Copernicus Global Land Service

Operational Product Validation

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on behalf CGLOPS-1 and CGLOPS-2 consortia
COPERNICUS GLOBAL LAND OPERATIONS - PORTFOLIO

VEGETATION
- Leaf Area Index (LAI)
- Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)
- Fraction of vegetation cover (FCOVER)
- Normalized Difference Vegetation Index (NDVI)
- Vegetation Condition Index *
- Vegetation Productivity Index *
- Dry Matter Productivity (DMP)
- Burnt Area
- Moderate Yearly Land Cover *
- Surface Soil Moisture (SSM)
- Soil Water Index (SWI)

ENERGY
- Top-of-Canopy reflectance *
- Surface Albedo *
- Land Surface Temperature

WATER
- Lake and river water level
- Lake Water Quality
- Lake surface water temperature
- Water Bodies

CRYOSPHERE
- Snow water equivalent (SWE)
- Snow cover extent (SCE)
- Lake Ice Extent

FREE AND OPEN ACCESS: https://land.copernicus.eu/global/

* Archive only

CGLOPS PRODUCTS IN LPV TOPICS

"CGLOPS" products in LPV topics

* Archive only
<table>
<thead>
<tr>
<th>Variable</th>
<th>Temporal coverage</th>
<th>Temporal resolution</th>
<th>Spatial coverage</th>
<th>Spatial resolution</th>
<th>Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAI – FAPAR (FCOVER)</td>
<td>1999 - 2020</td>
<td>10 days</td>
<td>Global</td>
<td>1 km* 300 m</td>
<td>SPOT/VGT + PROBA-V PROBA-V + S3/OLCI</td>
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<tr>
<td></td>
<td>2014 - present</td>
<td></td>
<td></td>
<td></td>
<td>PROBA-V + S3/OLCI&amp;SLSTR</td>
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<tr>
<td>Burnt Areas</td>
<td>2014 - present</td>
<td>1 day</td>
<td>Global</td>
<td>300 m</td>
<td>PROBA-V + S3/OLCI&amp;SLSTR</td>
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<tr>
<td>NDVI</td>
<td>1999 - 2020</td>
<td>10 days</td>
<td>Global</td>
<td>1 km* 300 m</td>
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<tr>
<td>Dynamic land cover</td>
<td>2015 - 2019</td>
<td>1 year</td>
<td>Global</td>
<td>100m</td>
<td>PROBA-V</td>
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<tr>
<td>Surface Soil Moisture</td>
<td>2015 - present</td>
<td>1 day</td>
<td>Europe</td>
<td>1 km</td>
<td>S1 CSAR</td>
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<tr>
<td>Soil Water Index</td>
<td>2007 – present</td>
<td>1 day</td>
<td>Global</td>
<td>0.1° 1 km</td>
<td>ASCAT S1 CSAR+ASCAT</td>
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<td></td>
<td>2015 - present</td>
<td></td>
<td>Europe</td>
<td></td>
<td></td>
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<tr>
<td>Snow Cover Extent</td>
<td>2018 – present</td>
<td>1 day</td>
<td>Northern Hemisphere</td>
<td>1 km 500 m</td>
<td>VIIRS MODIS</td>
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<tr>
<td></td>
<td>2017 - present</td>
<td></td>
<td>Europe</td>
<td></td>
<td></td>
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<tr>
<td>Snow Water Equivalent</td>
<td>2006 - present</td>
<td>1 day</td>
<td>Northern Hemisphere</td>
<td>5 km</td>
<td>SSMIS + VIIRS</td>
</tr>
<tr>
<td>Surface Albedo **</td>
<td>1999 - 2020</td>
<td>10 days</td>
<td>Global</td>
<td>1 km *</td>
<td>SPOT/VGT + PROBA-V</td>
</tr>
<tr>
<td>Land Surface Temperature</td>
<td>2010 - present</td>
<td>1 hour</td>
<td>Global</td>
<td>5 km</td>
<td>Geostationary sensors</td>
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* 1km time series stopped on 30th June 2020.

** Production of 300m time series moved to Copernicus Climate Change Service
• Quality Assessment:
  – Following, as much as possible when they exist, the CEOS LPV guidelines
  – **Direct validation**: comparison against in-situ data, yearly updates to reach LPV Stage 4
  – **Indirect validation**: Inter-comparison with existing satellite-derived products (e.g. MODIS)
Direct Validation example – Sentinel-1 Soil Moisture

**HOAL, Hoal-01 (lon 15.14°E, lat 48.16°N) - Austria**

**Surface Soil Moisture**
- In-situ International Soil Moisture Network
- CGLOPS Sentinel-1 SSM

![Surface Soil Moisture](https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_SQE2020_SSM1km_I1.00.pdf)

**Soil Water Index**

- **Sub-surface layer**
  - In-situ International Soil Moisture Network
  - CGLOPS Sentinel-1 & ASCAT SWI (T=10)

![Sub-surface Soil Water Index](https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_SQE2020_SWI1km_I1.00.pdf)

- **Deep soil layer**
  - In-situ International Soil Moisture Network
  - CGLOPS Sentinel-1 & ASCAT SWI (T=100)

Ground-Based Observations for Validation (GBOV) sites
(July 2018 – April 2019)

Direct Validation example – Sentinel-3/OLCI LAI, FAPAR, FCOVER

https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LAI300m-V1.1_I1.00.pdf available soon
In situ LST from various networks:

- BSRN
- ARM
- OzFlux
- EFDC
- GBOV

Day time (Sept – Dec 2019)

Night time (Sept – Dec 2019)

Indirect Validation example – inter-comparison: spatial consistency

CGLOPS-1 LST V2 – Sentinel-3/SLSTR LST
June / July / August 2020

Day time

Night time

CGLOPS-1 OLCI LAI – CGLOPS-1 PROBA-V LAI
20 July 2018


https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LAI300m-V1.1_I1.00.pdf available soon
Indirect Validation example – inter-comparison: statistical consistency

**Sentinel-3/OLCI LAI vs PROBA-V LAI**

720 LANDVAL sites  
07/2018 – 04/2019

![Graph](https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_NDVI1km-V3_I1.10.pdf)  
Available soon

**CGLOPS-1 NDVI vs MCD43A4 NDVI**

PROBA-V NDVI 1km  
Global sampling (21x21)  
2011-2016

![Graph](https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_NDVI11km-V3_I1.10.pdf)

Sentinel-3/OLCI NDVI 300m  
720 LANDVAL sites  
07/2018 – 06/2019

![Graph](https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_NDVI300m-V2_1I.00.pdf)  
Available soon

CGLOPS needs for product validation

- Quality controlled and harmonized ground data (e.g. GBOV)
  - More sites: « ... a significant (typically > 30) set of locations ... » is required to reach LPV validation stage 2 and beyond
  - Better ecosystems sampling
  - More super-sites to ensure consistency across variables
  - Better global distribution

[Map showing distribution of sites across different IGBP classifications]

https://land.copernicus.eu/global/gbov/  Last access: 20th May 2021
Spatial representativeness is challenging
  - Local measurement vs satellite pixel

Up-scaled products (like GBOV LPs) could be useful
  - Set-up to be representative at satellite pixel level

But are they reliable?
  - Some upscaling methods deviate from the LPV protocols
Recommendation

Build-up a reference database of in-situ measurements
- GBOV could be a starting point (quality control, harmonisation)
- Increase and better balance of the spatial sampling
- Invest in supersites with long-term maintenance
- Improve the timeliness (less than 3 months)
- Validate upscaling approaches by independent review
  - LPV groups/experts could contribute