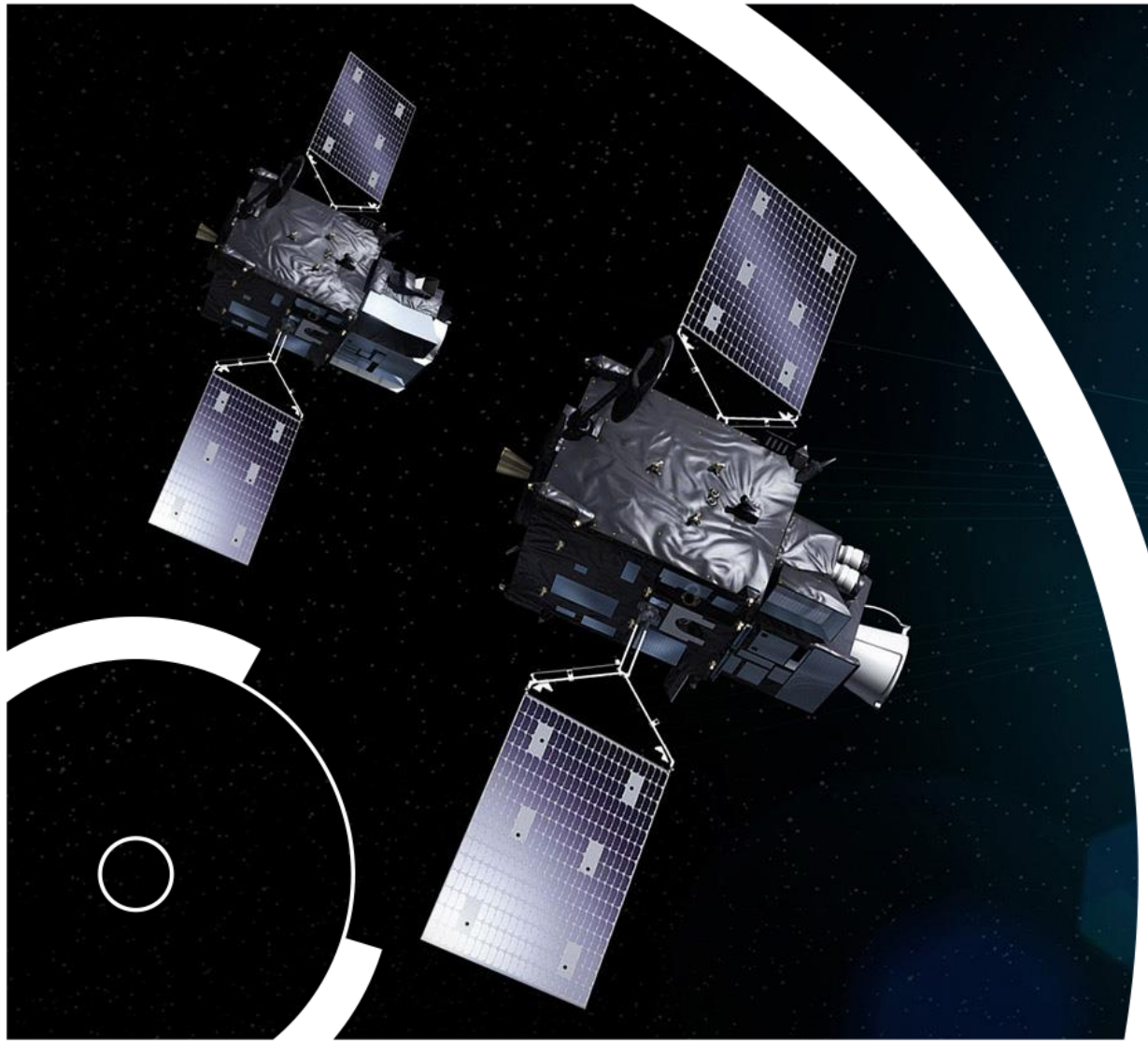
EUMETSAT



Detection of low-level humidity with FCI data

Ivan Smiljanic
Satellite Application and Training Expert
EUMETSAT Training Team

27 September 2023 , EUMeTrain Event Week, Online

Agenda

Low level moisture

Importance of moisture information

FCI moisture channels

Ways to detect moisture

View on low-level moisture

Examples of FCI proxy imagery

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Examples of FCI proxy imagery

MOISTURE in the atmosphere – can we see it?

MOISTURE in the atmosphere – where is it?

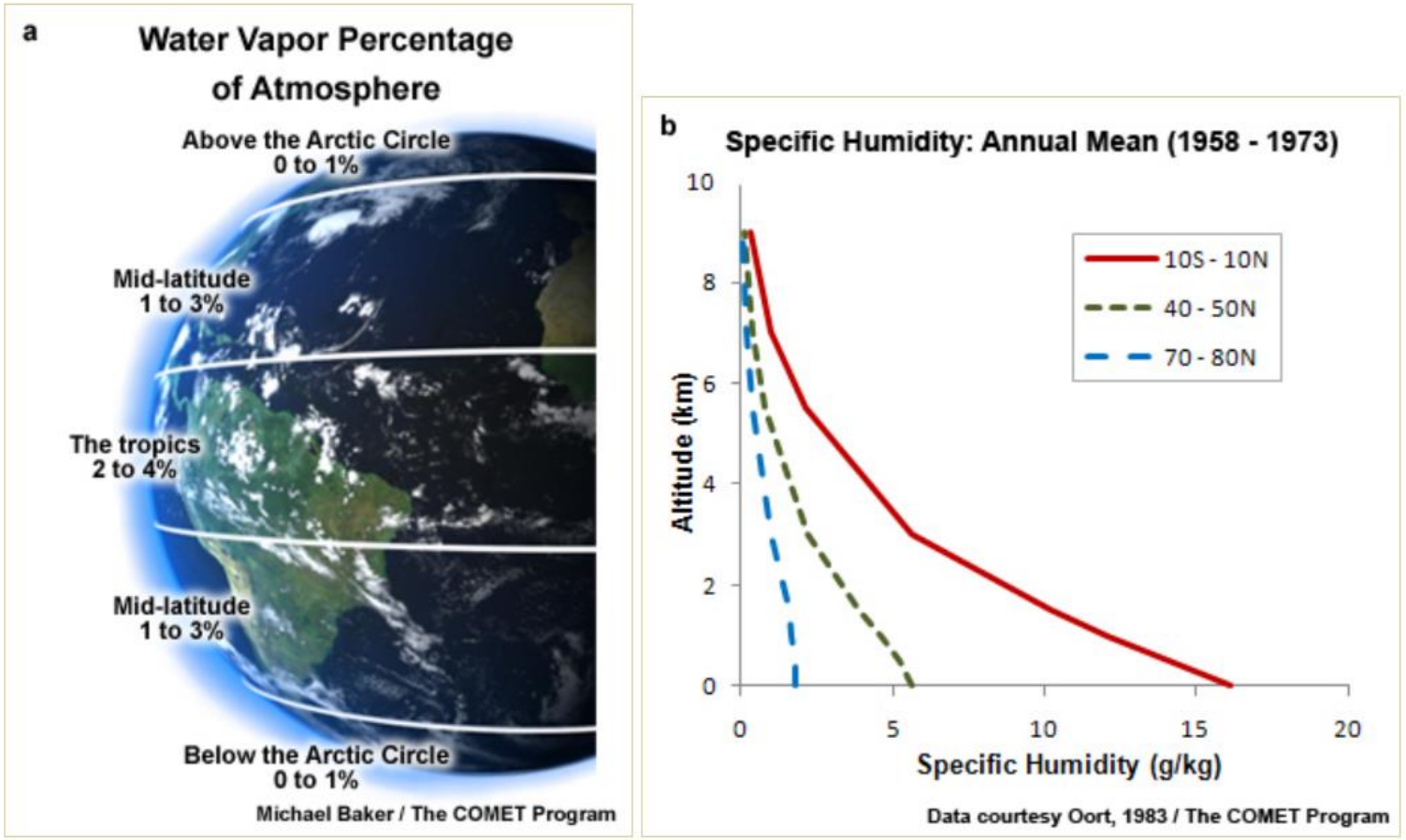

Fig. 1.19. (a) The distribution of surface water vapor percentage by latitude and (b) annual mean water vapor content (specific humidity) profile. Data in (b) from Oort (1983)[21]

Credit: COMET Program

Why do we want to know about low-level MOISTURE?

Unstable atmosphere supports upward motion
– rising moist air can lead to **severe weather**

Stable atmosphere resists rising motion
– usually **low clouds or fog** are produced

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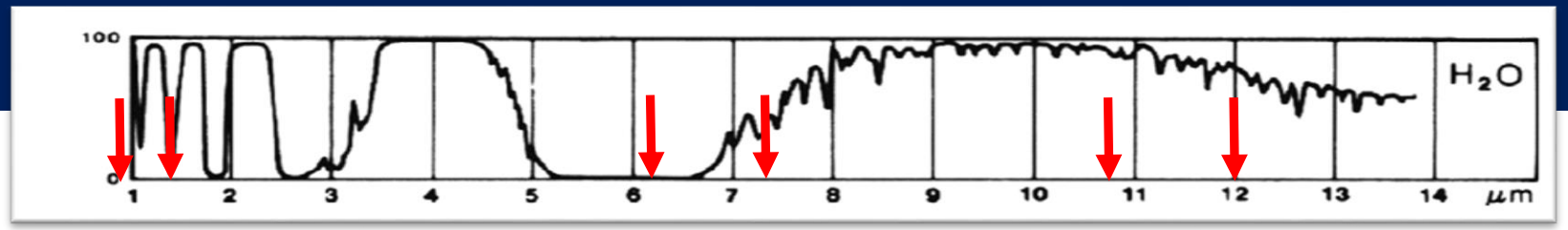
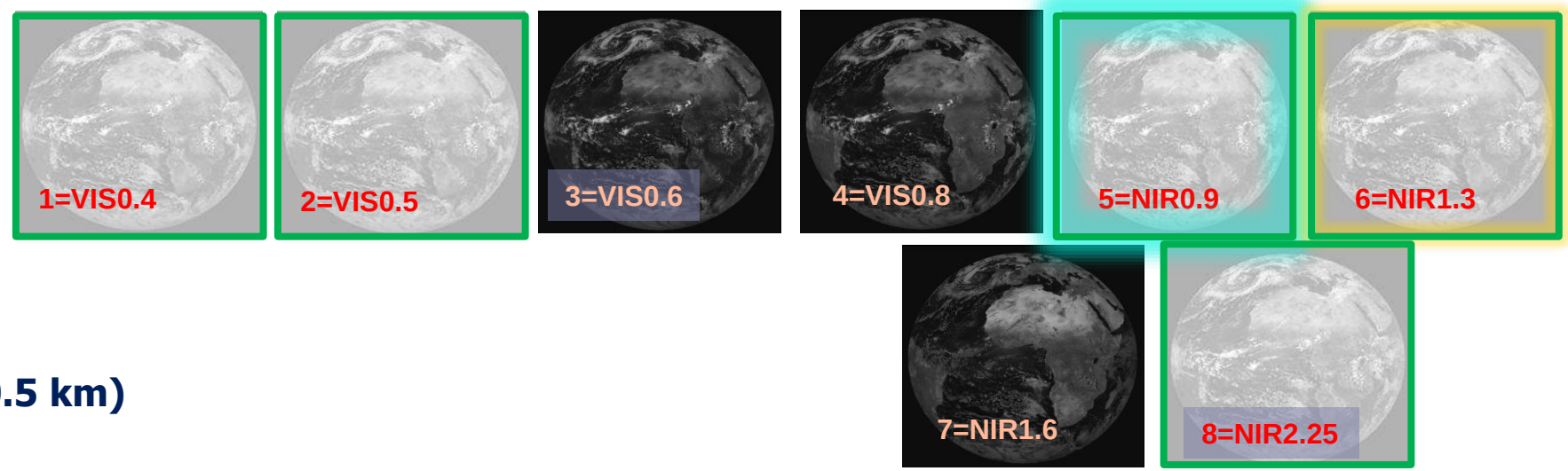
Example of LL moisture

- Diurnal development of the sea breeze front all along the coast(s)
- Strong moisture advection – area of local convection development (if other conditions met!)

https://www.eumetsat.int/diurnal-development-sea-breeze-front

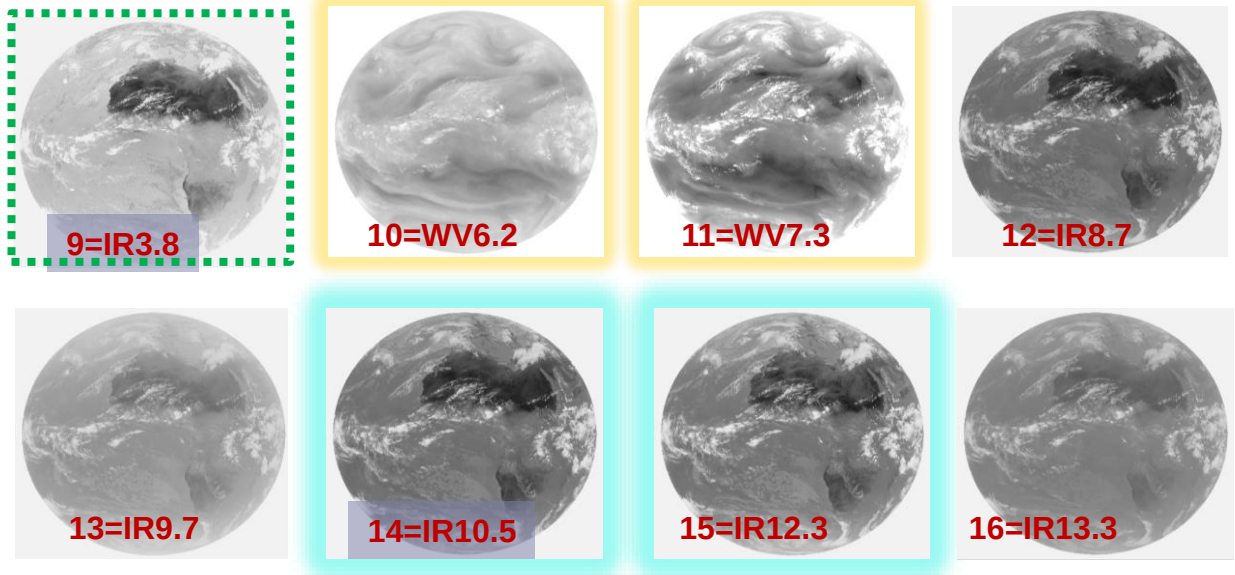
FCI vs SEVIRI





Solar
1.0 km (0.5 km)

Thermal
2.0 km (1.0 km)



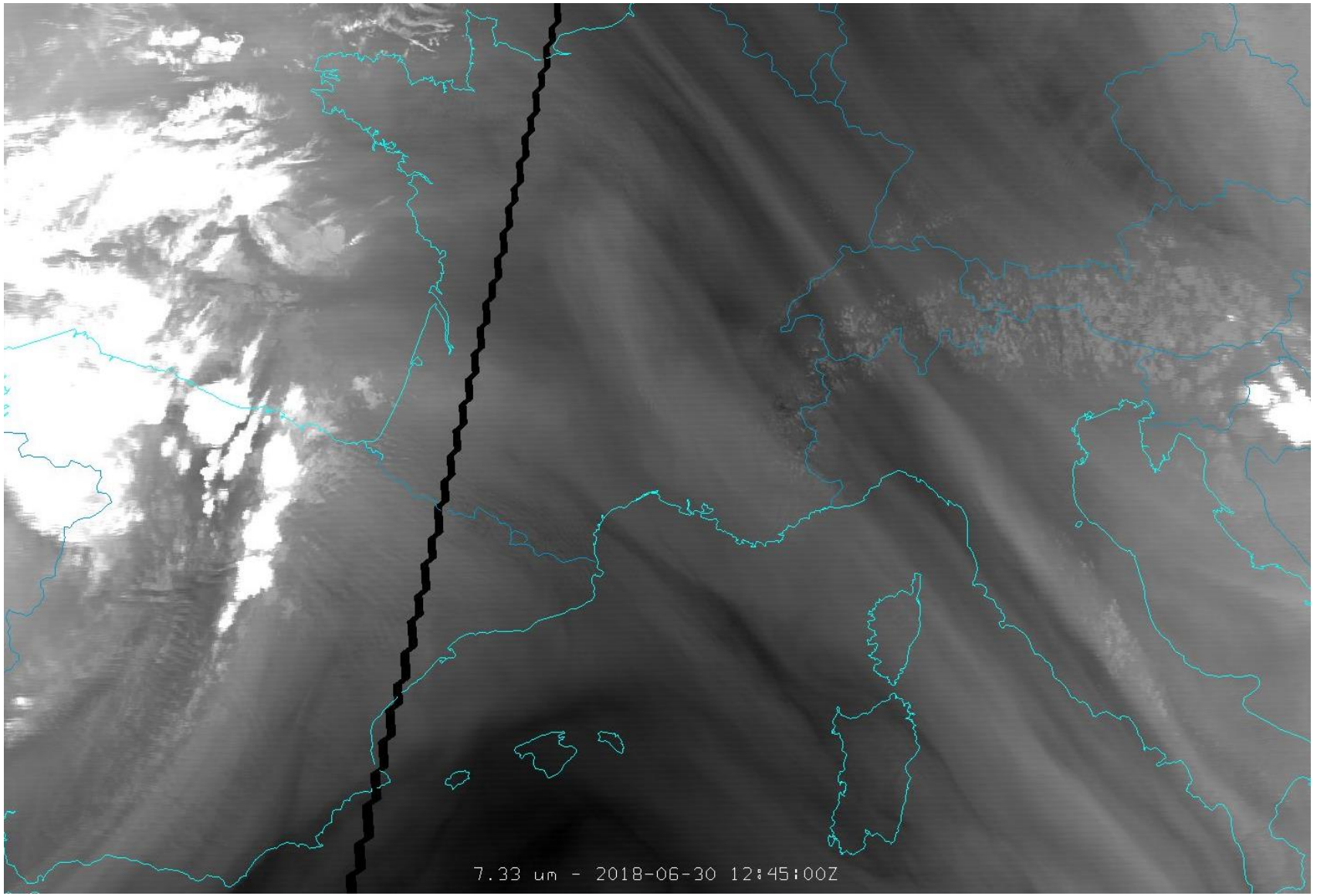
Higher level moisture

Mid-level moisture

MODIS

WV7.3 channel

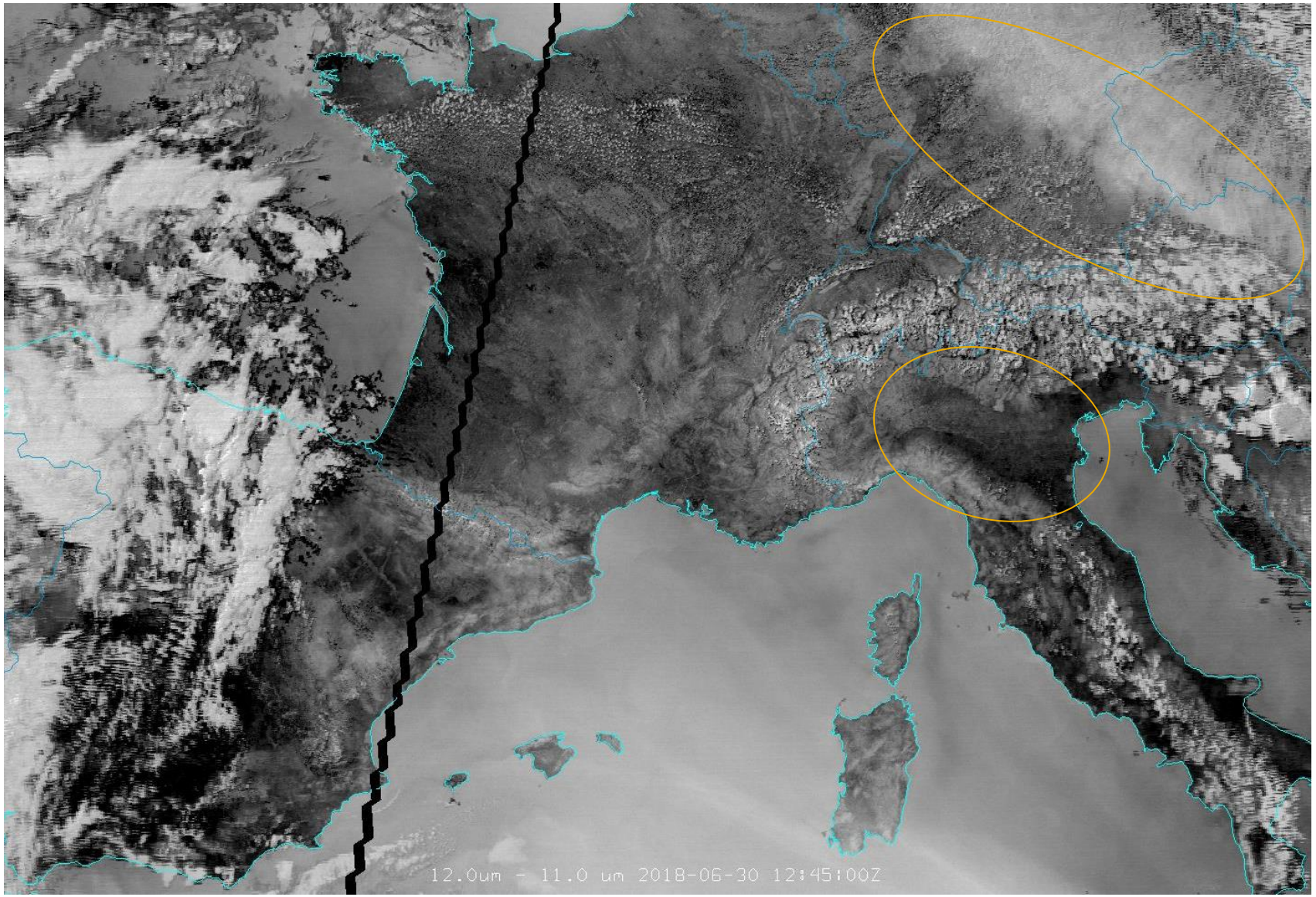
Locate moisture boundaries!



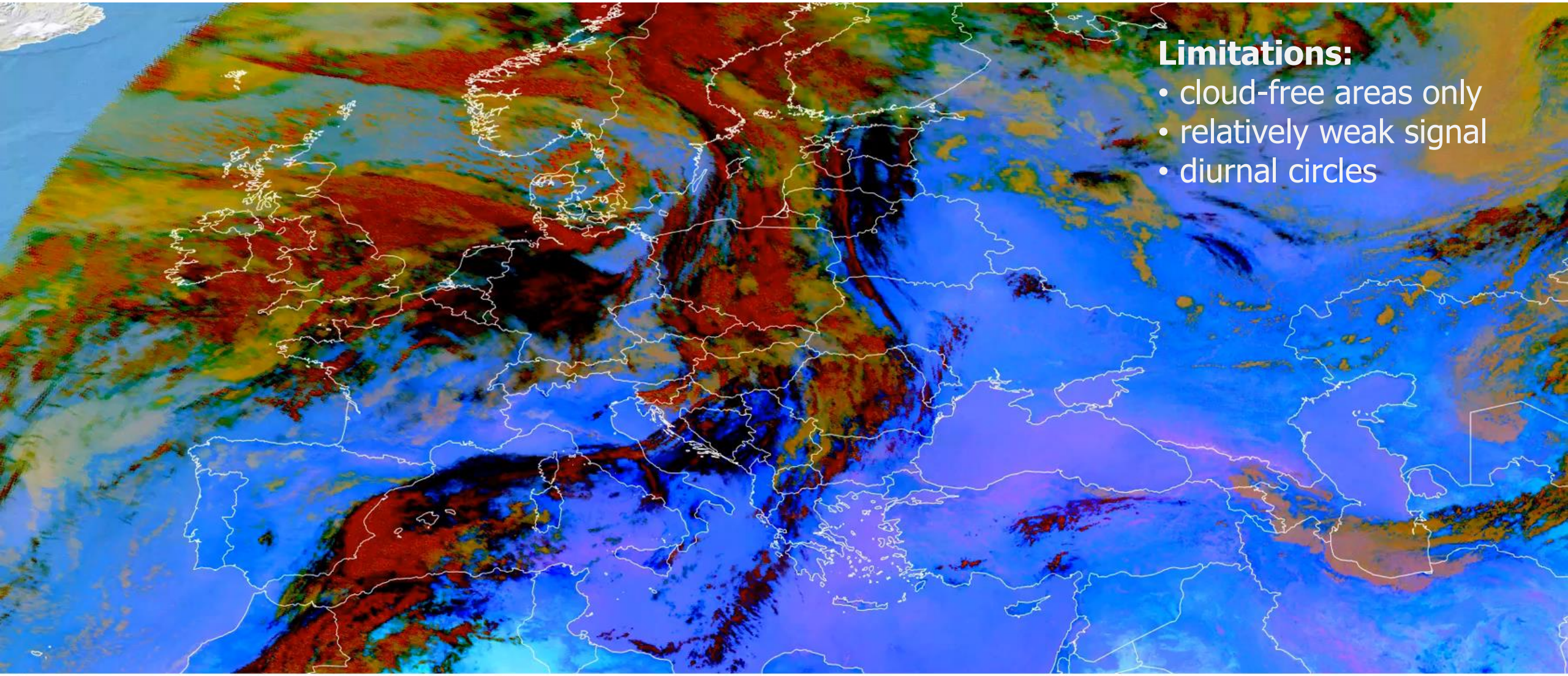
Higher level moisture vs low level moisture

Low-level moisture

MODIS **BTD12-11** channel

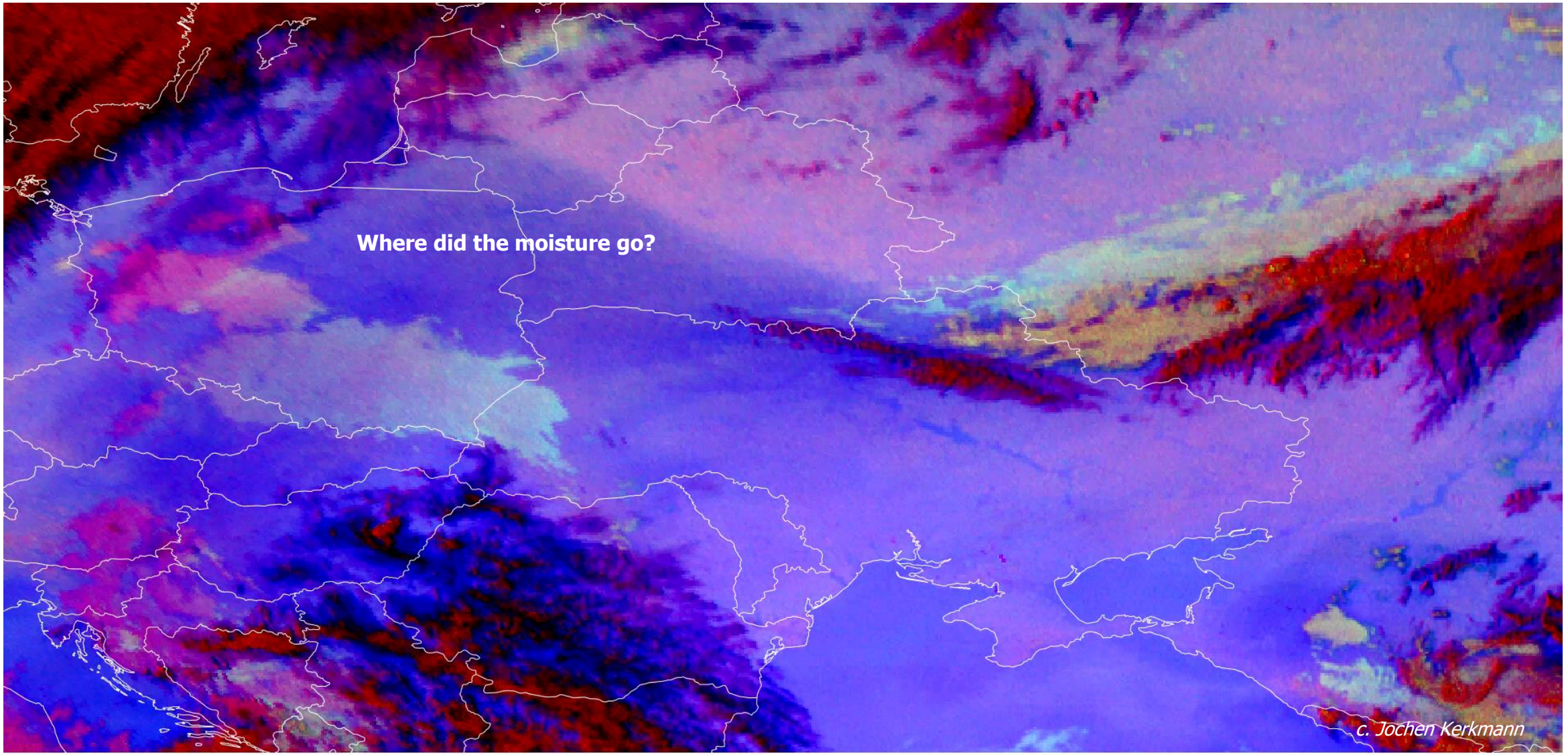


Examples of LL moisture



https://www.eumetsat.int/diurnal-development-sea-breeze-front

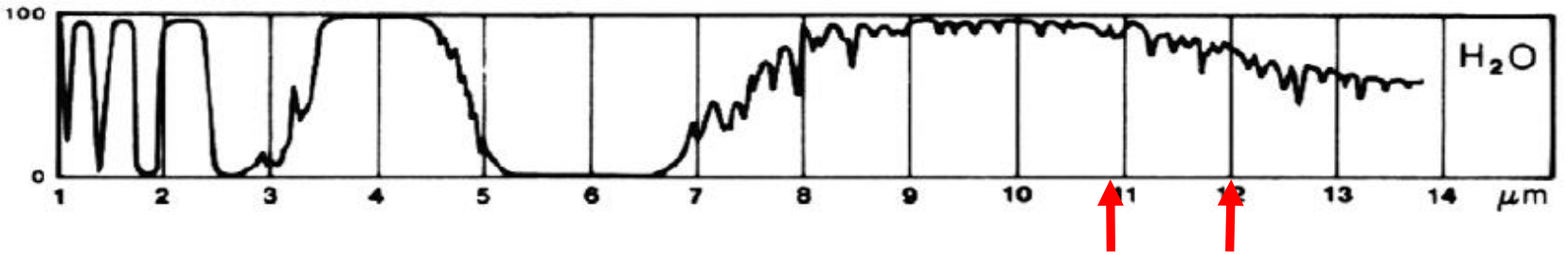
Examples of LL moisture

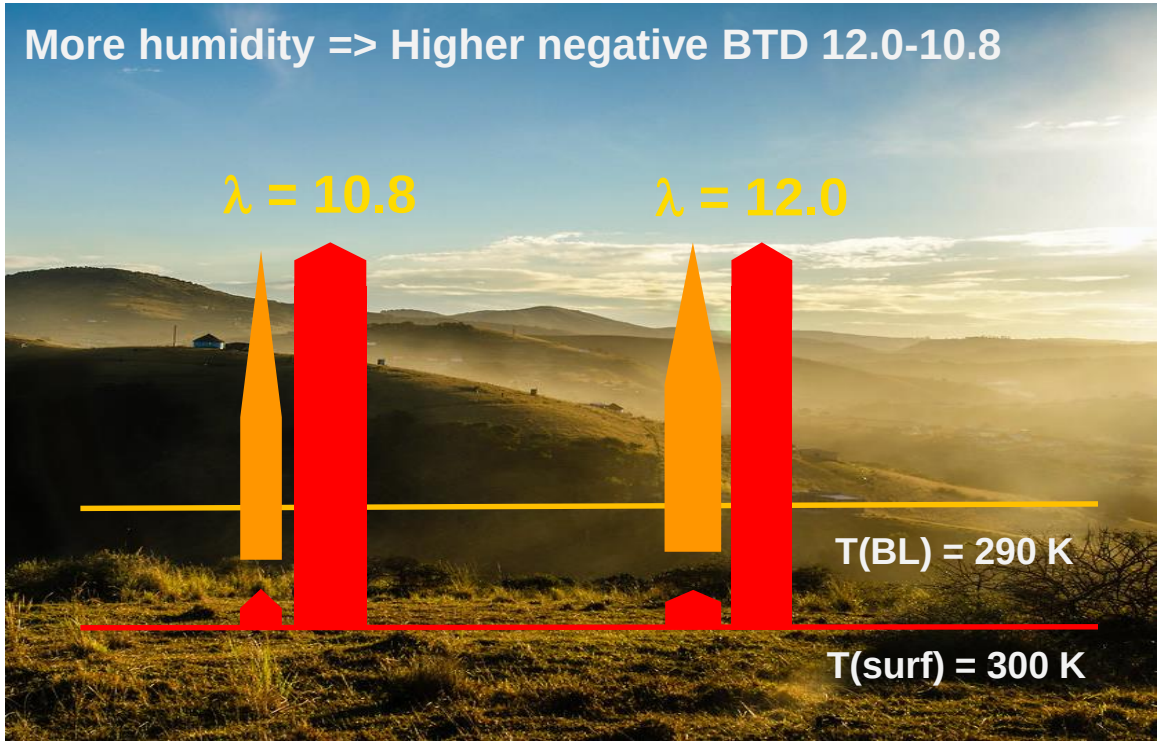


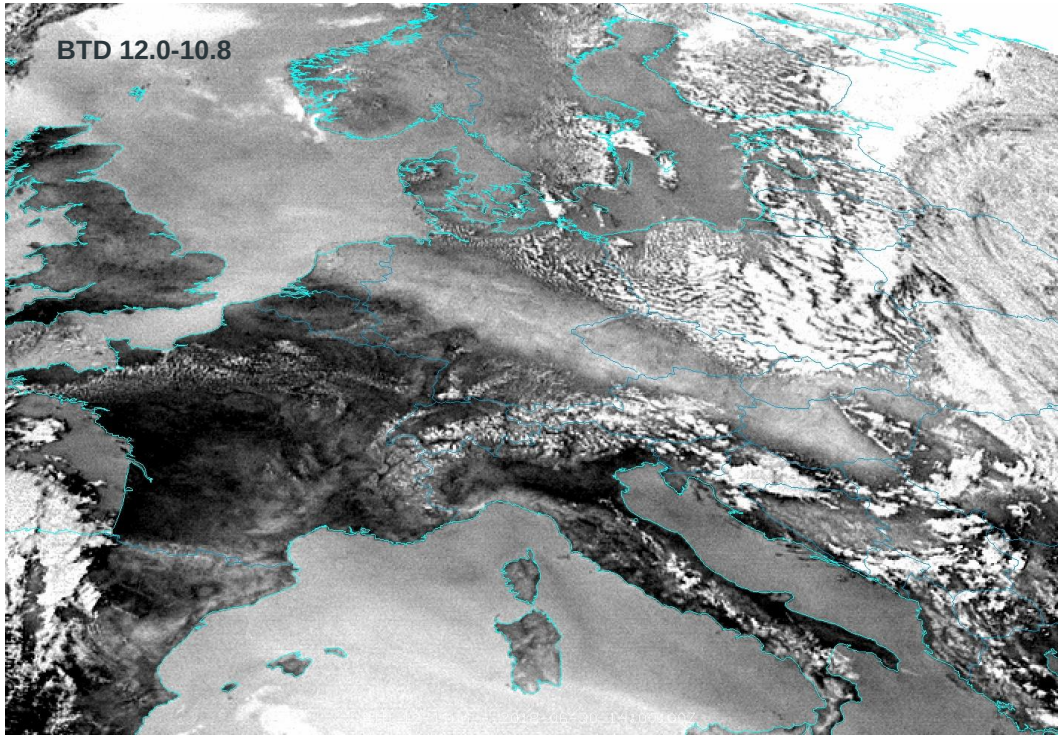
https://www.eumetsat.int/diurnal-development-sea-breeze-front

IR window region split difference:

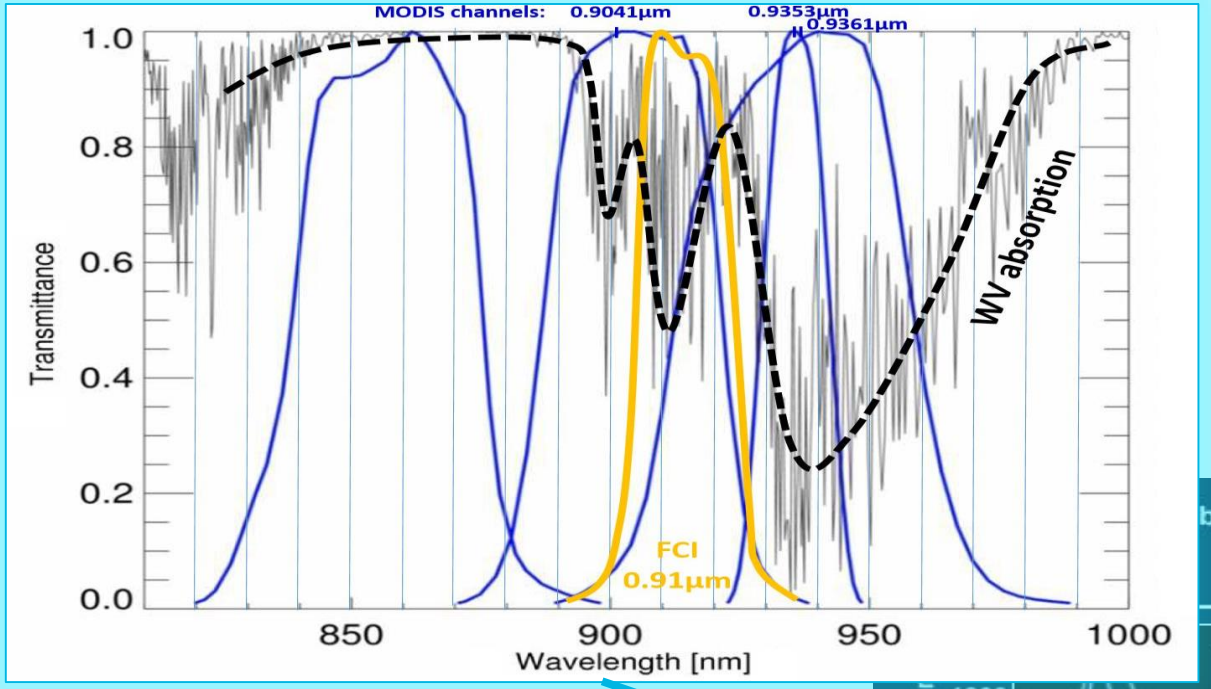
WV Absorption Bands in the IR 'window' region

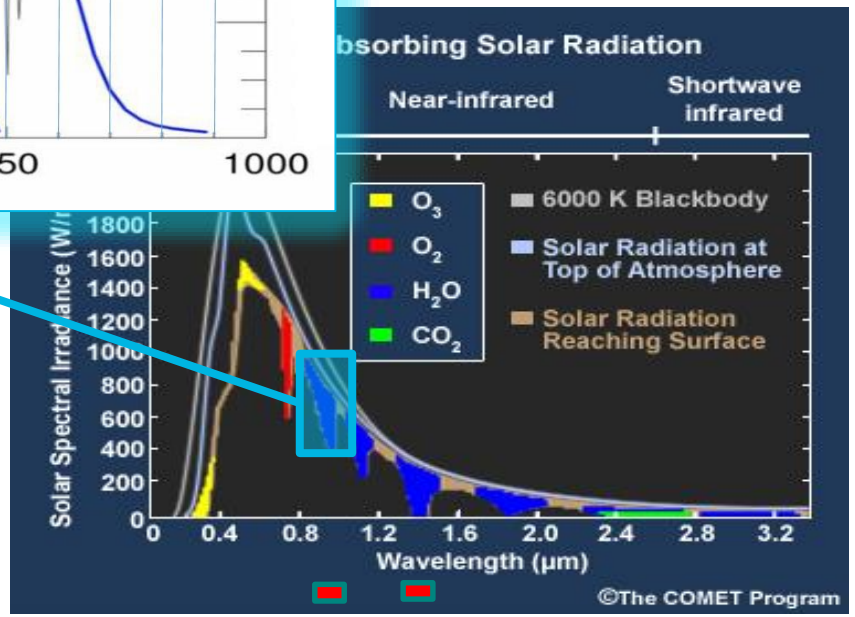






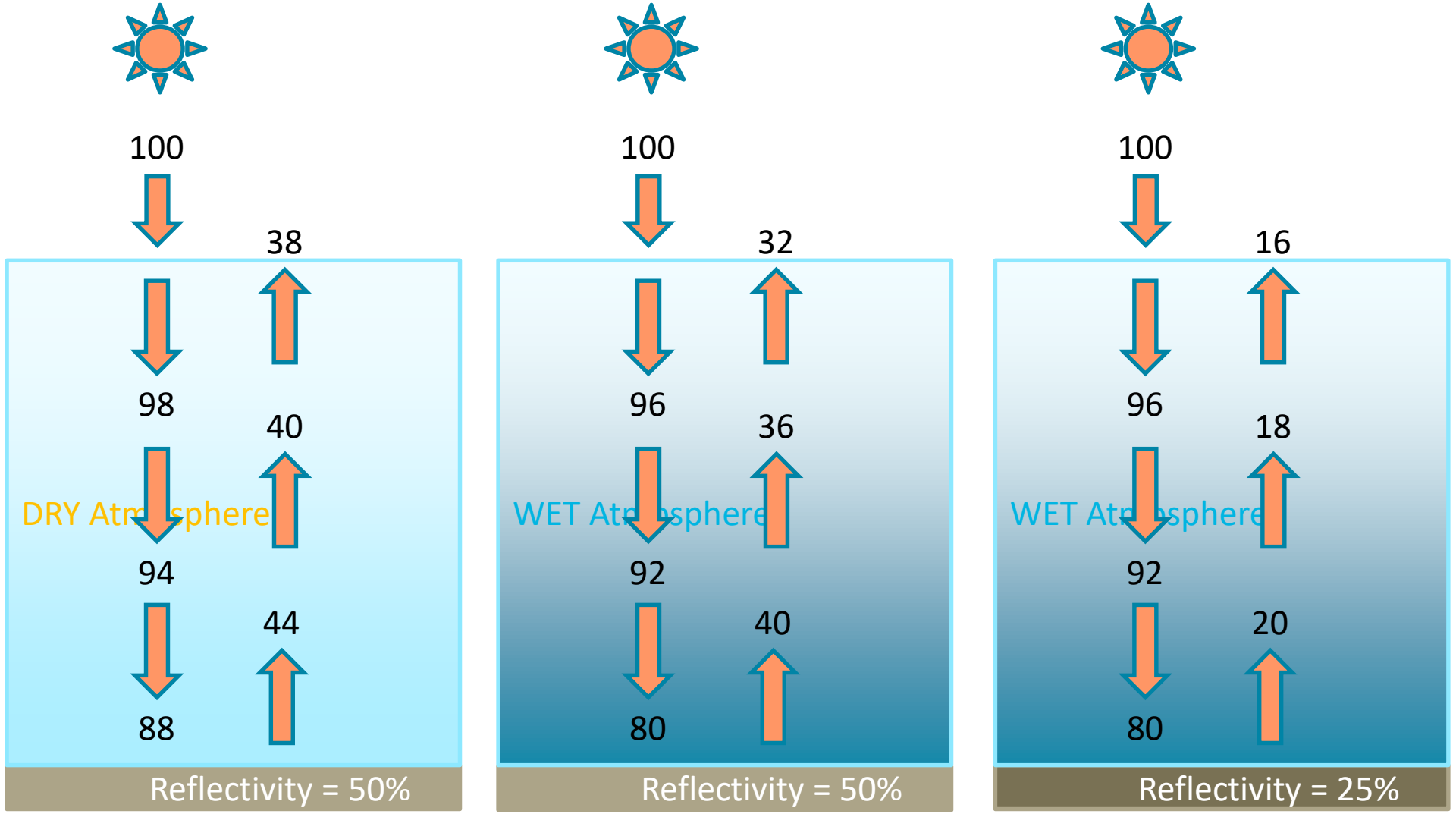
WV absorption (solar region)

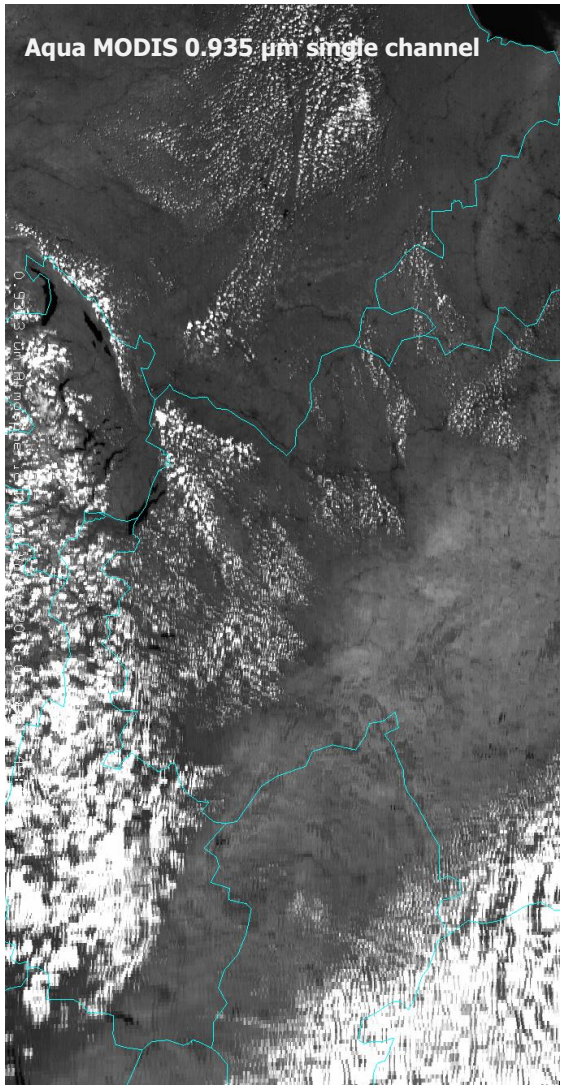




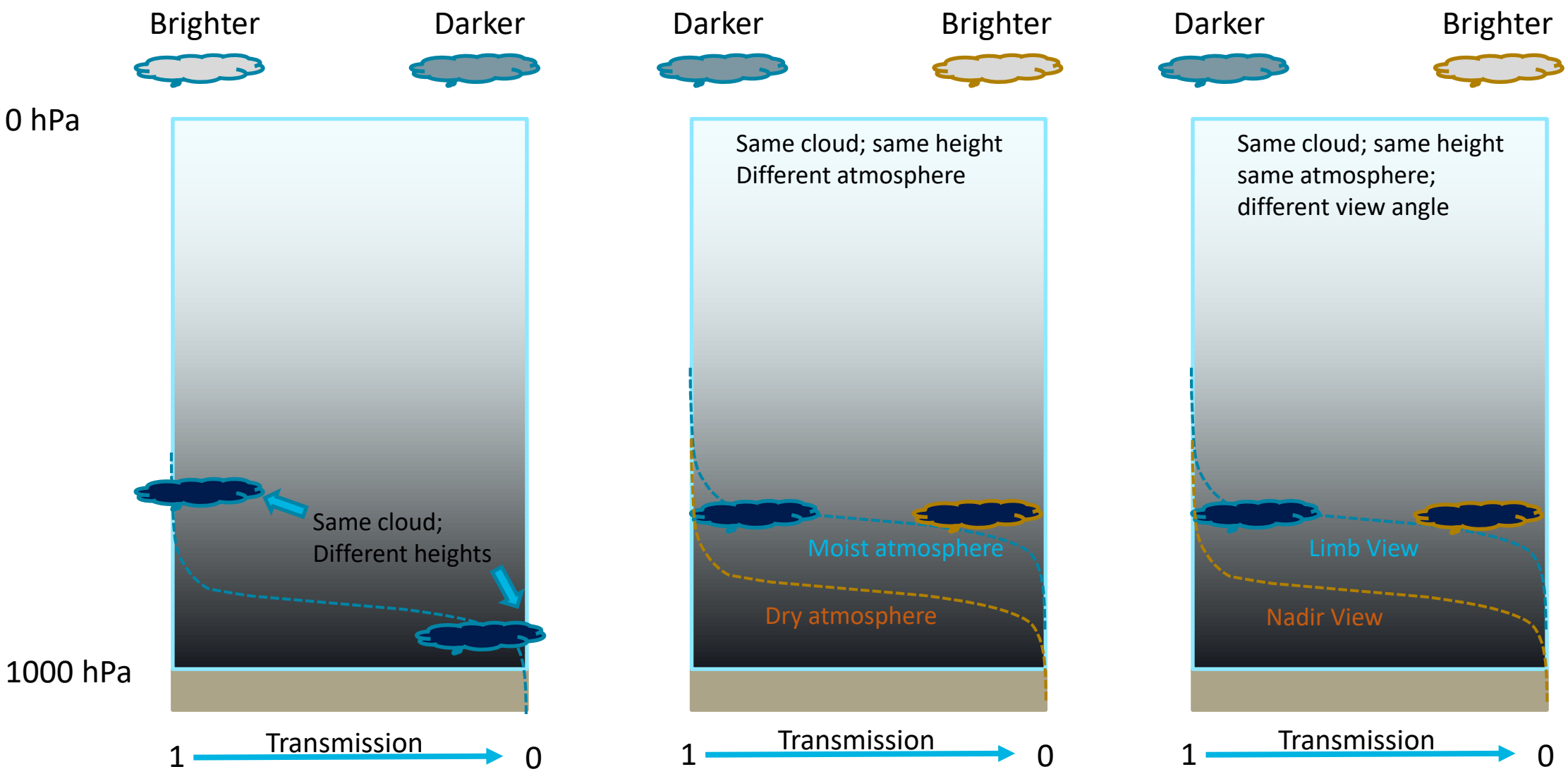
910 nm

WV Absorption: what does it mean in NIR0.91 region?





Regarding clouds, what can we say?



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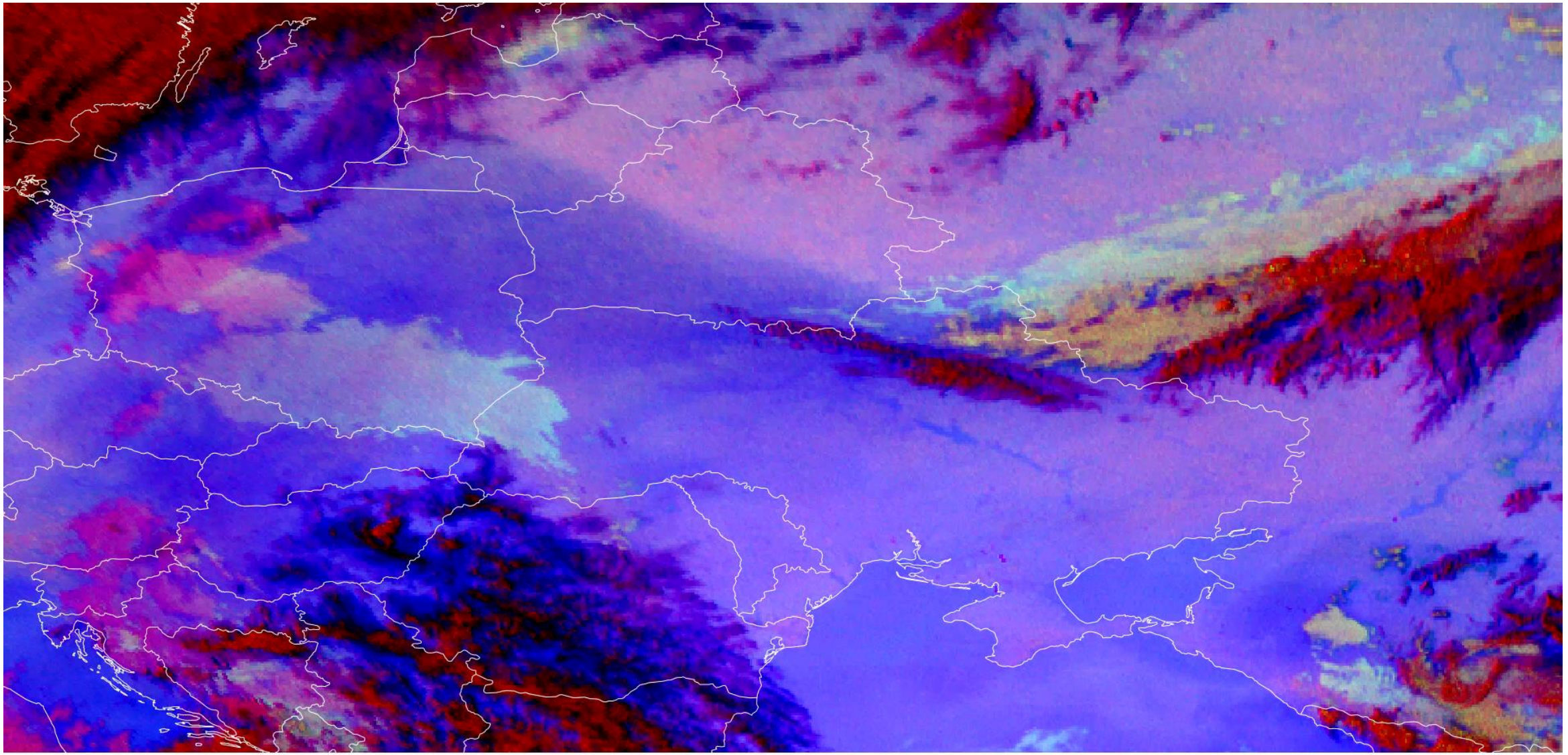
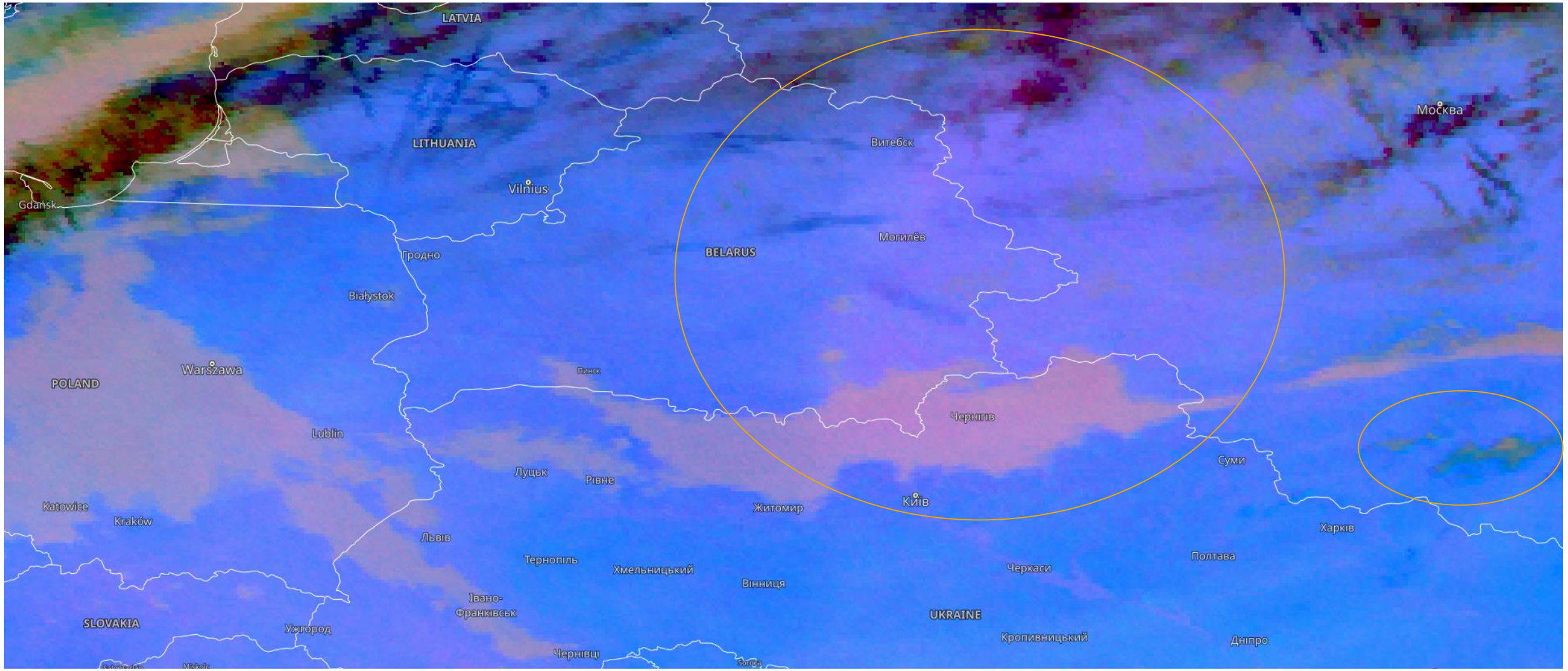
Examples of FCI proxy imagery

Examples of LL moisture - BTD



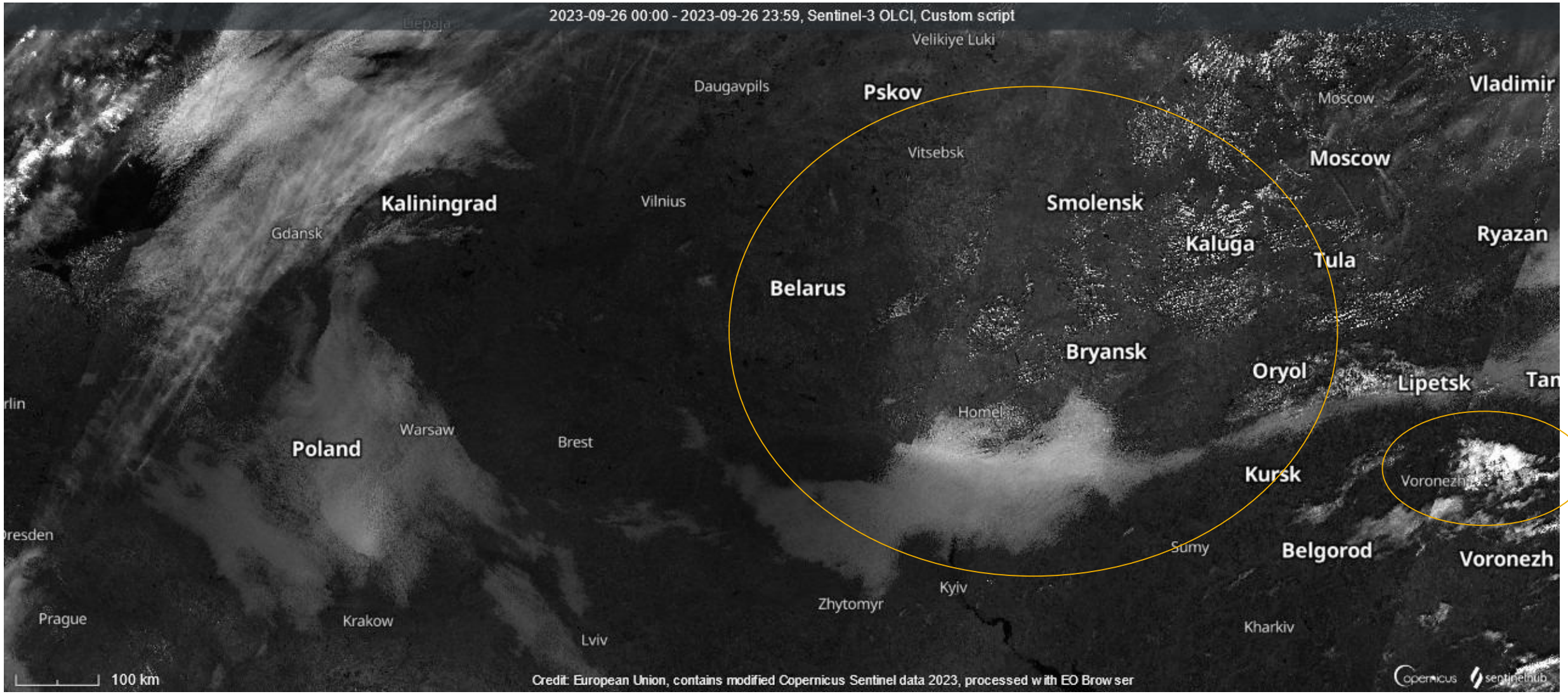
https://www.eumetsat.int/diurnal-development-sea-breeze-front

Examples of LL moisture - BTD



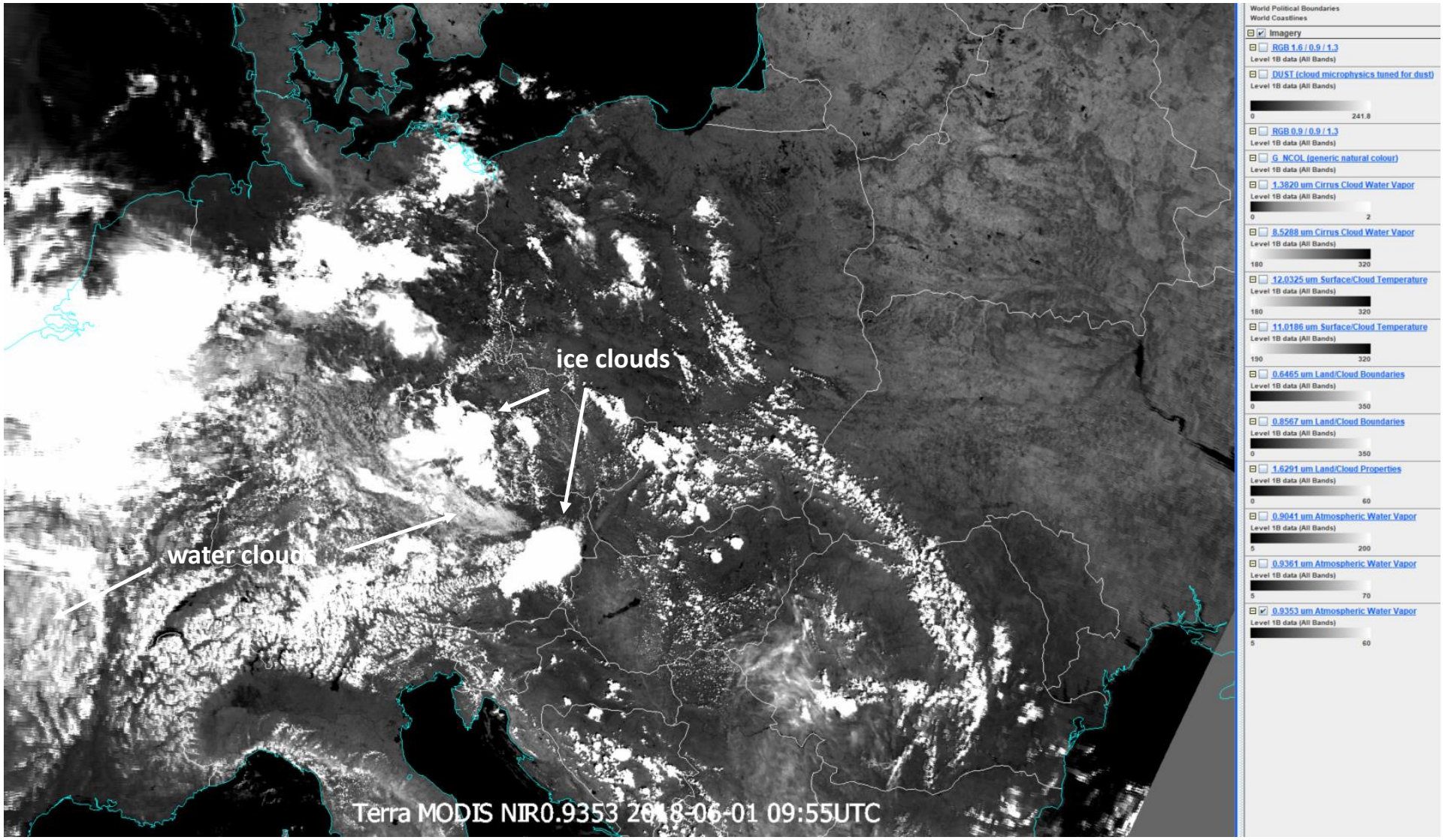
https://www.eumetsat.int/diurnal-development-sea-breeze-front

Examples of LL moisture – NIR0.9 channel



https://www.eumetsat.int/diurnal-development-sea-breeze-front

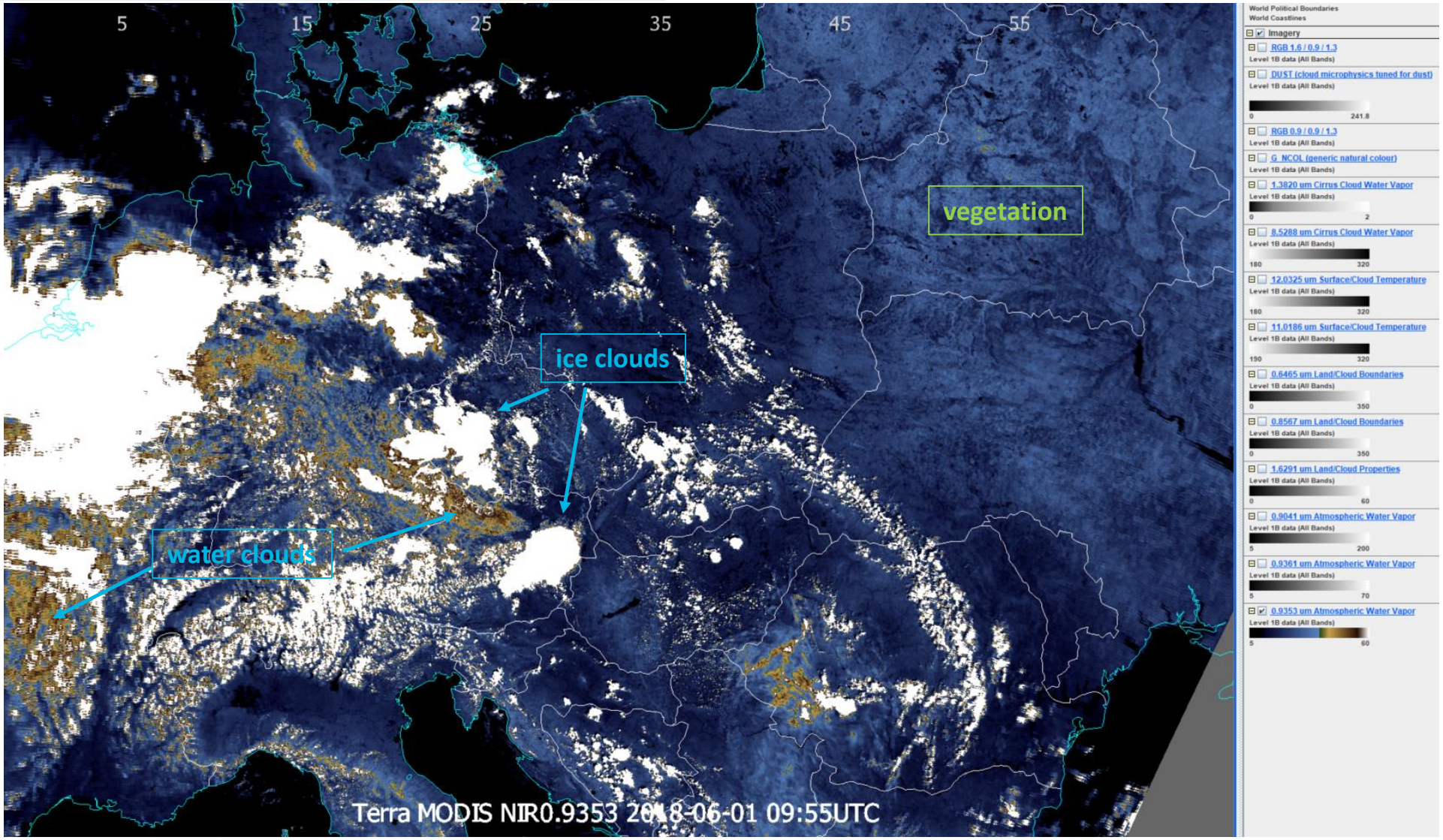
NIR0.9 imagery examples



VIIRS Cloud Phase 20170622, Germany

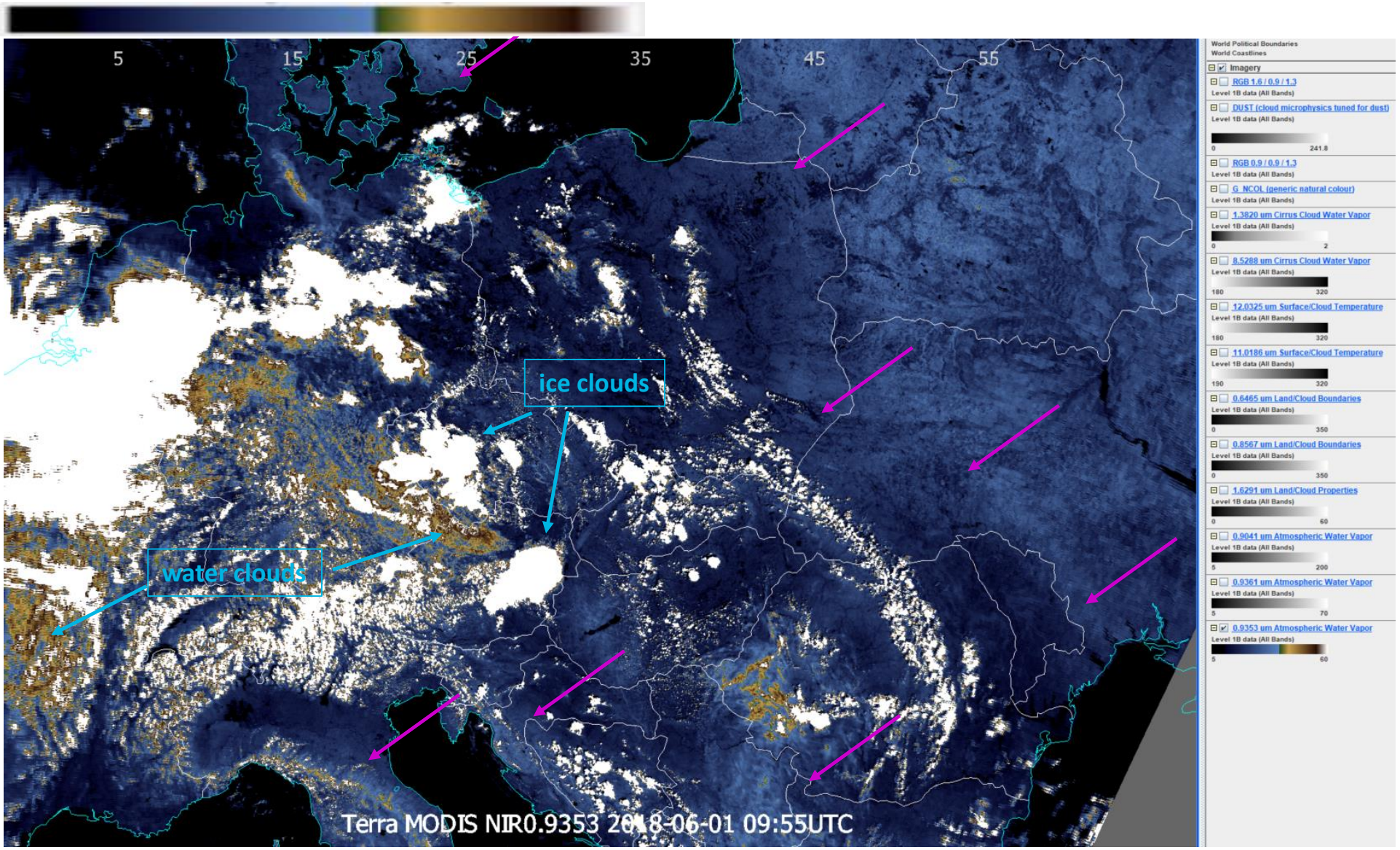
- NIR0.9 solar channel

NIR0.9 imagery examples – (cloud/vegetation classification?)



- NIR0.9 solar channel
- Colour coded single channel

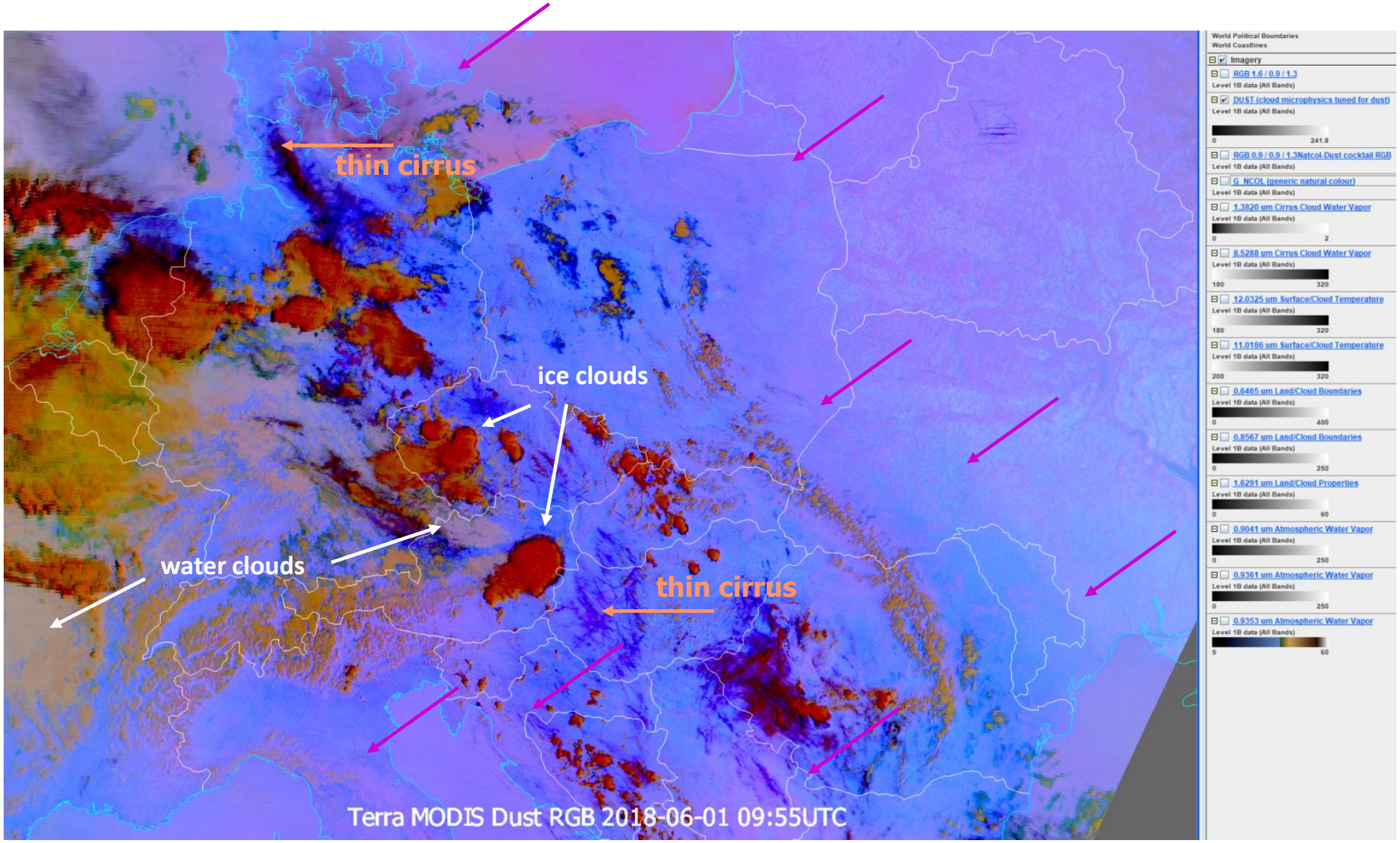
NIR0.9 imagery examples – low level moisture



- NIR0.9 solar channel
- Colour coded single channel

VIIRS Cloud Phase 20170622, Germany

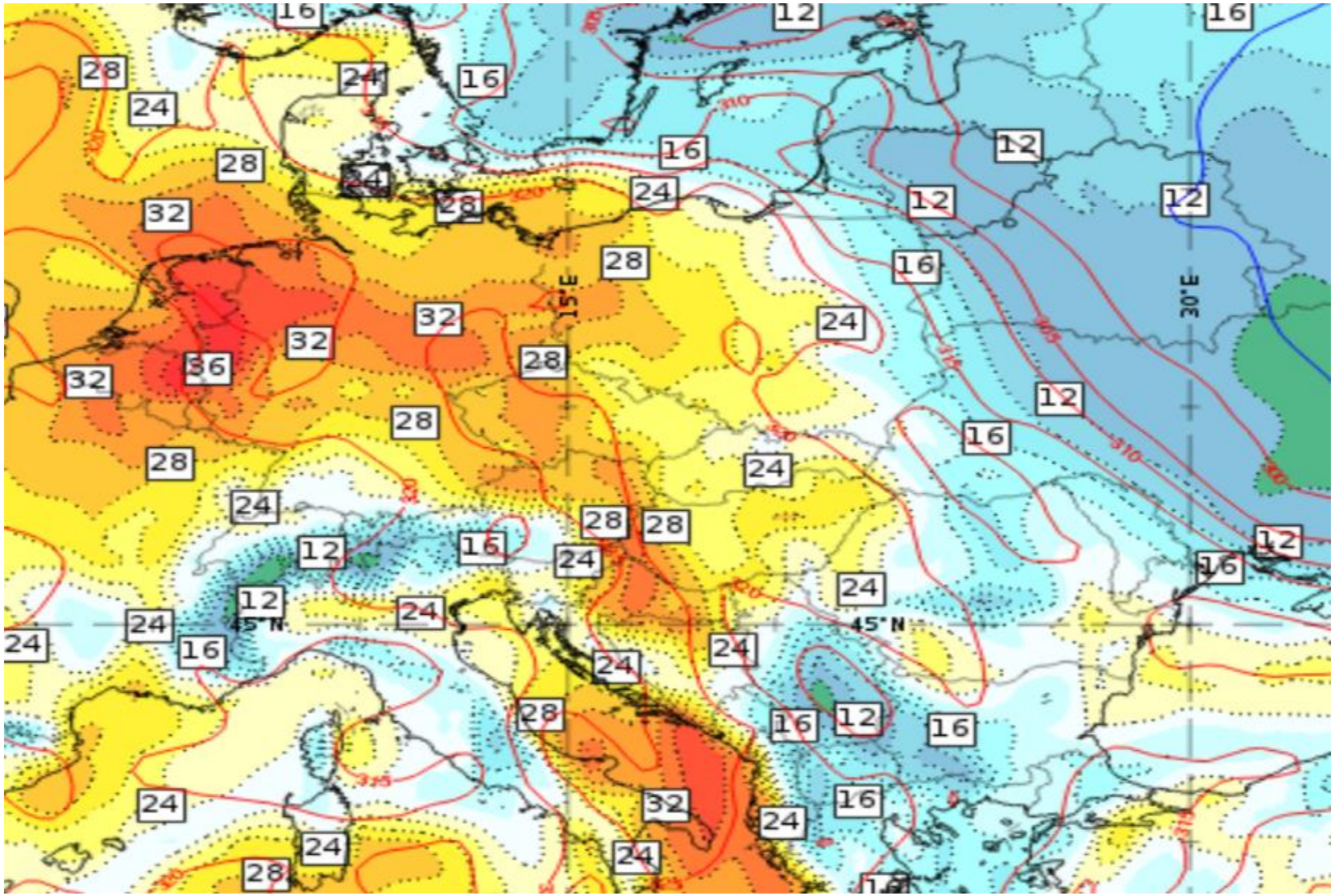
NIR0.9 imagery examples – thin cirrus/ low clouds / dry



- Dust RGB for comparison
  - Red component BTD12-10 (low level moisture, thin cirrus)

VIIRS Cloud Phase 20170622, Germany

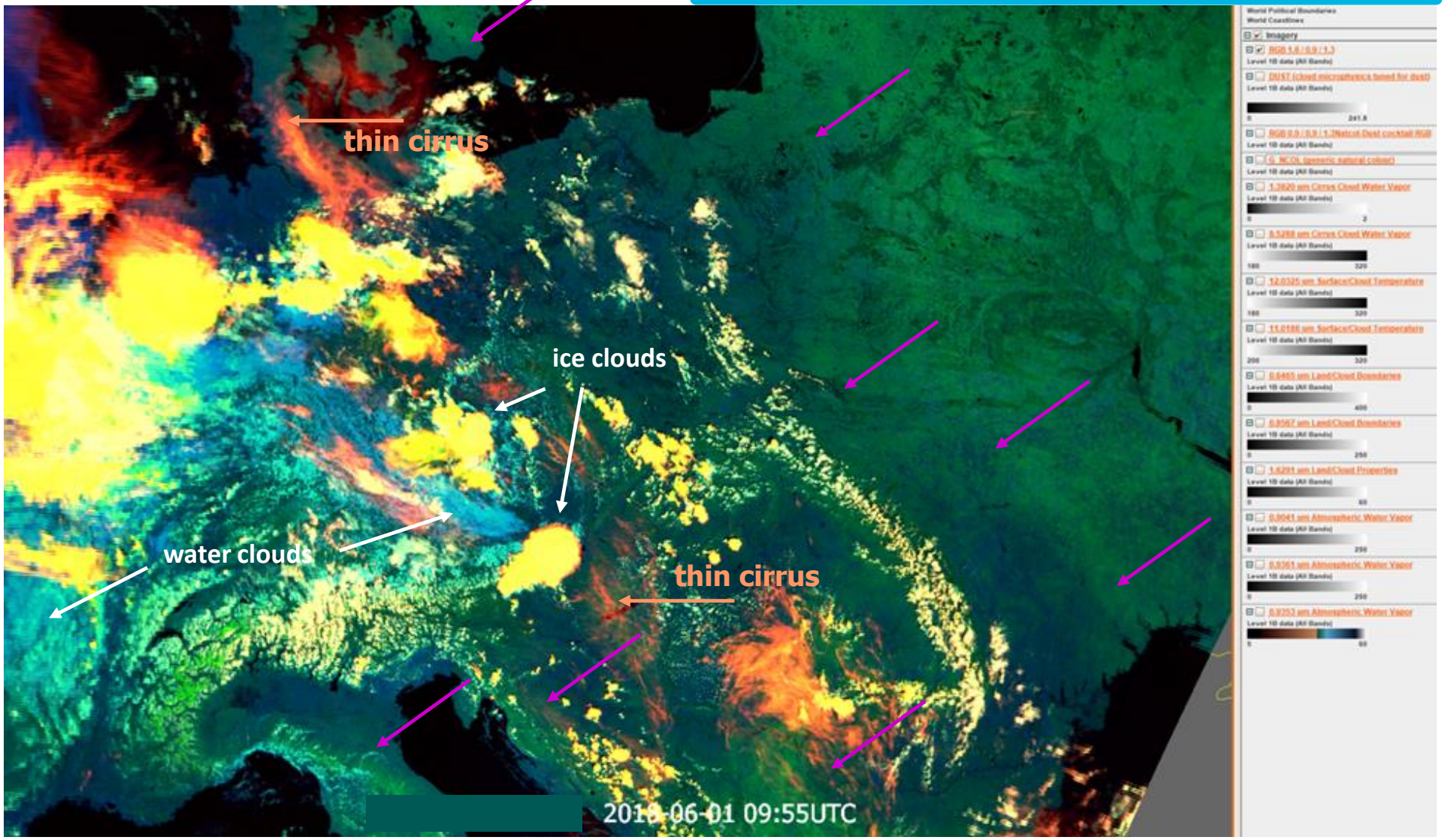
NIR0.9 imagery examples



- NWP comparison
  - Total Column Water + ThetaE at 850hPa

NIR0.9 imagery examples

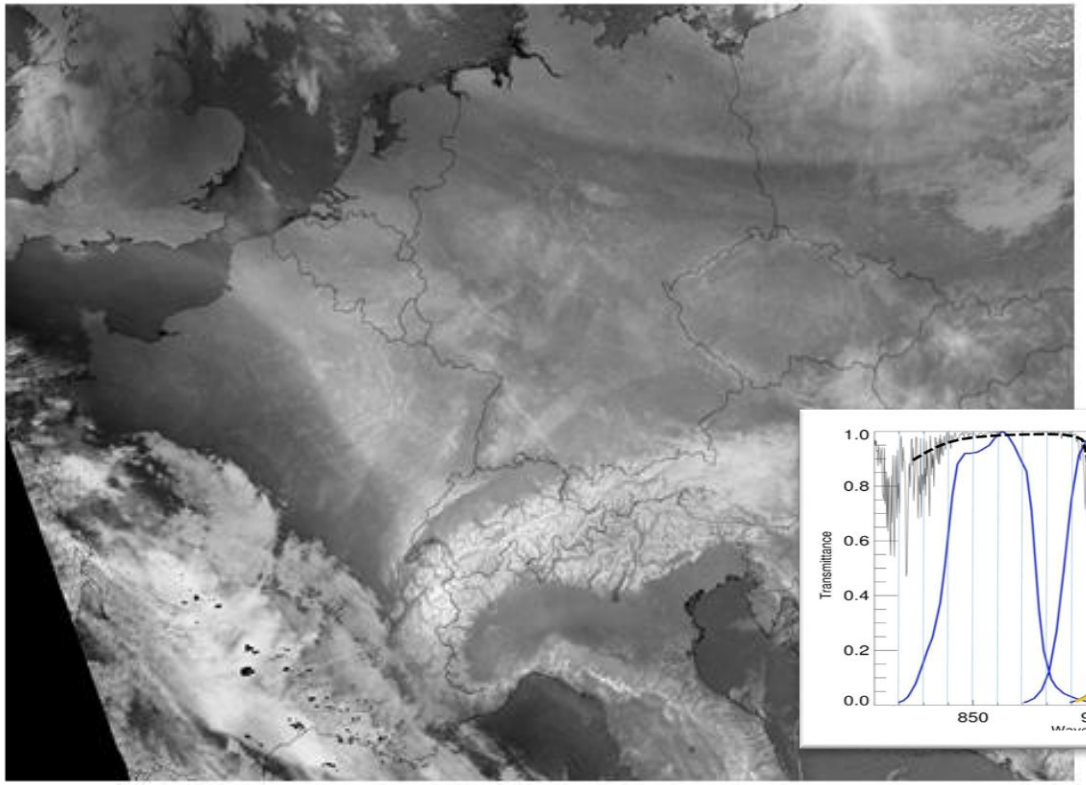
RGB: NIR1.38 (0-3%) - NIR0.9353 (lower end) - NIR1.64

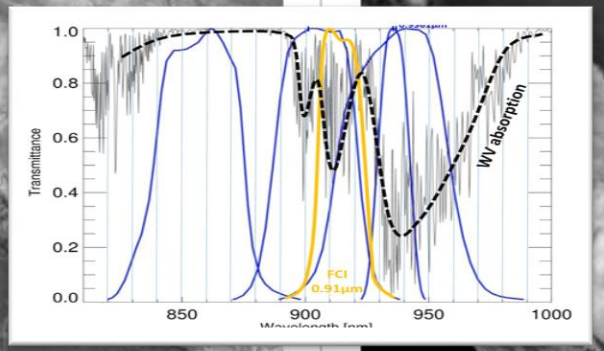


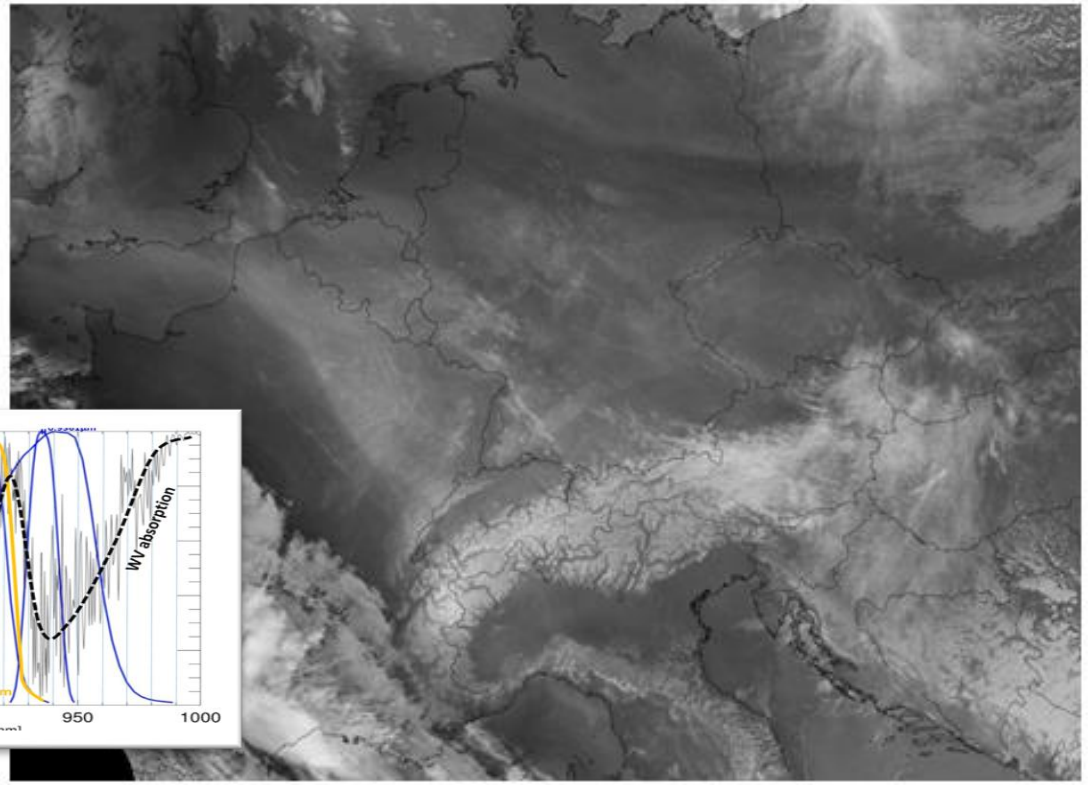
- ‘LL moisture’ RGB
  - Similarity with Cloud Type RGB

NIR0.9 imagery examples – slant angle ('MODIS vs FCI')

Aqua SMT (Solar Moisture Transmittance) 2005-10-15 11:55UTC







SMTproxy (NIR 0.905)
SMT range: 0.6 .. 1.0

alternative SMT (NIR 0.940)

- **SMT range: 0.2 .. 1.0**

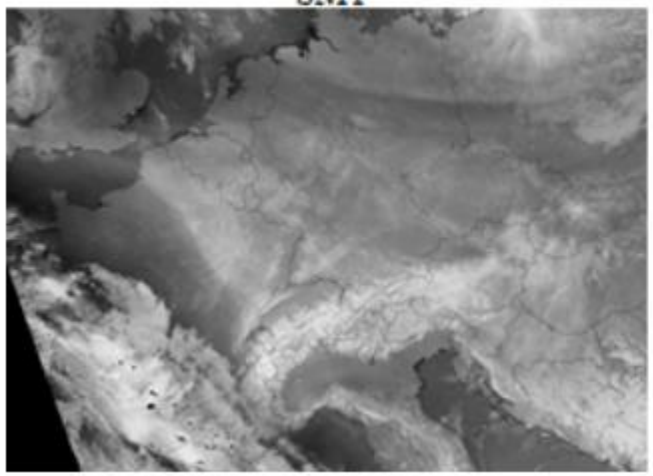
NIR0.9 imagery examples – smtNatcol: Natural Colour RGB heritage

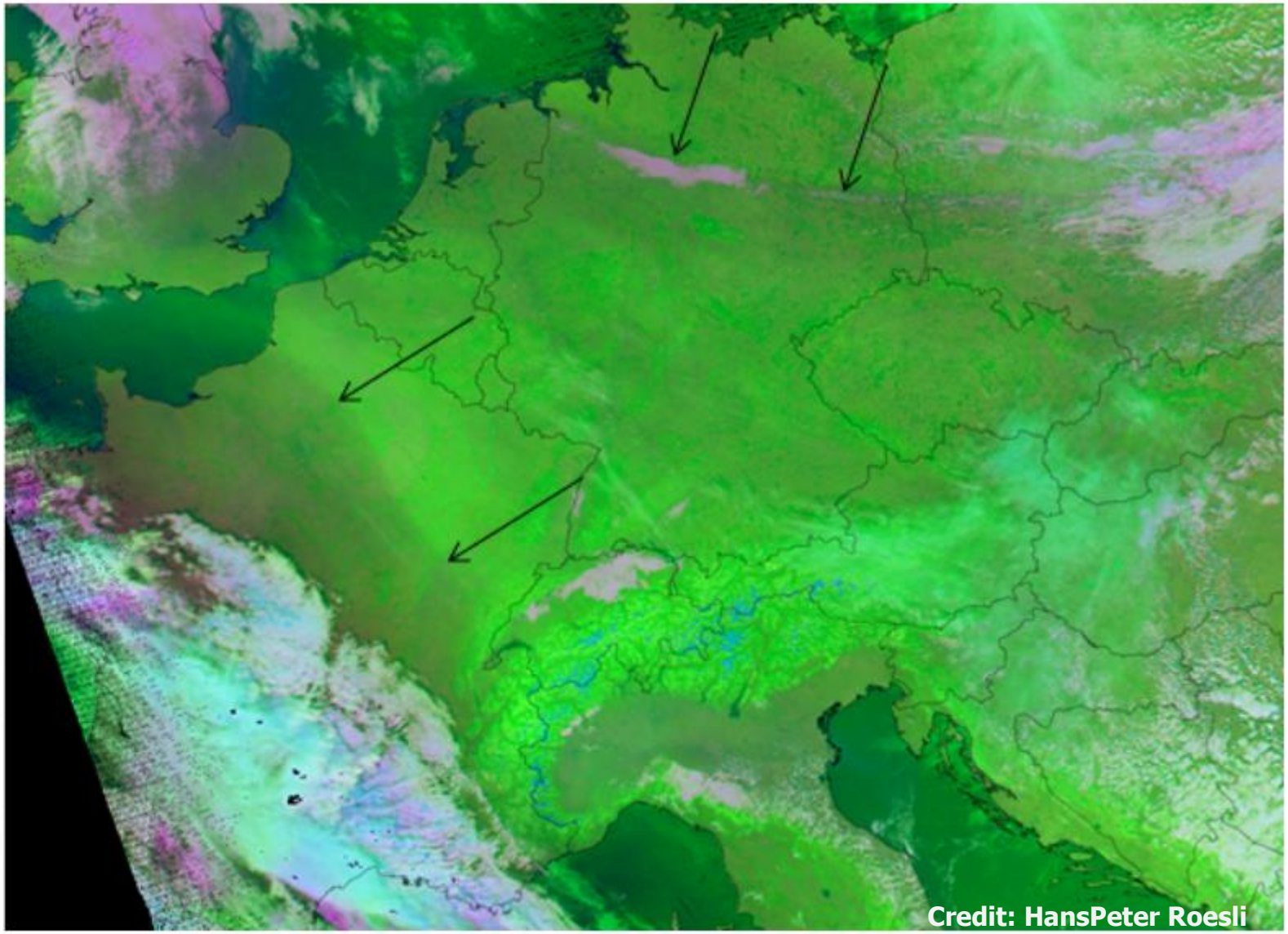
Aqua SMT Natural Colour RGB (SMT on green) 2005-10-15 11:55UTC

Natural Colour RGB

Aqua 2005-10-15 11:55UTC

SMT

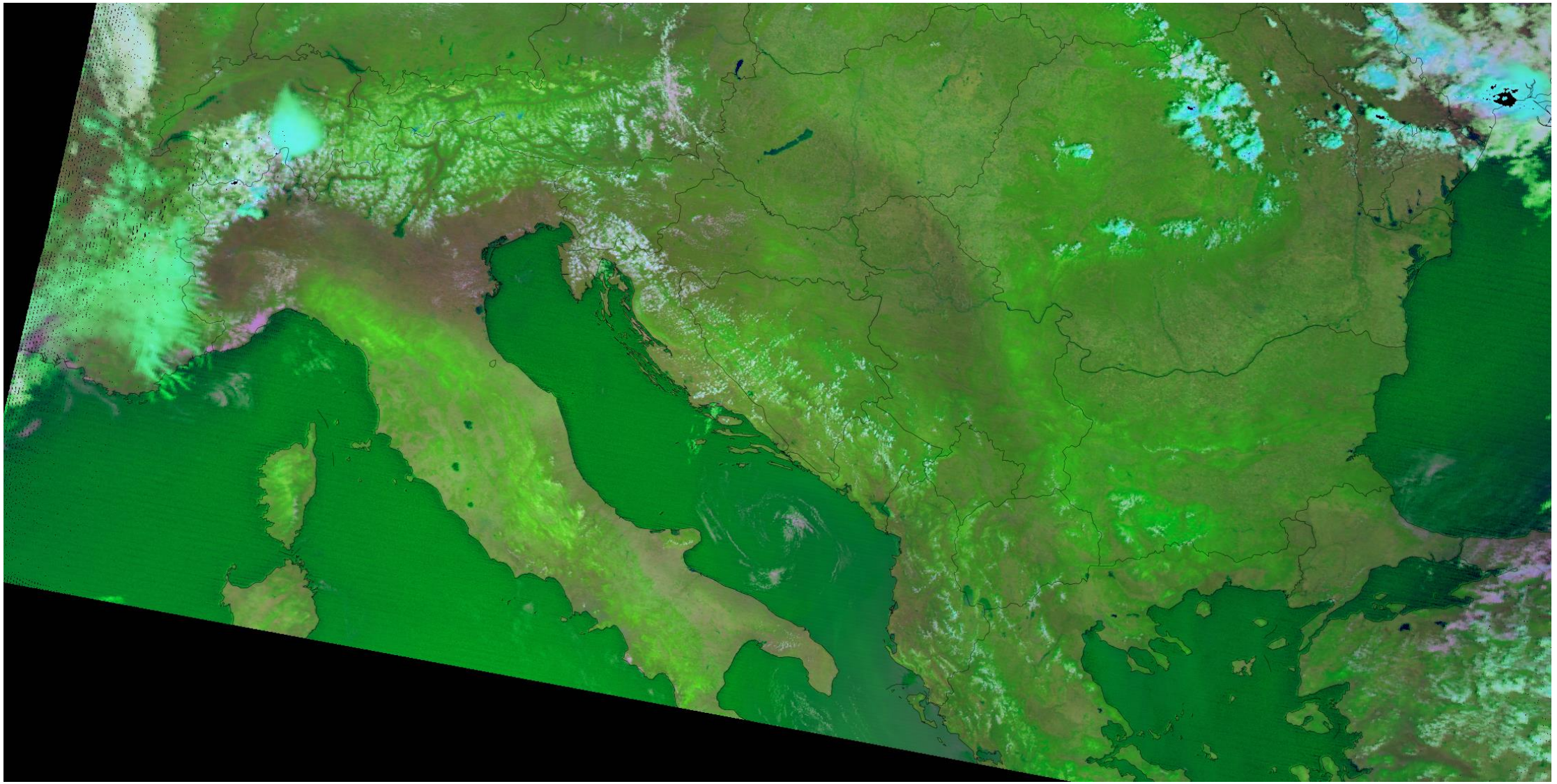




Credit: HansPeter Roesli

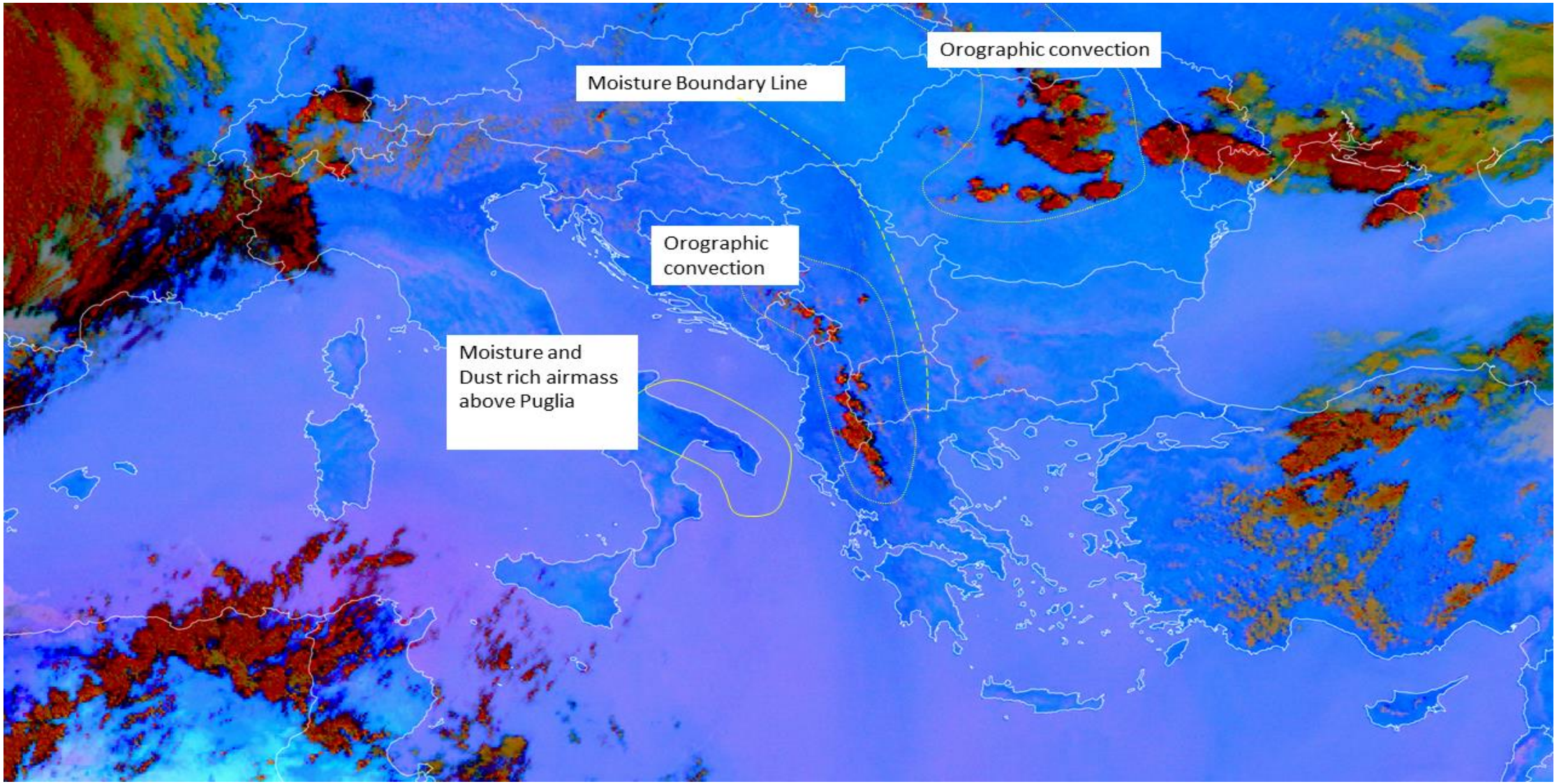
NIR0.9 imagery examples – 'masked' moisture

MODIS SMT Natural Colour RGB (SMT on green) 2022-06-30, 09:30UTC



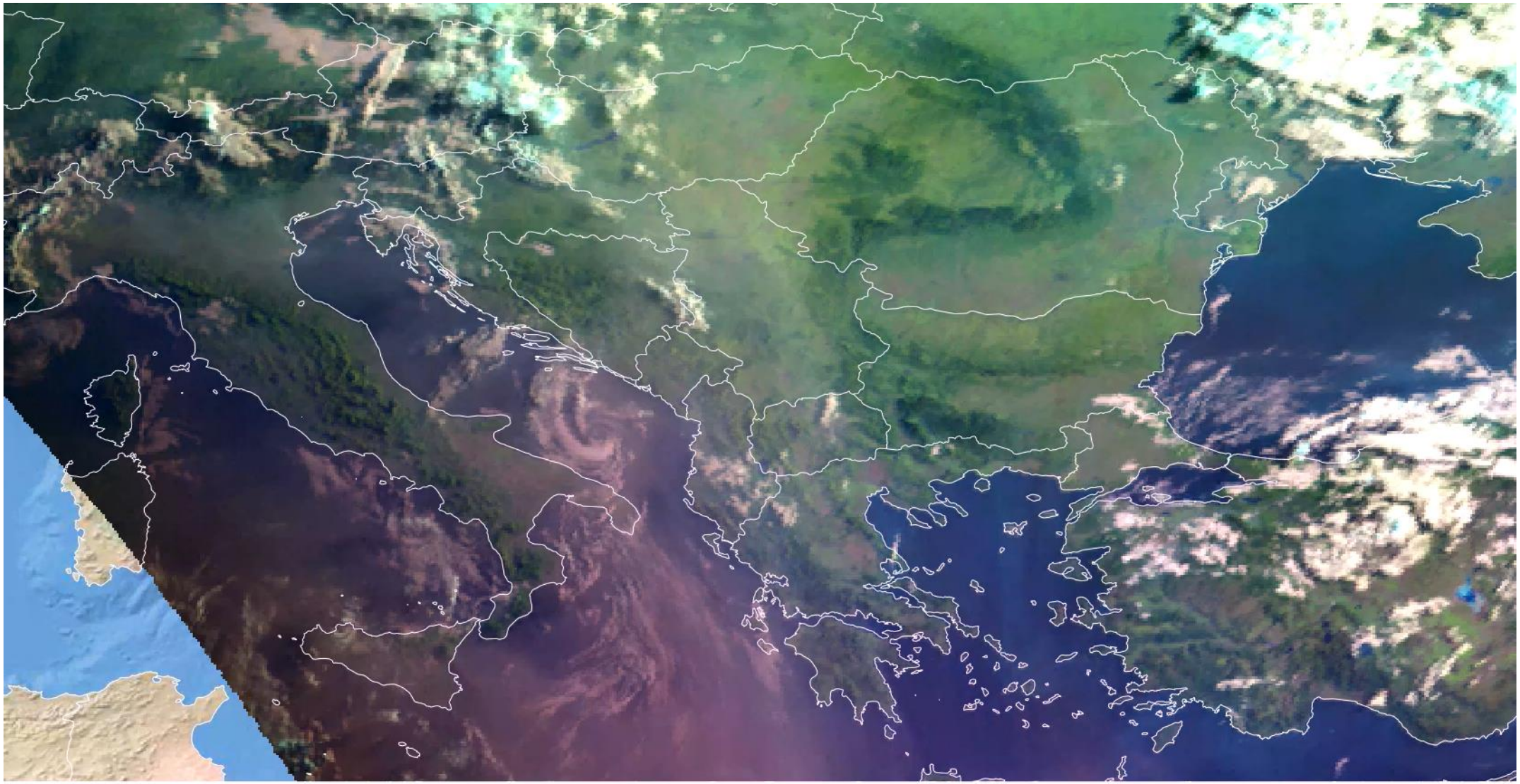
NIR0.9 imagery examples – 'masked' moisture

MODIS SMT Natural Colour RGB (SMT on green) 2022-06-30, 09:30UTC



NIR0.9 imagery examples – smtNatcol: Natural Colour RGB heritage

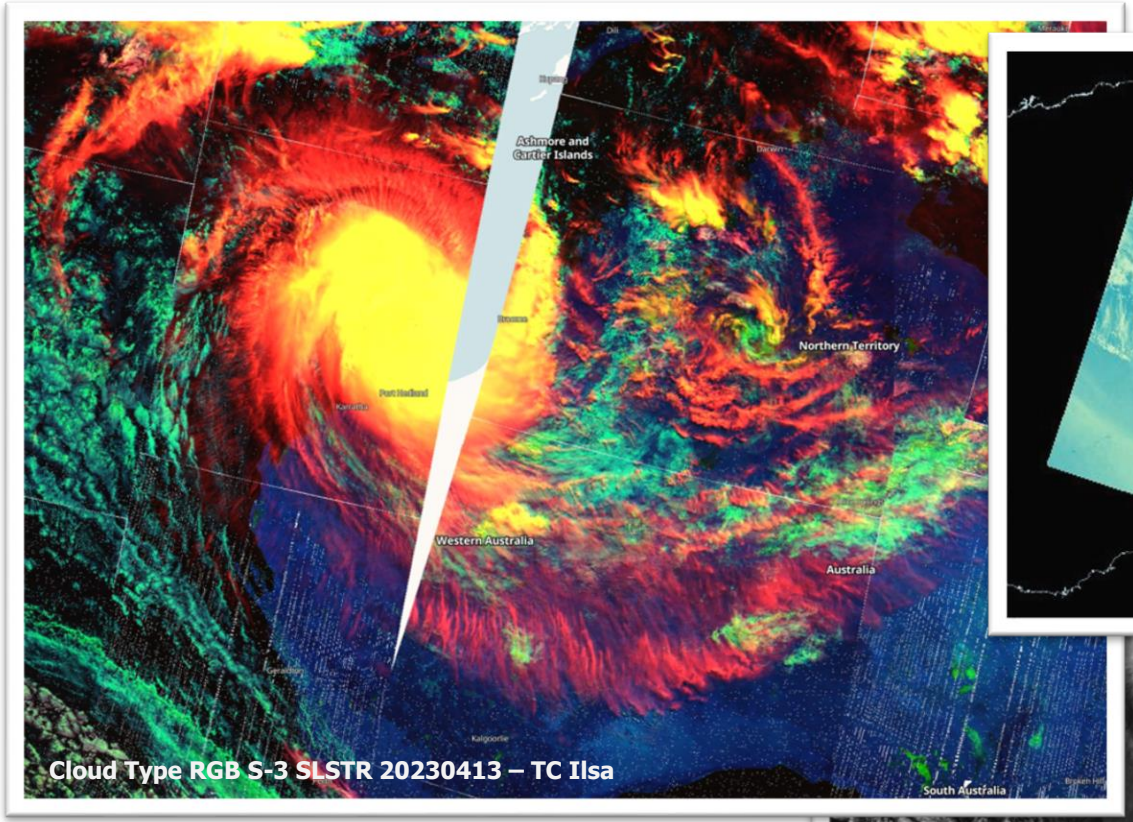
MODIS SMT Natural Colour RGB (SMT on green) 2022-06-30, 09:30UTC

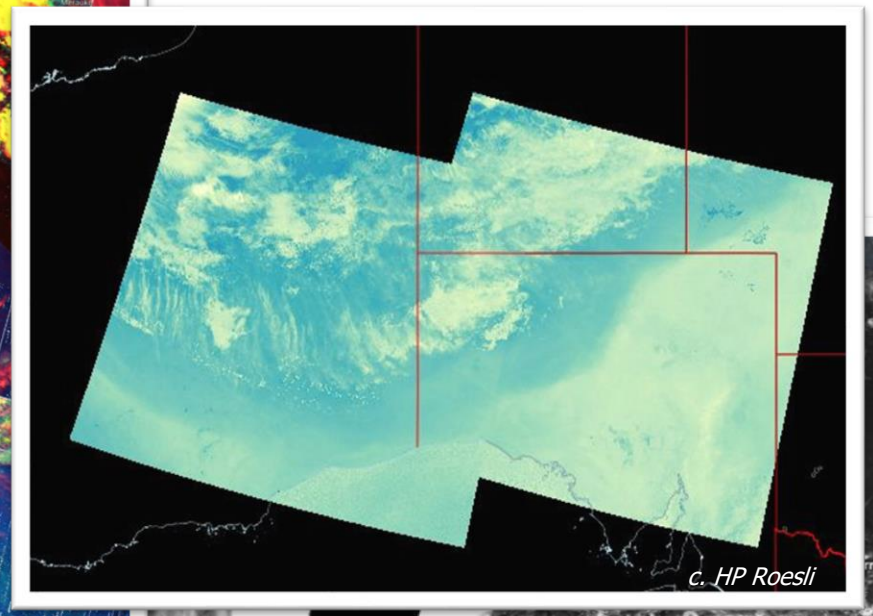


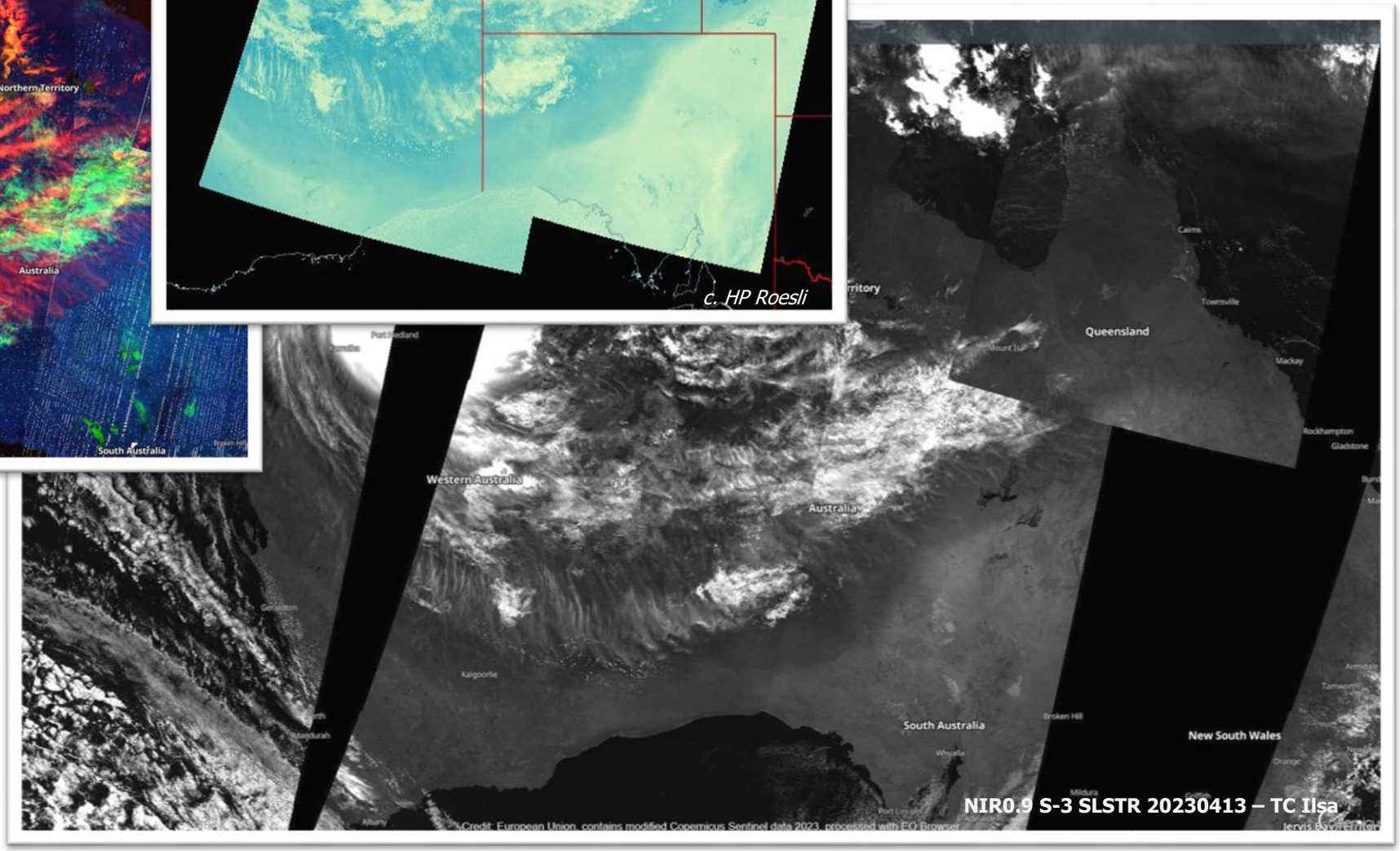
2022-06-30 04:00:00 UTC

Credit: HansPeter Roesli

Thank you – questions?







- LL moisture
  - Clouds
    - Vegetation
      - Aerosols
        - …