

**Recommendation S0**

# **Recommendation for implementing harmonized semantic concepts in data infrastructures and products**

## **Description**

Status: Under development, Date: 2025/05/07 10:18, Version: 001

## **Motivation for this Recommendation**

The use of shared, community-endorsed vocabularies for metadata annotation is key to ensuring unambiguous and standardized descriptions of data. This not only supports the alignment and integration of heterogeneous datasets but also enhances data discovery and reuse. Crucially, such practices form the foundation for machine-readability of metadata, which is essential for achieving semantic interoperability.

The basis for a comprehensive metadata annotation is the is that data is provided with sufficient and structured metadata and that there is agreement about which metadata is considered essential in communities. Standardized metadata categories and structures enable machines to interpret and connect data across disciplinary and institutional boundaries.

Within the Helmholtz research field Earth and Environment, there is a growing need for consistent approaches to metadata annotation that ensure semantic interoperability. This recommendation aims to address that need by guiding the selection and prioritization of controlled vocabularies and by supporting the optimization of metadata annotation workflows.

## **Recommendation**

Data infrastructures and data hosts—such as data repositories, sensor registries, electronic lab notebooks, or other platforms that store and make data available—should ensure the annotation of the vast majority of metadata using standardized terms from established and, where appropriate, FAIR-compliant controlled vocabularies (e.g., lists, thesauruses, taxonomies, standardized terminologies, or, ideally, ontologies) to promote semantic consistency, clarity, and interoperability. Data platforms such as data portals or knowledge graphs should incorporate these terms into their tools and reuse them for standardized representation and improved search.

# Binding Convention

	mandatory	conditional	optional
Helmholtz FAIR Principle		Annotation is mandatory when appropriate controlled vocabularies, expert recommendations on their use, and the necessary domain expertise are available, and when the systems support annotation technically.	

## Precondition for Implementation

The basis for a comprehensive metadata annotation is the is that data is provided with sufficient and structured metadata and that there is agreement about which metadata is considered essential in communities. Metadata annotation with semantic ressources is only effective if there is consensus within a research community about which controlled vocabularies or other semantic resources best meet the community's needs, and if these resources have clear governance, provenance, and documentation. Furthermore, they should be available and maintained over the long term (at least 5 years) and cover the vast majority of requirements.

## Contributors

## Content

### 1. Explanation of the Background and Benefits of the Recommendation

[About](#)

[History and structure](#)

[Current Use of ...](#)

[Motivation](#)

### 2. Possible alternative solutions

### 3. Consideration of the advantages and disadvantages of implementing the recommendation

(quality of content, limitations, interoperability, sustainability: expected future dissemination / technical availability / funding)

### 4. The Recommendation

Data infrastructures should ensure the annotation of the large majority of metadata using

standardized terms within metadata systems — such as data repositories, sensor registries, electronic lab notebooks, or other platforms that manage or reference data, including descriptions of files stored outside formal repositories — at the time of metadata creation or management, by applying terms from established and, where applicable, FAIR-compliant controlled vocabularies (e.g., ontologies, taxonomies, or standardized terminologies) to promote semantic consistency, clarity, and interoperability.

## **5. Naming of communities that have already implemented the recommendation**

## **6. Documentation of the test to validate correct implementation**

## **7. Examples of Instances**

## **8. Further Information**

### **References**

### **Relevant Community Recommendations**

## **9. History of this document**

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