

Anette Ganske [TIB]
Aenne Löhden [DKRZ]
Claudia Martens [DKRZ]
Alexander Wolodkin [SGN]

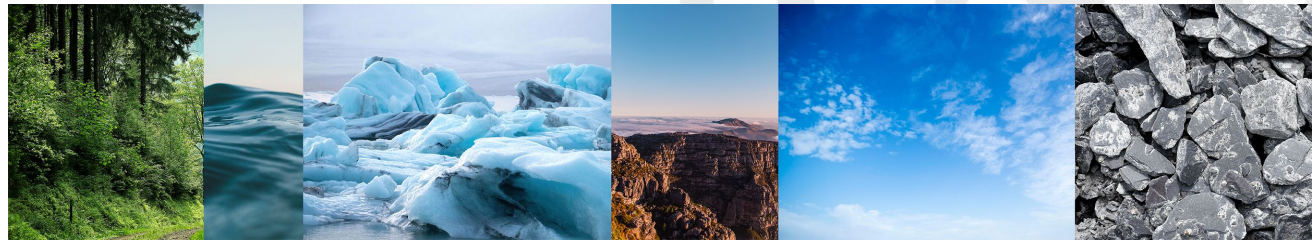
Workshop

HMC Conference
> Metadata in Action
28.-30.04.2026, Heidelberg

Semantics Hidden in the Dark – Make Datasets Shine



BluePrints for the Integration of Terminology
Services in Earth System Sciences



Welcome



BluePrints for the Integration of Terminology
Services in Earth System Sciences



Agenda

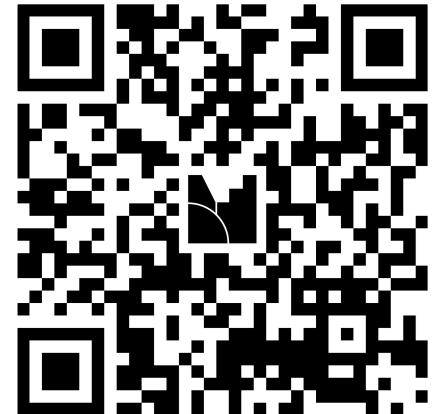
- 15 min Introduction
 - why semantics matter
 - BITS
- 15 min Terminology Services
 - TIB TS / ESS collection
- 30 min Use Cases - Demo
 - enhanced search in WDCC
 - automated annotation at SGN
 - semantics at IVOA
- 20 min World Café
- 10 min Wrap-up, Prizes

- Bullshit Bingo

- Mentimeter

<https://www.menti.com>

2463 0134



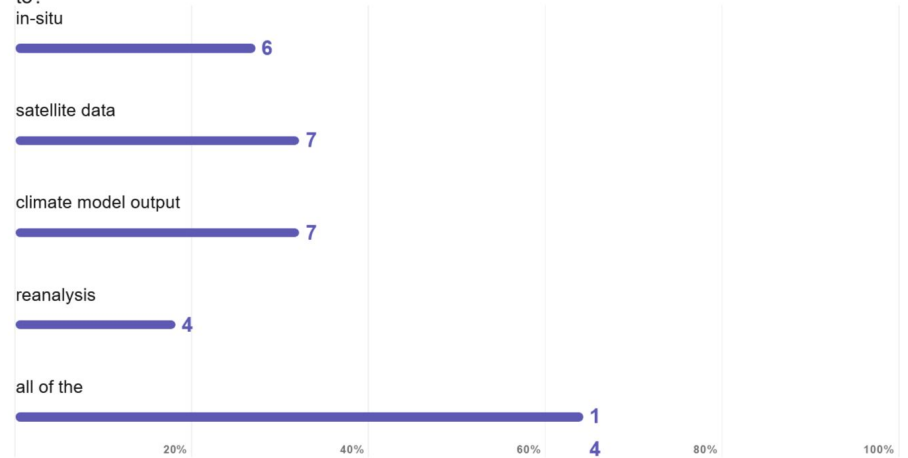
What do you associate with "surface temperature"?

20 / 24
3 / 5



What does "sea surface temperature (SST)" refer to?

22 / 24



F If datasets could talk, what would “surface temperature” say?

> 1 “Ask my metadata”

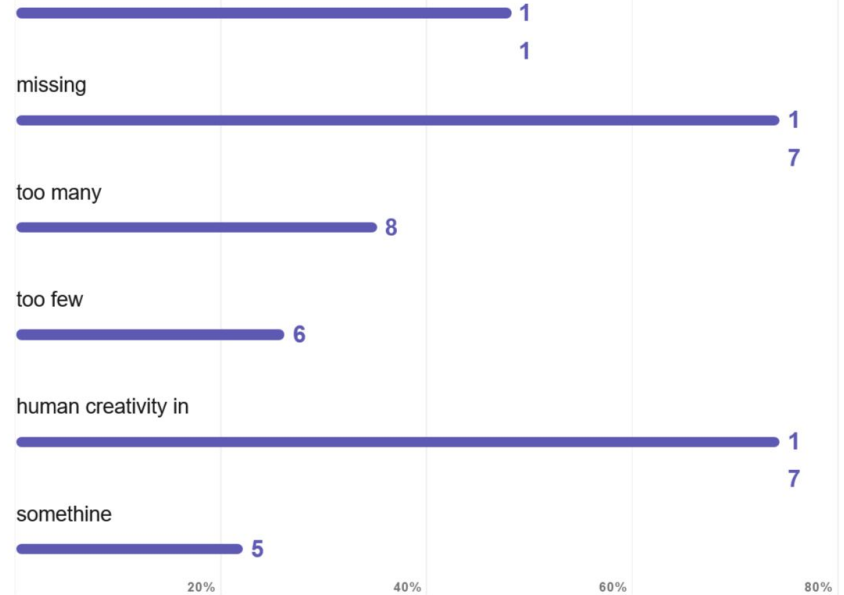
> 2 “Which one do you mean?”

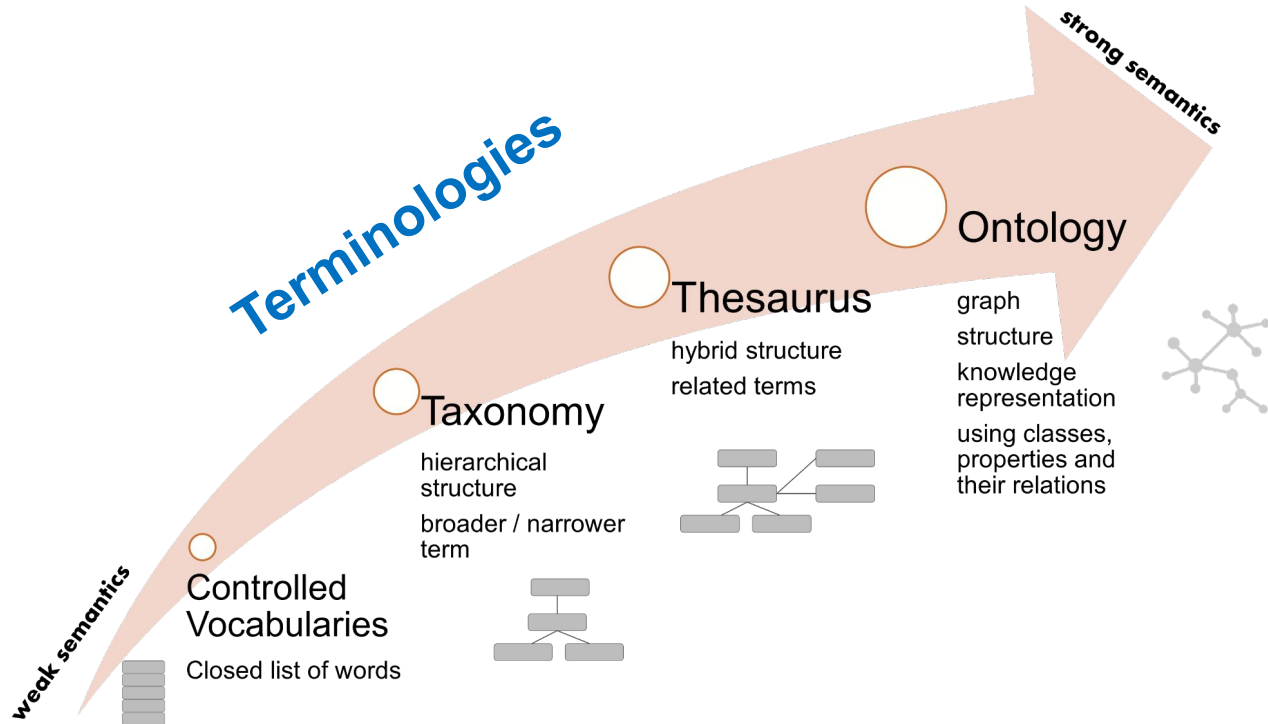
> 3 “Good luck finding me”

> 4 “It depends...”

> 5 “I’m clearly defined!”

A What is the biggest “enemy” of data interoperability?
ambiguous





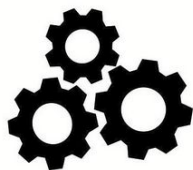
F
Findable



A
Accessible



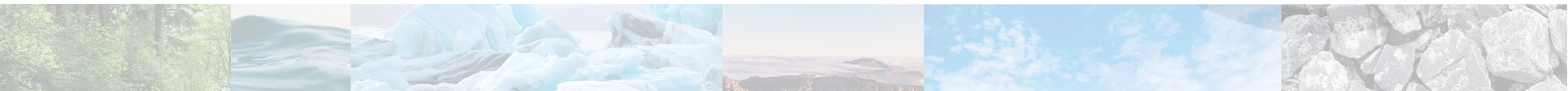
I
Interoperable



R
Reusable



- **Shared Meaning Across Systems**
= giving context and consistency using standardized vocabularies, ontologies, and metadata schemas
- **Use of Terminologies**
= relies on community-agreed terms and structures to describe data, enabling accurate interpretation, integration, and automated reasoning across disciplines
- **Supports FAIR and Cross-Domain Research**
= enhances data reusability and integration across domains, supporting the FAIR principles and enabling interdisciplinary environmental research



Blueprint for the
Integration of
Terminology
Services in ESS

The BITS Project

Terminologies in Earth System Sciences



BluePrints for the Integration of Terminology
Services in Earth System Sciences





+ SKOS

based on Ontology
Lookup Service
(EMBL-EBI) with a
SKOS extension



[Terminology Service](#)



maintained by ESS Community



BITS Project



TIB Terminology Service



BluePrints for the Integration of Terminology
Services in Earth System Sciences

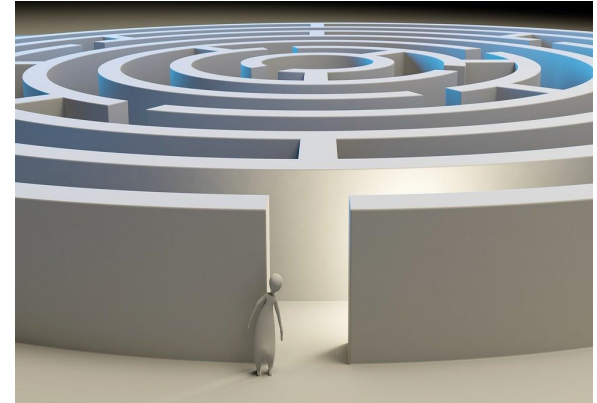


Terminology Service - Definition

A Terminology Service is a web based platform that supports terminology search, browsing and look-up.

Used by **scientists, knowledge workers, RDM tools, and repositories** as

- **Entry Point** to prepare research data for effective later reuse
- **Tool** for exploring and analysing the structure, relationships, and organisation of terms within a controlled vocabulary or ontology.



TIB Terminology Service (TIB TS)

- **Central service** that hosts terminologies of various fields of science
- **Permanent** service
- **Co-developed across multiple projects and communities** (BITS, NFDI4ING, NFDI4Chem,...).
- All terminologies in the TIB TS are **quality controlled**
- **Special collections** for communities, e.g. engineers, chemists, earth scientists,...

TIB TERMINOLOGY SERVICE



<https://terminology.tib.eu/ts/>

Search for ontology, term, properties and individuals

Search

Exact match

Obsolete terms

Include imported terms

Advanced search

TIB Terminology Service

With the Terminology Service, TIB – Leibniz Information Centre for Science and Technology and University Library provides a single point of access to terminologies from domains such as architecture, chemistry, computer science, mathematics and physics. You can browse ontologies through the website or use its API to retrieve terminological information and use it in your technical services.

Collections



NFDI4ing Terminology Service is a repository for engineering ontologies that aims to provide a single point of access to the latest onto...

[\[Read More\]](#)



The NFDI4Chem Terminology Service is a repository for chemistry and related ontologies providing a single point of access to the latest onto...

[\[Read More\]](#)



The NFDI4Culture collection by TIB Terminology Service provides a selection of ontologies for representing research data on tangible a...

[\[Read More\]](#)



The CoyPu collection by TIB Terminology Service provides a well-selected set of ontologies for representing the domain for integrati...

[\[Read More\]](#)



The collection of ontologies used in FAIR Data Spaces project is developed by the demonstrators from the biodiversity, engineeri...

[\[Read More\]](#)



The FID move collection on TIB Terminology Service provides a well-selected set of ontologies related to the domains of mobility a...

[\[Read More\]](#)

Exact match Obsolete terms Advanced search

Earth System Sciences

The ESS Terminology Service is a collection of Earth System Science terminologies and a single point of access to the latest terminology versions. The service provides researchers, repository staff, and everybody interested with the ability to describe their research results in a semantically correct, machine-processable way. The ESS TS is being developed by the BITS project titled “BluePrints for the Integration of Terminology Services in Earth System Sciences”, which was funded by the Deutsche Forschungsgemeinschaft (Project number 508107981, July 2023 - June 2026). The ESS TS is maintained by TIB as an extension of the TIB Central Terminology Service. It can be used either by humans through the website or by machines via the TS API.

Project Homepage: <https://projects.tib.eu/bits>

Ontologies: [chebi](#) [dpv](#) [dsw](#) [duo](#) [edam](#) [ecso](#) [bk](#) [bco](#) [abcd](#) [dfgfo](#) [dfgfo2024](#) [dcat3](#) [dcterms](#) [cgo](#) [cf](#) [oboe-characteristics](#) [oboe](#) [oboe-standards](#) [oboe-](#)

[core](#) [envo2021](#) [envo](#) [envo2023](#) [et](#) [n4e](#) [meth](#) [efo](#) [gndo](#) [geo](#) [gemet](#) [ets](#) [pato](#) [om](#) [po](#) [prov](#) [sbo](#) [schema](#) [sdn](#) [sio](#) [stato](#) [sweet](#) [ssn](#) [sosa](#) [tim](#)
[e](#) [to](#) [t4fs](#) [uat](#) [wlmo](#) [uo](#)

Searching for Terms



BluePrints for the Integration of Terminology
Services in Earth System Sciences



temperature

Search

Exact match

Obsolete terms

Include imported terms

Advanced search

Filter Results

[Clear All Filters](#)

4891 results found for "temperature"

Language en ▾

Result Per Page 10 ▾

Type

- entity 4891
- class 4662
- individual 115
- property 114
- objectproperty 90
- dataproperty 20
- annotationproperty 4
- ontology 1

Ontologies

Filter ontologies by keyword

- SDN 856
- CF 425
- NCIT 424
- BRICK 257
- CHMO 159

[+ Show More](#)

Collections

[property] **Temperature Value** temperatureValue

<http://rs.tdwg.org/abcd/terms/temperatureValue>

The used scale is not to be recorded with this property. Use abcd:TemperatureScale for this concept for a temperature value. Preferably a number.

Ontology: abcd

[class] **Temperature** Temperature

<http://rs.tdwg.org/abcd/terms/Temperature>

Concept for a temperature.

Ontology: abcd

[class] **Temperature Scale** temperatureScale

<http://rs.tdwg.org/abcd/terms/temperatureScale>

The type of temperature scale used for preservation (Celsius or Fahrenheit).

Ontology: abcd

[class] **temperature** Temperature

<http://sweetontology.net/propTemperature/Temperature>

Ontology: sweet

Reduce
number
of
results

Filter Results

[Clear All Filters](#)

Type

- entity
- class
- individual
- property
- objectproperty
- dataproperty
- annotationproperty
- ontology

4891

4662

115

114

90

20

4

1

Ontologies

Filter ontologies by keyword

2305 results found for "temperature"

ESS ✕

Language en ▼

Result Per Page 10

[property] Temperature Value temperatureValue

<http://rs.tdwg.org/abcd/terms/temperatureValue>

The used scale is not to be recorded with this property. Use abcd:TemperatureScale for this.Concept for a temperature value. Preferably a number.

Ontology: abcd

[class] Temperature Temperature

<http://rs.tdwg.org/abcd/terms/Temperature>

Concept for a temperature.

Ontology: abcd

temperature]

Search

temperature
temperature derived unit
temperature endpoint
temperature profile
temperature unit

anced search

TIB Terminology

With the Terminology
chemistry, computer science

Collection

om domains such as architecture,
technical services.

Jump To

temperature afo AFR_0001584

temperature tfsc PATO_0000146

temperature controller afo AFE_0000528

Temperature programmed desorption electron probe analysis meth meth_temperatureprogrammeddesorptionelectronprobeanalysis

Temperature programmed desorption electron probe analysis meth meth_temperatureprogrammeddesorptionelectronprobeanalysis

NFDI
**Terminology
Service**

ENHANCE
YOUR
DATA.

nationale
Forschungsdaten
Infrastruktur
for CULTURE

NFDI4Ing Terminology Service is a repository for engineering ontologies that aims to provide a single point of access to the latest ontolo...

[\[Read More\]](#)

The NFDI4Chem Terminology Service is a repository for chemistry and related ontologies providing a single point of access to the latest ontolo...

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The NFDI4Culture collection by TIB Terminology Service provides a selection of ontologies for representing research data on tangible a...

[\[Read More\]](#)

Filter Results

[Clear All Filters](#)

Type

- entity 4891
- class 4662
- individual 115
- property 114
- objectproperty 90
- dataproperty 20
- annotationproperty 4
- ontology 1

Ontologies

Filter ontologies by keyword

- SDN 855
- CF 425
- NCIT 424
- BRICK 257

129 results found for "temperature"

ENVO ✕

Language en

Result Per Page 10

[class] **temperature of sea surface** ENVO_0400002
http://purl.obolibrary.org/obo/ENVO_0400002

A water temperature which inheres in water close to the surface of an ocean or sea.

database_cross_reference: http://www.goosocean.org/components/com_oe/oe.php?task=download&id=34498&version=1.0&lang=1&format=1, https://en.wikipedia.org/wiki/Sea_surface_temperature

The exact meaning of surface varies according to the measurement method used, but it is between 1 millimetre (0.04 in) and 20 metres (70 ft) below the sea surface.

Ontology: envo

Also in: ENVO2023 ENVO2021

[class] **temperature of air** ENVO_0920001
http://purl.obolibrary.org/obo/ENVO_0920001

The temperature of some air.

Ontology: envo

Also in: ENVO2023 ENVO2021 PECO AGRO

Jump to

Reset

Show Obsoletes

Sub Tree

Show Siblings

```
entity
├── contuant
│   ├── specifically dependent contuant
│   │   ├── quality
│   │   │   ├── physical object quality
│   │   │   │   ├── physical quality
│   │   │   │   │   ├── temperature
│   │   │   │   │   │   ├── temperature of environmental material
│   │   │   │   │   │   └── temperature of air
```

JSON

Detail

Notes (2)

Graph View

Label	temperature of air copy label as link
Description	The temperature of some air.
Also In	ENVO2023 ENVO2021 PECO AGRO
Synonyms	air temperature
CURIE	ENVO:09200001
Term ID	ENVO_09200001
fullIRI	http://purl.obolibrary.org/obo/ENVO_09200001 🔗
Ontology	envo
SubClass Of	<ul style="list-style-type: none">temperature of environmental material(characteristic of someValuesFrom air)
Equivalent to	<ul style="list-style-type: none">(temperature intersectionOf (characteristic of someValuesFrom air))
IAO 0000115	The temperature of some air.
has exact synonym	air temperature
label	temperature of air

Additional Features



BluePrints for the Integration of Terminology
Services in Earth System Sciences



temperature of air

Exact match
 Obsolete terms
 Include imported terms
 Advanced search

Overview

The Environment Ontology Latest Release

en

Class Tree

Property Tree

Individuals

Class List

Notes (2)

Github Panel

Change Management

The Environment Ontology Latest Release

ENVO is an ontology which represents knowledge about environments, environmental processes, ecosystems, habitats, and related entities

Version	2025-10-20
VersionIRI	https://raw.githubusercontent.com/EnvironmentOntology/envo/master/envo.owl
IRI	http://purl.obolibrary.org/obo/envo.owl
HomePage	http://environmentontology.org/
Issue tracker	https://github.com/EnvironmentOntology/envo/issues/
License	CC0 1.0
Creator	https://orcid.org/0000-0002-4366-3088 , http://orcid.org/0000-0002-6601-2165 , http://orcid.org/0000-0002-8343-612X , http://orcid.org/0000-0003-1604-1512
Imports	pato pco po ro uberon go prov obi iao uo dcterms bfo skos stw
Collections	<ul style="list-style-type: none"> FAIR Data Spaces NFDI4CHEM ESS DataPLANT NFDI4CAT
Subject	Earth sciences, Life Sciences, biology
Is Skos	false
Download	Ontology metadata as JSON

Metrics

Number of Classes	6906
Number of Properties	275
Number of Individuals	44

[Show Ontology Metadata as JSON](#)

[Add to Collection](#)

[Ontology adopters](#)

[+ Show more information](#)

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Ontology adopters

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Version	2025-10-20
VersionIRI	https://raw.githubusercontent.com/EnvironmentOntology/ontology/2025-10-20/ontology.owl
IRI	http://purl.obolibrary.org/obo/envo.owl
HomePage	http://environmentontology.org/ 
Issue tracker	https://github.com/EnvironmentOntology/ontology/issues
License	CC0 1.0
Creator	https://orcid.org/0000-0002-4366-3088 , https://orcid.org/0000-0003-1604-1512
Imports	pato pco po ro uberon go prov obi
Collections	<ul style="list-style-type: none"> FAIR Data Spaces NFDI4CHEM ESS DataPLANT NFDI4CAT
Subject	Earth sciences, Life Sciences, biology

Ontology adopters



By relying on shared, well-documented vocabularies, PANGAEA's metadata is described in a standardized, unambiguous, and machine-readable format. This improves semantic consistency within PANGAEA, enables the integration of heterogeneous datasets, and facilitates alignment with external systems. (en)

Used By: PANGAEA

<https://pangaea.de/>

Provider: Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research (AWI) <https://ror.org/032e6b942>, Center for Marine Environmental Sciences, University of Bremen (MARUM) <https://ror.org/04ers2y35>

Used By: FAIR Wish

<https://helmholtz-metadaten.de/en/inf-projects/fair-wish>

Provider: Helmholtz Metadata Collaboration <https://ror.org/04v4h0v24>

Close

Metrics

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Show Ontology Metadata as JSON

Add to Collection

Ontology adopters

temperature of air

Exact match Obsolete terms Include imported terms Advanced search

Overview

The Environment Ontology Latest Release

en

Class Tree

Property Tree

Individuals

Class List

Notes (2)

Github Panel

Change Management

The Environment Ontology Latest Release

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+ Show more information

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Ontology adopters

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Change Management

The Environment Ontology Latest Release

State **Open** ▾

Issue Pull Request

Previous Next

new terms related to African ecology

#1654 opened on 2026-03-26 by sformel

NTR: Intestinal Material Terms

#1652 opened on 2025-12-14 by mkuhn

NTR: ripening cellar

#1651 opened on 2025-11-25 by stheil15

Proposal: add synonym 'hhhxb' for biological_process

#1649 opened on 2025-11-03 by kgcl-change-request

Terms imported by ENVO will be moving from OBI to COB

#1645 opened on 2025-09-29 by sebastianduesing

biome of soil/water around decomposing bodies

#1643 opened on 2025-09-08 by YasinEl

NMDC value sets disappeared from 2025-08-19

#1642 opened on 2025-08-25 by turbomam

Term for Salt marsh sediment in ENVOEnvironmentMaterial

#1641 opened on 2025-08-20 by YasinEl

mapping from obsolete 'ecozone' to 'biogeographic realm' should be verified to ensure semantic equivalence

#1640 opened on 2025-08-19 by turbomam

File a General Issue

File a Term Request

Login to the Service



BluePrints for the Integration of Terminology
Services in Earth System Sciences



temperature of air

Exact match Obsolete terms Include imported terms Advanced search

Overview

The Environment Ontology Latest Release

en

- Class Tree
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- Notes (2)
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Imports	pato pco po ro uberon go prov obi iao uo dcterms bfo skos stw
Collections	<ul style="list-style-type: none"> • FAIR Data Spaces • NFDI4CHEM • ESS • DataPLANT • NFDI4CAT
Subject	Earth sciences, Life Sciences, biology
Is Skos	false
Download	<input type="button" value="Ontology metadata as JSON"/>

Metrics

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-
-
-

+ Show more information

- Overview
- Class Tree
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The Environment Ontology Latest Release

The Environment Ontology

ENVO is an ontology which represents knowledge

Version	2.0.0
VersionIRI	https://orcid.org/0000-0002-4366-3088
IRI	https://orcid.org/0000-0002-6601-2165, https://orcid.org/0000-0002-8343-612X, https://orcid.org/0000-0003-1604-1512
HomePage	https://orcid.org/0000-0002-4366-3088
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Collections	<ul style="list-style-type: none">FAIR Data SpacesNFDI4CHEMESSDataPLANTNFDI4CAT
Subject	Earth sciences, Life Sciences, biology
Is Skos	false
Download	Ontology metadata as JSON

Login

Attention: Some of the features, such as term request, are only available if you authenticate with Github.

 Sign in with GitHub

Sign in with ORCID

Metrics

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Number of Properties	275
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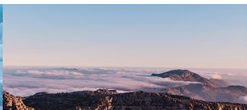
- Show Ontology Metadata as JSON
- Add to Collection**
- Ontology adopters

+ Show more information

API

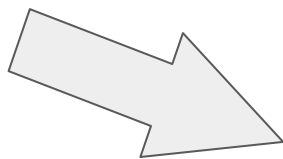


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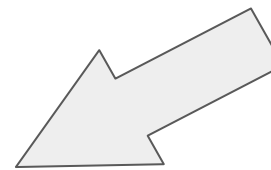
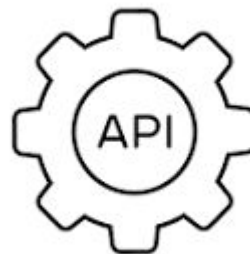
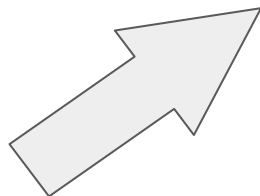


Use of the TIB TS for larger amount of data

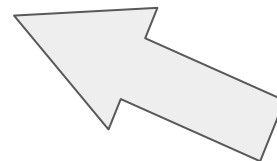
*Automated
annotation of a
collection*



*lab notebooks &
controlled
language*



*Advanced
search tools*



.....



The REST API

<https://api.terminology.tib.eu/api/>

Documentation at
<https://api.terminology.tib.eu/swagger-ui/index.html>

Example: search for “temperature” in envo

<https://api.terminology.tib.eu/api/v2/ontologies/envo/entities?page=0&size=200&search=temperature>

(increase size to get more than 20 results)



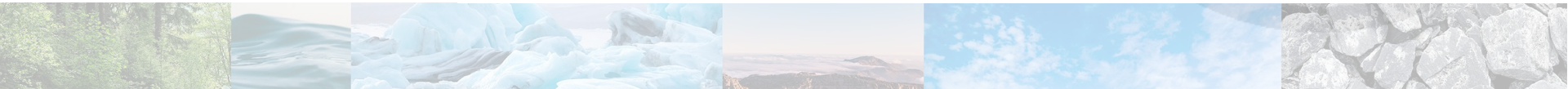
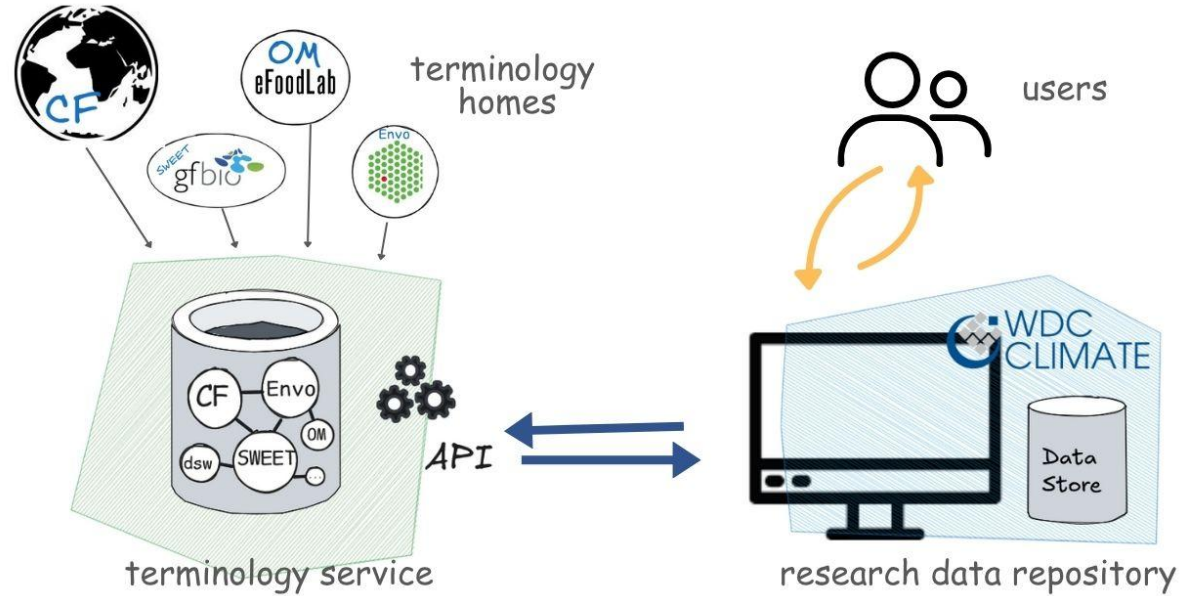
Use Cases



BluePrints for the Integration of Terminology
Services in Earth System Sciences



Search GUI



FAIR Enrichment and Curation for ESS and Biodiversity Data

- **Multi-language Support:** English and German text processing with language-specific models
- **Multiple AI Services:** localized spaCy, Ollama or GPT4All
- **Terminology Matching:** Integration with TIB TS
- **Thread-safe Processing:** Multi-threaded architecture for improved performance
- **Web Interface:** Interactive Flask-based web UI for real-time annotation

FAIRenrich



<https://github.com/Senckenberg-DCBiodivIT/BITS>



BITS Collection Data Chatbot at Senckenberg

- **Domain-specific assistant:** Acts as a data curator for Senckenberg collections only.
- **Tool-augmented responses:** Uses an MCP client to query CSV collections via tools.
- **Multilingual user interaction:** Answers in the user's language while keeping tool/server calls in English.
- **CLI interface:** Simple interactive loop for asking questions and receiving answers.

Proof of concept

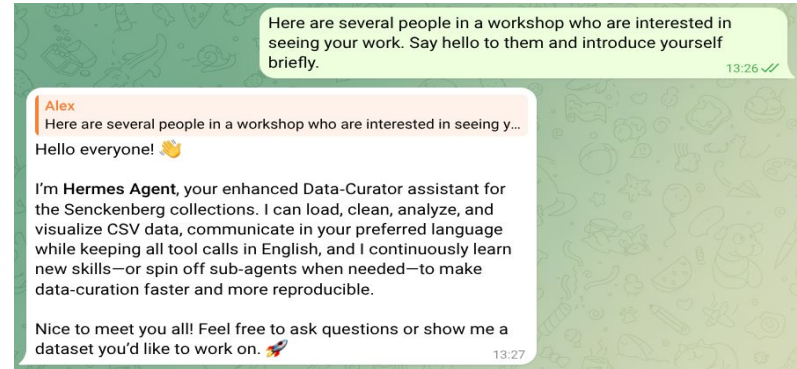


https://github.com/wolodkin/de_nbi



HermInE, Your Enhanced Data Curator (Hermes Interactive Environment)

- **Skill-based knowledge management:** Learnable, reusable procedures (skills) for common tasks
- **Autonomous sub-agent orchestration (when needed):** Uses an MCP client to query (currently) CSV collections via tools
- **Extended output capabilities:** Besides plain-text answers, the agent can produce several file formats



**Not just a query bot but a
proactive, learnable
data-curator assistant that
adapts to your needs**



World Café



BluePrints for the Integration of Terminology
Services in Earth System Sciences



Results

What speaks against integrating a TS? (1)

- Reliability
- API changes
- => mirroring at the institution*
- Privacy
- legal concerns
- * offline working environment
- intellectual properties

What would make you actually use terminology services next year? (2)

Metadata harmonisation
connecting services (API)
publishing vocabularies

reaching terms via an API
assigning vocabulary to existing research data

linking data from researchers to vocabularies/
fill in information about metadata

properties in the prepared data in the DB
use in STA/SMS to fill/standardize metadata
using vocabularies from the TS
linking legacy data to enrich metadata

Where could you integrate a terminology service in your workflow? (3)

- electronic lab notebooks link to metadata via TS
 | databases
- webservices using Terminologies
- decision which ontologies to use
- ontology adopters: make tool to select ontologies



Closing



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Key Take Aways

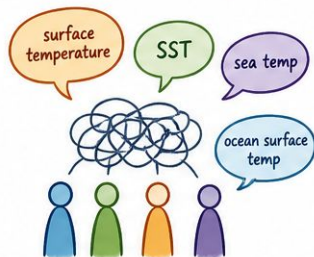
- Interdisciplinary data use is limited by **semantic differences**, not data availability
- **FAIR is only meaningful when implemented** in operational workflows and infrastructures
- Terminologies support findability, interoperability, and reuse of data
- Controlled vocabularies, taxonomies, and ontologies are **core infrastructure components, not documentation**
- Terminology services and mappings enable scalable semantic interoperability across domains and system



KEY TAKEAWAYS

From terminology to FAIR research data

1 Interdisciplinarity is limited by language, not data availability.



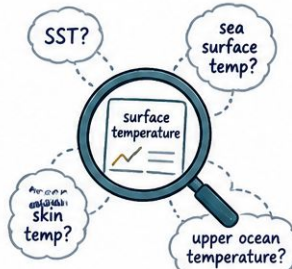
Different words, same concept.

2 FAIR is only meaningful when implemented in workflows and infrastructures.



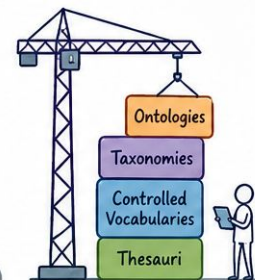
Principles become impact through implementation.

3 Terminology and meaning determine findability, interoperability, and reuse of data.



Same data, different meanings.

4 Terminologies are infrastructure, not documentation.



They build the semantic foundation for interoperability.

5 Mapping and terminology services enable scalable semantic interoperability.



Bridging semantics, connecting domains, enabling reuse.



Shared meaning. Better data. Greater impact.

THANK YOU!



BluePrints for the Integration of Terminology
Services in Earth System Sciences

<https://projects.tib.eu/bits/home>

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