

## Deliverable 2.12

# FAIR terminologies (2nd release)



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Comments	

## INTRODUCTION

The deliverable 2.12, produced within the framework of ITINERIS, is part of the activity 2.4 of the Work Package (WP) 2 concerning the access to facilities, FAIR data and services provided by the 22 Italian environmental Research Infrastructures (RIs) involved in the project. This deliverable (second release) belongs to the intermediate objective 2.5 of bimester 15 and it is produced under the responsibility of the Operative Unit (OU) of the National Research Council, Research Institute on Terrestrial Ecosystems (CNR-IRET) in Lecce.

The objective of this deliverable is to provide novel or existing FAIR terminologies (hereafter semantic artefacts; see Deliverable 2.11) relevant for ITINERIS RIs and OUs and which, therefore, concerns the four environmental domains considered within the project (i.e. atmosphere, marine, terrestrial biosphere and geosphere land surface).

## METHODS

Within the activities of task 2.4 on ITINERIS semantic interoperability, an initial collection and analysis of semantic artefacts and catalogues used and/or created and maintained by the ITINERIS RIs was performed (Deliverable 2.11). This analysis showed that 11 out of 22 RIs participating in ITINERIS use different semantic artefacts (details are provided in Tab. 3, Deliverable 2.11). Seven out of 11 RIs use semantic artefacts that are managed externally and available in semantic artefacts catalogues, whereas four RIs use semantic artefacts that are managed *in-house*. Of these four RIs, LifeWatch ERIC is the only RI that manages a repository of semantic artefacts, *i.e.* EcoPortal (Kechagioglou *et al.*, 2021). This initial analysis included a preliminary FAIR assessment of such semantic artefacts and an evaluation of semantic catalogues in which the semantic artefacts were available (Di Muri *et al.*, 2024). The analysis and collection of semantic artefacts and catalogues was then extended in breadth following the outcomes of the 2nd ITINERIS General Meeting and the Plenary session of WP2. After the meeting, an email was sent to the FAIR representatives of ITINERIS RIs and WP leaders to reach out to all possible ITINERIS OUs that perform (meta)data management activities using semantic artefacts and catalogues. This work was crucial to: *i.* define a final list of semantic artefacts and catalogues that should be considered for the design (Deliverable 2.13) and future integration within the ITINERIS Terminology Service (Deliverable 2.14); and *ii.* enhance the FAIRness of the ITINERIS semantic artefacts that are not fully compliant to the FAIR principles (*e.g.* not published in semantic catalogues, not available in standard knowledge representation languages, not described by rich metadata; Deliverable 2.12 first and second release). The aim of the activities described within this deliverable is to improve the FAIRness of ITINERIS semantic artefacts as required for their utilisation in the ITINERIS Terminology Service. In addition, based on specific RIs requests and community-driven needs, novel FAIR semantic artefacts were created to improve semantic interoperability of the RIs and of the ITINERIS project.

## RESULTS

A final list of semantic artefacts (Pulieri *et al.*, 2024) and semantic artefacts catalogues (Tab. 1) was defined. The compiled lists were used to design and develop the ITINERIS

Terminology Service accounting for all possible interactions and integrations that the Service should have to provide access to and reuse of ITINERIS semantic artefacts.

A number of semantic artefacts listed in Pulieri et al. (2024) were not fully compliant to the FAIR principles (*e.g.* not published in semantic catalogues, not available in standard knowledge representation languages, not described by rich metadata) and, as such, they were managed to improve their FAIRness and subsequently published in EcoPortal as part of the activities described herein.

A list of ITINERIS semantic artefacts published in EcoPortal is reported in Tab. 2. The activities associated with this deliverable are still ongoing and it is expected that they will continue until the release of the ITINERIS Terminology Service. For such a reason, all the future updates on the FAIR ITINERIS semantic artefacts (Tab. 2) are also available at: <https://ecoportal.lifewatch.eu/projects/ITINERIS>.

The activities on FAIR semantic artefacts included the creation of two novel FAIR semantic artefacts that are currently under validation and that will be published in EcoPortal by the end of the ITINERIS project. These resources are:

1. ICOS Instruments vocabulary: a thesaurus of instruments used by ICOS ERIC;
2. ITINERIS vocabulary: a thesaurus for ITINERIS structure and resources.

These two semantic artefacts were built as SKOS thesauri using VocBench v. 13.0.0 (Stellato et al., 2020), a semantic artefacts management tool integrated in EcoPortal. Specifically, for ICOS Instruments vocabulary, a list of instruments (models, types and manufacturers) was shared by ICOS managers. A subset of instruments ( $N=72$ ) from this list was used to structure a concept scheme including concepts describing instrument models and types, whereas manufacturers were used to define collections associated with specific instrument models. In addition, to satisfy the interoperability requirements, mappings (*skos:closeMatch* and *skos:exactMatch*) were used to align, wherever possible, concepts from ICOS instrument vocabulary with existing semantic artefacts using the following vocabularies and repositories as a reference: [AERIS Instruments](#), [ACTRIS Vocabulary](#), [Global Change Master Directory](#), and [NERC Vocabulary Server](#). In a series of online meetings, the ICOS Instrument Vocabulary was presented and discussed with ICOS managers. A couple of meetings were also dedicated to VocBench training and the ICOS managers are currently performing the validation and integration of the resource.

The ITINERIS Vocabulary was created through a joint effort of WP2 personnel to describe the structure of the ITINERIS project including its components (*e.g.* partners, actors, RIs and OUs) and environmental domains as well as to describe data, services, and facilities available through the ITINERIS Hub. This vocabulary will be validated during a workshop which will be held at the CNR-IRET Lecce (dates to be confirmed). During the workshop, representatives of ITINERIS RIs will be invited to collaboratively validate and refine the vocabulary using VocBench by: revising concepts and associated properties included in the vocabulary; adding concepts; suggesting changes in the structure (hierarchy) of the vocabulary.

**Table 1.** List of semantic artefacts catalogues (names and URLs) that will be considered for the integration to the ITINERIS Terminology Service.

Catalogue Name	Catalogue URL
AberOWL	<a href="http://aber-owl.net/#/">http://aber-owl.net/#/</a>
AgroPortal	<a href="https://agroportal.lirmm.fr/">https://agroportal.lirmm.fr/</a>
ARDC Research Vocabularies Australia	<a href="https://vocabs.ardc.edu.au/">https://vocabs.ardc.edu.au/</a>
BARTOC	<a href="https://bartoc.org/">https://bartoc.org/</a>
BiodivPortal	<a href="https://biodivportal.qfbio.org">https://biodivportal.qfbio.org</a>
BioPortal	<a href="https://bioportal.bioontology.org/">https://bioportal.bioontology.org/</a>
EarthPortal	<a href="https://earthportal.eu/">https://earthportal.eu/</a>
EcoPortal	<a href="https://ecoportal.lifewatch.eu/">https://ecoportal.lifewatch.eu/</a>
EMBL-EBI Ontology Lookup Service	<a href="https://www.ebi.ac.uk/ols4/index">https://www.ebi.ac.uk/ols4/index</a>
ESIP Community Ontology Repository	<a href="http://cor.esipfed.org/">http://cor.esipfed.org/</a>
Loterre	<a href="https://loterre.istex.fr/en/">https://loterre.istex.fr/en/</a>
Linked Open Vocabularies	<a href="https://lov.linkeddata.es/dataset/lov/">https://lov.linkeddata.es/dataset/lov/</a>
Marine Metadata Interoperability Ontology Registry and Repository	<a href="https://mmisw.org/">https://mmisw.org/</a>
NERC Vocabulary Server	<a href="https://vocab.nerc.ac.uk/">https://vocab.nerc.ac.uk/</a>
OBO Foundry	<a href="https://obofoundry.org/">https://obofoundry.org/</a>
Ontobee	<a href="https://ontobee.org/">https://ontobee.org/</a>
TERN Controlled Vocabularies	<a href="https://linkeddata.tern.org.au/prez/tern-cv/v/">https://linkeddata.tern.org.au/prez/tern-cv/v/</a>
TIB Terminology Service	<a href="https://terminology.tib.eu/ts/">https://terminology.tib.eu/ts/</a>

**Table 2.** Summary list of semantic artefacts (names and EcoPortal link) used by ITINERIS RIs and published in EcoPortal as part of the activities performed for this deliverable (first and second release).

Semantic artefact name	EcoPortal link
Ontology of Integrated Carbon Observation System (ICOS)	<a href="https://ecoportal.lifewatch.eu/ontologies/CPMETA">https://ecoportal.lifewatch.eu/ontologies/CPMETA</a>
ACTRIS Vocabulary	<a href="https://ecoportal.lifewatch.eu/ontologies/ACTRIS_VOCAB">https://ecoportal.lifewatch.eu/ontologies/ACTRIS_VOCAB</a>
ACTRIS Controlled Lists	<a href="https://ecoportal.lifewatch.eu/ontologies/ACTRIS_CL">https://ecoportal.lifewatch.eu/ontologies/ACTRIS_CL</a>
SnowTerm Thesaurus	<a href="https://ecoportal.lifewatch.eu/ontologies/SNOWTERM">https://ecoportal.lifewatch.eu/ontologies/SNOWTERM</a>
Biogeographical regions	<a href="https://ecoportal.lifewatch.eu/ontologies/BIOREGIONS">https://ecoportal.lifewatch.eu/ontologies/BIOREGIONS</a>
Geologic Structures	<a href="https://ecoportal.lifewatch.eu/ontologies/GEO_STRUCTURES">https://ecoportal.lifewatch.eu/ontologies/GEO_STRUCTURES</a>
Geologic Units	<a href="https://ecoportal.lifewatch.eu/ontologies/GEOLOGIC_UNITS">https://ecoportal.lifewatch.eu/ontologies/GEOLOGIC_UNITS</a>
Lithology	<a href="https://ecoportal.lifewatch.eu/ontologies/LITHOLOGY">https://ecoportal.lifewatch.eu/ontologies/LITHOLOGY</a>
The Linked Earth Core Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/LIPD_ONTOLOGY">https://ecoportal.lifewatch.eu/ontologies/LIPD_ONTOLOGY</a>
The Interpretation Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/INTERPRETATION">https://ecoportal.lifewatch.eu/ontologies/INTERPRETATION</a>

The Archive Type Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/ARCHIVE">https://ecoportal.lifewatch.eu/ontologies/ARCHIVE</a>
The Paleo Proxy Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/PALEO_PROXY">https://ecoportal.lifewatch.eu/ontologies/PALEO_PROXY</a>
The Linked Earth Instrument Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/INSTRUMENT">https://ecoportal.lifewatch.eu/ontologies/INSTRUMENT</a>
The Paleo Units Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/PALEO_UNITS">https://ecoportal.lifewatch.eu/ontologies/PALEO_UNITS</a>
The Paleo Variables Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/PALEO_VARIABLES">https://ecoportal.lifewatch.eu/ontologies/PALEO_VARIABLES</a>
Chemical Functional Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/CHEMFONT">https://ecoportal.lifewatch.eu/ontologies/CHEMFONT</a>
CODATA - Research Data Management Terminology	<a href="https://ecoportal.lifewatch.eu/ontologies/CODATA-RDMT">https://ecoportal.lifewatch.eu/ontologies/CODATA-RDMT</a>
EUNIS habitats	<a href="https://ecoportal.lifewatch.eu/ontologies/EUNIS_HABITATS">https://ecoportal.lifewatch.eu/ontologies/EUNIS_HABITATS</a>
FRBR-aligned Bibliographic Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/FABIO">https://ecoportal.lifewatch.eu/ontologies/FABIO</a>
WISE Classification system	<a href="https://ecoportal.lifewatch.eu/ontologies/WISE_CLASS">https://ecoportal.lifewatch.eu/ontologies/WISE_CLASS</a>
Soil Food Web Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/SFWO">https://ecoportal.lifewatch.eu/ontologies/SFWO</a>
FuTRES Ontology of Vertebrate Traits	<a href="https://ecoportal.lifewatch.eu/ontologies/FOVT">https://ecoportal.lifewatch.eu/ontologies/FOVT</a>
The DMP Common Standard Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/DCSO">https://ecoportal.lifewatch.eu/ontologies/DCSO</a>
Invasion Biology Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/INBIO">https://ecoportal.lifewatch.eu/ontologies/INBIO</a>
FAIR Vocabulary	<a href="https://ecoportal.lifewatch.eu/ontologies/FAIR_VOCABULARY">https://ecoportal.lifewatch.eu/ontologies/FAIR_VOCABULARY</a>
MarineTLO Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/MARINETLO">https://ecoportal.lifewatch.eu/ontologies/MARINETLO</a>
Biodiversity Thesaurus	<a href="https://ecoportal.lifewatch.eu/ontologies/BIODIVTHES">https://ecoportal.lifewatch.eu/ontologies/BIODIVTHES</a>
FAIR Implementation Profile (FIP) Ontology	<a href="https://ecoportal.lifewatch.eu/ontologies/FIP_ONTOLOGY">https://ecoportal.lifewatch.eu/ontologies/FIP_ONTOLOGY</a>
Annex I habitats for Natura 2000	<a href="https://ecoportal.lifewatch.eu/ontologies/N2000_HABITATS">https://ecoportal.lifewatch.eu/ontologies/N2000_HABITATS</a>

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