

Ground-Based Observations for Validation (GBOV-2)



Land Monitoring

European Commission – Joint Research Centre

Copernicus In-Situ WG

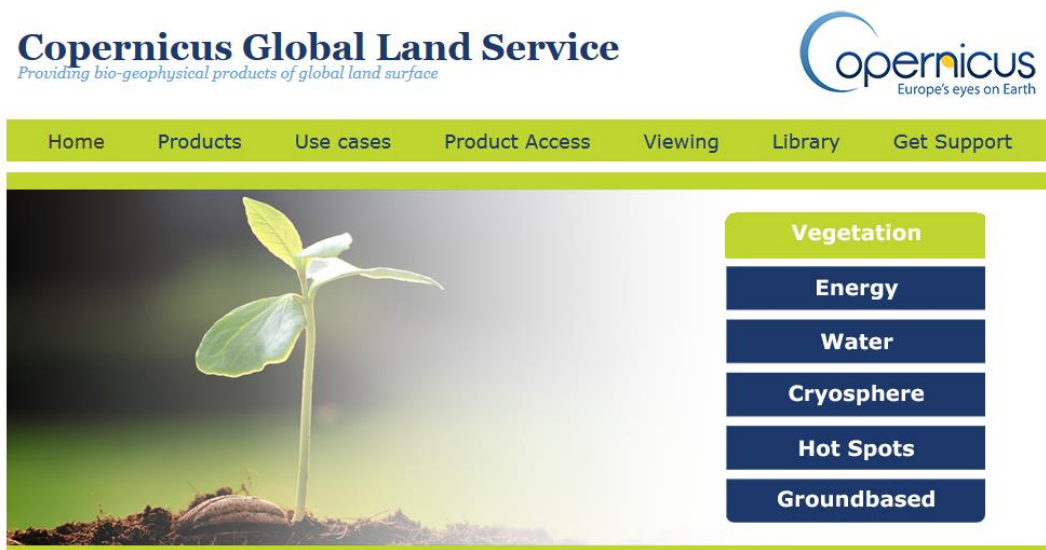
Copenhagen – 25th and 26th October 2023



Background

- Copernicus Global Land Service as been providing a wealth of EO products for several years
- There is a need for long term validation products derived from quality control data and consistent protocols

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



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

Land Surface Temp.
Surface Albedo
TOC Reflectance

Lake Surf. Water Temp.
Lake Water Quality
Water Bodies
Water Level

Lake Ice Extent
Snow Cover Extent
Snow Water Equiv.



Objectives and structure of GBOV

- GBOV Phase-2
 - FWC is signed as contract no. 941837 on 12/10/2021 (48 months)
 - 10 SCs foreseen until the end of the FWC.
- Component 1: collection data from existing network
 - Collection of multi-year ground-based observations of high relevance for the understanding of land surface processes from existing global networks.
- Component 2: network development
 - Upgrade of existing sites with new instrumentation or establishing entirely new monitoring sites to close thematic or geographic gaps.
- Component 3:
 - <https://land.copernicus.eu/global/gbov>



Reference Measurements (RMs)

RM#	RM definition
RM-1	Direct/Diffuse visible radiation
RM-2	Direct/Diffuse thermal radiation
RM-3	Atmospheric properties
RM-4	Transmission through canopy
RM-5	Soil BRF/BHR/DHR
RM-6	Fraction of Incident Photosynthetically Available Radiation (FIPAR)
RM-7	Leaf Area Index (LAI)
RM-8	Land Surface Emissivity (LSE)
RM-9	Ground and Surface Temperature
RM-10	Soil moisture at 5 cm
RM-11	Meteo properties



Short wave radiation



Long wave radiation



Atmospheric properties



Vegetation



Long wave radiation

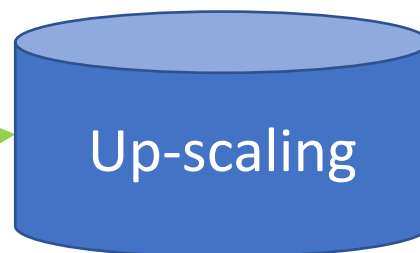


Soil moisture & meteo



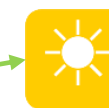
Land Products (LPs)

RM#
RM-1
RM-2
RM-3
RM-4
RM-5
RM-6
RM-7
RM-8
RM-9
RM-10
RM-11



Satellite/Instrument	Related LP
S2/MSI	1,2,3,4,5
MODIS	7
Landsat 8	1,2,3,4,5
Proba-V	6
SPOT	1,2

LP#	LP definition
LP-1	Top Of Canopy Reflectance (TOC-R)
LP-2	Surface Albedo (AI)
LP-3	Leaf Area Index (LAI)
LP-4	Fraction of Absorbed Photosynthetic Available Radiation (FAPAR)
LP-5	Fraction of Covered ground (Fcover)
LP-6	Soil Moisture (SM)
LP-7	Land Surface Temperature (LST)



Short wave 1km



Vegetation 20
300m



Soil moisture 10km



LST 7km



GBOV: The methodology

Ground-based observation:
Reference Measurements
(RM)

Intermediate
resolution
Satellite
observation

Land Products (LP)



Short wave radiation



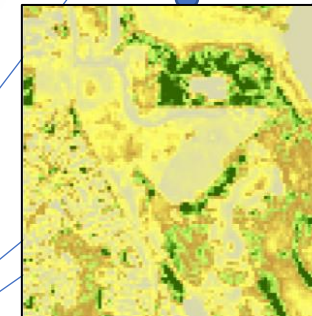
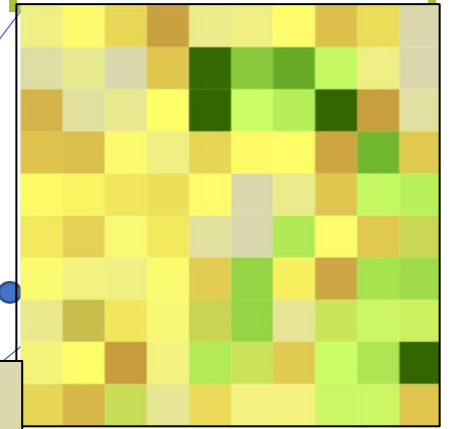
Long wave radiation



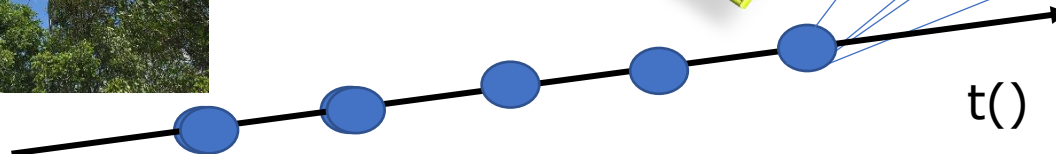
Vegetation



Soil moisture



Guanica Tower (Puerto Rico)
for FIPAR, LAI collection





Database Status

Site distribution by continent

2018

2019

2020

2021

2022

2023

2024

2025

GBOV phase 1

GBOV phase 2

90 sites: **121** at the end of 2023



35 short wave sites (LP1 & LP2) + **1** at the end of 2023



27 vegetation sites (LP3, 4 & 5) + **9** at the end of 2023 (mostly ICOS)



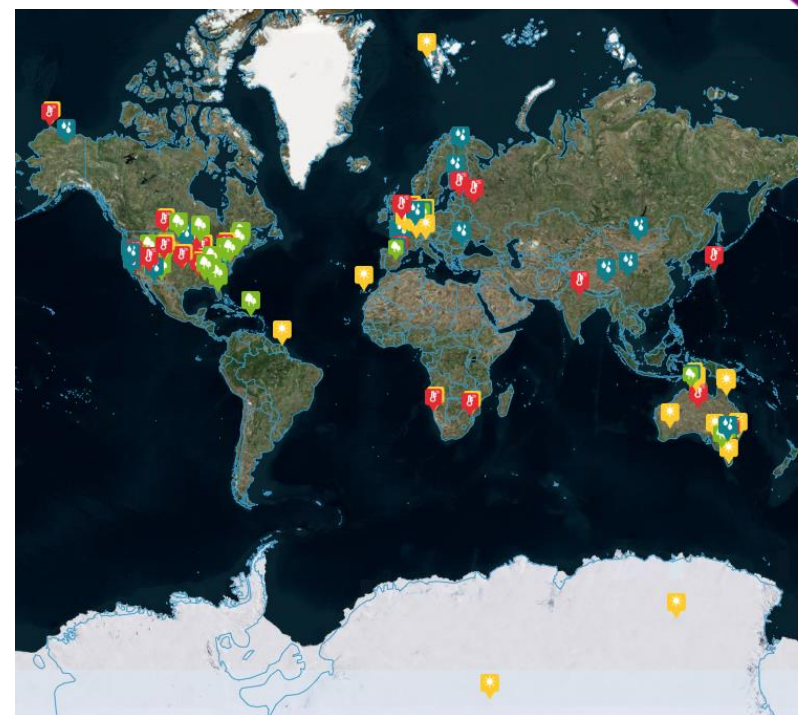
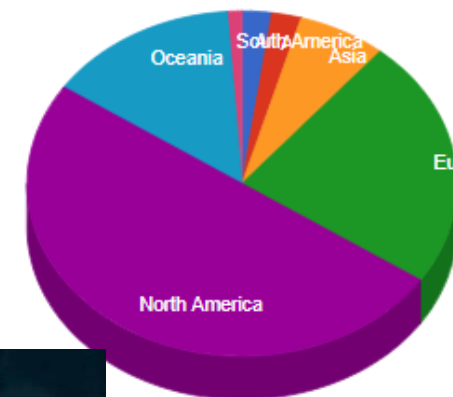
24 soil moisture sites (LP6) + **7** at the end of 2023



23 LST sites (LP7) + **17** at the end of 2023

Time series ≥ 2 years and up to 9 years

Covering 2014-2022



- Africa
- Antarctica
- Asia
- Europe
- North America
- Oceania
- South America



Database Status

TOC-R, Albedo - new site

- 1 FluxNet site, Rus.
 - Fyodorovskoye

SSM - 7 news sites

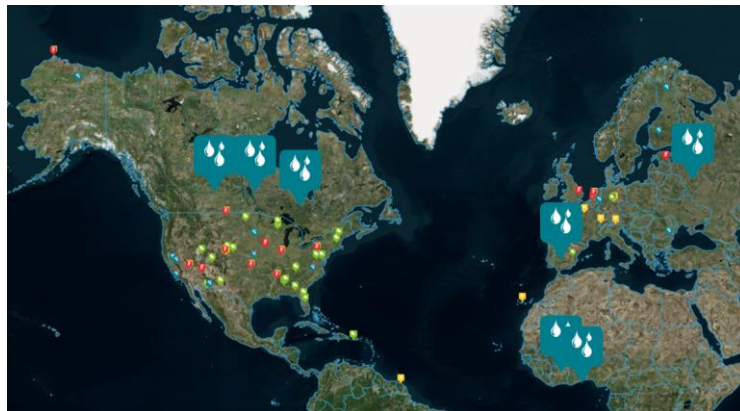
- 3 RISMA sites, Can.
 - Manitoba
 - Ontario
 - Saskatchewan
- 2 Thamo sites, Gan.
 - Tamate
 - CRIG
- 1 Remedhus site, Spa
 - Salamanca
- 1 FluxNet site, Rus.
 - Fyodorovskoye

VEG - 9 news sites

- 8 ICOS sites
 - Bilos, Fra
 - Fontainebleau-Barbeau, Fra
 - Hohes Holz, Ger
 - Hyltemossa, Swe
 - Hyytiala, Fin
 - San Rossore 2, Ita
 - Vielsalm, Bel
- 1 UoS/FRM4VEG site
 - Wytham Wood, UK

LST - 17 news sites

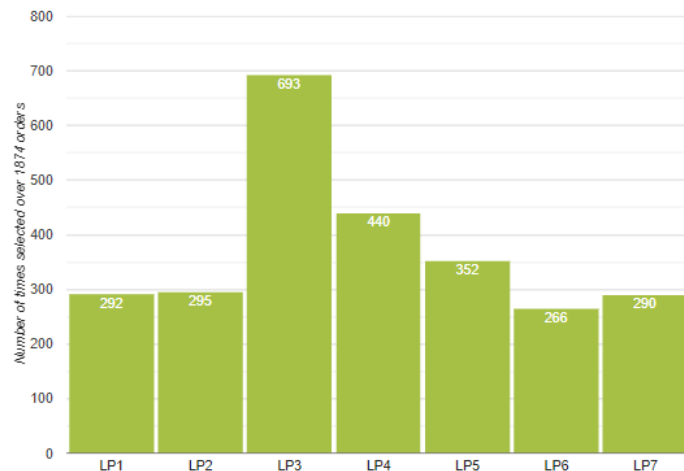
- 10 TERN sites (Aus.)
 - Calperum, Cumberland Plain SuperSite, Daly river, Dry River, Gingin,
 - Great Western Woodland, Robson Creek, Sturt plain, Warra, Whroo, Yanco
- the 5 LAW stations
 - Svartberget, Swe.
 - Hyytiälä, Fin.
 - Robson Creel, Aus.
 - KIT forest, Ger.
 - Puéchabon, Fra
- 2 BSRN sites
 - Payerne, Swi.
 - Budapest, Hun.



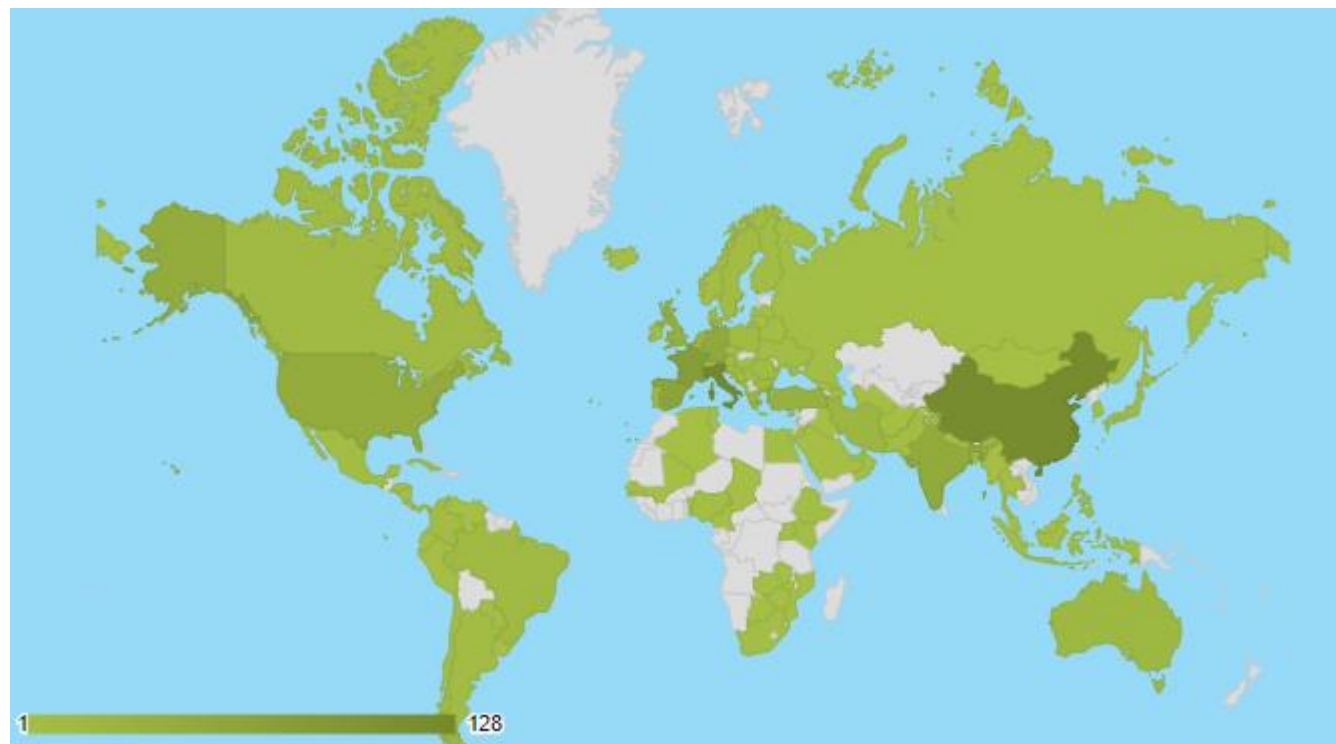
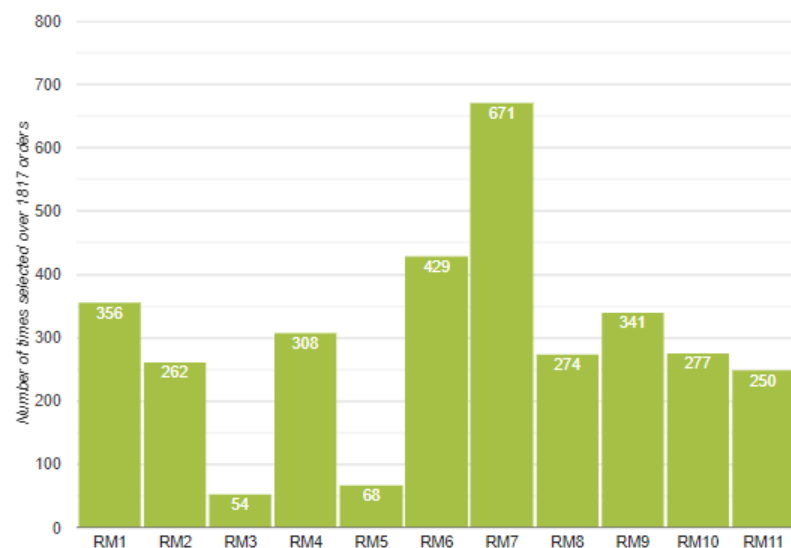


Data uptake

LP



RM



335.8 MILLIONS RM DATA
314.4 THOUSAND LP DATA
601.07 GB TOTAL DISTRIBUTED DATA

2013 TOTAL NUMBER OF ORDERS
1867 ORDERS INCLUDING LAND PRODUCTS
1810 ORDERS INCLUDING REFERENCE MEASUREMENTS
90 SITES
1043 USERS

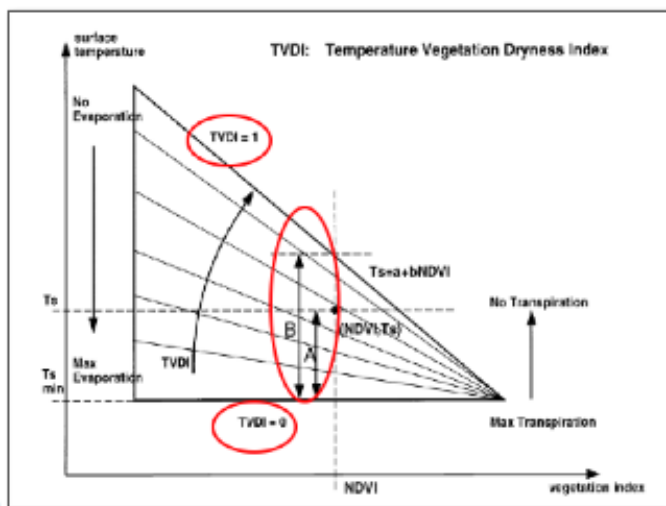


On-going evolutions

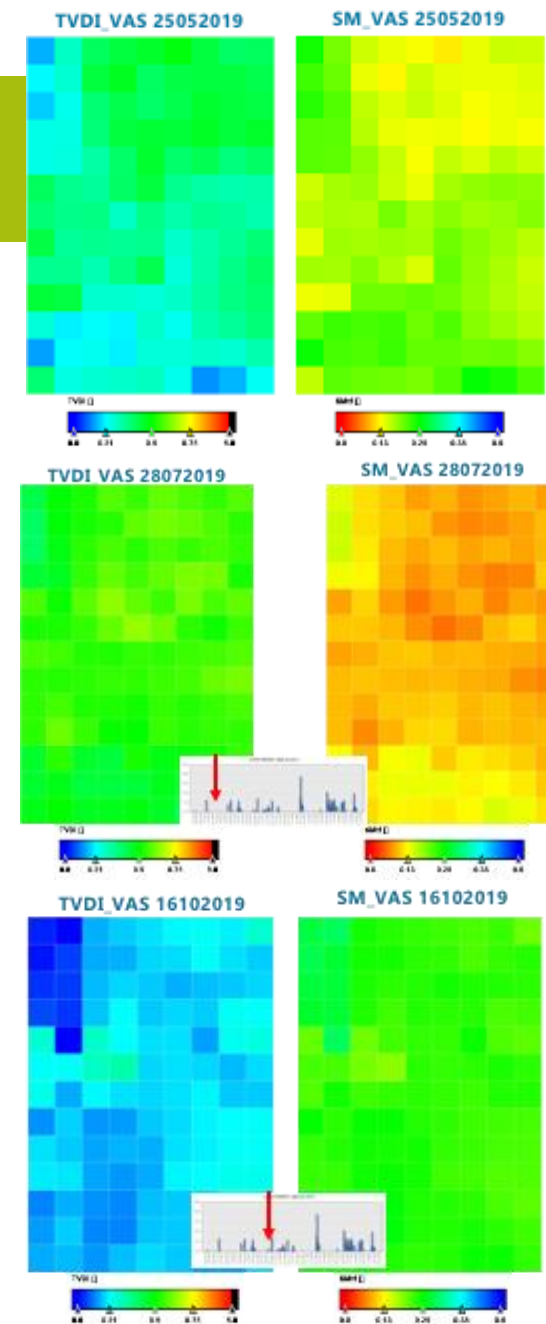
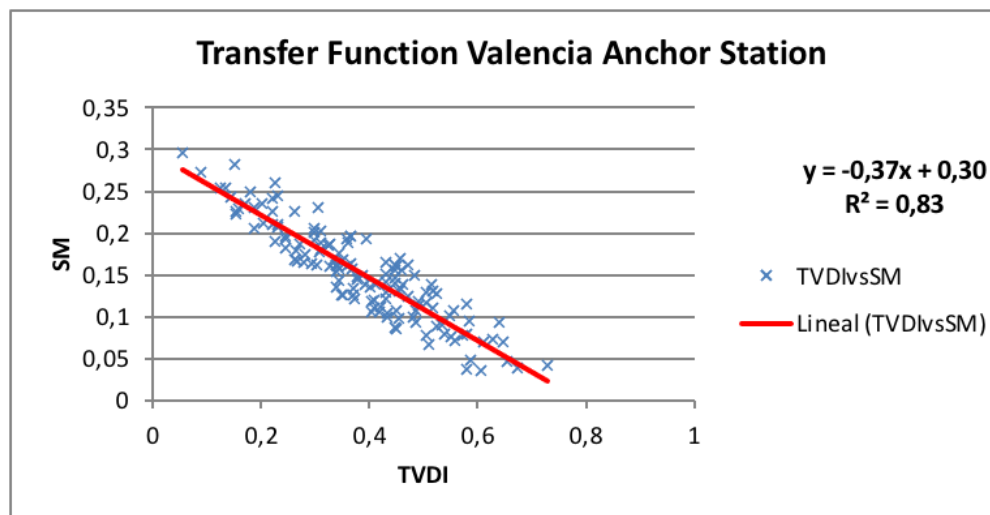
• Soil Moisture

- In development: a 1km grid Soil Moisture product (LP6) for 2022 dataset
- A full archive reprocessing will be implemented for this increased resolution

Temperature Vegetation Dryness Index (TVDI) (Sandholt et al., 2002)



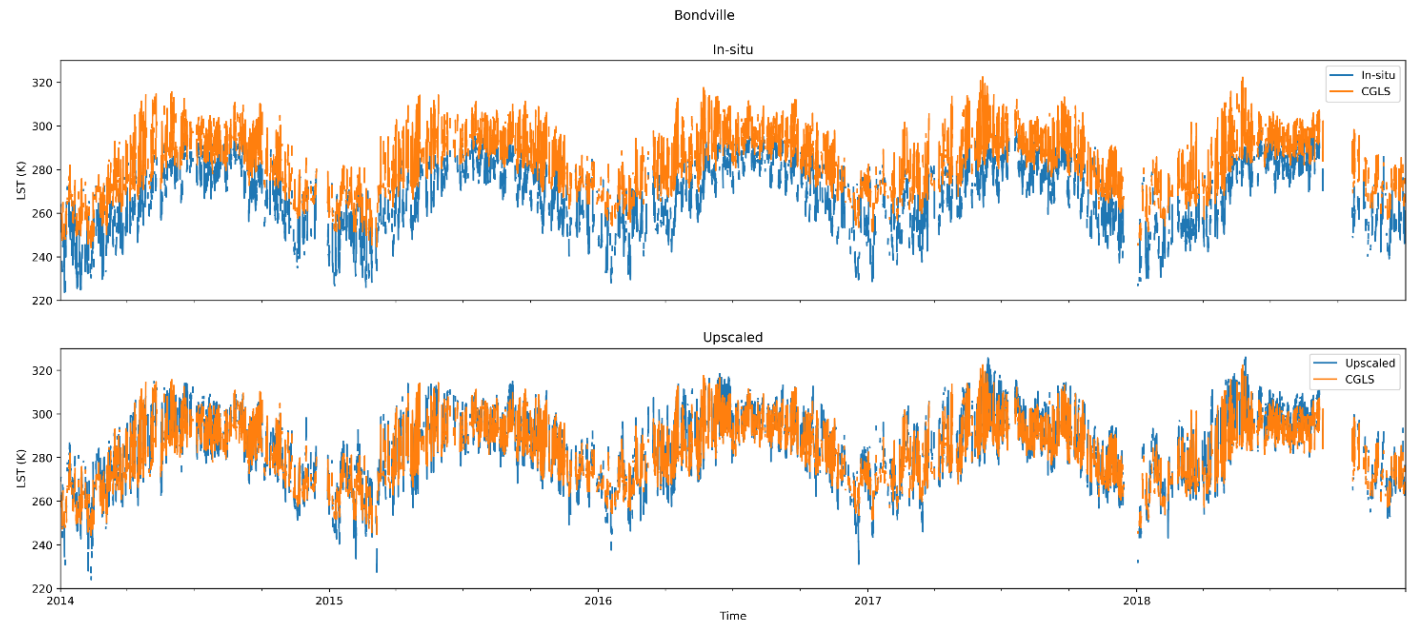
Transfer function between SM and TVDI for the Valencia Anchor Station using data from 2013 to 2019





On-going evolutions

- **Land Surface Temperature** (already available)
 - Hourly LST products for LP7 is provided from 2022 onward
 - The previous dataset (1 day time and 1 night time LP7) will be reprocessed (2013-2021 archive)
- Revised Quality Control data
- Example over Bondville





Instrument evolution

- GBOV phase 2 focus on **Vegetation** and **LST** stations

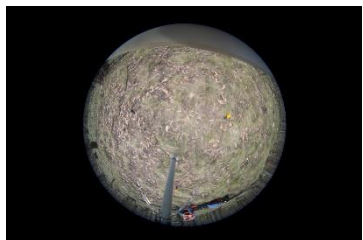


Vegetation:

- PAR network. 4 fluxes.
- Automated DHP system (L. Brown and J. Dash)
- Our phase 1 auto DHP provider (Cyclapse) has stopped production.
- Sigma has stopped the production of the 4,5mm fisheye

We have a new provider **TimeLapseGo** who designed a system specifically for our needs.

- It will be more robust and more reliable than the previous one
 - See poster on the right
- LST:
 - Heitronics KT-15
 - Similar to LAW (<https://law.acri-st.fr>)



Earth Observation LAI and FAPAR products operational Cal/Val

A new robust integrated system for long-term deployment
of Digital Hemispherical Pictures systems



TimeLapseGo is a specialist in Construction and industrial site monitoring and timelapse, has already monitored more than 2000 sites, in all types of environments, including tropical settings. Monitoring of construction sites requires strong stability in time and in harsh conditions while using high quality pictures to allow precise recognition of elements in a large environment.



contact@timelapsego.com - +33 6 09 93 48 21



GBOV-1 deployed instrumentation

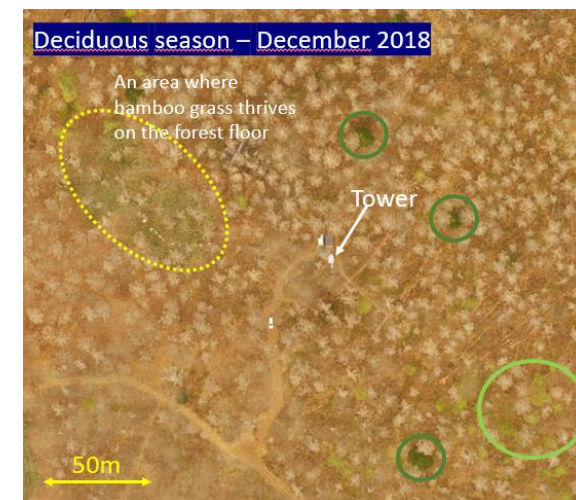
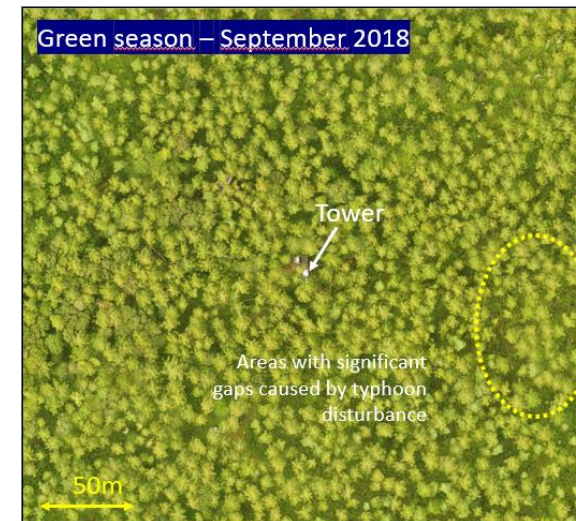
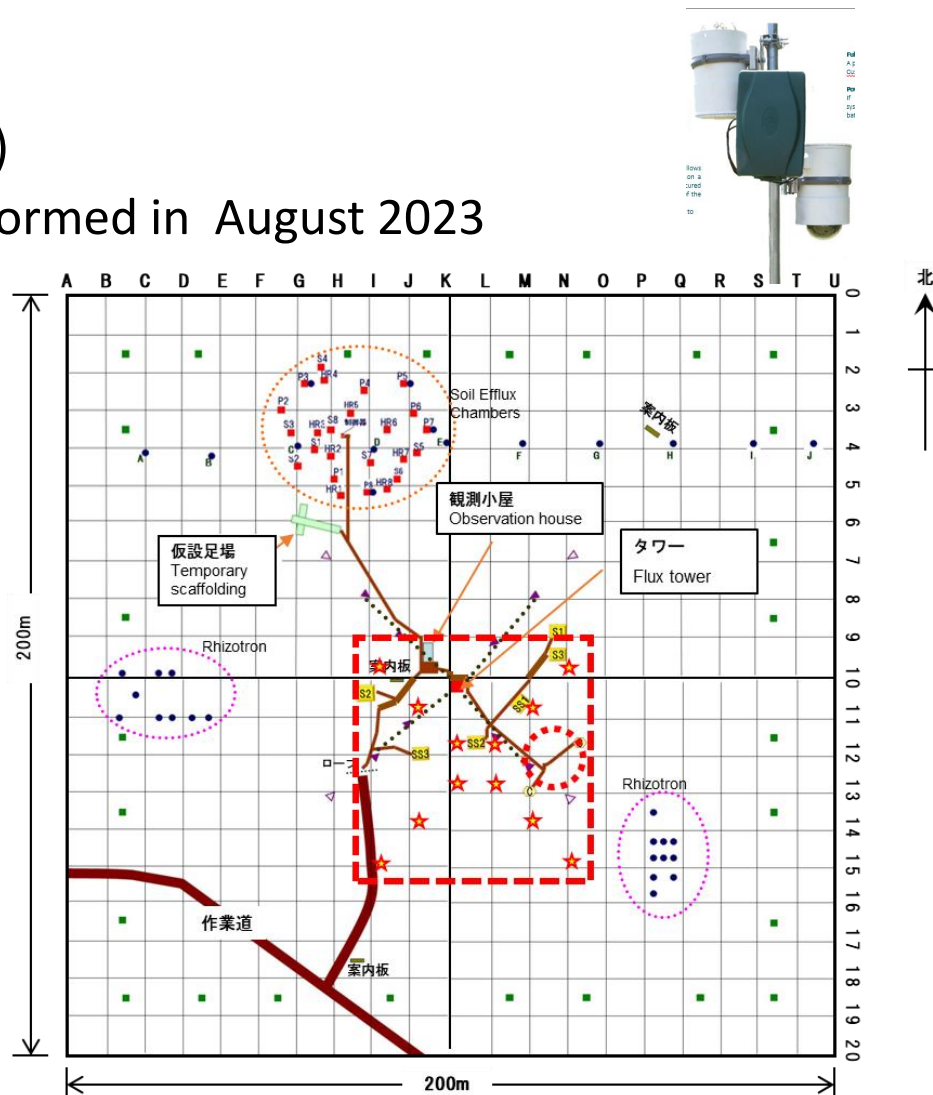
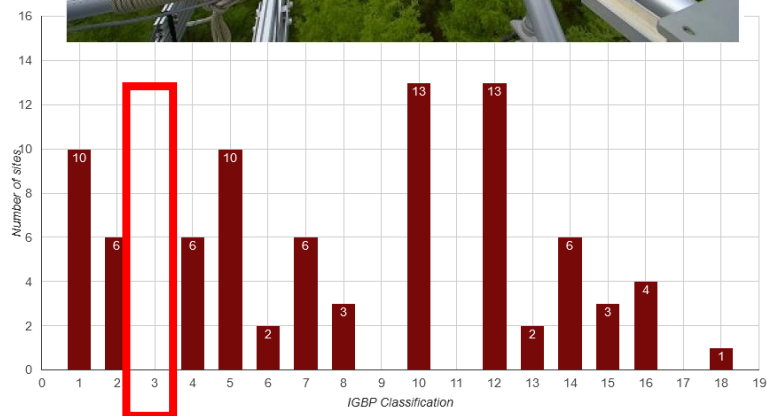
- Still in activity from phase one:
 - Valencia Anchor Station (Spain) – PAR network and LST measurements
 - Hainich National parc (Germany) - PAR network installed in march 2023 in addition to auto DHP
 - Litchfield Savanna (Australia – PAR Network and SSM - have survived the bush fires so far)
 - Wombat (Australia) – DHP measurements + FAPAR (when tower refurbished).
- Reborne after the 2019 bush fires
 - Tumbarumba





On-going for phase 2

- Fuji Hokuroku – JAPAN
 - Larch Forest (IGBP #3)
 - Field deployment performed in August 2023





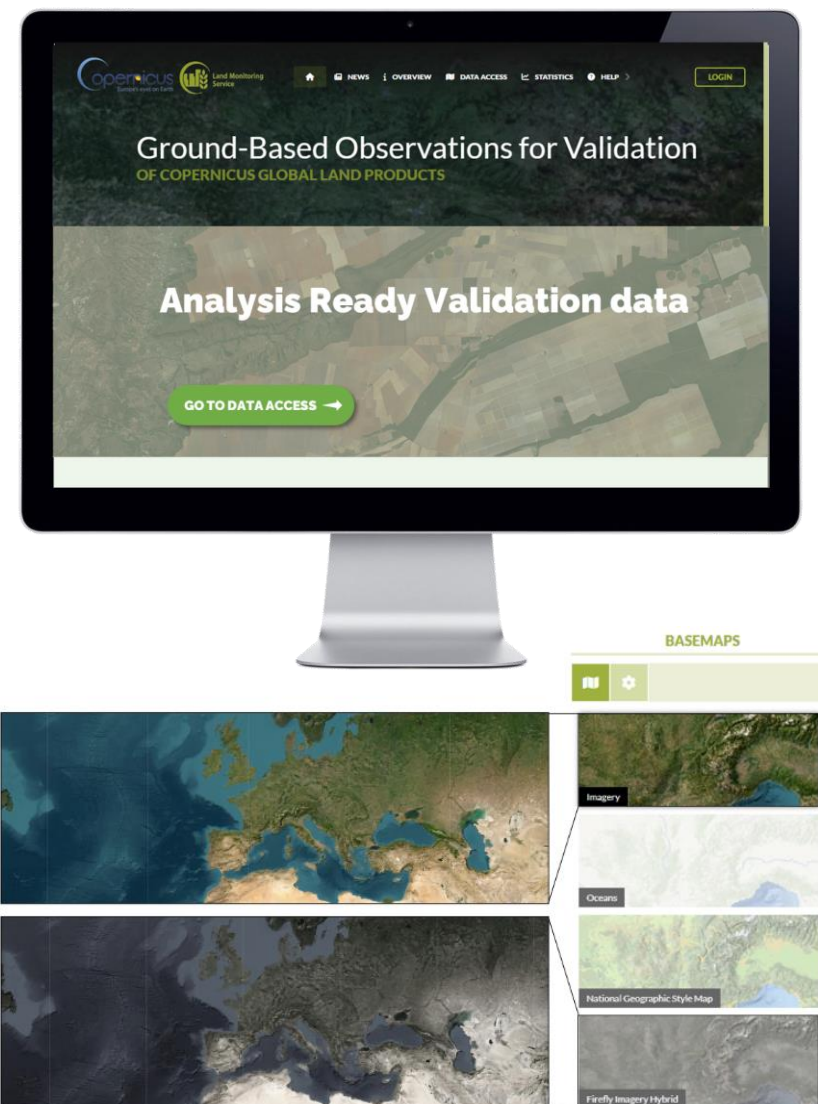
Next GBOV CP2

- Vegetation - collaboration with ICOS
 - Fontainebleau-Barbeau
 - PAR network + automated DHP
- LST
 - FujiHokuro (Japan) Larch forest not represented for LST
 - Litchfield (Australia) Woody savanna. Follow on from GBOV phase 1 (already installed a PAR network and soil moisture network).



On-going evolutions

- **The web portal** will be re-designed for a better user experience.
 - **REST API to query the DB for measurements**
To be released Q1 2024
 - CLC+ surface classification (instead of IGBP)
 - CORINE Land Cover for consistence with other Copernicus services
 - GISCO basemap
 - Land Product format updates (incl. Raster)
 - SSM, Albedo/TOC-R, LST
- **External independent review** of GBOV will be handled by
CGLOPS lot 4





Take-home messages

- **Improved QA/QC:** dedicated resource at the contractor and more systematic/formalized procedures.
- External **independent review** of GBOV (under CGLOPS Lot 4) of all LPs to be completed by Q1/2024.
- Implementation of API for querying the RMs/LPs database in programmatic manner (relevant for CIS2 ?).