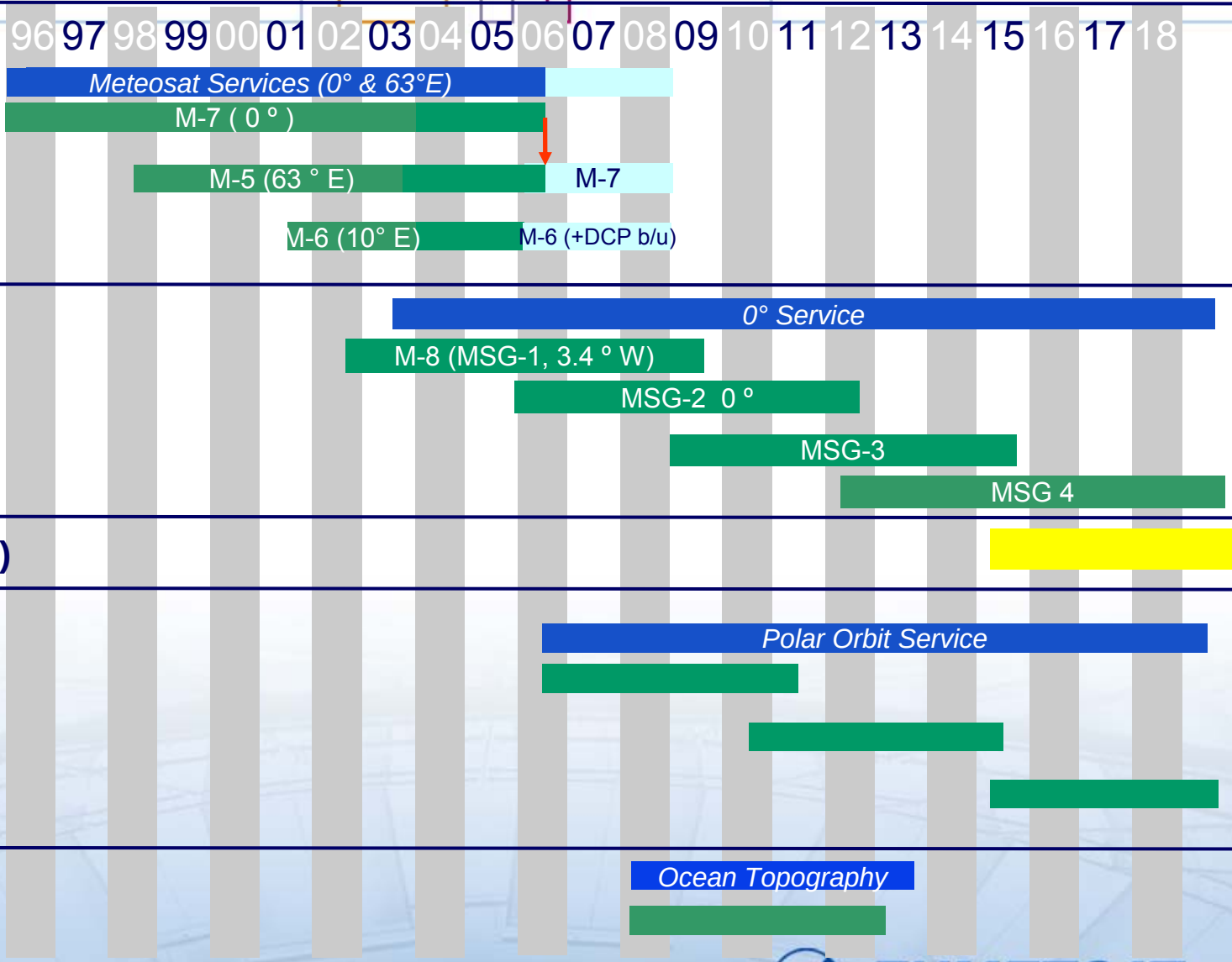
# EUMETSAT MISSION STATUS

## *Fire products / Fire requirements*

*Yves Govaerts et al.*

2nd Workshop on Geostationary Fire Monitoring and Applications
Darmstadt, Germany, 4-6 December 2006

# EUMETSAT mission status

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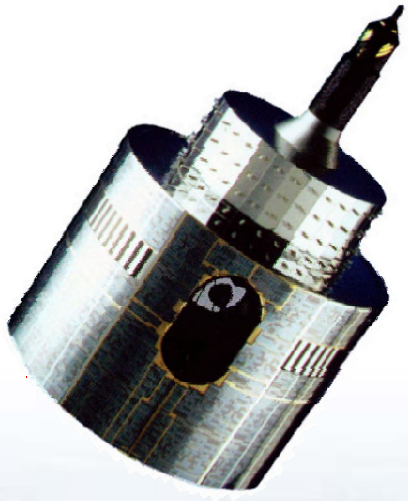
# METEOSAT FIRST GENERATION



Burnt surface from surface albedo seasonal cycle analysis
Experimental product, no operational generation

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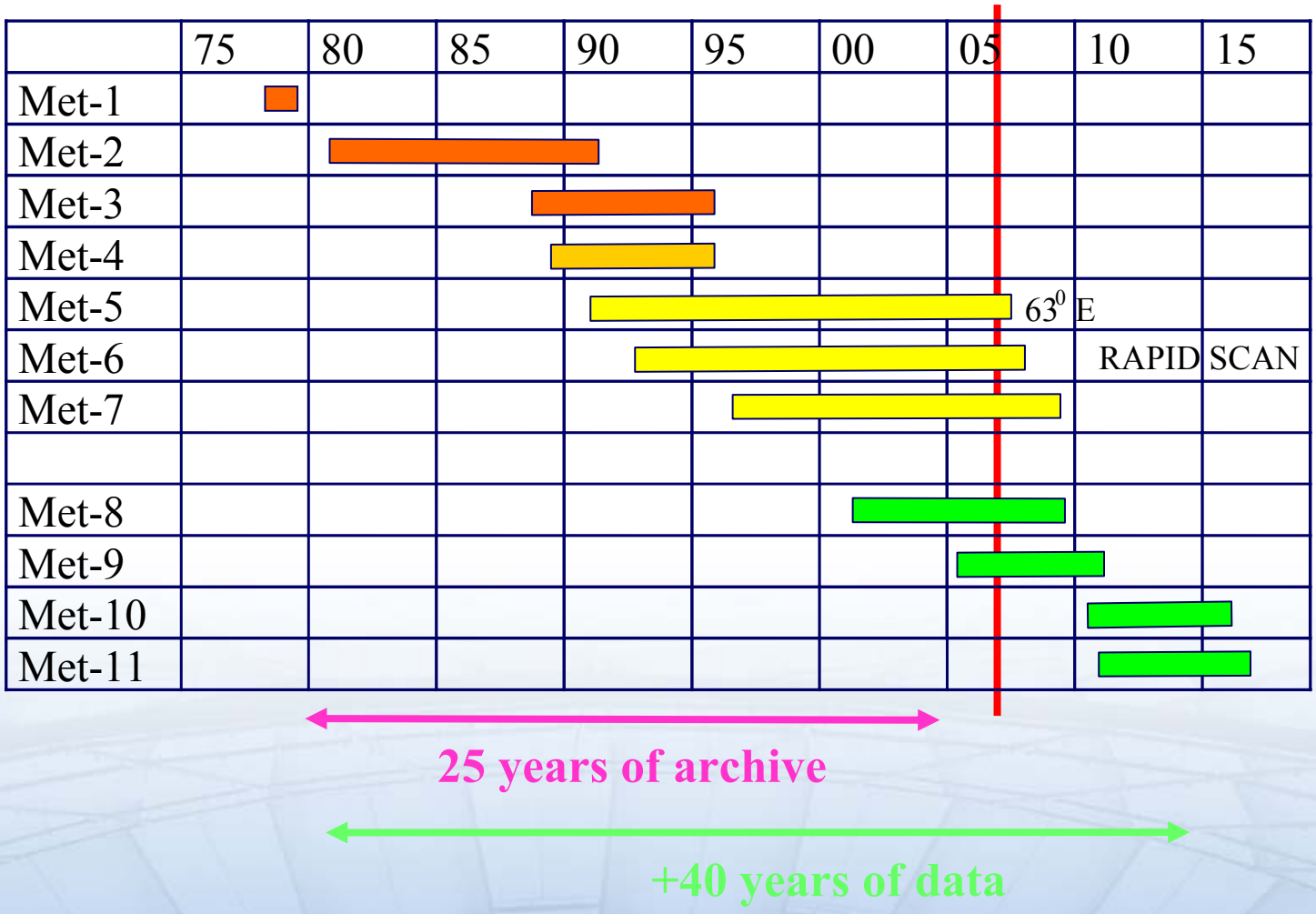
# METEOSAT ARCHIVE

**Pre-operational**
**VIS 6 bits**

**Operational**
**VIS 8 bits**

**MSG**
**10 bits**

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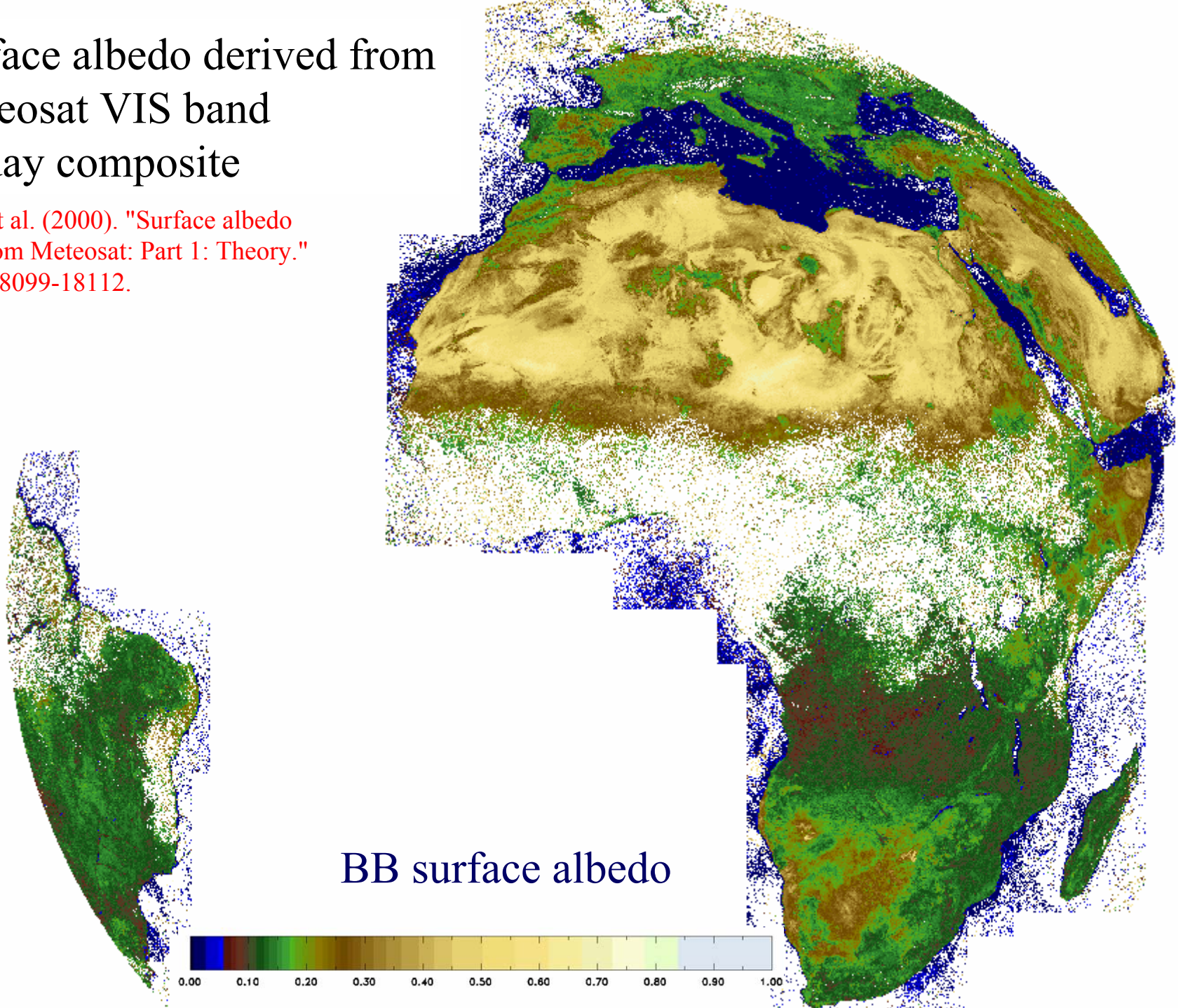
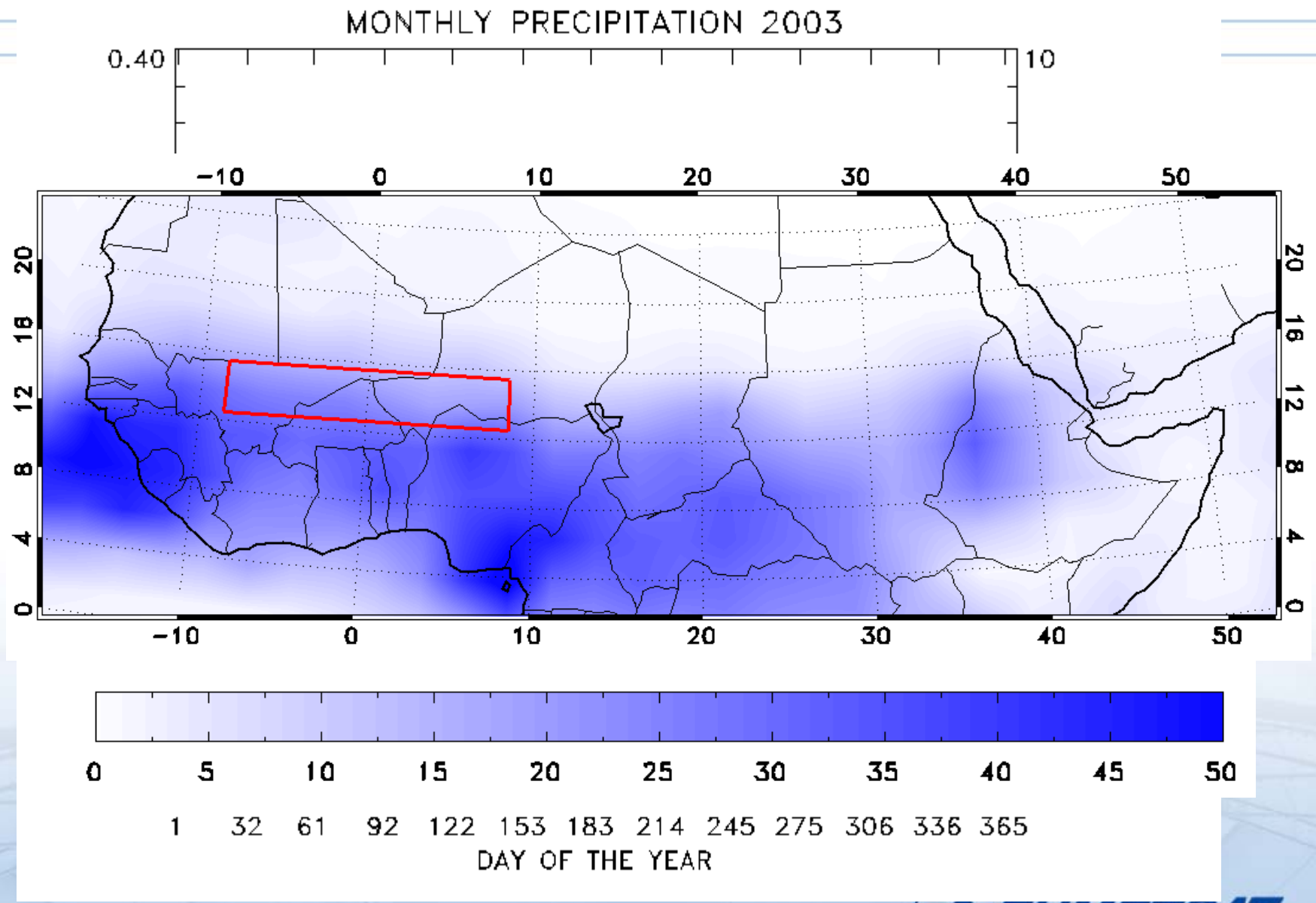
# Surface albedo derived from Meteosat VIS band 10 day composite

Pinty, B., et al. (2000). "Surface albedo retrieval from Meteosat: Part 1: Theory." JGR **105**: 18099-18112.



# Monsoon induced surface albedo seasonal cycle




GPCP precipitation

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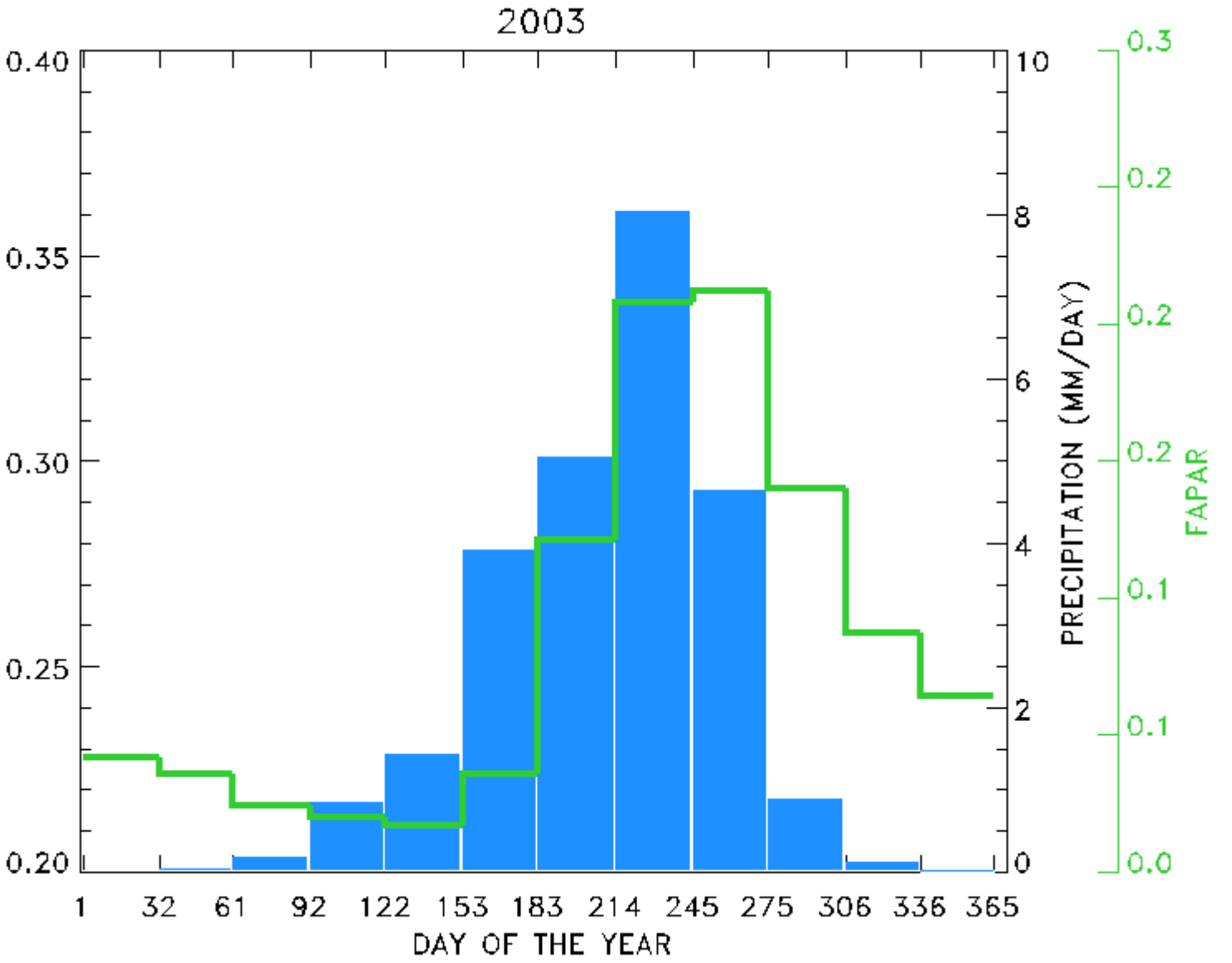
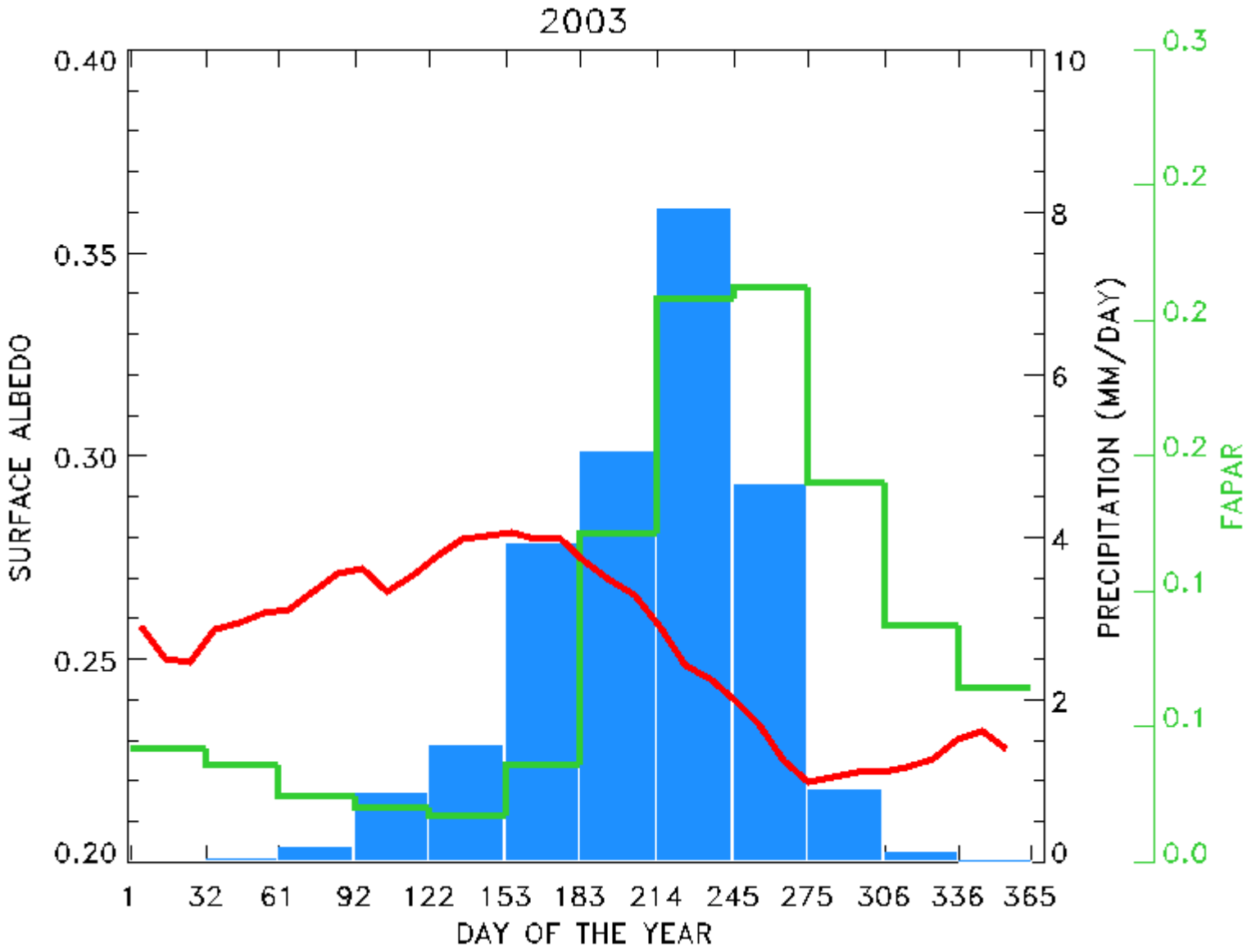
# Monsoon induced surface albedo seasonal cycle



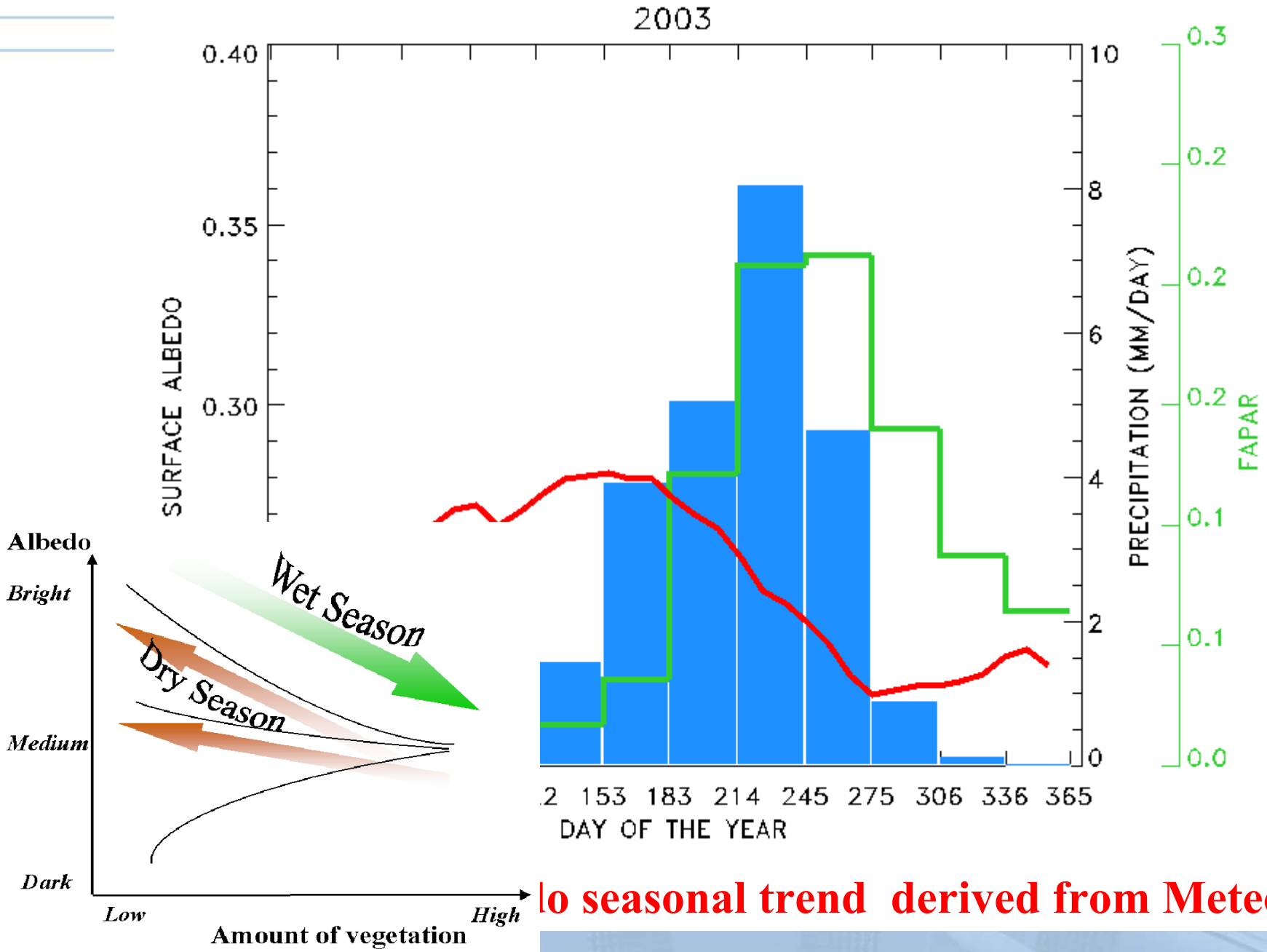

*Gobron N., et al.* (2002) '**Sea Wide Field-of-View Sensor (SeaWiFS) - An Optimized FAPAR Algorithm - Theoretical Basis Document**', **Institute for Environment and Sustainability**, EUR Report No. 20148 EN, 20 pp.

# Monsoon induced surface albedo seasonal cycle



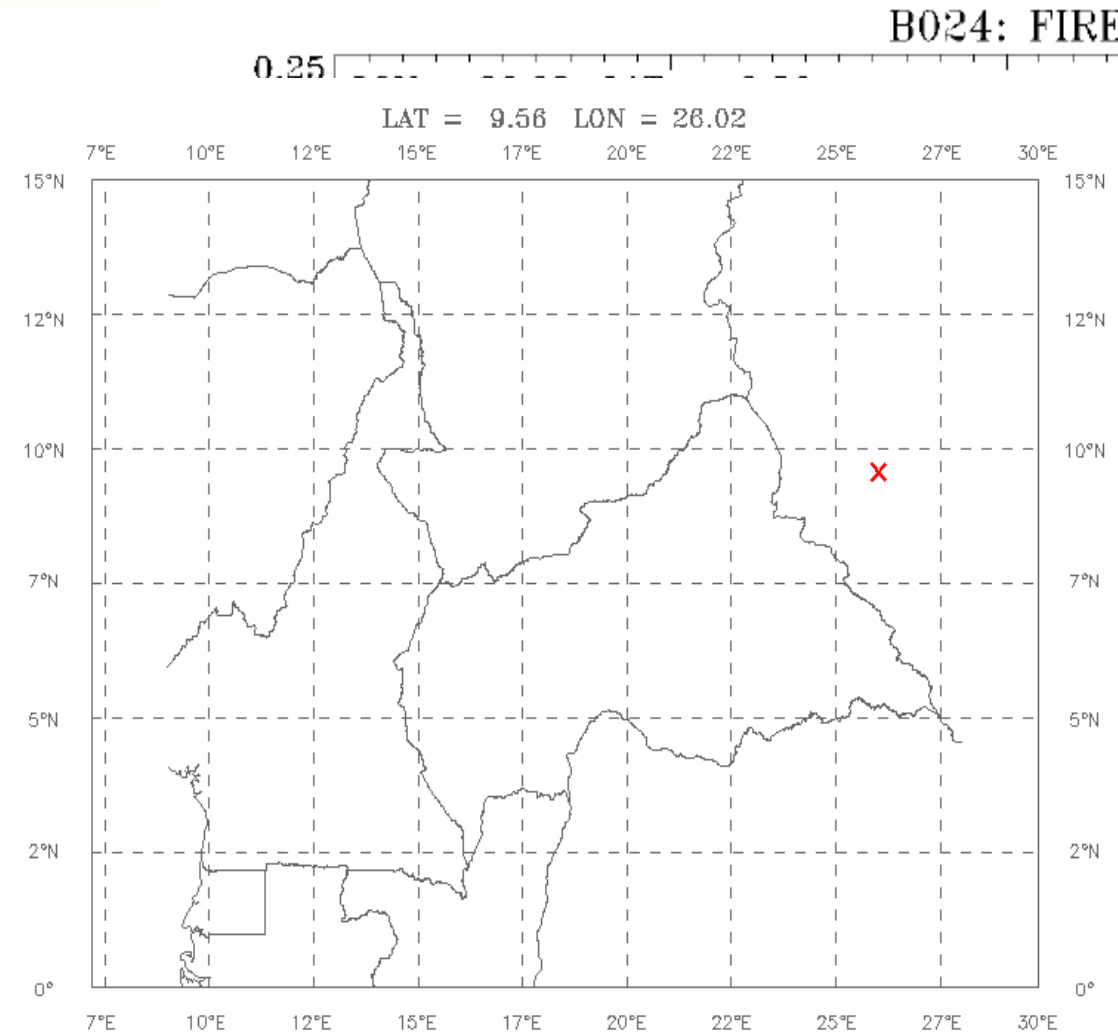

**Broadband surface albedo seasonal trend derived from Meteosat**

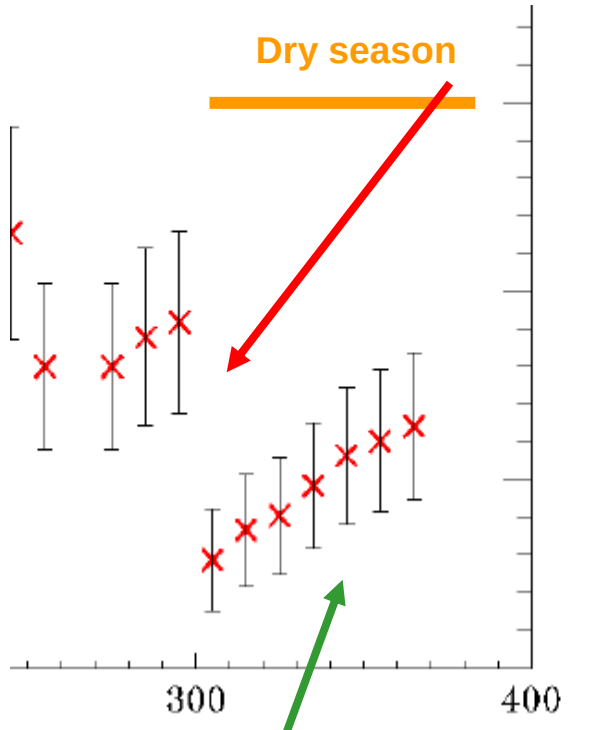
# Monsoon induced surface albedo seasonal cycle




lo seasonal trend derived from Meteosat

# FIRE IMPACT ON SURFACE ALBEDO




Govaerts, Y. M., J. M. Pereira, et al. (2002). "Impact of Fires on Surface Albedo Dynamics over the African Continent." JGR **107**(D22): doi:10.1029/2002JD002388.

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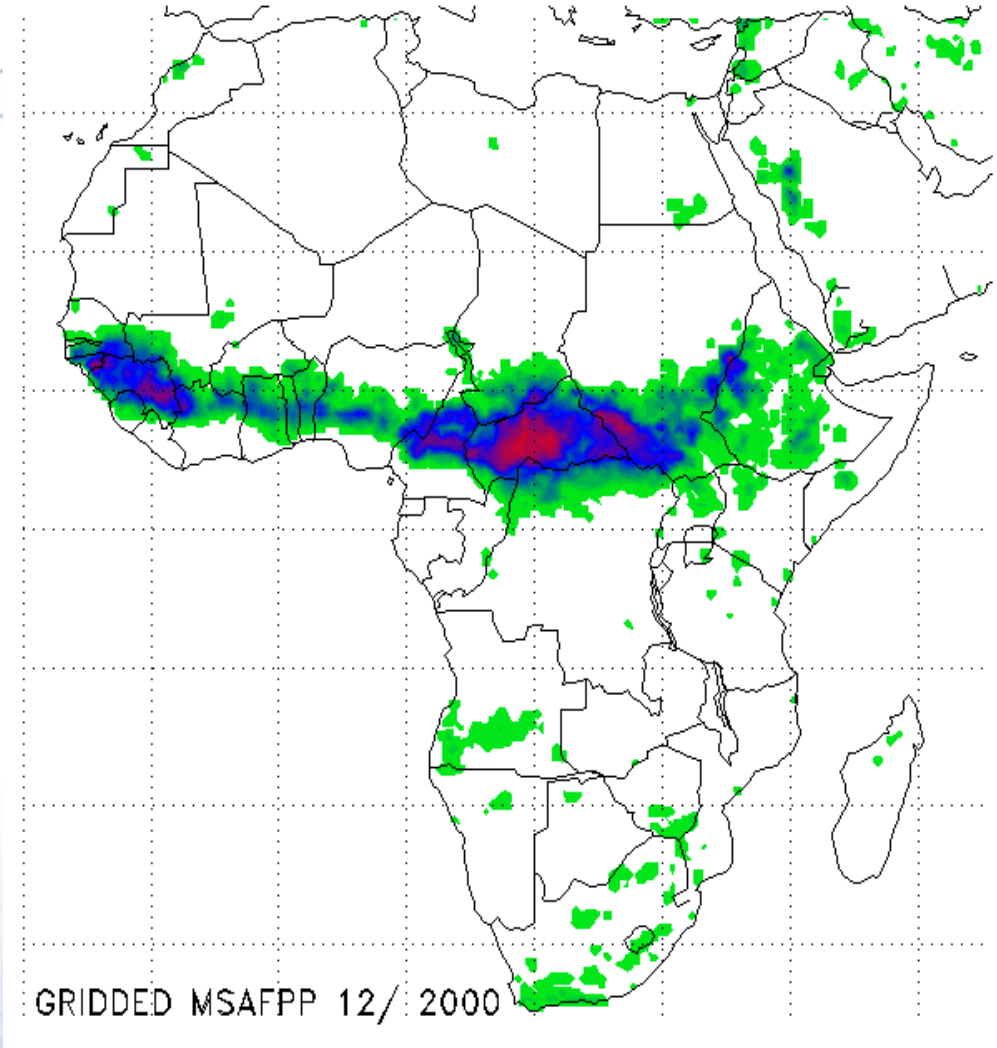


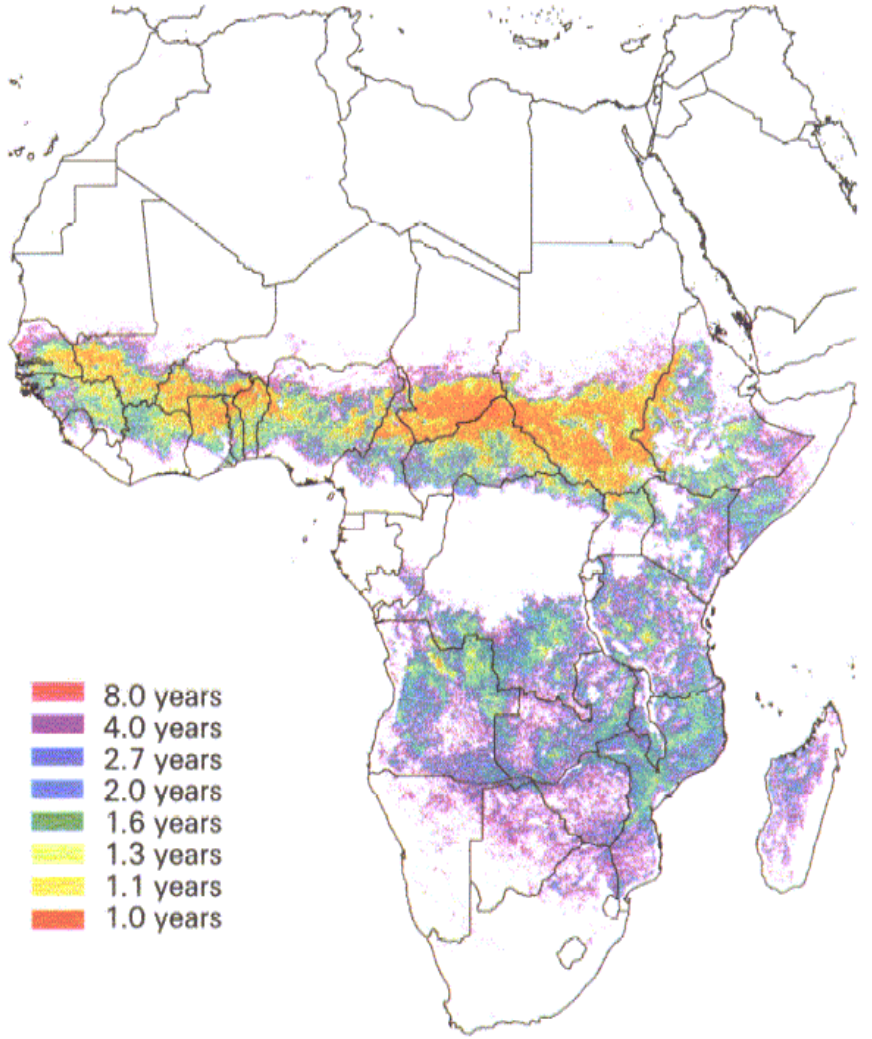
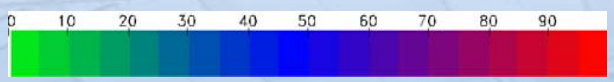
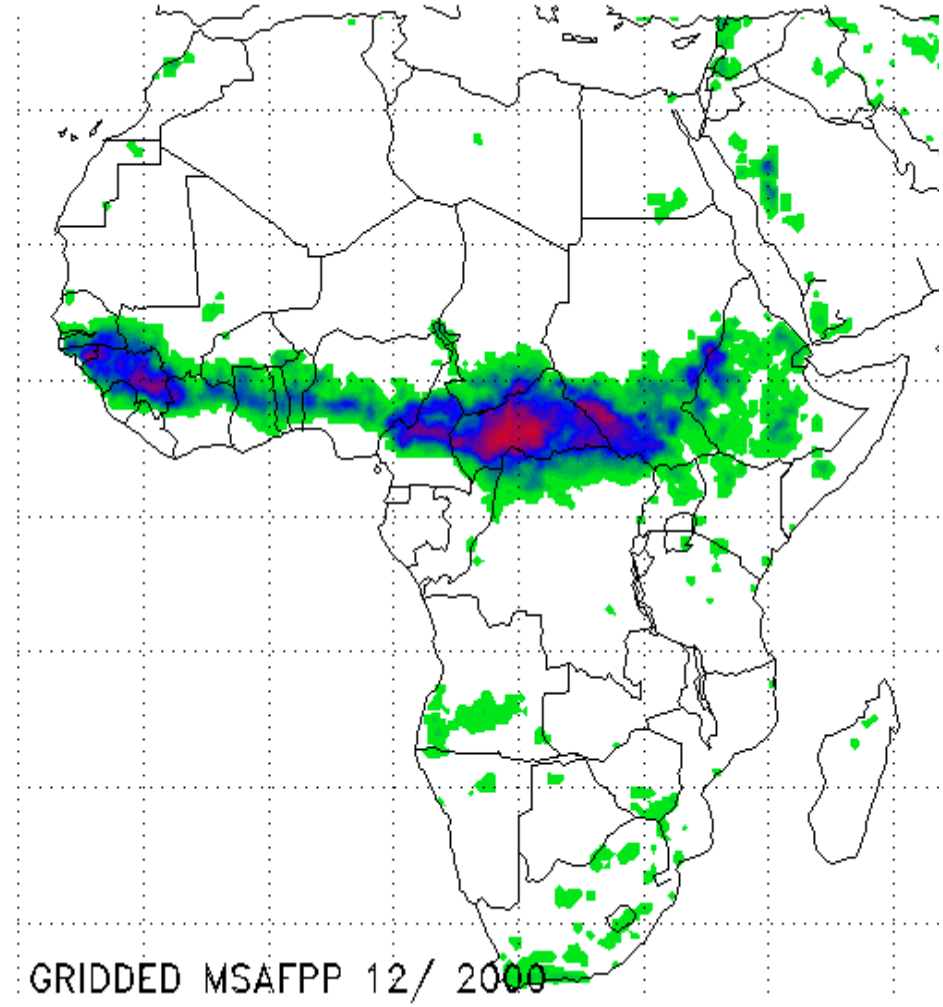



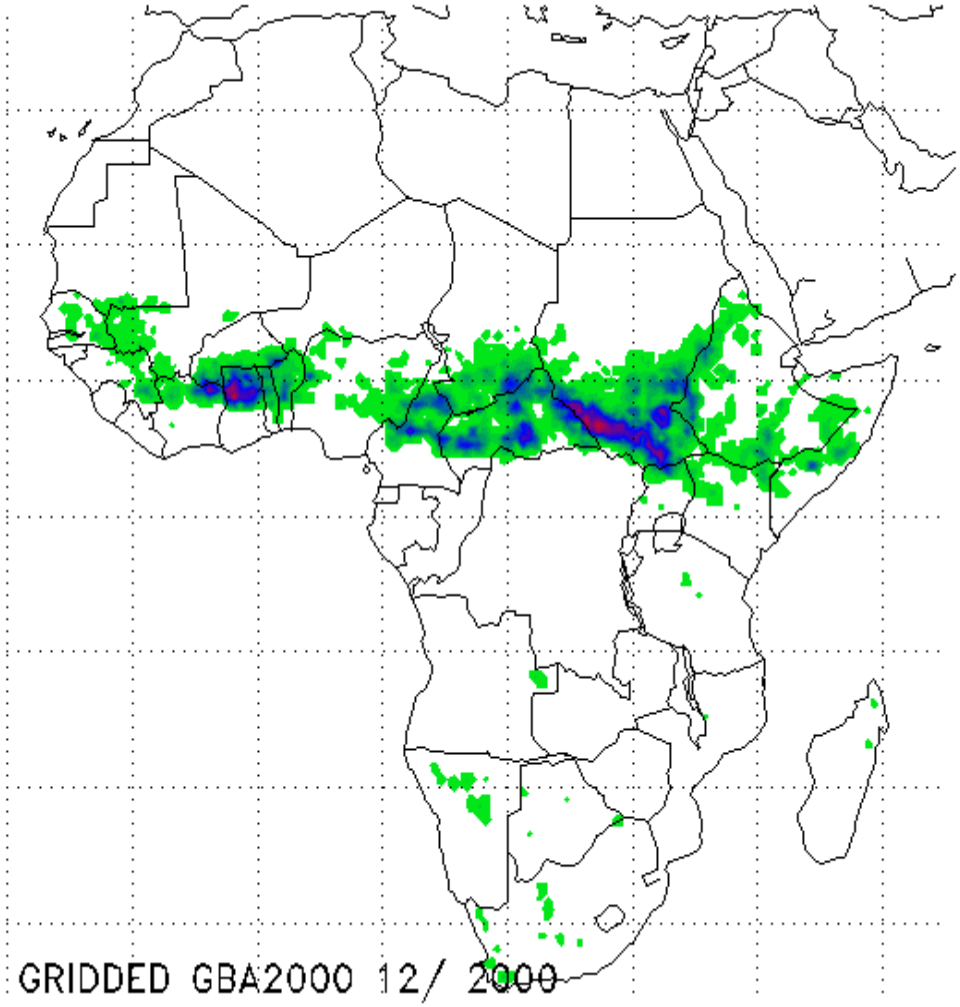

**Plate 2.** Burning frequency map for the 8 year period 1981-1983 and 1985-1991.

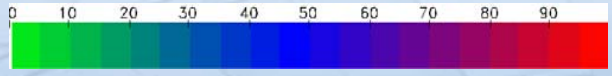



**Gridded MSA Fire Perturbation Probability**

Barbosa, P.M., Stroppiana, D., Gregoire, J.-M., and Pereira, J.M.C. (1999) An assessment of vegetation fire in Africa (1981-1991): Burned areas, burned biomass, and atmospheric emissions, *Global Biogeochemical Cycles*, 13, 933-950.




**Gridded MSA Fire Perturbation Probability**


**Gridded GBA2000 Percent Burnt Area**

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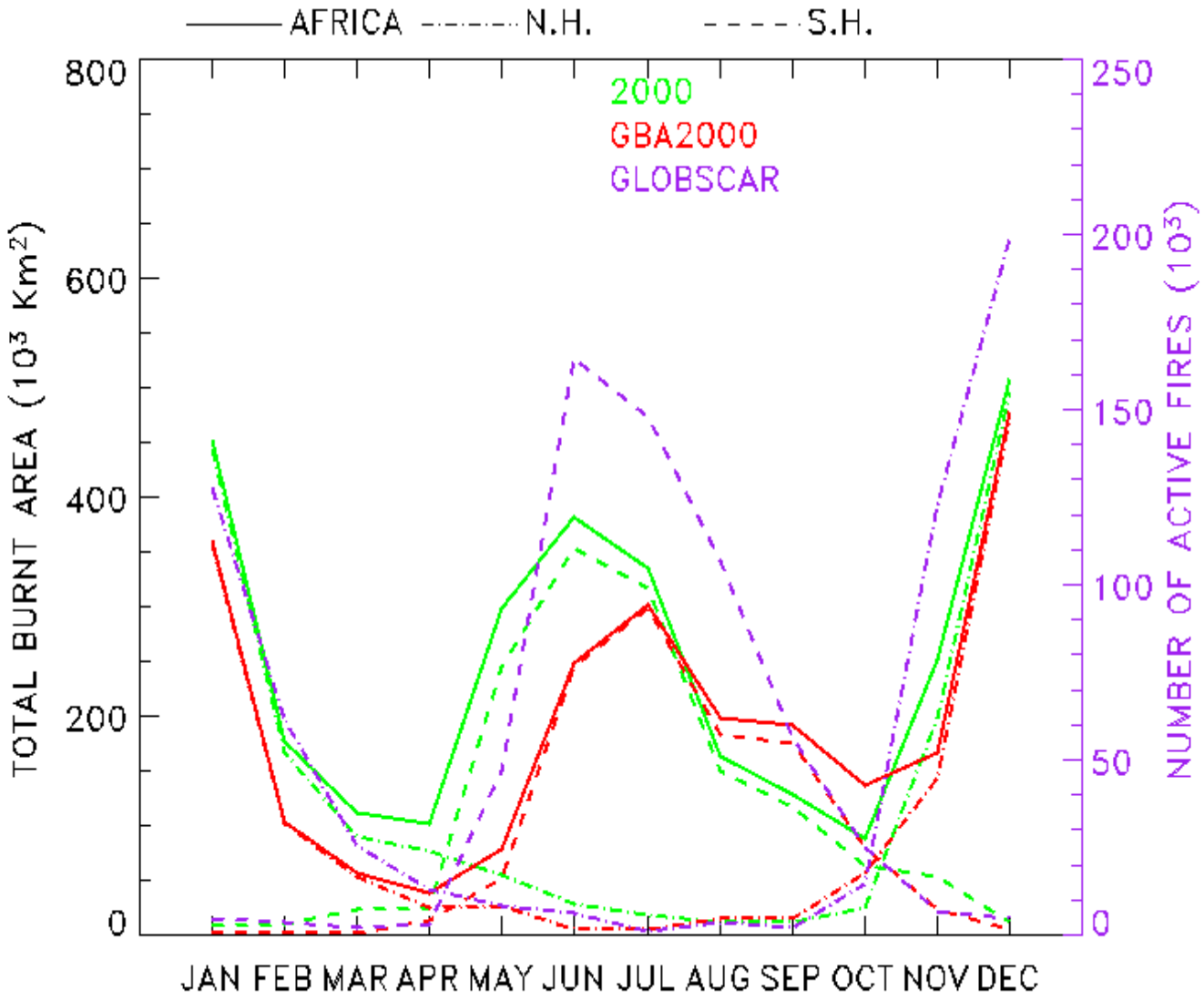
# MONTHLY TIME SERIES




**MSA PBA** **GLOBSCAR** **GBA 2000**

# COMPARISON WITH OTHER RESULTS

| Reference | N.H. $10^6\,km^2$ | S.H. $10^6\,km^2$ | TOTAL $10^6\,km^2$ |
|---|---|---|---|
| MSA PBA | 1.62 | 1.38 | 3.00 |
| GBA2000 0.5 X 0.5 | 1.18 | 1.08 | 2.36 |
| Barbosa et al. (1999) 1981 - 1991 | | 1.54 | 2.8 – 5.2 |
| Van der Werf et al. (2003) 1998 - 2001 | | 1.16 | |

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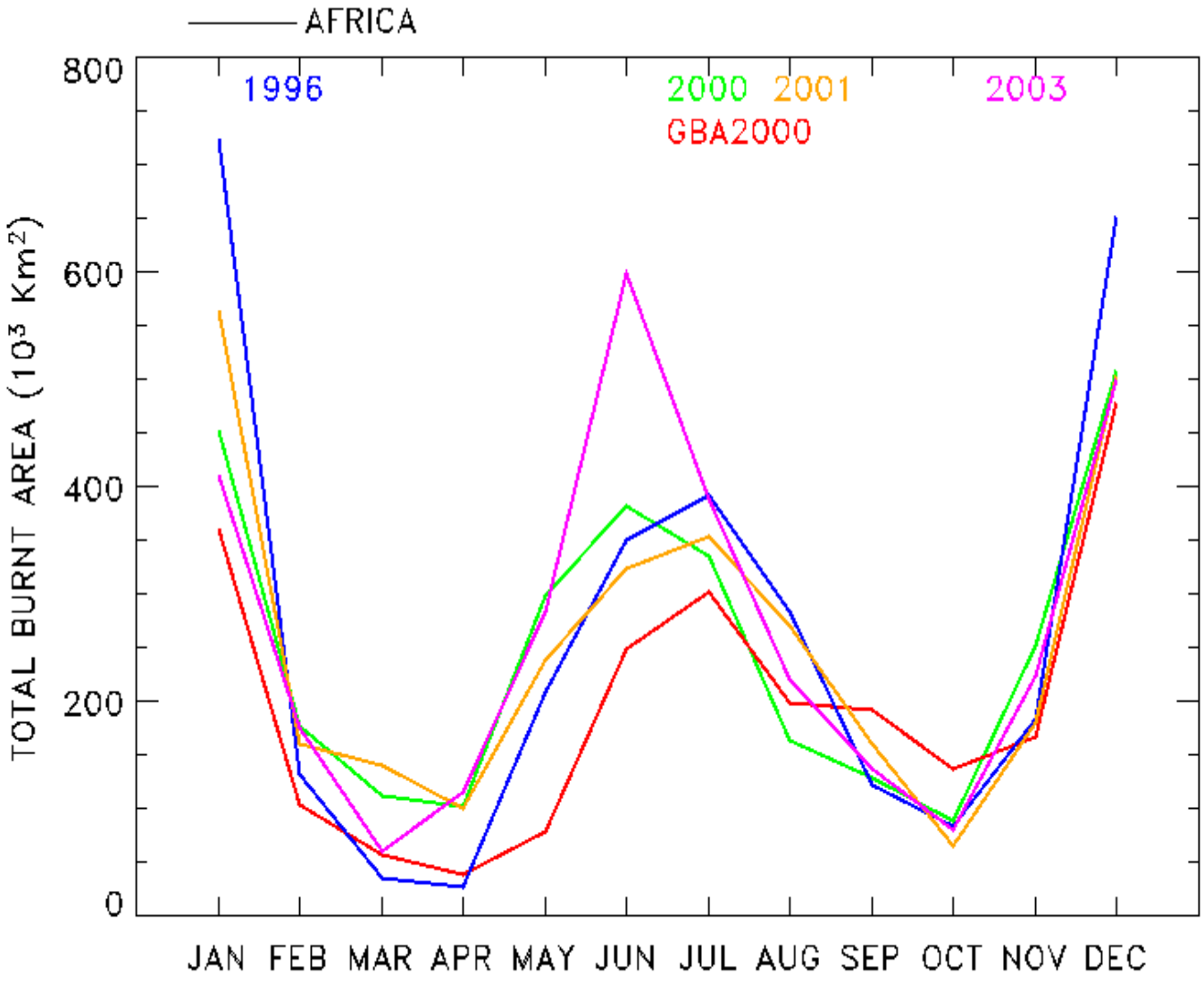
# MULTI-YEAR ANALYSIS

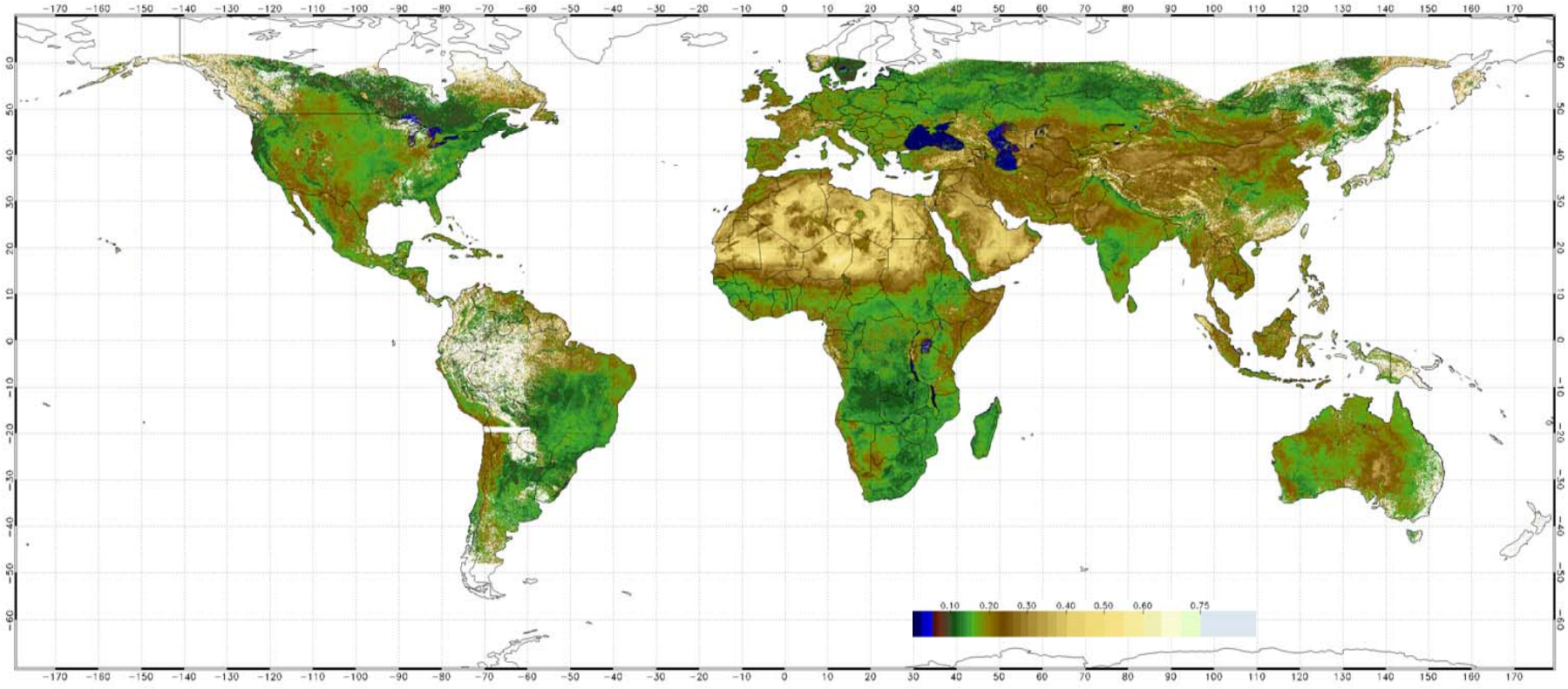



**Total Burnt ($10^6$ $km^2$)**

| | |
|---|---|
| 1996 | 3.19 |
| 2000 | 3.00 |
| 2001 | 3.05 |
| 2003 | 3.19 |

# Global surface albedo

A similar analysis can be repeated with all geostationary satellites




GSA Algorithm: the period analyzed for the study is 1-10 of May 2001.
Albedo is represented as the Directional Hemispherical Reflectance (DHR ) in the 0.3 - 3.0 µm spectral interval with a probability larger than 50%.

Govaerts, Y. and A. Lattanzio (2006). "Retrieval Error Estimation of Surface Albedo Derived from Geostationary Large Band Satellite Observations." JGR: In print.

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# METEOSAT SECOND GENERATION

- Active fire detection: MSG/MPEF, Land SAF (EUMETSAT distributed ground segment)
- Fire risk (Land SAF)
- Fire radiative power/energy (under development)

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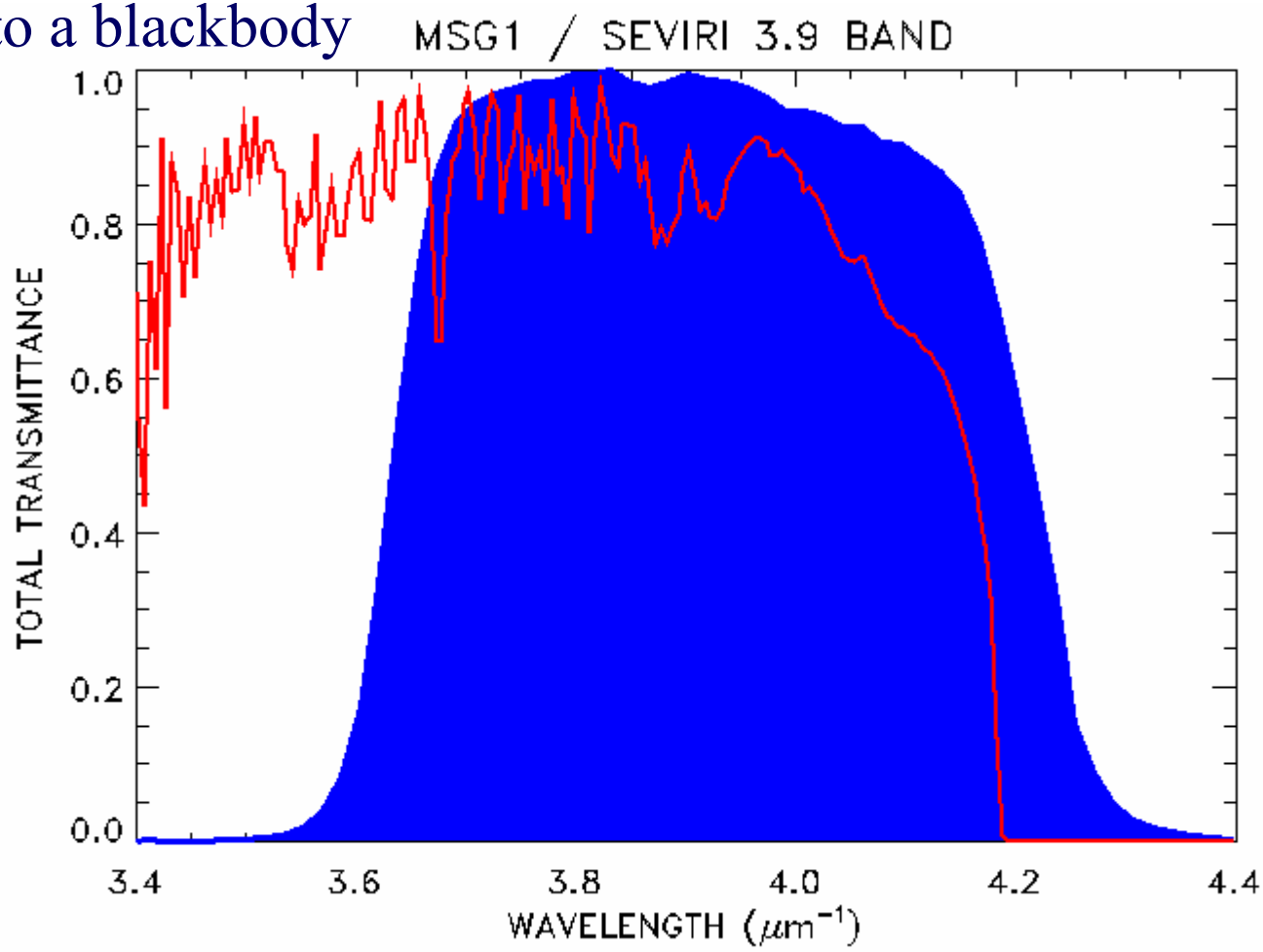
# SEVIRI instrument : the 3.9 band

- Dynamic range : 0 – 335K
- Noise : 0.35 @ 300 K (requirements)
- SSP pixel distance : 3km
- Calibrated in K wrt to a blackbody

Average atm trans
≈ 0.75



# The EUMETSAT Operational Active Fire Monitoring Product (FIR)

**The FIR product**

- is derived from MSG SEVIRI data
- is derived on pixel resolution (i.e. 3 x 3 km)
- is generated for every repeat cycle (15 minutes)

**The FIR algorithm uses the following tests:**

- Brightness temperature of channel IR3.9
- Standard deviation of channel IR3.9 (3x3 pixel)
- Brightness temperature difference of channels IR3.9 and IR10.8
- Standard deviation of channel IR10.8 (3x3 pixel)

# The EUMETSAT Operational Active Fire Monitoring Product (FIR)

**The FIR product**

- is available in near-real time and soon also as an archived product (UMARF archive)
- is disseminated currently via FTP, soon also via EUMETCast
- is available in GRIB2 format and as an ASCII text file
- has a file size between ~10 KB and ~25 KB

**To retrieve this product, please go to:**
**ftp://ftp.eumetsat.int/pub/OPS/out/simon/FIRE/**

**For more details - see poster of Lutz et al.**

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# Fire Radiative Power/Energy

- Prototyping of the algorithm of Wooster *et al*. 2005 for subsequent operational FRP and FRE product generation.
- The FTA (Fire Thermal Anomaly) algorithm generates the FRP and FRE.
- The FRP product is generated at the SEVIRI pixel resolution every 15min.
- The FRE product will be generated at a 1 - 5º degree resolution temporally integrated over 3 hours (TBD).
- Currently in a pre-operational phase, generating products for evaluation purposes.
- Product available to some limited beta-users for evaluation purposes, with emphasis on assimilation in NWP and climate models.

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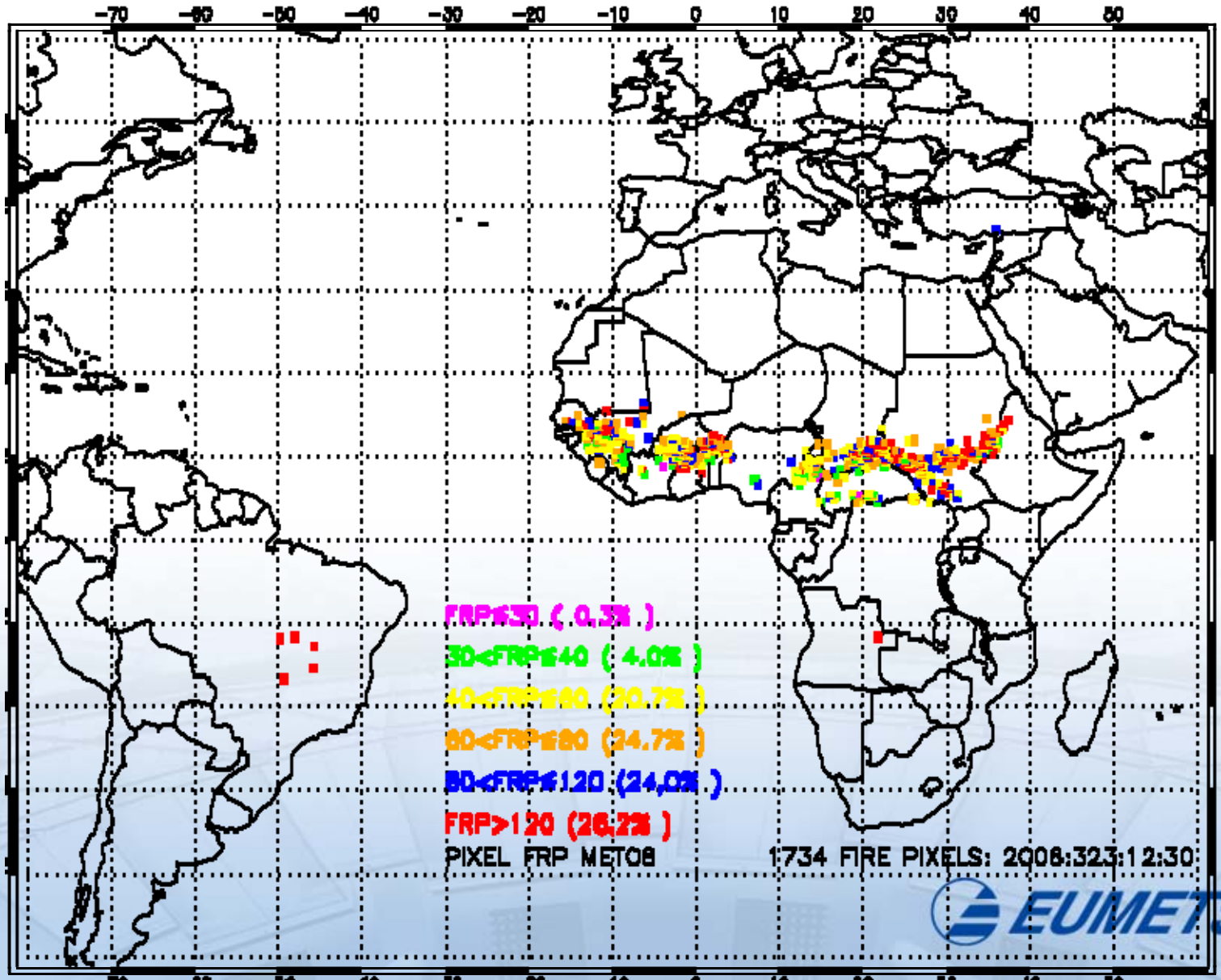
# Example of FRP product: MSG1 19 Nov 2006 12:30

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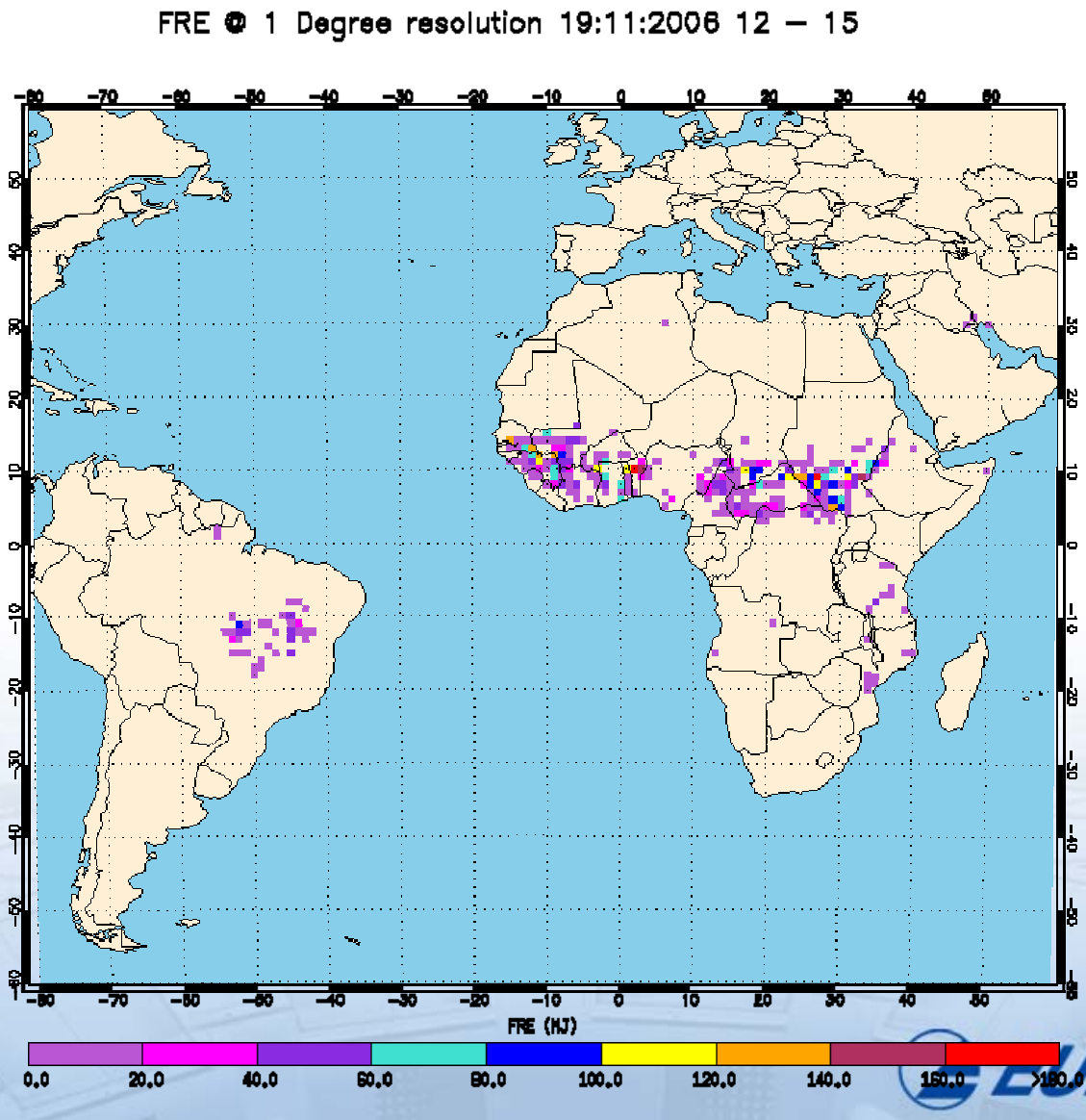
# Example of FRE product: MSG1 19 Nov 2006 12:00 – 15:00

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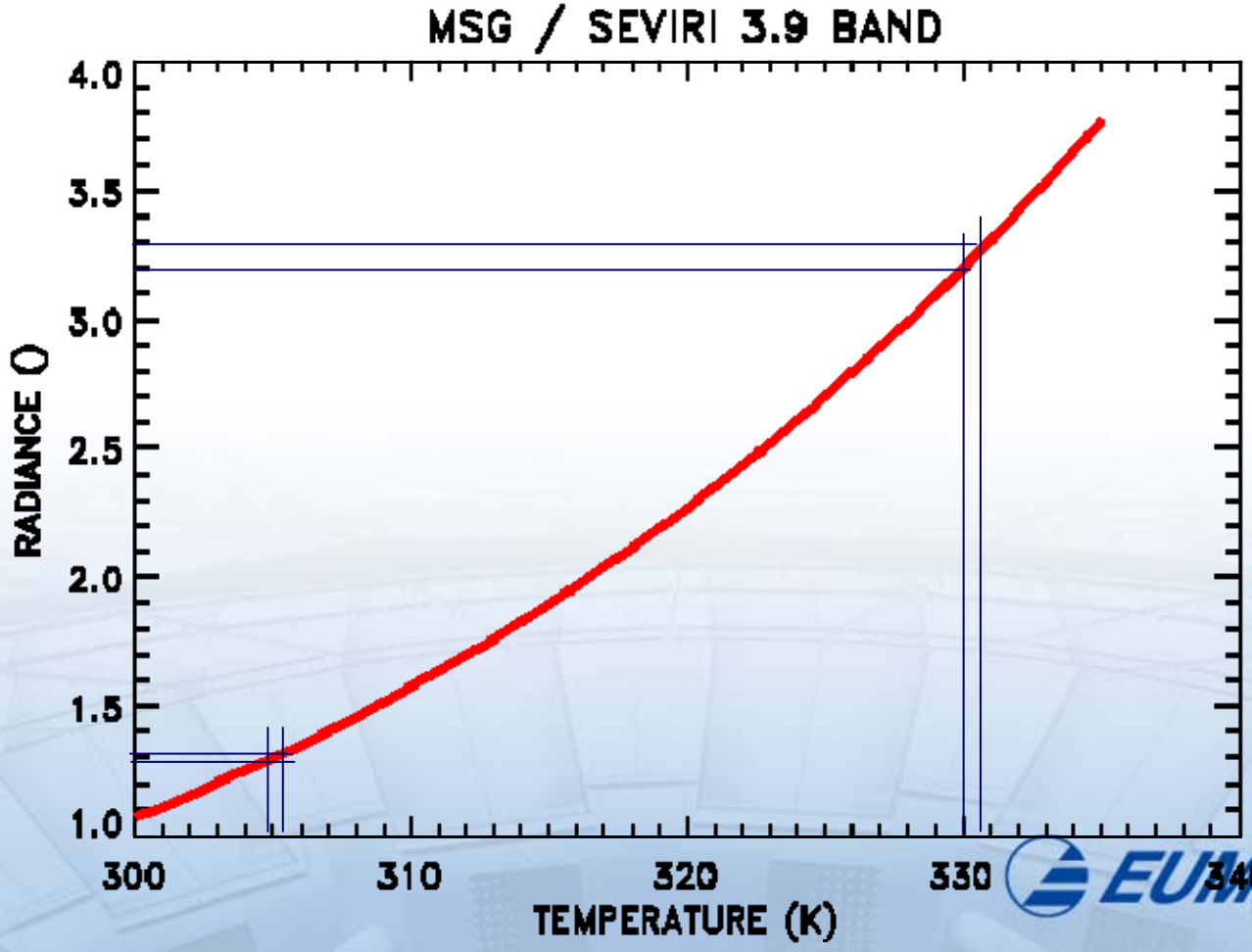
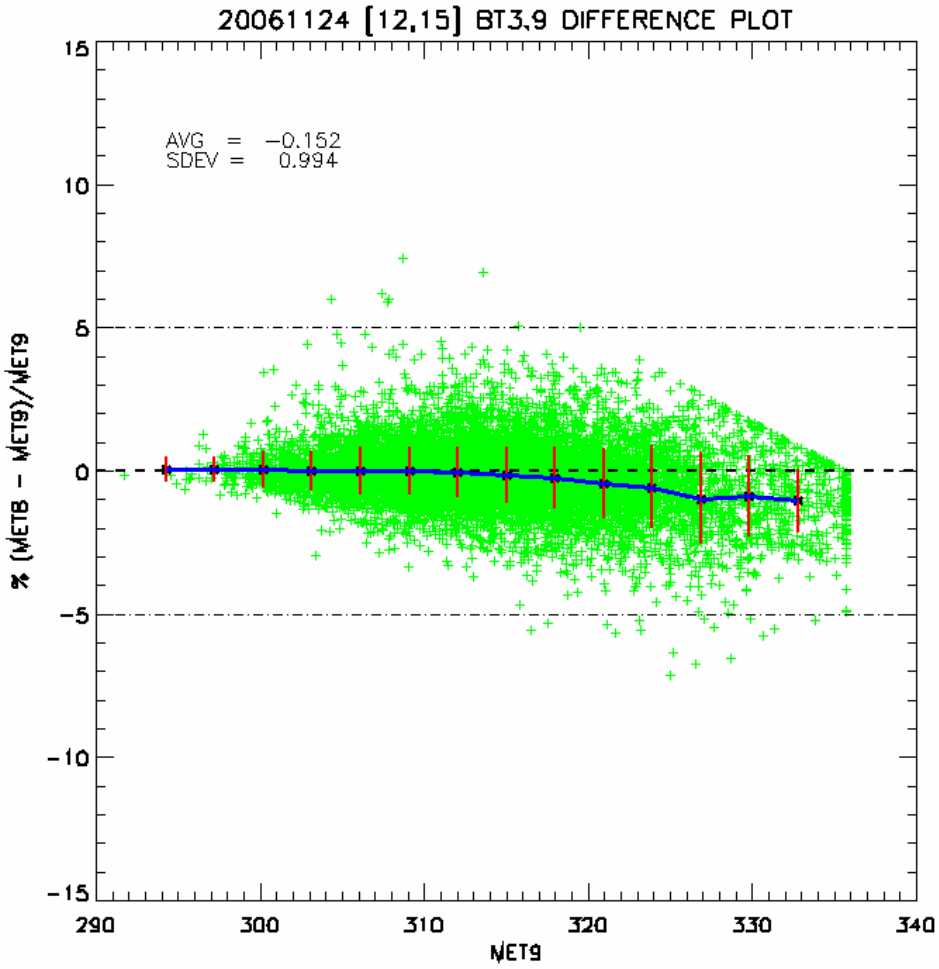
# Fire Radiative Power/Energy

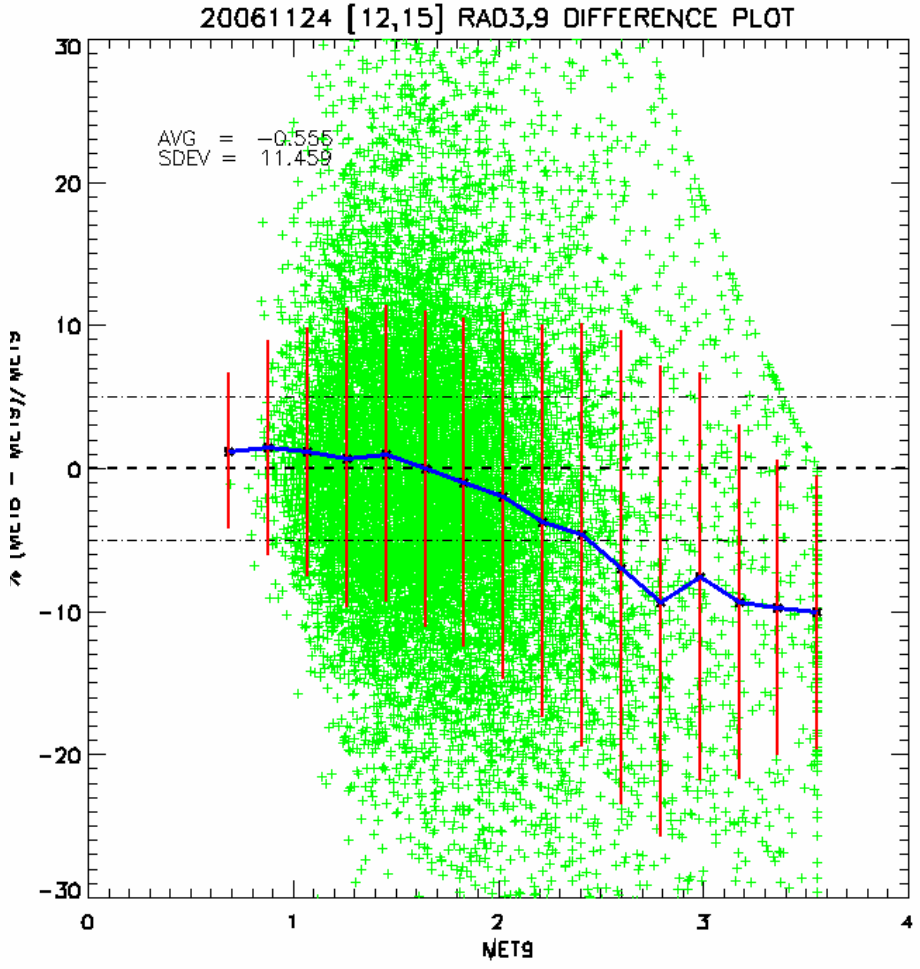
The quantitative exploitation of the 3.9 band for FRP assessment raises several issues.

Calibration specification (in ΔK rather than radiance)



# BT and radiance differences between Met-8 and Met-9

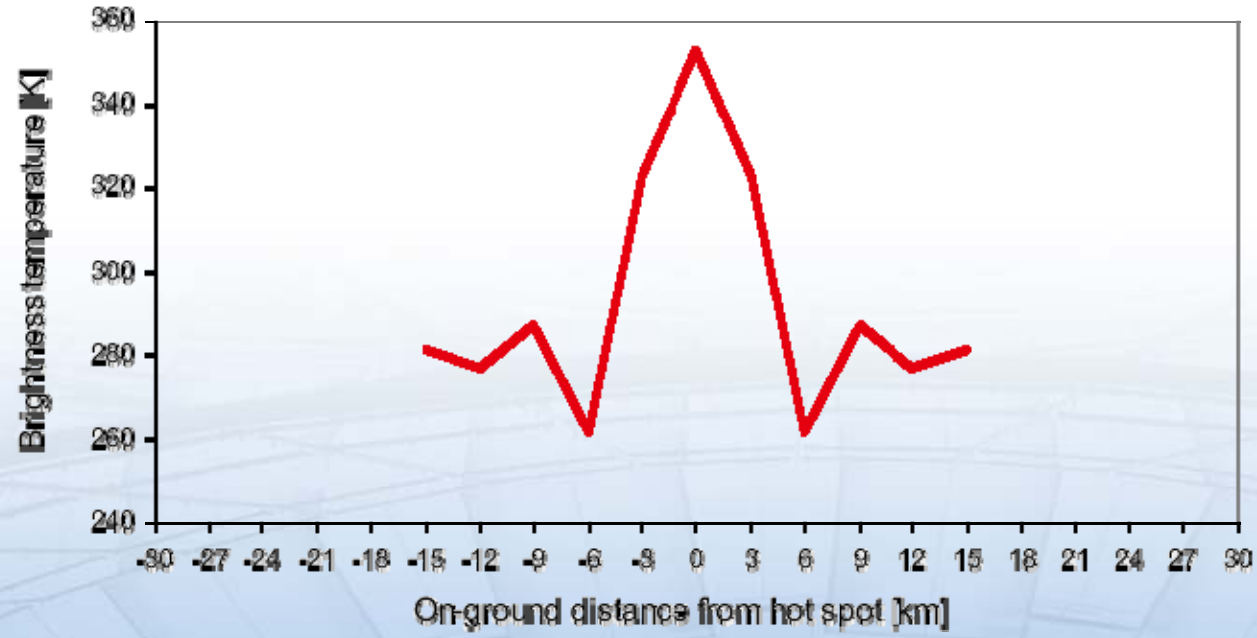


# Fire Radiative Power/Energy

The quantitative exploitation of the 3.9 band for FRP assessment raises several issues.

Negative side lobes of the Point Spread Function (Fourier transform of the MTF) + onbaord digital filtering (pixel bleeding)



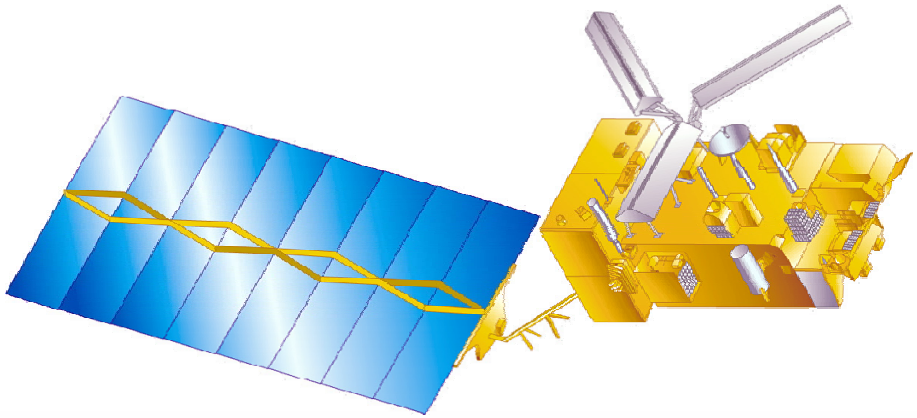

EW Cut Through Simulated Point Spread Function

# Fire Radiative Power/Energy

The quantitative exploitation of the 3.9 band for FRP assessment raises several issues.

- Level 1.5 image generation (level 1.b does not exist for MSG/SEVIRI). The image re-sampling tends to “blur” the fired pixels.
- Dynamic range (saturation at 335K), *i.e.*, about 5% of the SEVIRI fire pixels
- Spatial resolution: A lot of small fires are missed.

# EUMETSAT POLAR SYSTEM (EPS)



AVHRR-3 will be used for fire risk assessment (Land SAF)

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# AVHRR/3

| Table 3.1.2.1-1. Summary of AVHRR/3 Spectral Channel Characteristics. | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Ch. 1** | **Ch. 2** | **Ch. 3A** | **Ch. 3B** | **Ch. 4** | **Ch. 5** |
| Spectral Range (μm) | 0.58-0.68 | .725-1.0 | 1.58-1.64 | 3.55-3.93 | 10.3-11.3 | 11.5-12.5 |
| Detector type | Silicon | Silicon | InGaAs | InSb | HgCdTe | HgCdTe |
| Resolution (km) | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
| IFOV (milliradian) | 1.3 sq. | 1.3 sq. | 1.3 sq. | 1.3 sq. | 1.3 sq. | 1.3 sq. |
| S/N @ 0.5% albedo | ≥9:1 | ≥9:1 | ≥20:1 | - | - | - |
| NEdT @ 300K | - | - | - | ≤.12K | ≤.12K | ≤.12K |
| MTF @ 1.09 km | >.30 | >.30 | >.30 | >.30 | >.30 | >.30 |
| Temperature Range (K) | - | - | - | 180 - 335 | 180 - 335 | 180 - 335 |
| Note:<br>1. Tolerance on IFOV values are ±0.2 mr with a ±0.1 mr design goal. | | | | | | |

The channel 3B will be operated only during the night orbits.

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# METEOSAT THIRD GENERATION


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# MTG IMAGER REQUIREMENTS

- Specific “fire” requirements have been taken into account for the 3.9 channel
  - MTG Full Disk High Spectral Resolution Imagery (FDHSI) Mission. Sampling distance at SSP ≈ 2 km, repeat cycle 10 min (candidate mission)
  - High Resolution Fast Imagery (HRFI) Mission. Sampling distance at SSP ≈ 1 km, repeat cycle 2.5 min over a quarter of the disc. (candidate mission)
- 3.9 spectral range chosen not to be affected by the $CO_2$ absorption (3.8 ±0.20 )
- Dynamic range :
  - 200 - 350 K  noise 0.1k @ 300 K
  - 350 - 450 K noise 1K @ 450 K

# POST-EPS


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# Post-EPS

- Among the many PEPS missions, the VIS/IR Imaging Mission (VII) is a cross-purpose medium resolution, multi-spectral optical imaging serving operational meteorology, oceanography and climate applications as derived in terms of user needs by application experts.
- The primary objectives of the Post-EPS VII mission are to provide high quality imagery data for global and regional NWP and NWC through the provision of:
  - High horizontal resolution cloud products including microphysical analysis
  - Aerosol products
  - Atmospheric temperature gross profiles at high horizontal resolution
  - Atmospheric water-vapour gross profiles at high horizontal resolution
  - Land surface temperature, vegetation snow coverage and fire monitoring products
  - Sea and ice surface temperature, sea ice coverage

# Post-EPS

- Fire products:
  - Fire detection
  - Fire fractional cover
  - Fire temperature
  - Fire radiative power
  - (Smoke)