climate studies, ideas)

The possibility to access **COMPUTATIONAL RESOURCES** and **BIG DATA** for scientists (distributed calculus/cloud technology)

A potential source of **INFORMATION** about the local climate for citizens and stakeholders (through interactive Apps)

A FIRST DEMONSTRATOR with SEA SURFACE TEMPERATURE (SST)



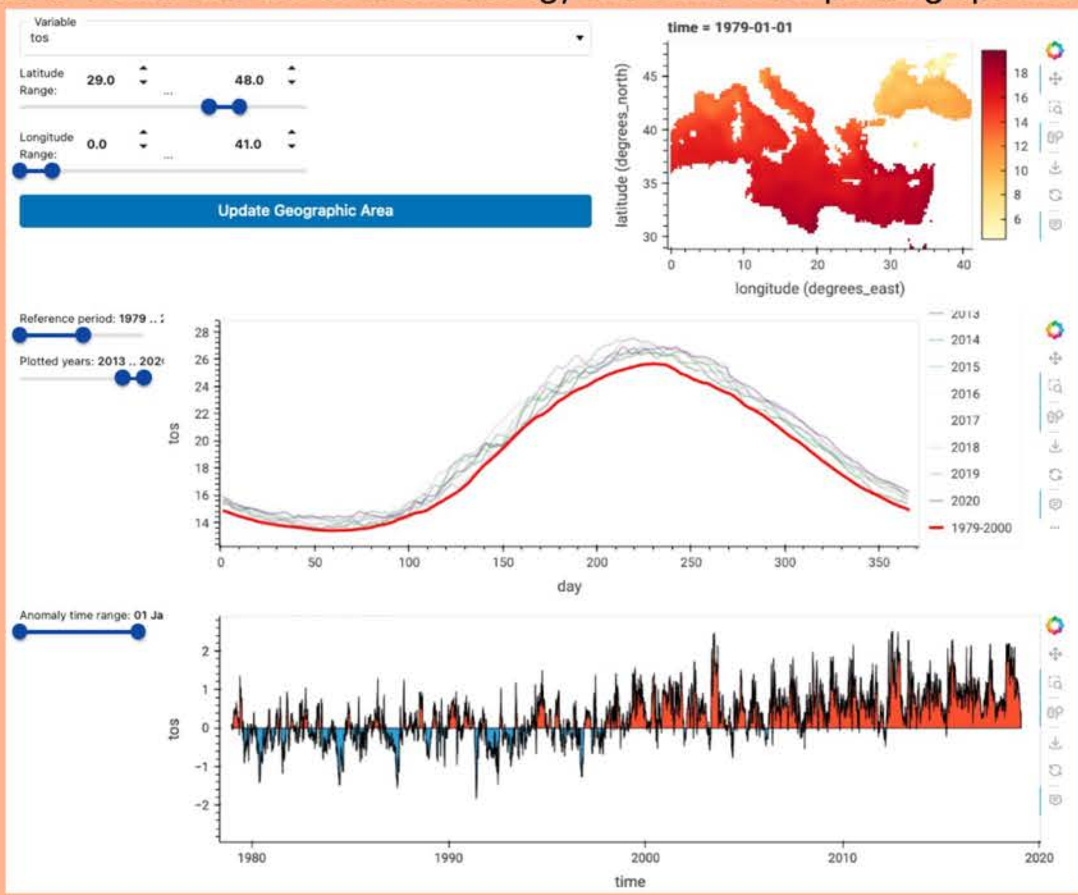
1. **SST data harvesting**: ERA 5 daily dataset from Azure Blob Storage (cloud storage designed for distributed access)

2. **Data harmonization** (format, variable names, spatio-temporal alignment)

3. **Data processing and visualization with interactive web application**: for this demonstrator we exploit the power of *dask* and *xarray* packages, defining a huge dataset as an ensemble of chunks. This approach is suited for handling computations on distributed systems (as available in CLIMA VRE).

The graphical interface is developed with the *Panel* package and allows the user to interactively change the geographic area of interest, the range of years to define the reference climatology and some main plotting options.

the application controls a cluster of cores that access only the useful part of the data, performs computations and updates plots



Application GUI with interactive plots of yearly SST and SST Anomaly (SST minus the climatology). A clear growing trend has been observed in last two decades

PERSPECTIVES

Following the same workflow, our goal is to create a catalogue of indicators available for the community of CLIMA VRE (4) collecting and processing data from many research infrastructures.

To join CLIMA VRE register at https://itineris.d4science.org/

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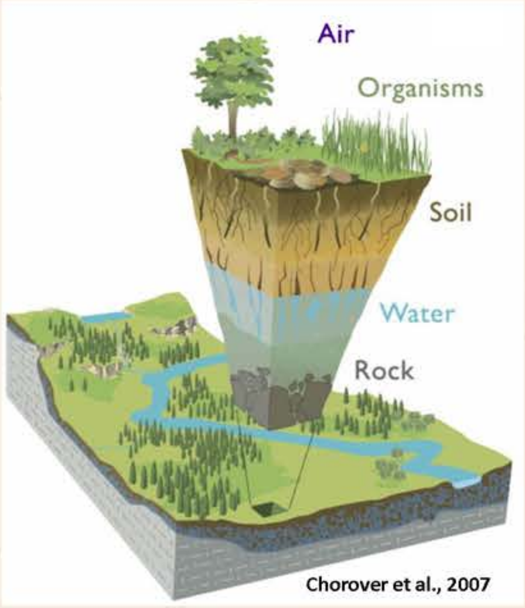
A VRE approach for the study of the Critical Zone

Bove P., Caparrini F., Gennaro S., Marta S., Menichini M., Raco B. & Provenzale A.

Italian National Research Council, Institute of Geosciences and Georesources (CNR-IGG), Pisa, Italy

The Critical Zone concept

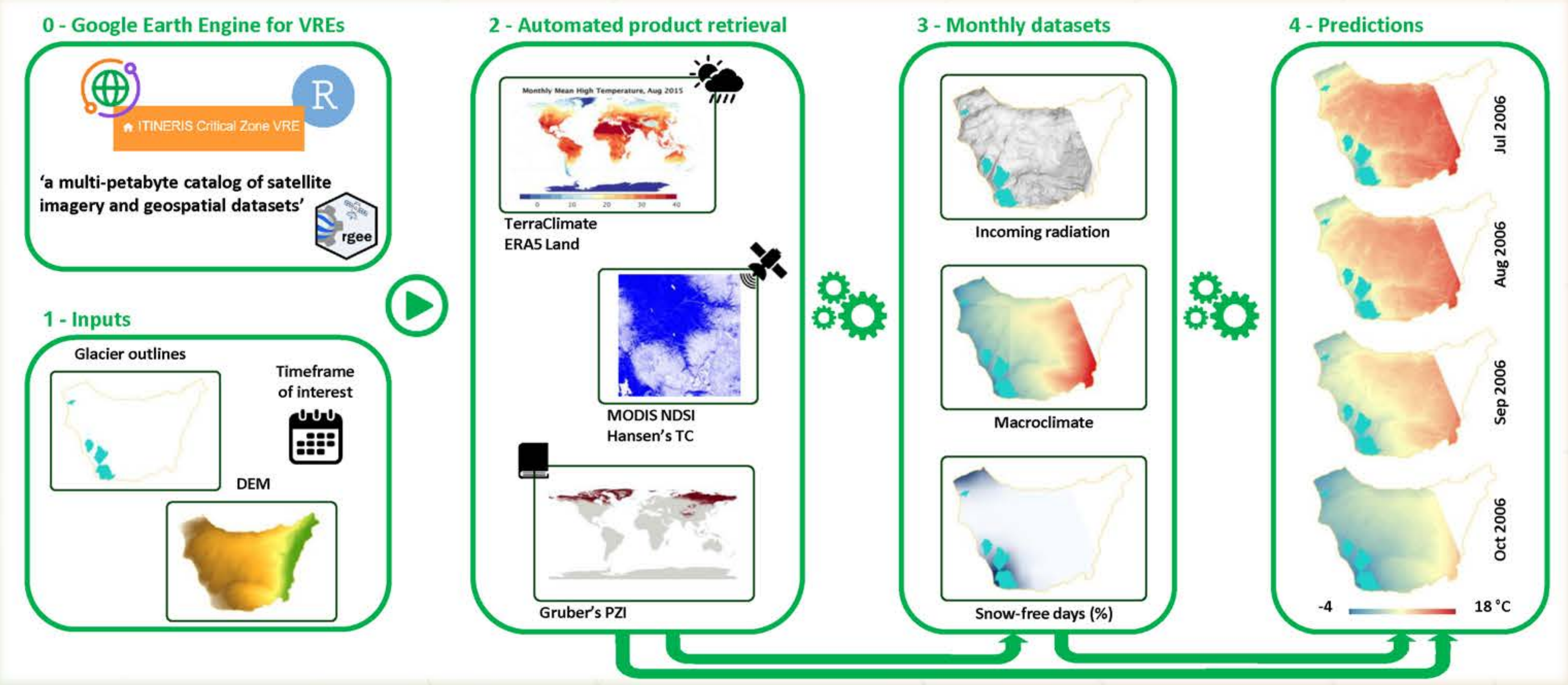
The **Critical Zone (CZ)** was defined as '***heterogeneous**, near surface environment in which complex **interactions** involving **rock**, **soil**, **water**, **air**, and **living organisms** regulate the natural habitat and determine the **availability of life-sustaining resources***' (NRC, 2001). In the CZ, physical, biological, geological and hydrological processes interact at multiple temporal and spatial scales. Analysis of CZ processes spans from sample collection to dataset harmonization, to modelling.



The **ITINERIS Critical Zone Virtual Research Environment** (CZ VRE, powered by D4Science) is an **e-Science** environment built according to **FAIR** and **Open Science principles** with the goal to **enhance collaboration** among researchers and stakeholders (e.g., park managers). The VRE (Candela et al., 2013) is built to **find solutions** and address **specific scientific and/or management questions** that require the integration among different disciplines (e.g., geology, ecology, hydrology, geomorphology, atmospheric science, and many more) and the collection of datasets, analysis and modelling solutions, and graphical tools.

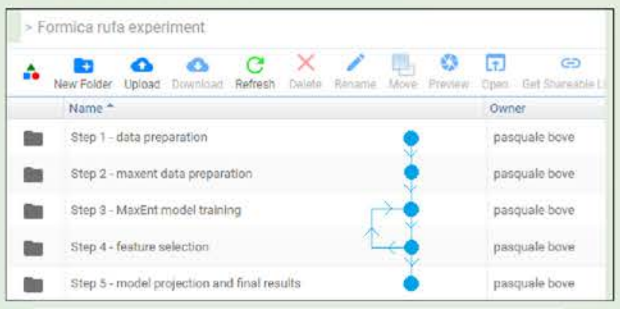
CZ VRE products

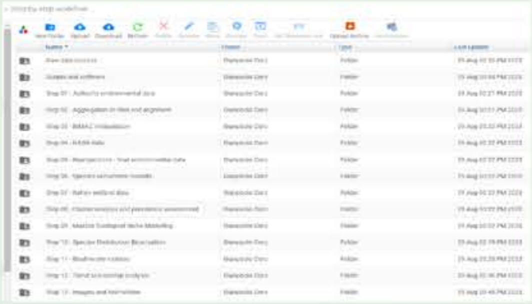
High-resolution soil microclimate in proglacial areas

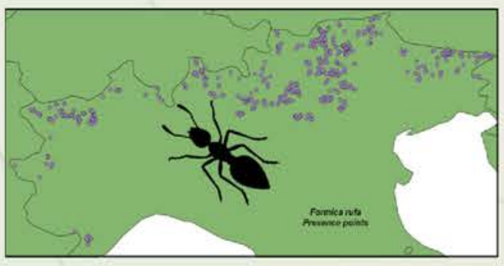


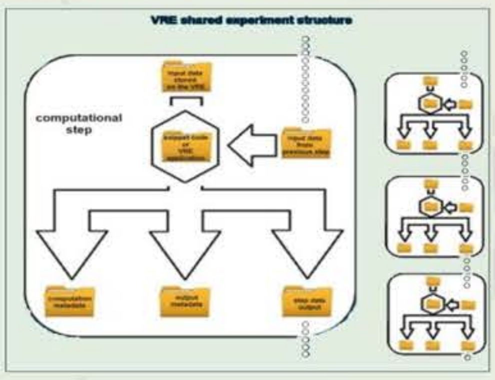
Investigating Ecological Niche Shifts in the CZ

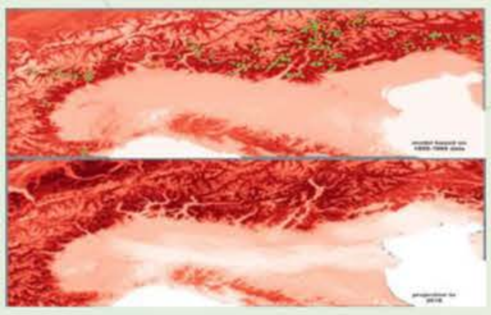
In addition to a well-maintained and harmonized collection of data and applications to view, manipulate and extrapolate them on the **CZ VRE**, some ecological niche modelling experiments exploit the previously hosted data. These **experiments** are described step by step including **data**, **metadata** and simple **code** that defines how the final and intermediate results are obtained.



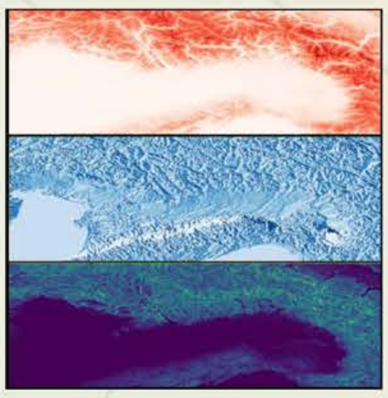


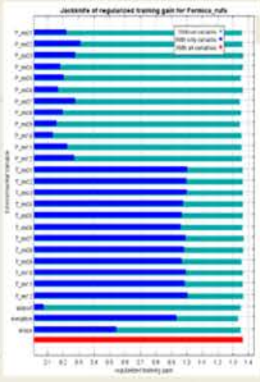






These experiments highlight the **reusability** of the **FAIR** paradigm, making shared experiments available to users that demonstrate both established workflows for studying ecological distribution and the methodology for structuring a **shared experiment** using the "**VRE**" tool.





In this shared experiment, several colleagues contributed to the reuse of data collected on the *Formica rufa* complex in the Alpine arc in the period 1959-1969. The data were used to generate an **ecological niche model** relating to that period and then be able to project it onto the 2016 data. The experiment was divided into conceptual phases and carried out transparently among participants by sharing **data**, **scripts**, **intermediate results** and computations **outputs**.

References

Candela et al., 2013 - https://doi.org/10.2481/dsj.GRDI-013
Chorover et al., 2007 - https://doi.org/10.2113/gselements.3.5.321
Gruber, 2012 - https://doi.org/10.5194/tc-6-221-2012
Hansen et al., 2013 - https://doi.org/10.1126/science.1244693
NRC, 2001 - https://doi.org/10.17226/9981

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Risposta di biomassa e produzione fitoplanctonica al riscaldamento globale: stima delle variazioni nella biomassa stabile in ampie fasce latitudinali

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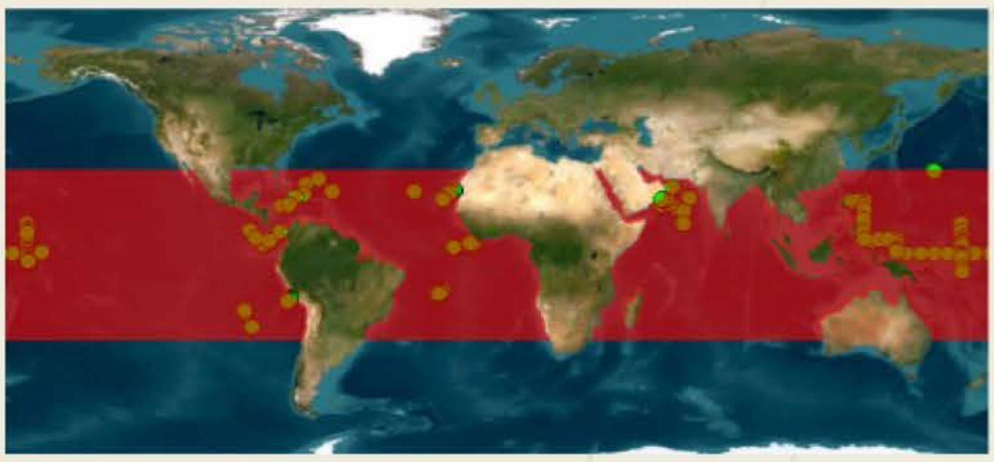
Obiettivi:

- Stimare potenziali variazioni della biomassa acquatica e della Produttività Primaria usando dati di campo di Chl-a e PPN stimata con il metodo del ^{14}C
- Applicazione della relazione tra temperatura, Chl-a e PPN a dati satellitari per sviluppare analisi temporali quanti/qualitative

Area di Studio



Materiali

Database con dati di campo di Chl-a e PPN reperibili da *Pangea* & *Ocean color* oltre ai dati MODIS di SST.

Metodo

- Individuazione di un modello regressivo tra variazione della temperatura superficiale degli oceani (SST) con Chl-a e PPN;
- Estrazione dei dati di SST dalle immagini MODIS, dal 2003 al 2023;
- Applicazione del modello regressivo tra SST e Chl-a/PPN ad ogni porzione di immagine;
- Estrazione dei profili temporali medi di Chl-a e PPN ricavati e calcolo della media mobile;
- Applicazione di un modello previsionale nel tempo.

Flusso 1

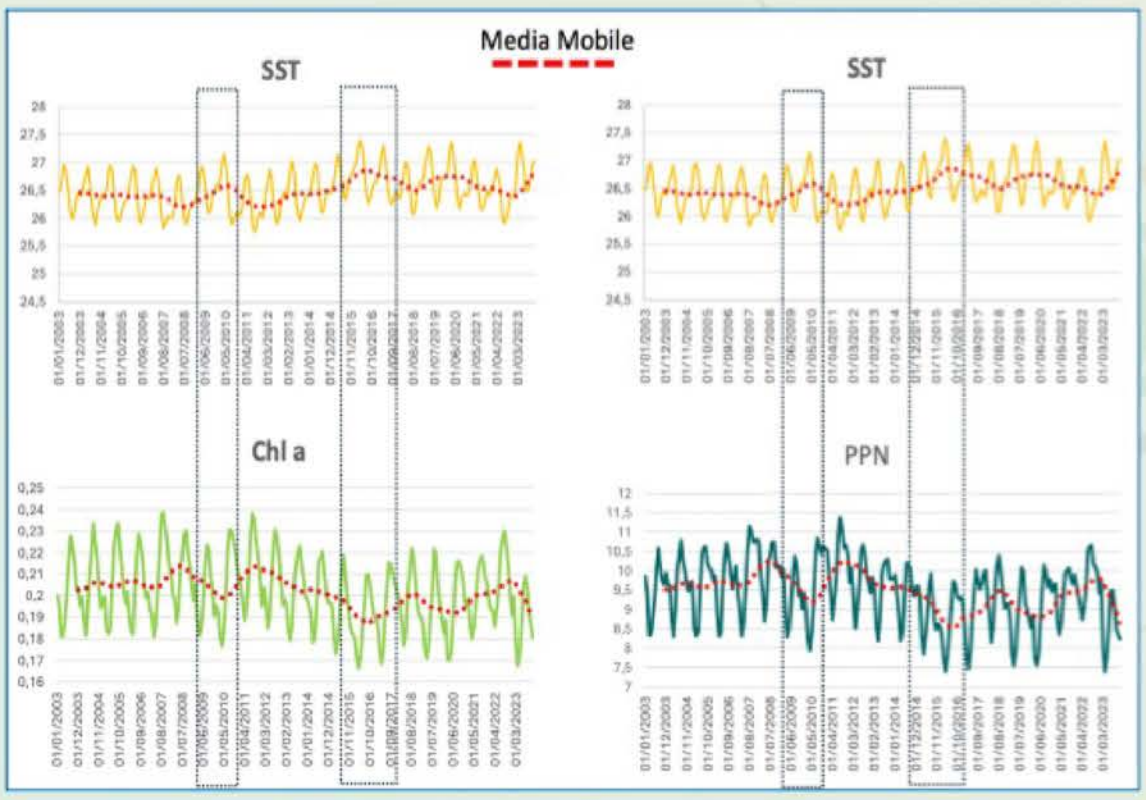
Risultato Flusso 1

Modello: Chl-a ~ T	RMSE	R2	MAE
Random Forest	0.798	0.713	0.563
Linear Regression	0.938	0.573	0.776

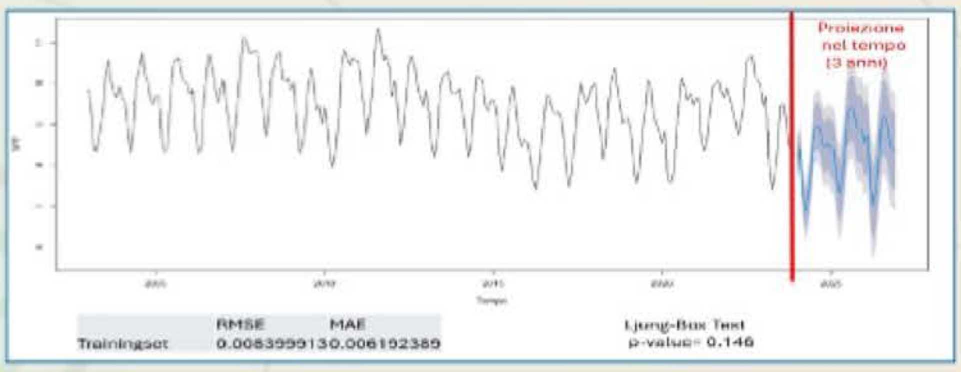
Modello: PPN~ T	RMSE	R2	MAE
Random Forest	0.982	0.632	0.748
Linear Regression	1.262	0.356	1.053

Flusso 2 *Flusso 3*

Risultato Flusso 2



Risultato Flusso 3



Conclusioni

Forti variazioni di Chl-a e PPN prodotti da eventi passati ENSO: 2009-2010 & 2014-2016.

Complessivamente si ha una riduzione di Chl-a e PPN dal 2003 al 2023. Si stima una leggera ripresa della PPN rispetto al 2022/2023 ma con valori ancora inferiori al 2003.

Annual meeting - Roma - 9-10/07/2024

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Downstream VRE for multidisciplinary applications: first developments

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DOWNSTREAM VRE

The DOWNSTREAM VRE is dedicated to the use of OGS and RI data on climate, carbon, and environment response nexus to provide services for the visualisation, analysis, and sharing of data provided by the different RIs if available. The toolboxes within the VRE are subdivided in two domains: Marine domain toolbox and Land domain toolbox .

Scan the QR Code to visit the website
Itineris.cnr.it

Marine domain toolbox

The ocean plays an important role in mitigating climate change by taking up a large part of the excess of heat and of CO2 released by human activities. A decrease in surface ocean pH (i.e., ocean acidification) is primarily a consequence of an increase in ocean uptake of atmospheric carbon dioxide (CO2) concentrations that have been augmented by anthropogenic emissions [Metzl et al., 2024] .

This toolbox will focalize in the North Adriatic Sea for the marine domain as UC. A first-order quantitative assessment of carbon cycling and acidification will be provided if enough information is available, highlighting critical gaps.

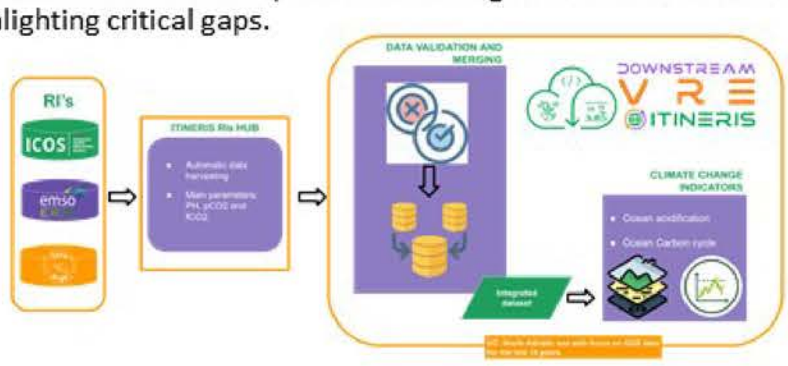

Figure 1. Marine domain toolbox workflow

Data Availability, libraries and applications

Reviewing the available data of pH, pCO2, fCO2, within the different RIs in the respective data portals for the North Adriatic, only ICOS data produced results (Figure 2) and only one of the two stations provided data from OGS (IT-FOS-MIRAMARE).

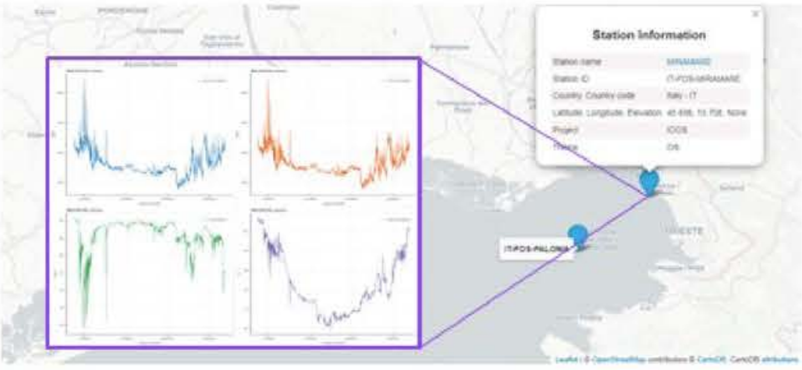

Figure 2. ICOS available stations and parameters. The plot has been generated using ICOScp python library in the downstream VRE.

Implementing the ICOScp python library in the VRE showed that only fCO2 and pCO2 data from the selected station was available, thus for pH another broker was needed. Accordingly the ERDDAPY library and the ERDDAP-navigator were implemented, showing Mambo1 station (nodc.ogs.it/erddap) holds records of pH, as well as pCO2 and fCO2. Additionally, the webODV application is now linked to the Downstream VRE for data extraction, analysis, exploration and visualization restricted for Argo (TS & BGC) and SeaDataNet (TS) products.

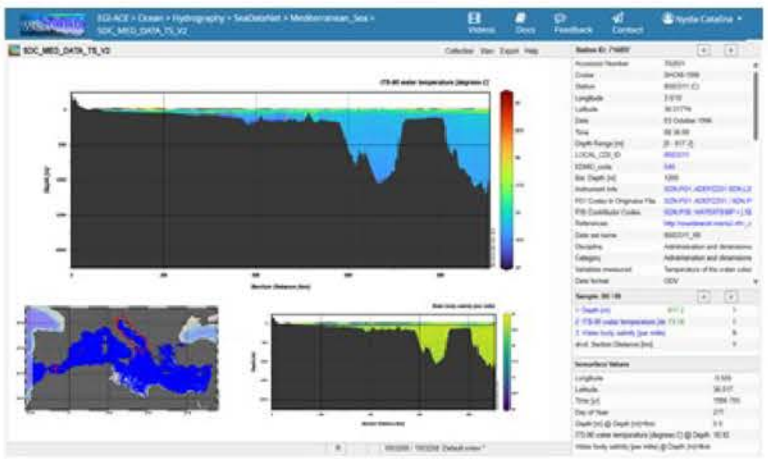

Figure 3. T&S section of the Adriatic Sea using BGC argo dataset available in the webODV application using the downstream VRE.

Land domain toolbox

The land domain aims to analyse areas subject to hydrogeological hazards, specifically landslide phenomena. There will be a focus on possible effects of climate change on pilot test sites taking advantage of a landslides inventory and data available, considering different tools.

The data from test site will be collected through monitoring systems (GNSS, inclinometer, GB-InSAR or EGMS by Copernicus, webcams, etc.). The data will be in different formats for map visualisation and event location, and there will also be tabular data to visualize time series of the displacement (Figure 4). In this context, a web GIS will be implemented.

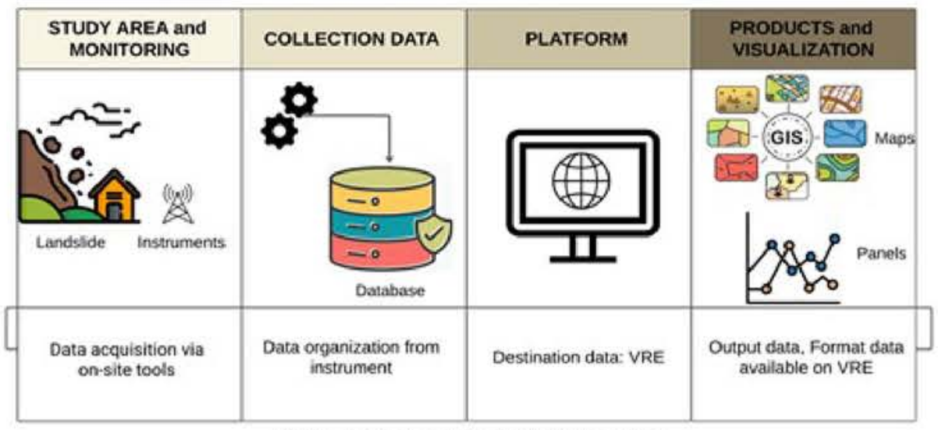

Figure 4. Land domain toolbox workflow.

The web GIS will enable the analysis of the spatial and temporal distribution of instability. The synergy of spatial and temporal data will provide a comprehensive picture and real-time evolution of the event

Web Gis

A prototype web Gis was created where, at present, shapefiles (polygons and points) and time series can be visualized (Figure 5).

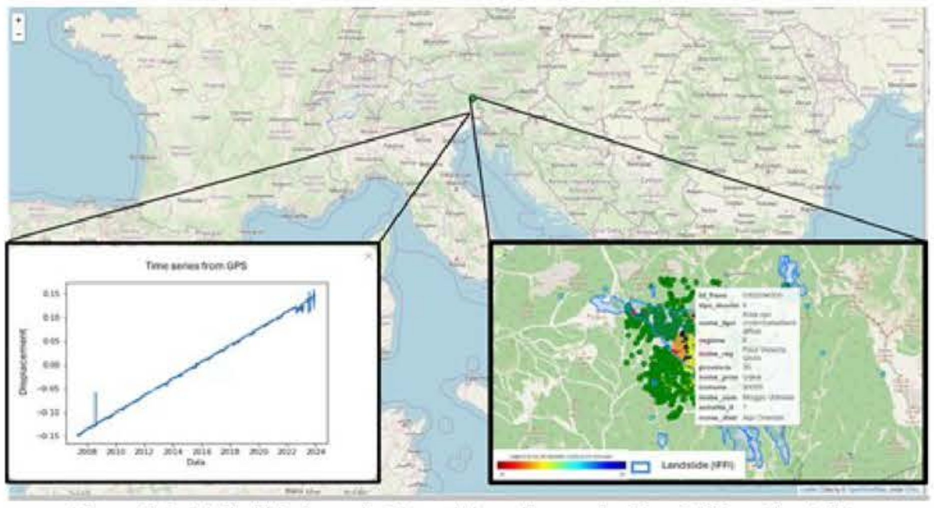

Figure 5. A detail within the web Gis prototype, time series from GPS and landslide polygons with EGMS.

Currently, within the web Gis it is possible to see a detail (or metadata) of the Italian landslide inventory (IFFI) in relation to EGMS data by Copernicus in ascending geometry (2018-2022) in Friuli Venezia Giulia Region. In addition, from the Friuli Regional Deformation seismic network (FReDNet), the time series of GNSS displacements located in Codroipo was downloaded and represented through pop-up.

The prototype currently has significant limitations. Updates are currently underway, including the implementation of a Geoserver and Geonetwork network within Downstream VRE.

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Adoption of FAIR practices in ITINERIS Environmental Research Infrastructures

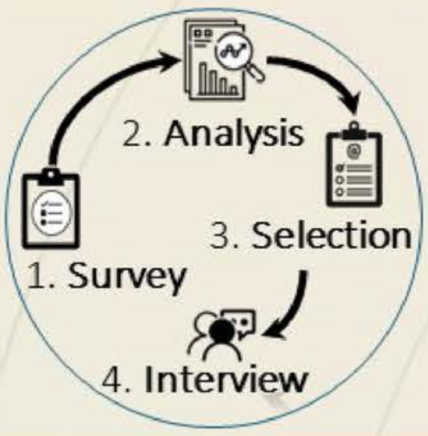
Gregorio Sgrigna; Gianmarco Ingrosso; Enrica Nestola; Andrea Tarallo; Ilaria Rosati
CNR - IRET (URT LECCE)

Background: FAIR principles have emerged as a revolutionary framework to guide the management and sharing of Digital Objects (DOs), and Research infrastructures (RIs) play a crucial role in this process. ITINERIS is building the Italian RIs HUB of the environmental domain, providing access to facilities, FAIR data and related services. **Aim:** Task 2.3 aims to support the implementation and adoption of FAIR enabling best practices within the RIs involved in the ITINERIS project.

Research questions

- How the DOs produced in ITINERIS will be managed, shared and preserved?
- Which are the FAIR implementation strategies adopted by the RIs involved in ITINERIS?
- How much the FAIR implementation choices of ITINERIS HUB converge with other RIs?

Data **management tool**: argos, DSW



FAIR Implementation Profile (FIPs): FIP Wizard

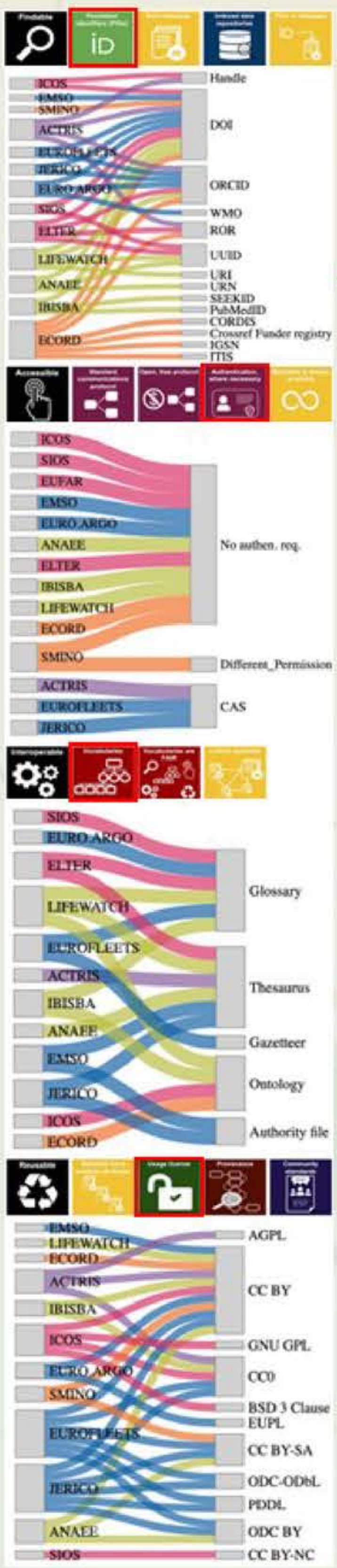
Data Management Plan

- Living document
- Management actions for DOs existing/produced within ITINERIS

What does the DMP describe?

- research data
- semantic artefacts
- policy document
- training materials
- codes & software
- metadata records

Overview on the FAIR practices implemented by the RIs



The heterogeneity of implemented strategies reflects the RIs diversity

Each FAIR principle is related to several strategies (an extract of the analysis is shown)

Essential insights for the design and development of the ITINERIS HUB and for the RIs at an emerging stage

FAIR implementation choices for the ITINERIS Data Hub: Convergence analysis

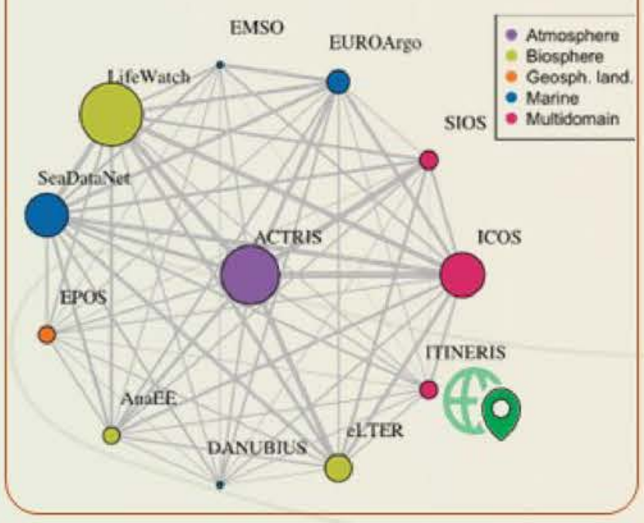
Data Hub FIP

FIP: a formal list of FAIR implementation choices declared by a specific community to fulfil FAIR principles.

A first version of the ITINERIS Data Hub FIP has been produced

An analysis of the FAIR implemented choices shared with others RIs that have a valid FIP has been carried out

The number of shared FAIR choices provides a picture of the potential connectivity between the ITINERIS Data Hub and the other RIs



Next steps:

- Indicate possible FAIR solutions to new developing RIs
- Inform on best FAIR choices for the ITINERIS HUB
- Update the DMP based on the research outputs of ITINERIS
- Release of new FIPs for those RIs interested to track their progress on FAIR readiness
- Update existing FIPs

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Approaches to achieve semantic interoperability in environmental sciences

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BACKGROUND: Semantic interoperability is a fundamental pillar of the FAIR principles, a set of guidelines to improve the Findability, Accessibility, Interoperability, and Reusability of digital objects. The adoption of Semantic Artefacts (SA) is required to achieve semantic interoperability and to describe meaning and structure of information and relations among them. SA (e.g. controlled vocabularies, thesauri, ontologies) ensure the unambiguous communication of information between humans and machines and enable the discovery, integration and reuse of digital objects.

AIM: to foster semantic interoperability among ITINERIS RIs through the publication of novel FAIR SA, and in the extension and/or FAIRification of the existing ones. In addition, a collection of SA and their catalogues, followed by a FAIR analysis, was used to identify the existing and most suitable semantic technologies in the field of environmental sciences.

SA from ITINERIS Research Infrastructures (RIs)

SA used and/or managed by ITINERIS RIs were gathered using the replies to the questionnaire "State of the Art of FAIR-enabling best practices" (WP 2.3).

AnaEE ERIC · Eurofleets · ACTRIS · LifeWatch ERIC · JERICO Research Infrastructure · ICOS · IBISBA · SIOS · emso ERIC · Euro Argo · eLTER

Collection of existing SA in environmental sciences

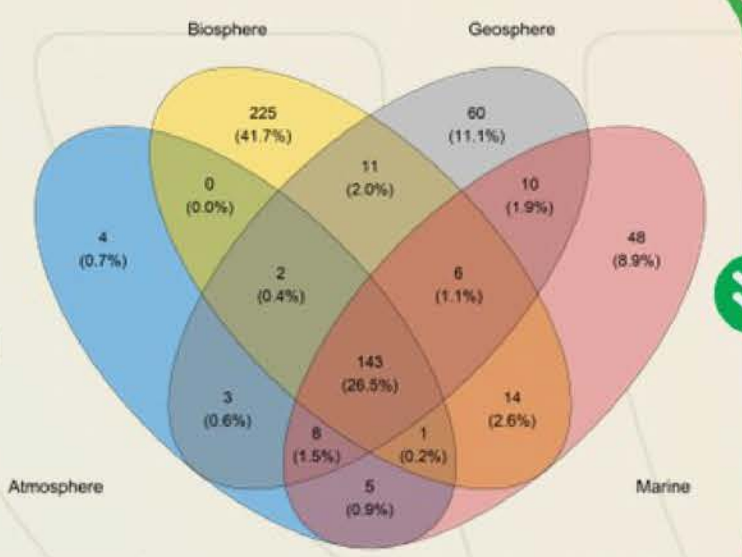
Search

17 catalogues of SA

Result

540 SA including:

- 225 SA of the terrestrial biosphere domain
- 60 of the geosphere land surface
- 48 of the marine
- 4 of the atmosphere
- 203 multidomain



Di Muri, Pulieri et al. accepted for publication in Sci. Data

FAIR analysis of SA

Evaluation of the compiled SA metrics associated to FAIR sub-principles.

Analyses

Findable	identifiers (F1) inclusion in semantic catalogues (F4)
Accessible	status (A1)
Interoperable	formality level, language and format (I1)
Reusable	description (R1) usage licence (R1.1) version (R1.2)

Results

F1 F4	18.5% of SA with DOIs 5.5% of SA not available in semantic catalogues
A1	64.6% of SA without status information
I1	8% of SA without standard languages and formats
R1 R1.1 R1.2	8.9% of SA without description 25% of SA without usage licences 22% of SA without version

Di Muri, Pulieri et al. accepted for publication in Sci. Data

Terminology service

The SA and their catalogues considered in the analyses will be used by a terminology service to facilitate the search and discovery of annotated digital objects to improve the interoperability within ITINERIS RIs.

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CNR ISAC

Aerosol typing using optical properties at different observatory from north to south Italy

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Introduction

The separation of total aerosol into **aerosol types** is necessary both to reduce the significant uncertainties in current aerosol forcing estimates (Forster et al., 2007), for assessing their climate impact, and to guide emissions-based control policies. An optical properties typing approach can be applied to remote sensing optical measurements of **AERONET database** (Holben et al., 1998) (CIMEL sun/sky/lunar photometer measurements).

Methodology

SSA is the effectiveness of scattering relative to extinction of aerosols (scattering + absorption).

- SSA = Scattering/(Scattering + Absorption)
- $SAOD_\lambda = AOD_\lambda \times SSA_\lambda$

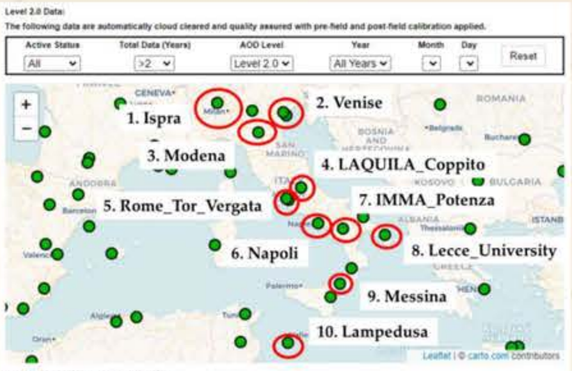
$$SAE = -\frac{\log\left(SAOD(\lambda_1)/SAOD(\lambda_2)\right)}{\log\left(\lambda_1/\lambda_2\right)}$$

$$AAE = -\frac{\log\left(AAOD(\lambda_1)/AAOD(\lambda_2)\right)}{\log\left(\lambda_1/\lambda_2\right)}$$

where λ1 = 440 nm and λ2 = 675 nm

Calculations of spectral Absorption AOD (AAOD) and Scattering AOD (SAOD):

- $AAOD_\lambda = AOD_\lambda \times (1 - SSA_\lambda)$

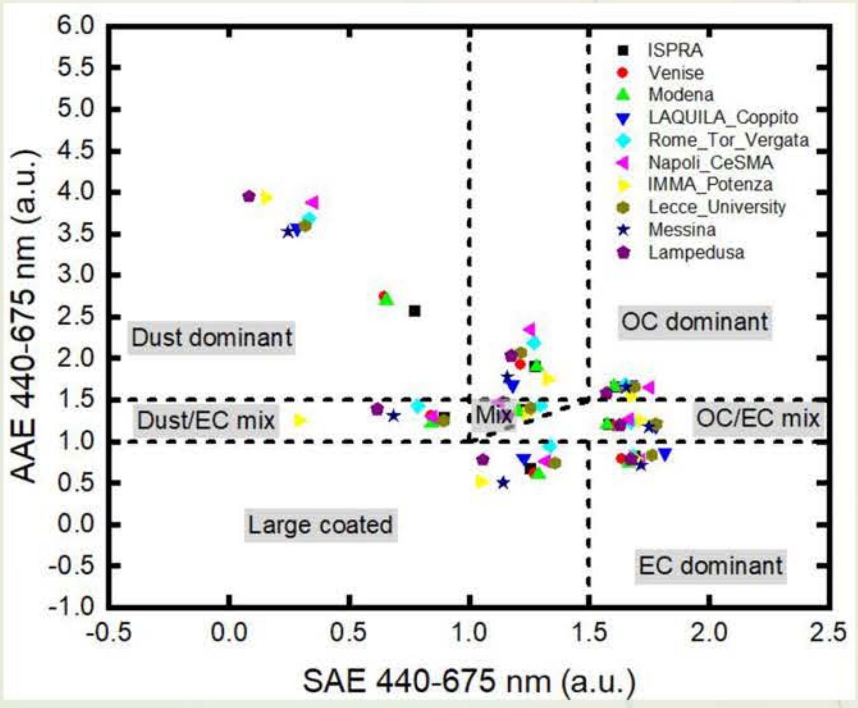


Site	Period	Level 2.0 data nr.
1. Ispra	1997 - 2023	1442
2. Venise	1999 - 2023	1454
3. Modena	2000 - 2021	1237
4. LAQUILA_Coppito	2015 - 2022	62
5. Rome_Tor_Vergata	2001 - 2023	571
6. Napoli_CeSMA	2016 - 2022	62
7. IMAA_Potenza	2004 - 2022	138
8. Lecce_University	2003 - 2023	746
9. Messina	2005 - 2023	373
10. Lampedusa	2000 - 2023	371

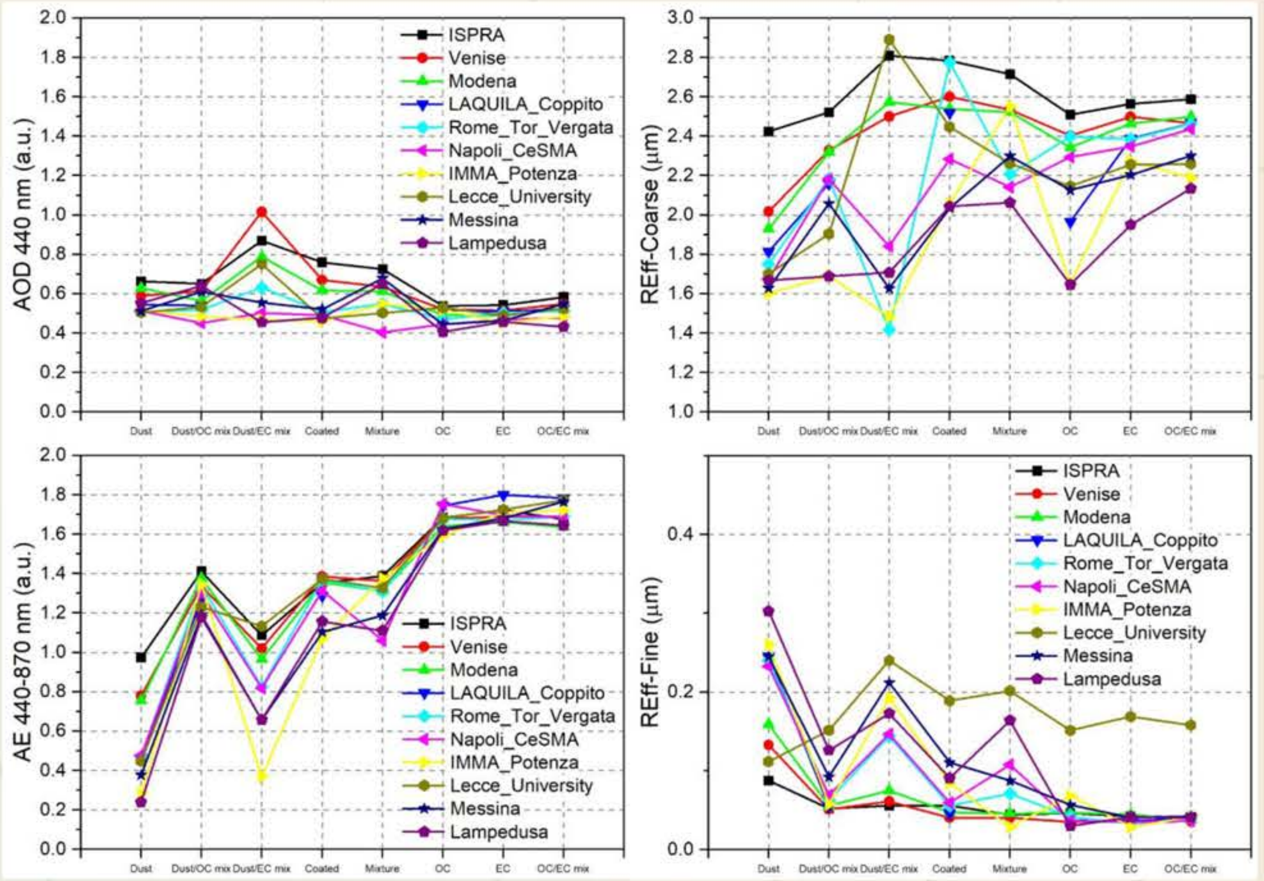
Data availability: AERONET level 2.0 data, Ver. 3 (cloud-screened, quality-assured, and AOD at 440 nm > 0.4 a.u.) of 10 long-term stations across Italy. Average analyzed period 2000 – 2023. 3 AERONET stations with less data (newer stations, or less impacted by pollution).

Results

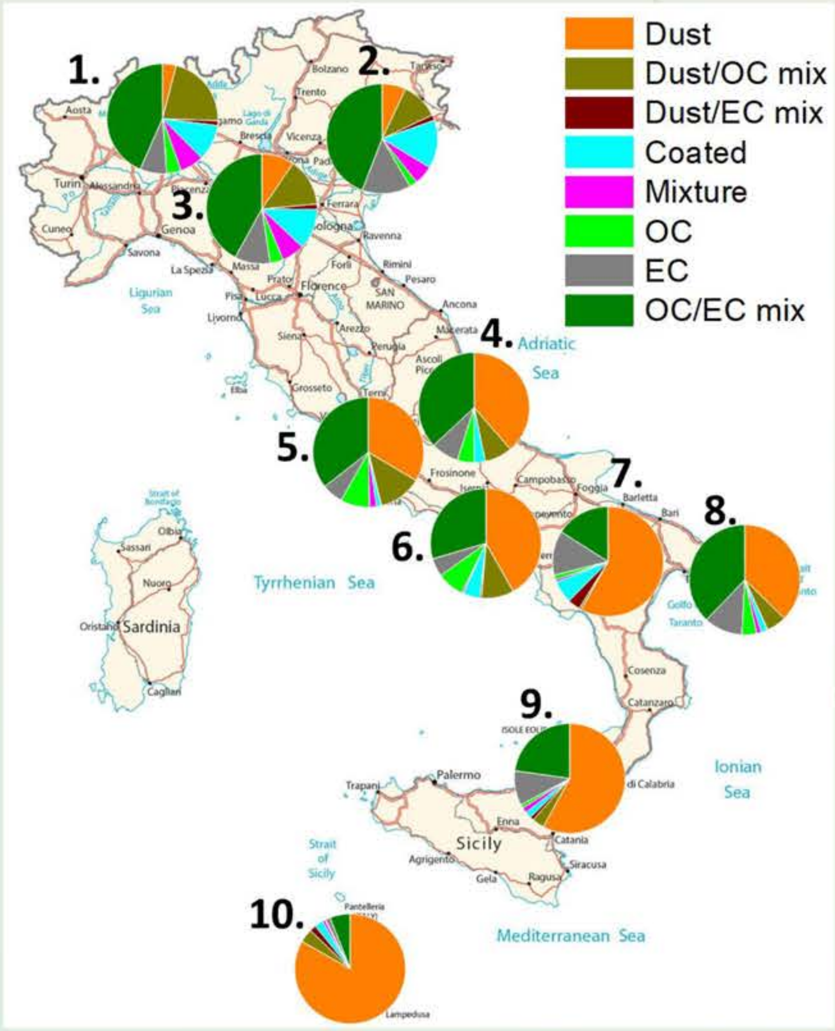
Average AAE vs. SAE 440-675 nm scatter plot



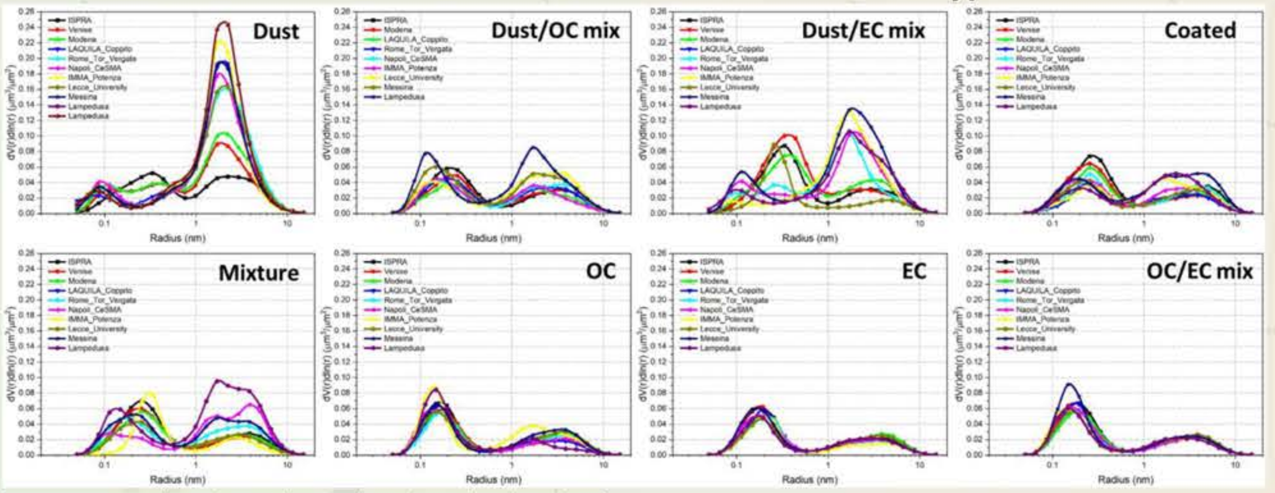
Microphysical properties of dominant aerosol type



Relative proportion of dominant aerosol types over Italy

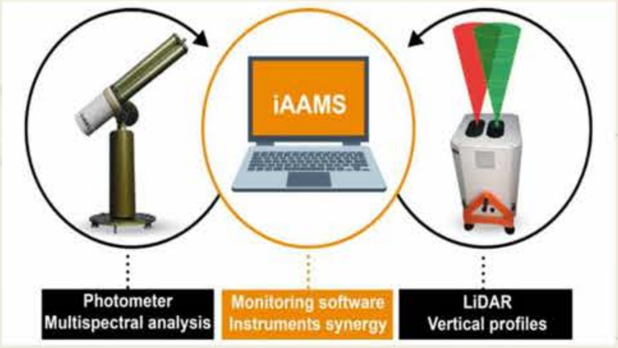


Volume size distribution of dominant aerosol type



Site	Dust %	Dust/OC mix %	Dust/EC Mix %	Coated %	Mixture %	OC %	EC %	OC/EC mix %
1. Ispra	4.02	21.57	1.46	10.54	6.93	4.23	7.77	43.48
2. Venise	7.02	10.87	1.65	14.24	5.57	2.27	14.17	44.22
3. Modena	9.58	14.07	1.54	11.96	6.63	3.80	10.35	42.12
4. LAQUILA_Coppito	38.71	8.06	-	3.23	-	4.84	8.06	37.10
5. Rome_Tor_Vergata	33.63	12.61	0.18	1.23	2.10	6.41	6.13	35.73
6. Napoli_CeSMA	41.87	9.36	0.49	4.93	0.49	7.88	5.42	29.56
7. IMAA_Potenza	57.97	0.72	3.62	6.52	0.72	1.45	13.04	15.94
8. Lecce_University	37.40	5.76	0.13	1.88	1.34	4.29	11.26	37.94
9. Messina	57.91	3.49	1.07	1.88	1.61	1.07	10.19	22.79
10. Lampedusa	83.29	4.04	1.89	2.43	0.81	0.27	1.35	5.93

Perspectives



Conclusions

Dust optical properties are different North versus South and Central sites. Higher proportion of Dust dominant aerosol type in the south (closer to source, Saharan desert). Higher proportion of OC/EC mixture in north (continental pollution). Effective Radius of fine particles is lower at ISPRA site, and higher at Lecce site (except Dust). Effective Radius of coarse particles is higher at ISPRA site, and lower at southern sites. Higher proportion of Dust dominant aerosol type in the south (closer to source, Saharan desert). Higher proportion of OC/EC mixture in north (continental pollution).

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Statistics of new particle formation at ECO site

A. Dinoi[1] *, G. Deluca[1], E. Bloise[1], A. Pennetta[1], D. Cesari[1], F. Unga[1], S. Potì[1,2], D. Contini[1]

[1]*Istituto di Scienze dell'Atmosfera e del Clima - ISAC-CNR, Lecce*
[2]*Dipartimento di Ingegneria dell'Innovazione. Università del Salento, Lecce*
*Email: adelaide.dinoi@cnr.it

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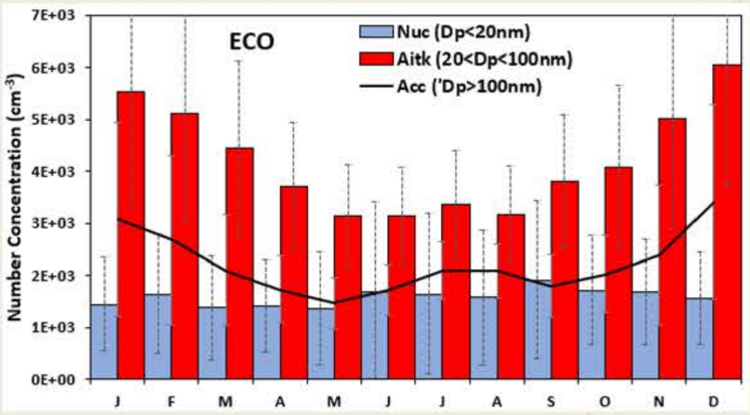
The formation of new particles (NPF), by nucleation of gas-phase species and consecutive growth, represents a significant source of secondary ultrafine particles and cloud condensation nuclei, ~50% of the particle number concentration (PNC) on a global scale. This study aims to characterize NPF events in a site of Southern Italy over a long-term dataset.

Experimental

ECO Observatory (40°N;18°E) urban background, 5 km from Lecce (regional station of GAWWMO/ACTRIS networks).
INSTRUMENTATION: PNC (10-800nm) by MPSS;
SO_2 (Thermo Instruments analyzers, TEI 43i)
Meteo data (T, WS, WD, RH, rain, Solar Flux).

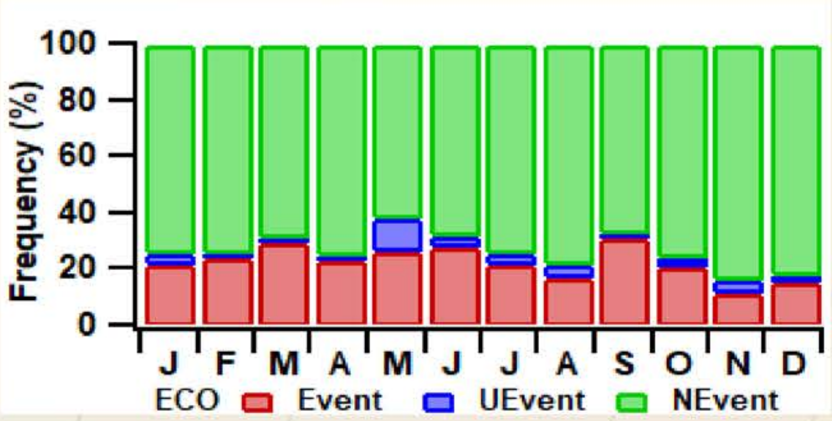
PNC concentrations



Contribution to the total PNC: 20% nucleation, 52% Aitken and 28% accumulation mode particles.

NPF events

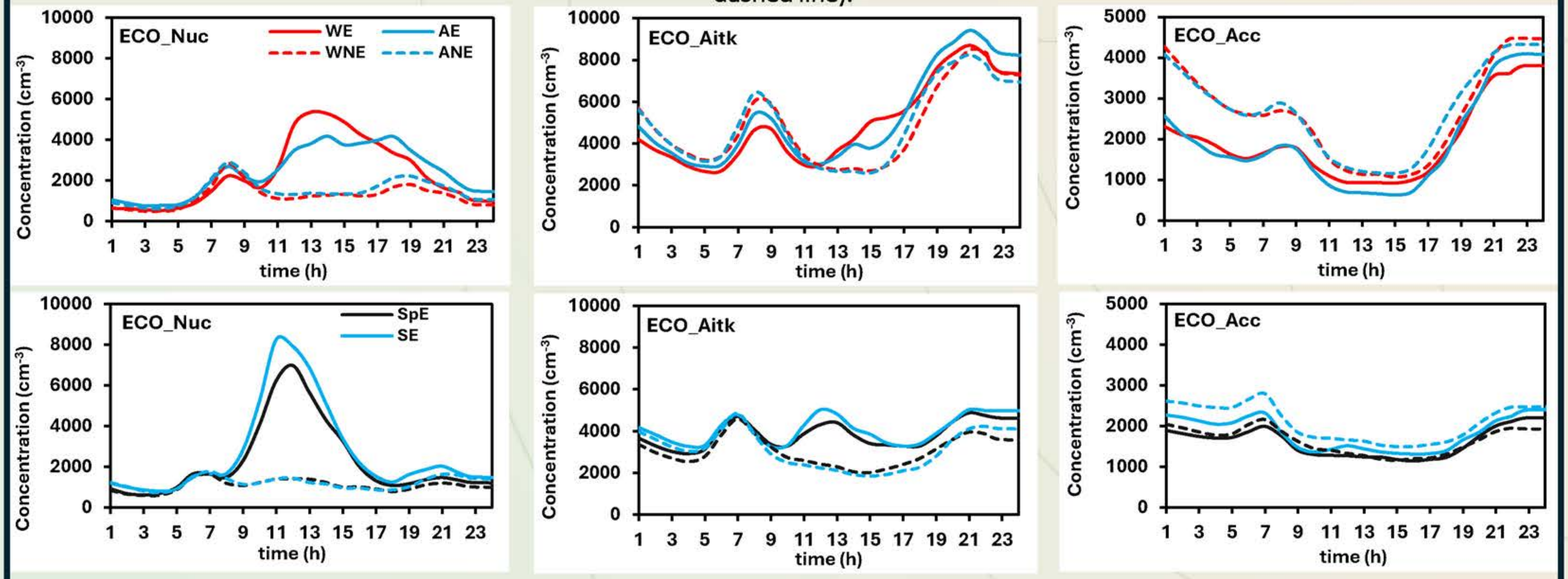
Classification of NPF events by visual inspection of daily contour plots: Event (25%); N(non)Event (71%); U(undefined)Event (4%)



NPF events more frequent in spring and summer, March and September (~30 %) vs November and December (12 % -16 %).

Impact of NPF events

The contribution of NPF in diurnal pattern of each mode fraction during events (N, solid line) and non-event days (NE, dashed line).



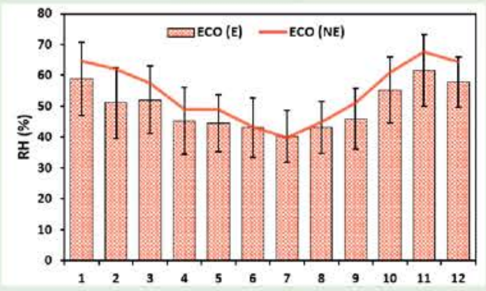
Nucleation mode: increase of 47 %, 52 %, 55 %, 39 %

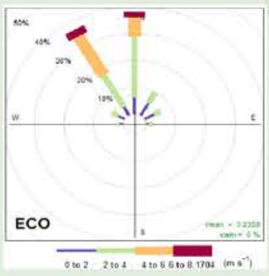
Aitken mode: increase of 21 % in spring-summer

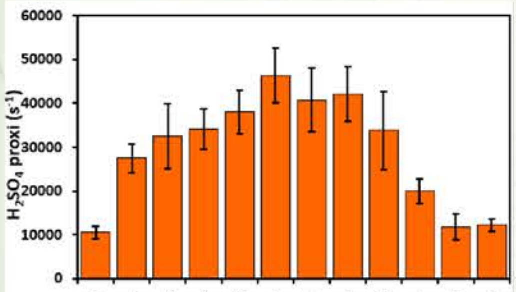
Accumulation mode: limited contribution to PNC

Factors associated with NPF events

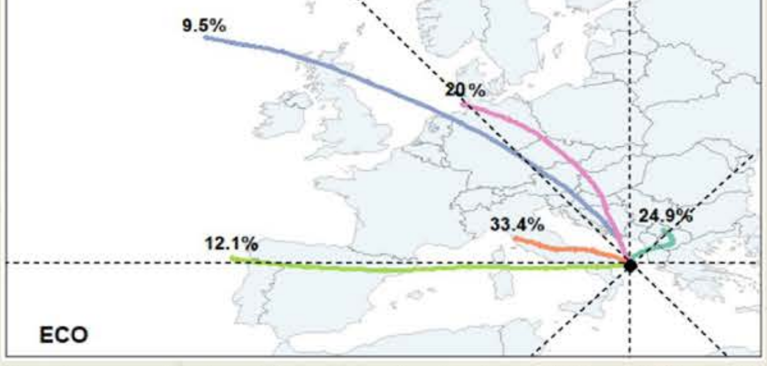
Local weather: clear skies, RH<52 % and moderate wind speed 3-4 m/s.







The monthly values of the H_2SO_4 proxy are larger in warm months with values ~ 35% higher during event days.



Cluster analysis of back trajectories (72 h, 500 m h) associated with NPF events shows 6 centroids.

Conclusion & outlook

Different seasonal frequency of NPF events was observed. **Common meteorological factors** (high pressure, low RH (~52%), moderate wind speed (3-4 m s^{-1})) and **origin of the air masses** from the North-Northwest sectors with likely transport of the chemical compounds involved in the NPF have characterized the events. **Further investigations, using NAIS measurements data, will be performed to better understand the complex NPF process in central Mediterranean area (Dinoi et al., ACP 23(3)2167-2181, 2023).**

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Studies at ChAMBRe on the viability of bacterial strains versus NO_x concentration

Virginia Vernocchi[1*], E. Abd El[1,2], M. Brunoldi[1,2], E. Gatta[2], T. Isolabella[1,2], D. Massabò[1,2], F. Mazzei[1,2], F. Parodi[1], P. Prati[1,2]

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ChAMBRe: the atmospheric simulation chamber

ChAMBRe (***Ch****amber for* ***A****erosol* ***M****odelling and* ***B****io-aerosol* ***Re****search*) is installed at the **National Institute of Nuclear Physics** in Genoa in collaboration with the **Environmental Physics Laboratory** at the Physics Department of Genoa University (*www.labfisa.ge.infn.it*). The facility is part of the **ERIC-ACTRIS**.

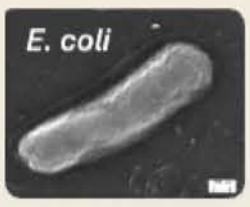
Massabò et al., (2018). Atmos. Meas. Tech., 11, 5885-5900

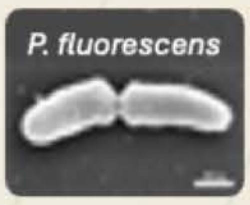
Bacteria and bacteria viability

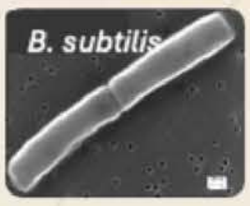
Bacteria belong to **bioaerosol**, they play a relevant role in the atmosphere due to their high concentration (10^4 cells m^{-3}) and long atmospheric residence time (consequence of micrometric size).

Bacteria strain
↓
Standard models

Bacteria viability ↔ ability of bacteria to survive
For pathogen bacteria: ability of bacteria to survive and maintain their pathogenicity
Different atmospheric conditions can influence the bacteria viability







A protocol to perform experiments on the impact of air quality on bacteria viability by ChAMBRe

BACTERIA PREPARATION

Bacteria growth

- Tryptic Soy Broth (TSB) – Nutrient Broth (NB)
- Mid-exponential phase: $OD_{600nm} \approx 0.5$
- Centrifugation and resuspension in physiological solution

Inoculum characterization

- Bacteria viable/total concentration:
  - *Quantum Tx Cell counter* [cells cm^{-3}]
  - Microscope with *live & dead* dyes [cells cm^{-3}]
  - Dilution plating on Petri dishes [CFU ml^{-1}]

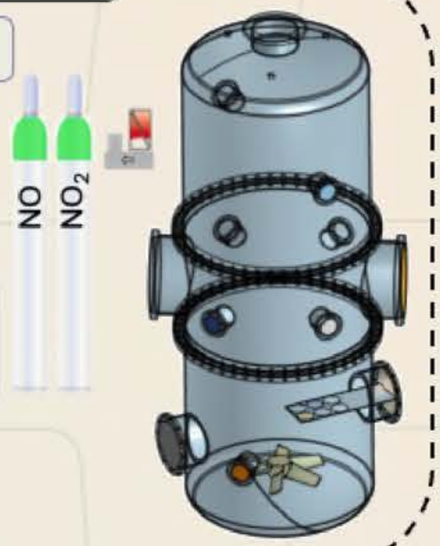
BACTERIA EXPOSURE

Setting of atmospheric conditions

- Baseline (clean air)
- NO / NO_2 (900 and 1200 ppb)

Bacteria injection

- Slag nebulizer* (automatic air flow control and automatic syringe pump)



*see Slag characterization in connection with ChAMBRe in
Danelli et al., (2021). Atmos. Meas. Tech., 14, 4461–4470

VIABILITY DETERMINATION

Determination of bacteria total concentration

- *WIBS bioaerosol online monitor*
- Software tool specific for each strain [cells cm^{-3} (t)]

Bacteria sampling → **Determination of bacteria viable concentration**

- Active sampling on petri by Andersen impactor (at fixed times)
- CFUs growth by overnight incubation [CFU cm^{-3} (t)]

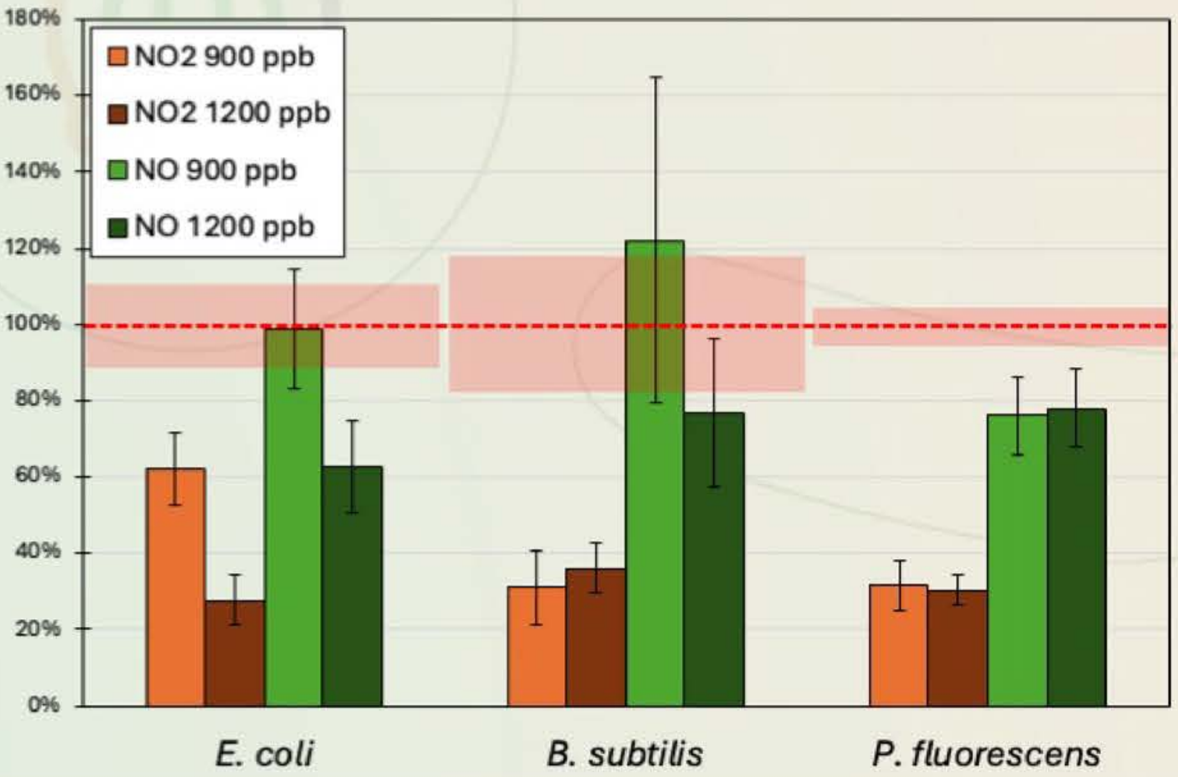
Vernocchi et al., (2023). Atmos. Meas. Tech., 16, 5479-5493

Results

$$\frac{\text{Viable concentration}}{\text{Total concentration}}(\text{time})$$

$$C(t) = C_0 e^{-\frac{t}{\tau}}$$ τ lifetime (min)

Changes in viability respect to the *Baseline*



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BLAnCA: a new broadband light absorption spectrometer for complex aerosol developed at NF-INFN-ChAMBRe

Tommaso Isolabella[1,2], Vera Bernardoni[3,4], Marco Brunoldi[1,2], Muhammad Irfan[1], Federico Mazzei[1,2], Franco Parodi[2], Paolo Prati[1,2], Virginia Vernocchi[2], <u>Dario Massabò</u>[1,2,*]

[1]Dipartimento di Fisica, Università degli Studi di Genova, Genova
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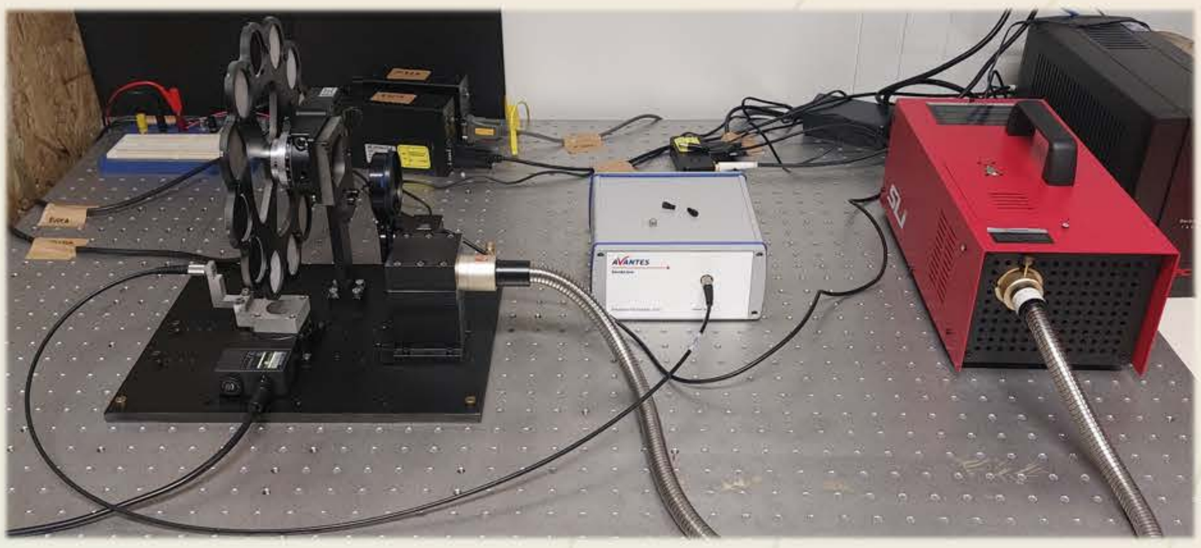
Due to the absorption and scattering properties of electromagnetic radiation, atmospheric particulate matter (PM) plays a major role in the Earth's energy balance. To fully understand this role and prevent its effects, it is more important than ever characterize in detail its optical properties, so connected to PM composition and size distribution.

At the INFN division of Genoa, in collaboration with the Department of Physics of the University of Genoa, a new benchtop instrument has been developed for the determination of the optical properties of PM collected on a filter: **BLAnCA (<u>Broadband Light Analyser of Complex Aerosol</u>)**

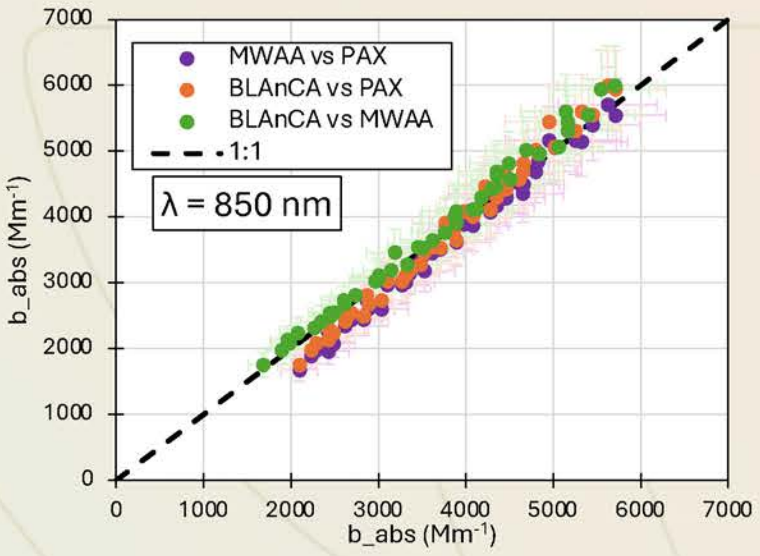


BLAnCA can measure the aerosol absorption coefficient in a wide spectral range (350 - 900 nm), with a high resolution (< 5 nm).

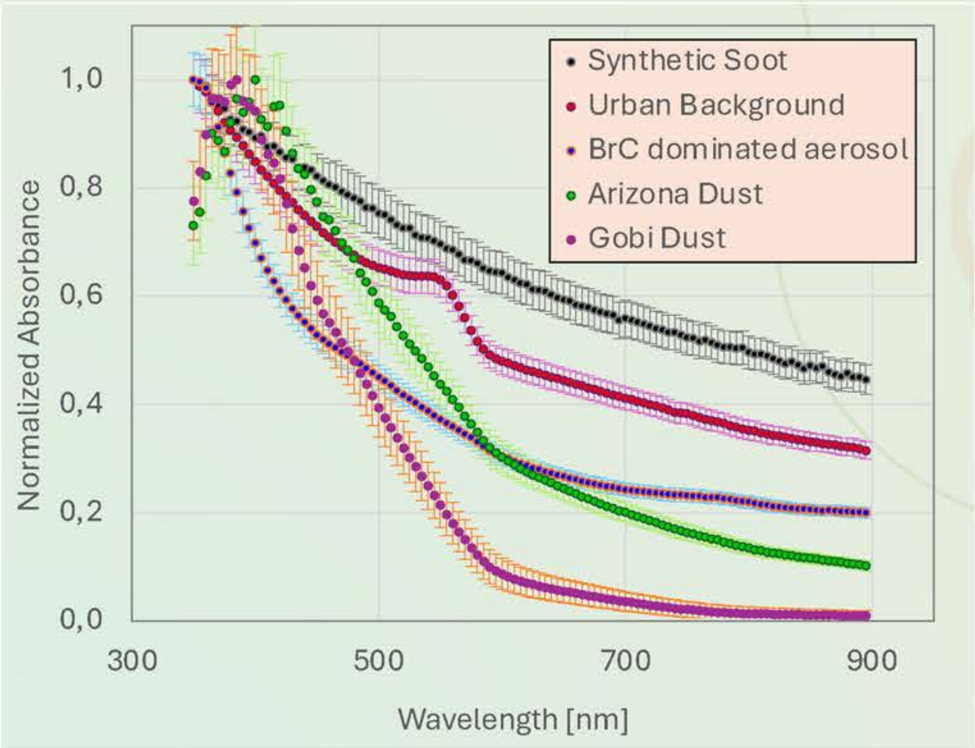
BLAnCA calibration

To calibrate the new instrument **BLAnCA**, an <u>atmospheric simulation chamber</u> has been used. **ChAMBRe** (***Ch**amber for **A**erosol **M**odelling and **B**io-aerosol **Re**search*) is installed at the **National Institute of Nuclear Physics** in Genoa in collaboration with the **Environmental Physics Laboratory** at the Physics Department of Genoa University (*<u>www.labfisa.ge.infn.it</u>*). The facility is part of the **ERIC-ACTRIS**.

Massabò et al., (2018). Atmos. Meas. Tech., 11, 5885-5900



Example of application: different aerosol injected into the chamber



Spectral absorbance measured by BLAnCA as a function of wavelength for different types of aerosols produced in ChAMBRe and collected on quartz fiber filters.

Conclusions and Outlook

Thanks to the use of the atmospheric simulation chamber, a set of completely characterized aerosols has been measured by BLAnCA (figure on the left): the new instrument has been calibrated and shown all its potentialities about the characterization of the aerosol absorption coefficient at high spectral resolution

- **other interesting physical parameters to be extracted** (e.g., <u>scattering coefficients, asymmetry parameters</u>, refractive index…)?
- The high resolution (<u>110 points each sample</u>) can be useful to extract **spectrally resolved physical parameters** to properties such as chemical composition, ageing and size distribution to a fine structure in optical properties.
- The fine structure of the absorption coefficient -and/or other parameters- could be useful in <u>advanced source apportionment studies</u> (e.g., <u>ME-2</u>)…what about a **source apportionment based on optical properties only?**

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Forest fires in the Mediterranean: influence of a very intense event on aerosol properties, radiation, and greenhouse gases observed at Lampedusa

F. Anello, V. Ciardini, L. De Silvestri, T. Di Iorio, A. G. di Sarra, P. Grigioni, **D. Meloni**, F. Monteleone, G. Pace, M. Pecci, S. Piacentino, E. Principato, C. Scarchilli, D. M. Sferlazzo

ENEA, Laboratory for Observations and Measurements for Environment and Climate, Italy

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The Lampedusa Station for Climate Observations

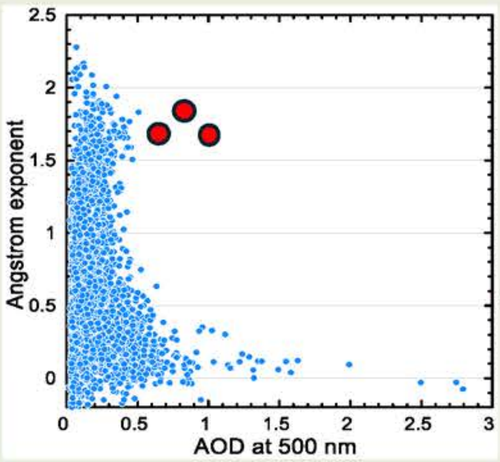
The Station for Climate Observations on the island of Lampedusa (http://www.lampedusa.enea.it), in the central Mediterranean sea, is composed of an Atmospheric Observatory (AO) an Oceanographic Observatory (OO) and a recently developed Terrestrial Ecosystem Observatory (EO). Lampedusa is a small island, with a surface area of about 20 km^2, sparse vegetation, limited pollution sources. The highest elevation of the island is 123 m.

The three sections are within a radius of 8 km and constitute an integrated Mediterranean observatory that allows the datailed characterization of the atmospheric structure and composition and their changes, the investigation of air-sea interactions and oceanic properties, and of the exchange between atmosphere and Mediterranean vegetation. In this study, measurements from AO and OO are used to assess the role played on regional climate by an intense smoke/gas plume originating from Greece.

Aerosol and greenhouse gases

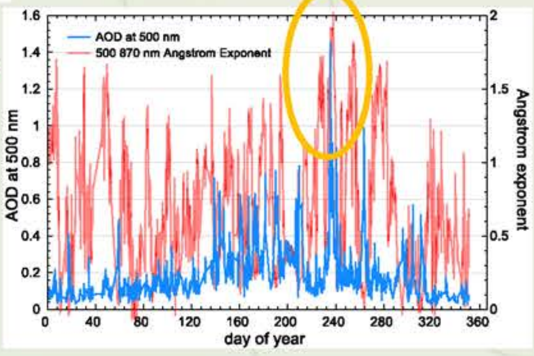
MODIS corrected reflectance maps of the central Mediterranean in the period 21-27 August 2023. Thermal anomalies are displayed in red.

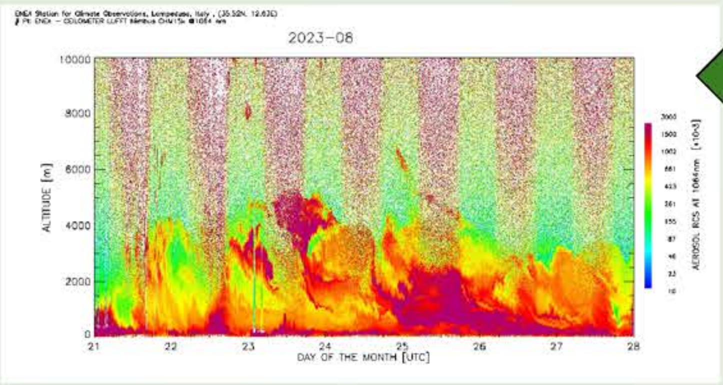
Airmass trajectories arriving at Lampedusa on 23 August 2023, at 12 UTC.



Daily average aerosol optical depth (AOD) at 500 nm and Ångström exponent (AE) for the period 1999-2019 (>4600 days) at Lampedusa. The daily values for 23, 24, and 15 August are shown in red.

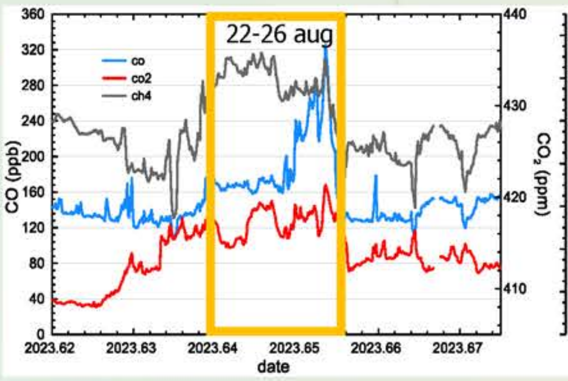
Annual evolution of instantaneous measurements of AOD and AE for year 2023. The AOD reached a peak value of 1.5 on 23 August, with an AE value of 1.8. These values are a significant anomaly in the >20 years record of AOD/AE observations at Lampedusa.



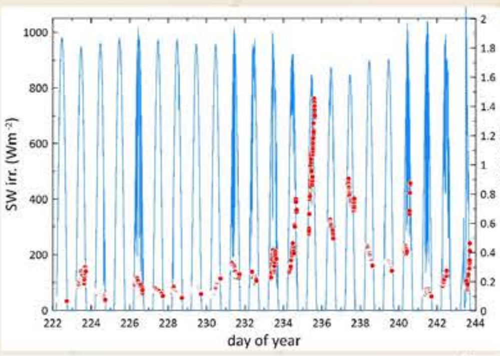


Evolution of the aerosol vertical profile during the period 21-27 August, as appears from CHM-15k ceilometer data (level 1.0 range corrected signals). It is evident that the transported smoke reached 4-5 km from the surface.

Evolution of CO_2, CH_4, and CO concentration as measured at the ICOS Atmosphere site of Lampedusa. The CO concentration reaches a peak never observed at Lampedusa since CO measurements begun in 2012.

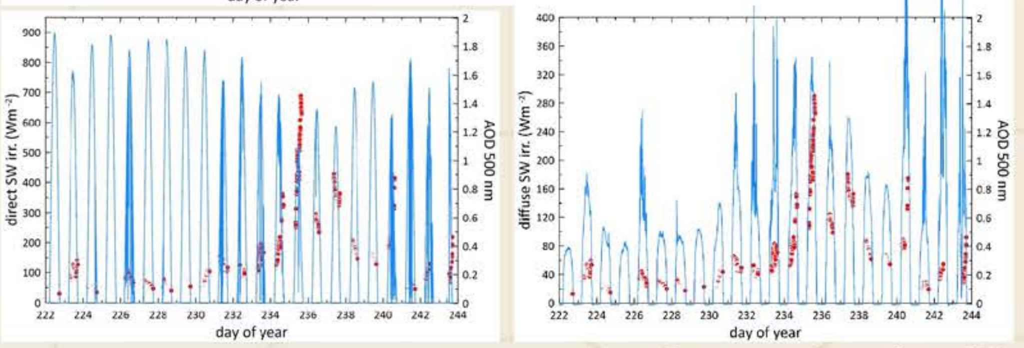


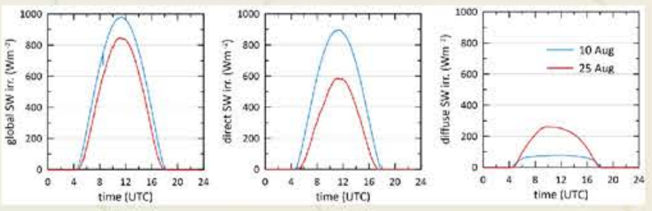
Effects on the surface radiation



Evolution of downward solar irradiance (blue curve; measurements referred to the World Radiation Reference scale, data corrected for thermal offset) and AOD (red dots) in the period 10-31 August 2023.

The two graphs below show the direct and diffuse solar irradiance, as measured at the Lampedusa BSRN station. The effect of the smoke plume is evident.

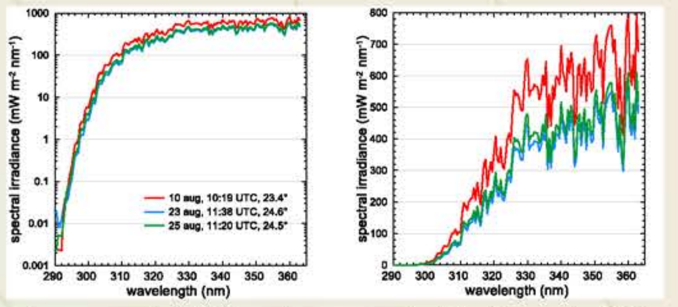




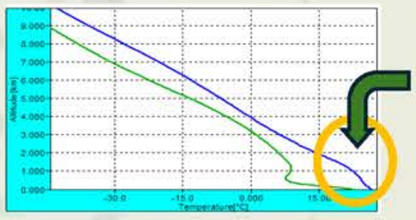
By comparing the SW irradiance on a day with low AOD (10 Aug.) and on the day with large biomass burning AOD (25 Aug.), the aerosol radiative effect can be estimated.

The reduction in global and direct SW irradiance at noon, 24.5° SZA, (AOD at 500 nm of 0.75) is -10% and -32%, respectively, with a strong increase in the SW diffuse component by +244%.

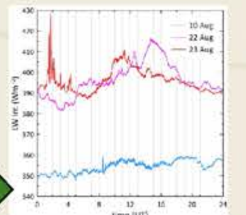
Spectral UV irradiance measured by the Brewer spectrophotometer at solar zenith angle of about 25° on 10, 23, and 25 August. Total ozone in addition to aerosol influences the irradiance below 320 nm.

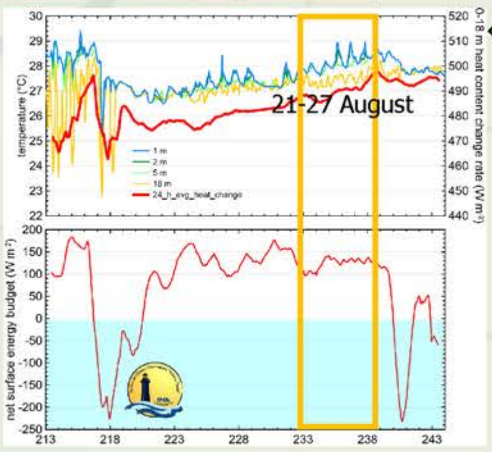


The larger turbidity on 23 and 25 August due to the smoke aerosol is clearly visible from the sky images.

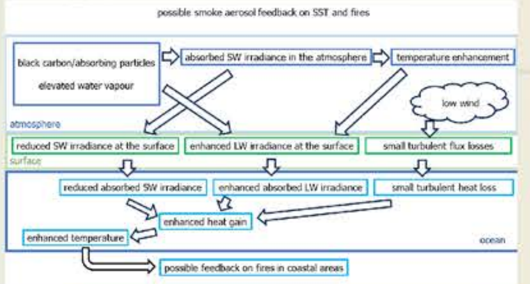


The Microwave Radiometer data (left) show elevated temperatures within the aerosol layer; downward IR radiation (right) is also higher during days with smoke.





Measurements at the Oceanographic Observatory show: elevated sea temperature during the 21-27 August period; a large positive surface energy budget, and an increasing ocean heat content. These conditions are likely to be driven by high pressure, low winds, high downwelling IR radiation, favouring heat accumulation in the ocean. Smoke aerosol are possibly playing an important role in this mechanism.



Is smoke aerosol contributing to a feedback mechanism leading to high heat accumulation in the ocean and favouring conditions for further wildfires in coastal areas?

Acknowledgements

The measurements at Lampedusa have been supported by the PON projects PER-ACTRIS-IT, PRO-ICOS_MED, and Marine Hazard, by the PRISCAV project by ASI, by the ESA (IDEAS-QA4EO) framework contract (n. 4000128960/19/I-NS). This study is also part of a project that is supported by the European Commission under the Horizon 2020 – Research and Innovation Framework Programme, H2020-INFRADEV-2019-2, Grant Agreement number: 871115 (ACTRIS-IMP).

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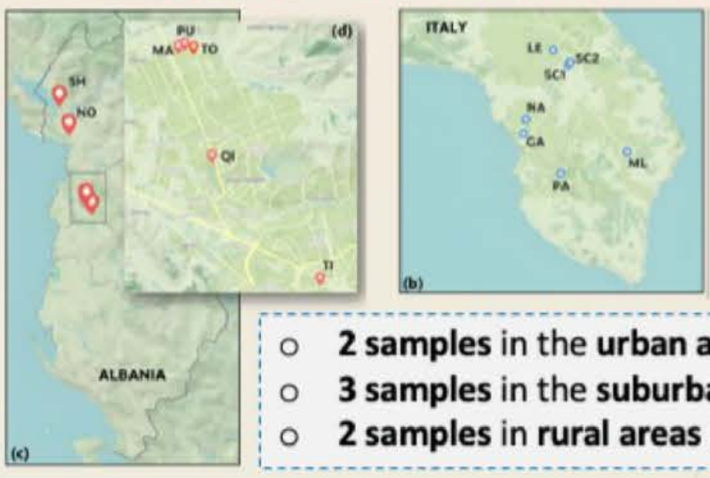
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Characterization of the biogenic component of atmospheric aerosol samples collected in different outdoor monitoring sites

Dalila Peccarrisi, Mattia Fragola, Salvatore Romano, Lekë Pepkolaj, Jostina Dhimitri, Alessandro Buccolieri, Adelfia Talà, Pietro Alifano, Gianluca Quarta, Lucio Calcagnile

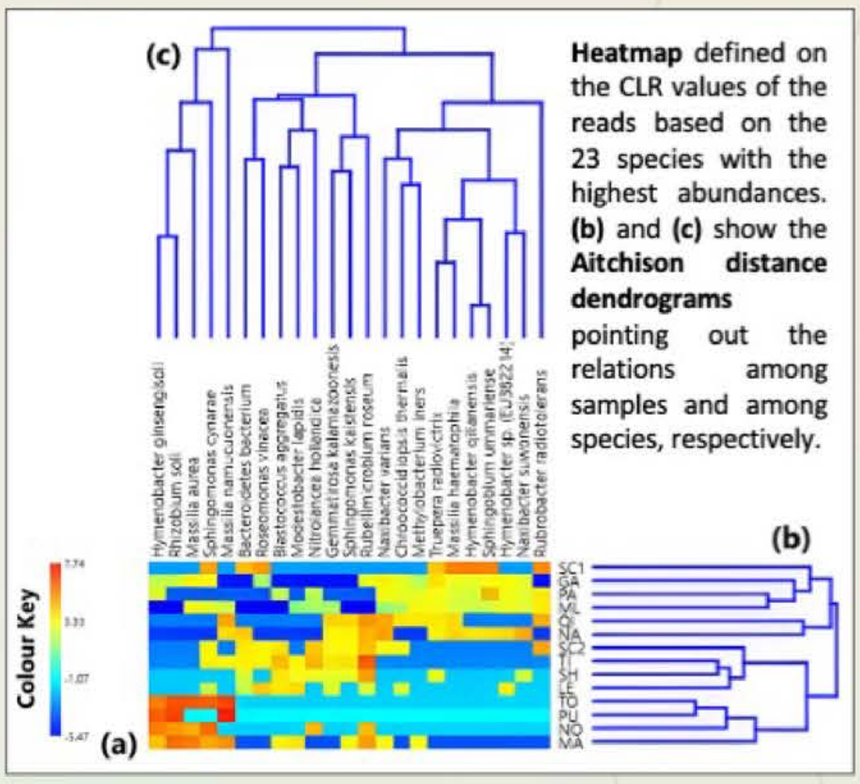
- **16S and ITS rRNA gene metabarcoding approach** was applied to the DNA extracted from 14 bioaerosol samples collected from October to November 2022 in two different areas of central Mediterranean, **Salento Peninsula (Italy)** and **Albania.**
- A compositional data analysis (**CoDA**) technique was used with the main goal of comparing the **airborne bacterial** and **fungal diversity** from several outdoor sites, at the species level.



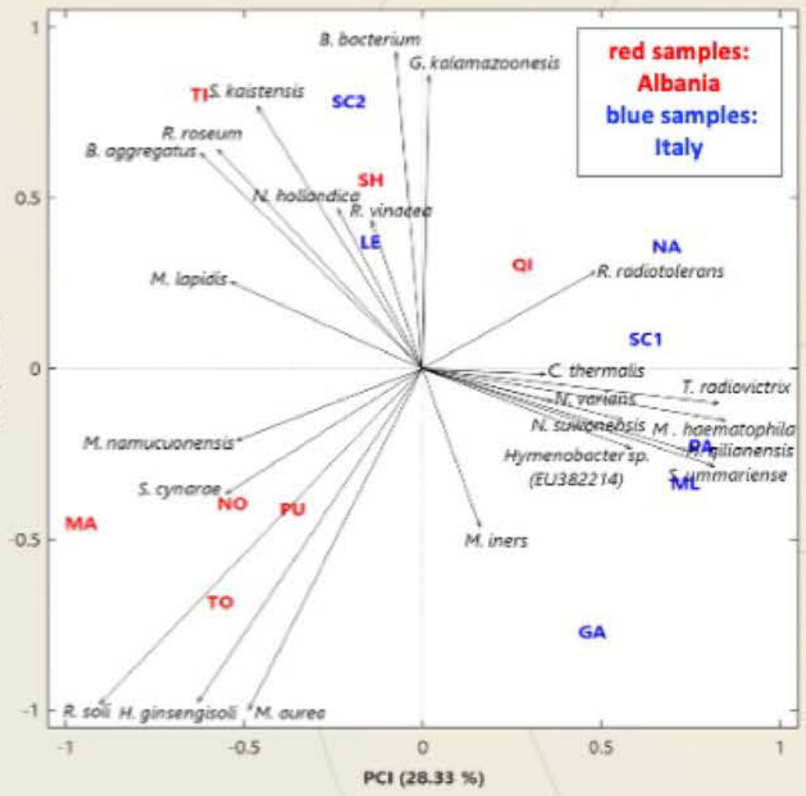
- **2 samples in urban sites** (University of Salento, "LE"; Nardò, "NA")
- **3 samples in small-sized towns** (Muro Leccese, "ML"; Parabita, "PA"; San Cesario di Lecce, "SC1")
- **2 samples in rural areas** (Galatone, "GA"; San Cesario di Lecce, "SC2")

- **2 samples** in the **urban area of Tirana** (Rruga Myslym Shyri, "TI"; University College Qiriazi, "QI")
- **3 samples** in the **suburban area of Tirana** (Marashi, "MA"; Pusi, "PU"; Tokat, "TO")
- **2 samples in rural areas** (Shkodër, "SH"; North Lezhë, "NO")

Overview of the bacterial community at the species-level



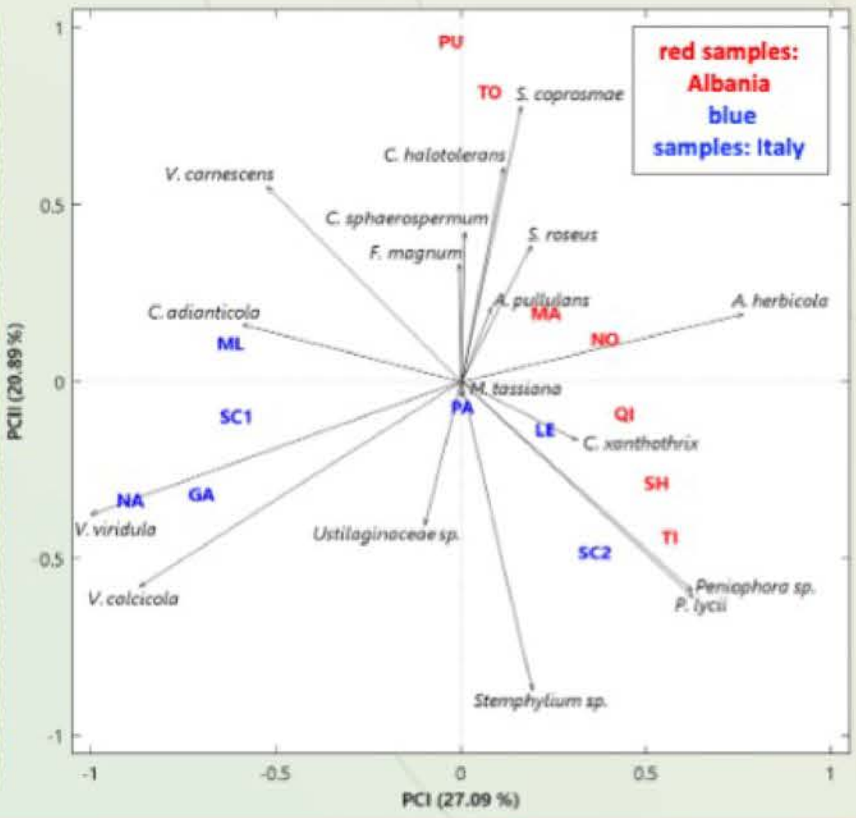
Heatmap defined on the CLR values of the reads based on the 23 species with the highest abundances. **(b)** and **(c)** show the **Aitchison distance dendrograms** pointing out the relations among samples and among species, respectively.

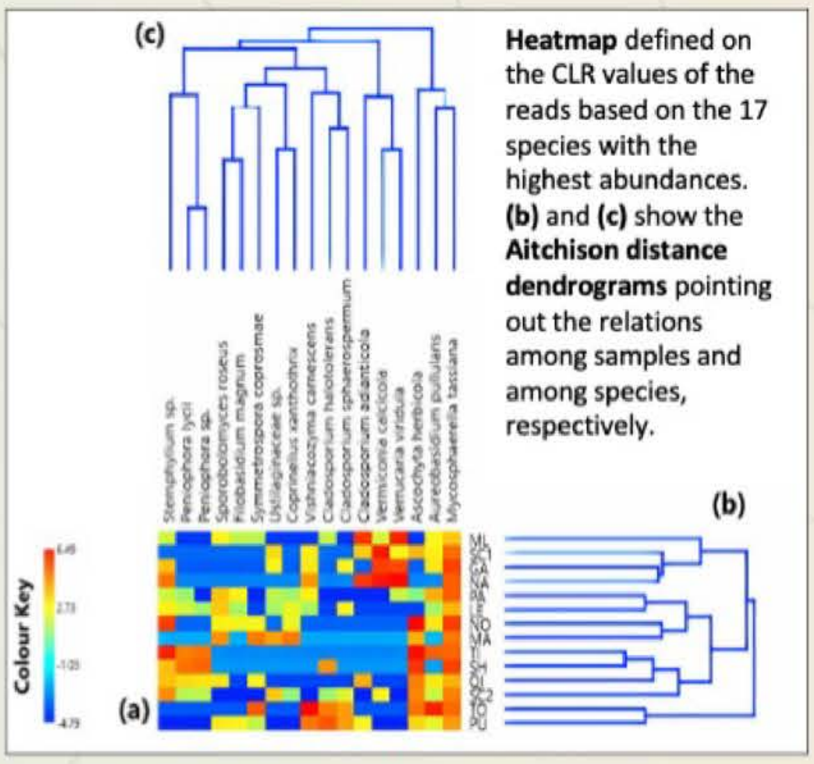


- **Bacterial species** with the highest abundances, such as *Rubellimicrobium roseum* and *Sphingomonas cynarae*, are predominantly associated with samples from Albania.
- The **radiation-resistant species**, *Truepera radiovictrix* and *Rubrobacter radiotolerans*, exhibit a pronounced association with the Italian sample cluster.

Overview of the fungal community at the species-level

- **Fungal species** with the highest abundances, such as *Aureobasidium pullulans* and *Ascochyta herbicola*, are strongly associated with samples from Albania.
- PU and TO samples are highly associated with two **fungal species** that were recognized as **potentially human pathogenic**, *Cladosporium halotolerans* and *C. sphaerospermum*.





Heatmap defined on the CLR values of the reads based on the 17 species with the highest abundances. **(b)** and **(c)** show the **Aitchison distance dendrograms** pointing out the relations among samples and among species, respectively.

Conclusions

1. The differentiation based on the geographical locations suggests the influence of local environmental factors on the airborne microbial compositions. The association of certain species with specific regions, as well as their interrelation within clusters, indicates potential ecological interactions and adaptations.
2. This study lays the groundwork for further investigations into factors shaping airborne microbial communities, contributing to our understanding of microbial ecology and its implications for environmental and human health.
3. This work also represents a first attempt to significantly characterize the main airborne bacterial and fungal communities in Albania where a limited number of studies have been conducted on this subject.

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Comparing methods for determination of Water-Soluble Organic Carbon

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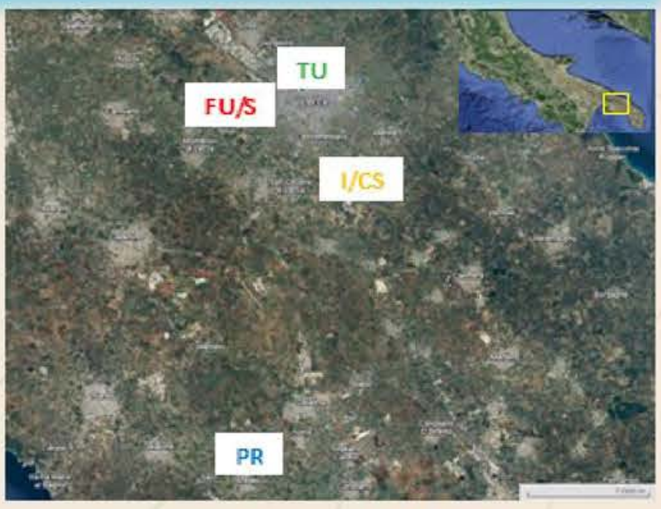
INTRODUCTION

Total carbon in PM is usually divided into organic carbon (OC), elemental carbon (EC) and inorganic carbon (IC), whose major fraction is carbonate carbon (CC). Water-soluble organic carbon (WSOC) is approximately 20 - 80% of OC, while water-soluble inorganic carbon (WSIC) is negligible. The origin of atmospheric WSOC can be attributed to both primary emissions from anthropogenic and natural sources and secondary formation through chemical reactions of volatile organic compounds (VOCs) in the atmosphere.

MATERIALS AND METHODS

Sampling

- $PM_{2.5}$ and PM_{10} daily samples in ECO observatory of Lecce (urban background FU/S), Campaign: Aug 2013 – Jul 2014
- $PM_{2.5}$ and PM_{10} monthly samples in public buildings, schools and private house (FU/S: urban background - ECO; TU: urban traffic; I/CS: commercial center; PR: site in the province (FAI Campaign)



Chemical Analysis: a quarter of filter was extracted in ultrapure water (15mL) for 30 min in an ultrasonic bath. After filtration, the WSOC was measured in a TOC Analyzer (TOC-LCPH/CPN, Shimadzu Corporation. Kyoto. Japan), using both TOC protocol (TC-IC) and NPOC protocol.

TOC Method

1) **TC** measurement

Sample → (Cat. Ox., Air; 680°C) → CO_2 NDIR detection

2) **IC** measurement

Sample → (HCl, Air; pH<3) → CO_2 NDIR detection

3) **TOC** calculation **TOC = TC - IC**

TOC-L CPH instrument

NPOC Method

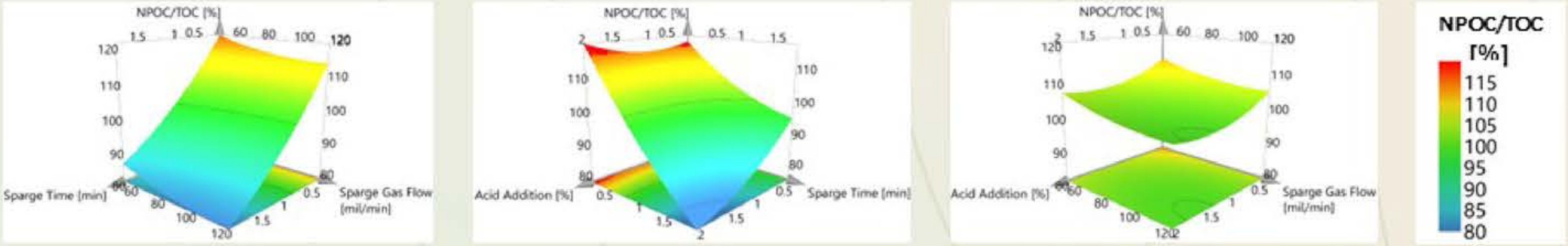
Sample → (HCl, Air; pH<3) → SPARGING (→ IC + purgeable OC) → (Cat. Ox., Air; 680°C) → CO_2 NDIR detection

Design of Experiment (DOE) to establish the NPOC operative conditions

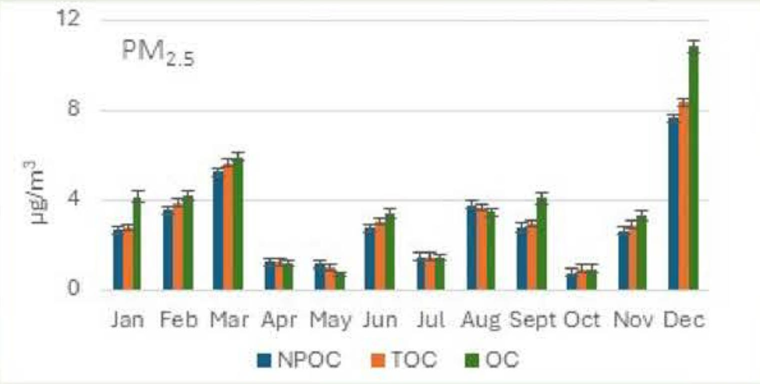
Design	Central Composite Face-centered (CCF)			
Factors	Abbr.	Units	Low	High
Sparge Gas Flow	SPG	mL/min	50	120
Sparge Time	ST	sec	10	114
Acid Addition	AA	%	0.2	2

RESULTS

SURFACE COUNTER PLOT

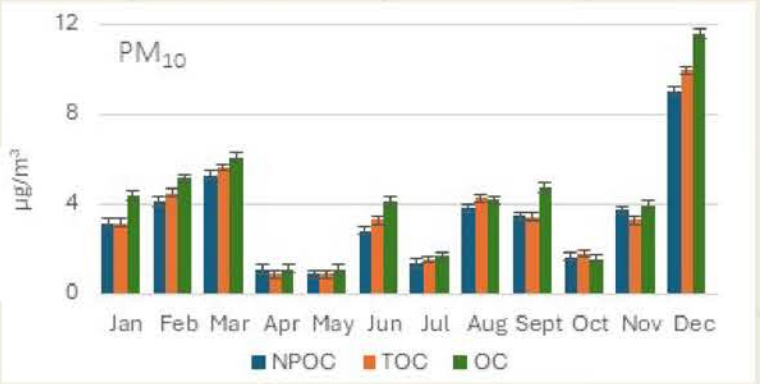


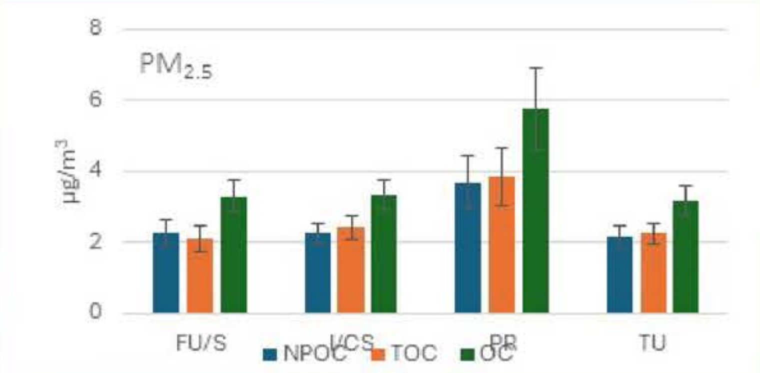
Optimized NPOC operative conditions: Sparge Time: 44 sec – Sparge Gas Flow: 101 mL/min – Acid Addition: 1.4 %



DAILY SAMPLES

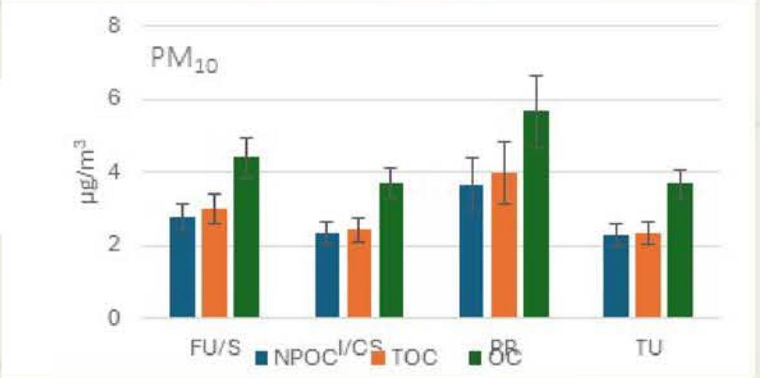
Average WSOC: $WSOC_{TOC}$: (3.3 ± 0.5) µg/m³ ; $WSOC_{NPOC}$: (3.2 ± 0.4) µg/m³

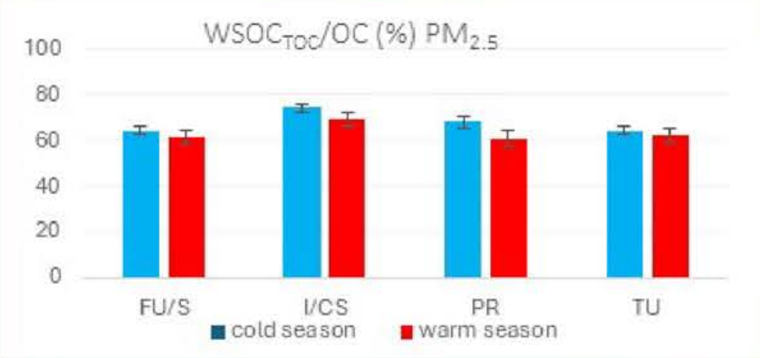




MONTLY SAMPLES

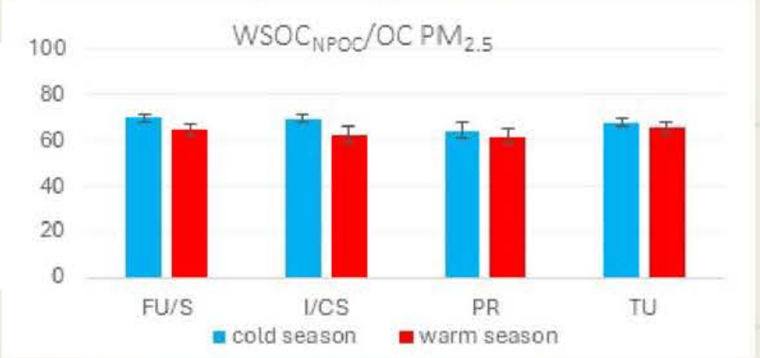
Good correlation on $PM_{2.5}$ and PM_{10} fractions - Not statistically different





MONTLY SAMPLES

The average solubility of OC is comparable (PM_{10} 66%; $PM_{2.5}$ 65%) Solubility of OC is greater in the cold season



CONCLUSIONS

WSOC results obtained by NPOC and TOC methods do not present statistically significant differences both in terms of samples type (daily or monthly) and seasonality. The NPOC method requires less sample than TOC (about half). Average WSOC is comparable in $PM_{2.5}$ and PM_{10} .

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Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

ISP Istituto di Scienze Polari, Consiglio Nazionale delle Ricerche

Unlocking data potential in a virtual research environment: **ERDDAP** integration and *machine learning* for enhanced utilization of **CCT** data from the **Italian Arctic Data Center**

Alice Cavaliere[1], Simone Pulimeno[1,2], Claudia Frangipani[1,3], Angelo Lupi[1], Mauro Mazzola[1], Chiara Ripa[1], Giulio Verazzo[1], Vito Vitale[1]

[1] CNR, Institute of Polar Sciences, Italy [2] Università Ca' Foscari, Venezia , Italy [3] Università degli studi G. D'Annunzio di Chieti-Pescara, Chieti-Pescara, Italy

INTRODUCTION

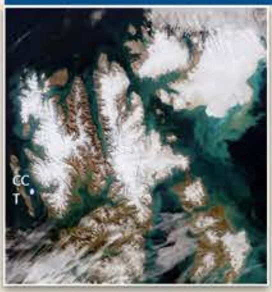

Fig. 1: The Copernicus Sentinel-2 mission captured this rare, cloud-free acquisition of Svalbard Norwegian archipelago in August 2022.

Fig. 2: Amundsen-Nobile CCT (Ny-Ålesund, Svalbard Norwegian archipelago.)

The **Amundsen-Nobile Climate Change Tower** (**CCT**) is a scientific platform, consists of 17 modules with a total height of 34 meter located in the Svalbard Norwegian archipelago (Ny-Ålesund) that provides continuous from 2009 to the present day.

This poster presents a **Jupyter Notebook** [1] example, designed for a **virtual research environment** to retrieve, plot, and visualize various **CCT** meteorological variables and the use of two most popular algorithms that are based on Gradient Boosted: **XGBoost** [3] and **LightGBM** [4] for a temperature inference task using the **CCT** dataset.

METHODS

- An **ERDDAP** instance operates specifically for Arctic data within the **Italian Arctic Data Center** (**IADC**), where the **CCT** Meteorological data are ingested, together with many others [2].
- **ERDDAP**'s **OPeNDAP** standard provides convenient access to **CCT** data for comprehensive analysis. In particular *Erddapy* is a package that takes advantage of **ERDDAP's** data retrieval through **ERDDAP** RESTful web services and creates the **ERDDAP URL** for any request.
- Once we downloaded the dataset it becomes feasible to visualize data for a comprehensive analysis using **Jupyter Notebook** with some open source libraries.

IADC | jupyter

```
e = ERDDAP(
    server="https://data.iadc.cnr.it/erddap",
    protocol="tabledap",
)
e.response = "nc"
e.dataset_id = "cct_meteo_d2"

e.constraints = {
    "time>=": "2009-01-01T00:00:00Z",
    "time<=": "2024-03-01T00:00:00Z",

}
df = e.to_pandas()
```

Fig. 3: Example of Erddapy CCT data request form IADC ERDDAP data center.

APPLICATIONS FOR A VIRTUAL RESEARCH ENVIRONMENT

This section presents a comparative analysis of **CCT** daily mean temperature data (at 2m) for 2023 from **ERDDAP** and a Svalbard reference period meteorology [5].

This comparative analysis facilitates a comprehensive exploration of deviations (ΔT) in the data over time, such as the notable anomaly of 10°C recorded on 14 April 2023.

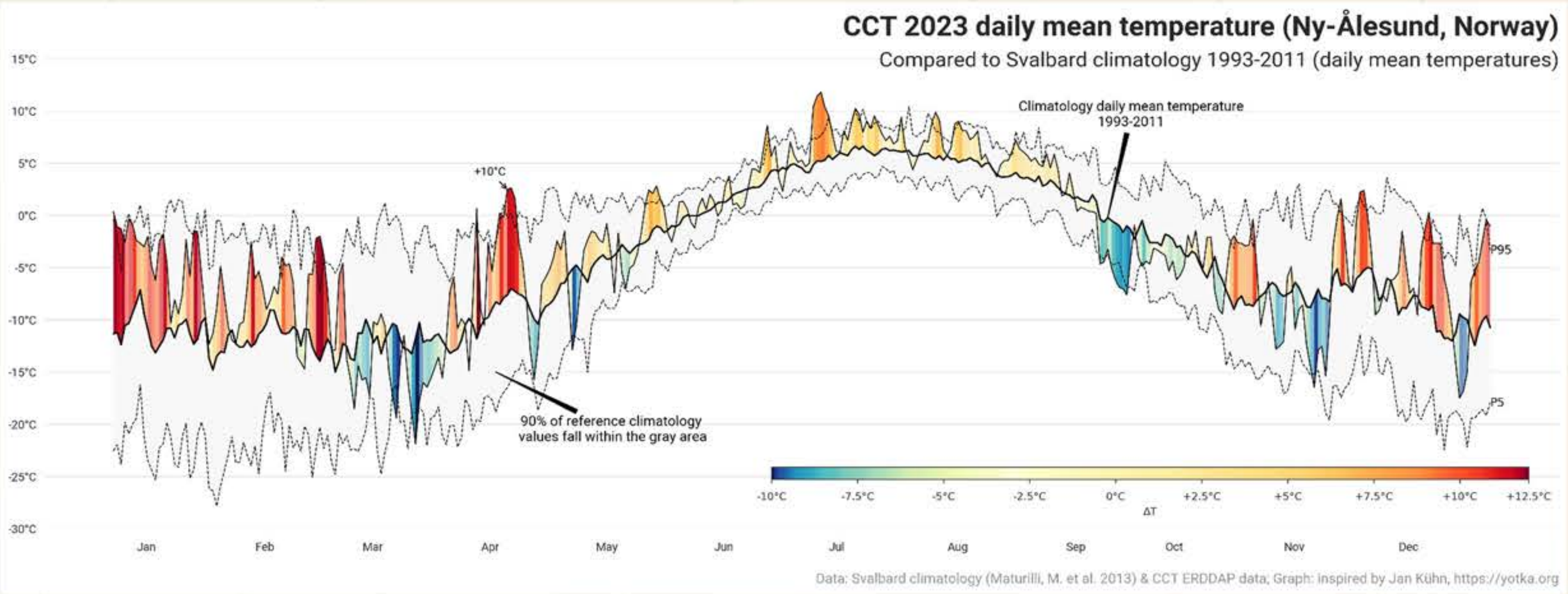

Fig. 4: CCT 2023 daily mean temperature vs Svalbard climatology 1993-2011.

TEMPERATURE INFERENCE

This section presents a comparison between **XGBoost** and **LightGBM** models for evaluating 2023 temperatures using **CCT** data spanning from 2009 to 2022 retrieved from **ERDDAP** (Fig. 5).

In addition to temperature data, other features at 2 meters such as relative humidity, wind direction and speed, along with temporal attributes like season and month, were incorporated into the models.

The results of this analysis are detailed in the table below, providing insight into the performance and effectiveness of each modeling approach.

MODEL	R-squared (R^2)	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)
LightGBM	0.82	3.0°C	2.3°C
XGBoost	0.77	3.5°C	2.6°C

Both **XGBoost** and **LightGBM** demonstrated the ability to handle nonlinear patterns and deliver high accuracy, with **LightGBM** showing especially high performance. Additionally, the **SHAP** [6] values for **LightGBM** are presented in the sections on the right (Fig.6,7), shedding light on the importance of each feature in the temperature evaluation process for a "*black box*" model. These **SHAP** values enhance interpretability, enabling a deeper understanding of the underlying relationships between the input features and temperature.

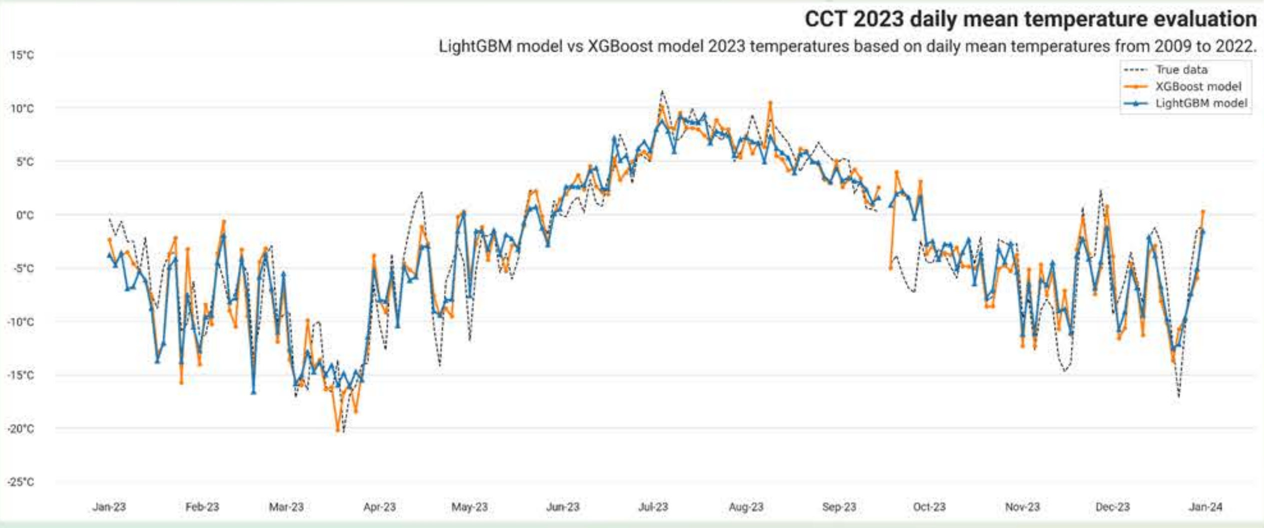

Fig. 5: LightGBM vs Xgboost 2023 CCT temperature based on daily mean temperatures from 2009 to 2022.

SHAP is a unified game theory approach to explain the output of any machine learning model. In our analysis, we found that **season** emerges as the most important feature, according to SHAP values.

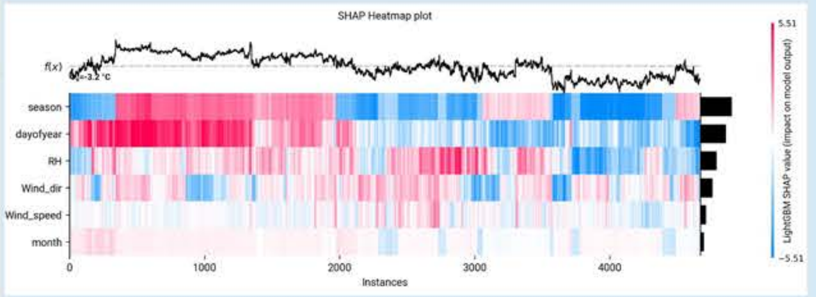

Fig. 6: Heatmap of SHAP values of LightGBM model. The heatmap displays the contribution of each feature to the model's predictions, with positive contributions represented by red cells and negative contributions by blue cells. Colour intensity denotes the magnitude of the contribution. The output of the model, *f(x)*, is shown above the heatmap matrix, centred around the explanation's base value (ϕ_0), and the global importance of each model input is shown in the bar plot on the right–hand side of the plot.

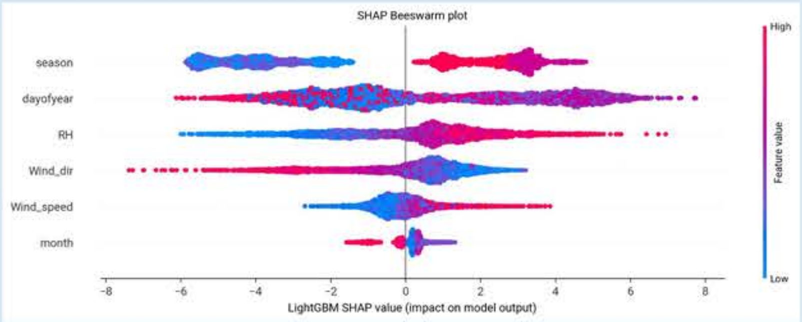

Fig. 7: Beeswarm plot showing the SHAP values calculated for each feature and instance using LightGBM model. Each instance of the given explanation is represented by a single dot on each feature row. The x position of the dot is determined by the SHAP value of that feature, and dots "pile up" along each feature row to show density. Color is used to display the original value of a feature.

REFERENCES

[1] https://jupyter.org/

[2] https://data.iadc.cnr.it/erddap/

[3] Chen, T., & Guestrin, C. (2016, August). Xgboost: A scalable tree boosting system. In Proceedings of the 22nd acm sigkdd international conference on knowledge discovery and data mining (pp. 785-794)

[4] Ke, G., Meng, Q., Finley, T., Wang, T., Chen, W., Ma, W., ... & Liu, T. Y. (2017). Lightgbm: A highly efficient gradient boosting decision tree. Advances in neural information processing systems, 30.

[5] Maturilli, M., Herber, A., & König-Langlo, G. (2013). Climatology and time series of surface meteorology in Ny-Ålesund, Svalbard. Earth System Science Data, 5(1), 155-163.

[6] Lundberg, S. M., & Lee, S. I. (2017). A unified approach to interpreting model predictions. Advances in neural information processing systems, 30.

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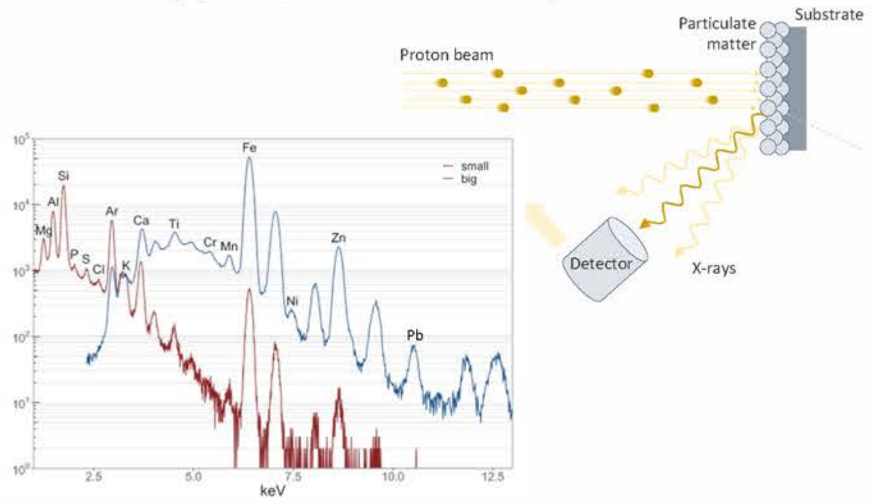
Elemental analysis at EMC2-LABEC: role, techniques and access opportunities

G. Calzolai[1], C. Fratticioli[1,2], F. Giardi[1], F. Lucarelli[1,2], S. Nava[1,2], P. Ottanelli[1], M. Chiari[1]

[1] National Institute for Nuclear Physics (INFN), Sesto Fiorentino (Florence), 50019, Italy
[2] Department of Physics and Astronomy, University of Florence, Sesto Fiorentino (Florence), 50019, Italy

THE TECHNIQUE

Ion beam analysis (**IBA**) techniques are particularly suitable for the study of environmental issues. In particular, the Particle Induced X-ray Emission (**PIXE**) technique is a powerful tool for the **elemental analysis** of atmospheric particulate matter (PM) samples. It allows to identify and quantify several elements thanks to the **characteristic X-ray** emissions of each element, as a result of the interaction of the particle (usually proton) beam with the sample.



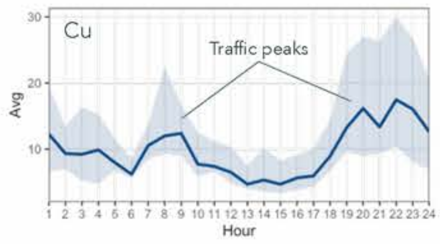
Advantages of PIXE

- **Very fast**
  1-2 minutes for each sample; crucial for extensive sampling campaigns
- **Simultaneous**
  quantitative analysis of elements with Z > 10 (Na–Pb)
- **No pre-treatment**
  of the samples, minimizing the contaminations from chemical reagents and loss of volatile species
- **High sensitivity**
  down to µg/g; major, minor and trace elements can be quantified in low-mass samples
- **Non-destructive**
  allows the following analysis of the same samples with other complementary techniques

Applications of PIXE

- **Mineral dust**
  PIXE is sensitive to all crustal elements (except O). Study of the desert aerosol which is one of the major component of the aerosol on global scale

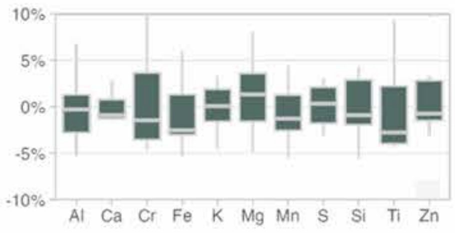
- **High Time Resolution**
  Analysis of hourly sampling to see daily trends, fast changes of the sources and link them to meteorological data



- **Polar PM**
  Analysis of low-mass samples (daily Arctic samples and dust from Antarctic ice cores

Repeatability of PIXE

- **Quality Control**
  Low variability in measurements on control samples and certified standards



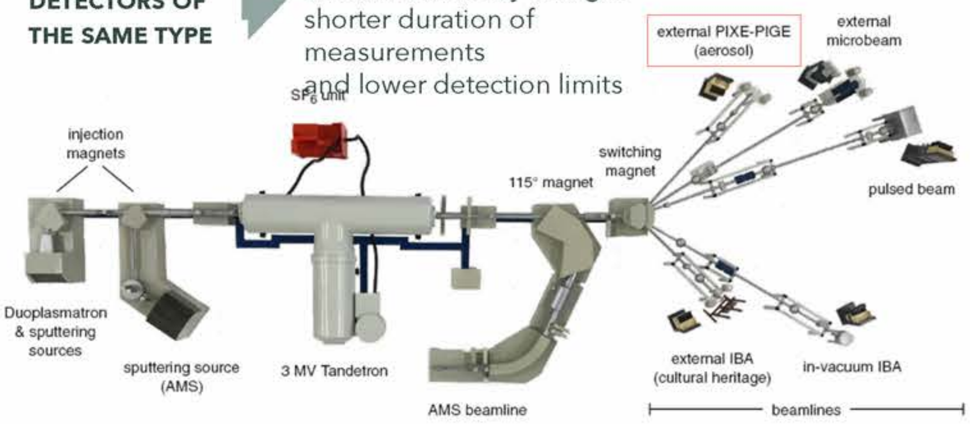
THE LABORATORY

A beamline dedicated to measurements of aerosol samples is operative at the **3 MV Tandetron accelerator** of the LABEC laboratory of the National Institute for Nuclear Physics (INFN)[a]. Since 2003 its set-up has undergone several upgrades to take full advantage of the PIXE technique:

Two different types of silicon drift detectors (SDD) → To measure both light and heavy elements simultaneously

Multiple detectors of the same type → To improve the throughput and the sensitivity and get shorter duration of measurements and lower detection limits

[a] Chiari et al., Eur. Phys. J. Plus 136, 472, 2021



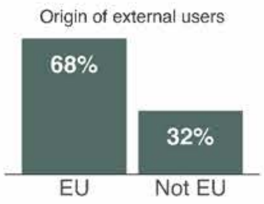
ROLE

EMC2 provides: proficiency tests of individual laboratory analysis through the organization of inter-comparison and round-robin exercises; operation support for quality assurance and quality control for the measurement of mass concentration of particulate heavy metals and inorganic elements; hands-on training of operators and scientists to NF and ACTRIS users.

ACCESS

External users can access the new PIXE set-up of for measurements through ITINERIS and the ACTRIS Center for Aerosol In-Situ measurement - European Center for Aerosol Calibration & Characterization (CAIS-ECAC), *www.actris-ecac.eu*

- **Samples**
  More than **35000 aerosol samples** (daily and hourly) analyzed in 2018-2023
- **ITINERIS access**
  250 hours of beamtime for aerosol samples analysis through ITINERIS PNRR project from 2023 till 2025



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- ITINERIS - Italian Integrated Environmental Research Infrastructures System (Project IR0000032), is funded by EU - Next Generation EU Mission 4 "Education and Research" - Component 2: "From research to business" - Investment 3.1: "Fund for the realization of an integrated system of research and innovation infrastructures"
- The channel upgrade has been supported by the Ministry of University and Research (*PON Ricerca e Innovazione FESR 2014-2020, project PER-ACTRIS-IT*) and the RADIATE H2020 EU project.

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Italiadomani

Agro-Ecological Modelling platform (WP 8.3)

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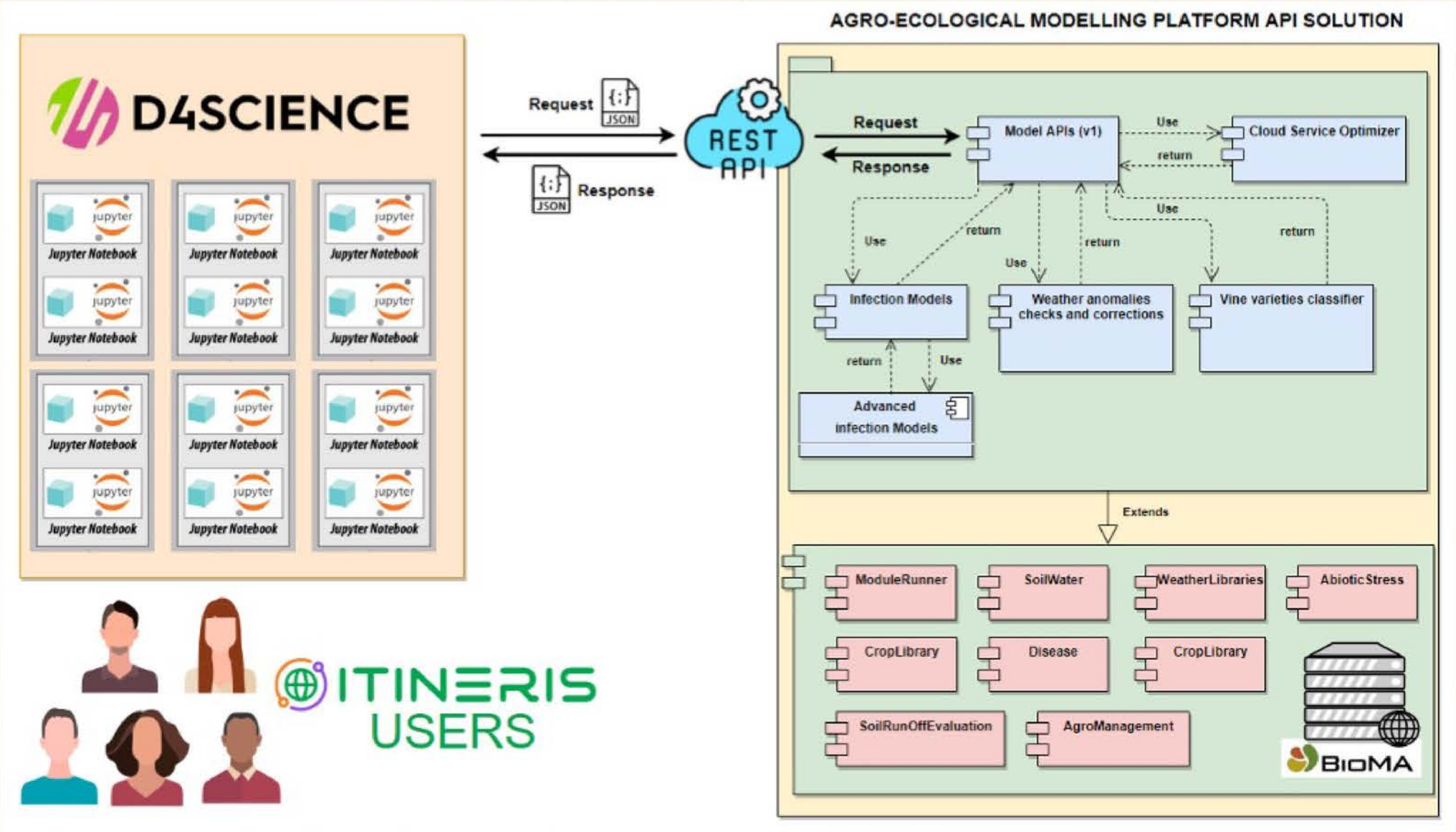
INTRODUCTION

The **Work Package 8.3 - Crop, Plants and Pests Virtual Research Environment** (CPP VRE) is part of WP 8 (*Virtual Research Environments and Cross-disciplinary Activities*) of Italian Integrated Environmental Research Infrastructures System (**ITINERIS**), a project funded by the Next Generation EU PNRR.

The main goal of CPP VRE is to make accessible an array of cross-platform modelling solutions, data transformation tools, and cloud hosted computational facilities to contribute to crop production, plant phenology, pest and disease spread, and cropping system. The CPP VRE will contribute to the research infrastructure by **(1) making accessible an array of cross-platform distributed modelling solutions**, **(2) data transformation tools**, and **(3) cloud hosted computational facilities**, allowing users of the cross-RI integrated VRE system to perform scenario analysis and digital twin components in an interactive way.

Proposed modelling solutions include well established process-based models for crop production, water use, plant phenology, pest and disease spread, pathogens dynamics and impact, and cropping system management as well as advanced statistical methods for image classification and time series analysis, and they will be published with the SaaS (*Software as a Service*) paradigm, enabling researchers to integrate them into different technological stacks, including VREs.



PLATFORM SYSTEMS ARCHITECTURE

CPP-VRE infrastructure is based on the following software engineering solutions:

1. **RESTful APIs**: a RESTful API is an *Application Programming Interface* (API or web API) that conforms to the constraints of REST (*REpresentational State Transfer*) architectural style and allows for interaction with RESTful web services. RESTful APIs now drive many web servers on the internet, and they are an industry standard that can be easily integrated into virtually any software product and in scientific platforms. Through the RESTful API, the CPP component can provide a uniform and well-known interface for interactions such as *Machine-to-Machine* (e.g., with other components of ITINERIS) and *Machine-to-Human* (e.g., with researchers and their own applications like R or Python scripts).

2. **BioMA**: *BioMA (Biophysical Model Applications)* represents the application's business logic, and contains the core business logic, operations, and algorithms of the application. BioMA is a modelling framework composed of models and applications designed for running, calibrating, and improving biophysical and crop growth models. Biophysical models are algorithms to simulate a part of the biophysical system. The BioMA modelling framework is based on independent components, for both modelling solutions and the graphical user interface. The framework also includes integrated tools to support the calibration of the models, to run the simulations at grid level, and to visualize the results. All services of the extended version of BioMA for Agro-Ecological Modelling platform are exposed by RESTful API.

3. **Cloud API management**: API Management is a solution encompassing the collections of tools used to design and manage APIs, referring to both the standards and the tools used to implement API architecture. Client requests are handled by the API management, which forwards them to the domain model (i.e., BioMA), which processes them and returns them to API management. API management then returns the response to the client in the most correct form.

CPP – VRE ENDPOINTS SERVICE

The endpoints developed for the Agro-Ecological Modelling platform APIs are as follows:

1. **Infections Models**: this endpoint incorporates different models of phytopathology infection in agricultural settings. Agro-Ecological Modelling platform hosts a growing collection of plant infection models (e.g., *Oidio*, *Peronospora*, and so on) tuned to perform well over the Italian territory. **Advanced Infections Models** extends **Infections Models** this endpoint includes a new set of infection models including crop phenology.
2. **Vine varieties classifier**: a computer vision model to identify grapevine variety from leaf images. Leaf images must be full frontal and in good light conditions. It identifies 27 distinct varieties from the CREA (Council for Agricultural Research and Economics) collection.
3. **Weather Anomalies Check and Corrections**: service to check anomalies in a weather data series and correct them according to a set of rules.
4. **Cloud Service Optimizer**: service to run optimization jobs over APIs exposed through the platform. Its main purpose is to allow model calibration.
5. **Model APOs-v1**: APIs to configure and run model executions.

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First measurements of organic and inorganic aerosols at CIAO with ToF-ACSM

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[a]Consiglio Nazionale delle Ricerche – Istituto di Metodologie per l'Analisi Ambientale CNR-IMAA, C. da S. Loja, Tito Scalo, Potenza, 85050, Italy

Aerosol in situ laboratory has been installed at the CNR-IMAA Atmospheric Observatory (CIAO) (Fig. 1).

On-line instruments for continuous measurements are available and operational (*Laurita et al., AMTD, submitted 2024*).

Figure 1: CIAO- CNR-IMAA Atmospheric Observatory (© Google Earth)

First data collected with the Time of Flight - Aerosol Chemical Speciation Monitor (ToF-ACSM) (*Fröhlich et al., AMT, 2013)* in the period February - April 2023 and May - June 2024.

ToF-ACSM provides real-time measurements of the mass of non-refractory PM1 aerosol particles and chemical composition (organics, sulfate, nitrate, ammonium and chloride).

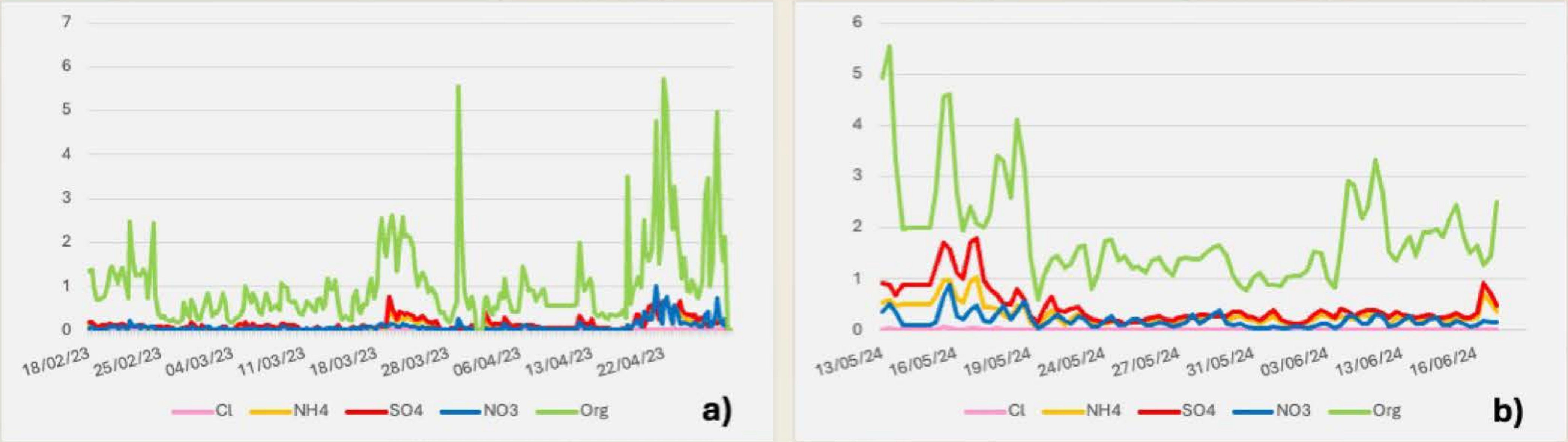
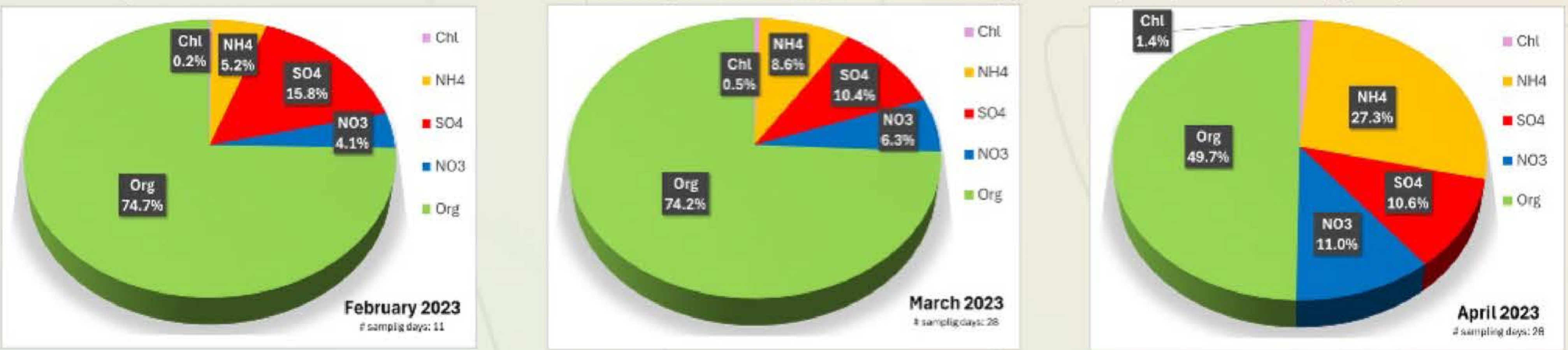


Figure 2. Overview of the time series chemical composition of NR-PM1 at CIAO: **(a)** February – April 2023 and **(b)** May – June 2024.



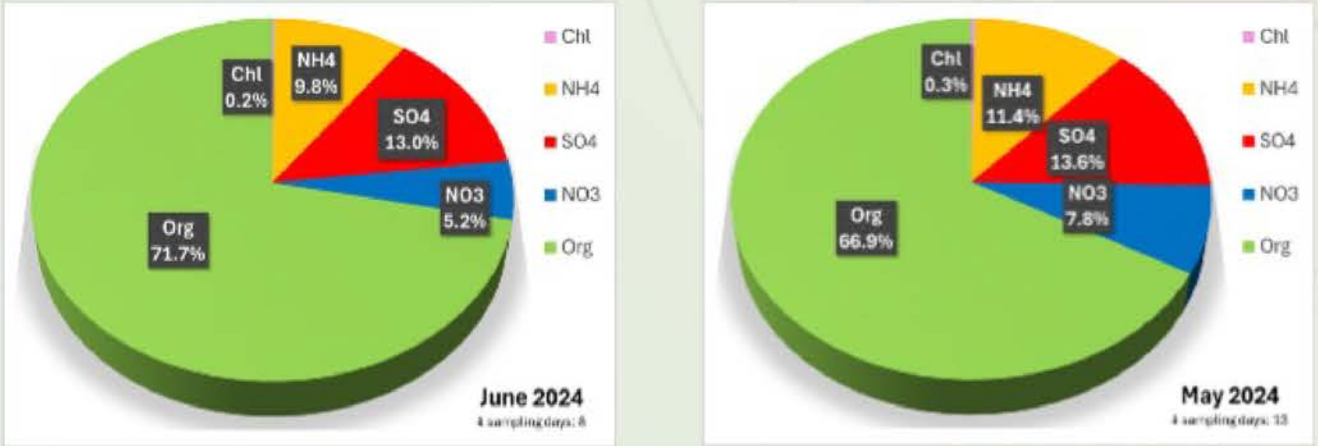


Figure 3. Percentages of monthly chemical composition.

	OA (μg/m³)	SO_4^{2-} (μg/m³)	NO_3^- (μg/m³)	NH_4^+ (μg/m³)	Cl^- (μg/m³)
Feb – Apr 2023	0.77±0.35	0.17±0.10	0.05±0.02	0.09±0.06	0.01±0.01
May – Jun 2024	2.12±0.84	0.71±0.41	0.17±0.10	0.26±0.14	0.01±0.01

Tab 1. median concentration (μg/m³) of PM1 for the 4 chemical components.

The organic aerosol (OA) component is prevalent with respect to the inorganic ones as is also observed in other stations in Europe (*https://ebas.nilu.no*).

Based on these first observations Potenza site seems to be similar to remote/regional background sites in terms of total PM1, with a high percentage of organic aerosol compared to Northern Europe remote sites (*Bressi et al., Atm. Env. 2021*).

First investigation of chemical composition of PM1 particulate has been carried out using the ToF-ACSM. Further investigation about different contribution to OA (like hydrocarbon-like (HOA), biomass burning (BBOA) and oxygenated OA (OOA)) will be carried out for source identification investigation.

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Diurnal and seasonal variability of aerosol chemical composition in an urban background site (Bologna): role of emissions through source apportionment methodologies

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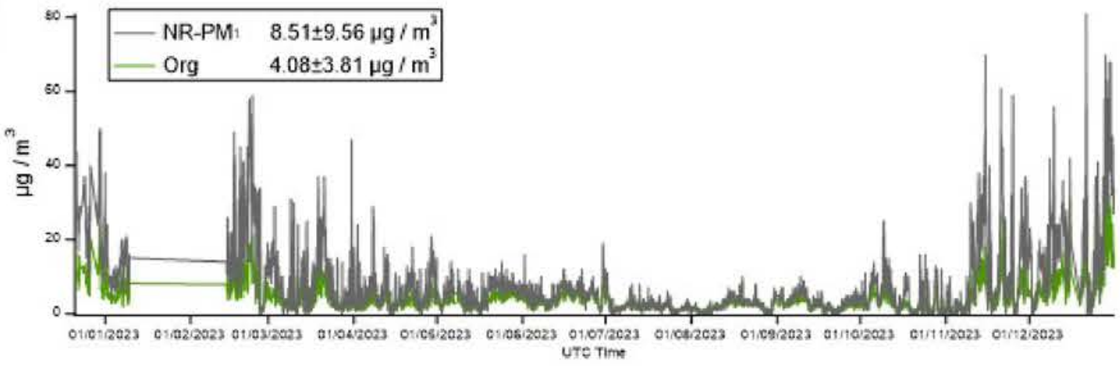
Introduction

The Po Valley region is among the most industrialized and populated (~ 14.850.000 inhabitants) areas in Italy and Europe[1]. Its orography (surrounded by Alpes and Appennines) makes it a natural basin costantly impacted by high levels concentration of aerosols (both biogenic and anthropogenic), hindering the atmospheric dispersion of pollutants. The study of aerosols is therefore essential to disentangle the role of sources/formation processes and meteorology on the variability of its physical chemical properties and their effects on climate, ecosystems and human health in that region.

Instrumentation and dataset

A reconstruction of non-refractory PM_1 (NR-PM_1) mass concentration and chemical composition has been obtained by Aerosol Chemical Speciation Monitor (**ACSM**) measurements (organics, sulfate, nitrate and amonium) throughout 2023 at CNR-ISAC research area in Bologna (urban background site, 44°31'25"N 11°20'18"E). Organic fraction of aerosol (Org) displays typical seasonal trends, characterized by higher concentrations during winter, according to the Planetary Boundary Layer (PBL) dynamics and local sources.



Organic Aerosol (OA) source apportionment

Positive Matrix Factorization (**PMF**) is a multivariate factor analisys technique for the chemometric evaluation of environmental datasets[2]. It has been applied to the ACSM measurements to identify recurring chemical classes (factors) from specific OA sources/formation processes. *Seasonal* PMF is performed by dividing the original input dataset into two seasonal submatrices; then PMF is applied separately[3].

By applying the Multilinear Engine 2 solver (ME-2)[4], PMF allows to employ profile constraints, forcing the identification of factors whose contribution and properties are well-known *a priori*.

OA sources/formation processes are classified in Primary OA (**POA**) and Secondary OA (**SOA**):

Primary Organic Aerosol:

HOA (Hydrocarbon-like OA) from fossil fuels combustion and traffic; ubiquitous in urban background sites[5,6].

BBOA (Biomass-Burning OA) from biomass combustion processes[6,7].

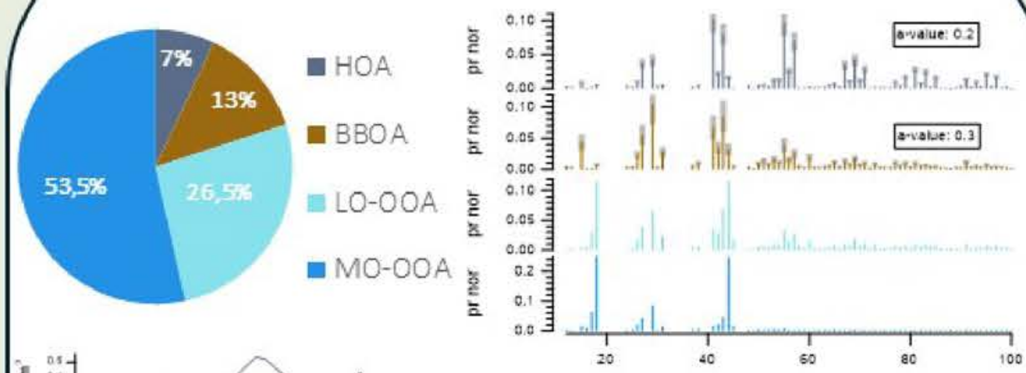
POA-type factors have been constrained

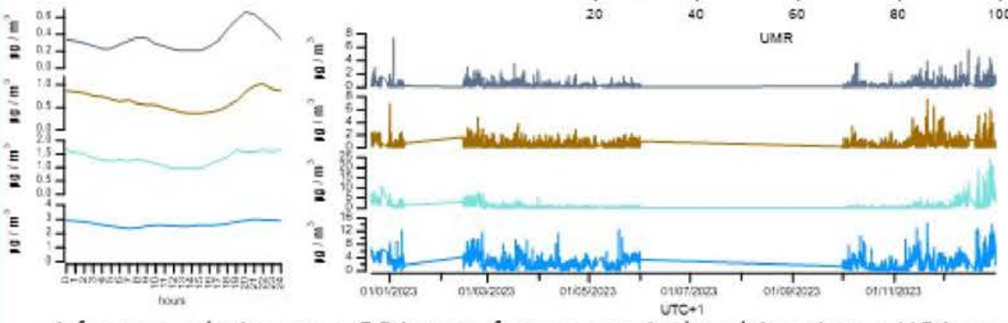
Secondary Organic Aerosol:

OOA (Oxygenated OA) are further classified in **LO-OOA** (Less Oxidized-Oxygenated OA) and **MO-OOA** (More Oxidized-Oxygenated OA), according to different degrees of oxidation and atmospheric aging[3,8].

SOA-type factors are left unconstrained

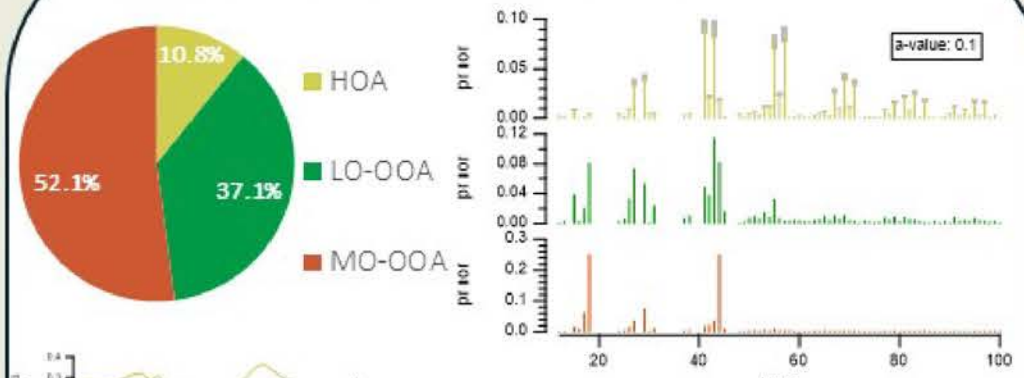
Winter (21/12/22 – 31/05/23 // 01/10/2023 – 31/12/2023)

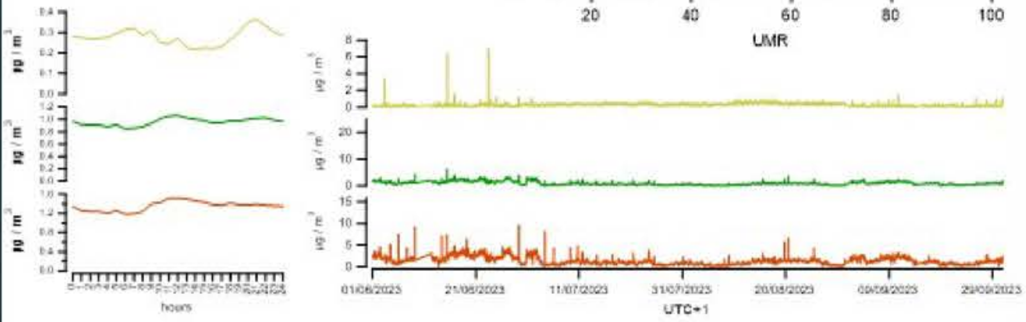




4-factors solution: two POA-type factors are isolated in winter: HOA and BBOA, whose diurnal trends are evidently shaped by emissions and PBL dynamics. A LO-OOA and a MO-OOA are also isolated and distinguished according to the relative contribution of masses *m/z* 44 and *m/z* 43, respectively more and less oxygen-containing signals in the OOA spectra.

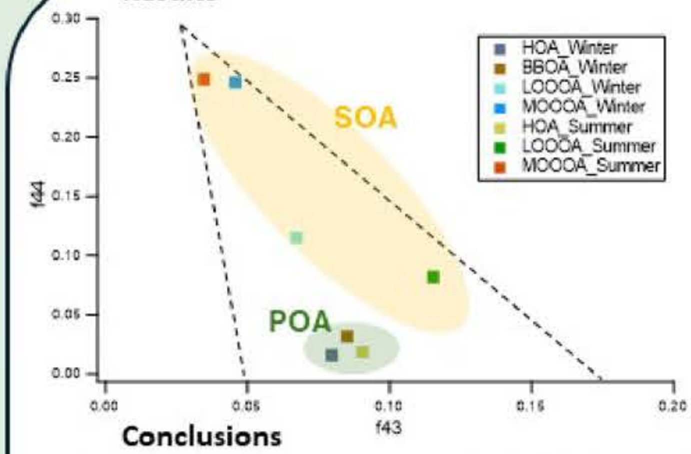
Summer (01/06/2023 – 30/09/2023)





3-factors solution: BBOA-type factor has not been identified during summer. HOA displays daily trends similar to what observed in winter but with lower concentrations. SOAs show a more evident profile distinction between LO-OOA and MO-OOA than in winter.

Results



The plot on the left represents the f_{44} vs f_{43} space (Ng et al., 2010). f_{44} and f_{43} are respectively defined as the relative contribution of masses *m/z* 44 and *m/z* 43 to the total Org signal.

POA have a lower f_{44} and a higher f_{43}, confirming their lower oxidation degree. Indeed, both HOA and BBOA fall within the lower part of the plot (base of the «triangle»).

On the other hand, SOAs insist on the upper area of the triangle plot indicating a higher degree of oxidation. In detail, MO-OOAs fall at the apex of the triangle, as typical of very oxidized organic mixtures. The position of the LO-OOAs reveal that they are closer in chemical composition to POAs as they probably underwent a lower degree of atmospheric processing.

References

1. European Environment Agency. *Air Quality in Europe: 2020 Report.*
2. Paatero, P. & Tapper, U. *Environmetrics* **5**, 111–126 (1994).
3. Chen, G. *et al. Environ. Int.* **166**, (2022).
4. Paatero, P. *J. Comput. Graph. Stat.* **8**, 854–888 (1999).
5. Ulbrich, I. M. *et al. Atmos Chem Phys* (2009).
6. Zhang, Y. *et al. Atmospheric Chem. Phys.* **19**, 14755–14776 (2019).
7. Paglione, M. *et al. Atmospheric Chem. Phys.* **20**, 1233–1254 (2020).
8. Jimenez, J. L. *et al. Science* **326**, 1525–1529 (2009).
9. Ng, N. L. *et al. Atmospheric Chem. Phys.* **10**, 4625–4641 (2010).

Conclusions

This study reveals how factors contributing to organic fraction of NR-PM_1 vary during a year-long campaign. HOAs from traffic emissions display an almost constant contribution, while BBOA shows that its abundance is mainly due to wintertime emissions of biomass-fueled heating appliances. So, POA-type factors unveil their dependence on anthropic activities. Concerning OOAs, they constitute the most relevant component (always above 75%) of the total organic fraction; their trends strictly depend on precursors (both anthropogenic and biogenic) and atmospheric processes and aging, which evolve depending on seasonality.

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The CNR Arctic CO_2 Fluxes CZ Observatory

Mariasilvia Giamberini, Ilaria Baneschi, Davide Cini, Letizia Costanza, Simona Gennaro, Silvio Marta, G. Jasmine Natalini, Gianna Vivaldo – Institute of Geosciences and Earth Resources (CNR-IGG), Pisa, Italy

The CZ Observatory (CZO) is aimed to make available CO_2 fluxes from the CNR-IGG CZO site in the High Arctic (Svalbard). It is funded by the "Programma di Ricerche in Artico" (PRA) project "WinterCZ"

PRA PROGRAMMA DI RICERCHE IN ARTICO

The WinterCZ Project Structure

igg

RESEARCH ACTIVITIES

Investigating **microbial processes** in winter soil

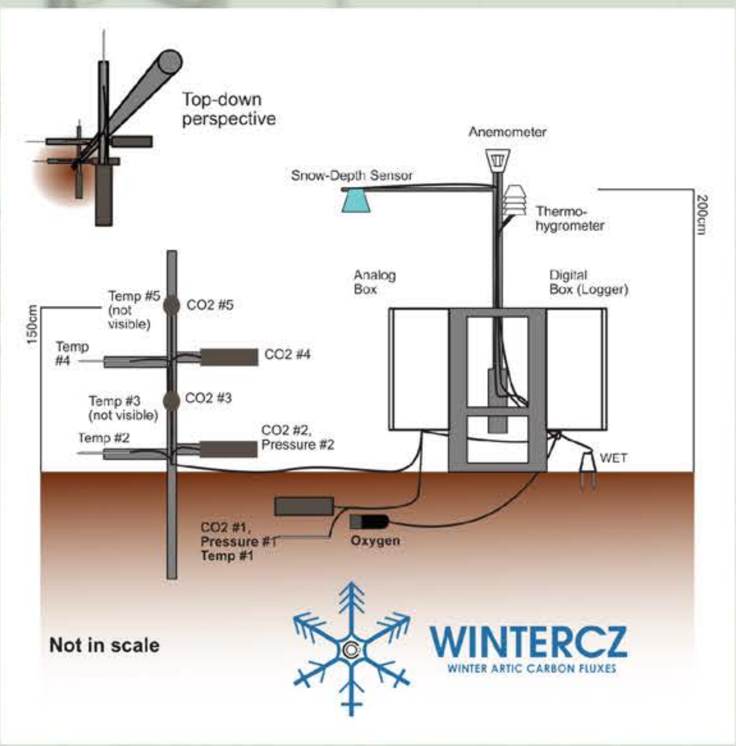
Developing data-driven and process-based **models**

CZO INFRASTRUCTURE IMPROVEMENT

Design and install a new flux tower set of sensors for measuring CO_2 fluxes from the snowpack

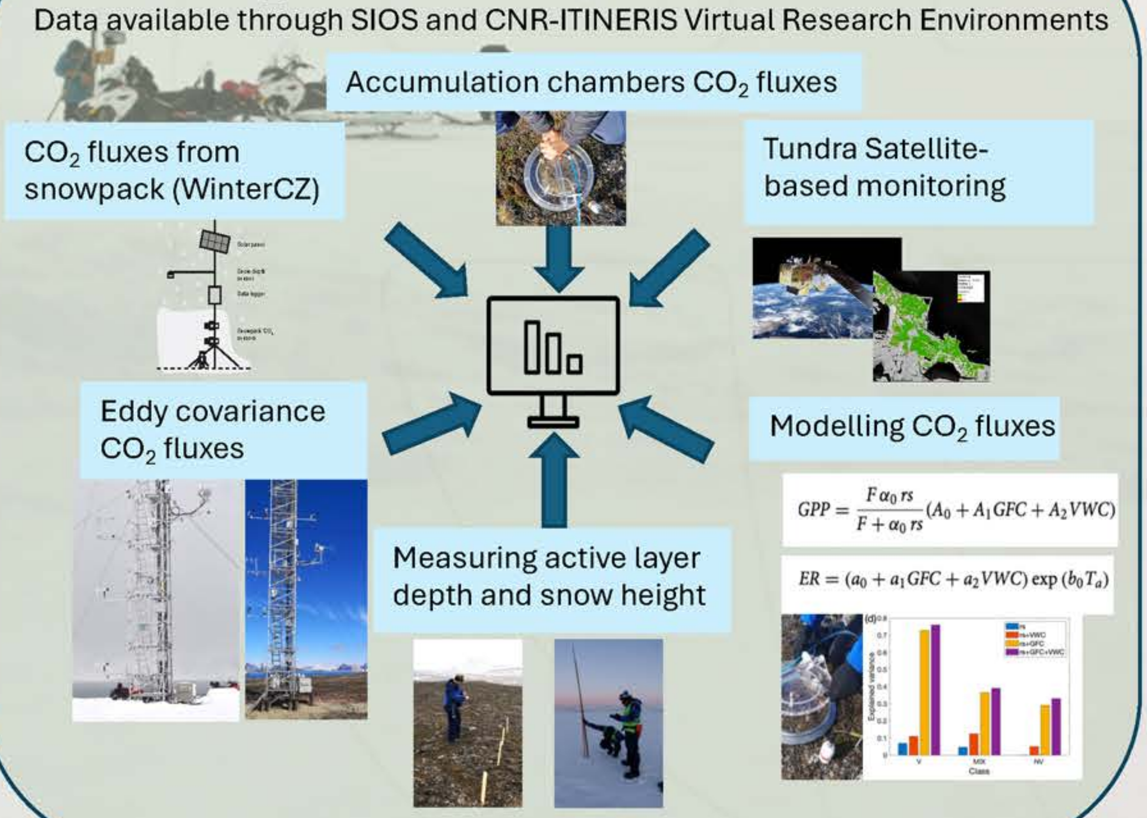
Establishing the new integrated CNR CO_2 fluxes virtual observatory

The WinterCZ CO_2 Flux tower



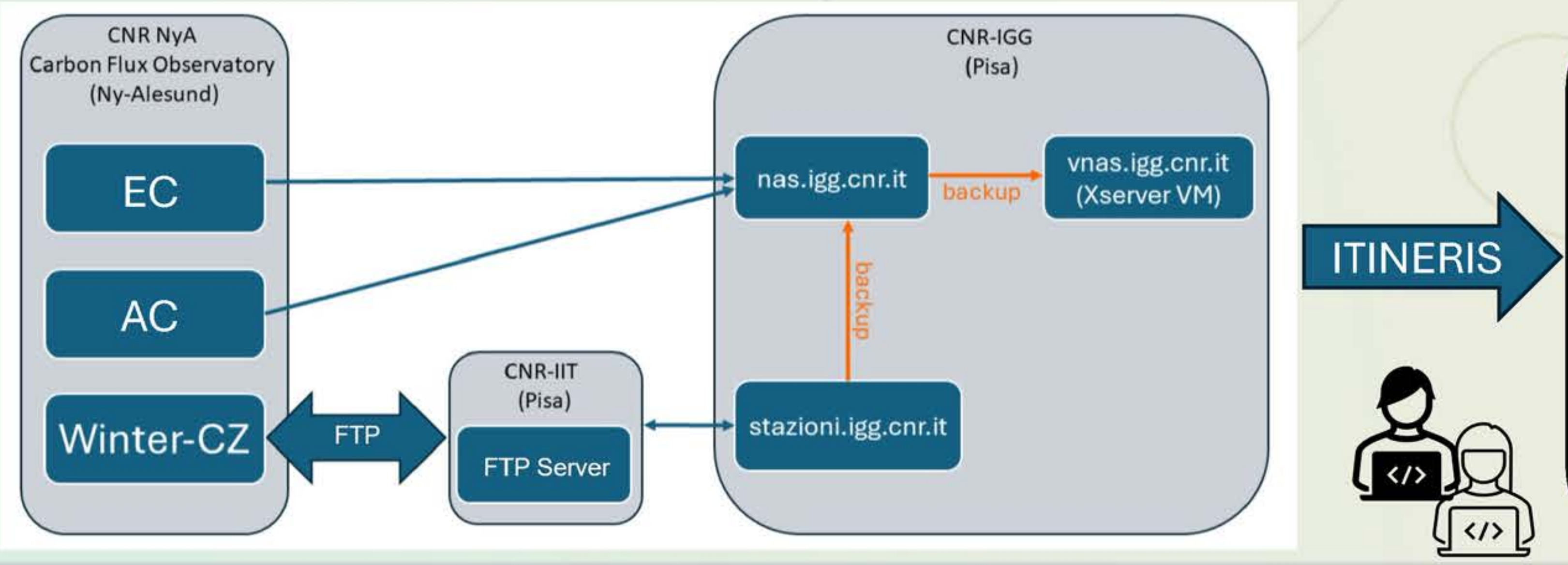
The CO_2 fluxes integrated observatory

Data available through SIOS and CNR-ITINERIS Virtual Research Environments



Raw data produced at the CZO at Bayelva (Svalbard) will be collected and stored at CNR-IGG servers. **Elaborated and selected products (CO_2 fluxes, meteoclimate statistics) will be made available through the CNR arctic data portal IADC and the ITINERIS Critical Zone Virtual Research Environment (CZ VRE) to form the integrated CNR Arctic CO_2 fluxes observatory**

Raw data production | **Raw data storage** | **Elaborated data and models made available in ITINERIS CZ VRE**



CO_2 fluxes point data (AC)

CO_2 fluxes from eddy covariance (EC)

CO_2 winter fluxes (WinterCZ)

Metoclimatic variables

Models

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Modernization of a multiple-mirror lidar at Atmospheric Rome joinT supersitE (ARTE) for ACTRIS NF labelling

Giovanni Giuliano[1], Gian Luigi Liberti[1], Marco Di Paolantonio[1,2], Davide Dionisi[1]

[1] Istituto di Scienze Marine, Consiglio Nazionale delle Ricerche (ISMAR-CNR), Rome, Italy

[2] Università degli Studi della Basilicata, Potenza, Italy

Research Infrastructure Overview

The multi-wavelength multi-telescope Rayleigh-Mie-Raman (RMR) system at CNR-ISMAR-RM is now included as a National Facilities (NF) of the Atmospheric Rome joinT supersitE (ARTE) for the Aerosol Remote Sensing (ARS) component. This work shows the maintenance and upgrading activities to adapt the system to the advanced technological solutions and operating mode required within the framework of the labelling process as a Centre for Aerosol Remote Sensing - Aerosol, Clouds and Trace Gases Research Infrastructure (CARS-ACTRIS) NF. ACTRIS is a European Research Infrastructure Consortium (ERIC) producing and coordinating the provision of harmonized high-precision data and products on short-lived atmospheric constituents and on the processes leading to the variation of these constituents.

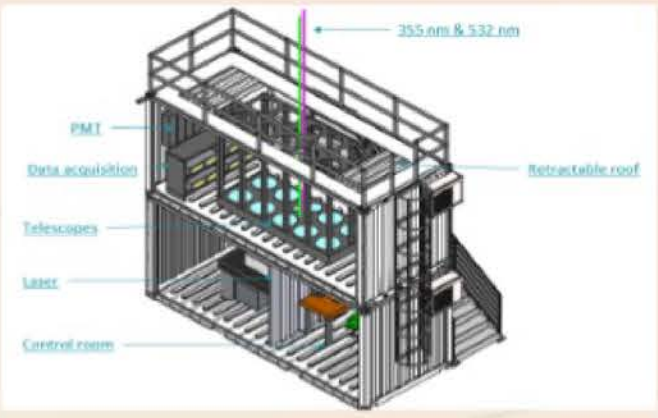

Figure 1. The high-power lidar installed at ARTE.

Telescopes upgrade

New multi-wavelength spectral separation units and polarization calibrator mounted above the 150 mm and 300 mm telescopes.

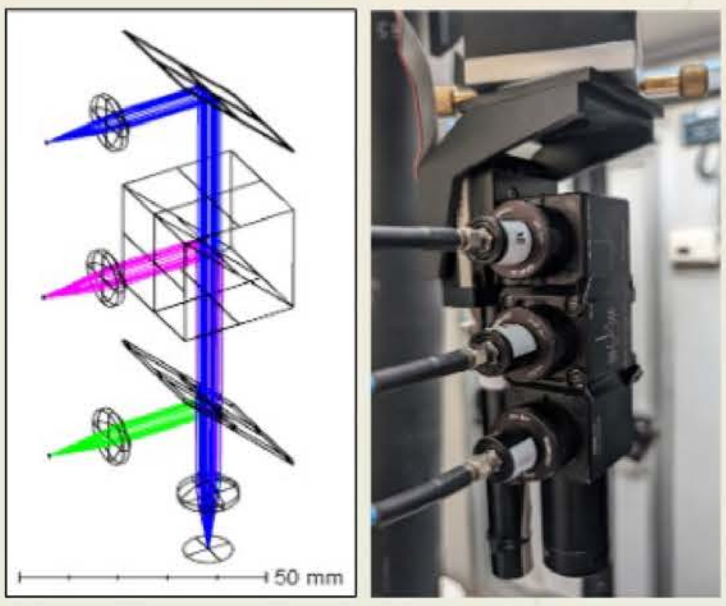

Figure 2. (left) Ray-tracing and (right) photograph of the multi-wavelength spectral separation unit.

Acquisition channels upgrade

The lidar signal is separated by an appropriate combination of optics designed to minimize the optical losses. The upgraded optical design increases the number of detection channels, and it meets the requirements of 1β + 1α + 1δ at 355 nm.

$2\beta + 1\alpha + wv + T \rightarrow 2\beta + 2\alpha + 1\delta + wv + T$

Current CH#	New CH#	Tele ⌀ (cm)	λ (nm)	Type	IF FWHM (nm)	PMT model
N/A	1	15	354,7	Elastic transmitted	0,5	H10721P-110-01
N/A	2		354,7	Elastic reflected	0,5	H10721P-210-01
N/A	3		386,7	N_2 Raman	0,3	H10721P-210-01
N/A	4		407,5	H_2O Raman	0,3	H10721P-210-01
1	5		532,1	Elastic	0,5	H10721P-113-01
N/A	6		607,6	N_2 Raman	1,0	H10721P-210-01
8	7	30	354,7	Elastic transmitted	0,5	H10721P-110-01
N/A	8		354,7	Elastic reflected	0,5	H10721P-210-01
4	9		386,7	N_2 Raman	0,3	H10721P-210-01
5	10		407,5	H_2O Raman	0,3	H10721P-210-01
2	11		532,1	Elastic	0,5	H10721P-113-01
N/A	12		607,6	N2 Raman	1,0	H10721P-210-01

Table 1. Specifications for the upgraded channels.

Detection subsystems

The light output is directed to PMTs after appropriate dichroic mirrors, narrow-band interference filters and focusing lenses.

Figure 3. (left) CAD of the optical separation assembly and (right) photograph of the optical enclosure for the receiving units.

Summary and future activities

- ✓ System upgrades with state-of-the-art components
- ✓ Installation of new Powerlite DLS high-energy Q-switched Nd:YAG laser
- ✓ Design and development of a power supply with EMI shielding and data logging to control up to 16 PMT modules
- ✓ Installation and characterization of new PMT modules
- ✓ Upgrade of the acquisition channels in accordance with the technical specifications required by ACTRIS
- ✓ Development of a custom software for remote power on and emergency shut down, instruments control, data acquisition and real-time data visualization
- ✓ First data from new channels analyzed with ATLAS
- ❖ Multi-grating spectrometer and 32-channel PMT for fluorescence and exploratory measurements

Main references

[1] Congeduti, F., Marenco, F., Baldetti, P., Vincenti, E., "The multiple-mirror lidar9-eyes'", J. Opt. A: Pure Appl. Opt. 1, 185 (1999).

[2] Dionisi, D., and Coatuhors, "Calibration of a multichannel water vapor Raman lidar through noncollocated operational soundings: optimization and characterization of accuracy and variability", JTECH 27.1, 108-121 (2010).

[3] Dionisi, D., Keckhut, P., Hoareau, C., Montoux, N., Congeduti, F. "Cirrus crystal fall velocity estimates using the Match method with ground-based lidars: first investigation through a case study", AMT, 6, 457–470 (2013).

[4] Liberti, G. L., Dionisi, D., Cheruy, F., Risi, C, "Feasibility study to measure HDO/H2O atmospheric profiles through a Raman lidar", ILRC28 EPJ Web of Conferences, 176 , 05032. 4 pp. (2018).

[5] Di Paolantonio, M., Dionisi, D., Liberti, G. L., "A semi-automated procedure for the emitter-receiver geometry characterization of motorcontrolled lidars", AMT, 15, 1217-1231 (2022).

[6] http://lidar.artov.ismar.cnr.it

Preliminary data analysis

Rayleigh fit plots and quicklooks with Automated Lidar Analysis Software (ATLAS) during daytime.

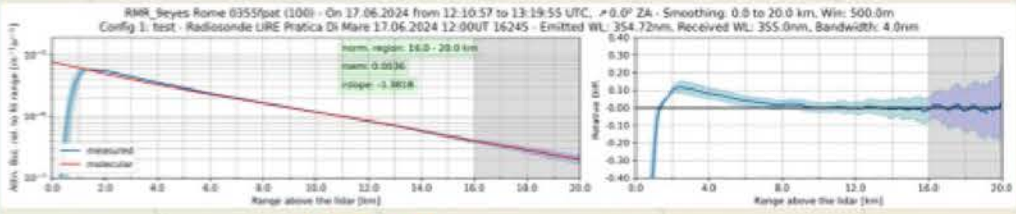

Figure 4. (left) Analog lidar signal from 300 mm telescope 355nm transmitted channel averaged over 1 h and calculated Rayleigh signal from local radiosonde data. Automatic identification of the normalization region between 16 and 20 km. (right) The relative deviation from the calculated Rayleigh signal.

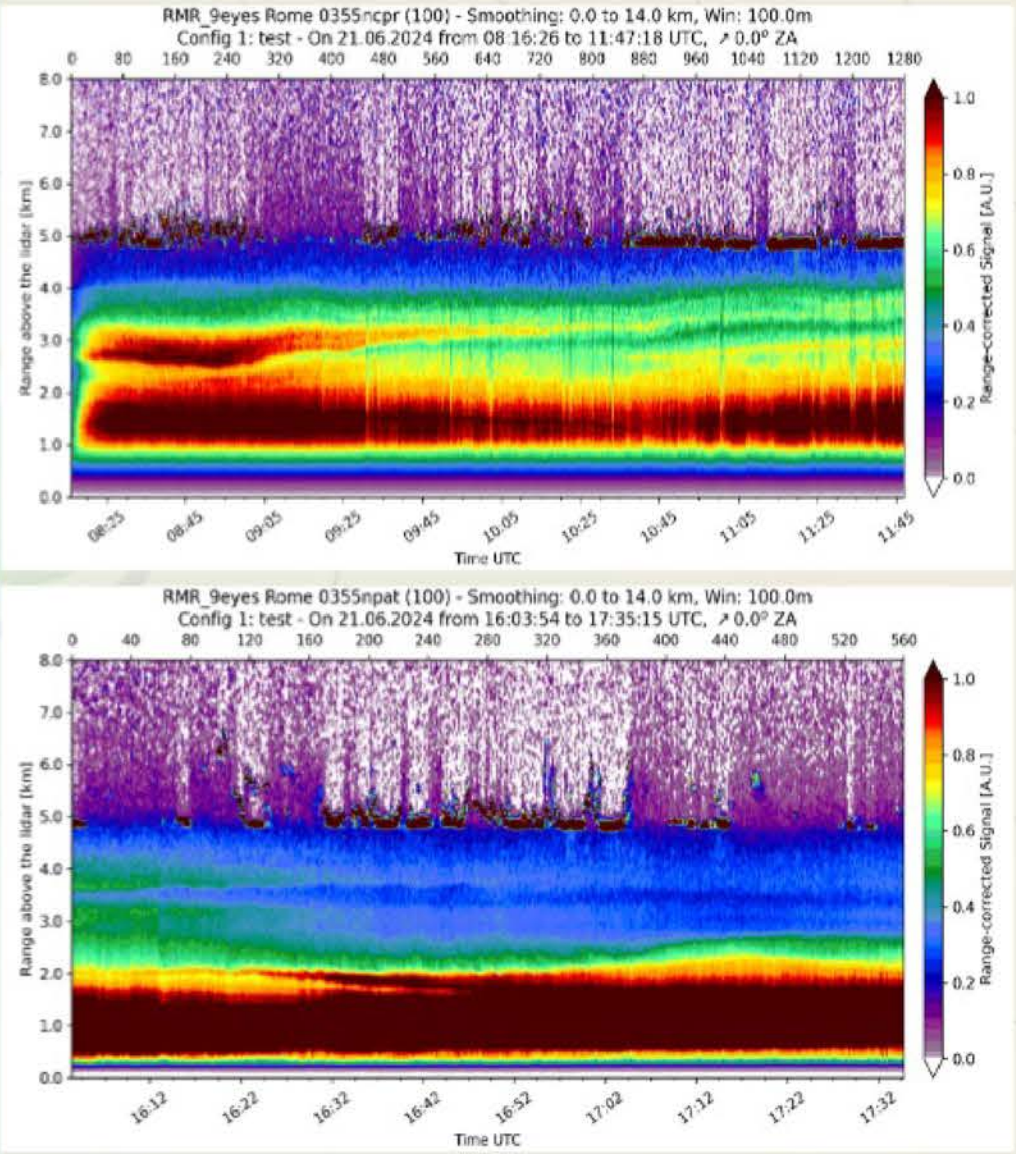

Figure 5. Range-corrected signal above the lidar from 150 mm telescope for 355nm (top) reflected and (bottom) transmitted channels during daytime.

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Setting up new methods to estimate GHG emissions from geologic sources: preliminary results and future perspectives

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State of Art

Atmospheric research efforts are always aiming for improvements meant to provide even more accurate estimates on natural and anthropic sources of GHGs, as well as their sinks. As of today, there's no known record of extensive and direct application of CRDS (Cavity Ring-Down Spectrometry) analyzers used to assess, with high precision, possible emission outputs from rock samples rich in organic matter or comparable compounds whose physical, thermal or chemical stress could result into additional GHG emissions into the atmosphere. Via a multidisciplinary approach, new experiments are set to provide unprecedented details on such estimates.

Purpose and Settings of the Experiments

Under the ITINERIS project, this experiment is set to combine two different disciplines – Earth and Atmospheric Sciences – in the estimate of carbon emissions from selected sedimentary rocks, though it may be applied to a wider range of samples at a later stage of data acquisition. Observation stations part of the WMO/GAW (World Meteorological Organization / Global Atmosphere Watch) network rely on very accurate instruments for continuous atmospheric measurements, such as the Picarro G2401 CRDS (Cavity Ring-Down Spectrometry) analyzers used to monitor mole fractions of CO_2, CH_4, CO, and H_2O (*e.g.*, Cristofanelli et al., 2017). For the first time, CRDS high-precision instruments are being employed to assess GHG emissions from rock samples under specific conditions. Preliminary experiments performed at the National Research Council of Italy – Institute of Atmospheric Sciences and Climate (CNR-ISAC) station of Lamezia Terme (LMT) in Calabria have been performed using two Picarro G2401 CRDS analyzers connected to a thermal chamber and a sample container (Fig. 1). Analyzed samples of Miocene lagoonal clays have been collected during a field survey in Cessaniti (Vibo Valentia, Calabria), which is an important fossiliferous site (Fig. 2). The experiments yielded notable results, with emission peaks up to 40 ppm in CO_2 (Fig. 3). No CO and CH_4 emissions have been detected so far from lagoonal clay samples, though future experiments with different samples are expected to yield at least extra CH_4 results.

The containers, prior to CRDS analysis, were treated via continuous injection of pure nitrogen to isolate the samples themselves from external air. In fact, these injections were closely monitored to ensure that the samples would not be perturbed during sampling: CO_2, CH_4 and CO levels inside the container became at least three orders of magnitude lower compared to those regularly detected in the atmosphere. After the successful isolation of the system, temperature increases from room levels (≈23-24 °C) to 55 °C have been tested across multiple thermal stress cycles to emulate conditions compatible with the summertime diurnal exposure of geologic outcrops in the context of the Mediterranean basin.

Future experiments are expected to consider slightly acidic rains to replicate parameters in accordance with current climate change scenarios. More importantly, different rock types will be surveyed to test changes in emission rates depending on several geological and chemical factors.

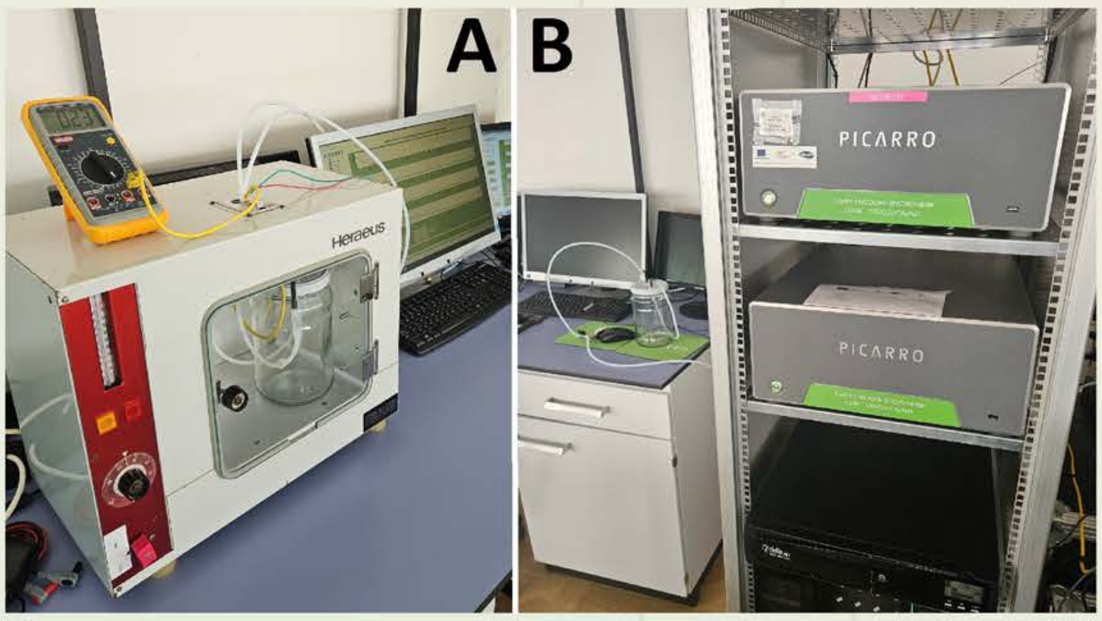

Fig. 1. Instruments and tools used to perform the first pilot experiments on Cessaniti lagoonal clays. A: thermal chamber and sample container, connected to two Picarro G2401 CRDS analyzers and a nitrogen tank; B: the Picarro G2401 analyzers used for these examples. The nitrogen tank is hereby not shown.

Fig. 2. Upper Miocene sedimentary outcrop of Cessaniti (Vibo Valentia, Calabria, Italy). Lagoonal clays constitute the bottom layers of the main fossiliferous sequence. The sediments appear dark due to the high content of mixed terrestrial-marine organic material. Samples have been collected during a field survey to perform preliminary experiments.

Preliminary Results

As shown in Fig. 3, logarithmic graphs have proven useful to report and visualize the main parameters of each experiment: temperature (red line), CO_2 output (yellow line) and humidity (turquoise line). Specifically, Fig. 3A shows the results of a test performed on an empty container with variable water vapor content. Fig. 3B shows the result of the first test on an actual rock sample and the consequent peak in detected CO_2 mole fractions related to thermal stress. Future experiments will integrate carbon isotope measurements via Picarro G2201i analyzers, which will provide unprecedented detail on the understanding of natural and anthropic balances of compounds such as methane (*e.g.*, Nisbet et al., 2019).

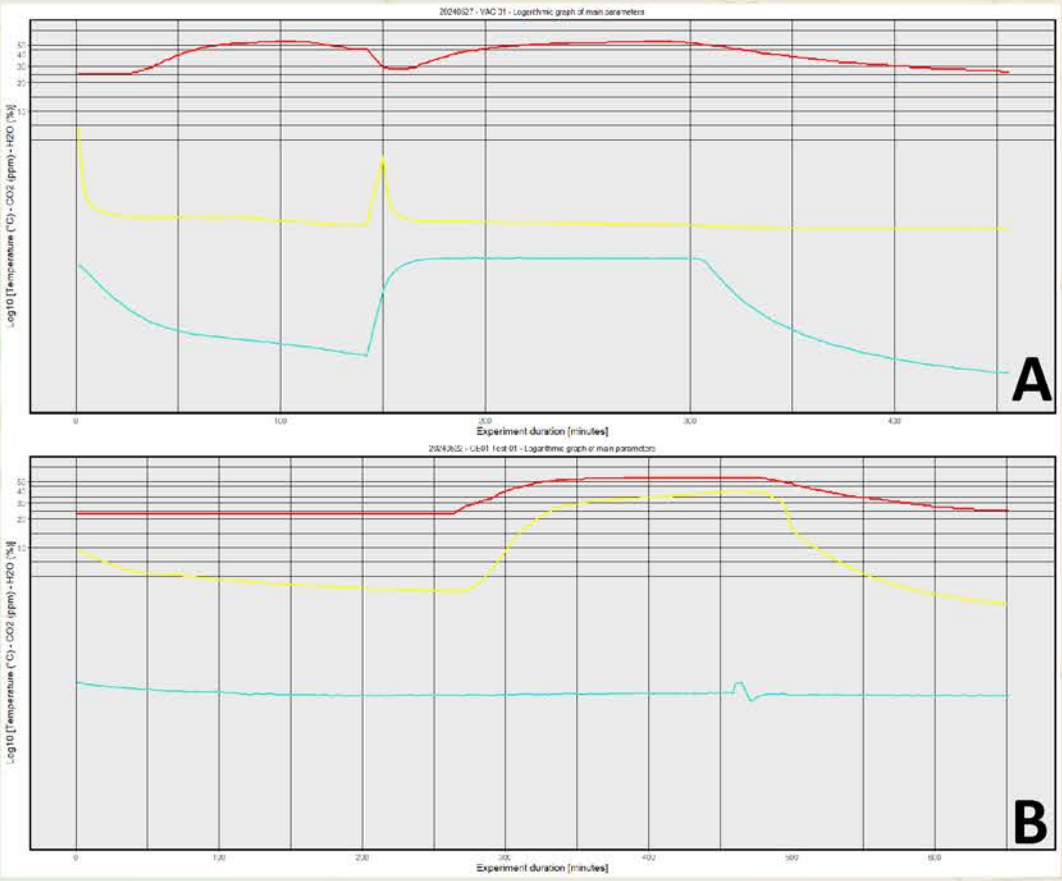

Fig. 3. Logarithmic graphs of preliminary tests. A: control experiment with an empty sample container, used as reference. The peaks/troughs indicate the moment 5mL of H_2O were added to test the influence of humidity on the results. B: Results from the third test showing CO_2 emissions triggered by an increase in sample temperature. Detected CO_2 concentrations were approximately in the 40ppm range at peak. Red line: temperature. Yellow line: CO_2 (ppm). Turquoise line: H_2O (%).

Acknowledgement

This research is performed under AIR0000032 – ITINERIS, the Italian Integrated Environmental Research Infrastructures System (D.D. n. 130/2022 - CUP B53C22002150006). The project is funded by EU - Next Generation EU PNRR - Mission 4 "Education and Research" - Component 2: "From research to business" - Investment 3.1: "Fund for the realization of an integrated system of research and innovation infrastructures".

References

Cristofanelli P, Busetto M, Calzolari F, Ammoscato I, Gullì D, Dinoi A, Calidonna CR, Contini D, Sferlazzo D, Di Iorio T, Piacentino S, Marinoni A, Maione M, Bonasoni P (2017). *Investigation of reactive gases and methane variability in the coastal boundary layer of the central Mediterranean basin.* Elementa: Science of the Anthropocene, 5: 12.

Nisbet EG, Manning MR, Dlugokencky EJ, Fisher RE, Lowry D, Michel SE, Myhre CL, Platt SM, Allen G, Bousquet P, Brownlow R, Cain M, France JL, Hermansen O, Hossaini R, Jones AE, Levin I, Manning AC, Myhre G, Pyle JA, Vaughn BH, Warwick NJ & White JWC (2019). *Very strong atmospheric methane growth in the 4 years 2014–2017: Implications for the Paris Agreement.* Global Biogeochemical Cycles, 33: 318–342.

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Strengthened atmospheric observations of mobile exploratory platforms through ITINERIS project

F. Pasqualini[a*], A. Bracci[a], C. Perfetti[a], L. Renzi[a], N. Zannoni[a], M. Zanatta[a], C. Magnani[a], F. Ferraccioli[b], P. Paganini[b], D. Latini[c], F. Barnaba[a], F. Cairo[a], L. Di Liberto[a] and A. Marinoni[a]

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Introduction

To achieve the main scientific goals of the ITINERIS project, through its financial support, CNR-ISAC is implementing a huge strengthening of its observation capacity, in particular for the advanced mobile exploratory platforms. These state-of-the-art mobile labs are important for detailed characterization of atmospheric aerosols, gases and cloud combining in situ and remote sensing techniques. The mobility and versatility of CNR-ISAC platforms enable comprehensive data collection in diverse and challenging environments (from urban to marine environment), in order to advancing our understanding of the atmospheric processes. We present highlights of these platforms and show the data collected during various national and international field campaigns.

Mobile Exploratory Platforms

Terrestrial Environments

This section describes a selection of the mobile laboratories available to ISAC-CNR. In the table 1, we provide an overview of the scientific equipment installed both on Aerolab (in its ground-based version) and within the trailer van Voyager III.

Table 1: Overview of Aerolab and Voyager III scientific instruments.

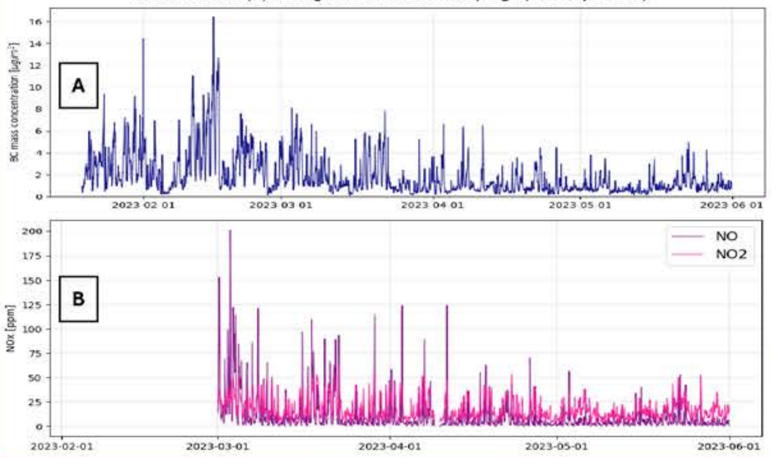
Instrument type	Measured parameter
APS	Aerosol size distribution (0.5-10um; aerodynamic)
ACSM	Aerosol chemical composition
Scanning Mobility Particle Sizer	Aerosol size distribution (8-800nm)
OPC	Aerosol size distribution (0.3-10 um; optical)
Nephelometer*	Aerosol scattering and back-scatt coefficient
Aethalometer	Aerosol absorption coefficient (eBC)
Meteo & radiation	Meteo Station + Pyranometer
Gas analyzer	NO_2 NO NO_x SO_2 H_2S CO CO_2 CH_4 H_2O
Ceilometer*	Vertical Profiles of Aerosol and Clouds, HPBL
Sun/Lunar photometer*	Direct solar irradiance and sky radiance
Lidar*	Elastic @ 355-532 nm, Polarization @355 nm, N2 Raman
Cloud radar doppler*	Radar Reflectivity, Doppler velocity, Doppler spectrum
VOCUS-PTR-MS	Volatile organic compounds

*ITINERIS instruments

Fig 1: Trailer van Voyager III.

Fig 2: Aerolab (ground-based version).

Fig 3: Timeseries of equivalent black carbon mass concentration (A), and NO_2 concentration (B) during Milano-Linate campaign (Jan-Sept 2023).



EC H2020 Project RI-URBANS (GA No 101036245)

Airborne for Environments

Thanks to the ITINERIS project (WP4.5) CNR-ISAC is implementing the 3-D observation capacity, through the acquisition of new instrumentation that will be customized for avionic use and installed onboard of the OGS Piper Seneca III. This new infrastructure will be usable for the in-situ vertical characterization of atmospheric particulate. The following tables list the instrumentation (table 2) that will be installed onboard and the aircraft technical details (table3).

Table 2: Overview of Piper Seneca III ITINERIS scientific instruments.

Instrument type	Measured parameter
Airborne Isokinetic inlet	Pick-up line
APS	Aerosol size distribution (0.5-10um; aerodynamic)
Dust monitor	Aerosol size distribution (0.3-10 um; optical)
Airborne Meteorological System	P, T, RH, Winds, Turbulence
Condensation Particle Counter	Total number concentration
Nephelometer	Aerosol scattering and back-scatt coefficient
Aethalometer	Aerosol absorption coefficient (eBC)
Scanning Mobility Particle Sizer	Aerosol size distribution (8-800nm)
Data Logger	Data acquisition

Table 3: OGS Piper Seneca III specifications.

Piper SENECA III specifications	
Cruise speed	188 kts
Stall Speed	61 kts
Gross weight	2165 kg
Empty weight	1457 kg
Range	870 nmi
Service Ceiling	25000 ft
Seats	6

Fig 4: Piper Seneca III.

Innovative platforms for atmospheric observations

Recently, CNR-ISAC developed an aerosol payload to be used on UAVs (with the further support of the ASI-funded project PRIMARY) and compact sensors for eBC mapping installed on good-delivery bicycles (used within RIURBANS) to improve spatial (3D/2D) resolution of aerosol measurements.

Fig 5: UAV-based BC and PM measurements during the ASI-PRIMARY activities.

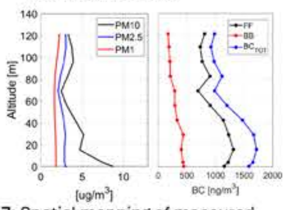


Fig 6: CNR-ISAC atmospheric payload and bicycles equipped with eBC compact sensor.

Fig 7: Spatial mapping of measured BC concentrations winter.

The "PRISMA Scienza" ASI-PRIMARY project Agreement n. 2022-3

Marine Environments

In synergy with PRIN 2022-GAIA project, CNR-ISAC developed GaInfra, the marine version of Aerolab, currently measuring in the Arctic Ocean onboard of the Polarstern icebreaker (AWI).

Fig 8: Icebreaker Polarstern.

Fig 9: GaInfra shelter with ITINERIS ceilometer and cruise coordinates.

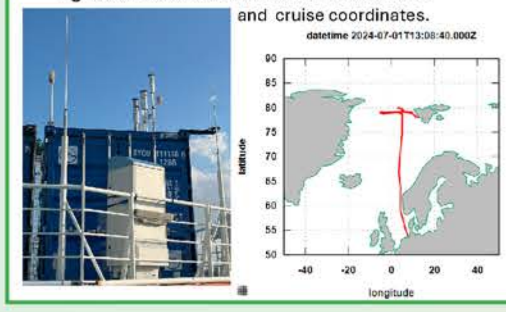
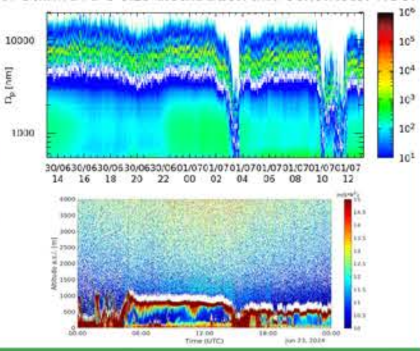


Fig 10: GaInfra APS size distribution and ceilometer RCS.



Conclusions

The Institute for Atmospheric Sciences and Climate (ISAC) has decades of experience in conducting measurement campaigns with scientific instrumentation on land, ocean and airborne platforms. The data will be available through the ISAC-CNR archive data center (https://adc.isac.cnr.it/), EBAS homeless data portal (https://ebas.nilu.no) and/or at the ITINERIS data Hub. The improvement of these mobile explorative platforms through the ITINERIS project improves CNR observational capacity, consolidating its contribution to the European Research Infrastructures such as ACTRIS, ICOS and EUFAR, as well as the participation in new national and international projects.

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Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Desert Dust vertical profile product and link to VRE-AERO

Michail Mytilinaios, Benedetto De Rosa, Emilio Lapenna, Serena Trippetta, Pilar Gumà-Claramunt, Gianluca Di Fiore, and Lucia Mona (CNR-IMAA)

Introduction

In the frame of the ITINERIS activity 4.11: *Aerosol Typing* (WP4), we produced a dataset of pure dust vertical profiles using aerosol lidar measurements provided by the ACTRIS/EARLINET lidar stations in Italy. The product is also linked to the activity 8.5: *Aerosol* VRE (WP8), where a virtual research environment provides information on the desert dust distribution over Italy (VRE-AERO Desert Dust tool). The dataset will also be available through the ITINERIS Hub (WP2).

Methodology

The dust component (Dust Backscatter Coefficient; DBC) was separated from the total aerosol profile (Particle Backscatter Coefficient; PBC) (Fig.1b) using the Particle Depolarization Ratio (PDR) (Fig.1a) according to the following equations [1]:

$$\text{if} \quad PDR \le 0.05 \rightarrow DBC = 0$$
$$\text{if} \quad 0.05 < PDR < 0.31 \rightarrow$$
$$DBC = PBC \cdot \frac{(PDR - 0.05)\cdot(1+0.31)}{(0.31-0.05)\cdot(1+PDR)}$$
$$\text{if} \quad PDR \ge 0.31 \rightarrow DBC = PBC$$

Then, the Dust Extinction Coefficient (DEC) was estimated, assuming that the lidar ratio is equal to 55 sr at 532 nm (Fig.1c).

[1] Tesche et al., 10.1029/2009JD011862, 2009

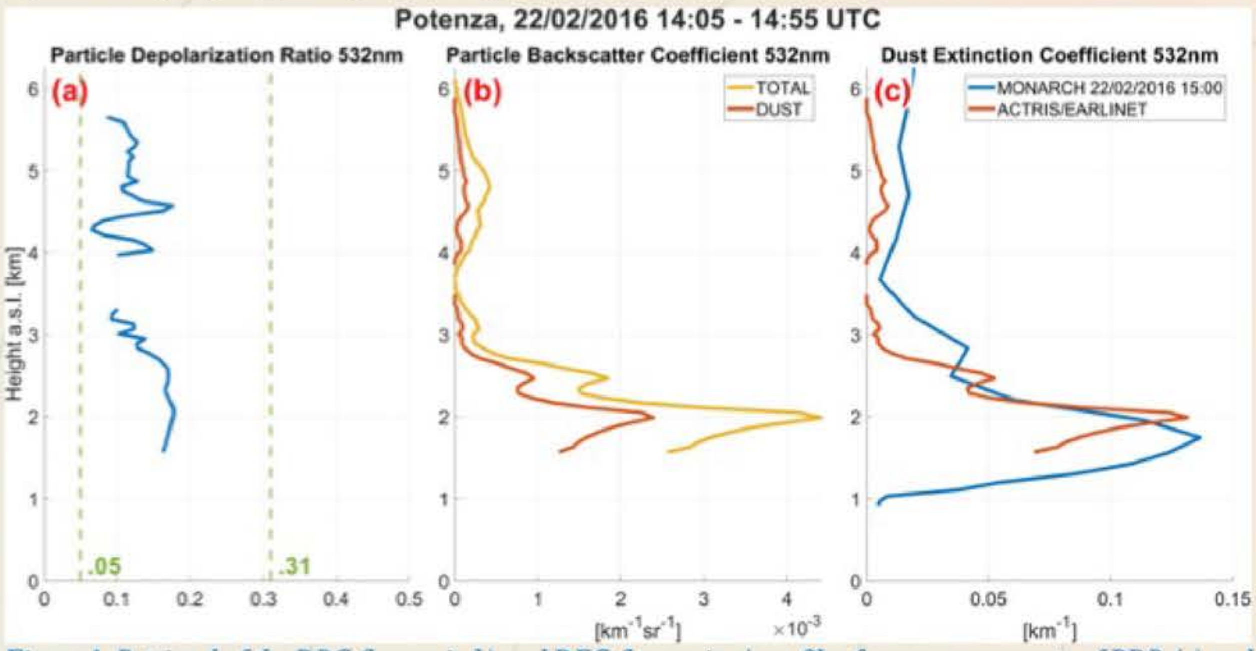


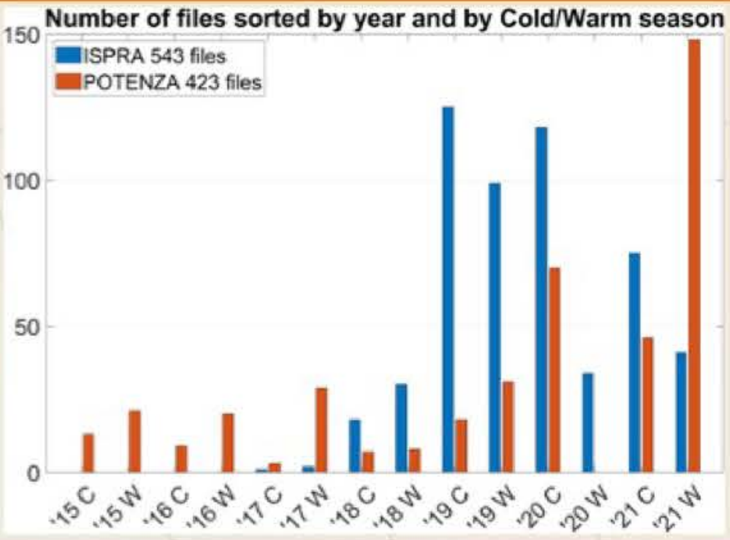
Figure 1. Retrieval of the DBC (brown in b) and DEC (brown in c) profiles from measurements of PDR (a) and PBC (yellow in b). In c the estimated DEC is plotted against the closest MONARCH Reanalysis output (blue).

Dataset Overview

Currently (June 2024) only Level 2.0 quality assured data from two ACTRIS/EARLINET stations have been used: Ispra (IPR) and Potenza (POT). More data from other stations in Italy will be added in the future.

4 new parameters
Dust Backscatter Coefficient (DBC)
Error of the DBC
Dust Extinction Coefficient (DEC)
Error of the DEC

Station	# Files	1st File	Last File
Ispra	543	July 2017	March 2021
Potenza	423	March 2015	November 2021



VRE-AERO Desert Dust tool

Case study: A strong desert dust transport originating in the western Sahara reached northern and southern Italy during the last week of February 2021, and affected both stations. The figures show the DEC product (Fig.2), the DOD (Dust Optical Depth) measurements (Fig.3) and the WMO dust model simulations (Fig. 1 & 3) made over Ispra and Potenza. For more details on VRE-AERO, check out Emilio Lapenna's presentation at the "Short Oral Session".

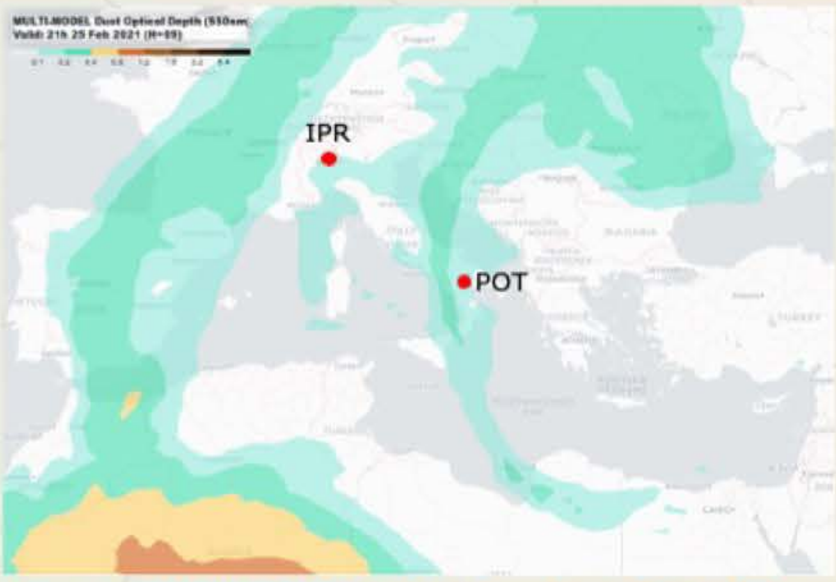


Figure 1. WMO SDS-WAS Multi-Model Dust Optical Depth at 550 nm

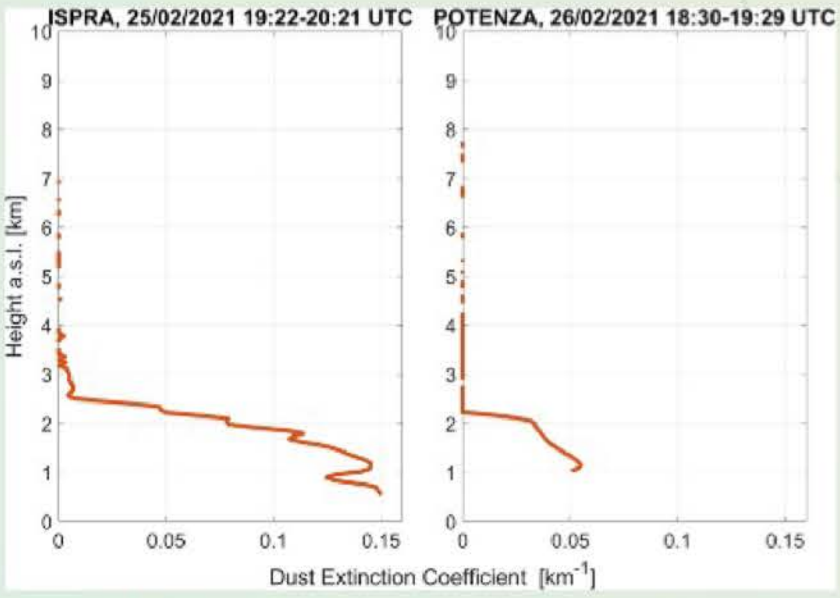


Figure 2. ACTRIS/EARLINET Dust Extinction product at 532 nm, over Ispra (left) and Potenza (right)

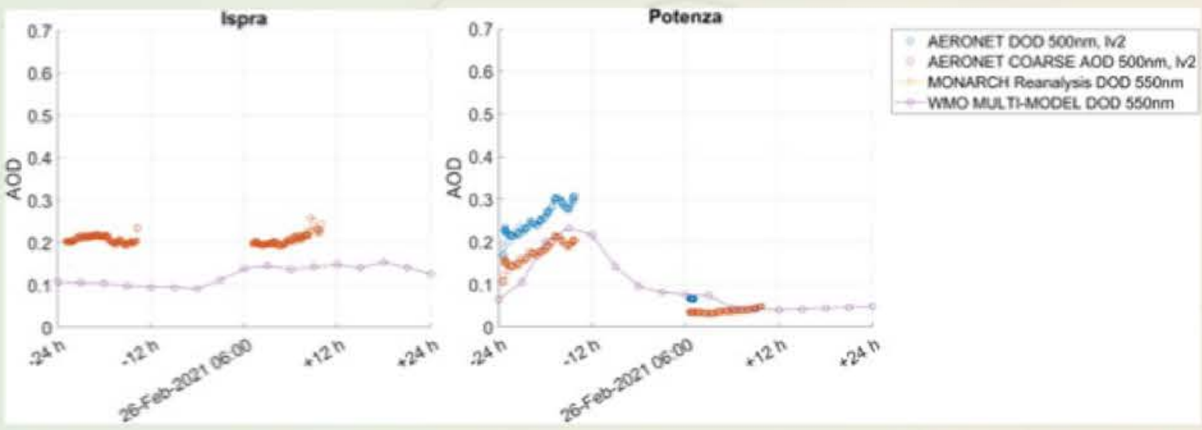


Figure 3. AERONET DOD and Coarse AOD at 500 nm, and WMO Multi-model DOD at 550 nm, over Ispra (left) and Potenza (right)

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DANUBIUS-RI International Centre for Advanced Studies on River-Sea Systems

Supersite of Po Delta and North Adriatic Lagoons: a living lab on transitional environments

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[1] Consiglio Nazionale delle Ricerche - Istituto di Scienze Marine, CNR-ISMAR; [2] CORILA - Consorzio per il coordinamento delle ricerche inerenti al sistema lagunare di Venezia; [3] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS; [4] Università IUAV di Venezia – Scuola di Dottorato

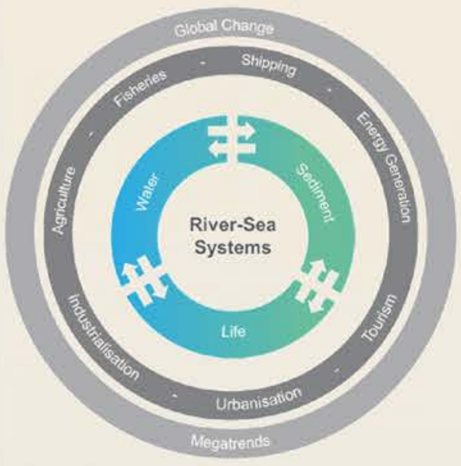
DANUBIUS-RI Mission

- *excellent science on the continuum river- sea*
- *state-of-the- art research infrastructures for a dialogue between river and marine research communities*
- *integrated knowledge required to sustainably manage and protect River-Sea systems*

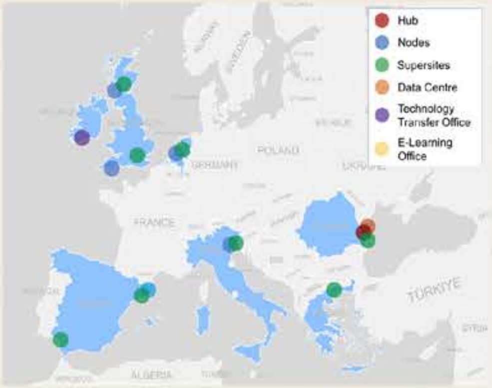
DANUBIUS-RI Vision

integrated observation system, toolboxes, living labs and services for investigating issues mainly connected to the interaction processes between freshwater and marine systems, feedbacks on ecosystems and the role of transitional environments within a highly humanized context

DANUBIUS-RI All components



DANUBIUS-RI All components



DANUBIUS-RI Supersites

DANUBIUS-RI Nodes

DANUBIUS-RI supports the Research and Innovation needed to achieve healthy River-Sea Systems.

The Implementation Phase (DANUBIUS-IP project) will last until 2025.

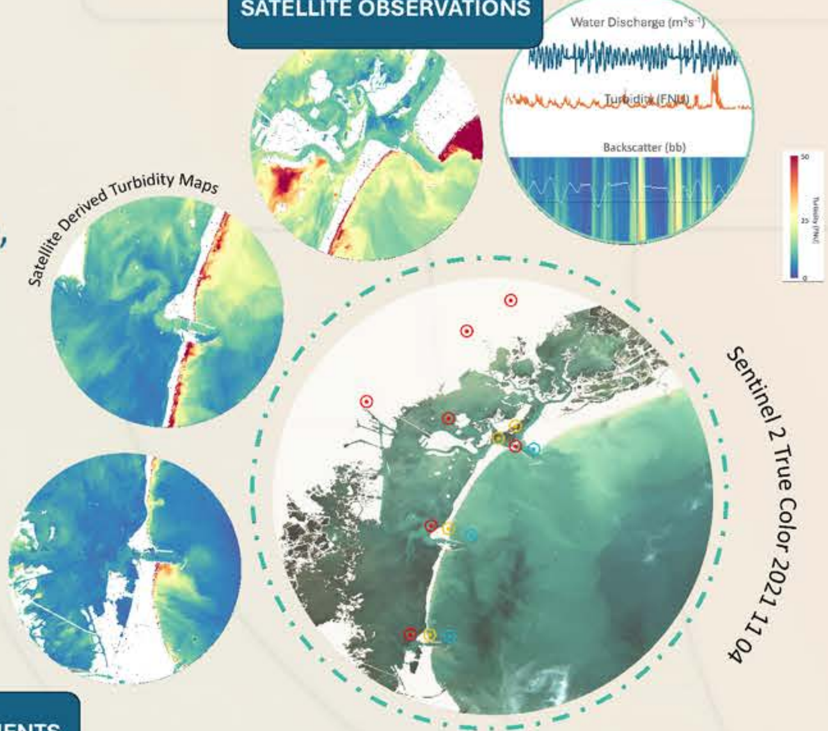
Supersites are the components intended as test bed of the DANUBIUS-RI scientifically excellent ideas. They are natural laboratories for observation, research, modelling and innovation at locations of high scientific importance and opportunity, covering RS systems from river source to transitional waters and coastal seas.

The italian scientific community is building the

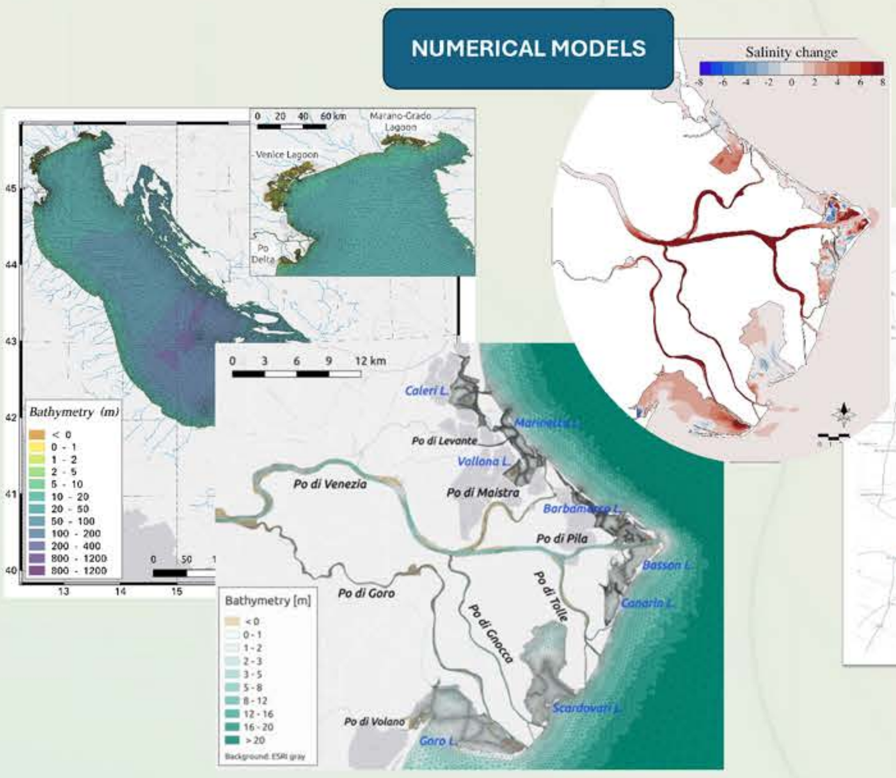
Po Delta and North Adriatic Lagoons Supersite

- Lateral source quantification for water, sediment and nutrient loads
- ROFI (Region of Freshwater Influence) coastal area characterization
- Specific models application
- calibration and validation of modelling tools and tailor-made EO algorithms
- Possible Digital Twin development for specific topics (e.g. saltwater intrusion, marine litter etc...)
- Increase, in synergy with the major monitoring entities and stakeholders
- Improvement of digitalization for the relevant EOV and ECV
- Creation of integrated products using in-situ, observations, satellite and modelling outputs.

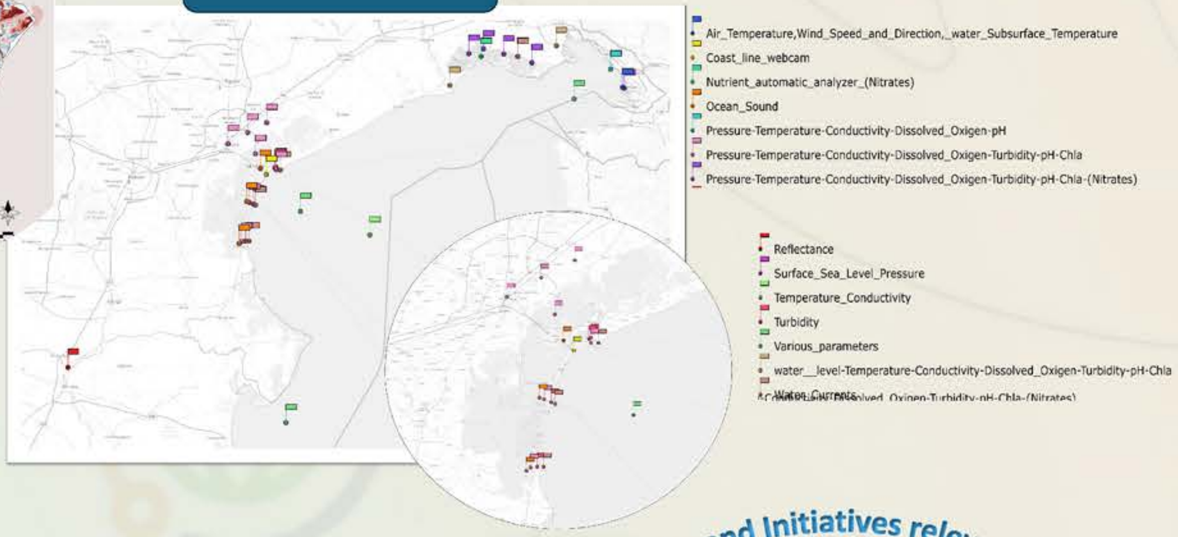
SATELLITE OBSERVATIONS



NUMERICAL MODELS



IN-SITU MEASUREMENTS



2024 ERIC step 2 submitted

2025 Building the Italian components

2026 Italian components services And service level agreements (SLA)

2027 SLA fully in place access for users

2028 Operational phase established

CNR ISMAR | OGS | CORILA

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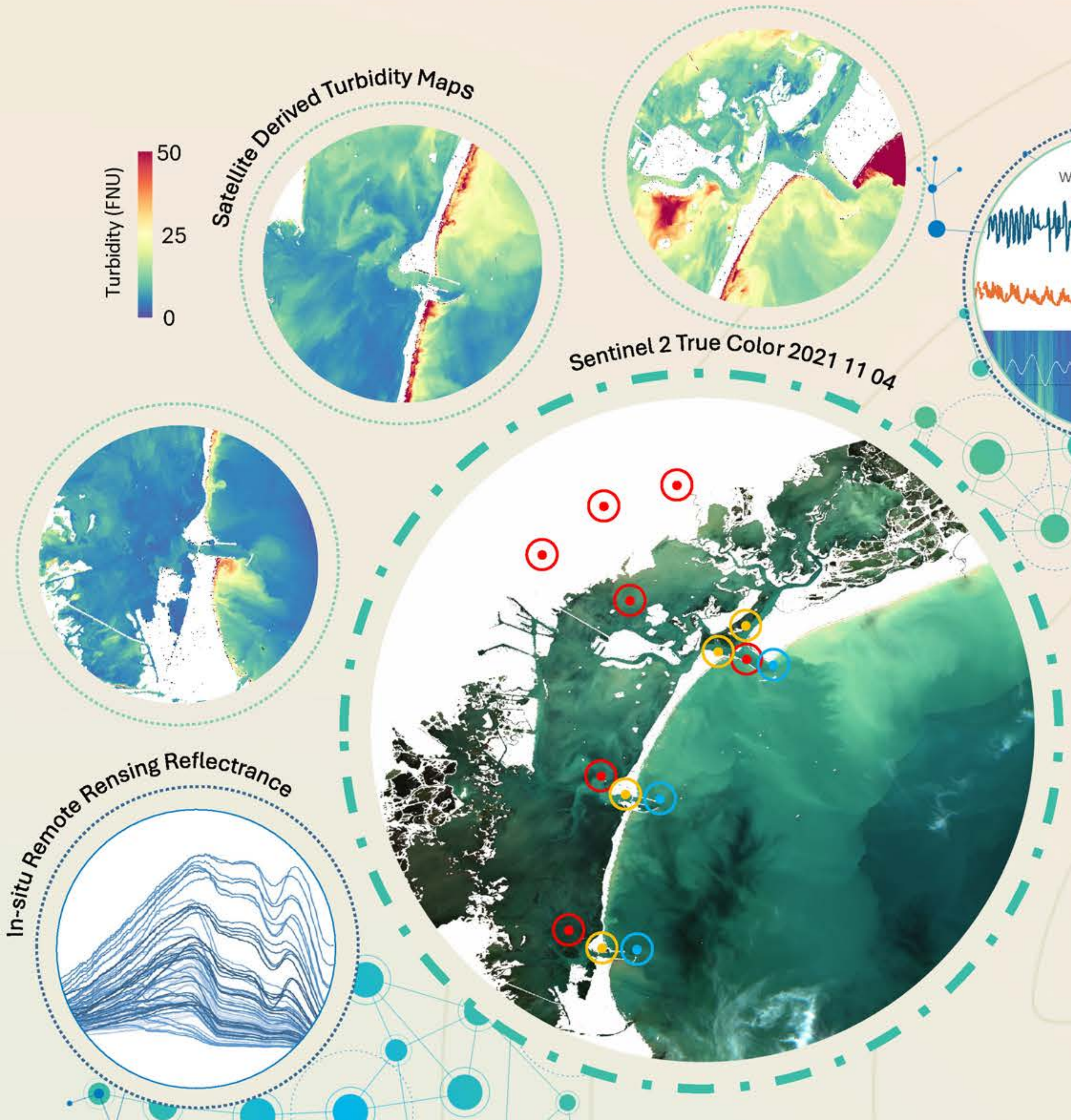
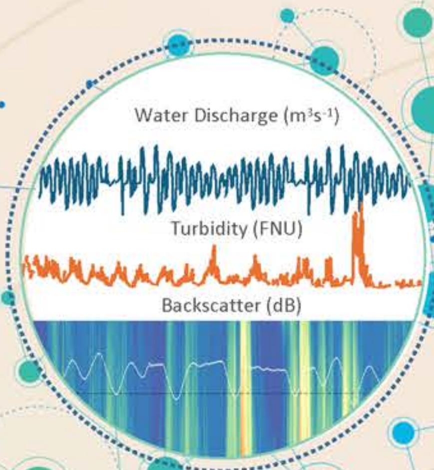
DANUBIUS-RI Multisensor Approach for Monitoring Water Turbidity in Transitional Aquatic Systems

Scarpa GM[1]., Braga F[1]., Manfè G[1]., Lorenzetti G[1]., Bellafiore D[1]., De Pascalis F[1].

[1]Institute of Marine Sciences -National Research Council (CNR-ISMAR), Castello 2737/F, 30122 Venice, Italy

DANUBIUS-RI





Monitoring turbidity in coastal and estuarine waters is crucial for comprehending and managing water quality and sediment dynamics.

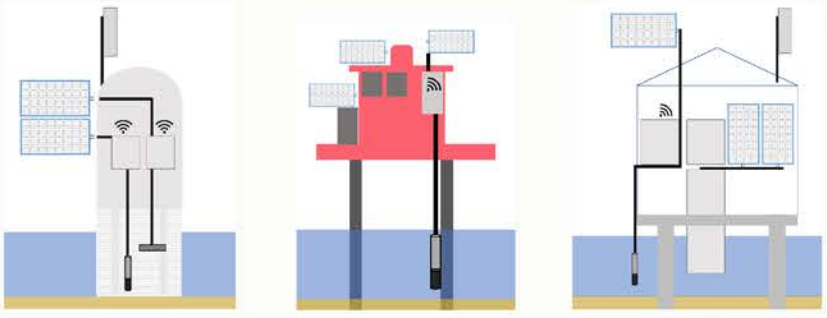
Satellite-based turbidity products, coupled with intercalibrated fixed instruments and in situ measurements, plays a pivotal role in this context. It provides valuable insights for estimating suspended particulate matter (SPM) and sediment transport.

In the framework of the ITINERIS program, within DANUBIUS-RI Italian Supersite an observation system is being implemented to continuously monitor, on a wider spatial scale, suspended sediment patterns and physical and bio-chemical parameters of the waters together with the waterflow considering freshwater inputs, longshore currents and tidal circulation along the lagoon channel network

The network implemented by ISMAR is composed of:

- Multisensors probes for the measurements of physical and bio-chemical parameters
- Optical turbidimeters
- Bottom-mounted Acoustic Doppler Current Profilers (ADCPs)

All the sampling stations are equipped with a datalogger for the transmission of real time data via GSM. The timeseries acquired are stored in dataset designed at the scope of this research



For the deployment of the instruments, custom-designed systems are developed for existing structures. These anchors were specifically designed to minimize the impact on the structures.

Field activities are regularly conducted for instrument maintenance and for calibration. The instrumental network is also fundamental for the validation of satellite products.

Together with the instrumental setup described for the Venice Lagoon, an in-situ radiometer has planned to be positioned in the Po river delta for real – time autonomous measurements.

The scope of this approach is to cover an urgent need to find accurate, reliable and cost-efficient monitoring techniques to assess the sediment dynamics in Transitional Aquatic Systems. The integrated system, once completed, will enable the assessment of short-to-long-term variations on sediment transport pathways, the exploitation and the enhancement of the existing data infrastructures and permit the characterization of morpho-hydrodynamic processes. The future datasets will be part of the offer of the ESFRI research infrastructure DANUBIUS-RI. This is also an important opportunity for modeling applications in lagoon and river-sea systems and offers the possibility of forcing, with continuous data, hydrodynamic models and sediment transport simulations.

gianmarco.scarpa@cnr.it

Connections with other projects

Venezia2021 CosteLab ERTO FOCCUS CoastObs LAND SEA

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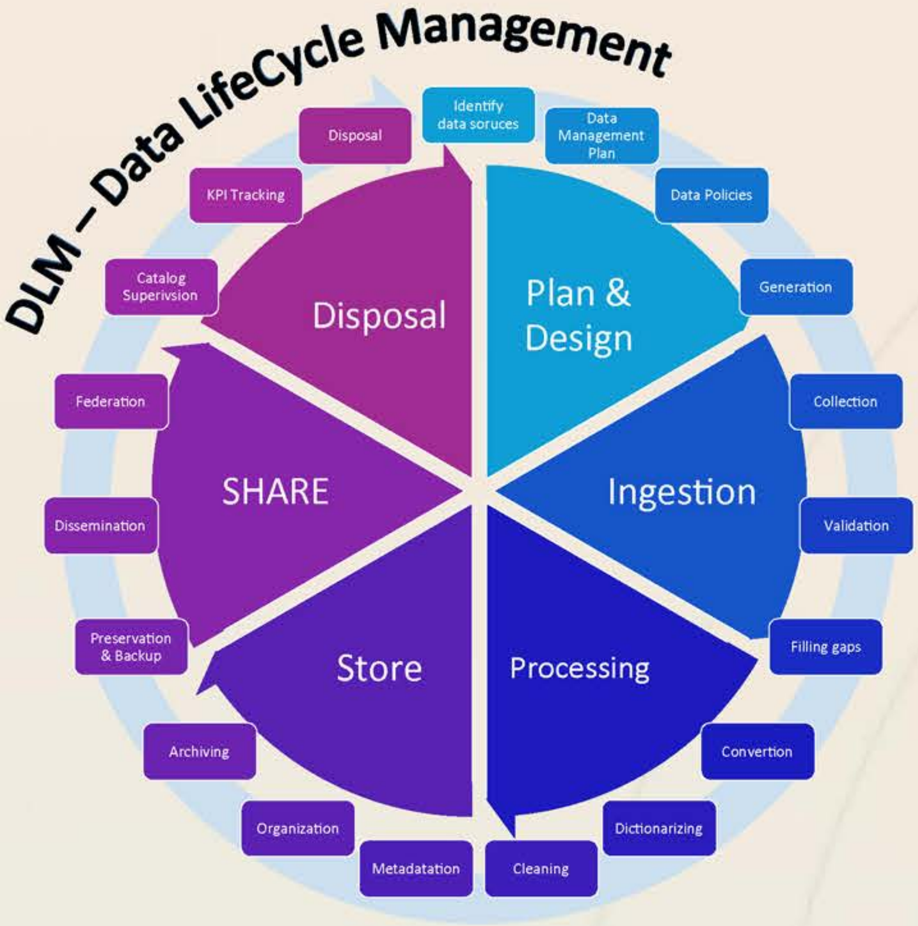
DANUBIUS-RI | CNR ISMAR Istituto di Scienze Marine

DANUBIUS-RI River-sea system data infrastructure

The technological integration of multiple heterogeneous data sources through a microservices approach to the data lifecycle.

F. Bellati, A. Fadini, E. Urbinati, D. Bellafiore, C. Cantoni, G. Castelli, V. Grande, F. Riminucci, G. Stanghellini, M. Bastianini, V. Langella, A. Pomaro, M. Caccavale, F. De Pascalis



Identify data soruces
Identification of new instruments prior to its acquisition, collection of technical data and validation of technical constraints.

Data Management Plan
Verification of compatibility with the institution's data management plan and adjustments.

Data Policies
Management of data policies of data and FAIR directive.

Generation
The data may be generated automatically or manually. Derived products can be managed as **autonomous** datasource

Collection
The data may be collected manually or automatically via various protocols and may come fron internal or external data sources.

Validation
The data must be validated via various rules garanting grammar correctness and timing

Filling gaps
The collection of data can have holes that can be filled with download retring or with calculation rules.

Convertion
The data must be converted and normalized to stnadard fom to simplify the next steps

Dictionarizing
The data must be corrected with standard variables name (es. from NERC) to respect formalisms.

Cleaning
The data may reaquire cleaning from spikes or other treatements to obtain a product of better quality.

Metadatation
The data must be metatyped with informatin from sensor catalog non already inserted on data messages.

Organization
The data must be organized in a structured form (ad es. structured database or filesystem tree to implement a better procedures of management.

Archiving
The data can be stored locally or in the cloud, it must be stored at least in a form that ensures its readability for years and guarantees its sovereignty.

Preservation & Backup
The data backup must respond to the DMP and ensure a copy that conforms to AgiD's Tier specifications.

Dissemination
Data are published in data portals such as Openddap, Erddap and Thredds. Metadata and identifier (e.g DOI) are added

Federation
Data federation is done through the capabilities of the CKAN catlogue system.

Catalog Superivsion
The architecture support the use of common external monitors to control the state of the module

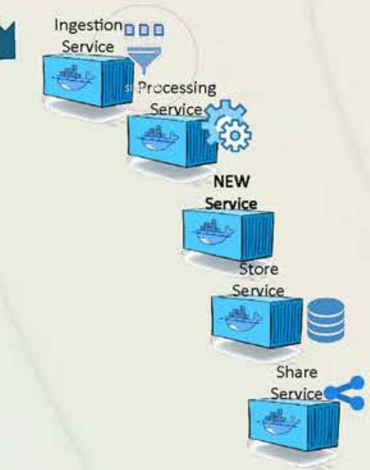
KPI Tracking
The presentation/dissemination step support the logging of number of access and others KPI.

Disposal
Each dataset is set up for long-term archiving or deletion after a predetermined period of time established early in the process

From Logic Process to microservices implementation

Scaling Horizontally to many many many data sources

Scaling vertically to introduce different steps in the pipeline

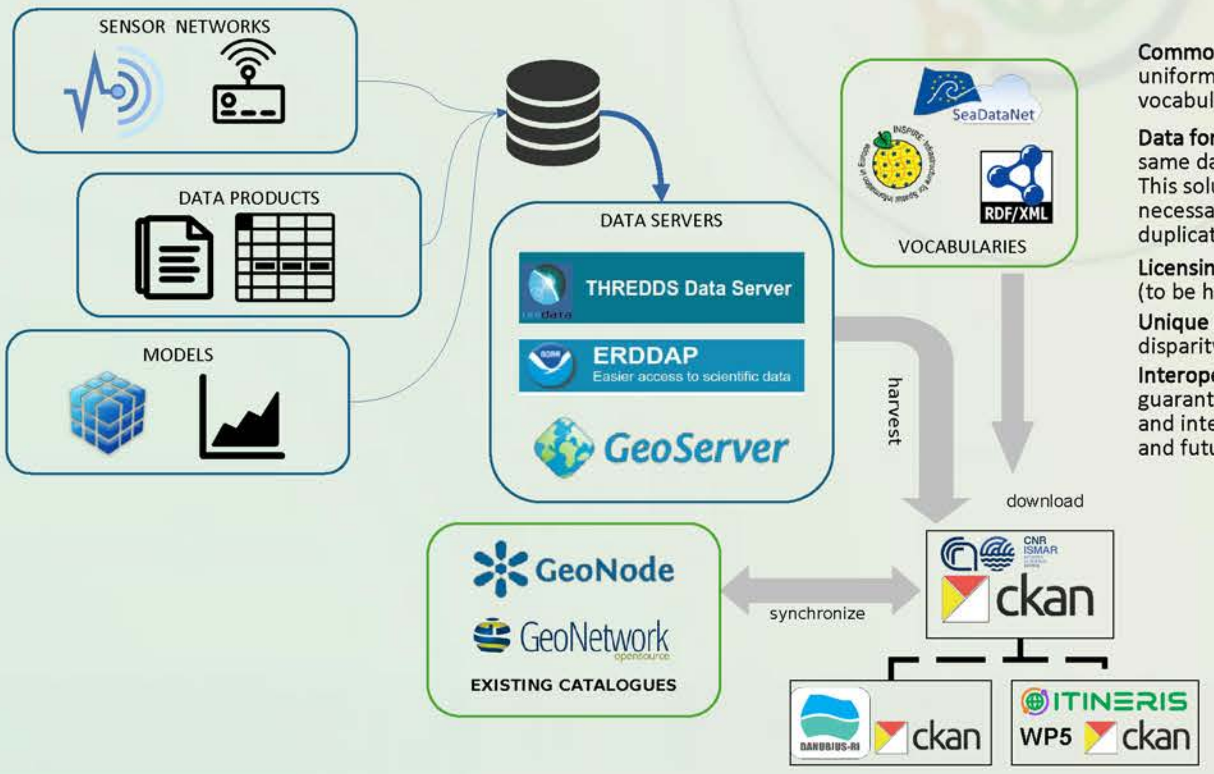


Data Life Cycle Management best practices

- Uses a **virtualized**, isolated microservice structure with container technology.
- Each stack of containers is **dedicated to a single facility**, sensor, or variable group.
- Addresses **specific needs** in processing and management organization.
- **Standardized** network communication **interfaces between containers**.
- Allows for easy **insertion of additional modules** along th pipeline.
- **Minimal resource requirements** per container enabling orizontal scalability.

Data discovery through the catalogue

The implementation of FAIR principles require to make the data **findable** using standard metadata and **accessible** using API and standard **interoperable** webservices



Common Vocabularies: to facilitate data interoperability within the same hub: a fair degree of uniformity among the different RIs of the marine domain is found in the use of a shared vocabulary (e.g SeaDataNet)

Data formats: to standardize the marine domain: the prevailing trend is to provide the same data in different formats.
This solution makes it possible to diversify the output format for the end user without necessarily
duplicating the stored data.

Licensing: almost all of the RIs in the marine domain adopt a CC-BY 4.0 data license (to be harmonising with ITINERIS existing licensing policies).

Unique data identification: The RIs use an unique PId, although there is some disparity as to type.

Interoperability: a distributed and federated infrastructure, as has been designed, guarantee high efficiency in terms of data/metadata security, efficiency in its dissemination and interoperability, and the necessary computing and storage resources for current and future long-term data.

CKAN catalogue federated architecture

- Support custom fields in schema
- Guided compilation
- Multiple organizations
- Multiple resources links for each dataset
- Spatial extension available
- Ready to use harvesting extensions (e.g. geonetwork)
- Python based, easy to extend to implement vocabularies (tested with MSP data framework)

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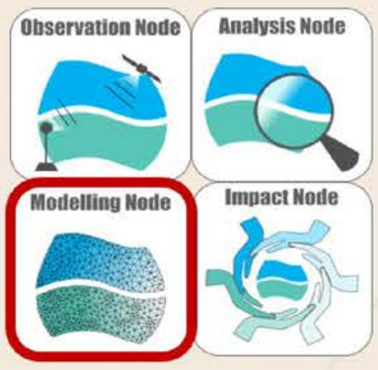
MODELLING OCEAN EXTREMES AND CLIMATE DYNAMICS IN THE NORTHERN ADRIATIC SEA

C. Ferrarin, D. Bellafiore, G. Umgiesser, M. Ghezzo, M. Bajo, F. Barbariol, A. Benetazzo, D. Bonaldo, F. De Pascalis, W. McKiver

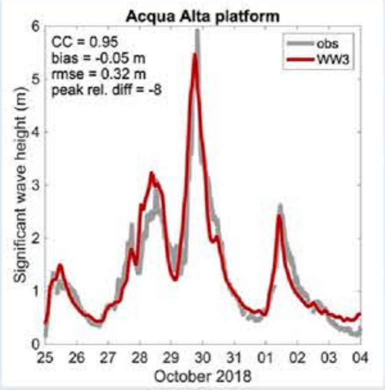
The DANUBIUS Modelling Node (led by CNR-ISMAR) provides expertise with a focus on the development of modelling tools to reproduce the feedback and interconnections between physical, biogeochemical and ecological processes along the entire River-Sea continuum and connect the environmental results to the social-economic impacts to investigate what-if and climate scenarios. The **Modelling Node** focuses on both developing suitable numerical tools to satisfy the need of complexity (full process reproduction) and improving the simplicity of interfaces.

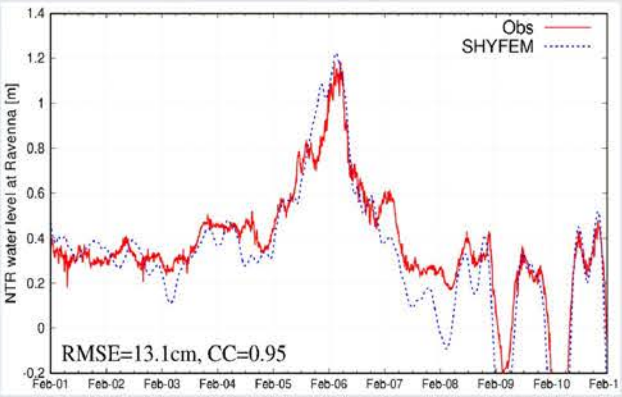


The 10 **DANUBIUS Supersites** are natural laboratories for observation, analysis, modelling and social-economic impact studies. The **Italian Supersite of Po Delta and North Adriatic Lagoons** is focused on the role of transitional environments within the RSS. The Vision for this Supersite is to provide an integrated observation system, toolboxes, living labs and services for investigating processes between freshwater and marine systems, feedback on ecosystems and the role of transitional environments within a humanized context.

OCEAN EXTREMES

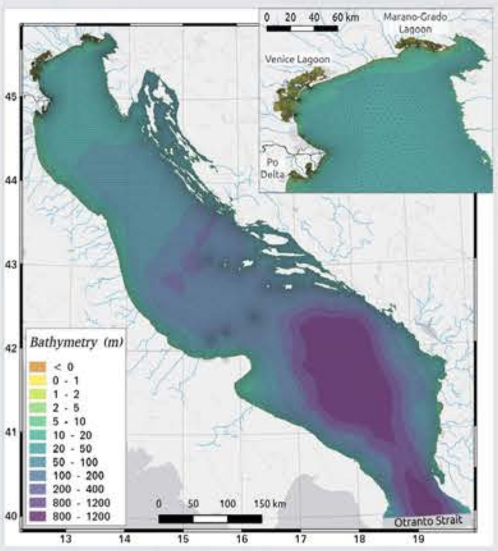
Hourly sea level (SHYFEM) and wave (WW3) hindcast over the Northern Adriatic Sea for 1994-2020.





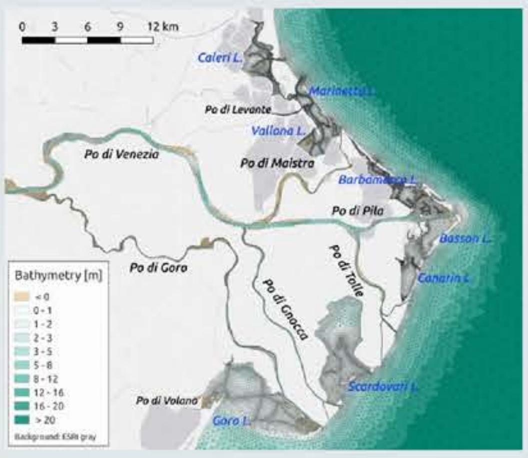
Accordo di collaborazione Mare ADBPO

BASIN-SCALE MODELLING



3D high-resolution unstructured modelling (SHYFEM) of the Adriatic Sea for reproducing the basin circulation as well as the coast to open sea dynamics. Hindcast simulations for the period 2015-2020.

SALTWATER INTRUSION



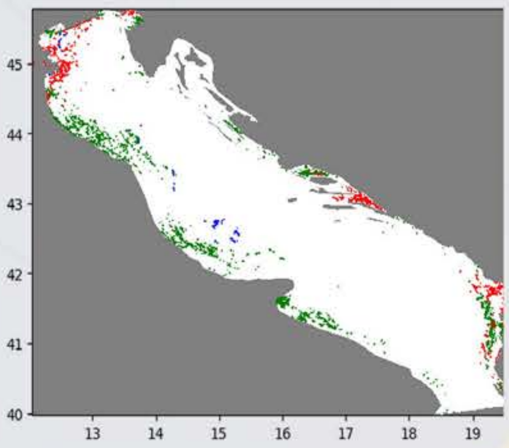
3D unstructured modelling (SHYFEM) of the Po Delta for reproducing river-sea interactions and saltwater intrusion. Hindcast simulations for the period 1994-2020.

EU LIFE CLIMAX PO

MACROLITTER DISPERSION

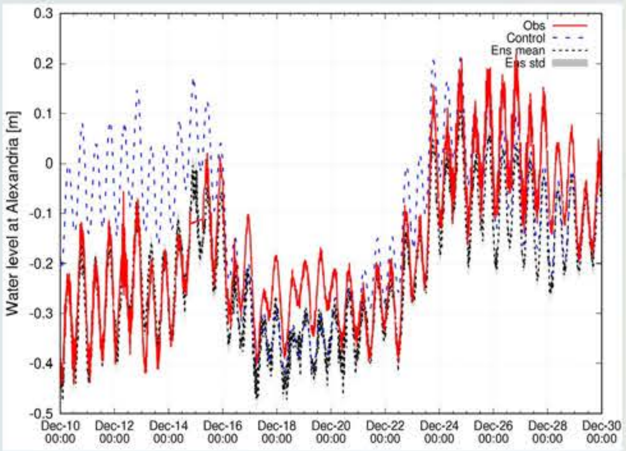
3D SHYFEM model coupled with marine litter dispersal module to assess the potential accumulation of marine litter coming from different sources, aquaculture (red), rivers (blue) and cities (green).

EU H2020 MAELSTROM



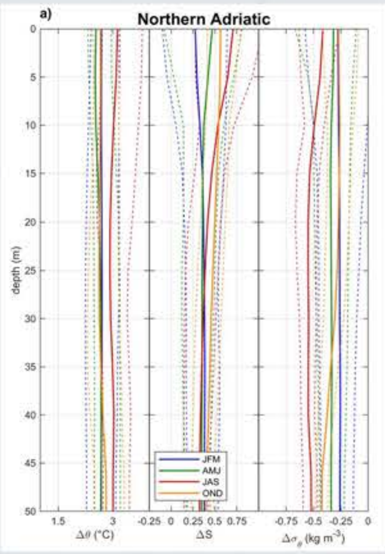
SEA LEVEL REANALYSIS

A data assimilation system based on EnKF for the SHYFEM model. Sea level reanalysis over the Mediterranean Sea assimilating all the available in-situ data from 1994 to 2020.



PNRR RETURN | COAST-CLIM

CLIMATE ENSEMBLE



3D, 6-member ocean model ensemble for the Adriatic Sea in a severe climate scenario (1987-2099, RCP8.5). Forcing from SMHI-RCA4 driven by different GCMs. Monthly fields available on Zenodo.

CNR ISMAR ISTITUTO DI SCIENZE MARINE

DANUBIUS-RI International Centre for Advanced Studies on River-Sea Systems

Annual meeting - Roma - 9-10/07/2024

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ITINERIS

Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

The new Danubius-RI Operational Lagoon Environmental Monitoring (MALO) Network to support the biogeochemical modelling and characterization of the Marano-Grado Lagoon

OGS

Brunetti, F .[1], Lanzoni, A.[1], Scroccaro, I.[1], Canu, D.[1]

[1] OGS, Istituto Nazionale di Oceanografia e Geofisica sperimentale

Introduction and motivation

Understanding coastal biogeochemical processes at the river-sea interface and within lagoon systems is crucial to support the assessment of state and trends of sea basins like the Adriatic Sea and the Mediterranean Sea.

This project activity focuses on the Marano and Grado Lagoon and aims at 1) building the observational MALO network (Monitoraggio Ambientale Lagunare Operativo - Operational Lagoon Environmental Monitoring), 2) developing a biogeochemical model with SHYFEM-BFM, and 3) integrating models and data. The final goal is to provide a better description of the trophic dynamics of the Marano and Grado Lagoon (figure 1a), located in the northeastern coastal area of Italy. This coastal ecosystem represents an interesting case study due to its regional and international ecological importance, requiring comprehensive management strategies.

This work will also contribute to build new knowledge and expertise to support Danubius-RI, addressing the fragmented research on River-Sea Systems (RSS) in Europe.

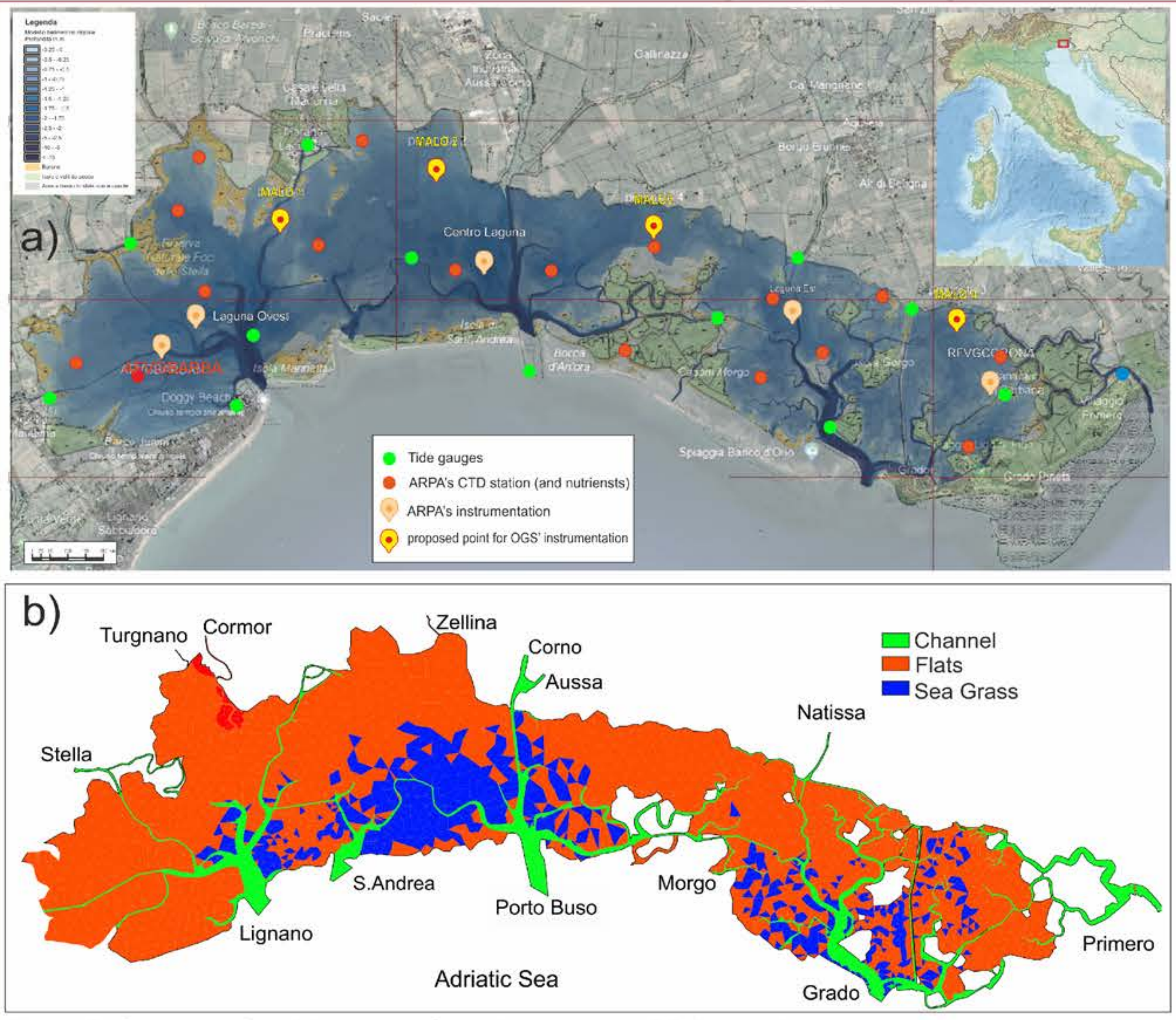

Figure 1: a) Location of the Marano and Grado Lagoon, with ARPA's sampling stations, tide gauges and the new MALO Network; b) The new finite element grid with the inclusion of seagrass (in blue color).

OGS new monitoring network in the Marano and Grado Lagoon

The new monitoring network, MALO (figure 2), will be integrated with the existing ARPA FVG monitoring system (Pittaluga et al., 2022), as shown in Fig. 1a, in order to capitalize and make synergies on existing observing systems. The MALO network will consist of:

- four buoys equipped with a multi-parameter probe (CTD);
- one nutrient station;
- six ADCP current meters (at monitoring lagoon inlets).

This new network will monitor both physical and biogeochemical parameters, including: temperature, salinity, chlorophyll-a, turbidity, dissolved oxygen, nutrients (particularly nitrates), and current profiles throughout the entire water column at the lagoon inlets.

All data collected in real time will be stored and made freely accessible at the OGS-NODC (National Oceanographic Data Center).

OGS will be a Production Unit (PU) for the ITINERIS - Danubius data (MALO and MAMBO). Moreover, OGS will also be an end point for the transmission of the data as an ITINERIS requirements.

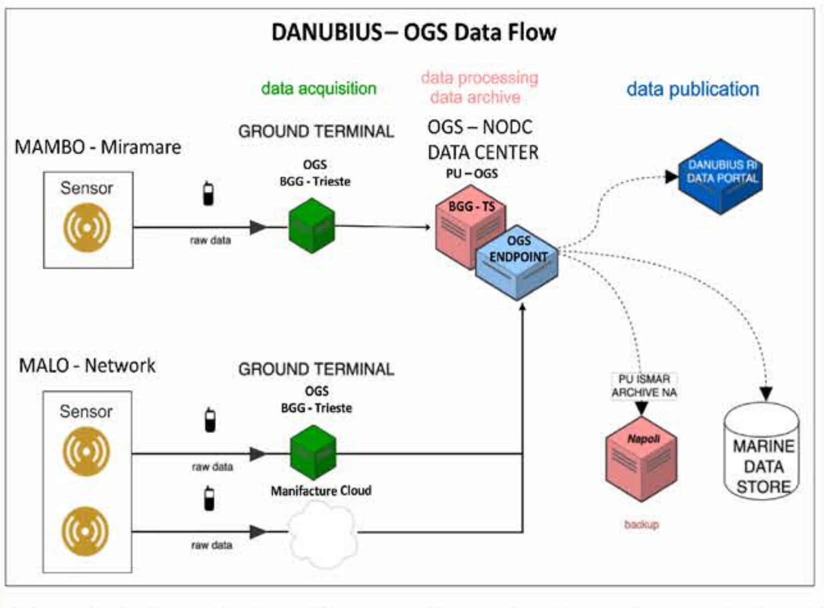

Figure 2: Schematic flow of the recording, collection and transmission of the data acquired by the MALO and MAMBO networks.

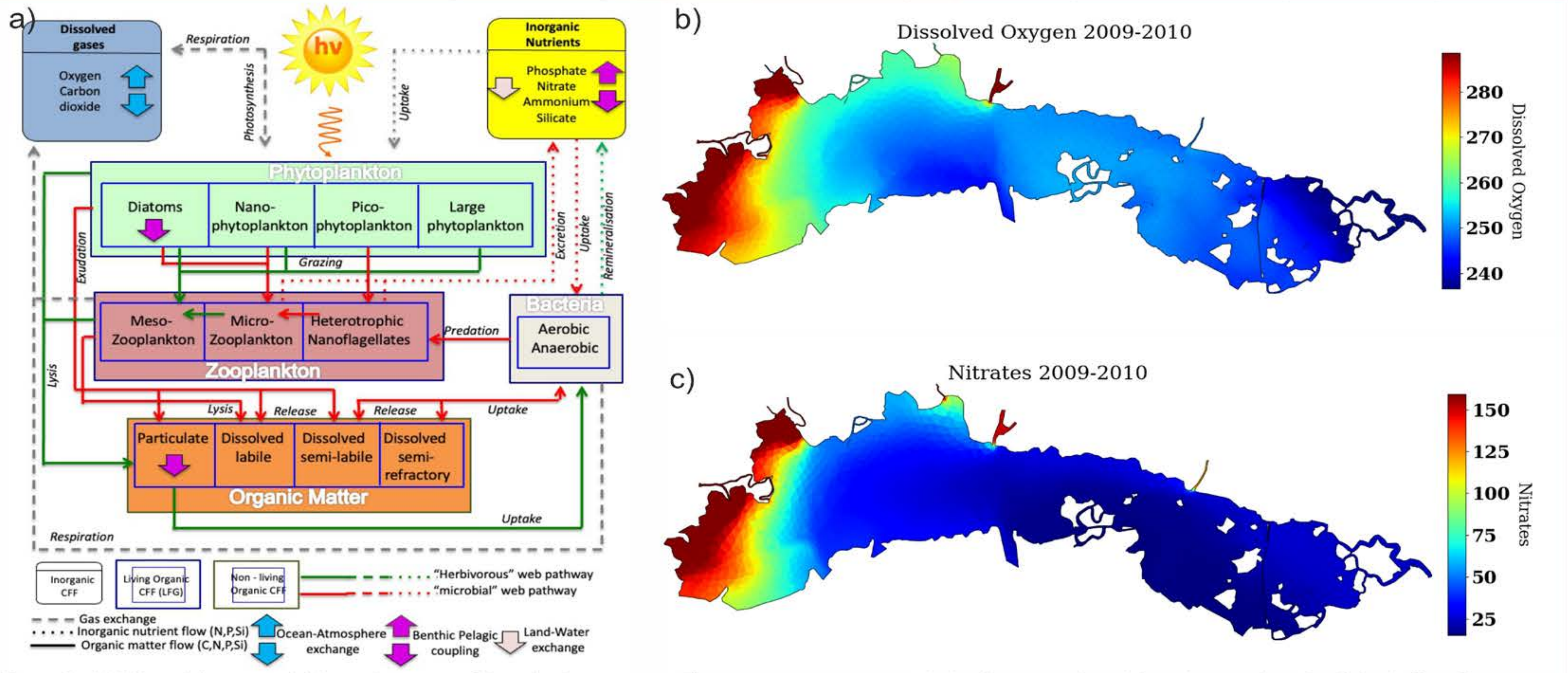

Figure 3: a) BFM model's state variables and structure,of the pelagic component. The green arrows represent the herbivorous web and the red arrows the microbial web (from Scroccaro et al.,2022); b) example of average distributions of some modeled state variables over the 2009-2010 period: c) Nitrates (mmol N/m^3); b) dissolved Oxygen (mmol O /m^3)..

Final consideration and perspective

Exploiting the availability of data and information coming from the operational lagoon environmental monitoring network (MALO), a better description of the ecosystem dynamics will be reached by improving and applying the integrated modelling system, developped by coupling the transport finite element model SHYFEM and the biogeochemical model BFM (figure 1a and 3a). Further work is also required to complete the tuning of site specific parameters of the model, especially improving the parameterization of the plankton dynamic, with the related nutrient uptake and oxygen production (Fig. 3b,c).

Reference

- Ferrarin, C., Umgiesser, G., Bajo M., Bellafiore, D., De Pascalis, F., Ghezzo M., Mattassi G. and Scroccaro I., 2010. Hydraulic zonation of the lagoons of Marano and Grado, Italy. A modelling approach. Estuarine, Coastal and Shelf Science, Vol. 87 (4), 561-572. DOI:10.1016/j.ecss.2010.02.012;
- Pittaluga, F.; Aleffi, I.F.;Bettoso, N.; Blasutto, O.; Celio, M.;Codarin, A.; Cumani, F.; Faresi, L.;Guiatti, D.; Orlandi, C.; et al. The SHAPE Project: An Innovative Approach to Understanding Seasonal and Diel Dissolved Oxygen Dynamics in the Marano and Grado Lagoon (Adriatic Sea) under *the WFD/2000/60/CE*. J. Mar. Sci. Eng.2022, 10, 208. https://doi.org/10.3390/jmse10020208
- Scroccaro I., Zavatarelli M., Lovato T., Lanucara P., Valentini A., 2022. The Northern Adriatic Forecasting System for Circulation and Biogeochemistry: Implementation and Preliminary Results. Water 2022, 14(17), 2729.

Annual meeting - Roma - 9-10/07/2024

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Interannual and seasonal chlorophyll variability from high resolution fluorescence time series at an eLTER site in the northern Adriatic Sea

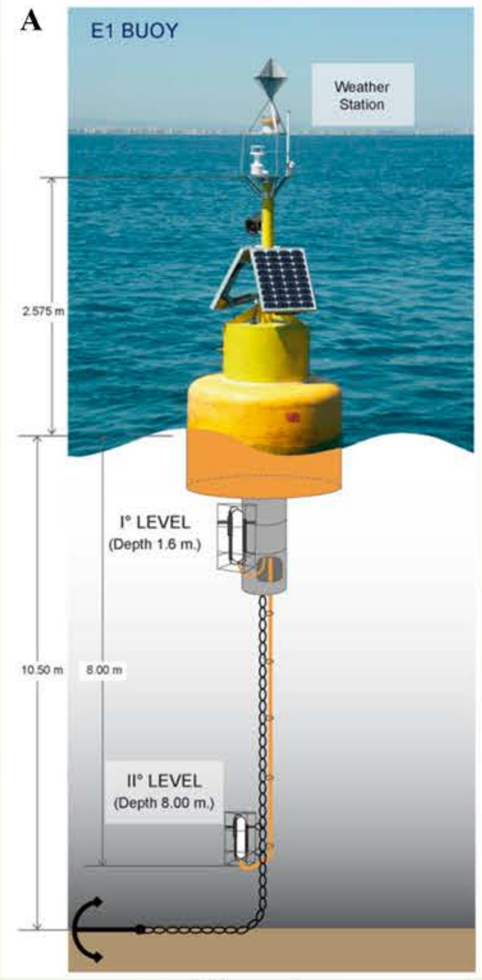
S. Toller[1], F. Riminucci[1-2], E. Böhm[3], L. Capotondi[1], A. Correggiari[1], M. Ravaioli[1], R. Santoleri[4], G. Stanghellini[1], C. Bergami[5]

[1] National Research Council (CNR), Institute of Marine Science (ISMAR), Via P. Gobetti 101, 40129 Bologna, Italy; [2] PROAMBIENTE Consortium, Tecnopole Bologna CNR, Via P. Gobetti 101, 40129 Bologna Italy; [3] National Research Council (CNR), Institute of Marine Science (ISMAR), Via Madonna del Piano 10, 50019 Sesto Fiorentino, Florence, Italy; [4] National Research Council (CNR), Institute of Marine Science (ISMAR), Via Fosso del Cavaliere 100, 00133 Rome, Italy; [5] National Research Council (CNR), Institute of Marine Science (ISMAR), Via Roberto Cozzi 53, 20126 Milan, Italy

INTRODUCTION: Continuous optical observations of chlorophyll fluorescence at the meteo-oceanographic buoy E1, located along the Emilia-Romagna coast in the Northern Adriatic Sea (NAS), were analysed. The dataset spanning a decade, consisting of 69705 hourly in-situ derived chlorophyll fluorescence observations, was employed to examine both seasonal and non-seasonal variability in chlorophyll, along with long-term trends in phytoplankton phenology and bloom events in the NAS. E1 buoy is located in the research site 'Delta del Po and costa Romagnola', which belongs to the Italian branch of the eLTER-RI and is integrated into the Italian national project PNRR ITINERIS.

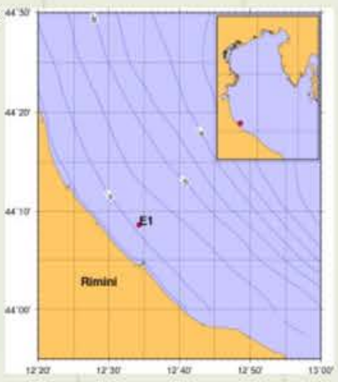
The analysed chlorophyll data is essential for studying the NAS marine ecosystems, since Chlorophyll concentrations serve as an indicator of phytoplankton biomass, which is a foundamental component of the marine food web and algal bloom events in the area.

A



E1 BUOY (A) operational since 2006, is located in the NAS 6 Km from the coast nearby Rimini **(B)** and is anchored at a depth of 10.5 m. It collects data every 30 minutes then transmitted hourly to the database at CNR ISMAR in Bologna, allowing for near-real-time (NRT) monitoring. Collected data is accessible online at http://e1.bo.ismar.cnr.it **(C)**.

B



C

SENSOR The ECO Triplet Optical Sensor **(D)** applies advanced optical technology to measure chlorophyll fluorescence in the water.

This sensor is capable of detecting chlorophyll concentrations with high sensitivity and accuracy making it an invaluable tool for monitoring phytoplankton dynamics and assessing primary productivity in marine ecosystems.

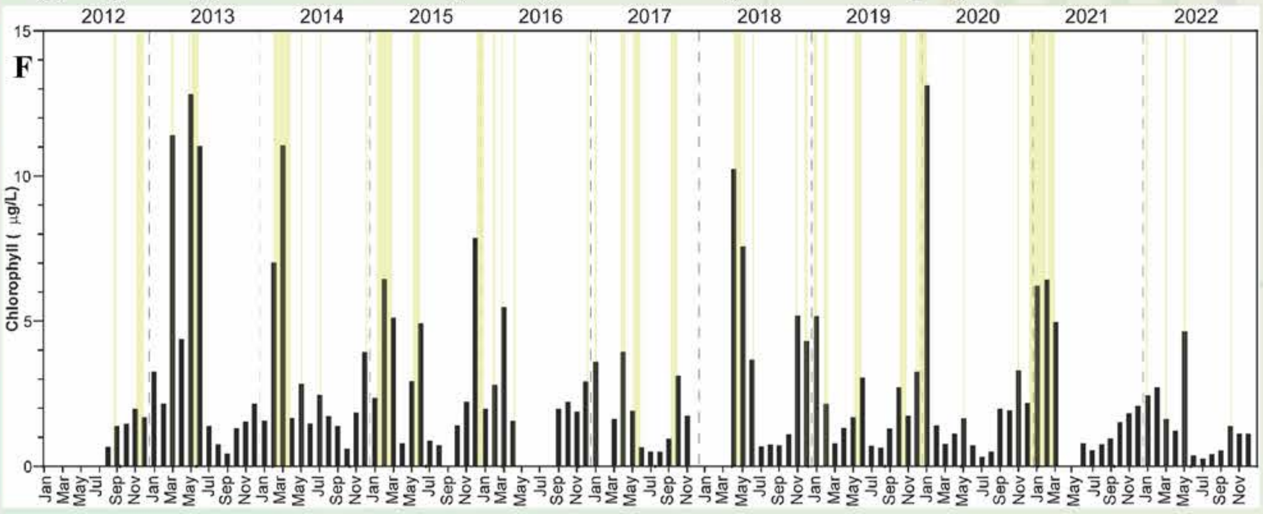
D

BLOOM IDENTIFICATION METHOD

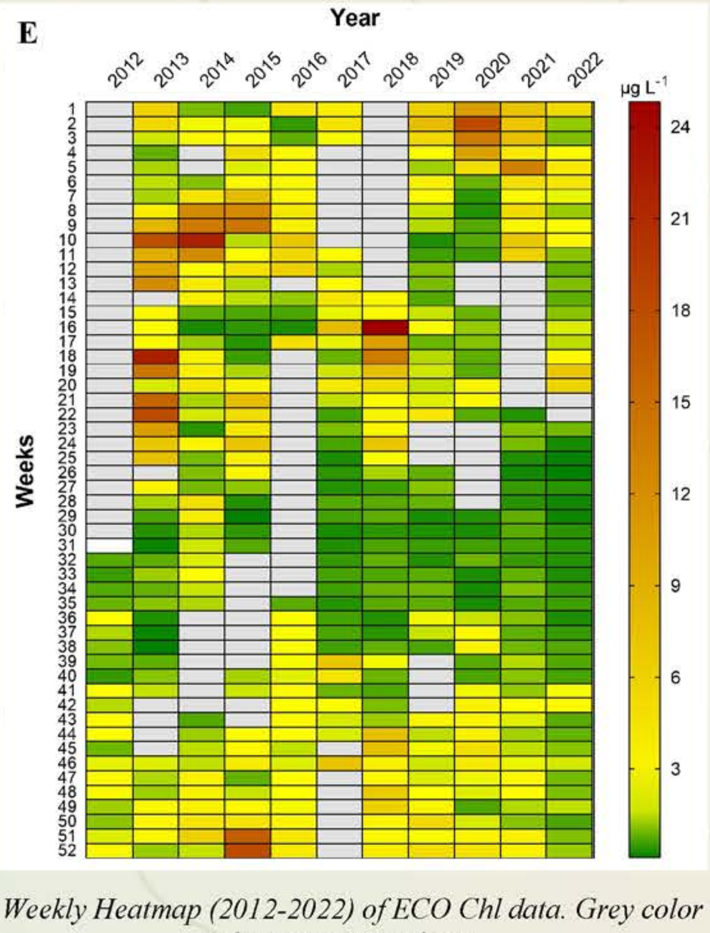
Identifying algal blooms over an extended period requires specific criteria. The onset is marked by at least two consecutive days of positive growth rates and a cumulative positive growth rate over at least five consecutive days. Due to site-specific characteristics a bloom is defined also by concentrations higher than the 95th percentile of the monthly average, addressing potential curtailment due to dilution, currents, or other factors. Incomplete events are classified as "sporadic events" rather than blooms. The end of a bloom is marked by the day preceding five consecutive days of negative growth rates.

RESULTS: In general, over the decade (2012-2022), chlorophyll concentration decreased **(E-F)**. This decline is evident when comparing the early years (2012-2015) with the more recent period (2020-2022), affecting both total chlorophyll levels and the characteristics (magnitude and duration) of algal blooms. From July to December, there is a consistent absence of algal blooms and generally low chlorophyll levels, though exceptions occurred in 2017 and 2018 with brief but notable blooms from September/October to November. The algal bloom identification methodology detected 46 blooms over the 10-year observation period, highlighting seasonal and yearly variability in chlorophyll concentration.

F



E



E, Weekly Heatmap (2012-2022) of ECO Chl data. Grey color indicates missing data;
F, Monthly Chl data istogram. Green color indicates bloom events

MAIN ISSUES and NEXT STEPS: The significance of these results lies in the long-term, high-frequency, continuous, and high-resolution data collection, which is uncommon in chlorophyll-related environmental studies. Future steps include correlating and integrating chlorophyll concentrations with other environmental parameters from the E1 buoy and in the land-sea continuum to gain a deeper understanding of the processes and dynamics of algal blooms in the NAS.

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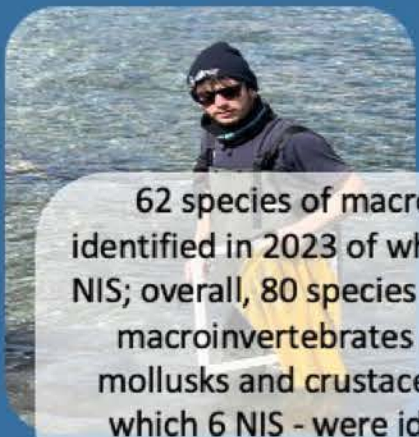
The eLTER sites Mar Piccolo of Taranto and Cabras Lagoon: progress, new activities, and first results

Denti G., Acquaviva M.I., Biandolino F., Caroppo C., Casiddu P., Cecere E., Cherchi M., Giandomenico S., Lugliè A., Manca B., Padedda B.M., Parlapiano I., Pittalis C., Prato E., Pulina S., Rubino F., Satta C.T., Spada L., Stabili L., Petrocelli A.

Mar Piccolo - Taranto

Historical activities

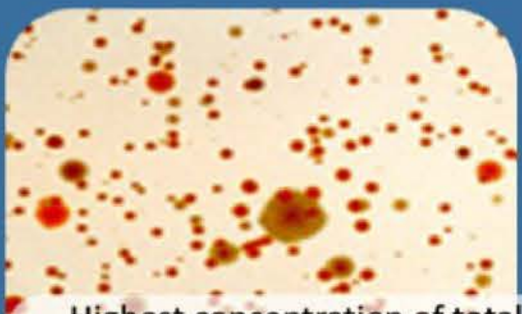
For the whole 2023, the average measured values of temperature, salinity and dissolved oxygen were respectively 20,9±4,7, 38,2±0,8 and 104,3±17,5 in the First Inlet and 21,2±5,3, 37,7±0,7 and 112,7±34,1 in the Second Inlet



62 species of macroalgae identified in 2023 of which 10 are NIS; overall, 80 species of benthic macroinvertebrates (mainly mollusks and crustaceans) - of which 6 NIS - were identified associated to seaweeds

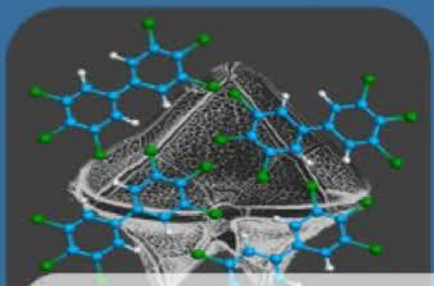
New activities

25 identified taxa producing HABs (NIS: *Pseudo-nitzschia multistriata*, *Ostreopsis ovata*, *Prorocentrum shikokuense*) in 2023



Highest concentration of total coliform (35,7±2,3 MPN/100mL) and *Escherichia coli* (6,8±2,3 MPN/100mL) in the Second Inlet in 2023

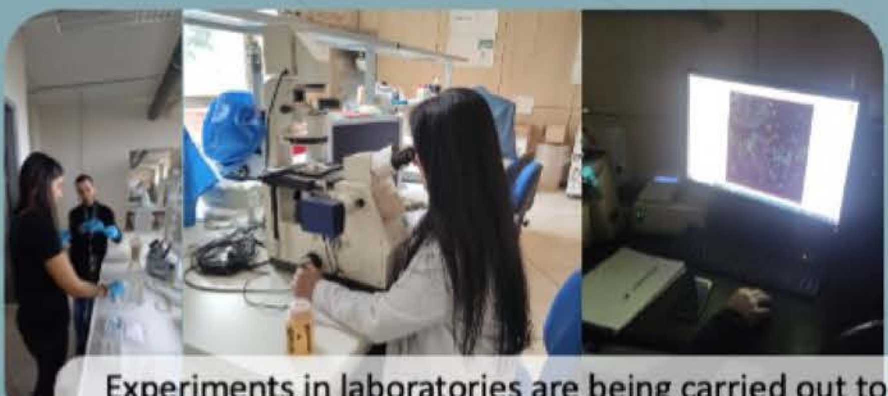
The most representative group of zooplankton observed in 2023 was the Calanoida. The identification to lower taxonomic levels is still ongoing, as well as the identification of resting stages present in the sediment samples



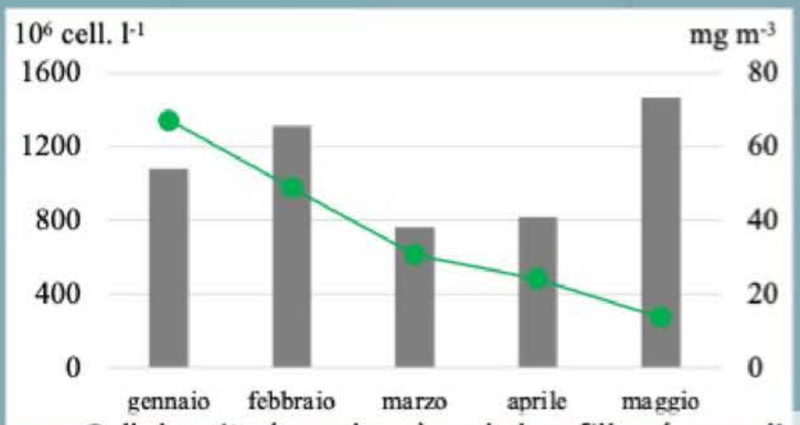
Σ7PCB concentration associated to phytoplankton ranged between the limit of quantification and 3,9 ng/g (dw); the hghest values were measured in July 2023

Cabras Lagoon

Field activities aim to acquire information on: temperature, salinity, pH, dissolved oxygen, transparency, alcalinity, NH_4^+, NO_3^-, NO^- and total nitrogen, reactive and total phosphorus, reactive silica, clorofill *a*, cell density, biovolume, biomass and taxonomic composition of phytoplankton, ciliates, mesozooplankton. Furthermore, the taxonomic composition of plankton is also studied with NextGeneration Sequencing



Experiments in laboratories are being carried out to investigate the effects of rising water temperature on size structure of phytoplankton with and without mesozooplankton



Cell density (grey bars) and clorofill *a* (green line) measured in the first 5 months of 2024

Since 1999, in Cabras Lagoon monitoring activities are conducted. Since the beginning of 2024 such activities are also funded in the framework of the project PRIN 2022 FUTURE.

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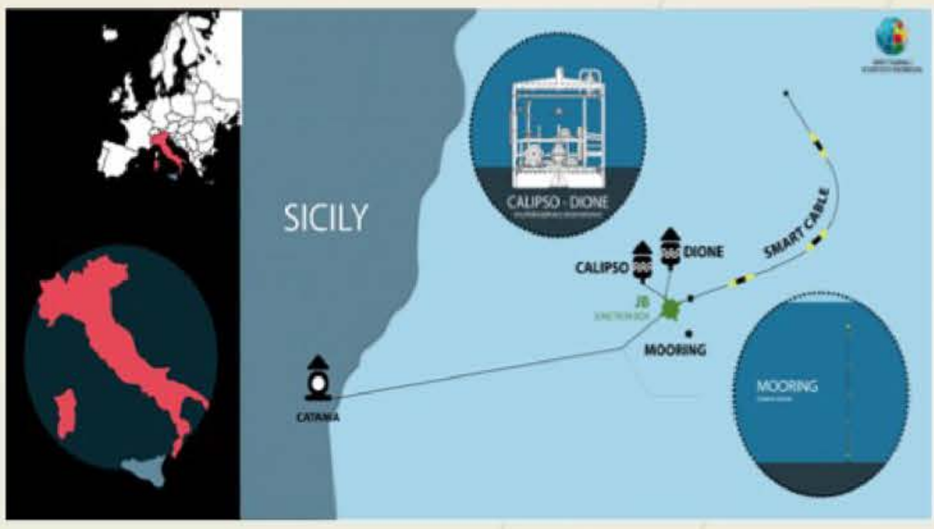
ITINERIS's contribution to EMSO Western Ionian Sea facility

Embriaco D., Beranzoli L., Marinaro G., Simeone F., Bagiacchi P., Giacomozzi E., Vagni R., Lo Bue N., Giuntini A.

Istituto Nazionale di Geofisica e Vulcanologia

The ITINERIS Operation Unit INGV-WIS is engaged in deploying **a new seafloor observation facility at the EMSO Western Ionian Sea (WIS) site,** to provide access on the long-term to equipment from various disciplines of the marine science. The new infrastructure consist of

- **A 33 km long underwater cable** with 3 electricity conductors and 32 fiber optics by Nexsans
- **A Cable Termination Frame** with Medium Voltage Converter from 1500 Vac to 375 VDC and 5kW available power at sea through 6 ROV operable connectors (ODI NRH) at 2100 m water depth
- **A Remote Control Box and Power-supply Equipment** at an existing land station hosted at LNS premises.

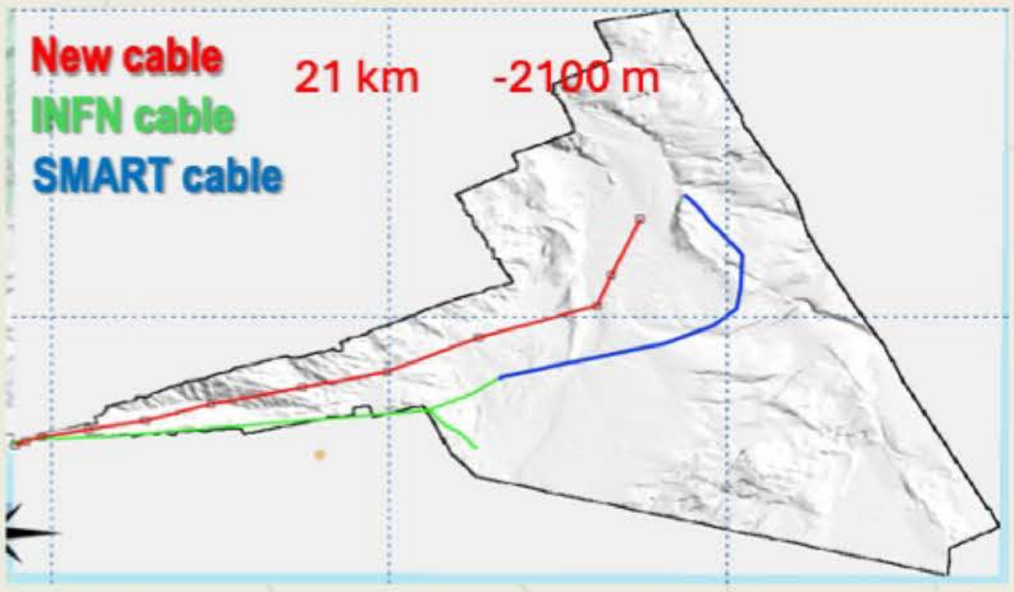


Sketch of the geographic location of EMSO WIS

EMSO WIS is one of the facility of EMSO pan-European research infrastructure, which acquires and delivers long-term data time series and scientific services. EMSO promotes a multi-disciplinary approach in the study of the deep sea environment according to an holistic view. EMSO WIS is managed by INGV, INFN and CNR-ISMAR; it relies on an underwater cable deployed in 2001 off-shore eastern Sicily, reaching about 2100 m water depth.

EMSO WIS presently includes 2 seafloor multidisciplinary cabled observatories (CALIPSO and DIONE); a stand-alone water column mooring; a prototype of SMART cable which incorporates 3 sensor-boxes (Temperature , Ground Acceleration, Bottom Pressure) 6 km a part.

The new observation facility will enrich the configuration of EMSO WIS and will enhance the present hosting capability toward additional sensors/equipment of users from other disciplines and provide new time series in real-time.



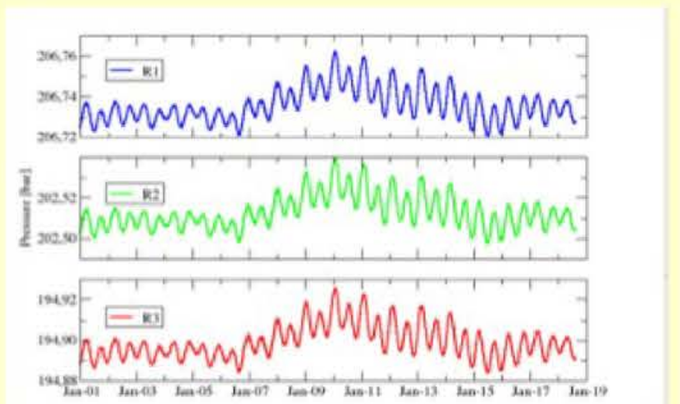
Seafloor map relief as per the survey performed in April 2024 aimed at identifying the route for the new cable

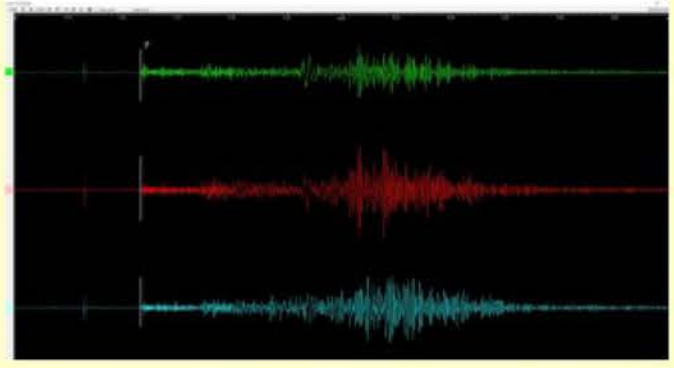
CALIPSO and DIONE seafloor observatories (-2100 m) operate as part of EMSO WIS.

Current Science Objectives at the EMSO WIS facility:

- **geo-hazards monitoring** (tsunami, landslides, seismic and volcanic activity)
- **oceanographic monitoring**
- **environmental monitoring** (e.g., acoustic noise)
- **mammals tracking** (bioacoustics).

Reference author: Davide Embriaco (davide.embriaco@ingv.it)





SMARTCable data (2024): pressure data (right top) and seismological data right). The ground accelerometers of the SMART cable recorded a strong earthquake (Mwpd 7.4) generated eastern Honshu, Japan, 01/01/2024

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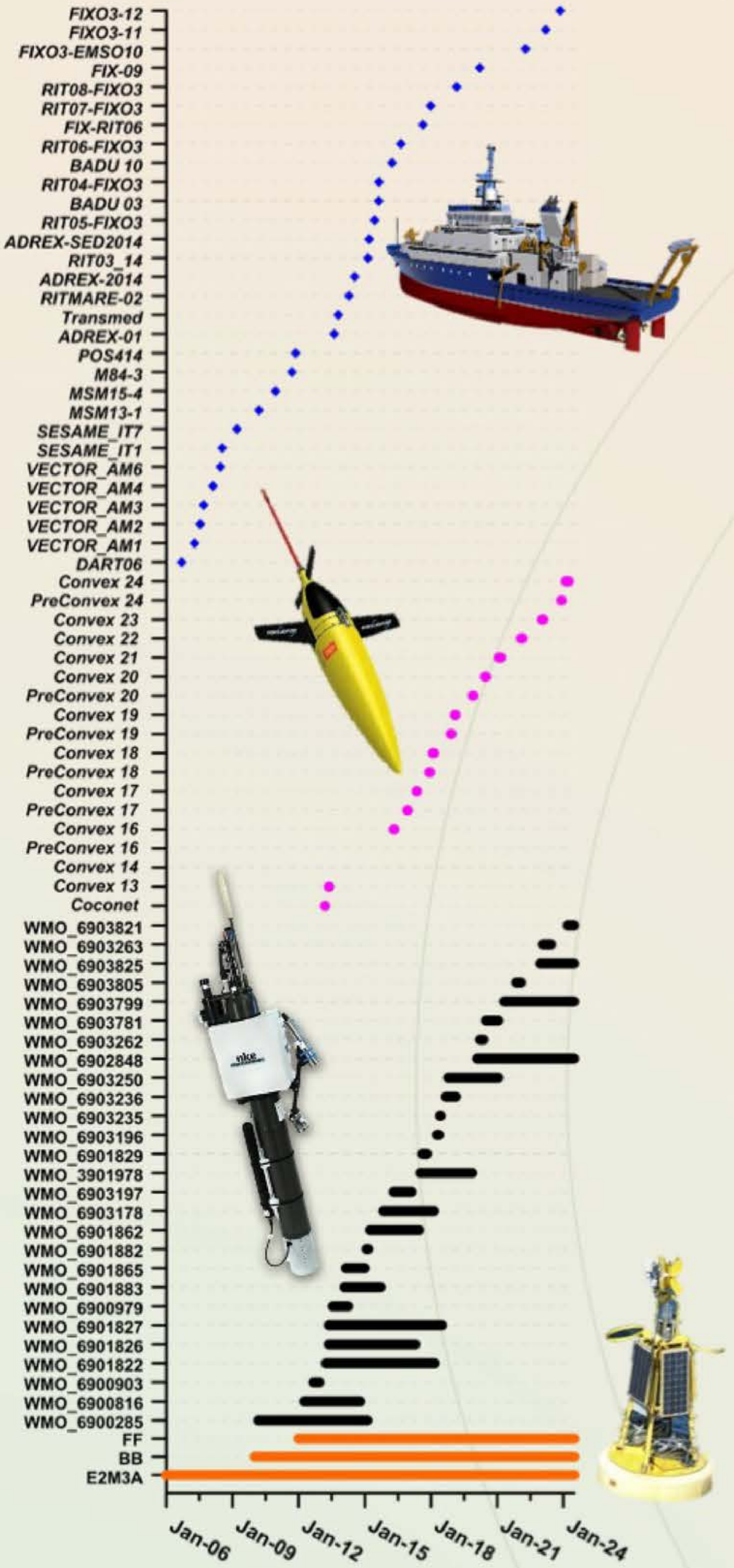
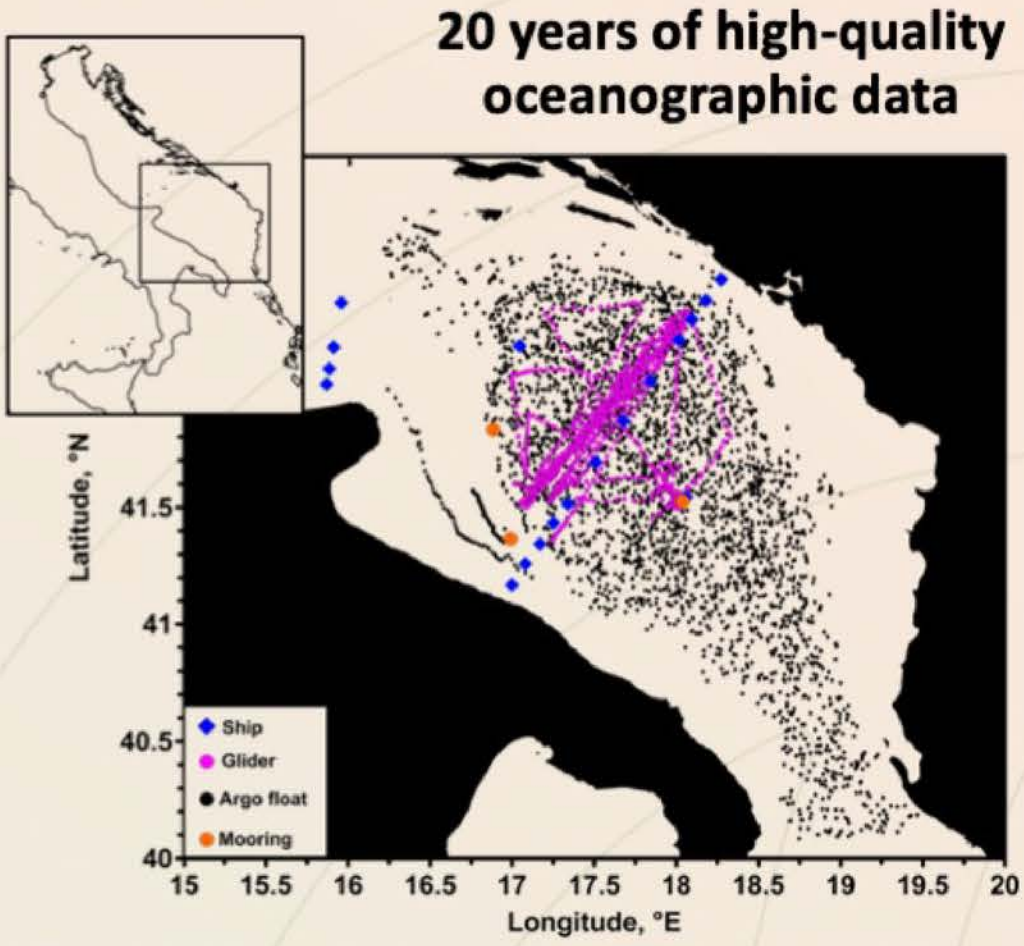
The Southern Adriatic site as an example of cross-infrastructures data integration

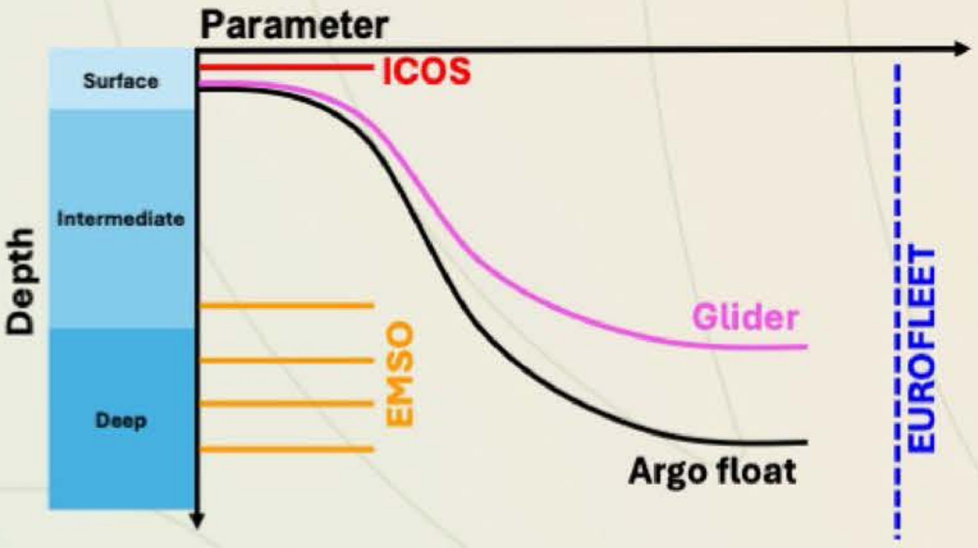
Martellucci R., Mauri E., Pirro A., Paladini de Mendoza F., Miserocchi S., Lo Bue N., Beranzoli L., Kokoszka F., Schroeder K., Giani M., Cardin V.



20 years of high-quality oceanographic data



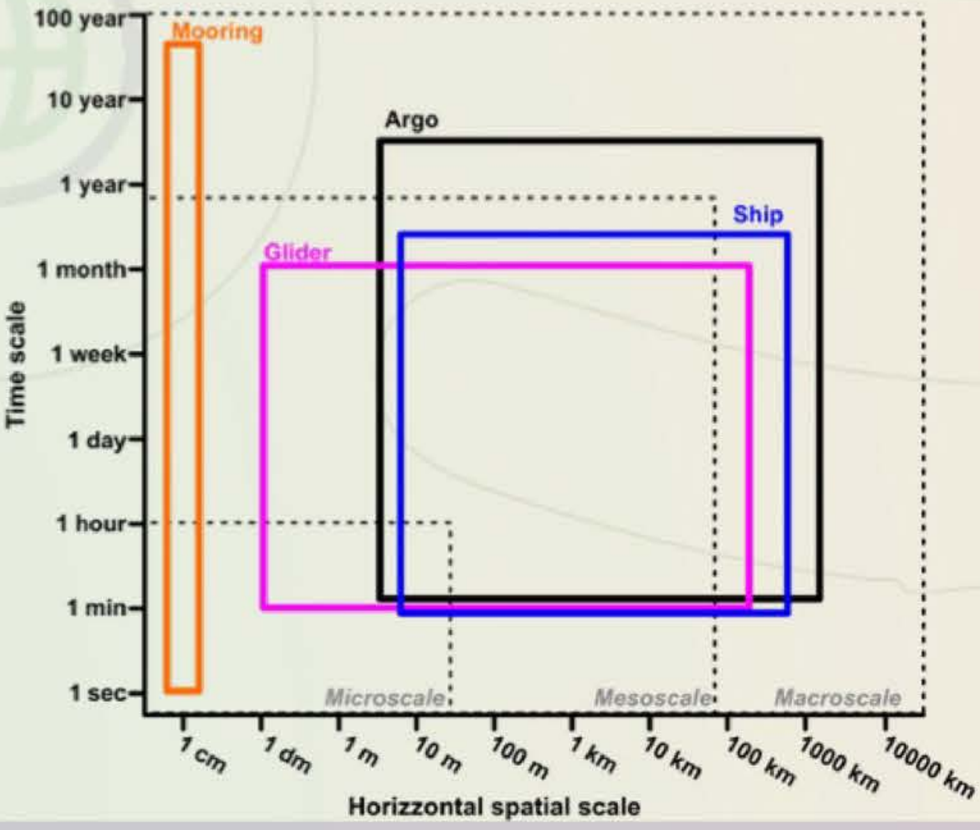
This activity will demonstrate the benefits of integrating cross-infrastructure data (both Eulerian and Lagrangian) by designing a prototype that provides a comprehensive overview (spatially and temporally) of all available observational variables (e.g., temperature, salinity, and oxygen). This integration will offer multidisciplinary information to enhance our understanding of the open sea.



Proposed best practice for multi-platform approach

Element of best practice	Relevant methodology
0. Definition of the process to be investigated	Variables, temporal extension
1. Characterization of the study site	Background analysis based on literature and other available historical data.
2. Multi-Platform Monitoring Systems data collection	Long-term in situ multi-variable time series
3. Consistency analysis among multi-platform datasets	Use of EOFs and multi-variate correlation analysis.
4. Integrated and coherent multi-variate analysis	Spatial interpolation and temporal evolution analysis.
5. Prototype Definition	Definition of a methodology prototype to be exported in other key areas

Coverage domains of the different research infrastructures and platforms



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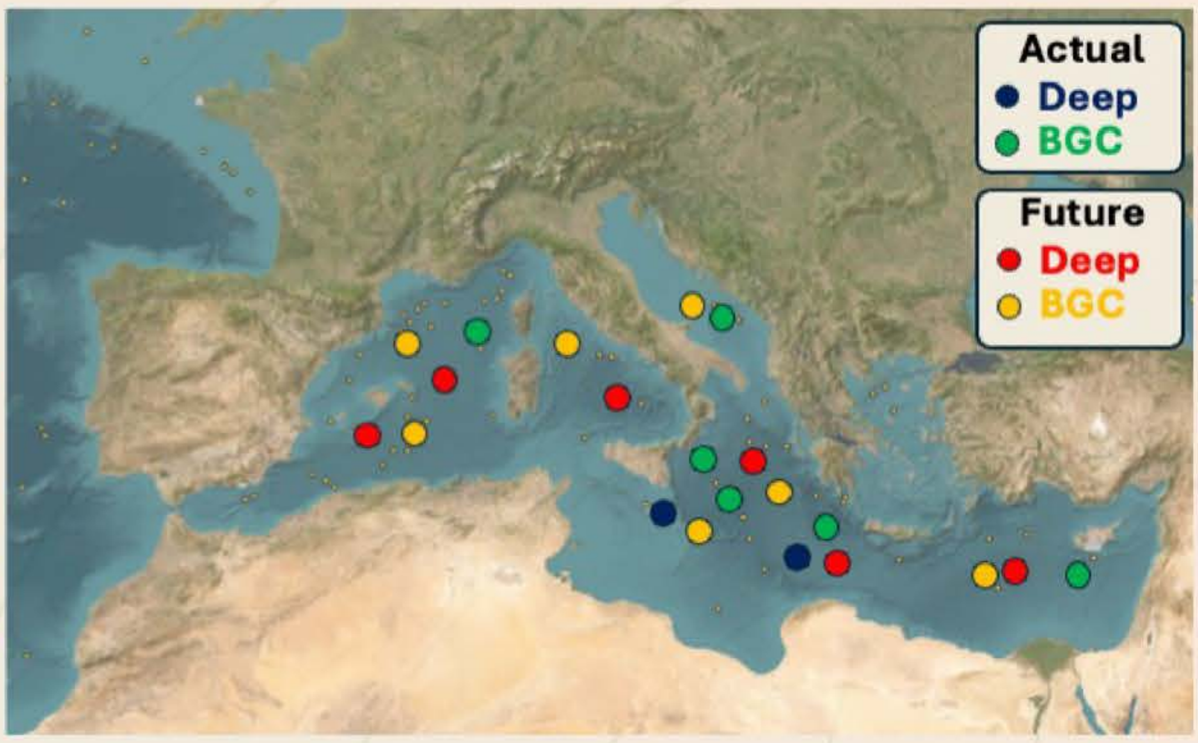
OGS Towards implementing OneArgo

G7 Future of the Seas & Oceans Initiative

Gallo A., Martellucci R., Mauri E., Pirro A., Notarstefano G., Dall'Olmo G.

OneArgo is the extension of the global Argo programme to full-depth and biogeochemical variables that includes polar oceans and marginal seas.



OGS, within the ITINERIS PNRR project, will increase the number of Argo floats in the Mediterranean Sea to high-quality provide data for climate-change studies, operational oceanography and ocean exploration.

Long-term vision: To achieve and sustain OneArgo in the Mediterranean Sea by demonstrating its societal impacts.

Strategy

Biogeochemical Argo

- **Improving resilience**

Alternative sensors:

RBR Tridente (BBP/CHLA):

> resolution

< power

Opus nitrate sensor:

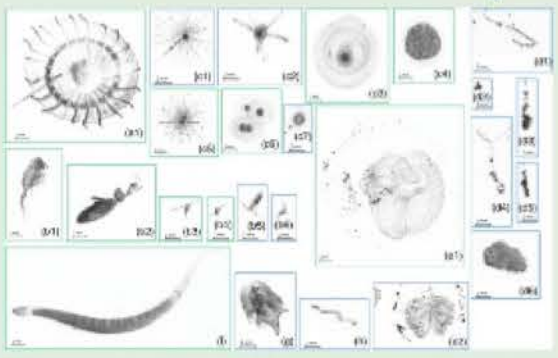
Suna vs. Opus

saving 50%

same performance

- **New science**

Underwater vision profiler

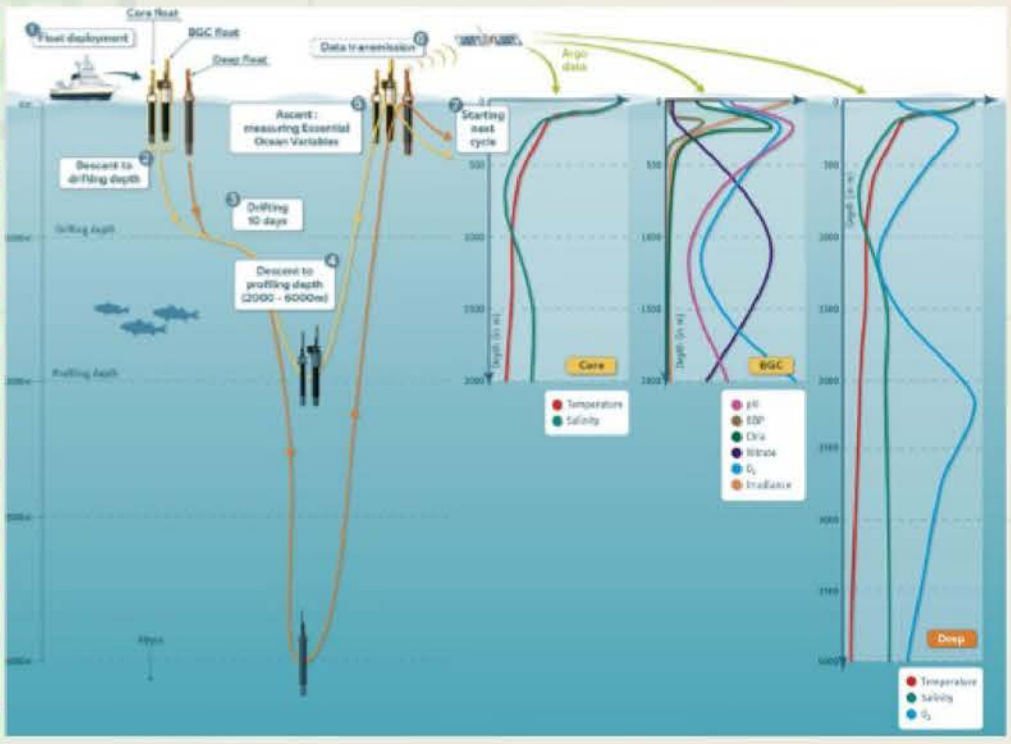


Passive acoustic listener:

"event"-driven mission

Deep Argo

- **Improving** the **deep-water** understanding of the Mediterranean Sea, to study deep water properties, circulation and heat content.
- **Implementing** the delayed-mode quality control **(DMQC)** of the physical variables.



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Spectral light penetration depths unveiled by BGC-Argo radiometric profiles

Giovanni La Forgia and Emanuele Organelli - ISMAR-CNR - Rome

In the ocean, sunlight sustains phytoplankton and primary productivity within the euphotic layer, while just below, within the the dysphotic layer, the remaining light does not support photosynthesis. Despite the gradual transition between the two layers, the boundary between these zones is unclearly defined. To address this issue, we identify the light spectral penetration depth $Z_P(\lambda)$ using in-situ oceanic downwelling irradiance data collected by Biogeochemical (BGC) Argo floats measuring *PAR* (λ = 400-700 nm) and $E_d(\lambda)$ at 380, 412, and 490 nm. Rather than focusing on irradiance values, we statistically analyze the shape of radiometric profiles to develop a real-time quality control algorithm. To determine $Z_P(\lambda)$ for daylight profiles, the algorithm distinguishes the well-lit layer from the lower region where a transition from light to darkness occurs.

Epipelagic community

- Biologically determined Compensation Depth Z_C — photosynthesis equals respiration
- Optical determined Euphotic Depth Z_{eu} — 1% of surface *PAR*
- $Z_{eu} < Z_C$ (Marra et al., 2014)

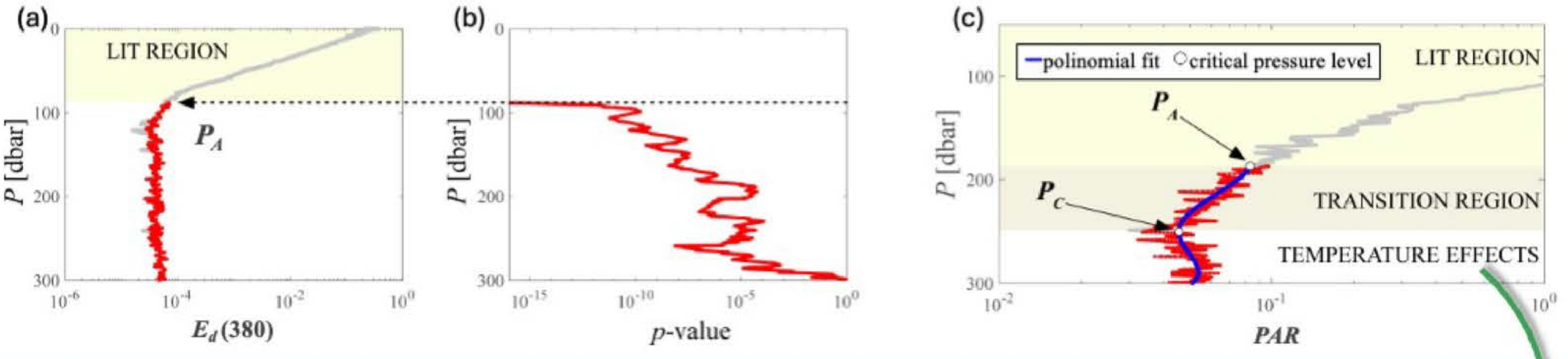
?

Mesopelagic community

- Optical determined Euphotic Depth Z_{dy} — *PAR* ~ 0,1 μmol quanta m^{-2}s^{-1}
- $Z_{eu} < Z_{dy}$ (Kaartvedt et al., 2019)

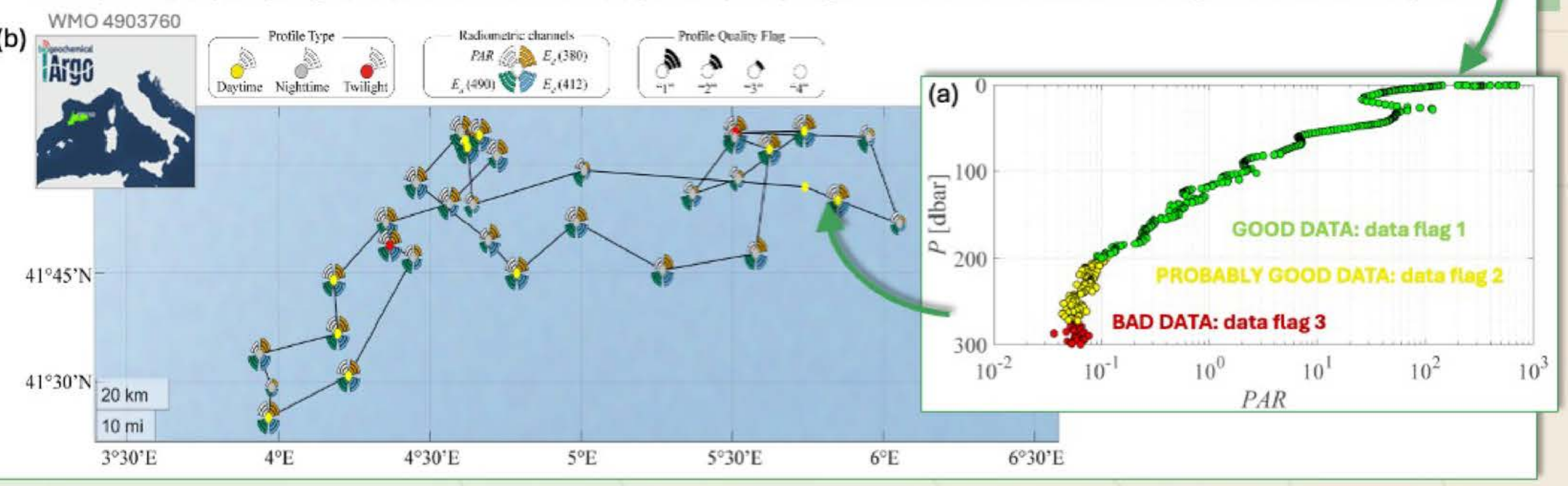
QUALITY CONTROL FOR RADIOMETRIC DATA

Lit region (a) derived from the Shapiro-Wilk normality test (b) and identification of data affected by temperature effects (c).



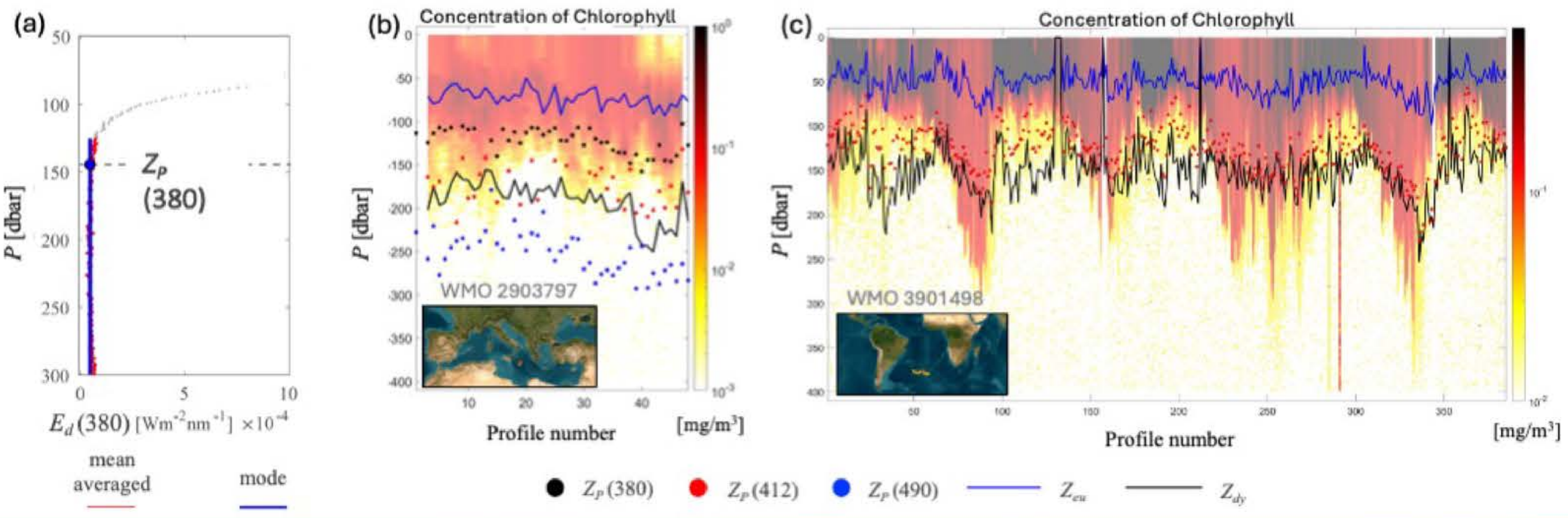
QUALITY CONTROL FOR RADIOMETRIC PROFILES

Example of (a) quality flags (DFs) for *PAR* data and (b) profile quality flags based on DFs distribution along each radiometric profile



SPECTRAL LIGHT PENETRATION DEPTH

(a) Light penetration depth $Z_P(380)$ and (b-c) comparison between $Z_P(\lambda)$, Z_{eu}, Z_{dy} over chlorophyll concentration time series



- The quality control algorithm for BGC-Argo radiometric profiles enabled us the identification of light penetration depth across the different investigated bands within the transition region between light and darkness.
- Beyond downwelling processes, chlorophyll concentration larger than 0,1 mg/m^3 results to entirely develop within the layer identified by $Z_P(380)$. Compared to Z_{eu} (based on *PAR*) it may better represent the region where primary production develops.
- The depth $Z_P(412)$ proves to be an effective parameter for delineating the boundary between the euphotic and dysphotic regions. Thus it can serve as a link between the epipelagic and mesopelagic scientific communities.

References

Marra et al., "Resolving the ocean's euphotic zone," Deep Sea Research Part I: Oceanographic Research Papers 83, 45–50 (2014)

Kaartvedt et al., "Enlightening the ocean's twilight zone," ICES Journal of Marine Science 76, 803–812 (2019)

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Accurate estimation of photosynthetic available radiation from multispectral downwelling irradiance profiles

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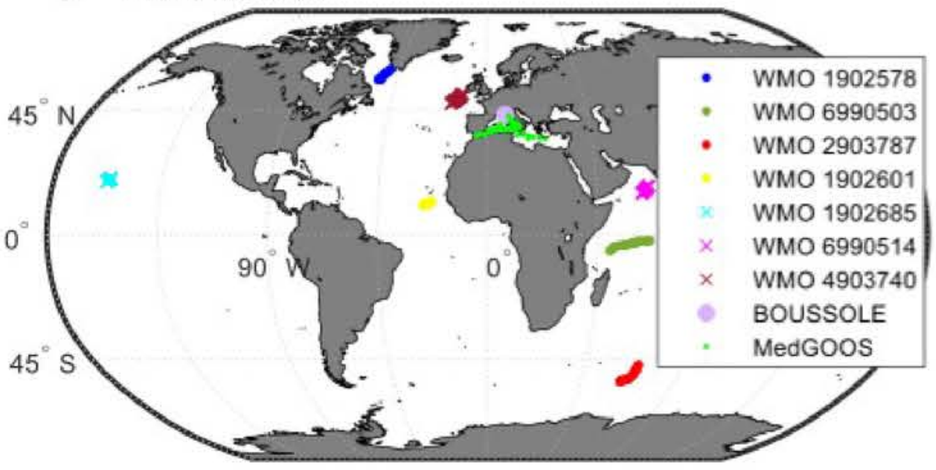
[2] Sorbonne Université, CNRS, Laboratoire d'Océanographie de Villefranche, LOV, Villefranche-sur-Mer, F-06230, France
[3] Sorbonne Université, CNRS, Institut de la Mer de Villefranche, IMEV, Villefranche-sur-Mer, F-06230, France
[4] Sorbonne Université, CNRS, OSU Station Marines, STAMAR, Paris, F-75006, France
[3]University of Florence, Department of Biology, Florence, Italy
*jaime.pitarch@cnr.it

INTRODUCTION

- Photosynthetic available radiation (PAR) is calculated from spectral irradiance measurements
- In principle, one needs the hyperspectral (continuous) spectrum from 400 nm to 700 nm to perform that calculation
- Here, we present a neural network-based algorithm to obtain unbiased par estimates from discrete (multispectral) irradiance
- The algorithm is envisaged for application to BGC-Argo data
- Validation is very satisfactory across many trophic and pelagic areas

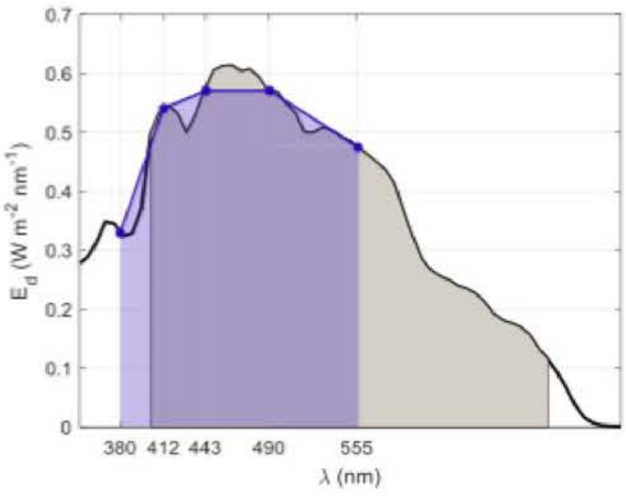
CALIBRATION AND VALIDATION DATA

- Data consists of hyperspectral irradiance spectra from all around the world:
  - BGC-Argo
  - Cruise profiles
  - Fixed-station



PROBLEM

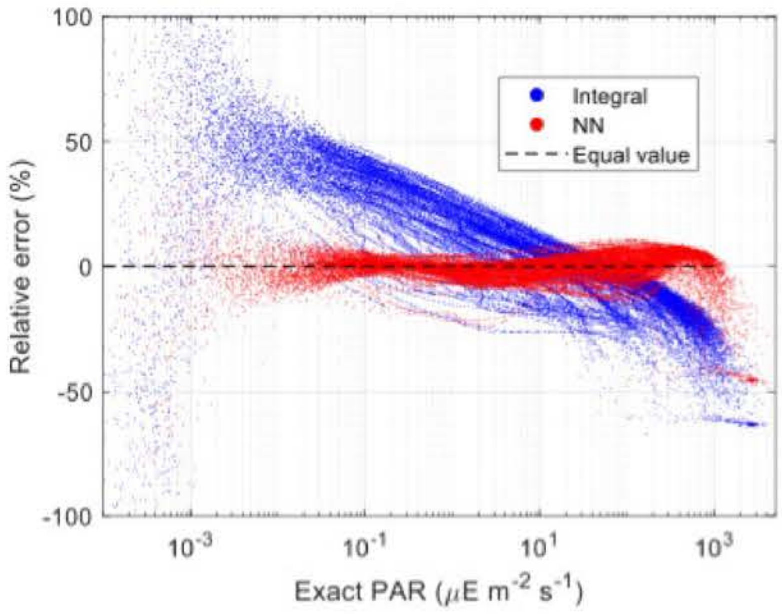
- Numerically integrating a spectrum given the available bands (blue shaded area) biases the true PAR calculation (gray area)



- → We develop an approach, alternative to the integration, to approximate the true value from the available bands

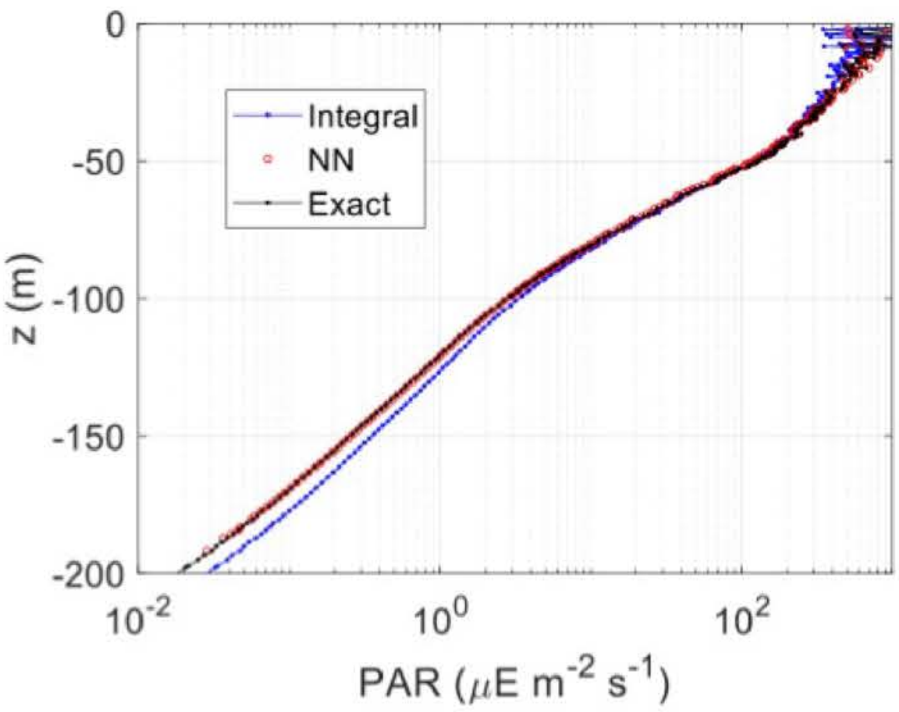
VALIDATION RESULTS

- Numerical integral (blue dots) has large and varying biases across the dynamic range
- Instead, biases are minimal for the neural network approach (red dots)



VALIDATION RESULTS

- PAR profile with the neural network approach agrees very well with respect to the exact one



CONCLUSIONS

- The neural networks consistently outperformed the result of the integration according to our validation results
- Calibration data had a very wide range, preventing from any out-of-range situation in practical applications
- Performance improved when the band configurations covers various regions of the spectrum
- The neural networks are fast, traceable and exportable to any programming language or platform

REFERENCES

- Organelli, E., Leymarie, E., Zielinski, O., Uitz, J., D'ortenzio, F., and Claustre, H.: Hyperspectral radiometry on biogeochemical-argo floats: a bright perspective for phytoplankton diversity, Oceanography, 90-91, 2021.
- Jemai, A., Wollschläger, J., Voß, D., and Zielinski, O.: Radiometry on Argo Floats: From the Multispectral State-of-the-Art on the Step to Hyperspectral Technology, Frontiers in Marine Science, 8, 10.3389/fmars.2021.676537, 2021.

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The R/V Gaia Blu as an acquisition host for environmental measurements: from the installation of the instrumentation onboard, to the data center for archival and online access

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Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine (CNR-ISMAR), Napoli[1], Venezia[2], Trieste[3], Bologna[4], Roma[5], Italy

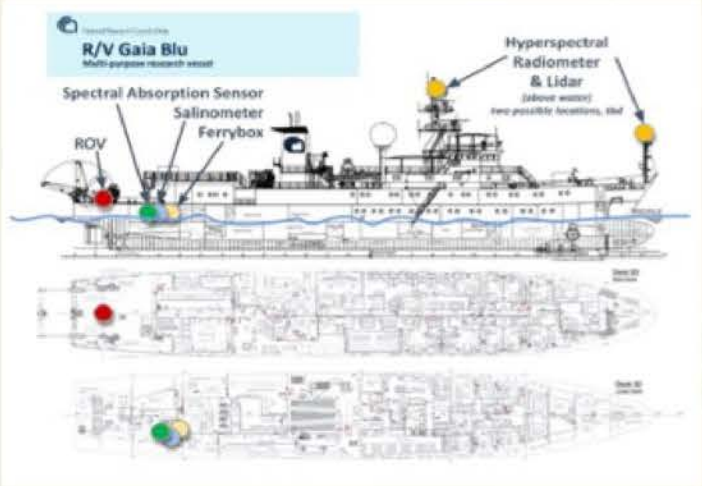
*Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Vesuviano (OV) 80124, Napoli, Italy

The Research Vessel (R/V) Gaia Blu, owned by the National Research Council (CNR), serves as a mobile platform for scientific exploration and data acquisition. It is set to be outfitted with state-of-the-art hardware and infrastructure, aimed at fostering joint research initiatives. These enhancements include advanced communication interfaces, near-real-time data exchange capabilities, data processing units, and comprehensive networking capabilities.
The need to obtain high-quality oceanographic data with high spatial and temporal resolution drives the enhancement of the R/V Gaia Blu's capabilities. This will be achieved through the implementation of continuous acquisition systems, automation of ongoing observations, and improved connectivity for real-time data transmissions. Effective ocean management relies on marine observations collected by national or regional ocean observing systems and networks, whose data is of importance to support climate change research, aids in disaster preparedness, marine policy and conservation efforts, and sustainable management of marine resources.

Fig.1 R/V Gaia Blu

Multi-purpose research vessel

Up to 26 people for the scientific staff and 18 for the maritime crew. Equipped with various laboratories such as the Survey Control Room, the Wet Lab, and the Dry Lab



Scientific Instrumentation will be completed by a set up of various additional instruments

Timeline

Contract Negotiation Phase: June 2024 - September 2024
Definition of Delivery Timelines: December 2024
Installation Phase: January 2025 – March 2025
Compliance Verification: March 2025
Staff Training Program: April 2025

Fig.2 Previsional onboard location of the instruments

Remotely Operated Vehicle (ROV)

The ROV is an underwater, unmanned vehicle, operated and controlled from the R/V Gaia Blu. It is designed for deep-sea operations and is equipped with cameras, sensors, and manipulators for data acquisition and geological and biological sample collection. The ROV's operations are overseen by PU ISMAR-BO.

Fig.3. *ROV SuBastian operated from R/V Falkor (before Gaia Blu)*

Hyperspectral Radiometers

These instruments capture continuous hyperspectral radiometric data above water, spanning a spectral range of 350 to 900 nm. Designed for autonomous use, they allow measurements in the absence of an operator and data transmission in near-real-time. Management of the Hyperspectral Radiometers is the responsibility of PU ISMAR-RM.

Spectral Attenuation, Absorption & scattering Sensors

These sensors perform underway measurements of the ocean's inherent optical properties, providing insights into water quality, phytoplankton distribution, and ecosystem health. Their autonomous operations allows for automatic data acquisition with low operator involvement and near-real-time data transmission. The IOPs sensors are under the stewardship of PU ISMAR-RM.

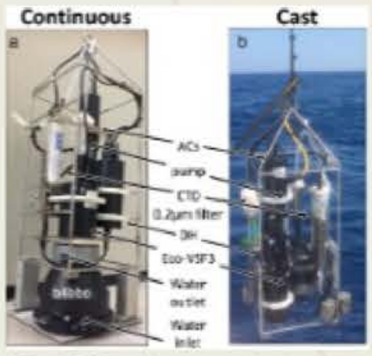


Fig. 4. *IOP package operating in continuous and cast modes, with sensors labeled (Volpe et al., Lim&Oc Methods, 2021)*

Light Detection And Ranging (LIDAR)

This instrument with its 3D scanning capability provides profiles of atmospheric and marine geophysical variables. It emits a pulsed laser beam at 355 nm and acquires the signal in 5 channels: 2 for the co and cross-polarized elastic backscattering signals at 355 nm, 2 for the Raman backscattered signals at 387 and 405 nm and 1 for the fluorescence signal at 450 nm. The estimated marine variables are:

- ❑ chlorophyll-a concentration
- ❑ particulate backscattering coefficient
- ❑ depolarization ratio of ocean waters
- ❑ diffuse attenuation coefficients of downwelling irradiance
- ❑ colored dissolved organic matter (CDOM) concentration.

It allows measurements in the absence of an operator and data transmission in near-real-time (i.e. less than 24 hours from the end of the measurement). Management of the LIDAR system is the responsibility of PU ISMAR-RM.

Fig. 5 *Example of Ferrybox*

Ferrybox

An automated data acquisition system, the Ferrybox is engineered for continuous data collection aboard the R/V Gaia Blu. It autonomously analyzes a variety of sea surface water parameters during navigation, including salinity, temperature, dissolved oxygen, high precision spectrophotometric pH, pCO2 and integrates them with the navigation system. It is designed to integrate other sensors (e.g. chlorophill, turbidity) and to host temporary instrumentation and collection of discrete samples. Integrated data are visualized and delivered in real time. The Ferrybox is managed by PU ISMAR-TS.

Salinometer

This high-precision, semi-portable instrument is utilized for offline salinity verification, complementing the Ferrybox's underway readings. It plays an important role in ensuring the accuracy and quality of the underway salinity data. The Salinometer's operations are managed by ISMAR-VE.

Fig. 6 *Example of salinometer used onboard during the campaign Pioneer (11/2023)*

Fig. 7. *3D scanning lidar system*

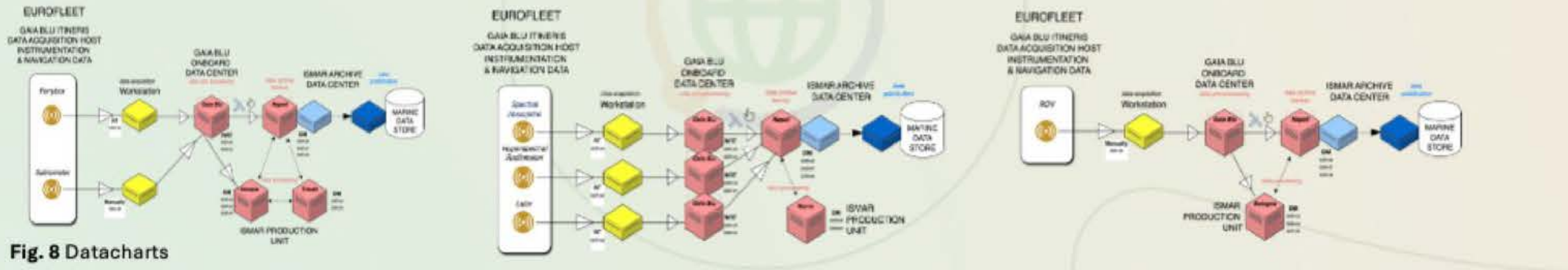


Fig. 8 Datacharts

Dataflow

From acquisition to transmission to the datacenter

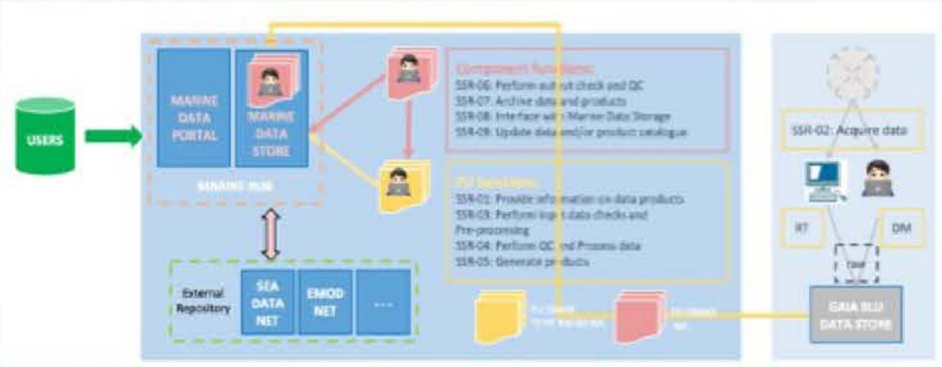


Fig.9 Dataflow line involving the different Sub-System Requirements (SSR)

Data Center & Web Access (ISMAR NA)

LONG-TERM STORAGE / Tape Library
(2 PB on line + 2 PB off line)
SHORT-TERM STORAGE / "Traditional Access" (~ 1,191 PB)

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Evaluating OMA Gap-Filling Performance in Coastal HF Radar System Using Drifter Data in the Ligurian Sea

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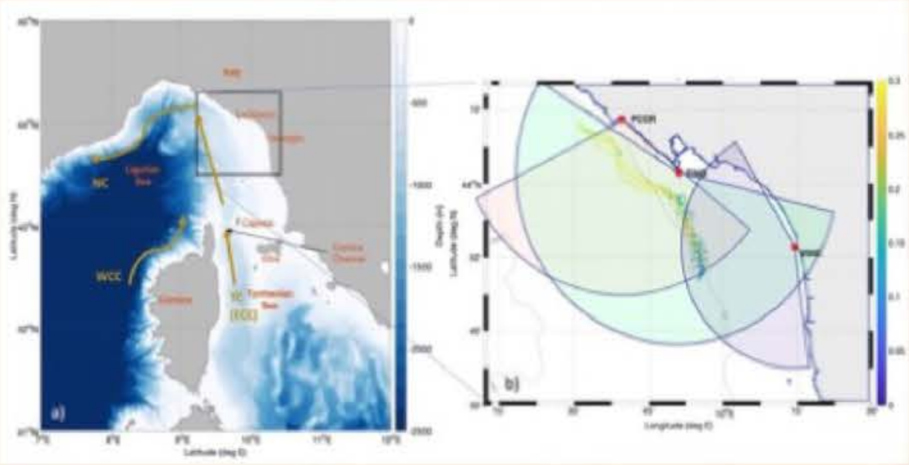
[b] Universite de Toulon, Aix-Marseille Univ., CNRS/INSU,IRD,MIO, Toulon, 60584, CS, France

Objective

High-frequency radars (HFR) are essential in ocean observing systems as they provide high-resolution ocean surface velocity data in extended coastal areas. They produce total velocities, by combining the radial vector velocities in regions covered by at least two radars.

This study assesses the HFR-TirLig network in the NW Mediterranean Sea, using gap-filling open boundary modal analysis (OMA) and in-situ drifter data.

Until 2020, the network has been consistently based on 3 radars, however only 2 of them were active during the experiment, requiring analysis of an area with data from just one radar.



Approach

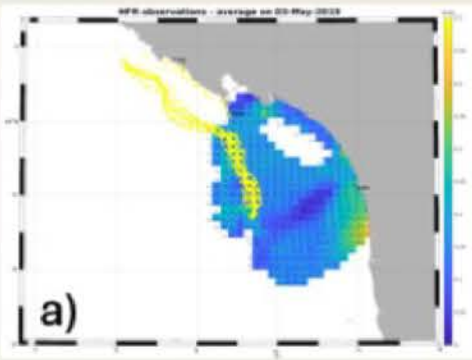
HFR data

Operation and Signal Acquisition: Direction-Finding-type radars.

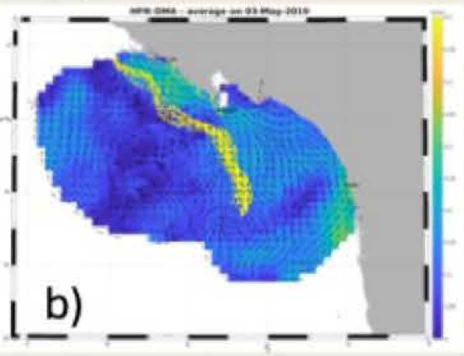
•**Signal Analysis :** Codar SeaSonde Radial Suite software using an optimized version of the MUltiple Signal Classification (MUSIC) algorithm.

OMA

OMA is used to fill spatiotemporal gaps. Its power consists in its ability to incorporate the flow across open boundaries with no priori knowledge of normal velocity [1].

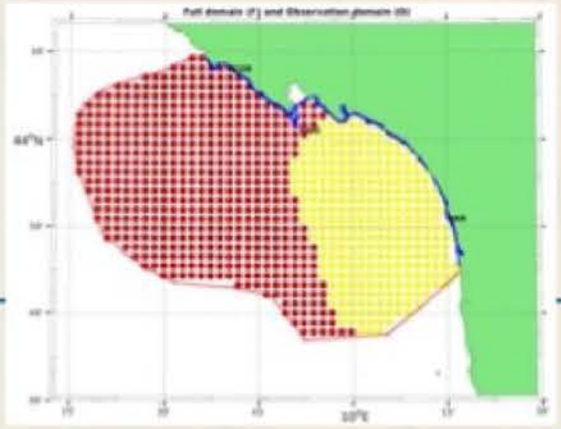


The OMA output is a set of time and data-independent modes that are used to interpolate velocities on arbitrary domains. These modes depend on the geometry of the boundary and do not change in time[1].



a) daily-averaged combined total velocity field and b) daily-averaged OMA-gap filled total velocity field.

Site Code	VIAR	TINO	PCOR
Central Freq.	26.275 MHz	26.275 MHz	26.275 MHz
Bandwidth	150 kHz	150 kHz	150 kHz
Totals grid res.	2 km	2 km	2 km
Vertical samp. res.	50 cm	50 cm	50 cm
Radial output	60 min	60 min	60 min



Drifter data

40 CARTHE drifters designed to sample the first 60 cm.
Launched in regular grid (6 km with 1 km step).
GPS position every 5 min with 5-10 m accuracy.

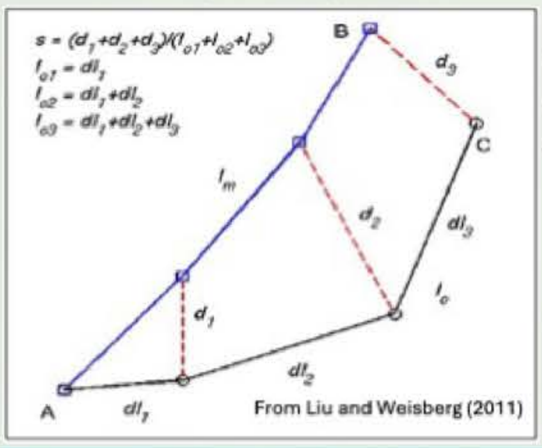
Results

Lagrangian Comparison

Drifters are used to validate HFR OMA total vectors by comparing Virtual Drifter (VD) with Real Drifter (RD) trajectories.

VDs are computed using the gap-filled OMA hourly surface velocity fields using a fourth-order Runge-Kutta scheme for the integration process [2].

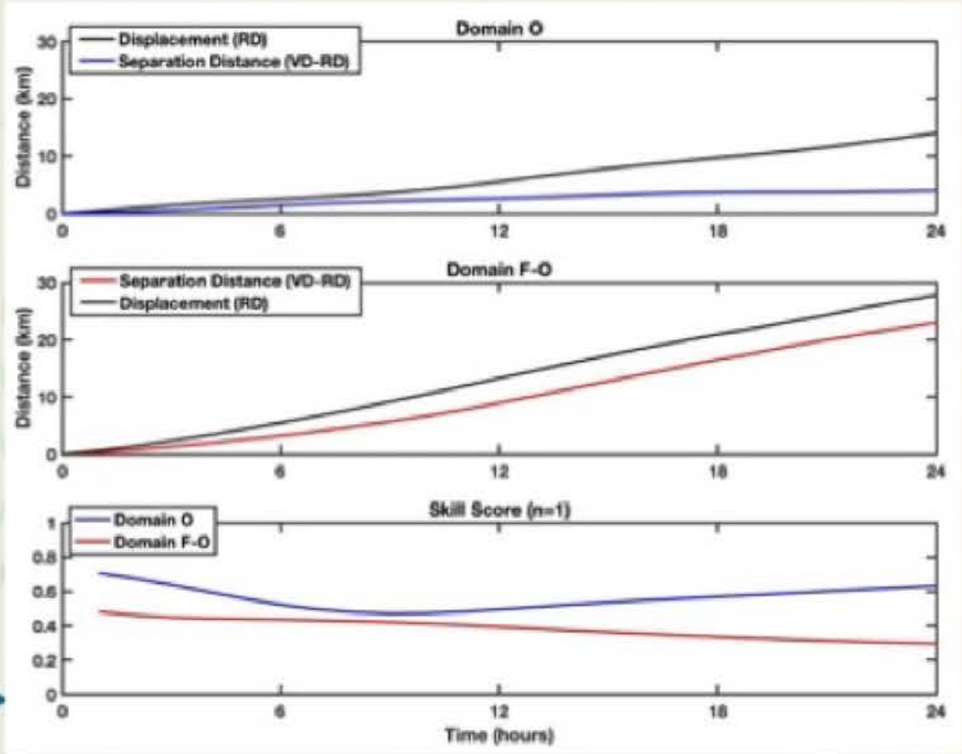
Results for the mean separation $d(t)$ are presented together with the mean displacement covered by the drifters for the O and F-O domains respectively.



Hourly Skill score (SS) metric is used, as a normalized and cumulative measure of the distance between VDs and RDs.

$$NCLS = \frac{\sum_{i=1}^{M} d_i}{\sum_{i=1}^{M} lo_i},$$ [3]

$$SS = \begin{cases} 1 - \frac{NCLS}{n}, (NCLS \leq n), \\ 0, (NCLS > n), \end{cases}$$



Discussion

Lagrangian diagnostics are especially relevant for practical applications involving the prediction of surface drift and provide an integrated performance assessment since the error is integrated in time.

Excellent performance in domain O, and significantly reduced performance in F-O, as expected, but a reliable performance for the first hours. There is also noticed a strong dependence of SS on the time horizon [4].

Overall the use of OMA gives positive results in areas with adequate coverage and encouraging results in areas with extreme gaps.

References

- [1] Kaplan, D.M.; Lekien, F. Spatial interpolation and filtering of surface current data based on open-boundary modal analysis. *J.G.R.-Oceans* **2007**, *112*, C12007. https://doi.org/doi.org/10.1029/2006JC003984
- [2] xl. I. Rypina and A. R. Kirincich and R. Limeburner and I. A. Udovydchenko. Eulerian and Lagrangian Correspondence of High-Frequency Radar and Surface Drifter Data: Effects of Radar Resolution and Flow Components. *Journal of Atmospheric and Oceanic Technology* **2014**, *31*, 945–966. https://doi.org/10.1175/JTECH-D-13-00146.1.
- [3] Liu, Yonggang and Weisberg, Robert H.. Evaluation of trajectory modeling in different dynamic regions using normalized cumulative Lagrangian separation. *Journal of Geophysical Research: Oceans* **2011**, *116*. https://doi.org/https://doi.org/10.1029/2010JC006837.
- [4] Révelard, Adèle and Reyes, Emma and Mourre, Baptiste and Hernández-Carrasco, Ismael and Rubio, Anna and Lorente, Pablo and Fernández, Christian De Lera and Mader, Julien and Álvarez-Fanjul, Enrique and Tintoré, Joaquín. Sensitivity of Skill Score Metric to Validate Lagrangian Simulations in Coastal Areas: Recommendations for Search and Rescue Applications. *Frontiers in Marine Science* **2021**, *8*. https://doi.org/10.3389/fmars.2021.630388.

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A clustering approach to characterize ocean dispersal in non-homogeneous environments: methodology and applications

Lagomarsino-Oneto D.[1], De Leo A.[2], Stocchino A.[2,3], Cucco A.[4], Merlino S.[1], Bianucci M.[1], Berta M.[1], Sciascia R.[1], Magaldi M.G.[1]

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PRELUDE: TURBULENCE is a chaotic phenomenon that spread substances (e.g. pollutant, nutrients and larvae) in environmental flows. Turbulent dispersion is often analysed under the strong assumption of homogeneous, isotropic and stationary (HIS) turbulence but this hypothesis is rarely met in real world. Many efforts have been done to overcome this limitation, trying to collect trajectories with similar dynamics in order to obtain more accurate evaluations of turbulent diffusion coefficients and time scales involved in the dispersal process. Under HIS hypothesis the theory is well established (Taylor 1921) and shows that the whole statistical information about the dispersion process is brought by the velocity autocorrelation functions (VAF) $\mathcal{R}_{uu}$ ($\mathcal{R}_{vv}$)

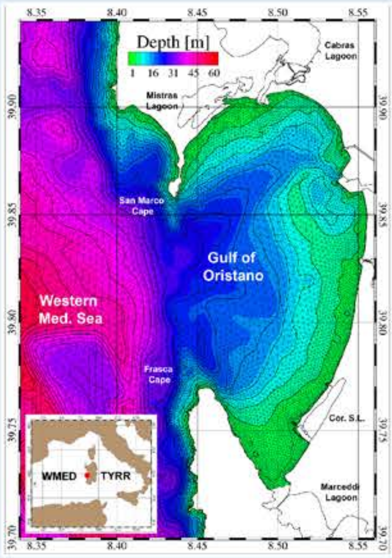
$$\mathcal{R}_{uu} = \frac{\rho_{uu}(\tau)}{\sqrt{\rho_{uu}(0)\rho_{uu}(0)}} \quad \text{where} \quad \rho_{uu}(\tau) = \langle u(t)u(t+\tau)\rangle$$

(with analogue definitions for the v velocity component)

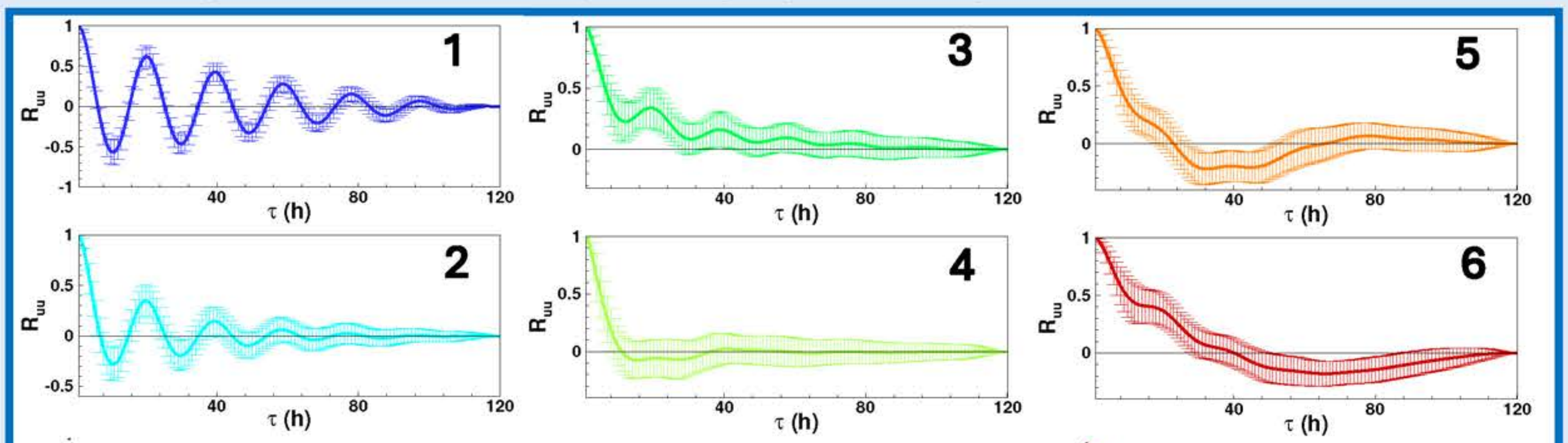
MAIN IDEA: In *Lagomarsino-Oneto, D., De Leo, A., Stocchino, A., & Cucco, A. (2024). Unraveling the non-homogeneous dispersion processes in ocean and coastal circulations using a clustering approach. Geophysical Research Letters, 51, e2023GL107900.* we used **CLUSTERING** techniques to identify, in a completely **DATA-DRIVEN** way, ensembles of trajectories that show similar VAF. Such ensembles (clusters) can be view as homogeneous in terms of dispersion.

Characterization of Coastal Dispersal: the case of Oristano Gulf (Lagomarsino-Oneto et al. 2024)

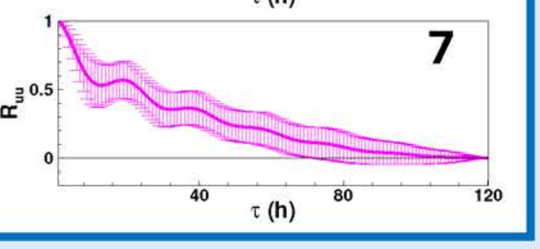
We developed this methodology for the COASTAL case study of the Oristano Gulf. We simulated 1 year of hourly sampled hydrodynamic fields with the SHYFEM model. We then initialized trajectories every 5 days along the year, from points on a regular 2D grid with stepsize of 100 m, resulting in 420700 simulated trajectories grouped in 72 sequences (simultaneous initializations).

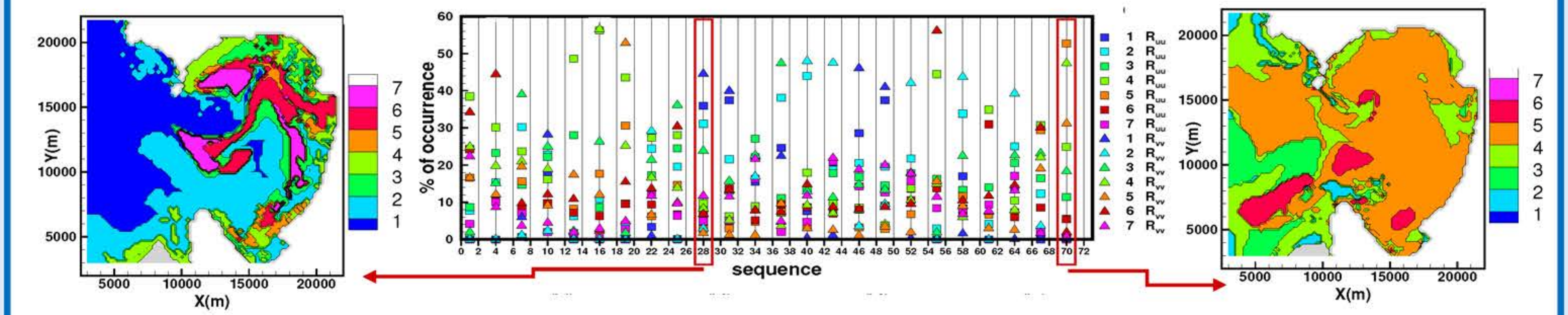


The study area and its bathymetry

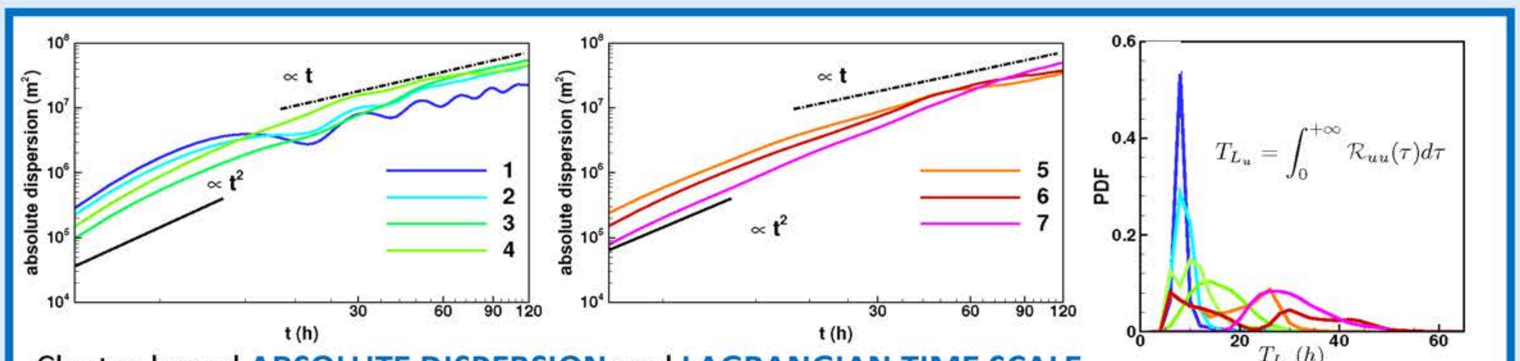


AUTOCORRELATIONS of the u-component averaged over each identified cluster. Features studied in previous works (e.g. looping trajectories, negative lobes, exponential decay) are automatically detected. Similar shapes are also found for the v-component.

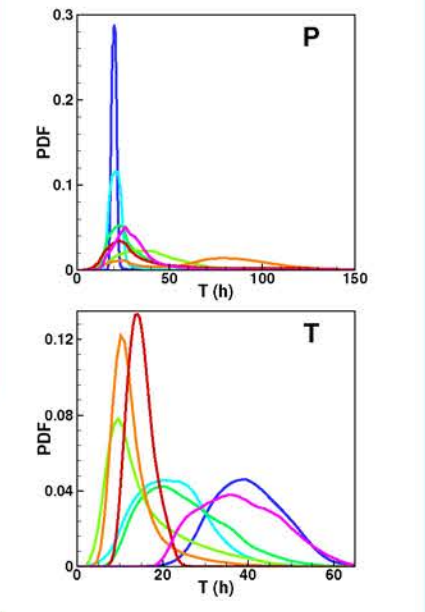




SPATIO-TEMPORAL CHARACTERIZATION OF THE AREA Associating the initial condition (time and position) of each trajectory with the corresponding label (1 to 7) we evaluated the abundance of each cluster along the year (middle panel) and across space (left and right maps show the distribution of $\mathcal{R}_{uu}$ clusters for two initialization times, indicated as sequences). Furthermore, beside the domain characterisation, this analysis also allow to correlate dispersal scenarios with the main forcing processes (e.g. the wind).

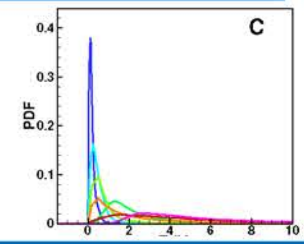


Cluster based **ABSOLUTE DISPERSION** and **LAGRANGIAN TIME SCALE**



ANALYTICAL EXPRESSION for the VAF that fits well all detected shapes. It is defined by three parameters (two time scales T, P and a non dimensional coupling constant C)

$$\mathcal{R}_{uu}(\tau) = \frac{e^{-\tau/T}(\cos\frac{2\pi}{P}\tau + C)}{1 + C}$$



PERSPECTIVES This data-driven technique has showed a good capability of describing non - homogeneous environments, also preserving explainability of results (which is a difficult to have in many powerful AI techinques). Our future efforts will be devoted to apply our method to real world trajectories. A particular application is that of a special class of drifters whose shapes are designed to mimic plastic marine litter (right picture), which is particularly sensitive to the action of wind. This technique can help uderstanding how winds affect complex dispersal scenario of floating litter.

Annual meeting - Roma - 9-10/07/2024

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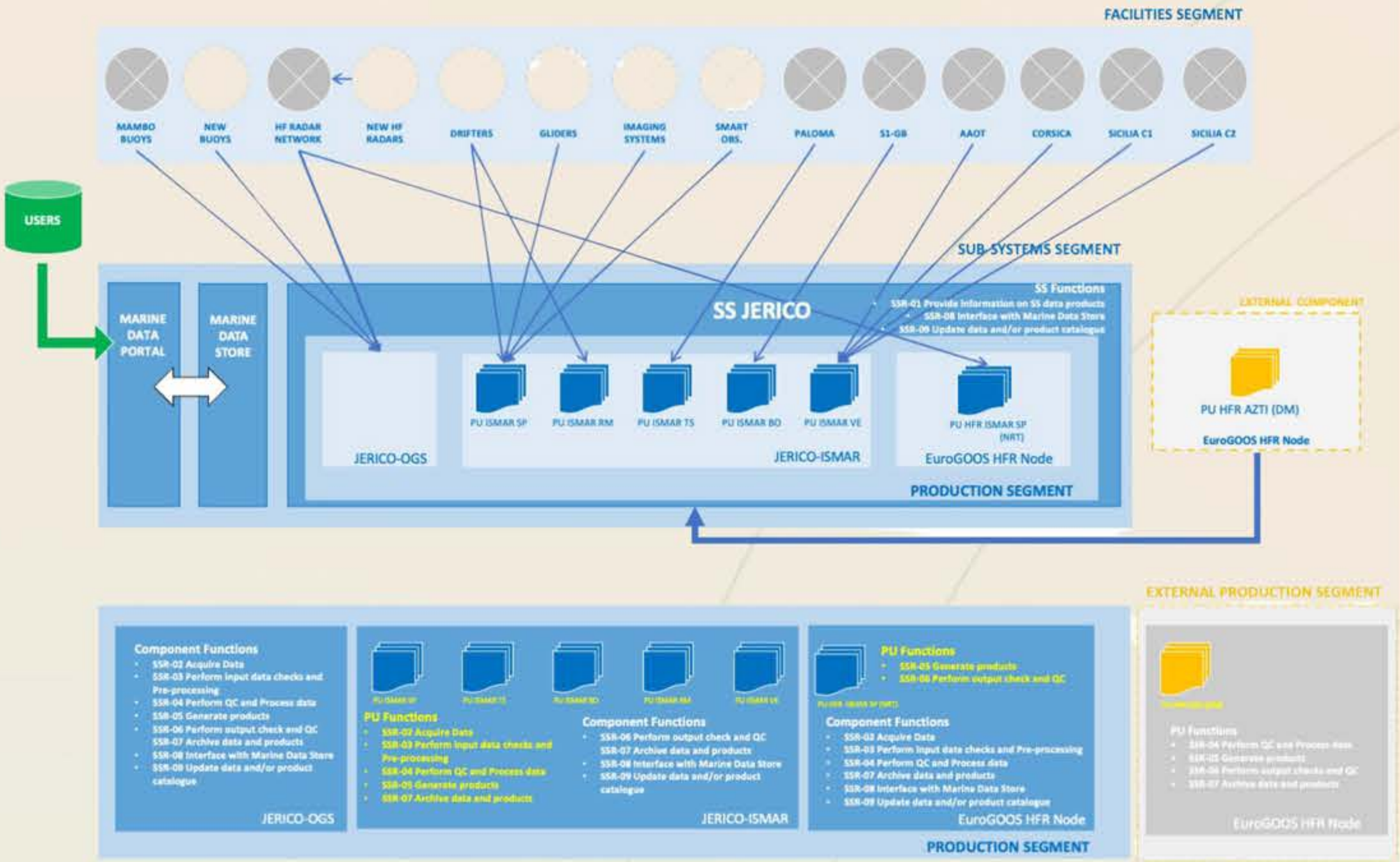
HYPER-CONVERGED INFRASTRUCTURE FOR A NEW RESEARCH NETWORK

Tagliavini R., Di Macco A., Chiappini C., Corgnati L.P., Mantovani C.

JERICO Architecture



Within the design of the Italian Integrated Ocean Observing System (IT-IOOS), The **JERICO** sub-system (SS) aims at being the future coastal component of the national ocean observing effort, as part of the IT-IOOS.

Through multidisciplinary observations, the **JERICO** sub-system will thus improve the knowledge on how national coastal marine systems respond to global and local drivers.

Within **JERICO** sub-system, the ISMAR SP & HFR ISMAR SP PUs, and JERICO-ISMAR & EuroGOOS HFR Node components collect data either directly from observing facilities and processed data from other **JERICO** PUs and guarantee the data flow towards the Marine IT-IOOS Data Store.

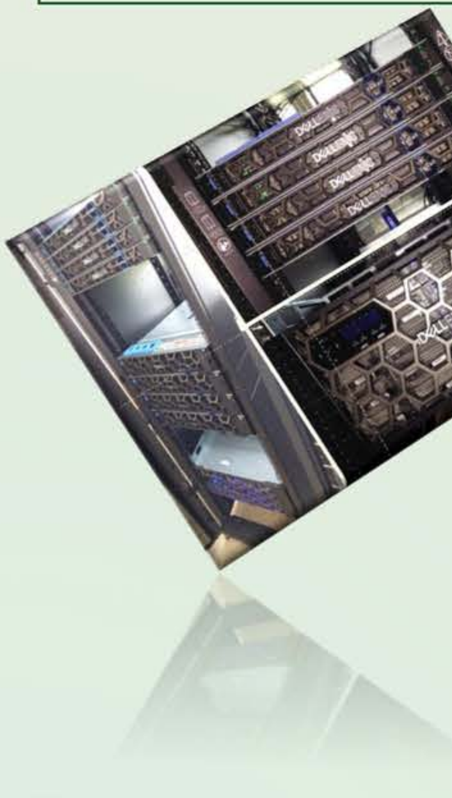
A suitable IT infrastructure supports the **JERICO** data flow.
DELL Powerscale A300 storage unit:

- 50TB of disk-space allocated for **JERICO** data, accessible through common network protocols;
- 4 nodes each one equipped with Intel Bronze CPU 1.9GHZ/6C, RAM 96GiB, 15 HDD 4TB SATA Enterprise;
- distributed fully symmetric clustered architecture that combines modular storage with **OneFS** operating system;
- almost unlimited scalability in terms of potentially available space;
- software tools for optimization and data protection (no single point of failure, FlexProtect file-level striping with support for N+1 through N+4 and mirroring data protection schemes);
- fast and flexible one-to-many file-based asynchronous replication between similar clusters located in other ISMAR labs (namely Bologna and Venezia);
- Suitable data transfer routines available for ALL **JERICO** SS Pus;

A hypercoverged system, based on DELL **VxRail** appliance and VMWare virtualization software:

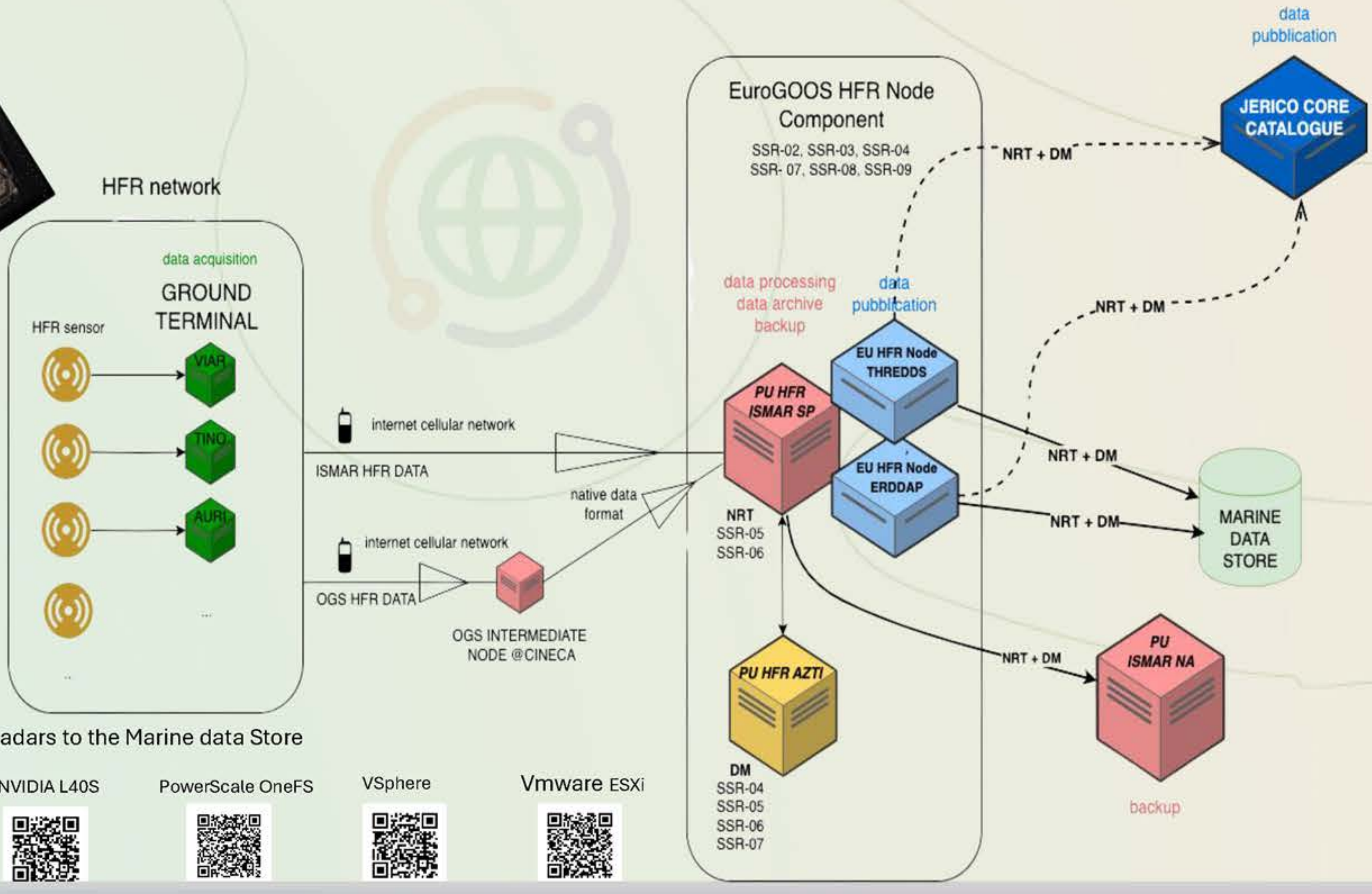
- complementary virtualized environment for running virtual machines (typically based on Ubuntu Linux Operating System) in high availability configuration;
- flexible computational resources, including GPUs suitable for AI workloads;
- running data processing scripts and services for data access and visualization (data servers THREDDS and ERDDAP, and MySql database);
- up to 2,5TB of RAM, 384 core (12 CPU Intel Xeon Gold), 4 GPU Nvidia L40S.

All the systems are located in a proper server room at the ISMAR lab in Lerici (SP) with air conditioning, GARR fiber channel connectivity and power supply redundancy.



Cluster-SP-ISMAR - *layout*

JERICO HFR Data Flow



JERICO SS: data flow from High Frequency Radars to the Marine data Store

VxRail | VxRail E600F | VxRail VP-760 | NVIDIA L40S | PowerScale OneFS | VSphere | Vmware ESXi

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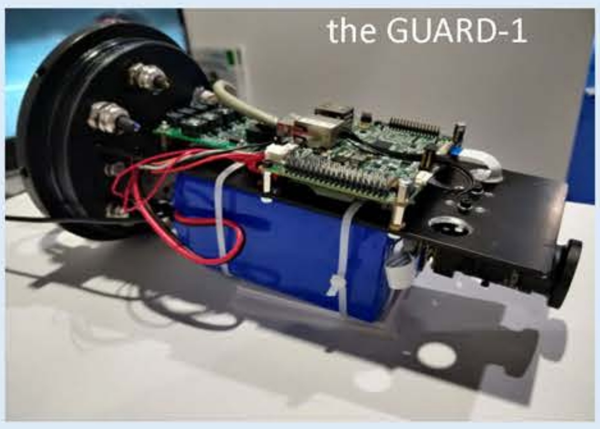
Testing and setting up the GUARD-1 device in different environmental conditions

authors: Boccacci A., Lagomarsino-Oneto D., Marini S.
National Research Council (CNR) – Institute of Marine Sciences (ISMAR), La Spezia, Italy



The **GUARD-1** is a standalone – autonomous – intelligent imaging system for underwater studies

Our **GOAL** is to set up the GUARD-1 in very different scenarios and make it able to autonomously tuning its operational flow to provide the more informative visual data for diverse applications and phenomenon →

- Eutrophication
- Non-indigenous species
- Biological diversity
- Marine Litter
- Commercial fish/ shellfish
- Elements of Marine Food Webs
- Sea floor integrity

For each application we face general and specific **CHALLENGES**

corrosion	biofouling	smart aquisition
power supply	structural stress	setup/ maintenance
lighting	extreme events	data stream/storage

MUSSEL FARMING in LA SPEZIA

The GUARD-1 can significantly help in the monitoring and maintenance of many economic activities. Since last year it has been placed in a mussel farm in the Gulf of La Spezia to observe which species are causing severe damages to the production. The presence of suspended particulate requires particular care in setting the lighting to preserve the image quality.


Fish grazing mussels in the La Spezia farm

SHALLOW → DEEP

ALBORAN SEA

The GUARD-1 is also exploited to explore and characterize the biological diversity in new environments. Thanks to its low consumption capabilities and small size, it was used in the OASIS–EUROFLEETS+ campaign to investigate mound of corals at 400 m depth in the Alboran sea. The device autonomously recorded images for 8 months.


GUARD-1 installed on a lander within the OASIS campaign


corrosion


biofouling

DEEP SEA

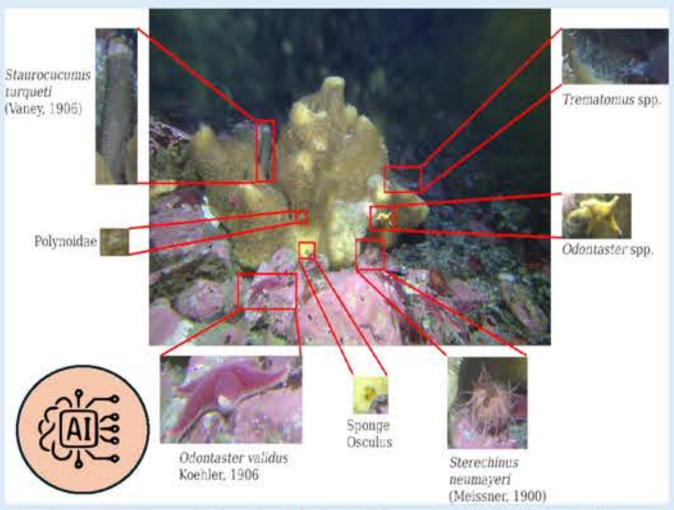
An ongoing project is devoted to adapting the GUARD-1 to withstand the extreme stress of deep waters. This is achieved by combining an already tested glass sphere case with a 3D-printed structure to enclose the GUARD-1, its batteries and a cleaning mechanism to remove deposited particulate from the external side of the glass.

First assembling of the deep sea setup

MAKING IT SMARTER ...

The GUARD-1 provides unique visual information from previously unexplored environments.
Acquiring data at high resolution for long periods might be unfeasible in terms of MEMORY and ENERGY. We will use AI integrated into an EDGE COMPUTING framework to make the GUARD-1 able to optimize its consumption and process data in real-time, extracting and keeping only the most relevant information.

This is particularly suited for SMART OBSERVATOIRES, where the GUARD-1 can be combined with other sensors in a multi-modal data framework.



Automatic object detection performed by an AI algorithm

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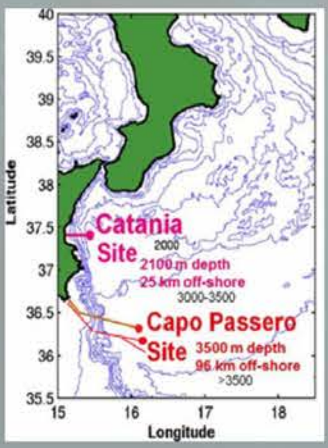
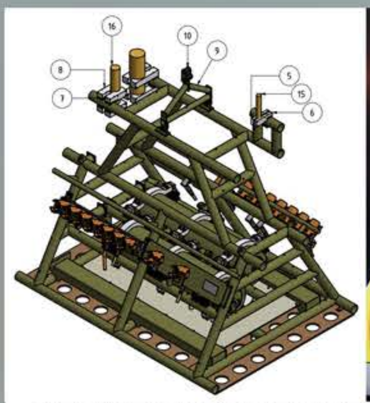
Construction of the ITINERIS submarine hub

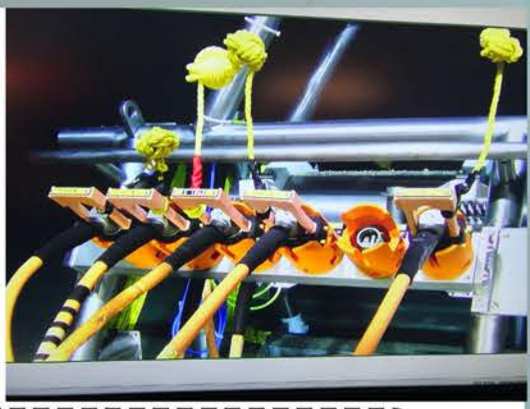
D. Bonanno[1]*, Riccobene G.[1], Sanfilippo S.[1], Cocimanno R.[1], Paesani D.[1], Pulvirenti S.[1], Randazzo N.[2] and Viola S.[1]
(1) INFN - Laboratori Nazionali del Sud, Via S. Sofia 62 - 95123, Catania
(2) INFN – Sezione di Catania, Via S. Sofia 64 - 95123, Catania
*email: danilo.bonanno@lns.infn.it

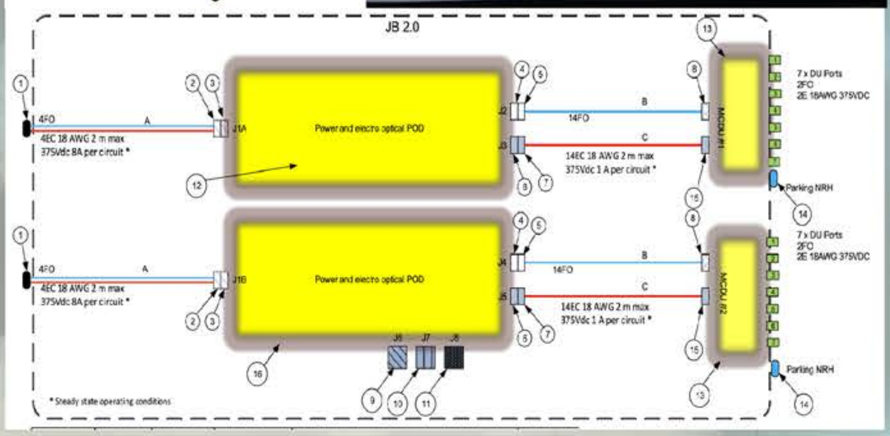
ITINERIS will build the Italian Hub of Research Infrastructures in the environmental scientific domain for the observation and study of environmental processes in the atmosphere, marine domain, terrestrial biosphere, and geosphere, providing access to data and services and supporting the Country to address current and expected environmental challenges.



The priority item of activity 5.7 of WP5 (MARINE DOMAIN) of the ITINERIS project is the design, integration, and installation of a high-reliability, high-availability, and high-speed subsea node for deep sea observatories. The new hub will be installed in the research infrastructure of the Southern National Lab of the National Institute for Nuclear Physics, located about 100 km offshore of Portopalo di Capo Passero at a depth of 3500 meters.

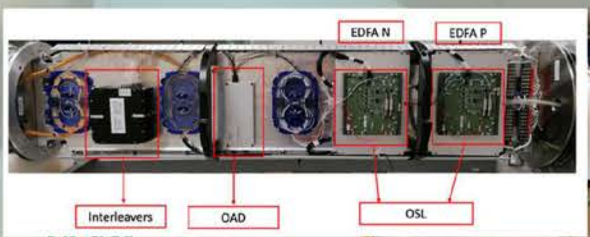






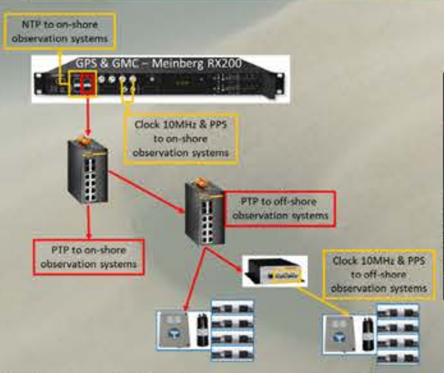
INFN has already successfully designed, built, and installed various prototypes of this kind of node, called Junction Box (JB). The main cable, through each of them, branches out into a network of electro-optical cables that allows interfacing with dozens of underwater observatories simultaneously, providing them with a high-speed optical connection and power supply. It was designed with full intrinsic redundancy and the use of space-military grade technology, hosting input and output ROV wet-mateable connectors and a double optical system. The power system box foresees redundant input and output lines. All the output lines are equipped with remotely operated relays. The mechanical frames and pressure vessels have been designed to ensure reliable operation for a period of 20 years. High-quality materials, such as Titanium, were chosen for their construction. The frames have been equipped with eyebolts to ensure safe operation and deployment.

Each JB is equipped with two pressure vessels in which all the electronic and optical components are housed. Electrical and optical tests are performed to verify that all functionalities are still present after each phase of construction, according to precise test procedures. In addition, a calibration of the optical paths is conducted to accurately characterize the latency of the digital signals.

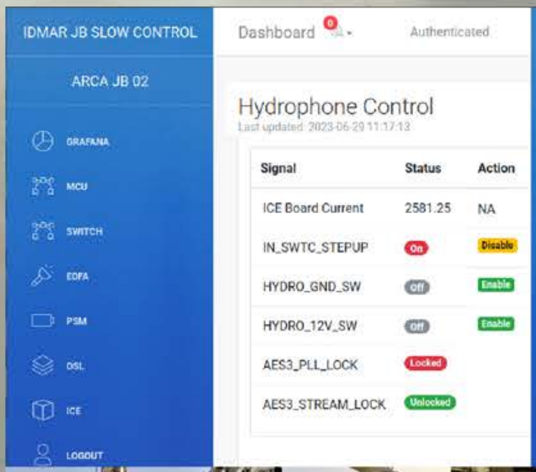


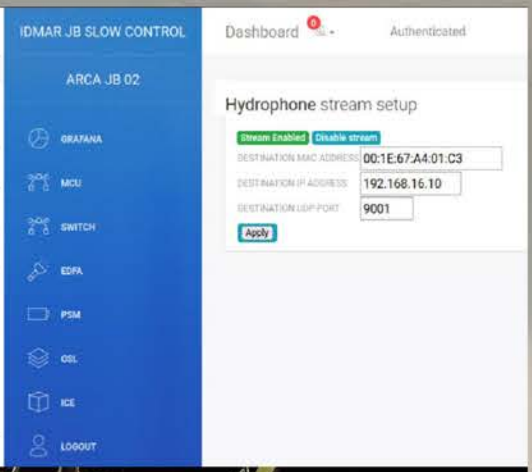
Complete functionality remote tests are also conducted before loading onto the ship and after diving, just before releasing the JB on the seafloor.

A PTP-BASED TIME DISTRIBUTION SYSTEM FOR ITINERIS



The LNS is developing a data transmission and time synchronization system based on the standard IEEE 1588v2 protocol that easily allows for synchronization, below the microsecond level, of arrays of acoustic sensors, thus enabling the creation of underwater hydrophone phased arrays. Within the ITINERIS Project, extensive testing is currently underway at the underwater infrastructure of the LNS in Catania





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The Ocean Sound data collection subsystem

S. Sanfilippo (1)*, D. Bonanno (1), Didac Diego-Tortosa (1), L. S. Di Mauro (1), G. Riccobene (1) and S. Viola (1)
1) INFN - Laboratori Nazionali del Sud, Via S. Sofia 62 - 95123, Catania
*email: *sanfilippo@lns.infn.it*

The cornerstone of the ITINERIS project is the creation of the *ITINERIS HUB*, designed to provide users with seamless access to data and services. Notably, ITINERIS opts for the optimisation and harmonisation of existing data centres rather than creating new ones. The project will fortify these centres through various activities, with a particular focus on enhancing the **FAIR** (*Findable, Accessible, Interoperable, and Reusable*) principles across all participating entities.

In the contest of WP5 (***Marine Domain***) INFN – Laboratori Nazionali del Sud (LNS) will provide real-time measurement of Essential Ocean Sound Variable (EOV) from Catania and Capopassero to create a network of ocean sound detectors (hydrophones) deployed on deep seafloor that (as demonstrated by the OnDE and SN1 acoustic data) allow monitoring of large marine areas. A schematic of the design of the Integrated Ocean Sound Sub System (IOOS) is reported in figure 1. Each Research Infrastructure (RI) will be responsible to ensure the quality of raw data and the availability of a subset of raw data for checks and reproducibility.

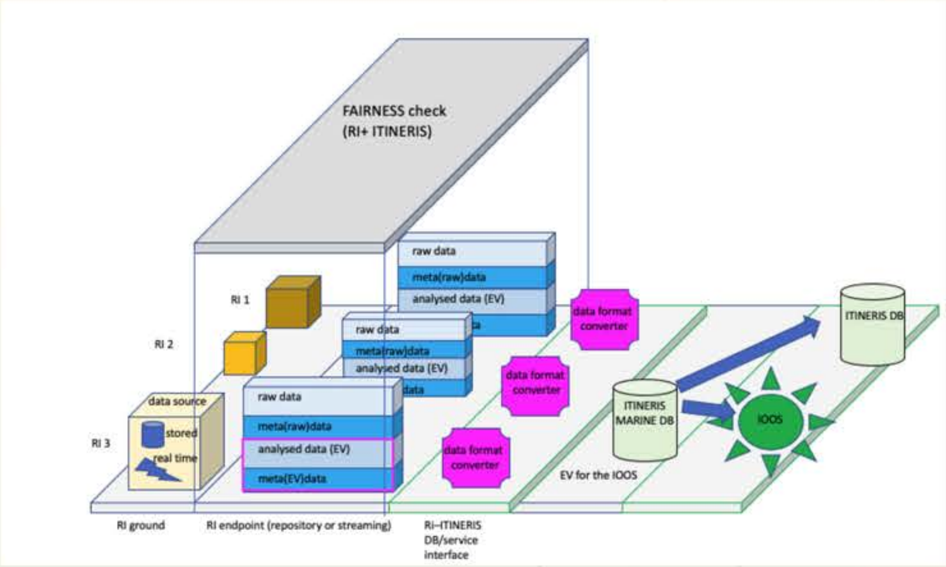

Fig. 1: Schematic of the design of the Ocean Sound Sub System.

According to (and extending) best practices suggested by GOOS and Emodnet on acoustic metadata formats, each RI will be responsible to define a metadata vocabulary for the raw (analysed) data files which contains useful information for the analysers in order to ensure the FAIR(ness) of the data. An example of metadata coding file is reported in figure 2.

a)

```
{
    "File info":{
        "Format": "HDF5",
        "Number of channels": 1,
        "Sampling rate": [195312.5,"[Hz]"],
        "Quantisation": [32,"[bit]"],
        "Encoding": "AES3",
        "Compression": "YES",
        "Compression type": "gzip"
    },
    "Sensor":{
        "Number of sensors": 1,
        "Nickname": "Hydro JB1",
        "Sensor ID": 1,
        "Manufacturer Name": "co.l.mar.",
        "Manufacturer Info": "https://www.colmaritalia.it/it/home/",
        "Part number or model": "DG1330 HP",
        "Serial number": "SN119",
        "Sensor LF cutoff": "N.D.",
        "Sensor HF cutoff": [700,"[Hz]"],
        "Sensitivity":{
            "Average value": [-156,"[dB re V/1uPa]"],
            "Curve": "N.D."
        }
```

b)

```
# Metadata creator

ana_info = f"""SPL data:
    Unit: dB re 1uPa
    Time window: {window_lenght} [s]
    FFT points: {nfft}
    Window type: Hamming
    Window points: {window_point}
    Overlap: {over*100} [%]
    Third-octave band list:
        f central band: {ffc} [Hz]
        fmin: {yticks_str[0]} [Hz]
        fmax: {yticks_str[-1]} [Hz]
```

Fig. 2: Example of the raw (a) and EOV (b) metadata content for an acoustic file recorded from the INFN site of Portopalo di Capopassero.

According to the descriptor 11 of Marine Strategy Framework Directive (MSFD) of EU, **Sound Pressure Level (SPL)** calculations in third-octave bands is mandatory to **monitor the Good Environmental Status** (GES) and the **impact of anthropogenic noise on marine mammals** and animals in the ocean environments. In fig.3 an example of 5 minutes spectrogram is given, while the SPL mean value together with the 25th, 50th, 75th, and 95th percentiles at 5 minutes are reported on figure 4.

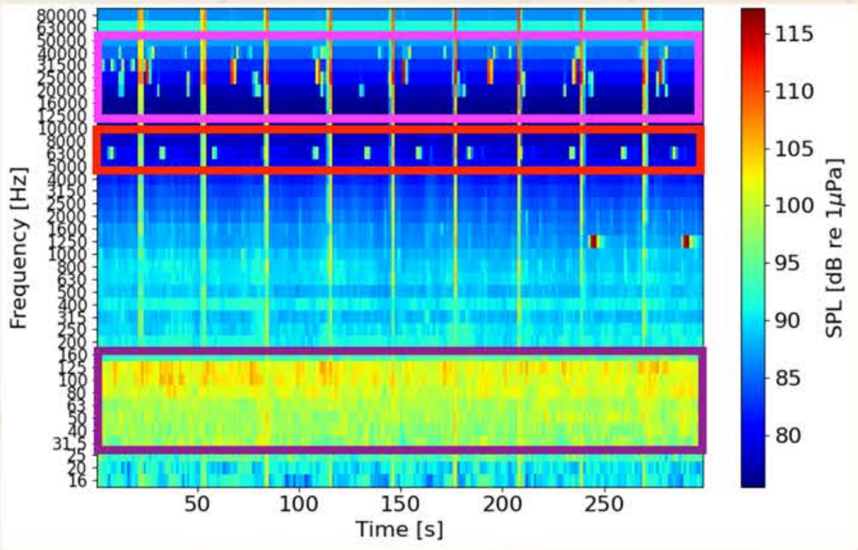

Fig.3: Five minutes spectrogram in third-octave bands recorded on 29th February 2024 (08:35 a.m. UTC) showing three sets of features from a vessel sub-profiler pinger at about 6.5 kHz (red box), and a time varying ping from acoustic emitters on the seabed at 3450 m (violet box). The 63 and 125 Hz bands highlights ships noise plus a component from a vessel sparker (magenta box).

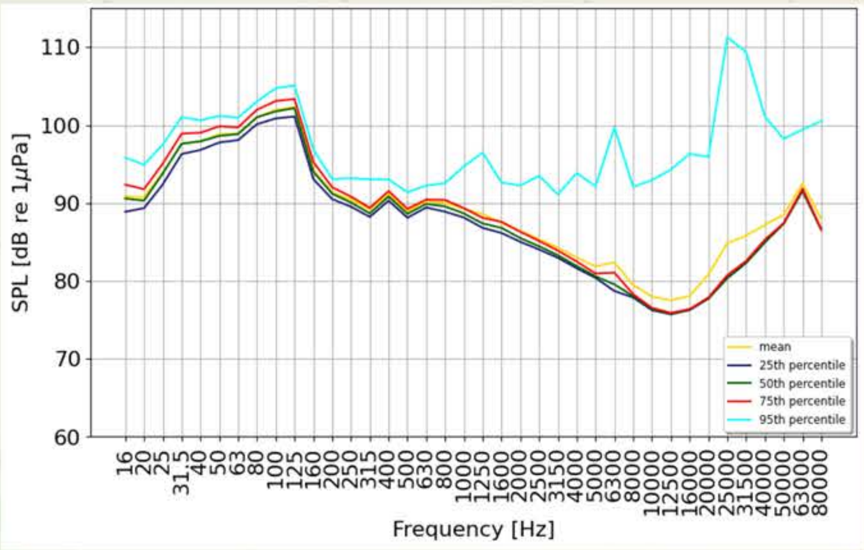

Fig.4: Sound Pressure Level (SPL), expressed in dB re 1μPa, for the same five minutes audio sample as before, in third-octave central frequency values recorded on 29th February 2024 (08:35 a.m. UTC). The 95th percentile calculation clearly shows the same three different sets of noise as in the above spectrogram.

INFN - Laboratori Nazionali del Sud is leading the WP 5.7 of the ITINERIS project, focused, among the others, on the collection of all the acoustic data from partners by developing, for the first time in the field, an integrated, flexible and **FAIR** national audio database (*ITINERIS HUB*). The work presented here is a test bench for the acoustic data treatment in the marine domaine. It demonstrates the ability to efficiently store, collect and analyse acoustic data from a test site node of INFN in almost real time.

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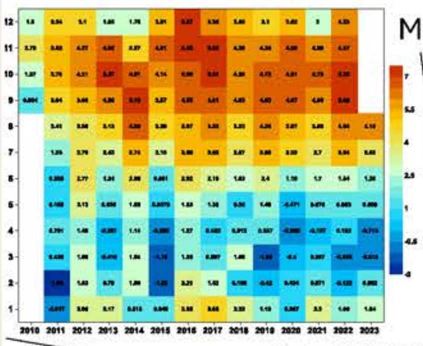
Improving the CNR-ISP Ocean Observing System in the Arctic Ocean: definition of the new architecture of SIOS observatory platforms

F. Paladini de Mendoza, M. Pansera, S. Miserocchi, M. Azzaro, L. Langone, F. Giglio, P. Giordano, G. Verazzo, F. Filiciotto, V. Sciacca, A. Lo Giudice, F. Decembrini, F. Smedile, M. Papale (CNR ISP); M. Bensi (OGS)

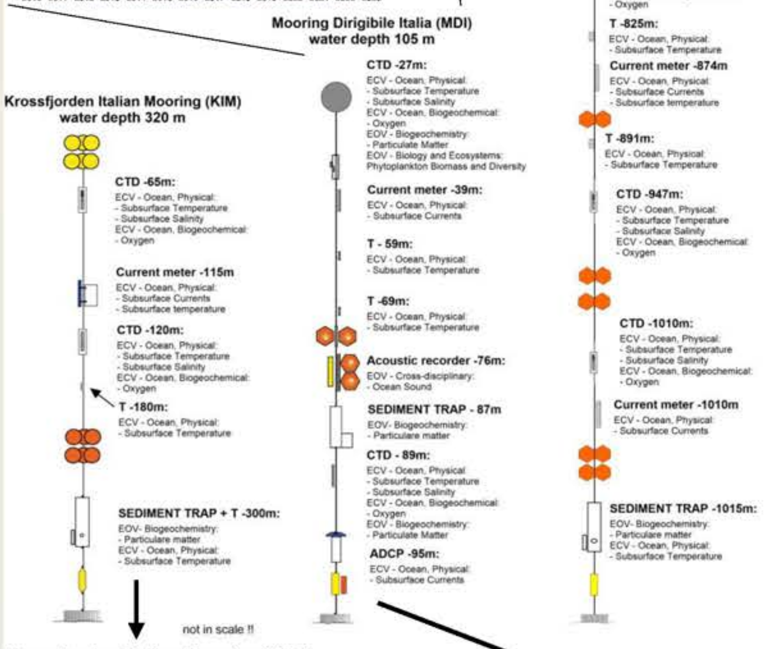
ACTIONS FOR FUTURE DEVELOPMENT OF SIOS-RI:

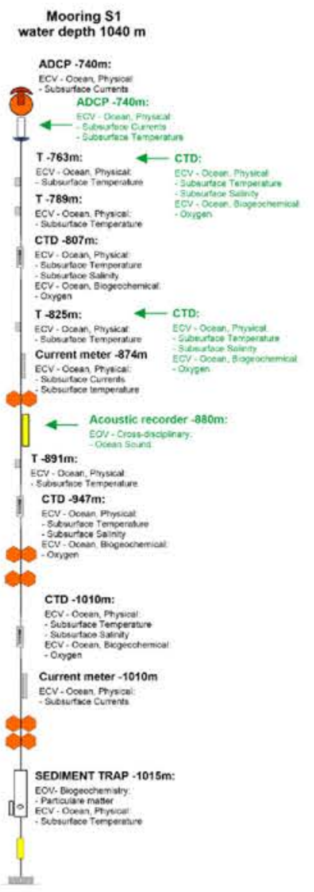
- Fill the GAPS of observed EV (EOV, ECV, EBV, Bio-Eco)
- Increase the spatio-temporal resolution of observations
- Ensure long-term measurement accuracy
- Reduce data delivery time: improve REAL-TIME data transfer
- Expand the Marine Data Storage CAPACITY of the ITALIAN ARCTIC DATA CENTER (IADC)
- Ensure data compliance with FAIR (Findable, Accessible, Interoperable, and Reusable) principles of GOOS to guarantee dataset reliability for users

Long-term observation since 2010 in Svalbard Region



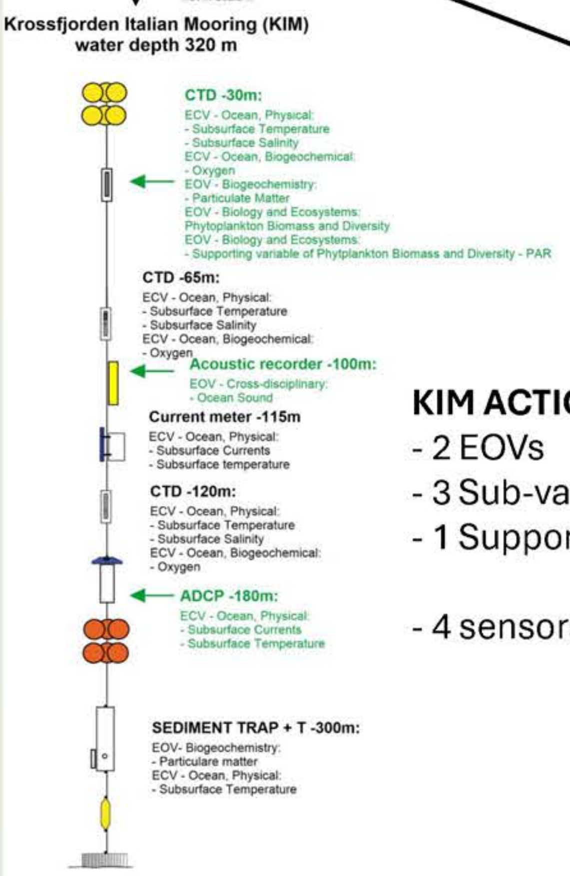
Monthly-mean Sea-temperature to 85m 2010 – 2023 (MDI site)





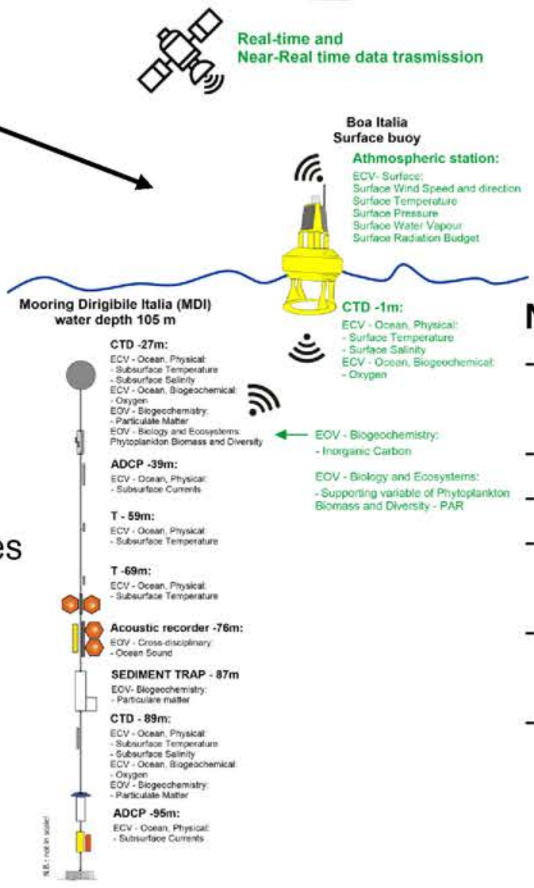
S1 ACTIONS:

- 1 EOV
- 4 sensors



KIM ACTIONS:

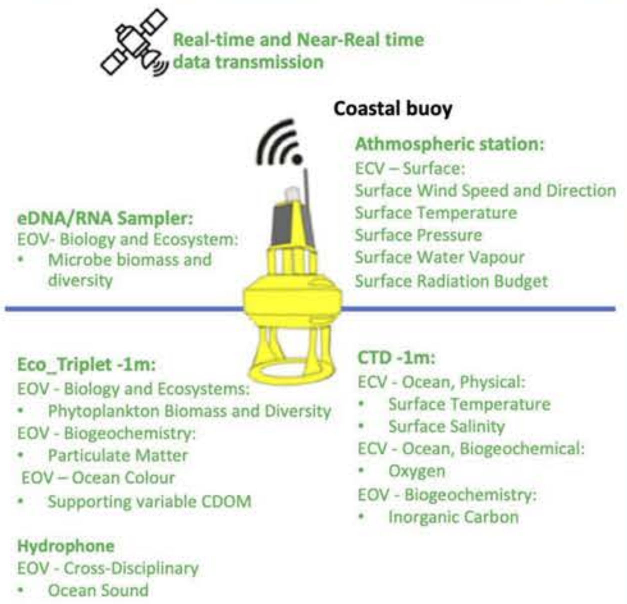
- 2 EOVs
- 3 Sub-variables
- 1 Supporting variables
- 4 sensors



MDI ACTIONS:

- Surface buoy
- 8 EOVs
- 9 Sub-variables
- 1 Supporting variables
- 10 sensors
- Real-time data transmission

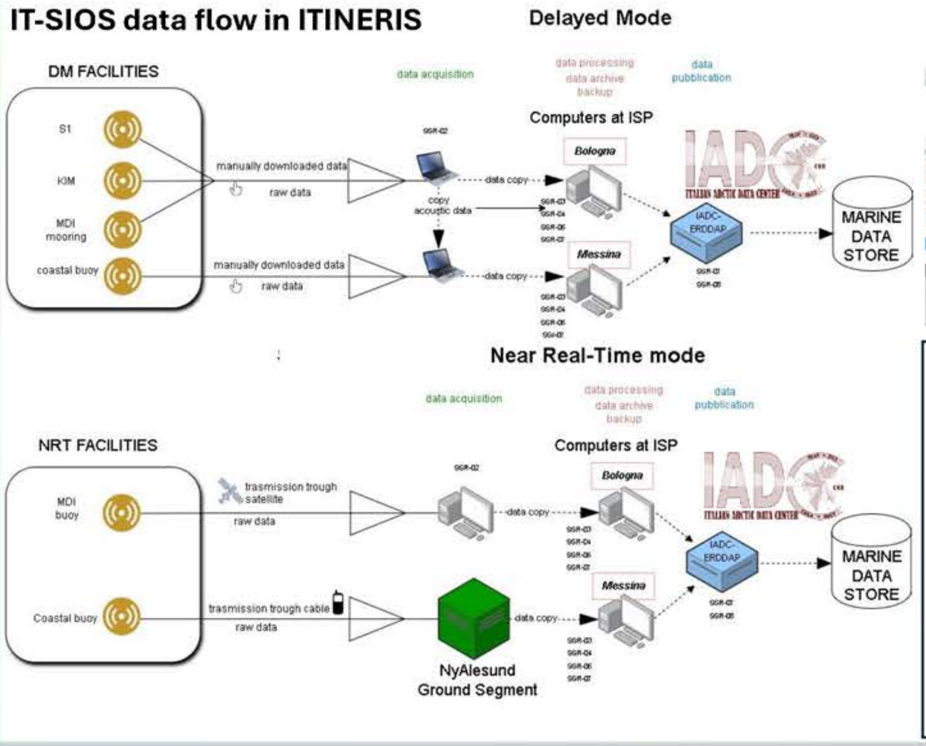
NEW FACILITY: COASTAL BUOY

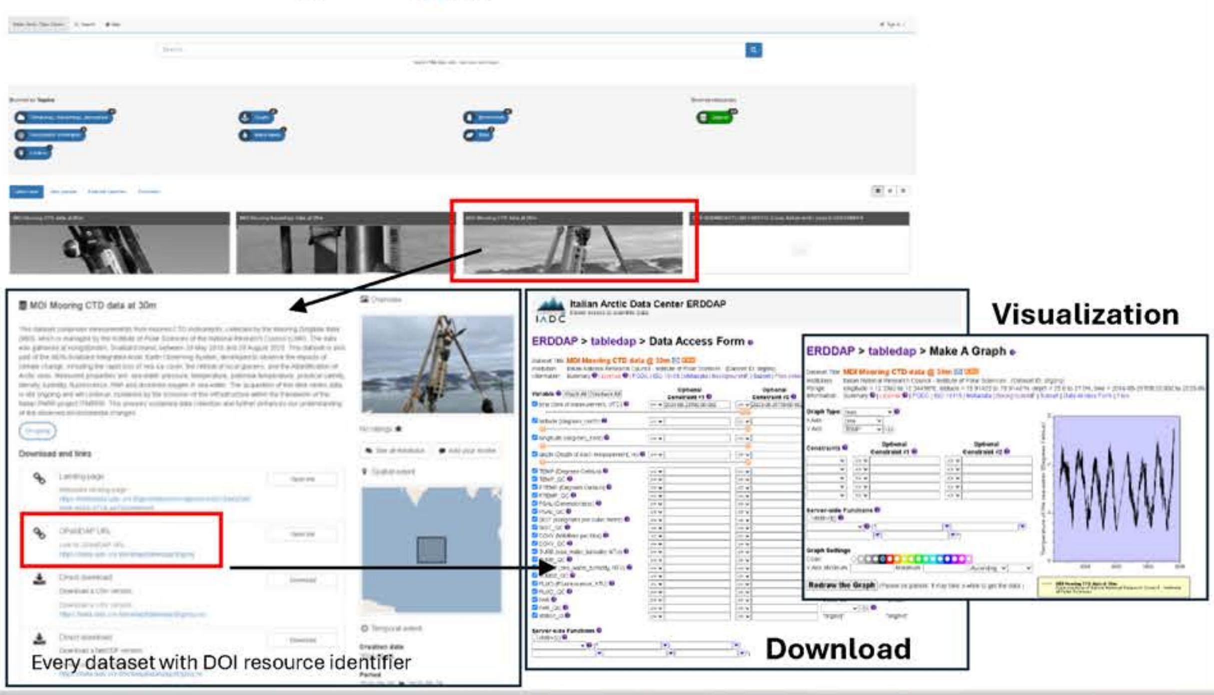


COASTAL BUOY ACTIONS:

- 13 EOVs
- 13 Sub-variables
- 1 Supporting variables
- 14 sensors
- Real-time data transmission

Contribution of IT-SIOS to IOOS Marine Data Store, Marine Data Catalogue, Marine Data Portal





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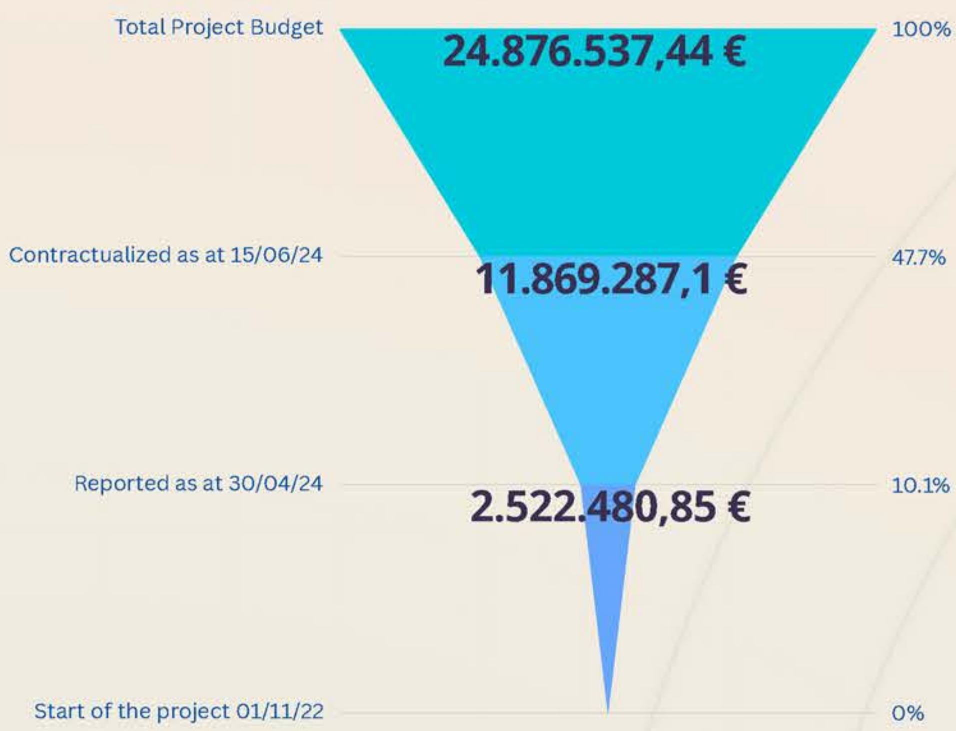
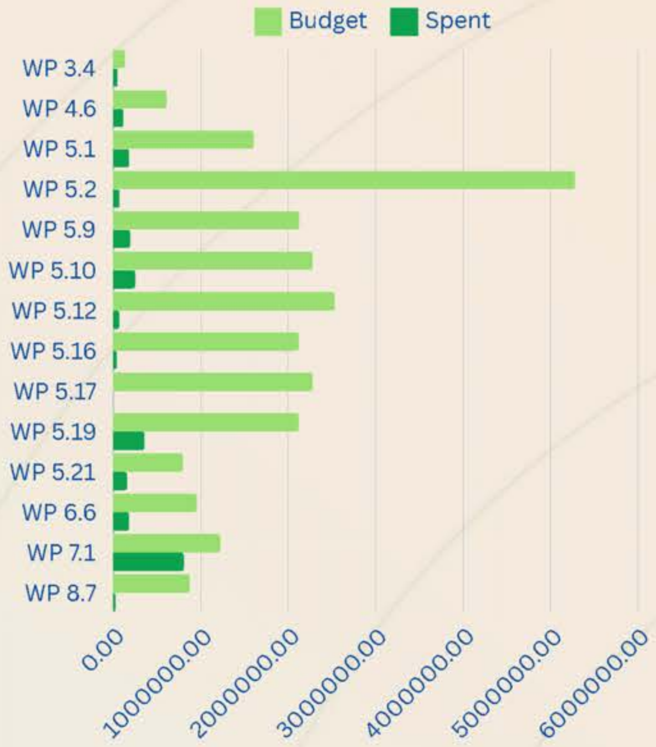
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

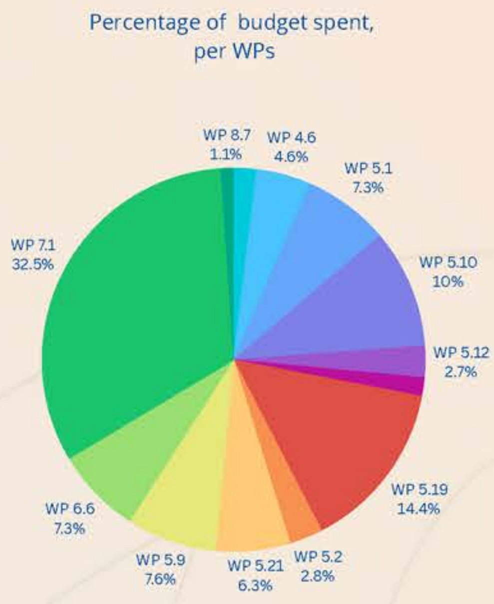
Managing the participation of CNR-ISMAR in ITINERIS: progress and challenges

G. Bologna [1], A. Corsi [2], M.L. Vitelletti [1], L. Barbieri [2]
[1] Consiglio Nazionale delle Ricerche (CNR), Istituto di Scienze Marine (ISMAR), Arsenale Tesa 104, Castello 2737/f, 30122 Venezia, Italia
[2] Consiglio Nazionale delle Ricerche (CNR), Istituto di Scienze Marine (ISMAR), Forte Santa Teresa, Pozzuolo di Lerici, 19032 Lerici (SP), Italia

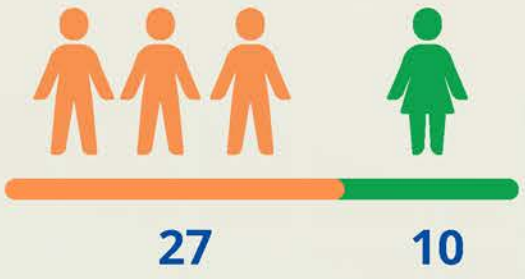
1 GENERAL INFO

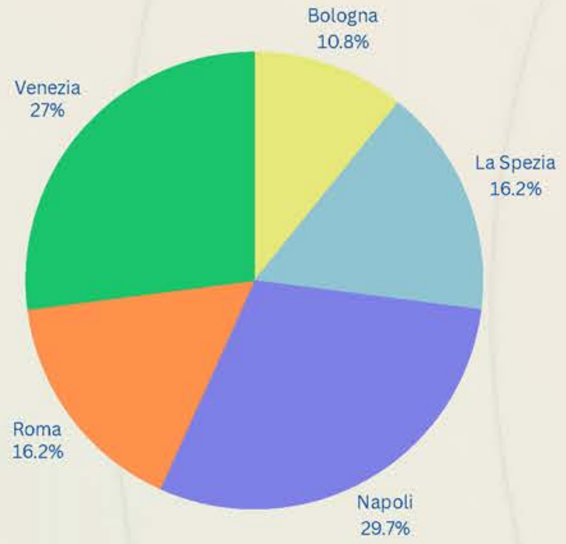


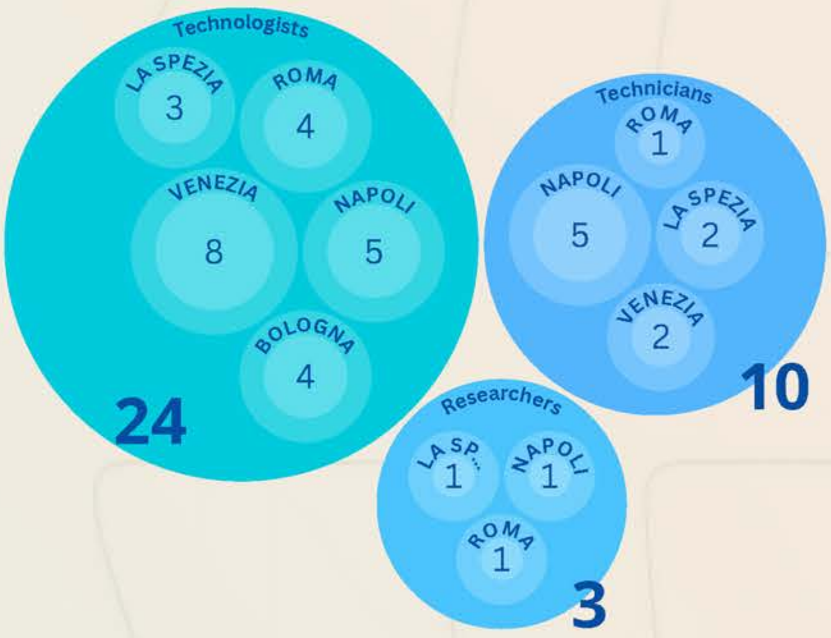




2 STAFF







37 out of 40 positions filled
1 position yet to be filled - ongoing process
2 non-contractual positions

3 DIRECT PROCUREMENT AND TENDERS

Direct Procurement - 15/06/24

Total Number	Awarded	Started	Contr...	Paid
51	39	45	37	27

Tenders - 15/06/24

Total Number	Awarded	Started	Contracted
16	11	13	8

4 TRAINING & OPEN ACCESS

- TRAINING: 1 doctoral programme ISMAR + UNIPI - 2 years
- ECORD Open Access

5 CRITICAL ISSUES

- Simplify documentation
- Gantt chart compliance issues
- Manage schedule variances
- Handle large teams

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Ocean dynamics and thermohaline properties in the Antarctic and Subantarctic regions of the Pacific Ocean: a comprehensive exploration through ARGO floats

Authors: Ana Amaral Wasielesky, Milena Menna, Riccardo Martellucci and Elena Mauri

Abstract

The Antarctic and Subantarctic regions of the oceans, situated mainly in the Southern Ocean, play a crucial role in connecting all oceans through the Antarctic Circumpolar Current (**ACC**). It is crucial to comprehend these regions because they are involved in several processes, including the formation of water masses, participation in deep convection, and consequently being part of the Meridional Overturning Circulation (**MOC**). This work focuses on the Antarctic and Subantarctic regions located south of New Zealand and associated with the formation of mode waters, including the Sub-Antarctic Mode Water (**SAMW**) and the Antarctic Intermediate Water (**AAIW**). We use Argo data, a global array of profiling floats that provide high-resolution measurements of temperature, salinity, and other oceanographic variables, to gather comprehensive information on the spatio-temporal variability of water masses in these regions. This will help us to better understand the oceanic processes and their impact on the ecosystem and climate in the Southern Ocean.

1. Study Region

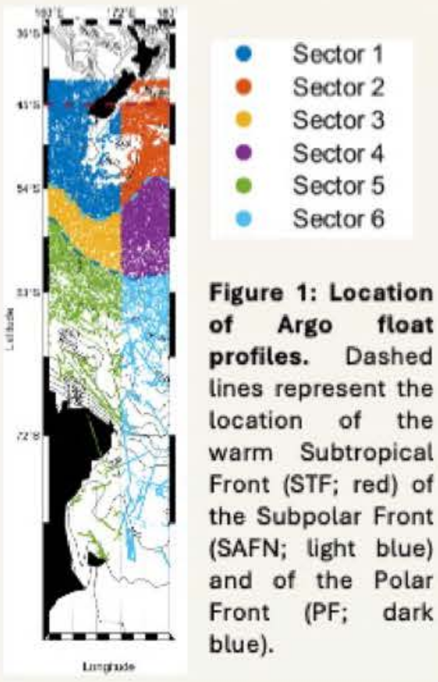

Figure 1: Location of Argo float profiles. Dashed lines represent the location of the warm Subtropical Front (STF; red) of the Subpolar Front (SAFN; light blue) and of the Polar Front (PF; dark blue).

2. Spatial Variability

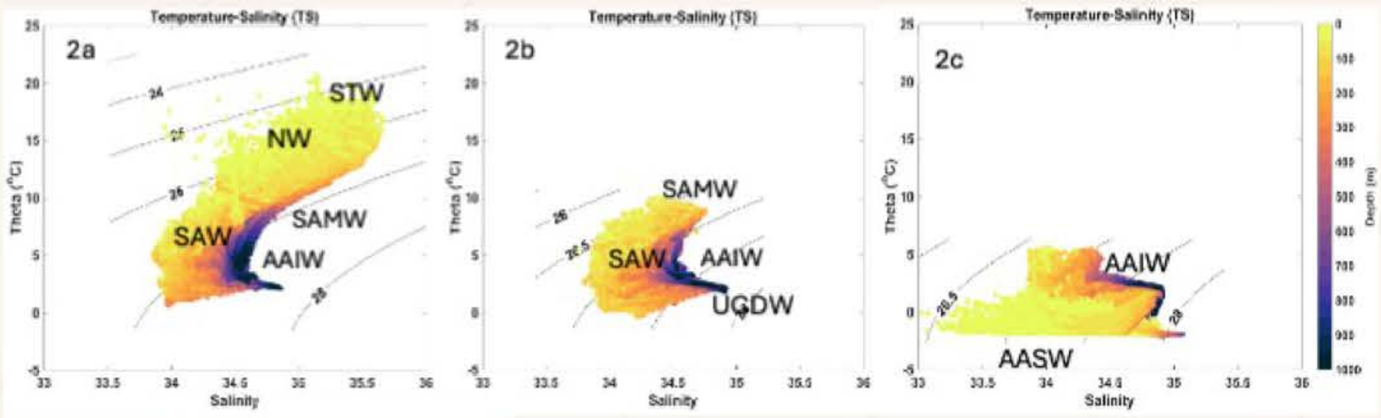

Figure 2: Temperature-Salinity Plots for Sectors 1, 3, and 5 of the Study Region
This figure displays Temperature-Salinity plots as described in Forcén-Vázquez et al. (2021) for different sectors of the study region:
Figure 2a: Sector 1, depth range from 0 to 1000 meters.
Figure 2b: Sector 3, depth range from 0 to 1000 meters.
Figure 2c: Sector 5, depth range from 0 to 1000 meters.

3. Vertical Variability

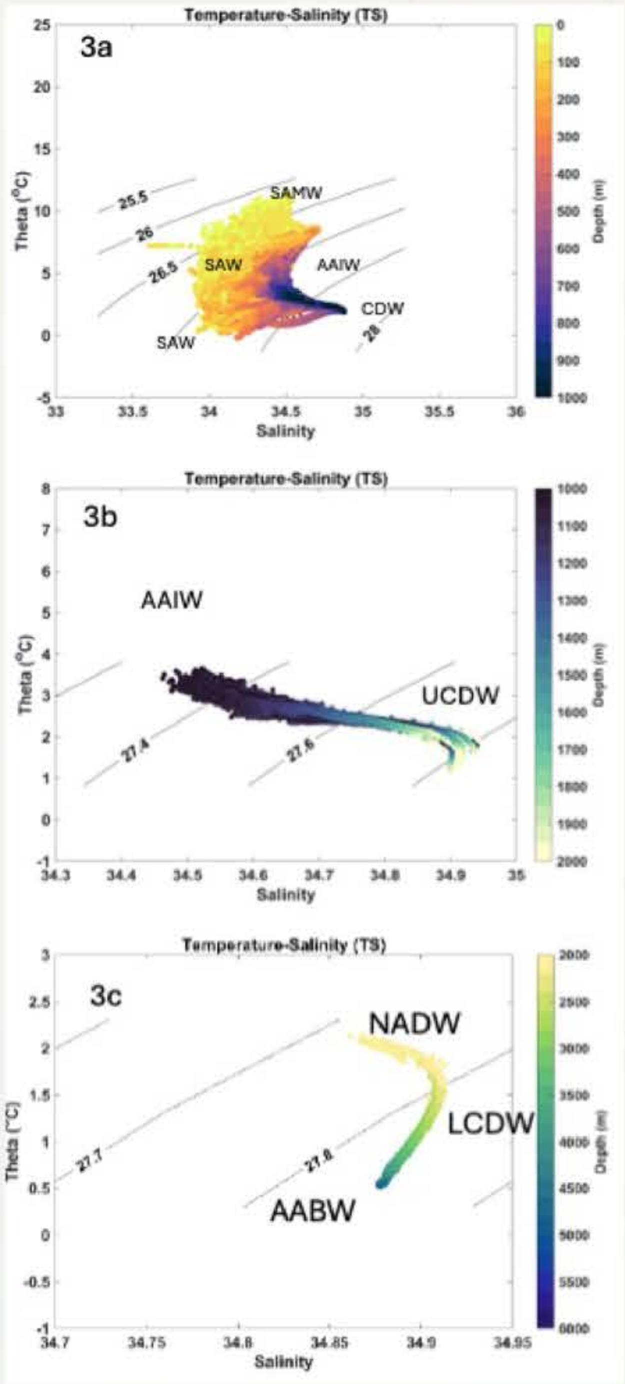

Figure 3: Temperature-Salinity Plots for Sector 4
This figure displays Temperature-Salinity at different depth ranges:
Figure 3a: Depth range from 0 to 1000 meters.
Figure 3b: Depth range from 1000 to 2000 meters.
Figure 3c: Depth range from 2000 to 6000 meters.

4. Salinity Transect at 172° East

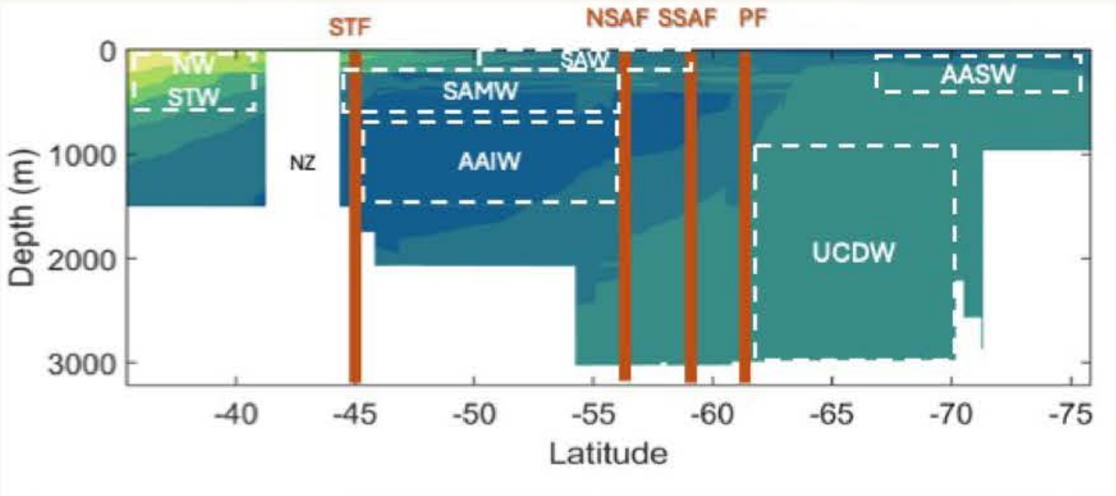

Figure 4: Salinity Transect at 172°East. Orange Lines: Denote the location of the STF, NSAF, SSAF, and PF, respectively. **Dashed White Squares:** Denote the different water masses encountered in the study region.

- NW - Closer to the coast of New Zealand at 172° East ;
- AASW and AAIW – migrate upper with a decrease of latitude;
- UCDW - migrate upper with a decrease of latitude;
- SAW and SAMW - signal found along the transect;
- AAIW - Strong salinity core;

5. Conclusions

- **Water Mass Identification:** The Temperature-Salinity (TS) plots successfully identified distinct water masses in the study region. The results are consistent with the existing literature, specifically the findings of Forcén-Vázquez et al. (2021). This confirms the reliability and accuracy of our methods and data.
- **Spatial/Vertical Variability**: This analysis accurately shows the mean distribution and depth of water masses over the last 20 years and paves the way for future studies on temperature and salinity trends in this area, which can be placed in the context of climate change.

Acronyms

Water Masses:
NW - Neritic Waters;
AAIW - Antarctic Intermediate Water;
AASW - Antarctic Surface Water;
SAMW - Subantarctic Mode Water;
SAW - Subantarctic Water;
STW - Subtropical Waters;
UCDW - Upper Circumpolar Deep Water;
LCDW - Lower Circumpolar Deep Water;
AABW - Antarctic Bottom Water;
NADW - North Atlantic Deep Waters;
Fronts:
STF - Subtropical Front;
NSAF -North Subantarctic front;
SSAF - South Subantarctic front;
PF - Polar Front;

OGS

Annual meeting - Roma - 9-10/07/2024

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PIANO NAZIONALE DI RIPRESA E RESILIENZA

The R/V Laura Bassi data harvesting system and ERDDAP as data sharing portal for the ITINERIS project: preliminary insights

OGS

Musco M.E., Trebbi A., Iurcev M., Coren F. (OGS)

Introduction

The research icebreaker Laura Bassi provides scientific and logistical support to the Italian National Antarctic Program (PNRA) and fosters the oceanographic and geophysical research of the scientific community, both at global and polar level.

The aim of the R/V Laura Bassi within the framework of the ITINERIS project is to enhance and broaden its digital integration, with a specific focus on the scientific equipment, automation, and data harvesting from all onboard equipment. At present, the data contributing to the Italian Integrated Ocean Observing System (IT-IOOS) are provided by the navigation facility and the weather station, nonetheless the system is constantly undergoing upgrades to integrate more and more devices. The vessel is equipped with several other instruments and systems, which will provide real time or delayed time data in the near future, depending on data type (fig. 2).

Fig. 1: R/V Laura Bassi in front of the Antarctica Ross Ice Shelf.

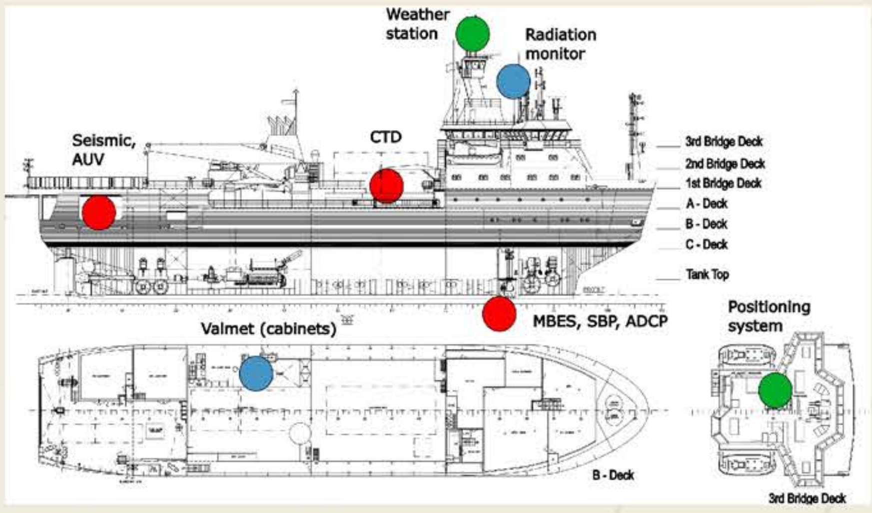

Fig. 2: localization of the instruments on board the R/V Laura Bassi. Green: already available; blue: available soon; red: available depending on data type.

Connectivity

The connectivity onboard is assured by a maritime-quality Starlink antenna. This upgrade, accomplished in June 2023, has increased the speed of data transmission. The download speed is now 40-220 MBPS, the upload speed is 8-25 MPBS, with 99 MS latency. This year two more antennae will be installed, one of which will be fully dedicated to scientific data transfer.

ERDDAP

ERDDAP stands for "Environmental Research Division's Data Access Program." It is a data server used by many institutions for delivering "FAIR" data, since it provides a simple and uniform way to access, analyze, and visualize scientific data from various environmental sources. It was created by the National Oceanic and Atmospheric Administration (NOAA).

We have configured our ERDDAP data server to make our data accessible. Our endpoint will be available at https://lbnode.ogs.it/erddap, as soon as we finalize the datasets. ERDDAP will constitute the main vector to the ITINERIS database.

Valmet automation system, data collection and telemetry

The Valmet system constitutes the ship's automation and data harvesting backbone. Thanks to the refit of the automation system, it is possible to monitor hundreds of parameters from different monitoring stations on board. The data collected are stored within the Valmet Historian Cloud and are accessible also from our ground facility. Different analyses can be run through the Process Analysis Tool (fig. 3) and selected data can be simultaneously displayed in dashboards, which are customizable through the Dashboard Creator (fig. 4). We are currently working to extract data from the cloud to share them in our ERDDAP.

Fig. 3: example of data monitoring in the Valmet Process Analysis Tool.

Fig. 4: example of data display on a custom Dashboard.

Vaisala Weather Station

The new Vaisala WXT536 weather station will be an upgrade of the previous weather station. It measures atmospheric pressure, temperature, relative humidity, wind speed and direction, rain current and peak intensity, duration of a rain event. The heating elements keep the sensors clean from snow and ice and the operating environmental temperature ranges from -52ºC to +60ºC. These two aspects are of fundamental importance during the Antarctic campaigns.

Radiation Solutions Stationary Radiation Monitor

The RS-250L POE Stationary Radiation Monitor is a new generation Perimeter Radiation Monitoring Detector. With this instrument, it is possible to monitor radiation levels in the atmosphere, both for research purposes and for mapping and measuring variations in values on a local and regional scale, as well as for nuclear monitoring applications. This instrument is capable of continuous measurements without the need for constant external interventions and provides real-time detection of gamma radiation exposure.

The R/V will be able to measure gamma radiation levels in the atmosphere during transit periods, collecting data on local and regional variations of such radiation, which can be used for scientific publications.

Kongsberg K-Bridge

The system will replace the present bridge management system. New radars will be installed (one of which is ice monitoring). A new ECDIS system will be also integrated into situation awareness information system and all the data could collected and stored.

Kongsberg AUV deployment system

The deployment system for the AUV will be implemented on board (fig. 5). It enables proper data flow and digital communication between the AUV and the RV. Moreover, it enables effective, safe and optimized mechanical recovery of the AUV. It is a fundamental component for data integration and transmission during research campaigns. The AUV is equipped with a multibeam echosounder, a side-scan sonar, and mounts sensors for measuring carbon dioxide, nitrates, turbidity and oxygen. Soon Hugin AUV will be operative onboard the R/V Laura Bassi and additional instrumentation will be implemented.

Fig. 5: AUV deployment system.

Fig. 6: the Kongsberg Hugin AUV during recent tests.

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Enhancing existing biodiversity knowledge through data FAIRness and e-Science tools

Flavio Monti, Jessica Titocci, Lorenzo Liberatore, Teodoro Semeraro, Alberto Basset

Research Institute on Terrestrial Ecosystems (IRET-URT Lecce), National Research Council of Italy (CNR), Campus Ecotekne, 73100 Lecce, Italy

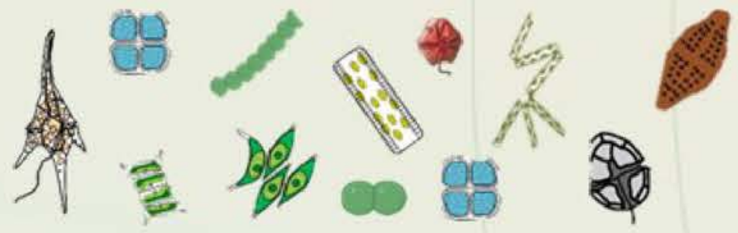
Current issues with Biodiversity data:

- The lack of global cooperation in biodiversity research coupled with the poor use of common standards and guidelines for collecting, organizing and describing biodiversity data, hampers the effective utilisation of data produced, ultimately jeopardising biodiversity management efforts.

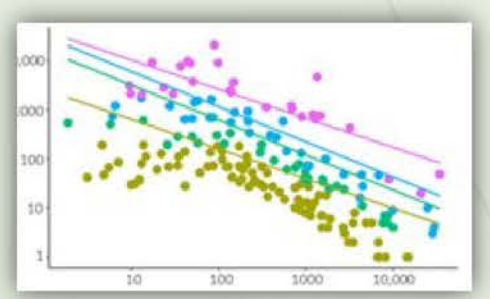
- In the current scenario of global biodiversity loss, make existing heterogeneous biodiversity and trait-based data Open and FAIR (Findable, Accessible, Interoperable, Reusable) is needed.

An individual-level trait-based phytoplankton dataset from transitional waters

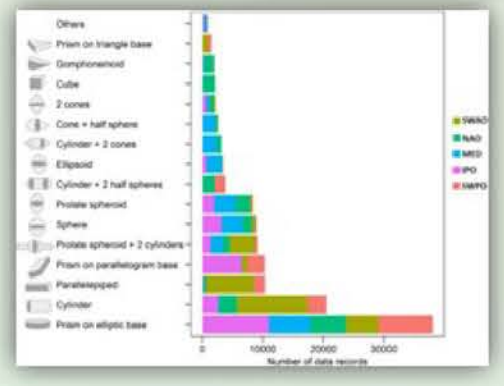
- 24 transitional water ecosystems
- 5 biogeographical areas
- 127311 records, 306 taxa
- Abundance & Morphological traits



- Taxonomic check with AlgaeBase
- Phytoplankton data template
- DwC & Phytoplankton Trait Thesaurus



Size-Abundance Distribution

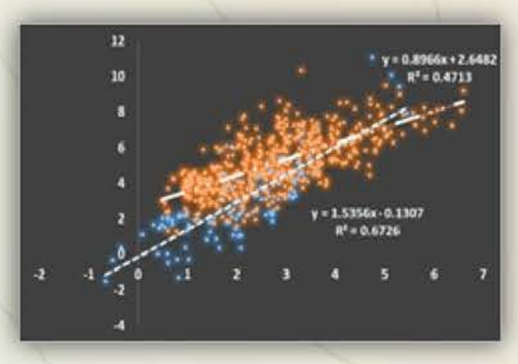


Shape Distribution

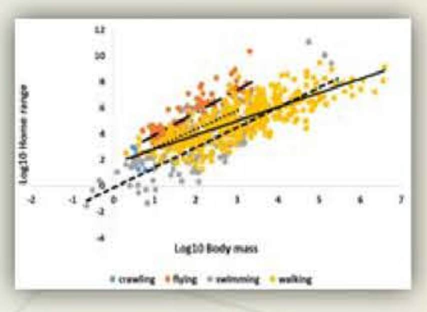
A global dataset of vertebrate behavioural & life-history traits

- ***Home range-Body mass*** 1166 sp.
- ***AnAge:*** longevity data, 3924 sp.
- ***GlobTherm:*** temperature tolerance, 1179 sp.

- Taxonomic check with GBIF
- DarwinCore standard & NERC vocabularies



Scaling of home range with body mass (ectotherms vs endotherms)



Scaling of home range with behavioral traits (e.g. locomotion)

Data acquisition → Data integration → Data standardisation & validation → Data analysis → Virtual Research Environment

Enhanced availability and interoperability of these data will turn existing biodiversity information into **actionable knowledge**, to be used to model future trends on responses to anthropogenic threats and global change.

CNR IRET | LifeWatch ERIC

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A prototype web application for visualization of data products based on SOURCE open code

Simona Simoncelli, Paolo Frizzera, Claudia Fratianni

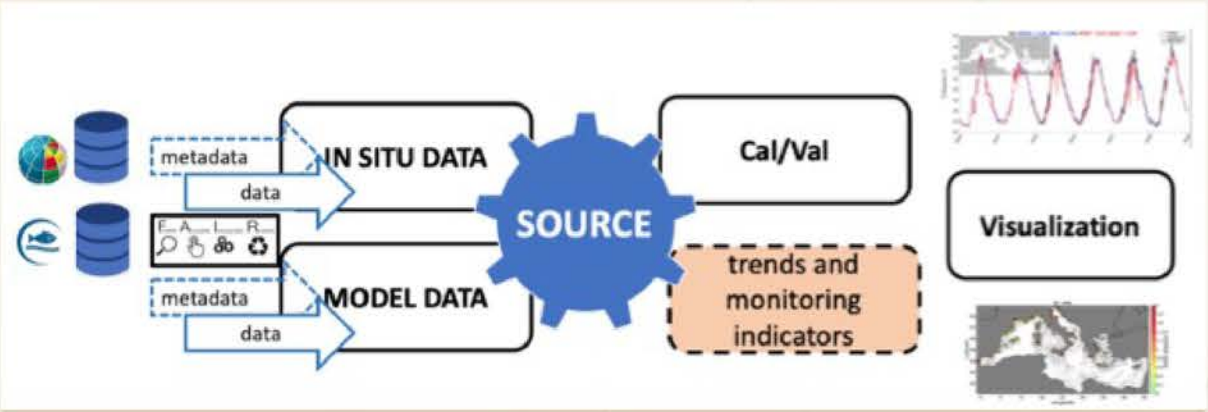
Istituto Nazionale di Geofisica e Vulcanologia

INGV

SOURCE

SOURCE* (**S**ea **O**bservations **U**tility for **R**eprocessing, **C**alibration and **E**valuation) utility for reprocessing, calibration and evaluation is an open software designed for web applications that permits to calibrate and validate ocean models within a selected spatial domain using *in-situ* observations. SOURCE has been designed to be relocatable and flexible to consider different model data and parameters and to enable further monitoring capabilities, such as extreme events identification and basid-wide statistics.

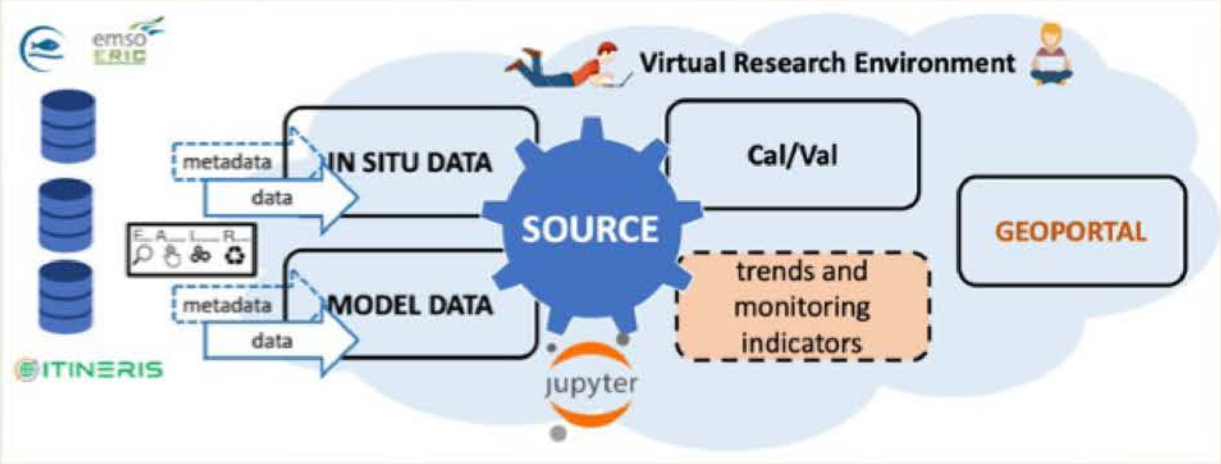
A good starting point...



- Conversion of all data coming from the different infrastructures in an unique common data format (netCDF)
- Merging observations and models metadata in one final database using accurate collocation procedures and duplicates detection
- Processing and further Quality Control analysis following the latest community best practices
- Model data management for Cal/Val

...evolution of the service ...

- SOURCE has been implemented in **Jupyter notebooks**
- in situ EOVs data time series selection (T&S)
- automatic data access to EMSO facilities (ITINERIS MDP)
- remote model data access and sub-setting
- SOURCE deployment on VRE (D4science)
- geoportal design
- computation of trends and monitoring indicators

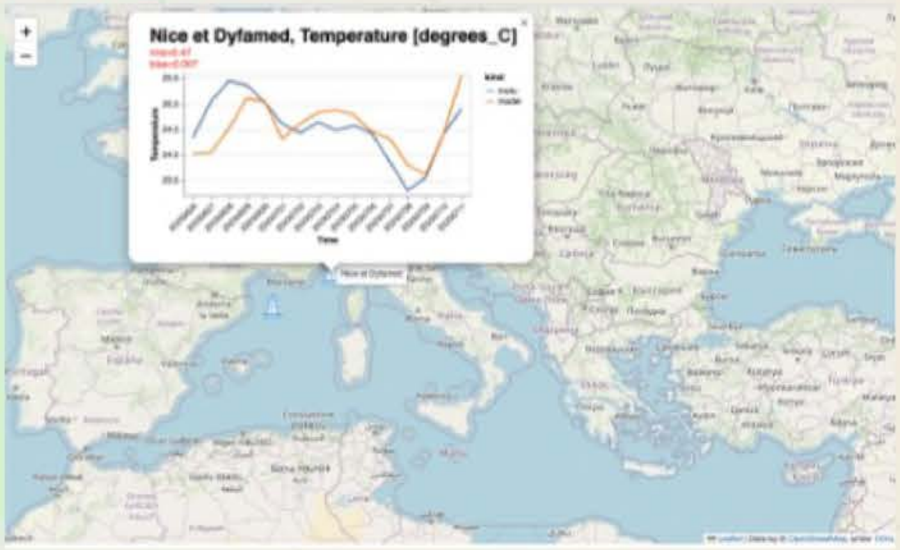


...Geoportal development and implementation

Interactive visualization of

- EOVs derived quantities, such as averages at different time frequencies (daily, monthly, yearly)
- trends
- model skill scores
- monitoring indicators

allowing a live characterization of the sites and a continuous monitoring of the marine environment.



Conclusions and Future work

SOURCE first implementation and its geoportal have been designed for its first delivery, considering data from the EMSO IT-IOOS sub-system. Additional sub-systems will be then considered for the service further expansion.

*Oliveri, and Simoncelli https://doi.org/10.5281/zenodo.5106546, Oliveri et al. 2022, https://doi.org/10.3389/fmars.2021.750387

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Recombinant protein as biomarker for identification of antibiotic resistant bacteria

Caterina Catalano, Pietro Roversi, Bianca Castiglioni & Paola Cremonesi

National Research Council, Institute of Agricultural Biology and Biotechnology (CNR-IBBA), Italy

Abstract

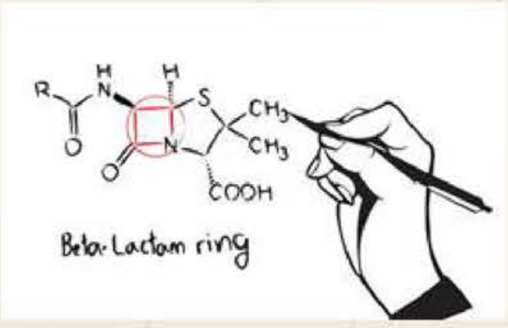
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major human and animal pathogen responsible for a wide range of infections. A plasmid for recombinant expression of Tpn IS431mec transposase in *E.coli* was obtained. The protein will be expressed and purified from BL21 *E. coli* cells. The purified protein will be used in MALDI-TOF mass spectrometry to identify peptide fragments that can be used as biomarkers of MRSA strains.

Background

Integration of the Staphylococcal Chromosomal Cassette *mecA* (SCCmec) into the *S. aureus* chromosome converts Methicillin-susceptible *S. aureus* (MSSA) into the notorious Methicillin-resistant *S. aureus* (MRSA), thus endowing bacteria with tolerance to practically all β-lactam antibiotics. SCCmec carries the *mec* regulatory genes, which comprise *mecA*, *Tpn IS431mec* and several other variable elements (*mecR1, ΔmecR1* and *mecI, IS431, IS272*). The ability of SCCmec to integrate DNA into the bacterial chromosome is carried by two of its specific genes, encoding cassette chromosome recombinase A and B (ccrA and ccrB) respectively. On the basis of the details of the *mec* and *ccr* gene clusters, SCCmec elements are classified into 11 types (labelled I to XI) and various subtypes (Liu et al., 2016). Rapid discrimination of MRSA from MSSA is essential for appropriate therapy and timely intervention for cross-infection control (Sogawa et al., 2017).

What mediates β-lactam antibiotic resistance?

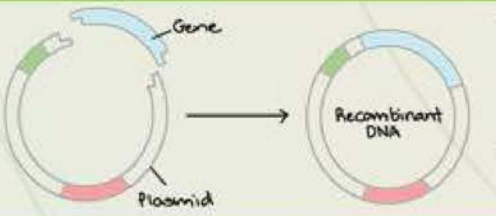
β-lactam antibiotics (such as penicillin and methicillin) act by interfering with the synthesis of peptidoglycan. In particular, they inhibit the Penicillin-Binding Protein transpeptidases (PBPs): as a result, weak areas are formed within the peptidoglycan, leading to lysis and death of the bacterial cell (Lim et al., 2002).



The β-lactam ring confers antibacterial properties to the antibiotics belonging to the β-lactam family.

In MRSA strains, the *mecA* gene encodes an extra PBP, known as PBP2' or PBP2a, whose expression makes MRSA cells resistant to β-lactam antibiotics.

In the context of the PNRR-sponsored IN-FACT project, a plasmid encoding the *Tpn IS431mec* transposase gene, specific to MRSA strains type IV, was obtained in order to use the recombinant protein in MALDI-TOF and establish one of its peptides as a novel biomarker for methicillin resistance.



The insert is C-terminally 6xHis tagged and cloned between the NdeI and BamHI restriction sites of the pET-15b vector. The protein will be expressed and purified from BL21 *E. coli* cells.

Currently, a PSM-mec peptide corresponding to a MALDI-TOF peak at 2415 ± 4 m/z is being used as a prediction marker for MRSA. However, this PSM-mec peptide is only present in SCCmec of MRSA Types II, III and VII (Rhoads et al., 2016). Therefore, a different biomarker for rapid MALDI-TOF detection of other SCCmec Types is needed. Our goal is to use peptides from the MRSA Tpn IS431mec transposase as biomarkers to discriminate MRSA from MSSA using MALDI-TOF mass spectrometry.

References

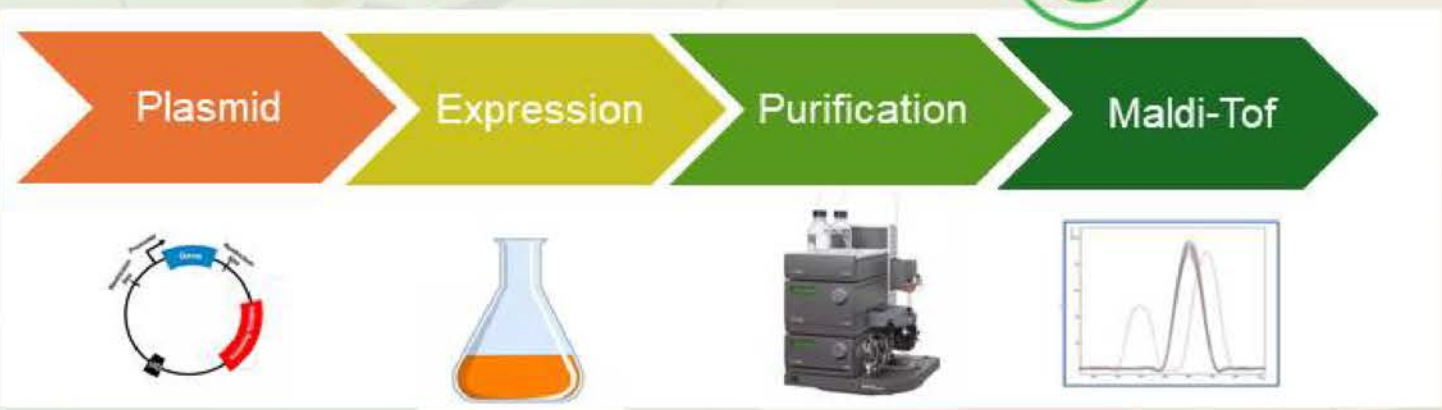
Lim D, Strynadka NC. Structural basis for the β lactam resistance of PBP2a from methicillin-resistant Staphylococcus aureus. Nature structural biology. 2002 Nov 1;9(11):870-6.

Liu, J., Chen, D., Peters, B.M., Li, L., Li, B., Xu, Z. and Shirliff, M.E., 2016. Staphylococcal chromosomal cassettes mec (SCCmec): A mobile genetic element in methicillin-resistant Staphylococcus aureus. Microbial pathogenesis, 101, pp.56-67.

Rhoads, Daniel D., et al. "The presence of a single MALDI-TOF mass spectral peak predicts methicillin resistance in staphylococci." Diagnostic microbiology and infectious disease 86.3 (2016): 257-261.

Sogawa K, Watanabe M, Ishige T, Segawa S, Miyabe A, Murata S, Saito T, Sanda A, Furuhata K, Nomura F. Rapid Discrimination between Methicillin-Sensitive and Methicillin-Resistant Staphylococcus aureus Using MALDI-TOF Mass Spectrometry. Biocontrol Sci. 2017;22(3):163-169.

From gene to......biomarker!



All data will be generated in accordance with FAIR principles, using the recommended file formats (ITINERIS standards).

Annual meeting - Roma - 9-10/07/2024

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Development of an integrated biotechnology platform for customized bioprocesses

Catalano C., Castiglioni B., Ceriotti, A., Cremonesi P., Luciani L., Menin B., Pedrazzini E., Roversi P.

National Research Council, Institute of Agricultural Biology and Biotechnology (CNR-IBBA), Italy

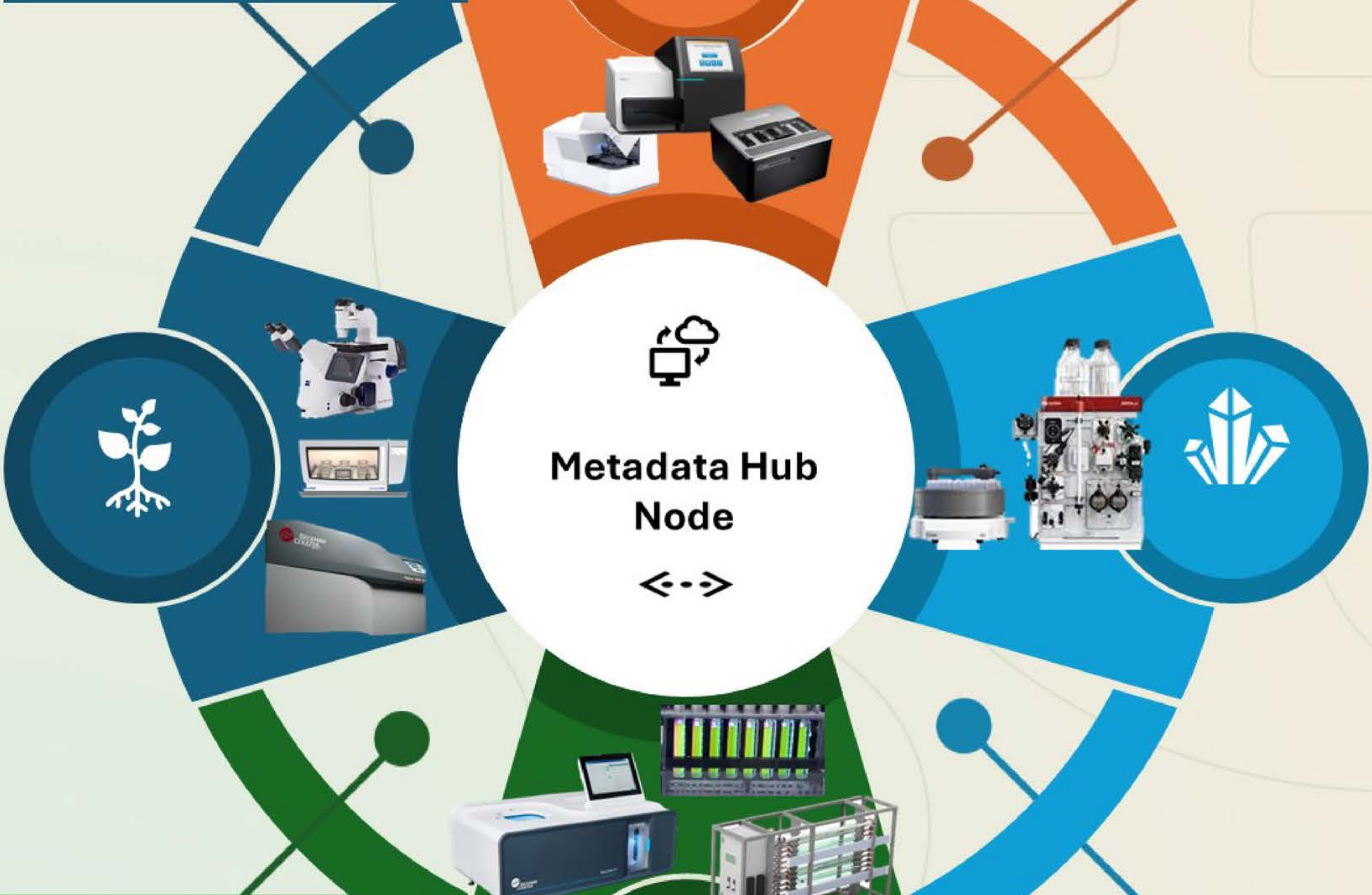
A metagenomic platform is being established through the acquisition of a coordinated system for bacterial single cell isolation and DNA library preparation, and a high throughput sequencing system. For biomolecule production, the acquisition of a high throughput microbioreactor and a set of bacterial and algal cultivation systems and monitoring equipment are underway. Structural/functional characterization of recombinant proteins/peptides is being supported through the acquisition of a set of separation, purification and structural characterization pieces of equipment. Standardization of the data produced by these platforms will be functional to the integration and harmonization of the platforms within the IBISBA research infrastructure.

Recombinant protein/peptide expression in plant systems

The platform offers design strategies to produce high levels of recombinant proteins and peptides in plants as bioreactors. Protein stability and subcellular localization as well as co- and post-translational modifications are monitored by microscopy and biochemical analysis. The platform comprises two refrigerated incubators for the growth of microorganisms for plasmid amplification and recombinant protein production, a growth chamber for plants, an ultracentrifuge for subcellular fractionations and an advanced video imaging system for fluorescence microscopy analysis.

Metagenomics

The metagenomic platform comprises a coordinated system for isolating bacterial single cells (B.Sight, Cytena) and preparing DNA libraries. Additionally, it incorporates two distinct high-throughput sequencing systems (MiSeq, Illumina, and Oxford Nanopore GridION). The resulting datasets offer a comprehensive perspective on the genetic and functional landscape of the bacterial community, facilitating detailed analysis of microbial diversity, gene content, and potential functional capabilities.



Biomolecule production

The biomolecule production platform includes a high-throughput microbioreactor equipped with different modules for working with light, anaerobiosis or modulated O_2 conditions, for the rapid optimization of photosynthetic and fermentation processes. Further scale-up is enable by a set of microalgal and bacterial cultivation systems.

The goal is to exploit the metabolic versatility of microorganisms to produce high-value metabolites (e.g. carotenoids and phenolic compounds).

Protein purification and structure determination

Recombinant protein is expressed in bacterial (*E. coli* BL21, Shuffle, etc.) and mammalian cells systems (HEK293F, Expi) and is purified by affinity, ion exchange, hydrophobic and/or size exclusion chromatography.

Protein structures are determined by X-ray crystallography and/or Cryo-EM single particle analysis.

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Fusion of satellite and airborne imagery with Radiative Transfer Models for plant traits retrieval in ITINERIS RI sites

Jose Luis Pancorbo[1]*, Carlos Camino[2], Paul Mille[3], Giandomenico De Luca[1], Lorenzo Genesio[1], Nicola Arriga[2], Miguel Quemada[4], María Dolores Raya-Sereno[4], Flor Álvarez-Taboada[3], Federico Carotenuto[1], Pieter S.A. Beck[2], Beniamino Gioli[1]

1 Consiglio Nazionale delle Ricerche—Institute of BioEconomy (CNR-IBE), Sesto Fiorentino, Italy.

2 Joint Research Centre (JRC), European Commission (EC), Ispra, Italy.

3 School of Agrarian and Forest Engineering, Universidad de León, León, Spain.

4 Department of Agricultural Production, Universidad Politécnica de Madrid, Madrid, Spain

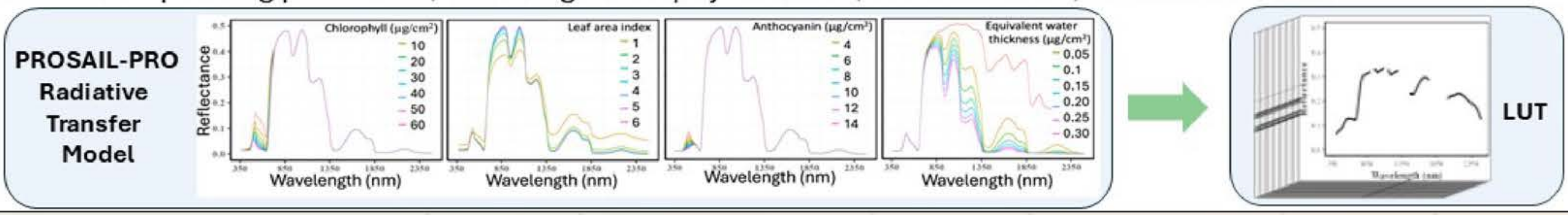
* Corresponding author: joseluis.pancorbodeonate@cnr.it

Introduction:

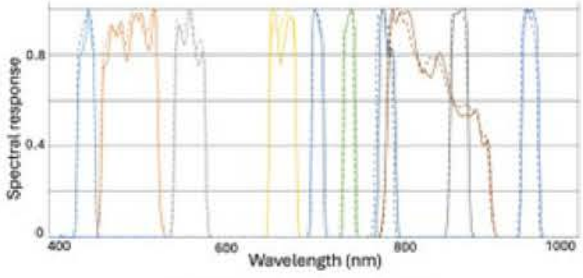
A hybrid inversion model integrating Machine Learning (ML) and biophysical radiative transfer models is proposed to monitor the spatio-temporal variability of plant traits using surface spectra reflectance. The model will be released as the R package ToolsRTM compatible with a wide range of multispectral and hyperspectral sensors.

Materials & Methods: Hybrid Machine Learning – Radiative Transfer Model

i) A Look up Table (LUT) is created using a radiative transfer model simulating various reflectance spectra with their corresponding plant traits; including chlorophyll content, leaf area index, or water content.

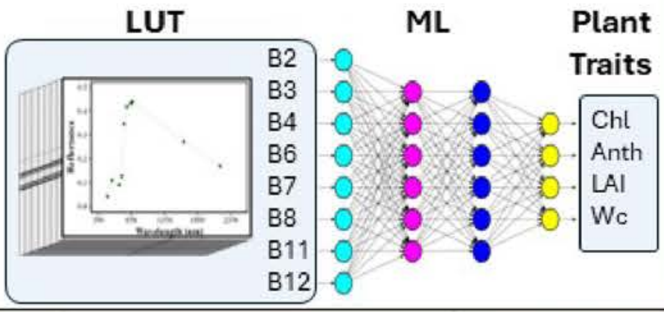


ii) Convolution of the LUT spectra to the sensor bands based on the spectral response function (SRF).

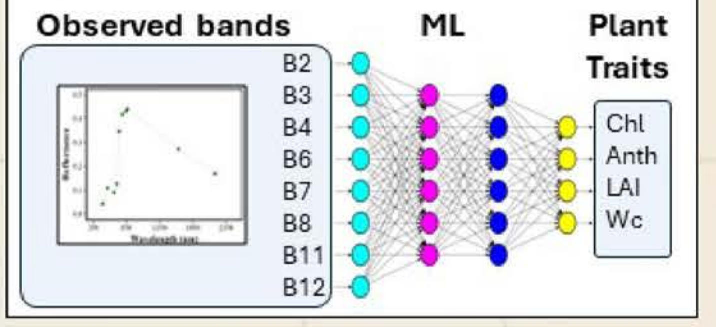


SRF of Sentinel-2

iii) A ML model is built with the LUT to retrieve plant traits based on spectral bands.



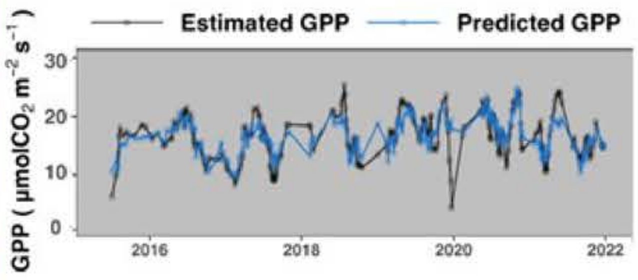
iv) The ML model is applied to the sensor bands to estimate plant traits.



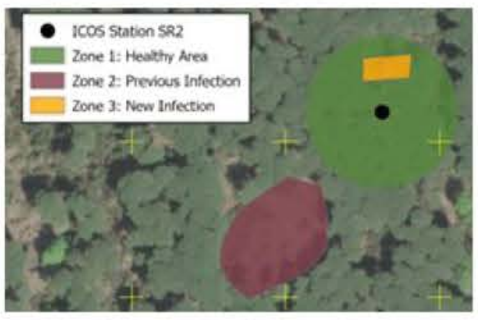
Study cases

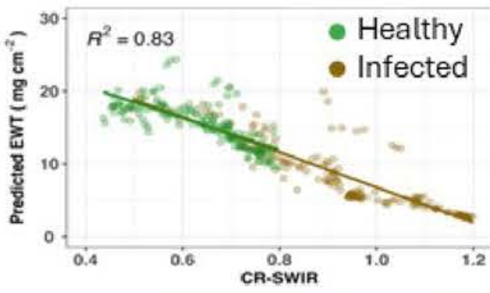
ICOS-Forest sites

Gross Primary Production (GPP): The plant traits from Sentinel-2 (S2) and PRISMA satellites time-series are validated with ground data and combined to retrieve GPP fluctuations on 13 ecosystem ICOS sites.



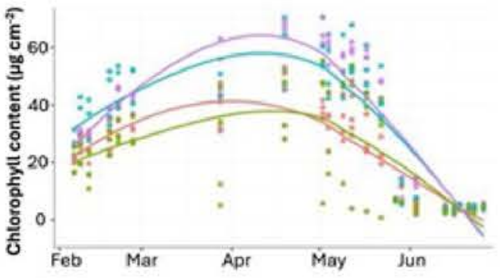
Early biotic infection detection: Plant traits from S2 and PRISMA in San Rossore showed early sensitivity to *fomes fomentarius* outbreak.

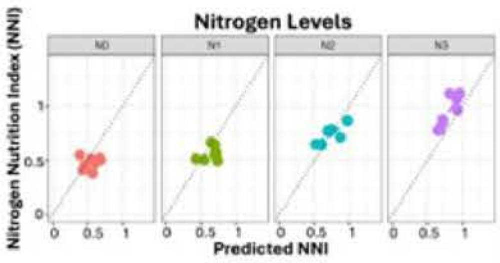




Agricultural sites

Optimizing N fertilization: Winter wheat traits from S2 matched physiological stages and ground data. Their combination identified N status. (Under review).





Deployable UAV: The hybrid model will be applied to hyperspectral 400-2500 nm images collected with an UAV. Agricultural and forest study sites from ITINERIS will be selected based on FOR2N meta database.

AnaEE | ICOS Integrated Carbon Observation System | eLTER | …

Conclusions:

The hybrid model through ToolsRTM is applied to S2 and PRISMA images to retrieve the spatio-temporal variability of plant traits. The transferability of the model is validated in winter wheat crops and in evergreen needleleaf, deciduous broadleaf, and mixed forests. The retrieved traits were sensitive to a fungus outbreak, and their combination can be used as proxy of plant health by estimating GPP and N status. Improved results are expected in the UAV images due to its enhanced spectral and spatial resolution.

Acknowledgments:

This study made use of PRISMA Products of the Italian Space Agency (ASI), delivered under an ASI License to use, and was made possible by the funding support of: the agreement ASI-CNR, n. 20195HH0 "Attività scientifica di CAL/VAL della missione PRISMA - PRISCAV"

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Investigation on the Impact of Ozone on Plants: Analysis of Visible Foliar Damage in an Experimental Infrastructure (Free air O_3 eXposure - FO3X)

Marra E., Hoshika Y., Moura B.B. , Manzini J., Viviano, A., Lazzara, L., Paoletti E.

(CNR, Italy)

Tropospheric Ozone (O_3)

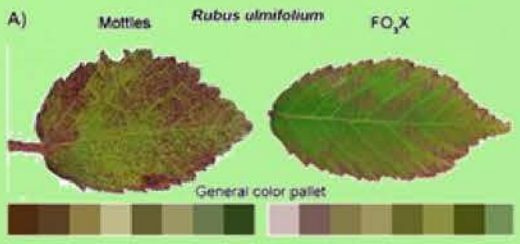
Toxic oxidative air pollutant with significant detrimental effects on natural vegetation and crop species. The high ozone concentrations observed in the Mediterranean region during summer, it is crucial to extend our knowledge on the possible damages.

FO_3X – Free-air O_3 exposure

Multidisciplinary ecosystem-level manipulative research facility to assess the effects of O_3 and other stress factors on vegetation under open-air conditions. Ensures long-term operability, fully replicated treatment plot connected with state-of-the-art ecophysiology and genomics labs and is available for undertaking new collaborative projects.

O_3 Visible Foliar Injury (O_3-VFI)

Assess the effects of only O_3 or combined with other stressors on plant attributes (drought, nitrogen, pathogens, nutrition) evaluated O_3-VFI. The findings are pivotal in understanding the effects of O3 on the morphological, structural, and physiological features of plants.



Specie	Color code / name	
R. ulmifolius	512E10	Bracken
	C7BAA1	Coral Reef
	726B53	Peat
	8A7D47	Pesto
	62582B	Costa Del Sol
	8E9457	Green Smoke
	4C5513	Saratoga
	2F481C	Clover

O_3 Critical Levels (CLs)

The United Nations Conventions on Long-Range Transboundary Air Pollution (CLRTAP) adopted O_3 critical levels (CLs) to estimate the cumulative O_3 stomatal flux (F_{st}) at a level that causes direct injury to vegetation (i.e. a 4% decrease in biomass). CL is calculated based on the Phytotoxic O_3 Dose above an hourly threshold y - **PODy**

Species	PODy (mmol m^{-2})	CL	Reference
Saccharum o.	POD_2	1.09	Moura et al., 2018
Quercus i.	POD_0	6.90	Hoshika et al., 2018
Quercus p.	POD_0	6.90	Hoshika et al., 2018
Quercus r.	POD_0	3.60	Hoshika et al., 2018
Populus O.	POD_4	4.60	Lu Zhang et al., 2018
Moringa o.	POD_4	1.10	Moura et al., 2021

29 Plant species fumigated at FO_3X so far:

1. *Acer platanoides* L. var. "Crimson king"
2. *Alnus glutinosa* (L.) Gaertn
3. *Arbutus unedo* L.
4. *Carpinus betulus* L.
5. *Coffea arabica* L.
6. *Cupressus sempervirens* L.
7. *Moringa oleifera* Lam.
8. *Ostrya carpinifolia* Scop.
9. *Populus × canescens* (Aiton) Sm.
10. *Populus deltoides W. Bartram ex Marshall x Populus nigra* L. clone i21
11. *Populus maximowiczii Henry x Populus berolinensis* Dipper – Oxford clone
12. *Passiflora edulis* Sims.
13. *Phaseolus vulgaris* L.
14. *Phillyrea angustifolia* L.
15. *Phoenix dactylifera* L.
16. *Pinus halepensis* Mill.
17. *Pinus pinaster* Aiton.
18. *Pinus pinea* l.
19. *Punica granatum* l.
20. *Quercus ilex* l.
21. *Quercus pubescens* Wild.
22. *Quercus robur* l.
23. *Robinia pseudoacacia* l.
24. *Rubus ulmifolius* Schott.
25. *Saccharum officinarum* L.
26. *Sorbus aucuparia* L.
27. *Ulmus minor* Mill.
28. *Vaccinium myrtillus* L.
29. *Vitis vinifera* L.

How to implement face – instruments and tools to assess and validate the O_3-VFI:

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FO3X: An Innovative Infrastructure for Studying the Effect of Ozone on Vegetation.

Lazzara L.*, Marra E., Hoshika Y., Moura B.B. , Manzini J., Viviano A., Materassi A., Fasano G., Paoletti E.

*Email: leonardo.lazzara@cnr.it

Ozone (O_3)

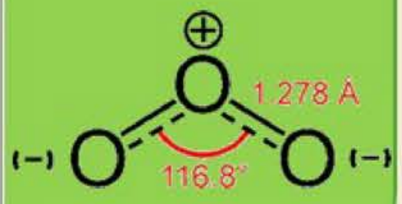
Ozone (O_3) is a secondary pollutant gas damage on vegetation occurs when O_3 enters into the stomata following gas exchanges during photosynthesis Hence, O_3 uptake is linked to plant physiology, which is strictly related to environmental conditions Ozone effects must be examined under "real conditions" to provide results useful to assess the actual risk in the field FO_3X provides this kind of responses, it is one out of the five ozone FACEs currently available in the world, and the only one in Mediterranean climate.

FO_3X – Free-air O_3 exposure

FO_3X Free-air O_3 eXposure

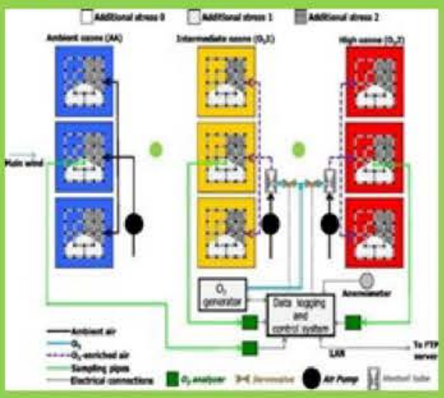
FO_3X is an innovative FACE (Free Air Controlled Exposure) system that allows to study effects of ozone pollution on vegetation under ambient conditions At present, most of results is from experiments carried out in the labs or in closed chambers, and thus under conditions that do not allow to evaluate all factors that affect ozone and plant physiology in particular the stomatal flux of ozone, which is directly related to the uptake impactsof this gas by plants.

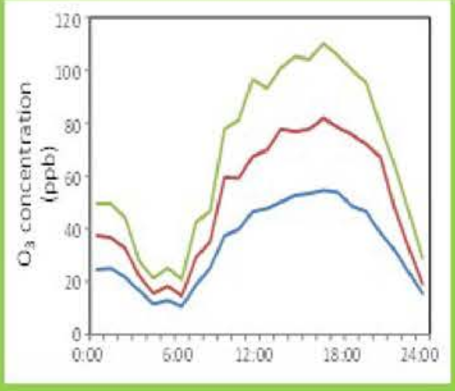
Located in Sesto Fiorentino, Italy.



Materials and methods: general

- FO_3X consists of 9 plots 5X5X2m (LXWXH)
- The design is a split-plot experiment Each O_3 treatment is replicated three times.
- A network of vertical vent pipes disperses the O_3 or ambient air across the plot to simulate treatments.





Materials and methods: specification

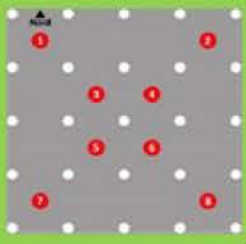
A meteorological station monitors the climate conditions (Temp., Pressure, RH, PAR, global radiation, wind speed and direction) Environmental conditions along the last 3 years (2020-2022).

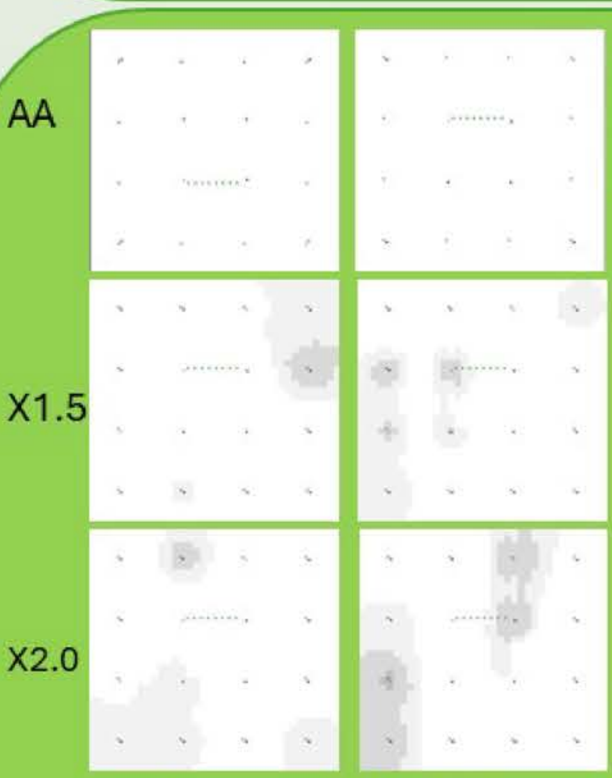
- Daily average of hourly, temperature (Temp), Air vapor pressure deficit (VPD), Daily integrated radiation.
- Daily average O_3 concentrations at AA, X1.5AA and X2.0AA

Diffusive samplers at different height

Up: 1.5 m

Botton: 0.5 m



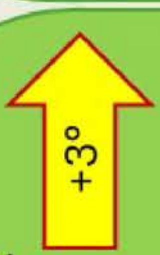


Up Bottom

With diffusive samplers it was possible to calculate the spatial concentration (below to 20%). Therefore the ozone concentration appears to be homogeneous in each plot.

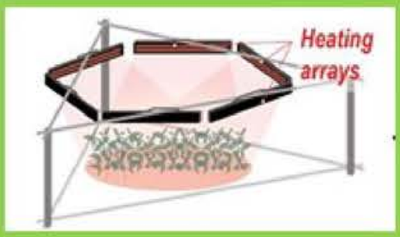
Work in progress:

Temperature Free-Air controlled enhancement



With the collaboration of Alessandro Zaldei (CNR - IBE) we are planning the use of this new technology called: Temperature Free Air Controlled Enhancement.

We will evaluate the interaction between ozone exposure and high temperatures on plant species eco-physiology.



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Stefano Di Natale[1], Enrico Fracassi[2], Elisabetta Lori[2], Paola Camilla Bressani[2], Andrea Cerofolini[3], Michele Bertoncini[3], Giulio Pandeli[3], Laura Bonfanti[3], Gianna Innocenti[2], Lorenzo Cecchi[1]

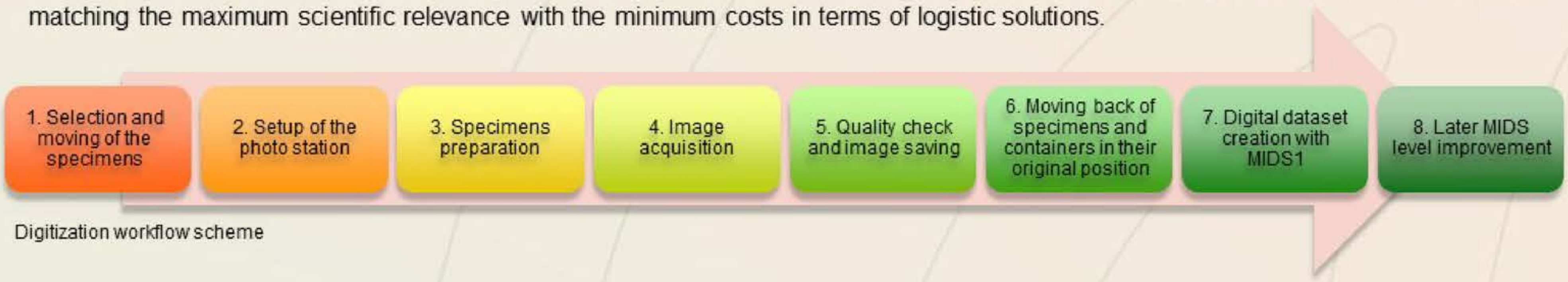
DiSSCo — NATIONAL BIODIVERSITY FUTURE CENTER

Digitization of scientific collections for understanding climate change: a case of study from the Natural History Museum of Florence

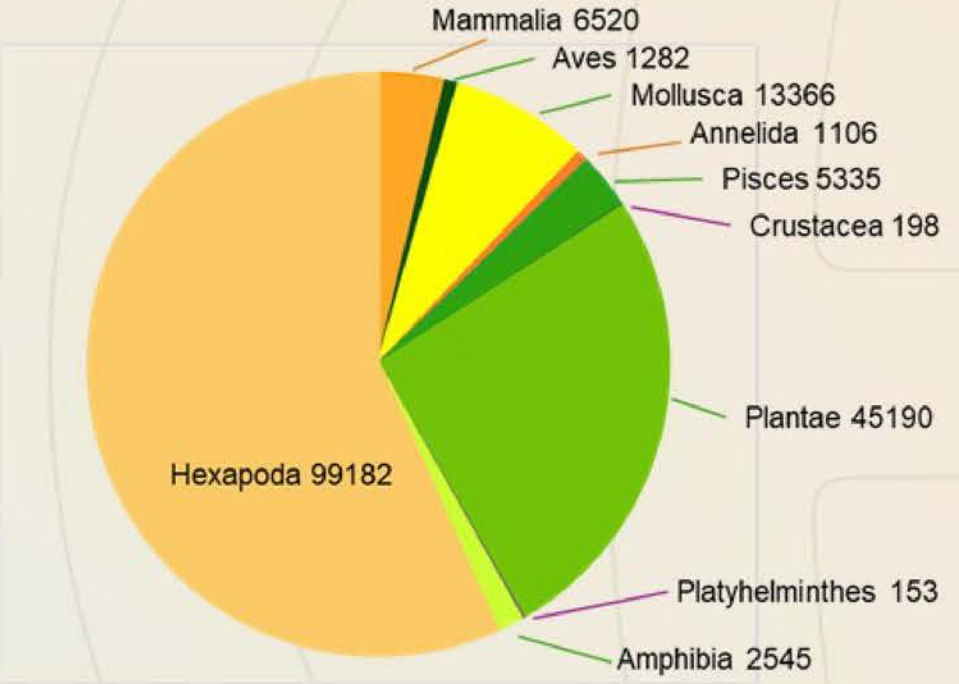
[1]Natural History Museum of the University of Florence SMA - Botanical Section "Filippo Parlatore"
[2]Natural History Museum of the University of Florence SMA - Zoological Section "La Specola"
[3]Department of Biology, University of Florence UNIFI - National Biodiversity Future Center NBFC

ABSTRACT - Digitization of Natural History Collections (NHCs) is a priority action to assess biodiversity dynamics over the widermost range of spatial and temporal variation possible. The priority way to make a change in the strategic forecasting of natural resources management, fundamental for climate change studies is to allow the sharing of as many collection data as possible. As part of ITINERIS project (WP6 6.4 activity) and of main purposes of DiSSCo RI, the Natural History Museum of the University of Florence (UNIFI-NHM) has begun an extensive work of digitization of zoological and botanical collections and, to date, more than 50% of the preset target have been achieved.

Italian NHCs hold around 30 millions specimens, 1% of which are aimed to be digitized as a pilot action within the present project activity along the 24-months "operative-phase" span with the effort of 3 fixed-term technicians and the support of other stakeholders (curators, research fellows) who were supplied with dedicated equipment. Imaging and databasing, with at least level 1 of MIDS (Minimum Information about a Digital Specimen), are aimed to be performed as much as possible focusing on climate-sensitive groups of non-marine distribution, from microorganisms to upper plants and vertebrates specimens belonging to the reference collections matching the maximum scientific relevance with the minimum costs in terms of logistic solutions.



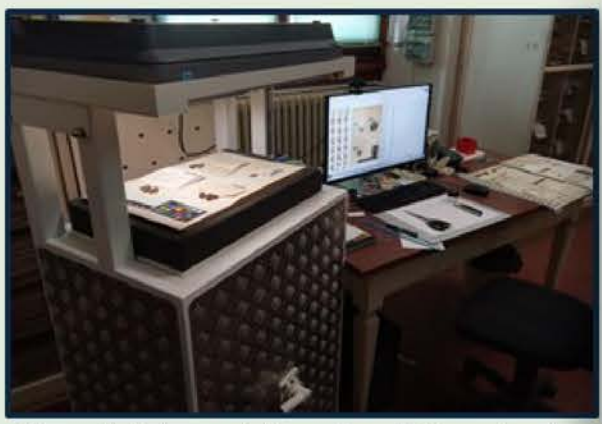
Digitization workflow scheme



The digitising station for invertebrates (a) and vertebrates (b): camera Nikon z50 with Nikkor ZDX18-140 (a, b); photostand (a); tripod (b); softbox Bresser Daylight set (a, b); colorchecker Calibrite and scalebar (a, b).

To date more than 160,000 images have been acquired, about 50% of the target, according to the timeplan with the partition of digitized specimens by taxonomic group as above.

Specimens from Verity collection and Micheli-Targioni Herbarium



The digitising station for bidimensional herbarium specimen: scanner HerbScan; colorchecker Calibrite and scalebar.

Among the digitized samples, many are part of collection of significant historical value, such as the Levier's liverwort Herbarium (ca. 20000 specimens); Micheli-Targioni Herbarium (ca. 21600); the entomological Verity collection (ca. 99000); the malacological Paulucci collection (8000 so far); the annelid Omodeo collection (1100 so far).

The digitization of NHCs allows an easier access to a lot of previously unavailable data. Once shared on an open-access platform, such as GBIF, such an enormous amount of data provides a very significant contribution to both botany and zoology and other related disciplines (i.e. climatology, ecology and geosciences). Moreover, in addition to providing a digital twin of physical specimens, digitization enables museum managers and curators to detect and address any significant conservation issues affecting the latters. Even if digitization only began one year ago, the positive outcomes are already tangible at the Florence NHM, and more "collateral benefits" for biological collections will come as the project goes on.

As part of the project, free training courses on digitization were offered to curators to involve other institutions. Several digitization equipment has been purchased and sent through bilateral agreements to institutions that hold NHCs in order to facilitate the acquisition of images and the return of digital datasets and metadata.

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IBISBA-IT: a digitalised distributed platform leveraging extremophiles for biomass valorisation in a transition towards a circular bioeconomy

Mauro Di Fenza[1], Angela Capaccio[1], Nicola Curci[1], Federica De Lise[1], Beatrice Cobucci Ponzano[1]

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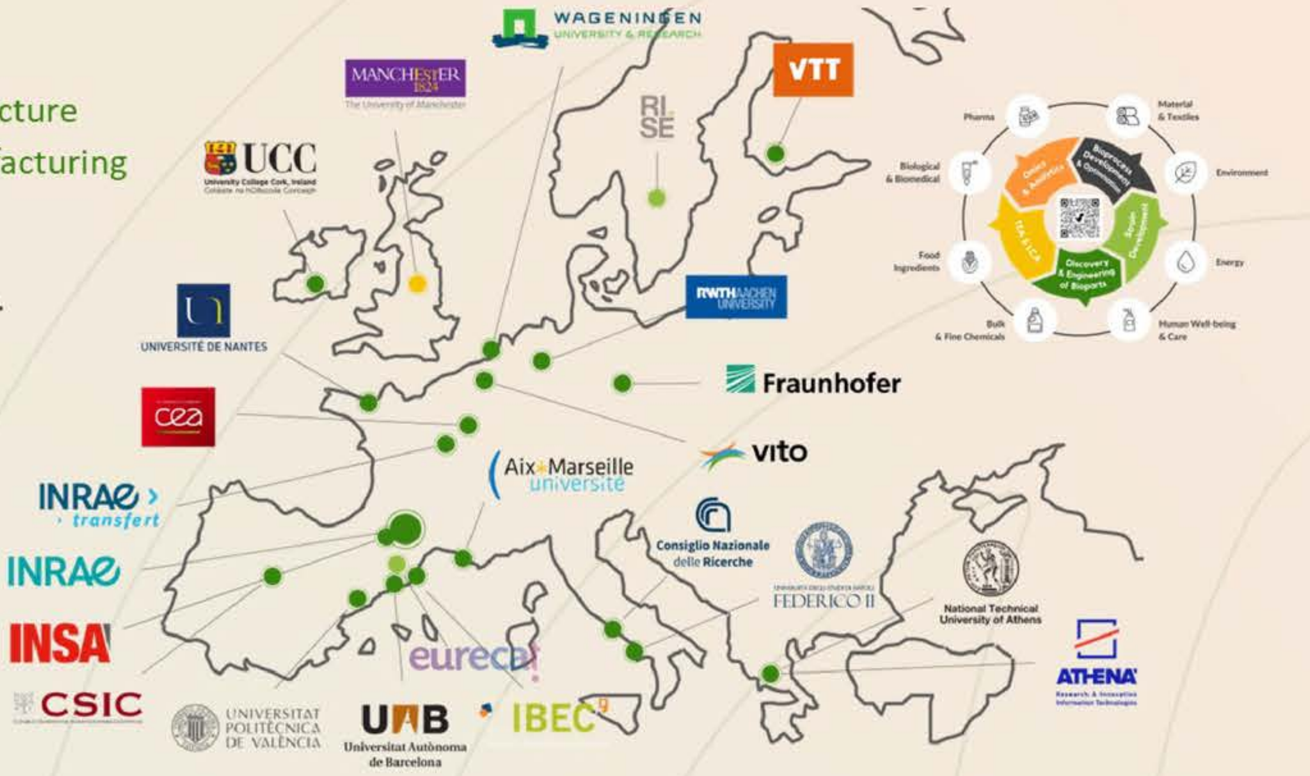

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Extremophiles are poised to play a significant role in the circular bioeconomy transition

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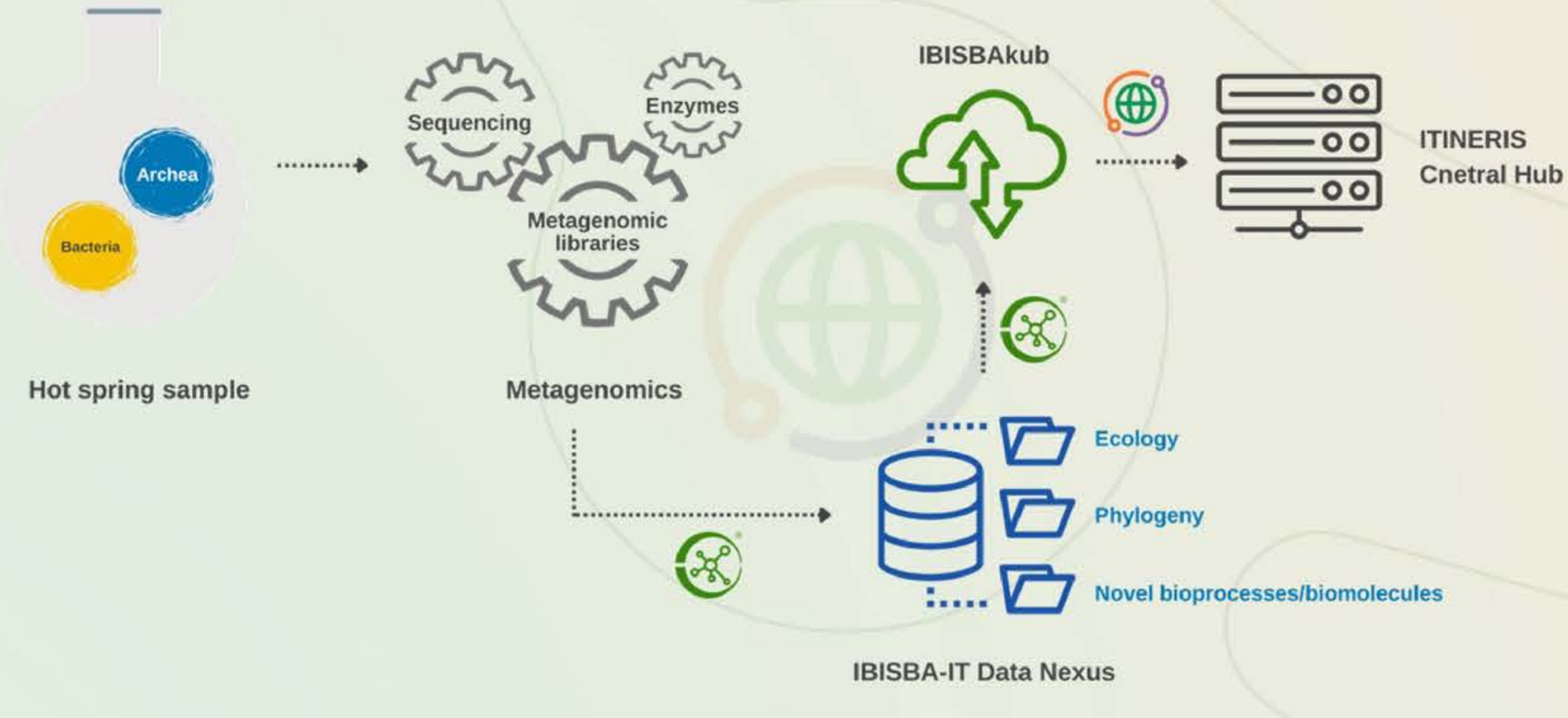

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ITINERIS

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ITINERIS meta database: A PROTOTYPE FROM FOR2N NETWORK

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BACKGROUND

Environmental data are of fundamental importance to assess and interpret the ecosystem's responses to global changes.

Data storage, preservation, accessibility, and sharing have become unpredictable actions to develop a global environmental change research that investigates the critical environmental issues and formulate specific long-term strategies and policies to predict and counteract the adverse global change effects.

Despite their value and importance, environmental data are often preserved and/or stored in a way that impedes their access and their sharing.

GOAL

ITINERIS - Italian Integrated Environmental Research Infrastructures System coordinates 22 Italian Research Infrastructures in the following domains **ATMOSPHERE, TERRESTRIAL BIOSPHERE, GEOSPHERE, HYDROSPHERE**.

One of the goals of ITINERIS is the creation of the **ITINERIS HUB**, a unique access point to the knowledge gathered in the 22 Italian Research Infrastructures covering the environmental scientific domains.

Particularly, **quality** and **rich metadata**, based on **FAIR** (**F**indability, **A**ccessibility, **I**nteroperability, and **R**euse) principles, are essential for efficient exploration and data selection from the large number of datasets expected from the **ITINERIS Hub**.

We present a metadata base elaborated from the **FOR2N network**, that studies the effects of Nitrogen deposition in forest ecosystems, which contains all qualitative and quantitative information about manipulative experiments, sensors and methodologies used to monitor biological, physical and chemical attributes.

METHODS

The metadata base implementation is based on the Model-View-Controller (MVC) architectural model, which was implemented through Spring boot, an open-source Java framework.

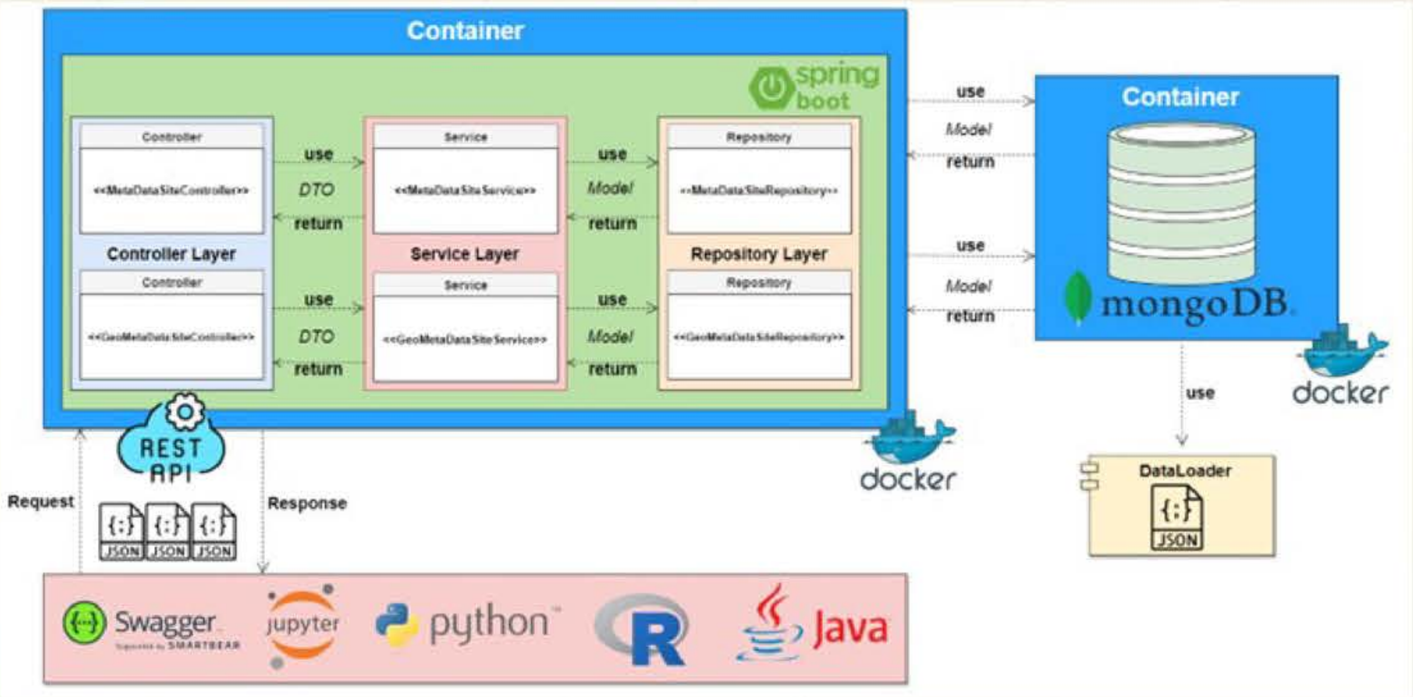
The Model-View-Controller (MVC) pattern is an architectural design pattern that separates an application into three interconnected components:

1. **Model** (Service Layer and Repository Later)
2. **View** (Swagger UI)
3. **Controller** (Controller Layer)

The **Model** represents the application's data and business logic. It is responsible for managing the data and the rules that govern it. In the implementation, the **Model** is represented by the *Service Layer* and the *Repository Layer*.

The *Service Layer* contains the core business logic, operations, and algorithms of the application.

The *Repository Layer* (Adapter or Persistence Layer), is responsible for database operation, and thus abstracts CRUD (*Create, Read, Update, and Delete*) operations.



To ensure data permanence, **MongoDB** was adopted as the solution. MongoDB is a NoSQL (i.e., non-relational) database which uses a flexible JSON-like document model to store data in collections.

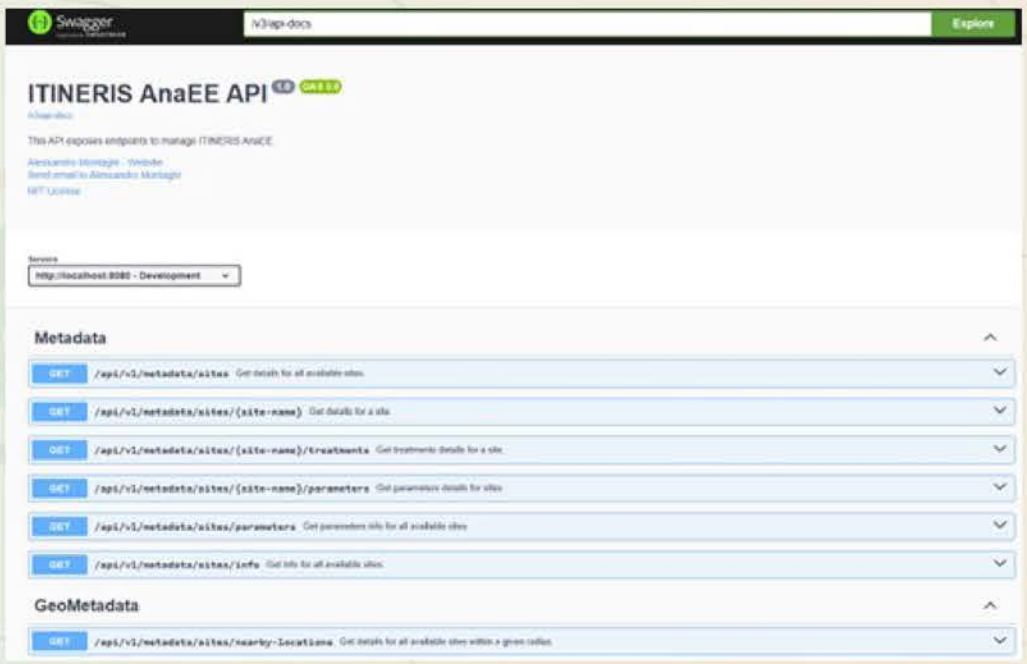
As a result, the system has been able to manage data more dynamically and scalably, since data can be added and modified without first defining a schema. The **View** represents the presentation layer and is responsible for displaying the data to the user. It handles user interface elements and rendering. In the metadata base the view is implemented using **Swagger UI**.

The **Controller** acts as a middle layer between the **Model** and **View**. It receives user input, processes it, and manages the flow of data between the Model and View. In Spring boot, the controllers handle user requests, manage the interaction between the Model and View, and control the application's flow.

Endpoints are exposed through the controller according to the RESTful APIs (Application Programming Interface) specification. By using the exposed endpoints, a user can request and receive JSON-formatted information directly from the system.

Swagger UI is an open-source tool that helps to visualize and interact with the REST APIs. Swagger UI helps to explore and test RESTful APIs created, by providing a user-friendly interface for developers or consumers to browse API documentation, test API endpoints, and observe with different parameters and options.

More experienced users can query the information via endpoints in major programming languages such as Python, R, and Java, integrating this information into their scientific analysis workflow.



CONCLUSION

The prototype of the metadata base proposed is in constant amelioration given the continuous communication with the responsible and the team members actively involved at each of the research infrastructures. The creation of the metadata base constitutes the first concrete action for conducting harmonization, standardization and sharing of data, outcomes and processes of the ITINERIS Research Infrastructures and a first step in the building of **ITINERIS Hub.**

FOR2N site information:
Monticolo – unibz - maurizio.ventura@unibz.it **Cembra** – FEM - damiano.gianelle@fmach.it
Cansiglio – UNIBO - r.guerrieri@unibo.it; federico.magnani@unibo.it **Collelongo** – IBE CNR - francesco.mazzenga@cnr.it, alessandro.messeri@cnr.it

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Protocol for advanced ecophysiological and microclimatic monitoring, through the use of Tree Talkers and Thermal Cameras, in some Italian forest ecosystems

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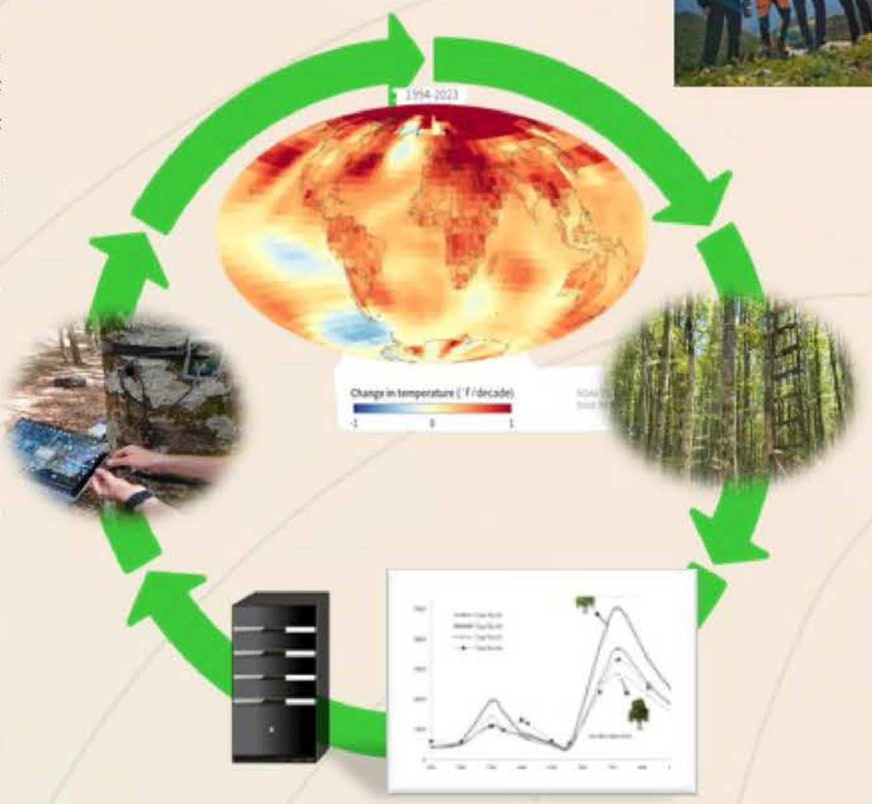
Introduction

The research infrastructures involved in the WP6 ITINERIS activities aim to increase knowledge on the impact that climate changes have on ecosystems, on the loss of biodiversity, land degradation and pollution. The improvement in the monitoring activities of Essential Variables (EVs) has a key role to implement the ecosystems dynamics understanding. For this reason, the measuring devices improve in eLTER, AnaEE and ICOS sites is scheduled to fill gaps in the ecophysiological, phenological and microclimatic continuous and real time monitoring at both population and individual plant levels. Canopy skin temperature and sap flow variations in relation to climate and anthropogenic disturbance are little monitored.



Objectives

- Improve the instrument equipments in eLTER, AnaEE and ICOS networks (**Figure 1**)
- Impact evaluation of climate change and anthropogenic factors on gas exchange processes between atmosphere and biosphere through the study of the canopy skin temperature, sap flow, trunk radial growth
- Provide usefull information for phenological development stages estimation and tree growth
- Use ground-based data to calibrate remote sensing data
- Setup of a multi-year dataset shared in the ITINERIS HUB through FAIR principles, in different forest stands (productive, transitional, sentinel)

Material and methods

Site	Network
Valbona	eLTER
Torgnon	eLTER,ICOS
Montagna di Torricchio	eLTER
Castelporziano	eLTER,ICOS, LifeWatch
Piano Limina	eLTER, ICP Forests
Cansiglio	ICP Forest, LifeSpan, LifeManFor, CBD
Renon	eLTER,ICOS, ICP Forests
Collelongo	eLTER, AnaEE, ICOS ICP Forests

Figure 1. Forest sites involved in instrumentation improvement for ITINERIS project (Google Earth image).

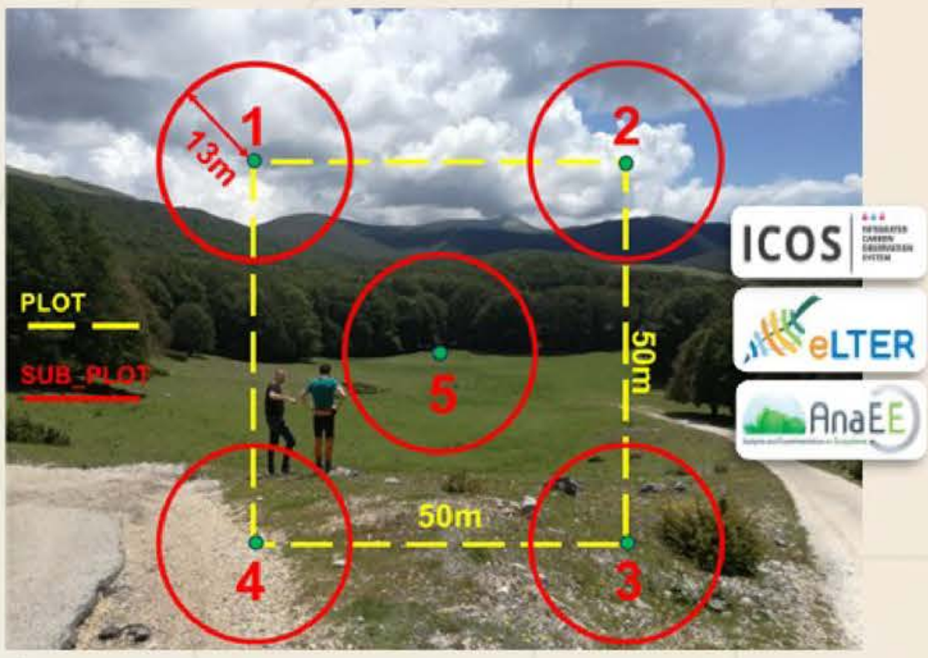


Figure 2. Survey scheme: Plot and Subplot in each study site.

Survey

- n. 5 trees will be chosen for Tree Talker (TT) installation in each of the 8 sites (1 tree/Subplot, **Figs. 2, 3, 4**) using the following criteria :
  - dominant individuals
  - target species
- n. 1 TT soil for soil moisture
- Additional monitoring:
  - Forest stand characterization
  - Deadwood components
  - Tree-related microhabitats/biodiversity
  - Soil sampling
  - Litter and seeds
  - A70 FLIR Thermal camera (**Figure 3**) will be used for skin canopy temperature monitoring

Figure 3. Tree Talker and Thermal camera that will be used in the study sites. Graph shows an example of sap flux, stem humidity and air temperature in hourly scale.

Tree Talker (TT) parameters

- Sap flow density (sap flux density (g m^{-2} s^{-1}))
- Stem moisture (%)
- Canopy light transmission - Radiometer 26 spectral bands (nm)
- Tree trunk radial growth (µm)
- Tree trunk axis movement (°)
- Air temperature (°C)
- Air humidity (%)

TT data transmission

- Wireless transmission from Tree Talker to Cloud
- LoRa-Wan method for hourly Cloud data transmission (**Figure 6**)
- Flash memory for data storage

Preliminary results

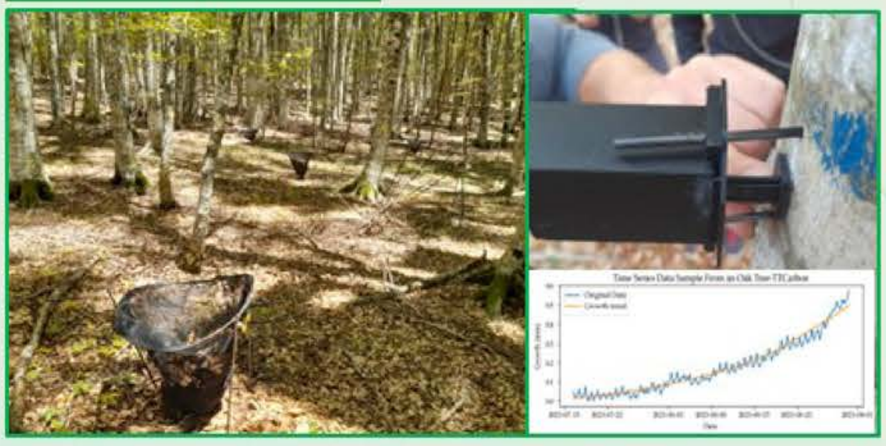


Figure 4. First survey and TT installation training in Collelongo site for AnaEE RI.

Figure 5. Synthesis paper draft of the Tree Talker Italian Group.

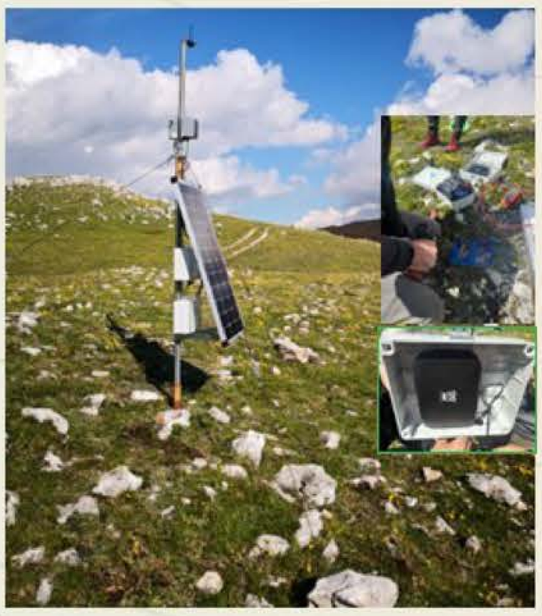


Figure 6. Cloud for TT transmission installed in Collelongo

References

Valentini, R., Belelli Marchesini, L., Gianelle, D., Sala, G., Yarovslavtsev, A., Vasenev, V., Castaldi, S., 2019. New tree monitoring systems: from Industry 4.0 to Nature 4.0. Annals of Silvicultural Research; Vol 43, No 2 (2019) – doi: 10.12899/asr-1847

Kim Y., Still CY., Hanson C.V, Kwon H., Greer B.T., Law B.E. 2016. Canopy skin temperature variations in relation to climate, soil temperature, and carbon flux at a ponderosa pine forest in central Oregon, Agricultural and Forest Meteorology, 226–227, 161-173pp. ISSN 0168-1923, https://doi.org/10.1016/j.agrformet.2016.06.001.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Advanced habitats biodiversity monitoring protocol, using camera traps and audio recorders, on eLTER network

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2 Research Institute on Terrestrial Ecosystems-National Research Council (IRET-CNR), Via Madonna del Piano, 10, 50019 Sesto Fiorentino (FI)

Introduction

The European Commission has adopted the new EU Biodiversity Strategy for 2030 (European Green Deal) and the main goal is to put the EU in a leading position in the world in addressing the global biodiversity crisis. According to the latest IPCC report, the Mediterranean basin represents one of the most important global warming hotspots with potentially increasing negative effects on ecosystem biodiversity. For this reason, a biodiversity continuous monitoring in ITINERIS international research networks (e.g. eLTER) takes on ever greater importance for assessing the global changes impact on ecosystems.

Figure 1. Instrumentations involved in the biodiversity monitoring on eLTER sites.

Objectives

The objective of the protocol is to provide guidelines for the installation of camera traps and audio recorders (audible to ultrasonic frequencies) [**Figure 1**] to monitor the response of wildlife to global changes. Particular attention will be paid to monitoring any entry of invasive species and the control of the endangered species. This research activity will be a useful tool in the management of natural resources, including the conservation of biodiversity and the sustainable management of forest ecosystems, in line with European Green Deal.

Automatic data collection systems such as camera traps and audio recorders will allow:

- mammals, birds and bats species monitoring
- wildlife activity and spatial distribution
- wildlife dataset

Figure 2. Ecophysiological and microclimatic monitoring in Collelongo (AQ).

Material and methods

The biodiversity survey will be carried out in the sites [**Figure 3**] also involved in ecophysiological and microclimatic monitoring [**Figure 2**]. Sample size and devices density will be defined considering Natura 2000 habitats and target species. In the survey will be installed:

- N. 70 Browning Spec Ops Elite HP5 camera traps (128 Gb storage card capacity)
- N. 8 Audiomoth v1.2.0 full-spectrum acoustic logger (128 Gb storage card capacity)

Site	Network
Valbona	eLTER
Torgnon	eLTER,ICOS
Montagna di Torricchio	eLTER
Castelporziano	eLTER,ICOS, LifeWatch
Piano Limina	eLTER, ICP Forests
Cansiglio	ICP Forest, LifeSpan, LifeManFor, CBD
Renon	eLTER,ICOS, ICP Forests
Collelongo	eLTER, AnaEE, ICOS ICP Forests

Figure 3. Forest sites involved in biodiversity monitoring for ITINERIS Project.

Site equipment

- 1 camera trap in the Tree Talker Italian Network test areas (1 ha)
- 9 camera traps arranged to maximize the number of habitats monitored (e.g. open land, forest stands, anthropized areas)
- 1 audio recorder [acustic and ultrasound *f*] in Tree Talker Italian Network test areas (1 ha)

Guideline for the installation

Camera traps

- looking for animal tracks and signs
- camera traps could be placed randomly with respect to the spatial distribution of animals or with an opportunist selection
- terrain morphological characteristics and target species must be considered [**Figure 4**]
- potential limitations (privacy regulations, fences)

Audio recorders

- avifauna characteristics (migratory/sedentary)
- chiropterans behaviour (hibernation)
- terrain morphological characteristics and target species to consider

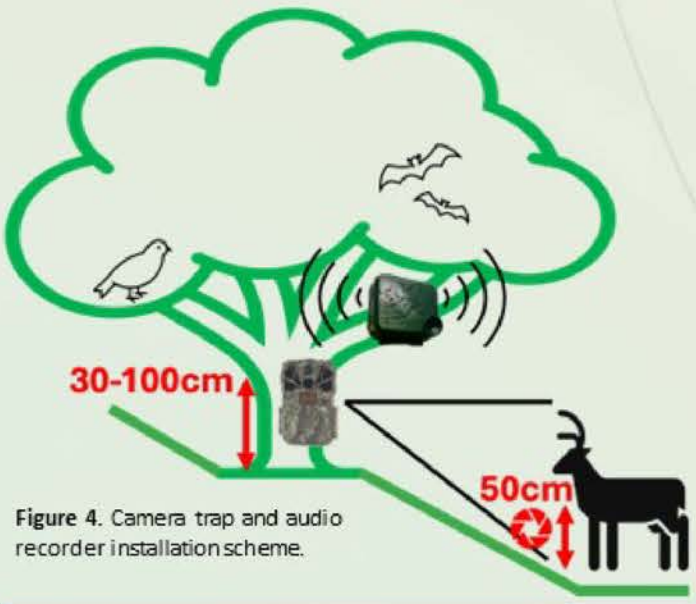

Figure 4. Camera trap and audio recorder installation scheme.

Attending results

Data recorded [**Figura 5**] will be periodically downloaded, stored and backed up in the ITINERIS data HUB [**Figure 6**]. Software tools for automated identification of animal species will be tested.

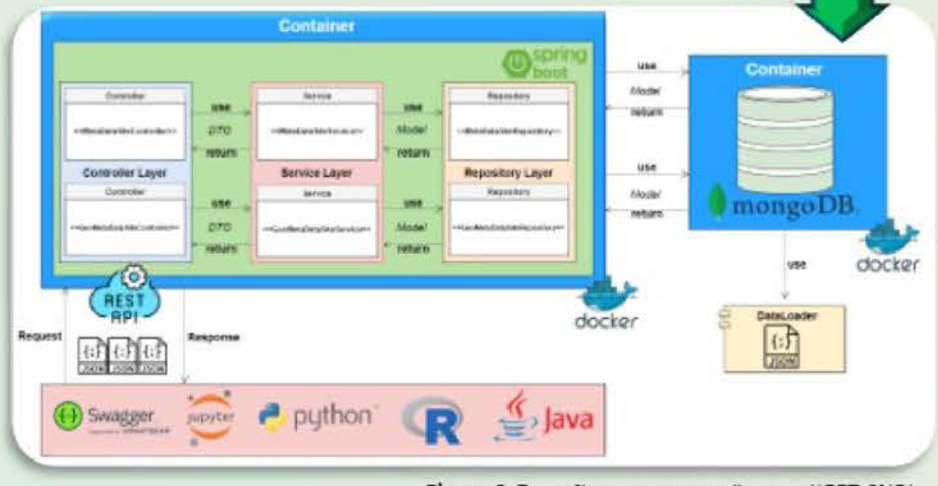

Figure 6. Data flow prototype diagram (IRET-CNR).

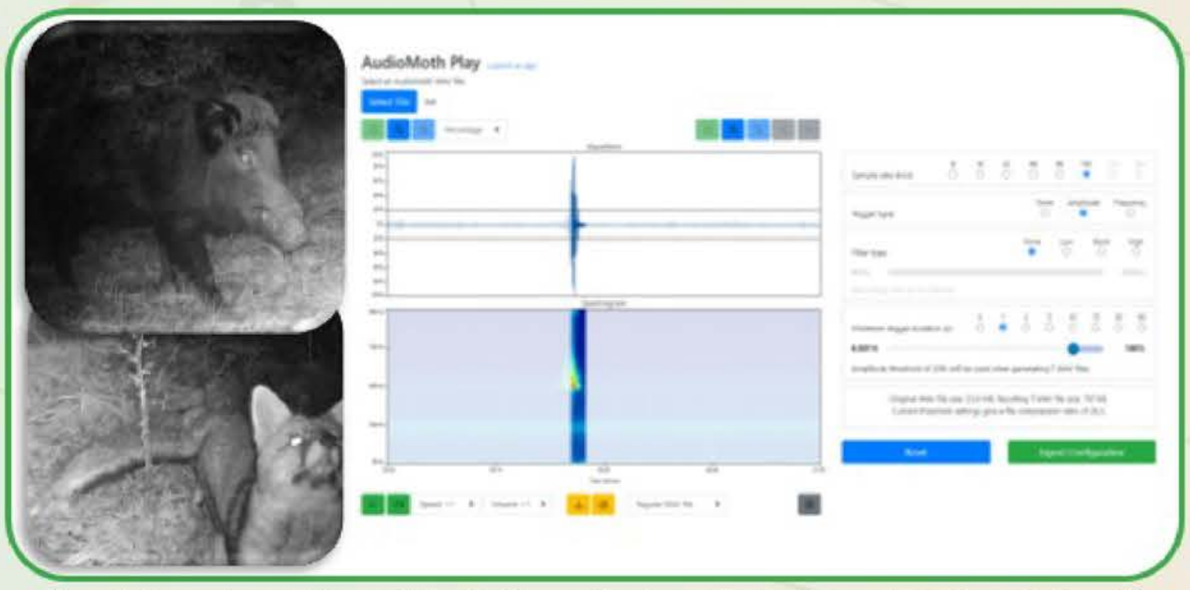

Figure 5. Camera trap night images (photo by S. Lapucci) and example of audio recording (software Audiomoth).

References

IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647.

Commissione europea, Direzione generale dell'Ambiente, EU biodiversity strategy : bringing nature back into our lives, Ufficio delle pubblicazioni, 2020, https://data.europa.eu/doi/10.2779/9896

Farrell A., Banelyte G. G., Rogers H.M.K., Lehikoinen P., Kerdraon D., Hardwick B., 2023. Lifeplan Audio Recording Protocol. protocols.io https://protocols.io/view/lifeplan-audio-recording-protocol-c4nqyvdw.

Tessa Rhinehart. (2021). rhine3/audiomoth-guide: 2021-06-17 (v3.0.0). Zenodo. https://doi.org/10.5281/zenodo.4976243

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Foraminifera Natural Science Collection: a multiyear repository of biodiversity data from the Northern Adriatic Sea

Roberta D'Onofrio (1*),Luciana Ferraro (2), Laura Giordano (2), Francesco Riminucci (3), Lucilla Capotondi (3)

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Role of DiSSCo and ITINERIS WP6.6 Activity in HARMONISING and SHARING biodiversity data

ITINERIS Activity WP6.6 — Aims to build a service to support RIs data usage for documenting the present and the past biodiversity status and providing solid foundations for observing the changes taking place in Terrestrial + Fresh/Transitional waters.

DiSSCo Distributed System of Scientific Collections — DISSCO is a Research Infrastructure (RI) for Natural Science Collections (NSC) which aims to digitally unifies all European Collection stored in Museum, University and Research Institute, sharing common policies and practices on access, curation, digitation. All the data complies with FAIR principles (Fig. 1).

Provides biodiversity (meta) data linked to NSCs focusing on the concepts of the **EXTENDED DIGITAL SPECIMEN (a dinamyc «box» in which collecting links to all core information about a physical object)** as identified by **MIDS - Minimum Information on Digital Specimens** levels (Fig. 2). The goal is to produce a easily readable and usable catalogue of information associated with the digital specimens that can be continuously updated and published on open access portals for biodiversity data.

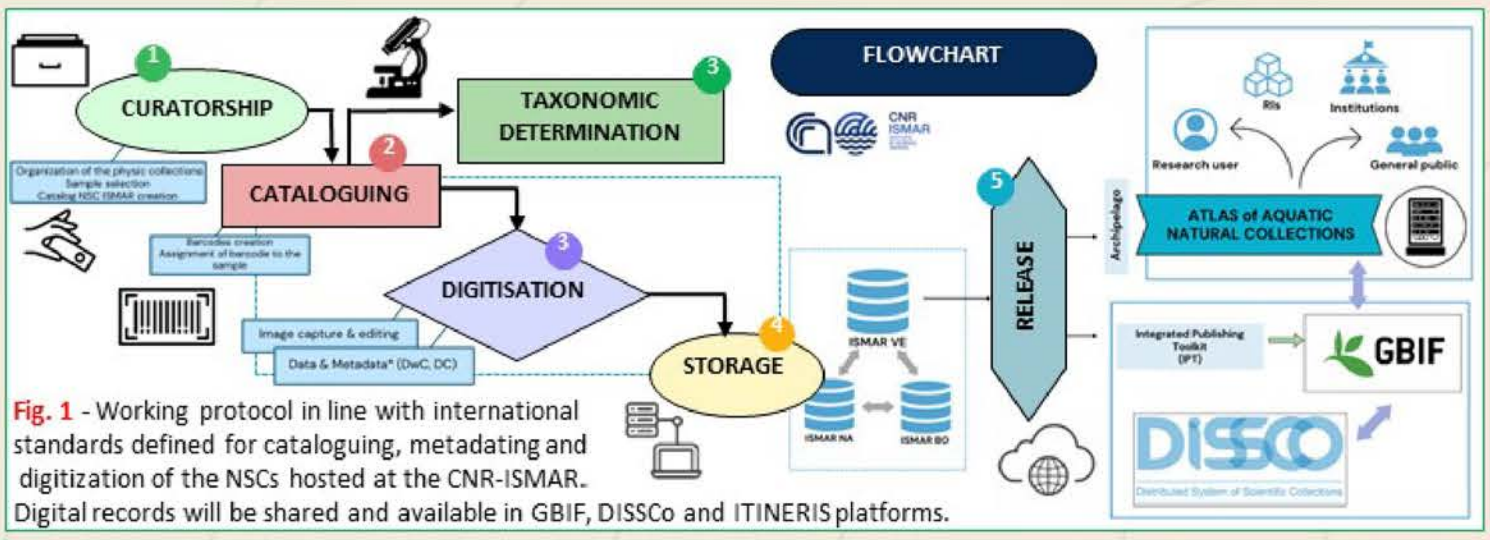
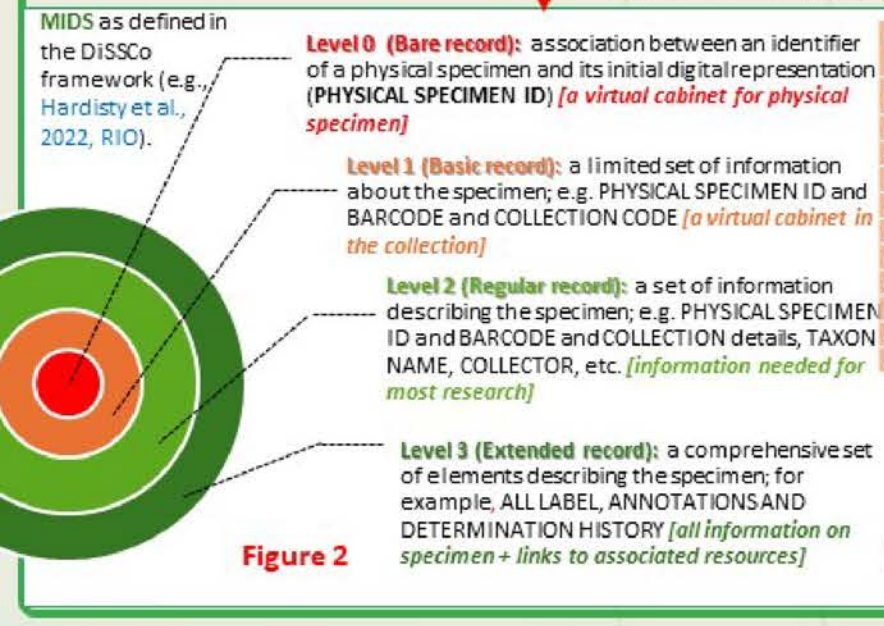
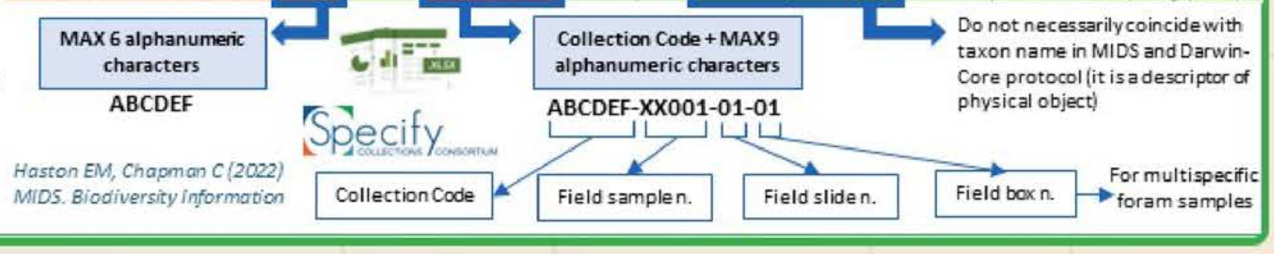


Fig. 1 - Working protocol in line with international standards defined for cataloguing, metadating and digitization of the NSCs hosted at the CNR-ISMAR. Digital records will be shared and available in GBIF, DISSCo and ITINERIS platforms.

Fig. 2 - Scheme of **MIDS** (left) a digitisation/cataloguing standard tool implying an increase in information complexity from level 0 to 3 and example of protocols (right) defined for cataloguing and metadating the NSCs hosted at the CNR-ISMAR.



Institution Code	Institution collection	Catalog Code (ID)	Collection Code	Serie (ID)	Specimen ID	Specimen Type (basisOfRecord)	Label	First taxonomic identification	Author/Year
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 00	PreservedSpecimen	Mantenimento Boa LTer E1-04/12/2018	Foraminifera	d'Orbigny, 1826
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 01	PreservedSpecimen	*Bolivina striatula*	*Bolivina striatula*	Cushman, 1922
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 02	PreservedSpecimen	*Bolivina variabilis*	*Bolivina variabilis*	(Williamson, 1858)
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 03	PreservedSpecimen	*Nonionella sp.*	*Nonionella sp.*	Cushman, 1926
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 04	PreservedSpecimen	*Nonionella sp.*	*Nonionella sp.*	Cushman, 1926
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 05	PreservedSpecimen	*Cibicides refulgens*	*Cibicides refulgens*	Montfort, 1808
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 06	PreservedSpecimen	*Bulimina elongata*	*Bulimina elongata*	d'Orbigny, 1846
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 07	PreservedSpecimen	*Bulimina aculeata*	*Bulimina aculeata*	d'Orbigny, 1826
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 08	PreservedSpecimen	*Reophax nana*	*Reophax nana*	Rhumbler, 1913
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 09	PreservedSpecimen	*Eggerelloides scabrum*	*Eggerelloides scabrum*	(Williamson, 1858)
CNR ISMAR	PAL	ISMARBO P	NAdFC	NAdFC 2018	NAdFC 18 SOS 01 10	PreservedSpecimen	*Ammonia parkinsoniana*	*Ammonia parkinsoniana*	(d'Orbigny, 1839)



Haston EM, Chapman C (2022) MIDS. Biodiversity Information

Biotic and Abiotic Record of the Cross RIs North Adriatic Foraminifera Collection (NAdFC)

N Ad F C North Adriatic Foraminifera Collection = DiSSCo + eLTER

The North Adriatic Foraminifera Collection (NAdFC) hosted at the CNR-ISMAR, **is an example of ITINERIS Cross RIs Case Study** as the related **biodiversity archive**, based on physical foram specimens, has been built **in synergy with Long Term Ecosystem Research (LTER)** remote sensing observations **by adopting the DISSCO EXTENDED DIGITAL SPECIMEN concept** in order to **harmonise physical and digital objects and the related meta(data).**

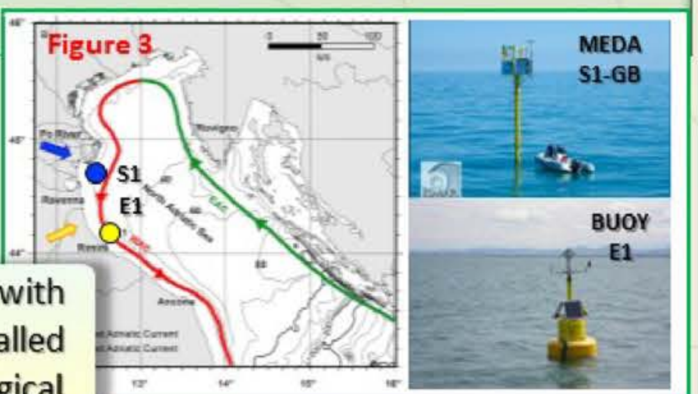


Fig. 3 - North Adriatic circulation pattern (modified from Giani et al., 2012) and location of the two autonomous meteo-marine systems (buoy E1, yellow circle, located in the Rimini off-shore and meda S1-GB, blu circle, south of the Po river Delta) installed at the "Delta del Po e Costa Romagnola" LTER Site in the Nort Adriatic Sea. Foram samples of the NAdFC has been collected in different time slice at the sea bottom of S1 and E1 LTER stations.

The digitization, archiving and storage of biological foraminiferal data (Fig. 4) together with environmental data (Fig. 5) provided by the two autonomous meteo-marine systems installed at the LTER stations E1 and S1-GB, allow to understand long-term ecosystem and ecological dynamics in a crucial Adriatic area affected by increasing urbanisation and tourism and strongly influenced by the Po river inputs. These informations are essential in predicting long-term consequences of human-induced environmental changes (also in terms of restoration action).

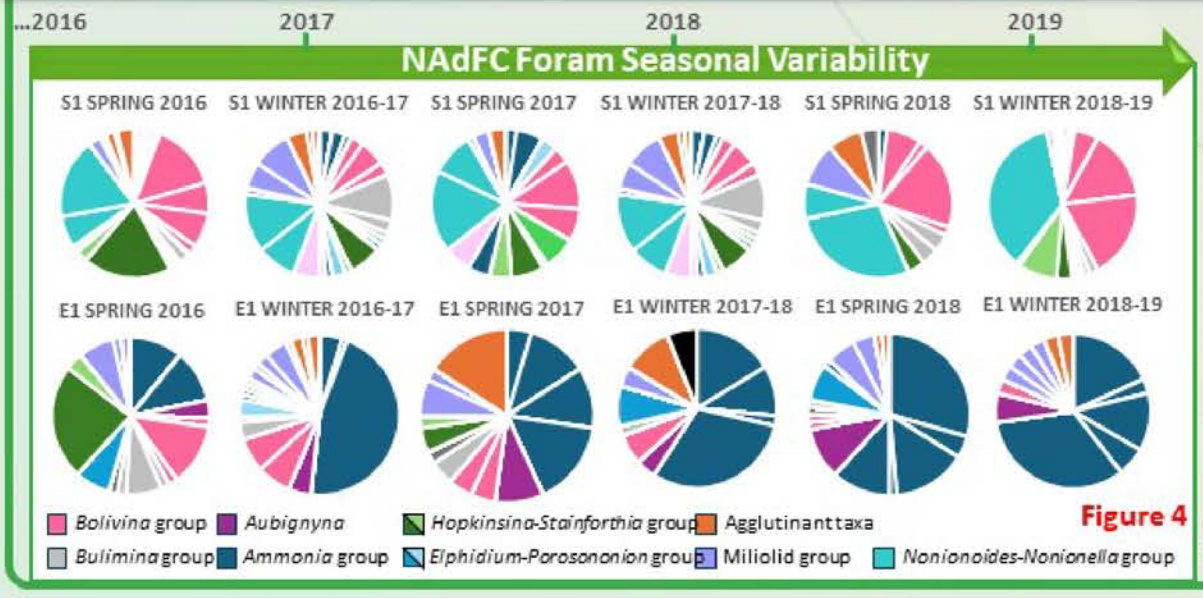
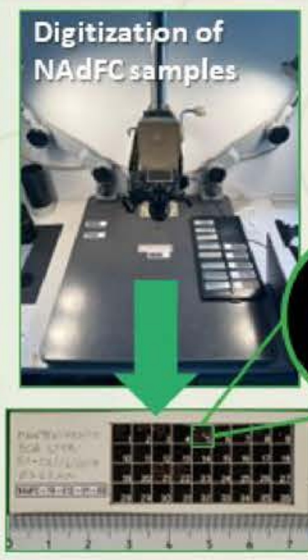


Figure 4



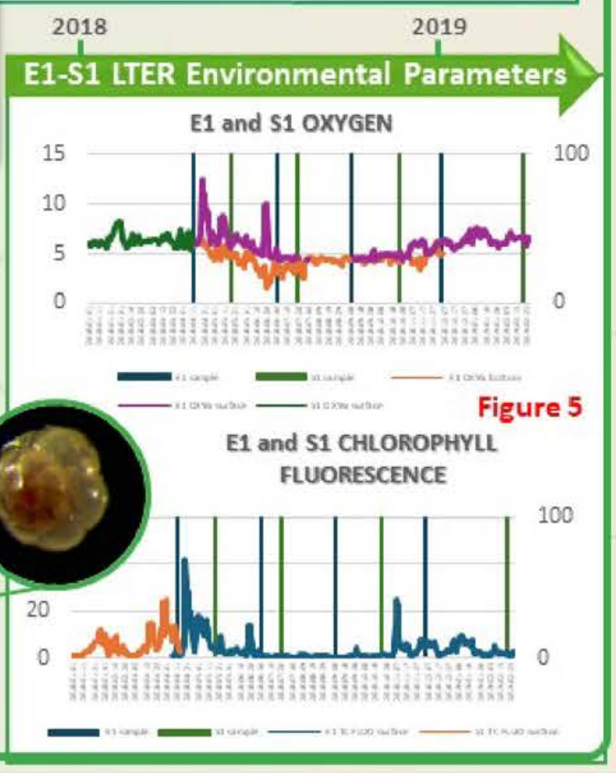


Figure 5

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The activities for the national network of Aquatic Science Collections (ASCs)

Di Russo E.[1*], Armeli Minicante S.[1], Cislaghi S.[2], D'Onofrio R.[1], Buffagni A.[2], Camatti E.[1], Capotondi L.[1], Cazzola M.[2], Cecere E.[2], Conese I.[1], Erba S.[2], Ferraro L.[1], Fontaneto D.[2], Giordano L.[1], Grande V.[1], Guarneri I.[1], Maggiore F.[1], Papa L.[2], Petrocelli A.[2], Sigovini M.[1], Spada L.[2], Zaupa S.[2]

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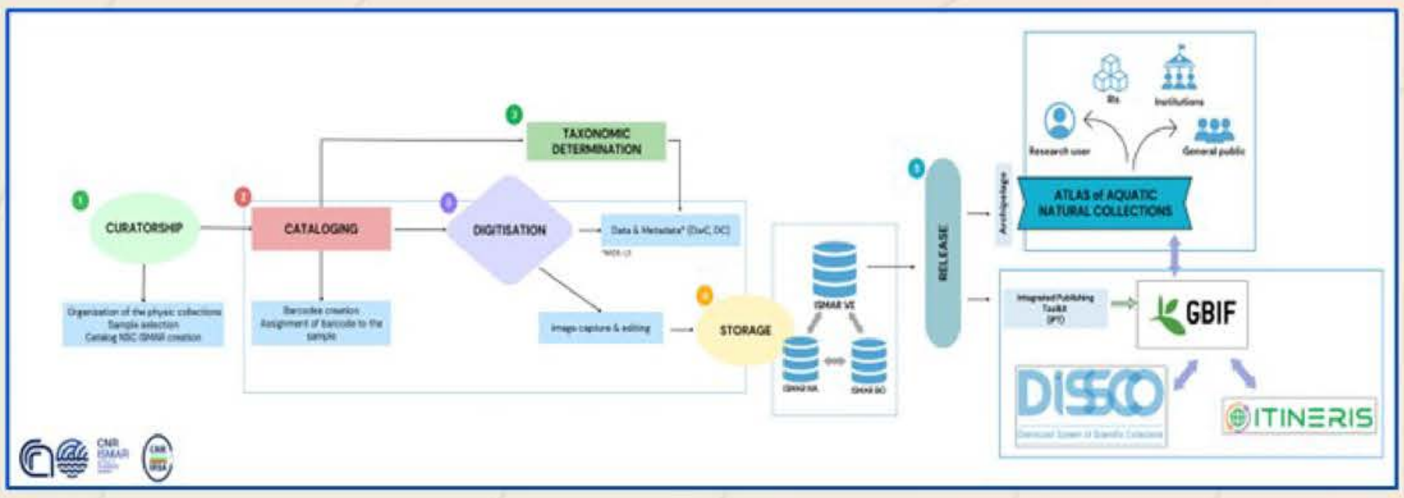
The Activity WP6.6 provides biodiversity (meta)data linked to Acquatic Science Collections (ASCs) focusing on *the extended digital specimen*, a virtual representation of the physical specimen stored in a collection and identified by different levels of MIDS and additional information (e.g. images and video, codification of functional traits, environmental parameters).

In this context, ASCs preserved in the Institute of Marine Science (CNR-ISMAR) and the Water Research Institute (CNR-IRSA) were selected. Here first results of the activity are presented.

Working protocols have been defined for the cataloguing, metadating and digitization of the ASCs hosted in CNR-ISMAR and IRSA, and in line with international standards. The digital records will be deposited in GBIF platform and available to DiSSCo and ITINERIS Hubs.



Items of the ACSs involved in the ITINERIS project

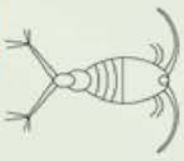
Marine Collections

Crustacea (c): 10000 specimens

Fitobenthos (fi): 2250 specimens

Foraminifera (fo): 6000 specimens

Other macroinvertebrates (mi): 1500 specimens



Zooplankton (z): specimens under evaluation

Freshwater Collections

Tardigrada (t): 4500 specimens

Invertebrates (i): 2000 specimens

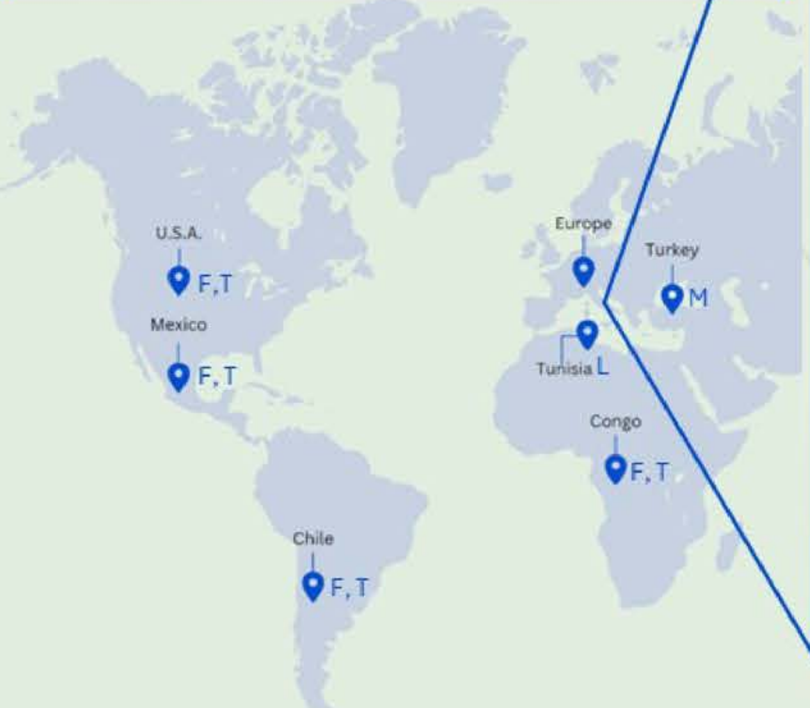
Ephemeroptera (e): 50 microscopic slides

The numbers of specimens refer to the potential size of the entire collection. In ITINERIS we started with the digitization of subsets for each collection

Distribution of items

M: Marine; F: Freshwater; L: Lagoon; T: Limno-Terrestrial

European countries:
Austria (Ft); Croatia (Mcmi); Denmark (Mcmi); Finland (Ft); France (Ft); Germany (MFtmi); Iceland (Ft); Netherlands (Mmi); Norway (Ft); Poland (Ft); Romania (Mt); Spain (Ftmi); Sweden (MFtmi); Switzerland (Ft)



Main areas of origin:

1. Lagoon of Venice (MLc,fi,mi,z,t)
2. Po Delta (Mfo)
3. Rimini shore (Mfo)
4. Ancona shore (Mfi)
5. Lagoon of Lesina (Lmi)
6. Mar Piccolo of Taranto (Mcfi)
7. Faro Lake (Lmi)
8. Lagoon of Mistras (Lmi)
9. Ligurian Sea (Mmi)
10. Linosa (Mfo)
11. Lake Maggiore-Verbania (Tt)
12. Lake Mergozzo (Tt)
13. Po Plain (Fie)
14. Trebbia River (Fie)
15. Sa Teula River (Fie)
16. Tanagro River (Fie)

N.B. Some tardigrada come from terrestrial ecosistems in several areas of Alps and Appennine Mounts.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

The herbaria of the CNR Istituto Talassografico of Taranto "A. Cerruti": digitization and sharing activities within the DiSSCo project

Loredana Papa, Antonella Petrocelli, Lucia Spada and Ester Cecere

The digitization of natural science collections was started about twenty years ago, to make this cultural heritage usable by the scientific community. But, only recently the creation and implementation of scientific infrastructures, such as the Distributed System of Scientific Collections (DiSSCo) allowed to start a mass digitization process of biodiversity data, to make collections digital and available online. In this context, within the framework of the PNRR project "ITINERIS", the CNR-IRSA of Taranto "A. Cerruti" is involved in the digitization of two marine macroalgal herbaria: herbarium **TAR** and the historical "**Irma Pierpaoli**" herbarium.

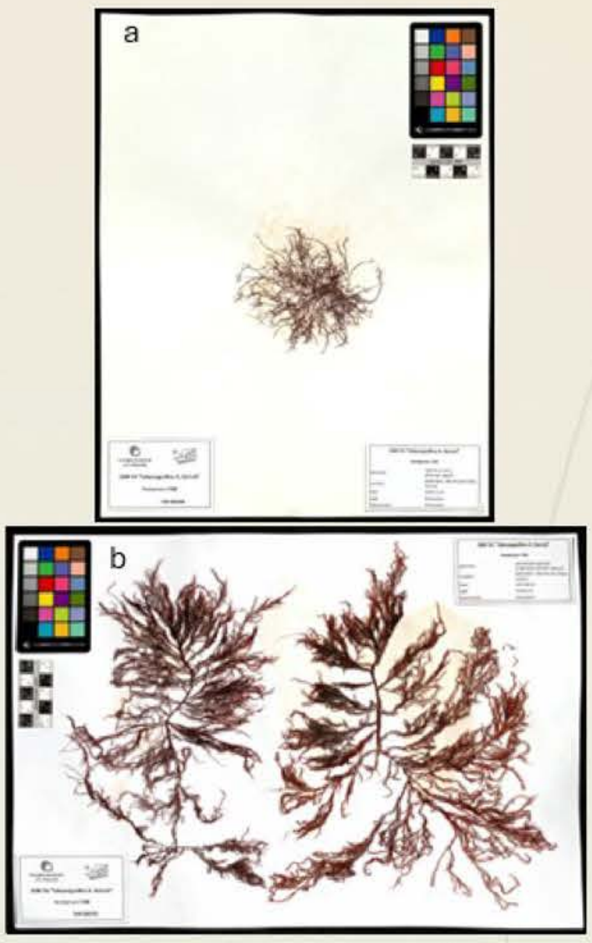

Fig. 1: Hypnea cornuta (a); Agardhiella subulata (b). Scanned with BUCAP Bookeye 5, V2

The importance of herbaria

- valorization of natural collections;
- description of algae biodiversity of the study area over time;
- evaluation of changes in algae composition due to natural and anthropogenic impacts;
- providing an historical record data in order to analyze responses to climate change;
- identification of alien species;
- increase studies in ecology, conservation biology, taxonomy and systematics, and species biology.

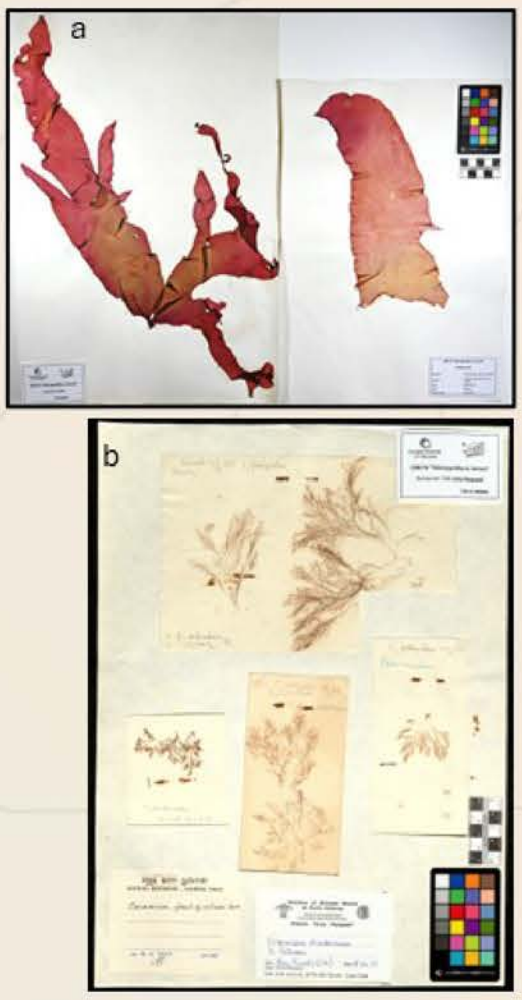

Fig. 2: Grateloupia turuturu (a). Scanned with BUCAP Bookeye 5, V2; Ceramium cimbricum (b). Captured with Nikon Z7 II.

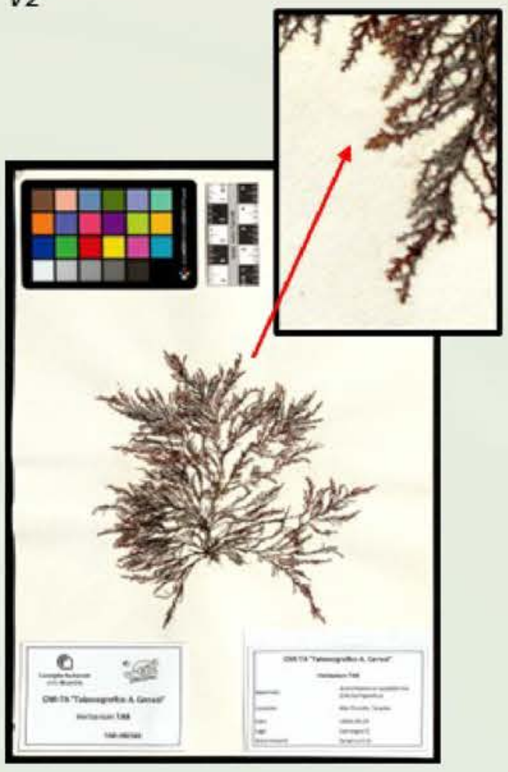

Fig. 3: Acanthophora najadiformis with vegetative propagules (Loc. Mar Piccolo, Ionian Sea).

Acanthophora najadiformis

Vegetative propagules of the species were described in 1994 in the Mar Piccolo of Taranto, Ionian Sea (Fig.3). Also thalli collected in other Mediterranean locations show the presence identical propagules (Fig.4). Therefore, it was possible to infer that vegetative reproduction is species-specific, independently of collecting localities.

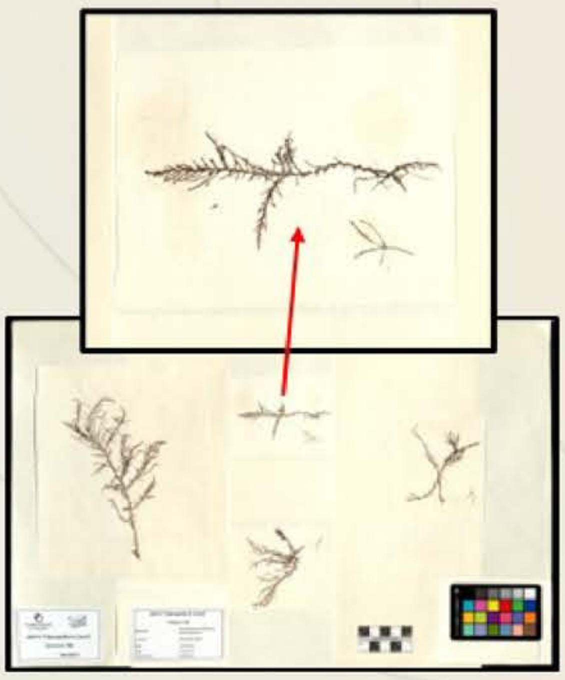

Fig. 4: Acanthophora najadiformis with vegetative propagules (Loc. Malta).

Fig. 5: Alsidium corallinum (Loc. Adriatic Sea).

Alsidium corallinum

Thalli of the species, with vegetative propagules, were collected in Ancona in summer 1941 (Fig. 5).
Even in the Gulf of Taranto, specimens bearing propagules were collected (Fig. 6).
Thus, it was confirmed that vegetative reproduction is species-specific regardless of sampling area.

Fig. 6: Alsidium corallinum (Loc. Mar Grande, Ionian Sea) with vegetative propagules.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Marine invertebrate collections (MSCs): the contribution of CNR-ISMAR Venice to the progress of DiSSCo Italia

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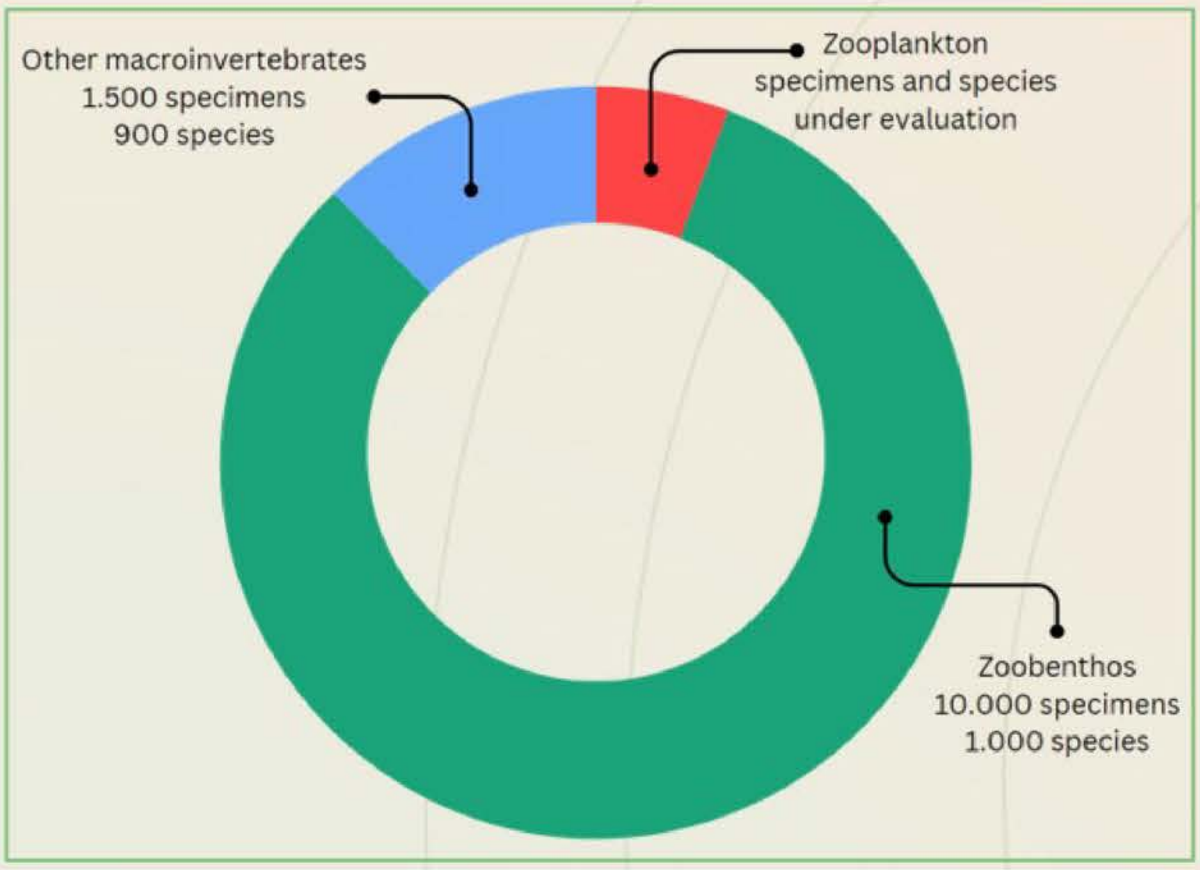
Research and biomonitoring activities on benthic and planktonic assemblages typically produce a big number of biodiversity samples with related (meta)data. When the original scientific questions are answered, the collected specimens can have different fates: they could be preserved for a long time, sometimes outliving those who collected them, or, in the other side of the spectrum, they can even be lost or destroyed once the original project is over. Unlike museal specimens, these samples are generally available only to experts in the sector, remaining inaccessible to a wider public. In order to make virtually available the MSCs to any level of audience simplifying access and sharing information a test-study has been performed in the framework of the RI-DiSSCo and project ITINERIS to virtually bring together MSCs and related information in a single Findable, Accessible, Interoperable and Reusable (FAIR) portal at European level.



We selected 4 MSCs as starting point:

"DC" Crustaceans of mobile bottom collected in the mud flat of the Dese estuary inside the Lagoon of Venice

"XLoVEU" wood borers collected in European seas

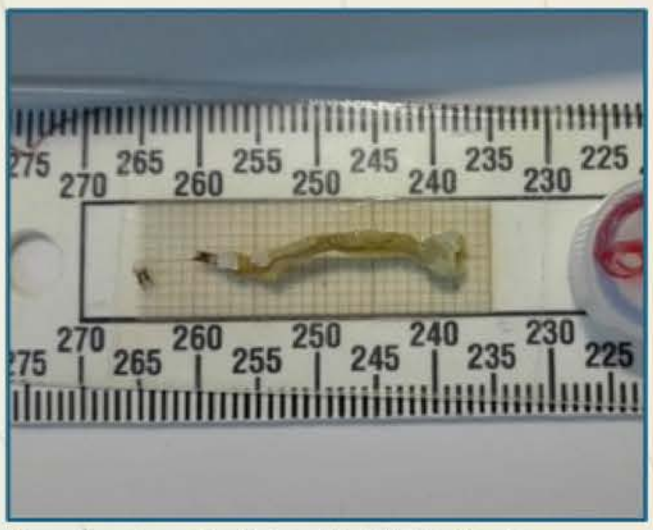
"NadEm" epimegabenthos organisms (>1 cm) collected in the Northern Adriatic

"Zplank" zooplankton collected from eLTER sites in the Northern Adriatic

The heterogeneity of these collections serves as a stress test, which made it possible to identify the critical issues and define the criteria useful for digitization.

The actions needed to organize and make the scientific collections available for research are the following: curatorship of physical collections, cleaning of samples, qualitative verification of the conservation liquid, sorting of specimens in good condition to be preserved; specimen cataloguing and assignment of the permanent identifier; taxonomic revision; digitisation and metadating to create digital collections according to international standards; data storage.

Goneplax rhomboides. NadEm Collection
Photo by Di Russo E.



Lyrodus cf. pedicellatus. XLoVEU Collection
Photo by Guarneri I.

Gammarus aequicauda. DC Collection
Photo by Di Russo E.

Temora stylifera. Zplank Collection
Photo by Di Russo E.

Documenting the present and the past biodiversity status provides solid foundations for observing the change staking place. The creation of digital twins of MSC physical objects originating from research activities, together with those deposited in museums, will offer fast and efficient information sharing, encouraging collaboration, communication, and dissemination.

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Long-Term Ecological Research in Lake Bidighinzu: studies on trophic state, phytoplankton, future perspectives

Padedda BM[1], Buscarinu P[2], Pulina S[1], Satta CT[1,4], Casiddu P[1], Manca B[1], Cherchi M[1], Pittalis C[1], Lugliè A[1], Petrocelli A[3]

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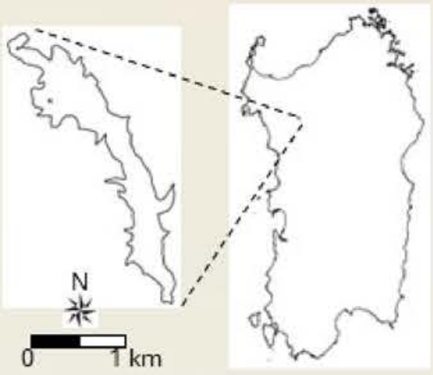
Introduction & objectives

Eutrophication is one of the most common forms of water quality degradation in freshwater ecosystems. Climate change is also threatening aquatic ecosystems, exacerbating eutrophication and promoting the proliferation of cyanobacteria (1). In the Mediterranean region, freshwater is a scarce resource and climate change is further impacting its availability and access. The Ente Acque della Sardegna (Enas) and the University of Sassari are engaged in water resource management and monitoring actions in the hypereutrophic and warm monomictic reservoir Lake Bidighinzu (BID, Fig. 1), which is part of the Italian LTER network (DEIMS ID: https://deims.org/3707cf71-7e04-41e3-8afc-518b293f6c07). BID is equipped with an instrumented raft for Real Time Remote Monitoring System (RTRMS; Fig. 1), managed by Enas. That point also corresponds to the LTER sampling station.



Watershade: 52×10^6 m^2
Trophic state: hypereutrophic
Altitude 334 m a.s.l.
Area: 1.7×10^6 m^2
Volume: 12.6×10^6 m^3
Mean depth: 7.3 m
Use: drinking water
Year of filling: 1956

Fig. 1 Location of the Lake Bidighinzu and its main characteristics. Photos show scientific recent activities at the lake and the RTRMS.

Data collection

sampling: monthly, collecting water samples for laboratory analyses from 0, 1, 2.5, 5, 7.5, 10, 15, 20 m, and from 0, 1, 2.5, 5, 7.5, 10 m for phytoplankton (Lugol's solution fixation), using a Niskin bottle

nutrients: ammonium ($N\text{–}NH_4$) (2), nitrite ($N\text{–}NO_2$), nitrate ($N\text{–}NO_3$), total nitrogen (TN), orthophosphate (RP), total phosphorus (TP), reactive silica (RSi), iron (Fe) and manganese (Mn) (3)

***in situ* measures:** temperature (Tem), pH, conductivity (Cond), dissolved oxygen (DO), turbidity (Tur), along the vertical profile with a multi-parametric probe; transparency by a Secchi disk (SD; Zeu=2.5 times the SD depth)

phytoplankton: chlorophyll *a* (CHL*a*) (4), cell density (5) and biomass (BIO) (6)

Results & comments

The new data collection series began in January 2024 (PRIN 2022 FUTURE) highlights that values fall within the average ranges defined by the LTER data series for the variables in the same months of the year (Fig. 2).

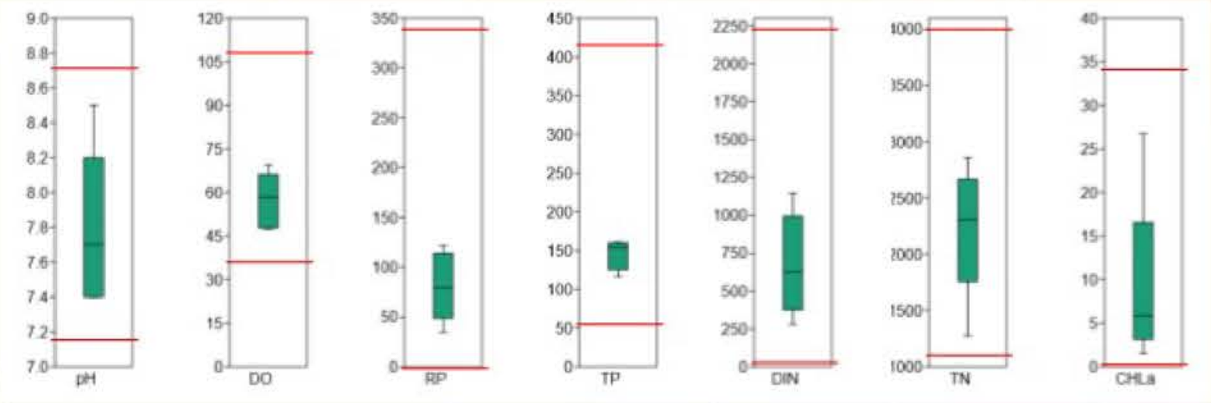


Fig. 2 BoxPlot summary of the main results from the new data collection for the first 5 months of 2024 for pH, DO, RP, TP, Dissolved Inorganic Nitrogen (DIN), TN and CHLa. Red lines indicate the average fluctuation ranges (mean maxim and minimum) of the variables from previous LTER series during the first 5 months of the years.

Notably, all variables tend to be closer to the minimum pluriannual values of the LTER series. This observation is especially pronounced for nutrients and a trophic descriptor such as the CHL*a*, confirming the multiannual trends already observed (7, 8). In addition, a similar indication derives from anomalies evaluation, i.e. monthly mean values of variables (CHL*a* and TP as example in Fig. 3) in each of the first investigated months in 2024 in respect to pluriannual mean values in the same months (Fig. 3). On the contrary, Tem shows only positive anomalies. The availability of a more complete set of new data will allow for new assessments of ongoing trends and their relationship with phytoplankton data.

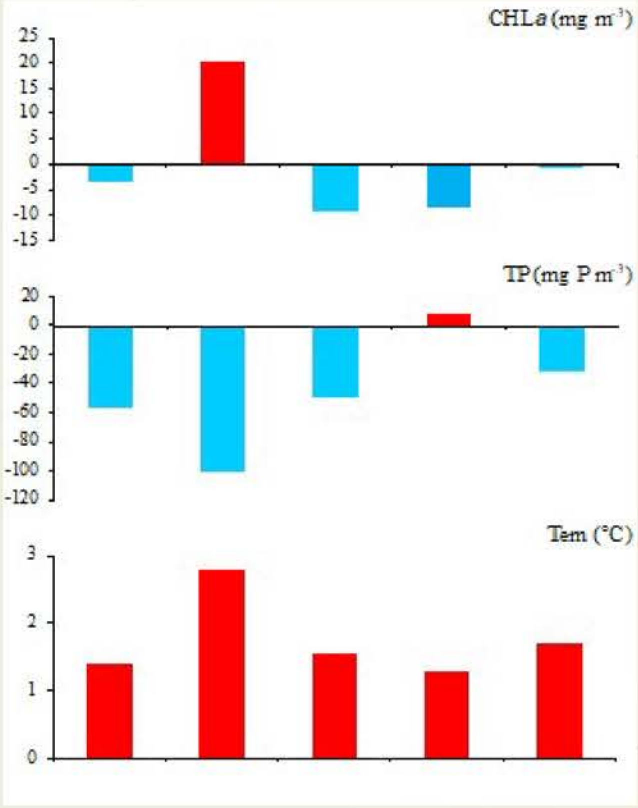


Fig. 3 Anomalies of CHL*a*, TP and Tem in the comparison between the monthly mean values and the LTER pluriannual mean values in each of the investigated months.

References

1 O'Neil JM et al. 2012. Harmful Algae 14: 313-334
2 Fresenius WKE et al. 1988. Springer-Verlag, Berlin: 320 pp.
3 Strickland JDH, Parsons TR 1972. Bull. Fish. Res. Board Can., 167, Ottawa: 310 pp.
4 Goltermann HL et al. 1978. I.B.P. N. 8. Blackwell Scientific Publications, Oxford: 214 pp.
5 Utermöhl H 1958. Mitt. Internat. Verein. Limnol., 9: 1-38.
6 Sun J, Liu DY 2003. Journal of Plankton Research 25(11): 1331-1346.
7 Mariani M et al. 2015. Inland Waters, 5: 339-354.
8 Pulina S et al. 2019. Nature Conservation 34: 163–191.

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Lago Maggiore LTER site: from long-term research to current environmental problems

David Brankovits, Michela Rogora, Dario Manca, Paola Giacomotti, Arianna Arca, Andrea Lami
National Research Council of Italy, Water Research Institute, Verbania

Lake Maggiore is a deep oligomictic lake belonging to the **LTER** Italian and European networks. Studies on physical, chemical and biological features of the lake have been performed continuously since the 1980s. In the last decade, climate change became the main driving factor for the long-term evolution of the lake, affecting hydrodynamic, nutrient status and biological communities (Rogora et al., 2021).

Long-term research

CIPAIS
Commissione internazionale per la protezione delle acque italo-svizzere

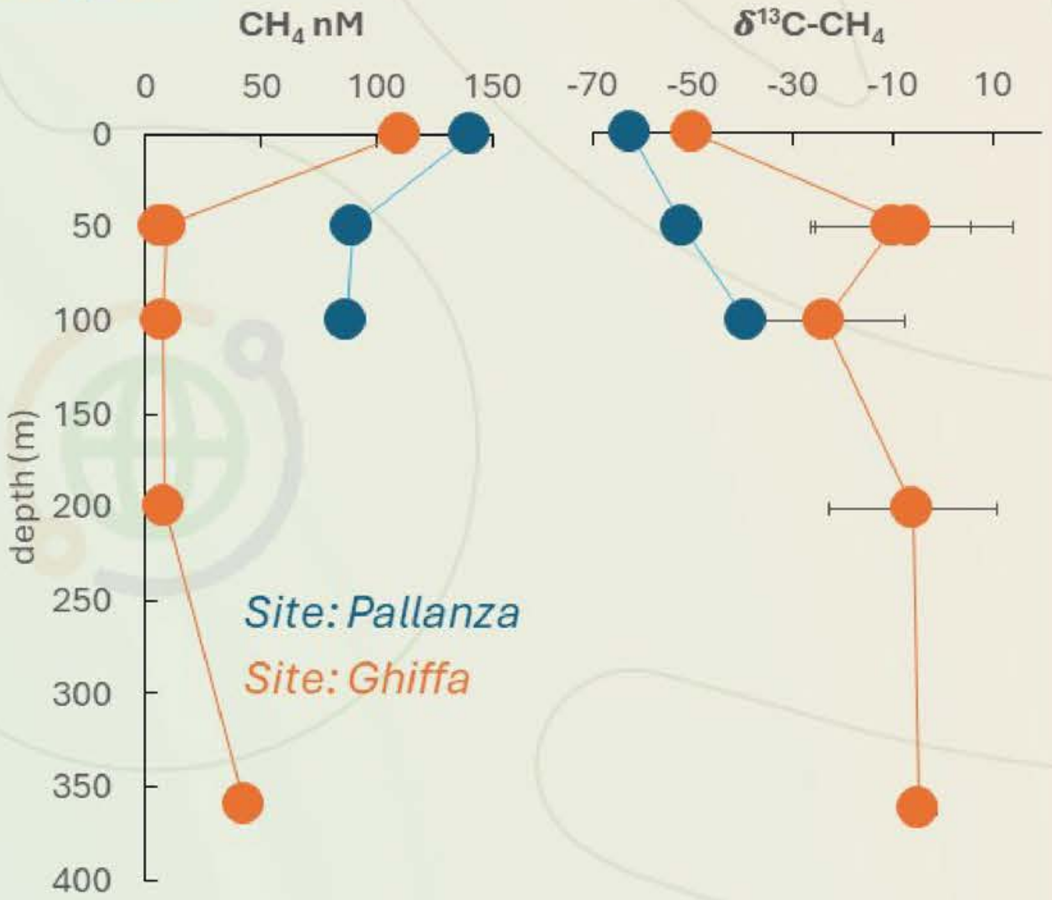
Monthly physical, chemical and biological variables along the water column at the deepest point. Meteo-hydrorologic data from stations in the lake watershed. Hydrodynamical and ecological modelling. High-frequency monitoring. Antibiotic resistance genes (ARGs). Metabarcoding.

High frequency monitoring (HFM)

Variable	Sensor/manufacturer	Measuring principle
Water temperature	Thermistor chain, PTCAN	
pH/Redox	PHEHT (Ponsel/Aqualabo)	Combined electrode
Dissolved oxygen	OPTOD (Ponsel/Aqualabo)	Optical measure/ lumine.
Conductivity	C4E (Ponsel/Aqualabo)	Conductivity sensor
Turbidity	NTU (Ponsel/Aqualabo)	Optical measure
Chlorophyll-a, PC, PE	Cyclops-7 (Turner)	Fluorescence
Meteorology	Weather station GILL MaxiMet	

A monitoring buoy (LM1) was placed in Lake Maggiore in 2020. It was developed in-house and conceived as a low-cost modular system (Tiberti et al., 2021). LM1 is equipped with sensors for water temperature, pH, conductivity, dissolved oxygen (surface and 10 m depth) and algal pigments (Chl-a, both at surface and 10 m depth, PC, PE), a weather station and a live webcam. A second buoy was added in 2023 (LM2). Data visualization and management: IstSOS (https://istsos.org/). Funded by INTERREG within a collaboration with the Regional Agency for Environmental Protection (ARPA) of the Lombardy region.

Carbon and greenhouse gases



Lake Maggiore is included in the eLTER PLUS Transnational and Remote Access Scheme (6 visits since 2017, and 2 visits foreseen in 2024). Most recently, project CALM in 2023 (Carbon Across Lago Maggiore) studied the production, storage, and processing of carbon, including greenhouse gases, such as carbon-dioxide (CO_2) and methane (CH_4) and aims to link the novel information to long-term datasets.

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Integration of GHGs emissions measurement and model simulations from different crop cultivation managements

Bindi, M., Padovan, G., Zavattaro, L., Pulina, A., Piccoli, I., Corinzia, A., Goglio, P., Verdi., L.

The acquisition of data from field experiments using proximal and remote sensing instruments will allow researchers to monitor crop stress (e.g. nutrient and water) and the agricultural footprint in terms of greenhouse gas balance. Here we present the case studies carried out by different CIRCULAR partners and the instruments acquired in the ITINERIS project.

Torino: The Tetto Frati Long-Term Experimental Platform site is located in Carmagnola. Since 1992, the platform hosts 38 treatments that are typical of dairy farms in the area. The treatments compare 4 maize-based cropping systems, over 9 N fertilisation levels.

Instruments: GHGs analyzer for studying long-term N and C balance, N losses.

Padua: The long-term experiment, started in autumn 1962, is structured as a split-plot design with three replicates, with a main splitting factor modified from one cycle to another (12 years) and the different rotations and fertilization combined. The LTE consider the comparison between a mixed arable/livestock farming system and one without livestock.

Instruments: Gas analyser for quantify many GHGs

Perugia: The Rotation field site, located in Papiano, is started in 1972 with the aim of assessing rotational effects across various cropping systems. Each of the rotation based on rainfed cropping systems from the Tiber valley are has two residue treatment (removal and burial).

Instruments: CO_2 and N_2O gas analyser

Florence: Ente Toscano sementi is a cereal farm that preserves

the biodiveristy of the typical Tuscan soft wheat, propagating and mantaining the purity of ancient varieties.

In the San Felice Vinery farm, vines are grown in a typical Mediterranean climate in the Chianti hills.

Instruments: Eddy covariance station for monitoring GHGs and Hyperspectral camera for monitoring plants stress indices.

Sassari: he experimental site is located in Arborea, Oristano. The area is characterised by an intensive dairy cattle system with high nutrient inputs, especially N and P, which are both the main cause of soil fertility and the main cause of nitrate pollution of groundwater and phosphorus eutrophication of the surrounding wetlands and lagoons.

Instruments: Smart Chamber and analyzer for measuring the GHGs flux in the soil.

Catania: The test site is located at the Azienda Agraria Sperimentale (AAS), in an area representative of Sicilian cereal production, on a typical xerofluvent soil with a predominantly clayey texture. The main cultivated crops are wheat and tomatoes.

Instruments: Multi point analyzer and Multi gas monitor

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TOWARDS A MULTI-SENSOR APPROACH FOR LARGE SCALE ECOSYSTEMS AND BIODIVERSITY MONITORING

A. Berton[(1)], A. Argentieri[(2)], L. Costanza[(1)], D. Cini [(1)], S. Trifirò[(1)], A. Baronetti [(1)], A. Provenzale [(1)],
[(1)]IGG-CNR, [(2)] ISASI-CNR

WP6 - Acquired innovative REMOTE SENSING system: UAV copter-plane with vertical take-off and landing capable of acquiring large areas thanks to the plane flight mode. The new system will allow overcoming the 120m limit, flying in manned airspace (imposed by EASA regulations), maintaining high spatial scalability thanks to the specifically purchased sensors.

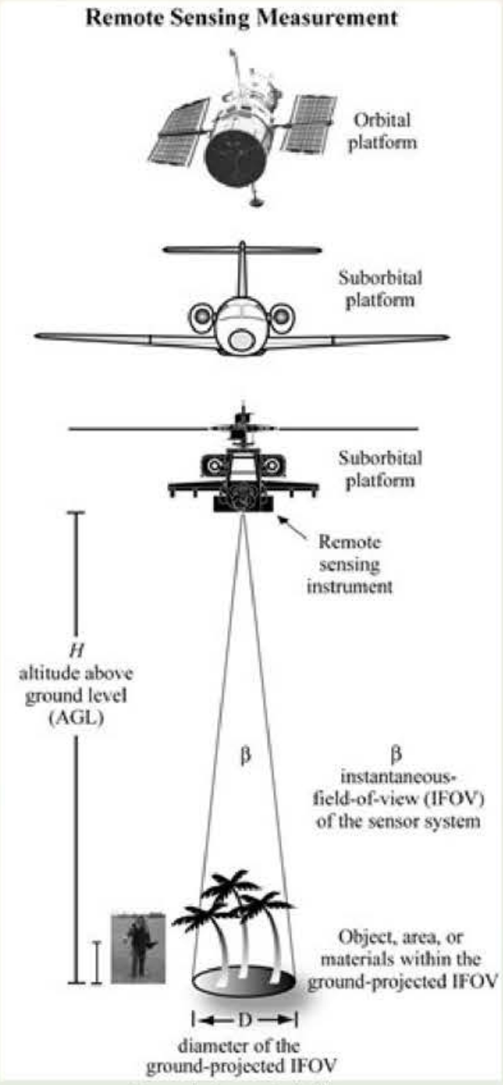
SONGBIRD 150

MicaSense Altum
- Multispectral Imaging
- Incl. NIR
- Incl. Thermal

PhaseOne iXM-100
- 100 MP
- Approx. 3 photos / second

Wingspan [cm]	312
MTOW [kg]	14.0
Maximum Payload [kg]	4.4
Body Material	Fiberglass/Carbon Composite

Max. Flight time [min] - camera only - max. payload - typical	 105 45 90
Altitude [m]	MAX. 5,000 AT TAKEOFF 4,000



Spatial scalability

MULTILAYER of LARGE AREAS

The **IGG-CNR** conduce UAV (multirotor) monitoring activities in various Italian natural parks, covering a variety of environmental parameters and sensors (LIDAR, multispectral, RGB, thermal, etc.). These surveys are complemented by ground monitoring to obtain information on parameters not easily estimated remotely (e.g., carbon and water fluxes) and to provide ground calibration/validation for drone data.

The technology solution used until now, while lightweight and easily transportable, has limitations in flight autonomy and logistics concerning the environment to be monitored. The VTOL, Vertical Take-Off and Landing, acquired allows overcoming these limits and expanding the monitoring area, considering also a potential 'airway' to reach the area of interest. However, the system requires **specific preparation for the pilots and an adequate ground infrastructure** for command and control. Since many years, the Mobile Research Unit has been responding to the technological needs of unmanned innovation.

Example: orthophoto-multispectral sequence (low-resolution RGB, RED, NIR, and NDVI)

MOBILE RESEARCH UNIT

- Independent cargo compartment
- Transport at controlled temperature (hot and cold)
- Energy autonomy
- Internet connection (4G-5G and SAT)
- Drone command and control
- First on-site data quality control
- On-site pre-processing of acquired data
- Data sharing

WORK in PROGRESS:

Following the testing conducted at the Migliarino, San Rossore, Massaciuccoli Regional Park, the critical issues to address have emerged: the aeronautical aspect to make the vehicle suitable and the management of the storage and processing of the acquired data.

- Expansion of the existing DATASTORAGE to accommodate RAW data: minimum dataset **RGB (100MP), RGB (20MP), Multispectral, and Thermal**. For example, a 40-minute flight generates a dataset of 150 GB;
- Authorisation process for BVLOS (Beyond Visual Line Of Sight) flight at an altitude above 120m AGL, i.e., in manned airspace; authorization by ENAC.

Since the CNR manages **"Base Ricerca Pianosa"** located in the Pianosa Island (Tuscan Archipelago National Park), which represents a site of interest for biodiversity studies and an excellent laboratory for conducting the first operational flights due to the low population density, as access to the island is limited.

In October 2024, joint flight activities (VTOL and traditional UAV) and co-registration of individual datasets are planned with the aim of **generating an acquisition and processing methodology** to create a single multiparametric shape.

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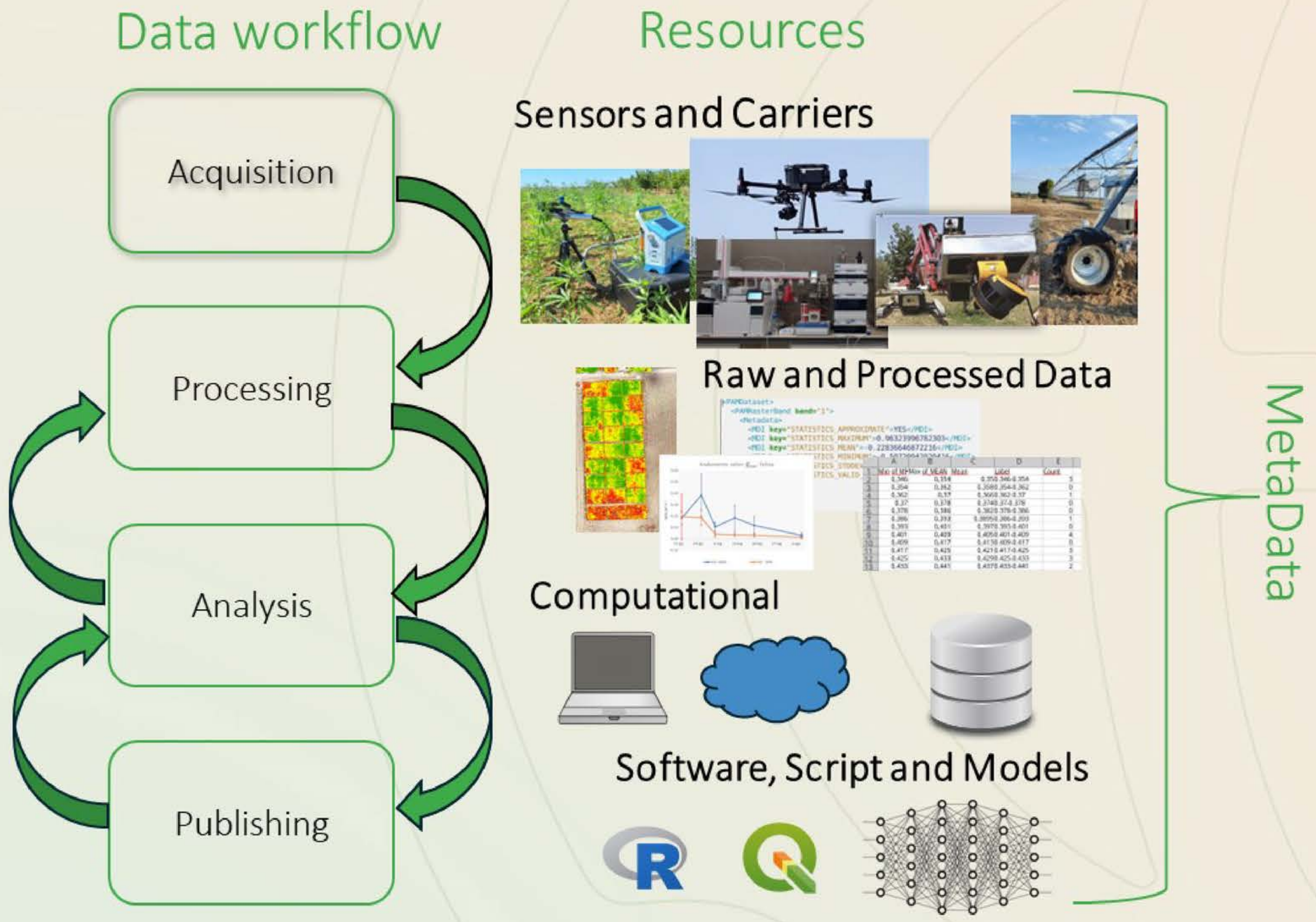
FAIR Modular Workflows for an Open Science Plant Phenotyping Platform

André Fabbri, Sabrina Mazzoni, Giovanni Marino, Matthew Haworth, Valeria Palchetti, Adriano Conte, Vincenzo Montesano, Giulia Atzori, Felicia Menicucci, Valentina Lazazzara, Donatella Danzi, Mauro Centritto.

High throughput plant phenotyping technologies increase volume, velocity, and variety of the data stream captured, including the metadata ensuring its veracity. A dedicated Plant Phenotyping cloud platform composed of Open-Science data portal and integrated workspaces is being developed to handle this increase in resources, workload and storage needs. Modular Data Workflows, comprising of resource specific machine and human readable code will orchestrate the whole process of data harmonization, automation, documentation and FAIR implementation.



Cloud Platform

Virtual Research Environment

- Interactive Versioned JuPyteR notebooks
- Collaborative Workspace
- Automated Data Model Pipelines
- Ready-to-use toolbox

Science Data Repository

- Ontology driven
- Web Portal and REST API
- Community supported
- Scalable infrastructure

Modular Workflow Methodology

- Scalable modularity (small, interchangeable...)
- Descriptive narrative (comment, notebooks ...)
- Traceability: embedded metadata (filenames, source parameters...)

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Vegetation response to droughts: The case of northern Italy

Alice Baronetti[1], Matia Menichini[1], Antonello Provenzale[1]
[1]Institute of Geosciences and Earth Resources, National Research Council, Pisa, Italy

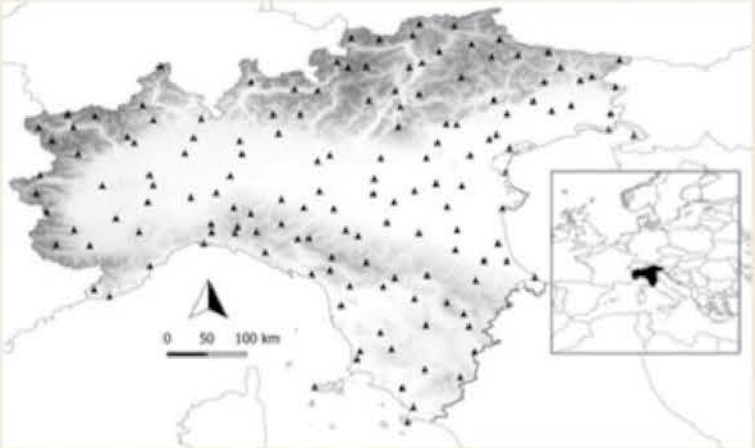

Figure1: Study area North of Italy

1 - INTRODUCTION and GOAL

Drought frequency has recently increased in northern Italy, affecting the hydrological behavior of the main rivers in this region.

Investigate on the spatial distribution of drought events and their effects on vegetation greenness in northern Italy during the 2000–2020 period, using MODIS images at 1 km spatial resolution

2 – DATA

Ground data:

- 150 weekly precipitation and temperature daily series.
- Quality control and reconstruction of the raw data.
- Spatialisation (Universal Kriging) with auxiliary variables (latitude, elevation, distance to shoreline) of the obtained precipitation and temperature series.

Modis products:

- 16-days Vegetation Indices: NDVI and EVI (MOD13A2).
- Corine Land Cover (MCD12Q1).
- Pixels that included no data, low quality or were covered with clouds, were removed.

3 – METHOD

- Application of SPEI (Vicente-Serrano et al. 2010) and SPI (McKee et al., 1993) drought indices at 12, 24 and 36 months.
- Identification of severe (<-1.28) and extreme (<-1.65) drought events that interest at least 25% for 3 consecutive weeks (Baronetti et al., 2018).
- Drought and vegetation greenness trend analysis using the Mann-Kendal test with 5% p-value.
- Creation of maps of drought duration for severe and extreme events.
- Production of correlation maps between vegetation indices (NDVI, EVI) and drought indices (SPEI and SPI) at 12, 24 and 36 months (Gouveia et al., 2016).
- Estimation of the drought impact on different vegetation types as the percentage of vegetation under drought.

4– DROUGHT RESULTS 2000-2020

Main Spring-Summer Drought Episodes

Table1: Main drought episodes recorded in northern Italy for the 2000-2020 period.

SPEI				SPI			
Start	End	Week	%Area	Start	End	Week	%Area
12/07/2003	29/08/2003	6	70	12/07/2003	29/08/2003	6	50
05/03/2004	06/04/2004	4	86	05/03/2004	22/04/2004	6	55
01/05/2005	18/08/2005	12	25	01/05/2005	28/07/2005	10	40
10/06/2006	26/06/2006	2	25	10/06/2006	26/06/2006	2	32
07/04/2007	23/04/2007	2	30	06/03/2007	09/05/2007	8	40
21/03/2012	06/04/2012	2	25	21/03/2012	06/04/2012	2	35
25/05/2014	10/06/2014	2	25	25/05/2014	10/06/2014	2	25
26/06/2017	29/08/2017	8	35	25/05/2017	29/08/2017	12	40
25/06/2020	28/08/2020	8	25	24/05/2020	11/07/2020	8	30

Drought trends at 12 months

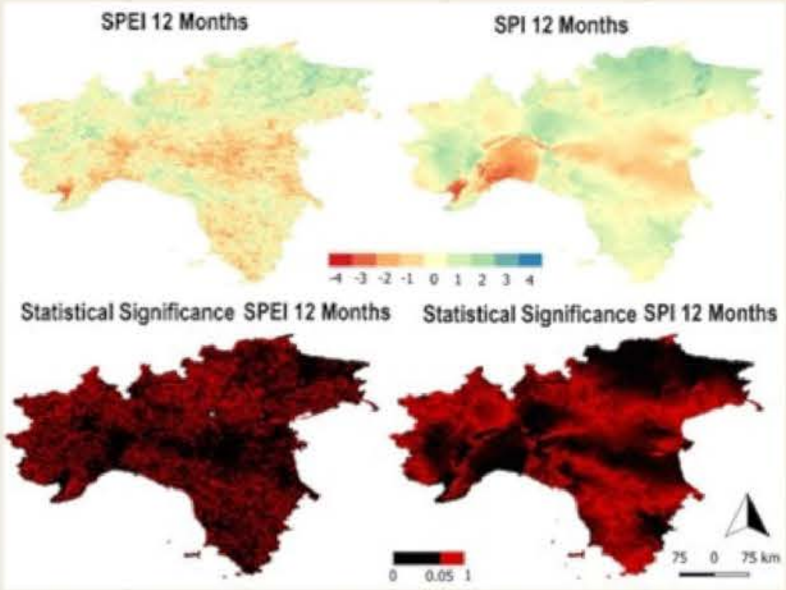

Figure 3: SPEI at 12 months trends. a) Spatial distribution. b) Statistical significance.

Negative and significant trends for the Po Valley and Tuscany hills.

Positive and significant trends for the eastern Alps.

Drought duration maps

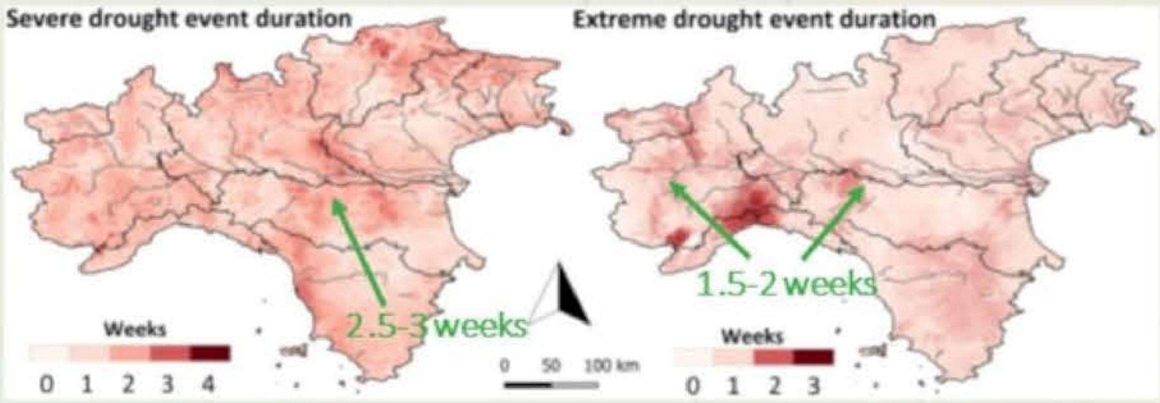

Figure 2: Spatial distribution of drought duration (in consecutive weeks) for severe (left) and extreme (right) events.

5–DROUGHT IMPACTS ON VEGETATION

Vegetation trends

Negative and non-significant trends for the plain (Po Valley), and Tuscany hills

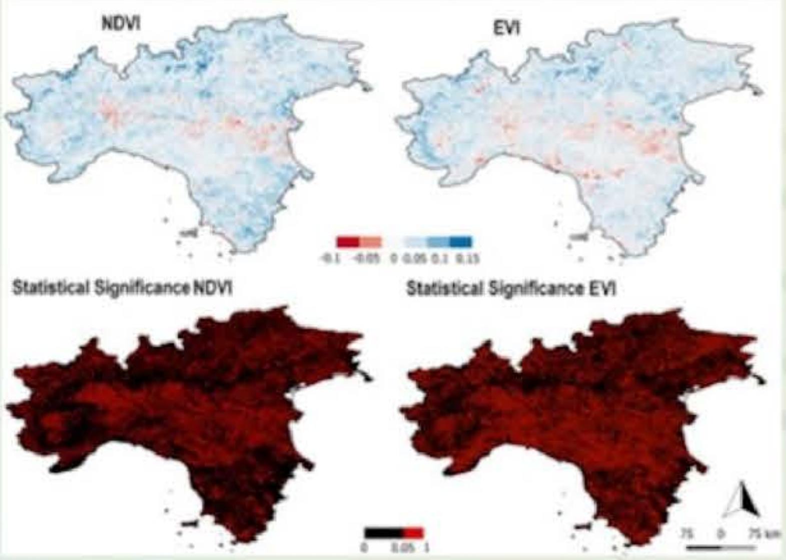

Figure 4: Vegetation trends for NDVI (left panel) and EVI (right panel). a) Spatial distribution. b) Statistical significance.

Drought and vegetation communities

Table 2 Percentages of vegetation under drought for the different vegetation types

	SPEI-NDVI (%)			SPEI-EVI (%)		
	12	24	36	12	24	36
Dense Forests	3.22	3.27	3.62	1.22	1.26	1.35
Evergreen Needleleaf Forests	4.40	4.78	5.07	2.48	2.58	2.88
Evergreen Broadleaf Forests	5.34	4.96	5.47	3.05	3.68	3.25
Deciduous Needleleaf Forests	5.65	6.07	6.21	2.96	3.24	2.95
Deciduous Broadleaf Forests	6.09	6.24	6.98	1.93	2.82	3.12
Broadleaf Needleleaf Forests	5.50	5.50	6.09	1.48	2.22	2.37
Broadleaf Evergreen/Deciduous Forests	5.32	6.18	7.04	2.29	3.44	3.59
Open Forests	11.36	13.58	14.64	3.70	3.84	5.30
Sparce Forests	11.29	12.18	13.40	4.97	4.81	6.87
Forest /Cropland Mosaics	20.87	25.28	31.80	9.41	10.50	13.95
Woody Wetlands	7.93	10.11	12.39	4.16	6.40	10.84
Herbaceous	5.16	6.71	7.01	2.68	3.49	3.49
Natural Herbaceous / Croplands Mosaics	5.20	8.20	12.62	3.53	4.91	9.08
Herbaceous Croplands	3.32	3.22	7.20	2.477	2.94	6.49

Drought and vegetation correlation

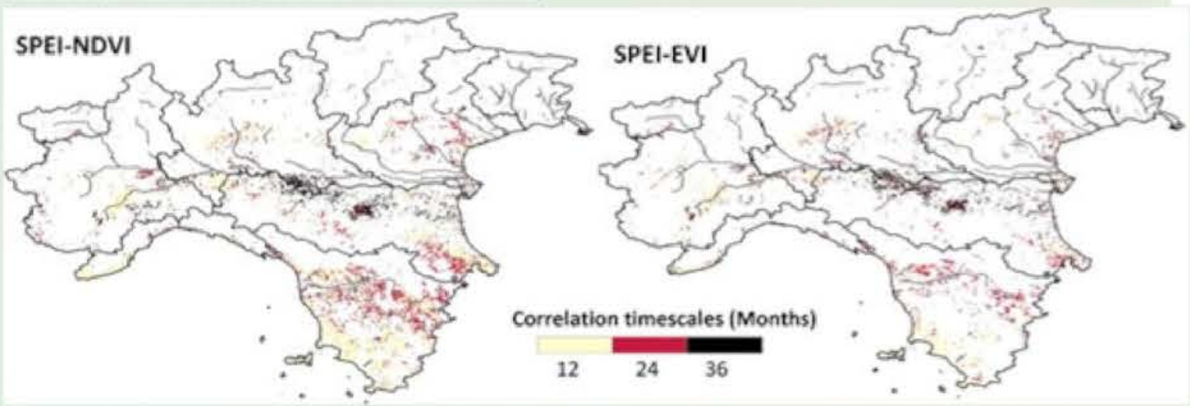

Figure 5: Aggregation timescales of SPEI I showing relevant correlations with NDVI and EVI

6 – FINAL REMARKS

- Nine Spring-Summer drought episodes.
- Droughts are mostly related to changes in temporal distribution of precipitation.
- Po Plain and the Tuscany hills have experienced marked droughts intensification and negative effects on vegetation greenness.
- Vegetation communities perturbed by agriculture are those that are most affected by droughts.

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Facing with the ozoneFACE: New perspective and future applications

Elena Paoletti

IRET-CNR Sesto Fiorentino, Via Madonna del Piano 10, 50019, Italy

Overview

FACE (Free-Air Concentration Enrichment) technology was developed to study plant responses to varying O3 concentrations in more natural environments than those provided by growth chambers or open-top chambers. Although it is easier to control fumigation in enclosed systems such as growth chambers, greenhouses or open-top chambers (OTCs), plants grown in these controlled conditions often respond differently compared to plants grown in open-field settings.


Open-top chamber


Environmental control room


Free-Air Controlled Exposure

Current O_3 FACE for trees around the world

AnaEE-ERIC is founded by 8 members, including 6 European member countries.

In Italy, 6 facilities occur.

Main achievements

Collaboration with 10 countries for a total of 48 visiting researchers.

Innovative research and scientific discoveries of extreme importance for the protection of tree, shrub, and crop species against ozone, covering several genera and plant species.

About 30 scientific research papers published from 2015 to the present

Involved in the NRRP ITINERIS project to amplify infrastructure to increase and diversify researches.

Future prespective

In the future, the infrastructure will see an expansion of research in the field of arboreal and faunal studies. Since 2023, important ecological and biological research focused on fauna has been conducted at the Ozone-FACE site.

In the summer of 2024, the research project "CosmO3Face" was launched, which will analyze the physiological and biological responses of lentic aquatic species, both plant and animal, including benthic meiofauna, within mesocosms.

Moreover, after our study on the behavioral and ecological effects of ozone on suburban pest birds, we will investigate the effects of ozone on arthropods with respect to agricultural and forest protection.

In the image, one of the three mesocosms installed at the FO3X infrastructure in Sesto Fiorentino. For each treatment (AA, 1.5xAA, and 2xAA), there is one mesocosm.

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The importance of the ICOS network to study carbon fluxes and pollution in forest ecosystems

Silvano Fares with the contribution of ICOS Ecosystem site PI

Institute for Agriculture and Forestry Systems in the Mediterranean (ISAFoM-CNR).

ICOS National Network Italy

Our network

- Two class-1 site, two class 2 sites, and eleven ICOS associated sites are part of the ICOS Italy ecosystem network covering Mediterranean forests, Spruce, Larch, Beech forests, mixed temperate forests, grasslands, urban parks.
- Fluxes of greenhouse gases measured with Eddy Covariance technique and ancillary measurements (air temperature, relative humidity measured at multiple heights using thermohygrometers on a scaffold towers, precipitation, PAR, soil water content, and other environmental parameters) are measured and recorded at 30-min time resolution, continuously, for years.

- Several sites also host additional sensors to measure concentration and fluxes of atmospheric pollutants (Ozone, Nitrogen oxides, Ammonia, Particles, Volatile Organic Compounds).
- Considerable efforts have been made for labelling in the last years, with a strong commitment from participating institutions.
- This is great chance of cooperation for the Italian scientific community (and > 10 different Institutions).
- Thanks to a rigorous protocol and use of advanced instruments we deliver high quality and open access data to inform on long-term carbon dynamics in response to climate changes & the effect of pollutants on agricultural and forest ecosystems.

More on https://www.icos-italy.it/ and access data on Carbon Portal →

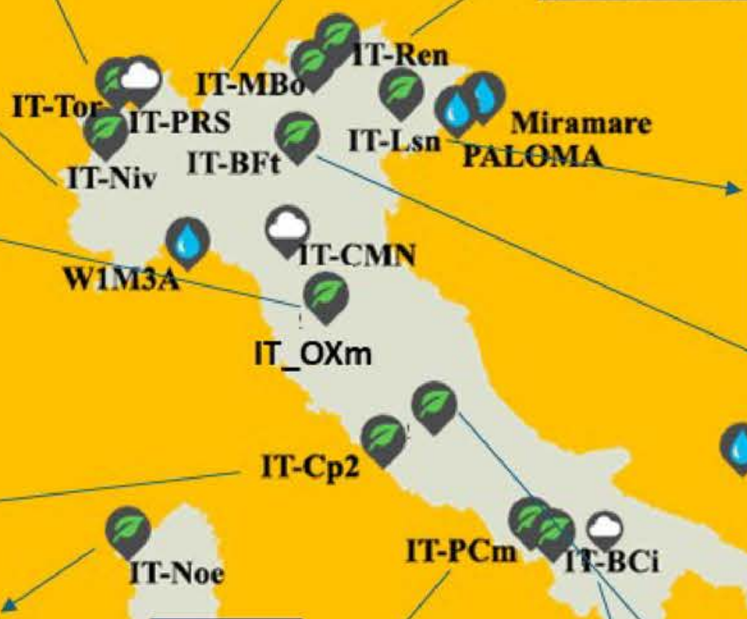
ICOS network– Coverage of a broad range of ecosystems

Nivolet (IT-Niv)
CNR IGG Grassland
PI: Antonello Provenzale
Associated

Torgnon (IT-Tor, IT-TrF)
ARPA VdA Grassland, Larch forest
PIs: Edoardo Cremonese, Marta Galvagno
Associated

Monte Bondone (IT-MBo)
Edmund Mach Foundation
Grassland
PI: Damiano Gianelle
Class 2

Renon (IT-Ren)
University of Bolzano & Provincia Autonoma di Bolzano
Spruce forest
PI: Leonardo Montagnani
Class 2



Lison (IT-Lsn)
University of Padova and University of Udine Wineyard
PI: Andrea Pitacco
Associato

Ximeniano observatory (IT-OXm)
CNR IBE Urban site
PI: Beniamino Gioli
Associated

Bosco Fontana (IT-BFt)
Cattolica University
Mixed Forest
PI: Giacomo Gerosa
Associated

Castelporziano (IT-Cp2)
CREA-CNR Holm oak forest
PI: Silvano Fares
Class 1

Arca di Noè & Sassari (IT-Noe)
University of Sassari
Mediterranean maquis & Urban site
PI: Donatella Spano
Associated

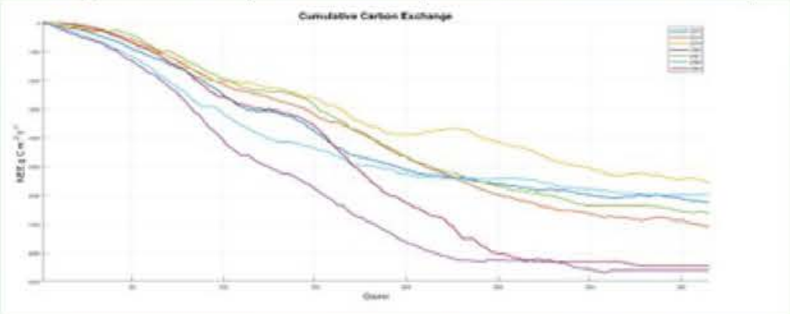
Lampedusa (IT-Lmp)
ENEA Mediterranean forest
PI: Daniela Meloni
Associated

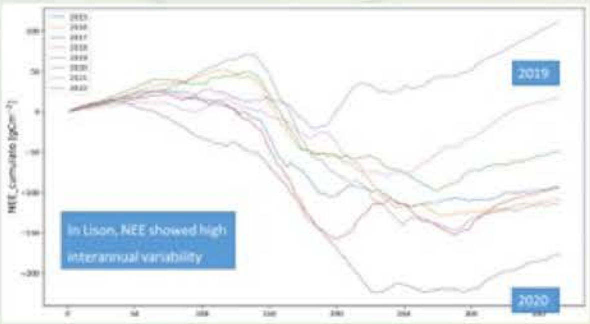
Collelongo
CNR IBE Beech forest
PI: Giorgio Matteucci
Associated

Capodimonte (IT-PCm)
CNR IRET Urban park
PI: Carlo Calfapietra
Associated

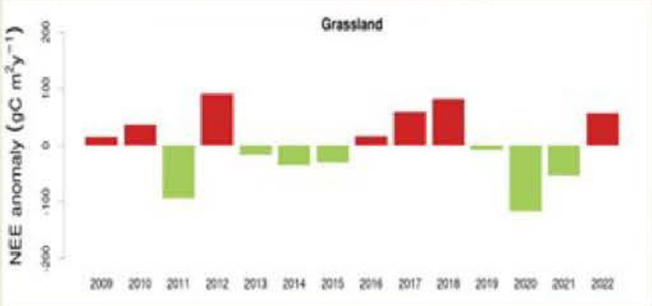
Borgo Cioffi (IT-Bci)
CNR ISAFOM Agricultural site
PI: Vincenzo Magliulo
Class 1

Changes in cumulative Carbon uptake in response to precipitation regimes at It-Cp2 Holm oak forest and at It-Lsn wineyard





Changes in cumulative Carbon uptake It-Tor Mountain grassland



Consiglio Nazionale delle Ricerche | ICOS Integrated Carbon Observation System | National Biodiversity Future Center

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Versatile applications of volatilome analysis across different matrices.

Daniela D'Esposito[1], Maurilia Maria Monti[1], Liberata Gualtieri[1], Simona Gargiulo[1], Francesca Palomba[1], Mariachiara Cangemi[1], Francesco Loreto[2], Mauro Centritto[3], Michelina Ruocco[1]

[1]Institute for Sustainable Plant Protection, National Research Council of Italy (CNR-IPSP), Portici, Italy [2]Institute for Sustainable Plant Protection, National Research Council of Italy (CNR-IPSP), Sesto Fiorentino, Italy [3]Department of Biology, University of Naples Federico II, Naples, Italy

Introduction

The understanding and the monitoring of the impact of environmental pressures on terrestrial biosphere biodiversity and integrity is urgently needed to provide knowledge to be transformed into actionable strategies. This involves coordinating and integrating data from different research infrastructures (RIs) operating to ensure optimal use and interoperability of collected data.

Objective

- Phenotyping data collection to flow toward the ITINERIS Hub.
- Implementation of Portici RIs

Materials and Methods

Facilities, resources and services for plant phenotyping provided from EMPHASIS were used (Figure 1). The phenotyping data acquired were the volatile organic compounds (VOCs) emissions related to datasets from different matrices. Examples are reported in Figure 1.

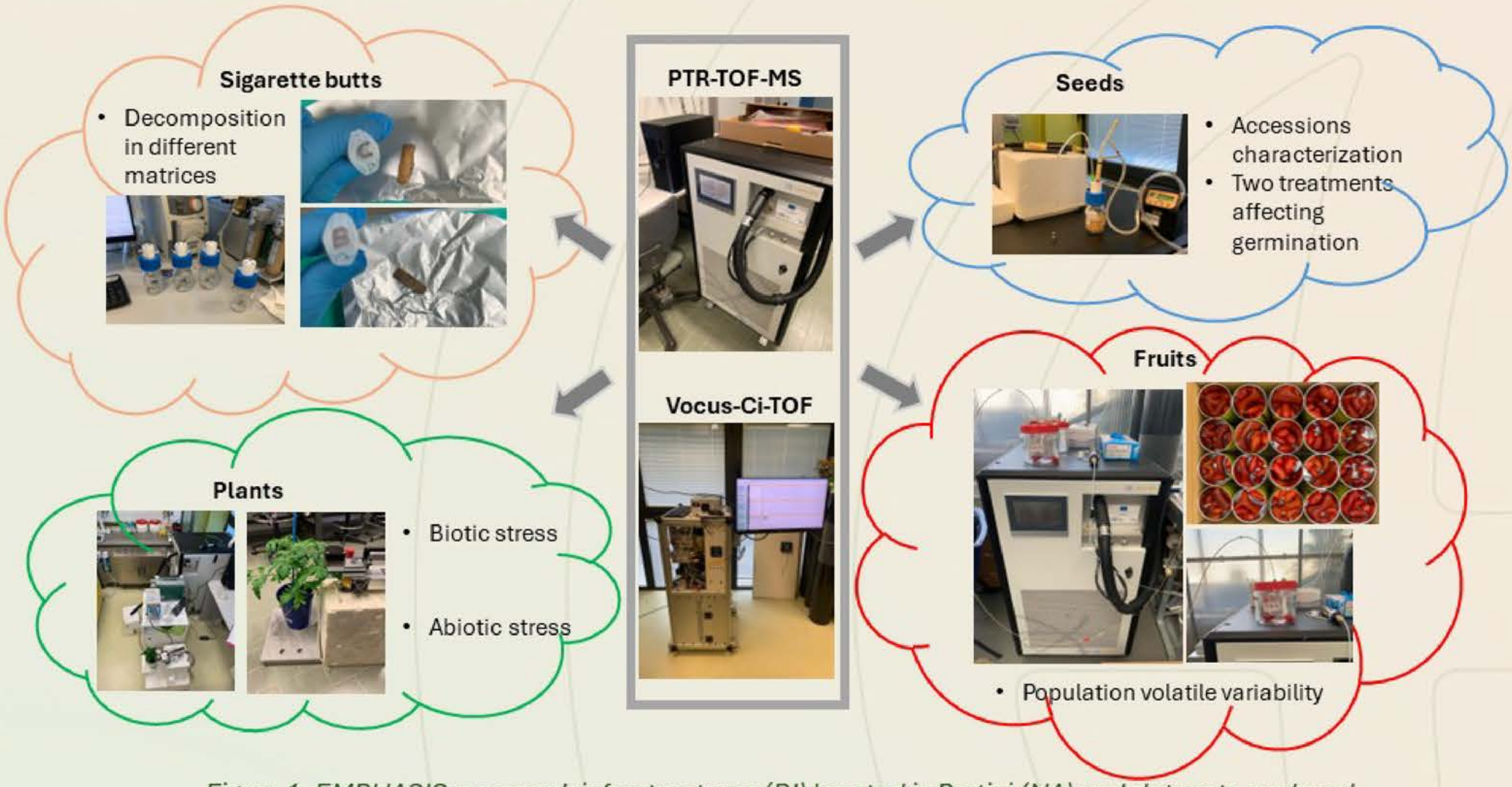

Figure 1. EMPHASIS reasearch infrastructures (RI) located in Portici (NA) and datasets analyzed.

Results

VOC emissions are evaluated in real time by using a proton-transfer-reaction time-of-flight mass spectrometry (PTR-TOF-MS). The volatiles raw spectra acquired from datasets are processed to obtain data tables reporting the identification and quantification of VOCs (Figure 2) as well as their putative annotation.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Sample**	**Group**	**15.023**	**15.9938**	**17.0015**	**17.0256**	**18.0041**	**18.0335**	**18.954**	**18.9875**	**18.9993**	**19.0069**	**19.0116**	**19.0281**	**19.033**	**20.0233**
2	Ctrl_Empura_1	Ctrl_Empura	1.39E-07	1.71E-08	0	0	1.46E-06	0	0	0	1.39E-05	0	0	1.49E-06	0	0
3	Ctrl_Empura_2	Ctrl_Empura	8.63E-08	2.92E-09	0	0	3.10E-07	0	0	0	1.21E-05	0	0	1.51E-06	0	0
4	Ctrl_Empura_3	Ctrl_Empura	4.09E-08	1.44E-08	0	0	2.95E-07	0	0	0	1.32E-05	0	0	1.56E-06	0	0
5	Ctrl_Empura_4	Ctrl_Empura	9.94E-08	1.06E-08	0	0	9.55E-07	0	0	0	1.34E-05	0	0	1.49E-06	0	0
6	Ctrl_Forrimax_1	Ctrl_Forrimax	5.69E-08	1.91E-08	0	0	2.45E-07	0	0	0	3.81E-05	8.26E-06	0.0001	0.00011	0	0
7	Ctrl_Forrimax_2	Ctrl_Forrimax	5.34E-08	3.34E-09	0	0	2.54E-07	0	0	0	4.19E-05	3.37E-05	0.0001	0.00011	0	0
8	Ctrl_Forrimax_3	Ctrl_Forrimax	3.96E-08	4.07E-08	0	0	2.66E-07	0	0	0	4.12E-05	2.29E-05	9.85E-05	0.00016	0	0
9	Ctrl_Forrimax_4	Ctrl_Forrimax	2.10E-08	1.46E-08	0	0	2.68E-07	0	0	0	4.34E-05	2.28E-05	9.54E-05	5.34E-05	0	0
10	Ctrl_Maleme_1	Ctrl_Maleme	9.71E-08	1.69E-08	0	0	1.40E-06	0	0	0	0	0.00011	0	0	0	0
11	Ctrl_Maleme_2	Ctrl_Maleme	9.48E-08	8.10E-09	0	0	1.53E-06	0	0	0	0	1.63E-05	0	0	0	0
12	Ctrl_Maleme_3	Ctrl_Maleme	1.33E-07	1.70E-08	0	0	1.40E-06	0	0	0	0	0.00021	0	0	0	0
13	Ctrl_Maleme_4	Ctrl_Maleme	1.12E-07	3.78E-08	0	0	1.42E-06	0	0	0	0	9.21E-05	0	0	0	0
14	Ctrl_Rayane_1	Ctrl_Rayane	1.02E-07	9.93E-09	0	0	1.10E-07	0	0	2.68E-06	9.27E-06	0	0	0	0	0
15	Ctrl_Rayane_2bis	Ctrl_Rayane	1.15E-07	1.11E-08	0	0	1.25E-07	0	0	1.12E-06	6.21E-05	0	0	0	0	0
16	Ctrl_Rayane_3	Ctrl_Rayane	4.45E-07	1.16E-08	0	0	4.02E-07	0	0	2.11E-07	6.57E-05	0	0	0	0	0
17	Ctrl_Rayane_4	Ctrl_Rayane	6.92E-07	1.15E-08	0	0	1.78E-06	0	0	6.51E-06	9.59E-05	0	0	0	0	0

Figure 2. Data tables reporting the volatile emissions.

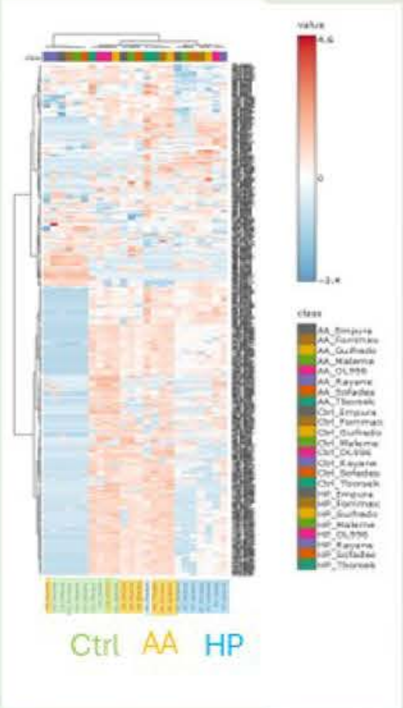

Figure 3. Volatilome profiles.

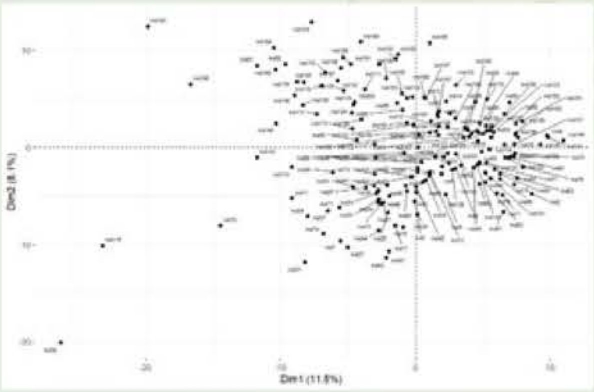

Figure 4. Principal Component Analysis (PCA).

Statistical analysis allows the generation of volatilome profiles (Figure 3), sample discrimination (Figure 4) and identification of variables with higher contribution to samples separation (Figure 5).

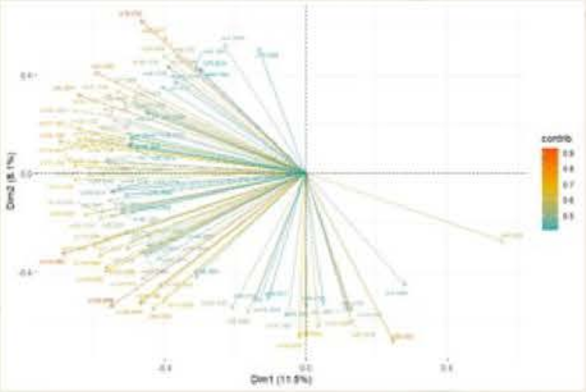

Figure 5. Contribute of volatiles in sample discrimination.

Conclusions

We collected VOC data from different matrices and different experimental conditions that will be shared within ITINERIS Hub. Implementation of RI for VOCs detection was achieved by acquiring and installing new instruments as Vocus-Ci-TOF.

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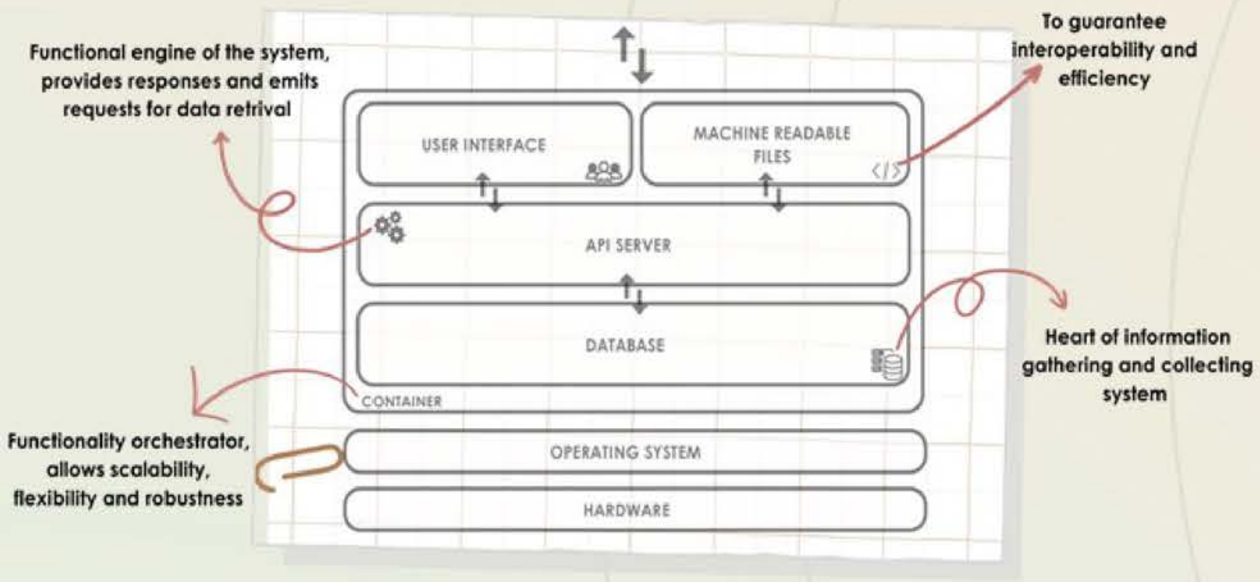
DiSSCo: Enhancing Open Science with effortless knowledge exchange - Data modelling

Eleonora Fornaro*, Massimo Ianigro**, Domenico De Paola*, Marina Tumolo*, Gabriele Bucci***
ITINERIS OU CNR-IBBR-BA (Activity 6.5) * CNR-IBBR, Bari; ** CNR-IRSA, Bari; *** CNR-IBBR, Firenze

Abstract

DiSSCo is a groundbreaking initiative aimed at advancing Open Science by integrating data management and knowledge exchange. It aims to create a seamless environment for managing biodiversity data on Natural Scientific Collections through a microservice infrastructure, robust databases, and a comprehensive data model, enhancing collaboration and accelerating scientific discoveries in biodiversity.

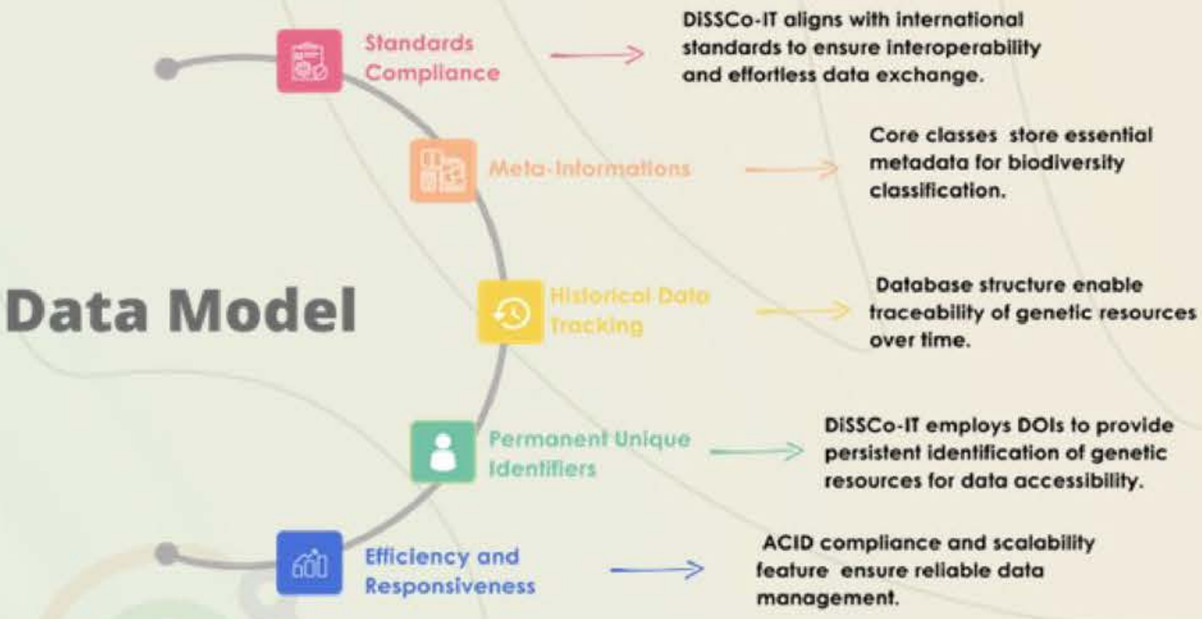


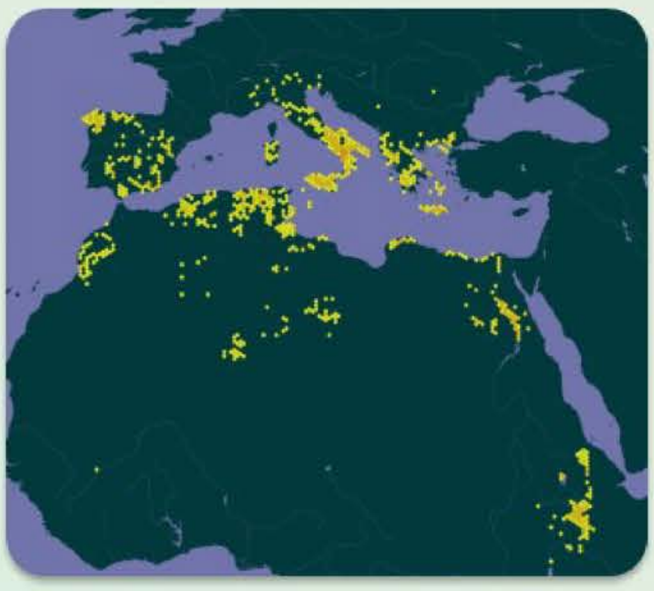
Microservice Infrastructure

- State-of-the-art open source technologies
- Enhanced scalability: microservices can be independently scaled based.
- Increased resilience: Single service failure may not affect the entire system as compared to monolithic architecture
- Greater flexibility: Diverse technologies and languages can be used for specific tasks.
- Designed for distinct functions and managed by accurate APIs.

Data model

The data model is designed to manage diverse biological data, ensuring complex relationships and constraints. Key features include normalization, ACID compliance, and scalability. It aligns with international standards like Darwin Core and MCPD, and uses meta-information, taxonomic details, and historical data tracking. Permanent unique identifiers bridge information gaps.





Future Perspectives

ITINERIS Activity 6.5 will pave the way for future research aimed to:

Assess Essential Biodiversity Variables (EBV) using georeferenced information;

Model species distribution under climate change future scenarios and map regions at risk of biodiversity erosion;

Map functional biodiversity to study climate change adaptation mechanisms based on taxonomic, genetic , geographical and eco-physiological information

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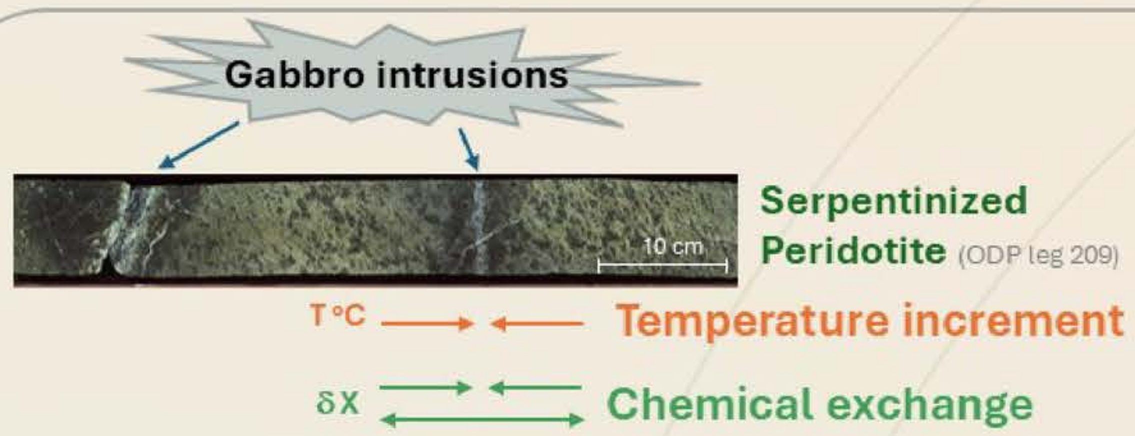
Multiple geochemical and isotopic proxies for tracing magmatic and serpentinization processes in abyssal peridotites

A. Bragagni[1,2], A. Rielli[2] & C. Boschi[2]

1 CNR ISMAR Istituto di Scienze Marine
2 igg

As part of WP 7.1, Data will be made available through the ITINERIS HUB following the FAIR principles

IODP International Ocean Discovery Program
ECORD European Consortium for Ocean Research Drilling
ECORD IODP ITALIA



Samples from leg 209 (ODP) were collected from the IODP repository of Bremen and petrographic investigations (optical and electron microscopy) are underway.

Gabbro intrusions represent a source of heat and fluids in exhumed portions of the mantle.
Along with sea-water, gabbro intrusion influence serpentinization processes, changing the mineralogy and physical properties of abyssal peridotites.
→ Implications for geodynamic processes (i.e. exhumation) and geochemical cycles (e.g. CO_2 and H_2)

Temperature of serpentinization

Oxygen isotope thermometry
@ IGG-CNR Pisa

Laser fluorination line coupled with a Thermo Delta mass spectrometer for oxygen isotope composition of silicate material.

Oxygen isotopes of serpentine, talc, magnetite allows inference on their temperature of formation (using equilibrium reaction with mineral couples, e.g., Früh-Green et al. 1996)
The temperature of serpentinization will allow testing if gabbro intrusions are associated with increment of temperature. This hypothesis will be tested at different scale from the cm scale (small gabbro intrusions) to the m scale (large gabbro).

Chemical exchange

The contribution of **different sources** in metasomatic and hydrothermal processes can be discriminated with radiogenic isotopes. Possible sources are peridotite, gabbro and seawater.

→ Sr, Nd, Hf isotopes

@ Uni-Köln (Germany)

Tracing the **amount of fluids** during serpentinization. Different generation of serpentinite vein show variable Si isotope composition depending on the fluid/rock ratio (Geilert et al., 2021).

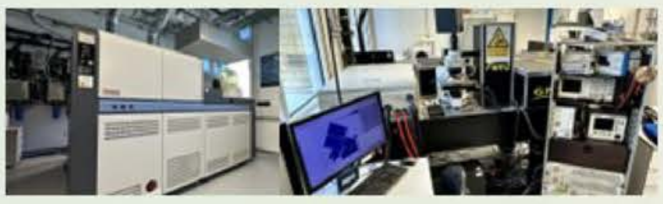
→ "in situ" Si isotopes

@GFZ-Potsdam (Germany)

The **mechanism of chemical exchange** within peridotites: It was proposed that mass-dependent processes could control the mobility of some elements (e.g., Zr and Hf) in peridotites (Niu, 2004).

→ Mass dependent Zr isotopes fractionation

@ CUG-Wuhan (China)



References

Früh-Green et al. (1996) *Proceedings-ODP, NSF* 235–254; Niu (2004) *JPet* 45, 2423–2458; Geilert et al., (2021) EPSL 575, 117193.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

WP7 - Activity 7.1 - Attività ricerca scientifico- tecnologica ECORD:

XRF core scanning technique as a tool for high resolution stratigraphy of Late Quaternary successions

Irene Sammartino[1], Annamaria Correggiari[1], Valentina Grande[1], Ilaria Conese[1], Andrea Gallerani[1], Alessandro Remia[1], Luisa Perini[2], Lorenzo Calabrese[2] and Andrea Argnani[1]

[1] CNR-Istituto di Scienze Marine (ISMAR) – via Gobetti 101, 40129 Bologna (Italy); [2] Servizio Geologico, Sismico e dei Suoli (Regione Emilia-Romagna) – viale della Fiera 8, 40127 Bologna (Italy)

Geological archives are so unique and complex. This contribution shows an integrated approach to the study and storage management of large amounts of data generated from **multiproxy analysis of late Quaternary core deposit** collected on the **Northern Adriatic shelf and coastal area** (Fig. 1).

We emphasize, here, the role of high-resolution core scanning techniques as a very effective tool, able to produce continuous geochemical profiles that allow the reconstruction of core history and stratigraphic correlation at the basin scale. We show an example of how data could be organized, made interoperable, and sharable with Italian Research Infrastructures (RIs) in the framework of **ITINERIS Project**.

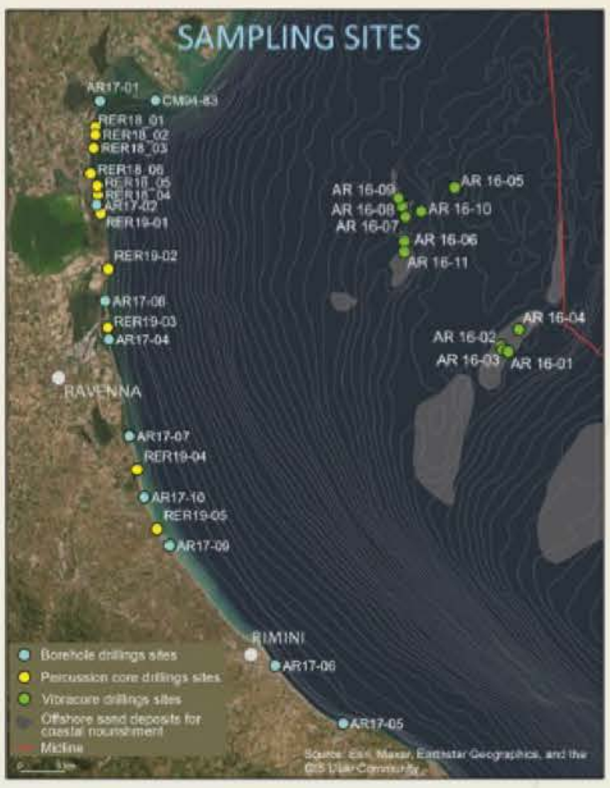

Figure 1 - Study area, showing the sampling locations and three types of sampling methods: 1- **Borehole drillings** (11 sites); 2- **Percussion core drillings** (10 sites); 3- **Vibracore drillings** (10 sites).

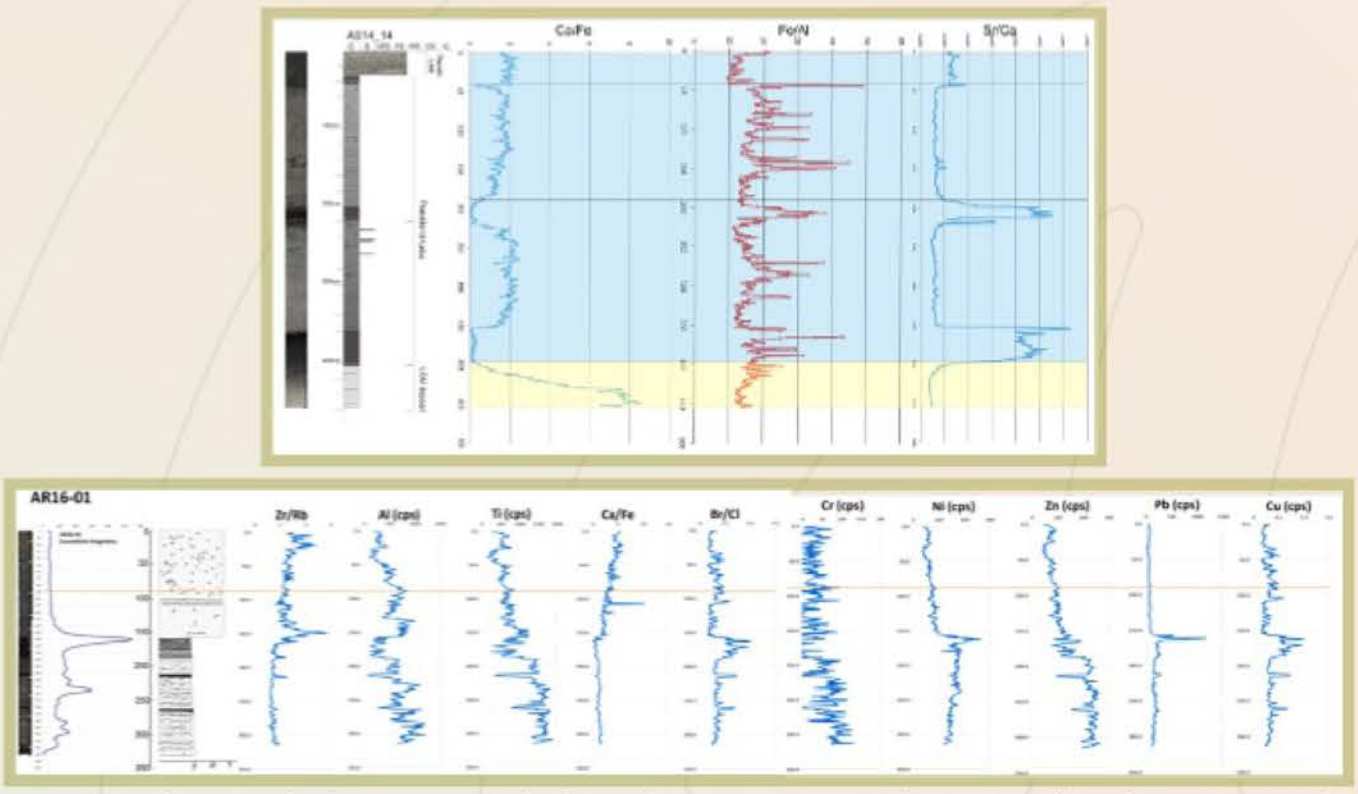

Figure 2 - This example shows some results from vibracore AR16-01, and AS14-14 collected in an area used for dredging operation for sands nourishment. Here we present **data from non-destructive analisys** derived from: stratigraphic log, XRF-CS analysis, and magnetic susceptibility.

CORE ANALYSIS

Sediment core analysis includes two types of analytical techniques:

1) **NON-DESTRUCTIVE PHYSICAL TECHNIQUES**, typically carried out on the whole core: high-resolution photographs, stratigraphic log, XRF-CS analysis, and magnetic susceptibility (example in Fig. 2).

2) **SEDIMENT SUB-SAMPLE ANALYSIS**, carried out on punctual samples includes grain size analysis, ^{14}C dating, heavy metal contents.

XRF-CORE SCANNER (CS) ANALYSIS

The XRF scanner is a **fast and non-destructive technique**. Analysis resolution varies from 10 mm to 0.1 mm and automatically scans sediment cores. **Chemical elements from Al to U can be measured**: analysis of the main elements can be performed within 90 minutes during a complete scan of a **one meter long core section**, with a sample **resolution of 1 cm**. The scanner is equipped with a **high-resolution (360 dpi) colour-line scan-camera** with diachronic RGB beam splitter-prism that allows colour and UV analysis. A continuous scan at the highest resolution takes about 1 min/m.

DATA FLOW

Drillings are described using **ISO19139 XML schema** (Fig. 3) and managed through the **GeoNetwork metadata catalogue** making them findable, accessible (according to their specific policy), and **interoperable with the ITINERIS data HUB**. The geoportal shows their distribution and provides some information about origin, type, overview. Data are stored in a NAS repository and are accessible through the catalogue. A barcode links the metadata to the physical object in the core repository (Fig. 4).

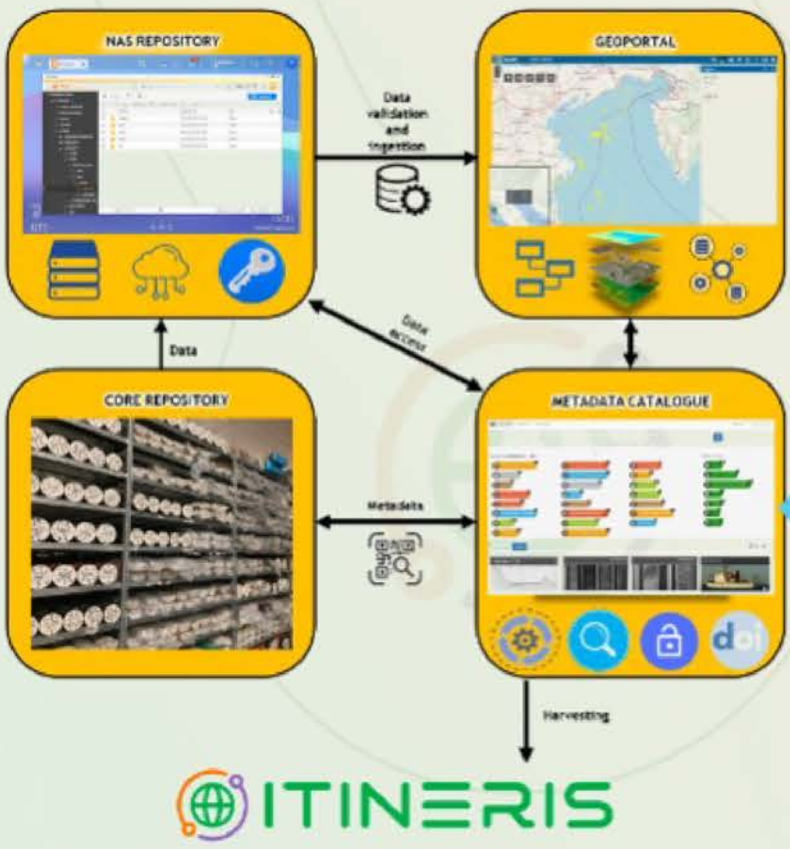

Figure 4 – Sketch of the data flow.

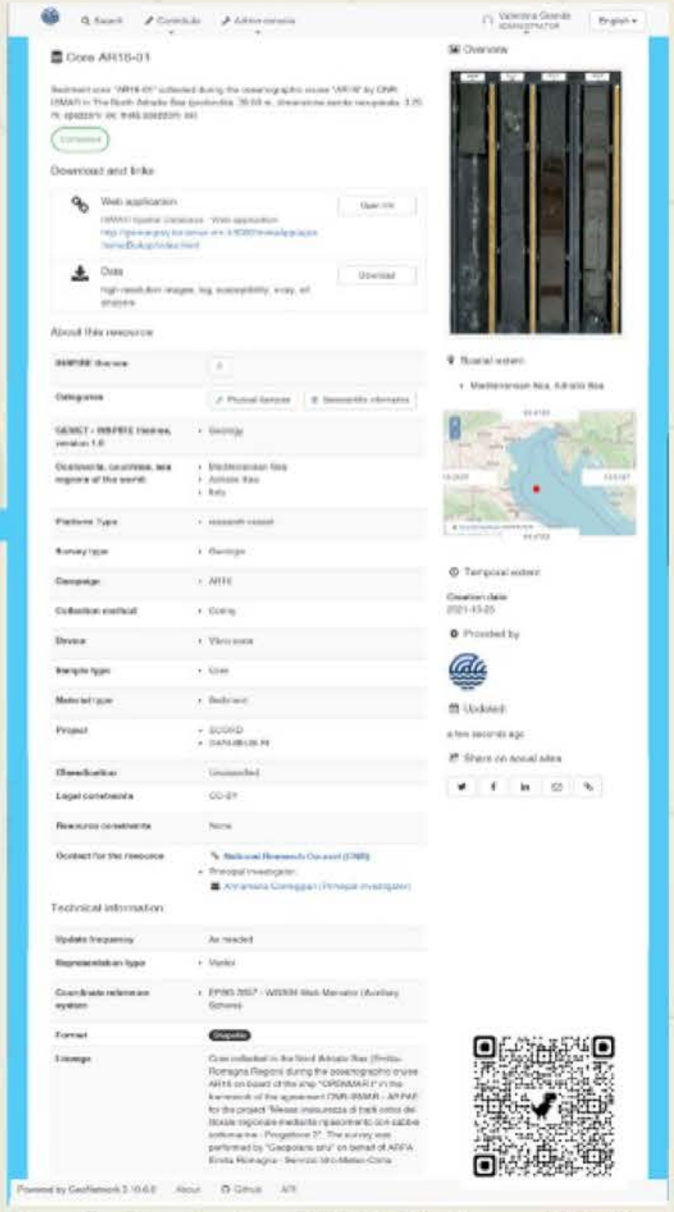

Figure 3 – **Metadata form ISO19139** for the core AR16-01.

CONCLUSION:

The results of this study will be made available (Findable, Accessible, Interoperable, Reusable – **FAIR**) through the **ITINERIS data HUB** in the framework of DANUBIUS-RI. Testing capacity of data transfer is one of the targets that will be managed in collaboration with the Geological, Seismic, and Soil Survey of Regione Emilia-Romagna as a partner of several collaborative projects.

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The new JEOL JXA-iSP100 Superprobe at the Laboratory of Microanalysis and Electron Microscopy (LAM[2]): application for the construction of a database of the Quaternary Mediterranean tephrochronology and of the Italian explosive volcanism

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Monaco, L.[1]*, Giaccio, B.[2], Petrosino, P.[3], Peña-Araya, V.[4], Siani, G.[5], Albert, P.G.[6], Conte, A.[2], Conticelli, S.[7], Insinga, D.D.[1], Leicher, N.[8], Lucchi, F.[9], Nomade, S.[10], Palladino, D.M.[11], Pereira, A.[5], Sulpizio, R.[12], Viccaro, M.[13], Wulf, S.[14]

[1]: ISMAR-CNR, Bologna, IT; [2]: IGAG-CNR, Montelibretti, IT; [3]: DiSTAR-UniNa, Naples, IT; [4]: INRIA-Saclay, Paliseau, FR; [5]: Université Paris-Saclay, Paris, FR; [6]: Swansea University, Swansea, UK; [7]: DST-UniFi, Florence, IT; [8]: Universität Zu Köln; Cologne, GE; [9]: BiGeA-UniBo, Bologna, IT; [10]: IPSL-LSCE, Gif-Sur-Yvette, FR; [11]: DST-Uniroma1, Rome, IT; [12]: DSTG, UniBa, IT; [13]: DIPBIOGEO-UniCT, Catania, IT; [14]: University of Portsmouth, Portsmouth, UK.

Fig. 1: The new JEOL JXA-iSP 100 installed at the Laboratory of Microanalysis and Electron Microscopy (LAM[2]).

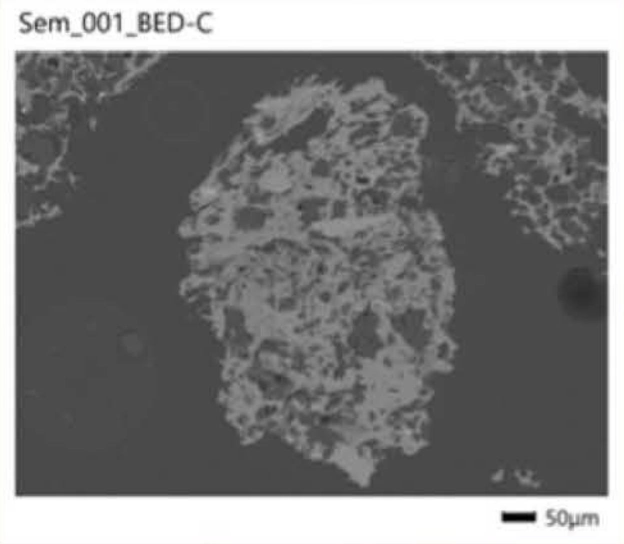
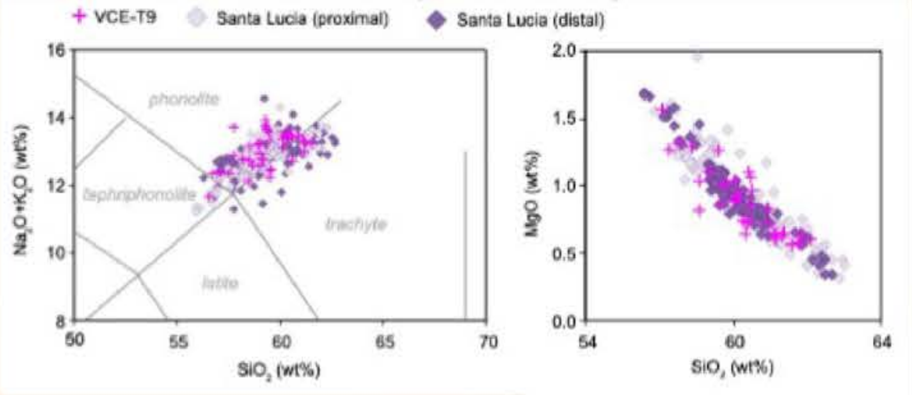


Fig. 2: Backscattered electrons (BSE) image of a micro-pumice (scale is reported at the bottom-right). The backscattered electron detector (BED) provides an image in grey tones, where samples with > Z_m result in brighter (white-whitish) images whilst lighter samples (< Z_m) will appear in darker-blackish tones, thus providing qualitative compositional information of the sample.



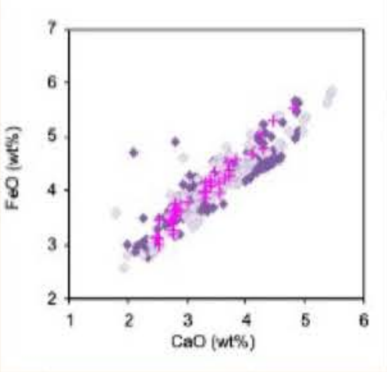


Fig. 3: Example of tephra correlation based on major-minor element compositions acquired with the electron probe microanalyzer. Diagrams description: *Total Alkali vs silica* (TAS; Le Maitre et al., 2002; up-left), SiO2 wt% vs MgO wt% (up-right) and CaO wt% vs FeO wt% (down-right).

Model	N° WDS	N° EDS	Filament-types	Counter
JXA-iSP100	5	1	K-type (W); LaB6	XPC (3), GPC (2)

Configuration				
Channel-1	Channel-2	Channel-3	Channel-4	Channel-5
XM-36030L	XM-36010XCE	XM-36010XCE	XM-36020H	XM-36040FCS
PETL	TAPJ	PETJ	PETH	TAPJ
LIFL	LDE2	LIF	LIFH	LDEB
				LDE1
				PETJ
XPCH	GPC	XPC	XPCH	GPC

- Tephra layers can be preserved in different sedimentary archives (continental and marine)
- Can be dated ($^{40}Ar/^{39}Ar$), providing age constraints
- Can be correlated via geochemical fingerprinting
- Can be traced over great distances, allowing to synchronize climate events at continental scale

Problem → Geochemical and geochronological data needed for tephra correlation is scattered in a large number of papers and "grey literature" that aggravates the work of "tephrostratigraphers".

Solution → Creation of a database gathering all the available glass geochemistry and geochronological data of both proximal pyroclastic units and distal tephra layers originating from Quaternary Italian volcanoes.

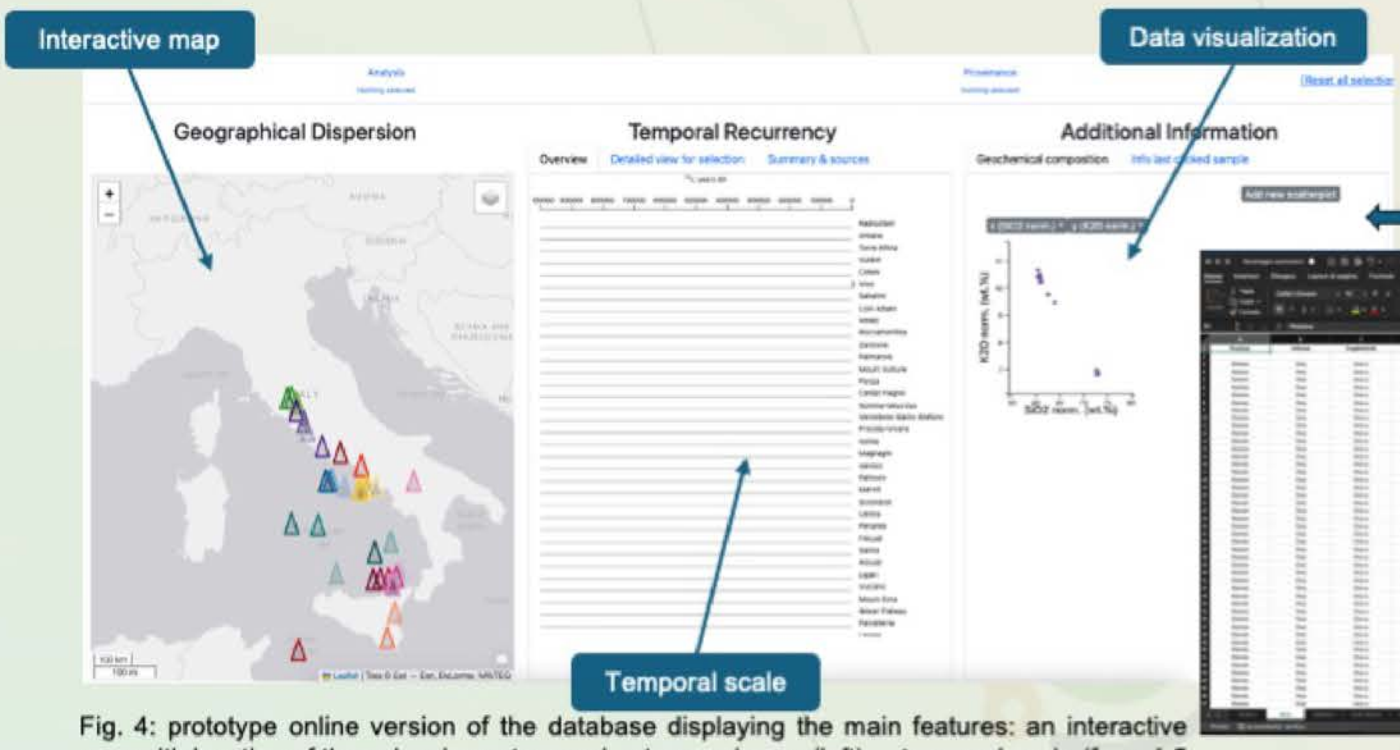


Fig. 4: prototype online version of the database displaying the main features: an interactive map with location of the volcanic centres and outcropes/cores (left); a temporal scale (from 1.5 Ma to present; front); bi-plots diagrams showing major, minor and trace element data (right). The structure is the same of Martìnez-Fontaine et al. (2023).

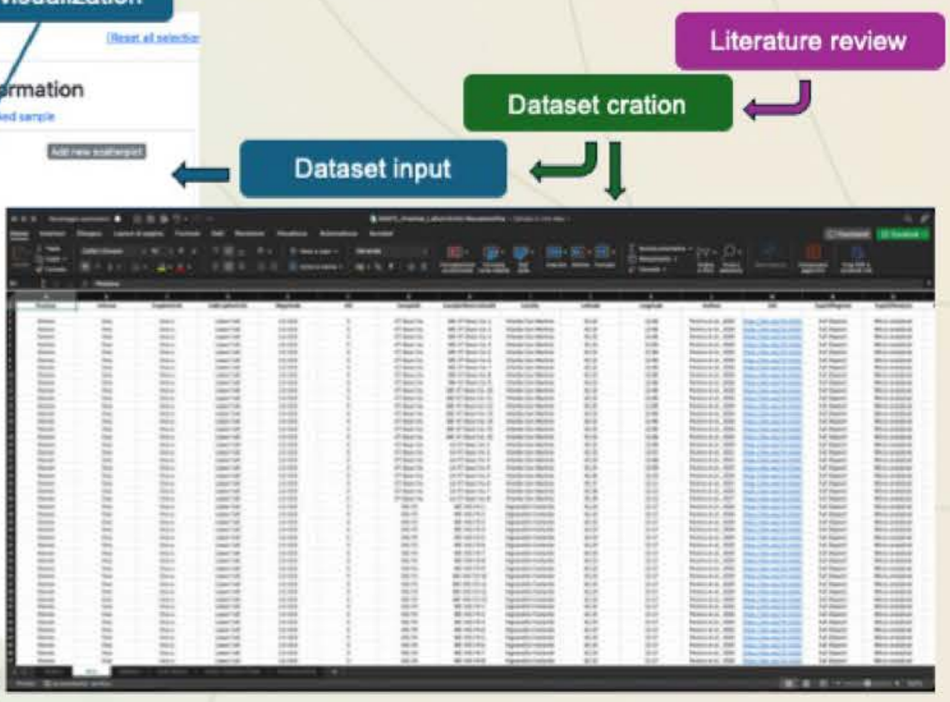


Fig. 5: Excel file with a collection of literature data.

→ Creating a reference database including all this data will provide the scientific community with an instrument that can be employed for a faster and easier way to retrieve geochemical data for tephra investigation.

→ This database will also provide us with an updated state of the art of all the available data of proximal deposits, highlighting potential gaps of knowledge and thus orienting future research to focus on their filling.

References

-Le Maitre et al., 2002. Igneous Rocks. A classification and Glossary of terms. In: Reccomendation of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks, second ed. Cambridge University Press, Cambridge, p. 236.

-Martìnez-Fontaine et al., 2023. BOOM! Tephrochronological dataset and exploration tool of the Southern (33–46° S) and Austral (49–55° S) volcanic zones of the Andes. Quaternary Science Reviews, 316, 108254.

Annual meeting - Roma - 9-10/07/2024

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Potentialities of electromagnetic and geoelectric geophysical methods in urban environment: first activities under the ITINERIS project

G. De Martino[1], L. Capozzoli[1], V. Giampaolo[1], L. Martino[1,2], A. Perrone[1], V. Serlenga[1], T. A. Stabile[1], V. Lapenna[1]

1 CNR-IMAA, Tito Scalo (PZ), Italy

2 UNIBAS, Potenza (PZ), Italy

Contacts: gregory.demartino@cnr.it; valeria.giampaolo@cnr.it;

FRAMEWORK

- The Italian Integrated Environmental Research Infrastructures System (ITINERIS) Project coordinates a network of national nodes from 22 RIs.
- The participating RIs work together towards a harmonized development and ensure full interoperability, promoting inter-RI data use and, whenever possible, colocation and standardization of methods and tools.
- The aim of WP7-7.4 task of project ITINERIS is providing scientific and open digital data of multi-scale and multi-resolution near-surface geophysical observations to the scientific community, practitioners, and decision-makers according to the Digital Earth concept.

OBJECTIVES

a) Upgrade the geophysical equipment;
b) Establishing a service aimed at integrating the data from a variety of geophysical sensors;
c) Investing in the next-generation technologies and enabling FAIR data access;
d) Demonstrating to the end-users of the integrated geophysical and airborne networking capabilities at the pilot sites in Basilicata Region affected by seismic and hydrogeological risks.

BASILICATA PILOT SITES

One of the three pilot sites is the Basilicata region (southern Italy), that is a predominantly mountainous zone affected by high seismic and hydrogeological risks. In particular, the first scientific activities were carried out in the city of Potenza.

Figure 5. From the left to the righ there are represented the Italian peninsula and the Basilicata Region.

NEW GEOPHYSICAL INSTRUMENTATIONS

Figure 1. New Syscal Terra system for the Electrical Resistivity Tomography (ERT).

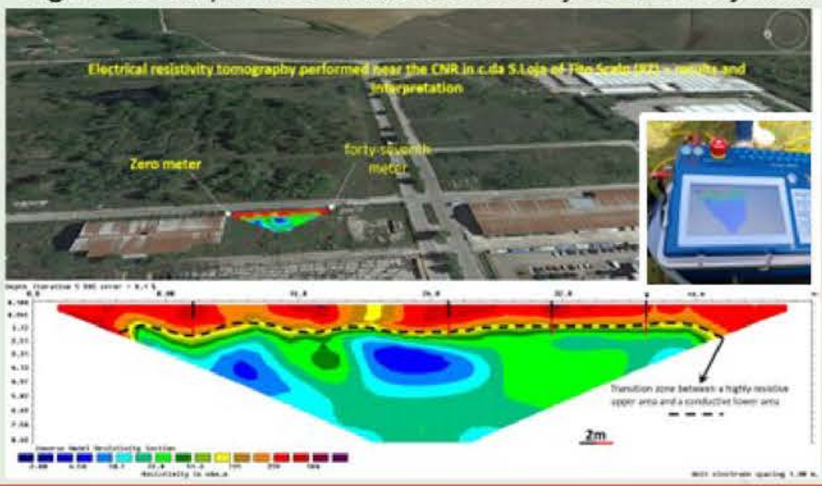
Figure 2. System for shallow and deep ERT (DERT). New transmitting and receiving systems for DERT measurements.

Figure 3. A Triton Accelerometer for analysis of near-surface-soil-infrastructure dynamical interactions and microzonation studies. One of the activities will be focused to integrate geoelectrical and seismic measurements.

Figure 4. Acquisition of geoelectrical data in one of the test sites of ITINERIS project (Tito industrial areas, Basilicata Region).

FIRST SCIENTIFIC ACTIVITIES

Figure 6. ERT performed with the new Syscal Terra system



The first results obtained with the Syscal Terra for mapping the groundwater table at the industrial site of Tito affected by groundwater pollution are presented in figure 6.

FUTURE PERSPECTIVES

- Monitoring of groundwater and identification of contaminated areas;
- Monitoring of landslide phenomena;
- Integration of geoelectrical and seismic methods for mapping active faults and evaluating seismic amplification effects.

References

- Olita, F.; Giampaolo, V.; Rizzo, E.; Palladino, G.; Capozzoli, L.; **De Martino, G.**; Prosser, G. Investigation of the Geological Structure of the Tramutola Area (Agri Valley): Inferences for the Presence of Geofluids at Shallow Crustal Levels. Geosciences 2023, 13, 83. https://doi.org/10.3390/geosciences13030083.
- ERT and GPR Prospecting Applied to Unsaturated and Subwater Analogue Archaeological Site in a Full Scale Laboratory- Luigi Capozzoli, Valeria Giampaolo, **Gregory De Martino**, Felice Perciante, Vincenzo Lapenna and Enzo Rizzo-doi.org/10.3390/app12031126 - Appl. Sci. 2022, 12, 1126.
- Haroon, A., Micallef, A., Jegen, M., Schwalenberg, K., Karstens, J., Berndt, C., ... & Chidichimo, F. (2021). Electrical resistivity anomalies offshore a carbonate coastline: Evidence for freshened groundwater?. Geophysical Research Letters, 48(14), e2020GL091909.
- A. Binley, A. and L. Slater. Resistivity and Induced Polarization Theory and Applications to the Near-Surface Earth by, Cambridge University Press, 388pp, 2020.
- Loke, M.H.; Chambers, J.E.; Rucker, D.F.; Kuras, O.; Wilkinson, P. B. Recent developments in the direct-current geoelectrical imaging method. Journal of Applied Geophysics, 2013, 95, 135-156. https://doi: 10.1016/j.jappgeo.2013.02.017.

This work shows the activities carried out in the framework of WP7-7.4 task of project ITINERIS - ITALIAN INTEGRATED ENVIRONMENTAL RESEARCH INFRASTRUCTURES SYSTEM financed by European Union – Next Generation EU Piano Nazionale di Ripresa e Resilienza Missione 4 - Componente 2, Investimento 3.1 "FONDO PER LA REALIZZAZIONE DI UN SISTEMA INTEGRATO DI INFRASTRUTTURE DI RICERCA E INNOVAZIONE". CUP B53C22002150006

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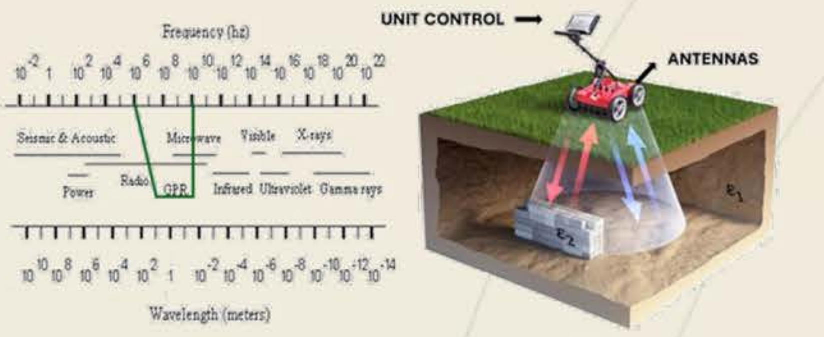
Development of an integrated electromagnetic sensing system for environment characterization

Francesco Mercogliano – WP7 Task 7.5 PhD Student (XXXIX cycle)

AIM: integrated electromagnetic sensing system for diagnostic and monitoring of the environment (geo-environment, urban and rural areas). Preliminary research activities towards the integrated use **of Ground Penetrating Radar** (GPR) and **magnetometric** methods.

GPR METHOD

- **Active** geophysical exploration method (from hundred MHz to few GHz).
- Detection and localization of electric contrasts.
- Exploration depth related to operating frequency and soil electromagnetic properties (dielectric permittivity and electric conductivity).



DATA PROCESSING

Input: **Raw Radargrams**

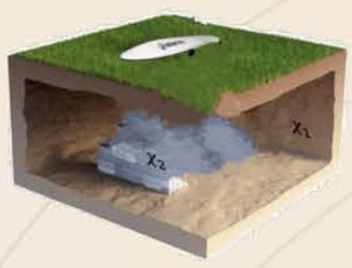
Pre-Processing: Zero Timing → Time Gating → BKGR → Gain → Depth Conv. → Data Inversion: DFT → Frequency Range Selection → Microwave Tomography Imaging

Output: **Microwave Tomography Image (MWI)**

Output: 2D (& 3D) map showing the spatial distribution of the normalised electric contrasts, where targets are represented by regions with not null contrast values.

MAGNETOMETRIC METHOD

- **Passive** geophysical exploration method exploiting the natural Earth's Magnetic Field (E.M.F.).
- Detection and localization of magnetization contrasts.
- Exploration depth related to the magnetic target position.



DATA PROCCESSING

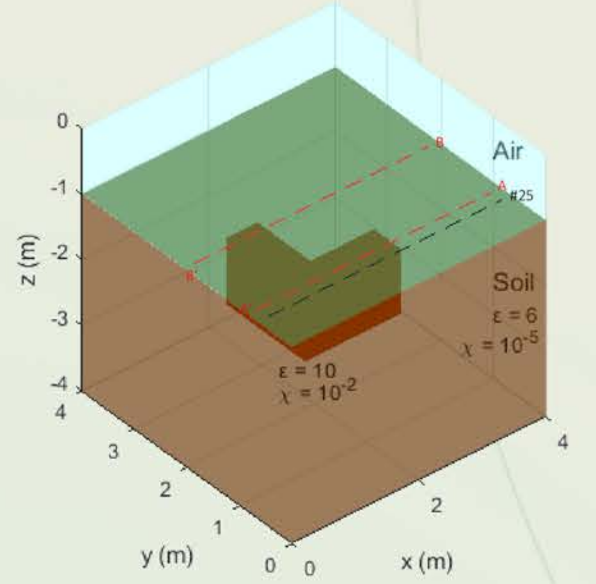
Input: **Raw Magnetic Anomaly Map**

Functional Transformation: Up/Down-ward Continuation → Directional Filters → Reduction To Pole → Boundary Analysis → Imaging: DEXP

Out: **Scaled Potential Field**

Output: 2D (& 3D) map showing the spatial distribution of the scaled field using DEXP method, where targets are represented by regions with maxima values.

PRELIMINARY SIMULATED RESULTS



Domain	Target Size
4x4x3 m^3	1.5(0.5)x0.5(1.5)x1 m^3

GPR PARAMETERS

f_c	300 MHz	Ntraces	38
ΔR	20 cm	Step	10 cm
ΔC	10 cm	Nmis	46

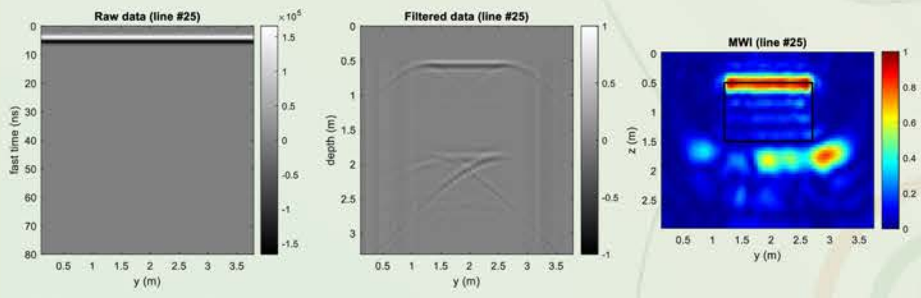
MAG PARAMETERS

$I_F = I_J$	56°
$D_F = D_J$	2°
Stepx = Stepy	5 cm

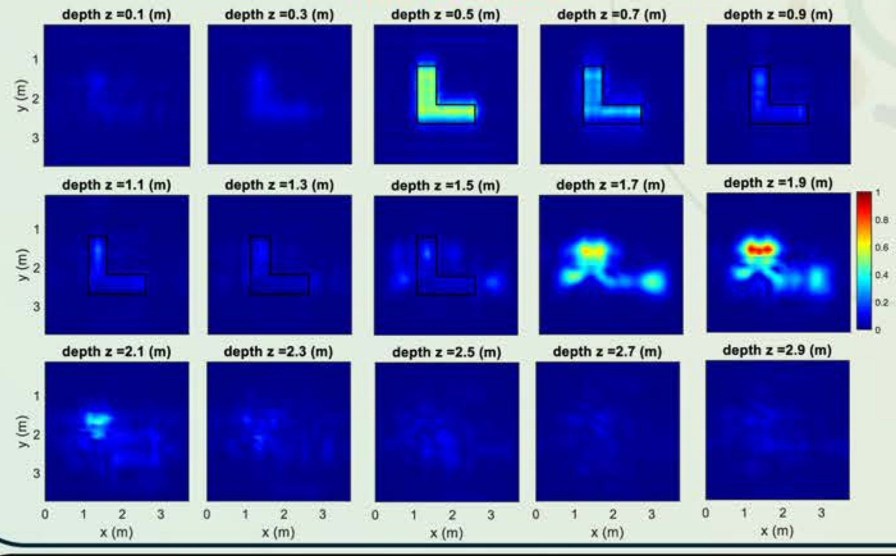
Simulation software:

- GPRMAX for GPR data (open-source simulation software www.gprmax.com)
- Proprietary simulation codes for MAG data

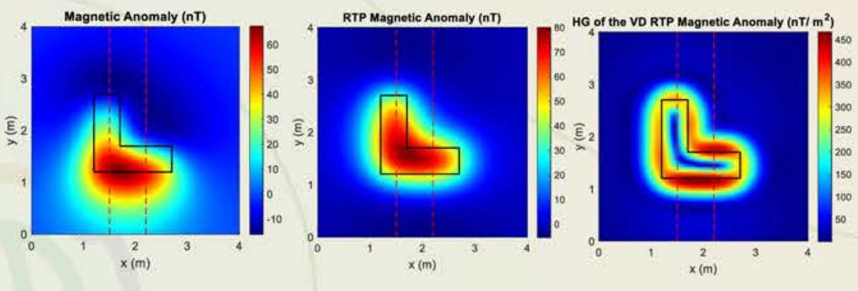
GPR DATA & RESULTS



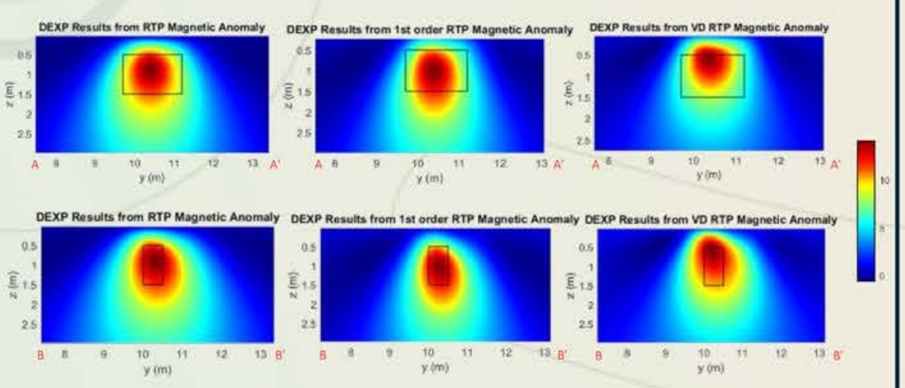
MWI depth slices



MAG DATA & RESULTS



Scaled Field Maps



GPR & MAG perform buried target imaging by exploiting different sensing principles and their joint use allows us to get related and complementary information on the surveyed environment. Future activities regard the employment of both the methodologies and the integration of their results also by taking advantage of AI algorithms.

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A multi-frequency airborne SAR system for Earth observation

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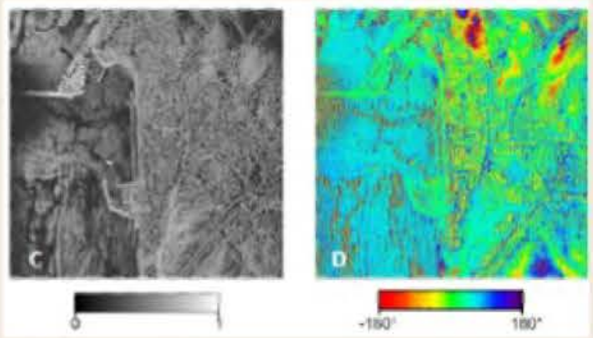
Benefits of Airborne SAR systems

- **High Spatial Resolution**
- **High Operational Flexibility**

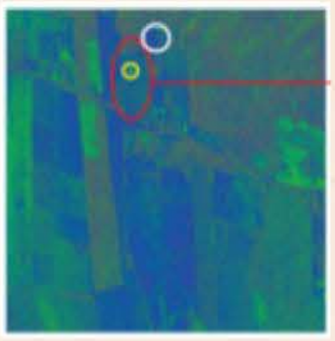
High responsiveness
Small revisit times
Reduced constraints in the choice of the observing geometry

Scientific Applications

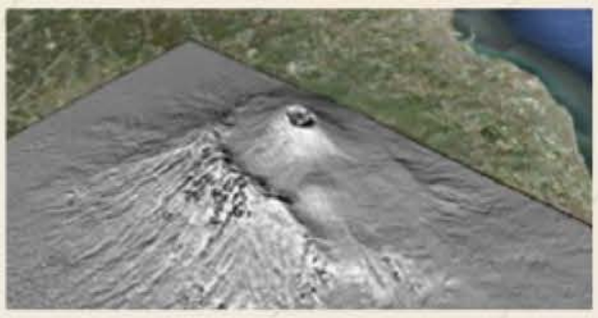
INTERFEROMETRY



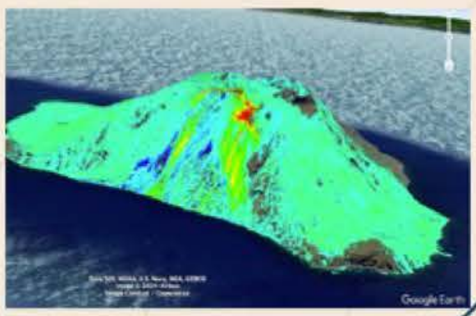
POLARIMETRY



DEM GENERATION



SURFACE DEFORMATION



Airborne SAR Infrastructure strengthening

Since a time ago in IREA there is already an airborne SAR infrastructure, through the ITINERIS project a new system has been acquired

A multi-band Airborne SAR system

Capable of pulsed transmission, operating in X-band and L-band modes, adjustable bandwidth up to 200MHz; single-pass interferometry in X-band; full-polarimetry in L-band, altitudes up to 8000 m, resolution of 80 cm range and 30 cm azimuth, and swath of 4500 m in X-band and 10000 m in L-band.

Source: https://www.topoflight.com

A Flight Management System

The system facilitates planning flight missions and precise SAR data acquisition, including a 3D flight planning module for photogrammetric acquisitions, an aircraft navigation module to follow the planned route, an LCD monitor for the pilot, and a laptop for system management.

GNSS/INS system PwrPak7D-E2

This is an advanced receiver offering all-constellation, multi-frequency positioning. It combines GNSS accuracy with IMU stability to deliver an exceptional, stable and continuous 3D navigation solution, providing real-time precise position and attitude information to the radar.

Source: https://novatel.com

Computing resources A cluster of computing servers will be acquired to store and process SAR data with the aim of generating added-value Products.

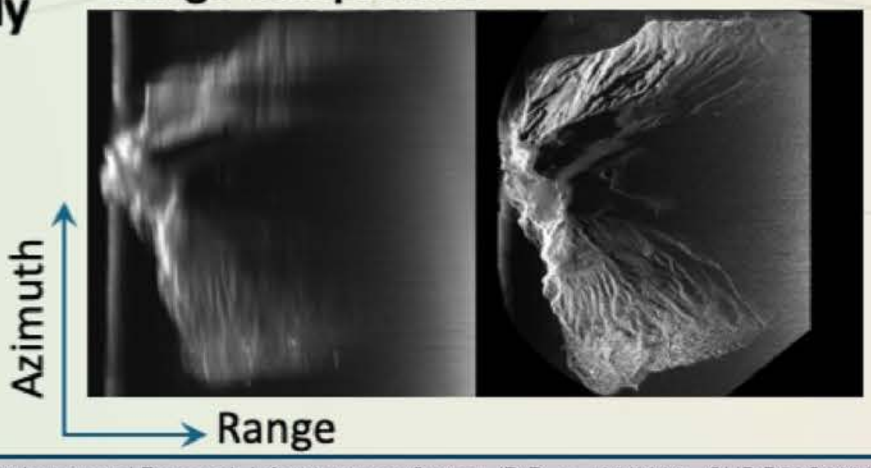
System	Progress status	%
SAR	In contract	75
Flight Management	Acquired	100
GNSS/INS	Acquired	100
Cluster	To be acquired	25

Activities developed in the Stromboli case study

- Review and training new softwares Novatel and Flight Management System TopoFlight.

- Adaptation of focusing algorithms for the new instrumentation.

RAW DATA



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Ministero dell'Università e della Ricerca

Italiadomani

Enhancing kinematic analysis of rock slopes using LiDAR systems

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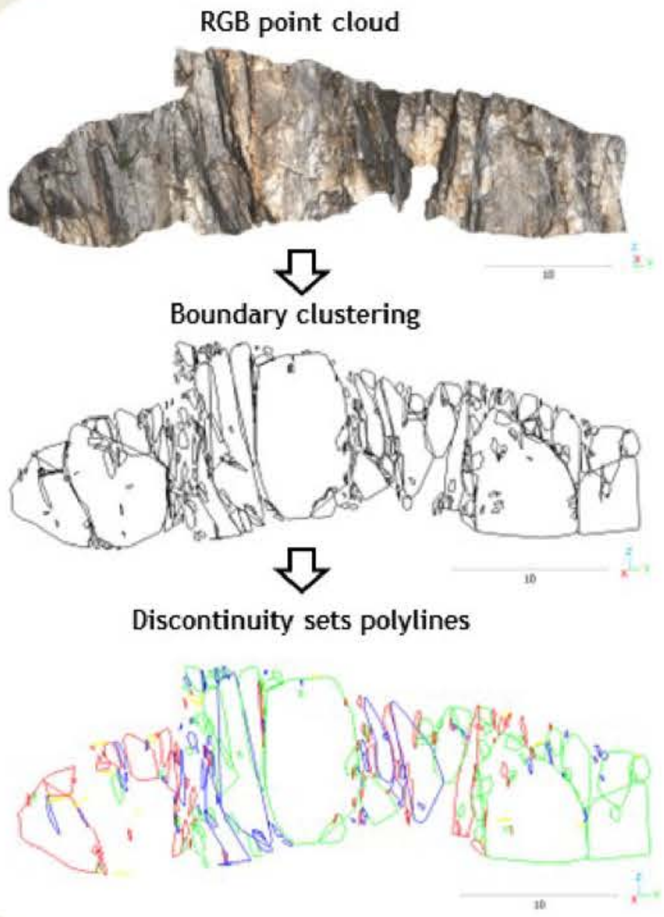
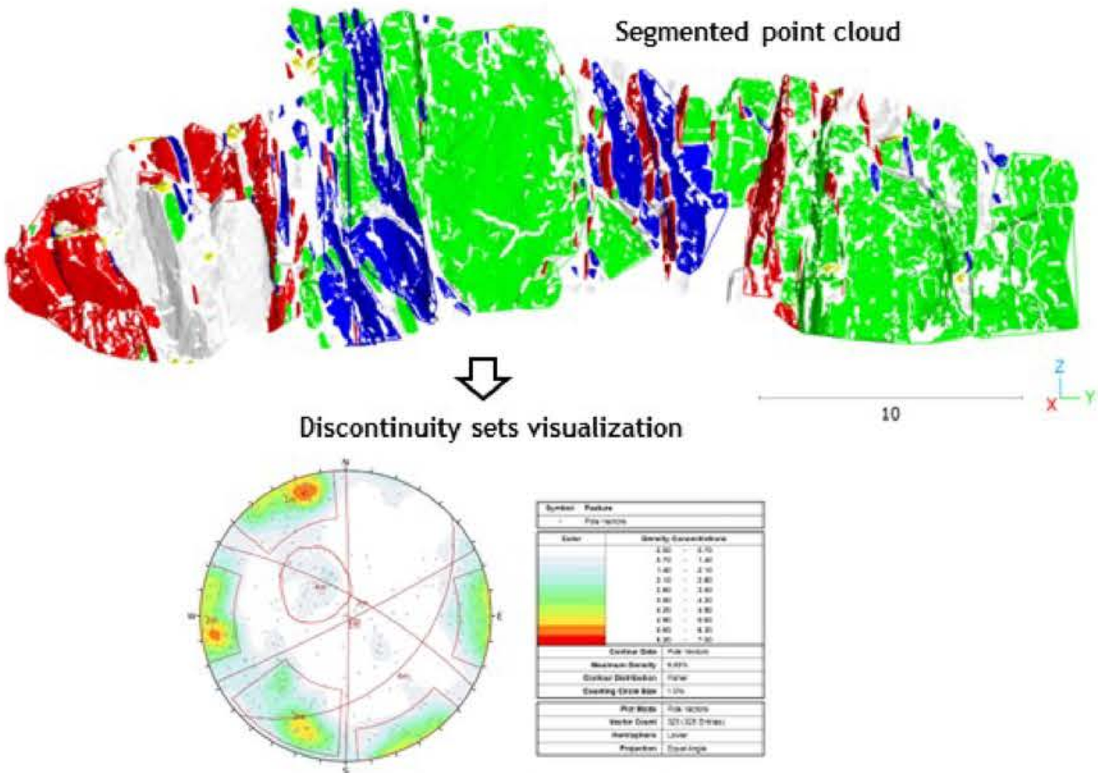
INTRODUCTION

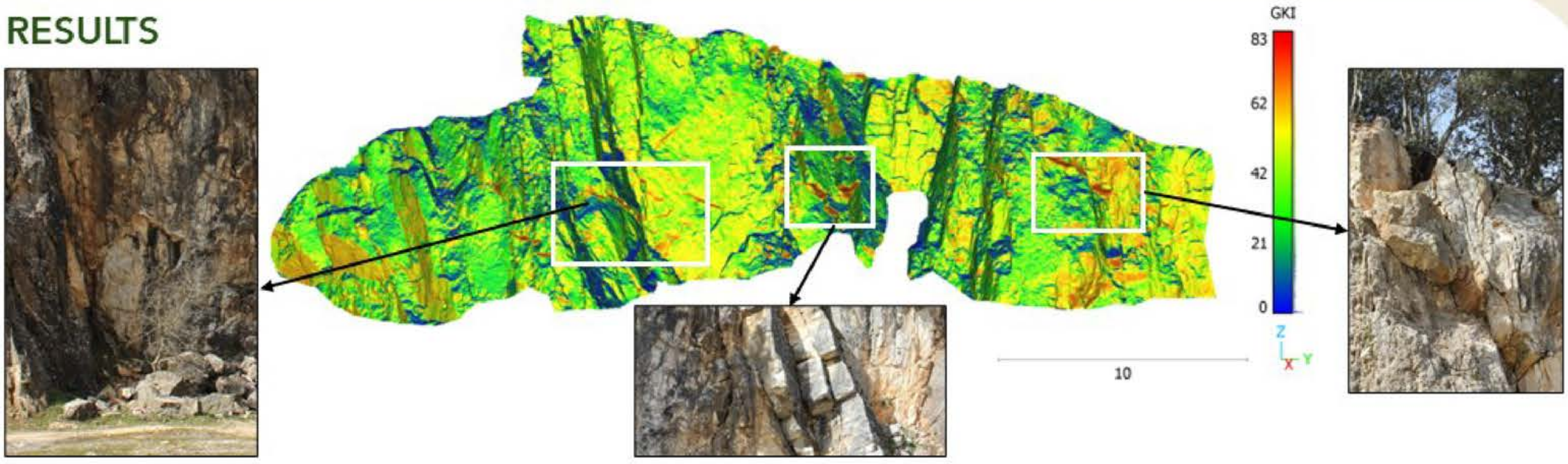
Kinematic analysis of rock slopes is a critical method for assessing slope stability and mapping potential geological hazards. Traditional methods often face limitations in accuracy and data resolution (Gigli and Casagli, 2011). This study explores the application of LiDAR (Light Detection and Ranging) systems to enhance the precision and comprehensiveness of kinematic analysis. By utilizing high-resolution **3D point clouds generated by LiDAR**, we aim to improve the detection and characterization of discontinuities within rock slopes, thereby providing a more detailed assessment of potential failure mechanisms using semi-automatic customized routines. This poster presents the instruments and research workflow, highlighting the significant advantages of integrating LiDAR technology into rock slope kinematic analysis.

MATERIAL AND METHODS





RESULTS



Through a semi-automatic analysis workflow (Gigli et al., 2022), a kinematic analysis was performed, allowing the creation of three-dimensional susceptibility maps for various instability mechanisms: plane failure, wedge failure, free fall, block toppling, and flexural toppling (Gigli and Casagli, 2011). The figure shows the Global Kinematic Index, or the Overall Rockfall Susceptibility, of the studied slope.

CONCLUSIONS

The presented work confirmed that using high-accuracy and precise LiDAR systems (both TLS and MLS) for geometric reconstruction of natural environments, such as rock slopes, is reliable for computing kinematic analysis to highlight the kinematic feasibility of structurally controlled instabilities. The analyzed three-dimensional data improve our understanding of the potential of LiDAR data to achieve reliable kinematic analysis. Further steps, including the possibility of assigning spatial weighting and distinct friction angles, can be taken to better incorporate the characteristics of individual discontinuities and intersections into the analysis of complex scenarios.

REFERENCES

- Gigli, G., Casagli, N. (2011). Semi-automatic extraction of rock mass structural data from high resolution LIDAR point clouds. International Journal of Rock Mechanics and Mining Sciences, 48(2), 187-198. 829 https://doi.org/10.1016/j.ijrmms.2010.11.009
- Gigli, G., Lombardi, L., Carlà, T., Beni, T., & Casagli, N. (2022). A method for full three-dimensional kinematic 834 analysis of steep rock walls based on high-resolution point cloud data. International Journal of Rock 835 Mechanics and Mining Sciences, 157, 105178. https://doi.org/10.1016/j.ijrmms.2022.105178

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Shallow landslides prediction at regional scale: from data collection to validation of results

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BACKGROUND

The analysis of slope stability over large areas is a demanding task due to:

- Need for extensive datasets
- Uncertainty of collected data
- Difficulty of accounting for site-specific factors
- Considerable computation time required
- Lack of detailed landslide datasets for calibration

RESEARCH RATIONALE

Set-up of a regional scale forecasting system for rainfall induced shallow landslides aimed at activating a real-time alert system based on distributed modelling.

METODOLOGY

Physically based distributed modeling using HIRESSS (HIgh REsolution Slope Stability Simulator), a powerful simulator based on a parallel code capable of providing real-time results for large areas.

RAINFALL INTENSITY →

Hydrological model

$$\frac{\partial h}{\partial t}\frac{d\theta}{dh}=\frac{\partial}{\partial x}\left[K_L(h)\left(\frac{\partial h}{\partial x}-\sin\alpha\right)\right]+\frac{\partial}{\partial y}\left[K_L(h)\left(\frac{\partial h}{\partial y}\right)\right]+\frac{\partial}{\partial z}\left[K_Z(h)\left(\frac{\partial h}{\partial z}-\cos\alpha\right)\right]$$

During rainfall

$$h(Z)=Z\beta\left(1-\frac{d}{Z}\right)+Z\frac{I}{K_Z}\left[R\left(\frac{t}{Z^2/4D_0\cos^2\alpha}\right)\right]$$

After rainfall

$$h(Z)=Z\beta\left(1-\frac{d}{Z}\right)+Z\frac{I}{K_Z}\left[R\left(\frac{t}{Z^2/4D_0\cos^2\alpha}\right)-R\left(\frac{t-T}{Z^2/4D_0\cos^2\alpha}\right)\right]$$

→ PORE PRESSURE →

Slope stability model

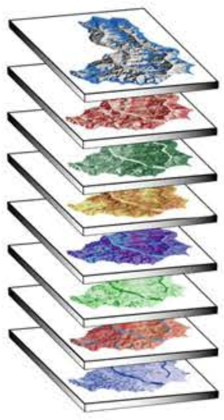
Unsaturated conditions

$$FS=\frac{\tan\varphi}{\tan\alpha}+\frac{c'}{\gamma_{NS}z\sin\alpha}+\frac{(u_a-u_w)\tan\varphi^b}{\gamma_{NS}z\sin\alpha}$$

Saturated conditions

$$FS=\frac{\tan\varphi}{\tan\alpha}+\frac{c'}{(\gamma_{NS}(z-h)+\gamma_s h)\sin\alpha}-\frac{h(z,t)\gamma_w\tan\varphi}{(\gamma_{NS}(z-h)+\gamma_s h)\sin\alpha}$$

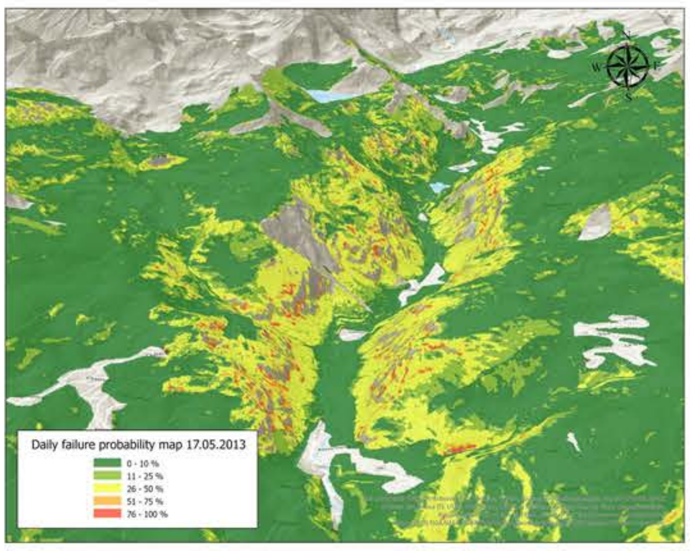
→ FAILURE PROBABILITY



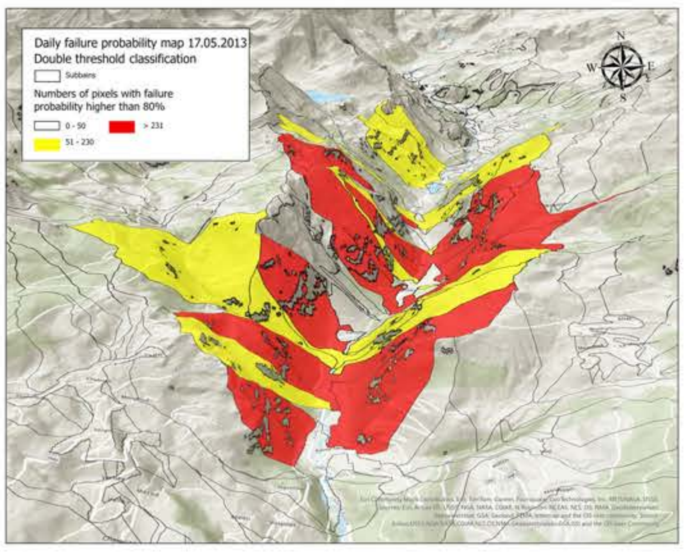
Static input data: slope gradient, effective cohesion (c'), root cohesion (c_r), effective friction angle (ϕ'), hydraulic conductivity (k_s), dry unit weight (γ_d), effective porosity (n), soil thickness, pore size index (λ), bubbling pressure (h_b), residual water content (q_r), and outcrops.
Dynamic data: rainfall intensity.

Recent applications: Alert area A and Alert Area B of Valle d'Aosta Region (approximately 800 square kilometers each).

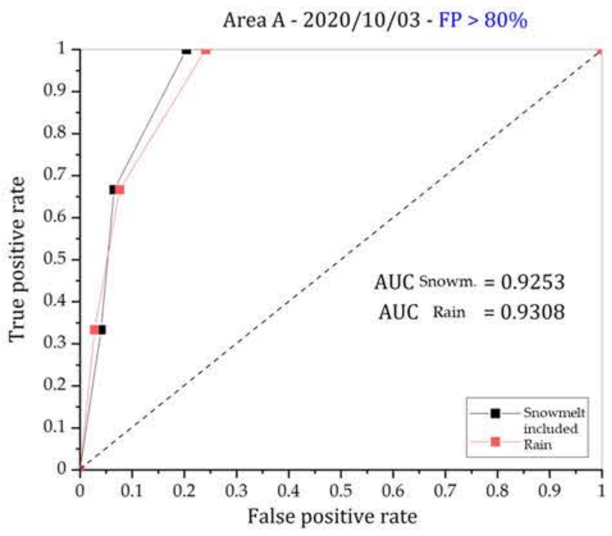
RESULTS



Model outputs: distributed map of failure probability (or factors of safety on demand) with less than hour time resolution and metric spatial resolution.



Outputs aggregation in subbasins (or other spatial units) based on a double threshold classification: number of pixels with a failure probability higher than a selected percentage.



Validation through back analysis (considering occurred landslides during the event) to calibrate the output aggregation process.

FINAL CONSIDERATIONS AND PROSPECTS

The accuracy of the predictions of shallow landslides through distributed modeling using Hiresss and the process of double threshold aggregation was very high, so the system thus composed is suitable for a rapid alert system at a regional scale.
Currently, developments are under way to make the system operational in a pilot area.

REFERENCES

Rossi G, Catani F, Leoni L, Segoni S, & Tofani V (2013) HIRESSS: a physically based slope stability simulator for HPC applications. Nat. Hazard Earth Sys. 13 (1), 151–166. https://doi.org/10.5194/nhess-13-151-2013

Salvatici T, Tofani V, Rossi G, D'Ambrosio M, Stefanelli CT, Masi EB,...(2018) Application of a physically based model to forecast shallow landslides at a regional scale. Nat. Hazard Earth Sys. 18 (7), 1919–1935. https://doi.org/10.5194/nhess-18-1919-2018

Masi EB, Tofani V, Rossi G, Cuomo S, Wu W, Salciarini D, Caporali E, Catani F (2023) Effects of roots cohesion on regional distributed slope stability modelling, Catena, 222, 106853, ISSN 0341-8162, https://doi.org/10.1016/j.catena.2022.106853

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PITOP FACILITY IMPROVEMENT AND TESTING OF RELEVANT EQUIPMENT IN THE FRAME OF THE ITINERIS PROJECT

eccsel eric

Authors: Bellezza C., Travan A., Schleifer A., Meneghini F., Zgauc F., Barison E., Pinna G.

OGS

Highlights:

- **PITOP** is an **ECCSEL geophysical testing facility** for research and development in the frame of **environmental sustainability**
- PITOP is equipped with **cutting-edge instrumentation**, implemented also owing to the **ITINERIS project** (WP7)
- The recent **drilling of a new well** (PITOP5) allowed **testing new surface** (NuSeis) **and borehole** (Avalon) **geophones** with different approaches/methods like Seismic While Drilling (**SWD**), **surface** and **cross-well seismic**
- A complete Distributed Acoustic System (**DAS**) facility and an **instrumented van** for in field geophysical acquisitions are being implemented
- **PITOP facilities** and **technical support** are available for **scientific/technological collaborations and services**

SUSTAINABILE ENVIRONMENT

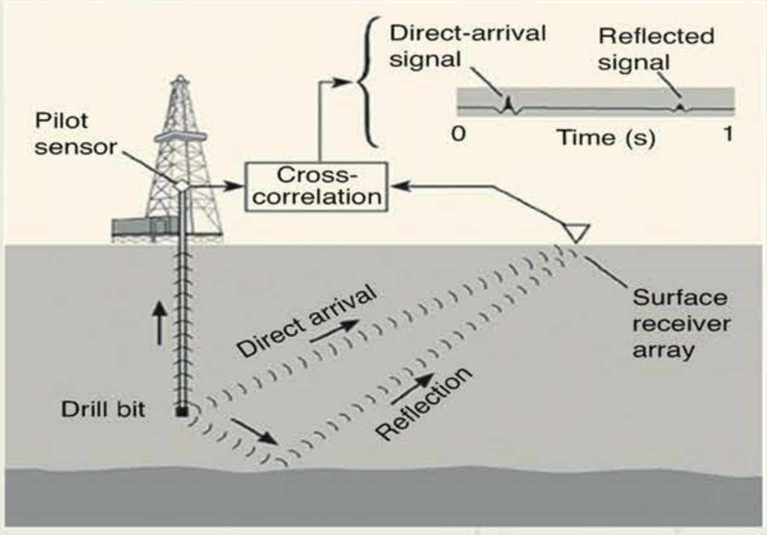
https://fiinovationblogs.wordpress.com/2014/04/18/

PITOP: GEOPHYSICAL TESTING SITE FOR:

- ✓ Studies for **CO_2 storage** site characterization and monitoring
- ✓ **Geothermal field** characterization
- ✓ **Hydrogen storage** site characterization and monitoring
- ✓ **Water resources** applications

PITOP FACILITY IN TRAVESIO (PN, ITALY)

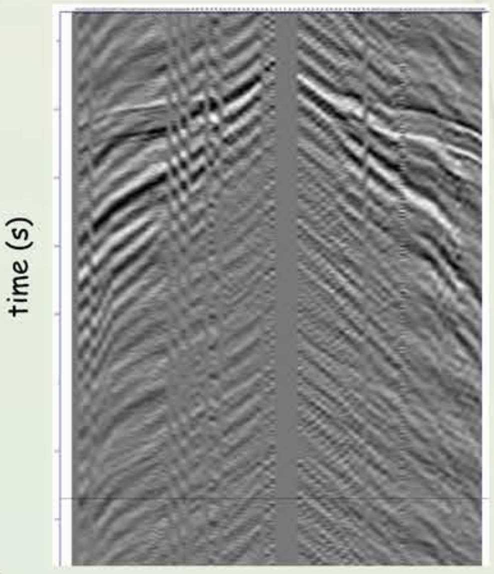
SEISMIC WHILE DRILLING (SWD) AND SURFACE SEISMIC



NuSeis Geophones (mono and three components):

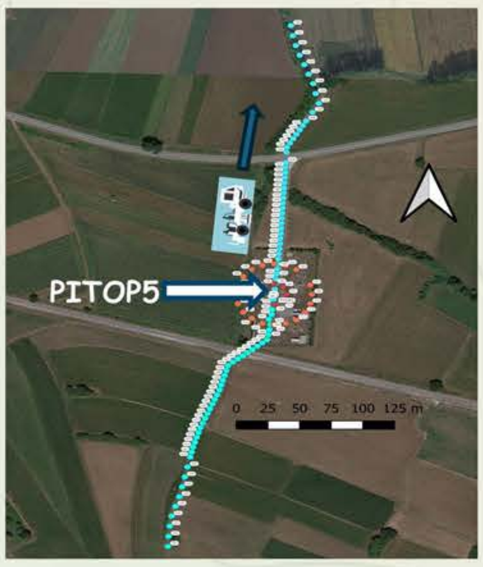
- Long battery life: providing up to 45 days of continuous operation.
- Wireless recording units
- GNSS and BLE comms: easy deployment and retrieval.
- SEG standard data formats: compatible with processing softwares.

SWD

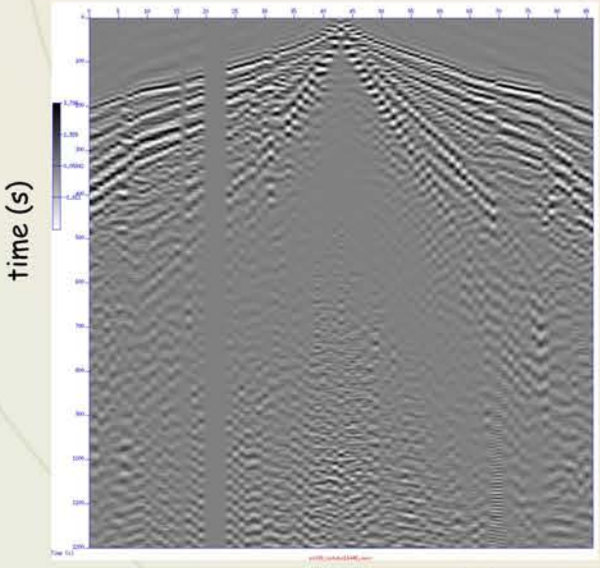


Horizontal distance (m)

Depoloyment of surface geophones during the drilling of PITOP5 well

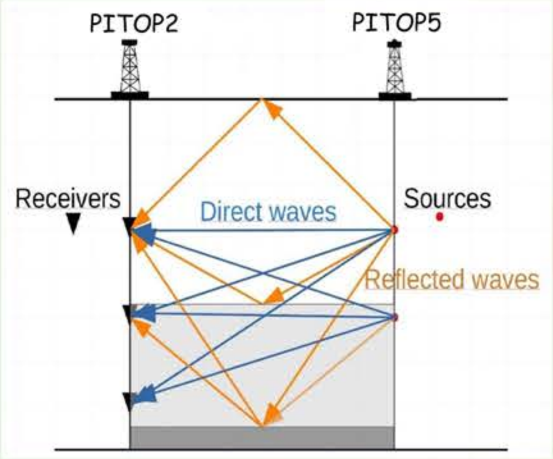


Surface seismic



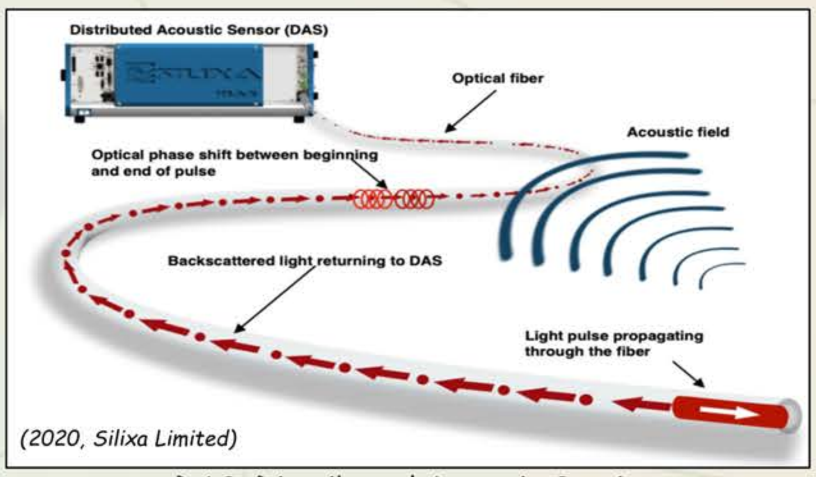
Horizontal distance (m)

CROSS-WELL SEISMIC



Cross-well with downhole geophones (e.g. Avalon GSR-1 in PITOP2)

FIBER OPTIC (DAS)



(2020, Silixa Limited)

DAS: Distributed Acoustic Sensing

Carina® Sensing System Interrogator (Silixa)

PITOP is equipped with borehole fiber optic (DAS) technology, surface DAS cables (buried in shallow trenches) and interrogators.

References:

- PITOP website (ECCSEL): https://www.eccsel.org/catalogue/126
- *"Geophysical exploration case histories at the geophysical test site PITOP – a key facility in the ECCSEL-ERIC consortium: an overview"* – Bellezza et al. 2024 (submitted to Bulletin of Geophysics and Oceanography)

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