

Land Surface Analysis SAF (LSA SAF)

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Acknowledgments: Isabel Trigo & the LSA SAF consortium

**Workshop on GMES GLOBAL LAND component of the Land Service
12-13 December 2011 Lisbon**



Layout



- **Overview of the LSA SAF: now and the future**
- **Examples & applications**
- **Future sensors & evolution of user needs**
- **Concluding remarks**



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- **EUMETSAT Satellite Applications Facility on Land Surface Analysis:**
Dedicated to algorithm development, validation and operational production of land surface related products (primarily) based on European meteorological satellites (MSG and METOP)
- **Real time operations (i.e., some products are available every 15 min, ~1 hour after observed)**
- **Effective use of MSG and EPS data related to:**
 - **LAND**
 - **LAND-ATMOSPHERE Interactions**
 - **BIOSPHERIC Applications**
- **Timely provide:**
 - **Products**
 - **User support**
- **Reviewed (~annually) by technical and scientific review panels**

A consortium of 7 Institutions in 6 countries



- Instituto de Meteorologia (IM), Portugal



- Meteo-France (MF), France



- Royal Meteorological Institute (RMI), Belgium



- Finnish Meteorological Institute (FMI), Finland



- Karlsruhe Institute of Technology



- IDL, University of Lisbon

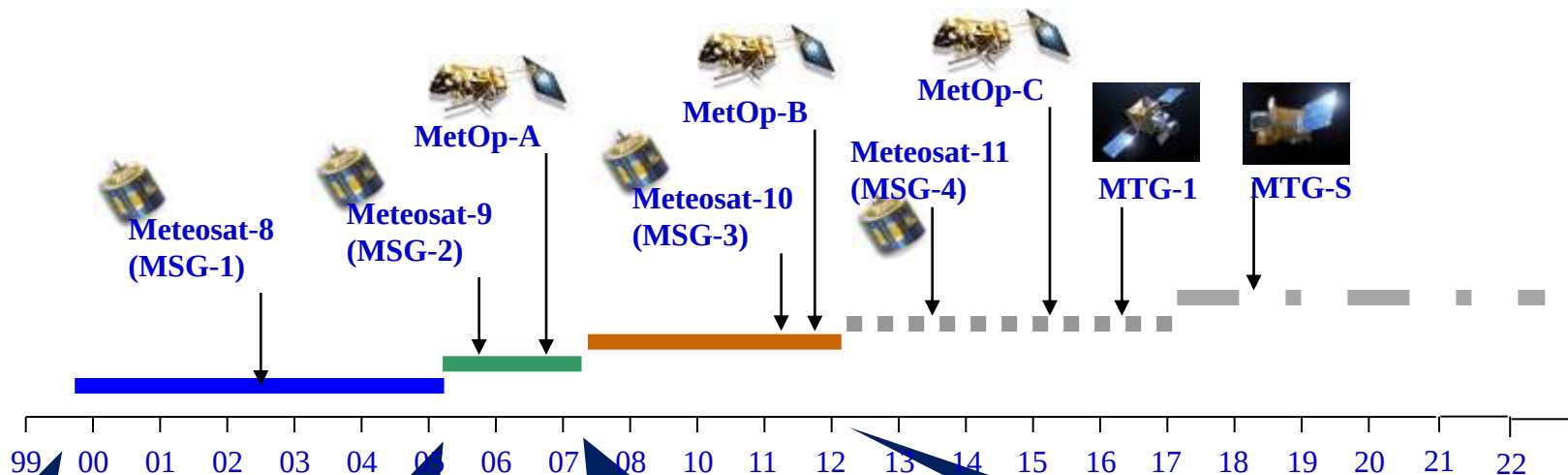


- UV, University of Valencia

- **Organisation principles**

- Algorithms developed and validated by one of the partners
- Algorithms handed over to IM for integration and production
- Operational chain in Lisbon

Land SAF Chronogram



**Development
Phase:
Sep 1999**

**Initial
Operations
Phase:
Feb 2005**

**Continuous
Development &
Operations Phase:
Mar 2007**

**Continuous
Development &
Operations Phase 2:
Mar 2012**



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CDOP-2 LSA SAF ~~current~~ consortium



- Instituto de Meteorologia (IM), Portugal



- Meteo-France (MF), France



- Royal Meteorological Institute (RMI), Belgium



- ~~• Finnish Meteorological Institute (FMI), Finland~~



- IMK, University of Karlsruhe



- IDL, University of Lisbon



- UV, University of Valencia

CDOP-2 new members:

- KCL (UK)
- VITO (Belgium)

Family of products: CDOP-2

Surface Radiation

LST

↓LongWave Flux

↓ShortWave Flux

Albedo

Vegetation

State

Fraction Veg Cover

LAI

fAPAR

NDVI

Water stres

Evapotranspiration

Reference Evap

Wild fires

Fire Detection

Fire Radiative Power

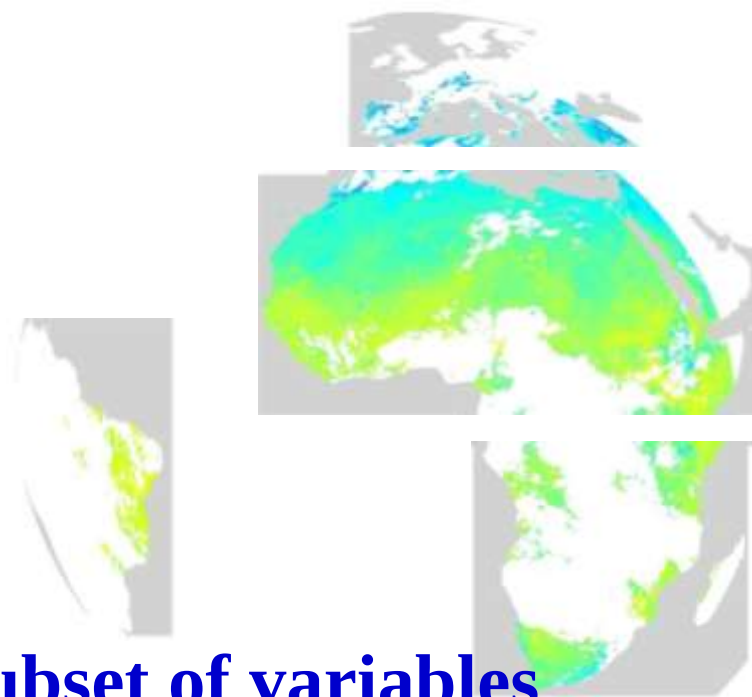
Fire Risk (Europe)

Increased level of maturity

MSG

Metop

- All products have a quality flag (a-priori error bar for LST) field associated
- All products have a **Product User Manual** and a comprehensive **Validation Report** (regularly updated)
- 4 production areas for MSG
 - Europe
 - N. Africa
 - S. Africa
 - S. America
- **SEVIRI resolution**
- **Variable time resolution**
 - 15 min to 10 days
- **EPS products generation for a subset of variables**





Additional information & service components

- **Users (> 500 registered users)**
 - **Numerical Weather Prediction**
 - **Update parameters, Assimilation & Forecast Verification (ECMWF, UKMO, MF, AEMET, IM, ...)**
 - **GMES Atmosphere (MACC & MACC II)**
 - **Agriculture & Forestry (JRC)**
 - **World Food Programme**
 - **Research (e.g. AMMA, U. Leicester)**
 - **Environmental Monitoring**
 - **Hydrology**
 - **(...)**
- **Help desk**
- **Regular workshops (biennially since 2002; Toulouse) for user feedback and evolution of user requirements**



Cooperation and training activities

- **Cooperation with other SAFs**
 - Shared validation of fluxes with CM and OSI SAF
 - Use of other SAF's parameters to improve LSA SAF products (e.g., H-SAF soil moisture to improve LSA SAF ET)
- **Cooperation with EUMETSAT Central Facility**
 - Production of Fire Radiative Power, developed at EUMETSAT HQ
 - Demonstrated flexibility of overall software architecture
- **Geoland-2 (FP7 project, 2008-2012): LSA SAF partners are consortium members**
- **Work closely with key users**
 - JRC (agrometereological applications, VEGA intercomparison)
 - ECMWF for Fire Radiative Power
- **Training**
 - One training event in Mozambique
 - Modules developed for EUMETRAIN
 - Regular participation in remote sensing courses in Brazil
 - ...



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Layout

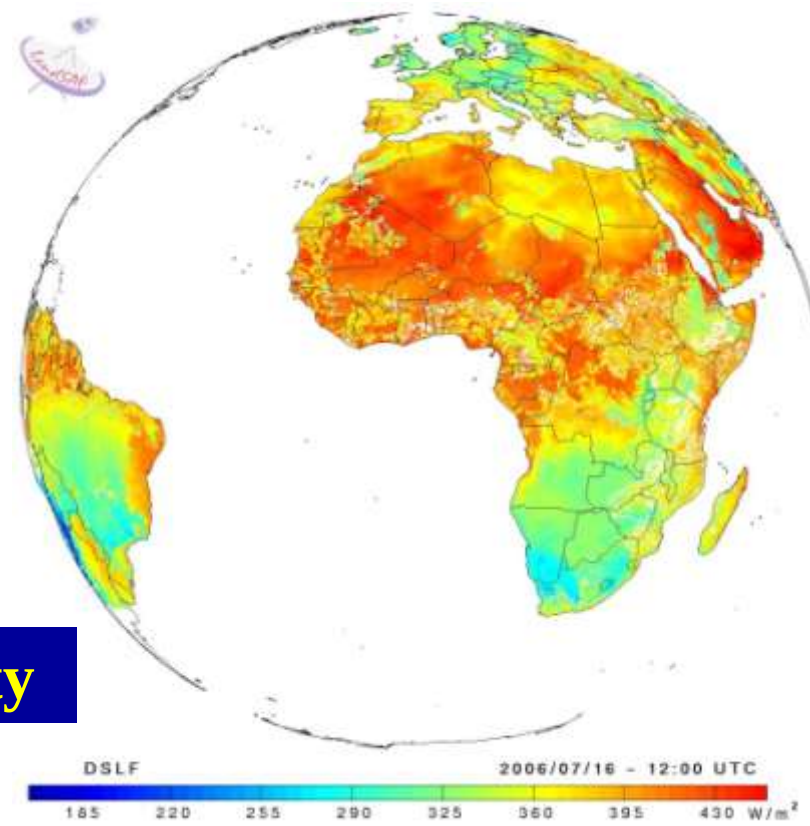
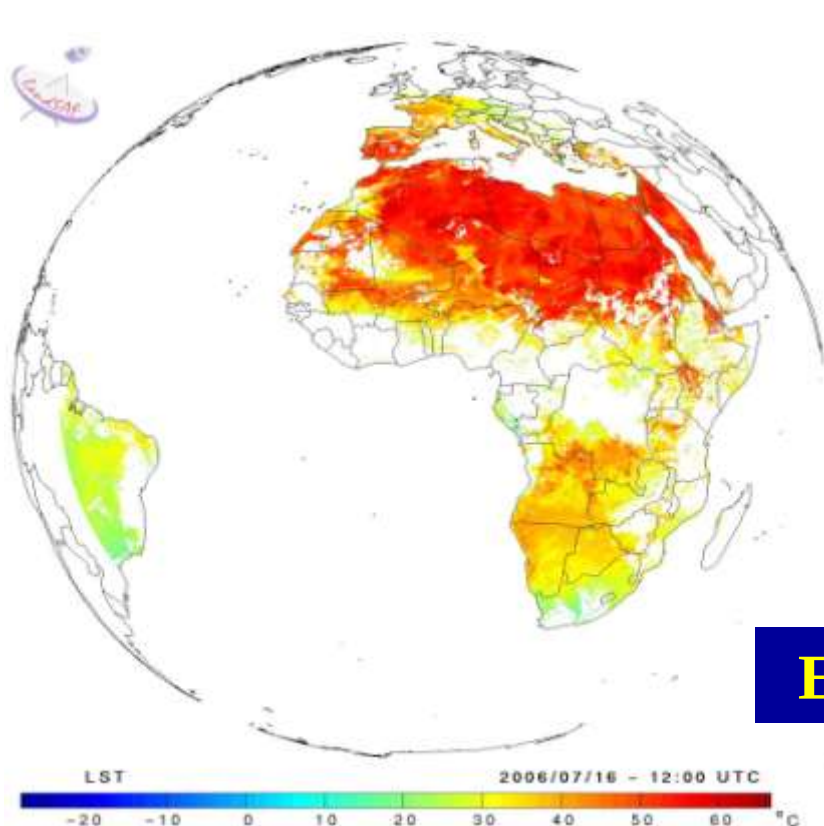


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Surface Radiation Budget: Longwave

**Surface Temperature
Every 15 min**

**Downwelling LW Flux
Every 30 min**

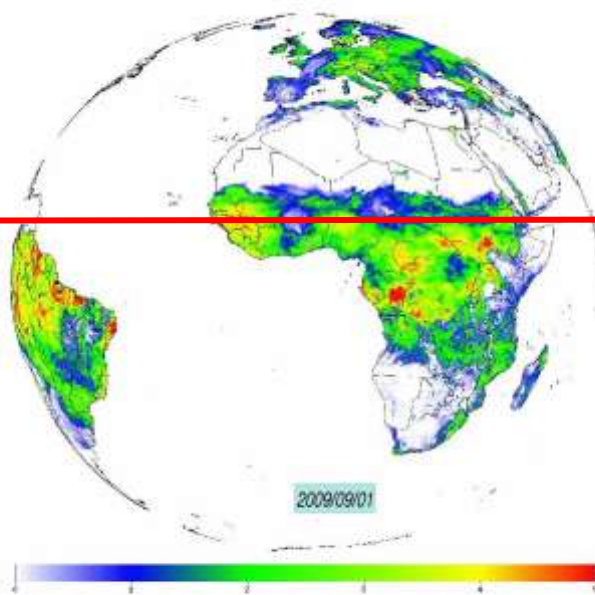


Emissivity

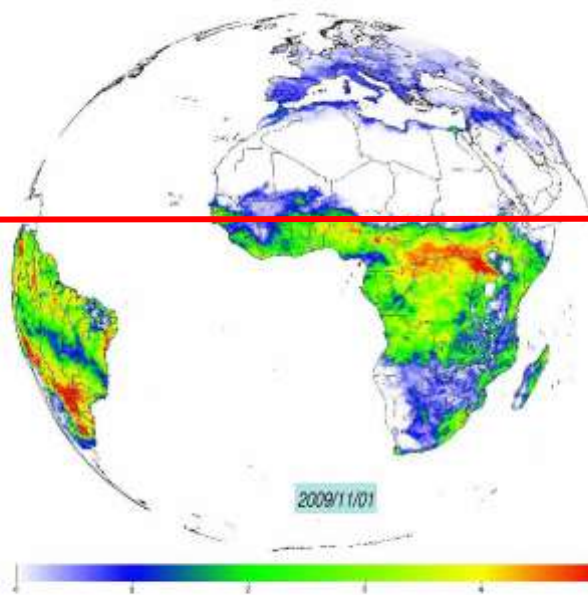
15 Jul 2006 (12 UTC) – 16 Jul 2006 (12 UTC)

Daily evapotranspiration (mm)

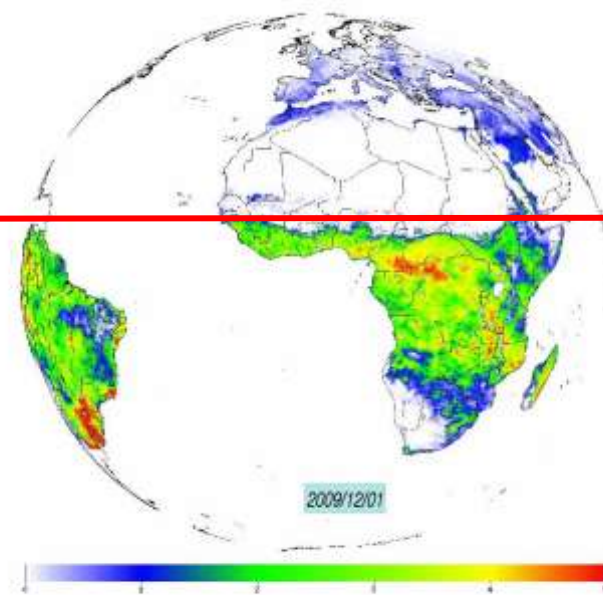
September 2009



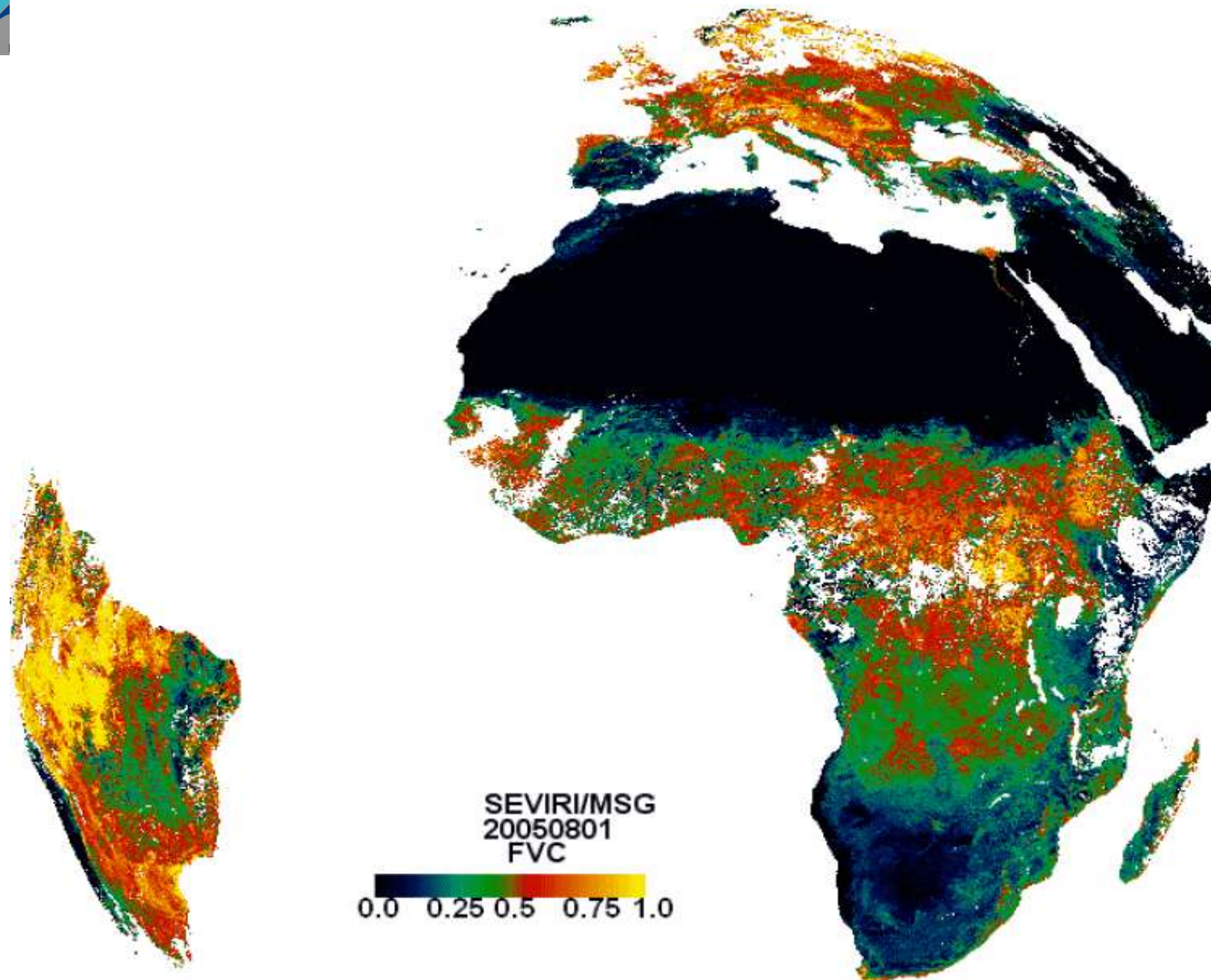
November 2009



December 2009



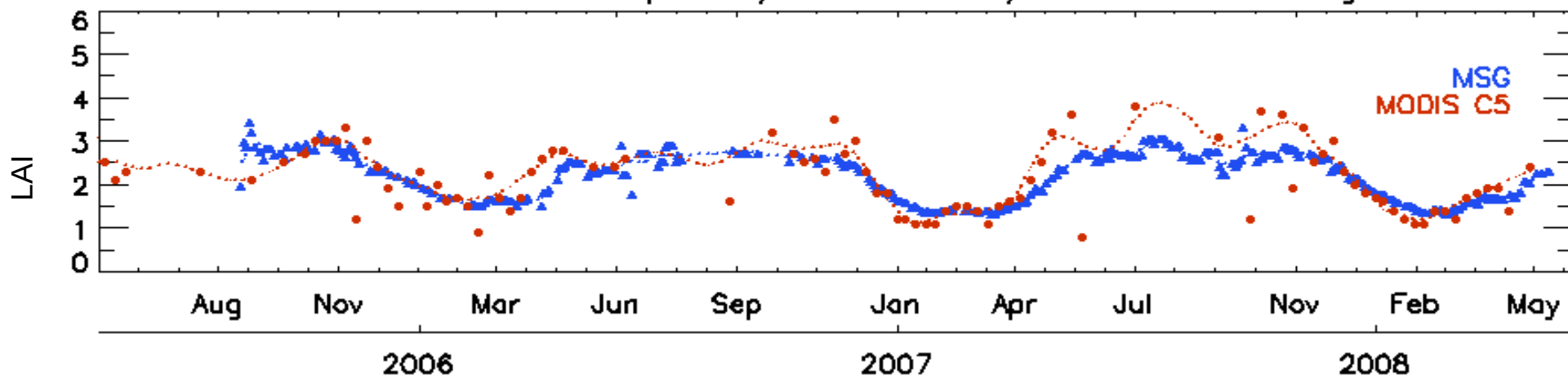
Fraction of vegetation cover (Sep 05- Sep 07)



Thanks to J. Garcia-Haro, U. Valencia

Leaf Area Index: Central Africa

GLC2000 17. Mosaic: Cropland / Tree Cover / Other natural vegetation



- MSG product more robust against double-season false alarms
- Temporal oversampling benefits the accuracy of retrieved seasonal parameters
 - Both products based on cloud-free images only
 - MSG samples 50 times/day; MODIS samples 2 times/day
 - Improved time sampling of MSG compensates for lower resolution



Fire Radiative Power



Algorithm:

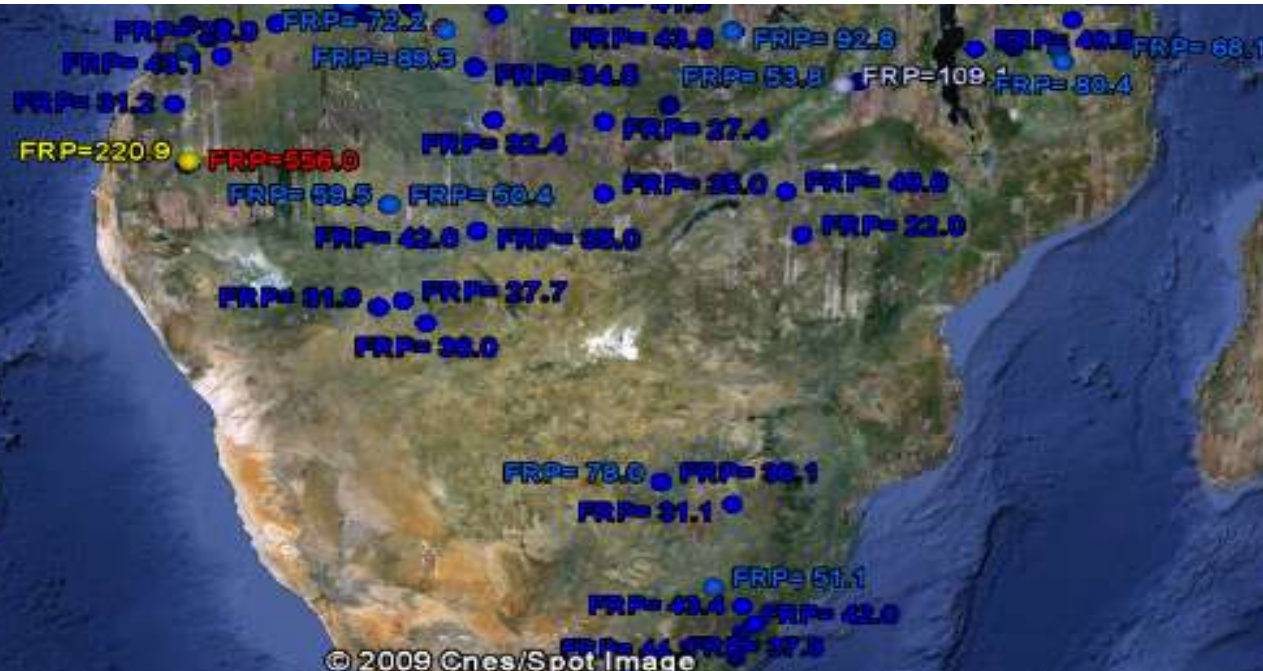
- Detects pixels containing active fires
- Reports their time/location and
- Fire Radiative Power (in MW)

Input:

- VIS, MIR + TIR data
- Cloud mask (SAF NWC)
- Landcover map

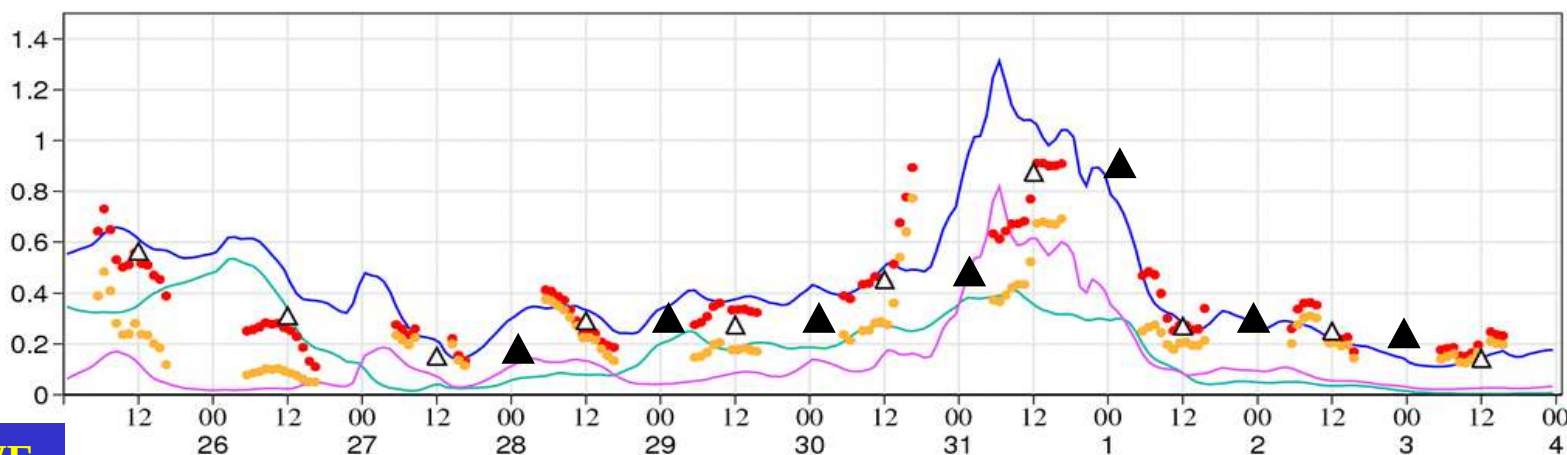
15-min

FRP $\propto$ Combustion rate
 $\propto$ Smoke release $\rightarrow$ CO₂eq emissions





- Comparison of model (eyvo) & MODIS AOT at 550nm and L1.5 Aeronet AOT at 500nm





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Product & Service Continuation

- Maintenance, quality monitoring & validation of MSG & EPS inherited products
- Upgrade of existing algorithms for MTG data

New Algorithms / Products aim to:

- Overcome known deficiencies of current products
- Address requests from user community

User support

- **Toolbox** to allow more friendly handling of data (NRT / off-line):
 - Selection of time window for processing
 - Definition of Regions of Interest and Projections
 - Data / image format
- **Training**
 - Series of LSA SAF workshops
 - Training courses, in cooperation with other programmes (EUMETRAIN, EUMETSAT)
 - Applications of LSA SAF products



LSA SAF products and MTG



- **LSA SAF will use radiances from the (Full Disk) Imagery Mission, (SEVIRI follow-up)**
- **Better spatial resolution will benefit all LSA SAF products**
- **Enhanced spectral characteristics vs. SEVIRI**
 - **FD-VIS 0.4** **Better aerosol, improvement of AL, SW flux, but also LW flux and LST**
 - **FD-IR 3.8/8.5** **Extended dynamical range for fire applications**
 - **FD-IR 1.3 et al** **Improved cloud mask and cloud type specification**
- **Impact on products**
 - **All products, given better clouds**
 - **Fire products**
 - **AL, radiative fluxes and LST, cascading into other products (VEGA, ET)**
 - **More competitive VEGA products with enhanced spatial resolution**



CDOP-2 new products: A sample

Family	Product
LST & Emiss.	Isotropic LST, All weather LST, Reprocessed LST
Albedo	Soil / vegetation / snow free Albedo, Reprocessed Albedo
Surface radiation fluxes	Total and diffuse DSSF, Net LW radiation
Turbulent heat fluxes	Reference evapotranspiration, Sensible heat flux, and Latent heat flux
Vegetation parameters & properties	Vegetation index, Net Primary Production, Gross Primary Production, Canopy water content
Wild Fire Products	FRP pixel bias correction, Burnt area/vegetation recovery, Daily Fire Radiative Energy / Carbon Emissions, Reprocessed Fire Radiative Power

Summary, conclusions and perspectives

- **Algorithm development, validation and operational production of land surface related products from remote sensing data, with a particular emphasis on EUMETSAT satellites:**
 - LAND
 - LAND-ATMOSPHERE Interactions
 - Land Biosphere Applications
- **Outlook**
 - Strengthen our links with users, emphasis on collaborative efforts with key users, including targeted training efforts
 - CDOP-2 and plans for the upcoming MTG products
- **Product dissemination**
 - Daily from our web site (<http://landsaf.meteo.pt>)
 - EUMETCAST
- **Further information**
 - <http://landsaf.meteo.pt>
 - Trigo et al. 2011, *Int. J. Rem. Sens.*, 32, 2725-2744
 - Other papers in the web site