

# Using LSA-SAF vegetation data to assess fire-prone conditions and fire impacts on terrestrial ecosystems

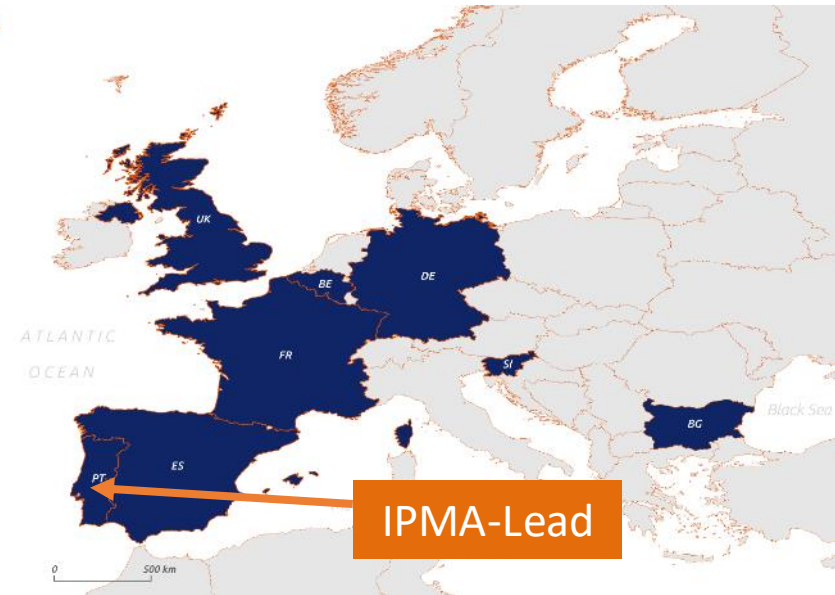
Célia Gouveia

IPMA, 1<sup>st</sup> May 2026

# LSA-SAF Objective

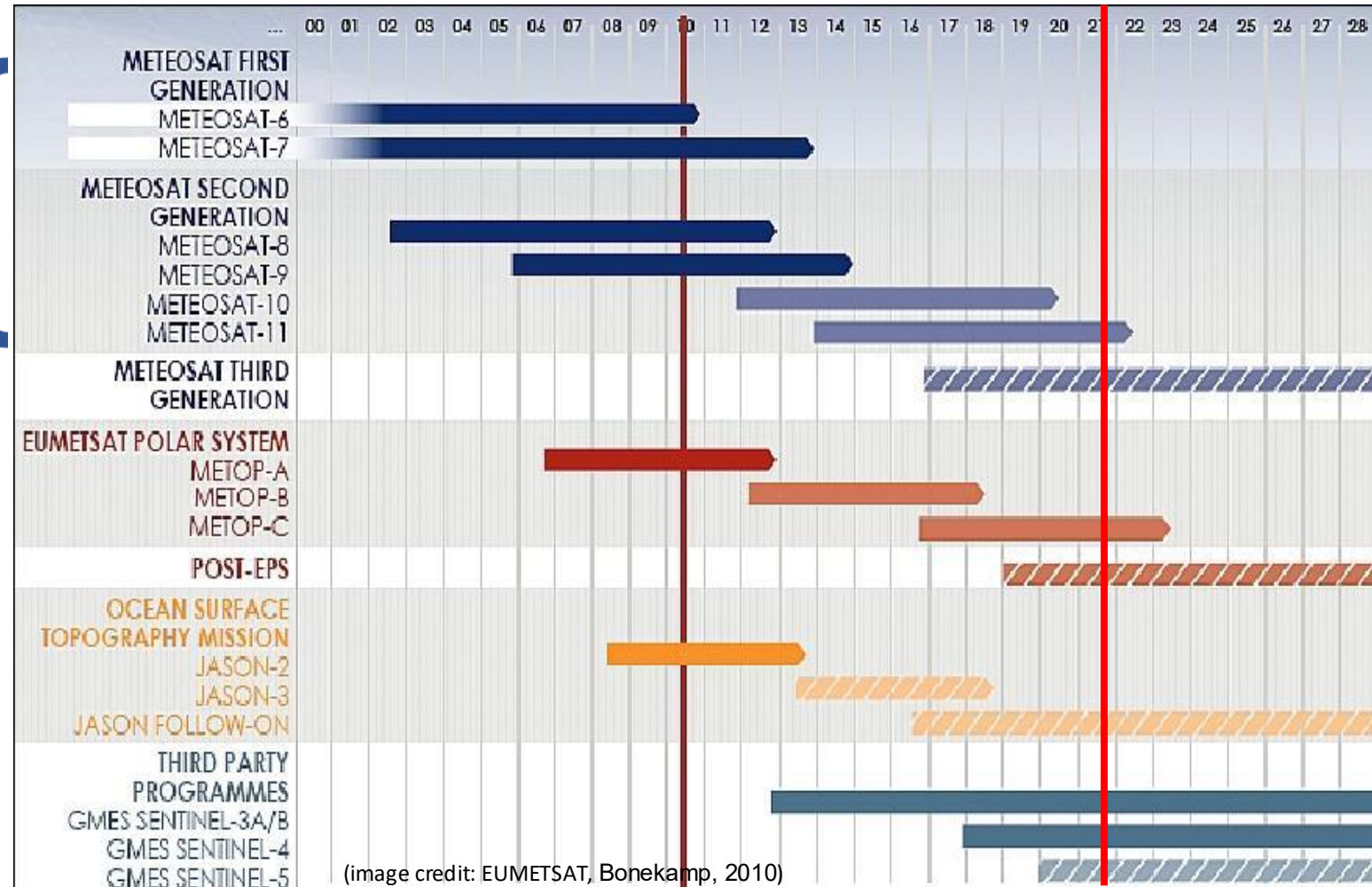
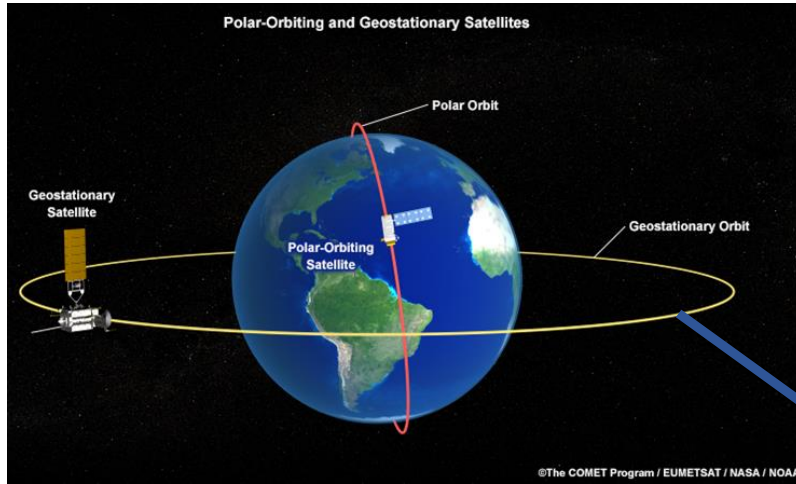
## Satellite Products related to Land Surfaces & Land-Atmosphere interactions

- Focusing primarily EUMETSAT satellites
- Maintain (& improve!) the service for current missions
- Ensure transition to Next Generation of EUM satellites: MTG & EPS-SG
  
- NRT & Off-line production of Land surface variables (EUMETCast, ftp & Website)
- Helpdesk User Support Service ([helpdesk.landsaf@ipma.pt](mailto:helpdesk.landsaf@ipma.pt))



IPMA	(Portugal) – Leading Institution
MF	(France)
RMI	(Belgium)
IDL	(Univ Lisbon)
KCL	(King’s College London)
KIT	(Karlsruhe Inst Technology)
UV	(Univ Valencia)
VITO	(Flemish Inst Technological Res)
ARSO	(Slovenian Env Agency)
NIMH	(Bulgarian Inst Met and Hyd)

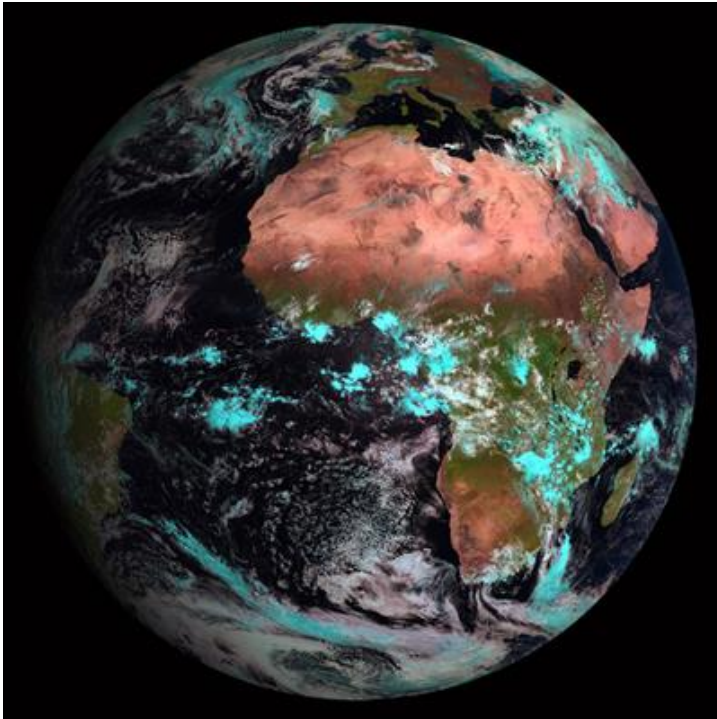
# EUMETSAT space segment



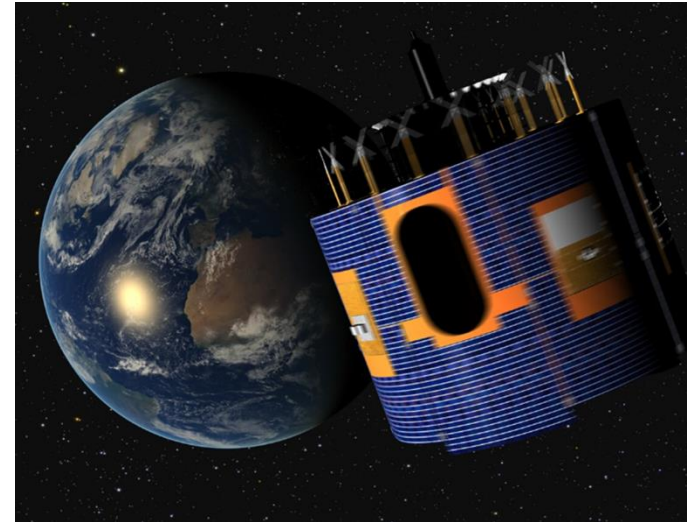
(image credit: EUMETSAT, Bonekamp, 2010)

## Meteosat Second Generation

- Geostationary orbit
- Nominal sub-satellite point at 0° long



## Main focus of LSA SAF until present



## Spinning Enhanced Visible and Infrared Imager (SEVIRI)

- explore 96 observations /day (every 15 min) ...
- 12 channels ...
- at 3 km at nadir

## **SURFACE RADIATION BUDGET**

DSSF: ↓Surface Short-wave Flux

DSLFL: ↓Surface Long-wave Flux

LST: Land Surface Temperature

AL: Albedo

## **WILDFIRES**

FRP: Fire Radiative Power

FRM: Fire Risk Map

## **VEGETATION STATE**

FVC: Fraction Vegetation Cover

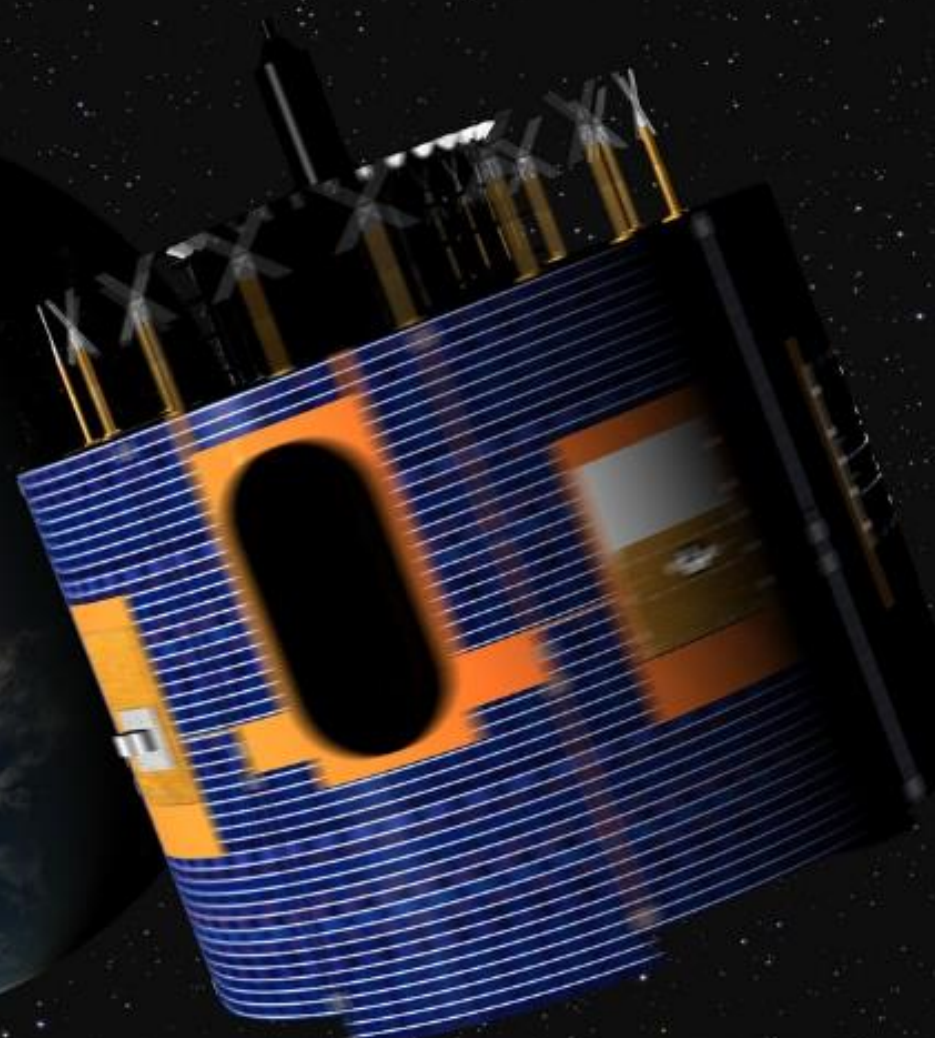
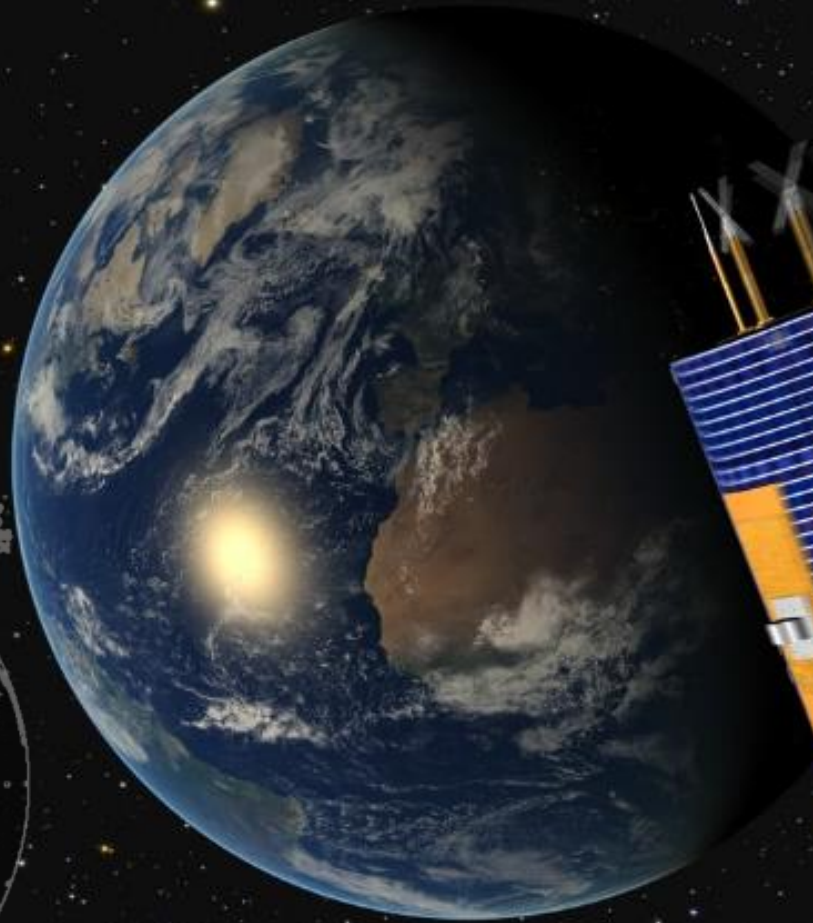
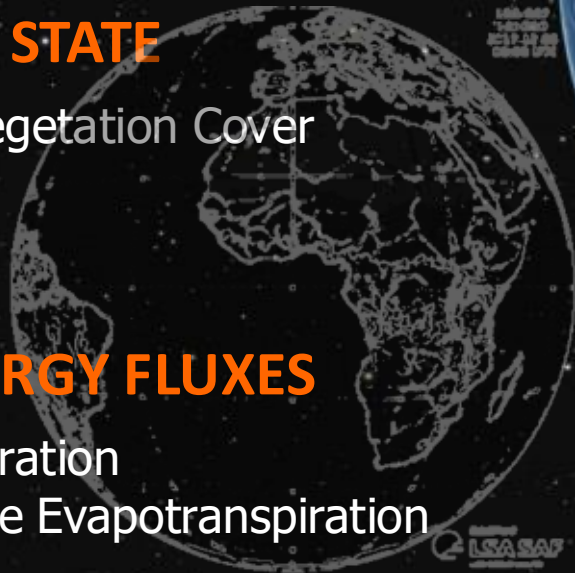
fAPAR

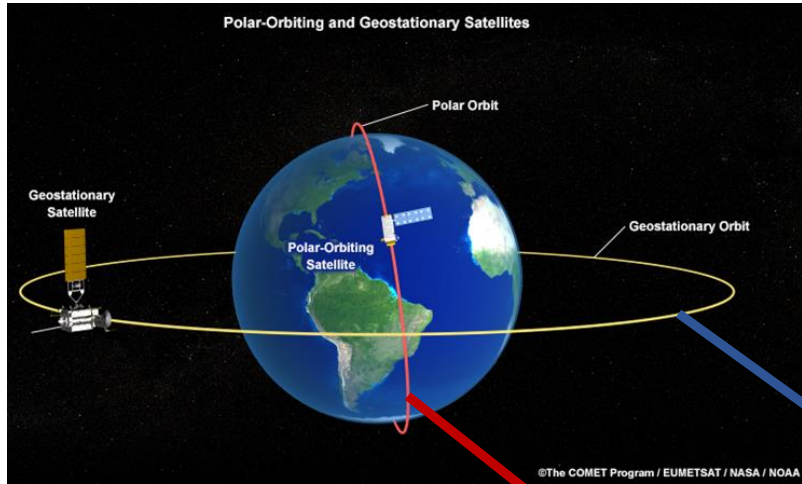
LAI

## **SURFACE ENERGY FLUXES**

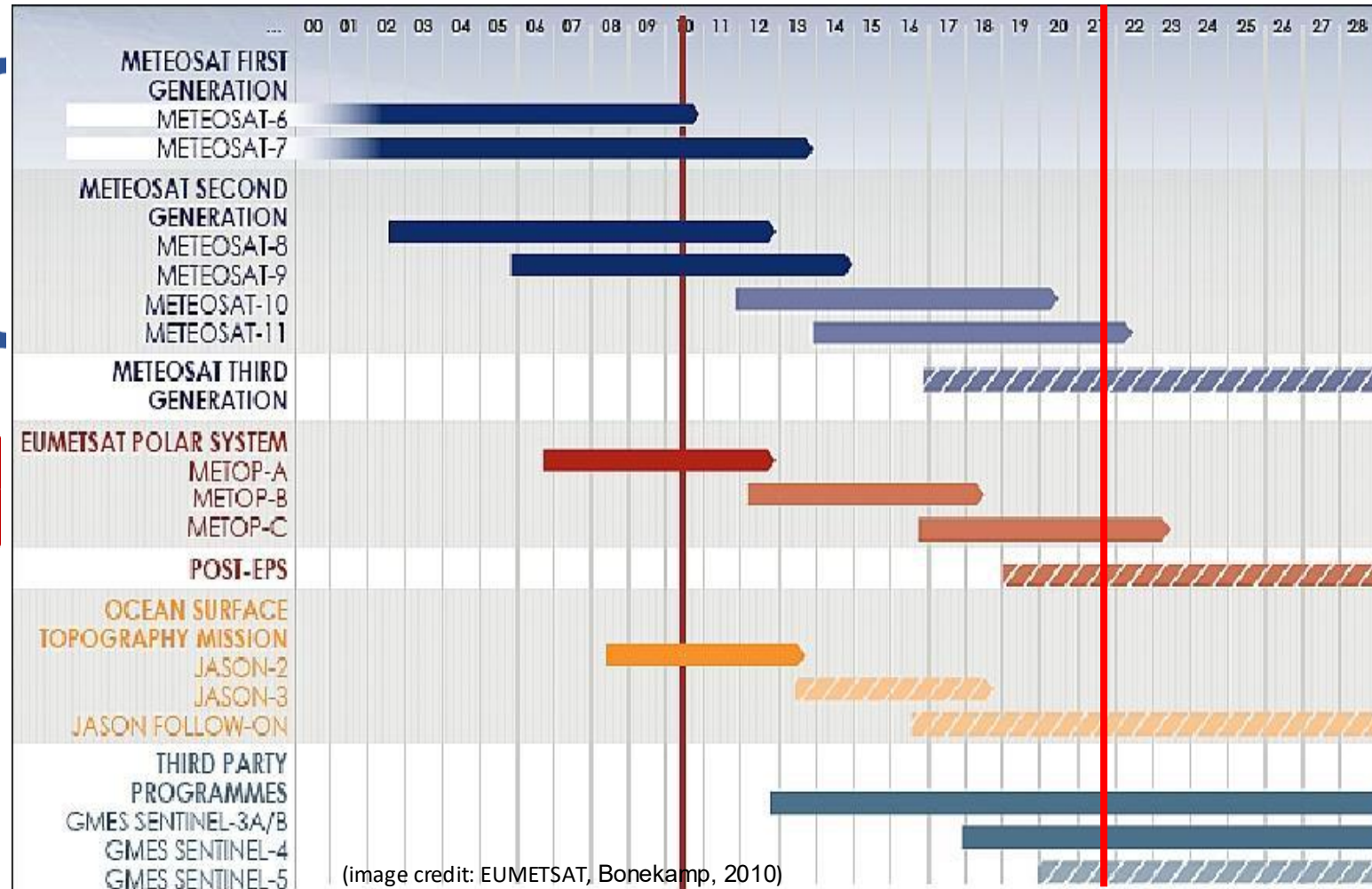
ET: Evapotranspiration

ETREF: Reference Evapotranspiration





## EUMETSAT space segment



(image credit: EUMETSAT, Bonekamp, 2010)

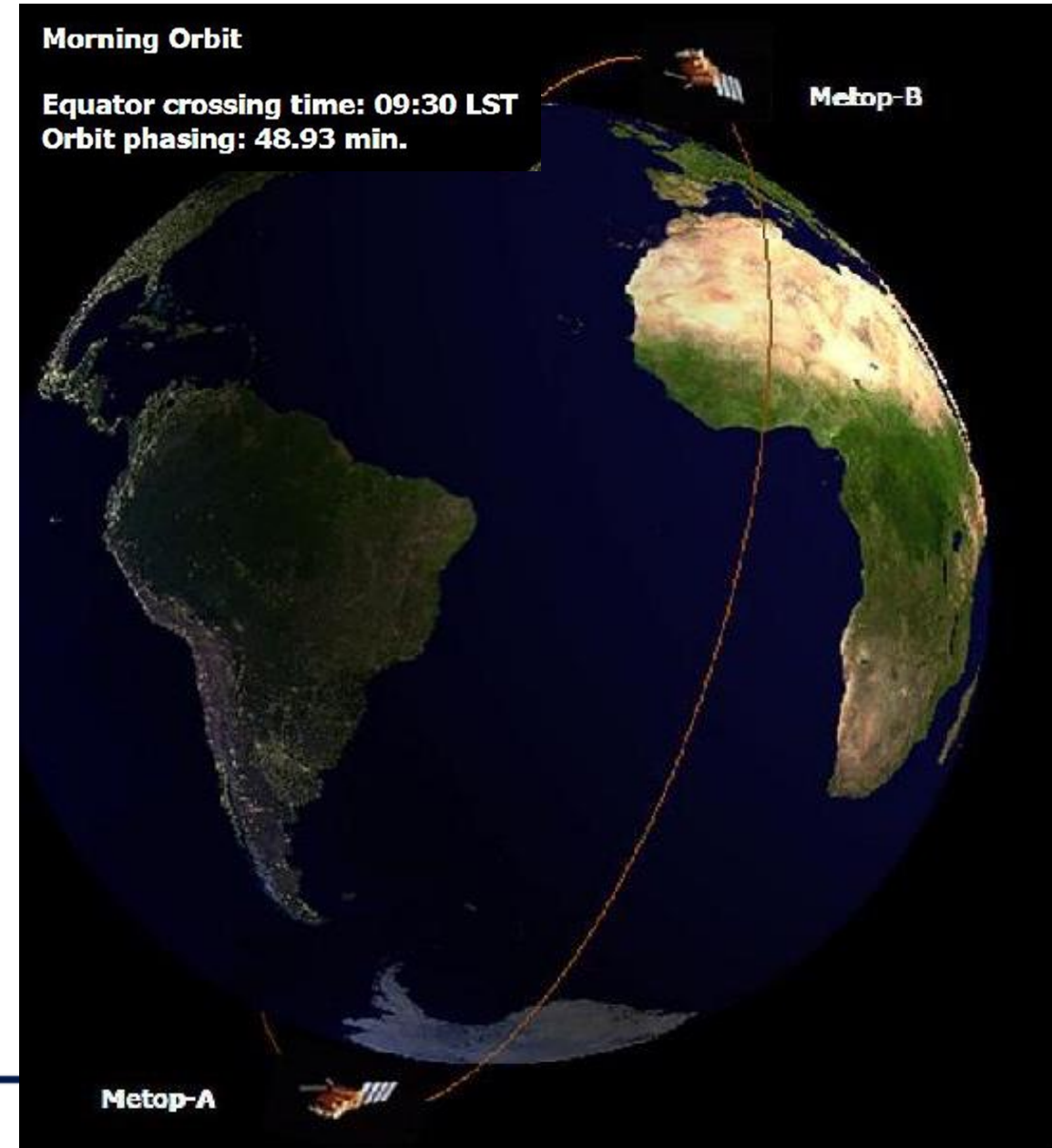
## Metop (EUM Polar-Orbiter)

### Advanced Very High-Resolution Radiometer (AVHRR)

- 5 channels
- 2 observations/day GLOBAL
- c.a. 1 km at sub-satellite point

### Metop (Polar-Orbit) – Payload:

- AVHRR
- HIRS
- AMSU-A



## SURFACE RADIATION BUDGET

EPS LST: Land Surface Temperature

EPS AL: Albedo

## VEGETATION STATE

FVC: Fraction Vegetation Cover

fAPAR

LAI

NDVI



## Climate Data Records

### MSG/SEVIRI-based

Reprocessed from 2004 onwards using

- the latest product algorithms – in line with “Near Real Time” products
- recalibrated level 1.5 SEVIRI data

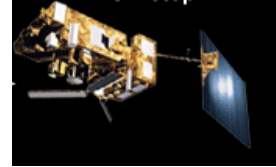
### EPS/AVHRR-based

Reprocessed from 2007 onwards using

- the latest product algorithms – in line with “Near Real Time” products
- level 1b AVHRR data

Atmospheric Fields: ERA-5

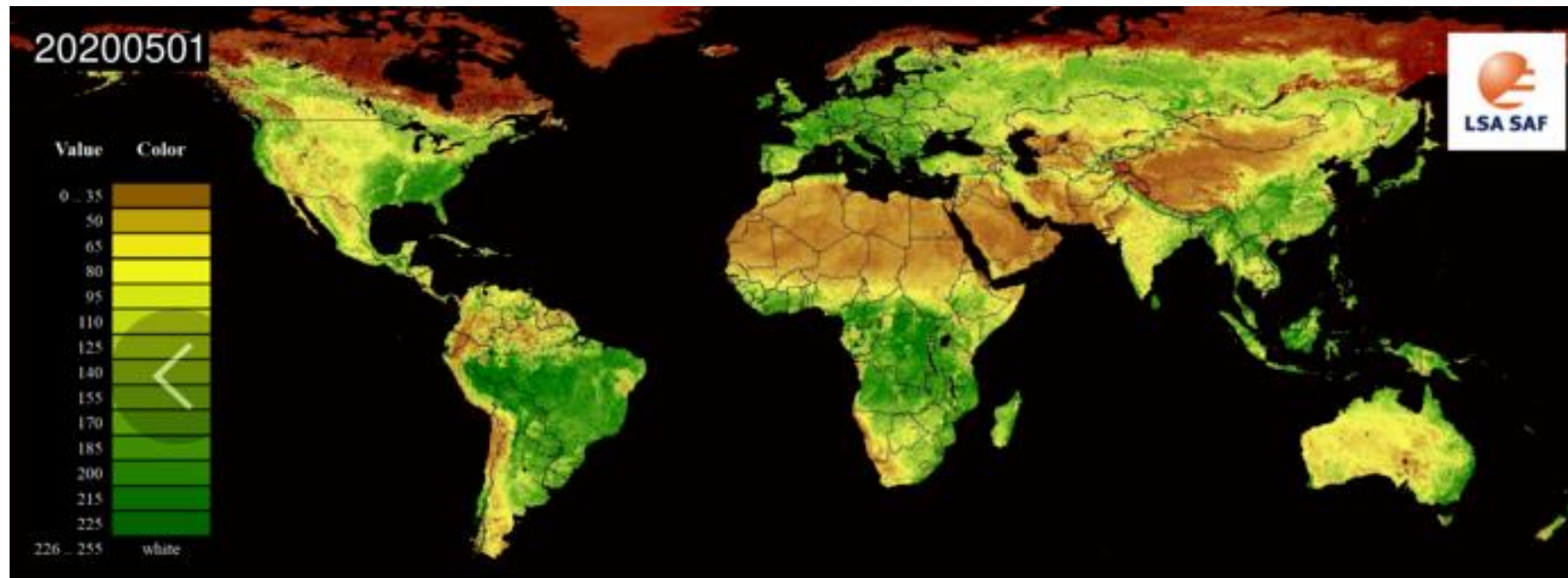
# LSA-SAF (EPS Products)



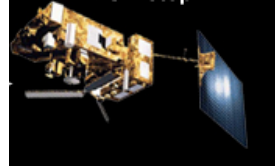
## NDVI

10 days

2007 - Present



# LSA-SAF (EPS Products)

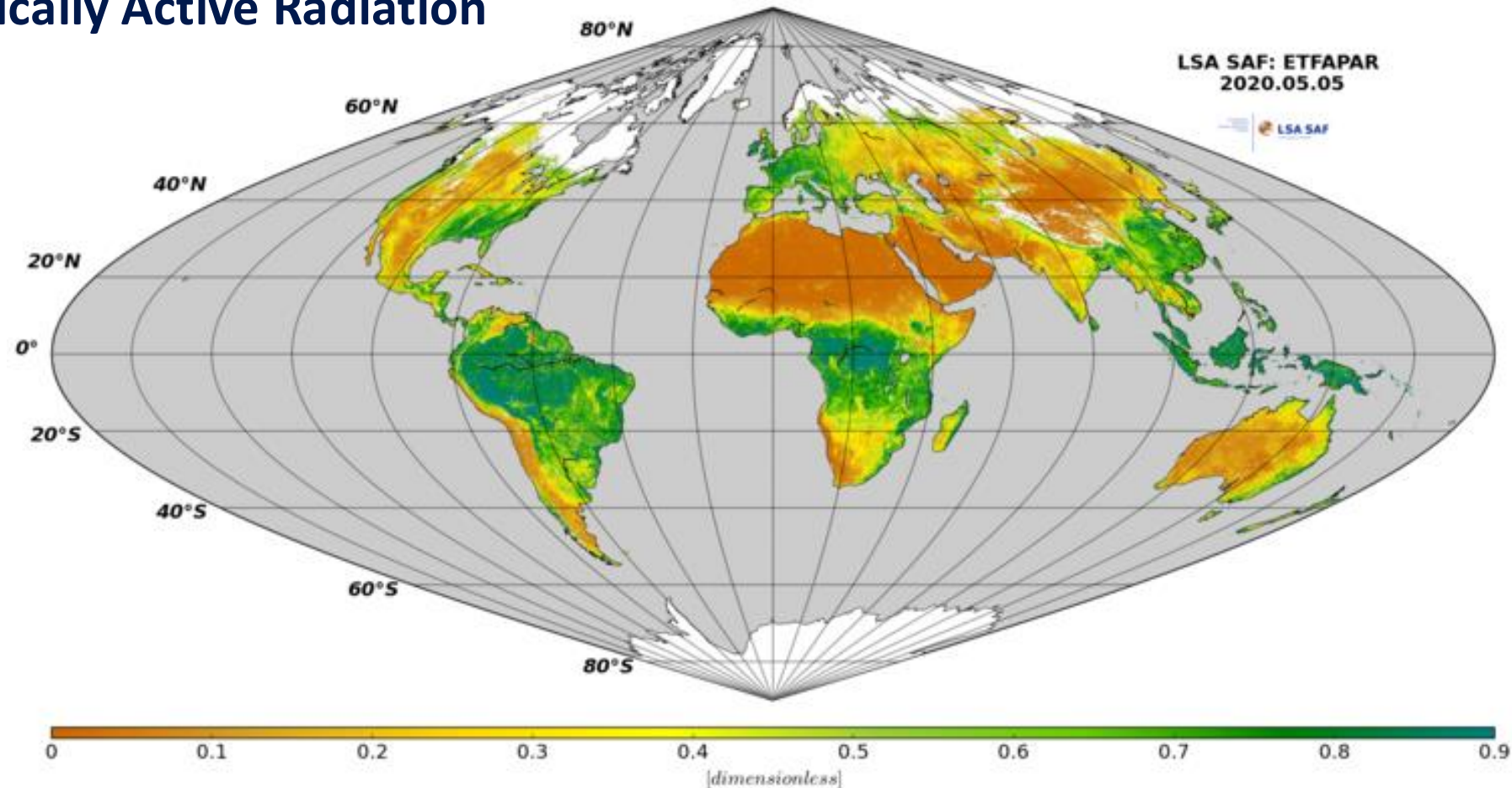


## Fraction of Photosynthetically Active Radiation (fAPAR)

Daily/10 days since 2007

Fraction of radiation in the PAR region ( $0.4 \mu\text{m} - 0.7 \mu\text{m}$ ) absorbed by the green parts of the canopy for the photosynthesis – indicator of the presence and productivity of alive elements of the canopy.

Depends canopy structure, Leaf and soil optical properties, Irradiance conditions

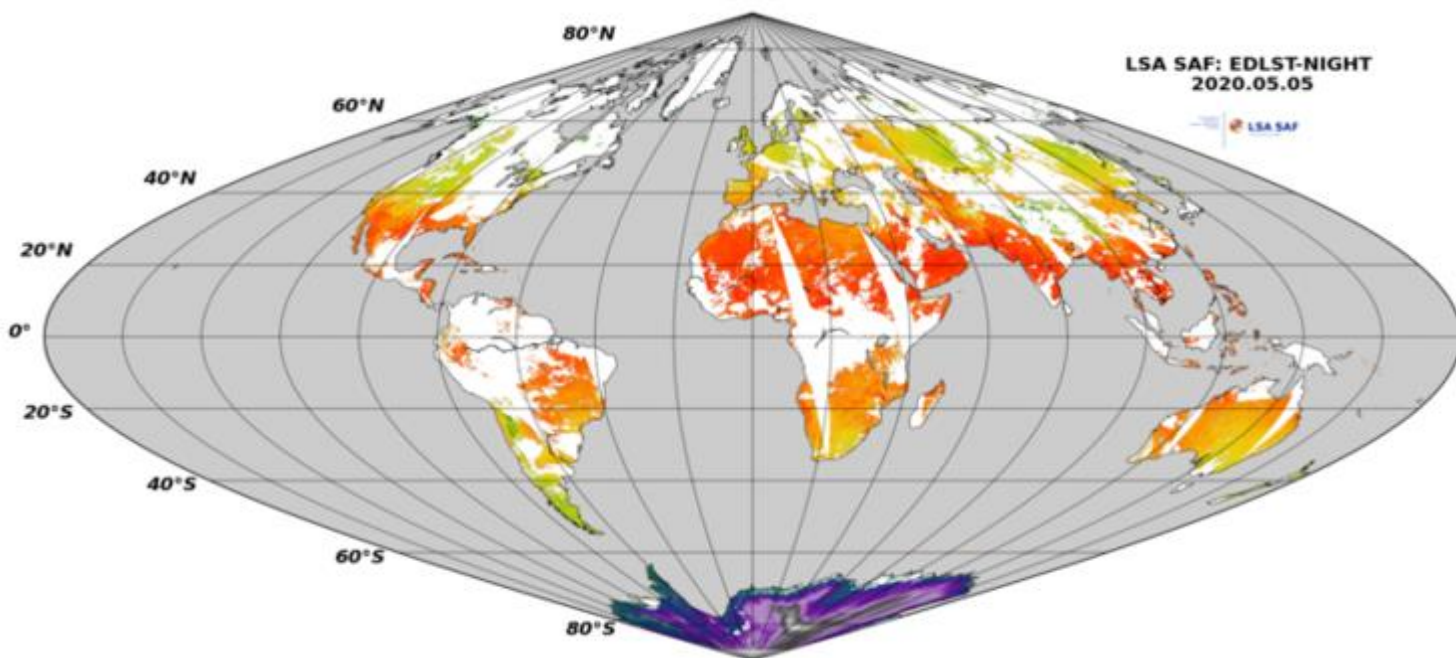
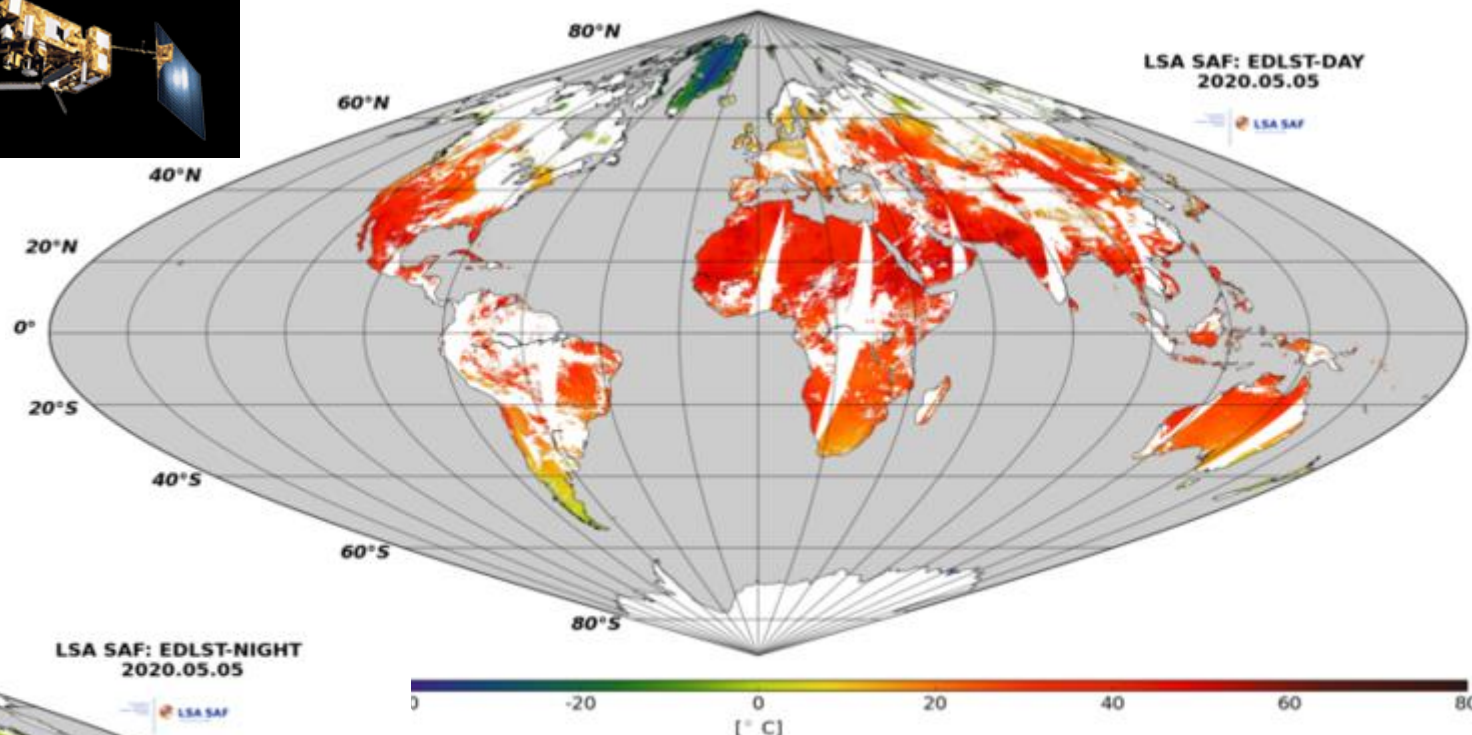
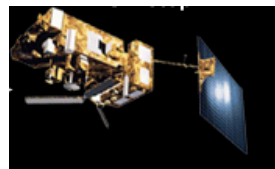


# LSA-SAF (EPS Products)

## LST

Daily: Day and Night

2007-2020 (will be available begin 2021)



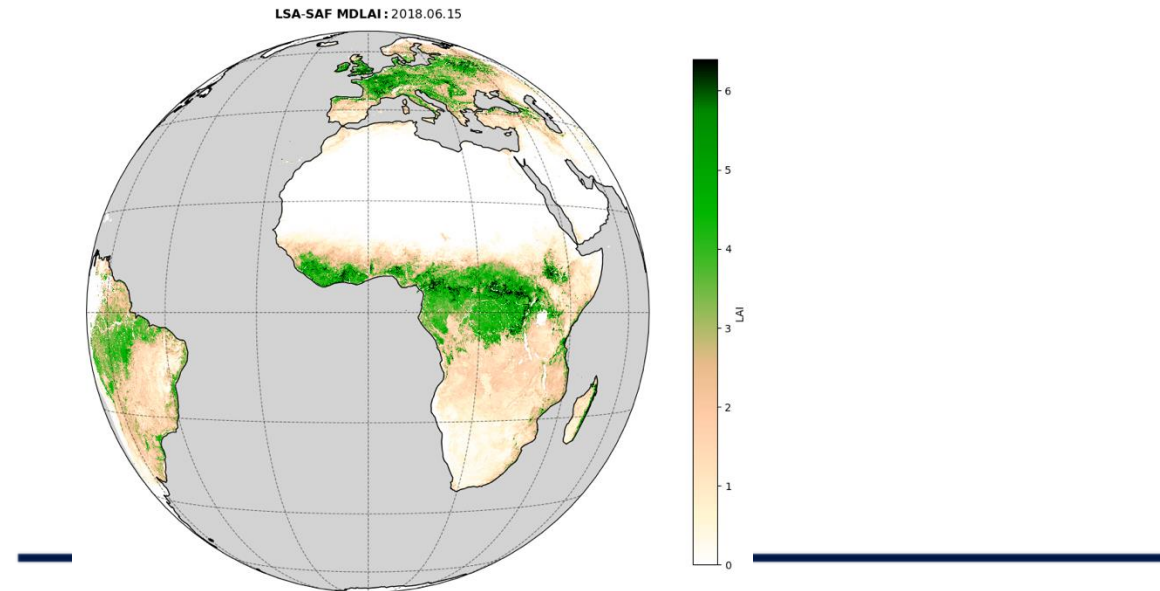
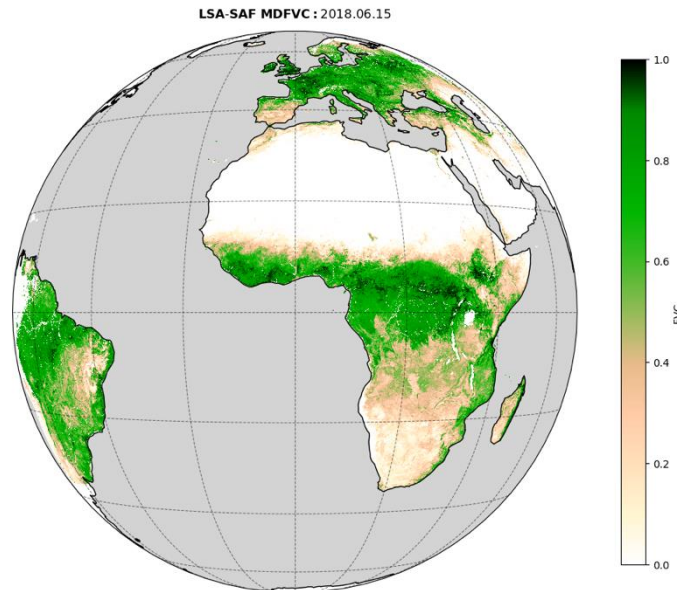
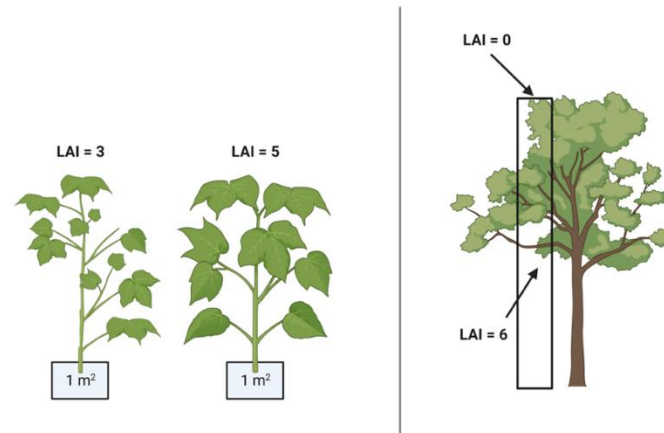
The **EDLST (EPS Daily Land Surface Temperature)** provides a day-time and night-time retrievals of LST based on clear-sky measurements from the Advanced Very High Resolution Radiometer (AVHRR) on-board EUMETSAT polar system satellites, the METOP series.

# LSA-SAF (MSG Products)

## Fraction of Vegetation Cover (FVC)

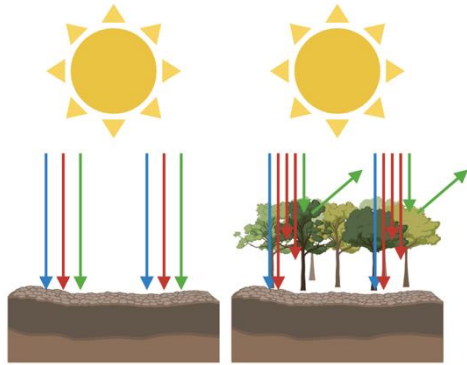


## Leaf Area Index (LAI)

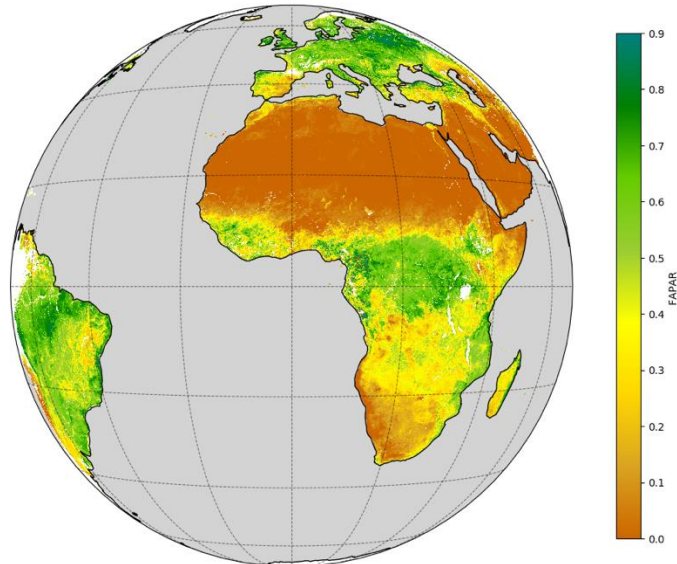


# LSA-SAF (MSG Products)

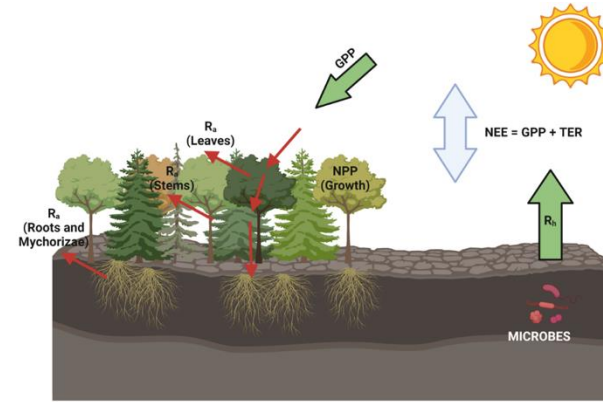
## Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)



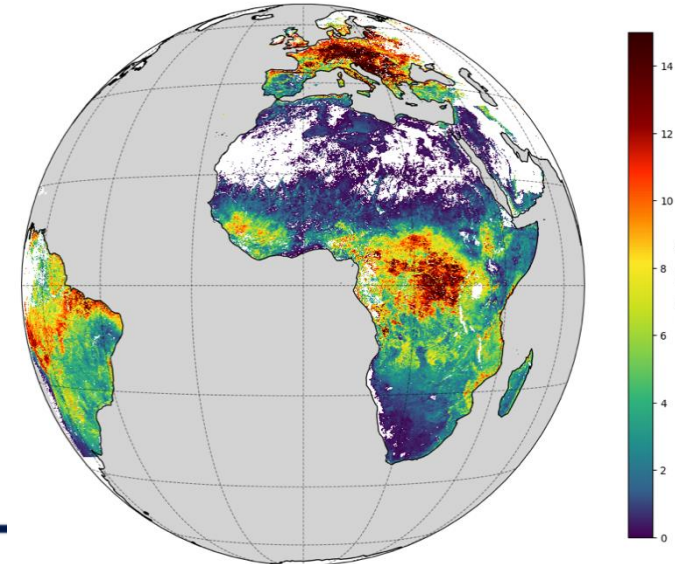
LSA-SAF MDFAPAR : 2018.06.15



## Gross Primary Production (GPP)



LSA-SAF MDGPP : 2022.06.15



# LSA-SAF (MSG Products)

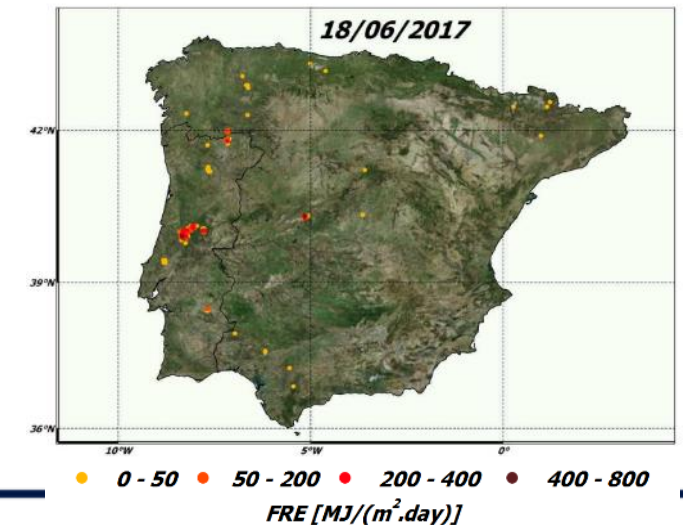
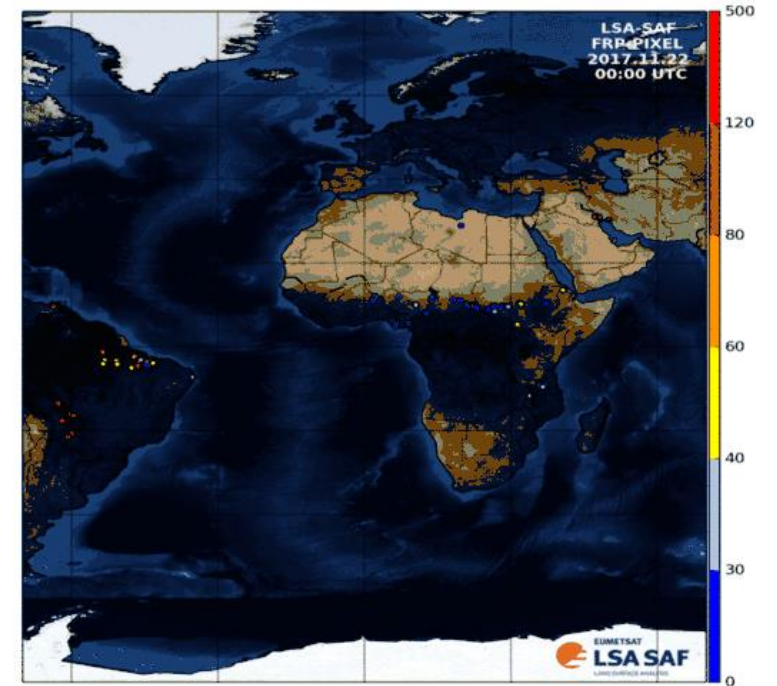


## Fire Radiative Power (FRP)

The product records information on the location, timing and fire radiative power (**FRP**, in **MWatt**) of landscape fires detected every **15 minutes** across the full **Meteosat Disk** at the native spatial resolution of the SEVIRI sensor.

Integrating FRP over the lifetime of a fire provides an estimate of the total **Fire Radiative Energy (FRE)** released (proportional to the total amount of biomass burned).

**Wildfires in Iberia:** Portugal in June 2017.  
Several very intense hot-spots (64 casualties).



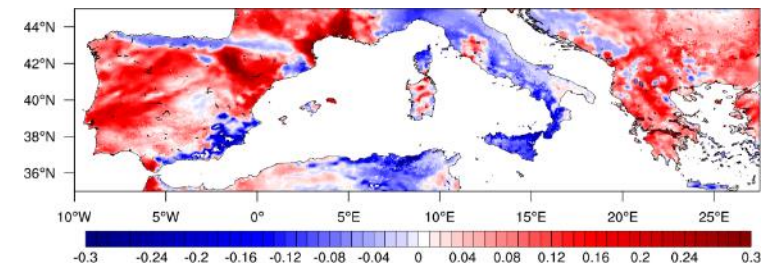
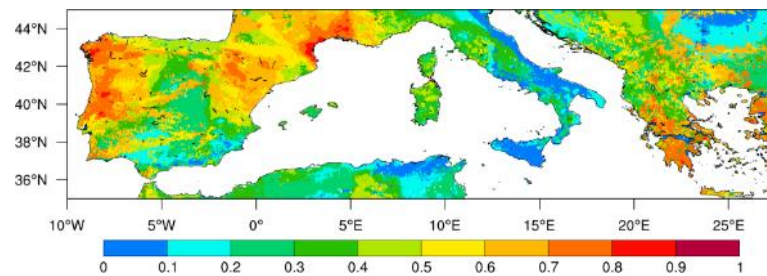
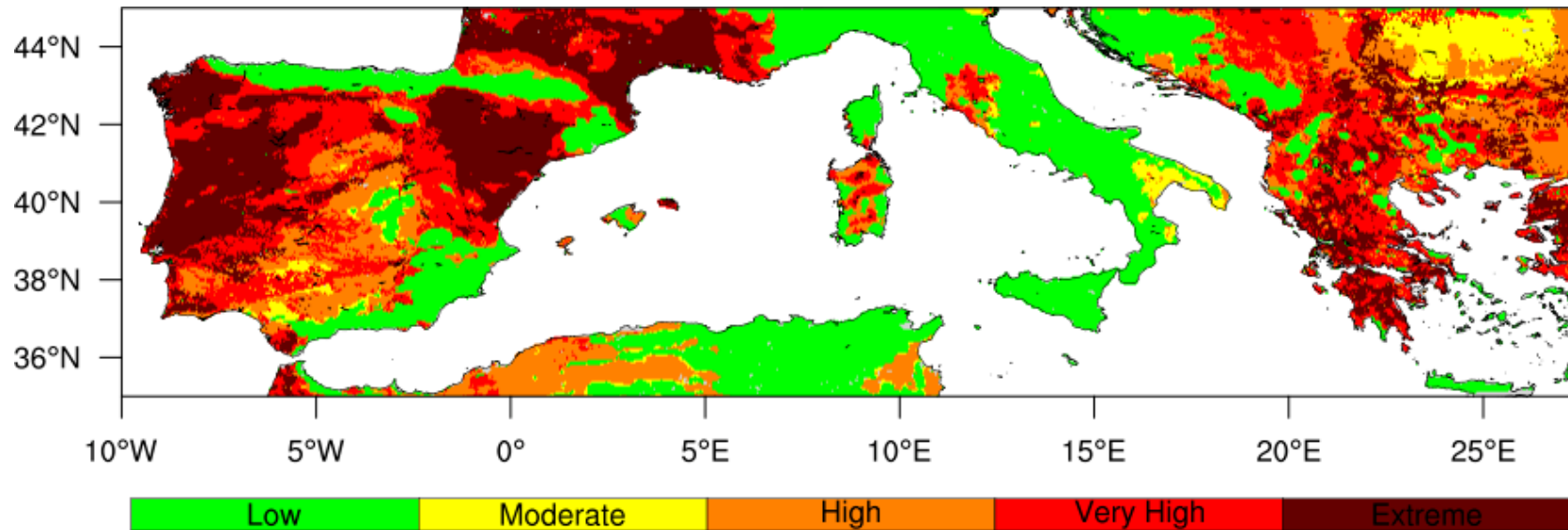
# LSA-SAF (MSG Products)

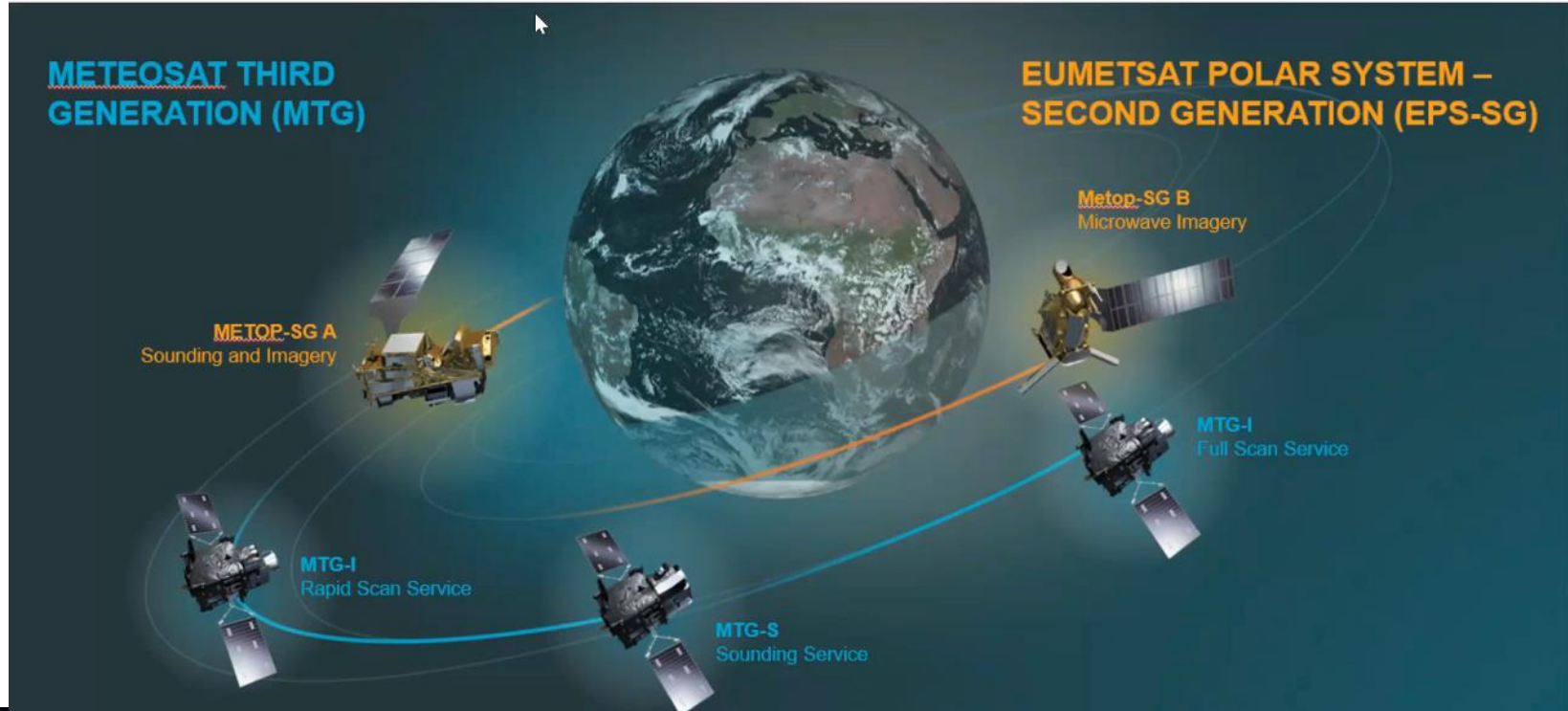


Mediterranean Europe

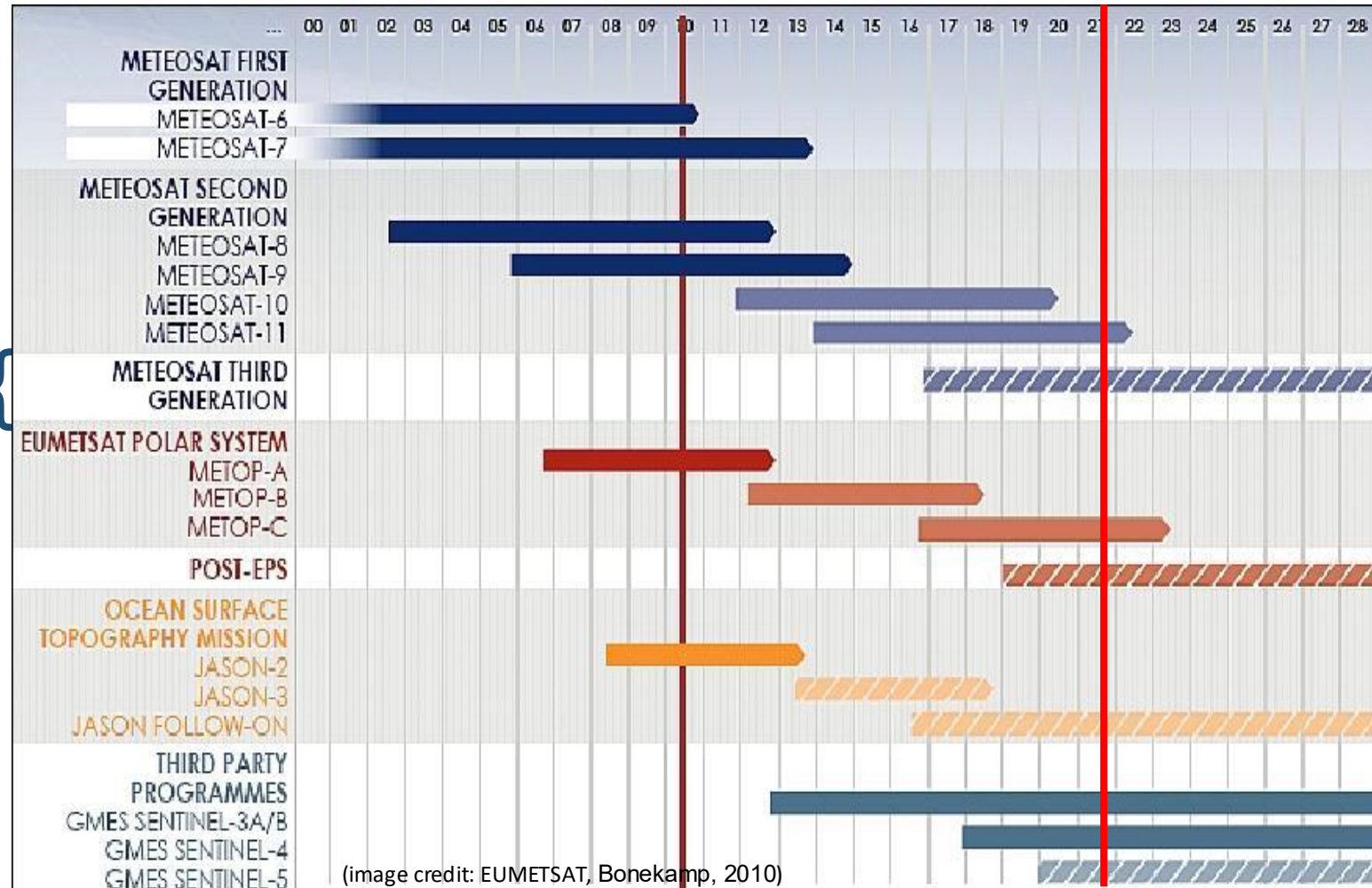
5 days of forecasted risk

## Fire Risk Map (FRM)





## EUMETSAT space segment



(image credit: EUMETSAT, Bonekamp, 2010)

### EPS – Second Generation

- Metop-SG A1 to be launched in 2024
  - ✓ Visible Infrared Imager (20 channels; 500m)
  - ✓ 3MI – Multi-spectral, Multi-angle, Multi-polarization
  - ✓ Sentinel-5 (UVNS)
  - ✓ IASI-SG, ....

### EPS – Second Generation

- Metop-SG B1 to be launched in 2024/2025
  - ✓ Microwave Imager Radiometer (MWI)
  - ✓ Ice Cloud Imager (ICI)
  - ✓ Scatterometer (SCA)
  - ✓ ...

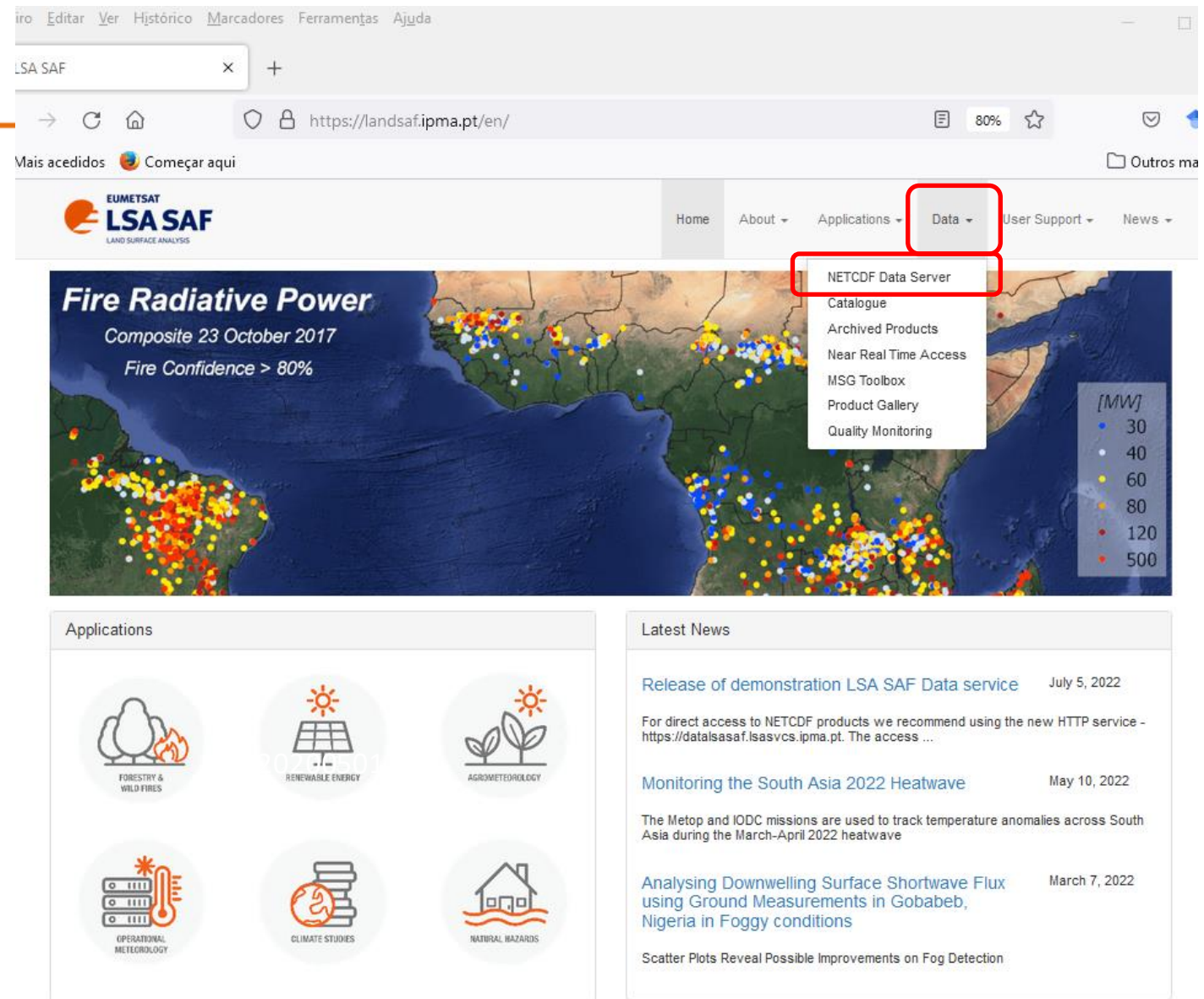
### Meteosat Third Generation

- MTG-I1 to be launched in 2023
  - ✓ Imager (16 channels; 1-2 km; 10-minute)
  - ✓ Lightning Imager
- MTG-S1 to be launched in 2023/2024
  - ✓ Infrared Sounder (0.754/0.625 cm<sup>-1</sup>; 30-60 minute)
  - ✓ Sentinel-4 (UV-VIS-NIR)

# How to access LSA-SAF data

LSA-SAF <https://landsaf.ipma.pt/en/>

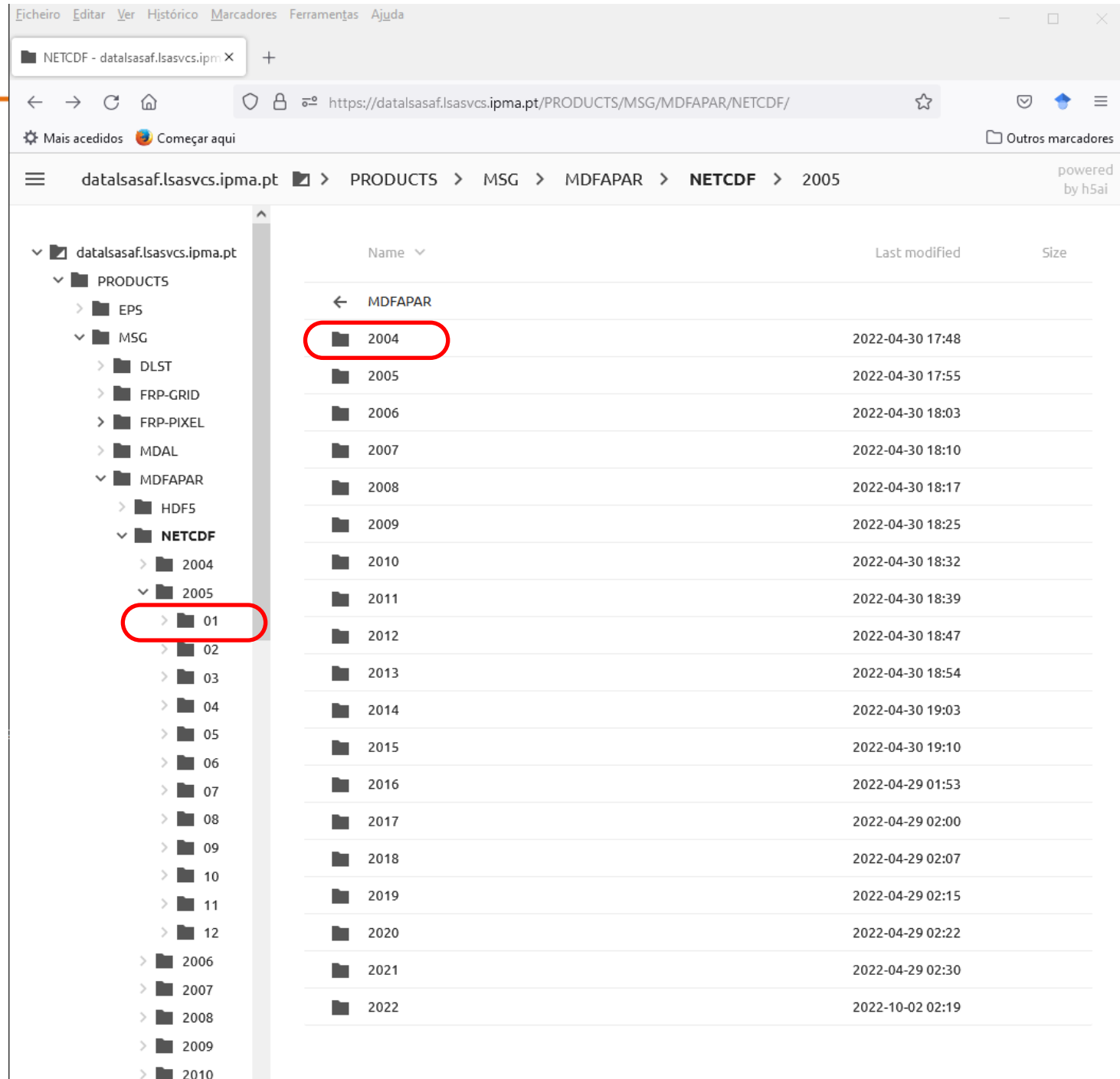
→ Data → NETCDF Data Server



The screenshot shows the LSA-SAF website interface. The browser address bar displays <https://landsaf.ipma.pt/en/>. The navigation menu includes Home, About, Applications, Data, User Support, and News. The 'Data' menu is expanded, showing options: NETCDF Data Server, Catalogue, Archived Products, Near Real Time Access, MSG Toolbox, Product Gallery, and Quality Monitoring. The main content area features a map titled 'Fire Radiative Power' for a composite of 23 October 2017, with a fire confidence of > 80%. The map uses a color scale from 30 to 500 MW. Below the map are sections for 'Applications' (Forestry & Wild Fires, Renewable Energy, Agrometeorology, Operational Meteorology, Climate Studies, Natural Hazards) and 'Latest News' (Release of demonstration LSA SAF Data service, Monitoring the South Asia 2022 Heatwave, Analysing Downwelling Surface Shortwave Flux using Ground Measurements in Gobabeb, Nigeria in Foggy conditions, Scatter Plots Reveal Possible Improvements on Fog Detection).

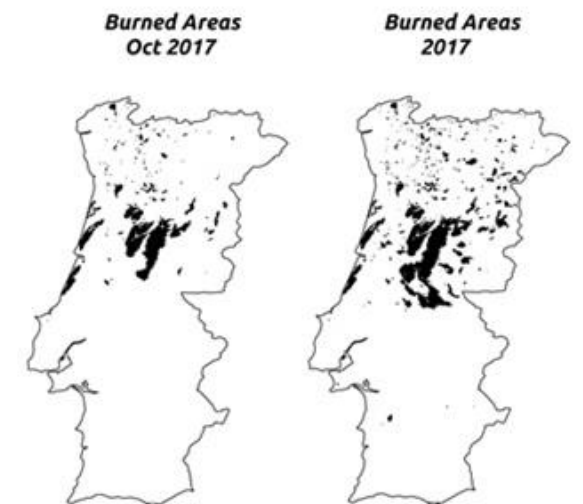
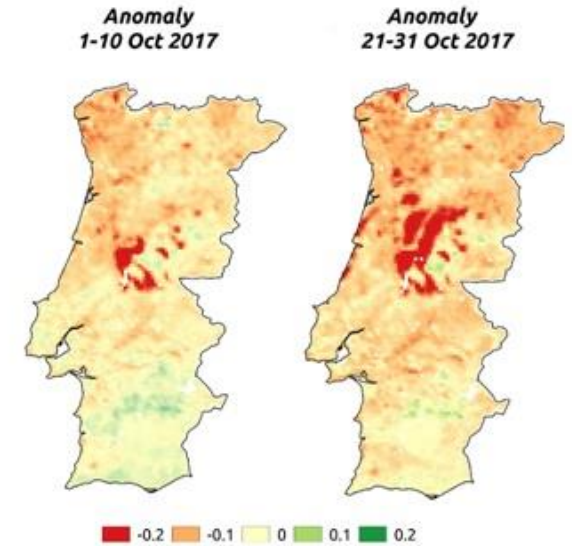
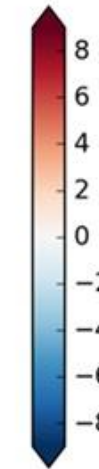
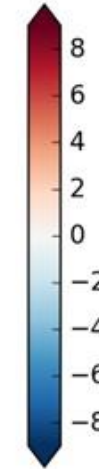
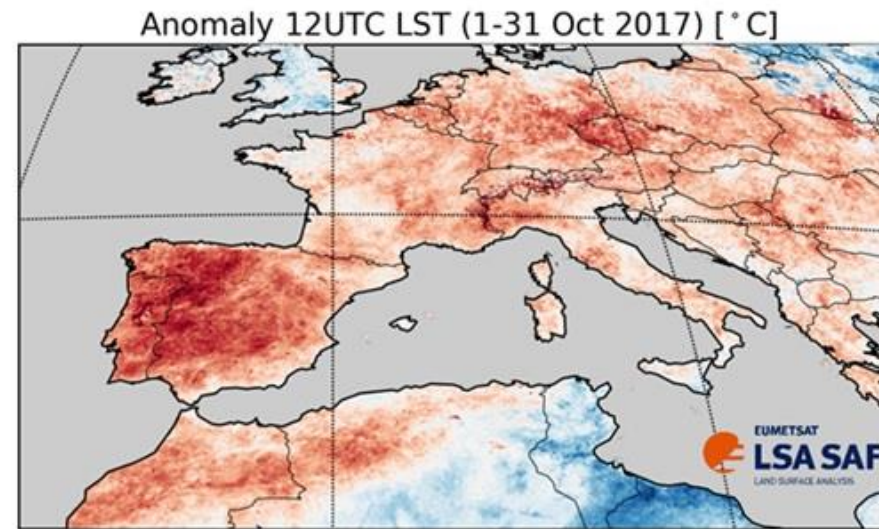
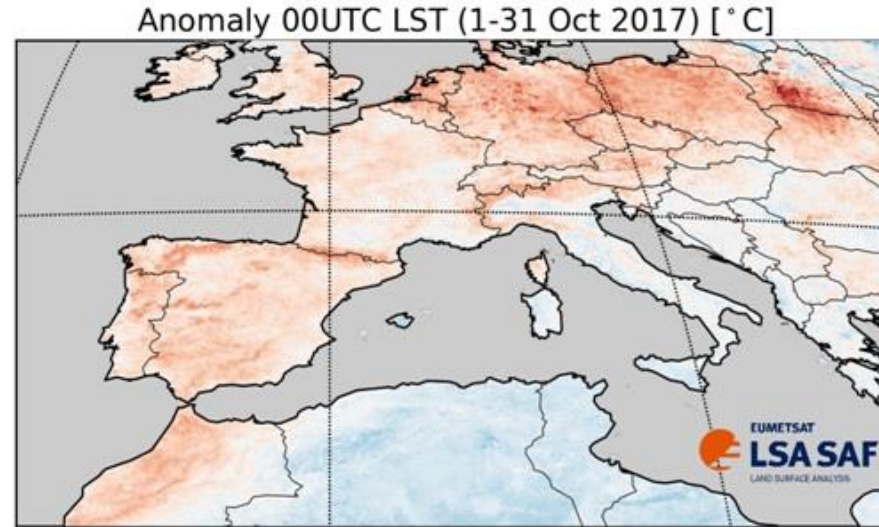
# How to access LSA-SAF data

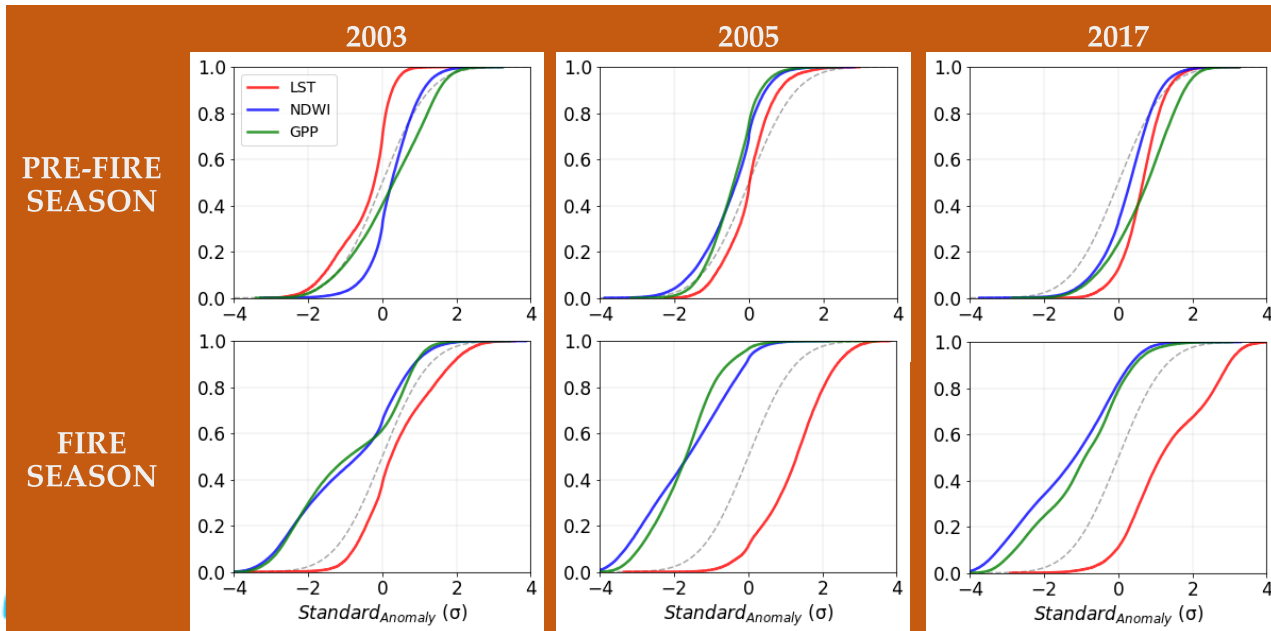
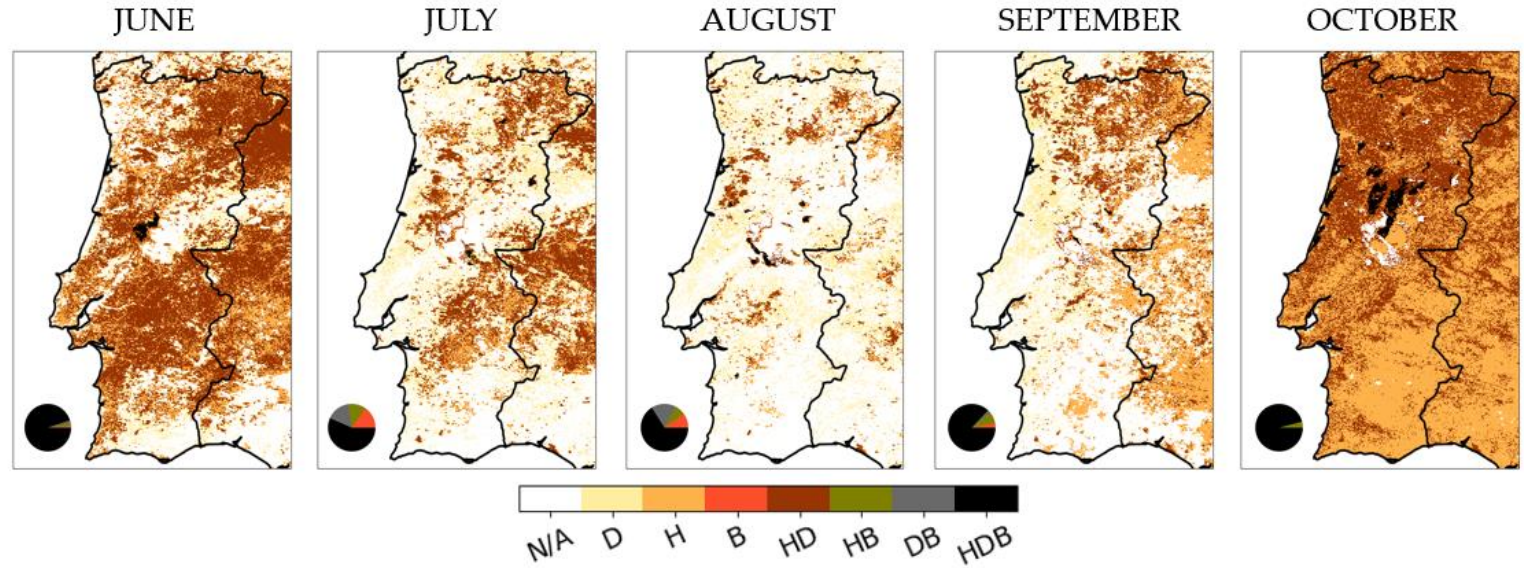
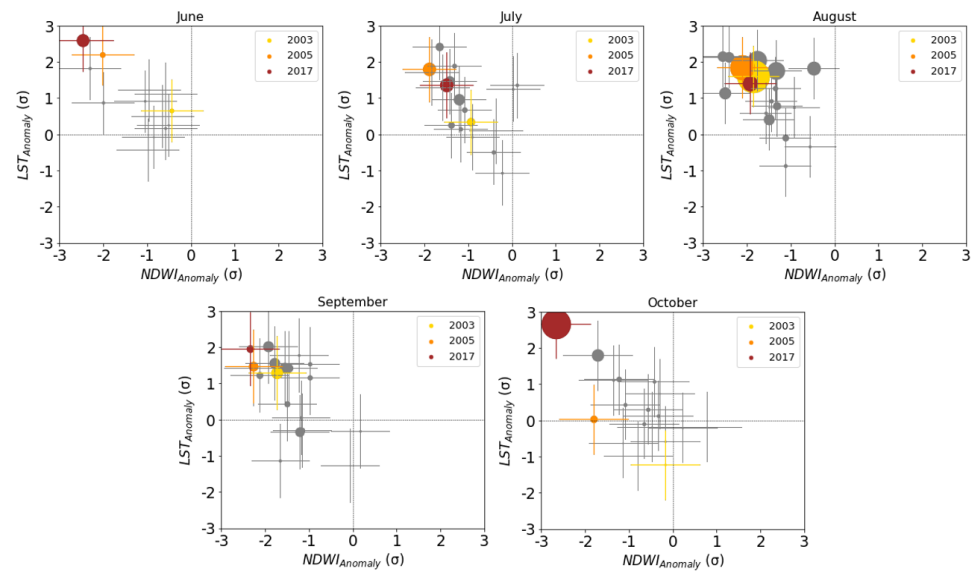
- Select year →
- Select month →



Name	Last modified	Size
← MDFAPAR		
2004	2022-04-30 17:48	
2005	2022-04-30 17:55	
2006	2022-04-30 18:03	
2007	2022-04-30 18:10	
2008	2022-04-30 18:17	
2009	2022-04-30 18:25	
2010	2022-04-30 18:32	
2011	2022-04-30 18:39	
2012	2022-04-30 18:47	
2013	2022-04-30 18:54	
2014	2022-04-30 19:03	
2015	2022-04-30 19:10	
2016	2022-04-29 01:53	
2017	2022-04-29 02:00	
2018	2022-04-29 02:07	
2019	2022-04-29 02:15	
2020	2022-04-29 02:22	
2021	2022-04-29 02:30	
2022	2022-10-02 02:19	

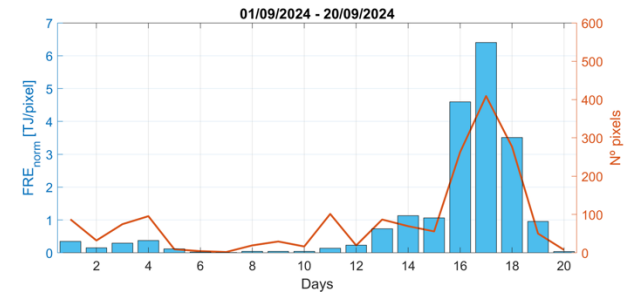
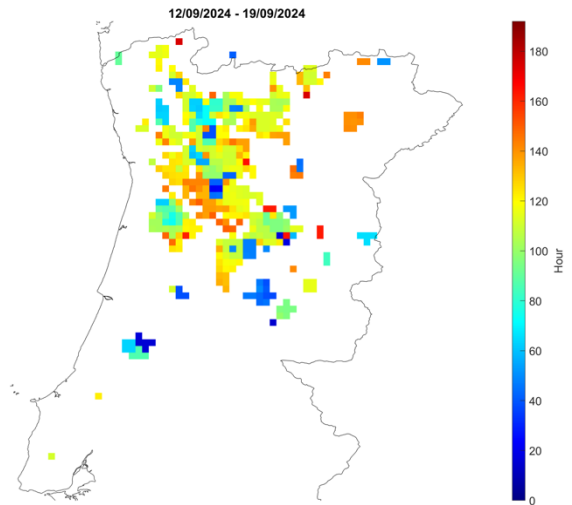
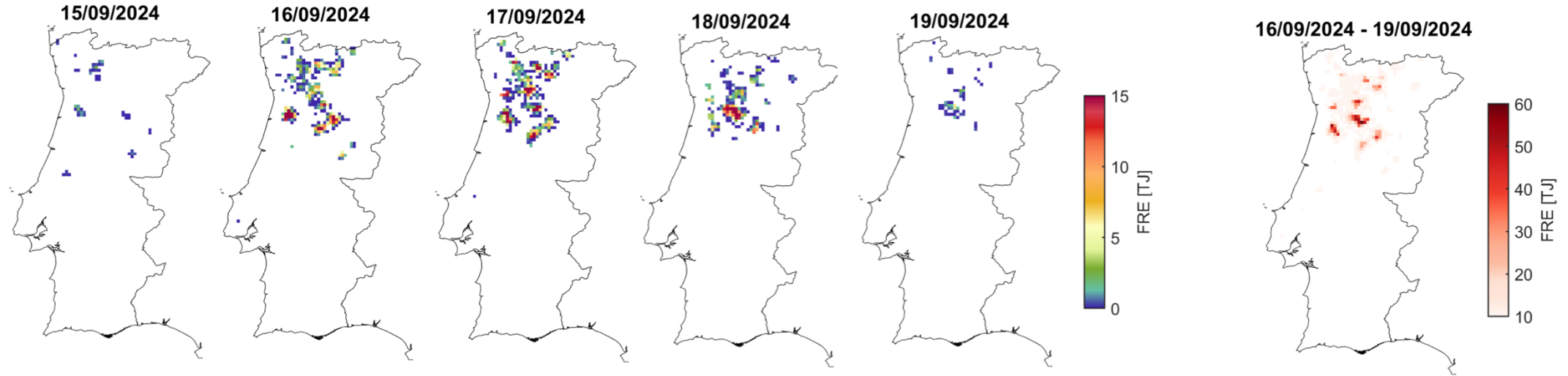
(Top, left) **Land Surface Temperature** anomaly at 00UTC. (Low, left) Land Surface Temperature anomaly at 12UTC. (Top, right) Anomaly of **Fraction Vegetation Cover** in the first ten days of October and in the last ten days of October. LSA-SAF data (Low, right) **Areas burned** in October and in total for the year 2017. ICNF data (Portugal).

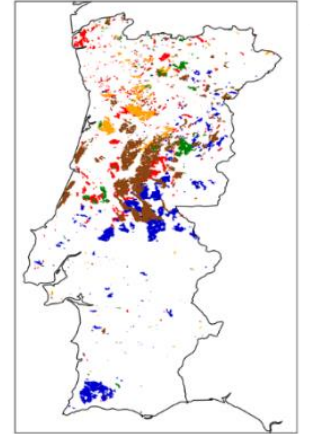




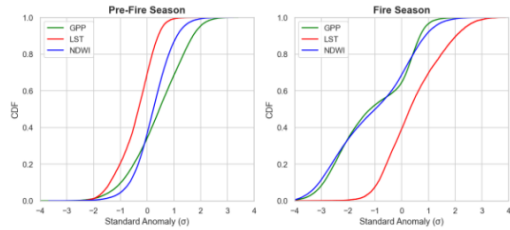
**Burned only, B** ( $LST_{ANOM} < 1\sigma$  and  $NDWI_{ANOM} > -1\sigma$ )  
**Hot and Burned, HB** ( $LST_{ANOM} > 1\sigma$ )  
 Dry and Burned, DB ( $NDWI_{ANOM} < -1\sigma$ )  
 Hot, Dry and Burned, HDB ( $LST_{ANOM} > 1\sigma$  and  $NDWI_{ANOM} < -1\sigma$ )

(Ermitão et. al 2022)

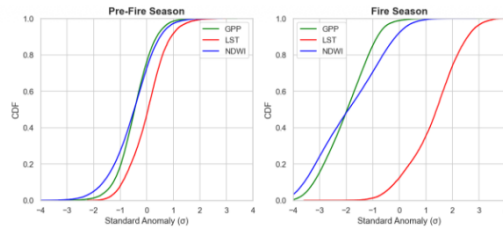




2003

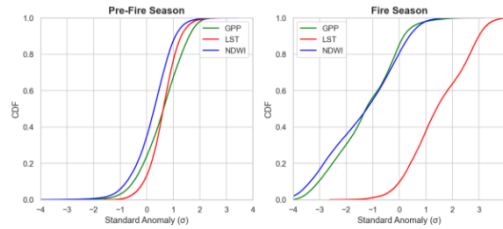


2005

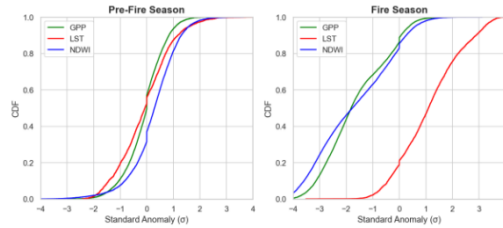


Finuras et al., 2026 (in preparation)

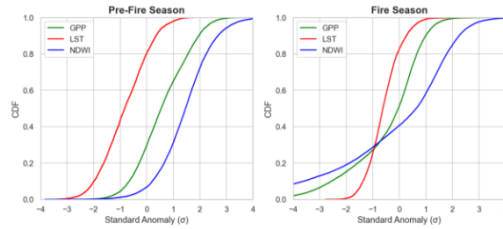
2017



2022



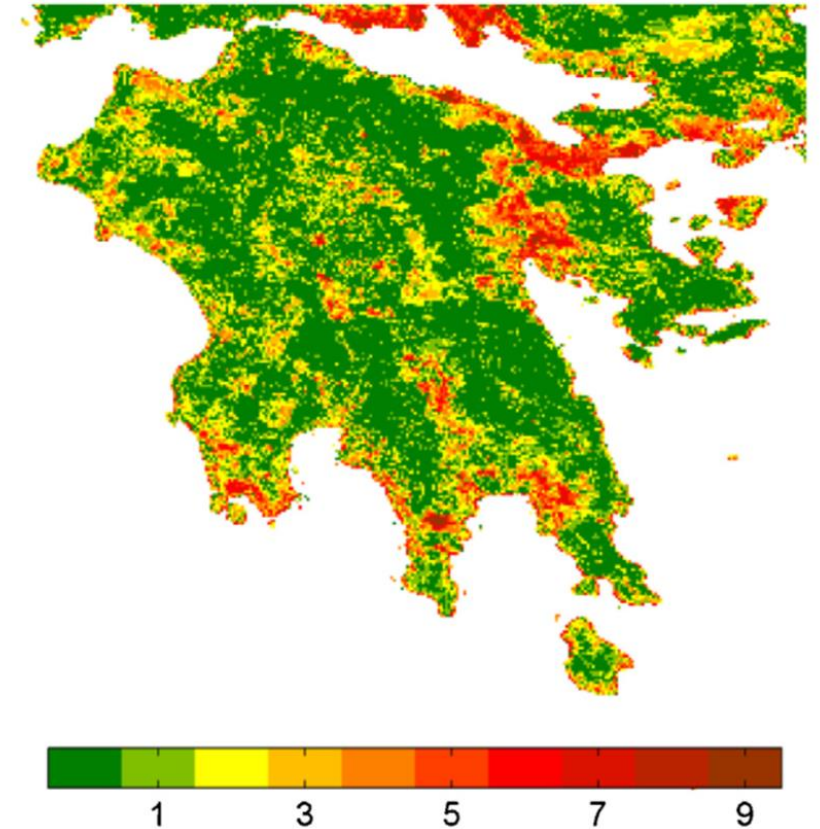
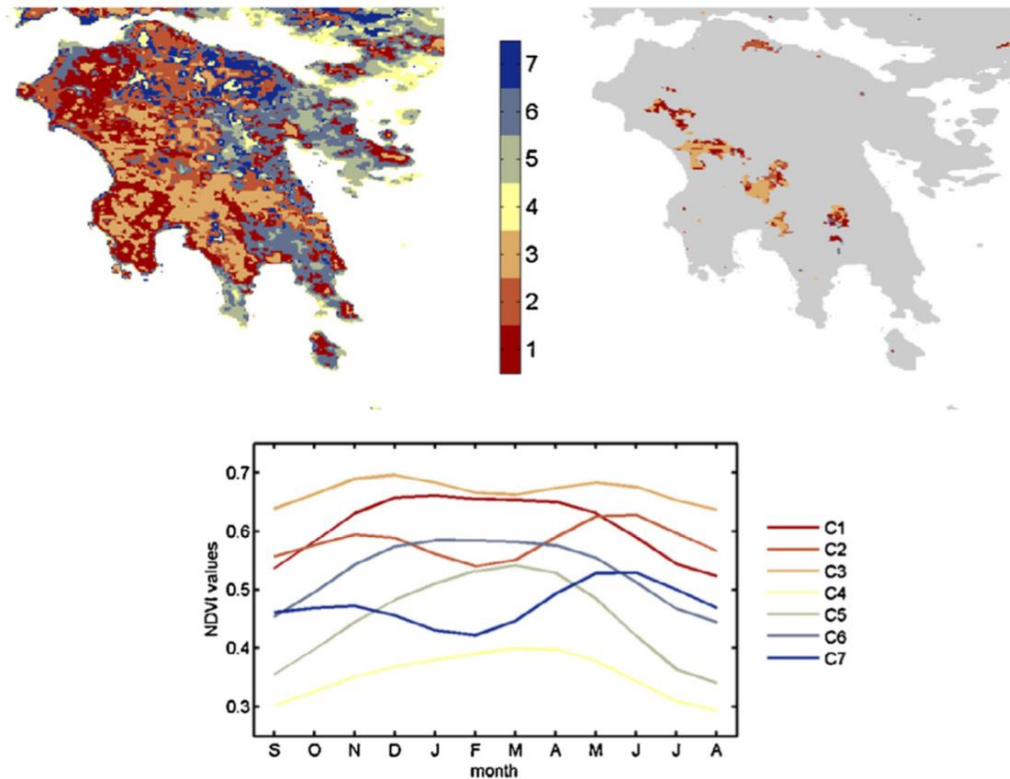
2024



Year	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
<b>2003</b>	-	-	-	-	-	0,05	0,05	-0,19	-0,22	-0,13	-0,14	-0,08	<b>-0,67</b>
2004	-0,06	-0,09	-0,10	-0,06	-0,15	-0,27	-0,19	-0,07	-0,14	-0,10	-0,08	-0,02	-1,33
2005	-0,04	-0,10	-0,14	-0,09	-0,19	-0,32	-0,20	-0,18	-0,12	-0,09	-0,09	-0,02	-1,56
<b>2005</b>	-	-	-	-	-	-0,16	-0,13	-0,22	-0,17	-0,12	-0,11	-0,05	<b>-0,96</b>
2006	-0,05	-0,09	-0,13	-0,02	-0,09	-0,17	-0,20	-0,20	-0,08	-0,03	0,00	-0,01	-1,06
2007	-0,01	-0,03	-0,01	-0,02	-0,02	0,05	0,03	0,01	-0,03	0,02	-0,01	-0,01	-0,02
<b>2017</b>	-	-	-	-	-	-0,24	-0,07	-0,15	-0,11	-0,20	-0,17	-0,11	<b>-1,06</b>
2018	-0,10	-0,20	-0,28	-0,22	-0,21	-0,17	0,09	-0,19	-0,24	-0,07	-0,10	-0,01	-1,71
2019	-0,01	0,03	0,03	-0,06	-0,03	-0,06	-0,05	-0,09	-0,04	-0,04	-0,09	-0,01	-0,42
<b>2022</b>	-	-	-	-	-	0,00	-0,07	-0,04	-0,05	-0,03	-0,02	-0,01	<b>-0,21</b>
2023	0,00	-0,01	0,00	0,00	-0,03	-0,04	0,00	-0,03	-0,01	-0,02	0,00	0,00	-0,13
2024	0,00	0,01	0,01	0,02	0,01	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,06
<b>2024</b>	-	-	-	-	-	0,02	0,02	0,00	-0,03	-0,04	-0,02	-0,01	<b>-0,04</b>

# Vegetation Products

## Fire and Drought



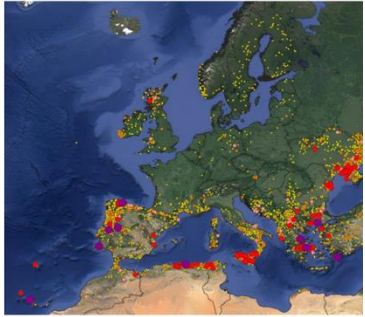
**Fig. 8.** Drought persistence was evaluated by adding up (for each pixel) the number of months between November 2006 and July 2007 with NDVI anomalies lower than  $-0.010$ .

NDVI from SPOT VEGETATION

Gouveia et al, 2016

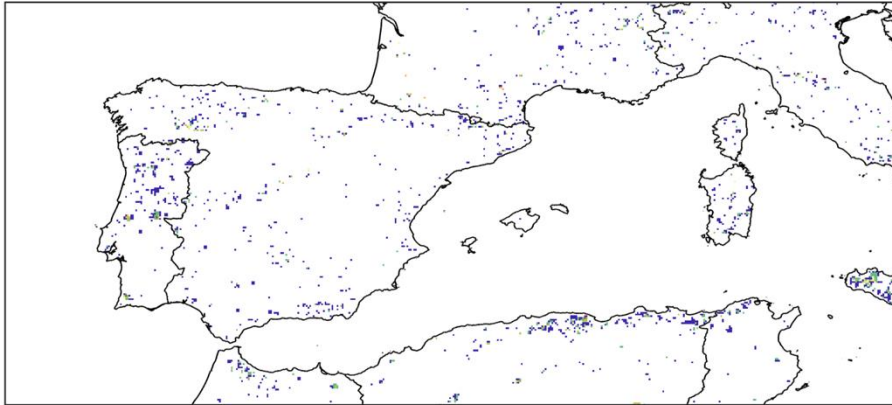
## Wildfires: 2023 among the worst in the EU in this century

A sharp increase in burnt areas was recorded during the summer months of 2023, mostly affecting the Mediterranean region. By total burnt surface area, 2023 was the fourth worst year since 2000.

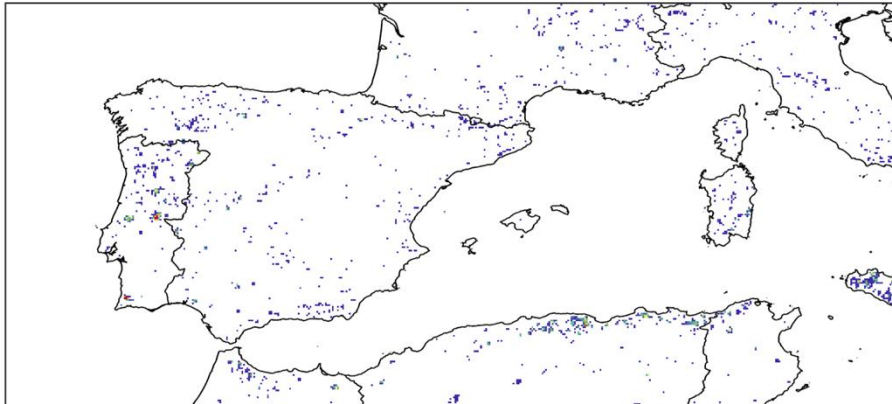


Extent of burnt areas in 2023 as reported by EFFIS. Yellow dots refer to orange up to 500 ha, pink up to 1000 ha, red up to 5000 ha, purple beyond 5000 ha. © EU, 2024 - GWIS

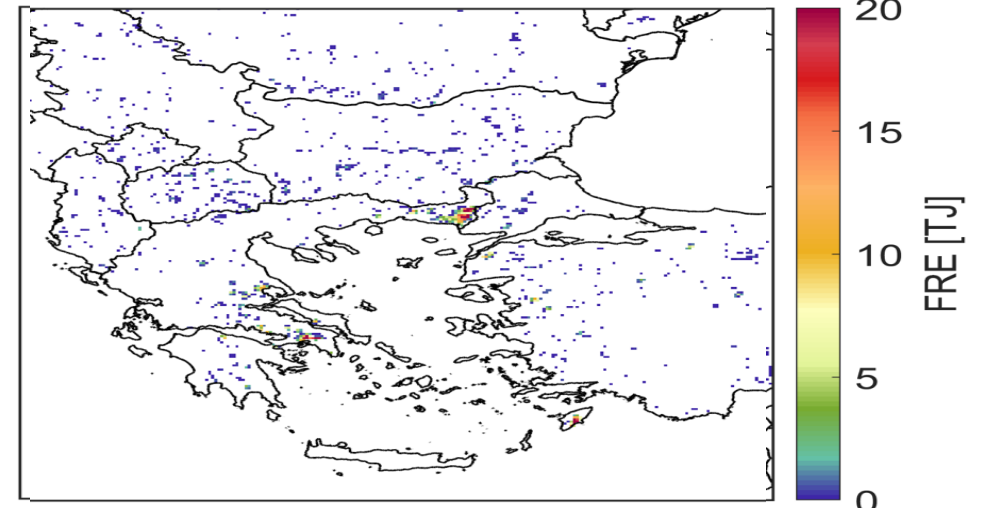
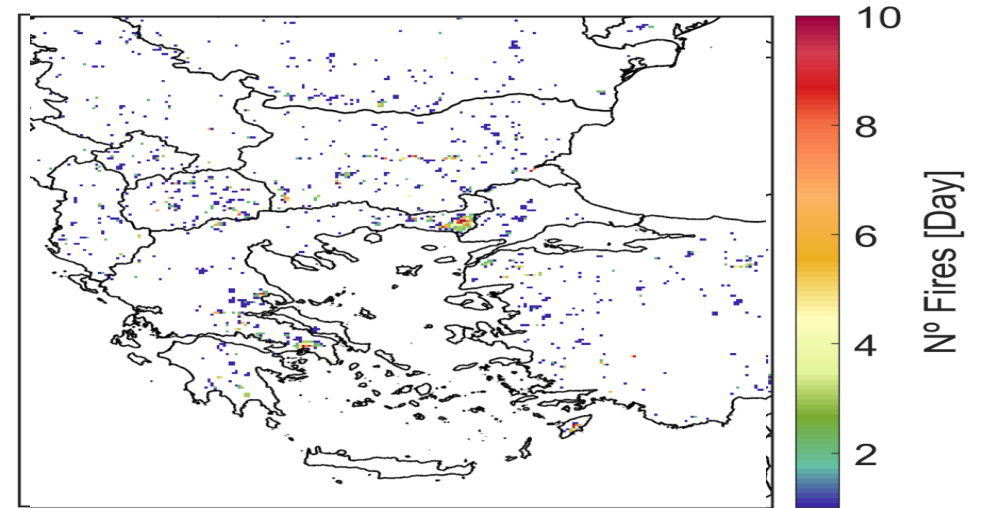
N° Fires 15/06/2023 -



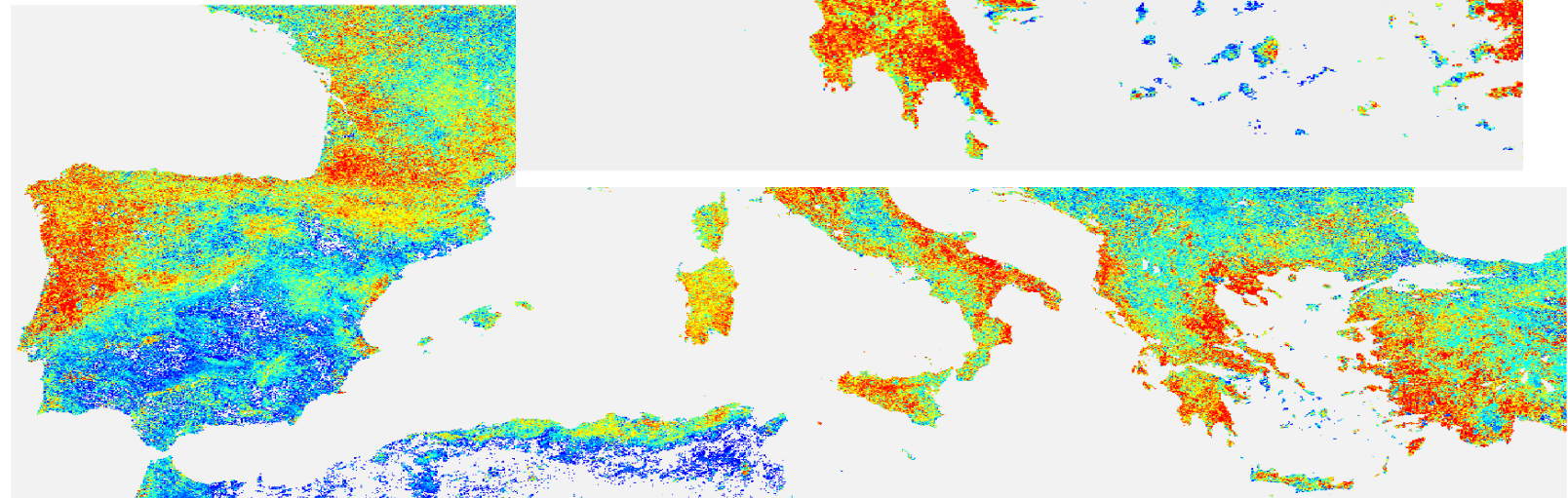
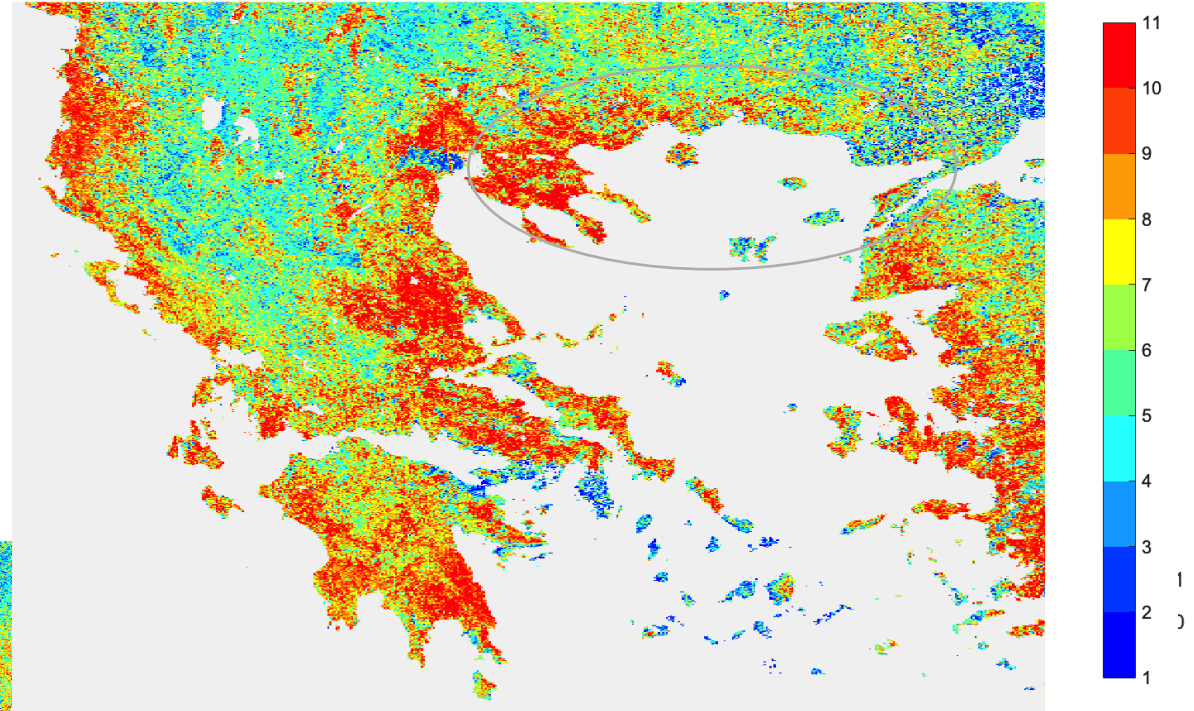
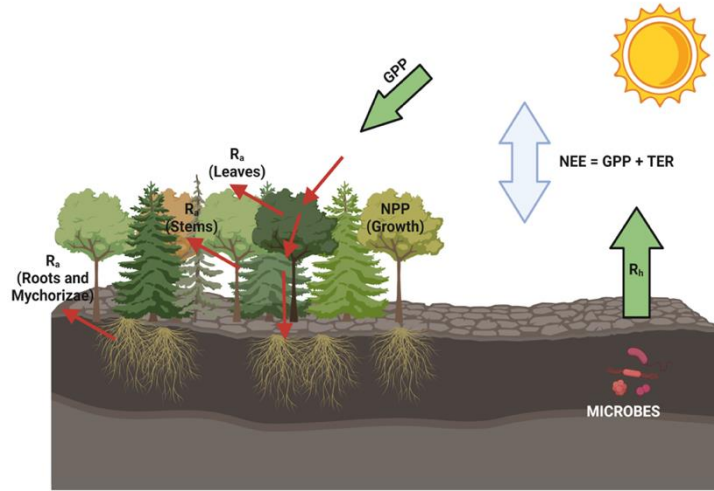
FRE<sub>max</sub> 15/06/2023 -



# Alexandroupoulos Fire 2023



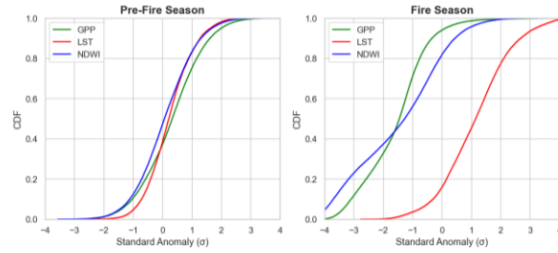
FRP  
SEVIRI -  
MSG



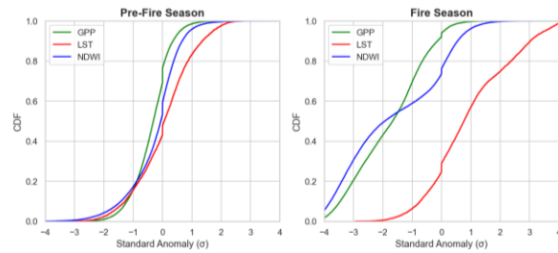
FRP  
SEVIRI –  
MSG

Number of bi-weekly periods with GPP > 0.05 (January to August 16<sup>th</sup>)

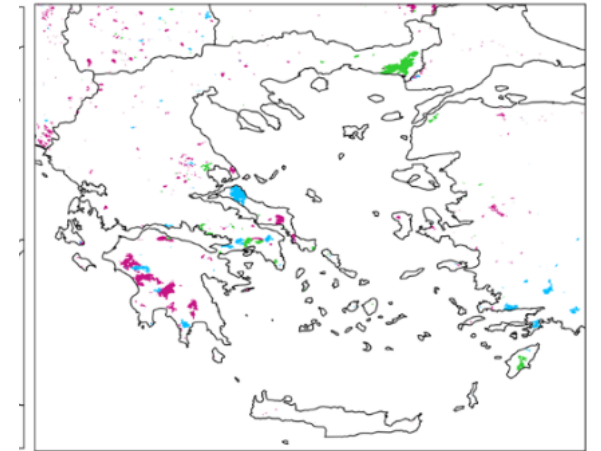
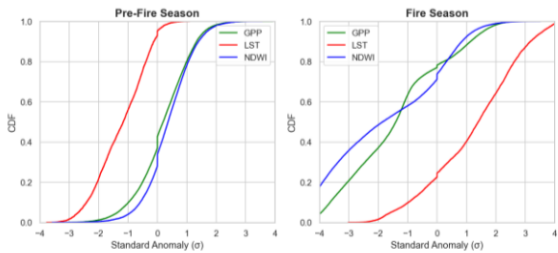
2007



2021



2023



Finuras et al., 2026 (in preparation)

Year	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
<b>2007</b>	-	-	-	-	-	-0,10	-0,15	-0,13	-0,20	-0,17	-0,14	-0,08	<b>-0,98</b>
2008	-0,04	-0,04	-0,06	-0,09	-0,09	-0,18	-0,14	-0,18	-0,19	-0,05	-0,10	-0,05	-1,20
2009	-0,04	-0,06	-0,06	-0,02	-0,02	-0,08	-0,08	-0,03	-0,04	-0,03	0,02	0,00	-0,43
<b>2021</b>	-	-	-	-	-	-0,03	-0,05	-0,10	-0,12	-0,08	-0,08	-0,04	<b>-0,50</b>
2022	-0,05	-0,06	-0,11	-0,06	-0,11	-0,10	-0,06	-0,03	-0,05	-0,03	-0,05	-0,01	-0,71
2023	0,00	-0,03	-0,02	-0,01	-0,04	0,03	-0,05	0,00	-0,03	0,00	-0,01	0,01	-0,15
<b>2023</b>	-	-	-	-	-	0,04	-0,05	-0,06	-0,11	-0,06	-0,06	-0,02	<b>-0,33</b>
2024	-0,02	-0,02	-0,01	-0,02	-0,10	-0,15	-0,11	-0,08	-0,07	-0,04	-0,05	-0,03	-0,69