

Climate from space at EUMETSAT – understand its evolution and support applications

Speaker

MARIE DOUTRIAUX-BOUCHER

Climate Product Expert - EUMETSAT





Switch^{to} Space 4

Climate from space at EUMETSAT – understand its evolution and support applications

Dr. Marie Doutriaux-Boucher, climate product expert

Thanks to EUMETSAT climate team/RSP colleagues

European Organisation for the Exploitation of
Meteorological Satellites (EUMETSAT)



An intergovernmental organisation with 30 member states



AUSTRIA



BELGIUM



BULGARIA



CROATIA



CZECHIA



DENMARK



ESTONIA



FINLAND



FRANCE



GERMANY



GREECE



HUNGARY



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ITALY



LATVIA



LITHUANIA



LUXEMBOURG



THE
NETHERLANDS



NORWAY



POLAND



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ROMANIA



SLOVAK
REPUBLIC



SLOVENIA



SPAIN



SWEDEN



SWITZERLAND



TURKEY



UNITED KINGDOM





Atmospheric remote sensing

Remote sensing = process of acquiring information about the Earth from a distance.

(Passive) satellites measure radiation emitted or reflected by the surface and the atmosphere

Two main types of orbits for weather satellites

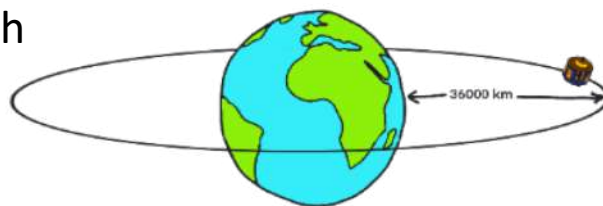
Geostationary orbit:

Always see the same part of the Earth

No global coverage

High temporal + spatial resolution

Example: **Meteosat**



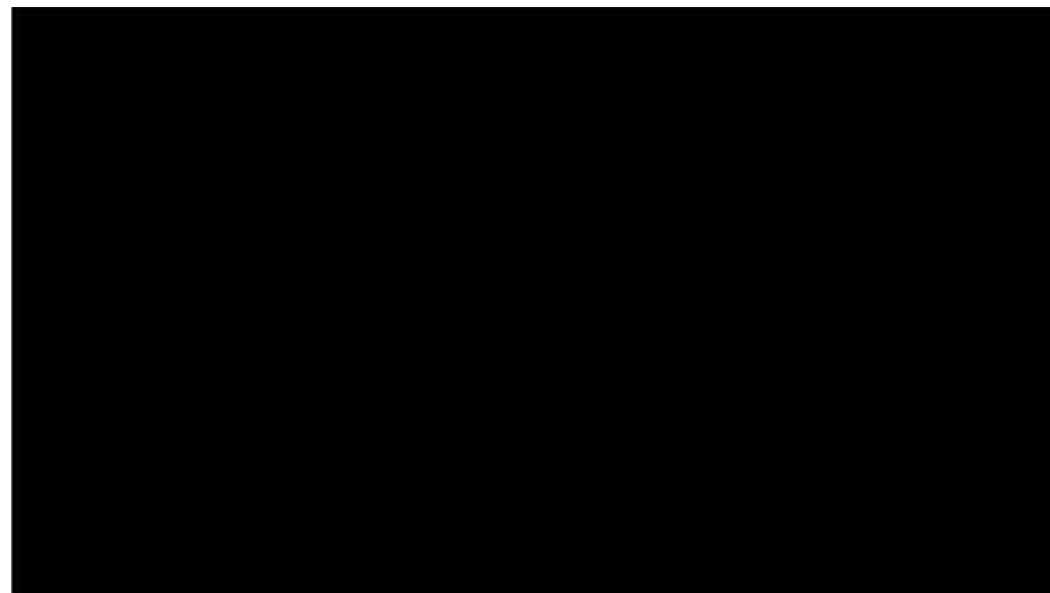
Polar orbit:

Global coverage, including of the poles

Two measurements per area per day

Coarse temporal resolution

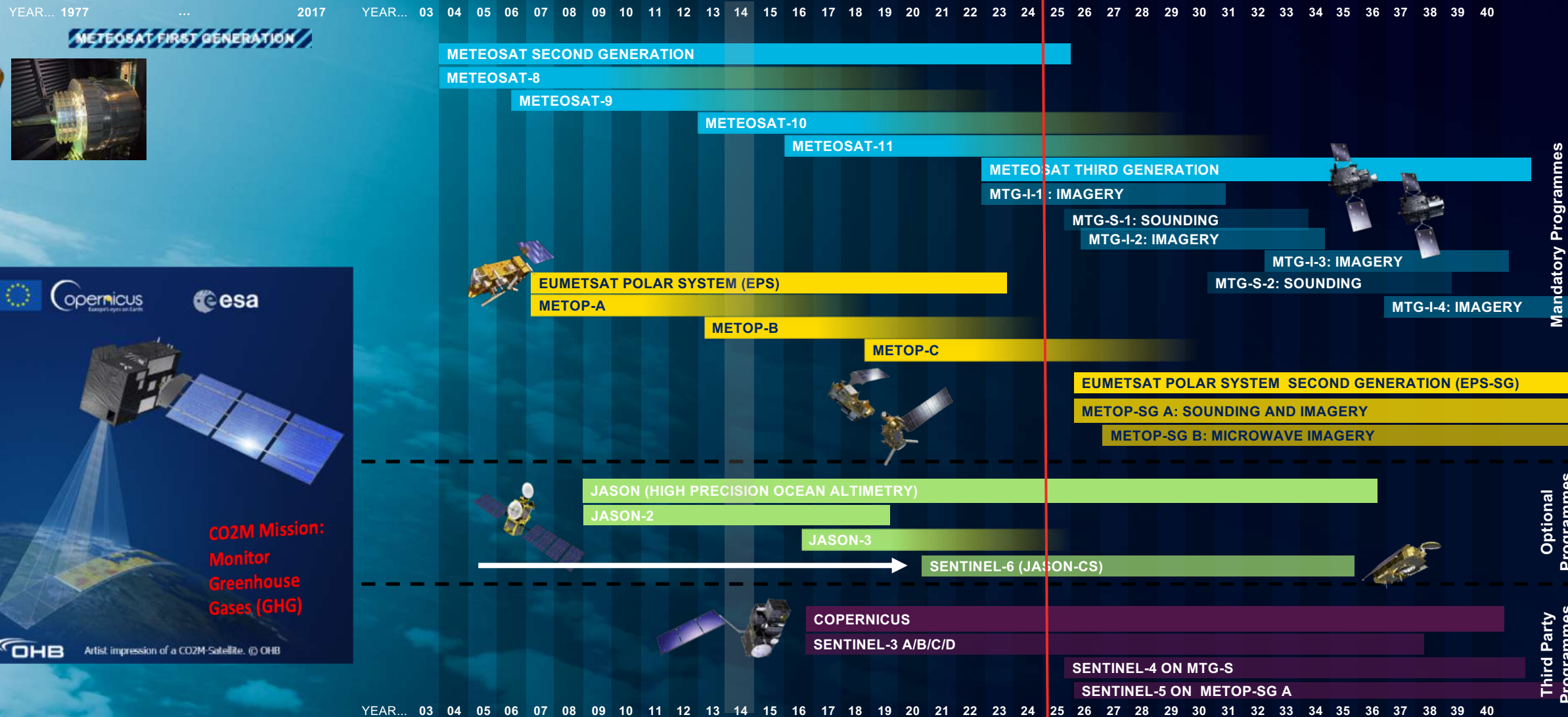
Example: **Metop**



There are also active satellites that rely on their own source of emission (e.g. lidar and radar)



EUMETSAT mission data and new products



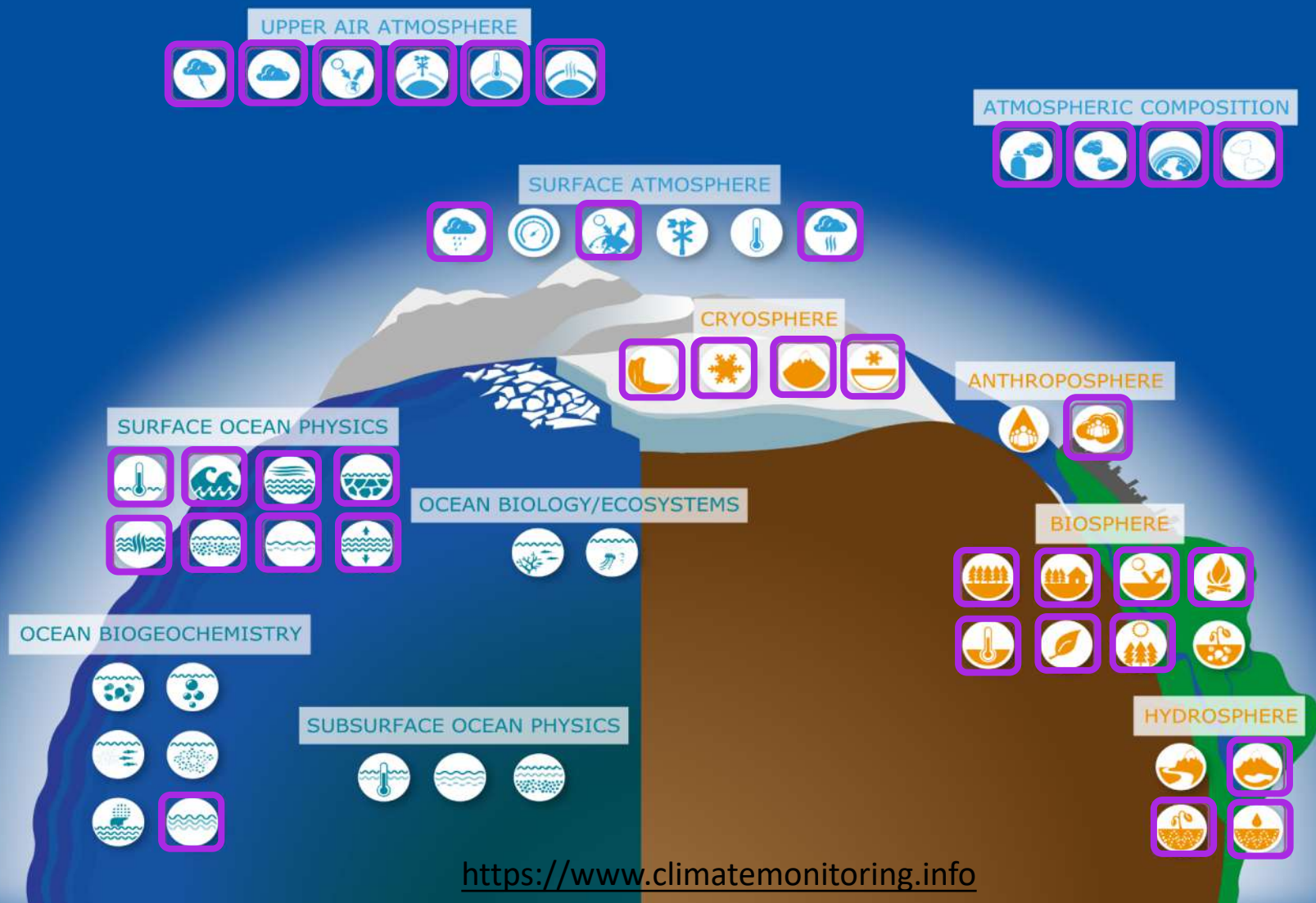


Essential Climate Variables

GCOS Essential Climate Variables

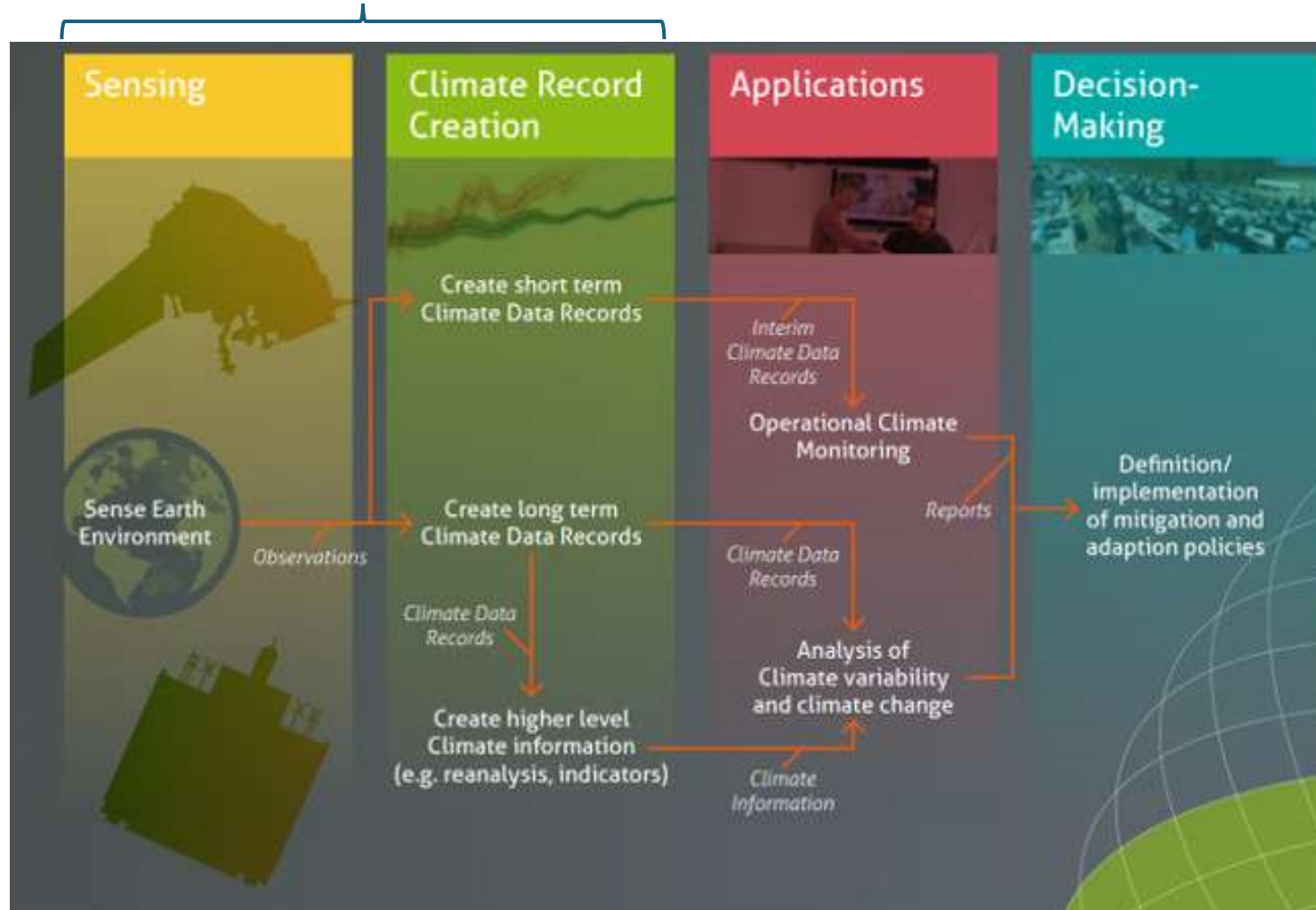
ECVs are variables (physical, chemical or biological) needed to obtain evidence of climate change and to support climate information services.

ECV are grouped in 3 categories: atmospheric, terrestrial and oceanic





EUMETSAT's Role in Climate Monitoring



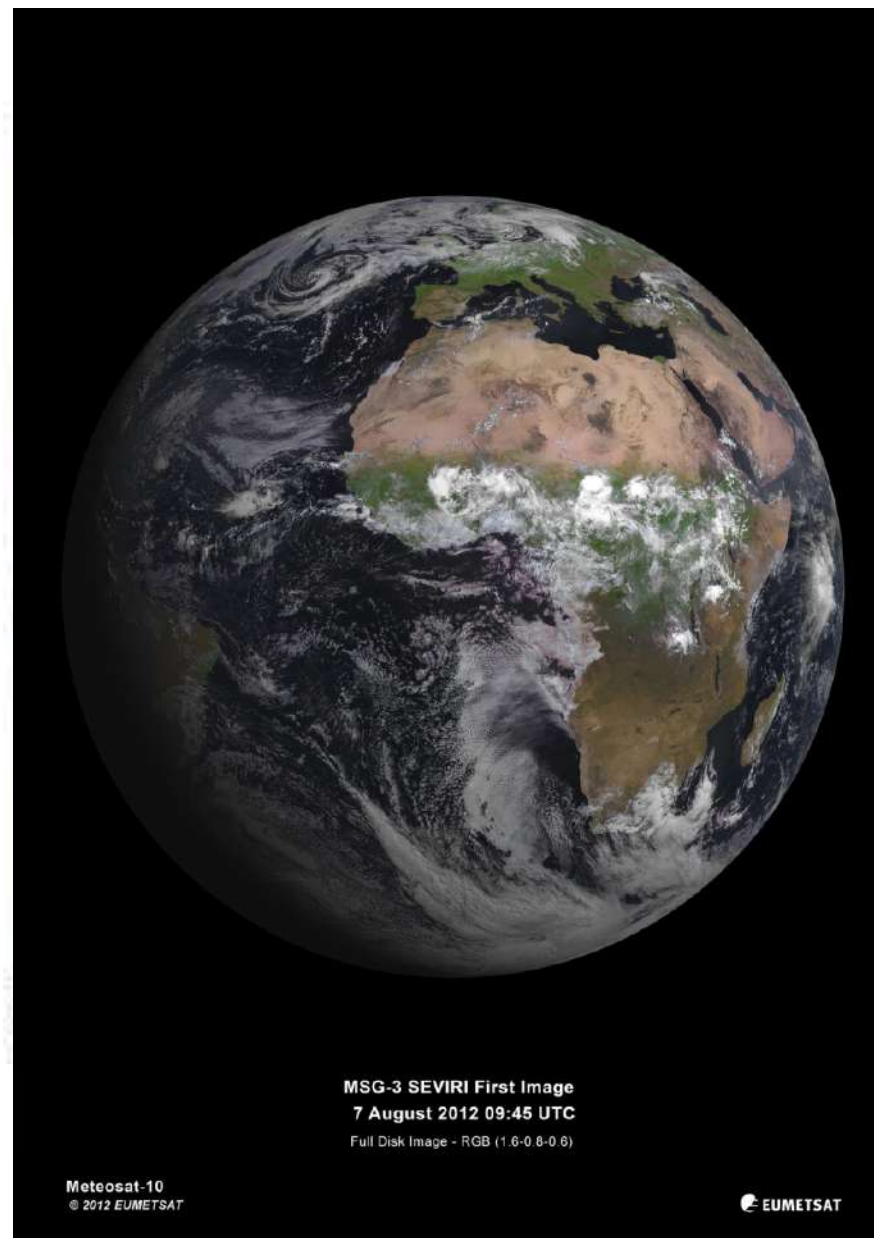
Climate Monitoring Architecture for space-based observations

EUMETSAT's role in the climate monitoring architecture

- **provide appropriate sensors** and satellite constellations (in global collaboration with other space agencies) to monitor these ECVs.
- **create CDRs** from past and current satellite measurements, to ensure continuity of these data records into the future and the contribute to the exploration of new technological possibilities.
- **facilitate the application** of these climate data, in collaboration with other data providers, with the aim to provide data and information for fact-based decision making.



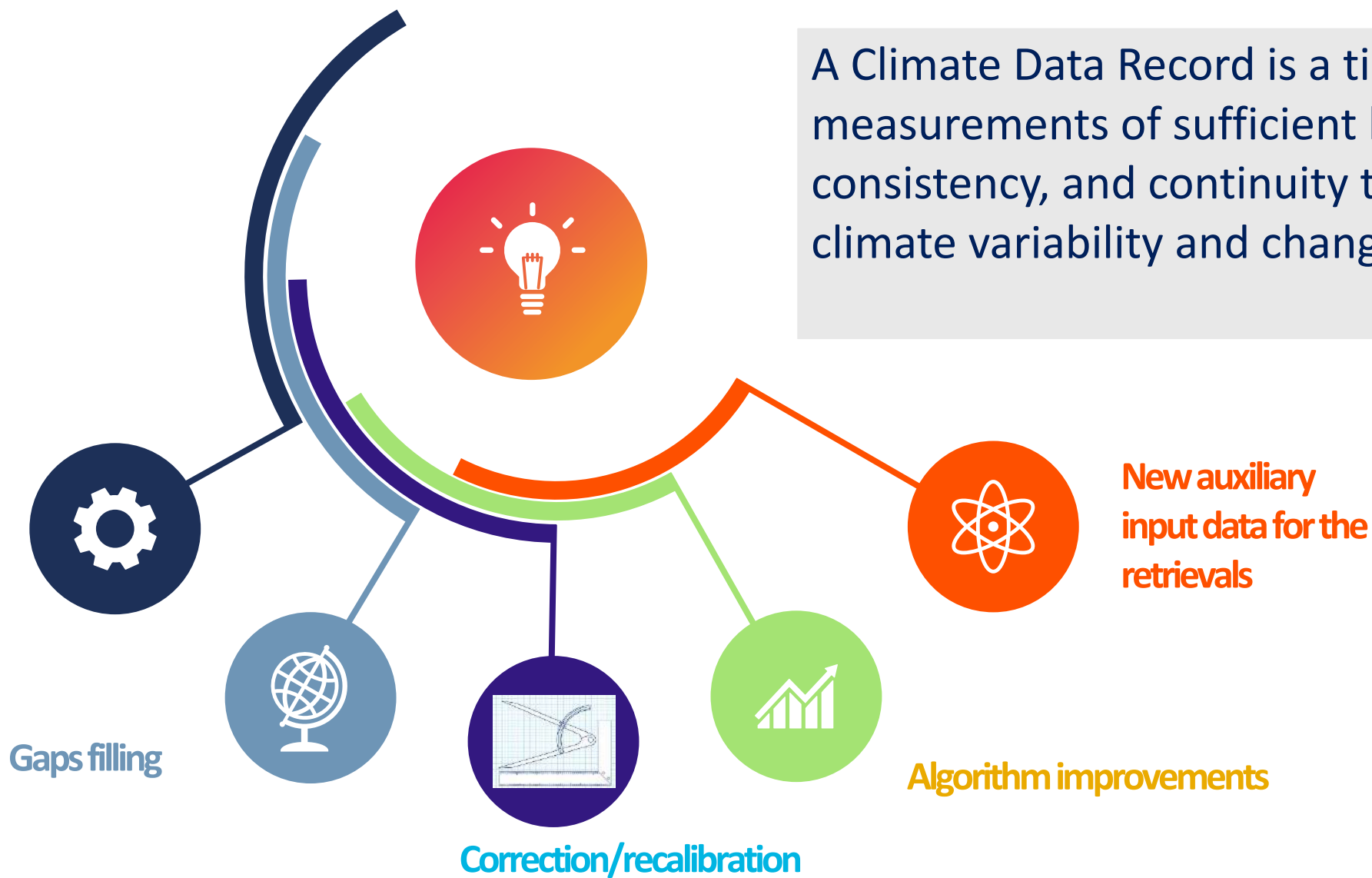
New technology for observation since 40 years





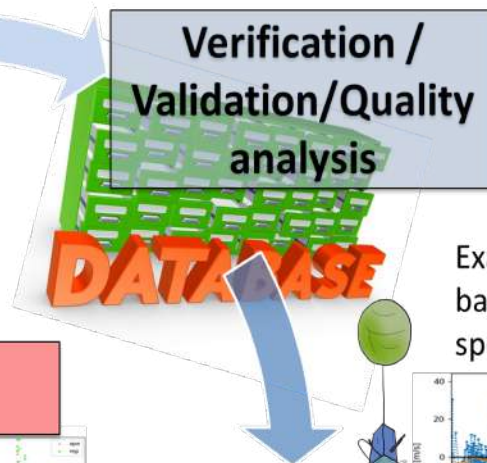
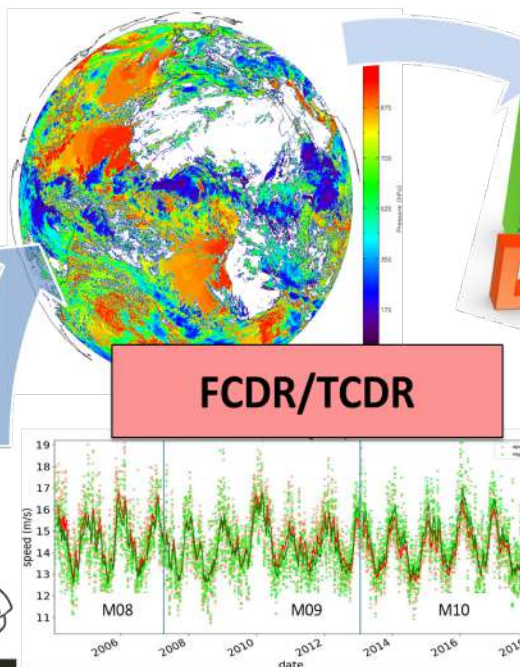
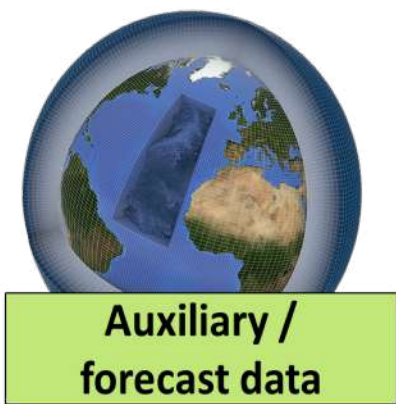
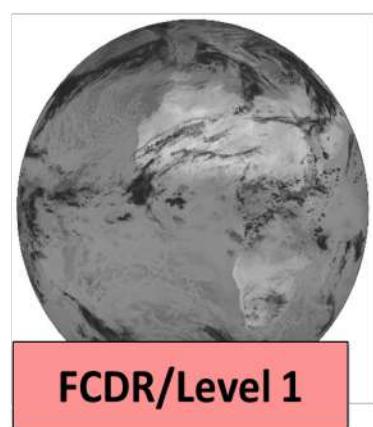
Reprocessing CDR – the main reasons to do it

A Climate Data Record is a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change.

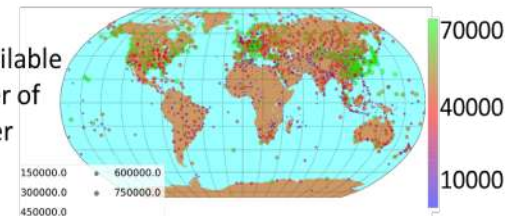




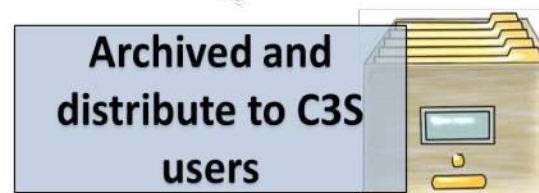
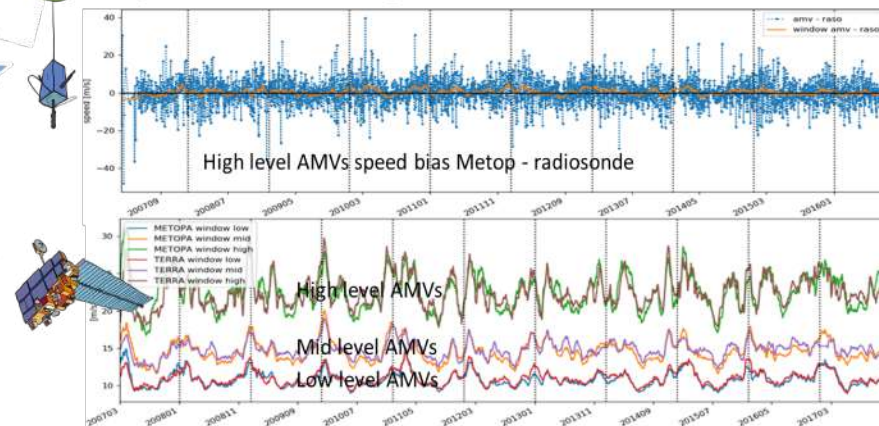
A complete sustainable production at EUMETSAT



RAOBCORE
observations available
scaled by number of
observations over
1980-2017



Example of a comparison against independent ground-based and satellite data: example of Metop-A AMVs speed over Arctic against RAOBS and MODIS



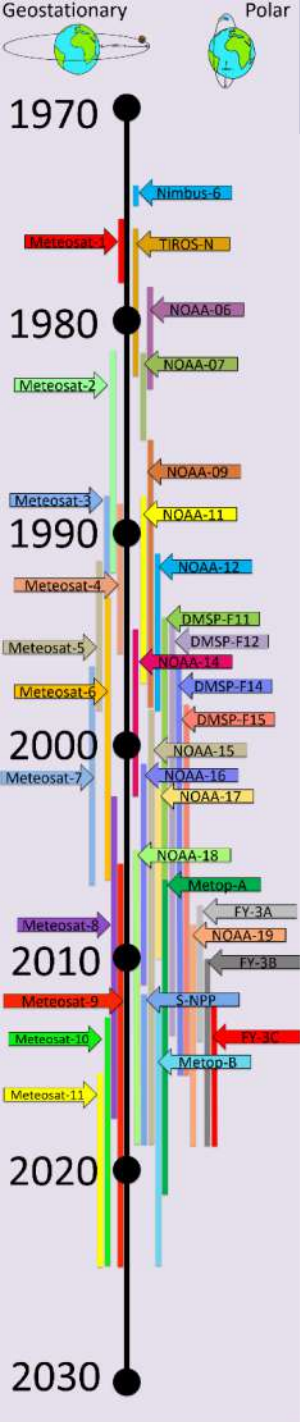
Climate Data Store



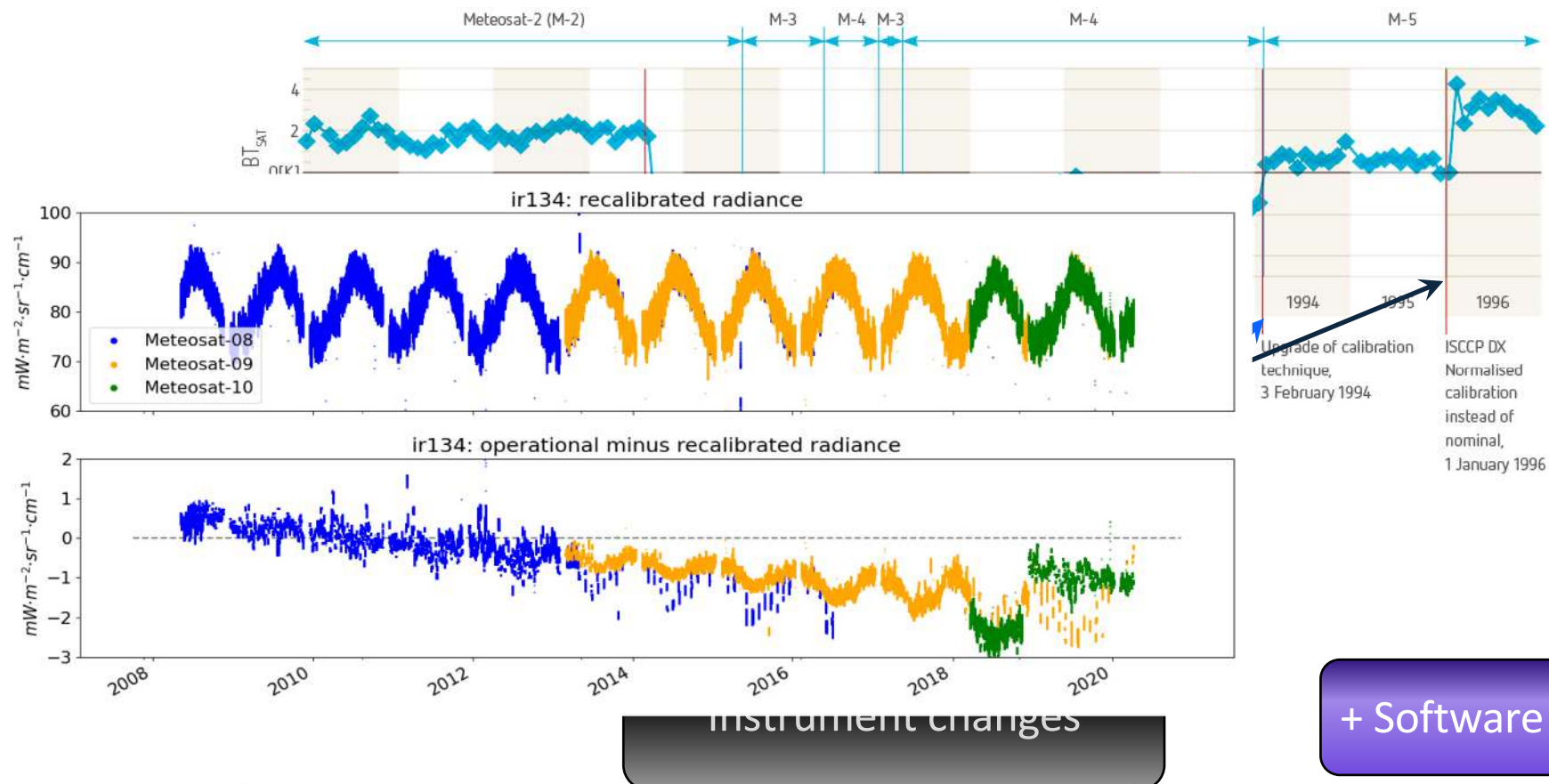
It must be **fast**, the processing
requirement is **1 year per day**

<https://data.eumetsat.int/>

<https://cds.climate.copernicus.eu/>



Creation of Climate Data Records



Time series of recalibrated radiance for IR channel 13.4 μm and MSG satellites 8-10. The upper plot shows recalibrated radiance, the lower plot operational minus recalibrated radiance.

Courtesy: Rob Roebeling



EUMETSAT's Satellite Application Facilities (SAFs)



Atmospheric composition data records from visible and infrared sounders
(e.g.: ECVs of greenhouse gases, aerosols, water vapour)



Atmospheric data records based on radio occultation data
(e.g.: ECVs of temperature and humidity profiles)



Land and atmospheric data records from imaging and/or microwave sensors
(e.g.: ECVs of cloud properties, precipitation, solar radiation, water vapour)



Land surface data records from imaging sensors
(e.g.: ECVs of land surface temperature, heat fluxes, vegetation)



Water cycle related data records from imagers, microwaves and/or scatterometers
(e.g.: ECVs of precipitation, soil moisture)



Ocean quantities data records from imagers, microwaves, scatterometer, and/or radars
(e.g.: ECVs of sea ice concentration, sea surface temperature, wind)

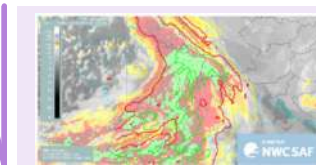
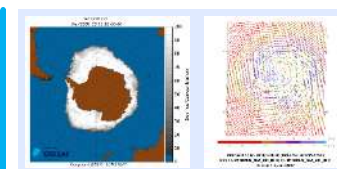
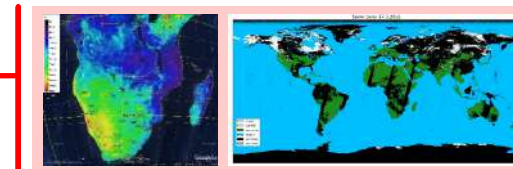
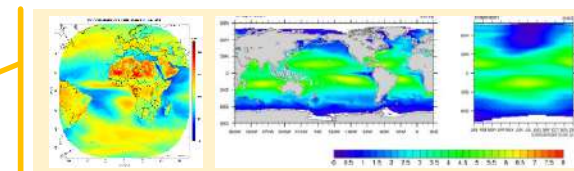
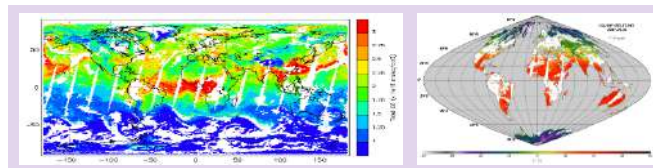


Software of generating nowcasting products from passive imaging satellites



Software for making radiative transfer simulations

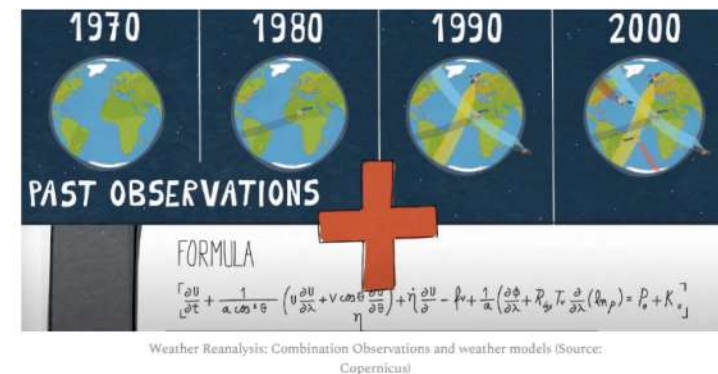
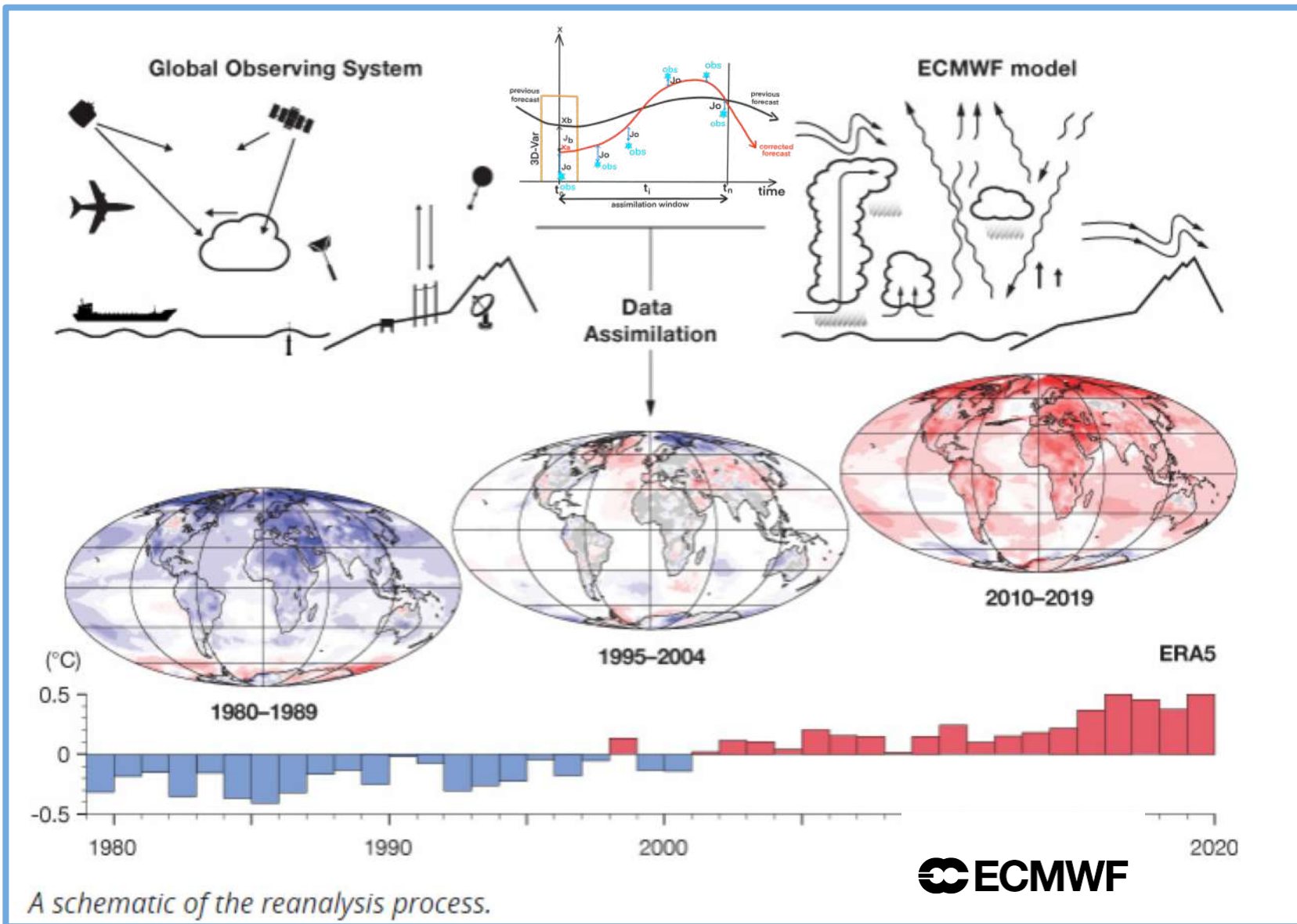
220 published ECV data records (April 2023)
See <https://www.eumetsat.int/eumetsat-data-store>





Usage in reanalyses ‘maps without gaps’

The main usage of the satellite reprocessed data is to be assimilated in the next generation of reanalyses. Reanalysis is an effective way of providing estimates of climate variables which are difficult to measure using in situ or satellite-based methods.

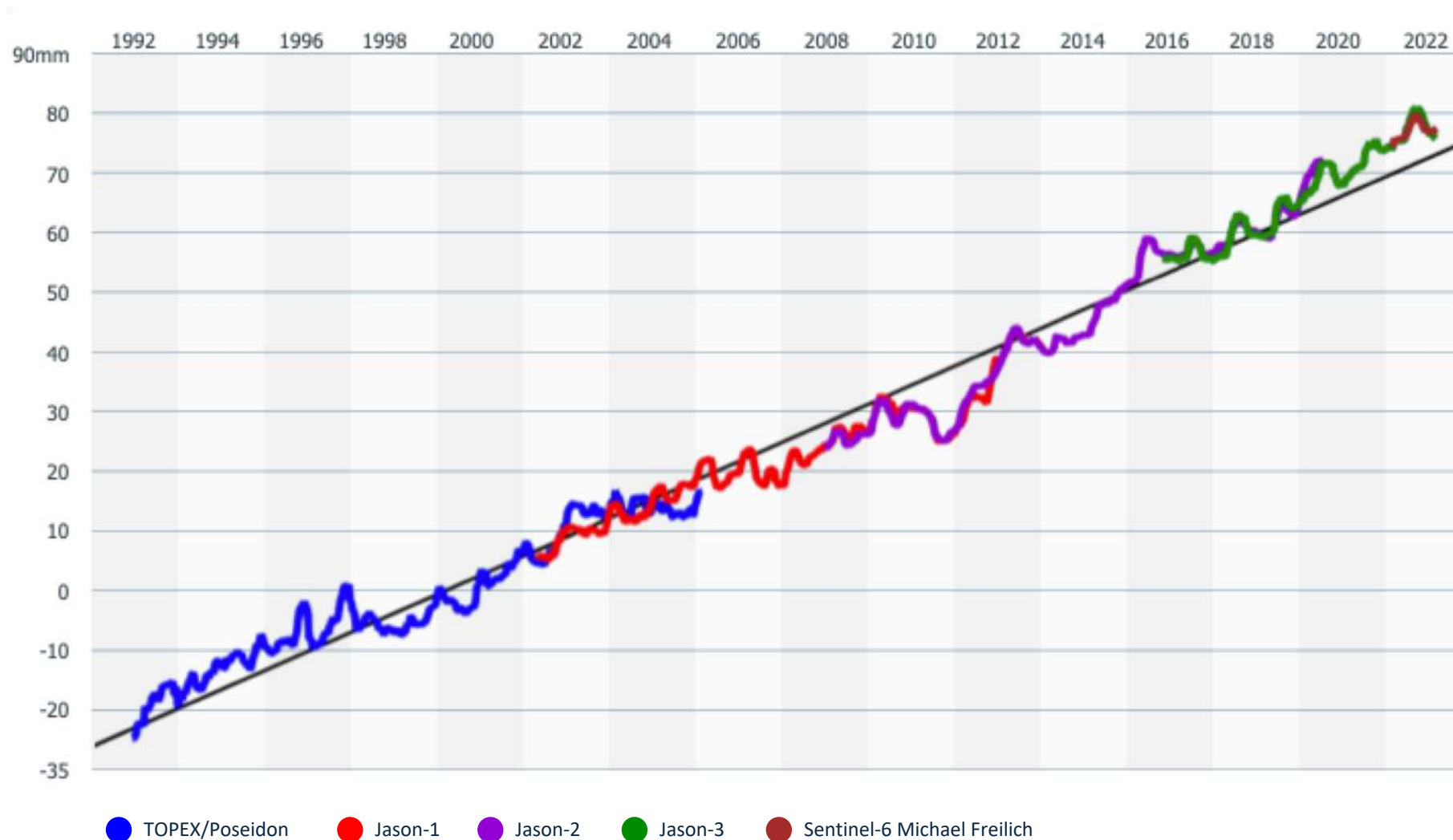


<https://climate.copernicus.eu/climate-reanalysis>





Jason missions: contribution to mean sea level observations



Overall trend: 3.29mm/yr
Core altimeters up to 66 latitude
Corrected for G/A
Annual signal removed



Climate Monitoring SAF (CM SAF)



Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the
Environment



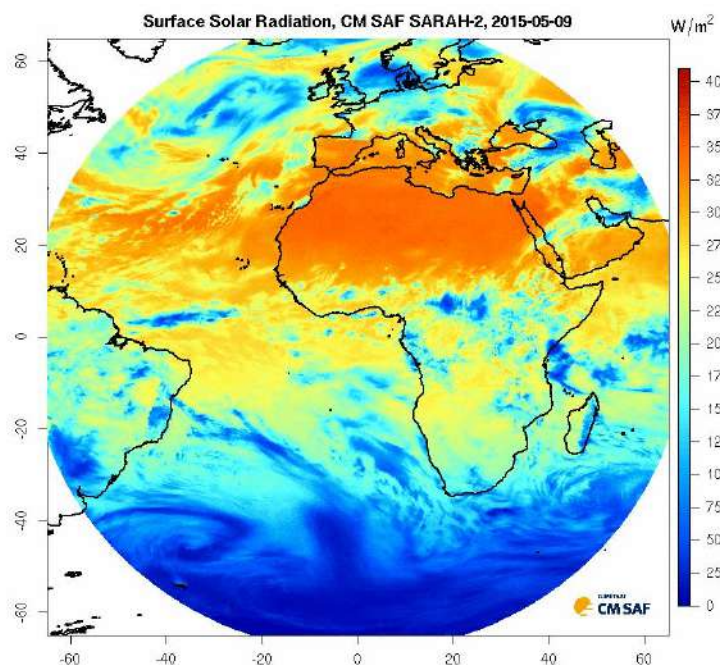
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Federal Department of Foreign Affairs FDFA
Federal Office of Meteorology and Climatology MeteoSwiss



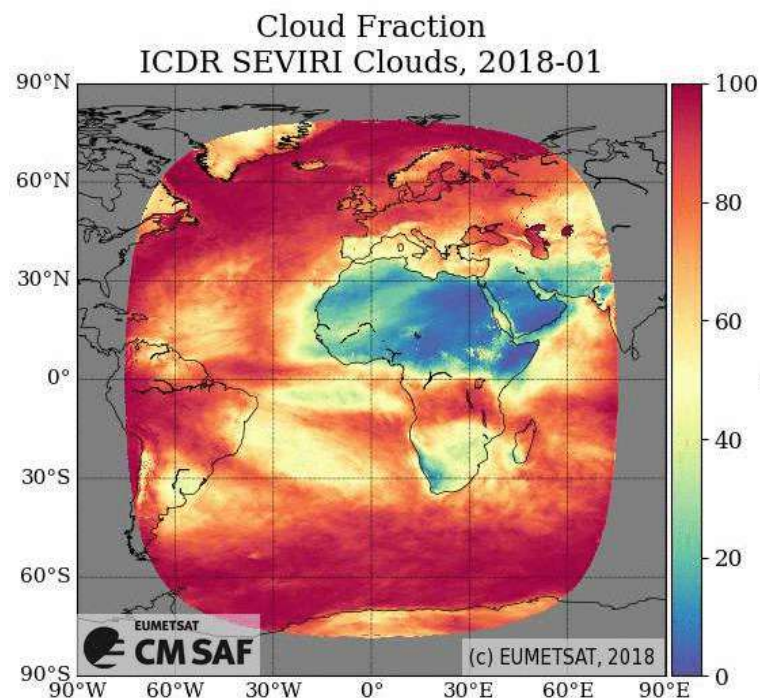
QR code to
access Sarah-3
CDR

CM SAF is a consortium of eight European meteorological services with Deutscher Wetterdienst (DWD, Germany) as the leading entity.

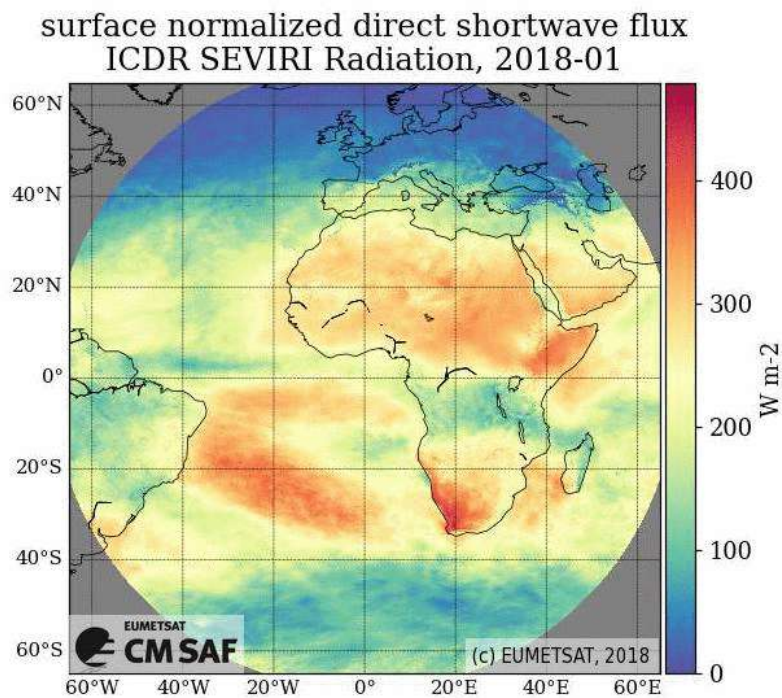
Get the data here: http://dx.doi.org/10.5676/EUM_SAF_CM/SARAH/V003



Surface solar incoming
radiation from SARAH-2 data
record, 2015



Cloud fraction derived
from SEVIRI data, 2018



Surface normalized direct
shortwave flux from SEVIRI data,
2018

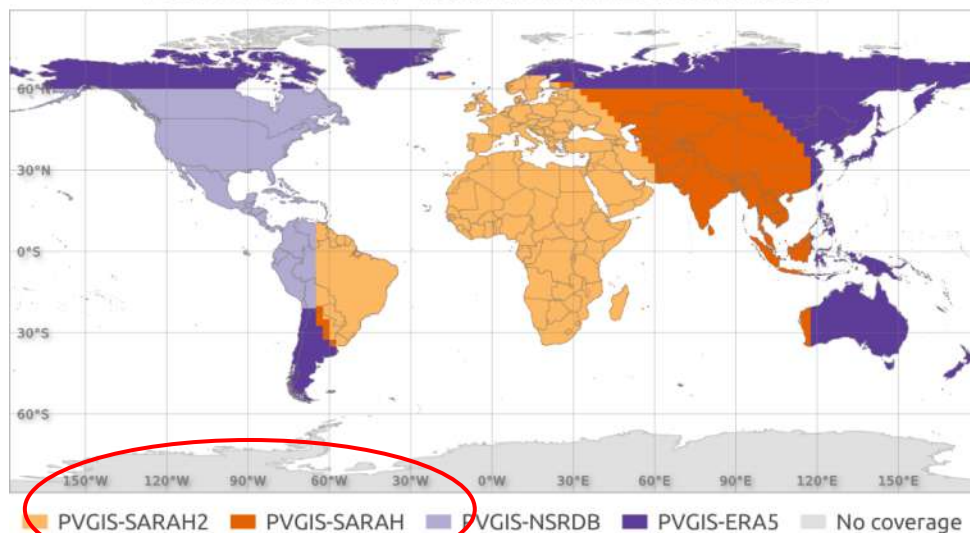


Use Cases: from SARAH-3 to PVGIS tool

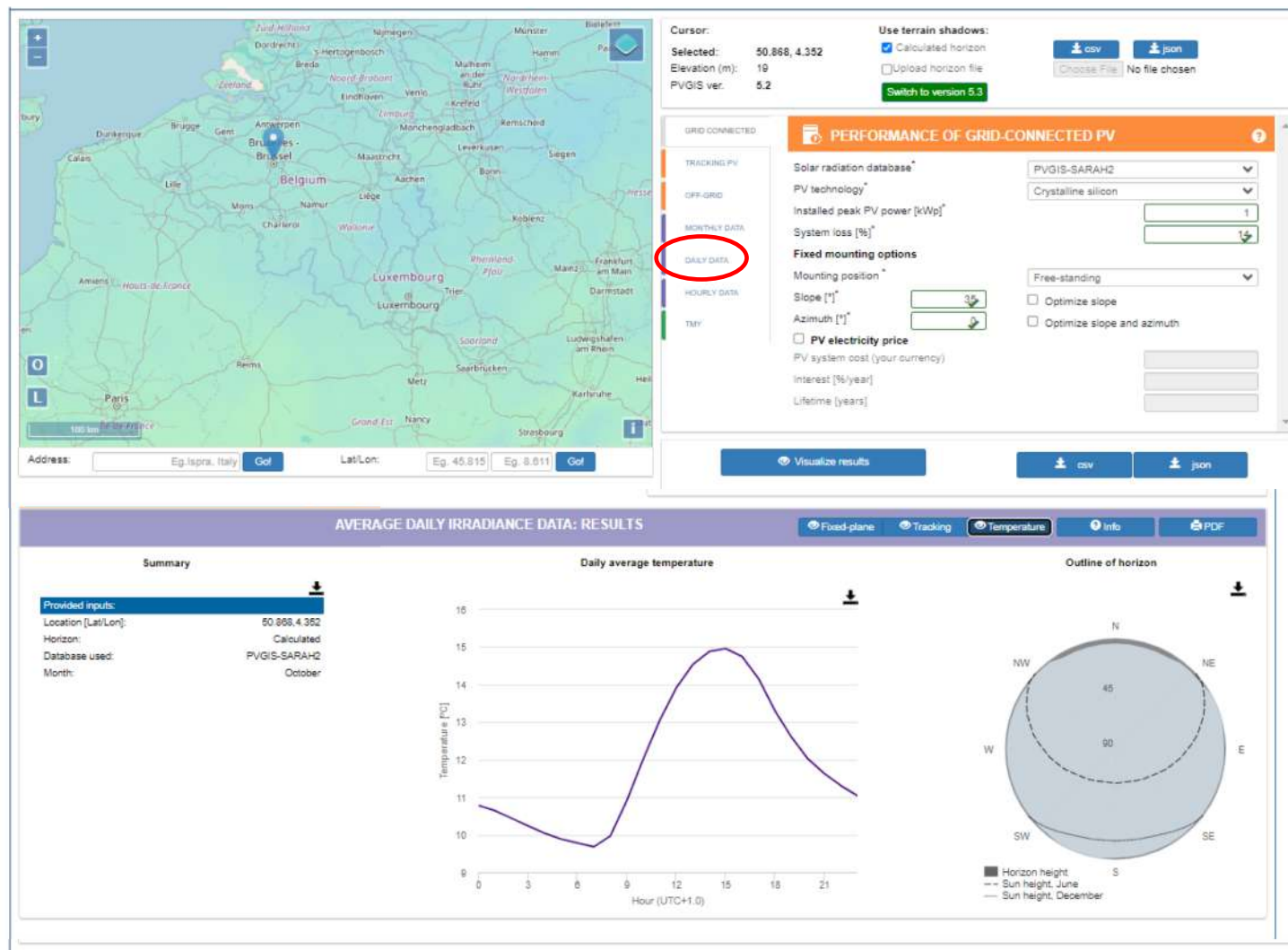
Information System for global PhotoVoltaic potential – PVGIS https://re.jrc.ec.europa.eu/pvg_tools/en/



Default Solar Radiation Databases



© European Union 2022





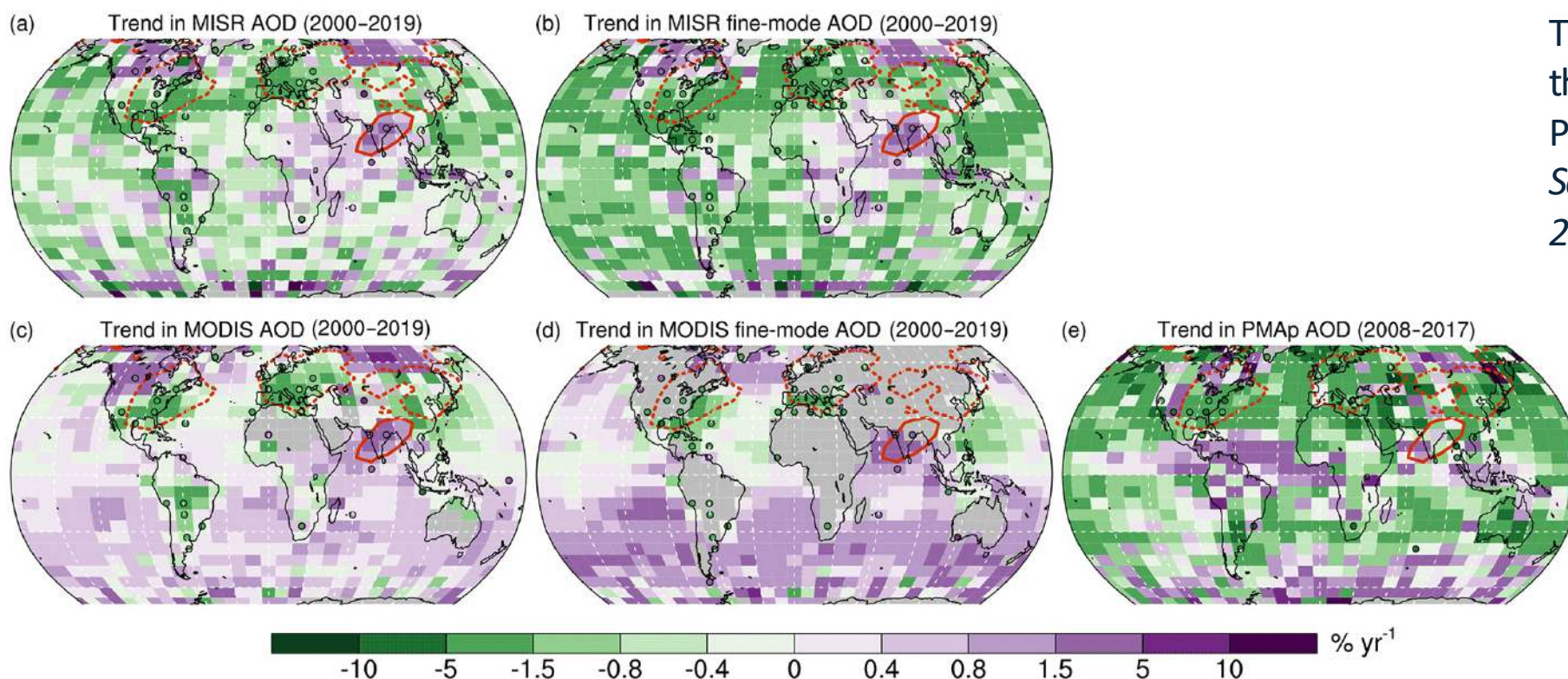
To analyse climate change: trend analysis

AOD CDR has been retrieved from several instruments.

It is the same but not the same...

Some work is still needed to understand the differences

Linear trends (2000–2019) of aerosol optical depth (AOD)



Quaas et al. (Leipzig University) has used satellite data to demonstrate that concentrations of pollutant particles have decreased significantly since the year 2000. This is necessary due to their impact on health. But it is also of great significance for another reason, since it has reduced the particles' cooling effect on the climate. The study findings have been published in the journal *Atmospheric Chemistry and Physics*.

See Quaas et al. *ACP*, 22, 12221–12239, 2022



Key messages

- Satellites observations cover more than 40 years.
- Satellites observations are (Quasi)Global and satellites sample, mostly, the Earth surface regularly in space and time
- Space based observations with undoubted quality play a supporting role in the implementation of the Paris Agreement together with ground-based observations and modelling.
- Space agencies provide long-term observations for many GCOS Essential Climate Variables (ECV). Data access is globally full, free and open for more than 90% of the data records.
- Through the systematic implementation of the Architecture for climate monitoring from space, EUMETSAT now provides ~25% of all available Climate Data Records.
- EUMETSAT's planned missions between 2020 and 2050 secure continuation of the past and present programs.
- EUMETSAT's planned missions between 2020 and 2050 set new standards for observing weather and climate of our Earth oceans, atmosphere, and land surfaces.

Early Career Program and internship program

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Space 4



Check our website

<https://www.eumetsat.int/careers-eumetsat/early-career-programme>

3 positions to be open in October + 9 internships opportunities



FOLLOW US



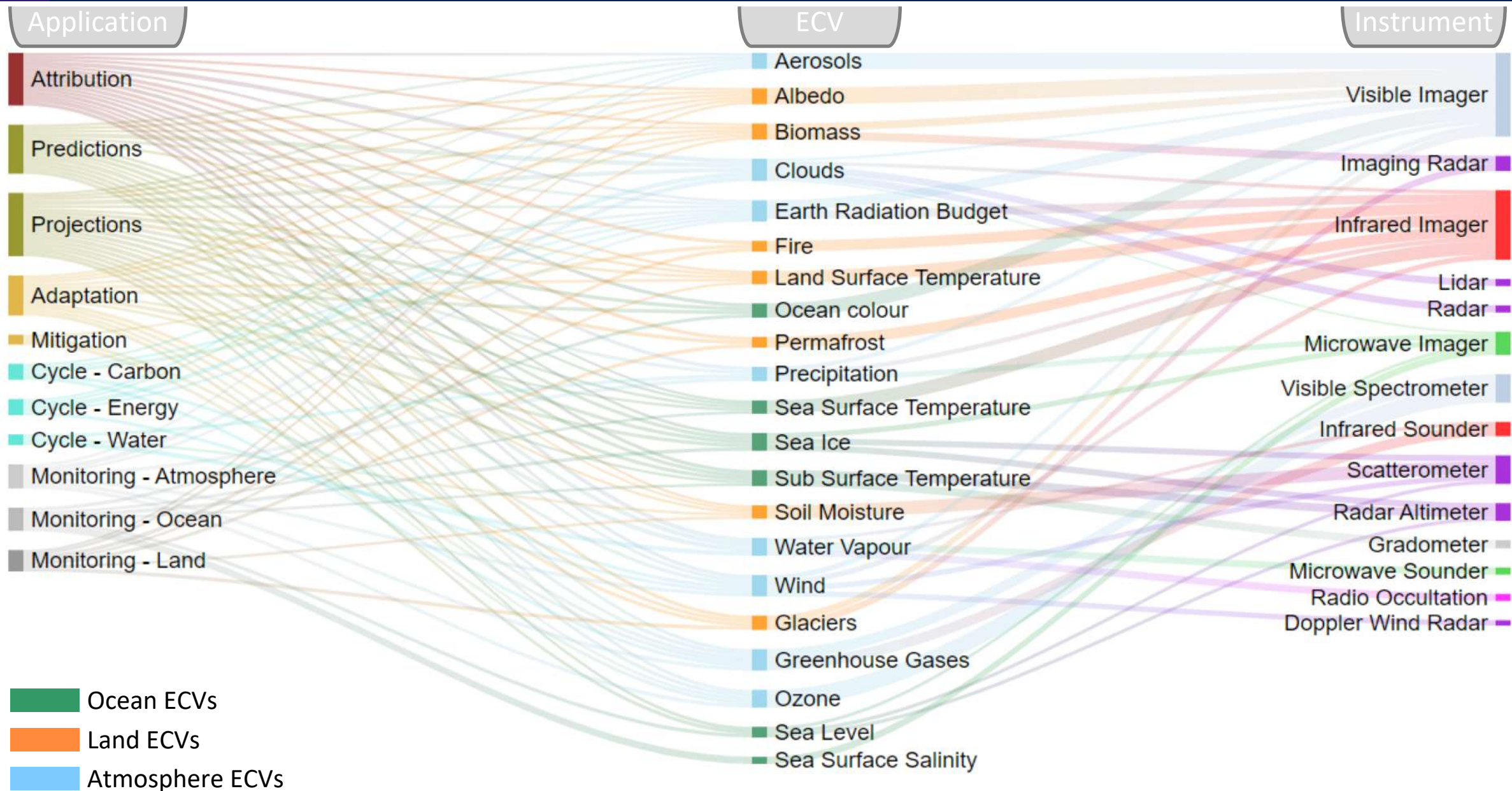
Meet EUMETSAT at the booth !

Spare slides

Switch ^{to}
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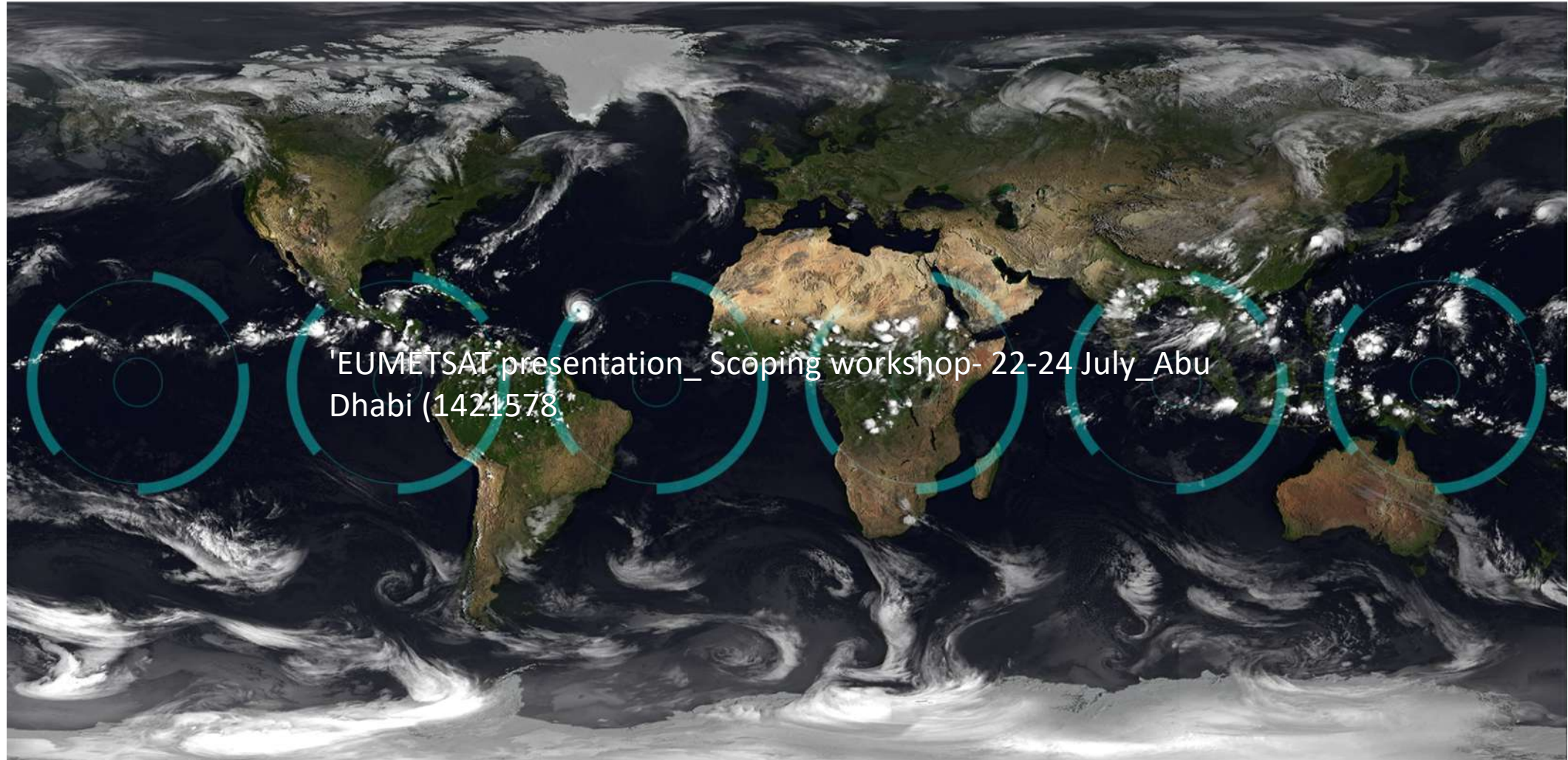


Linking applications to ECVs to satellites (Sankey Plot)





The value of international cooperation: “the GEO ring”



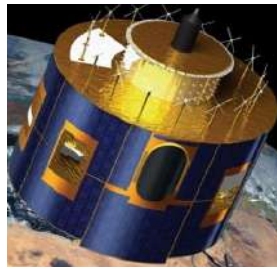


The EUMETSAT satellite fire constellation & associated users

- GEOstationary and global observation (LEO – Low Earth Orbit)
- Complementing American observation system

European
NRT
satellite
Fires
providers

GEO
LEO
(Morning)



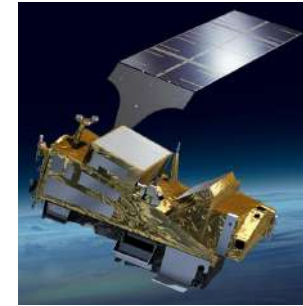
**Meteosat 2nd
Generation**



Sentinel-3



**Meteosat 3rd
Generation**



**European Polar
System
2nd Generation**



**Sentinel-3 New
Generation**

- OPERational science:
 - High stability (24h, 7 days)
 - Very fast (Near Real Time, < 3h)
 - Very high quality
 - Support to user needs / requests
 - Continuous evolution
 - Continuous validation + quality monitoring
 - Very reactive to alerts



Summer 2023 – Fires and Hazards



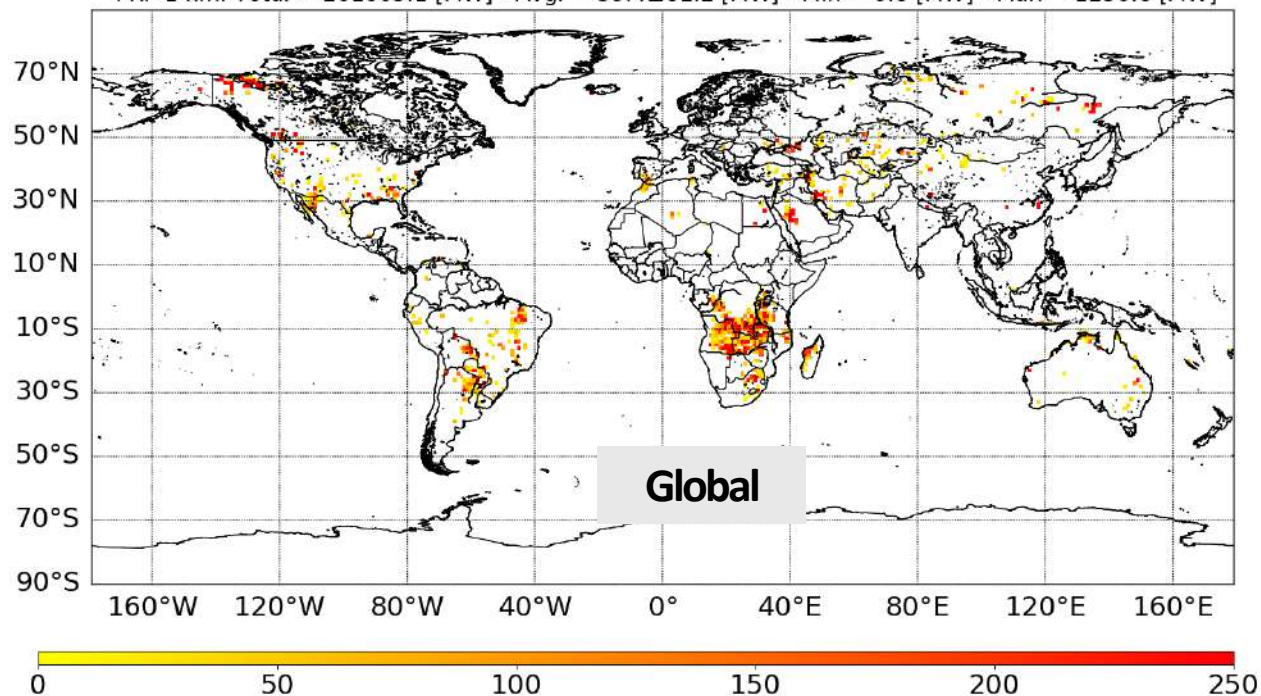
Copernicus
Europe's eyes on Earth

Sentinel-3 A+B SLSTR - Standard FRP MWIR [MW] - Day - 1.0 deg resolution - 01.08.2023

Total number 1 km hot-spots = 5118



FRP 1 km: Total = 201665.1 [MW] - Avg. = 39.4 ± 81.2 [MW] - Min = 0.8 [MW] - Max = 1250.6 [MW]



Global

Hundreds of firefighters battle raging Greek wildfires

Gale-force winds and hot, dry conditions whip up flames and hamper firefighting efforts



❖ A forest burns near the village of Sykiorahi, near the city of Alexandroupolis, in Greece's north-eastern Evros region. Photograph: Achilles Chiras/AP

More than 600 firefighters, including reinforcements from several European countries, backed by a fleet of water-dropping planes and helicopters, are battling three major wildfires in Greece, two of which have been raging for days.

Sentinel-3 A+B SLSTR - Standard FRP MWIR [MW] - Day - 0.25 deg resolution - 23.08.2023

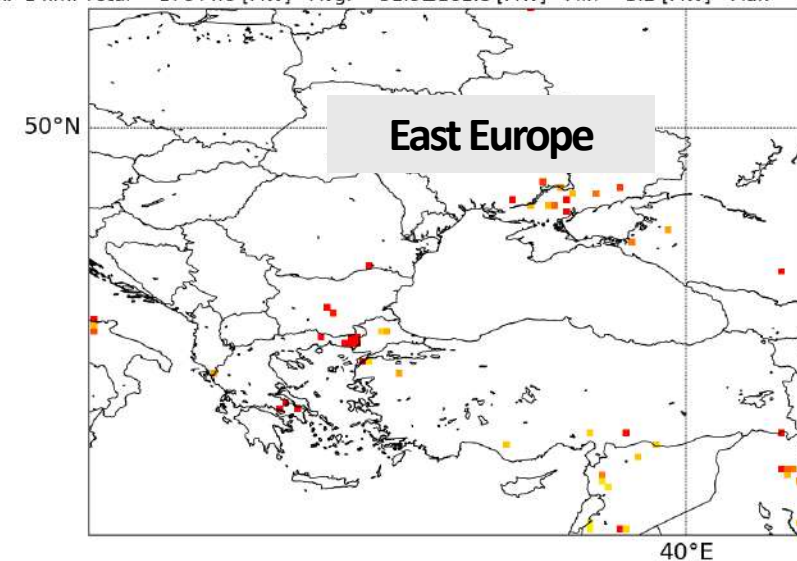


Copernicus
Europe's eyes on Earth

Total number 1 km hot-spots = 192



FRP 1 km: Total = 17644.6 [MW] - Avg. = 91.9 ± 161.8 [MW] - Min = 3.2 [MW] - Max = 1346.4 [MW]



East Europe



Sponsors

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