Proposed Knowledge Graph to Connect Data, Applications and People

Suggestion for joint work with Group on Earth Observations (GEO) Expert Advisory Group (EAG)
GEOSS\textsuperscript{1} Knowledge Hub Aspiration

- Curated and Linked Documents to...
- ...make reproducible results available
  - Methods
  - Data (esp. ARD)
  - Software

- Technologies
  - Cloud Computing
  - JSON-LD
  - schema.org

\textsuperscript{1}Global Earth Observations System of Systems
GEOSS Knowledge Hub Aspiration

Fig. 1 in GEO EAG Discussion Paper “Building the infrastructure for a results-oriented GEOSS”
Useful Artifacts in the Knowledge Hub

(a) Journal paper

(b) In-situ data

(c) R code in github

(d) Cloud data in AWS

(e) Results
Earth Observation Knowledge Graph

Connect together the main elements of EO knowledge AND context in a way that is:

• Machine-readable
• Human-usuable
• Curatable
This kind of Graph

Not this kind of Graph
GEOSS Connections

- Publication
- Result
- Exploitation System
- Instrument
- Satellite

- Person
- Workflow
- Dataset
- Application
- Discipline

- Software
- Model
- Essential Variable
- Project
- Organization
Other Important Connections

- Publication
- Result
- Exploitation System
- Instrument
- Satellite
- Person
- Workflow
- Dataset
- Application
- Discipline
- Software
- Model
- Essential Variable
- Project
- Organization
Other Important Connections

Publication → Result → Exploitation System → Instrument → Satellite

Person

Workflow

Dataset

Application

Discipline

Software

Model

Essential Variable

Project

Organization

Training Material
Example

Organization: NASA

Organization: ESA

sponsors

Project: MAAP

uses

Dataset:
doi:10.3334/ORNL DAAC/1601
Example

Instrument: UAVSAR
Project: MAAP
Dataset: doi:10.3334/ORNL DAAC/1601
Software: PLAnT
Person: orcid:0000-0002-9858-6454
Organization: NASA
Organization: ESA

Article: doi:10.1109/RADR.2006.1631770
Article: doi:10.1109/IGAR SS.2017.8127498
Article: doi:10.1109/IGAR SS.2016.7730395

AfriSAR uses works with AffiSAR
works on
works with
authored
produced
collected
described in
described in
described in
Potential Use Cases

Answering Questions for Developers and Users

- What **Organizations** are producing **Datasets** used by **Exploitation System X**?
- **Who** knows a lot about **Science Application X**?
- Which **Organizations** are using **Dataset X** and for what purpose?
- How was **Result X** obtained: which **data** and **tools/services**?

Connecting Systems
Suggested Pilots

- Knowledge Graph for NASA-ESA MAAP
- Knowledge Graph for GeoGLAM Crop Monitor
- Demonstration queries

ESA = European Space Agency
MAAP = Multi-mission Algorithm and Analysis Platform
GeoGLAM = Group on Earth Observations Global Agricultural Monitoring Initiative
## Suggested Division of Labor

<table>
<thead>
<tr>
<th>Task</th>
<th>GEO</th>
<th>WGISS / CEOS</th>
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<tbody>
<tr>
<td>Requirements and Design</td>
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<td>✓</td>
</tr>
<tr>
<td>Knowledge Hub Implementation</td>
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<td>Naming Authority Engineering*</td>
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<td>✓</td>
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<tr>
<td>Knowledge Hub Operations</td>
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</tbody>
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*Eliminating duplication is the key to curation; Unique identifiers is the key to preventing eliminating
Leveraging and Learning from Current Efforts

- Global Change Information System (GCIS)
- Global Change Master Directory (GCMD)
- Committee on Earth Observing Satellites (CEOS) Tool Inventory
- Unified Metadata Model (Services ↔ Collections)
- Javascript Object Notation-Linked Data (JSON-LD)
- OGC Testbed 15 EOPAD thread (JSON + Services)
Global Change Information System

Connecting global change resources.

18 indicators 2,063 reports

7,470 articles 1,602 figures

1,275 journals 378 findings

407 books 114 tables

3,199 datasets 7 scenarios

13,769 people 8,102 organizations

JSON YAML