EUMETSAT

AOMSUC-12

11 - 18 November 2022

Online, Hosted by Japan Meteorological Agency

EUMETSAT in Action Eyes to Check the Pulse of Earth

Paolo M Ruti

Chief Scientist

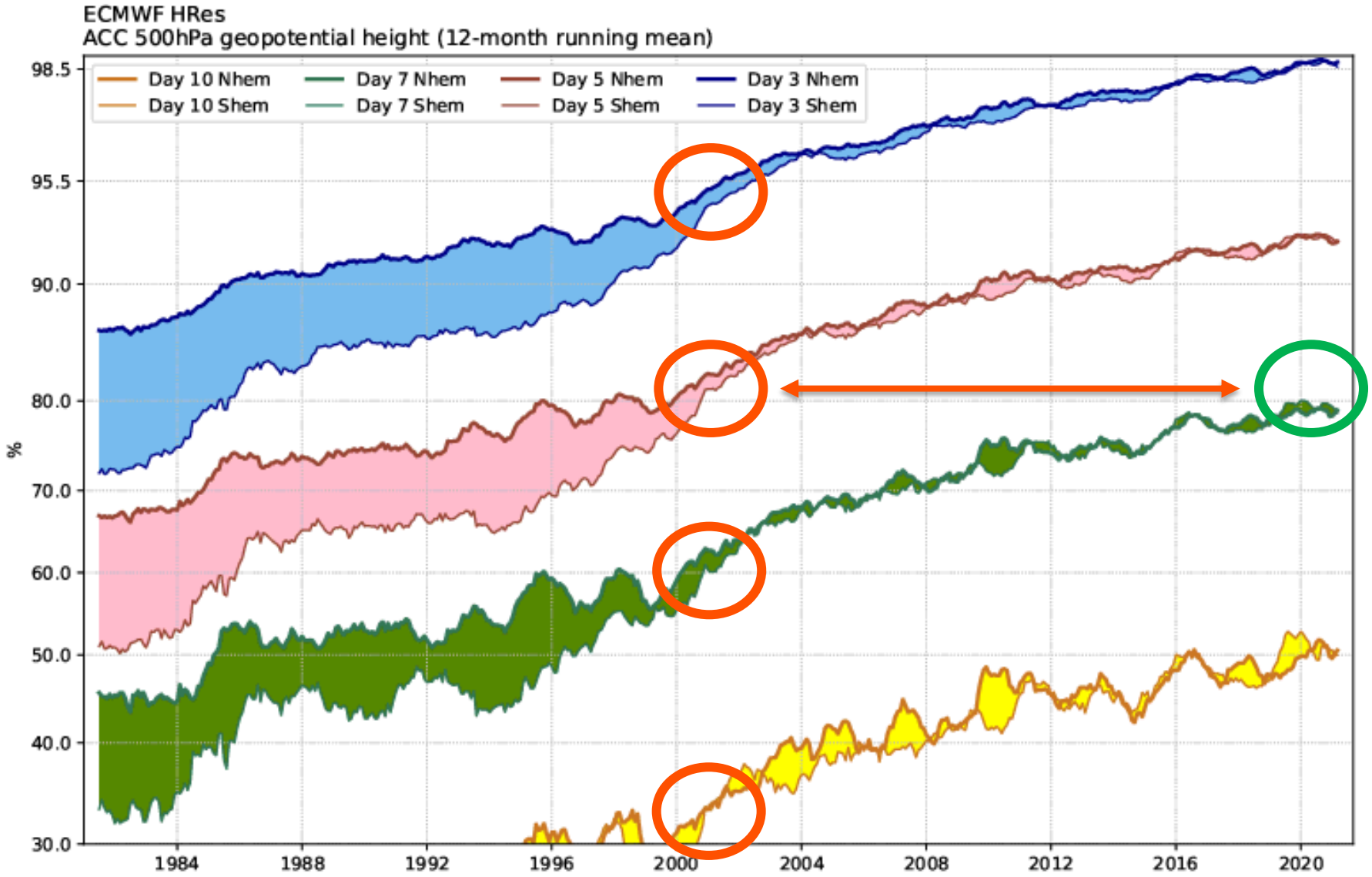
12th Asia-Oceania Meteorological Satellite Users' Conference

The new comer 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 2022
- Operational exploitation: 2023-2044
- 3800 Kg in orbit

The first journey then …. 14th December the launch

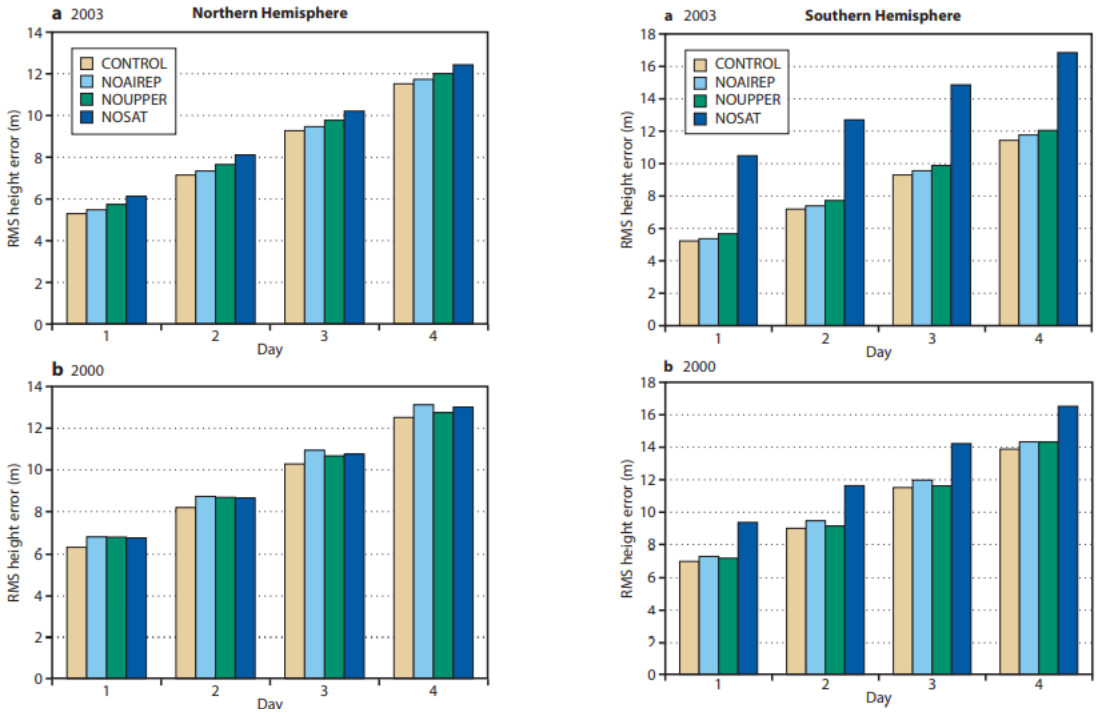
Europe is a world leader of medium-range numerical weather prediction



Source: ECMWF

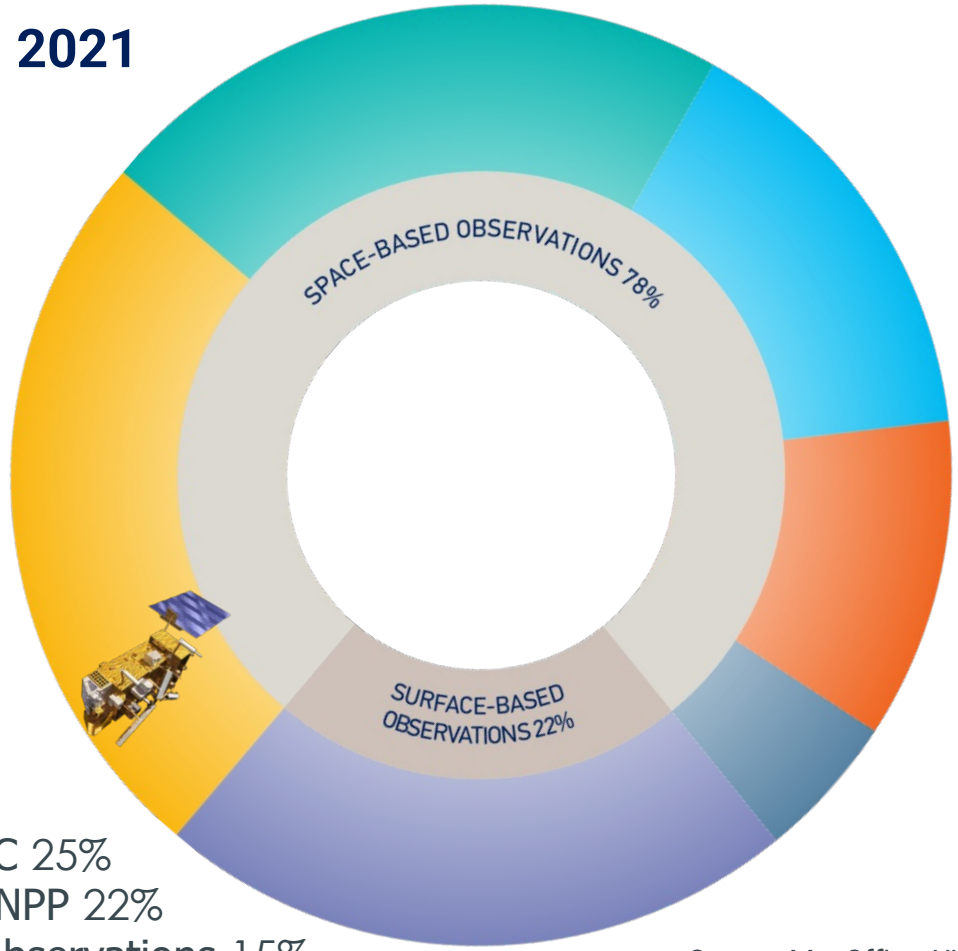
Contribution of Initial Joint Polar System satellites to reduction of day-1 forecast errors

G. Kelly, J-N Thépaut 2007 ECMWF



2000-2003

2021



- Metop-A, -B, -C 25%
- NOAA JPSS/S-NPP 22%
- GEO satellite observations 15%
- Other LEO satellite observations 11%
- Other radio occultation observations 5%
- In-situ/conventional observations 22%

Source: Met Office, UK

Metop satellites play a major role in global numerical weather prediction

www.eumetsat.int

Global NWP models with a horizontal resolution of typically 50-100 km and a vertical resolution of ~1km

Direct assimilation of radiances
Atmospheric Motion Vectors
Scatterometry

Model group	2001	2010
HIRLAM	OI and 3D-Var	4D-Var
UKMO	3D-Var	4D-Var Radar and satellite imagery
COSMO	Nudging	Nudging combined with 3D-Var for indirect observations
ALADIN	OI - 3D-Var	3D-Var, 4D-Var mix or more local techniques (OI, Kalman filter)
Environment Canada	3D-Var	4D-Var

Chemistry and Hydrology at regional scale

• horizontal: 8-15 km by 2015,
3-5 km by 2025
• vertical grid spacing:
• boundary layer: 70 m by 2015, 40 m by 2025,
• free troposphere: 300 m by 2015, 200 m by 2025,
• stratosphere: 500 m by 2015, 200 m by 2025.

• comprehensive Earth-system assimilation capability
• general improvement and extension in the use of obs, particularly satellite observations, including over land
• assimilation of ozone and possibly other minor constituents
• a focus on the quantification of uncertainties
• improved methods for analysis of humidity
• development of strategies for targetted observing systems

Extended range forecast
• sub-surface measurements of ocean temperature and salinity,
• more accurate observations of ocean surface wind stress,
• observations of the diurnal cycle of SST,
• more complete description of sea-ice
• observations of additional variables

Reducing error growths - increased observation resolution, particularly in the vertical, and accuracy to mitigate the rapid growth of small errors (10-20 km scale) in cloudy areas

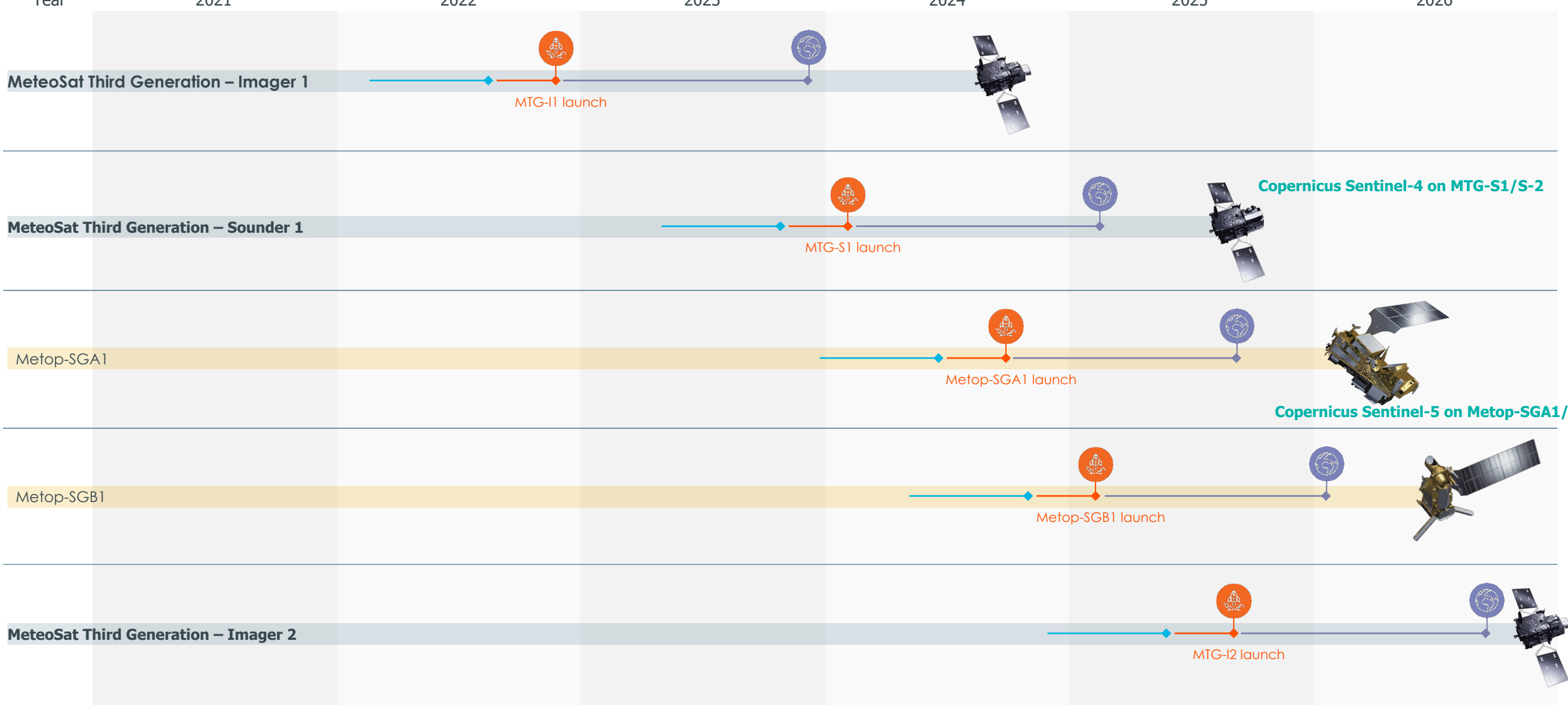
Assuming LAM at 1km or finer resolution
- Finer time and space scale winds and humidity;
- Detailed surface forcing;
- Detailed boundary layer winds;
- Detailed height and strength of stable layers;
- Detailed precipitation distribution.

Coupled model with hydrology

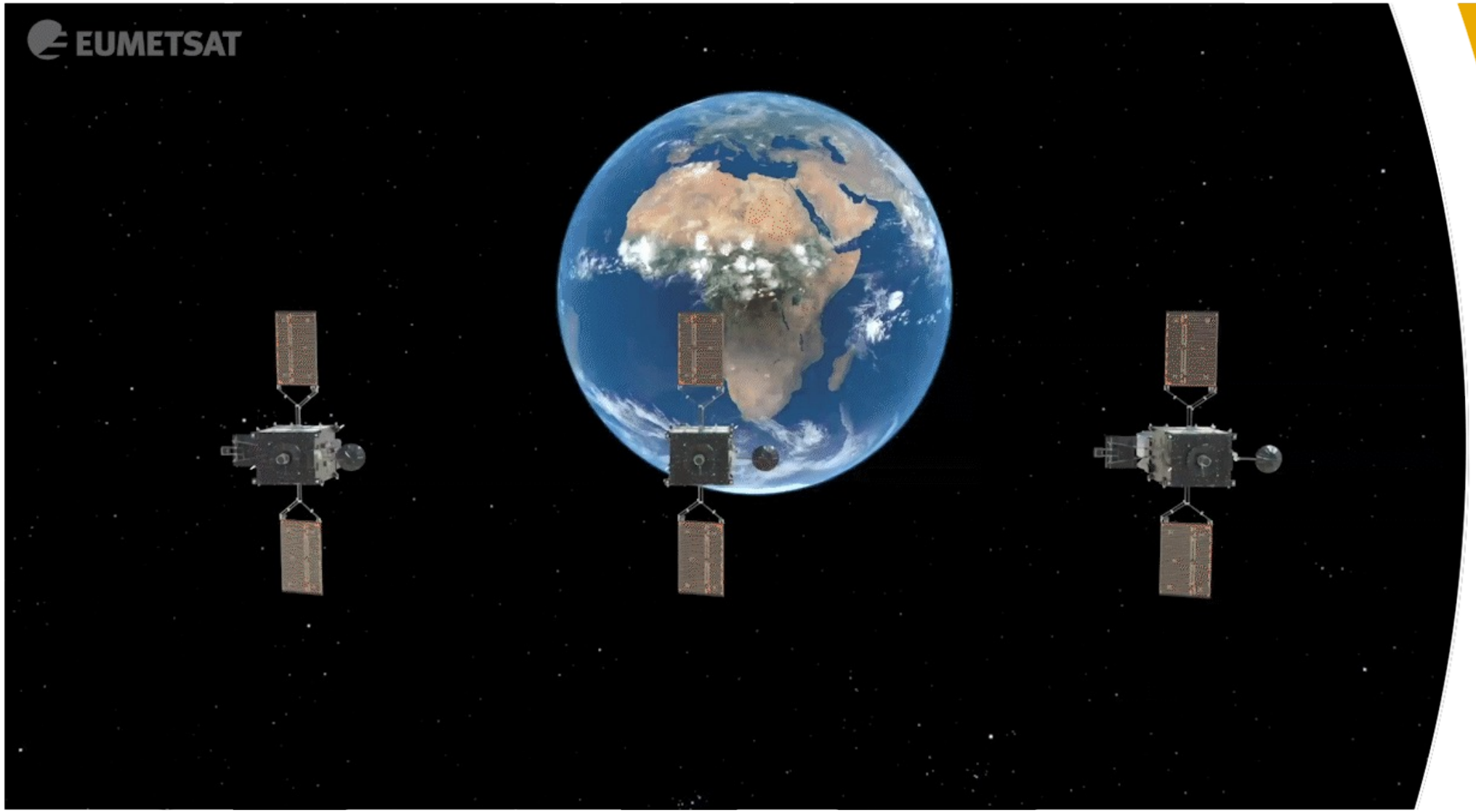
Source: Météo-France

Our new fleet in 2022-2025

www.eumetsat.int

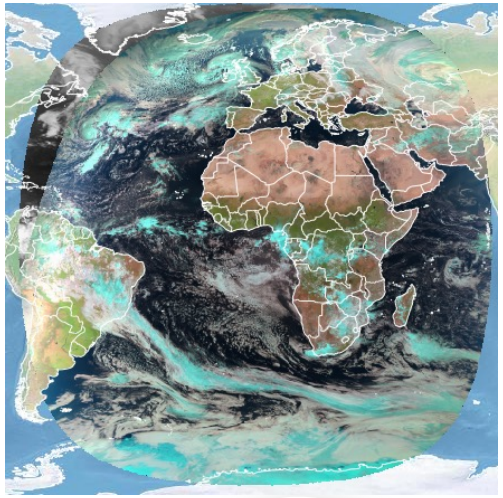


MTG in orbit configuration



Three satellite configuration

Meteosat Third Generation Missions



IMAGER FOR EUROPE & AFRICA

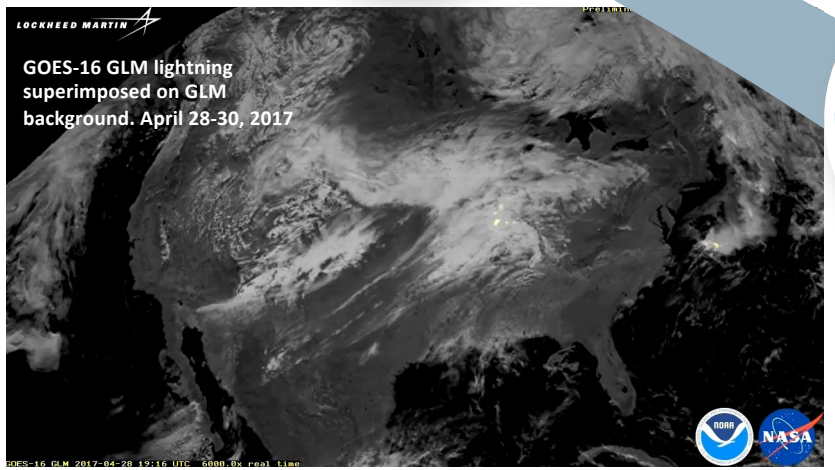
ACTION EYES TO CHECK THE PULSE OF EARTH

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.

A NEW COMER THE LIGHTNING IMAGER

FROM NOWCASTING TO SHORT-RANGE FORECASTING

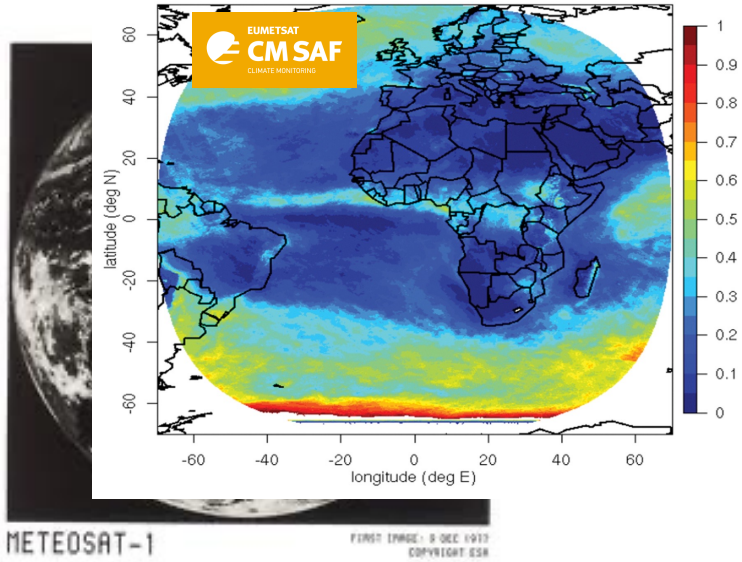
Lightning is a precursor of severe weather, with a lead time of up to tens of minutes. Most ground-based lightning location systems are mainly sensitive to cloud-to-ground lightning (CG). Often, no increase in CG due to weather intensification" observable Total lightning is the parameter of interest



MTG FOR CLIMATE

ESSENTIAL CLIMATE VARIABLES

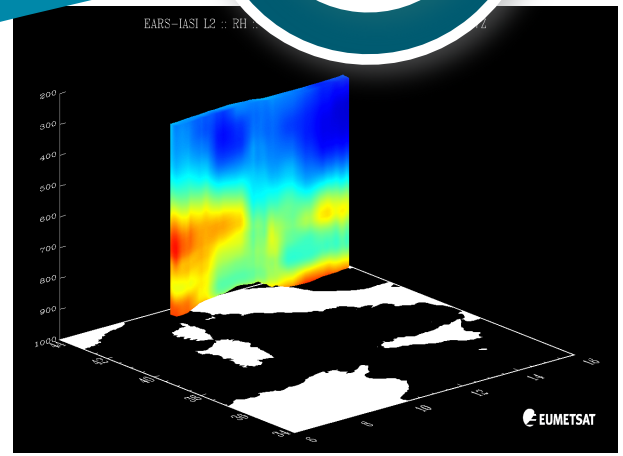
EUMETSAT is producing Fundamental Climate Data Records based on Geostationary observations. As an example the MSG observation period from 2004 up to 2019, providing a omogenous cloud properties time series.



A GAME CHANGER THE SOUNDER PLUS

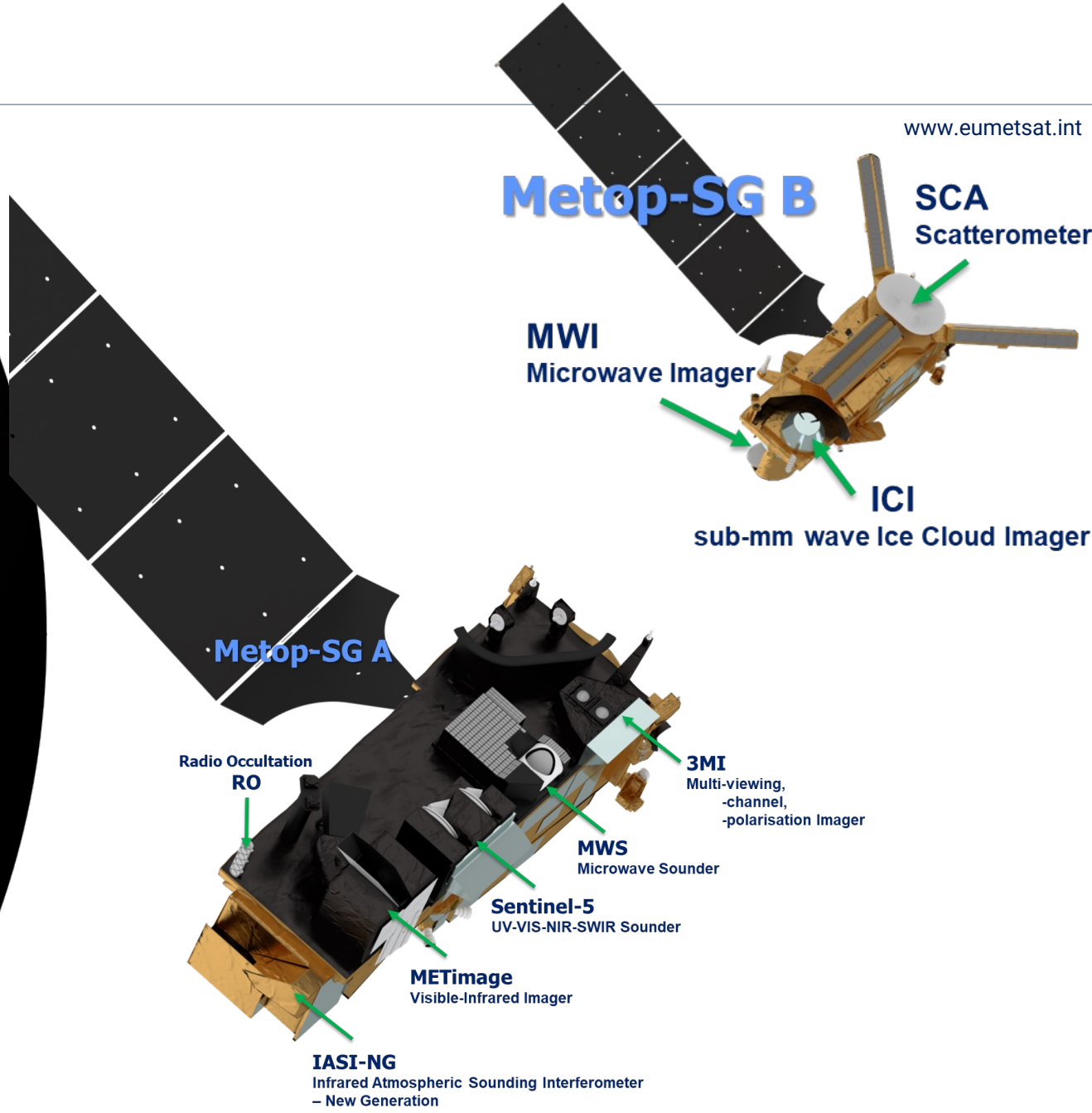
A FOCUS ON ATMOSPHERE VERTICAL STRUCTURE AND CHEMISTRY

Hyperspectral infrared sounding mission
4D weather cube: temperature, water vapour, O3, 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

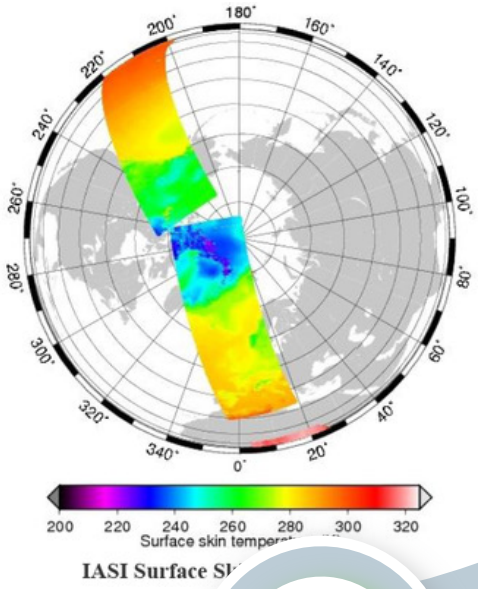


EPS-SG Missions

www.eumetsat.int



EPS-SG Missions



INFRARED ATMOSPHERIC SOUNDER AND IMAGER

WHEN NO ONE ELSE CAN SEE

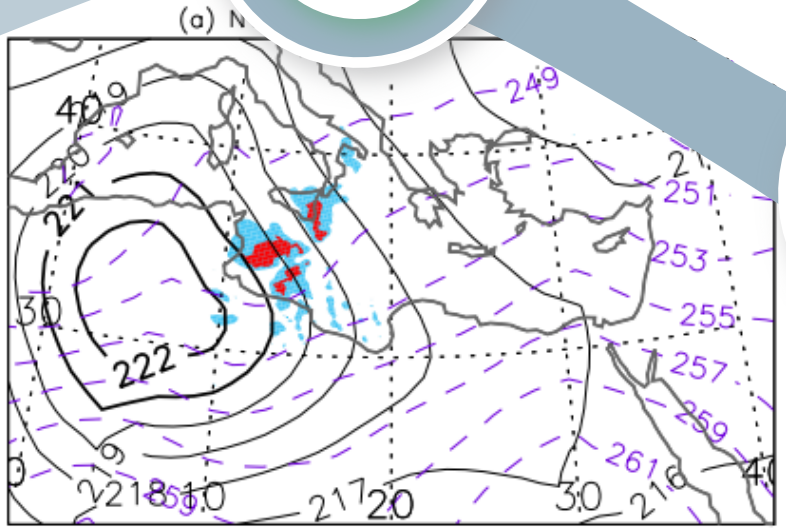
Infrared Atmospheric Sounding Interferometer - New Generation (IASI-NG) is a passive infrared sounder which has the capability to measure the temperature and water vapour profiles of the Earth's atmosphere.

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

MICROWAVE SOUNDERS AND IMAGER

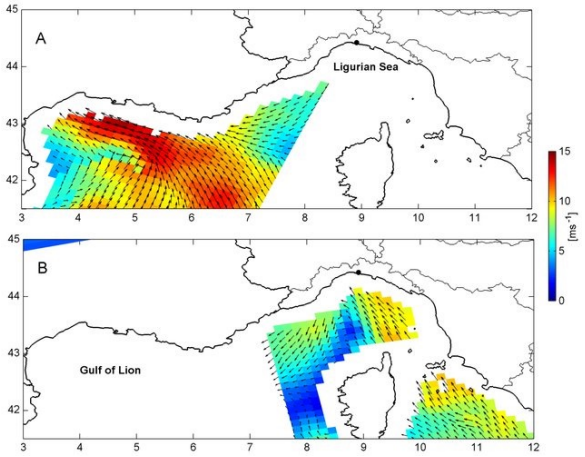
WHEN MICROWAVES MAKE A DIFFERENCE FOR STORMS' PREDICTION AND MONITORING

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.



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

SCATTEROMETERS



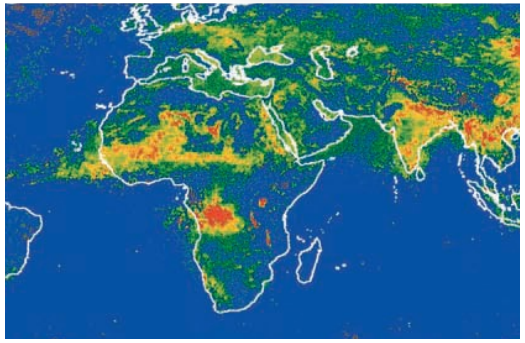
FOR WEATHER AND OCEAN FORECASTS

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



Satellite Application Facility (SAF) concept

www.eumetsat.int

EUMETSAT OSI SAF
OCEAN AND SEA ICE

EUMETSAT AC SAF
ATMOSPHERIC COMPOSITION MONITORING

EUMETSAT NWP SAF
NUMERICAL WEATHER PREDICTION

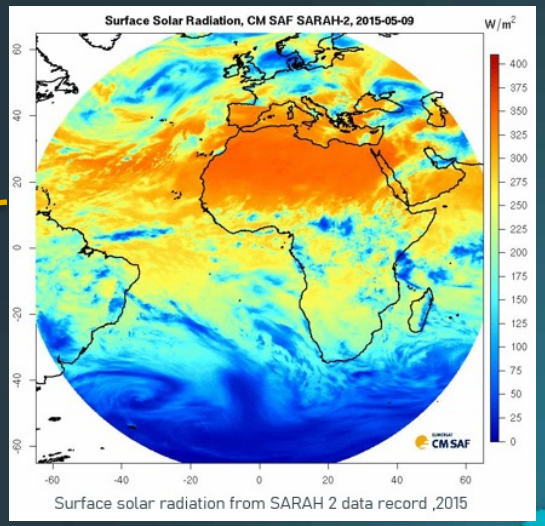
EUMETSAT ROM SAF
RADIO OCCULTATION METEOROLOGY

EUMETSAT NWC SAF
SUPPORT TO NOWCASTING AND VERY SHORT RANGE FORECASTING

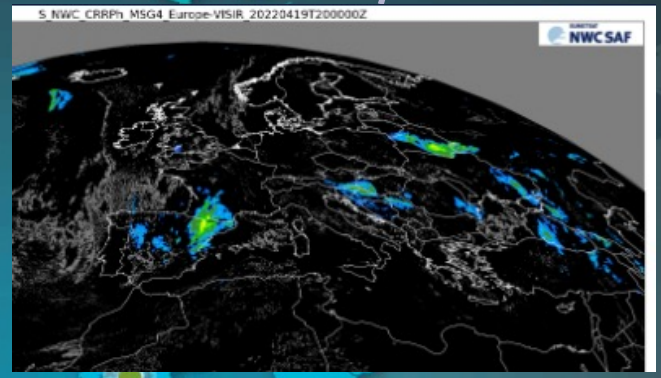
EUMETSAT CM SAF
CLIMATE MONITORING

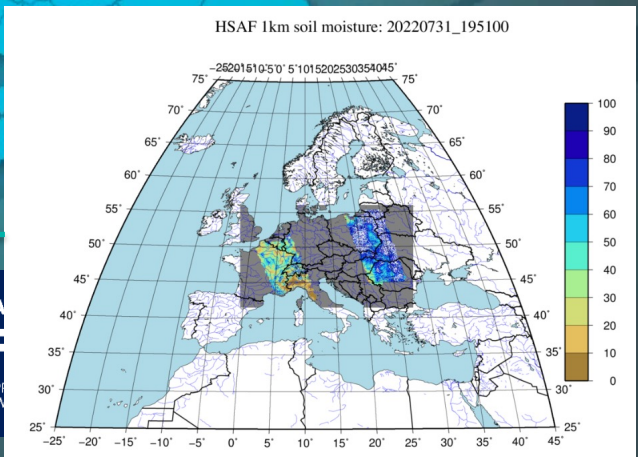
EUMETSAT LSA SAF
LAND SURFACE ANALYSIS

EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT



Surface solar radiation from SARAH 2 data record ,2015

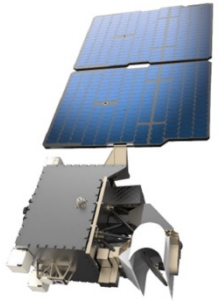




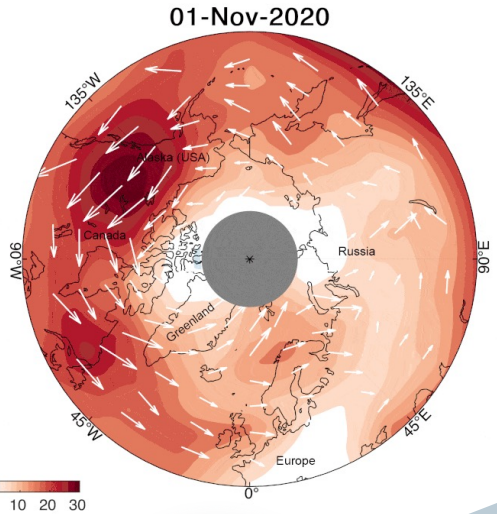
EUMETSAT SAF
SATELLITE APPLICATION FACILITY NETWORK

Potential New Operational Missions:

Doppler Wind Lidar
MW Sounder Constellation

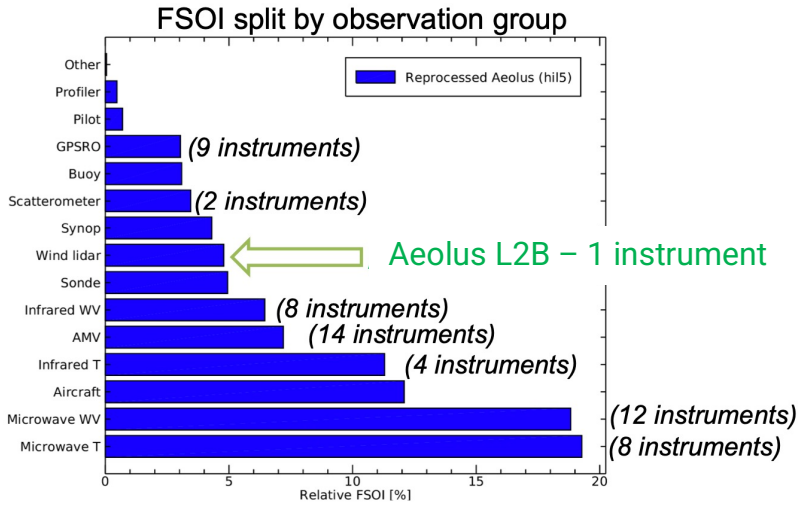


Doppler Wind Lidar – Applications & Benefits



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



WIND AS A PRIMARY SOURCE OF INFORMATION

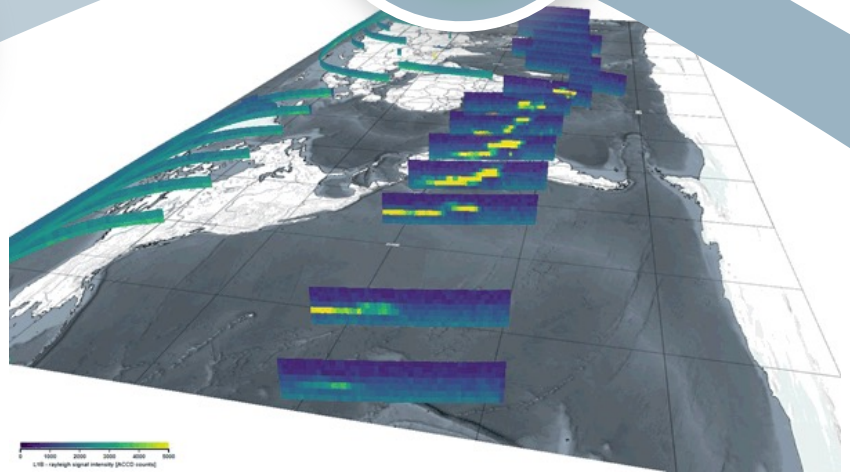
SATELLITE AS A UNIQUE OPPORTUNITY

HIGH IMPACT IN THE VALUE CHAIN

KEY BENEFITS

ATMOSPHERIC MOTION

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



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

STRENGTHEN THE NATIONAL FORECASTING CAPACITIES

All global models will improve their skill and downstream products

NATIONAL AND EUROPEAN FORECASTING CAPACITY

Member states Met agencies and ECMWF will benefit from DWL

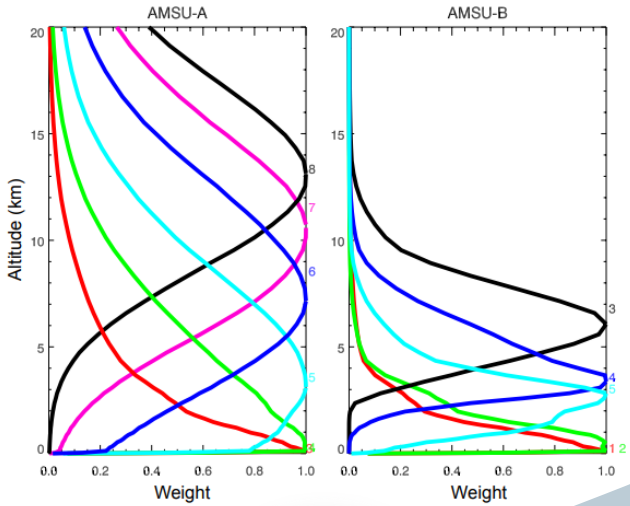
INNOVATIVE TECHNOLOGY IN SPACE

Advanced technology proven to be an operational asset

INTERNATIONAL FRAMEWORK

An added value for the international operational satellite agencies

MW sounder constellation – Applications and Benefits



WHEN NO ONE ELSE CAN SEE

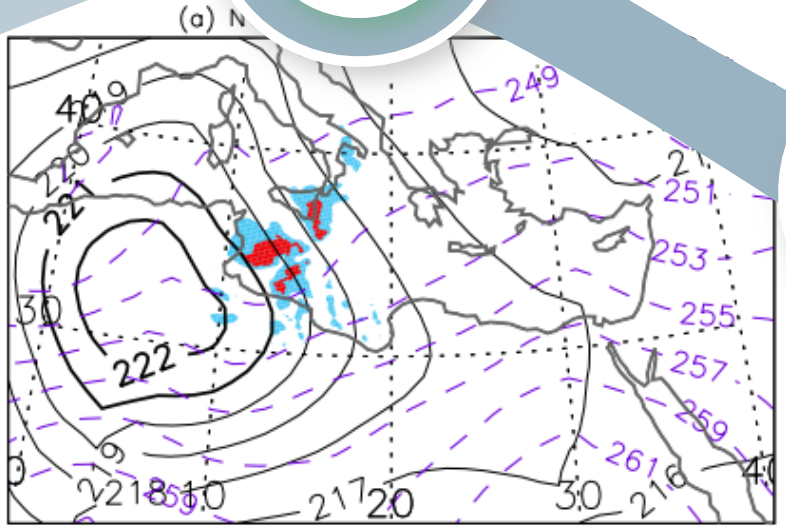
Microwaves can be used to interpret the vertical structure of the atmosphere in cloudy regions. (a) the AMSU-A
temperature channels sounding in the troposphere (3–8) and (b) AMSU-B channels at nadir, for a Mediterranean atmospheric profile

MICROWAVE ONE OF OUR BEST EYE FROM SPACE

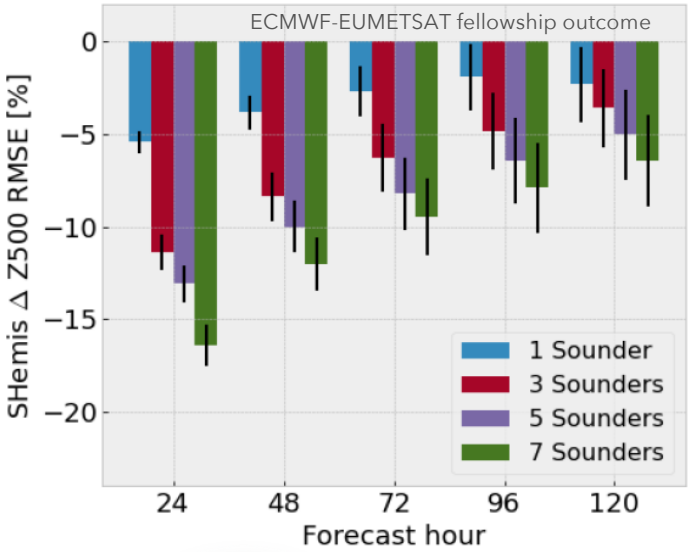
WHEN MICROWAVES MAKE A DIFFERENCE FOR STORMS' PREDICTION AND MONITORING

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 A KEY ASSET FOR PREDICTION



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



THERE IS NO LIMIT TO WHAT MICROWAVE CAN DO

ONE OF THE MOST RELIABLE INVESTMENT

Proven capacity of Microwave sounding to always improve forecasts

KEY BENEFITS

A FOCUS ON HIGH IMPACT WEATHER EVENTS

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

FROM MINUTES TO WEEKS

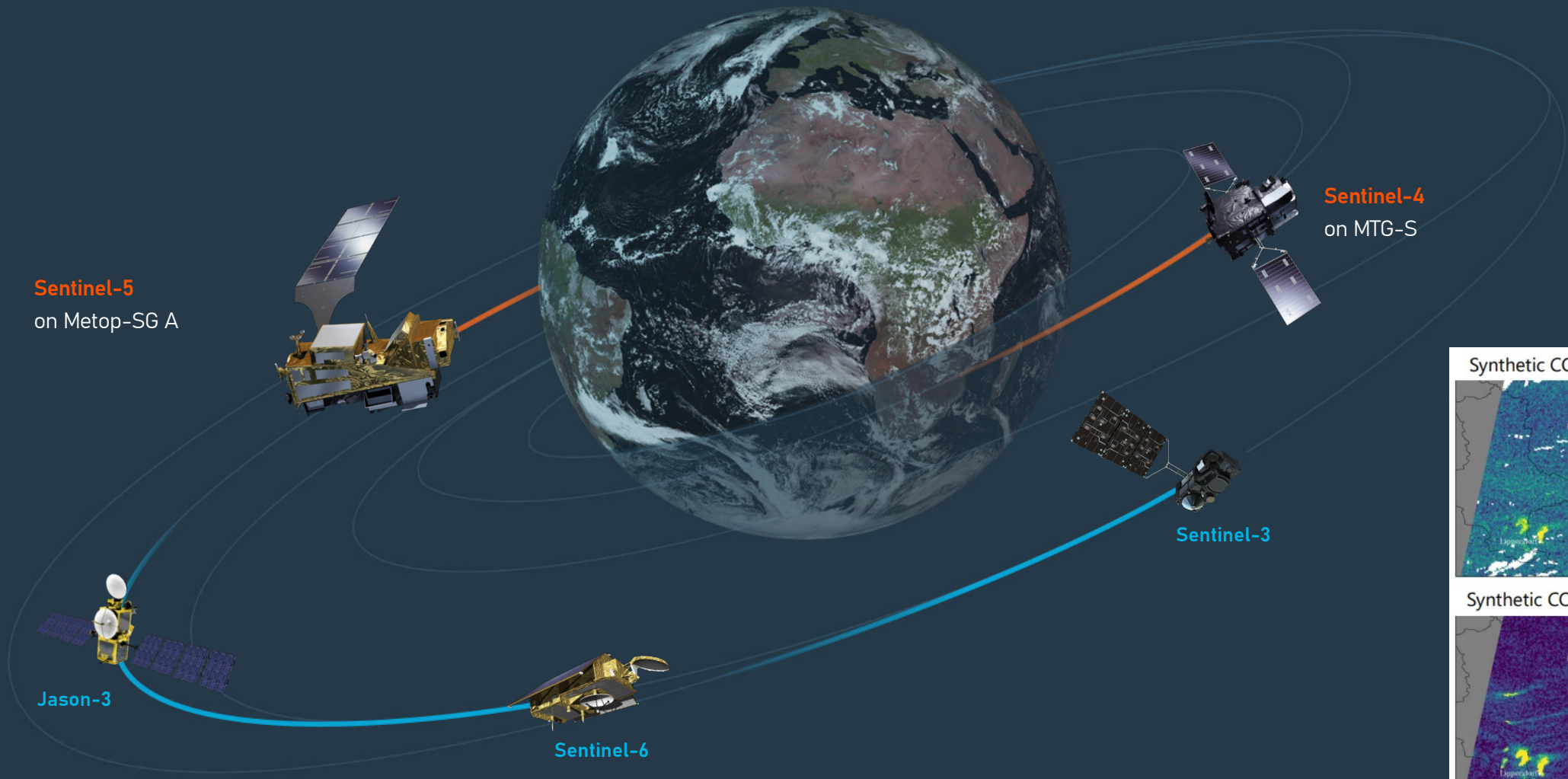
Highly flexible use of the operational data, with unprecedented revisit time

A BENCHMARK AT INTERNATIONAL LEVEL

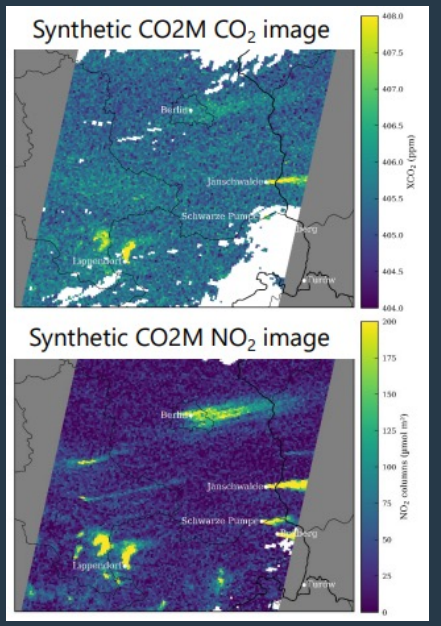
The first operational constellation among satellite agencies, and an important complement to the international polar systems

EUMETSAT & third party programmes in support of Copernicus

www.eumetsat.int



... in the near future CO2M mission



Thanks

www.eumetsat.int