Green Transition Information Factories (GTIF)

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European Space Agency – EO Programmes - Climate Action, Sustainability & Science Department

**FFG Vernetzungsveranstaltung
Digitaler Zwilling Österreich 2023
Vienna, Austria**

Outline of today's talk:

1) Context and objectives of Green Transition Information Factories (GTIF)

2) Showcase some selected capabilities for the GTIF Demonstrator Austria

3) Provide an overview of ongoing and upcoming GTIF activities

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Earth Observation Activities at ESA

Building satellites

Managing Missions

Cal/Val & Data Distribution

Applying the Data

Earth System Science

Emergency Response

Digital Twins

Climate Change

Innovation & **Commercialisation**

Φ-lab

Accelerate the future of EO with cutting edge research

in³

→ THE EUROPEAN SPACE AGENCY

SPACE FOR A GREEN FUTURE ACCELERATOR

Space bends the Curve

- **Co-governed & independent non-profit partnership of Green Transition actors**
- Engaging governments, businesses, multilateral institutions, civil society groups, end users and citizens
- Developing practical space-based solutions supporting Carbon Neutrality and greening of society by 2050.
- Partnering with stakeholders and users, aggregating the priorities of Green Transition sectors and seed solutions that address real needs.
- Accelerating the use of space by mobilizing resources and scaling solutions to full sectorial and global levels.

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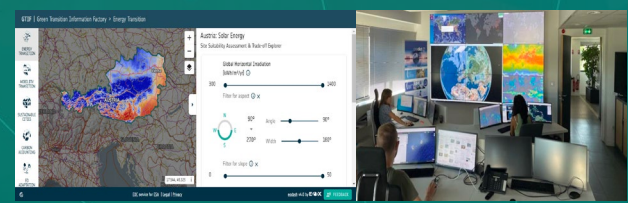
Green Transition Information Factories (GTIF)

ENABLE INSIGHTS: Demonstrate added value of EO and digital technologies for addressing the information needs of the Green Transition and the European Green Deal.

ACTIONABLE INFORMATION: enable users (e.g., citizens, policy makers, industry professionals) better understand related challenges and opportunities & join the public debate.

DEDICATED CAPABILITIES: value-added products, indicators & interactive tools, reproducible workflows.

Initial focus on set of 5 Green Transition **PRIORITY DOMAINS**:

ENERGY TRANSITION

MOBILITY TRANSITION

SUSTAINABLE CITIES

CARBON ACCOUNTING

EO ADAPTION SERVICES

GTIF - Demonstrator for Austria: User Driven Approach

- ❖ Coordinated with **stakeholders** to infer **national priorities** for the Green Transition
- ❖ Engaged **industry** to match expertise with set of required **capabilities**
- ❖ Development started in Spring 2022, first full release in May 2023

Capture User Requirements → **Address national priorities & information needs** → **Develop GTIF capabilities: Indicators, value-added products, interactive tools.**

CLEAN WATER   SUSTAINABLE MOBILITY   CIRCULAR ECONOMY

ENERGY TRANSITION   GREEN FINANCE   CARBON SEQUESTRATION
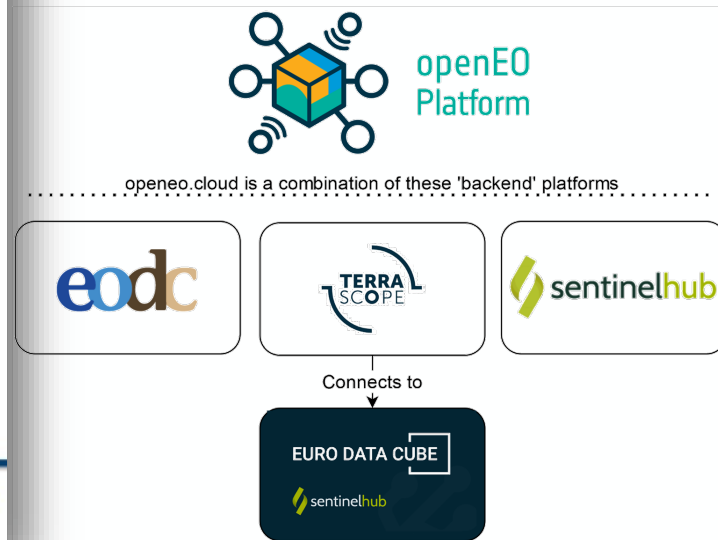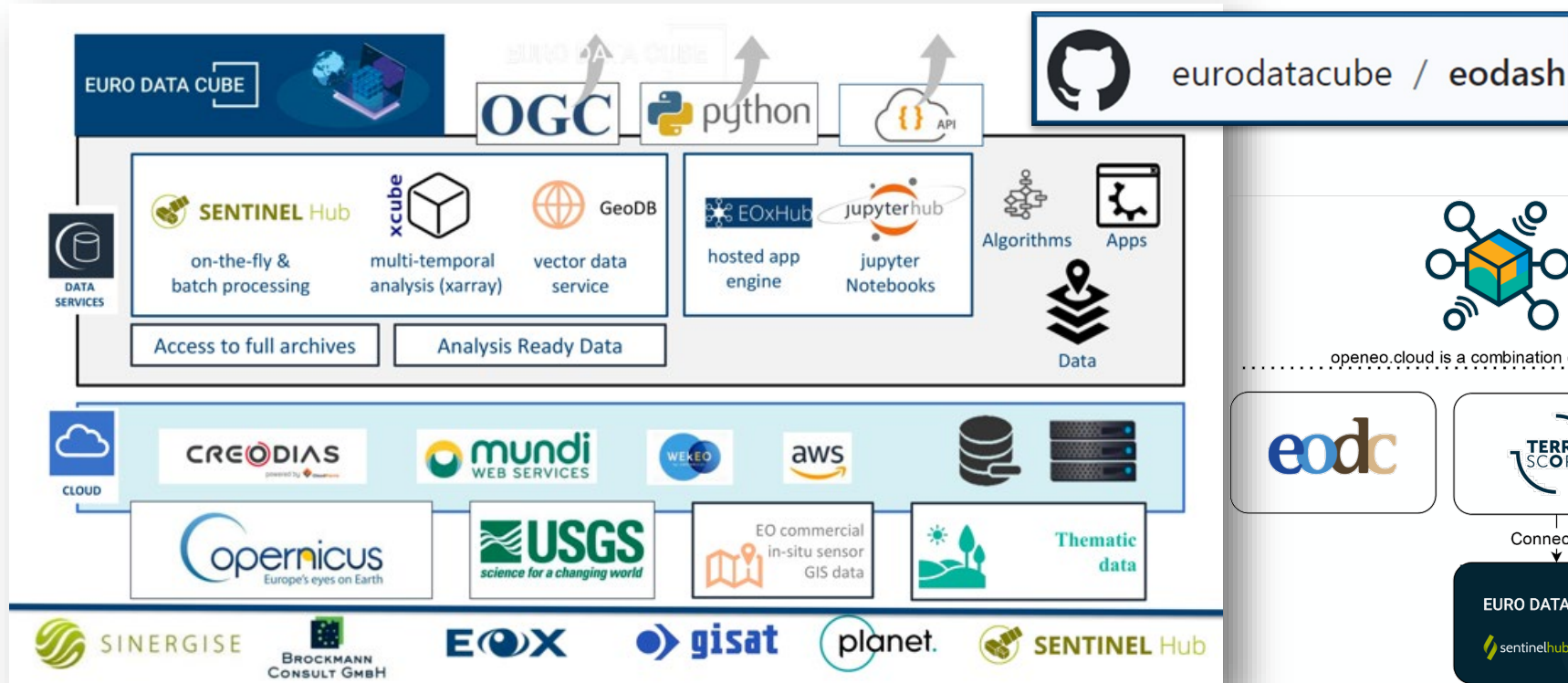
- Ministry for Climate Action (BMK) March 2023
- 40 invited Austrian stakeholder organizations
- 125 attendees for public part of the workshop
- More than 50 emerging additional requirements…

GTIF

## Green Transition Information Factory

FEEDBACK

GTIF | Green Transition Information Factory

DOMAINS & TOOLS

Energy Transition

Mobility Transition

Sustainable Cities

Carbon Accounting

EO Adaptation Services

Tools

> Air Quality Health   3

> Alpine Drought Observatory   4

> Biomass Tools   5

> Dynamic Human Presence   2

> EO4Alps   2

> Green Roofs   8

> Heat Explorer   1

> Human Mobility Patterns   6

> Hydropower Assessment   5

> Micro Hydropower Tools   1

> Mobility - Air Quality Correlation   7

> Moving Truck Detections   2

AUSTRIA

11.484, 47.865
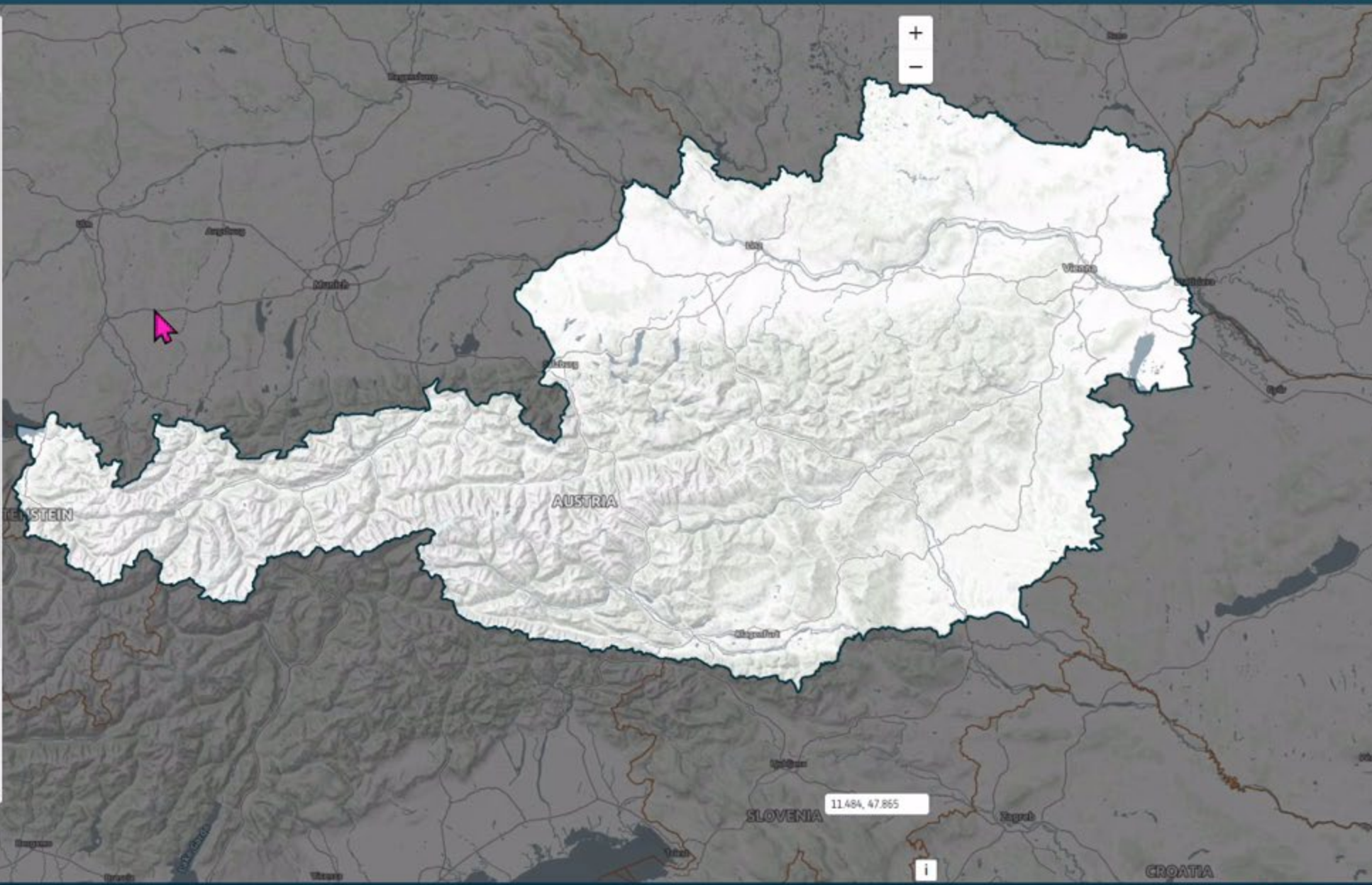
GTIF activities: ongoing & upcoming

GTIF-Demonstrator

First co-designed demonstrator
Upcoming "GTIF AT consolidation activity" to implement additional user requirements and hand over to Austrian users and stakeholders.

- Functionalities consolidation.
- **Transition** towards **full ownership** by stakeholders.

GTIF Kick-Starters

From national to regional upscaling
Three new contracts, national and regional showcase, new innovative capabilities, advanced co-design approach.

- Towards **scalable & interoperable** services.
- **Alignment of investments** by other stakeholders.

GTIF-Adaptation

Towards GT adaptation services
Set of R&D activities in 2024 workplan, embedding EO in advanced what-if scenarios.

- **Reproduceable analytics** ready for **integration**.
- Dedicated **end-driven vertical integration.**

GTIF ecosystem of reusable capabilities & services

Open-innovation with a seed & scale approach enabling

- Autonomous integration by third-parties.
- Long-term sustainability, mobilizing resources by stakeholders.
- Full end-user empowerment.
- Propagation of applications.
- Scalable and operational solutions.
- Catalyse commercial industrial services.

GTIF Austria – Consolidation Activity

1) Implement user requirements gathered at GTIF consultation event at BMK in March 2023.

2) Enhance capabilities to provide more effective decision support to Austrian policy.

3) Facilitate hand-over to Austrian stakeholders & sustainable future operation/evolution.

REQ-ID	DOMAIN	Requirement	Comments:	Requested by:
REQ-01	Energy Transition	Support zoning analysis for renewable energy expansion according to federal state policies.	-From BMK internal discussion	UBA, BMK
REQ-02	Energy Transition	Monitoring of heating networks and related heat emissions / leakage with thermal data (e.g. super resolved LST)	This requirement came up several times, internal part, and round tables - Is network data available?	BMK, Verbund AG Energy round table
REQ-03	Energy Transition	Monitoring of heating networks for heating supply and demand planning (per admin unit, block level or even individual buildings)	-Requirement to be clarified in detail	BMK, Verbund AG Energy round table
REQ-04	Energy Transition	Support the creation of "energy plans" for every community (as a service)	Details on energy plan specifics to be clarified	BMK, Stephan Renner (Kabinett Gewessler)

REQ-46	Sustainable Cities	Demand for time-series analysis: how did roofscapes develop over the past years?	Requires exploitation of I.e. 3rd party data providers	Cities round table
REQ-47	Sustainable Cities	Support quality assessment for green roofs, I.e. vegetation health indices.	A snapshot could perhaps be provided through NDVI influencing current analysis	Gruenstadtgrau
REQ-48	Sustainable Cities	Integration of socioeconomic data in viewer. Questions on what type of population is affected.	Data availability?	Cities round table
REQ-49	Sustainable Cities	Combination into green solar roofs indicator	Fairly "low hanging fruit", Analysis needs to be adjusted	GruenStadtGrau
REQ-50	Sustainable Cities	Export of selected data only in human readable format	"Low hanging fruit"	Cities round table
REQ-51	Circular Economy	Monitoring of waste deposits and gravel pits dynamic	-Volume monitoring and detection of volume changes of bulk material storages	Circular Economy round table

GTIF Kick-Starters – Invitation to Tender

- **GTIF Kick-Starters ITT**:
  - Next phase of GTIF activities, resulting in three separate contracts (closing 06/11/23)
  - Currently in negotiation phase. Kick-off Q1 2024

- **Goals & objectives**:
  - Develop novel innovative capabilities to address stakeholder needs within 5 GT domains
  - Within 6 months, demonstrate capabilities within a new national showcase
  - Enhance capabilities in terms of robustness and scalability
  - Demonstrate in a multi-national/regional showcase
  - Transform capabilities into replicable, FAIR compliant, on-demand services

Invitation to Tender: "GTIF Kick-Starters"

Interoperable on-demand services for GTIF

(1) Algorithm implementation following interoperable community best-practices (i.e., openEO, STAC, OGC Application Packages)

```python
import openeo
from openeo.processes import process

connection = openeo.connect("https://openeo.cloud")
connection.authenticate_oidc()

datacubeCropSAR = connection.datacube_from_process("CropSAR",
polygon = {"type": "Polygon", "coordinates": [[[9.95766264825904, 45.262257947054906],
11.58320016108509, 44.640742930016785], [11.099932251866536, 43.345601710375064], [
9.650128524210867, 43.6640958553983], [9.386527846455289, 44.20167799638173], [
9.95766264825904, 45.262257947054906]]]}, date = ["2023-08-01T00:00:00Z",
"2023-09-01T00:00:00Z"], namespace = "\"vito\"")

result = connection.execute(datacubeCropSAR)
```

(3) On-boarding of service with ESA Network of Resources to benefit from sponsorship for any pre-commercial usage

(2) Service integration in EO marketplaces

Example: wind turbine detection as a service (DHI Gras)

openEO Platform

openeo.cloud is a combination of these 'backend' platforms

eodc · TERRASCOPE · sentinelhub

Connects to

EURO DATA CUBE
sentinelhub
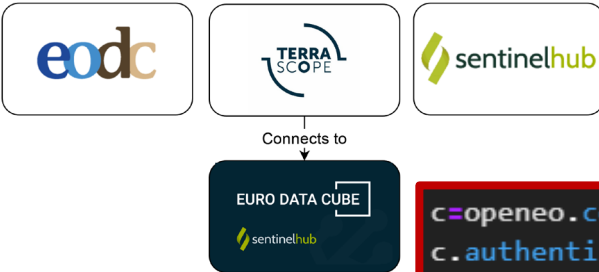
```python
c=openeo.connect("openeo.cloud")
c.authenticate_oidc()

# Define the geographical bounding box and year
bbox=[8.858, 53.951, 8.868, 54.961]
year=2023

out_file = "wt.nc"

# Request wind turbine detection data from openEO using
wt_detections = c.datacube_from_process(
    process_id="wt_detection",
    year=year,
    bbox=dict(zip(["west", "south", "east", "north"], bbox))
)

# Execute the process in batch mode and save the results
job = wt_detections.execute_batch(outputfile=out_file)
```

```python
# Post-process the results and convert to GeoDataFrame
gdf = post_processing(out_file)
gdf
```

```
100%|████████| 53/53 [00:00<00:00, 267.33it/s]
100%|████████| 45/45 [00:00<00:00, 765.20it/s]
```

	detection_date	geometry	confidence	wind_farm
0	2022-11-20	POLYGON ((8.85760 54.73004, 8.85760 54.73093, …	0.651886	0
1	2023-03-23	POLYGON ((8.86784 54.63766, 8.86784 54.63856, …	0.689915	1
2	2023-02-26	POLYGON ((8.85482 54.81235, 8.85482 54.81325, …	0.620947	2
3	2023-02-26	POLYGON ((8.86325 54.80571, 8.86325 54.80661, …	0.468735	2
4	2023-02-26	POLYGON ((8.85671 54.18900, 8.85671 54.18990, …	0.538064	3
5	2023-02-26	POLYGON ((8.86762 54.18048, 8.86762 54.18138, …	0.647633	4
6	2023-02-26	POLYGON ((8.86916 54.17778, 8.86916 54.17868, …	0.759312	4
7	2023-02-26	POLYGON ((8.86028 54.17687, 8.86027 54.17777, …	0.681168	4
8	2023-02-26	POLYGON ((8.86733 54.17598, 8.86732 54.17688, …	0.802262	4
9	2023-02-26	POLYGON ((8.85706 54.17597, 8.85706 54.17687, …	0.559620	4

Example: wind turbine detection as a service (DHI Gras)
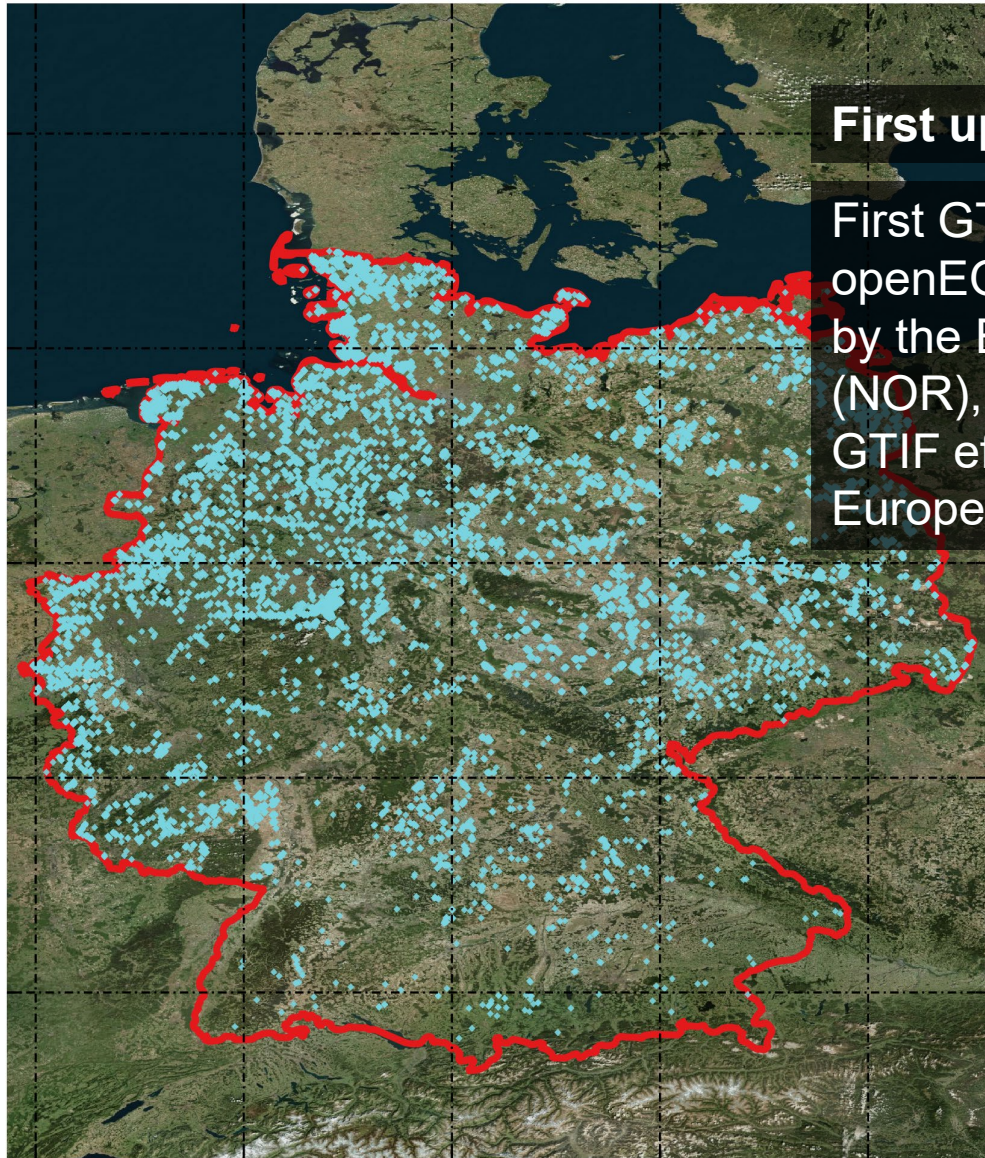
First upscaling result for Germany

First GTIF service, deployed in openEO platform, to be sponsored by the ESA Network of Resources (NOR), available to support future GTIF efforts and eventually pan European assessments.
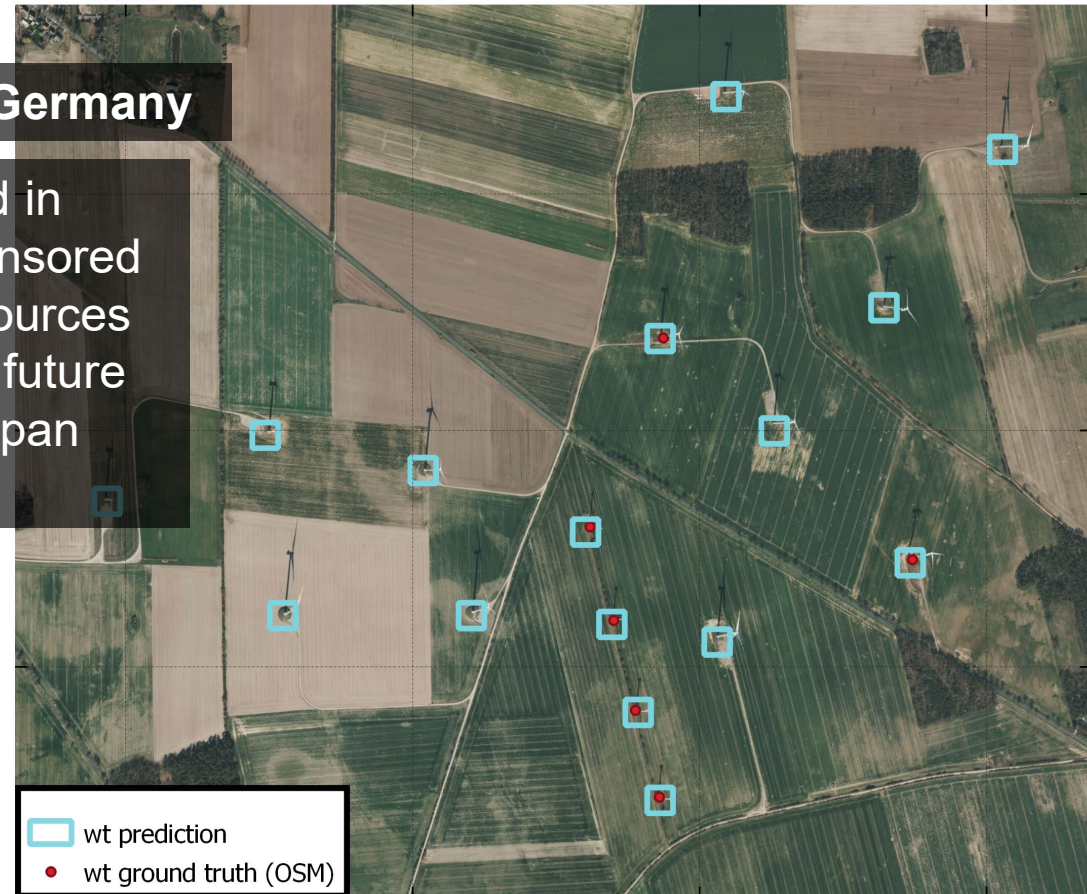
Legend:
- wt prediction
- wt ground truth (OSM)

vs Open Street Map	Recall	Precision
Version 1	0.901	0.867
Version 2	**0.936**	**0.951**

vs independent test set	Recall	Precision
Version 1	**0.966**	0.874
Version 2	0.960	**0.924**

Conclusions

- ❖ Green Transition Information Factories (GTIF) are a seed element of the Space for Green Future (S4GF) accelerator, which will support scaling efforts and ensure effective engagement of key green transition actors.

- ❖ GTIF Demonstrator for Austria will undergo an ESA guided consolidation phase (12 months) and then handed over to Austrian stakeholders and users.

- ❖ The FFG call for the Digital Twin Austria with a dedicated GTIF activity line is an opportunity to (1) facilitate the transition towards a sustainable future, and (2) incorporate more users and contributors with effective solutions to address Austrian Green Deal challenges.

- ❖ ESA is focussing on expanding GTIF activities across Europe (Kick Starters) and gradually building an ecosystem of reusable GTIF services that support scaling and can deliver continental level insights.

Thanks for listening!

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https://gtif.esa.int/

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