

Exam - the Copernicus program

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2 Vegetation

3 Energy

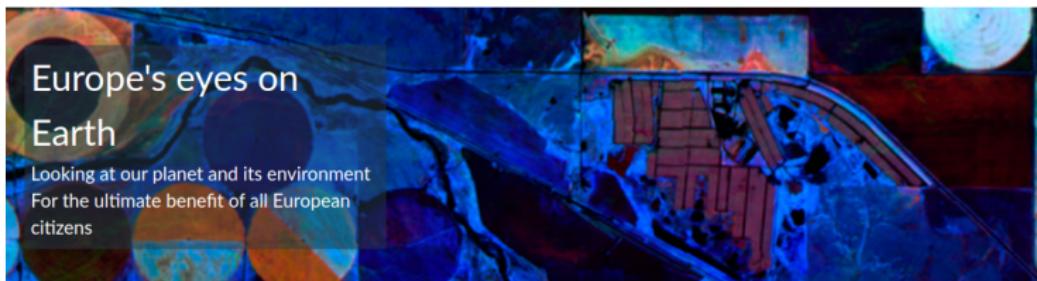
4 Water Cycle

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Copernicus



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Copernicus

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Providing bio-geophysical products of global land surface

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Vegetation

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Vegetation

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Burnt Area	NDVI
Dry Matter Prod.	Soil Water Index
FAPAR	Surf. Soil Moisture
FCOVER	VCI
Leaf Area Index	VPI
Land Cover	

LAI - Leaf Area Index

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Leaf Area Index

The Leaf Area Index is defined as half the total area of green elements of the canopy per unit horizontal ground area. The satellite-derived value corresponds to the total green LAI of all the canopy layers, including the understory which may represent a very significant contribution, particularly for forests. Practically, the LAI quantifies the thickness of the vegetation cover.

LAI is recognized as an Essential Climate Variable (ECV) by the Global Climate Observing System (GCOS).

LAI product updates

Update to vegetation products switching from PROBA-V to Sentinel-3 OLCI and SLSTR sensors
Fri, 17 April 2020
Several vegetation products switching from PROBA-V to Sentinel-3 OLCI and SLSTR sensors

LAI - Leaf Area Index

The Leaf Area Index is defined as the area of green elements of the canopy per unit horizontal ground area. Practically, the LAI quantifies the **thickness of the vegetation cover**.

FCOVER - Fraction of green Vegetation Cover

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FCOVER

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FCOVER - Fraction of green Vegetation Cover

The Fraction of Vegetation Cover (FCover) corresponds to the fraction of ground covered by green vegetation. Practically, it quantifies the **spatial extent of the vegetation**.

FAPAR - Fraction of Absorbed Photosynthetically Active Radiation

A screenshot of the Copernicus Global Land Service website. The header includes links for About, Contact Us, Home, Products, Use cases, Product Access, Viewing, Library, and Get Support. The main content area features a background image of green grass with water droplets. On the left, there's a small world map icon. On the right, a grid of nine boxes lists various bio-geophysical products: Burnt Area, NDVI, Dry Matter Prod., Soil Water Index, FAPAR, Surf. Soil Moisture, FCOVER, VCI, Leaf Area Index, VPI, and Land Cover.

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FAPAR - Fraction of Absorbed Photosynthetically Active Radiation

The FAPAR quantifies the **fraction of the solar radiation absorbed by live leaves for the photosynthesis activity**.

NDVI - Normalized Difference Vegetation Index

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NDVI - Normalized Difference Vegetation Index

The Normalized Difference Vegetation Index (NDVI) is an indicator of the **greenness of the biomes**. As such, it is closely linked to the FAPAR.

Even though it is not a physical property of the vegetation cover, its very simple formulation

$$\text{NDVI} = (\text{REF_nir} - \text{REF_red}) / (\text{REF_nir} + \text{REF_red})$$

where REF_nir and REF_red are the spectral reflectances measured in the near infrared and red wavebands respectively, makes it widely used for ecosystems monitoring.

VCI - Vegetation Condition Index

The image shows the Copernicus Global Land Service homepage. On the left, there is a large photograph of a corn field under a clear blue sky. In the bottom left corner of the image area, there is a small inset map of the world showing land cover in different colors. To the right of the image is a grid of eight colored boxes, each containing a text label. The boxes are arranged in two columns and four rows. The first column contains: "Burnt Area" (dark blue), "Dry Matter Prod." (medium blue), "FAPAR" (light blue), and "FCOVER" (blue). The second column contains: "NDVI" (dark blue), "Soil Water Index" (medium blue), "Surf. Soil Moisture" (light blue), and "VCI" (light green). The bottom row contains: "Leaf Area Index" (dark blue) and "VPI" (dark blue). The word "Land Cover" is centered at the bottom of the grid.

VCI - Vegetation Condition Index

The Vegetation Condition Index (VCI) compares the **current NDVI to the range of values** observed in the same period in previous years. The VCI is expressed in % and gives an idea where the observed value is situated between the extreme values (minimum and maximum) in the previous years. Lower and higher values indicate bad and good vegetation state conditions, respectively.

VPI - Vegetation Productivity Index

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VPI - Vegetation Productivity Index

The Vegetation Productivity Index (VPI) assesses the overall vegetation condition by referencing **the current value of the NDVI with the long-term statistics for the same period**. The VPI is a percentile ranking of the current NDVI value against its historical range of variability: values of 0%, 50% and 100% respectively indicate that the current observation corresponds with the historical minimum (worst vegetation state), median (normal) or maximum (best situation) ever observed.

Dry matter Productivity

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DMP - Dry matter Productivity

Dry matter Productivity (DMP) represents the overall **growth rate** or dry biomass increase of the vegetation and is directly related to ecosystem Net Primary Productivity (NPP), however with units customized for agro-statistical purposes (kg/ha/day).

Burnt area

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Burnt area

The Burnt Area product maps the **burnt scars**, and gives temporal information on the fire season.

Soil Water Index

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Soil Water Index

The Soil Water Index quantifies the **moisture condition** at various depths in the soil. It is mainly driven by the precipitation via the process of infiltration. Soil moisture is a very heterogeneous variable and varies on small scales with soil properties and drainage patterns. Satellite measurements integrate over relative large-scale areas, with the presence of vegetation adding complexity to the interpretation.

Surface Soil Moisture

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Surface Soil Moisture

Surface Soil Moisture (SSM) is the **relative water content of the top few centimetres soil**, describing how wet or dry the soil is in its topmost layer, expressed in percent saturation. It is measured by satellite radar sensors and allows insights in local precipitation impacts and soil conditions.

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Energy

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Top of Canopy Reflectance

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Land Surface Temp.

Surface Albedo

TOC Reflectance



Top of Canopy Reflectance

The Top-Of-Canopy (TOC) spectral reflectance quantifies the **fraction of the sunlight reflected by the surface** of the Earth, in a given spectral band. Because of the natural anisotropy of the land surface, it depends on the illumination and viewing angular conditions. Therefore, to compare and use jointly successive observations, it is necessary to normalize the measurements into a same angular configuration. The resulting value is the normalized TOC reflectance.

Surface Albedo

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A large aerial photograph of a dry, brown landscape with rolling hills under a clear blue sky. In the bottom left corner of the image area, there is a small inset map showing the world map with various regions highlighted in green and brown, indicating the global coverage of the service.

Land Surface Temp.

Surface Albedo

TOC Reflectance

Surface Albedo

The surface albedo quantifies the fraction of the sunlight reflected by the surface of the Earth.

Land Surface Temperature

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Land Surface Temperature

The Land Surface Temperature (LST) is the radiative skin **temperature** of the land surface, as measured in the direction of the remote sensor. It is estimated from Top-of-Atmosphere brightness temperatures from the infrared spectral channels of a constellation of geostationary satellites (Meteosat Second Generation, GOES, MTSAT/Himawari). Its estimation further depends on the albedo, the vegetation cover and the soil moisture.

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Lake Surface Water Temperature

The image shows the Copernicus Global Land Service logo at the top left, featuring the text "Copernicus Global Land Service" and "Providing bio-geophysical products of global land surface". To the right is the Copernicus logo with the tagline "Europe's eyes on Earth". Below the logo is a horizontal menu bar with links: Home, Products, Use cases, Product Access, Viewing, Library, and Get Support. The background of the page is a large, scenic photograph of a lake surrounded by green hills and buildings. On the left side of the image, there is a small graphic icon containing a yellow line graph and a blue thermometer.

Lake Surface Water Temperature

Lake surface water temperature (LSWT) describes the **temperature of the lake surface**, one important indicator of lake hydrology and biogeochemistry. Temperature trends observed over many years can be an indicator of how climate change affects the lake.

Lake Water Quality

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A large aerial photograph shows a deep blue lake nestled among dense green forests under a cloudy sky.

Lake Surf. Water Temp.

Lake Water Quality

Water Bodies

Water Level

Lake Water Quality

Monitoring **water quality** in lakes and reservoirs is key in maintaining safe water for drinking, bathing, fishing and agriculture and aquaculture activities. Long-term trends and short-term changes are indicators of environmental health and changes in the water catchment area. Directives such as the EU's Water Framework Directive or the US EPA Clean Water Act request information about the ecological status of all lakes larger than 50 ha. Satellite monitoring helps to systematically cover a large number of lakes and reservoirs, reducing needs for monitoring infrastructure (e.g. vessels) and efforts.

Water Bodies

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Lake Surf. Water Temp.

Lake Water Quality

Water Bodies

Water Level

Water Bodies

The Water Bodies product detects the areas covered by **inland water** along the year providing the maximum and the minimum extent of the water surface as well as the seasonal dynamics. The area of water bodies is identified as an Essential Climate Variable (ECV) by the Global Climate Observing System (GCOS).

Water Level

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Lake Surf. Water Temp.

Lake Water Quality

Water Bodies

Water Level

Water Level

The Water Level is defined as the **height**, in meters above the geoid, of the reflecting surface of continental water bodies. It is observed by space radar altimeters that measure the time it takes for radar pulses to reach the ground targets, directly below the spacecraft (nadir position), and return. Hence, only water bodies located along the satellite's ground tracks can be monitored, with a quality of measurement that not only depends of the size of the water body, but also on the reflecting targets in its surroundings such as topography or vegetation.

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Snow cover

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Lake Ice Extent

Snow Cover Extent

Snow Water Equiv.



Snow cover

Snow cover is highly sensitive to changes in temperature (freezing/thaw) and precipitation (snowfall, rain, hail) and affects directly the albedo and thus the energy balance of the Earth's surface. It is a relevant input parameter for weather forecasts and climate change observations. Snow stores a significant mass of water and, with its high dynamic, has a strong effect on regional and global energy and water cycles. Together with the Snow Water Equivalent (SWE) product from passive microwave sensors, that provides information on the water content in the snow on plain areas, with limitations in mountainous areas, up-to-date knowledge about the snow cover extent is an important information for hydrological runoff modelling and for assessing natural hazards such as flood events.

Lake Ice Extent

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Lake Ice Extent

Snow Cover Extent

Snow Water Equiv.

Lake Ice Extent

Lake Ice Extent (LIE) classifies **ice for freshwater bodies**, per cloud-free pixel, into:

- Fully snow covered ice
- Partially snow covered ice/clear ice
- Open water

Lake ice is a good climate indicator and interesting parameter in hydrological modelling, weather prediction and, after integration over time, estimating dates for ice phenology events (ice break-up, ice-off).



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