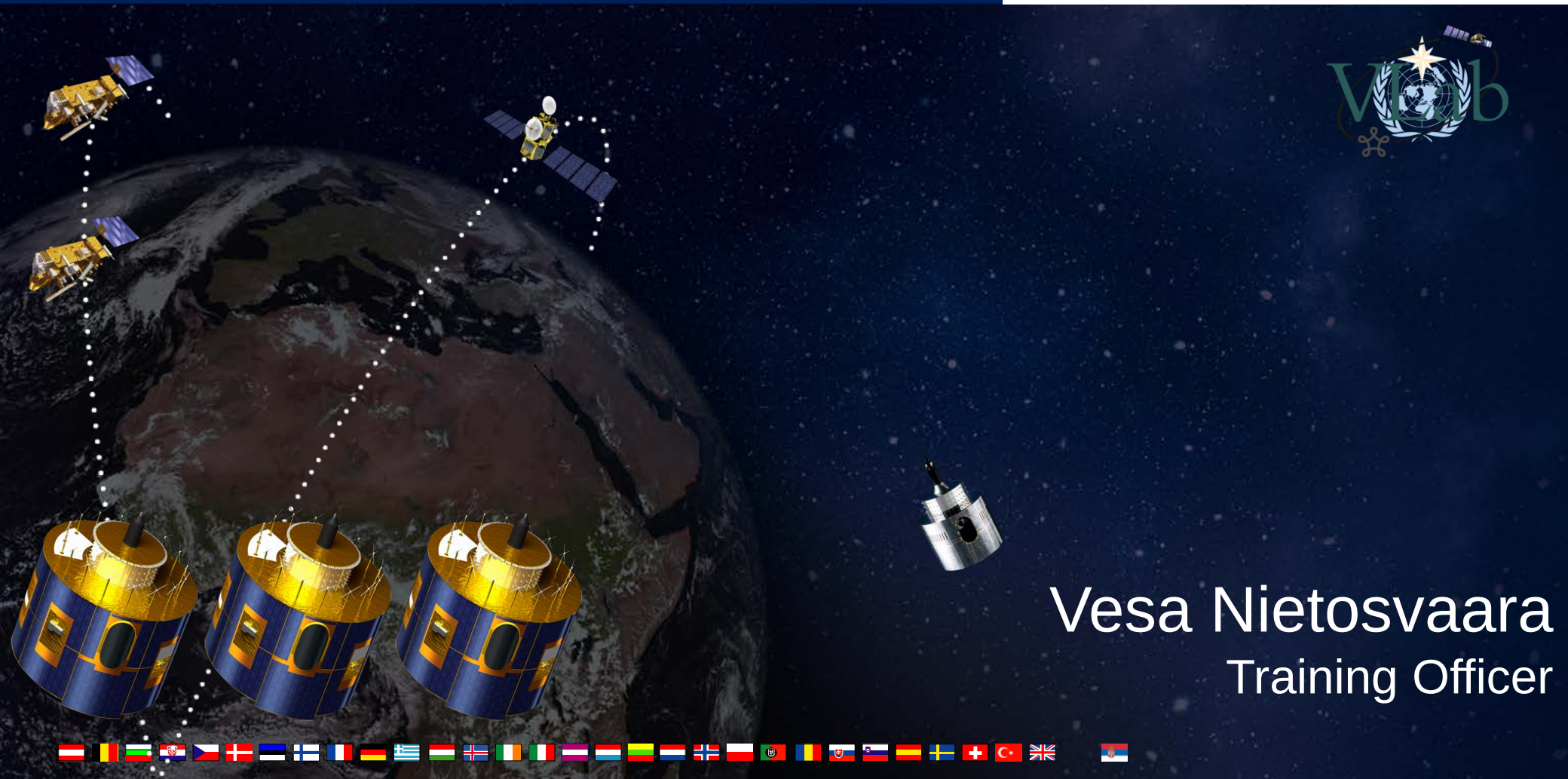
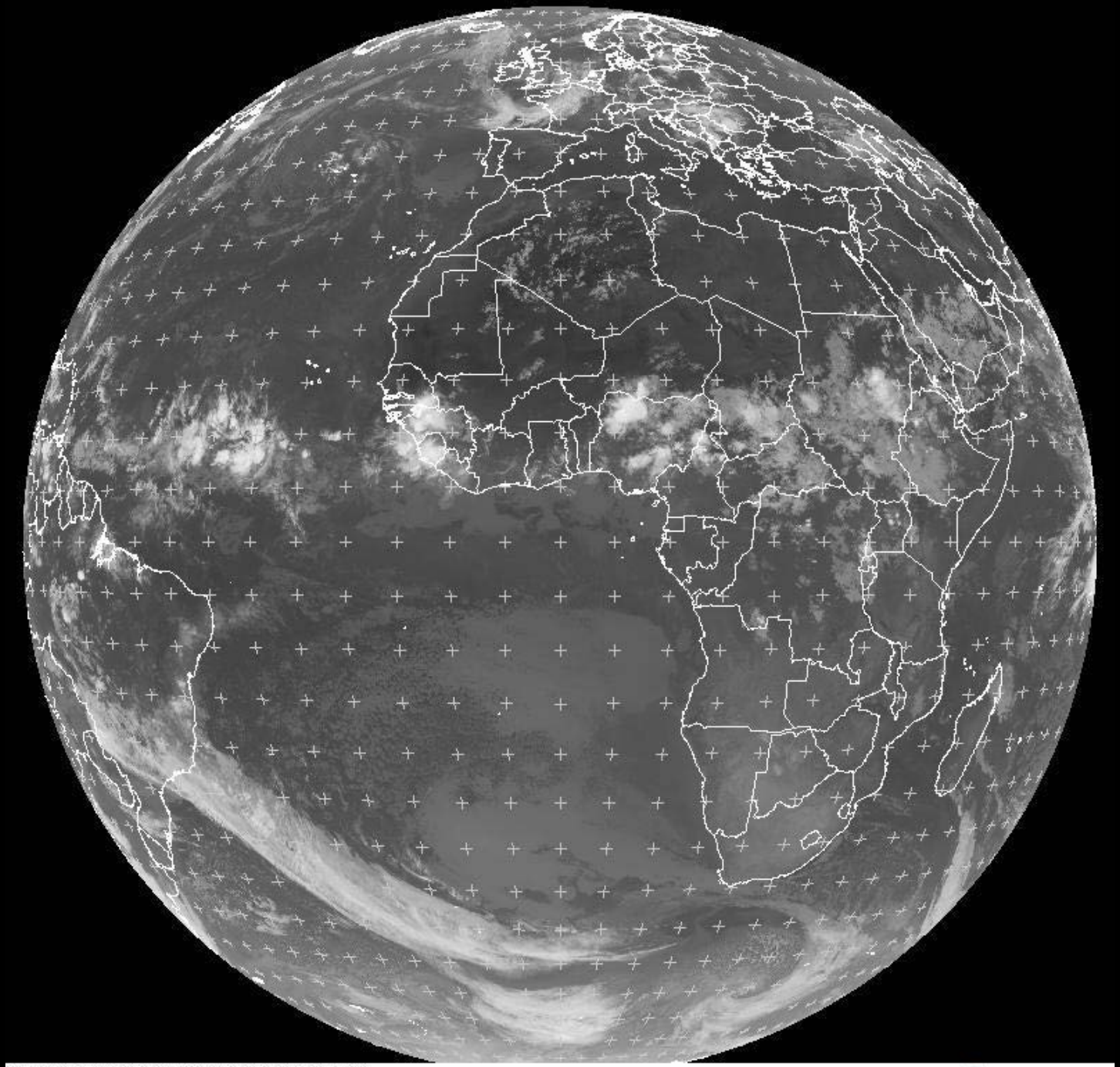
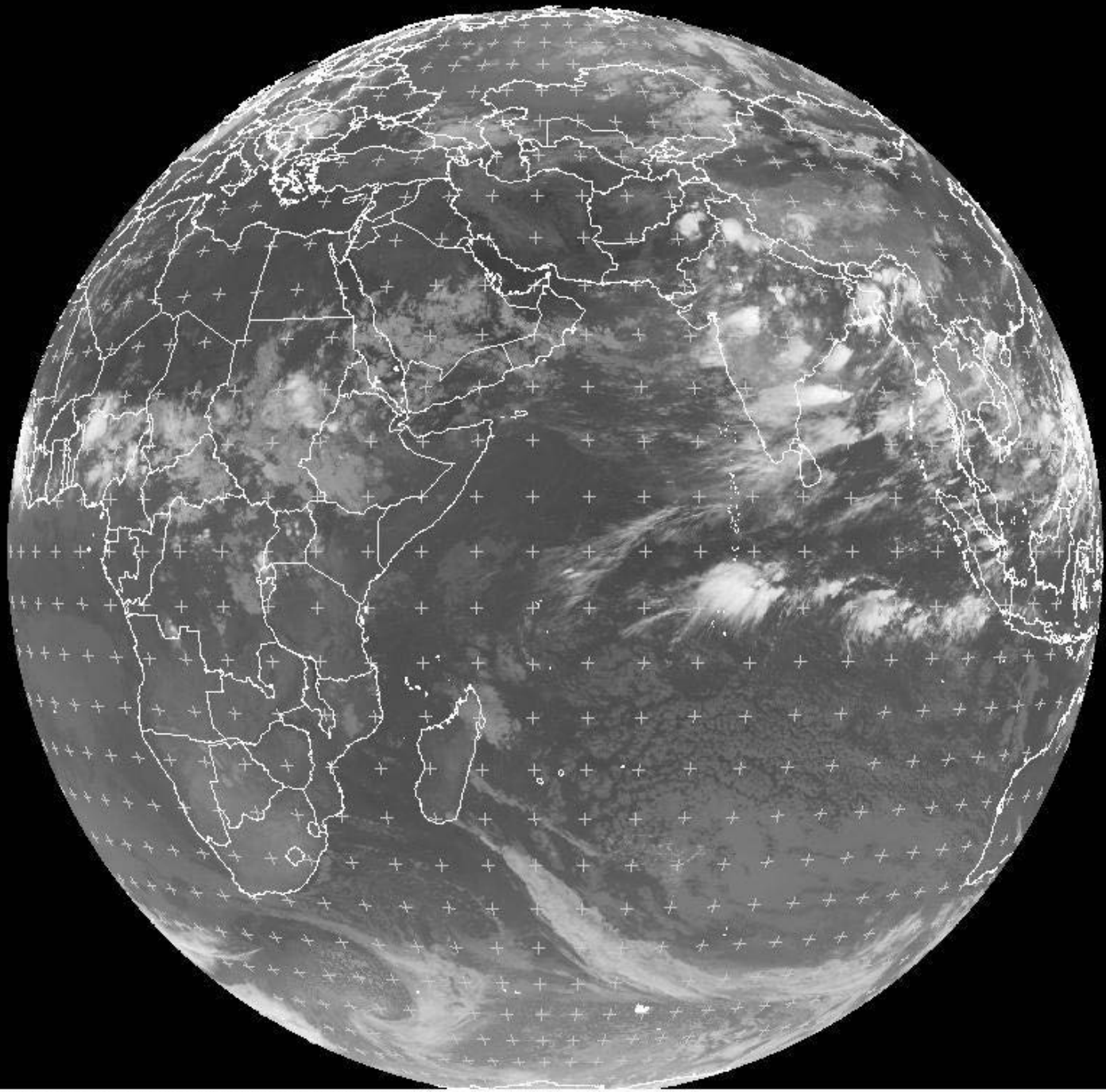
MONITORING WEATHER AND CLIMATE FROM SPACE

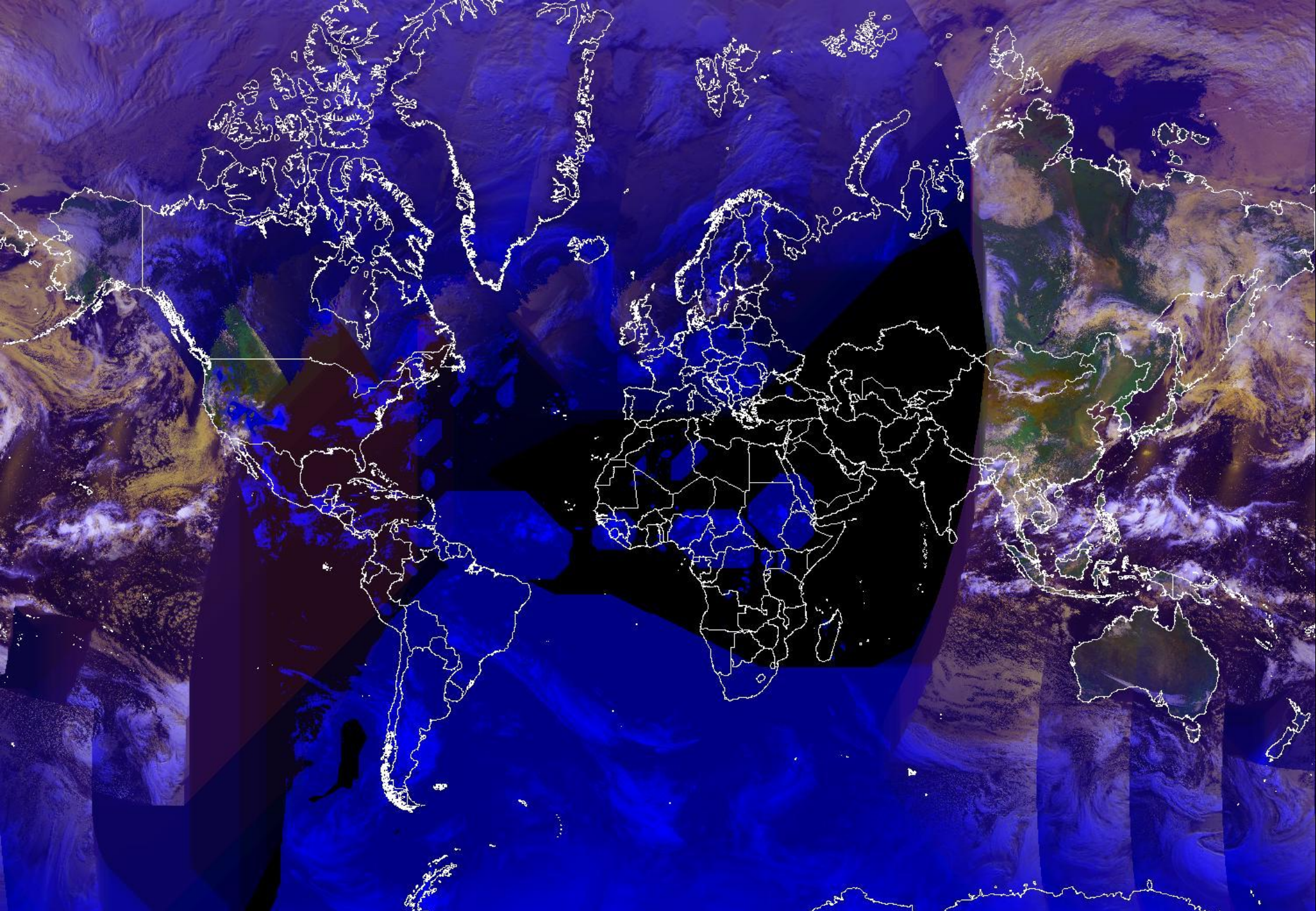
EUMETSAT



Vesa Nietosvaara
Training Officer


MET10 IR108 2014-07-28 00:00 UTC
EUMETSAT


MET7-IODC IR115 2014-07-28 01:00 UTC
EUMETSAT



EUMETSAT is an intergovernmental organisation with 30 Member and 1 Cooperating States

Member States

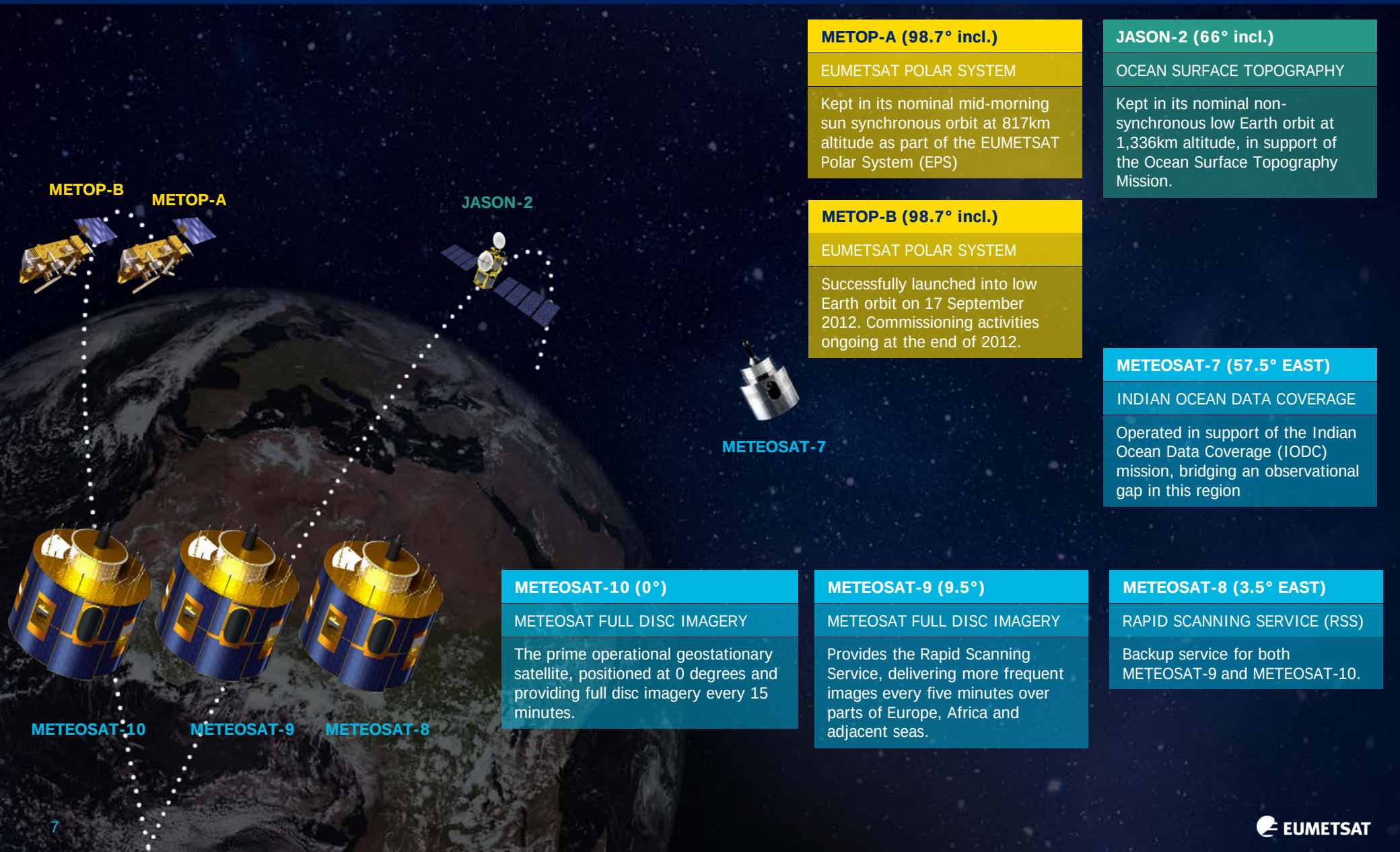
AUSTRIA
BELGIUM
BULGARIA
CROATIA
CZECH REPUBLIC
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ITALY
LATVIA
LITHUANIA
LUXEMBOURG
THE NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

Cooperating States

SERBIA

EUMETSAT headquarters

Current EUMETSAT satellites



METOP-A (98.7° incl.)

EUMETSAT POLAR SYSTEM

Kept in its nominal mid-morning sun synchronous orbit at 817km altitude as part of the EUMETSAT Polar System (EPS)

METOP-B (98.7° incl.)

EUMETSAT POLAR SYSTEM

Successfully launched into low Earth orbit on 17 September 2012. Commissioning activities ongoing at the end of 2012.

JASON-2 (66° incl.)

OCEAN SURFACE TOPOGRAPHY

Kept in its nominal non-synchronous low Earth orbit at 1,336km altitude, in support of the Ocean Surface Topography Mission.

METEOSAT-7 (57.5° EAST)

INDIAN OCEAN DATA COVERAGE

Operated in support of the Indian Ocean Data Coverage (IODC) mission, bridging an observational gap in this region

METEOSAT-10 (0°)

METEOSAT FULL DISC IMAGERY

The prime operational geostationary satellite, positioned at 0 degrees and providing full disc imagery every 15 minutes.

METEOSAT-9 (9.5°)

METEOSAT FULL DISC IMAGERY

Provides the Rapid Scanning Service, delivering more frequent images every five minutes over parts of Europe, Africa and adjacent seas.

METEOSAT-8 (3.5° EAST)

RAPID SCANNING SERVICE (RSS)

Backup service for both METEOSAT-9 and METEOSAT-10.

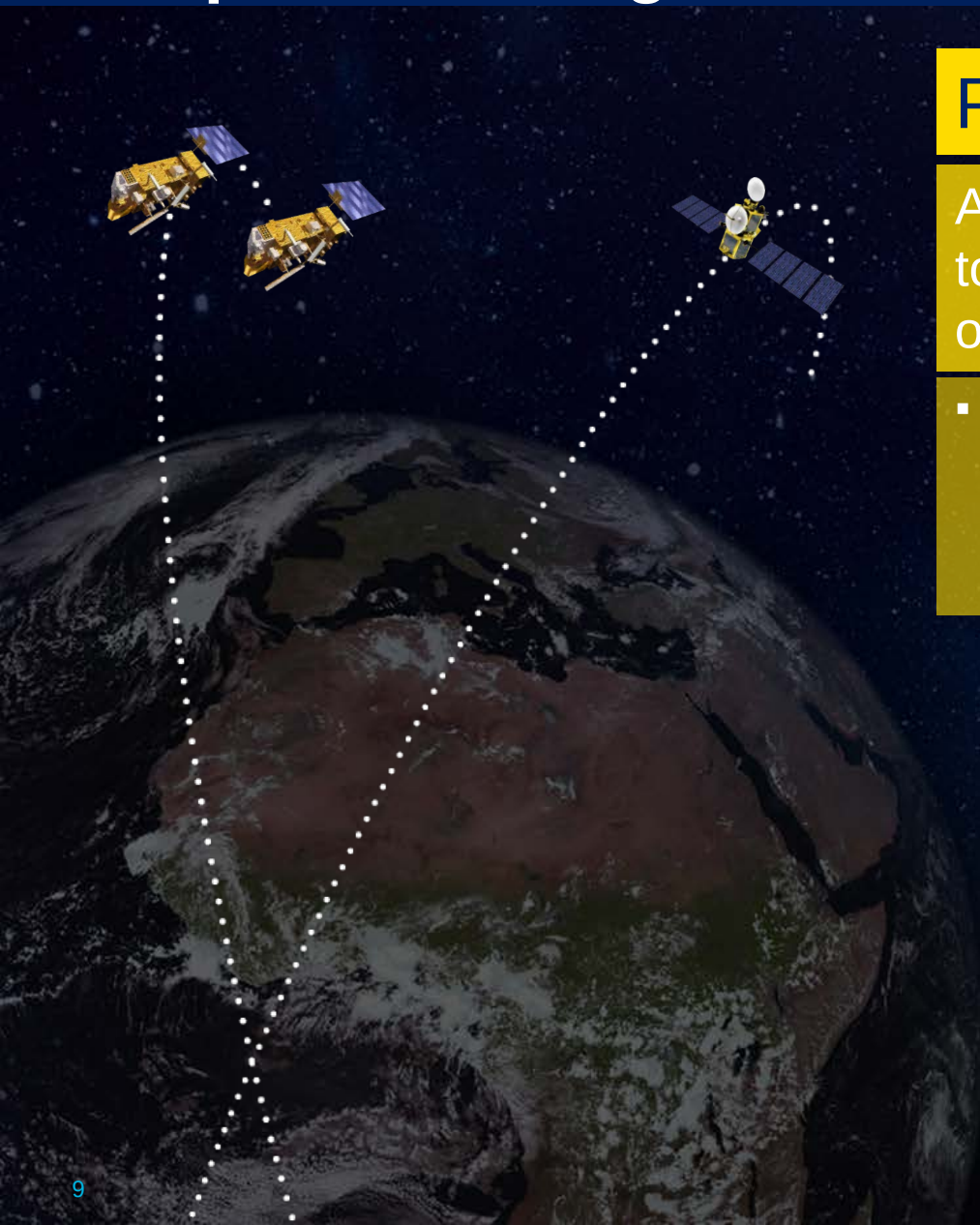
Respective roles of EUMETSAT's geostationary and polar-orbiting satellite programmes

Geostationary

Primary mission: "Nowcasting" of rapidly developing, high-impact weather up to six hours ahead.

- One of the most challenging tasks of the forecasters, vital for the safety of life, property and infrastructure
- Requires informative images of the atmosphere at a high frequency (some minutes) that can only be achieved from the geostationary orbit (36,000 km)

Respective roles of EUMETSAT's geostationary and polar orbiting satellite programmes

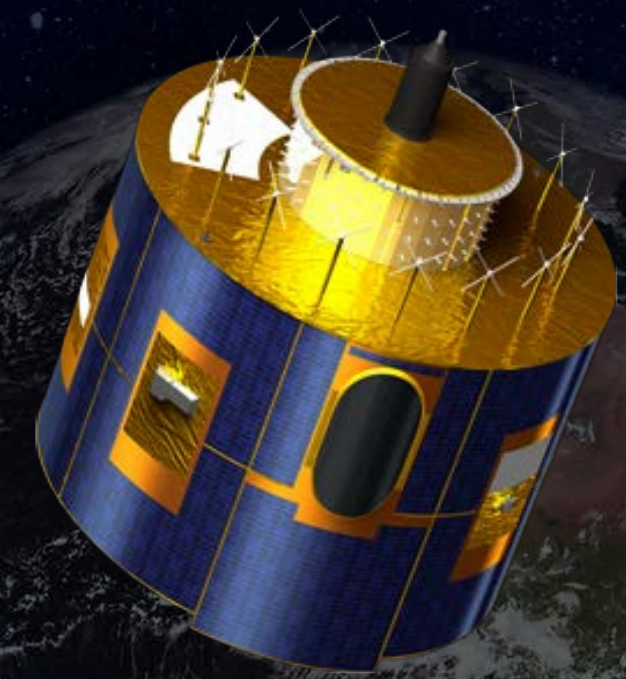


Polar Orbiting

A second system in lower orbit is needed to complement the data from geostationary orbit and provide global coverage

- Flying at a much lower altitude (817 km), Metop satellites deliver a wealth of less frequent but global and quantitative observations which are the most critical inputs to the Numerical Weather Prediction models used to forecast weather up to 10 days and for climate monitoring

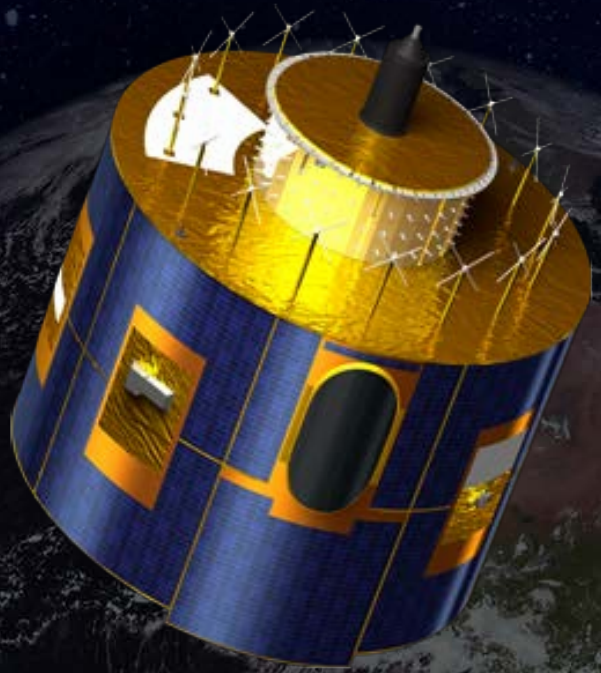
Meteosat Second Generation



The data provided by Meteosat satellites make a vital contribution to daily weather forecasting, in particular for nowcasting and very short range forecasting of high impact weather like thunderstorms and fog over Europe, Africa and adjacent seas.

- Operated as a two-satellite system since 2006:
- Meteosat-10 provides “full disk” images every 15 minutes over Europe, Africa and part of the Atlantic and Indian oceans
- Meteosat-9 provides “rapid scan” images every 5 minutes over European continent only

Meteosat Second Generation



Carries two instruments:

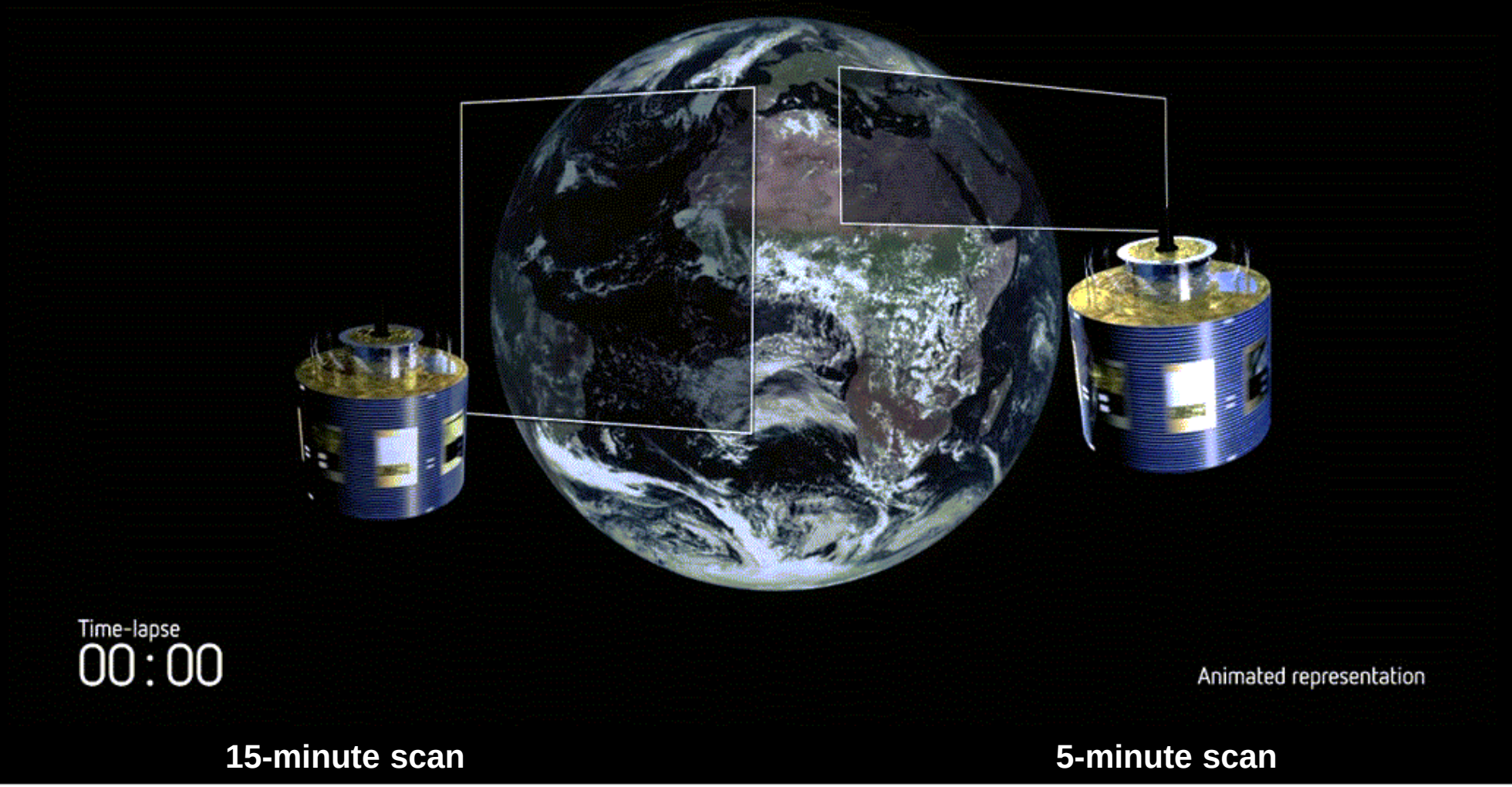
- Spinning Enhanced Visible and InfraRed Imager (SEVIRI) – main operational instrument – observes the Earth in 12 spectral channels covering visible, near-infrared and thermal infrared part of the spectrum
- The Geostationary Earth Radiation Budget (GERB) instrument observes the reflected sunlight and thermal emissions from the Earth in two broadband channels
- Another mission is the data collection service that collects and relays environmental data collected from Data Collection Platforms to users

Meteosat Second Generation

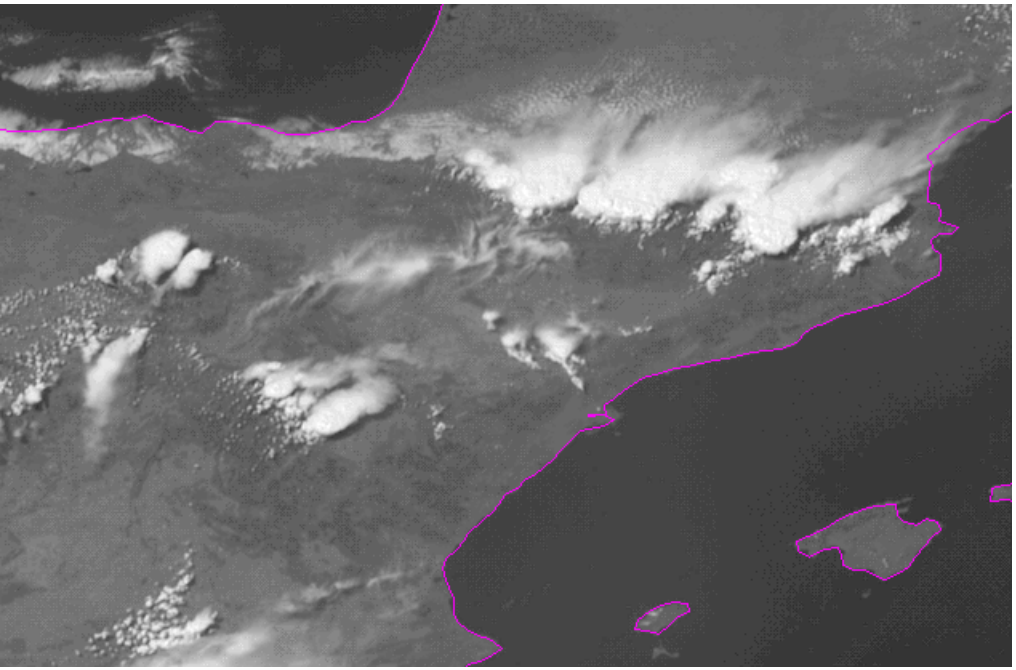
Other applications of MSG:

- Extraction of wind information from observed displacement of clouds and water vapour patterns as input for NWP models (to complement Metop observations which remain the primary source)
- volcanic ash monitoring
- climate monitoring

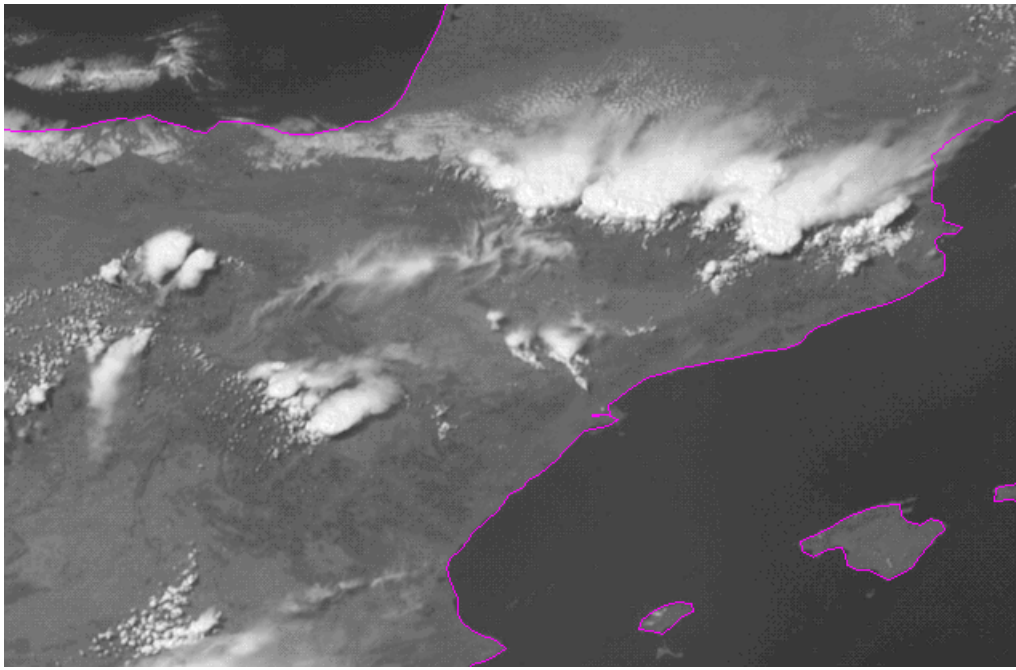
The operational capability of a two-satellite system



The operational capability of a two-satellite system

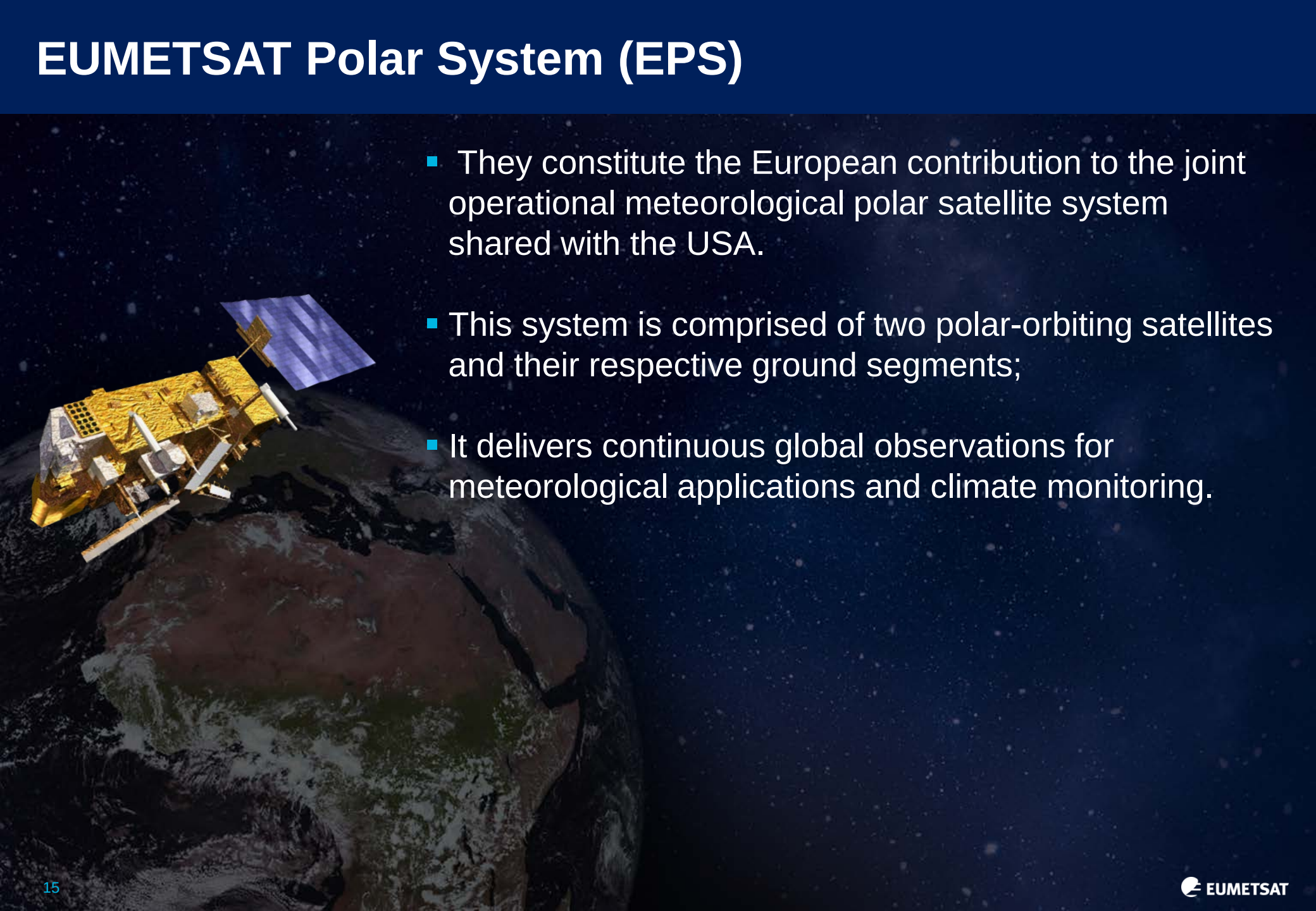


15-minute scan



5-minute scan

EUMETSAT Polar System (EPS)



- They constitute the European contribution to the joint operational meteorological polar satellite system shared with the USA.
- This system is comprised of two polar-orbiting satellites and their respective ground segments;
- It delivers continuous global observations for meteorological applications and climate monitoring.

EUMETSAT Polar System (EPS)

- Flying at an altitude of 817 km, each Metop satellite carries the same sophisticated suite of instruments;
- They provide fine-scale global data, which can only be gathered in the low Earth orbit, such as:
  - vertical profiles of atmospheric temperature and moisture;
  - wind speed and direction at the ocean surface;
  - some atmospheric trace gases
- They deliver data for NWP – the basis of modern weather forecasting – and climate and environmental monitoring;
- The three Metop satellites, launched sequentially (2006, 2012, 2017), will provide continuous data until 2020.

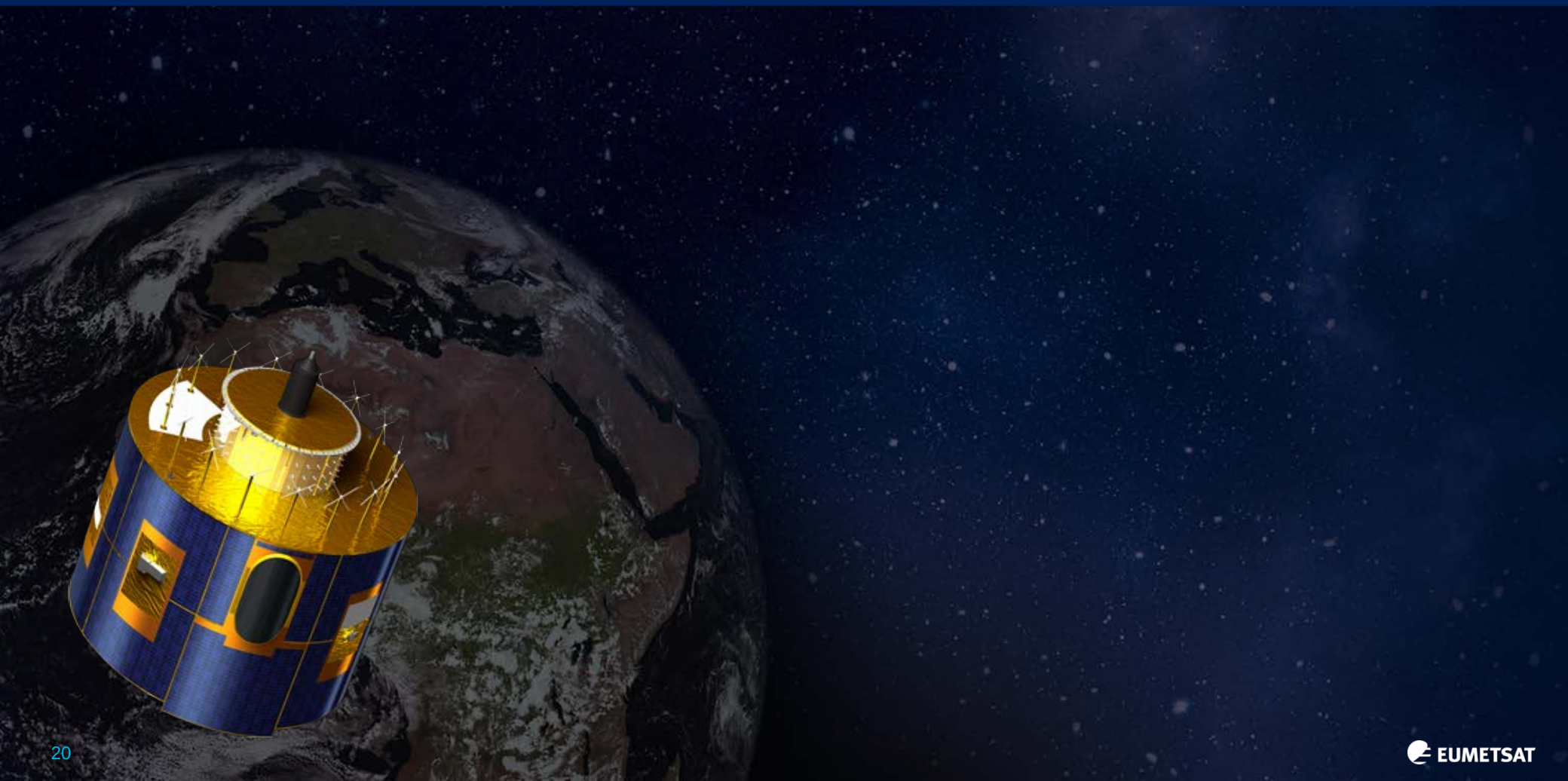
The Jason series : Delivering High Precision Ocean Altimetry

- Jason-2 delivers high-precision altimetry observations of:
  - wave height
  - mean sea level and ocean current, in support of operational oceanography; climate monitoring and marine meteorology.
- The unique sea level data series accumulated since 1992 by Topex/Poseidon and Jason-1 are also continued, forming an invaluable Climate Data Record.
- Jason-2 ocean surface topography mission continues successful partnership with NOAA, NASA and CNES.
- Jason-2 provides an indispensable reference against which measurements of other altimeter missions are cross-calibrated.

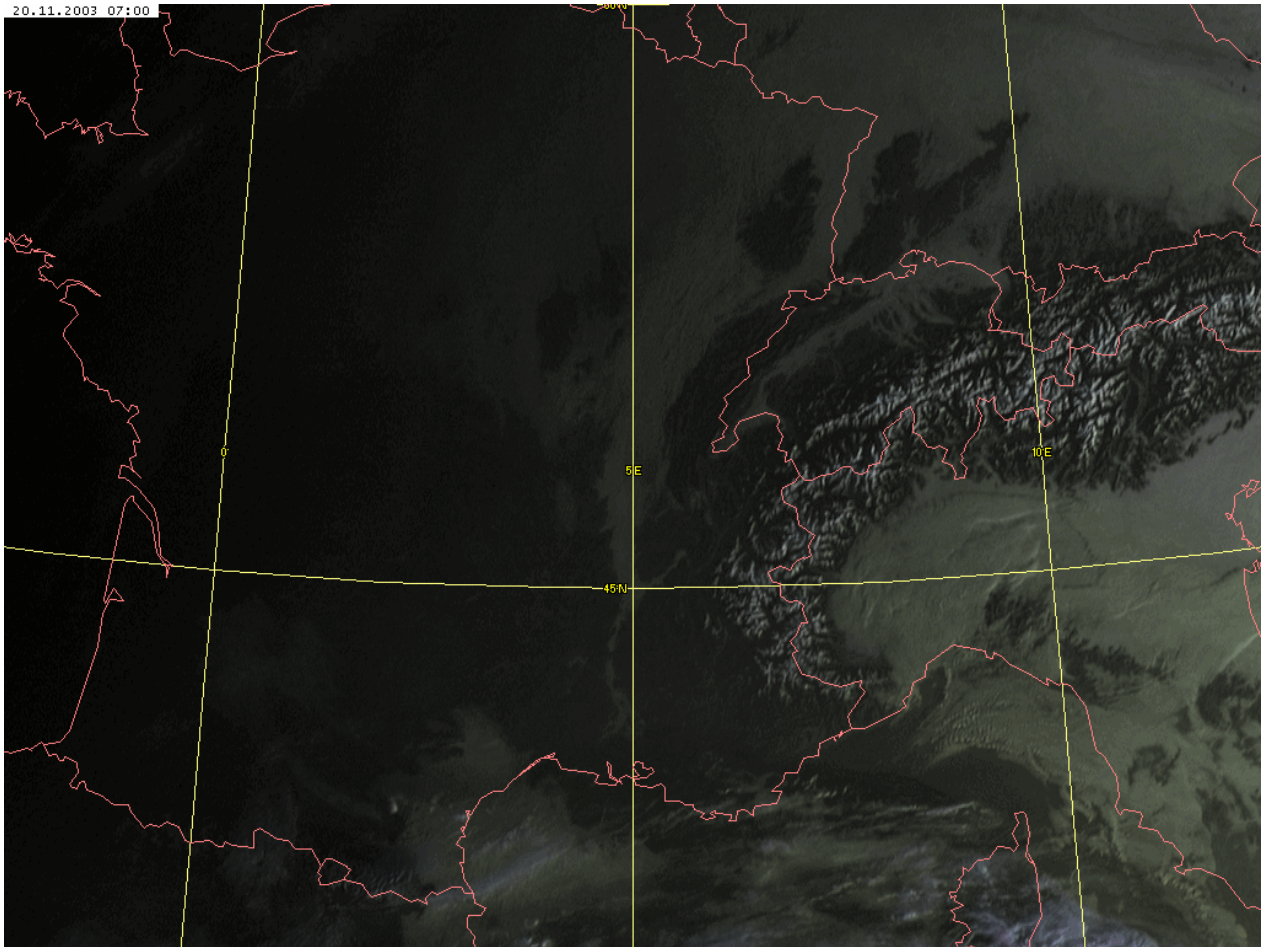
The Jason series: Delivering High-Precision Ocean Altimetry

- Jason-3, the follow-on satellite required to ensure continuity of measurements, is scheduled for launch in spring 2015.
- The Jason-3 mission will expand, into a third decade, the high precision altimetry observations required to monitor mean sea level and serve as a unique reference for other altimetry missions aimed at monitoring ocean circulation at various scales, including the altimetry mission of GMES Sentinel-3.
- Future altimetry missions (Jason-CS/Sentinel-6) are needed to secure the HPOA mission into the next decades.

METEOSAT PRODUCTS & APPLICATIONS



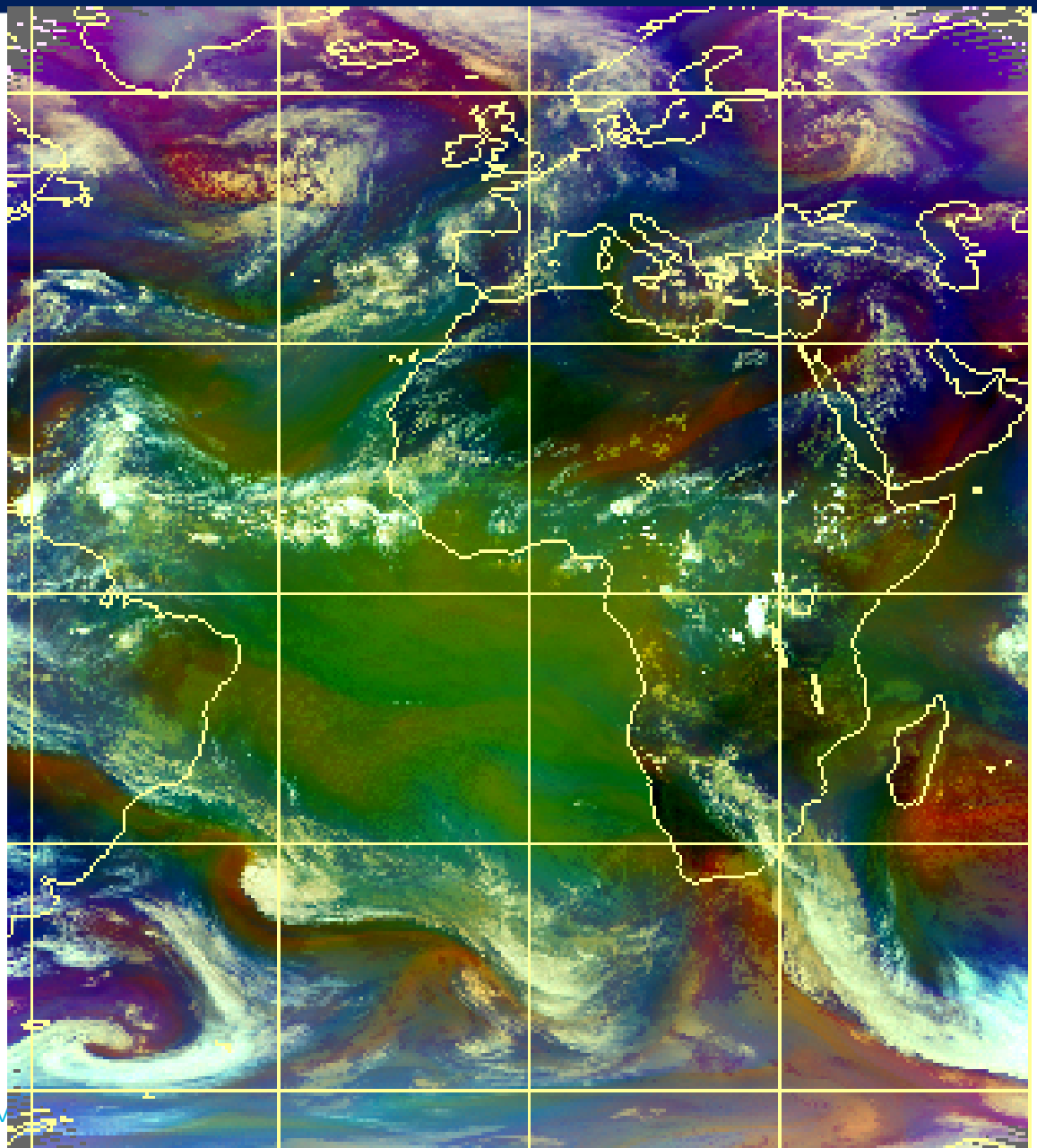
Fog RGB (animated)



Application:

Nowcasting formation / dissipation of fog

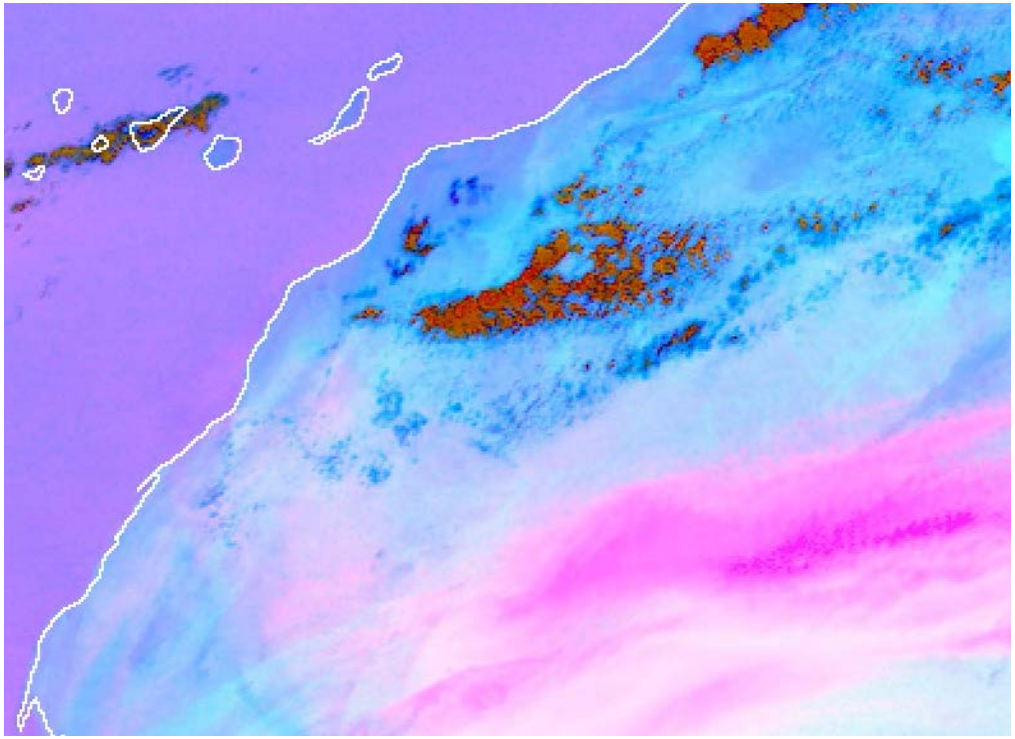
Airmass RGB

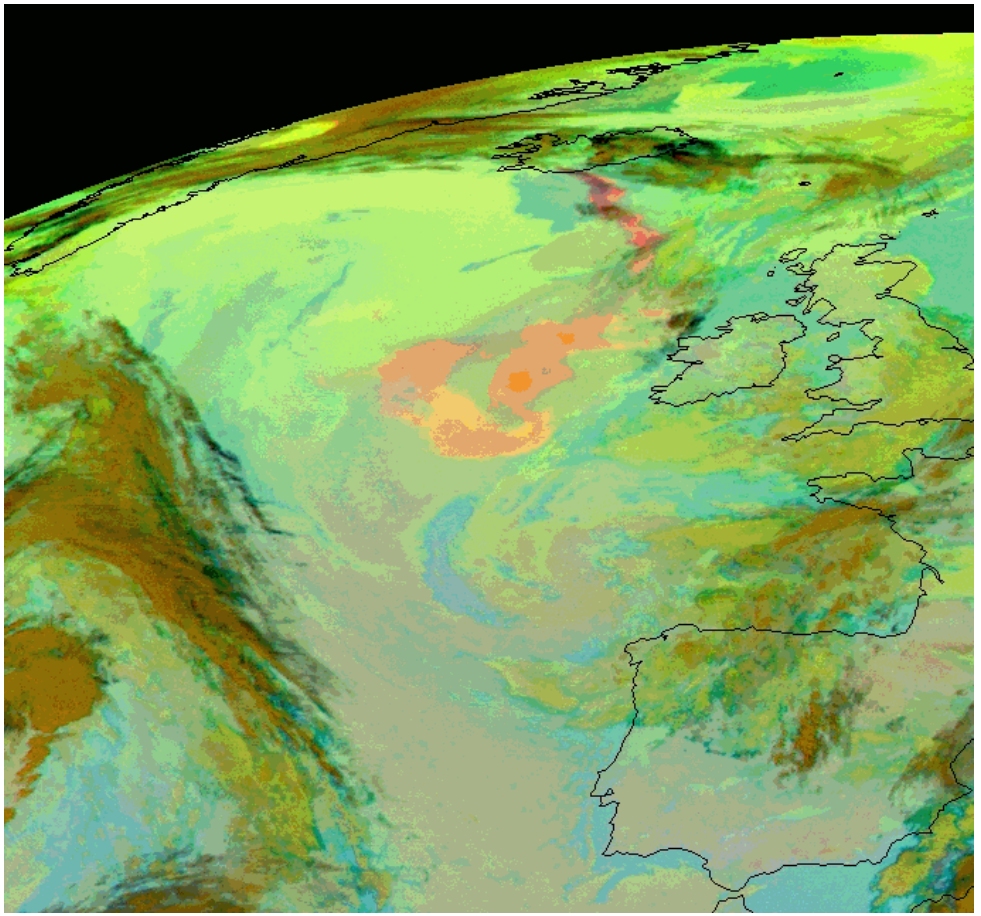


Application:

Temporal evolution and motion of midlatitude frontal systems; comparison to model forecasts

Dust / Ash RGB

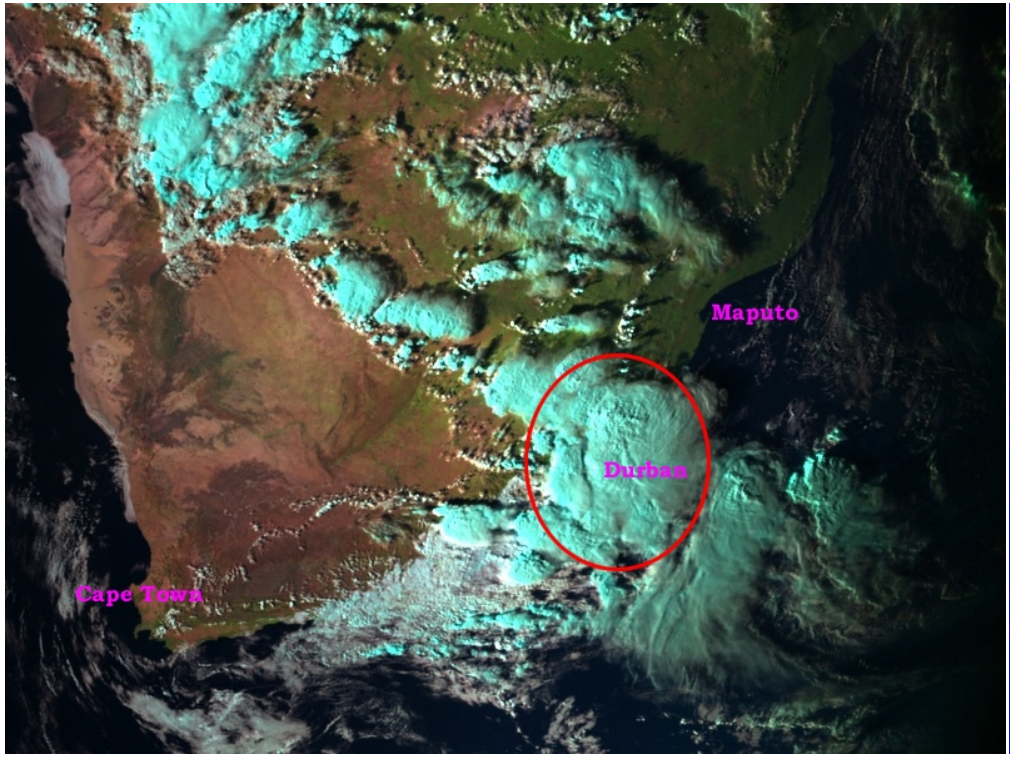


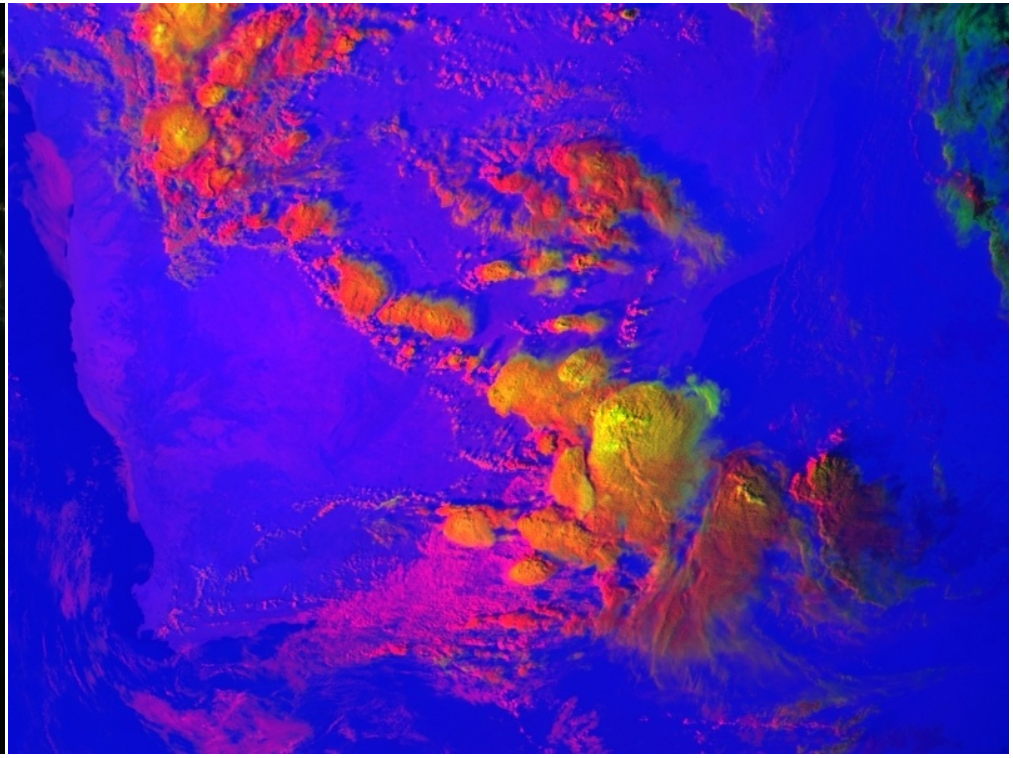


Applications:

Visibility issues
Ash warnings

Cloud Microphysics – e.g. Convection

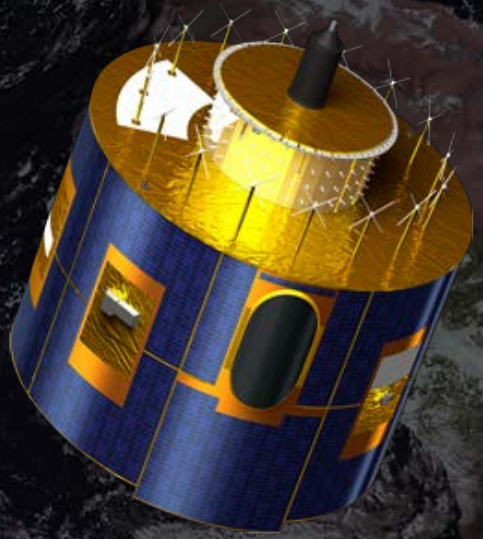




Application:

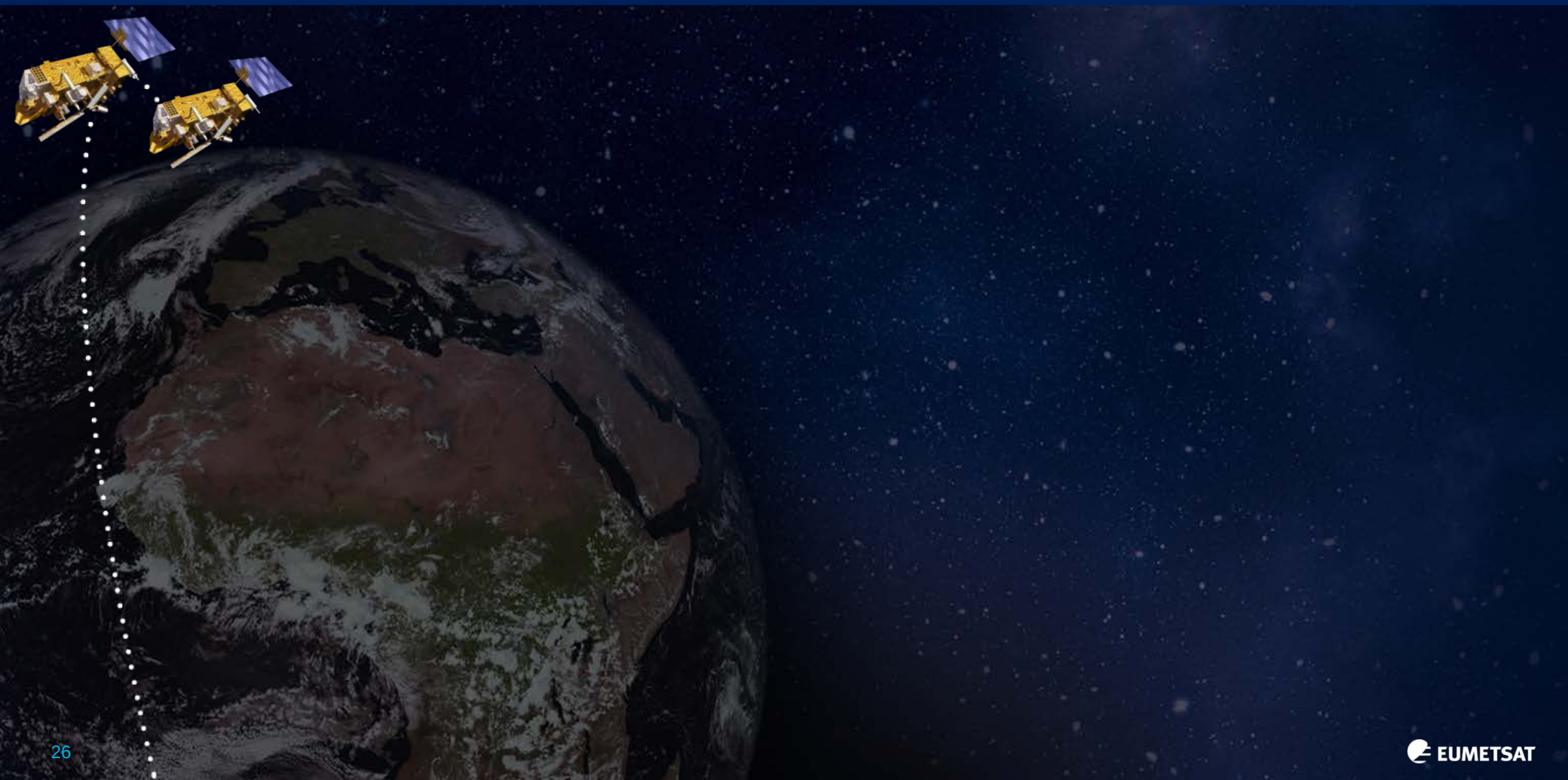
Nowcasting most severe part of convective storms (aviation, weather on the ground)

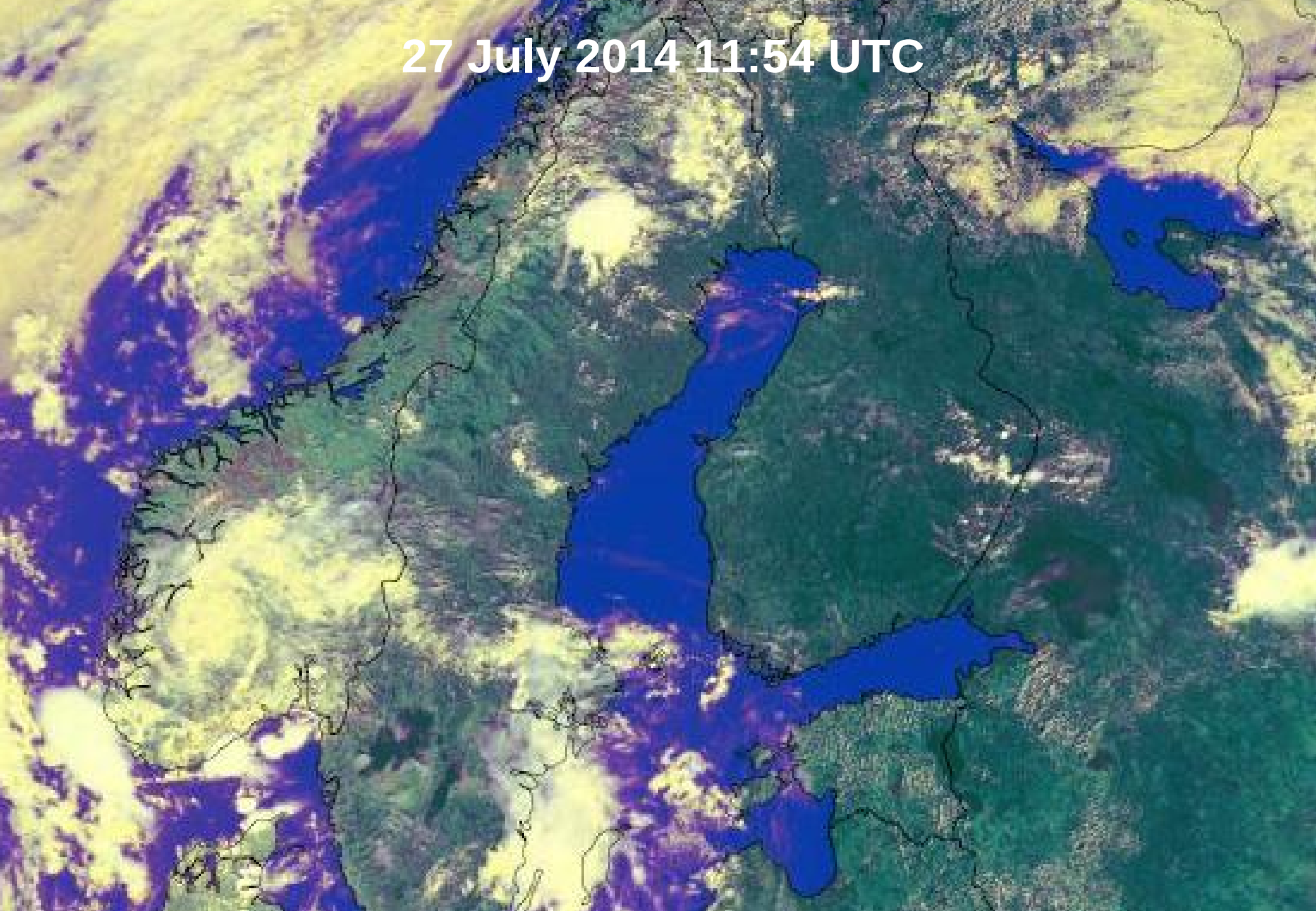
METEOSAT PRACTICALS

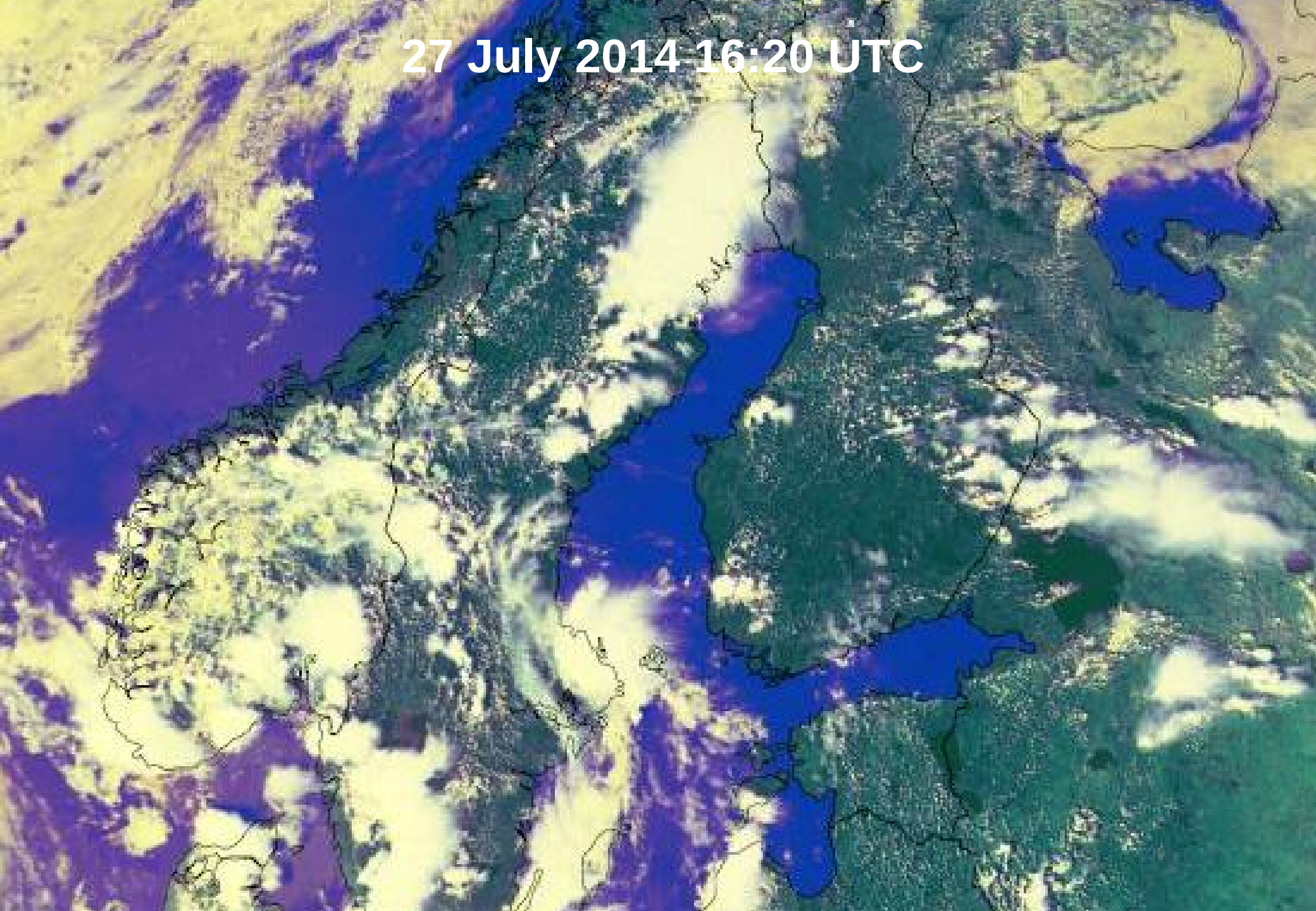


1. Go to: www.eumetsat.int
2. IMAGES > REAL-TIME IMAGES
3. Browse the images and try to investigate the cloudiness/weather in your own country/region

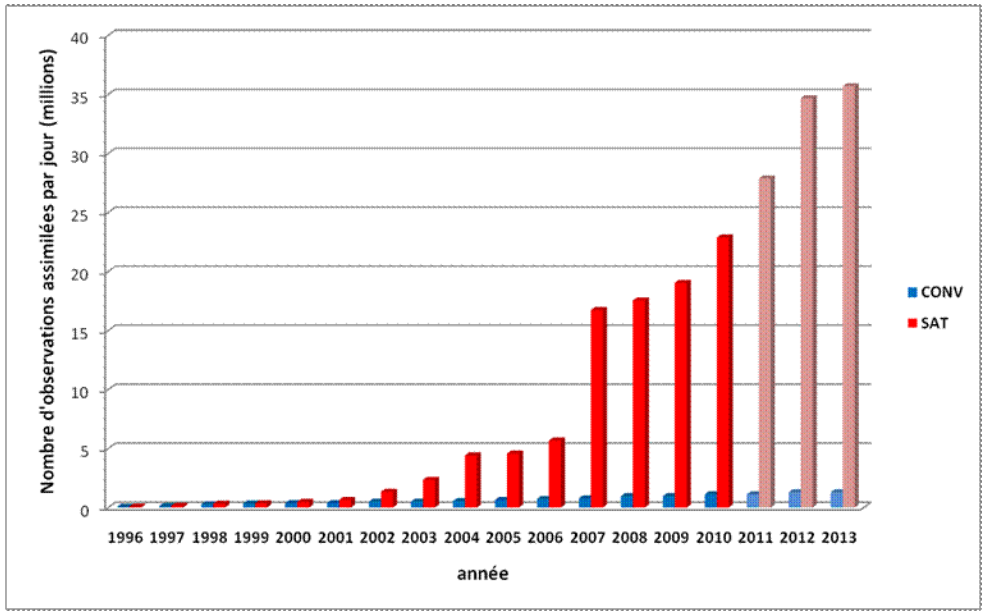
METOP PRODUCTS & APPLICATIONS

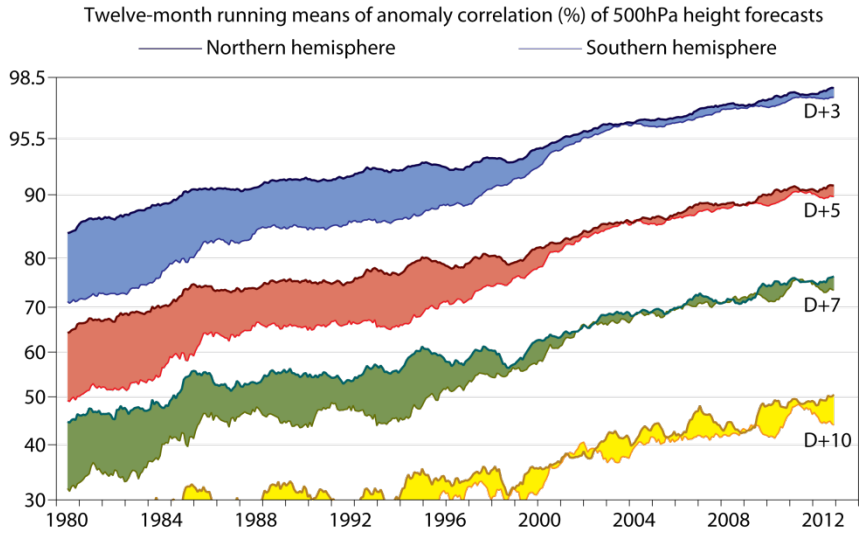



27 July 2014 11:54 UTC


27 July 2014 16:20 UTC

Metop-A: Impact on 3 to 10 day forecast

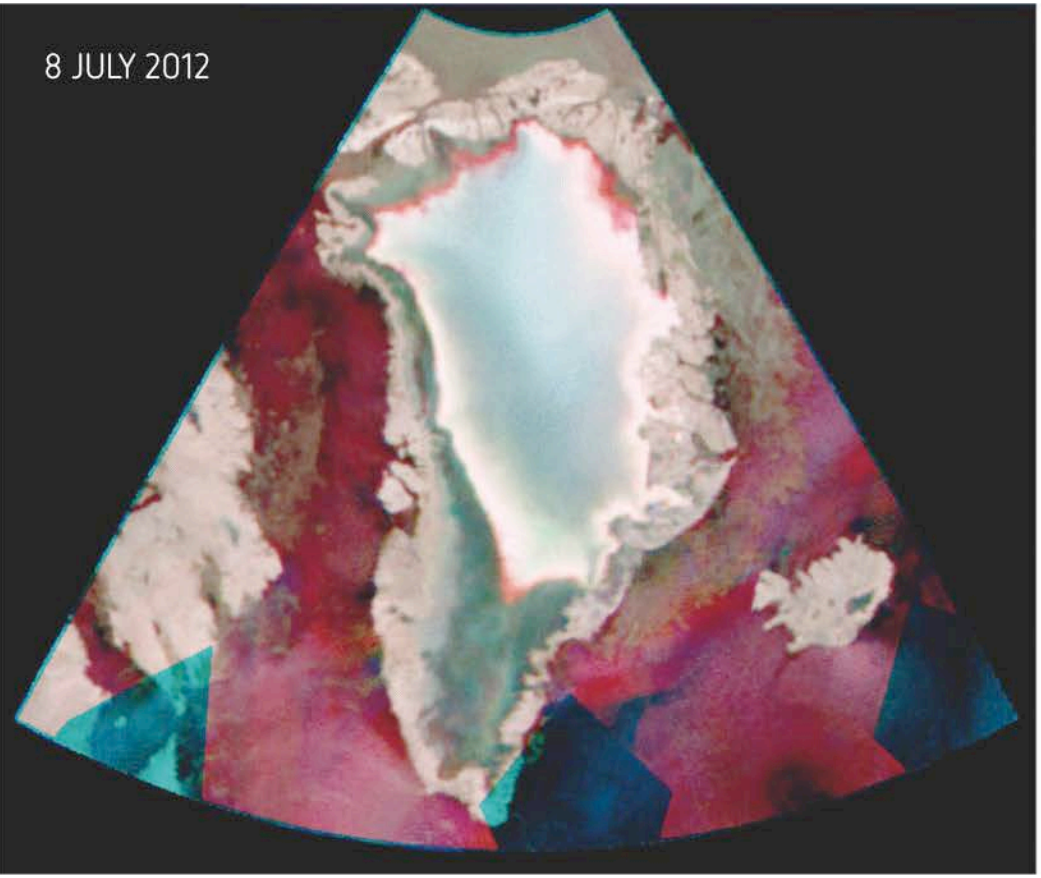


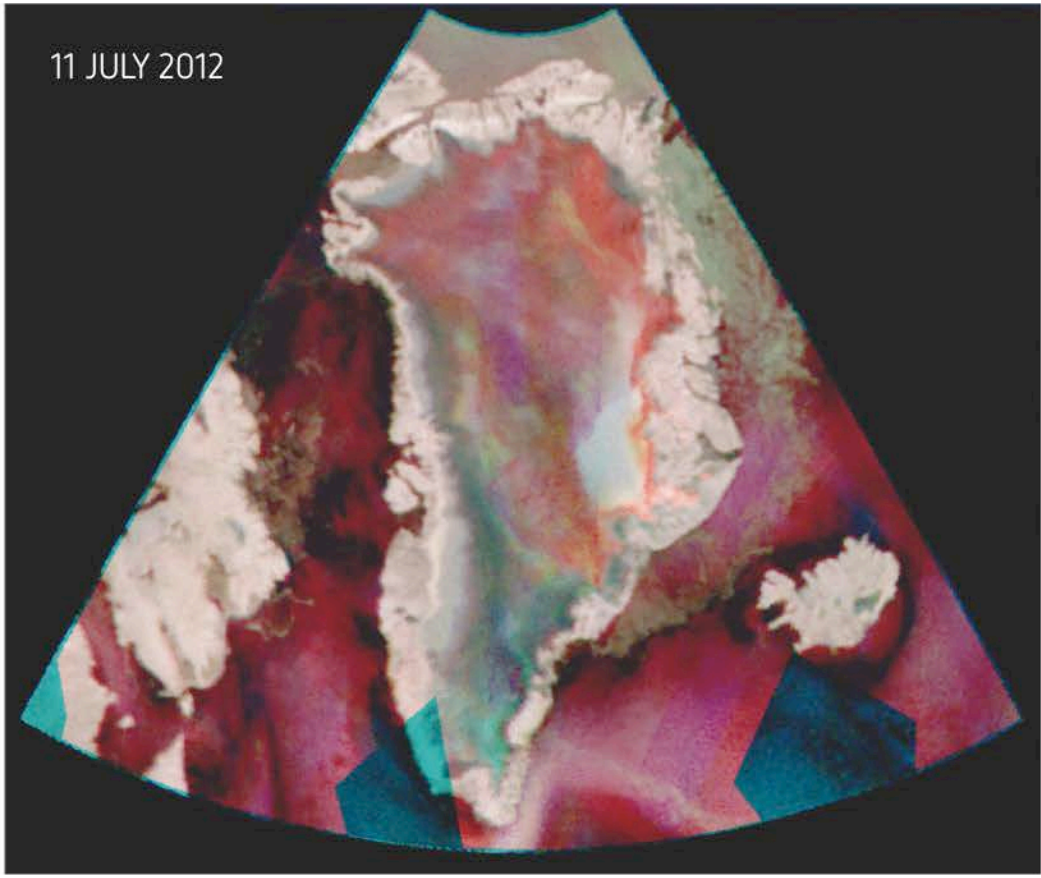


ECMWF

EUMETSAT

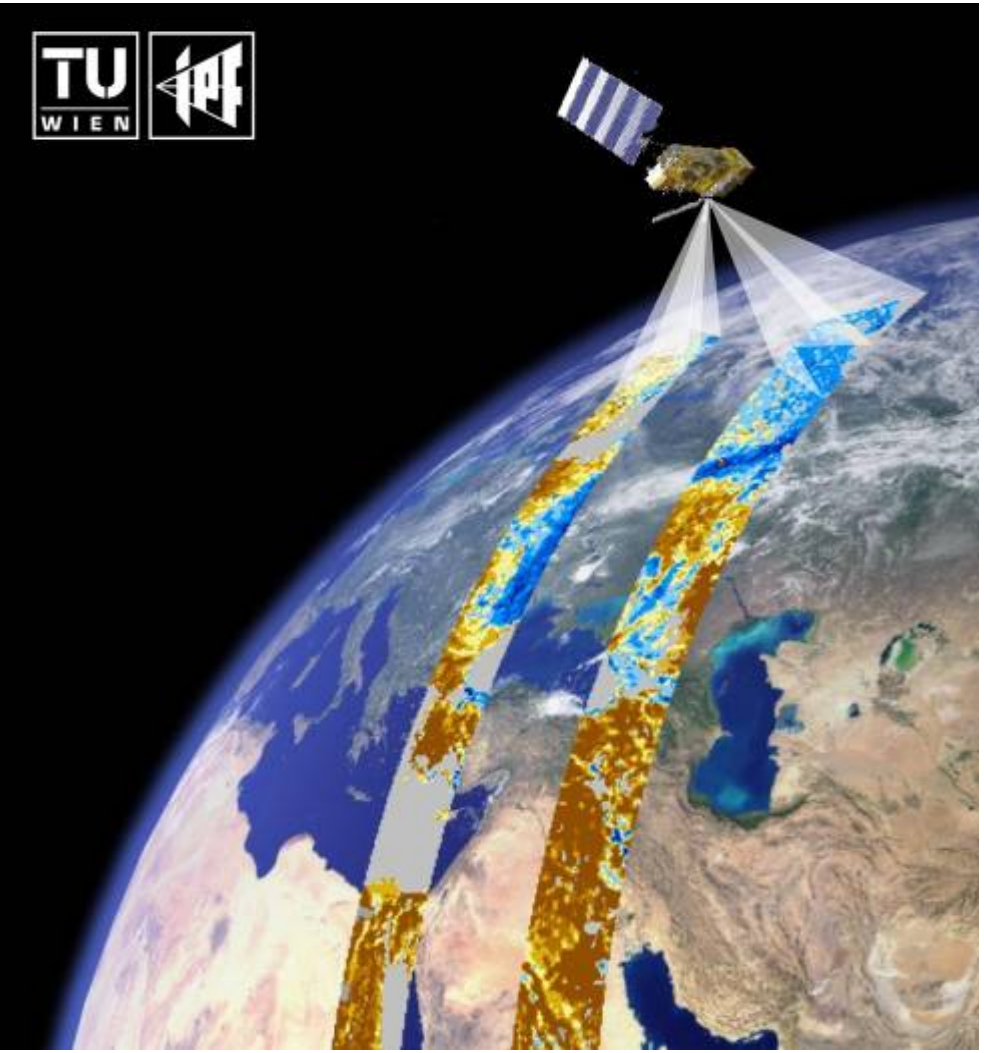
Extreme Greenland ice sheet melt

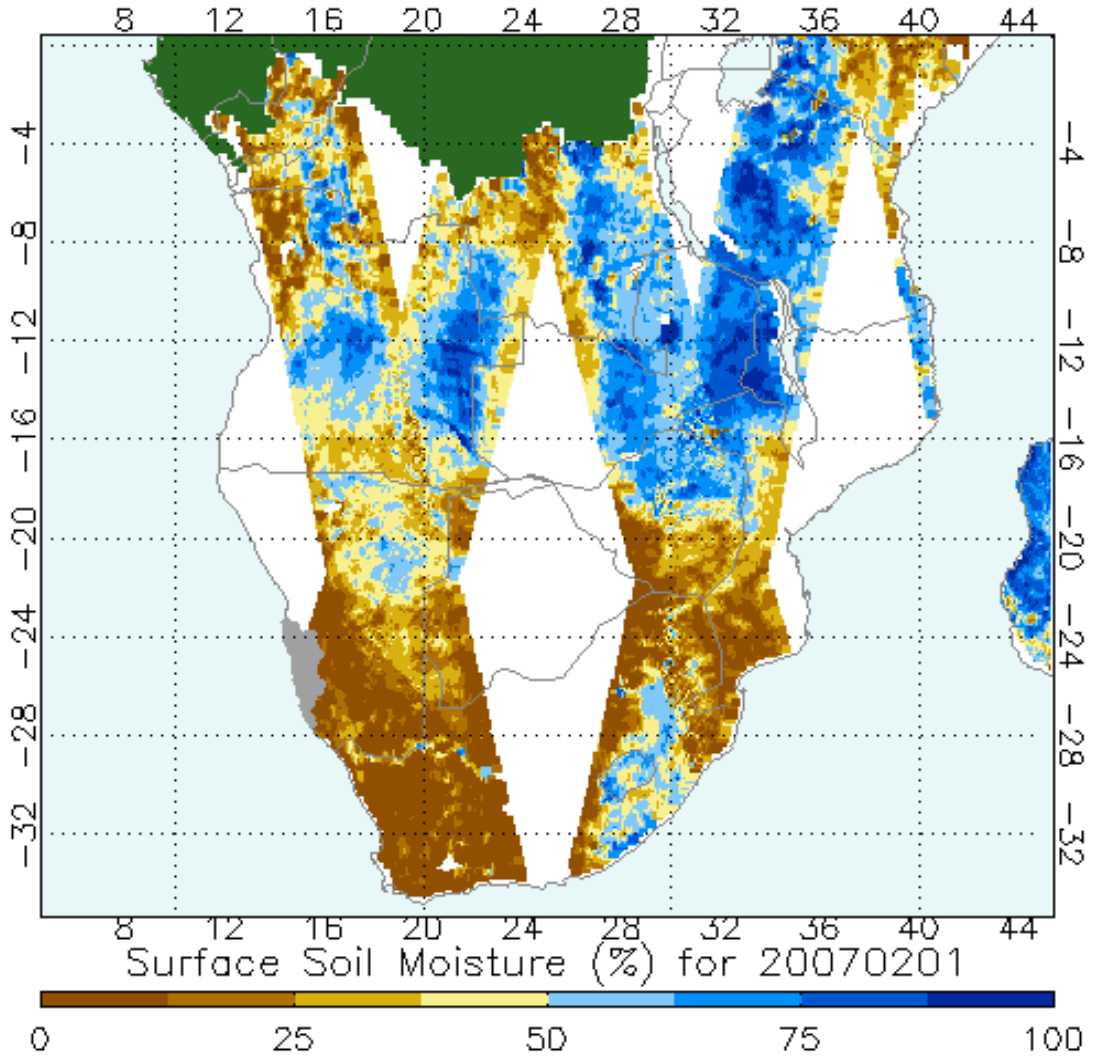




Metop-A ASCAT backscatter over Greenland changing dramatically from 8 and 11 July 2012. Imagery discriminates land (grey), summer melt (dark green), fast surface melt (red), refrozen melt (bright white) and non-melted (dark grey/blue). This event was likely due to extreme air surface temperature during those days.

Metop-A beyond expectations: soil moisture from ASCAT





EUMETSAT

Metop ASCAT Soil Moisture DataViewer

..:: About ::.. | ..:: Map Utilities ::.. | **..:: Map A ::..** | ..:: Map B ::.. | ..:: Map C ::.. | ..:: Map D ::.. | ..:: Colorbars ::.. | ..:: Help ::.. | ..:: Contact ::..

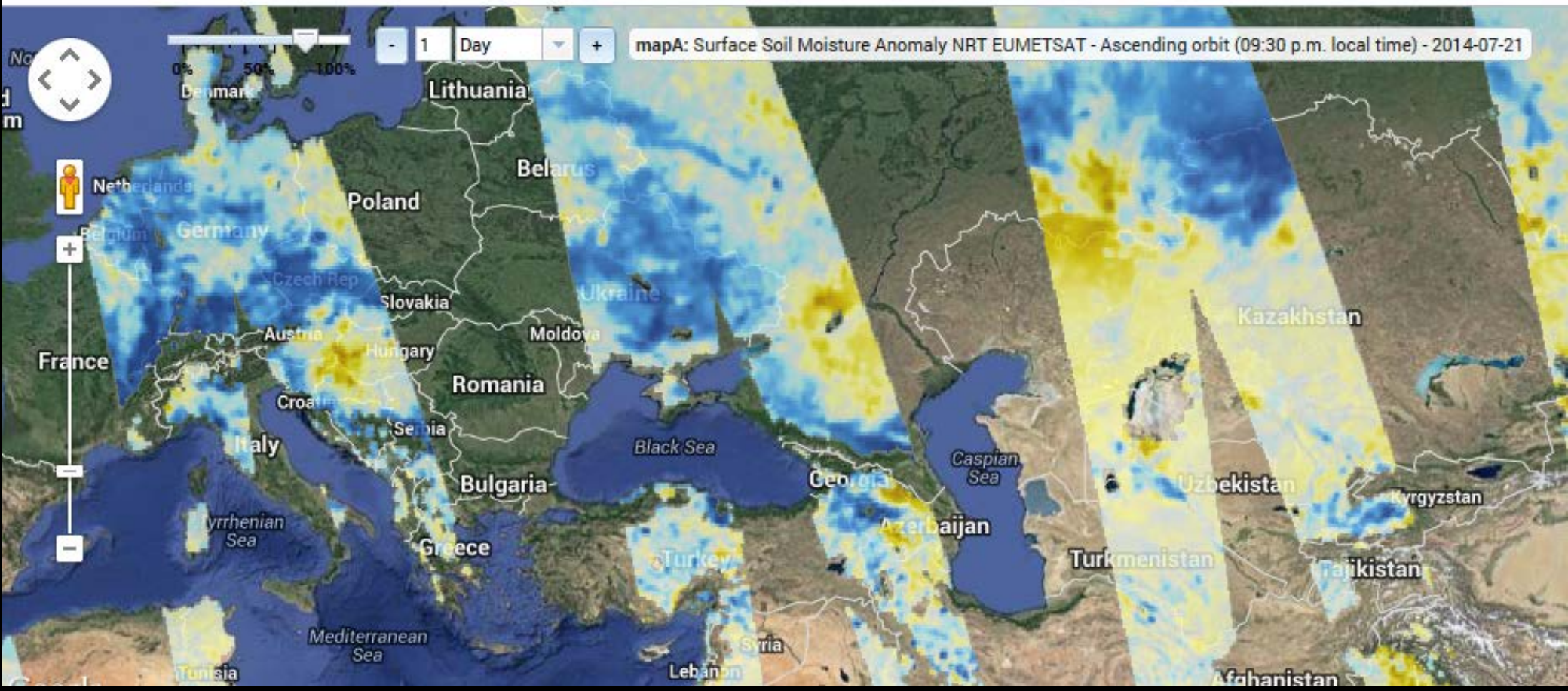
Instrument: METOP/ASCAT

Date: 2014 - 07 - 21

Product group: Surface Soil Moisture Anomaly NRT EUMETS

Product: Ascending orbit (09:30 p.m. local time)

Colorbar: Surface soil moisture anomaly (%) -70 0



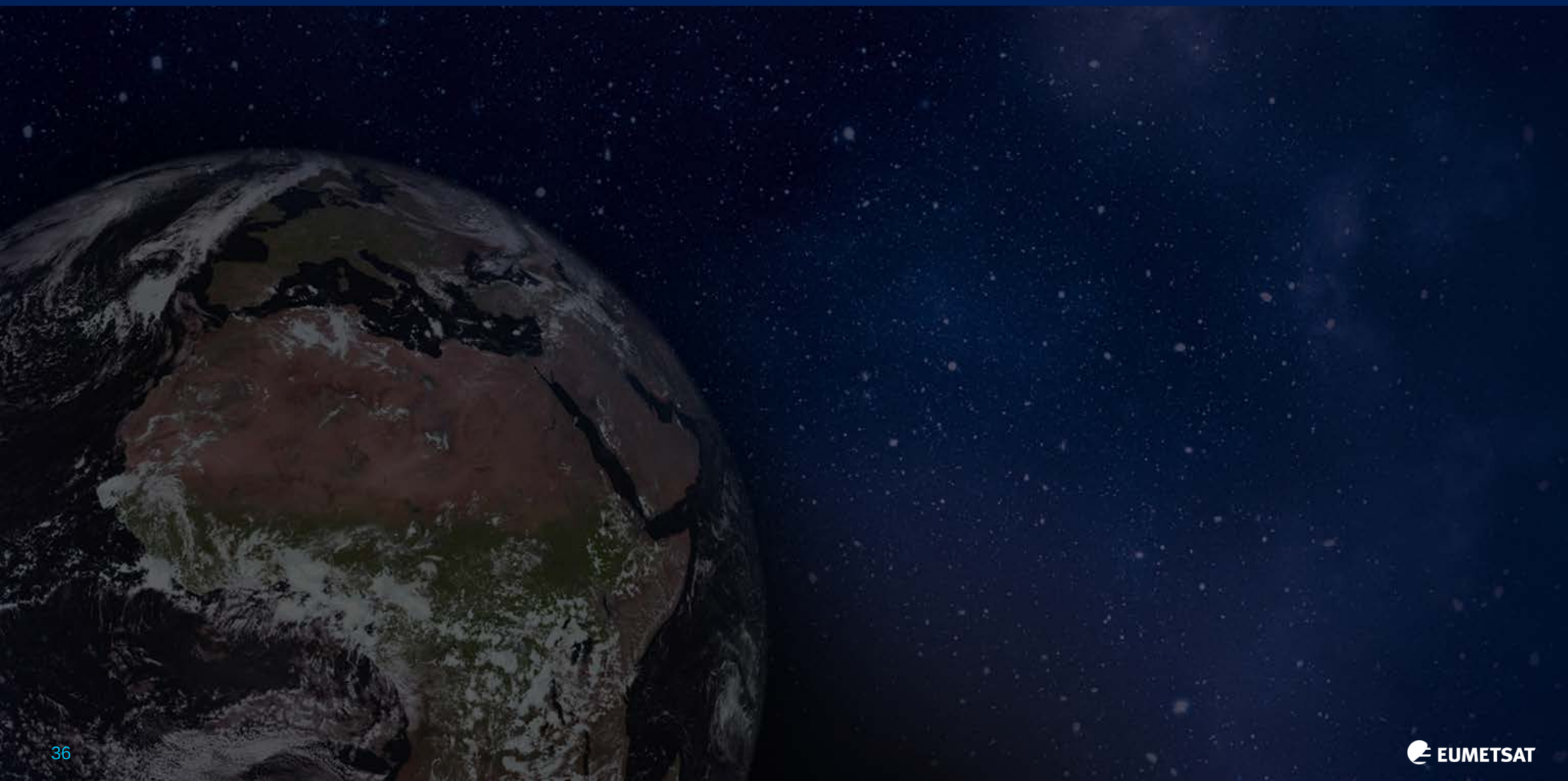
Monitoring large scale fires and associated pollution: Russia, summer 2010

IASI CO data

LATMOS-IPSL / ULB

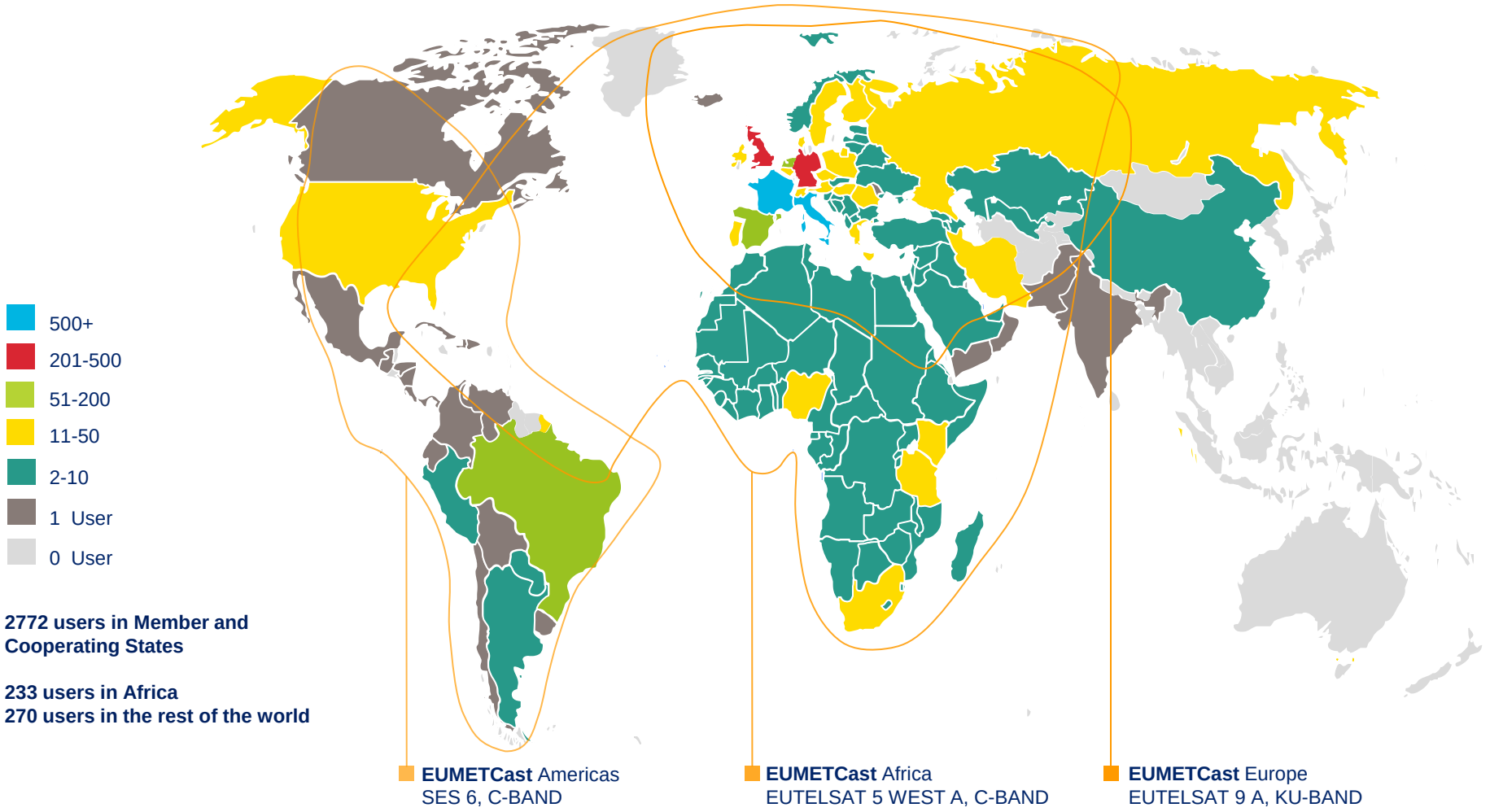
Source: Maya George (LATMOS)

DATA ACCESS

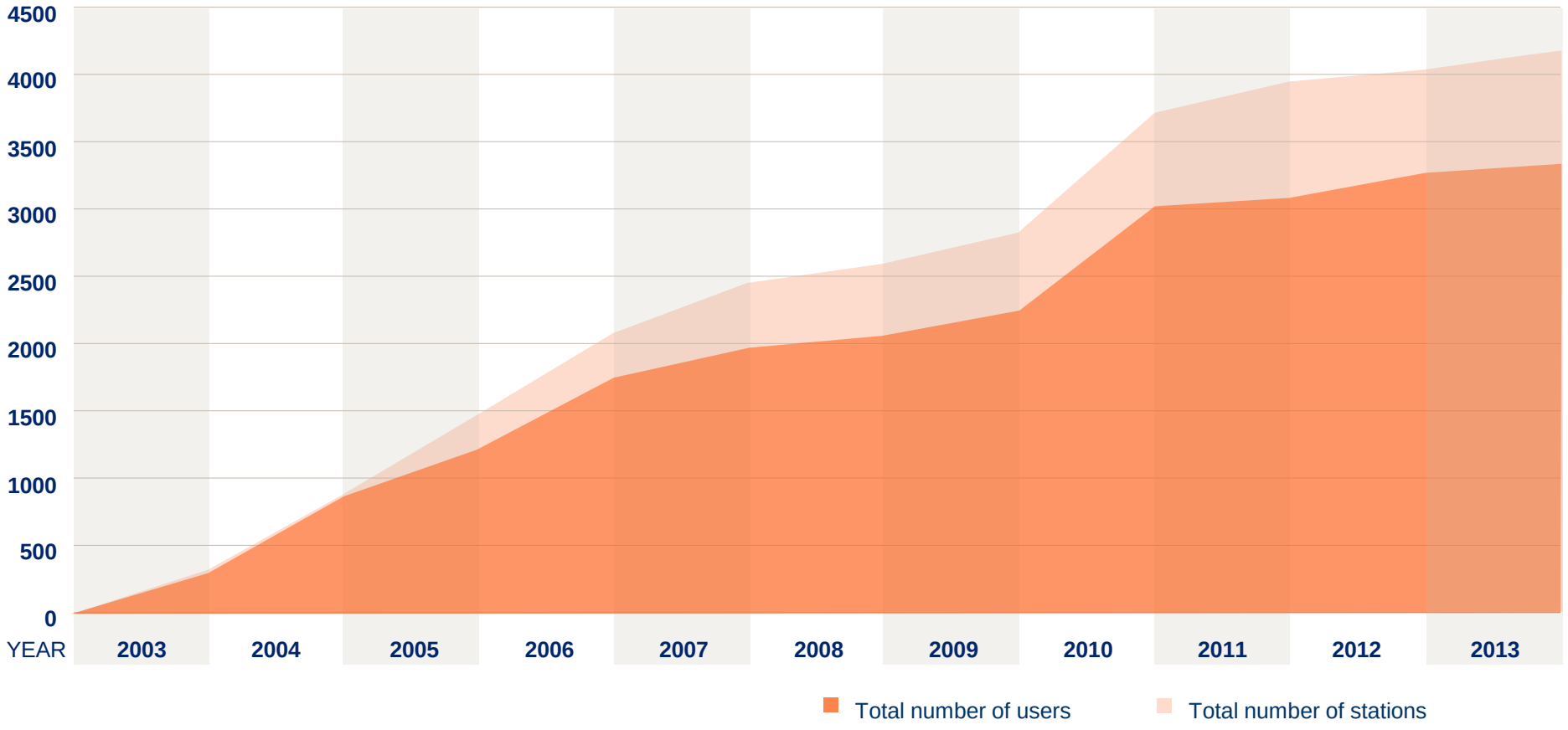


Delivering to users worldwide

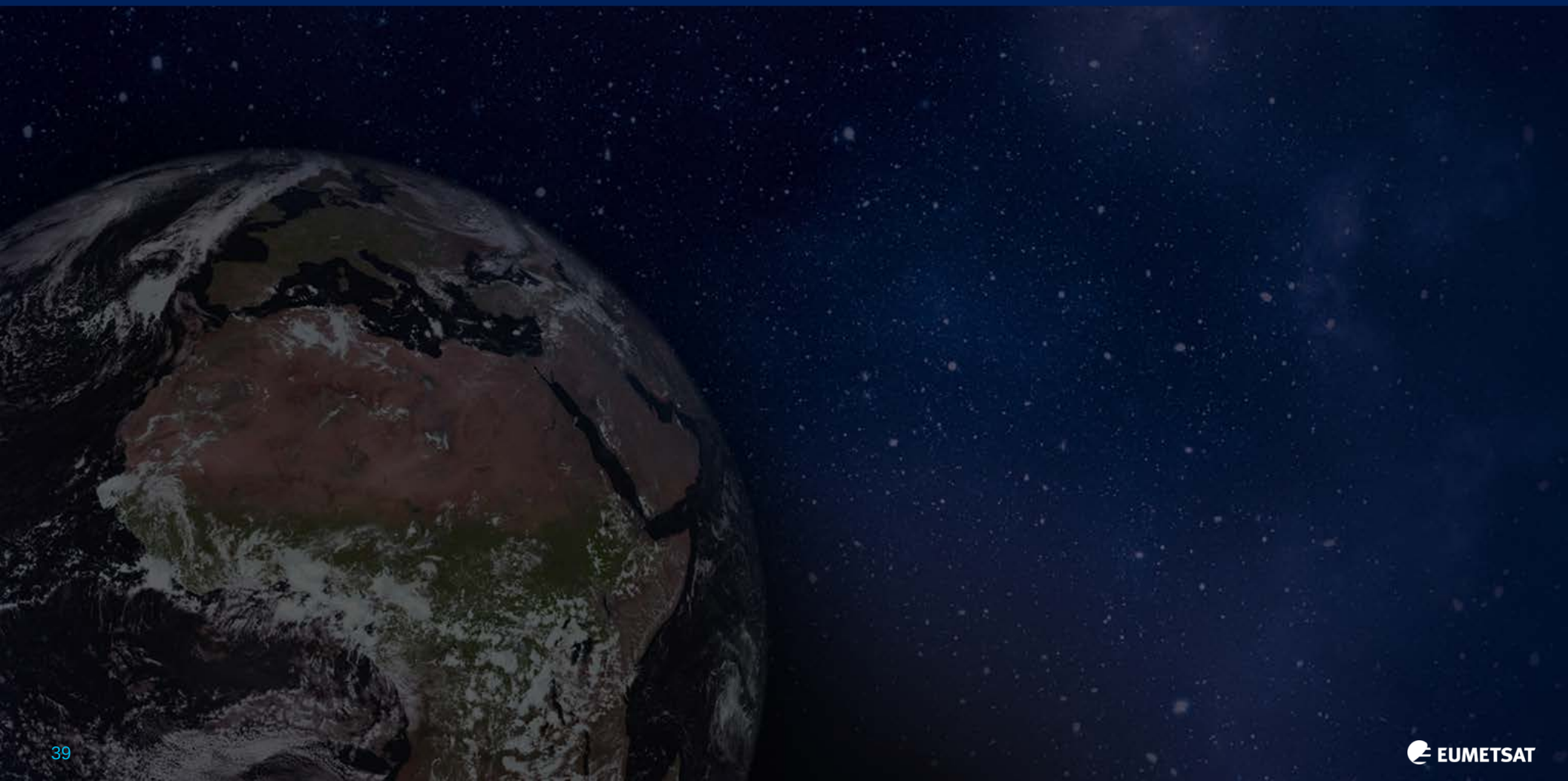
EUMETCast Users Worldwide as of 31 December 2013



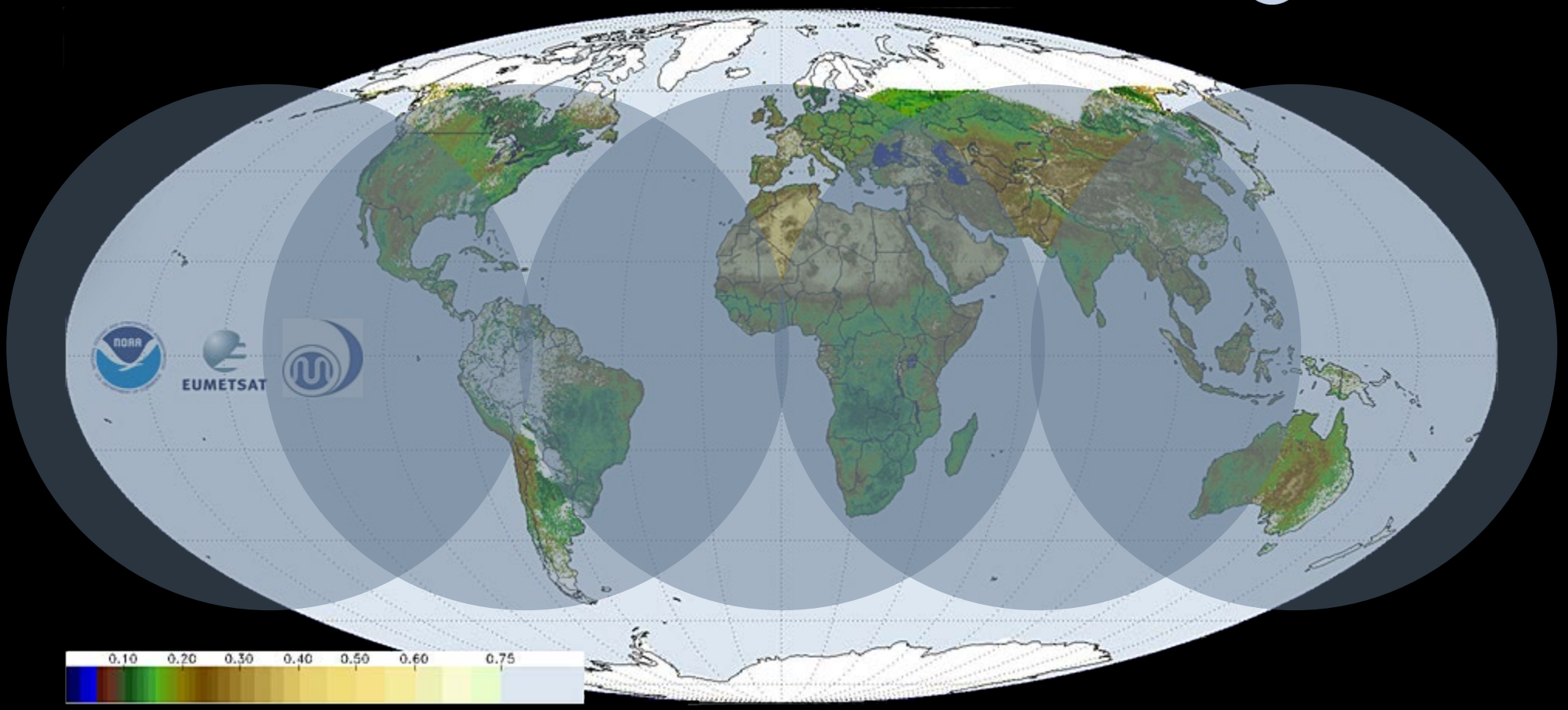
Growth in EUMETCast stations/users 2002-2013



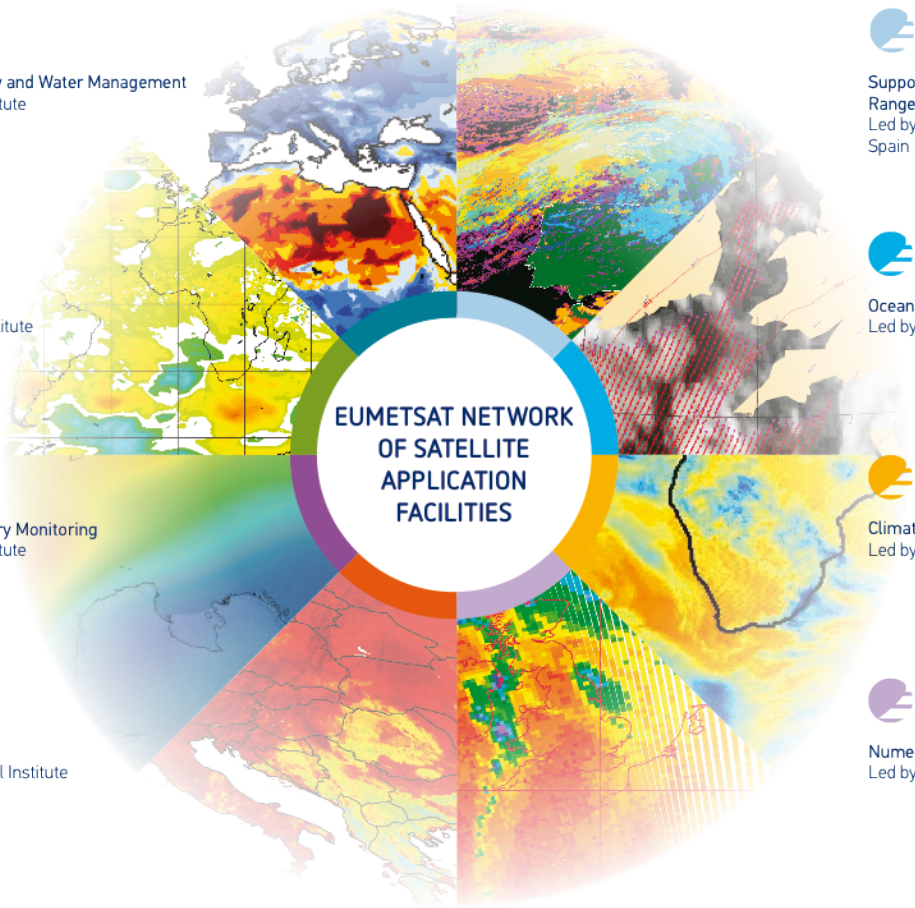
PARTNERSHIPS AND COOPERATION



Value of international cooperation: the “ring”



EUMETSAT SAF network across Europe



H SAF
Support to Operational Hydrology and Water Management
Led by Italian Meteorological Institute

ROM SAF
Radio Occultation Meteorology
Led by Danish Meteorological Institute

O3M SAF
Ozone and Atmospheric Chemistry Monitoring
Led by Finnish Meteorlogical Institute

LSA SAF
Land Surface Analysis
Led by Portuguese Meteorological Institute

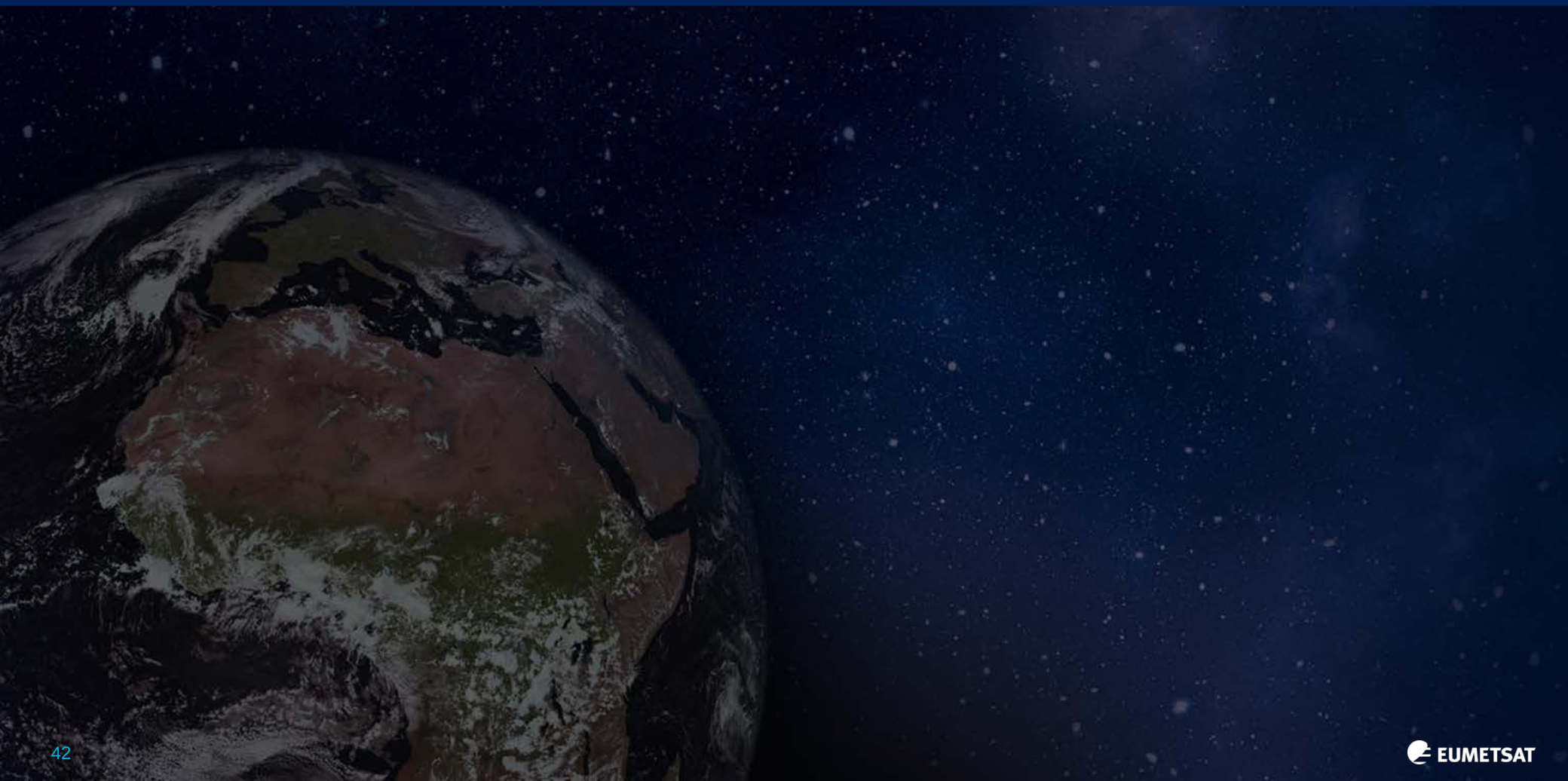
NWC SAF
Support to Nowcasting and Very Short Range Forecasting
Led by Agencia Estatal de Meteorología, Spain

OSI SAF
Ocean and Sea Ice
Led by Météo France

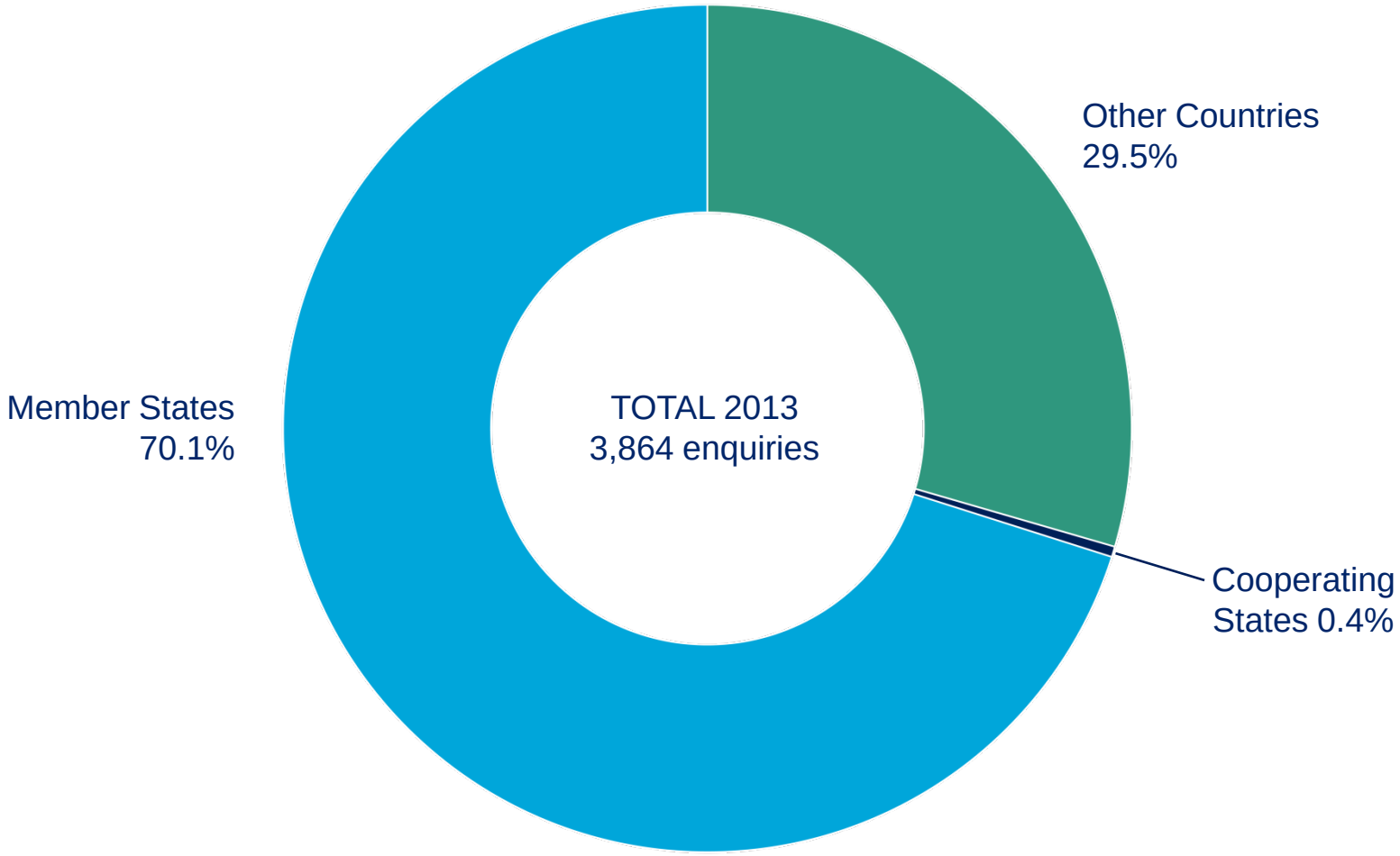
CM SAF
Climate Monitoring
Led by Deutscher Wetterdienst, Germany

NWP SAF
Numerical Weather Prediction
Led by Met Office (UK)

SUPPORTING THE USERS

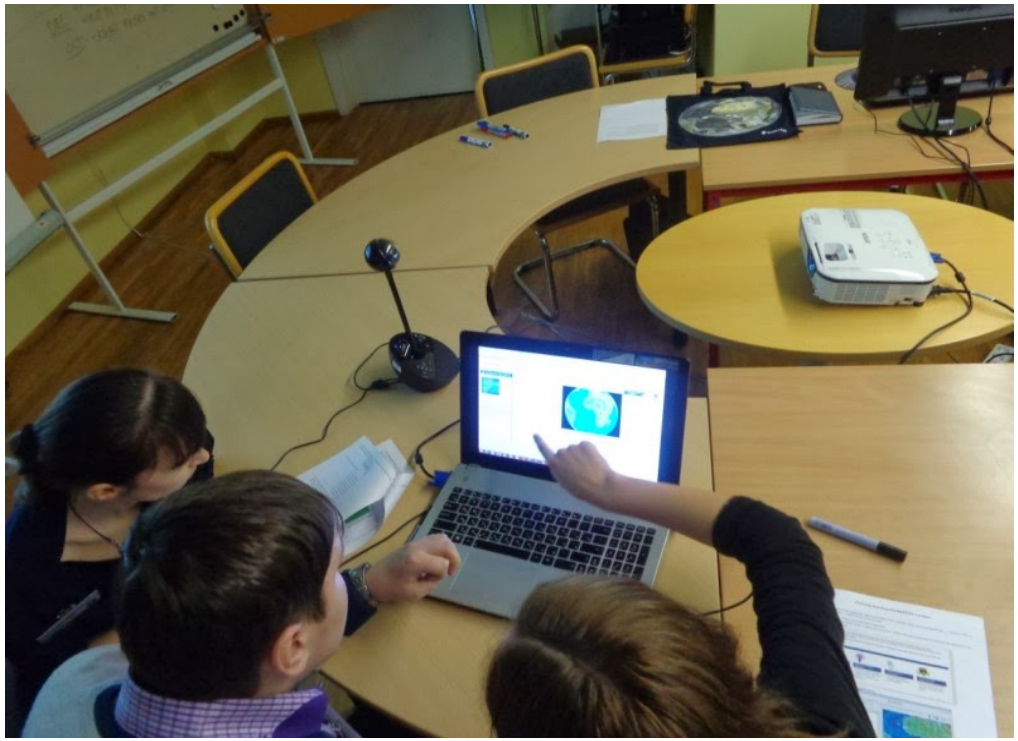


User support services



Helpdesk: ops@eumetsat.int

Training users in satellite technology



Local training in Riga

Local training in Yerevan, Armenia

INTERNATIONAL SUMMER SCHOOL 2014

INTERNATIONAL SCHOOL ON APPLICATIONS WITH THE NEWEST MULTI-SPECTRAL ENVIRONMENTAL SATELLITES.

10–18 JUNE 2014, BRACCIANO, ITALY

In June 2014, EUMETSAT and the Centro Nazionale di Meteorologia e Climatologia Aeronautica (CNMCA) of the Italian air force organised the 13th 'International Summer School on Applications with the Newest Multi-spectral Environmental Satellites'.

The course presented in depth explanation of methods and techniques used to extract information from environmental satellite data, with emphasis on the latest measuring technologies.

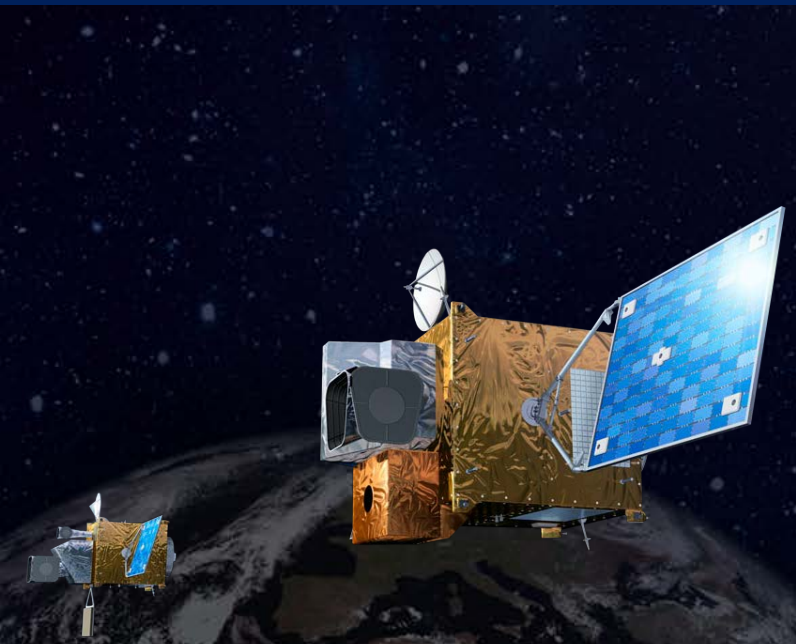
It was attended by 16 participants from Italy, Belgium, Czech Republic, Estonia, Germany, Hungary, Kenya, Latvia, Romania, Turkey and Ukraine. The lecturers and tutors were Ralf Bennartz and Mike Hiley, from the University of Wisconsin Cooperative Institute for Meteorological Satellite Studies; EUMETSAT trainer Jochen Kerkmann; Davide Melfi (CNMCA) and Zanita Avotniece, a EUMETSAT trainee from the Latvian Met Service.

The curriculum consisted of 13 lectures covering a number of subjects, including convective clouds and climate applications. Participants were also able to take part in 14 lab sessions and to access real-time MSG data to practice their new skills on actual weather situations.

Outlook to Future - Meteosat Third Generation

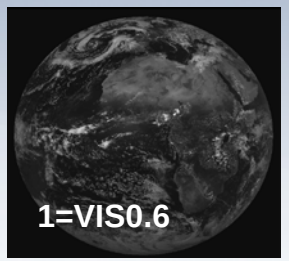
- Imagery mission implemented by a two-satellite MTG-I system:
  - Full disk imagery every 10 minutes in 16 spectral bands
  - Fast imaging of European weather every 2.5 minutes
  - new Lightning Imager (LI)
- Hyperspectral infrared (IRS) sounding mission:
  - 3D mapping of water vapour, temperature, O3 every 1 hour
  - Air quality monitoring and atmospheric chemistry in synergy with GMES Sentinel-4 Ultraviolet Visible

Outlook to Future - Meteosat Third Generation

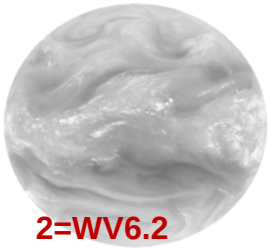


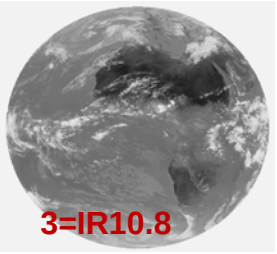
- 4 imaging (MTG-I) and 2 sounding (MTG-S) satellites,
- start of operations in 2018 and 2019
- operational exploitation: 2018 – 2038
- Full MTG mission implemented by two MTG-I satellites and MTG-S satellite in orbit

From MVIRI through SEVIRI to FCI on MTG



12=HRV





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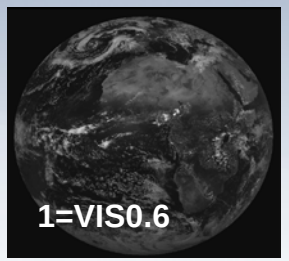
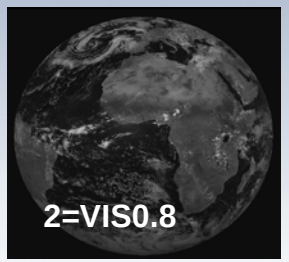
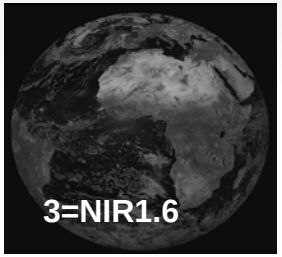
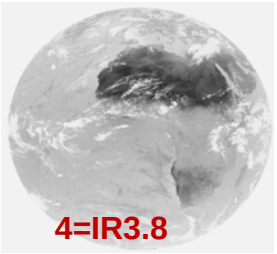
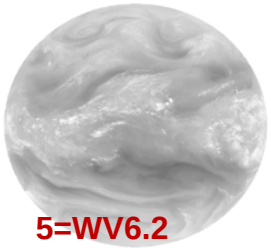
From MVIRI through SEVIRI to FCI on MTG

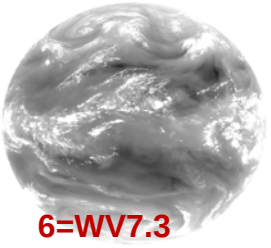


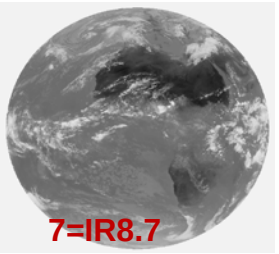


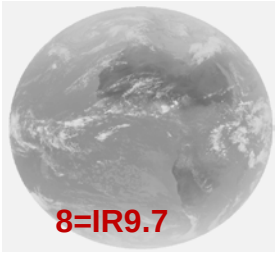


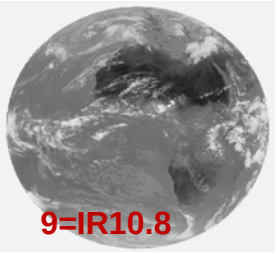


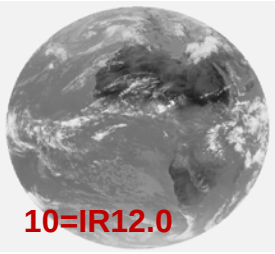


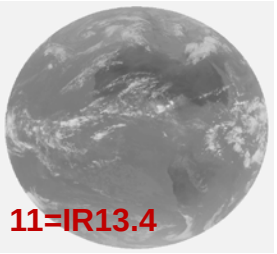












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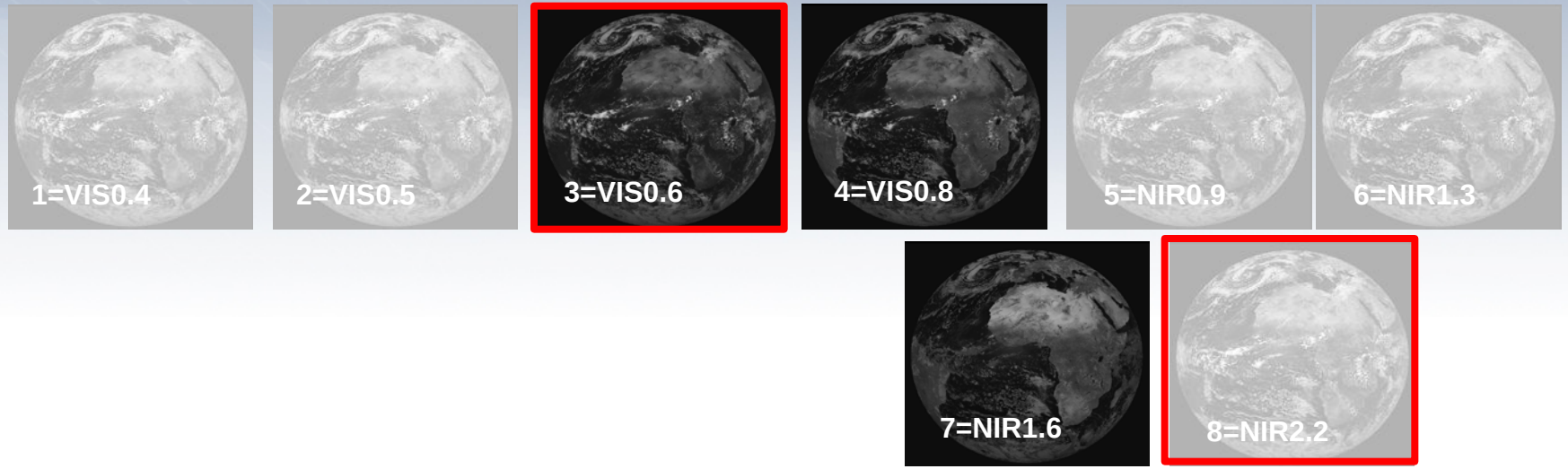
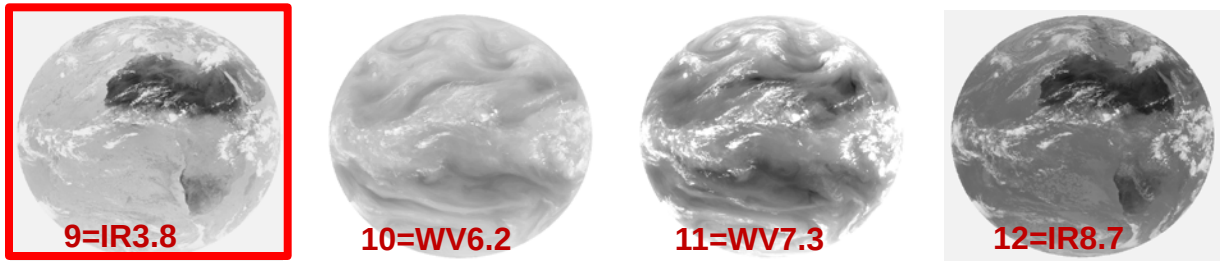
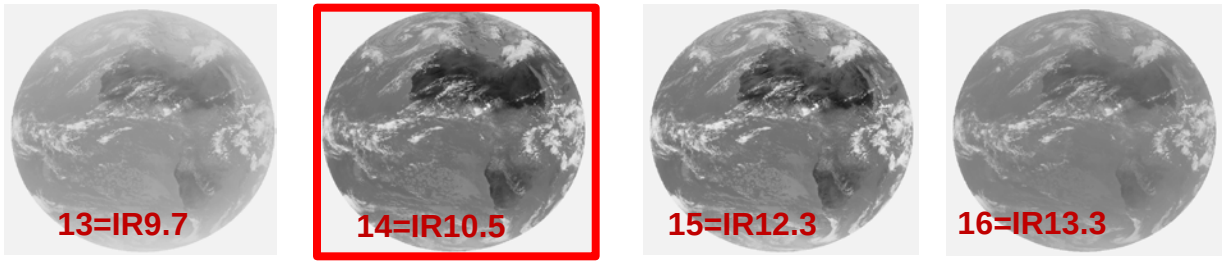
From MVIRI through SEVIRI to FCI on MTG







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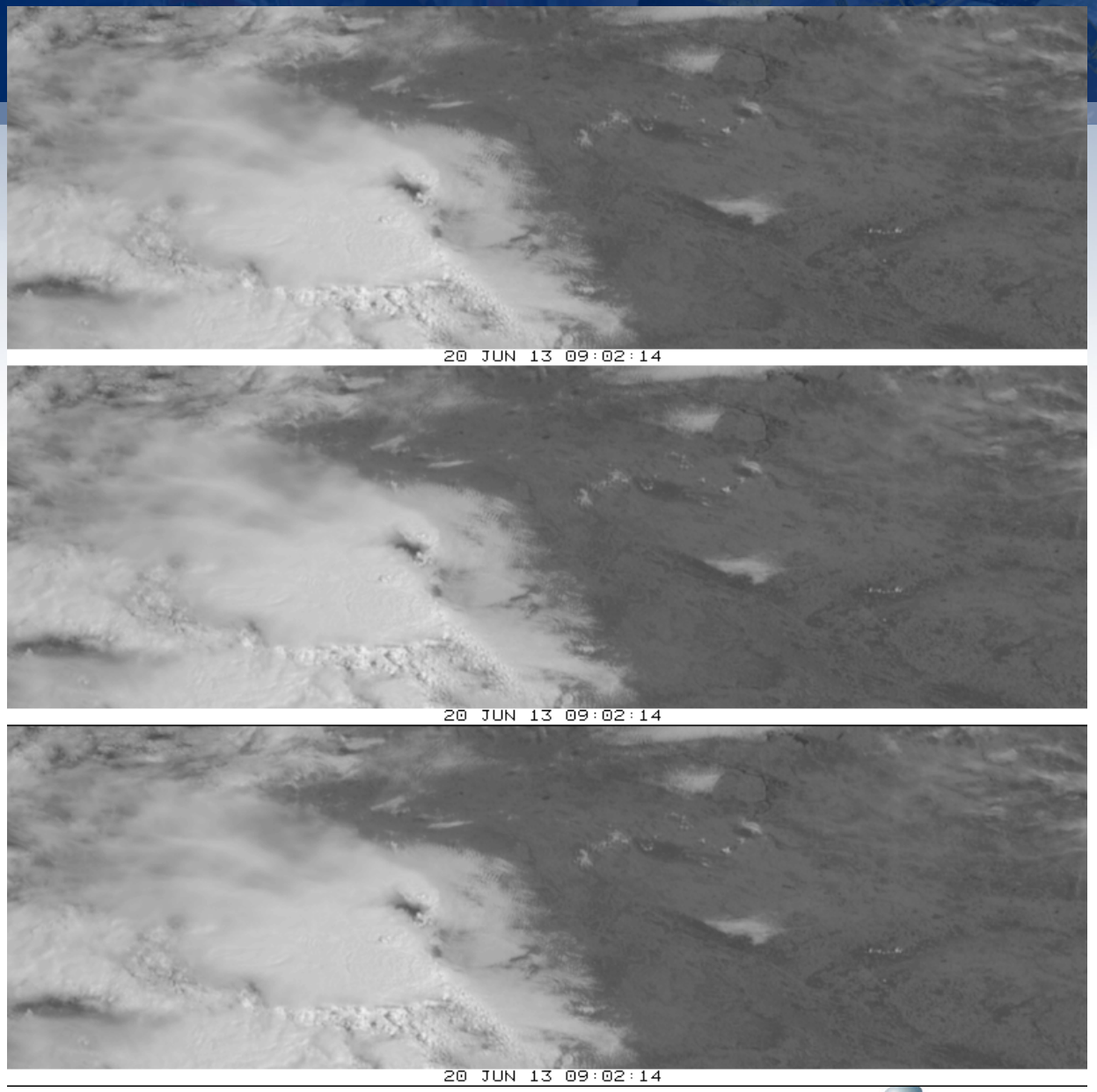
2.5 min Scans



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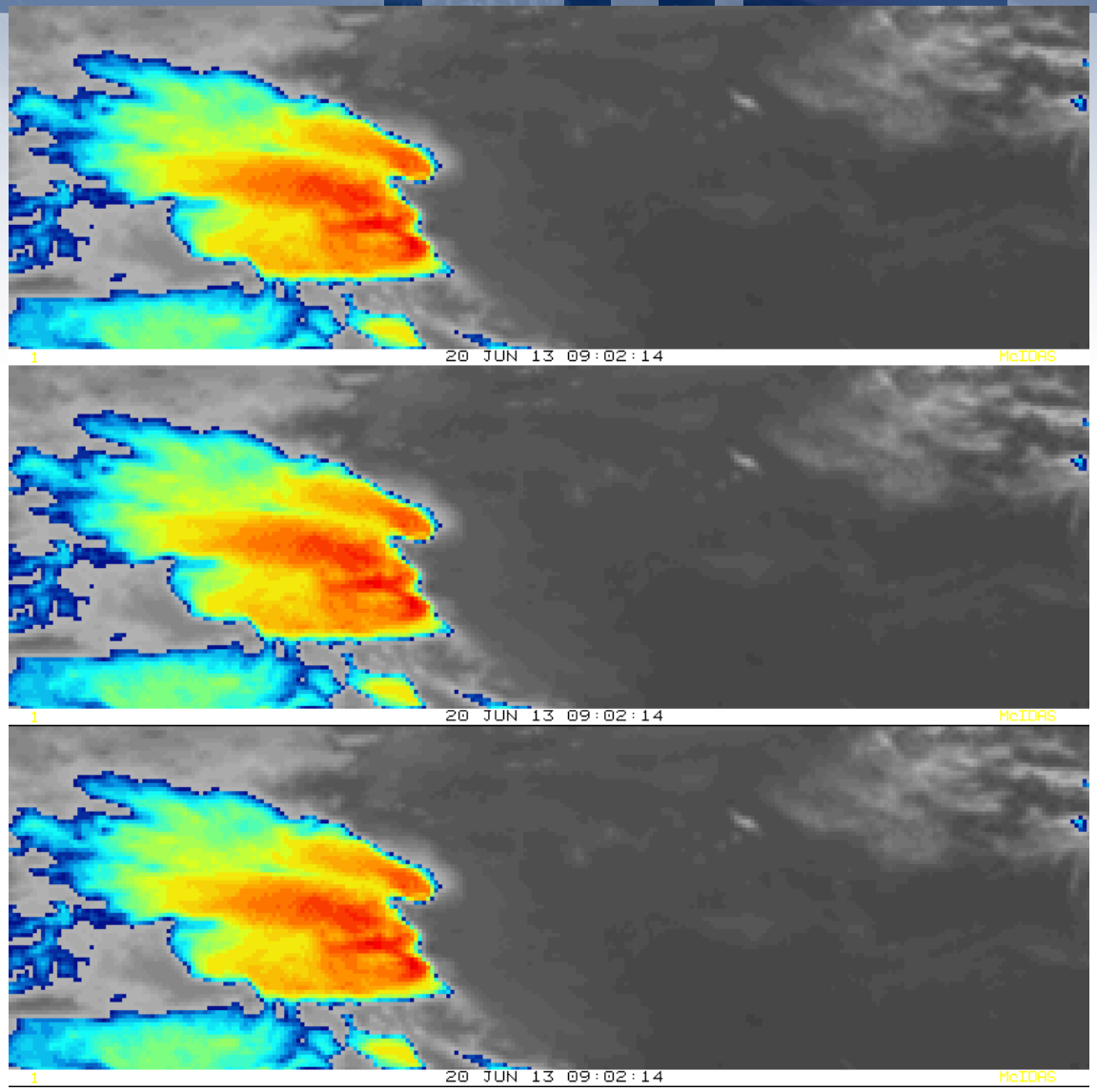
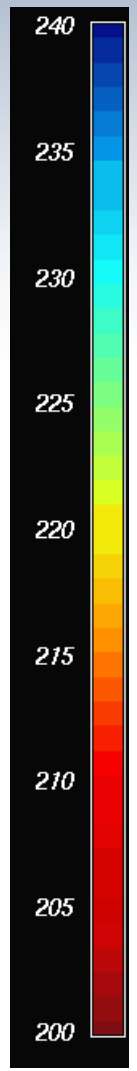
Time Resolution - IR





Temperature (K)

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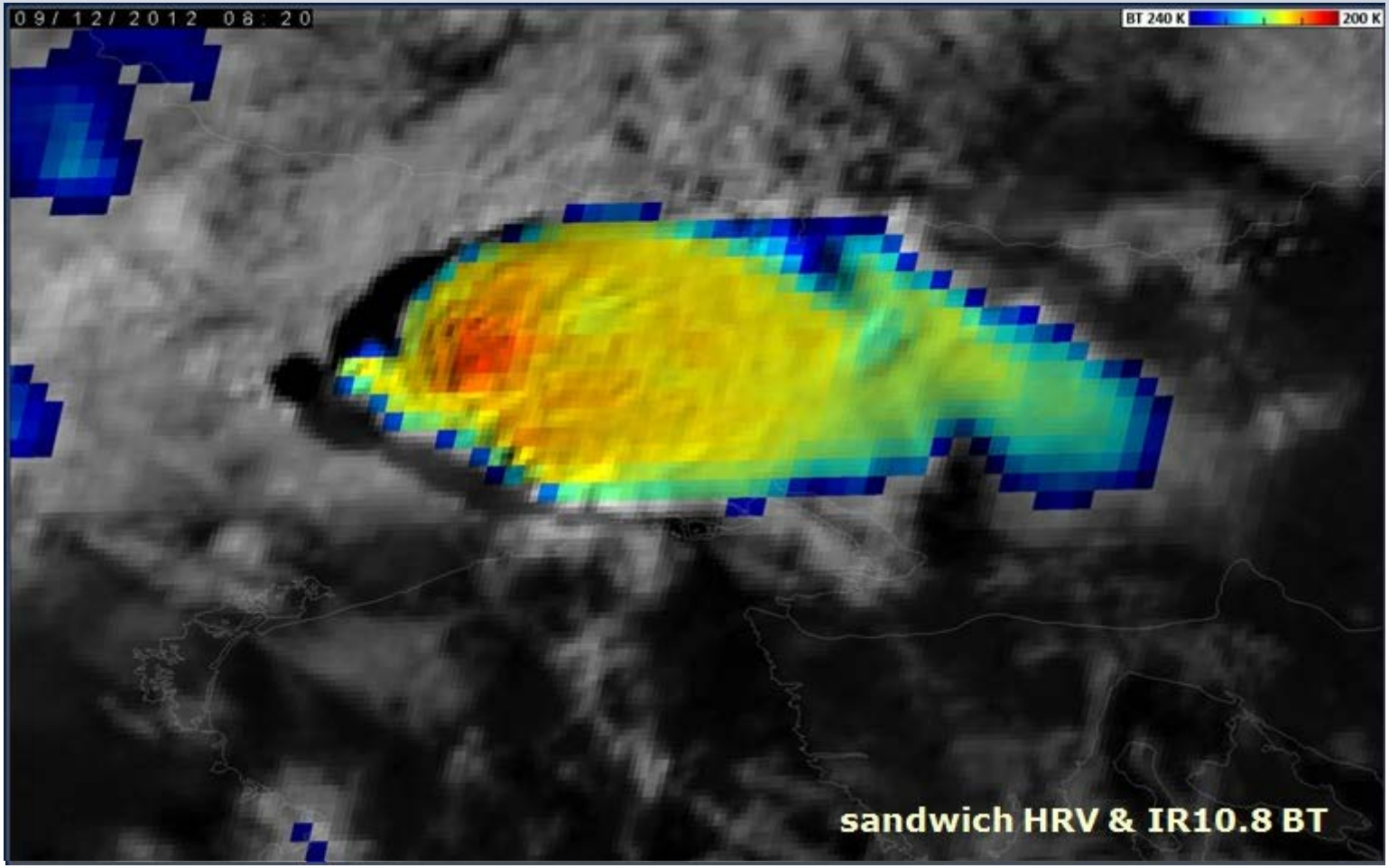
Spatial Resolution: Channel Overlays



MTG Application:

Also useful because of channel resolution differences

Courtesy M. Setvak, Czech Hydrometeorological Service

BT 240 K 200 K

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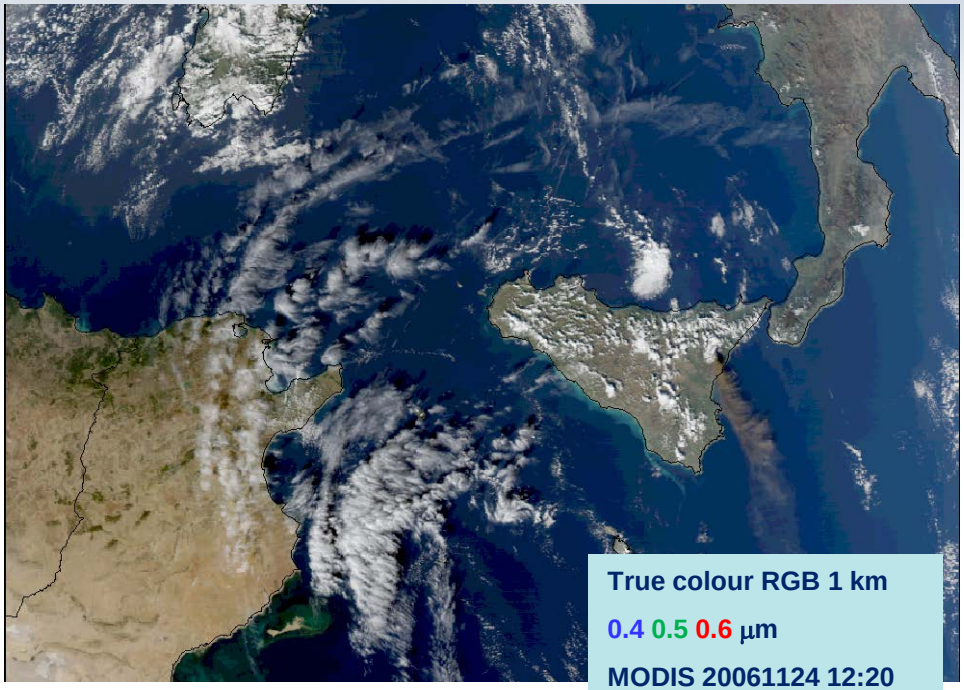
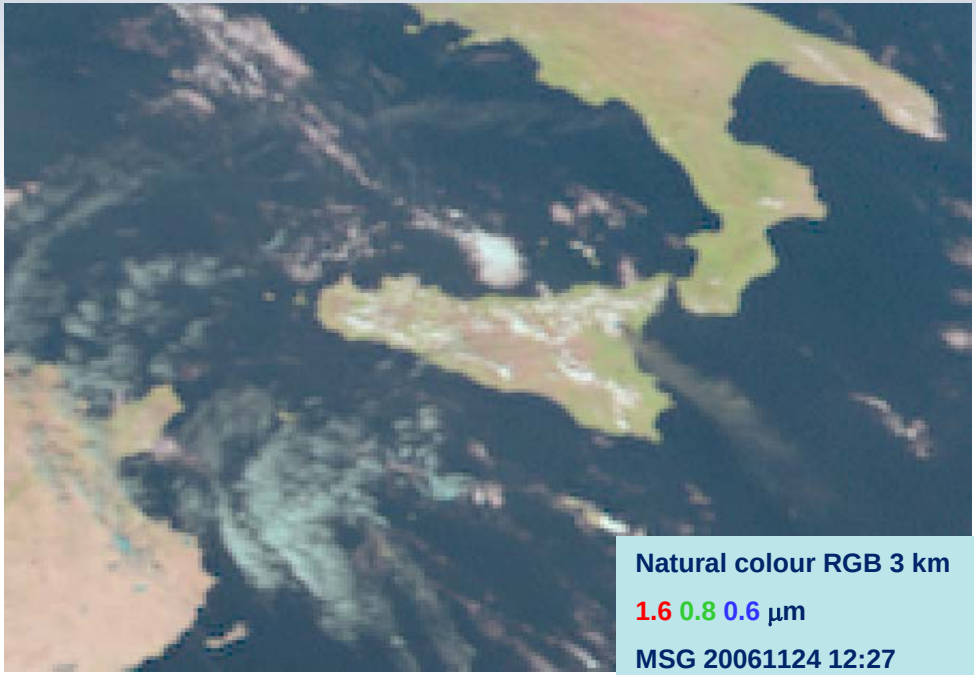
Spectral Resolution: “True Colour” RGB Possible



True colour RGB 1 km
0.4 0.5 0.6 µm
MODIS 20061124 12:20



Natural colour RGB 3 km
1.6 0.8 0.6 µm
MSG 20061124 12:27

A true “True Colour” image can be produced with VIS06/VIS0.5/VIS0.4 – this is really RGB

“True Colour” from the MSG perspective – acceptable for vegetation, less for dust/smoke

Application:

Weather forecasts for public
Quicklooks for forecasters

courtesy D. Rosenfeld, Univ. Jerusalem

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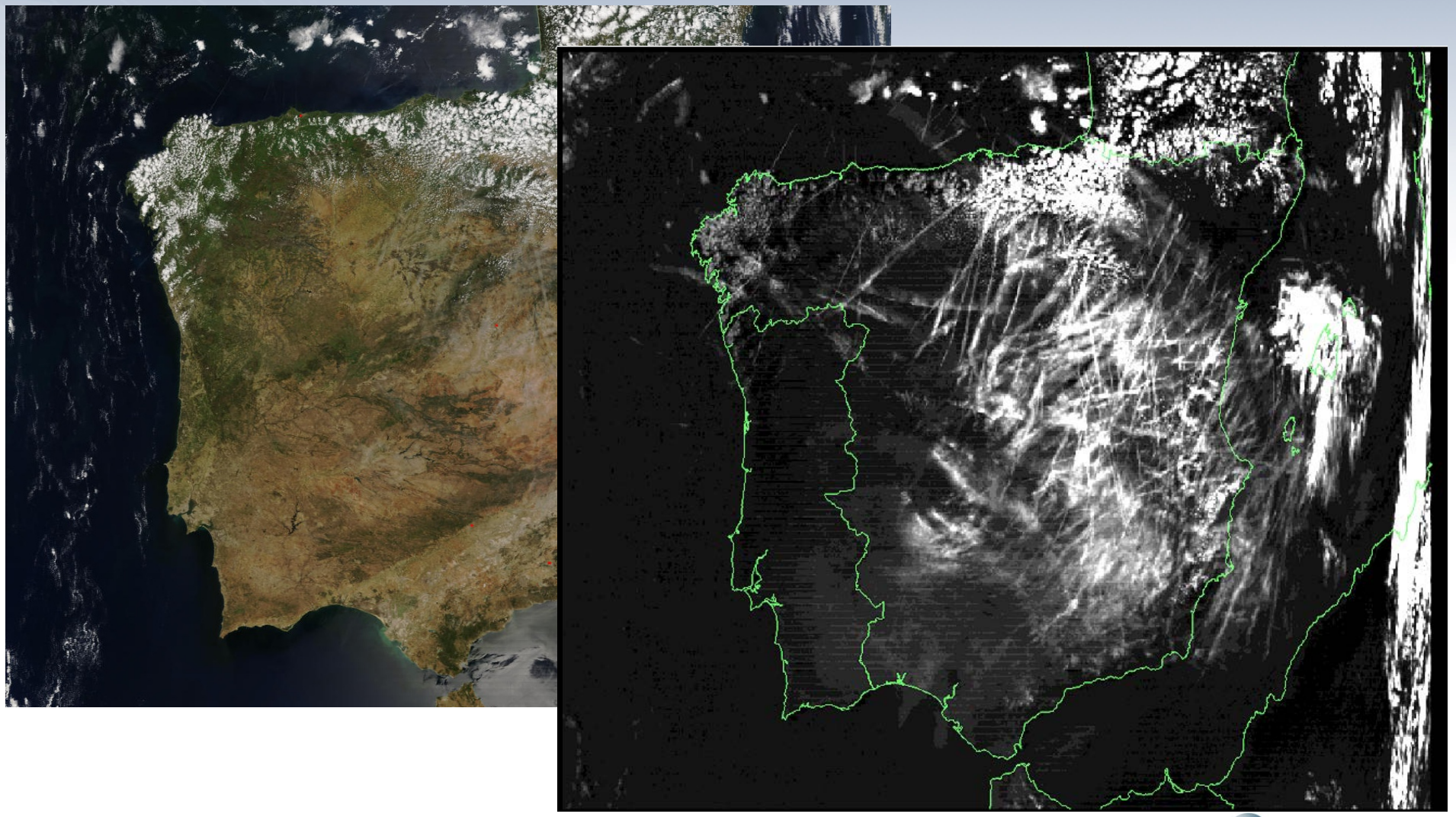
NIR1.3: Another Example



courtesy D. Rosenfeld, Univ. Jerusalem

Lightning Imager

Continuous lightning observations from space:

Recording of intra-cloud and cloud-to-ground lightning

Thank you!

vesa.nietosvaara@eumetsat.int

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