ESA's 2025 Big Data Foundations for Earth Observation Training Course

Thematic EO Applications & use-cases I (GREEN DEAL)

Helmut Herglotz
EOX IT Services
22.09.2025

European Commission | researchLatvia Value Through Knowledge | Ministry of Education and Science Republic of Latvia | esa academy

Content

11:30 – 13:00

- About EOX and me
- What is the Green Deal?
- Domains of the Green Transition
- Strategies applied to reach those goals
- EO applications and decision support with EO
- Synergy between big data methodologies and EO
- Overview of typical use cases

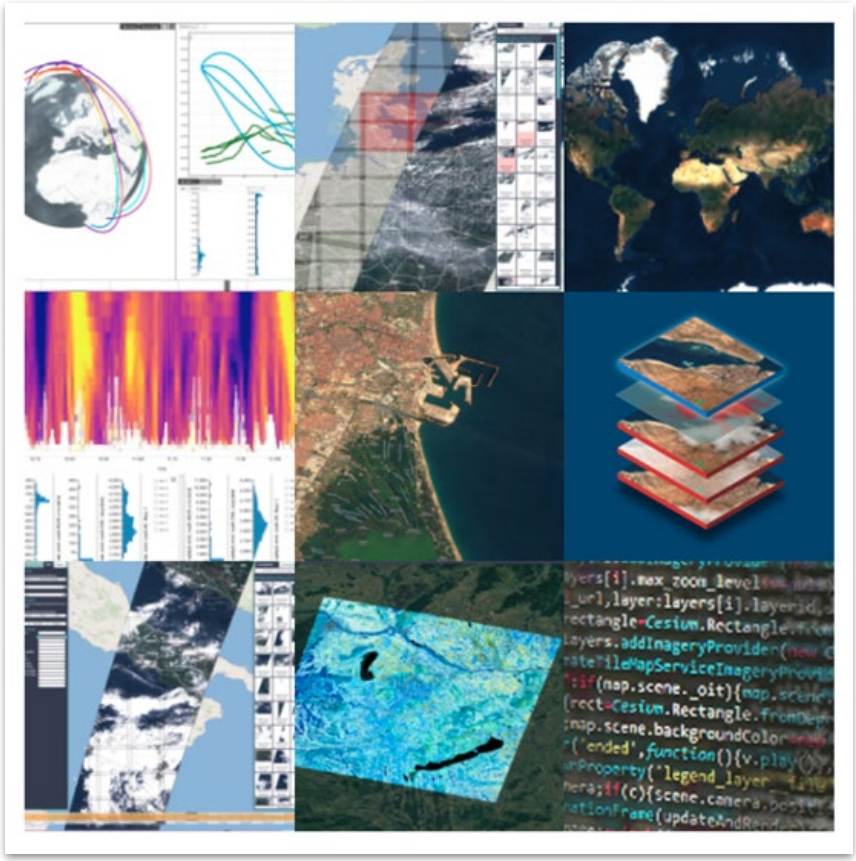
About EOX

EOX IT Services GmbH, Vienna, Austria

https://eox.at

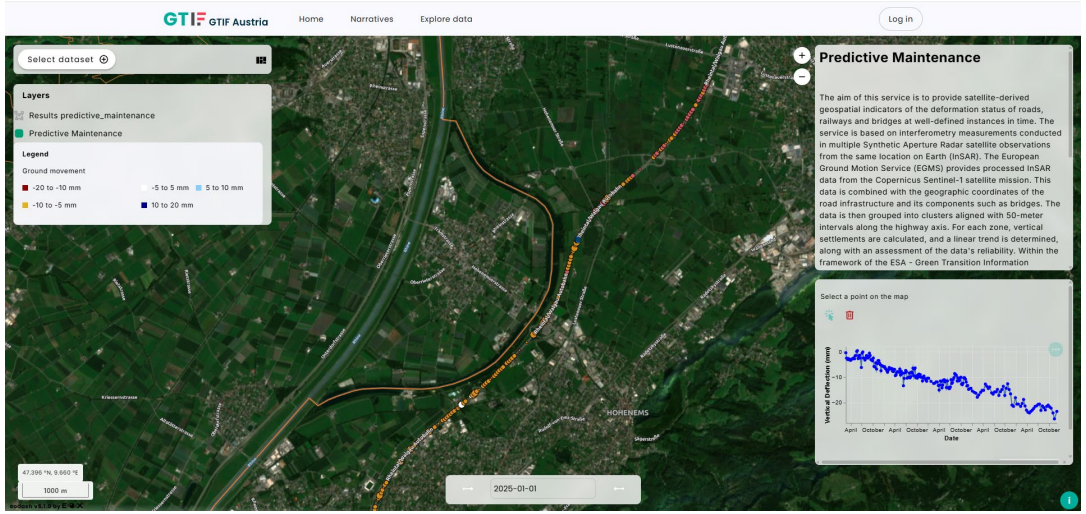
- **Geospatial IT** engineering, product and operations services
- **Cloud-based** platforms and (graphical) Web applications, EO-dashboards
- Value from **Earth observation** satellites data
- **Customers** in governments, space application industry, and geoscience
- Over **70 ESA contracts** since establishment of EOX in 2008

EOxFamily June 2024



About Me

GTIF Austria Consolidation



SatInSys (Satgrass Application)

Helmut Herglotz

Project Manager

EOX IT Services GmbH

The Green Deal

The Green Deal

Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions the European Green Deal, 2019

- *'a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use' EU Commission, 2019*

The Green Deal

- The EU Green Deal serves as a roadmap for sustainable growth and development within the European Union
- Its goal is to make Europe the world's first climate-neutral continent by 2050
- Introduced by the European Commission in December 2019
- Created to address climate change, biodiversity decline, and environmental pollution

Mobilising research and fostering innovation
Transforming the EU's economy for a sustainable future
Increasing the EU's Climate ambition for 2030 and 2050
A zero pollution ambition for a toxic-free environment
Supplying clean, affordable and secure energy
Preserving and restoring ecosystems and biodiversity
The European Green Deal
Mobilising industry for a clean and circular economy
From 'Farm to Fork': a fair, healthy and environmentally friendly food system
Building and renovating in an energy and resource efficient way
Accelerating the shift to sustainable and smart mobility
Financing the transition
Leave no one behind (Just Transition)
The EU as a global leader
A European Climate Pact

Key Objectives

- Reduce greenhouse gas emissions by at least 55% by 2030
- Establish a clear pathway toward achieving climate neutrality by 2050
- Transition the EU economy toward greater sustainability
- Promote a circular economy that minimizes waste and encourages recycling
- Improve energy efficiency and expand the use of renewable energy
- Safeguard and restore biodiversity and natural ecosystems

Domains of the Green Deal

Domains of the Green Deal

Domains of the Green Deal

EO Climate Adaptation

Energy Transition

Mobility Transition

Carbon Accounting

Sustainable Cities

Strategies to Reach the Key Objectives

Strategies to reach Key Objectives

- Policy Framework & Legislation ("Fit for 55")
  - Raising the 2030 climate target (cutting emissions by at least 55%).
  - Revising laws on emissions trading (ETS), renewables, energy efficiency, cars, aviation, etc.
  - Carbon Border Adjustment Mechanism (CBAM) to prevent carbon leakage.
- Sustainable Finance & Investment
  - EU Green Taxonomy: defining what counts as a “green” investment.
  - Sustainable Finance Strategy to guide private and public money into green projects.
  - Just Transition Mechanism: support for regions, industries, and workers most affected.
- Research, Innovation & Digital Tools
  - Funding through Horizon Europe for clean tech, energy storage, and climate solutions.
  - Digitalization and AI for smarter resource management.
  - Earth observation (Copernicus Programme) → monitoring emissions, land use, biodiversity, oceans, disasters.
- Sectoral Roadmaps & Action Plans
  - Farm to Fork Strategy → sustainable food systems.
  - Circular Economy Action Plan → product design, recycling, waste reduction.
  - Biodiversity Strategy 2030 → protect 30% of EU land and seas.
  - Renovation Wave → energy efficiency in buildings.
  - Sustainable and Smart Mobility Strategy → green transport shift.

Strategies to reach Key Objectives

- Carbon Pricing & Market Mechanisms
  - Expanding the EU Emissions Trading System (ETS).
  - Pricing carbon in aviation, shipping, and road transport.
  - Linking carbon pricing with global partners.
- International Action & Diplomacy
  - EU leadership in global climate negotiations (Paris Agreement, COP summits).
  - Partnerships for green energy and raw materials.
  - Green Deal diplomacy with developing countries.
- Citizen & Business Involvement
  - European Climate Pact: engaging citizens and organizations.
  - Support for SMEs to transition sustainably.
  - Education and skills programs for the green economy.

Space for a Green Future

EO applications and decision support systems

Space for a Green Future

PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

co-funded with esa

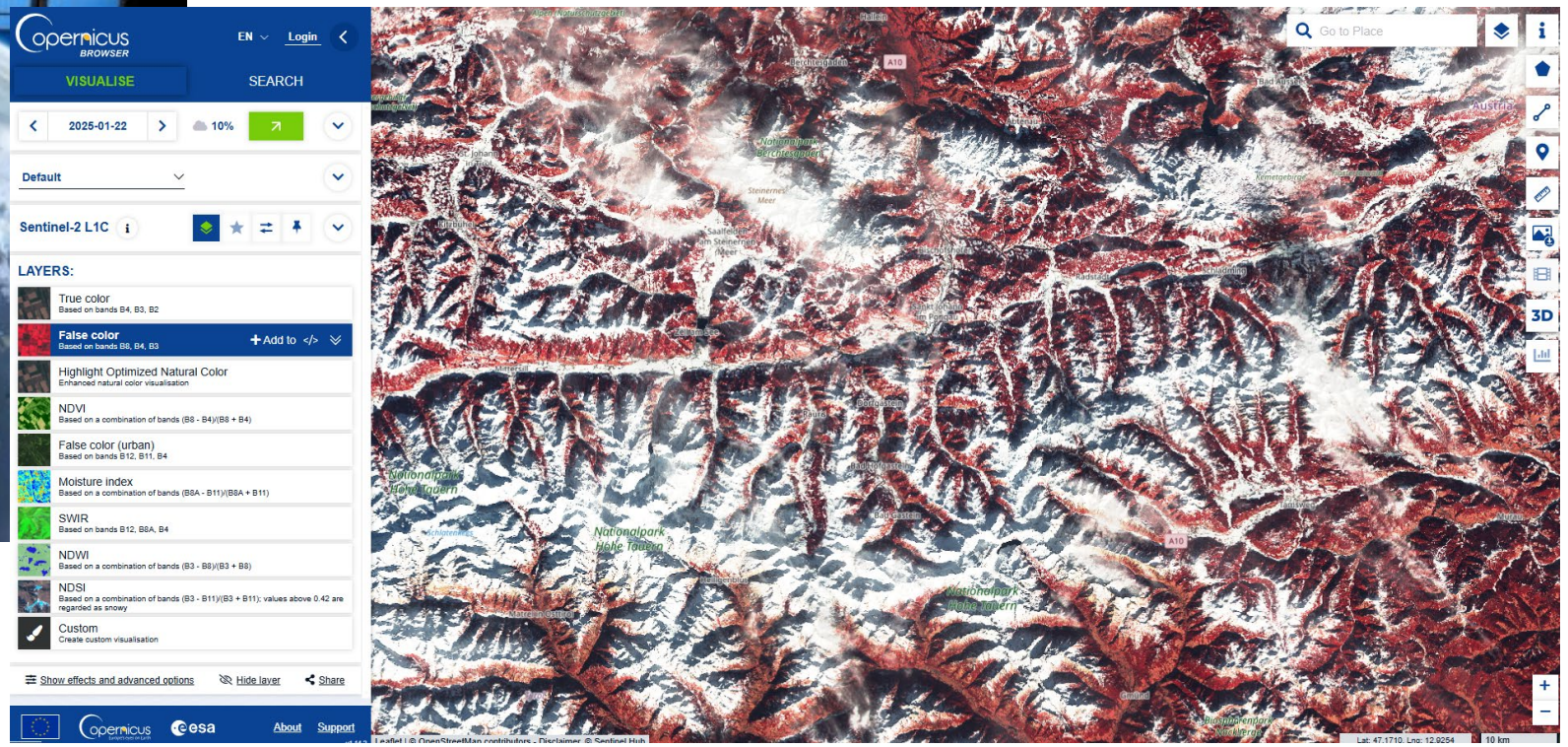
Copernicus

Earth Observation – Data from Space

Copernicus Sentinel-2 satellite:

- multispectral
- 10 m resolution on ground
- ~ weekly revisit

Copernicus Data Space Ecosystem – EO Browser



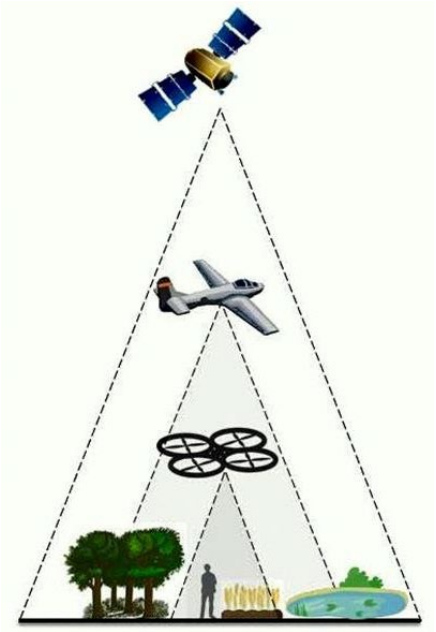
European Space Agency

Earth observation data from space was crucial to identifying climate change.

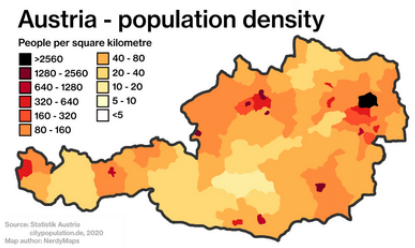
ESA is helping Europe to move from monitoring to managing, and to harness the use of space to pursue climate action, supporting national and European efforts to become carbon neutral by 2050.

Working with international partners – many of whom are from outside the space industry – ESA accelerates the use of space for a green future.

EO applications and decision support systems (Value Adding)



Earth-observation



Socio-economic

Data

Data Processing

Data Analytics

Data fusion

AI / ML Models

Information

Delivery
Application & Cockpit

Decision Ready Information

Synergy between big data methodologies and EO

How much data does the Copernicus Data Space Ecosystem (CDSE) produce daily?

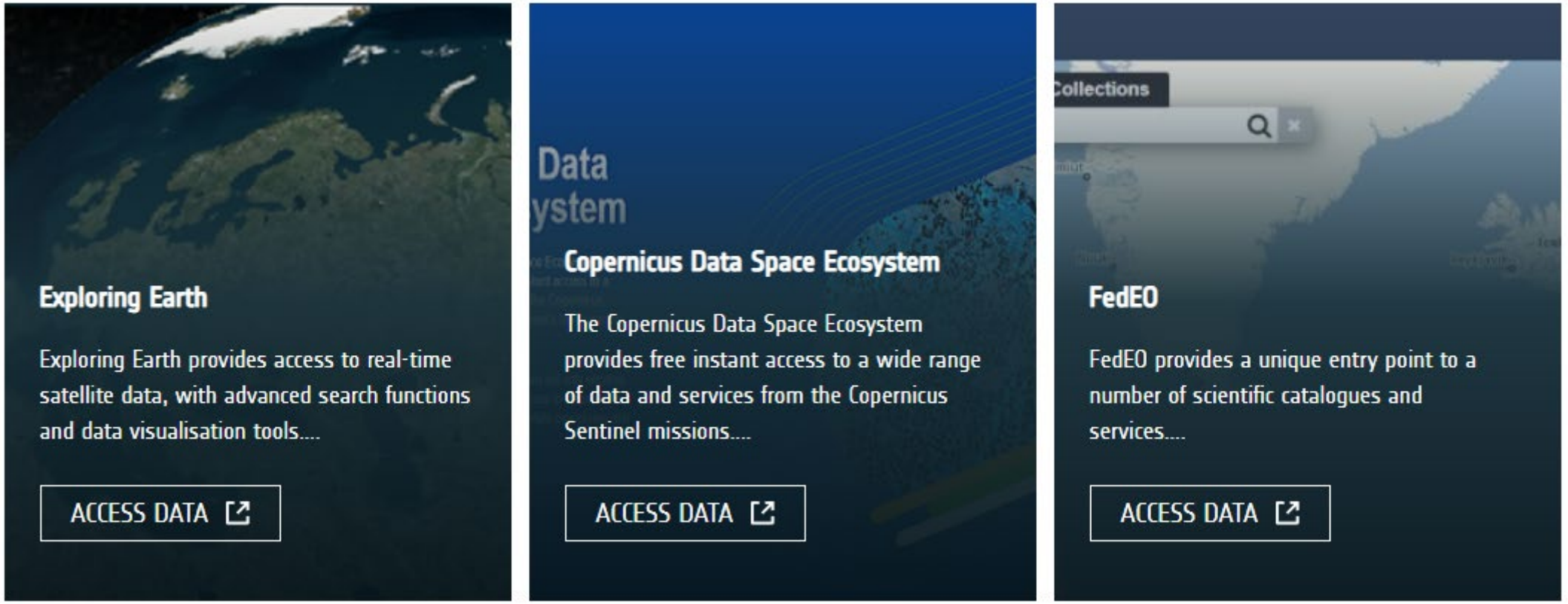
How much data does the Copernicus Data Space Ecosystem (CDSE) produce daily?

Up to 30 TB

(source: https://sentinels.copernicus.eu/-/copernicus-data-space-ecosystem-cdse-releases-annual-report-2023)

Synergy between big data methodologies and EO

DATA CATALOGUES



https://earth.esa.int/eogateway/catalog

1. Big Data Processing & Infrastructure

- Hadoop, Spark, Dask
- Google Earth Engine, AWS Earth on Cloud
- Kafka, Flink
- Example: Real-time flood mapping

2. Artificial Intelligence / Machine Learning

- Random Forests, SVM, Gradient Boosting
- CNNs, RNNs, Transformers
- Transfer learning, AutoML
- Example: Crop yield prediction

3. Data Fusion & Interoperability

- Combination of different remote sensing sources (Optical + Radar + LiDAR + Meteorological, etc.)
- Open Data Cube, xarray
- OGC, STAC standards
- Example: Biodiversity & climate studies

4. Visualization, Analytics & Decision Support

- GTIF Platform (eodash, EOxHub), ArcGIS, QGIS, PostGIS
- Dash, Kepler.gl, PowerBI
- Time-series visual analytics
- Example: Water management & carbon accounting

Overview of typical EO Usecases

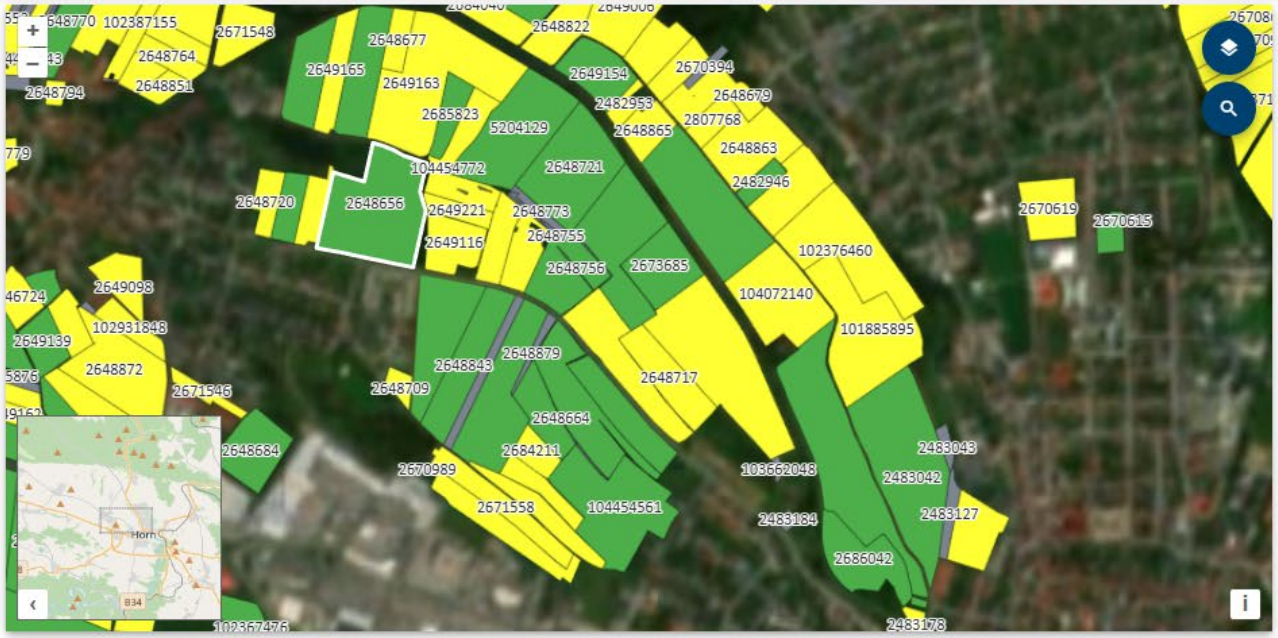
Agriculture & Food Security

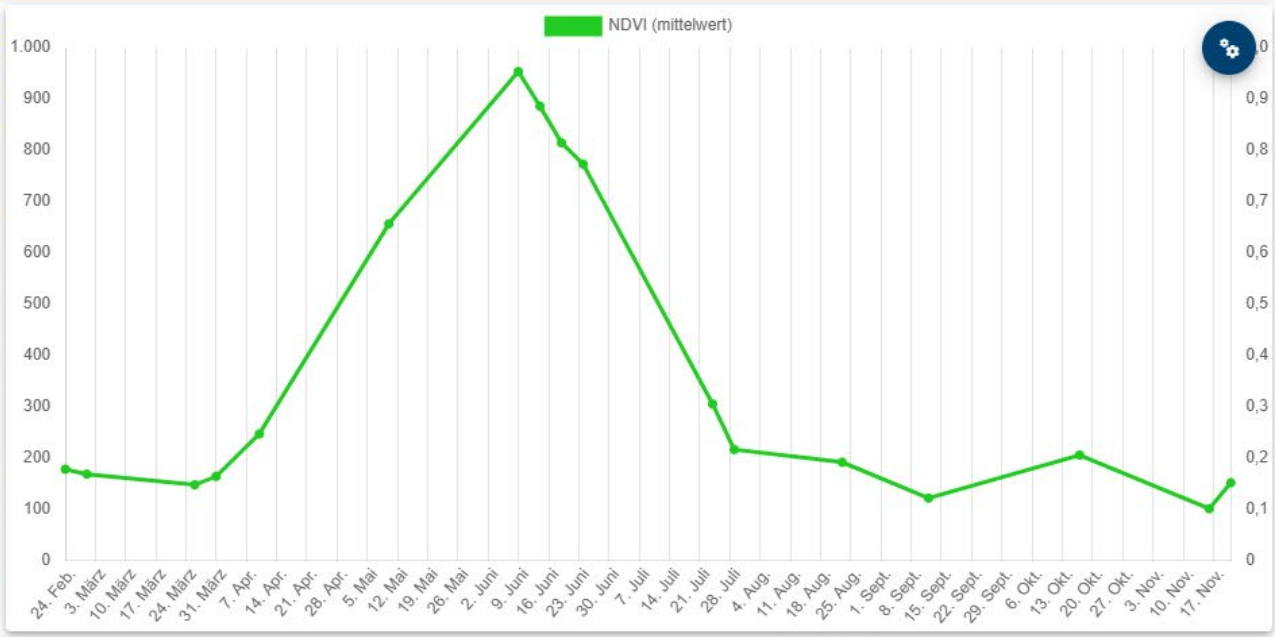
- Crop mapping, yield prediction, irrigation, area monitoring systems
  - E.g. Normalized difference vegetation index (NDVI) for health and density of vegetation
  - Machine Learning Models combining NDVI, metereological data trained with in situ data for yield and quality prediction

Overview of typical EO Usecases

Kulturgruppenbestimmung | AgriApp (data.gv.at)

demo@eox.at





Schlag-ID	Schlagnutzungsarten-Code beantragt	SNAR_BEZEICHNUNG	Compliance (Crop Type)	Kulturgruppen-Code beantragt	Kulturgruppe beantragt	VHR-Daten notwendig	Kulturgruppen-Code vorhergesagt - Rang 1	Kulturgruppe vorhergesagt - Rang 1	Wahrscheinlichkeit Vorhersage - Rang 1	Kulturgruppen-Code vorhergesagt - Rang 2	Wahrscheinlichkeit Vorhersage - Rang 2	Kulturgruppe vorhergesagt - Rang 2	In-Situ-Daten vorhanden

Keine Daten vorhanden

2021
Thu, Jul 29

July 2021

M	T	W	T	F	S	S
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

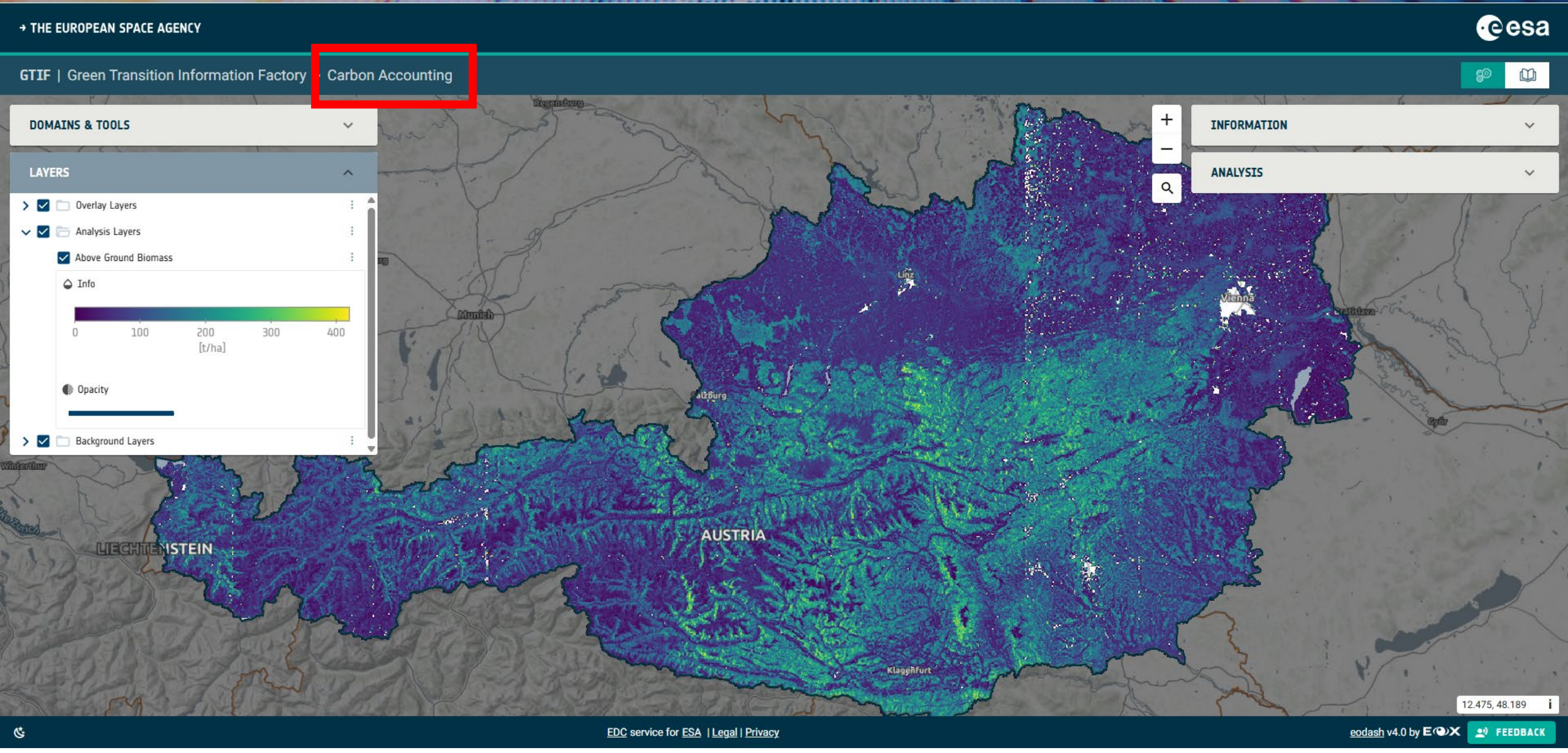
Biodiversity & Ecosystem Monitoring

- Habitat mapping, species detection

Forestry

- Deforestation, fire risk, carbon stocks

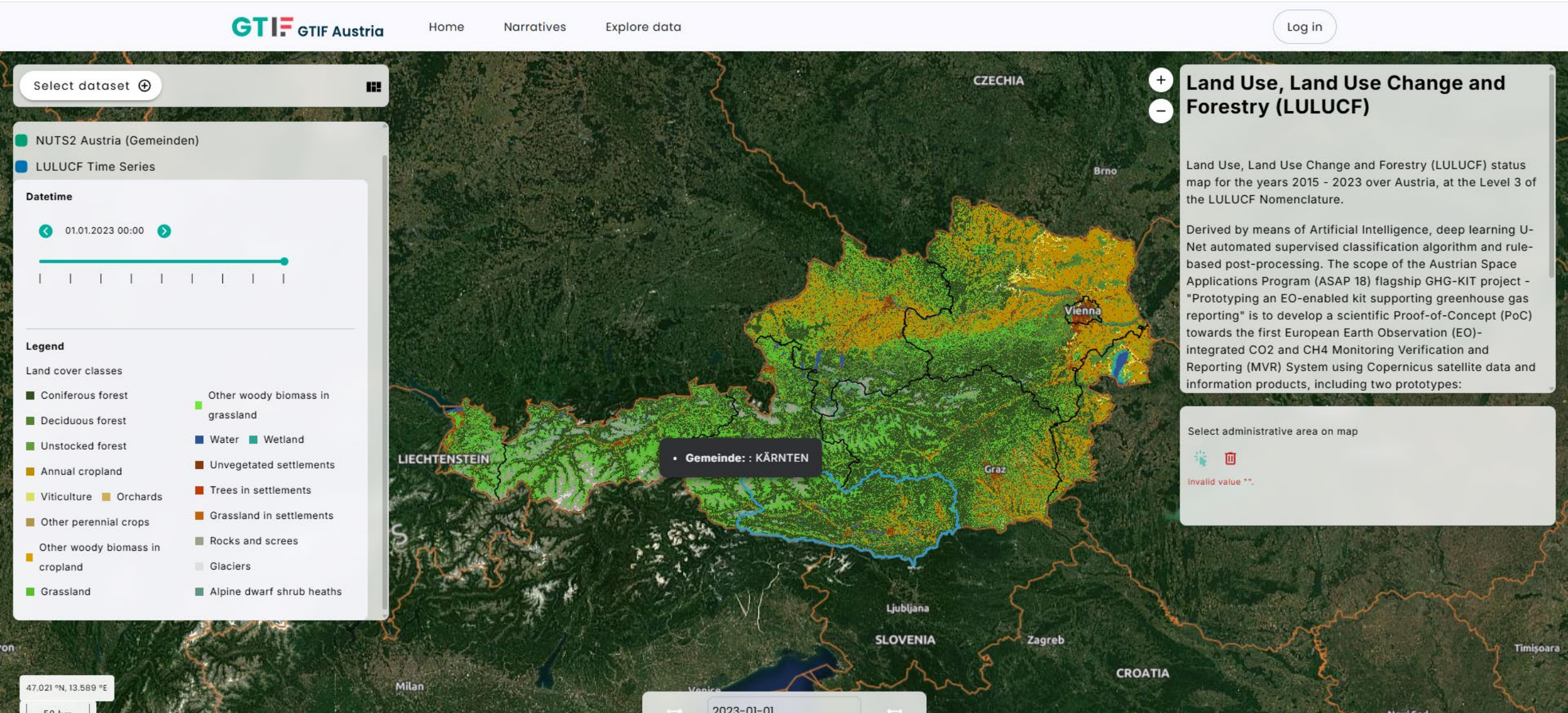
Overview of typical EO Usecases



Urban Development

- Land use change, heat islands

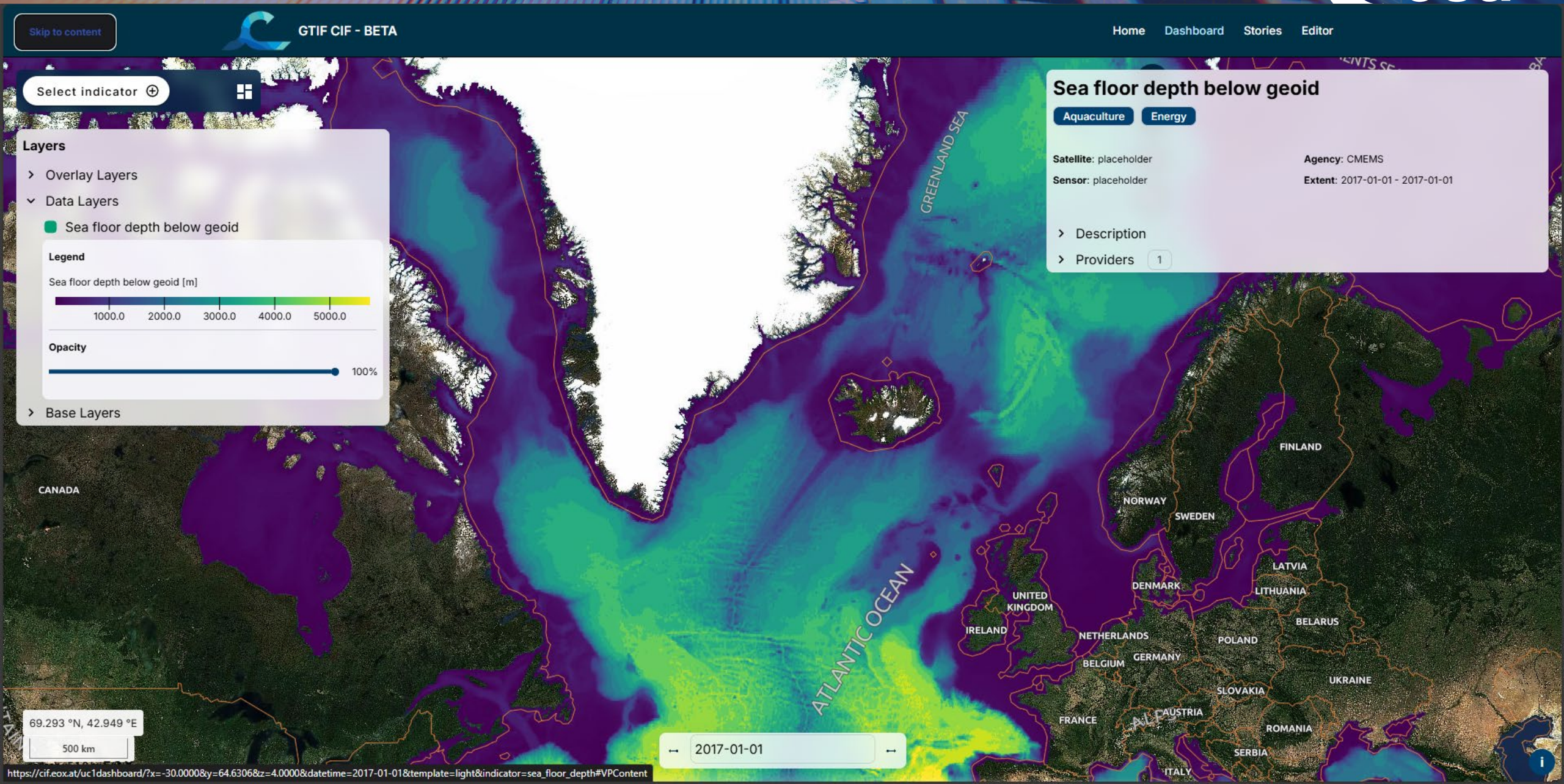
Overview of typical EO Usecases



Water Resources

- Droughts, glaciers, water quality

Overview of typical EO Usecases



Disaster Management

- Floods, landslides, wildfires

Climate & Atmosphere

- GHG, air quality, sea-level rise

Coastal & Marine Systems

- Coral reefs, oil spills, fishing

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Basic EO data exploration with Green Transition Information Factory (GTIF)

Helmut Herglotz
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European Commission | researchLatvia Value Through Knowledge | Ministry of Education and Science Republic of Latvia | esa academy

Content

14:00 – 15:30

- What is GTIF?
- Past and ongoing GTIF initiatives in Europe
- GTIF domains
- GTIF capabilities

DEMO

- Infrastructure Predictive Maintenance (AIT)
- The Austrian GTIF platform

What is GTIF?

What is GTIF (the Green Transition Information Factory)

→ THE EUROPEAN SPACE AGENCY

esa

GTIF | Green Transition Information Factory

GTIF

Green Transition Information Factory

Actionable information from Earth Observation
to *accelerate* the Green Transition of society and economy

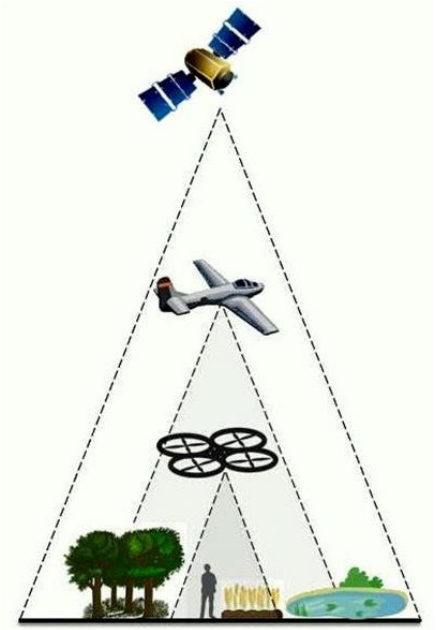
EXPLORE TOOLS

The ESA Green Transition Information Factory (GTIF) allows users to interactively discover the underlying opportunities and complexities of transitioning to carbon neutrality by 2050 using the power of

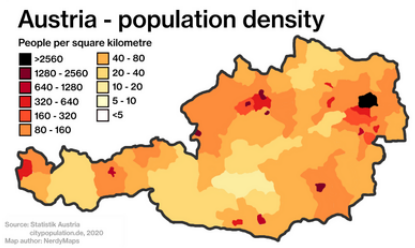
https://gtif.esa.int

FEEDBACK

RECAP: EO applications and decision support systems



Earth-observation



Socio-economic

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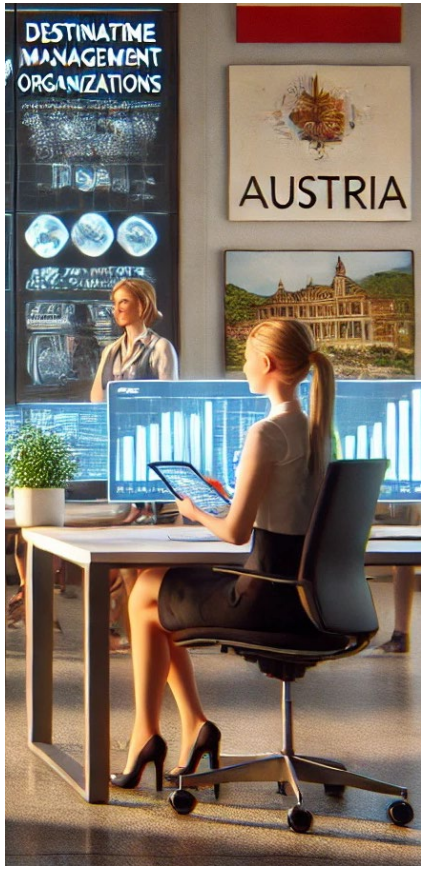
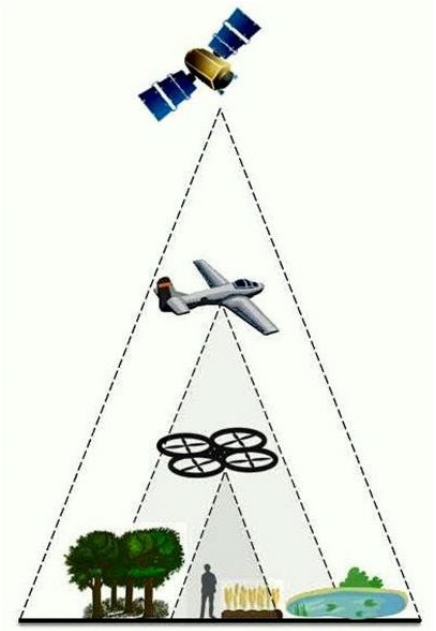
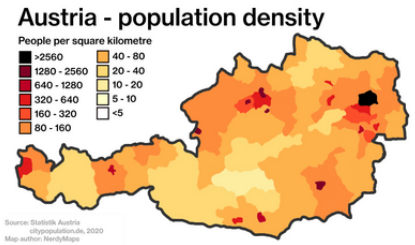


Green Transition Information Factories



Earth-observation



Socio-economic

Data

GTIF Renewable Energy Potentials

GTIF Microclimate Trends & Impacts

GTIF Ecosystems & Natural Resources

Brownfields, soil sealing, re-naturalization potential

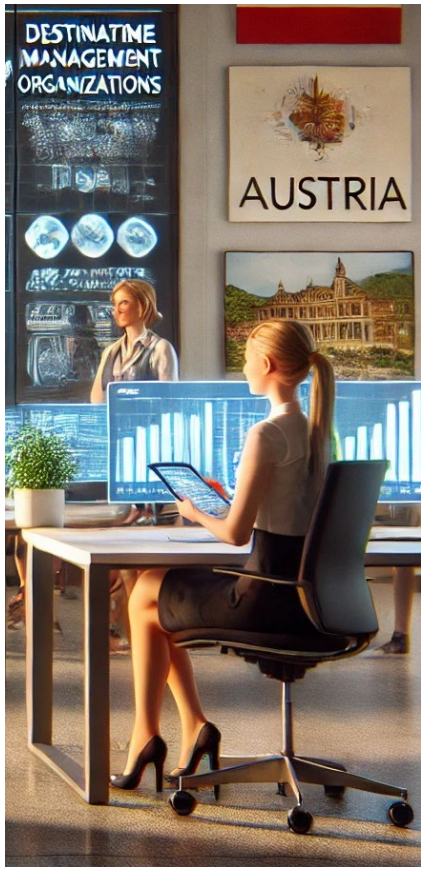
Air quality and health risk indicators

Information

GTIF Ecosystem
Application & Cockpit

GTIF GREEN TRANSITION INFORMATION FACTORIES

Decision Ready Information



Legend

GTIF GTIF Capability

Third Party Info Source (non-GTIF)

Past and Ongoing GTIF Initiatives

Past and ongoing GTIF activities in Europe

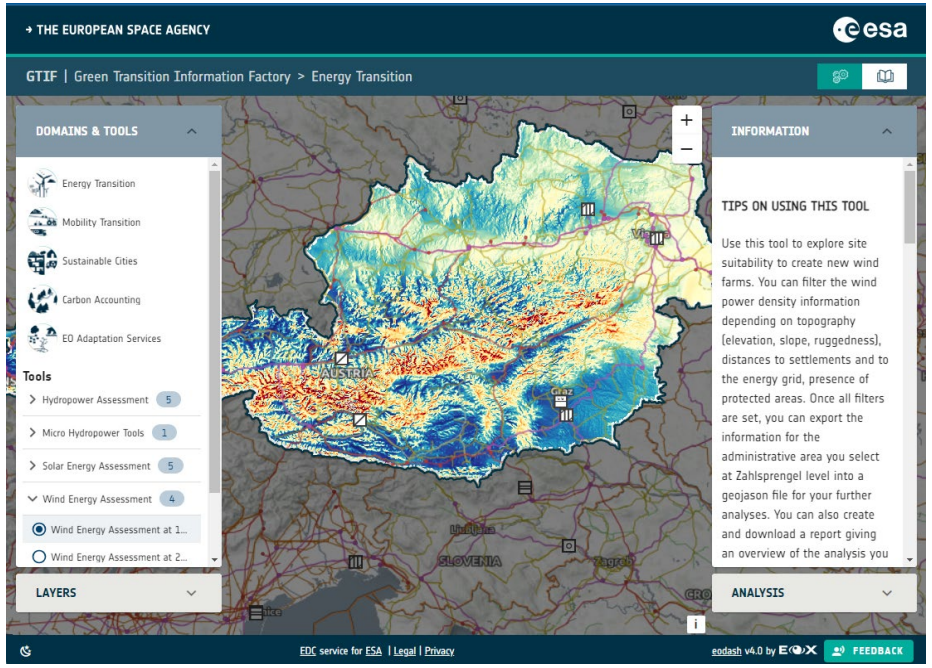
GTIF Activity	Focus
GTIF Austria Demonstrator	Austria
GTIF Austria Consolidation	Austria
Baltic GTIF	Baltic Sea States
Cerulean GTIF	Arctic Seas
Danube Information Factory	River Ecosystems (flooding, irrigation)
UK GTIF	UK, Ireland, Canada
GTIME	Vegetation Change
NoiseSphere	Mobility (noise)
Popsicle	Population simulation (resilience against climate change and related emergencies)
SAFIR	Sentinel assisted Forestry insight and research
[AND MANY MORE!!!]	

Past and ongoing GTIF activities in Europe

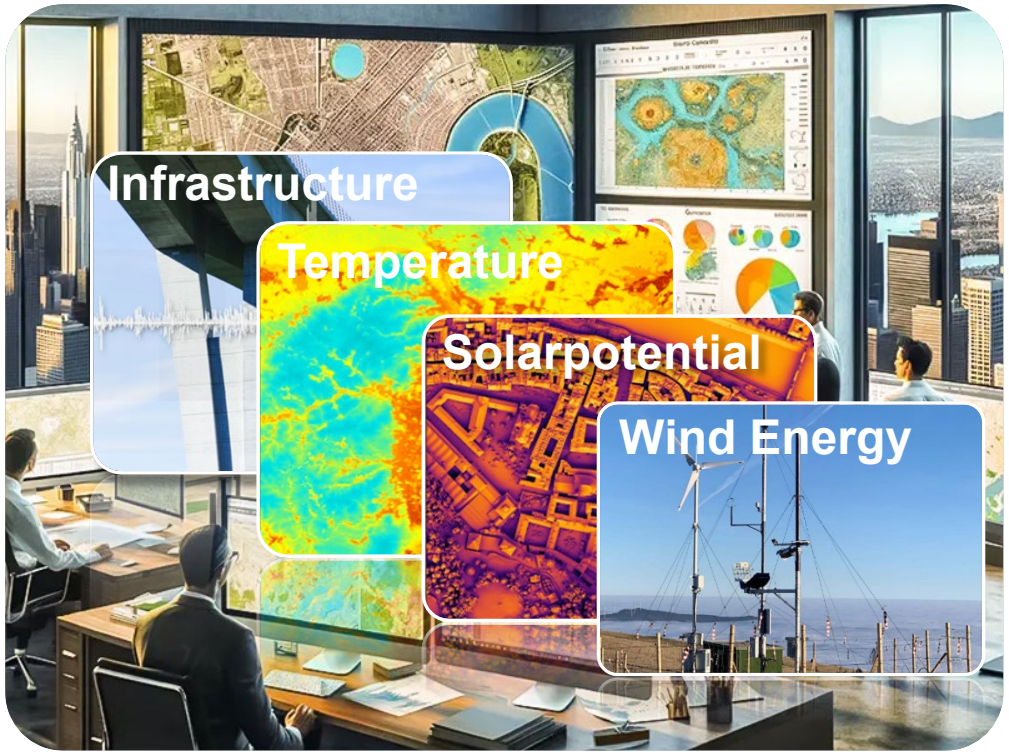
GTIF-AT Demonstrator

Handover of Governance

National Stakeholders



https://gtif.esa.int/explore



GTIF domains

Domains of the Green Deal

EO Climate Adaptation

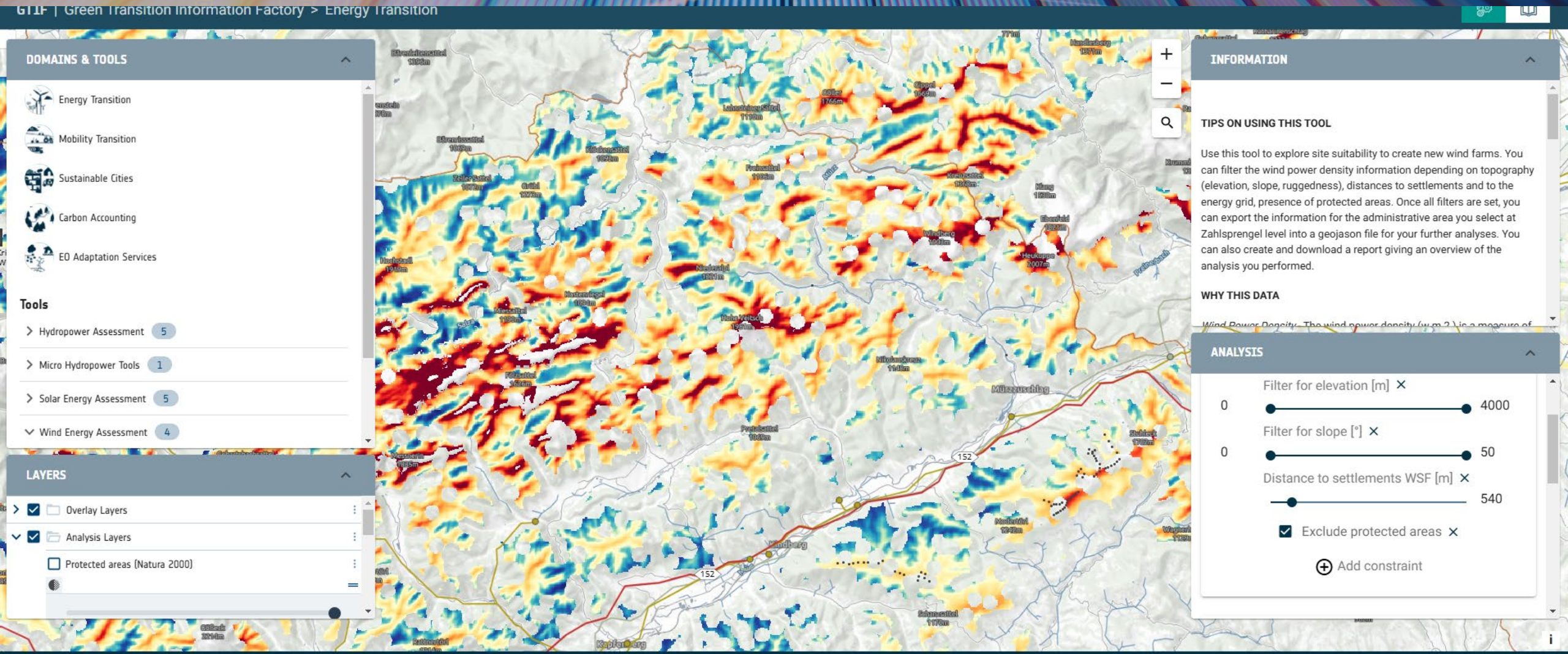
Energy Transition

Mobility Transition

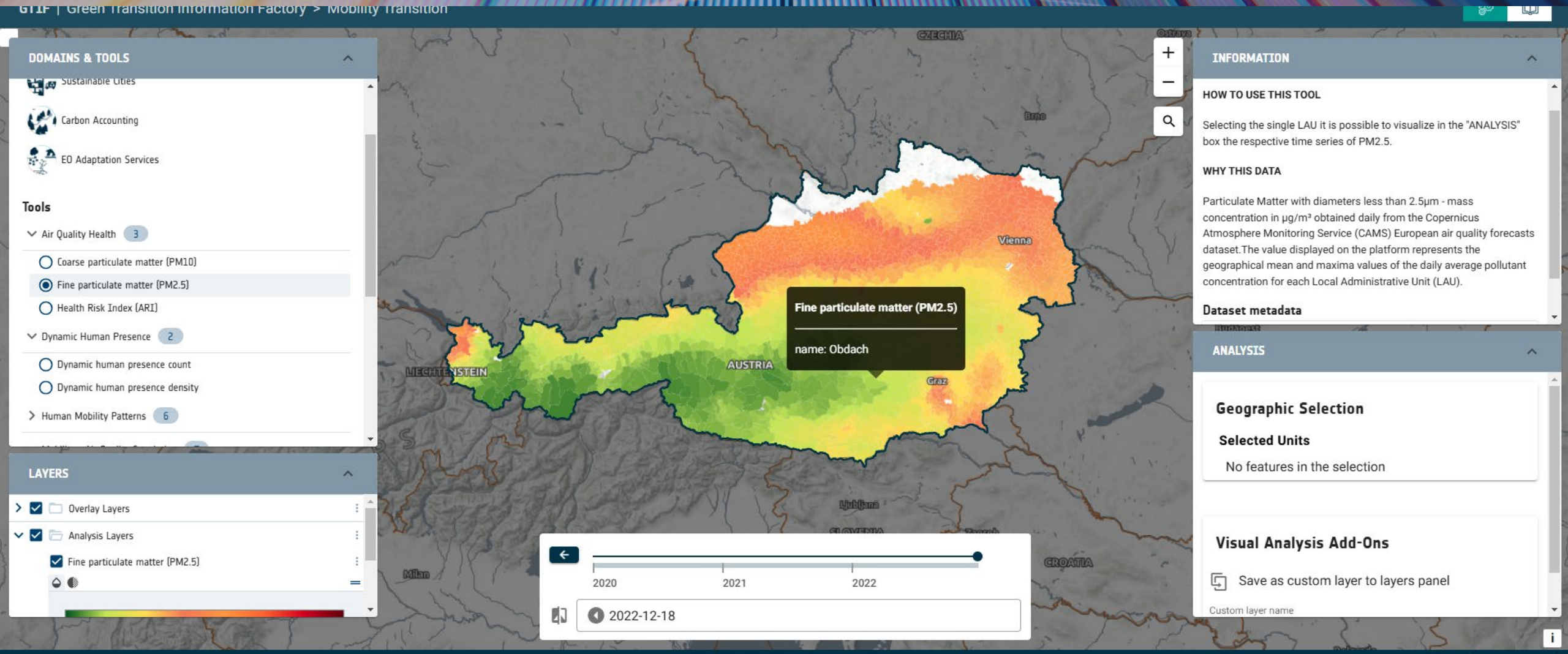
Carbon Accounting

Sustainable Cities

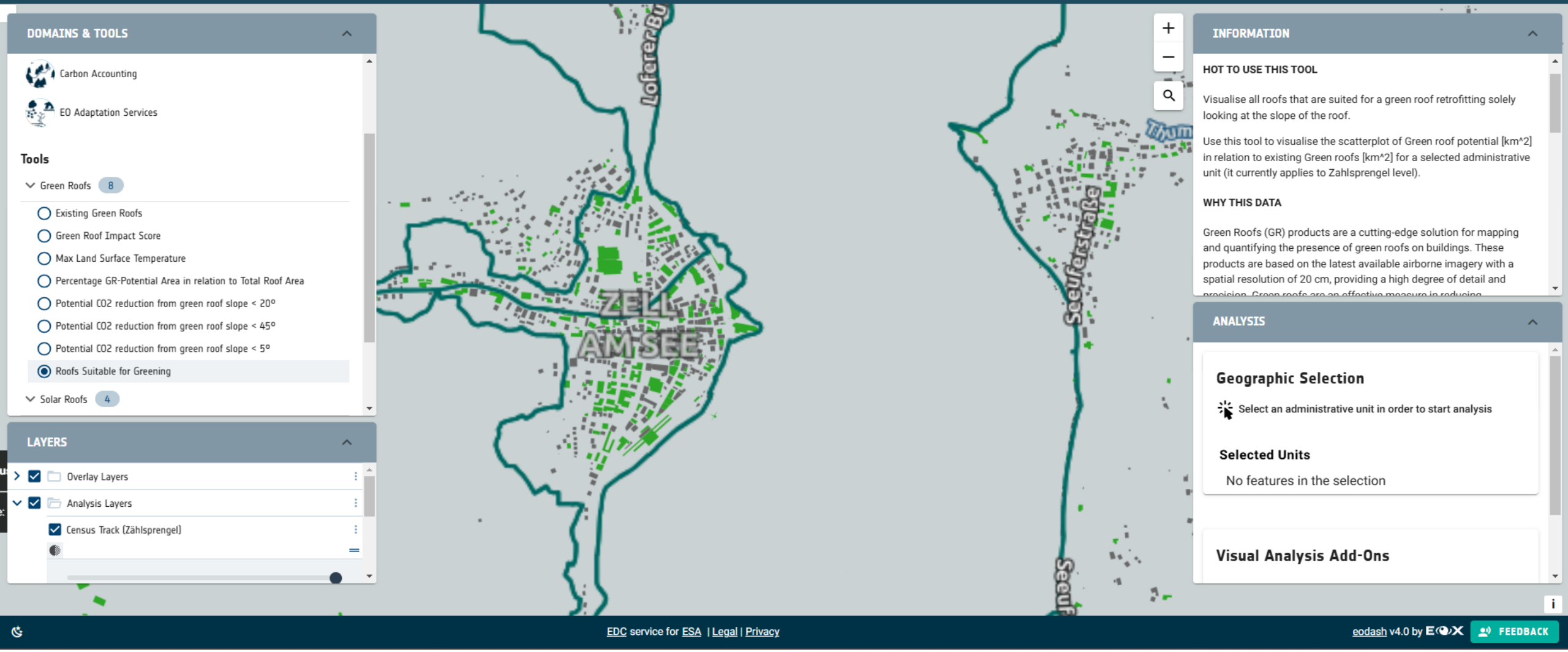
Energy Transition



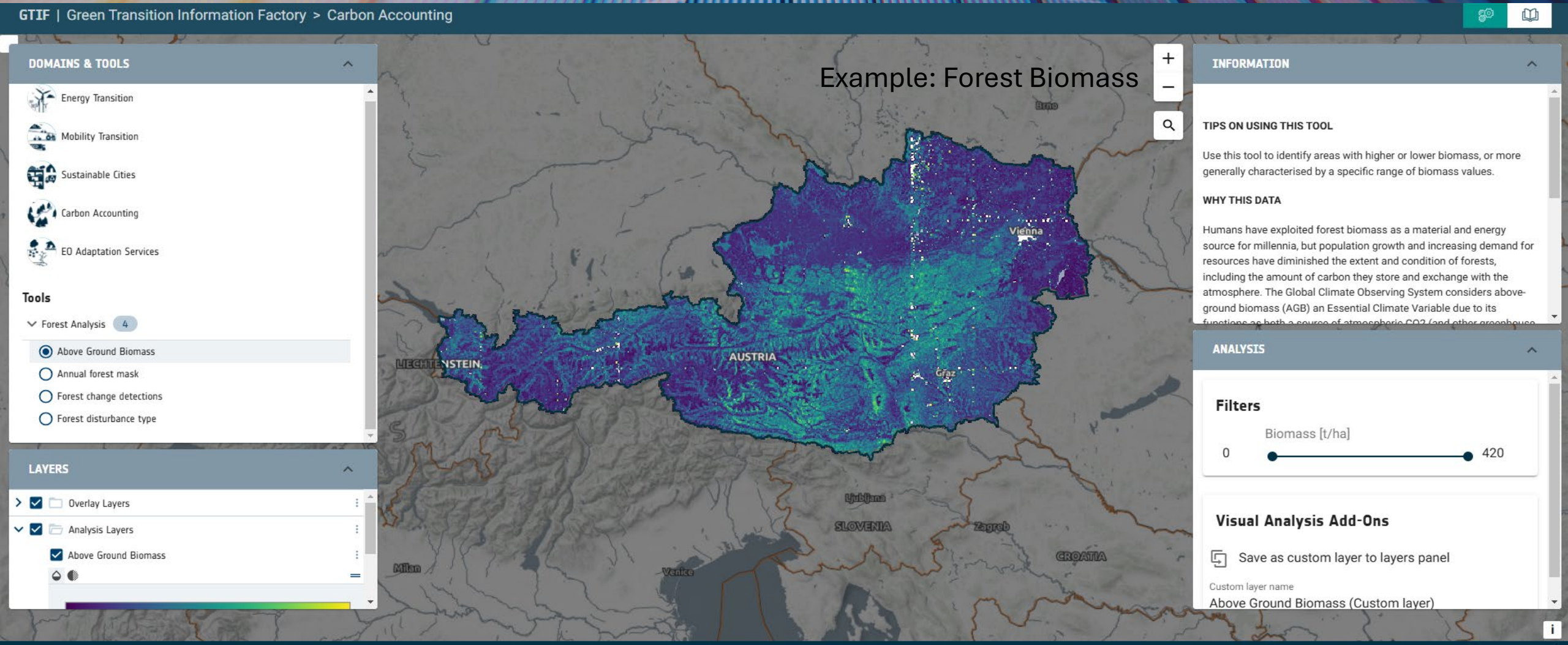
Mobility Transition



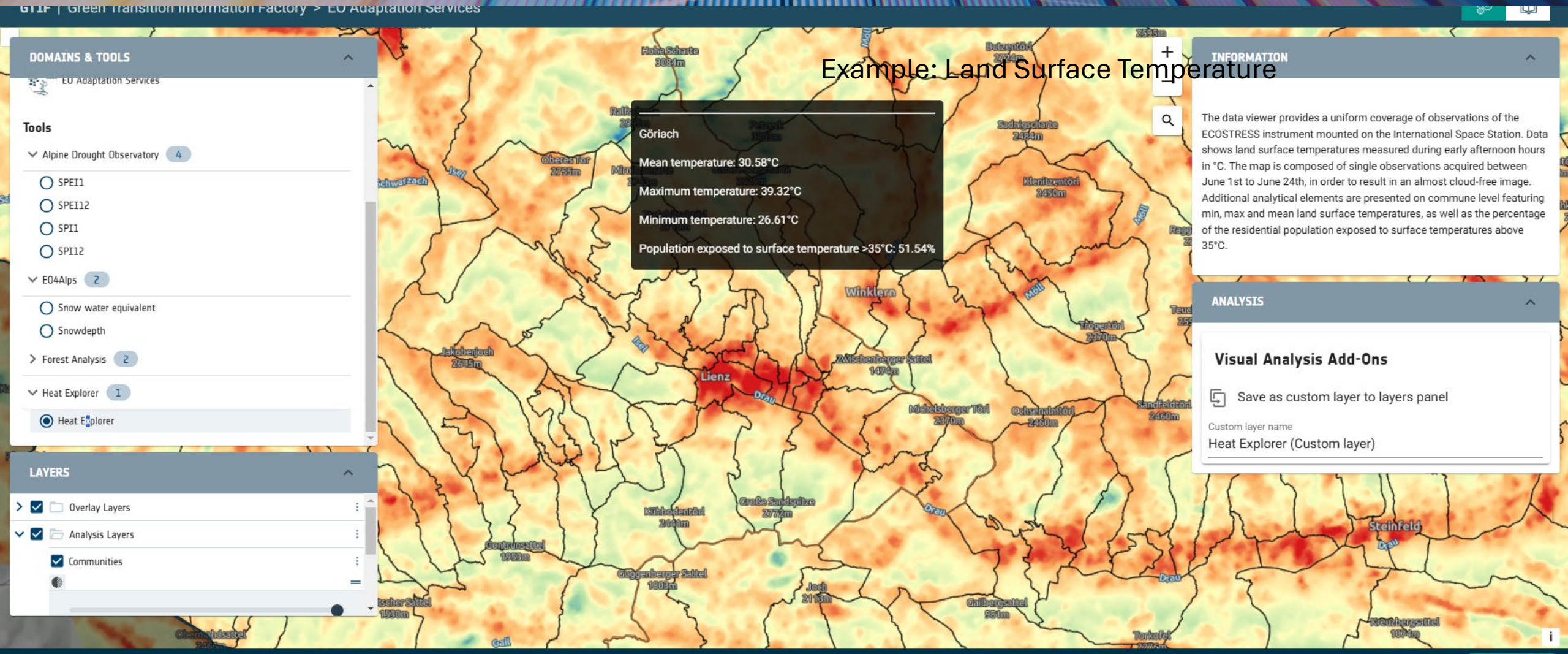
Sustainable Cities



Carbon Accounting



EO Adaptation Services



GTIF capabilities

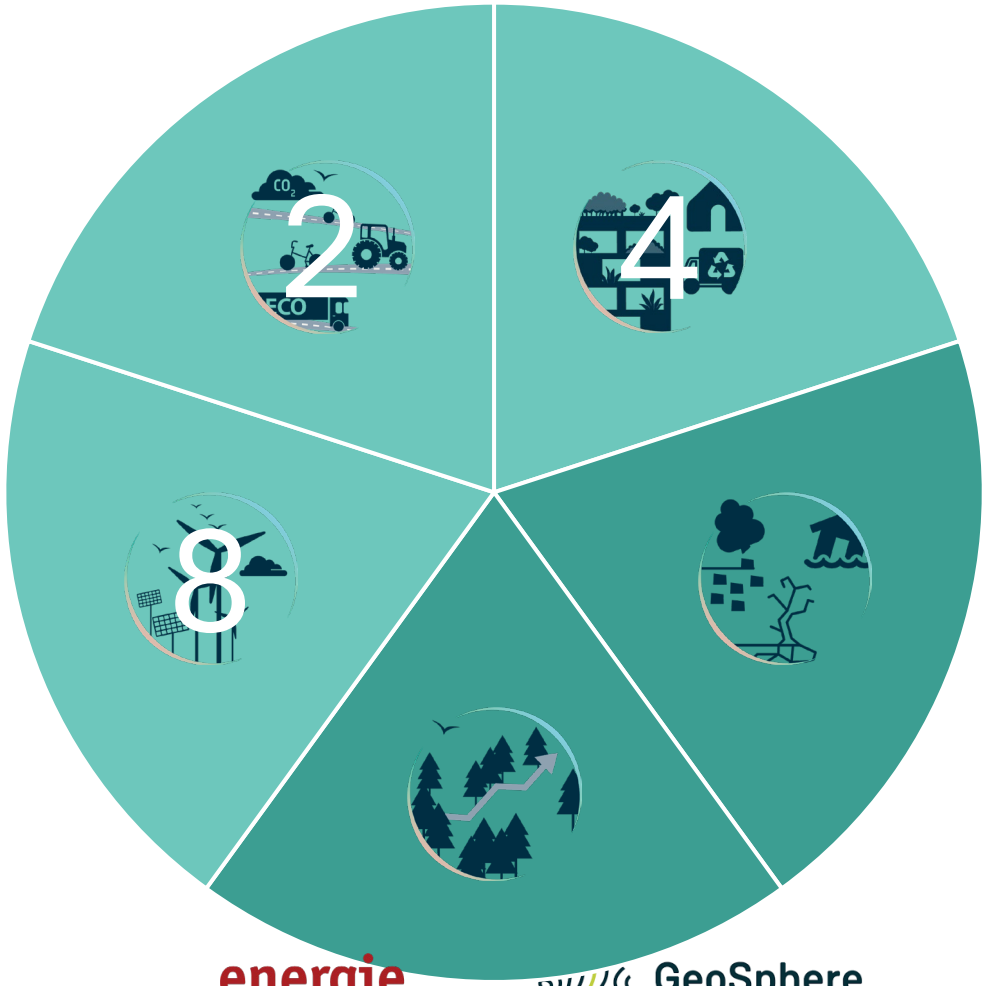
Internal tracking of GTIF Capabilities

Currently ca. 170 Capabilities

- AI/ML based capabilities (e.g. Windpower Assessment) – ENERGY DOMAIN
- Capabilities based on big data processing (Predictive Mobility Maintenance) – MOBILITY DOMAIN
- Capabilities based on Data Fusion (Renewable Energy Site Identification) – ENERGY DOMAIN
- …

Supported domains & GTIF capabilities (Austria)

Consolidation & Evolution & Operationalisation



+ consolidation and assessment of remaining GTIF-capabilities

energie werkstatt

GeoSphere Austria

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

EOX

Current GTIF enhancement implementations

GTIF Consolidation (ESA Work Requirements)		
Energy Transition	WR-01	WPD-as-a-service & update AT Wind Atlas
	WR-02	Evolve site identification capabilities for renewable energy expansion to support the identification of acceleration areas of the RED-III regulation
	WR-03	Energy nowcasting for solar- and wind energy
	WR-04	Support for energy supply and demand planning
	WR-05	Support the creation of "energy plans" for every community
	WR-06	Integration of energy grid capacity information
	WR-07	Explore support for geothermal energy potential assessment
	WR-08	Integrate BMK energy dashboard
Mobility Transition	WR-09	Assessment and integration of human mobility data sources
	WR-10	Transport Infrastructure Predictive maintenance
Sustainable Cities	WR-11	Rooftop characterisation as a service
	WR-12	Develop comparison feature for cities/regions as part of GTIF UI
	WR-13	Urban Vegetation monitoring
	WR-14	Fallow land and soil sealing identification and assessment capability

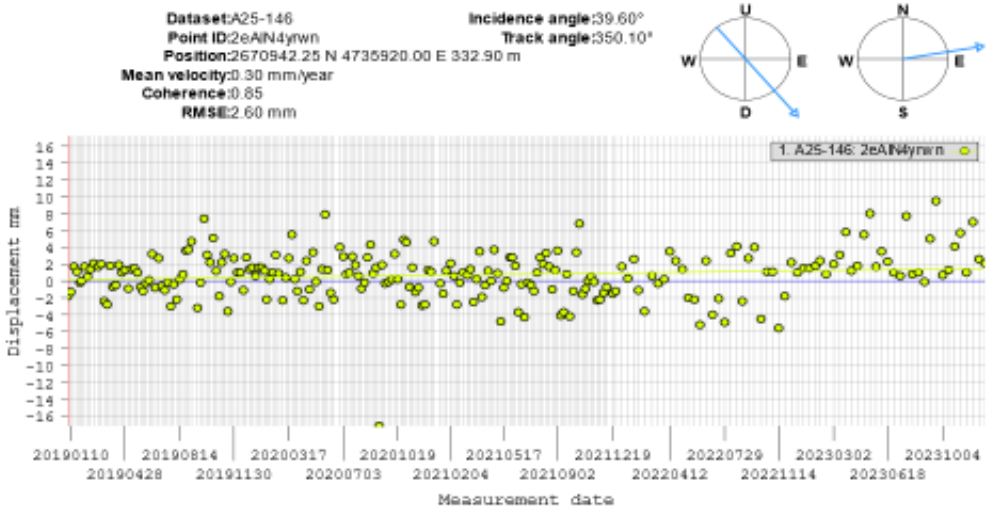
TRANSPORT INFRASTRUCTURE PREDICTIVE MAINTENANCE

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

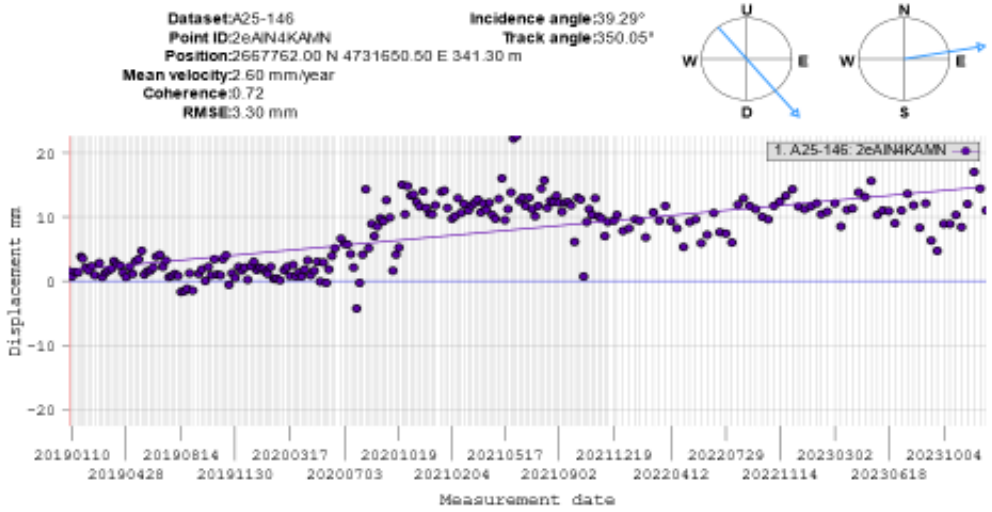
- Deformation monitoring of important infrastructure structures provides an early warning system for these structures
- Excessive settlements, washouts or structural deterioration, are often accompanied by early deformation, which can indicate upcoming damage or, in extreme cases, even failure.
- A demonstrator on a 45 km-long highway in Austria was prepared

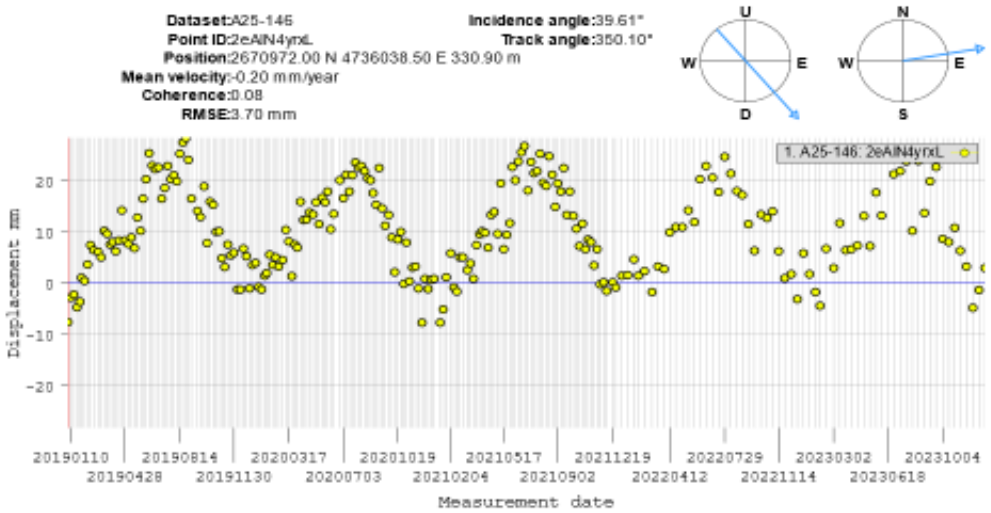
TRANSPORT INFRASTRUCTURE PREDICTIVE MAINTENANCE

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

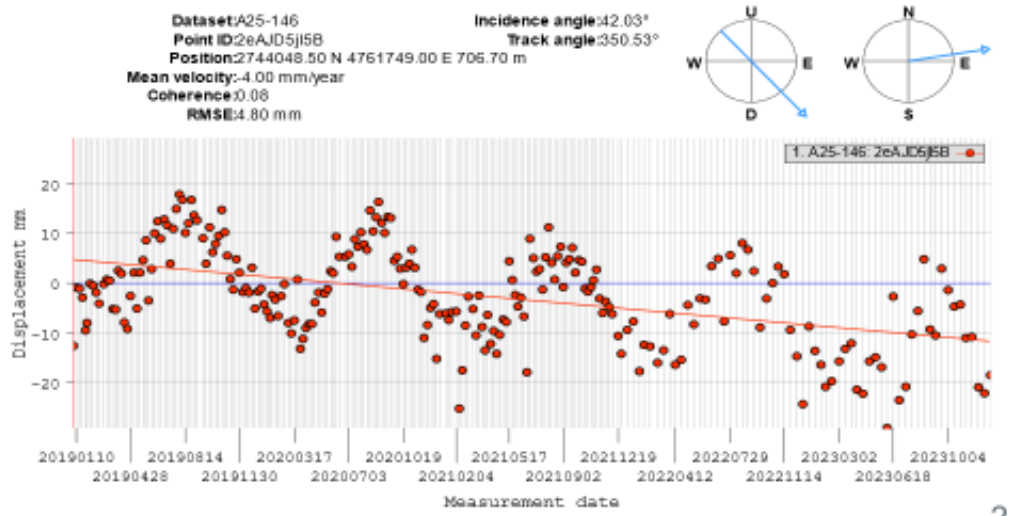


Highway

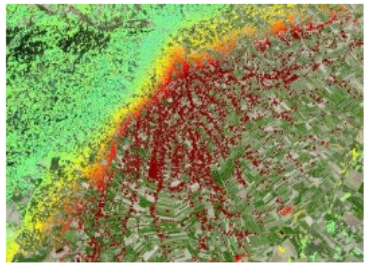




Bridge



European Ground Motion Service



Overview

Technical summary

Documentation

Datasets

Applications & use cases

The Earth's surface is in constant motion. Whether due to natural phenomena such as tectonic activity or volcanism, or because of human activities such as groundwater extraction or mining, the dynamism of the surface can have significant impacts on infrastructure and natural ecosystems. In recent years, increasing awareness of the potential risks related to ground motion has led to a demand for comprehensive and reliable information on these movements.

The European Ground Motion Service (EGMS) was created in response to user needs voiced at the Copernicus User Forum. This product represents the bleeding edge of space-based remote sensing technology, using Synthetic Aperture Radar Interferometry (InSAR) data derived from Sentinel-1 to detect and measure ground movements across Europe with milimetre precision. The product is updated annually and can be used for a variety of applications; city, regional, or state authorities can use it to monitor the structural integrities of dams, bridges, railways, and buildings. It allows urban planners to make data-driven decisions about where to build new infrastructure by assessing the likelihood of natural hazards such as landslides or subsidence. Researchers can also use EGMS data to study the impacts of climate change, such as thawing permafrost and coastal subsidence.

Datasets

You can only view and download the data in the EGMS Explorer (external site).

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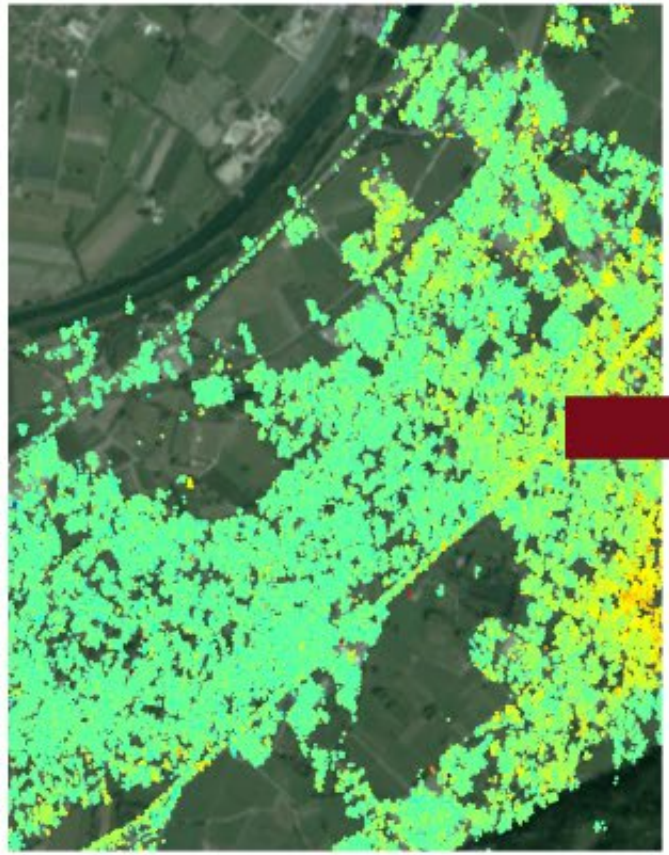

EGMS

Reselected points

Clustered and decomposed

TRANSPORT INFRASTRUCTURE PREDICTIVE MAINTENANCE

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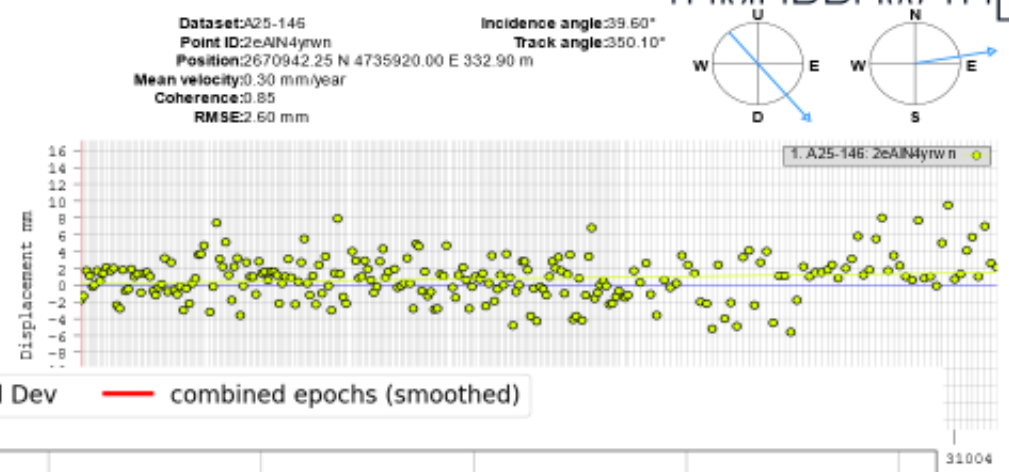
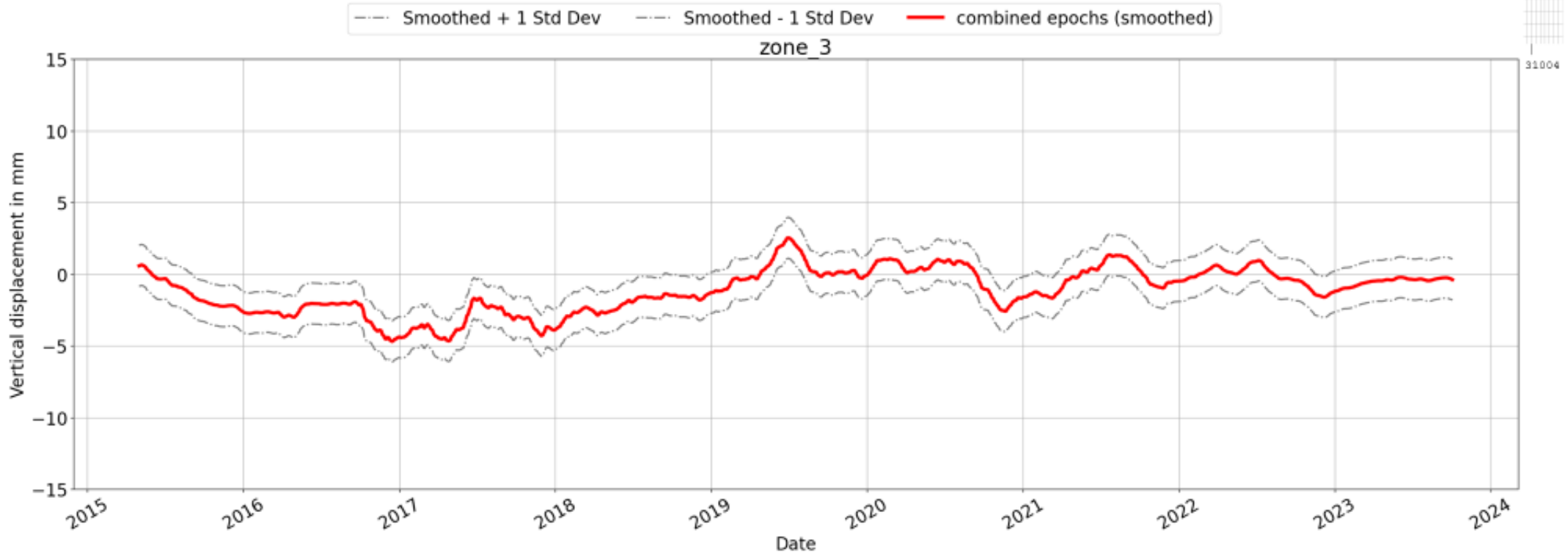
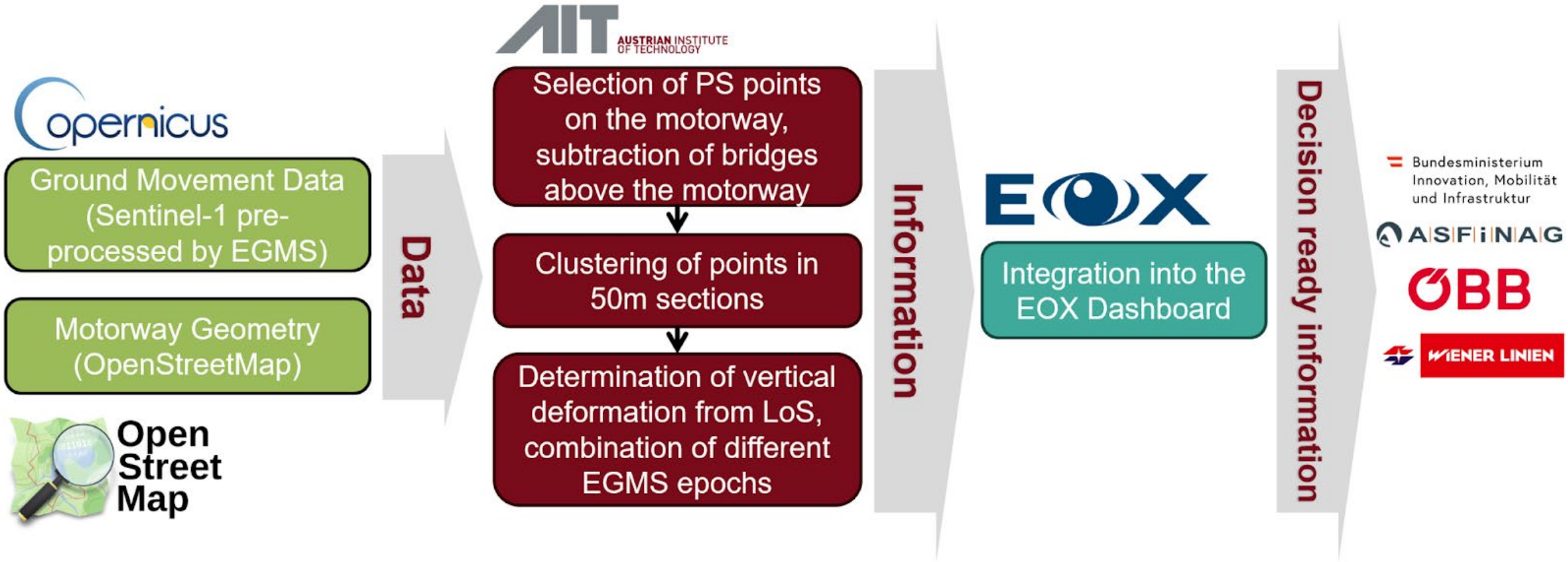
- Recalculation to vertical deformation for each zone
- Combine EGMS Epochs





GTIF capabilities



DEMO

The Austrian GTIF platform

Storytelling / Narratives

Explore

Repository

Workspace

https://gtif-austria.info

Thank you

Thank you for your attention.

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Find out more about GTIF Austria at

https://gtif-austria.info
https://github.com/GTIF-Austria

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