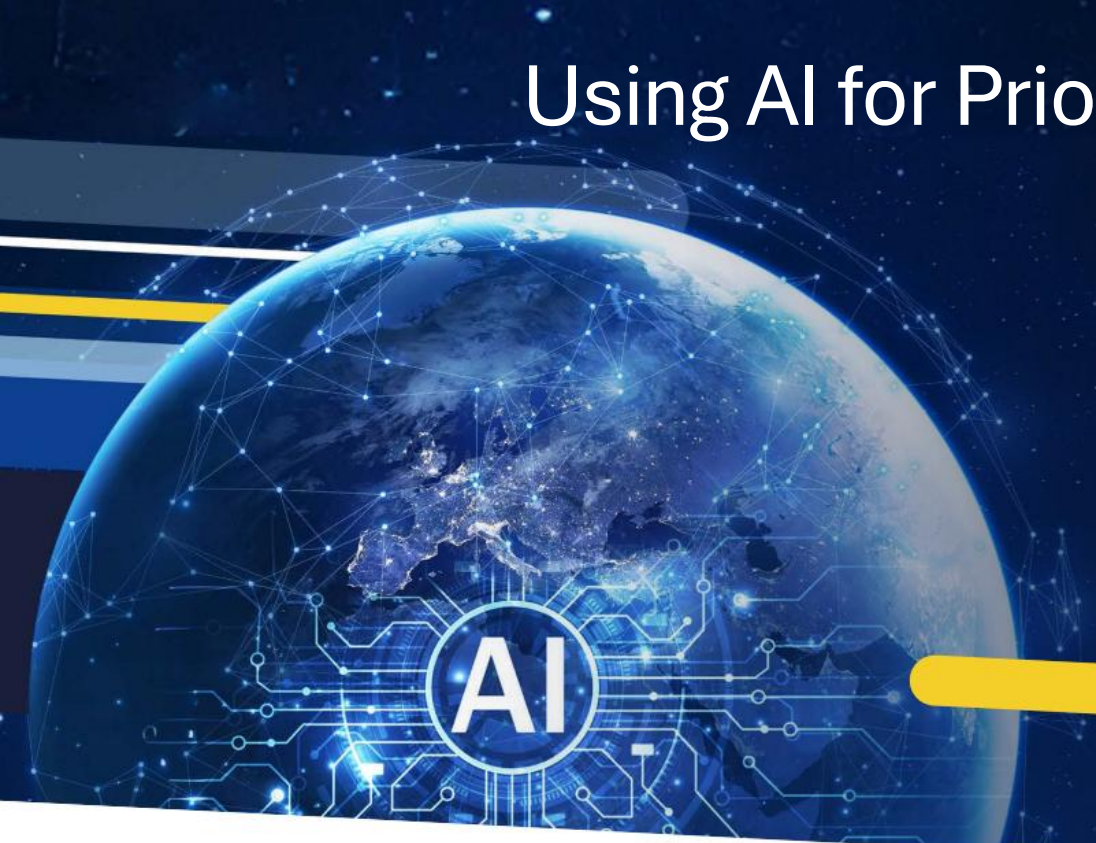
Using AI for Prioritizing Policy-Driven Earth Observation Product Requirements at the KCEO



Miguel Vallejo Orti
Knowledge Centre On Earth Observation (KCEO)
European Commission - Joint Research Centre

Artificial Intelligence and Earth Observation: from Innovation to Services

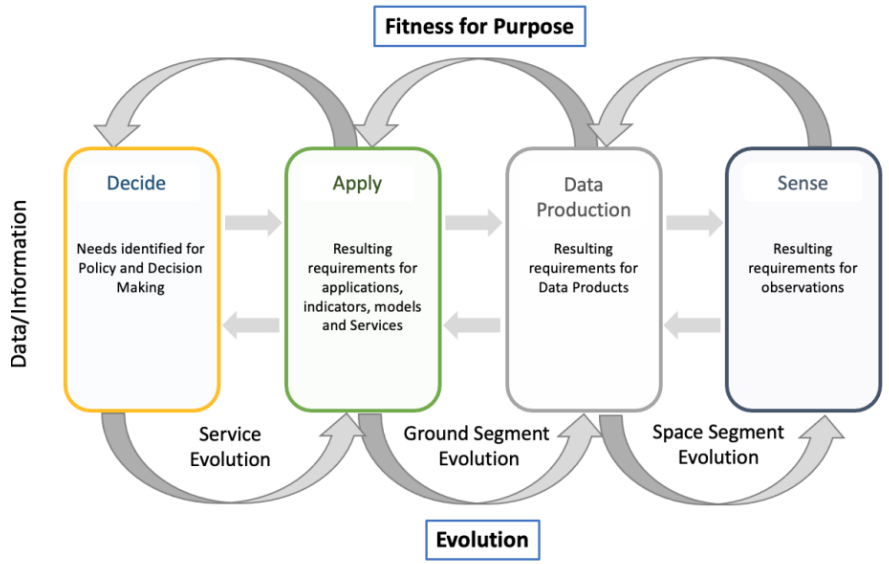
9 March 2026, Brussels

European Commission | PROGRAMME OF THE EUROPEAN UNION | opernicus Europe's eyes on Earth | Destination Earth | #EUSpace

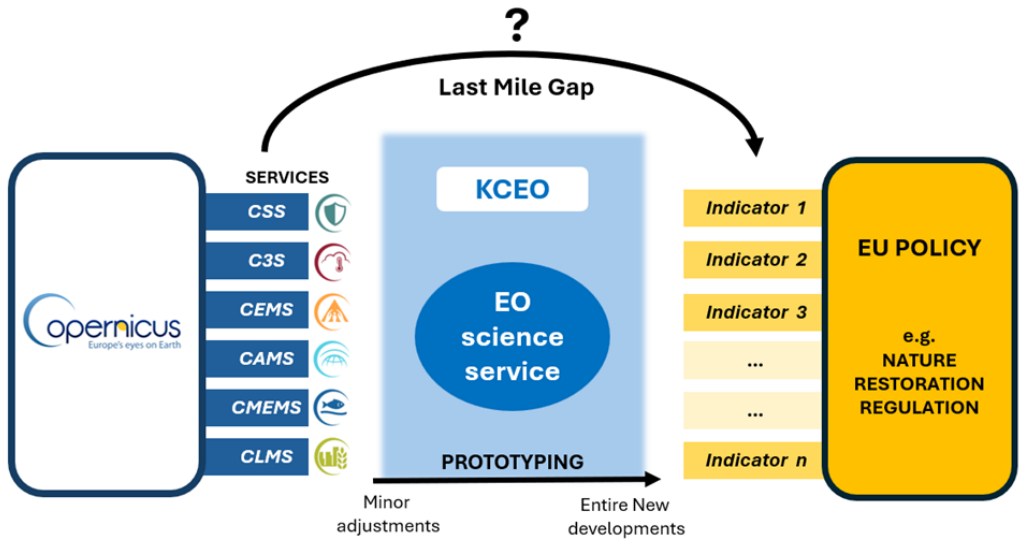
KCEO Overview

KCEO supports policymakers ***to fully exploit*** the potential of ***EO data, products and applications*** for the implementation of ***EU policies***.

Assessing ***EU policies needs*** and translating into ***technical requirements*** for EO products and services.



Analysing ***research needs*** and priorities for ***innovating*** EU Earth Observation programmes



KCEO Overview

EU Policies, Earth Observation and AI

European Commission

Deep Dives

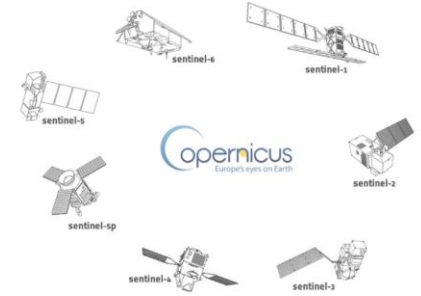
1. Identification of Policy EO Needs

2. Harmonization of Metadata

3. Data **Discovery (Products Taxonomy)**

EUR-Lex

EU Policies → **EO Needs** → **Product Requirements** → **ASSESSMENT** ← **Product Catalogues** ← **EO Products and Services**

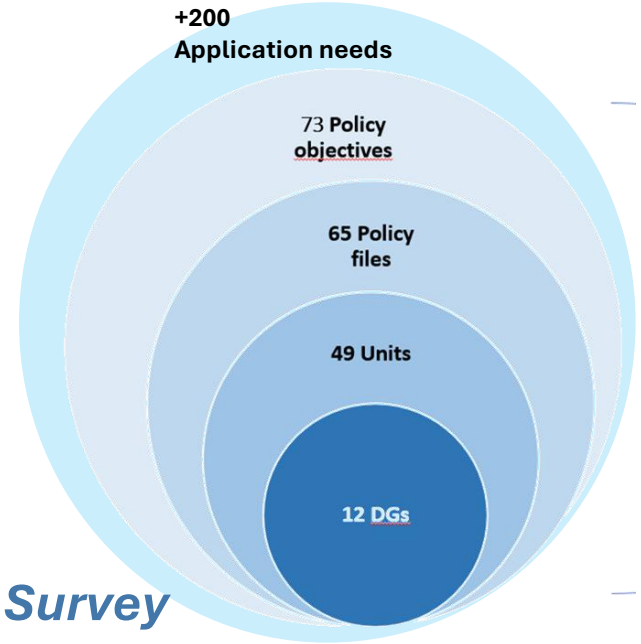


Match | **Partial Match** | **No Match**

4. Priorization of EO needs

342 EO products

Multiple Sensing Platforms

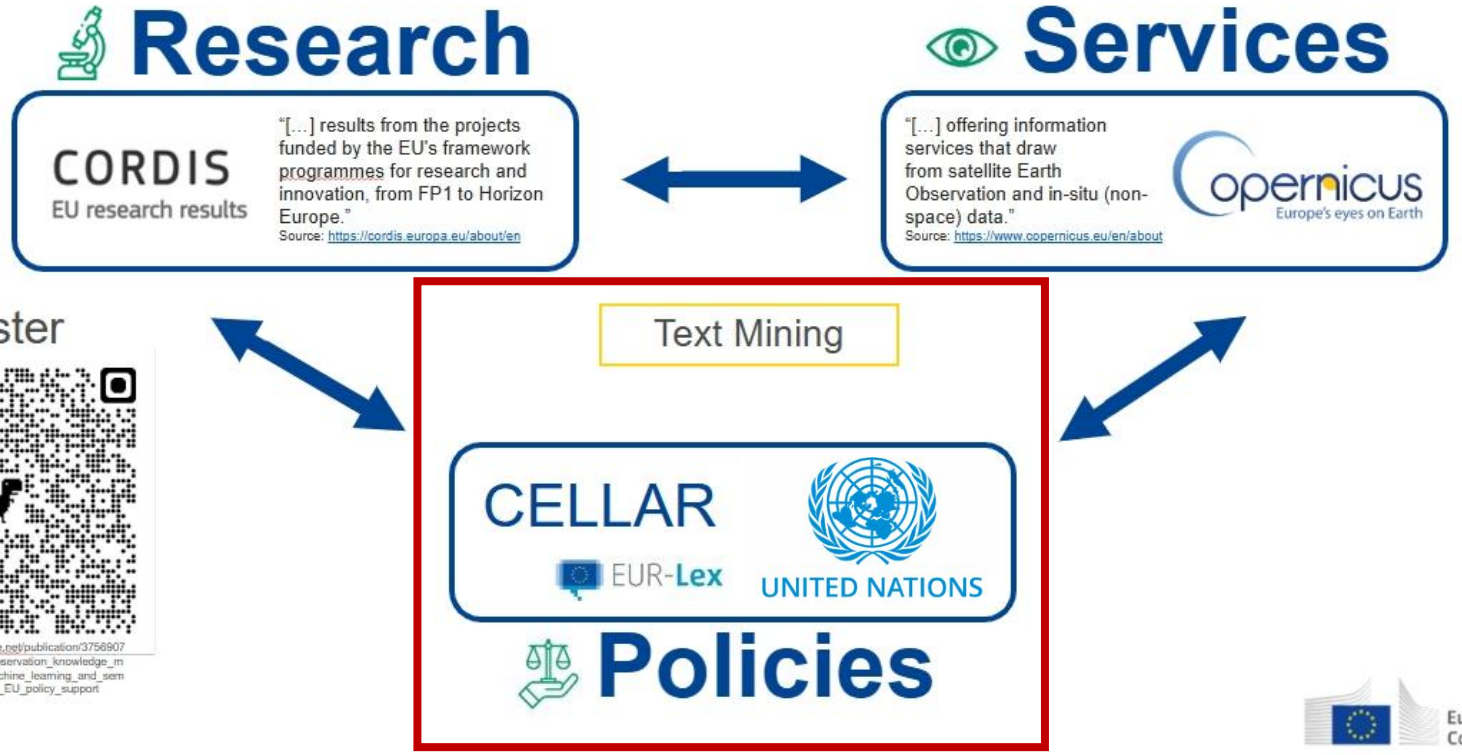


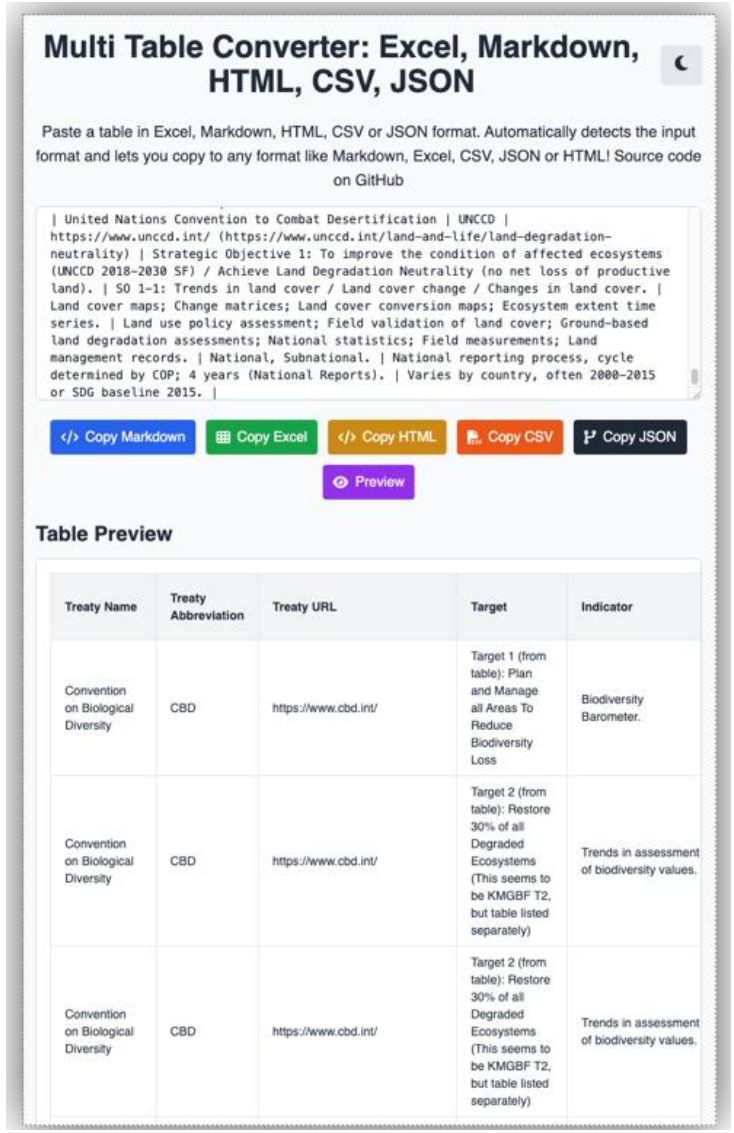
Survey

Where AI supports our work?

1. Identification of Policy EO Needs

Initial Extraction of Targets, Indicators and EO application needs





2. Harmonization of Metadata

European Commission | KCEO Glossary

Temporal extent

1 Definition

The **Period** during which **Data** was collected, **observations** were made, or for which the **Model** was run.

Notes

- In W3C is the definition of temporal coverage
- Time **Period** covered by a series of **observations** inclusive of the specified date/time indications (**Measurement** history). Defined based on the beginning and end dates of **observations**.

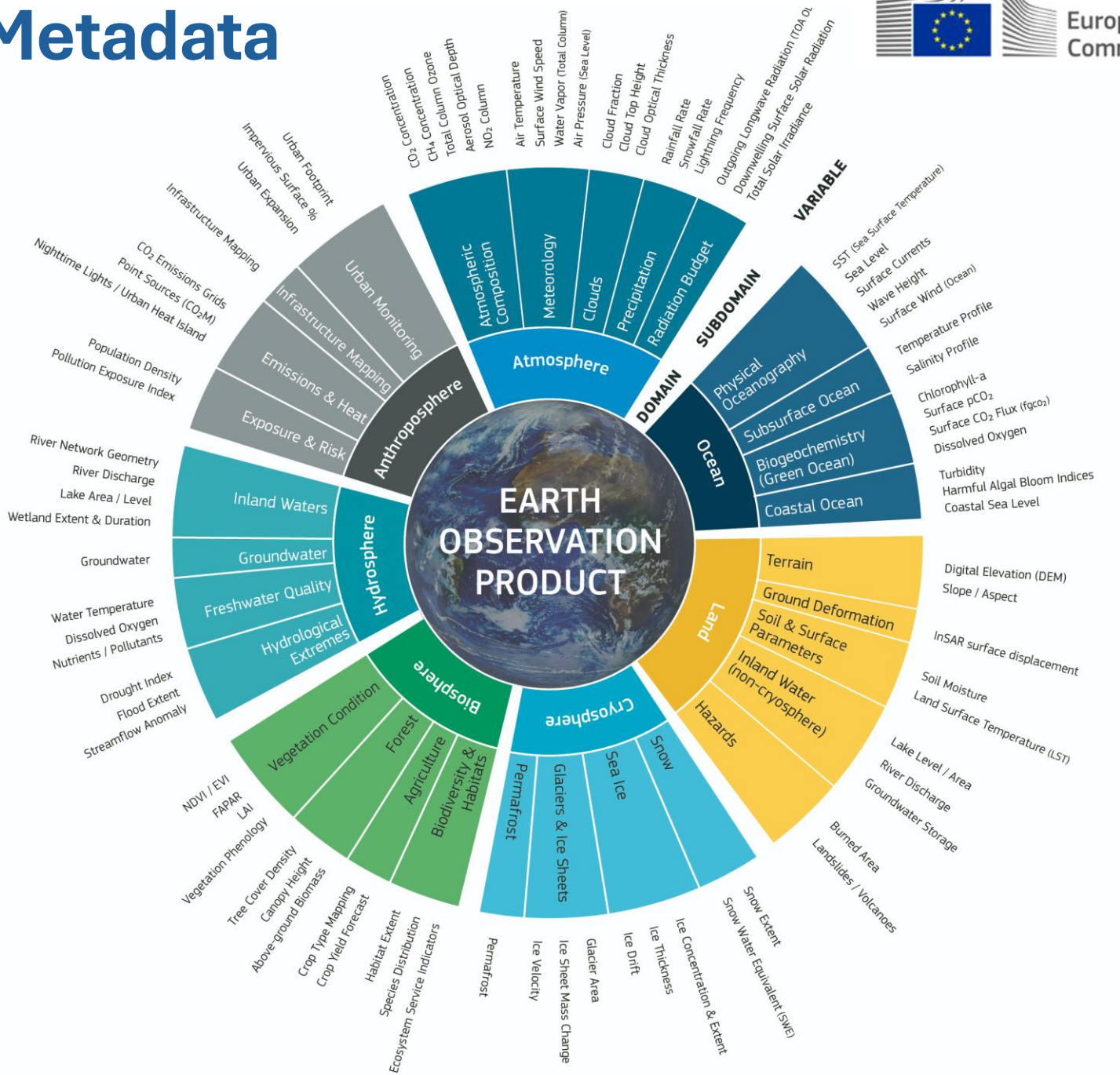
Examples

- WIGOS **Metadata**

Sources

- adapted from W3C

January 30, 2026 January 30, 2026 GitHub



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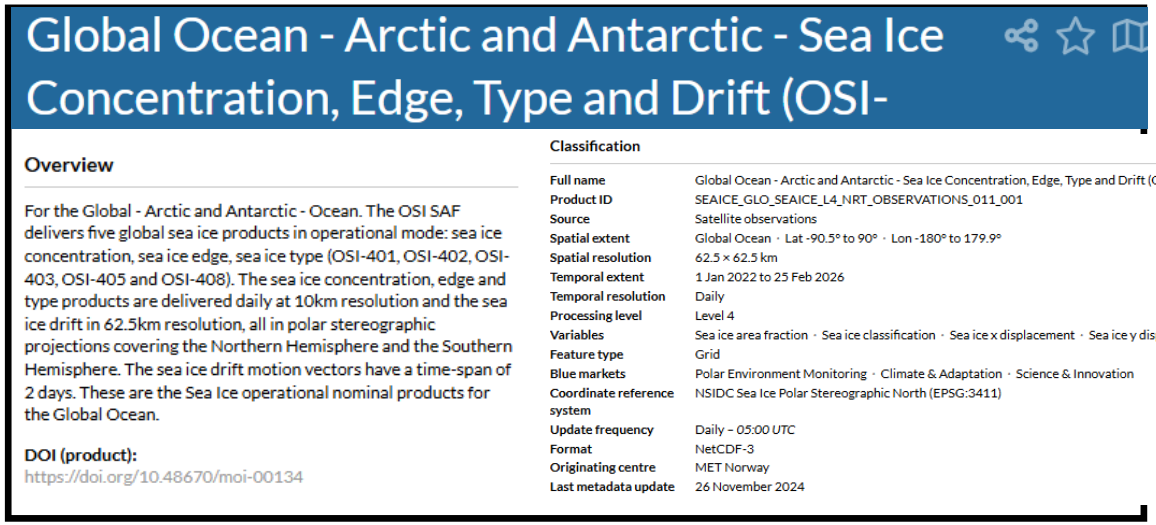


Global Ocean - Arctic and Antarctic - Sea Ice Concentration, Edge, Type and Drift (OSI-

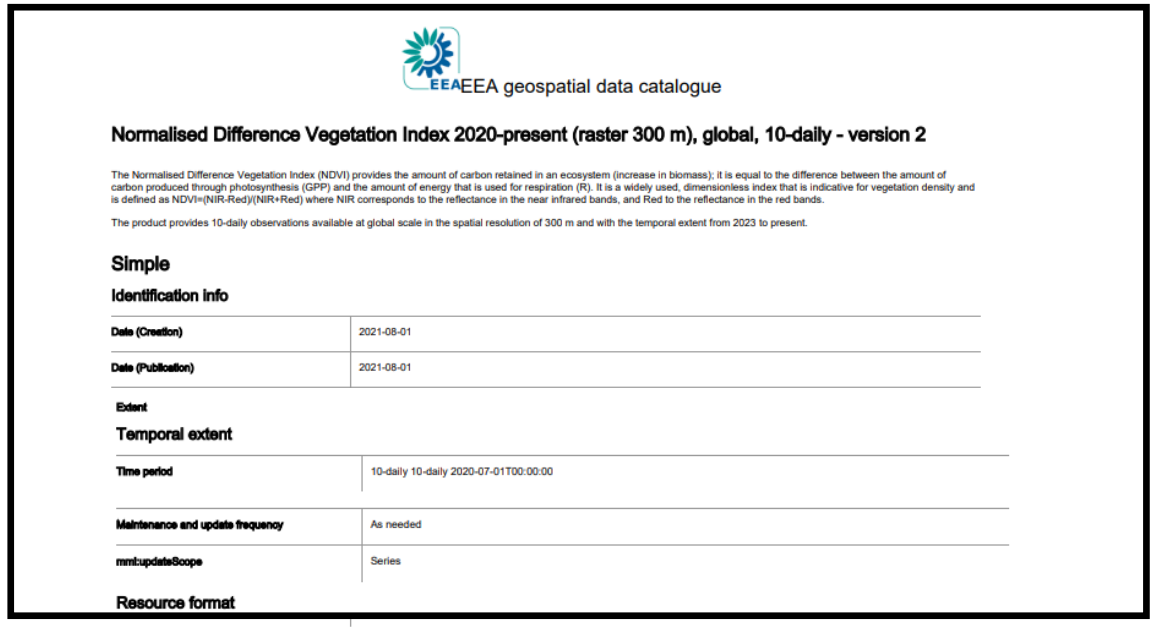
Overview

For the Global - Arctic and Antarctic - Ocean. The OSI SAF delivers five global sea ice products in operational mode: sea ice concentration, sea ice edge, sea ice type (OSI-401, OSI-402, OSI-403, OSI-405 and OSI-408). The sea ice concentration, edge and type products are delivered daily at 10km resolution and the sea ice drift in 62.5km resolution, all in polar stereographic projections covering the Northern Hemisphere and the Southern Hemisphere. The sea ice drift motion vectors have a time-span of 2 days. These are the Sea Ice operational nominal products for the Global Ocean.

DOI (product):
https://doi.org/10.48670/moi-00134

Classification

Full name	Global Ocean - Arctic and Antarctic - Sea Ice Concentration, Edge, Type and Drift (OSI-SAF)
Product ID	SEAICE_GLO_SEAICE_L4_NRT_OBSERVATIONS_011_001
Source	Satellite observations
Spatial extent	Global Ocean · Lat -90.5° to 90° · Lon -180° to 179.9°
Spatial resolution	62.5 × 62.5 km
Temporal extent	1 Jan 2022 to 25 Feb 2026
Temporal resolution	Daily
Processing level	Level 4
Variables	Sea ice area fraction · Sea ice classification · Sea ice x displacement · Sea ice y displacement
Feature type	Grid
Blue markets	Polar Environment Monitoring · Climate & Adaptation · Science & Innovation
Coordinate reference system	NSIDC Sea Ice Polar Stereographic North (EPSG:3411)
Update frequency	Daily – *05:00 UTC*
Format	NetCDF-3
Originating centre	MET Norway
Last metadata update	26 November 2024



EEA geospatial data catalogue

Normalised Difference Vegetation Index 2020-present (raster 300 m), global, 10-daily - version 2

The Normalised Difference Vegetation Index (NDVI) provides the amount of carbon retained in an ecosystem (increase in biomass); it is equal to the difference between the amount of carbon produced through photosynthesis (GPP) and the amount of energy that is used for respiration (R). It is a widely used, dimensionless index that is indicative for vegetation density and is defined as NDVI=(NIR-Red)/(NIR+Red) where NIR corresponds to the reflectance in the near infrared bands, and Red to the reflectance in the red bands.

The product provides 10-daily observations available at global scale in the spatial resolution of 300 m and with the temporal extent from 2023 to present.

Simple

Identification info

Date (Creation)	2021-08-01
Date (Publication)	2021-08-01

Extent

Temporal extent

Time period	10-daily 10-daily 2020-07-01T00:00:00
Maintenance and update frequency	As needed
mmi:updateScope	Series

Resource format

European Commission | KCEO Glossary

Domain Ontology	Land, Ocean
Temporal resolution	Daily
Spatial resolution	62 500 m
Temporal extent	From 2022
Spatial extent	Global
Update frequency	Daily

Domain Ontology	Land, Biosphere
Temporal resolution	10 days
Spatial resolution	300 m
Temporal extent	From 2023
Spatial extent	Global
Update frequency	10 days

2. Harmonization of Metadata

```
def build_prompt(metadata_row):
    return f"""
You are an expert Earth Observation data catalog curator.

TASK:
Convert the metadata below into EXACTLY ONE valid JSON object.

MANDATORY RULES:
- Output JSON ONLY (no markdown, no explanations)
- Use double quotes
- Do NOT add extra fields

ATTRIBUTE CONSTRAINTS:
- name: short product name
- thematic_domains: max 2 labels (land, atmosphere, marine, climate, urban, cryosphere)
- spatial_resolution_m:
    - numeric value ONLY in METERS
    - if a range is provided (e.g., "10–60"), use the maximum value only (e.g., 60)
- temporal_resolution:
    - MUST include unit: hours, days, months, or years
    - examples: "5 days", "1 month"
- spatial_extent:
    - MUST be one of: "Global", "EU", "National"
- temporal_extent:
    - MUST be a number representing total years (end year minus start year)
- latency:
    - MUST include time unit (hours or days)
- product_sustainability:
    - MUST be one of: "Operational", "Sustainable", "Experimental", "Inactive"
- short_abstract:
    - 1-2 sentence concise summary of the product

IF INFORMATION IS MISSING:
- Use "unknown"
```

	name	thematic_domains	spatial_resolution_m	temporal_resolution	spatial_extent	temporal_extent	latency
0	Sentinel 3 OLCI	[marine, land]	300	2 days	Global	7	unknown
1	Sentinel 3 SLSTR	[land, marine]	1000	1 day	Global	7	unknown
2	Sentinel 5 Precursor	[atmosphere]	5500	1 day	Global	5	unknown
3	Vegetation Phenology and Productivity parameters	[land]	10	1 year	EU	7	unknown
4	Vegetation Phenology and Productivity paramete...	[land]	10	1 year	EU	7	unknown
...	...	...	...	...	...	...	...

Metadata confidence score

100%

60%

90%

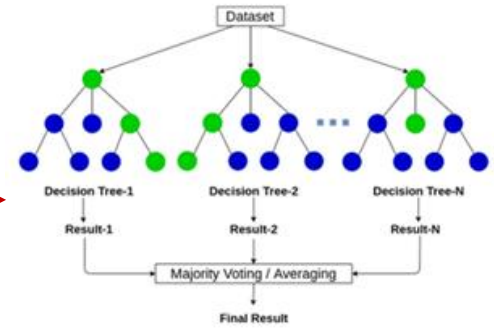
80%

70%

Impute values

Training Metadata Sheets

Atr .1	Atr .2	Atr. 3	...	Latency
A	A	A	...	C
A	A	A	...	C
A	A	A	...	C
B	B	B	...	B

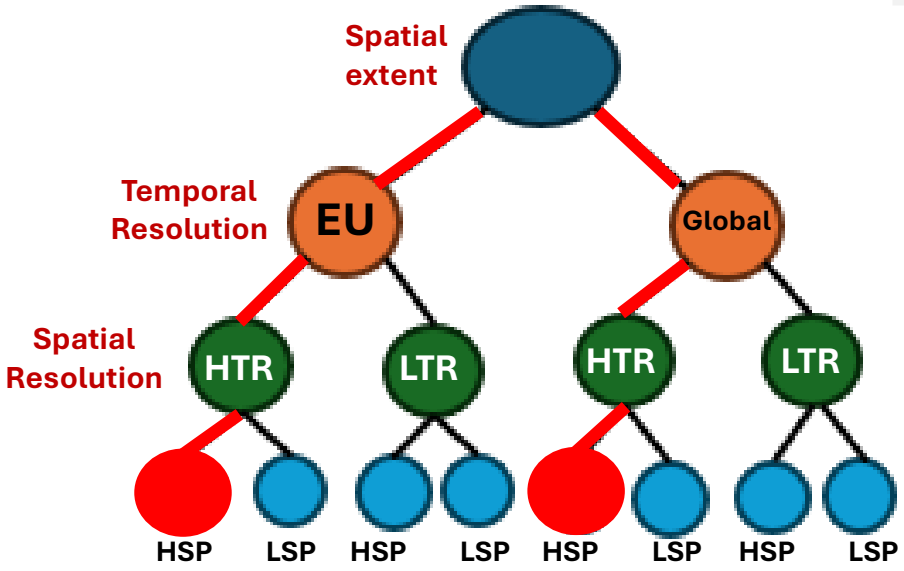


3. Product Discovery (Dynamic Taxonomy)

High Temporal Resolution (HTR)
High Spatial Resolution (HSR)
EU Products

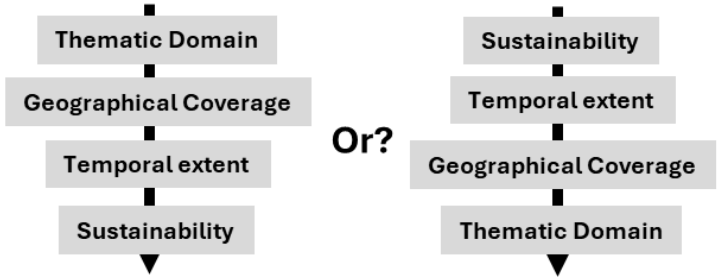
	name	thematic_domains	spatial_resolution_m	temporal_resolution	spatial_extent	temporal_extent
0	Sentinel 3 OLCI	[marine, land]	300	2 days	Global	7
1	Sentinel 3 SLSTR	[land, marine]	1000	1 day	Global	7
2	Sentinel 5 Precursor	[atmosphere]	5500	1 day	Global	5
3	Vegetation Phenology and Productivity parameters	[land]	10	1 year	EU	7
4	Vegetation Phenology and Productivity paramete...	[land]	10	1 year	EU	7
...	...	...	...	...	...	...
66	Copernicus Global Land NDVI product V1	[land]	300	10 days	Global	7
67	Copernicus Global Land NDVI product V3	[land]	1000	10 days	Global	21
68	Copernicus Global Land NDVI product V2	[land]	1000	10 days	Global	23
69	Copernicus Land Soil Water Index product V1 ov...	[land]	1000	1 day	EU	8
70	ECMWF AGERA5 meteo dataset	[atmosphere, land]	10	1 day	Global	8

?



We want to create a Taxonomy of products:

How to predefine the hierarchies (parents-child relationships)?



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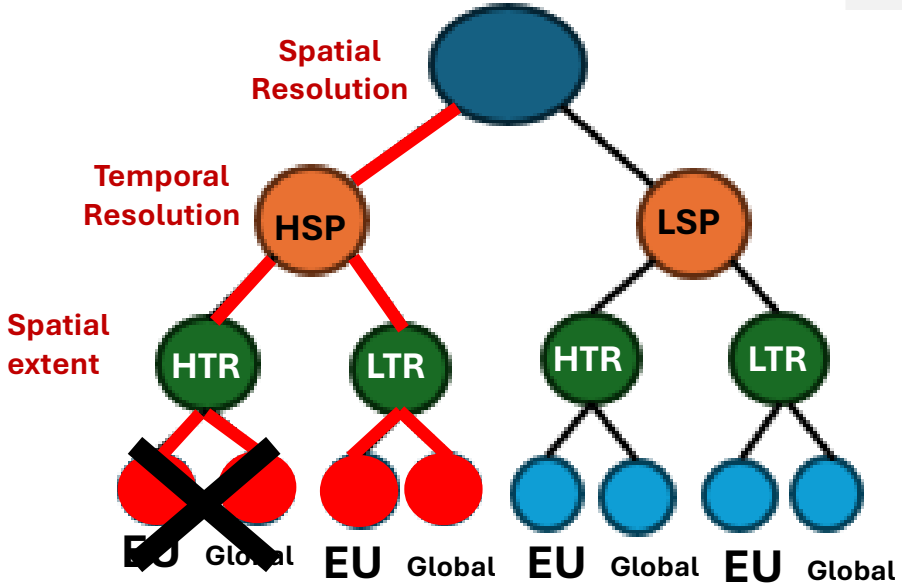
High Temporal Resolution (HTR)
High Spatial Resolution (HSR)
EU Products

?



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...	...	...	...	...	...	...
66	Copernicus Global Land NDVI product V1	[land]	300	10 days	Global	7
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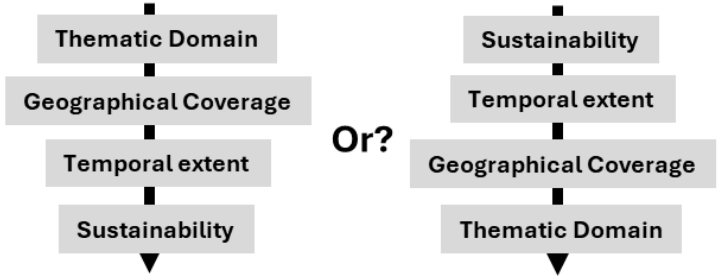
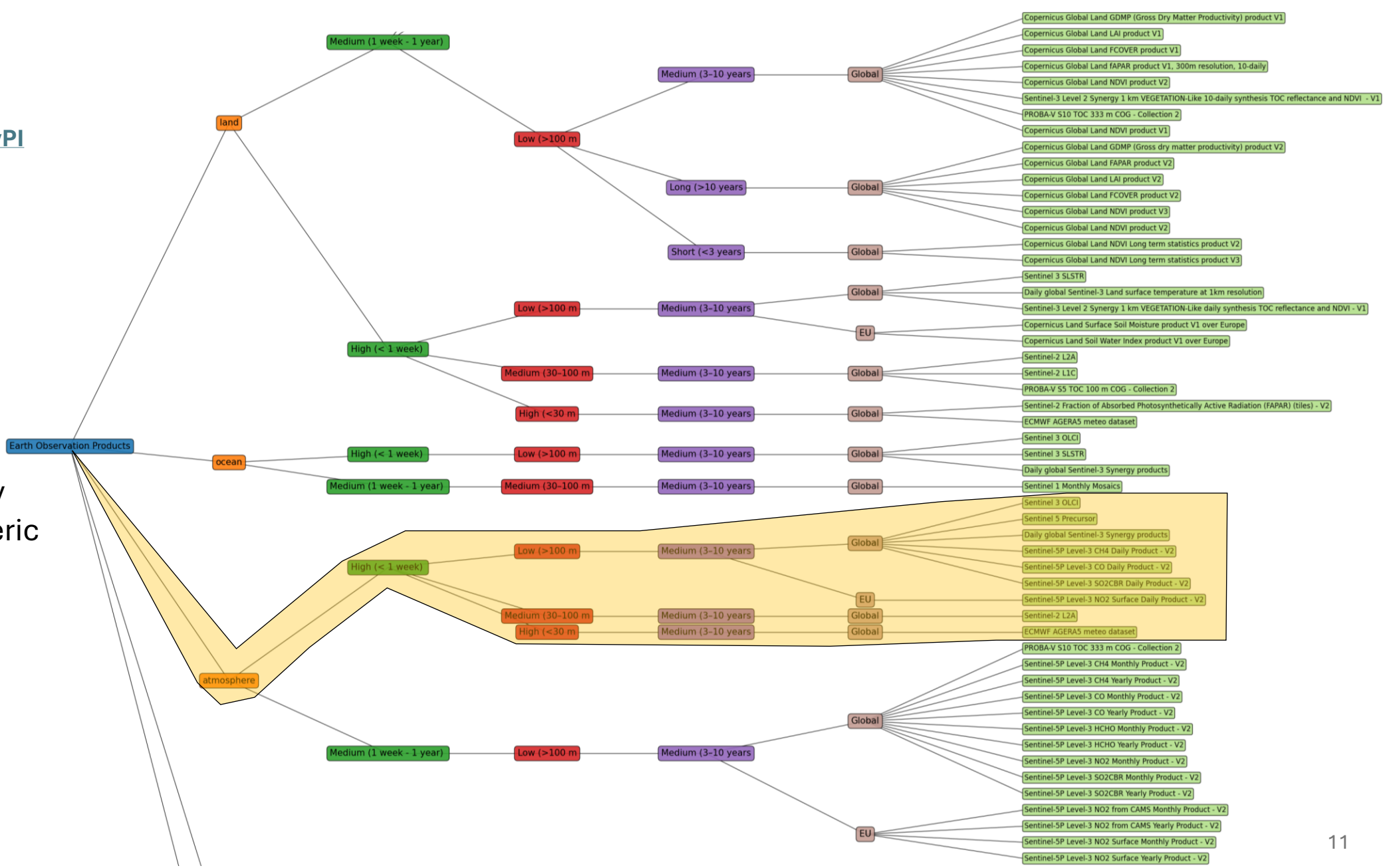


→ **Usually depends on the Application Need**
Lets make it dynamic (user dependant)

[taxonomy-synthesis · PyPI]

EO products for early warning of atmospheric outbreaks in cities?

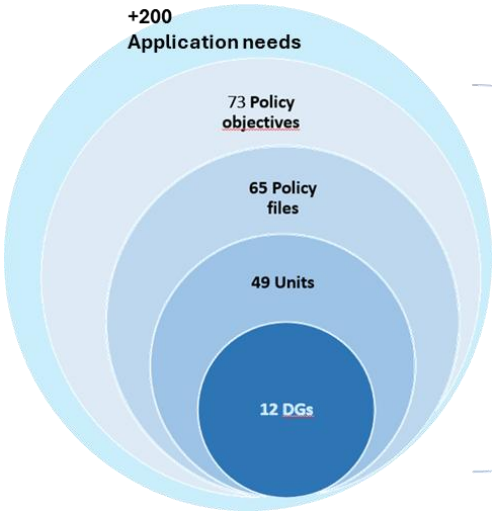


3. Product Discovery (Dynamic Taxonomy)

How to sort the taxonomy tree levels?

EO Application Needs & Product Requirements

Monitoring land cover and land use to determine annual changes from 2023, at 10 m spatial resolution at EU level.

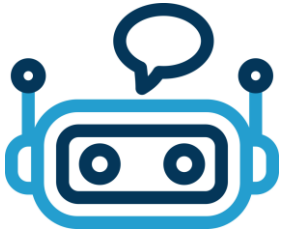


Survey

→

Users

Chatbot



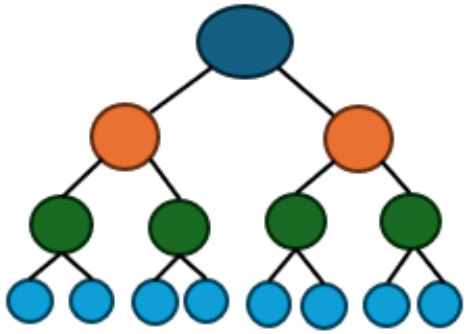
→

Statistical occurrence

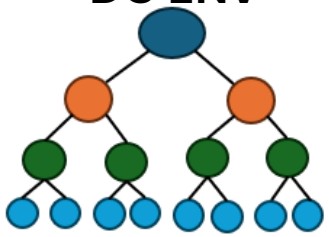
80% AN → Temporal resolution 1 week
50% AN → Thematic Domain Air
20% AN → Spatial resolution 30m

→

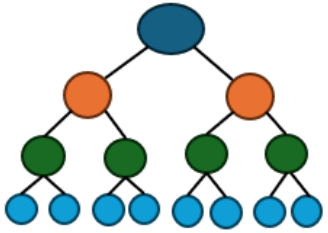
Nature Restoration Regulation . AN1



DG ENV

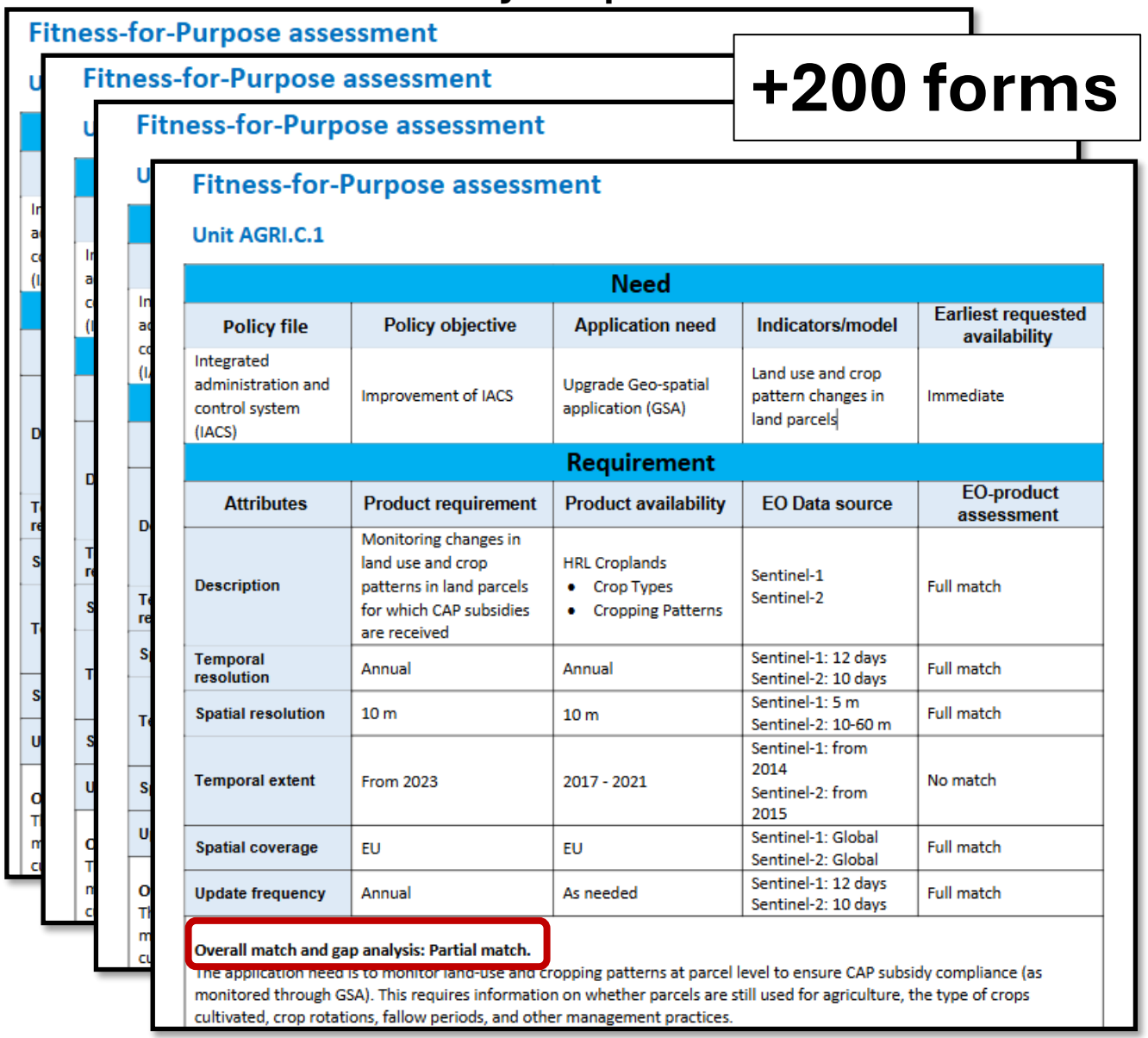


DG CLIMA



4. Priorization of EO needs

Survey Chapter 6



+200 forms

Need				
Policy file	**Policy objective**	**Application need**	**Indicators/model**	**Earliest requested availability**
Integrated administration and control system (IACS)	Improvement of IACS	Upgrade Geo-spatial application (GSA)	Land use and crop pattern changes in land parcels	Immediate

Requirement				
Attributes	**Product requirement**	**Product availability**	**EO Data source**	**EO-product assessment**
Description	Monitoring changes in land use and crop patterns in land parcels for which CAP subsidies are received	HRL Croplands • Crop Types • Cropping Patterns	Sentinel-1 Sentinel-2	Full match
Temporal resolution	Annual	Annual	Sentinel-1: 12 days Sentinel-2: 10 days	Full match
Spatial resolution	10 m	10 m	Sentinel-1: 5 m Sentinel-2: 10-60 m	Full match
Temporal extent	From 2023	2017 - 2021	Sentinel-1: from 2014 Sentinel-2: from 2015	No match
Spatial coverage	EU	EU	Sentinel-1: Global Sentinel-2: Global	Full match
Update frequency	Annual	As needed	Sentinel-1: 12 days Sentinel-2: 10 days	Full match

Overall match and gap analysis: Partial match.

The application need is to monitor land-use and cropping patterns at parcel level to ensure CAP subsidy compliance (as monitored through GSA). This requires information on whether parcels are still used for agriculture, the type of crops cultivated, crop rotations, fallow periods, and other management practices.

ORIGINAL SURVEY FORMS (+200)

Text mining (LLM)

No Match

Partial Match

Full Match

Text mining (LLM)
Key Words extraction

Clustering

- **AN Forms Clustering**

4. Priorization of EO needs

Survey Chapter 6

Fitness-for-Purpose assessment

Fitness-for-Purpose assessment

Fitness-for-Purpose assessment

Fitness-for-Purpose assessment

+200 forms

Unit AGRI.C.1

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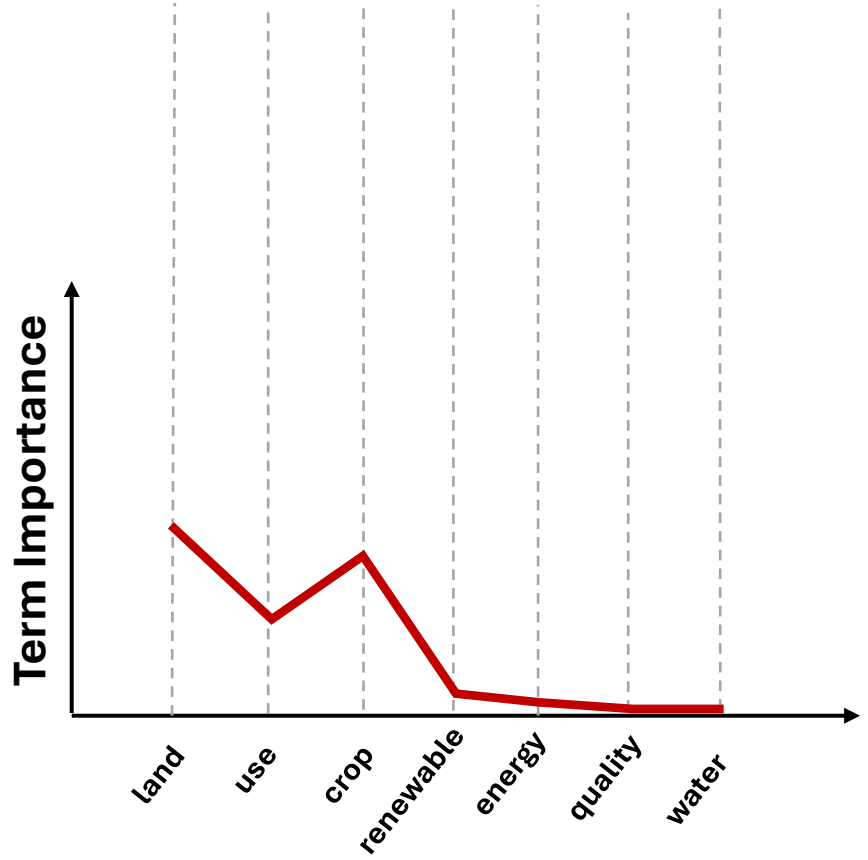
TF-IDF Vectors

Improvement of **IACS**	**Geo-spatial** application (GSA)	**Land use** and **crop pattern** changes in **land parcels**	Monitoring changes in **land use** and **crop patterns** in land parcels for which **CAP subsidies** are received

Vector $_{AgriC2}$ = (300 , 100 , 250 , 3 , 1 , 0, 0 ...)



4. Priorization of EO needs

Survey Chapter 6

Fitness-for-Purpose assessment

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+200 forms

Fitness-for-Purpose assessment

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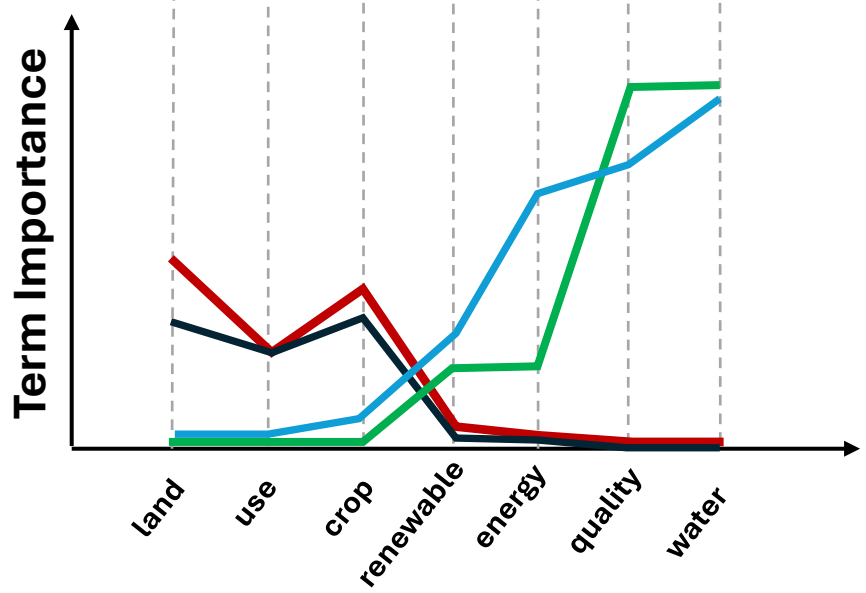
Vector $_{AgriC2}$ = (300 , 100 , 250 , 3 , 1 , 0, 0 ...)

Vector $_{AgriC1}$ = (200 , 100 , 150 , 2 , 1 , 0, 0 ...)

Vector $_{EnerC2}$ = (45 , 10 , 500 , 20 , 10 , 400, 500 ...)

Vector $_{EnvC2}$ = (0 , 0 , 0 , 2 , 1 , 500, 500 ...)



4. Priorization of EO needs

Survey Chapter 6

Fitness-for-Purpose assessment

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+200 forms

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Update frequency	Annual	As needed	Sentinel-1: 12 days Sentinel-2: 10 days	Full match

Overall match and gap analysis: Partial match.

The application need is to monitor land-use and cropping patterns at parcel level to ensure CAP subsidy compliance (as monitored through GSA). This requires information on whether parcels are still used for agriculture, the type of crops cultivated, crop rotations, fallow periods, and other management practices.

TF-IDF Vectors

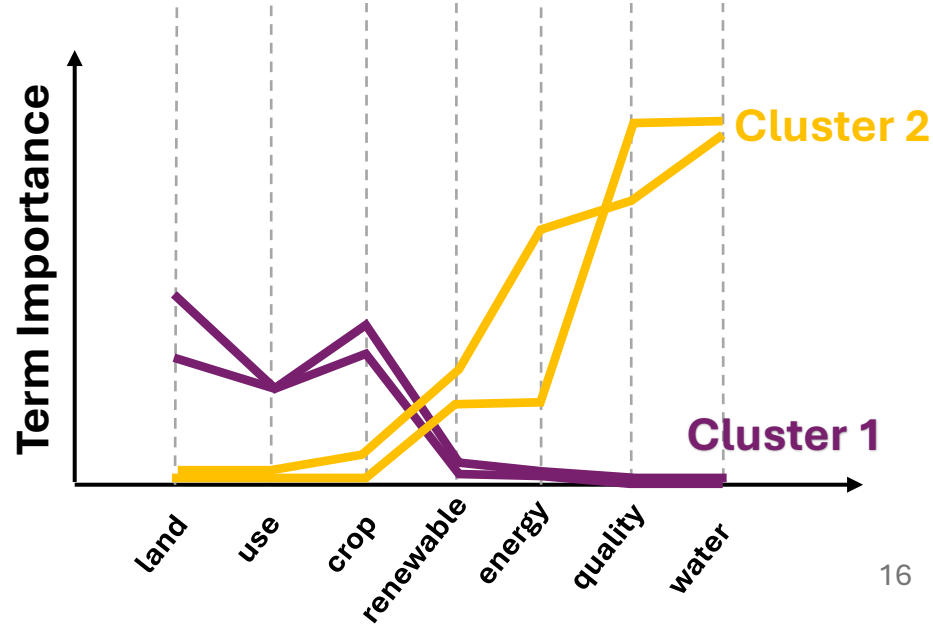
Improvement of **IACS**	**Geo-spatial** application (GSA)	**Land use** and **crop pattern** changes in **land parcels**	Monitoring changes in **land use** and **crop patterns** in land parcels for which **CAP subsidies** are received

$\text{Vector}_{\text{AgriC2}} = (300, 100, 250, 3, 1, 0, 0 \ldots)$

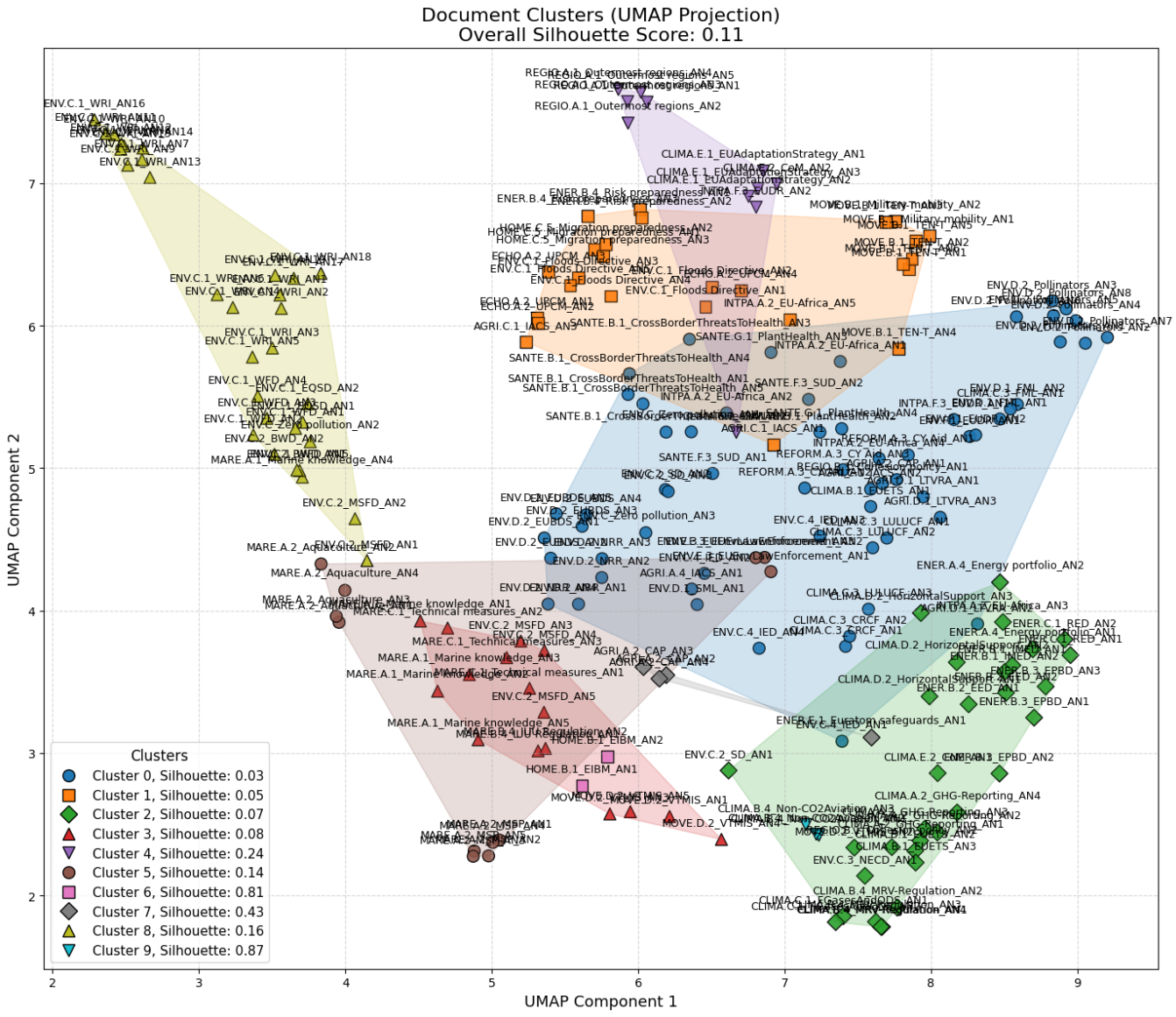
$\text{Vector}_{\text{AgriC1}} = (200, 100, 150, 2, 1, 0, 0 \ldots)$

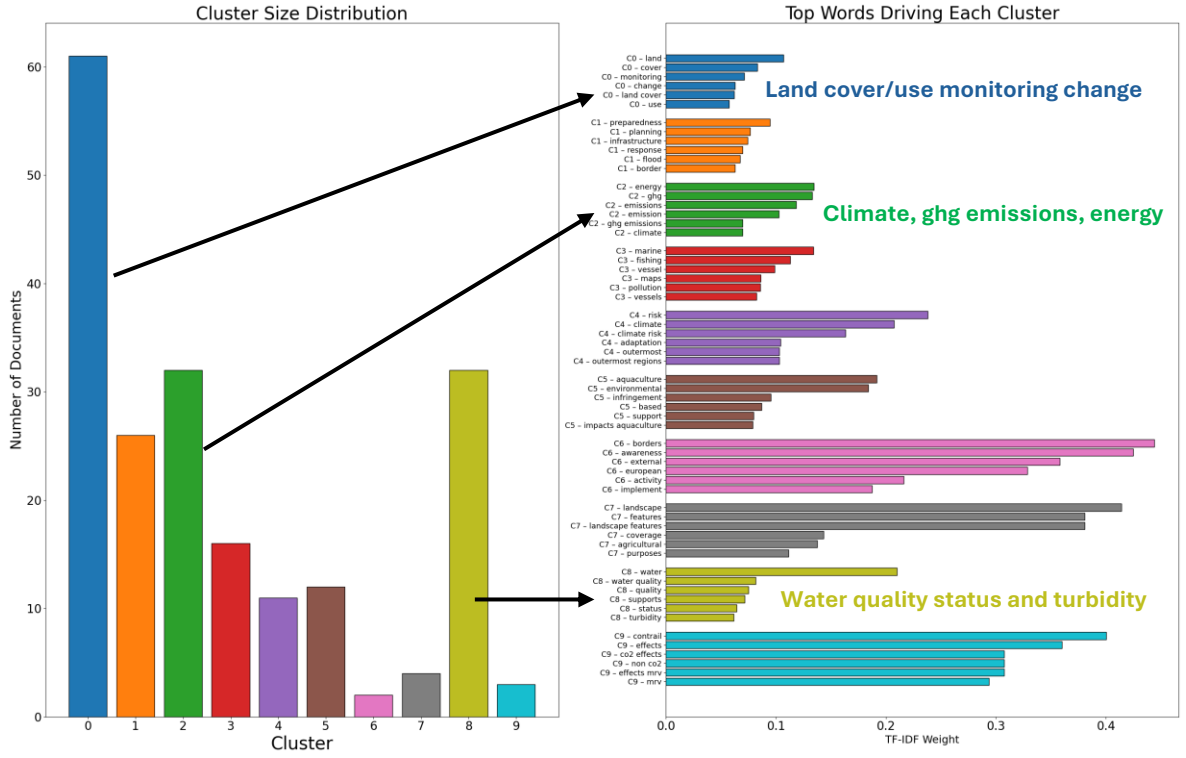
$\text{Vector}_{\text{EnerC2}} = (45, 10, 500, 20, 10, 400, 0 \ldots)$

$\text{Vector}_{\text{EnvC2}} = (0, 0, 0, 2, 1, 500, 200 \ldots)$



4. Priorization of EO needs





Direct outcome:

- ***Evolution of services and products***
- ***In-situ*** *development*
- *Prioritize* ***prototyping activities***
- Inform ***Strategic Research and Innovation Agenda (SRIA)***

Different levels of analysis:

- Aggregate by **DGs** → Overlapping strategic needs
- Aggregate by **Policy File** → Simplification (Measure once, serve multiple polices)

Conclusions and Further Discussion

- **ML/AI** can **reduce manual work in extracting information** from policy files and products metadata, and support in **analyzing trends** in EO needs and product assessments (although systematic **human verification** is still required).

- **Increase the discoverability** and exploration of EO and Copernicus data, products and services.

- **Manage uncertainty in AI-driven results**, including transparency around model limitations and reliability.

- Opportunities to **better integrate AI and/ML methods** in products and services to reduce the “last mile” gap.

European Commission

Thank you!

miguel.vallejo-orti@ec.europa.eu

Panel discussion 1: Use of AI in implementing services to close specific user needs gaps

Ruben Piroska, Coordinator of CEMS, German Federal Office of Civil Protection and Disaster Assistance

Antoine Guion, Research Engineer in H21and Forecasting, French National Institute for Industrial Environment and Risks

Matteo Mattiuzzi, Expert Copernicus Land Monitoring Service, European Environment Agency

AI4FloodDamage

Project aim: reliably identify resulting damage to buildings and infrastructure in natural disasters

Ruben Piroska
Federal Office for Civil Protection and Disaster Relief (BBK)

Key message:

“Use AI as ONE branch for decision-making in CM.”

9 March 2026, Brussels

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Artificial Intelligence and Earth Observation: from Innovation to Service

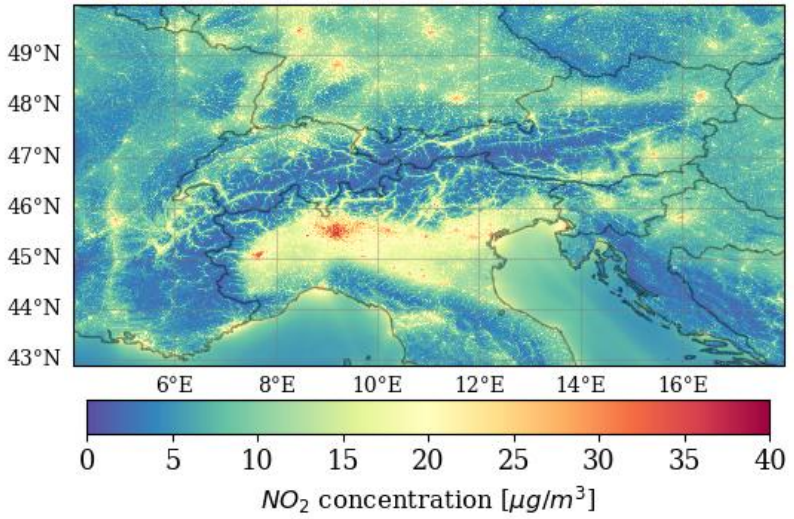
9 March 2026, Brussels

Antoine Guion

Research Engineer in Air Quality Modeling and Forecasting

At the French National Institute for Industrial Environment and Risks (INERIS)

Using AI to downscale CAMS reanalysis for high-resolution air quality mapping across Europe



- **CHROMAP model**
- **500 m resolution**
- **Demo room (10 March)**

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Panel discussion 2: Implementing trustworthy and ethical AI solutions

Stefanie Lumnitz, Policy Officer Climate & Planetary Boundaries, DG RTD, European Commission

Hannah Kofler, Product Manager Image Processing and Data Science, G10Constellr

Alistair Francis, Co-founder and Partner, Asterisk labs

constellr

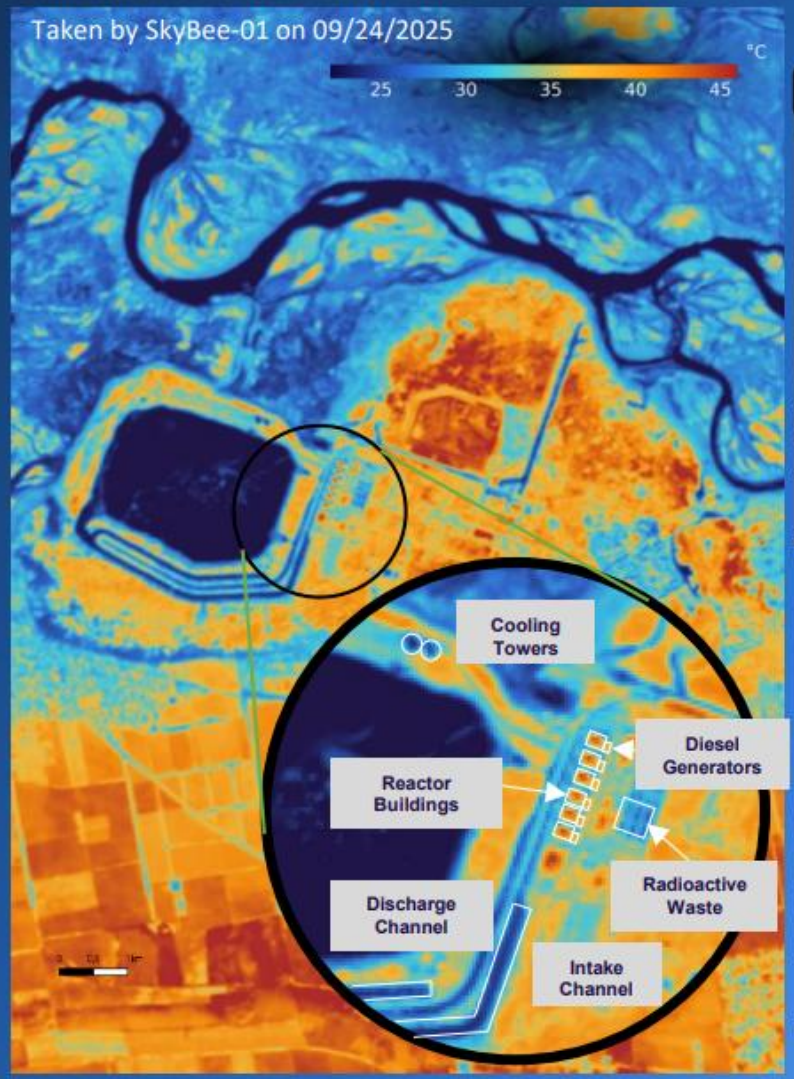
Use case example

Critical Infrastructure Monitoring:

Independent verification of claims and effects

- **THE SITUATION:**
  A facility claims normal operation, but optical imagery cannot confirm real activity
- **WHAT THERMAL REVEALS:**
  Heat patterns show which systems are active, cooling, or offline - instantly exposing true operational status
- **THE ENABLED INSIGHT:**
  Analysts can verify claims, detect disruption, and track changes over time with a physics-based signal that cannot be disguised

Hannah Kofler



Zaporizhzhia Nuclear Power Plant, Ukraine

Science and Innovation for Earth Intelligence

AI for Science · EO · Public Governance

Stefanie Lumnitz

Policy Officer – Climate & Planetary Boundaries

DG Research & Innovation (RTD)

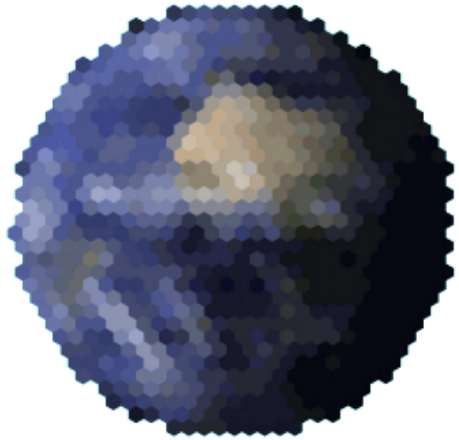
In Earth Intelligence, AI earns trust when it is grounded in science, aligned with planetary constraints, and governed with accountability.

Horizon Europe projects using EO and AI for the benefit of science and society

European AI in Science Strategy

Alistair Francis

asterisk labs



interdisciplinary research lab making the most of open data

Earth Compress

An open-source initiative for traceable, trustable AI compression of Earth data at scale

Democratizing access to global analysis by radically reducing data size

"A trustworthy **API** is a prerequisite for a trustworthy **AI**"