The Land-SAF suite of Vegetation Products

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1. Description of the MSG vegetation products
2. Validation of products
3. Added value and potential applications

Characteristics of SEVIRI vegetation (VEGA) products

⇒ Status: preoperational

exhaustive validation analysis, competitive against existing products

Input: BRDF parameters (AL2 product)

Frecuency of production: 1 day (time scale of 5 days)

Resolution & coverage: SEVIRI disk

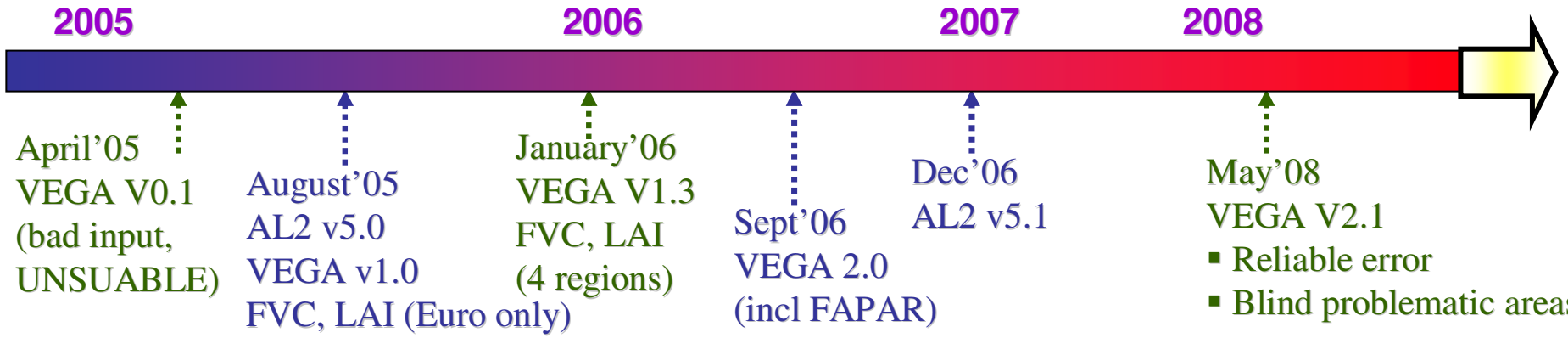
3 data sets: product, error estimate and quality flag

See Detailed documents (updated)

- **Product User Manual: LSA_LAND_UV_PUM_VEGA_2.1**
- **Validation Report: LSA_LAND_UV_VR_VEGA_v2.1**

- FAPAR: fraction of PAR (400-700 nm) absorbed by the canopy

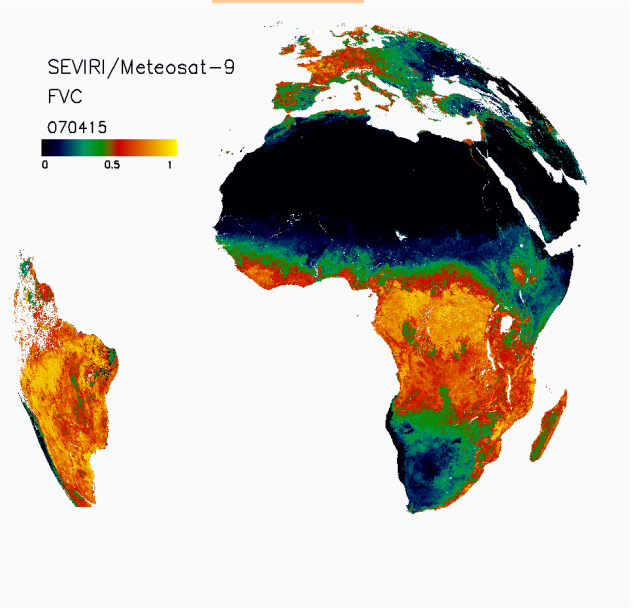
  statistical relationship in an optimal geometry (Roujean & Bréon, 1995)



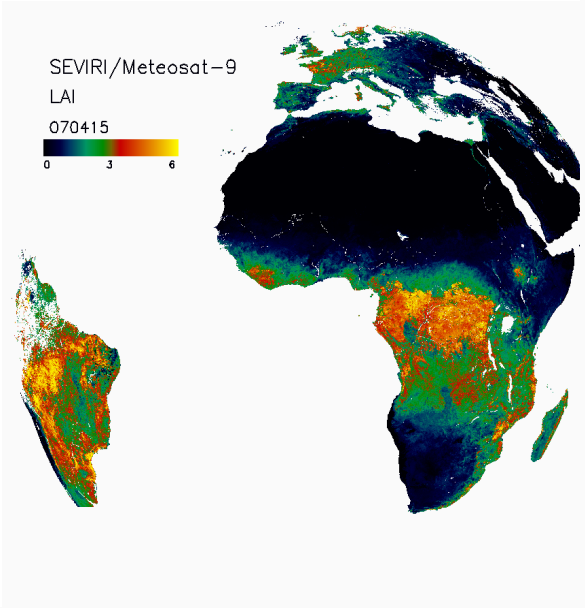
The product content

Example: 15 April 2007

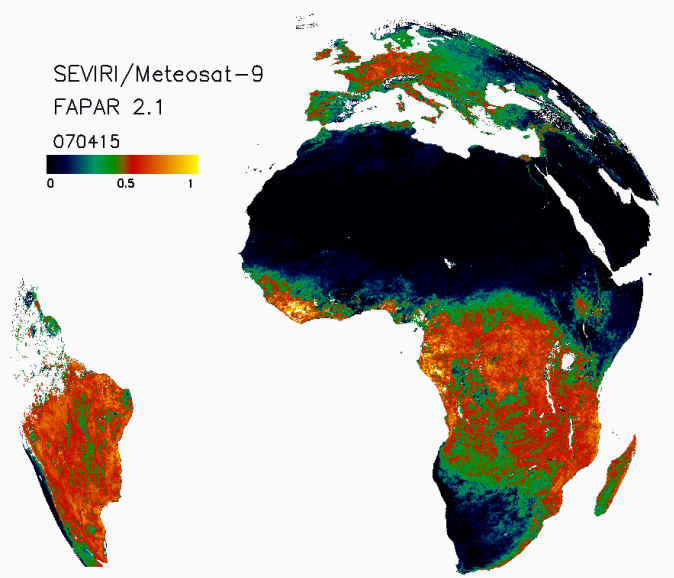
FVC

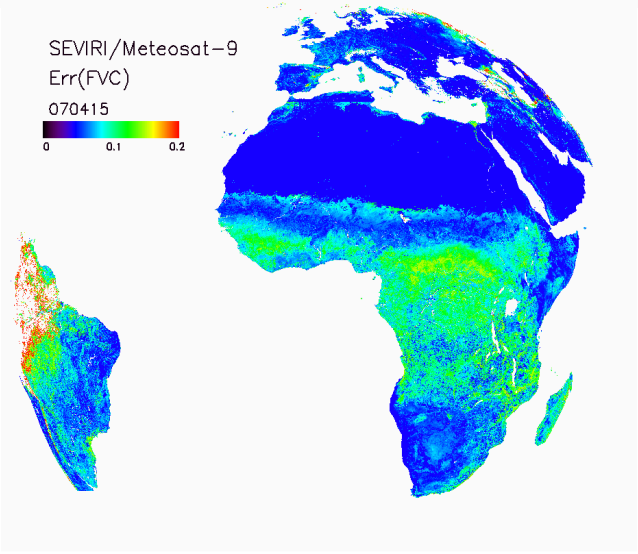


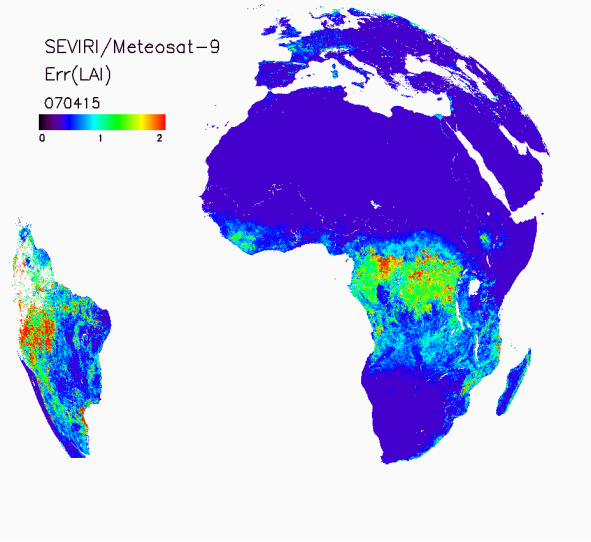
LAI

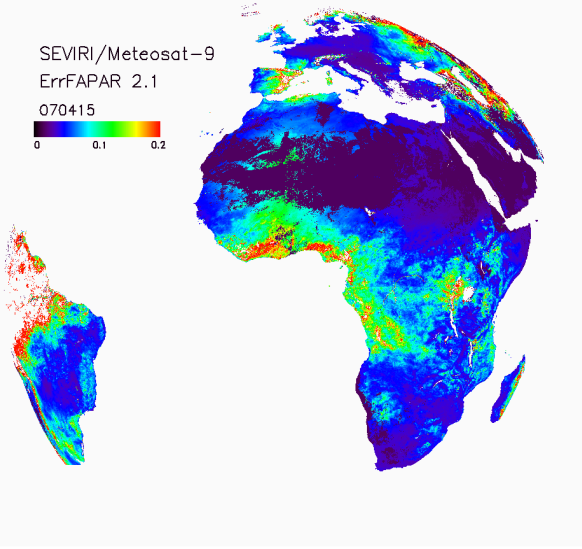


FAPAR









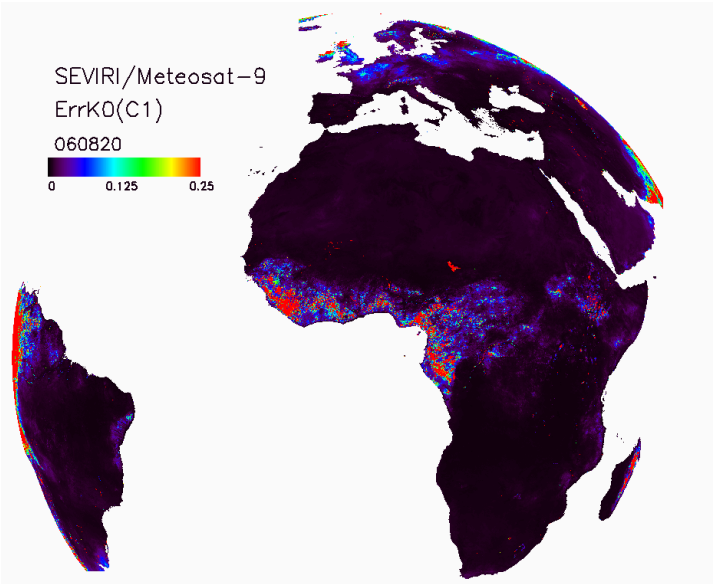
Input data quality

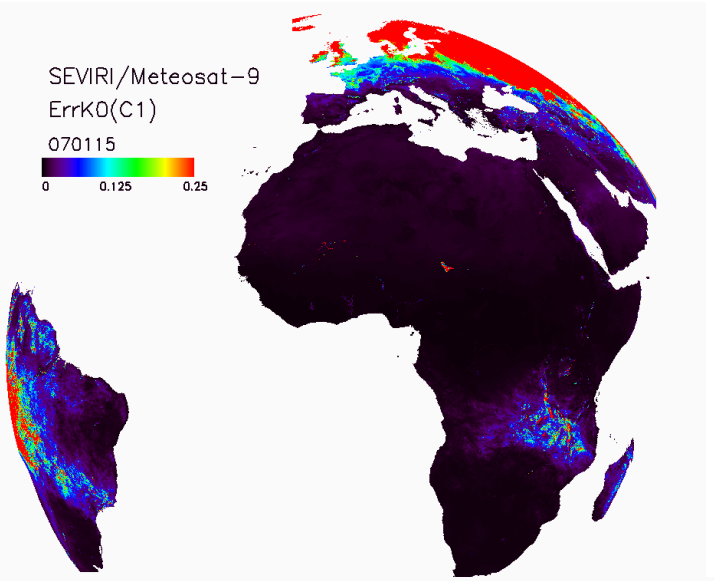
Error estimate (k0, k2)

Summer

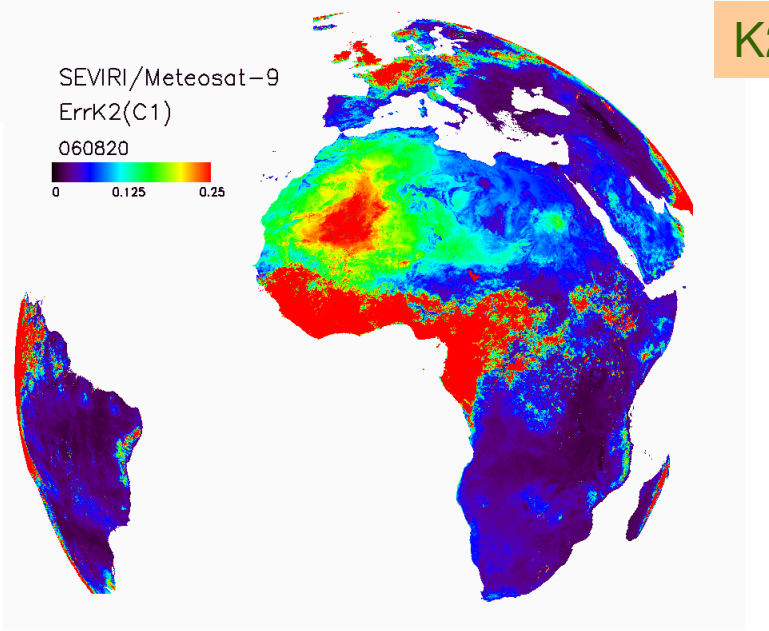
Winter

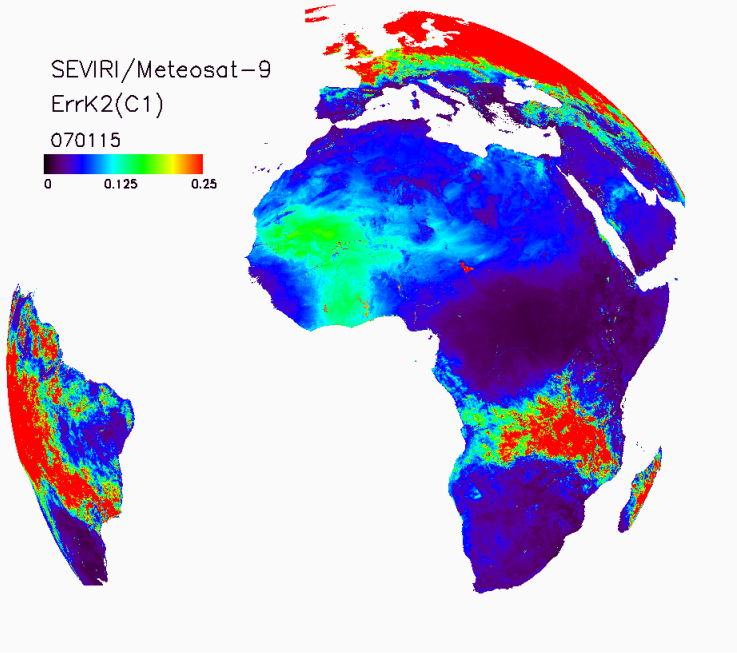
K0





K2

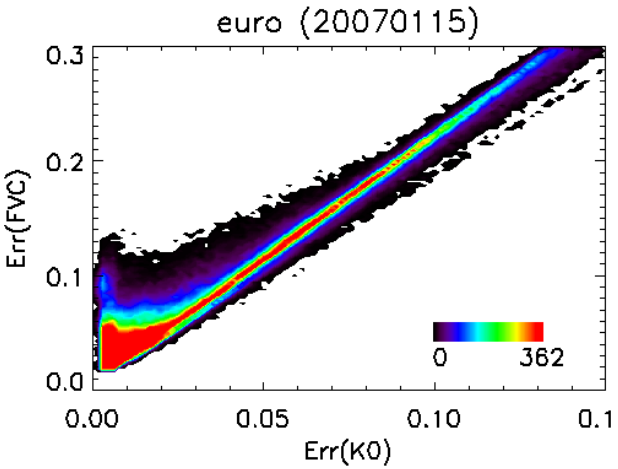


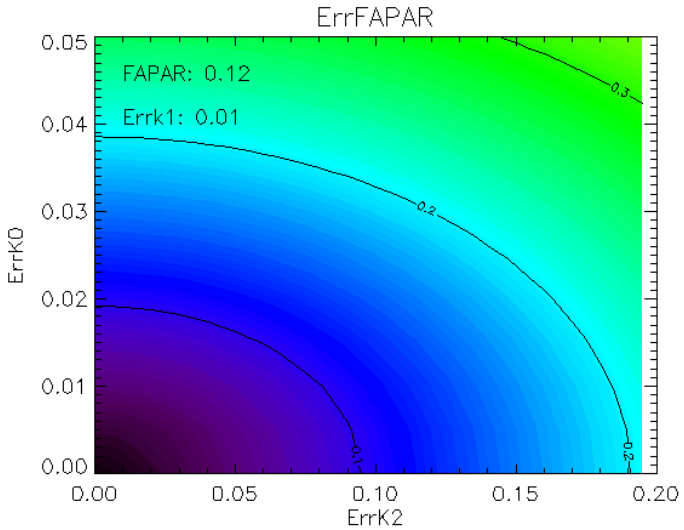


Blind problematic areas

Large errors

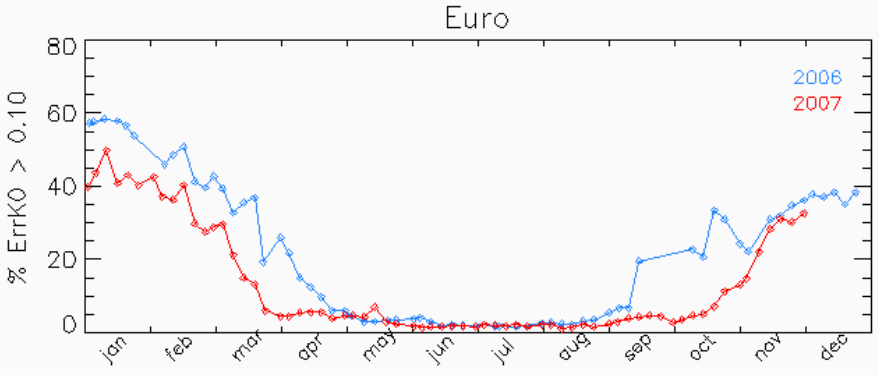
- Assessment of VEGA products uncertainties

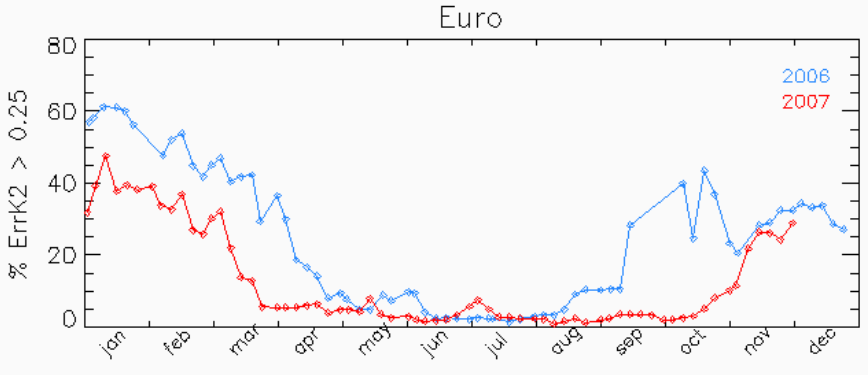




- Outcomes with large errors are not given

Unacceptably large input errors: K0>0.10 k2>0.25





Blind problematic areas

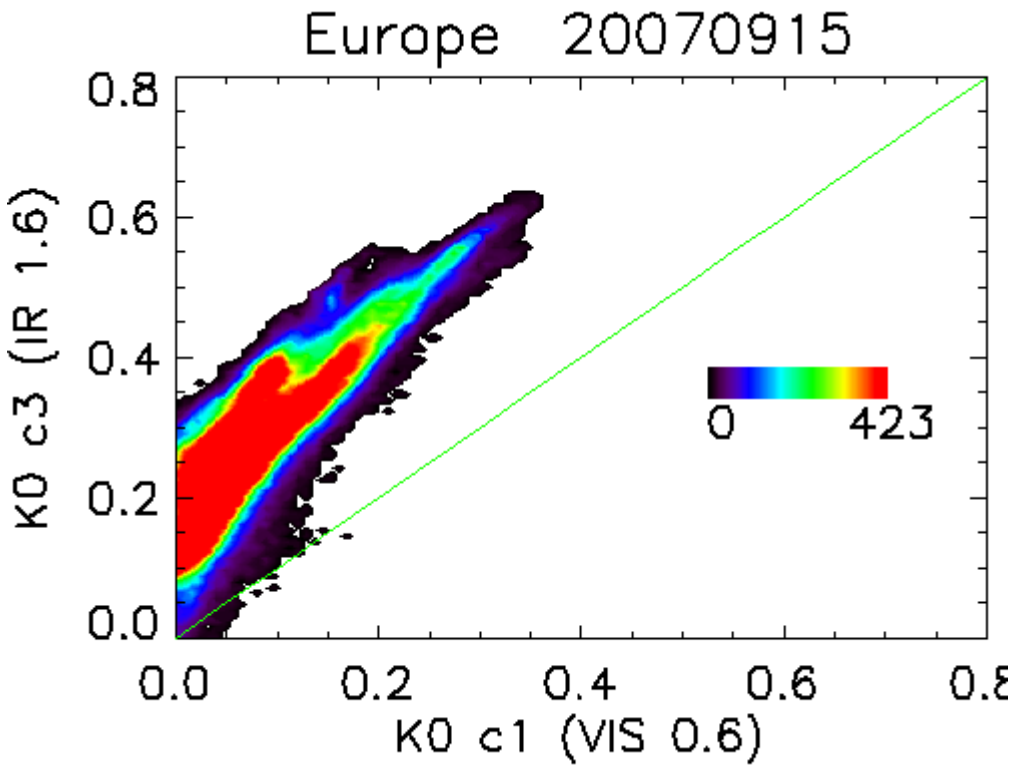
Traces of snow

Bias in the input due to unmodeled environmental factors (e.g. snow)

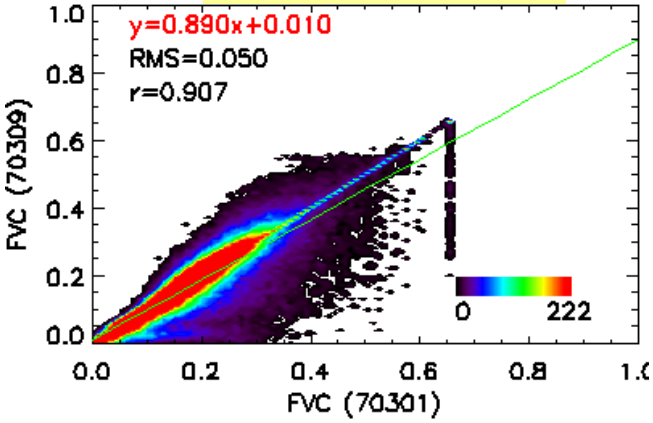
- A “traces of snow” contition → discard unreliable inputs (prone to large errors)

$$k_o(c_1) - k_o(c_3) > Th$$

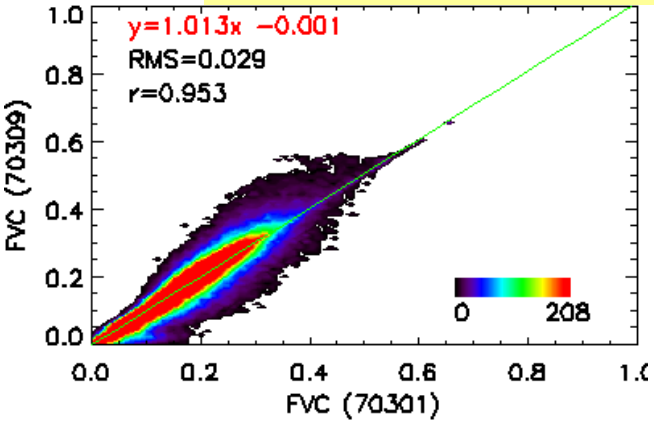
Th ≅ 0



All pixels



Without traces of snow

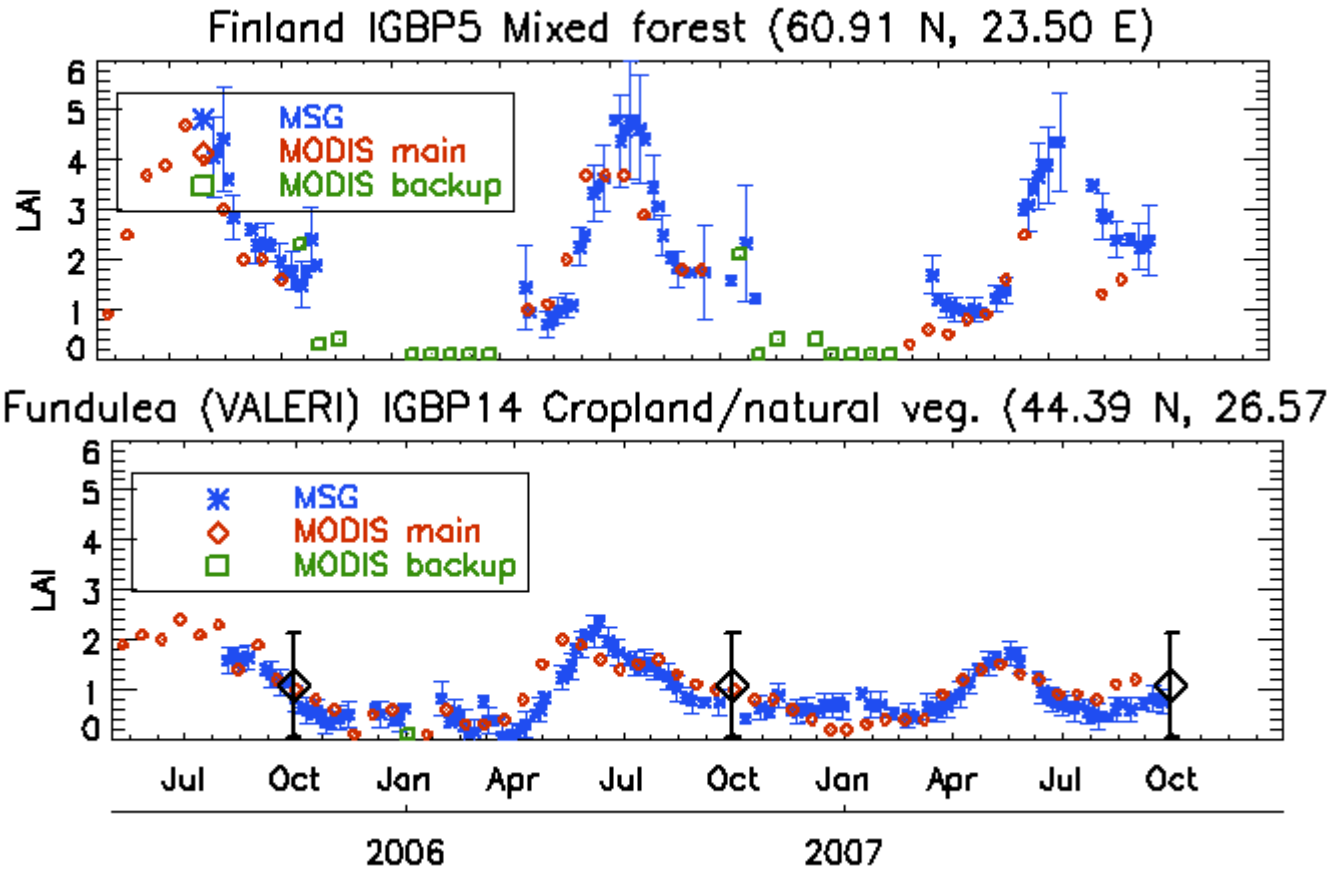


Blind problematic areas

Temporal profiles, Euro

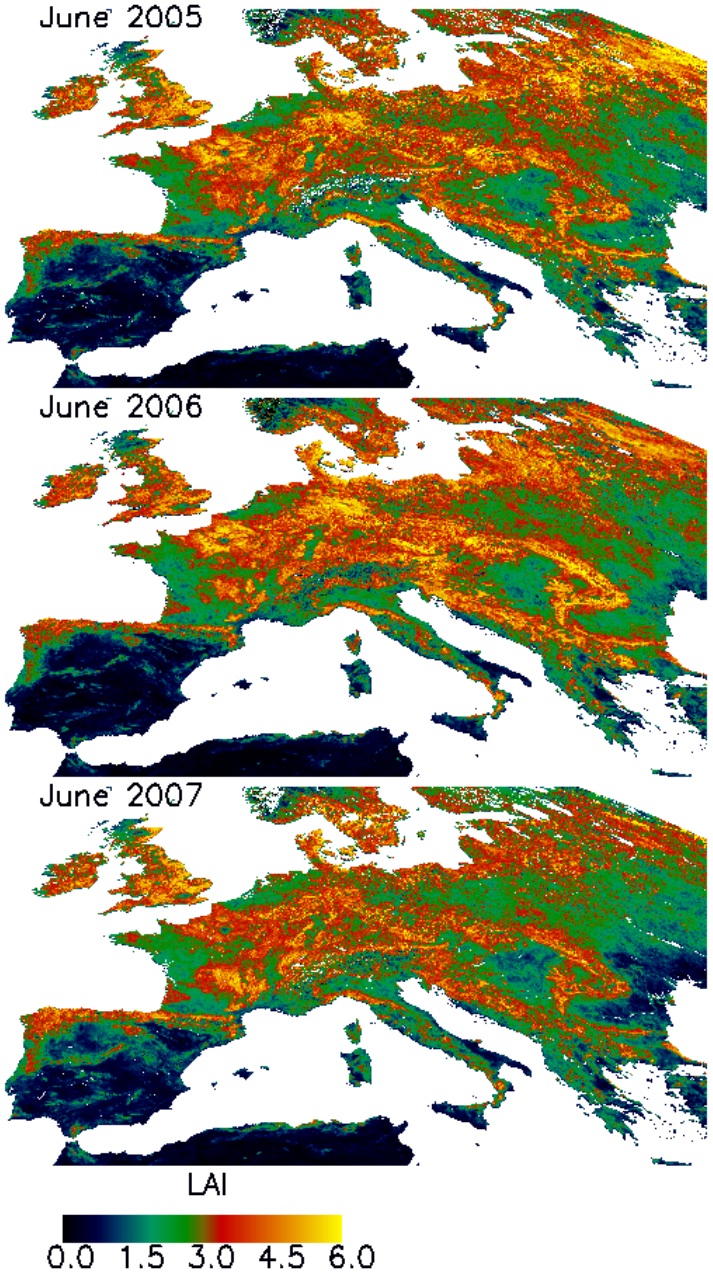
Consolidation of problematic areas

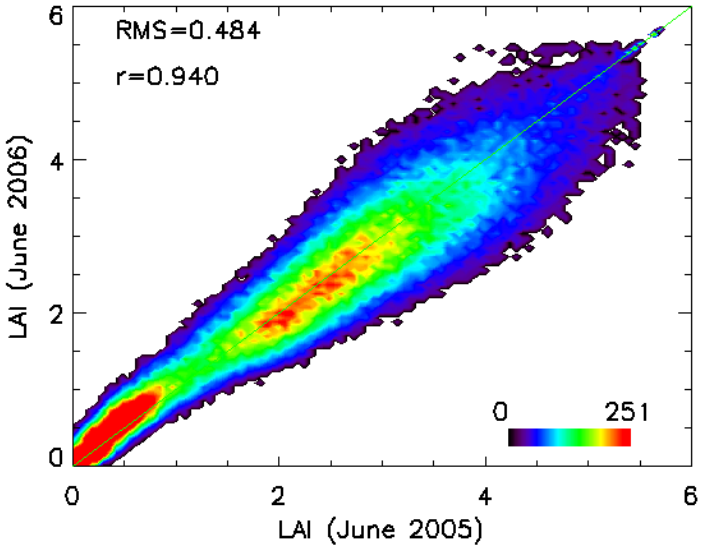
- v2.0: traces of snow were processed (and flagged)
- v2.1: unreliable pixels are not processed→ clean temporal profiles

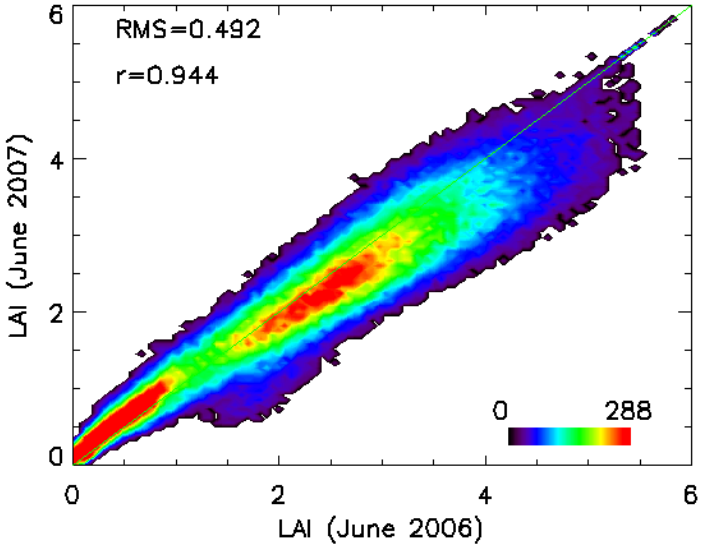


Products analysis

Spatial consistency

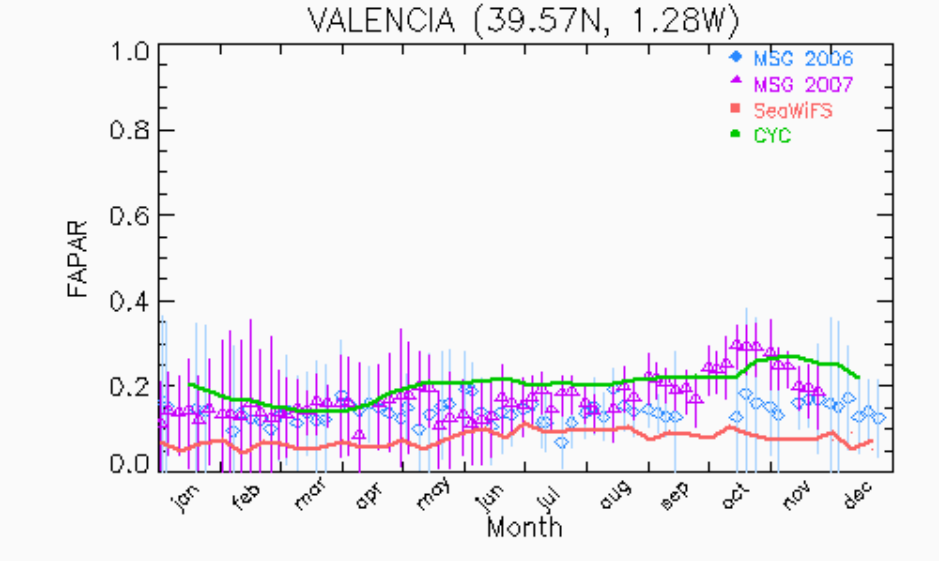


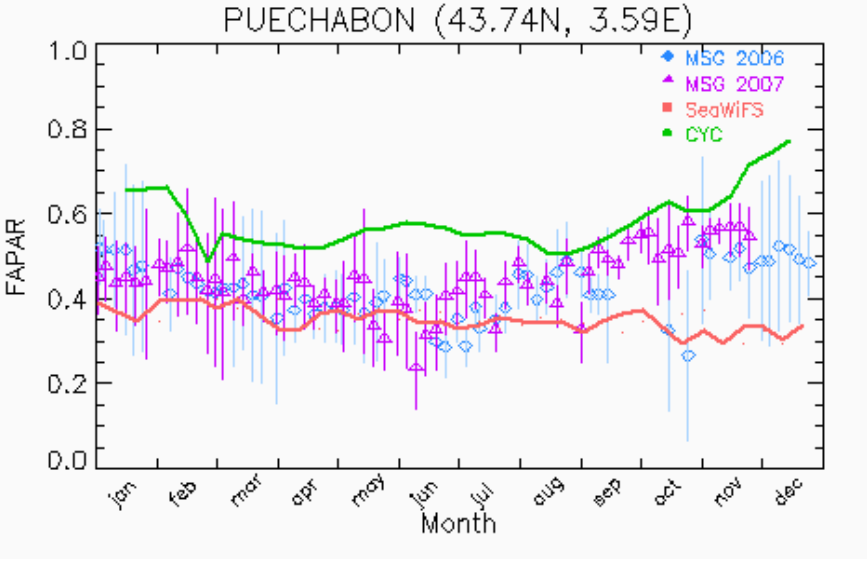


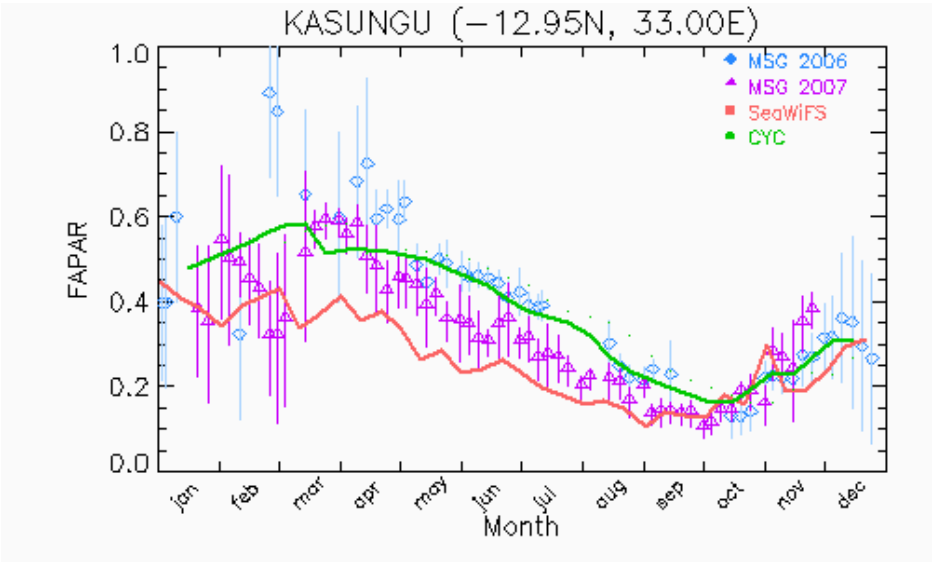


Uncertainties assessment

Analysis of temporal profiles



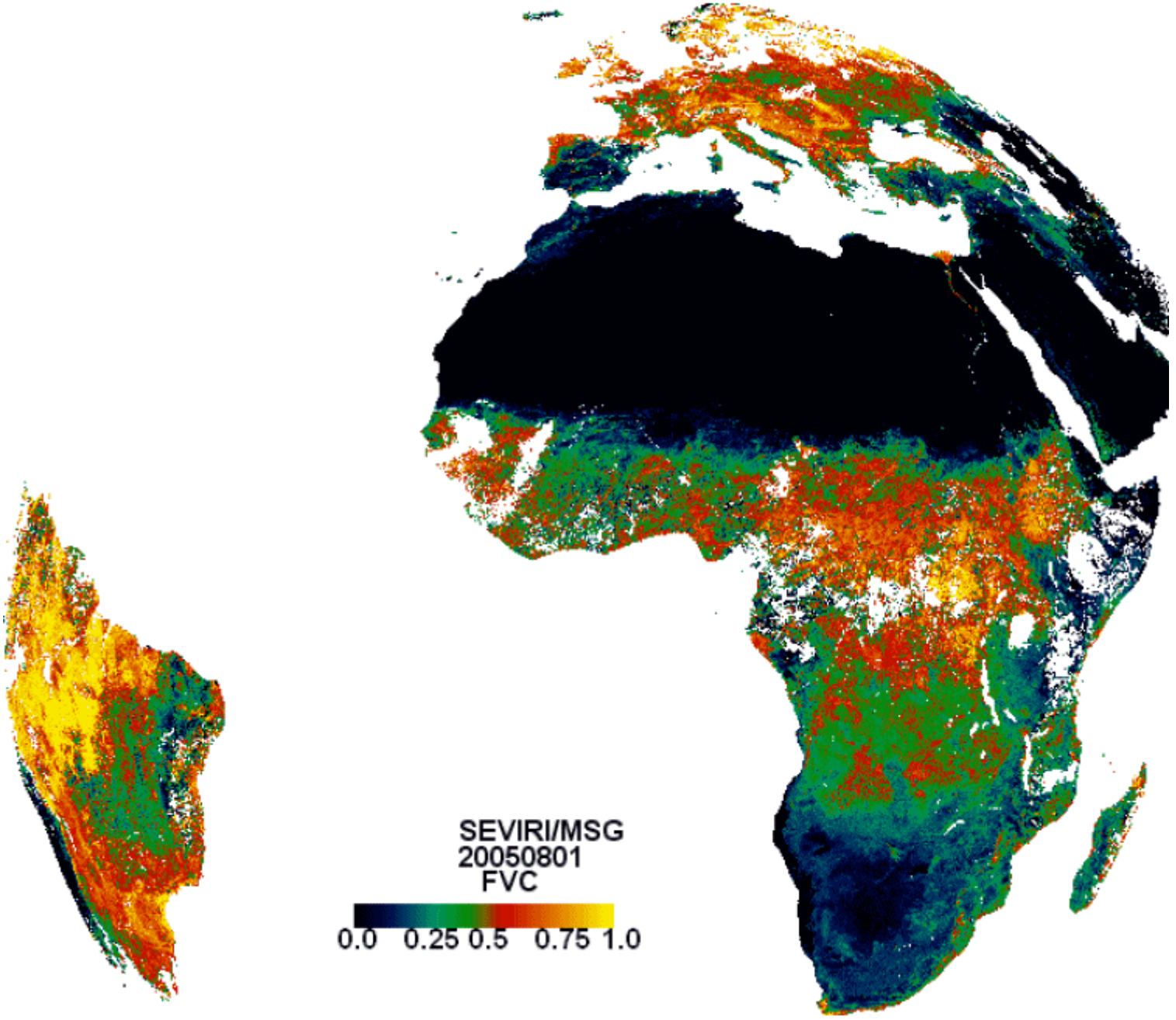




- Error bars provide reliable information about the accuracy level
- MSG FAPAR product fits well with the baseline products (SeaWiFS, CYC) within the error bar

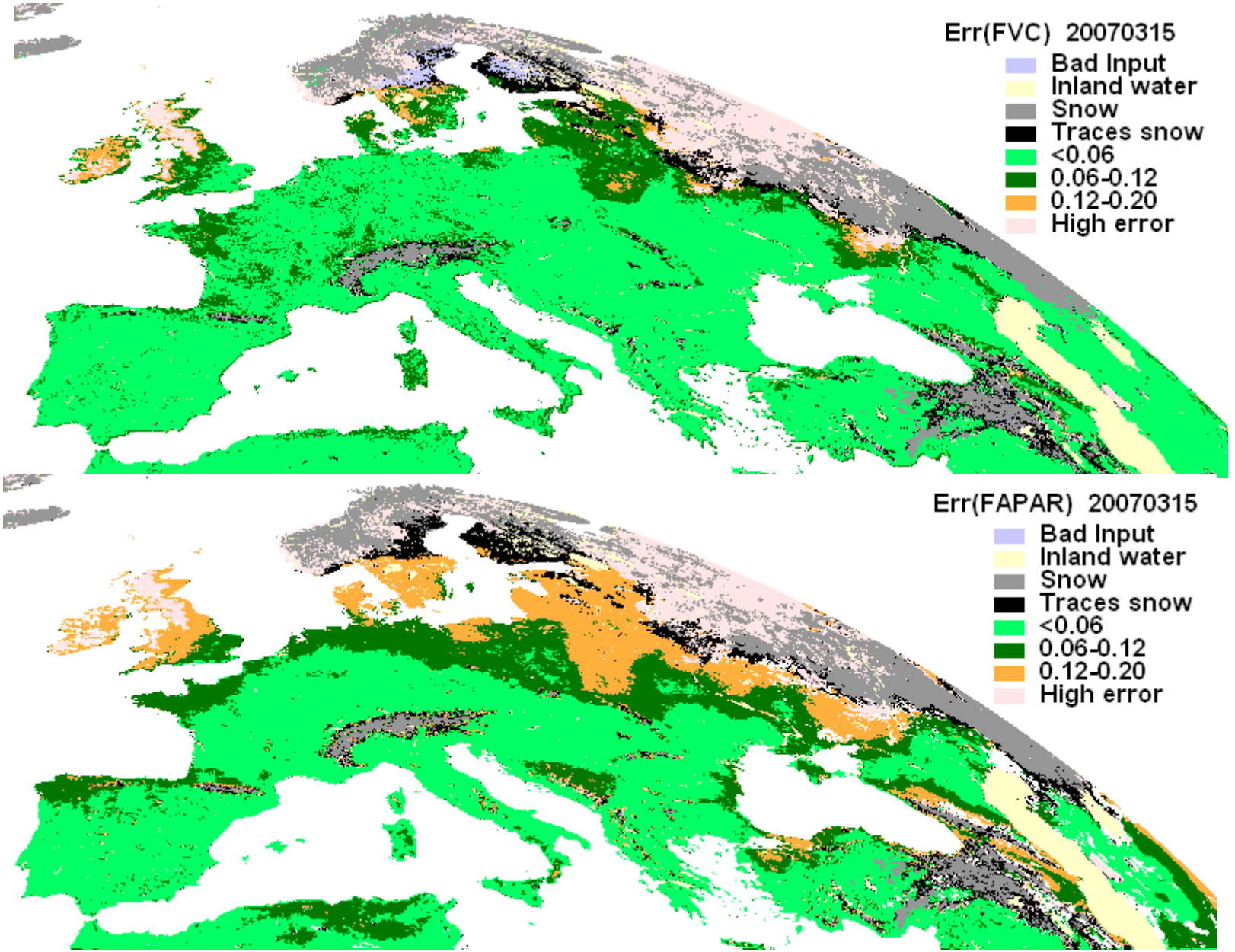
FVC (Sept' 05- Sept'07)

FVC v2.1



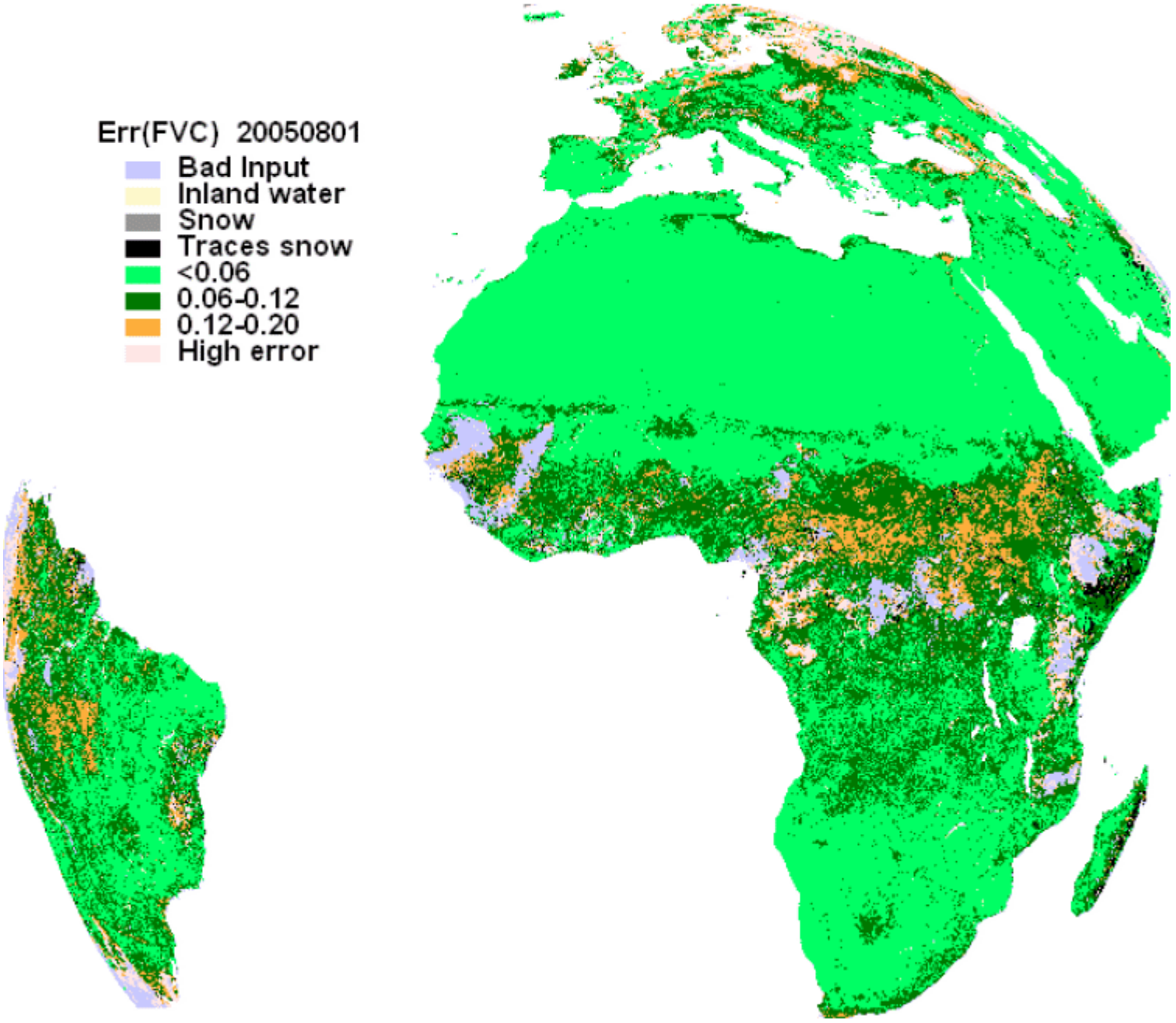
Error estimate and qualiy flag of products

Wintertime Europe



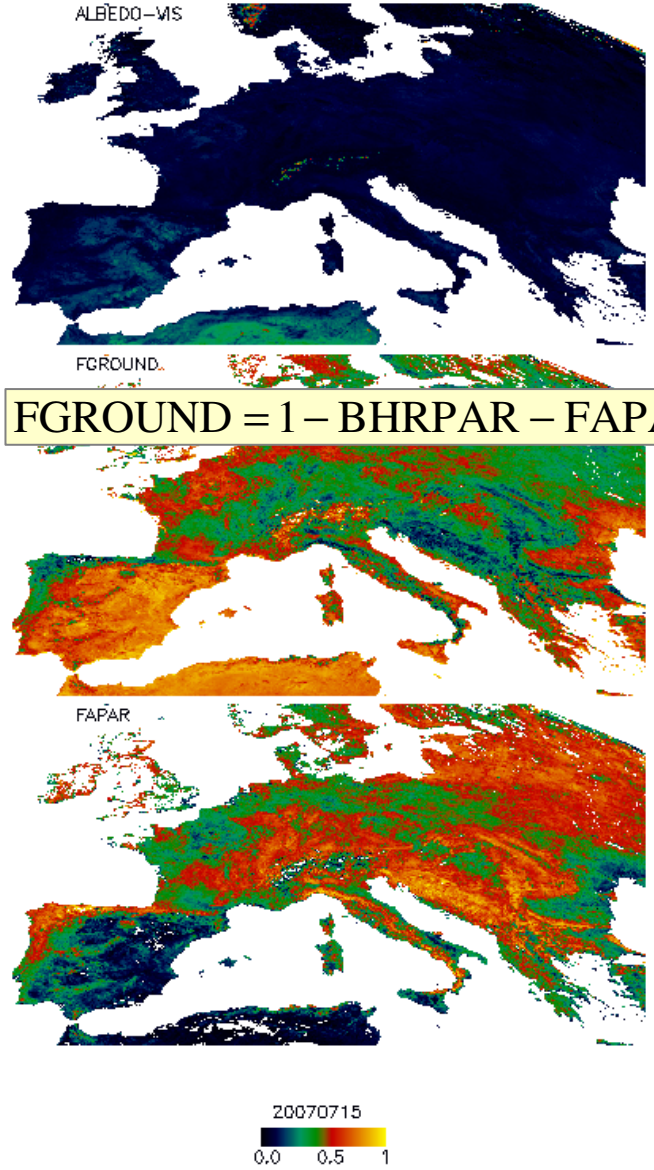
Error Map (Sept'05-Sept'07)

FVC v2.1



Internal consistency among products

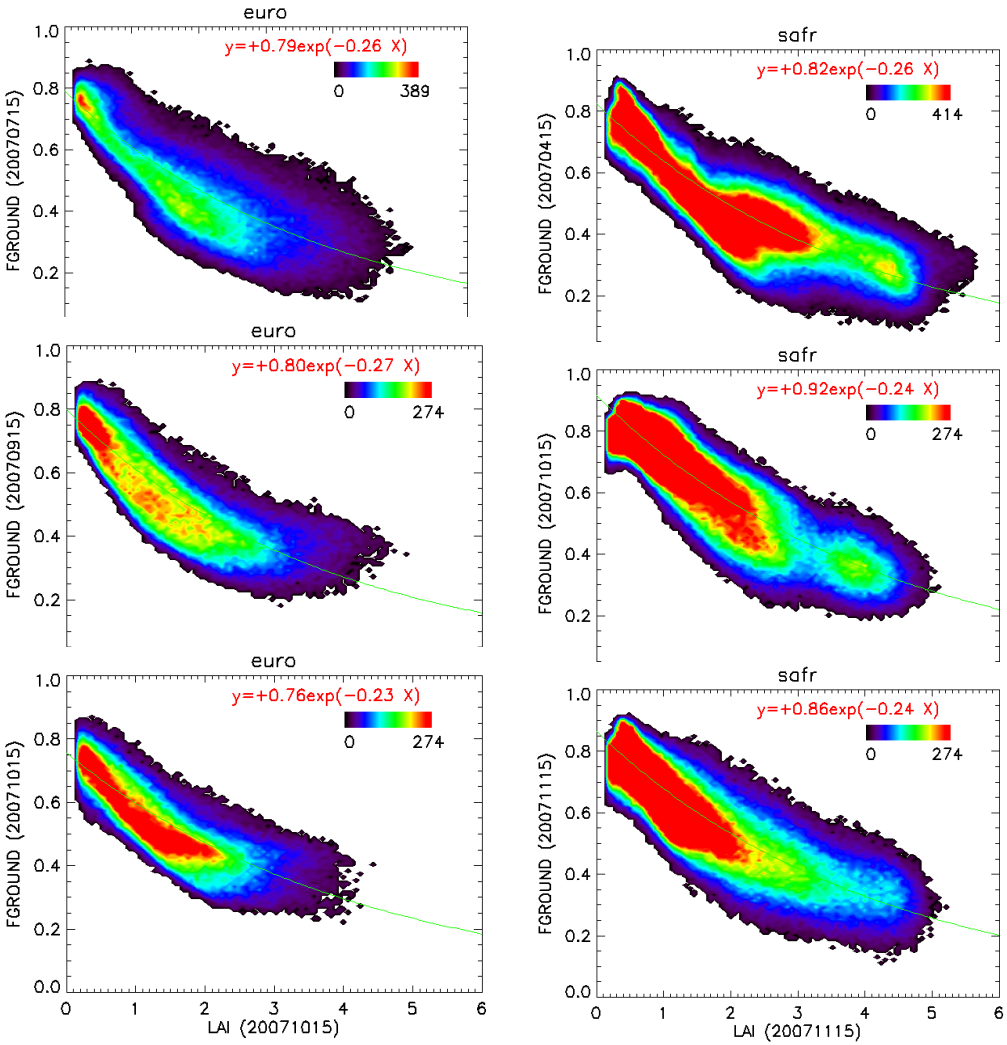
VEGA +ALBEDO



$$FGROUND = 1 - BHRPAR - FAPAR$$

Hu et al. 2007:

$$FGROUND \approx \frac{1-\alpha}{1-\alpha\, r^{*}} \exp[-G(\theta_s)\cdot LAI/\cos(\theta_s)]$$



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Validation of products

DIRECT VALIDATION

- VALERI global sites
- Temporal profiles (Mongu, Dahra)
- Spatial gradient along the Kalahari transect

INDIRECT VALIDATION

- Product analysis (histograms, coverage, spatial consistency, seasonality)
- Temporal analysis (dynamics, cleaness of profiles)
- Spatial and temporal consistency against reference products

  class level, regional level, pixel level (BELMANIP, MODIS ascii sites)

  statistical indicators (bias, correlation, RMS)

REFERENCE PRODUCTS

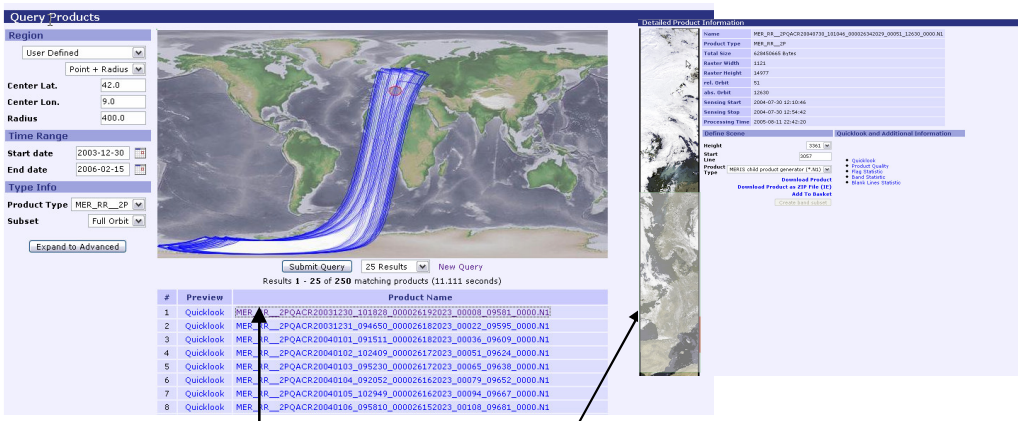
MODIS C5 -1km 8-day, monthly.
MERIS/ENVISAT-1km 10-day (MGVI & TOAVEG)
VEGETATION-SPOT-1km. 10-day (JRC, CYCLOPES)
SEAWIFS-2km. 10-day
POLDER/PARASOL-6km

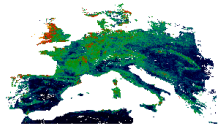
INDIRECT VALIDATION

MERIS/ENVISAT Products

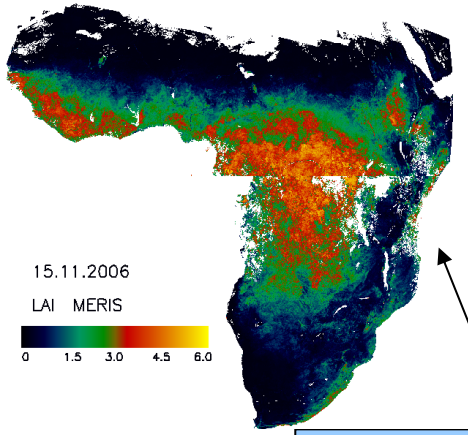
Application of MERIS data to the validation of coarse resolution vegetation

ESA category-1 Research Projects Program





FVC, LAI, FAPAR



MERIS TOAVEG RR reflectance: Selection of dates, orbits and subsets

- Downloading
-Rectification

Apply 2 MERIS BEAM algotihms:
- **MGVI** (FAPAR)
- **TOAVEG** (FVC,LAI, FAPAR)

- Instantaneous biophysical products
-cloud filtering

- Temporal compositing (8-day)
-Reprojection MSG mosaics

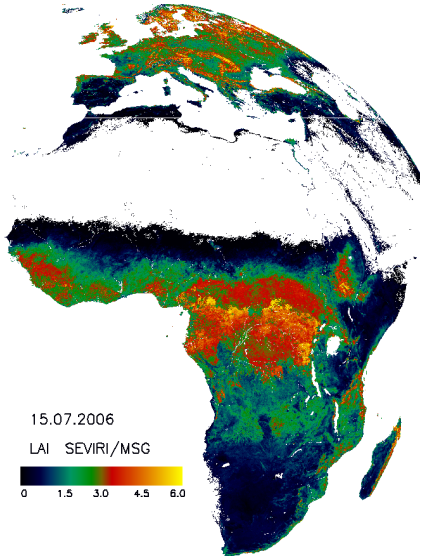
Imagery database (>4000 images)

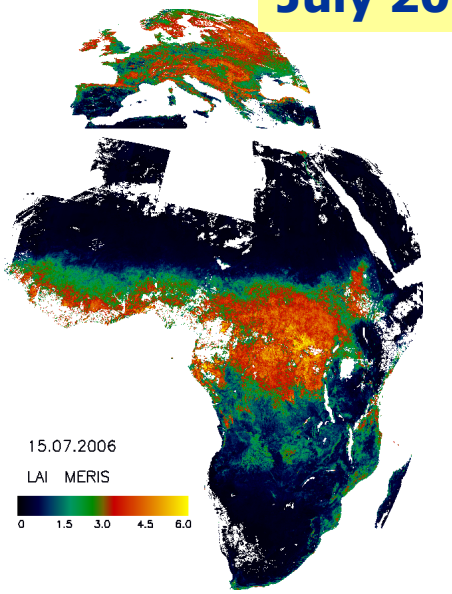
Processing

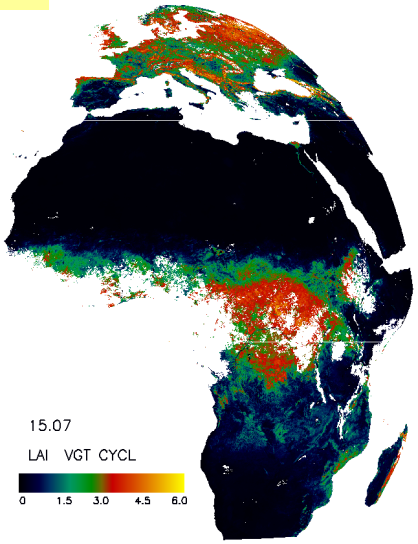
INDIRECT VALIDATION

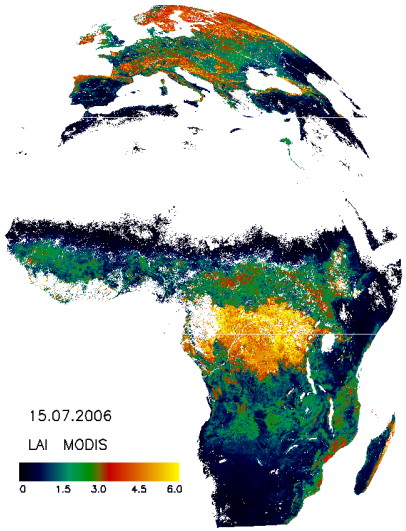
Spatial consistency

July 2006

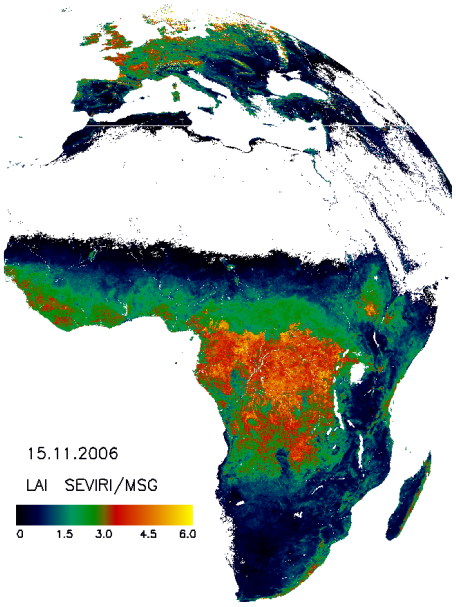


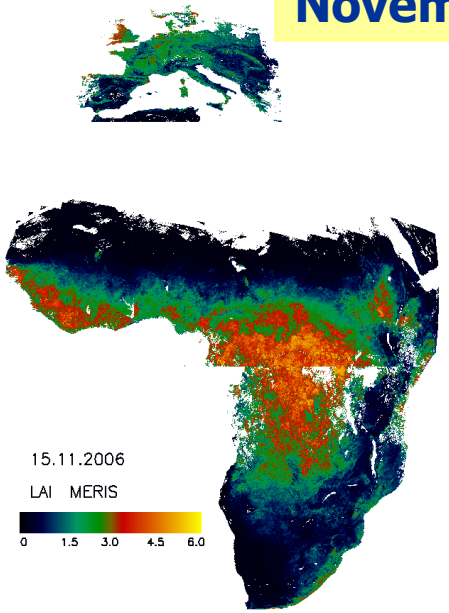


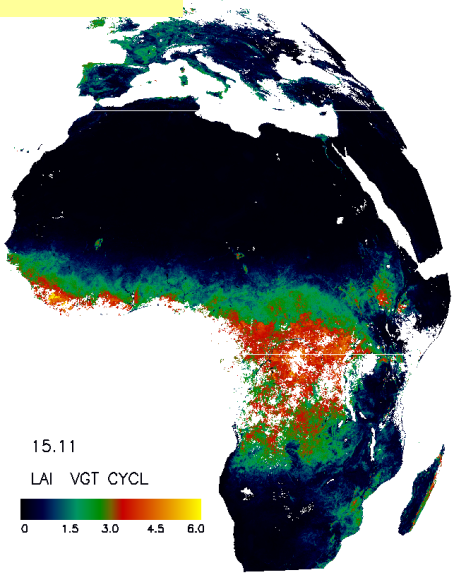


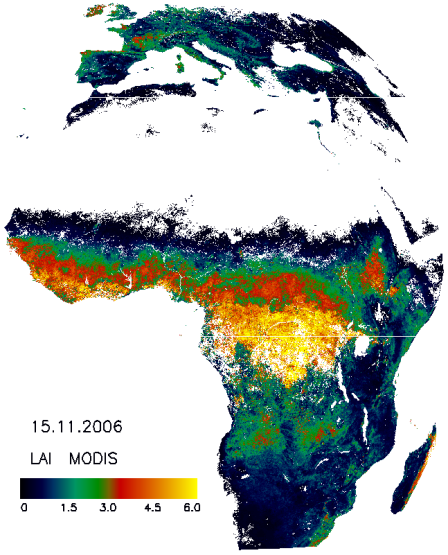


November 2006







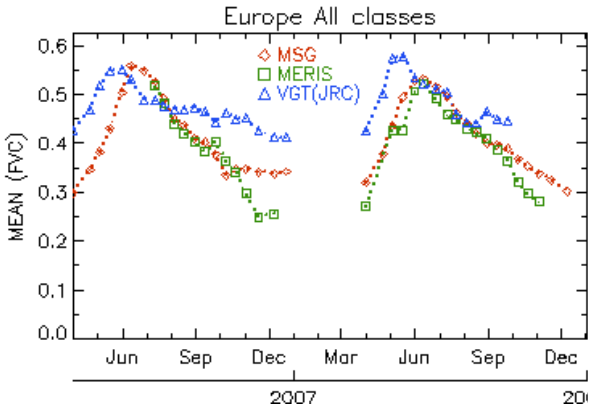


INDIRECT VALIDATION

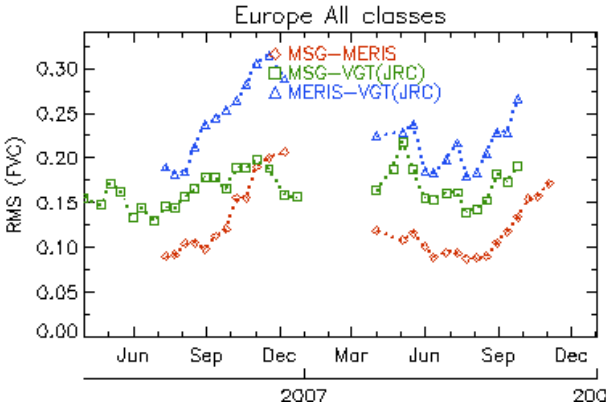
Time series of FVC statistics

FVC (all valid pixels in Europe)

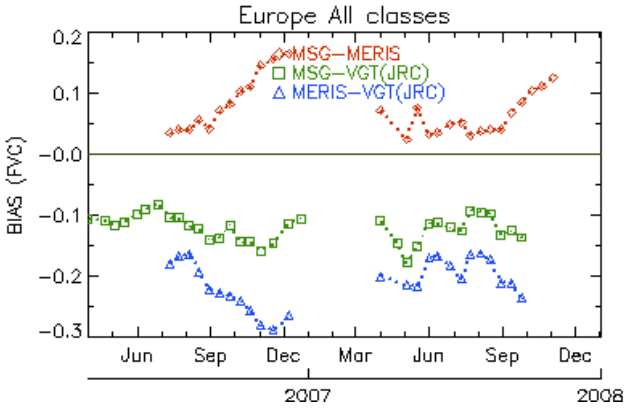
Mean



RMS

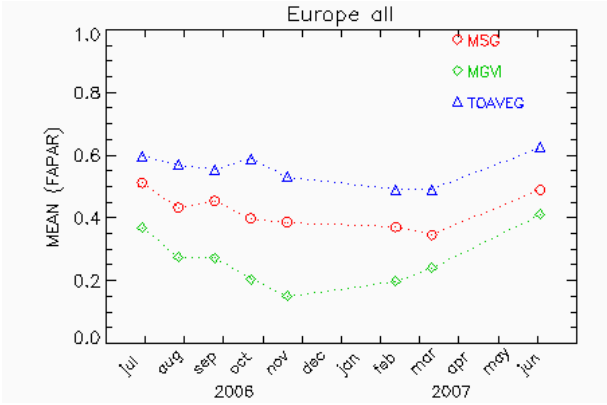


Bias

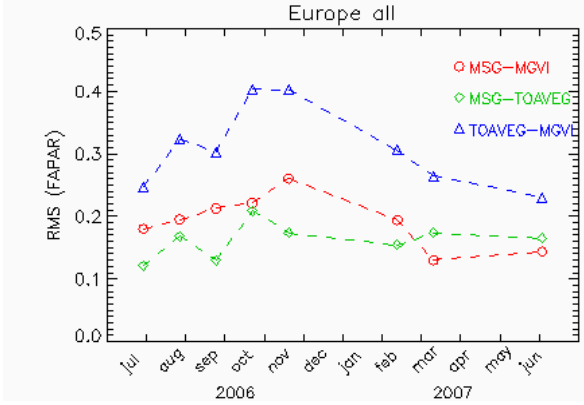


FAPAR (all valid pixels in Europe)

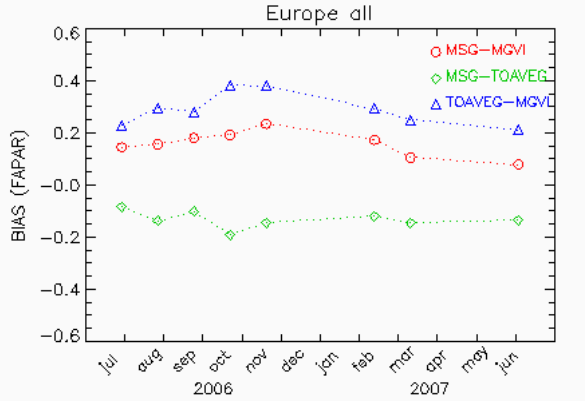
Mean



RMS



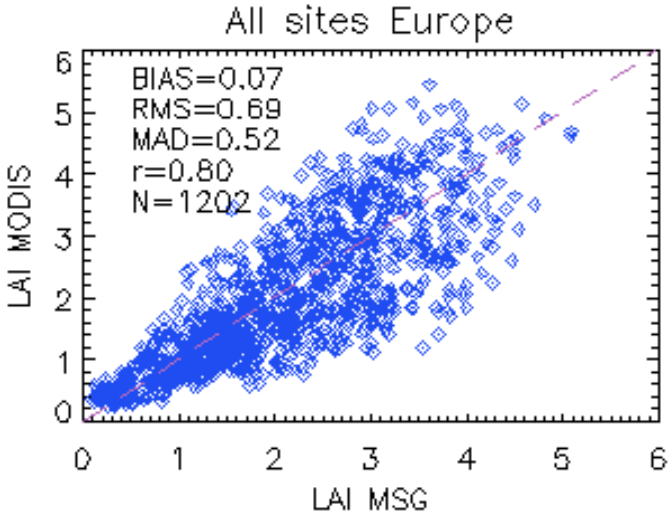
Bias

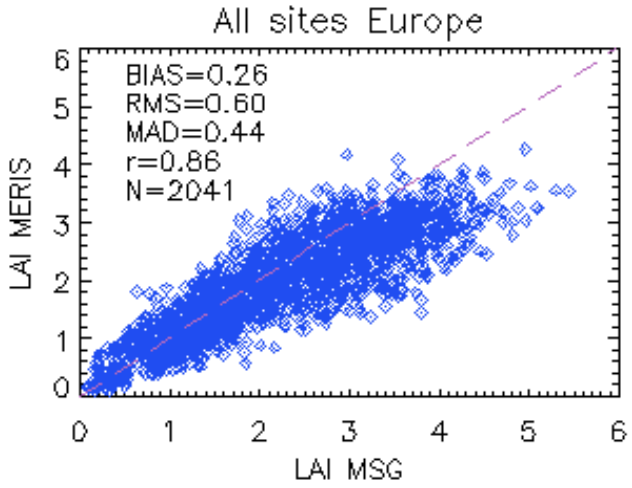


INDIRECT VALIDATION

Scatter-plot BELMANIP sites in Europe

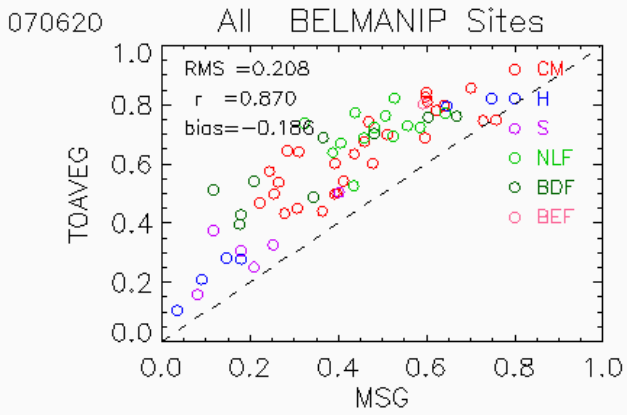
LAI products Europe (2006-2007)

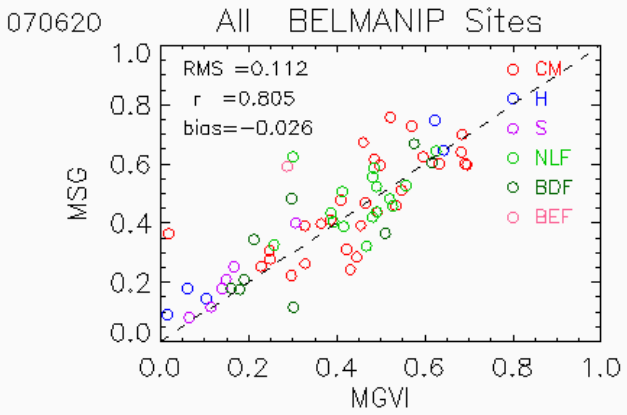


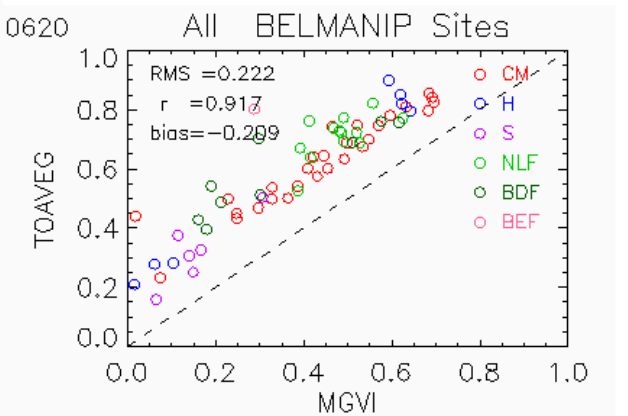


MSG LAI is spatially and temporally consistent (RMS<0.70)

FAPAR products 20 June 2007





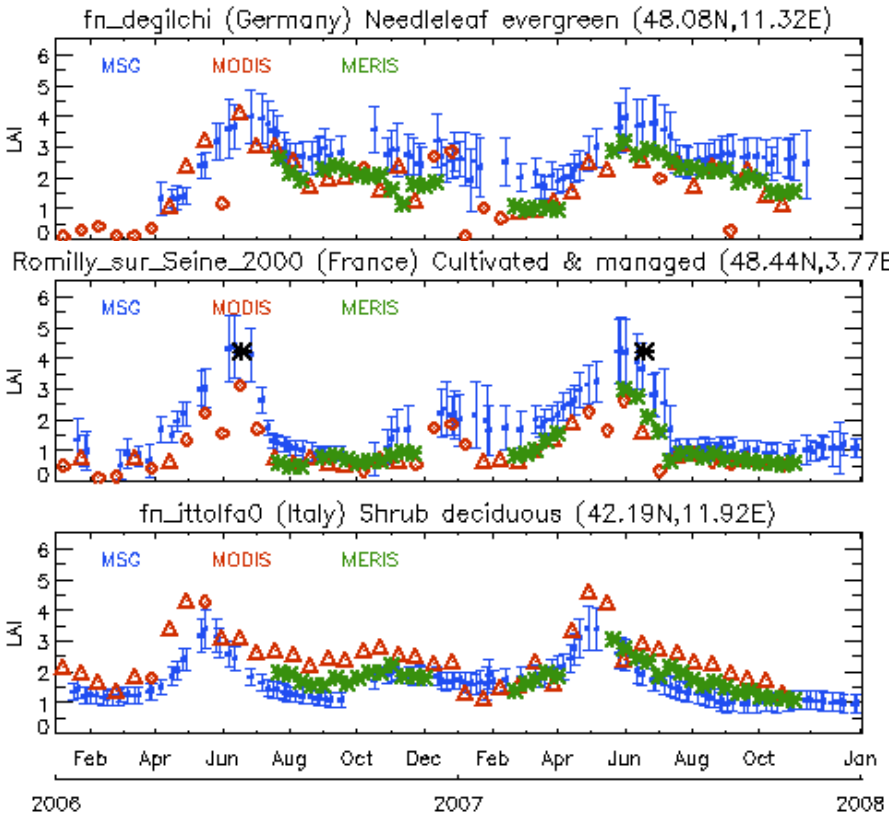


MSG FAPAR retrievals are beteween MERIS estimates from MGVI and TOAVEG

INDIRECT VALIDATION

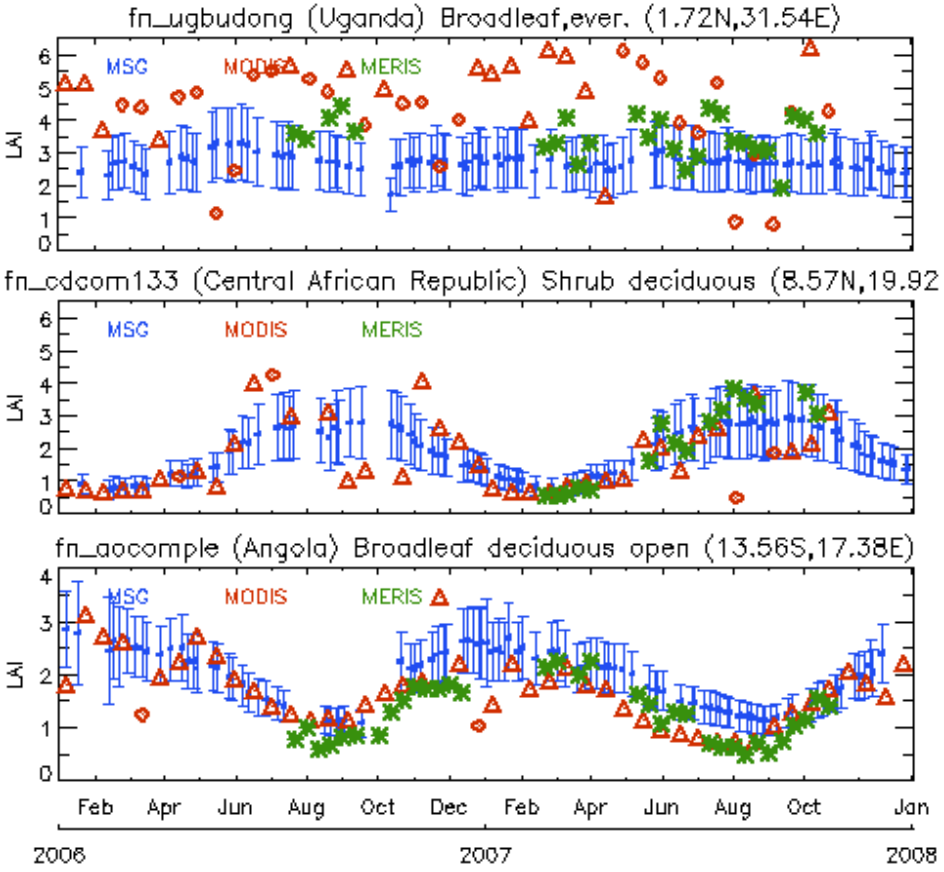
MSG LAI time profiles

Europe



- some biome-dependent differences (e.g. needle-leaf forest)
- partial coverage and higher errors for high latitudes
- stable and in good agreement with MODIS and MERIS in Mediterranean areas

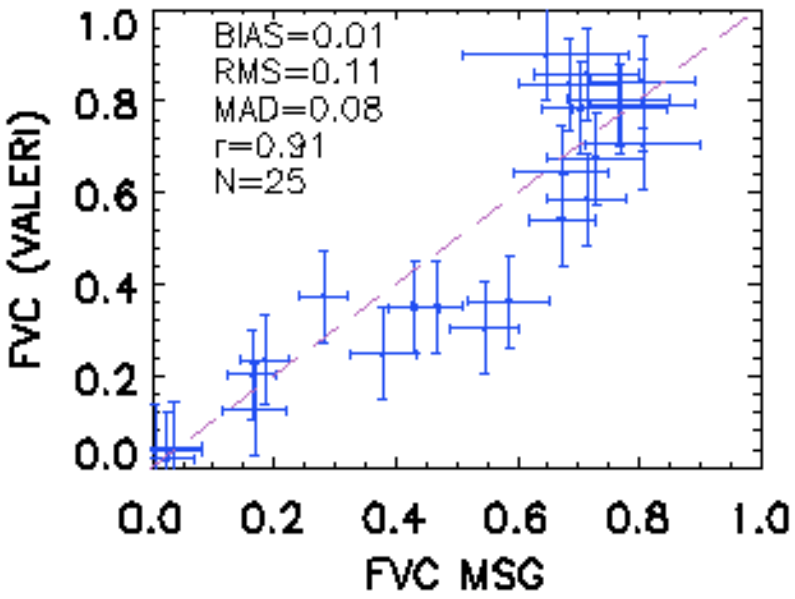
Consolidated regions (Africa)



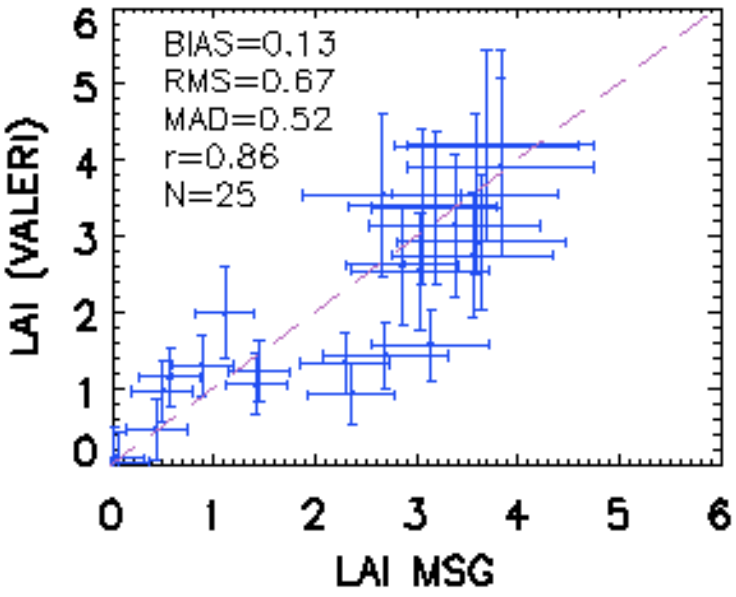
- optimal quality for all biomes
- product is available all the time, with no gaps during the growing season

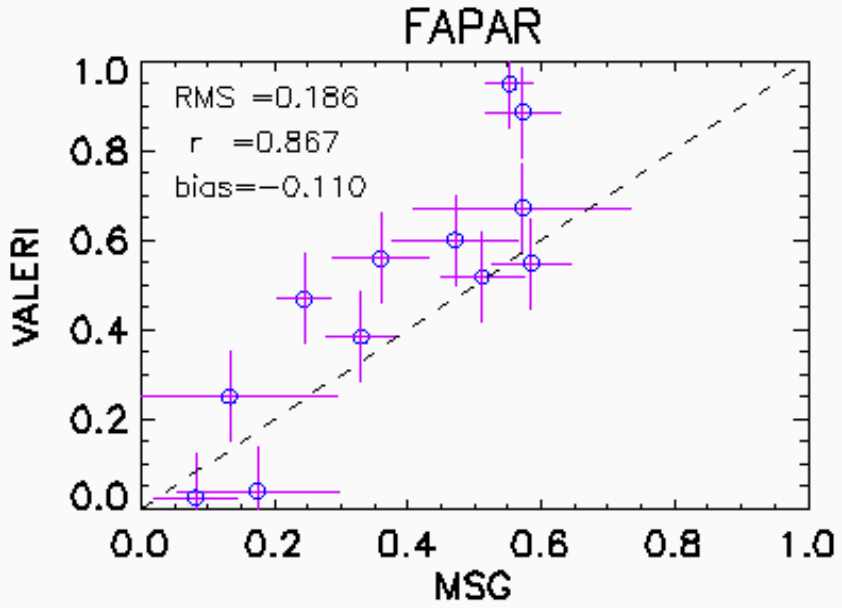
DIRECT VALIDATION

VALERI ground based maps



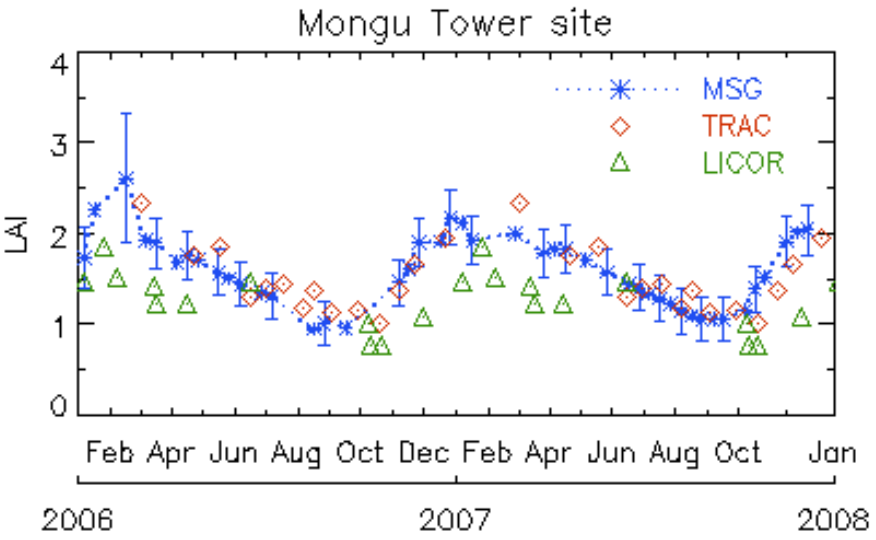
Land-SAF products compare well with globally distributed VALERI in-situ based maps

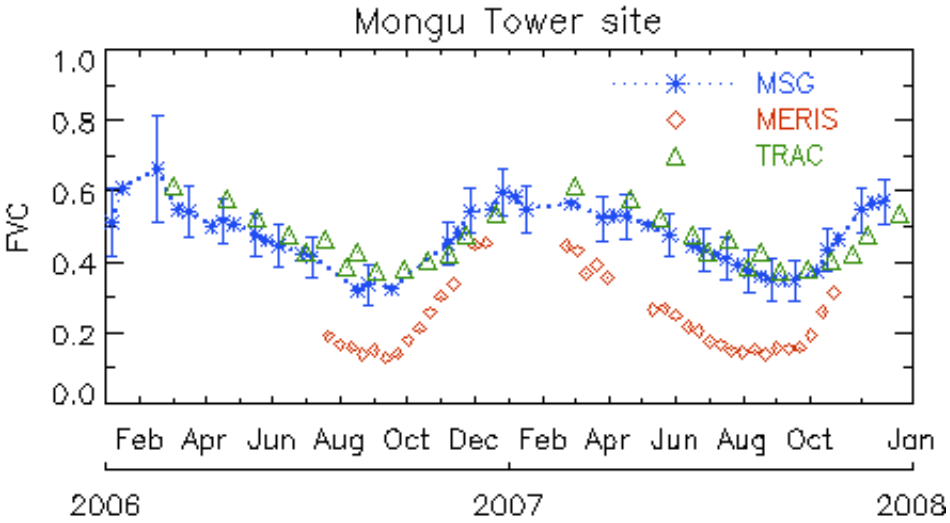




DIRECT VALIDATION

Data supplied by SAFARI team



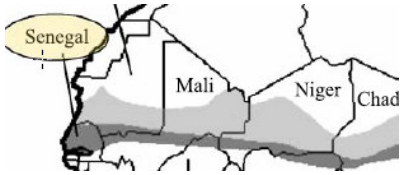


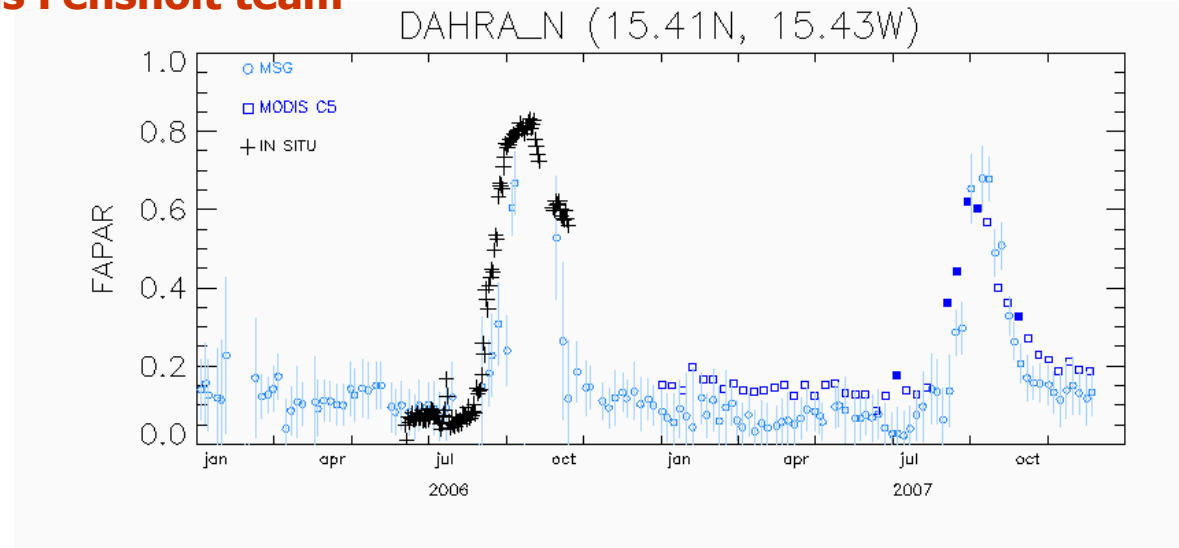
- LAI and FVC describe the pattern of seasonal vegetation change observed at a Kalahari Woodland, Mongu (Zambia)
- FVC is closer than MERIS to ground measurements

DIRECT VALIDATION

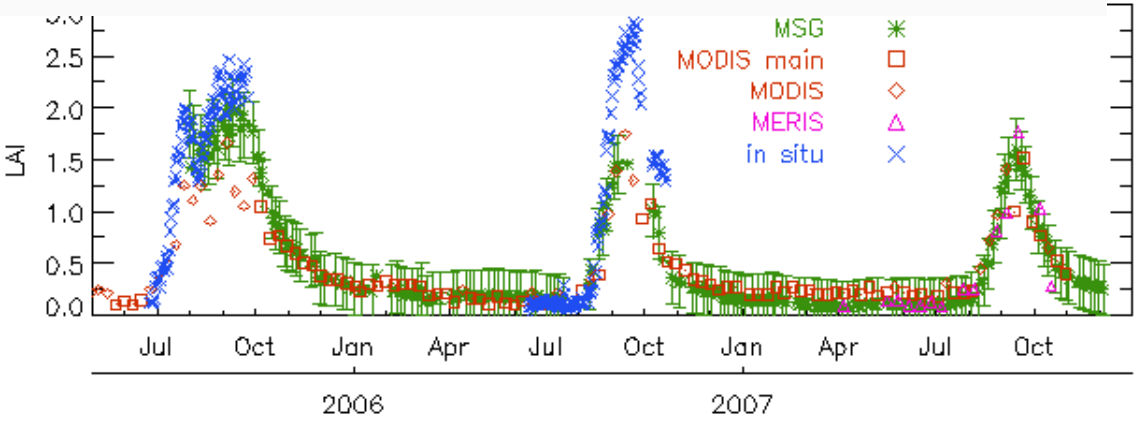
Perfiles temporales

Data supplied by Rasmus Fensholt team





$$FAPAR \approx 1 - \exp\left[\frac{-G(\mu_0)}{\mu_0} < LAI >\right]$$

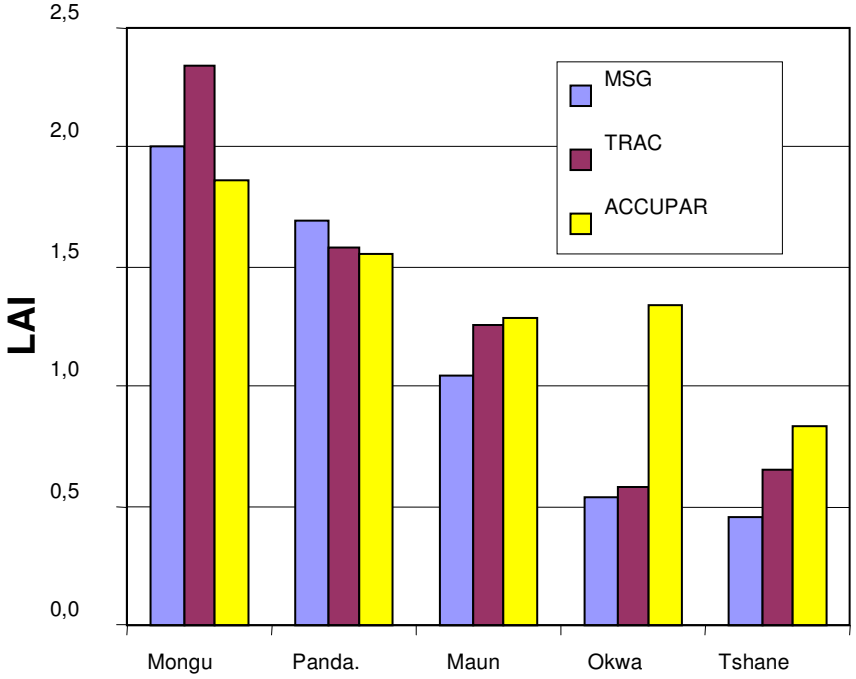


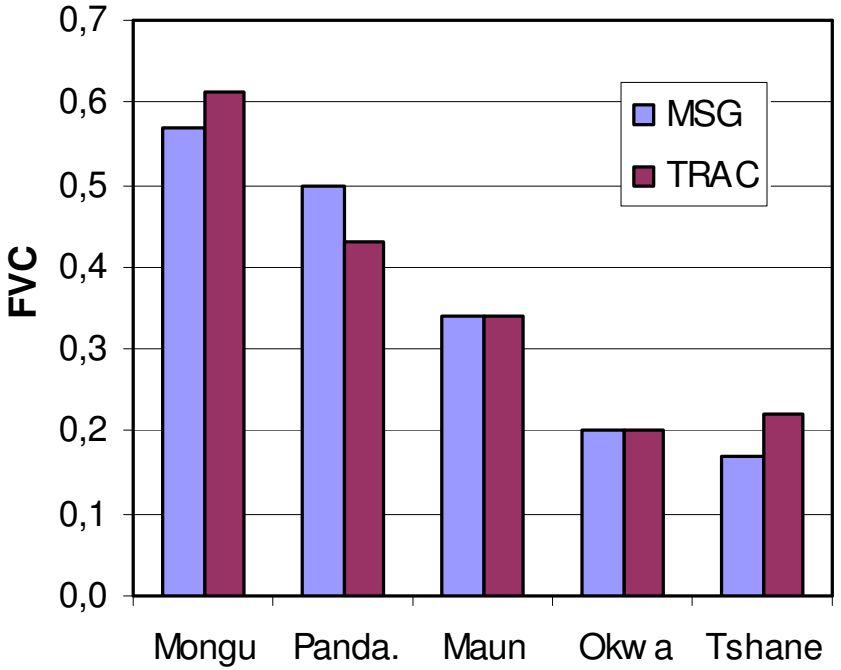
- FAPAR and LAI products follow the seasonality of the vegetation activity during 2005 and 2006 at Sahel grasslands, Dahra (Senegal).

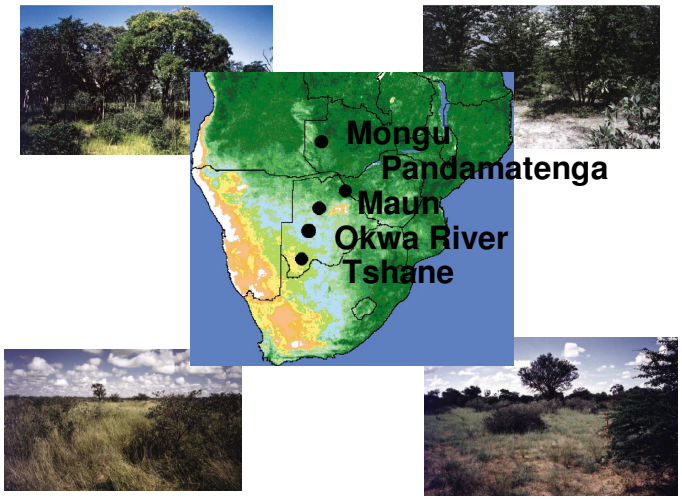
Comparison with ground measurements (SAFARI 2000)

KALAHARI TRANSECT

A gradient with different shrubland/woodland structures







FVC and LAI captured the decreasing vegetation productivity along the Kalahari transect in the wet season

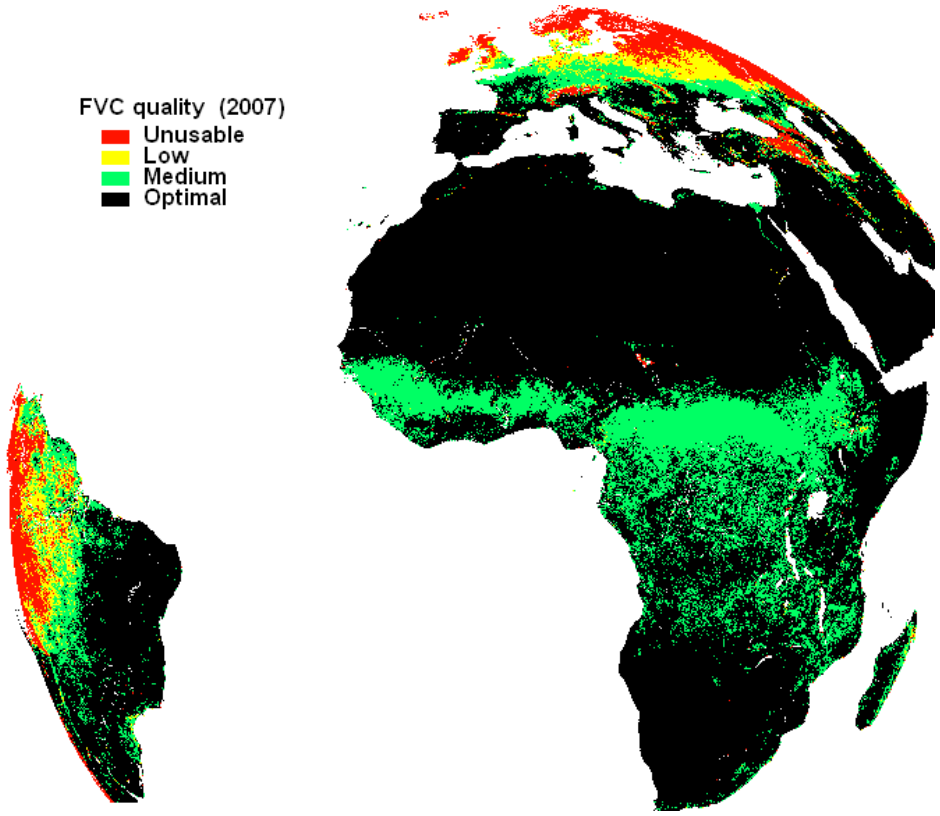
We conclude that Land-SAF products performed remarkably well for African semiarid grasslands, woodlands and savannas

INDEX

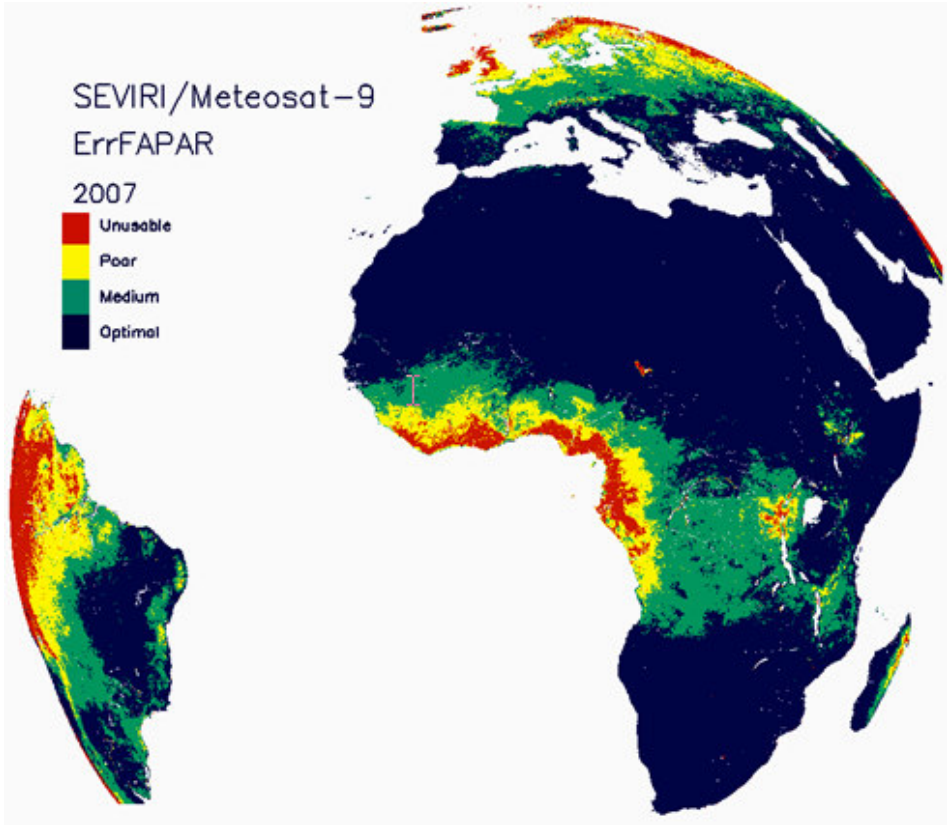
1. Description of the MSG vegetation products
2. Validation of products
3. Added value and potential applications

Compliance with the URD

Mean values over 2007



Optimal: Err(FVC)<0.10
Medium: 0.10<Err(FVC)<0.15
Low: 0.15<Err(FVC)<0.20
Unusable: Err(FVC)>0.20

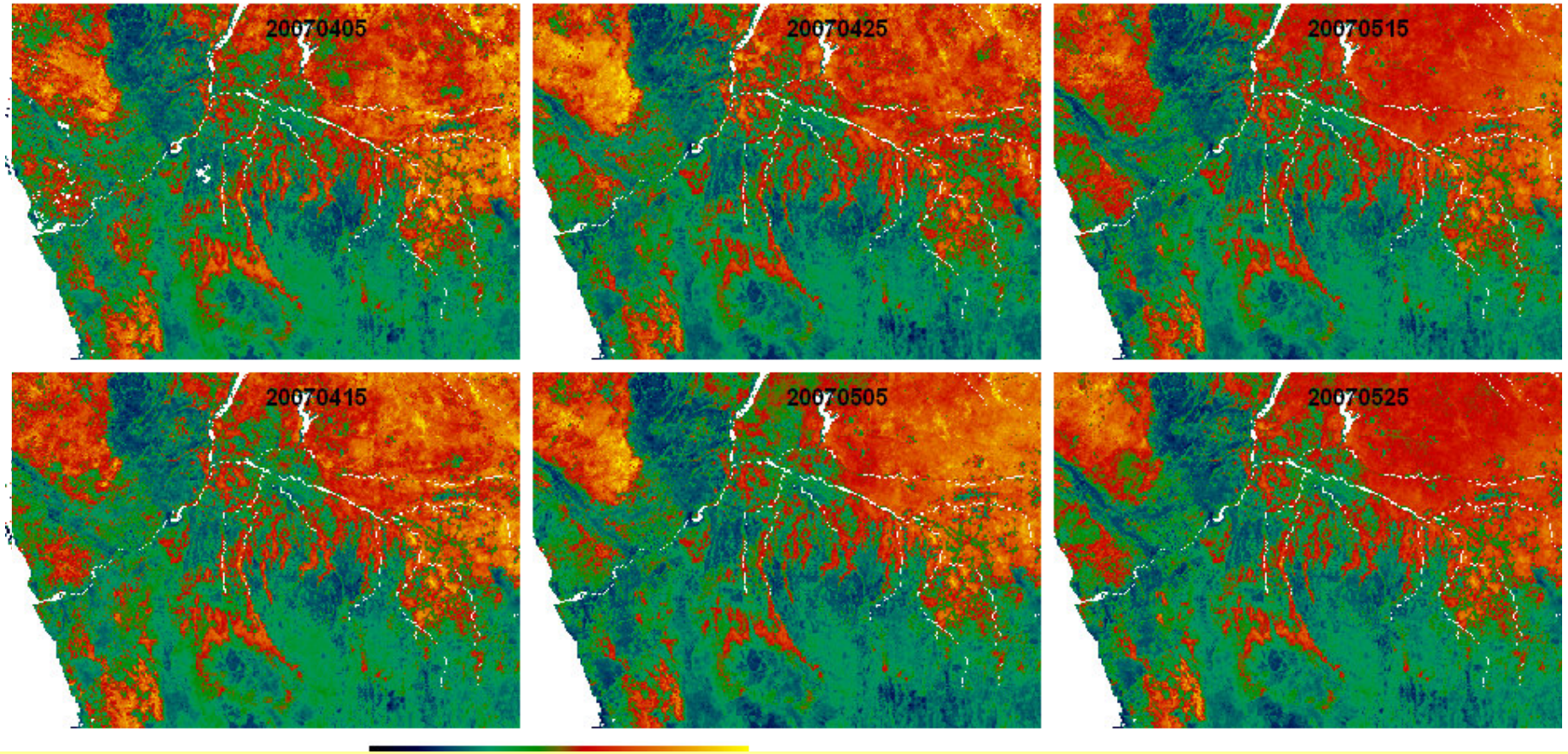


Optimal: Err(FAPAR)<0.10
Medium: 0.10<Err(FAPAR)<0.15
Low: 0.15<Err(FAPAR)<0.20
Unusable: Err(FAPAR)>0.20

FURTHER ADDED-VALUE WITH REGARD TO SIMILAR PRODUCTS

Sequence of products over a 50-day period, S_Africa (0º S, 11.2º E – 8.3ºS, 23.2ºE).

Land-SAF LAI product

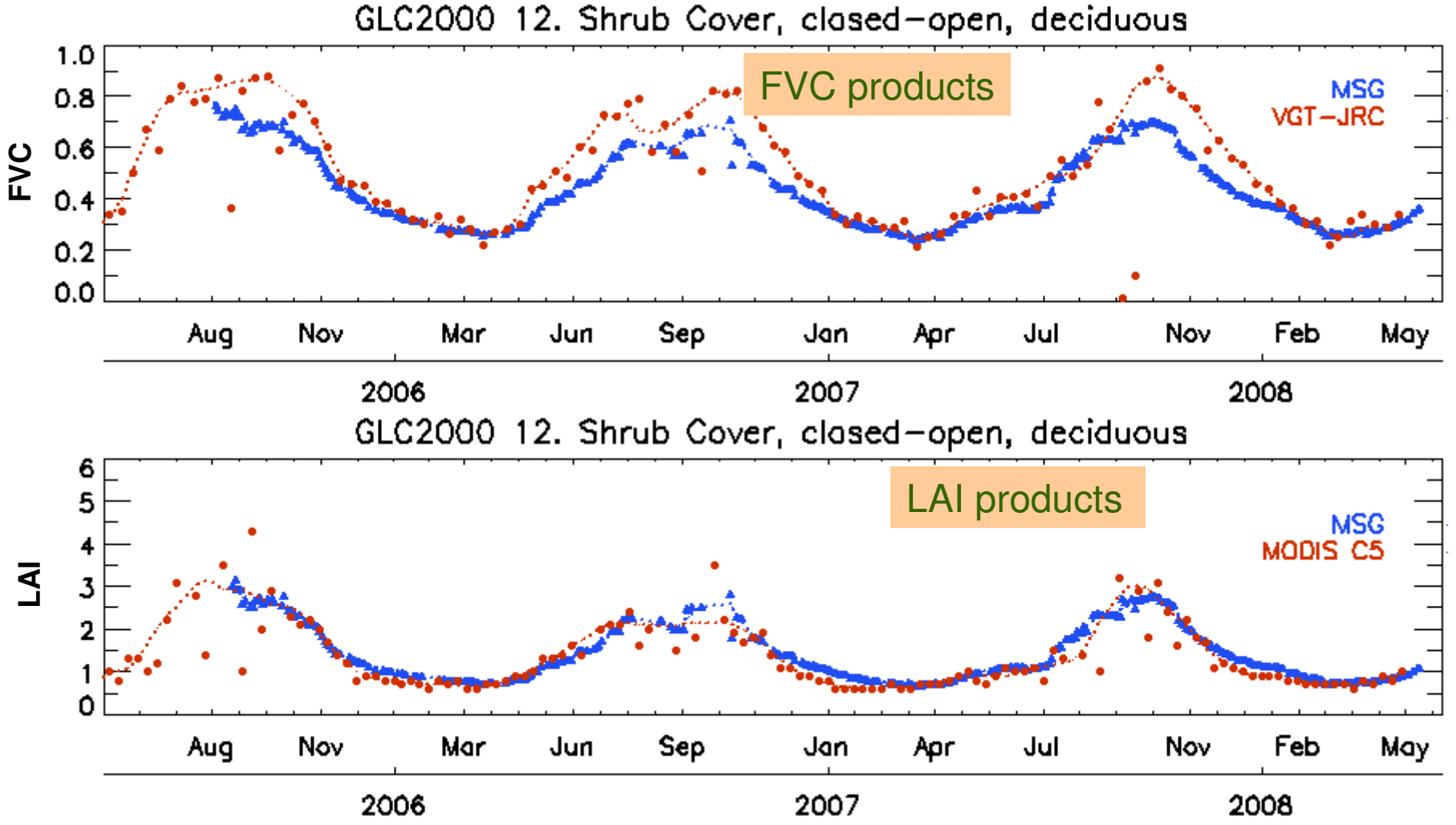


The temporal continuity and stability of LAI MSG product clearly outperforms that of MODIS collection 5 product.

APPLICATION: INTERANNUAL DYNAMICS

FVC & LAI (Subsahelian region)

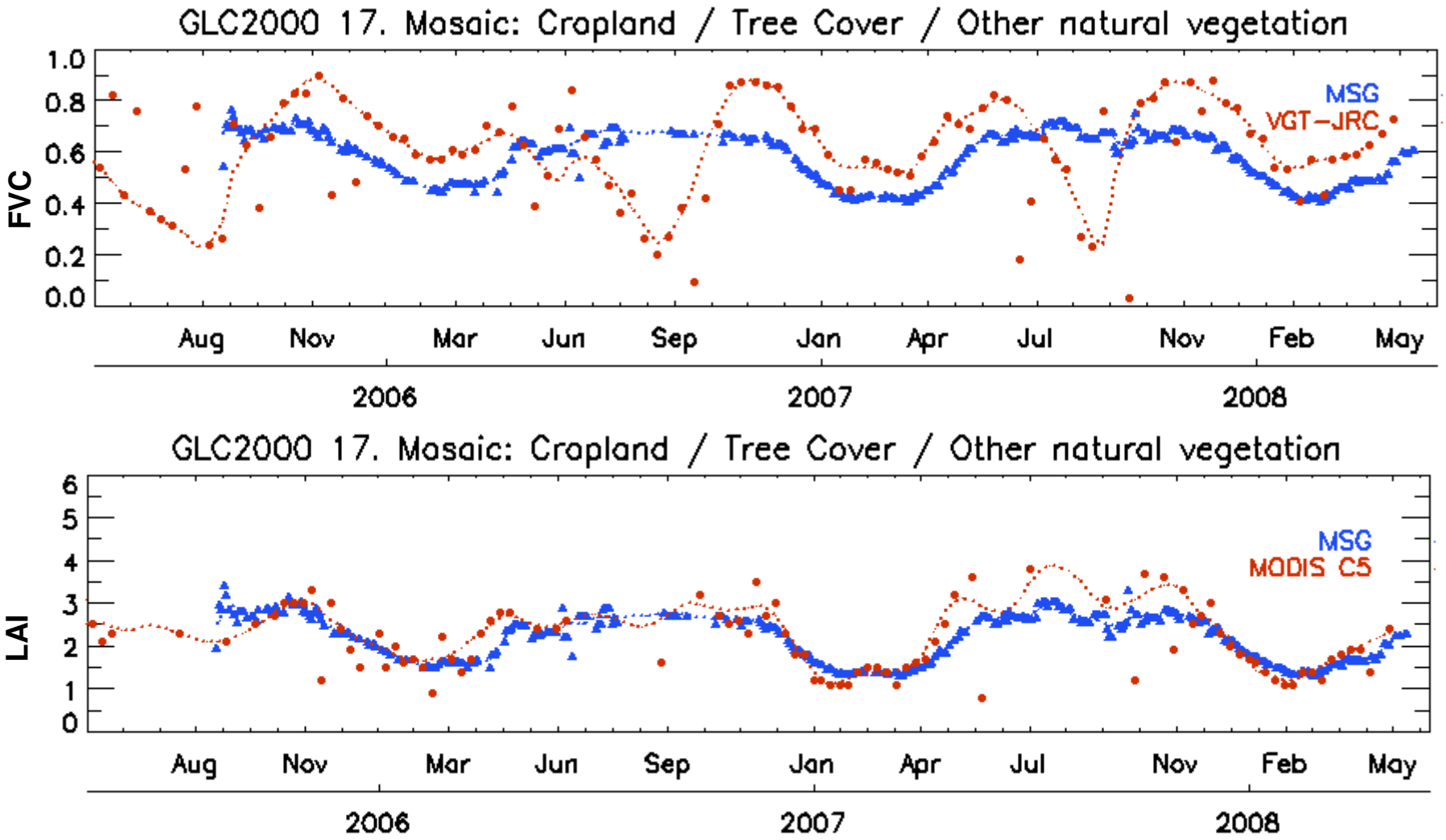
Reconstruction of inter and intra-annual trajectories from time series of products
→ Robust Loess (Locally weighted) methods



MSG (every 2 days): reconstruction is straightforward, residual are negligible

APPLICATION: SEASONALITY RECONSTRUCTION

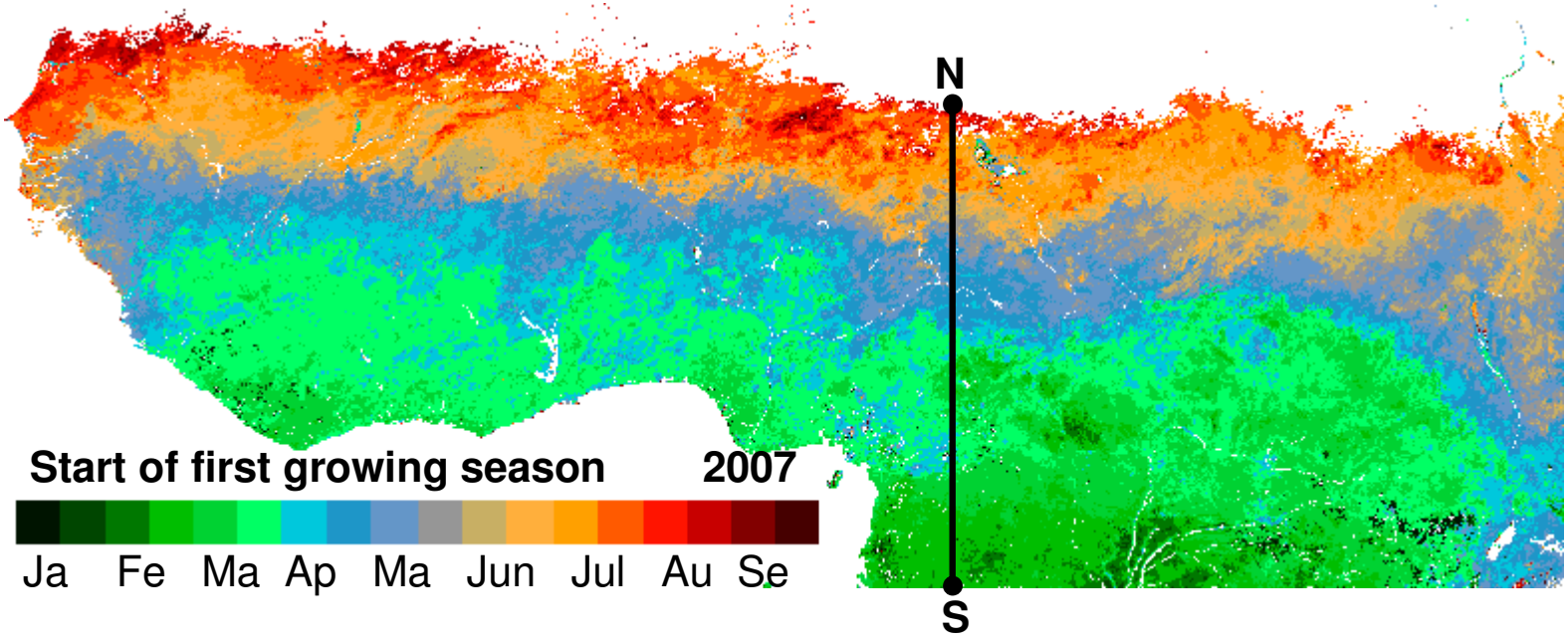
FVC & LAI (C.Afri-Guinean Gulf)



- Robust against double-seasons false alarms
- The temporal continuity benefits the accurate retrieval of key seasonal parameters

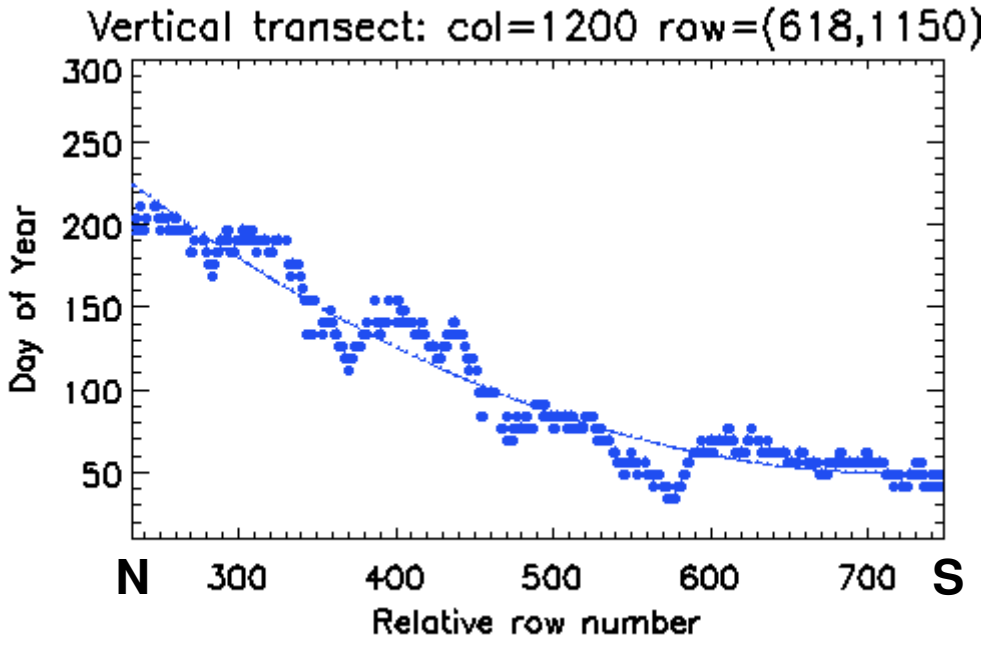
APPLICATION: DERIVATION OF PHENOLOGY PARAMETERS

NAfr



FVC MSG time series:

- ability to generate spatially consistent images of phenology parameters
- good agreement with pattern of the intertropical convergence zone (ITCZ)



8. Concluding remarks

. The suite of daily VEGA products provides relatively clean profiles for monitoring vegetation activity

- The product values fit well with the existing satellite products within the (reliable) error bar
- MSG VEGA products present added value against operational ones (MODIS, VGT, MERIS). In particular, due to its high spatial and temporal continuity, as well as temporal stability
- The products could meet the requirements of several communities involved in both application domains and research activities
- **The Project team is willing to establish contacts with potential users to improve existing applications (*Visiting Scientist* planned)**
- Different frequencies of production are also possible if required by the user needs

The Land-SAF suite of Vegetation Products

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Remote Sensing Unit
- EOLAB

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