



Land Monitoring

Copernicus Land Monitoring Services: High-Resolution Products for Evaluating Environmental Impacts of the CAP

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Good Practice Workshop - Assessment of environmental impacts on the CAP



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FULL, FREE AND OPEN
ACCESS TO DATA



-  ATMOSPHERE MONITORING
-  MARINE ENVIRONMENT MONITORING
-  LAND MONITORING
-  CLIMATE CHANGE
-  EMERGENCY MANAGEMENT
-  SECURITY



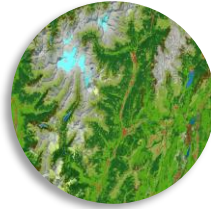
Copernicus Land Monitoring Service



Full-coverage Land Cover & Use

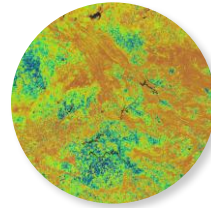
Full-coverage land cover and land use mapping tracks different types of land cover and its changes in Europe and around the world.

European maps include detailed layers showing the extent of impervious surfaces, tree cover and forests, grasslands, croplands, small woody areas and water and wetness.



Bio-geophysical Variables

The systematic monitoring of bio-geophysical variables includes long time-series of qualified global and pan-European bio-geophysical products on the status and evolution of land surfaces.



Land Satellite Mosaics

High- and very high resolution land satellite image mosaics include satellite image mosaics from commercial providers covering the territory of Europe as well as Sentinel-2 image mosaic production at global level. These mosaics serve as the foundation for many other CLMS products.



Land Cover & Use in Priority Areas

Priority area monitoring provides tailored and more detailed land cover, land use and crop types information in specific areas of interest in Europe and globally, often called "Hot Spots". Hot Spots in the context of our service are areas prone to environmental change.



Ground Motion Data

Ground motion data in Europe are provided by the European Ground Motion Service, which uses Synthetic Aperture Radar Interferometry (InSAR) data derived from Sentinel-1 to detect and measure ground movements such as landslides, subsidence, and deformation.



Reference & Validation Data

Reference datasets providing homogeneous pan-European coverage of some key geospatial themes, such as hydrography, and in situ measurements collected at global scale to validate some of the CLMS bio-geophysical products.



Copernicus Land Monitoring Services: From Monitoring to Harmonised Evaluation of CAP Environmental Impacts

- **CORINE Land Cover:** Used in CAP and agri-environmental indicators.
- **Woody Landscape Features on Agricultural Land (EEA Indicator/ derived from CLMS data):** Used for tracking the presence, density, and structure of hedgerows, tree lines, and small woodlots—key for evaluating biodiversity, landscape connectivity, and the uptake of agri-environmental measures.
- **Vegetation Productivity & Phenology Data:** Used to monitor the productivity and seasonal dynamics of different farming systems, supporting indicators on crop growth, grassland management, and land use intensity.



Vegetated Land Cover Characteristic (VLCC) Product Suite

- The VLCC product suite offers systematic, high-resolution, pan-European data.
- Member States and evaluators can report on key CAP environmental impacts—such as permanent grassland maintenance, crop rotation, mowing intensity, and land use change—in a harmonised, comparable way across all of Europe.
- VLCC enables robust, evidence-based evaluation of CAP outcomes, supporting both national reporting and EU-wide assessments.



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Harmonized products: Forest, Grassland, and new **Crop Type** products for improved land cover monitoring, building on the established HRL Forest and Grassland products (20m, 3-yearly).

Change layers: 20 m

3-yearly change layers: 2018–2021, 2021–2024, etc.

Pan-European coverage:EEA38 countries

Aligned with **EAGLE** highest hierarchical level: **LCC-2**

Biotic / Vegetation



Vegetation Cover Thresholds for HRL VLCC Classification

Non-Vegetated vs. Vegetated Distinction

Primary Threshold: Areas with $\leq 30\%$ vegetation cover throughout the year are classified as **non-vegetated**.

Implementation Criteria

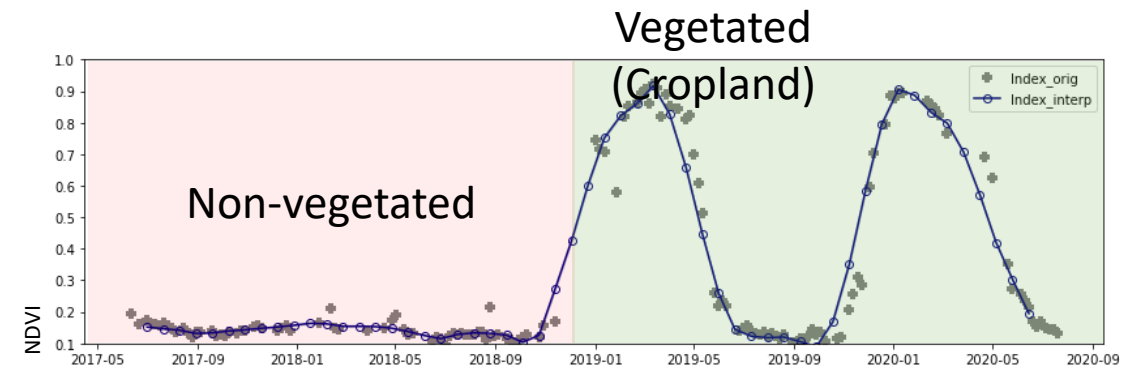
NDVI-Based Validation: Vegetated surfaces are characterized by:

- **NDVI ≥ 0.4** for at least 10 weeks per year (standard climates)
- **NDVI ≥ 0.2** for at least 10 weeks per year (very dry climates)

Rationale

This threshold framework:

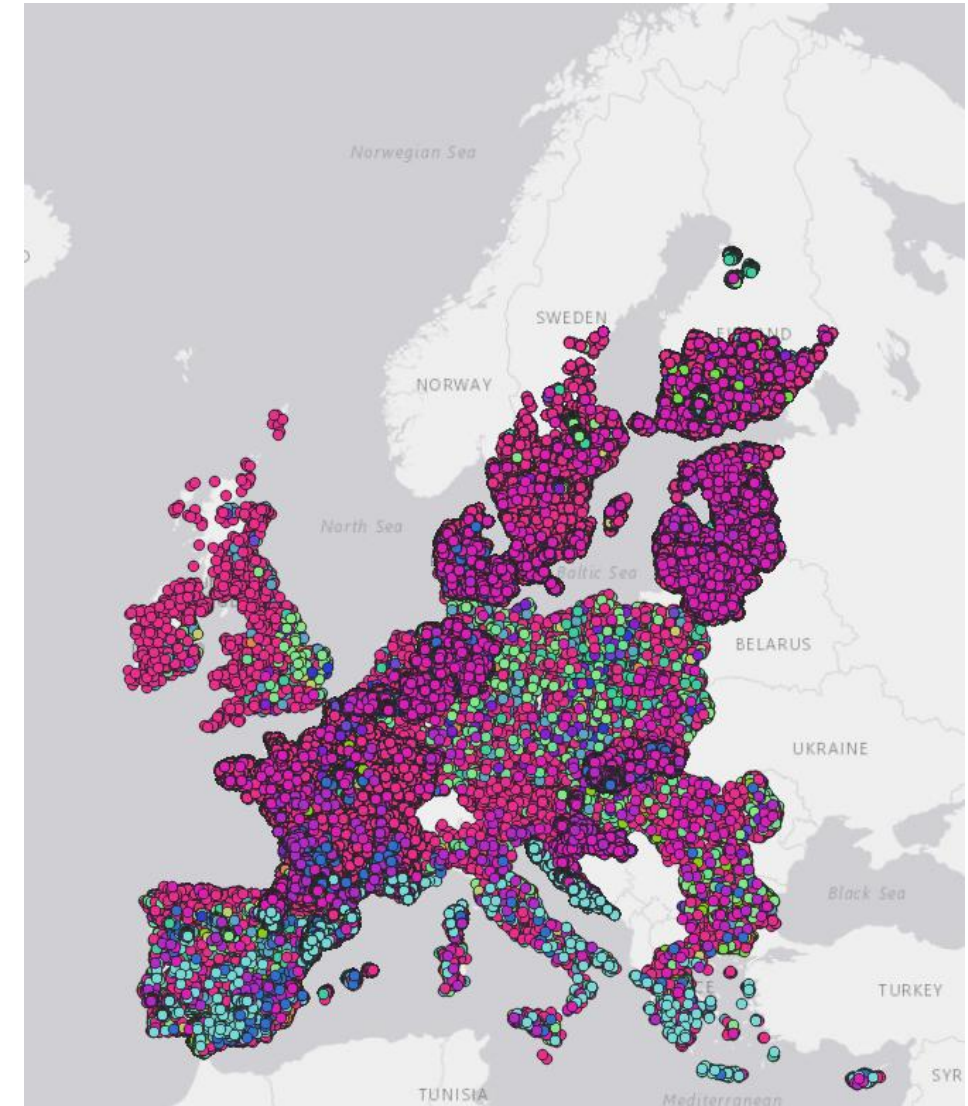
- Aligns with other products (CLC+ Backbone and HRL Imperviousness)
- Reduces classification errors below the 30% detection threshold
- Ensures consistency across the Tree Cover & Forests, Grasslands, and Croplands product suite



Training data

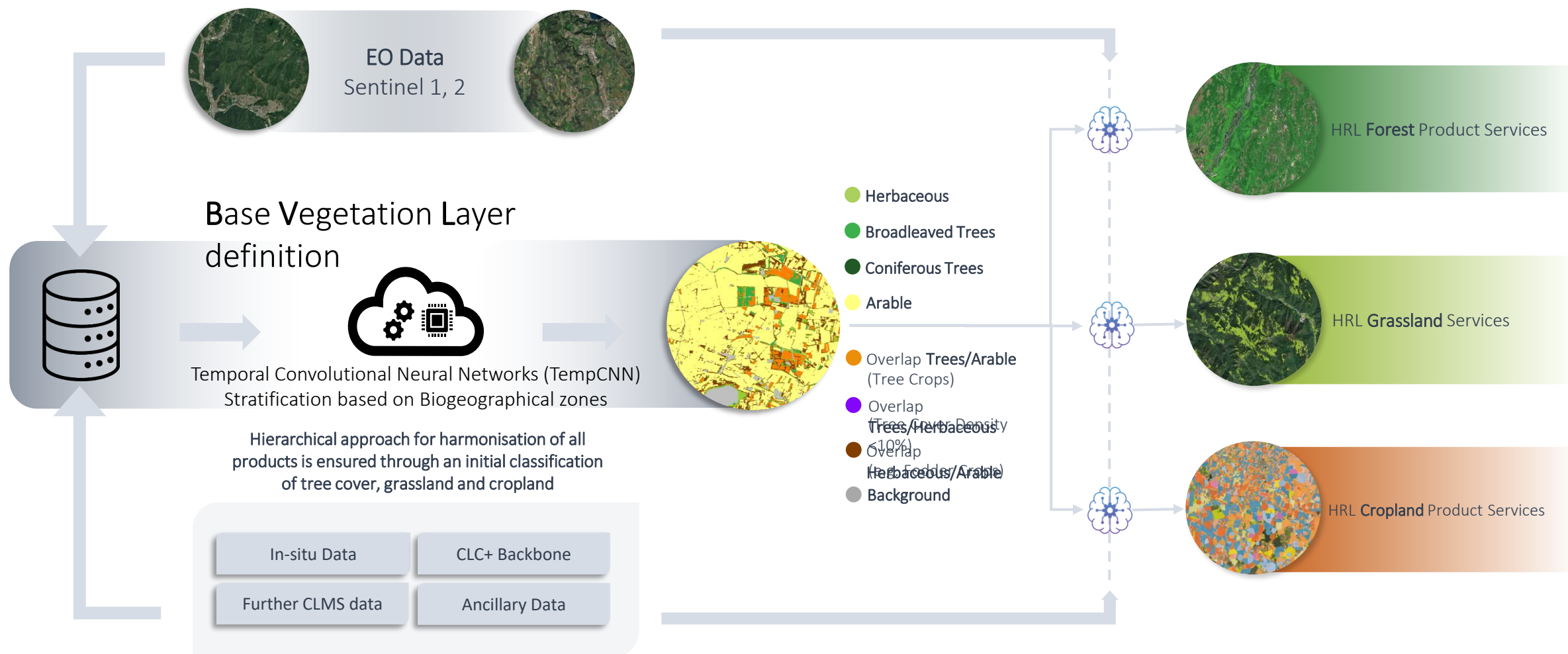
- High-quality European reference datasets
- Harmonized to a common legend
- Active learning cycle to sample additional training points
- National level compatibility

Over 1 Million sites including data from LUCAS Copernicus and LPIS/ GSAA



HRL Vegetated Land Cover Characteristics

Overarching method and harmonisation



HRL Vegetated Land Cover Characteristics

Product Suit



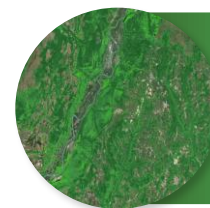
HRL Cropland Product Services

- **Crop Types** (10m, MMU 0.25 ha)
- **Cropping Patterns** (10m, MMU 0.25 ha)
Main Crops | Bare Soil |
Secondary Crops
| Secondary Crops | Fallow Land |
Annual Crop Characteristics
- Additional **expert layers** (e.g. confidences)



HRL Grassland Services

- Grassland (10m, 100m)
- **Herbaceous Cover** (10m)
- **Grassland Change** (20m, MMU 1ha, 18-21)
- **Grassland Mowing events** (10m, MMU 0.25ha)
- Additional **expert layers** (e.g. confidences, Ploughing indicator)



HRL Forest Product Services

- **Dominant Leaf Type** (10m)
- **Tree Cover Density** (10m, 100m)
- **Forest Type** (10m, 100m)
- **Forest Change** (20m, MMU 1ha, 18-21)
- Additional **expert layers** (e.g. confidences, Leaf Type Density)



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VLCC Products as Tools for Evaluating CAP Environmental Impacts

VLCC products can assist addressing environmental impacts of the CAP following Good Agricultural and Environmental Conditions (GAEC) standards, Eco-schemes and Agri-Environment-Climate Measures (AECMs)

GAEC 1: Maintenance of permanent grassland.

The ratio of permanent grassland to agricultural area cannot decrease by more than 5% (10%) compared to 2018.

Objective: The main goal is to safeguard the carbon stored in grassland soils and prevent its release through land conversion, thereby contributing to climate change mitigation and supporting biodiversity



GAEC 7: Crop rotation/Diversity

Implement crop rotation and/or crop diversification on arable land. Crop rotation (at least two crops in 4 years per parcel) and/or crop diversification (two-/three-crop rule).

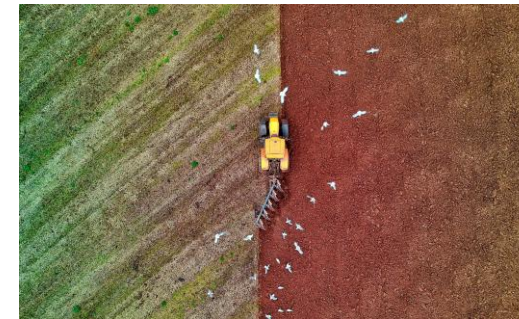
Objective: Its primary goal is to preserve soil potential, maintain soil fertility, and support long-term productivity and environmental sustainability.



GAEC 9: Ban on ploughing permanent grassland

Ban on converting or ploughing permanent grassland designated as environmentally-sensitive permanent grasslands in Natura 2000 sites.

Objective: This measure is crucial for protecting carbon-rich soils, preserving biodiversity, and maintaining ecosystem services.



Eco-schemes

Agri-Environment-Climate Measures (AECMs)

Herbaceous (HER) & Grassland (GRA)

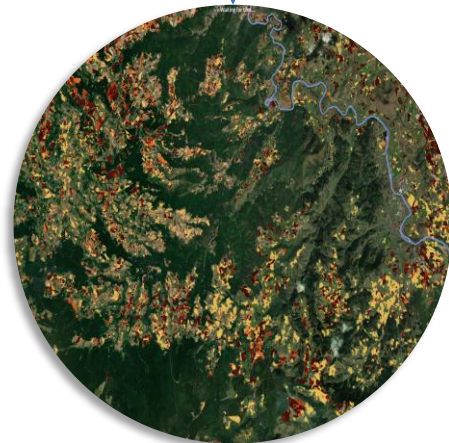
Herbaceous cover is an annual binary layer showing the **presence or absence** of herbaceous vegetation, including both permanent and temporary grasslands, as well as managed fodder crops.



● Herbaceous



● Grasslands



Ploughing Indicator (PLOUGH)

- 0: Indication of ploughing in current year
- 1: 1 year since last indication of ploughing
- 2: 2 years since last indication of ploughing
- 3: 3 years since last indication of ploughing
- 4: 4 years since last indication of ploughing
- 5: 5 years since last indication of ploughing
- 6: 6 years since last indication of ploughing
- 100: Change of herbaceous cover

Grasslands cover is an annual binary layer mapping permanent grassland—areas with **uninterrupted herbaceous cover for at least six consecutive years.**

GAEC 1: Maintenance of permanent grassland.

GAEC 9: Ban on ploughing permanent grassland

Example Evaluation Scenarios

GAEC 1 Compliance and Permanent Grassland Protection

Question: Is the CAP effectively maintaining permanent grassland area and preventing illegal conversion?

Grassland Application:

- Use GRA time series to track permanent grassland ratio stability at national/regional level.
- Apply PLOUGH to detect illegal conversion events, especially in Natura 2000 sites
- Use GRA Change to quantify grassland losses and gains, ensuring <5% decrease from baseline

Grassland Mowing Events (GRAME)

Number of **mowing events** (0–4) detected per year on permanent and temporary grassland

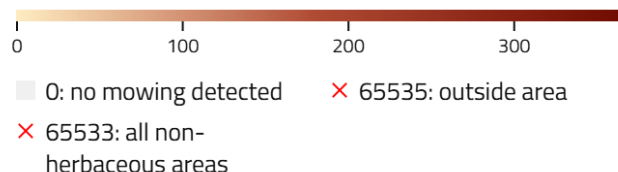


- Non-mowing areas
- Mowed once
- Mowed twice
- Mowed three times
- Mowed four times or more

Grassland Mowing Dates (GRAMD)



Day-of-year (DOY) of each mowing event (up to four per year, each in a separate layer) (GRAMD)



GAEC 1: Maintenance of permanent grassland.

GAEC 9: Ban on ploughing permanent grassland

Eco-scheme effectiveness

habitat for pollinators, benefits for nesting birds

Example Evaluation Scenario Management Intensity and Biodiversity Impact Assessment

Question: Are CAP measures promoting extensive grassland management that benefits biodiversity?

Grassland Mowing Events Application:

- Combine GRAME (≤ 2 mowing events = extensive) with GRAMD timing to create "biodiversity-friendly management" index
- Use GRA stability over time as proxy for habitat continuity
- Apply GRA confidence layer to focus analysis on high-certainty areas



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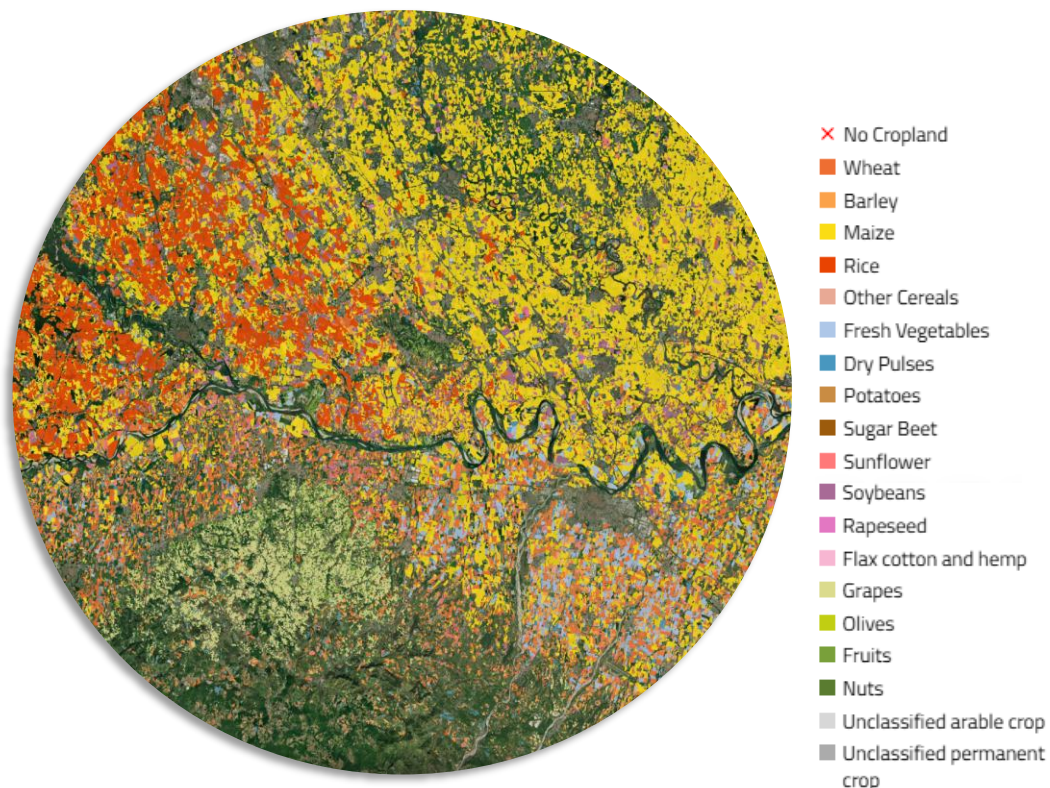


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Crop Types (CTY)

[Main Crop Harvest](#) provides the harvest date of the main growing season while [Main Crop Emergence](#) provides information on when seedlings break through the surface and



GAEC 7: Crop diversification

Eco-scheme effectiveness

cover crops, sustainable practices

Climate adaptation

resilient crop choices

Biodiversity conservation

landscape diversity, fallow habitat

Example Evaluation Scenarios

Scenario 1: Eco-scheme Effectiveness

Question: Is CAP successfully promoting crop diversification?

CTY Application: Compare crop diversity time-series using multi-year CTY products

Scenario 2: Regional Climate Adaptation

Question: Is CAP supporting climate-resilient crop choices?

CTY Application: Track changes in drought-resistant crop adoption in climate-vulnerable regions

Scenario 3: Biodiversity Impact Assessment

Question: Are CAP measures enhancing farmland biodiversity through crop diversity?

CTY Application: Correlate CTY-derived landscape heterogeneity with biodiversity indicators such as species richness data



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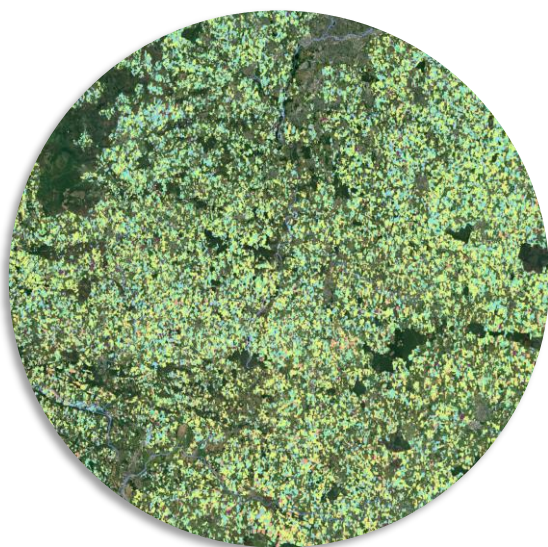


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Main crops

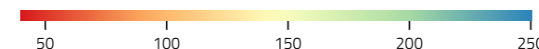
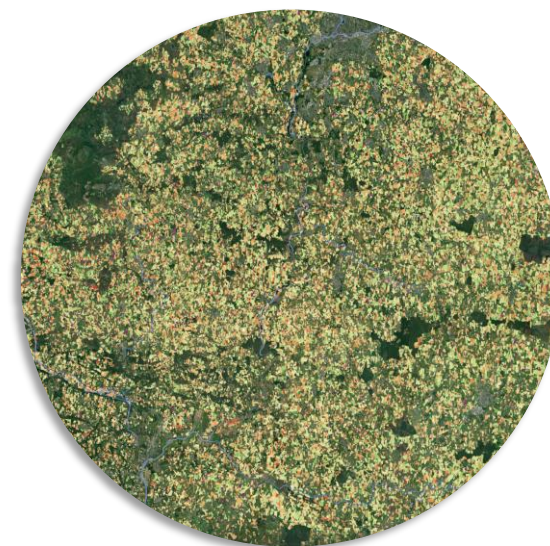
[Main Crop Harvest](#) provides the harvest date of the main growing season while [Main Crop Emergence](#) provides information on when seedlings break through the surface and become visibly established in the soil. [Main Crop Duration](#) captures the total duration of the main growing season, information that is especially important for assessing crop health, estimating yields and understanding regional differences in agricultural intensity.



- ✗ No annual cropland
- Jan (selected year)
- Feb (selected year)
- Mar (selected year)
- Apr (selected year)
- May (selected year)
- Jun (selected year)
- Jul (selected year)
- Aug (selected year)
- Sep (selected year)
- Oct (selected year)
- Nov (selected year)
- Dec (selected year)

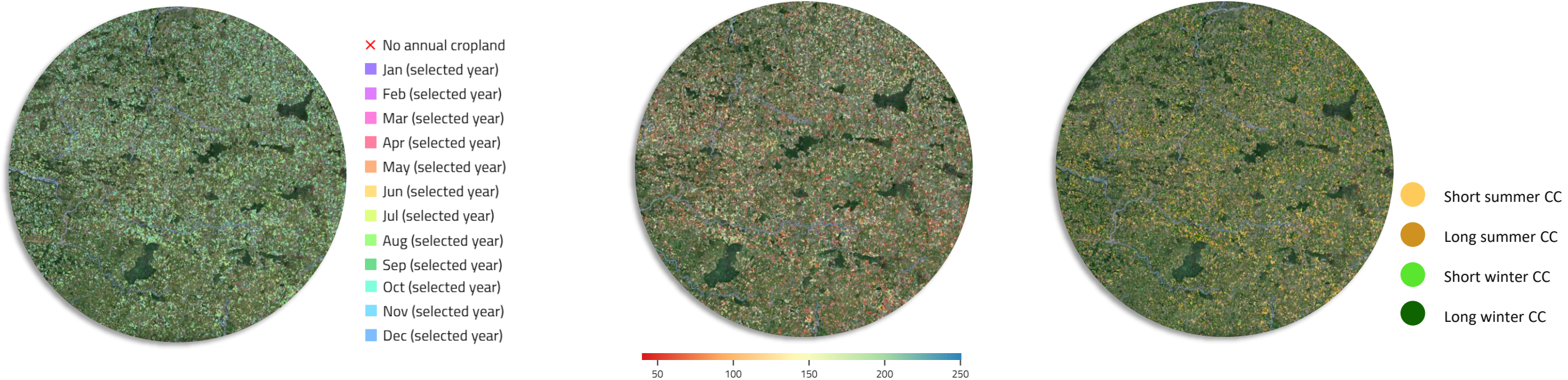


- ✗ No annual cropland
- Jan (selected year)
- Feb (selected year)
- Mar (selected year)
- Apr (selected year)
- May (selected year)
- Jun (selected year)
- Jul (selected year)
- Aug (selected year)
- Sep (selected year)
- Oct (selected year)
- Nov (selected year)
- Dec (selected year)



Secondary crops

Much like the Main Crop products, Secondary Crop products offer layers on [emergence](#) and [duration](#), but instead of a harvest product, users have access to a [Secondary Crops Type](#) product which provides information on the type (4 categories) of the secondary crop season. This is because secondary crops are typically grown as cover crops, which is to say they are grown to cover the soil rather than harvest with the goal of improving soil health, reducing erosion and enhance nutrient cycling.



Cropping Seasons

[Cropping Seasons Yearly](#) identifies the number of growing seasons in a given area within a calendar year, while [Cropping Seasons Types over 3 years](#) provides information on the annual crop type diversity over a three-year period. These products are designed to support analyses of cropping intensity, rotation practices and long-term agricultural sustainability.



- One Growing Season
- Two Growing Seasons



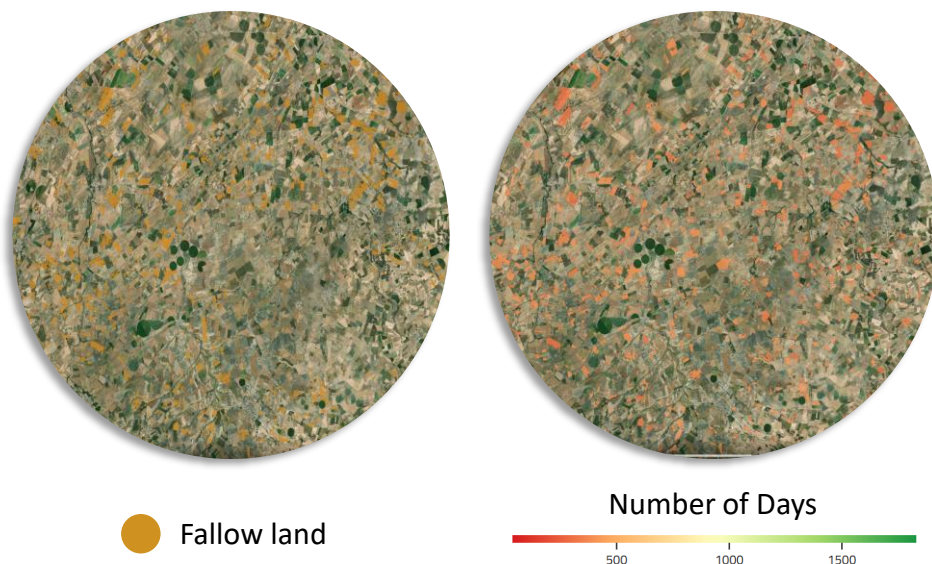
- 1 annual crop type over 3-year period
- 2 annual crop type over 3-year period
- 3 annual crop type over 3-year period

Class Name	Description	Example Sequence
1 annual crop type over 3 years	Same crop each year (monoculture)	Wheat–Wheat–Wheat
2 annual crop types over 3 years	Two crops, at least one repeated	Wheat–Barley–Wheat
3 annual crop types over 3 years	Three different crops, no repeats	Wheat–Barley–Maize



Fallow lands

The [Fallow Land Presence](#) product identifies the presence of land that is intentionally left unplanted for a period of time while the [Fallow Land Duration](#) product quantifies the length of that period. This information can be used to assess **land use intensity**, support **soil conservation** strategies,



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GAEC 7: Crop rotation/Diversity

Eco-scheme effectiveness

cover crops, sustainable practices

Climate adaptation

resilient crop choices

Biodiversity conservation

landscape diversity, fallow habitat

Soil protection

reduced tillage, cover crops, strategic fallow

Scenario: Evaluating CAP's Biodiversity Impact Through Crop Landscape Diversity

Question: Have CAP crop diversification measures enhanced farmland biodiversity by creating more heterogeneous agricultural landscapes?

Fallow lands, Main Crops and Secondary Crops Application:

- Main Crops: Calculate landscape-level crop diversity and field size patterns using CTY spatial analysis
- Assess provision of pollinator resources through flowering cover crops during critical periods
- Fallow Contribution: Quantify fallow areas as wildlife habitat and stepping stones for biodiversity



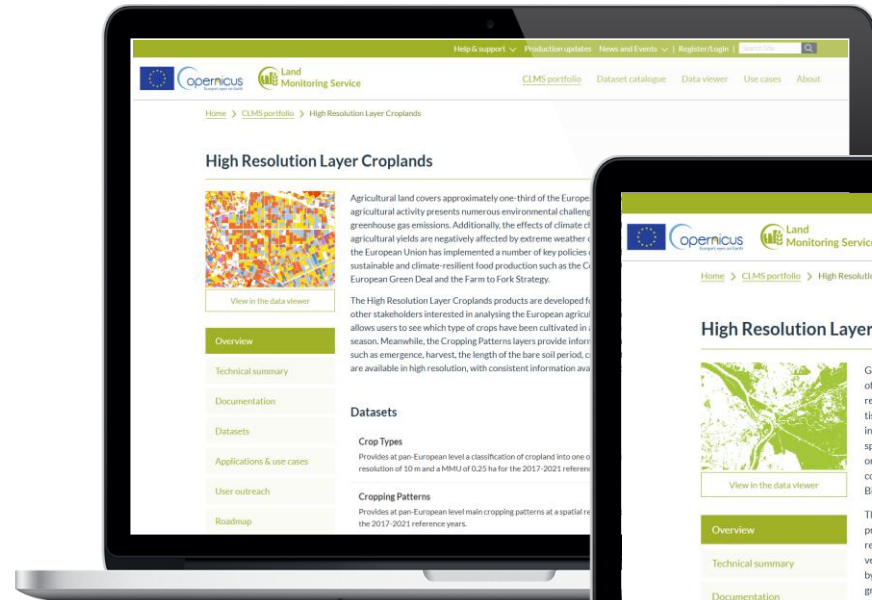
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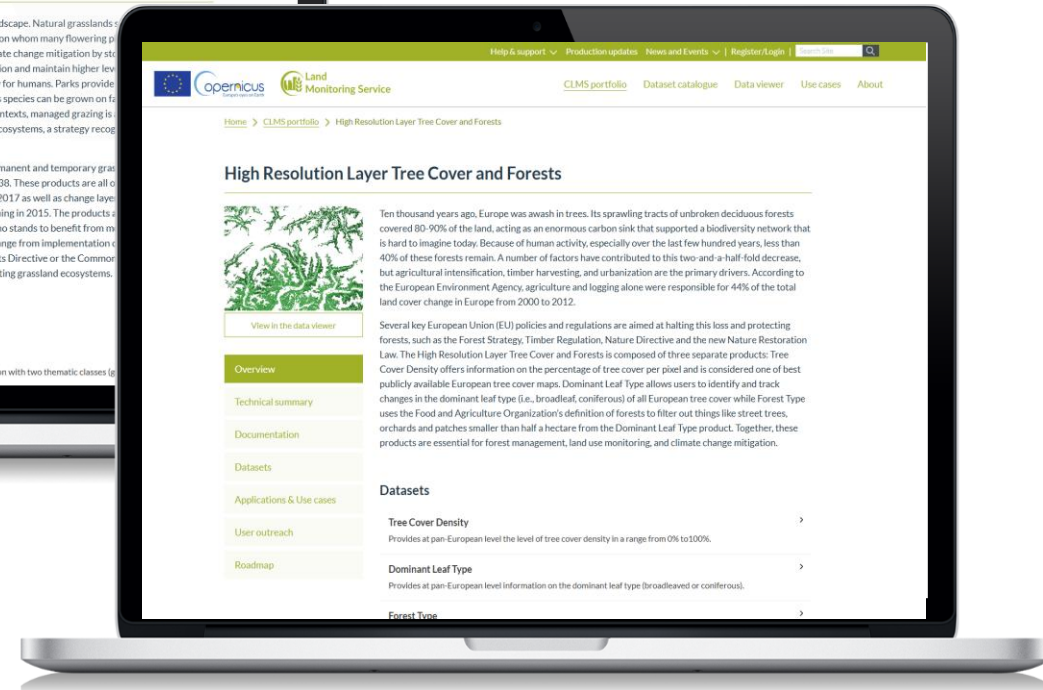
Data Access via EEA CLMS portal



<https://land.copernicus.eu/en/products/high-resolution-layer-croplands>



<https://land.copernicus.eu/en/products/high-resolution-layer-grasslands>



<https://land.copernicus.eu/en/products/high-resolution-layer-forests-and-tree-cover>



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Data Access and Download via WEkEO portal



<https://wekeo.copernicus.eu/>



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