Land Monitoring

Copernicus Global Land Service

Operational Product Validation

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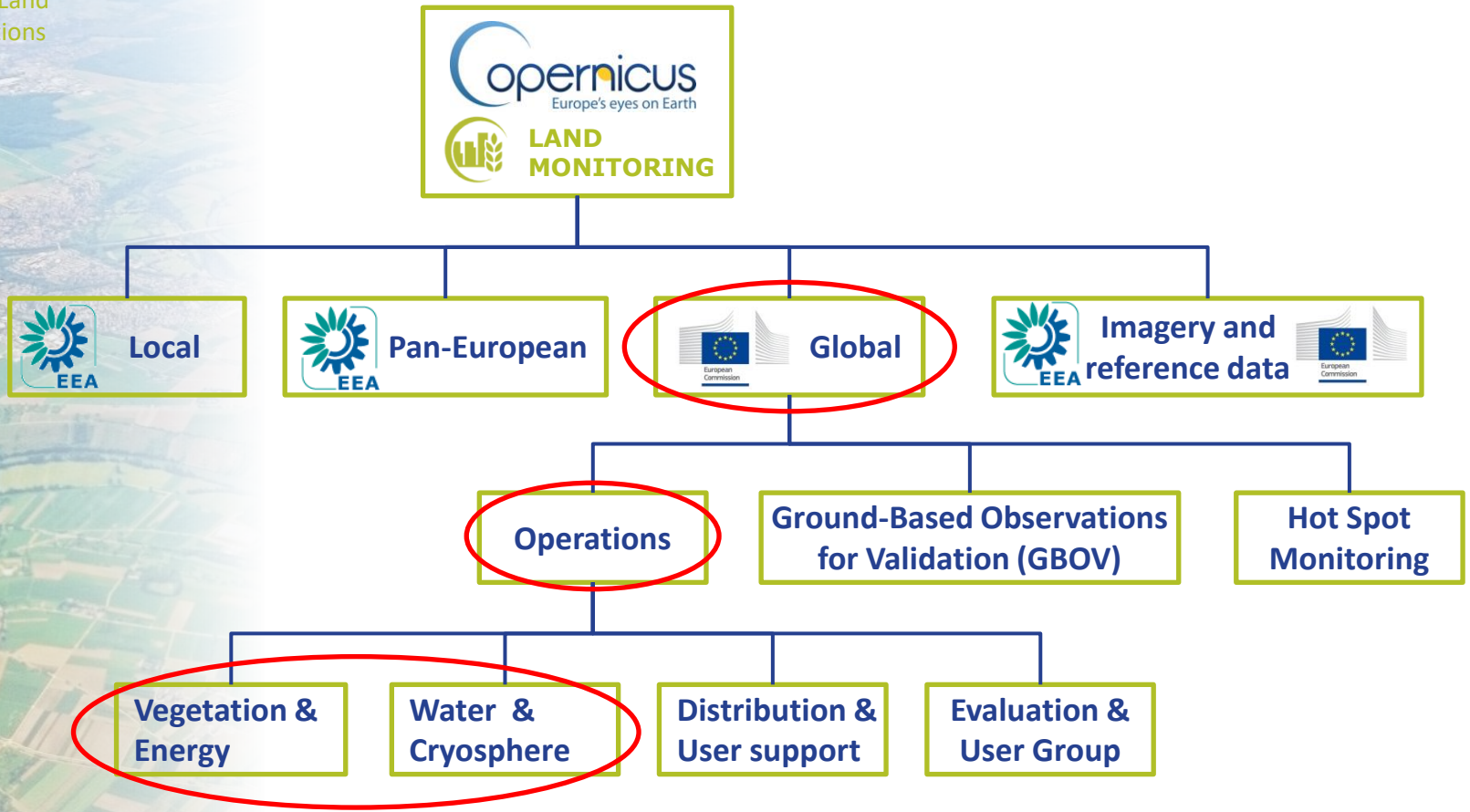
on behalf CGLOPS-1 and CGLOPS-2 consortia

Copernicus
Europe's eyes on Earth

European Commission

Global Land Operations

Copernicus Land Monitoring Service



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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

Free and Open Access : https://land.copernicus.eu/global/

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

CGLOPS products in LPV topics

** Archive only*

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CGLOPS Products in LPV topics

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

**** 1km time series stopped on 30th June 2020.***

***** Production of 300m time series moved to Copernicus Climate Change Service***

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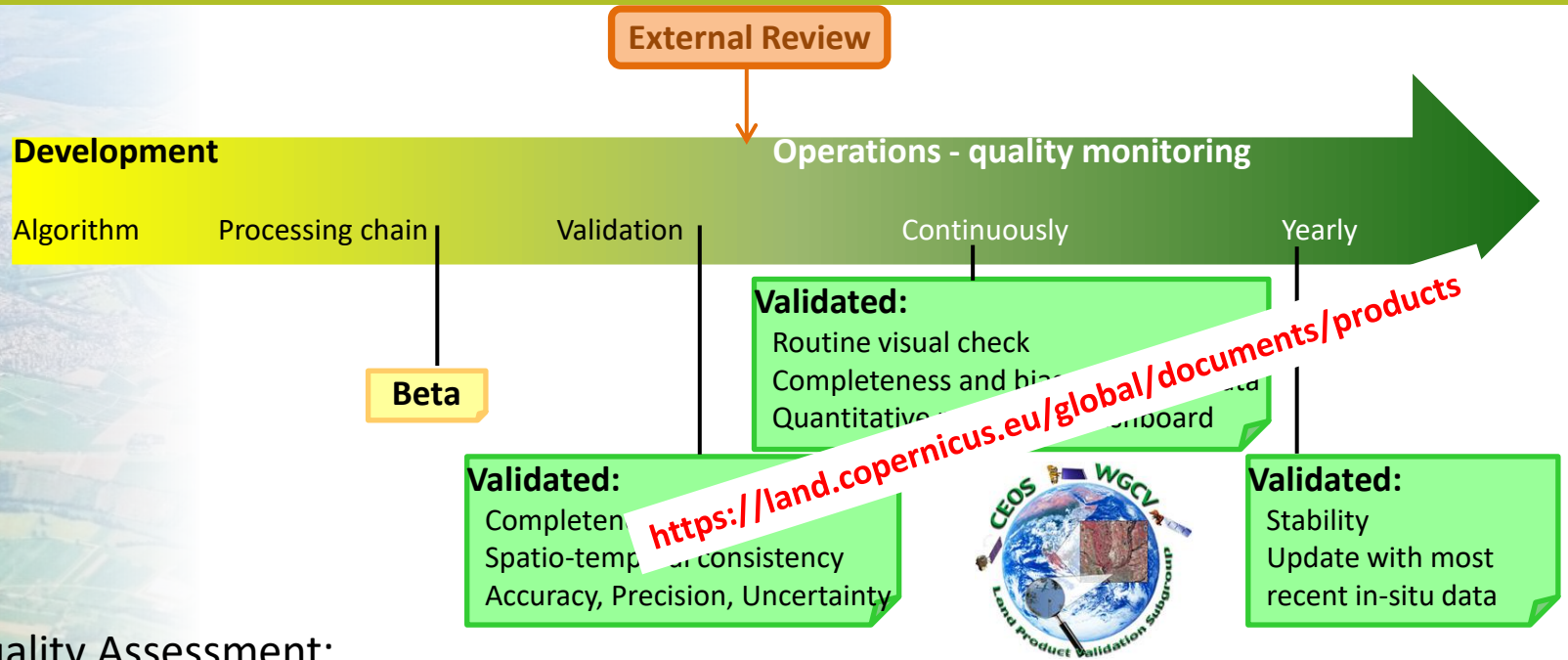
Quality assessment approach



- 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

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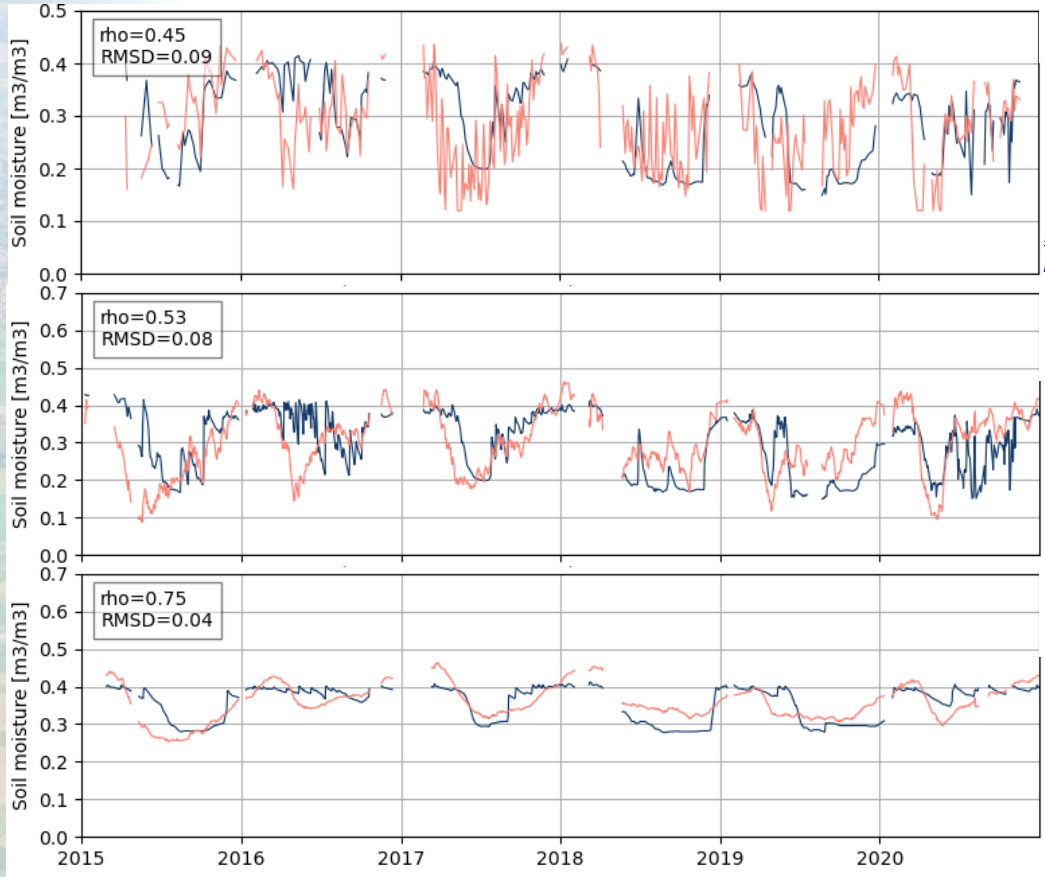
Direct Validation example – Sentinel-1 Soil Moisture

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

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)

Soil Water Index

Deep soil layer

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

https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_SQE2020_SWI1km_I1.00.pdf

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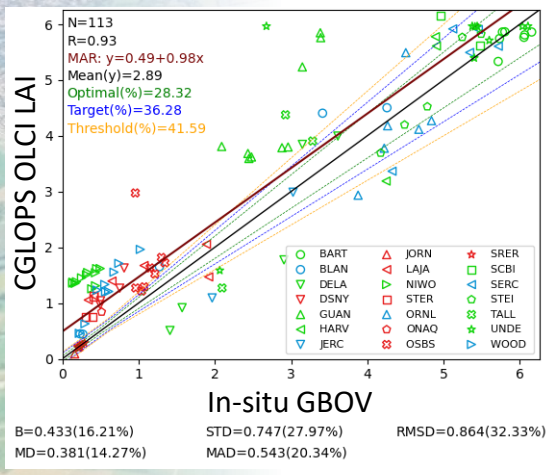
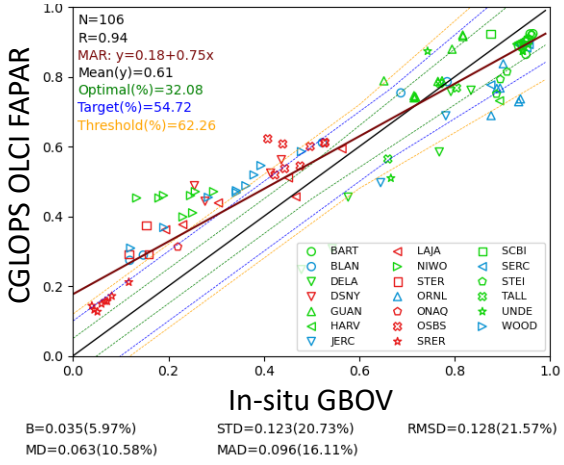
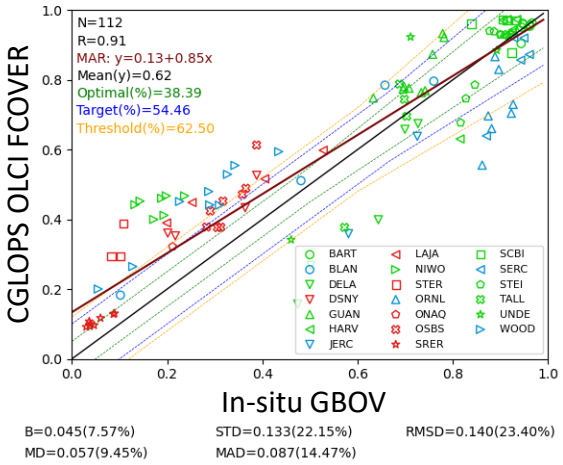
Direct Validation example – Sentinel-3/OLCI LAI, FAPAR, FCOVER

Ground-Based Observations for Validation (GBOV) sites

(July 2018 – April 2019)







https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LAI300m-V1.1_I1.00.pdf available soon

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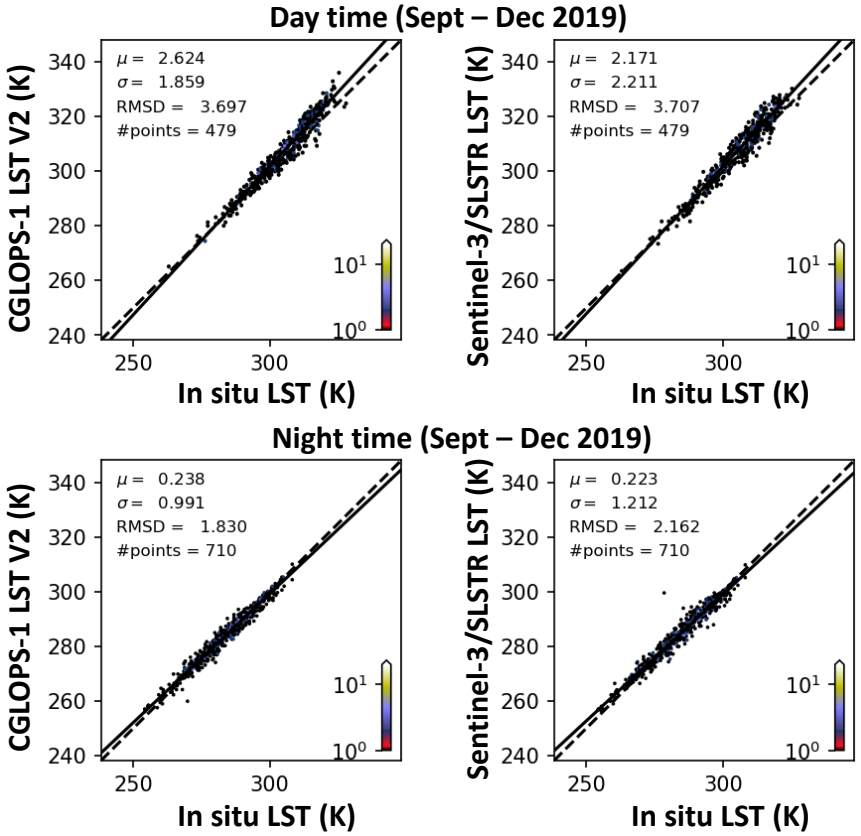
Direct Validation example – Land Surface Temperature

In situ LST from various networks:

- BSRN
- ARM
- OzFlux
- EFDC
- GBOV



https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LST-V2.0_I1.10.pdf

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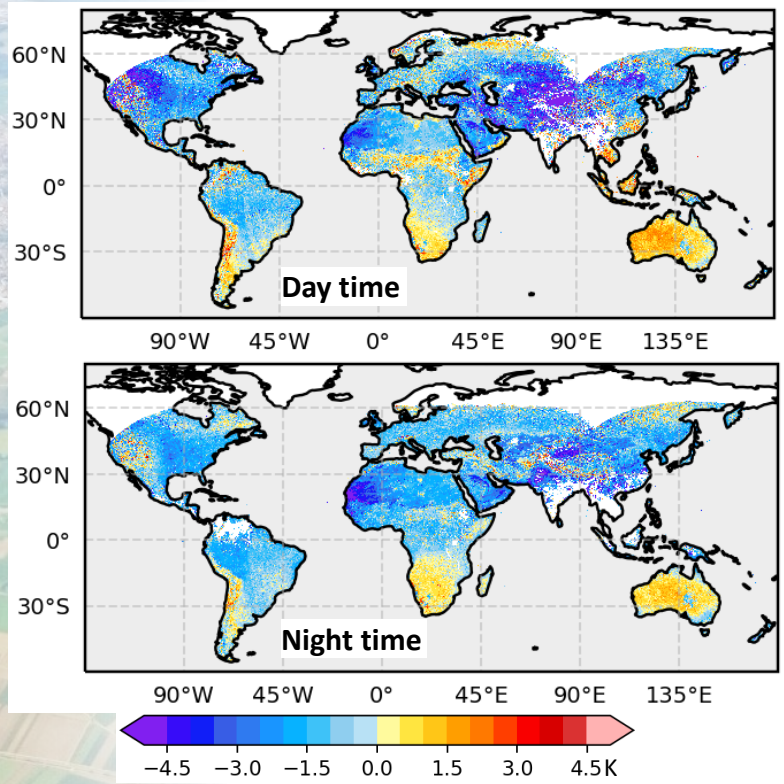
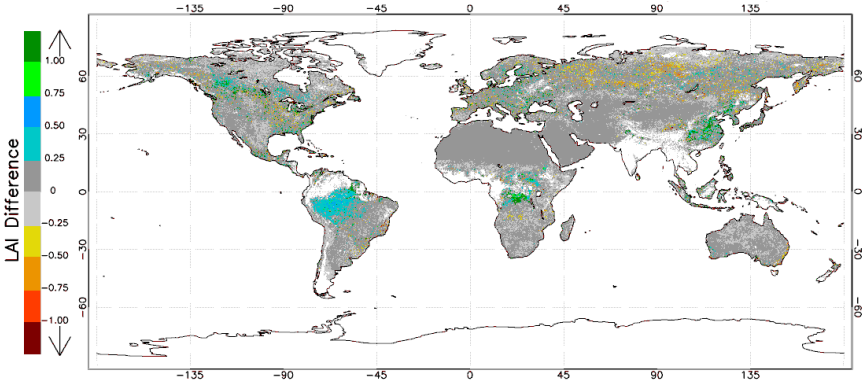
Indirect Validation example – inter-comparison : spatial consistency

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



https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LST-V2.0_I1.10.pdf

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*

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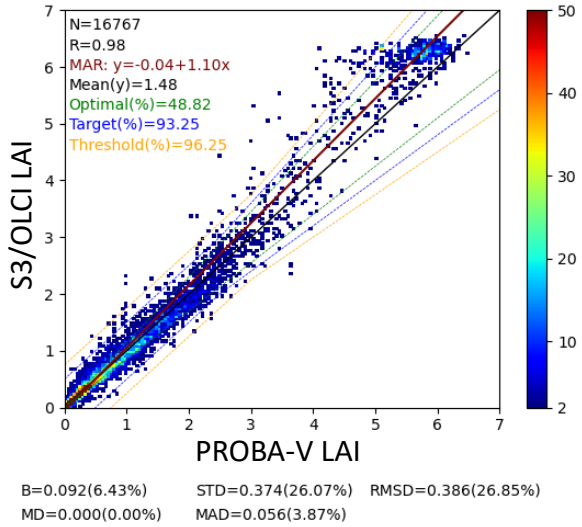
Indirect Validation example – inter-comparison : statistical consistency

Sentinel-3/OLCI LAI vs PROBA-V LAI

720 LANDVAL sites
07/2018 – 04/2019



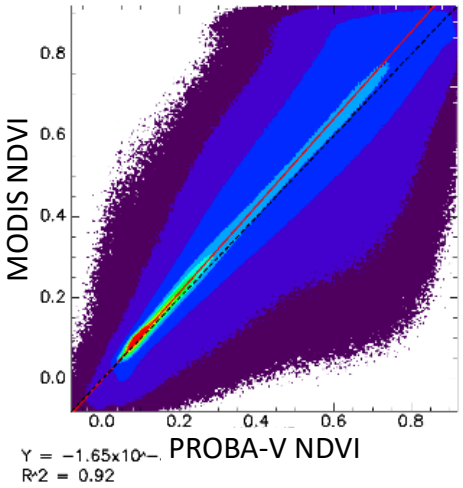
B=0.092(6.43%) STD=0.374(26.07%) RMSD=0.386(26.85%)
MD=0.000(0.00%) MAD=0.056(3.87%)

https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_LAI300m-V1.1_I1.00.pdf available soon

CGLOPS-1 NDVI vs MCD43A4 NDVI

PROBA-V NDVI 1km

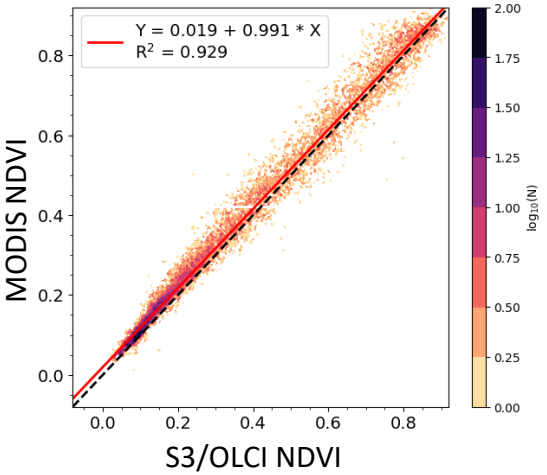
Global sampling (21x21)
2011-2016



https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_NDVI1km-V3_I1.10.pdf

Sentinel-3/OLCI NDVI 300m

720 LANDVAL sites
07/2018 – 06/2019



https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_QAR_NDVI300m-V2_I1.00.pdf available soon

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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

Radiometry 34 sites

Vegetation 23 sites

Soil Moisture 20 sites

Land Surface Temperature 21 sites

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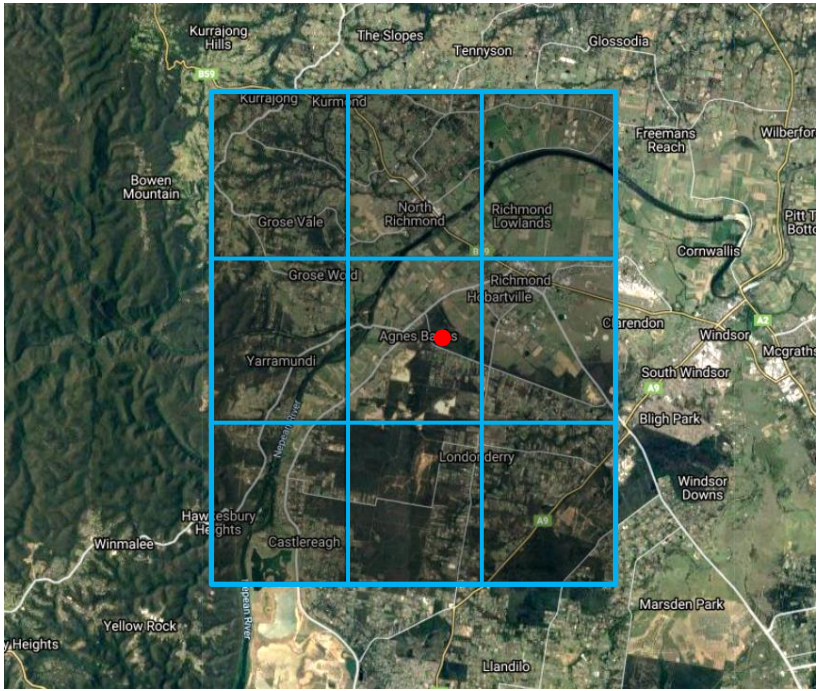
CGLOPS needs for product validation

- 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



Google Earth image
Cumberland site, Australia
3 x 3 CGLOPS LST pixels

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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

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