GMES Fast Track Service Land

Monitoring soil and vegetation fluxes of carbon and water at the global scale: towards a GMES service

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Albergel C, Météo-France
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Balzarolo M, UNITUS
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Boussetta, S, ECMWF
Cescatti A, JRC/IES
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Kullmann L, OMSZ
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Szczypta C, Météo-France

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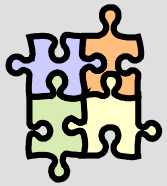
European Commission Fast Track Service Land within the GMES initiative in FP-7

FP7 Fast Track Service Land project: geoland2

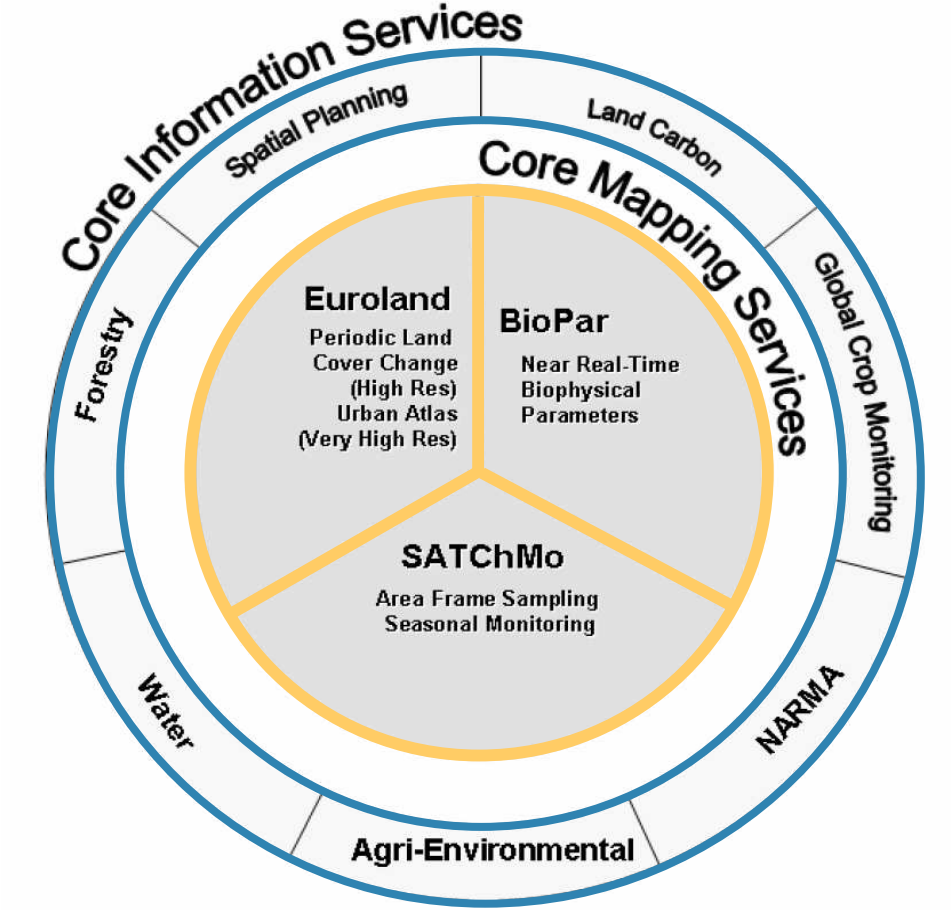
	**FP7 Project funded by European Commission** **Implementing the Land Monitoring Core Service -** contributing to GEO, interacting with INSPIRE & SEIS
	**50 partners** **171 collaborating user organisations** (81 directly committed to geoland2)
	22.4 Mio. € EC grant (FP7) 32.5 Mio.€ in total – 4 years (**2008-2012**)
	**11 thematic tasks** – 1 coordination office **3 stakeholder platforms** (users, science, service providers)

- **Objectives:**
  - Land Monitoring Core Service of GMES (LMCS)
  - Prepare, validate, demonstrate the pre-operational LMCS (chain & products)
  - Propose a functional organisation of the LMCS

geoland2: from mapping to monitoring

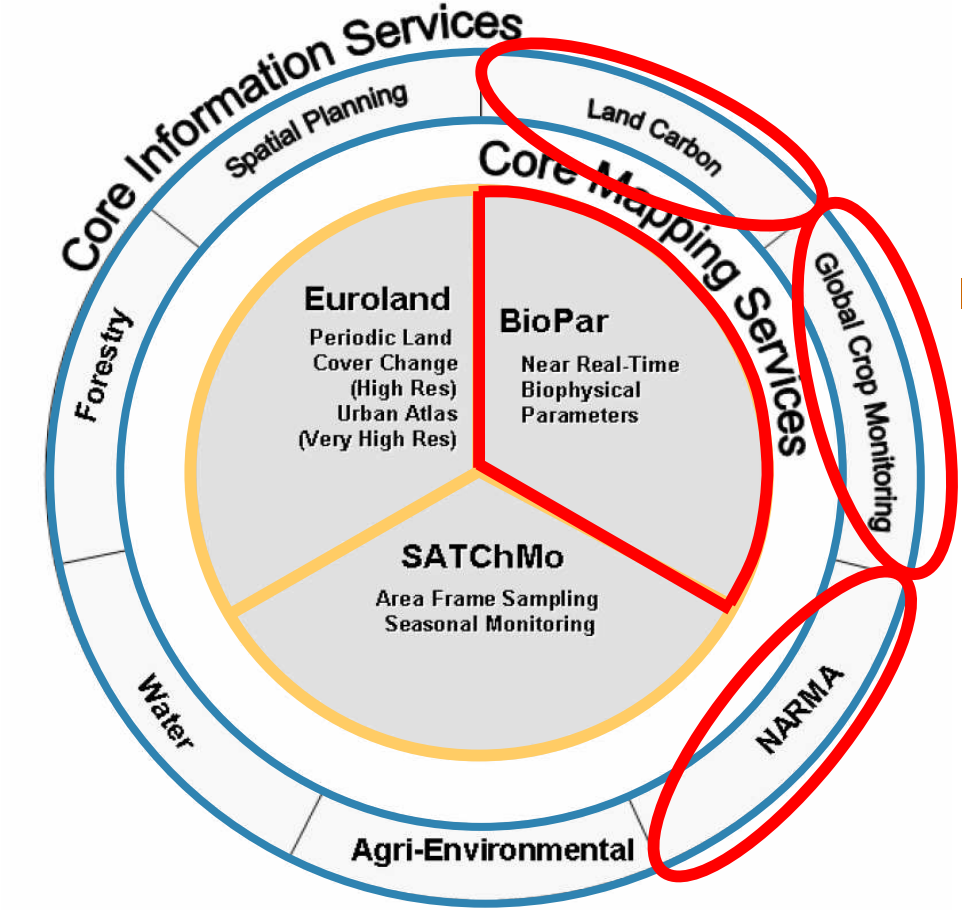
- **Current status**
  - design and implementation phase
  - moving from a “fast track” parallel production towards an “operational” sequential processing chain
- **Global component**
  - global ECVs (biophysical variables)
  - and assimilation into land surface models
  - mainly public institutions
- **Pan-EU HR component**
  - 5 layers: sealings, forests, grasslands/crops, wetlands, water bodies
  - local component (hot spot areas, e.g. NATURA2000, coastal areas)
- **User needs**
  - monitoring: change detection approaches are needed
  - that are not covered at the national level
- **Validation/verification: synergy with national activities**
  - in situ data for verification
  - methods and product benchmarking
  - R&D

geoland2: functional organization



- **3 Core Mapping Services**
  - **Euroland (Land Cover)**
  - **BioPar (Biophysical Products)**
  - **SATChMo (Seasonal Monitoring)**
- **7 Core Information Services**
  - **Land Carbon**
  - **Global Crop Monitoring**
  - **Natural Resource Monitoring in Africa (NARMA)**
  - **Agri-Environment**
  - **Forest**
  - **Water**
  - **Spatial Planning**

geoland2: functional organization – global part



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BIOPAR portfolio – global products

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VEGETATION	NRT / Off-line	Spatial Resolution	Spatial coverage	Temporal Resolution	Sensor
LAI, fCover, fAPAR, DMP, NDVI, Phenology	NRT	1 km	Global	10-days	VGT
Time series of vegetation products	Off-line	4 km	Global	10-days	AVHRR + VGT
Burnt areas + seasonality	NRT	1 km	Global	Daily	VGT

WATER	NRT / Off-line	Spatial Resolution	Spatial coverage	Temporal Resolution	Sensor
Water Bodies + seasonality	NRT	1 km - 250 m	Africa	10-days	VGT - MODIS
Soil Moisture + Freeze/Thaw	NRT	25 km	Global	Daily	ASCAT
Time series of soil moisture products	Off-line	25 km	Global	Daily	ERS-1&2 Scat

RADIATION	NRT / Off-line	Spatial Resolution	Spatial coverage	Temporal Resolution	Sensor
Downwelling Shortwave Surface Flux Downwelling Longwave Surface Flux	NRT	~ 5 km	Global	hourly	ΣGEO + AVHRR
Land Surface Temperature	NRT	~ 5 km	Global	hourly, daily, 10-days	ΣGEO + AVHRR
Surface Albedo	NRT	1 km	Global	10-days	VGT
Surface Albedo	NRT	~ 5 km	Global	10-days	ΣGEO + AVHRR

BIOPAR portfolio – global products

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- **LAI, FAPAR, Fcover, NDVI**
  - Today: NRT global 10-day from VGT, since 11/2009, at vito
- **SWI and freeze/thaw**
  - Today: daily global products from ASCAT, 06/2007-04/2010, at
- **Downwelling Surface Fluxes and LST**
  - Today: 1y demo from ΣGeo satellites, NRT in test at
- **Albedo**
  - Today: NRT global 10-day from VGT, since 11/2009, at vito
  - ΣGeo in test at
- **Burnt areas in Africa**
  - Today: demo NRT from SPOT/VGT at vito
- **Water bodies in Africa**
  - Today: 18-month demo from SPOT/VGT at vito

Land Carbon CIS: overview

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- **Objectives:**
  - Natural CO_2 sink strengths vary with weather and climate
  - Build a global Land Data Assimilation System (LDAS)
  - Product portfolio
    - carbon/water fluxes, analyzed: soil moisture, LAI, biomass, C storage
    - global scale + focus on 3 EU test countries (F, HU, NL)
  - Link to meteo/climate services:
    - use the existing infrastructures/expertise (ECMWF, Météo-France, OMSZ, KNMI)
    - interoperability with existing NWP data assimilation systems
    - global and regional components of MACC: “carbon meteorology”
- **Future operations: link to MACC**
  - global component of MACC – operations NRT 24/7 at ECMWF
  - regional component of MACC – pre-operations
    - MOCAGE (MF) and CHIMERE (CEA) atm. chemistry models (will) include CO_2
- **Continuous development: model upgrades, new processes**
  - Better integration with the carbon science community
  - Validation through HR models, benchmarking, in situ data (FLUXNET)

Land Carbon CIS: key scientific/technical results

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- **Achievements:**
  - Greening of NWP land surface models
    - Carbon flux model coded in (MF) SURFEX and in (ECMWF) TESSEL
    - Carbon storage model coded in SURFEX
  - Added value of seasonal LAI in NWP models demonstrated
    - MODIS seasonal LAI improves ECMWF forecast of surface air temperature/humidity
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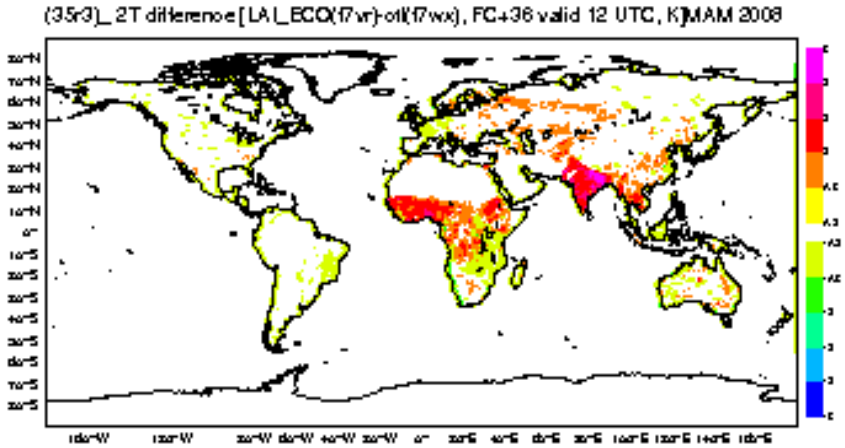
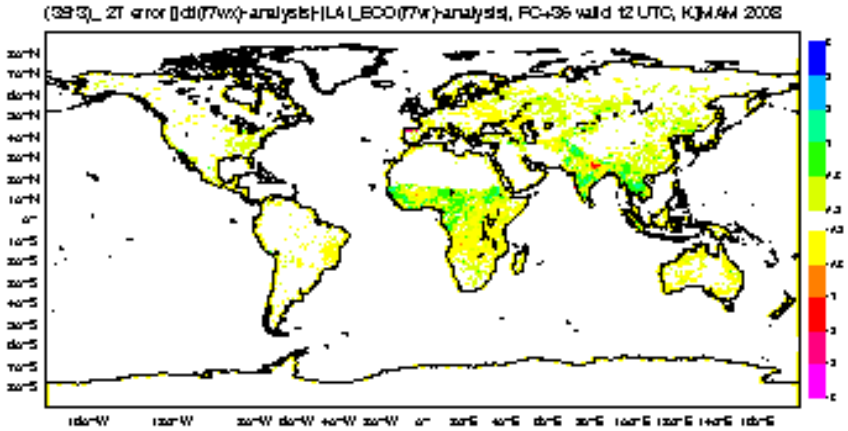
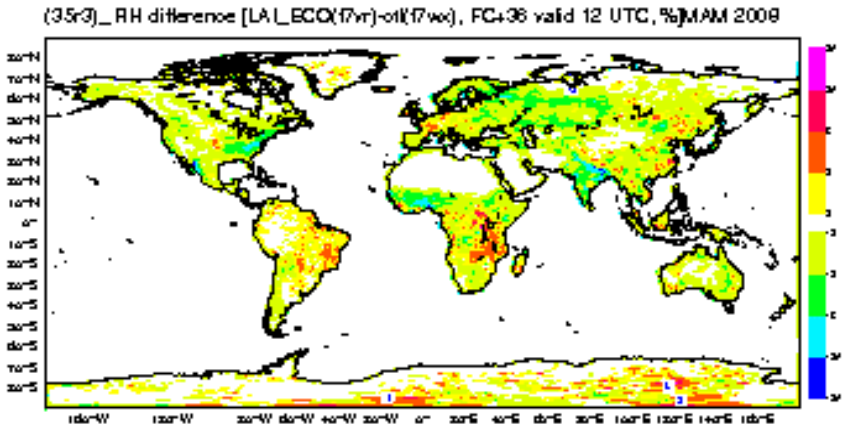
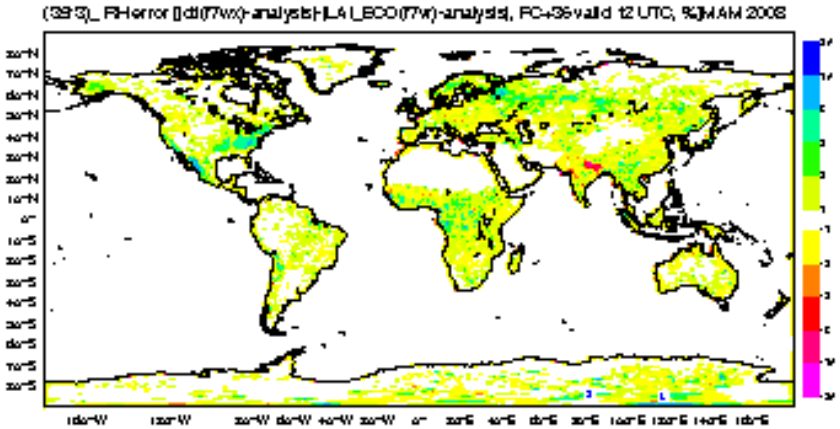
Added value of seasonal LAI in NWP models

- **Springtime (MAM) sensitivity/impact of LAI seasonality in ECMWF model**

	Sensitivity	Impact
T2m		
RH2m		

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Atmospheric reanalyses

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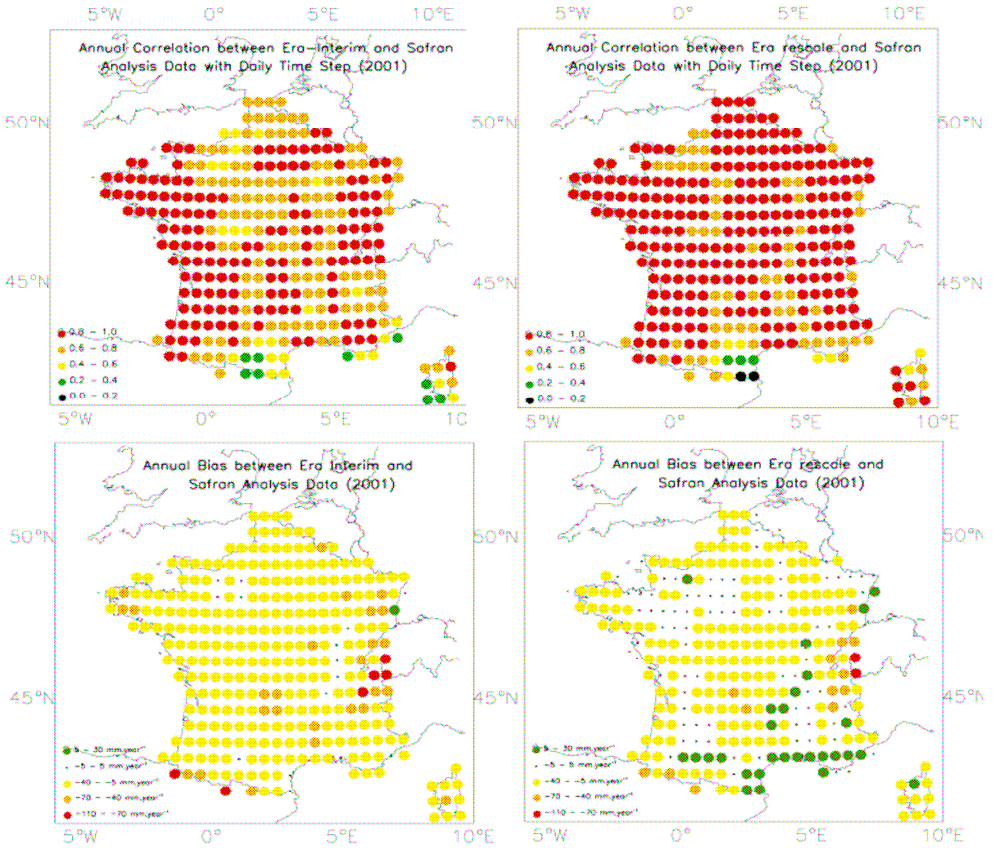
Squared correlation coefficient

Mean bias

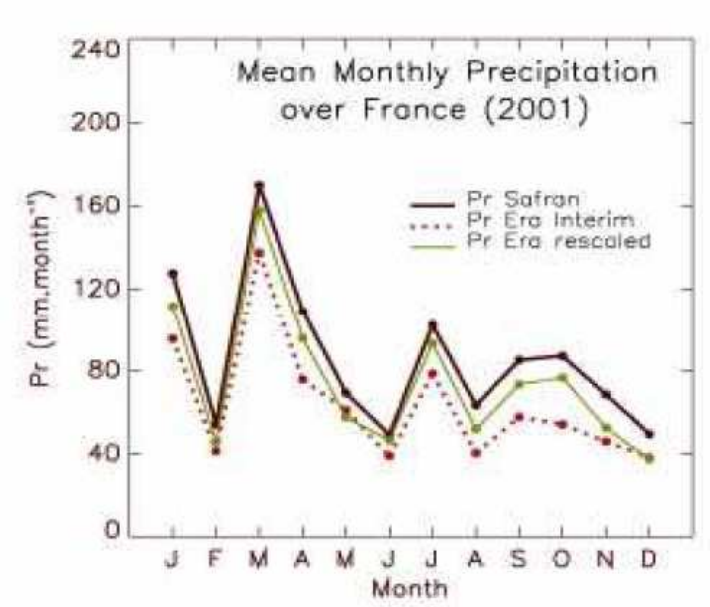


ERA-I **ERA-I rescaled**

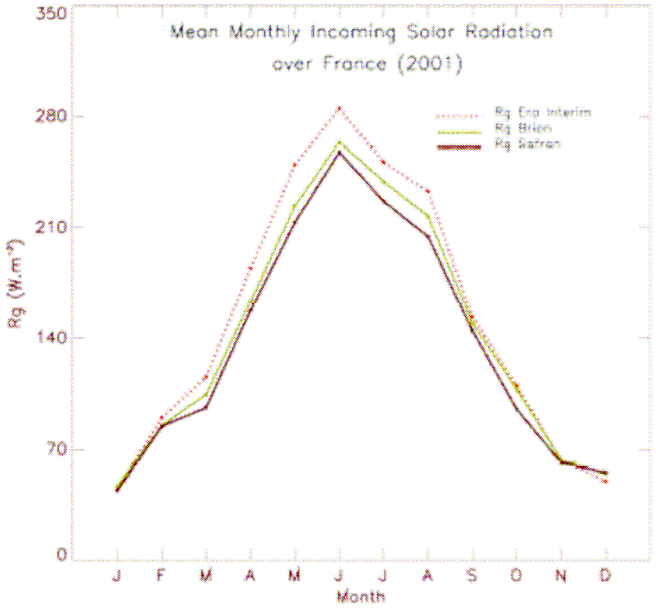
Szczypta et al. 2010

ERA-I vs. SAFRAN: Precipitation 2001

Precipitation 2001



ISR 2001



Szczypta et al. 2010

ERA-I vs. SAFRAN: Precipitation & Incoming Solar Radiation

Atmospheric reanalyses

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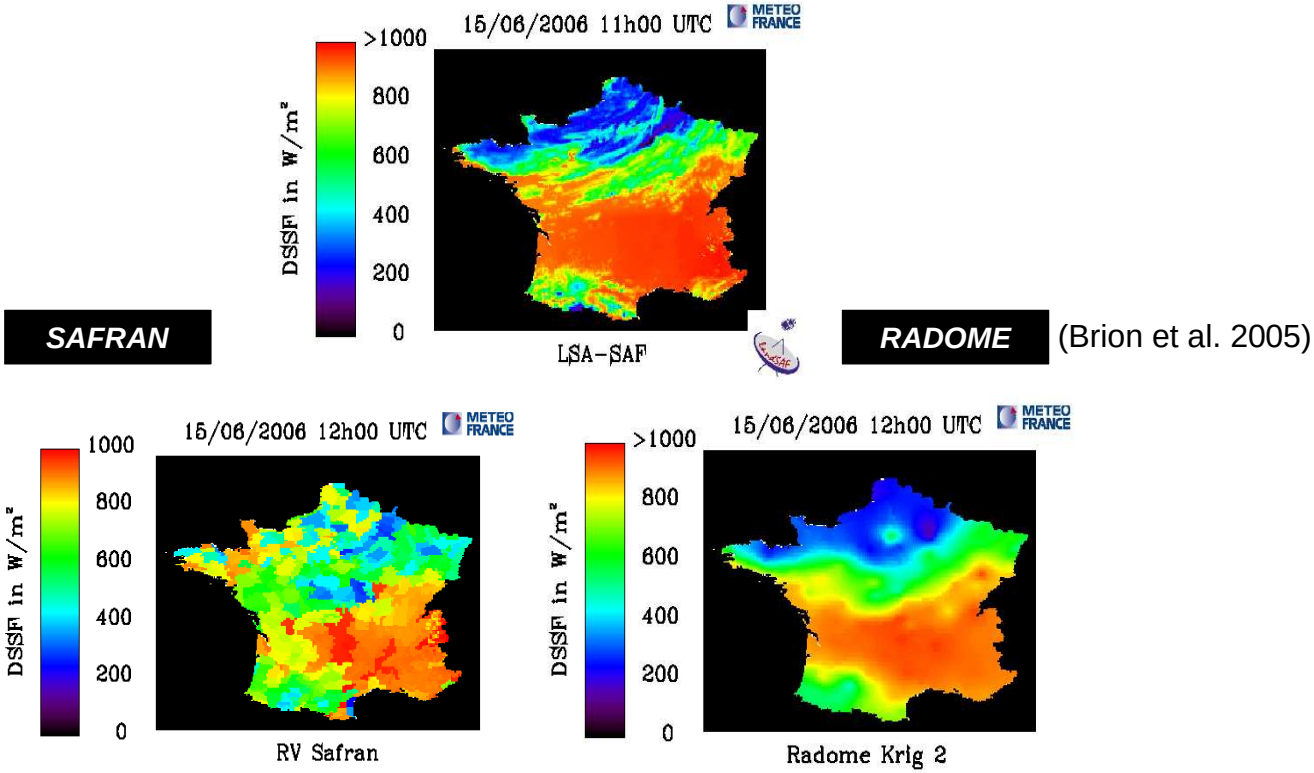
The EUMETSAT Network of Satellite Application Facilities

LSA SAF
Land Surface Analysis



(Brion et al. 2005)

Incoming Solar Radiation: the METEOSAT LSA-SAF product

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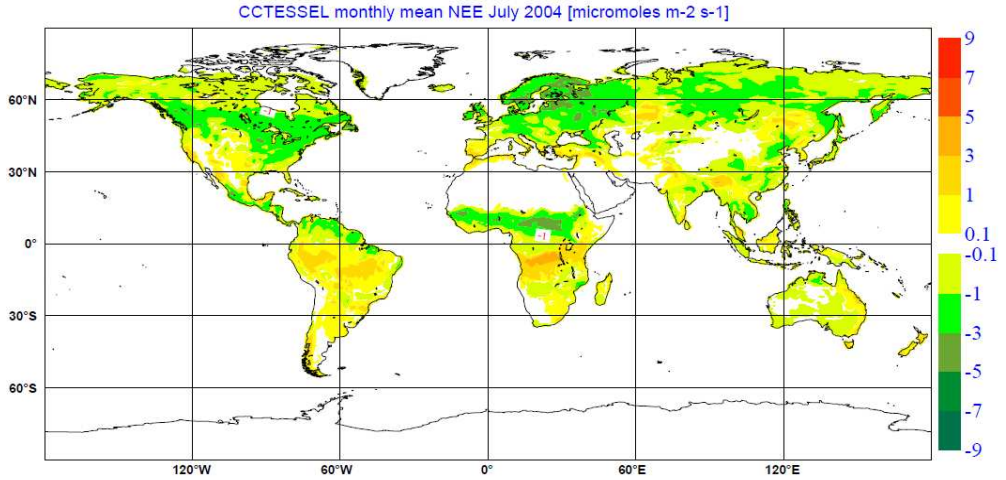
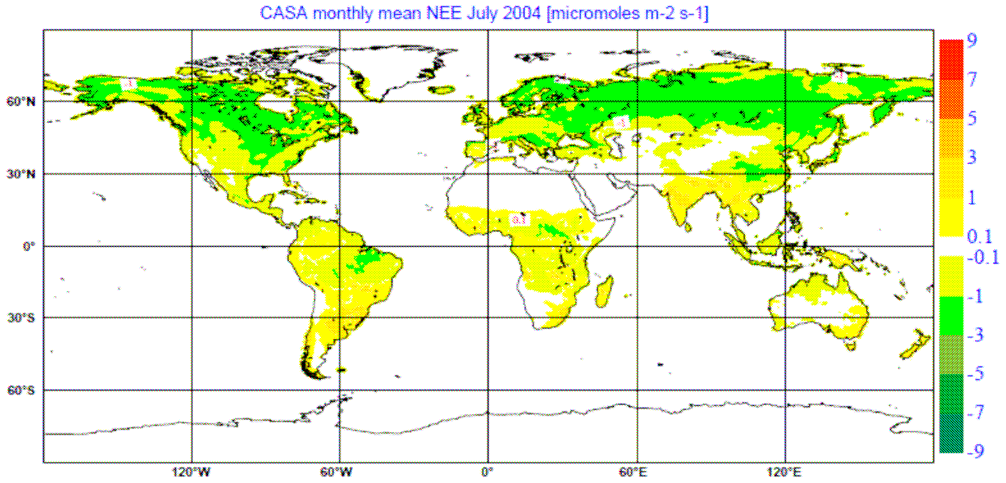
C-TESSEL vs. CASA (July 2004)

C-TESSEL



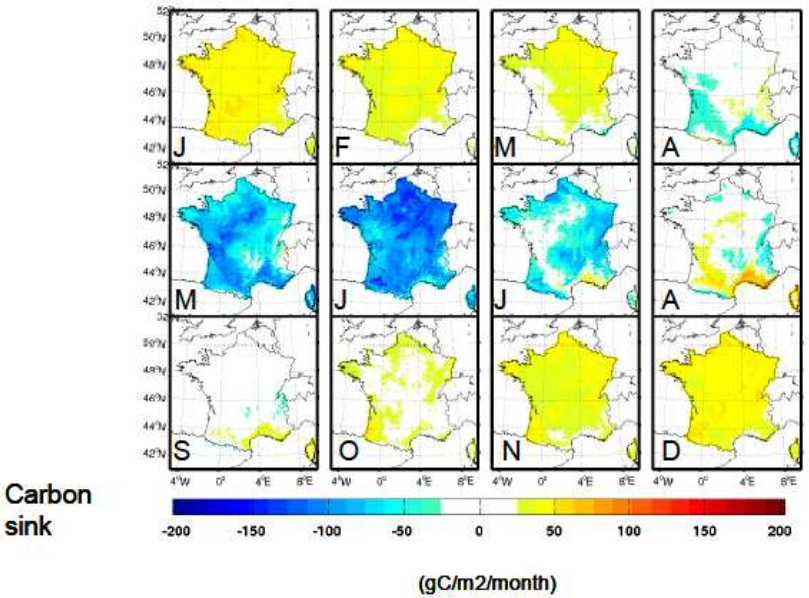
CASA



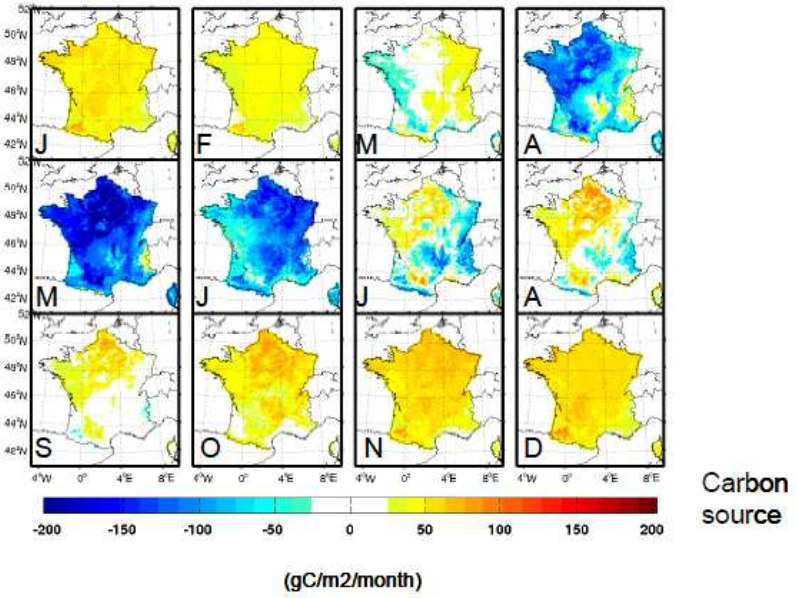
Boussetta et al. 2010

- **SURFEX vs. ORCHIDEE: NEE**
  - 8km NEE climatology over France (1994-2008)
  - Differences are observed, especially in cropland areas. However, the two models are in the range of the natural fluxes provided by the Carboscope project (www.carboscope.eu/?q=flux_map&param=co2_dgvm)

SURFEX

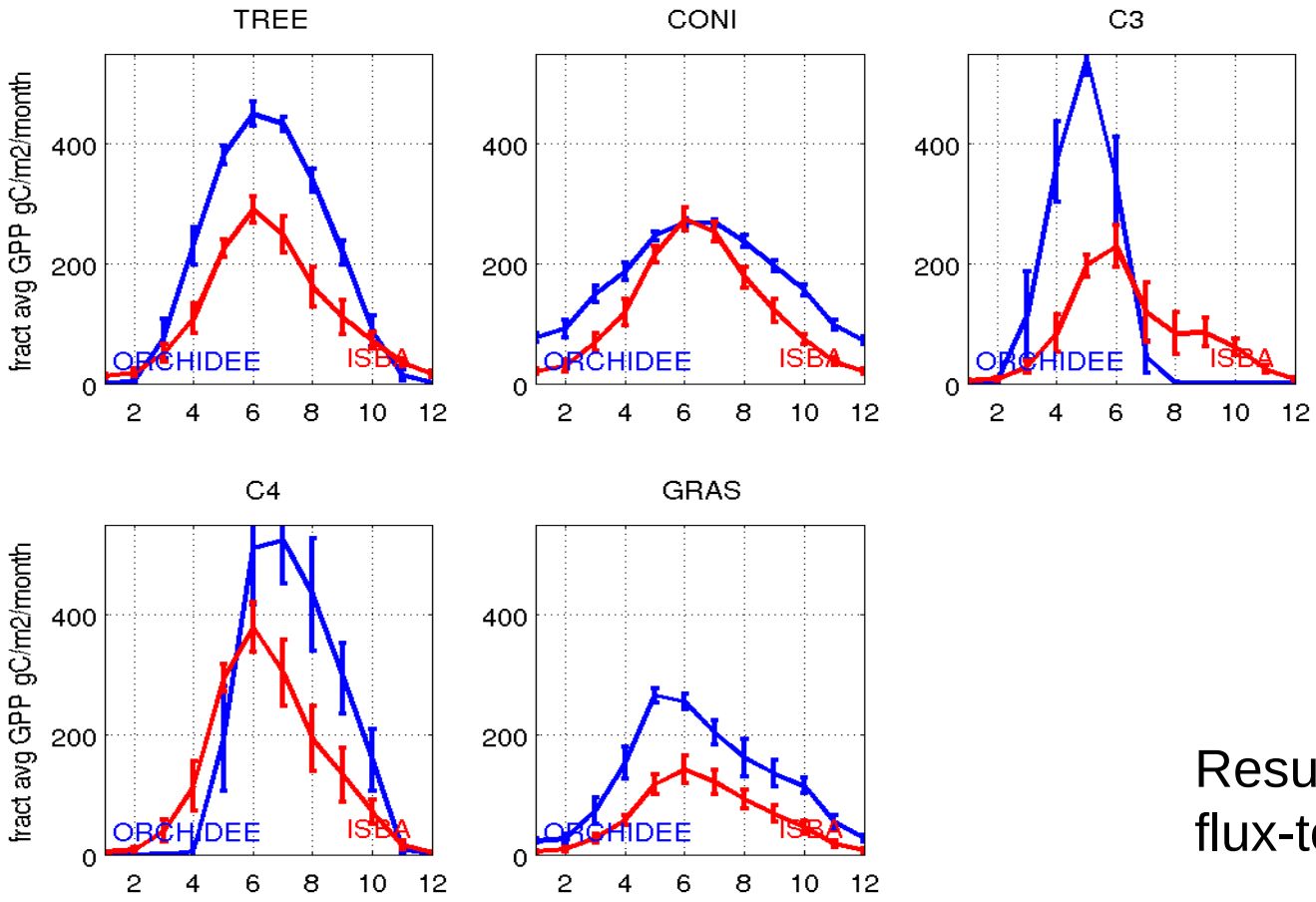


ORCHIDEE



Lafont et al. 2010

SURFEX vs. ORCHIDEE: GPP



Results similar on flux-tower sites

Model benchmarking

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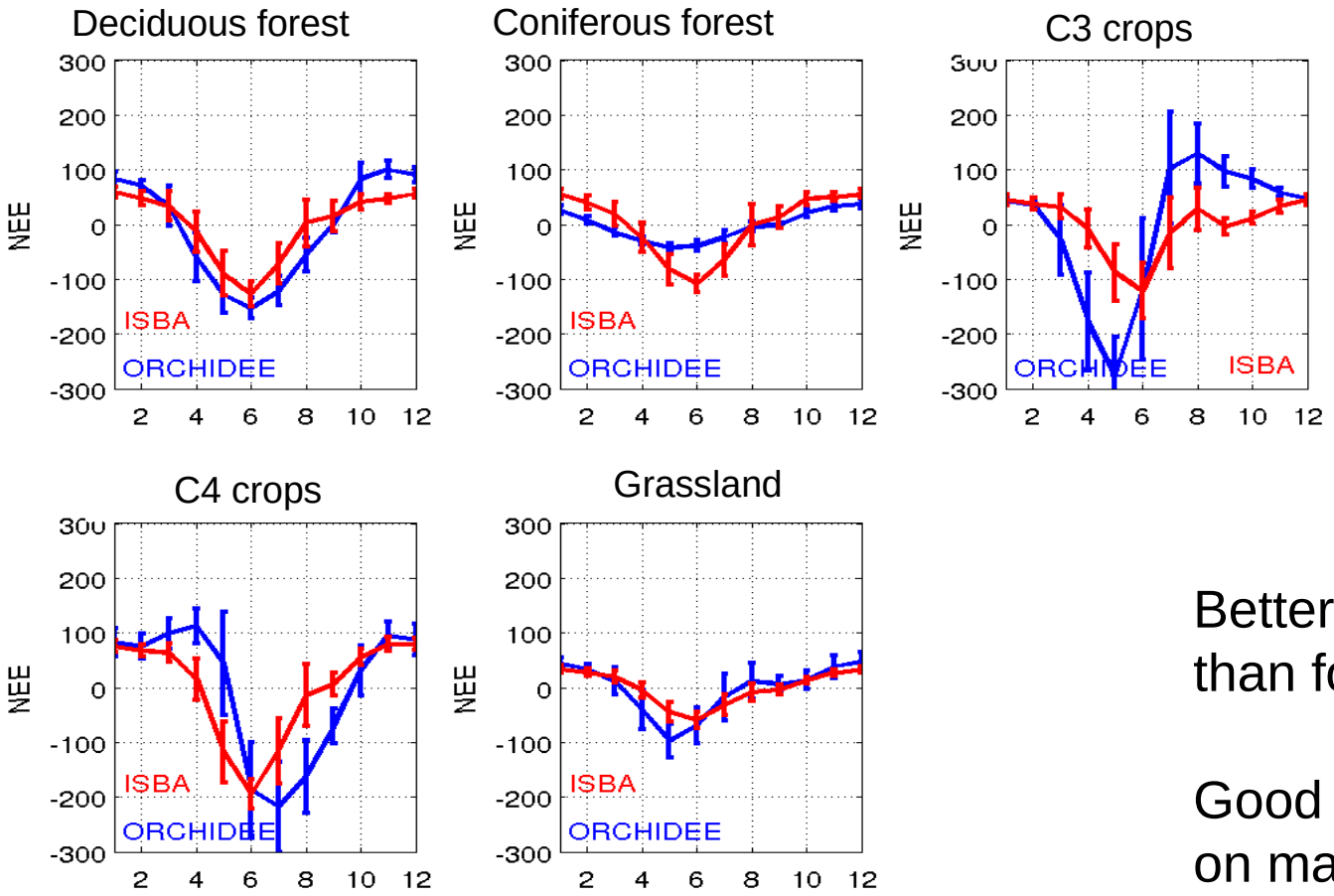
SURFEX vs. ORCHIDEE: NEE



Better agreement than for GPP

Good agreement on magnitude

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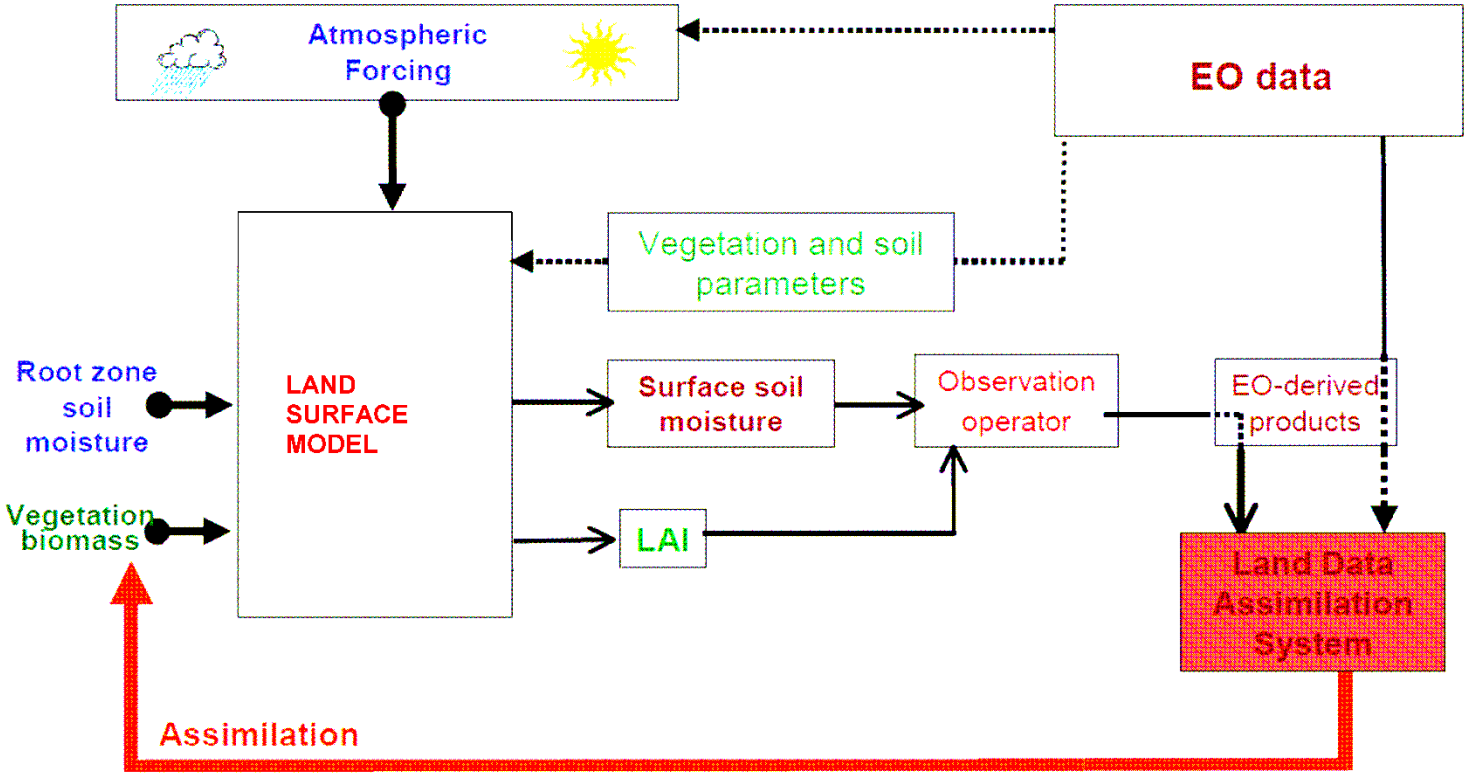
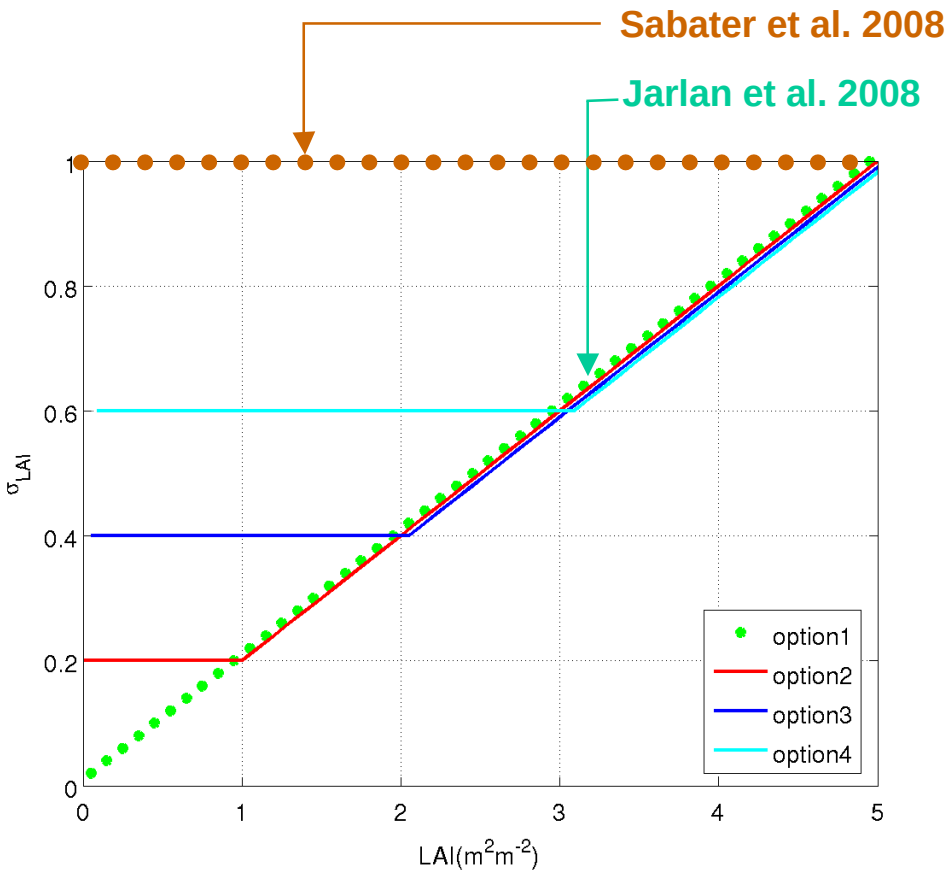
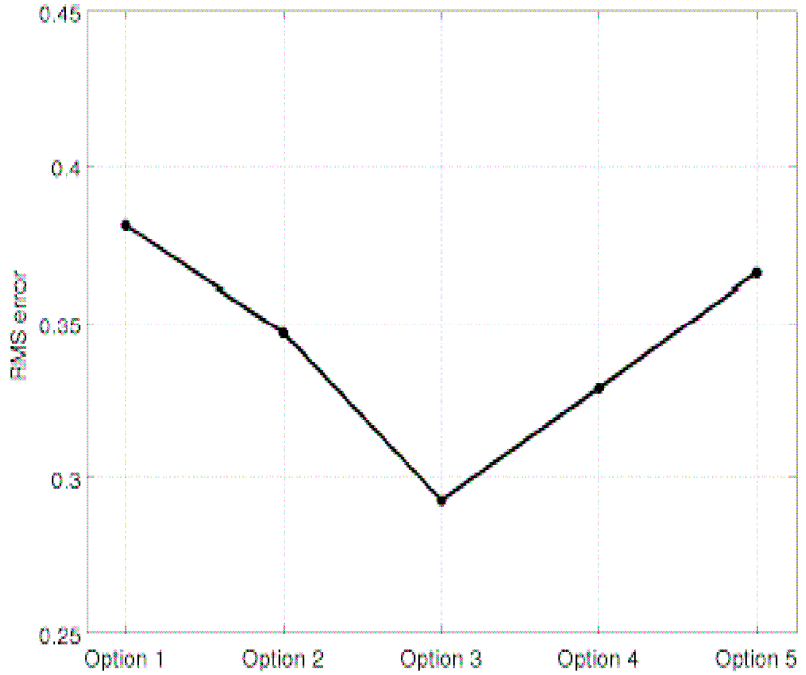
Data assimilation

- **Satellite data assimilation into land surface models**
  - Sequential Kalman filtering
  - Observations are used when available



Data assimilation



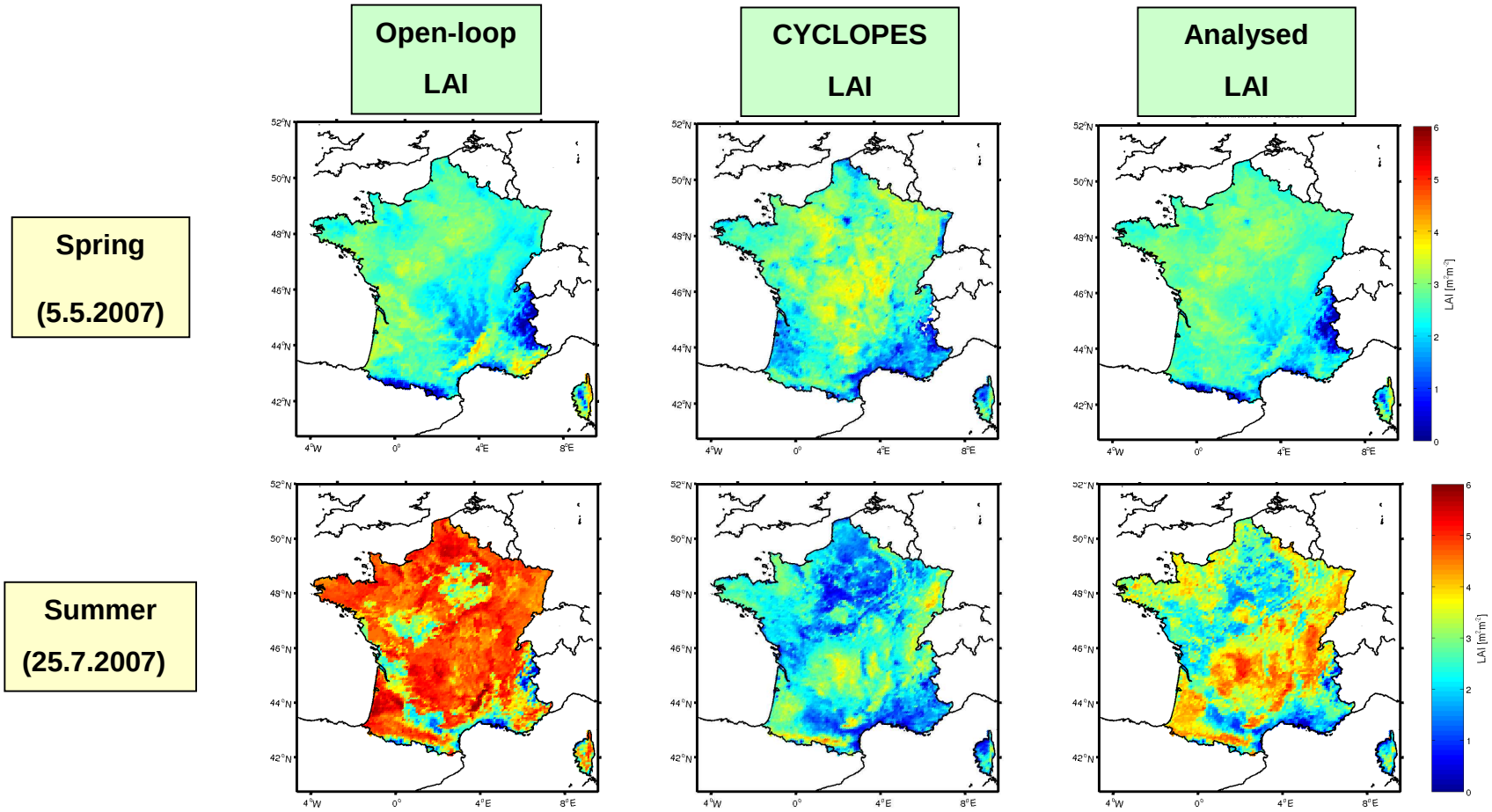


Barbu et al. 2010

Assimilation of LAI products: specification of background/observation LAI errors (test over the SMOSREX grassland)

Data assimilation

geoland2



Barbu et al. 2010

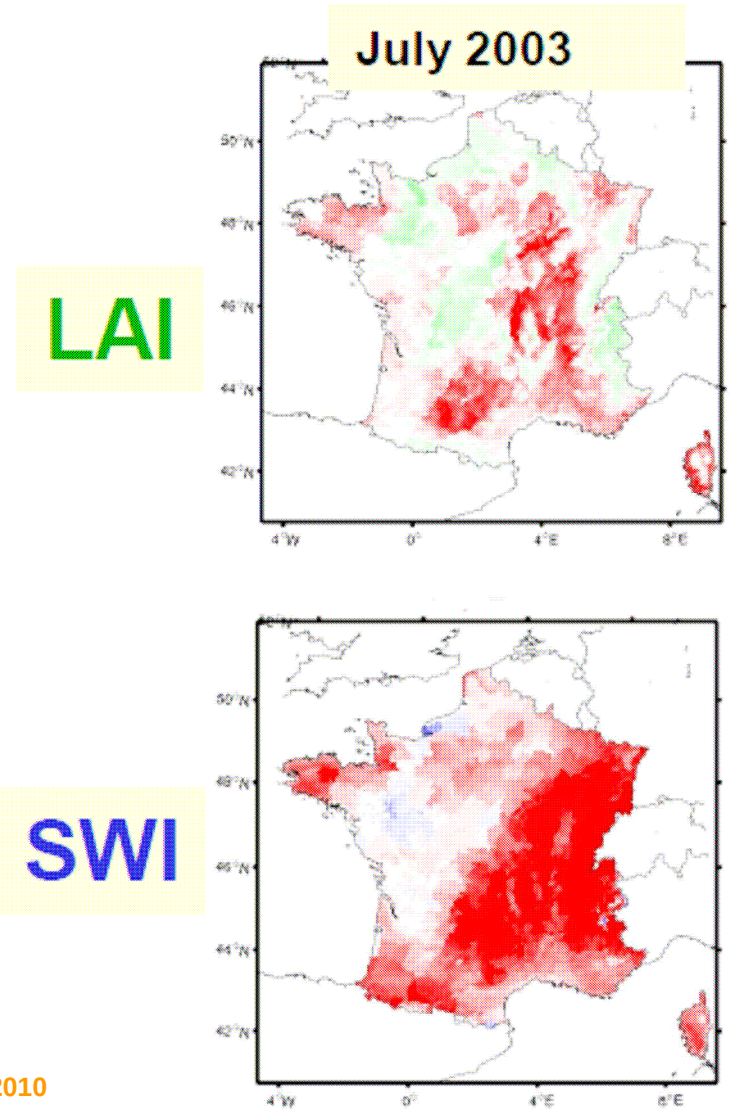
2D assimilation of LAI products over France:
ISBA model in SURFEX

Data assimilation

geoland2

- **Analysed LAI and soil moisture**

e.g. 2003 heatwave normalised anomaly of LAI and SWI over France simulated by ISBA (8km resolution)



Lafont et al. 2010

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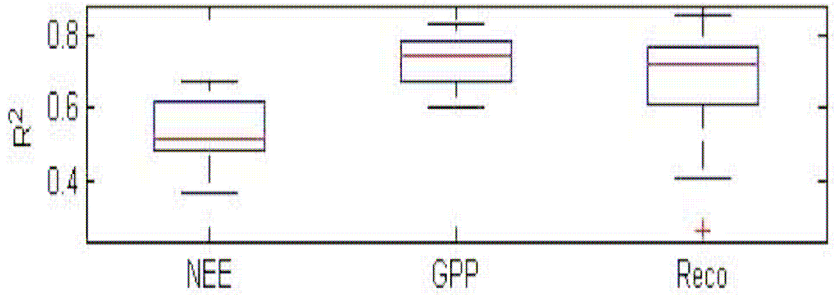
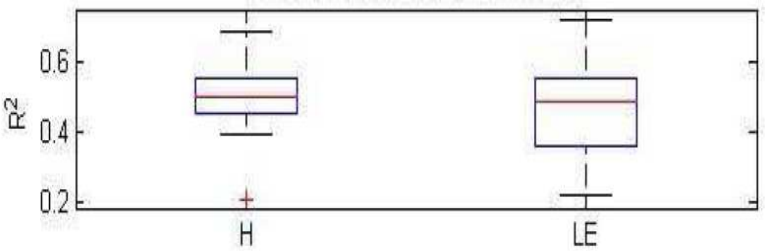
- **SURFEX verification using in situ FLUXNET data (forest sites)**

CARBON FLUXES

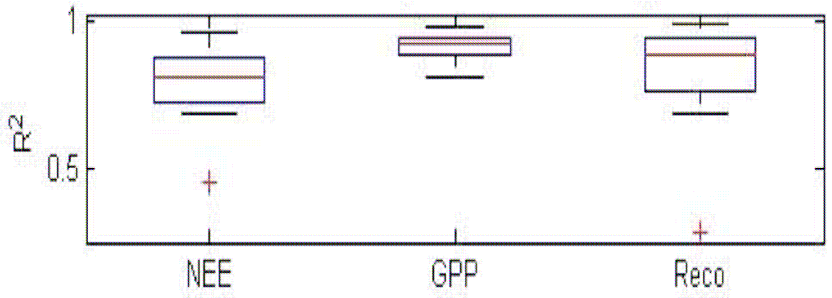
WATER/HEAT FLUXES

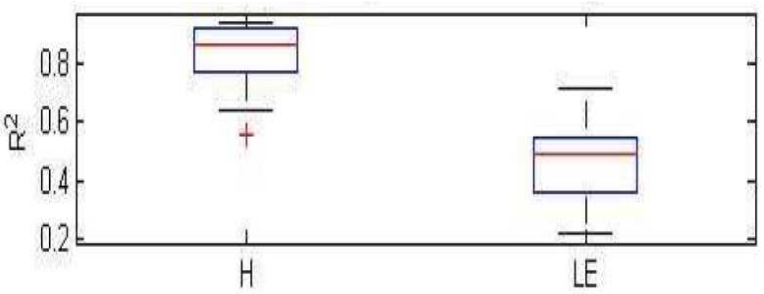
DAILY





MONTHLY





Balzarolo et al. 2010

Prospects (1)

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- **Progress in modelling surface fluxes**
  - Absorption of direct/diffuse solar radiation
    - New scheme is being implemented in ISBA
  - Other issues: AWC, T response, heterogeneity, management,…
  - Benchmarking is key
    - ISBA-ORCHIDEE-CTESSEL
    - In situ: flux data and agricultural statistics (e.g. AGRESTE in France)
    - Satellite data (LAI, Ts, …)
- **Joint assimilation of LAI and SSM values**
  - Has potential to improve the simulated CO_2 fluxes
  - Interoperability with operational NWP systems is possible
  - More work is needed to prescribe observation/model error statistics
    - Difficult for LAI (saturation & definition issues)
    - Long-term in situ observations of soil moisture and reflectances are needed
- **Positive meteorological response of NWP systems to LAI**
  - Shows the potential of fully integrated systems (link to MACC and NWP systems)

Prospects (2)

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- **GEOLAND2 (2008-2012)**
  - C-TESSEL: global pre-operational implementation
  - SURFEX:
    - Test EU countries pre-operational implementation
    - Carbon storage
    - Go pan-European
- **GIO (2012-2013)**
  - More room to operations
  - Continuous development and validation activities are essential to guaranty the quality / upgrade the service
- **TbD**
  - Link to JRC activities (ACP countries, crop monitoring)
  - Preparation of the use of future sensors (Sentinels?)

www.gmes-geoland.info

Thank you for your attention!