LSA SAF Geostationary-based Products & MTG Evolution

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Thanks: X. Ceamanos, E. Dutra, S. Ermida, D. Juncu, C. Lira, M. Wooster, W. Xu, & LSA SAF Team

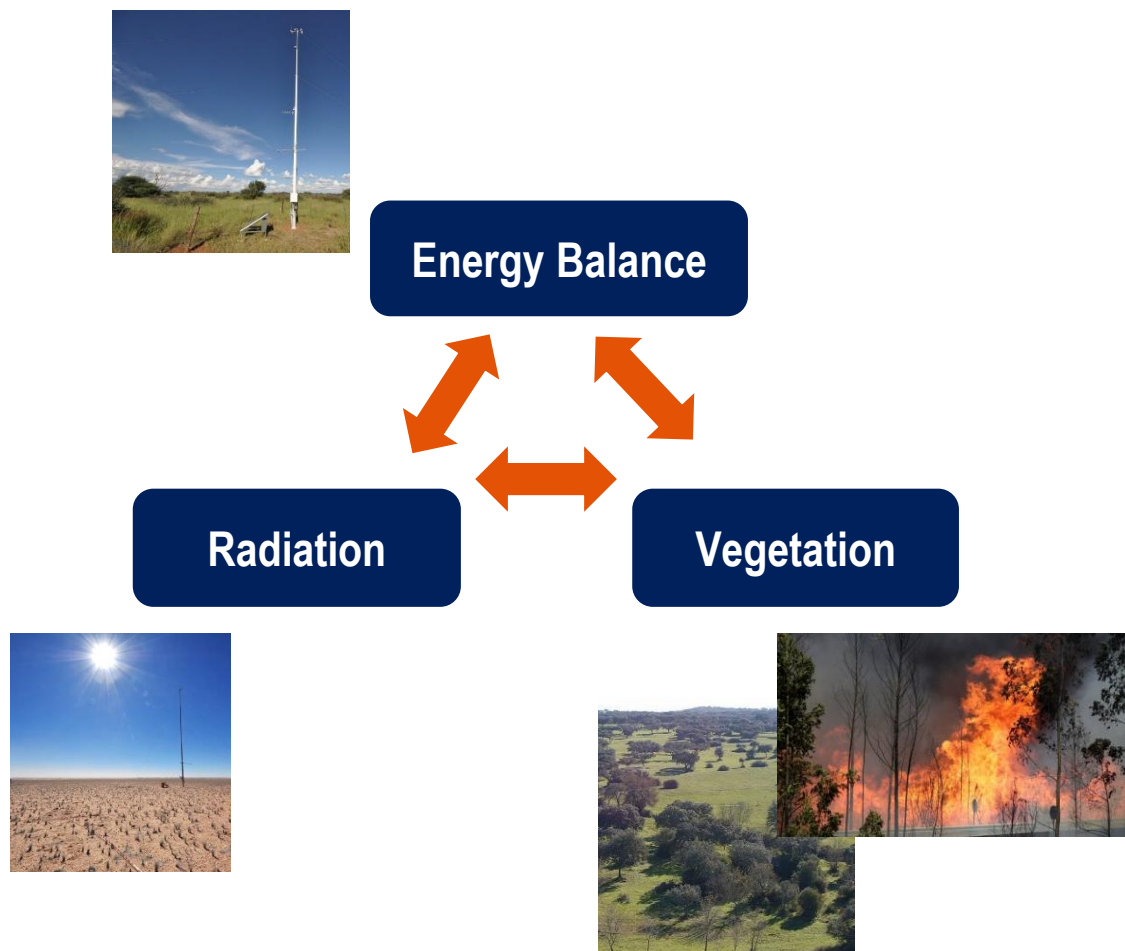*EUMeTrain MTG Event Week (23 – 27 Jun 2025)*

LSA SAF - Scope

MTG Products

- Strategy
- First Products being processed:

  LST

  Albedo

  Fire Radiative Power
- Next Steps

EUMETSAT LSA SAF

lsa-saf.eumetsat.int
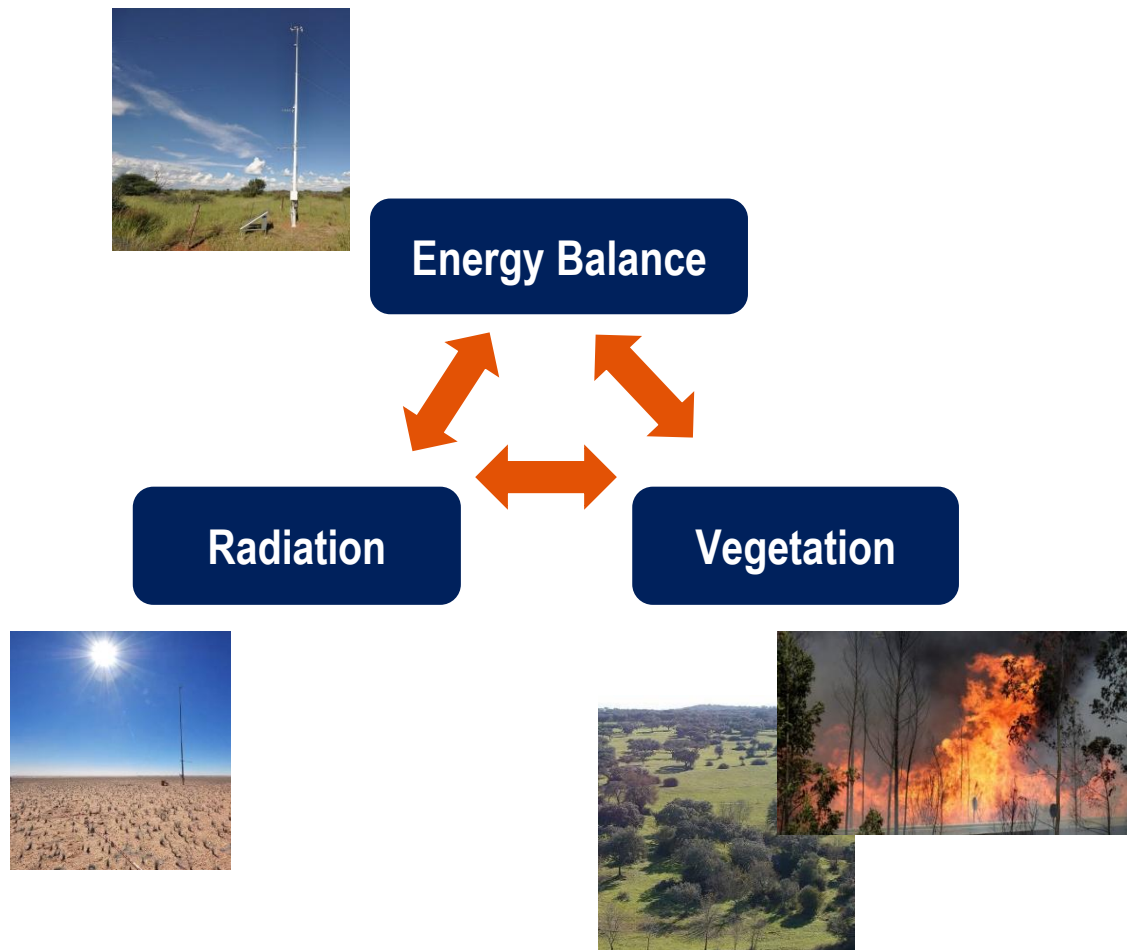
Energy Balance

Radiation

Vegetation

Explore **Earth Observations [EUMETSAT Satellites]** to monitor and characterize:

- Land Surfaces
- Land – Atmosphere Interactions

✓ Part of EUMETSAT's Ground Segment

■ Provides Satellite Products in Near Real Time

■ Data Records (Climate)

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Energy Balance

Radiation

Vegetation

Geostationary

Meteosat Second (MSG) and **Third Generation (MTG)** observations provide NRT products & Data Records:

✓ Pronounced diurnal cycles – Land Surface Temperature, Radiation Downward Fluxes, Fire Hotspots/FRP

✓ Possibly experiencing abrupt changes (Albedo, Vegetation, …)

✓ Turbulent Fluxes (level 4) - Evapotranspiration
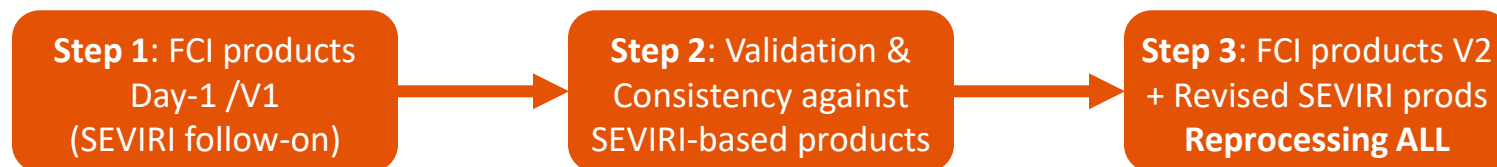
Polar-Orbiting

EPS (later **EPS-SG**) observations provide NRT products:

✓ Global Coverage / Higher Spatial Resolution

▪ AVHRR: LST, Albedo, Vegetation Fr, LAI, FAPAR

▪ MetImage (2026?) - … FRP, Burned Areas

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Continuity *versus* Enhanced Observations

✓ LSA SAF GEO-based products will benefit from improved **FCI**/MTG characteristics: spatial & temporal samplings, radiometric performance, new channels

- LSA SAF products will be derived from FCI Level 1c (1km to 2km at nadir)
- Take advantage of 10-minute observations (enhanced description of diurnal cycles; more robust daily products)

✓ Continuity matters: many applications rely on contextual analysis of NRT data, e.g., assessments of drought and heat stress often consider anomalies of Land Surface Temperature, Vegetation products, Evapotranspiration, ….

- Consistency with MSG data records is considered essential!

**Step 1**: FCI products Day-1 /V1 (SEVIRI follow-on) → **Step 2**: Validation & Consistency against SEVIRI-based products → **Step 3**: FCI products V2 + Revised SEVIRI prods **Reprocessing ALL**

Data Distribution – EUMETCast, DataServer (lsa-saf.eumetsat.int), LSA SAF WMS, …. [EUM Data Store, EUMETView, …]

MSG SEVIRI Datasets/Products

- ✓ Geostationary Projection (pixel-wise)
- ✓ Up to 15-minute
- ✓ HDF5 or NetCDF
- ✓ 2004 – onwards

MSG – MTG Compatible formats

All covering the Full Disc, available in NRT & Off-line

- ✓ Regular Grid (0.05º)
- ✓ Up to Hourly
- ✓ NetCDF
- ✓ **2004 – onwards (NRT update with MTG)**

MTG FCI Products

- ✓ GEO & Regular Grid (0.025º)
- ✓ Up to 10-minute
- ✓ NetCDF
- ✓ Mid- 2024 onwards

Step 1: FCI products Day-1 /V1 (SEVIRI follow-on) → **Step 2**: Validation & Consistency against SEVIRI-based products → **Step 3**: FCI products V2 + Revised SEVIRI prods **Reprocessing ALL**

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LST

- Aggregated radiometric surface temperature of the ensemble of components within the sensor FOV

- Important for evaluating heatwaves/cold-spells, Urban Heat Island (given its high correlation with T2m); as an indicator of heat (& water) stress, …

- Highly variable in space & time

  - ✓ Pronounced diurnal cycle – only captured by GEO-based / high frequency observations

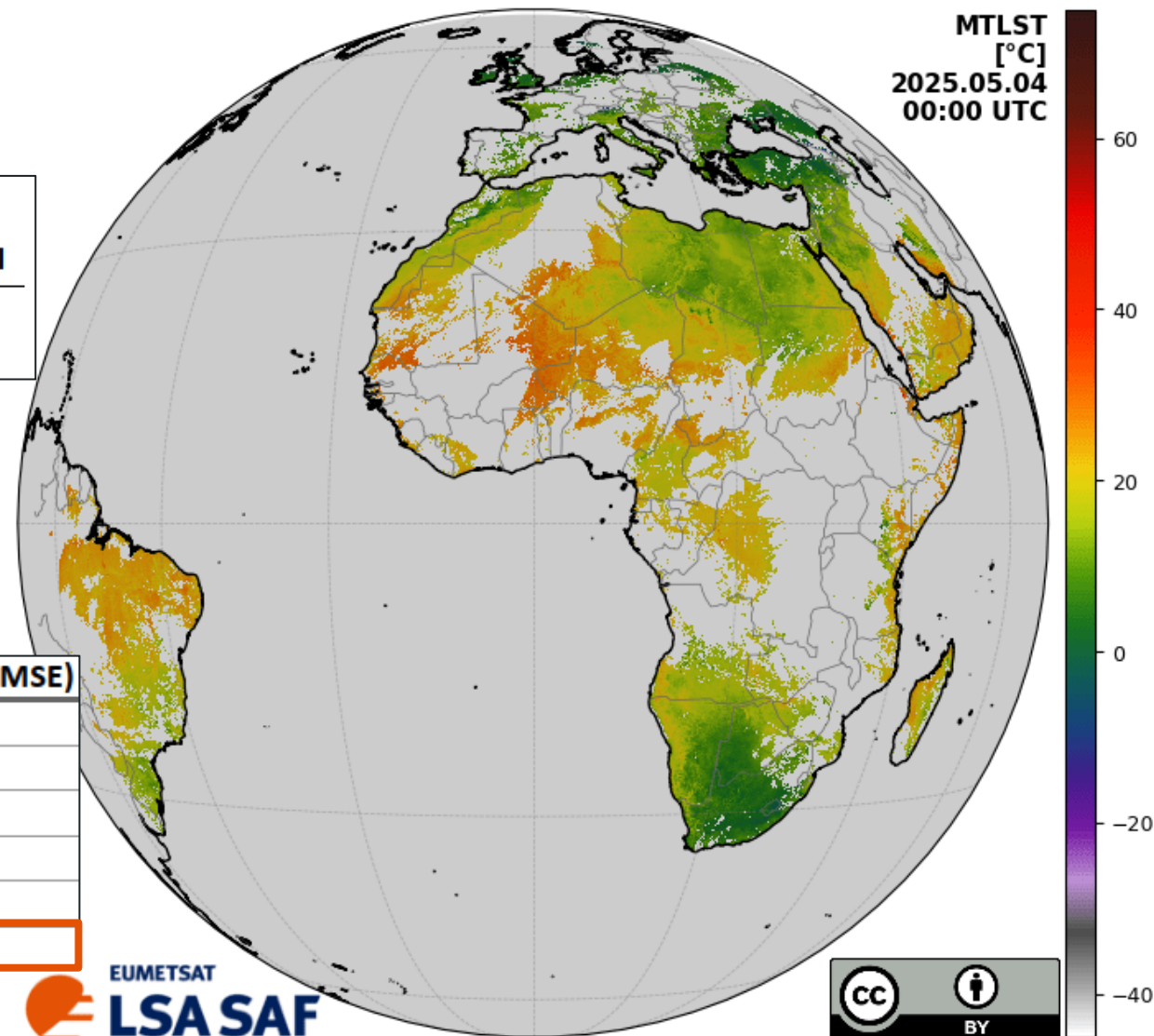 - ✓ Spatial features detection – may depend on data spatial resolution

In Situ Observations

Land Surface Temperature
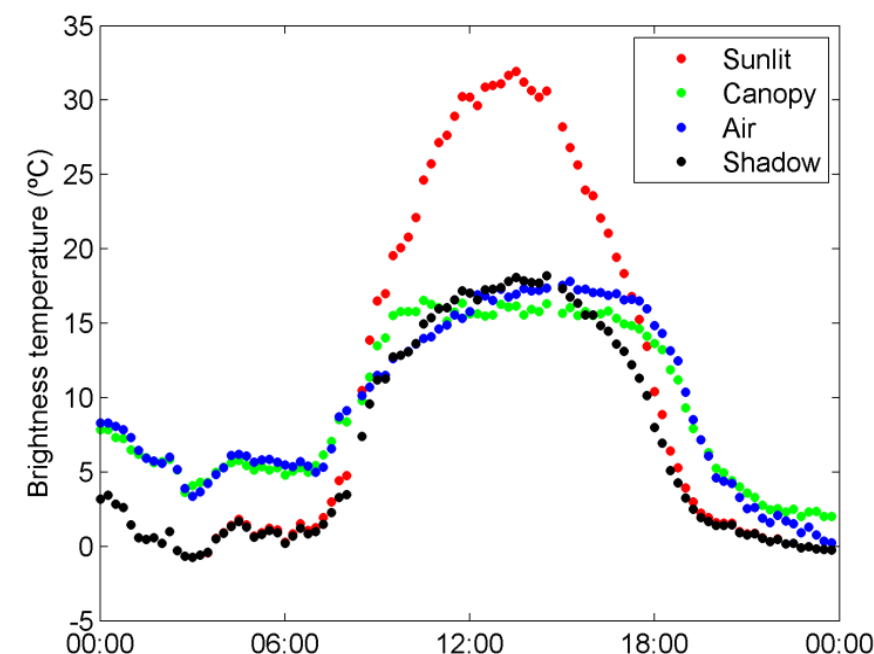
MTG (FCI) LST

MTG/FCI LST: Day-1 Product Requirements:

LST Product	Coverage	Resolution		Accuracy		
		Temporal	Spatial	Threshold	Target	Optimal
MTLST (LSA-007)	MTG disk	10 min	MTG pixel resolution	4 K	2 K	1K

Comparison against in situ obs: Sep 2024 – Feb 2025

Station	Accuracy (μ)	Precision (σ)	Total uncertainty (RMSE)
Lake Constance (CNS)	-0.54	0.58	0.83
Évora (EVO)	0.62	1.60	1.76
Gobabeb Plains (GBB_P)	-0.21	0.67	0.82
Gobabeb West (GBB_W)	0.27	1.66	1.76
KIT Forest (KIT_F)	-0.03	0.80	1.33
All stations	0.02	1.06	1.30

MTLST [°C] 2025.05.04 00:00 UTC

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EUMETSAT LSA SAF LAND SURFACE ANALYSIS

@2025 EUMETSAT

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Land Surface Temperature: MSG vs MTG
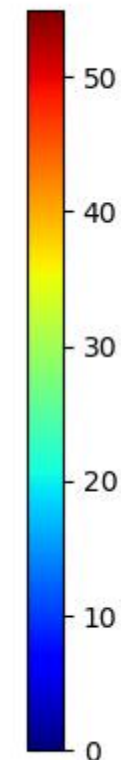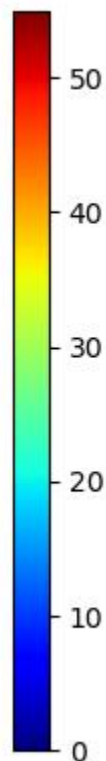
MSG/SEVIRI LST
18 Jun 2025, 13:00 UTC
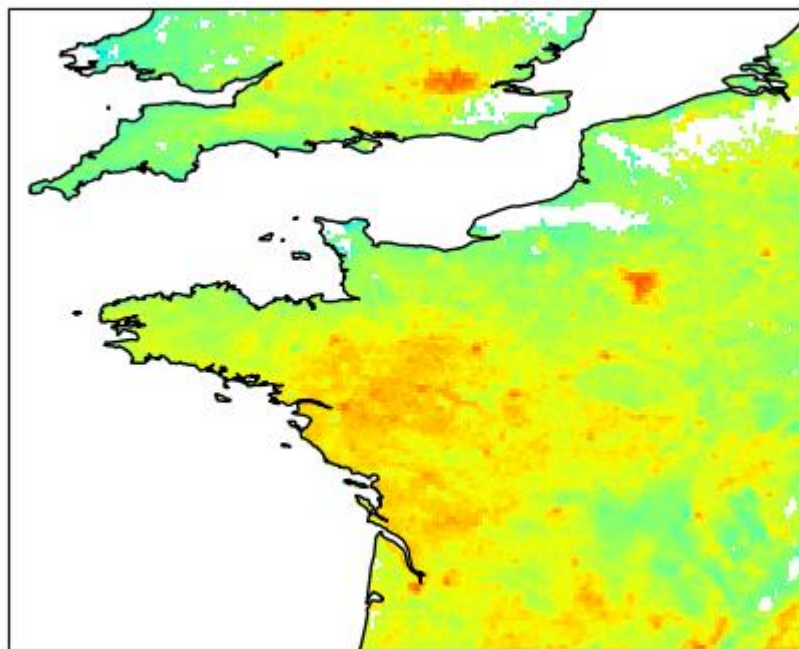
3 km at nadir
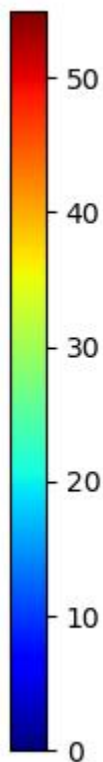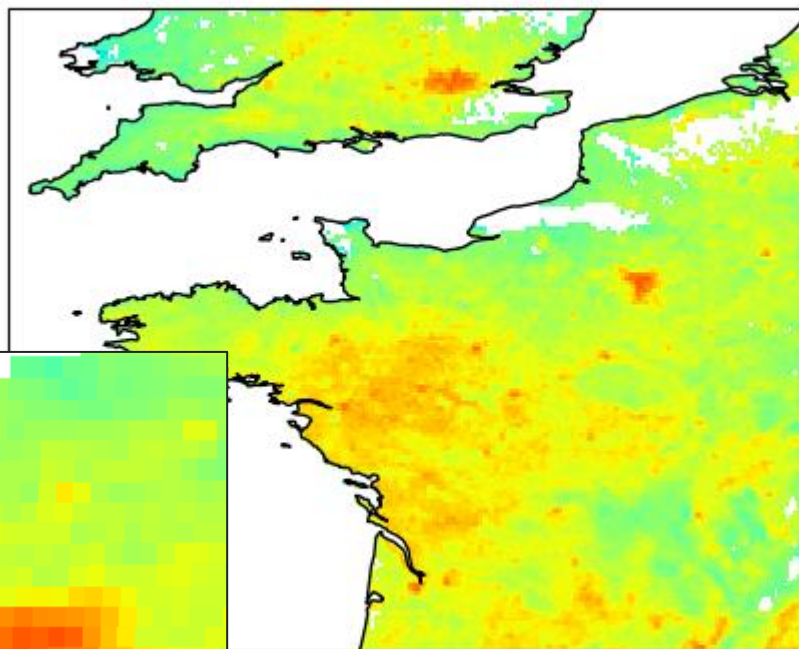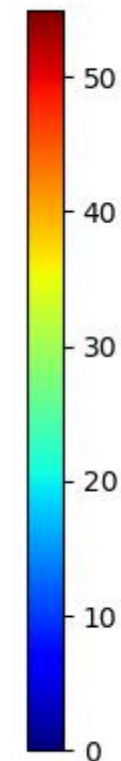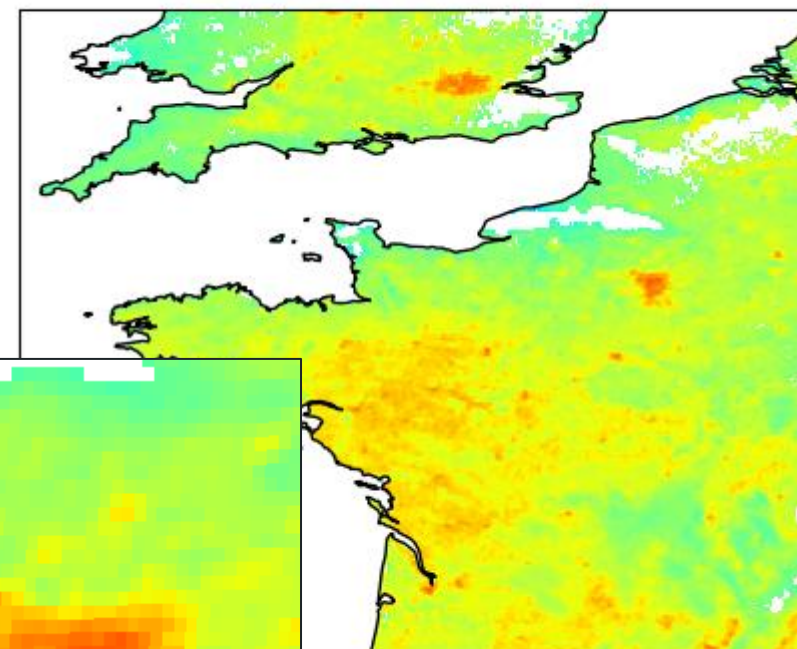
MTG/FCI LST
18 Jun 2025, 13:00 UTC

2 km at nadir

MSG/SEVIRI LST
18 Jun 2025, 13:00 UTC

MTG/FCI LST
18 Jun 2025, 13:00 UTC

Paris

Paris
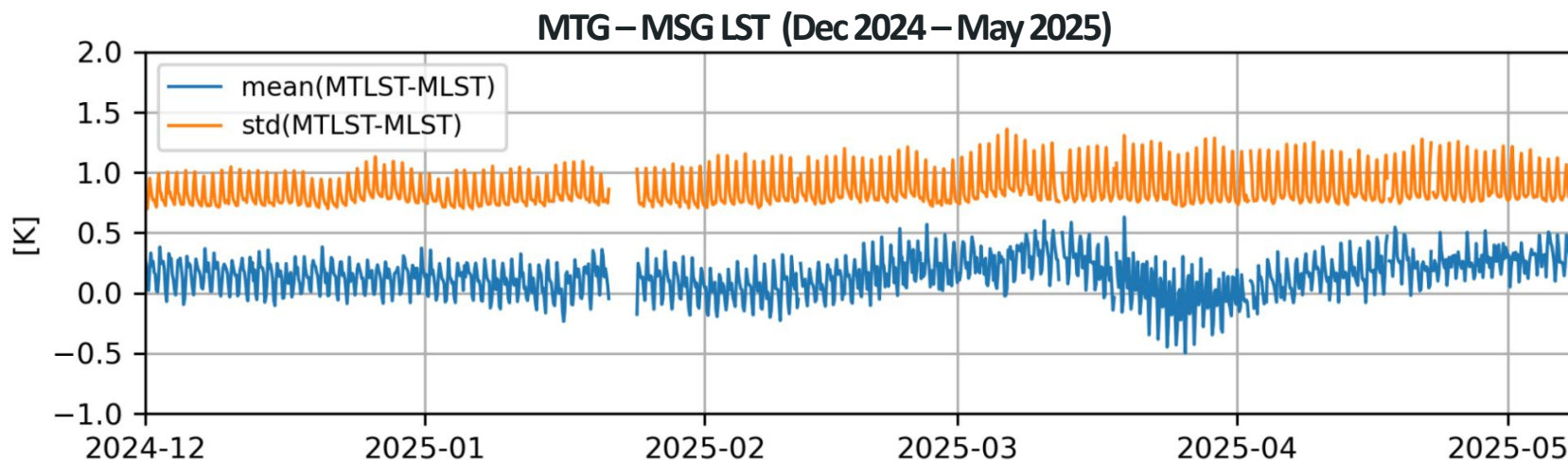
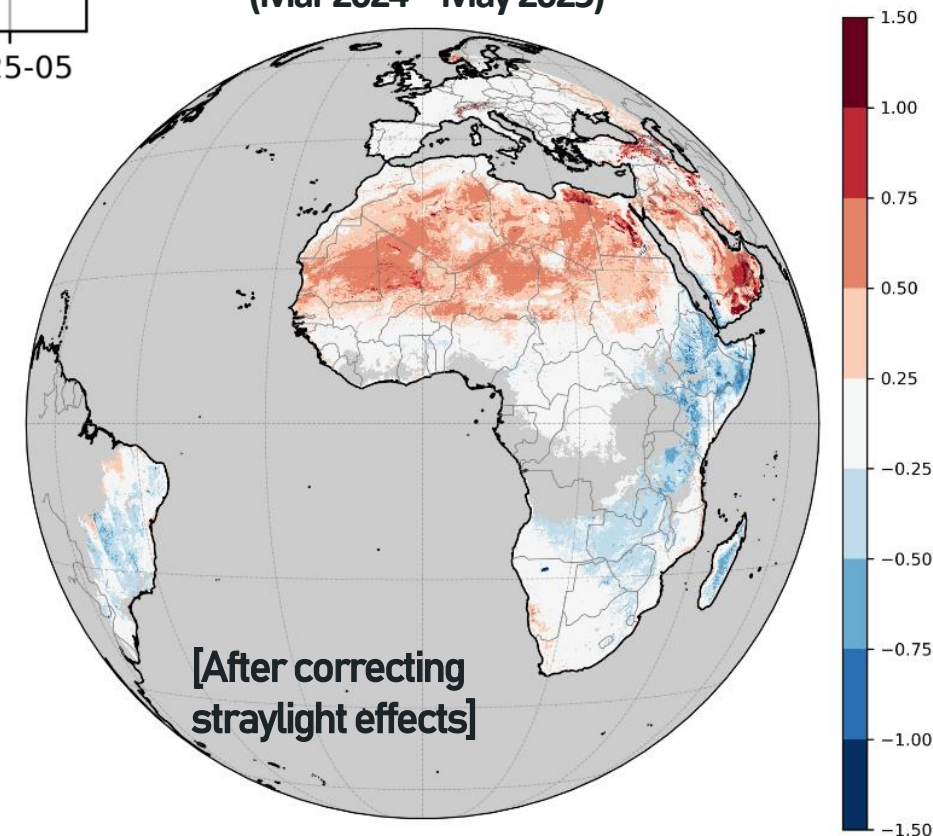✓ Increased spatial detail, retaining (enhancing) the capability to monitor the dirunal cycle of Urban Heat Islands.

MTG − MSG LST (Dec 2024 − May 2025)

**MTG − MSG LST
(Mar 2024 − May 2025)**

[After correcting straylight effects]

- Following the correction of FCI straylight artefacts (IR12.3), MSG − MTG LST comparisons remained reasonably stable.

- Short overlapping period for final conclusions, but

  - MTG LST is warmer than MSG LST – especially over desert regions;

  - Differences likely attributed to atmospheric correction and emissivity used in both algorithms ;

  - Harmonization considered top priority: new versions of MSG and MTG LST to be released in 2025/2026!
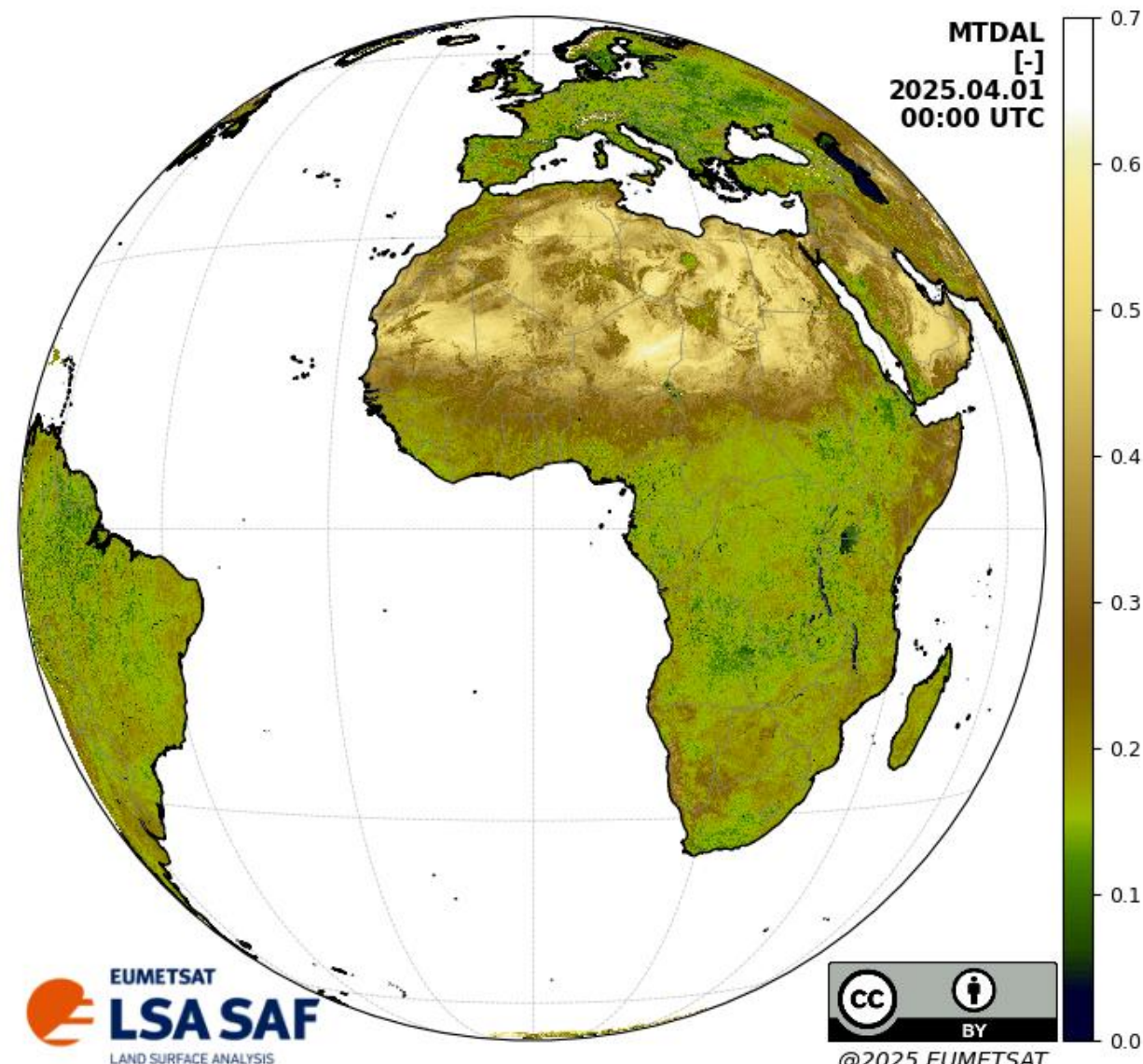
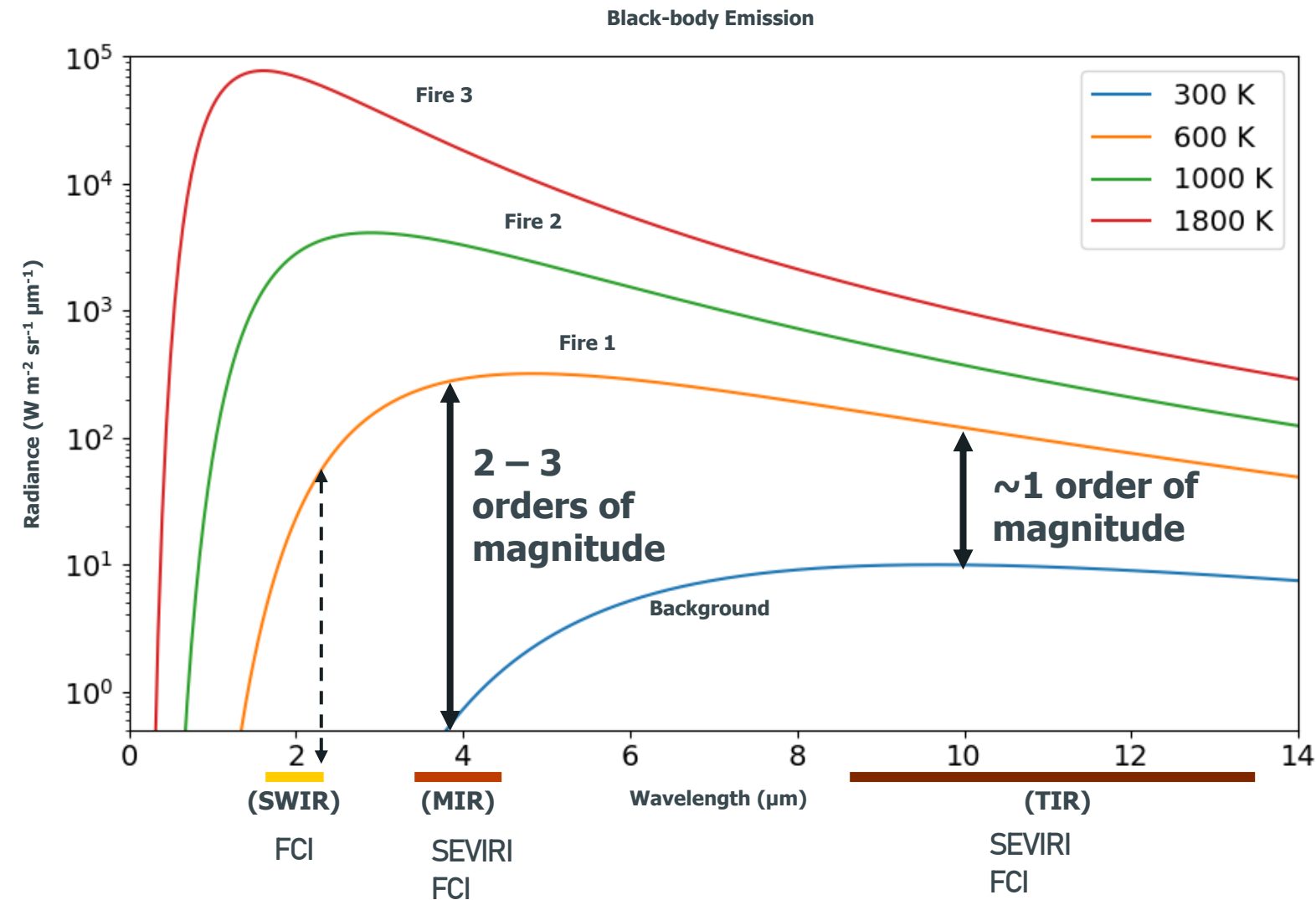**Daily Albedo: 1 – 30 Apr 2025**

MTG/FCI Albedo

- Part of the SW radiation budget

- Input to other LSA SAF products (e.g., Vegetation Products, Evapotranspiration)

  - Enhanced spatial resolution – relevant for LAI, FAPAR, FVC

  - More obs/day – expected to allow more robust daily estimates
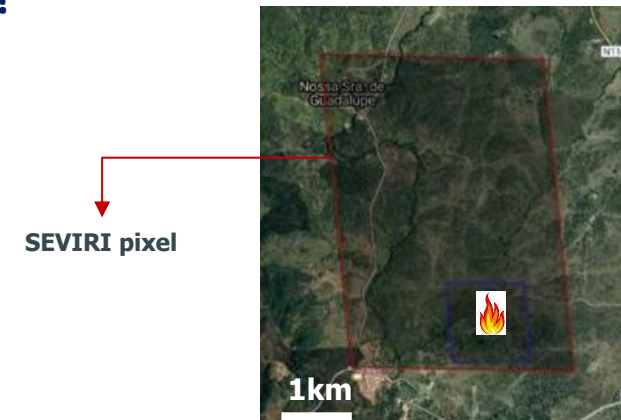
Comparison MTG versus MSG Albedo:

➢ Biases (0.001 – 0.002 for Broad-Band Albedo)

➢ Harmonization considered top priority: new versions of MSG and MTG Albedo to be released in 2025/2026!


MTDAL
[-]
2025.04.01
00:00 UTC

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Black-body Emission

Are sub-pixel fires detectable from space?

SEVIRI pixel

1km

✓ Bands close to Emission Maximum for Wildfire typical Temperatures (MIR) reveal a strong contrast against the (non-burning) background.

✓ Detectability depends on

- Temperature (or FRP) of the fire (intense events within < 1% of the pixel can be detected);

- Minimum detectable FRP scales with pixel size
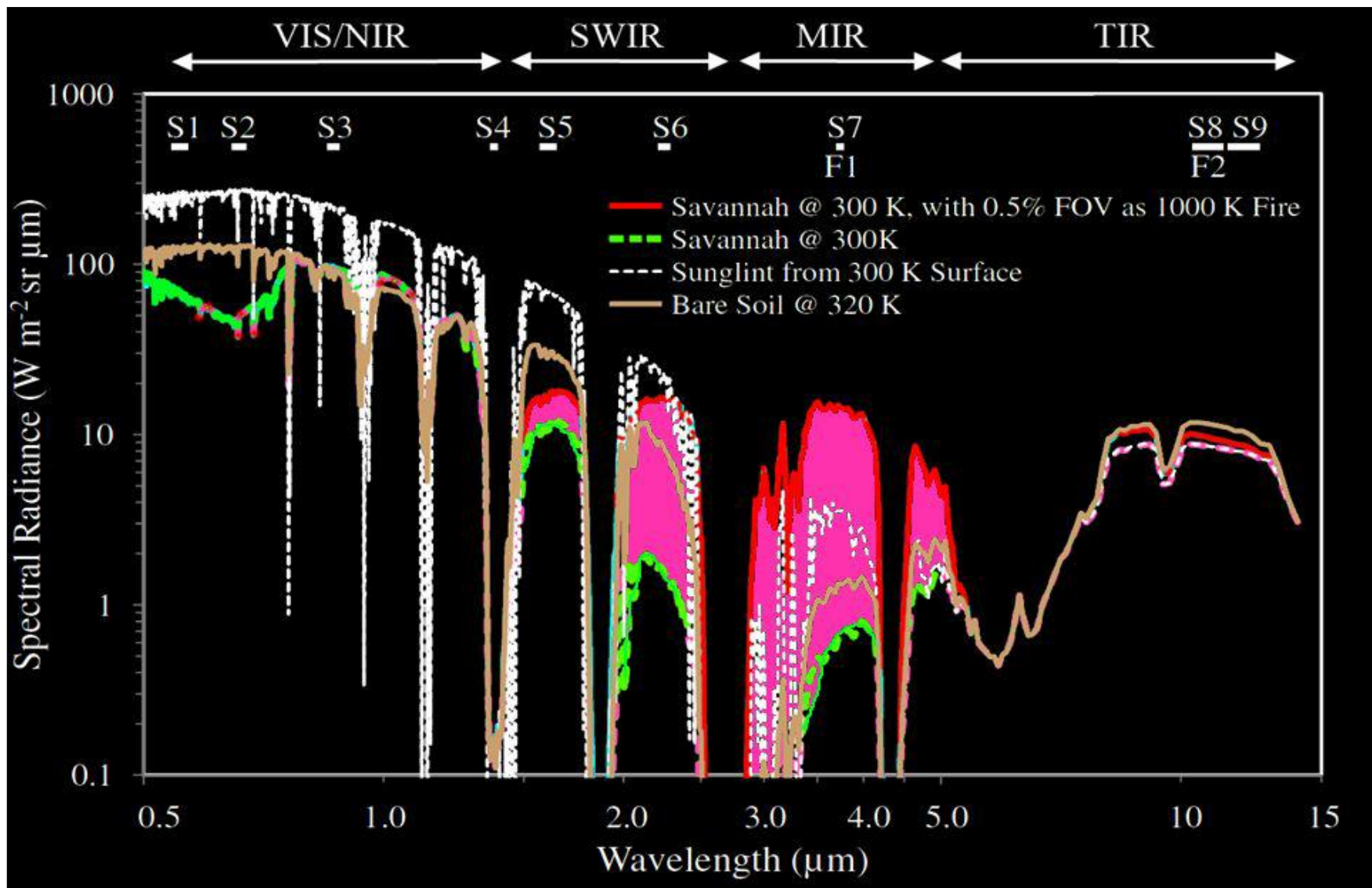
Top-of-Atmosphere Spectra:
0.5 – 15 μm

Impact of a **1000 K** wildfire over **0.5%** of the Field-of-View

Fire Radiative Power Algorithm:

- Identifies "hotspots" using spectral contrasts

- Estimates the wildfire temperature → Fire Radiative Power

(thanks M. Wooster)

Wildfire Portugal: August 2023

Impact of increased spatial Resolution: MTG versus MSG

FCI True Colour 0.5km
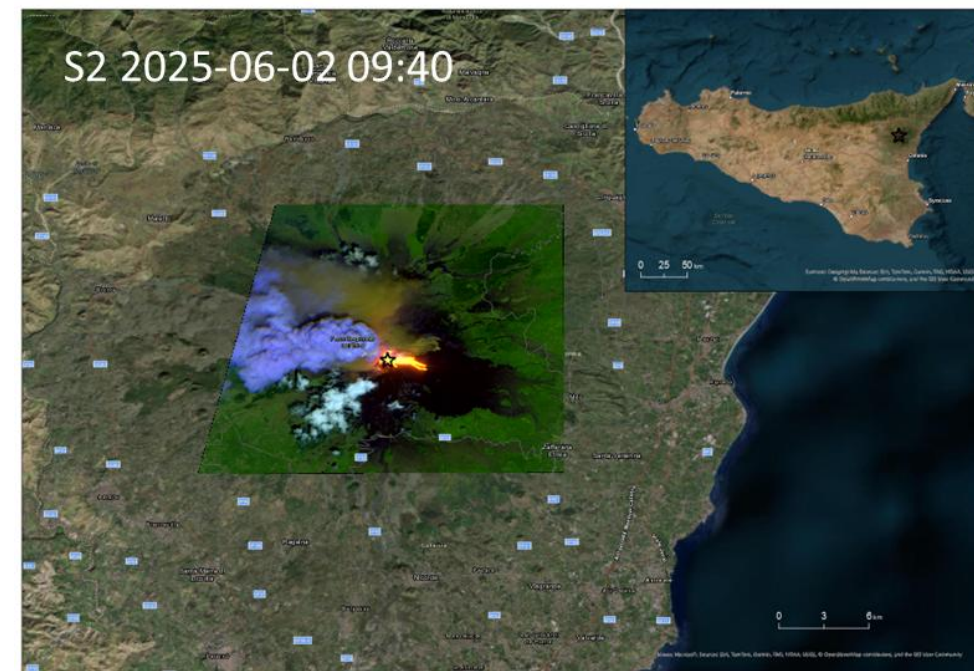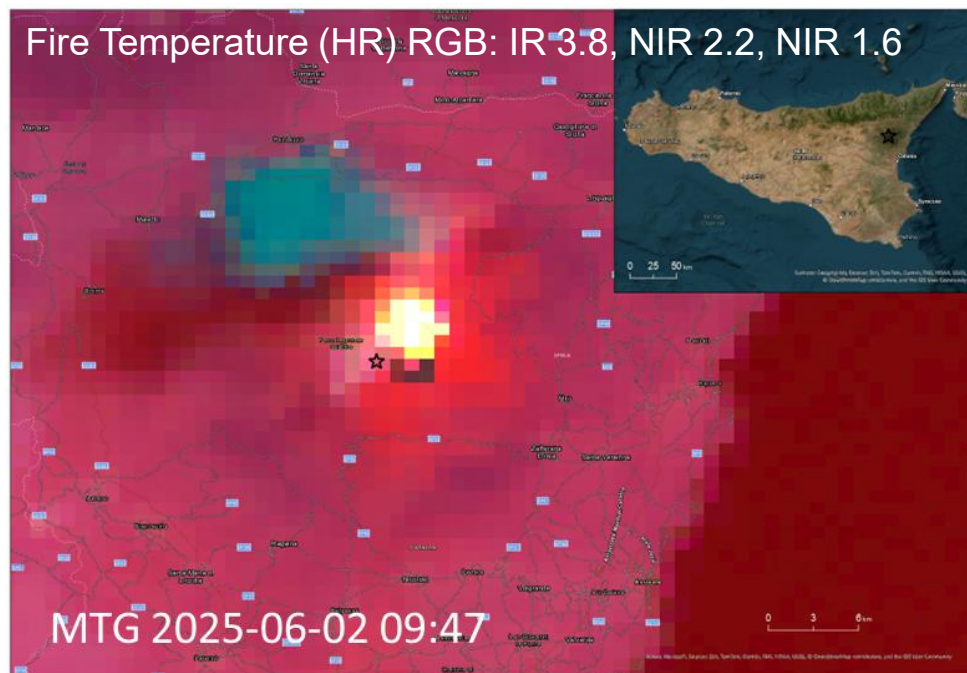Fire Temperature HR: 0.5 km (2.2 μm), 1km (3.8 μm)

SEVIRI Natural Colour 3km
Fire Temperature: 3km (3. 9μm)

5/8/2023 10:00 UTC

5/8/2023 10:00 UTC

(thanks W. Xu, KCL)

Fire Temperature (HR) RGB: IR 3.8, NIR 2.2, NIR 1.6

MTG 2025-06-02 09:47

S2 2025-06-02 09:40

FRP from MSG at 2025-06-09 15:30:00

LSA SAF MSG/SEVIRI FRP

Fire Radiative Power (MW)
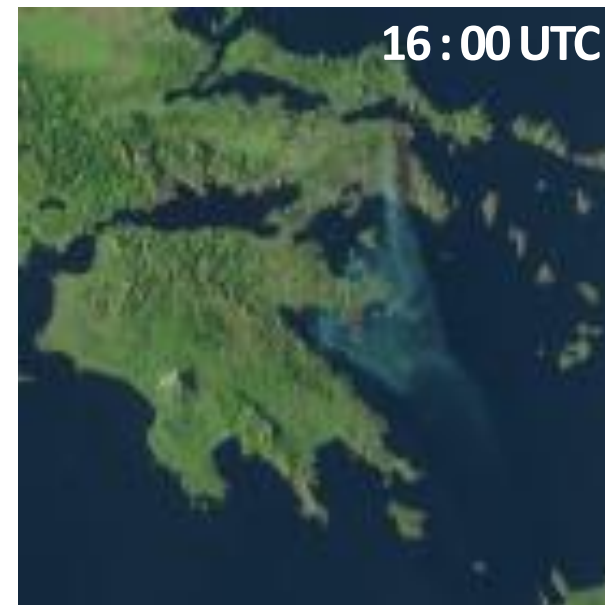
✓ Higher FCI resolution will contribute to identify hotspots' location with better precision.

(thanks C. Lira)

LSA SAF MTG FRP: Athens, 11 August 2024

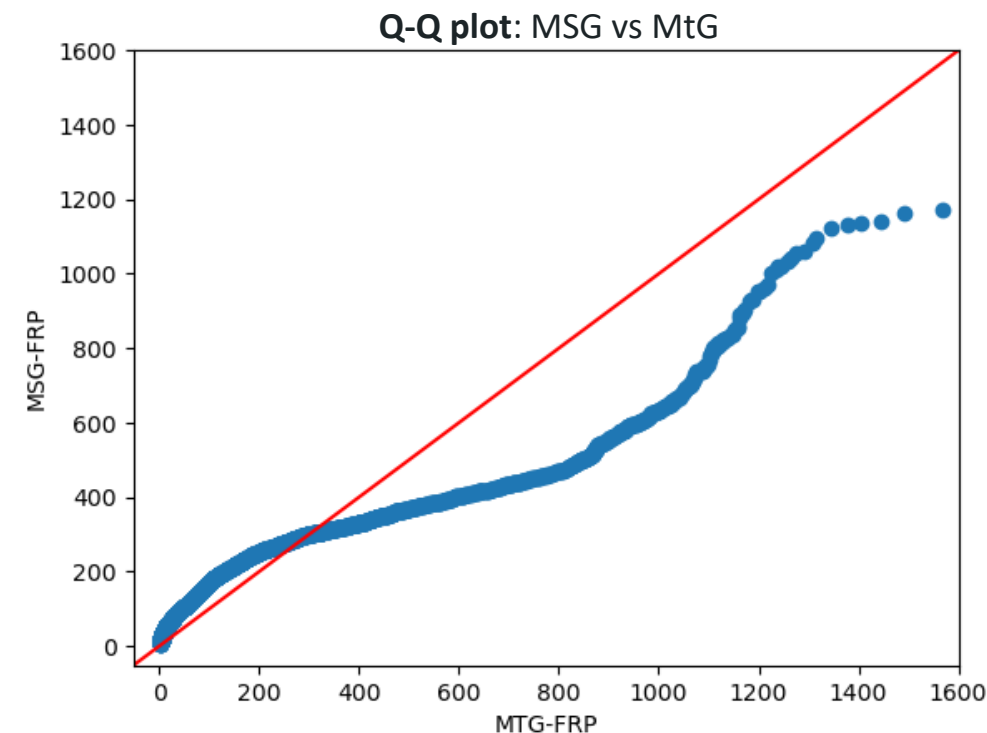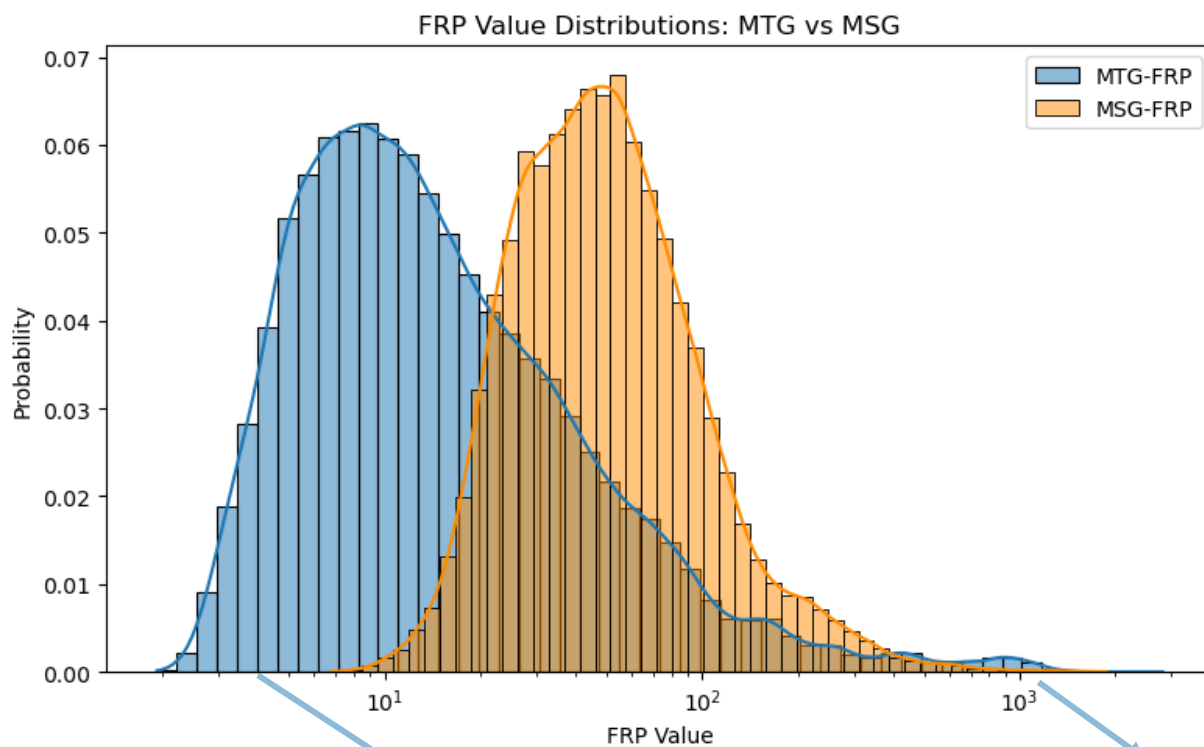EUMETSAT LSA SAF

lsa-saf.eumetsat.int

12:00

16:00 UTC

✓ First successful application of LSA SAF FRP Algorithm:

- MTG/FCI detected the fire at 12:00 UTC, with FRP ~40MW

- VIIRS confirmed it at 12:06 UTC (FRP ~34MW)

- LSA SAF MSG/SEVIRI FRP: identified the hotspot in the 13:15 UTC slot (~13:25 UTC over Greece), with FRP ~61.4MW

(thanks W. Xu, KCL)

## Impact of increased spatial Resolution & Radiometric performance: MTG versus MSG

Statistical Distributions of MTG and MSG FRP estimated over the whole Meteosat disc
18 Jun 2025 16:00 UTC – 20 Jun 2025 10:00 UTC (less than 2 days)

MTG detects low intensity fires

MTG identifies very high FRP – does not
show SEVIRI saturation limitations

(thanks C. Lira)

Complete the MTG/FCI LSA SAF Portfolio

✓ Taking advantage of advanced capabilities

✓ Ensuring continuity with MSG/SEVIRI)

Solar Radiation at Surface

Vegetation Fraction (LAI, FAPAR)

Evapotranspiration

(…)
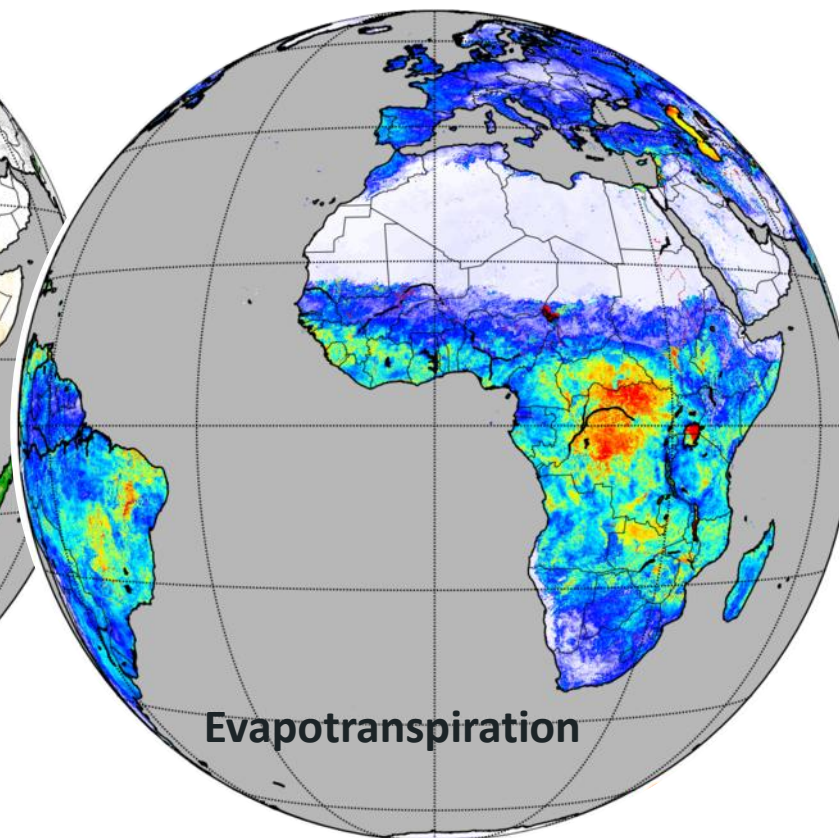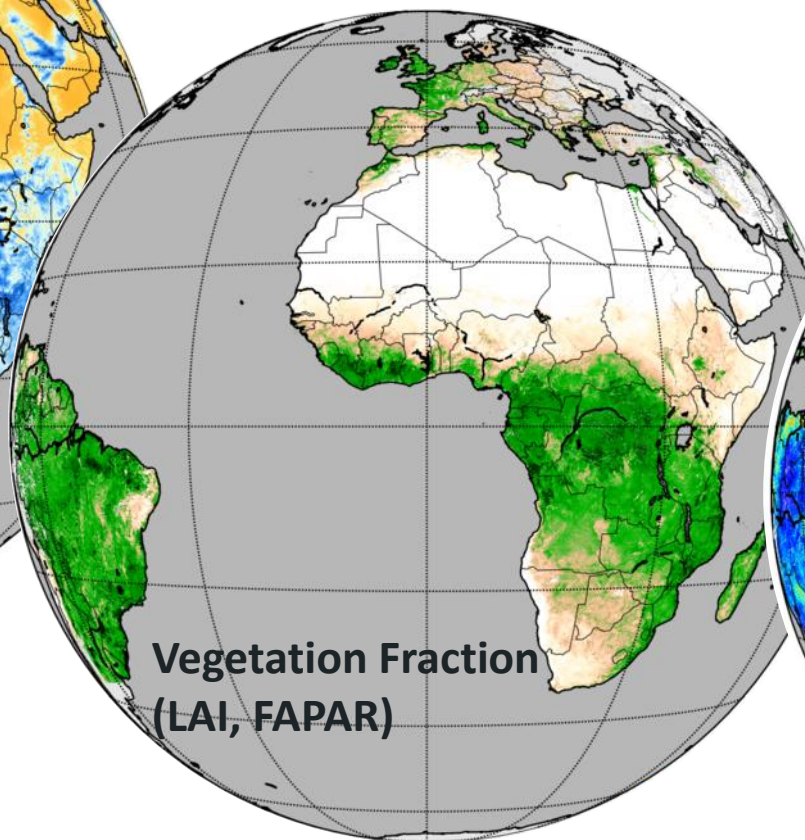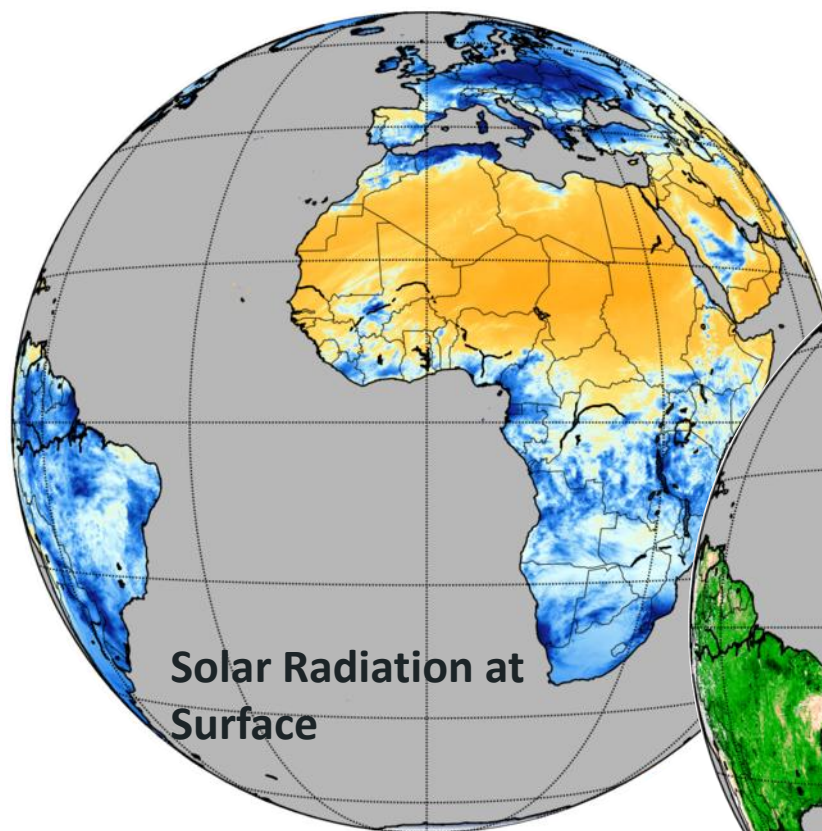
Improve User Services

✓ Widening access/ visualization of LSA SAF Products
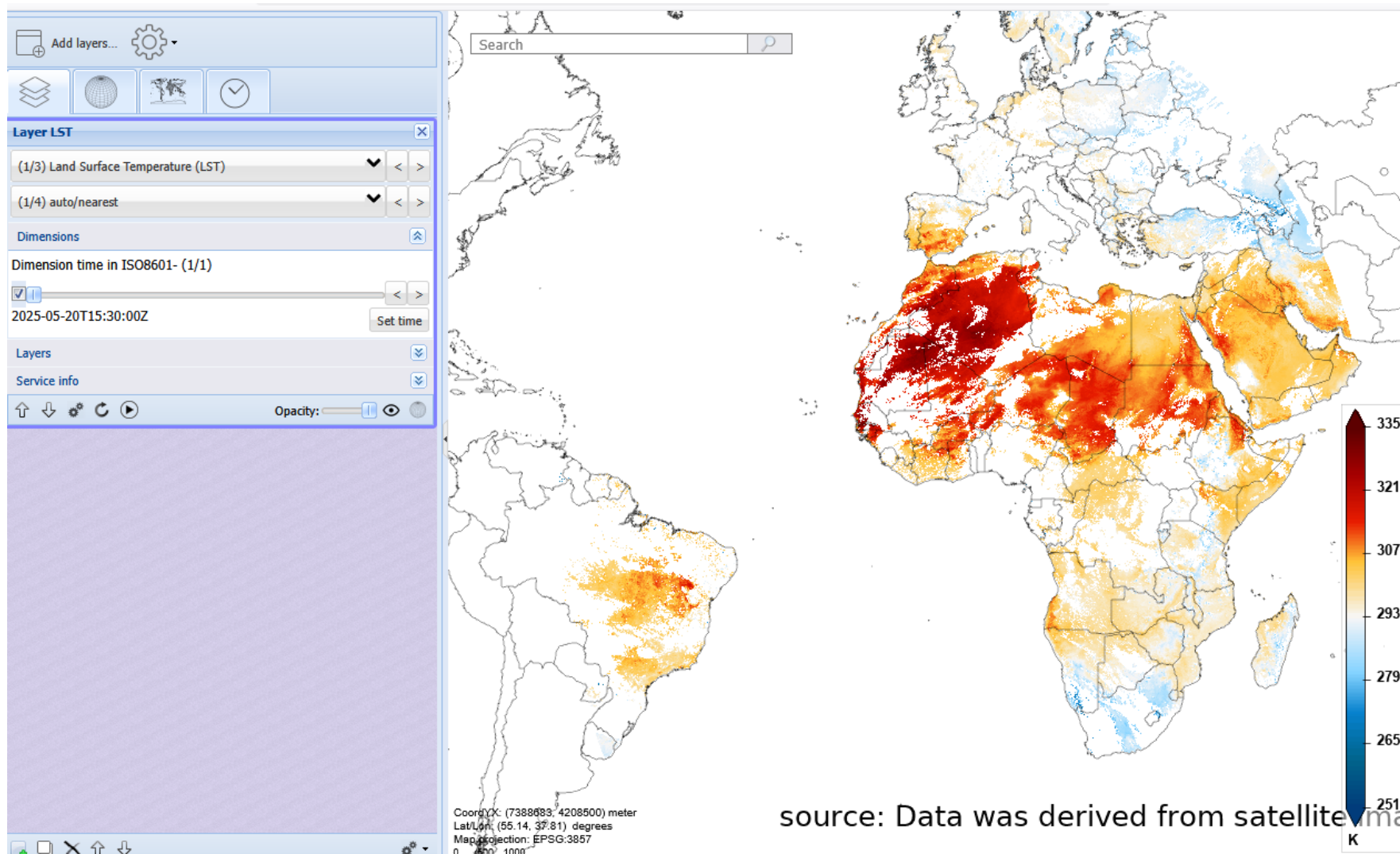
WMS based on
Adaguc under testing

Website: lsa-saf.eumetsat.int

Look for "Data"

Under "Data Server"

- ✓ Browse the Archive
- ✓ Look into the User Guide

- ✓ First MTG products already available!