

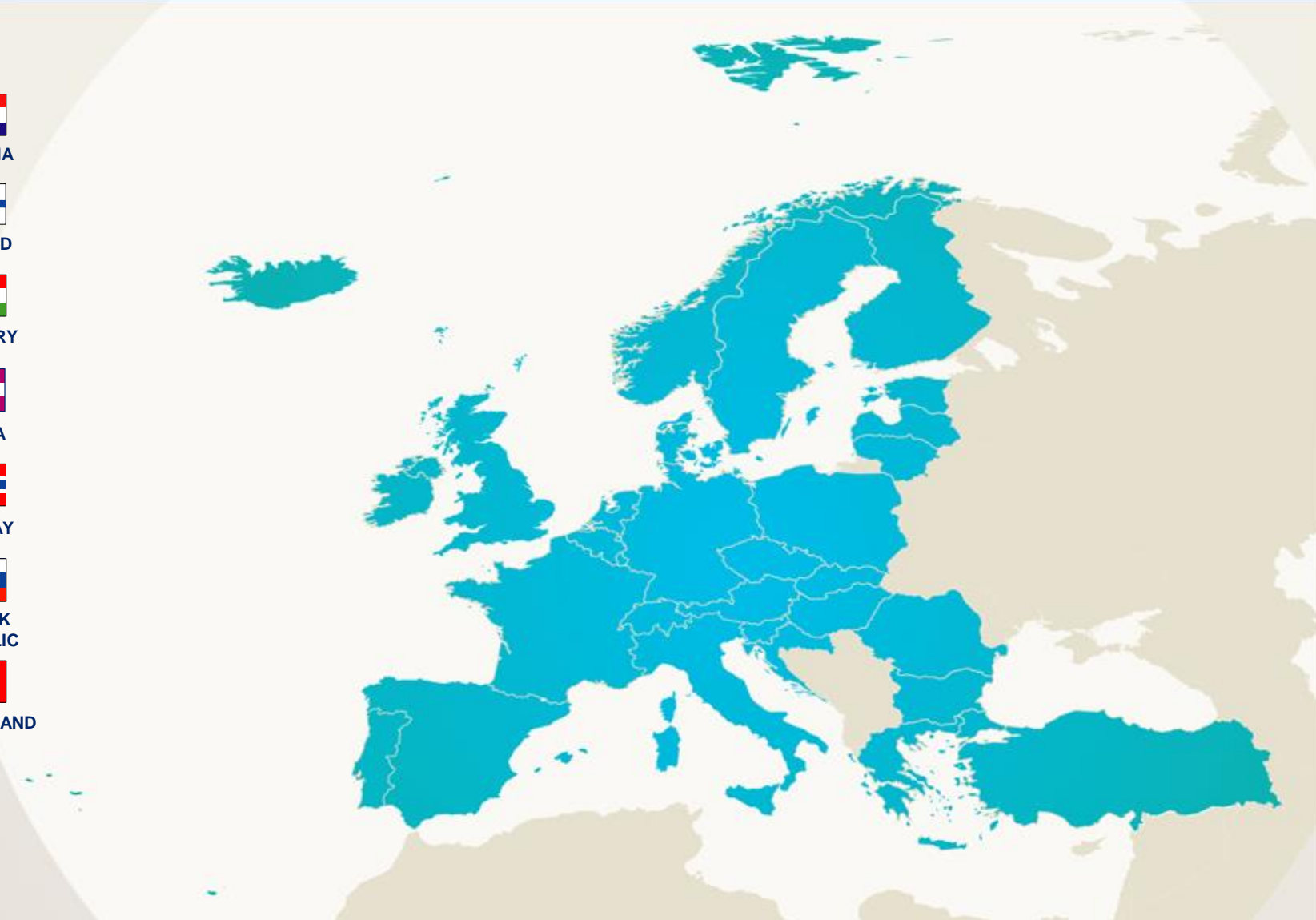


Providing data and services world wide  
Dr Ken Holmlund  
EUMETSAT Chief Scientist



# 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.

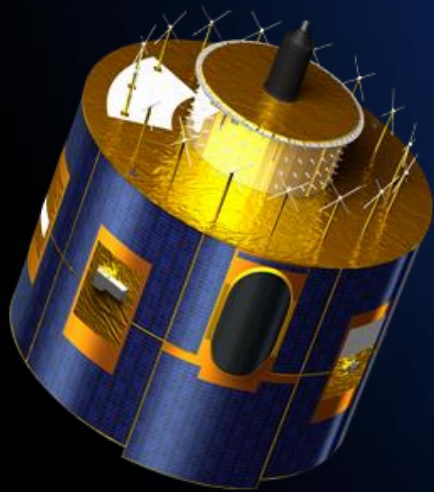
## **Further objective:**

Contribute to the operational monitoring of the climate and the detection of global climatic changes.

## **Vision:**

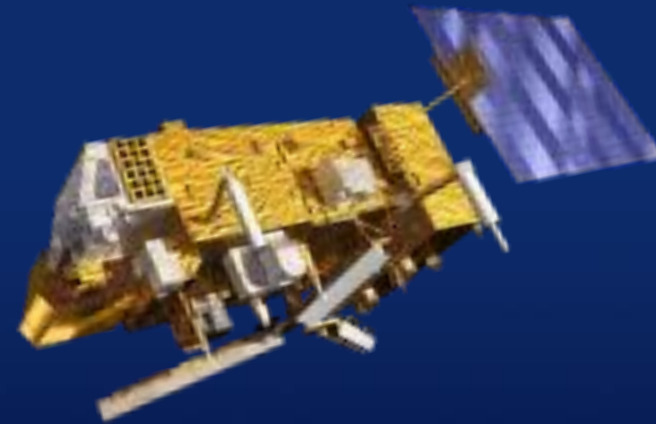
Be the leading user-driven operational agency in Europe for Earth observation satellite programmes that fulfil the objectives of its Convention, and a trusted global partner for those outside Europe who share these objectives.

# => The need for two types of meteorological satellites = The EUMETSAT mandatory programmes



## **Geostationary orbit**

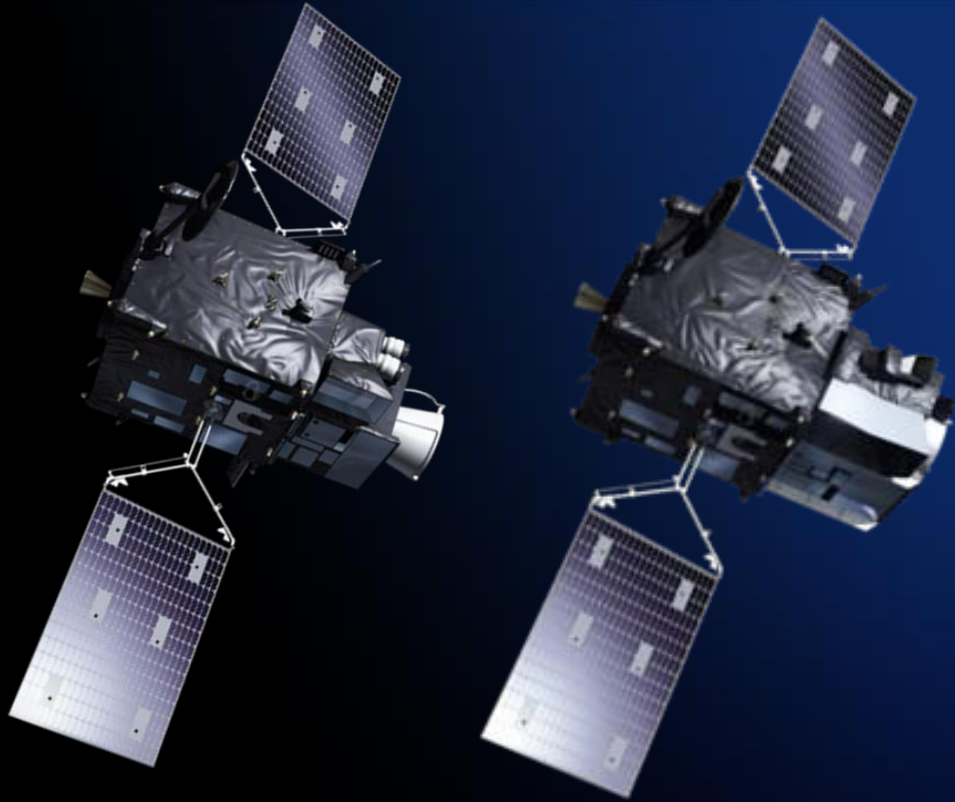
Vital for forecasts up to a few hours



## **Polar orbit**

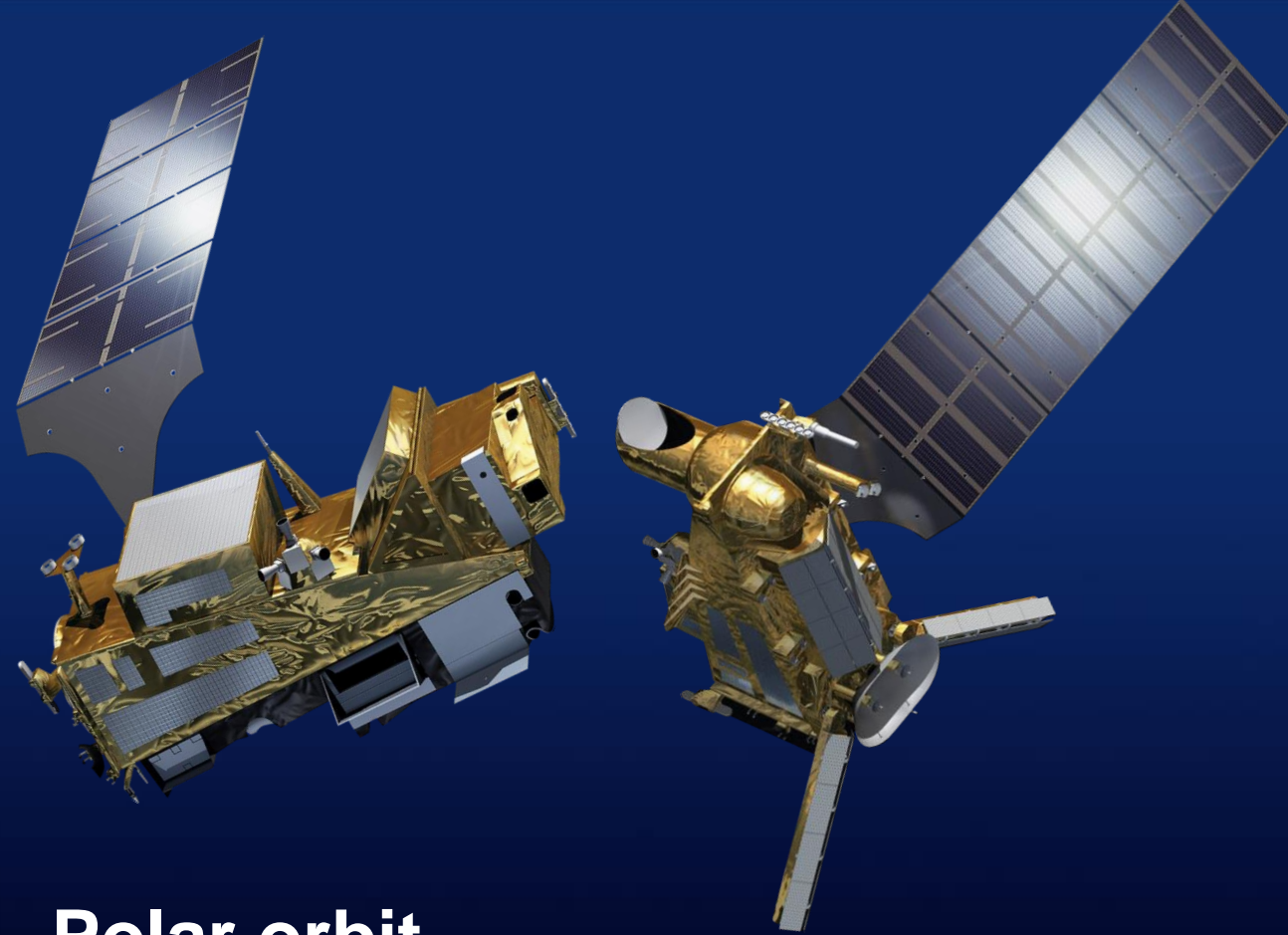
Critical for forecasts up to 10 days

**=> The need for two types of meteorological satellites  
= In the future dual-satellite systems!**



## **Geostationary orbit**

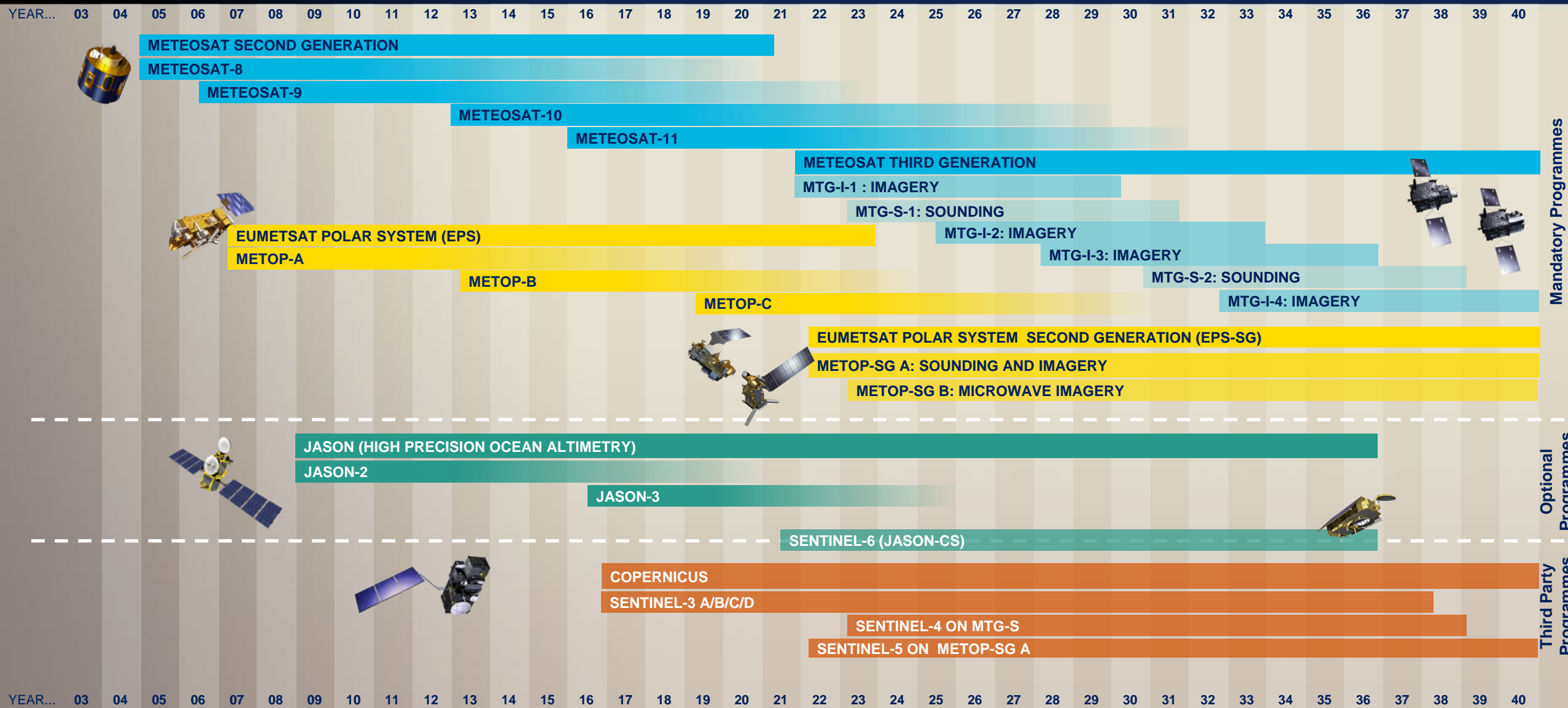
Vital for forecasts up to a few hours



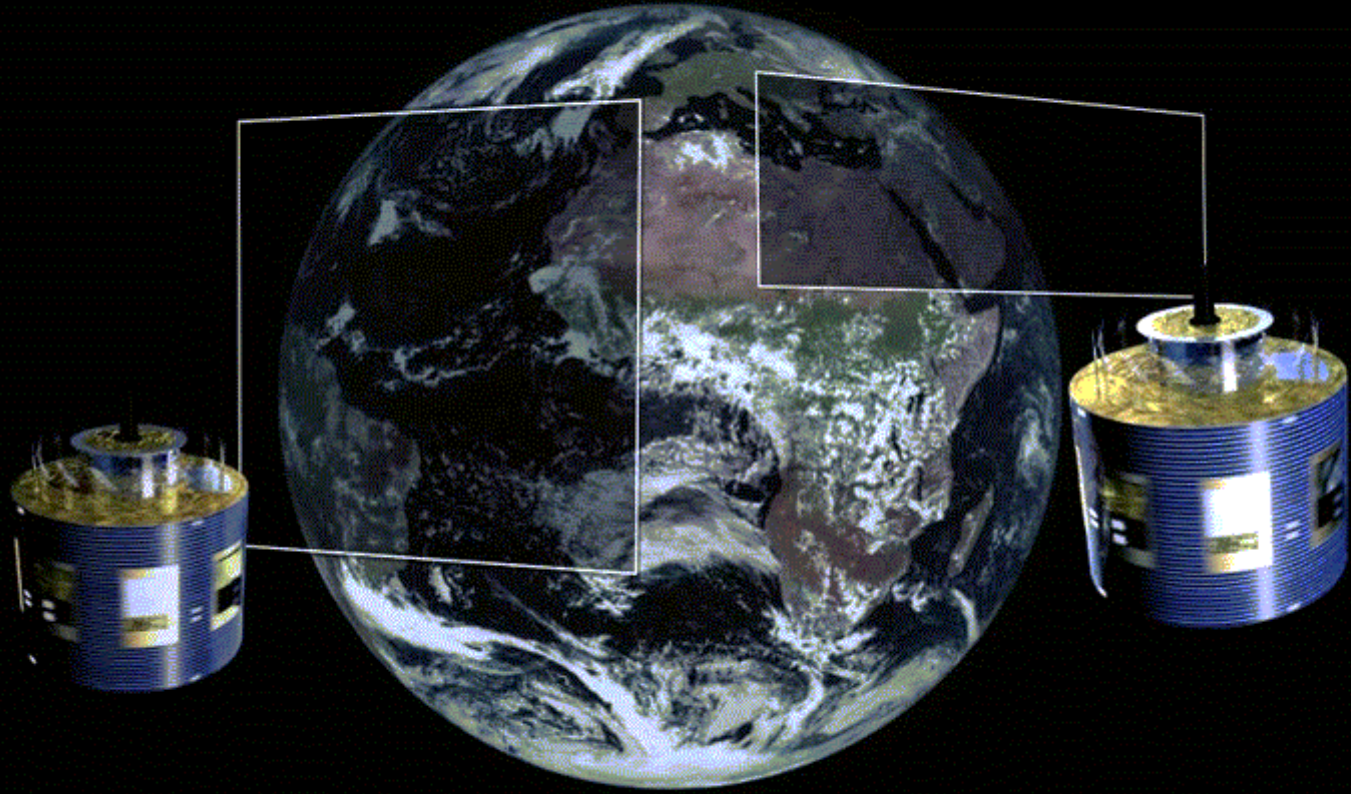
## **Polar orbit**

Critical for forecasts up to 10 days

# EUMETSAT Mission Planning



# Meteosat Second Generation: a two-satellite operational system



Time-lapse  
00:00

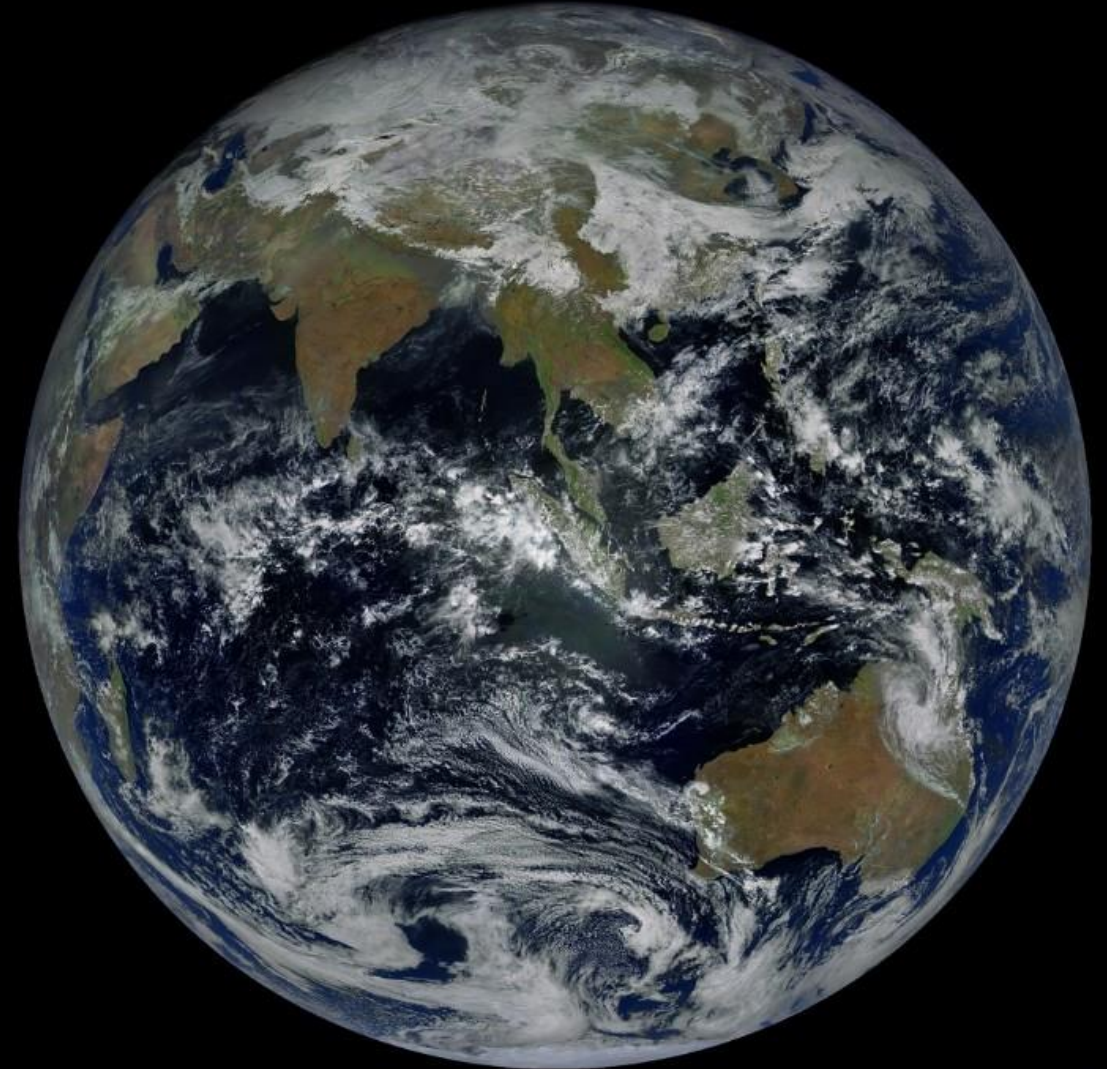
Animated representation

# Meteosat Second Generation: Indian Ocean Data Coverage

- 12 channels
- 3/1 km resolution
- 15 min full disk
- Meteosat-8 until 2022
- Follow-on TBC
- But we have
  - FY-2H and FY-4

## FY-4A GEOSTATIONARY METEOROLOGICAL SATELLITE

The First Colour Composite Image of FY-4A AGRI



February 20th, 2017 05:15 (UTC)



Processed by NSMC

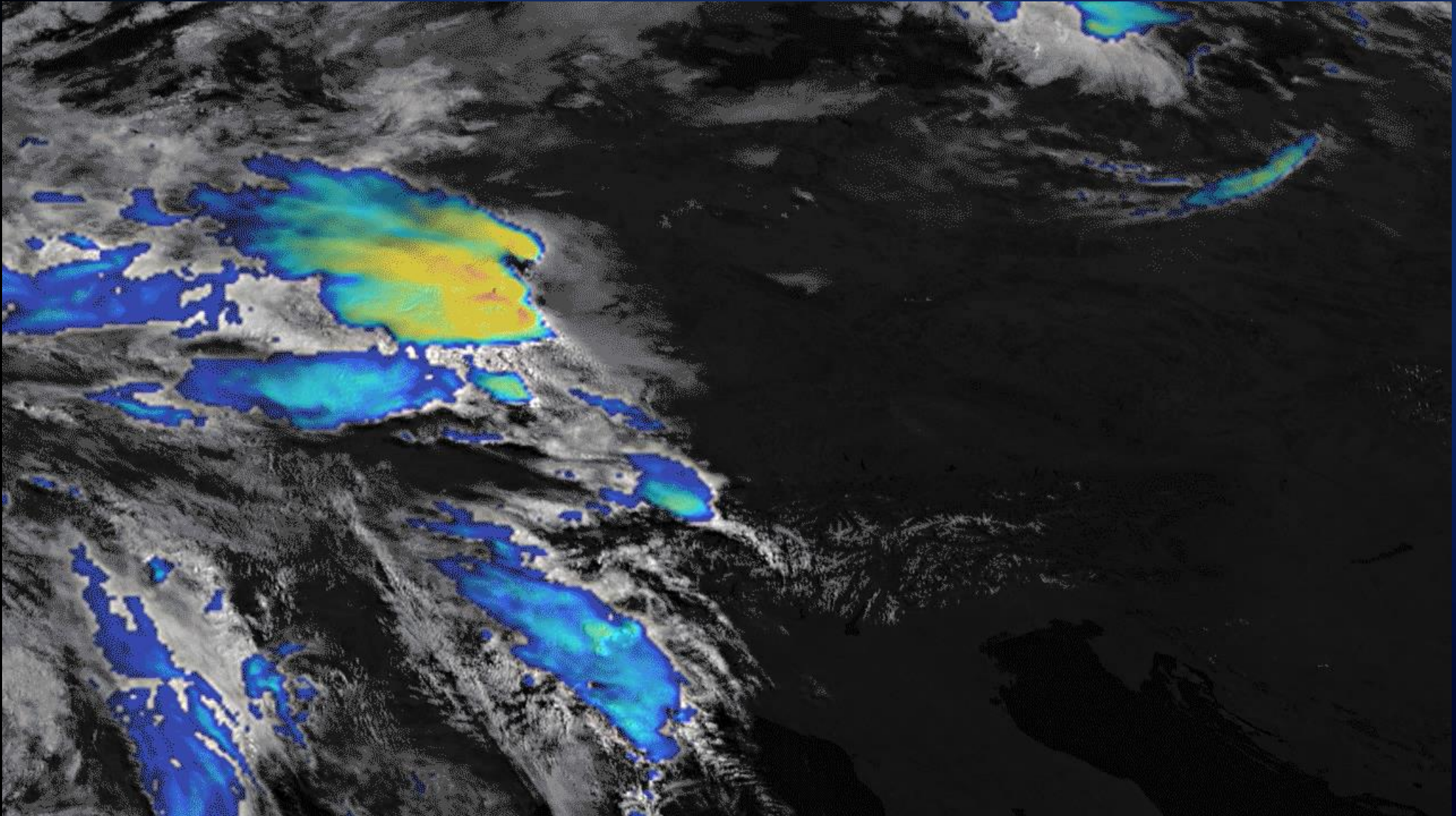


# The GEO-RING

## Geo-Leo Corresponding VIS-IR Imagery Bands ( $\mu\text{m}$ )

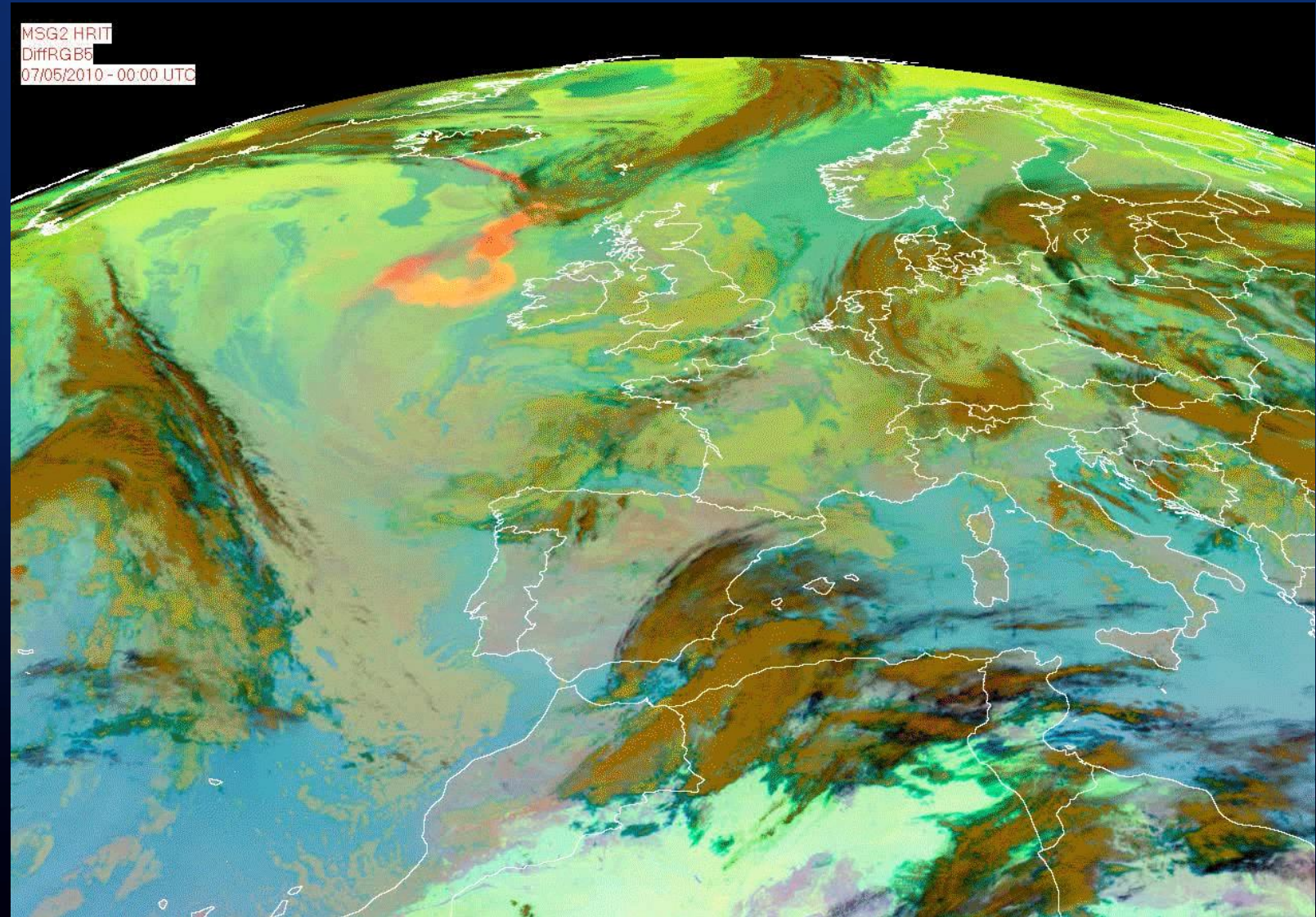
#	Himawari -8/ AHI	MTSAT-2/ IMAGER	MSG/ SEVIRI	MTG/ FCI	KOMPSAT -2A/AMI	FY-4/ AGRI	GOES- R/ABI	GOES -15	GOES -11	SNPP,JPSS/ VIIRS	Terra, Aqua/ MODIS	GCOM-C/SGLI	NOAA/ AVHRR
1	0.47			0.444	0.455	0.47	0.47			0.488 (M03)	0.488	0.490 (VN4)	
2	0.51			0.510	0.511					0.555 (M04)	0.531	0.530 (VN5)	
3	0.64	0.68	0.635	0.640	0.642	0.65	0.64	0.65	0.65	0.672 (M05) 0.64 (I01)	0.667	0.6735 (VN7,VN8,P1)	0.630
4	0.86		0.81	0.865	0.860	0.825	0.86			0.865 (M07) 0.865 (I02)	0.870	0.8685 (VN10, VN11, P2)	0.862
				0.914							0.905		
				1.380	1.38	1.375	1.38			1.378 (M09)	1.375	1.380 (SW2)	
5	1.6		1.64	1.610	1.61	1.61	1.61			1.610 (M10) 1.61 (I03)	1.640	1.630 (SW3)	1.61
6	2.3			2.250		2.25	2.26			2.250 (M11)	2.130	2.210 (SW4)	
7	3.9	3.7	3.92	3.80	3.85	3.75	3.90	3.90	3.90	3.70 (M12) 3.74 (I04)	3.750		3.74
8	6.2	6.8	6.25	6.30	6.24	6.25	6.15	6.55	6.75		6.715		
9	6.9				6.95	7.1	7.00						
10	7.3		7.35	7.35	7.34		7.40				7.325		
11	8.6		8.70	8.70	8.60	8.5	8.50			8.55 (M14)	8.550		
12	9.6		9.66	9.66	9.63		9.70				9.730		
13	10.4	10.8	10.8	10.50	10.43	10.7	10.3	10.70	10.70	10.763 (M15)		10.8 (T1)	10.80
14	11.2				11.20	11.0	11.2			11.45 (I05)	11.030		
15	12.4	12.0	12.0	12.30	12.30		12.3		11.95	12.013 (M16)	12.020	12.0 (T2)	12.00
16	13.3		13.4	13.30	13.30	13.5	13.3	13.35			13.335		

# Multispectral geostationary for nowcasting of severe weather: MSG example of thunderstorms

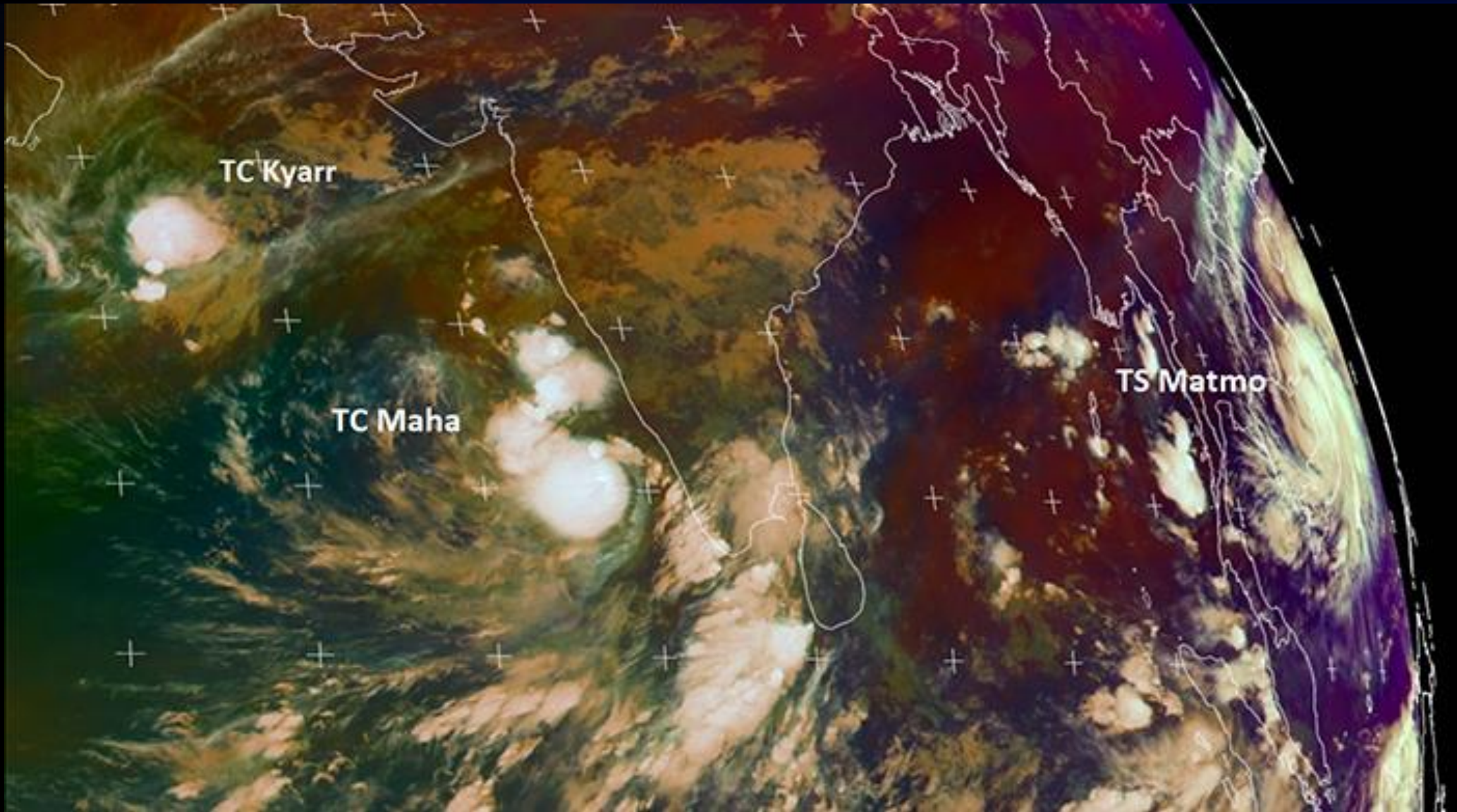


# MSG for transport: Aviation

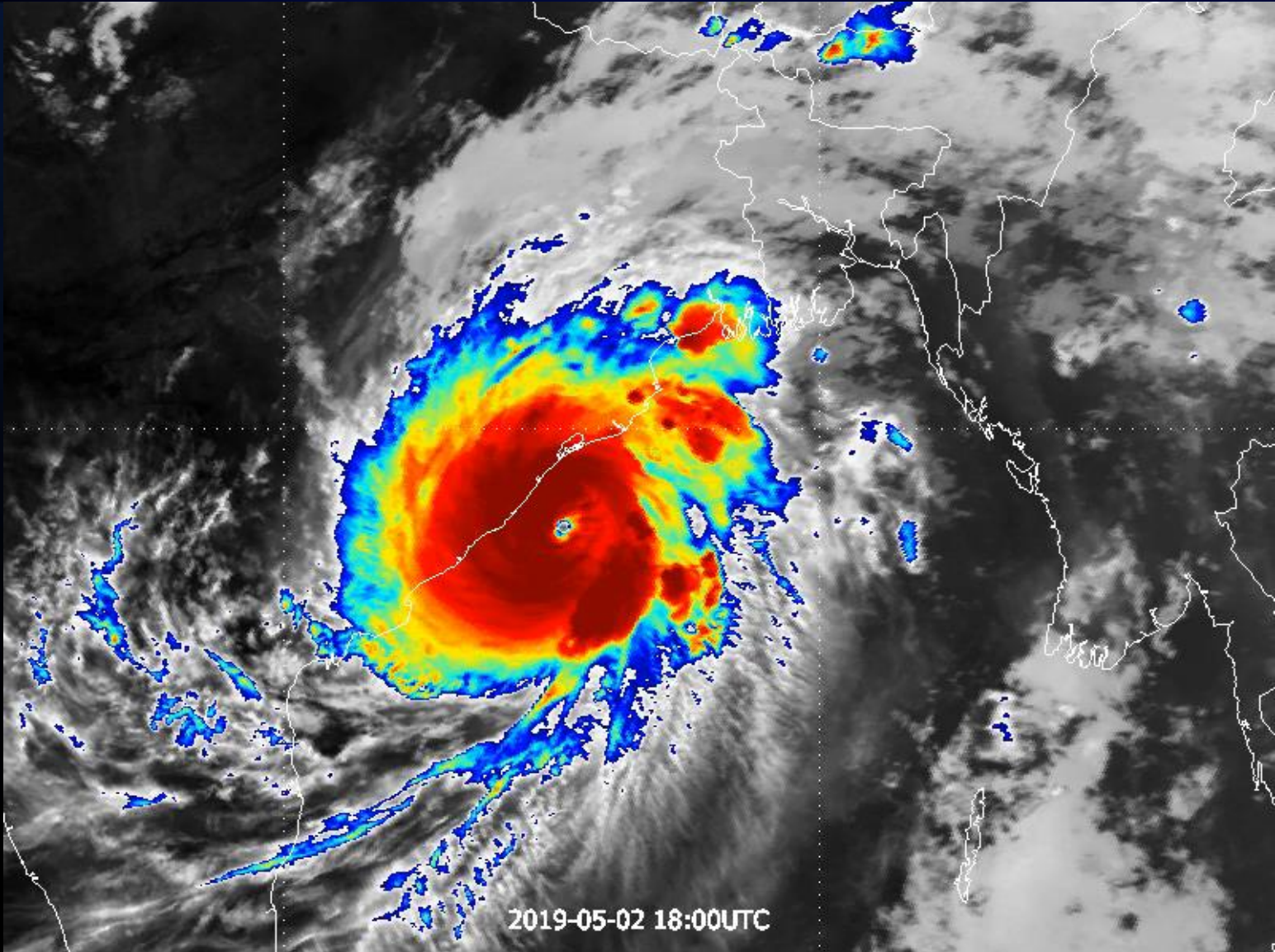
Eyjafjallajökull ash cloud  
from 7 to 11 May 2010 (second eruption)



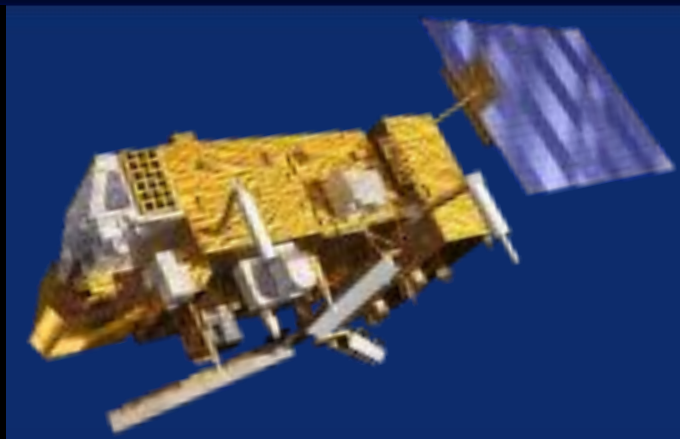
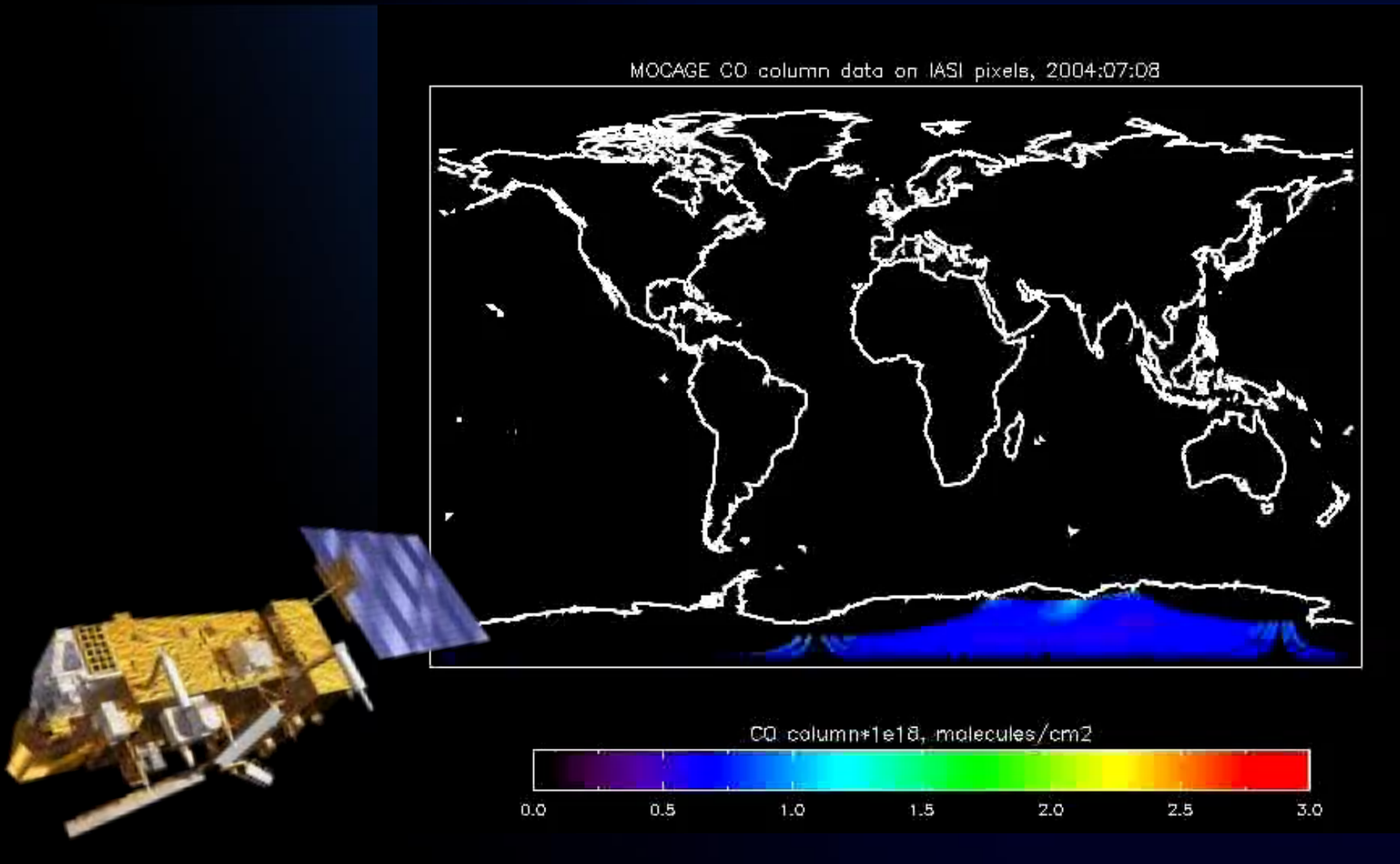
# Meteosat Second Generation: Provides Indian Ocean Data Coverage



# Meteosat Second Generation: Taifuun Fani makes landfall



# Polar orbit : Global observations from 800 km

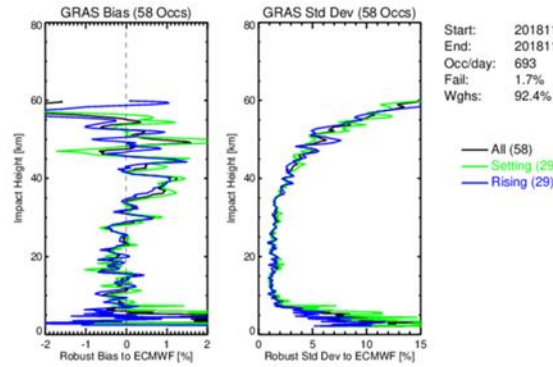




# Metop-C Latest in the fleet

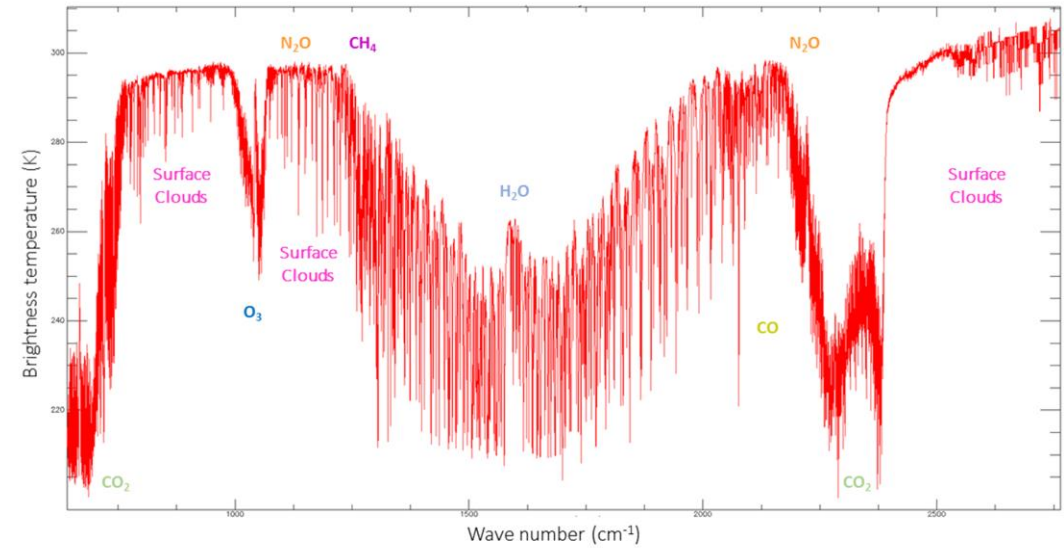
METOP-C | 12/11/18 09:27 to 9:42 UTC | Center: 15.0N 0.0W

## First Statistics against ECMWF

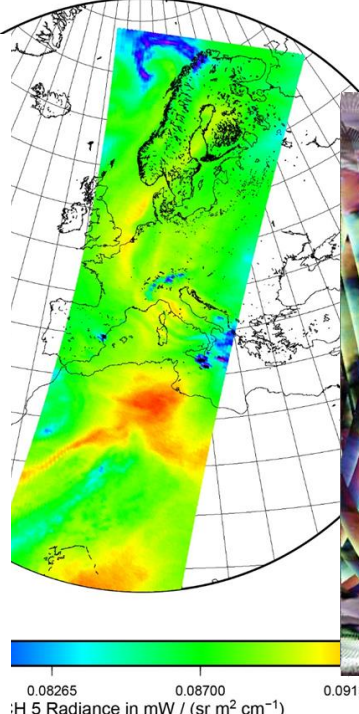
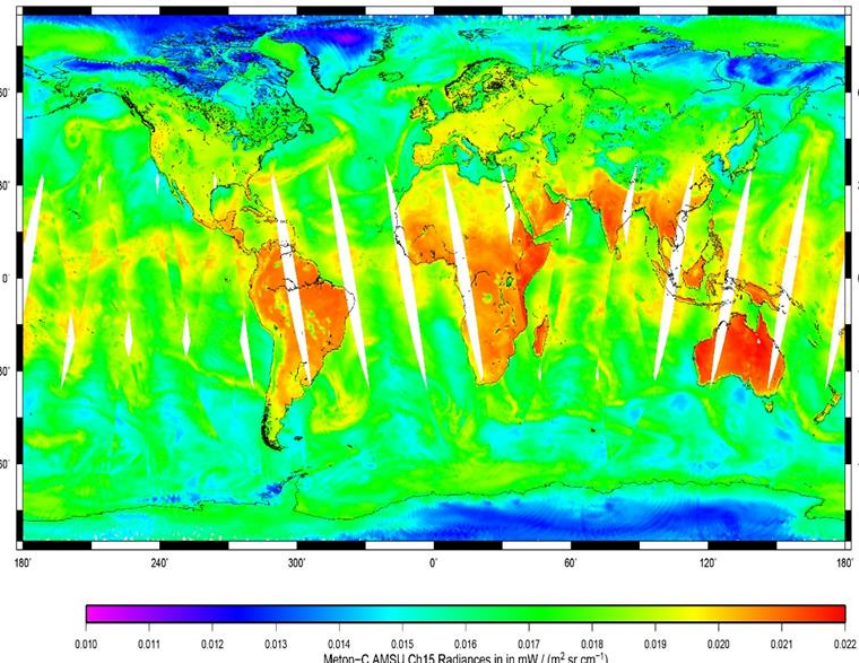


Generated on: Tue Nov 13 13:45:05 2018

## First IASI/Metop-C spectrum, 12/12/2018

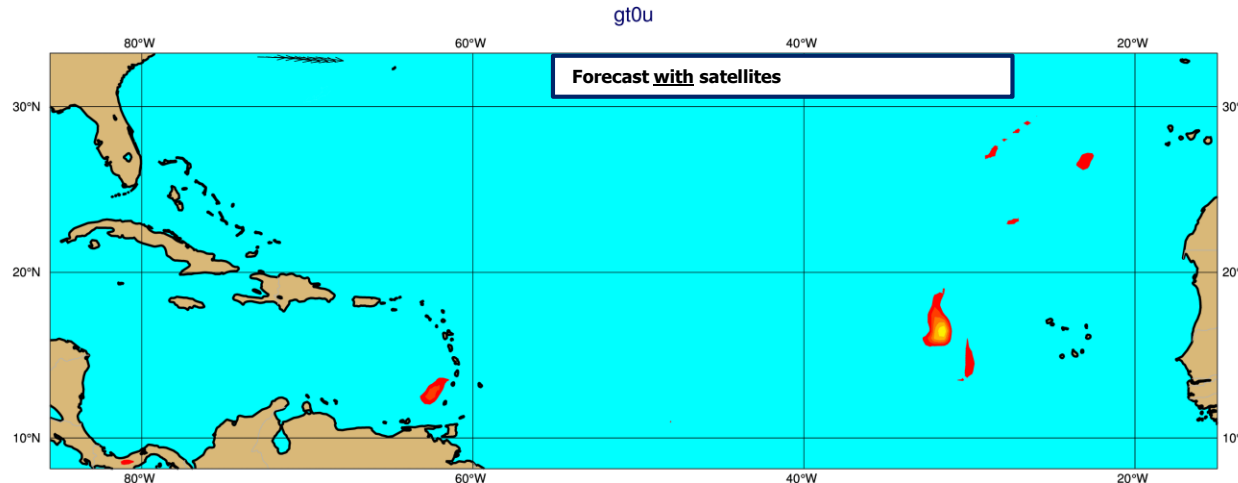


s nomi

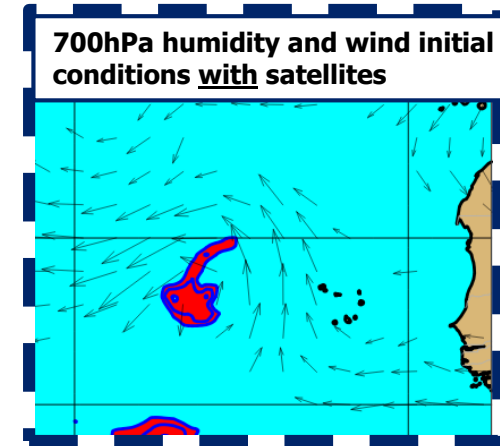
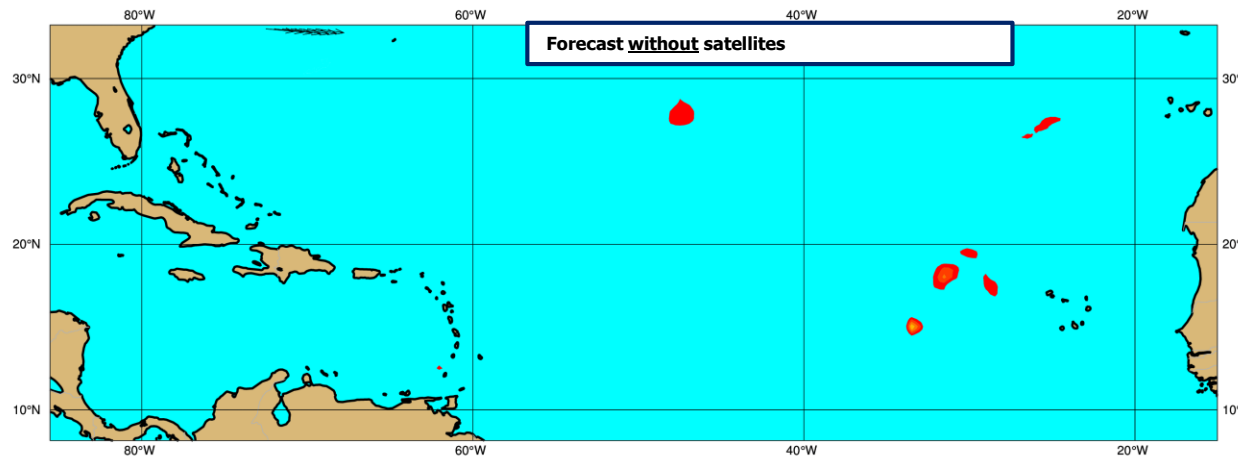




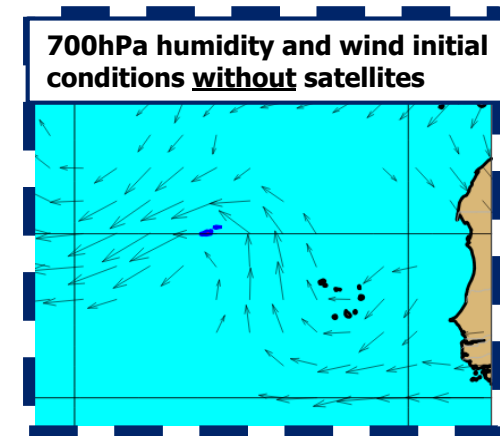
# IJPS contribution to forecasting IRMA



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



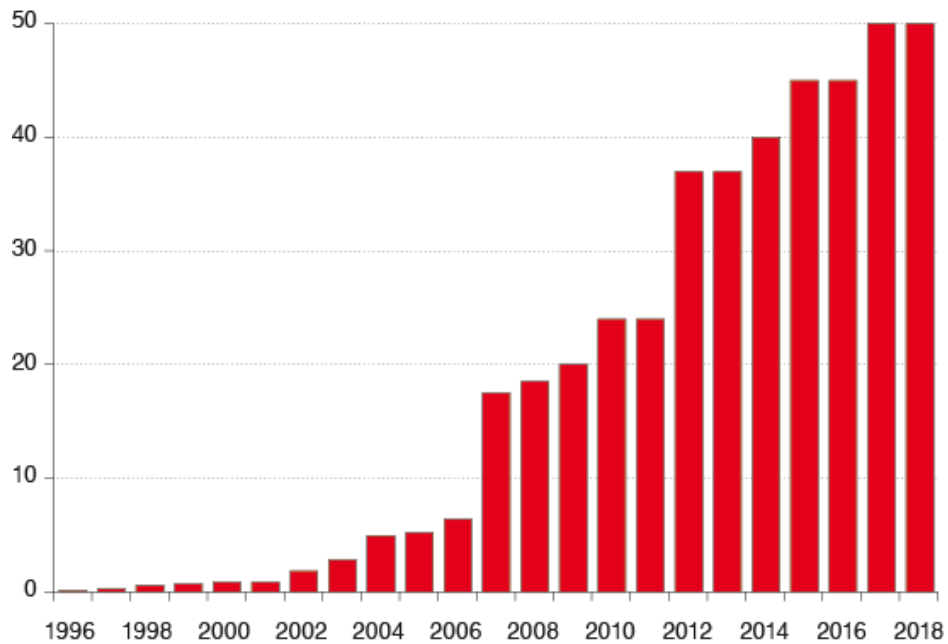
Red shading humidity > 95%



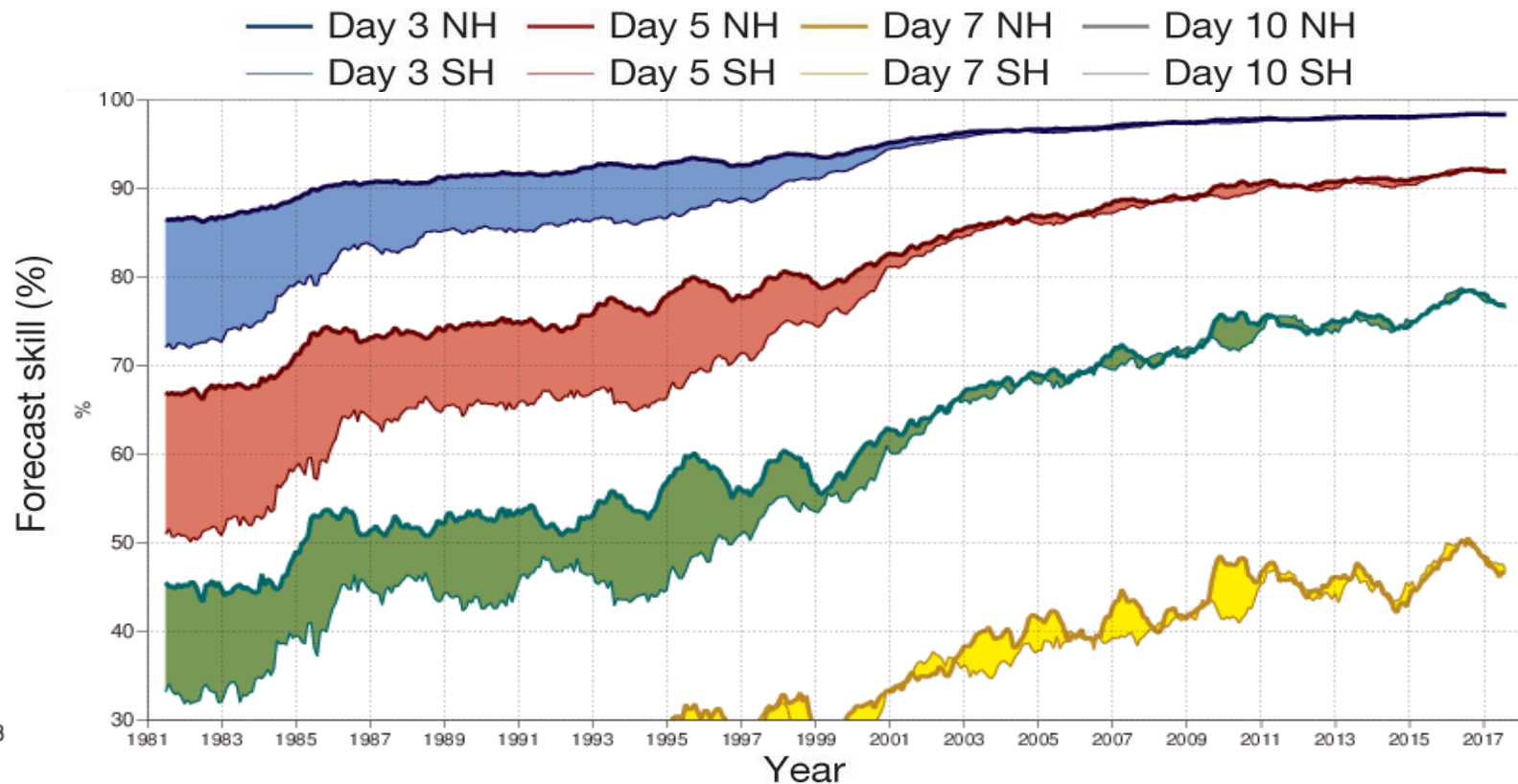
Source: ECMWF

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

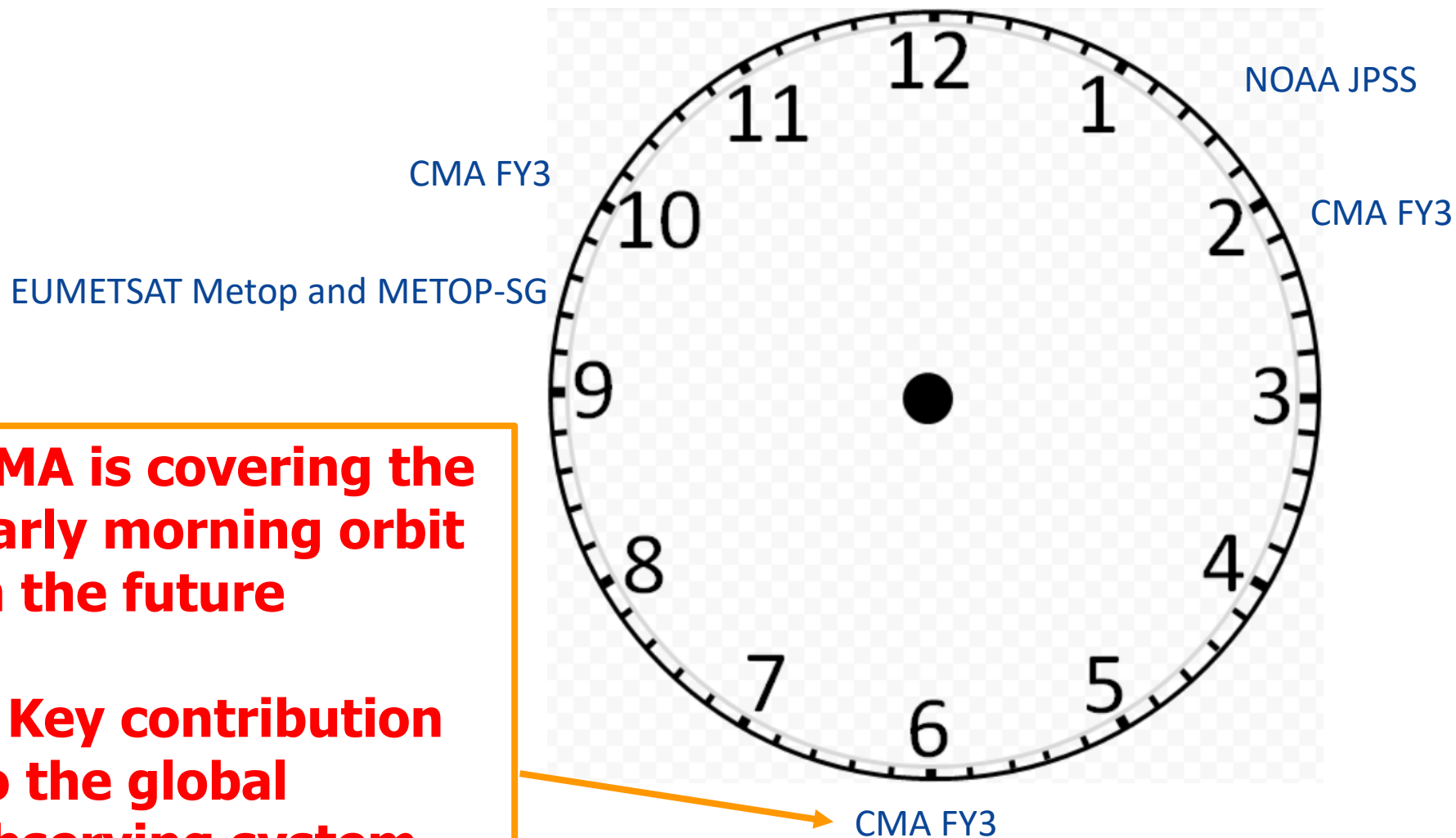
Total number of observations monitored at ECMWF



Source: ECMWF



# Example of Microwave Sounder Coverage from NOAA, EUMETSAT, CMA in the early 2020's vs optimisation (courtesy Mitch Goldberg)



**CMA is covering the early morning orbit in the future**

**A Key contribution to the global observing system**

# EPS-SG A sounding and imagery mission



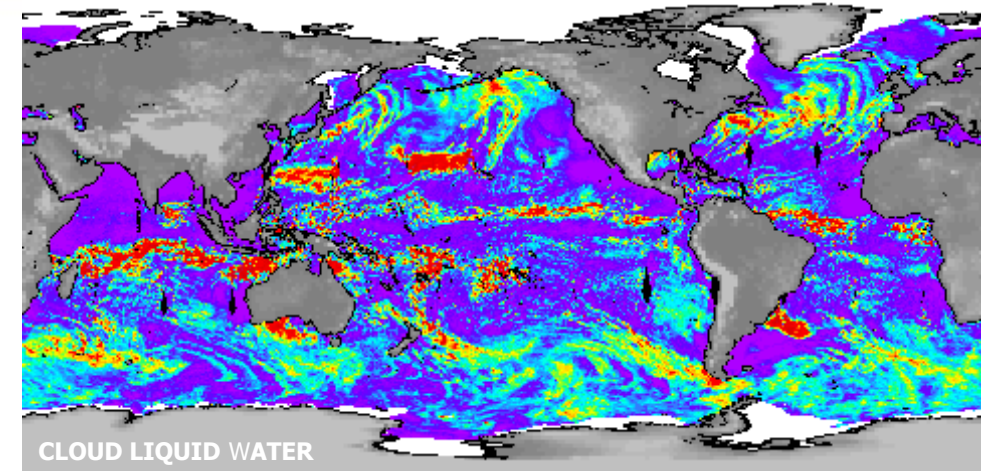
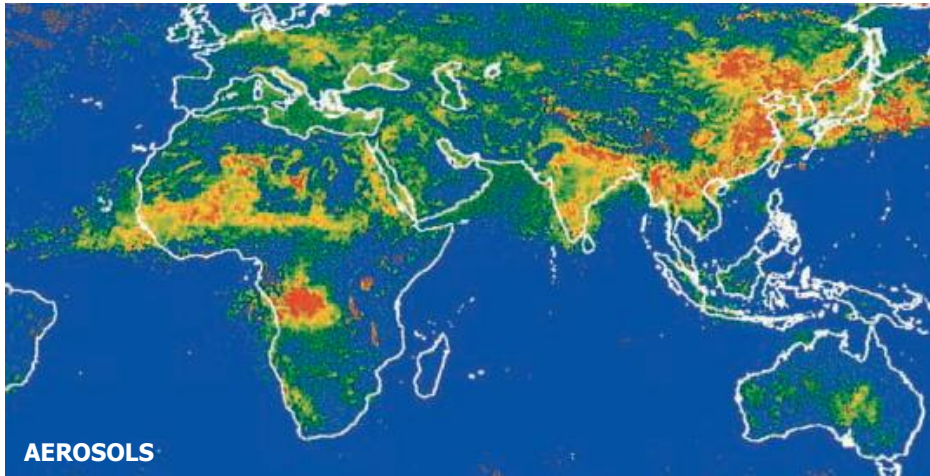
- 1. IASI-NG**  
Infrared Atmospheric Sounding
- 2. MWS**  
Microwave Sounding
- 3. METImage**  
Visible-Infrared Imaging
- 4. RO**  
Radio Occultation
- 5. 3MI**  
Multi-viewing, -channel, -polarisation  
Imaging
- 6. Copernicus Sentinel-5**  
UN/VIS/NIR/SWIR Sounding

# EPS-SG B microwave imagery mission

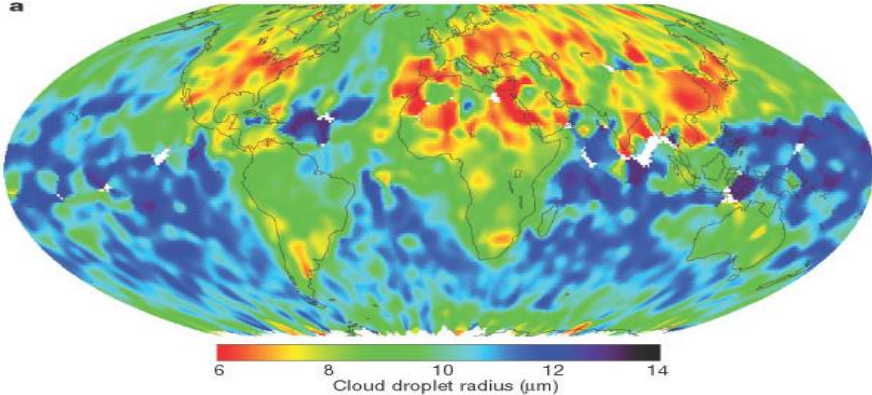
1. **SCA**  
Scatterometer
2. **RO**  
Radio Occultation
3. **MWI**  
Microwave Imaging for Precipitation
4. **ICI**  
Ice Cloud Imager
5. **ARGOS-4**  
Advanced Data Collection System



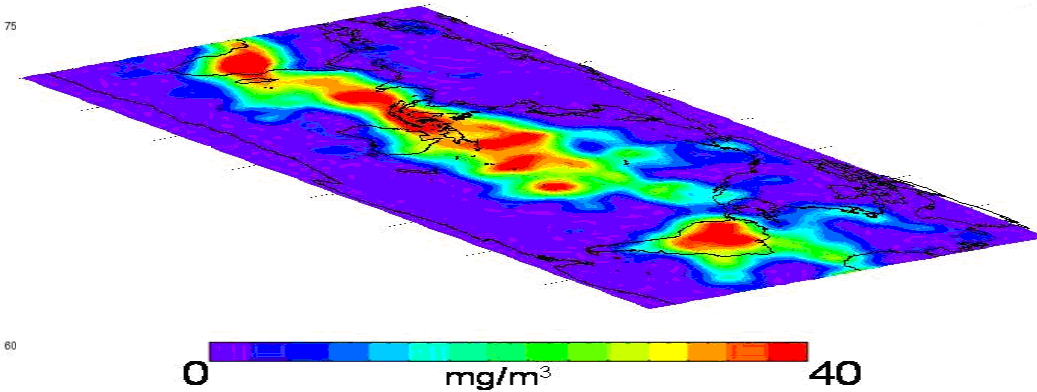
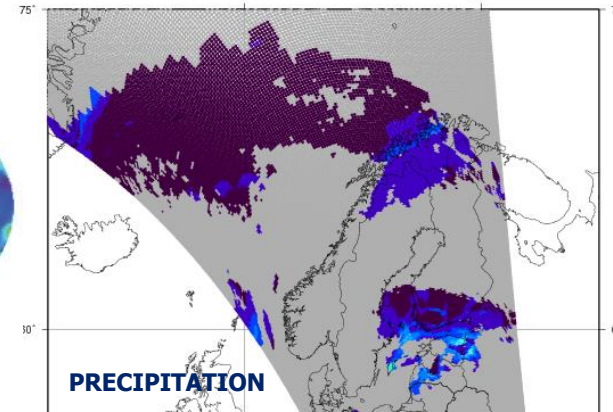
# New measurements from EPS-SG



CLOUD DROPLET RADIUS

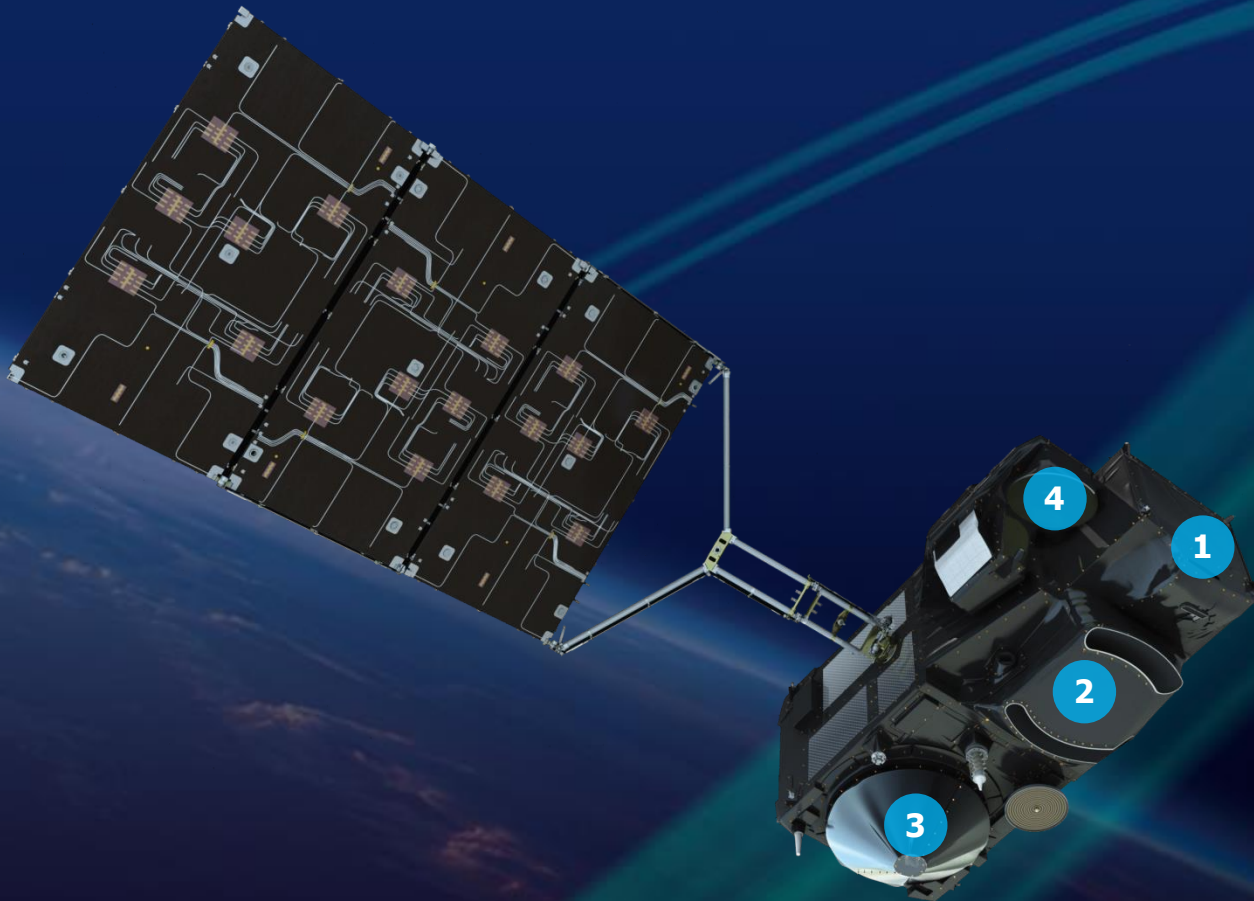


EUMETSAT H-SAF PR-OBS-1 Instantaneous Rain Rate from Conical MW Scan



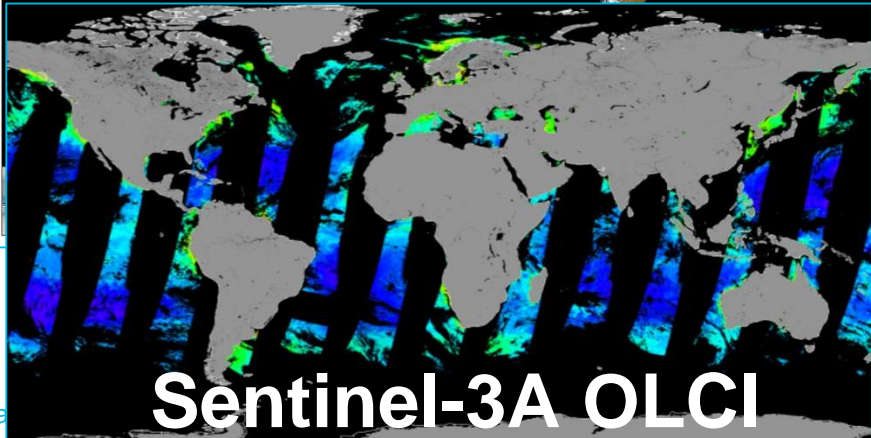
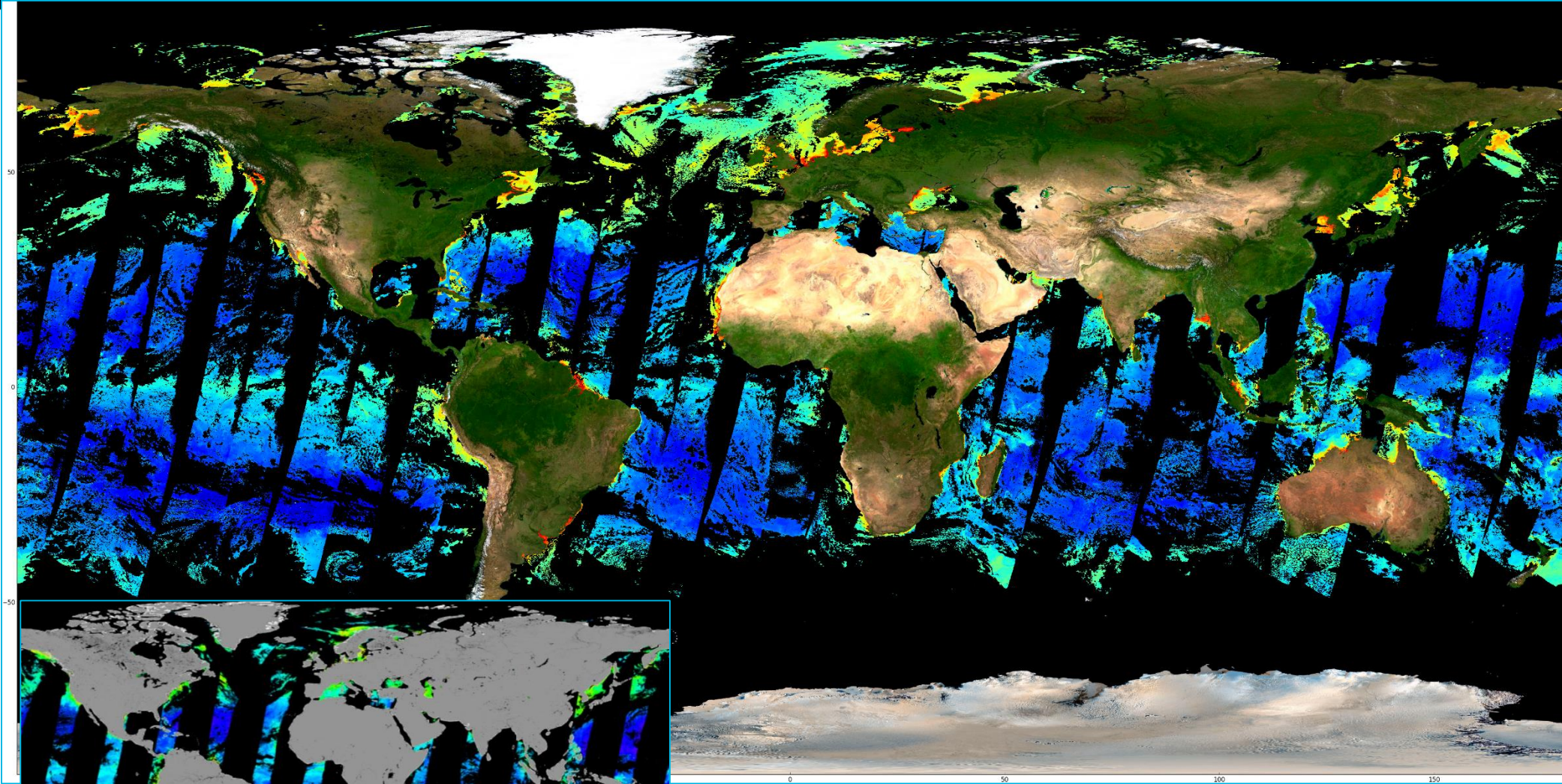
ICE CLOUDS

# 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

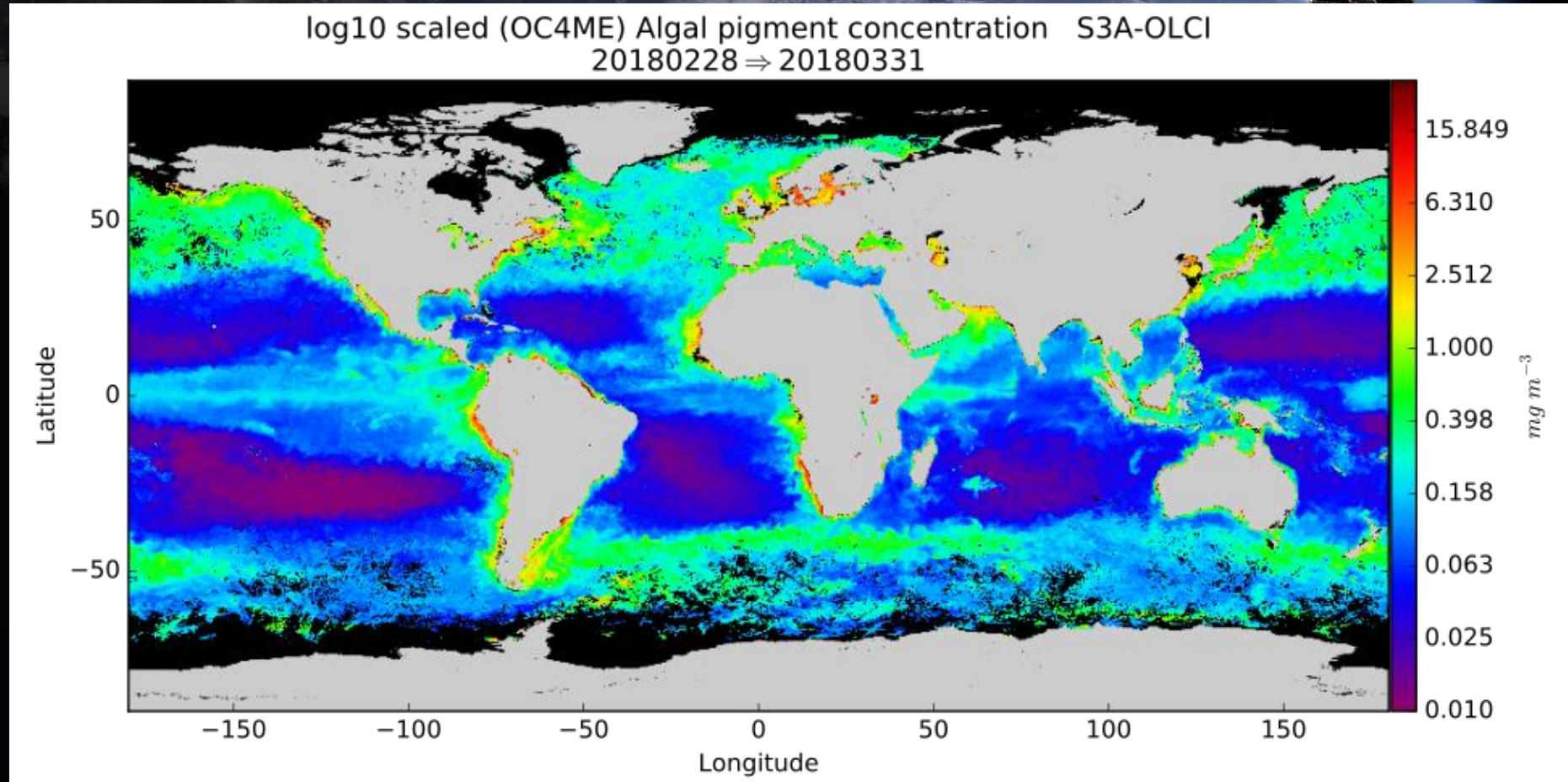
# Sentinel-3A + 3B OLCI increase in daily global coverage





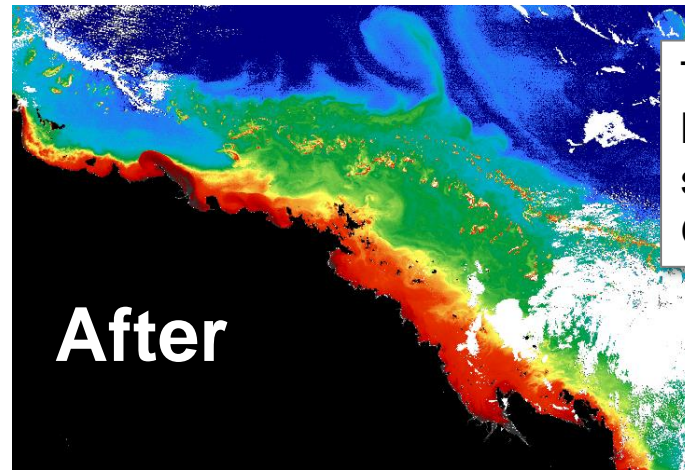
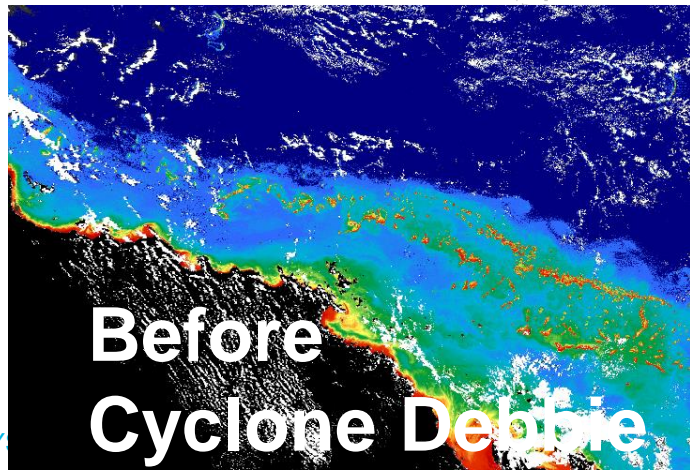
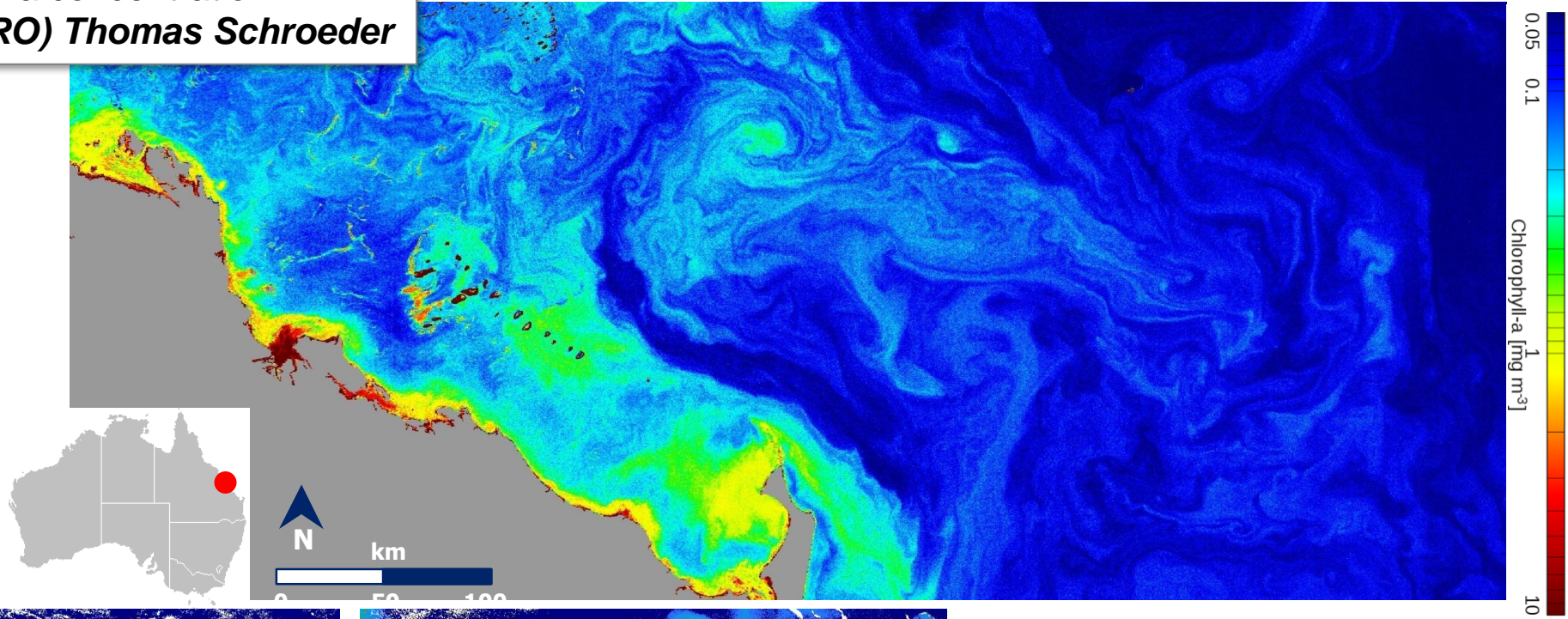
# Sentinel-3 Ocean and Land Colour Instrument (OLCI)

OLCI spectral bands	$\lambda$ center	width	
1	aerosol, in-water properties	400	15
2	yellow substance, detritus	412.5	10
3	chlorophyll absorption max	442.5	10
4	chlorophyll and other pigments	490	10
5	suspended sediments, red tide	510	10
6	chlorophyll absorption min	560	10
7	suspended sediments	620	10
8	chlorophyll absorption, fluorescence	665	10
9	fluorescence	673.75	7.5
10	chlorophyll fluorescence peak	681.25	7.5
11	chlorophyll fluoresc. ref., atm. corr.	708.75	10
12	vegetation, clouds	753.75	7.5
13	O <sub>2</sub> R-branch absorption	761.25	2.5
14	atmospheric parameters	764.375	3.75
15	cloud top pressure	767.5	2.5
16	O <sub>2</sub> P-branch absorption	778.75	15
17	atmospheric correction	865	20
18	vegetation, water vapour reference	885	10
19	water vapour, land	900	10
20	atmospheric correction	940	20
21	atmospheric correction	1020	40



# S3 OLCI for ecosystem monitoring and forecast

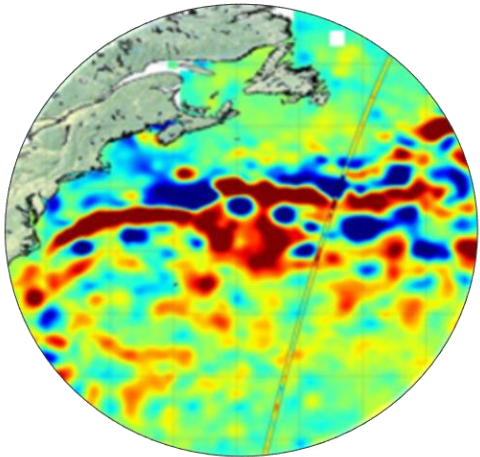
Great Barrier Reef  
Chlorophyll-a concentration  
*FUB-(CSIRO) Thomas Schroeder*



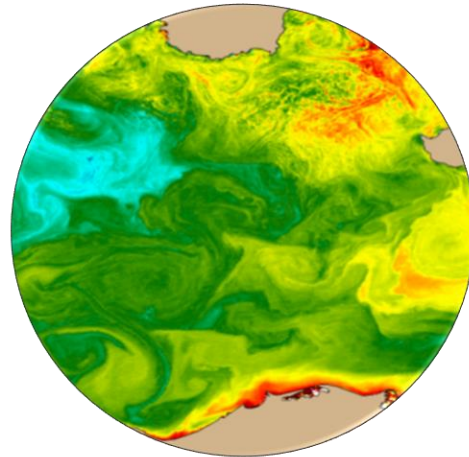
Tropical Cyclone Debbie caused large flooding and carried a lot of sediments and pollution into the Great Barrier Reef

# EUMETSAT marine products

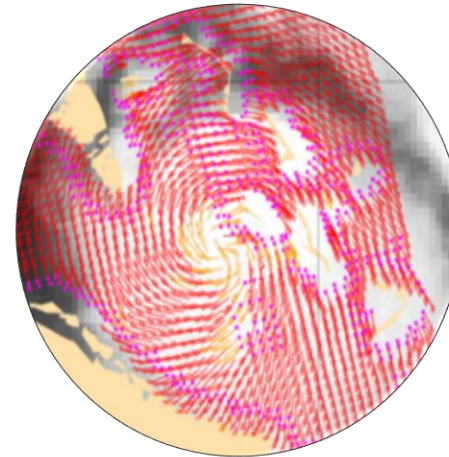
Sea Surface Height  
Significant Wave Height  
Wind Speed



Sea Surface  
Temperature



Wind Vectors  
Sea Ice Parameters



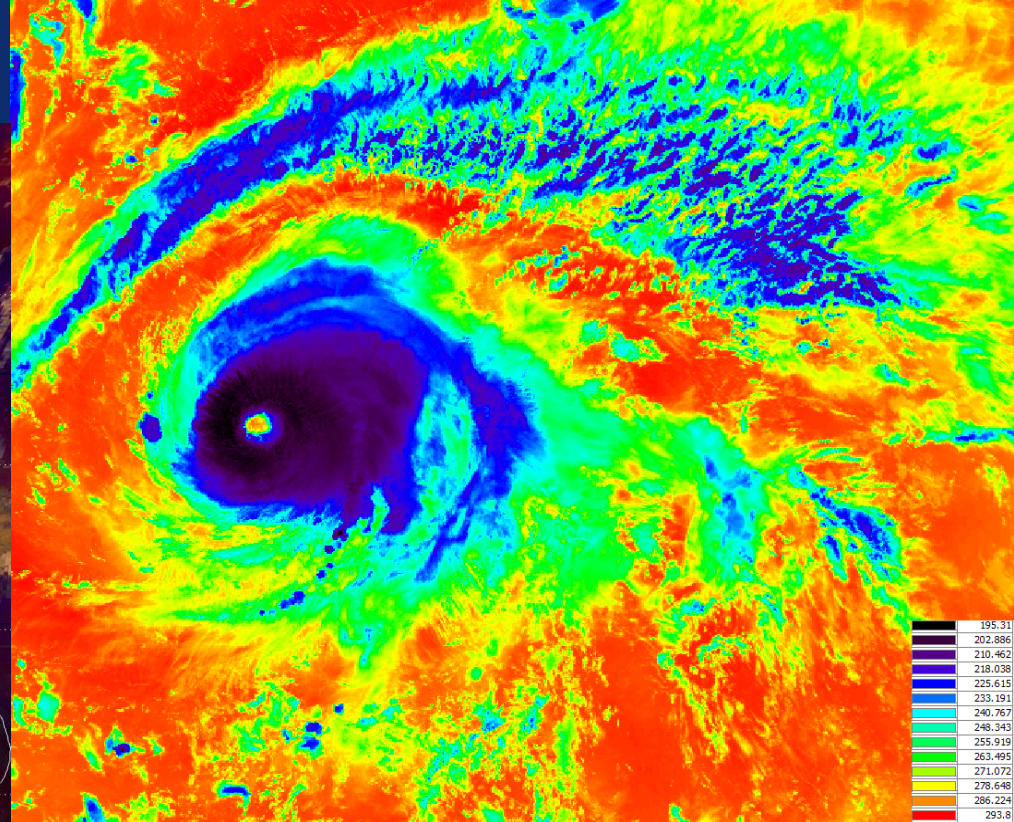
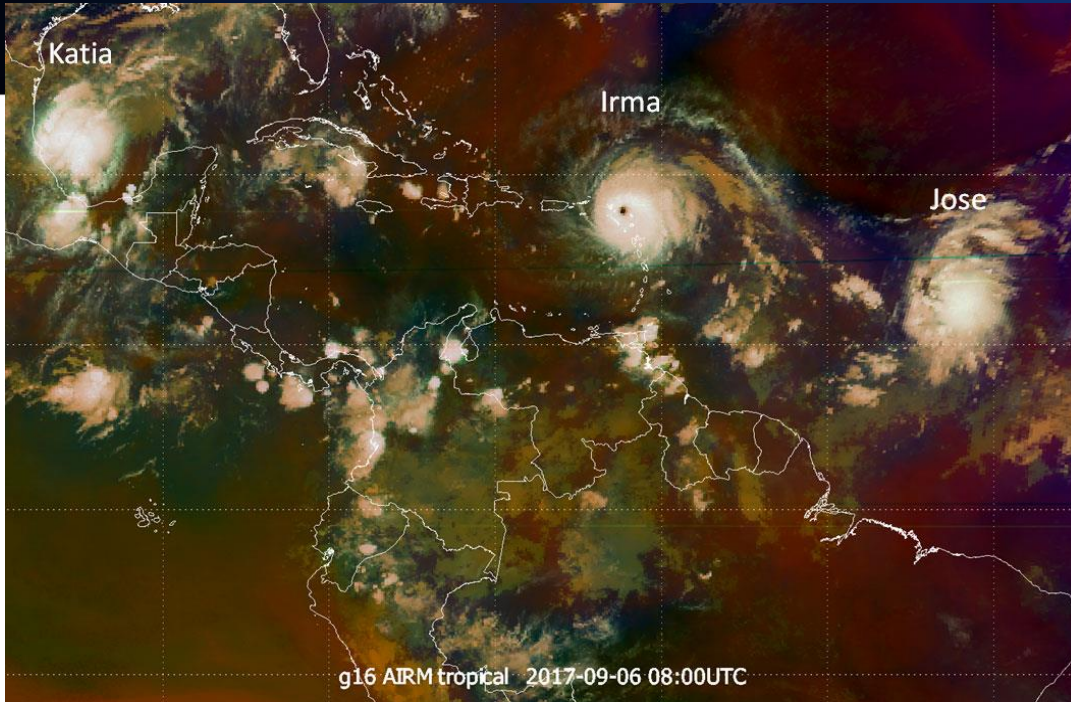
Ocean Colour



# Typhoon Halong with Sentinel-3 August 2014



# Hurricane forecasting

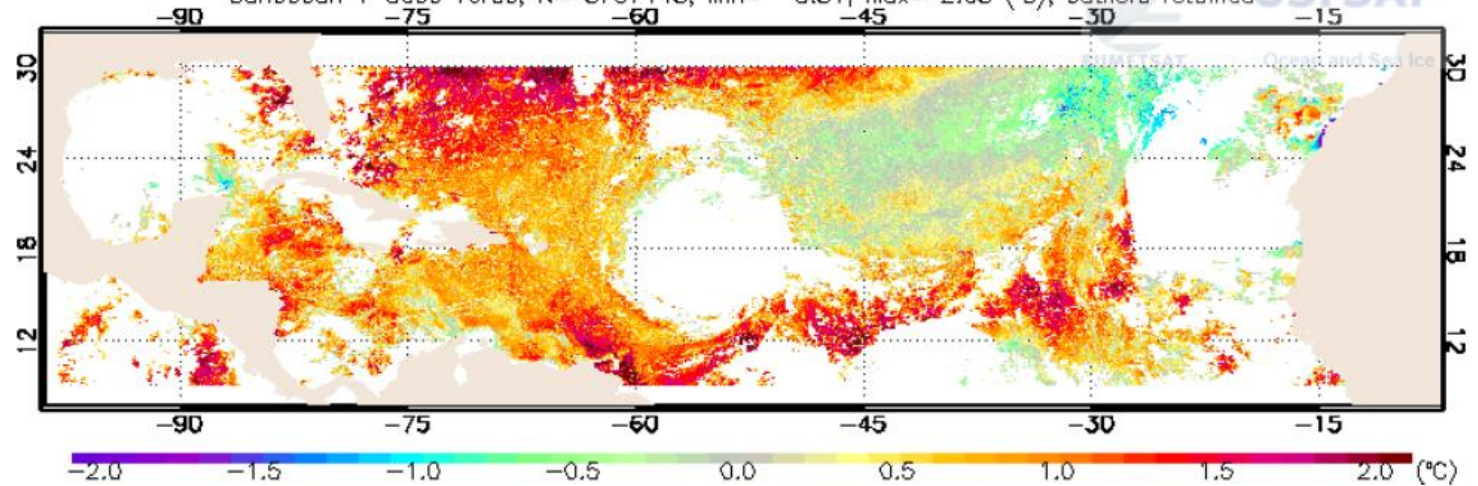


2017 saw major hurricane season in Tropical Atlantic

SST data important for forecasting hurricane track and intensity

Metop-B AVHRR L2P SST minus UKMO OSTIA Monthly Climate, Night, 20170905, outliers retained, Caribbean &

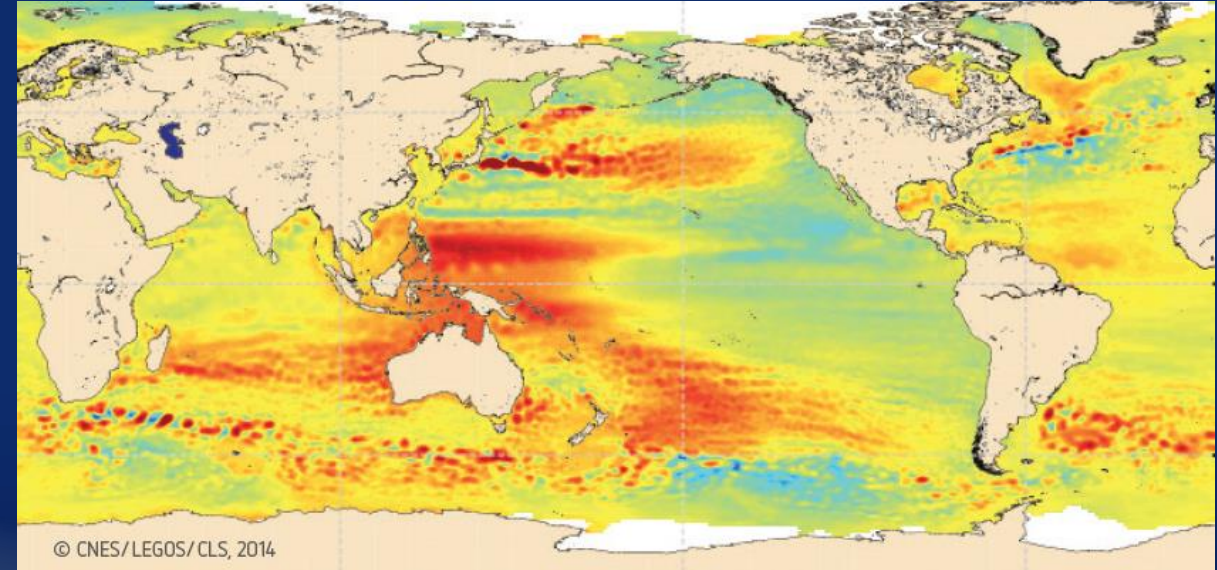
20170905 Night EUMETSAT OSISAF Metop-B AVHRR v02.0 - OSTIA (monthly climate) Caribbean + Cabo Verde, N= 5797143, Min= -3.31, Max= 2.68 (°C), outliers retained



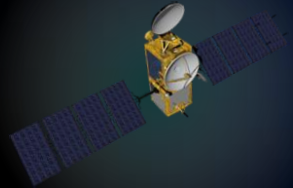
# Altimetry - Cooperative Jason missions



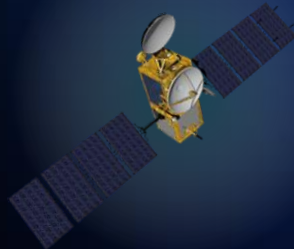
**TOPEX-POSEIDON**  
1992-2006



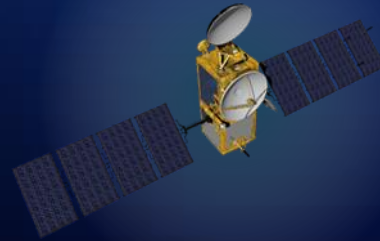
**JASON-1**  
2001



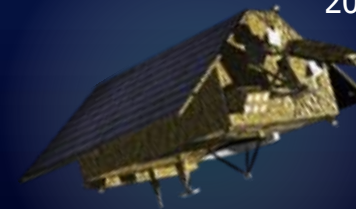
**OSTM/JASON-2**  
2008



**JASON-3**  
2016



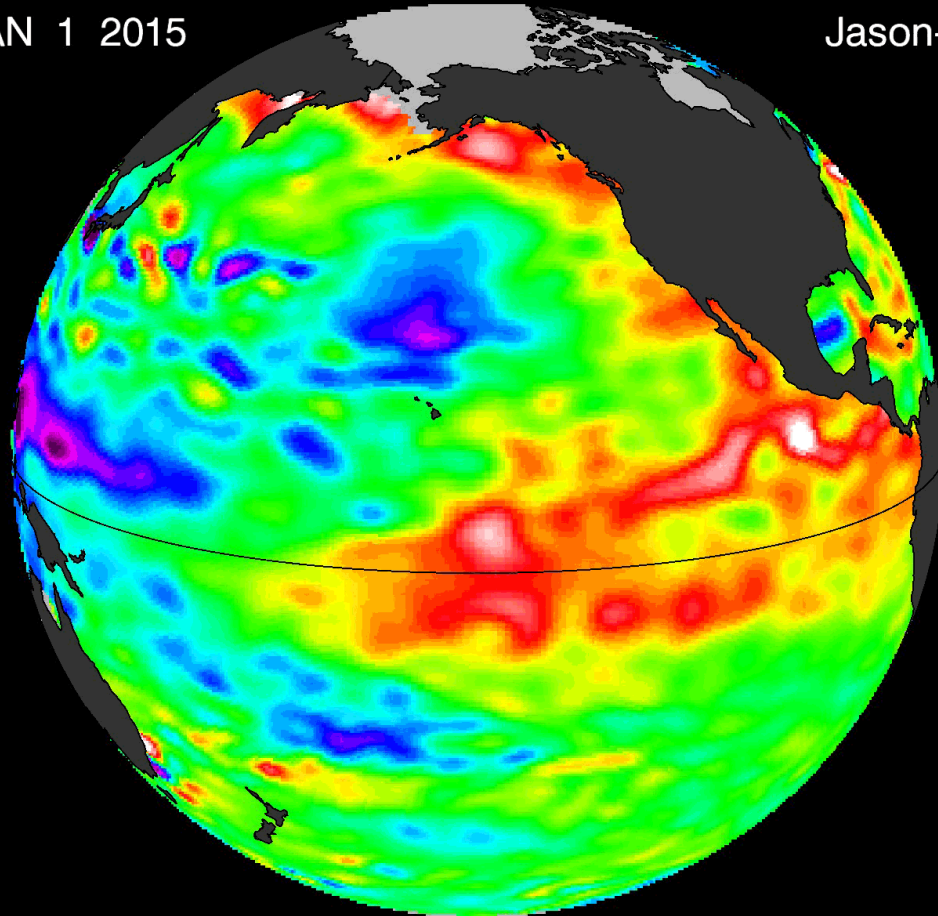
**SENTINEL-6/JASON-CS**  
2020



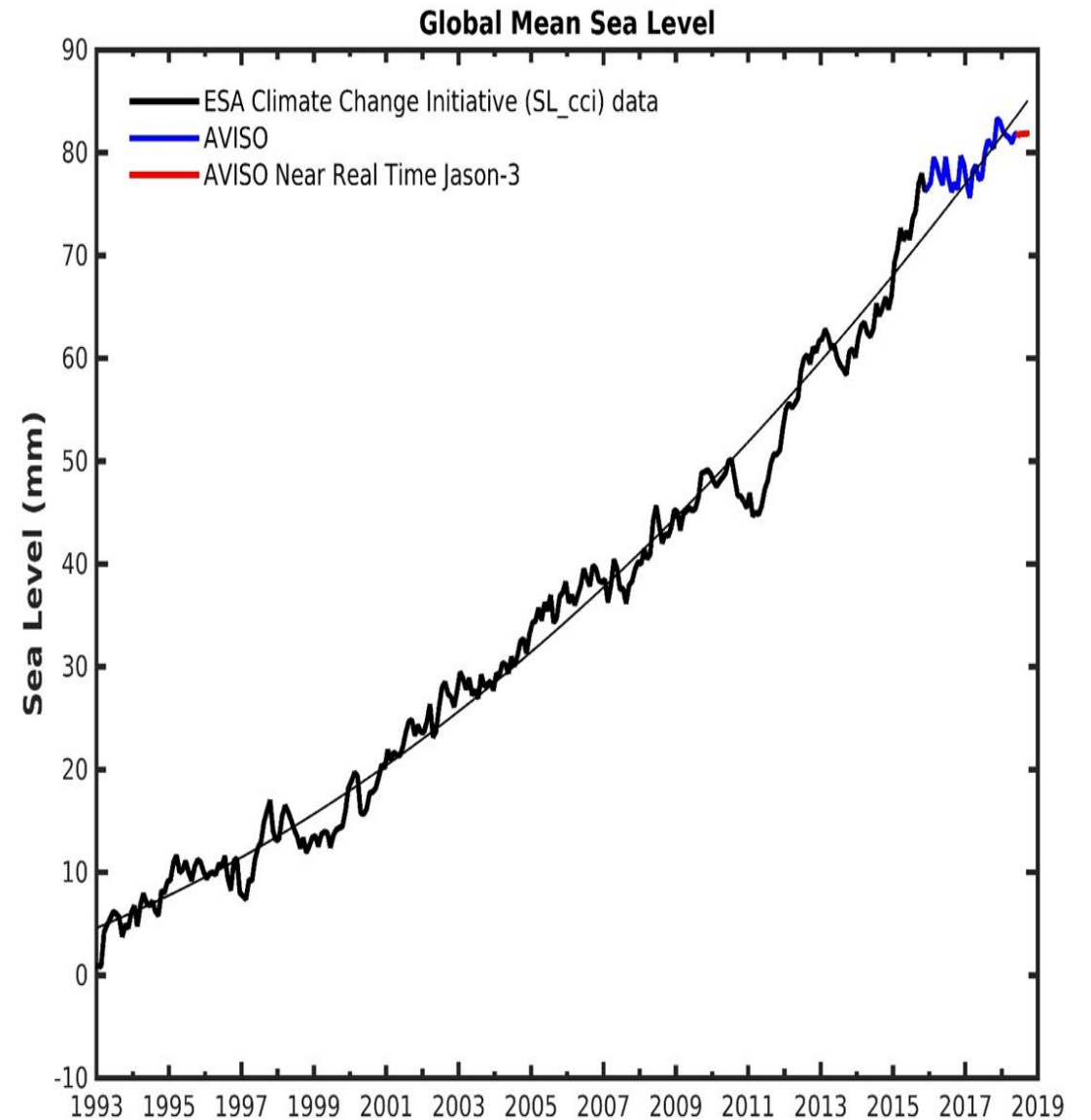
# Monitoring El Nino and sea level rise

JAN 1 2015

Jason-2



Jason-2/Jason-3 2015-2017



# Summary

- EUMETSAT has a strong user focus and programmes driven by elaborated user requirements
- Continuity of relevant operational missions provided through the EUMETSAT mandatory programmes
- EUMETSAT is the operational agency for key Copernicus missions: Sentinel 3 – 6
- International partnerships brings coordination and optimisation of the operational EO-missions
  - WMO, CGMS, CEOS, GEO, bilateral cooperation with other agencies
  - Special relationship with CMA
- EUMETSAT/ESA partnership provides efficient system development into operations



- **你有什么问题要问吗?**
- **谢谢**