Copernicus Land Monitoring Service: Portfolio OverView

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What is Copernicus

- Copernicus is the **European Union programme** aimed at developing European information services based on satellite Earth Observation and in situ data
- Copernicus is coordinated and **managed** by the **European Commission**
- Copernicus is **implemented in partnership** with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan
- Copernicus data and infrastructure **guaranteed** beyond 2030

COPERNICUS SIX SERVICES

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Europe's eyes on Earth
European Commission

The Copernicus Land Monitoring Service

Land Monitoring

- **Land cover and land use mapping**
- **Priority area monitoring**
- **Satellite data**
- **Bio-geophysical parameters**
- **Ground motion monitoring**
- **Reference and validation data**

- **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
- **Harmonized** and **consistent** in time and space
- Products and manuals are **free** and **open**
- Implemented by **JRC** and **EEA**
- Website: https://land.copernicus.eu/

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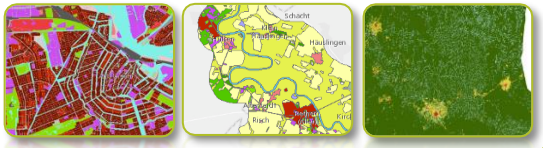
Land Monitoring

Portfolio

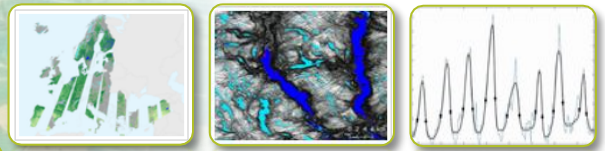
Land cover and land use mapping

Priority area monitoring

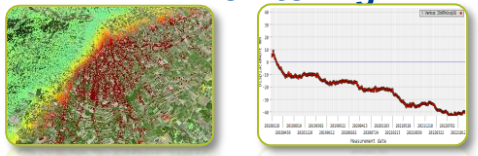


Satellite data

Bio-geophysical parameters



Ground motion monitoring



Reference and validation data

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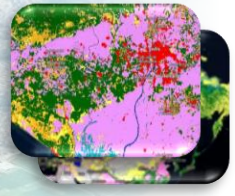
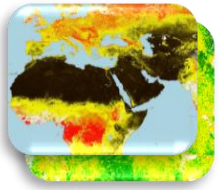
CLMS product @JRC

Global Land Cover
2015-16-17-18-19-24



Global Image Mosaic
S2GM 2017-present

Vegetation

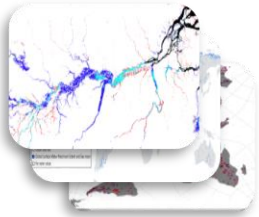


FAPAR
Fractional Cover
LAI
NPP/GPP
Phenology

Energy

Soil Water Index
Surface Soil Moisture
Land Surface Temperature

In-land Water

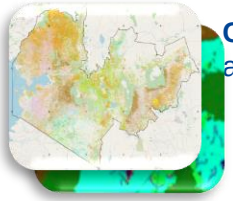


Water Bodies
Lake turbidity
Lake surface water temperature
...

Cryosphere

Snow Cover Extent
Snow Water Equivalent

Hot Spot Monitoring



Copernicus4GEOGLAM - agriculture

HSM – biodiversity

Reference & Validation

GBOV present

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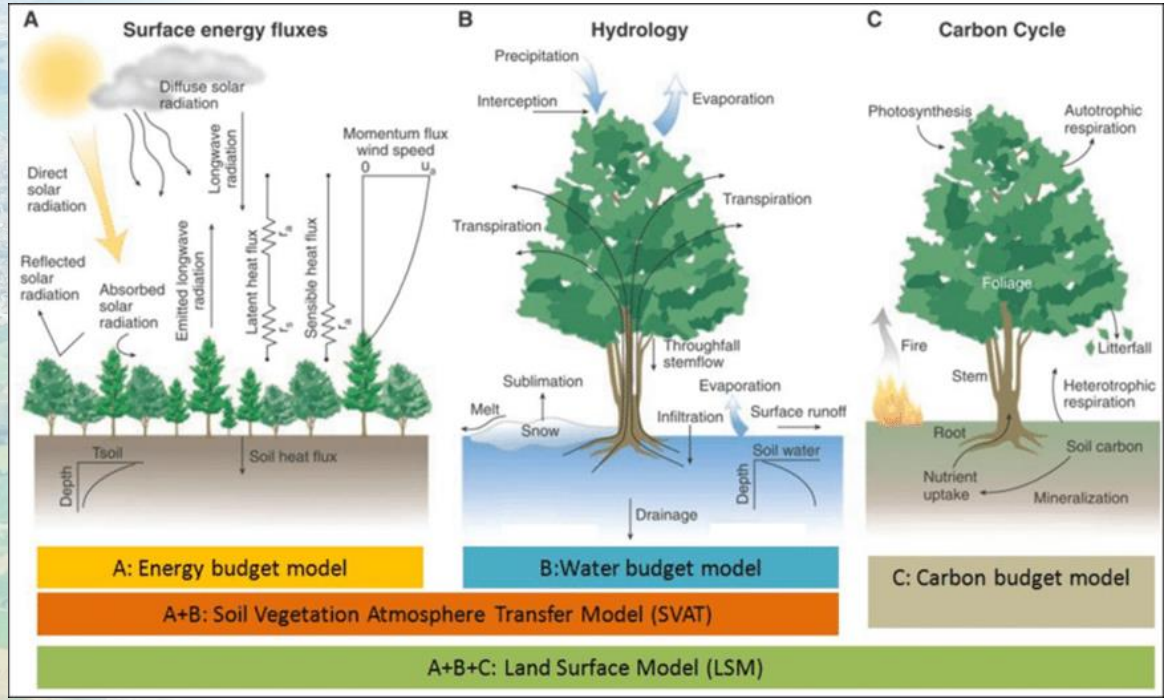
Where can CLMS products be used?



The current generation of land surface models (LSM) treats the biosphere and atmosphere as a coupled system based on modeling the transfers of (A) energy, (B) water and (C) carbon fluxes between land surface and atmosphere. Soil Vegetation Atmosphere (SVAT) models are based on the coupled water and energy cycles. (Source: Bonan (2008), modified)

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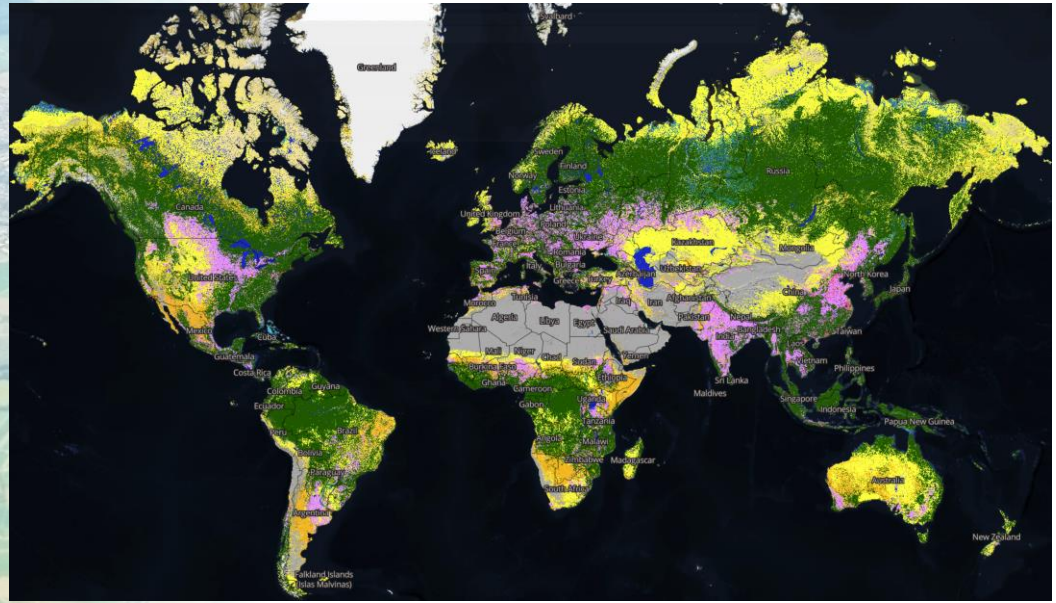
Global Land Cover Products

Proba-V since 2015 - 100m Global / Yearly



Used by the **UN Biodiversity Lab platform** to provide key information on Aichi Biodiversity targets and nature-based Sustainable Development goals.

CLMS CL class	IPCC class
Decidous broadleaf closed forest	Forest Land
Decidous broadleaf open forest	
Deciduous needleleaf closed forest	
Deciduous needleleaf open forest	
Evergreen broadleaf closed forest	
Evergreen broadleaf open forest	
Evergreen needleleaf closed forest	
Evergreen needleleaf open forest	
Mixed closed forest	
Mixed open forest	
Unknown closed forest	
Unknown open forest	
Cultivated and managed vegetation/agriculture (cropland)	Cropland
Herbaceous vegetation	Grassland
Shrubland	
Urban / built up	Settlements
Herbaceous wetland	Wetlands
Bare / sparse vegetation	Other Land
Moss and lichen	
No input data available	
Open sea	
Permanent water bodies	
Snow and Ice	

Land Monitoring

Global Land Cover & Tropical Forest Mapping (LCFM)

- Production of land cover and land cover change maps at high and mid resolution – 10m - 100 m
- New LCFM Contract using Sentinel 1 and Sentinel 2 at 10m
- Including a specific Tropical Tree Cover component to derive Forest cover maps and FC change maps to support the World Forest observatory of the EU Deforestation Regulation

@LDA: Non Static LC Map Cross-Scale

Land Cover Characteristics	Land Surface Categories	Land Cover Map	Land Cover Change Map	Land Cover Map	Land Cover Change Map	Land Cover Characteristics
Sub-annual	Sub-annual	Annual	Annual	Annual	Annual	Annual
10m	10m	10m	10m	100m	100m	10m
2020-2026	2020-2026	2020-2026	2021-2026	2020-2026	2021-2026	2020-2026
Per pixel based feature extractions	Categories of direct observable surface properties	Land cover map minimum of 11 land cover classes	Annual land cover changes	Land cover map, cover fraction layers	Annual land cover changes	Per pixel based yearly statistics

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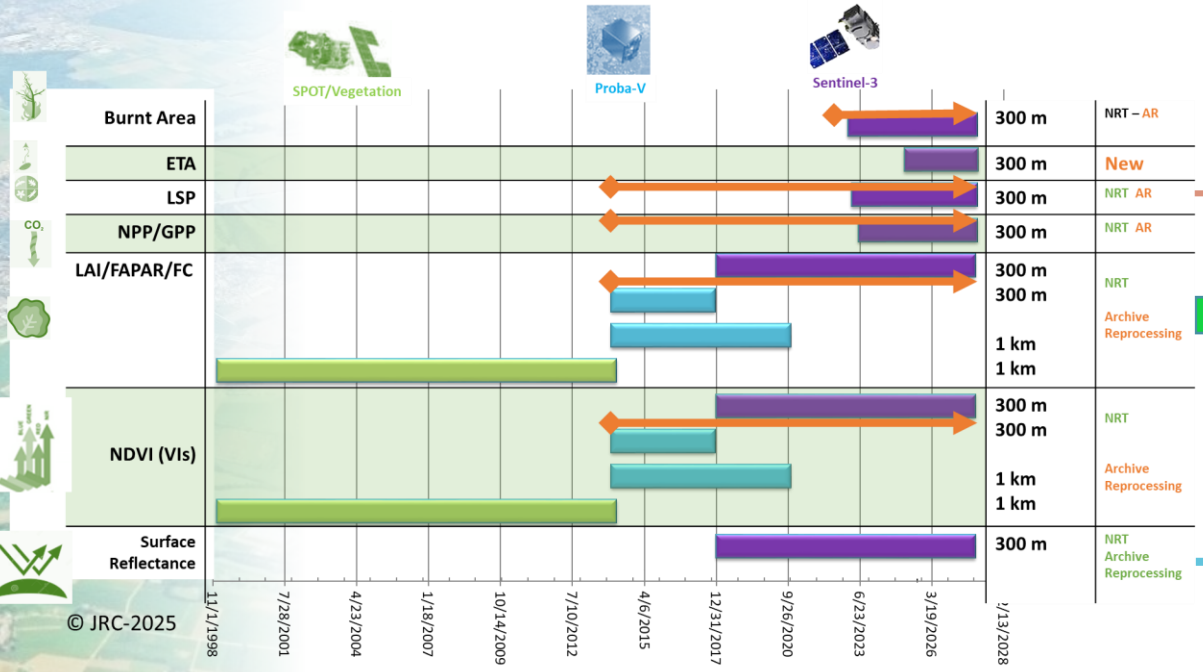
Vegetation Biophysical NRT parameters



Annual phenology published in March each year

Direct NRT assimilation of FC, LAI and FAPAR

@LDA: Assuming land model has 1D-RT model

Direct assimilation if land model has it own Vegetation Radiative Transfer Model

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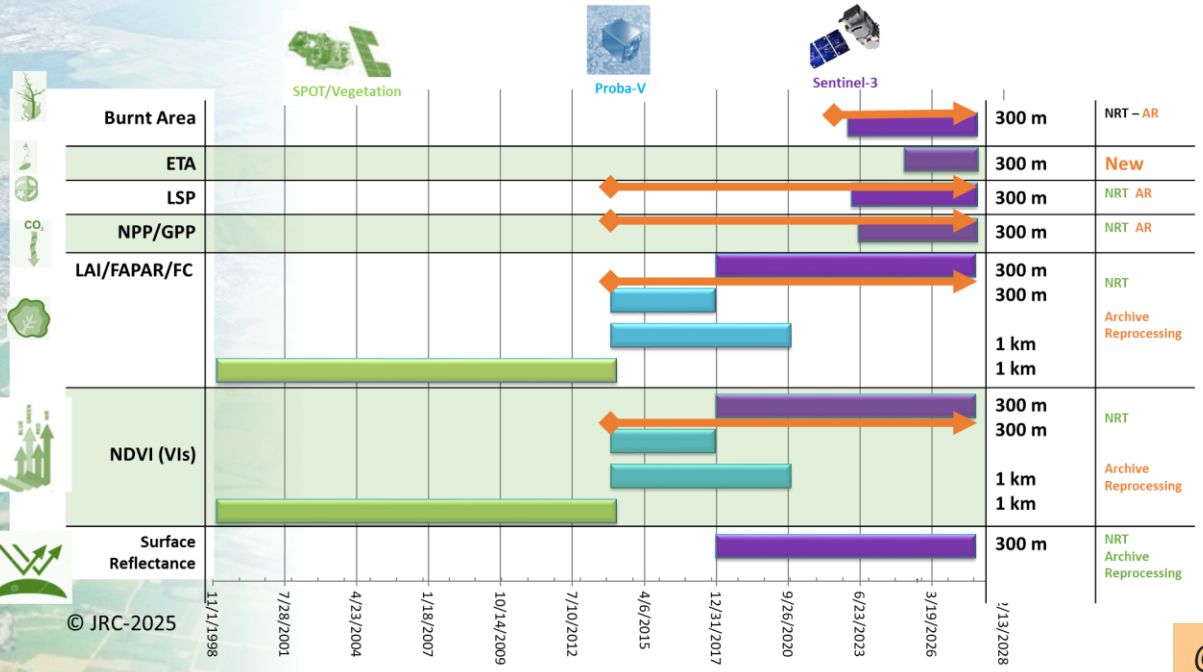
Vegetation Biophysical NRT parameters



Direct NRT assimilation of Evapotranspiration

Direct NRT assimilation of NPP/GPP

@LDA: Assuming same ETA & NPP models as CLMS

Products Receipt

Land Monitoring

- CLMS product
- CLMS intermediate product
- Satellite data
- Satellite ancillary data
- Other Copernicus service
- Non-Copernicus service

CLMS-TOCR-300 top-of-canopy reflectance	
TOA reflectance	Sentinel-3 OLCI L1B
TOA reflectance	Sentinel-3 SLSTR L1B
total water vapor column	Sentinel-3 OLCI L1B
sea-level surface pressure	Sentinel-3 OLCI L1B
AOD 550	CAMS NRT
AOD 550	CAMS global reanalysis
total ozone column	CAMS NRT
total ozone column	CAMS global reanalysis
air temperature	MERRA-2
Surface elevation	GTOPO30

CLMS-FAPAR-300	
TOC reflectance	CLMS-TOCR-300
Ocean mask	Sentinel-3 OLCI L1B
land cover	ESA CCI LC 2010

CLMS-LAI-300	
TOC reflectance	CLMS-TOCR-300
Ocean mask	Sentinel-3 OLCI L1B
land cover	ESA CCI LC 2010

CLMS-FC-300 fractional vegetation cover	
TOC reflectance	CLMS-TOCR-300
Ocean mask	Sentinel-3 OLCI L1B
land cover	ESA CCI LC 2010

CLMS-LSP-300 land surface phenology	
TOC reflectance	CLMS-TOCR-300
Surface shortwave incoming radiation (diffuse)	ERA5

NBAR-300 nadir BRDF adjusted reflectance	
TOC reflectance	CLMS-TOCR-300

CLMS-GDMP-300 gross dry matter productivity	
FAPAR	CLMS-FAPAR300
surface shortwave incoming radiation	ECMWF HRES forecast
air temperature	ECMWF HRES forecast
land cover	ESA CCI LC 2010

x 0.5

CLMS-GPP-300 gross primary production	
GDMP	CLMS-GDMP-300

Unit conversion

CLMS-DMP-300 dry matter productivity	
GDMP	CLMS-GDMP-300

CLMS-NPP-300 net primary production	
DMP	CLMS-DMP-300

Unit conversion

CLMS-NDVI-300	
NBAR	NBAR-300

C3S albedo	
NBAR	NBAR-300

Today status

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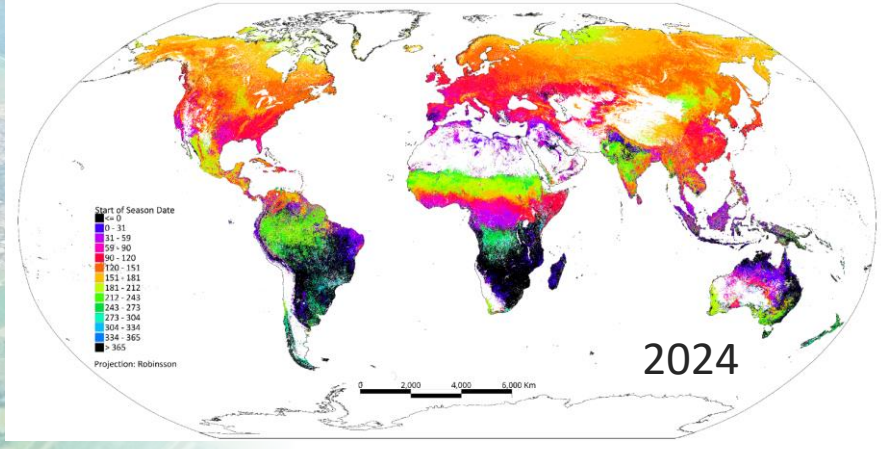
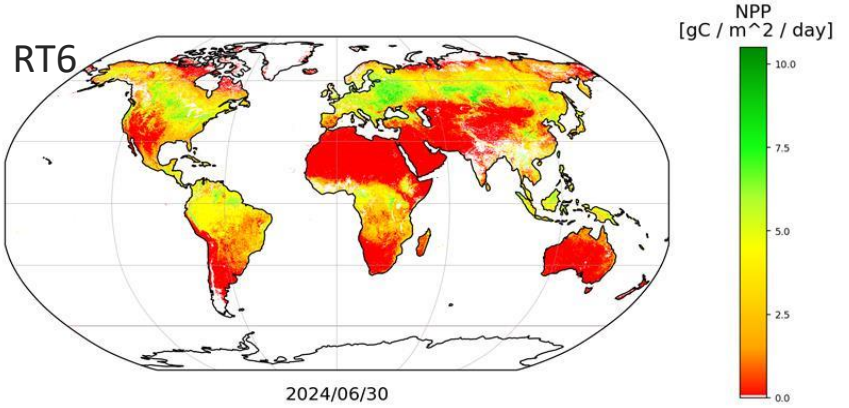
Vegetation Products Examples

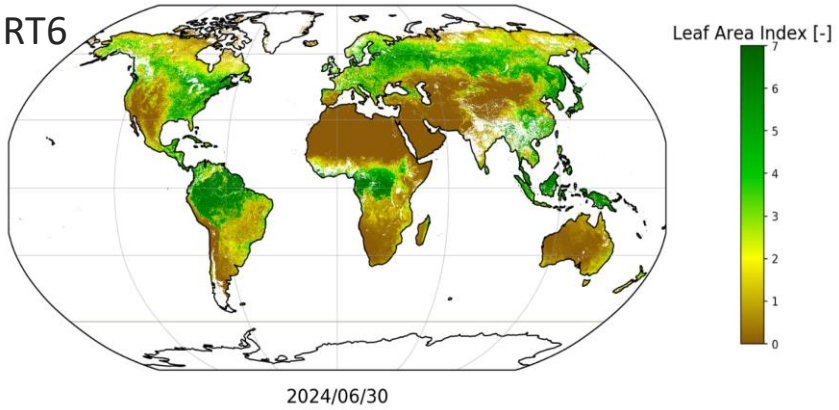
300 m, 10 day (2014-now)



start-of-season ; end-of-season; max-season; season amplitude; season length; season minimum value; slope of the green-up/down period; season/total productivity indicator

PROBA-V
Sentinel-3/OLCI,SLSTR





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Cryosphere products

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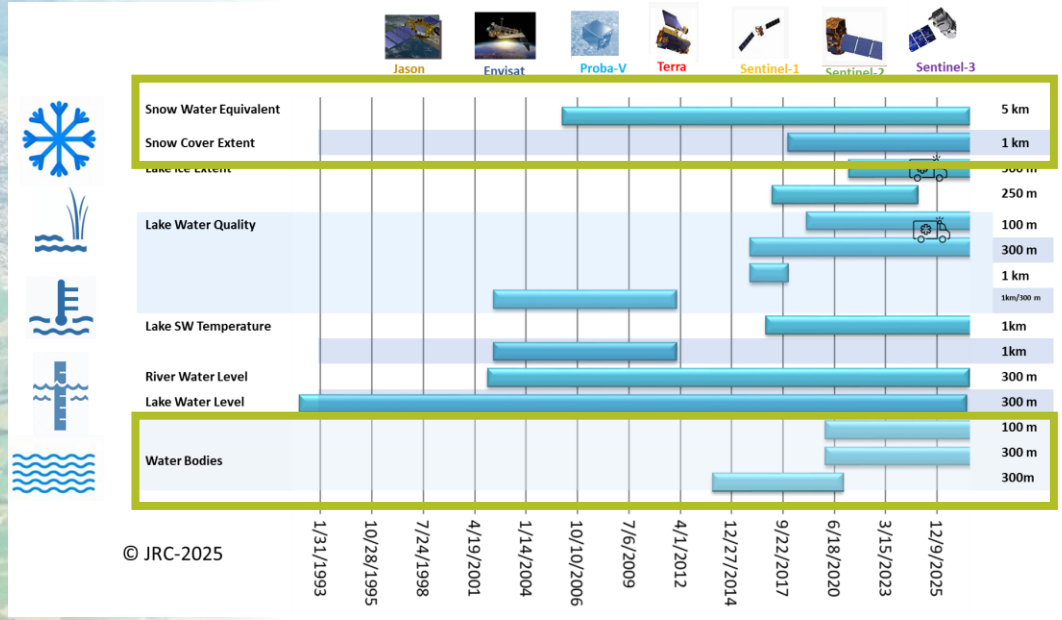
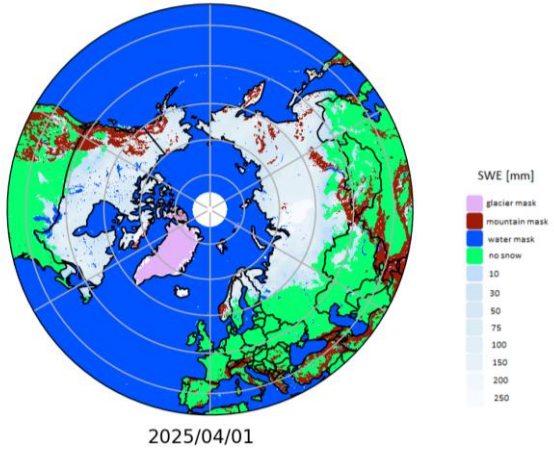


SSMIS, VIIRS

NH → Global



5 km, 1 day (2006-now)

Essential climate variable, hydrological models (flood forecasting, water resource management), avalanche forecasting

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GSWE Integration in CLMS

Disappearing Aral Sea

Lake expansion in the Tibetan Plateau

Disappearing lake (Lake Milh, Iraq)

New dam (Sudan)

- Updated up to December 2021 (LandSat Coll. 1)
- Adaptation to Coll. 2 (2022-24)
- Integration in the CLMS and its platform
- Extension to Sentinel-2 image for fusion product

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In-land water products: level

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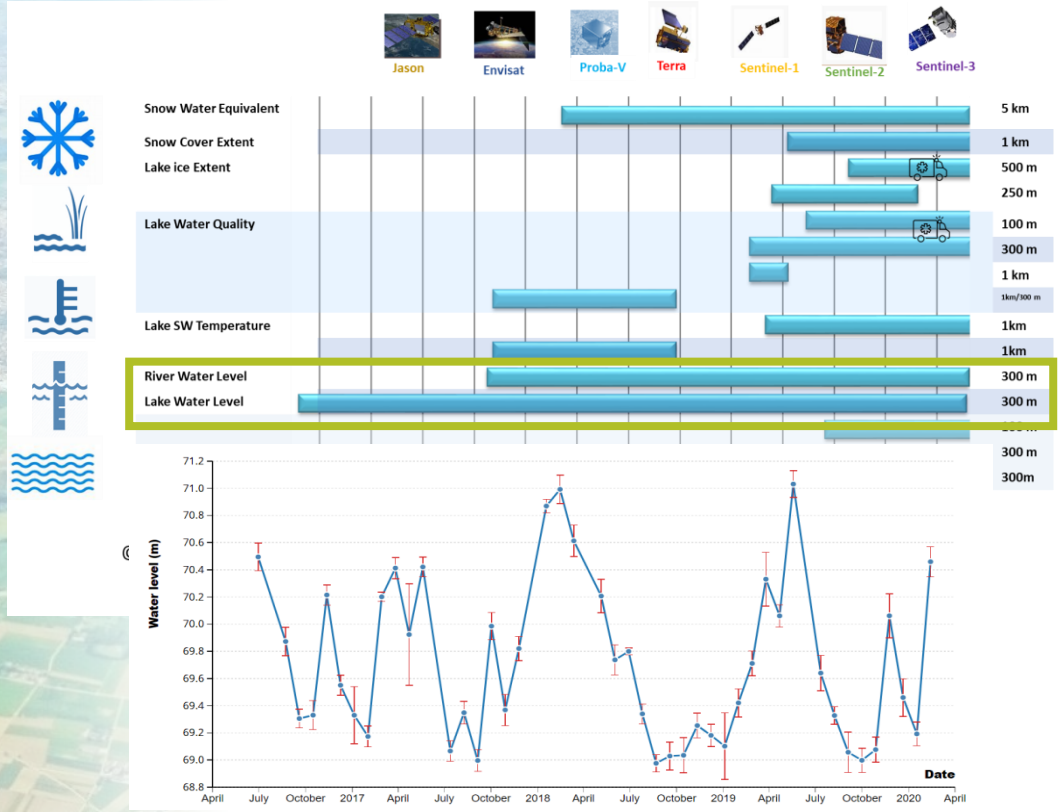

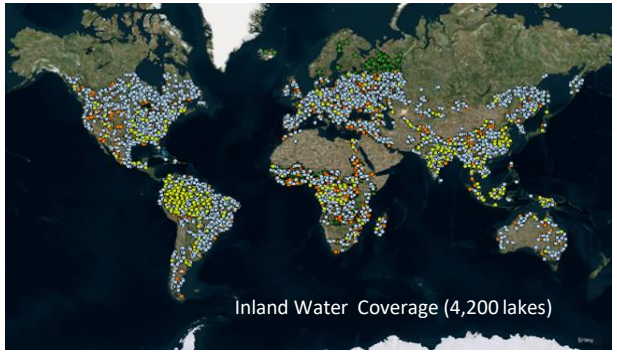

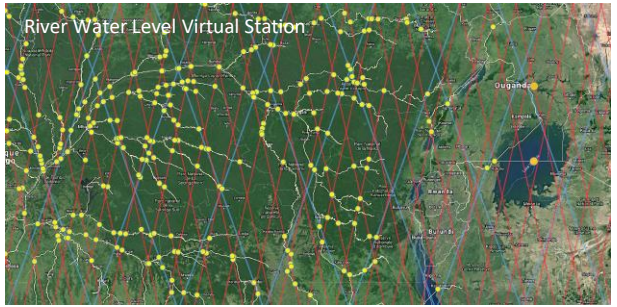

Hydrological models, flood forecasting

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LST and Soil Moisture

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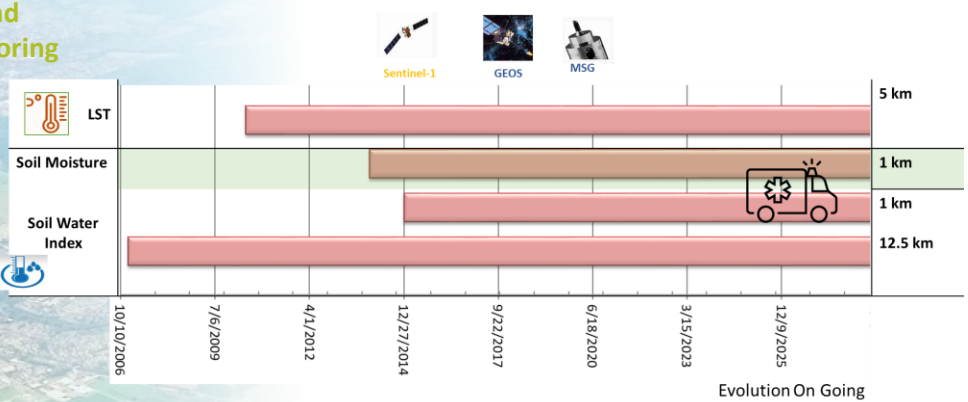
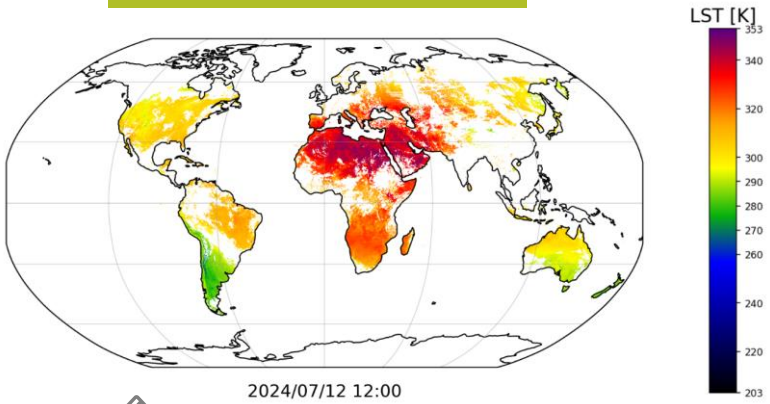
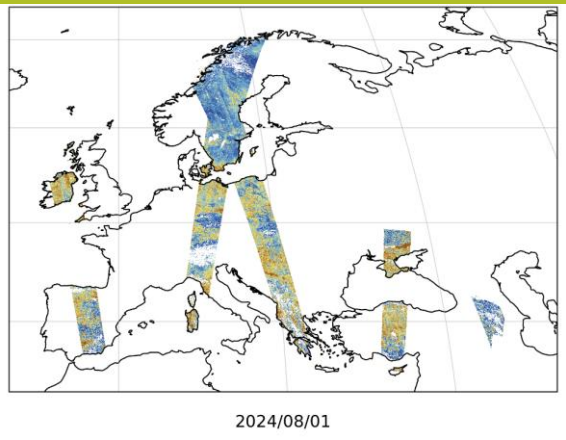


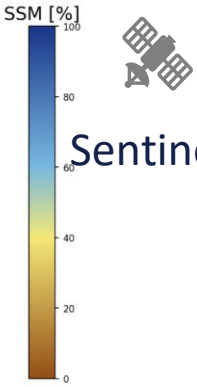
5 km, 2021-now



GEO-Ring: Meteosat, GOES, Himawari

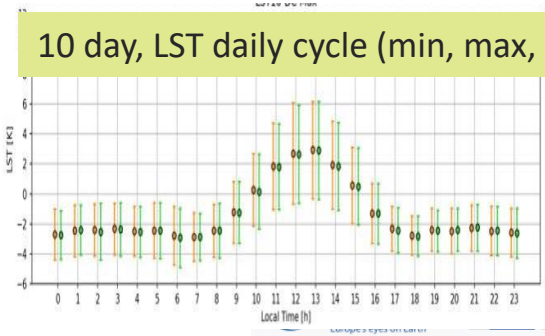
1 km, 1 day (2014-now)





Sentinel-1/C-SAR

10 day, LST daily cycle (min, max, med)



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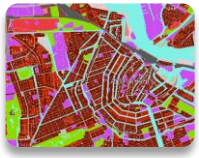
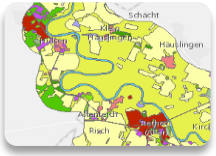
CLMS - European HR Products

Urban Atlas
2006-12-18-21



Riparian Zones
2012-18-24



Protected Areas
2006-12-18-21

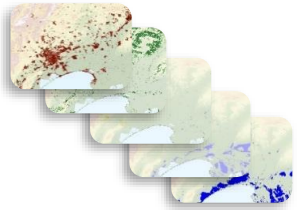
Coastal Zones
2012-18-24

VHR optical images
(2-5m pixel)

CLC & CLCC
1990-2000-06-12-18-24

CLC+ BackBone
2018-21-23

High Resolution Layers
2006-09-12-15-18-various

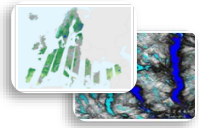


HR optical images
(Sentinel 2 10-20m pixel)

EU-Hydro
Next update 2021

European Ground Motion Service
Yearly 2018 to 2022-2023

Biophysical Parameters
Near Real Time



HR radar images
(SRTM, Sentinel 1 14m pixel)

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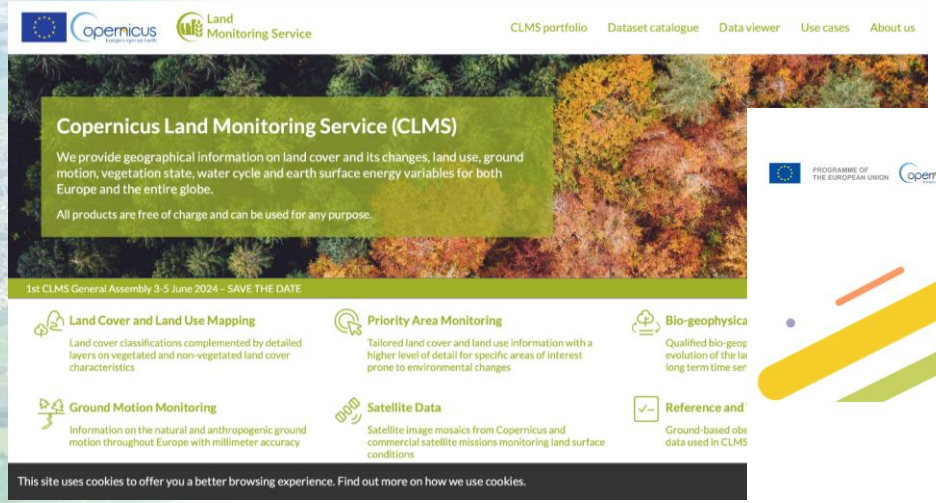
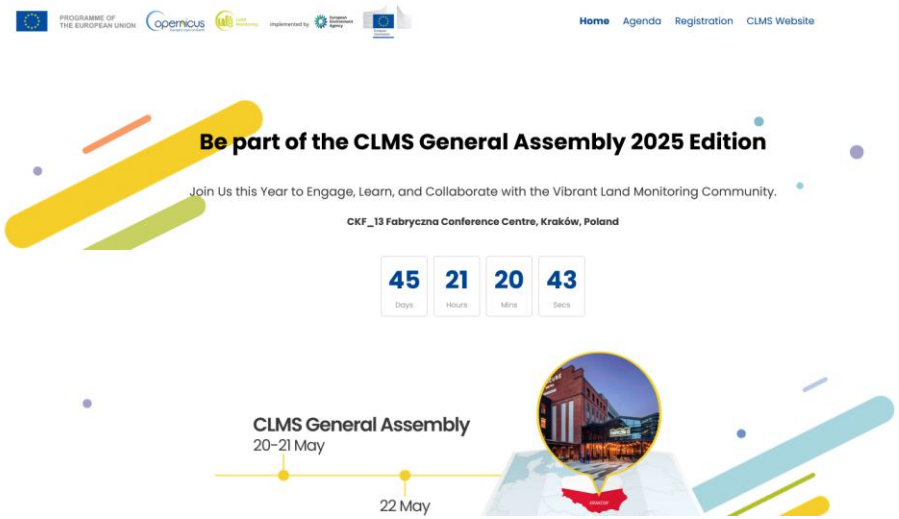
SERVICE PRODUCT ACCESS





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Thank you

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Space