Sustainable FAIR Data management is challenging for RIs and it is challenging to solid Earth scientists

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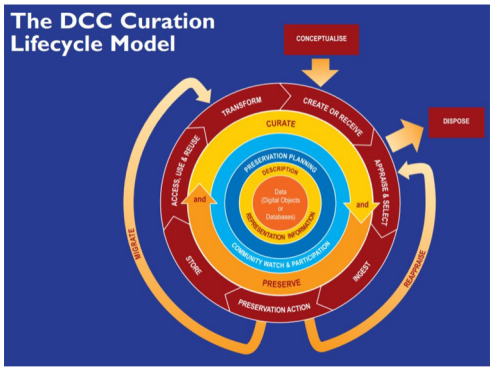
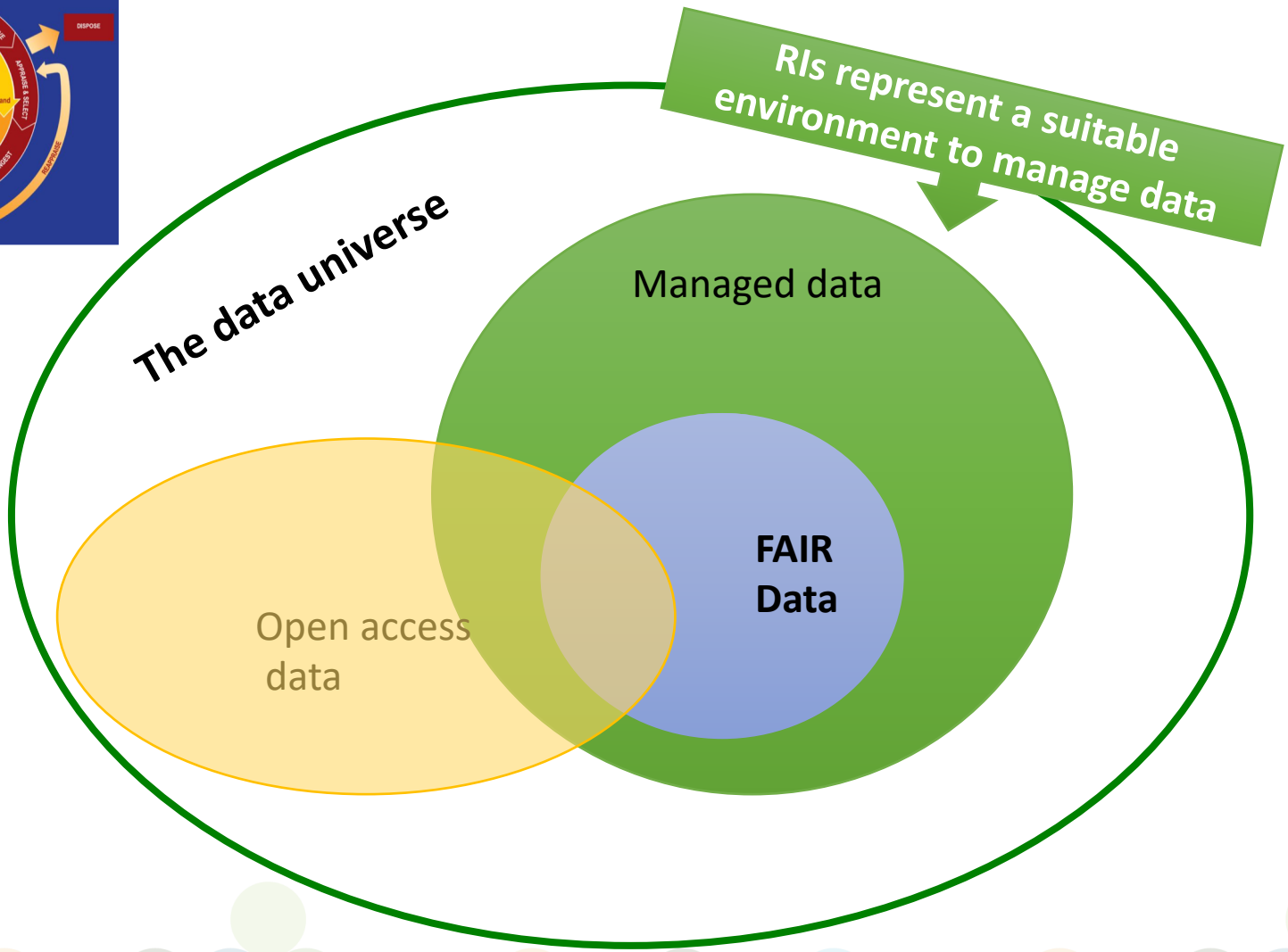
The Data Generation Universe

Research Infrastructures (RIs) sample a limited portion of the Data Generation Universe, while ensuring:

- Quality Controlled data
- Standardized Data & Metadata
- Metadata Curation & Integration
- Data Curation and Integration
- Services curation and integration
- Access to data and products
- Visualization of integrated data
- Access to multidisciplinary data
- Generation of new scientific products
- Data qualification
- Service qualification

All Research Data





Sketch from S Venkataraman, DCC

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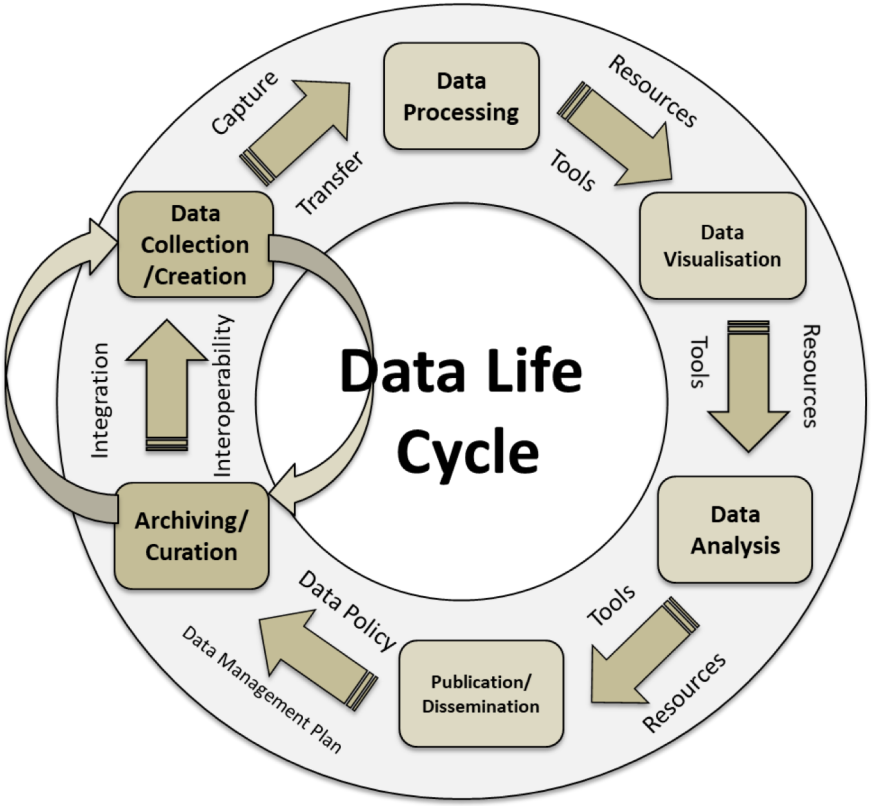
RIs experiences corroborate that good data requires good management of the research data lifecycle

- **Data Management (plan)** requires the full control over the entire Data Life Cycle
- Data Management involves **Technical** and **Legal** aspects and it implies **Governance**
- This requires resources, thus involving a **Financial** dimension
- DLC starts with **data creation/collection**
- It is followed by **processing, visualization and analysis**
- Final stage is **publication/dissemination** of data and **open access**
- It is then necessary to have the **archiving and curation** in place, following the **FAIR principles**
- This requires **integration** and **interoperability**



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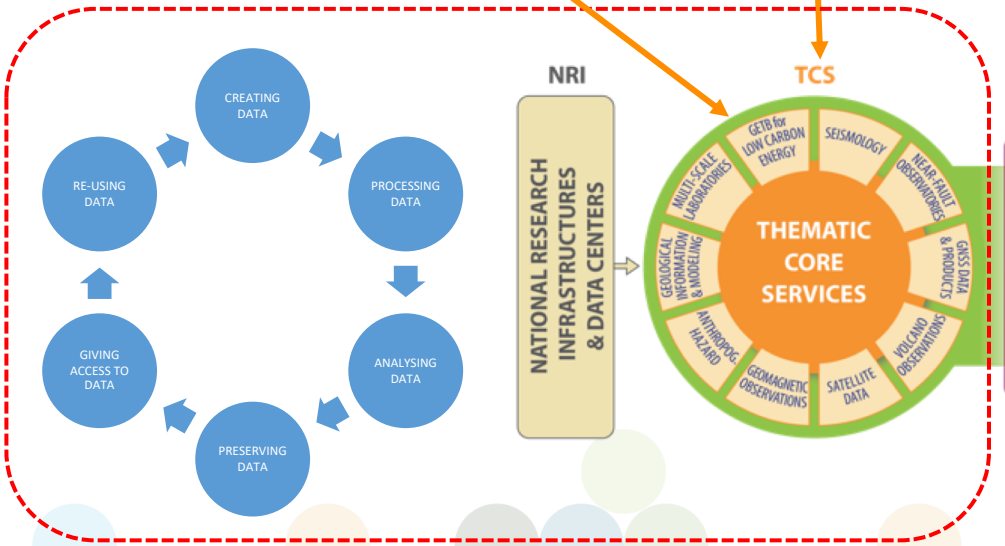
RIs work on data interoperability since decades according to their architecture

TCS currently involved in EPOS



Findable
Accessible
Interoperable
Reusable
+
Reproducible

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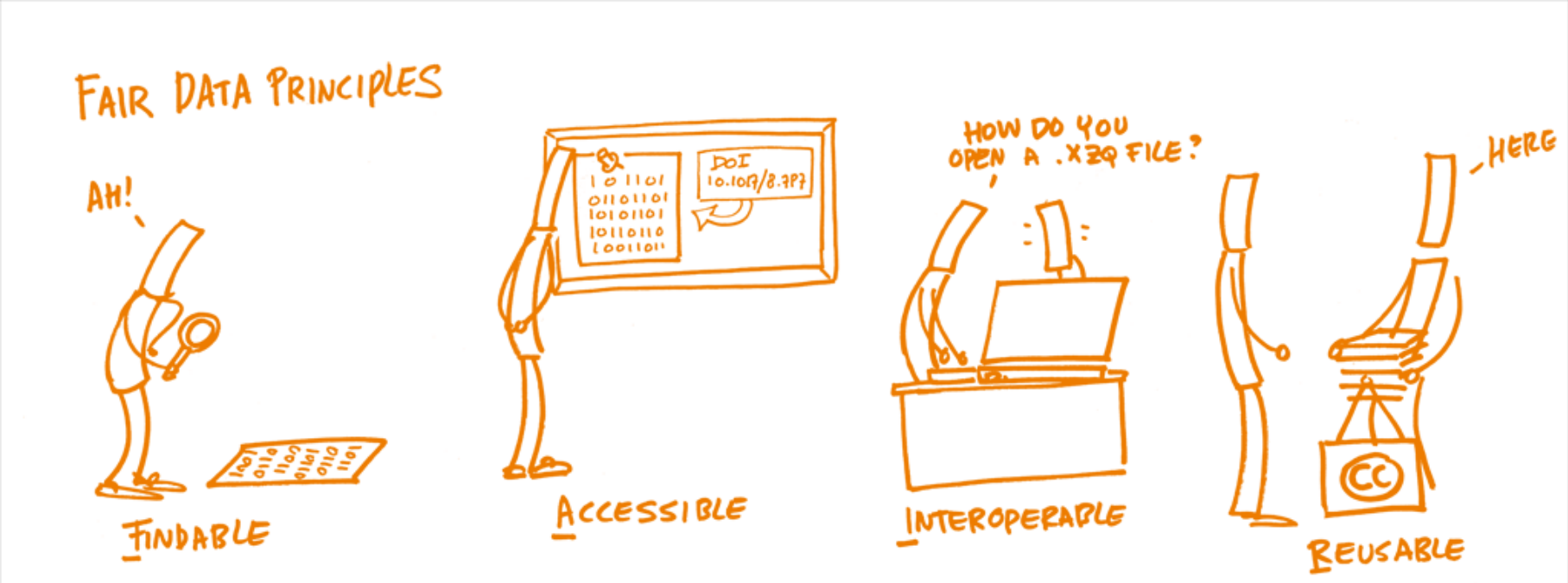
FAIR guiding principles for research data have further and better defined the FAIRness horizon



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FAIR DATA PRINCIPLES

Findable:

F1. (meta)data are assigned a globally unique and persistent identifier;

F2. data are described with rich metadata;

F3. metadata clearly and explicitly include the identifier of the data it describes;

F4. (meta)data are registered or indexed in a searchable resource;

Accessible:

A1. (meta)data are retrievable by their identifier using a standardized communications protocol;

A1.1 the protocol is open, free, and universally implementable;

A1.2. the protocol allows for an authentication and authorization procedure, where necessary;

A2. metadata are accessible, even when the data are no longer available;

Interoperable:

I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.

I2. (meta)data use vocabularies that follow FAIR principles;

I3. (meta)data include qualified references to other (meta)data;

Reusable:

R1. meta(data) are richly described with a plurality of accurate and relevant attributes;

R1.1. (meta)data are released with a clear and accessible data usage license;

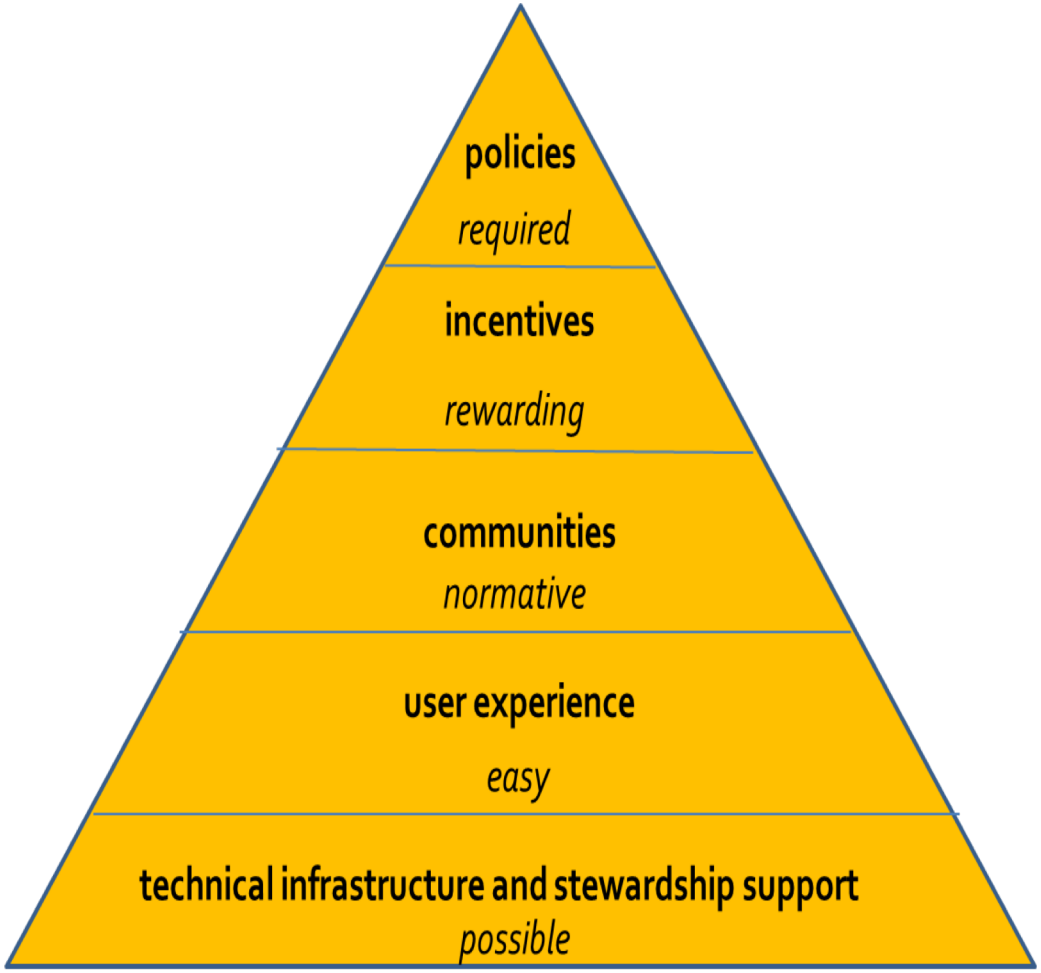
R1.2. (meta)data are associated with detailed provenance;

R1.3. (meta)data meet domain-relevant community standards;

OpenAIRE

https://www.force11.org/group/fairgroup/fairprinciples

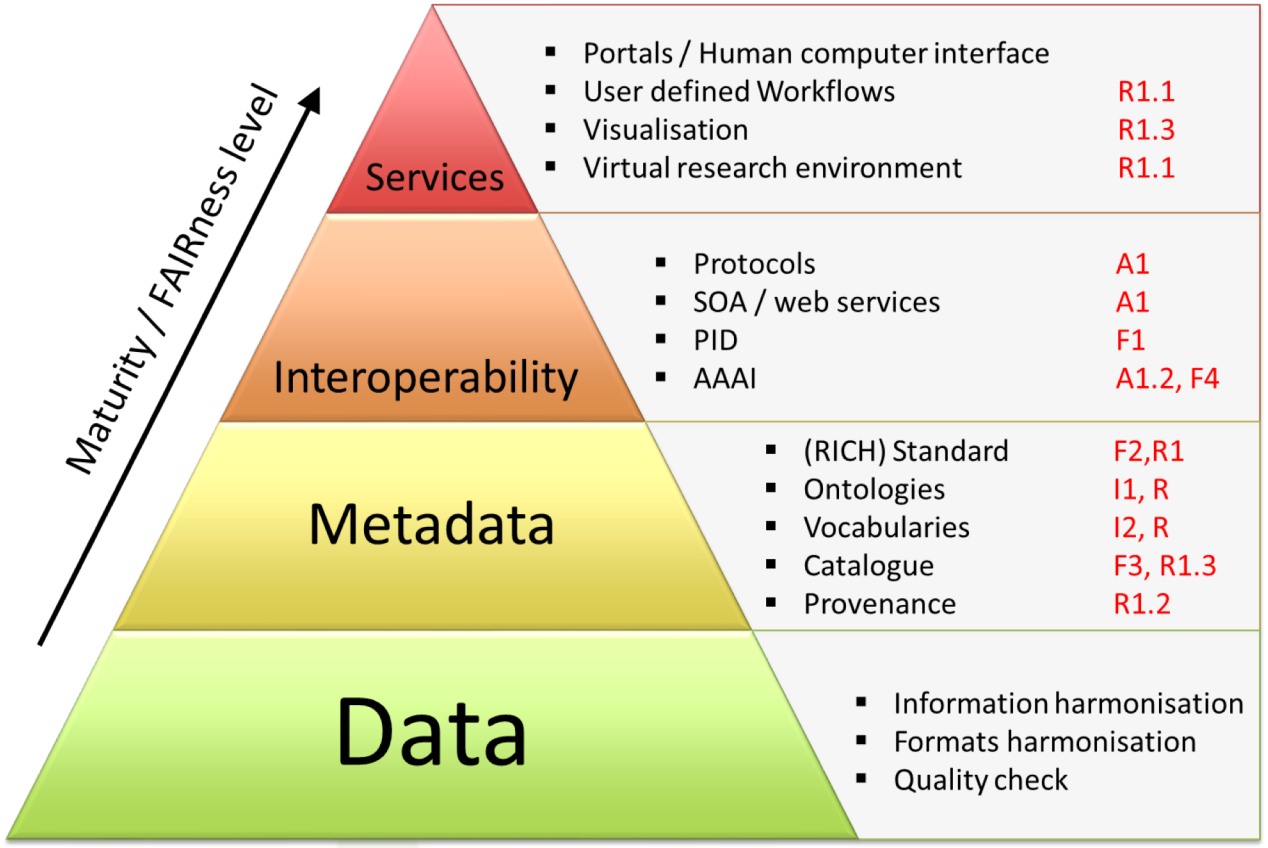
Data Management and FAIR principles demands for FAIR Data Management Plans



[Matt Spritzer, COS]

FAIR principles requires practices and solutions

Maturity / FAIRness "roadmap"



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Bailo et al. (2020) [Front. Earth Sci., 31 January 2020 | https://doi.org/10.3389/feart.2020.00003]

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FAIR Data Management through sustainable practices

- The adoption of PRACTICES following FAIR data principles involves:
  - Suitable **Technical** solutions for data integration and interoperability (Integrated metadata, shared metadata standards - 15 metadata formats to be standardized in DCAT-, SOA Interoperability services , data provenance …)
  - Effective **Legal** solutions (shared Data Policies, access rules, licensing of data - CC:BY - and metadata - CC:0)
  - Effective **Governance** of integrated Data engaging data and service providers and IT experts (community building, awareness, trust)
  - A **Financial** dimension to ensure sustainable management ensuring resources for data archiving, storage and long-term preservation, data qualification, access and management of persistent identifiers, ….
- Turning FAIR principles into practice requires:
  - ✓ adequate human resources and skills
  - ✓ Shared and adopted Data Management Plans
  - ✓ ICT solutions and resources
  - ✓ Adopting a suitable timeline, being aware that it does not necessarily correspond to the expectations of the authorities promoting FAIRness.

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Conclusive Remarks

- FAIRness requires clear methodologies and technical activities in order to move from principles to reality
- FAIR Data Management needs active participation of data producers and practitioners
- FAIR Data Management needs a suitable timeline involving all interested stakeholders
- The sustainability of FAIR DATA Management is still a challenge for Research Infrastructures (RIs)
- FAIR DATA Management is even more challenging to Earth scientists

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Open Science & FAIR Data require Resources

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