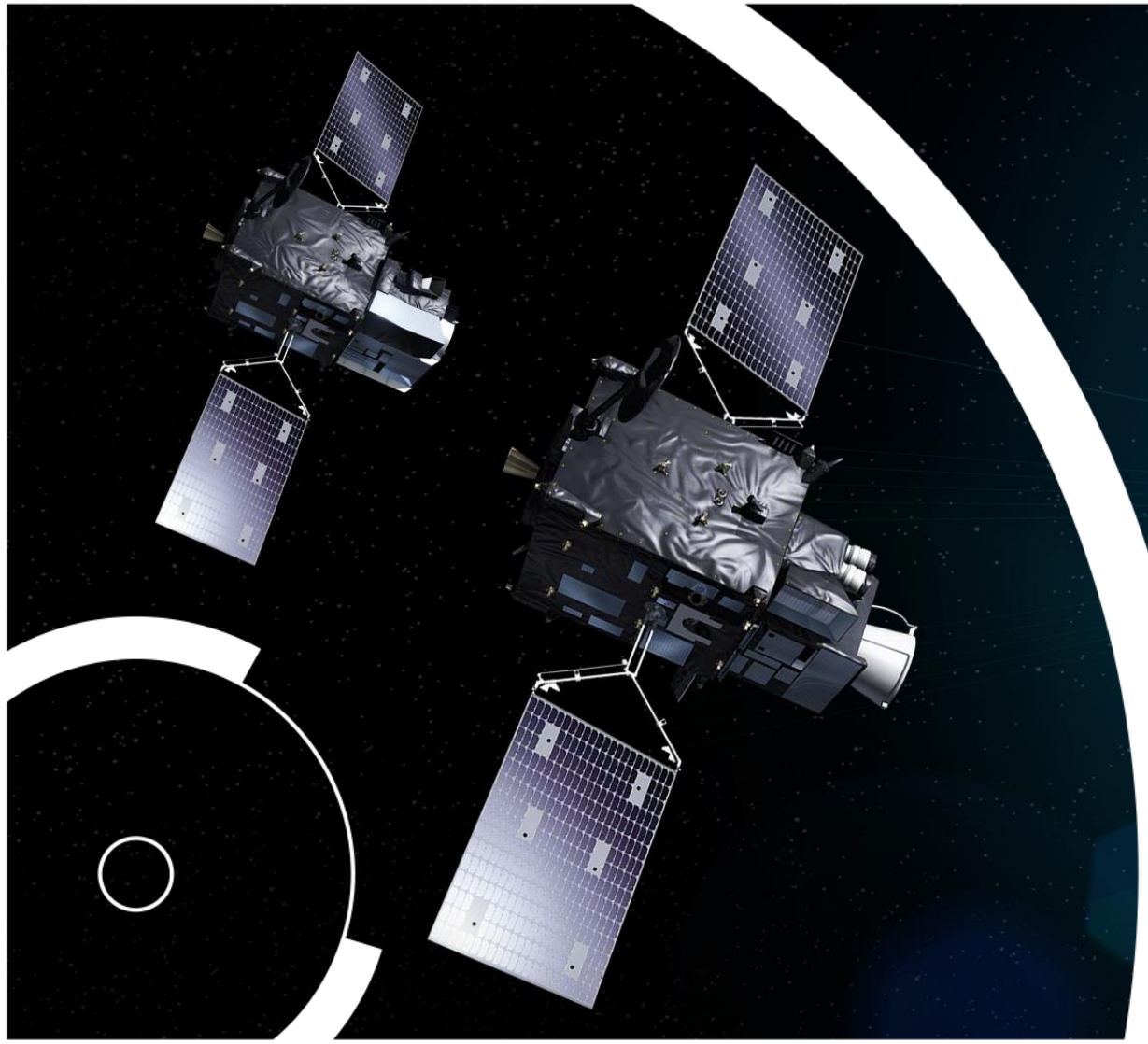
EUMETSAT



MTG and EPS-SG – the benefits of New Generation Satellites for Nordic Countries

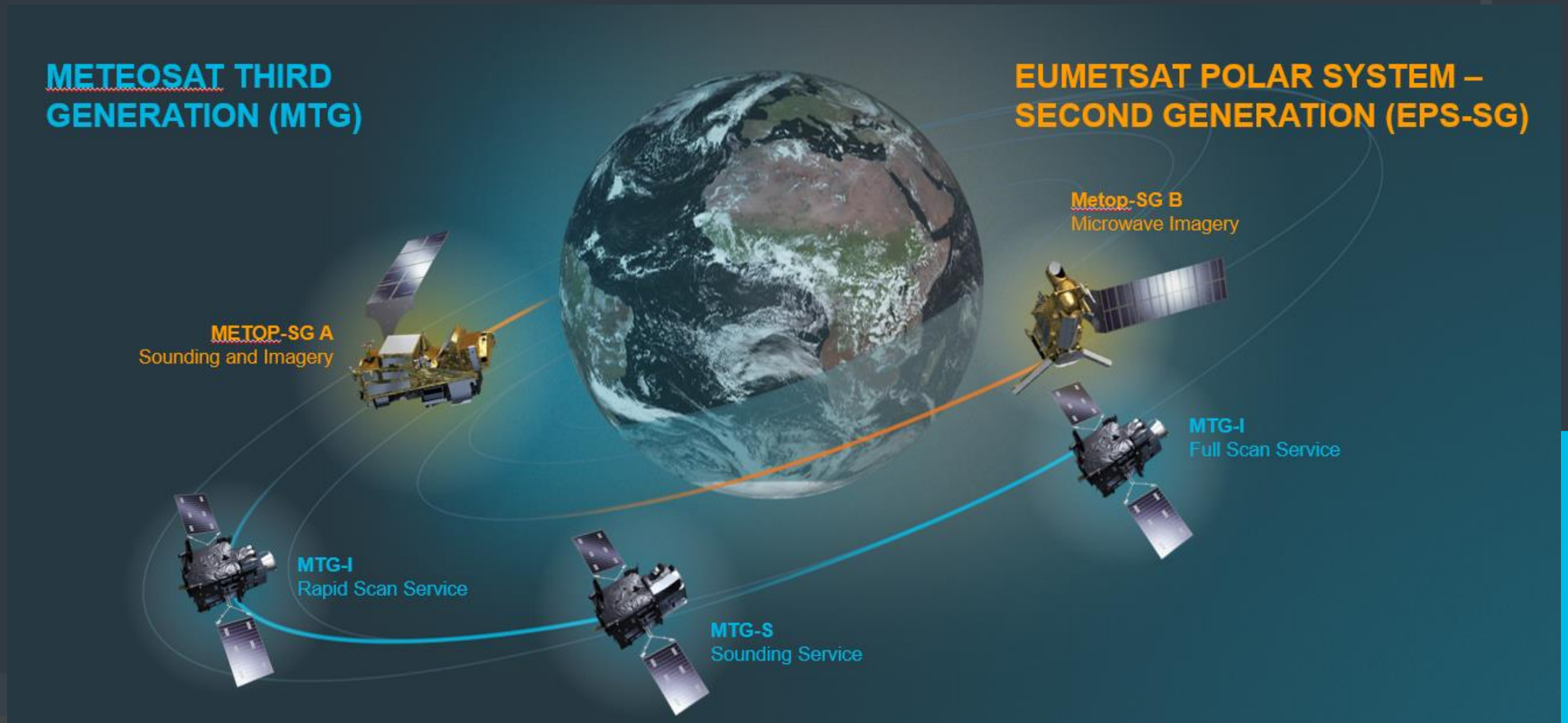
Vesa Nietosvaara, EUMETSAT

16 June 2022

MTG + EPS-SG

EUMETSAT FUTURE FOCUS: TWO HIGHLY INNOVATIVE PROGRAMMES

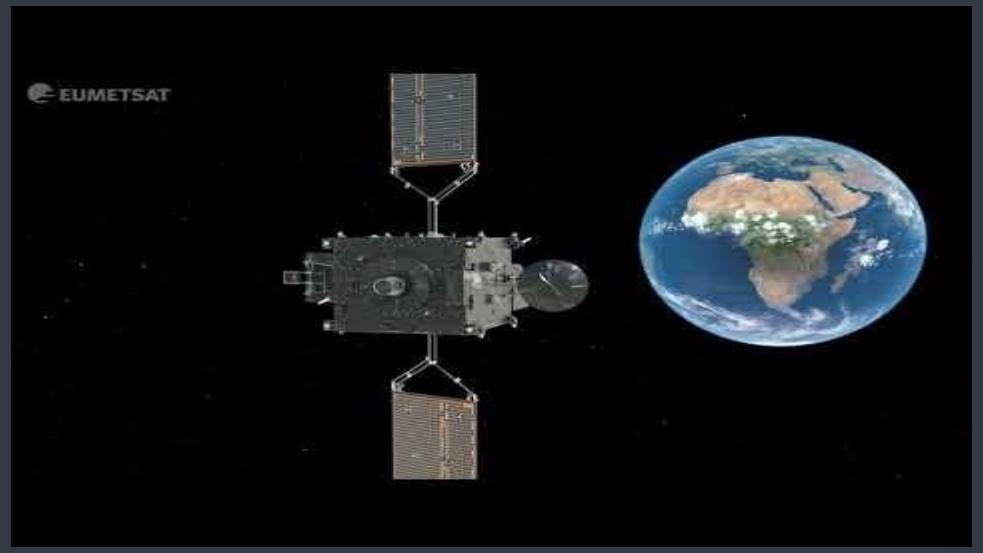
EUMETSAT

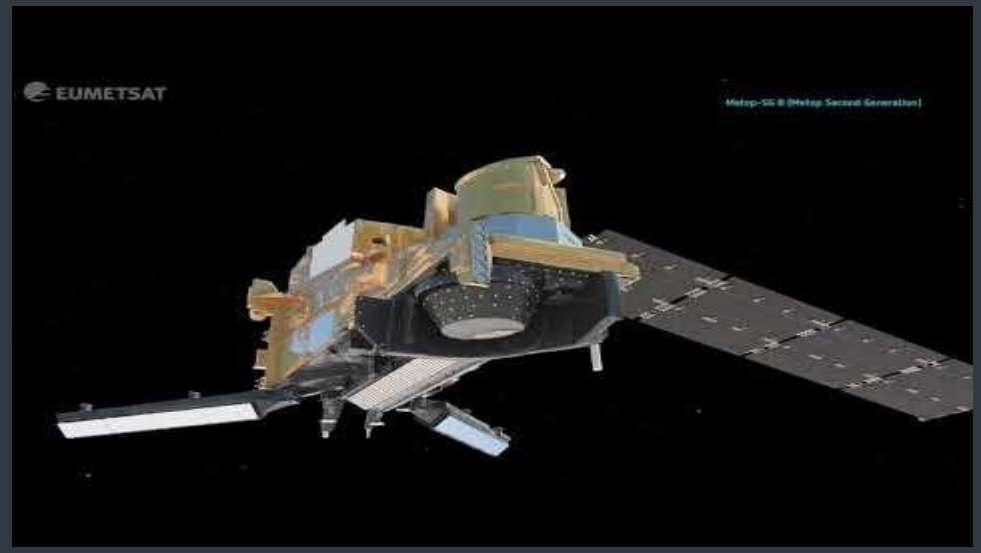


MTG + EPS-SG

EUMETSAT FUTURE FOCUS: TWO HIGHLY INNOVATIVE PROGRAMMES

EUMETSAT

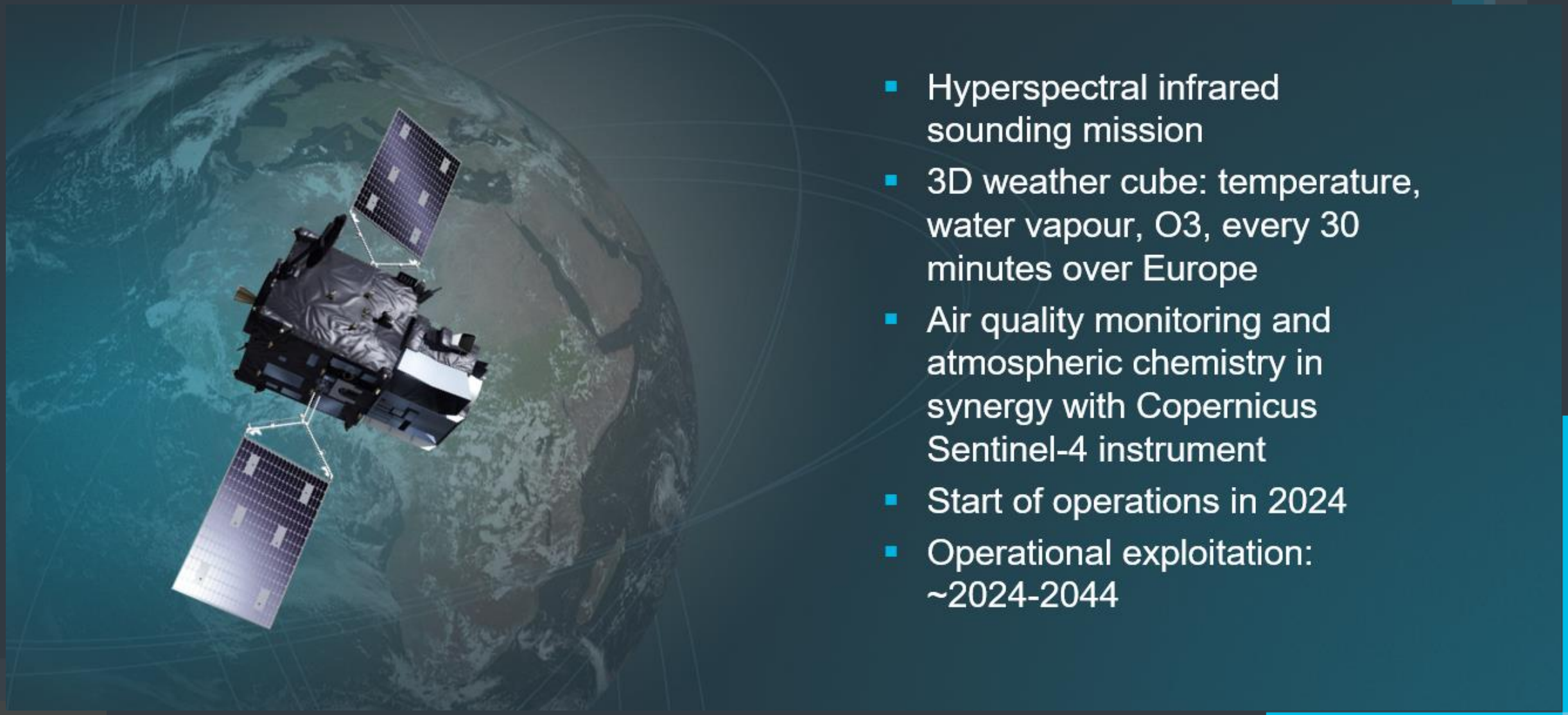




MTG-I IMAGING MISSION

- 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 2023
- Operational exploitation: ~2023-2043

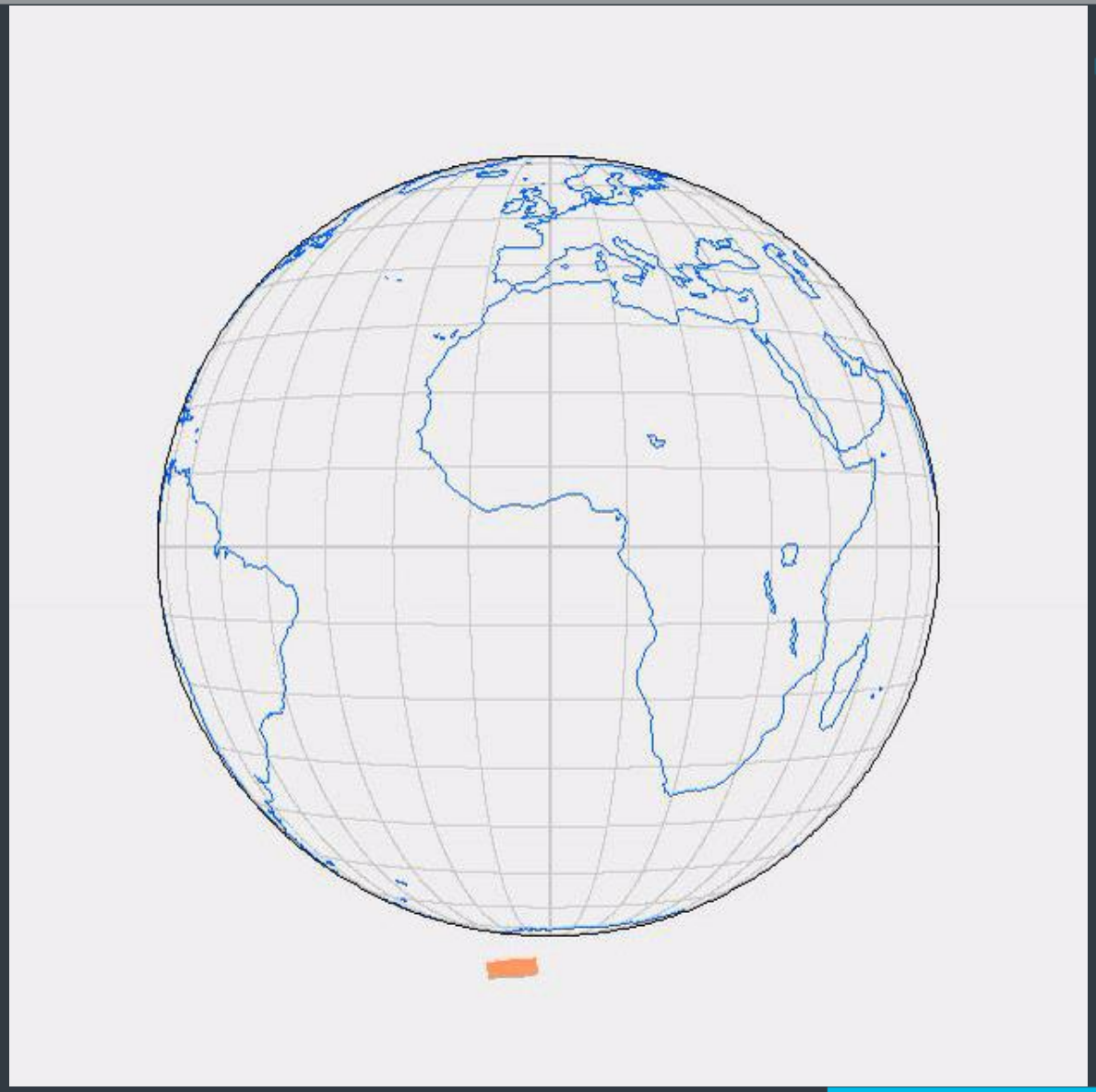
MTG-S SOUNDING MISSION



- Hyperspectral infrared sounding mission
- 3D 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 2024
- Operational exploitation: ~2024-2044

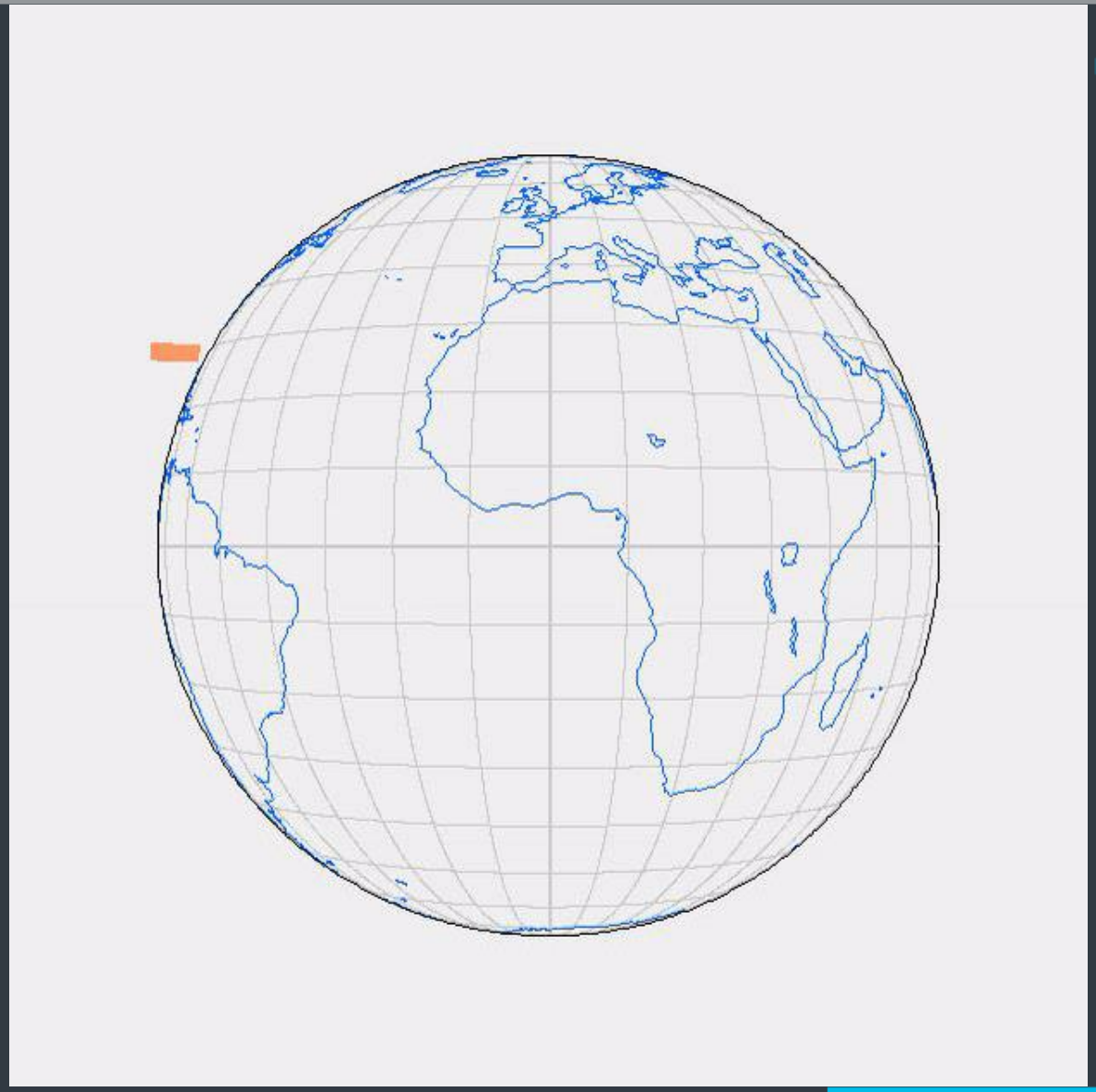
MTG-FCI FULL DISC SCANNING SERVICE (FDSS)

To support the Full Disc Scanning Service, the FCI on MTG-I1 will sample all channels of the Full Disc every 10 minutes.

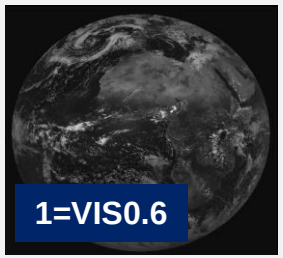


MTG-FCI RAPID SCANNING SERVICE (RSS)

To support the Rapid Scanning Service, FCI on MTG-I2 will sample all channels in the top quarter of the Full Disc every 2.5 minutes.

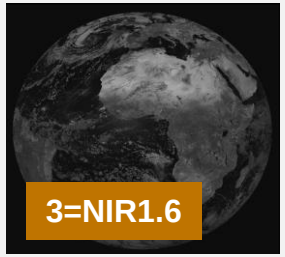


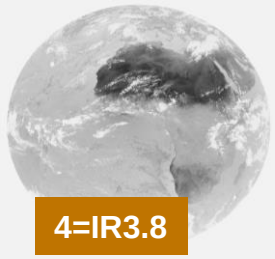
CURRENT AND FUTURE IMAGERS CHANNELS

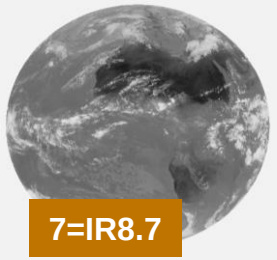


SSD: 1km

SSD: 3km

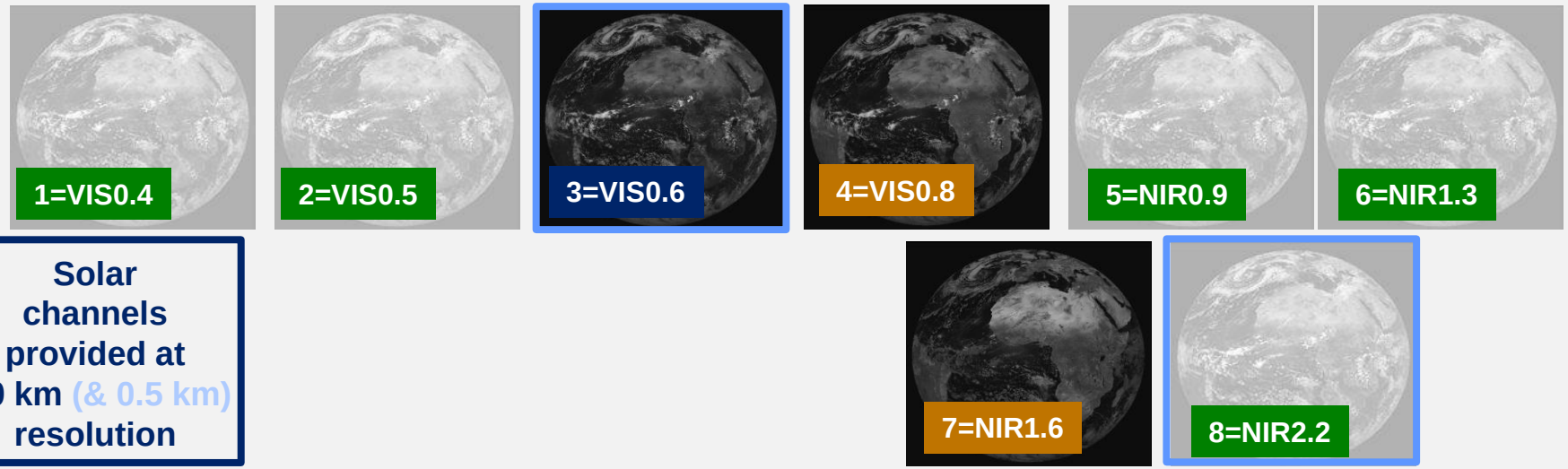




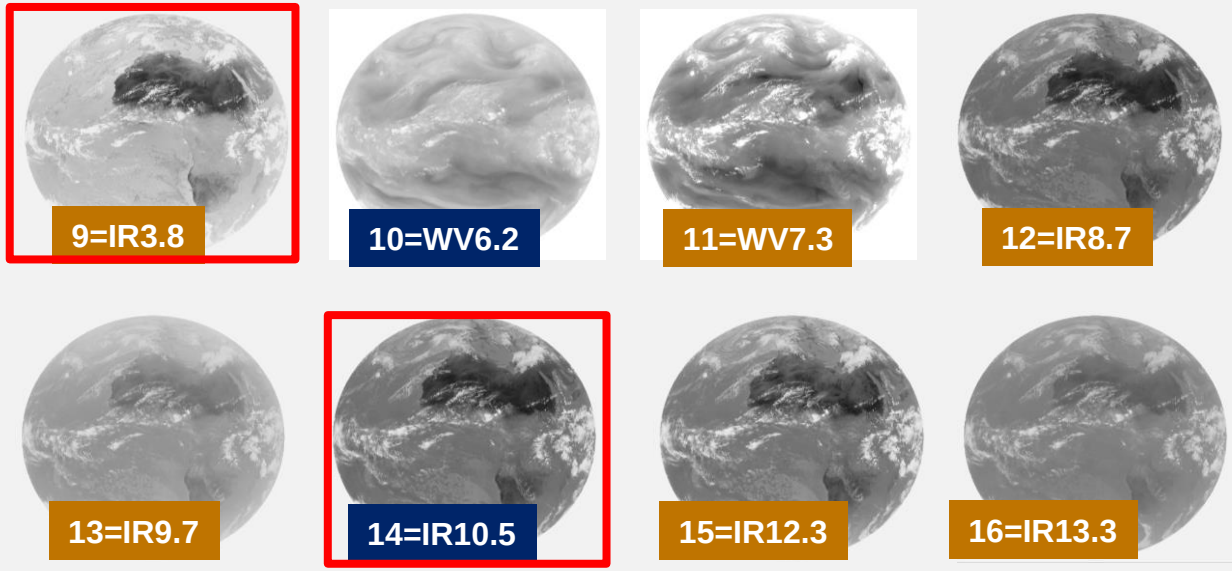


Current SEVIRI

CURRENT AND FUTURE IMAGERS CHANNELS



Solar channels provided at 1.0 km (& 0.5 km) resolution



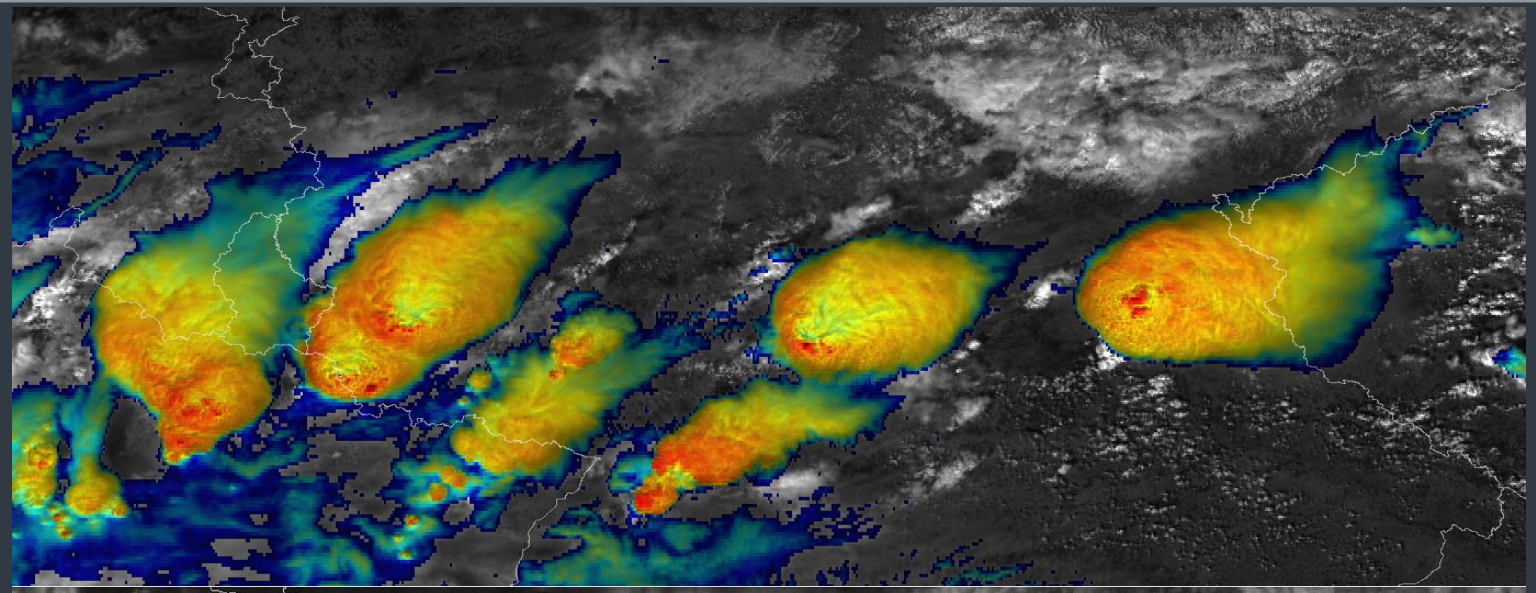
Thermal channels provided at 2 km (& 1 km) resolution

Future FCI

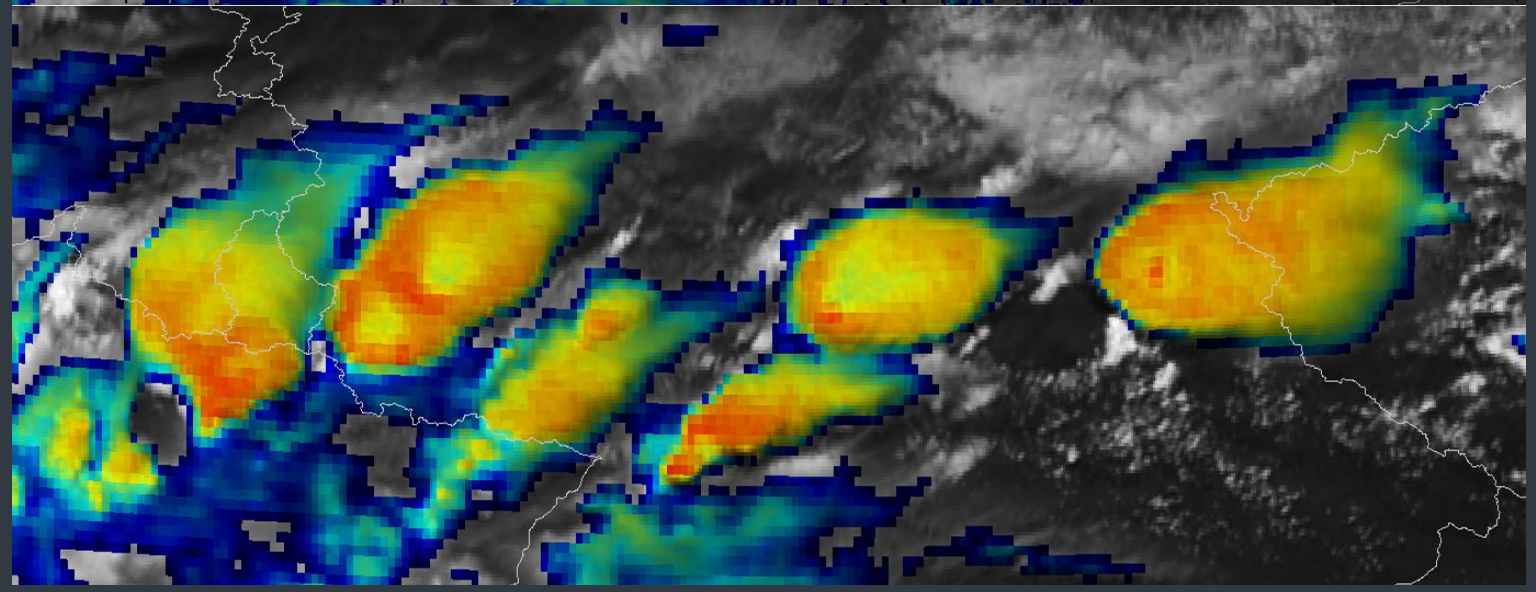
- ✓ **Continuity**
- ✓ **Innovation**

EXPECTED IMPROVEMENTS FROM MTG-I MISSION

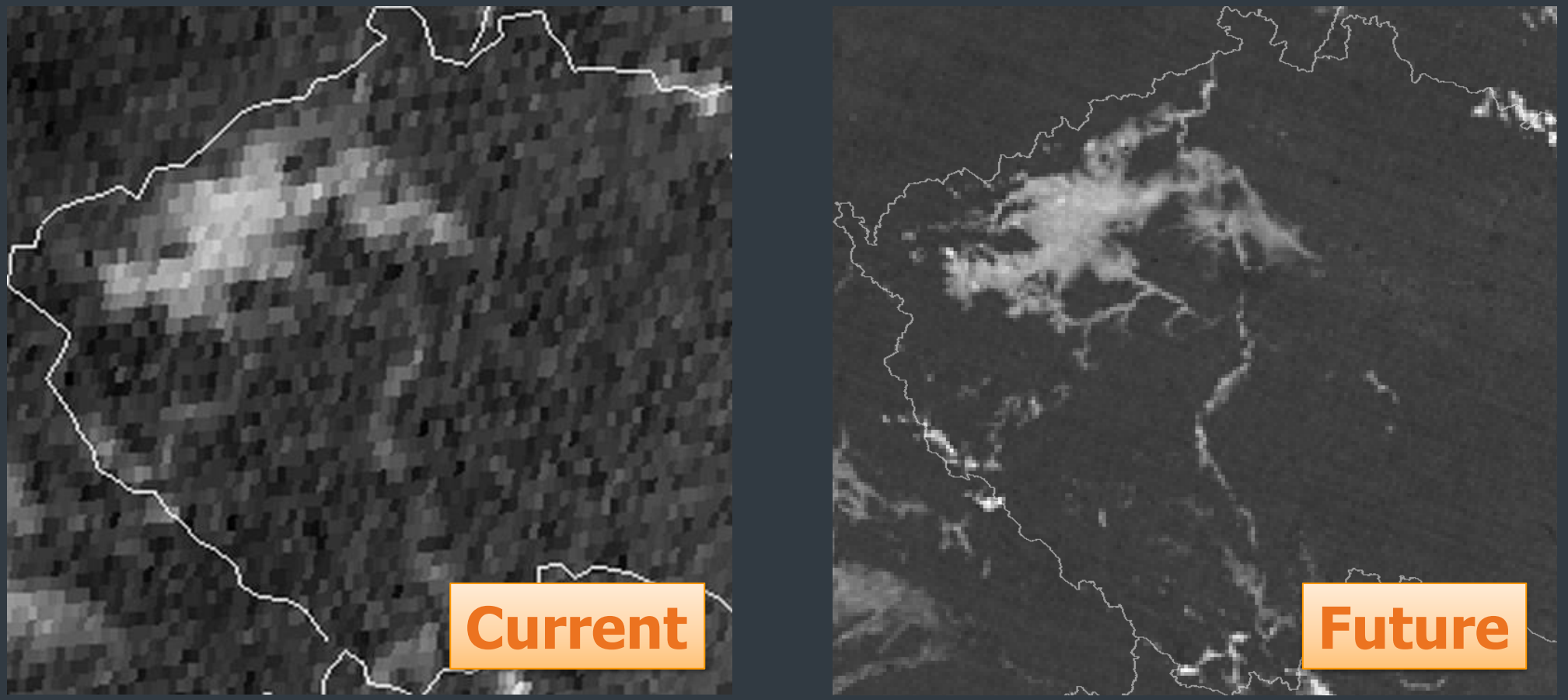
Future



Current



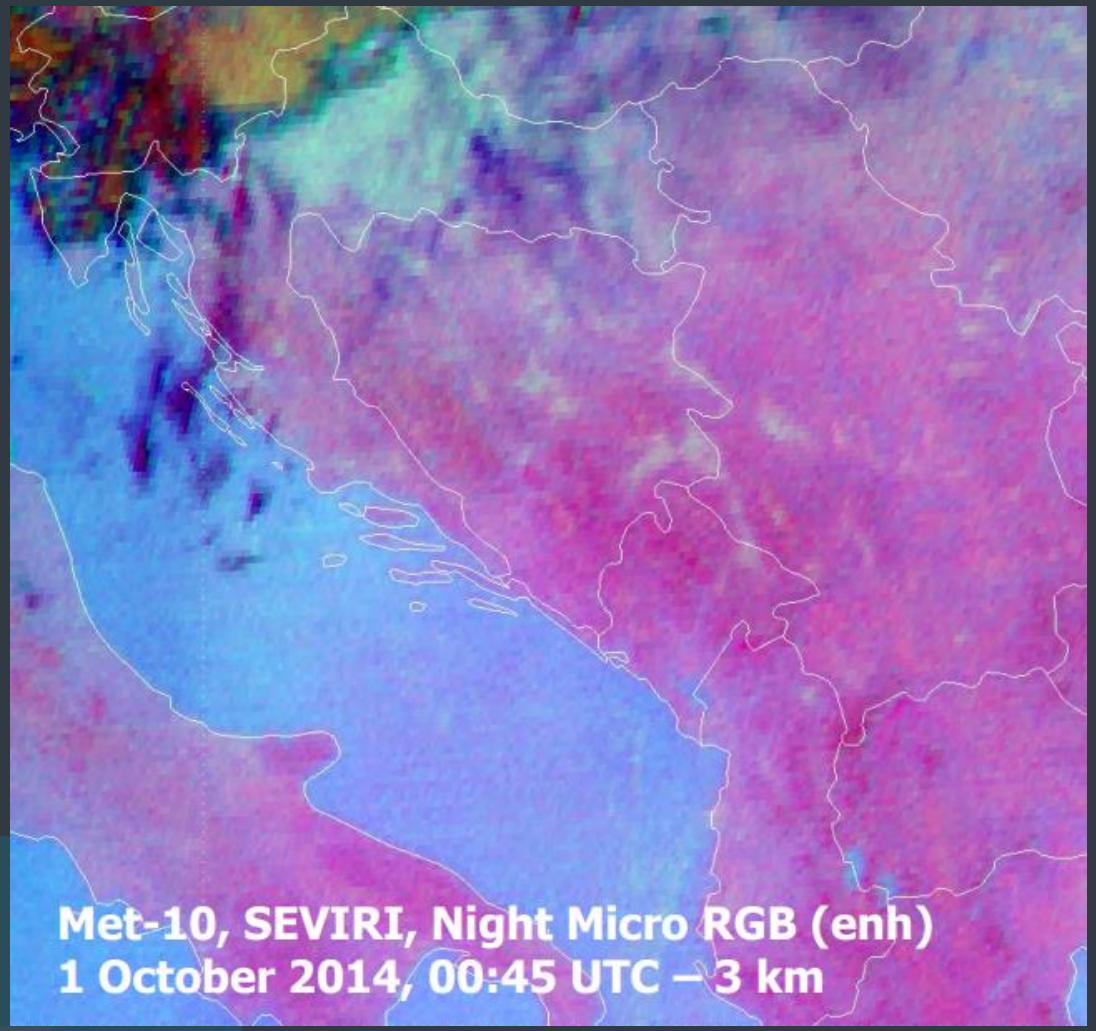
EXPECTED IMPROVEMENTS FROM MTG-I MISSION

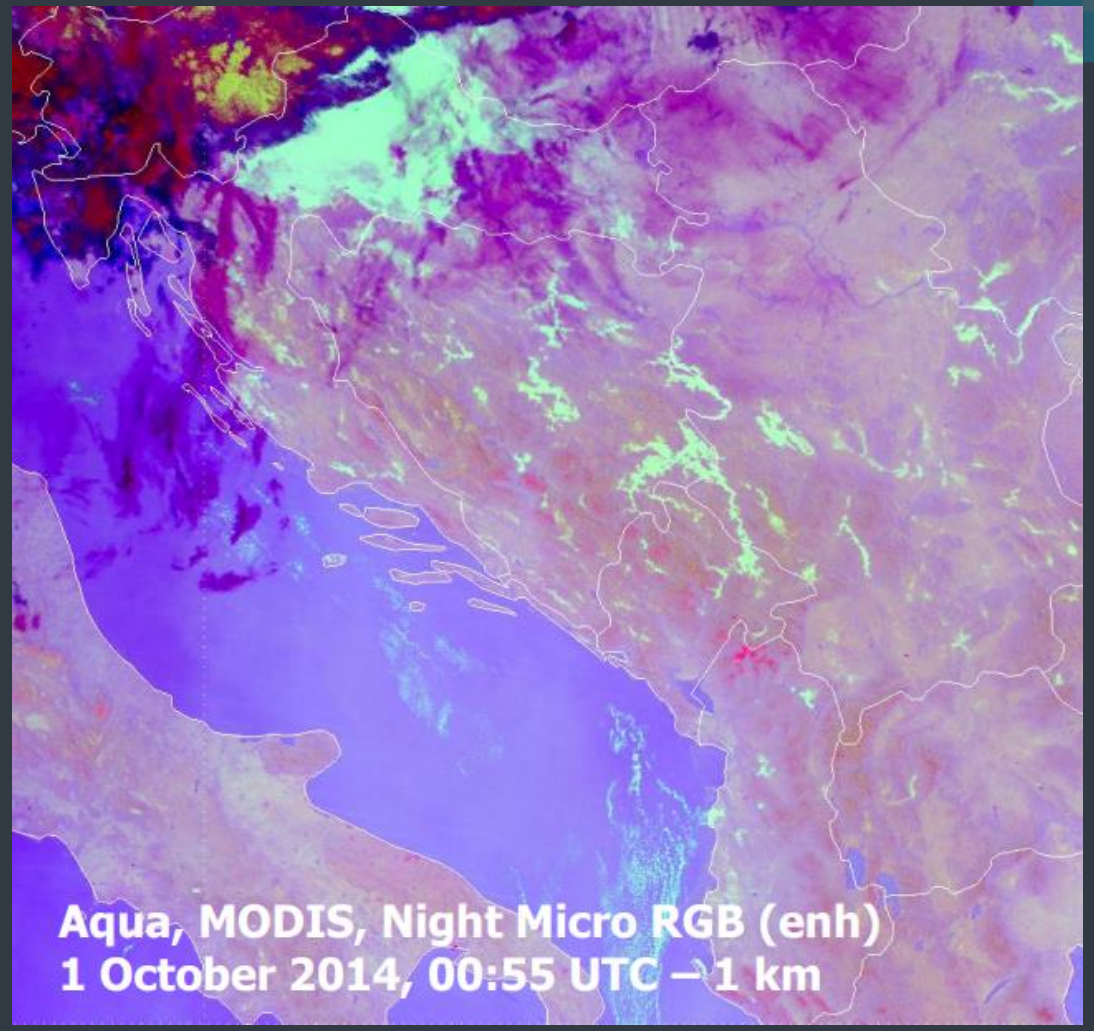


Example of fog detection over Czech Republic

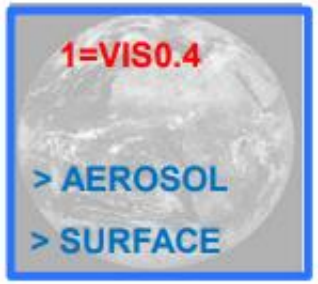
Source: M. Setvak, J. Kerkmann; 16 Nov 2018, 01.37 UTC
Right panel: simulated FCI imagery at ~2 km horizontal resolution
(1 km at nadir), based on NOAA Suomi-NPP VIIRS data
Left panel: MSG SEVIRI imagery at 5 km horizontal resolution (3 km at nadir)

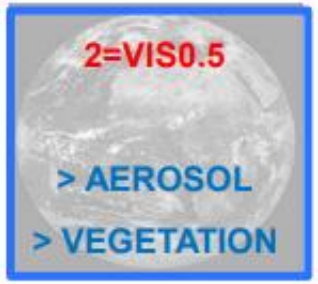
EXPECTED IMPROVEMENTS FROM MTG-I MISSION

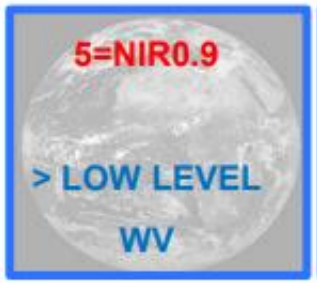


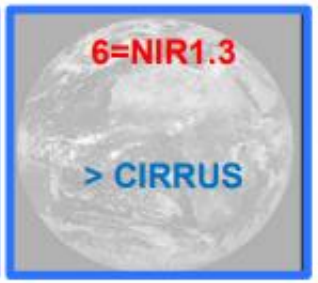


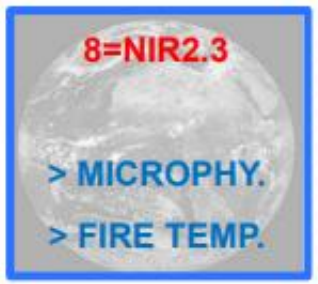
NEW CHANNELS - NEW RGB COMBINATIONS









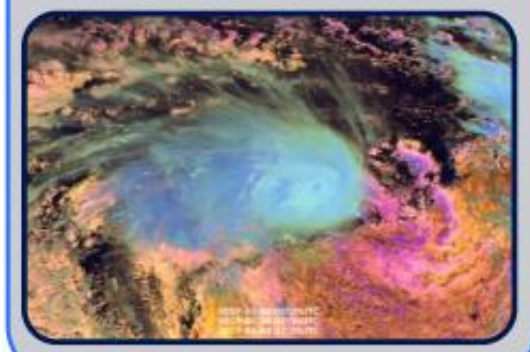


True Colour RGB

R VIS0.6
G VIS0.5
B VIS0.4

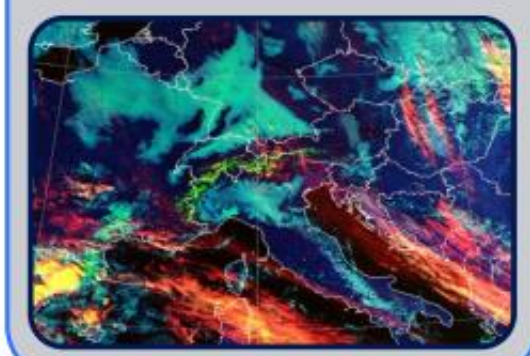
Cloud Phase RGB

R NIR1.6
G NIR2.3
B VIS0.5/VIS0.6



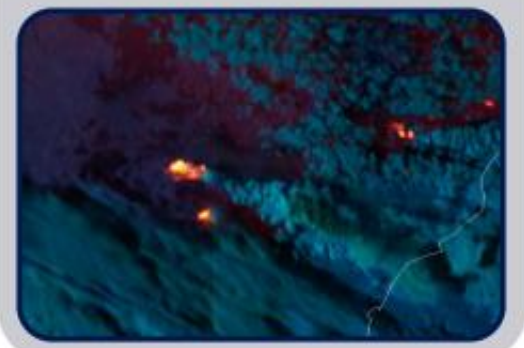
Cloud Type RGB

R NIR1.3
G VIS0.8
B VIS1.6

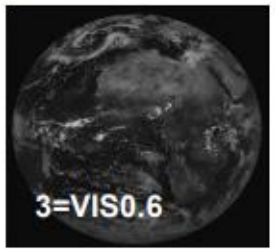


Fire Temp. RGB

R IR3.9
G NIR2.3
B NIR1.6



TRUE COLOUR RGB



2=VIS0.5

> AEROSOL

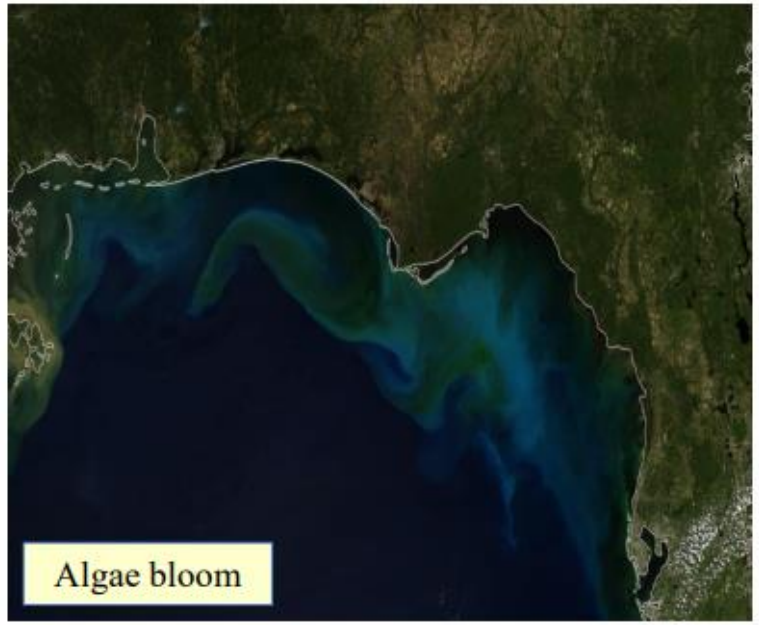
> VEGETATION

1=VIS0.4

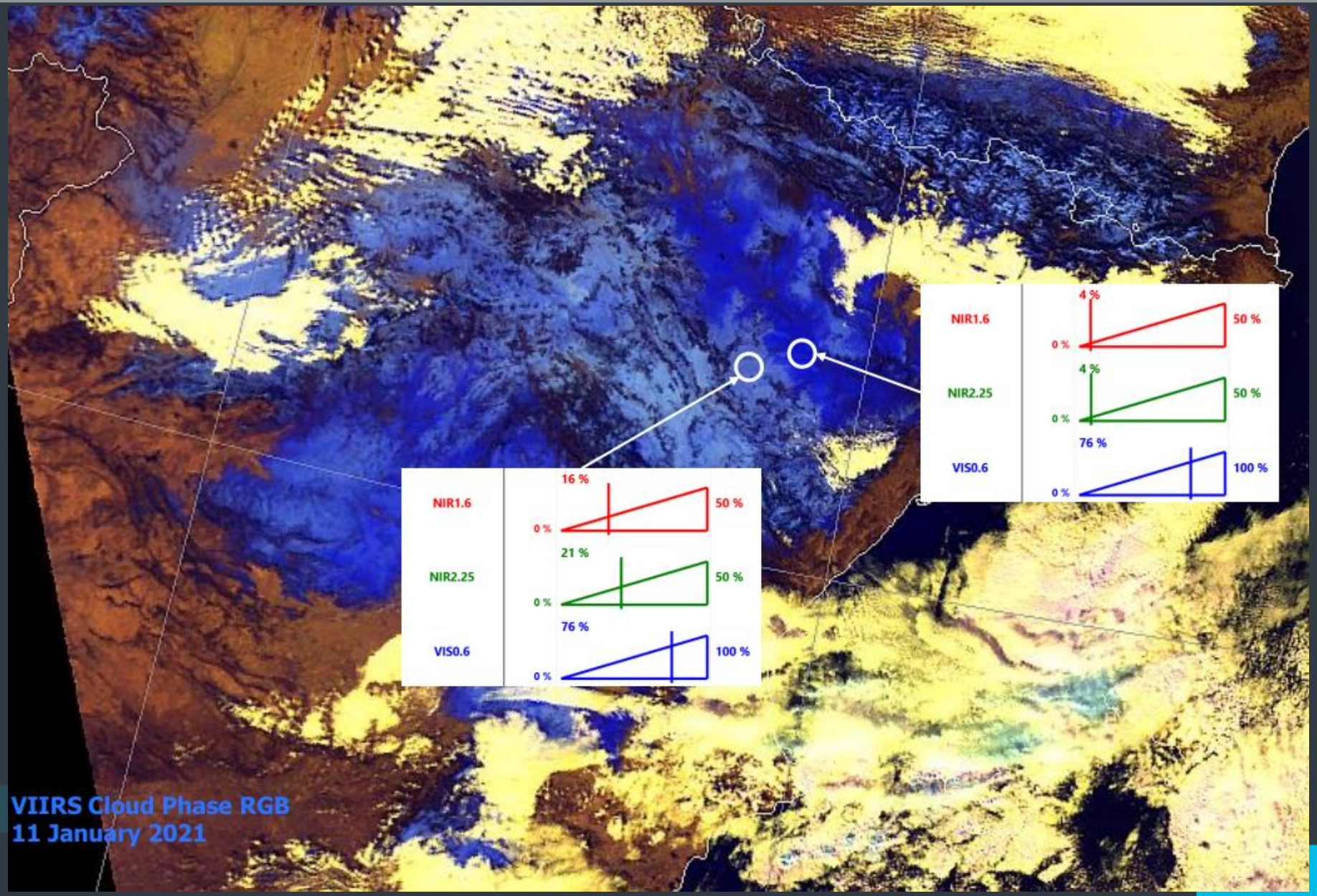
> AEROSOL

> SURFACE

- Clouds
- Aerosols (dust, ash, smoke, smog)
- Ocean Colour
- Vegetation



CLOUD PHASE RGB

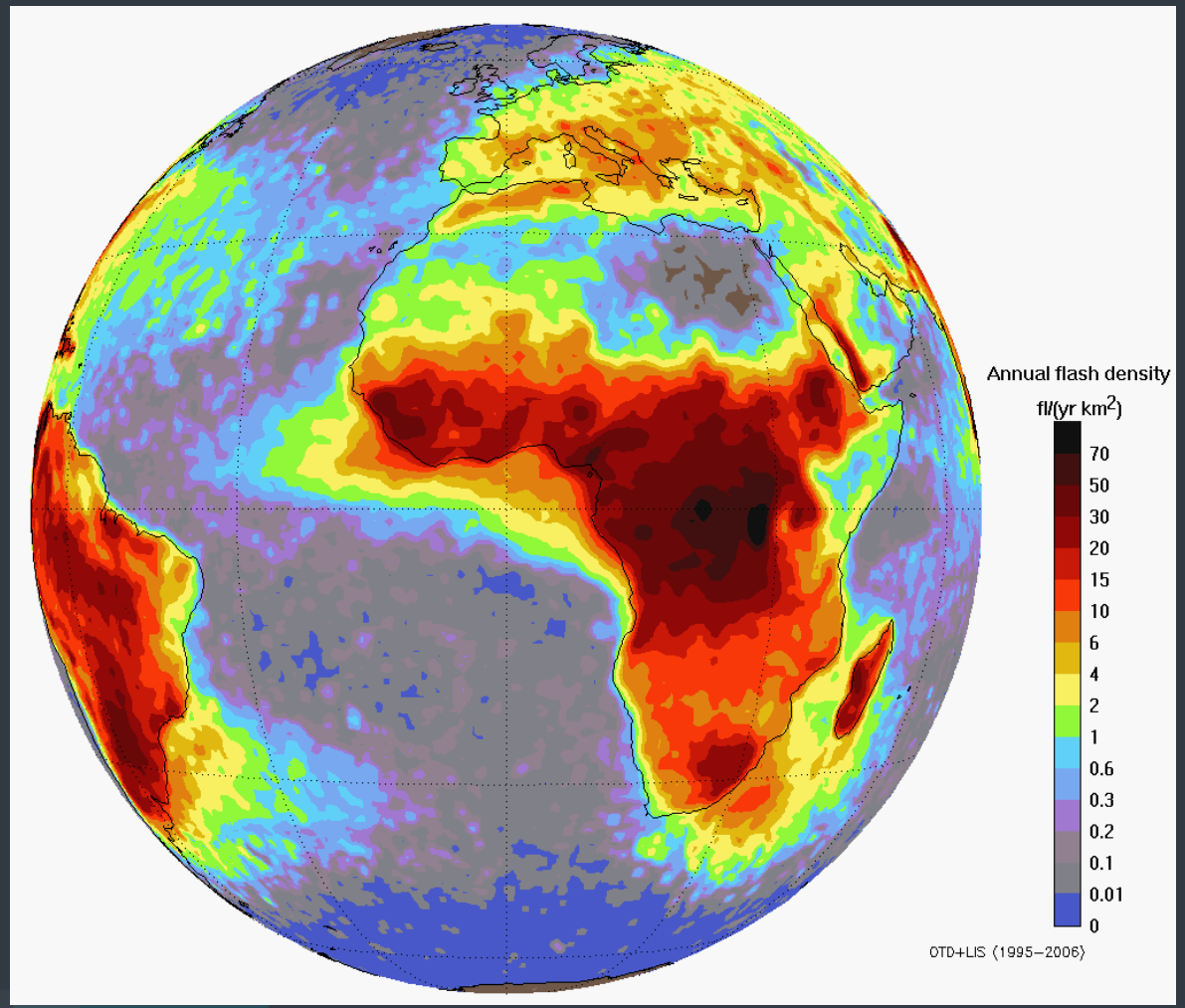


MTG LIGHTNING IMAGING MISSION

Foto: Daniel Pavlinovic

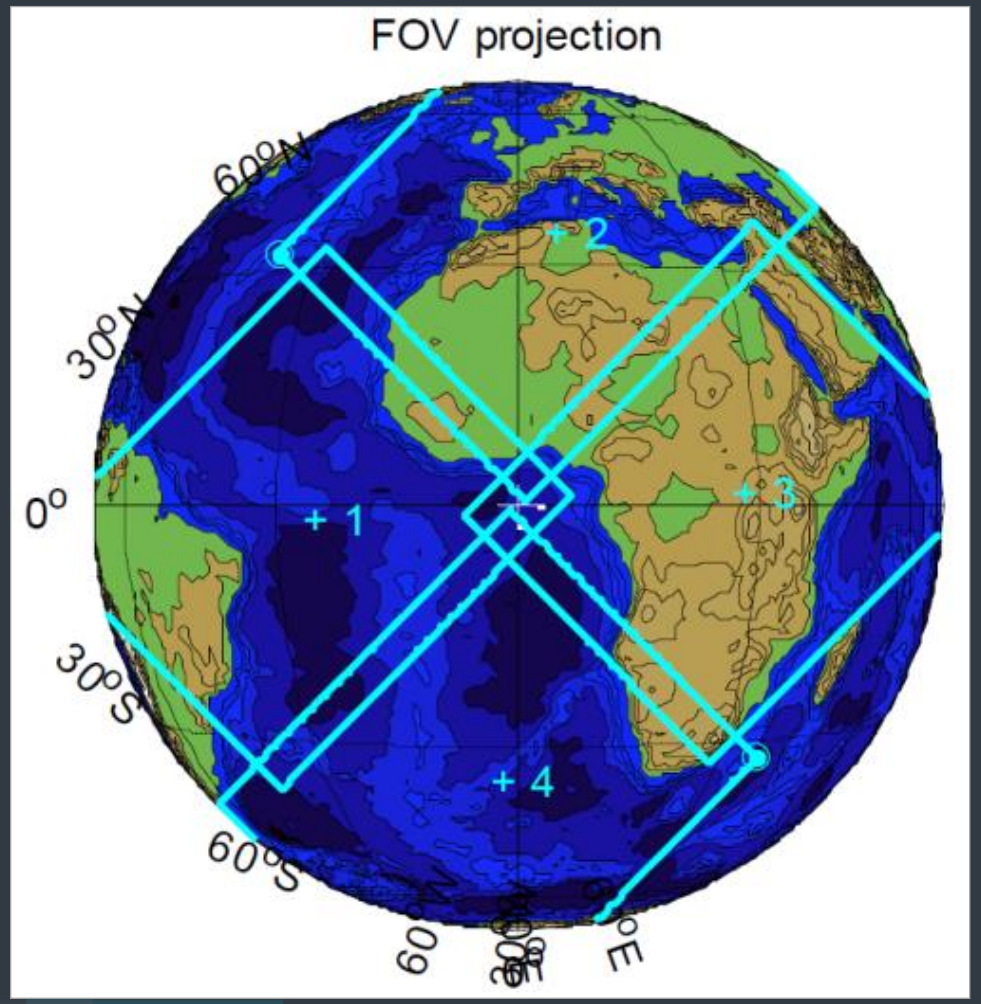
- Lightning is a precursor of severe weather, with a lead time of tens of minutes
- Most ground-based lightning location systems are mainly sensitive to cloud-to-ground lightning (CG)
- Often, no increase in CG due to “weather intensification” observable → Total lightning is the parameter of interest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

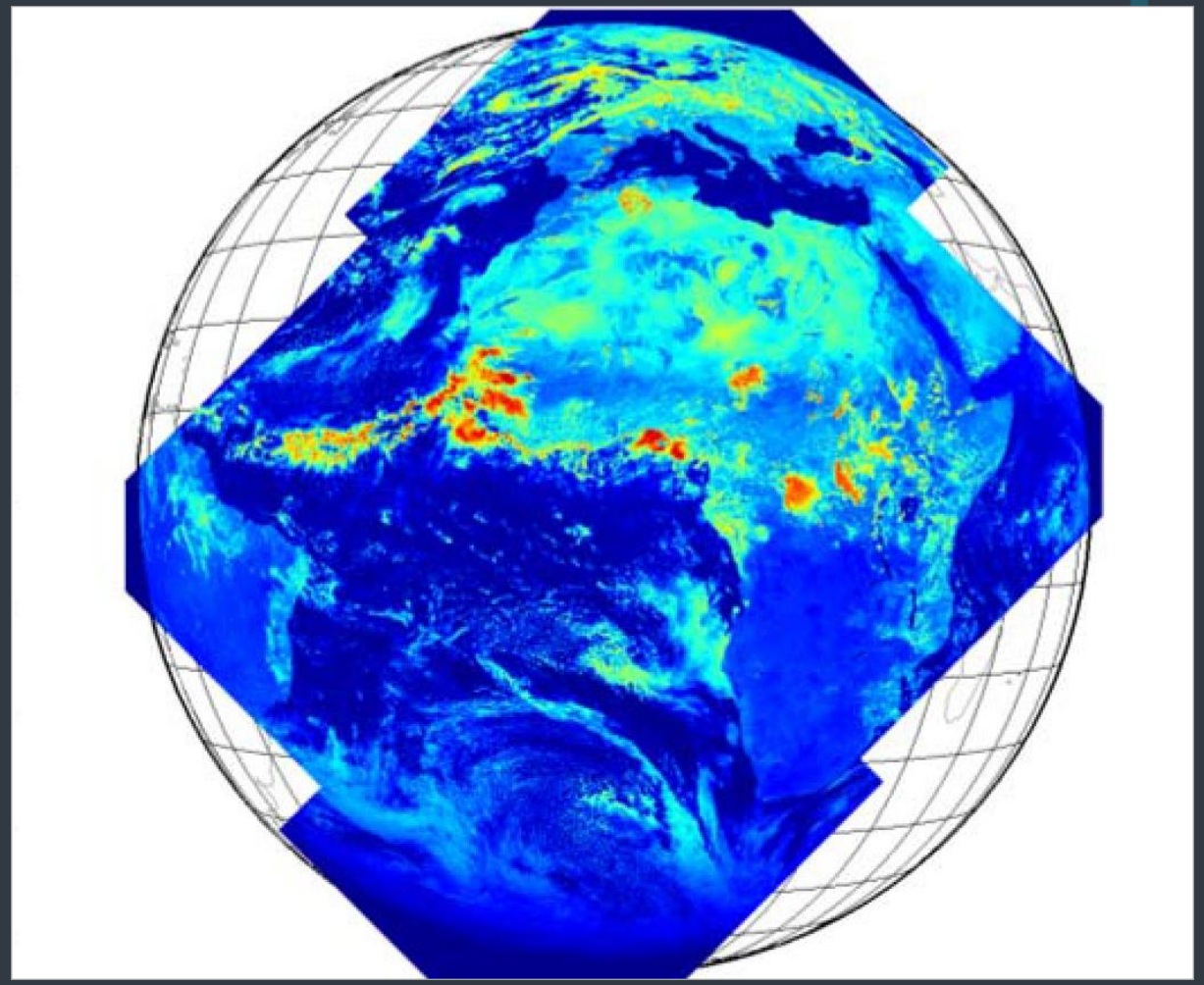
MTG LIGHTNING IMAGING MISSION



- High flash density over South and SE Europe, and sub-Saharan Africa
- MTG LI will measure total lightning, whereas ground-based networks are mostly sensitive to cloud-to-ground lightning

MTG LIGHTNING IMAGING MISSION

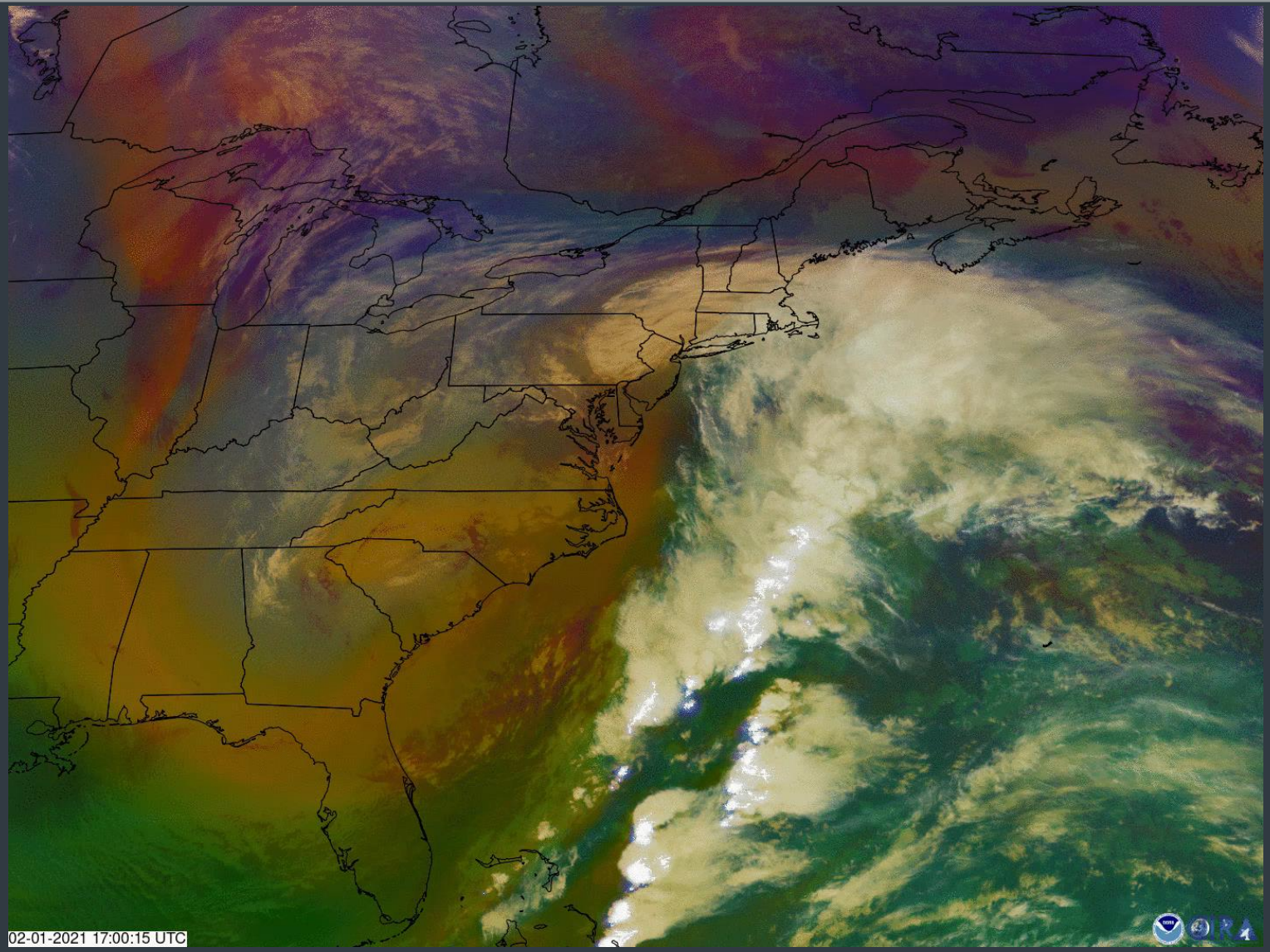




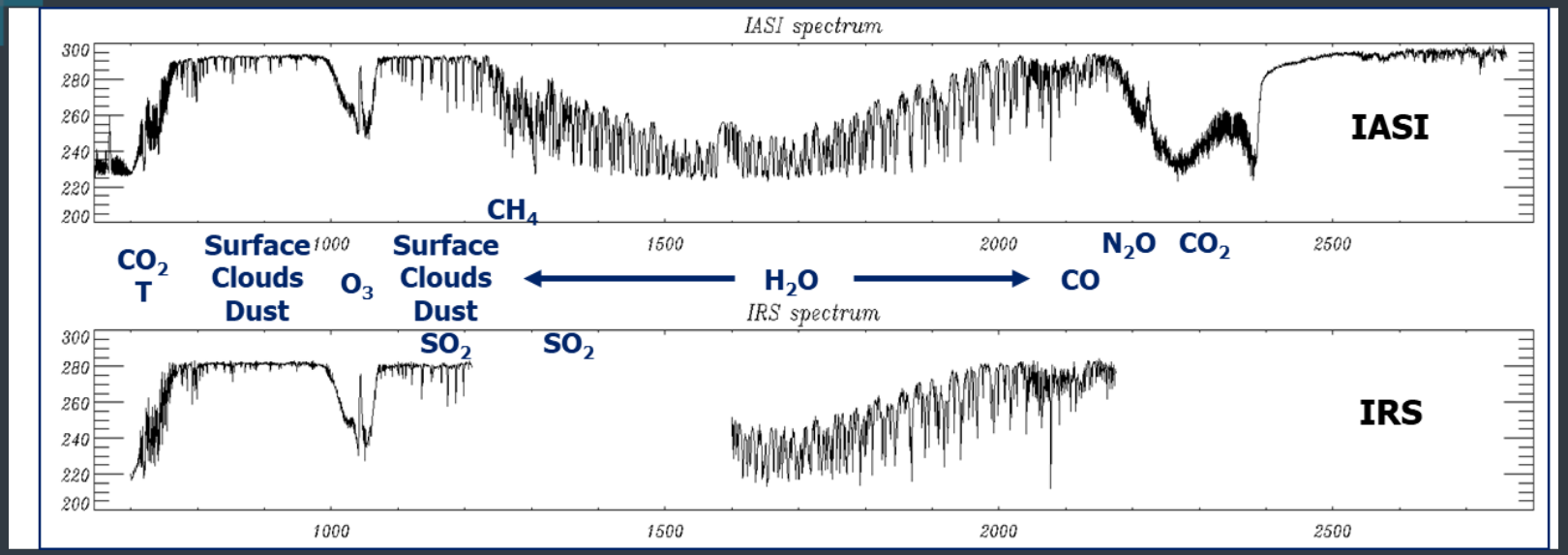
MTG + EPS-SG

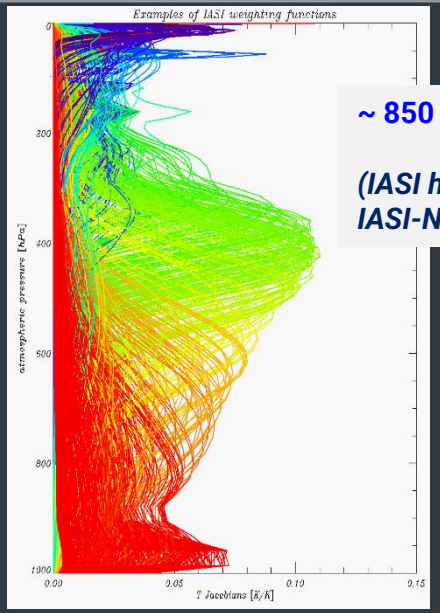
MTG LIGHTNING IMAGING MISSION

EUMETSAT



MTG INFRA-RED SOUNDER (IRS)





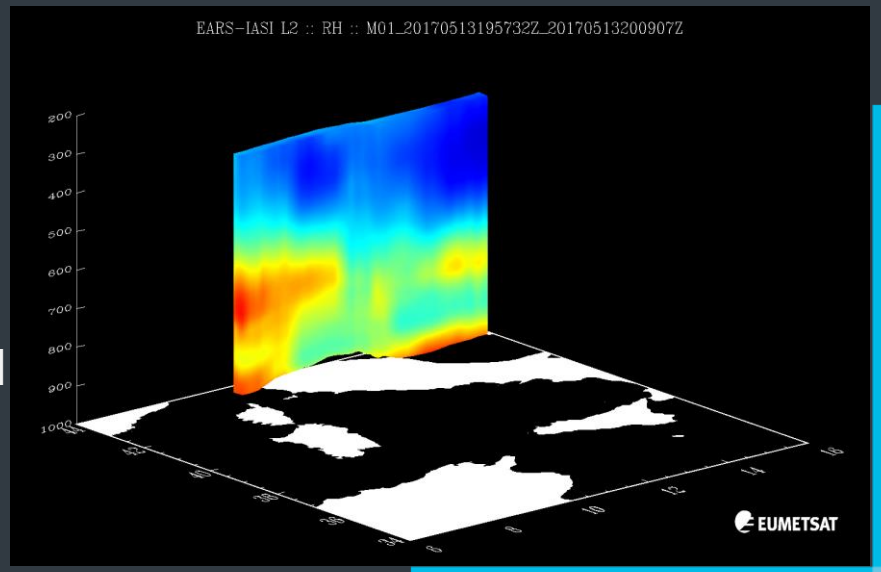
~ 850 channels

(IASI has 8461, IASI-NG 16921)

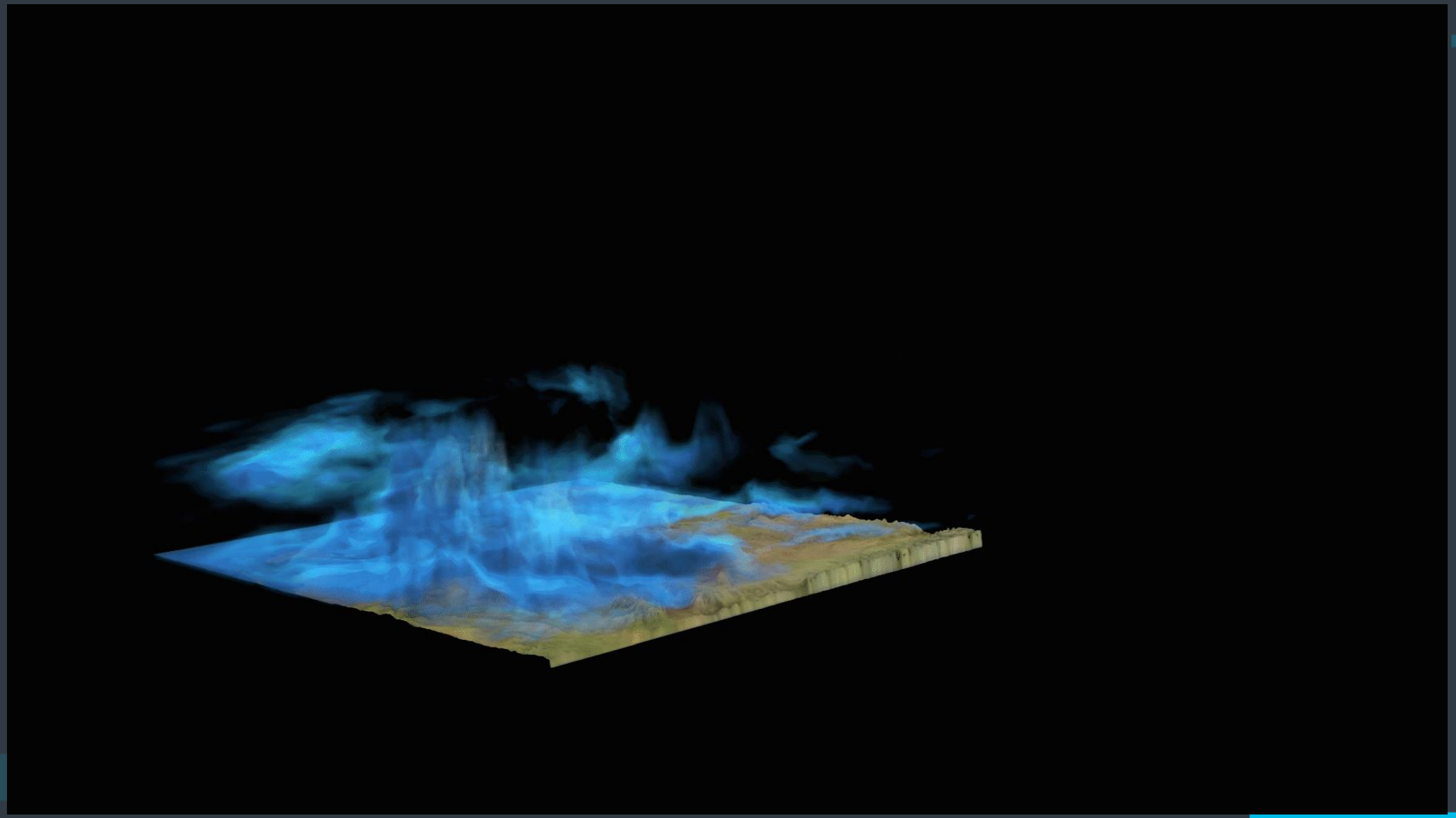
Operational spectro-imagery at high spectral, spatial & temporal resolution:

Two spectral bands: MWIR: 1600 to 2250 cm-1 (4.44–6.25 μm) and LWIR: 680 to 1210 cm-1 (8.26–14.70 μm)

Sampling: 0.6cm-1 spectral, 4km at nadir spatial, 30min temporal over Europe and parts of North Africa



4D WEATHER CUBE WITH MTG-I AND MTG-S



MTG – CONTRIBUTION TO PREDICTING HIGH-IMPACT WEATHER

Cloud Height

Bright sky / Humidity convergence / convective instability

IRS

Development of convective clouds

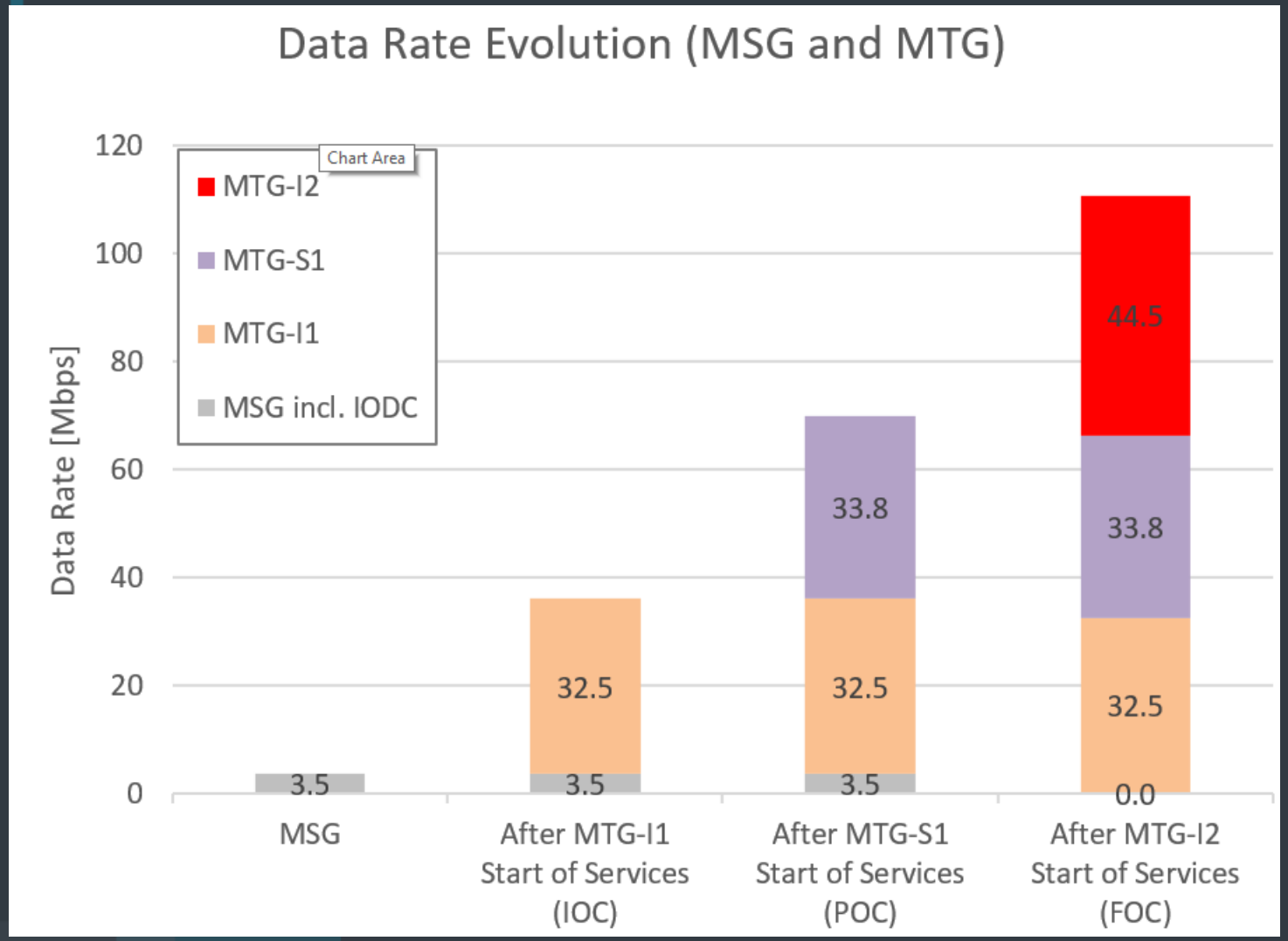
IRS + FCI

Anticipate storms

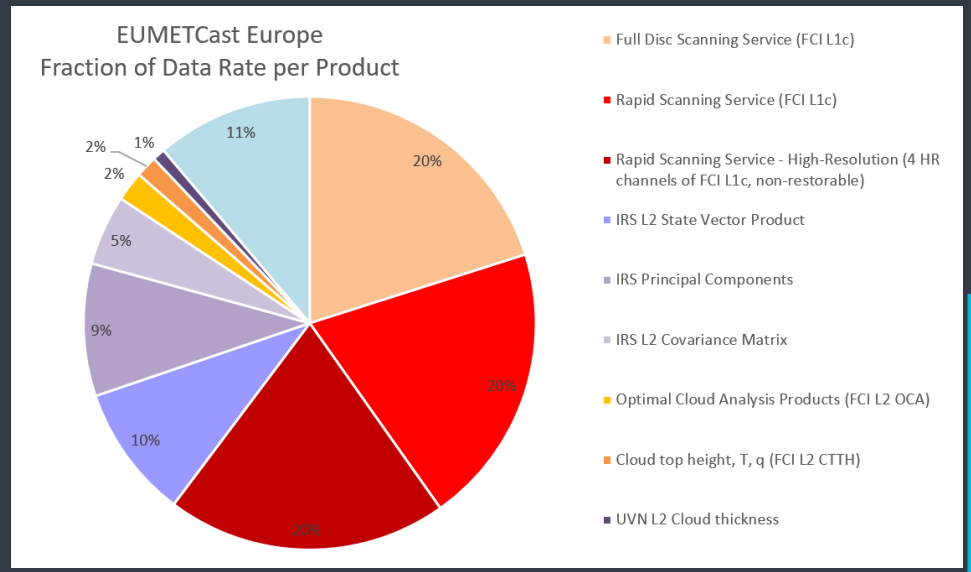
LI

Time

MTG DATA ACCESS AND PROCESSING



Evolution of data rates from current MSG to the full MTG operations.



MTG > EPS-SG

- Geostationary satellites have their limitations at high latitudes: polar satellites crucial.
- For the Nordic community EUMETSAT Polar System-Second Generation (EPS-SG) will be of particularly high interest.
- Support to Nowcasting applications
- Several novel and enhanced instruments onboard: **METimage**

METImage VII – AVHRR and VIIRS heritage

METimage on board EPS-SG will:

- provide enhanced continuity to the AVHRR (Advanced Very High Resolution Radiometer) series on board the EPS and NOAA satellites, and continuity to the VIIRS on board NOAA satellites.
- offer great improvement with respect to AVHRR and comparable performance with respect to VIIRS
- enable additional observation slots in the constellation with other polar orbiters

Temporal resolution

Adding another satellite to the polar constellation with Suomi NPP and JPSS-2 (VIIRS) and METOP (AVHRR)

– enhancing number of overpasses – particularly important over high latitudes

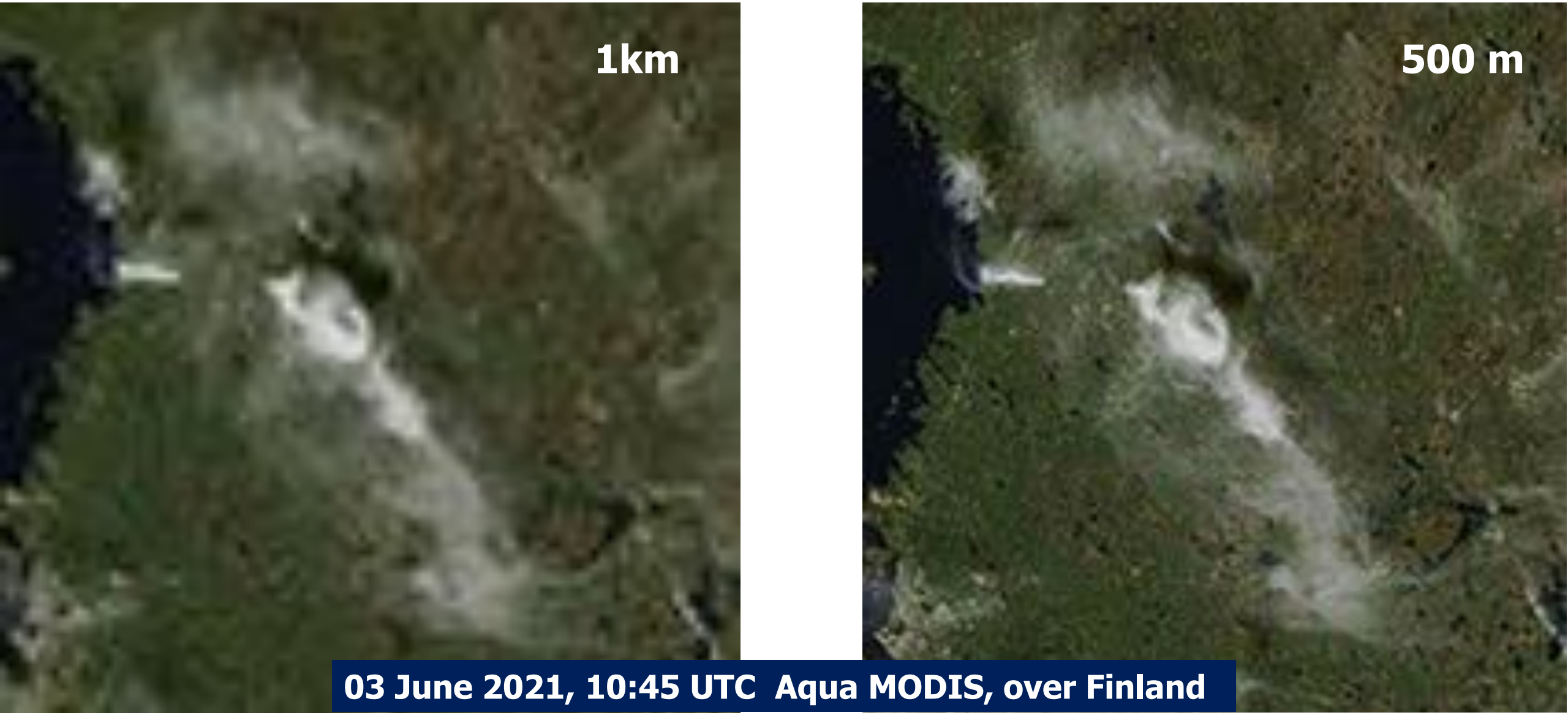
24 h VIIRS coverage of N. Europe – 24 May 2021

24 h AVHRR coverage of N. Europe – 24 May 2021

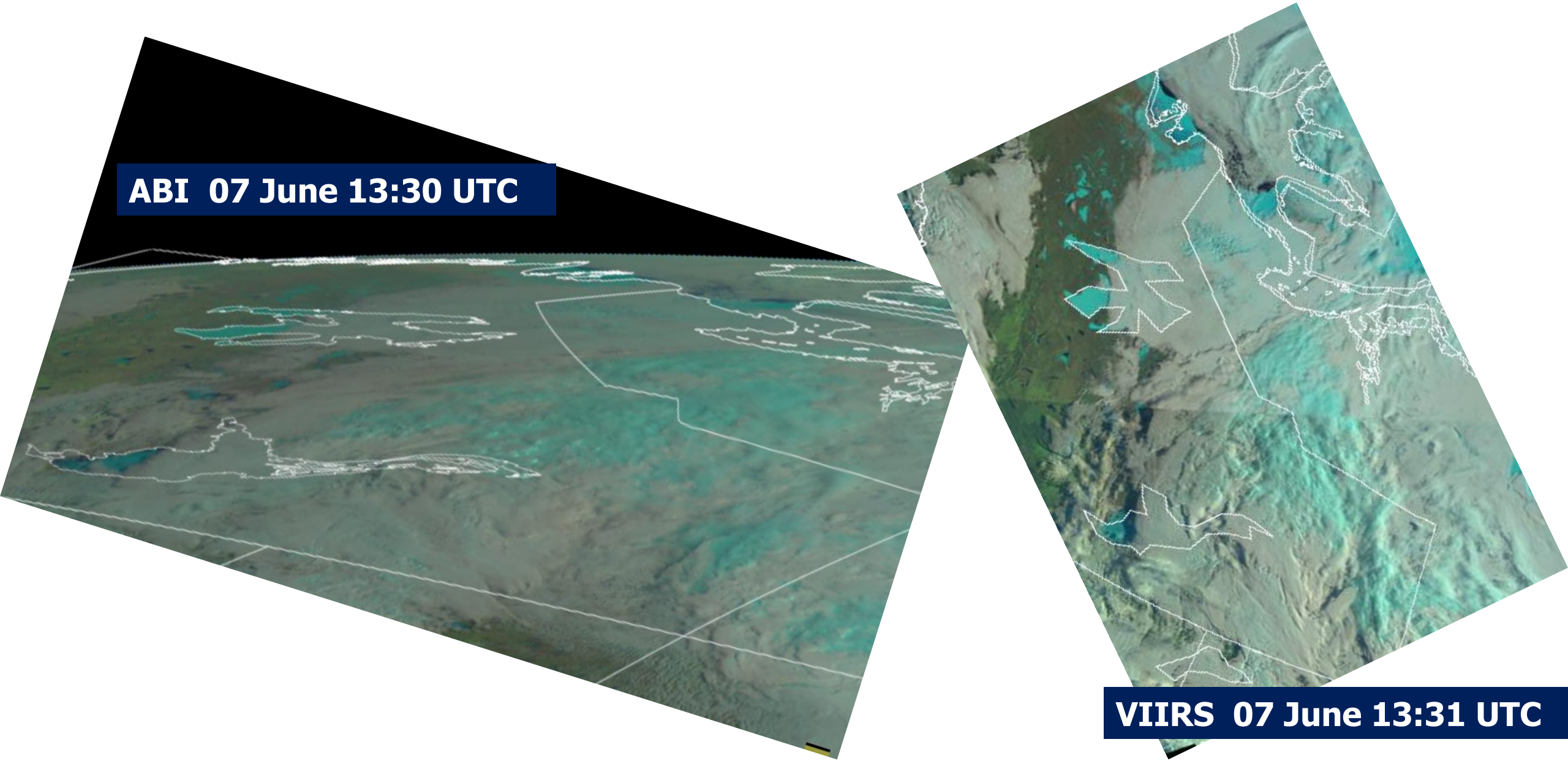
Courtesy: Adam Dybbroe, SHMI

METimage Channel	λ (μm)	FWHM (μm)	Primary Use	AVHRR channel	VIIRS channel
1	0.443	0.03	Aerosol, 'true colour imagery' (blue channel), vegetation	No	Yes
2	0.555	0.02	Clouds, vegetation, 'true colour imagery' (green channel)	No	Yes
3	**0.668**	**0.02**	**Clouds, vegetation, 'true colour imagery' (red channel)**	**Yes**	**Yes**
4	0.752	0.01	Atmospheric corrections (aerosol), optical cloud top height assignment, vegetation	No	Yes
5	0.763	0.01		No	No
6	**0.865**	**0.02**	**Vegetation, aerosol, clouds, surface features**	**Yes**	**Yes**
7	0.914	0.02	Water vapour imagery Water vapour total column	No	No
8	1.24	0.02	Vegetation, aerosol	No	Yes
9	1.375	0.04	High level aerosol, cirrus clouds, water vapour imagery	No	Yes
10	**1.63**	**0.02**	**Cloud phase, snow and ice, vegetation, aerosol, fire**	**Yes**	**Yes**
11	2.25	0.05	Cloud microphysics at cloud top, vegetation, aerosol over land, fire (effects)	No	Yes
12	3.74	0.18	Cloud variables, cloud microphysics at cloud top, absorbing aerosol, SST, LST, fire, sea and land ice, snow	No	Yes
13	3.959	0.06	SST, LST, fire	No	No
14	4.05	0.06	SST, LST fire	No	Yes
15	6.725	0.37	Water vapour imagery (including wind in polar regions), water vapour profile (coarse vertical resolution)	No	No
16	7.325	0.29		No	No
17	8.54	0.29	Cirrus clouds, cloud emissivity	No	Yes
18	**10.69**	**0.5**	**Cloud variables including cirrus detection, surface temperatures and other radiative variables, surface imagery (snow, ice etc),**	**Yes**	**Yes**
19	**12.02**	**0.5**		**Yes**	**Yes**
20	13.345	0.31	CO_2 slicing for accurate cloud top height. Temperature profile (coarse vertical resolution)	No	No

Enhanced Spatial Resolution



Spatial resolution and viewing geometry



New RGBs

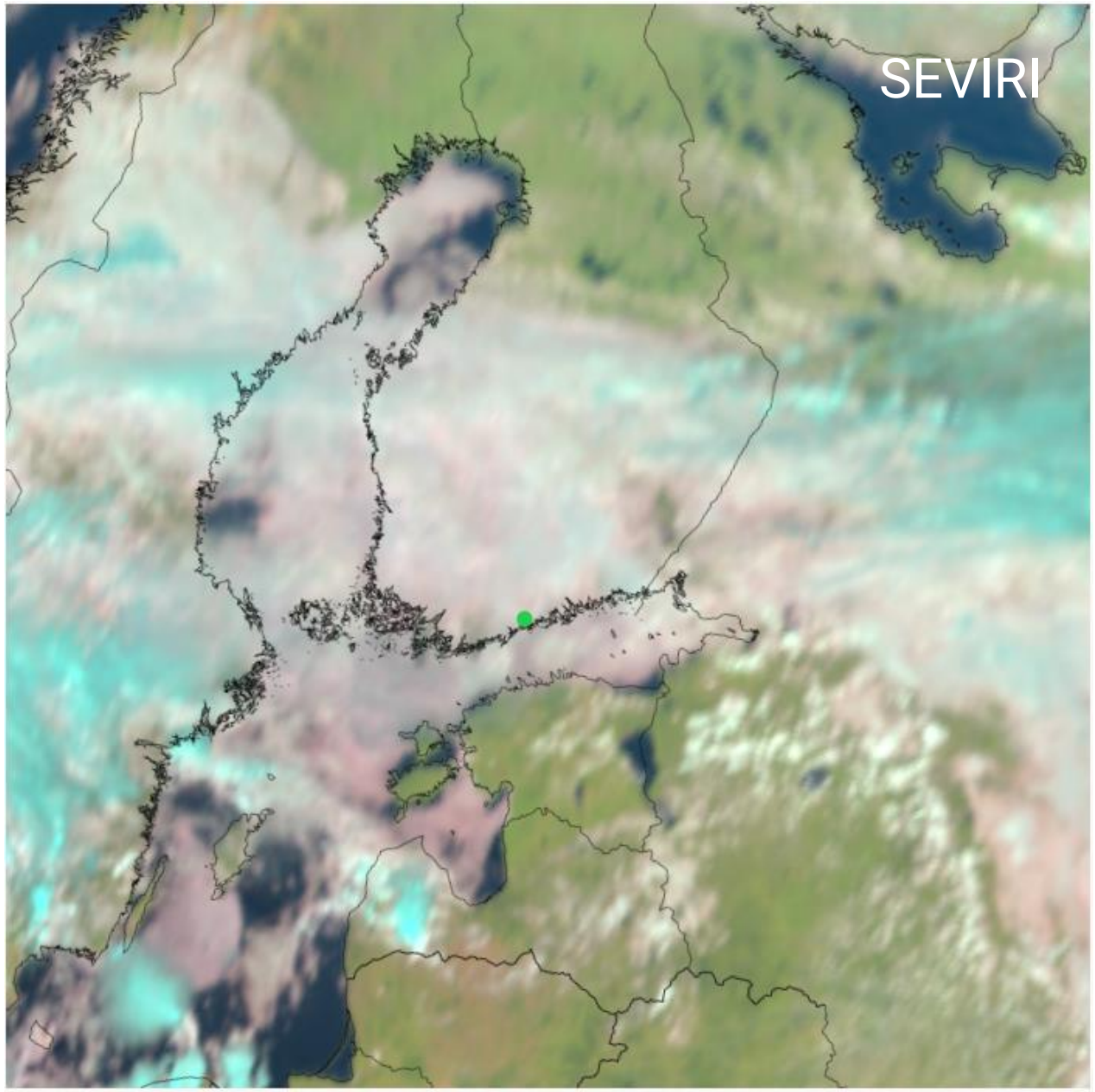
- New channels will enable production of new RGBs currently not available with AVHRR:

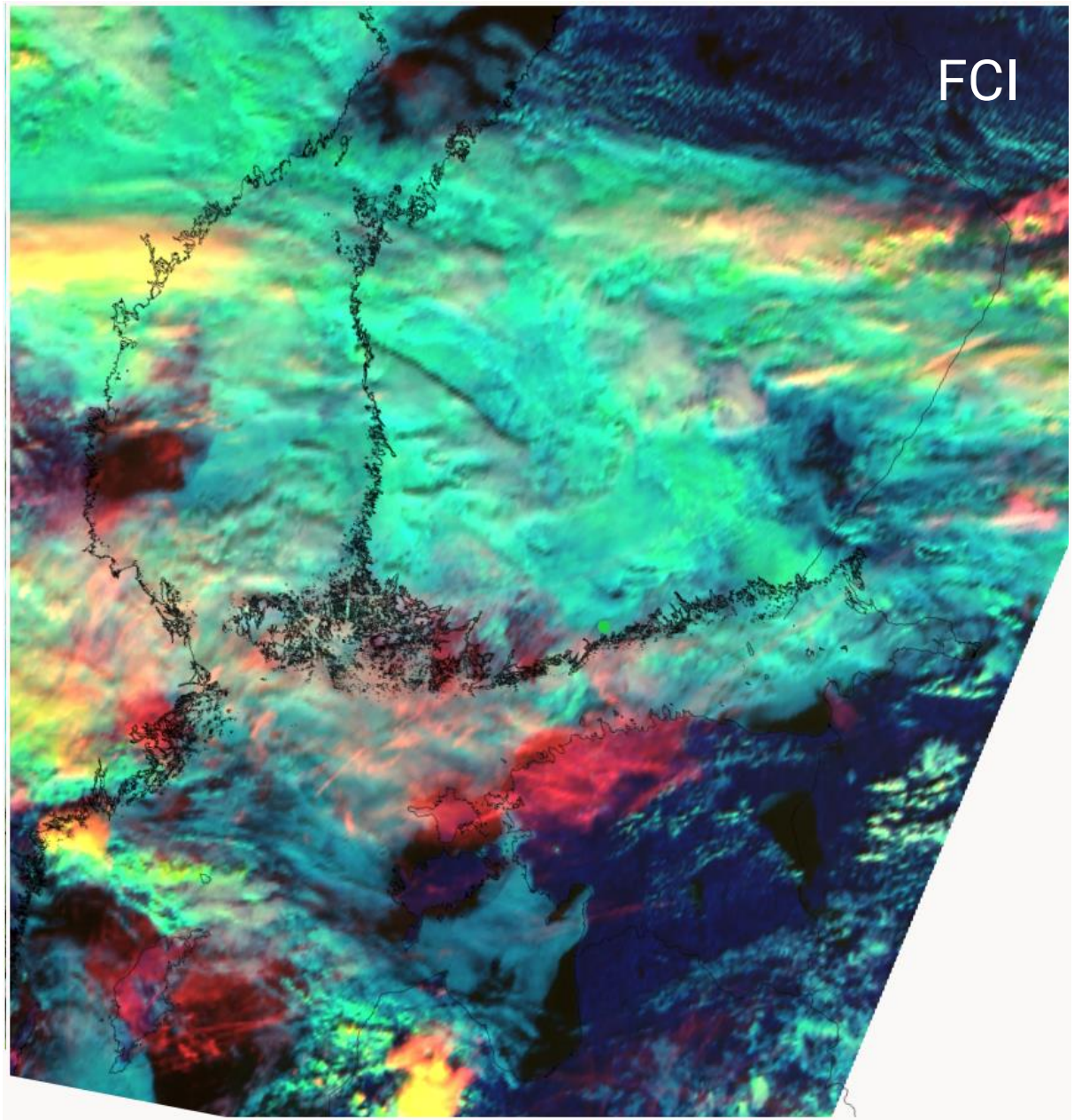
True Colour RGB	(0.67 - 0.56 - 0.44 µm)
Cloud Phase RGB	(1.63 - 2.25 - 0.67 µm)
Cloud Type RGB	(1.38 - 0.67 - 1.63 µm)
Daytime Snow RGB	(0.86 - 1.24 - 2.25 µm)
Dust RGB	
24-h Microphysics RGB	(12.0-10.7; 10.7-8.5; 10.7 µm)
Ash RGB	
Fire Temperature RGB	(3.96 - 2.25 - 1.63 µm)

High Latitude Cases – Finnish Meteorological Institute

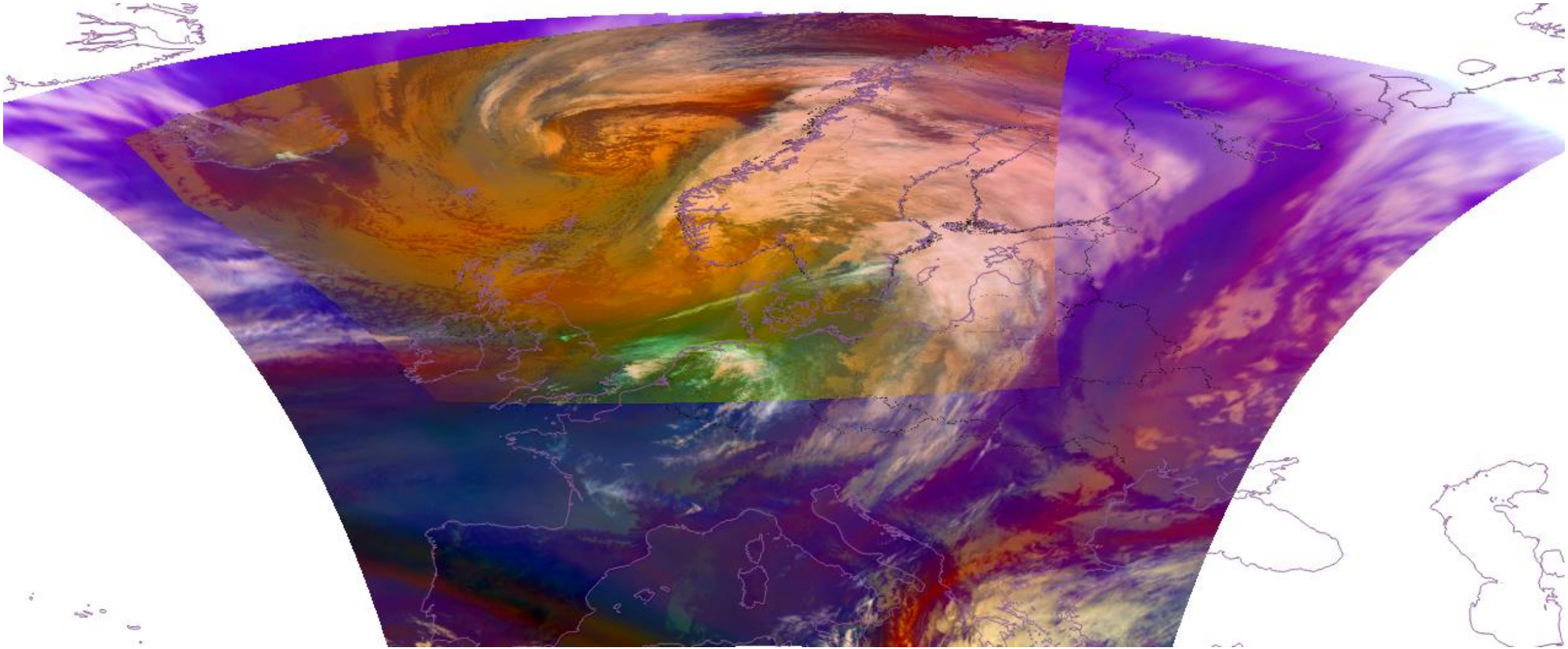
- FMI is currently preparing application cases highlighting the improvements to be expected with FCI on MTG and METimage on EPS-SG
- Project completes end of June
- Results and cases will be shared in EUMETSAT Image Library
- Cases:
  - Fog, Freezing Precip, Winter Storm “Malik”/”Valtteri”, Mountain Waves over Norway, Summer Storm “Ahti”, US Forest Fires

Fog case September 2021

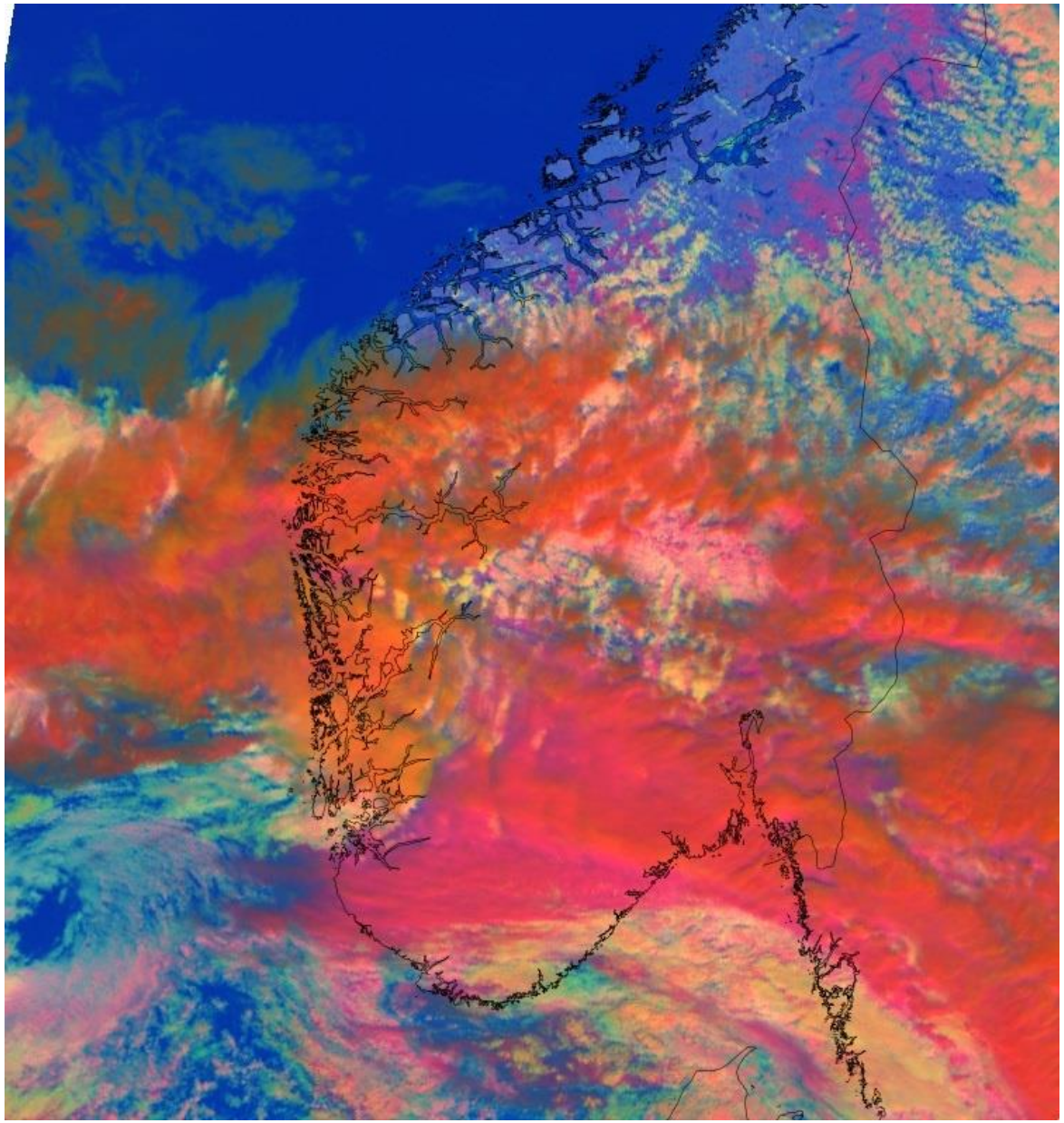


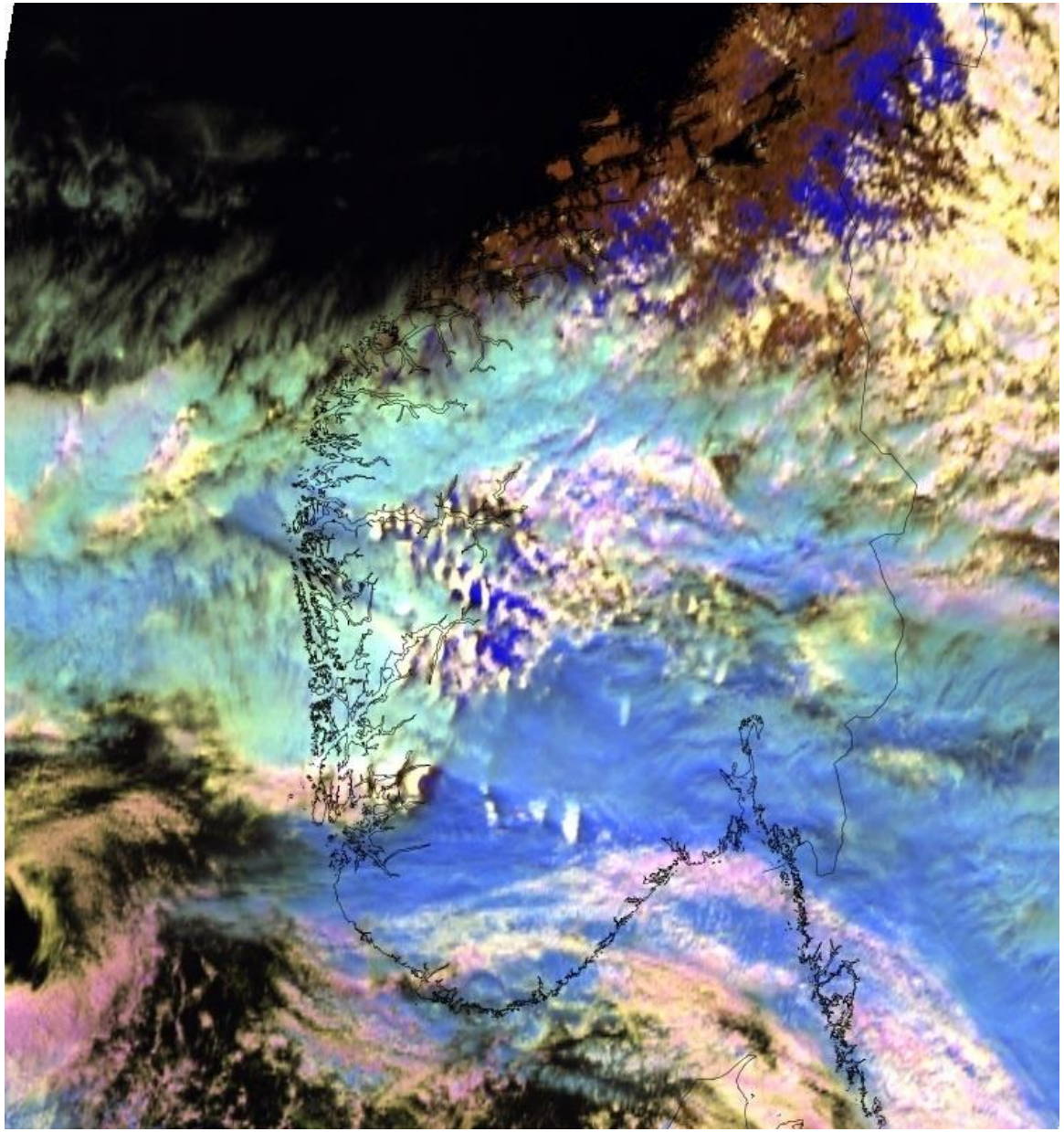


Storm Malik / Valtteri



Mountain waves – FCI simulated





PREPARATION FOR MTG

EUMETSAT is fostering preparation among NMHS

- User Preparation Projects
- User Days (recently in Darmstadt, Germany)
- Technical Webinars (https://www.eumetsat.int/mtg-resources)
- Science Conferences
- Test data (https://www.eumetsat.int/mtg-test-data)
- Training
- Engagement with private sector, SW/HW manufacturers

PREPARATION FOR MTG

Training

- The EUMETSAT training programme has started to focus on MTG and EPS-SG applications. There will be a range of opportunities for and staff of NMHS to engage.
- Regional courses (NOMEK, BALTIC+, SEEMET, DACH, …), EUMeTrain
- Testbeds (i.e. Aviation Testbed hosted by FMI)
- Online learning (https://training.eumetsat.int)

Fellowship Programme: Recent focus on nowcasting applications, in addition to NWP

Data Services: Evolution of NRT push & pull services, Data discovery and handling tools

User Support: User Service Helpdesk: ops@eumetsat.int

Thank you!

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