MISSIONE 4
ISTRUZIONE
RICERCA

ITINERIS

Deliverable 2.5

Catalogue of data and services - Specification document

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

Deliverable number:	D2.5
Work package:	WP2 - ACCESS TO FACILITIES, FAIR DATA AND RELATED SERVICES
Intermediate Objective:	IO2.3
Deliverable type:	X Document, report
	☐ Websites, patent filings, videos, etc.
	☐ Other: please specify .....
Dissemination level:	X Public
	☐ Restricted
Estimated delivery (bimester):	B8
Actual delivery date:	B10 – 31/08/2024
Second release	15/09/2025
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Note:	Revisions of the 2nd deliverable release: - update definition of Research Infrastructure - ICOS sheet update according to received revisions - Update metadata schema Services/VRE at EOSC V. 5.0

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

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1. LIST OF ACRONYMS

ACTRIS: Aerosols, Clouds, and Trace Gases Research Infrastructure
AERIS: Data and Services for the Atmosphere
AnaEE: Analysis and Experimentation on Ecosystems
ATLaS: Advanced Technologies for LandSlides
CeTrA: Centre for Trace Analysis
Danubius: International Centre for Advanced Studies on River-Sea Systems
DEIMS-SDR: Dynamic Ecological Information Management System - Site and dataset registry
DISSCO: Distributed System of Scientific Collections
ECORD: European Consortium for Ocean Research Drilling
eLTER: Integrated European Long-Term Ecosystem, critical zone and socio-ecological Research
EMPHASIS: European Infrastructure for Multi-scale Plant Phenomics and Simulation
EMSO: European Multidisciplinary Seafloor and water column Observatory
EOSC: European Open Science Cloud
ERA: European Research Area
ERDDAP: Environmental Research Division's Data Access Program
ERIC: European Research Infrastructure Consortium
ESFRI: European STRategy Forum on Research Infrastructures
EUFAR: The EUropean Facility for Airborne Research
Eurofleets: An alliance of European marine research infrastructure to meet the evolving needs of the research and industrial communities
EURO ARGO: Europe's contribution to the International Argo Programme, overseeing European in situ ocean observations
FAIR: Findability, Accessibility, Interoperability, and Reusability
GeoScienceIR: A Research Infrastructure for the Italian Geological Surveys Network
IBISBA: Research Infrastructure for Industrial Biotechnology
ICOS: Integrated Carbon Observation System
INFN-LNS: Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali del Sud - Italia
IODP: Integrated Ocean Drilling Program
ISIA: Information System for the Infrastructure of Agriculture
ITINERIS: Italian Integrated Environmental Research Infrastructures System
IT-IOOS: ITalian Integrated Ocean Observing System
JERICO: Joint panEuropean Research Infrastructure for Coastal Observations
LifeWatch: e-Science European infrastructure for biodiversity and ecosystem research
N/R Laura Bassi: Nave da ricerca Laura Bassi
OGS: National Institute of Oceanography and Experimental Geophysics
SIOS: Svalbard Integrated Arctic Earth Observing System
SMINO: Sistema di monitoraggio terrestre dell'Italia Nord Orientale
TNA: Trans National Access
VRE: Virtual Research Environment
WMO: World Meteorological Organization

2. INTRODUCTION

The main goal of this document is to report on the preliminary work for designing the ITINERIS Catalogue of Resources (from now onwards Catalogue). The Catalogue is one of the main components of the ITINERIS HUB, serving as a common, comprehensive, and discoverable online registry of the resources offered by the RIs.
The Catalogue is realized to collect and organize all the knowledge, data, analytics tools, and services provided by the RIs within ITINERIS and increase their visibility, access, and use by the communities.
The Catalogue aims to bridge the gap between the different maturity levels of the RIs participating in ITINERIS, including the resources already available from existing catalogues and others that are currently dispersed or not yet openly provided. These resources often remain difficult to locate and integrate due to metadata inaccuracies or the lack of interoperability between standards. The catalogue promotes the openness principles with all the resources publicly listed in the registries and provided as open as possible, and aligned with the FAIRness principles (Findable, Accessible, Interoperable, and Reusable).
The Catalogue support the ability to publish and search metadata for data, services, and related information objects. Metadata in catalogues represent resource characteristics that can be queried, presented for evaluation and processing by both humans and machine to machine system.
The use of standard metadata schemas or profiles with set of mandatory attributes/elements ensures interoperability, helps standardization of resources, dataset formats and protocols, and facilitates better management across communities of different scientific domains.
This promotes comprehensive and multidisciplinary research and facilitates the discovery, reuse, and transparency promotion of existing information optimizing the use of time and resources.

2.1 Purpose of this document

This deliverable contains the requirements and specifications to drive development and configuration activities for the online Catalogue, together with design proposals and wireframes. The work was carried out in the framework of activity 2.2. “Design and Developing of the Italian Environmental Research Infrastructures (RIs) HUB” of the Work Package (WP) 2.
The document is structured to provide a comprehensive understanding of the ITINERIS catalogue, starting with the main concept and outlining the fundamental principles and goals that guide its development. It then delves into the specific purposes, boundaries, and intended impact of the catalogue, clarifying its role within the broader ITINERIS framework. Once the resources are defined, the document includes a detailed mapping of all RIs catalogues to ensure that existing resources are consistent with and aligned to the overall framework identified in the ITINERIS Catalogue.
It will then continue with the description of the metadata schema for each resource identified in the catalogue. Given the continuous evolution of policies and technologies related to the RIs, access policies and metadata standards to be used in catalogues, this document will be continuously updated to align with the policies and definitions established by the European Commission and in accordance with the European Open Science Cloud (EOSC).
A dedicated document will be released on the onboarding process for ITINERIS, detailing manual and automated onboarding, including guidelines.

3. ITINERIS CATALOGUE MAIN CONCEPT

The ITINERIS Catalogue is an online tool integrated with the ITINERIS HUB and accessible via the ITINERIS Website. It provides the user access to a digital registry for searching, viewing, and getting all the relevant resources for environmental research and offered by Research Infrastructures (RIs) participating in ITINERIS.

The Catalogue pursues the following objectives:

- Resource Visibility and Discoverability. The Catalogue aims to maximize the utilization of all ITINERIS resources by significantly improving their visibility and ease of discovery. By making information readily accessible, it ensures that users can efficiently find the resources they need.
- Facilitation of Interoperability. Supports seamless interaction and integration among the various ITINERIS research infrastructures. ITINERIS facilitates interoperability by adopting common standards and protocols for efficient communication and data sharing across research infrastructures. It provides a centralized platform for accessing diverse resources, ensuring consistent quality through unified governance. This approach optimizes resource use, enhances collaboration, and accelerates scientific discoveries. Additionally, the interoperable system is adaptable to future technological advancements, ensuring long-term sustainability and resilience
- Value for user and stakeholder. The catalogue ensures that all ITINERIS stakeholders are fully aware of the value ITINERIS provides in creating, maintaining, and delivering services essential to excellent scientific research. By highlighting these contributions, it underscores the importance of ITINERIS in the research community.
- Long-term sustainability. In line with the ERA Policy Agenda 2022-2024, ITINERIS aims to ensure the long-term sustainability of research infrastructures. A key strategy is to entrust provider responsibility to participating research infrastructures, ensuring efficient management and consistent quality of resources. This model promotes resilience and supports innovation and scientific collaboration at the European level.

Through these objectives, the ITINERIS Catalogue plays a key role in supporting the mission of ITINERIS by providing an accessible, informative, and interoperable platform for researchers and all potentially interested stakeholders.

3.1 Scope of the catalogue

The Catalogue gathers and organizes information about the following resources that are relevant in the framework of ITINERIS for the 22 participating RIs:

1. Research Infrastructures (RIs): The 22 RIs participating in ITINERIS providing facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include associated human resources major scientific equipment or sets of instruments, knowledge-related facilities such as collections, archives and/or scientific data infrastructures, such as data and computing systems and communication networks and any other infrastructure of a unique nature and open to different Users, essential to achieve excellence in research and innovation. Where relevant, these resources may be used beyond research, for example for training and education or public services. They may be virtual, 'single-sited' or 'distributed'[1].

2. Providers: the entities (academic institutions, research organizations, ERIC, etc.) that supply the variety of resources listed in the Catalogue. ITINERIS providers play a pivotal role in

[1] Article 2 (1) of Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 (EU) and (EU) No 1291/2013

the research ecosystem by ensuring the provision and maintenance of these resources in the Catalogue.

3. Services: *"Way to provide value to customers through bringing about results that they want to achieve[2]"*. ITINERIS service refers to any support, tool, or functionality provided to enabling users to conduct scientific/technical/innovation activities and offered in the framework of ITINERIS through physical, remote, and hybrid access by the participating RIs.

4. Dataset: "*A set or collection of data, records or information that constitutes distinct units of information in the knowledge generation process[3]".*

5. Research products: *"Digital objects, described by metadata, resulting from a scientific process[4]".* It includes Publication, Software and Other research products not included in the two previous subtypes.

6. Training resources: "*By training resource, we mean a persistent resource that has one or more physical or digital representation, and that explicitly involves, specifies or entails a learning activity or learning experience* [5]". ITINERIS Training resources include and are not limited to tutorials, webinars, and video lectures, documentation (manuals, user guides, etc.), workshops and courses, interactive modules (quizzes, simulations, and hands-on exercises to reinforce learning), case studies (examples and detailed descriptions of how specific tools or datasets have been used in real research scenarios, illustrating best practices and successful applications), etc.

7. Virtual Research Environment (VRE): The ITINERIS Virtual Research Environment (VRE) is a sophisticated platform designed to integrate data analysis and external datasets (such as Copernicus, NASA, and local data). This environment combines data, analysis, and modeling tools, enabling users to gain comprehensive insights into various problems and incorporate their own data and analysis methods to address evolving needs. Each VRE service focuses on a specific topic, and all VRE services are harmonized to share information across different activities. The outcome will be a prototype of operational VRE services aimed at addressing environmental issues with significant societal impacts, with potential for extension to other topics and challenges.

As reported in the Deliverable 2.4 ITINERIS HUB – Specifications, the catalogue will not duplicate the resources, data and metadata already present in other national and European catalogues and data portals. Instead, it will create a single and harmonized interface to access

[2] EOSC definition according to FITSM (https://eoscpilot.eu/eosc-glossary)
[3] Definition from the ITINERIS controlled vocabulary: VocBench
[4] OpenAire: Research products definition (https://openaire-guidelines-for-literature-repository-managers.readthedocs.io/en/v4.0.0/introduction.html)
[5] EOSC definition of training resource (https://wiki.eoscfuture.eu/display/PUBLIC/F.+EOSC+Training+Resource+Profile)

this information that will include also other resources and data not curated by the RIs developed inside the ITINERIS project or however of interest for ITINERIS.

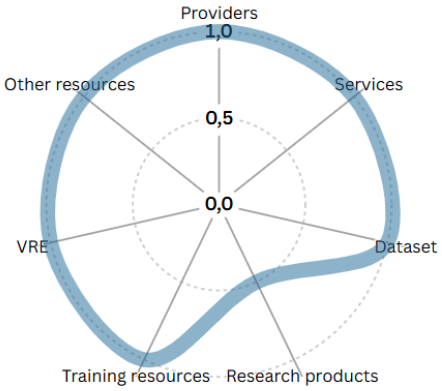
4. MAPPING THE ITINERIS PARTICIPATING RIS CATALOGUES

The first step of our study has been an in deep analysis of the existing catalogues of resources of the 22 RIs participating in the project. The goal of this analysis is to systematically integrate each catalogue within the ITINERIS framework. The analysis explores how each RI defines its catalogue, including structure, scope, and resource selection criteria, to assess uniformity and identify areas for standardization. It also examines the resources included in each catalogue, comparing them to those in the ITINERIS catalogue to identify overlaps, gaps, or inconsistencies. Additionally, the study evaluates the search functionalities and metadata schemas used by each RI, aiming to ensure consistency, usability, and seamless integration across the ITINERIS infrastructure.
The results of the analysis are reported for each RI in the following sections in the form of tabs.
The coherence analysis started by mapping all RI catalogues and cross-referencing them with the ITINERIS resources catalogue to check the consistency and alignment of the identified resources.
Analysis has been critical to identify these gaps and propose solutions for better integration and harmonization within the ITINERIS framework.

4.1 Coherence analysis

For each RI, the existence of a catalogue and the consistency of resources with those defined for ITINERIS (see section 3.1) - such as providers, services, datasets, research products, training resources, and VREs - were evaluated, along with the presence of other types of resources.
The current status of each RI is summarized in a radar chart with values ranging from 0 to 1: a score of 0 indicates the absence of a resource, 0.5 denotes that the resource is being developed or organised, and 1 indicates the existence of the resource and its accessibility. The analysis also involved investigating the technologies and metadata schemas used in the creation of the catalogues, as well as the possibility of filtering catalogue information and the distribution of entries. Figure 3 also shows information on the maturity of the catalogue for each RI, represented by different symbols: check mark: RI with a catalogue/coherence of existent resources with ITINERIS catalogue; hour-glass sign: RI with an ‘on building’ catalogue/coherence of existent resources with ITINERIS catalogue; red cross sign: RI without a catalogue/coherence of existent resources with ITINERIS catalogue.
Below is a summary sheet for each RI with the survey done on the status of the catalogues and the presence of the various resources. The resource mapping survey sheets for RI included in this document have been reviewed by the reference person of each Research Infrastructures.

ACTRIS



The ACTRIS Catalogue of Services offers a comprehensive listing of resources provided by the RI. The name of the catalogue is: "ACTRIS catalogue of resources." The catalogue is divided into two main sections: Service Type, which classifies services such as data, research, and technological offerings, and Category, which organizes resources based on domains like air quality, aerosols, and climate.
The catalogue supports filtered searches, enabling users to refine results based on provider, service type, research area, and other parameters.

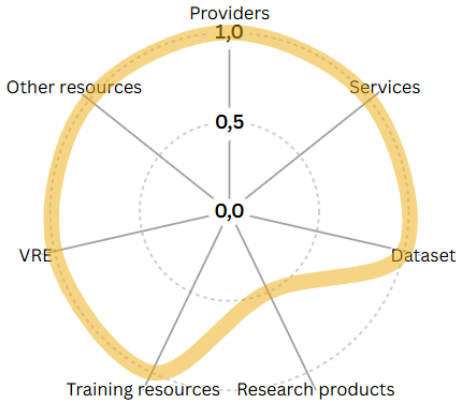
In terms of alignment with ITINERIS resources:

- Providers are not listed as distinct catalogue entries but are mentioned in the descriptions of all available resources.
- Services cover a broad spectrum, including technological, innovation, data, and research services.
- Dataset resources are hosted by the ACTRIS Data Portal.
- Research Products are not metadata-tagged but are only listed in a specific section named Documents on the ACTRIS website.
- Training Resources are referred to as "training services" within the catalogue.
- Regarding the VRE there is the ACTRIS Jupyter Hub.

The standards utilized for dataset include ISO 19115-2, all standards and specific metadata used in ACTRIS are available on Github[6].

Reviewed by Lucia Mona and Ermann Ripepi, CNR-IMAA.

ICOS



The ICOS "Data & Services" catalogue primarily features data and tools, with other resources available in sections like "Science & Impact," "Resources," and "Observation.". Additionally, ICOS describes the Station of Origin, where data is produced, with details on station ID, location, and involved and former staff and specific information function of the type of station (atmospheric, ocean or ecosystem).
The catalogue aligns with ITINERIS resource categories in the following ways:

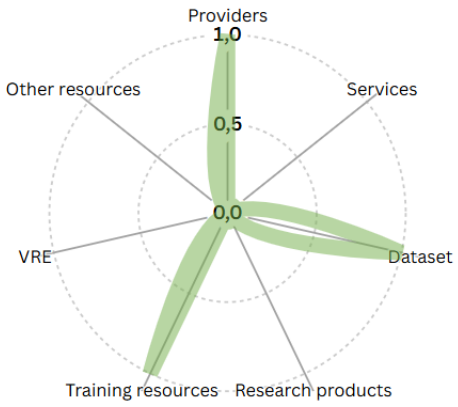
[6] Github ACTRIS link: https://github.com/actris/data-management-plan/blob/master/DMP/ACTRIS-DMP.md#432-metadata-standards-and-meta-data-services

- Providers are not listed explicitly but are referenced under data filters as "Data Submitters," indicating the organizations credited with submitting data.
- Services include community services such as ATC, ICOS Central Analytical Laboratories (CAL), ICOS Ecosystem Thematic Center (ETC), and OTC, found under "Community Services."
- The dataset is accessible via the ICOS data portal.
- Training resources include webinars from the Carbon Portal, though these are somewhat hidden in the "Science & Impact" and "Education" section. Part of the training material is hosted in the thematic center web pages (Atmosphere Thematic Centre - ATC, Ecosystem Thematic Centre - ETC, Ocean Thematic Centre - OTC and Central Analytical Laboratories - CAL).
- Research products are not metadata-tagged but are only listed in a specific section: "Science & Impact". In addition to this unstructured list of research products, there are a number of products that fall under Level3 in the data portal[7]. Some of these are classified as research products.
- The VRE in ICOS, based on Jupyter, provides tools for interactive computing and serves researchers, policymakers, and the public.

For metadata, ICOS uses ISO19115, FGDC-STD-001-1998, and the technology is supported by GeoNetwork. In the Ecosystem domain the metadata are organized following the BADM protocol (in use in the ecosystem flux networks globally) and within ITINERIS a process to create vocabularies in VocBench has been started.

Reviewed by Dario Papale, University of Tuscia

SIOS



The SIOS research infrastructure has developed the Observation Facility Catalogue, which provides an overview of observation structures that collect SIOS data. An observation facility can be one instrument or a collection of instruments, e.g. a weather station, and is a term used by the World Meteorological Organization (WMO). The SIOS catalogue allows research filtering by multiple parameters, such as observation facilities, RI responsible institution, etc.
The catalogue's coherence with ITINERIS resources includes:

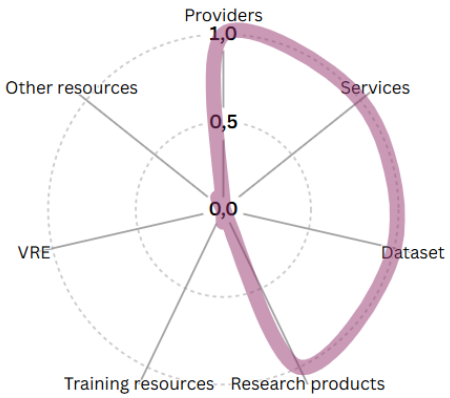
[7] Link: https://data.icos-cp.eu/portal/#%7B%22filterCategories%22%3A%7B%22level%22%3A%5B3%5D%7D%7D

- Providers: listed indirectly through filters in the Observation Facility Catalogue, referred to as RI responsible.
- Services: while there isn't a dedicated "Services" section in line with ITINERIS' definition, SIOS includes services like data management, remote sensing, logistics, training and communication. These are primarily informational resources rather than access points to services. The SIOS Access Programme facilitates access to the full breadth of research infrastructure on Svalbard that has been made available to SIOS by its members.
- Dataset: the SIOS Data Access Portal consolidates data from SIOS partners, offering a unified search tool to access this data.
- Research products: there is no specific section for research outputs.
- Training resources: available under "Services," with additional materials like PDFs and YouTube workshop recordings in the Support & Online material section.
- VRE: SIOS does not have a VRE but links to external tools such as Rosetta for dataset validation and Svalbox for visualization.

SIOS catalogue uses the MET internal metadata model which is currently mapped to ISO19115 and GCMD DIF. Other metadata mappings (EML, DCA, schema.org and others) and under development. The catalogue is custom made and offers OAI-PMH, OGC and OpenSearch technologies for metadata exchange available at https://sios.csw.met.no/
Specifically for SIOS, resources relevant to the marine domain will also be cataloged within the IT-IOOS, linked to the ITINERIS HUB, and seamlessly integrated into the ITINERIS catalogue. More broadly, the RIs within the ITINERIS marine domain are developing a dedicated metadata catalogue of data and facilities, known as the ITalian Integrated Ocean Observing System (IT-IOOS). This metadata catalogue will contribute to and harmonize with the ITINERIS catalogue.

Reviewd by Vito Vitale and Giulio Verazzo, CNR-ISP

EUFAR



The EUFAR Data Catalogue is hosted by AERIS, the French Data and Services Cluster for the Atmosphere, and can be accessed at EUFAR Data Catalogue. Other resources are found in sections like EUFAR Facilities and Resources, with descriptions of the aircraft operators, calibration facilities, and instrumentation.
AERIS is currently developing the new EUFAR Data Catalogue, which will integrate previously acquired datasets under EUFAR as well as new data from future EUFAR-funded campaigns.

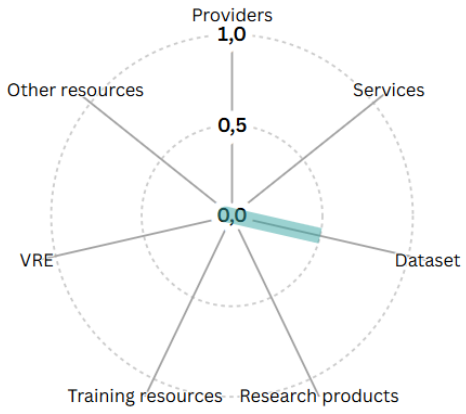
The catalogue aligns with ITINERIS resource categories in the following ways:

- Providers: providers are sometimes mentioned, such as operators in the calibration facilities section, but other cases, such as the datasets, list the campaigns without further details.
- Services: EUFAR offers a range of facilities, including aircraft operators, instruments, calibration services, and tools for metadata creation and data processing.
- Dataset: accessible through the EUFAR Flight Finder, which aggregates data collected during campaigns.
- Research products include publications and documents.
- Training resources: these are mainly workshops and meetings, accessible via the Activities section but require user login.
- VRE: EUFAR does not have a VRE.

The standards include ISO 19115-2:2009, INSPIRE, NetCDF, GCMD, and ECHO. Regarding the technology used to manage the catalogue, EUFAR developed its own project with a proprietary solution.

Reviewed by Francesco Cairo CNR-ISAC

CeTrA



RI CeTrA is an inter-institutional and inter-departmental single-site young research infrastructure that is developing its first systematized catalogue of resources through the project. Both organizational and digital resources of CeTrA are hosted by Ca' Foscari University of Venice. The only current reference is the web page,[8] reporting a list of uncatalogued resources. The webpage is being upgraded through the project to serve as a structured access portal directly linked to the ITINERIS HUB. The architecture of the portal has been outlined in the Deliverable 4.10.2, as well as a drafted list and description of services.

The catalogue of CeTrA will align with ITINERIS resource categories in the following ways:

- Providers: providers will be listed as distinct catalogue entries as reference operator and institution/department for services, and responsible for datasets;
- Services: CeTrA will offer access to datasets (in-situ observation data, mostly related to atmospheric pollutants, and analytical standard operating procedures), specialized equipment and expert support;
- Datasets will be stored in and accessed through the CeTrA - Environment Data Repository[9] and managed according to the DMP and support infrastructure of Ca' Foscari[10];

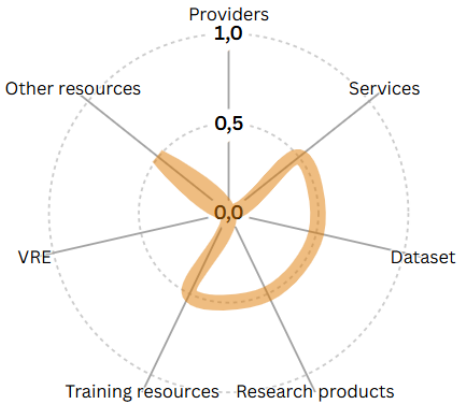
[8] CeTrA website: https://www.unive.it/pag/42456
[9] CeTrA - Environment Data Repository: https://datarepository.unive.it/dataverse/cetra-environment/
[10] Ca' Foscari Data Repository support infrastrutture: https://www.unive.it/pag/49381/

- Research products will include publications metadata and internal search/filtering integrated in CeTrA website, linked to corresponding documents deposited in the Open Archive of Ca' Foscari (ARCA, OpenAire compliant)[11];
- Training: advanced training will be offered and managed as form of analytical services;
- VRE: CeTrA does not have a VRE (but will likely provide datasets to the ISOTOPE VRE).

All the above resources will be part of the CeTrA web portal under construction and linked to the ITINERIS HUB. The metadata schemes will mirror those being implemented in the ITINERIS HUB within the limits of CeTrA's specificities.

Reviewed by Marco Roman, Ca' Foscari Venice university

DANUBIUS-RI



A detailed catalogue for the Italian components of DANUBIUS-RI is currently being developed as part of the DANUBIUS-RI Implementation Phase project. The services that will be offered include access to datasets such as Earth Observation, satellite and in-situ data, model outputs and products, numerical models with associated codes and manuals, as well as specialized equipment and expert support. Although a prototype of the catalogue exists, it has not yet been made public.

In particular:

- Services: this resource include: "tools, methods and expert support": access to facilities and equipment, specific methods and tools, and expert support provision for analysts; study and measurements: analyses provision, and sampling campaign with the user or on its behalf. This can include physical, chemical, biological, biogeochemical, ecotoxicological, hydromorphological, sedimentological, and bathymetric sampling and analyses; tests, audit, validation and certification: validation and quality assure observations, analyses and modelling outputs, and DANUBIUS Commons accreditation and Accredited Service Providers certification services provision
- Dataset: "Digital and non-digital data": access to metadata, data and samples produced or collected by DANUBIUS-RI, either online for digital formats, or physical for samples such as sediment cores.
- Research products: tool for "diagnostic and impact": modelling and impact assessment analyses that harness data from previous or expected results (diagnostic) or with forecasts (from models).

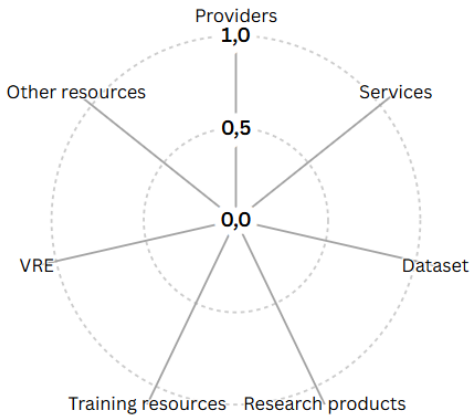
[11] Ca' Foscari Archive of Reseach Producs (ARCA): https://iris.unive.it/

- Training resources: design, development and delivery of co-designed trainings and courses to companies, innovators and authorities in the four areas of expertise (Observation, Analysis, Modelling, and Impact), developing partnership with the user to organize bespoke conferences and workshops to address River-Sea System challenges.
- Other resources: Solution development: partnerships development with the user, or connection with the right partners with wide-ranging scientific expertise to develop solutions for your specific challenges in River-Sea Systems.

Example: The project DANUBIUS-RI developed a test call to test the provision first set of services[12]. At Italian level within the ITINERIS DANUBIUS-RI is developing its own metadata catalogue of data and facilities, the IT-IOOS. With this metadata catalogue will contribute to and integrate with the ITINERIS catalogue. Specifically, the IT-IOOS catalogue will be connected to the ITINERIS HUB and seamlessly interfaced with the ITINERIS catalogue[13].

Reviewed by Francesca De Pascalis and Georg Umgiesser, CNR-ISMAR

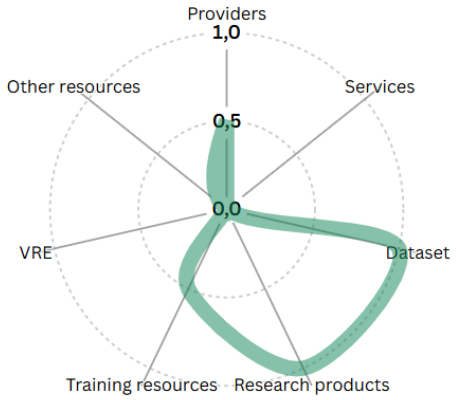
GeoSciencesIR



Geoscience IR is a relatively young research infrastructure that has not yet developed a catalogue of resources. The only reference remains the website with its objectives to be achieved for the duration of the project.
The RIs within the ITINERIS marine domain are developing their own metadata catalogue of data and facilities, the IT-IOOS. With this metadata catalogue will contribute to and integrate with the ITINERIS catalogue. Specifically, the IT-IOOS catalogue will be connected to the ITINERIS HUB and seamlessly interfaced with the ITINERIS catalogue.

[12] DANUBIUS services first pilot call: https://danubius-ip.tumblr.com/pilotcall2
[13] ITINERIS Deliverable 5.11: Report and release of IOOS metadata catalogue of data and facilities

EURO ARGO



Euro-Argo does not have a traditional catalogue but offers access to Environmental Research Division's Data Access Program (ERDDAP) server and two data portals for users. Argo data are freely available using the ERDDAP server[14] that allow to download subsets of scientific datasets in common file formats and make graphs and maps. The Euro-Argo fleet monitoring tool allows users to visualize Argo float metadata, ocean measurements, trajectories, and technical parameters. It also provides access to a fleet dashboard and detailed information on individual floats via their WMO numbers. The second portal, the Euro-Argo data selection tool, is designed for users to select, visualize, and download Argo scientific data, such as profile files, in various formats. These tools facilitate access to comprehensive oceanographic data.

The resources align with ITINERIS resource categories in the following ways:

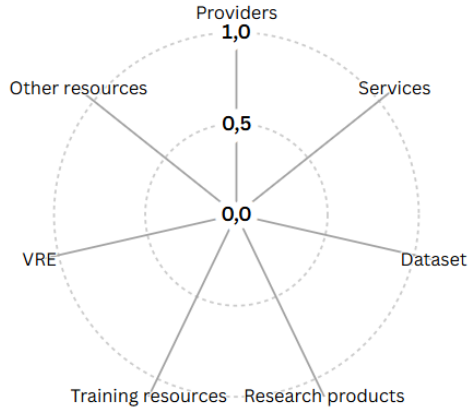
- Providers: There is a list of Euro-Argo partners, including both members and candidate members, which is available on the website. However, the partners are only listed with links to their respective websites, without any additional metadata schema.
- Dataset: ERDDAP data server, Euro-Argo fleet monitoring tool[15] and Euro-Argo data selection tool[16].
- Research products: list of publication, reports, deliverables and "The Argopy software"
- Training resource: include educational materials such as the Argo Online School, other teaching resources, the Discover Argo Floats program, and the Ocean Observers initiative. However, these resources are presented as a simple list without any metadata.

ERDDAP is the technology adopted for the catalogue. The metadata standards include FGDC-STD-001-1998 and ISO19115-2/19139.

Reviewed by Antonella Gallo, Elena Mauri and Alexia Cociancich, OGS

[14] https://erddap.ifremer.fr/erddap/index.html
[15] https://fleetmonitoring.euro-argo.eu/dashboard
[16] https://dataselection.euro-argo.eu/

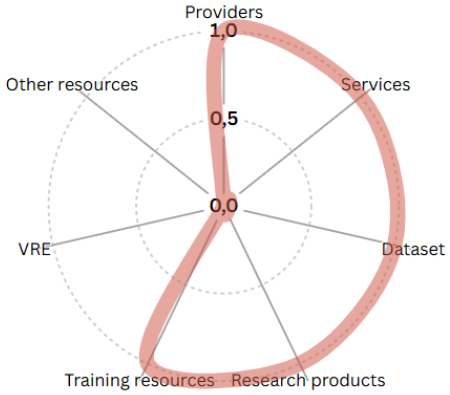
N/R Laura Bassi



The N/R Laura Bassi, a research vessel operated by OGS, does not have a dedicated website or catalogue for its resources. Information about the ship and its activities is available on the OGS website[17], the PNRA website[10], the Eurofleets+ website[11] and the CNR Polar Sciences Institute website[12] The Naval Infrastructure Management Center handles the operational management of the Laura Bassi, providing geophysical and oceanographic exploration services and technical management of research vessels and equipment for offshore operations. However, the center does not maintain a specific catalogue or website dedicated to its resources.

Reviewed by Maria Elena Musco, OGS

Eurofleets



Eurofleets provides access to research vessels and marine infrastructure, but unlike other RIs it does not have a traditional catalogue of resources. Instead, the European Virtual Infrastructure in Ocean Research (EVIOR)
offers a centralized gateway for getting information about European Research Vessels DB, equipments, and instruments. Researchers can request access to these resources for their projects, which include marine research vessels from various European institutions. The resource on the website aligns with ITINERIS resource categories in the following ways:

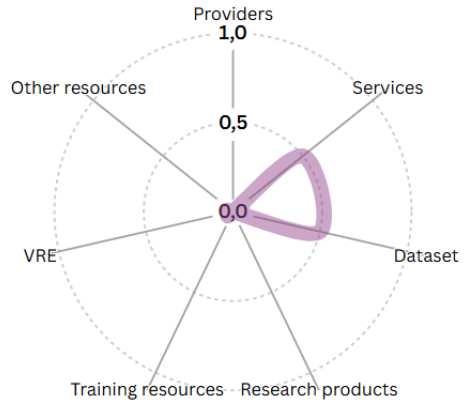
- Providers: Cruise ID with the metadata description
- Services: Cruise Summary Reports DB, European Research Vessels DB, Cruise Data Sets Catalogue, Dashboard for information, from sailing research vessels, Eurofleets+ Virtual Playground.
- Dataset: reference is made to the EMODNet and SeaDataNet data portals for accessing and downloading the relevant data.
- Research products: deliverables
- Training resources: several training resources are present in the learn section: workshops, internships with universities, webinars and presentations.

The technology adopted for the catalogue is SPARQL, and the metadata standards used are based on ISO19115/19139 and NetCDF CF 1.7.

Reviewed by Anna Vetrano and Katrin Schroeder, CNR-ISMAR

[17] OGS website: https://www.ogs.it/en/research-vessel-laura-bassi

INFN-LNS



INFN-LNS does not currently have a specific catalogue for its resources or dataset. On the official website of the institute[18], information on facilities and instruments is provided in the "applications," "accelerators," and "equipment" sections. However, the website offers only general descriptions of these instruments, without detailed metadata or inclusion in a dedicated catalogue. This means that although information on various tools and facilities is available, there is no formal cataloguing system that organizes and manages these resources through standardized metadata.

To cover this gap, INFN – LNS is working to publish a marine domain catalogue that aligns with ITINERIS resources in the following way:

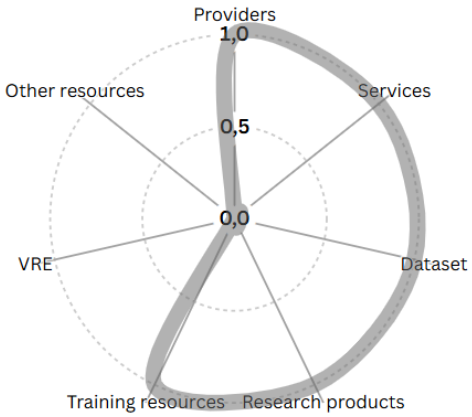
- Services: physical access to deep sea hub (Junction Boxes) and access to data library;
- Dataset: INFN-LNS is developing a dedicated data portal using an ERDDAP server, allowing users to download marine data and metadata (Ocean Sound pressure level);
- Research products: data analysis, data tagging tools and related documentation to support users.

ERDDAP is the technology adopted for the catalogue. The metadata standards include FGDC-STD-001-1998 and ISO19115-2/19139.

Reviewed by Giorgio Riccobene, Emidio Giorgio and Salvatore Viola, INFN-LNS.

[18] INFN-LNS website: https://www.lns.infn.it/it/

EMSO



EMSO provides access to a wide range of data and resources through its catalogue[19].
The EMSO Data Portal serves as a central hub where users can access data collected by its observatories, covering oceanographic, geophysical, and environmental parameters from various deep-sea and water column observatories across Europe.
The catalogue aligns with ITINERIS resource categories in the following ways:

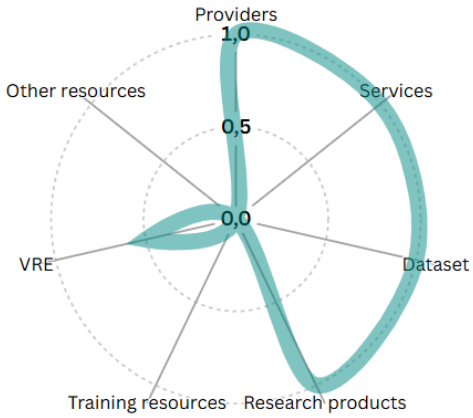
- Providers: The research organizations managing the regional facilities of EMSO provide the resources. The list of the organizations and the links to their institutional website are available on the EMSO Eric website.
- Services: Access to the Infrastructure Services, Climate Change Services, Marine Ecosystem Services, Geo-hazards Services and other.
- Dataset: EMSO has created a dedicated data portal using an ERDDAP server, allowing users to download marine data and metadata in standard formats. This portal is designed to meet the specific needs of the EMSO marine research community.
- Research products: data tools and documentation.
- Training resources: webinars and training events.

ERDDAP is the technology adopted for the catalogue. The metadata standards include FGDC-STD-001-1998 and ISO19115-2/19139.

Reviewed by Claudia Fratianni, INGV, Laura Beranzoli, INGV and Elena Partescano OGS Trieste.

[19] https://emso.eu/

JERICO



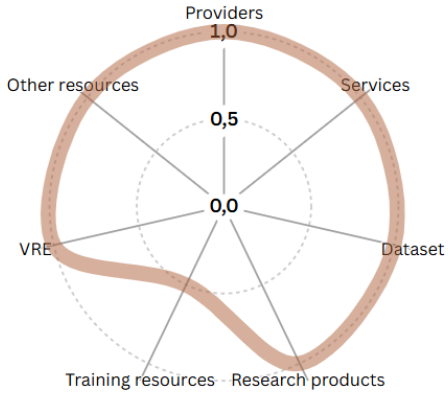
JERICO has catalogue of services to support coastal and marine research. This catalogue includes access to observational data from coastal observatories, covering physical, chemical, and biological parameters. Through the TNA program, researchers can use coastal research platforms, observatories and equipment for in situ studies. JERICO provides access to two main catalogues: JERICO-Sextant Catalogue[20] and JERICO Service Catalogue[21].
All resources in the catalogue show consistency with those identified in ITINERIS as follows:

- Providers: institutions with associated metadata are described.
- Services: Physical Infrastructure, Data Services, Virtual Services, Tools services.
- Dataset: reference is made to the EMODNet, SeaDataNet, and CMEMS data portals for accessing and downloading the relevant data.
- Research products: deliverables, milestones, graphics and logos
- VRE: the Blue-Cloud JERICO-CORE VLAB and the VRE developed in the framework of the ITINERIS project will be the first test applications.

The technology adopted for the catalogue is SPARQL, and the metadata standards used are based on ISO19115/19139 NetCDF CF 1.7.

Reviewed by Rosalia Santoleri, Lorenzo Corgnati and Carlo Mantovani, CNR-ISMAR.

eLTER



eLTER is currently developing a comprehensive service catalogue, which will provide access to data, information on eLTER in-situ facilities (eLTER sites and eLTSER platforms) through DEIMS-SDR (Dynamic Ecological Information Management System - Site and dataset registry), and details on activities, sensors and personnel.
DEIMS-SDR is an information management system that allows to discover eLTER in-situ facilities. DEIMS-SDR contains information on site's location, ecosystems, facilities, and observed properties. To find a specific site(s), DEIMS-SDR provides a keyword search, predefined filters or a map search. Each site is assigned with a persistent identifier (DEIMS.ID). By including accurate, up-to-date information in DEIMS-SDR, site managers could benefit from greater visibility for their eLTER site, LTSER platform and datasets, which

[20] https://www.jerico-ri.eu/sextant-catalogue/
[21] https://www.jerico-ri.eu/jerico-ri-catalogue/#/map

can help attract funding to support site investments and enhance collaborations. The aim of DEIMS-SDR is to be a globally comprehensive catalogue of environmental research and monitoring facilities, featuring foremost but not exclusively information about all eLTER in-situ facilities and providing that information to science, politics and the general public. DEIMS-SDR is one of the catalogues for specific resources that eLTER is currently providing. The other eLTER catalogues are easily reachable by the One-Stop-Shop eLTER webpage[22], where applications such as eLTER DAR (Digital Asset Registry), eLTER Vocabularies, and DataLabs are listed.

All resources in the catalogue show consistency with those identified in ITINERIS as follows:

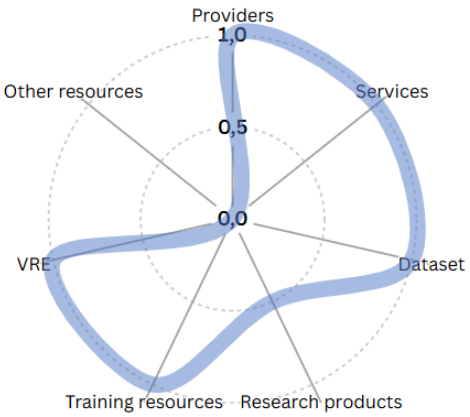
- providers: all organizations/affiliation providing data and services for the DEIMS-SDR catalogue and not only for eLTER are registered and described in the catalogue;
- services: this resource includes different entities such us: activity, sensor, network, and eLTER in-situ facilities;
- dataset: Data is mainly described through B2Share, the data portal maintained by the European Data Infrastructure (EUDAT), while data is findable and accessible through eLTER Digital Asset Register (DAR). The eLTER DAR serves as a comprehensive hub for information on eLTER data sets, including both own eLTER data and those aggregated from external sources (B2SHARE, Zenodo, CITES, etc.);
- research products: some application such as eLTER DiV (Data and Integrated Visualisations): a visualisation tool powered by eLTER Horizon projects for visualising different Remote Sensing data as well as sensor time-series data. Metadata information is collected from DEIMS-SDR and eLTER DAR; the Spatial Data CDN: a central data node intended for the management, sharing, and visualization of standardized spatial data. It is based on the Spatial.IO tool and integrates the GeoServer platform; SO Costs (Standard Observation Costs): an interactive tool designed to assist researchers and site managers associated with the eLTER-RI in defining Standard Observations (SOs) and calculating the associated costs to upgrade and operate them at their sites; Validiraptor: application for data validation aligned to an eLTER schema;
- training: eLTER offers various trainings for different user groups ranging from students to site personnel and from data managers to researchers, including both hands-on, on-site trainings and a wide selection of online courses. Nevertheless, these resources are not yet catalogued with specific metadata;
- VRE: DataLabs application is a JupyterHubs environment for analysis of eLTER datasets;
- other resources: eLTER vocabularies[23].

The different entities are provided by using different formats. Activities, sensors, networks, and eLTER in-situ facilities, through a triple store technology, are reachable in RDF format. Data about eLTER in-situ facilities are also shared also through GeoServer and Spatial.IO technology and metadata are stored in a GeoNetwork catalogue service. The same technologies are currently adopted for sharing metadata of datasets.

Reviewed by Alessandro Oggioni, CNR-IREA and Caterina Bergami CNR-ISMAR.

[22] https://portal.elter-ri.eu/en-gb
[23] ELTER vocabulary: https://vocabs.lter-europe.net/so/en/page/022

LifeWatch



The "LifeWatch ERIC Metadata Catalogue" serves as the central repository for metadata related to biodiversity and ecosystem research resources and services. LifeWatch Italy has its own dedicated website[24] and a Data Portal[25].
On the LifeWatch Italy Data Portal, rich metadata for datasets are displayed. Additionally, metadata for other digital resources produced by LifeWatch Italy are currently accessible through the LifeWatch ERIC Metadata Catalogue.
A new Data Portal and a LifeWatch Italy Metadata Catalogue are currently in development.

In terms of consistency with the ITINERIS catalogue, LifeWatch Italy focuses on several key resources:

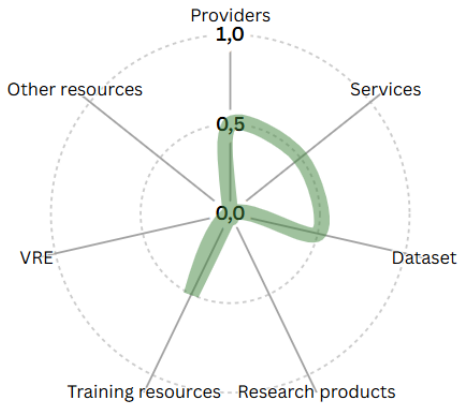
- Providers: although organizations are listed and searchable through filters, they are not considered distinct resources within the catalogue;
- Services: in the LifeWatch ERIC Metadata Catalogue, and in the future LifeWatch Italy Metadata Catalogue, this category includes web services, web applications and platforms (e.g. Semantic Platform, CitizenScience Platform, DataLabs, EcoPortal, etc.[26]);
- Dataset: LifeWatch Italy has a data portal containing datasets and associated metadata;
- Research Products: there is no specific section for the category "research products" within the LifeWatch ERIC Metadata Catalogue, and in the future in the LifeWatch Italy Metadata Catalogue, but there are categories such as workflow, scripts, research site, audio and training that can be included below the category "Research Products". Moreover, there is a "Publications" section on the website that lists articles, reports, presentations, and posters, though without detailed metadata;
- Training Resources: LifeWatch Italy offers a range of training resources through a dedicated platform[27] (Training service), which includes tutorials, educational games, webinars, and conferences. All the related metadata are available on the LifeWatch Italy Metadata Catalogue;
- VRE: the LifeWatch ERIC Metadata Catalogue, and in the future the LifeWatch Italy Metadata Catalogue include this category. Currently, there are 29 VREs available, 2 of which are specific to LifeWatch Italy.

The metadata standards include EML2.2.0 for dataset, ISO 19139 for VRE, workflows, services and research site MOD Ver. 2.0 for semantic artefacts on EcoPortal, and EOSC Traning Profile 5.0 for training resources. The metadata catalogues, ERIC and Italy, are based on Geonetwork. The new Data Portal is based on DSpace.

[24] LifeWatch Italy website: https://www.lifewatchitaly.eu/
[25] LifeWatch Italy data Portal https://dataportal.lifewatchitaly.eu/data
[26] LifeWatch Metadata catalogue: https://metadatacatalogue.lifewatch.eu/srv/eng/catalog.search#/search?facet.q=type%2Fservice%26groupOwner%2F2264&resultType=details&sortBy=relevance&fast=index&_content_type=json&from=1&to=20
[27] LifeWatch Italy Training Platform https://training.lifewatchitaly.eu/en/home-2/

Reviewed by Ilaria Rosati and Andrea Tarallo, CNR-IRET, URT Lecce

DiSSCo



The DiSSCo is currently in the transition phase, and as a result, neither a European[28] nor an Italian node[29] offering access is available at this stage. Recently, DiSSCo introduced the Knowledge Area of DiSSCo Transition (DTP), a dedicated hub for exploring all project outputs, including workshops, demonstrations, videos, publications, and more. The demos highlight progress in the development of DiSSCo's data infrastructure, core services, and other components of its technical framework. However, DiSSCo is still in the development phase, where resources have not yet been integrated into a structured catalogue with an applied metadata schema technology.

In terms of consistency with the ITINERIS catalogue, the following resources are currently available:

- Providers: for the time being, several metadata of providers and the organizations participating in DiSSCo-IT are available through the Global Biodiversity Information Facility (GBIF)[30,31,32].
- Services: physical access to collections maintained by the Providers, access to laboratories and technical support for digitization, skills, and know-how in taxonomy (e.g., plants, algae, plankton, crustaceans, etc. from freshwater, marine, and terrestrial ecosystems). Additional online services will be included soon[33];
- Dataset: The full list of datasets, including the digital twins of the collection specimens and their enriched metadata, is accessible through the GBIF platform[34,35,36];

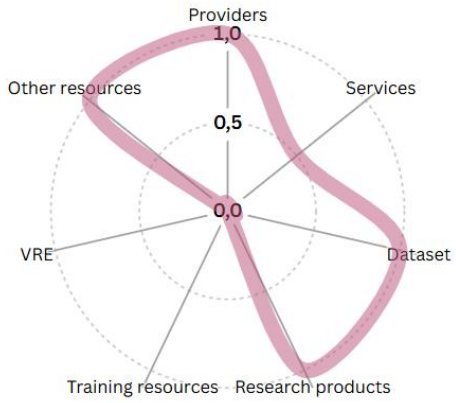
[28] https://www.dissco.eu/
[29] https://www.dissco.eu/it-it/
[30] Consiglio Nazionale delle Ricerche, Istituto di Bioscienze e BioRisorse (CNR-IBBR) - Publisher page on GBIF (https://www.gbif.org/publisher/6563e0ba-fab7-431c-b897-b6bf364f4f1e/metrics), API-JSON (https://api.gbif.org/v1/organization/6563e0ba-fab7-431c-b897-b6bf364f4f1e)
[31] Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine (CNR-ISMAR) - Publisher page on GBIF (https://www.gbif.org/publisher/200bba32-9373-46aa-b1d2-16da3a4266f7/metrics), API-JSON (https://api.gbif.org/v1/organization/200bba32-9373-46aa-b1d2-16da3a4266f7)
[32] Consiglio Nazionale delle Ricerche - Istituto di Ricerca sulle Acque (CNR-IRSA) – Publisher page on GBIF (https://www.gbif.org/publisher/e8f79b81-11bb-4881-9f42-1b46bd4cfbc6/metrics), API-JSON (https://api.gbif.org/v1/dataset/search?publishingOrg=e8f79b81-11bb-4881-9f42-1b46bd4cfbc6)
[33] https://www.ibbr.cnr.it/climate-dt/
[34] CNR-IBBR dataset catalogue (https://www.gbif.org/dataset/search?publishing_org=6563e0ba-fab7-431c-b897-b6bf364f4f1e), and the corresponding endpoint (API-JSON: https://api.gbif.org/v1/dataset/search?publishingOrg=6563e0ba-fab7-431c-b897-b6bf364f4f1e)
[35] CNR-ISMAR dataset catalogue (https://www.gbif.org/dataset/search?publishing_org=200bba32-9373-46aa-b1d2-16da3a4266f7) and the corresponding endpoint (API-JSON: https://api.gbif.org/v1/dataset/search?publishingOrg=200bba32-9373-46aa-b1d2-16da3a4266f7)
[36] CNR-IRSA dataset catalogue (https://www.gbif.org/dataset/search?publishing_org=e8f79b81-11bb-4881-9f42-1b46bd4cfbc6) and the corresponding endpoint (https://api.gbif.org/v1/dataset/search?publishingOrg=e8f79b81-11bb-4881-9f42-1b46bd4cfbc6)

- Research Products: deliverables, publications and documents will be soon available;
- Training resources: support for metadata enrichment and cataloging will be soon available. See DiSSCo Digitization Guide[37], DiSSCo Knowledge Area[38], DiSSCo GitHub[39].

The Darwin Core[40] and its extensions[41] are the data and metadata standards and schemas adopted in the construction of the Italian node of DiSSCo (DiSSCo-IT). The extensive use of such TDWG[42] schemas in biodiversity research allows for the semantic interoperability between various repositories and the main ITINERIS catalogue.

Reviewed by Simona Armeli Minicante, CNR-ISMAR, Gabriele Bucci, CNR-IBBR, Luca Bellucci, L. Cecchi, and Gianna Innocenti, University of Florence

IBISBA



IBISBA is an ESFRI Research Infrastructure that is currently in its preparatory phase, with its main nodes based in Italy and France. It is still in the early stages of development the catalogue is hosted in the IBISBA Knowledge Hub[43].
In addition, on the IBISBA website[44], specifically through the *One-Stop-Shop portal*[45], users can browse the services offered by IBISBA. The One-Stop-Shop platform aims to centralize access to a wide variety of research services, particularly in the field of industrial biotechnology, allowing users to select modular services that can be tailored to specific project workflows.

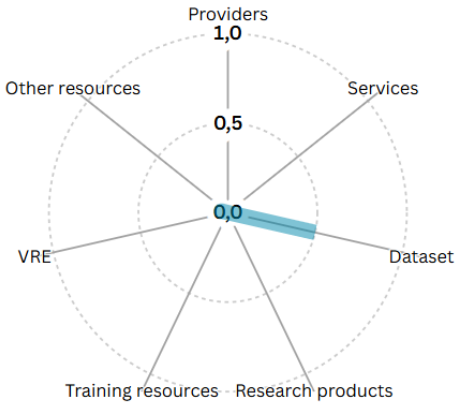
- Providers: "Institutions" and "people" are described with a specific metadata
- Services: the catalogue within the One stop shop allows users to browse and use modular services, which can be adapted to specific project workflows, especially in the field of industrial biotechnology.
- Dataset: the section "Data files[46]" describe any file containing data relevant to the assay (raw data, processed data, calibration information etc). They can be in any format (word files, e-lab notebooks, code, annotated spreadsheets etc). Relevant data files can be linked directly to the assay via the dropdown menu.
- Research products: the section "Publications" present a metadata schema describing the resource and where it is available.
- Other resources: under the category "Experiments" are listed different resources like investigation, studies and assays

[37] https://dissco.github.io/
[38] https://www.dissco.eu/knowledge-area/
[39] https://github.com/DiSSCo
[40] https://dwc.tdwg.org/terms/
[41] https://rs.gbif.org/extensions.html
[42] Biodiversity Information Standards, originally called the Taxonomic Databases Working Group - TDWG (https://www.tdwg.org/)
[43] IBISBA Knowledge Hub https://hub.ibisba.eu/
[44] IBISBA One Stop Shop https://ibisba.eu/one-stop-shop/
[45] One-Stop-Shop portal: https://ibisba.eu/One-Stop-Shop/
[46] https://hub.ibisba.eu/data_files

Technologically, IBISBA uses the FAIRDOME-SEEK platform to manage data and services, and it follows the RO-Crate metadata schema to ensure data interoperability and alignment with FAIR principles.
IBISBA-IT[47] as a distinctive expertise and research area. In terms of alignment with ITINERIS resources, IBISBA-IT will provide datasets related to metagenomics of extreme environments, characterization of carbohydrate-active enzymes, as well as protocols and pipelines for bioprocess development.

Reviewed by Mauro di Fenza, IBISBA, Beatrice Cobuzzi Ponzano, CNR-IBBR and Pietro Roversi CNR-IBBA.

EMPHASIS



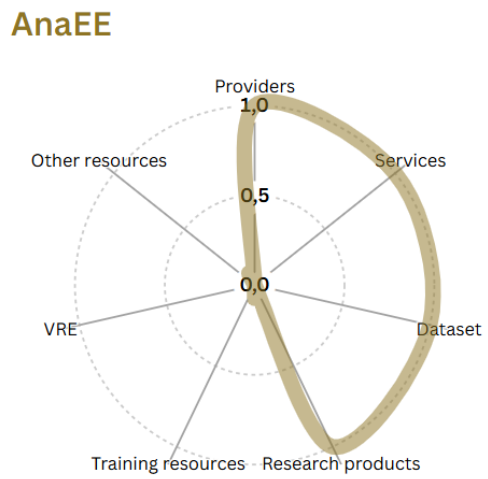
EMPHASIS does not currently have a dedicated resource catalogue. However, its official website[48] provides detailed information about RI's collaborations with other research projects and infrastructures, as well as news about events and partnerships. Information on ongoing activities and partnerships in the plant phenotyping research community is available.

- Providers: IPSP will lead the development of a pilot platform for data management. All organization/affiliation to PhenItaly will progressively contribute providing datasets coming from their individual plant phenotyping infrastructures and extend it to the broader Emphasys Community;
- Services: a range of physical instruments, computational workflows and integrated platforms, that will enable researchers to work on many different levels, starting with the metabolomic level (in the laboratory) through to the individual plant (in controlled environments) and up to the cultivation level (in the open field). These services include, but are not limited to automated data capture, workflow analysis and data management, online experimentation and analytical extraction. As previously stated, these are being rolled out internally and will become access points to services to the ITINERIS community;
- Datasets: the pilot platform will deploy instances of OpenSILEX (a data management system developed by and for the plant phenotyping community) to catalogue the data gathered by the infrastructure;
- Research Products: publications (ongoing planned), scripts and workflow used for data processing open and also machine learning model trained for specific applications;
- Training: still internal but will extend it along with the other services;
- VRE: no VRE is currently available, but concrete proposals are being developed in line with those already developed on the D4Science ITINIRIS platform.

[47] IBISBA-IT website: www.ibisba.it
[48] EMPHASIS website: https://emphasis.plant-phenotyping.eu/

The metadata schema used for the dataset will comply with MIAPPE, a common schema for plant phenotyping, but differs from the one adopted by ITINERIS. Solutions are being explored to ensure the required compatibility, including the development of scripted procedures to map the MIAPPE schema to the ITINERIS standard (ISO 19115).

Reviewed by Sabrina Mazzoni and Andrè Fabbri, CNR-IPSP.



The AnaEE ERIC main mission is to provide to the community access to experimental platforms across Europe for scientific research in the domain of experimental ecology. In AnaEE, a series of Open-air and Enclosed experimental platforms covers major biomes and ecosystems of Europe. Characteristic to AnaEE its versatile facilities that can simulate a wide range of environmental drivers from land-use change, pollution, biological invasions, and rising atmospheric greenhouse gases concentrations, to increasing extreme events such as droughts and heatwaves. Another important feature of AnaEE is that it facilitates coordinated use of experimental, analytical, and modeling resources.

AnaEE links its facilities with an array of user communities, including scientists, land managers, the bio-economy industry and policy makers, with the goal to minimize human environmental impact and maximize societal benefits in a dynamic world. The AnaEE catalogue, is built on the ISIA software platform, which integrates resources from the multiple research infrastructures and projects in the domain of experimental ecology. The catalogue aligns with ITINERIS resource categories in the following ways:

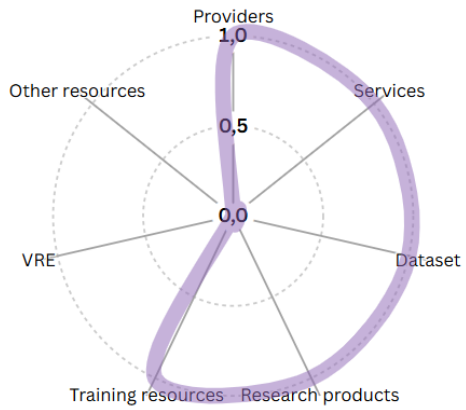
- Providers: The catalogue includes exhaustive information about service providers;
- Services: the AnaEE research facility and catalogue offers dedicated services to various actors. Among this we can mention Services to academic users (e.g., access to a comprehensive catalogue of facilities and services, a single point of access to facilities, information and guidance about application procedures and costs, open access to data and metadata acquired from AnaEE RI, integrated analytical and modelling services, and training for advanced scientists and students), Services to its facilities (e.g., : coordination of procedures for quality standards and regulations across facilities, support to develop, test and implement new instrumentation, processes, methods), Services to private partners and NGOs (e.g., tests of new products, new technologies, new management methods for agriculture and nature conservation, as well as support for innovation activities, including open innovation and living labs, and finally training for technical users), and Services to policy-makers and society (e.g., expert public policy advice on improving management and methodologies for sustainable agriculture and ecosystem management, as well as coordination and support of the facility/national nodes' education like schools and outreach);

- Dataset: the datasets are accessible through two portals. The first portal is based on API (Application Programming Interface) protocols, expose an OpenAPI 3.0 specification, and based on the principles of being Findable, Accessible, Interoperable, and Reusable (FAIR). The second portal, the Data portal, is currently non-functional (December 2024);
- Research Products: the resources section provides also a list of scientific publications, reports, presentations, as well as governance and strategic documents;
- Training Resources: there are no explicit references to training resources, except for a specific training program targeted at PhD students, located under the outreach section;
- VRE: currently, the AnaEE research facility does not offer a VRE.

AnaEE utilizes the D-CAT AP metadata schema, a standard designed for data catalogue interoperability and aligned with European data infrastructure requirements.

Reviewed by Alessandro Montaghi, CNR-IRET.

ECORD



The ECORD and IODP Databases catalogue, serves as a portal to access[49] data and resources collected from various ocean drilling expeditions under the IODP. This includes core samples, geophysical logs, and other related scientific data, crucial for research into Earth's history, paleo-climate, geodynamics, geological hazards, georesources and deep biosphere. The catalogue offers users access to both physical samples and datasets, with sample requests managed through the Sample and Data Requests Database (SaDR[50]), and decisions on distribution made by the Curatorial Advisory Board.

In terms of coherence with ITINERIS resources:

- Providers: The term "providers" refers to key entities: The drilling platform provider (ECORD Science Operator - ESO) implements Mission Specific Platforms for drilling expeditions and core/data collection. Within ESO, the European Petrophysics Consortium (EPC) undertakes petrophysics research combining borehole geophysics, laboratory experiments and geology;
- Services: include access to IODP core repositories, offering researchers physical samples from drilling expeditions, and tools like maps and KML for geographic data visualization. In ECORD the Bremen Core Repository (BCR) manages the core data archive and the distribution of data and samples;

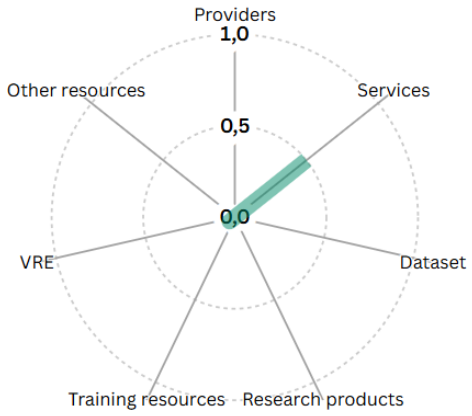
[49] ECORD catalogue: https://www.iodp.org/resources/access-data-and-samples
[50] SdRM: https://web.iodp.tamu.edu/SDRM/#/

- Datasets: All data and core material/samples in IODP and ECORD activities are Open Access after a 1-year moratorium following the expedition. All data are accessible through the centralized portal "Access Data and Samples" through which access is granted to both digital data and physical samples;
- Research Products: Each IODP/ECORD Drilling expedition produces set of openly accessible publications: Expedition Scientific Prospectus, Preliminary report, Expedition Proceeding, and a searchable bibliographic database maintained by IODP Publication Services;
- Training Resources: ECORD offers annual training activities for PhD e Early-Career Researchers: Summer Schools, Training Courses, Distinguished Lecturer Program for which Research Grants and Scholarships are granted following competitive calls;
- VRE: no specific VRE are indicated.

The metadata schema used for the dataset is ISO 19115. The IODP and ECORD metadata are managed through the Scientific Earth Drilling Information Service (SEDIS) now funded by ECORD and supported by MARUM in Bremen.
However, there is currently no information about the technology used to manage the catalogue.
Note: The data management structure of ECORD is integrated with that of the companion infrastructure International scientific Continental Drilling Program (ICDP) managed in Potsdam by GFZ. The meta-data and data collection and management are coordinated through the mDIS tool (mobile Drilling Information System).

Reviewed by Angelo Camerlenghi, OGS, Elisabetta Erba, University of Milan and Annalisa Iadanza, CNR-DTA.

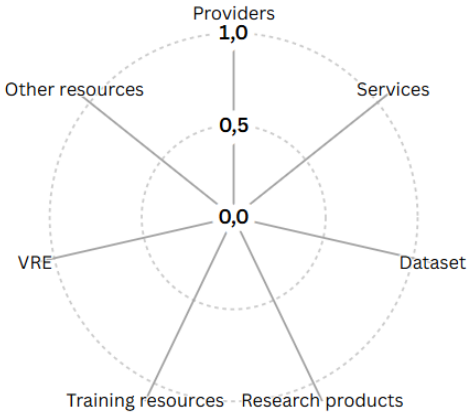
ATLaS



Atlas RI is currently in the process of developing its resources catalogue. The development of the catalogue and the website is being supported by the ITINERIS project. At this stage, the only available reference to Atlas catalogue is a dedicated page hosted on the University of Florence's website[51]. Although the catalogue is not yet operational, differently form the others, ATLaS does have a section outlining available services, instrument and facilities as well as a specific access management plan guideline. These services, while not yet fully documented with metadata, are already in place and accessible.

[51] ATLaS website: https://www.ri-atlas.unifi.it/

SMINO



Currently, SMINO does not have a structured catalogue for services or data. The management of resources is fragmented across approximately five different sites[52]. SMINO is in the process of developing an integrated data portal as part of the ITINERIS initiative, aiming to centralize and unify the resources from these various locations. This future portal will provide a more coherent and accessible platform for users to locate and access the resources of SMINO.

The RIs within the ITINERIS marine domain are developing their own metadata catalogue of data and facilities, the ITalian Integrated Ocean Observing System (IT-IOOS). The IT-IOOS metadata catalogue will contribute to and integrate with the ITINERIS catalogue. Specifically, the IT-IOOS catalogue will be connected to the ITINERIS HUB and seamlessly interfaced with the ITINERIS catalogue.

[52] European Integrated Data Archive (EIDA): https://eida.ingv.it/en/ ; Centro di Ricerche Sismologiche (CRS): http://www.crs.ogs.it/bollettino_new/; RTS – CRS: https://rts.crs.inogs.it/; Friuli Regional Deformation Network (FreDNet): https://frednet.crs.ogs.it/ItalianSite/XFReDNetHome.htm; SMINO general information: https://www.ogs.it/en/northeast-italy-monitoring-system-smino

4.2 Summary of catalogue's mapping

The analysis reveals a wide range of maturity levels among RI catalogues: some have fully developed catalogues with a large number of resources, others have partial catalogues with limited entries, and some are still in the early stages of development or lack a catalogue at all. The two graphs in the Figure 1 provide a detailed overview of the status of catalogues in ITINERIS RIs and the alignment of their resources with those identified for the ITINERIS catalogue.
The donut graph on the left visually represents the distribution of RIs with and without catalogues. Of the 22 total RIs an half have developed some form of resource catalogue. However, the levels of development and maturity of these catalogues vary. The radar chart on the right analyses the types of resources available and aligned to ITINERIS resources for RIs that have catalogues. The chart includes axes that represent the categories of providers, services, datasets, research products, training resources, VREs, and other resources. The strongest alignment is in the categories of datasets and services, indicating that these are the most common and developed resources within the catalogues.

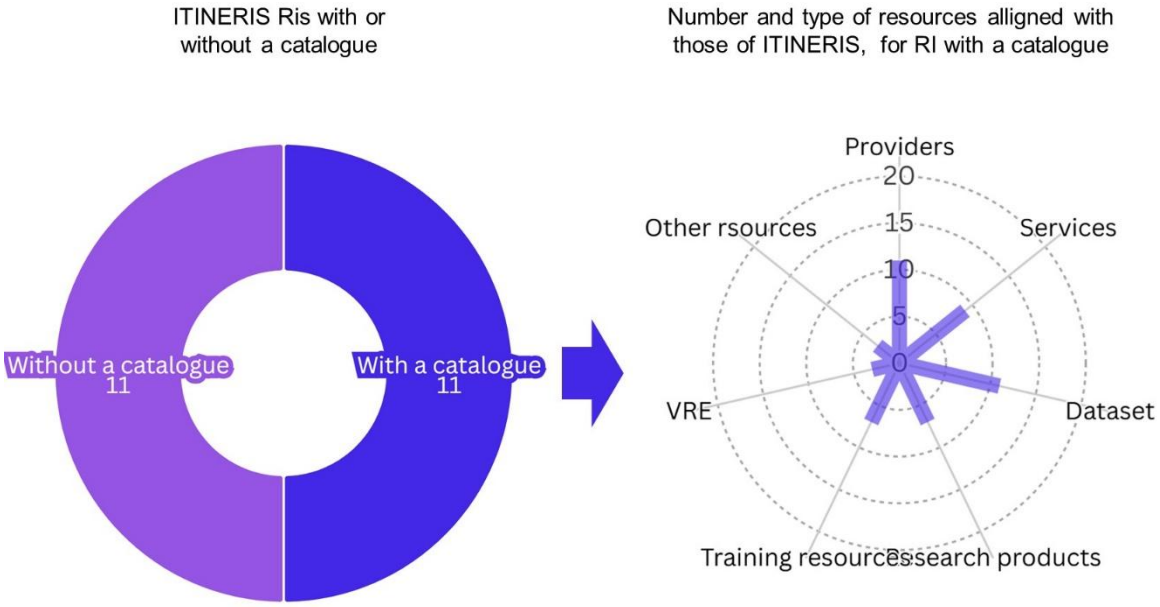


Figure 1 On the left the number of the ITINERIS RIs with or without a catalogue, on the right the radar graph of the number and type of resources, aligned with those of the ITINERIS, for RIs with a catalogue.

Although half of the RIs have developed catalogues, significant variability remains in their maturity. All RIs with a catalogue have data catalogues, but not all offers service catalogues. Of the 22 RIs, only 3 have VREs and 9 provide service catalogues, many of which are still in various stages of maturity. This variation highlights a heterogeneous landscape of resource availability. This is equally evident from the bar graph shown in Figure 2. This bar graph compares the availability of various resources among RIs that have and do not have a catalogue. For example, 59% of RIs provide access to datasets and only 32% offer training resources. In particular, the presence of VREs is limited: only 18% of RIs offer them, while 82% do not. This graph highlights both maturity and gaps in resource provision among RIs.

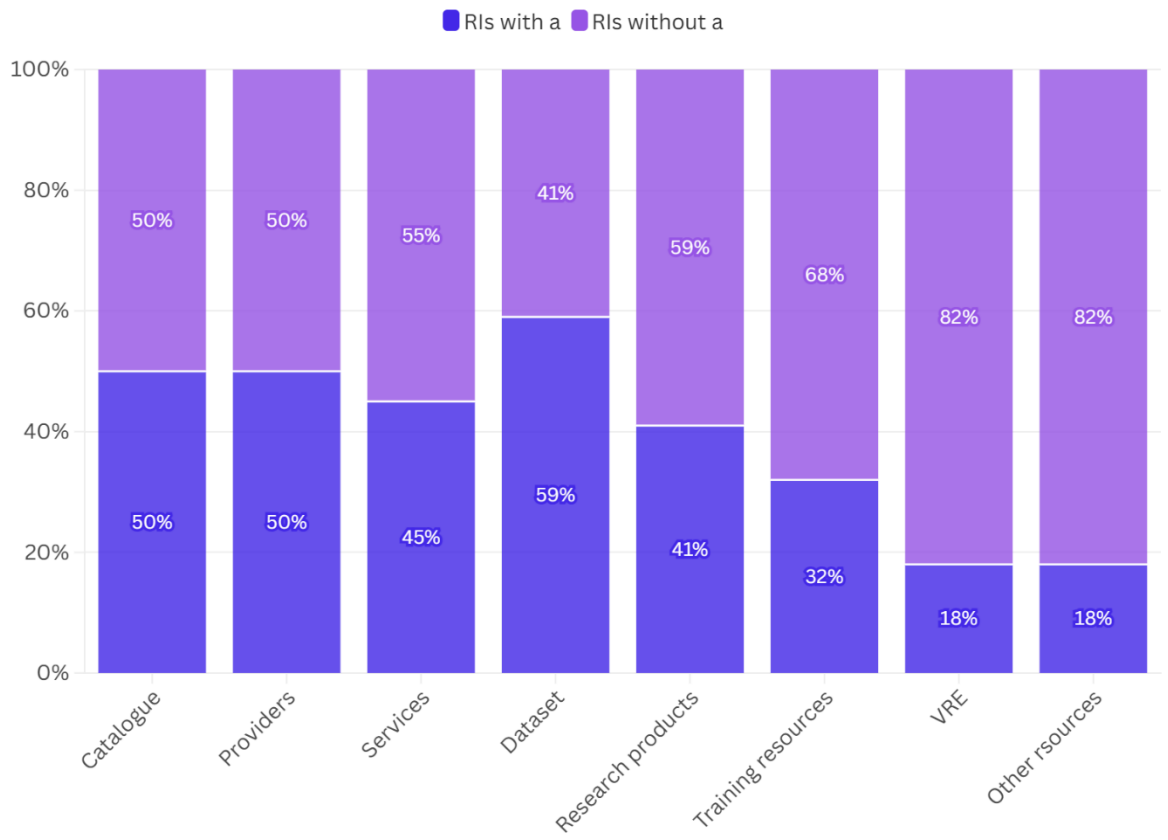


Figure 2 Bar graph of the distribution of resource availability in RIs with or without a Catalogue.

The summary and details of this information is provided by table in Figure 3, where three symbols indicate the presence of a catalogue and his resources, the absence of a catalogue and his resources, and catalogues currently under development.

ITINERIS RI	CATALOGUE	PROVIDERS	SERVICES	DATASET	RESEARCH PRODUCTS	TRAINING RESOURCES	VRE	OTHER RESOURCES
ACTRIS	✓	✓	✓	✓	⧗	✓	✓	✓
ICOS	✓	✓	✓	✓	⧗	✓	✓	✓
SIOS	✓	✓	✗	✓	✗	✓	✗	✗
EUFAR	✓	✓	✓	✓	✓	✗	✗	✗
CeTrA	⧗	✗	✗	⧗	✗	✗	✗	✗
DANUBIUS-RI	⧗	✗	⧗	⧗	⧗	⧗	✗	⧗
GeoScienceIR	✗	✗	✗	✗	✗	✗	✗	✗
EURO ARGO	⧗	⧗	✗	✓	✓	⧗	✗	✗
N/R Laura Bassi	✗	✗	✗	✗	✗	✗	✗	✗
Eurofleets	✓	✓	✓	✓	✓	✓	✗	✗
INFN-LNS	⧗	✗	⧗	⧗	✗	✗	✗	✗
EMSO	✓	✓	✓	✓	✓	✓	✗	✗
JERICO	✓	✓	✓	✓	✓	✗	⧗	✗
eLTER	⧗	✓	✓	✓	✓	⧗	✓	✓
LifeWatch	✓	✓	✓	✓	⧗	✓	✓	✗
DiSSCo	✗	⧗	⧗	⧗	✗	⧗	✗	✗
IBISBA	✓	✓	⧗	✓	✓	✗	✗	✓
EMPHASIS	⧗	✗	✗	⧗	✗	✗	✗	✗
AnaEE	✓	✓	✓	✓	✓	✗	✗	✗
ECORD	✓	✓	✓	✓	✓	✓	✗	✗
ATLaS	✗	✗	⧗	✗	✗	✗	✗	✗
SMINO	✗	✗	✗	✗	✗	✗	✗	✗

LEGEND: ✓ RI with a catalogue/coherence of existent resources with ITINERIS catalogue; ⧗ RI with a "on building" catalogue/coherence of existent resources with ITINERIS catalogue; ✗ RI without a catalogue/coherence of existent resources with ITINERIS catalogue

Figure 3 Detailed table of the coherence analysis

5. ITINERIS CATALOGUE METADATA SCHEMA

RIs catalogues use different metadata standards to describe resources (for a detailed panorama within ITINERIS see D 2.7 State of the art review of FAIR-enabling best practices). The adoption of standardized metadata schemas and protocols can translate and align existing metadata formats, ensuring seamless integration and accessibility of all resources within the unified catalogue. To this end, the next section of the document provides metadata schemas/profiles identified for each seven resources. These profiles capture the fundamental characteristics of a resource entity through several attributes that describe unequivocally each resource. For every element, the schema defines its semantics, which is the meaning intended to be conveyed, and establishes rules for its content, including data type, permissible value ranges, and conditions for inclusion (mandatory or optional). The attributes targeted as "mandatory" allow to have the minimum set of information for ensuring efficient resource categorization and interoperability across various platforms and applications.
The metadata schemas adopted for ITINERIS Catalogue to meet the diverse requirements and needs of every type of resource are provided in Table 1. EOSC and OpenAire metadata profiles have been selected and adopted for the ITINERIS catalogue as recognized standards widely discussed and agreed by the larger context of EU research communities.

Resource	*Adopted metadata schema*
Research Infrastructure	EOSC Provider profile EOSC V. 5.0
Providers	EOSC Provider profile EOSC V. 5.0
Services	EOSC Resource profile EOSC V. 5.0
Dataset	ISO19139
Research products	Research products profile OpenAire V. 4.0
Training resources	EOSC Training Resource Profile EOSC V. 5.0
VRE	EOSC Resource profile EOSC V. 5.0

Table 1 Table of the standard and profile adopted for the ITINERIS resources

In the next pages, the deliverable will provide descriptive metadata schema related to the listed resources based on different standard profiles.

5.1 Research Infrastruttures metadata schema

All 22 ITINERIS RIs will be catalogued with the following metadata schema based on a EOSC Provider profile (Version 5.0 that includes 8 sections containing a total of 36 metadata elements). The minimum mandatory metadata schema is defined by 15 essential (mandatory) attributes.

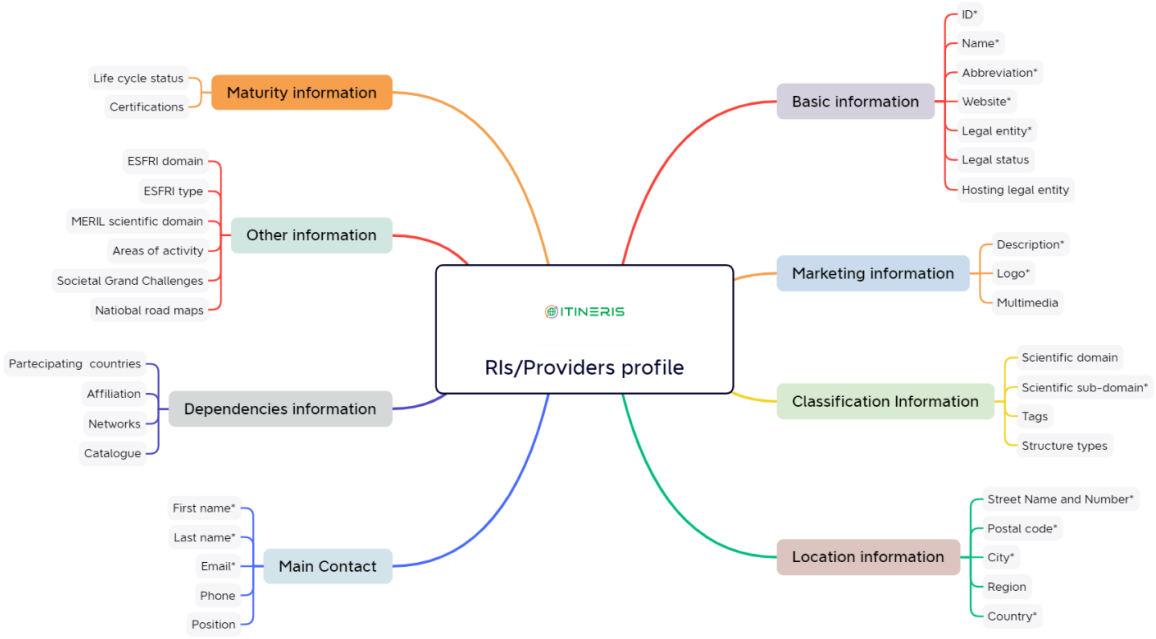


Figure 4 Metadata schema for the ITINERIS RIs and Providers profile. The asterisk (*) denotes mandatory attributes.

BASIC INFORMATION						
Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
ID	A persistent identifier, a unique reference for provider/research infrastructure	ProviderID	1	Mandatory	Yes	
Name	Full name of the provider/RI offering the resource and acting as the main contact point	String (max 100)	1	Mandatory	Yes	Aerosol, Clouds, and Trace Gases
Abbreviation	Abbreviation or short name of the RI	String (max 30)	1	Mandatory	Yes	ACTRIS
Website	Webpage with information about the provider/RI	URL	1	Mandatory	Yes	https://www.actris.eu/
Legal entity	A Yes/No question to define whether the provider/RI is a Legal Entity or not	Boolean (Y/N)	1	Mandatory	Yes	Yes
Legal status	Legal status of the Provider. The legal status is usually noted in the registration act/statutes. For independent legal entities (1) - legal status of the Provider. For embedded providers (2) - legal status of the hosting legal entity. It is also possible to select Not a legal entity.	List of controlled value (Example: Association, Consortium, Corporation, ERIC, European Economic Interest Grouping, Foundation, etc.)	1	Optional	Yes	ERIC

Hosting legal entity	Name of the organization/institution legally hosting (housing) the provider/research infrastructure or its coordinating centre. A distinction is made between: (1) research infrastructures that are self-standing and have a defined and distinct legal entity, (2) research infrastructures that are embedded into another institution that is a legal entity (such as a university, a research organization, etc.). If (1) - the name of the research infrastructure, If (2) - the name of the hosting organization.	String (max 80)	1	Optional	Yes	ACTRIS-ERIC

MARKETING INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Description	A high-level description of the Provider/RI in fairly non-technical terms, with the vision, mission, objectives, background, and experience.	String (max 1000)	1	Mandatory	Yes	The Aerosol, Clouds, and Trace Gases Research Infrastructure (ACTRIS) is the pan-European research infrastructure (RI) producing high-quality data and information on short-lived atmospheric constituents and on the processes leading to the variability of these constituents in natural and controlled atmospheres. ACTRIS enables free access to high-class long-term atmospheric data through a single-entry point. We offer access to our world-class facilities providing researches, from academia as well as from the private sector, with the best research environments and expertise promoting cutting-edge science and international collaborations.
Logo	Link to the logo/visual identity of the RI	URL	1	Mandatory	Yes	https://www.actris.eu/themes/paranoid/logo-actris-white.png
Multimedia	Link to video, photos, screenshots with the details of the RI	URL	Multiple	Optional	Yes	

CLASSIFICATION INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Scientific Domain	A named group of RI that offers access to the same type of resource or capabilities.	List of controlled value	Multiple	Optional	Yes	
Scientific Sub-domain	A named group of RI that offer access to the same type of resource or capabilities, within the defined domain	List of controlled value	Multiple	Mandatory	Yes	
Tags	Keywords associated to the provider/RI to simplify search by relevant keywords	String (max 20)	Multiple	Optional	Yes	
Structure types	Defines the Provider structure type (single-sited, distributed, mobile, virtual, etc.).	List of controlled value	1	Optional	Yes	
Scientific Domain	A named group of RI that offers access to the same type of resource or capabilities.	List of controlled value	Multiple	Optional	Yes	

Scientific Sub-domain	A named group of RI that offer access to the same type of resource or capabilities, within the defined domain	List of controlled value	Multiple	Mandatory	Yes	
Tags	Keywords associated to the provider/RI to simplify search by relevant keywords	String (max 20)	Multiple	Optional	Yes	

DEPENDENCIES INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Participating countries	Providers/Research Infrastructures that are funded by several countries should list here all supporting countries (including the Coordinating country).	List of controlled value	Multiple	Optional	Yes	
Affiliations	Providers/RIs that are members or affiliated or associated with other organizations should list those organizations here.	String (max 30)	Multiple	Optional	Yes	ESFRI, ENCRI, ICOS, EUFAR, EUDAT, GEOSS
Networks	Providers/RIs that are members of networks should list those networks here.	List of controlled value	Multiple	Optional	Yes	

LOCATION INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Street Name and Number	Street and Number of incorporation or Physical location of the provider/RI or its coordinating centre in the case of distributed, virtual, and mobile providers.	String (max 50)	1	Mandatory	Yes	
Postal Code	Postal code of incorporation or Physical location of the RI or its coordinating centre in the case of distributed, virtual, and mobile providers.	String (max 20)	1	Mandatory	Yes	
City	City of incorporation or Physical location of the RI or its coordinating centre in the case of distributed, virtual, and mobile providers.	String (max 20)	1	Mandatory	Yes	
Region	Region of incorporation or Physical location of the RI or its coordinating centre in the case of distributed, virtual, and mobile providers.	String (max 50)	1	Optional	Yes	
Country	Country of incorporation or Physical location of the RI or its coordinating centre in the case of distributed, virtual, and mobile providers.	List of controlled value	1	Mandatory	Yes	

CONTACT INORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
First Name	First Name of the RI's main contact person/RI manager.	String (max 50)	1	Mandatory	No	
Last Name	Last Name of the RI's main contact person/RI manager.	String (max 50)	1	Mandatory	No	

Email	Email of the RI's main contact person/RI manager.	Email	1	Mandatory	No
Phone	Phone of the RI's main contact person/RI manager.	String (max 20)	1	Optional	No
Position	Position of the RI's main contact person/RI manager.	String (max 50)	1	Optional	No

MATURITY INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Life cycle status	Current status of the Provider/RI life-cycle.	List of controlled value	1	Optional	Yes	
Certifications	List of certifications obtained for the Provider (including the certification body, the certificate number, or URL if available).	String (max 250)	Multiple	Optional	Yes	

OTHER INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
ESFRI domain	ESFRI domain classification.	List of controlled value	Multiple	Optional	Yes	Environment
ESFRI type	If the research infrastructure is (part of) an ESFRI project indicate how the RI participates: a) is a node of an ESFRI project, b) is an ESFRI project, c) is an ESFRI landmark, d) is not an ESFRI project or landmark.	List of controlled value	1	Optional	Yes	
MERIL scientific domain	MERIL scientific domain / subdomain classification.	List of controlled value	Multiple	Optional	Yes	
Areas of activity	Basic research, Applied research or Technological development.	List of controlled value	Multiple	Optional	Yes	
Societal Grand Challenges	Provider's participation in the Grand Societal Challenges defined by the European Commission.	List of controlled value	Multiple	Optional	Yes	
National road maps	Provider's participation in a national roadmap.	Yes/no	1	Optional	Yes	

5.2 Providers metadata schema

The onboarding of the provider's information is mandatory as a preliminary step for the onboarding of any resource in the Catalogue.
The providers will be catalogued with the same metadata schema of Research infrastructures (EOSC Provider profile V.5.0). The minimum mandatory metadata schema is defined by 17 essential (mandatory) attributes. Refer to the Excel tables attached to the following document for lists of controlled values.

5.3 Services metadata schema

Services will be catalogued with the following metadata schema based on the EOSC resource profiles (version 5.0 which includes 12 sections containing a total of 53 metadata elements). Resources to be included in the Catalogue need to be described with a minimum set of attributes, identified as "mandatory" (19 attributes).
Refer to the Excel tables attached to the following document for lists of controlled values.

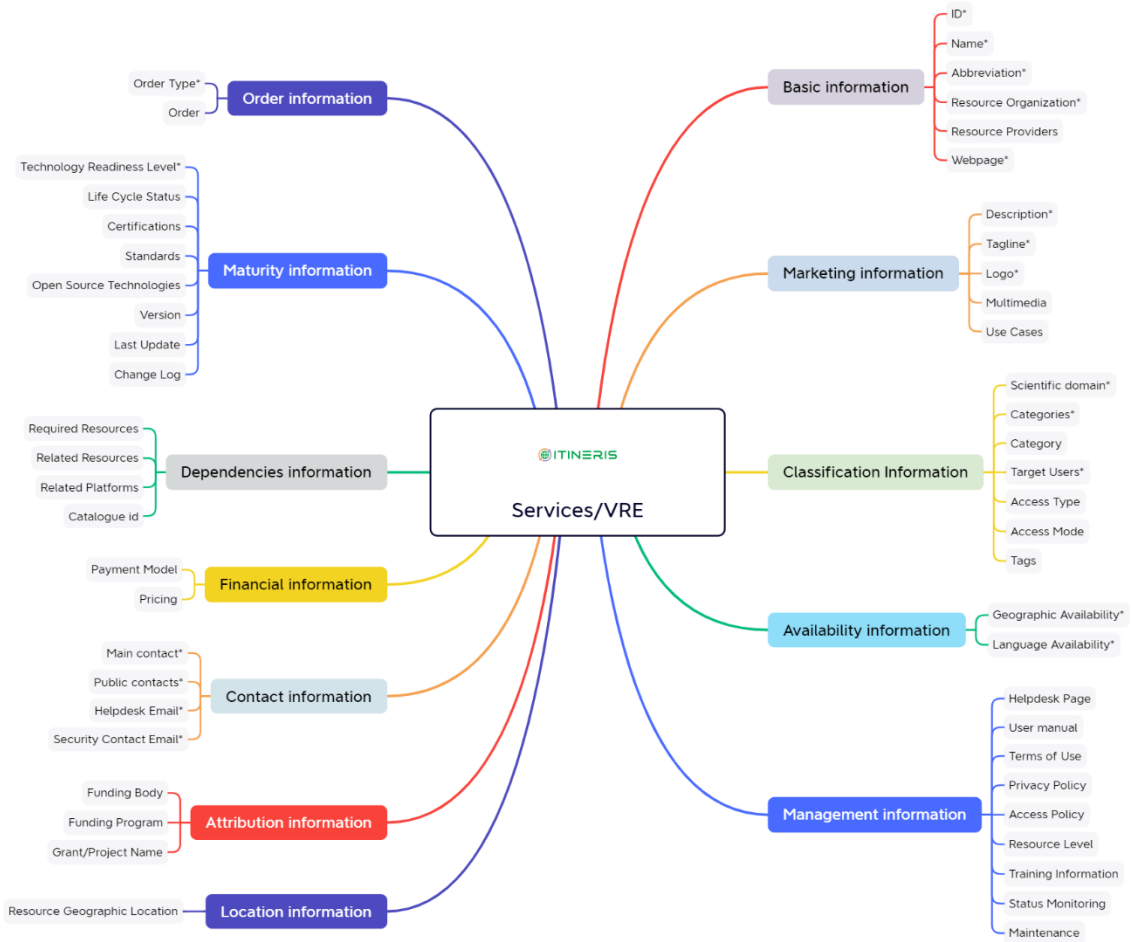


Figure 5 Metadata schema for the ITINERIS resources. The asterisk (*) denotes mandatory attributes.

BASIC INFORMATION

Attribute Name	Definition	Type	Multiciplity	Required	Public	Example
Id	A persistent identifier, a unique reference to the Service/Resource in the context of the ITINERIS Catalog	String	1	Mandatory	Yes	Automatically assigned
name	Service/Resource Full Name as assigned by the Provider	String	1	Mandatory	Yes	Training on Lidar data analysis, SCC and on technical aspects of Lidar systems

Abbreviation	An abbreviation of the Service/Resource Name as assigned by the Provider	String	1	Mandatory	Yes	
Resource Organization	The name (or abbreviation) of the organization that manages or delivers the service/resource, or that coordinates resource delivery in a federated scenario	String (RI id)	1	Mandatory	Yes	RI id: ACTRIS
Resource Providers	The name(s) (or abbreviation) of all the Provider(s) that manage(s) or deliver(s) the service/resource, in a federated scenario.	String (Provider id)	1	Optional	Yes	Provider id: CNR IMAA
Webpage	Webpage with information about the Service/Resource usually hosted and maintained by the Provider	anyURL	1	Mandatory	Yes	https://ciao.imaa.cnr.it/observatory/instruments/

MARKETING INFORMATION

Attribute Name	Definition	Type	Multiciplity	Required	Public	Example
Description	A high-level description in fairly non-technical terms of a) what the Service does, functionality it provides and Resources it enables to access, b) the benefit to a user/customer delivered by a Resource; benefits are usually related to alleviating pains (e.g., eliminate undesired outcomes, obstacles or risks) or producing gains (e.g. increased performance, social gains, positive emotions or cost saving), c)list of customers, communities, users, etc. using the Service	String	1	Mandatory	Yes	CIAO, the CNR-IMAA Atmospheric Observatory (40.60 N, 15.72 E, 760 m a.s.l.) is a research facilities managed by the National Research Council of Italy (CNR) at Institute of Methodologies for Environmental Analysis (IMAA). This service is meant to increase the expertise of the users but also to spread ACTRIS standards and methodologies to stakeholders and users. It can offer different possibilities related to: • application of algorithms for Lidar data analysis • experimental technical aspects typically encountered in Lidar systems • access and use of the ACTRIS Single Calculus Chain (SCC)
Tagline	Short catchphrase for marketing and advertising purposes. It will be usually displayed close to the Resource name and should refer to the main value or purpose of the Resource	String	1	Mandatory	Yes	
Logo	Link to the logo/visual identity of the Resource. The logo will be visible at the Portal. If there is no specific logo for the Resource the logo of the Provider may be used.	anyURL	1	Mandatory	Yes	
Multimedia	Link to video, slideshow, photos, screenshots with details of the Provider.	tns:multimediaPair	Multiple	Optional	Yes	
Use Cases	Link to use cases supported by this Resource	tns:useCasesPair	1	Optional	Yes	

CLASSIFICATION INFORMATION						
Attribute Name	**Definition**	**Type**	**Multiciplity**	**Required**	**Public**	**Example**
Scientific Domains	The branch of science, a scientific discipline that is related to the Service/ Resource	tns:serviceProviderDomain, List of controlled values (See Table Resource Scientific Domain)	1	Mandatory	Yes	
Categories	A named group of Resources that offer access to the same type of Service/Resources	tns:serviceCategory, List of controlled values (see Table Resource Category)	1	Mandatory	Yes	
Category		tns:serviceCategory	Multiple	Optional	Yes	
Target Users	Type of users/customers that commissions a Provider to deliver a Resource	String: List of controlled values (see Table Target Users)	1	Mandatory	Yes	
AccessTypes	The way a user can access the Service/Resource (Remote, Physical, Virtual, etc.)	String: List of controlled values (see Table Access Type)	1	Optional	Yes	
Access Mode	Eligibility/criteria for granting access to users (excellence-based, free-conditionally, free etc.)	String: List of controlled values (see Table Resource Access Mode)	1	Optional	Yes	
Tags	Keywords associated to the Service/Resource to simplify search by relevant keywords	String	1	Optional	Yes	

AVAILABILITY						
Attribute Name	**Definition**	**Type**	**Multiciplity**	**Required**	**Public**	**Example**
Geographic Availability	Locations where the Service/Resource is offered	String	1	Mandatory	Yes	
Language Availability	Languages of the (user interface of the) Service/Resource	String	1	Mandatory	Yes	

LOCATION

Attribute Name	Definition	Type	Multiciplity	Required	Public	Example
Resource Geographic Location	List of geographic locations where data, samples, etc. are stored and processed	String	1	Optional	Yes	

CONTACT INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Main contact	Service's main contact/resource owner info	tns:serviceMain Contact	1	Mandatory	No	
Public contacts	List of service's Public Contacts info	tns:servicePublic Contact	1	Mandatory	Yes	
Helpdesk Email	The email to ask more information from the Provider about this Resource	String	1	Mandatory	Yes	
Security Contact Email	The email to contact the Provider for critical security issues about this Resource	String	1	Mandatory	No	

MATURITY INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
trl: Technology Readiness Level	The Technology Readiness Level of the Resource (to be further updated in the context of EOSC)	String: List of controlled values (see Table Resource TRL)	1	Mandatory	Yes	
Life Cycle Status	Phase of the Resource life-cycle	List of controlled values (see Table Resource Life Cycle Status)	1	Optional	Yes	
Certifications	List of certifications obtained for the Resource (including the certification body)	String	1	Optional	Yes	
Standards	List of standards supported by the Resource	String	1	Optional	Yes	
Open Source Technologies	List of open source technologies supported by the Resource	String	1	Optional	Yes	
Version	Version of the Resource that is in force	String	1	Optional	Yes	
Last Update	Date of the latest update of the Resource	anySimpleType	1	Optional	Yes	
Change Log	Summary of the Resource features updated from the previous version	String	Multiple	Optional	Yes	

DEPENDENCIES INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Required Resources	List of other Resources required to use this Resource	String	1	Optional	Yes	Resource ID
Related Resources	List of other Resources that are commonly used with this Resource	String	1	Optional	Yes	Resource ID
Related Platforms	List of suites or thematic installation/platforms in which the Resource is engaged or Providers (Provider groups) contributing to this Resource	String	1	Optional	Yes	
Catalogue id	The ID of the Catalogue this Resource is originally registered at	String	1	Optional	Yes	Catalogue id

ATTRIBUTION INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Funding Body	Name of the funding body that supported the development and/or operation of the Resource	String: List of controlled values (see table Funding body)	Multiple	Optional	Yes	
Funding Programs	Name of the funding program that supported the development and/or operation of the Resource	String: List of controlled values (see table Funding program)	1	Optional	Yes	
Grant/Project Name	Name of the project that supported the development and/or operation of the Resource	String	1	Optional	Yes	

MANAGEMENT INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Helpdesk Page	The URL to a webpage to ask for more information from the Provider about this Resource	anyURI	1	Optional	Yes	
User Manual	Link to the Resource user manual and documentation	anyURI	1	Optional	Yes	
Terms of Use	Webpage describing the rules, Resource conditions and usage policy which one must agree to abide by to use the Resource	anyURI	1	Optional	Yes	
Privacy Policy	Link to the privacy policy applicable to the Resource	anyURI	1	Optional	Yes	
Access Policy	Information about the access policies that apply	anyURI	1	Optional	Yes	
Resource Level	Web Page with information about the levels of performance that a Provider is expected to deliver	anyURI	1	Optional	Yes	
Training Information	Webpage to training information on the Resource	anyURI	1	Optional	Yes	
Status Monitoring	Webpage with monitoring information about this Resource	anyURI	1	Optional	Yes	
Maintenance	Webpage with information about planned maintenance windows for this Resource	anyURI	1	Optional	Yes	

ORDER INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Order Type	Information on the order type (requires an ordering procedure, or no ordering and if fully open or requires authentication)	String	1	Mandatory	Yes	
Order	Webpage through which an order for the Resource can be placed	anyURI	1	Optional	Yes	

FINANCIAL INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Payment Model	Webpage with the supported payment models and restrictions that apply to the Resource	anyURI	1	Optional	Yes	
Pricing	Webpage with the information on the price scheme for the Resource in case the customer is charged for	anyURI	1	Optional	Yes	

5.4 Dataset metadata schema

Metadata harvesting should be possible through metadata services implementing Catalogue Service for WEB (CSW), an Open Geospatial Consortium (OGC) standard. The dataset will be catalogued in ISO/TS 19139, a metadata schema based on the international standard for geographic metadata (gmd) representation, which provides the XML implementation schema derived from ISO 19115.
OGC Catalogue interface standards specify the interfaces, bindings, and framework for defining application profiles required to publish and access digital catalogues of metadata for geospatial data, services, and related resource information. Metadata acts as generalized properties that can be queried and returned through catalogue services for resource evaluation and, in many cases, invocation or retrieval of the referenced resource.

5.5 Research products metadata schema

Research products will be catalogued with the following metadata schema based on an OpenAire Research products profile (Version 4.0 that includes 6 sections containing a total of 31 metadata elements). Resources to be included in the Catalogue need to be described with a minimum set of attributes, identified as "mandatory" (7 attributes).
Refer to the Excel tables attached to the following document for lists of controlled values.

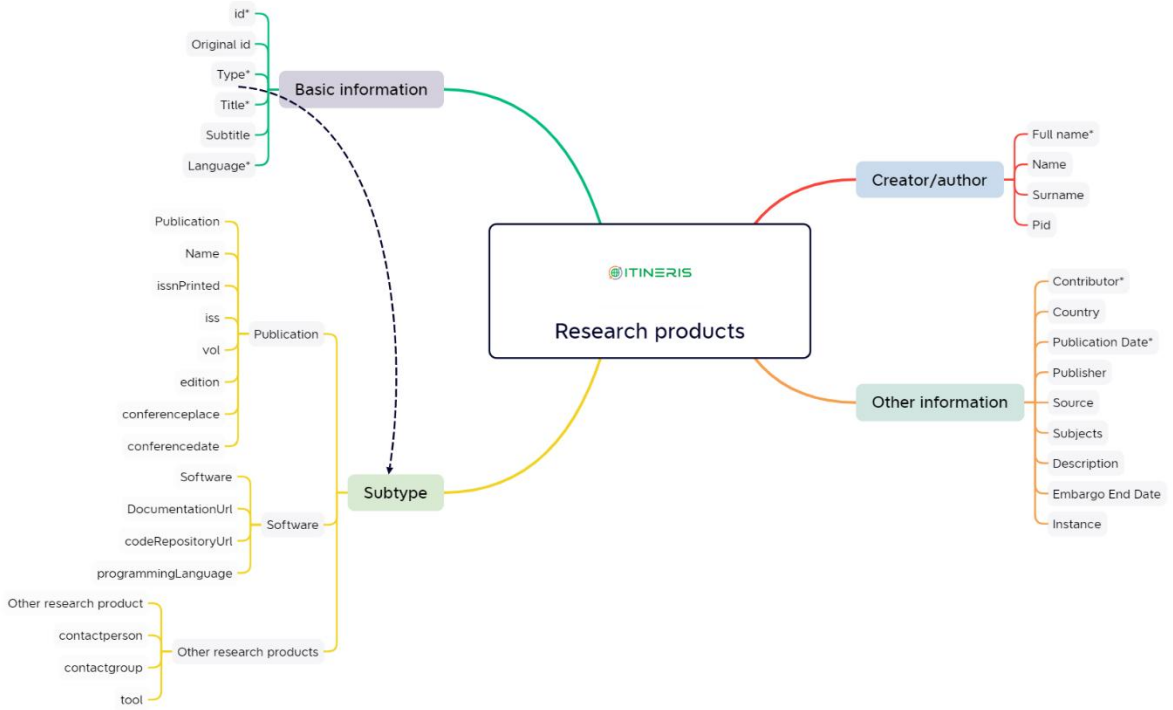


Figure 6 Metadata schema for the ITINERIS Research products. The asterisk (*) denotes mandatory attributes.

BASIC INFORMATION						
Attribute Name	**Definition**	**Type**	**Multiplicity**	**Required**	**Public**	**Example**
id	The global unique identifier within a particular data management system. Typically, a DOI or the citable identifier	String	1	Mandatory		

Original id	Identifiers of the record at the original sources	String	Multiple	Optional	PubMed, WebofScience, ISSN, Handle
Type	Type of research products sub-types	List of controlled value	1	Mandatory	
Title	A name or title by which a research product is known. May be the title of a publication, of a dataset, or the name of a piece of software.	String	1	Mandatory	
Subtitle	Explanatory or alternative name by which a research product is known.	String	1	Optional	
Language	A language of the intellectual content of the resource.	List of controlled values	1	Mandatory	

CREATOR/AUTHOR OF THE RESEARCH PRODUCT

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Full name	Author's full name	String	Multiple	Mandatory		
Name	Author's name	String	Multiple	Optional		
Surname	Author's surname	String	Multiple	Optional		
Pid	Persistent identifiers of the research product. See also the OpenAIRE entity identifier and PID mapping policy to learn more.	String	1	Optional		
Full name	Author's full name	String	Multiple	Mandatory		

OTHER/GENERAL INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Contributor	The institution or person responsible for collecting, managing, distributing, or otherwise contributing to the development of the resource.	String	Multiple	Mandatory		
Country	The country associated with the research product: it is the country of the organization that manages the institutional repository or national aggregator or CRIS system from which this record was collected. The country of affiliations of authors can be found instead in the affiliation relation.	List of controlled values	Multiple	Optional		
Publication Date	A date is associated with an event in the life cycle of the resource. Typically, the Date will be associated with the creation or availability of the resource. Recommended best practice for encoding the date value is defined in a profile of ISO 8601 [W3CDTF] and follows the YYYY-MM-DD format.	ISO 8601 [W3CDTF]	1	Mandatory		YYYY-MM-DD (e.g. 1997-07-16)
Publisher	The name of the entity that holds, archives, publishes prints, distributes, releases, issues, or produces the resource.	String	1			

Source	A related resource from which the described resource is derived. See definition of Dublin Core field dc:source.	String	Multiple			
Subjects	Subject, keyword, classification code, or key phrase describing the resource.	String	Multiple			
Description	An account of the content of the resource. Description may include but is not limited to: an abstract, table of contents, reference to a graphical representation of content or a free-text account of the content.	String	1	Optional		
Embargo End Date	Date when the embargo ends and this research product turns Open Access.	String	1	Optional		
Instance	Specific materialization or version of the research product. For example, you can have one research product with three instances: one is the pre-print, one is the post-print, one is the published version.	List of controlled values (pre-print, post-print, published version)	Multiple	Optional		

RESEARCH PRODUCTS SUB-TYPES: PUBLICATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Publication	Metadata records about the research literature	List of controlled values	1	Optional		
Name	Name of the journal or conference.	String	1	Optional		
issnPrinted	The journal printed issn.	String	1	Optional		
iss	The journal issue.	String	1	Optional		
vol	The journal volume.	String	1	Optional		
edition	The edition of the journal or conference.	String	1	Optional		
conferenceplace	The place of the conference.	String	1	Optional		
conferencedate	The date of the conference.	String	1	Optional		

RESEARCH PRODUCTS SUB-TYPES: SOFTWARE

Attribute Name	Definition	Type	Multiplicity	Required	Public
Software	Metadata records about research software	List of controlled values			
DocumentationUrl	The URLs to the software documentation.	URLs	Multiple	Optional	

codeRepositoryUrl	The URL to the repository with the source code.	URL	1	Optional
programmingLanguage	The programming language.	string	1	Optional

RESEARCH PRODUCTS SUB-TYPES: OTHER

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Others research products	Metadata records about research products that cannot be classified as research literature, data or software	List of controlled value	1	Optional		
contactperson	Information on the person responsible for providing further information regarding the resource.	string	Multiple	Optional		
contactgroup	Information on the group responsible for providing further information regarding the resource.	string	Multiple	Optional		

5.6 Training resources metadata schema

The Training resources metadata schema will be based on the EOSC – Training Profile[53] (Version 5.0 that includes 6 sections containing a total of 28 metadata elements).
The resources will be described with a minimum set of attributes, identified as "mandatory" (21 attributes).

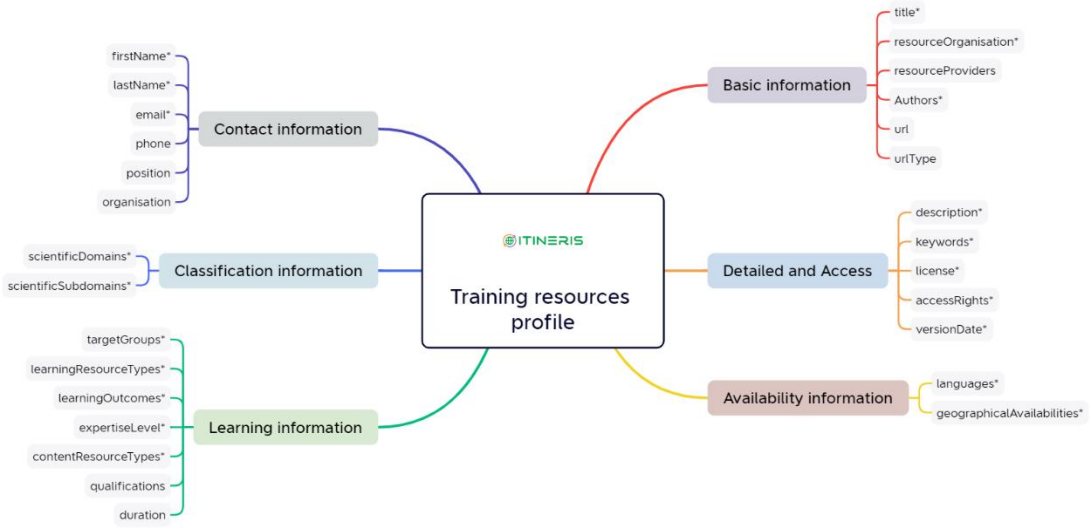


Figure 7 Metadata schema for the ITINERIS Training resources. The asterisk (*) denotes mandatory attributes.

BASIC INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
title	The human readable name of the learning resource.	String	1	Mandatory		

[53] https://eosc-training-profile.readthedocs.io/en/latest/elements.html

resourceOrganisation	The name of the organisation that manages or delivers the resource, or that coordinates the Resource delivery in a federated scenario.	String	1	Mandatory		
resourceProviders	The name(s) of (all) the Provider(s) that manage or deliver the Resource in federated scenarios.	String	Multiple	Optional		
Authors	The name of entity(ies) authoring the resource.	String	Multiple	Mandatory		
url	The URL that resolves to the learning resource or to a "landing page" for the resource that contains important contextual information including the direct resolvable link to the resource, if applicable.	anyURI	1	Mandatory		
urlType	The designation of identifier scheme used for the resource URL. It represents the type of the URL of the resource, that is the used scheme (e.g., Web Address URL, DOI, ARK, etc.).	Controlled vocabulary		Optional		

DETAILED AND ACCESS INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
description	A brief synopsis about or description of the learning resource.	String	1	Mandatory		
keywords	The keyword(s) or tag(s) used to describe the resource.	String	Multiple	Mandatory		
license	A license document that applies to this content, typically indicated by URL.	String	1	Mandatory		
accessRights	The access status of a resource (open, restricted, paid).	Controlled vocabulary	1	Mandatory		
versionDate	The version date for the most recently published or broadcast resource.	dateTime	1	Mandatory		

LEARNING INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
targetGroups	The principal users(s) for which the learning resource was designed	Enumerated (Resource Target Users)	Multiple	Mandatory		
learningResourceTypes	The predominant type or kind that characterizes the learning resource.	Controlled vocabulary	1	Mandatory		
learningOutcomes	The descriptions of what knowledge, skills or abilities students should acquire on completion of the resource.	String	1	Mandatory		
expertiseLevel	Target skill level in the topic being taught.	Controlled vocabulary	1	Mandatory		
contentResourceTypes	The predominant content type of the learning resource (video, game, diagram, slides, etc.).	Controlled vocabulary	Multiple	Mandatory		
qualifications	Identification of certification, accreditation or badge obtained with course or learning resource.	String	Multiple	Optional		
duration	Approximate or typical time it takes to work with or through the learning resource for the typical intended target audience.	String	1	Optional		

AVAILABILITY INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
languages	The language in which the resource was originally published or made available.	Enumerated (Resource Language Availability)	Multiple	Mandatory		

Geographical Availabilities	Locations where the Resource is offered.	Enumerated (Resource Geographical Availability)	1	Mandatory		

CLASSIFICATION INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
Scientific Domains	The branch of science, scientific discipline that is related to the Resource.	Enumerated (Resource Scientific Domain)	1	Mandatory		
Scientific Subdomains	The subbranch of science, scientific discipline that is related to the Resource.	Enumerated (Resource Scientific Domain)	1	Mandatory		

CONTACT INFORMATION

Attribute Name	Definition	Type	Multiplicity	Required	Public	Example
firstName	First Name of the Resource's main contact person/manager.	String	1	Mandatory		
lastName	Last Name of the Resource's main contact person/manager.	String	1	Mandatory		
email	Email of the Resource's main contact person/manager.	String	1	Mandatory		
phone	Telephone of the Resource's main contact person/manager.	String	1	Optional		
position	Position of the Resource's main contact person/manager.	String	1	Optional		
organisation	The organisation to which the contact is affiliated.	String	1	Optional		

5.7 VRE metadata schema

The VRE will be catalogued with the same metadata schema of the Services (EOSC resource profiles V. 5.0). The minimum mandatory metadata schema is defined by 19 essential (mandatory) attributes.
Refer to the excel tables attached to the following document for lists of controlled values.