EUMETSAT

SAC Nairobi

Basics of remote sensing and cloud identification

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User Training Officer

EUMETSAT

CURRENT EUMETSAT SATELLITES

SENTINEL-3A & -3B (98.65° incl.)
Low Earth, sun-synchronous orbit
Copernicus satellites delivering marine and land observations

JASON-3 (63° incl.)
Low Earth, non-synchronous orbit
Copernicus ocean surface topography mission (shared with CNES, NOAA, NASA and Copernicus)

Sentinel-6 Micheal Freilich (66° incl.)
Low Earth, drifting orbit
Copernicus ocean surface topography mission (shared with CNES, NOAA, NASA and Copernicus)

METEOSAT-9, -10, -11
Geostationary orbit
Meteosat Second Generation

Two-satellite system
Full disc imagery mission (15 mins)
(Meteosat-11 (0°))
Rapid scan service over Europe (5 mins)
(Meteosat-10 (9.5° E))
BACKUP SATELLITE and gap filler for RSS
(Meteosat-9 (3.5°E))

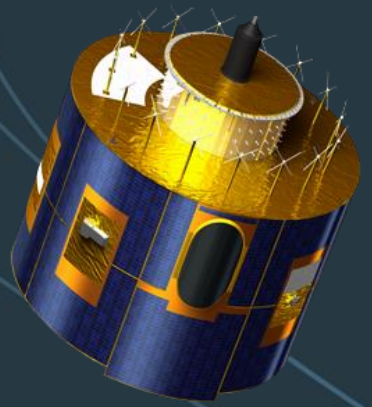
METEOSAT-8 (41.5° E)
Geostationary orbit
Meteosat Second generation providing IODC from February 2017 – mid-2020

METOP-A, -B & -C (98.7° incl.)
Low Earth, sun-synchronous orbit
EUMETSAT Polar System (EPS)/ Initial Joint Polar System

TWO TYPES OF METEOROLOGICAL SATELLITES

GEOSTATIONARY ORBIT

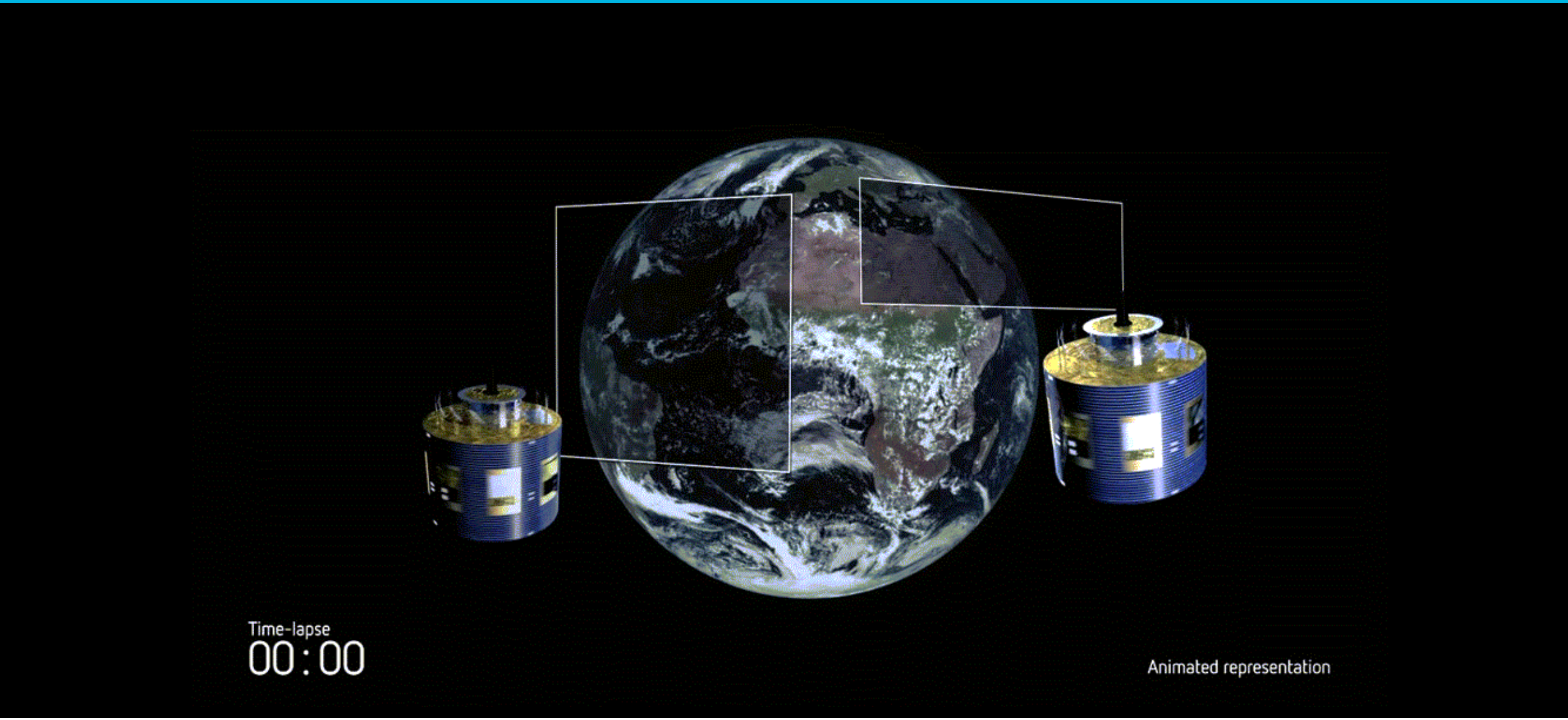
Vital for forecasts up to a few hours



POLAR ORBIT

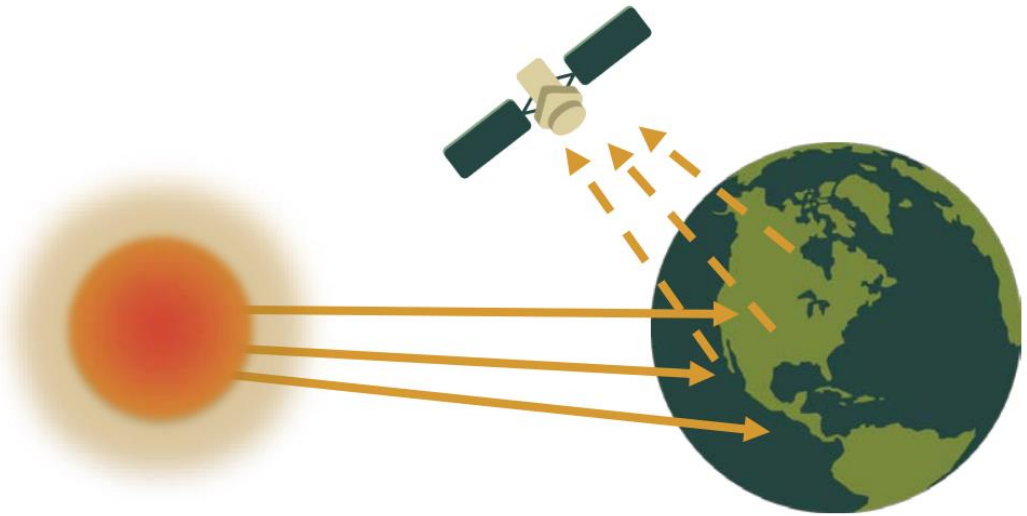
Critical for forecasts up to 10 days

METEOSAT SECOND GENERATION: A TWO-SATELLITE OPERATIONAL SYSTEM

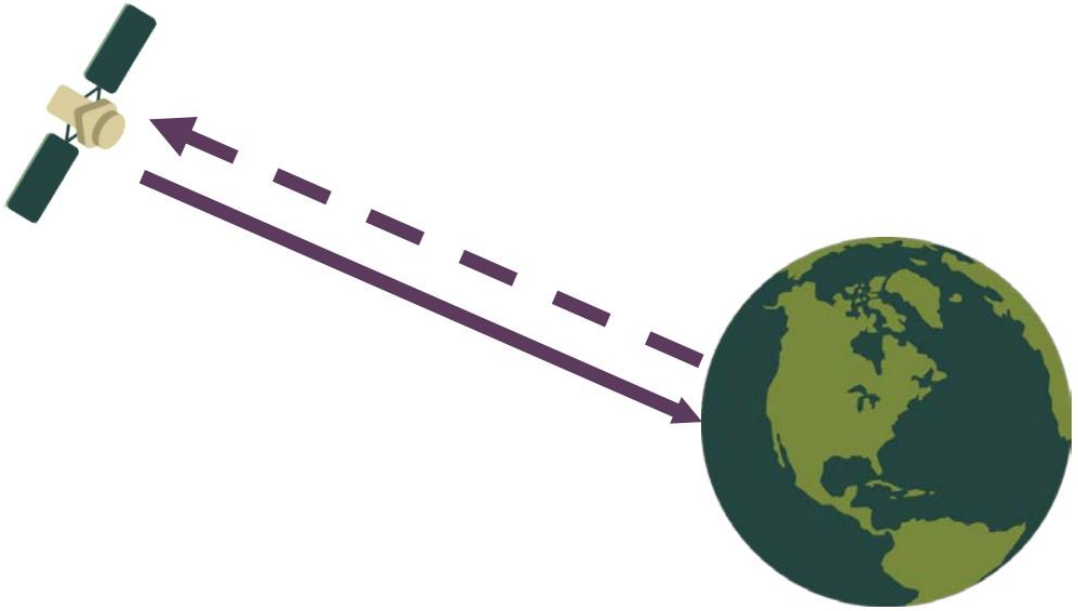


SATELLITE SENSORS

Passive Sensors



Active Sensors



Credit: NASA Applied Remote Sensing Training Program

REMOTE SENSING OF THE ATMOSPHERE

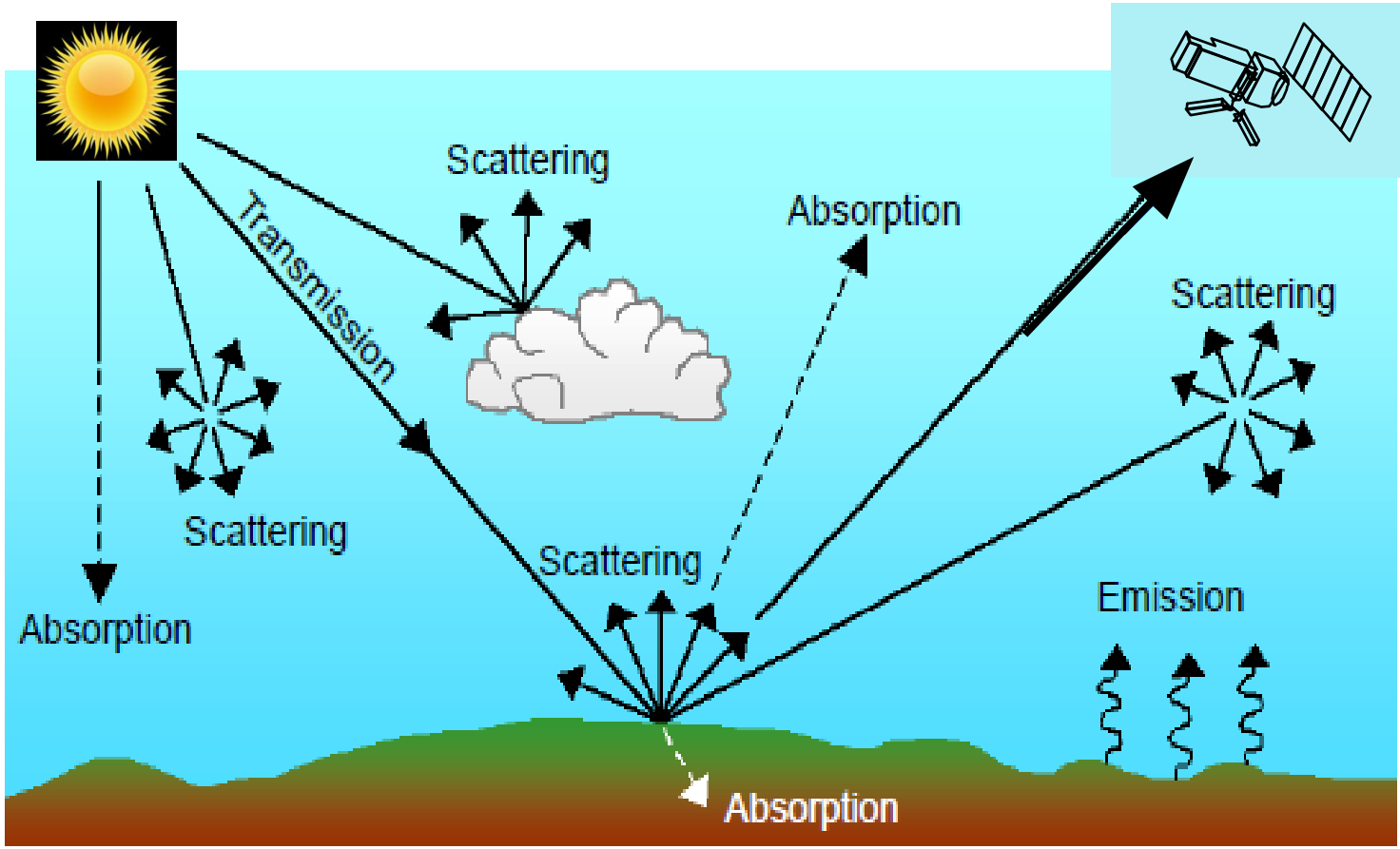
What do we measure?

- Solar radiation: reflected by the surface, scattered by molecules, cloud droplets, ice crystals, aerosols, absorbed by the atmosphere

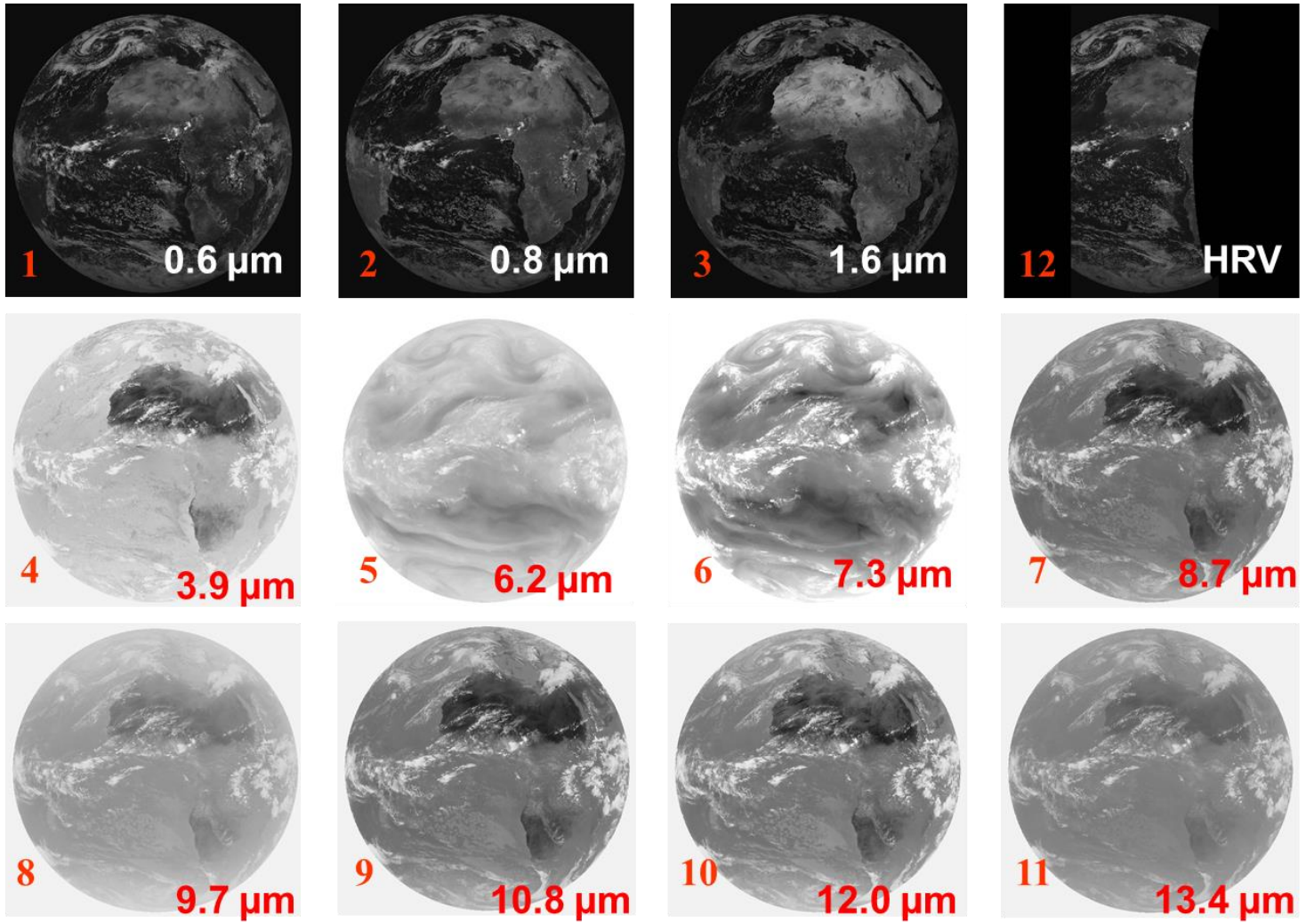
=> SOLAR CHANNELS

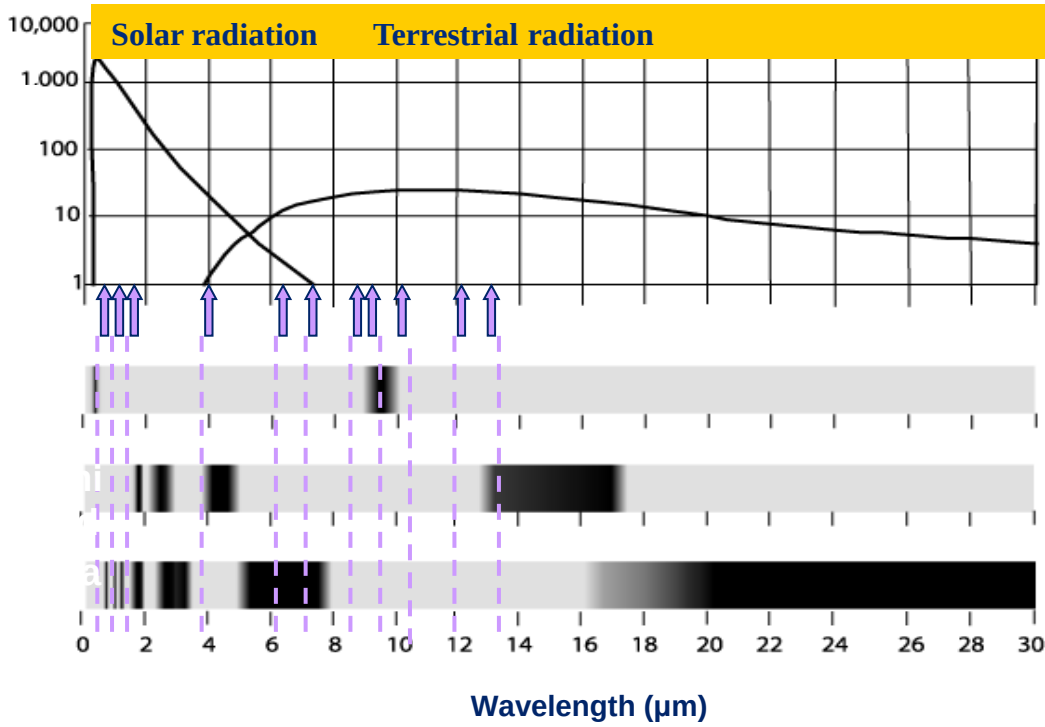
- Thermal radiation: emitted by the Earth / clouds / atmosphere, absorbed by the atmosphere, clouds, aerosols

=> IR CHANNELS



MSG SEVIRI SPECTRAL CHANNELS





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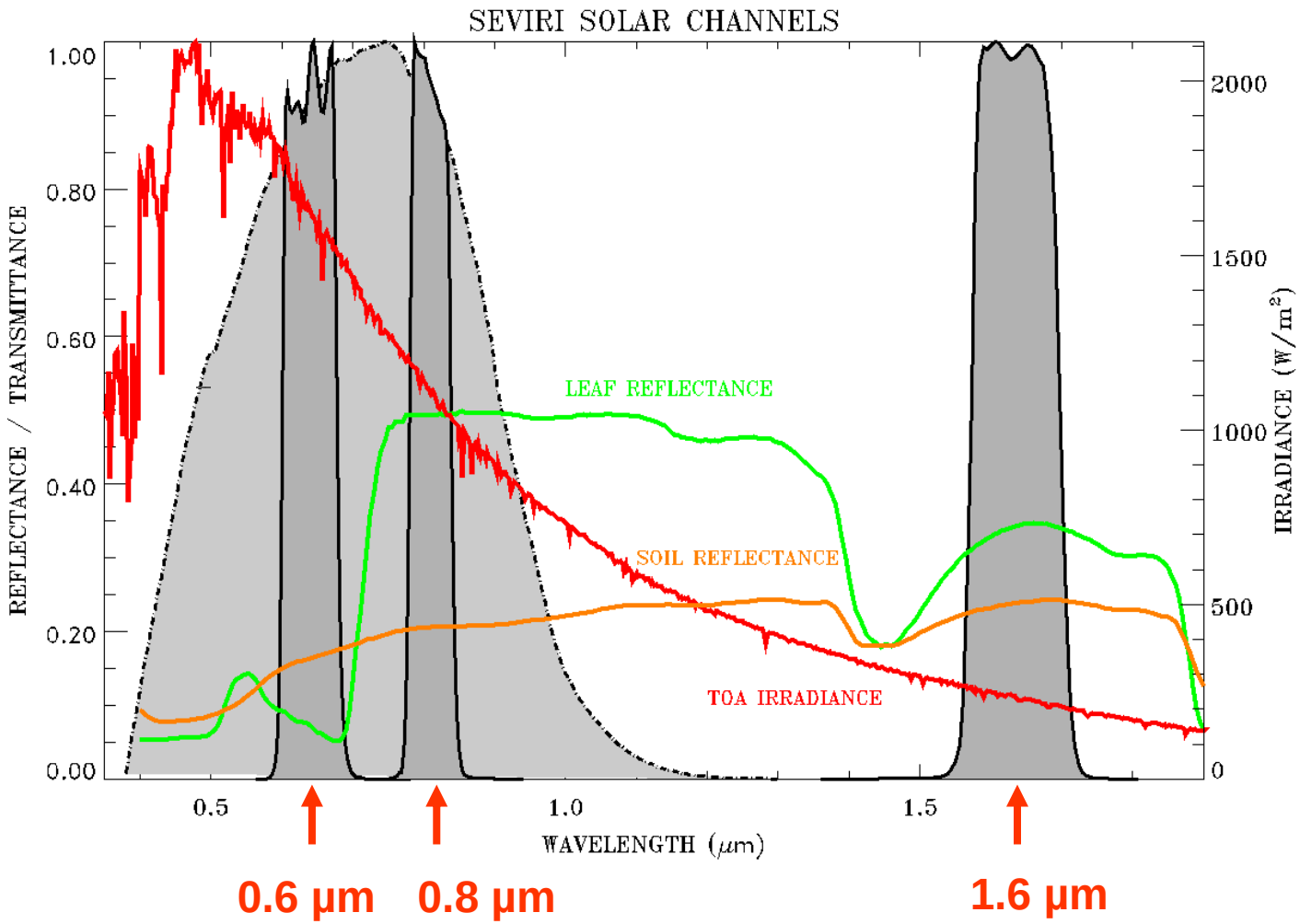
SOLAR CHANNELS 0.6 AND 0.8

Solar channels: 0.6, 0.8 µm:

- Reflected solar radiation
- Available during daytime only
- Cloud monitoring
- In 0.8 µm vegetation reflects much more – used for land an vegetation products



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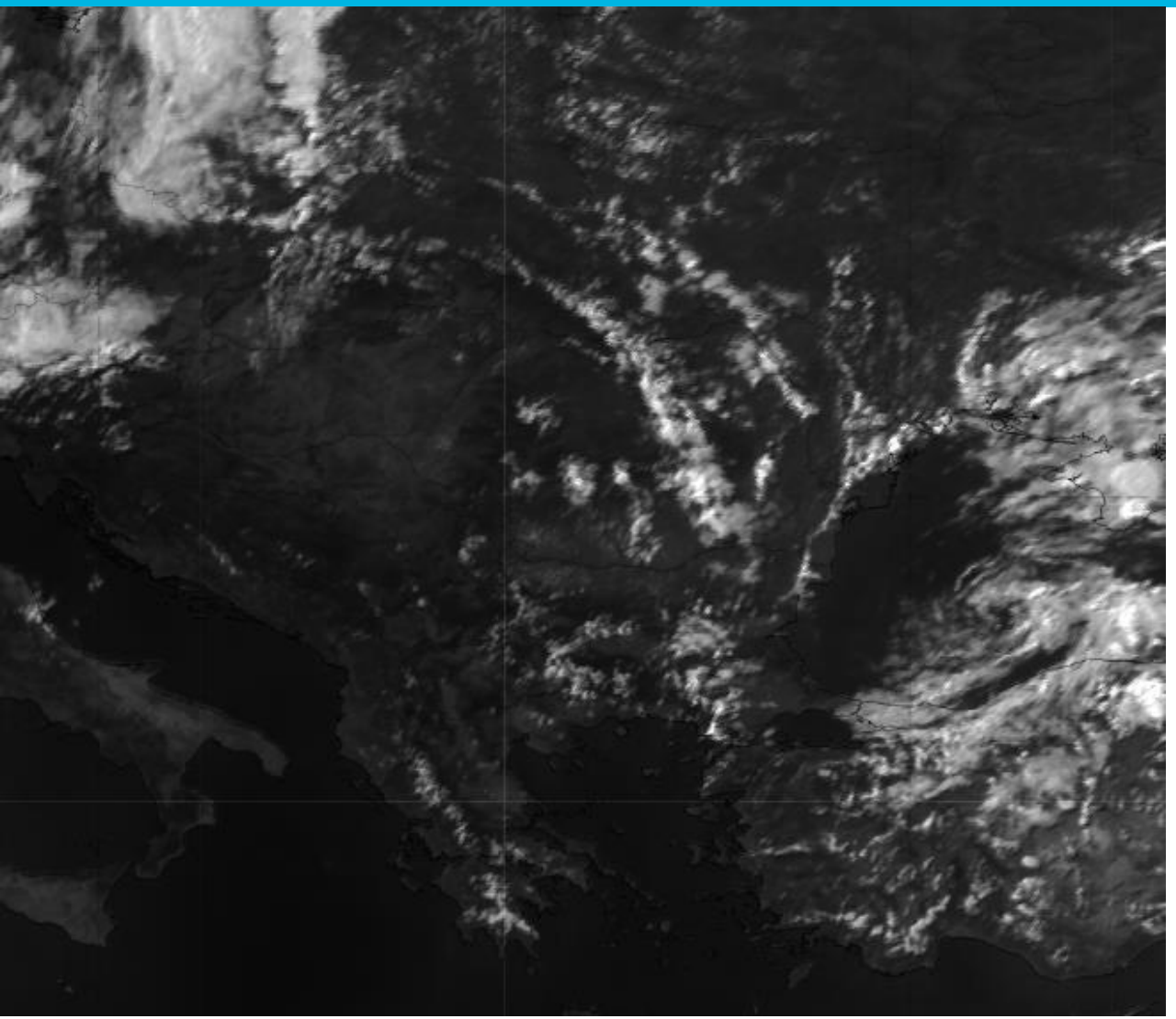

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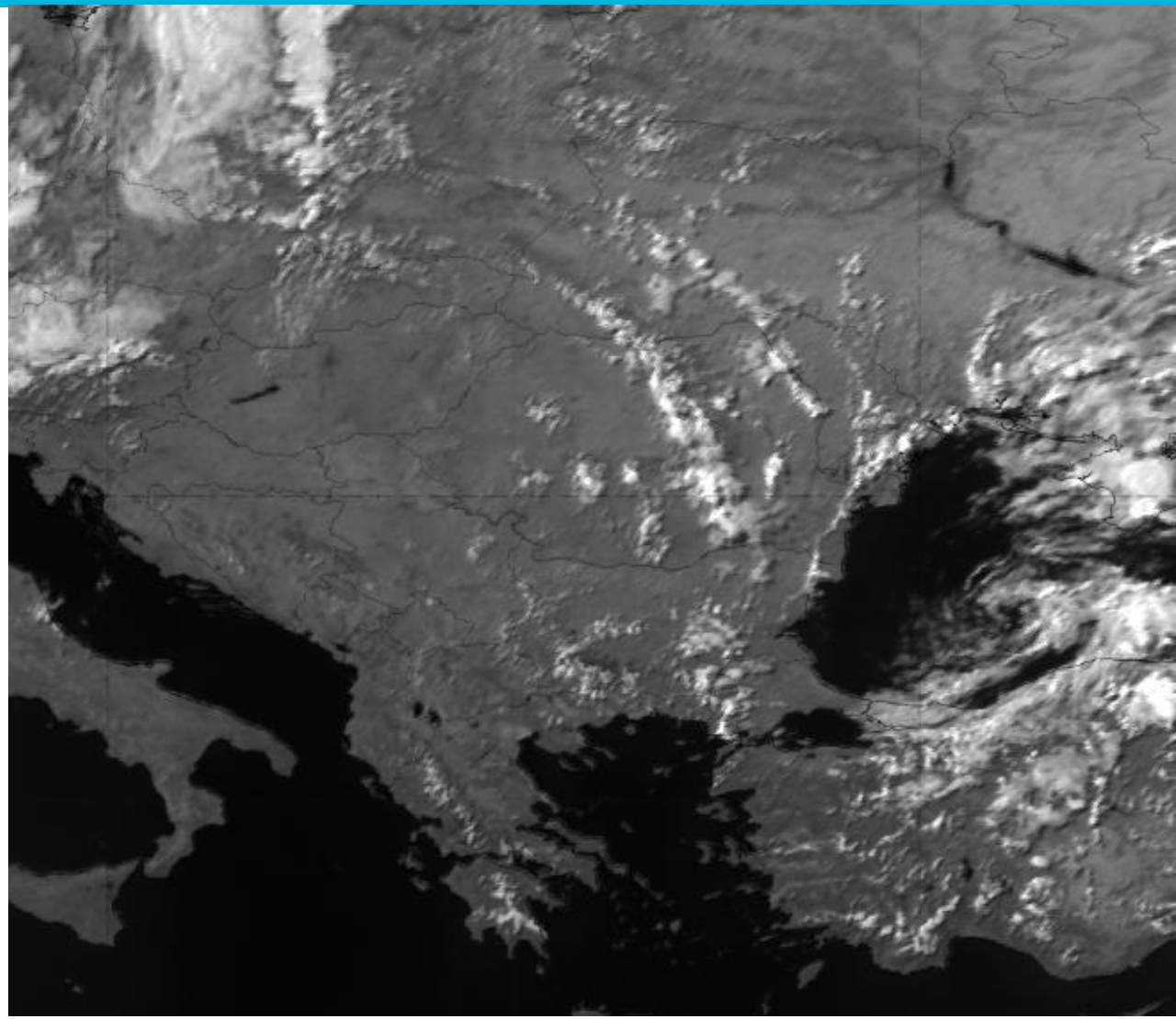
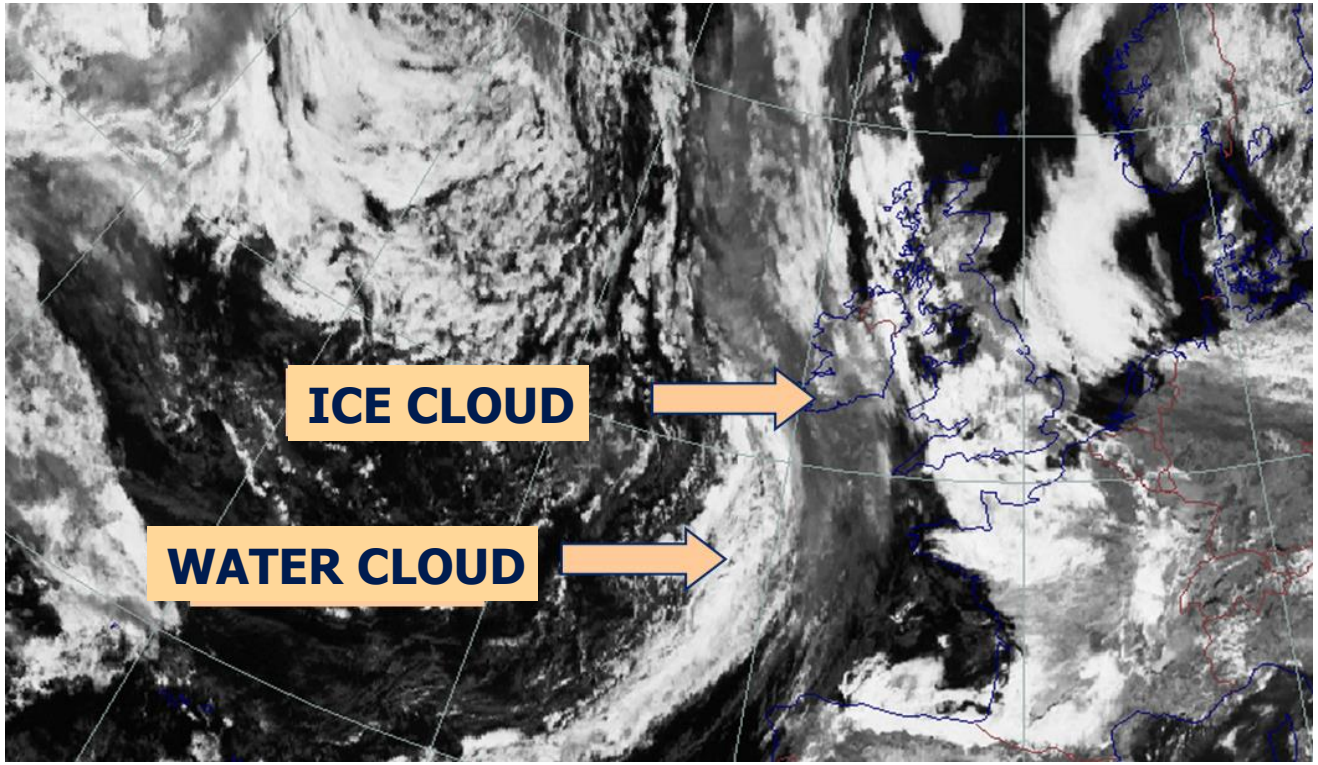
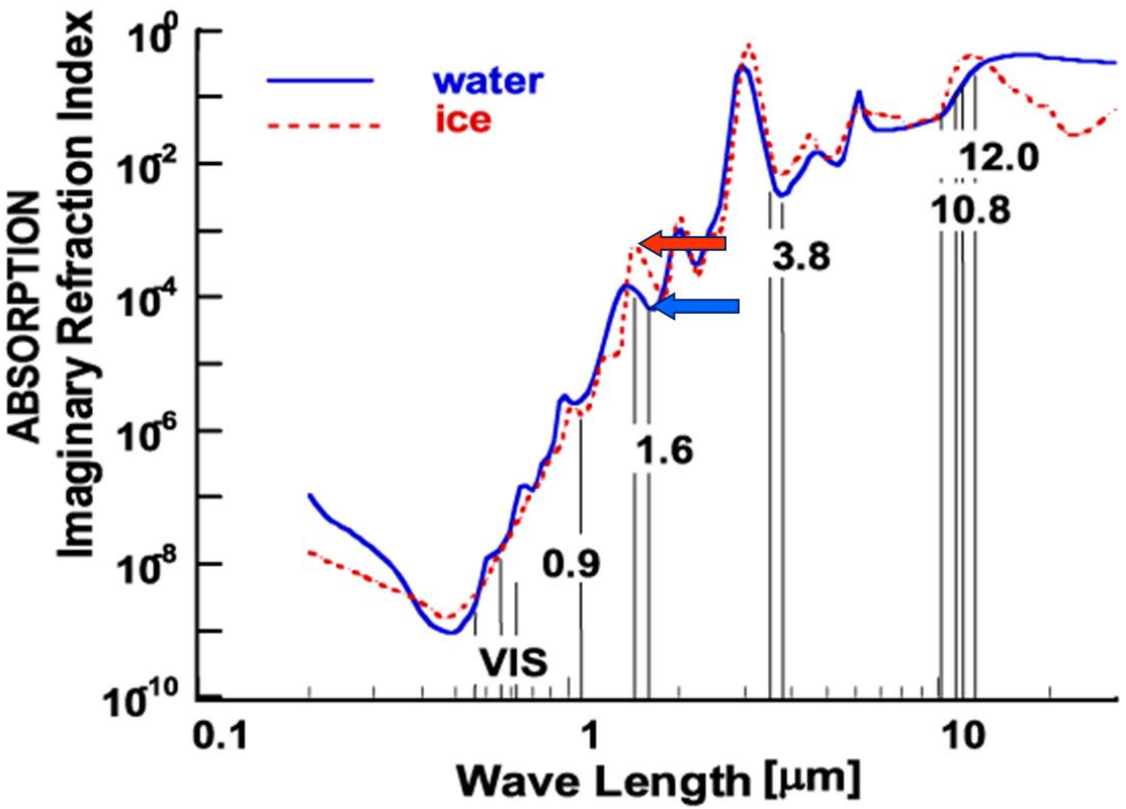


SOLAR CHANNEL NIR1.6

- Different reflectivity of ice and water!
- Ice absorbs more in 1.6 – ice clouds are dark!
- Differing snow from water clouds





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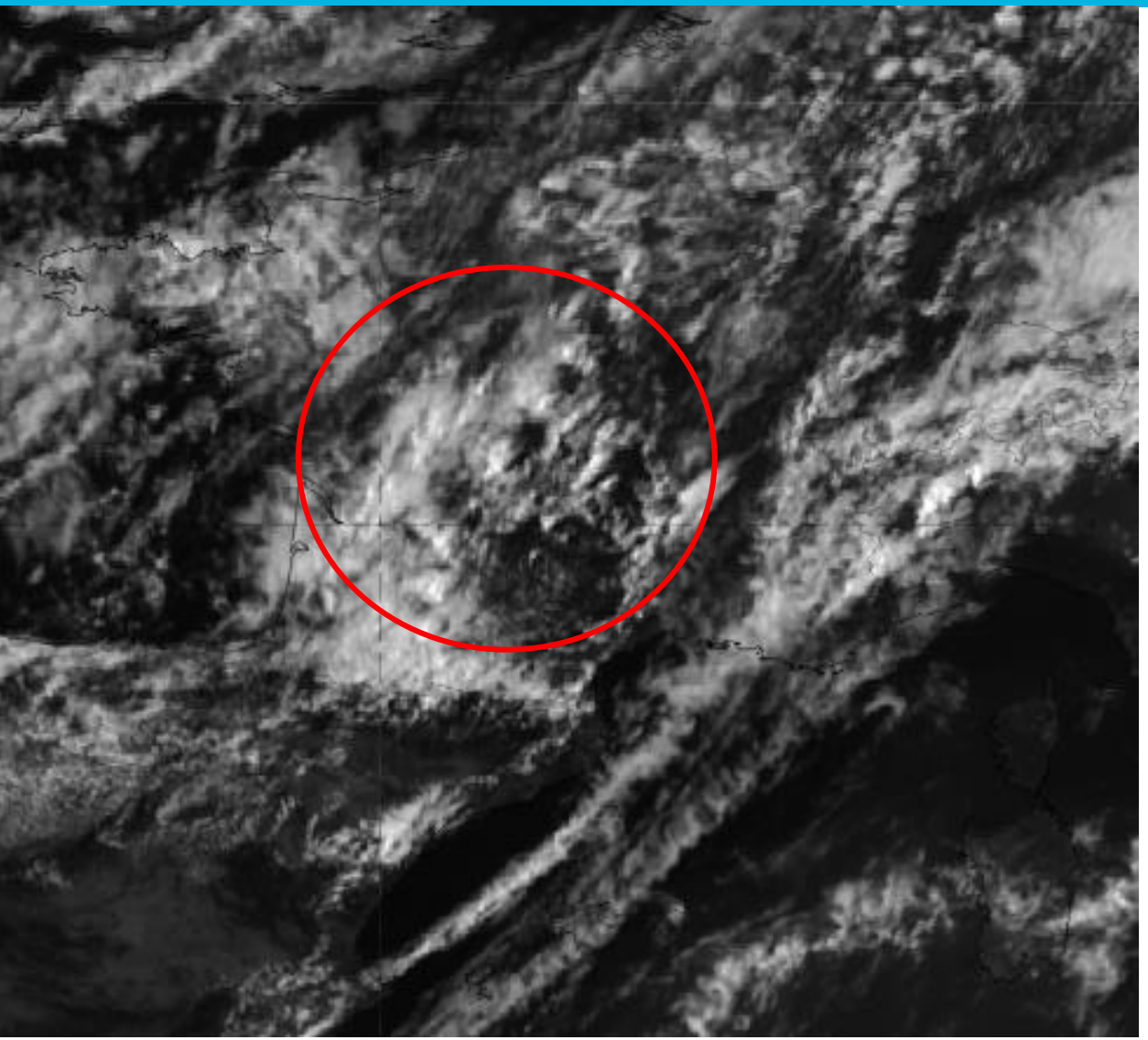

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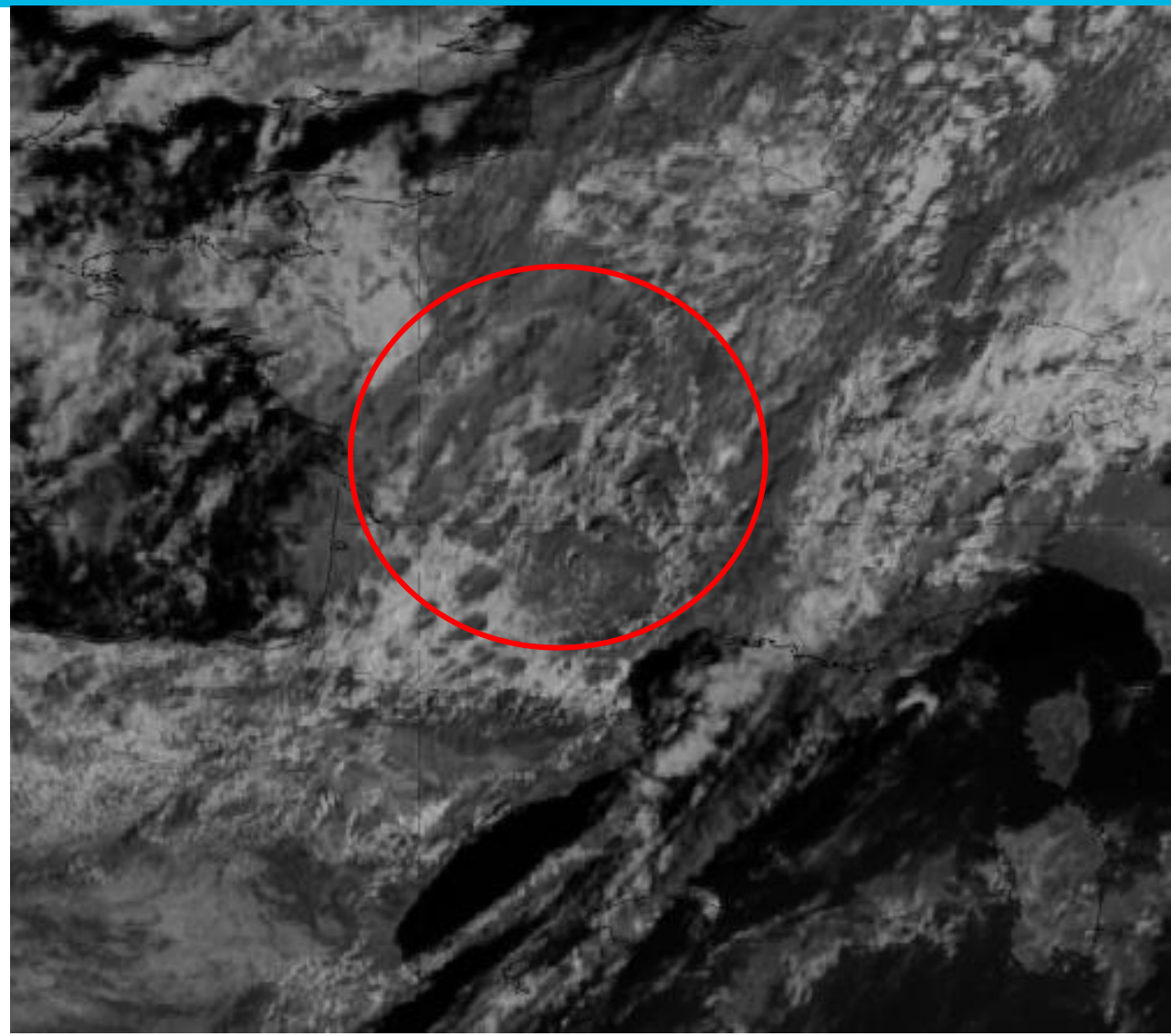
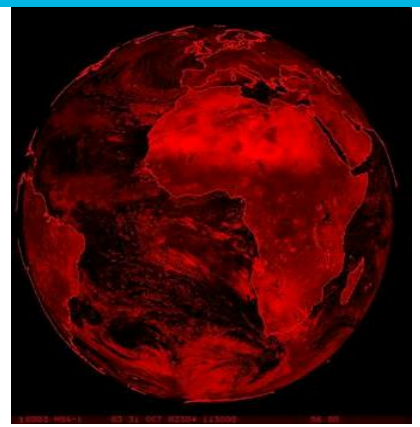
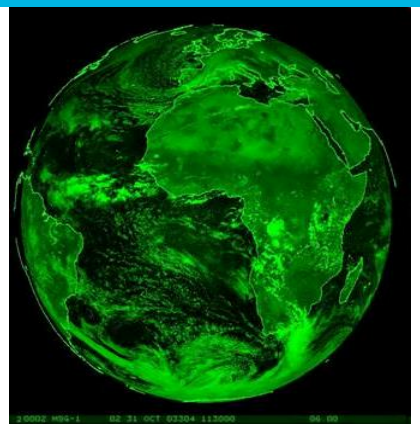


NATURAL COLOURS RGB

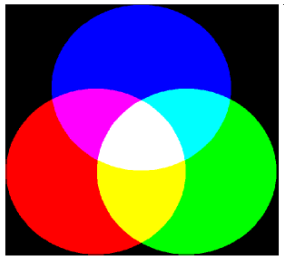




RED: NIR 1.6 µm

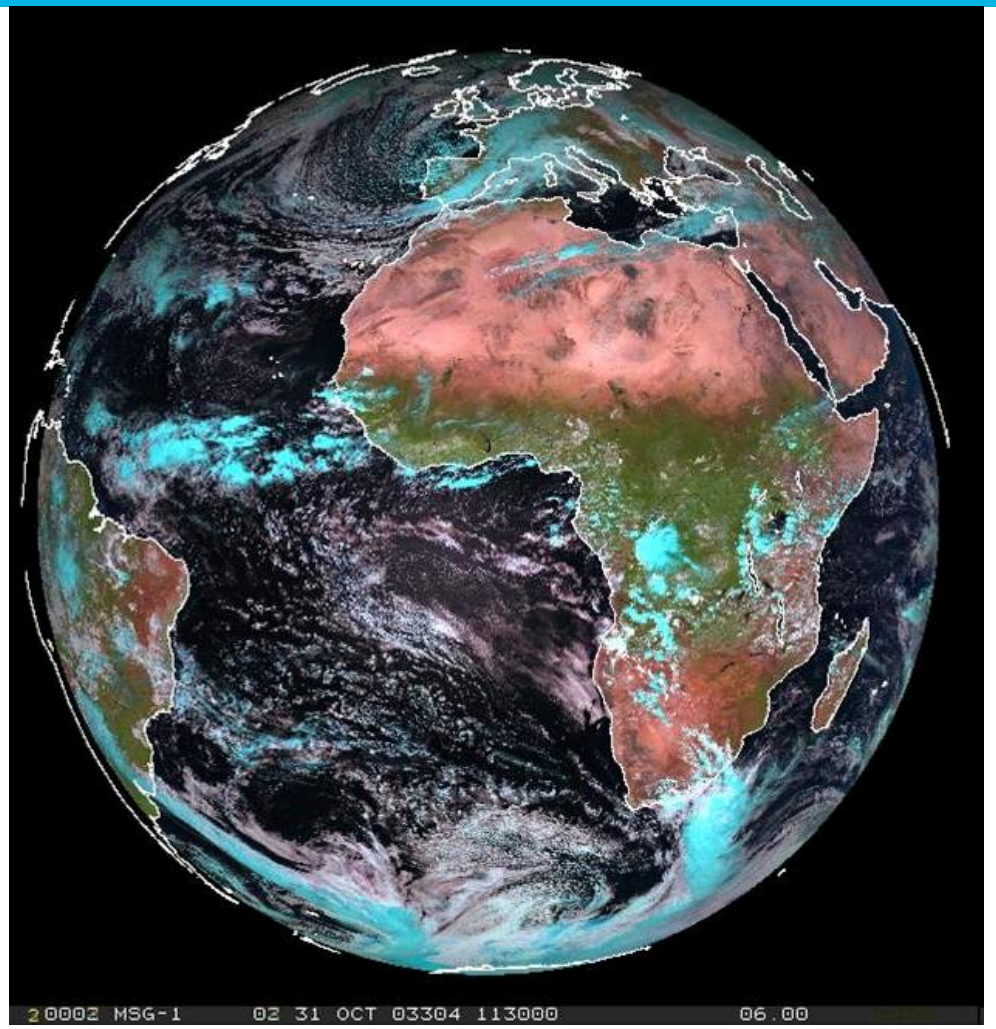
GREEN: VIS 0.8 µm

BLUE: VIS 0.6 µm

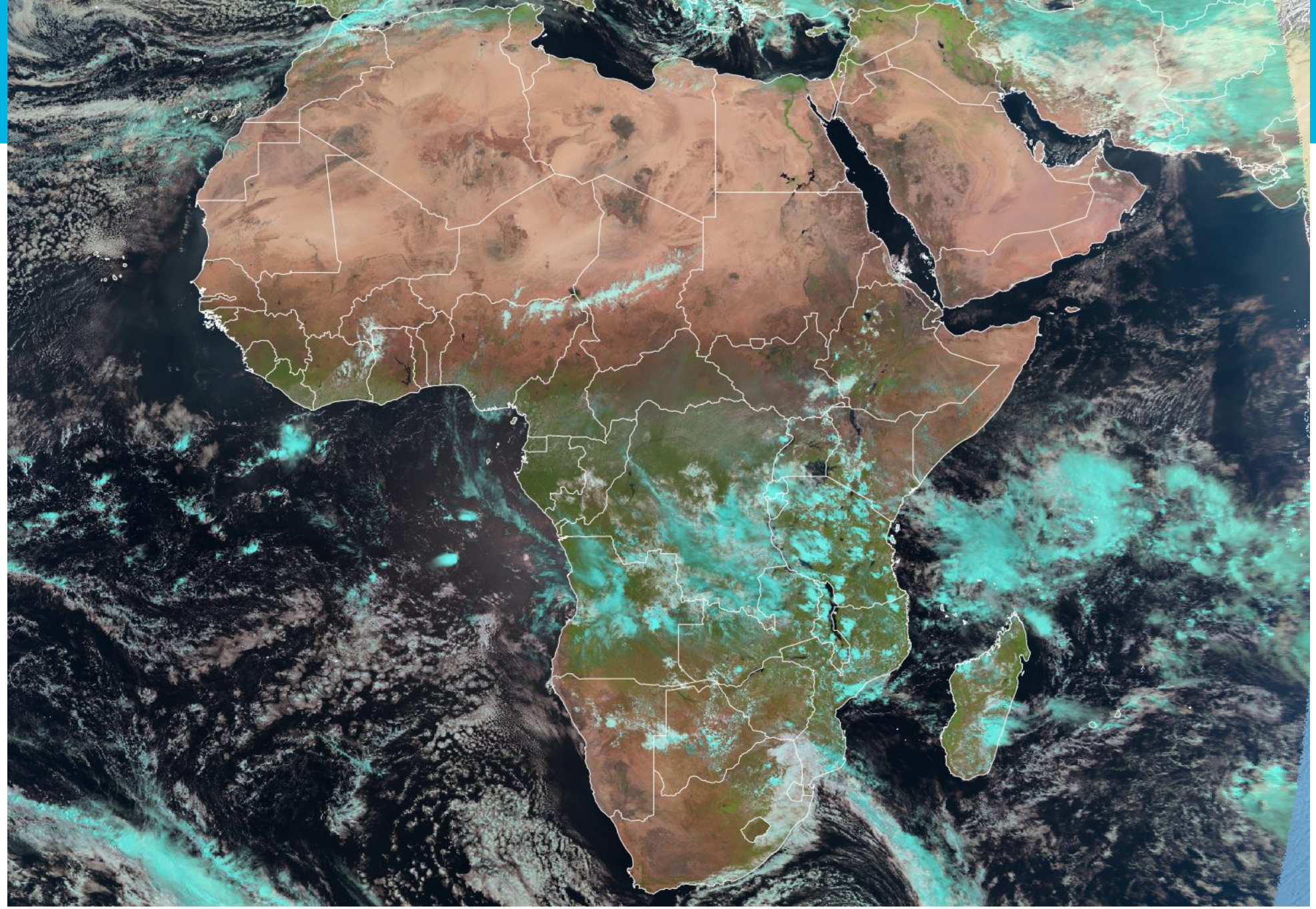


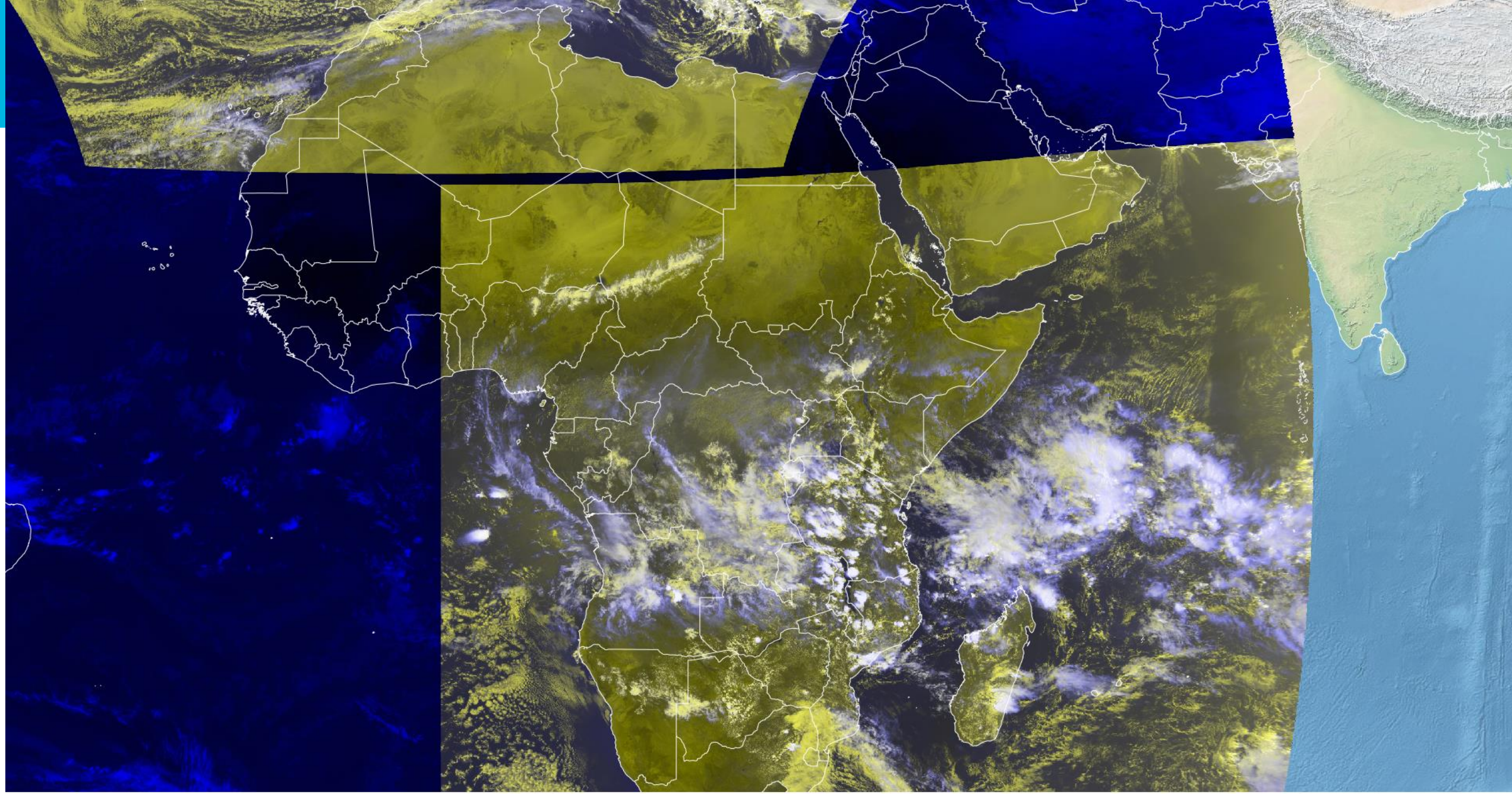
Combining the three channels you get:

More on RGBs and their use – on eumetrain.org:
http://www.eumetrain.org/resources/bsc_2014_s7.html
http://www.eumetrain.org/resources/operational_use_rgb.html
http://www.eumetrain.org/resources/operational_use_rgb2.html



Natural colours RGB

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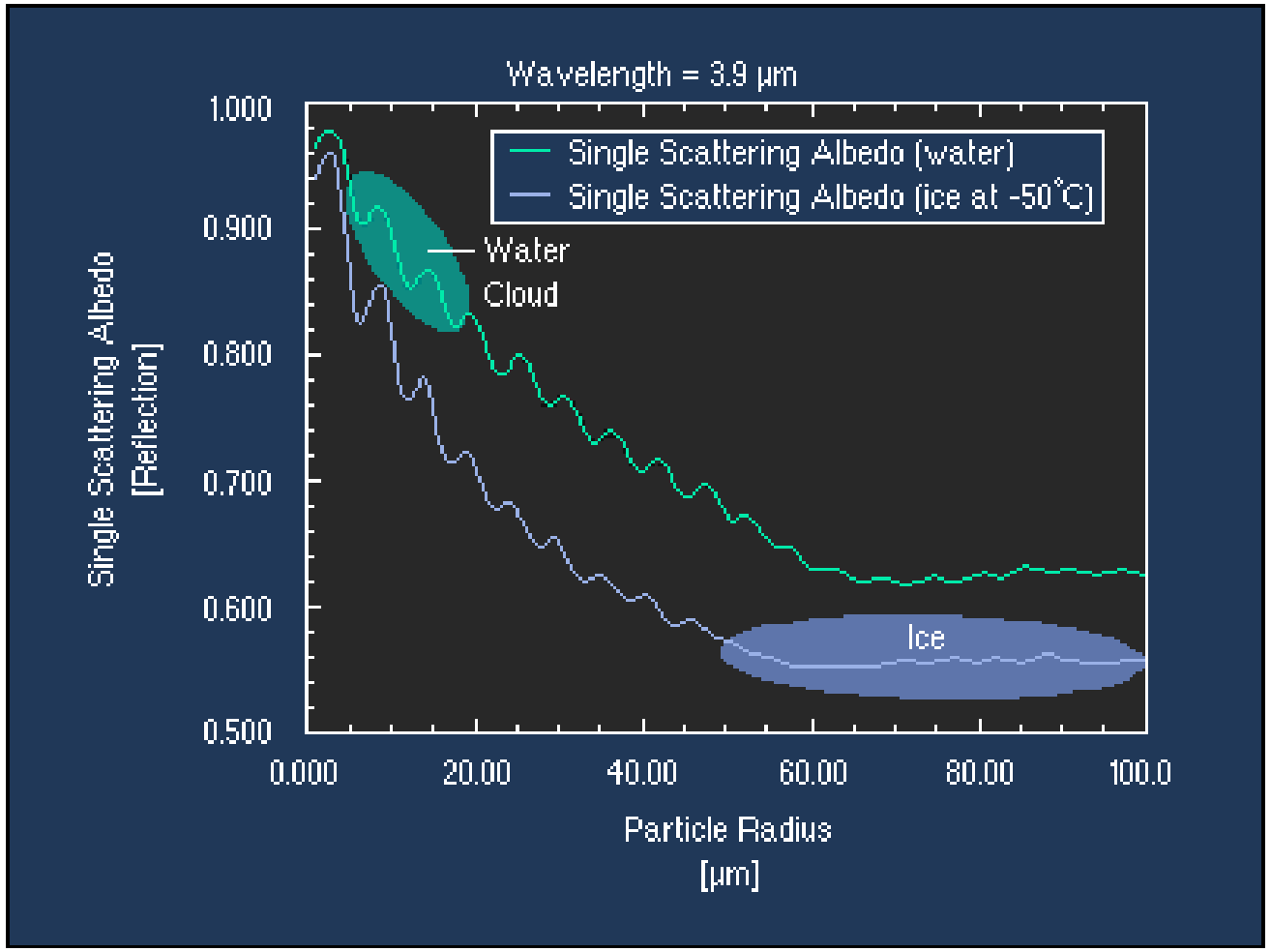
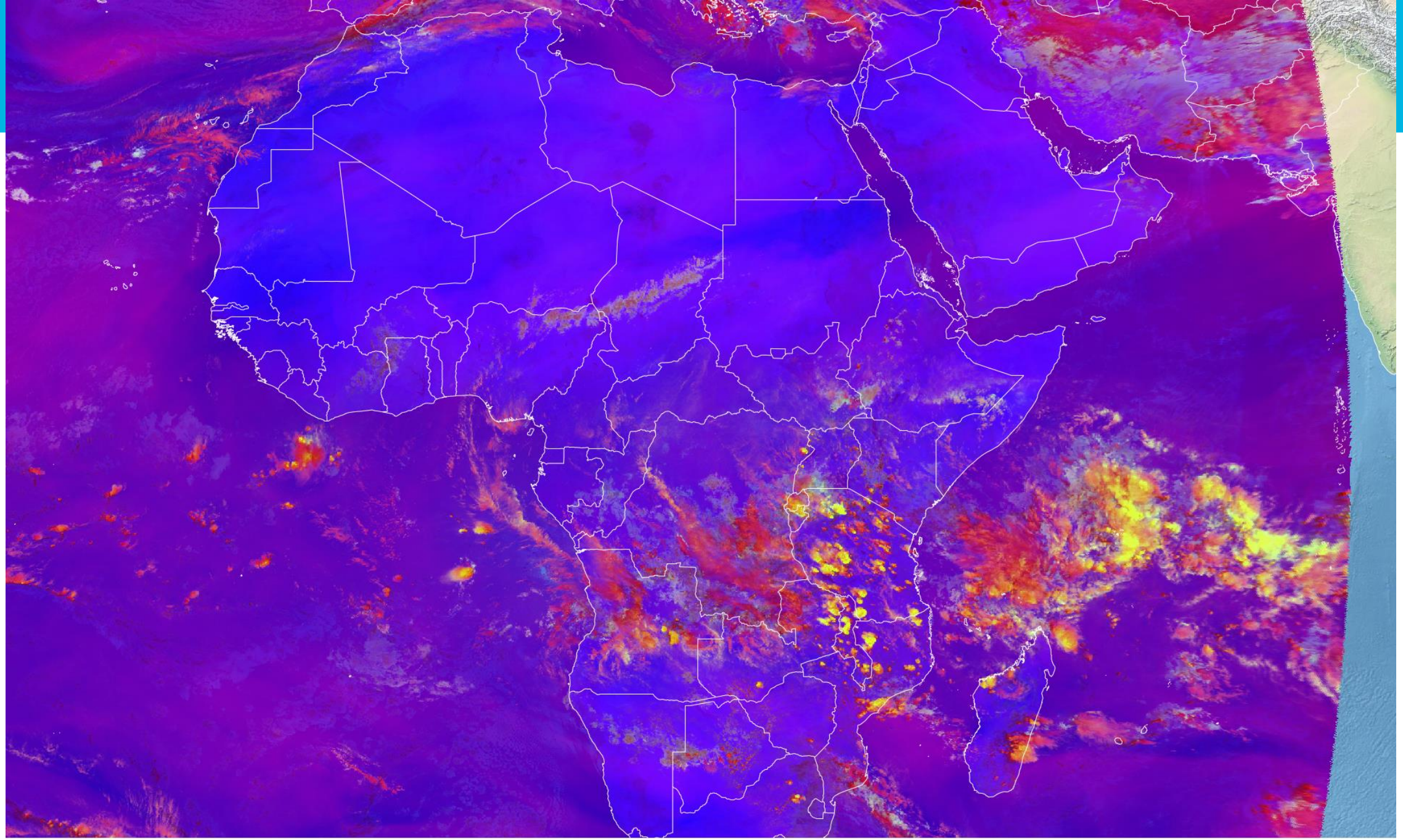
IR3.9 CHANNEL

Reflectivity in IR3.9 – depends on cloud phase but even more on particle size of cloud droplets (ice crystals)

- water droplets reflect more than ice crystals!
- smaller particles reflect more than bigger ones!





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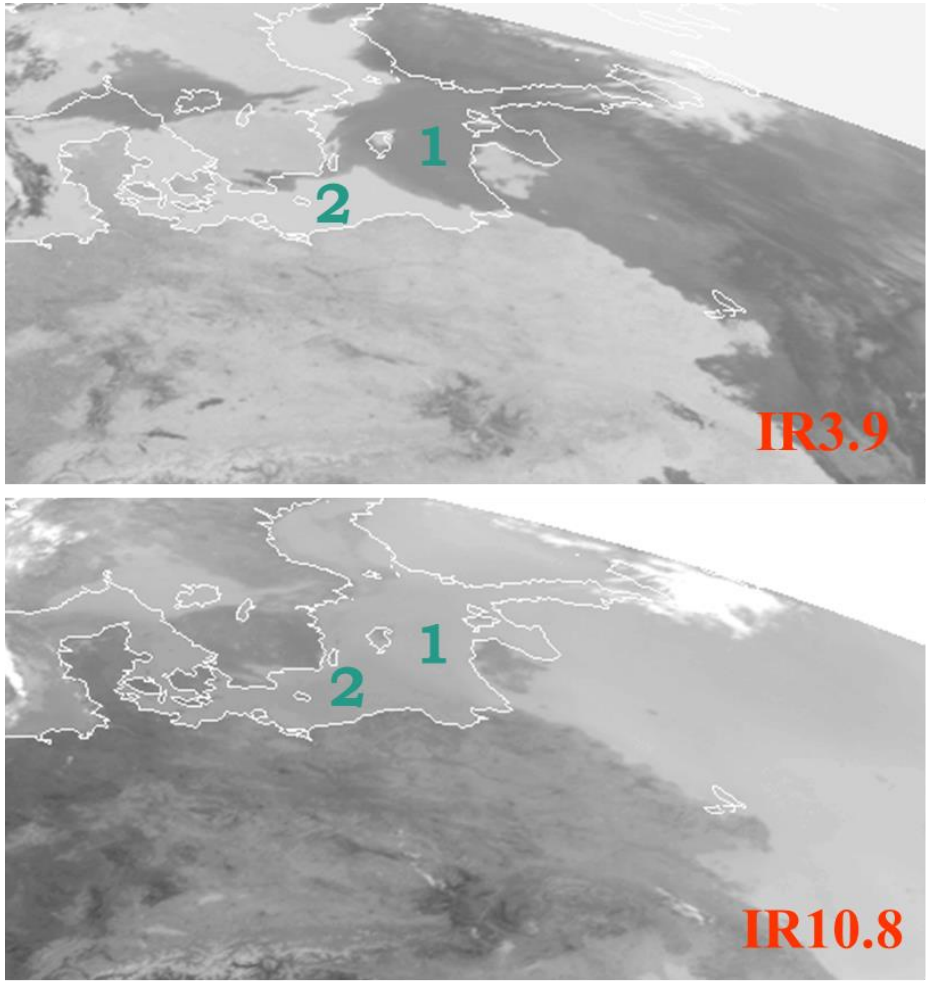
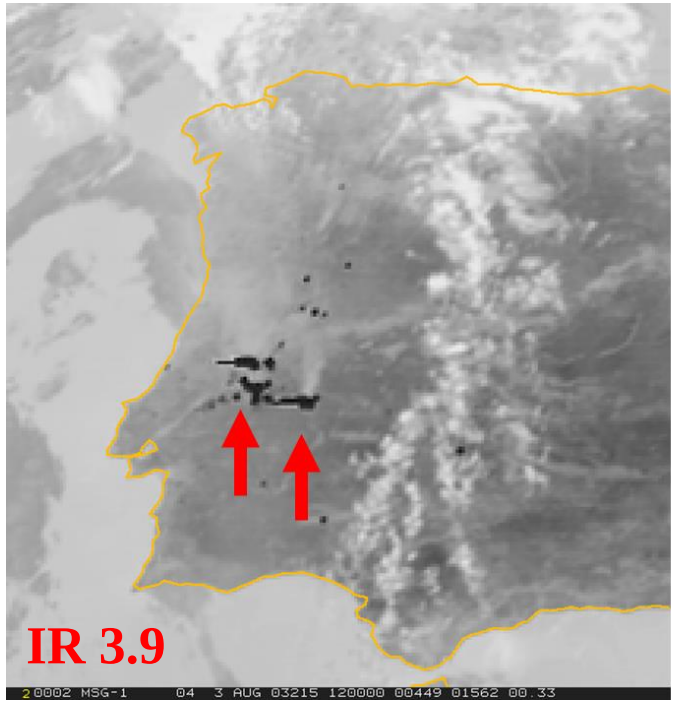
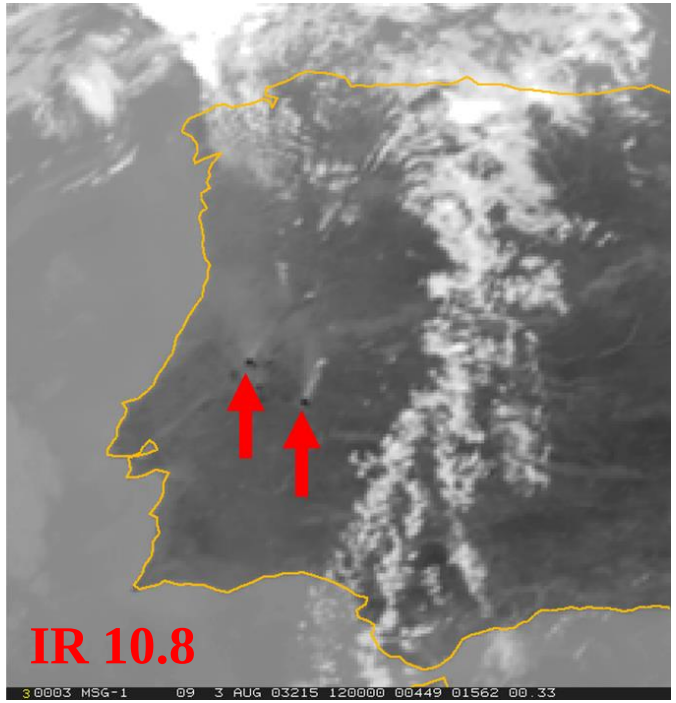
APPLICATIONS OF IR3.9

Daytime fog detection



Fires/hot spots



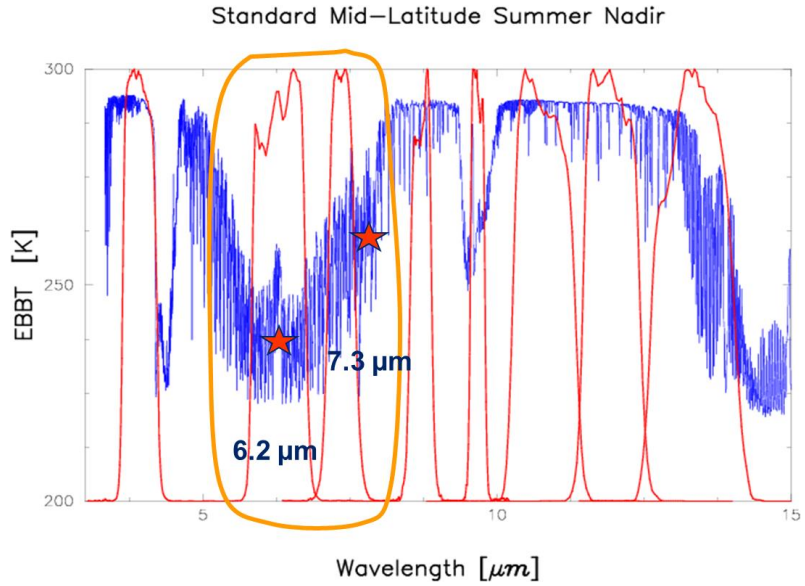


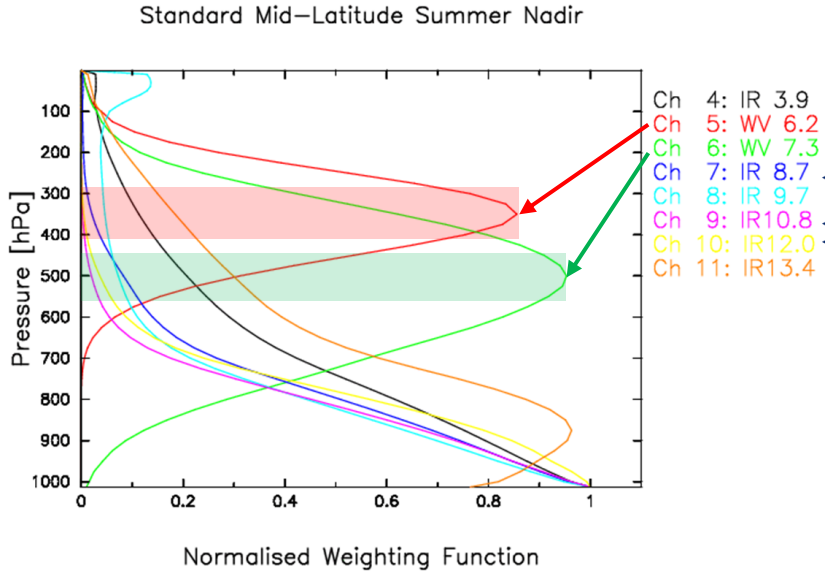
WV ABSORPTION CHANNELS

- 6.2 – highest absorption – only radiation from upper atmosphere reaches satellite
- 7.3 – close to edge of the absorption band, allows also radiation from mid atmosphere to reach the satellite

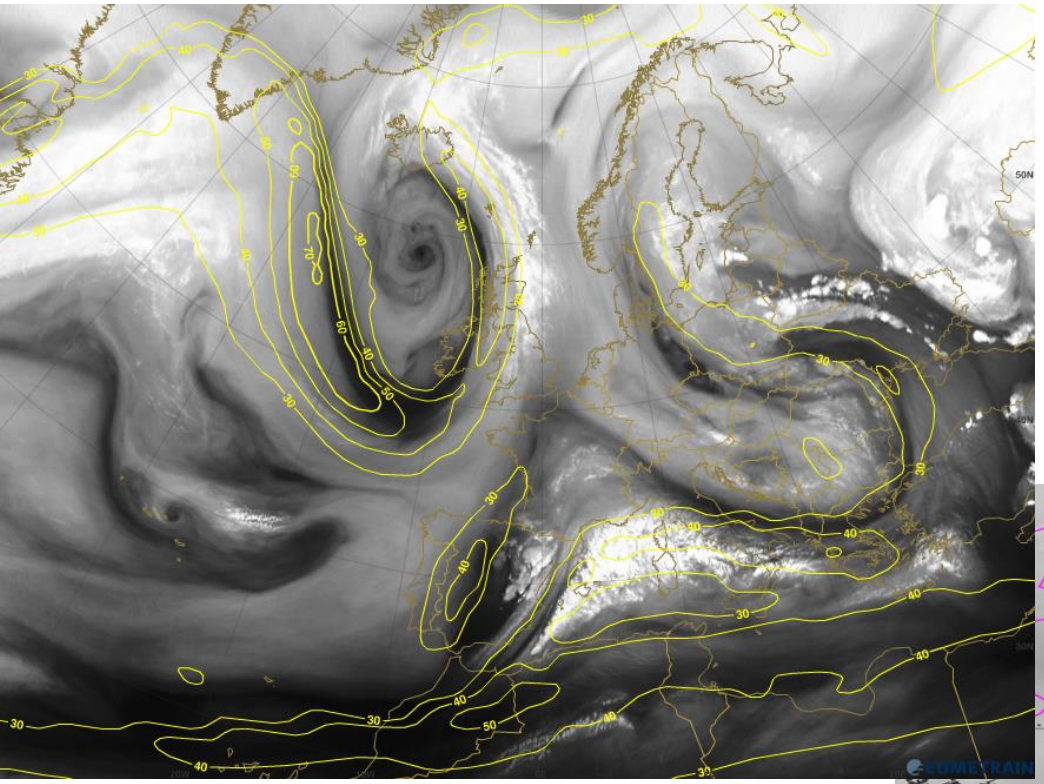
Applications:

- Jet stream
- WV vortices, eddies
- PV anomalies
- Tropopause folding



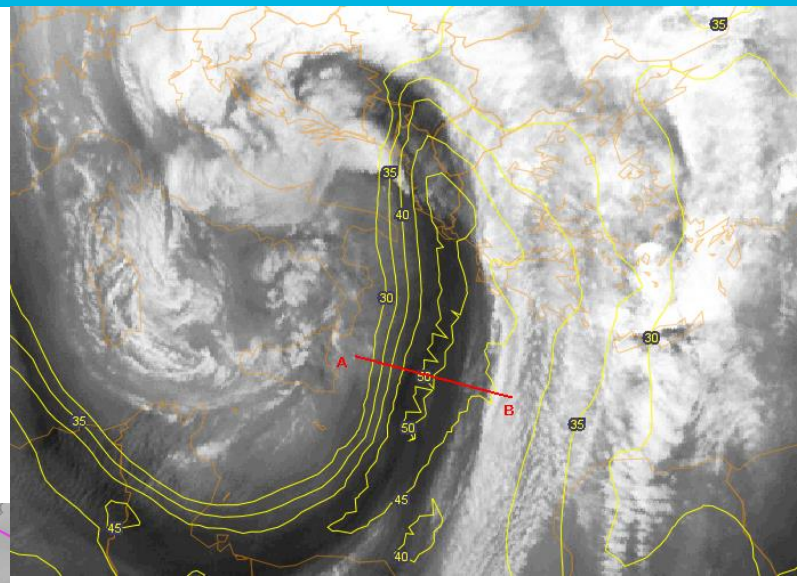


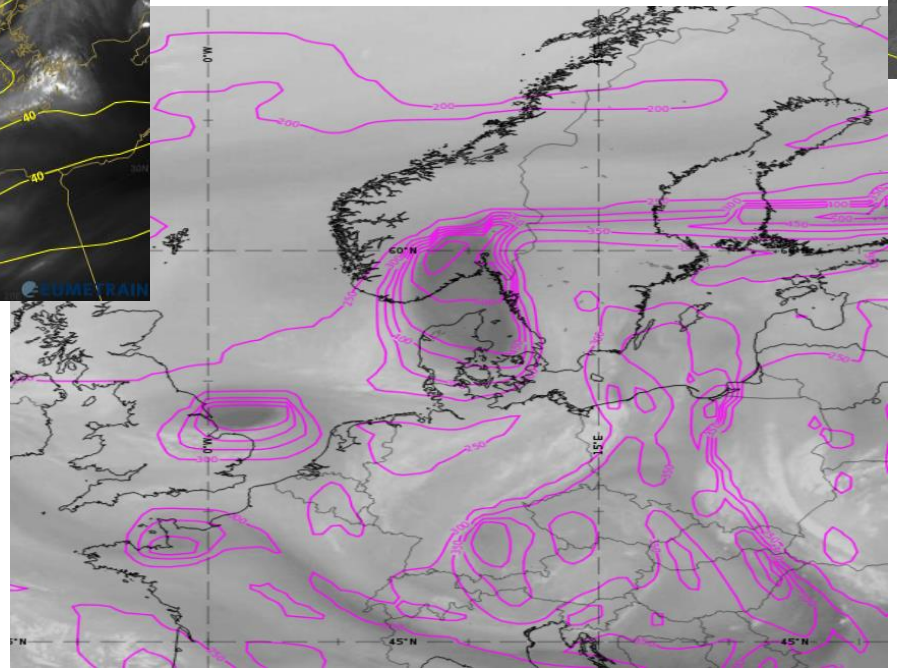
WV IMAGERY

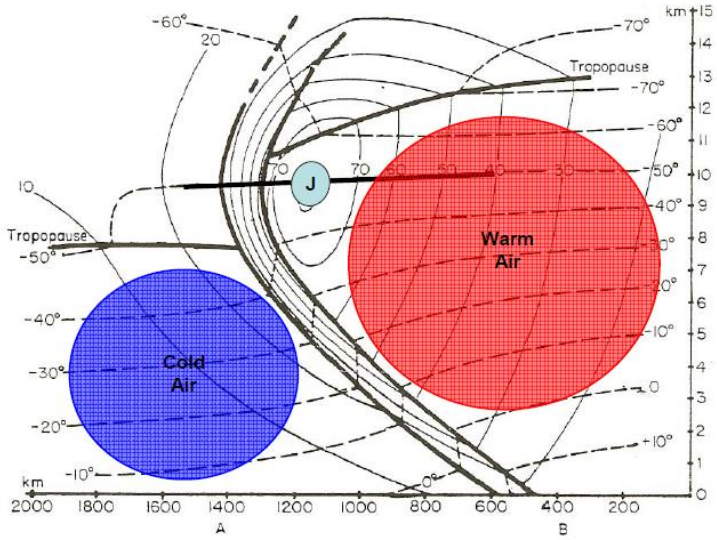


Dark zones – DRY air:

- jet stream
- tropopause folding
- PV anomalies







More on WV imagery pallet:
http://www.eumetrain.org/data/3/306/index.htm

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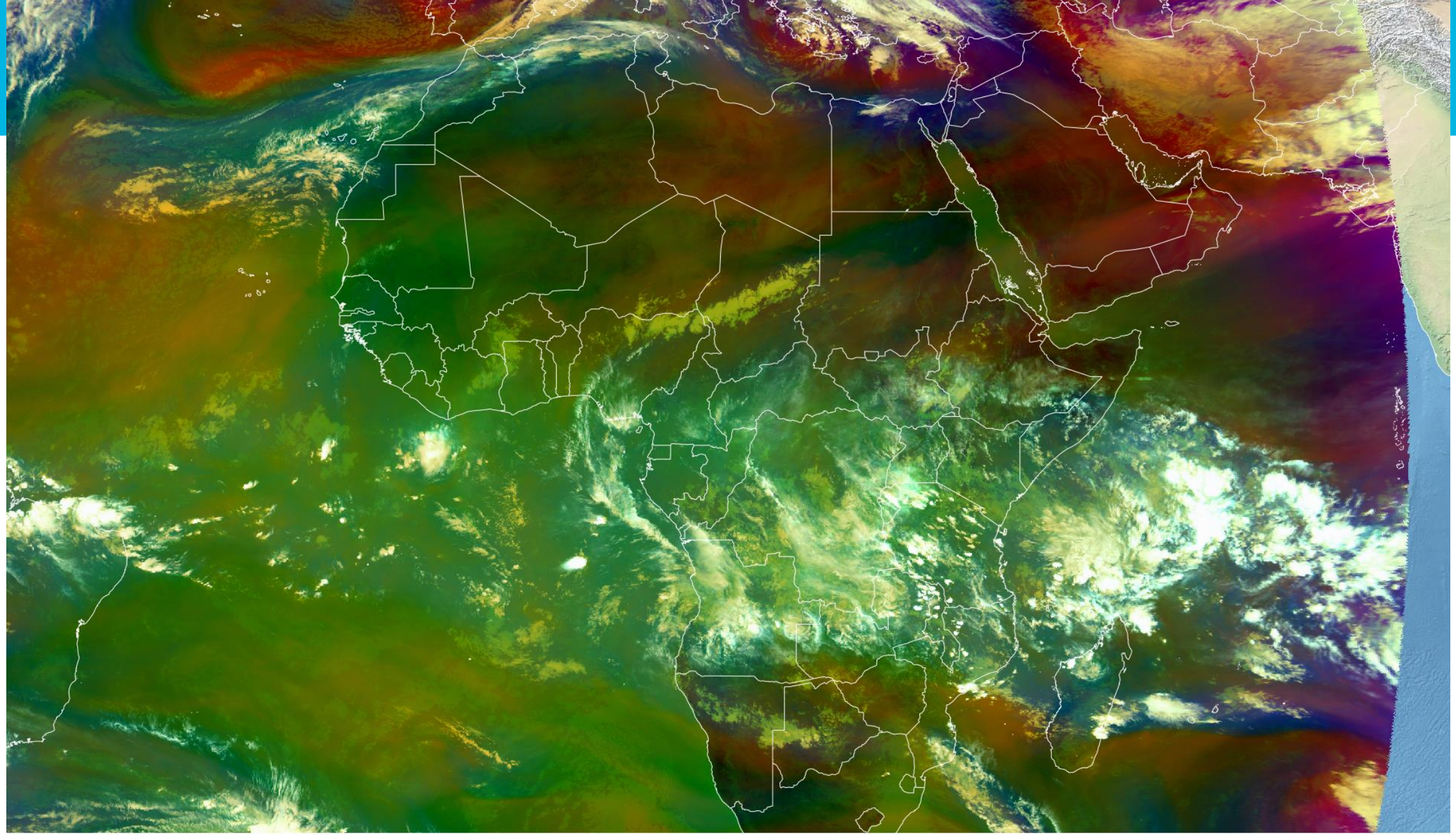

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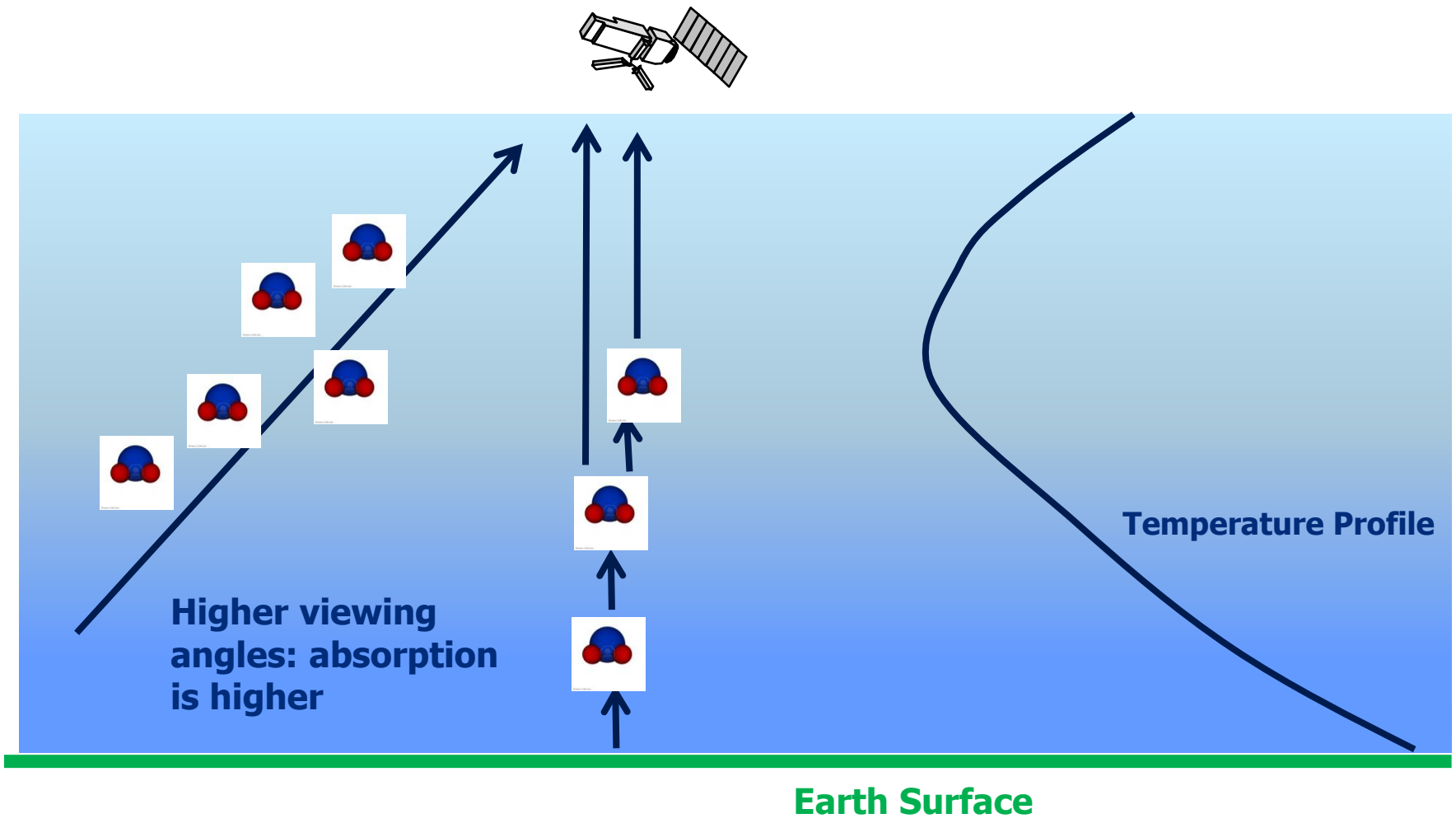
METSAT

ILLUSTRATION: BEAM AT 6.5 MM WAVELENGTH (WV ABSORPTION)



WINDOW (THERMAL) CHANNELS

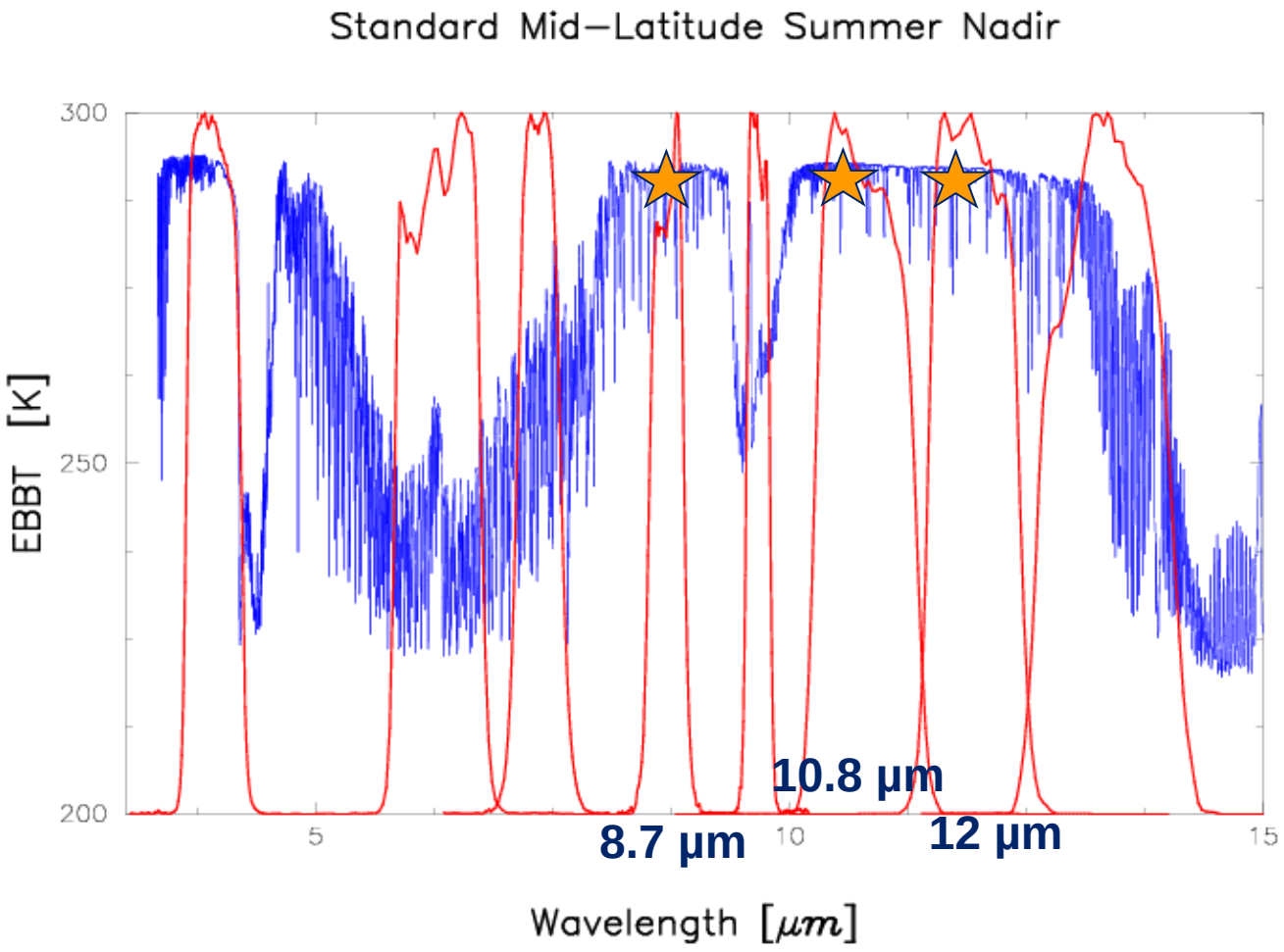
Channels 8.7, 10.8 and 12.0 µm are placed in atmospheric “windows” – least absorption

Thermal radiation emitted by the surface or clouds is measured.

Property of IR8.7 to discriminate ice from water clouds used during night when NIR1.6 is not available.

Applications:

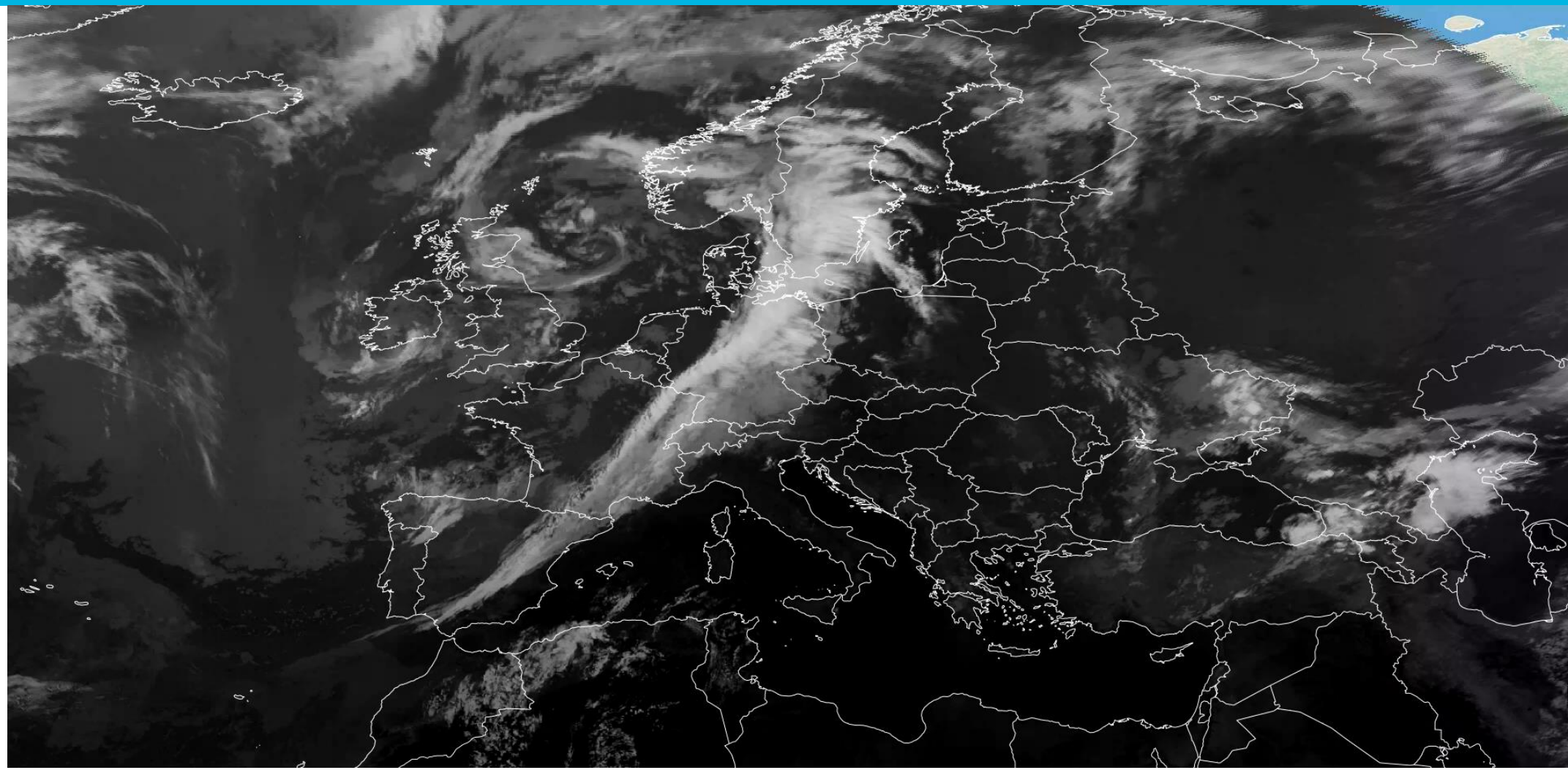
- Image Interpretation of cloud features:
  - Temperature of radiating surface → temperatures of cloud tops
  - Temperature of the surface
- Input for Day Microphysics, HRV, Airmass, Dust, 24 hours Microphysics, Severe Storm RGBs



WINDOW (THERMAL) CHANNELS

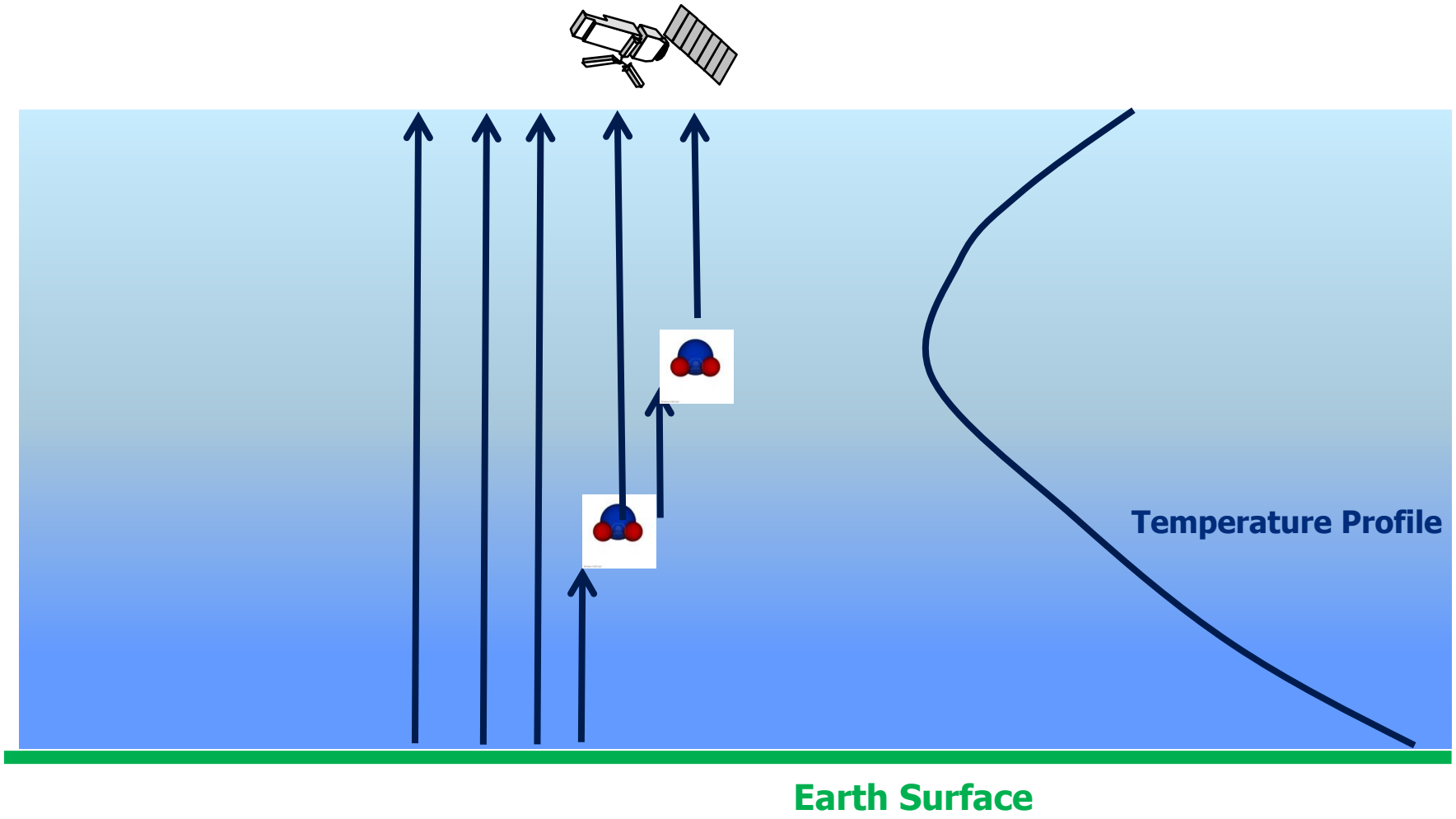
IR10.8
07 July 2021

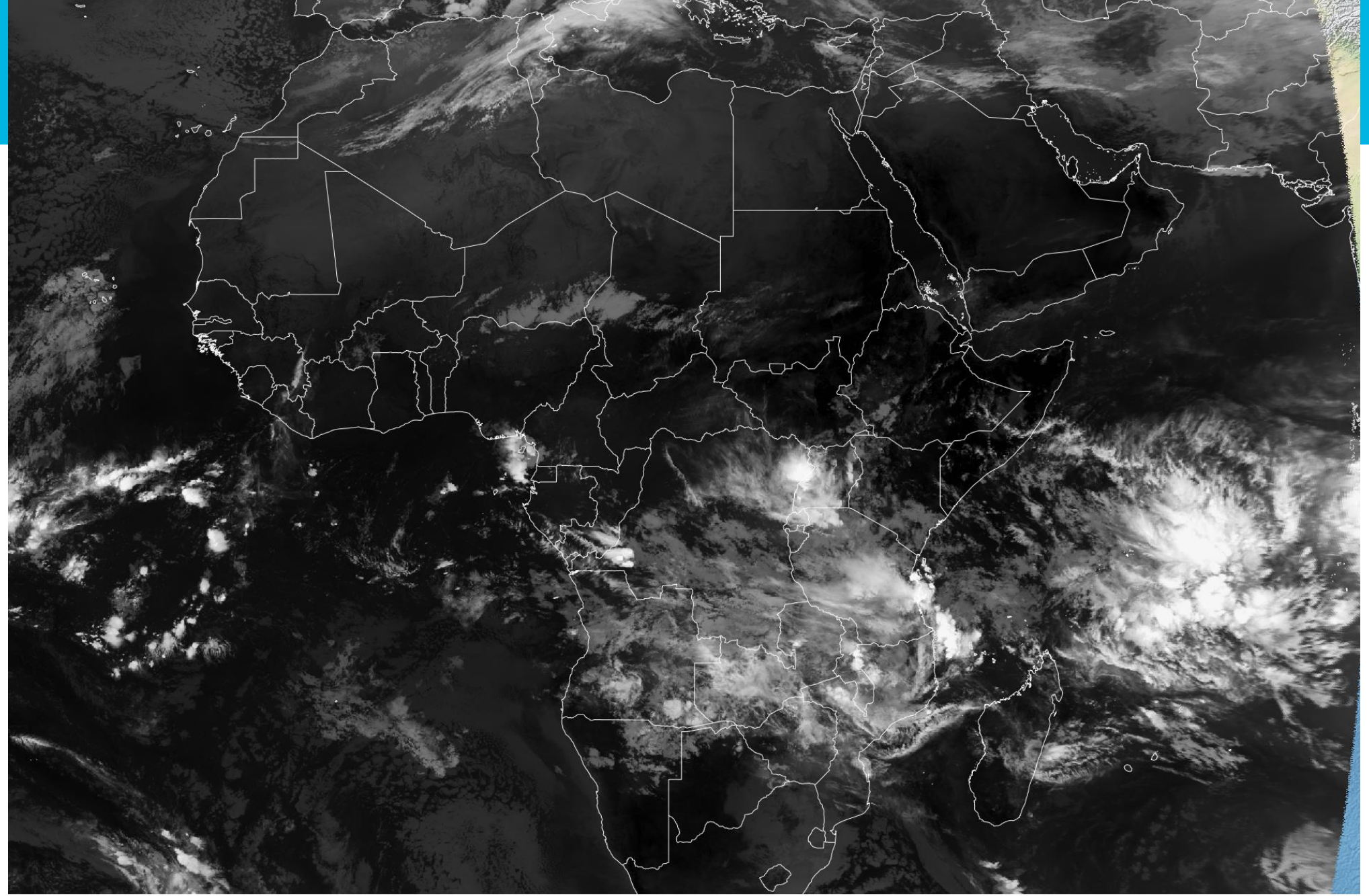
White = COLD
Black = WARM



More about SEVIRI channels and their interpretation:
http://www.eumetrain.org/satmanu/Basic/Basic_Channels/print.htm
http://www.eumetrain.org/resources/resource_guide/print_6.htm

ILLUSTRATION: BEAM AT 11 MM WAVELENGTH (“WINDOW”)





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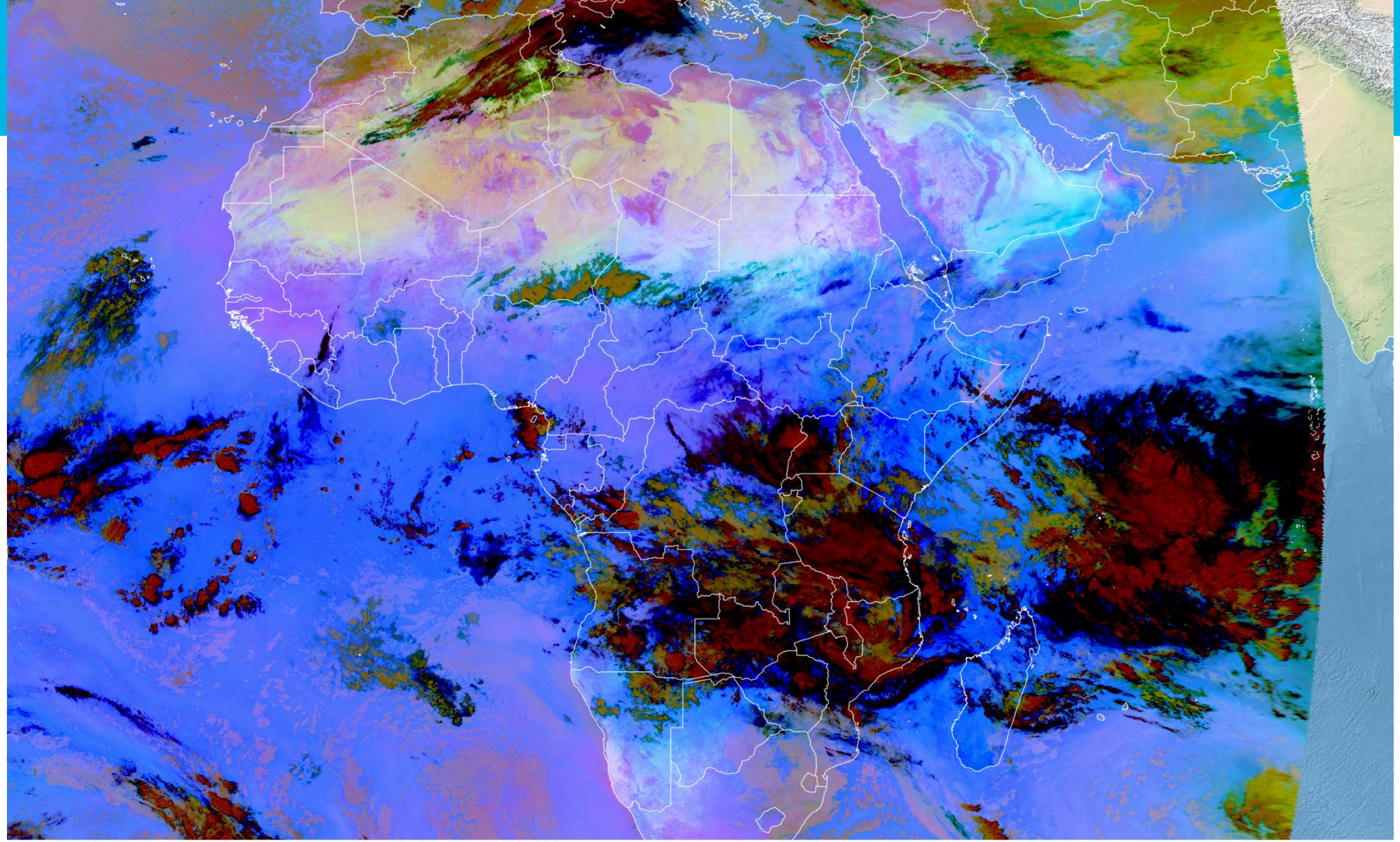

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USEFUL LINKS

https://www.eumetsat.int
http://www.eumetrain.org/
https://training.eumetsat.int/
https://www.eumetsat.int/case-studies

THANK YOU!

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