Biophysical (1/13)

Overview

- What is new
- Good practices update status
- Website updates: new datasets & tools
- GROUNDED EO fiducial reference database
- Updates from GBOV
- Emerging sources of reference data: StrucNet

Biophysical (2/13)

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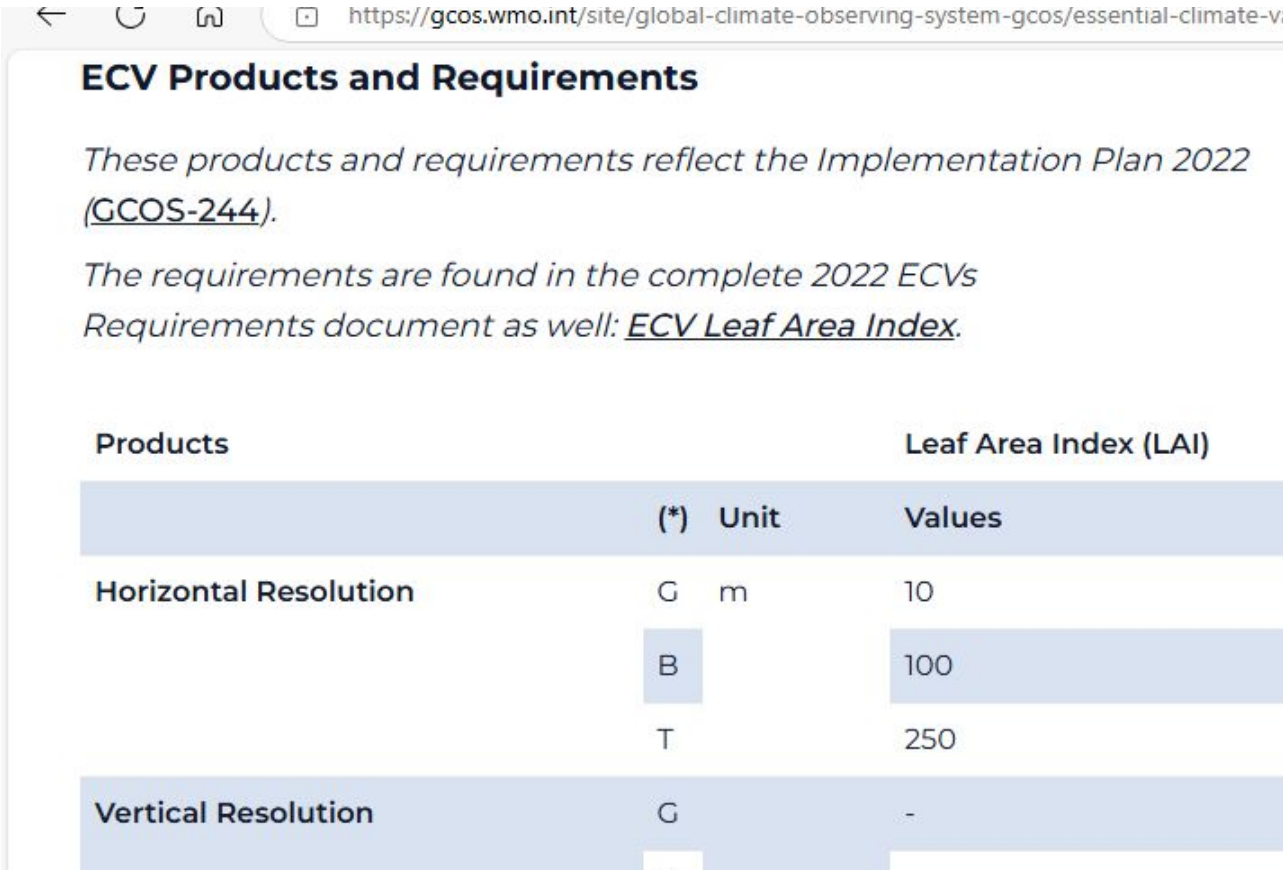
Biophysical (3/13)

Enhanced user requirements

- Systematic high spatial resolution products



https://gcos.wmo.int/site/global-climate-observing-system-gcos/essential-climate-v

ECV Products and Requirements

These products and requirements reflect the Implementation Plan 2022 (GCOS-244).

The requirements are found in the complete 2022 ECVs Requirements document as well: ECV Leaf Area Index.

Products			Leaf Area Index (LAI)
	(*)	Unit	Values
Horizontal Resolution	G	m	10
	B		100
	T		250
Vertical Resolution	G		-

GCOS

GEO BON

GEOGLAM Global Agricultural Monitoring

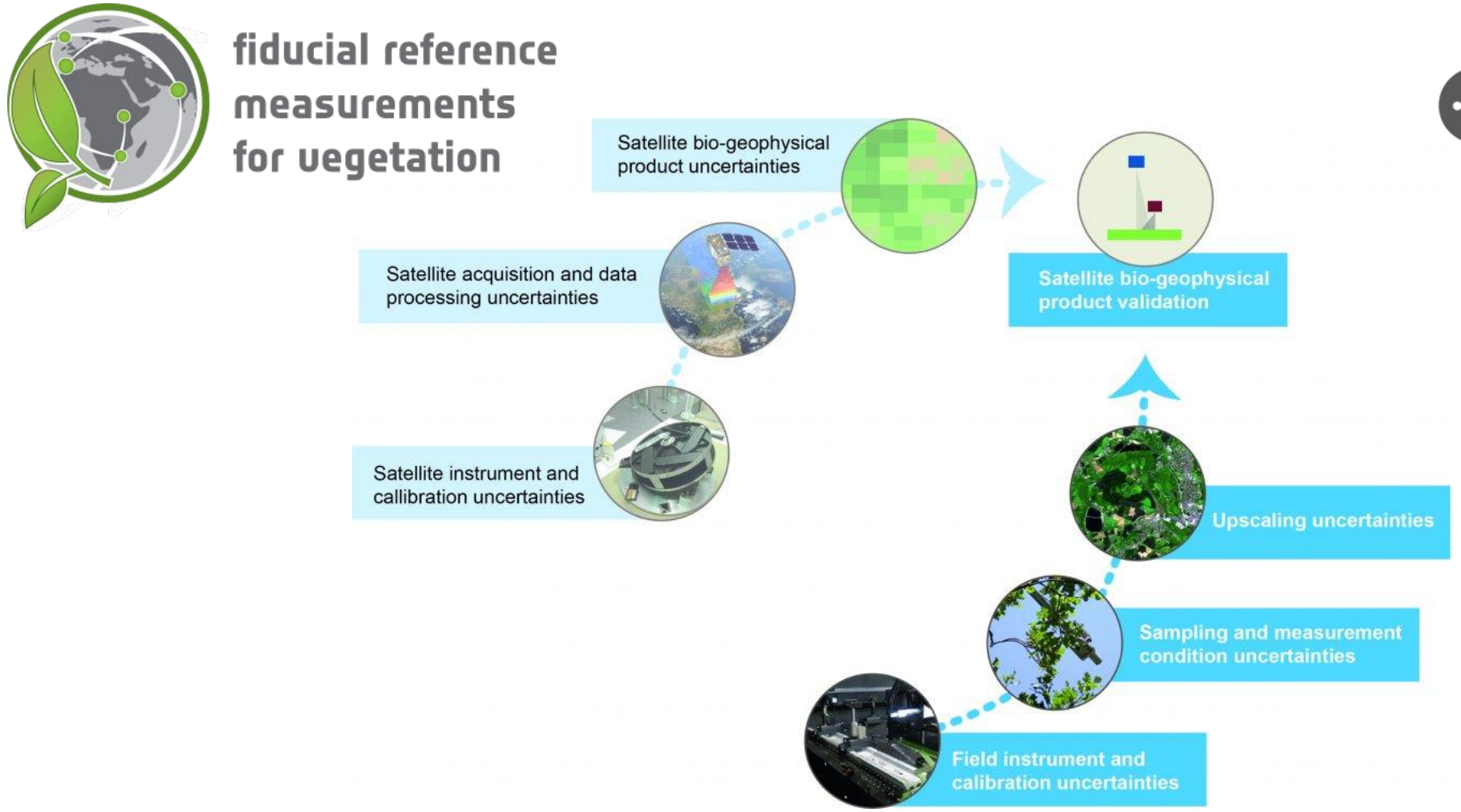
Land Monitoring Service

opernicus Europe's eyes on Earth

CEOS WORKING GROUP ON CALIBRATION & VALIDATION

Biophysical (4/13)

Focus on uncertainty & fiducial reference measurement concept



Biophysical (5/13)

Goals

1. **Act as a source of up-to date, objective information** on definitions, products and good practices for researchers and producers

2. **Increase access and interoperability of reference measurements**

3. **Improve validation status** of new products

4. Influence high-capacity groups (CLMS, ESA, GLASS, NASA, USGS) to invest in **open-source validation tools**

Biophysical (6/13)

Good practices update status

- **Update in form of review paper targeting RSE special issue** (‘*Development, Validation, and Application of Medium- and High-Resolution Satellite Products at Regional to Global Scales*’)

- Specific focus on addressing current gaps:
  - Validating products related to vegetation cover (FCOVER) and light interception (FAPAR)
  - Validating higher resolution (< 100 m) products

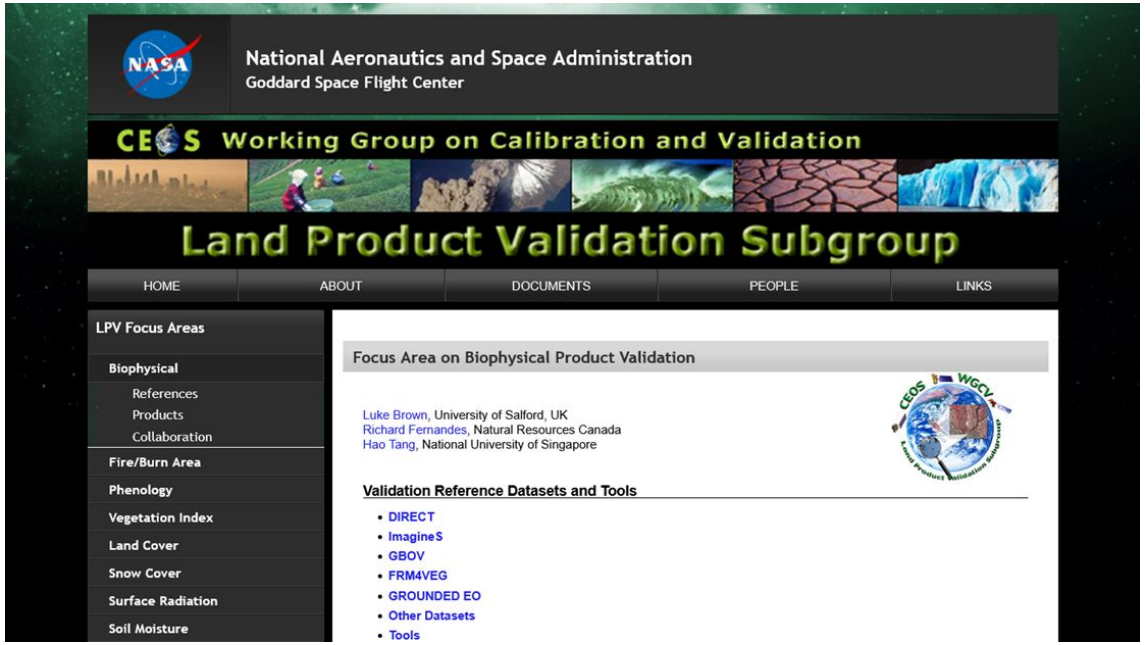
- **Email sent to mailing list on 17th June** to solicit contributors and reviewers (RSVP 1st September)

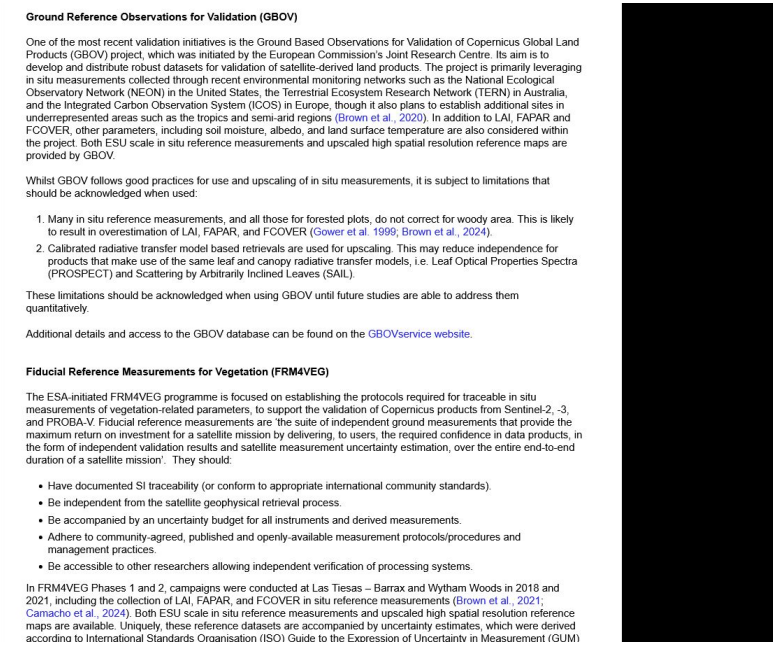
- Special issue **submission deadline 28th February 2026**

Biophysical (7/13)

Website updates: new datasets & tools

- Biophysical **home page updated**
  - **Datasets updated** (now includes GBOV, FRM4VEG, GROUNDED EO)
  - **Links to tools added** for processing raw measurement data from networks





Ground Reference Observations for Validation (GBOV)

One of the most recent validation initiatives is the Ground Based Observations for Validation of Copernicus Global Land Products (GBOV) project, which was initiated by the European Commission's Joint Research Centre. Its aim is to develop and distribute robust datasets for validation of satellite-derived land products. The project is primarily leveraging in situ measurements collected through recent environmental monitoring networks such as the National Ecological Observatory Network (NEON) in the United States, the Terrestrial Ecosystem Research Network (TERN) in Australia, and the Integrated Carbon Observation System (ICOS) in Europe, though it also plans to establish additional sites in underrepresented areas such as the tropics and semi-arid regions (Brown et al., 2020). In addition to LAI, FAPAR and FCOVER, other parameters, including soil moisture, albedo, and land surface temperature are also considered within the project. Both ESU scale in situ reference measurements and upscaled high spatial resolution reference maps are provided by GBOV.

Whilst GBOV follows good practices for use and upscaling of in situ measurements, it is subject to limitations that should be acknowledged when used:

1. Many in situ reference measurements, and all those for forested plots, do not correct for woody area. This is likely to result in overestimation of LAI, FAPAR, and FCOVER (Gower et al., 1999; Brown et al., 2024).
2. Calibrated radiative transfer model based retrievals are used for upscaling. This may reduce independence for products that make use of the same leaf and canopy radiative transfer models, i.e. Leaf Optical Properties Spectra (PROSPECT) and Scattering by Arbitrarily Inclined Leaves (SAIL).

These limitations should be acknowledged when using GBOV until future studies are able to address them quantitatively.

Additional details and access to the GBOV database can be found on the GBOVservice website.

Fiducial Reference Measurements for Vegetation (FRM4VEG)

The ESA-initiated FRM4VEG programme is focused on establishing the protocols required for traceable in situ measurements of vegetation-related parameters, to support the validation of Copernicus products from Sentinel-2, -3, and PROBA-V. Fiducial reference measurements are 'the suite of independent ground measurements that provide the maximum return on investment for a satellite mission by delivering, to users, the required confidence in data products, in the form of independent validation results and satellite measurement uncertainty estimation, over the entire end-to-end duration of a satellite mission'. They should:

- Have documented SI traceability (or conform to appropriate international community standards).
- Be independent from the satellite geophysical retrieval process.
- Be accompanied by an uncertainty budget for all instruments and derived measurements.
- Adhere to community-agreed, published and openly-available measurement protocols/procedures and management practices.
- Be accessible to other researchers allowing independent verification of processing systems.

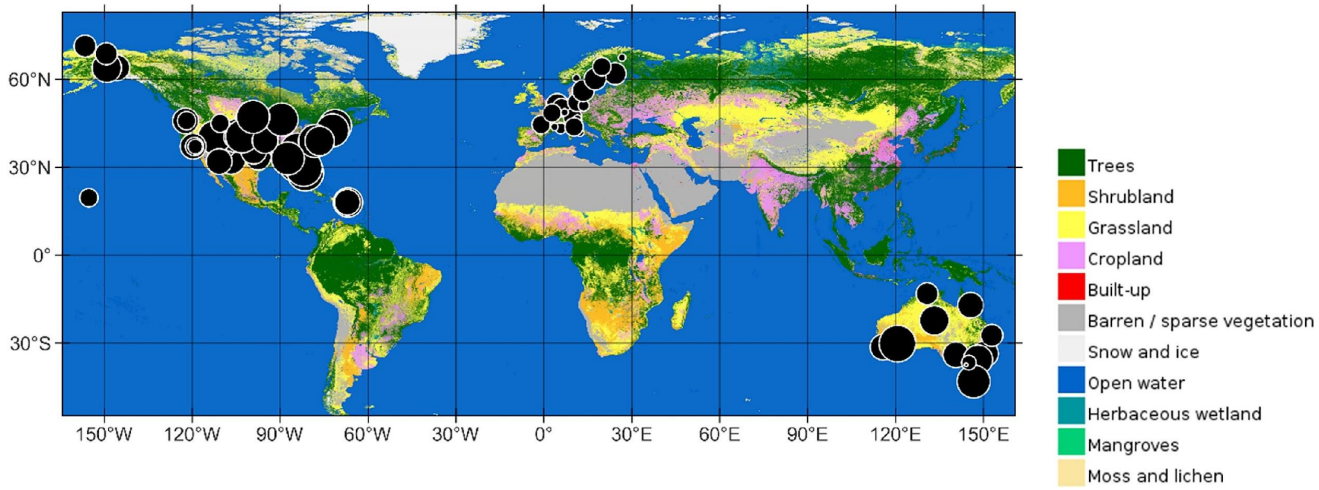
In FRM4VEG Phases 1 and 2, campaigns were conducted at Las Tiesas – Barrax and Wytham Woods in 2018 and 2021, including the collection of LAI, FAPAR, and FCOVER in situ reference measurements (Brown et al., 2021; Camacho et al., 2024). Both ESU scale in situ reference measurements and upscaled high spatial resolution reference maps are available. Uniquely, these reference datasets are accompanied by uncertainty estimates, which were derived according to International Standards Organisation (ISO) Guide to the Expression of Uncertainty in Measurement (GUM)

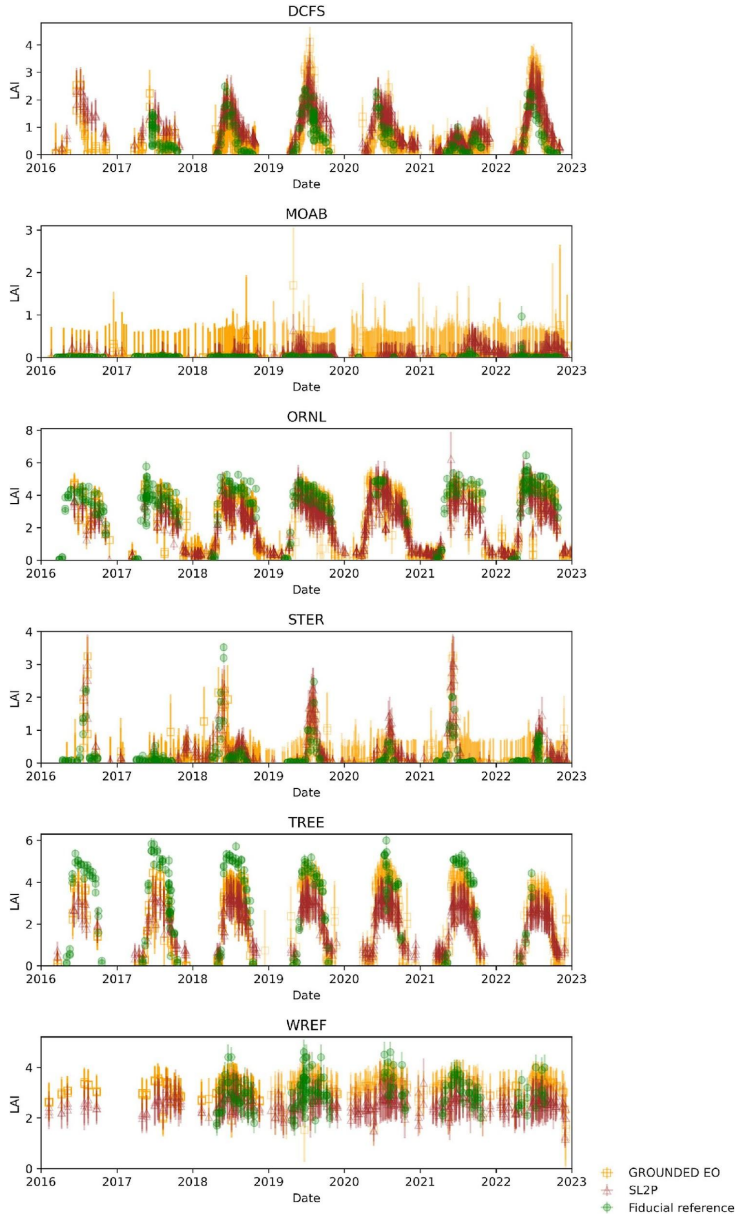
https://lpvs.gsfc.nasa.gov/Biophys/Biophys_home.html

Biophysical (8/13)

GROUNDED EO fiducial reference database

- **81 NEON, ICOS & TERN sites** (covering 2013-2022)
- > **16,000 fiducial reference measurements** (LAI, FAPAR, FCOVER)
- Provided at **ESU scale** (10 m to 100 m)
- **Multitemporal** (captures phenology)
- **Uncertainties** quantified according to FRM4VEG recommendations

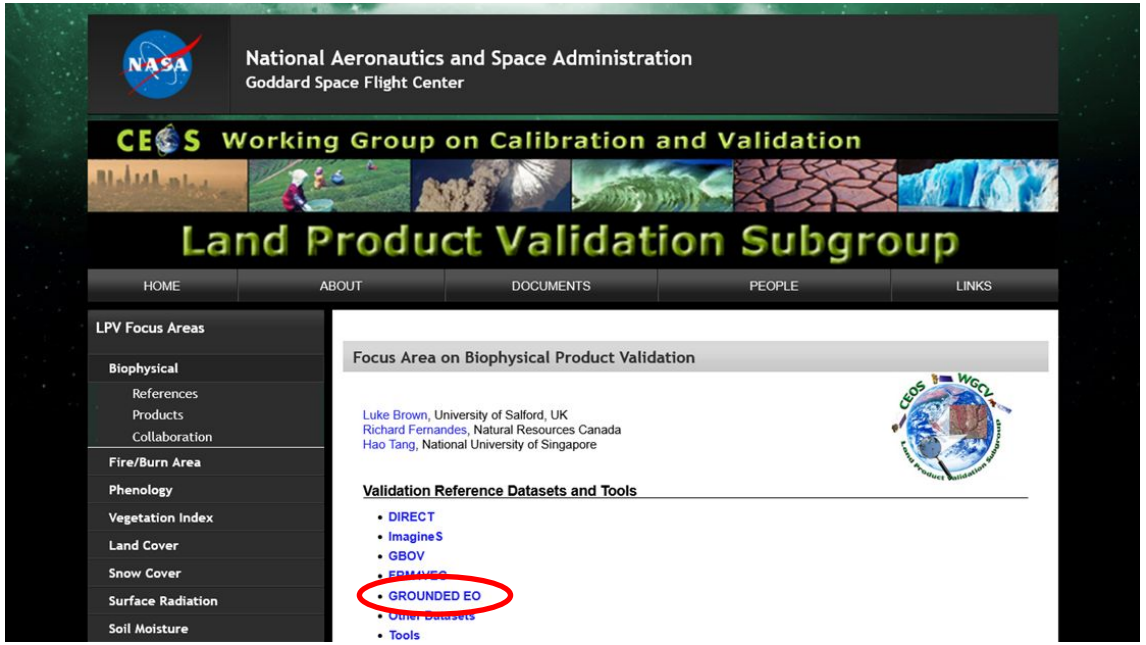




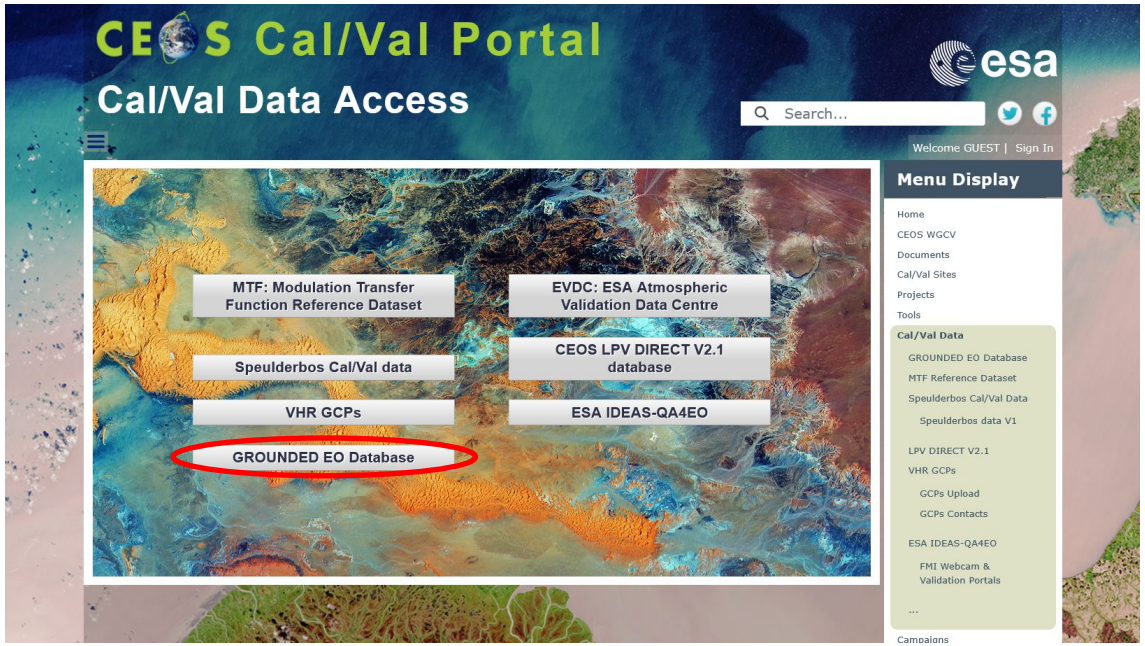
Biophysical (9/13)

GROUNDED EO fiducial reference database

- **Publicly available** on Zenodo: https://doi.org/10.5281/zenodo.14293472
- Also easily accessible via biophysical home page & CEOS cal/val portal



https://lpvs.gsfc.nasa.gov/Biophys/Biophys_home.html



https://calvalportal.ceos.org/data-access

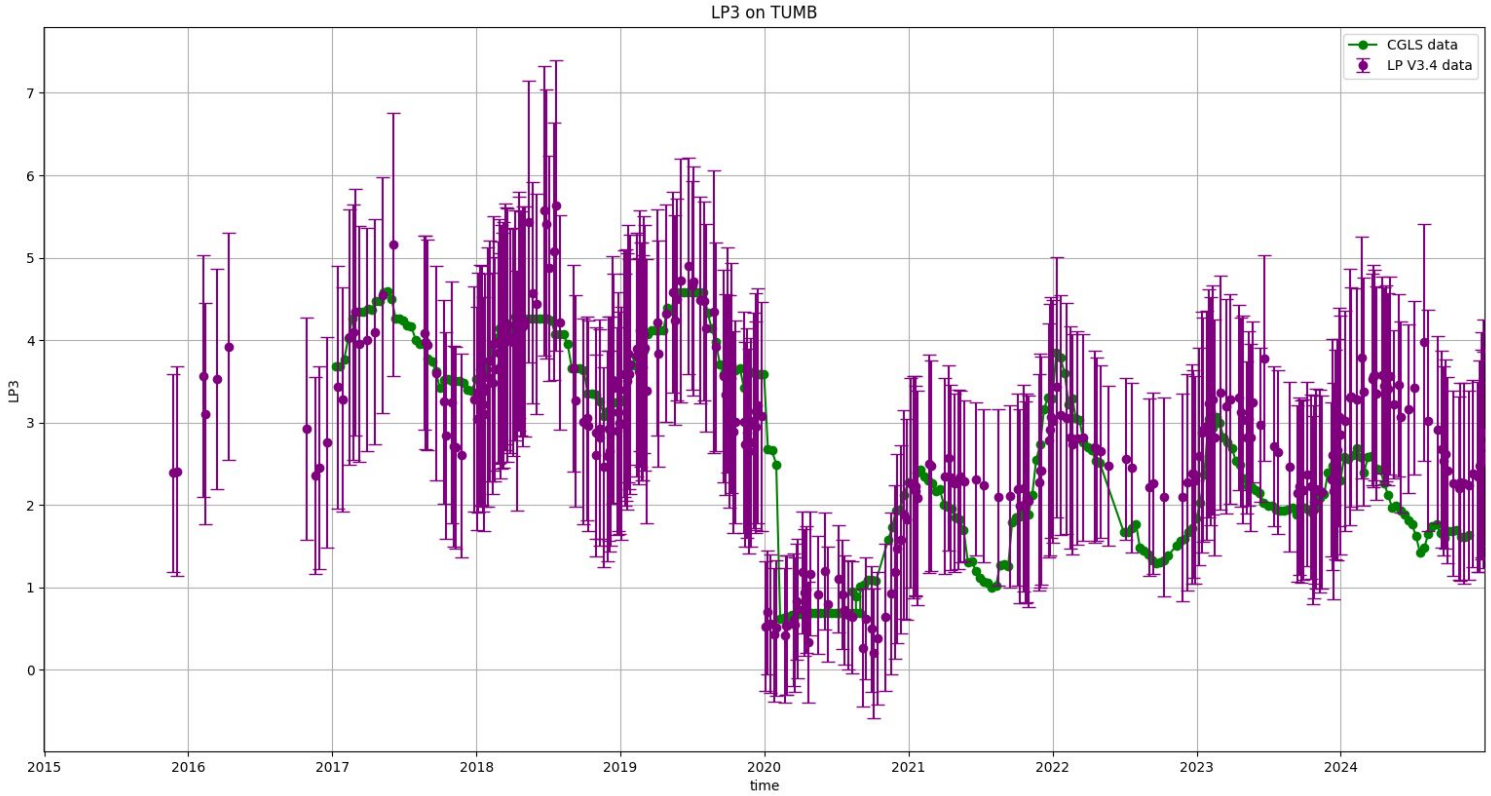
Biophysical (10/13)

Updates from GBOV (C. Lerebourg)

- **Web portal upgrades**: more straightforward download process, possibility to select processing version
- Entire vegetation **LP archive reprocessed for heterogeneous (forest) sites** – improvements to transfer functions
- Transfer functions for **sparsely vegetated sites being reviewed** – VI rather than RTM based for these sites
- Welcoming contributors to the database (DHP, PAR)
- Users should register for the newsletter to keep updated with data releases

Biophysical (11/13)

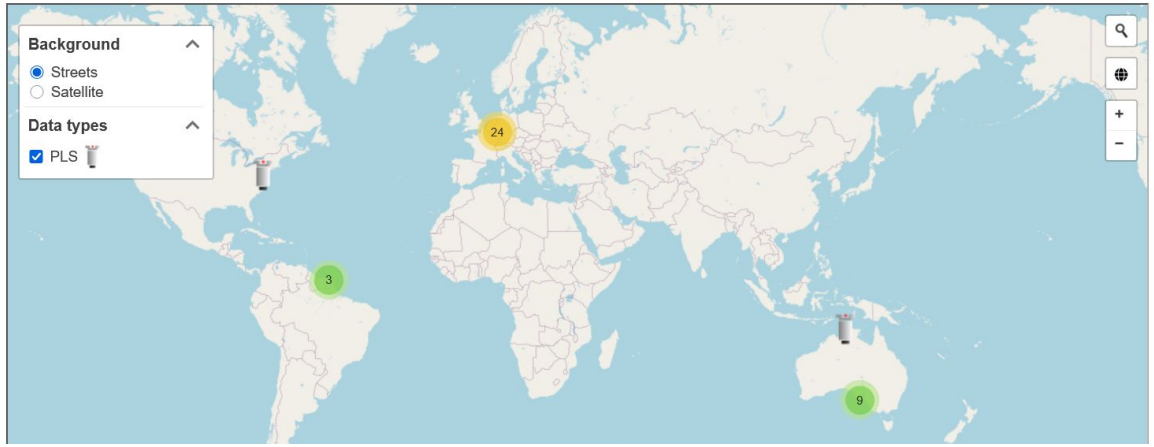
Updates from GBOV (C. Lerebourg)



Biophysical (12/13)

Emerging sources of reference data: StrucNet

- **StrucNet – in situ monitoring LiDAR** for PAI (& vertical foliage profiles)
- Second workshop recently held in Gent (May), initial results show some challenges
- Comparison with GBOV automated DHP to be performed…



https://strucnet.org

Biophysical (13/13)

Longer-term needs

- **Consistency with land cover and phenology validation** (high resolution products)
- **Open-source validation tools** (ideally not tied to specific platforms)
- Development of **FRM protocols for upcoming missions and variables**
  - Global hyperspectral missions (e.g. CHIME) focusing on biochemistry
  - Microwave vegetation properties?