



# The EUMETSAT Satellite Programmes

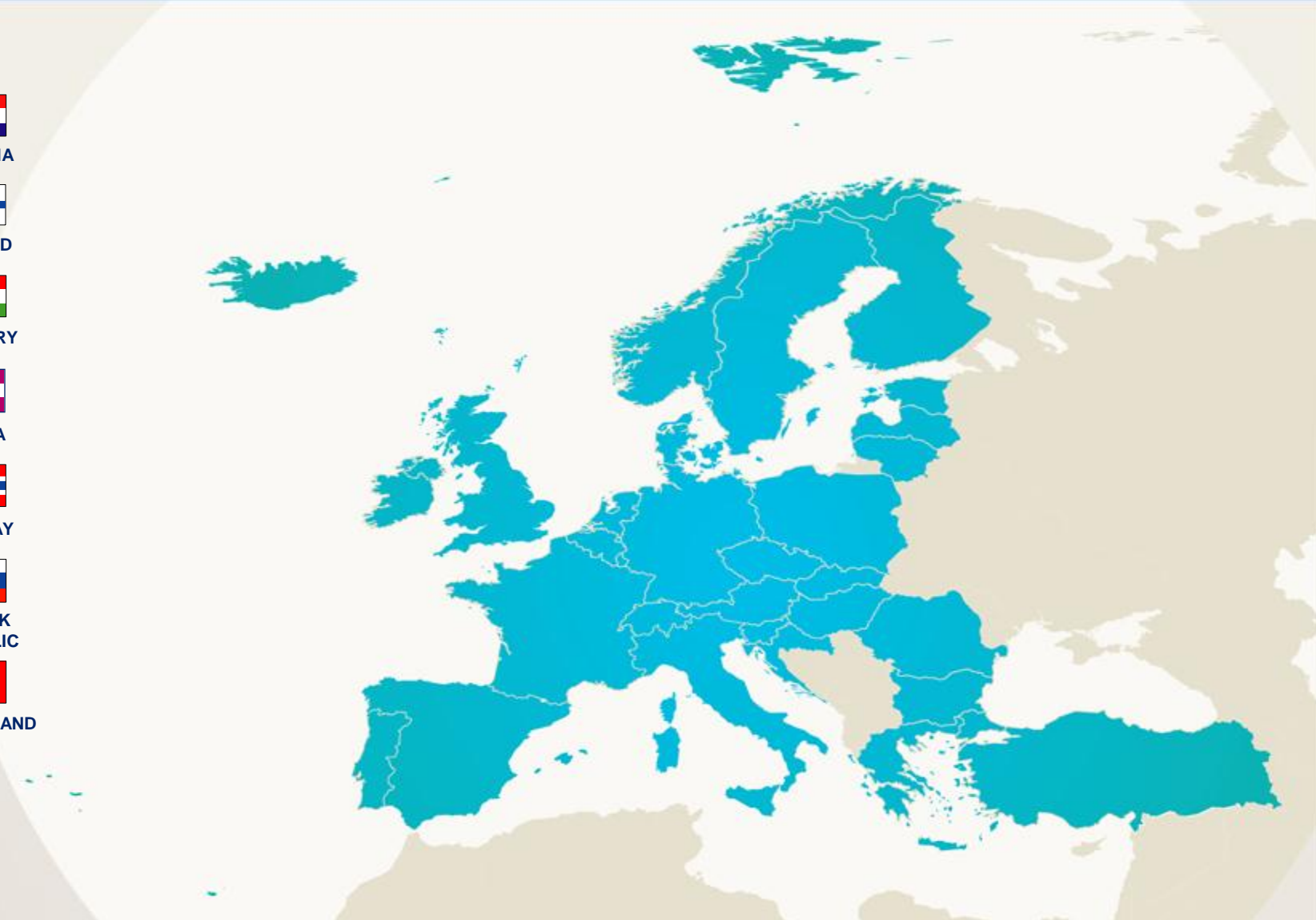
## An Integral part of the Operational Global Space-based Observing System

Dr Ken Holmlund  
Chief Scientist  
EUMETSAT



# EUMETSAT – an intergovernmental organization with 30 Member States

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



# EUMETSAT Mission and Vision

## Primary objective:

Establish, maintain and exploit European systems of meteorological satellites.

## Further objective:

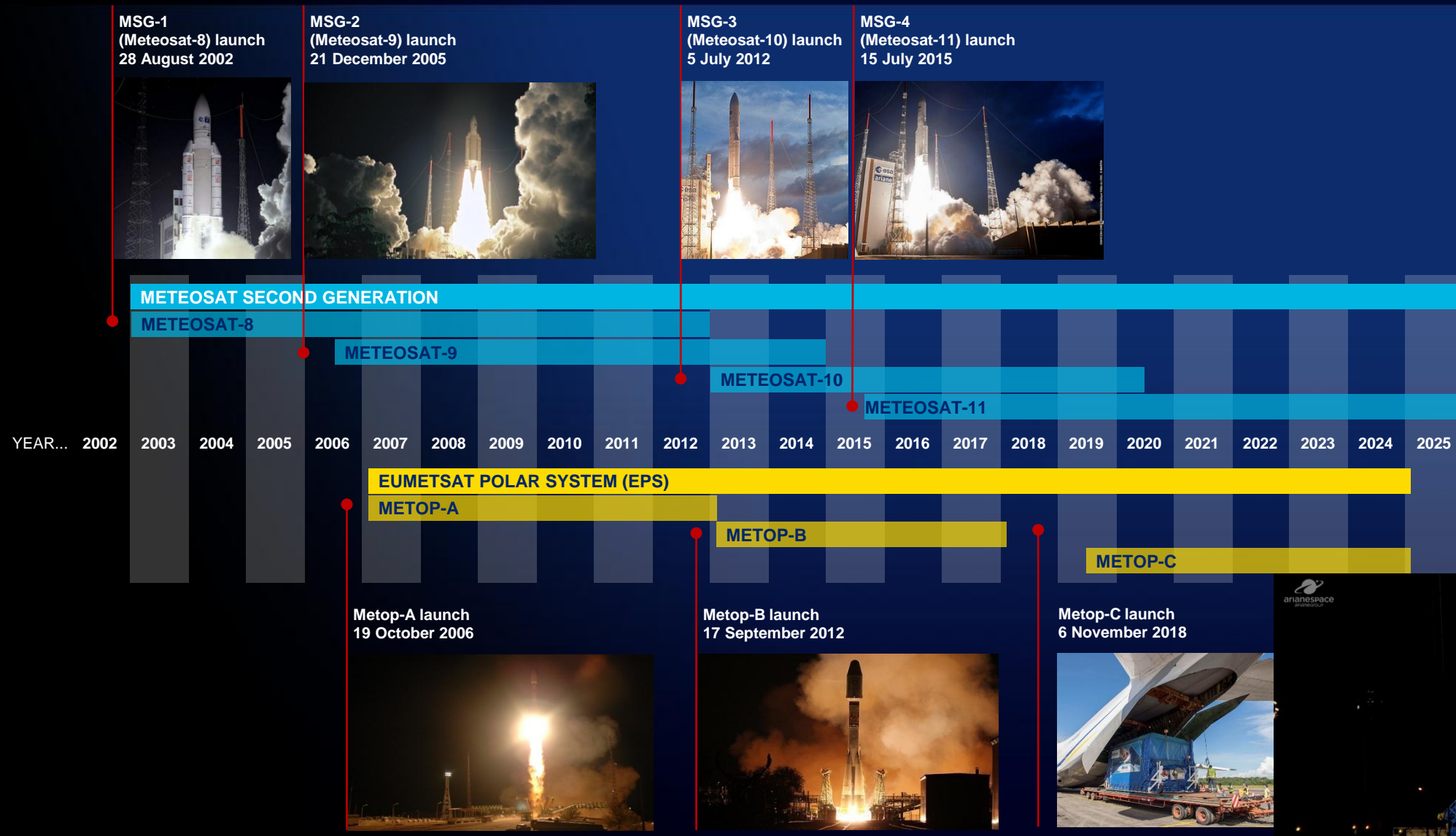
Contribute to the operational climate monitoring

## Vision:

Be the leading user-driven operational agency in Europe for Earth observation satellite programmes that fulfil the objectives of its Convention

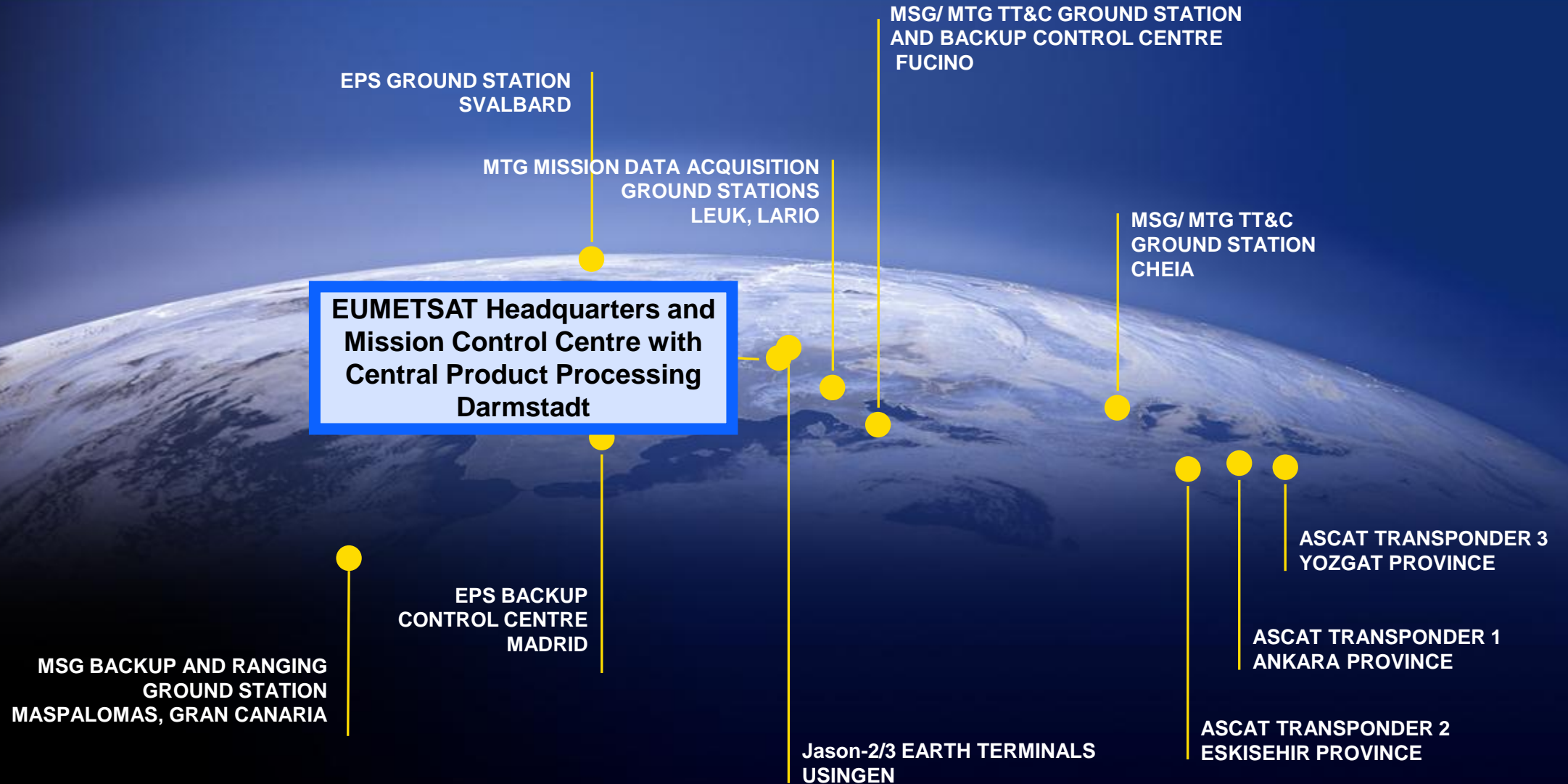
A trusted global partner for those outside Europe who share these objectives.

# Current Operational Mandatory Programmes





# EUMETSAT A distributed segment



# EUMETSAT Network of Satellite Application Facilities





# Benefit areas of weather forecasting



**Safety of life, property and infrastructure...**



**Transport ...**

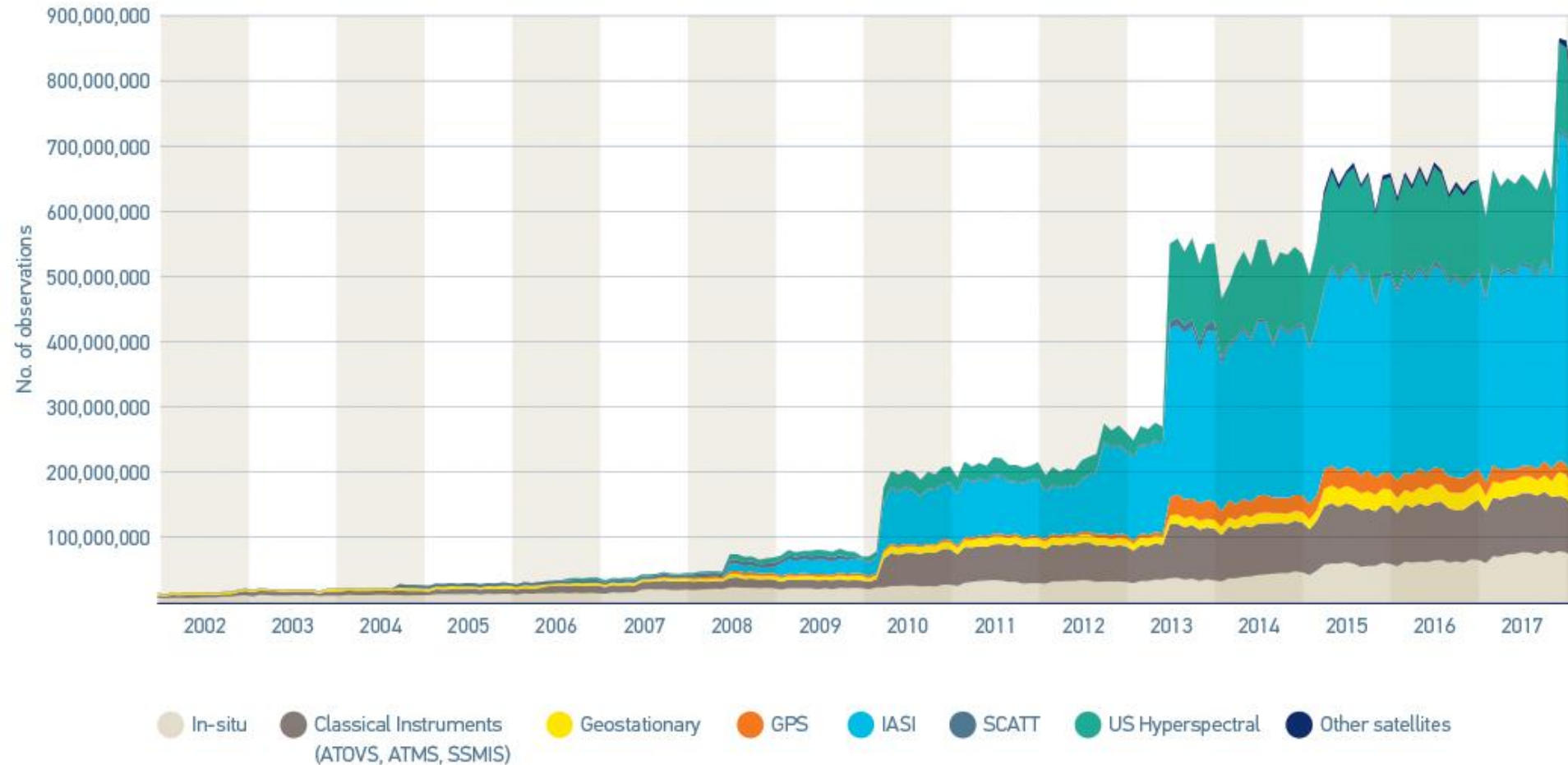


**....Energy, agriculture, tourism....**



**...Climate policy and environment protection**

# Metop satellites play a major role in global NWP



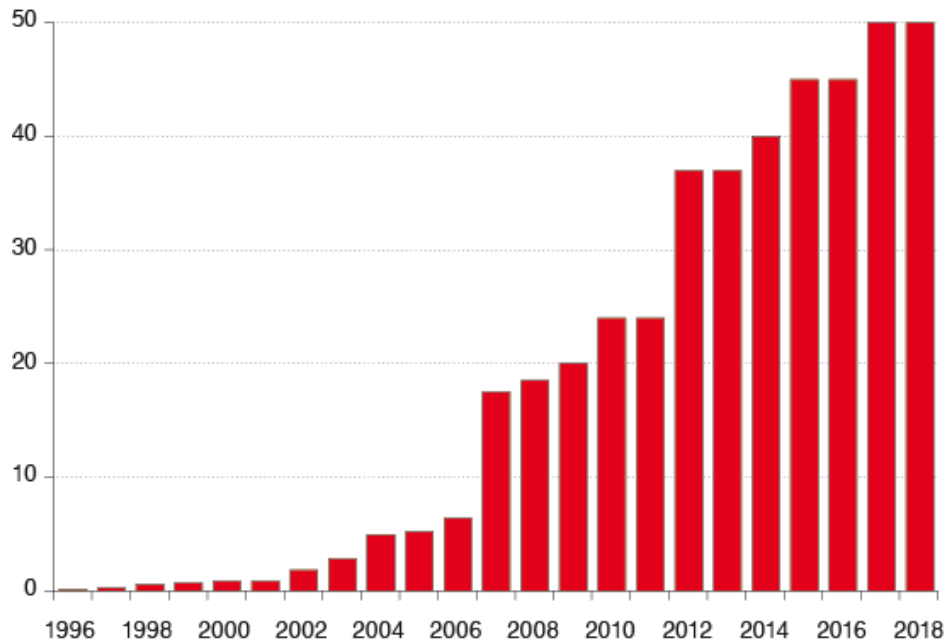
Monthly usage of observations in Météo-France global model ARPEGE

Source: Météo-France



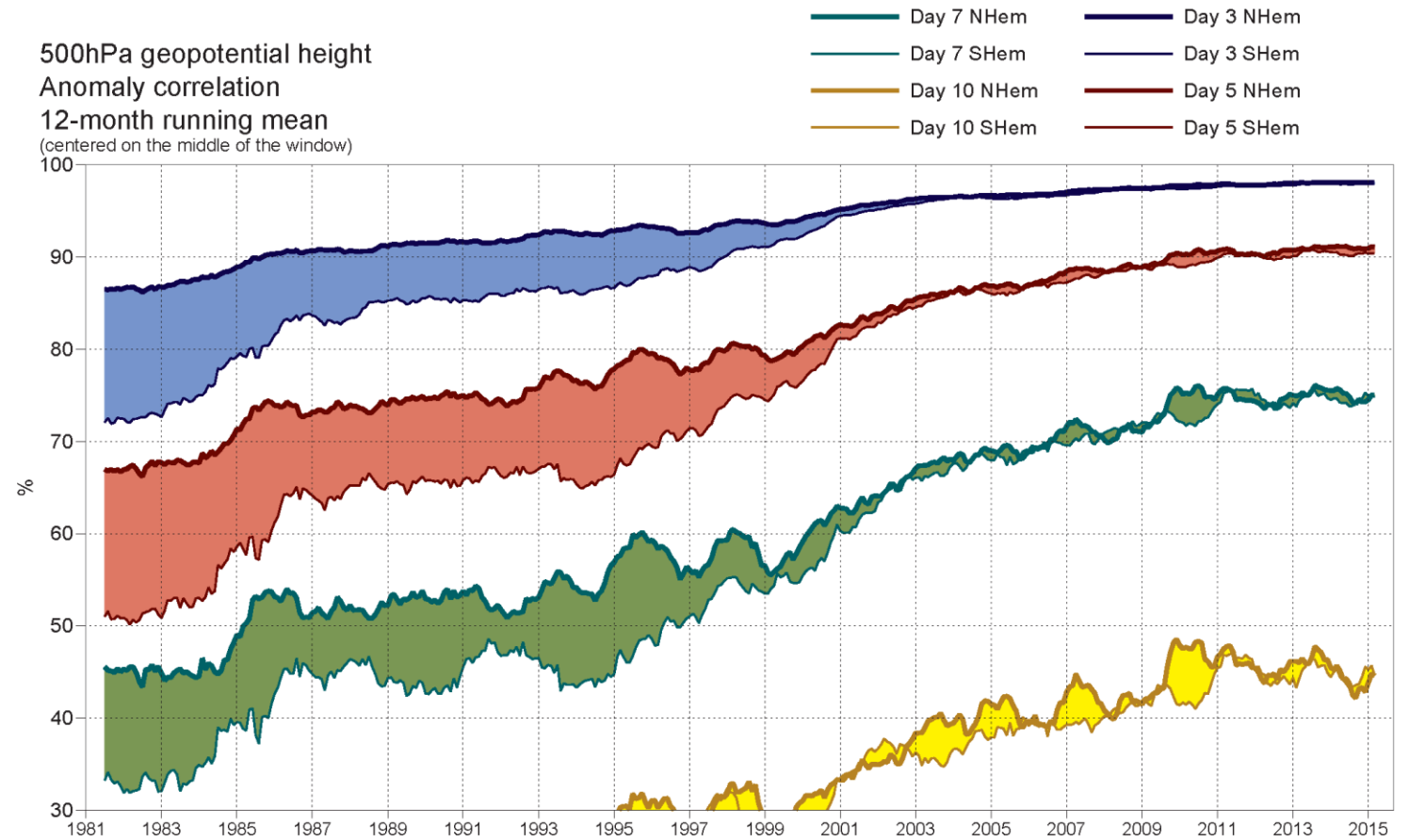
# ECMWF – Europe is a world leader of medium-range numerical weather prediction

Total number of observations monitored at ECMWF

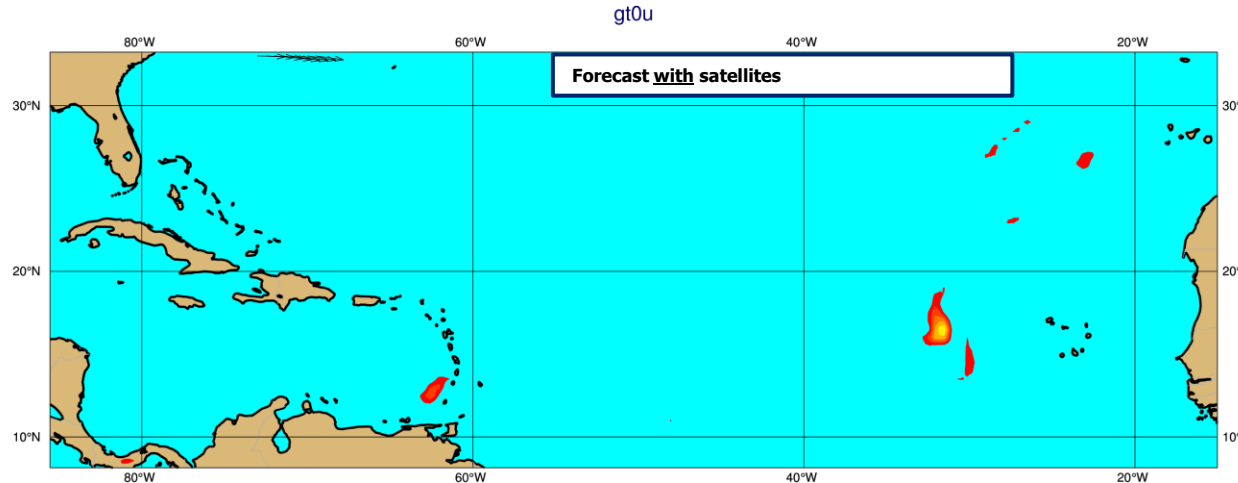


Source: ECMWF

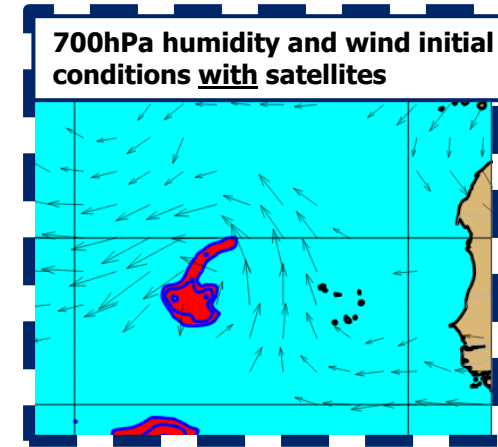
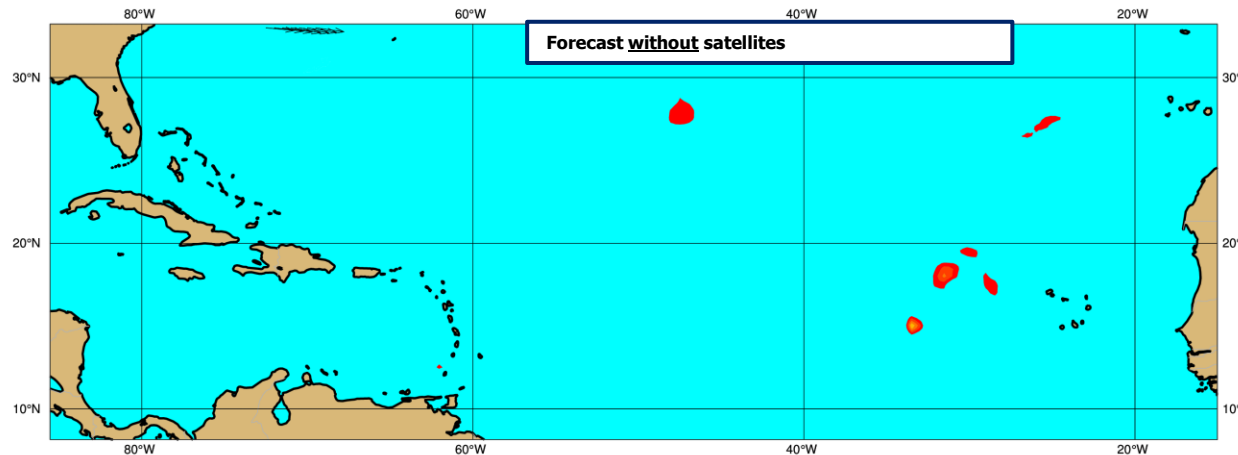
500hPa geopotential height  
Anomaly correlation  
12-month running mean  
(centered on the middle of the window)



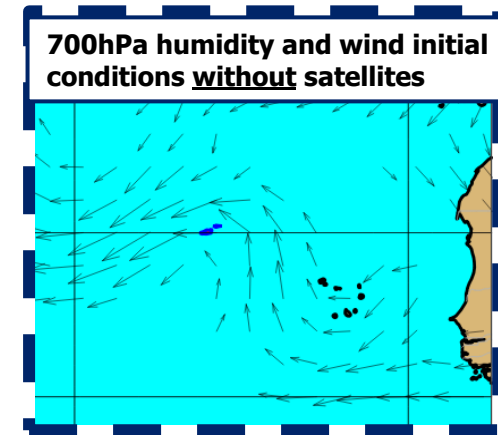
# Satellite contribution to forecasting IRMA



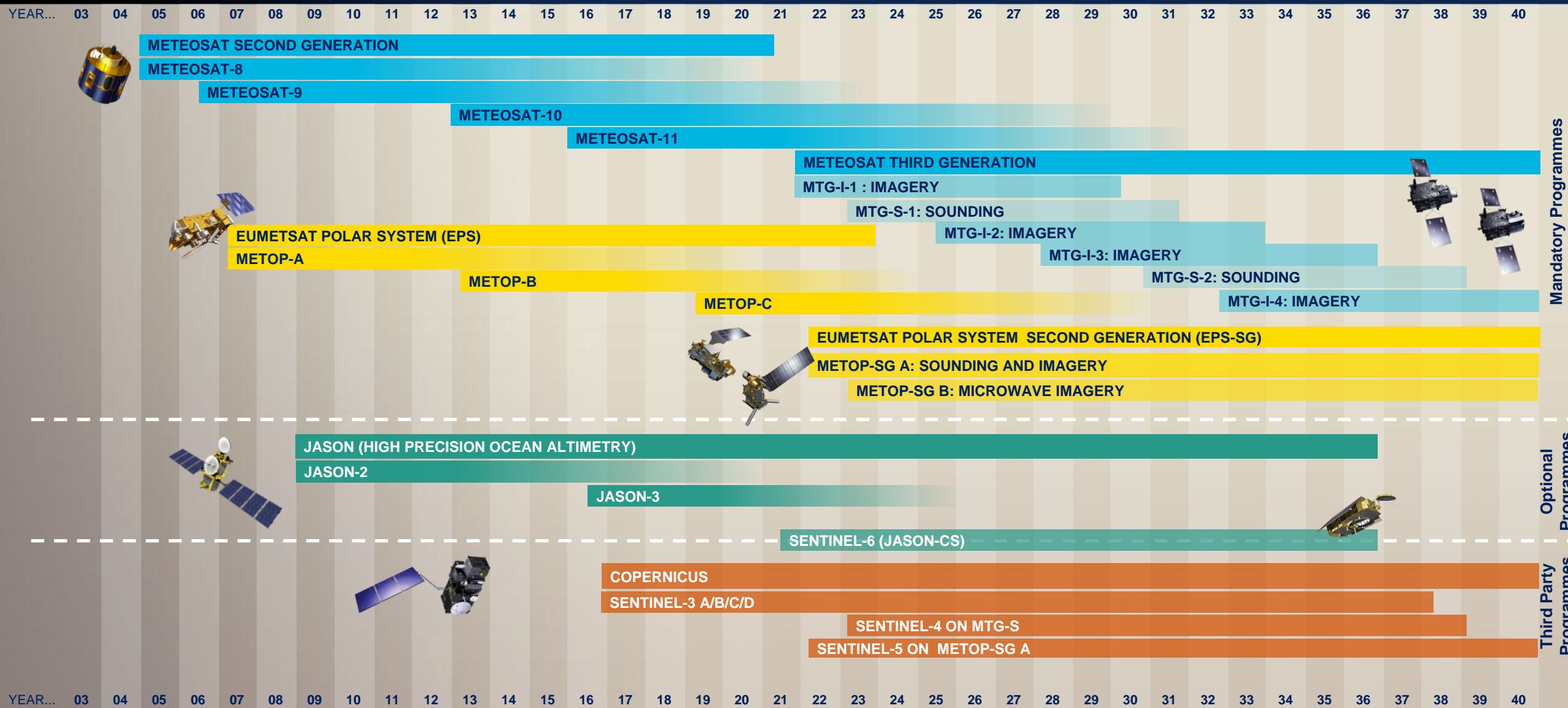
Thursday 31 August 2017 00 UTC ecmf 500 hPa Vorticity (relative)  
Thursday 31 August 2017 00 UTC ecmf 500 hPa U component of wind/V component of wind  
gt0v



Red shading humidity > 95%

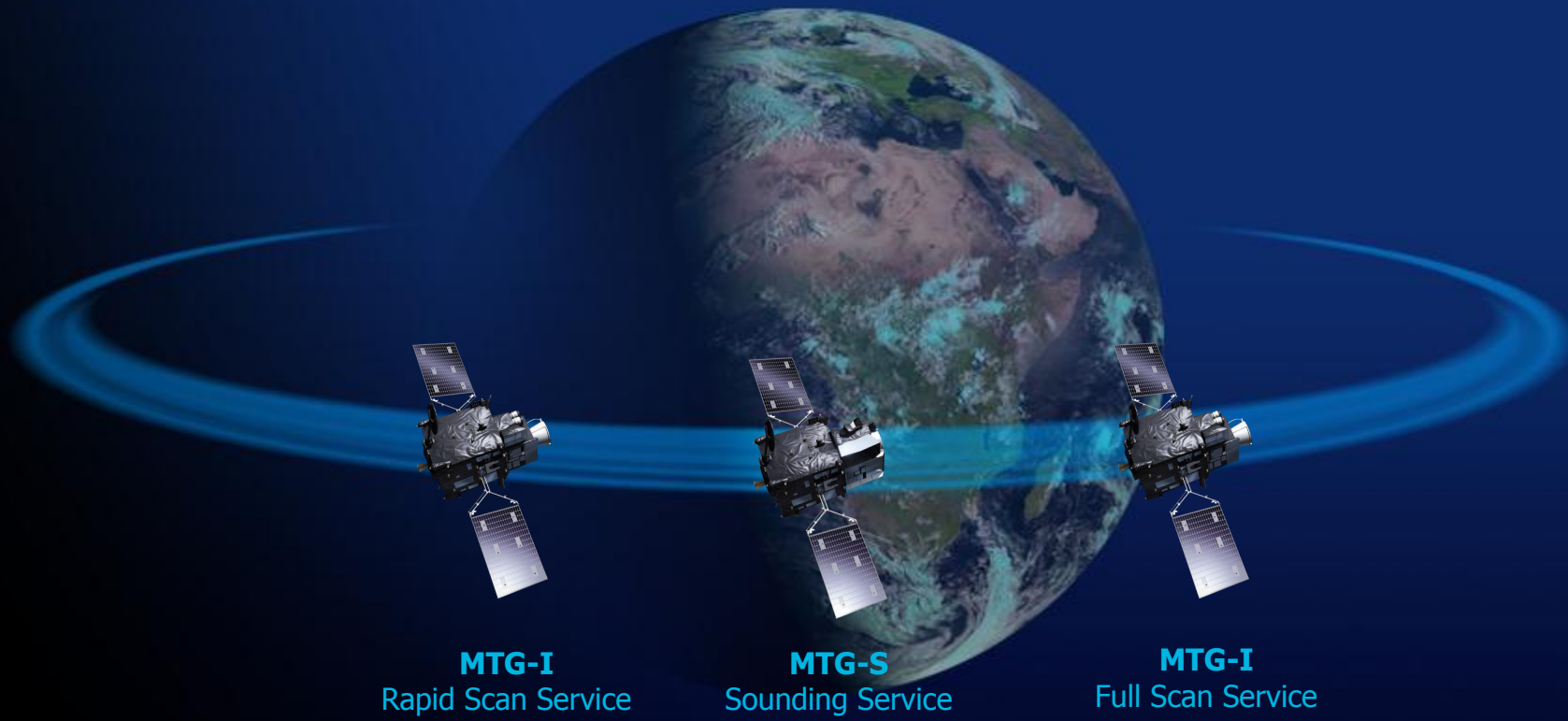


# EUMETSAT Mission Planning

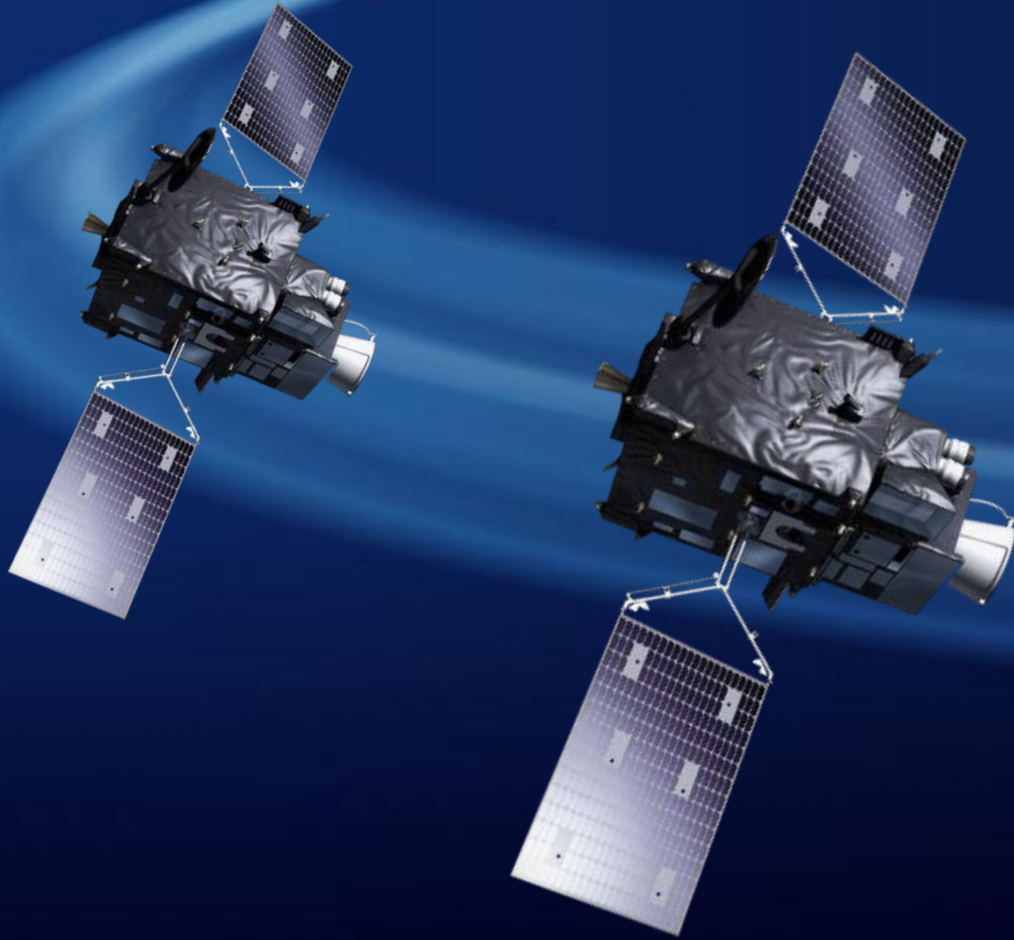




# MTG full operational configuration



# MTG-I imaging mission



- Imagery mission implemented by two MTG-I satellites
- Full disc imagery every 10 minutes in 16 bands
- Fast imagery of Europe every 2.5 minutes
- New Lightning Imager (LI)
- Start of operations in 2021
- Operational exploitation: 2021-2042

# MTG-S sounding mission

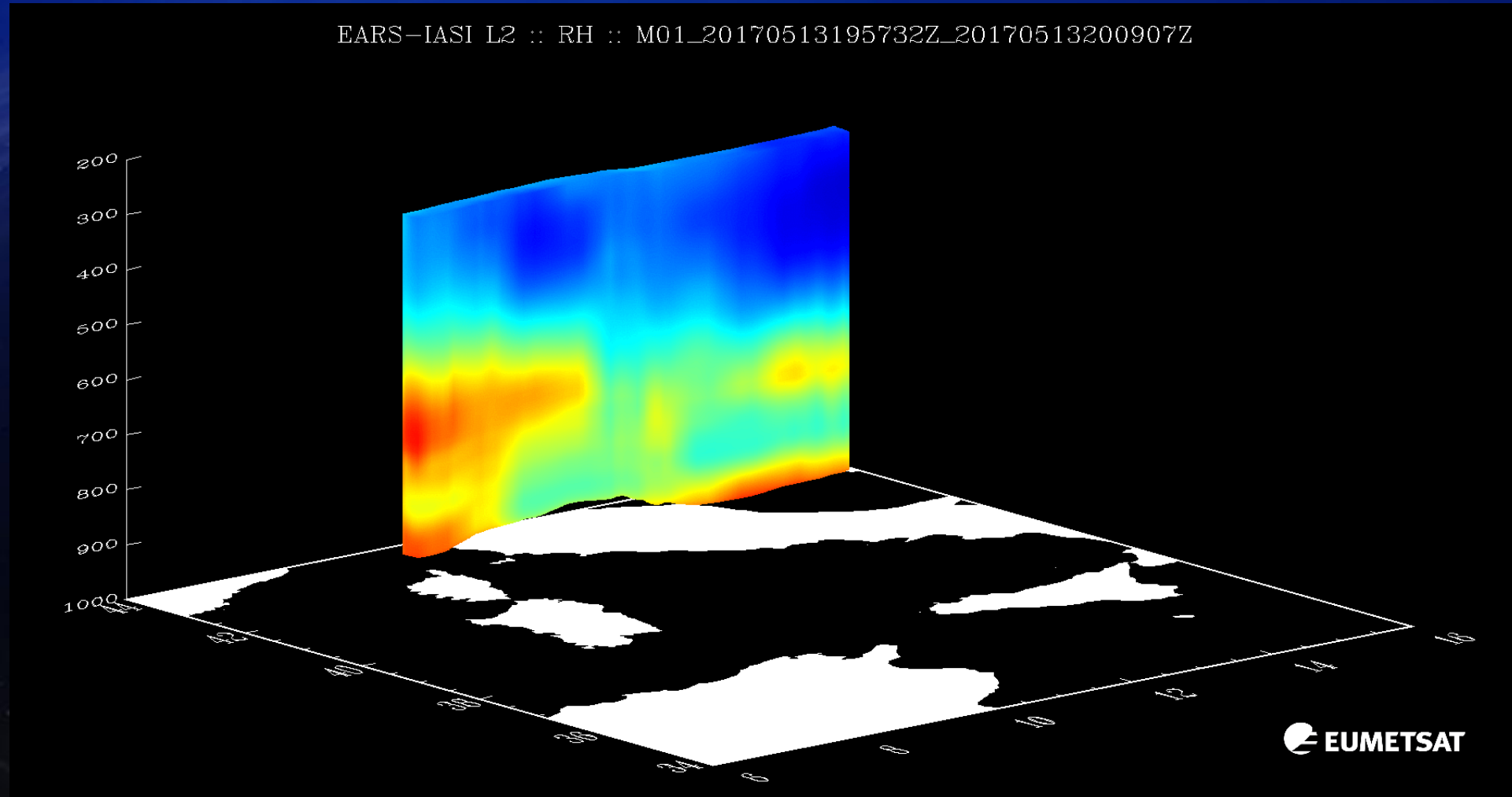


- Hyperspectral infrared sounding mission
- 3D weather cube: temperature, water vapour, O<sub>3</sub>, every 30 minutes over Europe
- Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument
- Start of operations in 2023
- Operational exploitation: 2023-2042



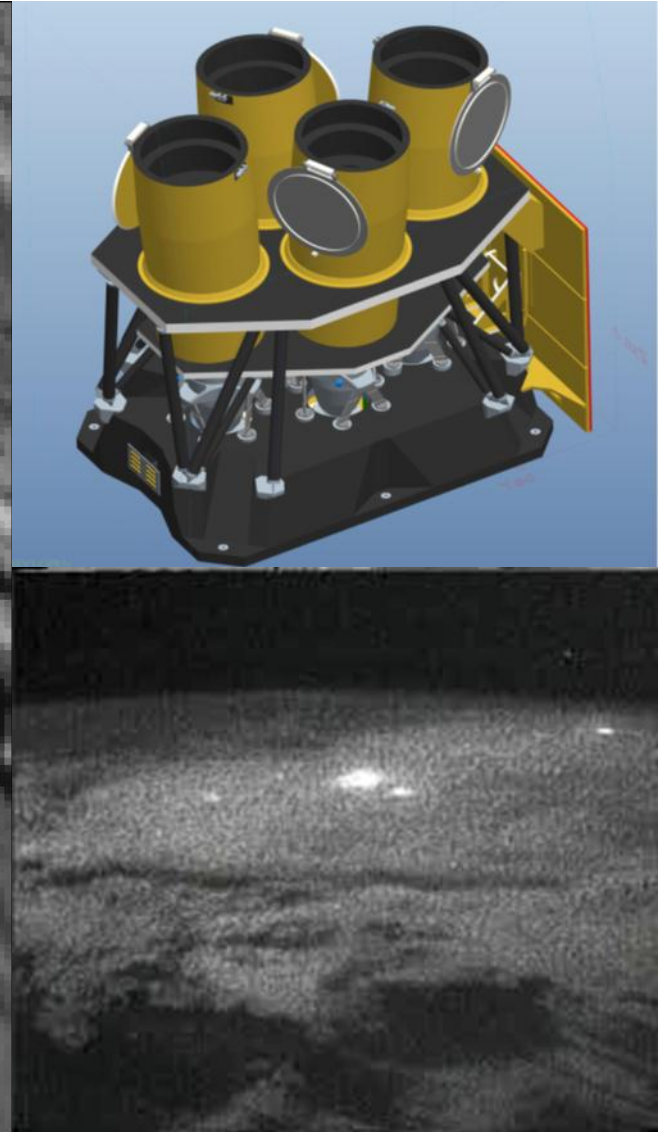
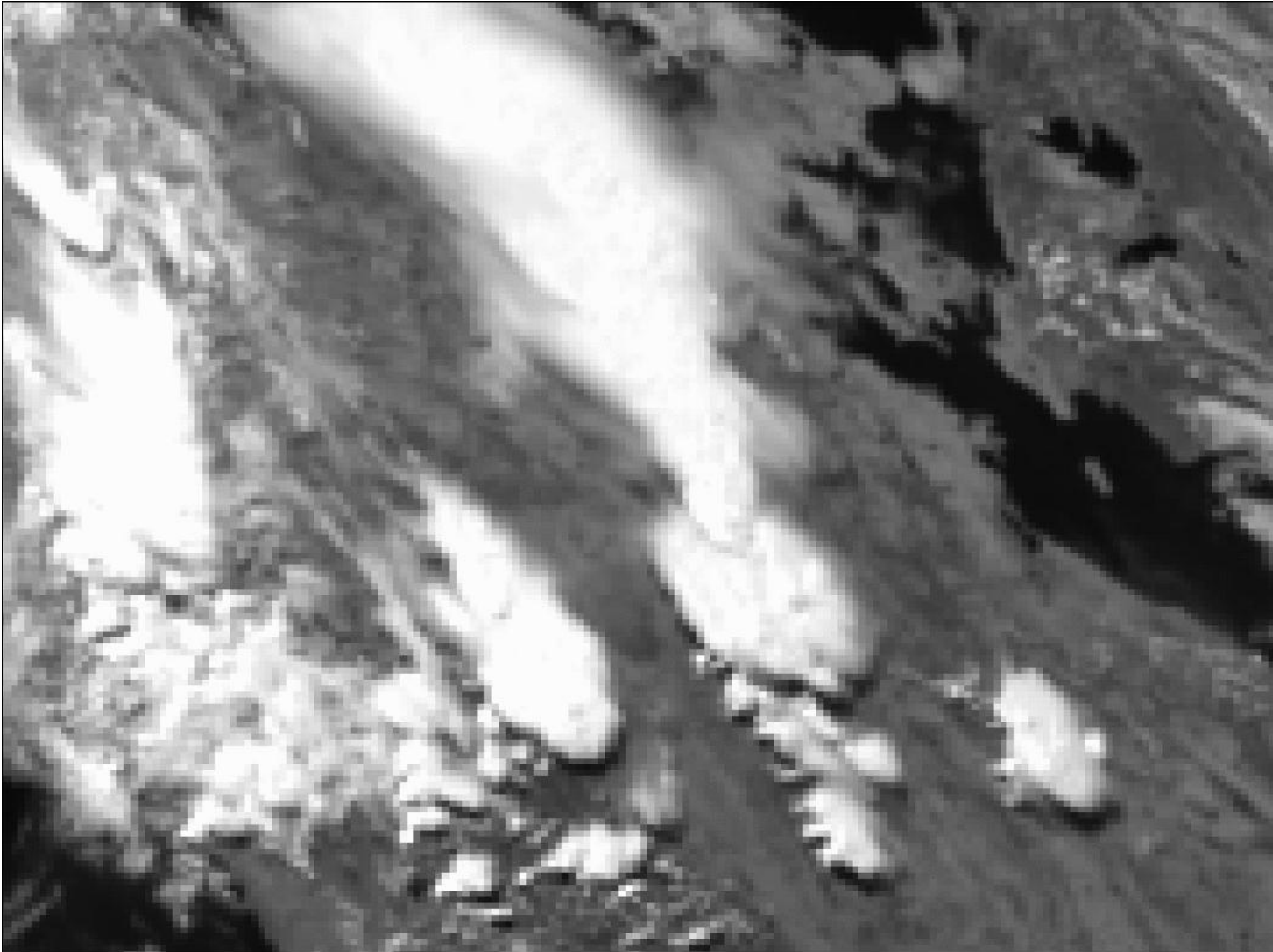
# Three dimensional structures with hyperspectral data From IASI (this example) to IRS

3D humidity fields (%RH) with IASI L2 'all-sky' processor

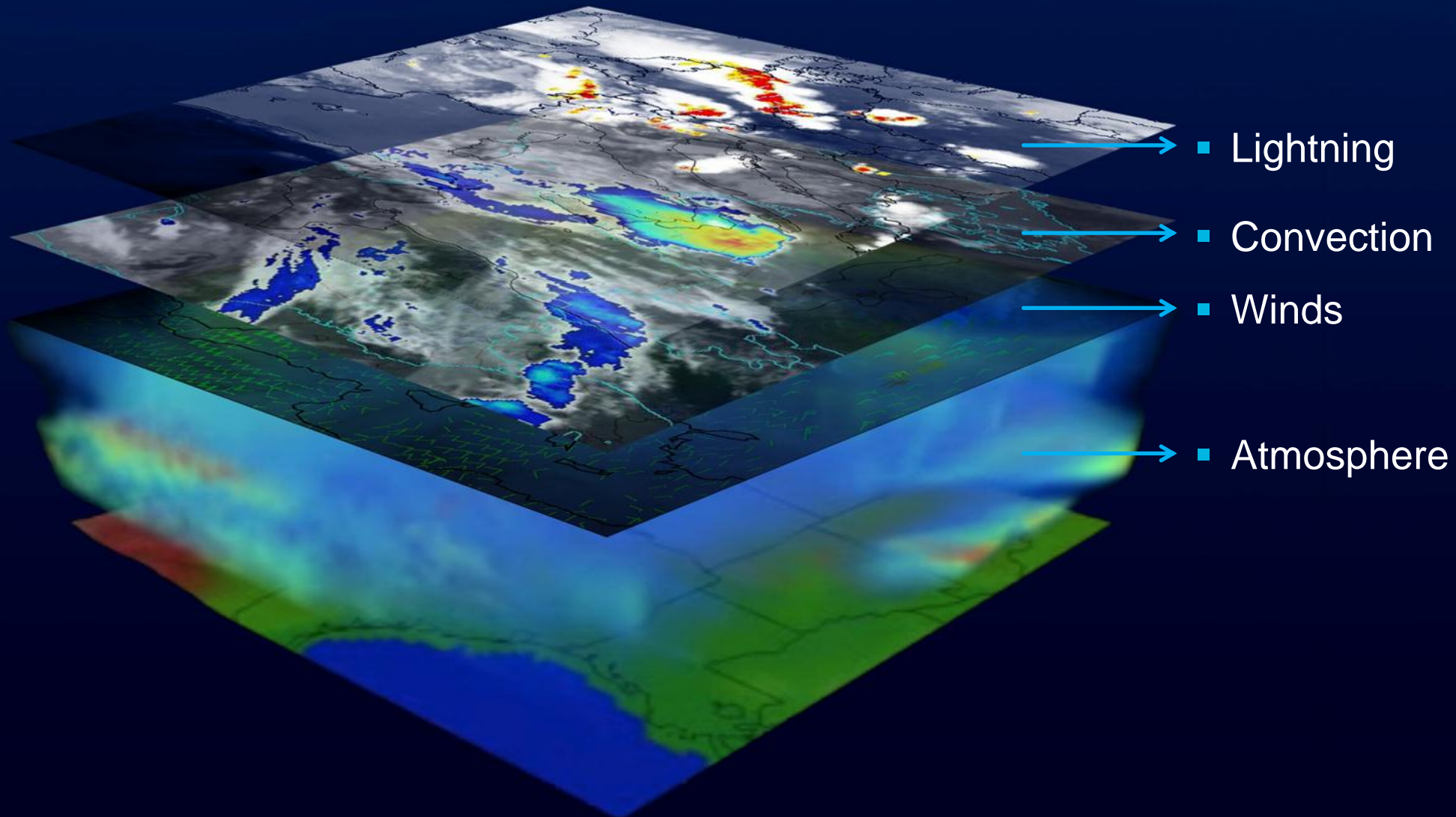


# The MTG Lightning Imager (simulation)

Courtesy Sauli Joro, EUM



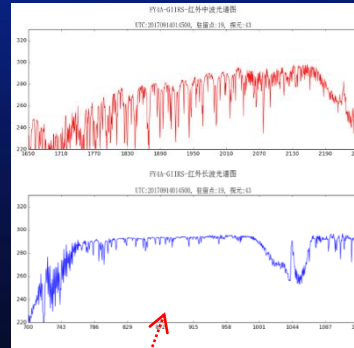
# 4D weather cube with MTG-I and MTG-S





# FY-4 already has it all! Courtesy CMA

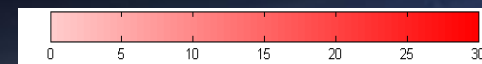
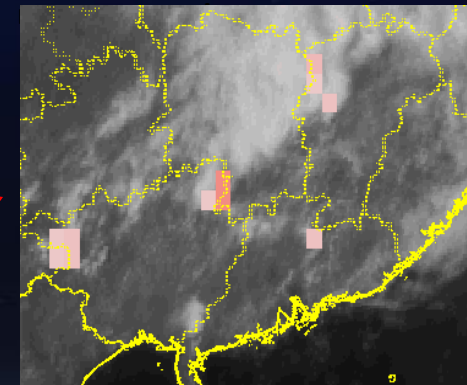
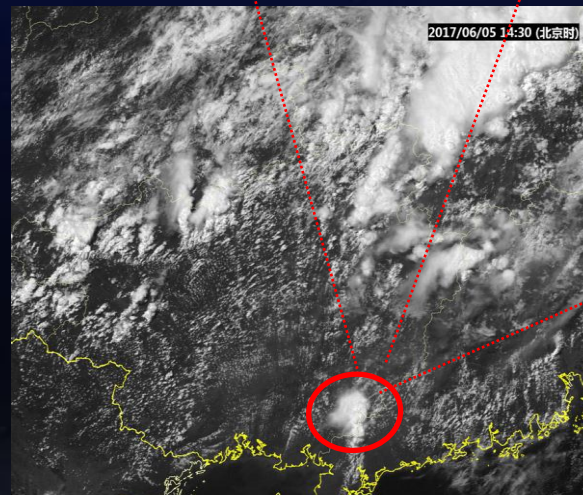
## AGRI + GIIRS + LMI



1. FY-4A lightning frequency map: strong convective cloud clusters often accompany with obvious lightnings.

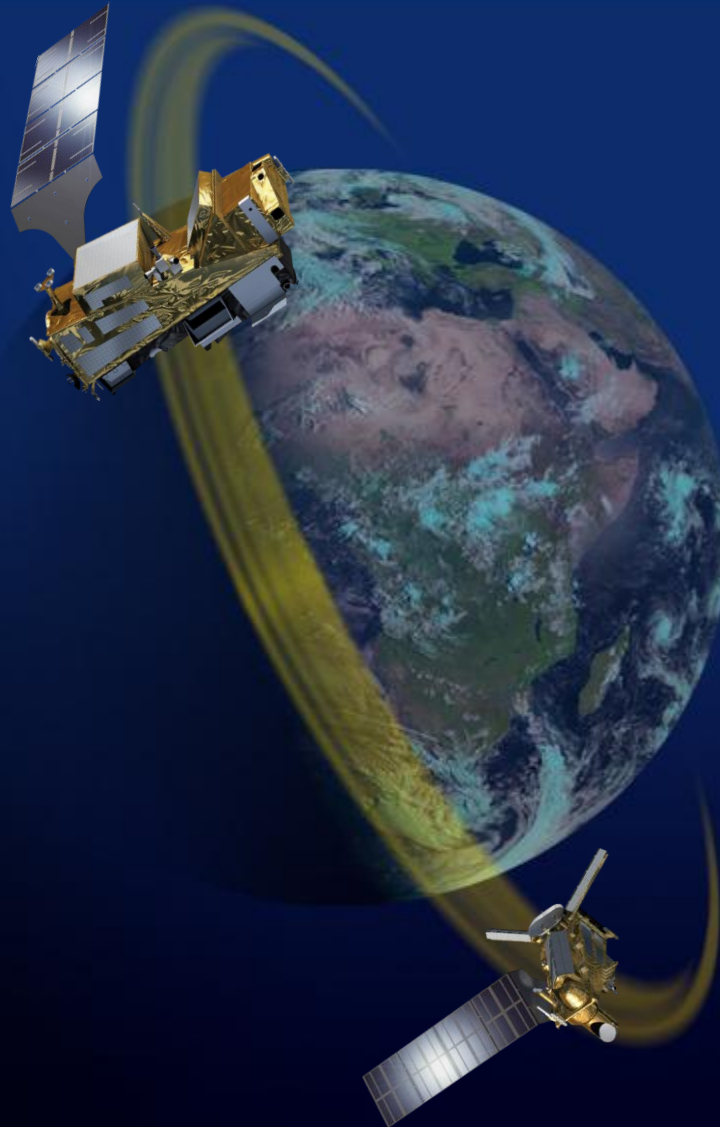
2. FY-4A high spatial resolution imager: finer structure and texture of strong convective cloud cluster; and clearer small scale cumulus line.

3. Cloud free atmospheric profile acquired from GIIRS can be used for



# EPS-SG full operational configuration

**Metop-SG A**  
Sounding & Imagery



**Metop-SG B**  
Microwave Imagery

# EPS-SG A sounding and imagery mission



- 1. IASI-NG**  
Infrared Atmospheric Sounding
- 2. MWS**  
Microwave Sounding
- 3. METImage**  
Visible-Infrared Imaging
- 4. RO**  
Radio Occultation
- 5. 3MI**  
Multi-viewing, -channel, -polarisation  
Imaging
- 6. Copernicus Sentinel-5**  
UN/VIS/NIR/SWIR Sounding



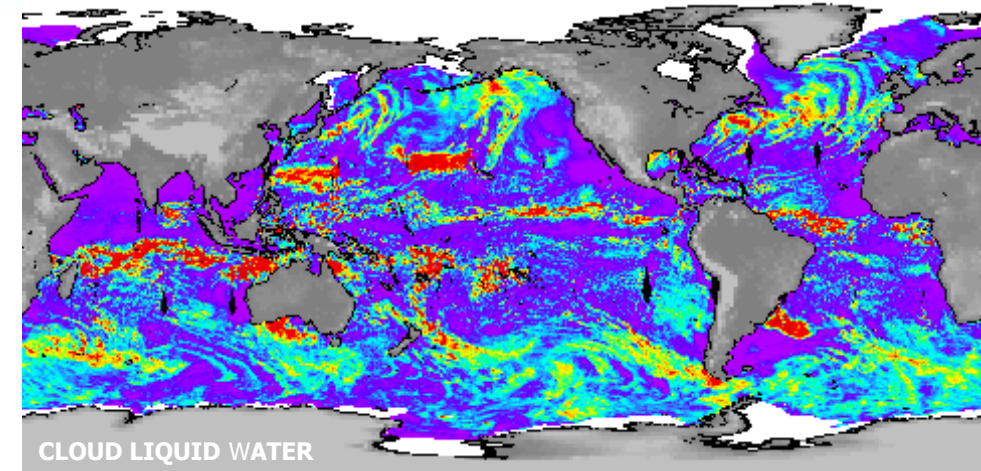
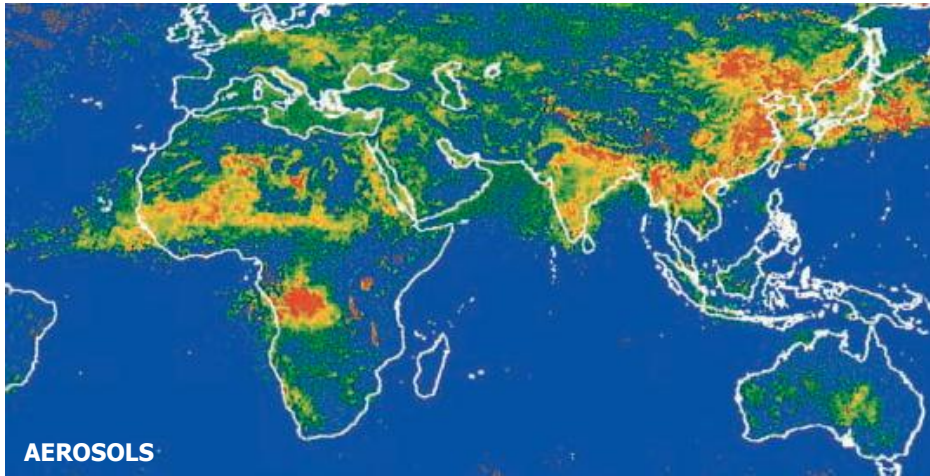
# EPS-SG B microwave imagery mission

1. **SCA**  
Scatterometer
2. **RO**  
Radio Occultation
3. **MWI**  
Microwave Imaging for Precipitation
4. **ICI**  
Ice Cloud Imager
5. **ARGOS-4**  
Advanced Data Collection System

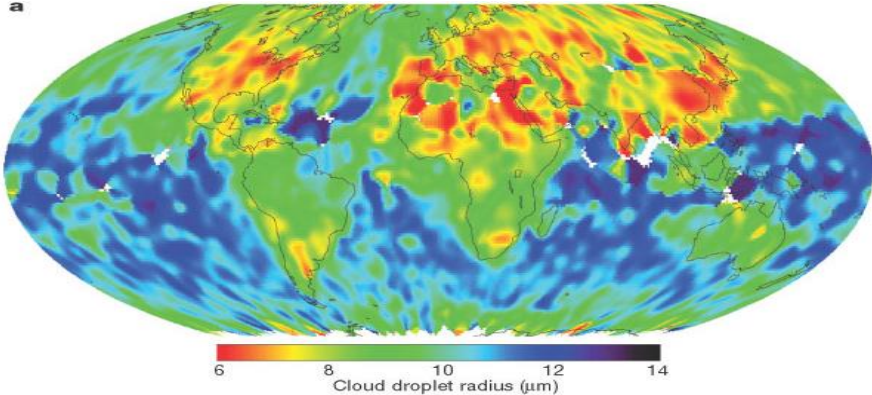




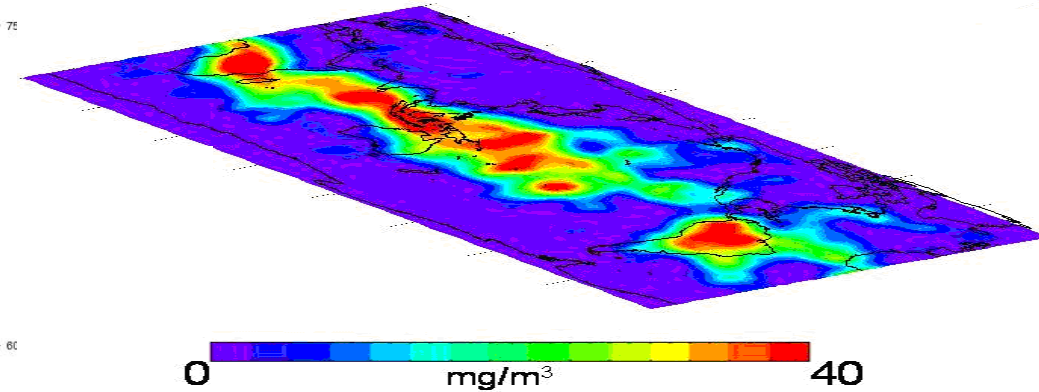
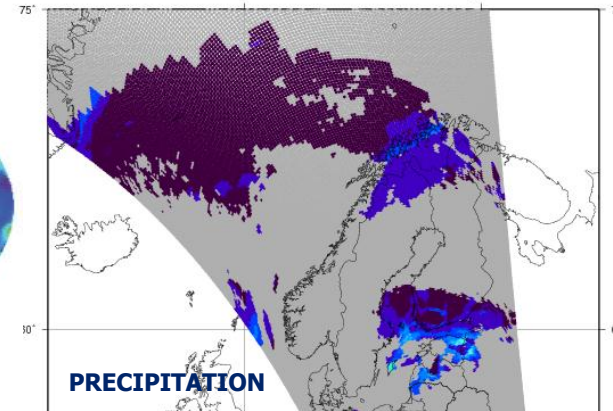
# New measurements from EPS-SG – ICI, MWI, 3MI



CLOUD DROPLET RADIUS



EUMETSAT H-SAF PR-OBS-1 Instantaneous Rain Rate from Conical MW Scan



ICE CLOUDS

# International cooperation

- Cooperation in satellite meteorology, oceanography and climate monitoring
- Focus on operational data exchange, data redistribution, production of climate-relevant datasets, scientific exchange, user training, coordination through multilateral partnerships (CGMS, CEOS, GEO)



# International cooperation partners



Country	Agency
Canada:	ECSCC
China:	CMA, CNSA, NSOAS
India:	ISRO, IMD
Japan:	JAXA, JMA
Russian Federation:	Roshydromet
South Korea:	KMA
United States:	NASA, NOAA



# Benefits of international cooperation meeting WIGOS Vision 2040

## Three primary orbits covered by EUMETSAT, NOAA and in the near-future CMA

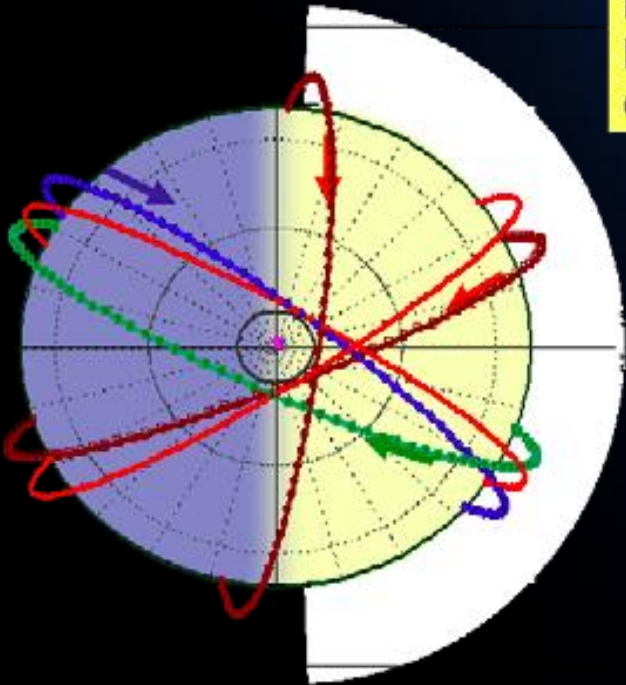
**EUMETSAT: 09:30 desc**

**NOAA: 13:30 asc**

**CMA: 06:00 desc**

**Not to forget**

**CMA: 14:00 asc**



Proposed new baseline with in-orbit redundancy

**Metop-C**

**Suomi-NPP**

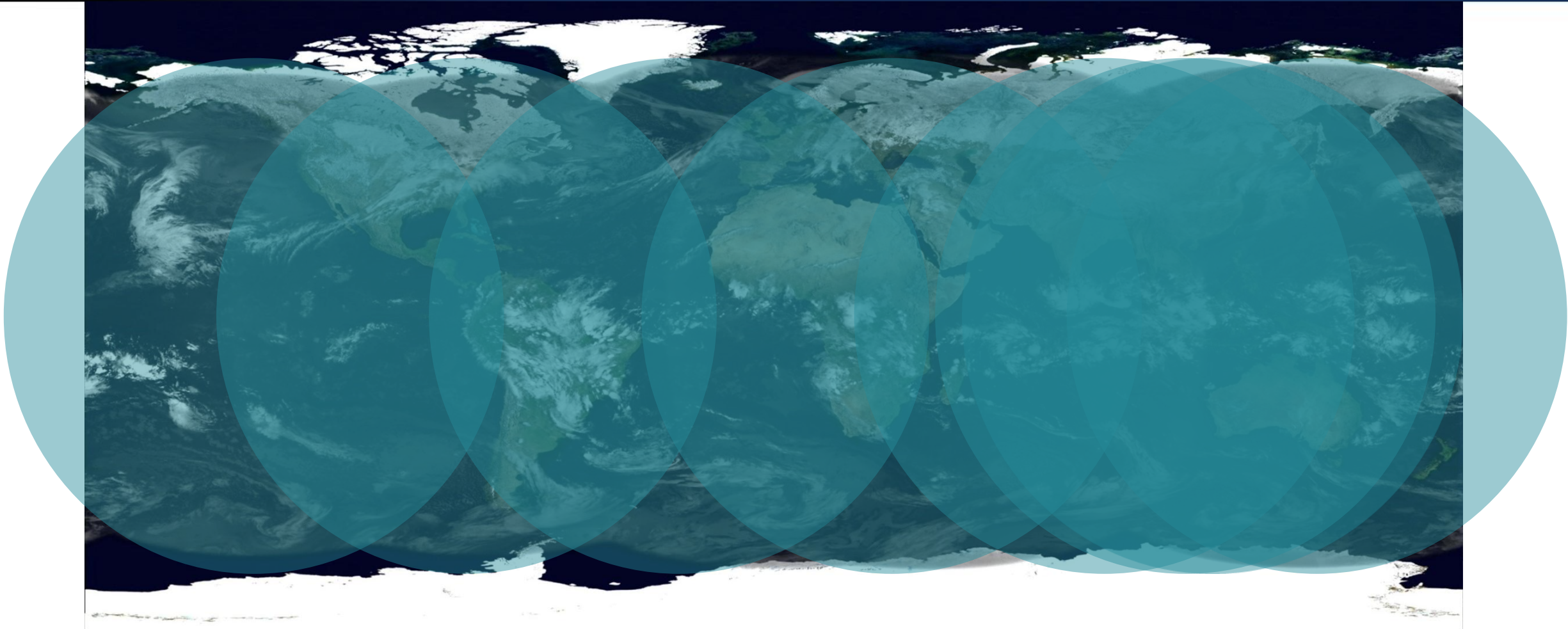
**FY-3E**

**JPSS-1**

**Metop-B**



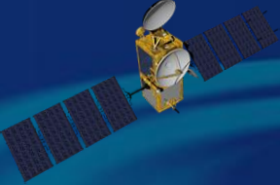
# The value of international cooperation: “the GEO ring”



# International Partnership - Cooperative Jason missions



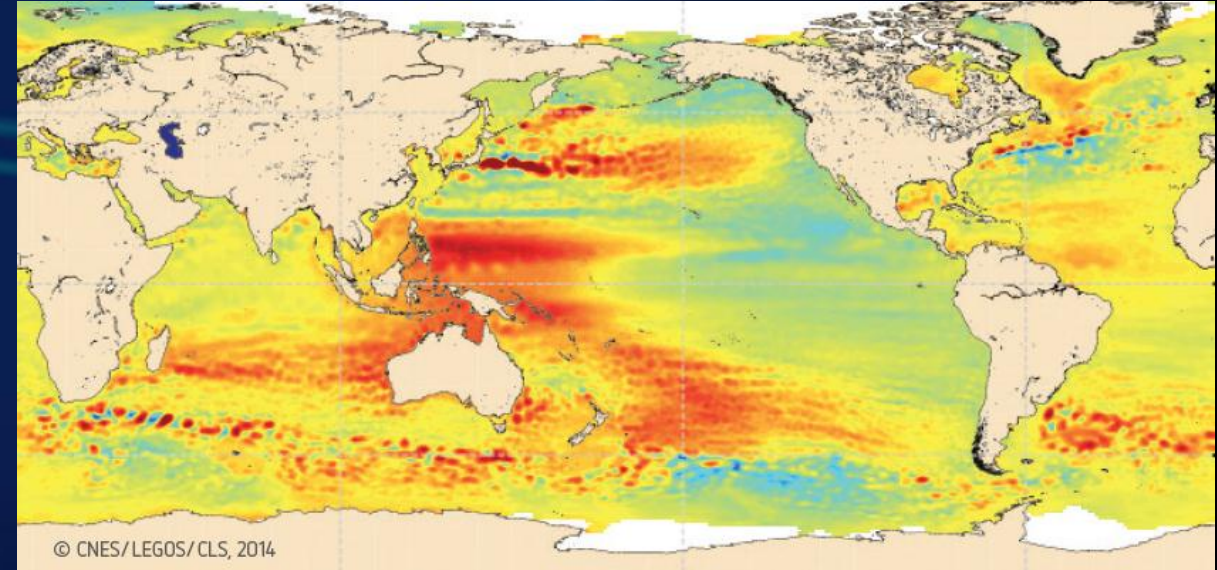
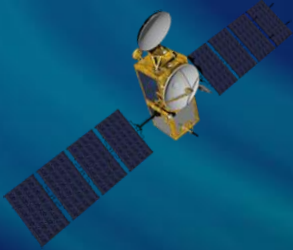
**JASON-1**  
2001



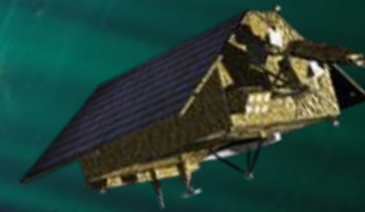
**TOPEX-POSEIDON**  
1992-2006



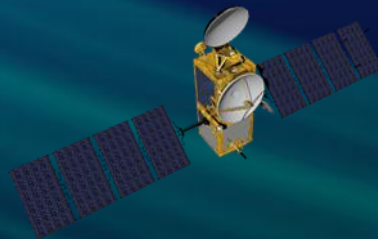
**OSTM/JASON-2**  
2008



**SENTINEL-6/JASON-CS**  
2020



**JASON-3**  
2016

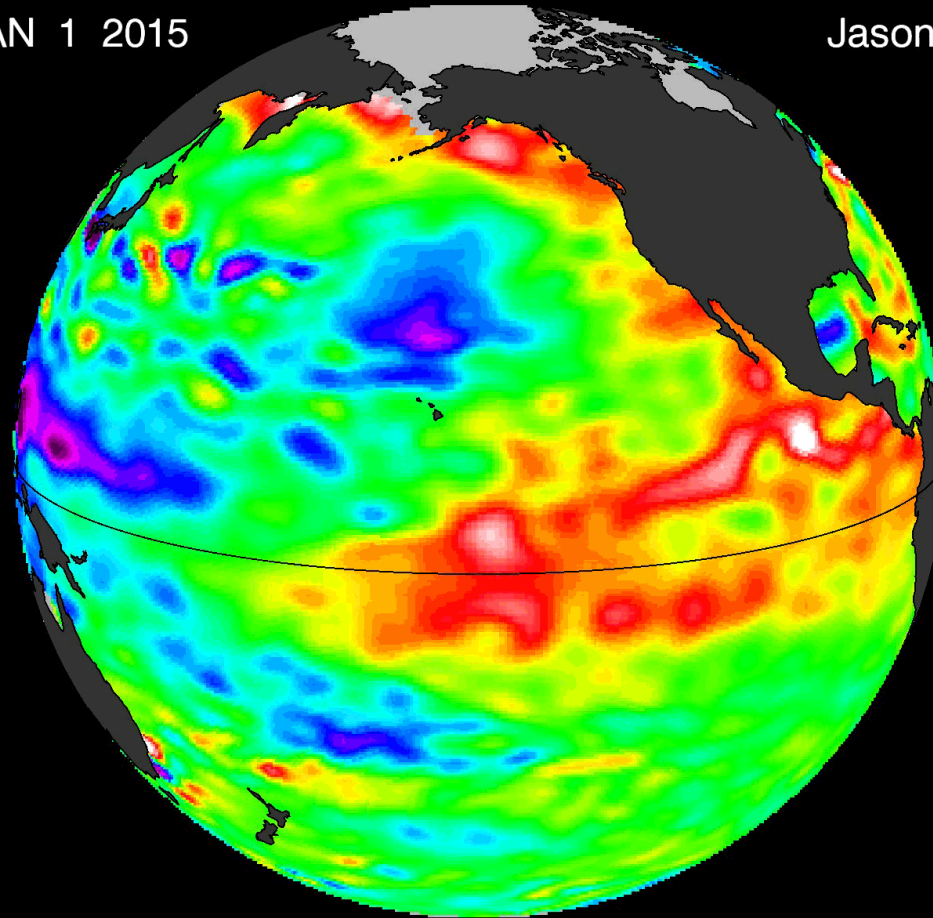




# Jason-3 contributing to El Nino observations

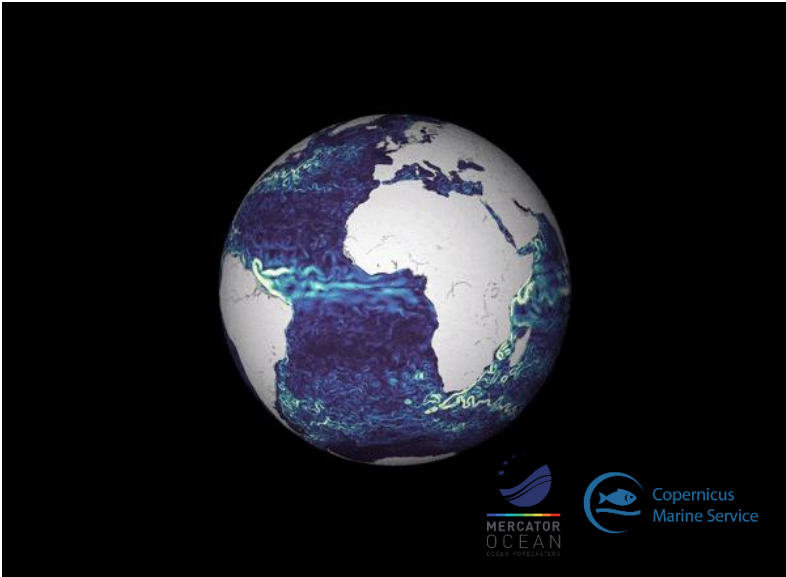
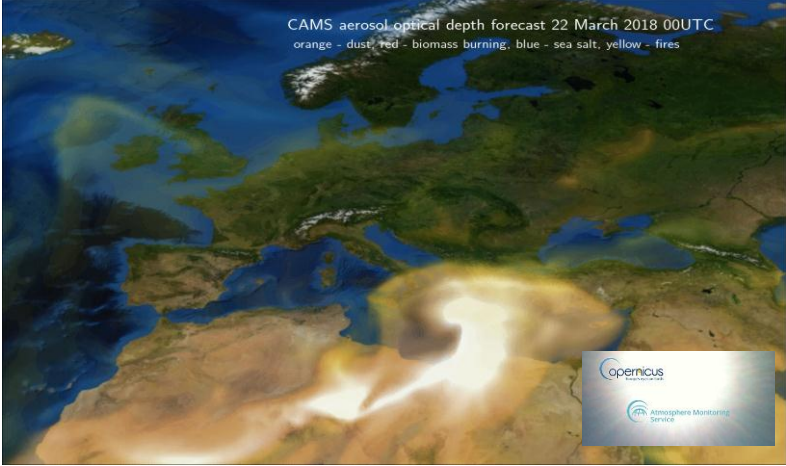
JAN 1 2015

Jason-2

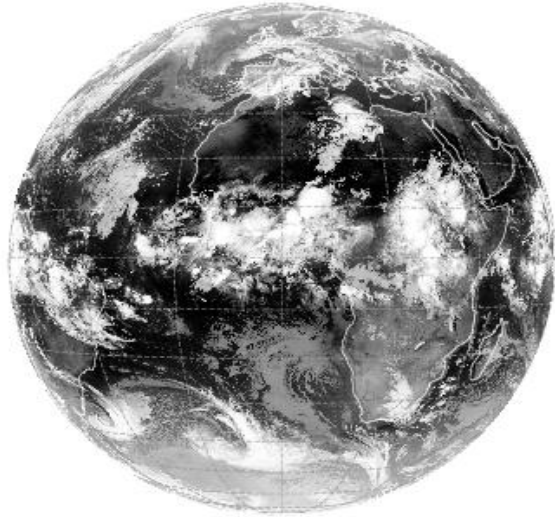


**Jason-2/Jason-3 2015-2017**

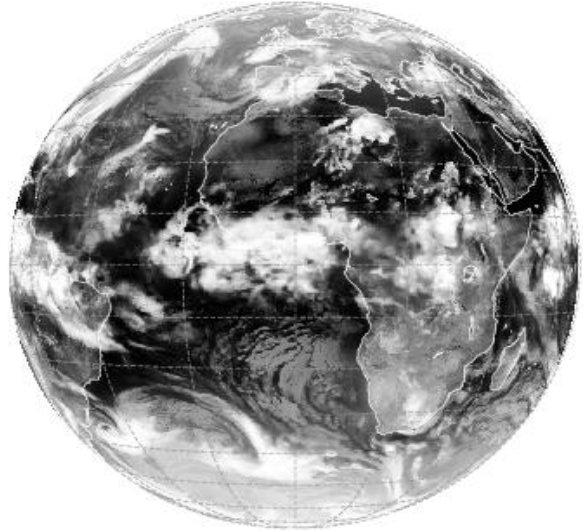
# From weather to environmental forecasting



Meteosat 9 IR10.8 20080525 0 UTC



ECMWF Fc 20080525 00 UTC+0h:

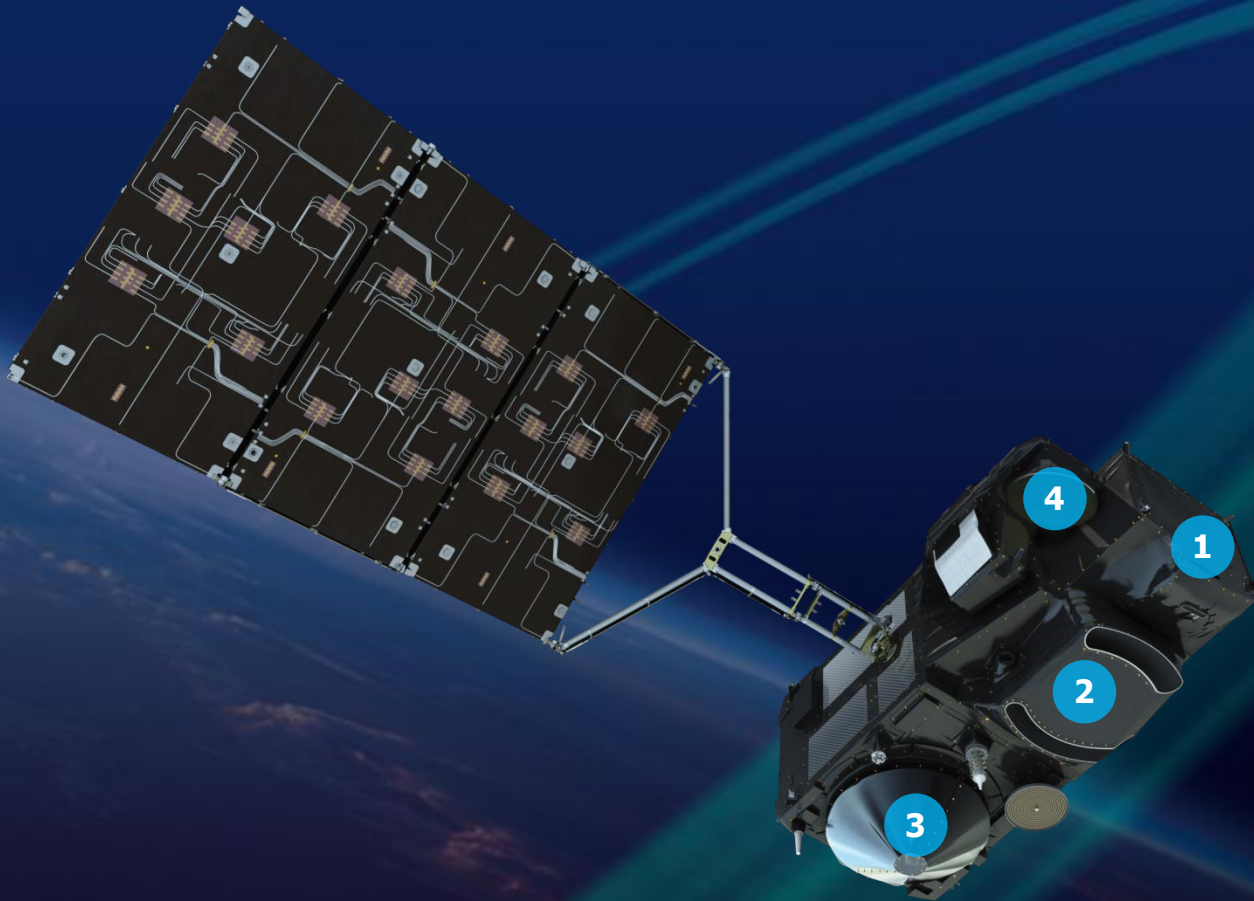






# EUMETSAT and Copernicus

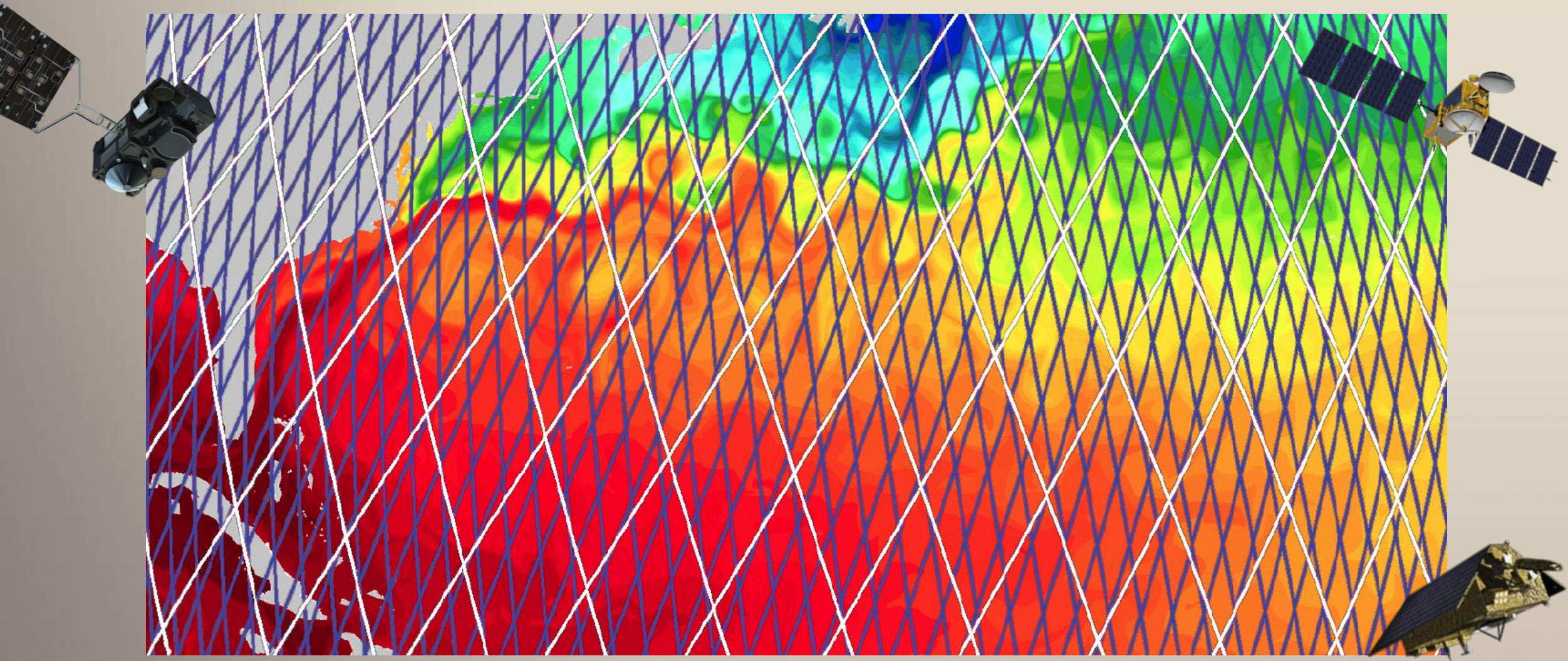
# Sentinel-3



1. **OLCI**  
Ocean and Land Colour Instrument
2. **SLSTR**  
Sea and Land Surface Temperature Radiometer
3. **SRAL**  
SAR Radar Altimeter
4. **MWR**  
Microwave Radiometer

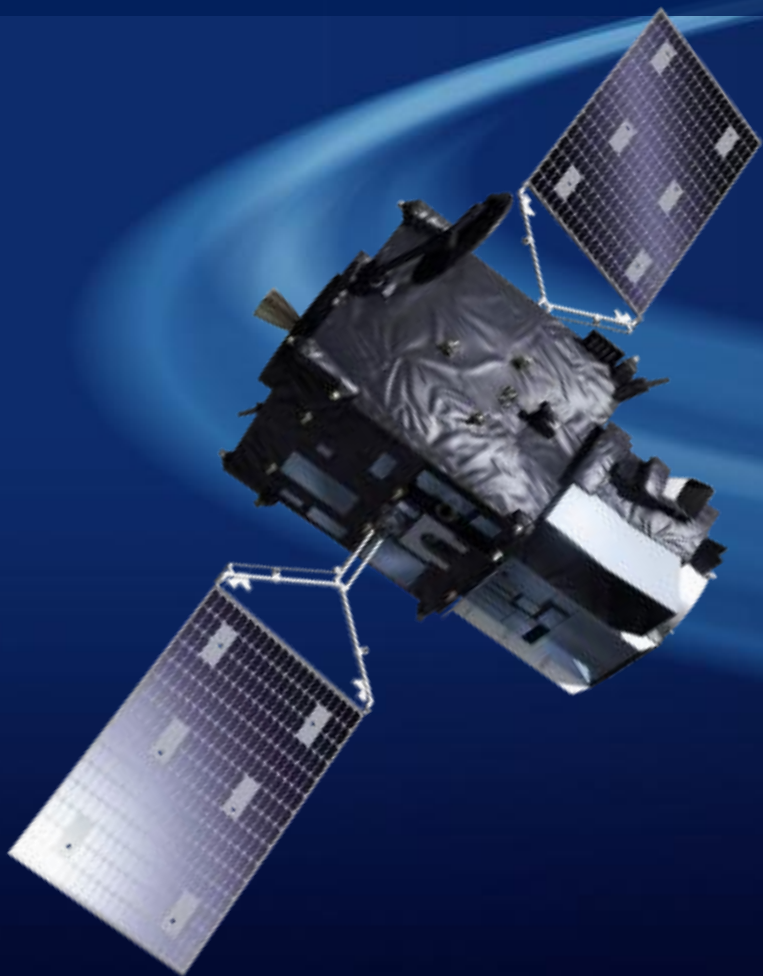


# Combining Sentinel-3 and Jason for operational oceanography and climate change monitoring





# MTG: IRS and Sentinel-4 (UVN)



IRS on MTG-S

O<sub>3</sub>

CO

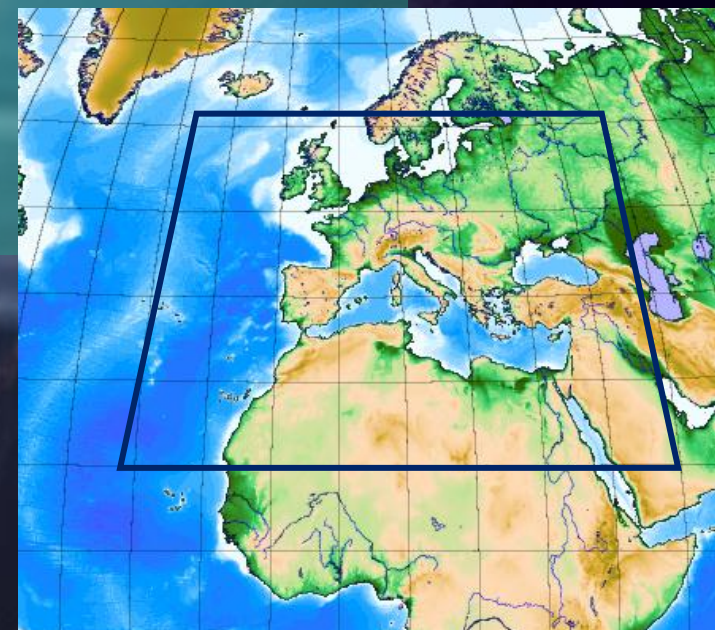
NO<sub>2</sub>

SO<sub>2</sub>

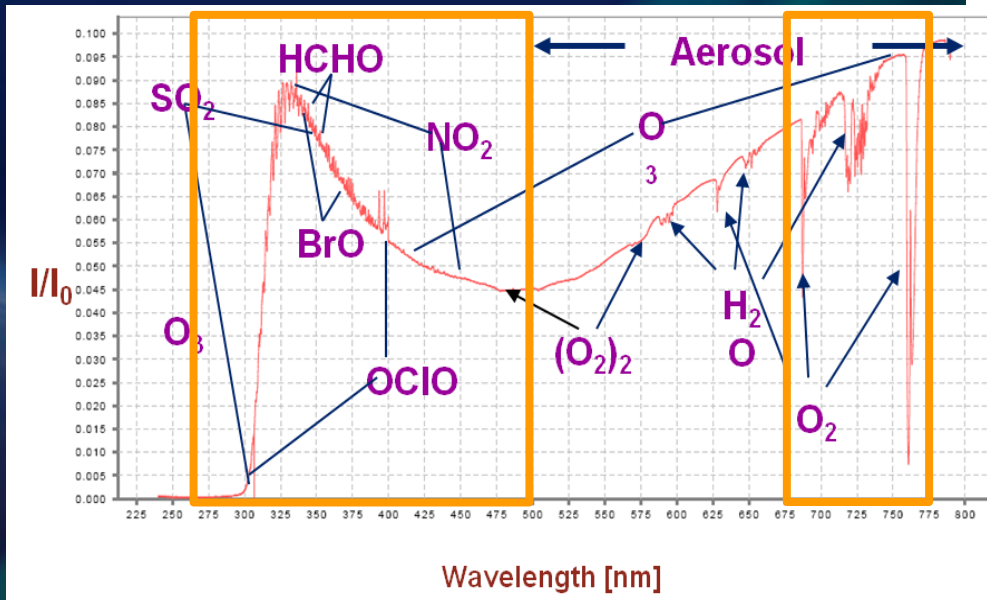
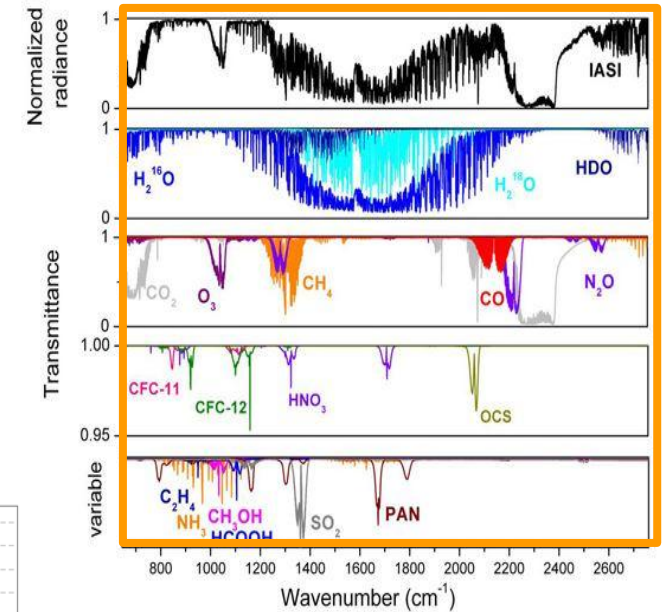
VOC(H<sub>2</sub>CO, CHOCHO)

Aerosol/PM

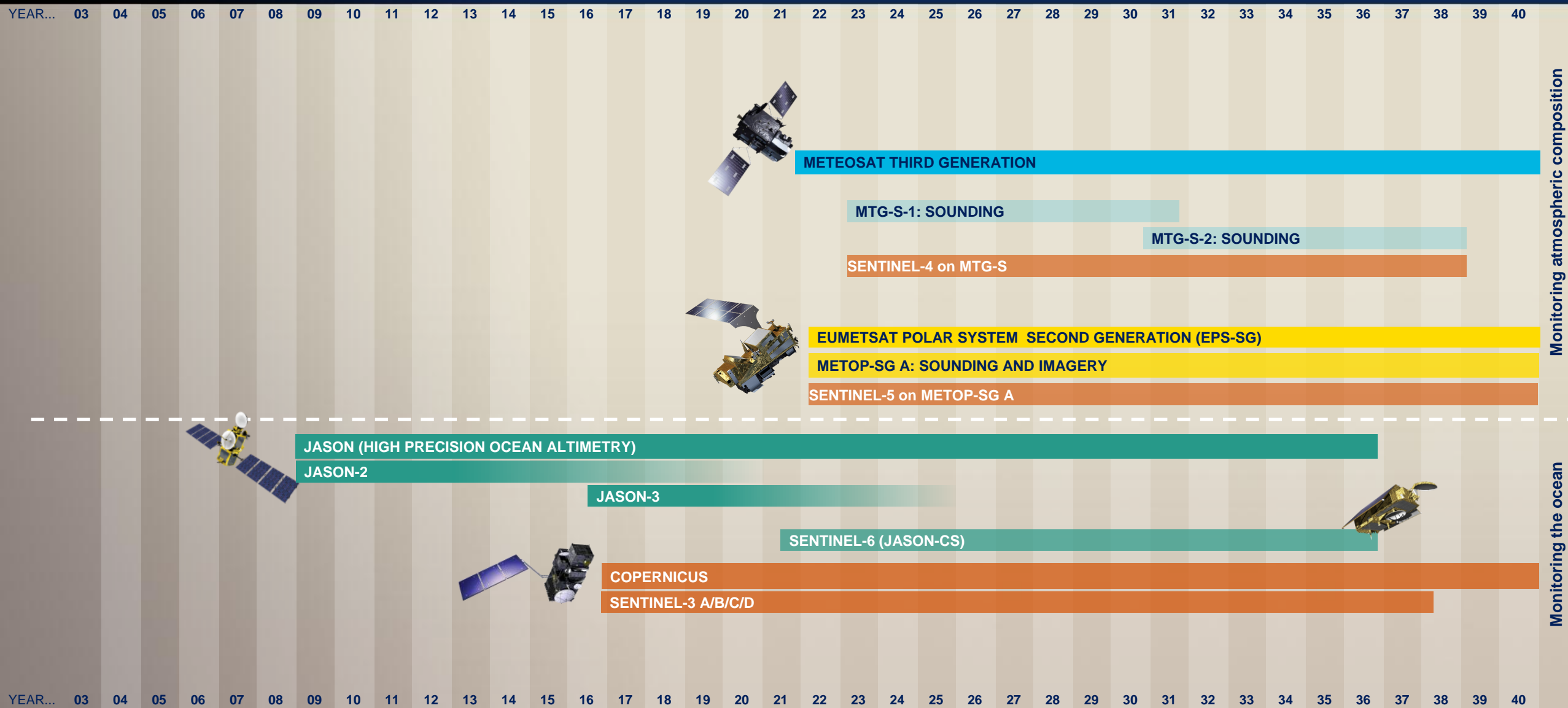
S4-UVN on MTG-S



# EPS-SG: IASI-NG and Sentinel-5 (UVNS)

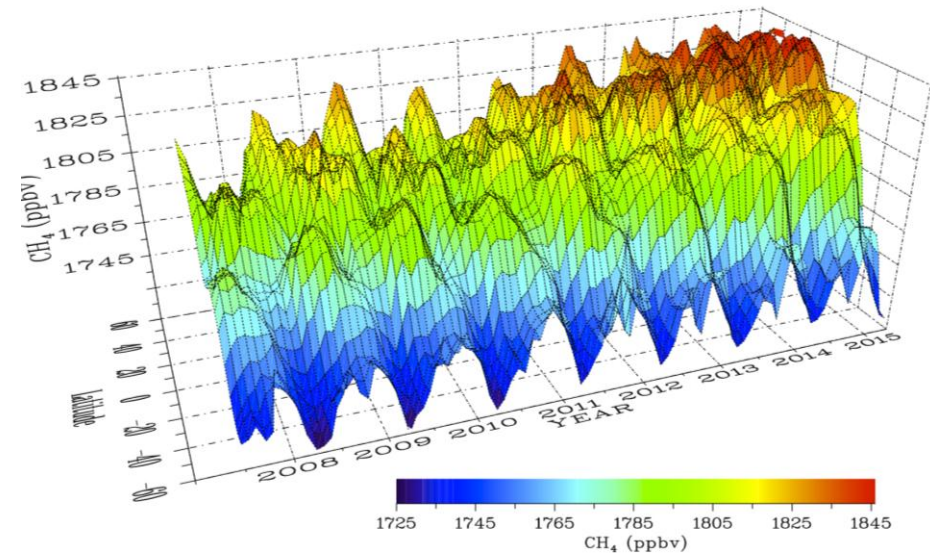
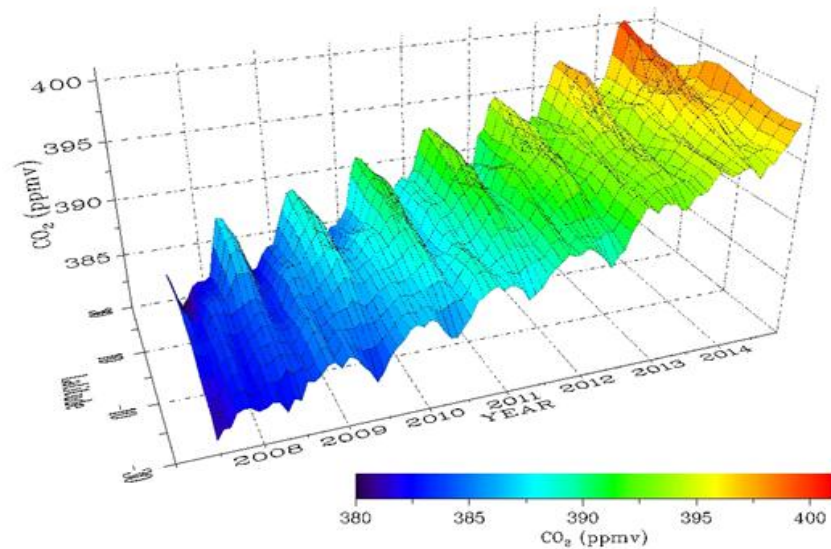
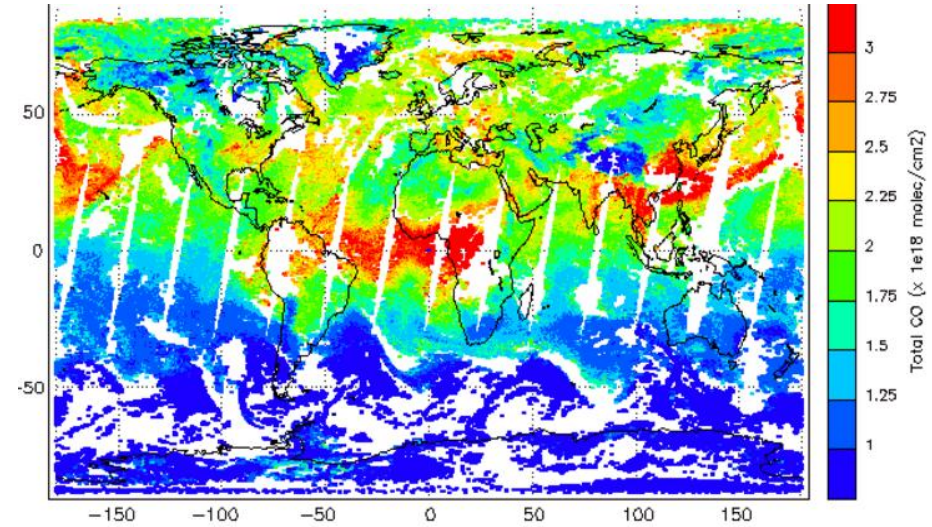
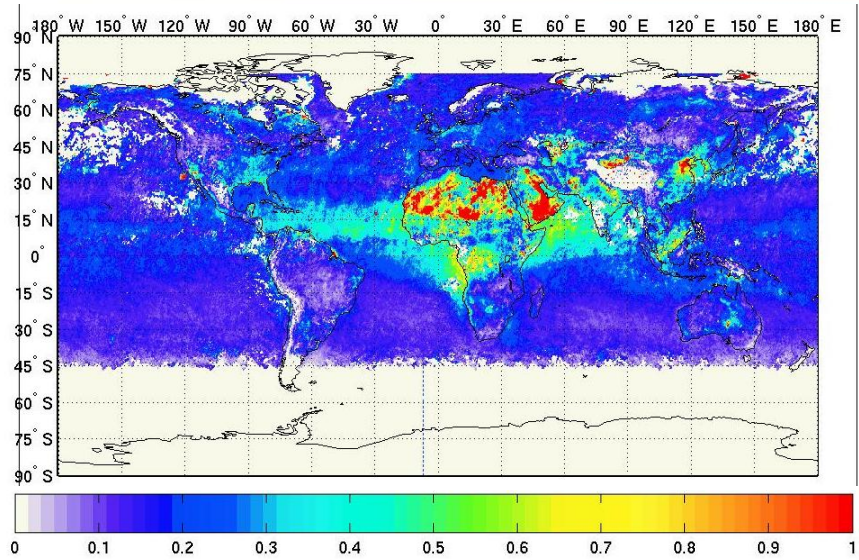


# Third party programmes in support of Copernicus











# GHG and CO2 monitoring – preparing for Sentinel-7



# Explore our data! Thank you

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	<a href="https://eumetcast.com">eumetcast.com</a>	Learn more about our push delivery service
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	<a href="https://archive.eumetsat.int">archive.eumetsat.int</a>	Order past data
	<a href="https://eumetview.eumetsat.int">eumetview.eumetsat.int</a>	Visualise and explore, create layers in GIS applications