



Land Monitoring

High Resolution Vegetation Phenology and Productivity

NCP training

Luca Battistella

27/02/2026



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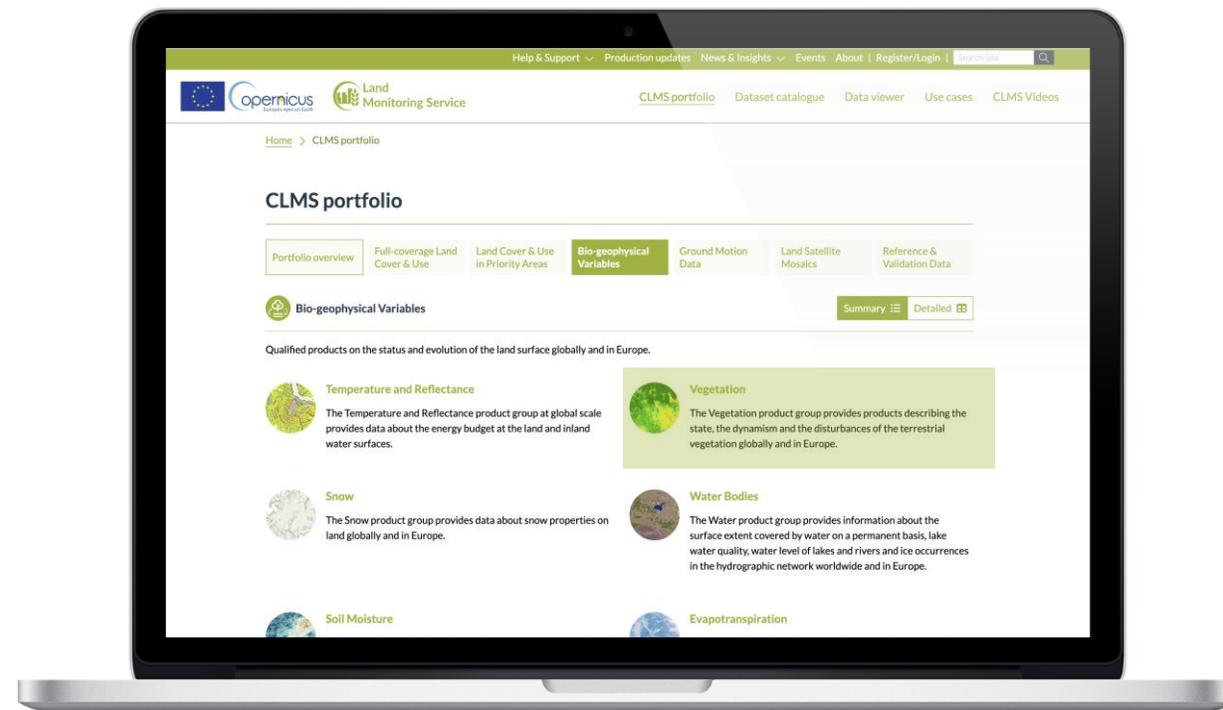
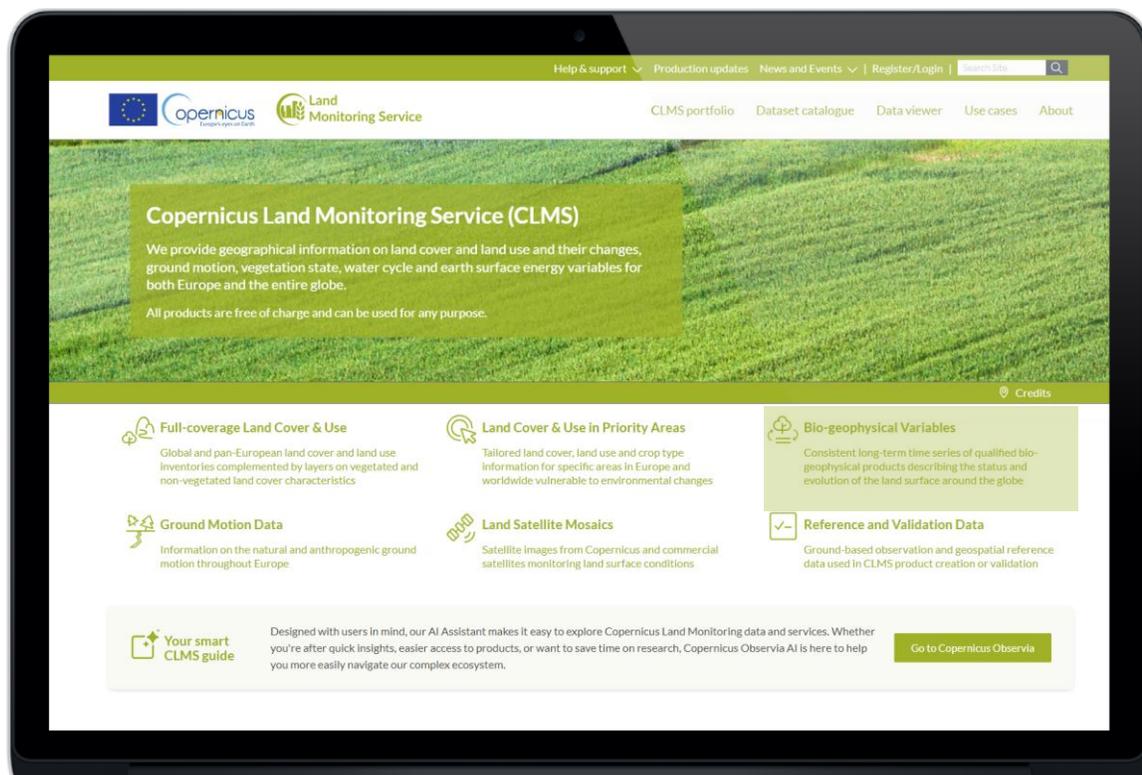
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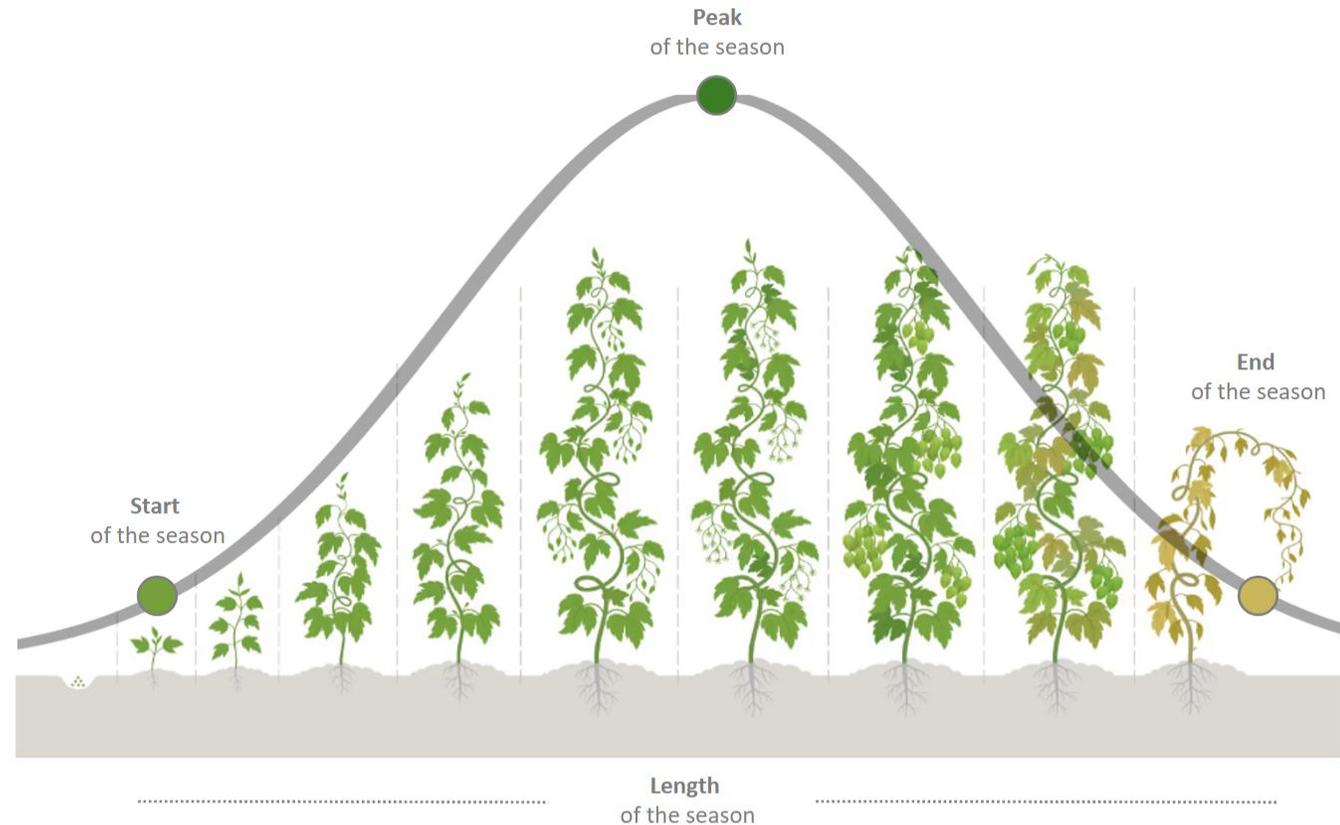
Pan-European Biophysical Variables

<https://land.copernicus.eu/en/products/vegetation>



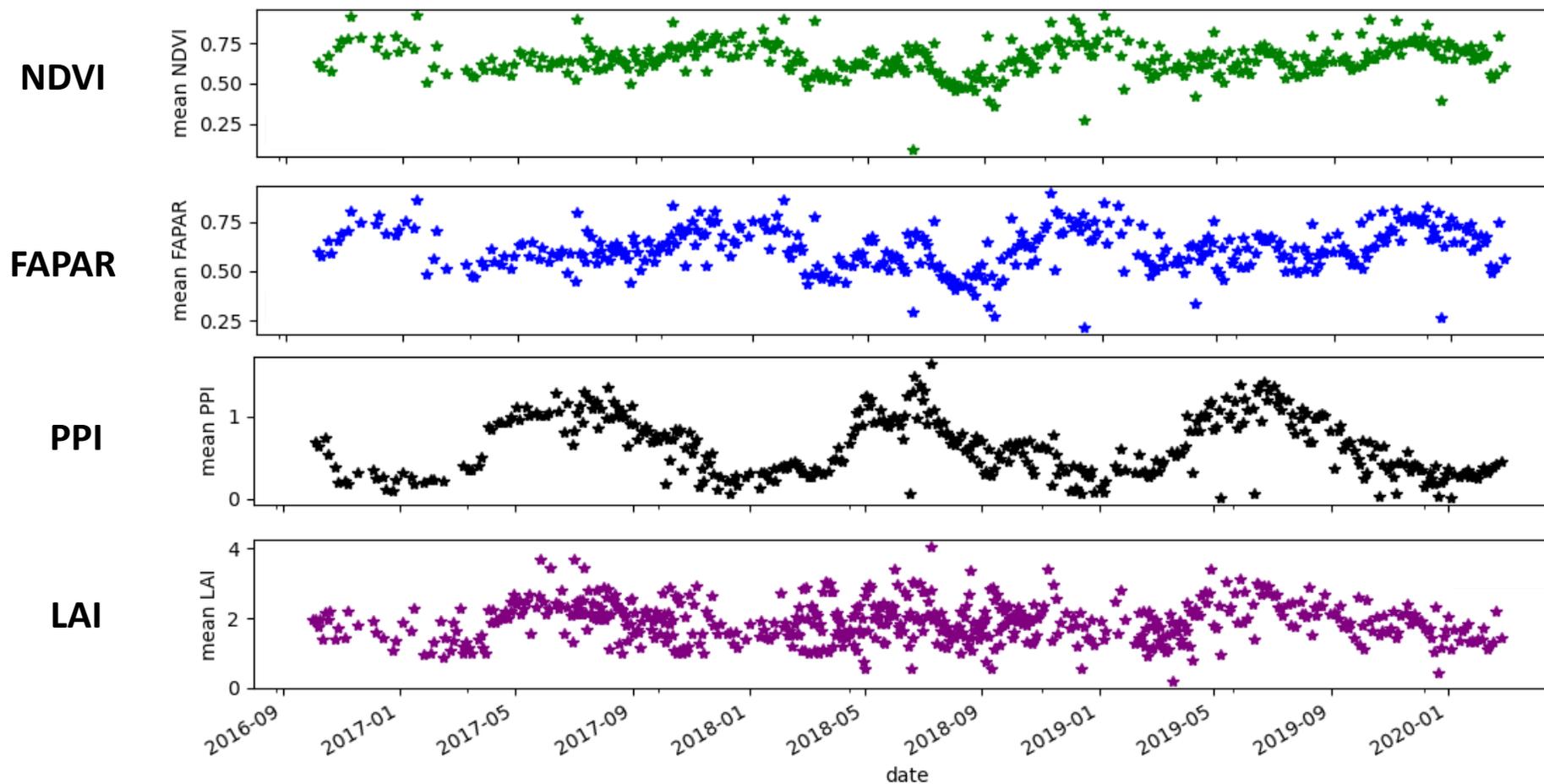
Phenology and Productivity

- **Phenology:** The timing of recurring plant life-cycle events
 - Stages of leaf development
 - Affected by external factors
- **Productivity:** the rate at which biomass
 - Plant growth
 - Gross/Net Primary Productivity
 - Vegetation vigour and health



Comparison of Vegetation Indices and Biophysical Variables

Mean VI/BV for vegetated pixels across Tile 31UFS (Belgium)



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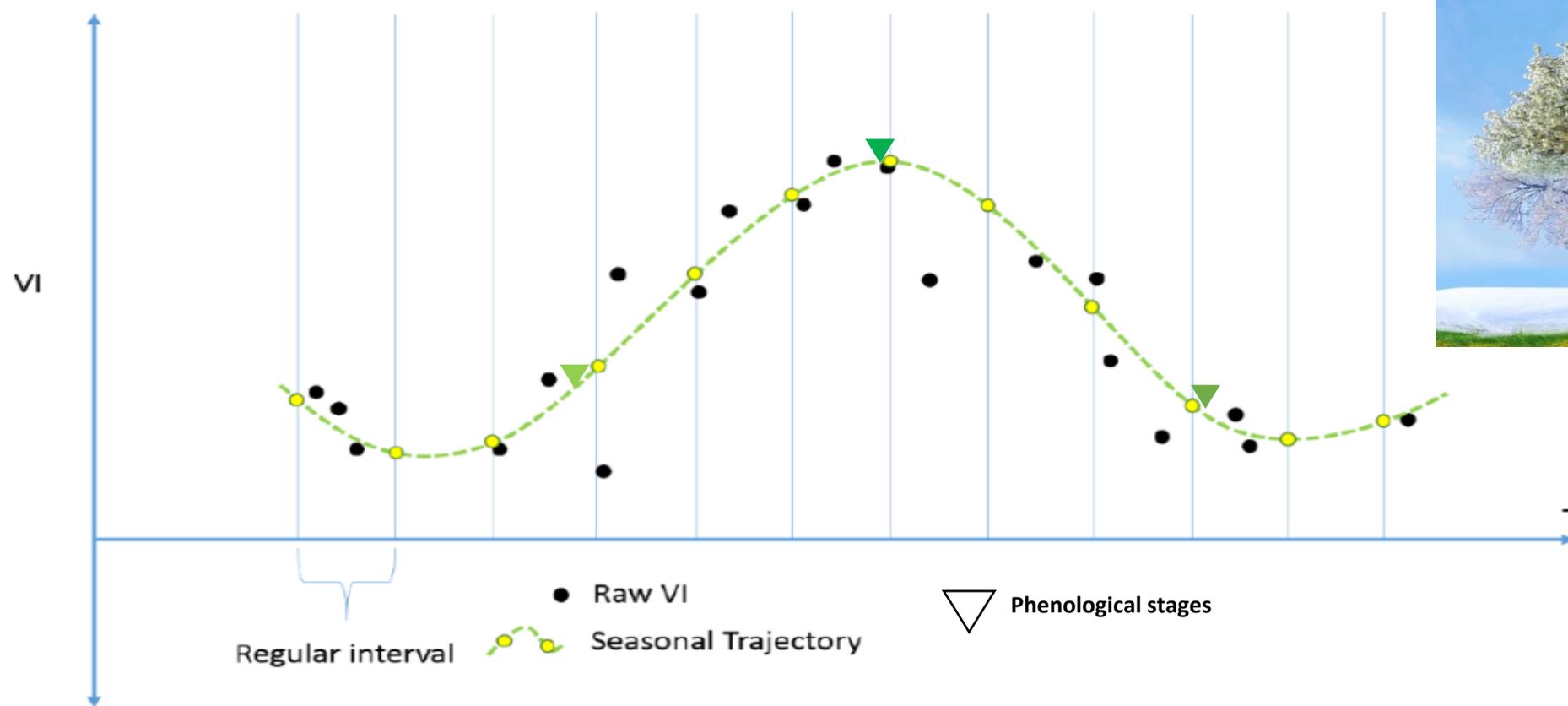
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HRVPP Seasonal Trajectories and Metrics



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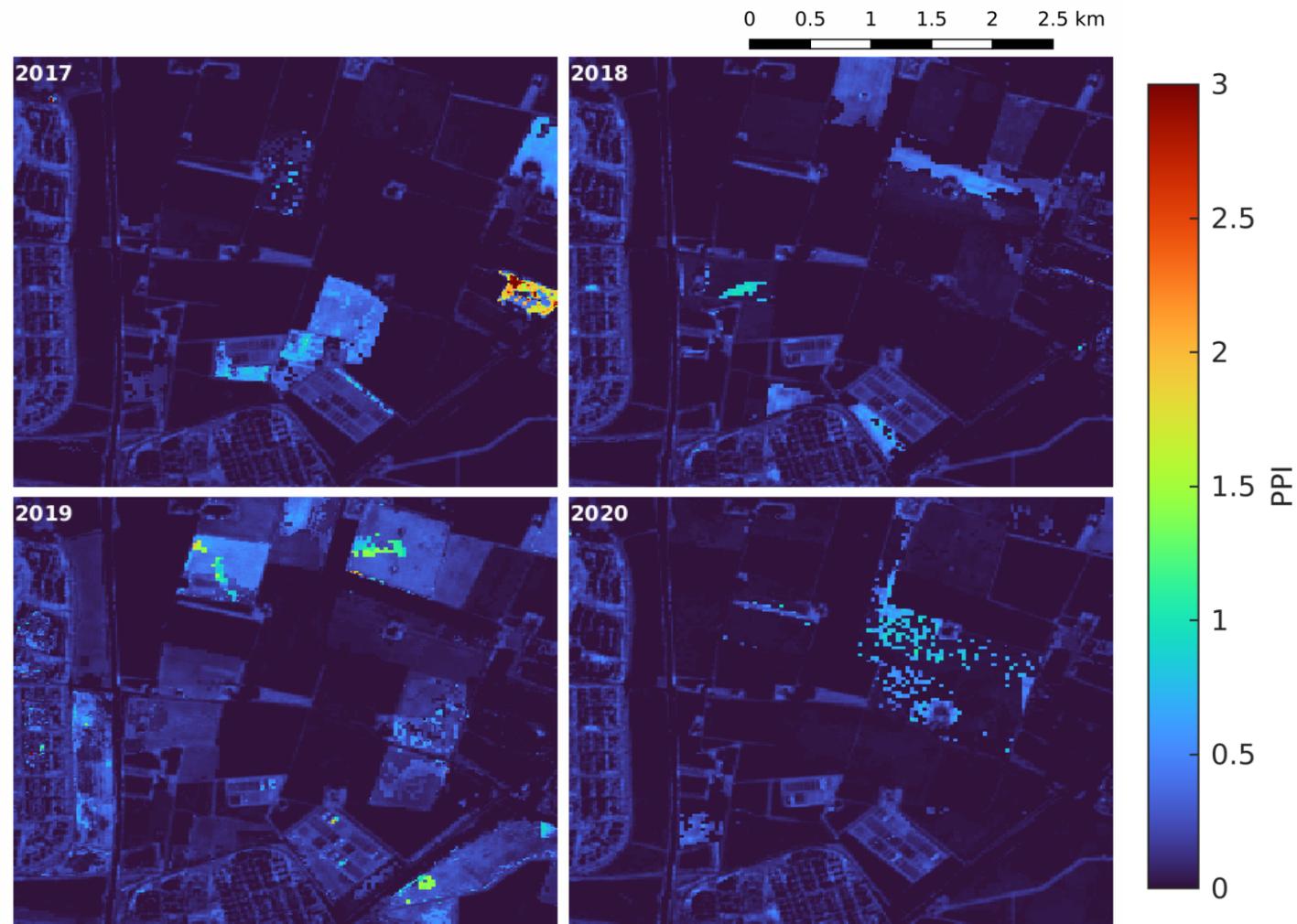
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10-day PPI ST, Lönnstorp Sweden



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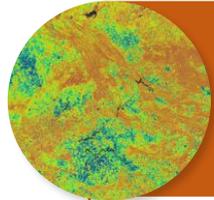
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HR Vegetation Phenology & Productivity

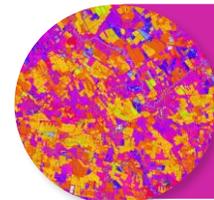
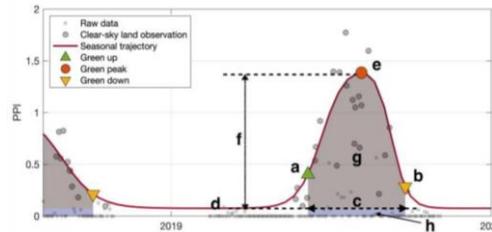
2017

2024



Seasonal Trajectories of the Plant Phenology Index (PPI)

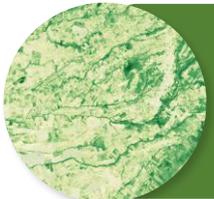
- Gap filled seasonal trajectories
- 10 days temporal resolution
- 10 meters spatial resolution
- Produced annually



Vegetation Phenology Parameters (VPPs)

Two seasons

- **Start of the Season** (date and value) (10m)
- **End of the Season** (date and value) (10m)
- **Season Length** (10m)
- **Season max** (date and value) (10m)
- **Season min** (date and value) (10m)
- **Total Productivity** (10m)
- ...



Vegetation Indices and Biophysical Parameters (PPI, FAPAR, LAI, NDVI)



Low-level Vegetation Indices and Biophysical Parameters are stored in a **rolling 1.5-year archive** but are not disseminated to the public. Users are instead provided with **Jupyter Notebooks** to compute these products on the fly, available at: <https://github.com/copernicus-land/HRVPP-Vis/tree/main>



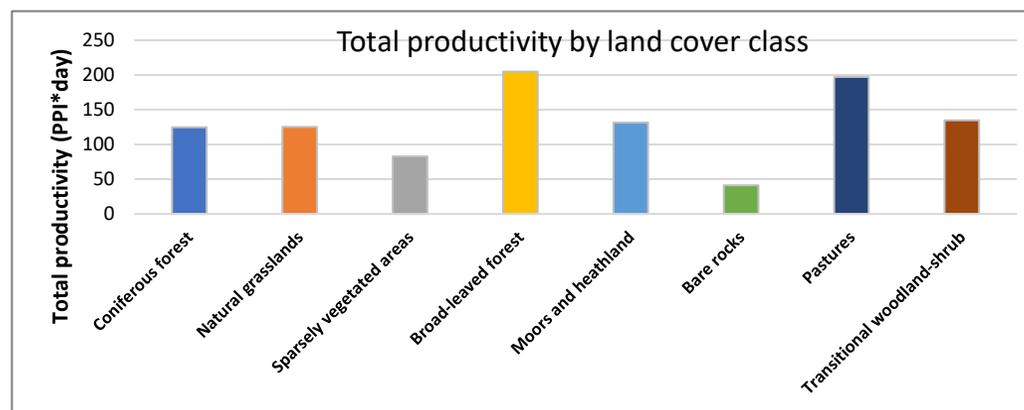
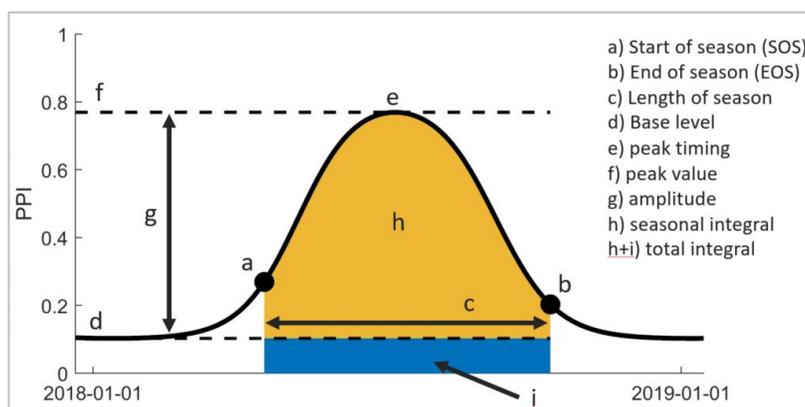
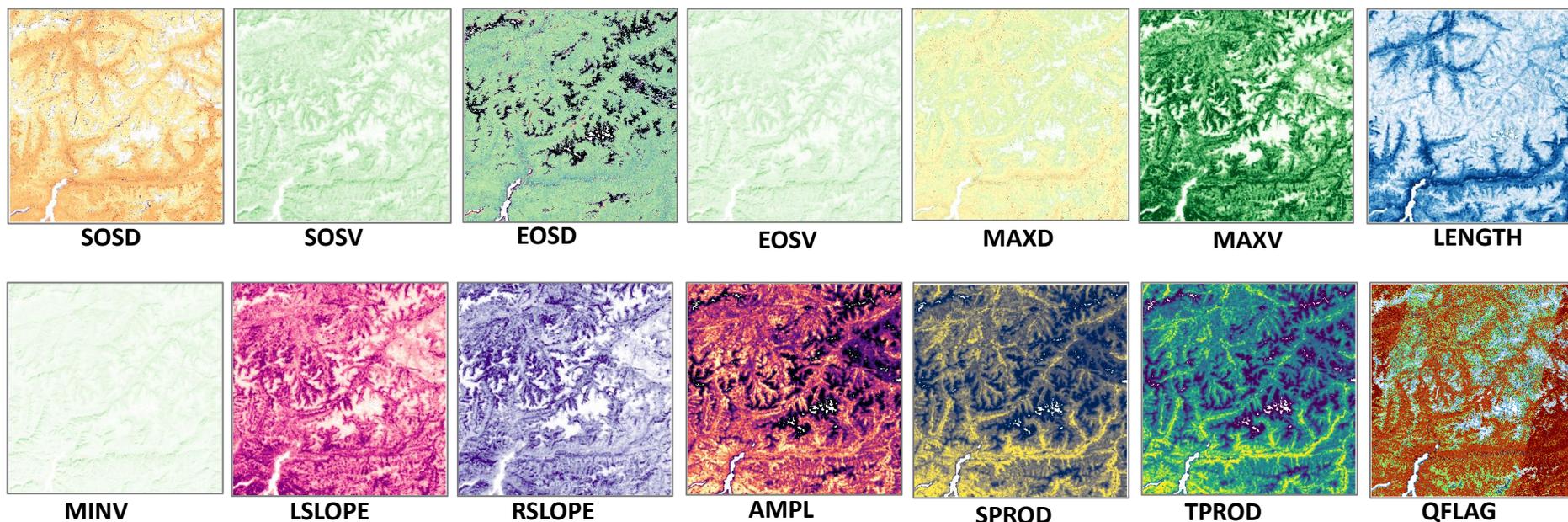
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Phenological metrics

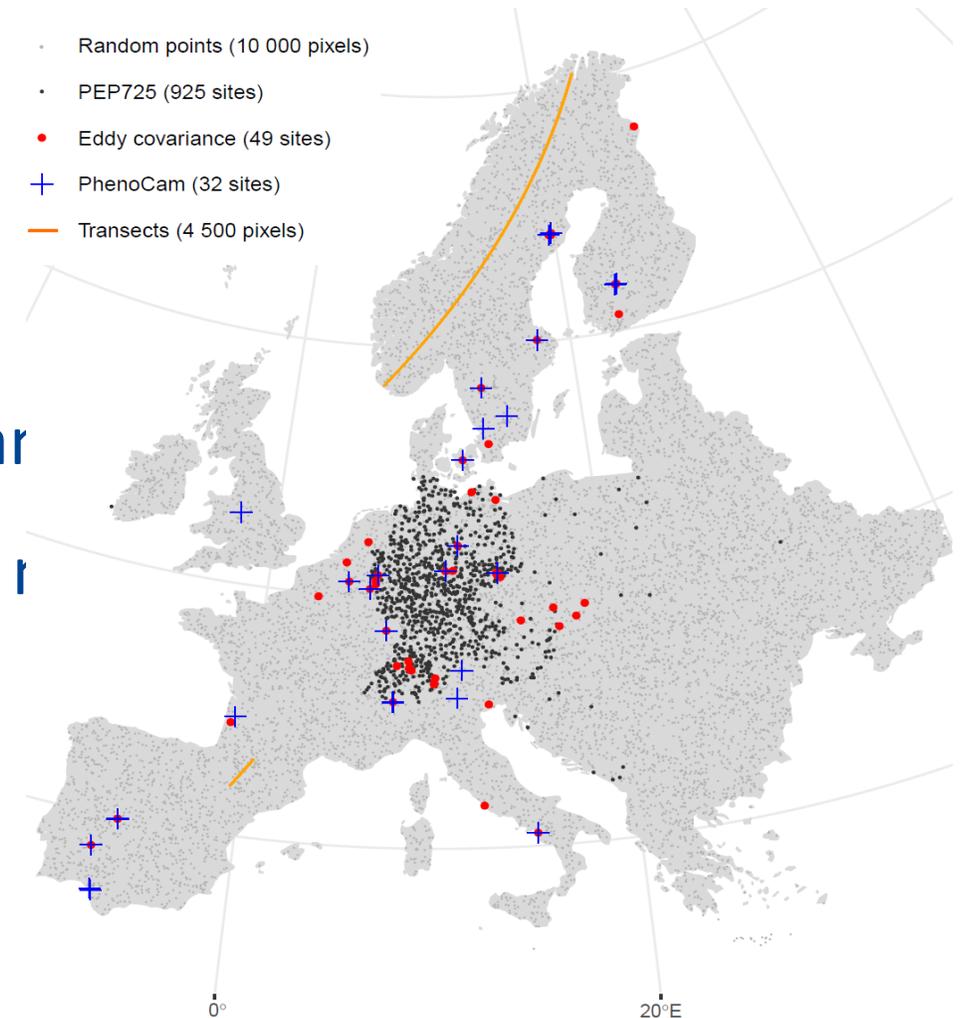


Calibration against reference data

Reference datasets

- **GPP:** from eddy covariance (flux towers): 49 sites
- **PhenoCam:** greenness from phenological cameras: 32 sites
- **PEP725 ground phenological observations:** 925 sites
- **Agricultural crop data (Belgium, Austria):** 150 + 278 + 600 fields

Tian, F., et al., 2021, Calibrating vegetation phenology from Sentinel-2 using eddy covariance, PhenoCam, and PEP725 networks across Europe. Remote Sensing of Environment, 260, 112456.



HR Vegetation Phenology & Productivity - Plan

✓ HR-VPP has started a **major revamp** and the introduction of additional products

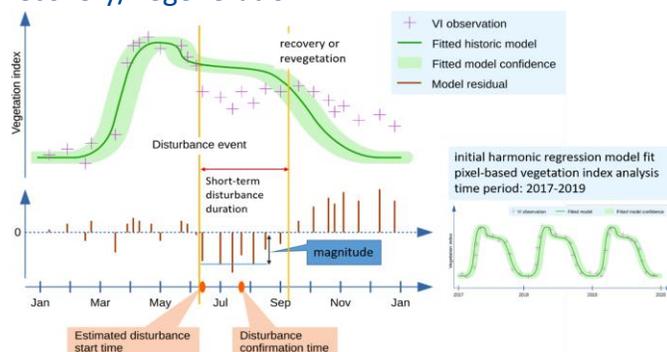
Key milestones of HR-VPP2

- Ramp-up phase** culminating in a **calibration report** to be published in **Q2 2026**:
 - Cloud Mask
 - Land cover-specific parameterization
 - BRDF correction of TOC
 - Calibration of vegetation indices, seasonal trajectories and phenological metrics
- Operational Readiness Reviews** is scheduled for **Q2 & Q3 2026**,
- Archive processing** (2017-2025) is scheduled for **Q3 2026**
- Production** will continue until **Q2 2028**

Tree Cover Disturbance NEW

Short-term and Long-term

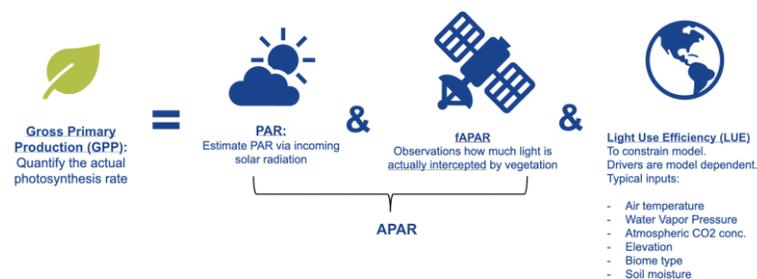
Minimum Requirements: Timeliness, Magnitude, Duration, Recovery/Regeneration



Biomass Productivity NEW

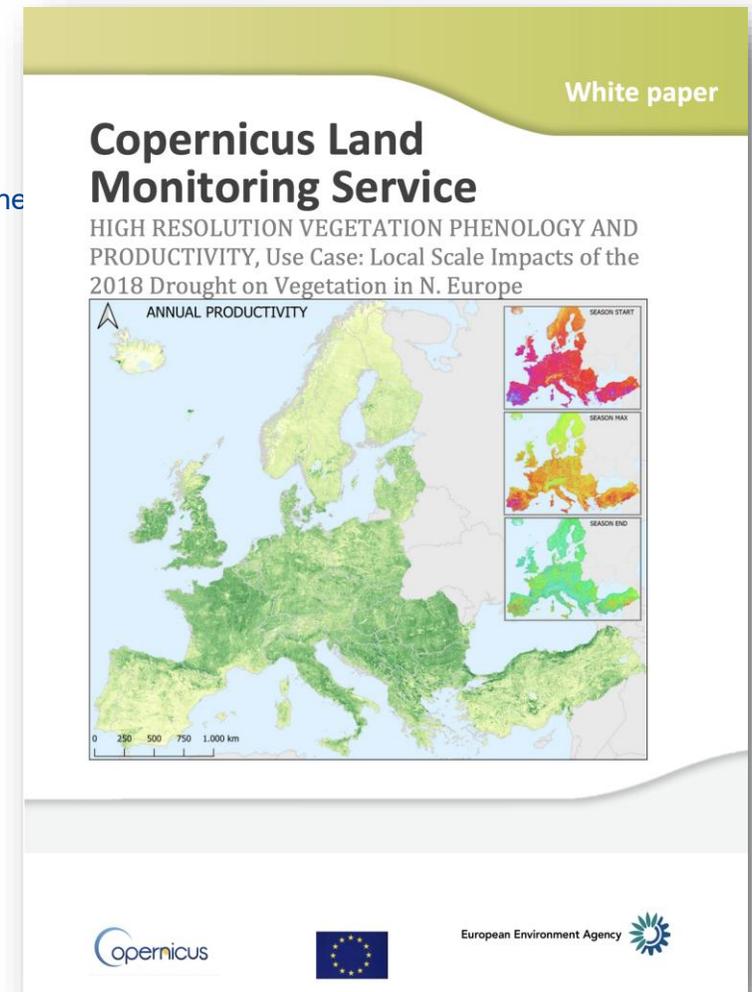
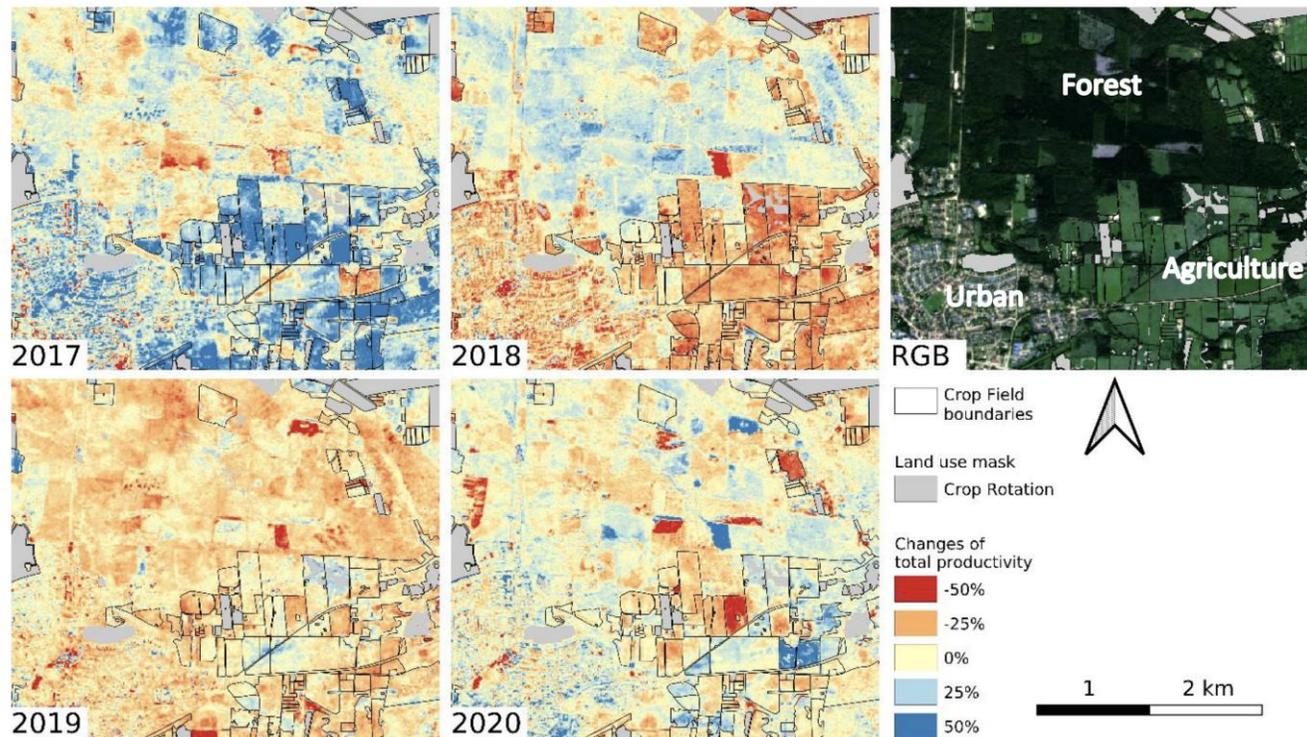
Seasonal Trajectories (GPP)

Total and Seasonal Aboveground Gross Primary Productivity
Total and Seasonal Aboveground Net Primary Productivity



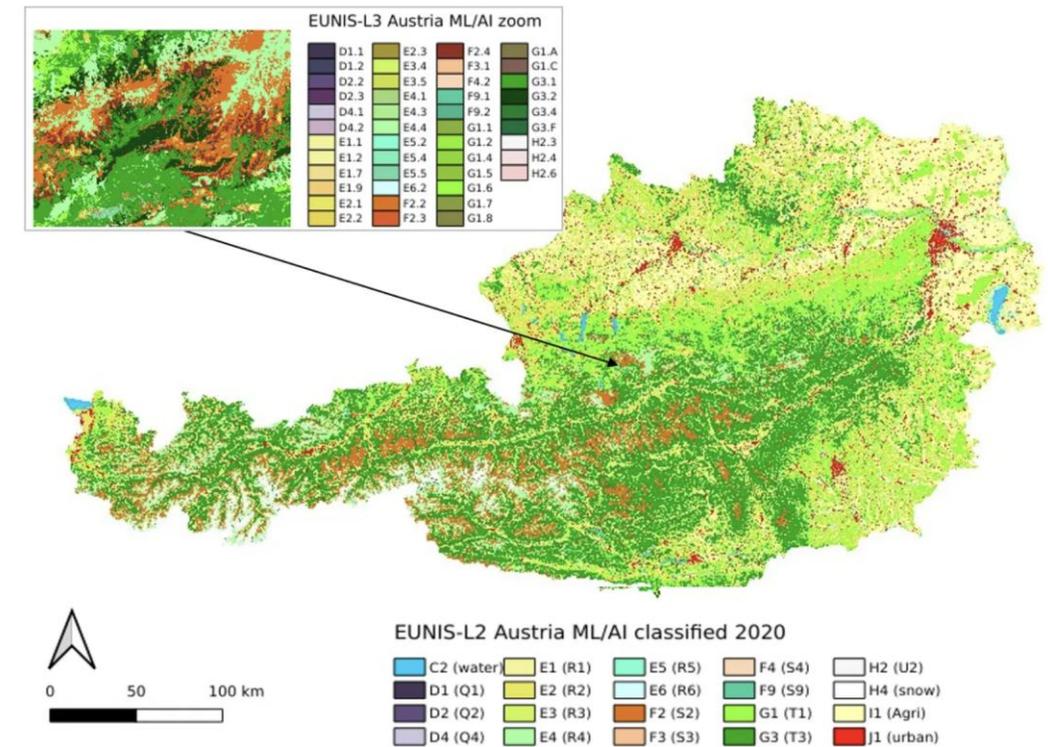
High Resolution Phenology and Productivity data for Drought Impact Assessments

- HR-VPP supports the implementation of the drought indicator for the 8th EAP
- Local drought effects are clearly observable in seasonal trajectories and phenology and productivity parameter of the



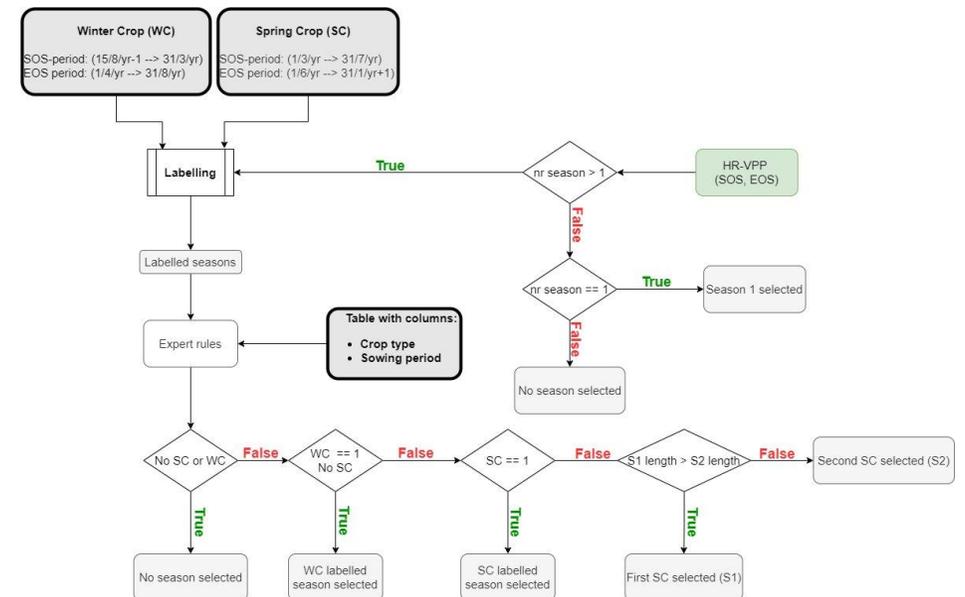
High Resolution Phenology and Productivity data for Biodiversity Monitoring

- HR-VPP can contribute to Essential Biodiversity Variables, particularly ecosystem function and ecosystem structure.
- HR-VPP is an important predictor for habitat mapping – describing the ecosystem structure.



High Resolution Phenology and Productivity data for Agriculture

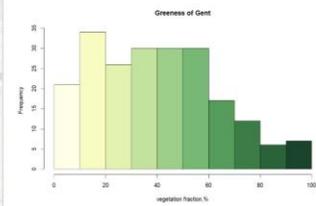
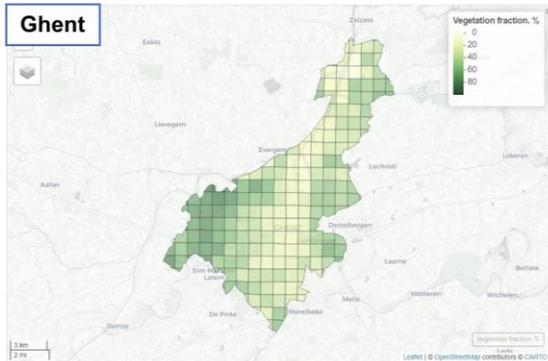
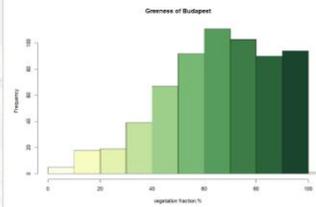
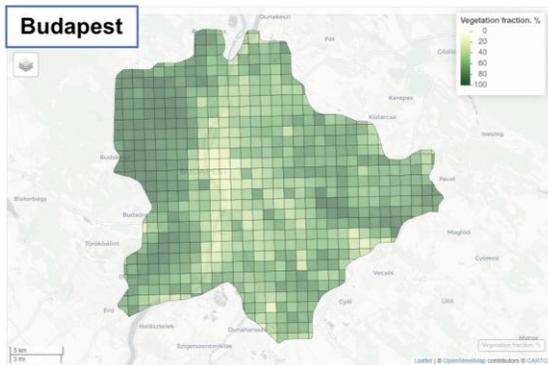
- By combining a crop type layer with HR-VPP phenology metrics—especially SOS and EOS—we can build regional crop calendars at 10 m resolution, and summarize them per crop to map typical development windows and their year-to-year shifts.
- HR-VPP can support crop yield estimation by providing consistent time-series products that describe (1) how the canopy develops through the season and (2) how much vegetation productivity occurred, which can be statistically calibrated to reported yields.



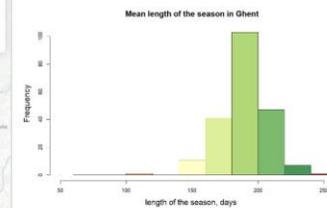
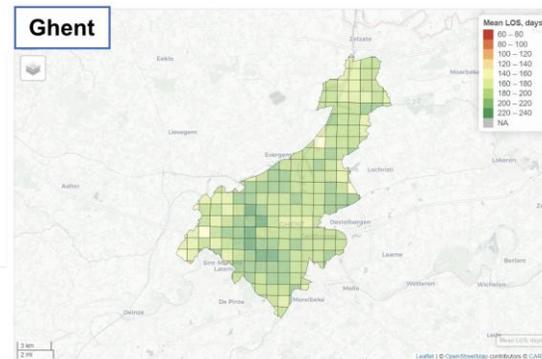
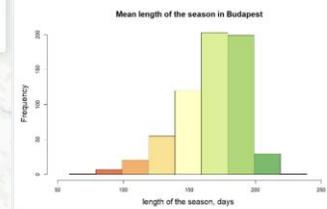
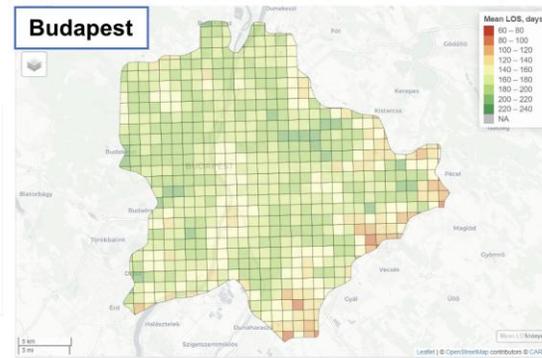
High Resolution Phenology and Productivity data for Urban Areas

- HR-VPP can help estimate “greenness” of the cities, monitor its structure.
- HR-VPP is a versatile product suit that can assist urban planning, tourism and other applications.

Vegetation fraction (%) in 1 km grid



Length of the season (days) in 1 km grid



Understanding and managing urban green spaces

Urban green spaces are increasingly recognized as essential features of modern cities. They increase biodiversity, improve human health, and offer a host of additional benefits too numerous to list. Because of this, the United Nations has set a goal of universal access to green spaces by 2030—a goal which can only be achieved with clear and decisive action from urban planners, city managers, and labourers.

Satellite data are increasingly being used to assess existing land use patterns in urban areas and to plan future projects. Companies like Italy-based *Ithaca* offer a wide range of services for clients interested in obtaining tailored geospatial information from satellite data. Ithaca utilizes a variety of data sources, including the freely available datasets provided by the European Union's *Copernicus programme*.

Vanina Fissore, a project development specialist at Ithaca, recently co-authored a study with Professor Enrico Borgogno Mondino of the Department of Agricultural, Forest and Food Sciences at the University of Torino. In it, they examined how the Copernicus Land Monitoring Service's (CLMS) *High Resolution Vegetation Phenology Parameters (HR-VPP)* product suite could be used by urban planners to better understand and manage urban green spaces. The study was focused on Torino, a city in the northwest of Italy which is known to be one of the greenest in Europe.



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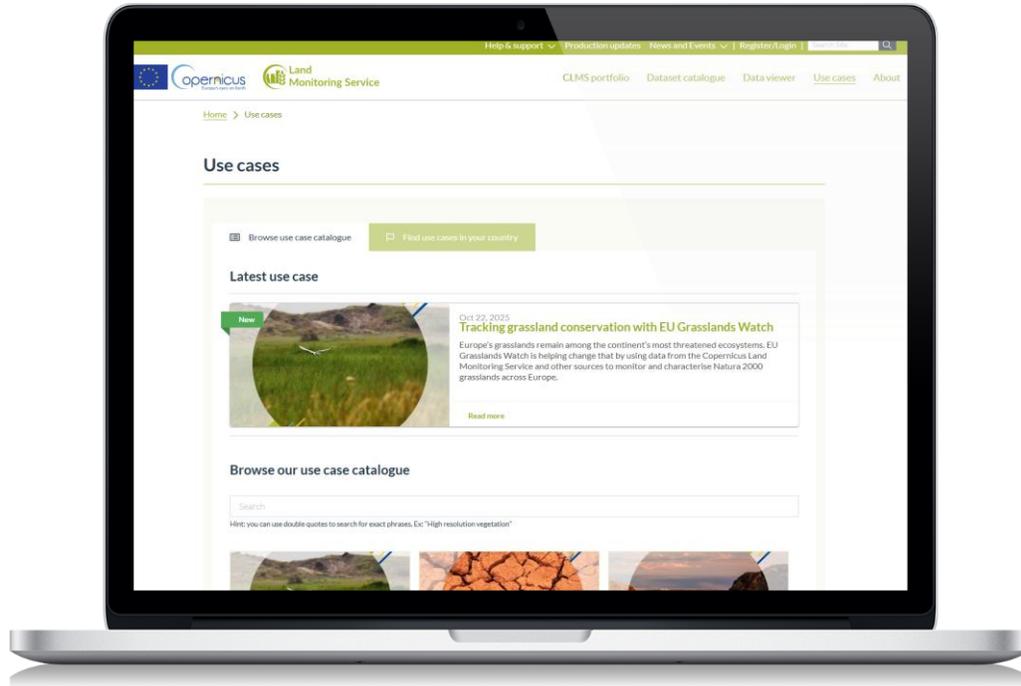
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Use Cases



land.copernicus.eu/en/use-cases/submit-use-case

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Image by Luca from Pixabay

Products:

Pan-European High Resolution Vegetation Phenology and Productivity Parameters

Use case type:

Scientific, Commercial

Responsible organisation:

Ithaca, University of Torino

Coverage:

Torino, Italy



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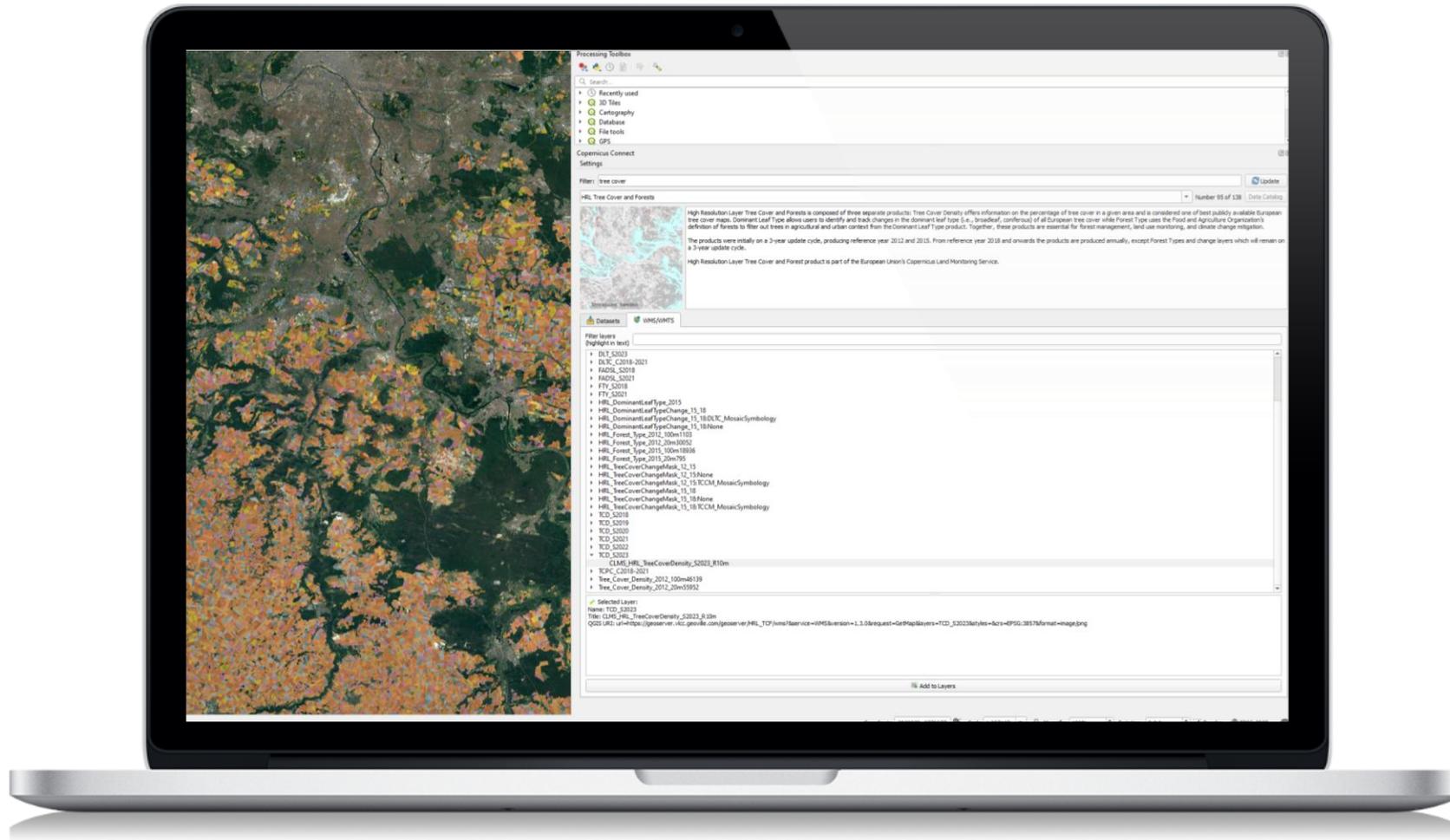


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QGIS Copernicus Connect Plug-in



https://plugins.qgis.org/plugins/Copernicus_Connect



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Data Access

CLMS Portal:

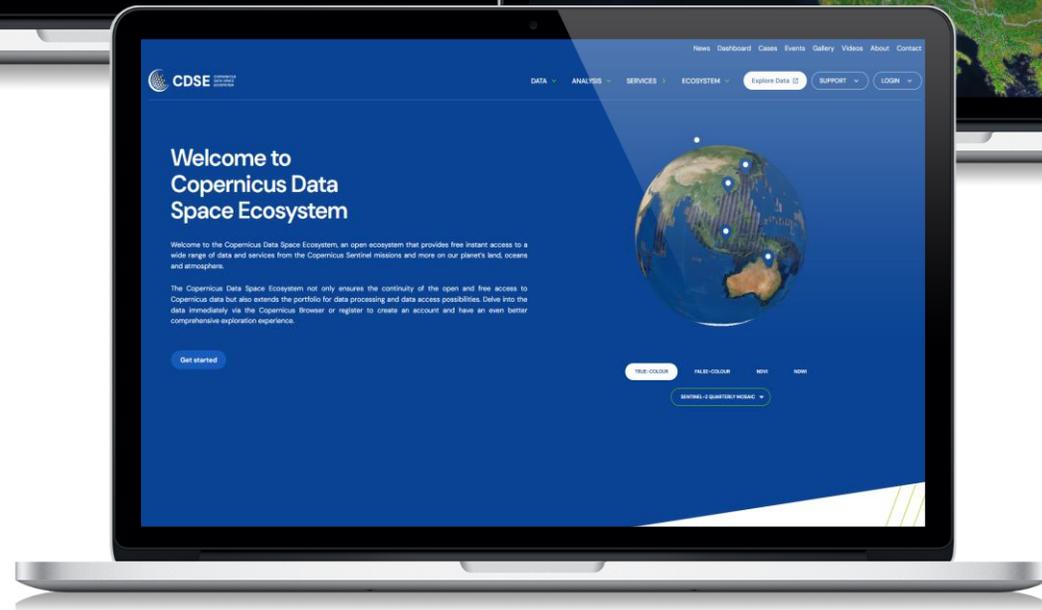
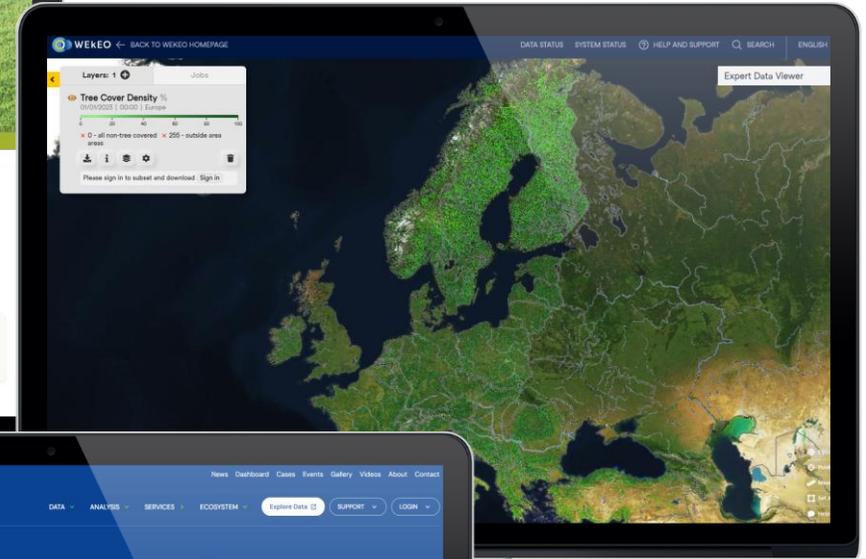
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WEKEO:

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CDSE:

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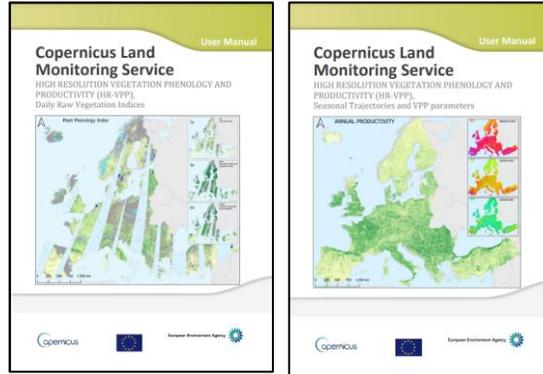


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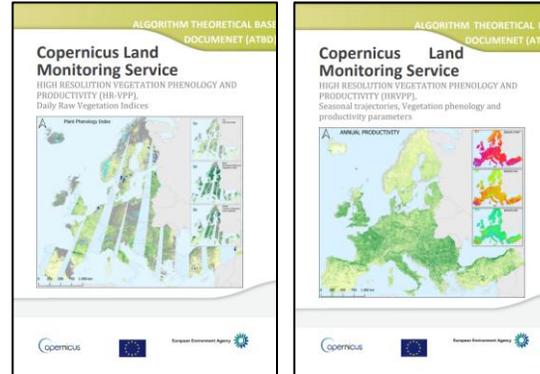


HRVPP Documentation

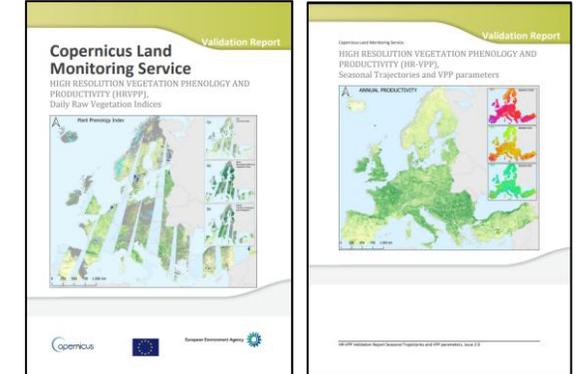
Product User Manual



Algorithm details



Validation details



Data Access Manuals

Human



Machine2Machine



Tutorials

Vegetation

<https://land.copernicus.eu/en/events/your-toolbox-for-vegetation-indices-a-hands-on-hr-vpp-webinar>