



Session | Advancing Environmental Science through Integrated Research Infrastructures

Convener: Anna Santoro | Co-conveners: Gustavo Naumann, Quertenmont Pierre, Elena Garbarino

Towards Harmonised Environmental Research: The Role of ITINERIS in Integrating Italian Research Infrastructures

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Poster on site | Attendance Mon, 28 Apr, 16:15–18:00 (CEST) | Display Mon, 28 Apr, 14:00–18:00 | Hall X4













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The Earth's system approach to environmental challenges

Most critical issues currently faced by our society involve key environmental challenges: pollution, land use and climate change, and their impacts on biodiversity and ecosystem integrity.





Research Infrastructures (RIs) play a crucial role to realize a comprehensive and integrated approach that extend beyond the different environmental sub-domains for understanding and predicting the Earth's system and developing effective actionable strategies.











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The environmental research in Italy



A fragile country from an *environmental* point of view with a strong and *multidisciplinary* scientific community working in this sector for many years.

Actively involved in amost all the *ENV ESFRI* RIs, contributes to other pan-European ENV RIs and hosts other nationally relevant Ris, testifying the importance that Italy places in environmental research.

A *Coordinated actions* are essential to build on this commitment and integrate the large number of research infrastructures.











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ITINERIS: Empowering Italy's Environmental Future

ITINERIS estabilishes 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.



Harmonizing RI developments

to ensure interoperability and highest accessibility to data, tools and services.



Developing crossdisciplinary actions

to empower research and foster innovation



Promote transfer of best practices

from the most mature to the new and developing Ris to strenghten the national RI landscape













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€ 155M

Investment

8 WP

89 activities

ITINERIS: Empowering Italy's Environmental Future

ITINERIS - Italian Integrated Environmental Research *Infrastructures System* is a project funded by EU – Next Generation EU PNRR- Mission 4 "Education and Research" – Component 2: "From research to business" – Investment 3.1: "Fund for the realization of an integrated system of research and innovation infrastructures".

The project is coordinated by the **CNR (National Research**) Council). It started in November 2022, and during 30 (+6) months will carry out an ensemble of cross-disciplinary actions across the different environmental sub-domains.











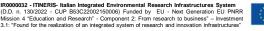






















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A network of excellence





PHISICAL SCIENCES &

ENGINEERING





ITINFRIS include the national nodes of 22 ESFRI/European/National RIs in the Environment, Physical science, Health & Food domains.











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ITINERIS: main Objective

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.

The *main goal* is to develop *cross-disciplinary* research in environmental sciences through the use and re-use of existing data and services and new observations, to address scientifically and societally relevant issues such as sustainable use of natural resources, pollution reduction, ecosystem management and restoration, mitigation of the downstream effects of climate and environmental change.

This broad-scale vision of environmental research, sustained by the main Italian environmental scientists involved in European RIs, is truly innovative and it will support the Country (and not only) to address current and expected environmental challenges.













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The ITINERIS HUB - Mission



The ITINERIS HUB is the *unique access point* to the comprehensive collection of knowledge, data, analytics tools and services *provided by the Italian RIs in the environmental scientific domain* for the observation and study of processes in the atmosphere, marine domain, terrestrial biosphere, and geosphere.













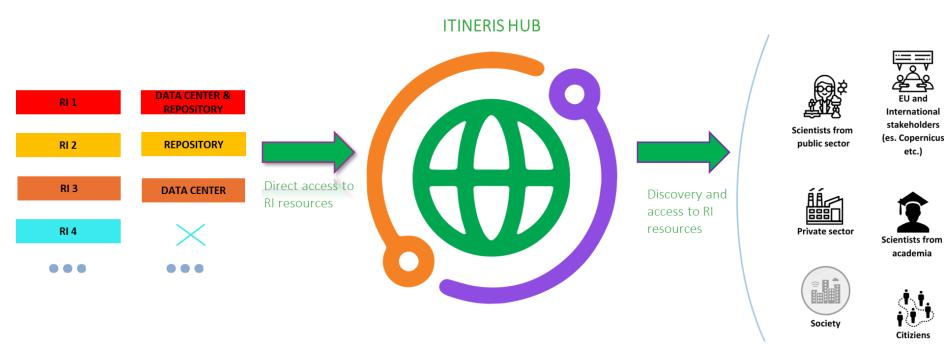
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The ITINERIS HUB - Goals



- Maximization of resource accessibility
- Minimization of redundancy
- Propose a solution to be applied as a model for similar initiatives at international scale for fostering harmonization and integration among RIs in the environmental domain.













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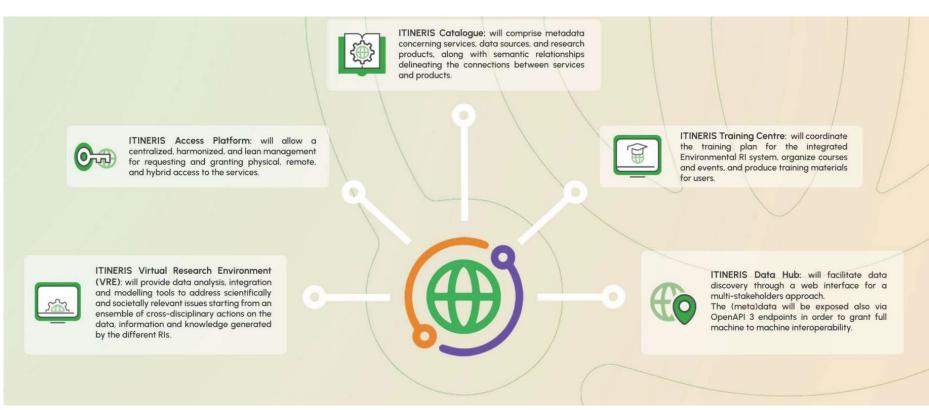
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The ITINERIS HUB

















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The ITINERIS Catalogue



ITINERIS Catalogue: will comprise metadata concerning services, data sources, and research products, along with semantic relationships delineating the connections between services and products.























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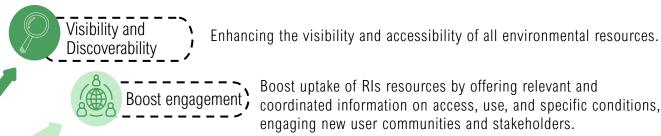
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Unlocking the potential of RIs: ITINERIS as a catalyst for Science and Innovation





• Provide harmonized information to enhance interoperability and promote the cross-disciplinary research



Identify overlapping and gaps and optimize efforts



Sustainability and Maintain RIs commitment and support the long-term ITINERIS sustainability by ensuring the stakeholders recognize the value created and offered by ITINERIS for high-quality scientific research.



Provide access also to other digital resources of interest for environmental investigation at national level













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The ITINERIS Catalogue of Resources

- It serves as a comprehensive online registry with a user-friendly interface, advanced search capabilities, and detailed metadata empowering users with easy access to the knowledge, data, analytical tools, and services provided by the network of environmental RIs.
- Existing RI catalogues and repositories will serve as the foundation for the developments within ITINFRIS.
- Neverthless, resources often remain difficult to locate and integrate since they are currently dispersed or not yet openly provided, due to inaccuracies of their description or the lack of interoperability between standards.
- The Catalogue aims to bridge the gaps between the *different maturity levels* of the RIs participating in ITINERIS by estabilishing common references and uniform positioning of their offer.











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Building the ITINERIS Catalogue

A metadata catalog serving as a standardized framework for organizing and detailing information pertaining to resources within Research Infrastructures (RIs) across the various environmental research domains.

Despite its simple premise, the implementation of this concept involves a considerable amount of complexity.















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Resources and scope of the Catalogue

Dataset



Services



Training resources





Research products



- Resources resulting from the ITINERIS activities and delivered through the ITINERIS HUB (e.g., Virtual Research Environments, Training platform, Access Platform and the data HUB)
- Rls' existing resources openly accessible and already offered by the RIs via their own catalogues/repositories.











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- Data is any observation, measurement or fact digitally represented as text, numbers, or symbols that form the basis to extract information.
- A dataset is a collection of data organised in the same format and associated with a unique body of work.
- Metadata describing the dataset includes descriptive information about its contents, structure, provenance, and context. They are systematically gathered and organized according to specific criteria and methodologies.











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- In the context of research infrastructures, "a Service refers to any support, tool, or functionality provided to facilitate scientific research activities. Services are integral to enabling researchers to effectively conduct their work by offering the necessary infrastructure, resources, and expertise. "
- Services are provided by RIs to deliver value for the end-user through physical, remote, virtual and hybrid access.
- Example of services: access to facilities / platforms / research sites, consultation, experts, analysis tools, users support and much more.









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- Any "persistent resource that has one or more physical or digital representation, and that explicitly involves, specifies or entails a learning activity or learning experience".
- ITINERIS Training resources will be provided by the ITINERIS Training Platform developed in WP3 and include, for example: tutorials, webinars, and video lectures, documentation (manuals, user guides, etc.), workshops and courses, interactive modules (guizzes, simulations, and hands-on exercises to reinforce learning), etc.











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- ITINERIS VREs are sophisticated platform designed to integrate data analysis and external datasets (such as Copernicus, NASA, and local data) enabling users to gain comprehensive insights into various problems and incorporate their own data and analysis methods to address evolving needs.
- Each ITINERIS Virtual Research Environments (VREs) will be listed in the catalogue to
 describe the focus on specific topic and the services aimed at addressing
 environmental issues with significant societal impacts, with potential for extension to
 other topics and challenges.











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- Any "digital objects, described by metadata, resulting from a scientific process".
- It includes Publication, Software and Other research products.
- Examples can be:
 - Publication: Article, Book, Conference object, Contribution for newspaper or weekly magazine, Doctoral thesis, Research, Review, Preprint, Report, Patent, Data Paper, Software Paper, Other literature type, Journal, Thesis, Data Management Plan, Presentation etc.
 - Software: software or other software type
 - Other research products: Lecture, Annotation, Other ORP type, Event, Interactive Resource, Model, etc.











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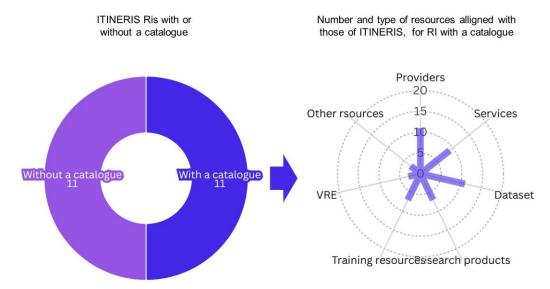


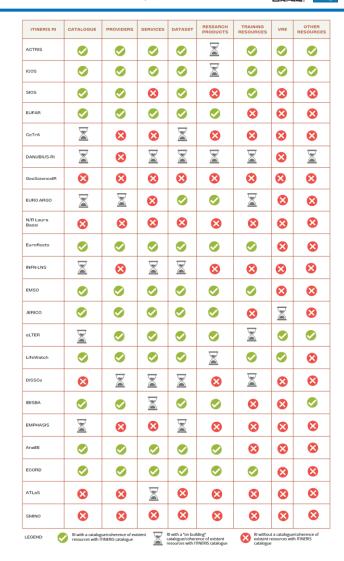




Different maturity level of RIs

The RI catalogues show a wide range of maturity levels: some have fully developed catalogues with a large number of resources, some have partial catalogues with limited entries and some are still in the early stages of development or do not have a catalogue at all.















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Most critical issues currently faced by our society involve key environmental challenges: pollution, land use transformation and climate change, and their impacts on biodiversity and ecosystem integrity.





Research Infrastructures (RIs) play a crucial role to realize a comprehensive and integrated approach that extend beyond the different environmental sub-domains for understanding and predicting the Earth's system and developing effective actionable strategies.

Given the complexity of such problems, a multi-disciplinary approach to the Earth System is essential to provide quantitative knowledge to be translated into concrete, efficient, timely and applicable strategies. This approach involves integrating and combining field observations, experimental activities in the laboratory, data analysis and modelling tools across different environmental domains, with RIs playing a crucial role in delivering the systematic and coherent information required for high-level research



According to the National Research Infrastructure Plan (PNIR) 2021- 2027, Italy actively participates in the main pan-European environmental RIs and hosts numerous RIs of national relevance, occupying a privileged position to make a significant contribution in the environmental domain.

Italian RIs in the environmental domain: 17% of the total including European, global and national RIs.

To maximise their impact on environmental research and sustainability, the diverse Italian RIs require coordinated integration. In response, 22 RIs have come together under the ITINERIS network, which promotes a unified framework for the observation and study of Earth system processes across the atmosphere, marine, terrestrial biosphere, and geosphere domains.

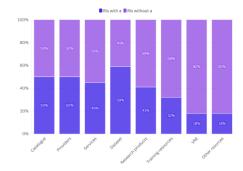


Toward an Integrating catalogue of services

A key aspect of ITINERIS is the ITINERIS HUB, a single access point that integrates and expands the array of resources available in the catalogues across the participating RIs, enhance accessibility, and foster multidisciplinary collaborations among the scientific community and various public and private stakeholders, nationally and internationally. This study presents a comprehensive analysis of existing RI resource catalogues, evaluating their structure, scope, and criteria for resource selection. The analysis assesses consistency, identifies gaps and overlaps, and evaluates the metadata schemas and search functionality of the catalogues to ensure harmonisation into the ITINERIS HUB. The analysis provides a detailed resource mapping of each RI, highlighting alignment with the resource categories defined by ITINERIS, such as providers, services, datasets, research products, training resources and virtual research environments (VREs).

Landscape analysis of RIs

Results of this study show a considerable variability in the maturity levels of the RIs' catalogues; some have fully developed and resource-rich catalogues, others have partial catalogues with a limited number of resources, while some are still in the early stages of development or have no entries at all. The RI catalogues show a wide range of maturity levels: some have fully developed catalogues with a large number of resources, some have partial catalogues with limited entries, and some are still in the early stages of development or do not have a catalogue at all.



Graph 1 Bar graph of the distribution of resource availability in RIs with or without a Catalogue.





ESFRI/European/National RIs in the Environment, Physical science, Health & Food domains,

Figure 1 list of the 22 RIs participating in ITINERIS specifying the domains they belong to.





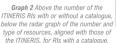




Table 1 Detailed table of the coherence analysis





















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