



eurac
research

*Institute for Earth Observation /
Center for Climate Change and Transformation*

Lessons Learned from Dataset FAIR-ification

...and the Long Hard Road towards Open Science

15.03.2023

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0 The FAIR guiding principles

A concise review of what we all should know already at this point.

But first: a bit of History

jan
2014



“Jointly designing a data FAIRPORT”

Lorentz Center (Leiden, NL) [\[link\]](#)

The FAIR term is launched.



“The FAIR Guiding Principles for scientific data management and stewardship”

Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.*

Sci. Data 3:160018

[doi:10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18)

mar
2016



jan
2019



“The FAIRsharing Registry and Recommendations”
are formally adopted by RDA.



may
2020



FAIR 4 Research Software WG

RDA, FORCE11, and Research Software Alliance (ReSA) Taskforce

<https://www.rd-alliance.org/groups/fair-research-software-fair4rs-wg>

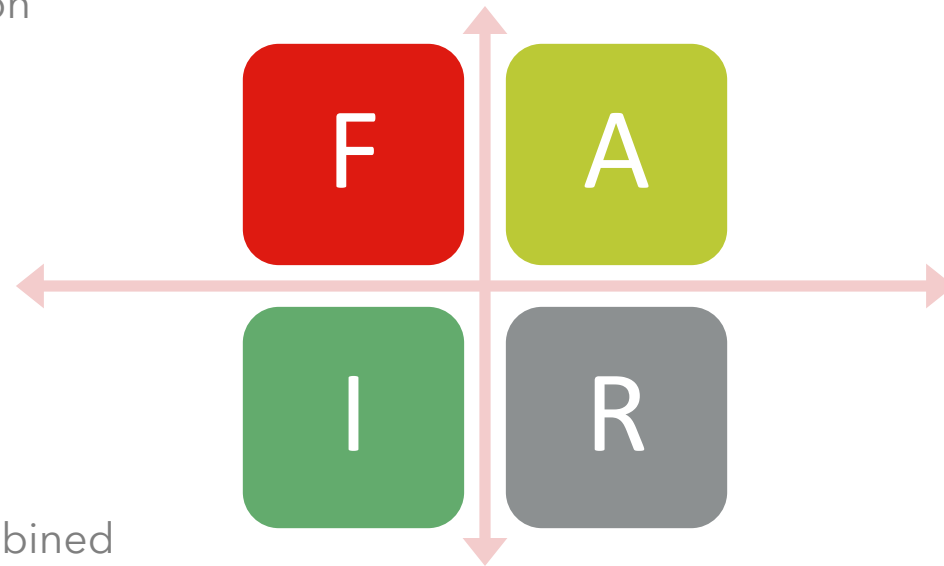


FINDABLE

The first thing to be in place to make data reusable is the possibility to find them. It should be easy to find the data and the metadata for both humans and computers. Automatic and reliable discovery of datasets and services depends on machine-readable **persistent Identifiers** (PIDs) and metadata.

INTEROPERABLE

The data should be able to be combined with and used with other data or tools. The **format** of the data should therefore be open and interpretable for various tools, including other data records. The concept of interoperability applies both at the data and metadata level.



ACCESSIBLE

The (meta)data should be retrievable by their identifier using a standardized and open **communications protocol**, possibly including **authentication** and authorisation. Also, metadata should be available even when the data are no longer available.

RE-USABLE

Ultimately, FAIR aims at optimizing the reuse of data. To achieve this, **metadata** and data should be well-described so that they can be replicated and/or combined in different settings. Also, the reuse of the (meta)data should be stated with (a) clear and accessible **license(s)**.

FINDABLE

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of datasets and search engines that can read machine-readable

Identifiers (PIDs)

INTEROPERABLE

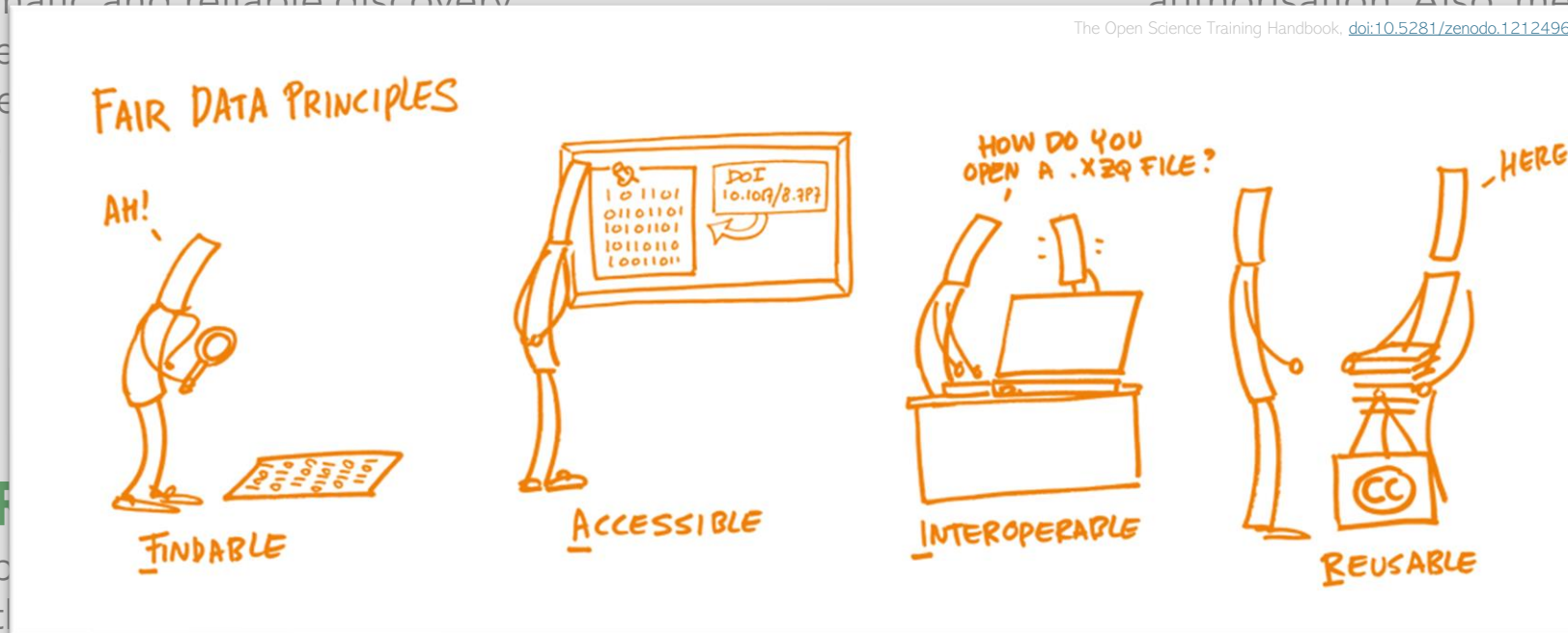
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The Open Science Training Handbook, [doi:10.5281/zenodo.1212496](https://doi.org/10.5281/zenodo.1212496)



RE-USABLE

Efforts at optimizing data reuse require this, **metadata**

and data should be well-described so that they can be replicated and/or combined in different settings.

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... a few remarks

Remark #1

The FAIR principles are both for **machines** and for **people**.

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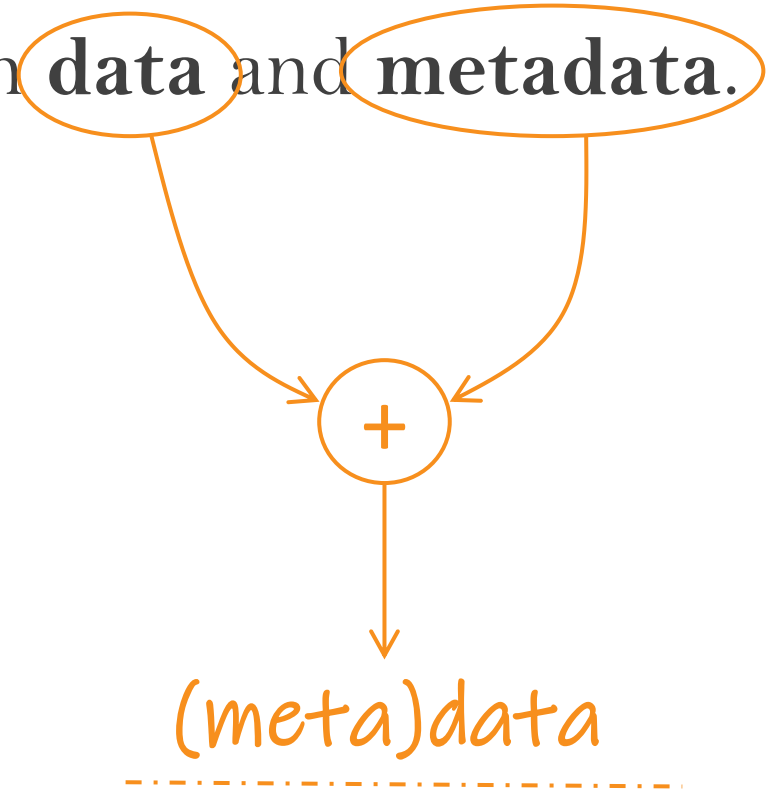
machine-actionability

Remark #2

The FAIR principles often apply to both **data** and **metadata**.

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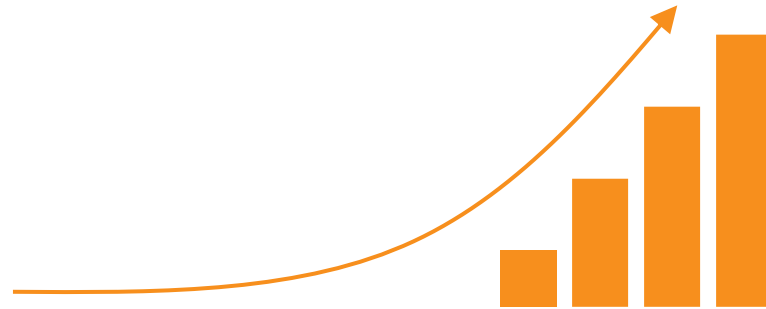


Remark #3

The FAIR principles are not on/off switches but can be implemented **incrementally**.

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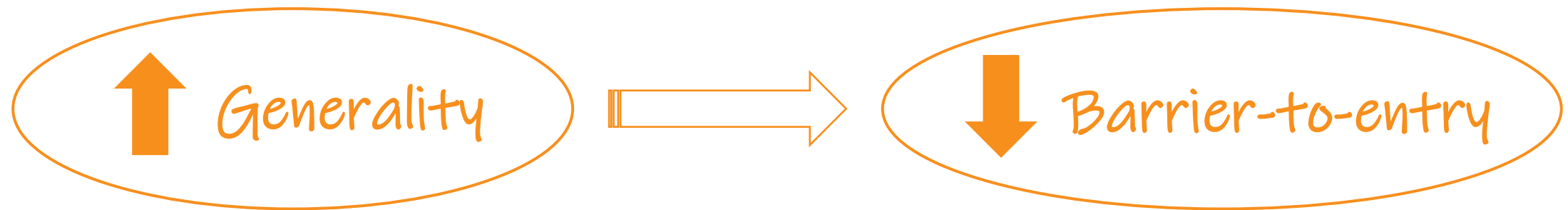
Degrees of 'FAIRness'

Remark #4

The FAIR principles are **domain-independent** and inalienable: they do not suggest any specific technology, standard, or implementation-solution.

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Remark #5

FAIR \neq publicly available data.

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but ...

Remark #6

The FAIR principles are essential to **Open Science**.

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Remark #7

No FAIRness = No Data Management Plans (DMPs).

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No FAIRness = No Data Management Plans (DMPs).

??

"Data Management Plan workshop for natural sciences and engineering" @ Eurac Research

...Last remark

The FAIR principles are not only about the (meta)data, but also:

...Last remark

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- ❖ FAIR research software

...Last remark

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- ❖ FAIR research software
- ❖ FAIR workflows

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...Last remark

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- ❖ FAIR web services
- ❖ ...

Dig deeper: helpful FAIR initiatives



<https://www.go-fair.org/>

Bottom-up, stakeholder-driven and self-governed initiative that aims to implement the FAIR data principles through Implementation Networks (INs).



<https://www.fairsfair.eu/>

Practical solutions for the use of FAIR principles throughout the data life cycle, fostering a FAIR data culture and the uptake of good practices.



<https://www.fairpoints.org/>

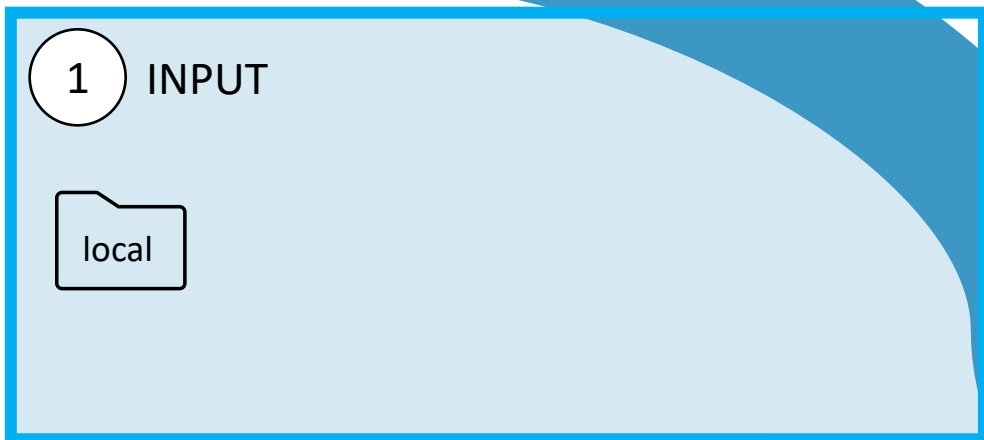
Event series aims to discuss, highlight, and share pragmatic solutions to making FAIR a reality from viewpoints that transverse geographic and domain areas.

1 The practice of FAIR-ness

Data-sharing chronicles from the Institute for Earth Observation.

Alice's journey







1 INPUT



2 CODE





2 CODE



1 INPUT



3 RESULTS





1 INPUT



2 CODE



4 PUBLICATION



Classical
Journal

3 RESULTS





2 CODE



1 INPUT

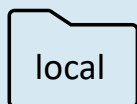


4 PUBLICATION



Classical
Journal

3 RESULTS

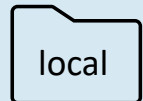


5 IMPACT





2 CODE



1 INPUT



Accessible

4 PUBLICATION



Classical Journal

3 RESULTS



5 IMPACT





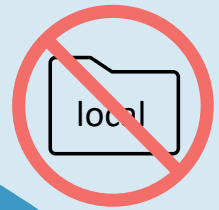
1 INPUT



3 RESULTS



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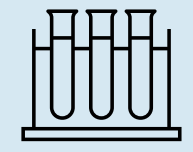
github



Docu-
mentation



Environ-
ment



Examples



FAIR
Workflow

4 PUBLICATION



Classical
Journal

5 IMPACT



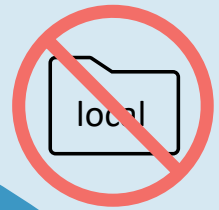


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Accessible

2 CODE



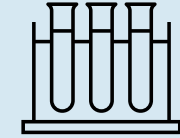
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Docu-
mentation



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Examples



FAIR
Workflow

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Classical
Journal

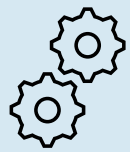
3 RESULTS



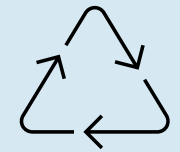
Findable
Catalog, DOI



Accessible
Open



Interoperable
Standard Formats



Reusable
License



FAIR
Data

5 IMPACT





1 INPUT



Accessible

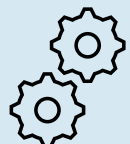
3 RESULTS



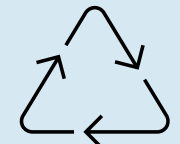
Findable
Catalog, DOI



Accessible
Open



Interoperable
Standard Formats

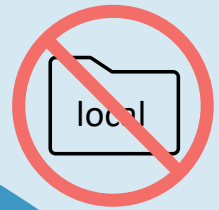


Reusable
License



FAIR
Data

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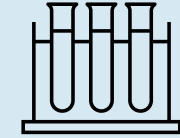
github



Docu-
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Environ-
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Examples



FAIR
Workflow

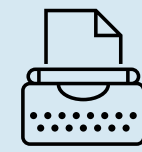
4 PUBLICATION



Classical
Journal



Open
Access



Pre-
Print



With Data
and Code

5 IMPACT



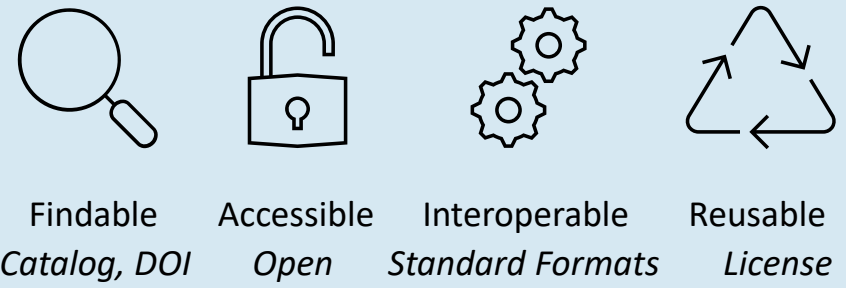


1 INPUT



Accessible

3 RESULTS



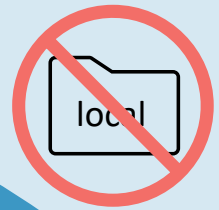
Findable
Catalog, DOI

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Interoperable
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Reusable
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2 CODE



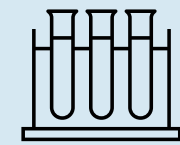
github



Docu-
mentation



Environ-
ment



Examples



FAIR
Workflow

4 PUBLICATION



Classical
Journal



Open
Access



Pre-
Print



With Data
and Code



FAIR
Data

5 IMPACT





1 INPUT



Accessible

2 CODE



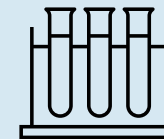
github



Docu-
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Environ-
ment



Examples



FAIR
Workflow

4 PUBLICATION



Classical
Journal



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With Data
and Code

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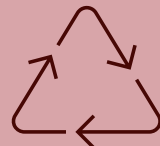
Findable
Catalog, DOI



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Interoperable
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Reusable
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FAIR
Data

5 IMPACT

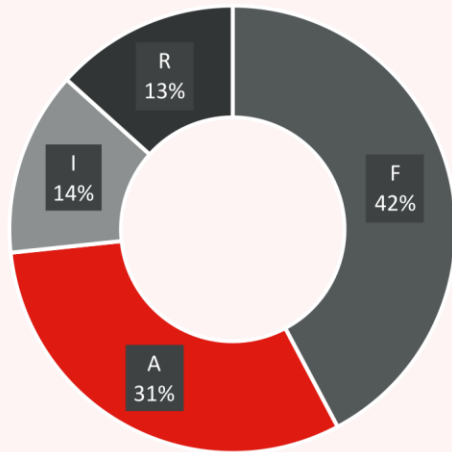


How FAIR are we now, anyway?

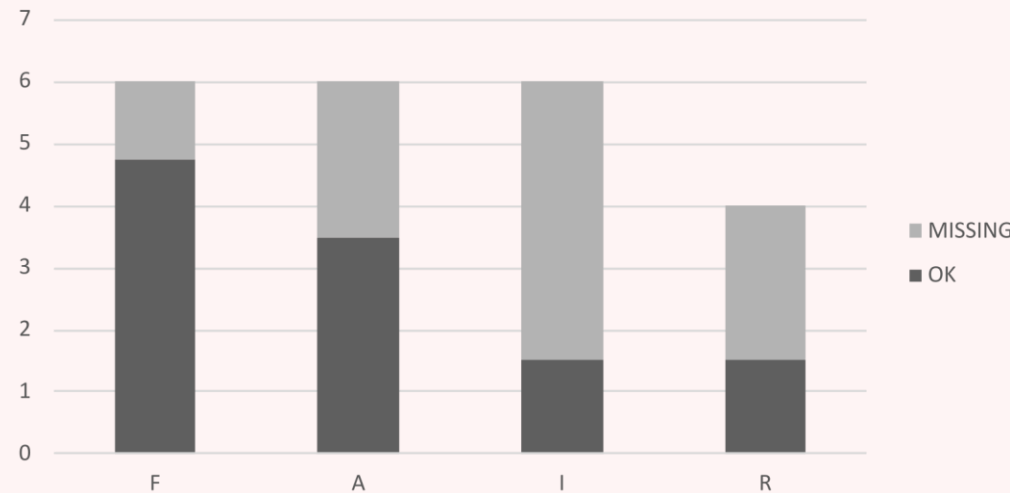
The FAIRness assessment

[How FAIR are we?](#) @ Eurac Research / EO

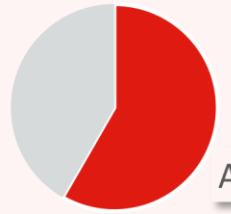
% OF IMPLEMENTED PRINCIPLES



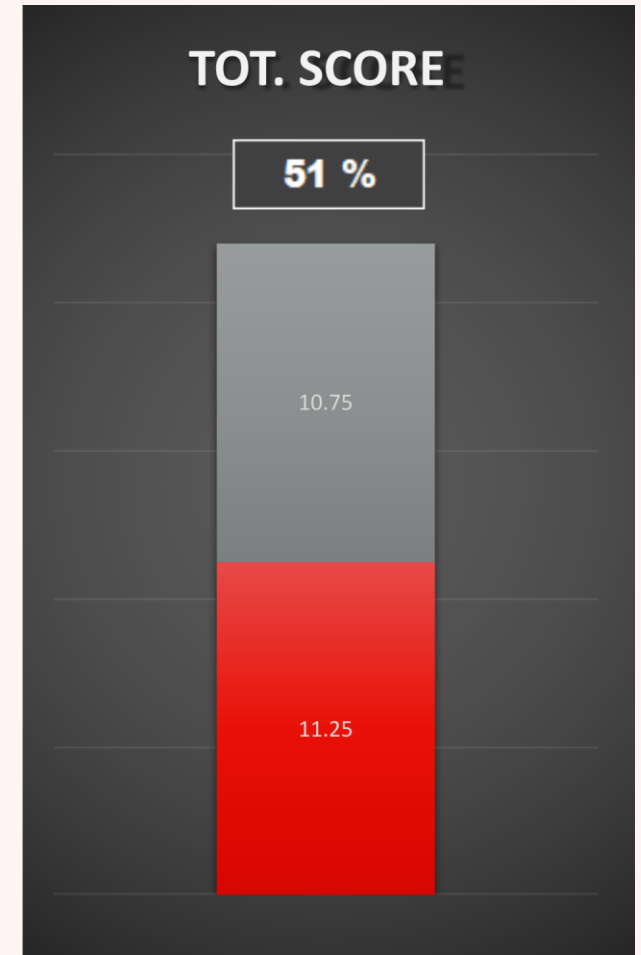
OK/MISSING PRINCIPLES



■ OK
■ MISSING



TOT. SCORE



Choosing a metric

Manual assessment with arbitrary criteria

Choosing a metric

Manual assessment with arbitrary criteria



Manual assessment with FAIR metrics/rubrics

Choosing a metric

Manual assessment with arbitrary criteria



Manual assessment with FAIR metrics/rubrics



Open tools for automatic FAIR assessment



FAIRshake

<https://fairshake.cloud/>



FIP Wizard

<https://fip-wizard.ds-wizard.org/>



F-UJI

Automated FAIR Data
Assessment Tool

<https://www.f-uji.net/>

Choosing a metric

Manual assessment with arbitrary criteria

our choice
(based on the [FIP Questionnaire](#))

Manual assessment with FAIR metrics/rubrics

Open tools for automatic FAIR assessment



FAIRshake

<https://fairshake.cloud/>



FIP Wizard

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FAIR-enabling resources

What are they?

Any digital object that provides a **function** needed to achieve some aspect of FAIRness and is explicitly linked to one (or more) FAIR Principles.

Schultes, E., Magagna, B., Hettne, K.M., Pergl, R., Suchánek, M., Kuhn, T. (2020). Reusable FAIR Implementation Profiles as Accelerators of FAIR Convergence. In: Grossmann, G., Ram, S. (eds) Advances in Conceptual Modeling. ER 2020. Lecture Notes in Computer Science(), vol 12584. Springer, Cham. https://doi.org/10.1007/978-3-030-65847-2_13

What are they?

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Examples:

Identifiers, metadata schemas, communication protocols, vocabularies, web services, etc.

Schultes, E., Magagna, B., Hettne, K.M., Pergl, R., Suchánek, M., Kuhn, T. (2020). Reusable FAIR Implementation Profiles as Accelerators of FAIR Convergence. In: Grossmann, G., Ram, S. (eds) Advances in Conceptual Modeling. ER 2020. Lecture Notes in Computer Science(), vol 12584. Springer, Cham. https://doi.org/10.1007/978-3-030-65847-2_13

Discovering the resources:

<https://fip-wizard.ds-wizard.org/>

The screenshot displays the FIP Wizard web application. The top navigation bar includes 'Questionnaire', 'Metrics', 'Preview', 'Documents', and 'Settings'. A 'Share' button is located in the top right corner. The main content area is divided into a left sidebar and a main workspace.

Left Sidebar:

- Chapters:**
 - I. About (checked)
 - II. Declare your FAIR Implementation Community (3)
 - III. Declarations for Findability (17)
 - IV. Declarations for Accessibility (15)
 - V. Declarations for Interoperability (18)
 - VI. Declarations for Reusability (11)**
 - Declaration R1.1 Metadata: Which usage license do y...
 - Declaration R1.1 Datasets: Which usage license do yo...
 - Declaration R1.2 Metadata: What metadata schema d...
 - List the FAIR Enabling Resource(s)
 - Declaration R1.2 Datasets: What metadata schema do...
 - Declaration R1.3: Your community uses this FAIR Impl...

Main Workspace:

- VI.3.b.1 List the FAIR Enabling Resource(s)**
- VI.3.b.1.a.1 Select the FAIR Enabling Resource**
-
- Descriptive documentation of the content, meaning, provenance, and access for a single data set or series*
- DataCite Metadata Scheme** **GFF**
The DataCite Metadata Schema is a list of core metadata properties chosen for accurate and consistent identification of a resource for citation and retrieval purposes, with recommended use instructions in the documentation. The resource that is being identified can be of any kind, but it is typically a dataset. We use the term 'dataset' in its broadest sense. We mean it to include not only numerical data, but any other research objects in keeping with DataCite's mission (<https://datacite.org/value.html>). The metadata schema properties are presented and described in detail in the section DataCite Metadata Properties in this document.
- DwC-A | Darwin Core Archive** **GFF**
DwC-A is a biodiversity informatics data standard that makes use of the Darwin Core terms

Discovering the resources:

<https://fip-wizard.ds-wizard.org/>

FIP Wizard

Questionnaire Metrics Preview Documents Settings

View Comments TODOs Version history

Chapters

- I. About ✓
- II. Declare your FAIR Implementation Community 3
- III. Declarations for Findability 17**
- IV. Declarations for Accessibility 15
- V. Declarations for Interoperability 18
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VI.3.b.1 List the FAIR Enabling Resource(s)

VI.3.b.1.a.1 Select the FAIR Enabling Resource

Descriptive documentation of the content, meaning, provenance, and access for a single data set or series

DataCite Metadata Scheme GFF

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DwC-A | Darwin Core Archive GFF

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FIP Wizard

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Descriptive documentation of the content, meaning, provenance, and access for a single data set or series

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DwC-A | Darwin Core Archive GFF

DwC-A is a biodiversity informatics data standard that makes use of the Darwin Core terms

Discovering the resources:

<https://fip-wizard.ds-wizard.org/>

The screenshot displays the FIP Wizard interface. On the left, a sidebar titled 'Chapters' lists sections I through VI. Sections III, IV, V, and VI are highlighted with orange borders, and orange arrows point from a dashed circle on the left towards them. The main content area shows a section titled 'VI.3.b.1 List the FAIR Enabling Resource(s)'. Below this, a sub-section 'VI.3.b.1.a.1 Select the FAIR Enabling Resource' contains a search box and a list of resources. The first resource is 'DataCite Metadata Scheme' with a GFF icon and a description: 'The DataCite Metadata Schema is a list of core metadata properties chosen for accurate and consistent identification of a resource for citation and retrieval purposes...'. The second resource is 'DwC-A | Darwin Core Archive' with a GFF icon and a description: 'DwC-A is a biodiversity informatics data standard that makes use of the Darwin Core terms'.

Discovering the resources:

<https://fip-wizard.ds-wizard.org/>

FIP Wizard

Questionnaire Metrics Preview Documents Settings

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VI.3.b.1 List the FAIR Enabling Resource(s)

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Descriptive documentation of the content, meaning, provenance, and access for a single data set or series

DataCite Metadata Scheme GFF

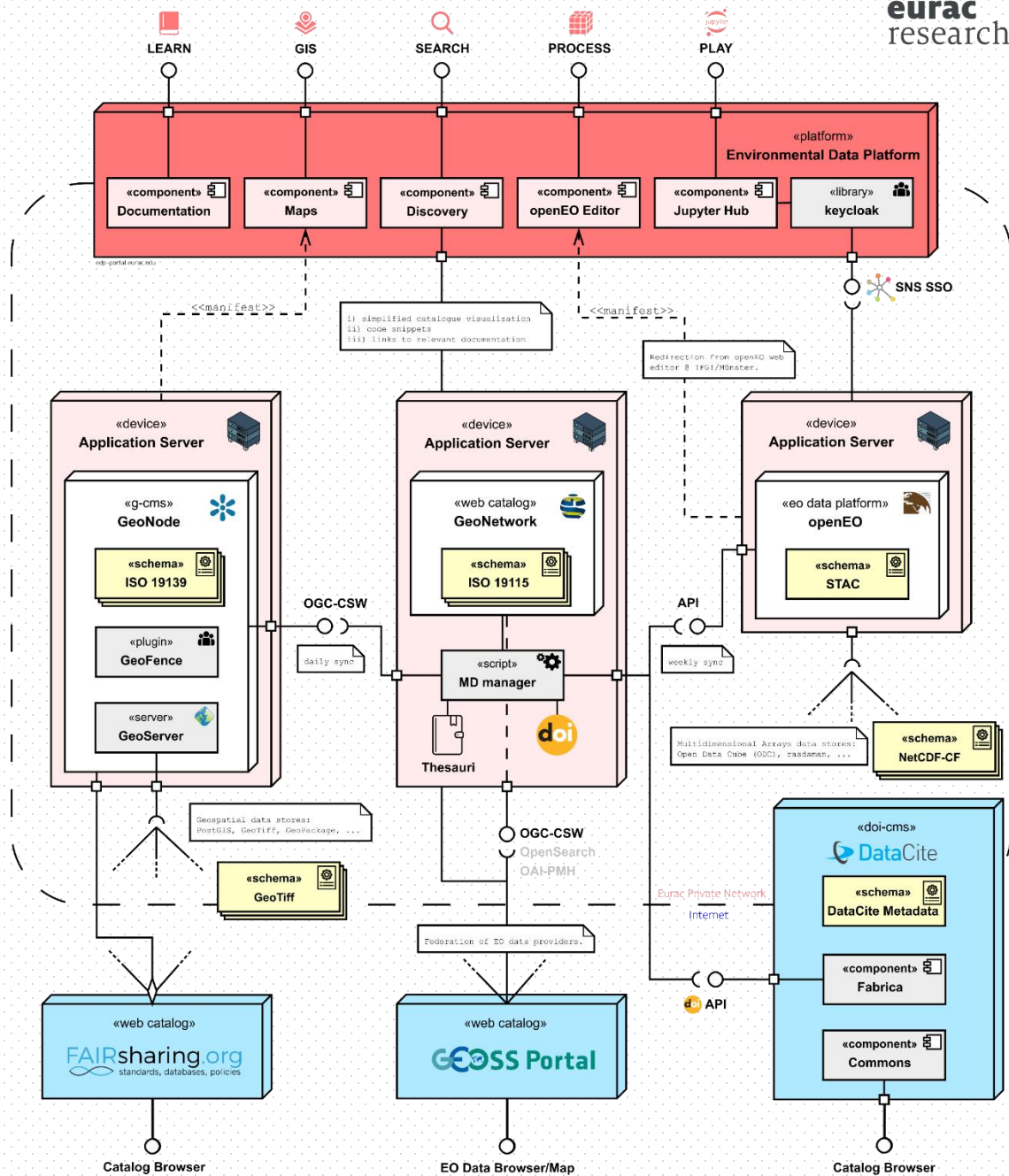
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DwC-A is a biodiversity informatics data standard that makes use of the Darwin Core terms

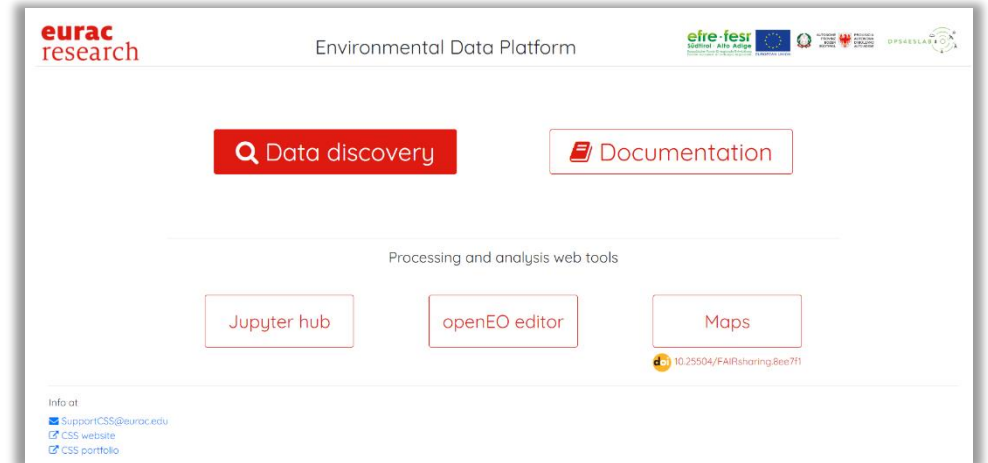
... talking about FAIR-enabling resources:

Spatial Data Infrastructure (SDI)

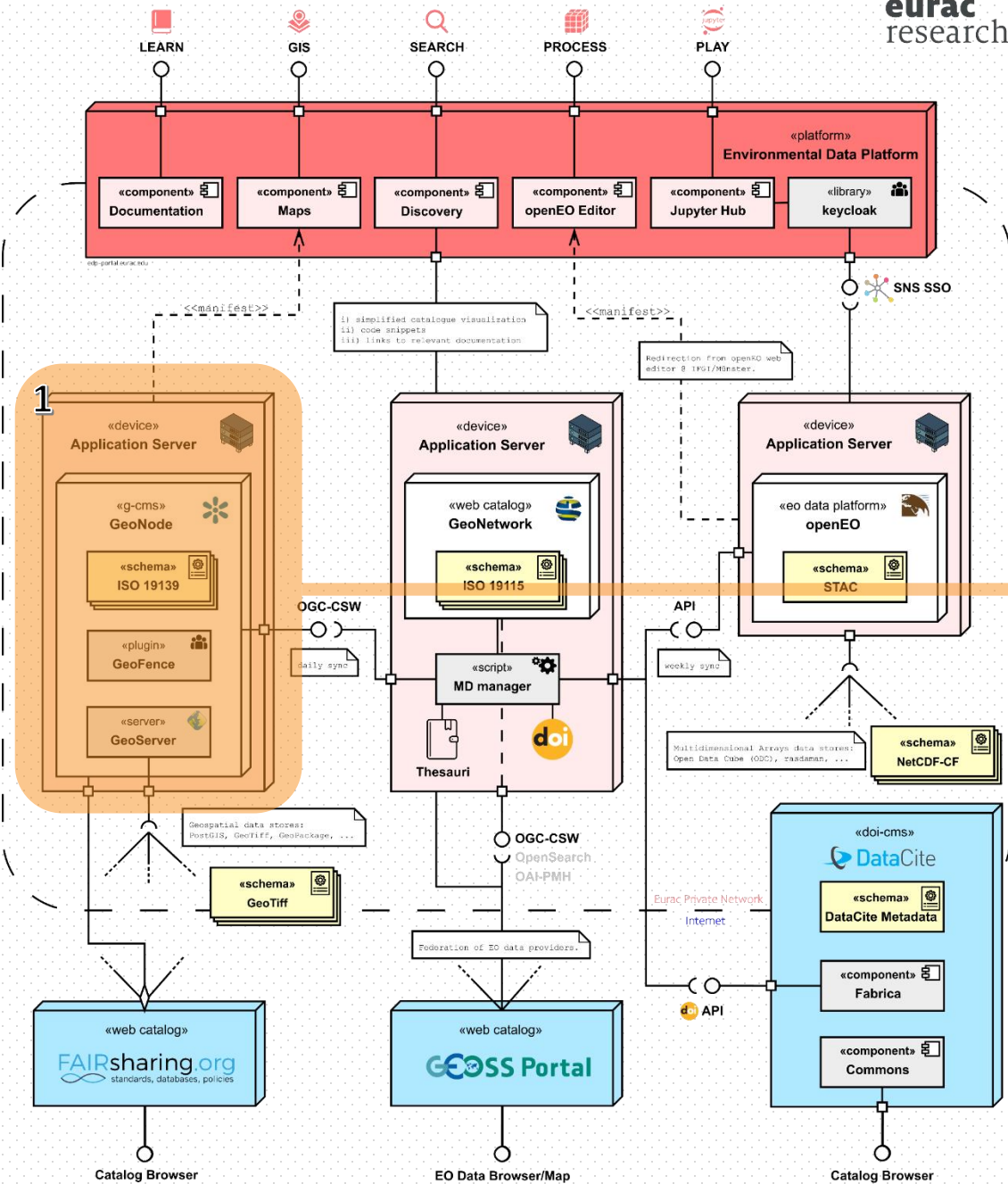


Center for Sensing Solutions (CSS)

The Environmental Data Platform (EDP)

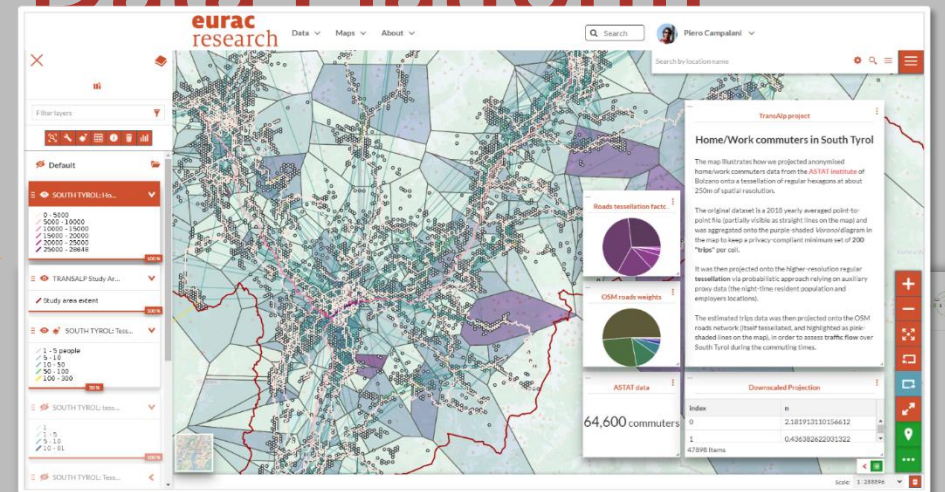


<https://edp-portal.eurac.edu/>

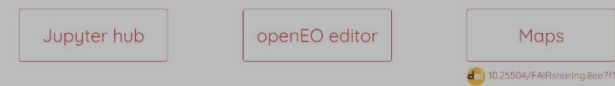


Center for Sensing Solutions (CSS)

The Environmental Data Platform

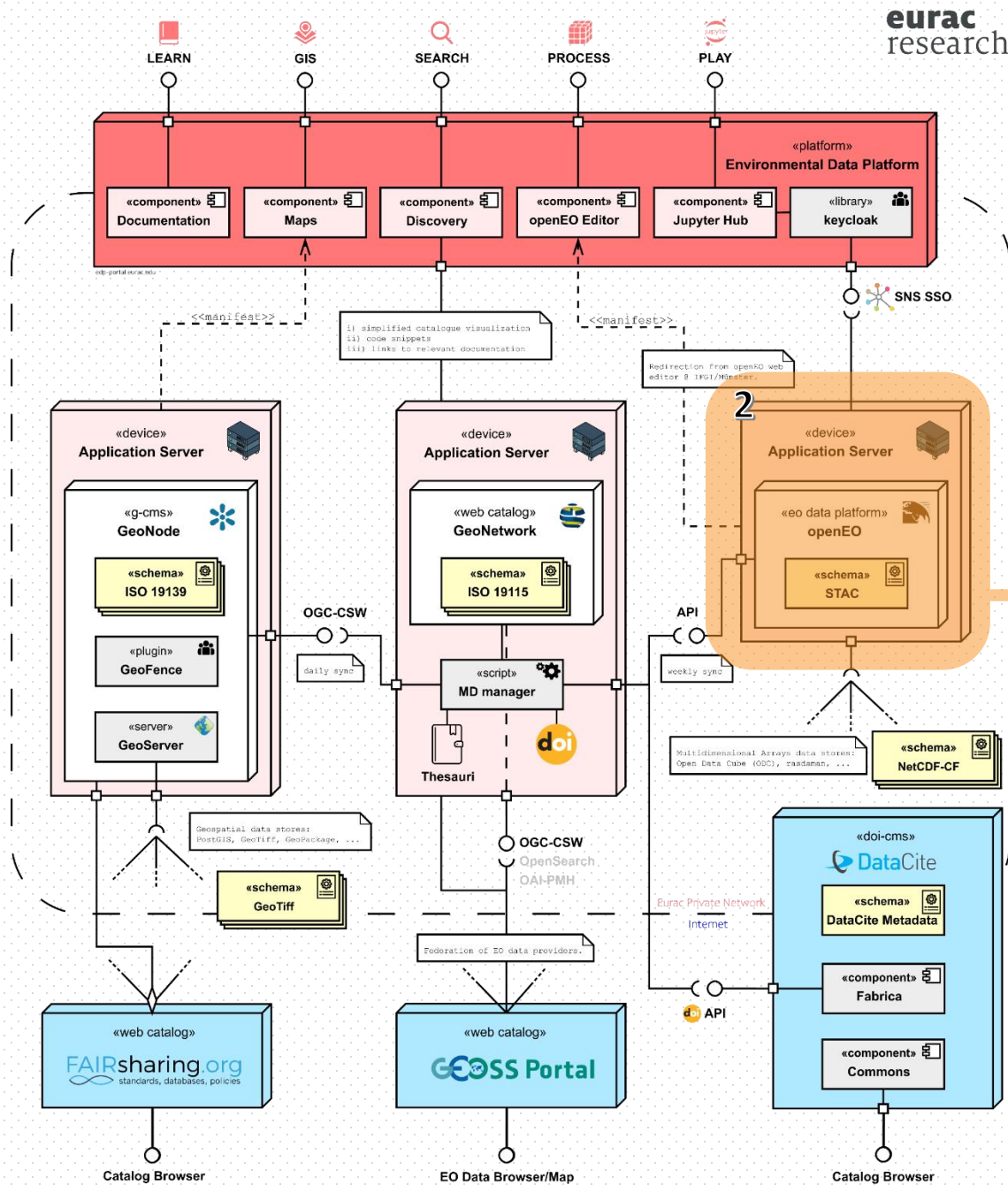


Processing and analysis web tools



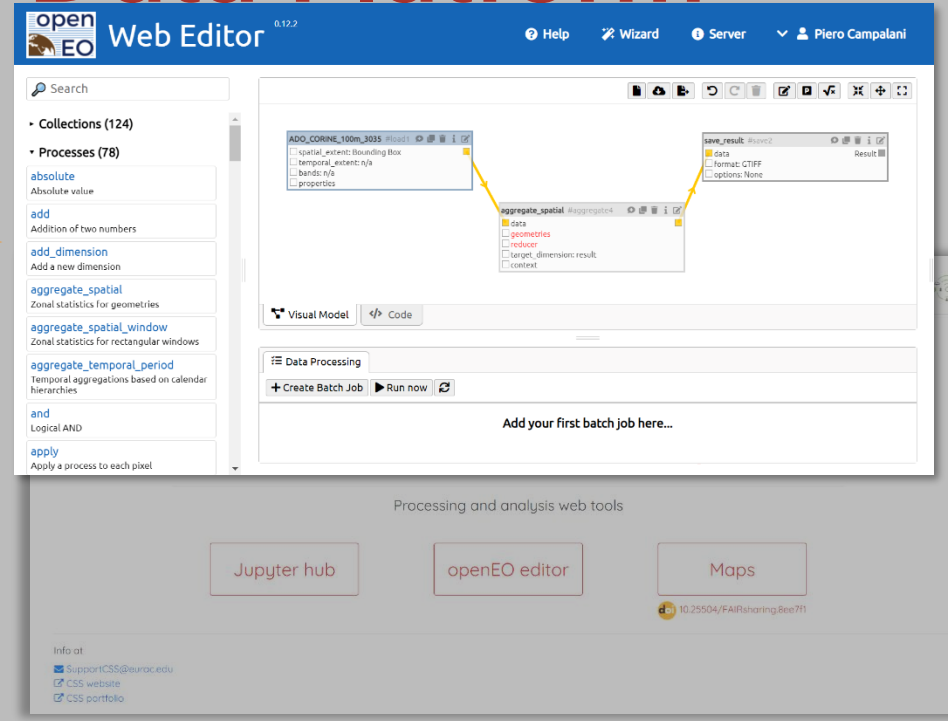
Info at:
 SupportCSS@eurac.edu
 CSS website
 CSS portfolio

<https://edp-portal.eurac.edu/>

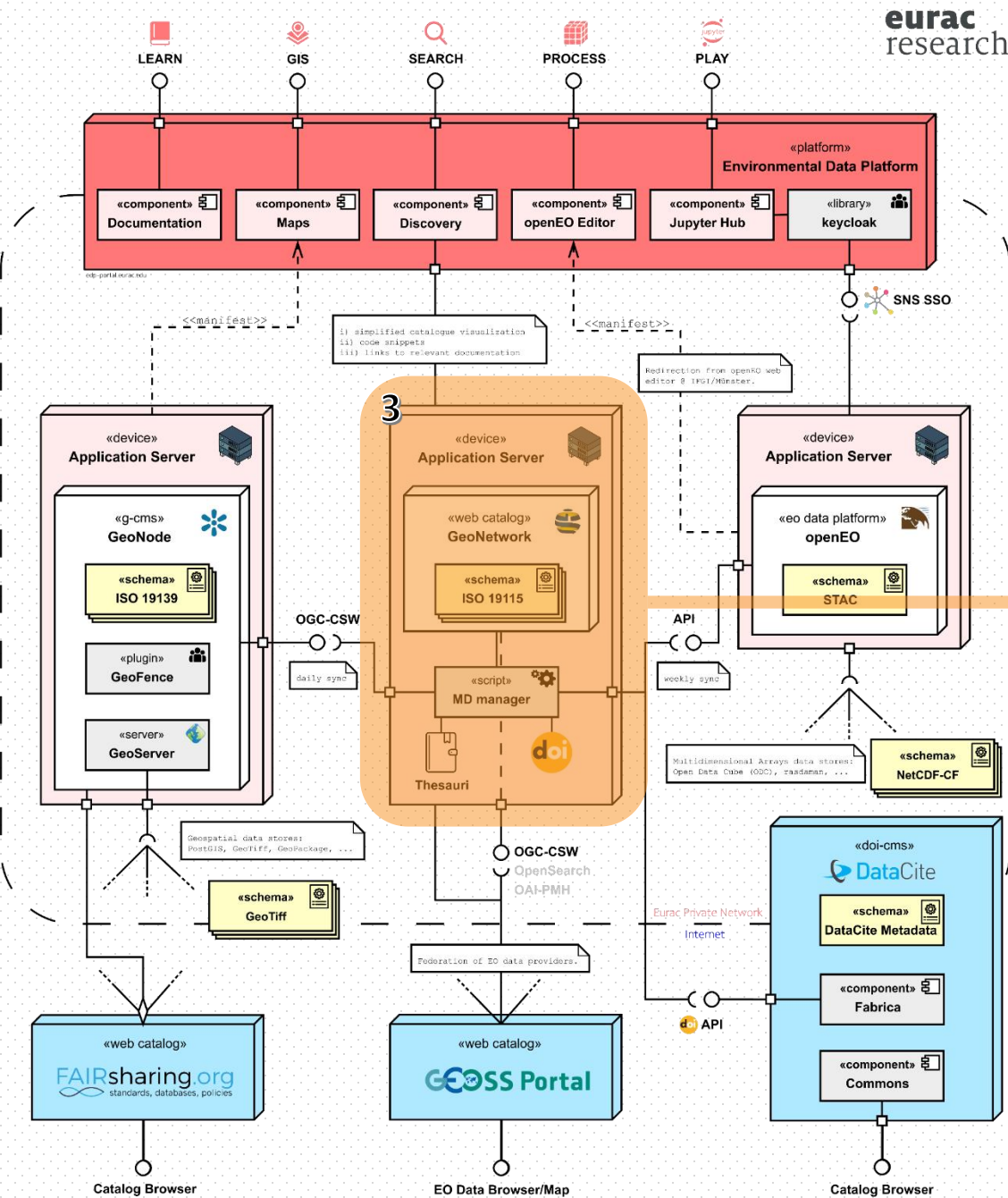


Center for Sensing Solutions (CSS)

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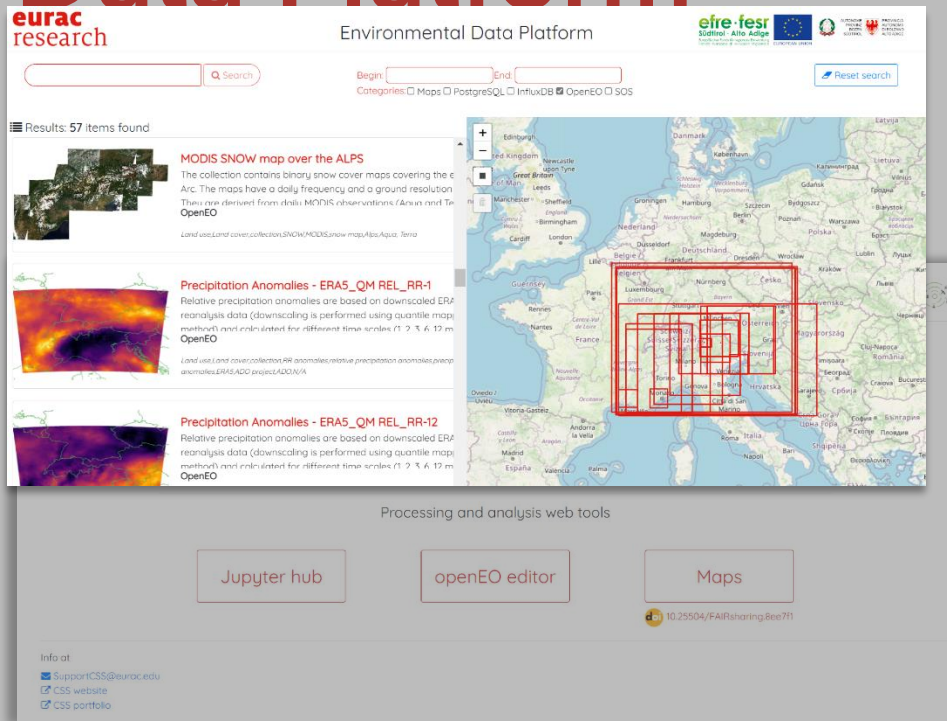


<https://edp-portal.eurac.edu/>

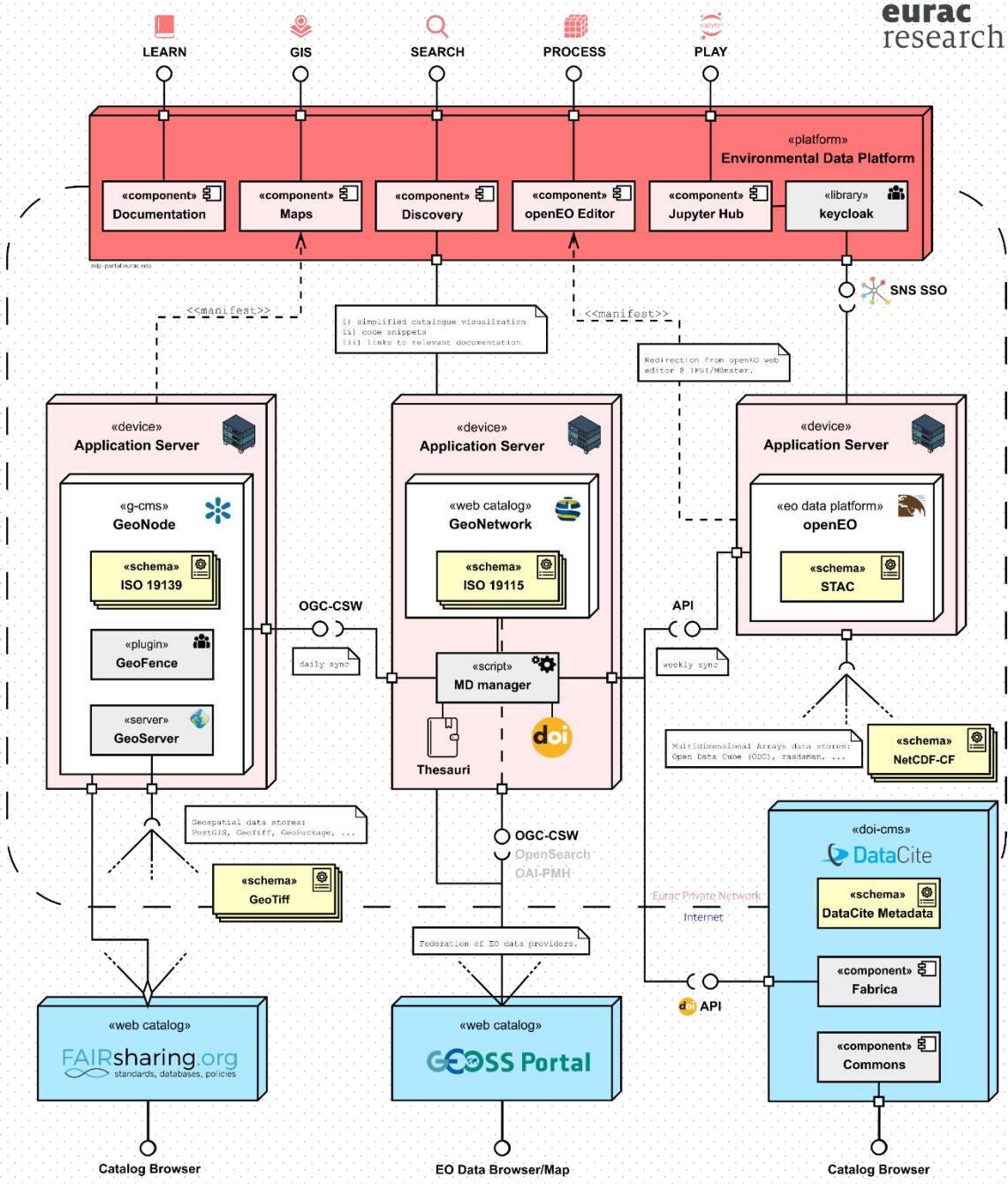


Center for Sensing Solutions (CSS)

The Environmental Data Platform

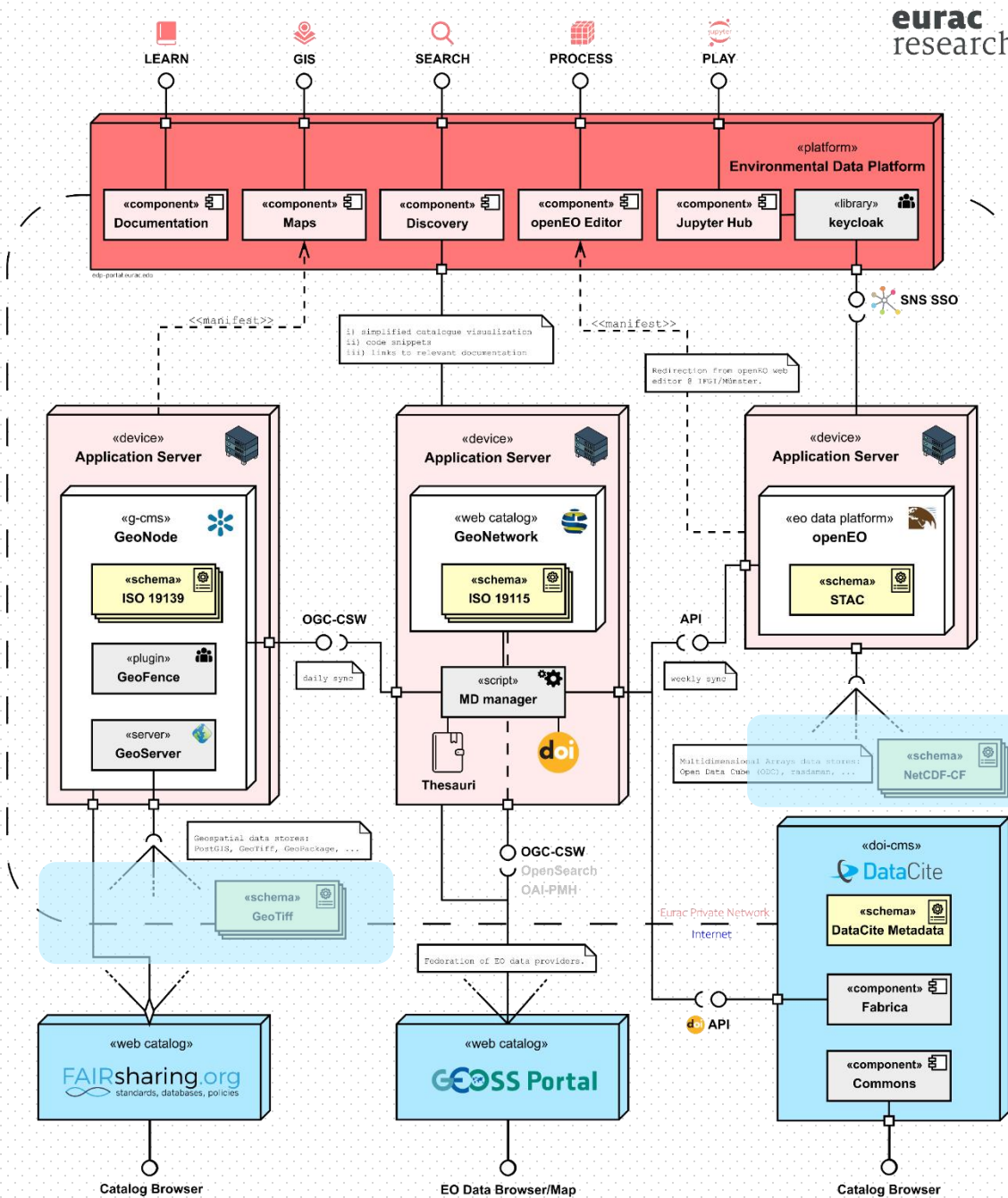


<https://edp-portal.eurac.edu/>

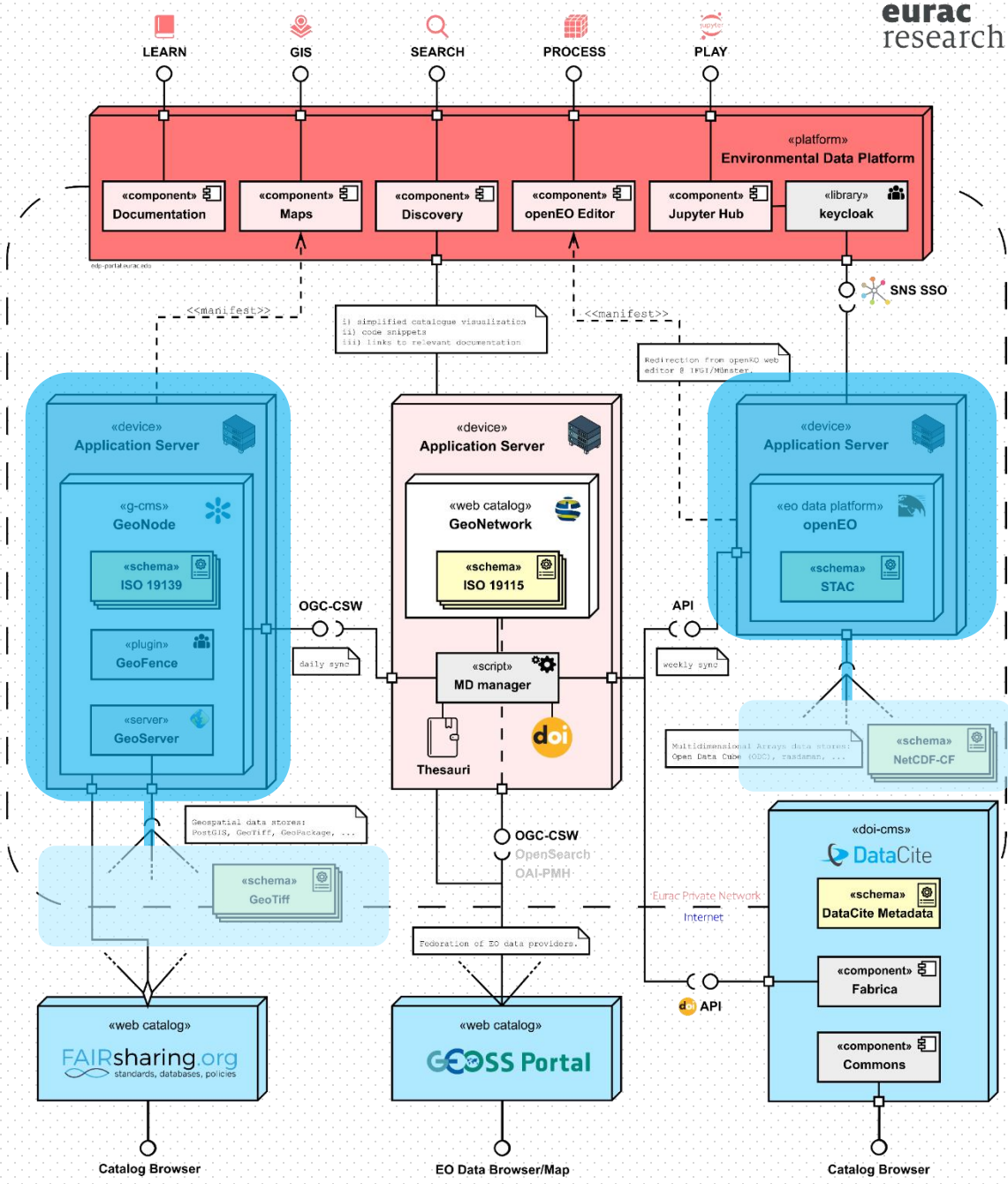


The Dataset FAIR-ification



The Dataset FAIR-ification

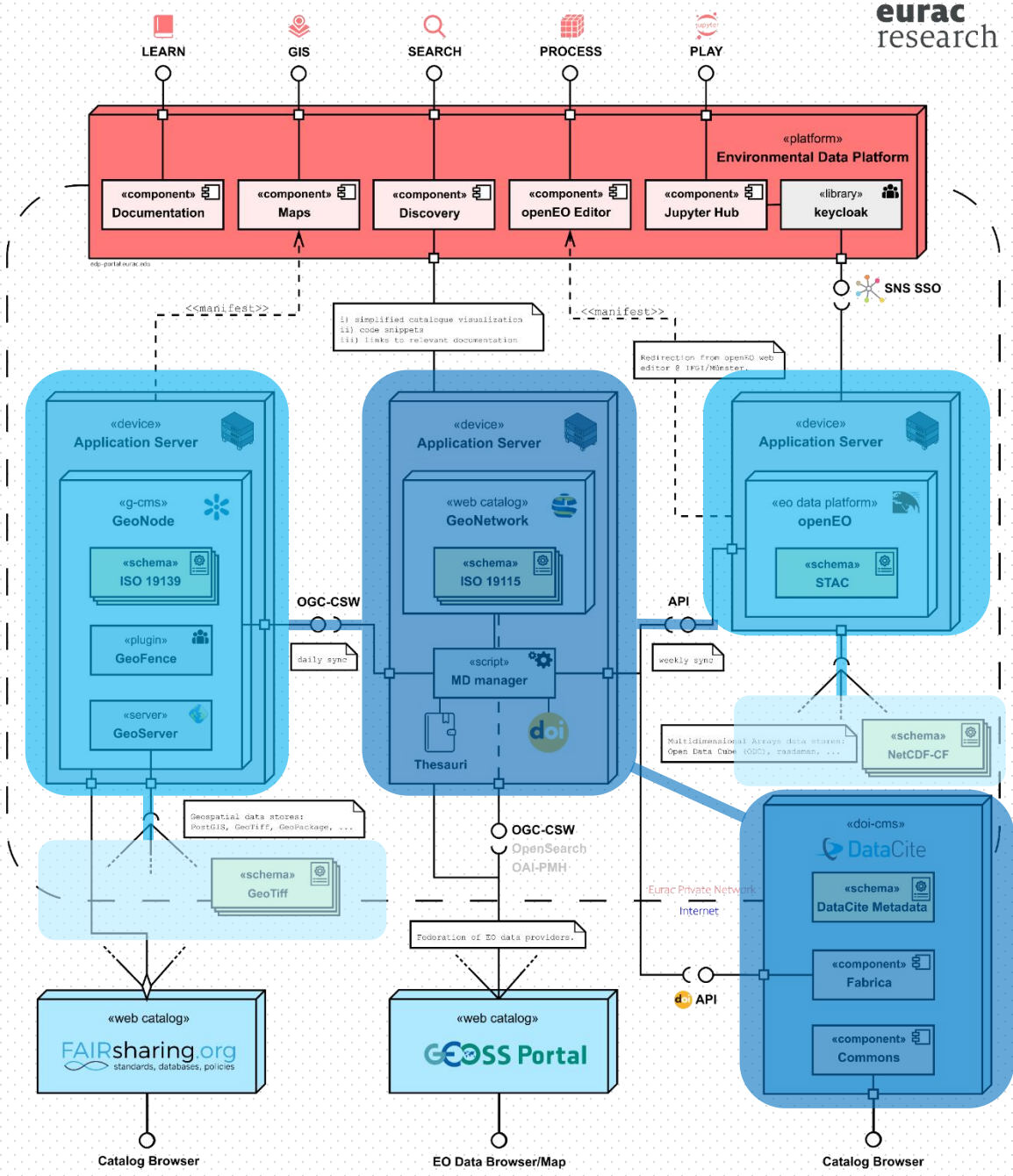


Generate
Produce the (meta)data files and store them in a long-term archive.






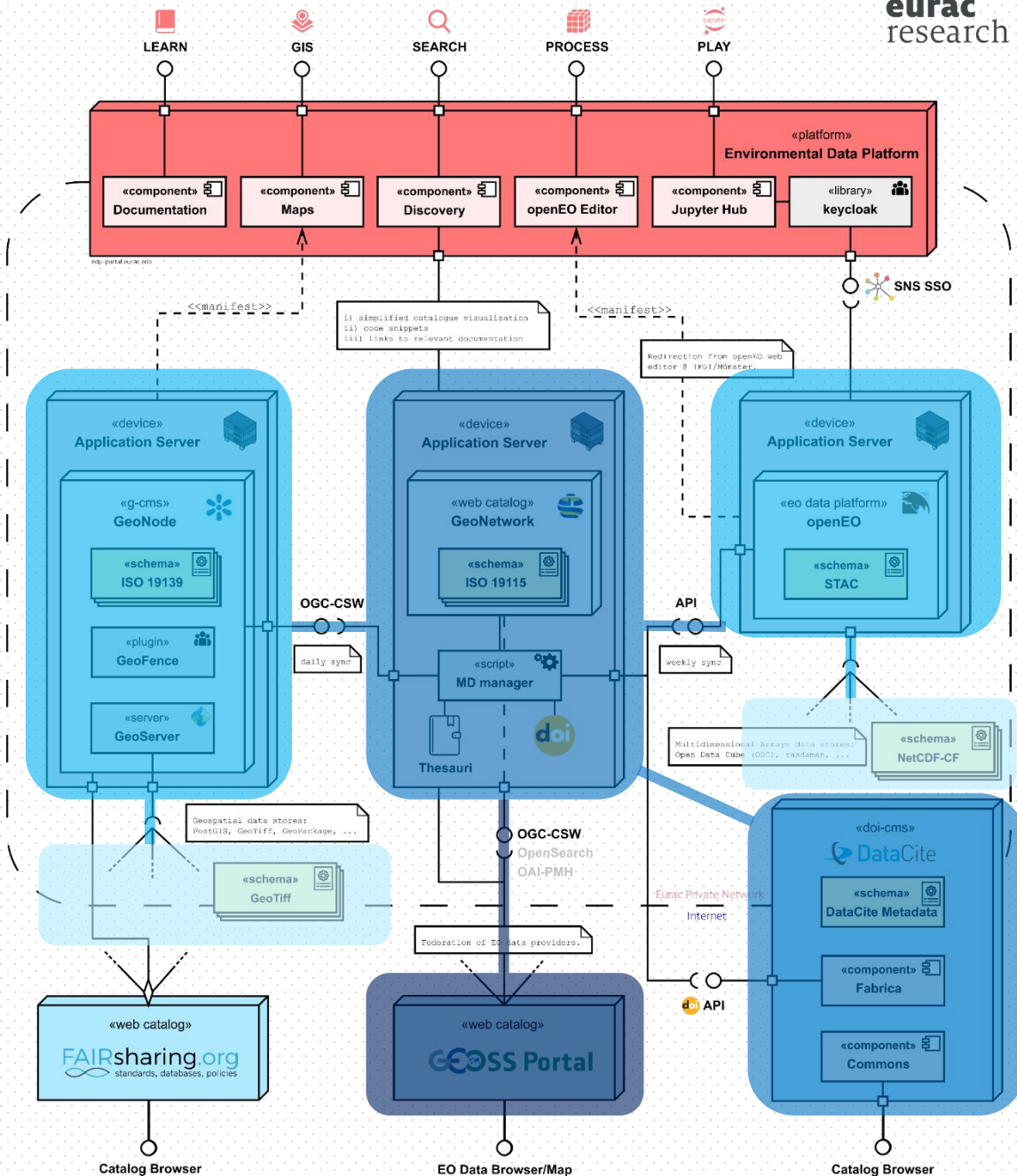
The Dataset FAIR-ification

- 
Generate
 Produce the (meta)data files and store them in a long-term archive.
- 
Publish
 Register the dataset onto a FAIR-enabling server/platform.



The Dataset FAIR-ification

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Generate
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Publish
 Register the dataset onto a FAIR-enabling server/platform.
- 
Synchronize
 Align the centralized metadata catalog with the new dataset.



The Dataset FAIR-ification



Generate

Produce the (meta)data files and store them in a long-term archive.



Publish

Register the dataset onto a FAIR-enabling server/platform.



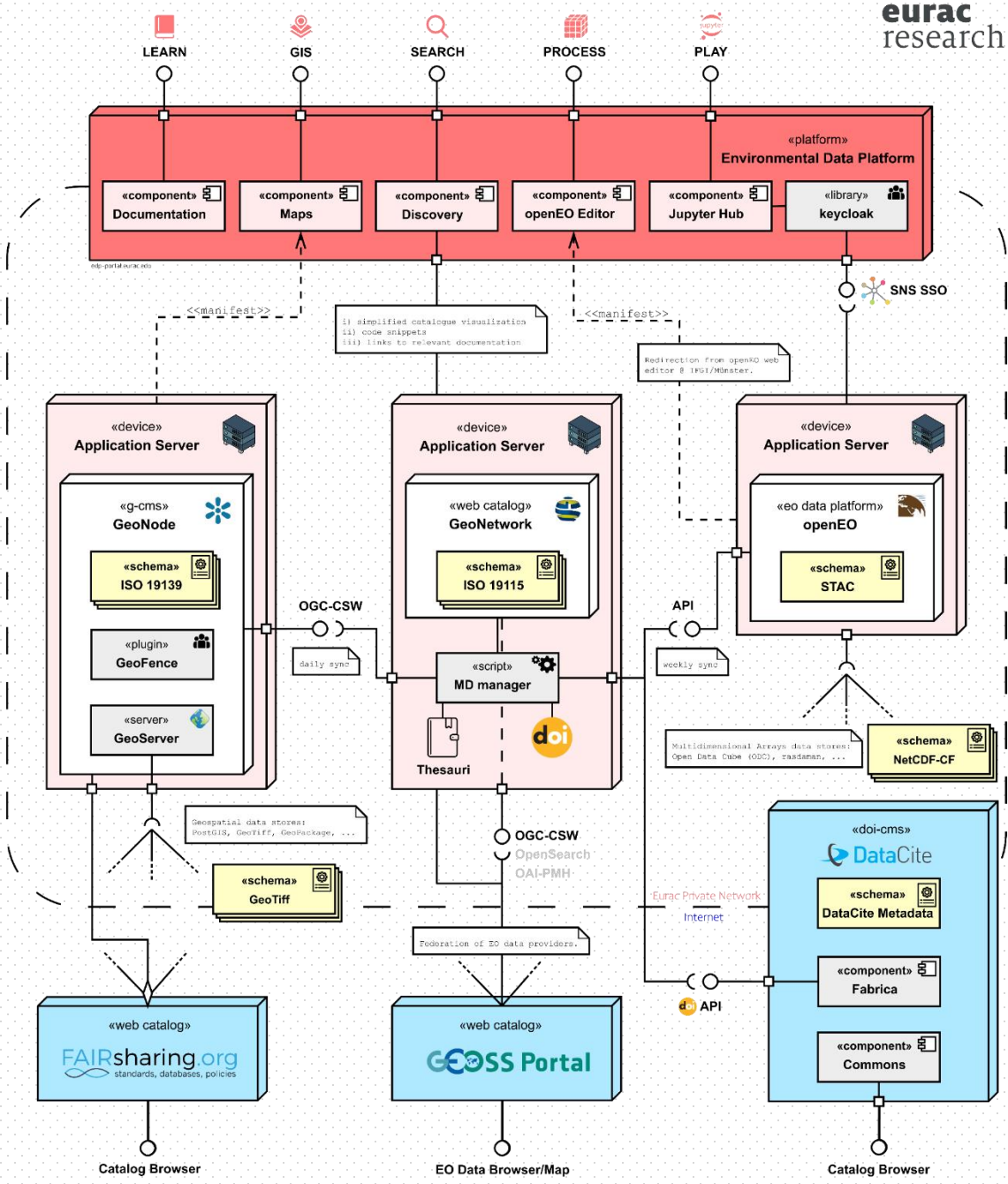
Synchronize

Align the centralized metadata catalog with the new dataset.

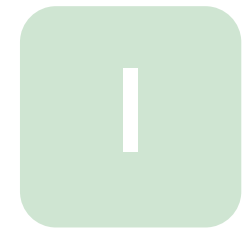


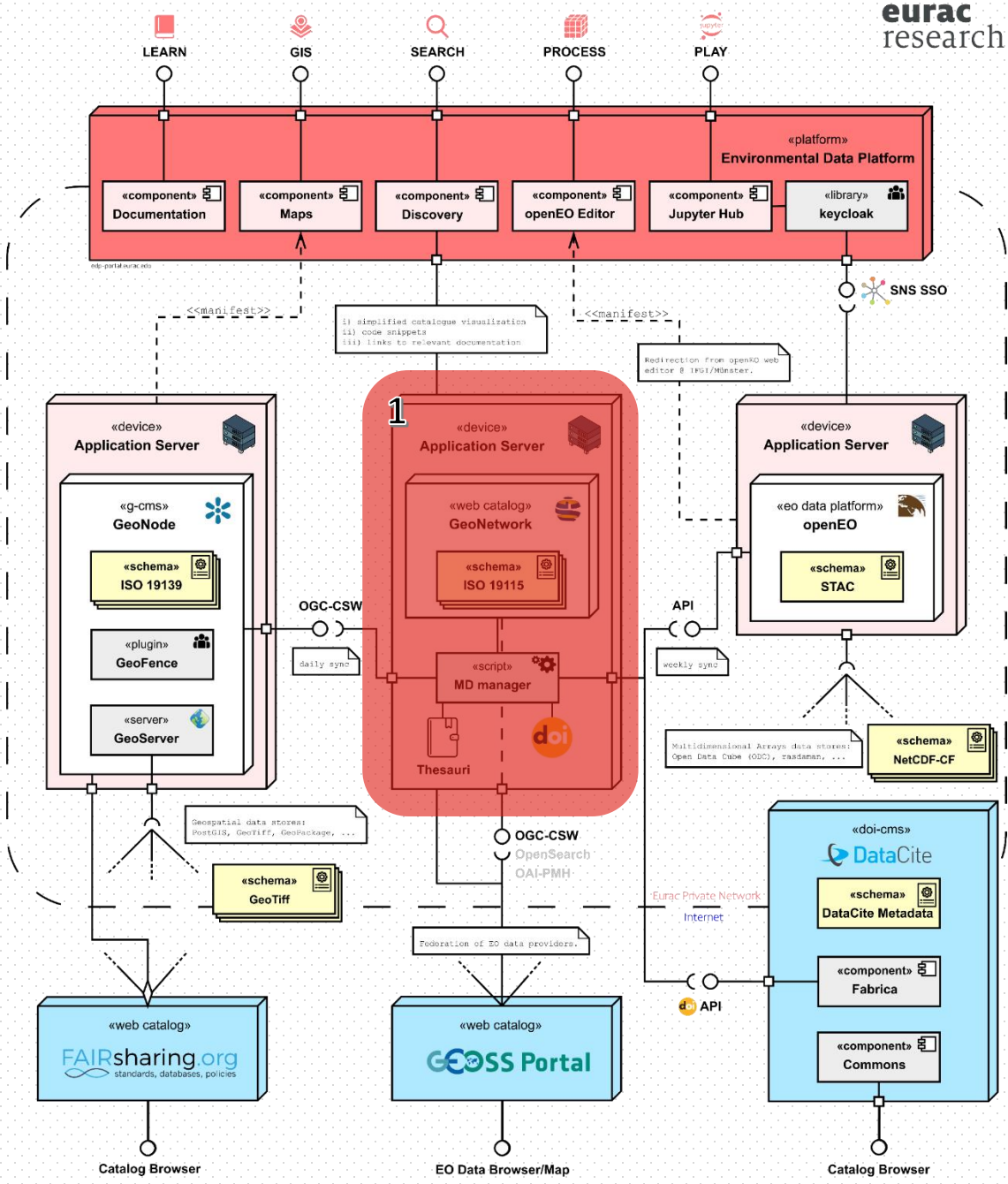
Propagate

Expose the new catalog item to external linked catalogues.

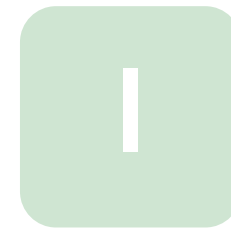


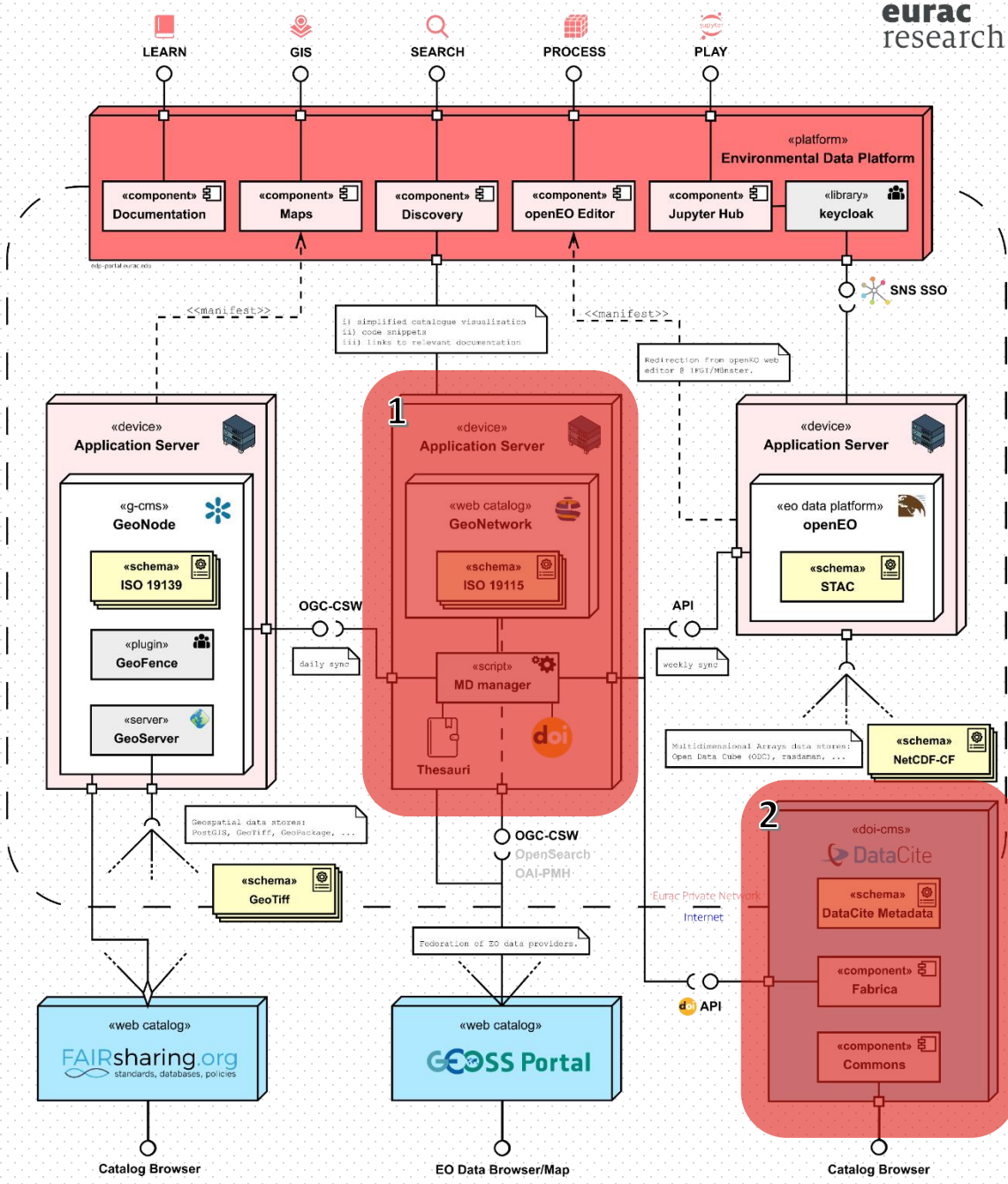
Findability



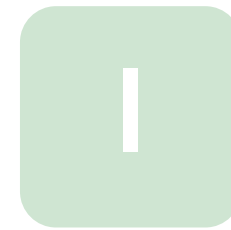


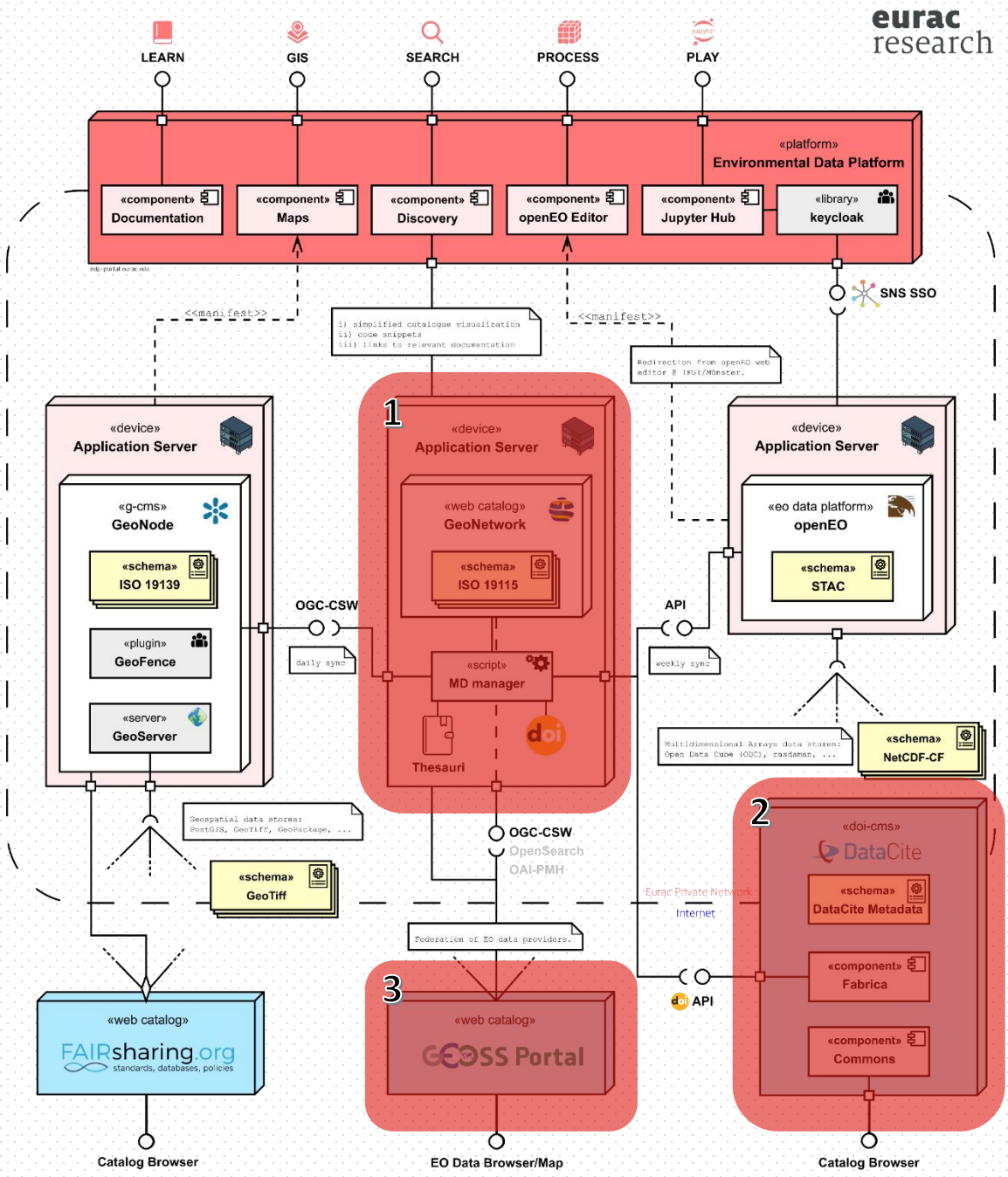
Findability



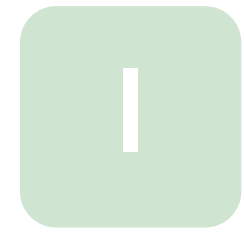


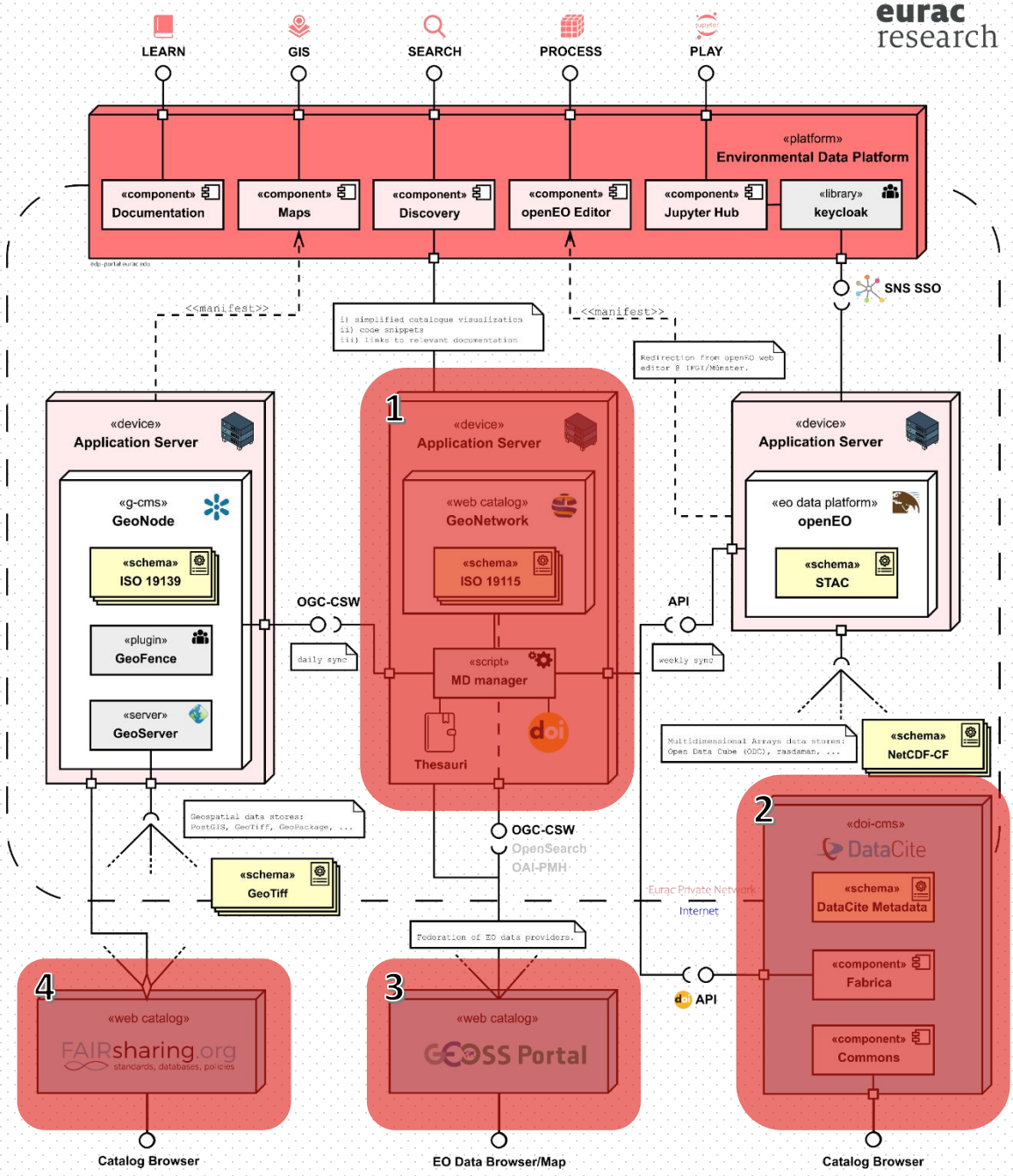
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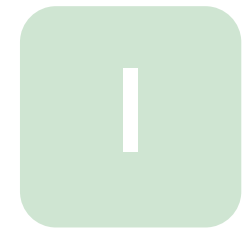


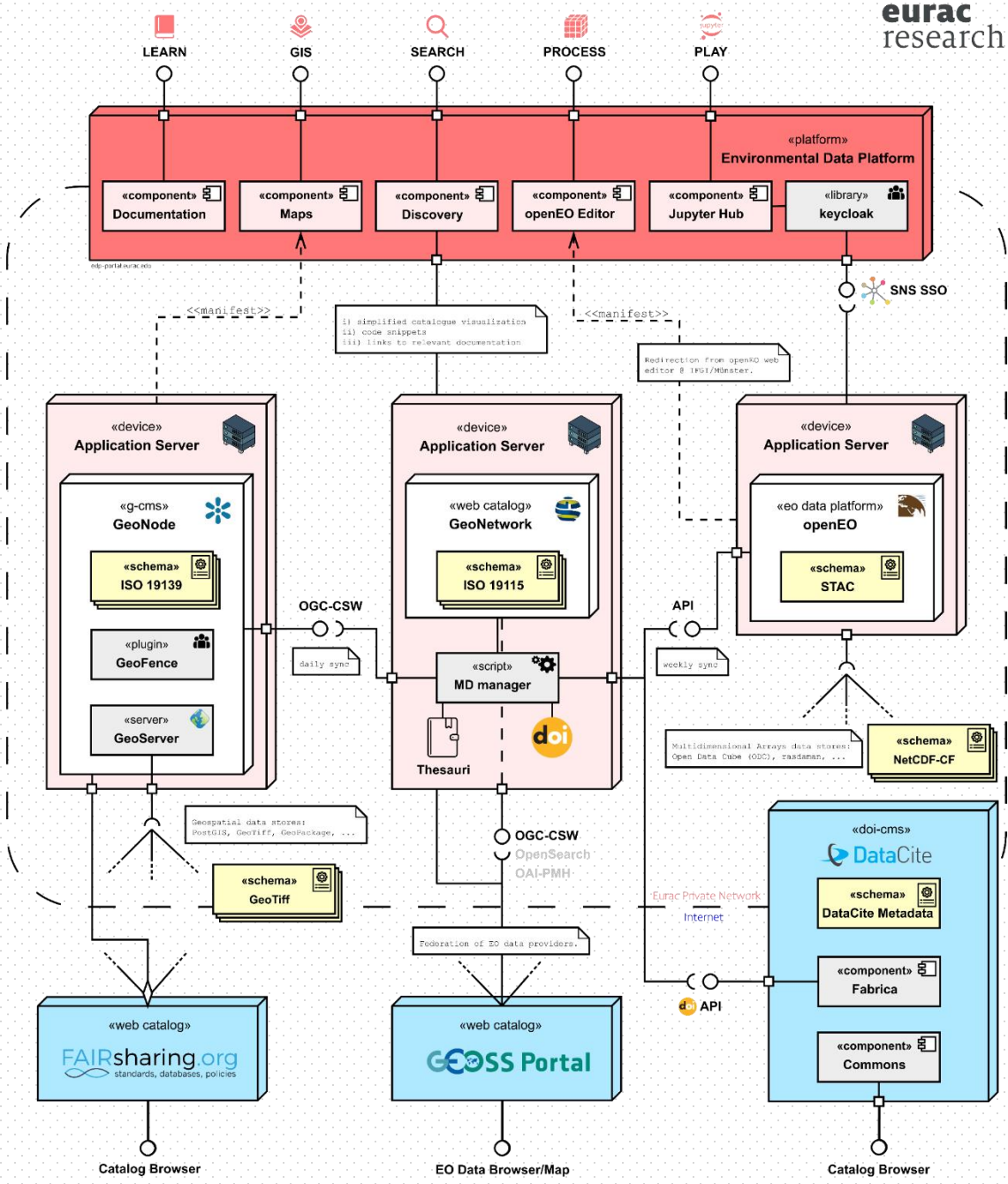
Findability





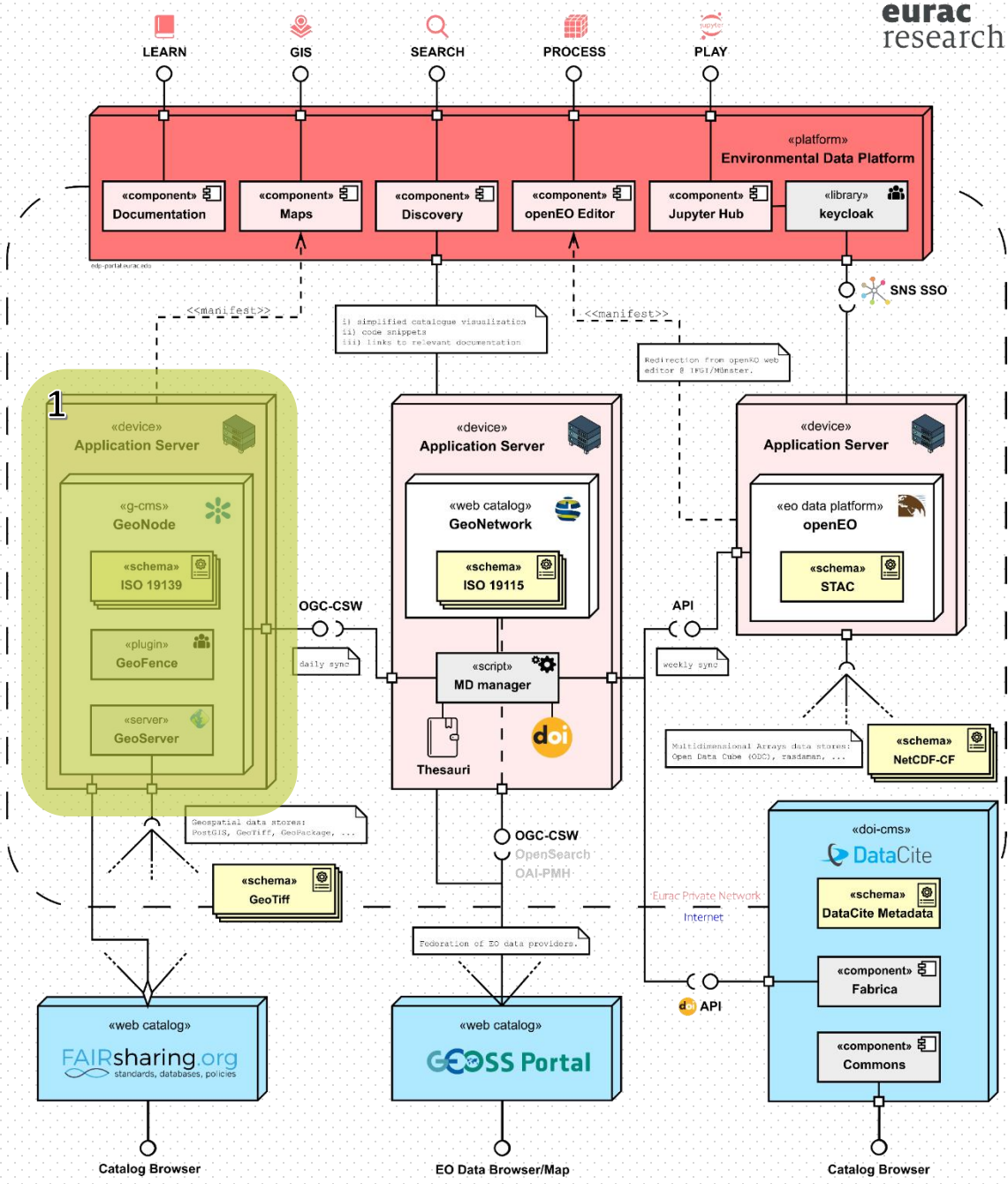
Findability





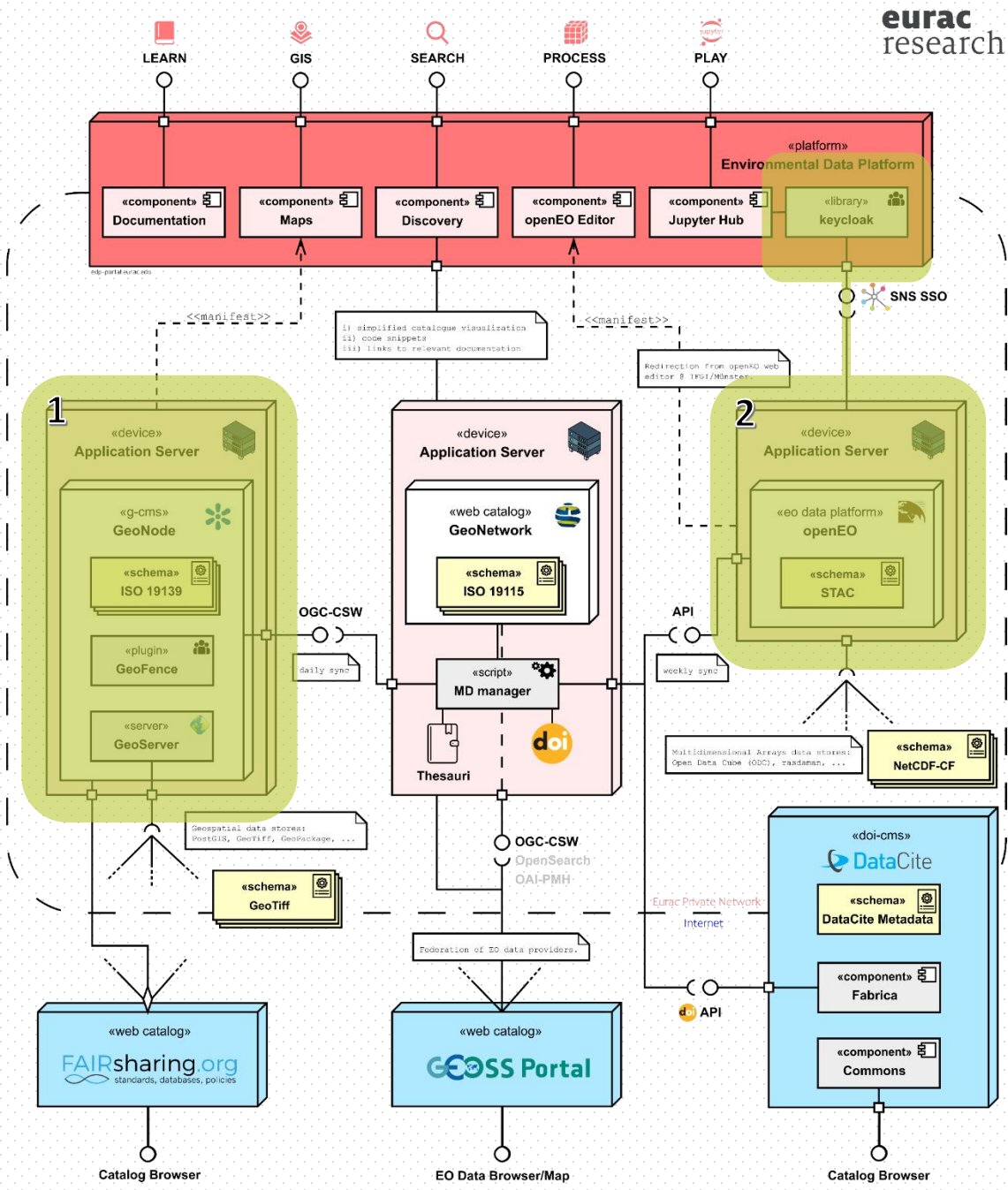
Accessibility





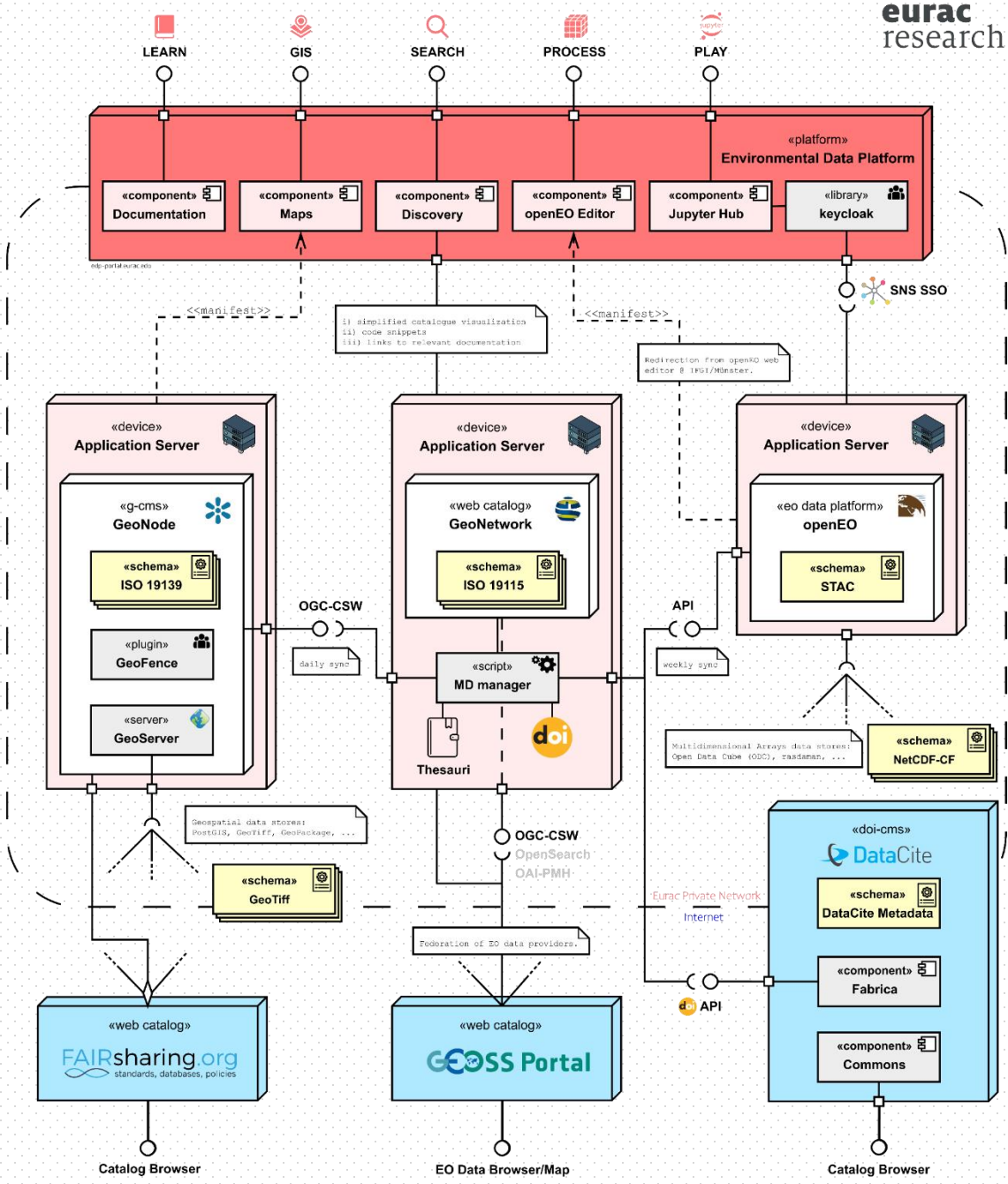
Accessibility



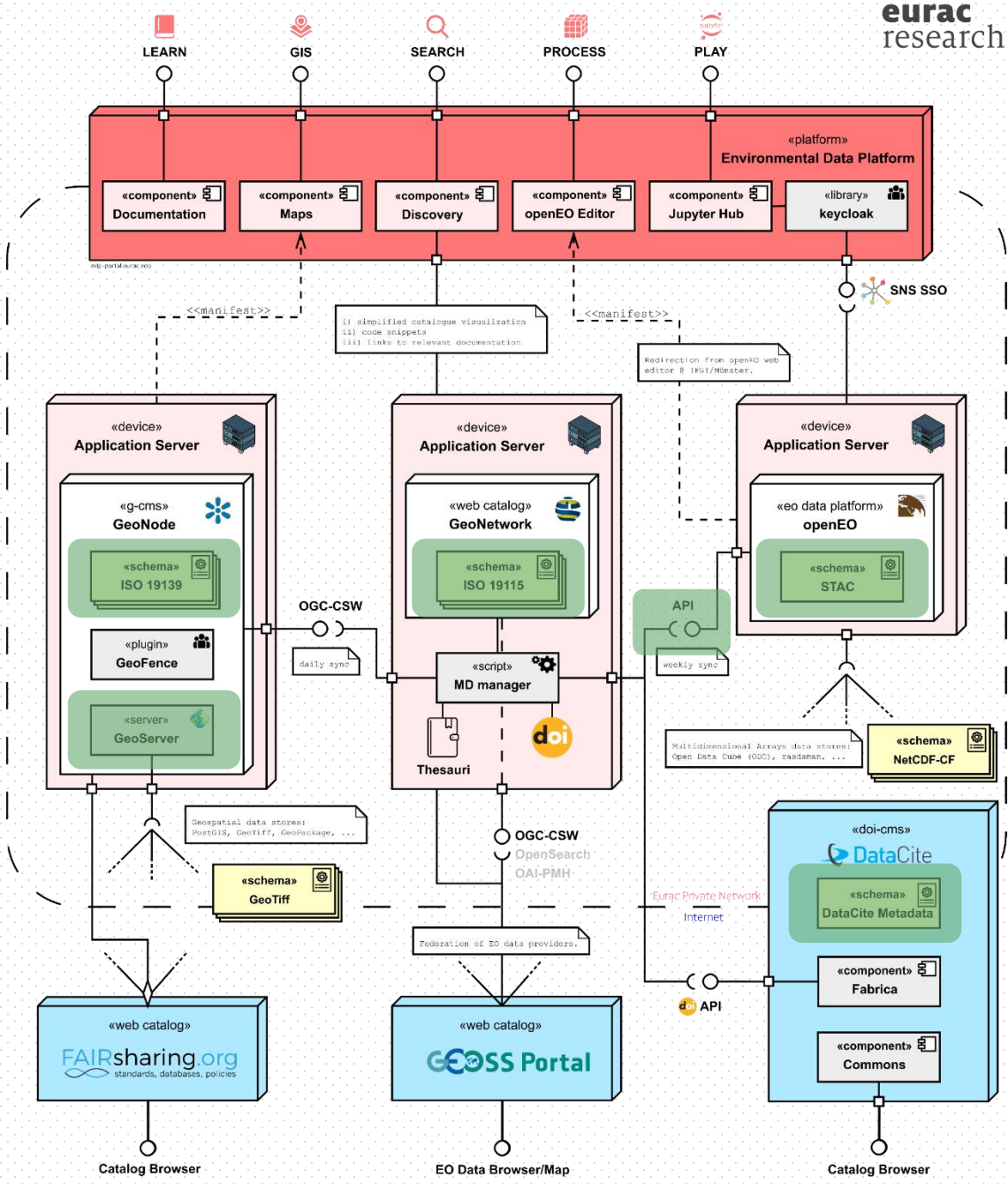


Accessibility

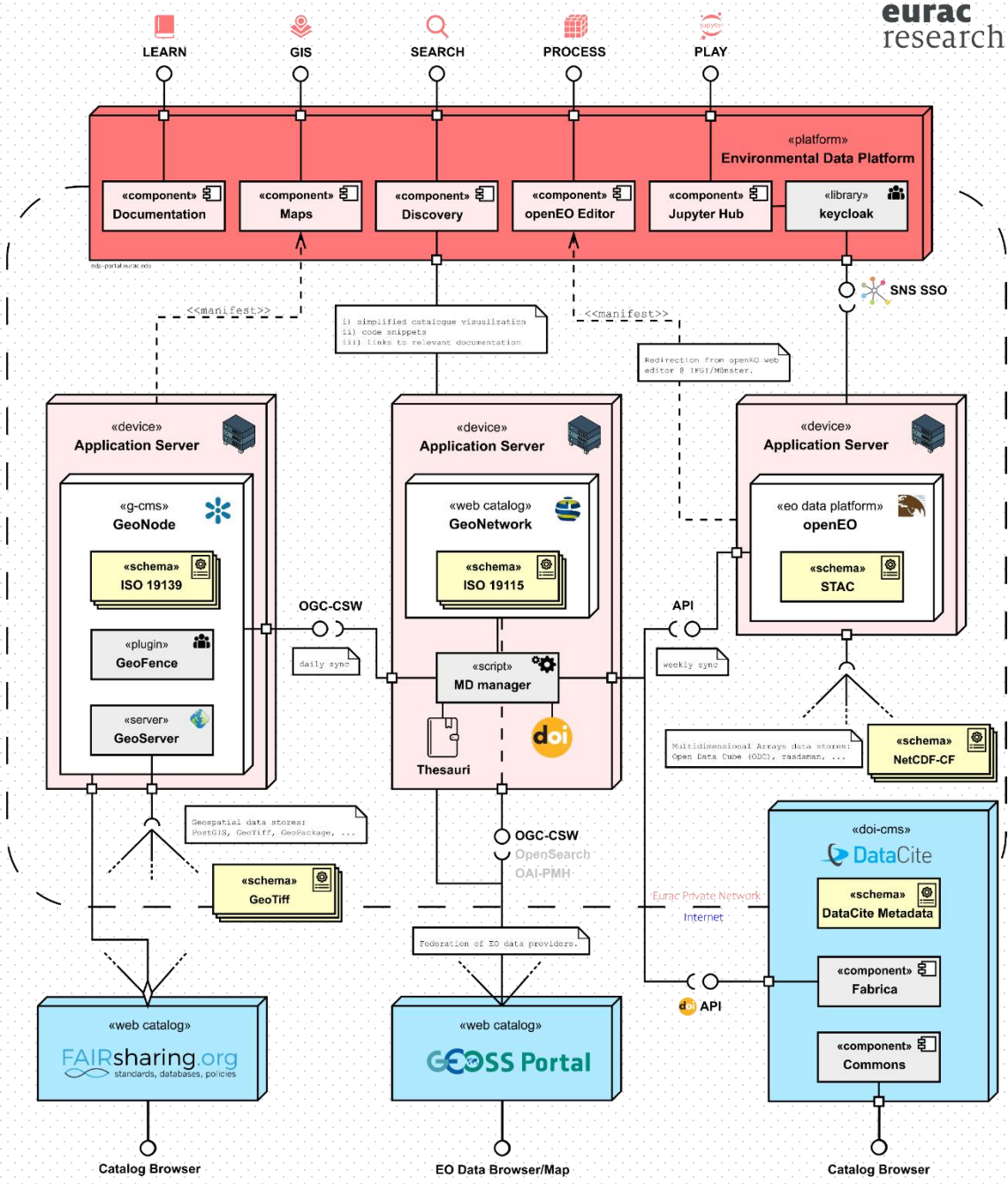




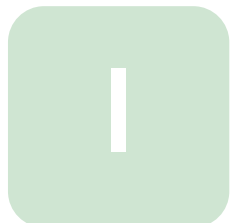
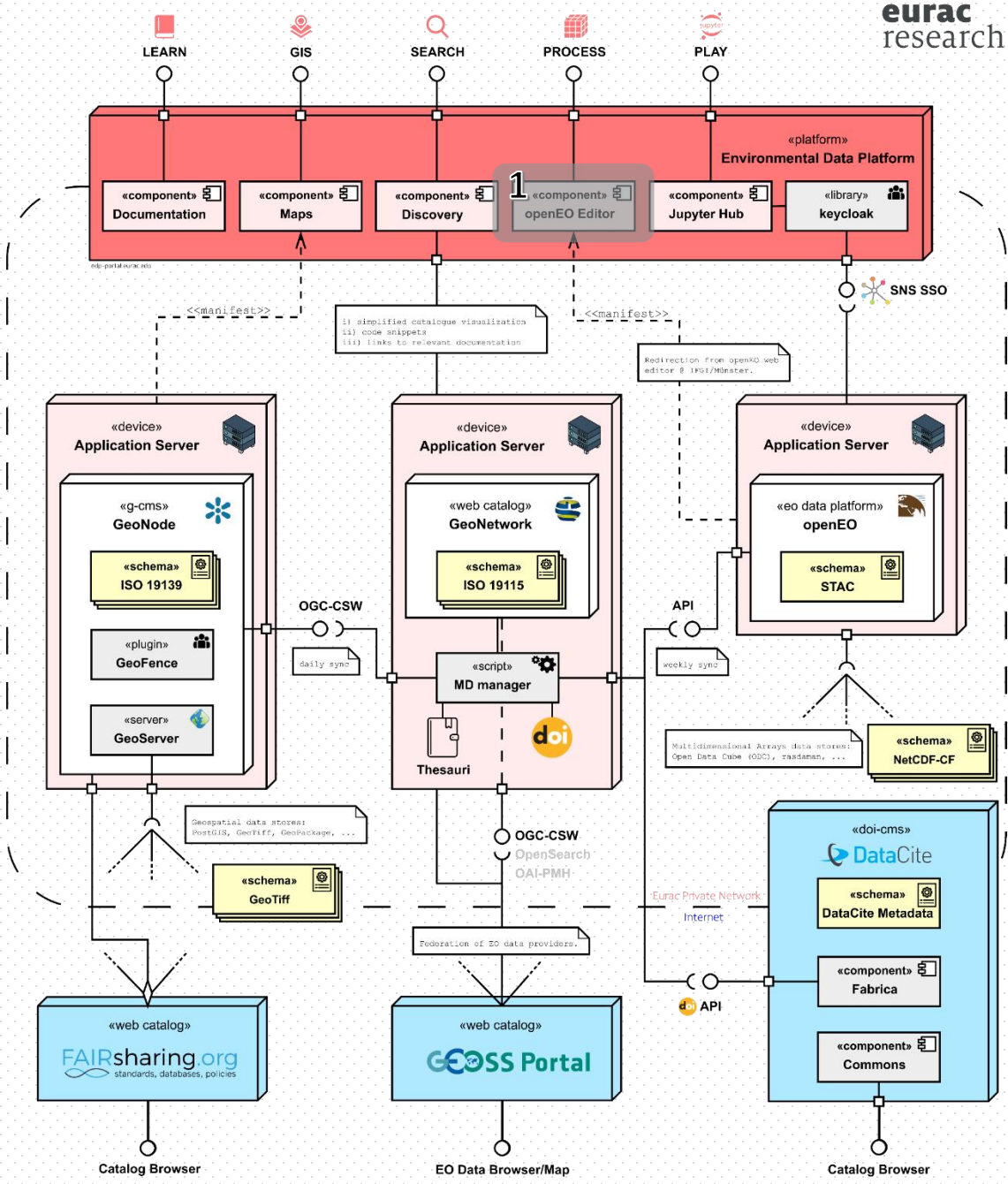
Interoperability¹



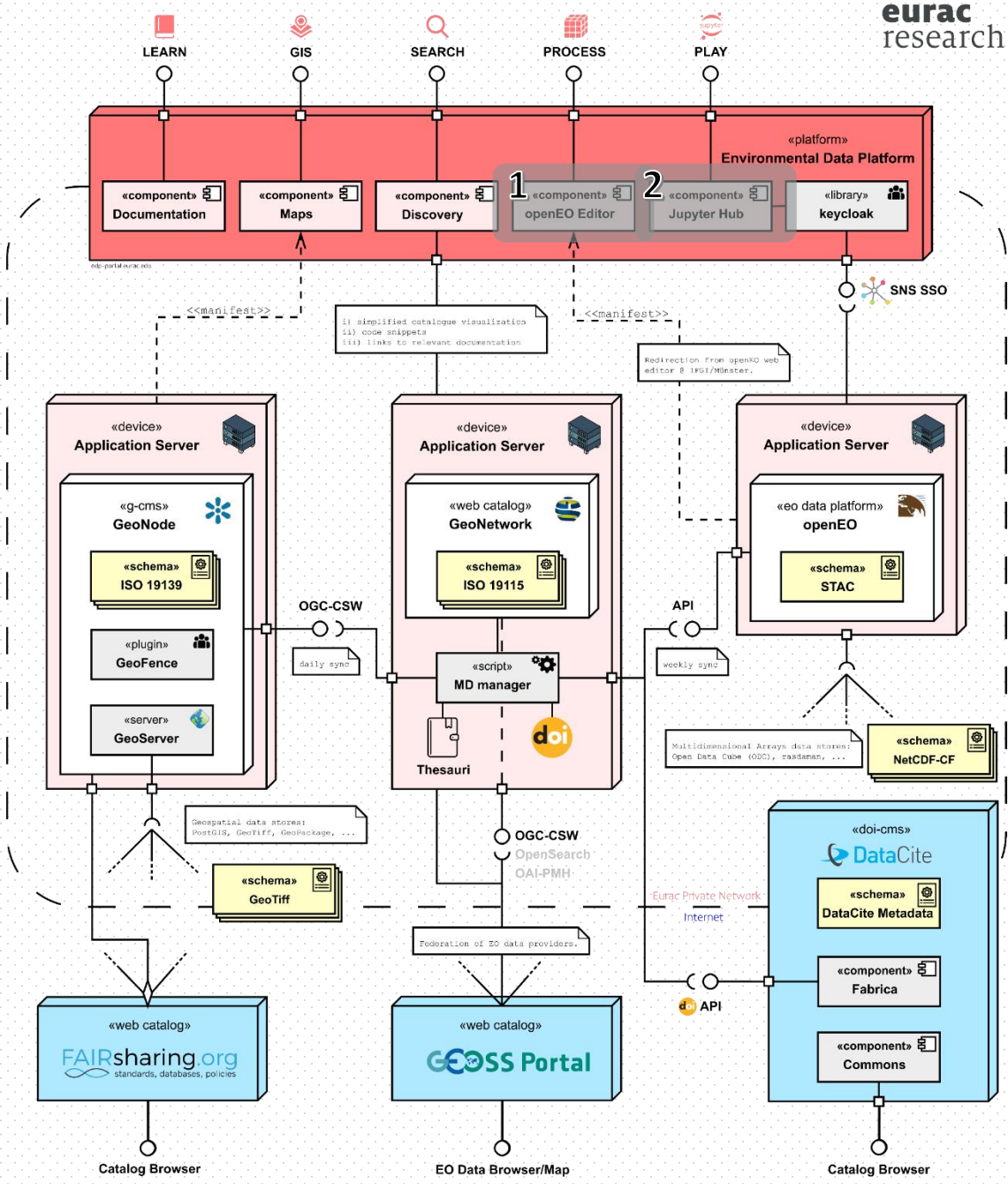
Interoperability₁



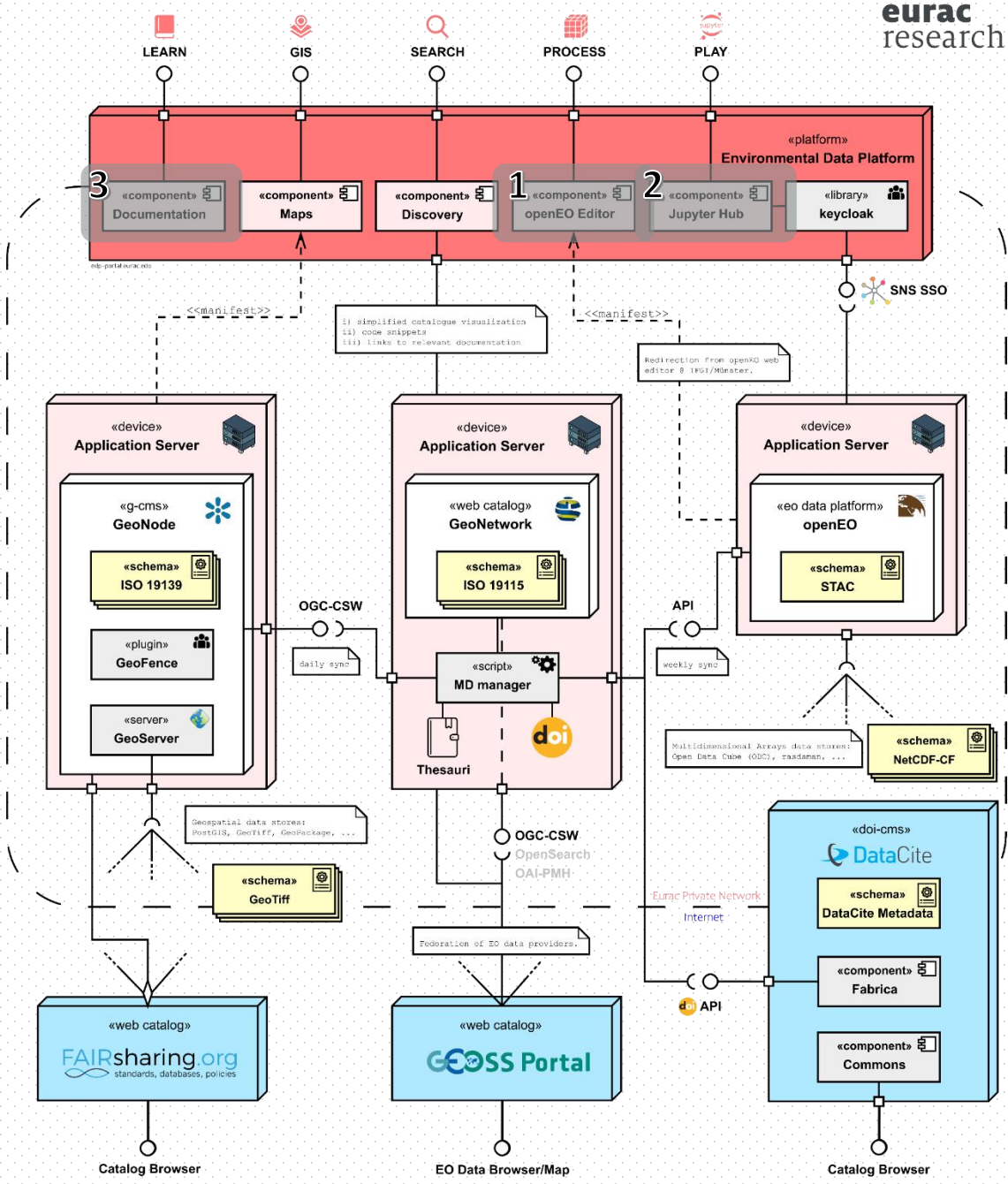
Re-usability



Re-usability



Re-usability



Re-usability

The Bright Side of things

Ready-to-use FAIRness

Ready-to-use FAIRness

❖ Free and Open Source Software (FOSS)

Ready-to-use FAIRness

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- ❖ Standard: protocols, APIs, services, metadata schemas

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- ❖ Metadata compilation wizards
- ❖ R/Python code snippets
- ❖ Long-term

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Monthly climatologies - Climate Data Base


Alice Crespi

Version 1.0 of Climatologies published 2020 in [EDP Metadata Catalogue - Eurac Research](#)

The dataset contains the 1981 – 2010 monthly climatologies of mean, minimum and maximum temperature and total precipitation for more than 250 locations in Trentino – South Tyrol. They were derived from the observation records of the regional meteorological network after checking all series for quality and homogeneity. Climatologies (or normals) are the mean monthly values computed over a 30-years reference interval and they represent the mean local climatic conditions.

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Abstract

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Keywords

climatology, meteorological observations, temperature, precipitation, etc.

Bounding box



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Identification Distribution Quality Lineage Ref. system Metadata

Identification info


Data Identification

Citation

Date (Creation) 15-01-2020 00:00

Overviews


Spatial extent



Keywords

climatology, meteorological observations, precipitation, temperature

GEMET-INSPIRE themes, version 1.0




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Keywords

climatology, meteorological observations, temperature, precipitation, cdb

Bounding box



Period

2

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Bounding box



Period

2

- ✓ Globally unique
- ✓ Persistent
- ✓ Machine resolvable



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[Export \(XML\)](#)

[Keywords](#)

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GUI - Graphical User Interface
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Keywords

```

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The dataset contains the 1981 – 2010 monthly climatologies of mean, minimum and maximum temperature and total precipitation for more than 250 locations in Trentino – South Tyrol. They were derived from the observation records of the regional meteorological network after checking all series for quality and homogeneity. Climatologies (or normals) are the mean monthly values computed over a 30-years reference interval and they represent the mean local climatic conditions. Citation: Crespi, A. (2020). Monthly climatologies - Climate Data Base (Version 1.0) [Data set]. Eurac Research. https://doi.org/10.48784/EGX7-RZ63
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<!-- mri:responsibility -->
  
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ISO-19115

Cite REST API
[datacite.org/doi/10.48784/egx7-rz63](https://api.datacite.org/doi/10.48784/egx7-rz63)

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  "publicationYear": 2020,
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      "name": "Crespi, Alice",
      "type": "Personal"
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DataCite Commons

Works People Organizations Repositories

<https://doi.org/10.48784/egx7-rz63>

Monthly climatologies - Climate Data Base
Alice Crespi

Version 1.0 of Climatologies published 2020 in EDP Metadata Catalogue - Eurac Research

The dataset contains the 1981 – 2010 monthly climatologies of mean, minimum and maximum temperature for more than 250 locations in Trentino – South Tyrol. They were derived from the observation records of the regional meteorological network after checking all series for quality and homogeneity. Climatologies (or normals) are the mean monthly values computed over a 30-years reference interval and they represent the mean local climatic conditions.

DOI registered July 8, 2022 via DataCite.

Dataset Earth and related environmental sciences English

<https://doi.org/10.48784/egx7-rz63>

eurac research EDP-PORTAL Search Map Sign in

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Monthly climatologies - Climate Data Base

The dataset contains the 1981 – 2010 monthly climatologies of mean, minimum and maximum temperature and total precipitation for more than 250 locations in Trentino – South Tyrol. They were derived from the observation records of the regional meteorological network after checking all series for quality and homogeneity. Climatologies (or normals) are the mean monthly values computed over a 30-years reference interval and they represent the mean local climatic conditions.

Citation: Crespi, A. (2020). Monthly climatologies - Climate Data Base (Version 1.0) [Data set]. Eurac Research. <https://doi.org/10.48784/EGX7-RZ63>

Climate Database Documentation
Documentation http://edp-doc.eurac.edu/cdb_doc/

PgAdmin
GUI - Graphical User Interface
<http://10.8.244.139/phpPgAdmin/>

```

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        quality and homogeneity. Climatologies (or normals) are the mean monthly values computed over a 30-years reference interval and they represent the
        mean local climatic conditions. Citation: Crespi, A. (2020). Monthly climatologies - Climate Data Base (Version 1.0) [Data set]. Eurac Research.
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Cite REST API
datacite.org/doi/10.48784/egx7-rz63

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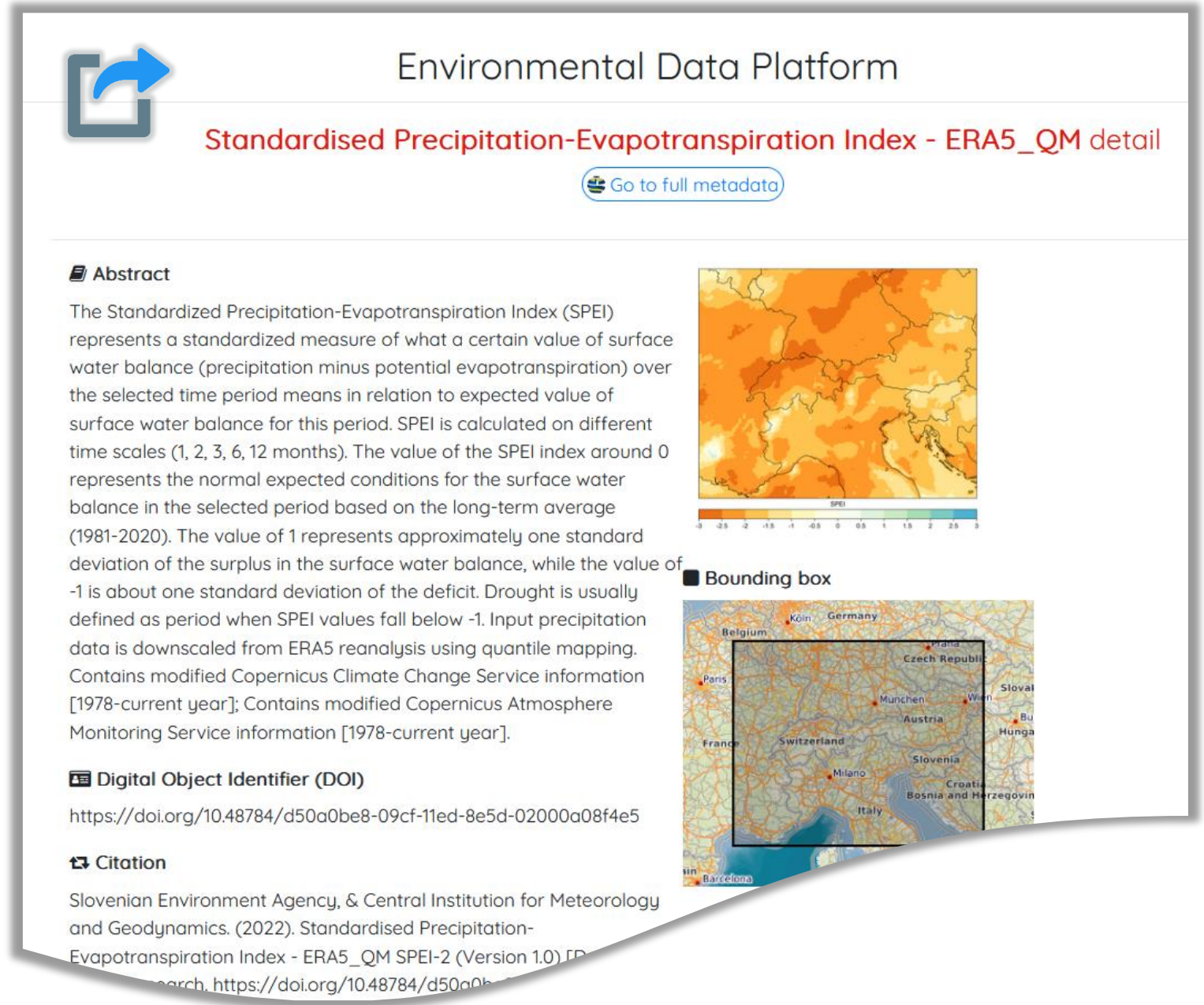
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OGC-CSW

A fairly good example:

- ✓ Readable title
- ✓ Descriptive abstract
- ✓ License
- ✓ DOI
- ✓ Citation
- ✓ Keywords
- ✓ Time validity
- ✓ Contact information
- ✓ Thumbnail
- ✓ ...



The screenshot displays a web page for the 'Environmental Data Platform'. At the top, there is a blue icon of a document with a right-pointing arrow. The title 'Environmental Data Platform' is centered at the top. Below it, the dataset title 'Standardised Precipitation-Evapotranspiration Index - ERA5_QM detail' is shown in red. A button labeled 'Go to full metadata' is positioned below the title. The main content area is divided into sections: 'Abstract', 'Digital Object Identifier (DOI)', and 'Citation'. The 'Abstract' section contains a detailed description of the SPEI index, its calculation, and its application. The 'DOI' section provides the URL 'https://doi.org/10.48784/d50a0be8-09cf-11ed-8e5d-02000a08f4e5'. The 'Citation' section lists the Slovenian Environment Agency and Central Institution for Meteorology and Geodynamics as the authors, with the year 2022. To the right of the text, there are two maps. The top map is a heatmap showing SPEI values across a region, with a color scale ranging from -3 (dark orange) to 3 (dark blue). The bottom map is a geographical map of Central Europe, with a black bounding box highlighting the area covered by the SPEI data. The bounding box map includes labels for countries like Belgium, France, Switzerland, Italy, Germany, Austria, Slovenia, and Croatia, as well as cities like Paris, München, Wien, and Milano.

Environmental Data Platform

Standardised Precipitation-Evapotranspiration Index - ERA5_QM detail

[Go to full metadata](#)

Abstract

The Standardized Precipitation-Evapotranspiration Index (SPEI) represents a standardized measure of what a certain value of surface water balance (precipitation minus potential evapotranspiration) over the selected time period means in relation to expected value of surface water balance for this period. SPEI is calculated on different time scales (1, 2, 3, 6, 12 months). The value of the SPEI index around 0 represents the normal expected conditions for the surface water balance in the selected period based on the long-term average (1981-2020). The value of 1 represents approximately one standard deviation of the surplus in the surface water balance, while the value of -1 is about one standard deviation of the deficit. Drought is usually defined as period when SPEI values fall below -1. Input precipitation data is downscaled from ERA5 reanalysis using quantile mapping. Contains modified Copernicus Climate Change Service information [1978-current year]; Contains modified Copernicus Atmosphere Monitoring Service information [1978-current year].


Digital Object Identifier (DOI)

<https://doi.org/10.48784/d50a0be8-09cf-11ed-8e5d-02000a08f4e5>

Citation

Slovenian Environment Agency, & Central Institution for Meteorology and Geodynamics. (2022). Standardised Precipitation-Evapotranspiration Index - ERA5_QM SPEI-2 (Version 1.0) [Dataset]. Environmental Data Platform. Search. <https://doi.org/10.48784/d50a0be8-09cf-11ed-8e5d-02000a08f4e5>

Bounding box



A fairly good example:

- ✓ Readable title
- ✓ Descriptive abstract
- ✓ License
- ✓ DOI
- ✓ Citation
- ✓ Keywords
- ✓ Time validity
- ✓ Contact information
- ✓ **Thumbnail**
- ✓ ...

The screenshot displays the Environmental Data Platform (EDA) interface. At the top, it says "Environmental Data Platform" and "Standardised Precipitation-Evapotranspiration Index - ERA5_QM detail". A button labeled "Go to full metadata" is visible. Below this, the GEOS Portal header includes logos for GEO GROUP ON EARTH OBSERVATIONS, GEOS Portal, and ESA, along with a language selector set to "English".

The main content area shows search results for "SPEI". The first result is "Standardised Precipitation-Evapotranspiration Index - ..." by EURAC Research, featuring a thumbnail map of Europe. The second result is "SPEI-6 monthly gridded dataset, CARPATCLIM area" by Danube Open Data Portal. The third result is "High resolution SPEI monthly projection for the globe..." by Joint Research Centre Data Catalog. The fourth result is "SPEI-12 monthly gridded dataset, CARPATCLIM area" by Danube Open Data Portal. A "Sources: GEOS [72]" filter is shown at the bottom of the results list.

Below the search results, a "Citation" section is visible, providing the following text: "Slovenian Environment Agency, & Central Institution for Meteorology and Geodynamics. (2022). Standardised Precipitation-Evapotranspiration Index - ERA5_QM SPEI-2 (Version 1.0) [Dataset]. Research. https://doi.org/10.48784/d50a0b...".

The Dark Side

System maintenance

Multiple catalogues/sub-systems/schemas/ ...
They all make up a complex architecture to be managed and synchronized.

System maintenance

Multiple catalogues/sub-systems/schemas/ ...
They all make up a complex architecture to be managed and synchronized.

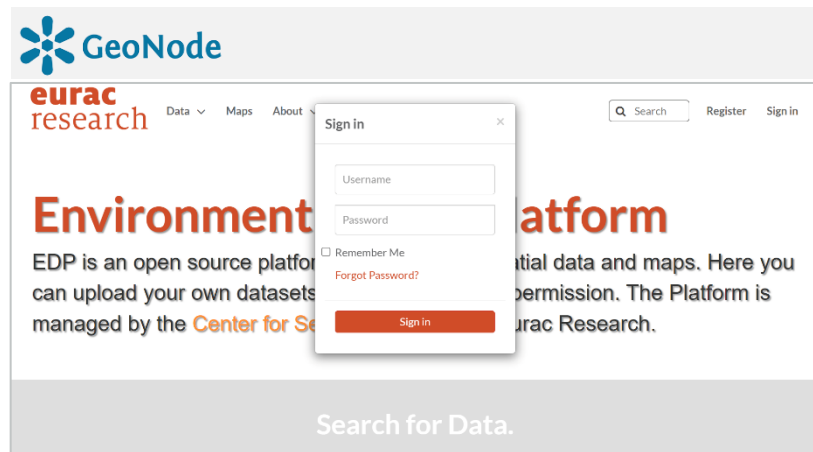
- Tangle of metadata mappings
- How to edit/update a field smoothly?
- Software updates

Unharmonized realms

Non-expert users can feel pulled back by the heterogeneity of the system.

Unharmonized realms

Non-expert users can feel pulled back by the heterogeneity of the system.



The human factor

Poor, incorrect, or missing metadata fields are a major problem to FAIRness.



2 The road ahead

Towards a more rugged and complete adherence to the principles.

Truly complete metadata records

Incrementally add compliance to a plurality of relevant data attributes for full re-usability.

Truly complete metadata records

Incrementally add compliance to a plurality of relevant data attributes for full re-usability.

- Data provenance
- Relations and qualified references among datasets
- Formal knowledge representation / ontologies
- Data access levels

Data versioning

Implement the metadata support and the proper processes for a viable versioning of datasets.

Data versioning

Implement the metadata support and the proper processes for a viable versioning of datasets.

→ DOI replacement

→ Tombstone page

→ Legacy data (un)availability?

The data steward bottleneck

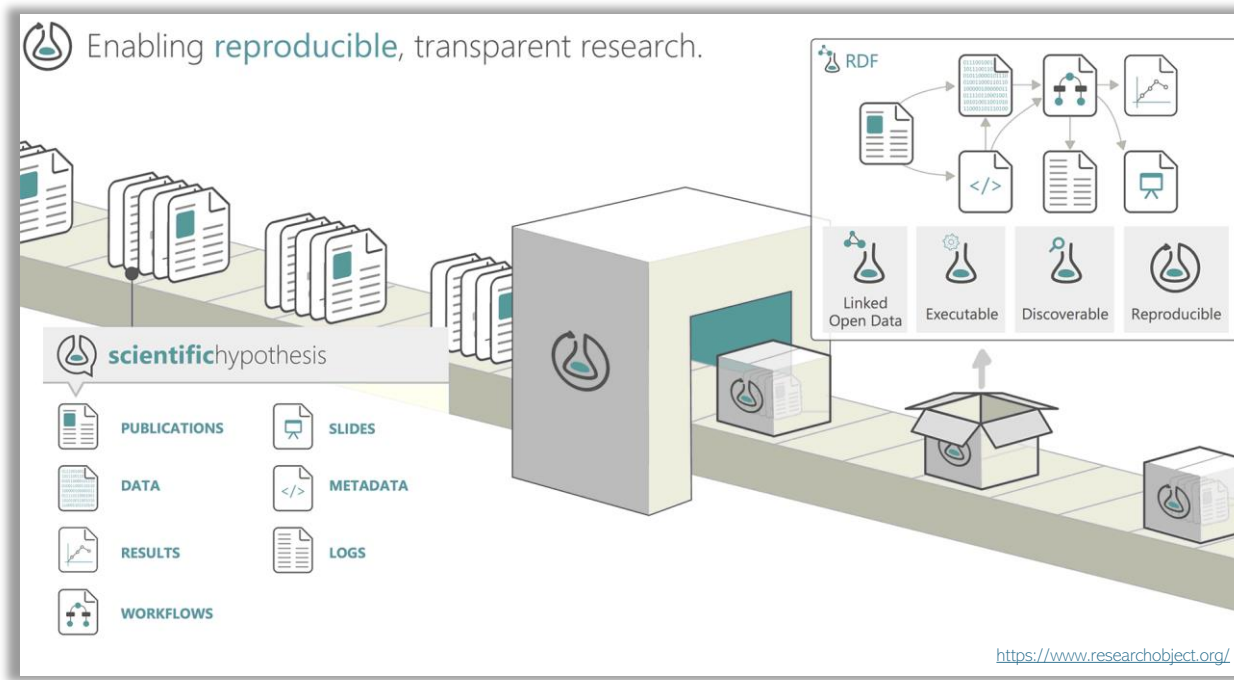
Raise awareness among all co-researchers about the importance of rich metadata, distributing the workload away from the data steward.



Research Objects

[doi:10.1038/NPRE.2010.4626.1](https://doi.org/10.1038/NPRE.2010.4626.1)

Manage datasets as just a component of a reproducible research experiment.



Further links:

- ❑ The FAIR guiding principles

<https://force11.org/info/the-fair-data-principles/>

- ❑ FAIRdata Forum

<https://fairdataforum.org/>

- ❑ Open Science Handbook

<https://open-science-training-handbook.gitbook.io/book/>

eurac research

 <https://ror.org/01xt1w755>



Link to this presentation:

[doi:10.5281/zenodo.7743977](https://doi.org/10.5281/zenodo.7743977)