



Land Monitoring

# Copernicus Land Monitoring Service

EO for Monitoring, Reporting, and Verification of Carbon Removals

Usue Donezar

Copenhagen – 9 October 2024



PROGRAMME  
OF THE EUROPEAN UNION



Implemented by



European  
Environment  
Agency



# Copernicus Land Monitoring Service

- **Geographical** information on **land cover and its changes, land use, vegetation state, water cycle** and Earth's **surface energy variables** on European and global levels for environmental applications;
- **Harmonised, operational, and consistent** in time and space;
- Products and manuals are **free and open**;
- Implemented by **JRC and EEA**.



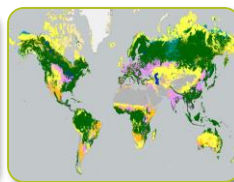
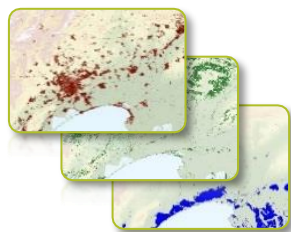
<https://land.copernicus.eu/>



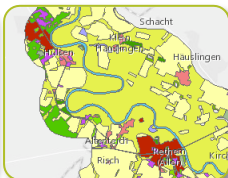
# CLMS portfolio: Categories of products



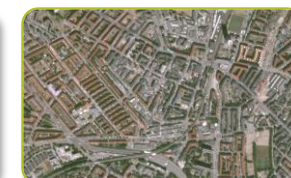
**Land cover and  
land use mapping**



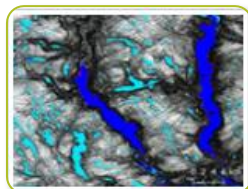
**Priority area  
monitoring**



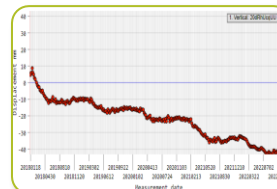
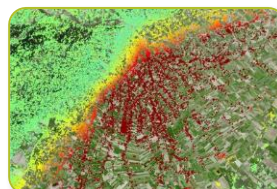
**Satellite data**



**Bio-geophysical  
parameters**



**Ground motion  
monitoring**



**Reference and  
validation data**



# HRL – Vegetated Land Cover Characteristics

## FOREST

Tree Cover Density TCD (10m)

Dominant Leaf Type DLT (10m)

Broadleaved Cover Density  
BCD(100m)

Coniferous Cover Density CCD  
(100m)

Tree Cover Presence Change  
TCPC (20m)

Dominant Leaf Type Change  
DLTC (20m)

Forest Type FTY (10, 100m)

Forest Additional Support  
Layer FADSL (10m)

## GRASSLAND

Grassland GRA (10m)

Herbaceous cover HER  
(10m)

Plough PLOUGH (10m)

Grassland Probability  
Index GRAVPI (10m)

Mowing events GRAM  
(10m)

Grassland Change GRAC  
(20m)

## CROP TYPES

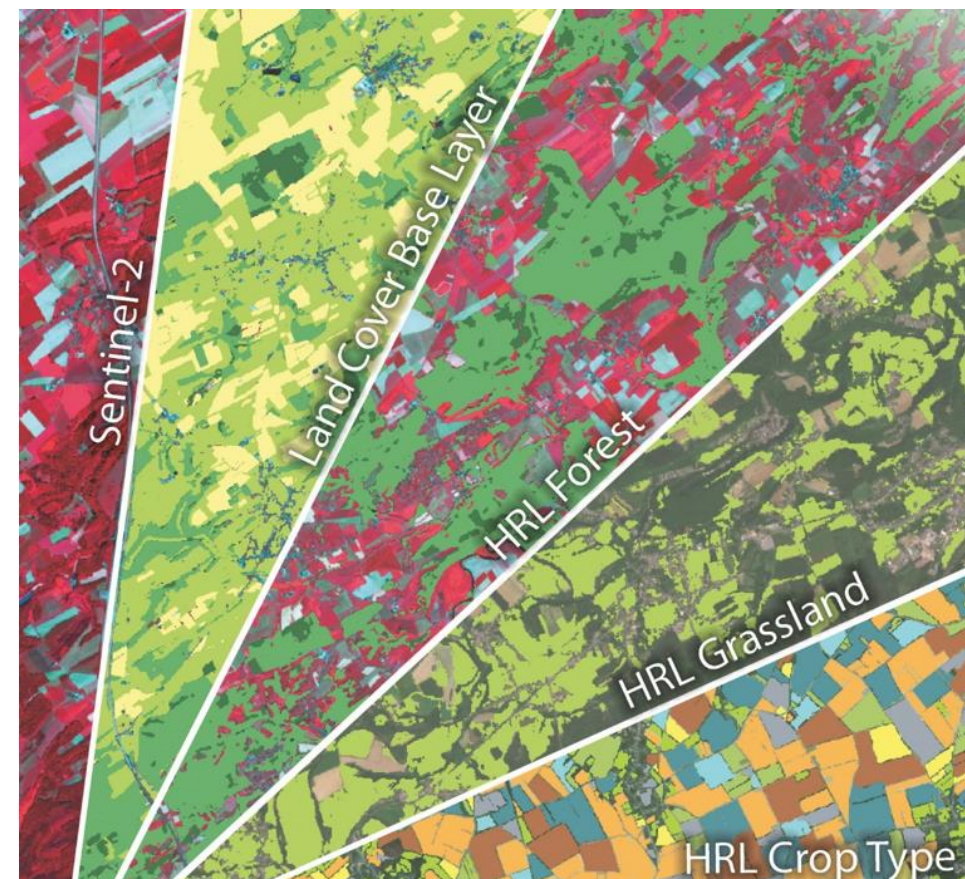
Crop Types CT (10m)

Crop Diversity and  
Diversification CDD (10m)

Harvest and Bare Soil HBS  
(10m)

Fallow Land FL (10m)

Cover Crops CC (10m)



2012

2015

2017

2018

2019

2020

2021

2022

2023



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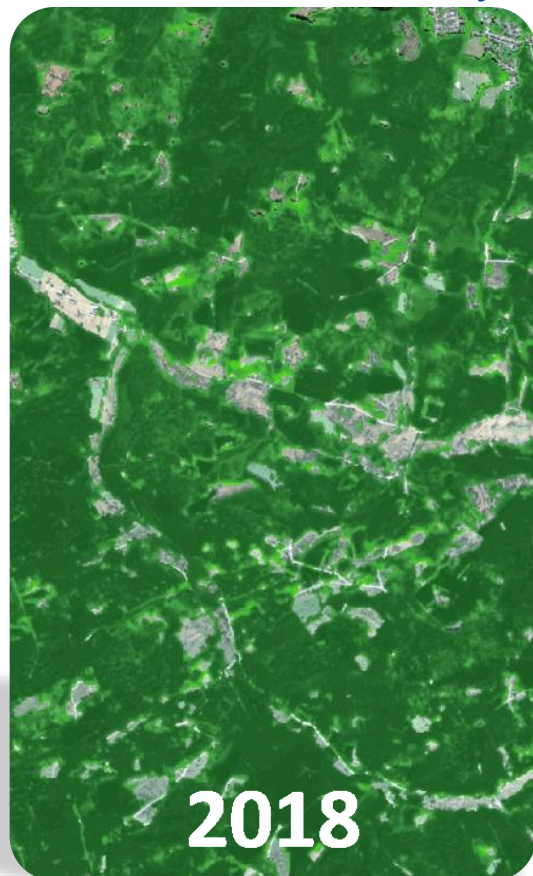
European  
Commission

# High Spatial & Temporal resolution

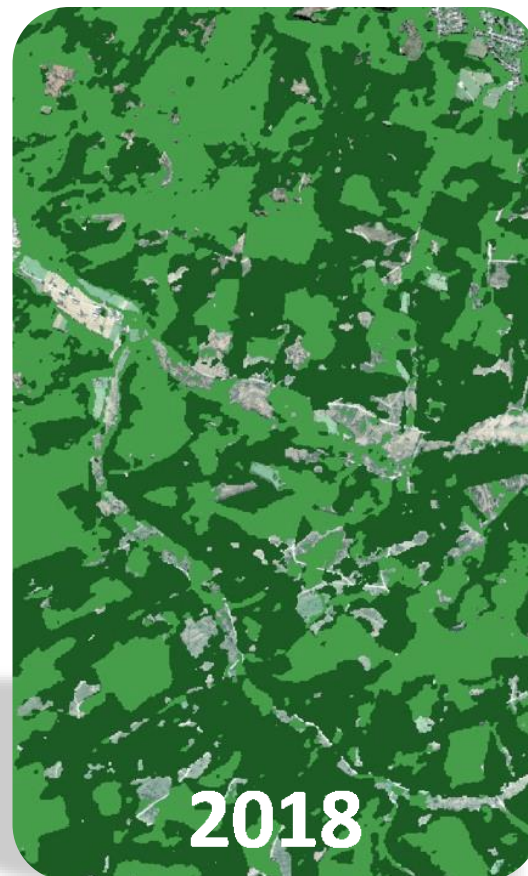
2018



Tree Cover Density



Dominant Leaf Type



2021



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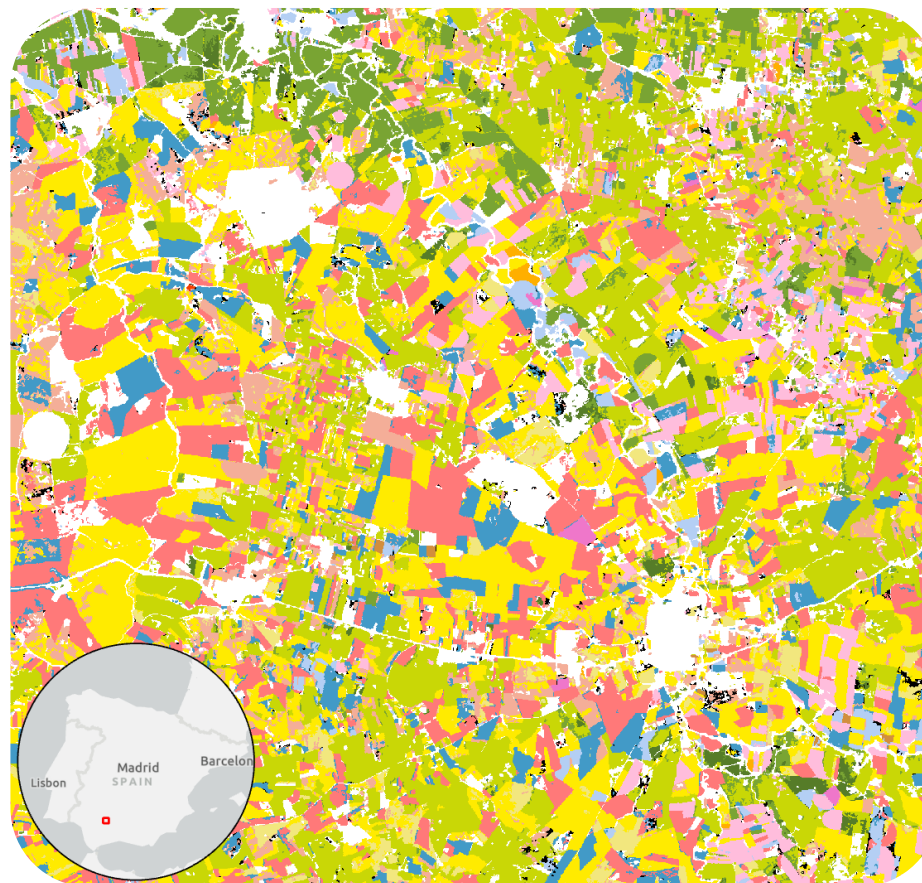


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# HRL Crop Types (CTY)

- Spatial resolution: **10 meter**
- Update frequency: **Annual**
- **CTY 2017-2021 EEA38** to be published in **April**
  - **EU-27** available on-demand
- **Cropping Patterns EEA38** available in August (examples in May)








## Crop Types 2021

0: No Cropland

- 1110: Wheat
- 1120: Barley
- 1130: Maize
- 1140: Rice
- 1150: Other Cereals
- 1210: Fresh Vegetables
- 1220: Dry Pulses
- 1310: Potatoes
- 1320: Sugar Beet
- 1410: Sunflower
- 1420: Soybeans
- 1430: Rapeseed
- 1440: Flax, cotton and hemp
- 2100: Grapes
- 2200: Olives
- 2310: Fruits
- 2320: Nuts



# Cropping Patterns

Group	Metric	Unit
 <b>Main Crops</b>	Emergence	DOY
	Harvest	DOY
	Duration	Nr. Days
 <b>Secondary Crops</b>	Type	Cover Crop (L/S-Summer/Winter)
	Emergence	DOY
	Duration	Nr. Days
 <b>Bare Soil</b>	Before Main Crop	Nr. Days
	After Main Crop	Nr. Days
 <b>Fallow Land</b>	Presence	1: Fallow
	Duration	Nr. Days of timeseries (2017-2021)
 <b>Cropping Seasons</b>	Yearly Seasons	0, 1, 2
	Over 3 years	0, 1, 2, 3+

# HRL Grassland Portfolio



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# Grassland Mowing Events 2021 Grassland Status 2021

Events	Colour
0	
1	
2	
3	
4+	



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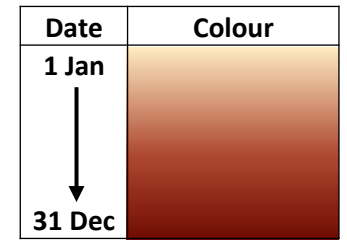
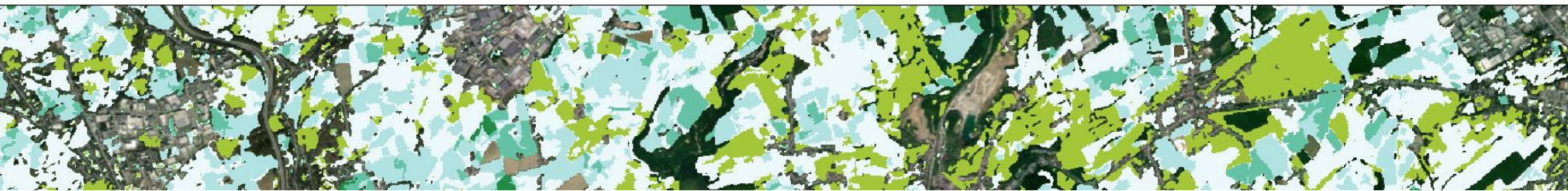
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### Grassland Mowing Dates



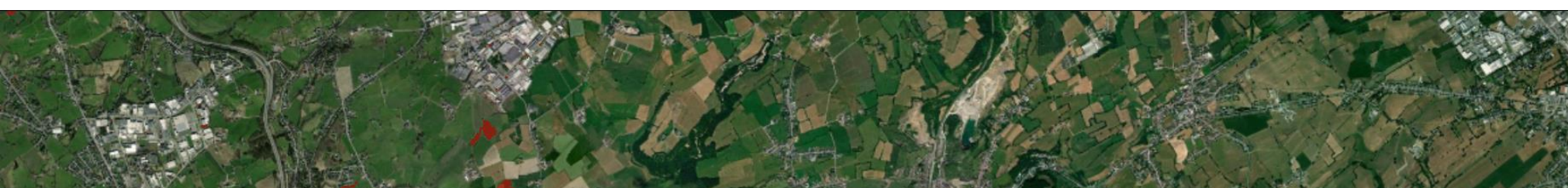
1<sup>st</sup> Event



2<sup>nd</sup> Event



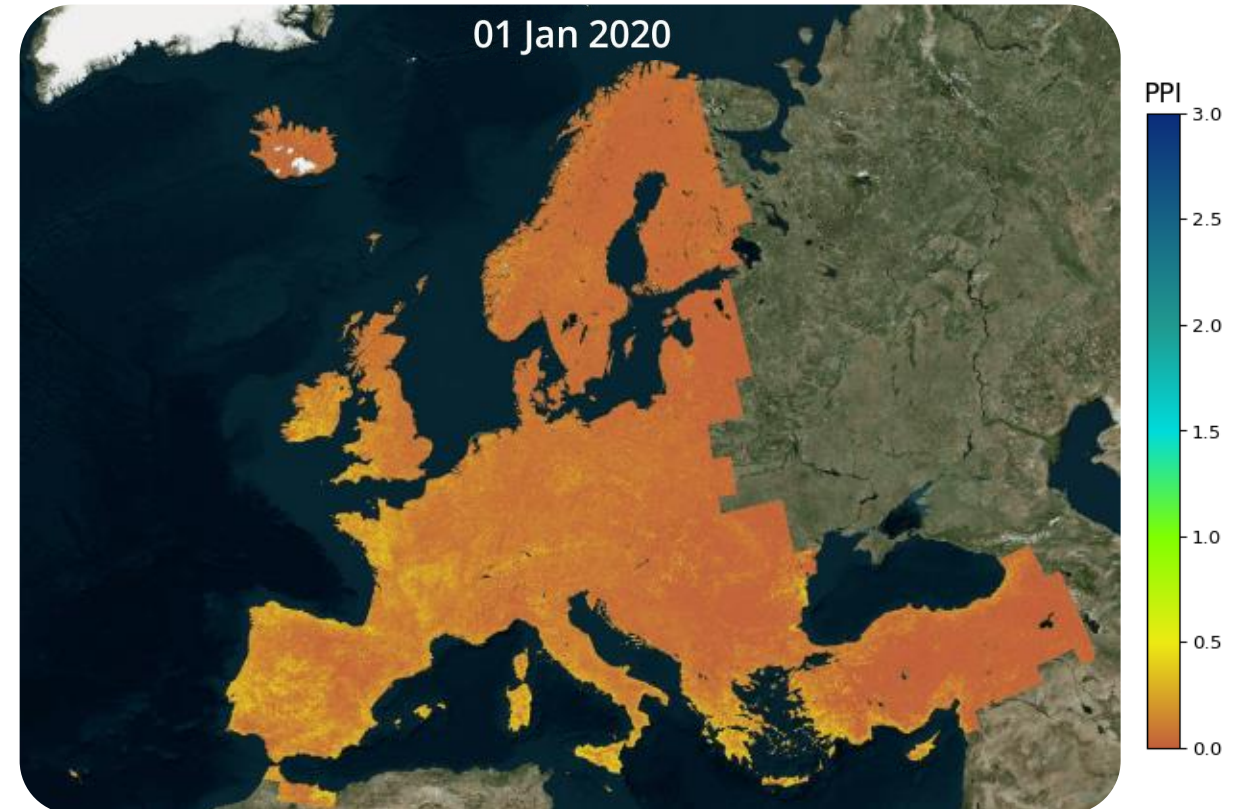
3<sup>rd</sup> Event



4<sup>th</sup> Event

# HR – Vegetation Phenology & Productivity (HR-VPP)

- **2017-2023**
- **10 meter annual processing of Phenology & Productivity metrics.**
- **Near Real-Time:** vegetation indices & biophysical variables
- **Future prospects:**
  - **Tree Cover Disturbances**
  - **Biomass Productivity (GPP/NPP)**



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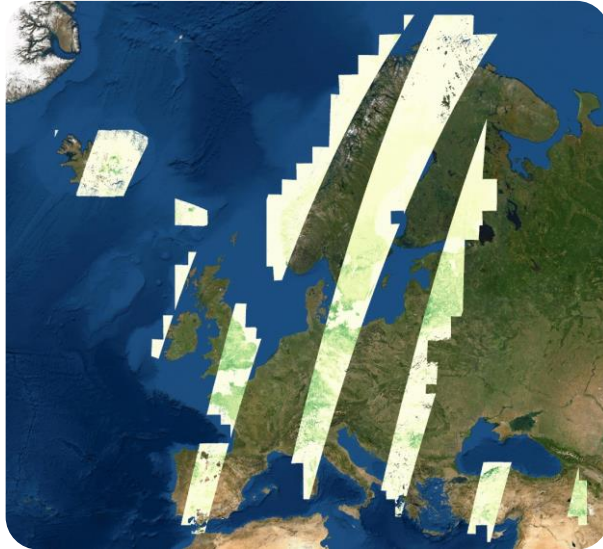


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# HR-VPP 1.0

## Vegetation Indices



### Daily (NRT)

- ✓ PPI
- ✓ FAPAR
- ✓ LAI
- ✓ NDVI
- ✓ Quality Flag

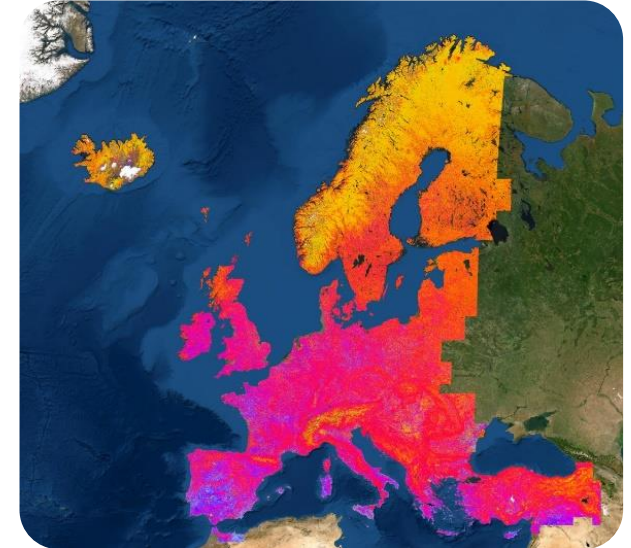
## Seasonal Trajectories



### 10 Days

(Plant Phenology Index)

## Phenology & Productivity



### Yearly (2 seasons)

- ✓ Start-of-Season
- ✓ End-of-Season
- ✓ Season length
- ✓ Season Max
- ✓ Season Min
- ✓ Amplitude
- ✓ Slope of green up/down
- ✓ Seasonal Productivity
- ✓ Total Productivity



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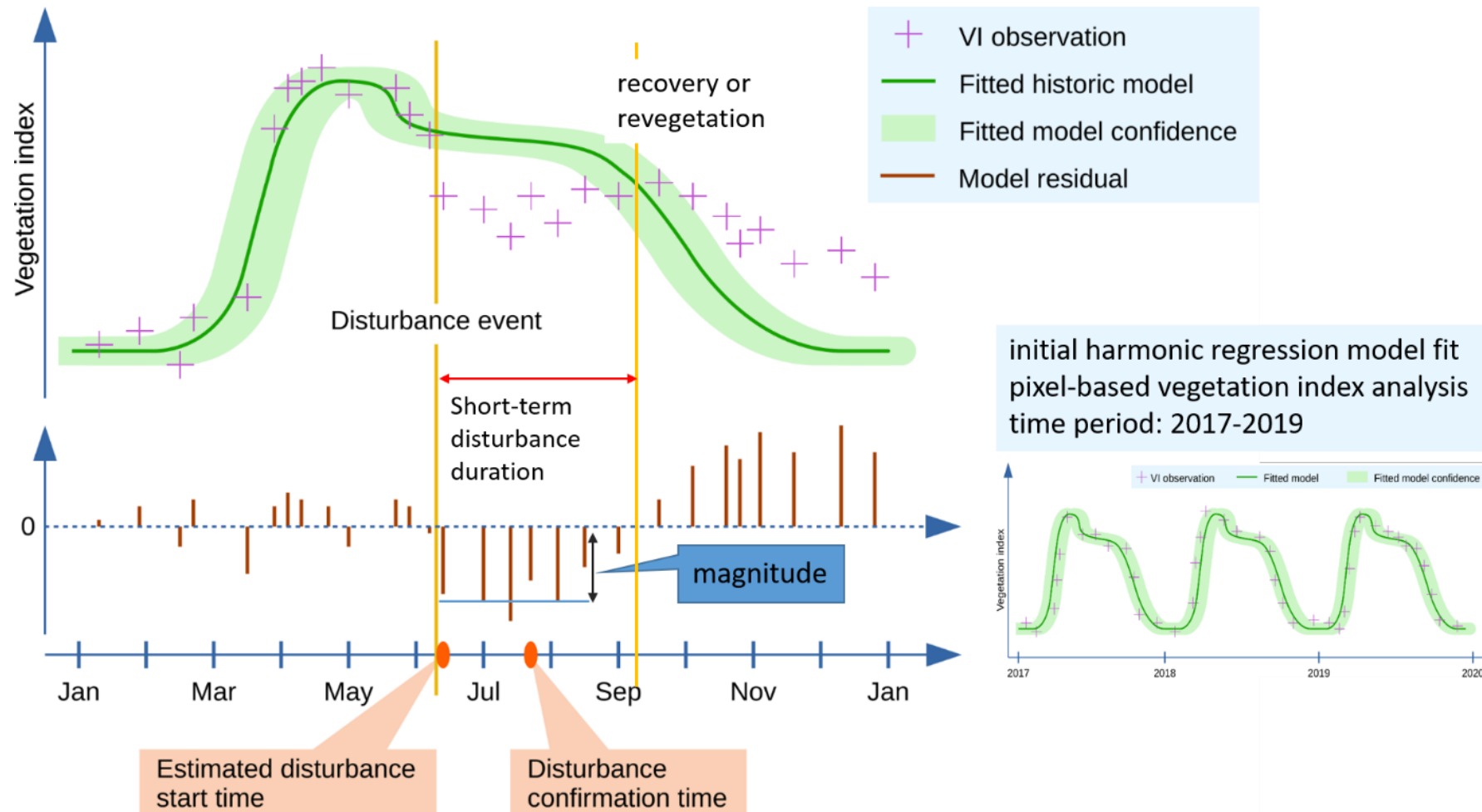
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# Tree Cover Disturbances - Proposal

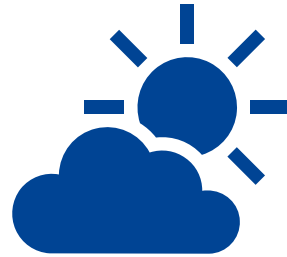


# Gross Primary Productivity (GPP) - Proposal



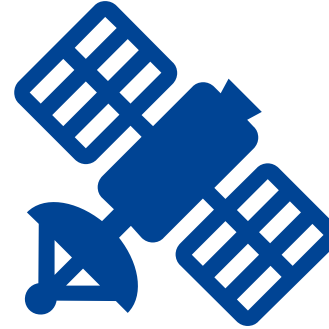
**Gross Primary Production (GPP):**  
Quantify the actual photosynthesis rate

=



**PAR:**  
Estimate PAR via incoming solar radiation

&



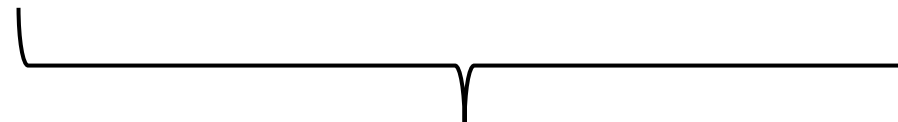
**fAPAR**  
Observations how much light is actually intercepted by vegetation

&



**Light Use Efficiency (LUE)**  
To constrain model.  
Drivers are model dependent.  
Typical inputs:

- Air temperature
- Water Vapor Pressure
- Atmospheric CO<sub>2</sub> conc.
- Elevation
- Biome type
- Soil moisture



**APAR**

*Meteo data*

*Optical satellite imagery*

*Various sources*



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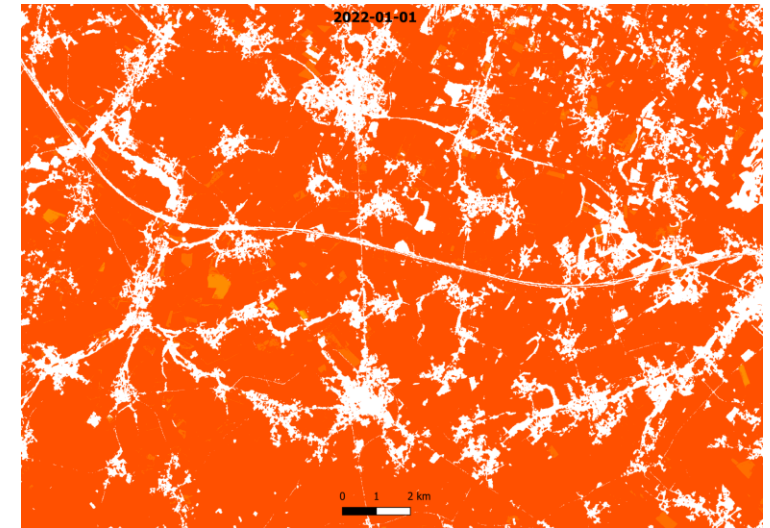
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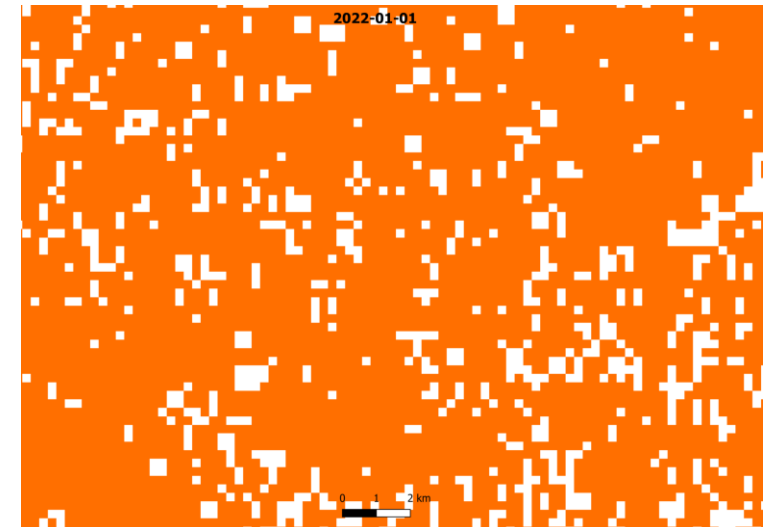
# HR-VPP continuation

- Ramp-up phase for next 12 months;
- Reviewing and testing options:
  - BRDF normalisation of Sentinel-2;
  - fAPAR smoothing;
  - Phenology metrics derived from GPP timeseries;
  - Assessing several methods for Disturbances;
  - ...
- All tests, discussions and conclusions will be published in the **Product Calibration Report**;
- Full archive processing of the Sentinel-2 Collection-1;

GPP (10 m)



GPP (300 m)





Land Monitoring

# Thank you!

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