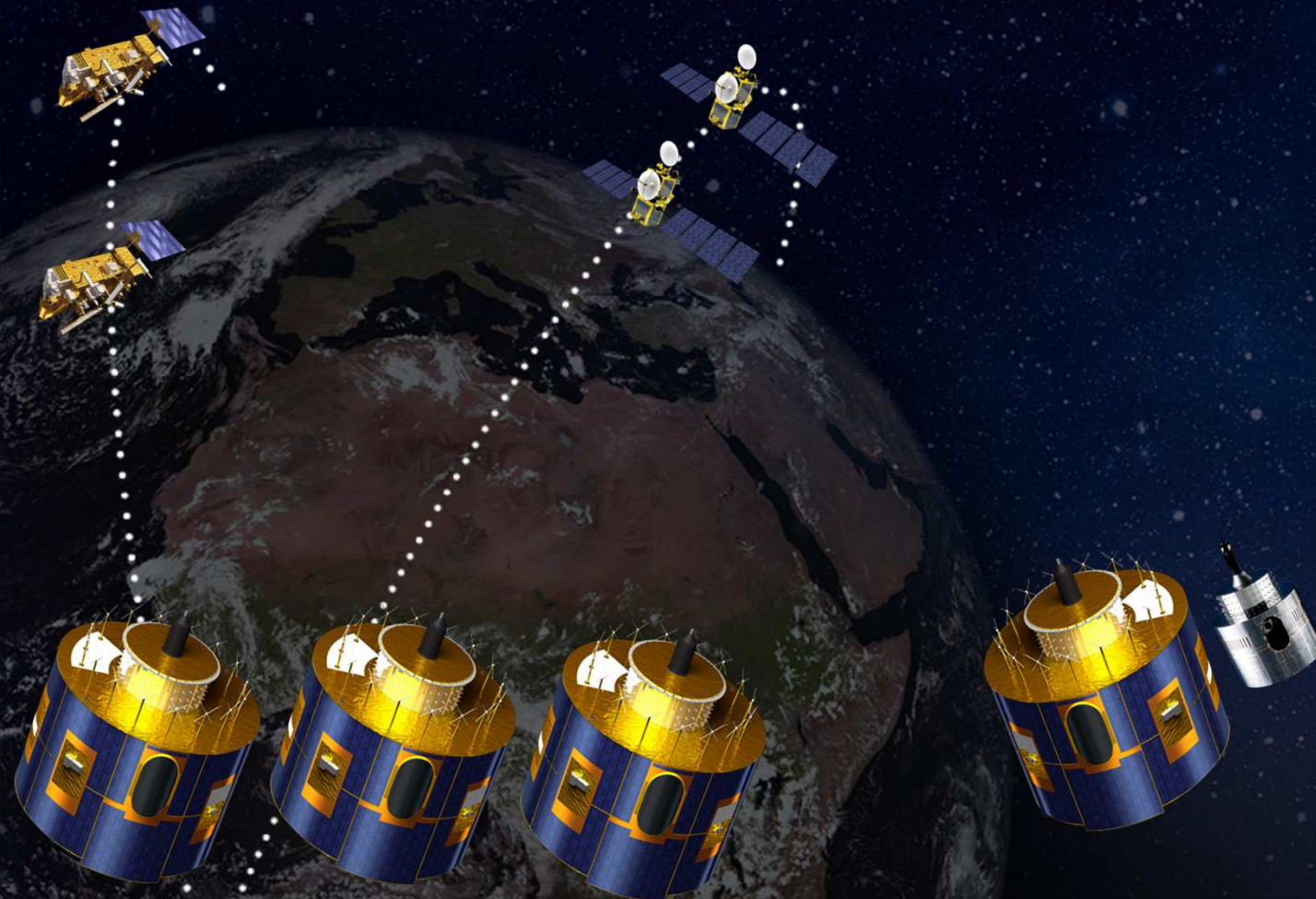
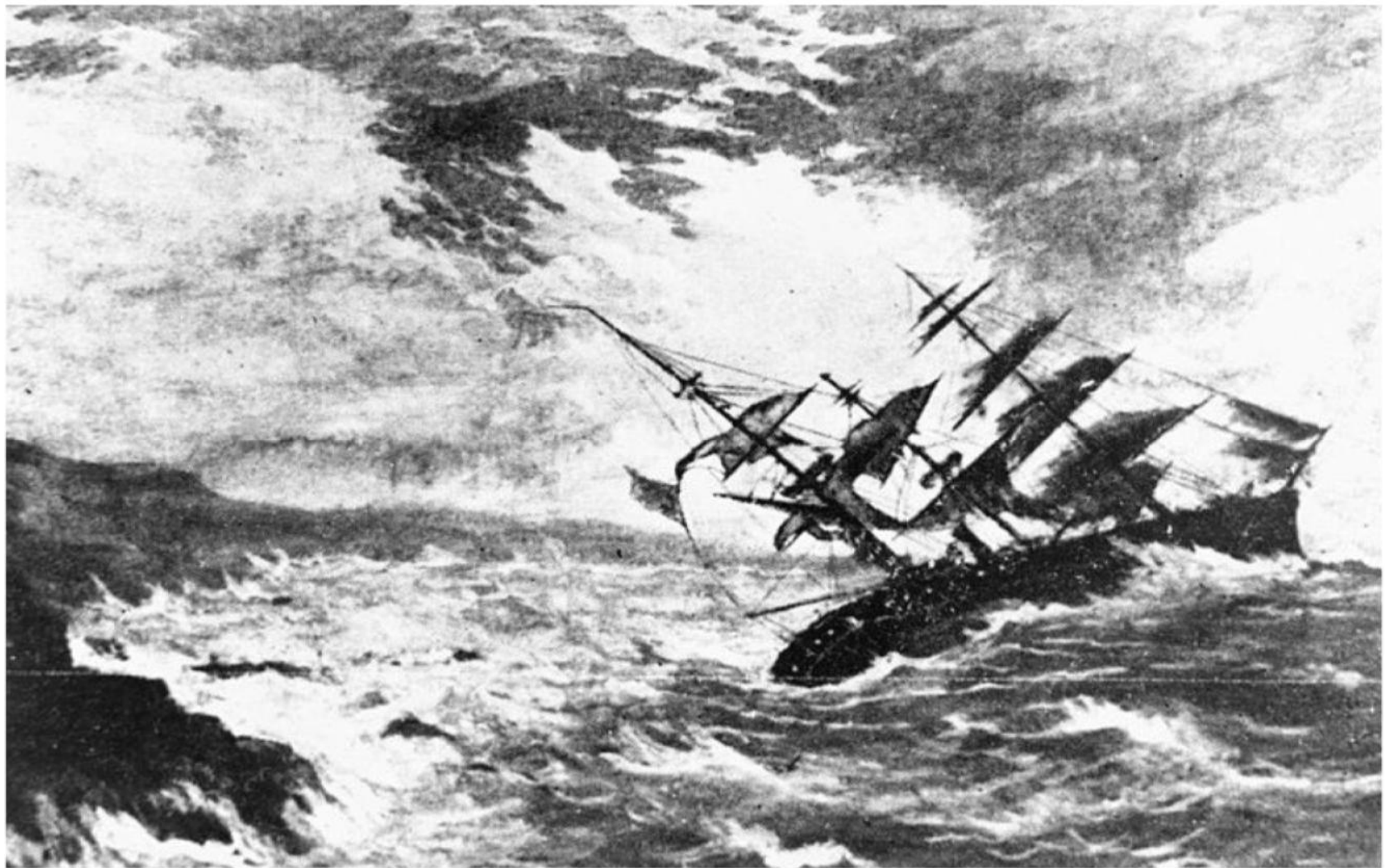


# MONITORING WEATHER AND CLIMATE FROM SPACE

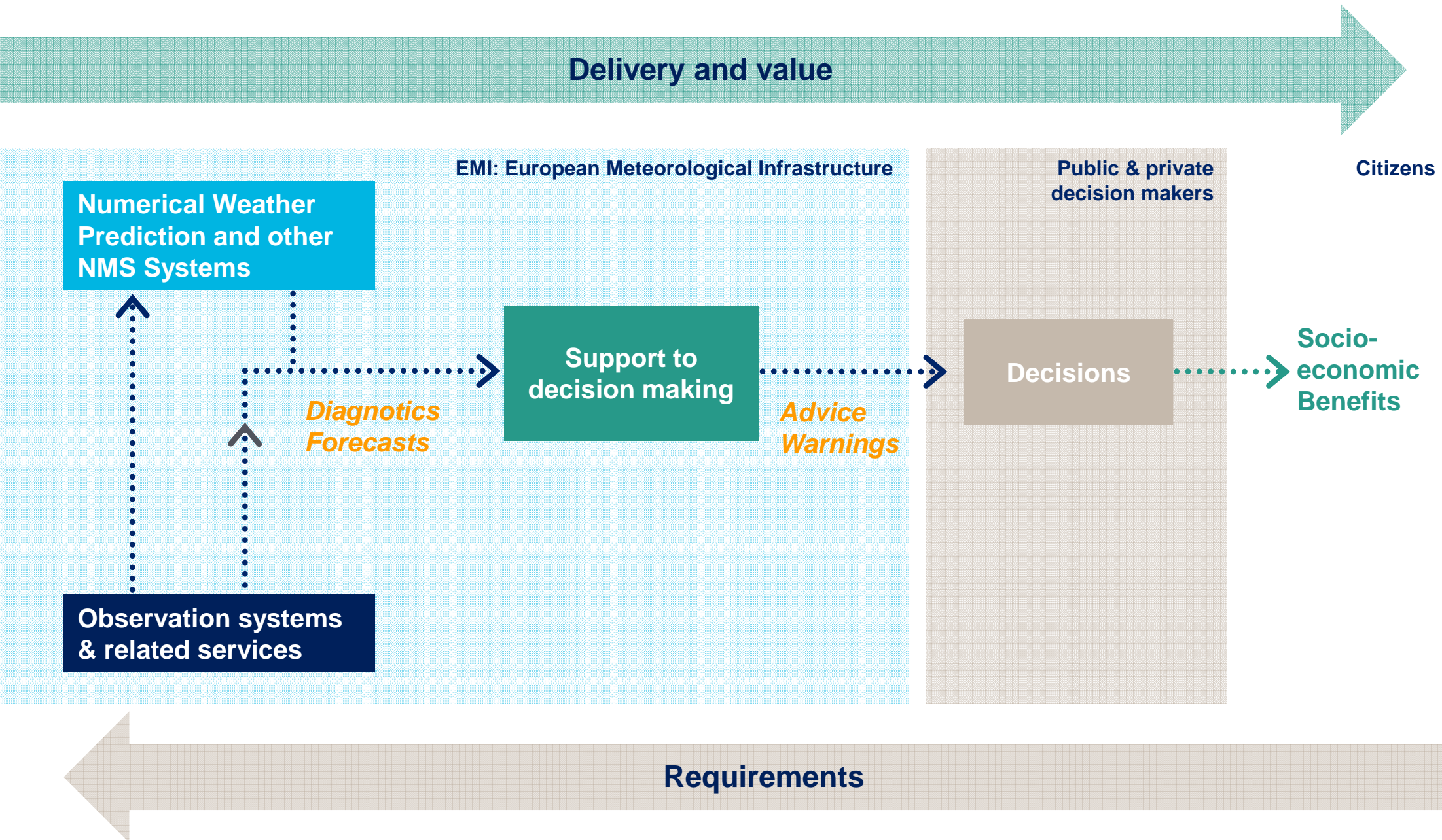




Royal charter: 25/26 October 1859



# From observation to decision making: EUMETSAT's role in the value adding chain



# From observation to decision making: EUMETSAT's role in the cookie factory?

Delivery and value

EMI: European Meteorological Infrastructure

Numerical Weather  
Prediction and other  
NMS Systems

Diagnostics  
Forecasts

Support to  
decision making

Advice  
Warnings

Decisions

Socio-  
economic  
Benefits

Citizens

Observation systems  
& related services

Cookies – for non complex, highly repetitive tasks, and if you eat it wrong it shouldn't kill you

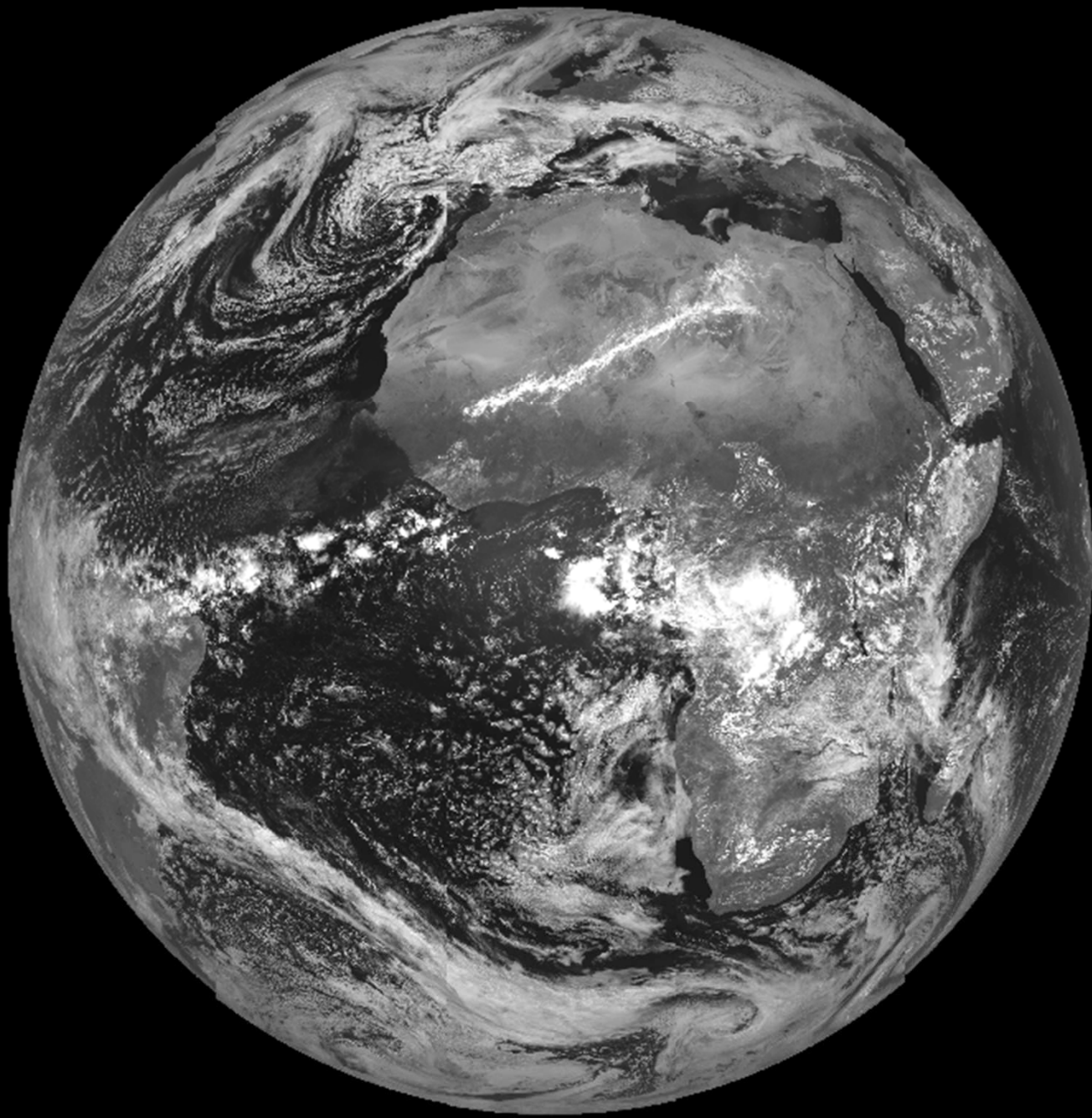
Requirements **The people serving, eating and preparing the cookies talk to each other?**



# Cookie factory: Happiness is an empty control room



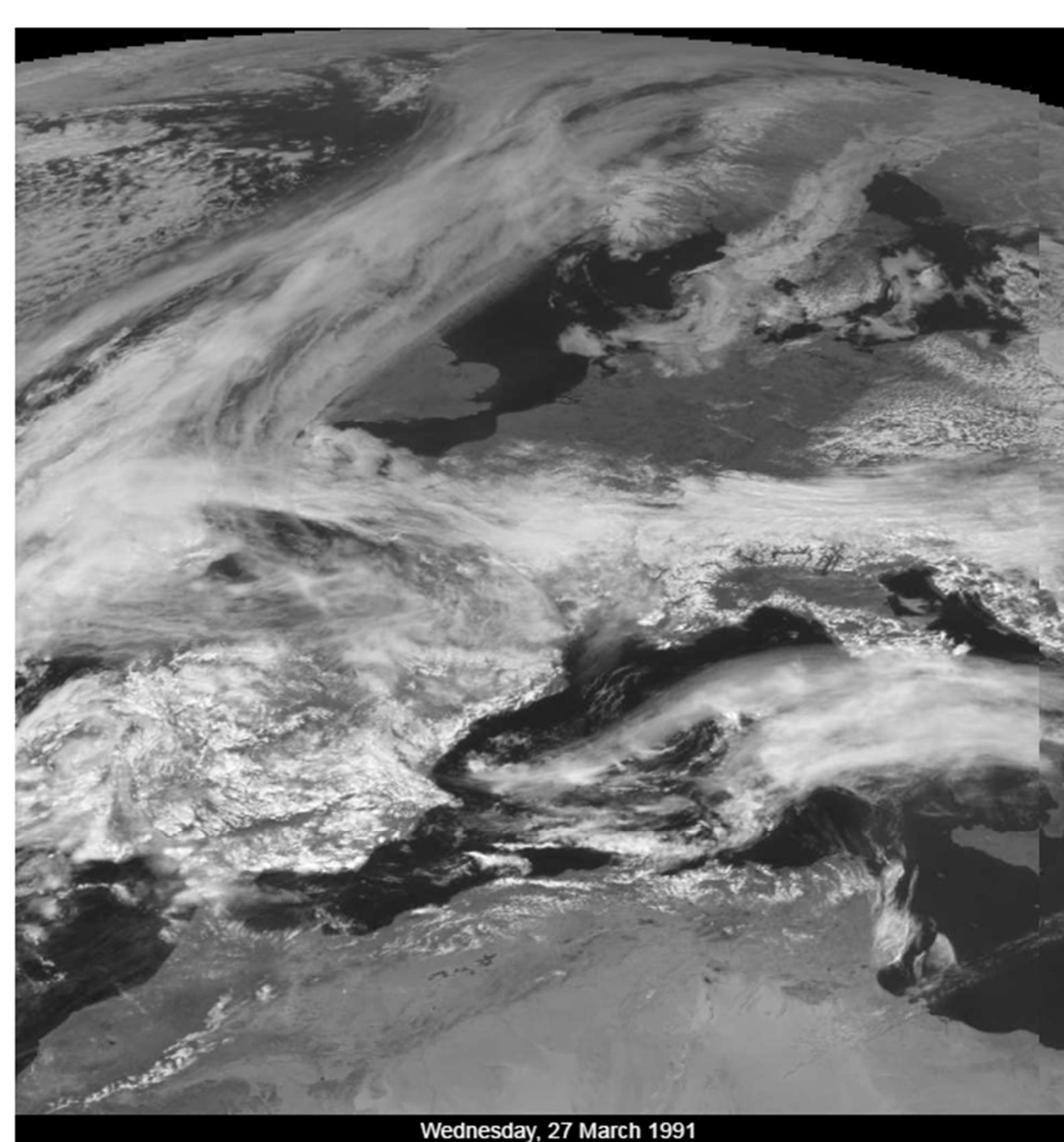
[pics.eumetsat.int](http://pics.eumetsat.int)



Wednesday, 27 March 1991

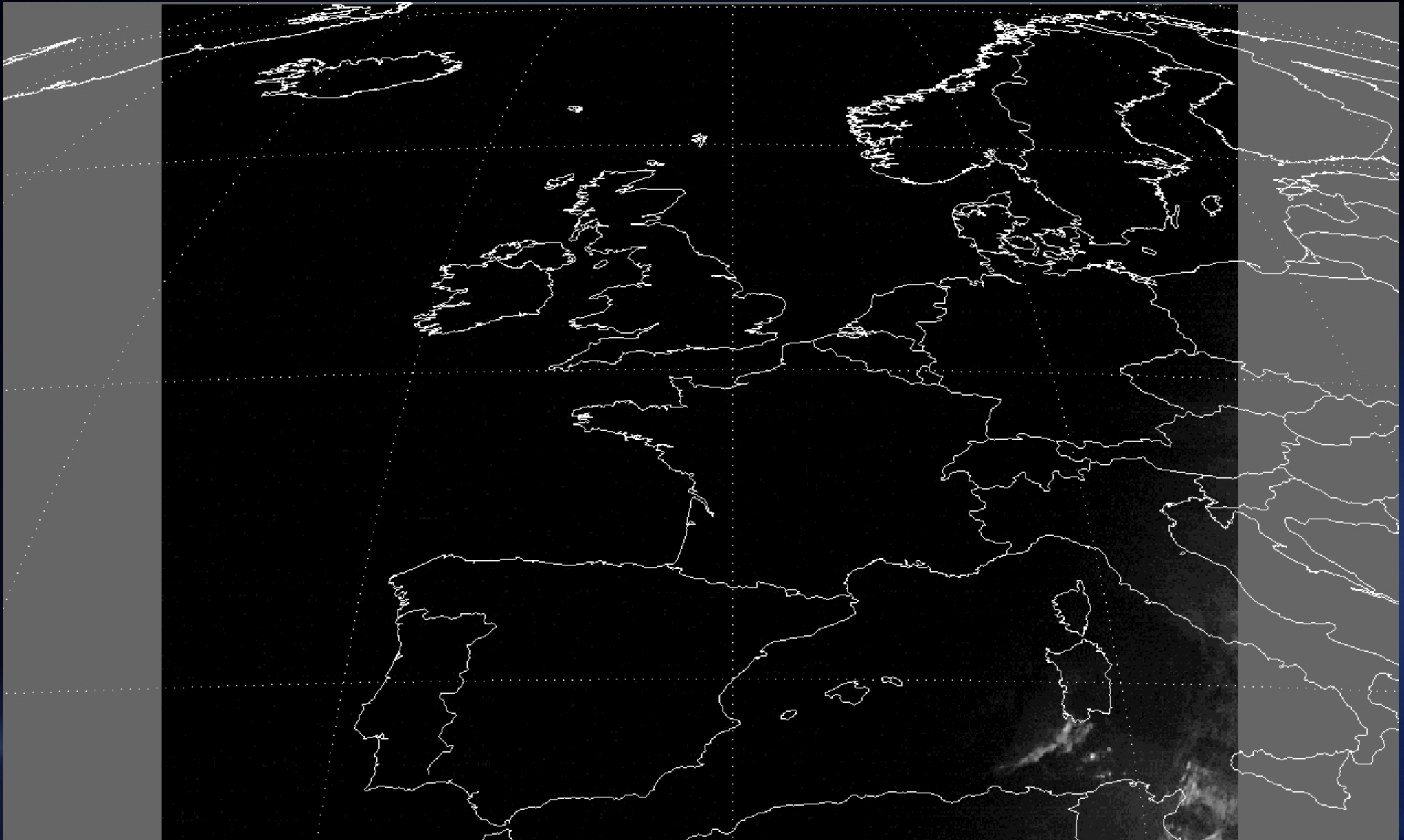


[pics.eumetsat.int](http://pics.eumetsat.int)



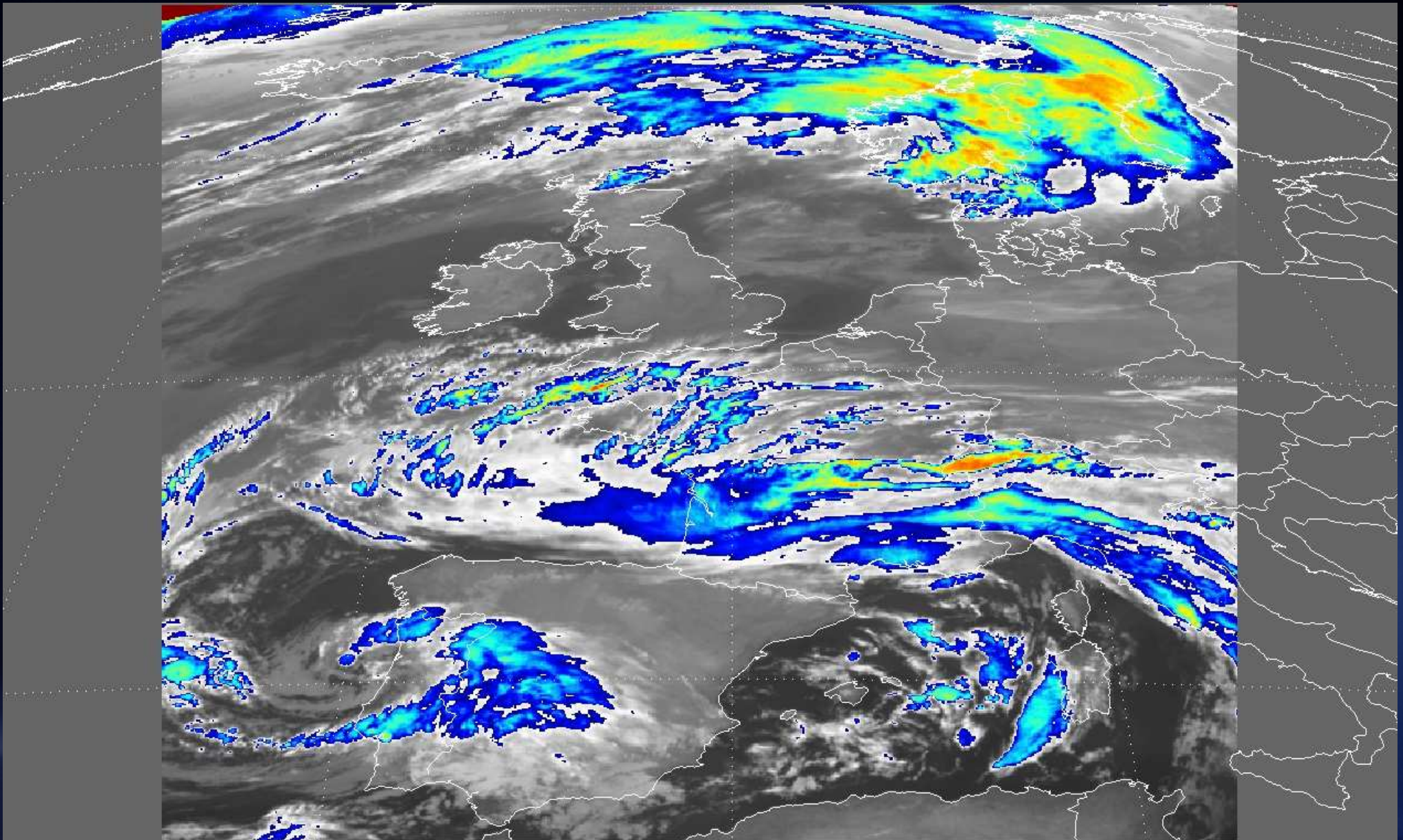
Wednesday, 27 March 1991

**2016-11-25 06Z – 0.8 micron**



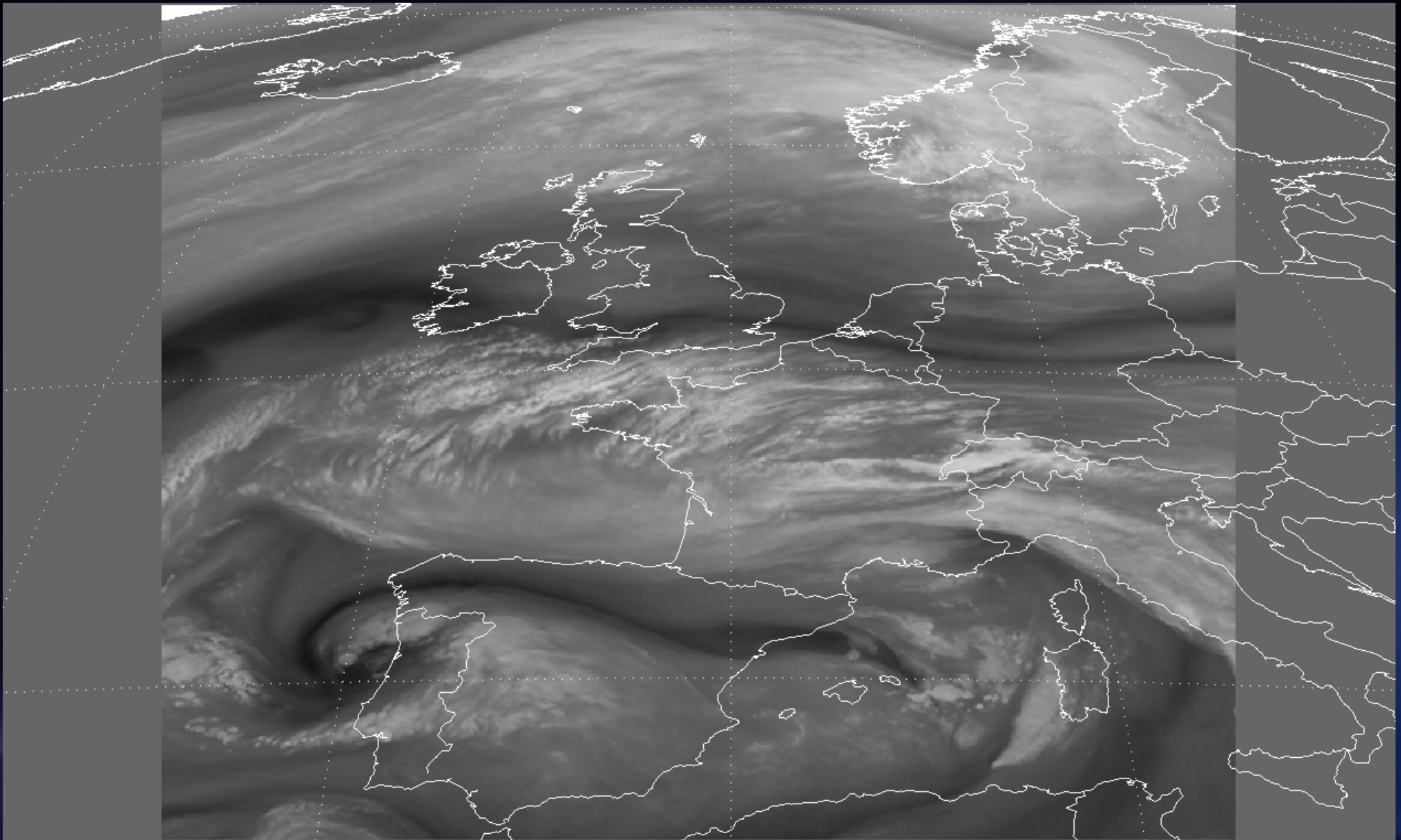


2016-11-25 06Z – 10.8 micron



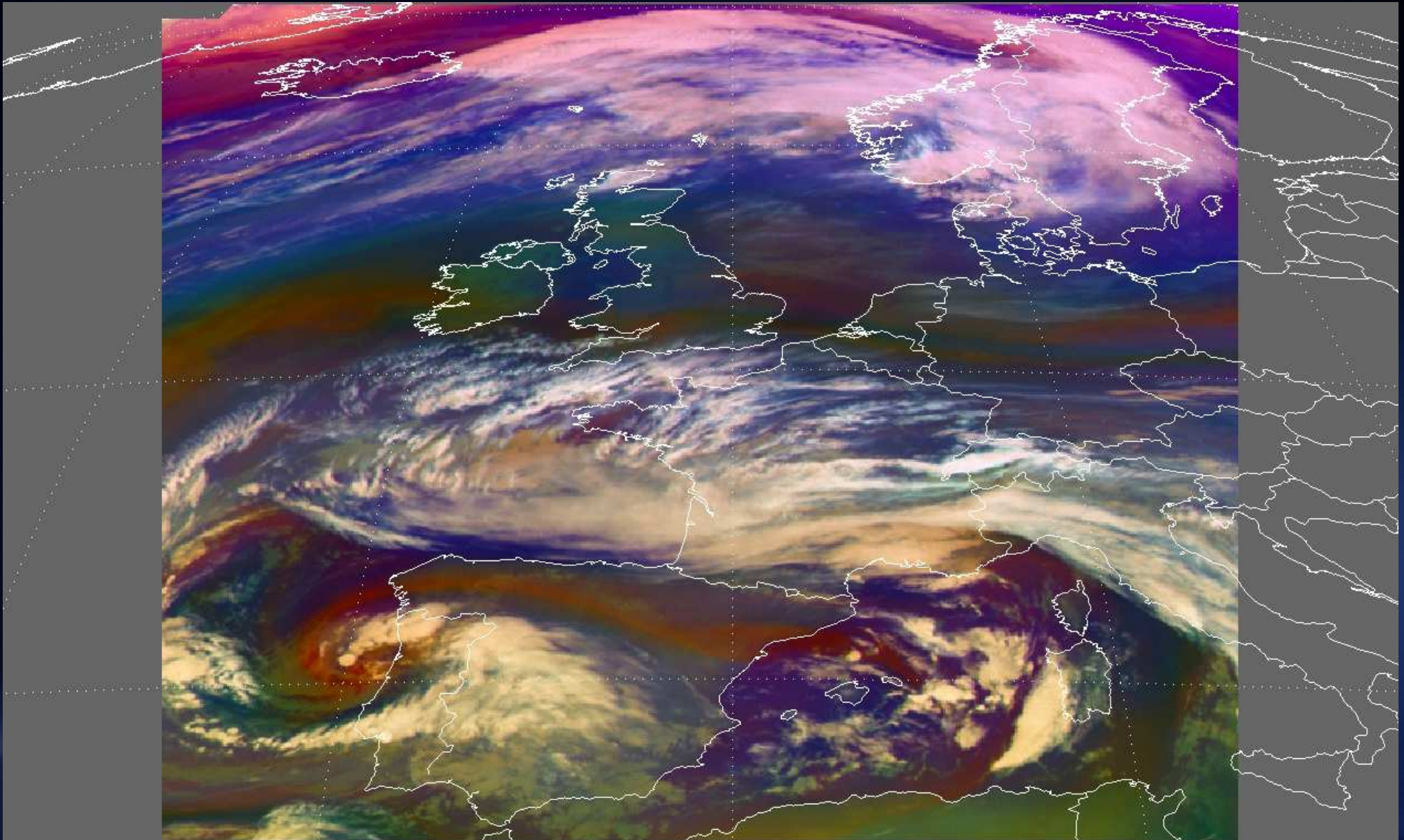


**2016-11-25 06Z – 6.2 micron**



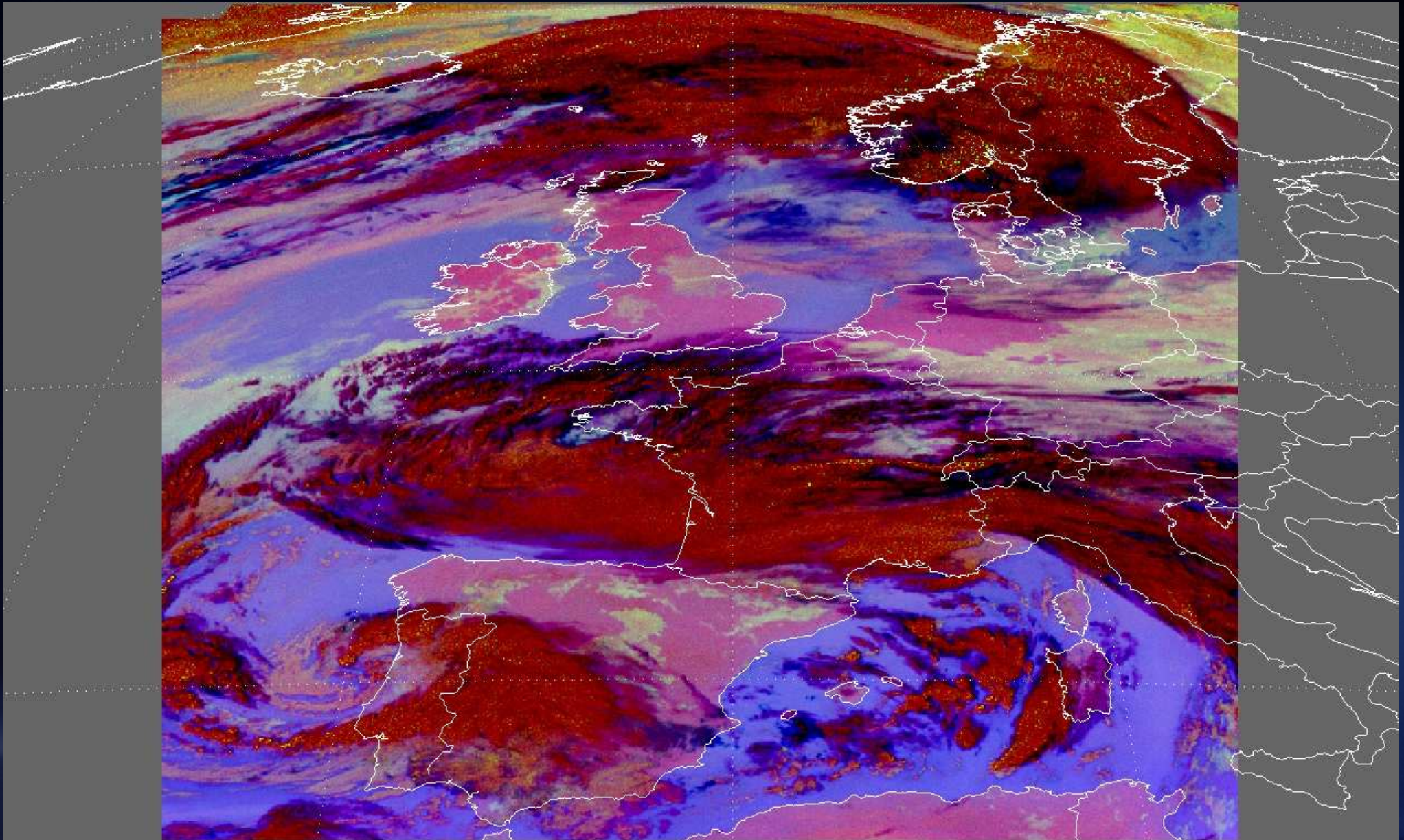


# 2016-11-25 06Z – Airmass RGB



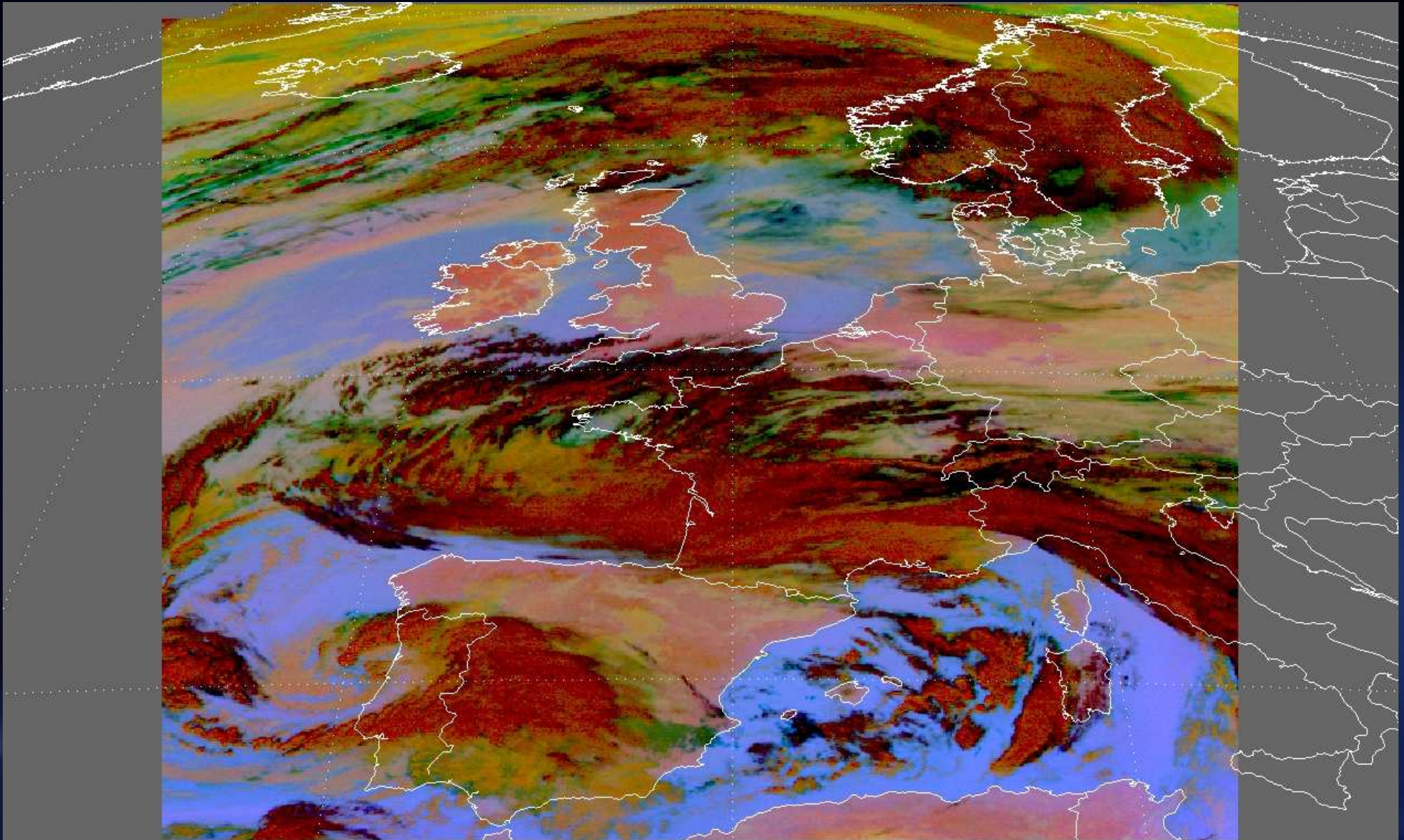


# 2016-11-25 06Z – Night microphysics RGB





2016-11-25 06Z – Dust RGB



# Estimated benefits of EPS-SG in the period 2020-40

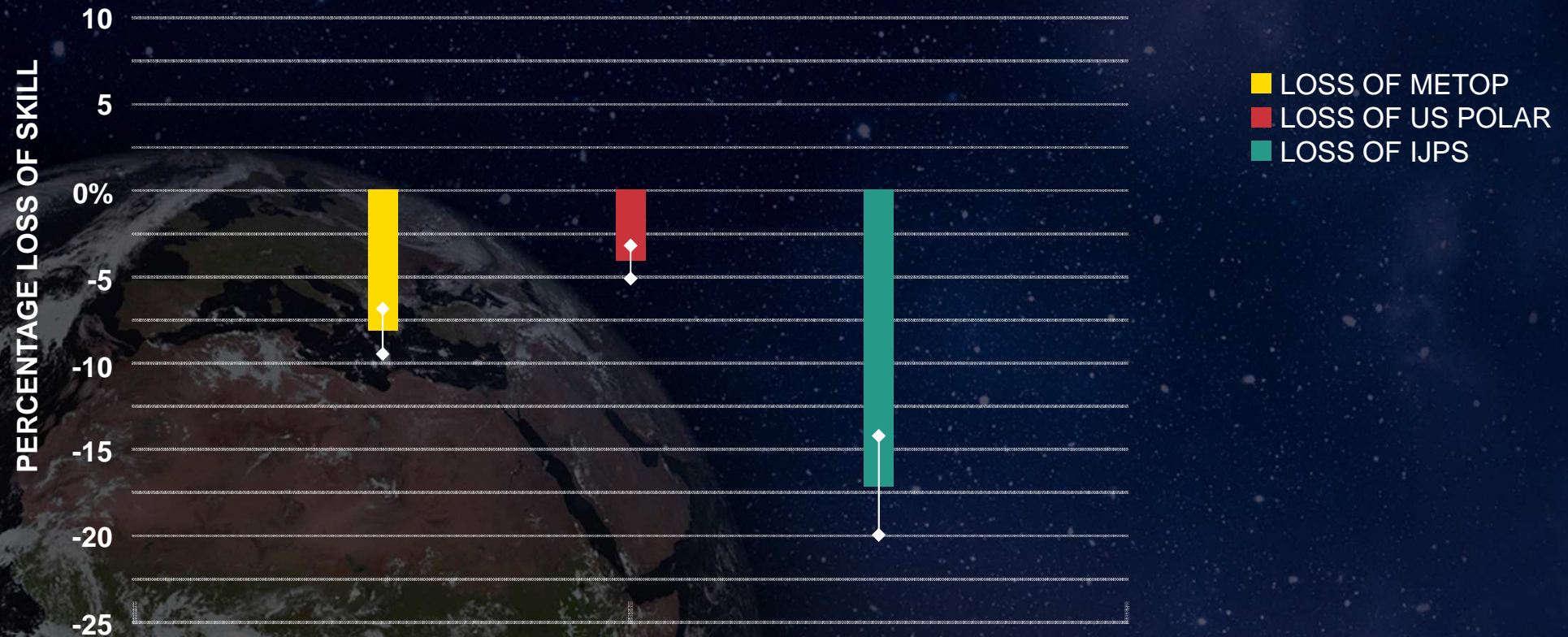
Estimated benefits of EPS-SG programme based on very conservative assumptions (8% contribution)

BENEFIT AREAS	SOCIO-ECONOMIC BENEFIT (over 20 years of EPS/Metop-SG)	
	MINIMUM	LIKELY
Protection of property and infrastructure	€1.5 billion	€6.0 billion
Added value to the European economy	€11.3 billion	€45.2 billion
Private use by European citizens <sup>30</sup>	€3.0 billion	€11.45 billion
<b>TOTAL</b>	<b>€16 billion</b>	<b>€63 billion</b>

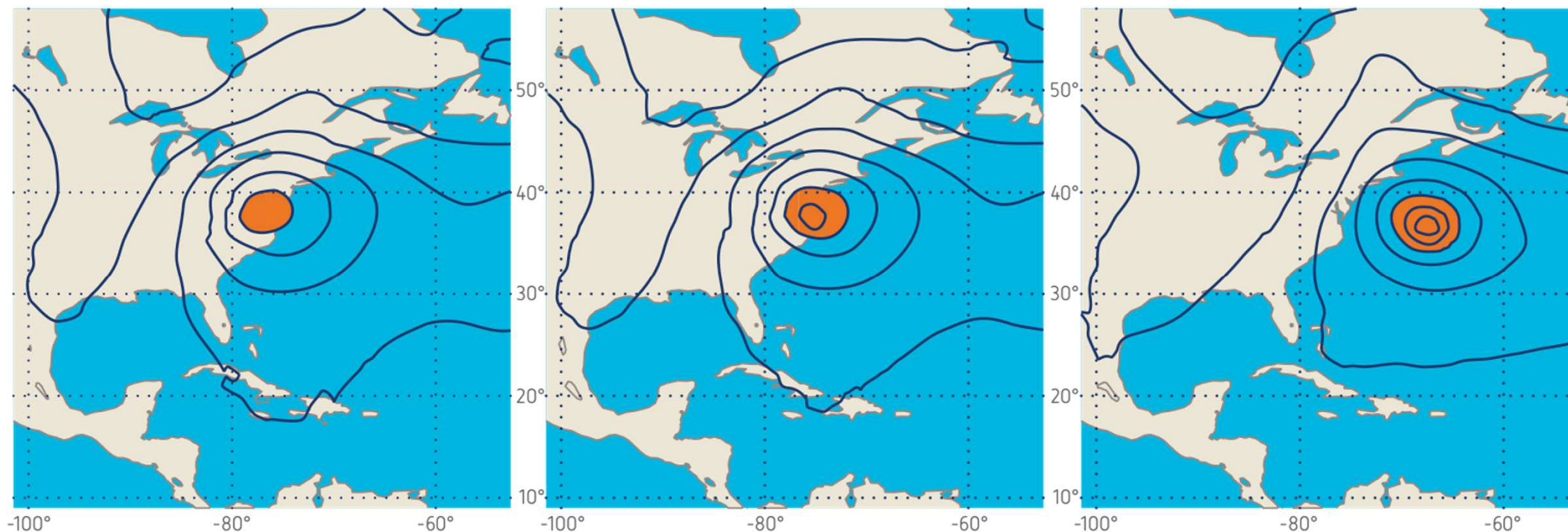
Benefit to cost ratio of the EPS-SG programme (3.4 billion at 2012 e.c.) exceeds 20 and may even reach 60.



# Loss of forecast skills in the event of satellite data loss



# Hurricane Sandy



**Five-day forecast of cyclone Sandy landfall on the US coast by the ECMWF global model, with (left) and without (right) ingestion of observations from polar orbiting satellites, compared to the operational analysis (best approximation of ground truth, centre)**

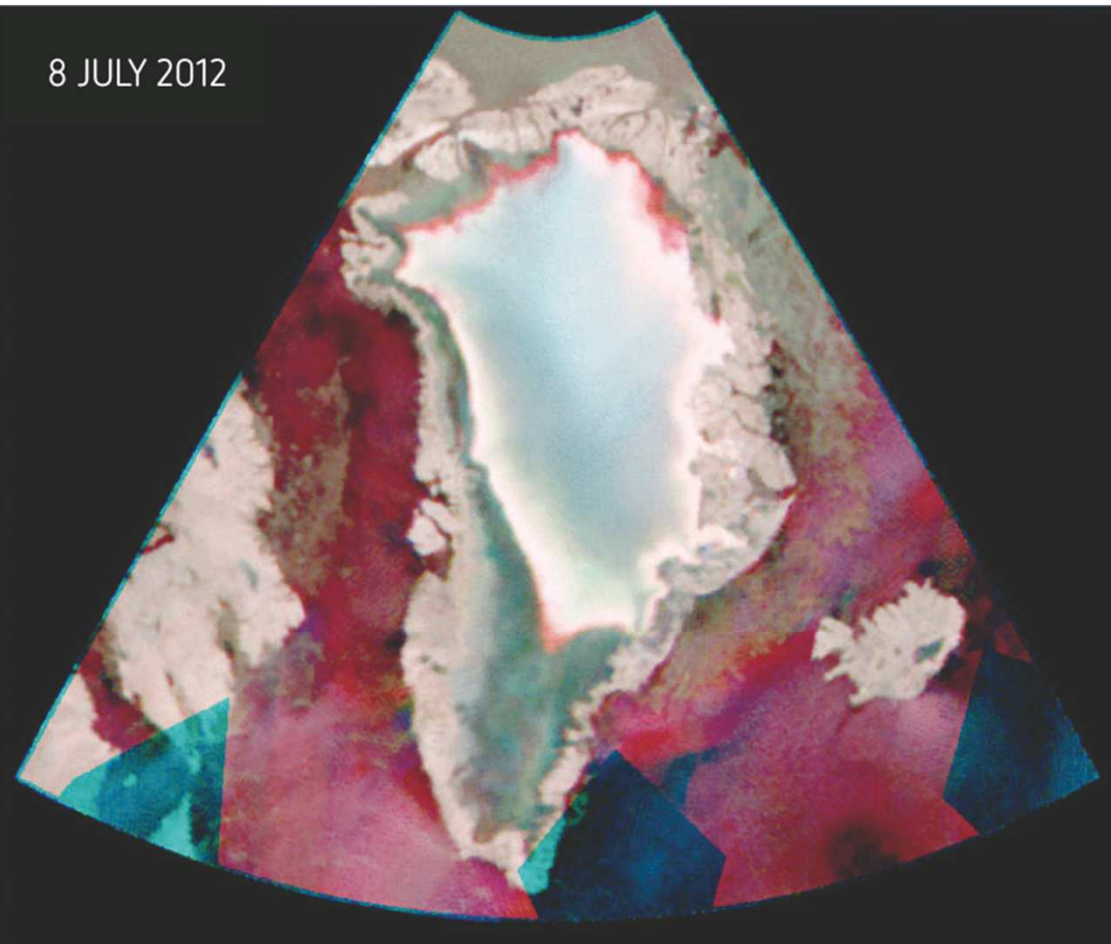


# Do we still need the pretty pictures ....

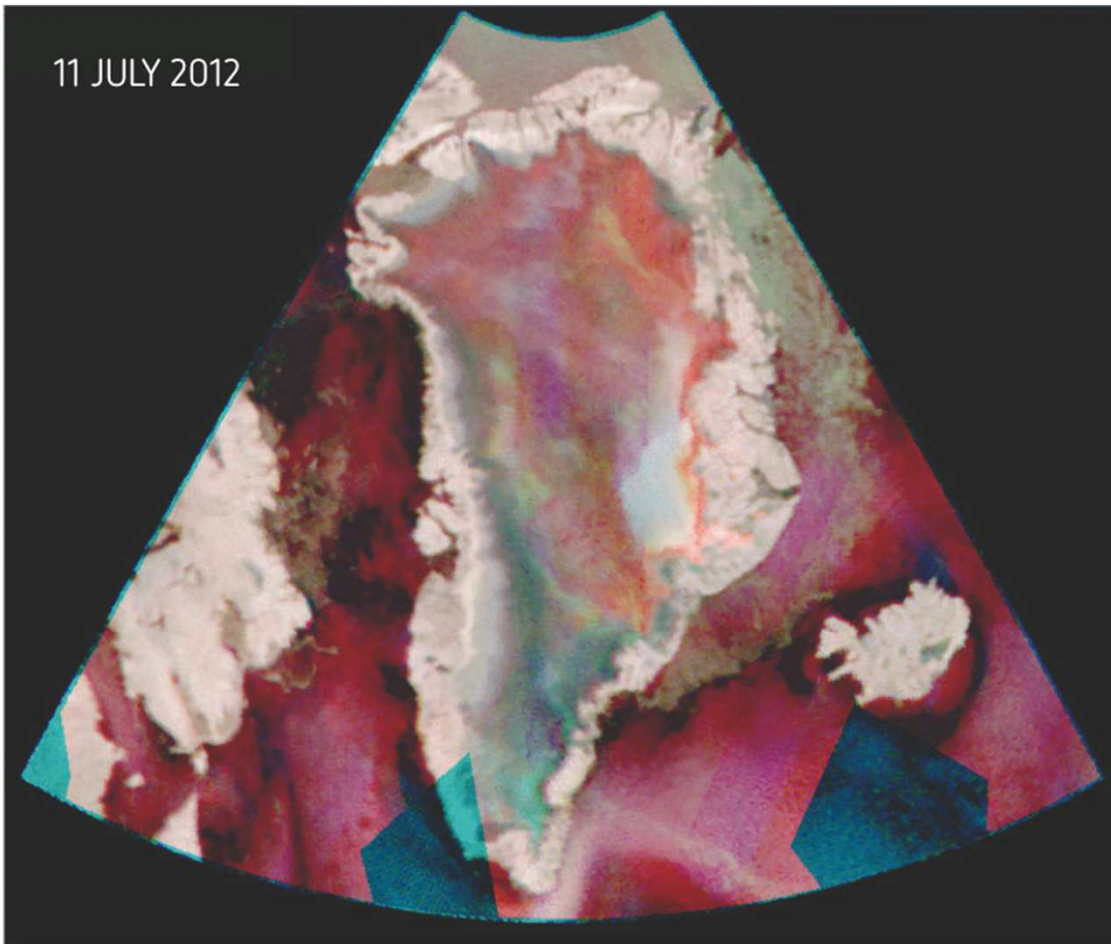
- In operations
- In talking to clients
- In teaching and learning
- The models and integrated products are pretty good ...
- Yes ... right thing ... right time

# Extreme Greenland ice sheet melt

8 JULY 2012



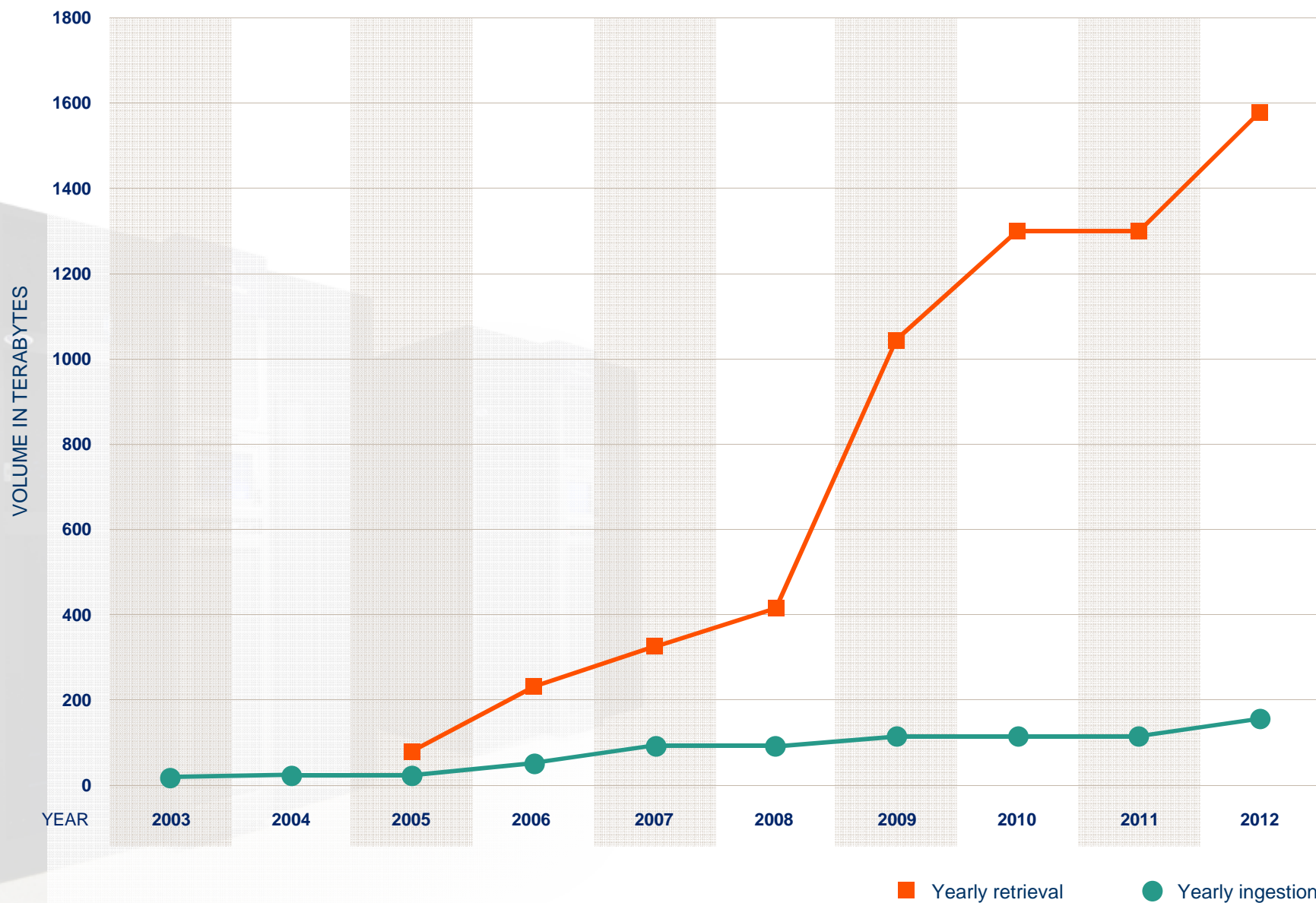
11 JULY 2012



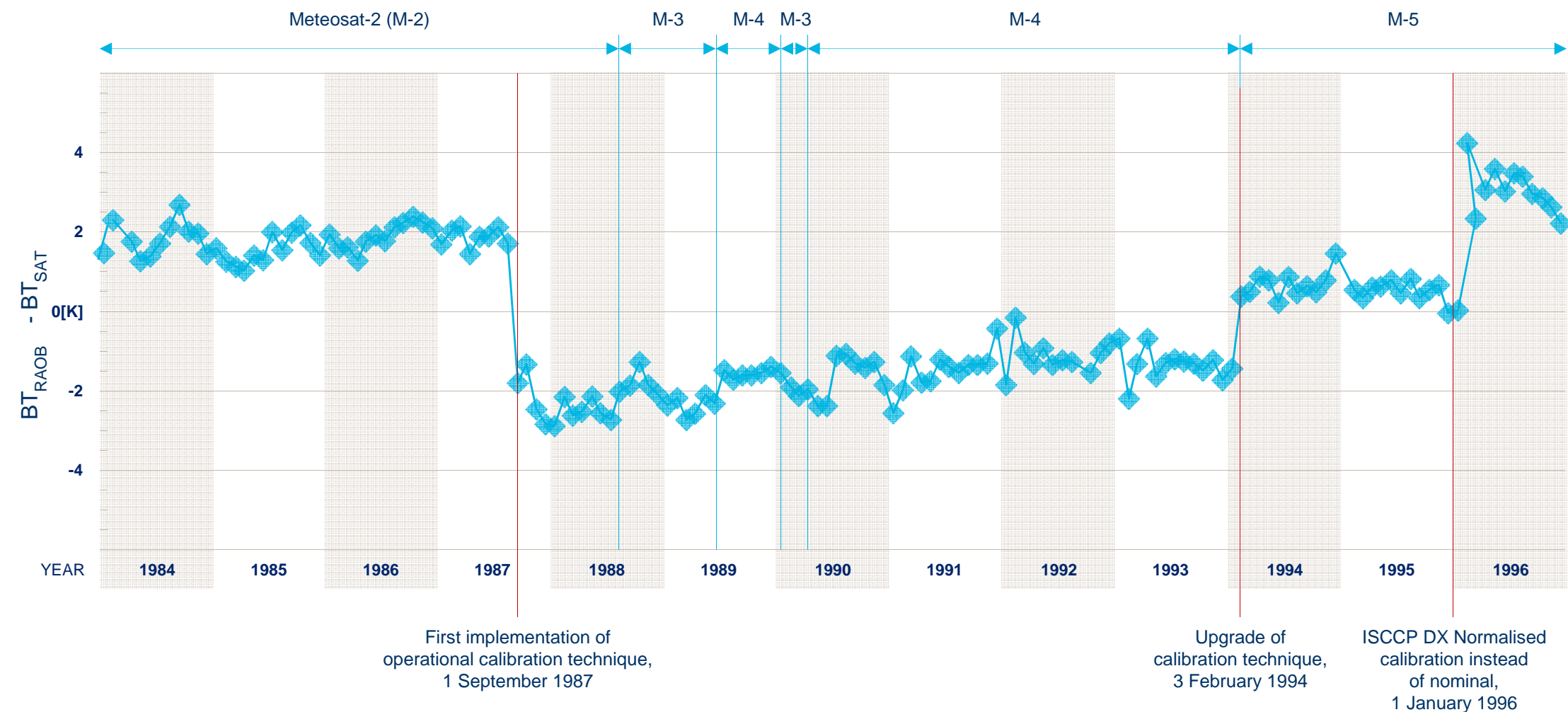
Scatterometer backscatter over Greenland changing dramatically from 8 and 11 July 2012. Imagery discriminates land (grey), summer melt (dark green), fast surface melt (red), refrozen melt (bright white) and non-melted (dark grey/blue). This event was likely due to extreme air surface temperature during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



# EUMETSAT Data Centre



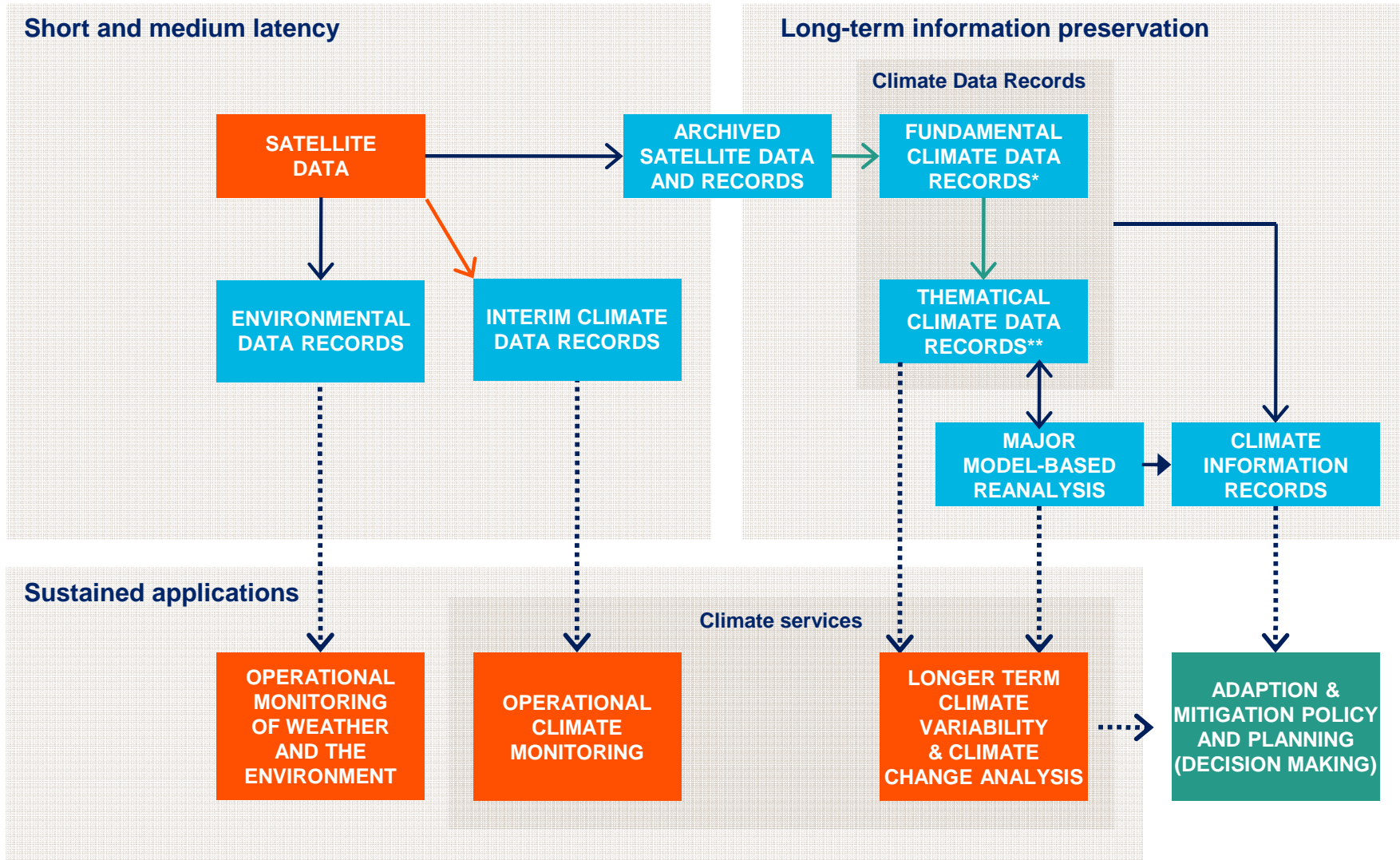
# Climate record generation: an overview



Differences between clear sky infrared Brightness Temperatures at  $6.2 \mu\text{m}$  (from the ISCCP DX data set) from successive Meteosat satellites and those calculated from night-time radiosonde data available each month. The difference (in Kelvin) is plotted as a function of time, showing the need to cross-calibrate data from successive missions. (Source: Remy Roca, LMD)



# Climate record generation: an overview

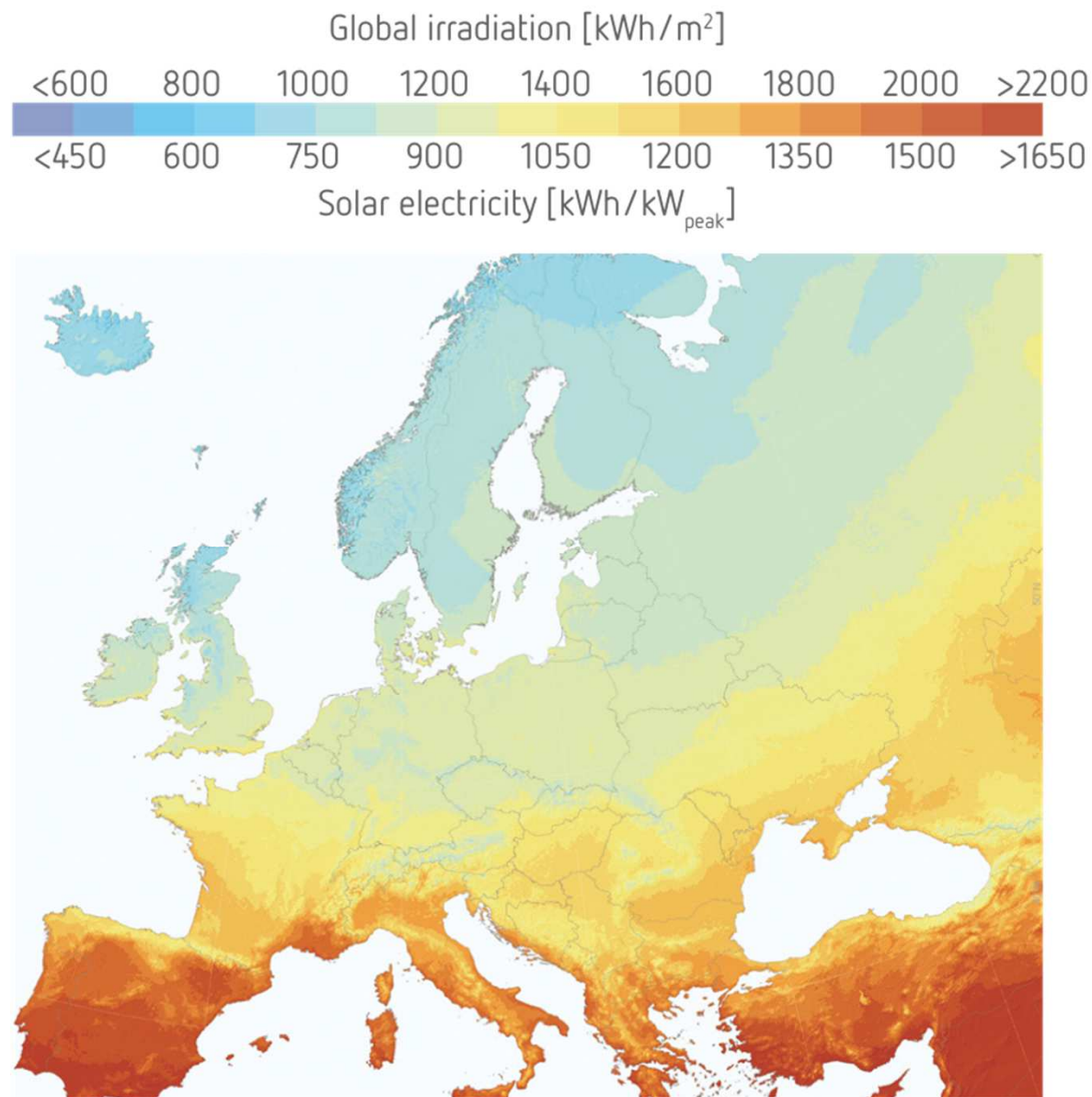


**\* Fundamental Climate Data Record (FCDR):** a long-term data record of calibrated and quality-controlled sensor data designed to allow the generation of homogeneous products that are accurate and stable enough for climate monitoring

**\*\* Thematic Climate Data Record (TCDR):** a long-term data record of validated and quality-controlled geophysical variables derived from FCDRs.

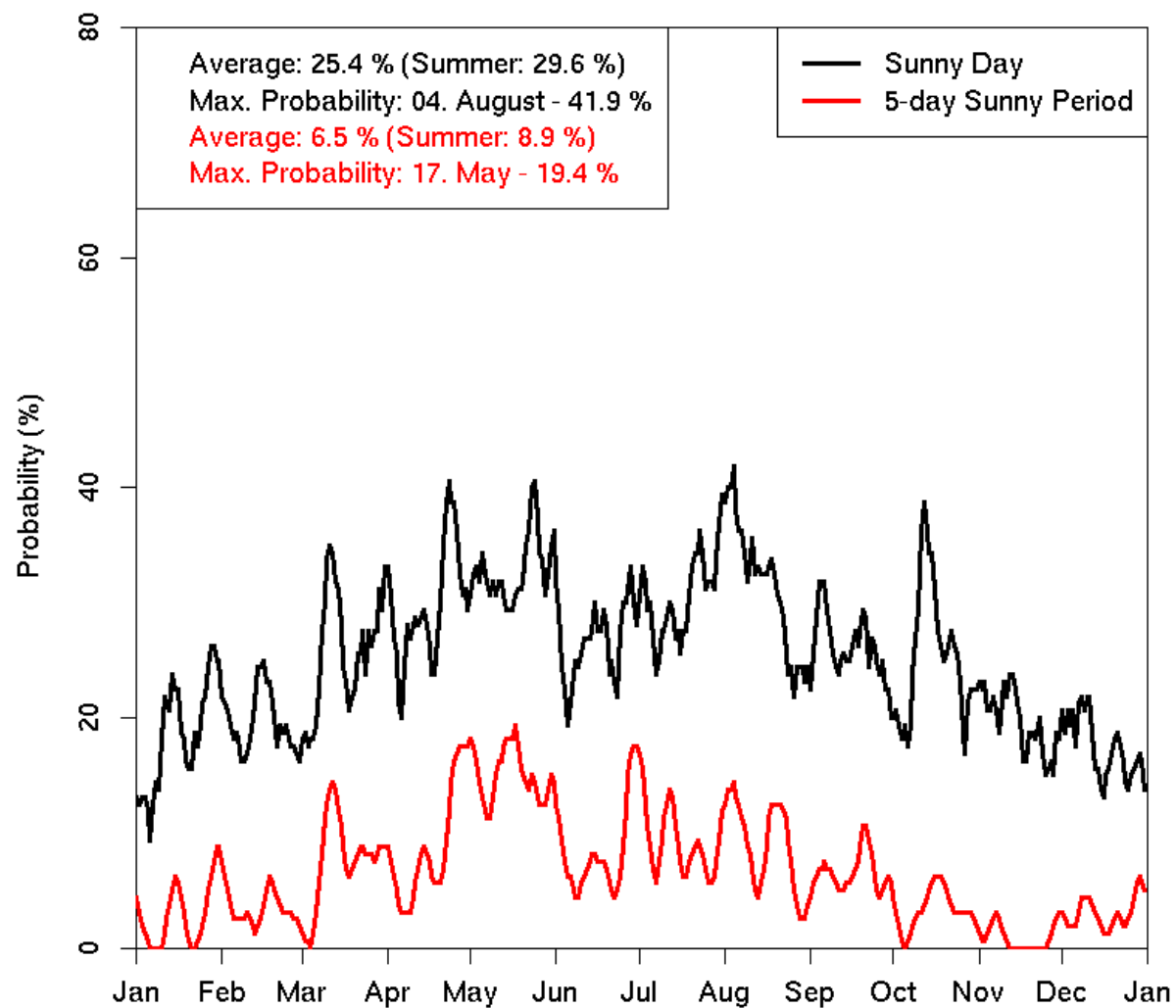
# Examples of available Climate Data Records

**Photovoltaic solar electricity potential based on Meteosat solar irradiance climatology at the surface provided by CM SAF (Source CM SAF)**

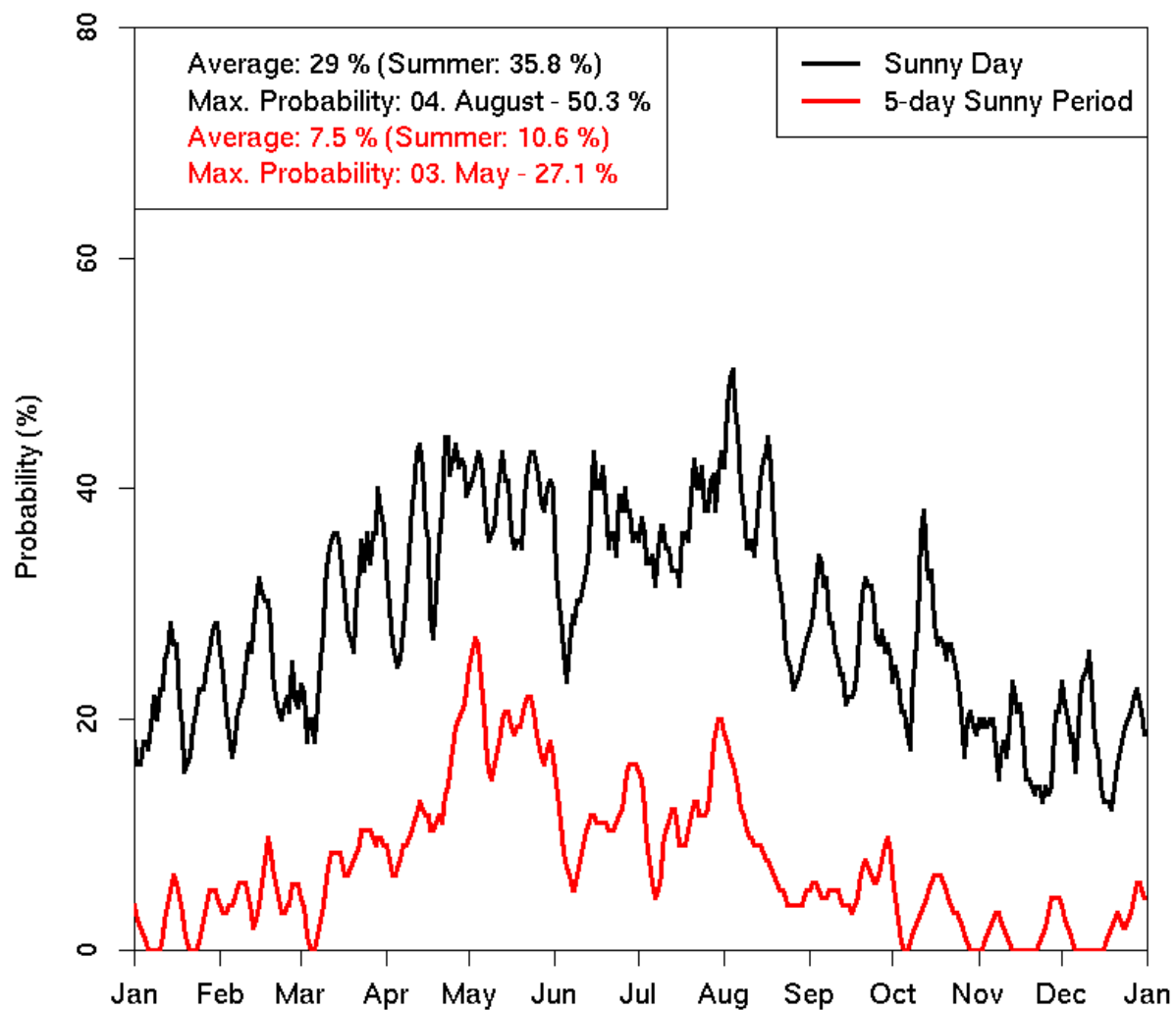




Probability of Sunny Days / Periods, Utrecht

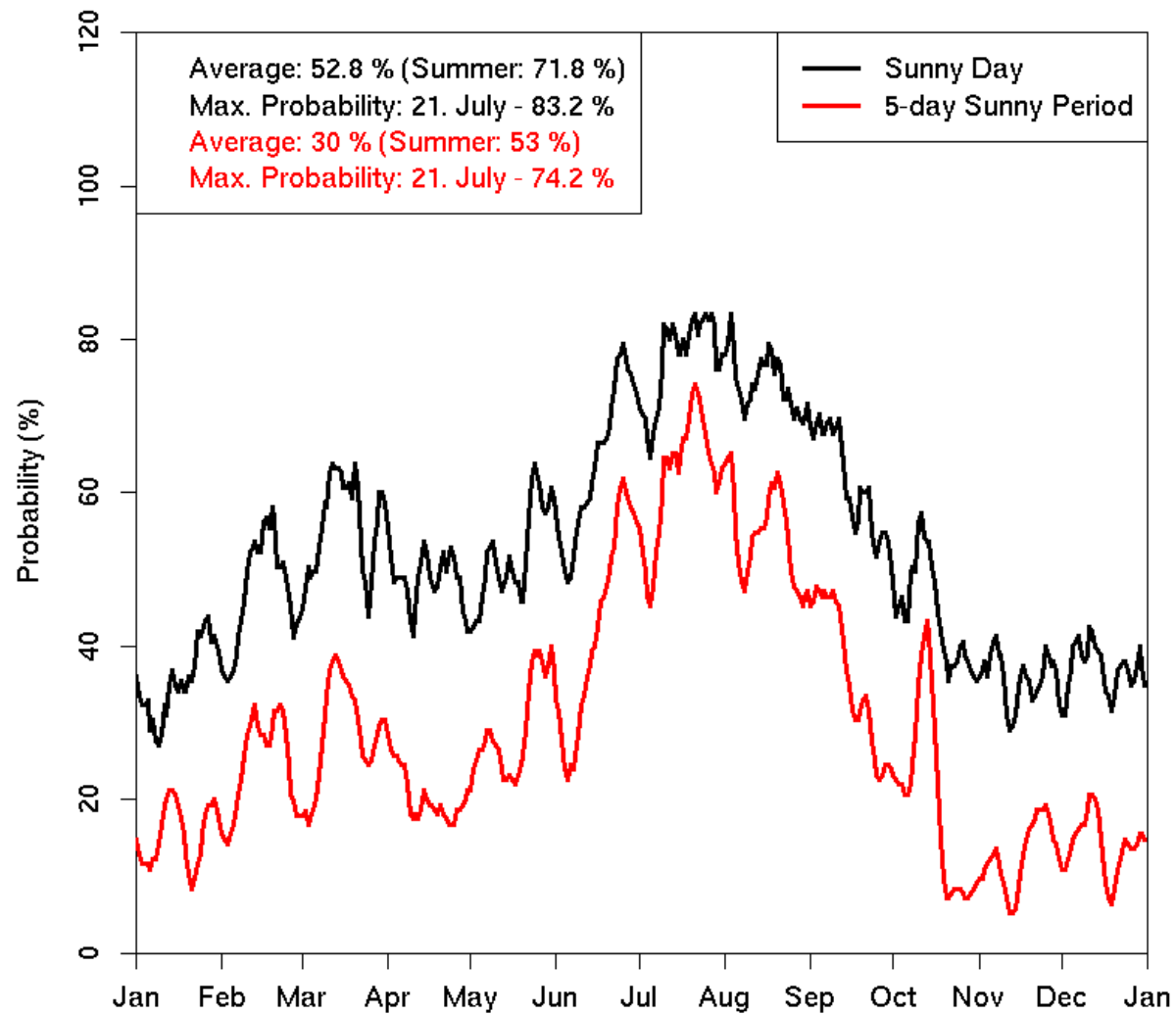


Probability of Sunny Days / Periods, The Hague

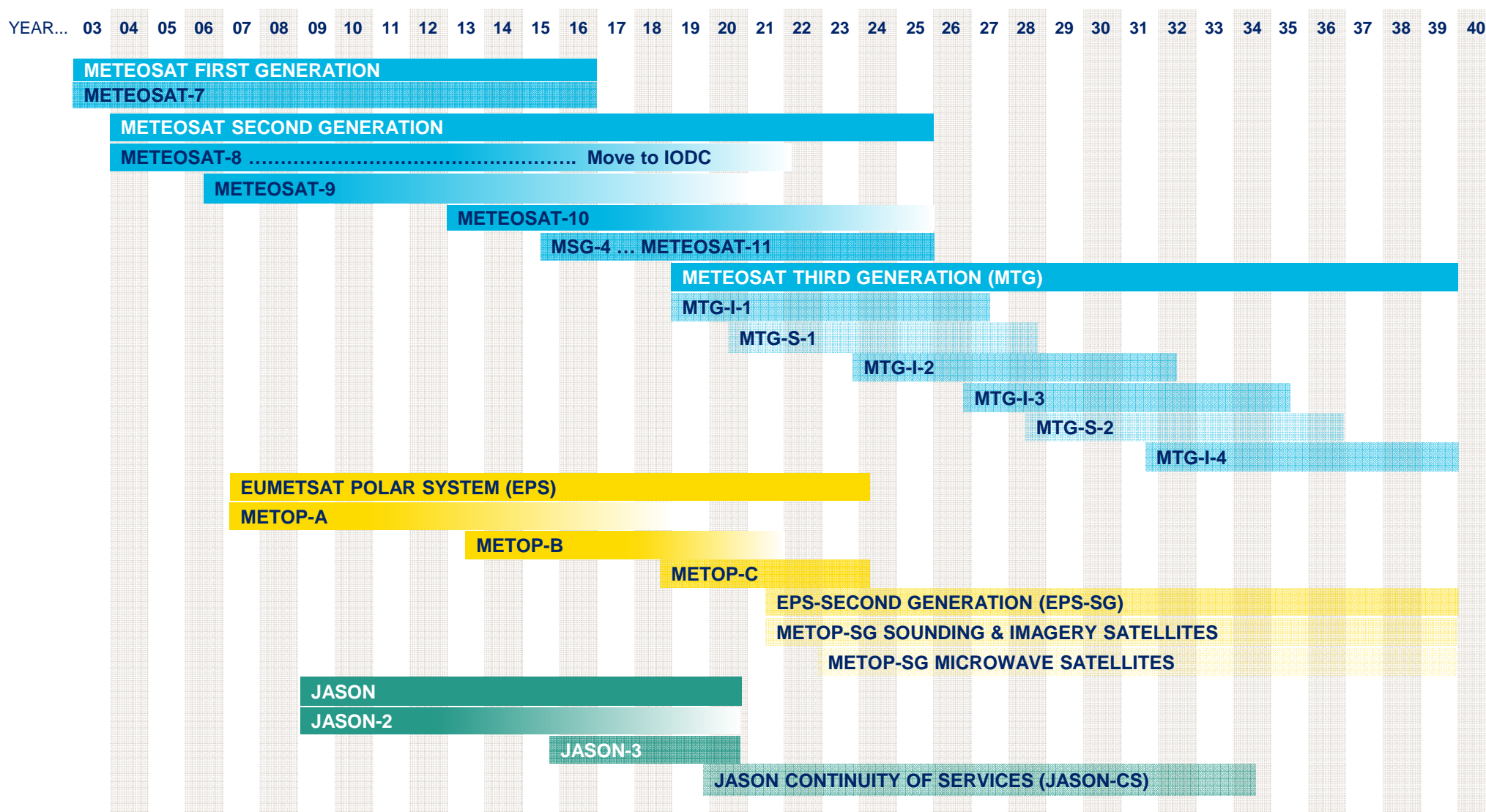




Probability of Sunny Days / Periods, Milan

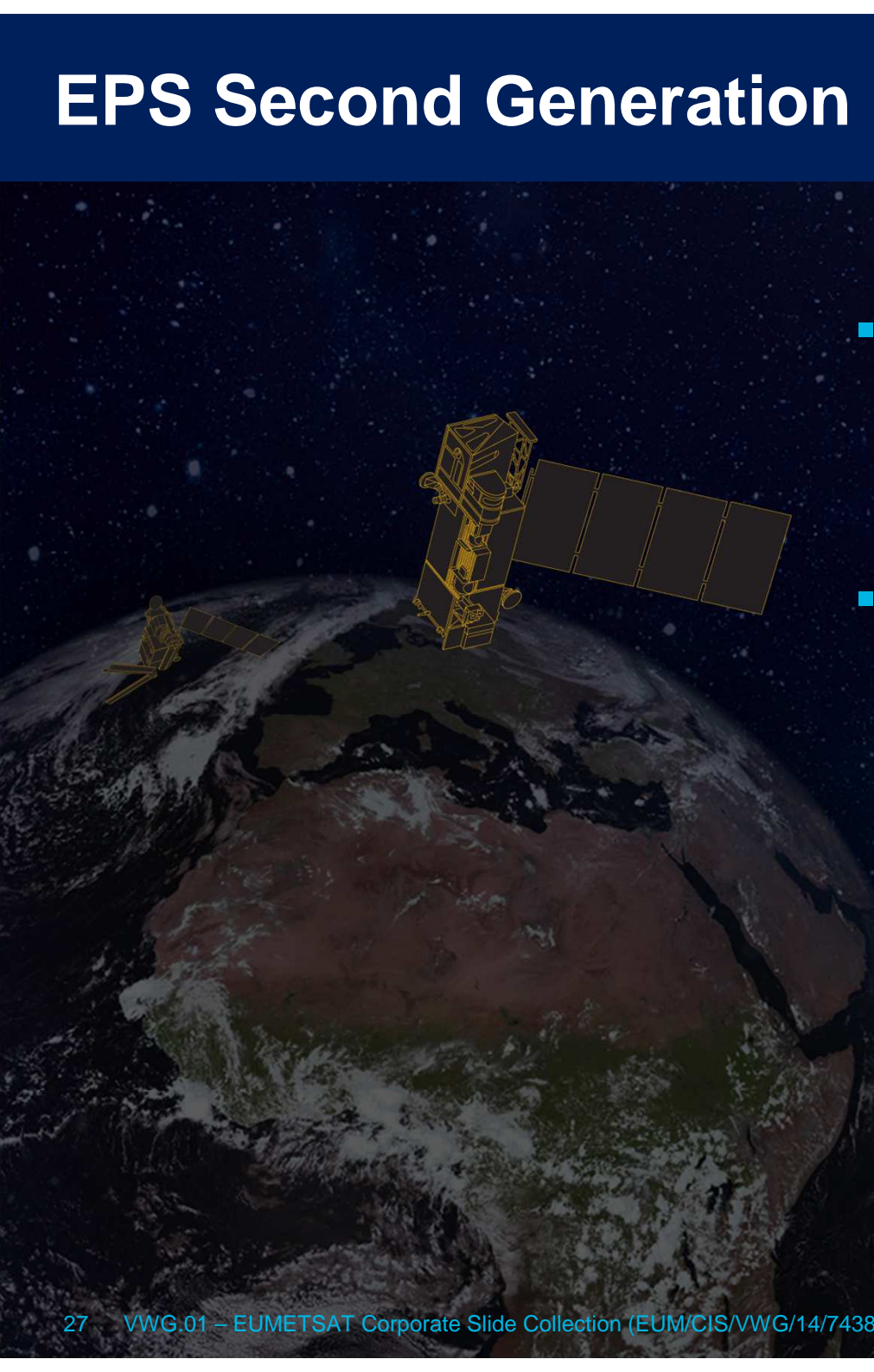


# EUMETSAT mission planning...





# EPS Second Generation

- 
- Primary mission: further improvement observational inputs to Numerical Weather Prediction models
  - Significant improvements of other applications
    - Nowcasting at high latitudes
    - Marine meteorology and operational oceanography
    - Operational hydrology
    - Air quality monitoring
    - Climate monitoring



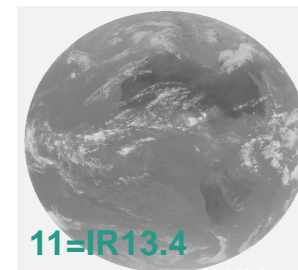
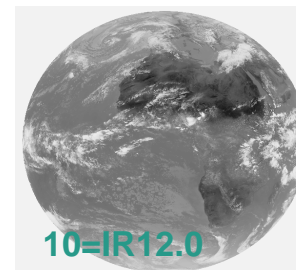
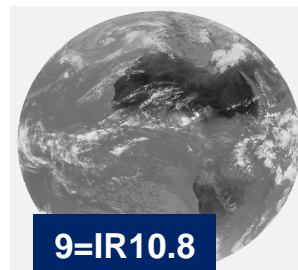
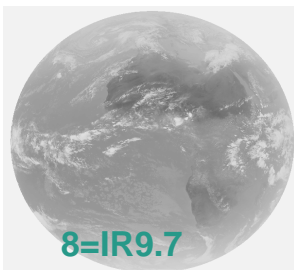
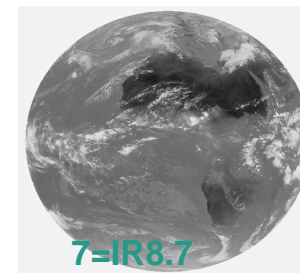
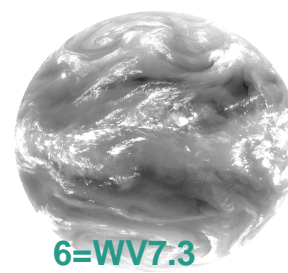
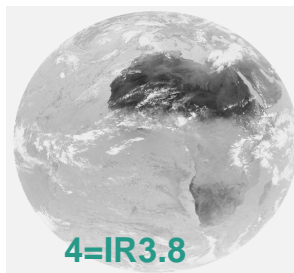
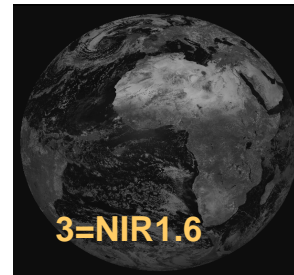
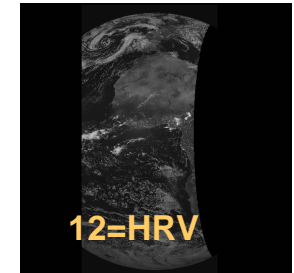
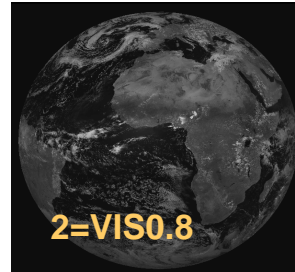
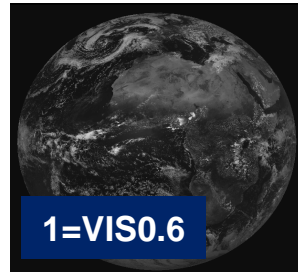
# Meteosat Third Generation



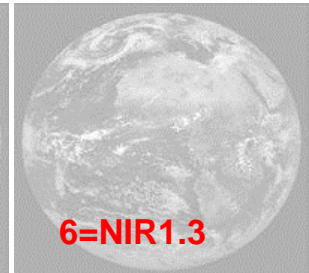
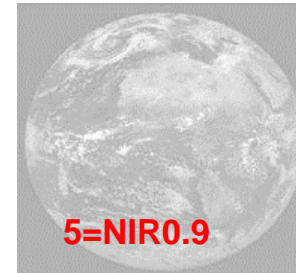
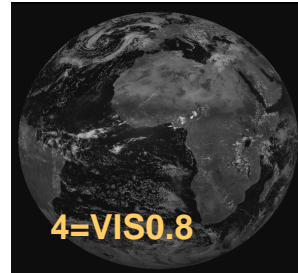
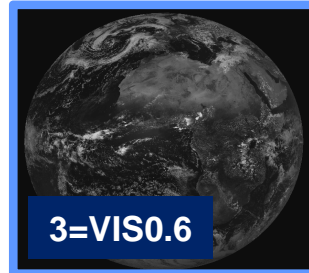
- Imagery mission implemented by a two-satellite MTG-I system:
  - Full disk imagery every 10 minutes in 16 spectral bands
  - Fast imaging of European weather every 2.5 minutes
  - new Lightning Imager (LI)
- Hyperspectral infrared (IRS) sounding mission:
  - 3D mapping of water vapour, temperature,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



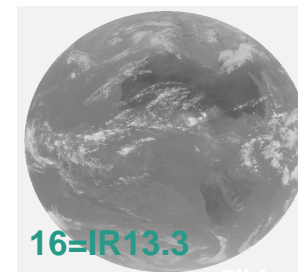
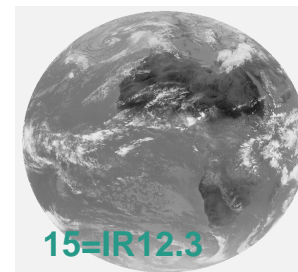
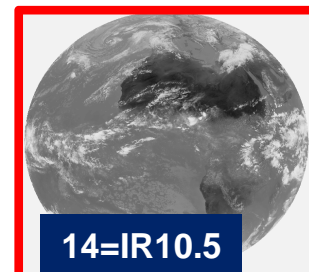
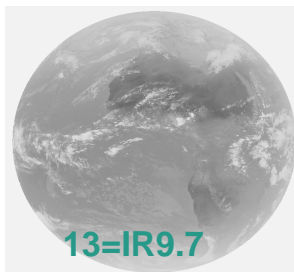
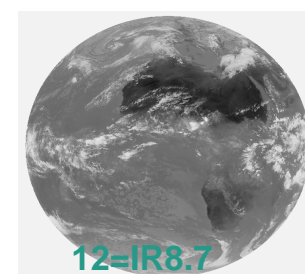
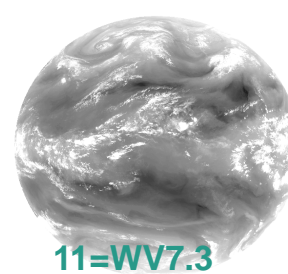
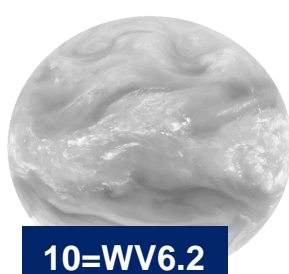
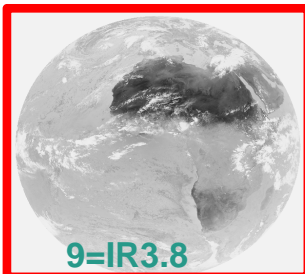
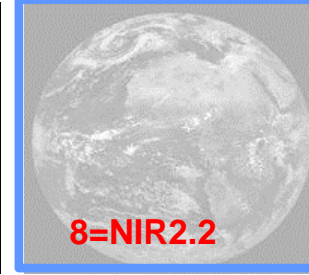
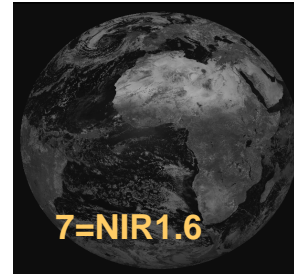
# From SEVIRI on MSG to FCI on MTG



# From SEVIRI on MSG to FCI on MTG



solar  
channels  
provided in  
0.5 km / 1.0 km  
resolution



thermal  
channels  
provided in  
1 km / 2 km  
resolution



# MTG Missions FCI – Benefits Summary

- The 0.444  $\mu\text{m}$  and the 0.51  $\mu\text{m}$  channels will permit **surpassing current aerosol retrievals** especially over land – also an important contribution to air quality monitoring
- The 0.91  $\mu\text{m}$  channel will provide during **daytime total column precipitable water** especially **over land surfaces**.
- The 1.375  $\mu\text{m}$  channel will improve **detection of very thin cirrus clouds** not seen by the current system introducing errors in all clear sky products.
- The 2.26  $\mu\text{m}$  channel will provide the capability for an **improved retrieval of cloud microphysics**.
- The improved spatial resolution (1 km and 2 km) and the extended dynamical range (from 350 K to 450 K) of the 3.8  $\mu\text{m}$  channel will firstly **outperform the fire detection quality of MSG** and secondly **outbid the quality of products as Fire Radiative Energy (FRE)** – a climate relevant product directly related to the  $\text{CO}_2$  production of active fires.

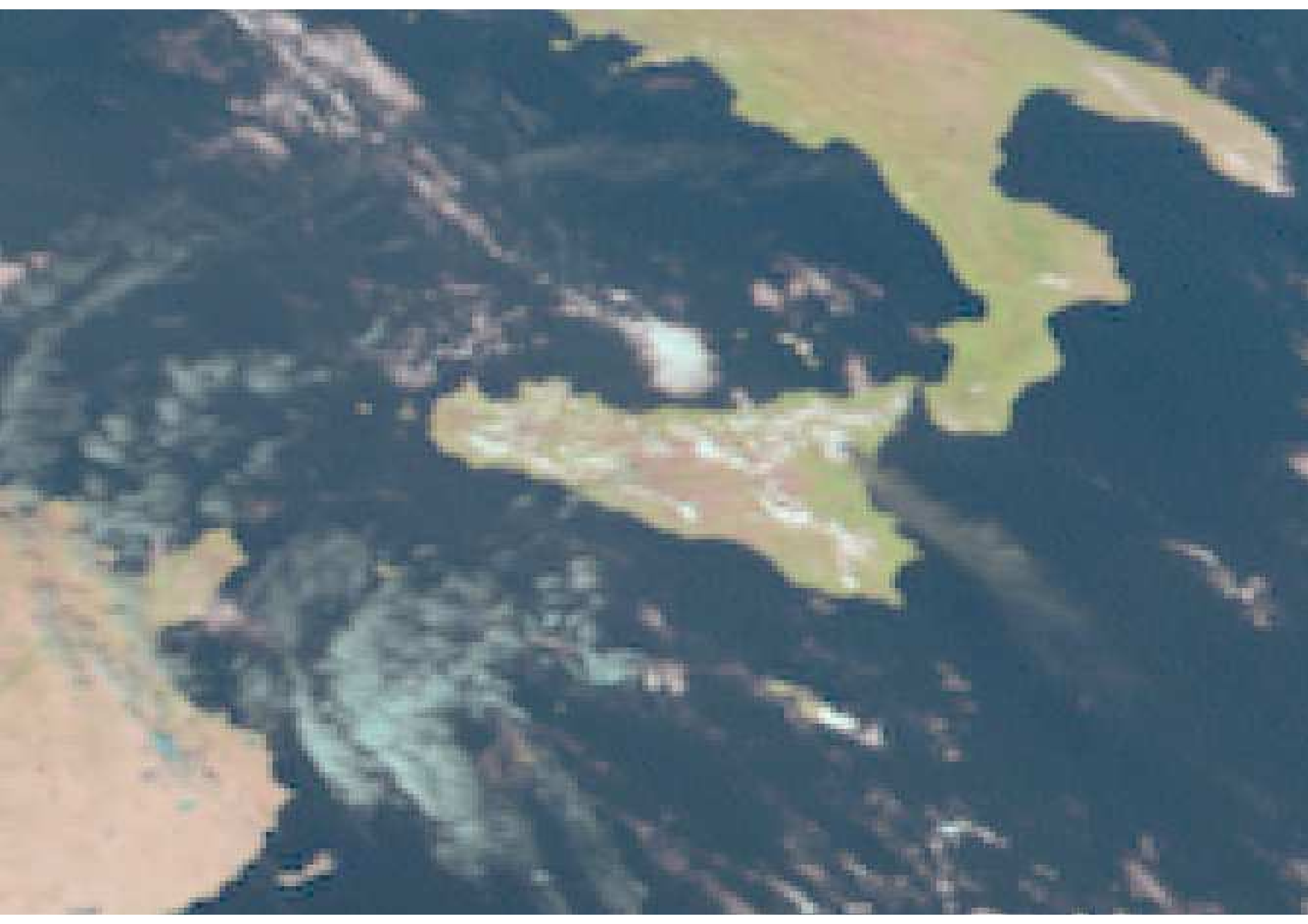
# MTG Missions LI – Benefits Summary

- The MTG LI measurements of total lightning will complement global measurements of ground based systems (e.g. ATDnet) **improving the quality of information essential for air traffic routing and safety**
- MTG-LI IC+CG lightning information to **assess impact of climate change on thunderstorm activity** by monitoring and long-term analysing lightning characteristics (coordination with NOAA's GLM mission on GOES-R and GOES-S essential)
- IC+CG information on a global scale as prerequisite for studying and **monitoring the physical and chemical processes in the atmosphere** regarding NO<sub>x</sub>, playing a key role in the ozone conversion process and acid rain generation
- IC+CG information on a global scale with **known error-characteristic** a prerequisite for: assimilation in regional models to **improve very short range forecasts** of convective events **verification/validation of algorithms to nowcast** (time and location) convective initiation

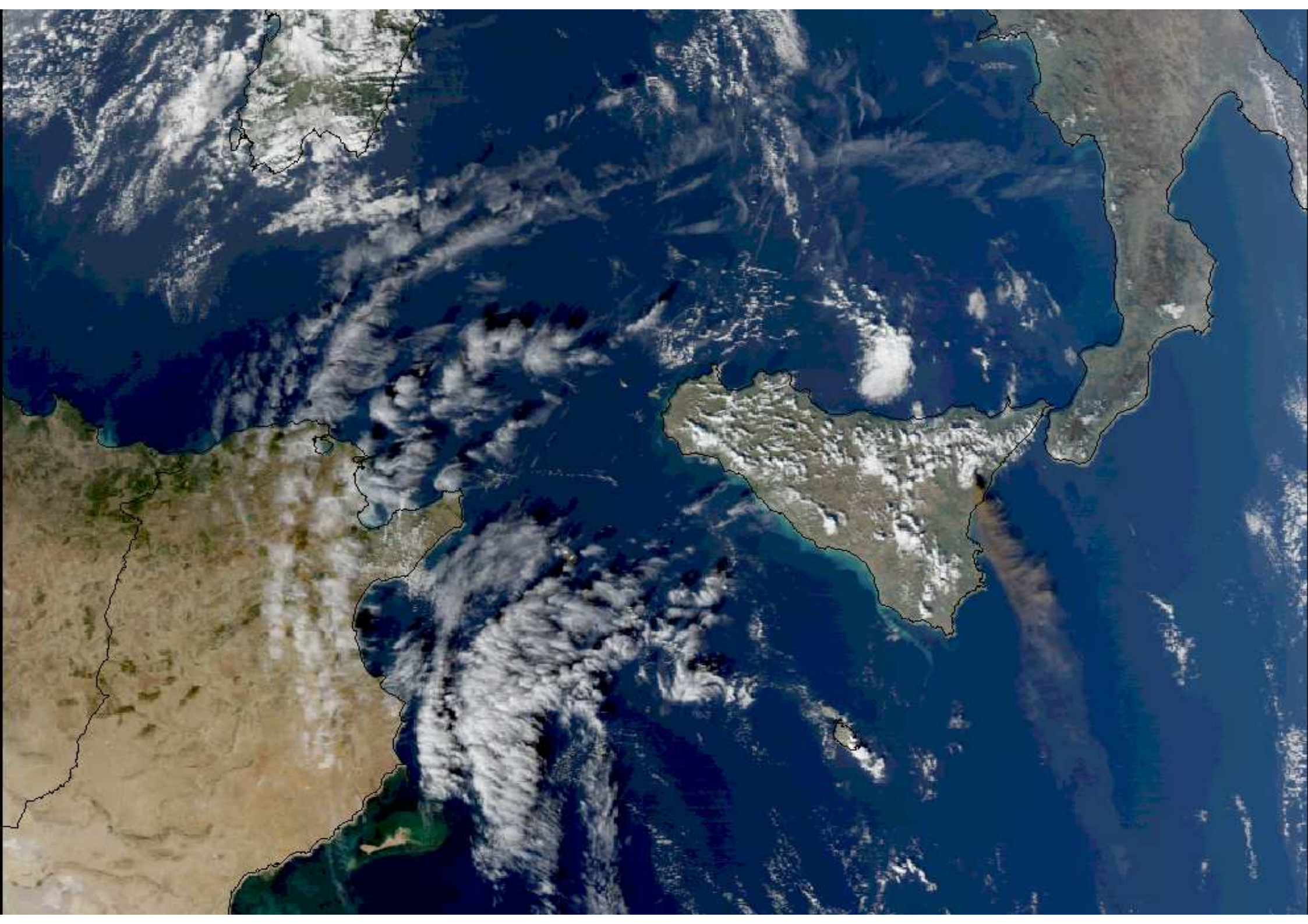


# MTG Missions IRS – Benefits Summary

- The IRS (30 min repeat cycle over Europe) will fill large spatial and temporal voids in the 12-hour standard radiosonde observations and will provide time and space interpolation of moisture/temperature observations taken from the polar orbiting satellites.
- The IRS derived information on tropospheric moisture structures and their variation in time is expected to lead to a better depiction of the hydrological cycle in models, potentially providing better precipitation forecast.
- The IRS will provide information on vertically resolved atmospheric motion vectors with improved height assignment, which in particular is beneficial for the tropical areas having only a weak coupling between the dynamic and thermodynamic atmospheric fields.
- The IRS will provide information to identify pre-convective situations supporting NWC applications to forecast convective initiation.
- IRS will support forecasting pollution and monitoring of atmospheric minor constituents through its capability to provide estimates of diurnal variations of tropospheric contributions of atmospheric trace gases as O<sub>3</sub> and CO.









# Getting ready for MTG .... dS

- Data flows
- Assimilation
- Product development
- Science
- Linkage between research and development
- Training and briefing ...