MTG + EPS-SG

EUMETSAT

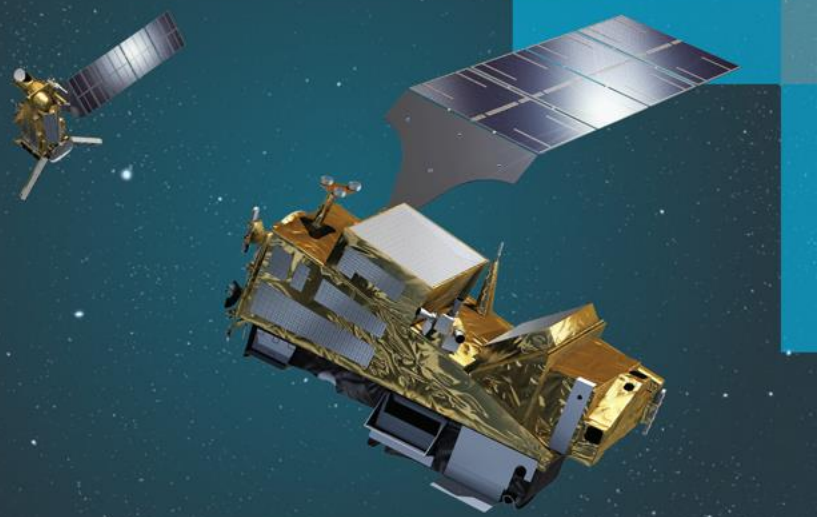
FUTURE FOCUS

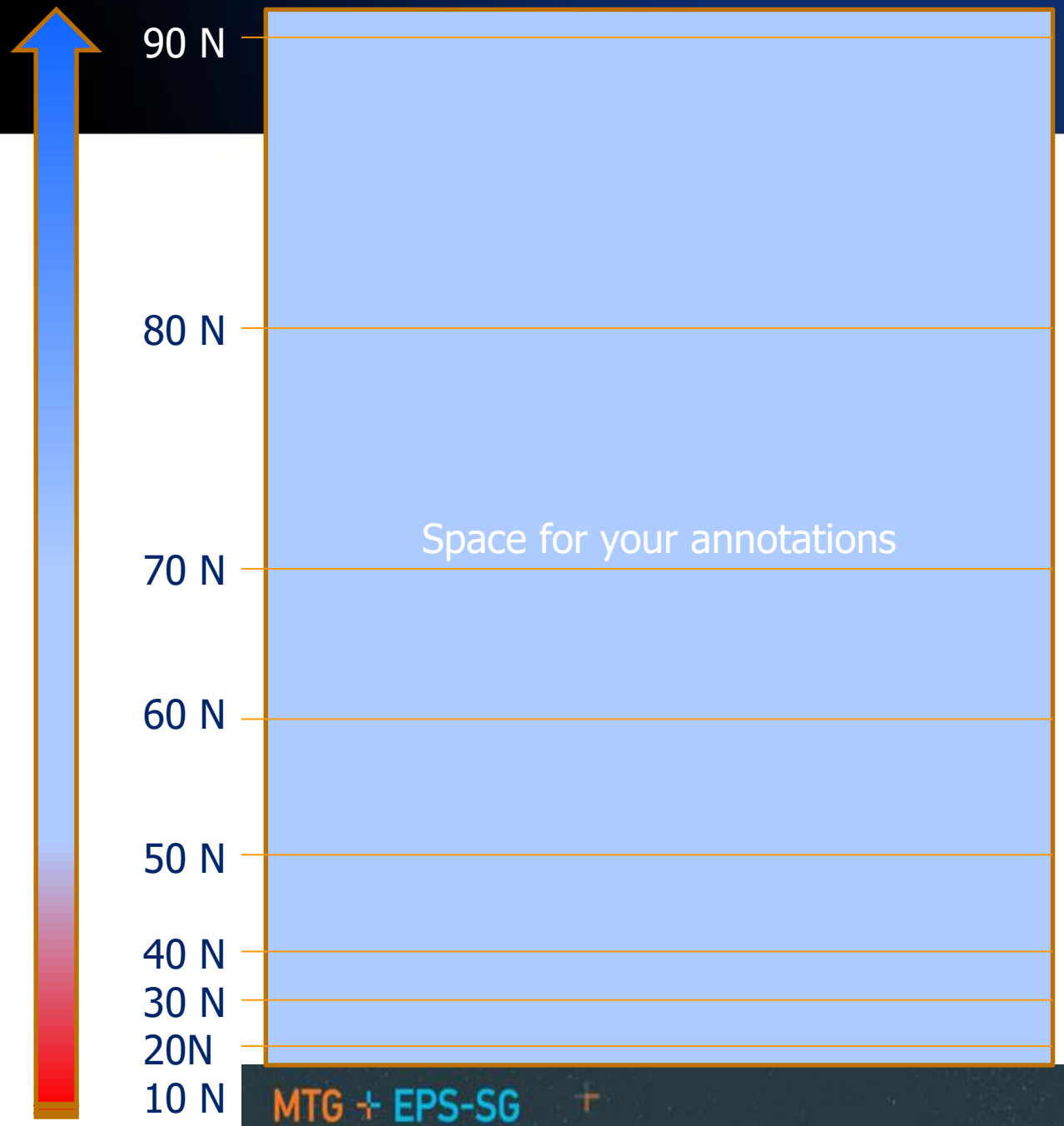
Weather and climate data like never before

MTG & EPS-SG

Vesa Nietosvaara
EUMETSAT

EUMeTrain High Latitudes Event – 31.1.2023





Where do high latitudes begin?

Place your opinion

in the blue space on left

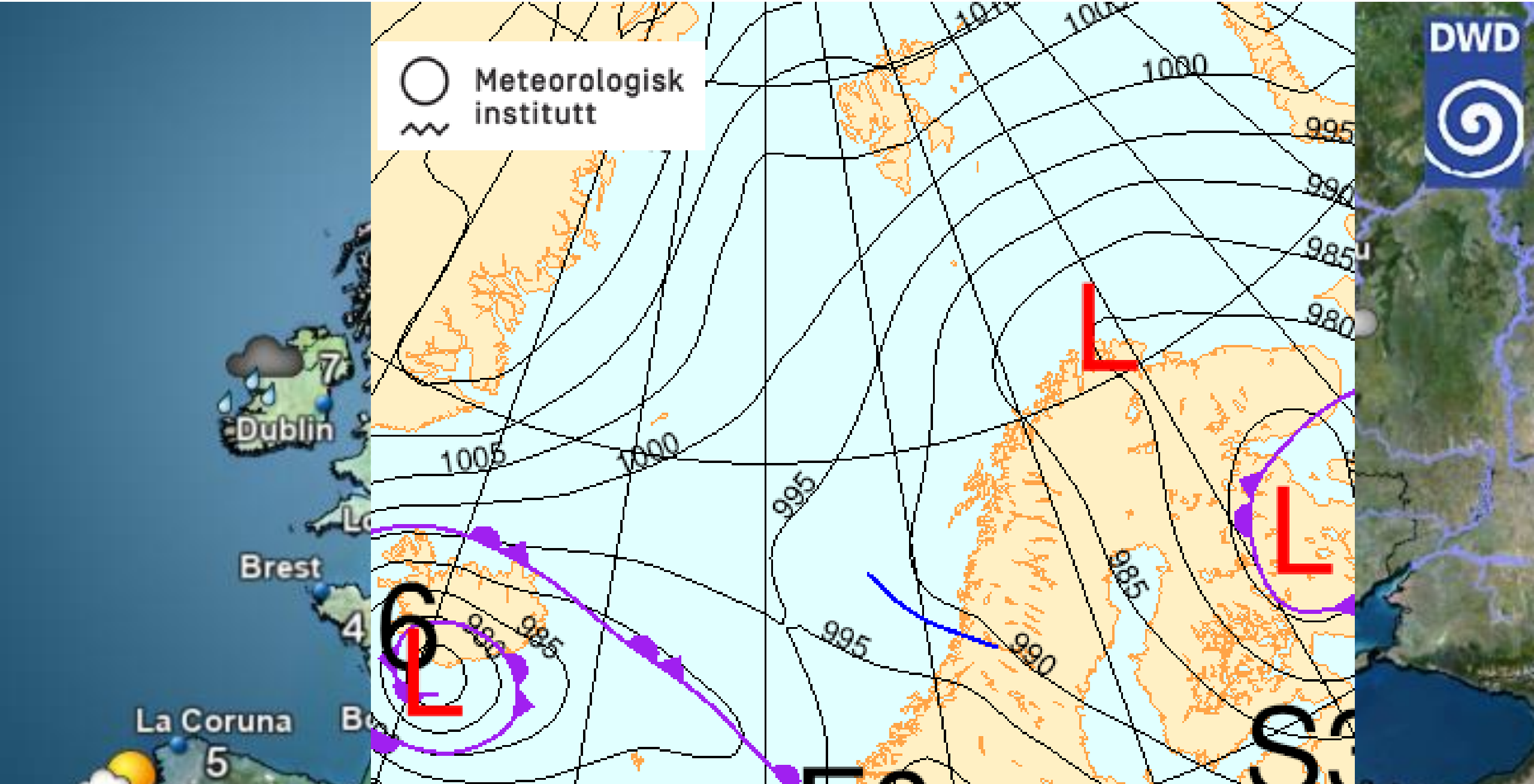
MTG & EPS-SG

Vesa Nietosvaara
EUMETSAT

EUMeTrain High

Latitudes Event – 31.1.2023

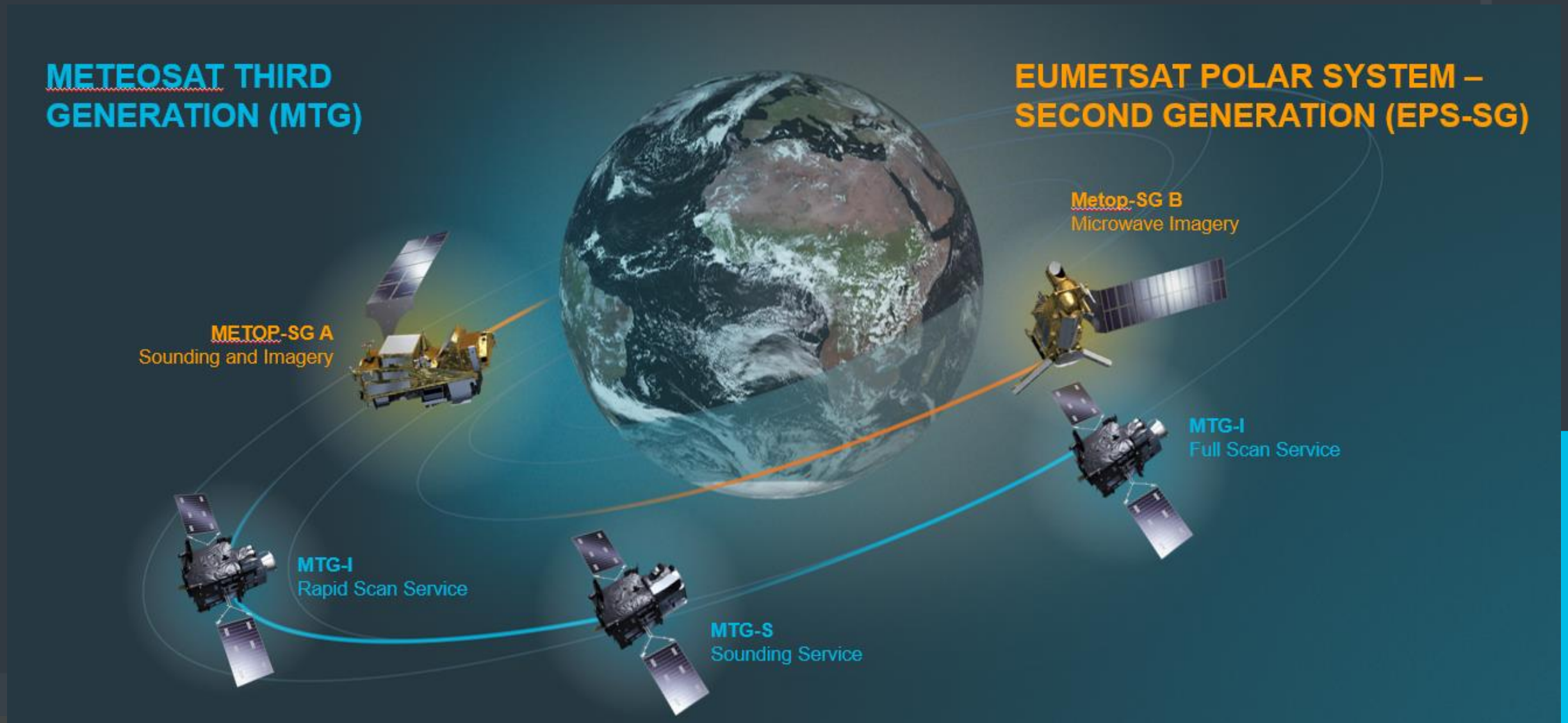
The definition of “High Latitude” depends on our point of view



MTG + EPS-SG

EUMETSAT FUTURE FOCUS: TWO HIGHLY INNOVATIVE PROGRAMMES

EUMETSAT



LAUNCHES

13th Dec 2022

Meteosat Third Generation-I1

Meteosat Third Generation-S1

Jul 2024 - Sep 2024

Metop - Second Generation A1

Oct 2024 - Dec 2024

Jan 2025 - Apr 2025

Metop-Second Generation B1

Sentinel-3C

Oct 2025 - Dec 2025

Oct 2025 - Dec 2025

CO2 Mission A

Oct 2025 - Dec 2025

Sentinel-6B

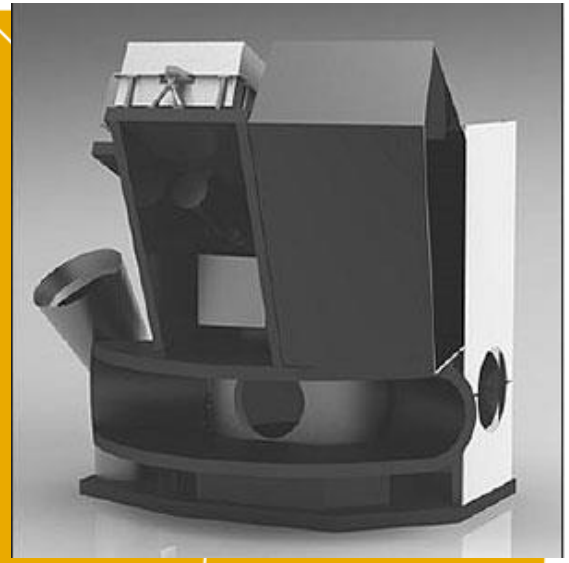
Meteosat Third Generation-I2

Jan 2026 - Mar 202

MTG > EPS-SG

- Geostationary satellites have their limitations at high latitudes: polar satellites are crucial.
- For the users at High Latitudes EUMETSAT Polar System-Second Generation (EPS-SG) will be of particularly high interest.
- Several novel and enhanced instruments onboard: **METimage**

METImage – AVHRR and VIIRS heritage



- ✓ High horizontal resolution cloud products including microphysical analysis
- ✓ Sea surface temperature
- ✓ Vegetation, snow coverage, and fire monitoring products
- ✓ Aerosol products
- ✓ Polar atmospheric motion vectors

METimage instrument 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

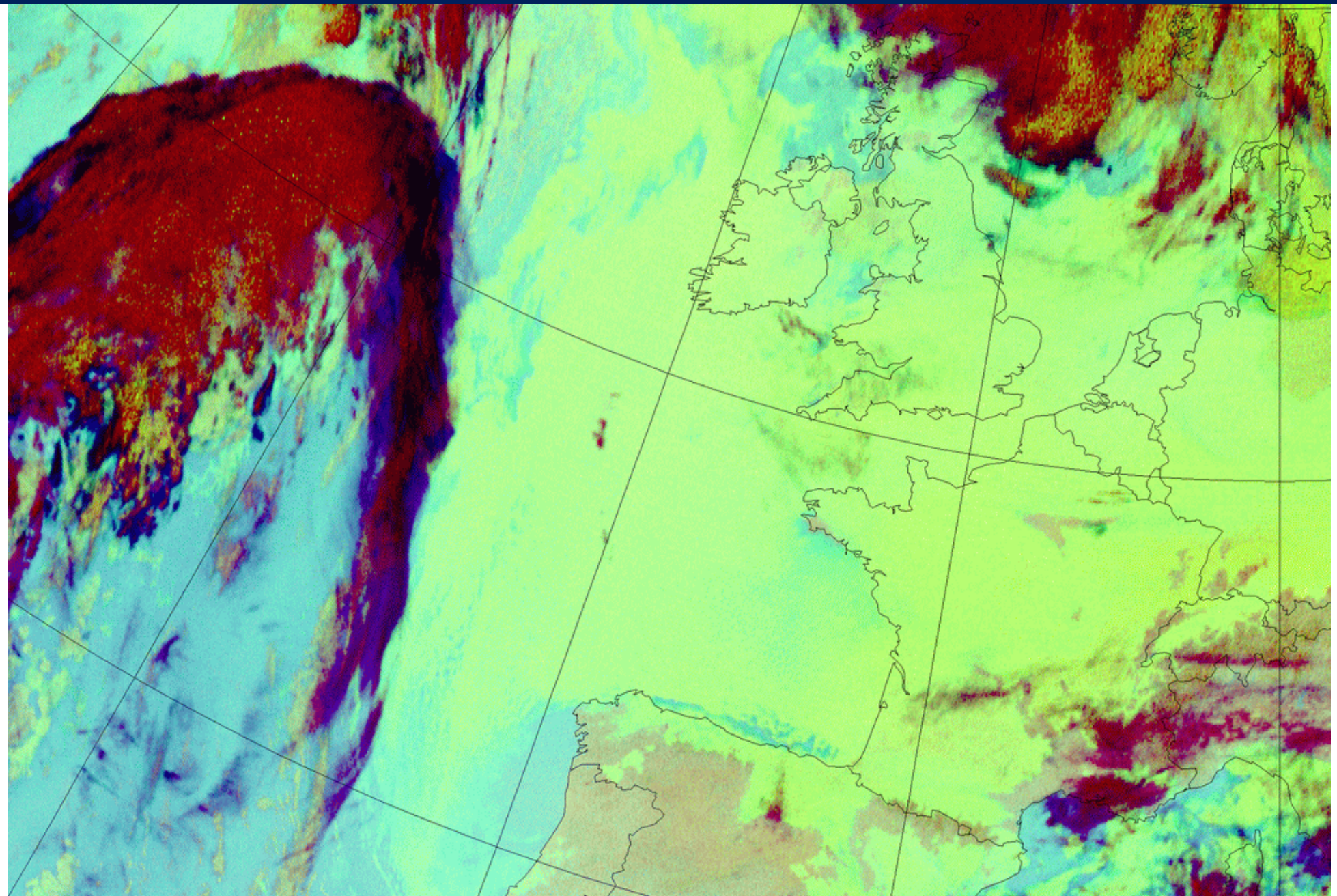
EPS-SG will bring…

Continuity

Improvent

Innovation

Example of Continuity



Example of Improvement – Enhanced Spatial Resolution

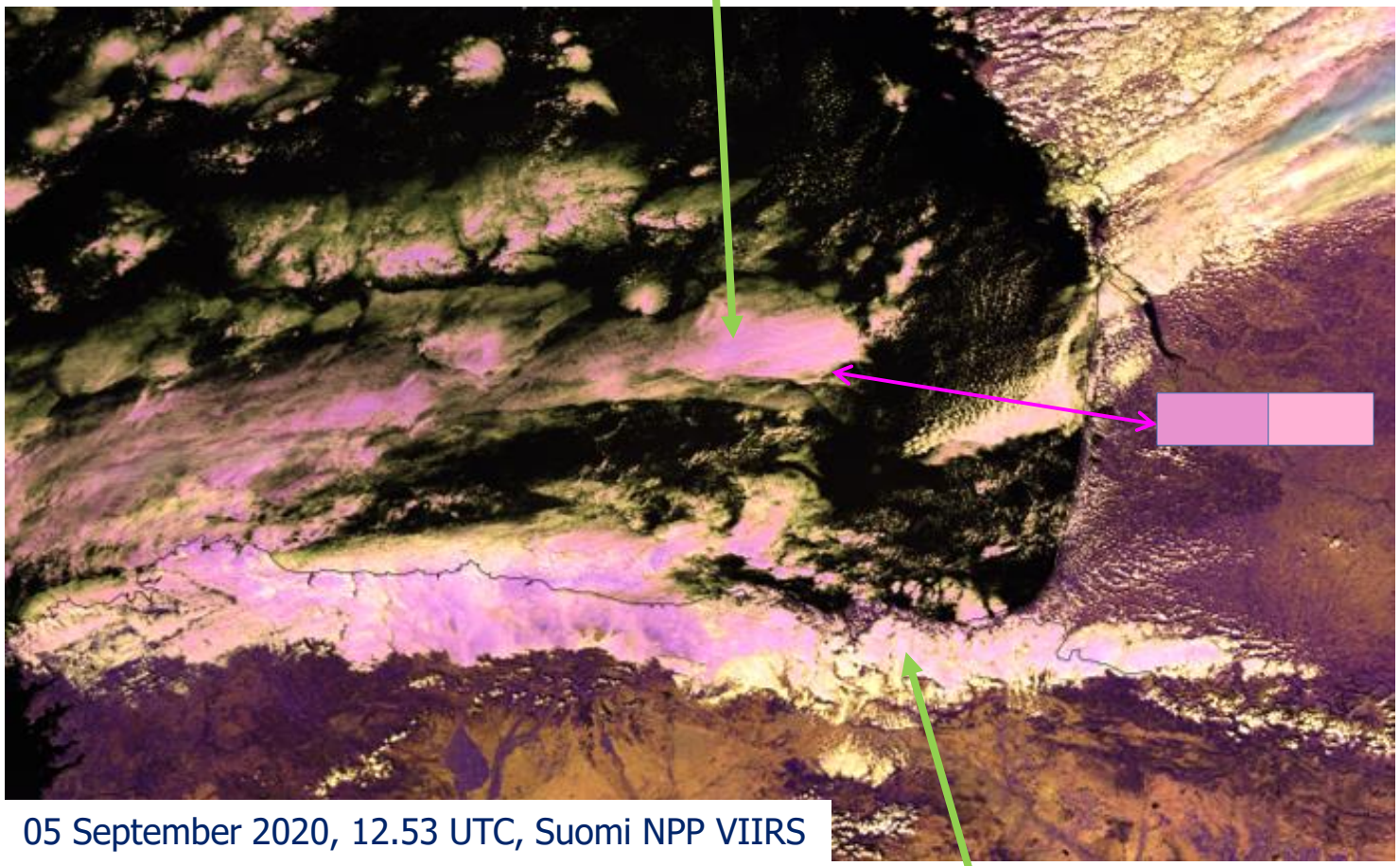
03 June 2021, 10:45 UTC Aqua MODIS, over Finland

Example of Innovation - Cloud Phase RGB (1.63 - 2.25 - 0.67 µm)

Application:
Cloud phase distinction

- Availability of 2.25 µm channel, together with 1.63 µm will enable more reliable cloud phase analysis!

Large droplets in maritime stratocumulus – dark pink



05 September 2020, 12.53 UTC, Suomi NPP VIIRS

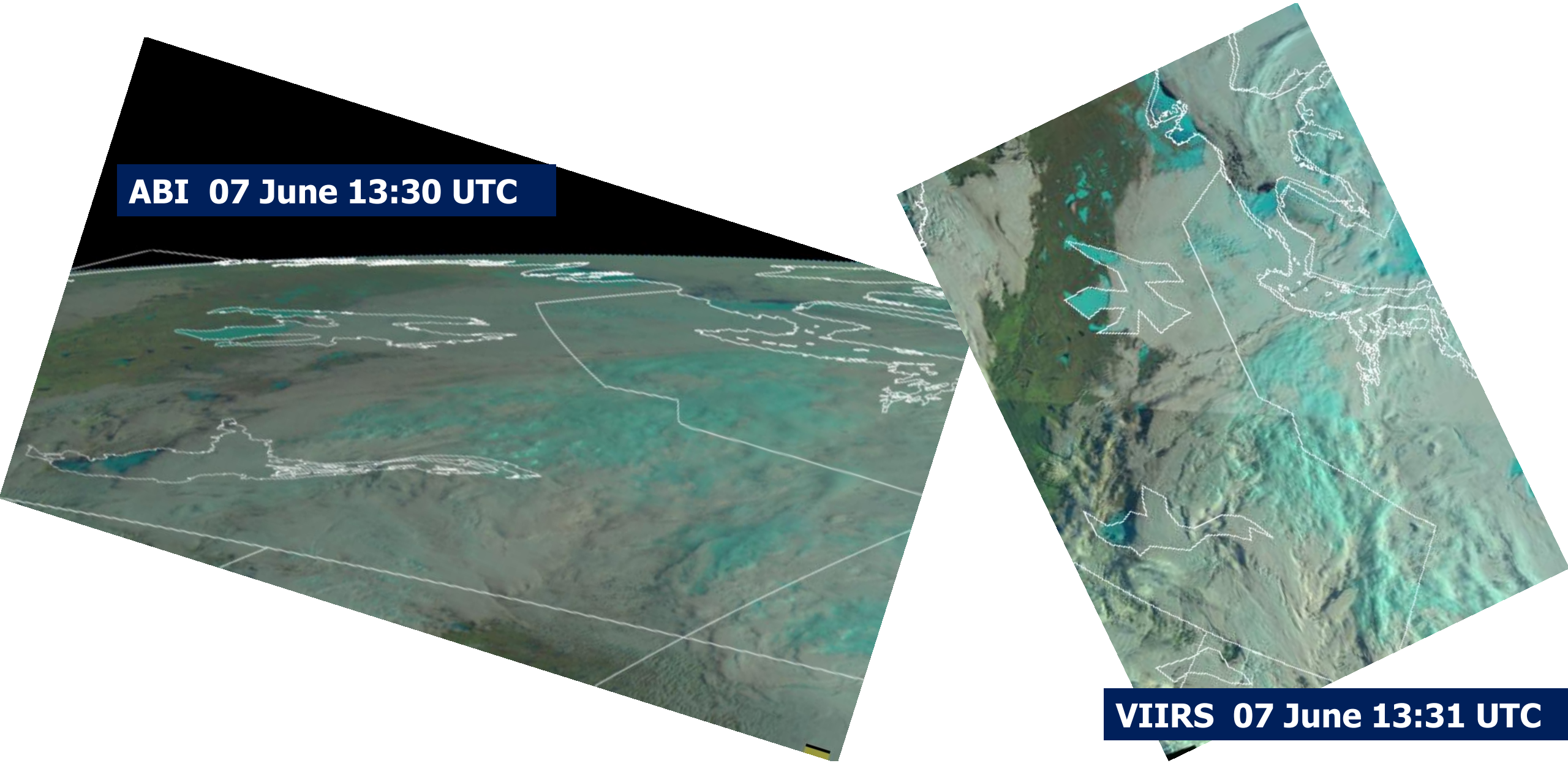
Smaller droplet size – yellow to light pink

http://www.eumetrain.org/rgb_quick_guides/quick_guides/CloudPhaseRGB.pdf

What is the most important for you ?
Use the space on right to vote

Continuity (availability of old products)	Annotate here
Improvent (old products getting better)	Annotate here
Innovation (new products)	Annotate here

Particular for EPS-SG – Spatial resolution and viewing geometry

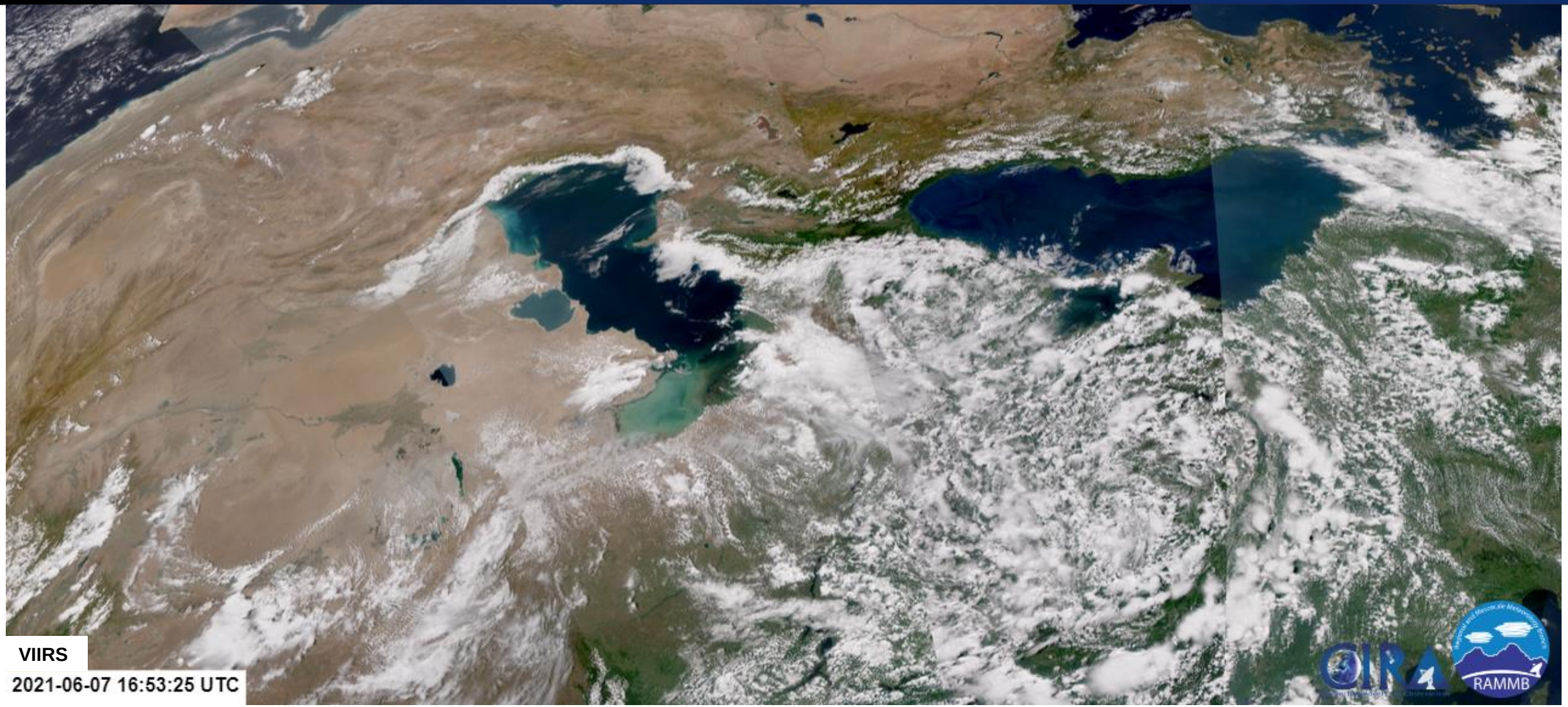


New RGBs

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

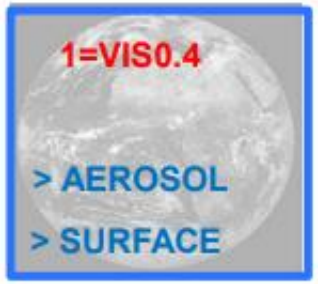
True Colour RGB	(0.67 - 0.56 - 0.44 µm)
Cloud Phase RGB	(1.63 - 2.25 - 0.67 µm)
Cloud Type RGB	(1.38 - 0.67 - 1.63 µm)
Daytime Snow RGB	(0.86 - 1.24 - 2.25 µm)
Dust RGB	
24-h Microphysics RGB	(12.0-10.7; 10.7-8.5; 10.7 µm)
Ash RGB	
Fire Temperature RGB	(3.96 - 2.25 - 1.63 µm)

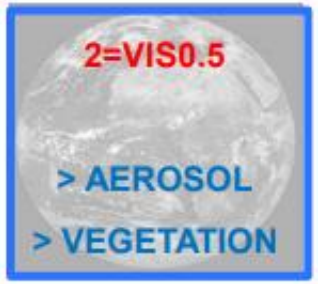
True Colour RGB (0.67 - 0.56 - 0.44 µm)

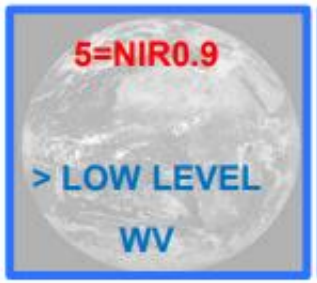


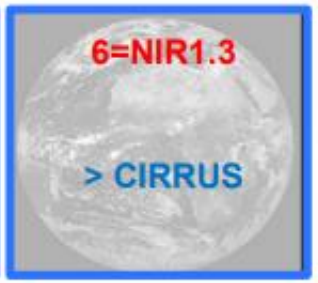
http://www.eumetrain.org/rgb_quick_guides/quick_guides/TrueColourRGB.pdf

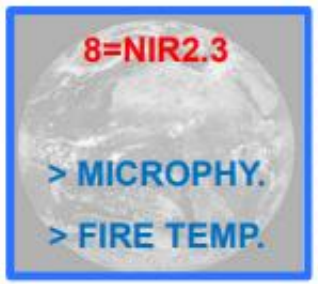
NEW CHANNELS - NEW RGB COMBINATIONS









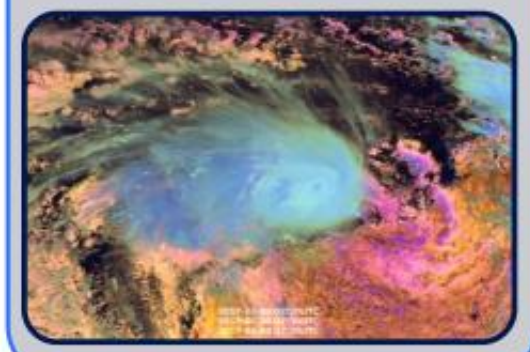


True Colour RGB

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

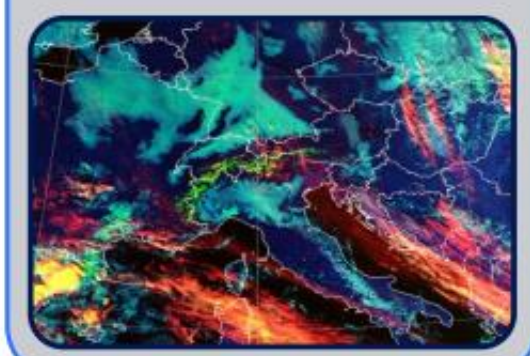
Cloud Phase RGB

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



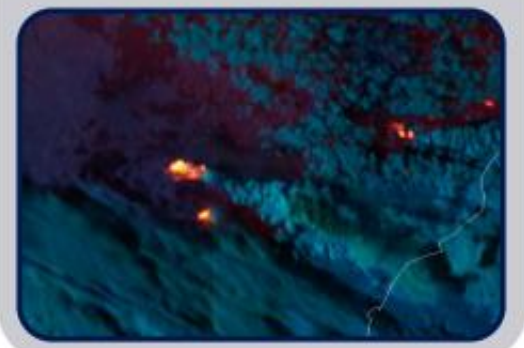
Cloud Type RGB

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

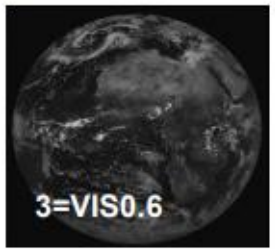


Fire Temp. RGB

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



TRUE COLOUR RGB



2=VIS0.5

> AEROSOL

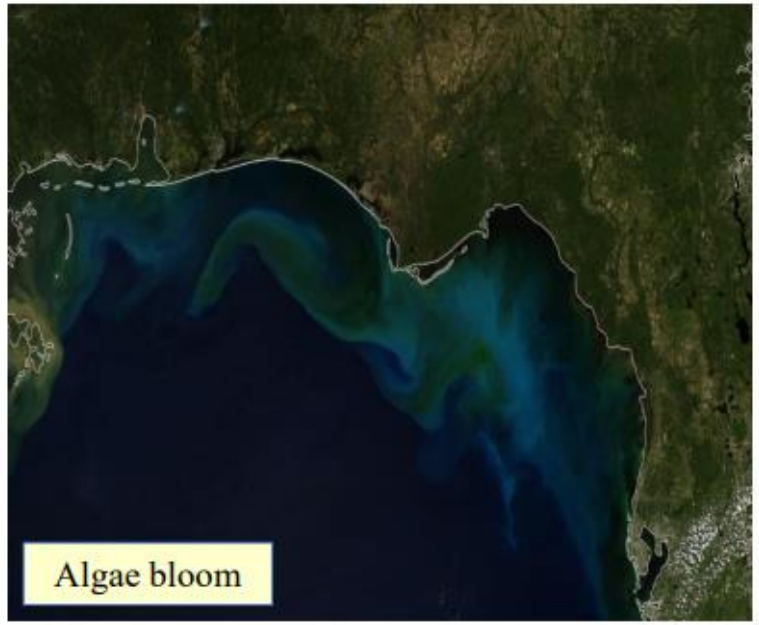
> VEGETATION

1=VIS0.4

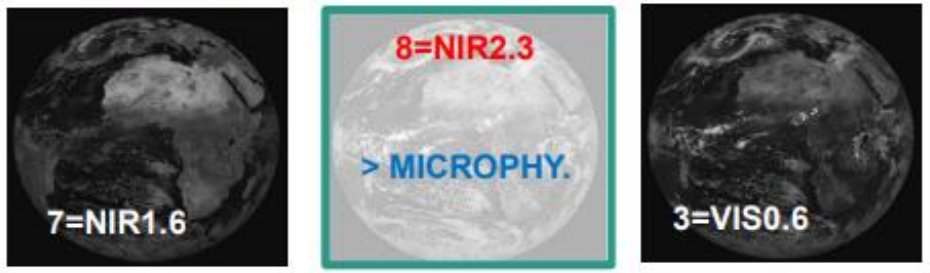
> AEROSOL

> SURFACE

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

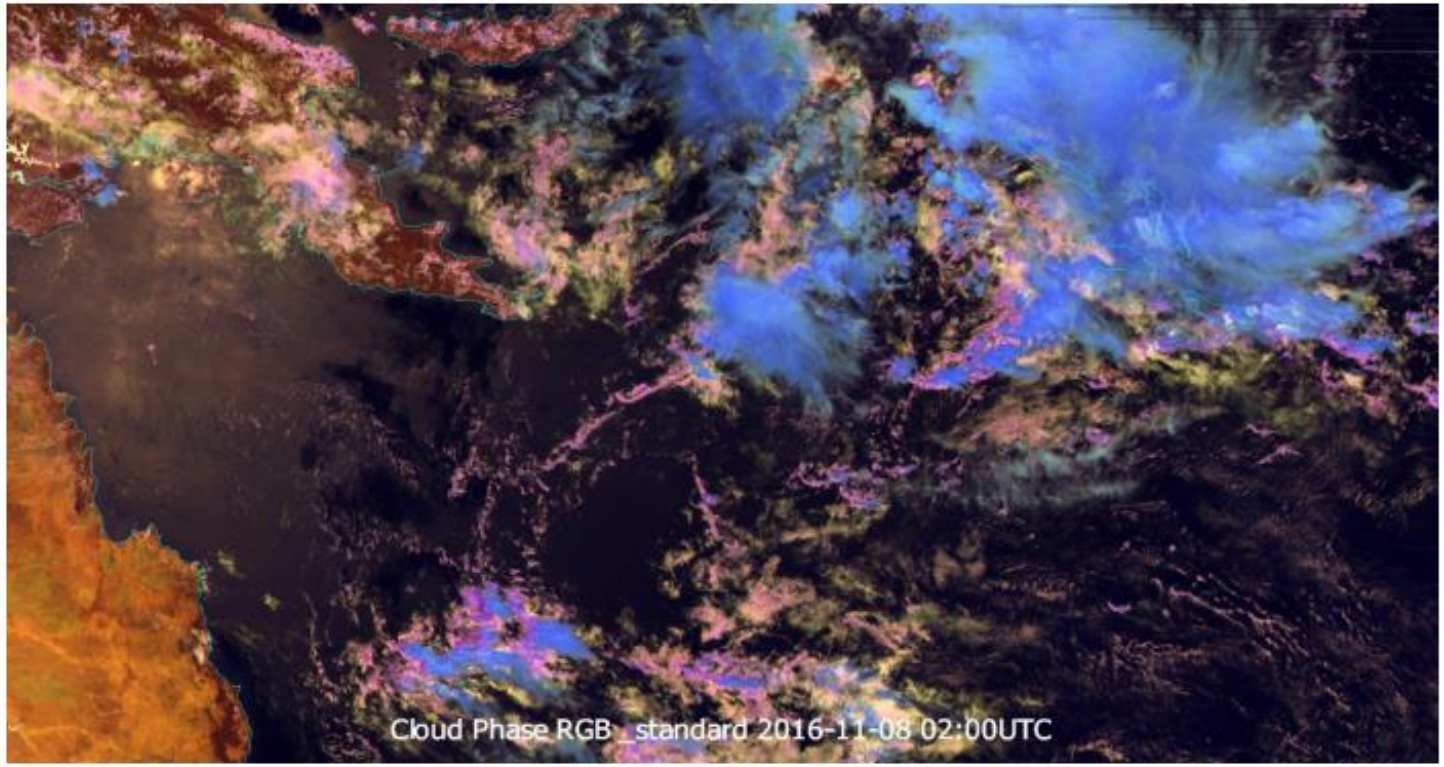


CLOUD PHASE RGB

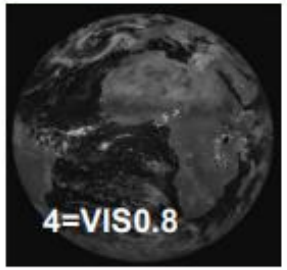


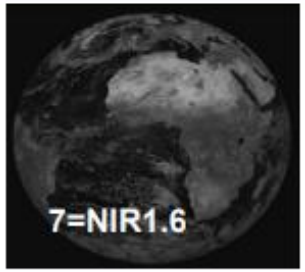
- Cloud phase
- Particle size
- Snow/ice
- Vegetation

	Range
R NIR1.6	0 to 50 %
G NIR2.3	0 to 50 %
B VIS0.6	0 to 100 %



CLOUD TYPE RGB

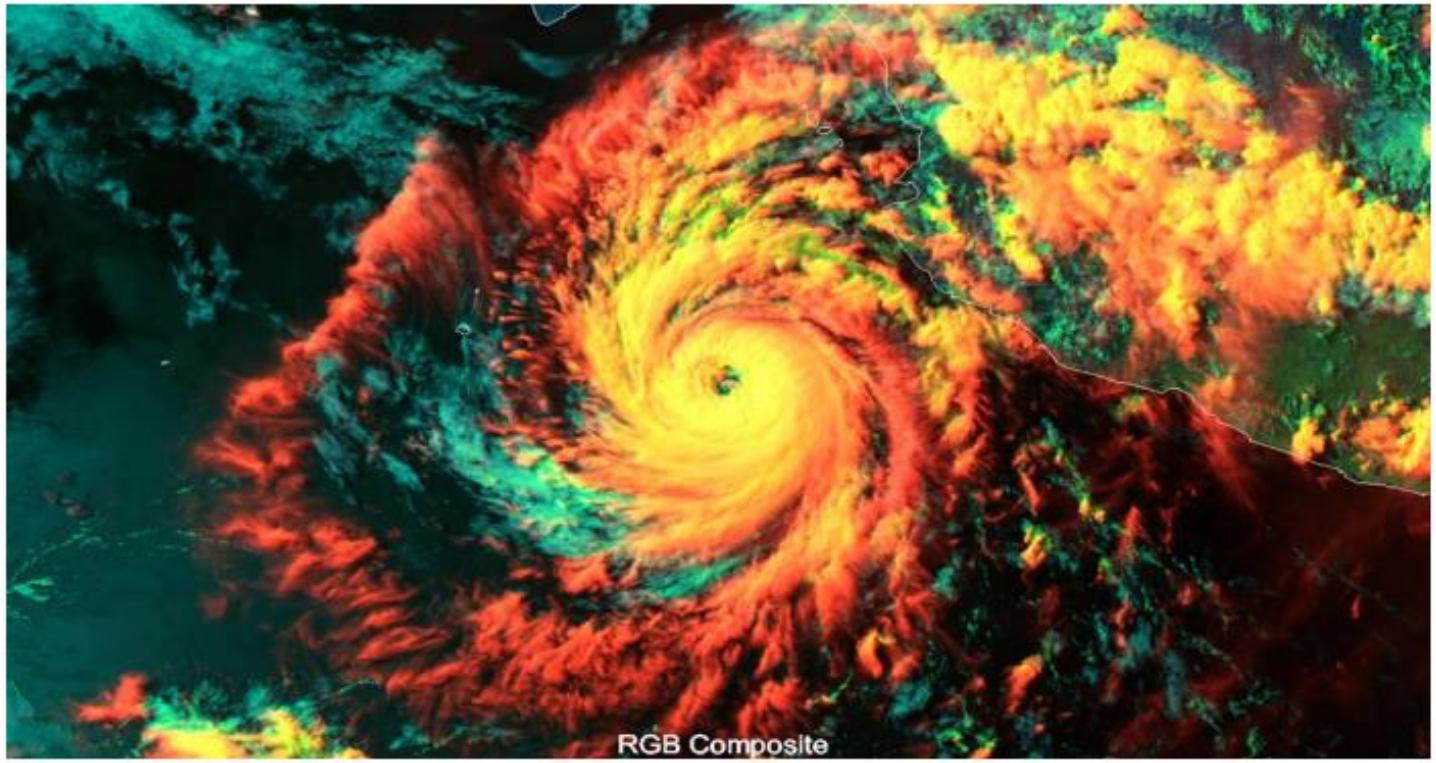




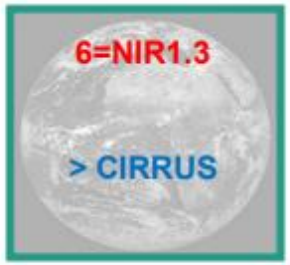
- Cloud optical depth
- Cloud phase
- Snow/ice
- Vegetation

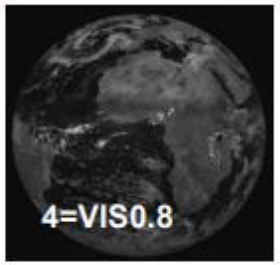
Range

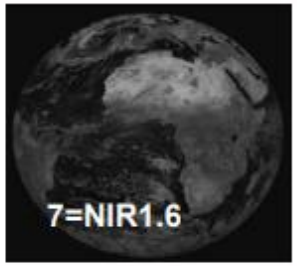
R NIR1.3	0 to 10 % G1.5
G VIS0.8	0 to 80 % G0.75
B NIR1.6	0 to 80 % G1.0



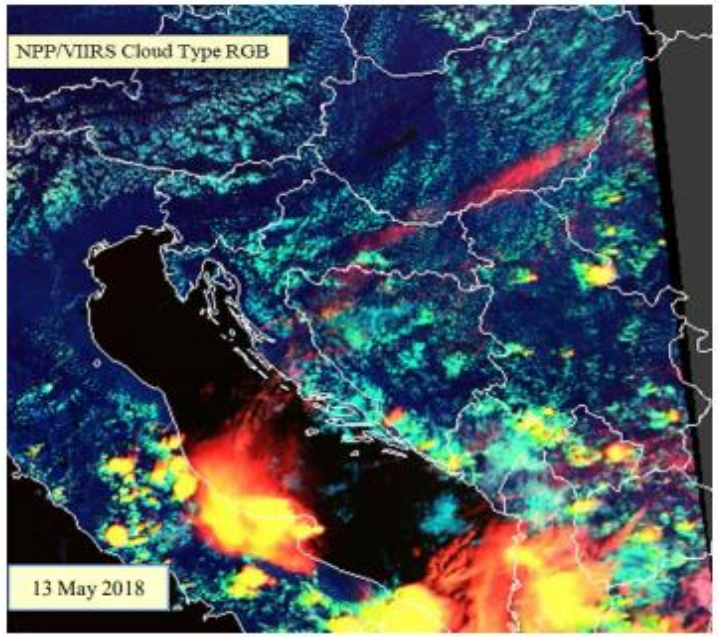
CLOUD TYPE RGB

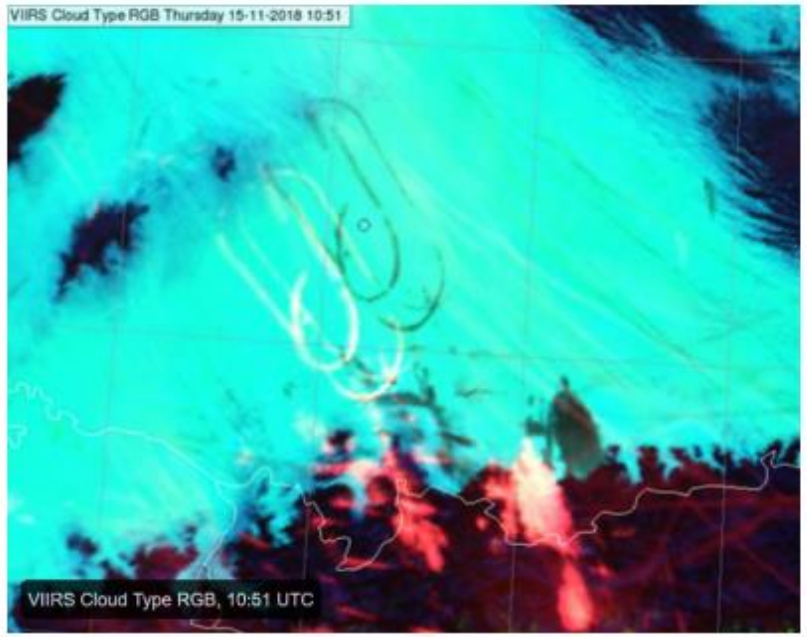




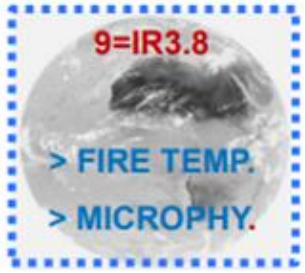


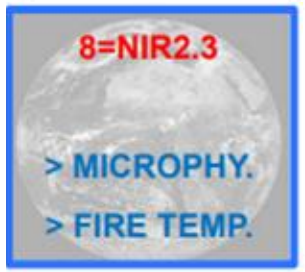
- Cloud optical depth
- Cloud phase
- Snow/ice
- Vegetation

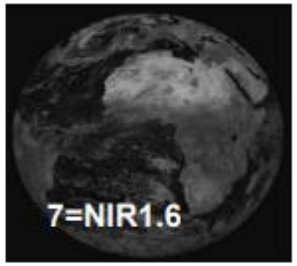


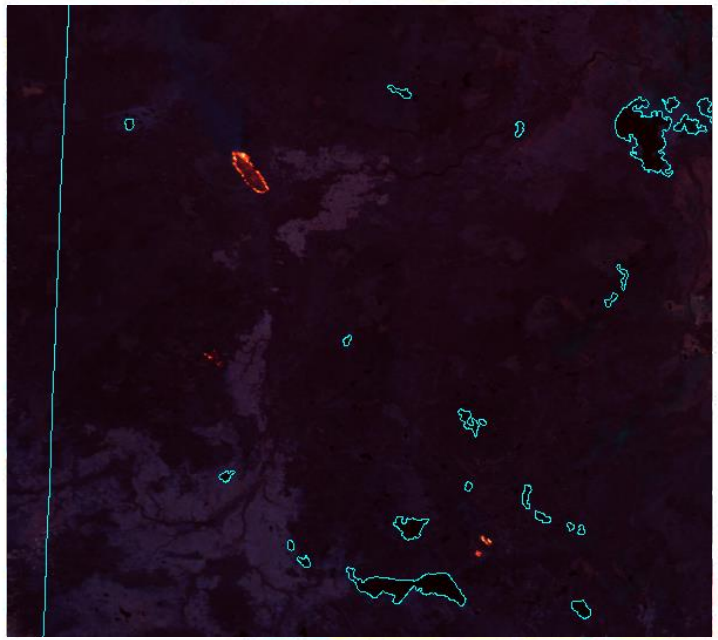


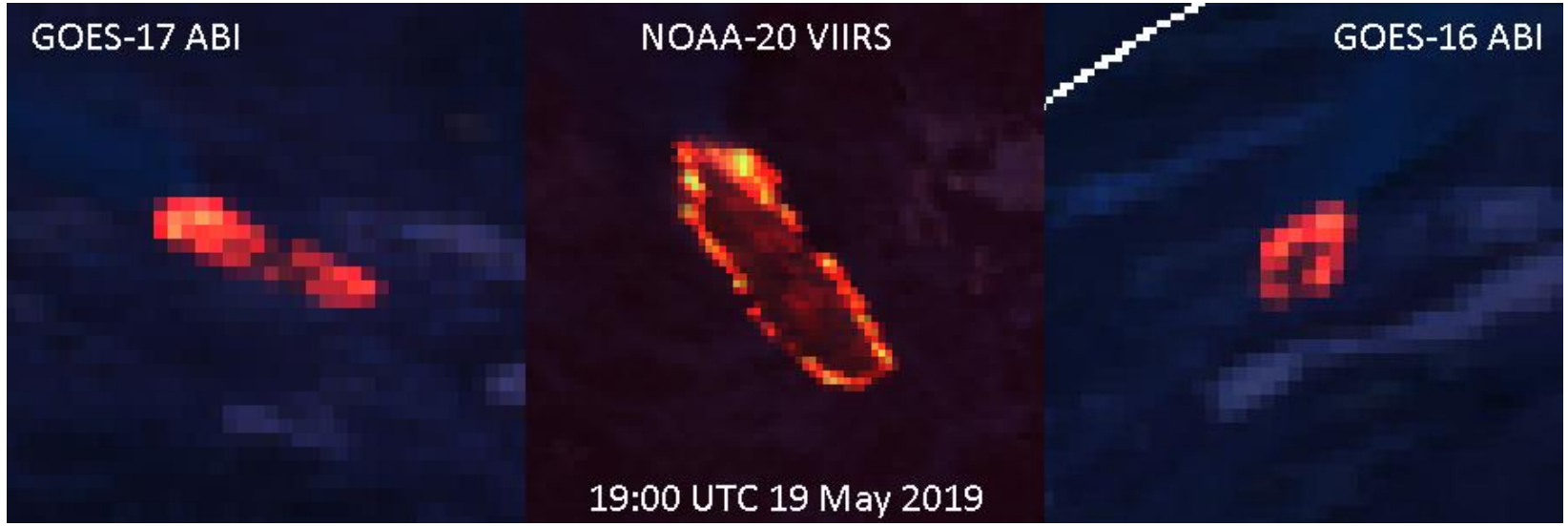
FIRE TEMPERATURE RGB



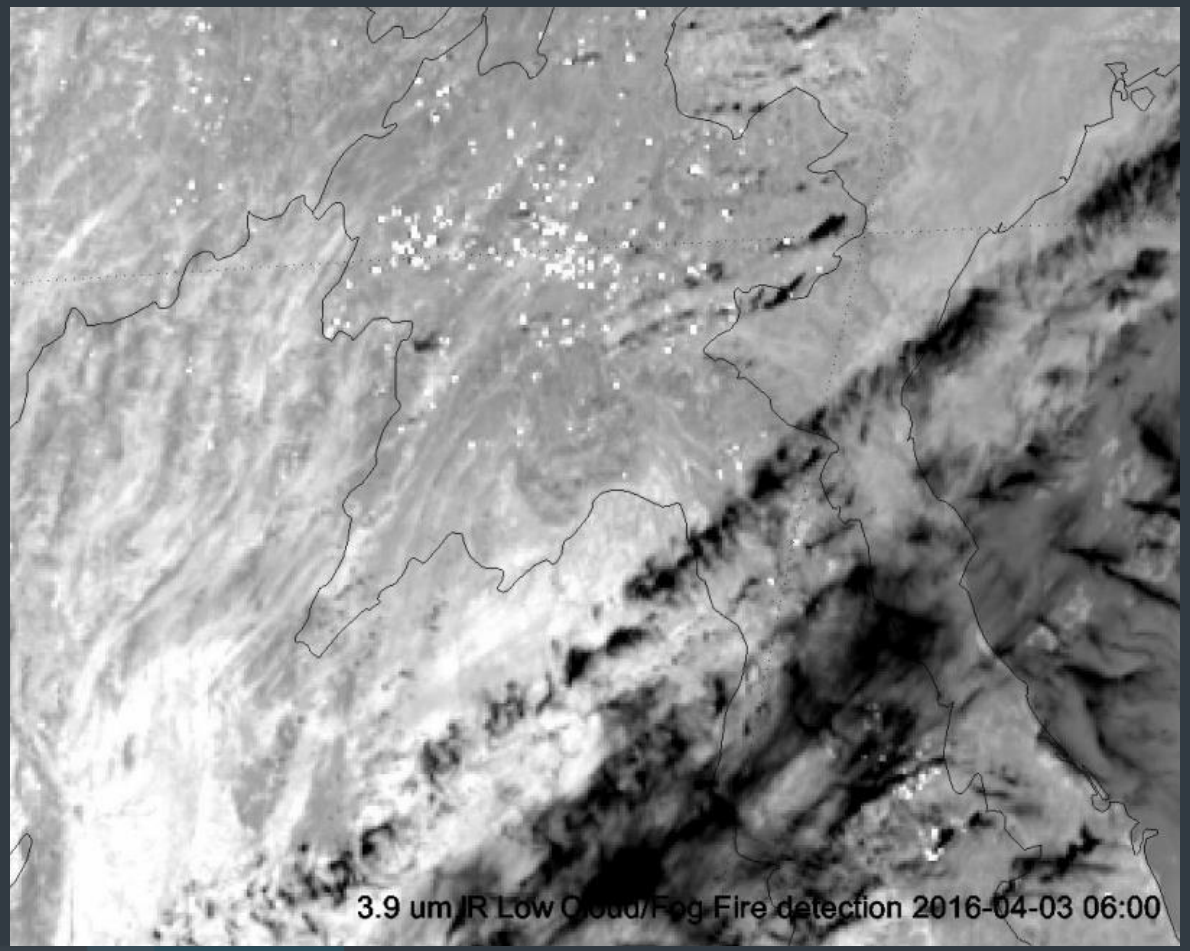


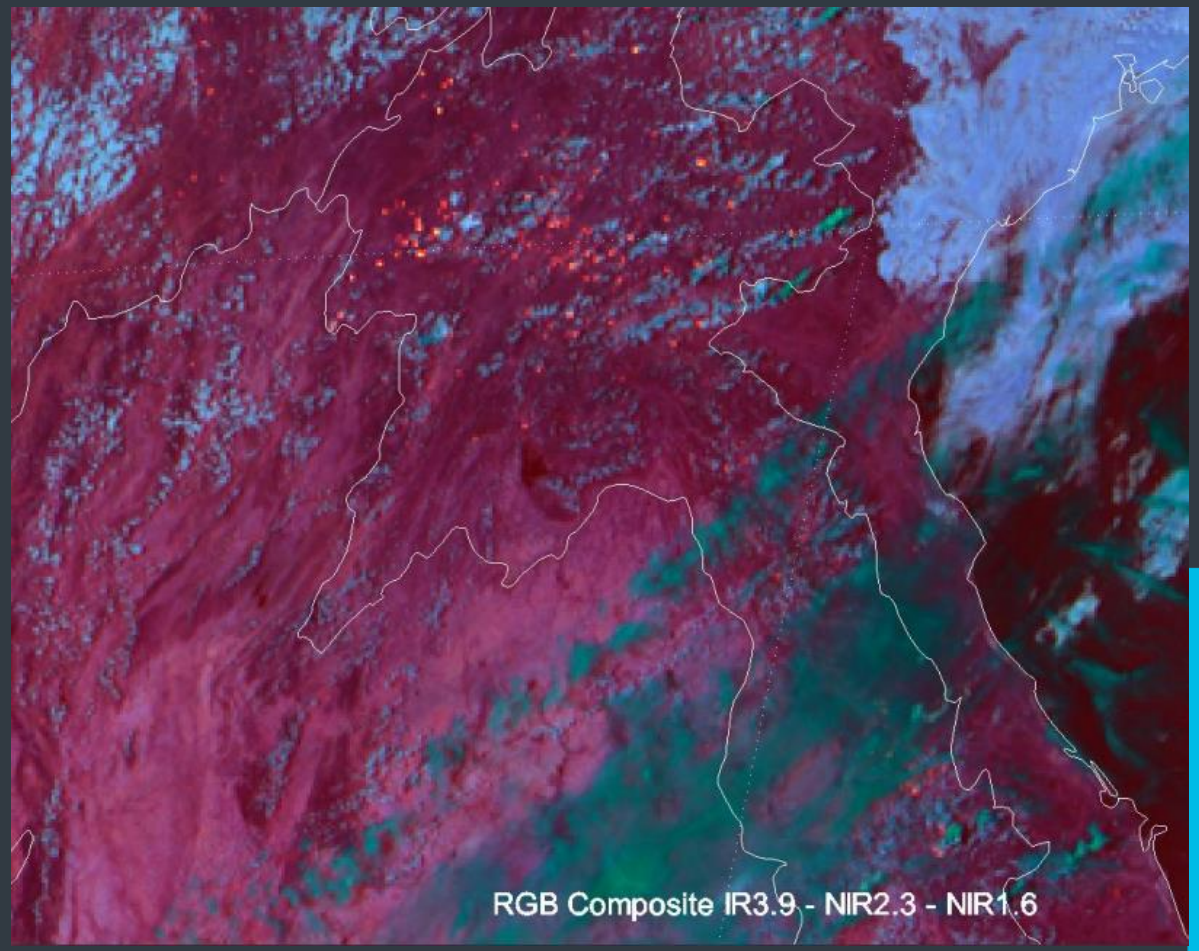






FIRE TEMPERATURE RGB



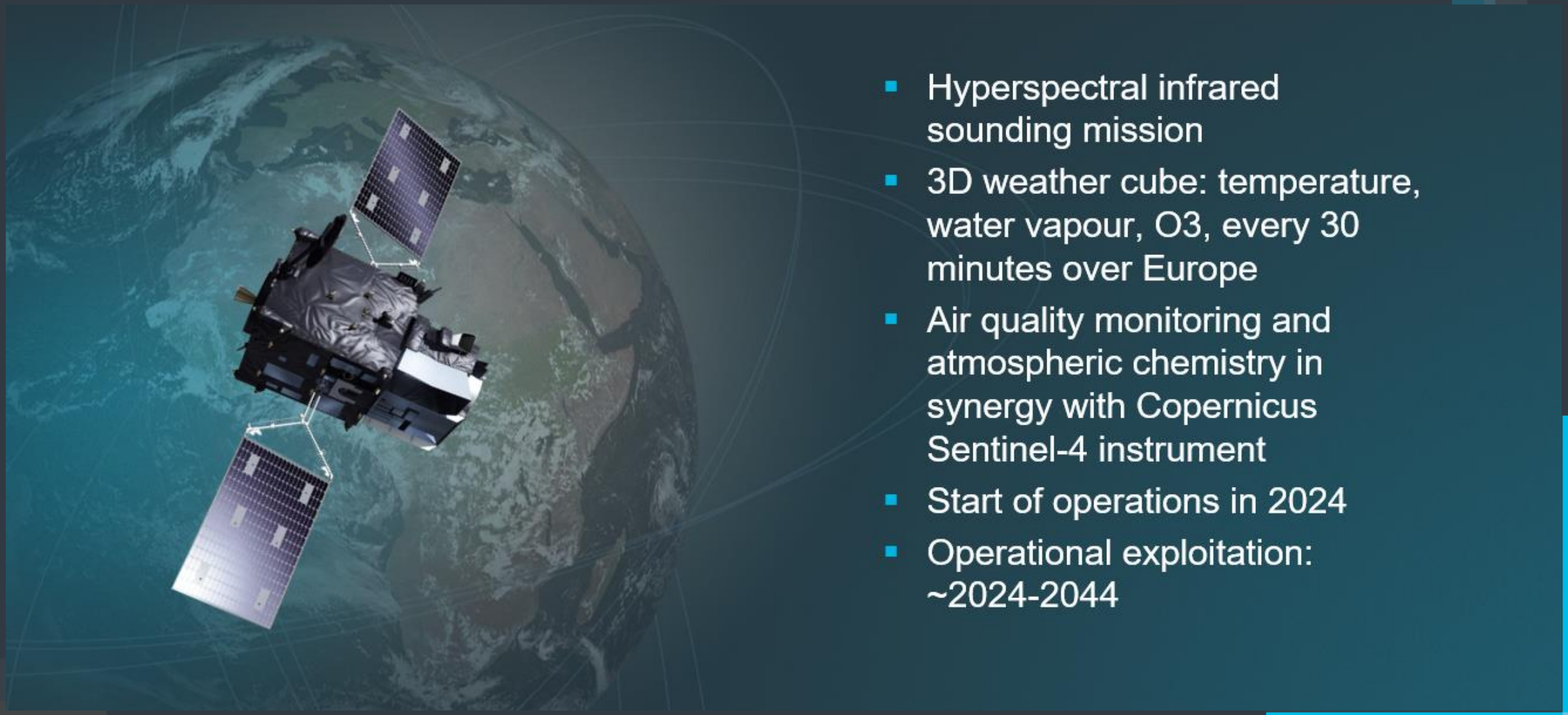


MTG briefly

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

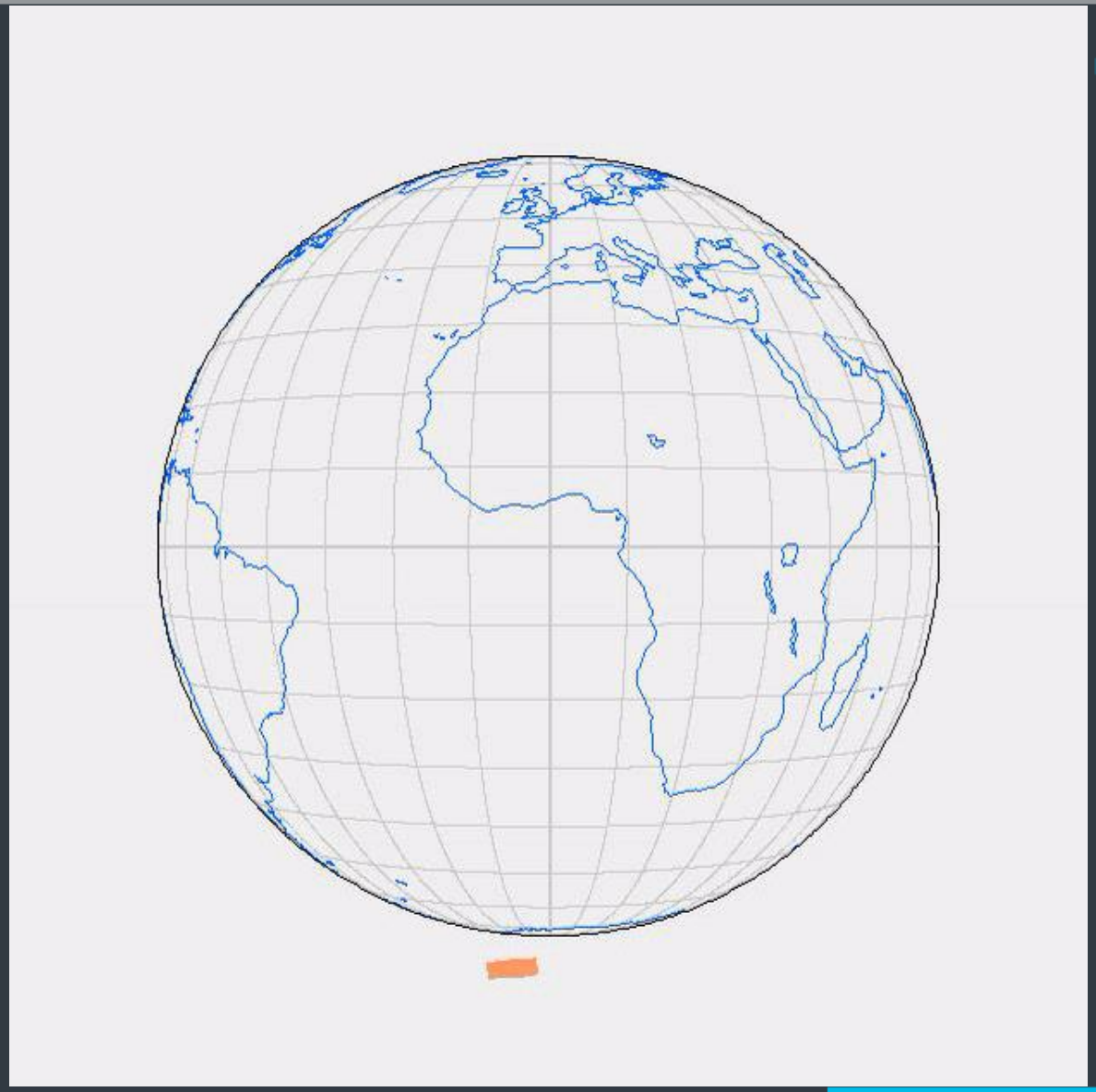
MTG-S SOUNDING MISSION



- 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

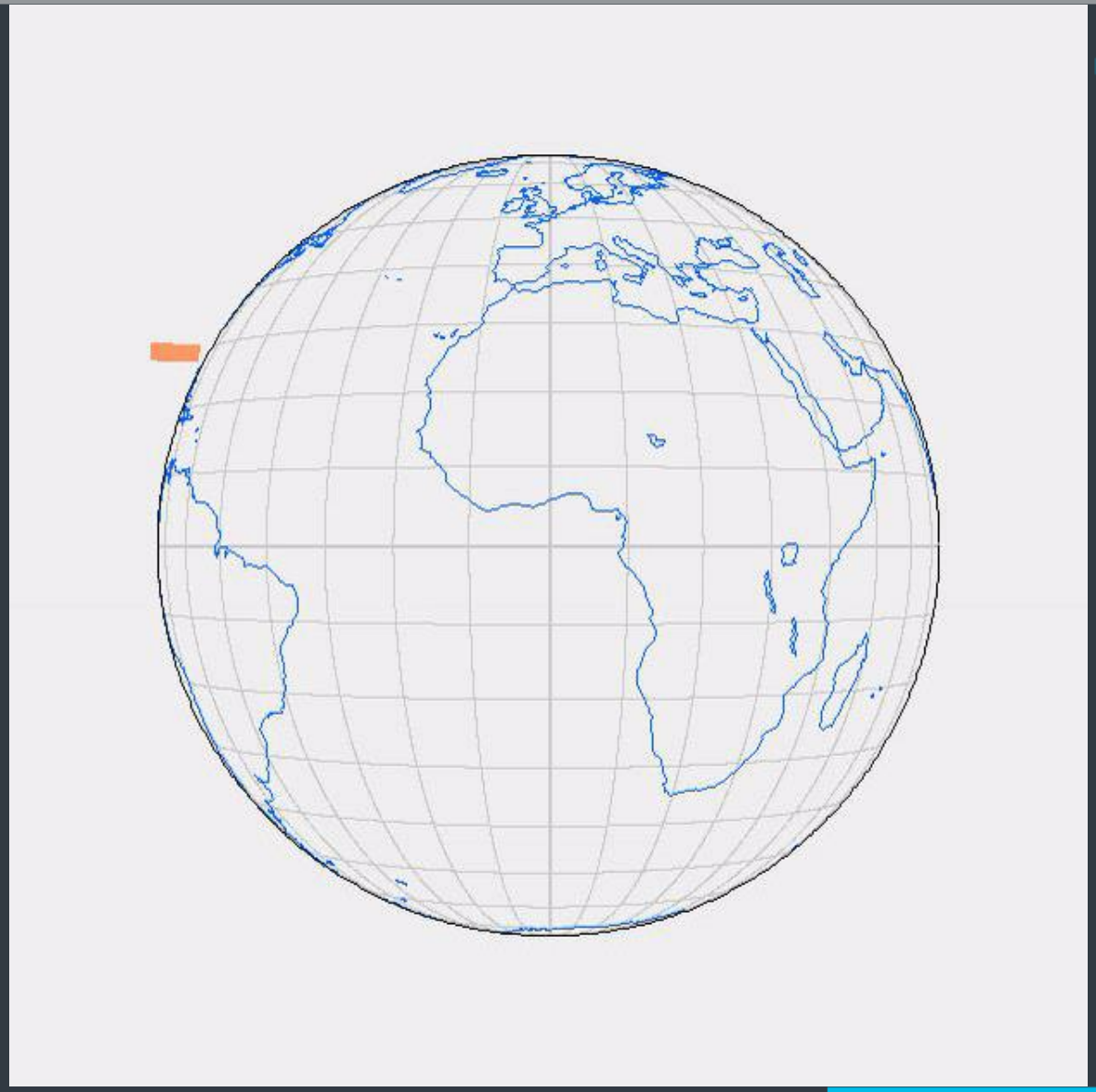
MTG-FCI FULL DISC SCANNING SERVICE (FDSS)

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

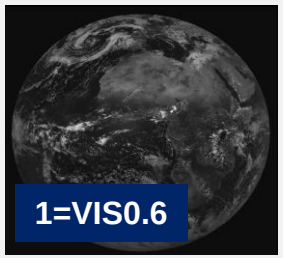


MTG-FCI RAPID SCANNING SERVICE (RSS)

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.

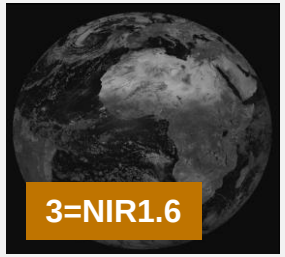


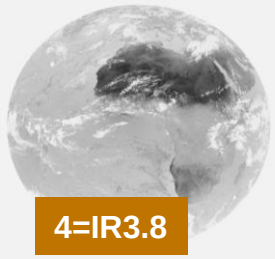
CURRENT AND FUTURE IMAGERS CHANNELS

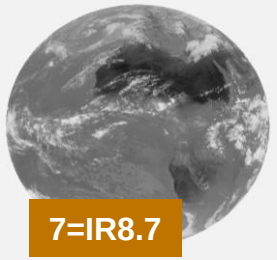


SSD: 1km

SSD: 3km

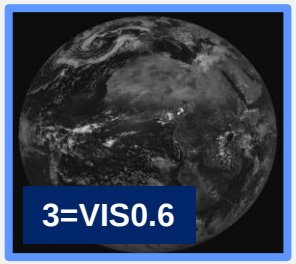




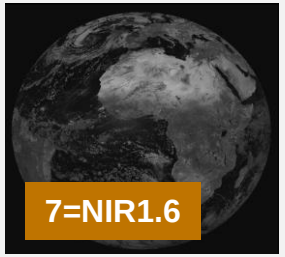


Current SEVIRI

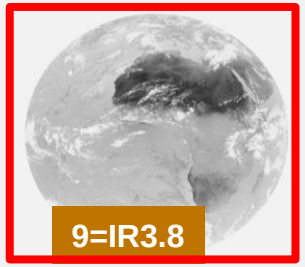
CURRENT AND FUTURE IMAGERS CHANNELS

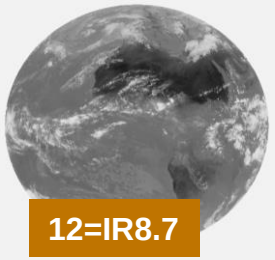


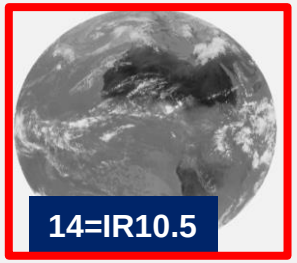
Solar channels provided at 1.0 km (& 0.5 km) resolution



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







Future FCI

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

Continuity and improvement

CONTINUITY

- All current channels and products will continue
- Current RGB products will continue to be available

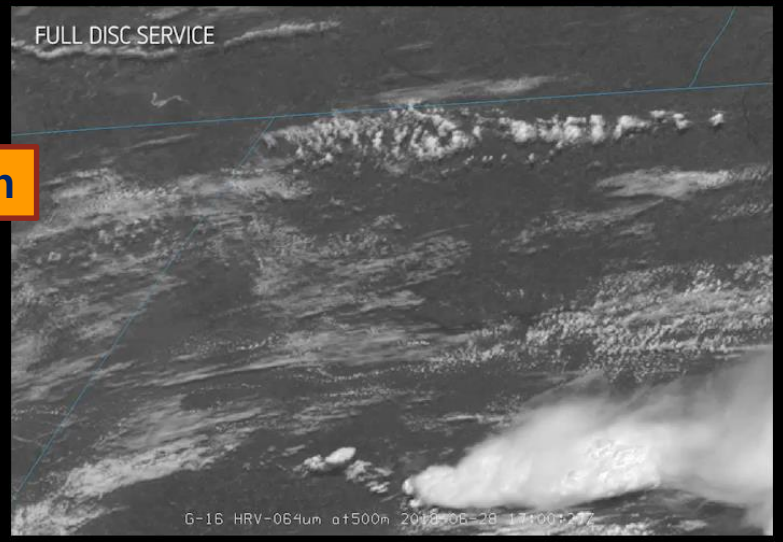
IMPROVEMENT

- Improved spatial resolution
- Improved temporal resolution
- Improved spectral resolution
- Improved dynamic range

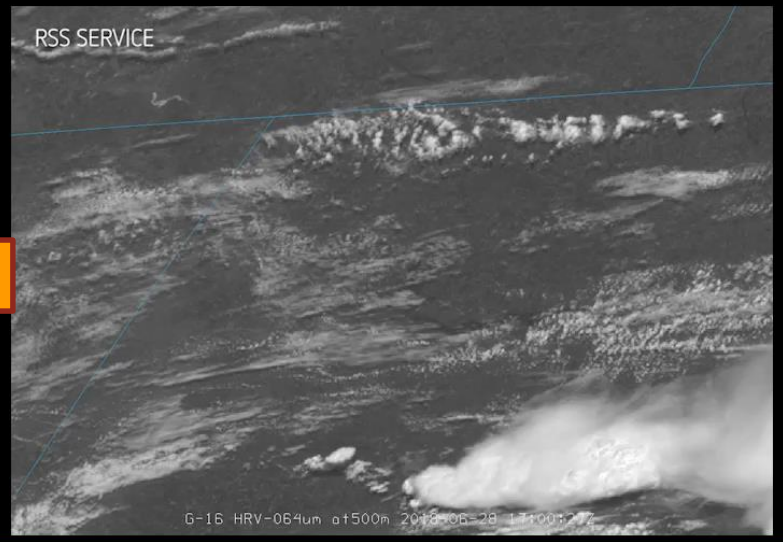
EXPECTED IMPROVEMENTS FROM MTG-I MISSION

MSG

15 min



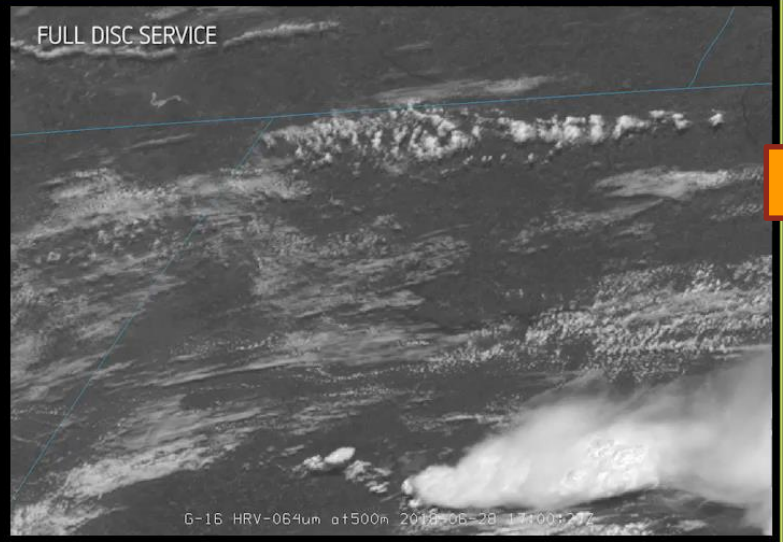
5 min



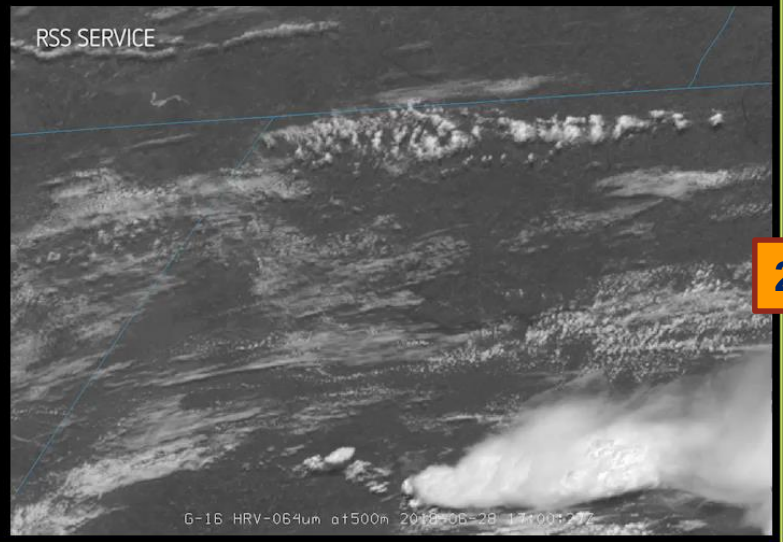
Current

MTG

10 min



2.5 min

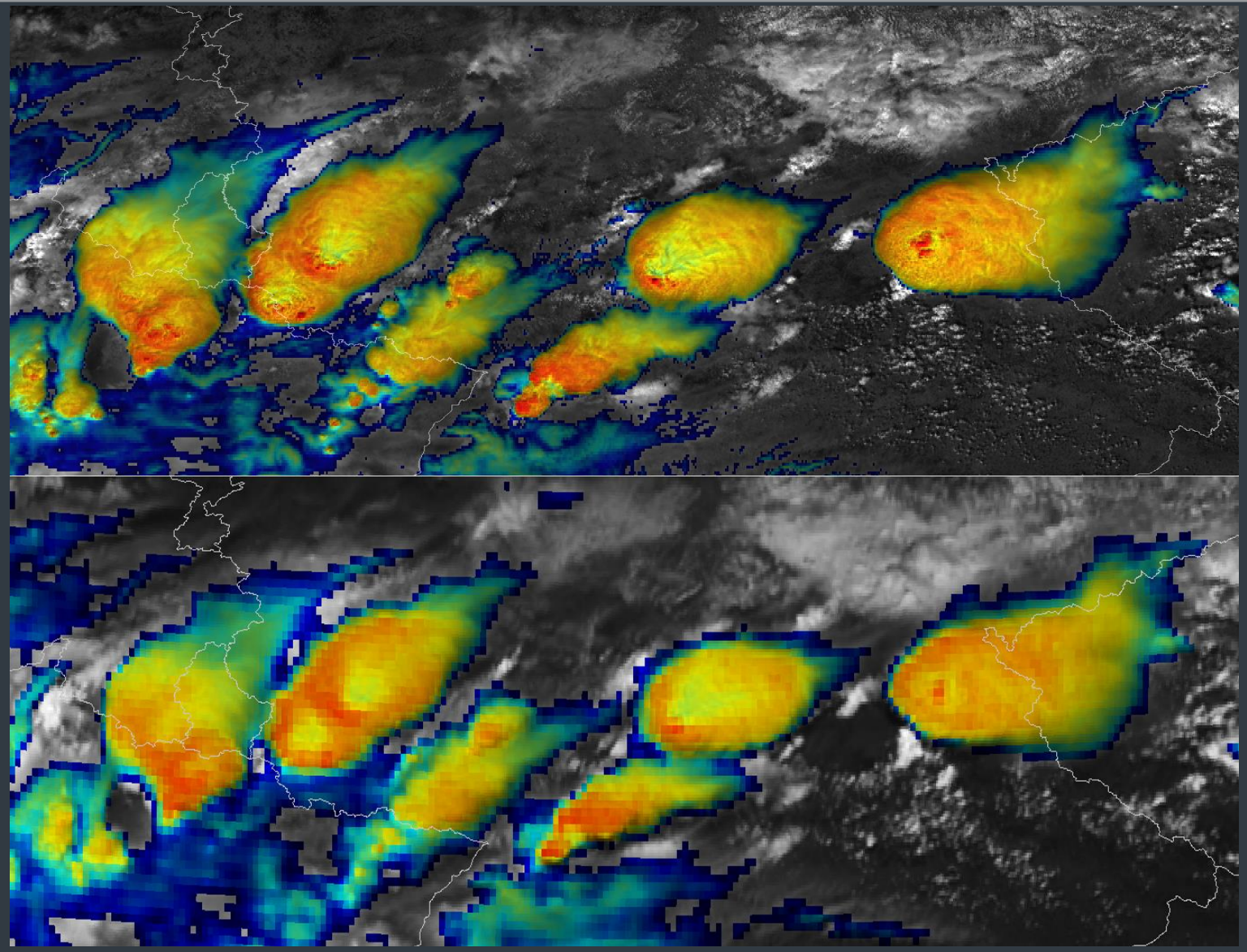


Future

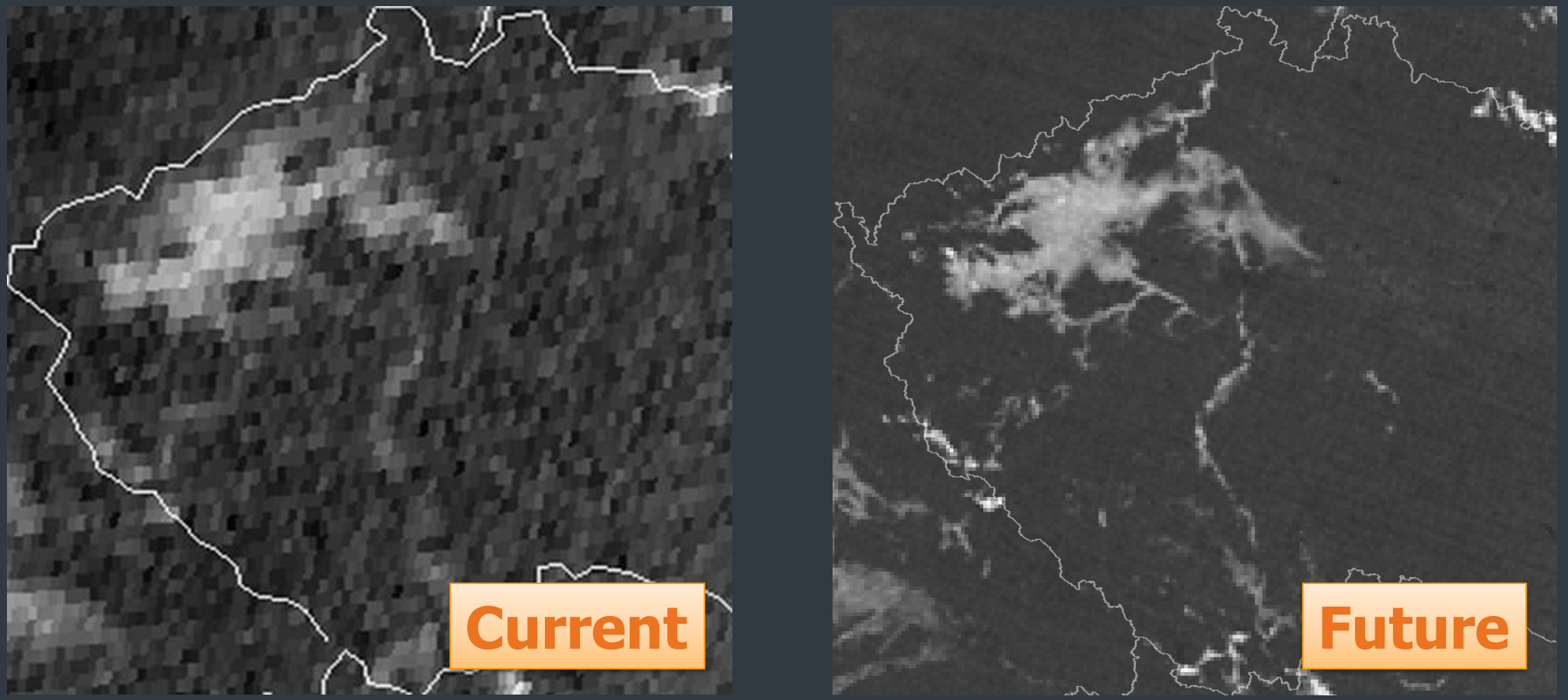
EXPECTED IMPROVEMENTS FROM MTG-I MISSION

Future

Current

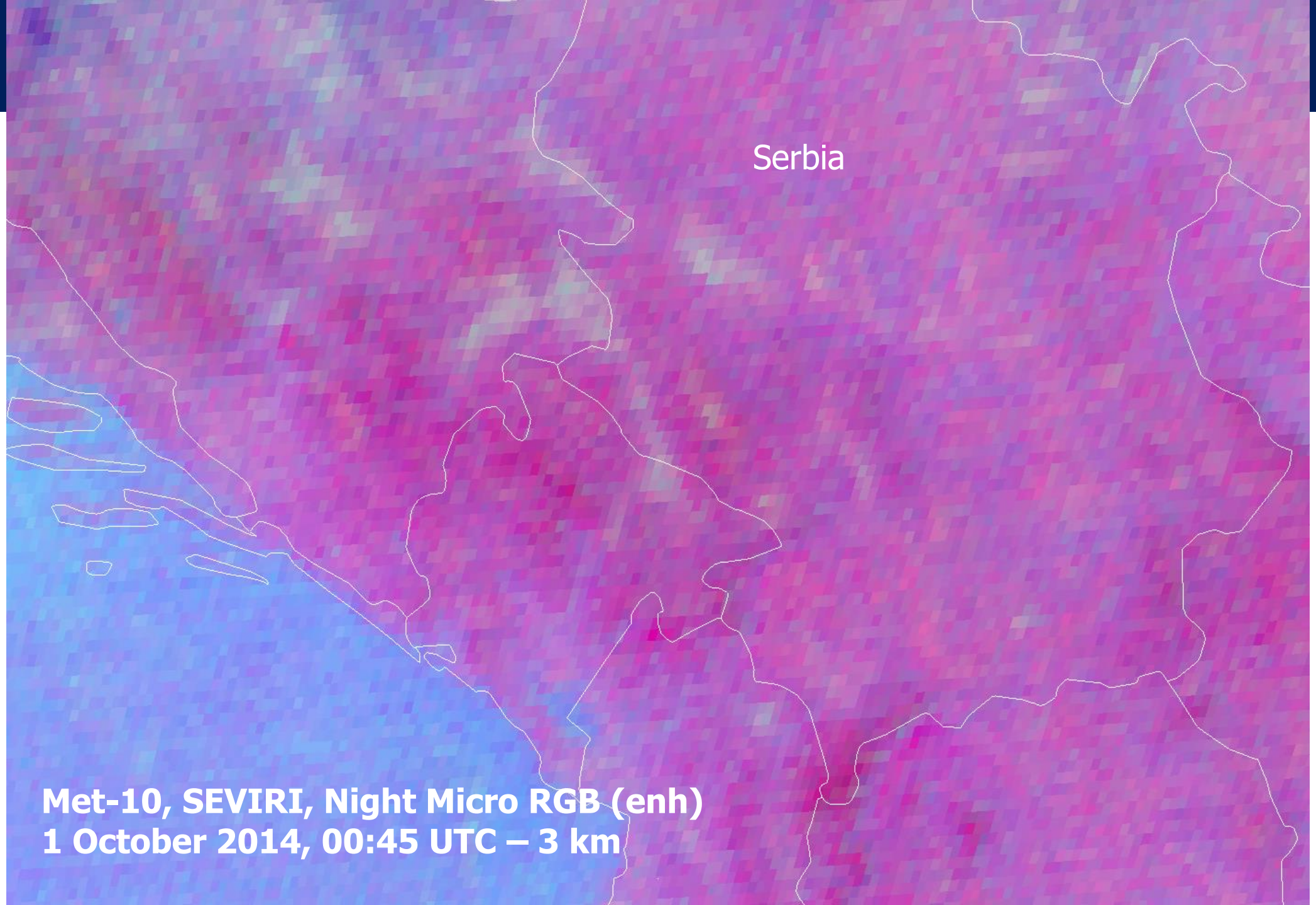


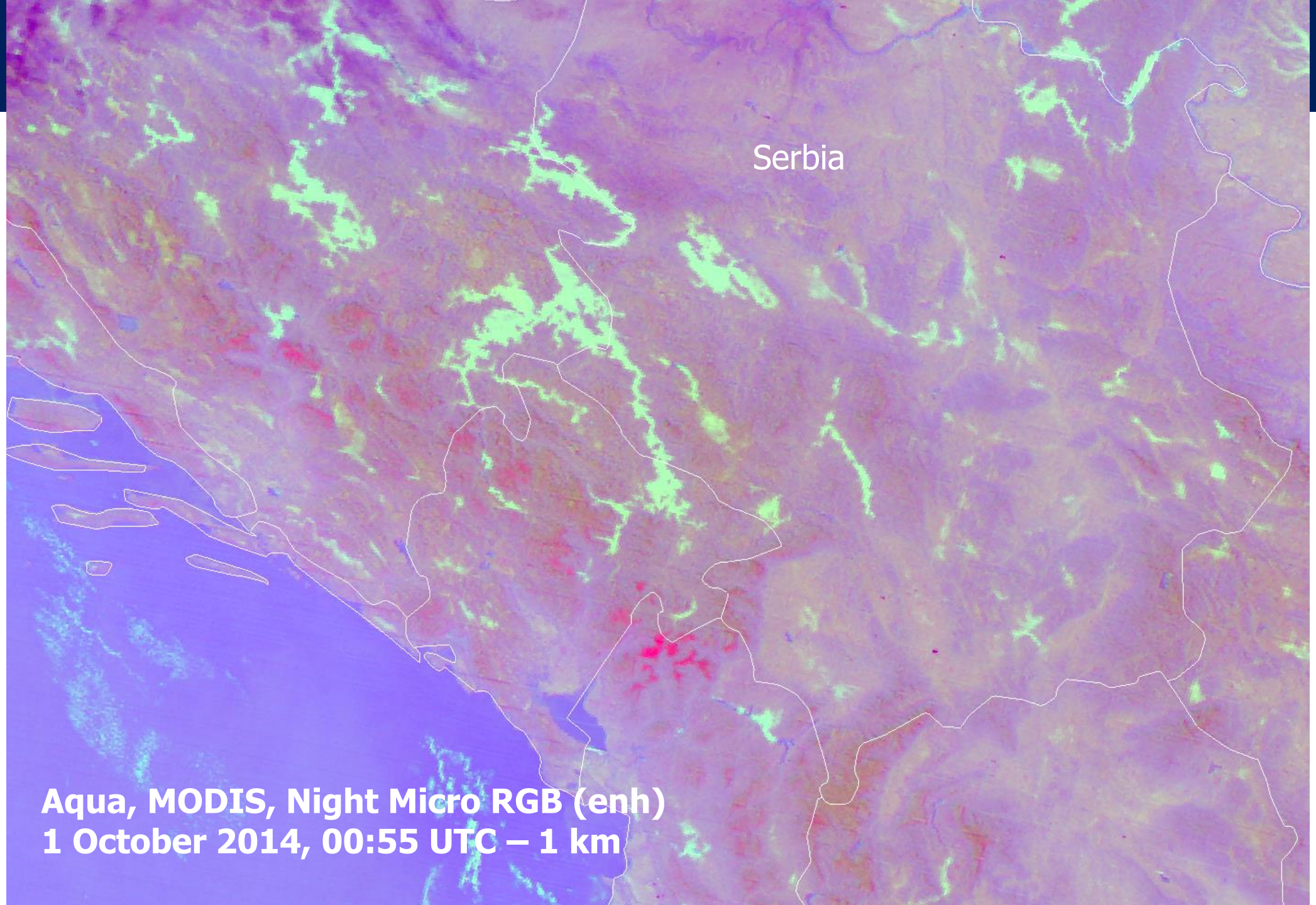
EXPECTED IMPROVEMENTS FROM MTG-I MISSION

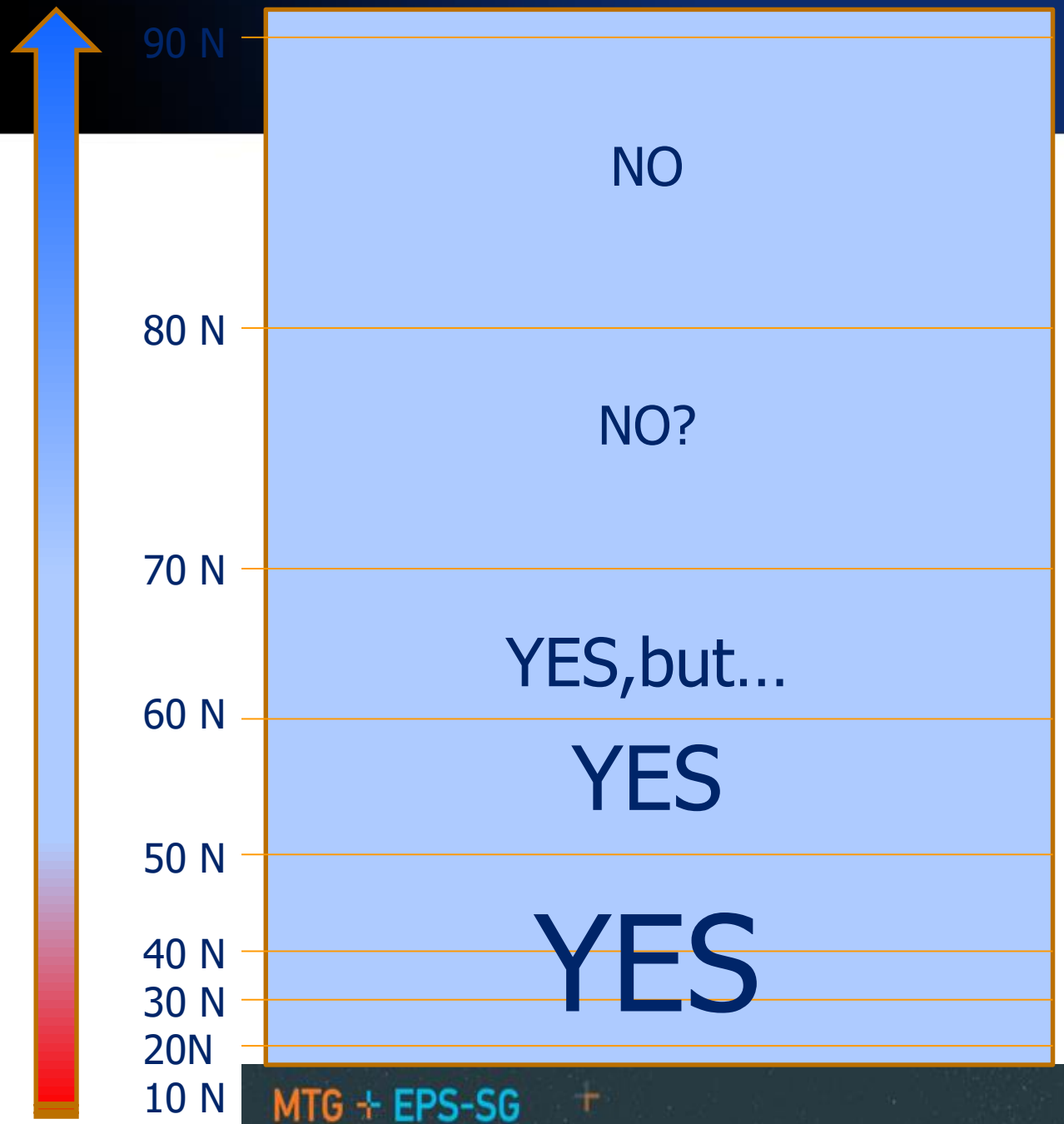


Example of fog detection over Czech Republic

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)


Serbia
Met-10, SEVIRI, Night Micro RGB (enh)
1 October 2014, 00:45 UTC – 3 km


Serbia
Aqua, MODIS, Night Micro RGB (enh)
1 October 2014, 00:55 UTC – 1 km



Will High Latitudes actually benefit from MTG??

MTG & EPS-SG

Vesa Nietosvaara
EUMETSAT

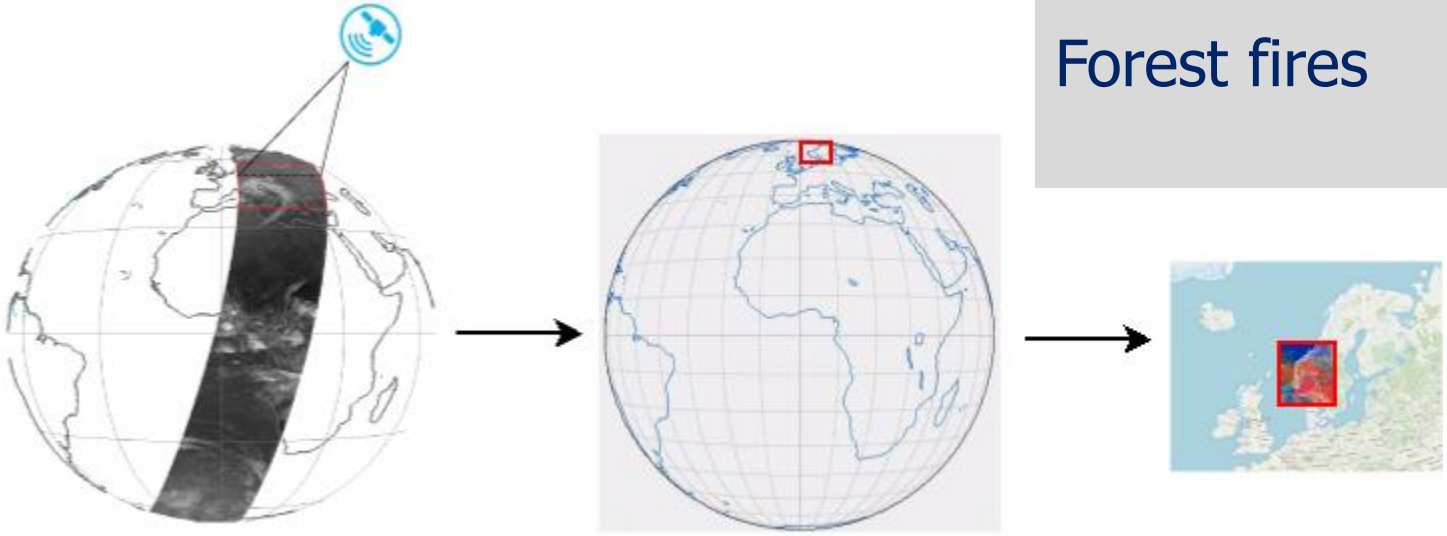
EUMeTrain High

Latitudes Event – 31.1.2023

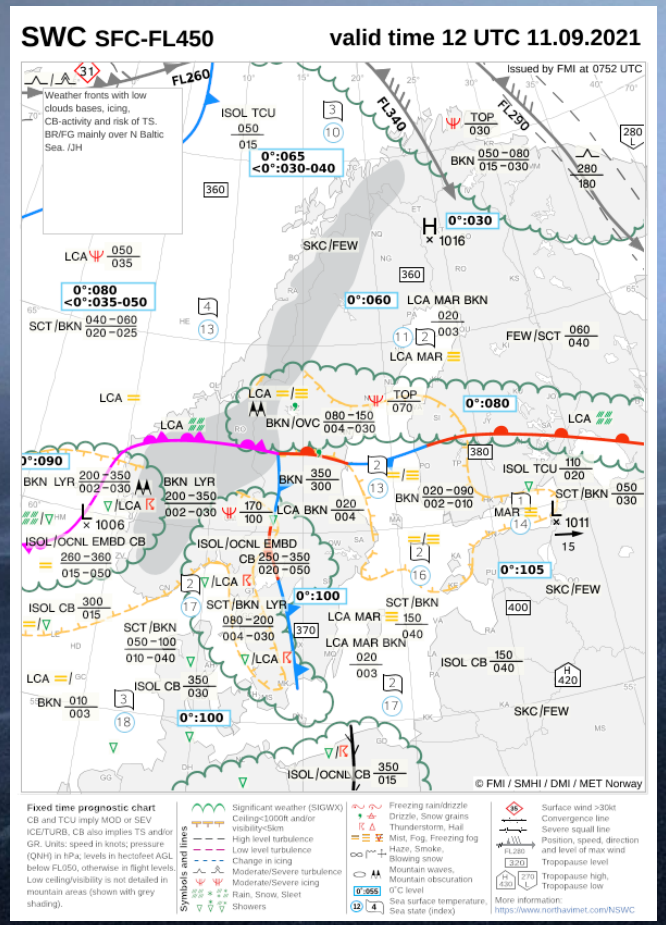
FMI recently produced case studies demonstrating expected improvements

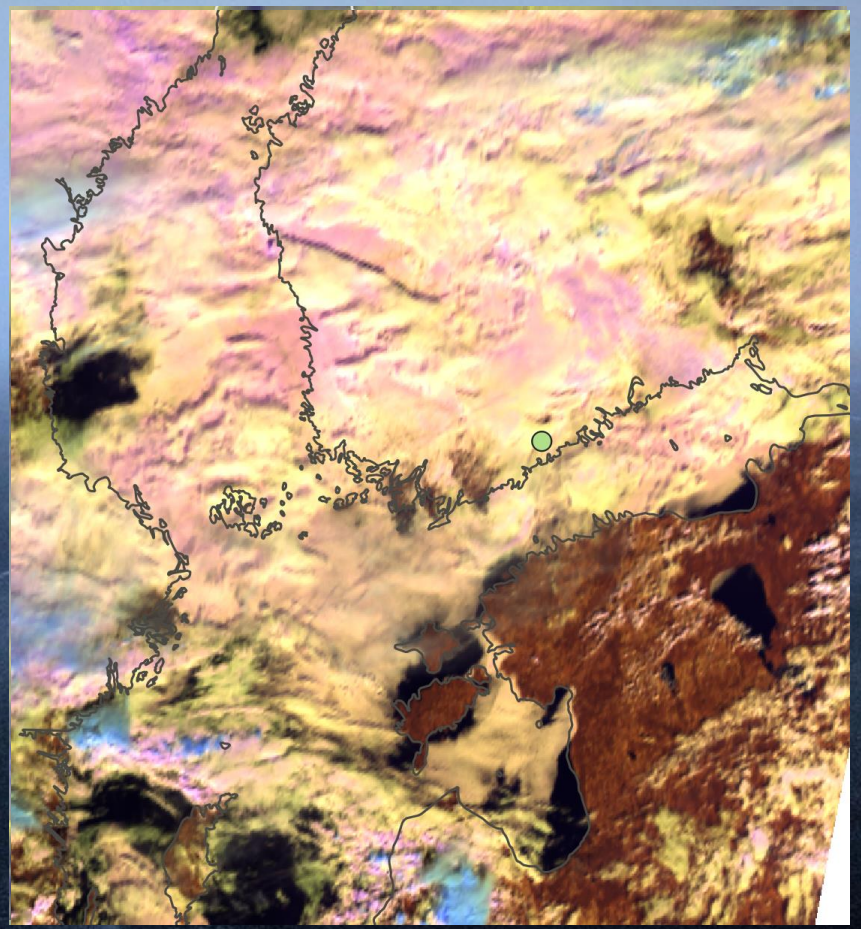
Six case studies within 60-66 N
FCI simulator (py)
Code available at EUMETSAT gitlab

Dense fog
Freezing precipitation
Summer storm
Winter storm
Mountain waves
Forest fires



Dense fog over southern Finland





SEVIRI Day Nat Col

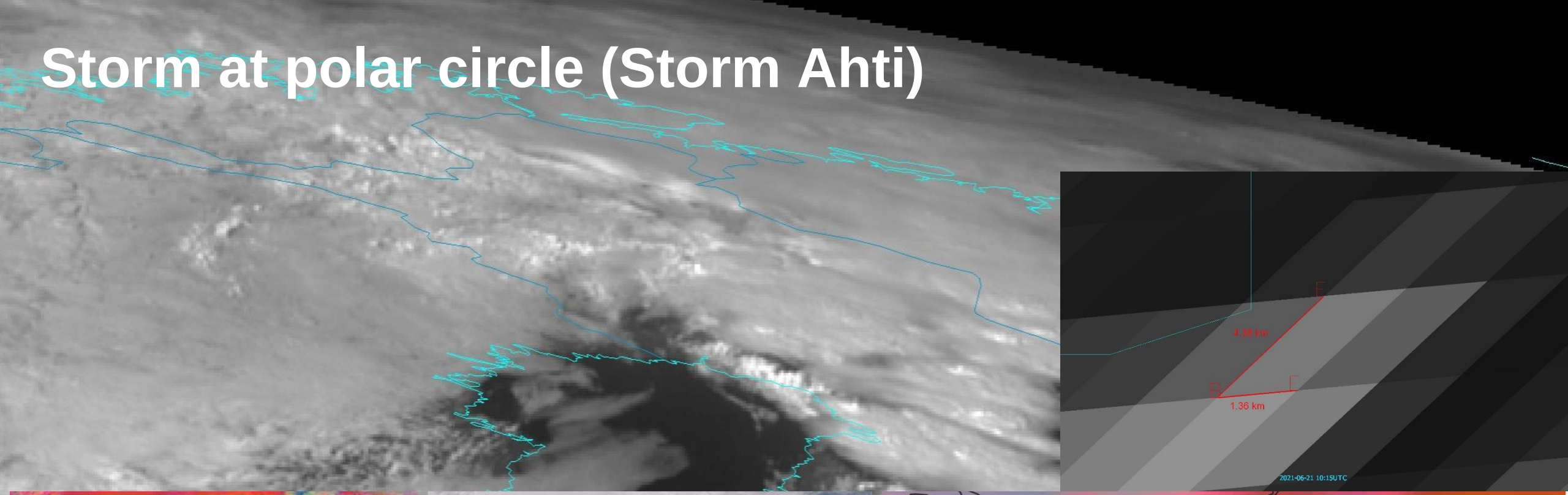
SEVIRI HRV RGB

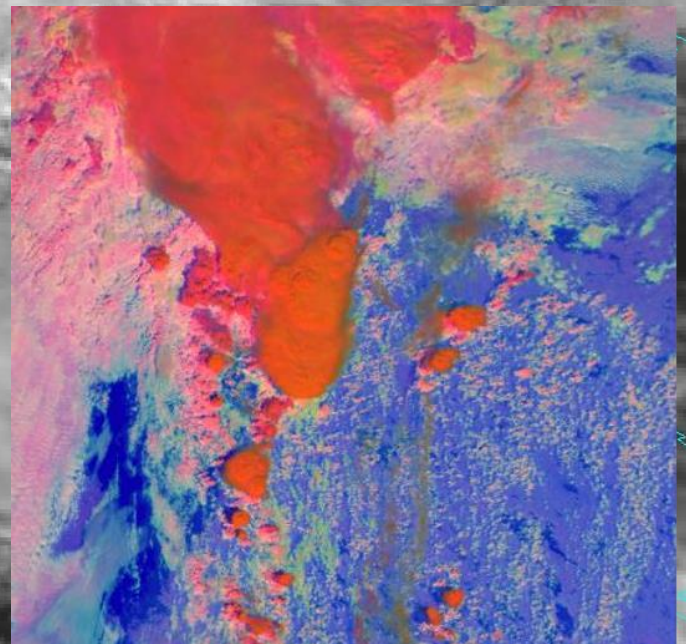
VIIRS Natural Color

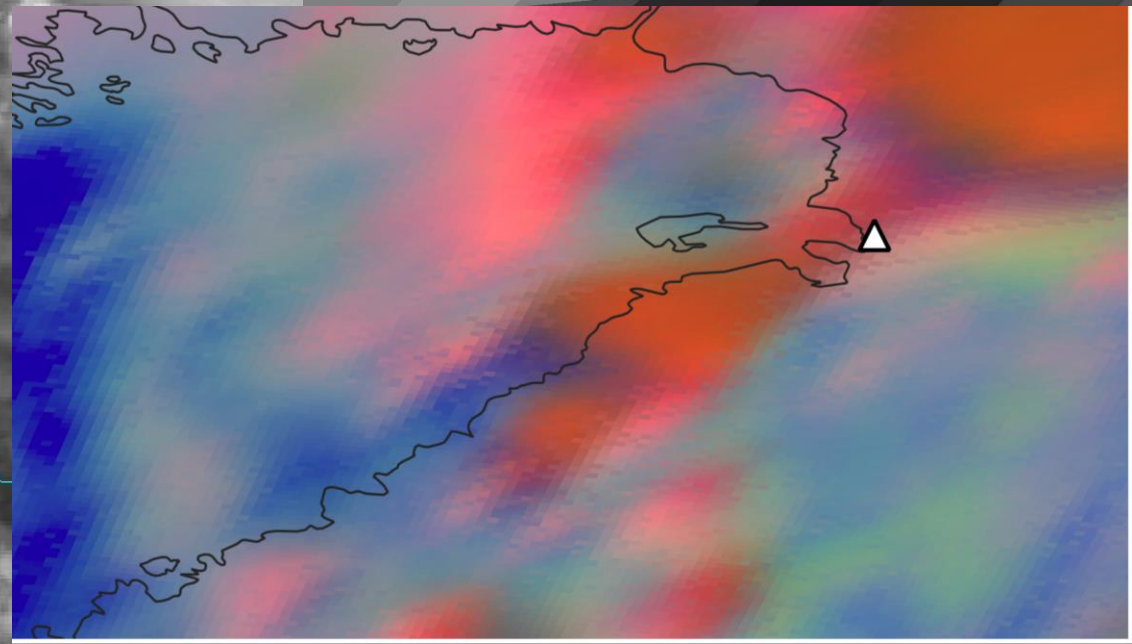
FCI Nat Col Simulated

FCI Cloud Phase RGB Simulated

Storm at polar circle (Storm Ahti)







Parallax is an issue also for polar satellites

The new generation of satellite images and parallax issues

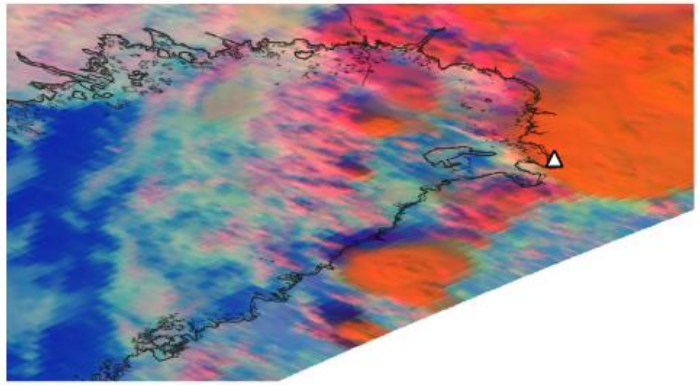


Figure 6a: Day Microphysical RGB (Terra, MODIS) 21 June 2021 11:50 UTC, the edge of the polar satellite swath

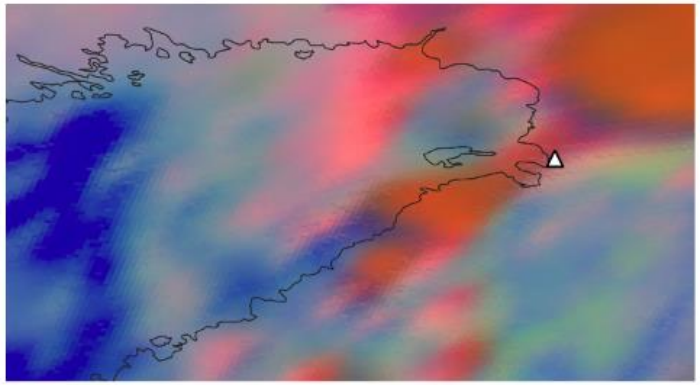


Figure 6b: Day Microphysical RGB (Meteosat-11, SEVIRI) 21 June 11:45 UTC

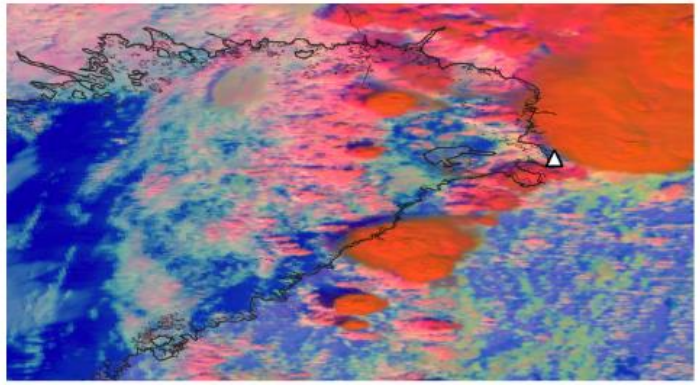


Figure 6c: Day Microphysical RGB (NOAA-20, VIIRS) 21 June 11:48 UTC, the middle of the polar satellite swath

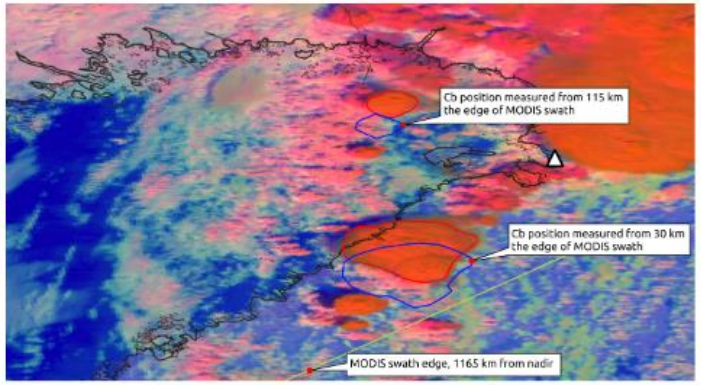
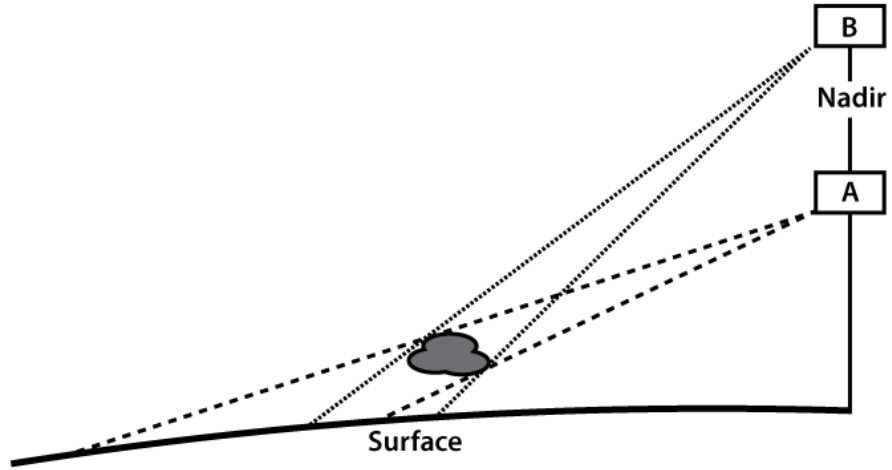
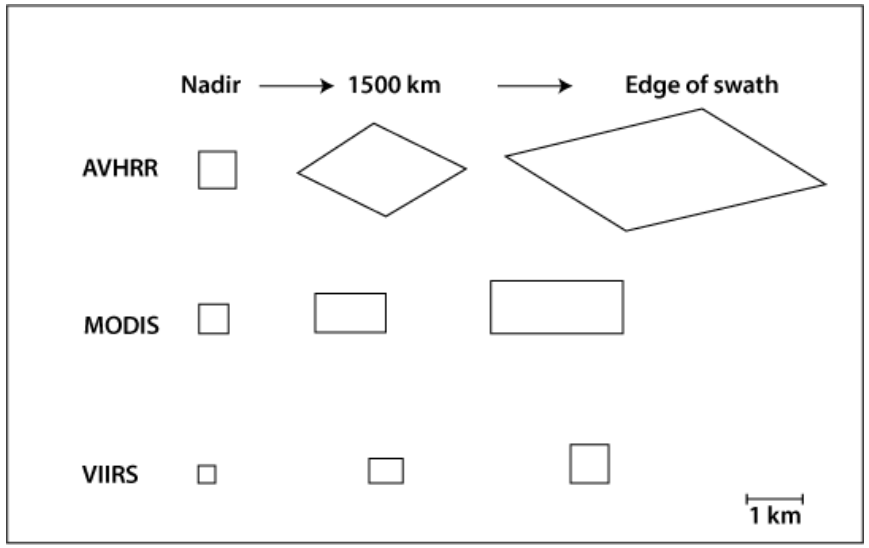
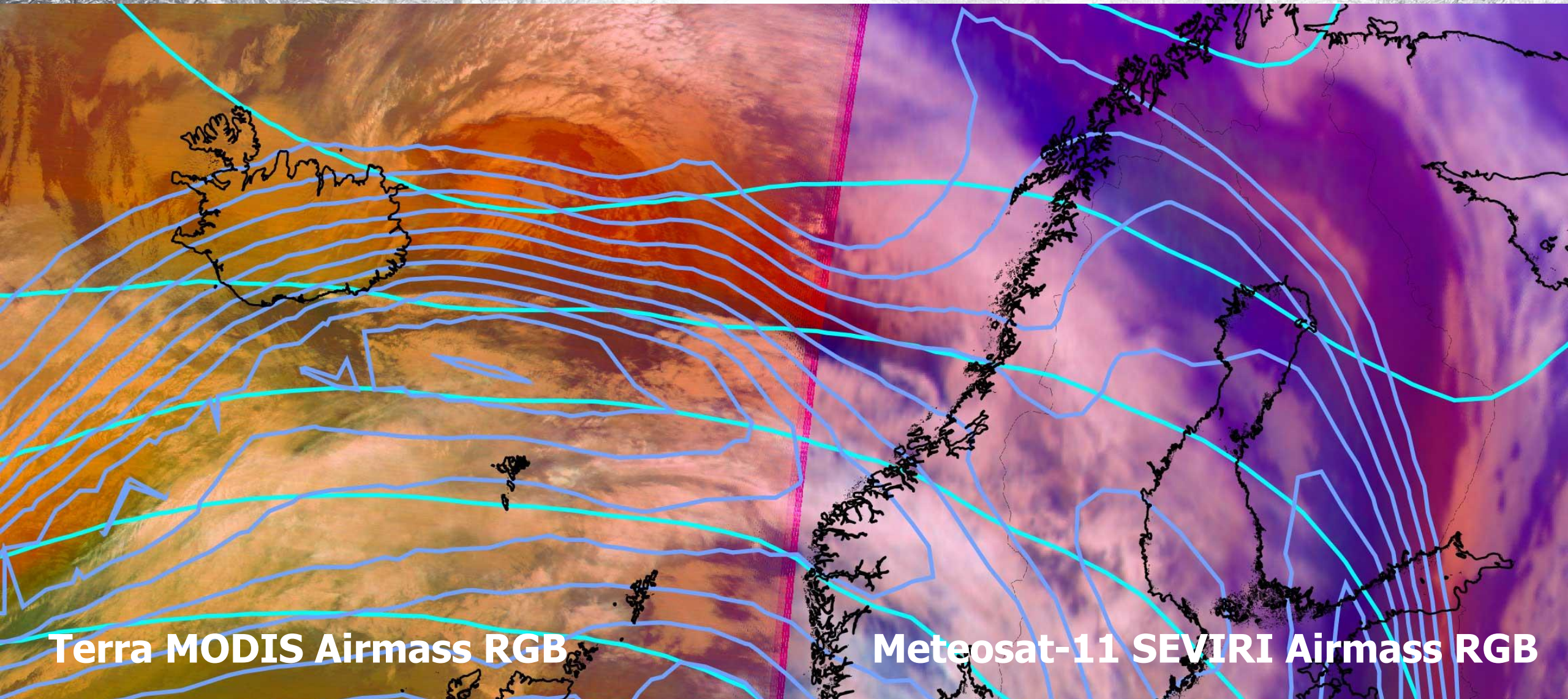


Figure 6d: Day Microphysical RGB (NOAA-20, VIIRS) 21 June 11:48 UTC. Comparison of Cb clouds position between the middle of polar satellite swath (red) and the edge of swath (blue). The city of Oulu is marked with a triangle





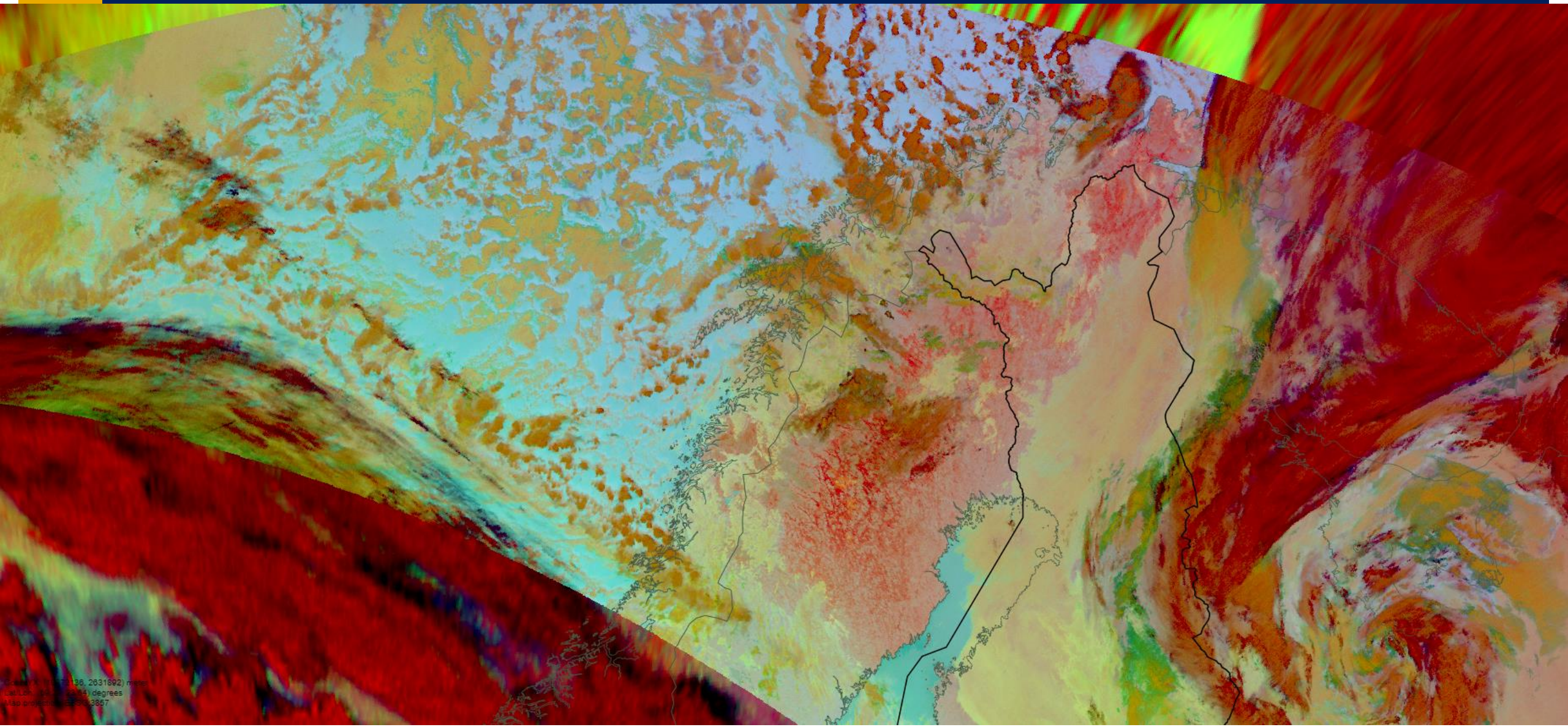
Storm Malik (Valtteri) and Airmass RGB 29.1.2022



Tour

A short tour into today images at HIGH latitudes

FMI Geoweb 31.1.2023



Thank you !

Questions and comments?