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LSA SAF

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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LSA SAF in a nutshell

- **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**

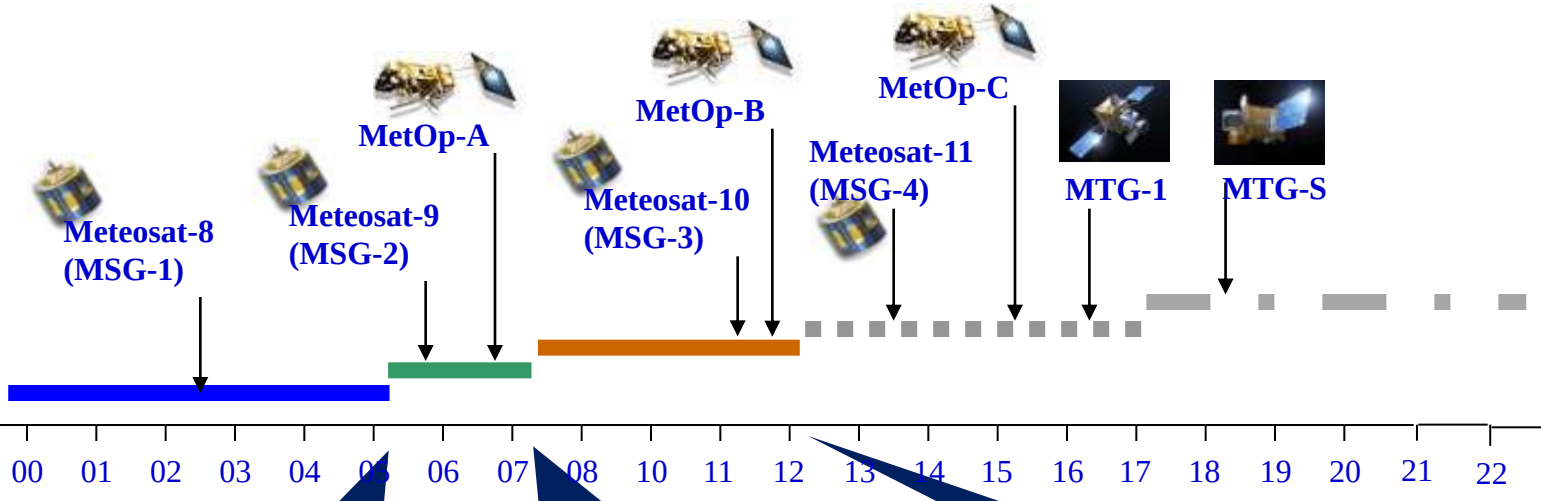
The Land SAF Consortium

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 patners
  - 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

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

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Surface Radiation

LST | ↓LongWave Flux | ↓ShortWave Flux | Albedo

Vegetation

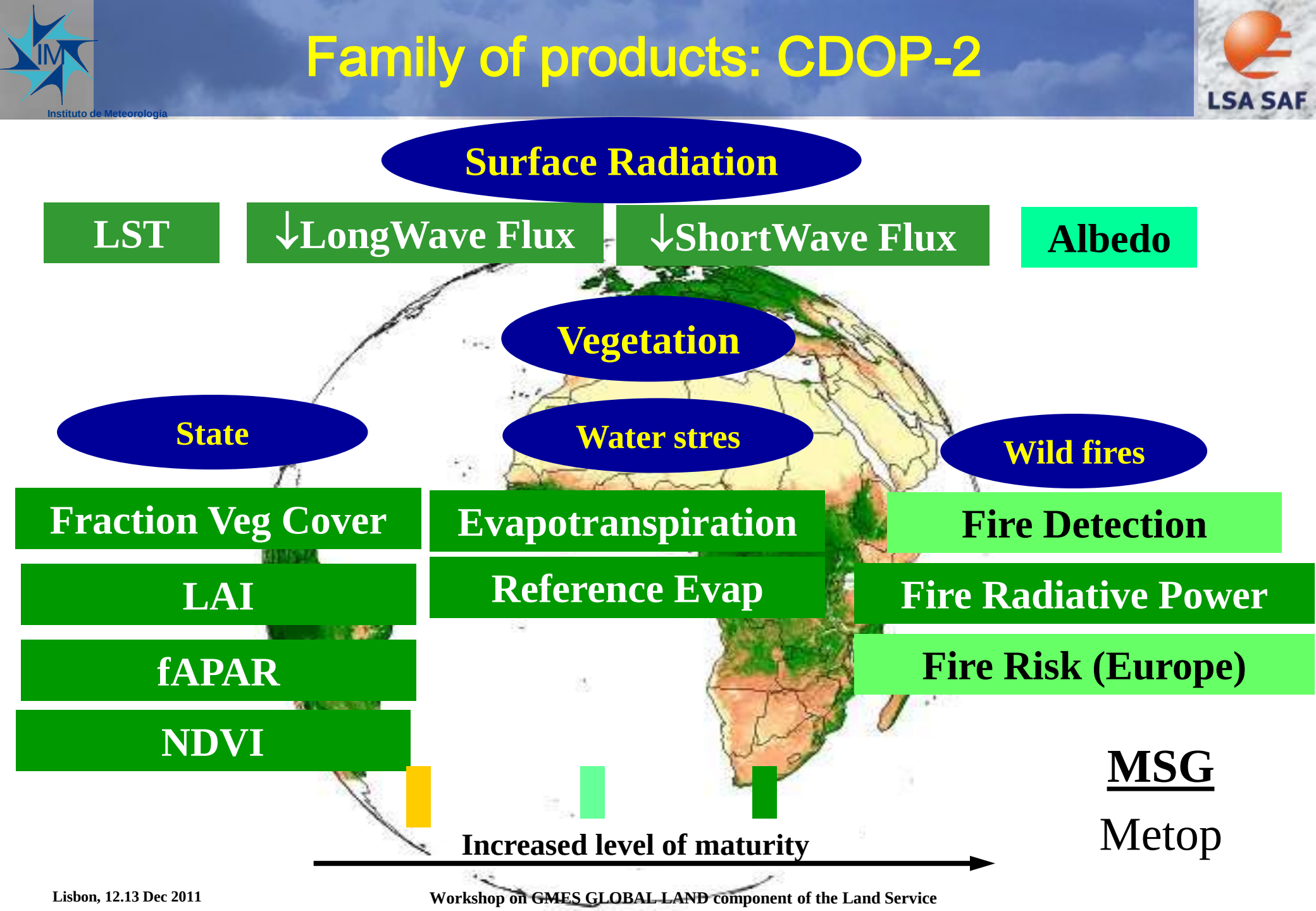
State | Water stres | Wild fires

Fraction Veg Cover | Evapotranspiration | Fire Detection

LAI | Reference Evap | Fire Radiative Power

fAPAR | Fire Risk (Europe)

NDVI



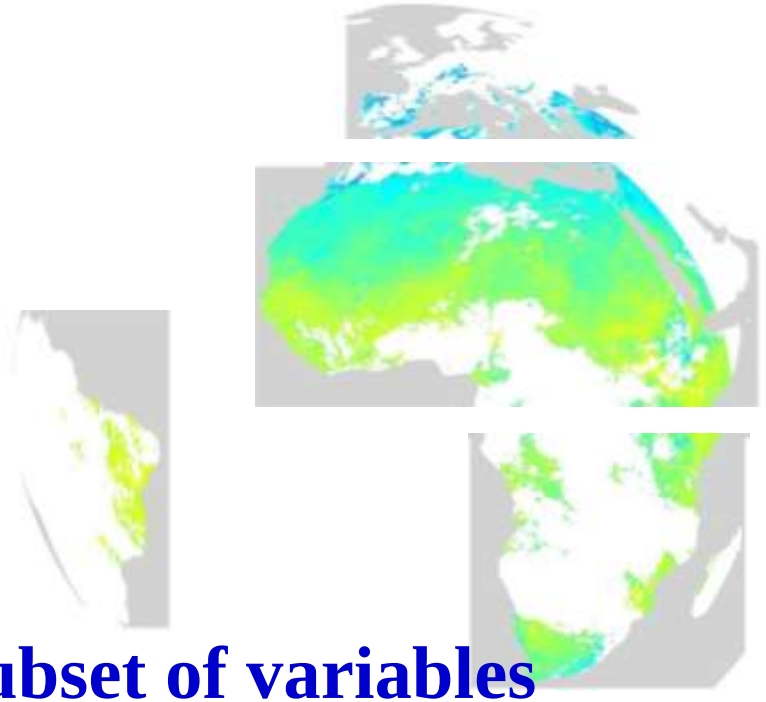
Increased level of maturity

MSG

Metop

Product characteristics

- 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 (biennally 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 Radative Power, developped 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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Surface Radiation Budget: Longwave

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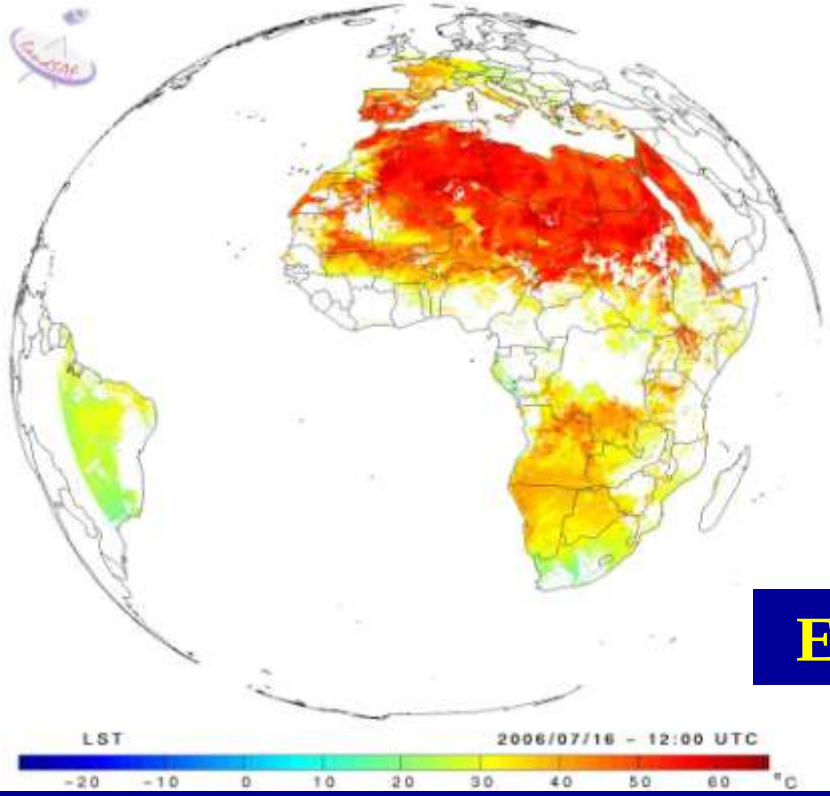
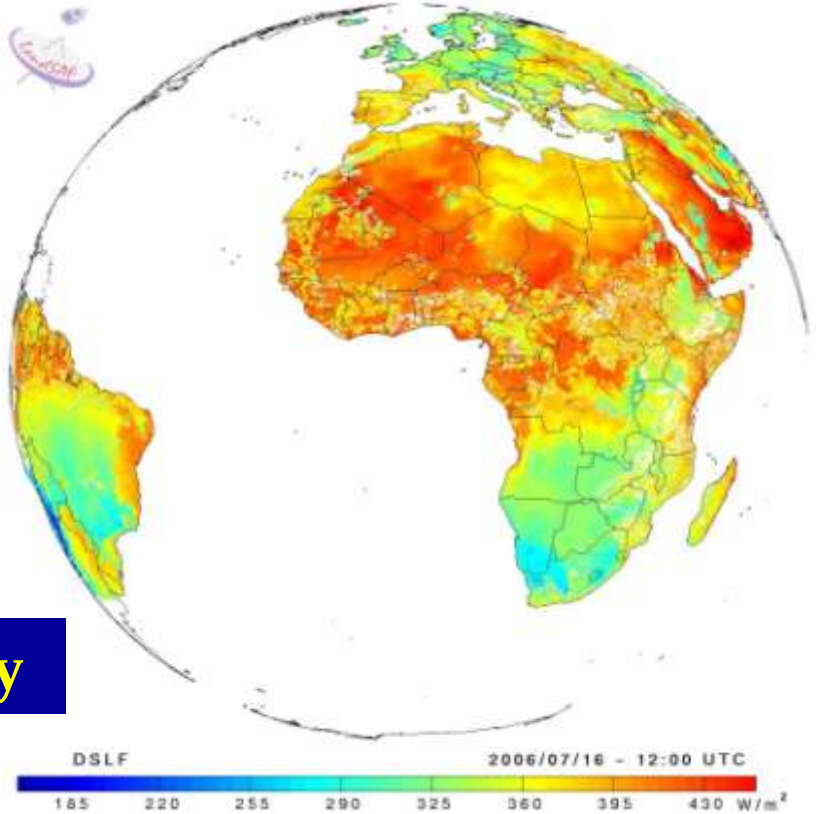
Surface Temperature Every 15 min



Downwelling LW Flux Every 30 min



Emissivity

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

Daily evapotranspiration (mm)

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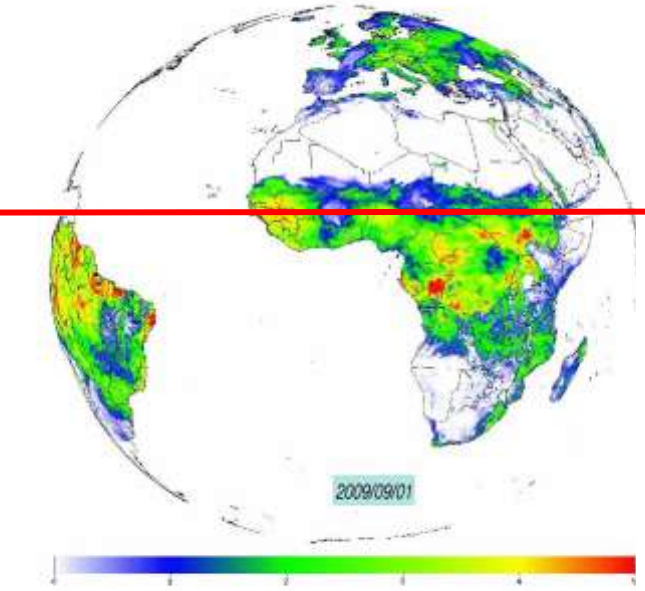
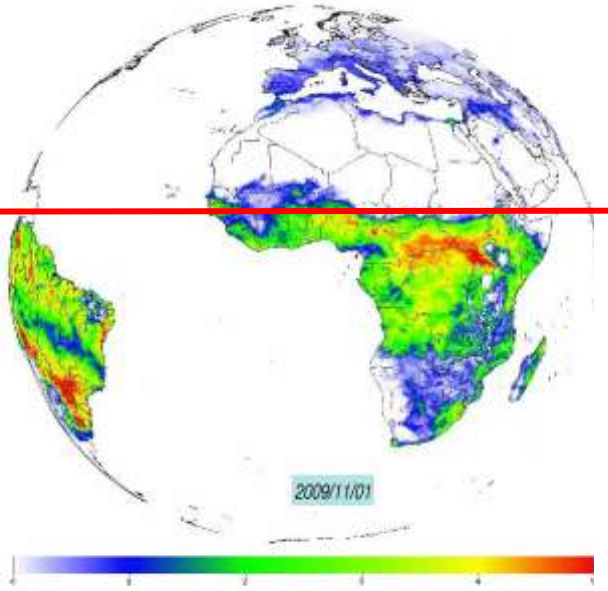
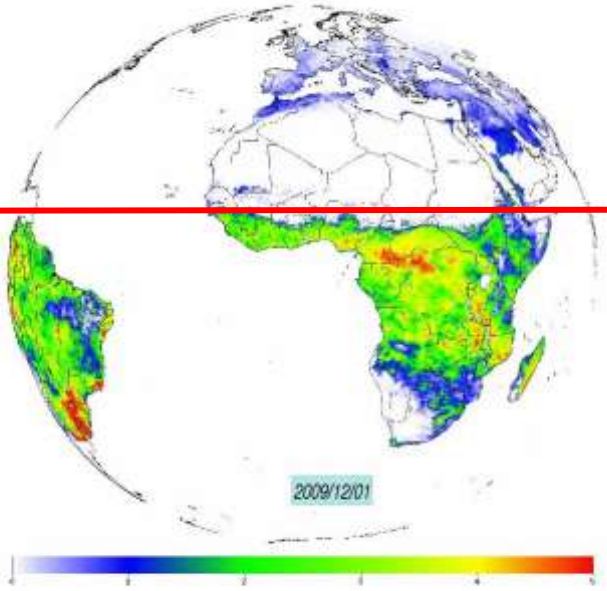
September 2009



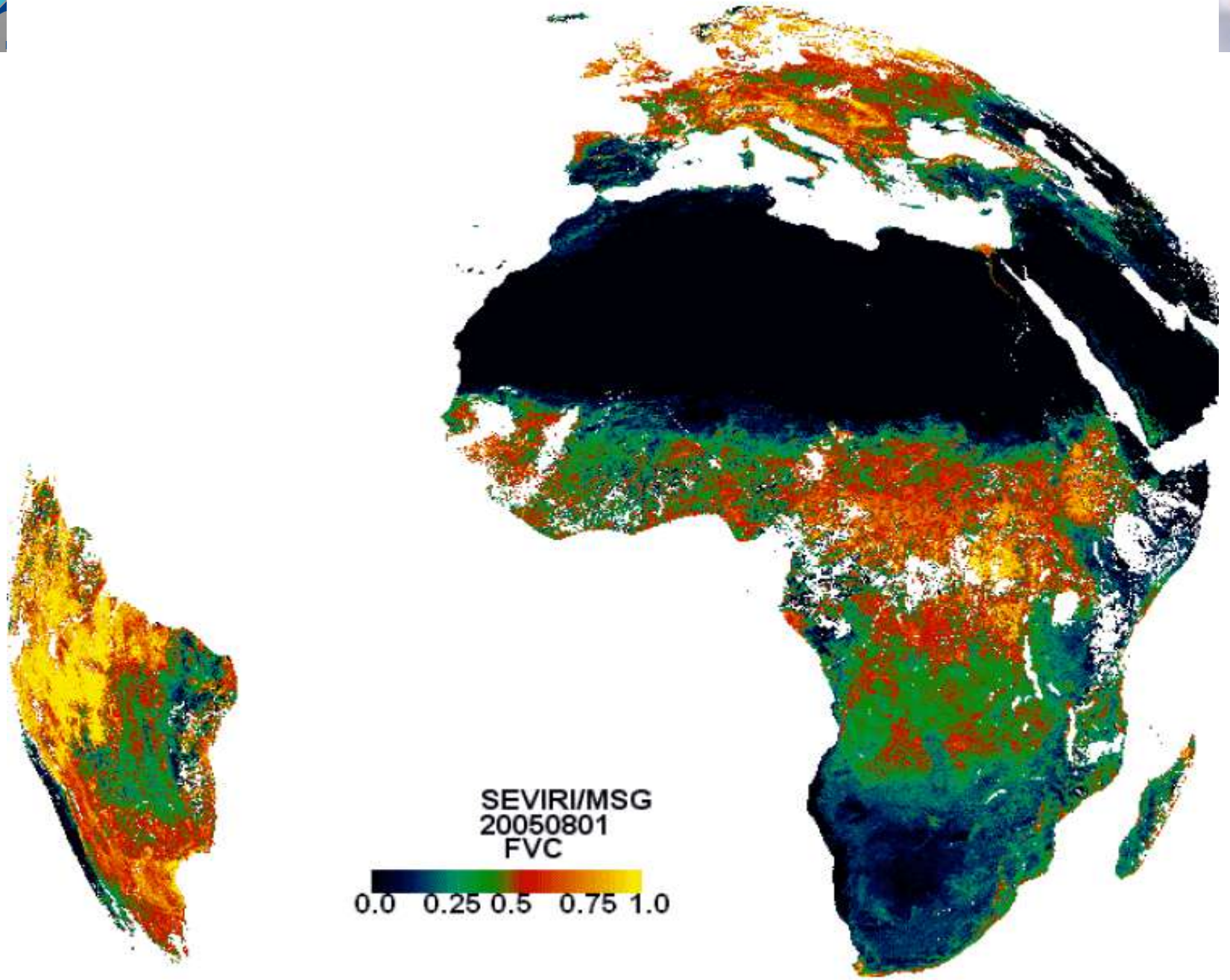
November 2009



December 2009



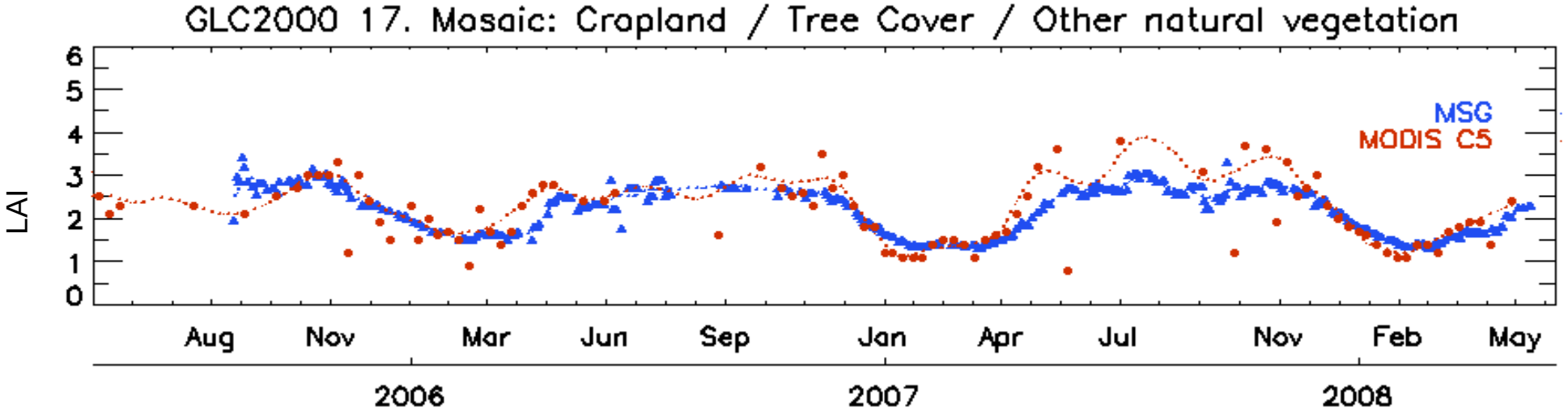
Fraction of vegetation cover (Sep 05- Sep 07)



Thanks to J. Garcia-Haro, U. Valencia

A common misconception: Higher resolution is better

Leaf Area Index: Central Africa



- 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

Thanks to J. Garcia-Haro, U. Valencia

Fire Radiative Power

Algorithm:

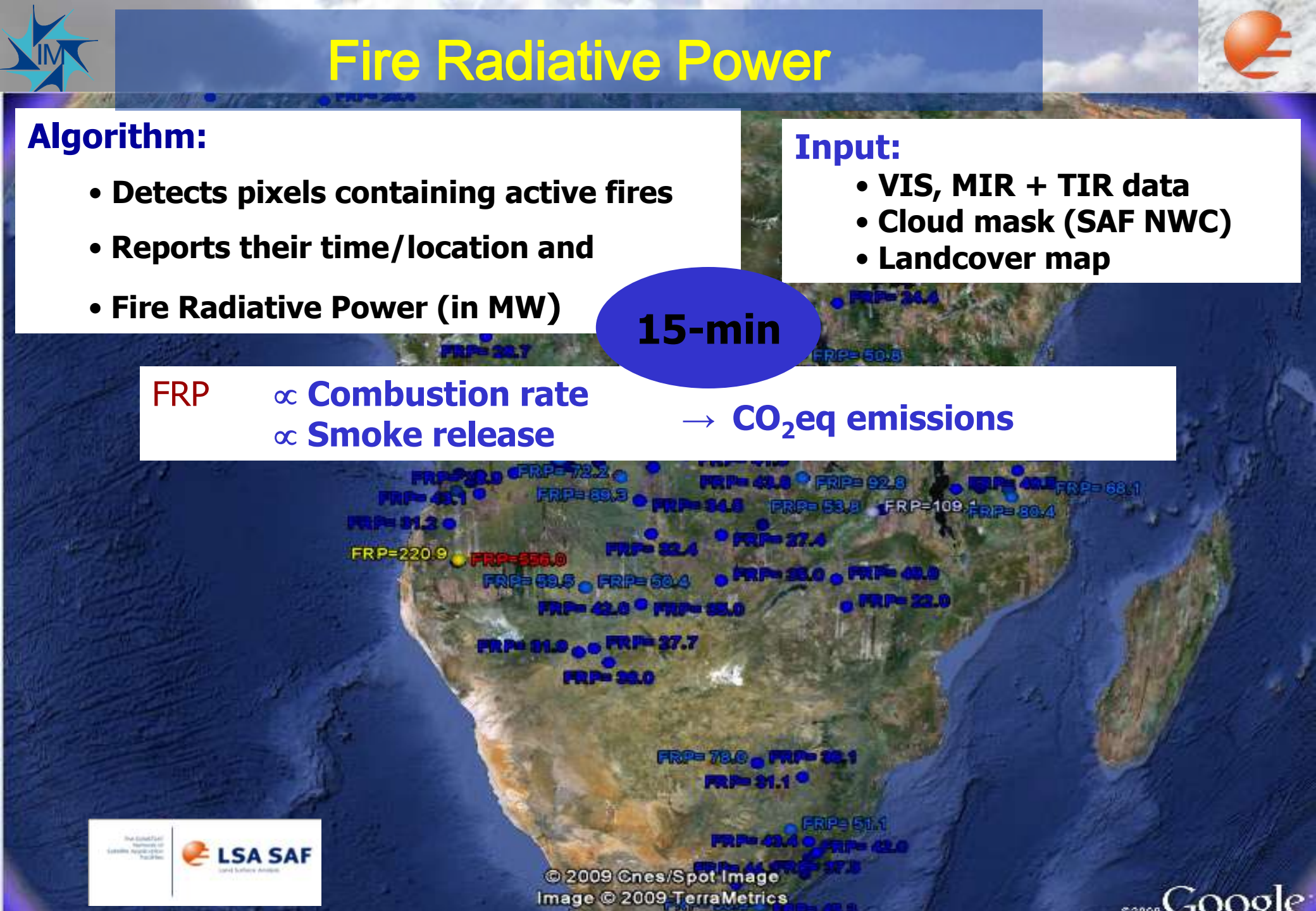
- Detects pixels containing active fires
- Reports their time/location and
- Fire Radiative Power (in MW)

Input:

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

15-min

FRP ∝ Combustion rate
∝ Smoke release
→ CO_2eq emissions



Modelled AOD of Greek Fire Plumes, August 2007

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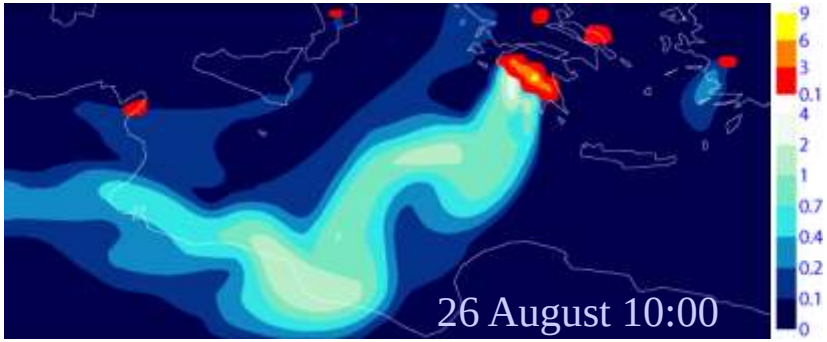
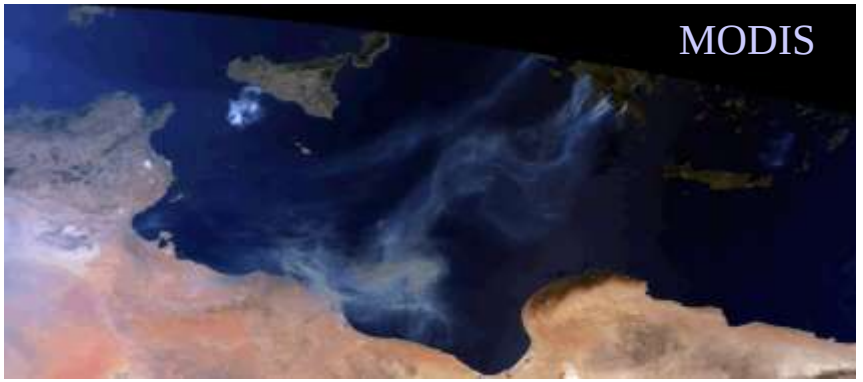
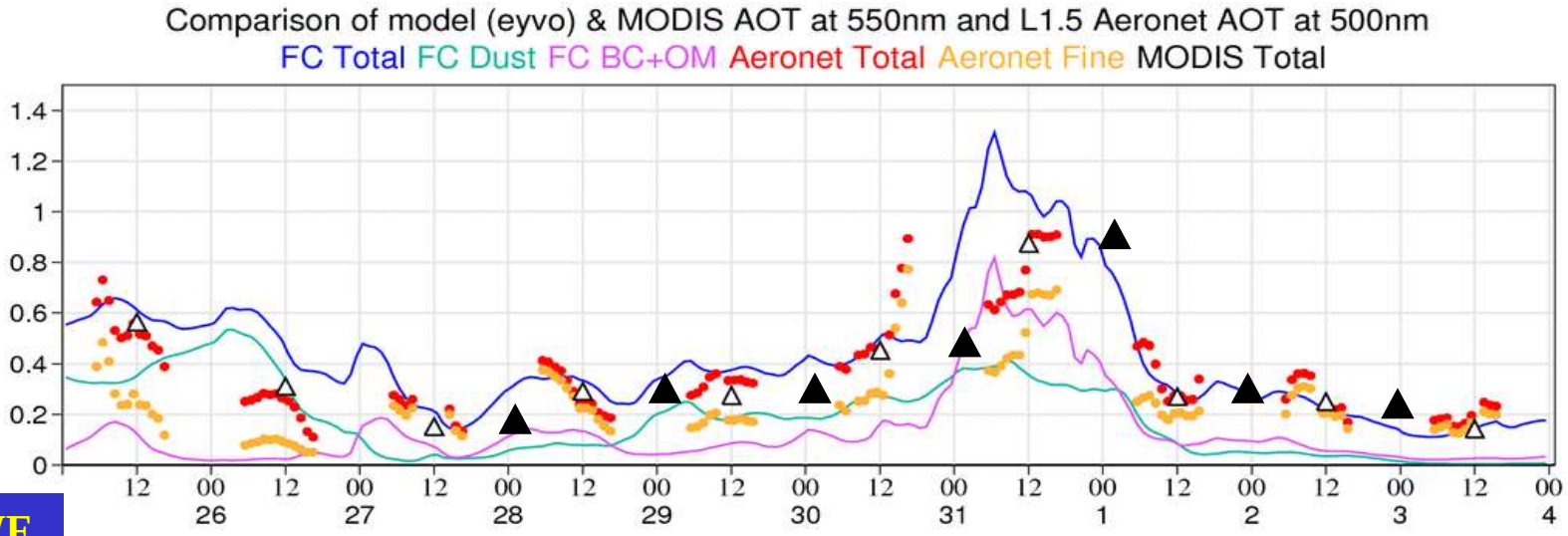




- **Emissions calculated from Fire Radiative Power observed by SEVIRI on Meteosat.**
- **Emission factors from *Andreae & Merlet 2001* and *Ichoku & Kaufman 2005*.**
- **Run at 25km global resolution, typical for regional models.**



J. Kayser, ECMWF

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LSA SAF outline for CDOP-2

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

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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**
  - **Strenghten 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**