

## Deliverable 2.4

# ITINERIS HUB - Specifications



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Reviewed by	Lucia Mona and Ermann Ripepi
Comments	<p>A first release of ITINERIS HUB specifications has been realised at B5.</p> <p>The first release of ITINERIS HUB realised at B6 included mock-up developments and the integration with the project web-site in coordination with WP1.</p> <p>The second release of the present specifications document has been updated consequently.</p>

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## 1. INTRODUCTION

This deliverable is produced within the framework of the ITINERIS project. It is part of activity 2.2 “Design and Developing of the Italian Environmental Research Infrastructures (RIs) HUB” of the Work Package (WP) 2.

The main objective of WP2 “ACCESS TO FACILITIES, FAIR DATA AND RELATED SERVICES” is to establish a substantial connection between the existing network of distributed national environmental Research Infrastructures (RIs) and a broad user base. The majority of the 22 participating RIs in ITINERIS already provide data and services spanning various domains of the Earth system: Atmosphere, Marine domain, Terrestrial Biosphere, and Geosphere.

ITINERIS will enhance interdisciplinary Research and Innovation capacities addressing environmental societal challenges (i.e. climate-related risks on the environment, etc.) in Italy by providing a common framework for the access to facilities, data, and related services from 22 RIs through a central HUB as an integrated access and service portal named ITINERIS HUB.

The objective of activity 2.2 is to design and implement the unified digital ITINERIS HUB to streamline the integration of National Environmental RIs, that will represent a unique access point to explore data and resources made available by Italian environmental RIs.

Currently, the RIs’s resources are accessible through diverse systems, protocols, portals, and procedures. Following a user-centric approach, ITINERIS will establish access services to the national RIs’ facilities and resources (including data, services, and research outputs) developed building upon various levels of FAIR (Findable, Accessible, Interoperable, Reusable) principles adoption.

This deliverable outlines the functional requirements of the ITINERIS HUB. It includes a brief description of key features of existing hubs and relevant information that will delineate the characteristics and functionalities of the ITINERIS HUB. A comprehensive exploration of the functional and technical characteristics will be addressed in the deliverables related to each specific component of the ITINERIS HUB.

## 2. ITINERIS HUB CONCEPT

The ITINERIS HUB will serve as a unified access point, enhancing the visibility and accessibility of RIs' offerings to enable users to effortlessly explore a vast array of knowledge, data, analytical tools, and services within the ITINERIS framework. It will seamlessly integrate cutting-edge applications and tools designed within ITINERIS to aggregate information on data, products, resources, facilities, and services, promoting effective use and accessibility. Acting as a data management system alongside online accessible data hubs and portals, the ITINERIS HUB will manage and provide access through an easy-to-navigate interface to diverse environmental content, applications, resources, knowledge, services, data, and analytic tools developed within project work packages, bolstering collaboration and interdisciplinary research within the four subdomains of environmental sciences (atmosphere, marine domain, biosphere, and geosphere).

ITINERIS HUB shall contribute towards the systemisation of environmental data within Italian RIs and connect them with the broader scientific community operating in Italy and abroad. This entails creating a single access point where users can easily discern the available resources at a national level. This centralized hub aims to fill a gap in the Italian landscape, giving direct access to information that is currently dispersed or not openly provided. By engaging a diverse community of researchers, ITINERIS HUB will facilitate connections to a range of resources from a heterogeneous array of RIs with different levels of maturity regarding FAIR compliance, access management, and discoverability of resources. The ITINERIS HUB addresses the existing heterogeneity among RIs, encompassing those already providing data through RI international-specific portals, those with data portals/hubs existing at the national level, and national RIs for which data are not yet hosted on data portals and repositories. Furthermore, the ITINERIS HUB will provide a dedicated resource catalogue for all the RIs from less to the more mature RIs, providing support for physical, remote, and hybrid access to their services. The HUB will serve as a centralized repository platform of catalogues, functioning as an aggregator of resources already existing at the more mature RIs, providing the opportunity for less mature RIs to take benefit from the other RIs to progress in a common direction using shared solutions. In this way, the ITINERIS HUB will facilitate the transfer of best practices from the most mature RIs to the new and developing RIs. It will support a complementary and synergist development of competencies, services, and observations, contributing to strengthening the national RI landscape in the environmental domain.

RIs with a high level of maturity in FAIR and OpenData principles, such as ACTRIS, EMSO, Euro-Argo, ICOS, and LifeWatch, will lead the development and implementation of interoperable services at the subdomain level and will offer support and guidance to less mature and emerging RIs. In this way, advanced RIs will coordinate the enhancement of their observation capacity and their potentiality in data analysis and processing, and will offer services and support to other RIs, e.g. for the standardization of measurement protocols, data handling, and interoperability. For instance, within the ITINERIS project, standardized observations from one RI could be combined with observations from other infrastructures, yielding synergistic products not available elsewhere. ITINERIS HUB will prioritize data discovery and focus on providing links to existing and new resources wherever hosted, thereby maximizing accessibility, and minimizing redundancy.

The overarching objective of the ITINERIS HUB is to serve as a model for similar initiatives in other countries or on an international scale for fostering harmonization and integration among RIs in the environmental domain.

The delineation of specifications and release of the HUB, resulting from activity 2.2 *Designing and Developing the National Environmental RIs HUB*, will benefit also from the results of intermediate results of Activities 2.3 Supporting the Implementation and Adoption of FAIR-Enabling Best Practices, 2.4 Interdisciplinary Data and Interoperability within WP2; as well as from the research activities developed within the topical domains WP4 – WP5 – WP6 – WP7, and the transversal work packages WP8 and WP3. These activities will feed the HUB generating a Virtual Research Environment of data and samples and the ITINERIS Training Platform.

### 3. FEATURES AND FUNCTIONALITY OF THE ITINERIS HUB

To identify the key characteristics that will define the functionality of the ITINERIS HUB, a study was conducted on several existing solutions within the European research community. This analysis aimed to highlight noteworthy features and address critical issues in the functionality of hubs to accentuate areas of improvement and distinctions compared to the pre-existing models. Specifically, the models that were selected as reference points for analysis, focusing on aspects such as available content, user interface, functionality, and innovative elements are the following:

- *EOSC (European Open Science Cloud) Portal* is the unified access to the European hub of research data, tools, and services for innovation and education (<https://eosc-portal.eu/>). This hub is a federated and open multi-disciplinary environment that provides 1.8 million European researchers and 70 million professionals in science and technology a virtual environment with open and seamless services for storage, management, analysis, and re-use of research data, across borders and scientific disciplines.
- *ENVRI (Environmental Research Infrastructure) Hub* is the central gateway to environmental data and services offered by the European environmental research infrastructures (<https://envri-hub.envri.eu/>). The data offered through the hub is interoperable across the Earth system disciplines and therefore easy to use for interdisciplinary environmental research. ENVRI Hub data is open and free to use by anyone. Users of the ENVRI hub are also able to use the Virtual Research Environments and do their science computing directly inside the hub.
- *Data Terra* is a research E-Infrastructure in the Earth system and environment domain (<https://www.data-terra.org/en/>). Its main mission is to develop a global access and processing facility for Earth observation data, products, and services. The Data Terra research infrastructure is composed of several Data Hubs, each representing a compartment of the Earth system.
- *Blue-Cloud* is an Open Science platform for collaborative marine research (<https://blue-cloud.org/>). Blue-Cloud 2026 is a collaborative project that leverages Europe's expertise in aquatic environmental observation and data handling. Building on existing infrastructures like Copernicus and EMODnet, Blue-Cloud aims to create a federated ecosystem for FAIR and open data in marine research. Through a web-based platform, it offers simplified access to multidisciplinary datasets, analytical services, and computing facilities.

The analysis of the above existing portals allowed for the exploration of innovative solutions and informed selection of optimal functions for the ITINERIS HUB. By leveraging insights gained from these comparisons, the ITINERIS HUB aims to incorporate best practices while introducing novel or tailor-made features to meet the needs of its users.

The ITINERIS HUB will serve as a centralized and comprehensive discovery service, offering insights into the available resources and redirecting to the data access point provided by various RIs spanning diverse scientific environmental subdomains (atmosphere, marine domain, biosphere, and geosphere). Accordingly, the ITINERIS HUB will provide a centralized portal providing access to services, facilities (observatories, laboratories, data repositories, etc.), research knowledge (data, metadata, publications, etc.), and other pertinent resources. Whenever access to resources will need authentication mechanisms, these will be implemented through standardized procedures for maintaining data security and privacy, for example, authentication through institutional credentials.

ITINERIS will not duplicate data and metadata already present in other national and European data portals. Instead, it will create a single and harmonized interface to access this information. In addition, RIs that have not yet developed their own data portal will be able to use the ITINERIS HUB for this purpose. Similarly other data not curated by the RIs developed inside the ITINERIS project or however of interest for ITINERIS will be reachable through ITINERIS HUB. Therefore, the ITINERIS HUB will include various resources managed by the RIs alongside data generated within the ITINERIS project, encompassing synergistic data and products, information derived from measurement campaigns, etc.

One of the innovative features of the ITINERIS HUB will be the further development of an intuitive user interface to accommodate the discovery and interpretation of RIs data in environmental subdomains. Through interactive digital tools and resources, users will navigate to discover available services, including data analysis tools, filtering by main information like geographic region, time range, measurement techniques, and observed variables. These detailed descriptions empower users to make informed decisions regarding resource utilization for their research projects within the ITINERIS ecosystem. This aspect aims to develop a robust and user-friendly hub that could meet the diverse needs of the ITINERIS environmental research community. Once users will identify the resources they need, an access management platform for regulating user access will facilitate access and usage.

The ITINERIS HUB will adopt standards and interoperability guidelines to ensure seamless integration and exchange of data and services. This will facilitate data interoperability across different platforms and infrastructures, enabling data reuse and collaboration.

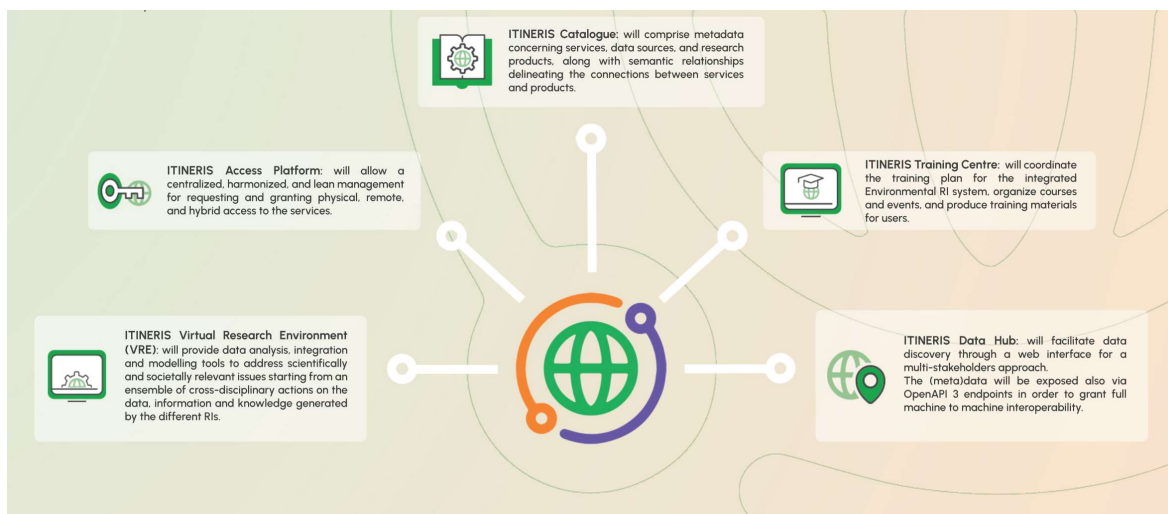
Another feature expected in the ITINERIS HUB is a platform for environmental researchers to access training resources, workshops, webinars, and other educational opportunities. This aspect will facilitate professional development and capacity building within the environmental research community by providing access to training materials on diverse topics such as data management, analytical techniques, and research methodologies.

## 4. ARCHITECTURE OF THE ITINERIS HUB

The ITINERIS HUB will act as a unified access point, enhancing the visibility and accessibility to the comprehensive set of knowledge, data, analytical tools, and services.

It will be developed as an open-source data management system accessible through a web portal interface from the ITINERIS website.

The ITINERIS HUB will be independently populated due to the diverse nature of the resources it oversees. However, despite their independence, the HUB will guarantee interrelatedness among resources. An ITINERIS terminology service will be integrated to enhance data interoperability, discovery, and exploitation. Functioning as a lightweight federator, this service will leverage cutting-edge technologies to facilitate harmonization, FAIRness assessment, accessibility of terminologies within the network, and facilitate discovery and mediation tasks.



*Figure 1: Main components of ITINERIS HUB*

The ITINERIS HUB will include the following tools/digital components for in-depth analysis and access to the various resources:

- **ITINERIS Catalogue:** it will enable access, categorization, archiving, and retrieval of all the following resources:
  - Services and facilities available for physical, virtual, and remote access
  - Dataset catalogue
  - Research products and documentation
  - Glossary of terminologies
  - Training objects.

The resources will be structured and presented using categories, tags, or keywords to facilitate navigation and exploration. Users can search for relevant resources, including research infrastructures, providers, repositories, and data archives, utilizing filtering options, sorting capabilities, and advanced search functionalities, thereby enhancing the user experience and streamlining resource discovery.

- **ITINERIS Data Hub:** Data Hub will facilitate data discovery through a web interface for a multi-stakeholder approach. The data will be exposed also via

OpenAPI 3 endpoints and, thanks to it, the Data HUB will be fully interoperable with other systems (machine to machine).

- **ITINERIS Virtual Research Environment (VRE):** will be developed as data analysis and integration tools also with external datasets (such as Copernicus, NASA, local data, etc.). Data, analysis, and modelling tools will be integrated allowing users to gain insight into the problems at hand and add their own data and analysis methods to respond to changing needs. Each VRE service will address a specific topic, and the ensemble of VRE will be harmonized, sharing information among the different activities. The outcome will be a prototype of operational VRE services for addressing environmental issues with strong societal impact and could be extended to other topics and challenges.
- **ITINERIS Access Platform:** will be the single and coherent access channel for requesting and granting physical, remote, and hybrid access to the services. The Access Platform will allow a centralized, harmonized, and lean management of user access as defined in the Access Master plan, from the collection of access requests; to management, coordination, and capture of reviews; to the collection and reporting of access metrics and feedback from the users; etc. Authentication, authorization, and security services will be provided to enable user-specific and login-protected content.
- **ITINERIS Training Center:** will coordinate the training plan for the integrated Environmental RI system, organize courses and events, and produce training materials for users.

The following mock-up is a first preview of the ITINERIS HUB, serving as the central access point for all ITINERIS resources, and bringing together the various digital tools into a single location. An integrated search function will enable users to search for resources available across different sections of the ITINERIS HUB.

## Welcome to the ITINERIS HUB

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

Search...



### ITINERIS Catalogue

Find the services and other relevant resources provided by the research facilities of the RIs.

Coming soon



### ITINERIS Access Platform

ITINERIS supports physical and remote access to the services offered by selected research facilities. Use the Access Platform to submit applications within the available access program and get support in the scope of your scientific project.

Coming soon



### ITINERIS Data HUB

Discover metadata through a geospatial visualization tool and get access to the datasets and digital products produced by the different RIs.

Coming soon



### ITINERIS Virtual Research Environment (VRE)

Make full benefit of the knowledge generated by the RIs using the flow of data, analysis and modelling tools, and/or including own data sets and methods to tackle specific issues.

Coming soon



### ITINERIS Training Center

Find courses, events and training material.

Coming soon



Figure 2: Mock-up of ITINERIS HUB

## 5. CONCLUSION AND NEXT STEPS

The present document provides the specifications of the ITINERIS Hub providing an overview of the digital components that will be incorporated in the hub. The hub is designed to fulfil specific functional requirements aimed at facilitating seamless access to resources and services. These requirements will encompass various aspects such as data cataloguing, access platforms, access master plan, FAIR implementation, data exploitation, terminology services, and asset releases. In conjunction with the functional requirements, the hub demands meticulous technical specifications to ensure optimal performance and interoperability. Detailed technical guidelines will be provided for each component of the hub in specific deliverables. The following deliverables will define in detail the specifications and technical guidelines for the development of each component of the Hub:

D2.5: Catalogue of data and services

D2.6: Access-Platform

D2.2: Access Master Plan

D2.9: Design document describing FAIR implementation choices for the ITINERIS catalogue

D2.14: Release of the ITINERIS TERMINOLOGY service

D3.7-D3.15: Training resources made available by the Environmental RIs on the ITINERIS FAIR Training Catalogue.

Tailored initiatives will be implemented to encourage the utilization of the hub aiding users in effectively navigating the hub's resources and services. These initiatives encompass training programs, workshops, and educational resources aimed at optimizing user engagement and utilization.