EUMETSAT update including Satellite Application Facilities

Frank Kaspar
Head of Climate and Data Analytics (incoming)
EUMETSAT

CCI colocation & CMUG integration meeting 2026

24 - 26 March 2026, ESA ECSAT, Harwell, UK

EUMETSAT is an intergovernmental Organisation

www.eumetsat.int

AUSTRIA
BELGIUM
BULGARIA
CROATIA
CZECH REPUBLIC
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ITALY
LATVIA
LITHUANIA
LUXEMBOURG
THE NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

Tasks

- Develop, maintain, exploit European systems of meteorological satellites, taking into account as far as possible the recommendations
- Contribute to operational climate monitoring and the detection of global climatic changes.

Europe's New Generation of Weather Satellites

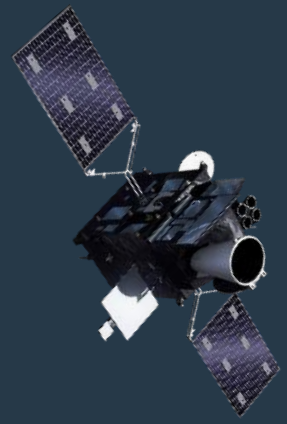
www.eumetsat.int

Meteosat Third Generation

Three satellites in geostationary orbit
EUMETSAT operates a further 10 EO satellites

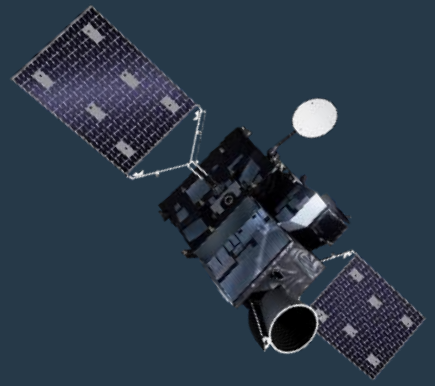
MTG-I1 (Meteosat-12)

- 16-channel spectral imagery at 10min repeat rate, 0.5-2km spatial sampling at nadir
- Lightning imagery, 1ms repeat rate, 4.5km spatial sampling
- Europe, Africa, Middle East
- Operational since 12/2024



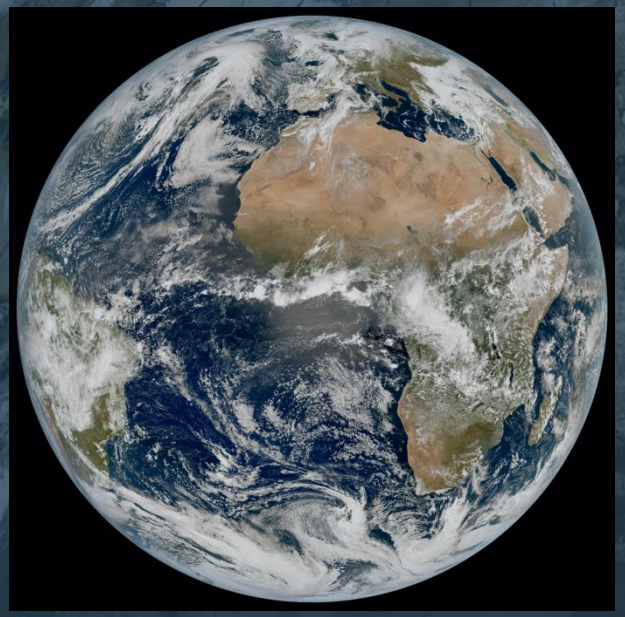
MTG-I2

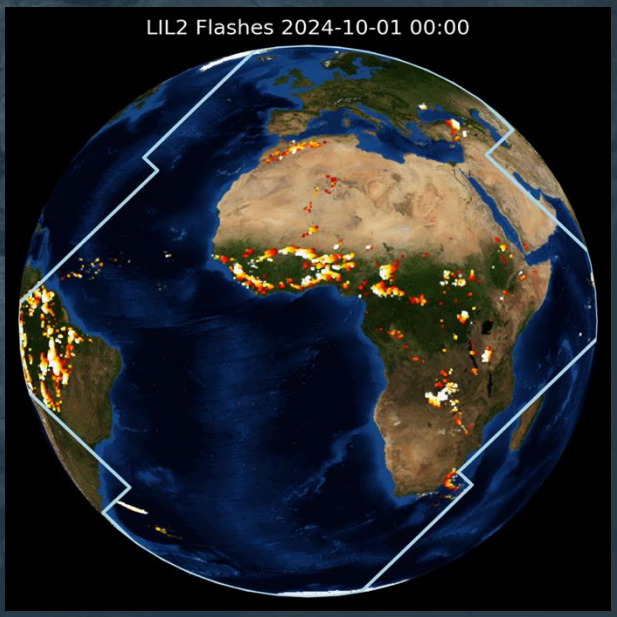
- 16-channel spectral imagery at 2.5min repeat rate
- Europe
- Launch 2026



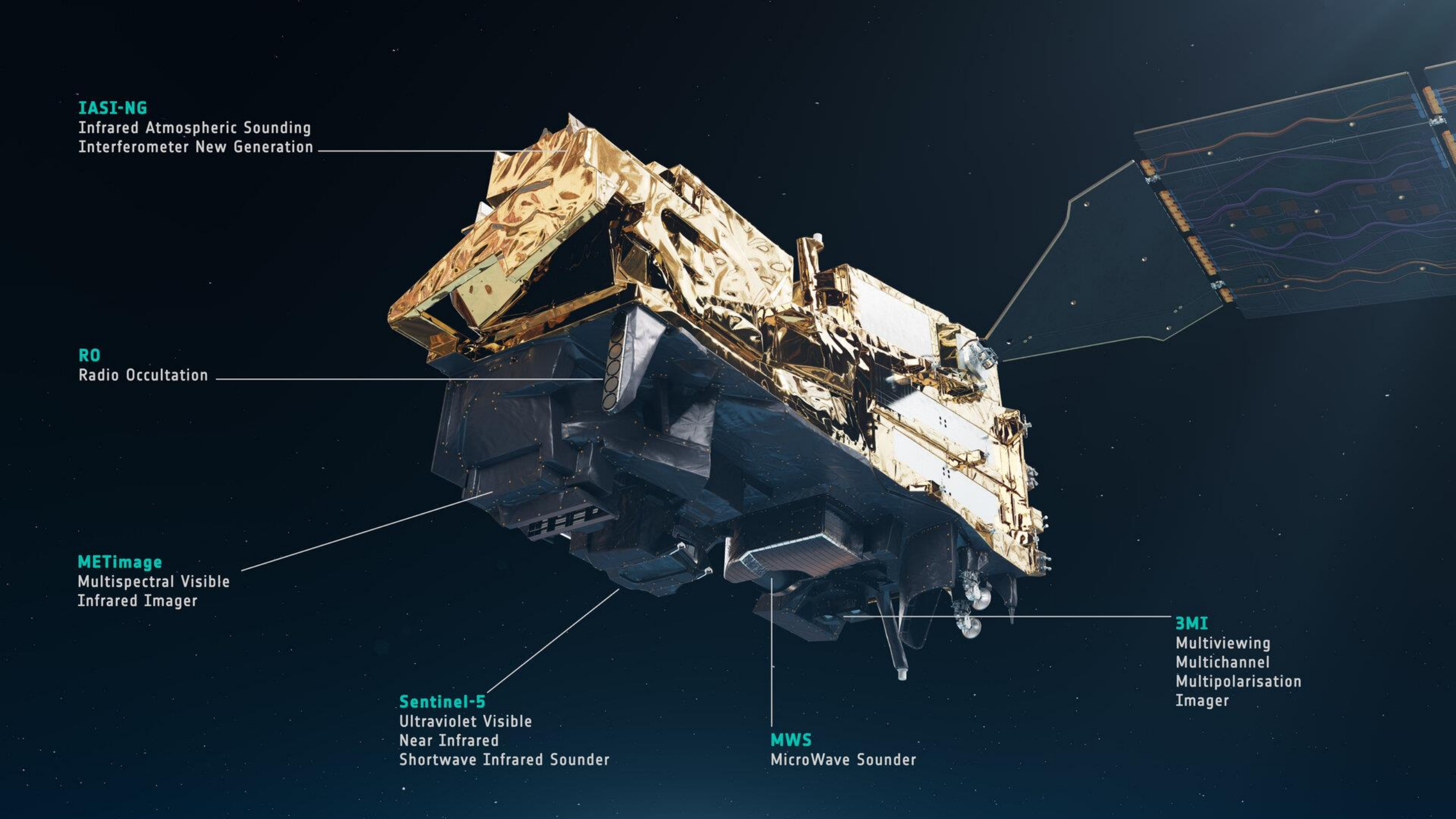
MTG-S1

- Hyperspectral InfraRed Sounder, repeat rate 30min over Europe
- Copernicus Sentinel-4/UVN spectrometry for air quality monitoring
- In space since 1 July 2025, commissioning



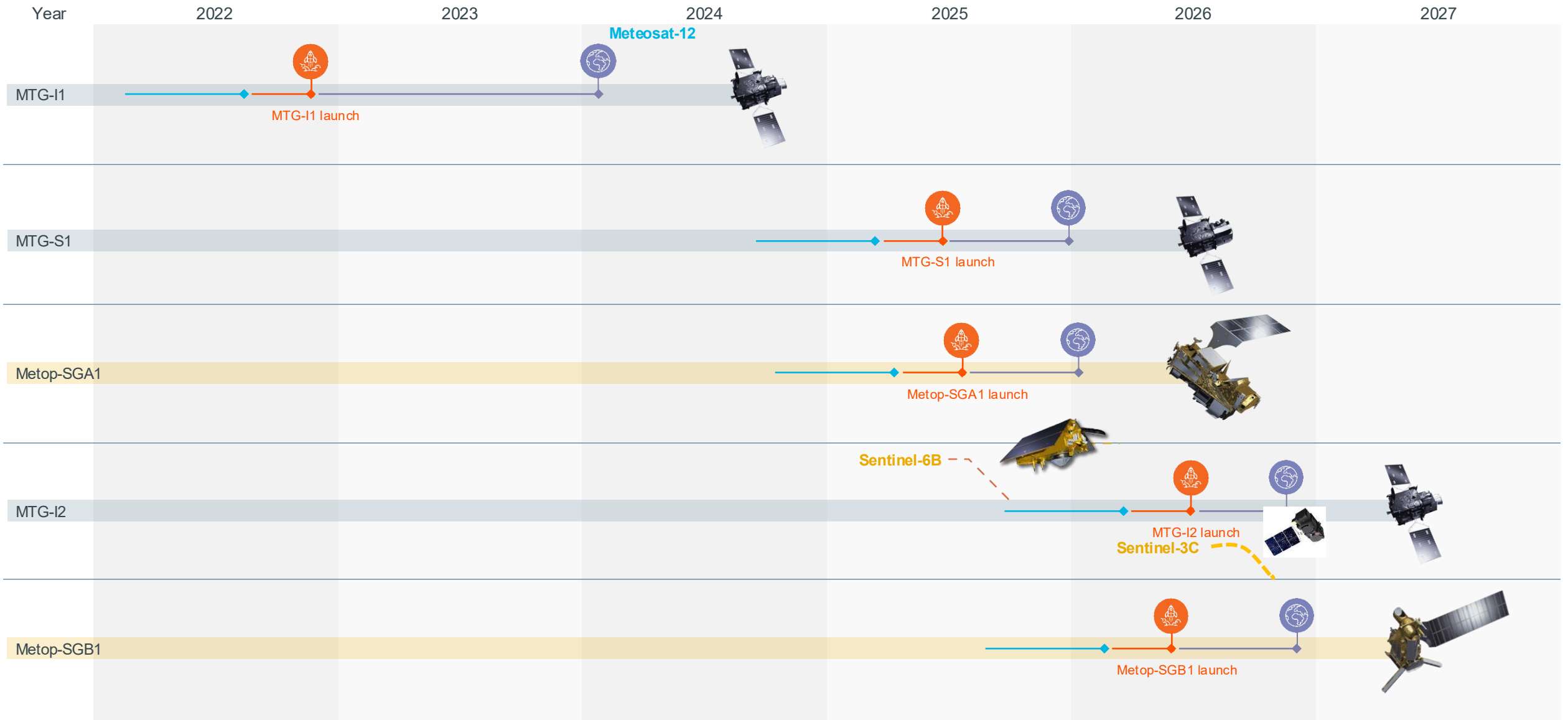


Metop SG-A launch 13 August 2025


IASI-NG
Infrared Atmospheric Sounding
Interferometer New Generation
RO
Radio Occultation
METimage
Multispectral Visible
Infrared Imager
Sentinel-5
Ultraviolet Visible
Near Infrared
Shortwave Infrared Sounder
MWS
MicroWave Sounder
3MI
Multiviewing
Multichannel
Multipolarisation
Imager

Launch of next-generation satellites 2022-2027

www.eumetsat.int



Climate Monitoring Architecture – EUMETSAT View

Satellite Observations

Climate Data Products

Climate Applications

Policy/Decision Making

EUMETSAT

EUMETSAT SAF
SATELLITE APPLICATION FACILITY NETWORK

CO2M

Research

WCRP World Climate Research Programme

International Science Council

IAMC

Climate Change

Atmosphere Monitoring Service
atmosphere.copernicus.eu

Copernicus Marine Service

Emergency Management

Assessment
ipcc
INTERGOVERNMENTAL PANEL ON climate change

CLIMATE

Policy

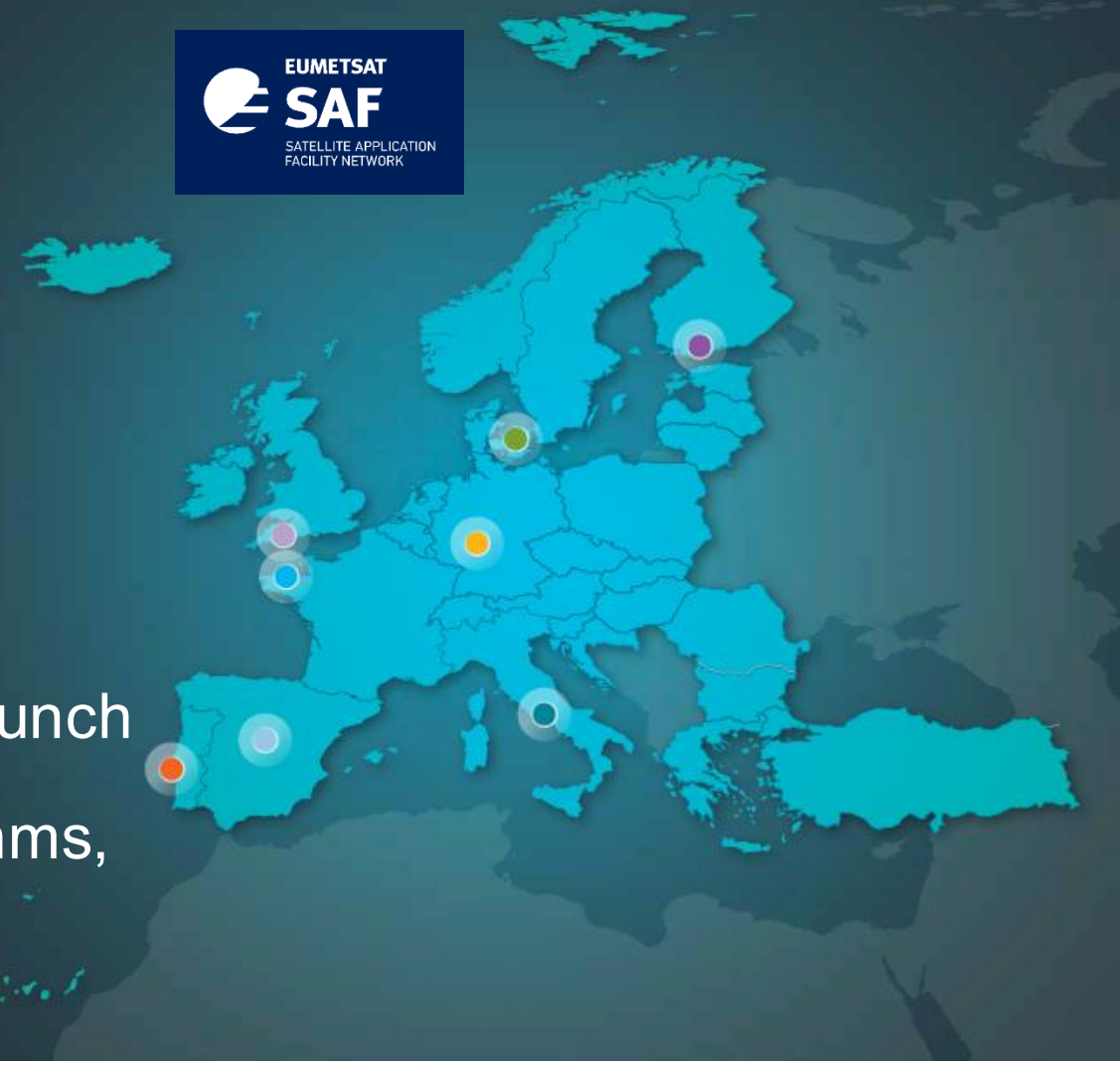
United Nations Framework Convention on Climate Change

PARTIES

SBSTA / SBI
COP/ CMA/ CMP

The EUMETSAT Network of Satellite Application Facilities

- SAF = **Satellite Application Facility**
- Distributed part of the EUMETSAT application ground segment
- **Operational products** and services to users
- Committed **continuity** for:
  - data provision, improvements
  - quality monitoring and user services
- Validation and review before official release/launch
- Complete Documentation of Products, Algorithms, Validation Results



EUMETSAT's network of Satellite Application Facilities

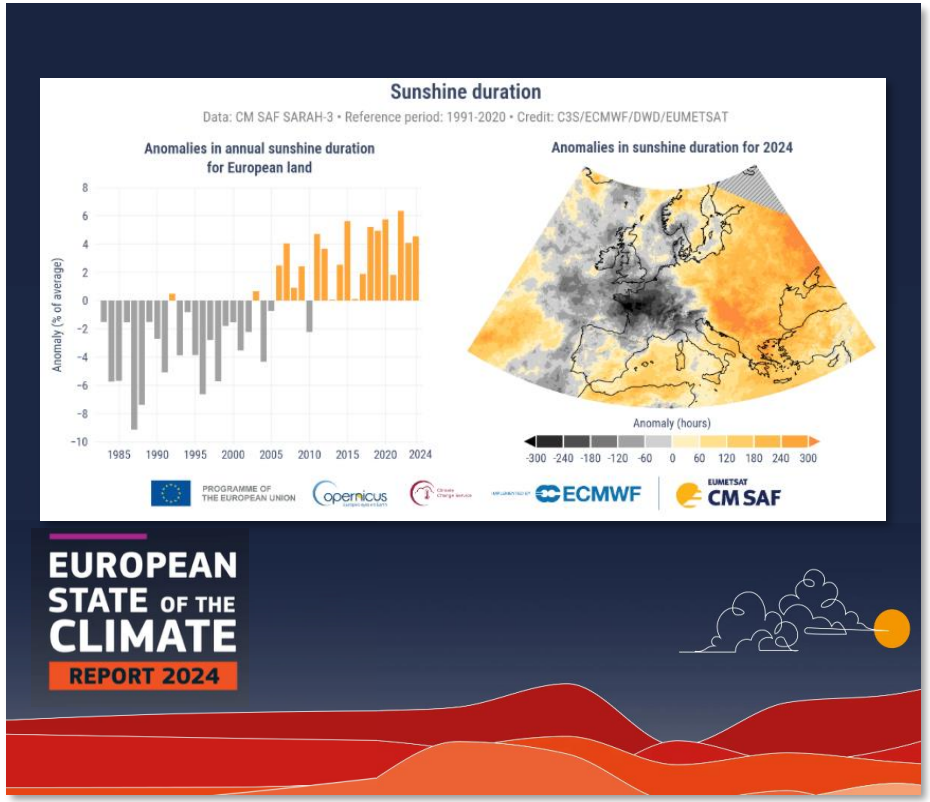
www.eumetsat.int

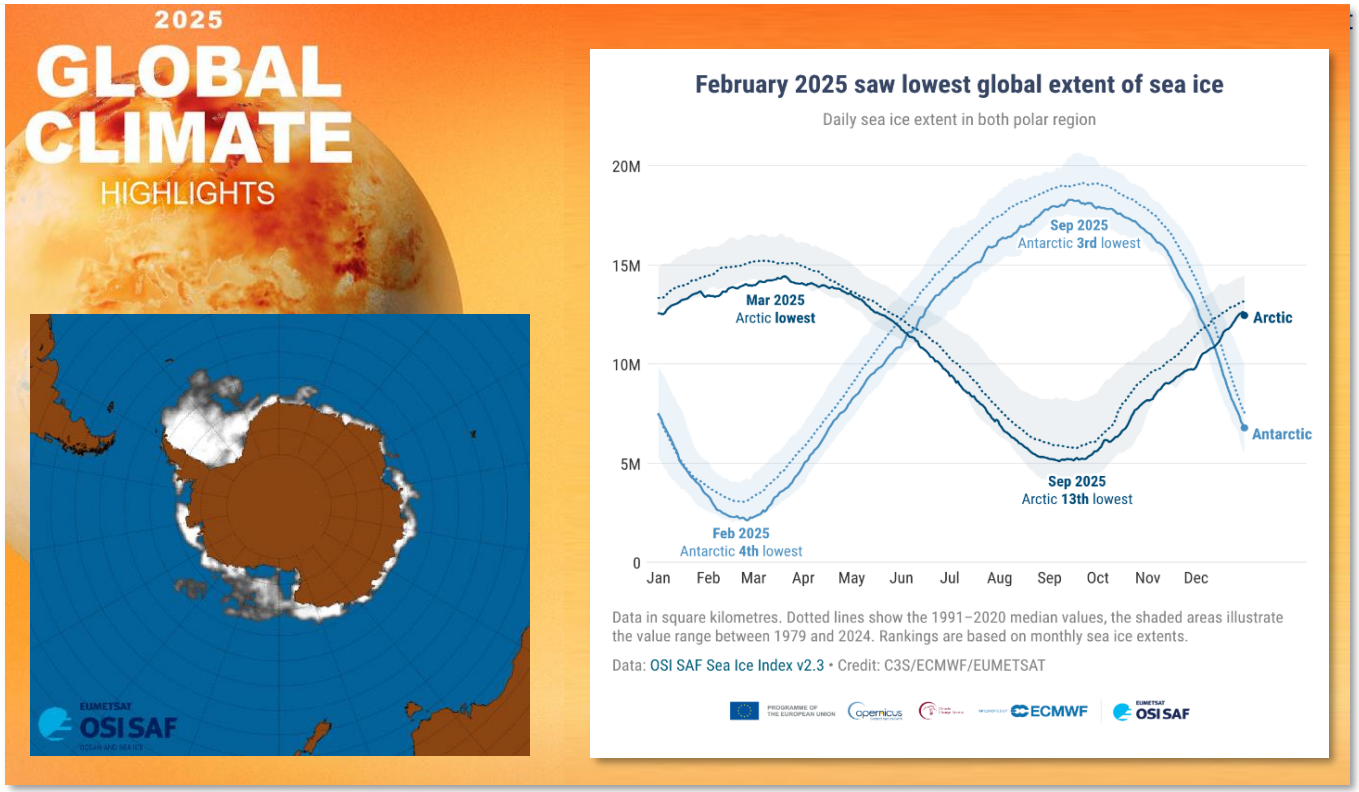
EUMETSAT's Satellite Application Facilities (SAFs) are dedicated centres of excellence for processing satellite data, making use of specialist expertise in our member states. They form an integrated part of the distributed EUMETSAT ground segment.

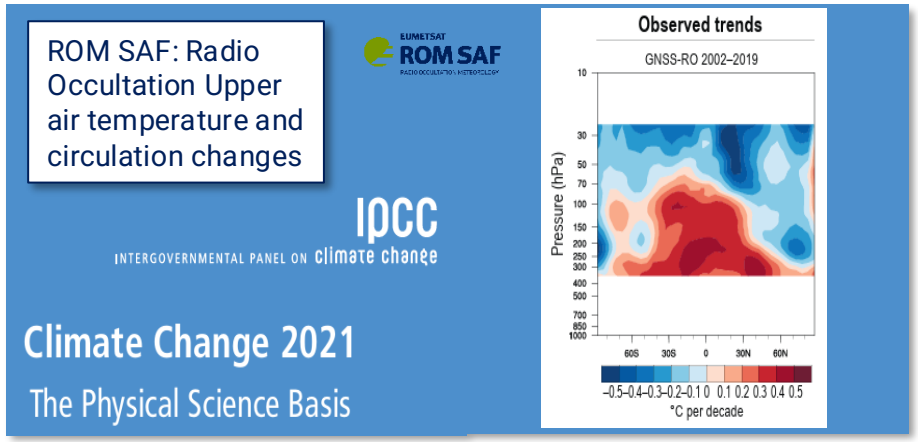
The eight EUMETSAT SAFs provide operational data and software products, each one for a dedicated user community and application area.

EUMETSAT SAF
SATELLITE APPLICATION FACILITY NETWORK

SAF climate data records in action: Selected examples

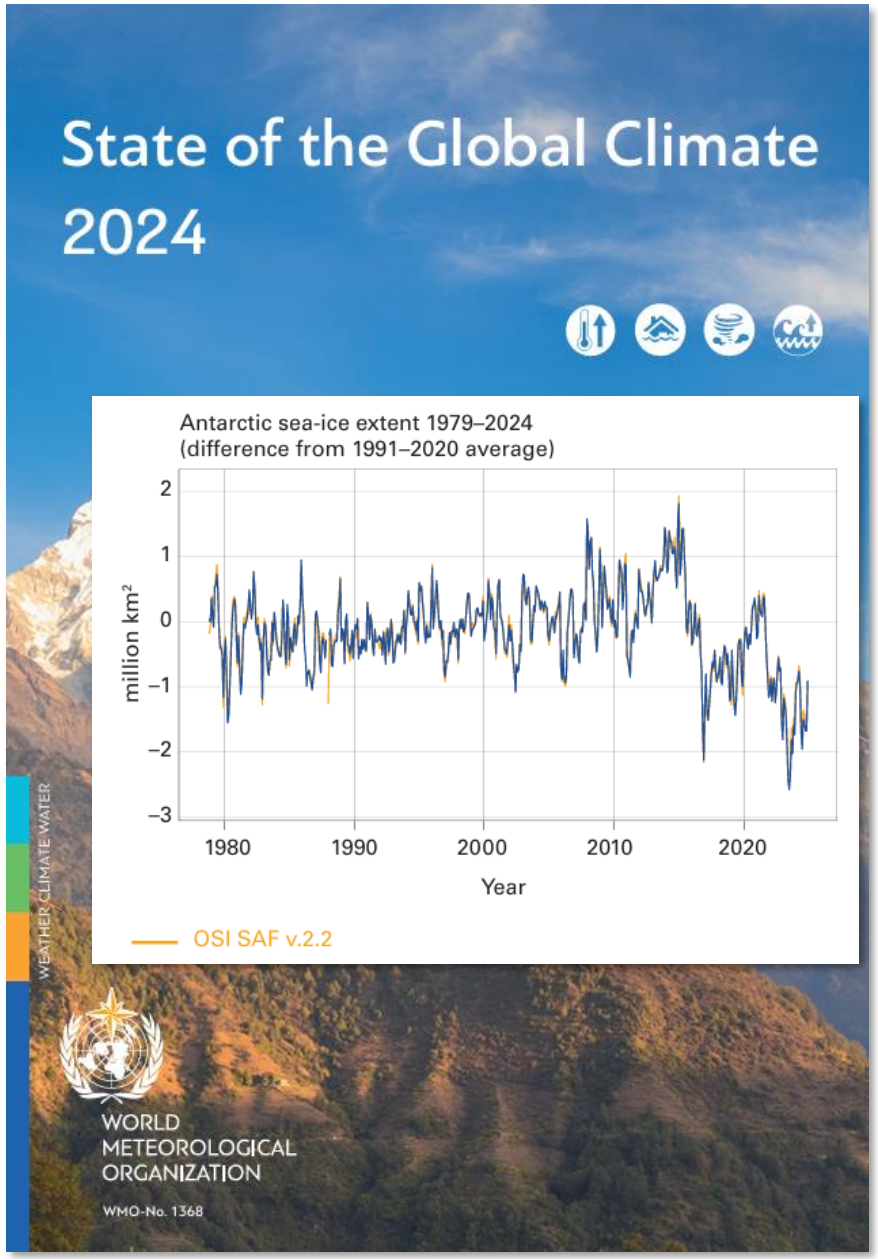


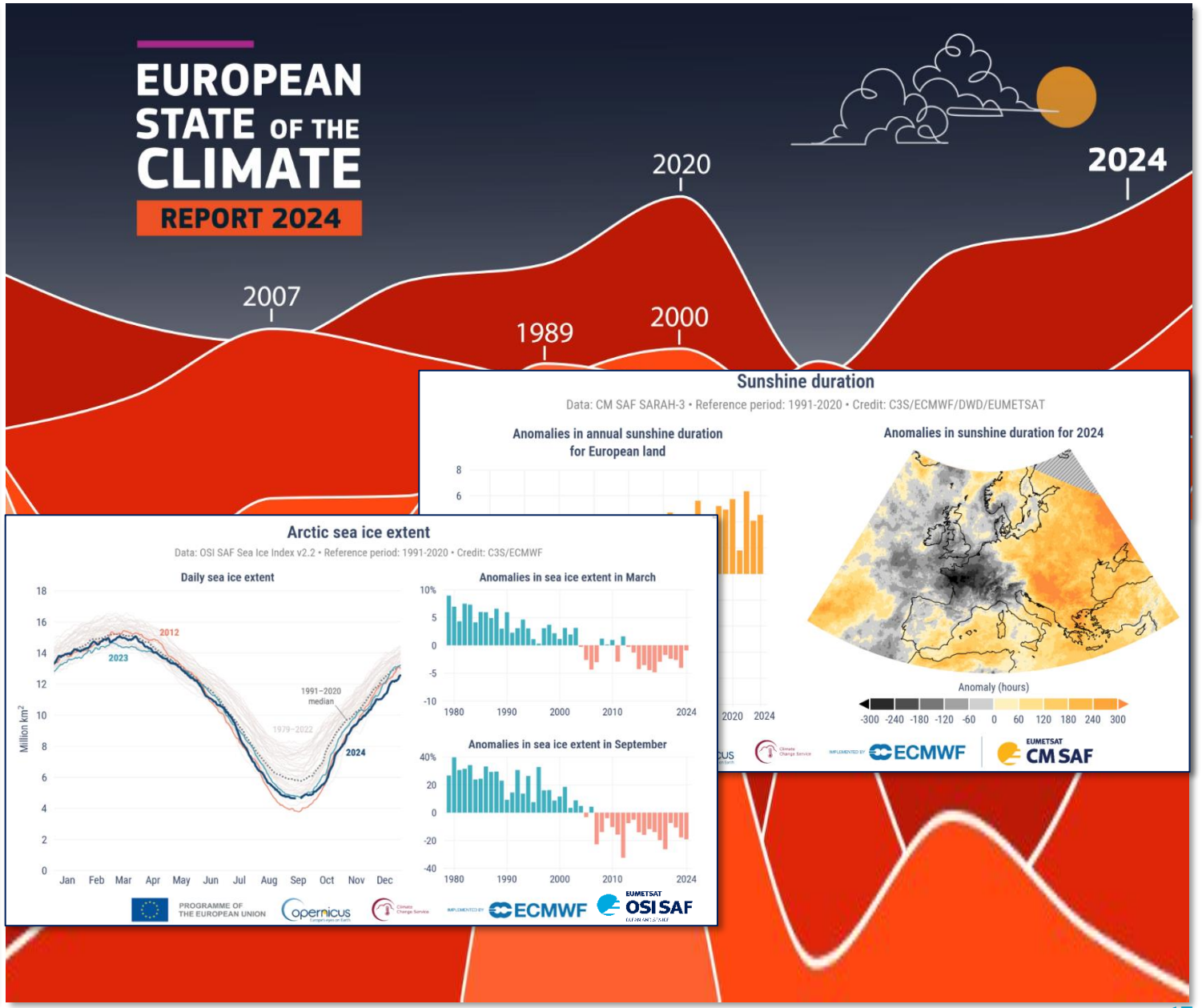




Zonnestraling in Nederland in 2025 en het verschil met het langjarig gemiddelde (1991-2020), op basis van Meteosat-satellietmetingen (databron: CM SAF / SARAH-3).

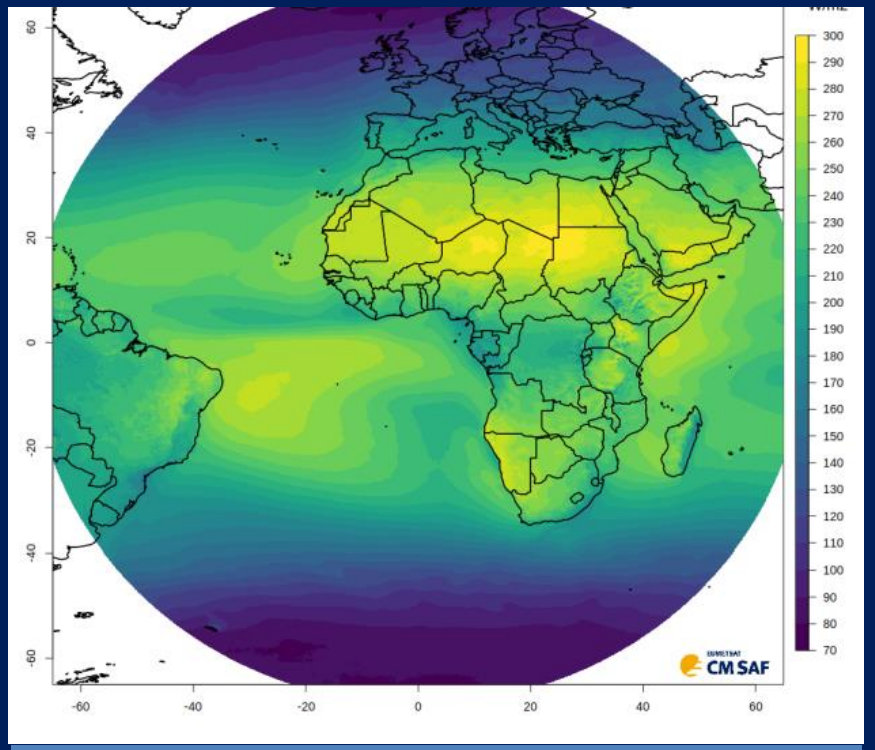
SAF products in Climate Reports





CM SAF: SARAH-3 Surface Radiation Data Record

- Climatology of essential surface solar radiation characteristics
- Based on observations from Meteosat satellites
- Data record covering years since 1983 - 2020
- Operational extension (ICDR) until last completed month with 5 day latency
- DOI: 10.5676/EUM_SAF_CM/SARAH/V003
- Available via http://cm-saf.eumetsat.int
- Released 5 May 2023



Climatology of Surface Irradiance: 30 year mean value of 1991-2020 as per CM SAF SARAH-3 data record

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

GIRAFE v1 – CM SAF‘s first dedicated precipitation CDR

EUMETSAT CM SAF

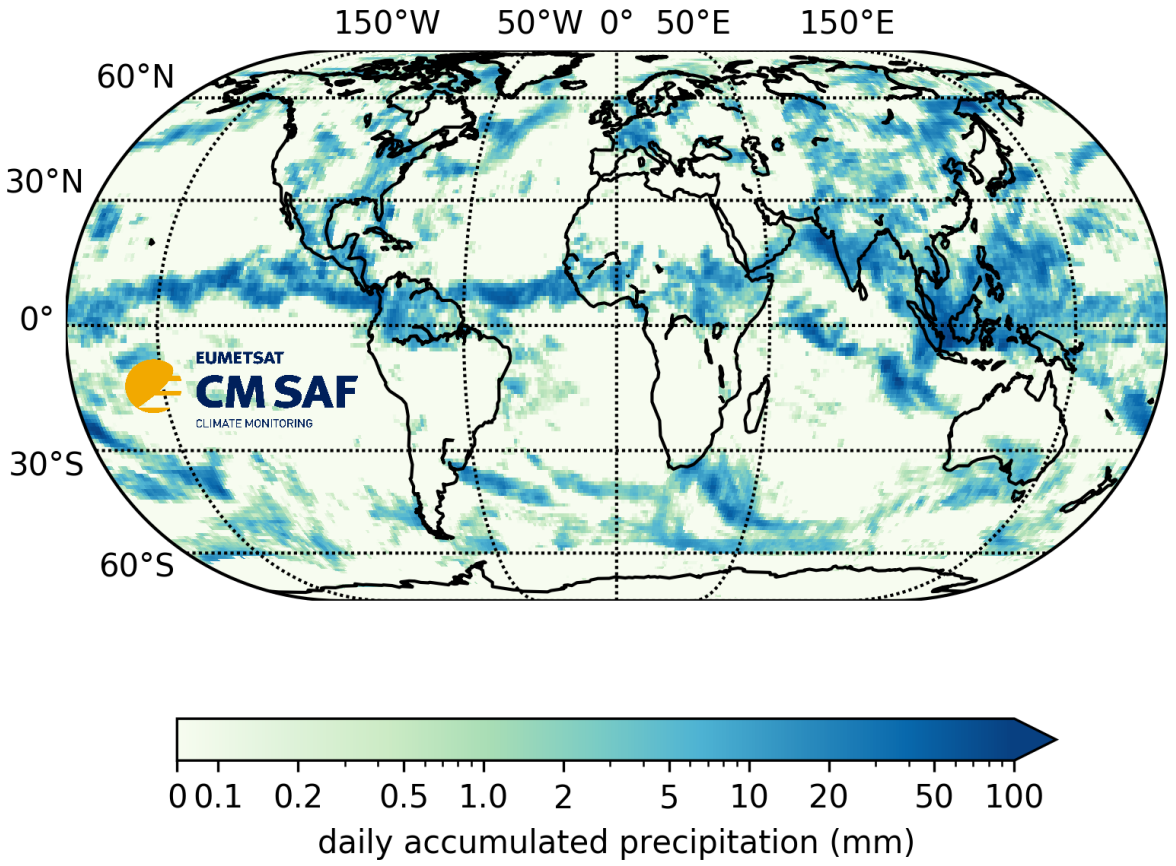
www.cmsaf.eu

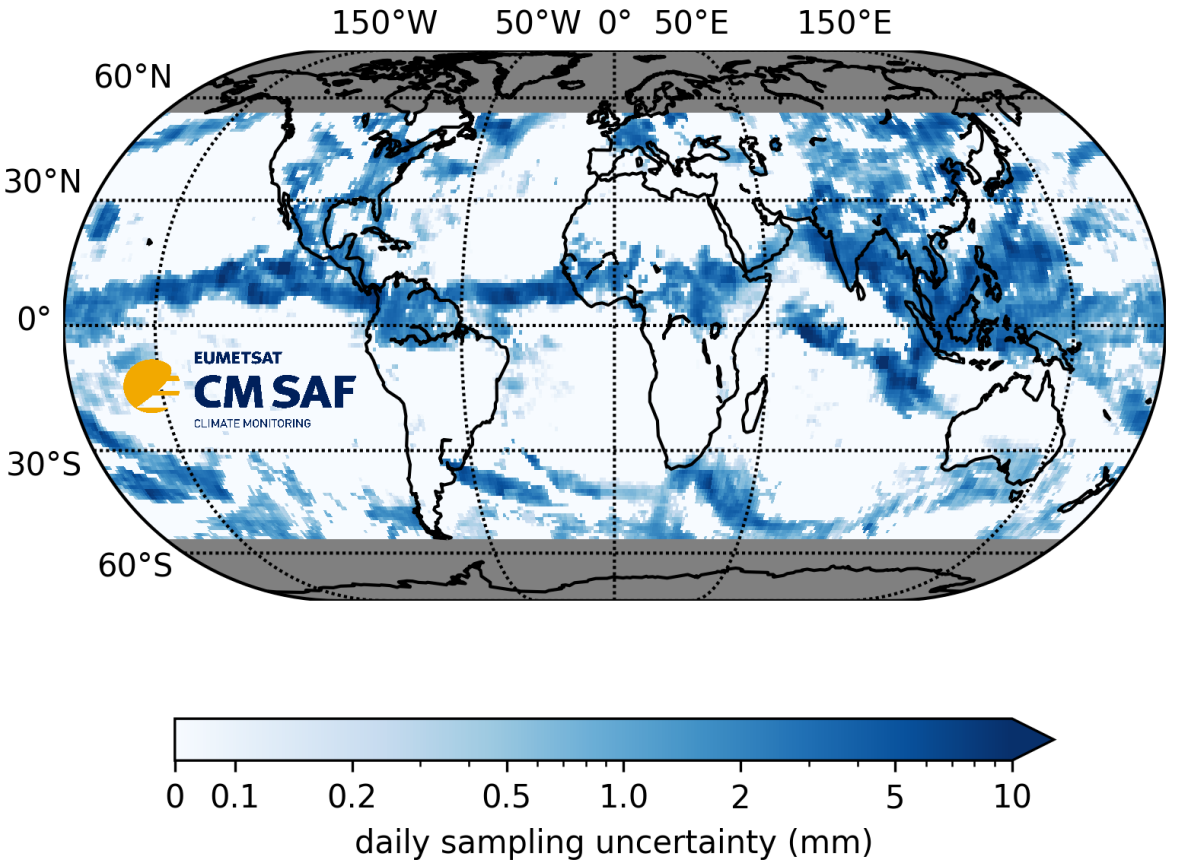
- Currently covering precipitation globally 2002-2022 at 1° daily and monthly resolution
- Continuous extension (a.k.a. ICDR) coming up in April/May 2026 (latency: 3 months to ~10 days)
- Based on merging microwave observations (low-earth orbiters) and infrared observations (geostationary) up to 55°N/S
- Plausible, stable, featuring sampling uncertainty
  - Konrad et al., ESSD, 2025
- Gaps are present in the CDR, but there are options for near-complete updates
- Development in progress for a climate normals and anomalies service for GIRAFE

GIRAFE v1 DOI

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

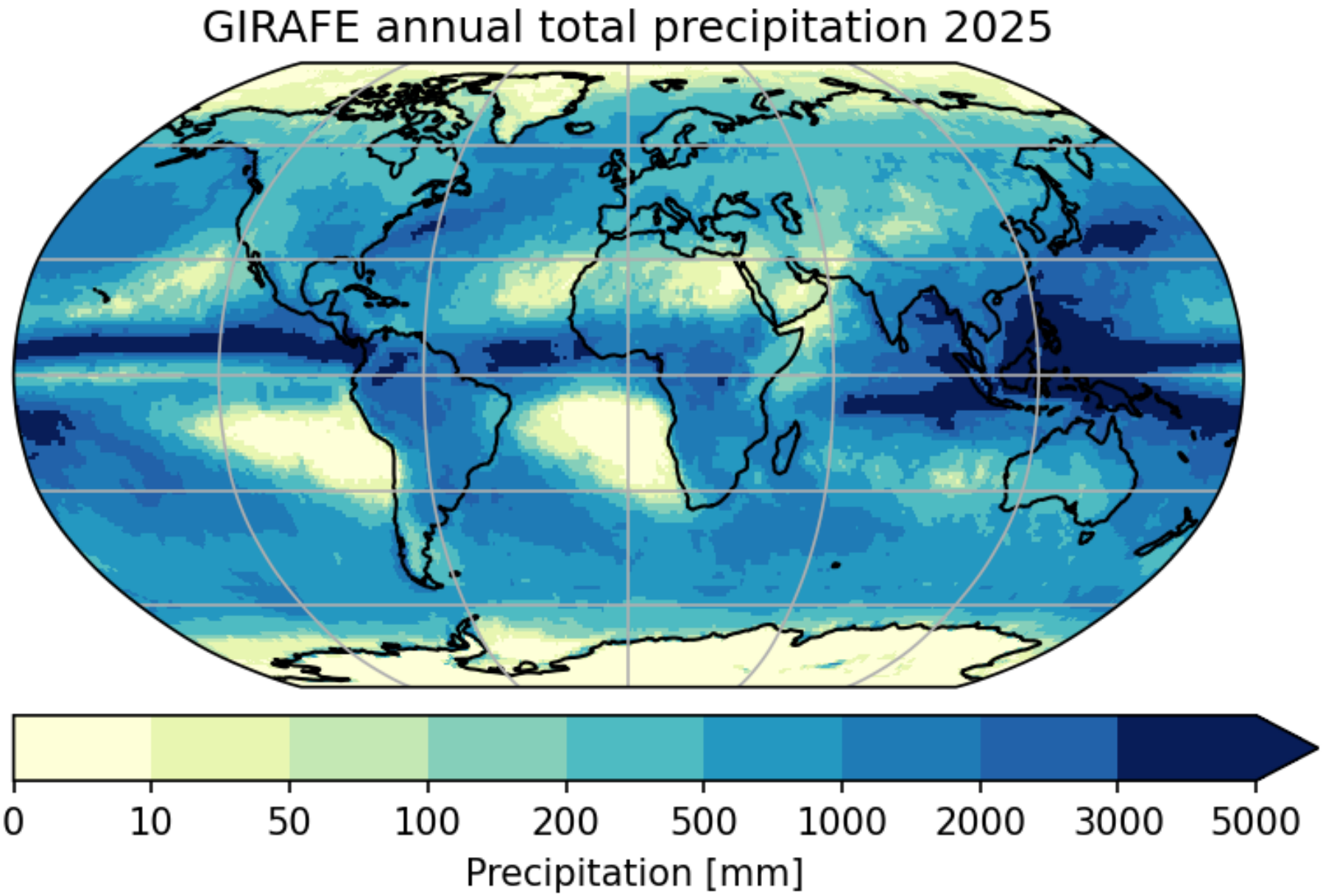
GIRAFE v1 – first dedicated global precipitation data product by CM SAF





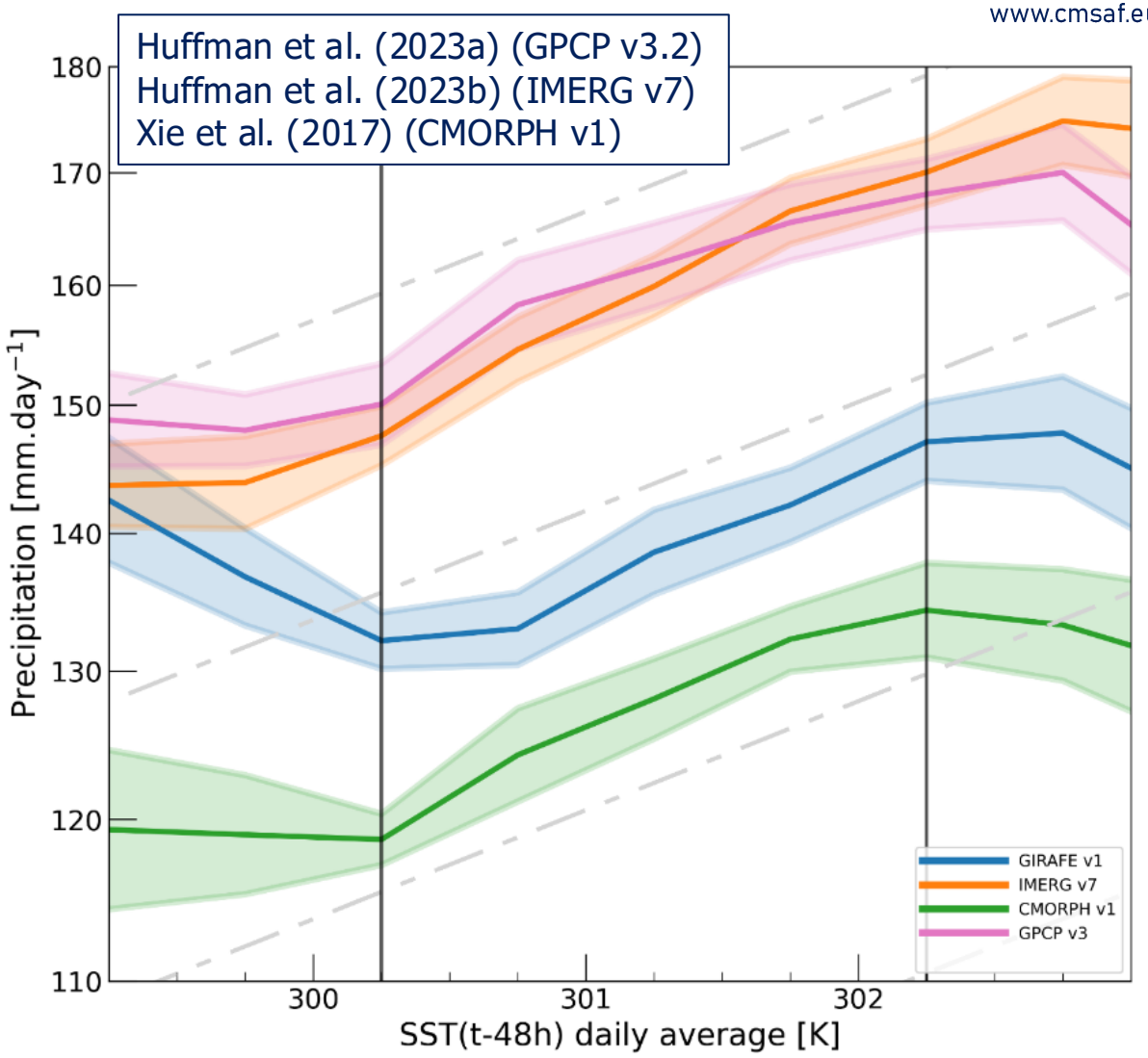
Time period	2002/01 – 2022/12
Temporal resolution	daily accumulated precipitation, monthly means of daily accumulated precipitation
Spatial coverage / resolution	global on a regular latitude/longitude grid / 1.0° x 1.0°
Data access / DOI	https://doi.org/10.5676/EUM_SAF_CM/GIRAFE/V001 .

Annual total precipitation



Scaling of precipitation extremes over ocean

- SST = sea surface temperature
- For ~300 K < SST < ~302 K, precipitation extremes follow the expected behaviour (Clausius Clapeyron):
- Scaling with colocated SST (lag of 48 h) of ~6-7%
- Analysis following De Meyer and Roca (2021)



Konrad et al., ESSDD, 2025

There is much more ….

EUMETSAT CM SAF
CLIMATE MONITORING

- Focus on Earth's Energy Budget & Water Cycle
  - Surface Radiation Components
  - Atmospheric Moisture (Water Vapour)
  - Clouds & Cloud Properties
  - Precipitation
- Long-term climate data records
- www.cm-saf.eumetsat.int

EUMETSAT AC SAF
ATMOSPHERIC COMPOSITION MONITORING

- Focus on atmospheric composition
  - Trace gases
  - Aerosols
  - Radiation
- Some long-term records available
- www.ac-saf.eumetsat.int

EUMETSAT LSA SAF
LAND SURFACE ANALYSIS

- Focus on Radiation, Vegetation, Energy – Water – Carbon Exchanges
  - Albedo
  - Land Surface Termperature & Emissivity
  - Surface Radiation
  - Vegetation
  - Evapotranspiration & Turbulent Fluxes
  - Wildfires
- Some long-term records available
- www.lsa-saf.eumetsat.int

EUMETSAT OSI SAF
OCEAN AND SEA ICE

- Ocean observations
  - Sea Ice
  - Sea Surface Temperature
  - Wind over ocean
- Some long-term records available (Sea ice, SST)
- www.osi-saf.eumetsat.int

EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

- Focus on operational hydrology and water management
  - Soil Moisture
  - Snow
  - Precipitation
- Soil moisture data records available
- www.h-saf.eumetsat.int

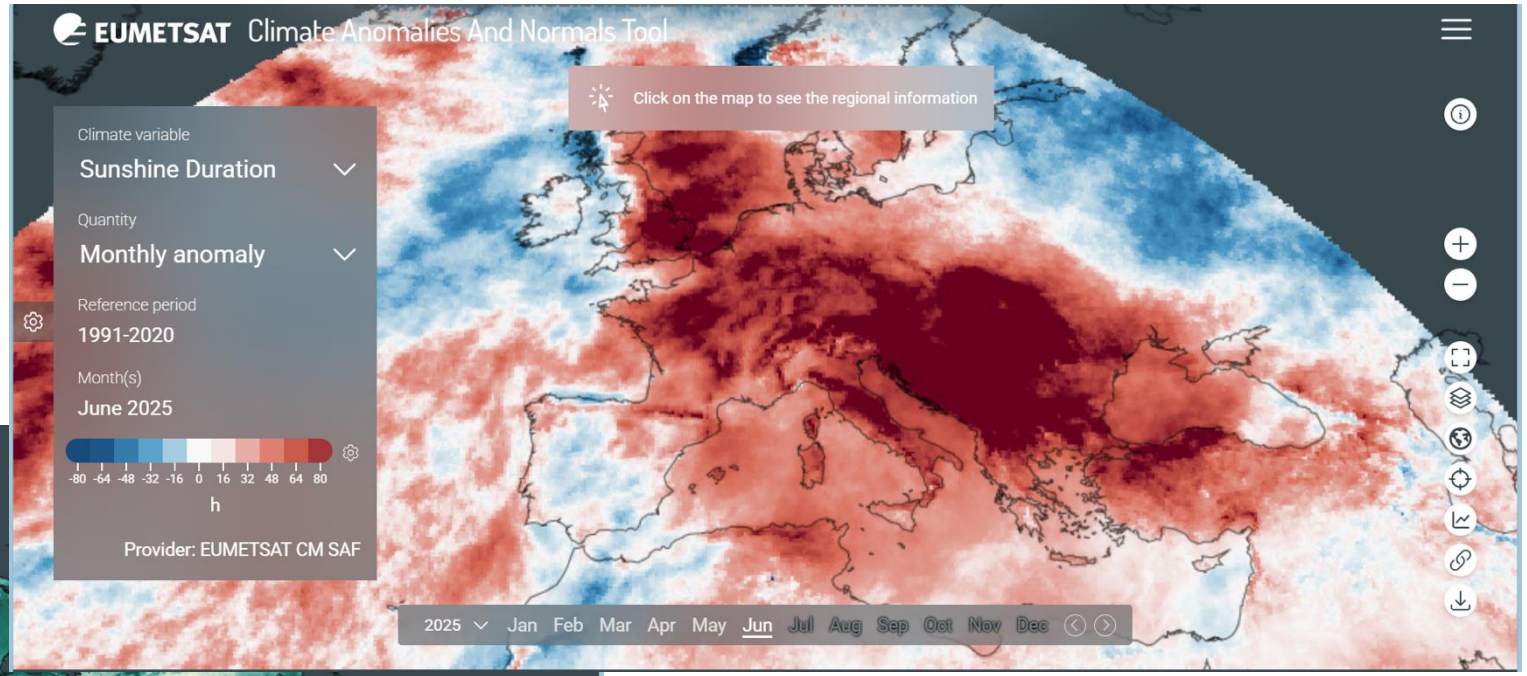
EUMETSAT ROM SAF
RADIO OCCULTATION METEOROLOGY

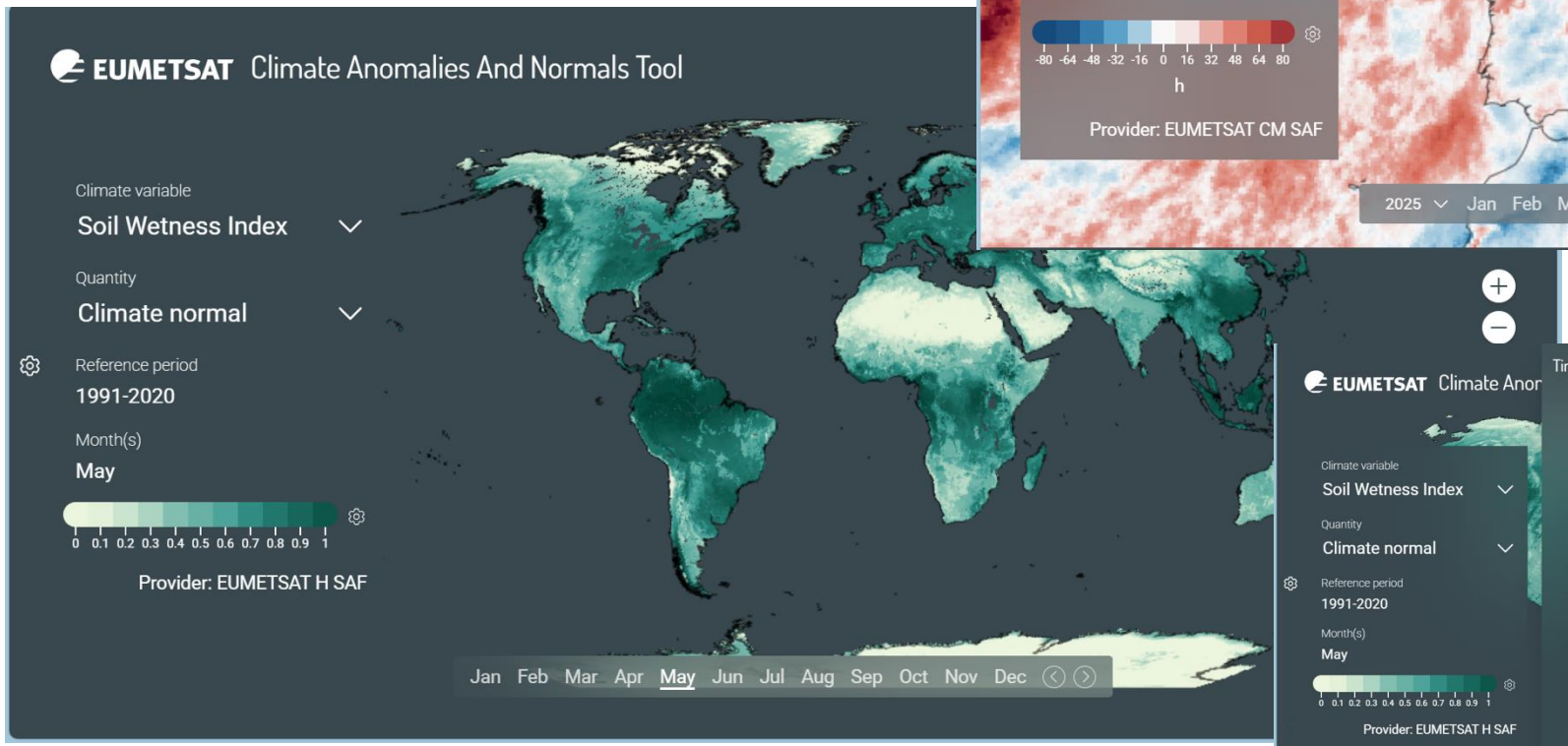
- Profiles of stratosphere & troposphere
  - Temperature
  - Pressure
  - Humidity
  - Bending angles & refractivity
- Long-term Climate Data Records available
- www.rom-saf.eumetsat.int

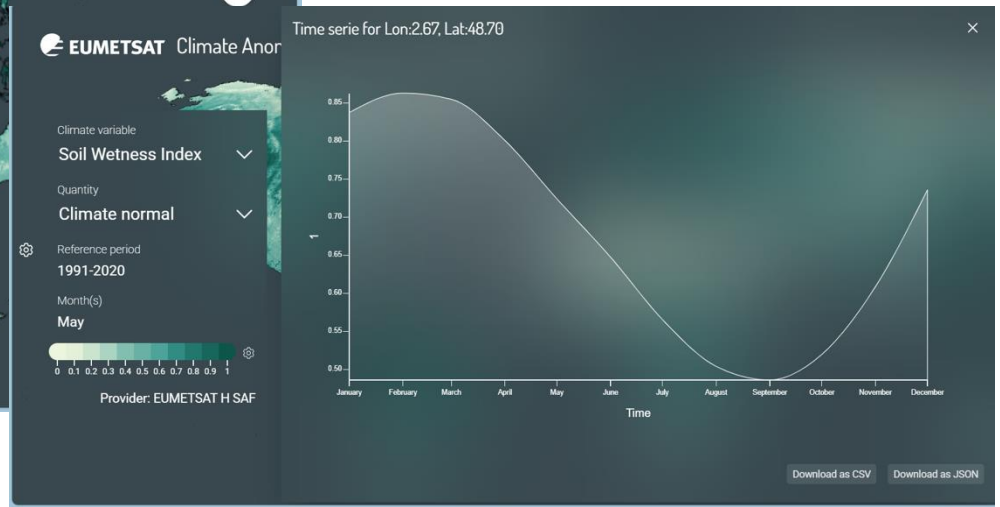
EUMETSAT Climate Anomalies Service

www.eumetsat.int

- Provides anomalies with a monthly latency based on coupled CDR&ICDR
- First release planned for 2026

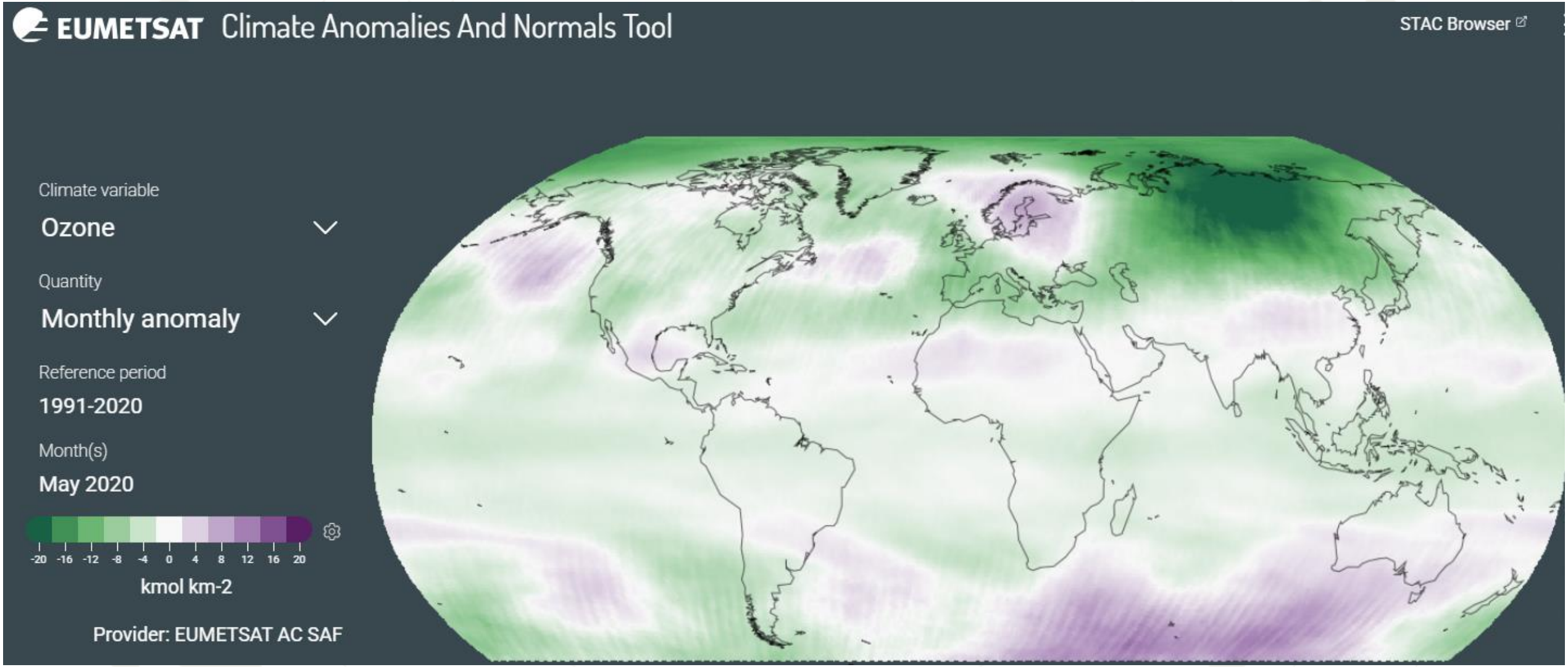






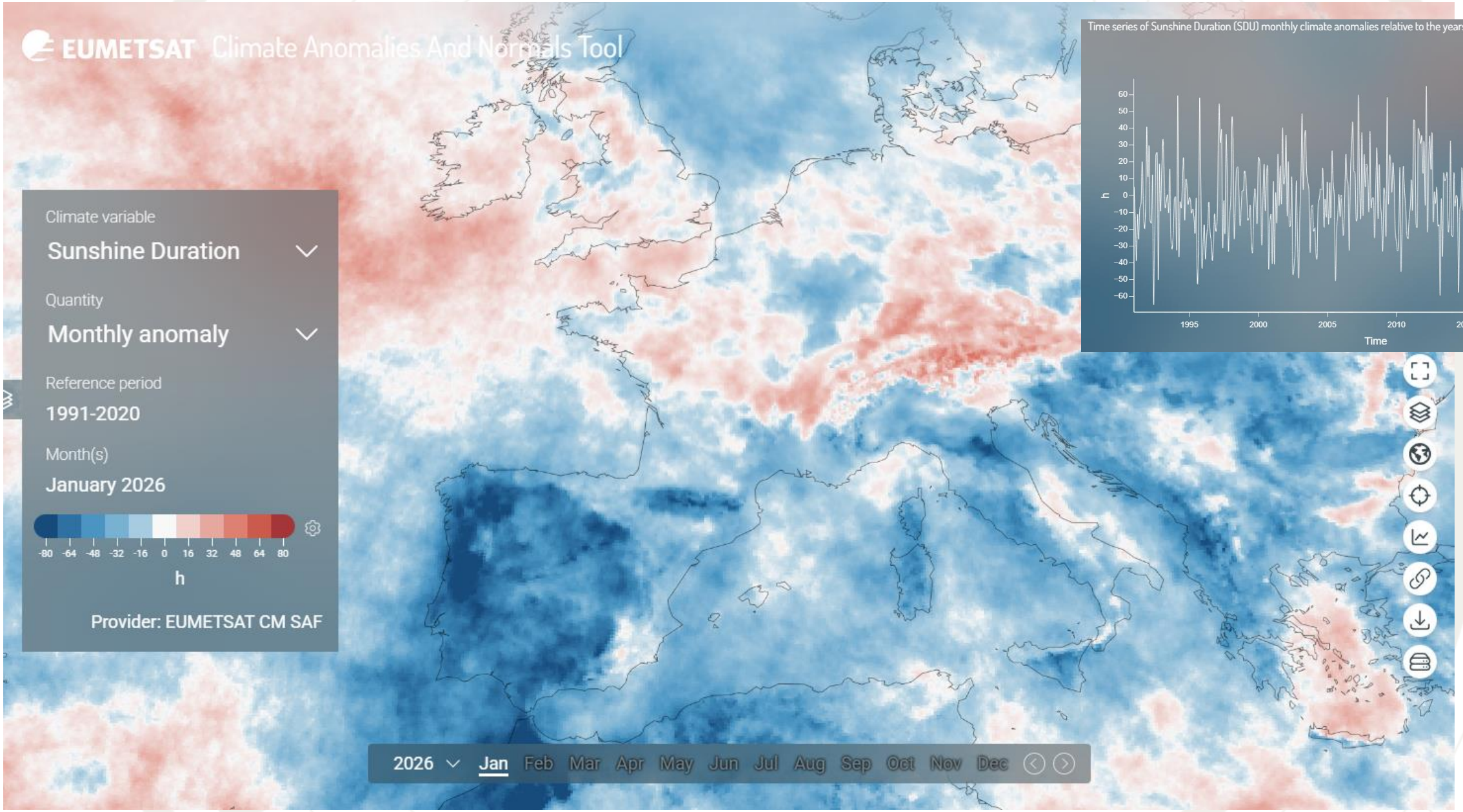
Climate Anomalies: Ozone

www.eumetsat.int

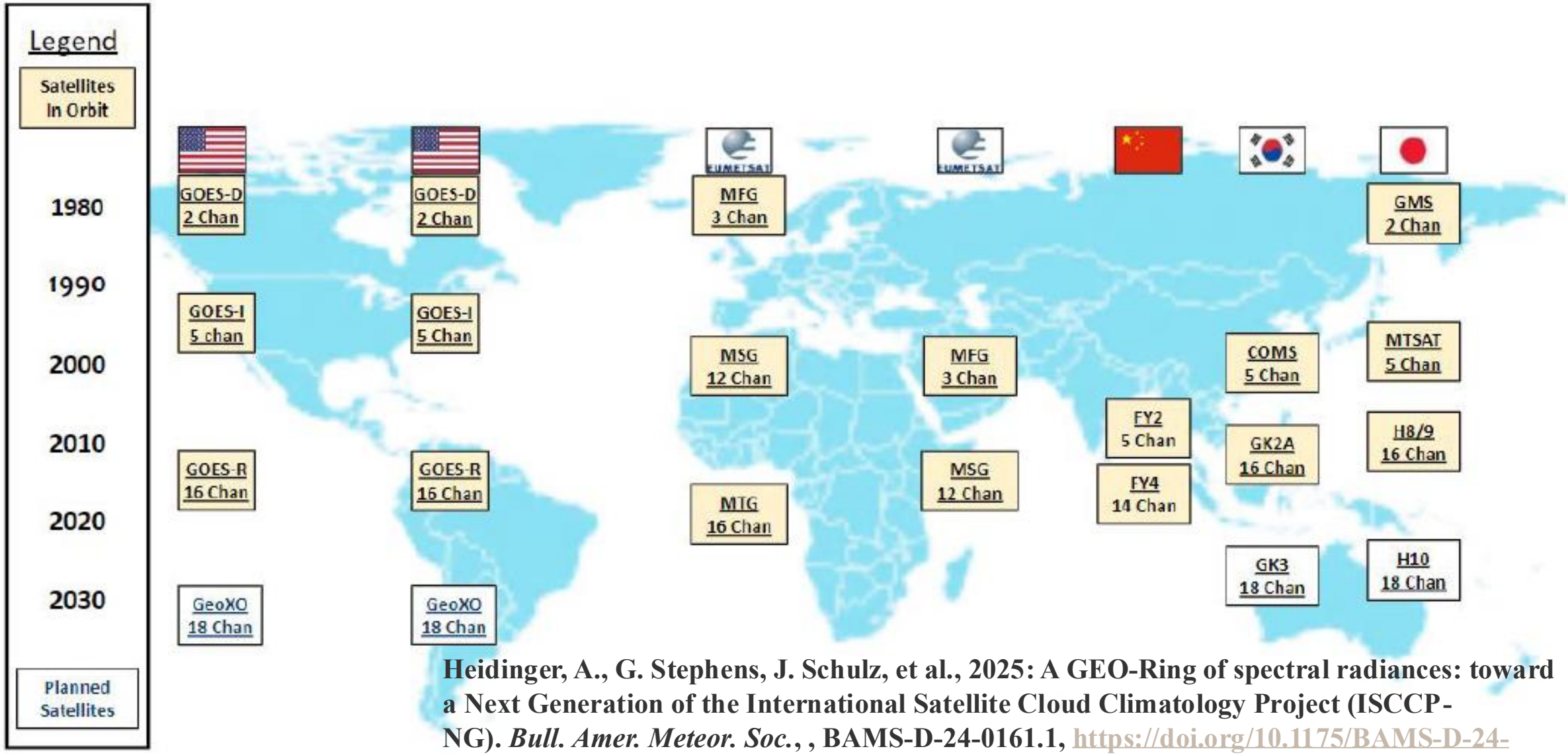


Climate Anomalies: Sunshine duration

www.eumetsat.int



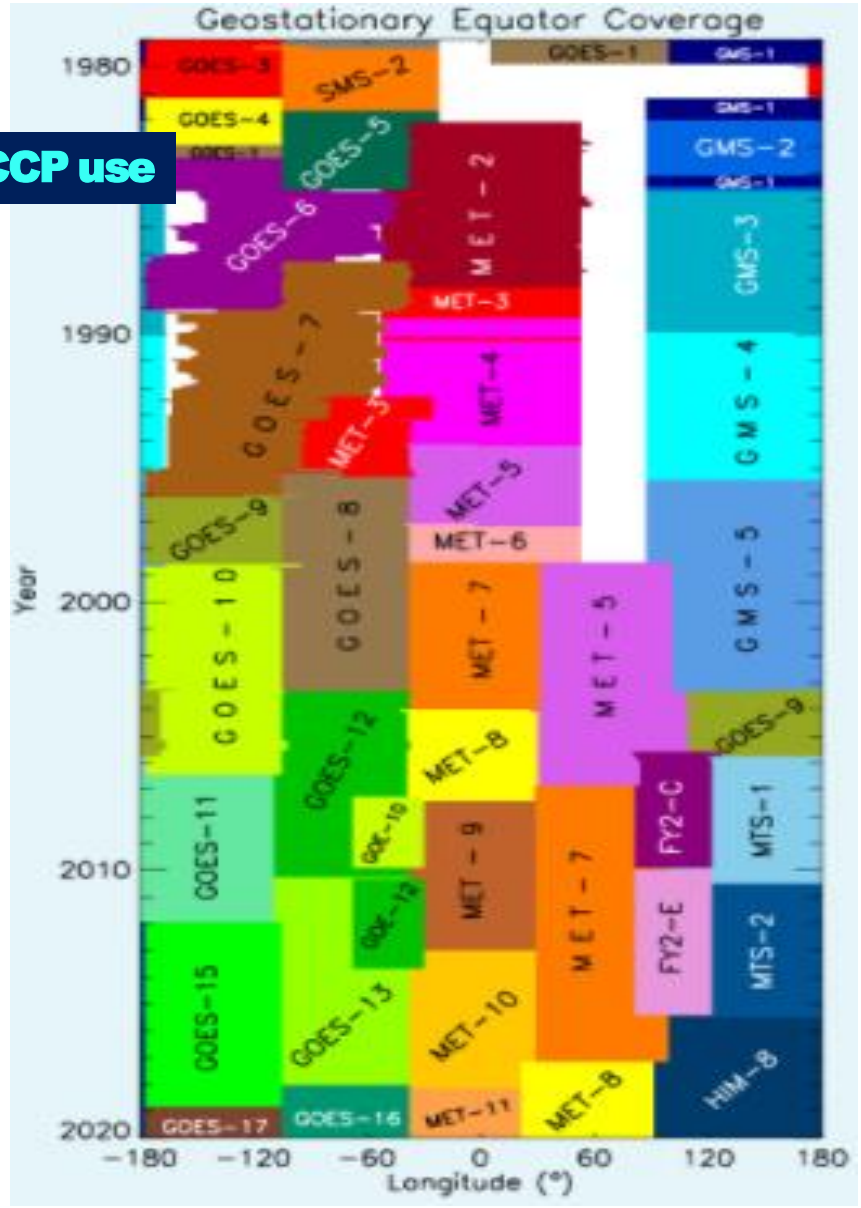
Evolution of the Imager GEO-Ring



Heidinger, A., G. Stephens, J. Schulz, et al., 2025: A GEO-Ring of spectral radiances: toward a Next Generation of the International Satellite Cloud Climatology Project (ISCCP-NG). *Bull. Amer. Meteor. Soc.*, , BAMS-D-24-0161.1, https://doi.org/10.1175/BAMS-D-24-0161.1, in press.

Enhance Value of Historic Observations

ISCCP use

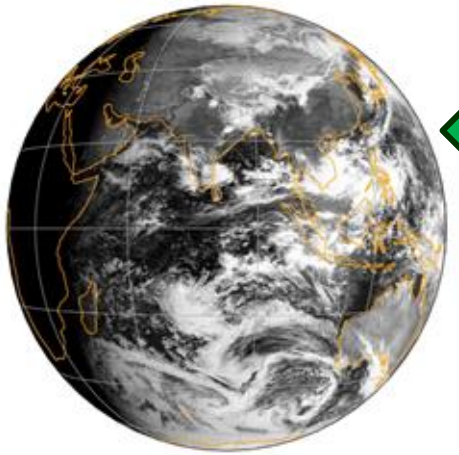


www.eumetsat.int

Satellite	Sensor	1980-1990	1990-2000	2000-2010	2010-2020
INSAT-1A (1982)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-1B (1983)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-1C (1988)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-1D (1990)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-2A (1992)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-2B (1993)	VHRR (VIS,TIR)	OLR, CMV, Rain, Cloud Image			
INSAT-2E (1999)	VHRR (VIS,WV,TIR) CCD (VIS,NIR,SWIR	OLR, AMV, UTH, Rain, Cloud Image			
Kalpana-1 (2002)	VHRR (VIS,WV,TIR)	OLR, AMV, UTH, Rain, Cloud Image			
INSAT-3A (2003)	VHRR (VIS,WV,TIR) CCD (VIS,NIR,SWIR	OLR, AMV, UTH, Rain, Cloud Image			
INSAT-3D (2013)	Imager (VIS, SWIR, MIR, WV, TIR1, TIR2) Sounder (18 IR + VIS)			OLR, AMV, UTH, Rain, Cloud Image Temperature, humidity profiles, Ozone	
INSAT-3DR (2016)	Similar to INSAT-3D			OLR, AMV, UTH, Rain, Cloud Image Temperature, humidity profiles, Ozone	
INSAT-3DS (2022)	Similar to INSAT-3D				OLR, AMV, UTH, Rain, Cloud Image Temperature, humidity profiles, Ozone

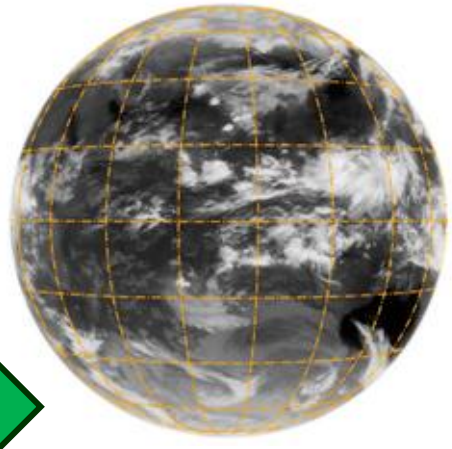
1998-10-01 02:56:54.960

1998-10-01 02:56:54.960



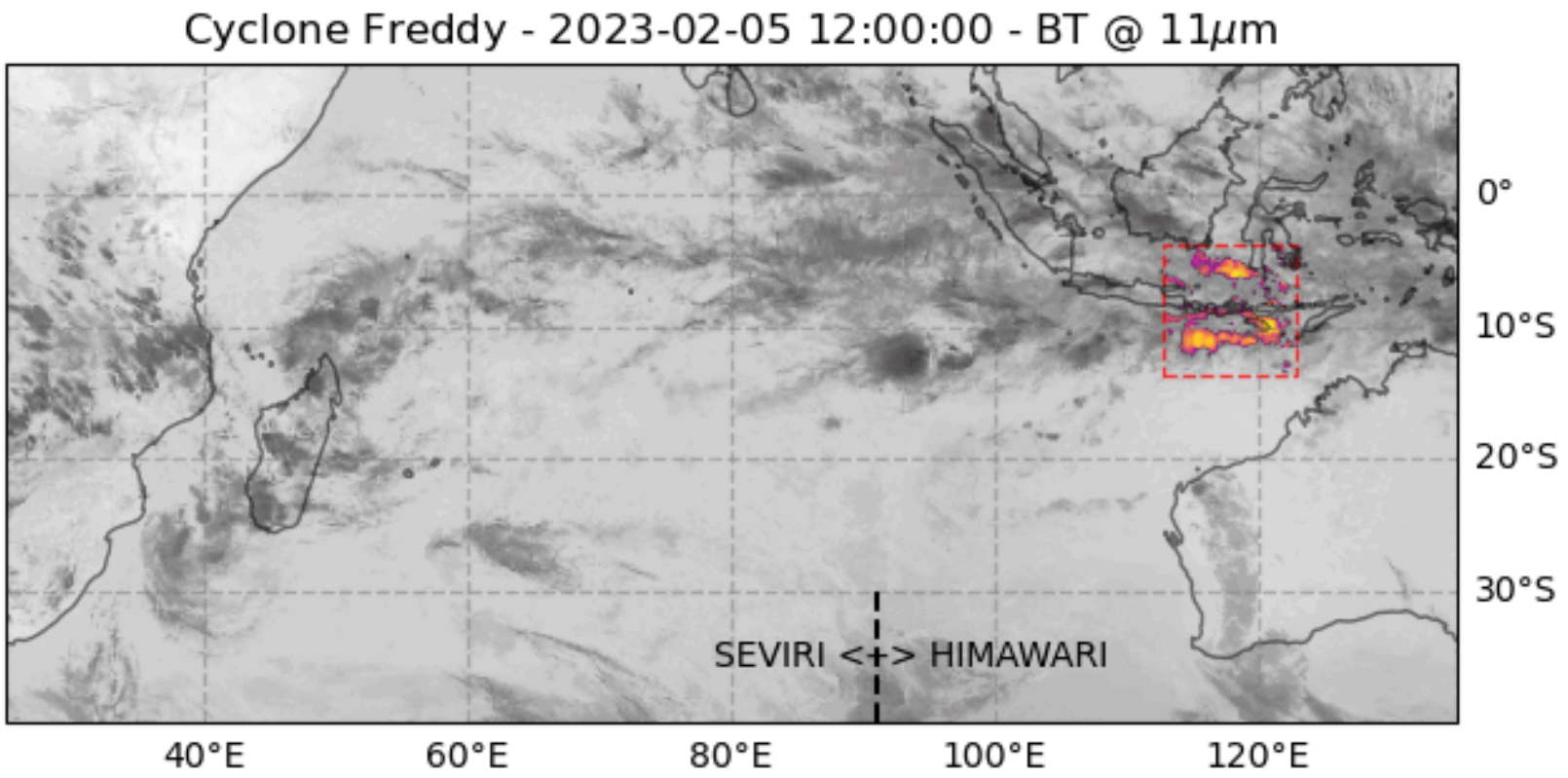
VIS channel, 2.75 km resolution

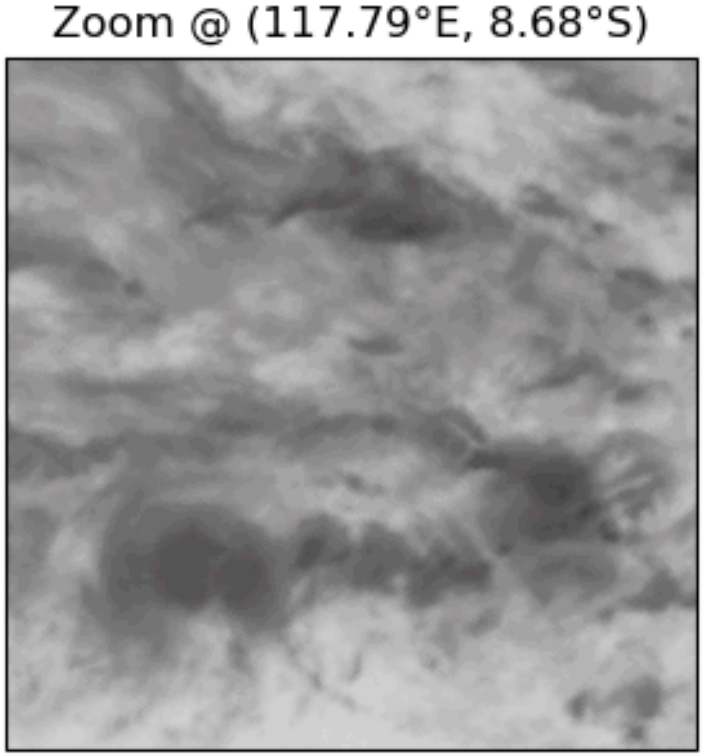
IR channel, 11 km resolution



Seamless Satellite Data Like Model Output

Cyclone Freddy from GEO-Ring data set on an equal area HEALPix grid with 5 km^2 spatial sampling and 30-minute temporal sampling



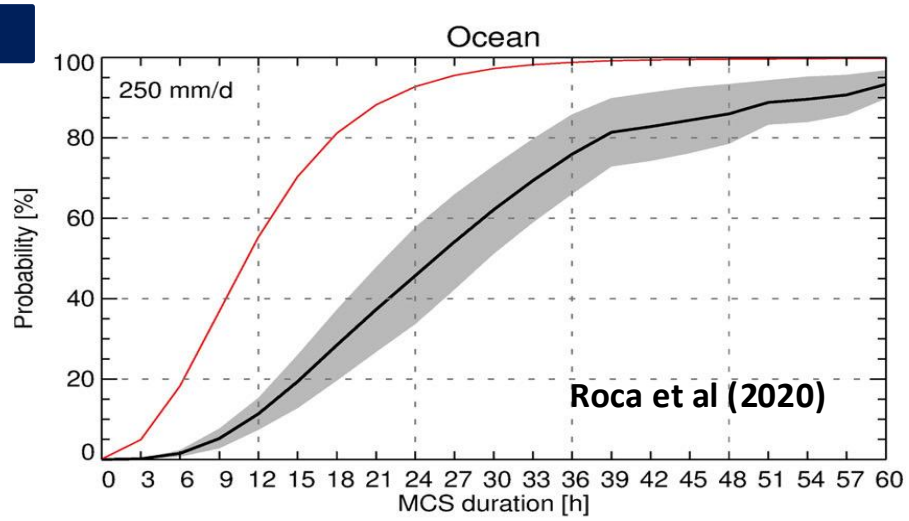


Test data set covering 2019-2024 is ready to use, feedback workshop at EUM 24-26 June 2026
Full record starting in the 1970s comes in 2027

Deep Convective Cloud Systems (DCS) and Precipitation

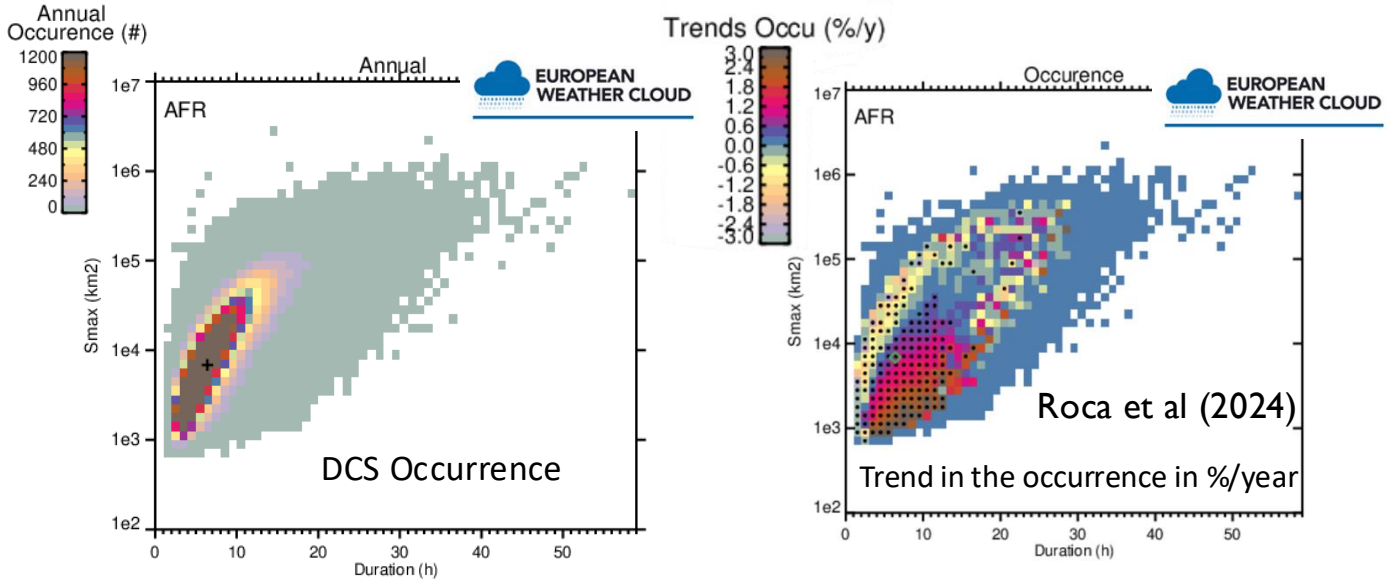
- Climatology of convective systems over Africa and the Atlantic based on 40+ years of Meteosat FCDR have been generated and published. Data: https://data.eumetsat.int/product/EO:EUM:DAT:0986

Joint analysis of the extreme precipitation and convective systems distributions.



Long-lived convective systems contribute disproportionally to extreme precipitation

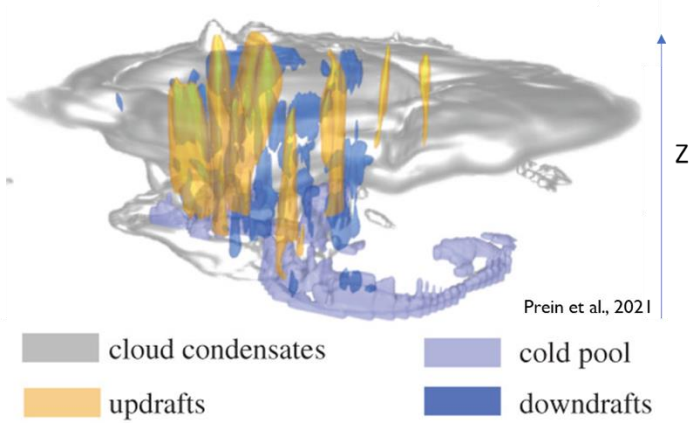
A 1983-2024 climatology of annual occurrence of Deep Convective Systems over Africa



Changes in Convective Organization over Tropical Africa and Atlantic Ocean

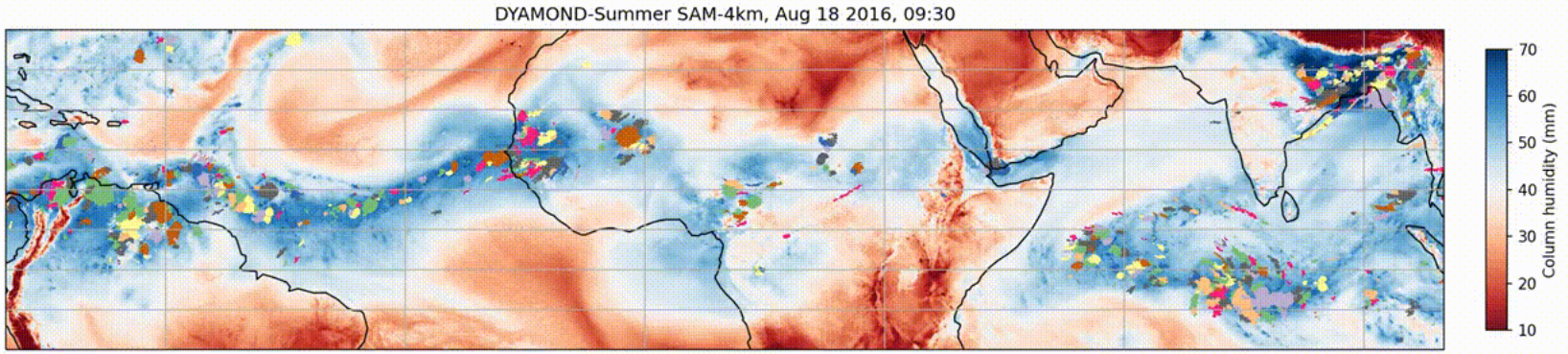
➔ new constraints at process level, external drivers, Organization of Deep Convective Systems for CRM models

Global Cloud Resolving Models (Courtesy of Thomas Fiolleau, CNRS)



➔ At kilometer scale, deep convection explicitly represented with realistic simulations of cold pools/Updrafts/Downdrafts…

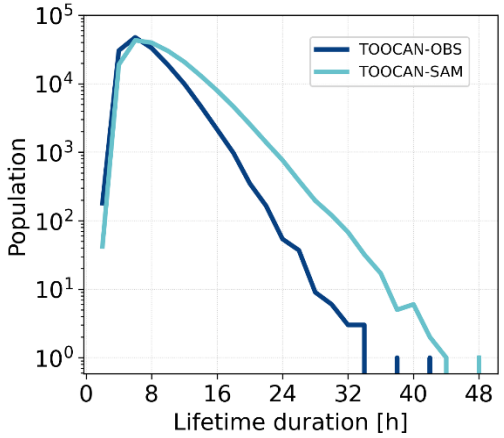
TOOCAN on SAM/DYAMOND CRM

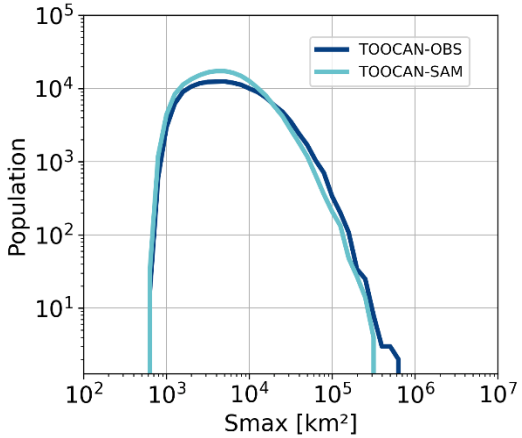


2016/08/01 – 2016/09/10
4km/30min

Courtesy B.Fildier

Evaluation of CRM through object-oriented diagnostics aligned with satellite observational framework





The SAM model successfully captures the overall characteristics of observed DCS

Abramian et al (2025)

➔ **MCSMIP :** Extension to all DYAMOND models

Feng et al (2025)

AI Direct Observation Prediction concept:
learning an Earth System model from observations

End-to-end observations → forecast (no explicit data assimilation step)

Training objective:

- using observations in an input time window, predict all future observations in the next time window **(with <u>no reanalysis</u> data used)**
- To accurately predict future observations the network must **learn a representation of the state and processes** that those observations are sensitive to

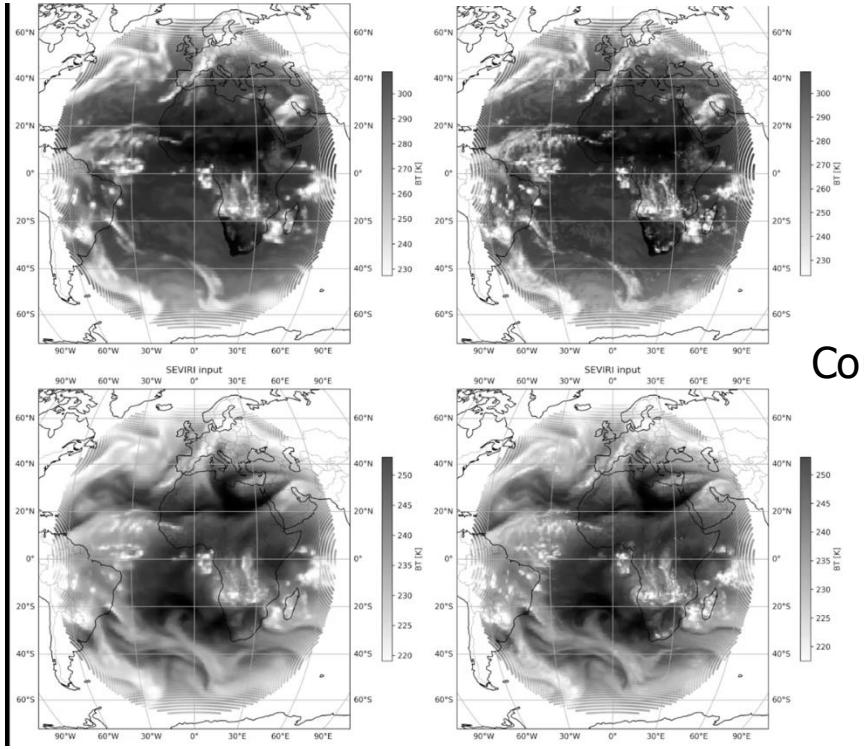
5-day forecast:

10.8μm (window channel)

Representations of convection and extra-tropical dynamics

6.3μm (water vapor channel)

GraphDOP (prediction) SEVIRI (observed)



Courtesy: Peter Lean, ECMWF

ECMWF

Thank you for your attention.

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https://user.eumetsat.int/catalogue

https://www.eumetsat.int/about-us/satellite-application-facilities-safs

EUMETSAT is an intergovernmental Organisation

www.eumetsat.int

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BELGIUM
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ITALY
LATVIA
LITHUANIA
LUXEMBOURG
THE NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

Tasks

- Develop, maintain, exploit European systems of meteorological satellites, taking into account as far as possible the recommendations
- Contribute to operational climate monitoring and the detection of global climatic changes.

Climate Monitoring Architecture – EUMETSAT View

Satellite Observations

Climate Data Products

Climate Applications

Policy/Decision Making

EUMETSAT

EUMETSAT SAF
SATELLITE APPLICATION FACILITY NETWORK

CO2M

Research

WCRP World Climate Research Programme

International Science Council

IAMC

Climate Change

Atmosphere Monitoring Service
atmosphere.copernicus.eu

Copernicus Marine Service

Emergency Management

Assessment
ipcc
INTERGOVERNMENTAL PANEL ON climate change

CLIMATE

Policy

United Nations Framework Convention on Climate Change

PARTIES

SBSTA / SBI
COP/ CMA/ CMP

The Satellite Application Facilities

www.eumetsat.int

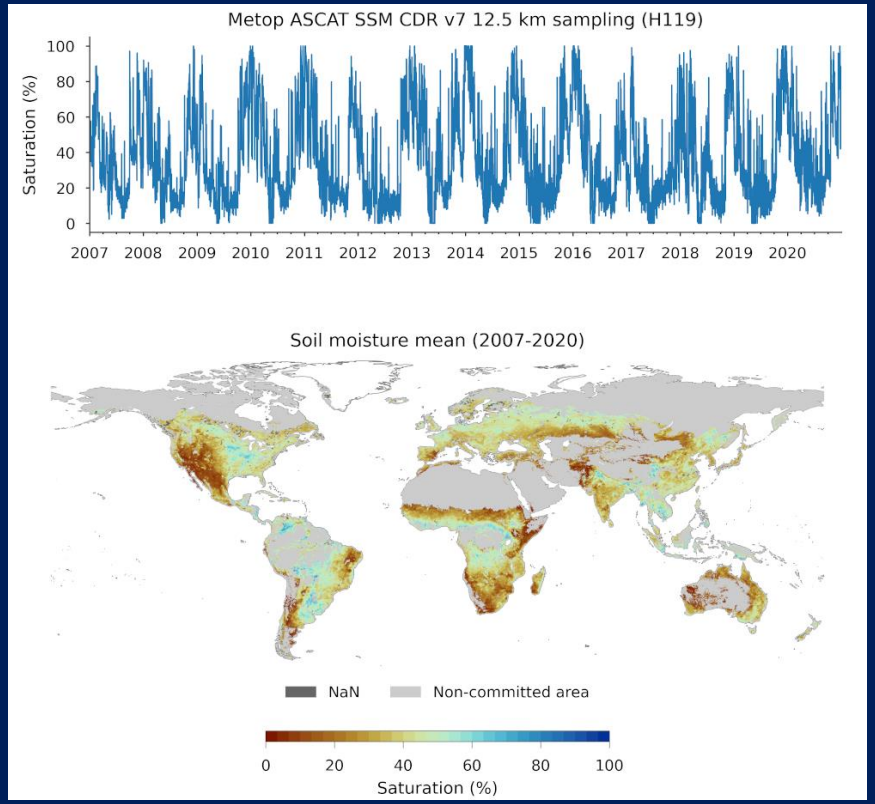
EUMETSAT SAF

SATELLITE APPLICATION FACILITY NETWORK

- EUMETSAT has a network of different Satellite Application Facilities (SAFs)
- SAFs are dedicated centers of excellence for processing satellite data
  - research, development and operational activities
  - each SAF focusses on specific user communities or application areas
- Each SAF is a consortium of entities from EUMETSAT member states

H SAF: Surface Soil Moisture Data Record

- Consistent soil moisture content in the surface layer
- Based on ASCAT sensors onboard Metop Satellites
- Covering the years 2007-2020 and continuation since 2020
  → *update will be soon available*
- 12.5 km sampling
- Available via http://h-saf.eumetsat.int
- Released 15 September 2022



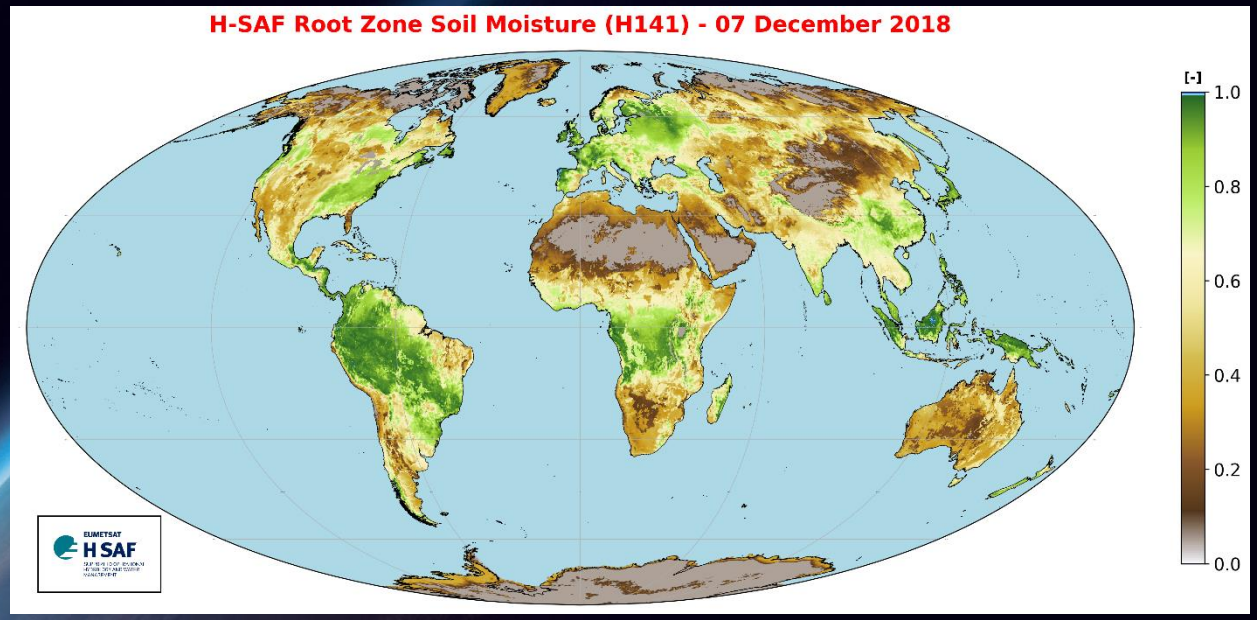
Complete time series and overall mean (2007 2022) of the ASCAT Soil moisture data record

EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

More info: http://h-saf.eumetsat.int

H SAF: Root Zone Soil Moisture Data Record

- Data record of Global Liquid Soil Wetness Index
- Covering the years 1992-2018, with extension to [today - 1]
- Generated using the Land Data Assimilation System (LDAS) at ECMWF
- Fed with ERS/SCAT and Metop/ASCAT scatterometer observations
- 10 km spatial resolution
- doi.org/10.15770/EUM_SAF_H_0008
- Released 17 April 2020



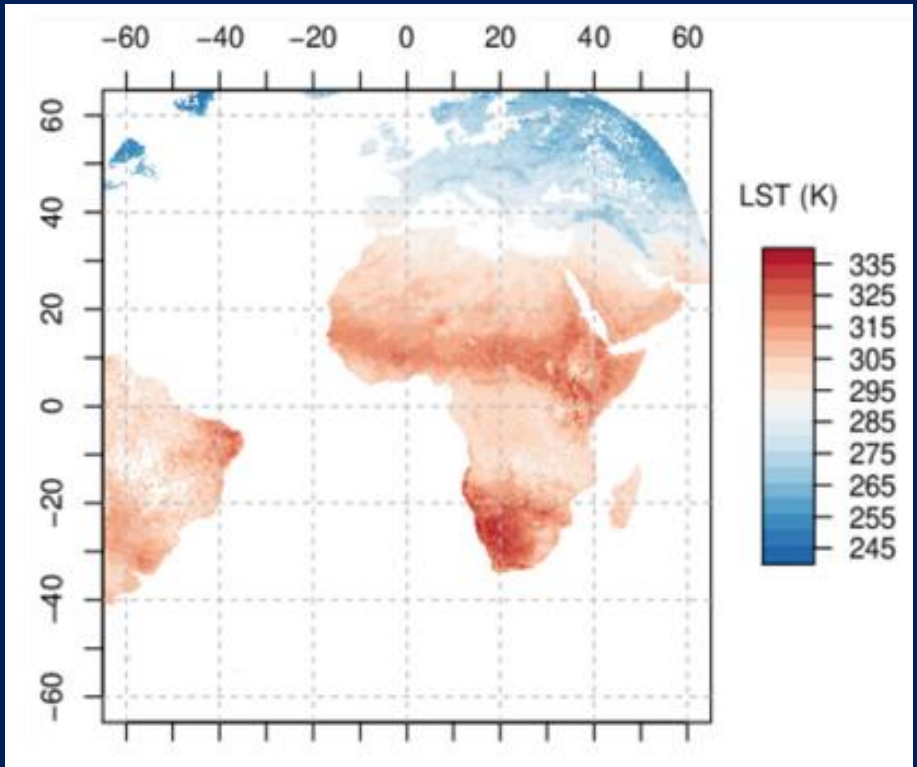
Soil Wetness Index related to top 100cm
7 December 2018

More info: http://h-saf.eumetsat.int

EUMETSAT
H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

CM SAF: Land Surface Temperature Satellite Climate Data Record – SUMET

- Hourly data and monthly averaged diurnal cycle composits of the Land Surface Temperature (LST)
- Derived from thermal channels of imagers on Meteosat first and second generation (MVIRI and SEVIRI)
- Data record covering years 1983 – 2020
- Provided on 0.05° x 0.05° grid over Meteosat disc.
- DOI: 10.5676/EUM_SAF_CM/LST_METEOSAT/V002
- Available via http://cm-saf.eumetsat.int
- Released 15 May 2024



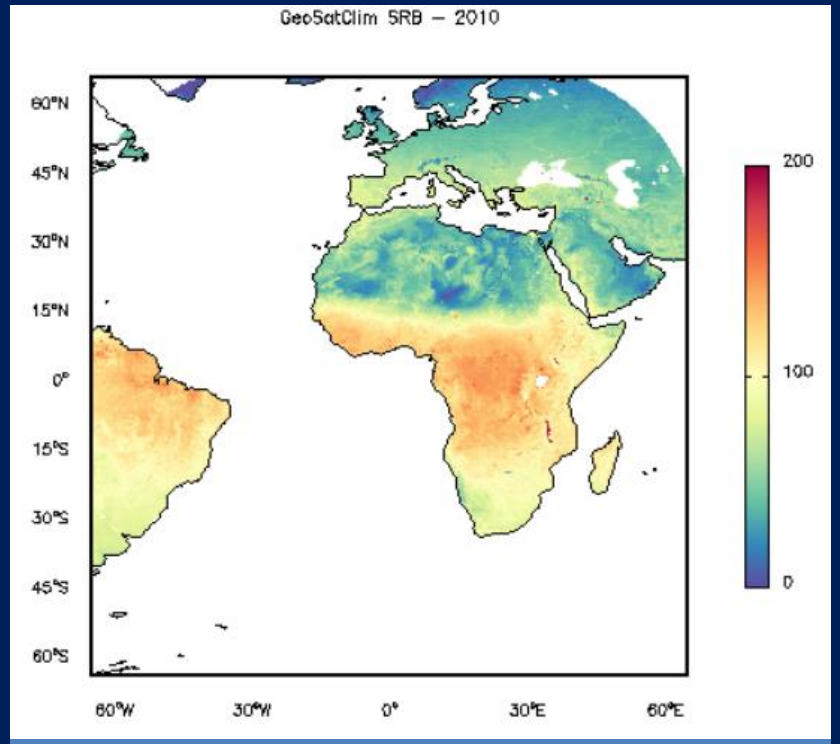
Example of CM SAF LST data record (SUMET ed.2) of Land Surface Temperature for January 2005 12:00 (monthly diurnal cycle)

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

CM SAF: Surface Radiation and Fluxes from Meteosat – LANDFLUX

- Hourly, daily and monthly composites of Surface Radiation Budget, Latent and Sensible Heat Fluxes
- Derived from thermal and optical channels of MVIRI & SEVIRI on Meteosat 1st and 2nd Generation; Heat Fluxes obtained with LSA SAF land surface model
- Data record covering years from 1983 to 2020
- Provided on a 0.05° x 0.05° grid for the Meteosat disc
- DOI: 10.5676/EUM_SAF_CM/SLF_METEOSAT/V001
- Available via http://cm-saf.eumetsat.int
- Released 25 June 2024



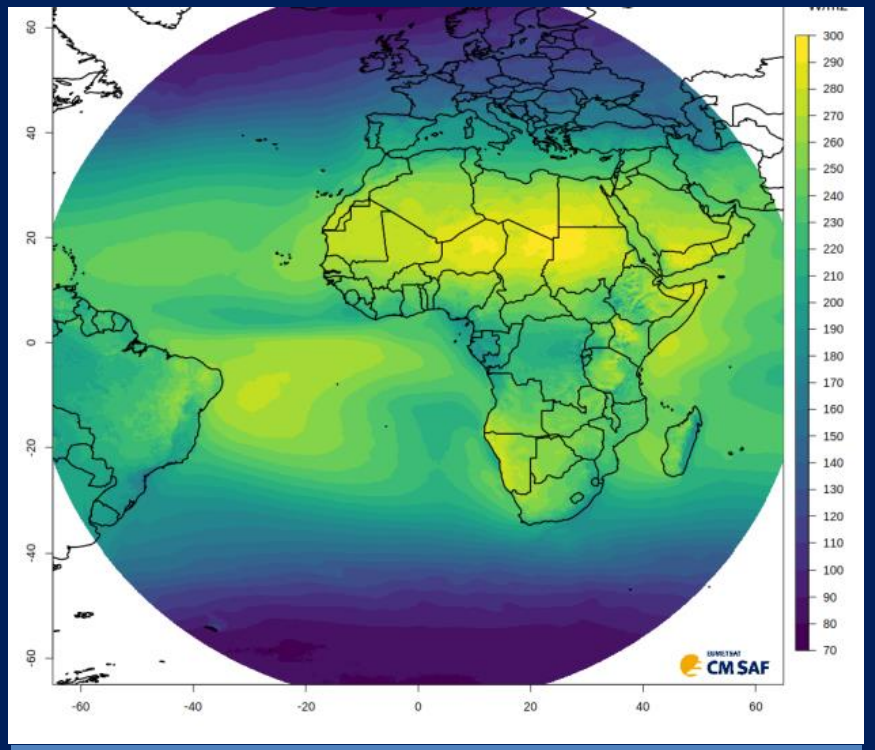
Meteosat annual mean of Surface Radiation Budget for 2010, in Wm-2

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

CM SAF: SARAH-3 Surface Radiation Data Record

- Climatology of essential surface solar radiation characteristics
- Based on observations from Meteosat satellites
- Data record covering years since 1983 - 2020
- Operational extension (ICDR) until last completed month with 5 day latency
- DOI: 10.5676/EUM_SAF_CM/SARAH/V003
- Available via http://cm-saf.eumetsat.int
- Released 5 May 2023



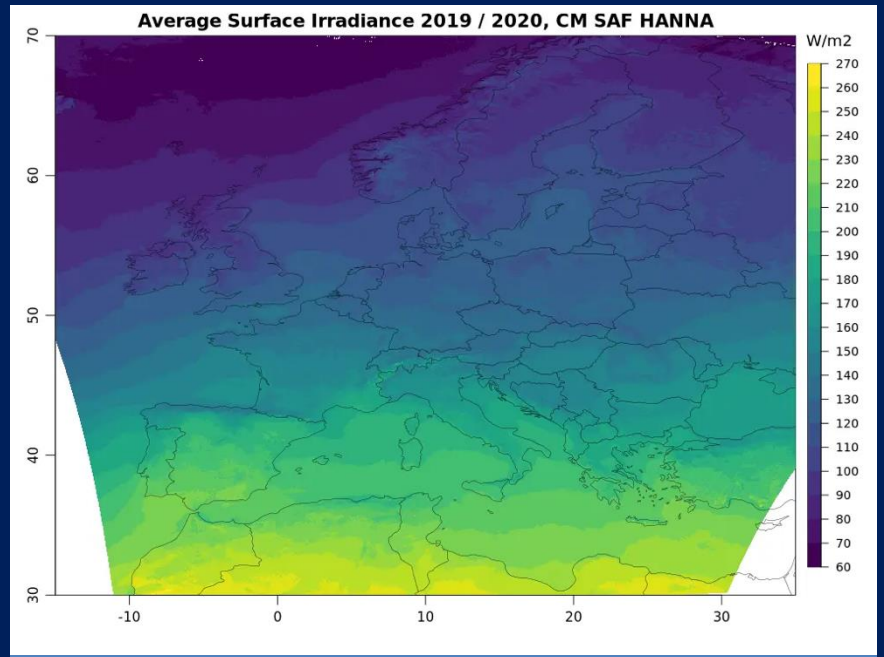
Climatology of Surface Irradiance: 30 year mean value of 1991-2020 as per CM SAF SARAH-3 data record

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

CM SAF: High Resolution Solar Radiation for Europe (HANNA)

- Provides surface incoming solar radiation, with an unpreceded temporal and spatial resolution.
- Explores the full potential of the high resolution channel of the MSG rapid scanning mode, which samples Europe with a spatial resolution of about **1 km**.
- Data record covering years 2019 and 2020
- Temporal resolution **15 min** + daily and monthly averages
- Provided on a 0.01° x 0.01°grid for Europe
- Released as “demonstrational” on 16 April 2024



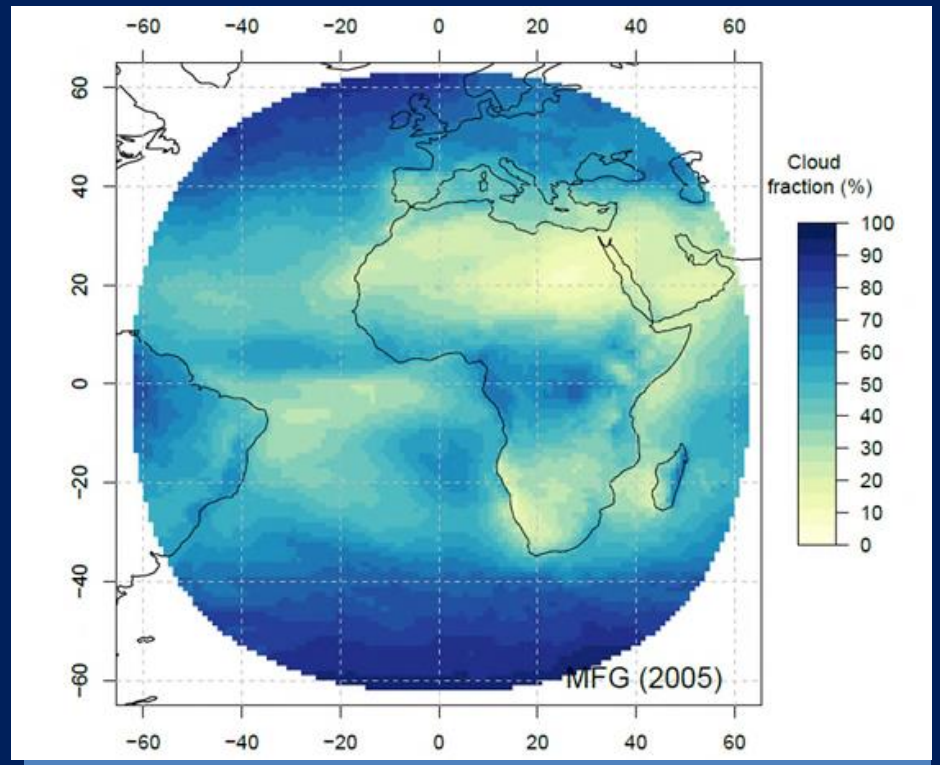
Example of average high resolution solar radiation for Europe for 2019/2020

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

CM SAF: Meteosat Cloud Cover Data Record COMET Edition 2

- Hourly, daily and monthly composites of the Cloud Fractional Cover (CFC)
- Derived from intercalibrated visible thermal channels of imagers on Meteosat first and second generation (MVIRI and SEVIRI)
- Data record covering years 1983 – 2020
- Provided on 0.05° x 0.05° grid over Meteosat disc.
- DOI: 10.5676/EUM_SAF_CM/CFC_METEOSAT/V002
- Available via http://cm-saf.eumetsat.int
- Released 15 May 2024



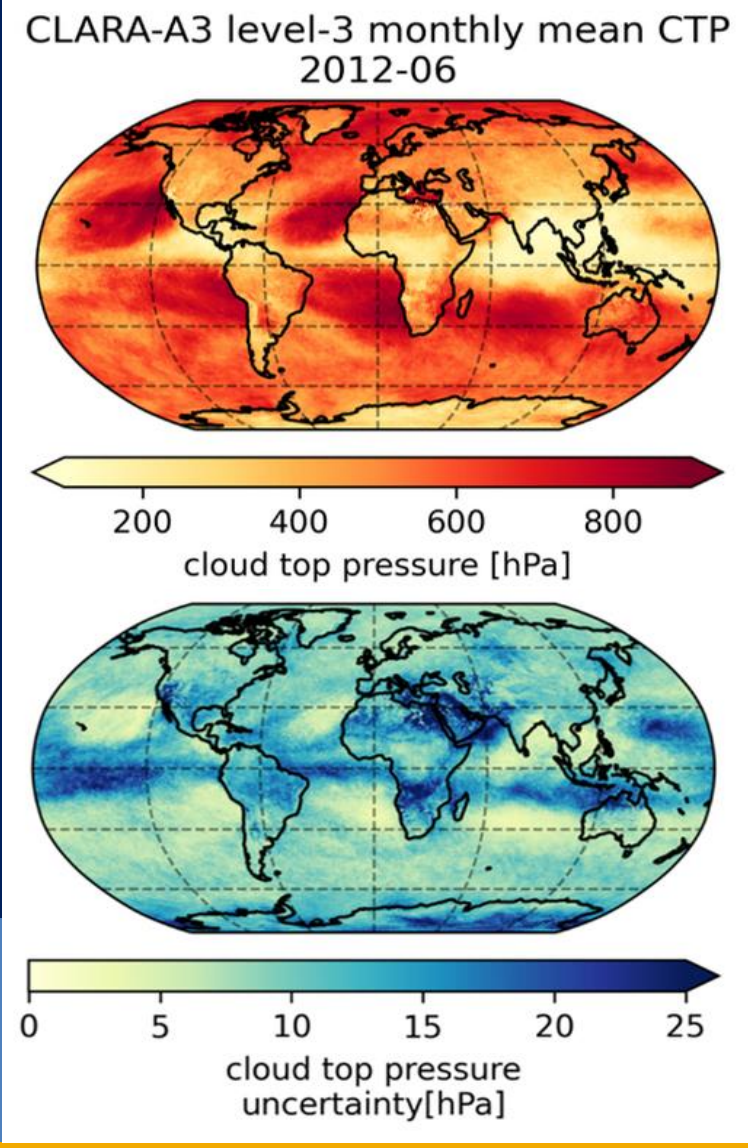
Annual mean of cloud fractional coverage (CFC) for the year 2005

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

CM SAF: CLARA A3 Cloud Data Record

- Climatology of essential cloud, surface and Top of Atmosphere (ToA) radiation characteristics
- Based on observations from AVHRR onboard NOAA and Metop satellites
- Data record covering years since 1979 – 2020
- Operational extension (ICDR) with 10 day latency
- Available via http://cm-saf.eumetsat.int
- Released 27 April 2023



CLARA-A3 Monthly mean cloud top pressure (CTP) and related uncertainties for June 2012

EUMETSAT CM SAF CLIMATE MONITORING

More info: http://cm-saf.eumetsat.int

There is much more ….

EUMETSAT CM SAF
CLIMATE MONITORING

- Focus on Earth's Energy Budget & Water Cycle
  - Surface Radiation Components
  - Atmospheric Moisture (Water Vapour)
  - Clouds & Cloud Properties
  - Precipitation
- Long-term climate data records
- www.cm-saf.eumetsat.int

EUMETSAT AC SAF
ATMOSPHERIC COMPOSITION MONITORING

- Focus on atmospheric composition
  - Trace gases
  - Aerosols
  - Radiation
- Some long-term records available
- www.ac-saf.eumetsat.int

EUMETSAT LSA SAF
LAND SURFACE ANALYSIS

- Focus on Radiation, Vegetation, Energy – Water – Carbon Exchanges
  - Albedo
  - Land Surface Termperature & Emissivity
  - Surface Radiation
  - Vegetation
  - Evapotranspiration & Turbulent Fluxes
  - Wildfires
- Some long-term records available
- www.lsa-saf.eumetsat.int

EUMETSAT OSI SAF
OCEAN AND SEA ICE

- Ocean observations
  - Sea Ice
  - Sea Surface Temperature
  - Wind over ocean
- Some long-term records available (Sea ice, SST)
- www.osi-saf.eumetsat.int

EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

- Focus on operational hydrology and water management
  - Soil Moisture
  - Snow
  - Precipitation
- Soil moisture data records available
- www.h-saf.eumetsat.int

EUMETSAT ROM SAF
RADIO OCCULTATION METEOROLOGY

- Profiles of stratosphere & troposphere
  - Temperature
  - Pressure
  - Humidity
  - Bending angles & refractivity
- Long-term Climate Data Records available
- www.rom-saf.eumetsat.int

GIRAFE v1 – CM SAF's first dedicated precipitation CDR

EUMETSAT CM SAF

www.cmsaf.eu

- Currently covering precipitation globally 2002-2022 at 1° daily and monthly resolution
- Continuous extension (a.k.a. ICDR) coming up in April/May 2026 (latency: 3 months to ~10 days)
- Based on merging microwave observations (low-earth orbiters) and infrared observations (geostationary) up to 55°N/S
- Plausible, stable, featuring sampling uncertainty
  - Konrad et al., ESSD, 2025
- Gaps are present in the CDR, but there are options for near-complete updates
- Development in progress for a climate normals and anomalies service for GIRAFE

GIRAFE v1 DOI

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

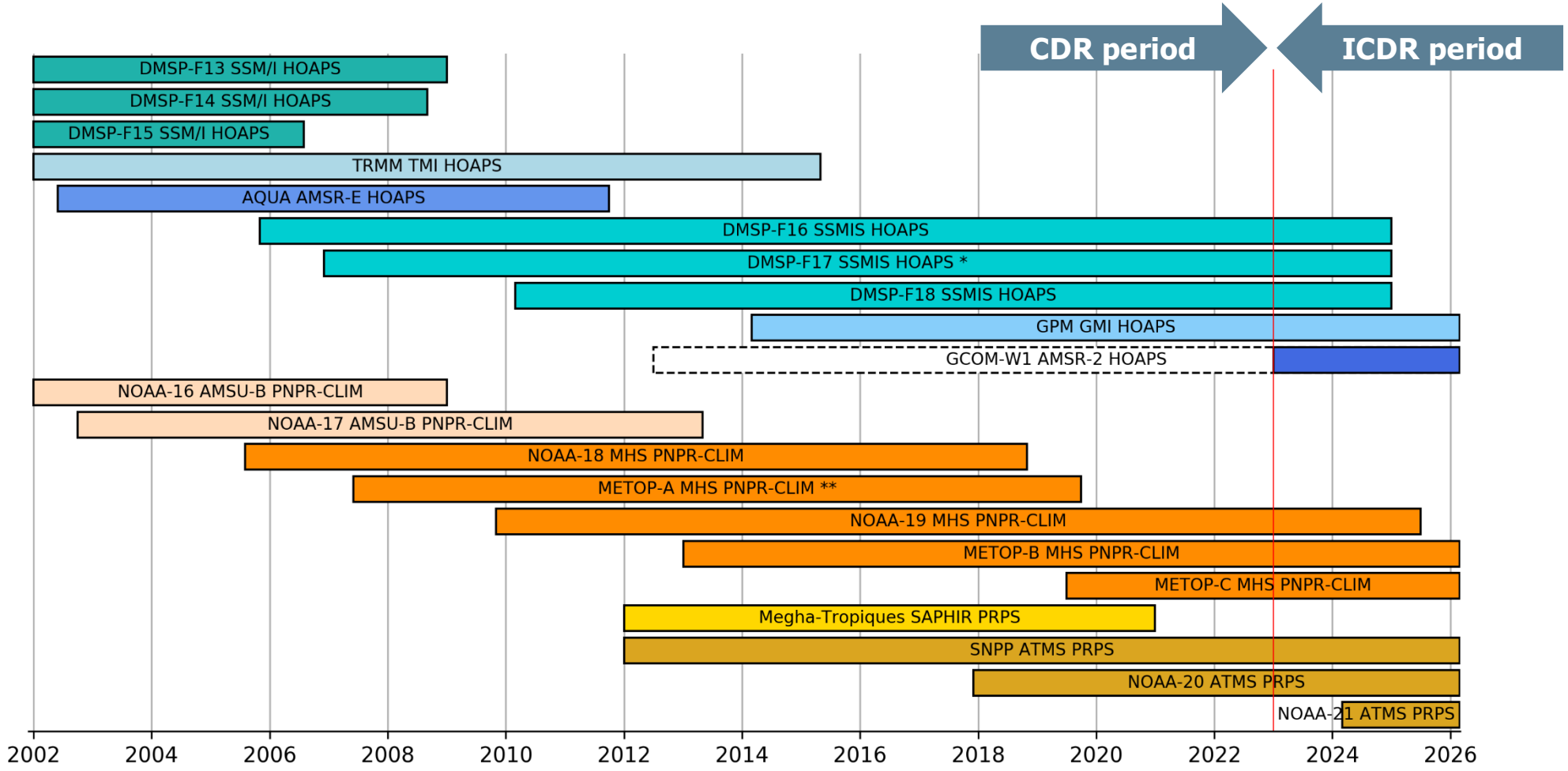
GIRAFE ICDR chain

- High complexity in GIRAFE
  - Microwave
    - 9 different MW sensors (CDR, plus AMSR-2 in ICDR)
    - three different retrieval algorithms
    - Pre-/post-processing steps at different stages (intercalibration, L2 per algorithm, quantile mapping)
  - Geo-Ring infrared at ~11 microns, various instruments

Constellation – LEO MW

EUMETSAT CM SAF

www.cmsaf.eu

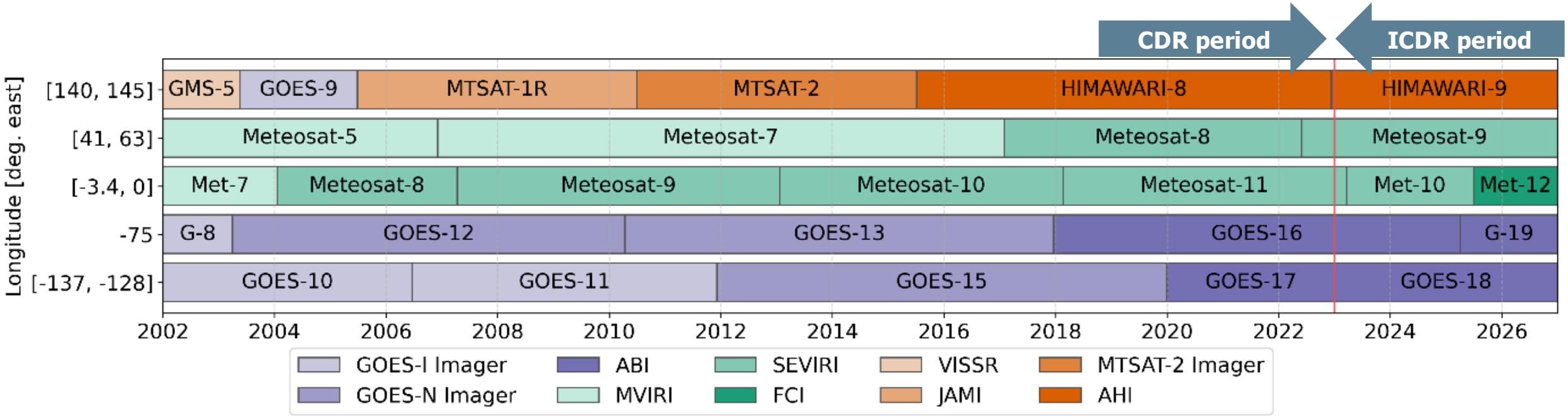


Phase out SSMIS from 2025/01/01

Compensate by adding AMSR-2 from 2023/01/01

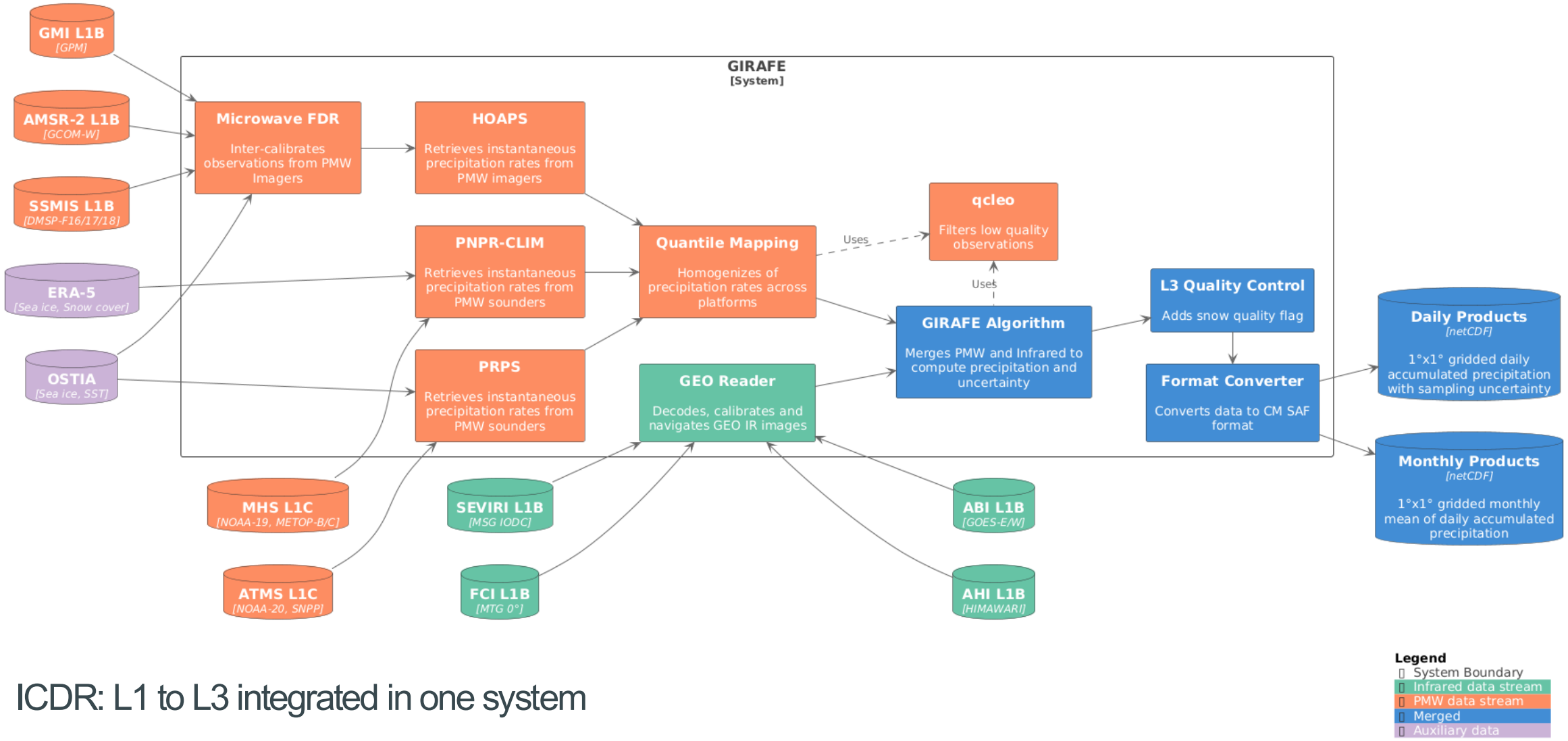
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Constellation – Geo IR



With the upcoming GIRAFE v1 ICDR service, MTG FCI has entered climate monitoring at CM SAF.

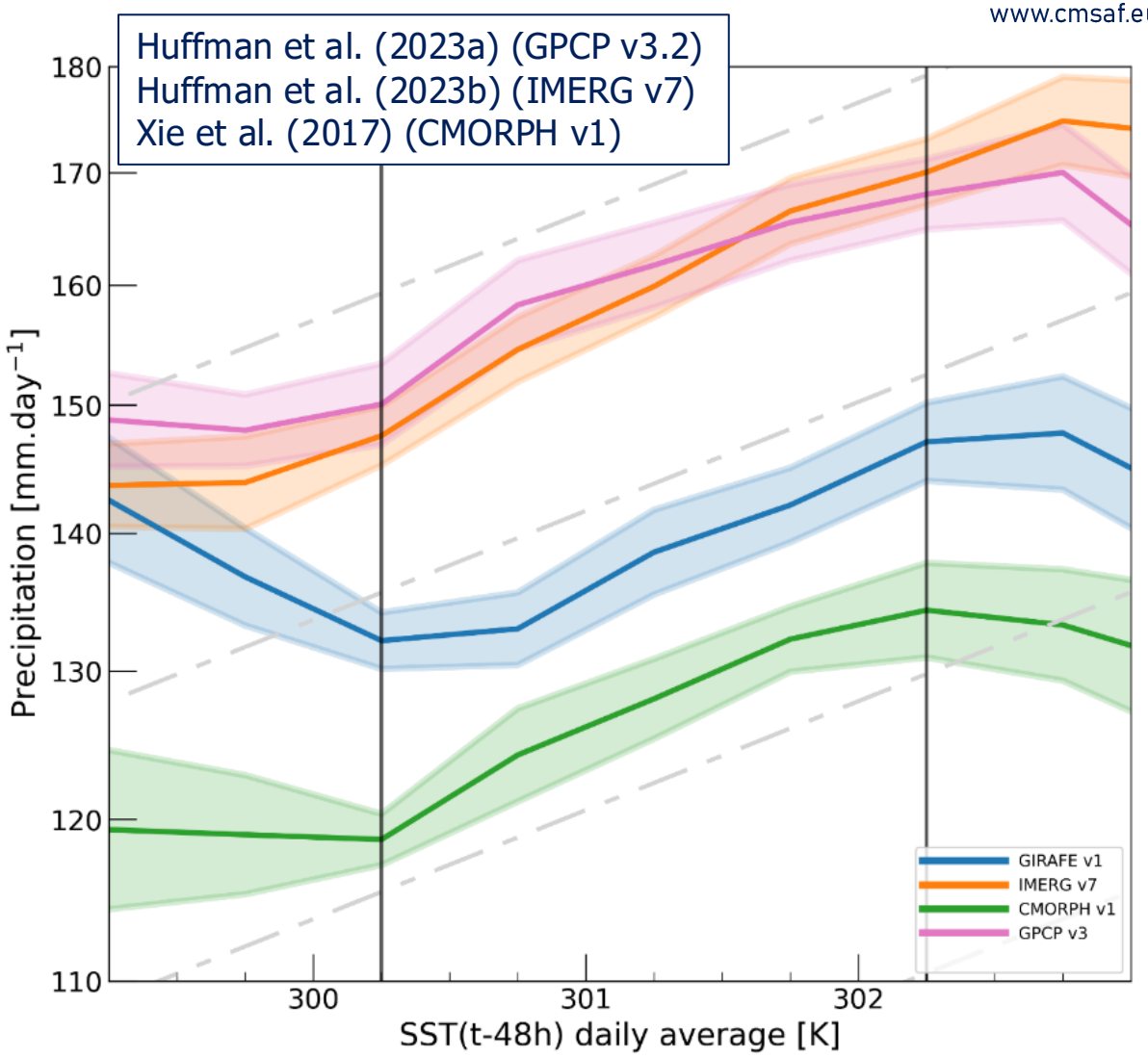
Various sub-modules in the GIRAFE chain



ICDR: L1 to L3 integrated in one system

Scaling of precipitation extremes over ocean

- SST = sea surface temperature
- For ~300 K < SST < ~302 K, precipitation extremes follow the expected behaviour (Clausius Clapeyron):
- Scaling with colocated SST (lag of 48 h) of ~6-7%
- Analysis following De Meyer and Roca (2021)

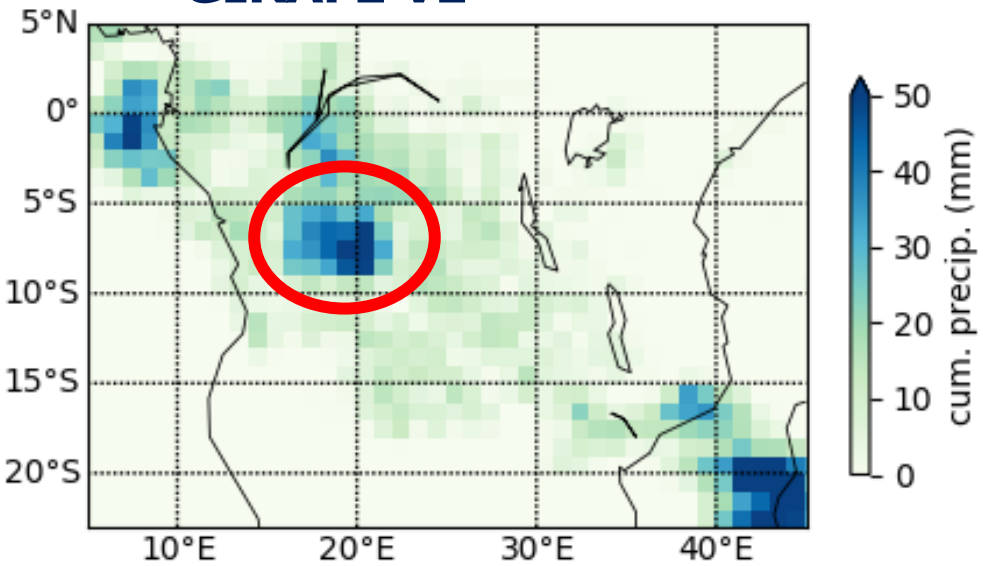


Konrad et al., ESSDD, 2025

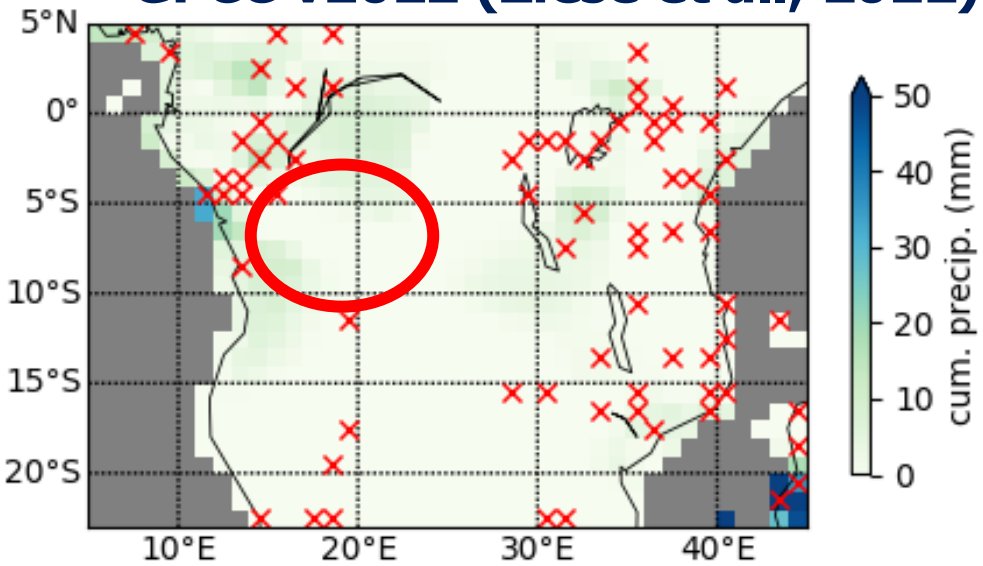
Detecting extremes in areas of low station density

- Rain gauges etc measure precipitation much more directly, but:
- Example: 16 Nov 2019 (contributing to the 2019/20 Congo river floods)
- No ground-based observation (x) in precipitation area, so a station-based dataset like GPCC is „blind“ to this event on this day

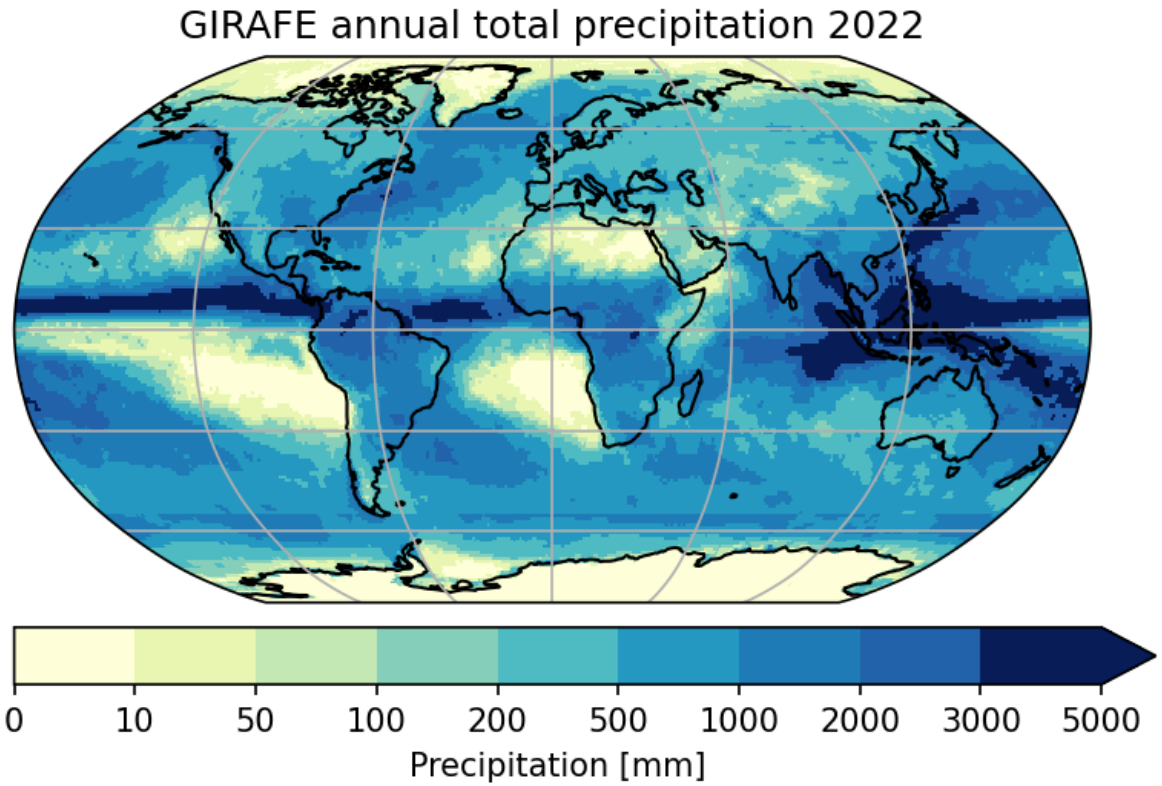
GIRAFE v1



GPCC v2022 (Ziese et al., 2022)



Annual total precipitation



Example constellation