

The background of the slide is a photograph of a modern, multi-story building with a curved facade and large glass windows. In the foreground, there are several tall, thin flagpoles with flags, and some greenery. The image is partially obscured by a dark blue semi-transparent box containing text.

# Next-generation eyes to check the pulse of Earth

**Stephan Bojinski** *MTG User Preparation Manager*

**Paolo M Ruti** *Chief Scientist*

*13<sup>th</sup> Asia-Oceania Meteorological Satellite Users' Conference*

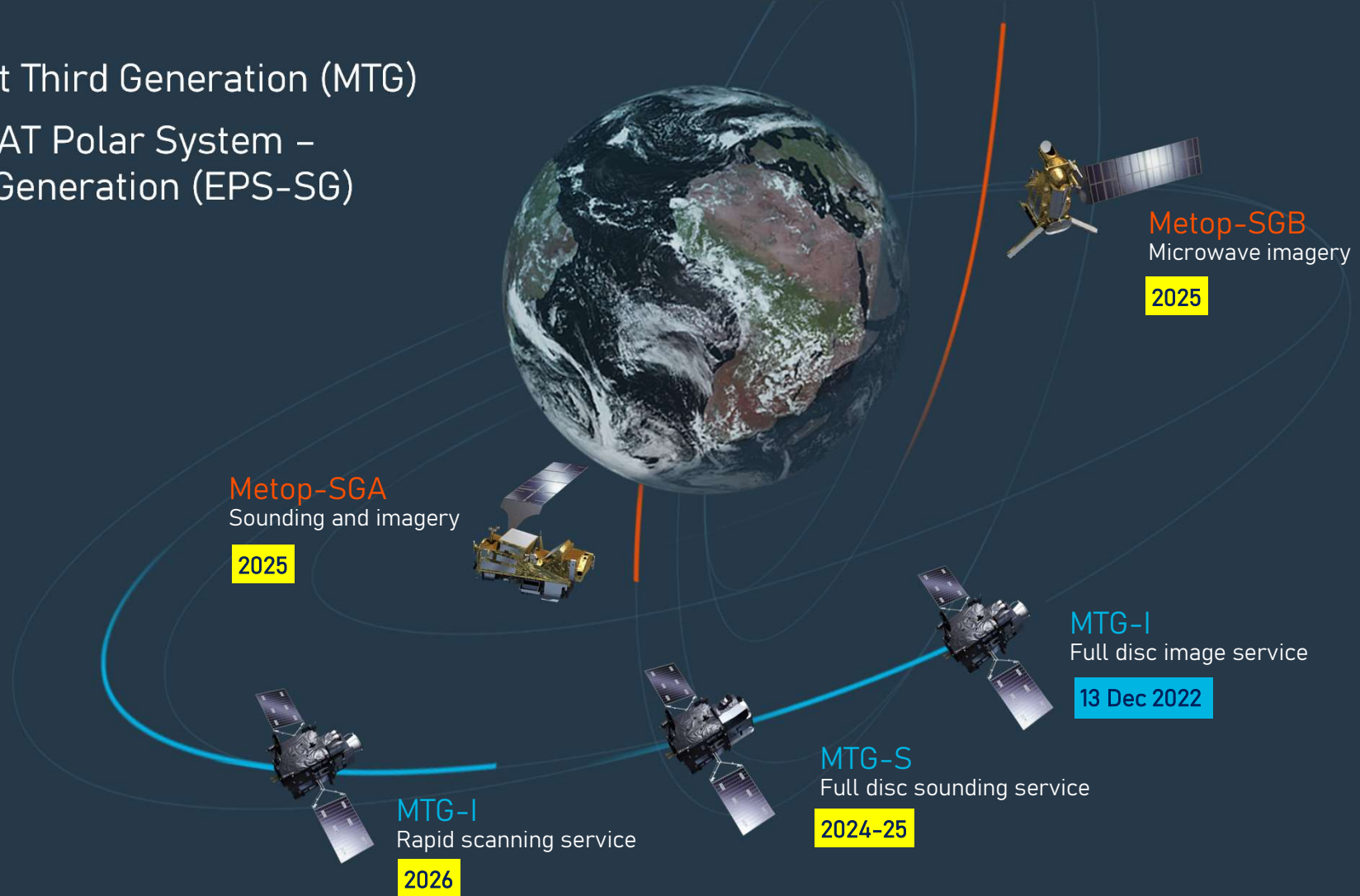
*Busan, Republic of Korea*

*6 November 2023*



# Future focus: two highly innovative programmes

- Meteosat Third Generation (MTG)
- EUMETSAT Polar System – Second Generation (EPS-SG)





# Meteosat Third Generation: Mission objectives

www.eumetsat.int

## MTG-I1

### Full Disc image service

- 16 spectral channels over Europe and Africa every 10 minutes
- Lightning Imager

- Start of operations 2023

- Operational exploitation 2024-2045

## MTG-S

### Full Disc sounding service

- Hyperspectral Infrared Sounder
- Copernicus Sentinel-4 UVN

## MTG-I2

### Rapid Scanning Service

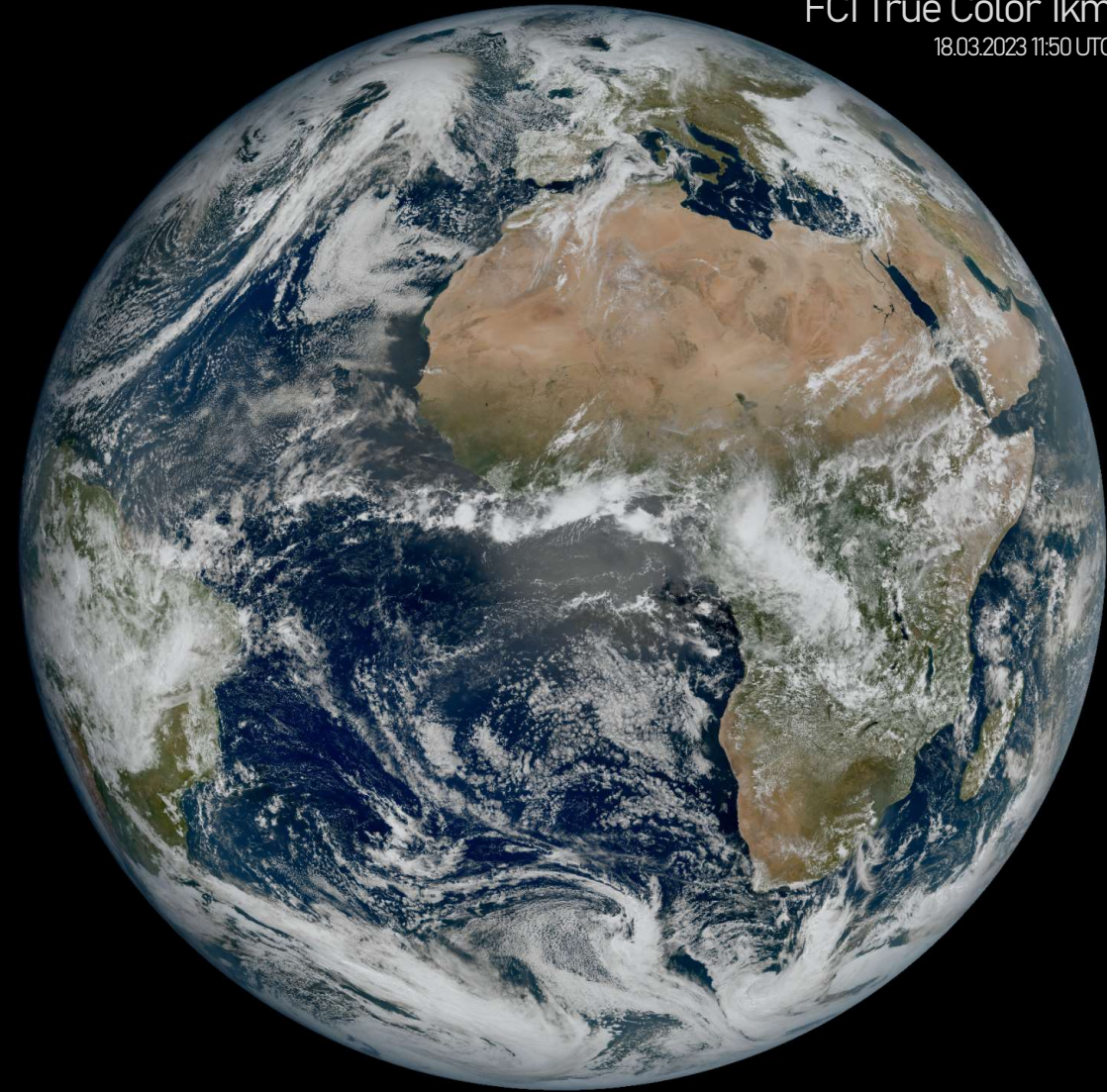
- 16 spectral channels over Europe every 2.5 minutes



1. Nowcasting and Short range Forecasting of High-Impact Weather
2. Air quality and atmospheric trace gas monitoring over Europe (Copernicus Sentinel-4 mission)

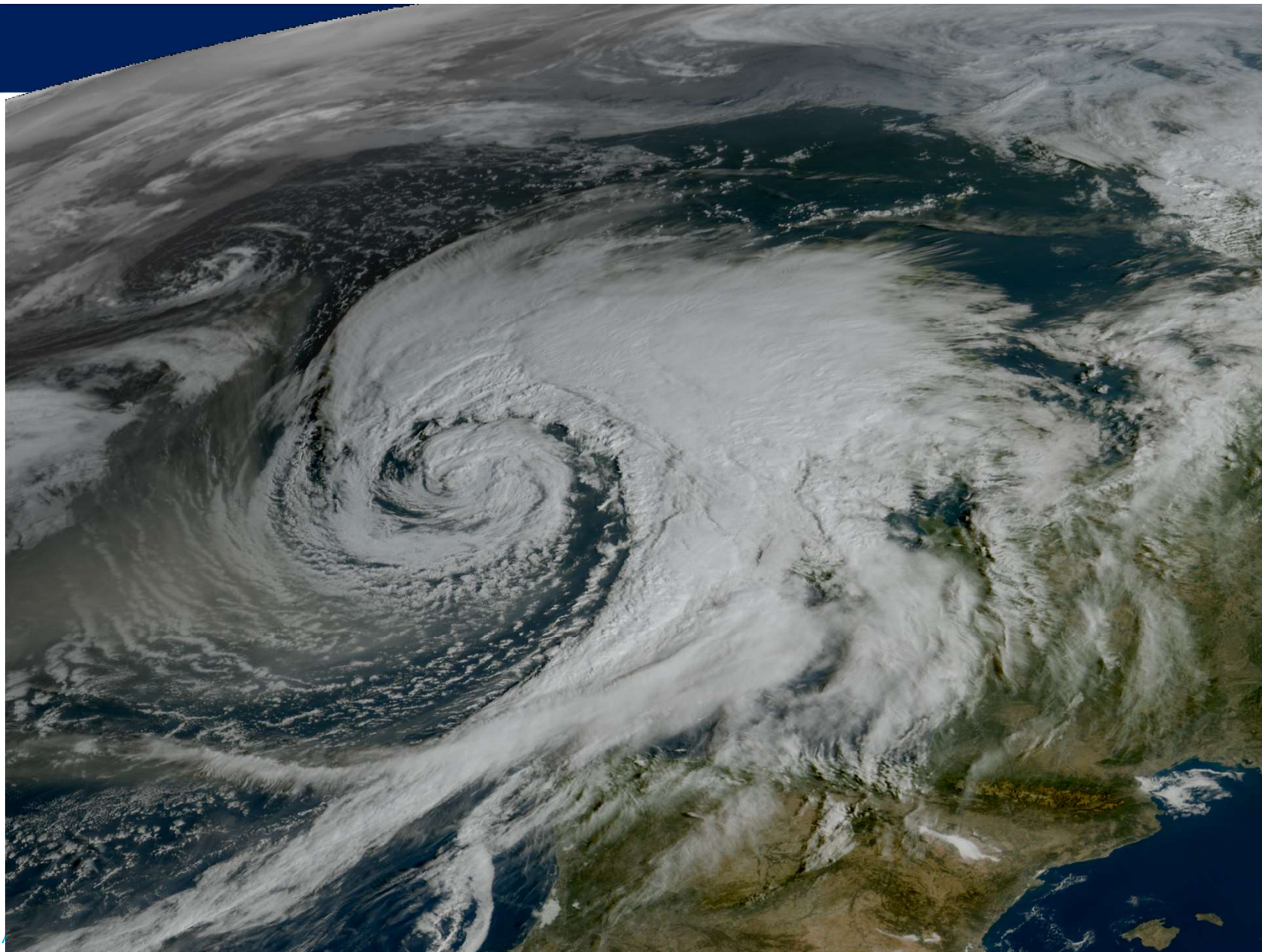
First MTG Flexible Combined Imager (FCI) image – released 4 May 2023

FCI True Color 1km  
18.03.2023 11:50 UTC



# A walk through the first months of FCI data

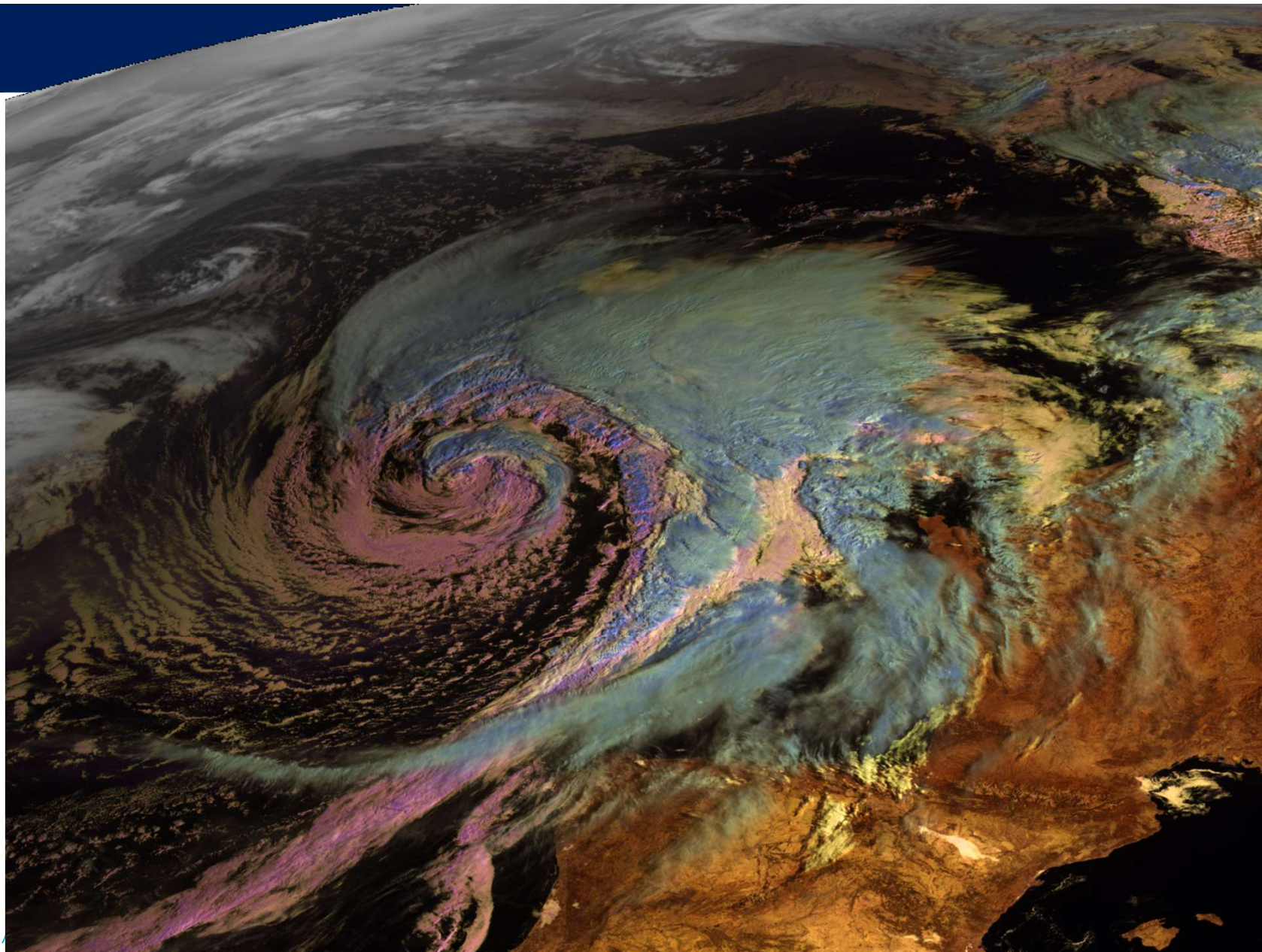
*What you will see are preliminary results using FCI commissioning data that are not ready for any operational use.*



[www.eumetsat.int](http://www.eumetsat.int)

MTG Flexible Combined  
Imager:  
True Colour RGB with  
nighttime IR layer top-left,  
**Storm Agnes**  
27 Sep 2023

Credit: Johan Strandgren,  
EUMETSAT



[www.eumetsat.int](http://www.eumetsat.int)

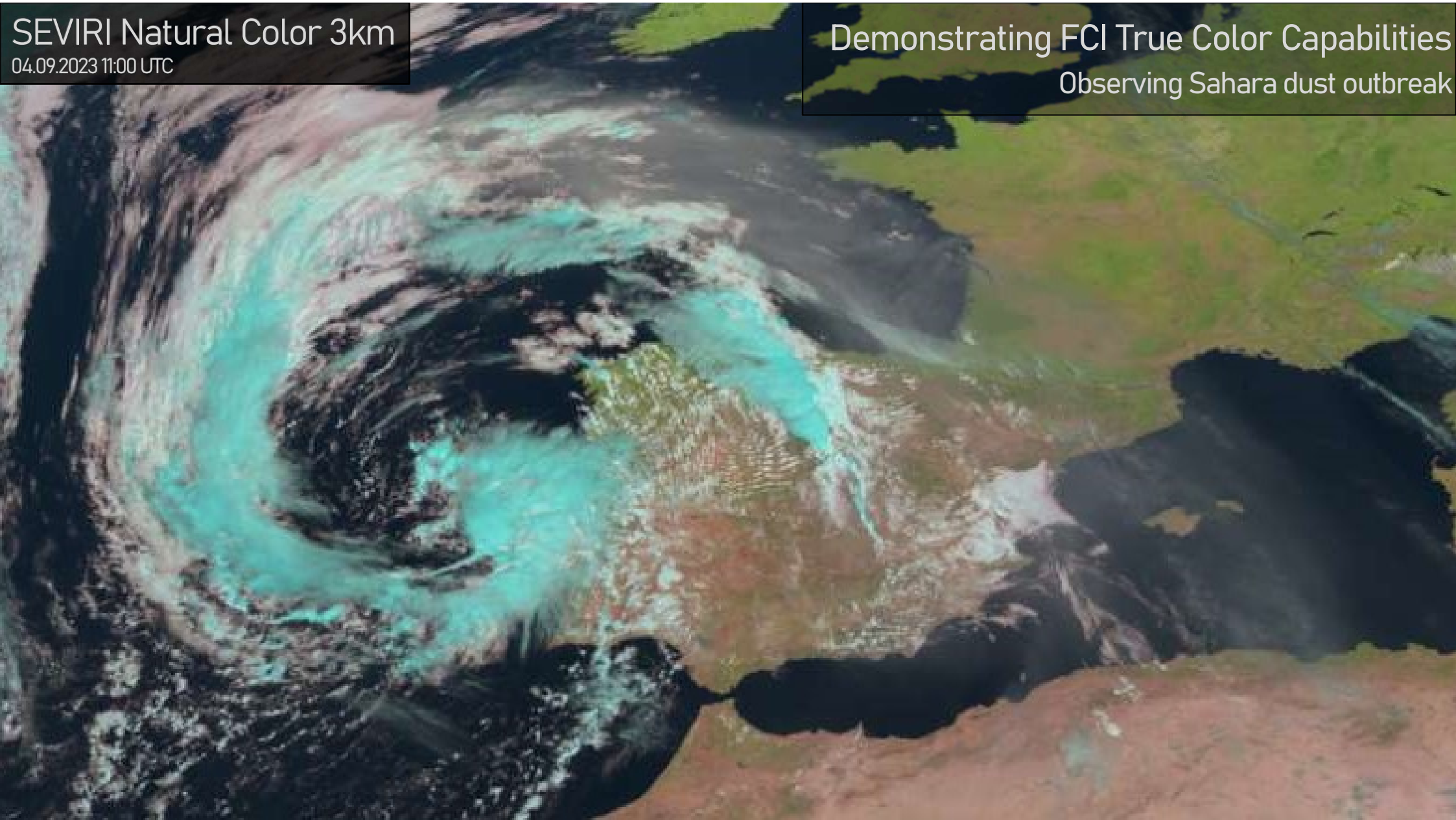
MTG Flexible Combined  
Imager:  
Cloud Phase RGB with  
nighttime IR layer top-left  
**Storm Agnes**  
**27 Sep 2023**

RGB Reference:  
EUMETrain [RGB Quick  
Guides](#)

Credit: Johan Strandgren,  
EUMETSAT

SEVIRI Natural Color 3km  
04.09.2023 11:00 UTC

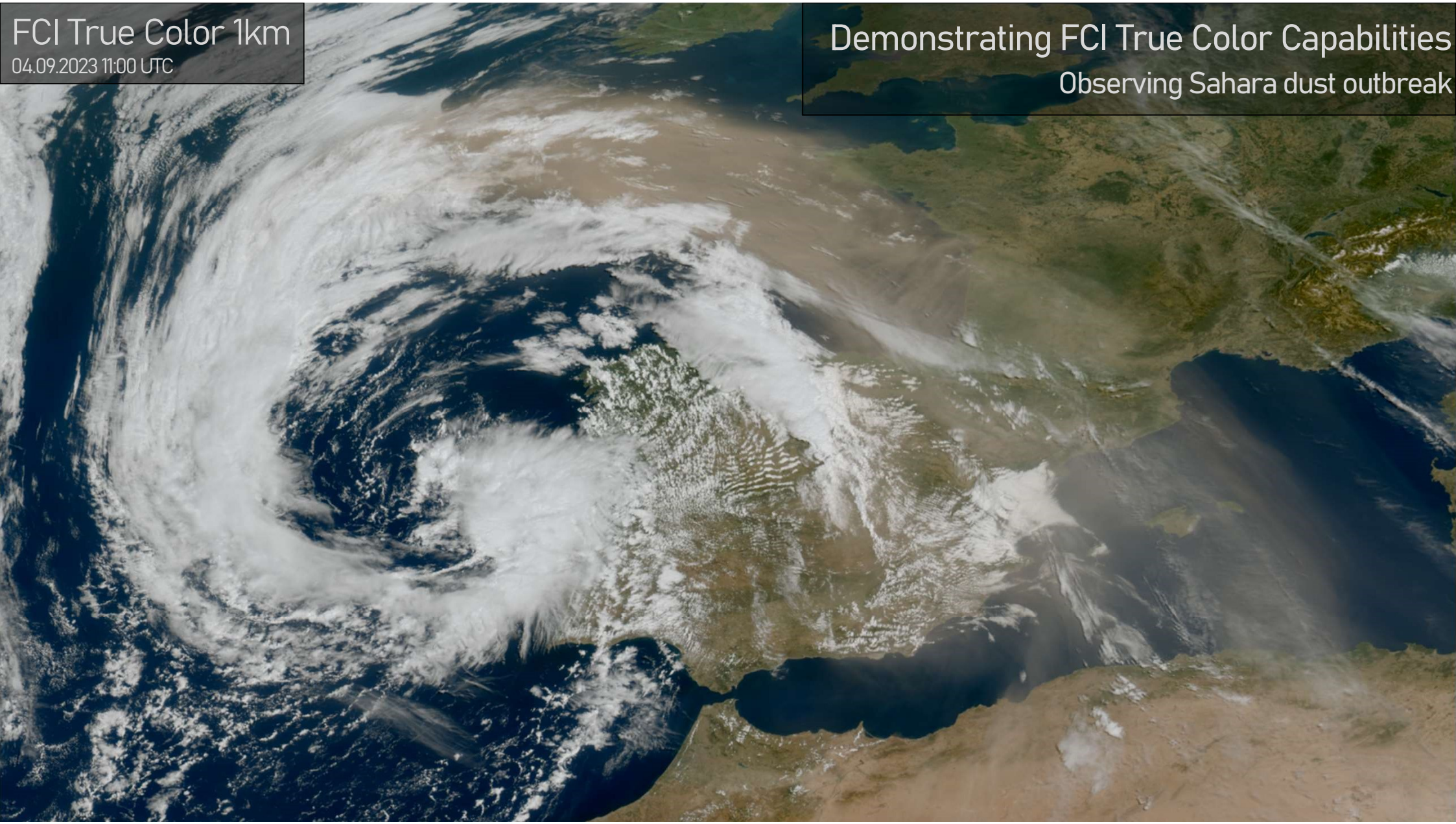
Demonstrating FCI True Color Capabilities  
Observing Sahara dust outbreak





FCI True Color 1km  
04.09.2023 11:00 UTC

Demonstrating FCI True Color Capabilities  
Observing Sahara dust outbreak



SEVIRI Natural Color 3km

14.08.2023 06:45 UTC

Demonstrating FCI True Color Capabilities

Observing Etna eruption

FCI True Color 1km

14.08.2023 06:40 UTC



SEVIRI Natural Color 3km  
Fire Temperature 3km  
(3.8 $\mu$ m)

05.08.2023 10:00 UTC

Demonstrating FCI's True Color Capabilities

Observing wild fires in Portugal

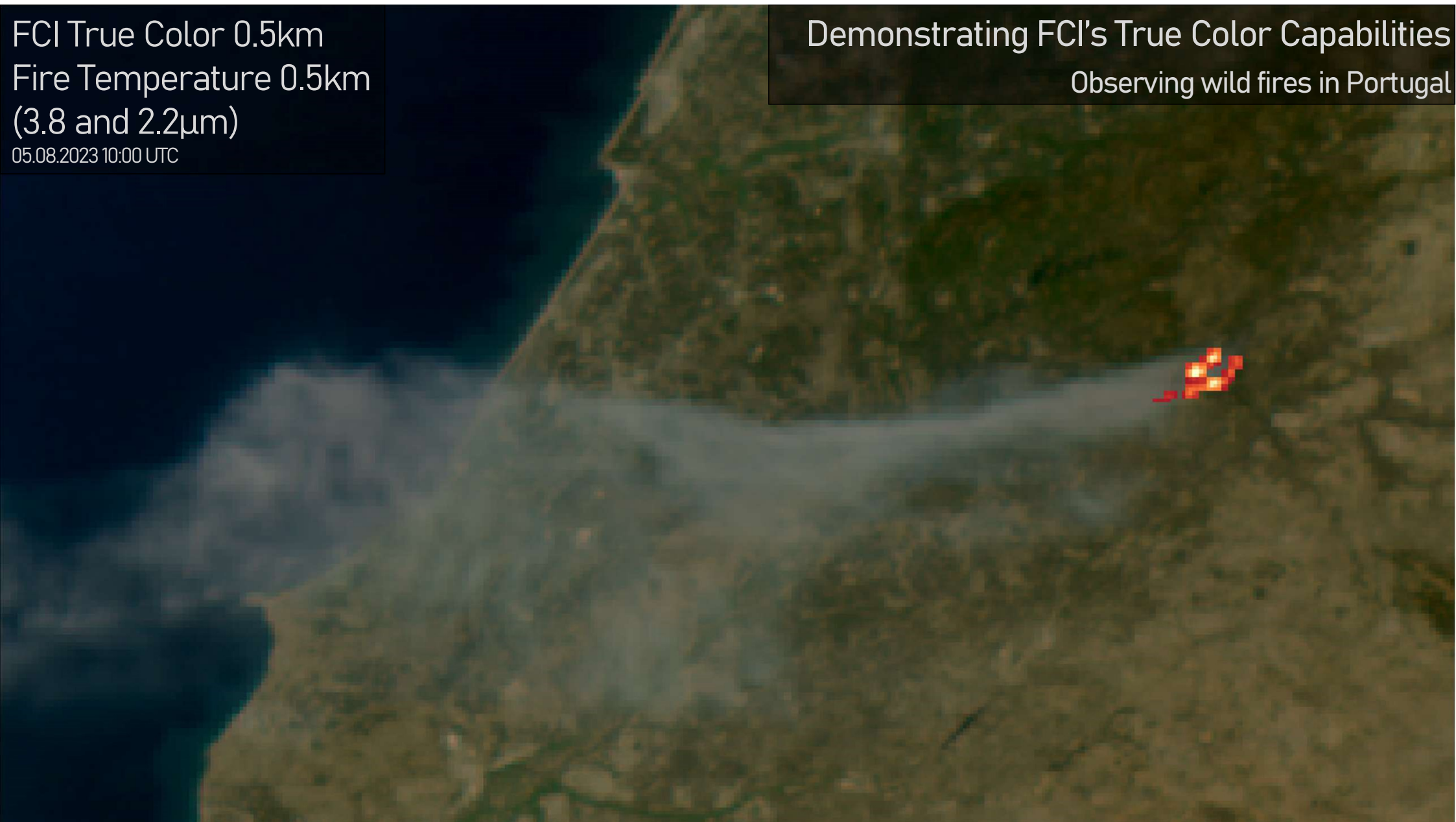


FCI True Color 0.5km  
Fire Temperature 0.5km  
(3.8 and 2.2 $\mu$ m)

05.08.2023 10:00 UTC

Demonstrating FCI's True Color Capabilities

Observing wild fires in Portugal



FCI True Color 1km  
Fire Temperature 0.5km  
(3.8 and 2.2 $\mu$ m)  
22.07.2023 10:00-16:30 UTC

Demonstrating FCI's True Color Capabilities  
Observing the Rhodes wildfire





# Preliminary data from MTG Lightning Imager (2 June 2023)

2023-06-02 00:02



North Camera

2023-06-02 00:02



East Camera



# Meteosat Third Generation Missions

www.eumetsat.int



## FROM NOWCASTING TO SHORT-RANGE FORECASTING

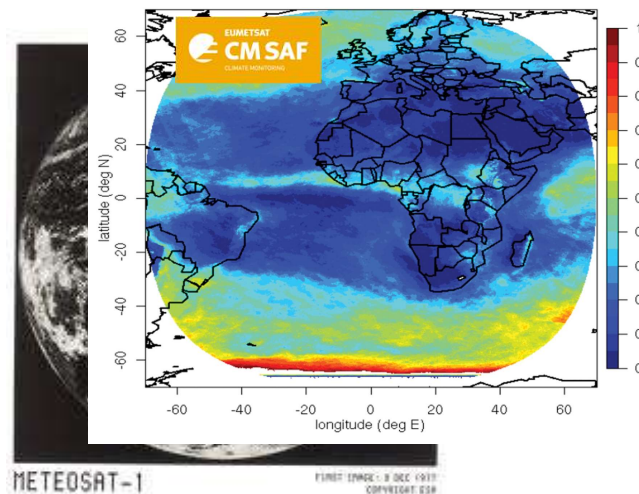
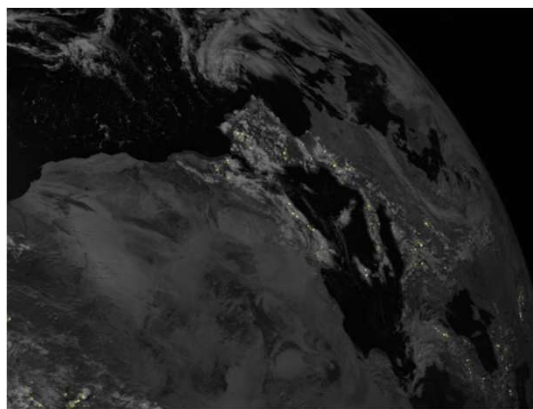
Lightning is a precursor of severe weather, with a lead time of up to tens of minutes. Most ground-based lightning location systems are mainly sensitive to cloud-to-ground lightning (CG). Often, no increase in CG due to weather intensification observable. Total lightning is the parameter of interest.

A NEW COMER  
THE LIGHTNING  
IMAGER

IMAGER FOR  
EUROPE &  
AFRICA

## ACTION EYES TO CHECK THE PULSE OF EARTH

Building on the long-standing partnership between ESA and Eumetsat, the MTG-Imager satellites carry the Flexible Combined Imager instrument which is natural successor of the Spinning Enhanced Visible and Infrared Imager (SEVIRI). The Flexible Combined Imager has 16 channels. It operates at wavelengths between 0.3 and 13.3 microns, and has a spatial resolution of 1-2 km delivering a full image of Earth every 10 minutes, it can 'zoom in' on smaller areas of the Earth disc with four spectral channels, (to 0.5 km) delivering data images every 2.5 minutes.



METEOSAT-1

FIRST IMAGE: 9 DEC 1977  
COPYRIGHT ESA

## A FOCUS ON ATMOSPHERE VERTICAL STRUCTURE AND CHEMISTRY

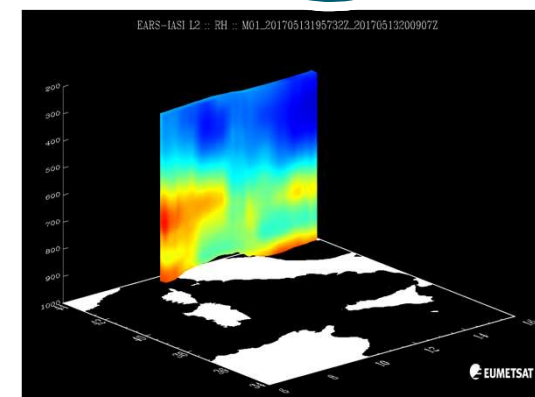
Hyperspectral infrared sounding mission 4D weather cube: temperature, water vapour, O<sub>3</sub>, every 30 minutes over Europe  
Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument  
Start of operations in 2023 Operational exploitation: 2024-2043

A GAME  
CHANGER:  
THE  
SOUNDER

MTG FOR  
CLIMATE

## ESSENTIAL CLIMATE VARIABLES

EUMETSAT is producing Fundamental Climate Data Records based on Geostationary observations. As an example the MSG observation period from 2004 up to 2019, providing a omogenous cloud properties time series.



EARS-IASI L2 :: RH :: MO1\_20170513195732Z\_20170513200907Z

EUMETSAT



# EPS Second Generation

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## EPS-SGA 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-SGB microwave imagery mission



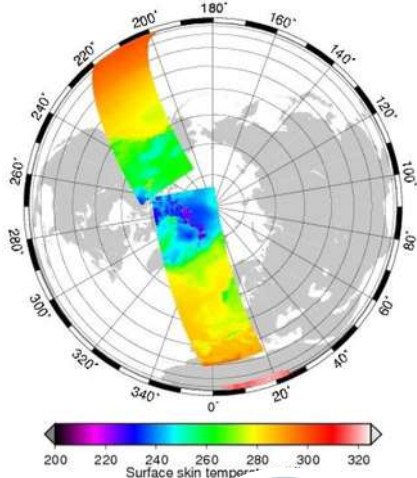
1. SCA  
Scatterometer
2. RO  
Radio occultation
3. MWI  
Microwave imaging for precipitation
4. ICI  
Ice cloud imaging
5. ARGOS-4  
Advanced data collection system





# EPS-SG Missions

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**INFRARED  
ATMOSPHERIC  
SOUNDER AND  
IMAGER**

## WHEN NO ONE ELSE CAN SEE

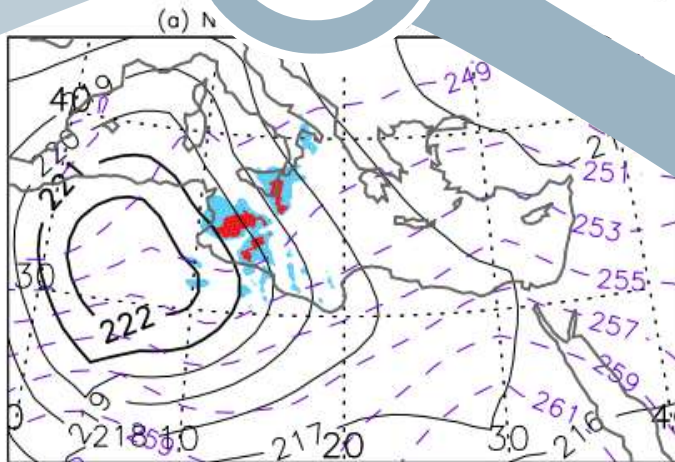
Infrared Atmospheric Sounding Interferometer - New Generation (IASI-NG) is a passive infrared sounder which has the capability to measure the temperature and water vapour profiles of the Earth's atmosphere.

In addition to this, IASI-NG has a huge potential to measure greenhouse gases, clouds, aerosols, ozone and trace gases.

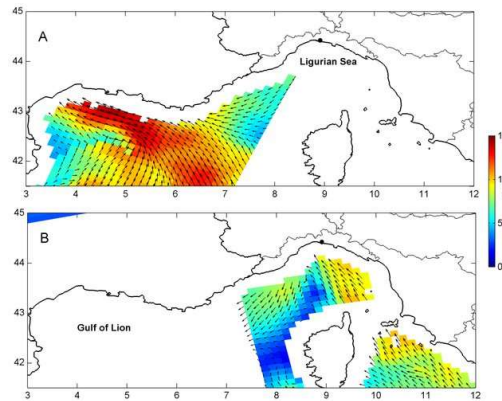
## WHEN MICROWAVES MAKE A DIFFERENCE FOR STORMS' PREDICTION AND MONITORING

The assimilation of all-weather information provides crucial sounding information on the status of the atmosphere where the weather is, e.g. close to frontal regions or in mesoscale convective systems, tropical cyclones, etc.

**MICROWAVE  
SOUNDERS AND  
IMAGER**



EUMETSAT AMSU and NOAA microwave rainfall band for Medicane of 13 Dec 2005 (Nat. Hazards Earth Syst. Sci., 10, 2199–2213, 2010)



**SCATTERO  
METERS**

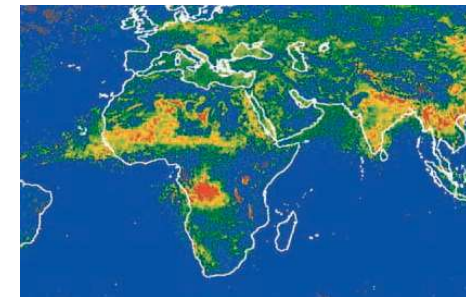
## FOR WEATHER AND OCEAN FORECASTS

Surface Wind is the most relevant parameter to forecast ocean motion and to provide relevant information to operational ocean systems

## A FOCUS ON CHEMISTRY AND HIGH IMPACT WEATHER EVENTS

From global to regional scale, chemistry and aerosol will be key parameters that EPS-SG will monitor. The missions Sentinel-4, -5 and -5 precursor (S4, S5, S5P, respectively) are conceived as complementary elements of a constellation serving the specific needs of the Copernicus Atmospheric Monitoring Services (CAMS)

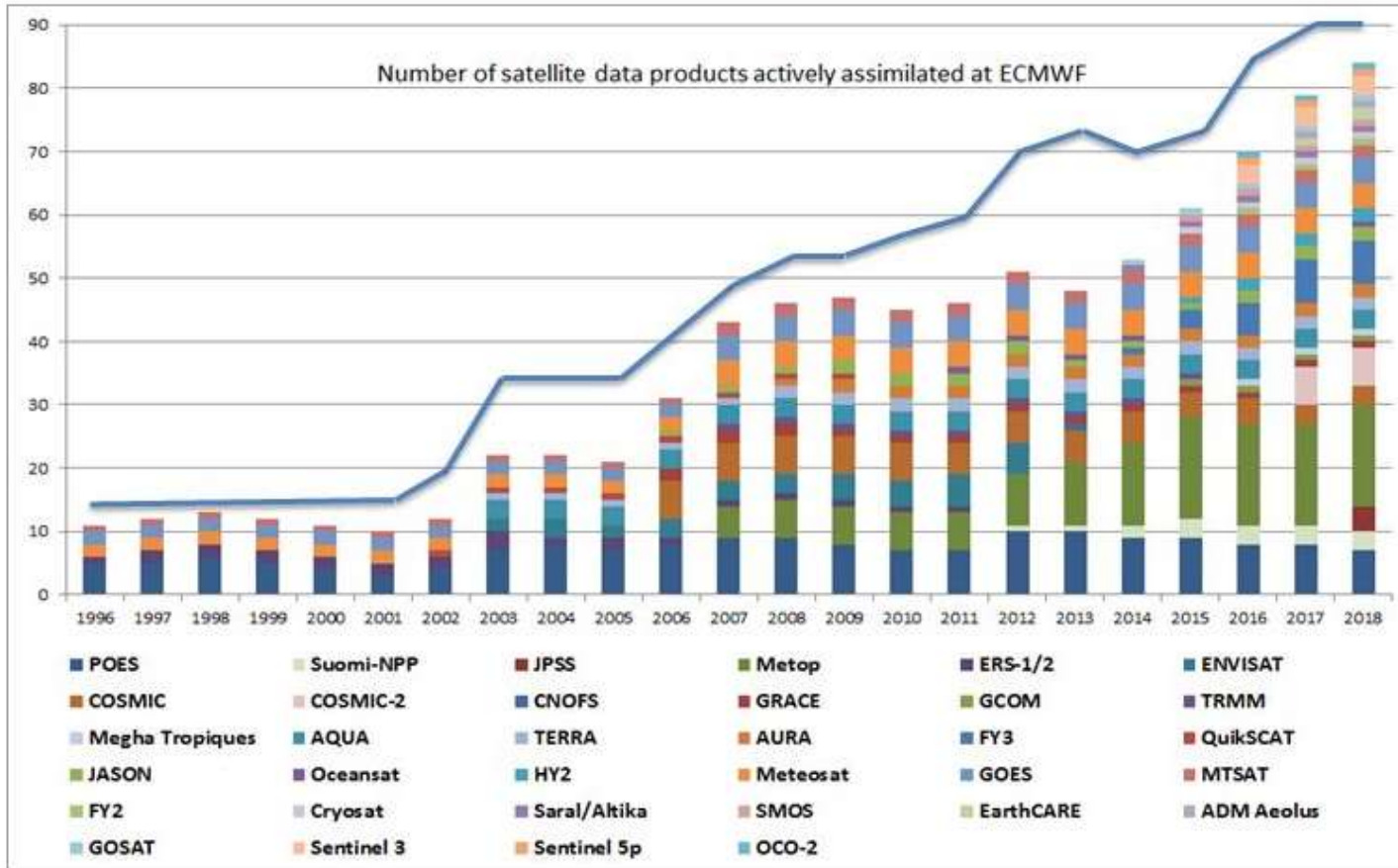
**COPERNICUS  
SENTINEL 5  
AND 3MI**





# Use of satellite data increases for numerical weather predictions

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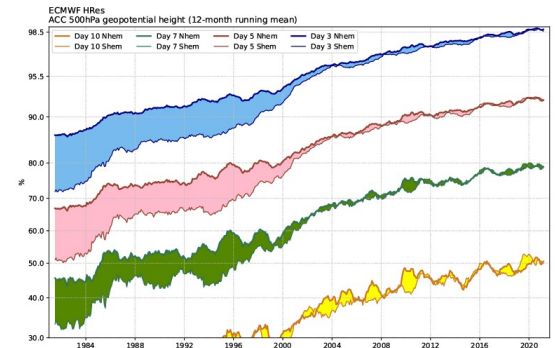


— Number of satellite products operationally monitored

EPS-SG  
MTG  
FY4

2019-2025

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



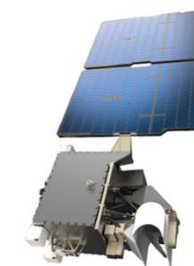
Source: the ECMWF

EUM/CS/DOC/23/1366809, v1 Draft, 19 June 2023



## Potential New Operational Missions:

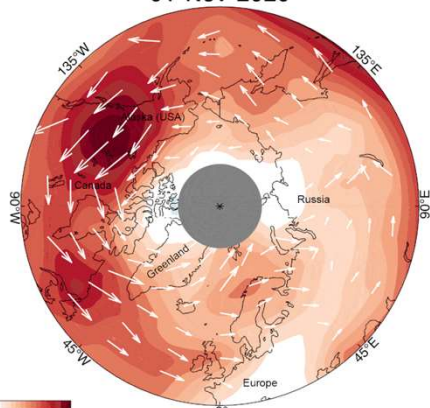
- EPS-Aeolus  
(Doppler Wind Lidar)
- EPS-Sterna  
(MW Sounder Constellation)





# EPS-Aeolus – applications and benefits

01-Nov-2020

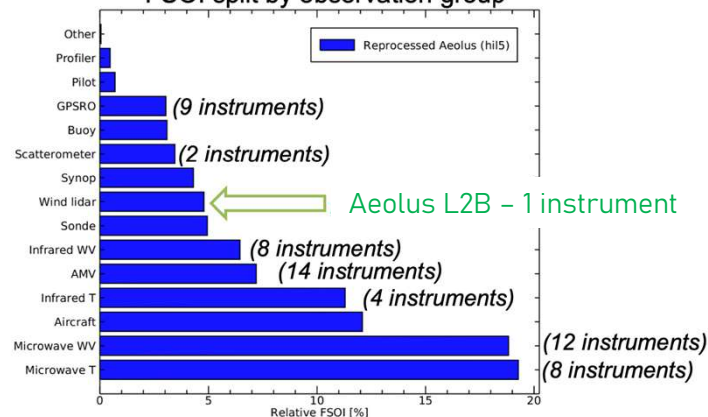


## DOPPLER WIND LIDAR MEASURES WINDS ACROSS THE ATMOSPHERE AND IN REMOTE REGIONS

Over the ocean, over the polar regions, over most of the Southern Hemisphere

SATELLITE AS A UNIQUE OPPORTUNITY

## FSOI split by observation group

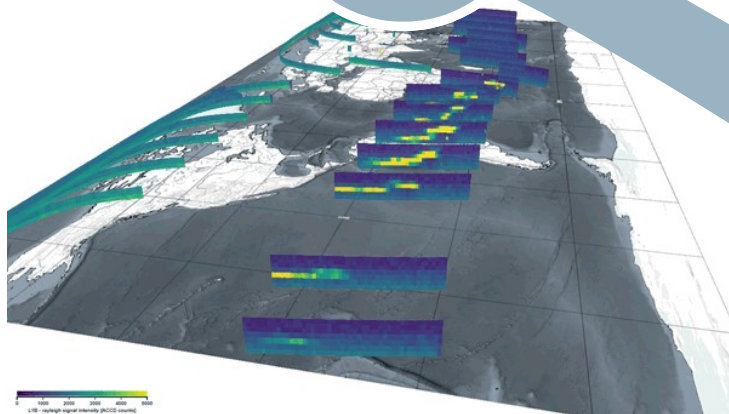


KEY BENEFITS

WIND AS A PRIMARY SOURCE OF INFORMATION

## ATMOSPHERIC MOTION

Wind is the most relevant parameter to forecast the global dynamic of the atmosphere and to accurately reproduce the teleconnection between different parts of the globe



With Aeolus data from about 18:00 UTC on 27 January to 06:00 UTC on 28 January, the plume (showing 22-30km lidar curtain) from the Tongan eruption can be seen to have circumnavigated the globe. As shown by the L2B Mie winds and L1B signal strength (from Mike Rennie, ECMWF).

HIGH IMPACT IN THE VALUE CHAIN

## STRENGTHEN THE NATIONAL FORECASTING CAPACITIES

All global models will improve their skill and downstream products

## NATIONAL AND EUROPEAN FORECASTING CAPACITY

Member states' meteorological agencies and the ECMWF will benefit from DWL

## INNOVATIVE TECHNOLOGY IN SPACE

Advanced European technology proven to be an operational asset

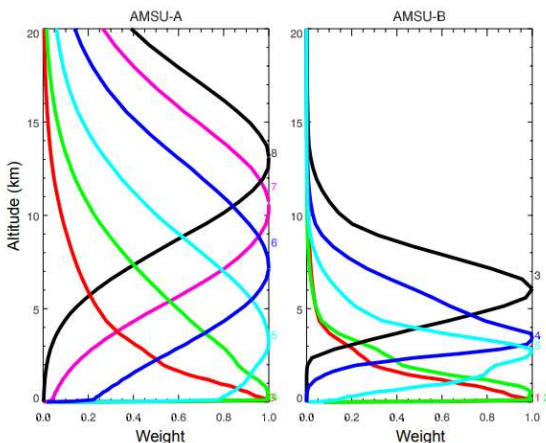
## INTERNATIONAL POSITIONING

An added value for the international operational satellite agencies



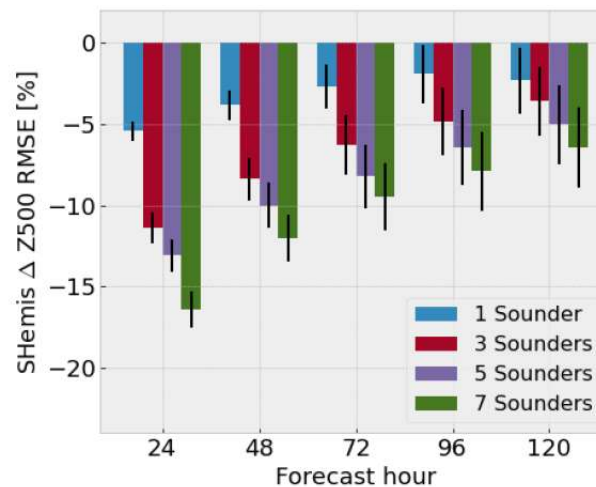
# EPS-Sterna – applications and benefits

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## WHEN MICROWAVES MAKE A DIFFERENCE FOR STORM PREDICTION AND MONITORING

The assimilation of all-weather information provides crucial sounding information on the status of the atmosphere where the weather is, eg, close to frontal regions or in mesoscale convective systems, tropical cyclones, etc.



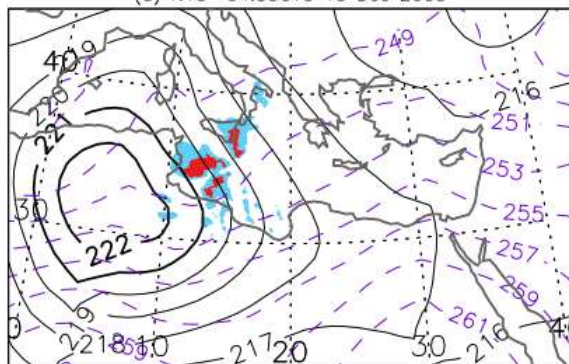
MICROWAVE SOUNDERS A KEY ASSET FOR PREDICTION

MICROWAVE ONE OF OUR BEST EYES FROM SPACE

## WHEN NO ONE ELSE CAN SEE

Microwaves can be used to interpret the vertical structure of the atmosphere in cloudy regions. (a) the AMSU-A temperature channels sounding in the troposphere (3-8) and (b) AMSU-B channels at nadir, for a Mediterranean atmospheric profile

(a) N15 04:55UTC 13 Dec 2005



EUMETSAT AMSU and NOAA microwave rainfall band for Medcane of 13 Dec 2005 (Nat. Hazards Earth Syst. Sci., 10, 2199–2213, 2010)

THERE IS NO LIMIT TO WHAT MICROWAVE SOUNDING CAN DO

## ONE OF THE MOST RELIABLE INVESTMENTS

Proven capacity of microwave sounding to always improve forecasts

KEY BENEFITS

## A FOCUS ON HIGH-IMPACT WEATHER EVENTS

From global to regional scale, AWS will be a plus in forecasts of rapidly evolving weather phenomena (extreme storms)

## FROM MINUTES TO WEEKS

Highly flexible use of the AWS operational data, with unprecedented revisit time

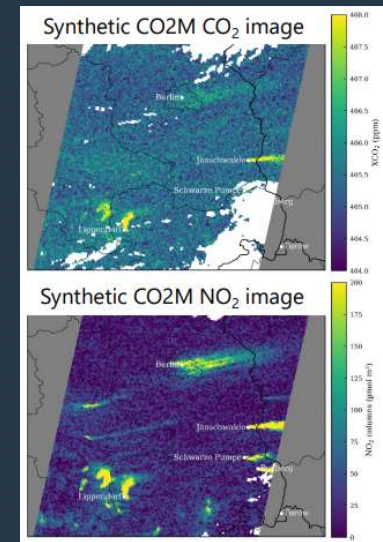
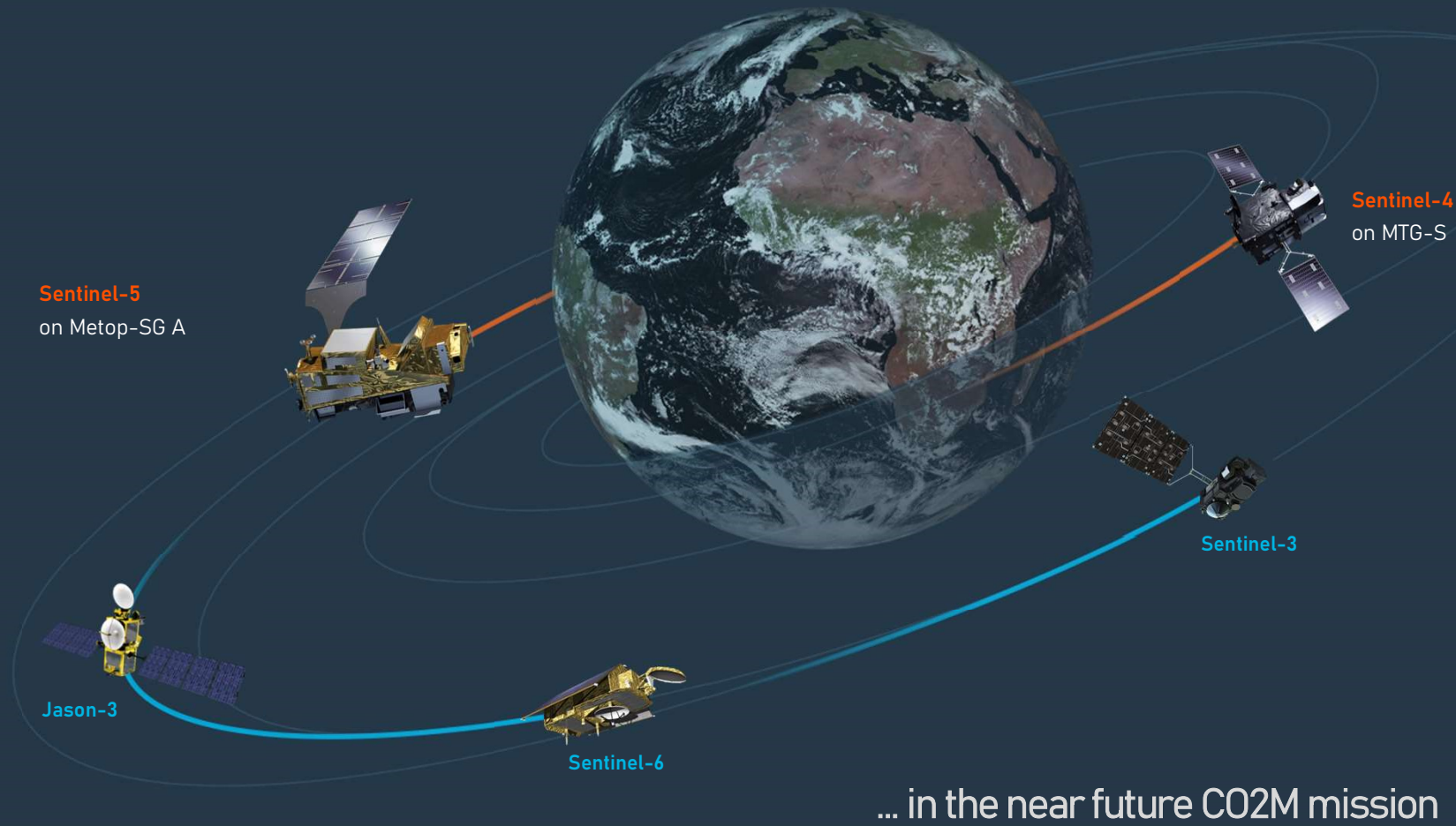
## A BENCHMARK AT INTERNATIONAL LEVEL

The first operational constellation among satellite agencies, and an important complement to the international polar systems



# EUMETSAT & third party programmes in support of Copernicus

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... in the near future CO2M mission



# Multiple dimensions of user requirements/ scene evolution

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## AI/ML FOR ENVIRONMENTAL PREDICTION

Will AI/ML reshape part of the weather and climate value cycle? New methods demonstrate very interesting outcomes for nowcasting and NWP. A potential major use of satellite data.



## EVOLUTION OF EO MARKET – A FAST CHANGING LANDSCAPE

Climate Services - End users represent much larger markets than the Earth Observation (EO) downstream market  
New Emerging Sectors for Earth System prediction - The energy & utilities, Autonomous vehicle (i.e., cars, drones) but also climate finance, adaptation and mitigation.



## EVOLUTION OF THE SEAMLESS EARTH SYSTEM PREDICTION

Requirements for future satellite missions depend more and more on the evolution of the seamless earth system prediction. Could we guess what such system will be in 10-15 years time?



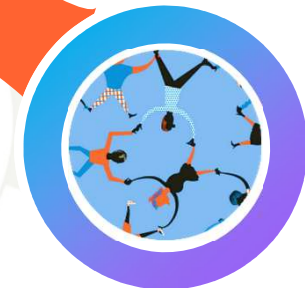
## CLOUD SERVICES

Will Cloud services drastically modify the way we design and develop products? International companies are largely investing on Clouds as a framework to gain and develop new markets.



## ACCELERATION AND DISAGGREGATION

New scientific and industrial missions have shortened the Phase0-to-D. Disaggregation of EO missions (specialized small-sat or cubesat constellations) allows a modular way to answer user requirements





# EUMETSAT horizons

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## Our New Fleet

15-20 years ago, expert groups identified the key requirements for future geostationary and polar system missions (EUMETSAT-ESA)..



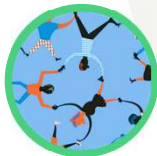
## Data Strategy

Access to data in real time will become a technological challenge – how does a cloud approach facilitate it?



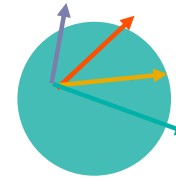
## Community products

EUMETSAT, together with the Member States, developed a strong scientific network (Satellite Application Facilities) working on new L2 and synergetic products



## Multiple dimensions

How do we keep track of a fast changing landscape (i.e. earth system prediction, air quality, ocean, CO2 ...)



## International Coop.

Operational Satellite agencies rely on strong collaboration and capacity to share data and knowledge (CGMS).



## User Req Evolution

We observed a fast evolution of the user's requirements and the way we analyse and inject into the satellite production chain.







# Thanks

[www.eumetsat.int](http://www.eumetsat.int)





# BACKUP