6TH S3VT

SENTINEL-3 VALIDATION TEAM MEETING

Use of the SYN product for estimating key vegetation variables within the context of FLEX

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(3) Universidad Autónoma de Nayarit, Mexico

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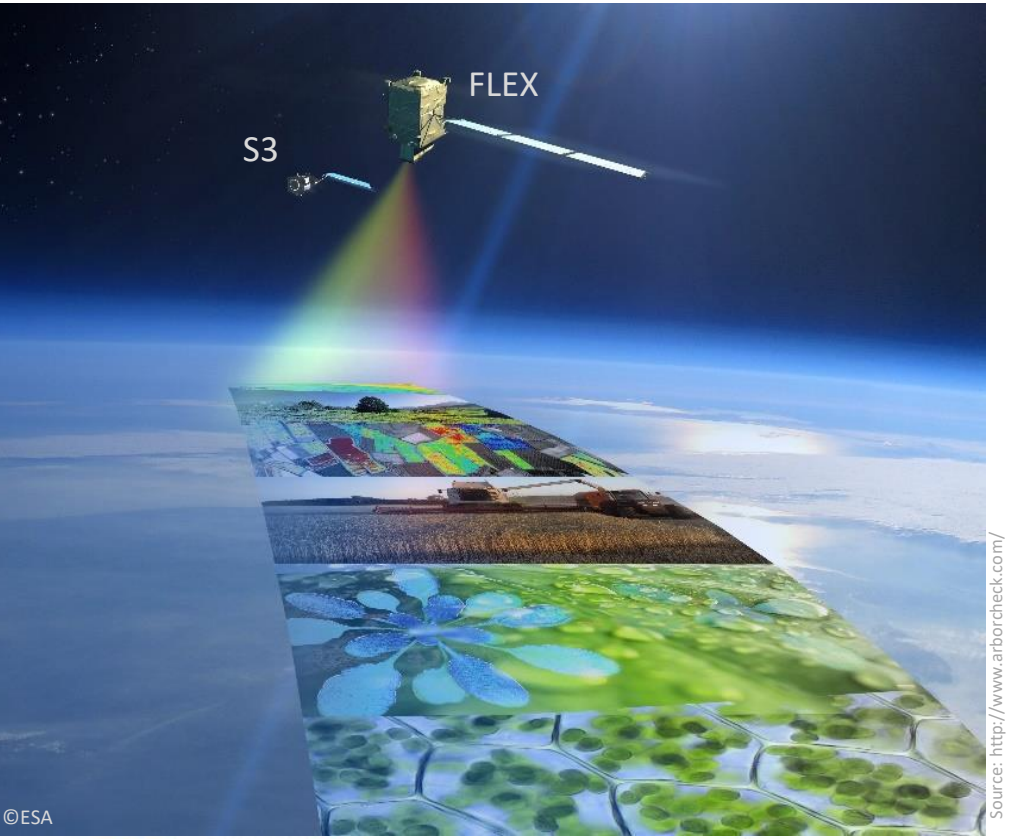
Context

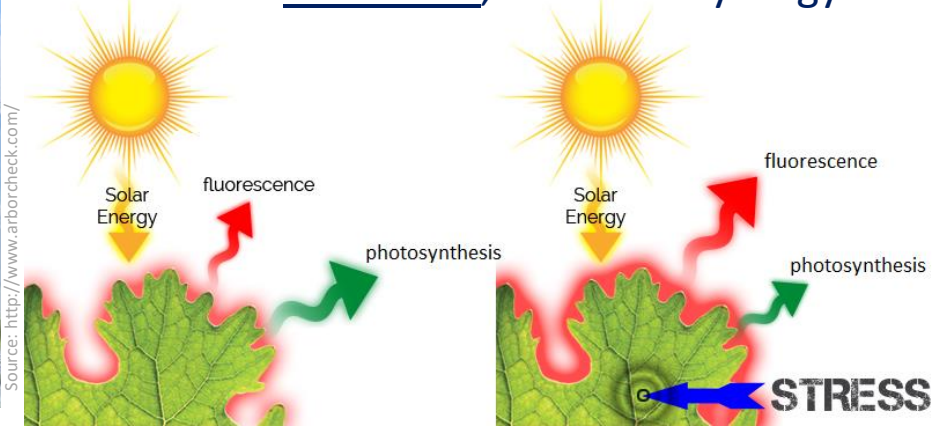


- FLEX will measure fluorescence = probe for photosynthetic activity and stress

- Concurrent characterization of other vegetation properties (LCC, LAI, FAPAR, FVC)

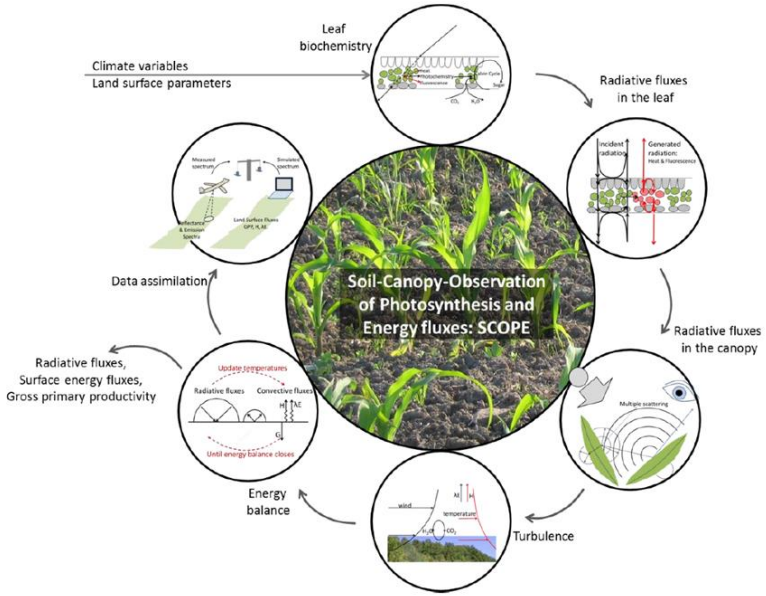
LCC: Leaf Chlorophyll Content **FVC**: Fractional Vegetation Cover **LAI**: Leaf Area Index
FAPAR: Fraction of Absorbed Photosynthetically Active Radiation

- Vegetation retrieval algorithms developed for FLEX and Sentinel-3, and their synergy

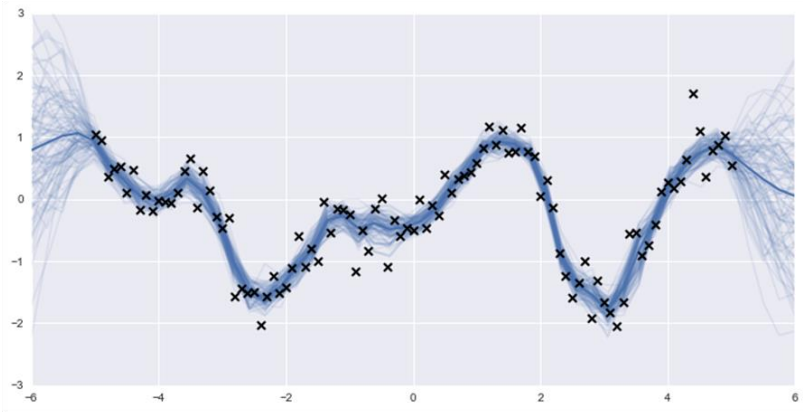


Source: http://www.arborcheck.com/

Hybrid retrieval method



+



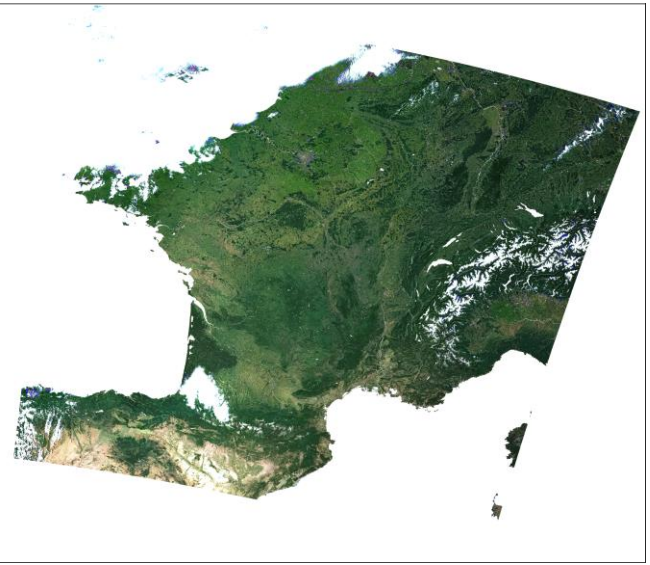
Radiative Transfer Model (RTM)
SCOPE (v 1.70)
(+ bare soil spectra from SYN products)

Machine Learning Algorithm
Gaussian Process Regression
(GPR)

Maps of vegetation variables

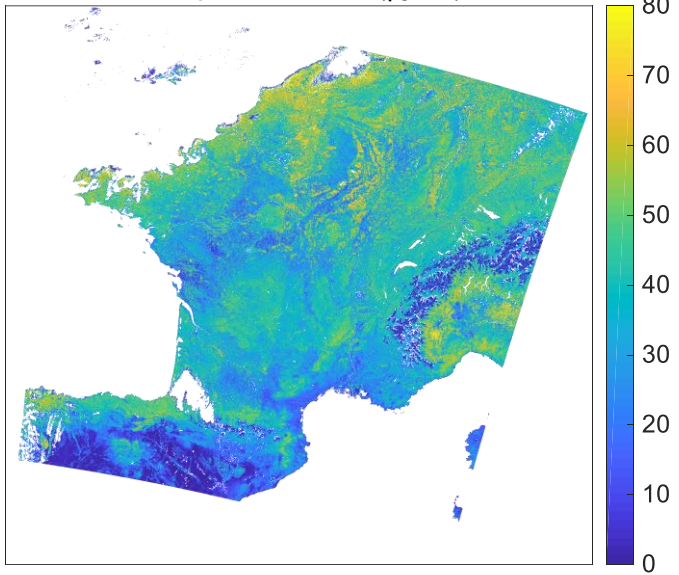
- Models applied to S3 SYN reflectance product (16 OLCI bands)

RGB Map (Oa8, Oa6, Oa4)

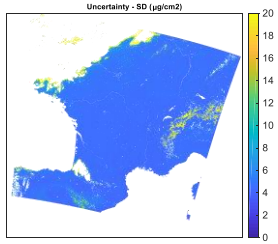


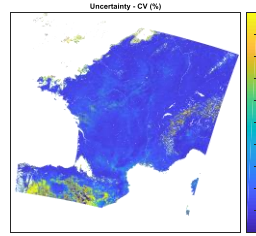
SYN product from 26/06/2019

Map of estimated LCC (µg/cm2)

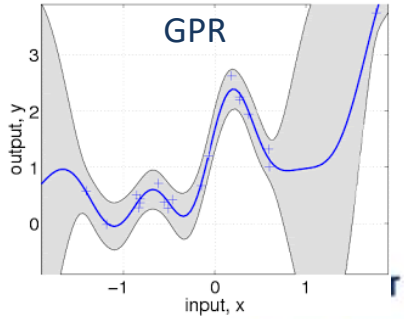


LCC = Leaf Chlorophyll Content





Relative Uncertainty (CV = µ/σ)



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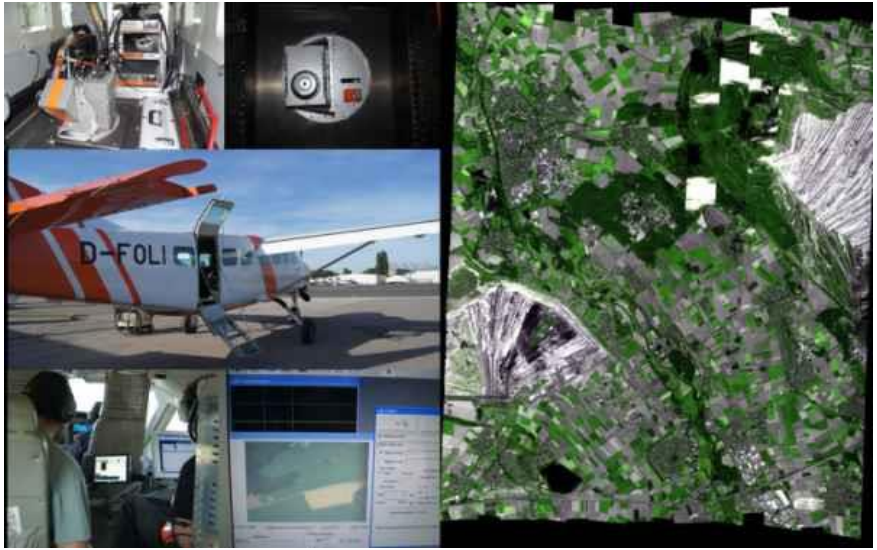
Model validation

1. Indirect validation using S3 official products : **OGVI** (~ FAPAR) and **OTCI** (index related to LCC)

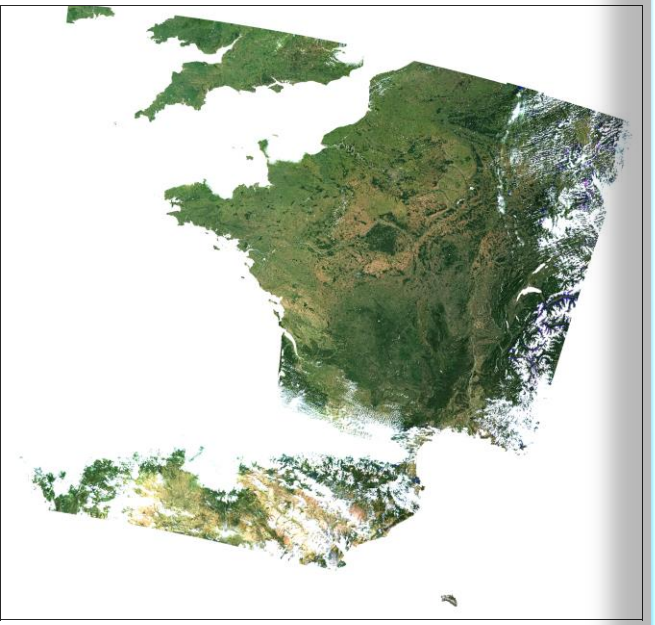
2. Validation using **field measurements** < Hyplant (airborne imaging spectrometer) - FlexSense campaign 2018 near Forschungszentrum Jülich (Germany) : LCC and LAI



FAPAR: Fraction of Absorbed Photosynthetically Active Radiation
LCC: Leaf Chlorophyll Content
LAI: Leaf Area Index
OGVI: OLCI Global Vegetation Index
OTCI: OLCI Terrestrial Chlorophyll Index

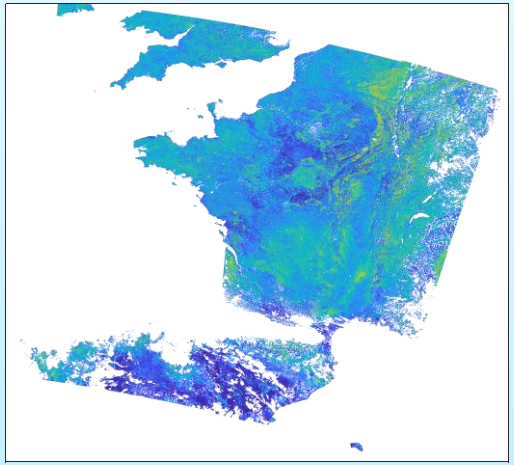
Indirect validation

RGB Map (Red wl:Band$_8$, Green wl:Band$_6$, Blue wl:Band$_4$)

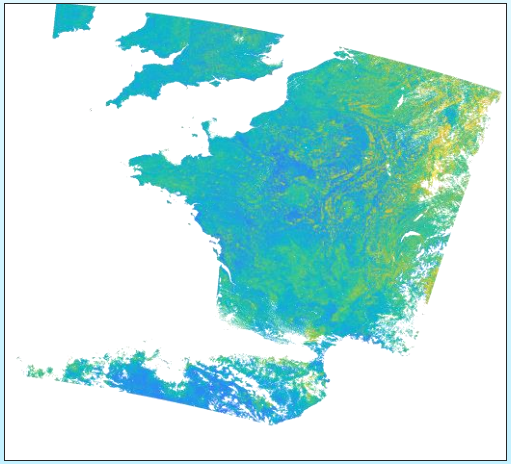


SYN product from 28/06/2018

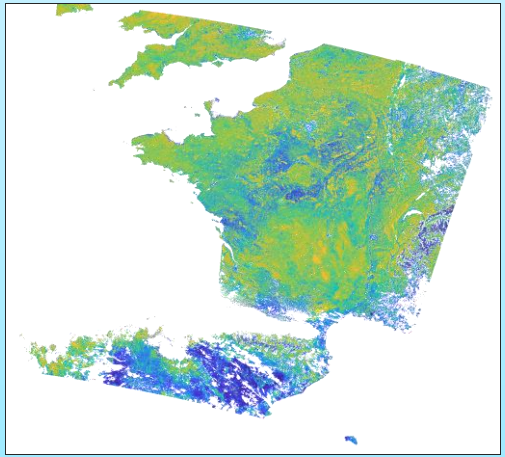
LCC (µg.cm-2)



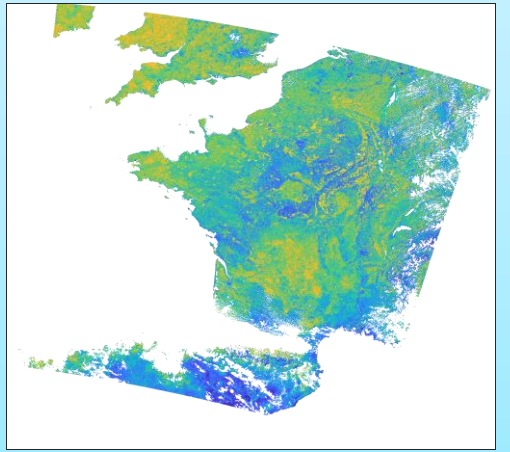
OTCI (-)



FAPAR (-)



OGVI (-)



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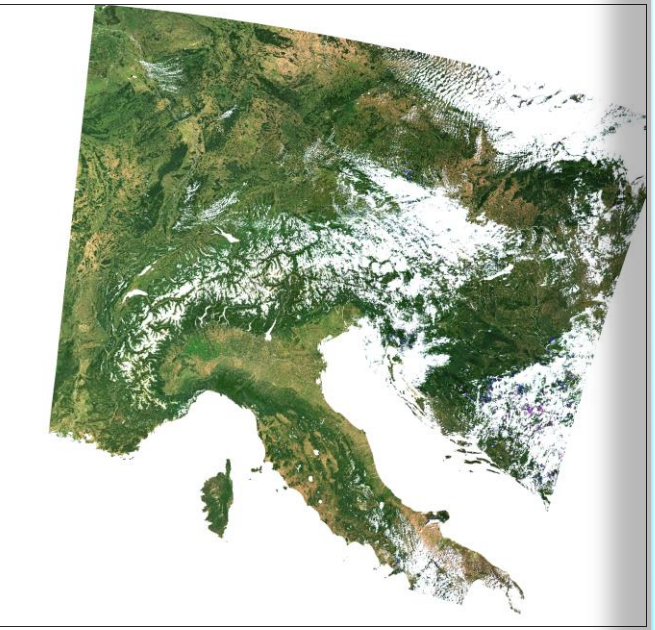
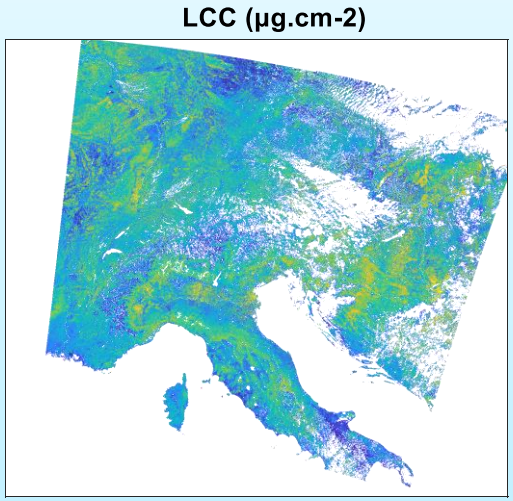
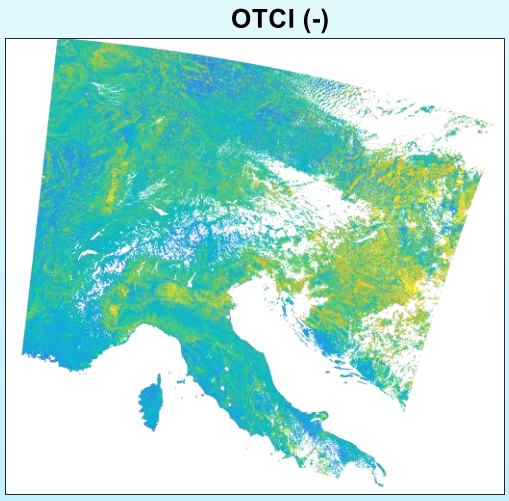
Indirect validation

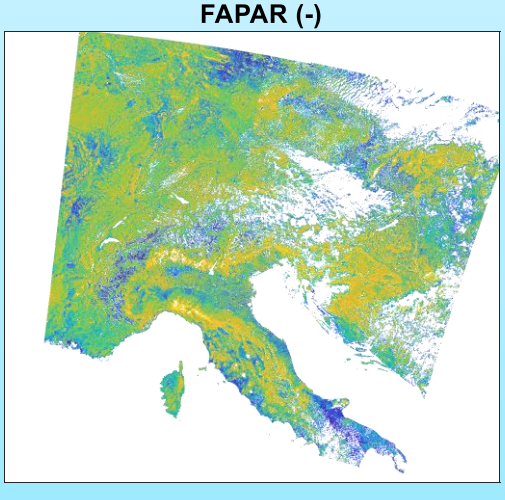
RGB Map (Red wl:Band$_8$, Green wl:Band$_6$, Blue wl:Band$_4$)

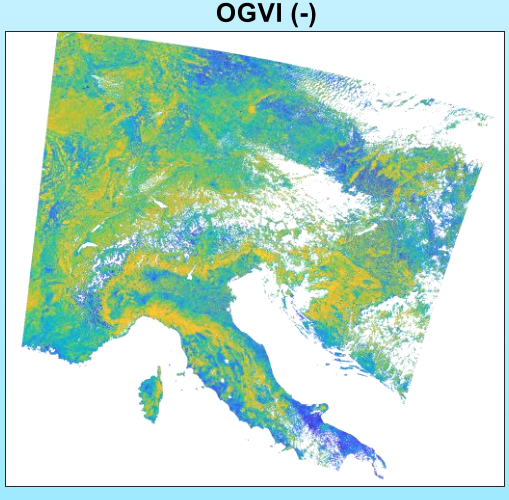


SYN product from 30/06/2018









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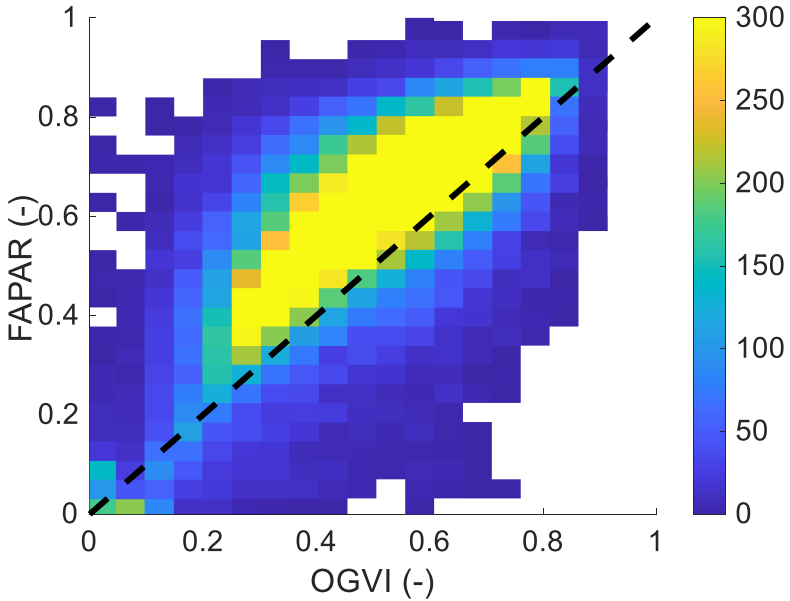
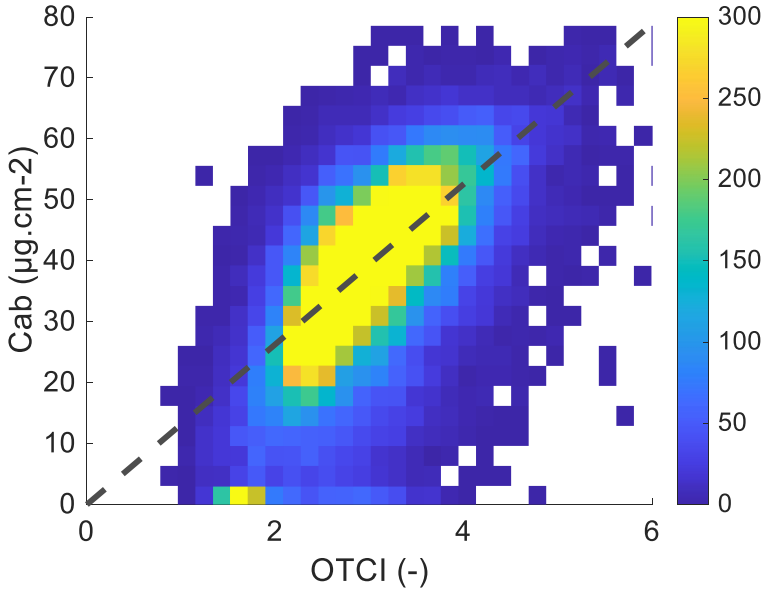
Indirect validation





SYN and LFR products from 28/06/2018

R2 : 0.58 RMSE: 0.12 RRMSE: 24.7%

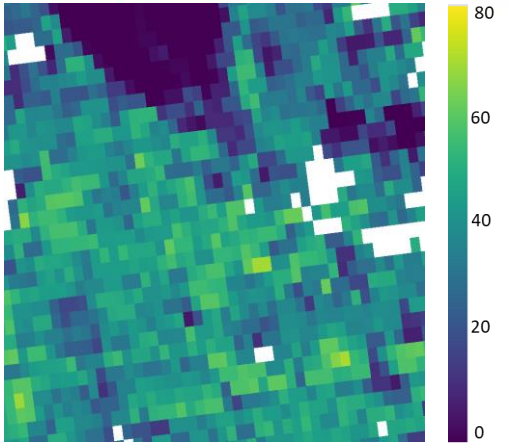
y = -2.74 + 13.3x R2 : 0.41

Indirect validation

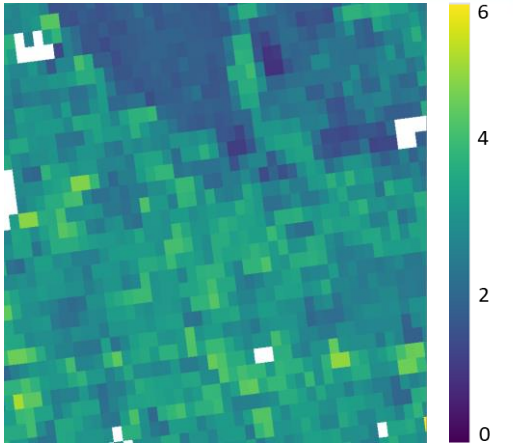
(665,560,490)

Subset of SYN product from 28/06/2018

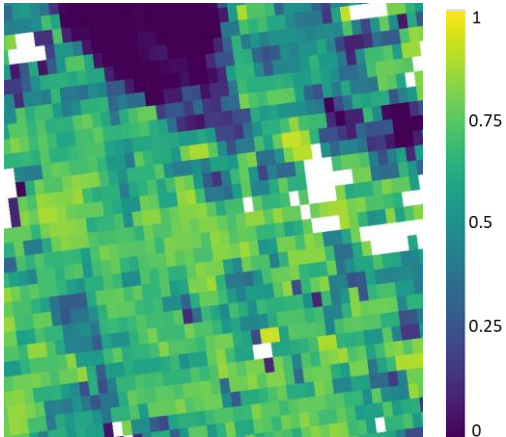
LCC (µg.cm-2)



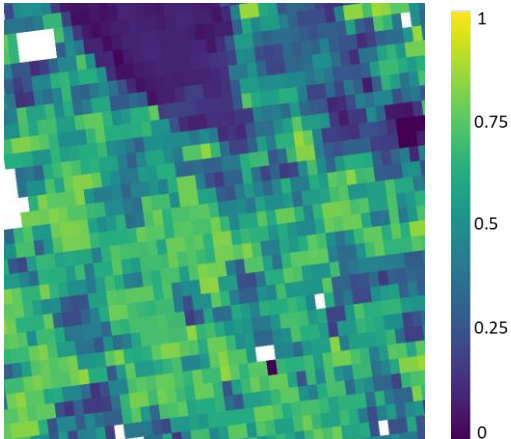
OTCI (-)



FAPAR (-)



OGVI (-)



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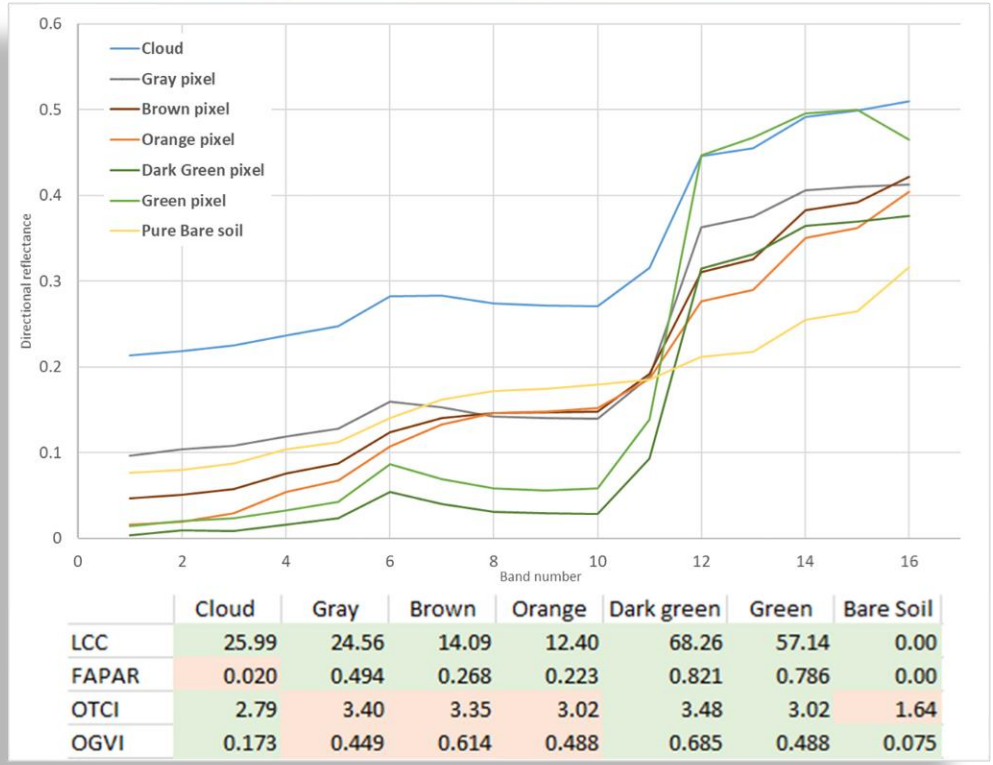
Indirect validation

Subset of SYN product from 28/06/2018



	Cloud	Gray	Brown	Orange	Dark green	Green	Bare Soil
LCC	25.99	24.56	14.09	12.40	68.26	57.14	0.00
FAPAR	0.020	0.494	0.268	0.223	0.821	0.786	0.00
OTCI	2.79	3.40	3.35	3.02	3.48	3.02	1.64
OGVI	0.173	0.449	0.614	0.488	0.685	0.488	0.075

OTCI & OGVI:

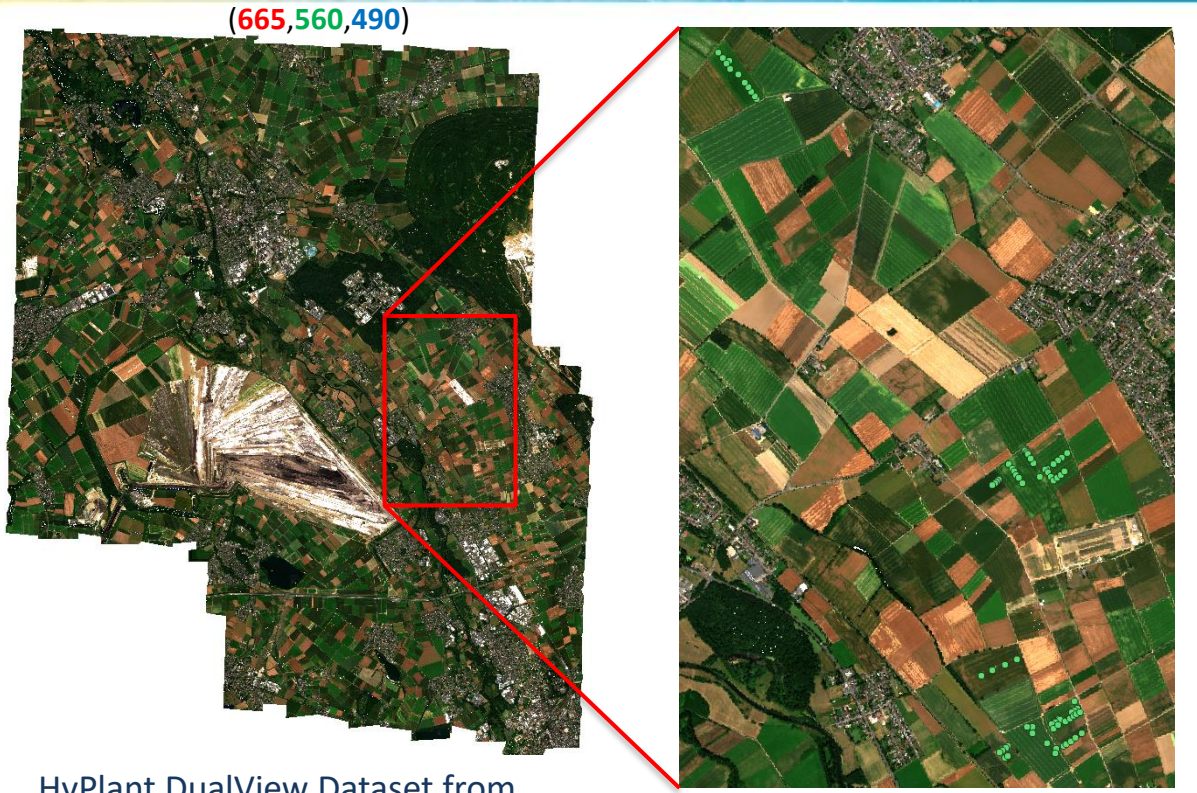
✔ homogeneous pixels
✘ heterogeneous pixels

OTCI:
too high values for bare soil pixels

OGVI: lower values for green pixels than FAPAR

Cloud contaminated pixels?

Field campaign data

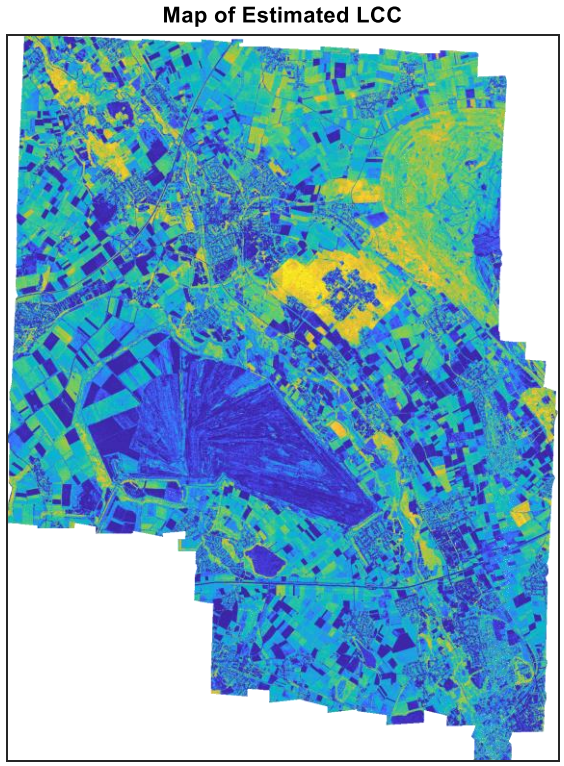


HyPlant DualView Dataset from 26/06/2018 - resampled to 16 OLCI bands - 3m spatial resolution

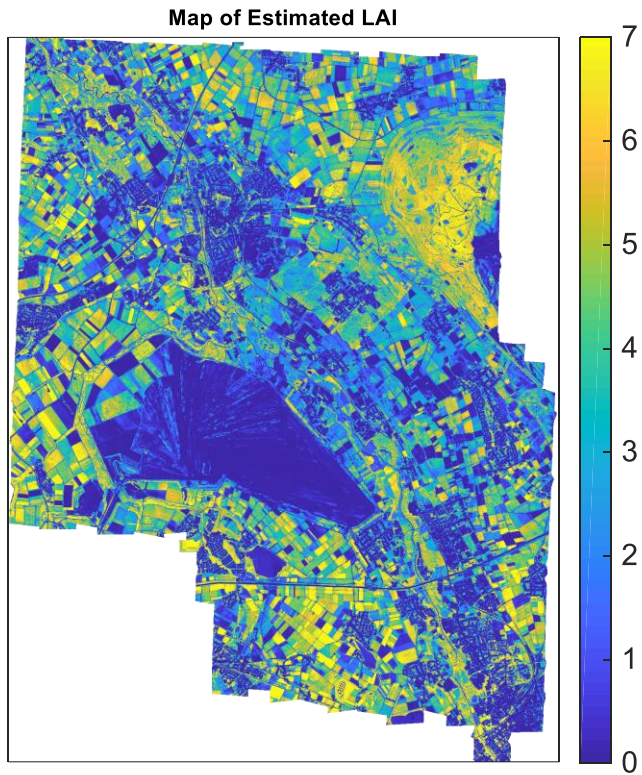
- LCC and LAI measurements
- crops: sugar beet, maize, potato and wheat
- dates: 26/06 - 29/06/2018
- LCC: SPAD-502Plus Chlorophyll meter (Konika Minolta Inc., Japan) - average of 10 upper leafs of 1 plant
- LAI: Li-3200C Area Meter (LI-COR, USA)

Model validation - 3 m

HyPlant DualView Dataset from 26/06/2018 - resampled to 16 OLCI bands - 3m spatial resolution



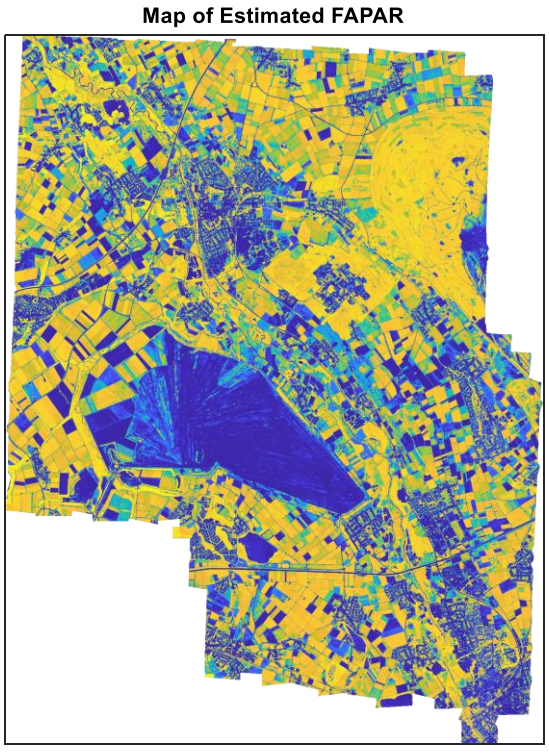
LCC = Leaf Chlorophyll Content



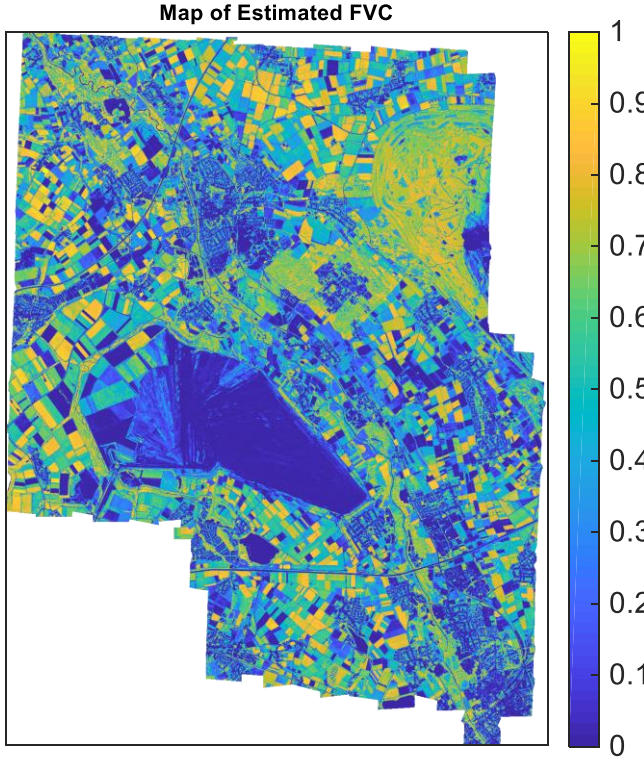
LAI = Leaf Area Index

Model validation - 3 m

HyPlant DualView Dataset from 26/06/2018 - resampled to 16 OLCI bands - 3m spatial resolution

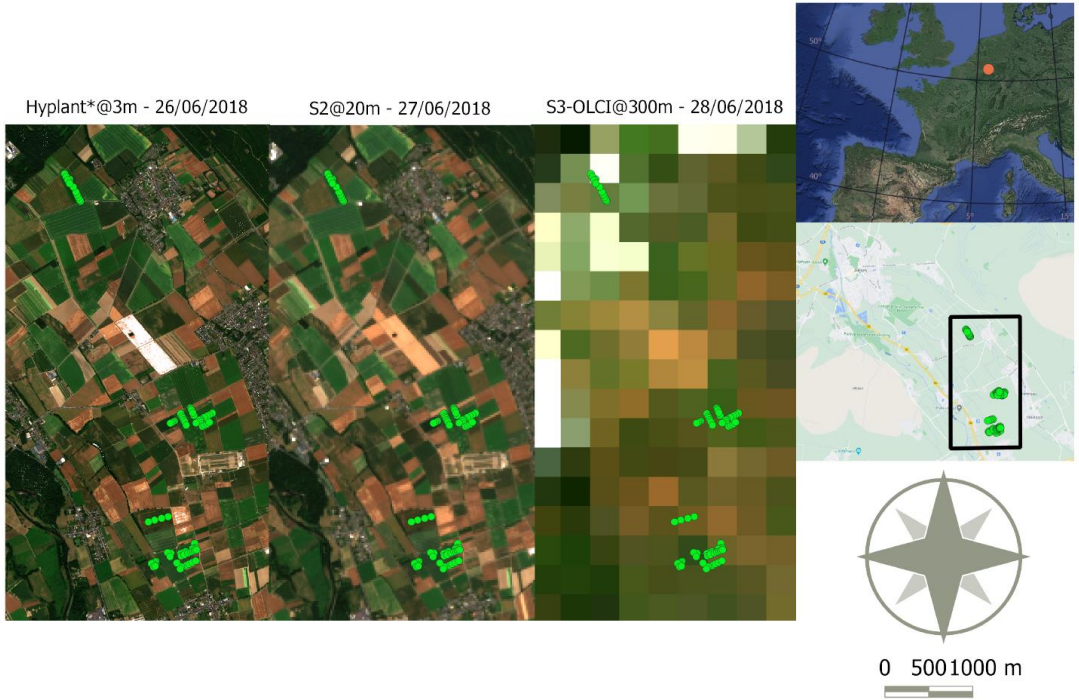


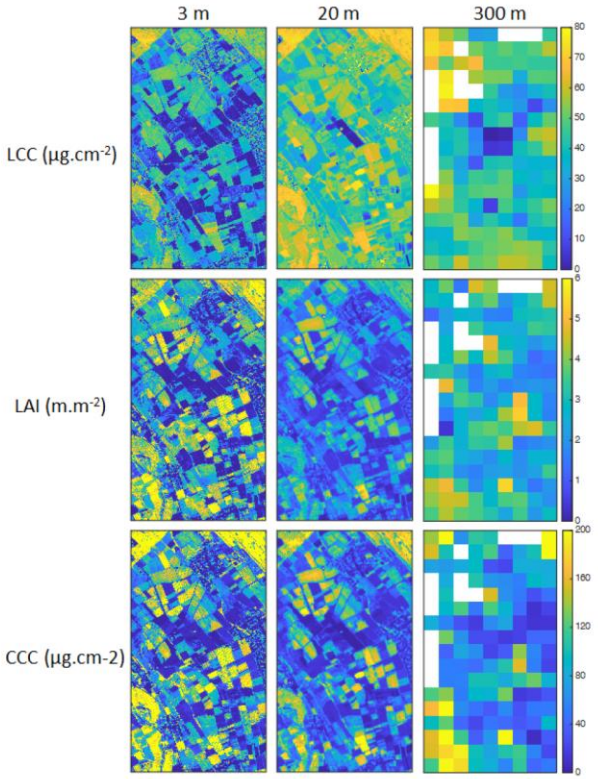
FAPAR = Fraction of Absorbed Photosynthetically Active Radiation



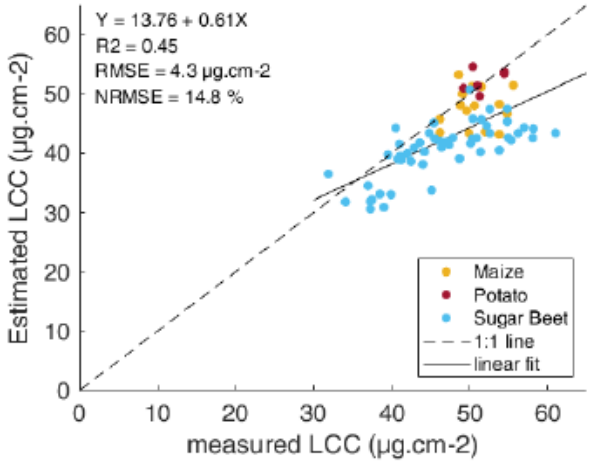
FVC = Fractional Vegetation Cover

Model validation - 300 m

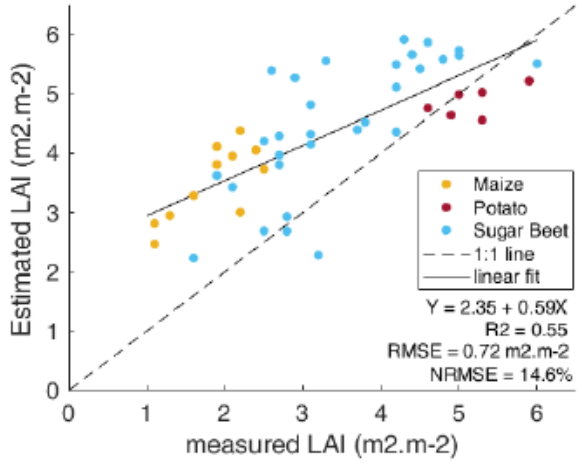




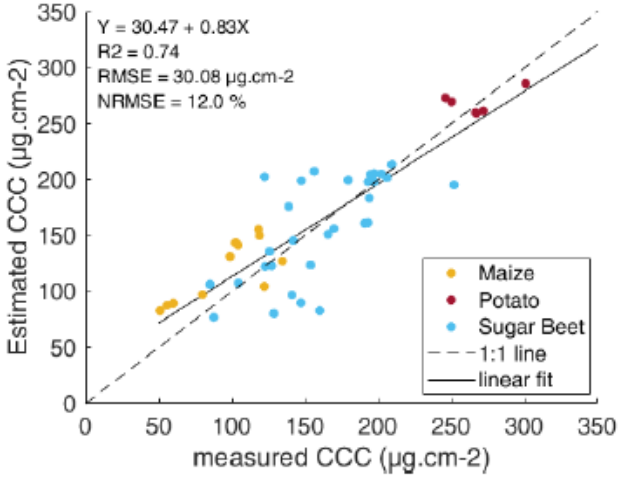
Model validation - 3 m



LCC = Leaf Chlorophyll Content

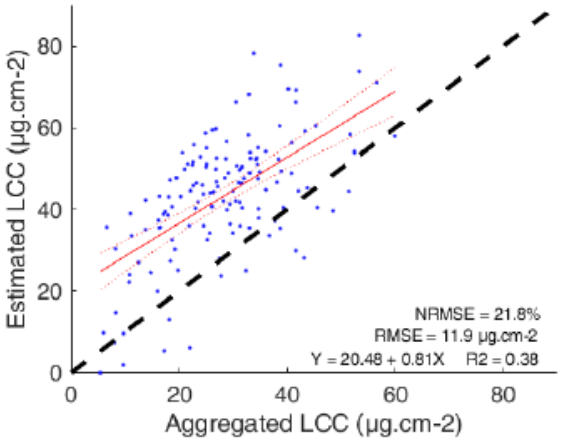


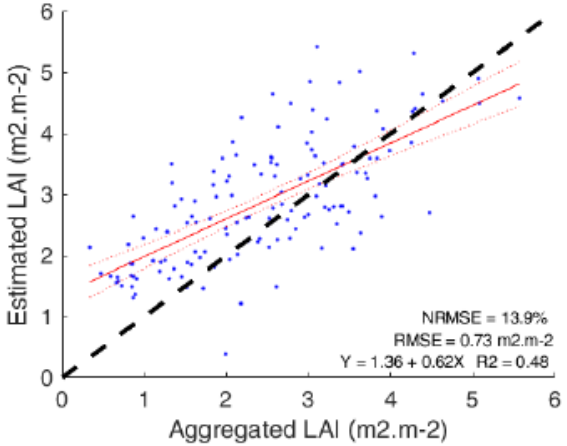
LAI = Leaf Area Index

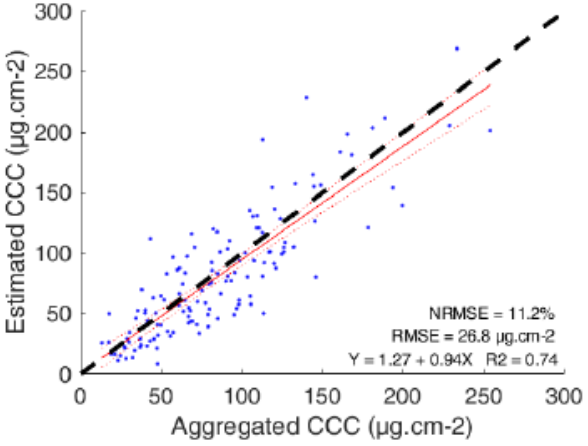


CCC = Canopy Chlorophyll Content

Model validation 300 m



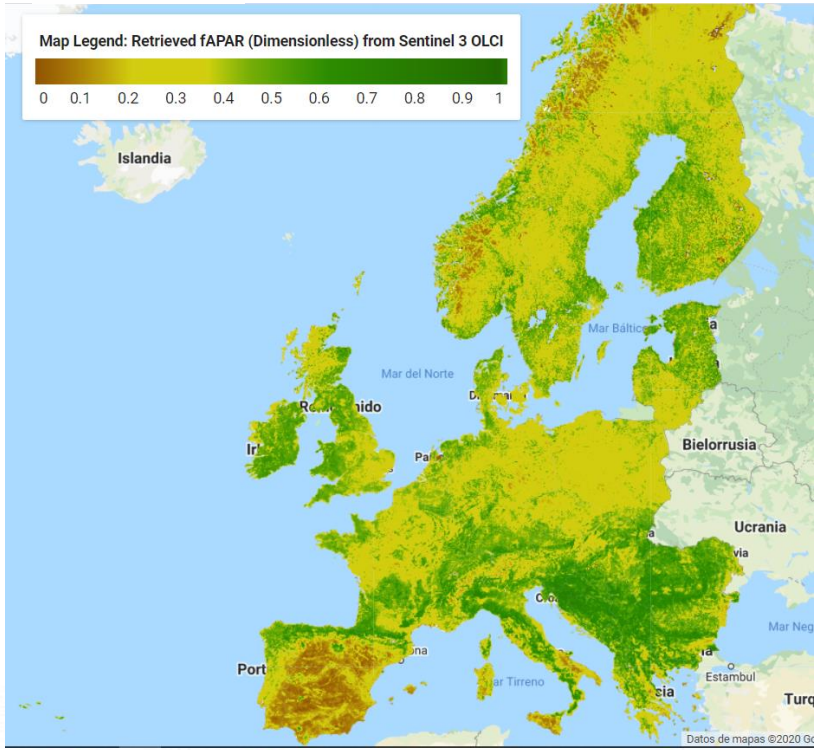




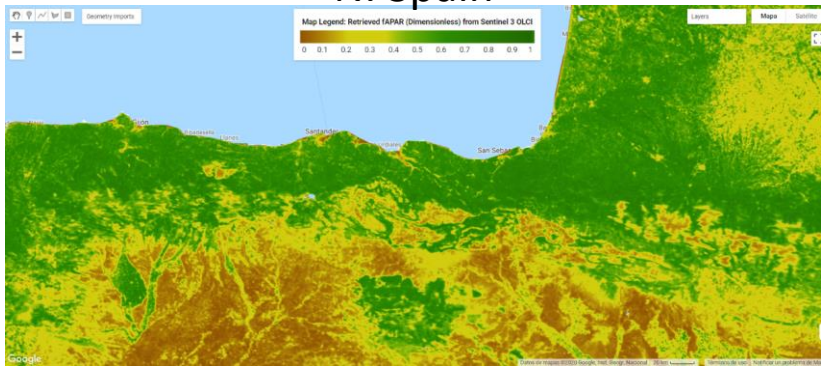
Towards operational prcessing in GEE (1/4)

FAPAR (Monthly averaged July 2019)

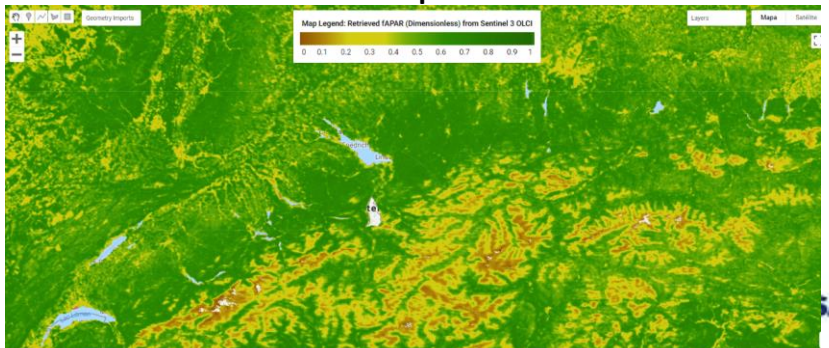
Google Earth Engine



N. Spain



Alps

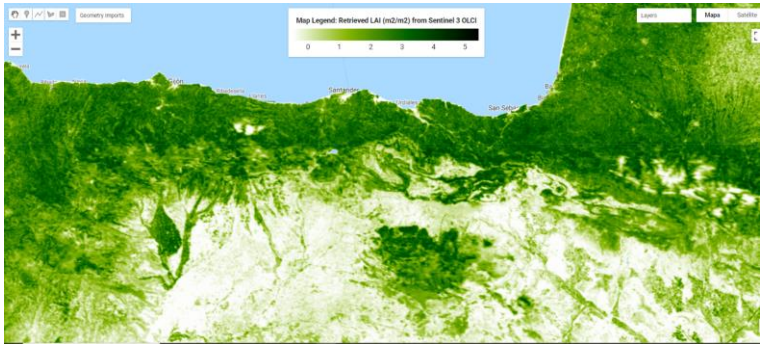


Towards operational prcessing in GEE (2/4)

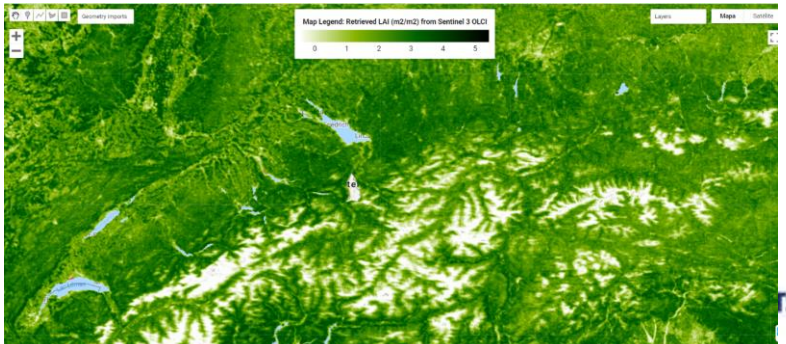
Google Earth Engine

LAI (Monthly averaged July 2019)

N. Spain



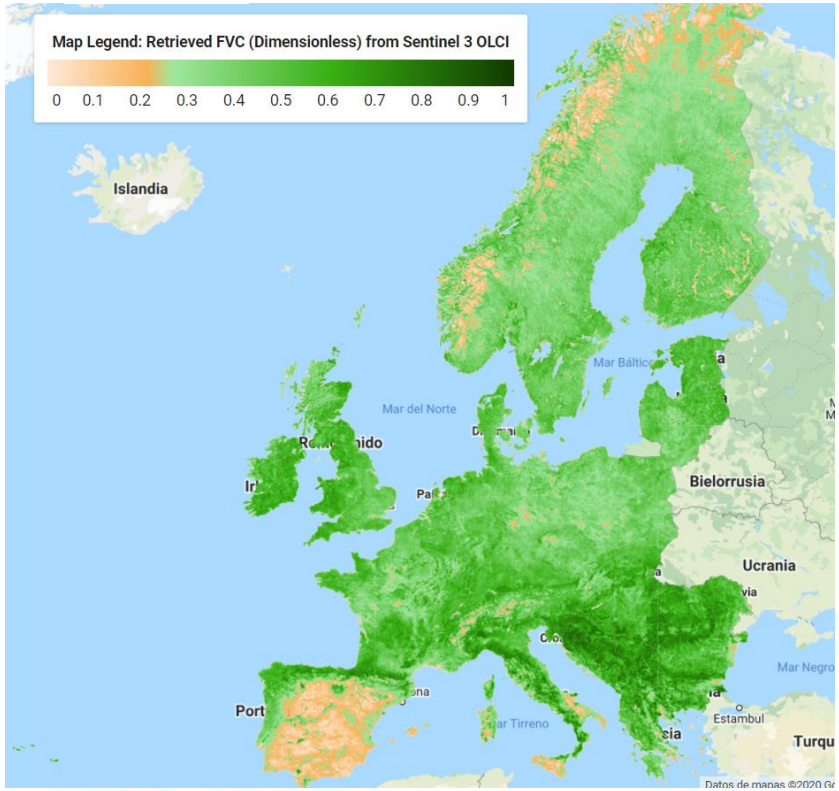
Alps



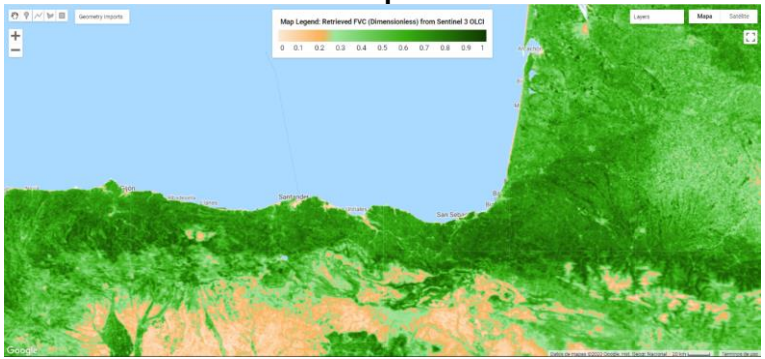
Towards operational prcessing in GEE (3/4)

Google Earth Engine

FVC (Monthly averaged July 2019)



N. Spain

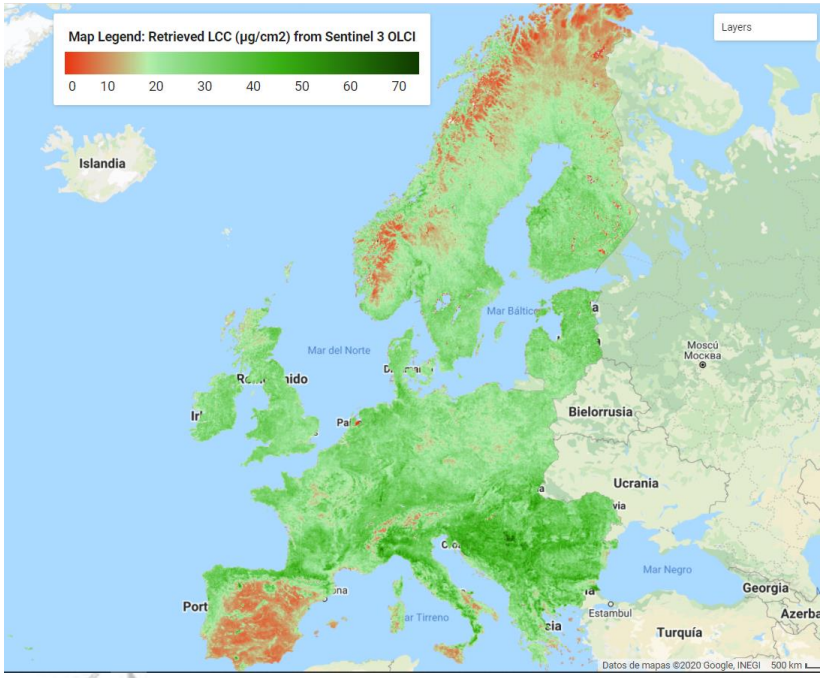


Alps

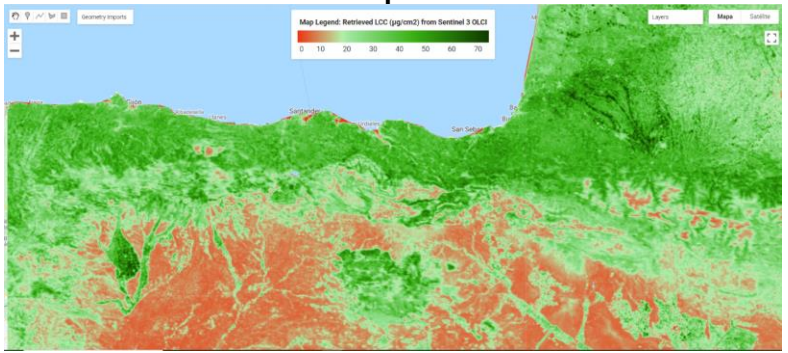
Towards operational prcessing in GEE (4/4)

Google Earth Engine

LCC (Monthly averaged July 2019)



N. Spain



Alps

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SAT

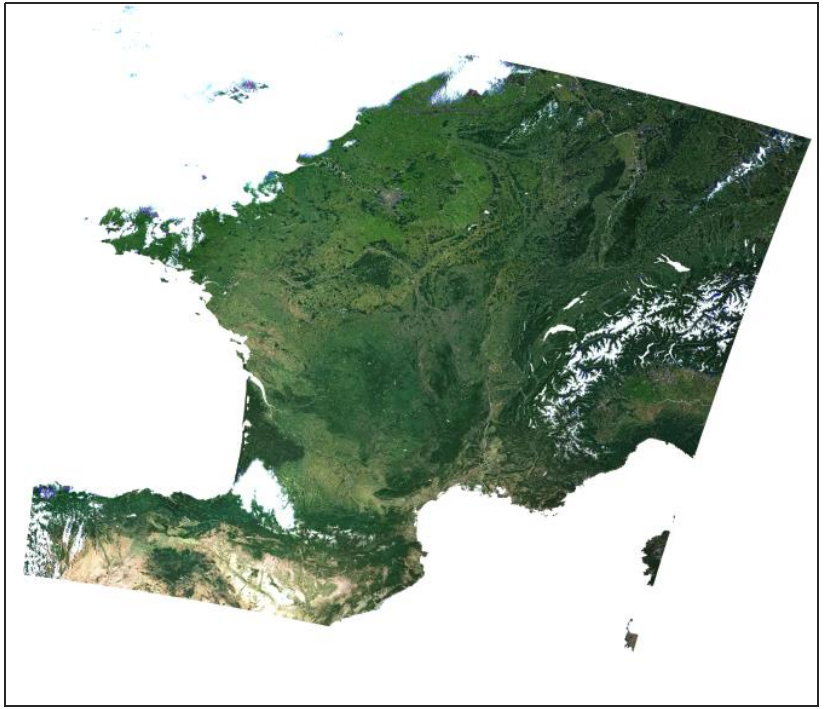
Concluding remarks

- SYN product clearly improved since last S3VT.
No longer: → stripping effect, underexposed images < improper radiometric calibration; weird spectra due to SLSTR bands

- **Still** some pixels with incomplete atmospheric correction (near water or clouds) + cloud-contaminated pixels in blue

- OGVI, OTCI: work very well over homogeneous pixels, less good over heterogeneous pixels

RGB Map (Oa8, Oa6, Oa4)



SYN product from 28/06/2018

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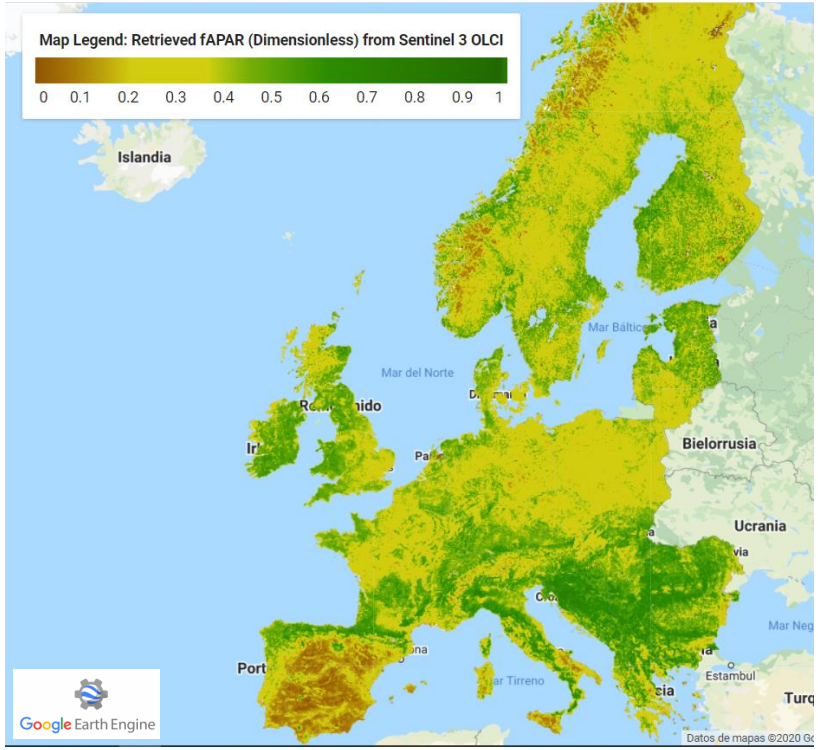
Concluding remarks

- Validation of our OLCI vegetation retrieval algorithms:
→ LCC and FAPAR products consistent with OTCI/OGVI
→ LCC and LAI products @3m validated with in situ data → upscaled to @300m

- Implementation into GEE for operational processing



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THANK YOU !

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