METEOSAT SECOND GENERATION (MSG)

METEOROLOGICAL USE OF THE SEVIRI IR WINDOW CHANNELS

Ch07: 8.7 μ

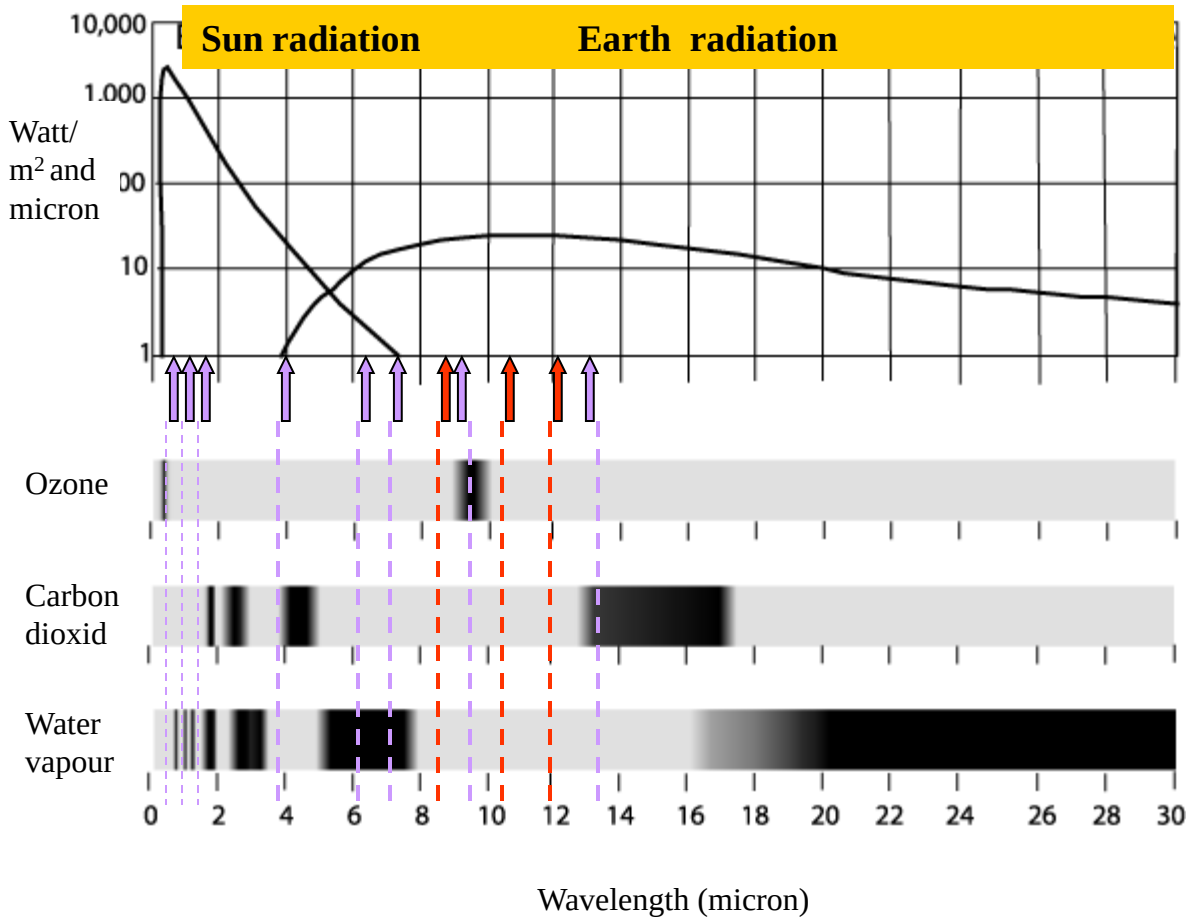
Ch09: 10.8 μ

Ch10: 12.0 μ

OVERVIEW SEVIRI CHANNELS

- Channel 01: VIS 0.6 µ
- Channel 02: VIS 0.8 µ
- Channel 03: NIR 1.6 µ
- Channel 04: IR 3.9 µ
- Channel 05 WV 6.2 µ
- Channel 06: WV 7.3 µ
- Channel 07: IR 8.7 µ
- Channel 08: IR 9.7 µ („Ozone Channel“)
- Channel 09: IR 10.8 µ
- Channel 10: IR 12.0 µ
- Channel 11: IR 13.4 µ („CO_2 Channel“)
- Chanell 12: HRV (High Resolution Visible)

Ch07: 8.7 µ
Ch09: 10.8 µ
Ch10: 12.0 µ



Land Surface Channel 07 (IR8.7) Clouds

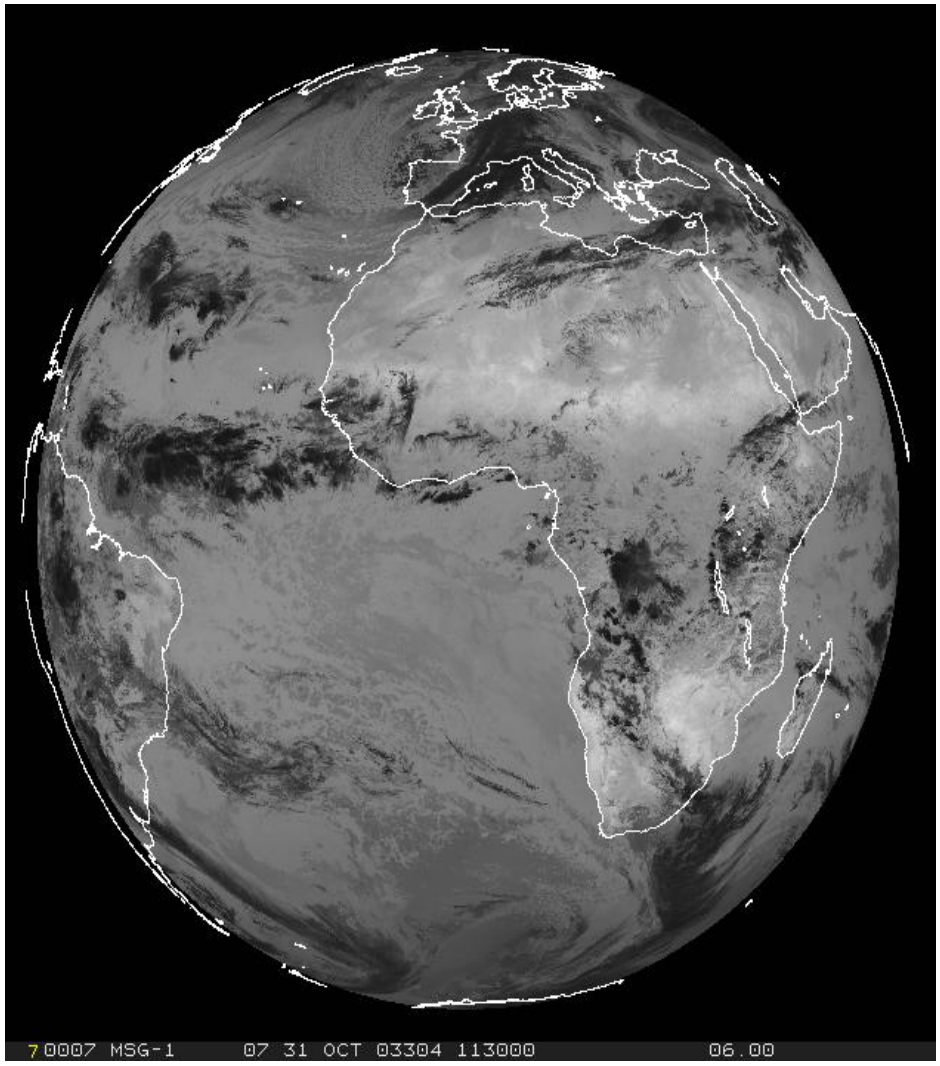
Warm

Hot Land Surf.

Warm Sea Surf. (tropical oceans, seas, lakes)

Sand

Cold Land Surf. (arctic ice areas)



Low-level Clouds

Mid-level Clouds

High-level Clouds

Cold

31 October 2003, 11:30 UTC

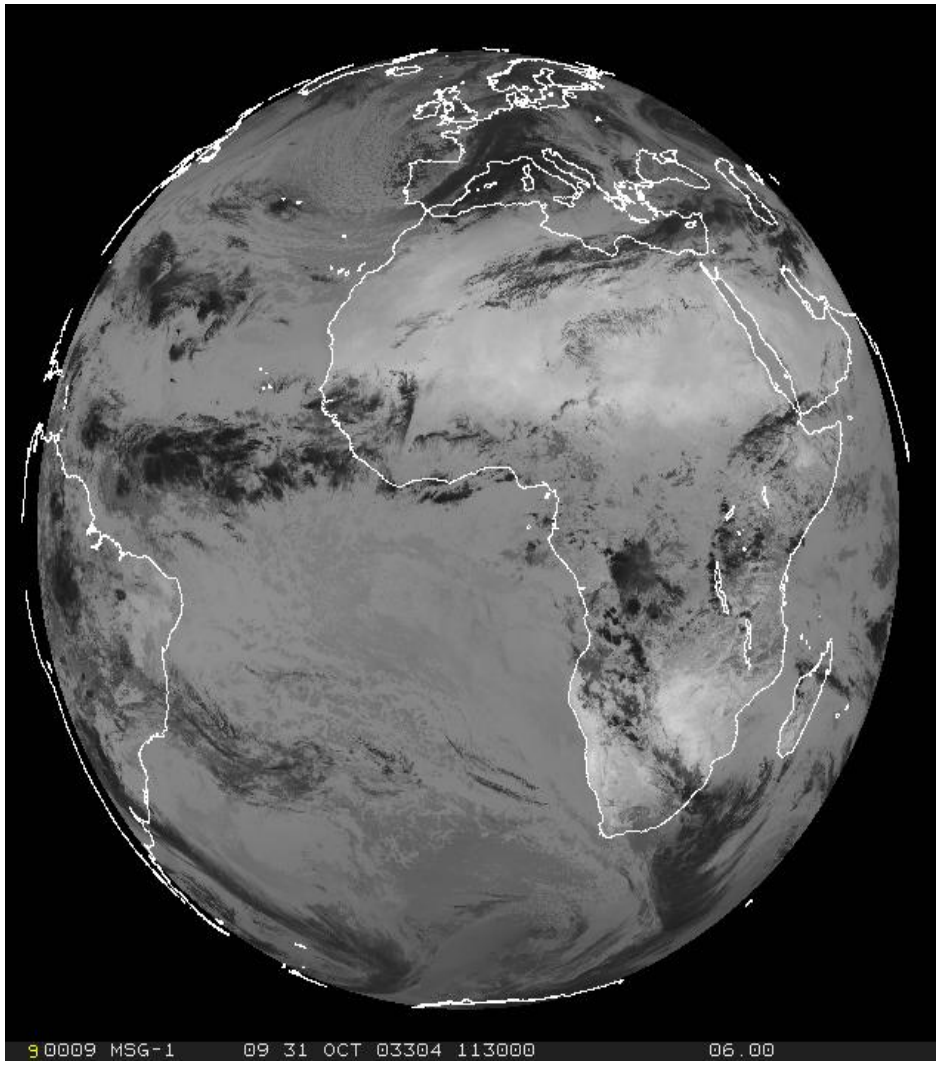
Land Surface Channel 09 (IR10.8) Clouds

Warm

Hot Land Surf.

Warm Sea Surf. (tropical oceans, seas, lakes)

Cold Land Surf. (arctic ice areas)



Low-level Clouds

Mid-level Clouds

High-level Clouds

Cold

31 October 2003, 11:30 UTC

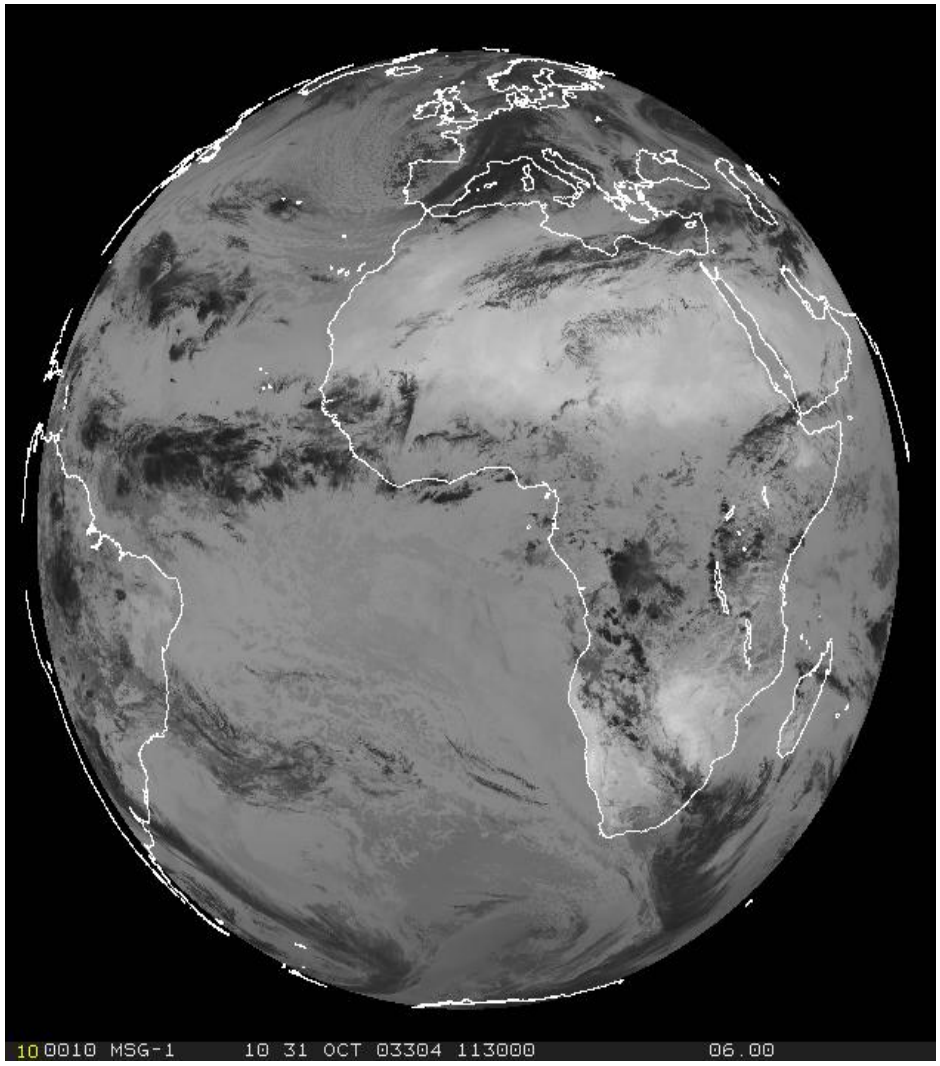
Land Surface Channel 10 (IR12.0) Clouds

Warm

Hot Land Surf.

Warm Sea Surf. (tropical oceans, seas, lakes)

Cold Land Surf. (arctic ice areas)



Low-level Clouds

Mid-level Clouds

High-level Clouds

Cold

31 October 2003, 11:30 UTC

Weighting functions
Source: EUMETSAT

Max. signal in the window channels from the surface and lower part of troposphere

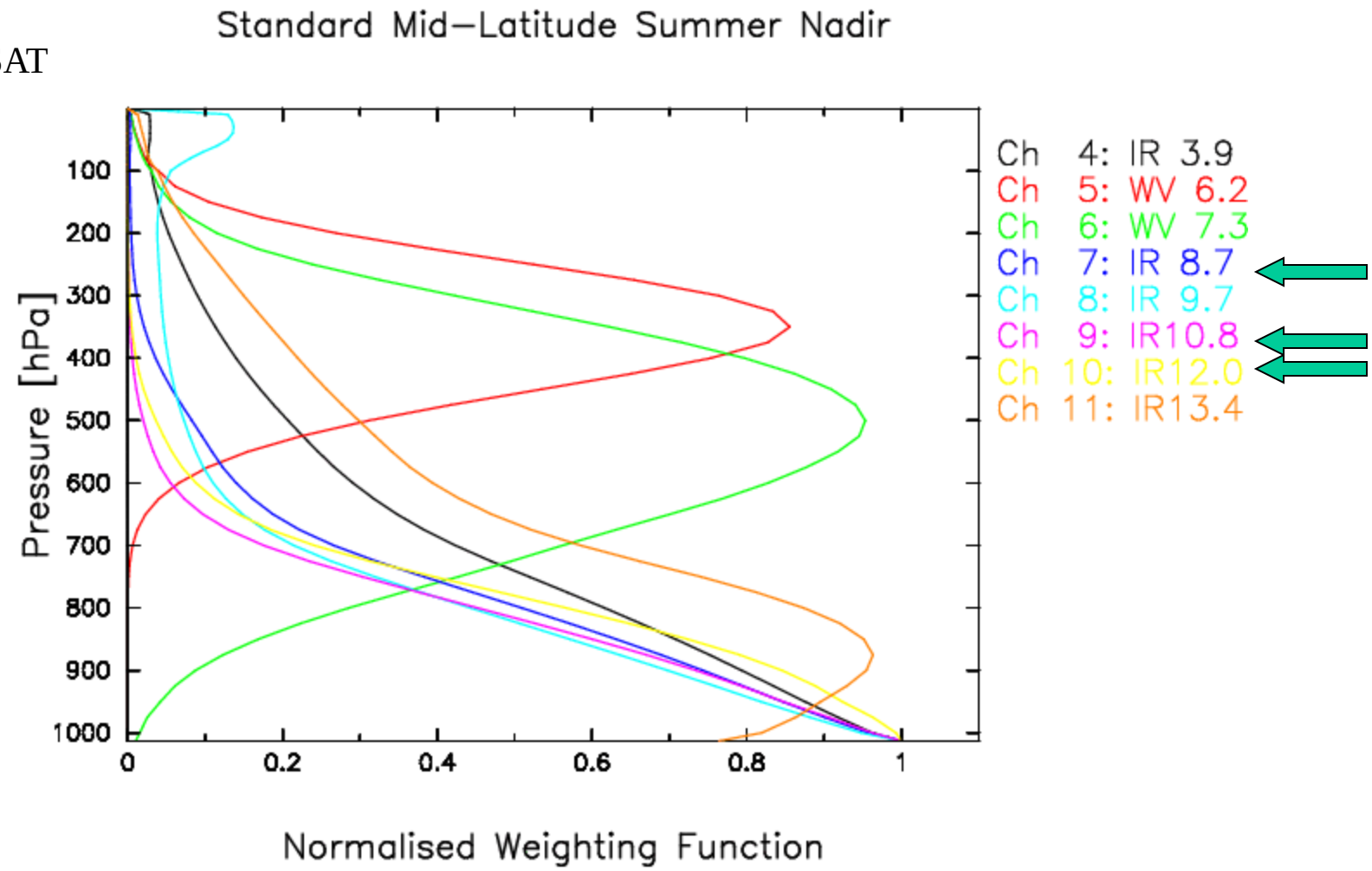
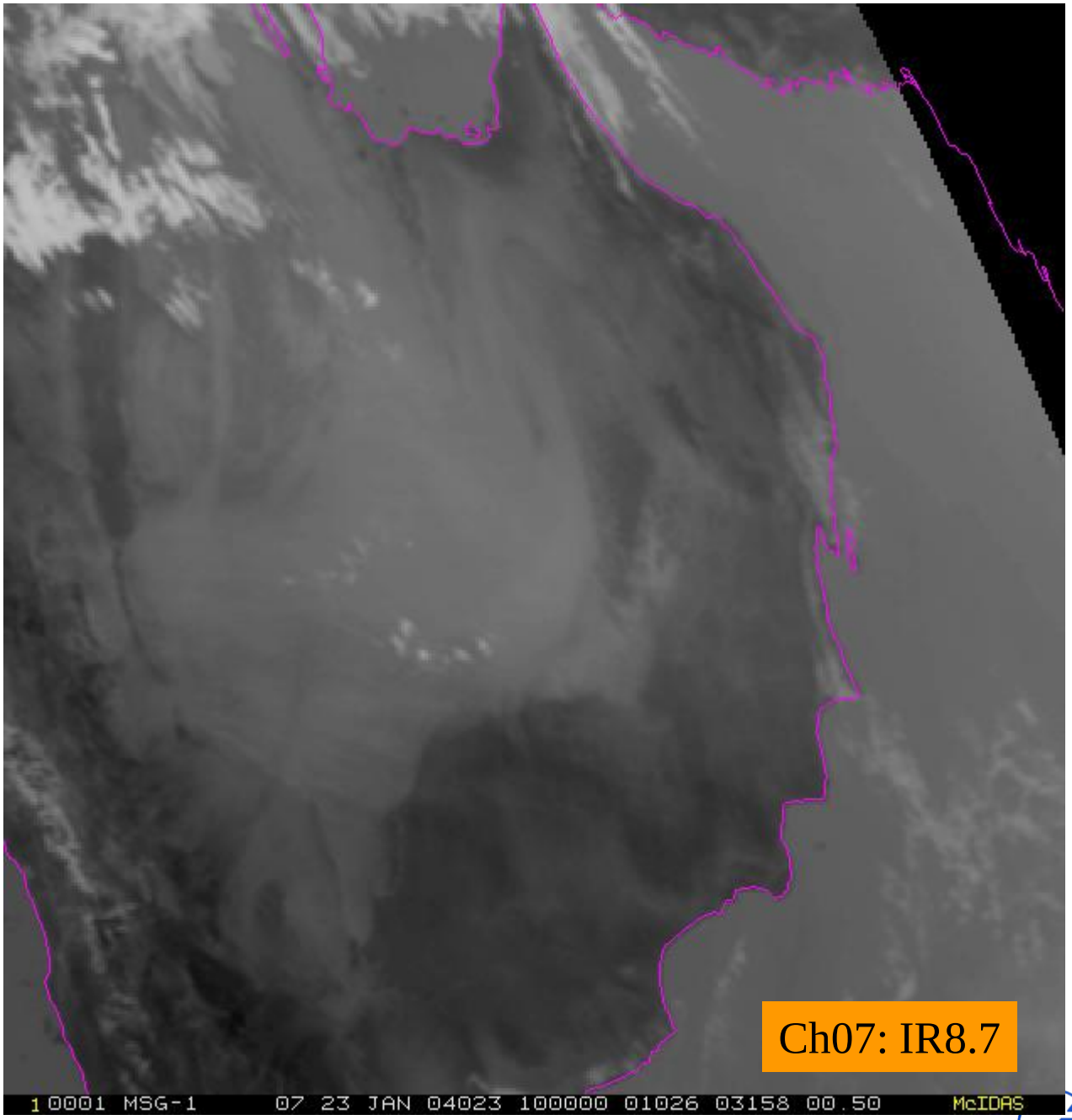
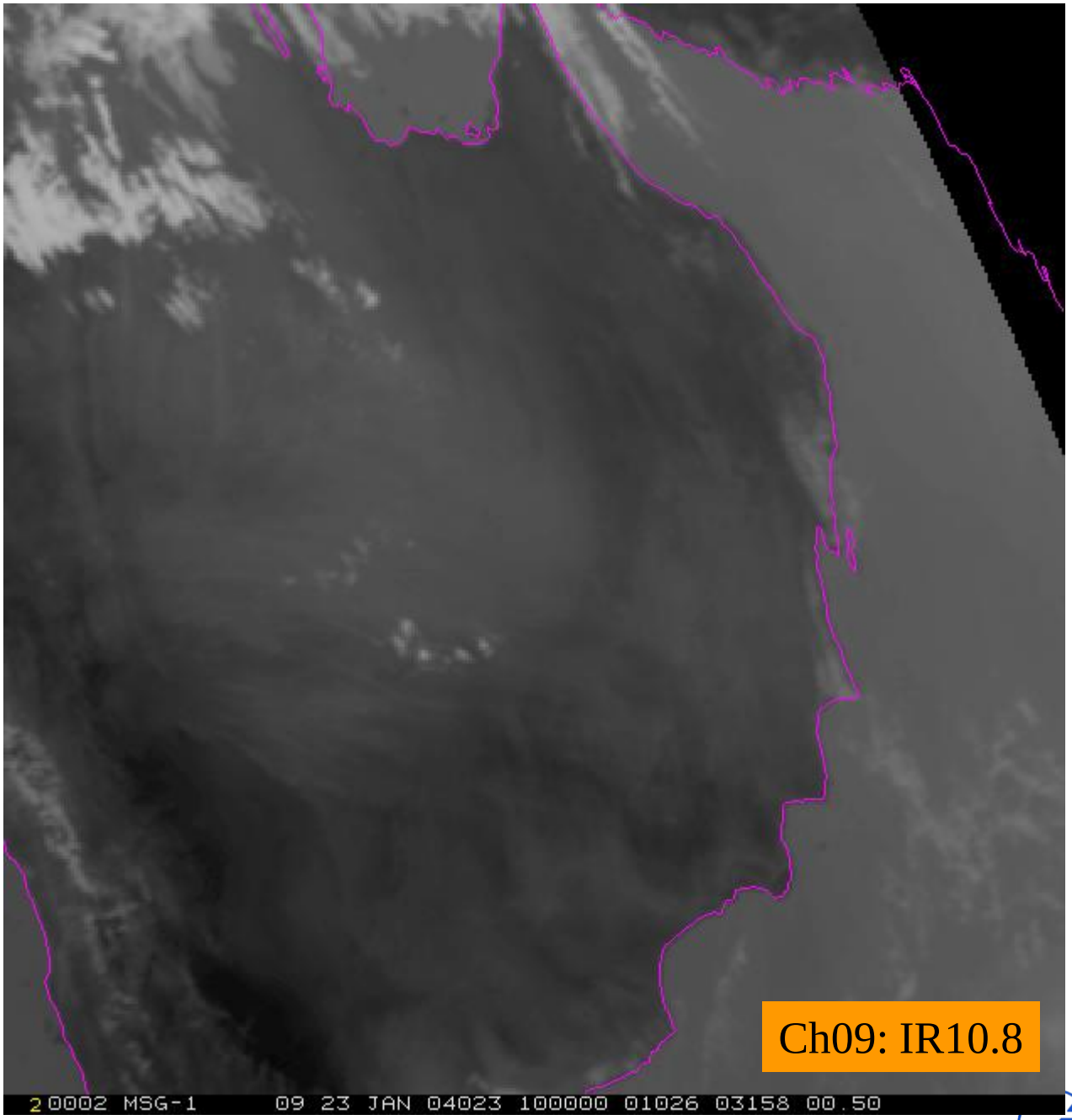


Figure 3c

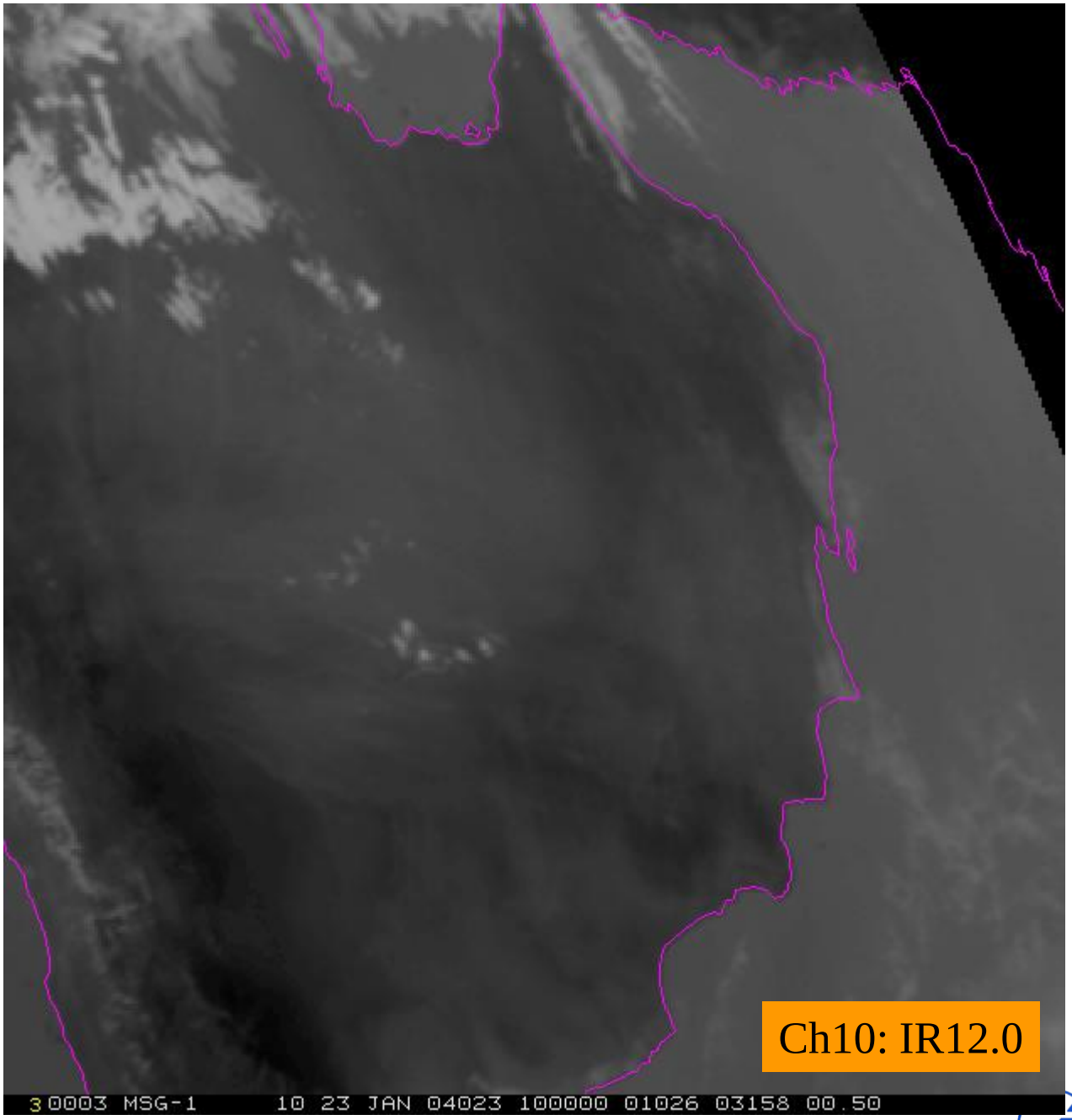


MSG-1
23 January 2004
10:00 UTC



MSG-1
23 January 2004
10:00 UTC

EUMETSAT



MSG-1
23 January 2004
10:00 UTC

METEOROLOGICAL USE OF SEVIRI CHANNELS

IR 8.7/10.8/12.0 μm

- Surface and cloud top temperatures
- Lower tropospheric humidity
- Cloud detection
- Cloud tracking
- Quantitative information on thin cirrus clouds
- Cloud phase (ice or water)
- Scene identification
- Data for NWP (clear-sky radiances)

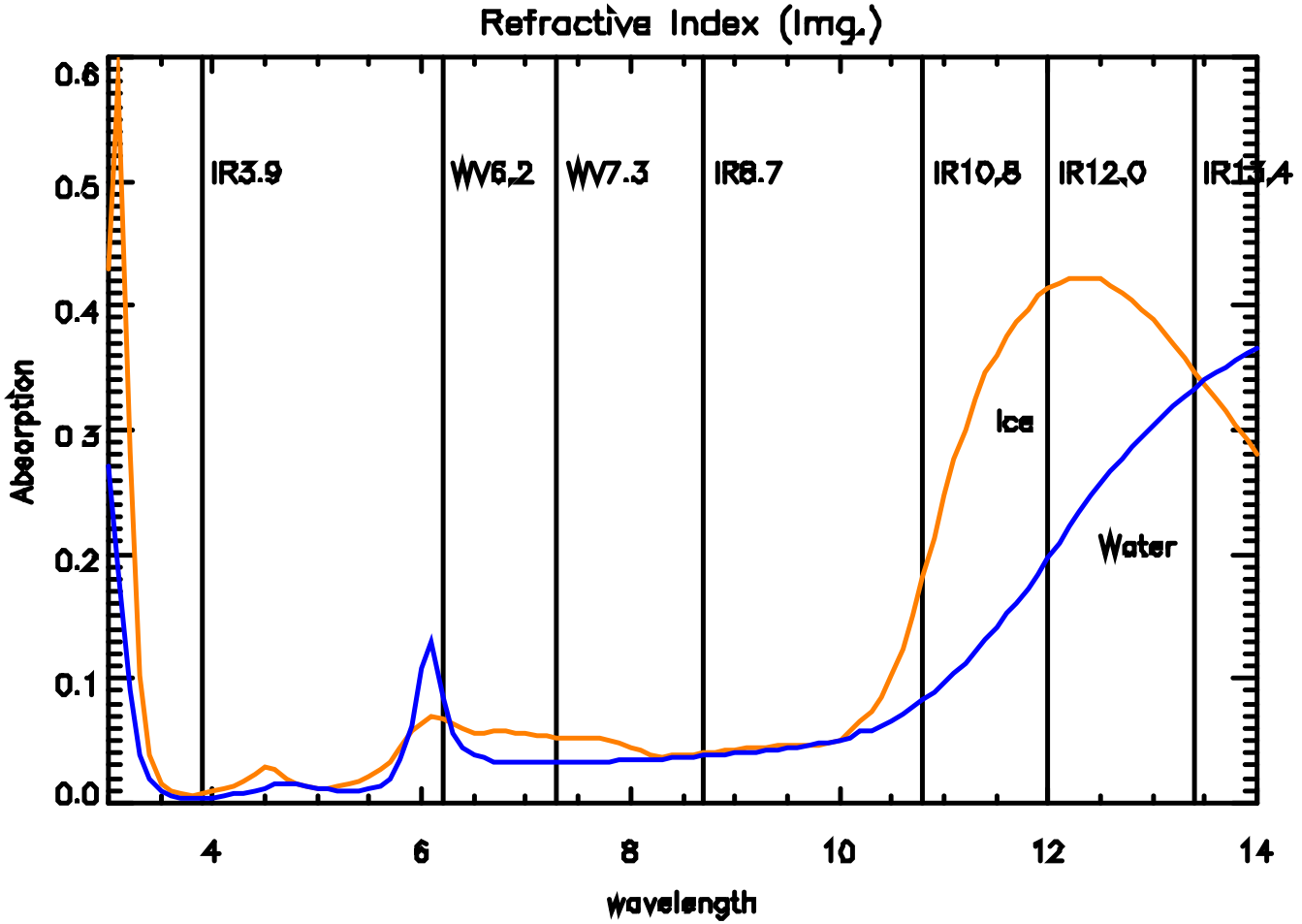
Similar "atmospheric window" channels on many meteorological satellites

CHARECTERESTICS OF IR WINDOW CHANNELS

CASE 1: CLOUD FREE

- CH7 (IR8.7) is the "dirtiest window" channel!
  - Sand has very low emissivity
  - Higher absorption from water vapour compared with other two IR window channels
- CH9 (IR10.8) is the "cleanest" window channel
- CH10 (IR12.0) is also "dirty window"
  - Higher absorption of water vapour compared to 10.8 but less than IR8.7
  - Higher Emissivity of Sand compared to other two Channels

CASE 2: Thin CLOUDS



* High Thin clouds : Channel8.7 has the highest brightness temp. (BT)
* As the cloud top lowers, the BT of the difference Ch7-Ch9 changes from positive to negative depending on how thick the cloud and how humid the atmosphere in the lower level

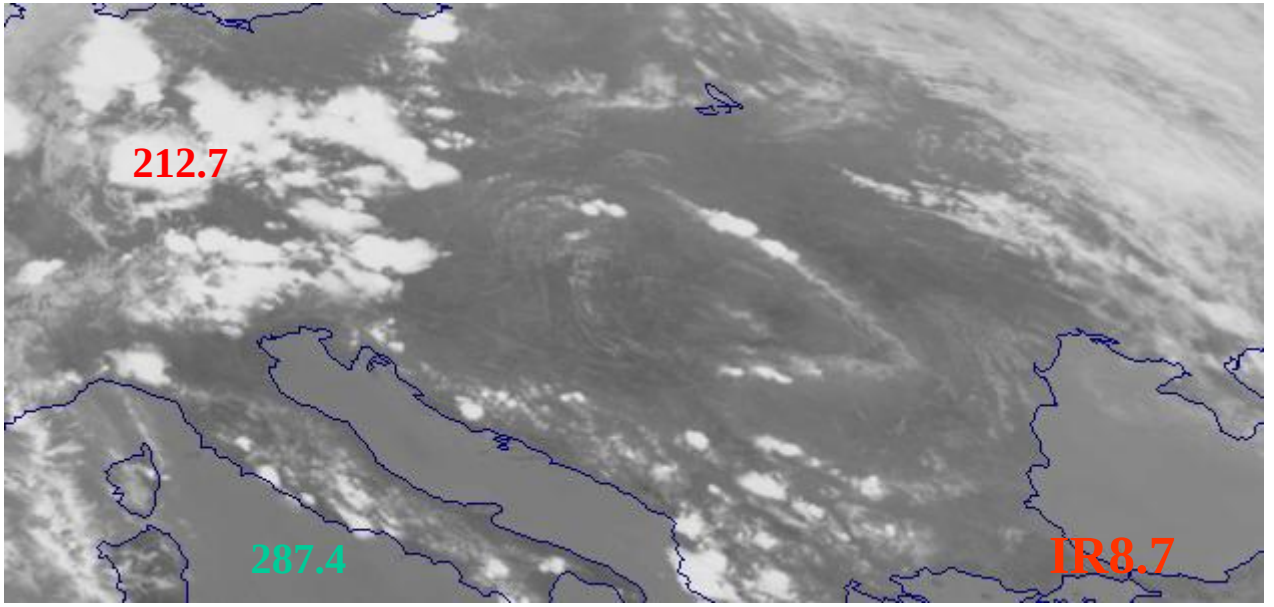
CHARECTERESTICS OF IR WINDOW CHANNELS

CASE 3: Thick Clouds

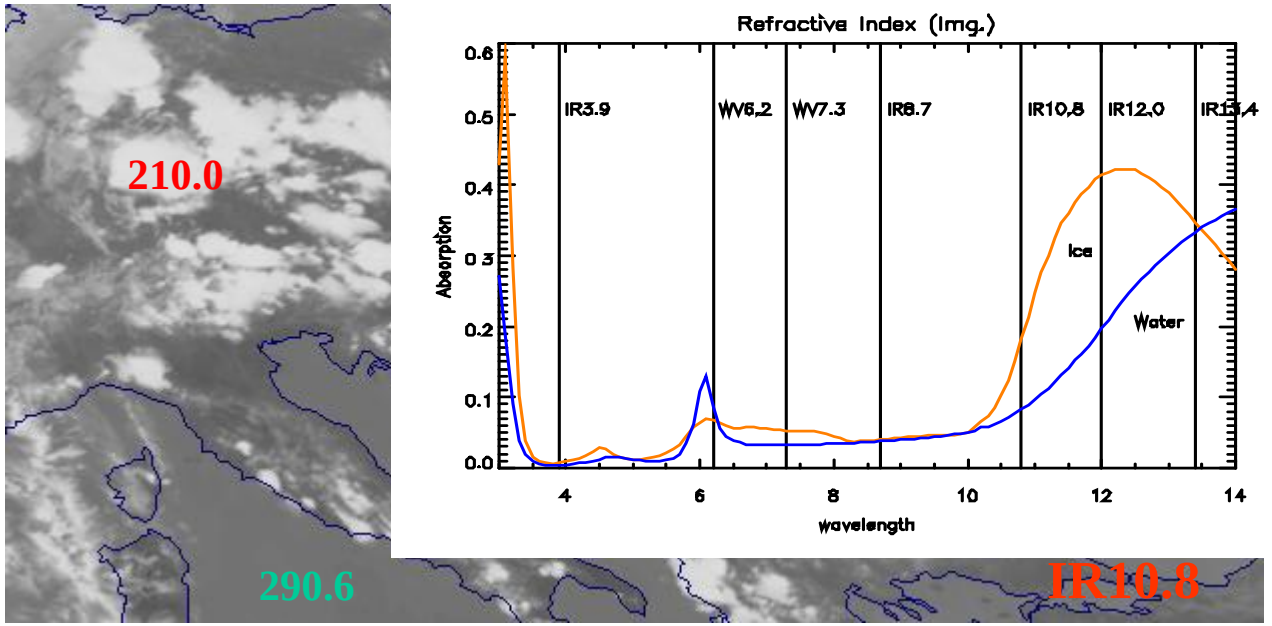
- Very High very Thick clouds has almost the same BT for all IR channels

- As the cloud top lowers, the BT of the difference Ch7-Ch9 changes from close to zero to negative depending on how thick the cloud and how humid the atmosphere in the lower level

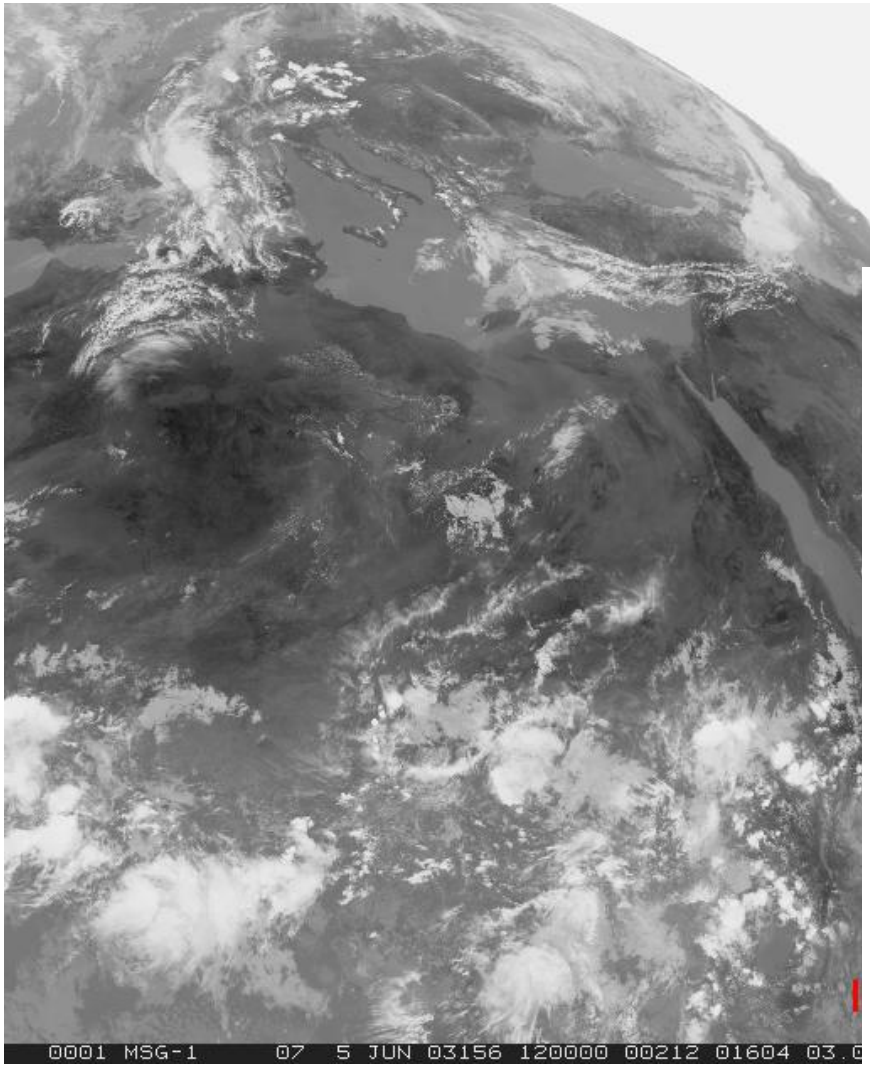
Ice Clouds:
higher in BT IR8.7
because of higher
transparency



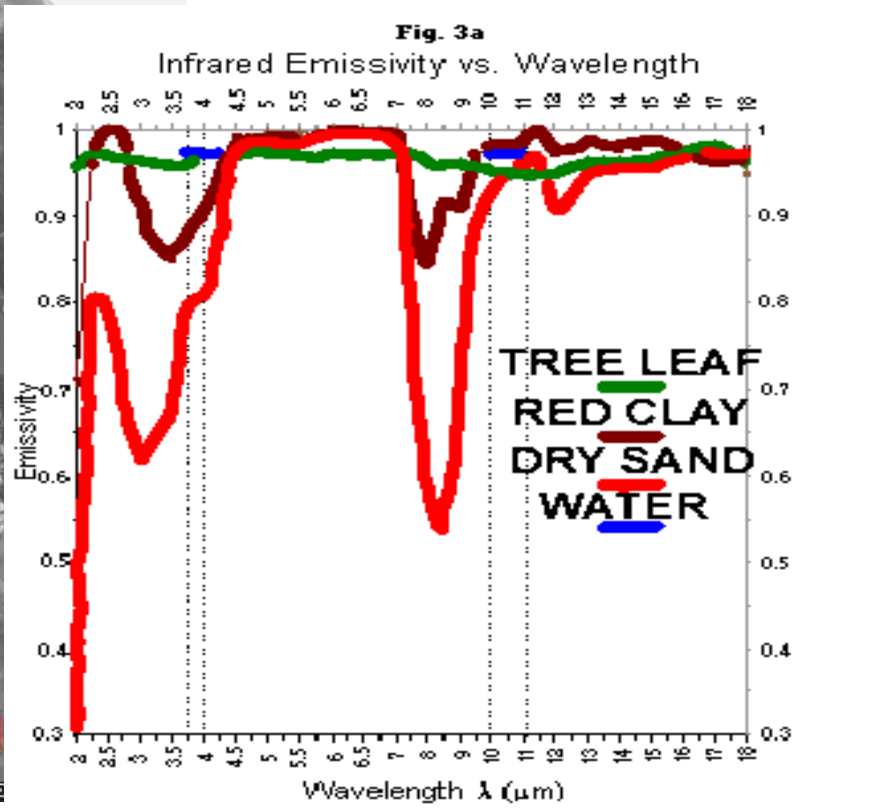
Cloud free ocean:
lower in IR8.7 because
of water vapour
absorption



SEVIRI IR8.7: Sand Surfaces



IR8.7: sand has much less emissivity than at IR10.8

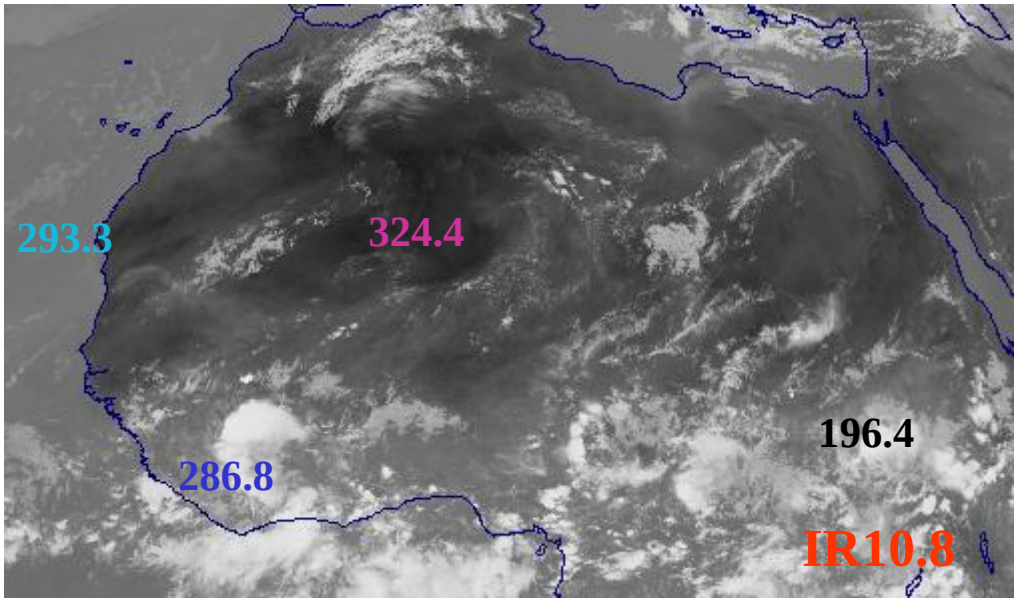


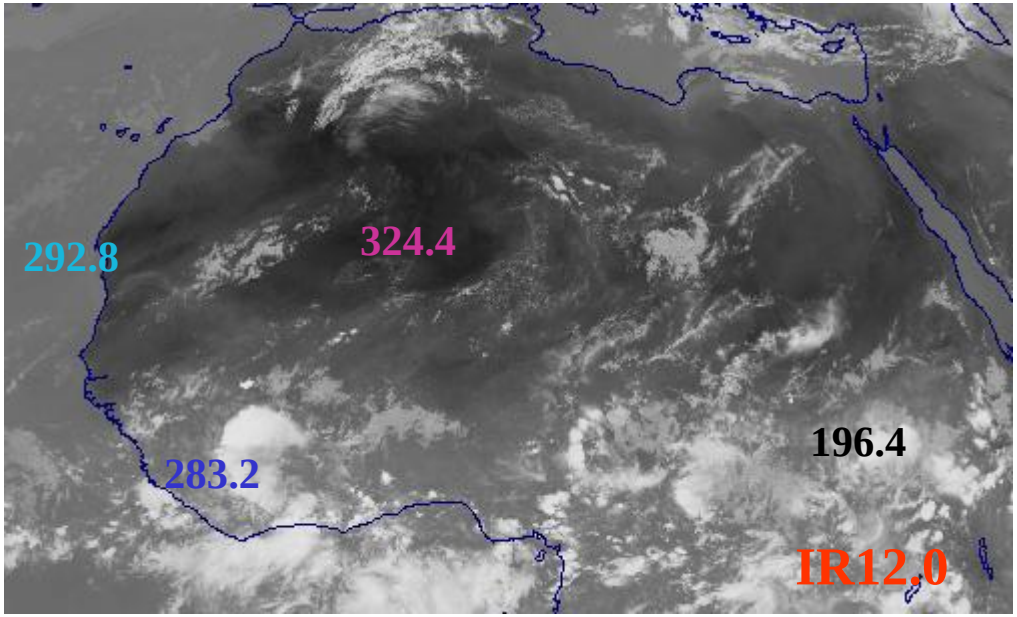
SEVIRI IR10.8 & IR12.0 Channels

"Classical" window channels, mostly surface contribution

IR12.0 has some more H2O absorption

IR12.0 is less transparent for thin ice clouds





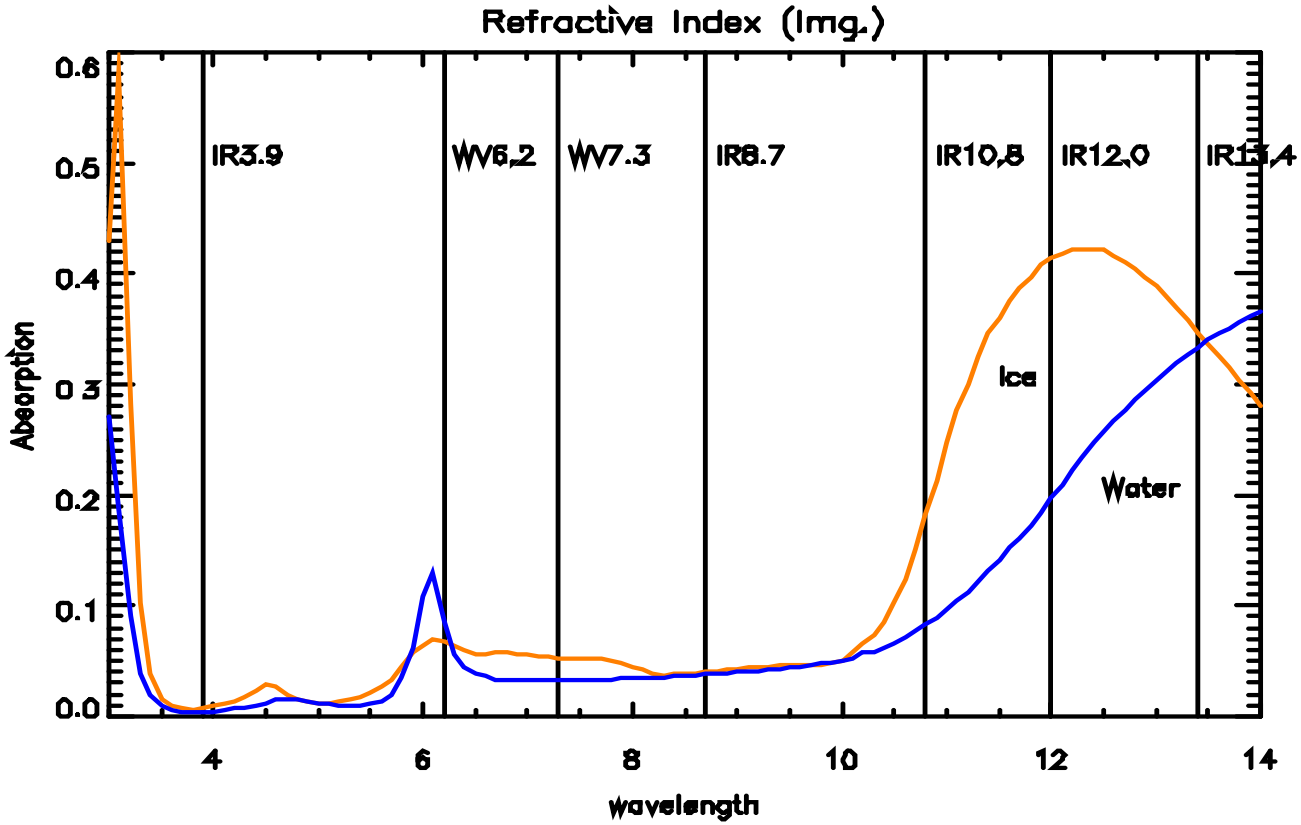
dry atmosphere: same temperature

moist atmosphere: IR12.0 colder (absorption)

thin ice clouds: IR12.0 a lot colder (emissivity)

same temperature over thick high clouds

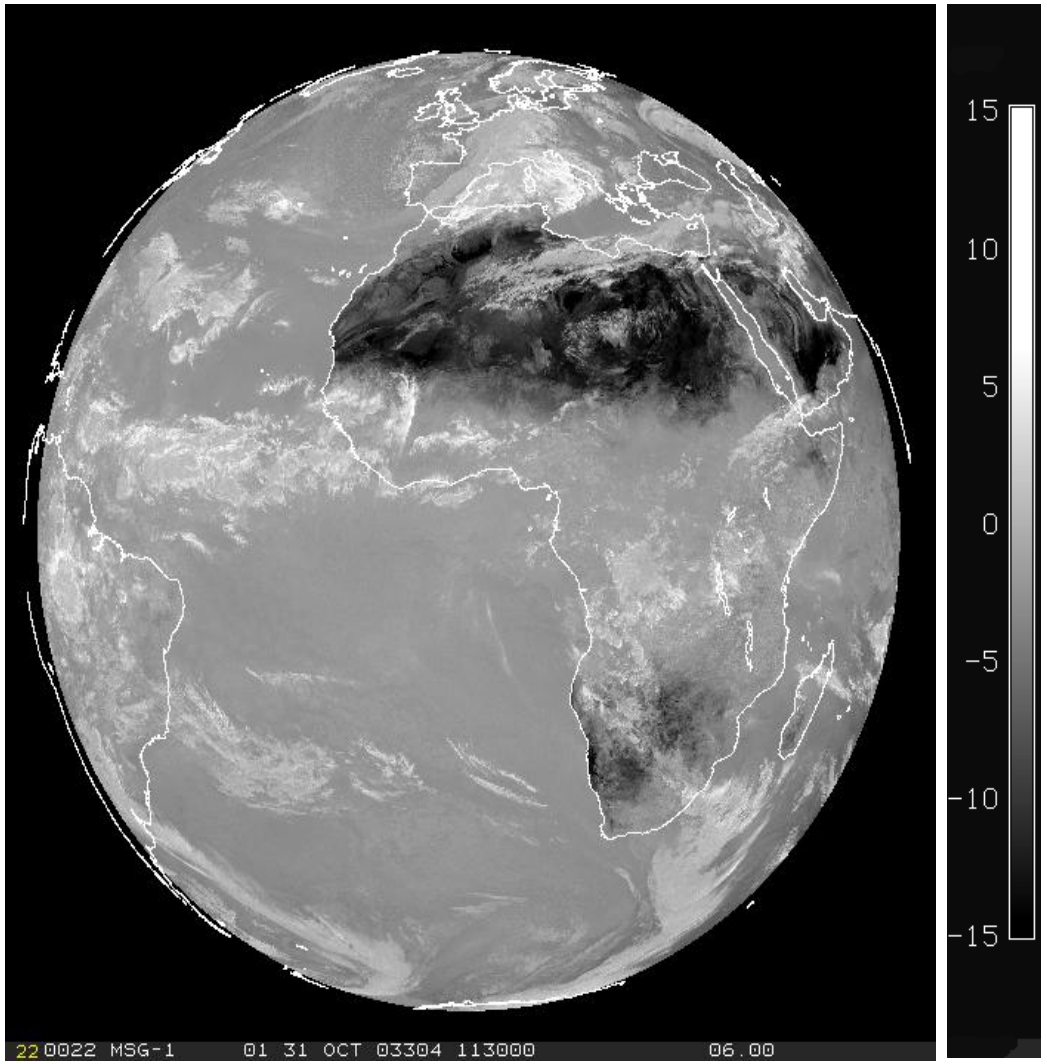
BTD for Thin Ice Clouds



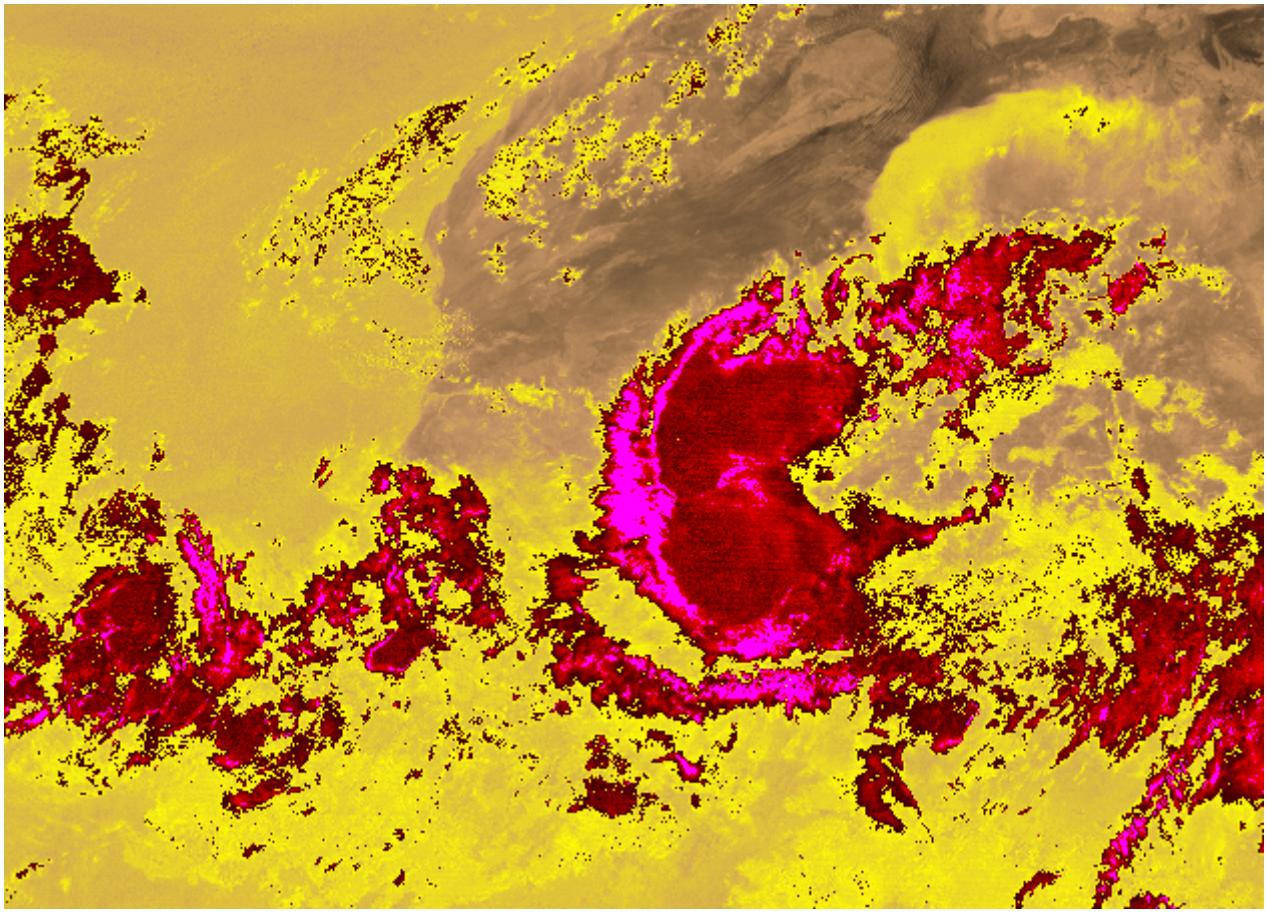
IR8.7 - IR10.8 around +3 to +15 K

IR12.0 - IR10.8 around -4 to -15 K

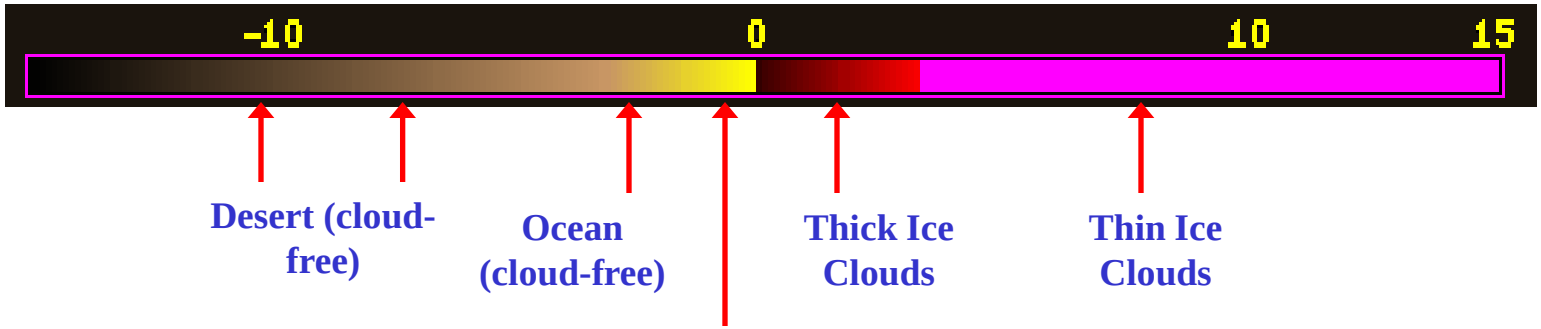
Difference IR8.7 - IR10.8



31 October 2003, 11:30 UTC



MSG-1
14 July 2003
02:00 UTC
Difference Image
IR8.7 - IR10.8
[BTD in K]



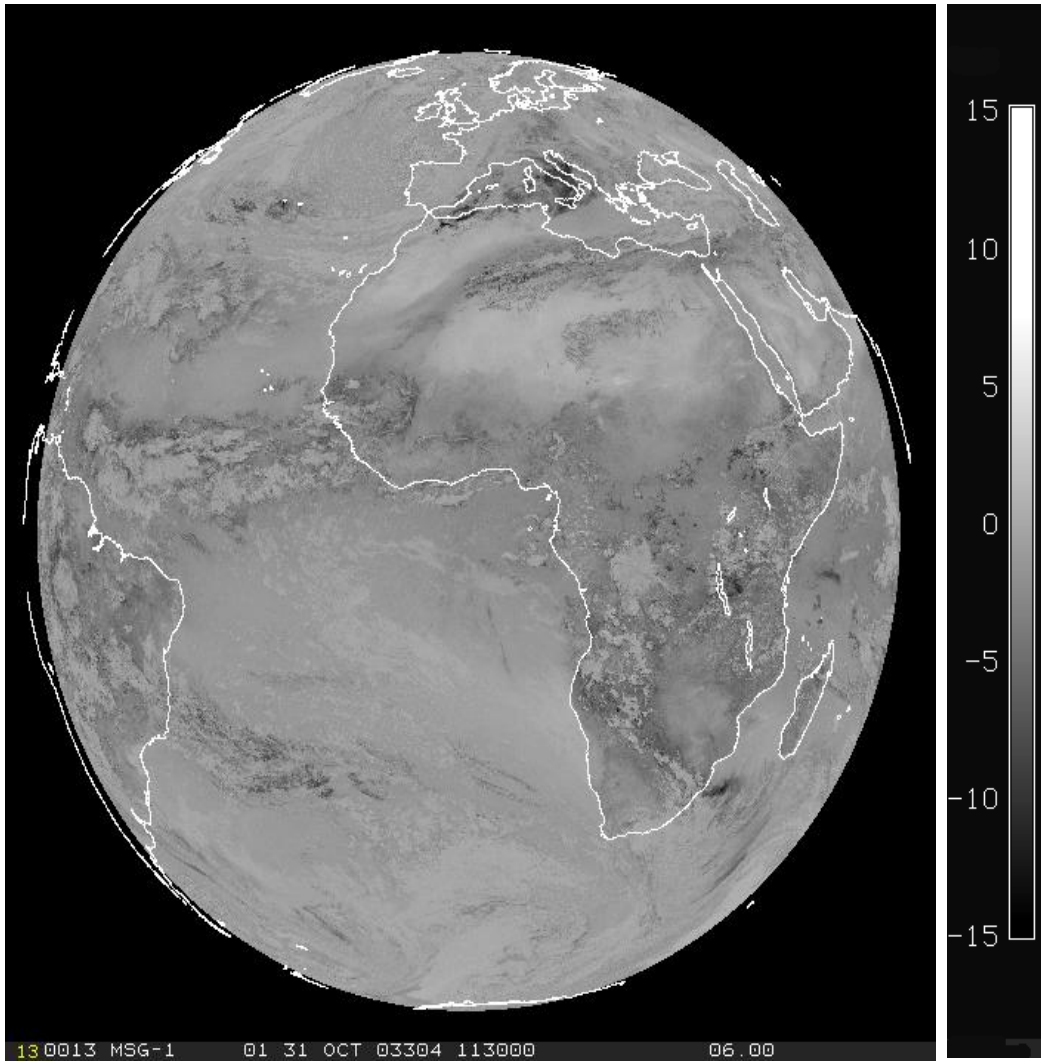
Difference IR12.0 - IR10.8

- Normally, this difference will be negative (thin clouds, cloudfree) or close to zero (e.g. for high thick clouds). However, there are several scenes/situations when this difference can get positive

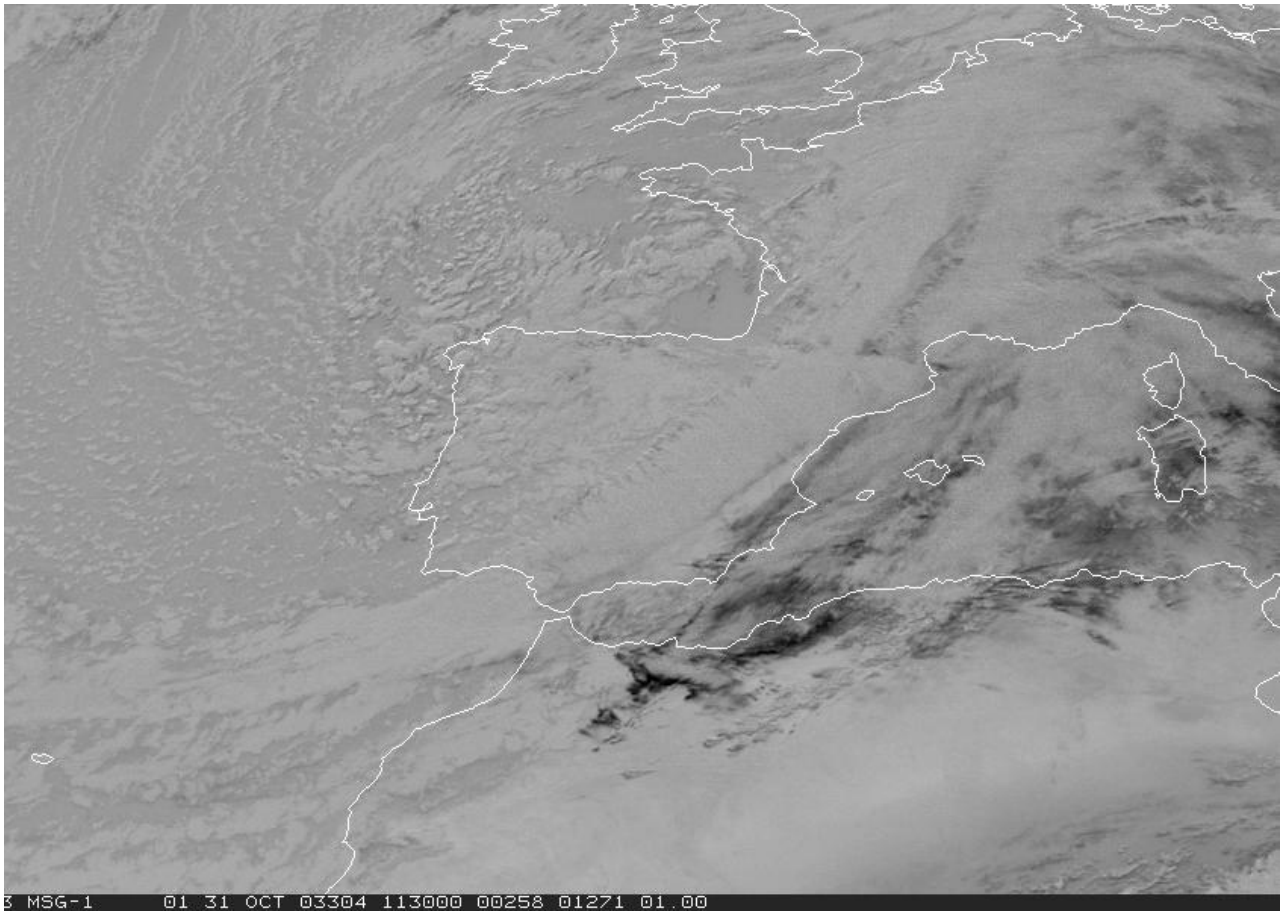
  1) dust storms
  2) volcanic ash
  3) certain desert surfaces
  4) cloud-free with strong temperature inversion

  In the latter case the absorbing gas (H2O), instead of cooling the IR12.0 channel, is making this channel warmer than the IR10.8 channel.

Difference IR12.0 - IR10.8



31 October 2003, 11:30 UTC



MSG-1
31 Oct 2003
11:30 UTC
Difference Image
IR12.0 - IR10.8
[BTD in K]

Thin Clouds (Water or Ice)

Ocean (cloud-free)

Desert

Thick Clouds (Water or Ice)

EXAMPLES OF THE METEOROLOGICAL USE OF SEVIRI CHANNELS

IR 8.7 μm

IR 10.8 μm

IR 12.0 μm

Detection of dust storms

Dust RGB Product

R = Difference IR12.0 - IR10.8
G = Difference IR10.8 - IR8.7
B = Channel IR10.8

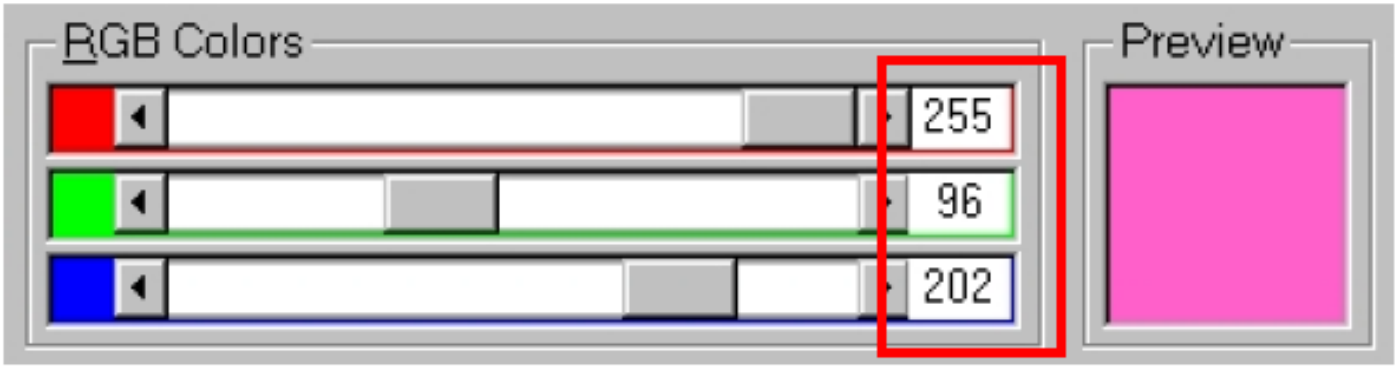
Applications:	Dust, Thin Clouds, Contrails
Area:	Full MSG Viewing Area
Time:	Day and Night

Dust RGB Product

10 - 09

09 - 07

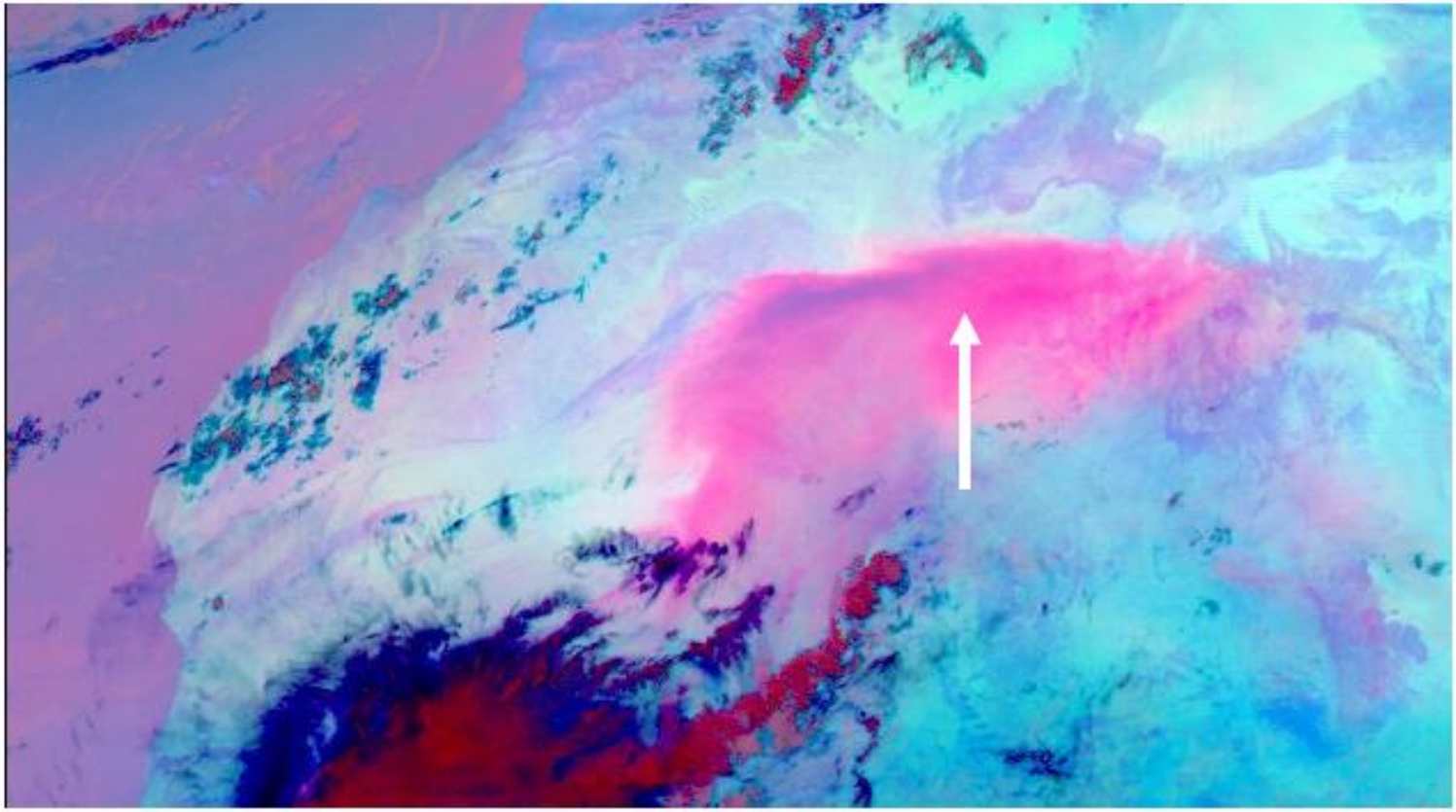
09



In dust RGB product images, dust appears in magenta colours !

The values shown above (in the red box) correspond to the location (shown by an arrow) on the next page !

Dust RGB Example 1



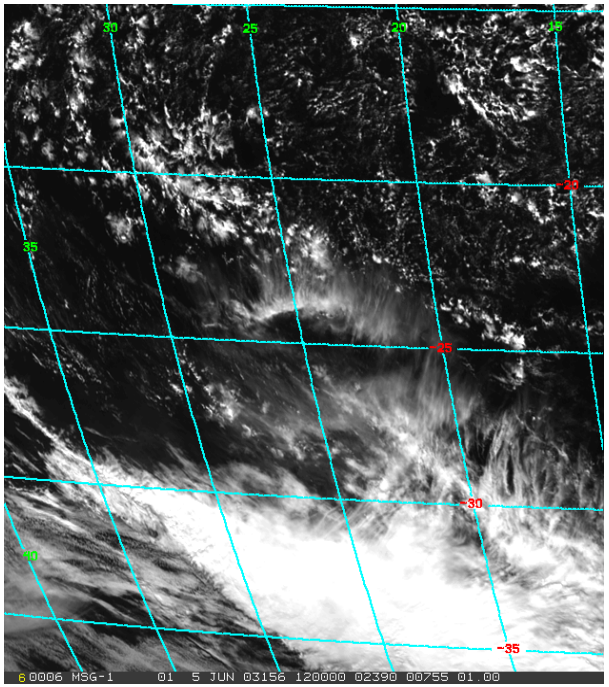
MSG-1, 14 July 2003, 10:00 UTC

Dust RGB Example 2

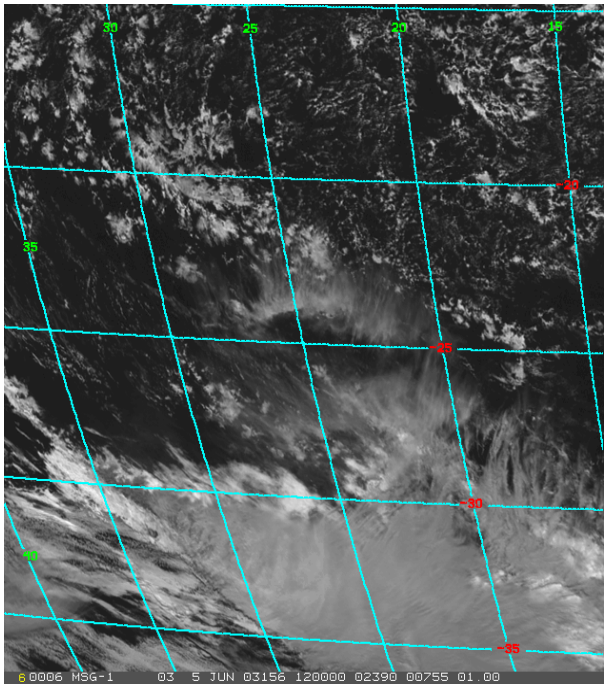
MSG-1, 25 June 2003, 10:00 UTC

Examples for visualisation of high Cirrus

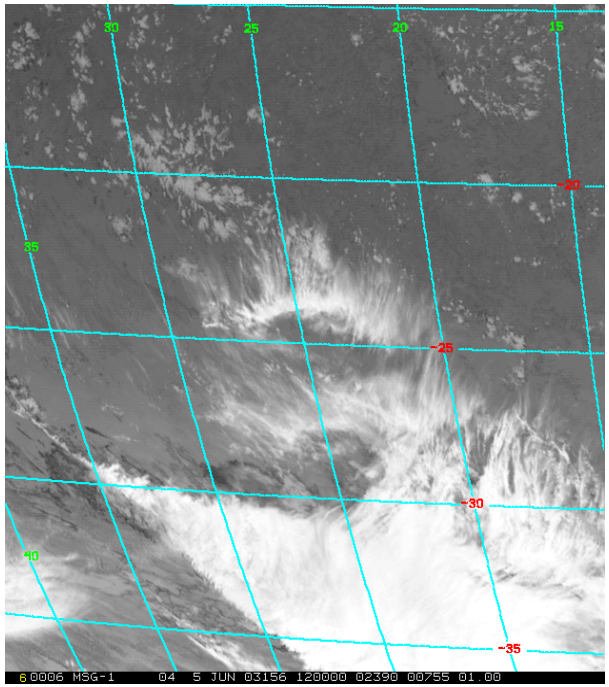
Difference of IR8.7, IR10.8, IR12.0



Channel 01 (0.6 μm)

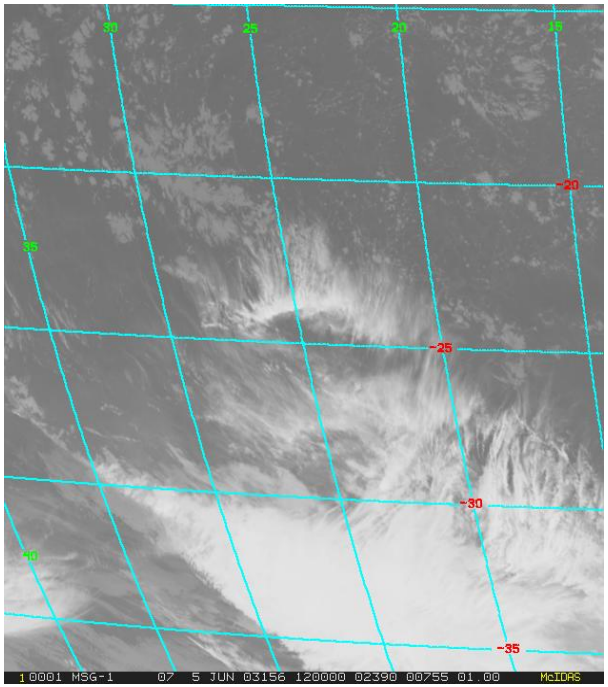


Channel 03 (1.6 μm)

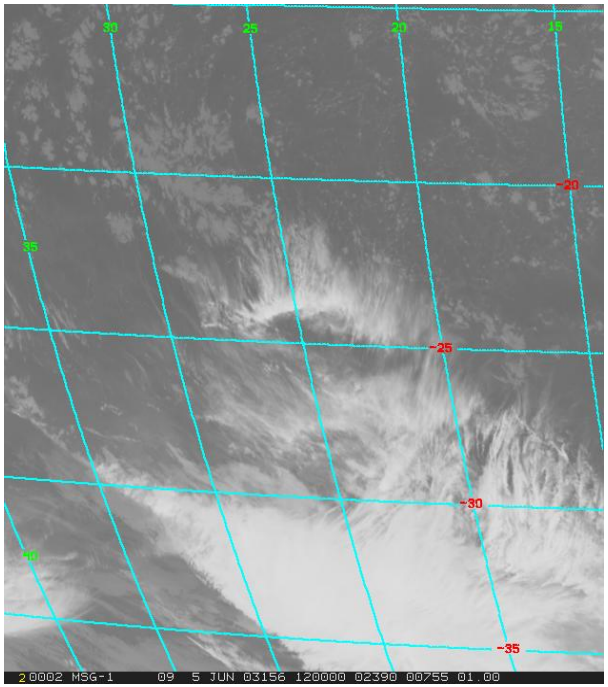


Channel 04 (3.9 μm)

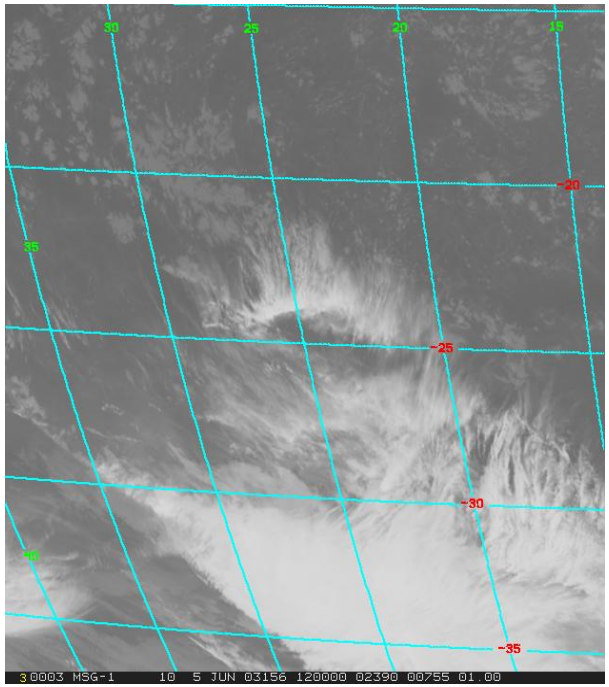
Ice and water clouds in the Southern Atlantic as seen by the VIS0.6, NIR1.6 and IR3.9 channels.
MSG-1, 5 June 2003, 12:00 UTC



Channel 07 (8.7 μm)

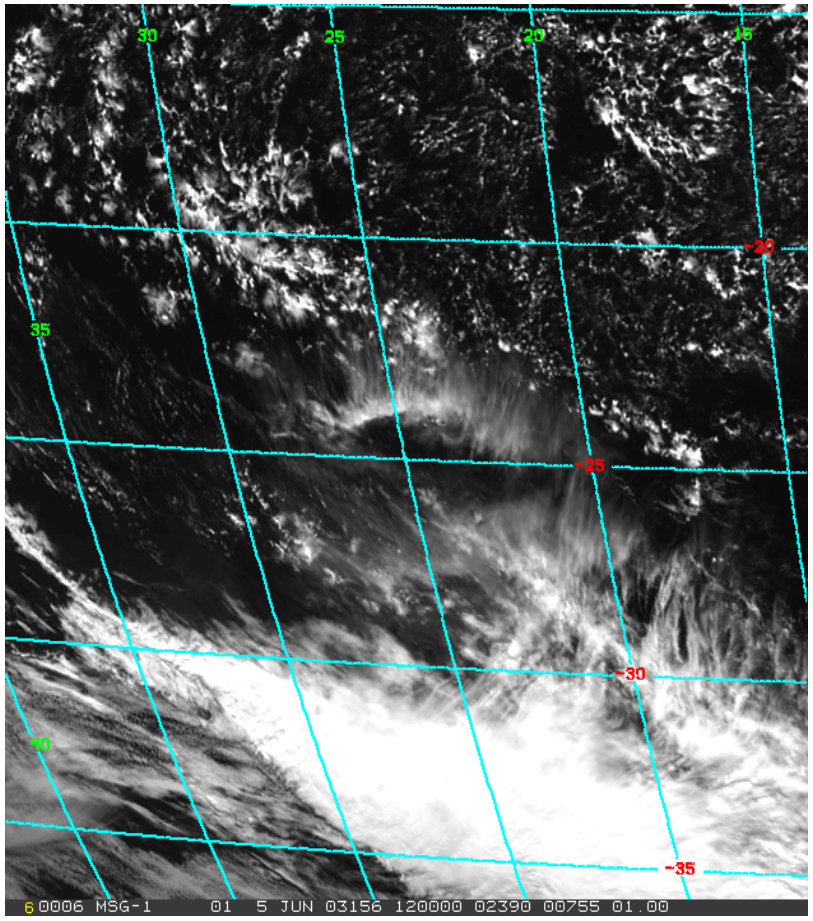


Channel 09 (10.8 μm)



Channel 10 (12.0 μm)

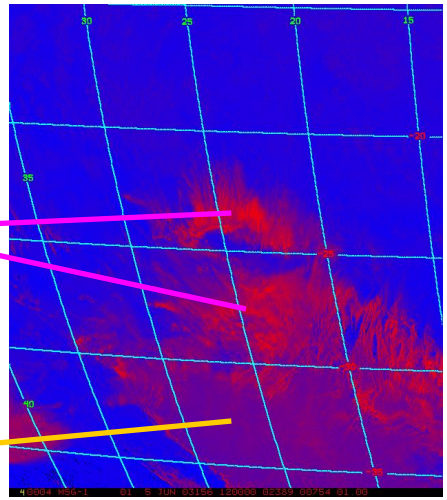
Ice and water clouds in the Southern Atlantic as seen by the IR8.7, IR10.8 and IR12.0 channels.
MSG-1, 5 June 2003, 12:00 UTC



Ch. 0.6, 5 June 2003, 12:00 UTC

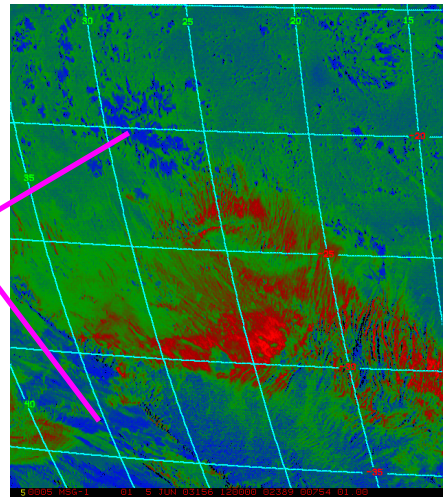
Thin Cirrus

Thick ice clouds



Infrared Temperature Difference - 87 μm - 10.8 μm

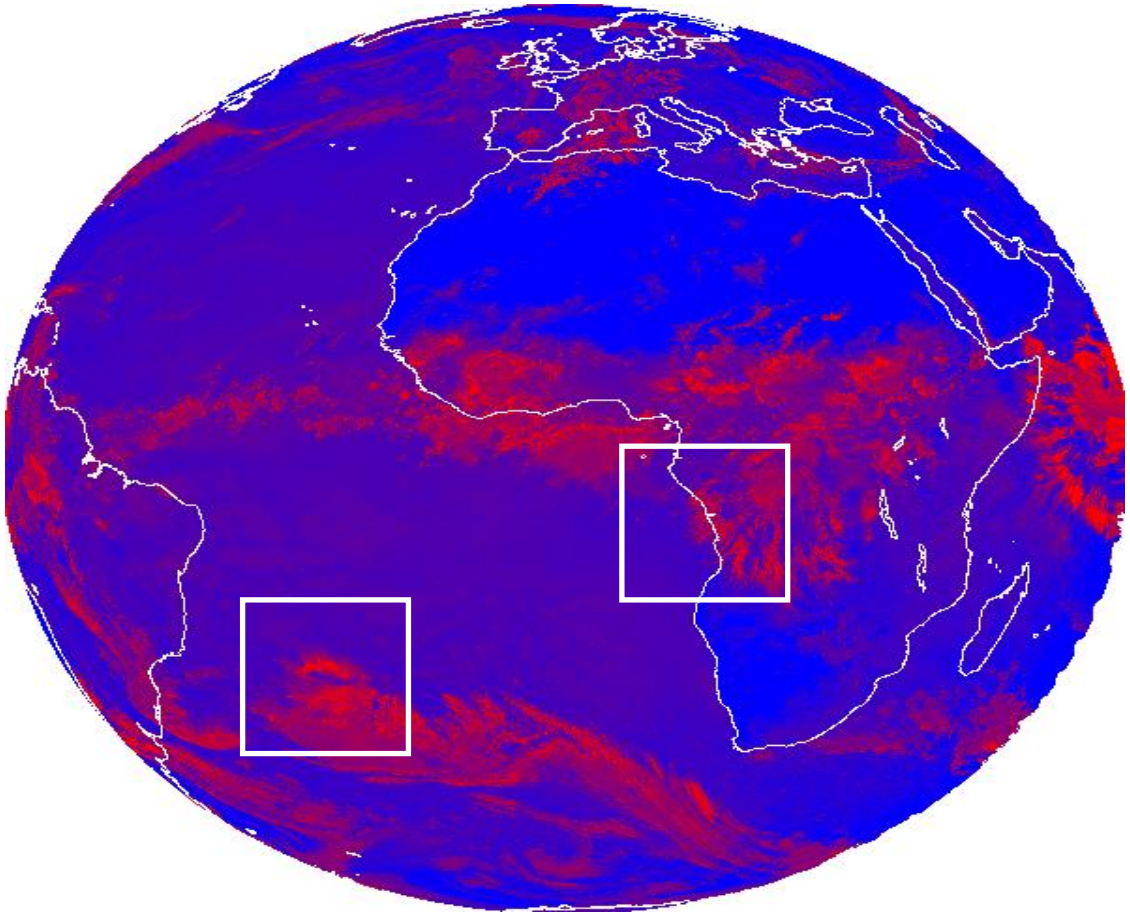
Water Cloud



Infrared Temperature Difference - 10.8 μm - 12.0 μm

MSG image over the Southern Atlantic on 5 June 2003.

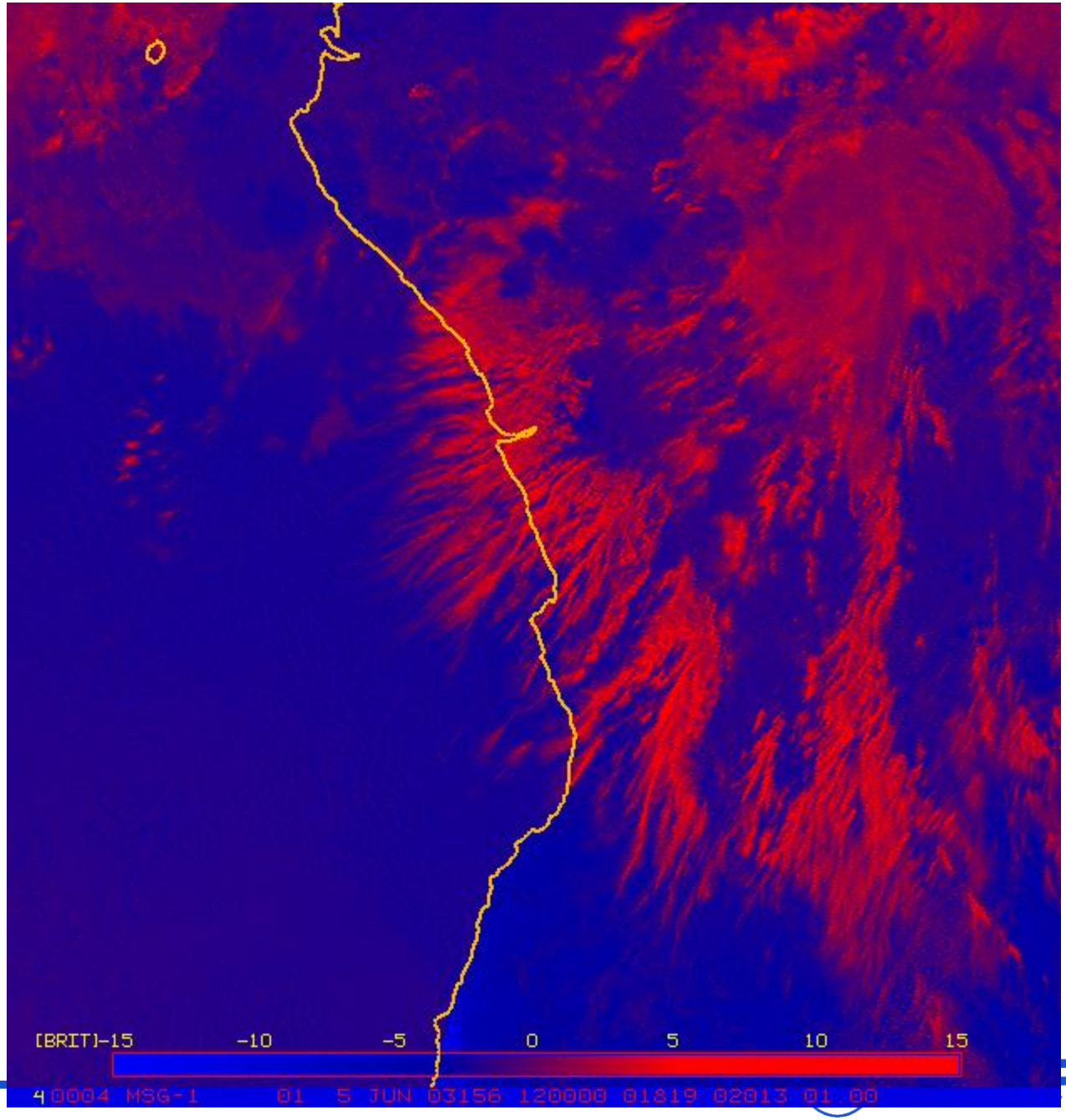
Ice/Water clouds separate in 8.7-10.8 versus 10.8-12.0 μm BT plots.



5 Jun 2003, 12:00, IR8.7 - IR10.8

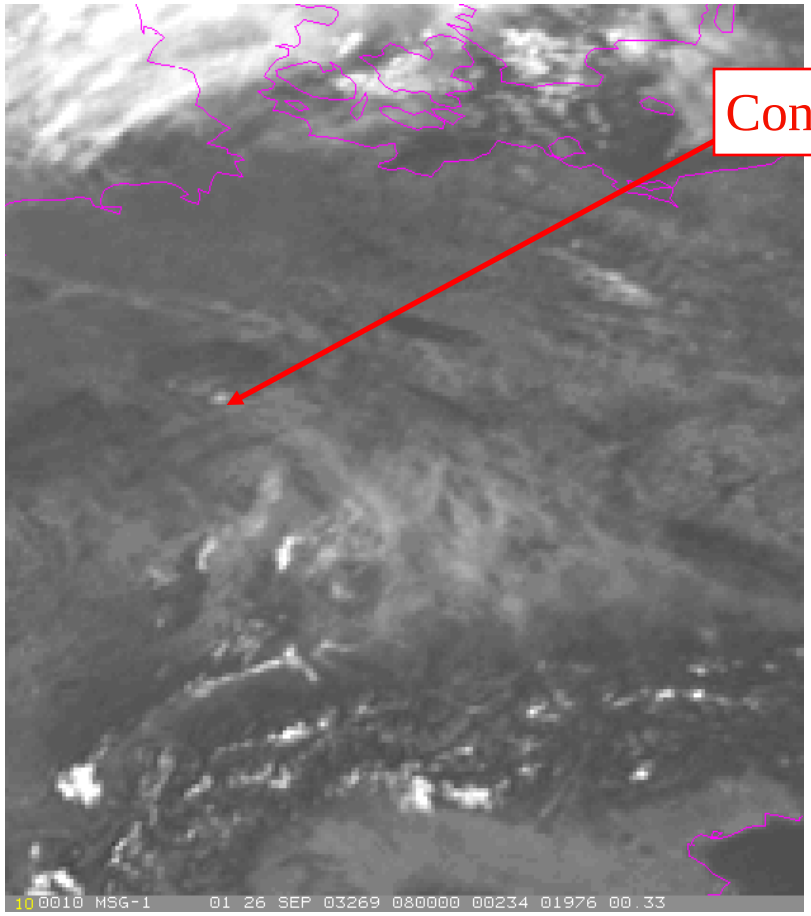
Ice cloud detection using the 8.7 μm channel: areas of ice clouds (in particular thin cirrus) are red (positive difference), clear ground and water clouds show up as blue shades (negative difference).

Difference
I07 - I09
Angola

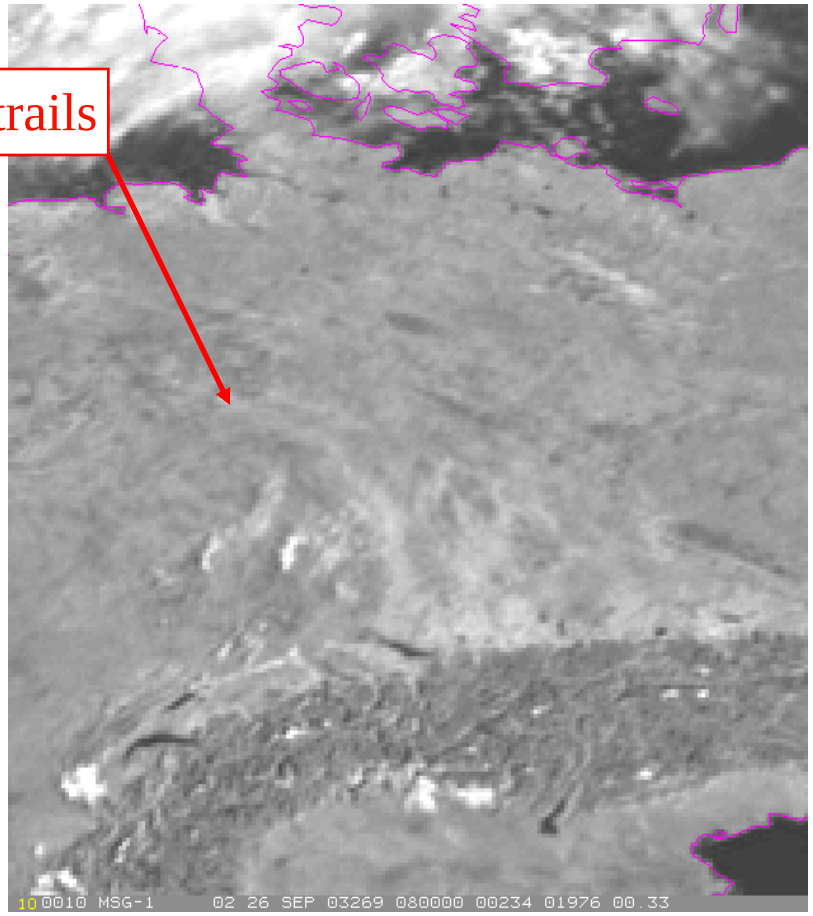


Detection of Contrails

Contrails over Southern Germany

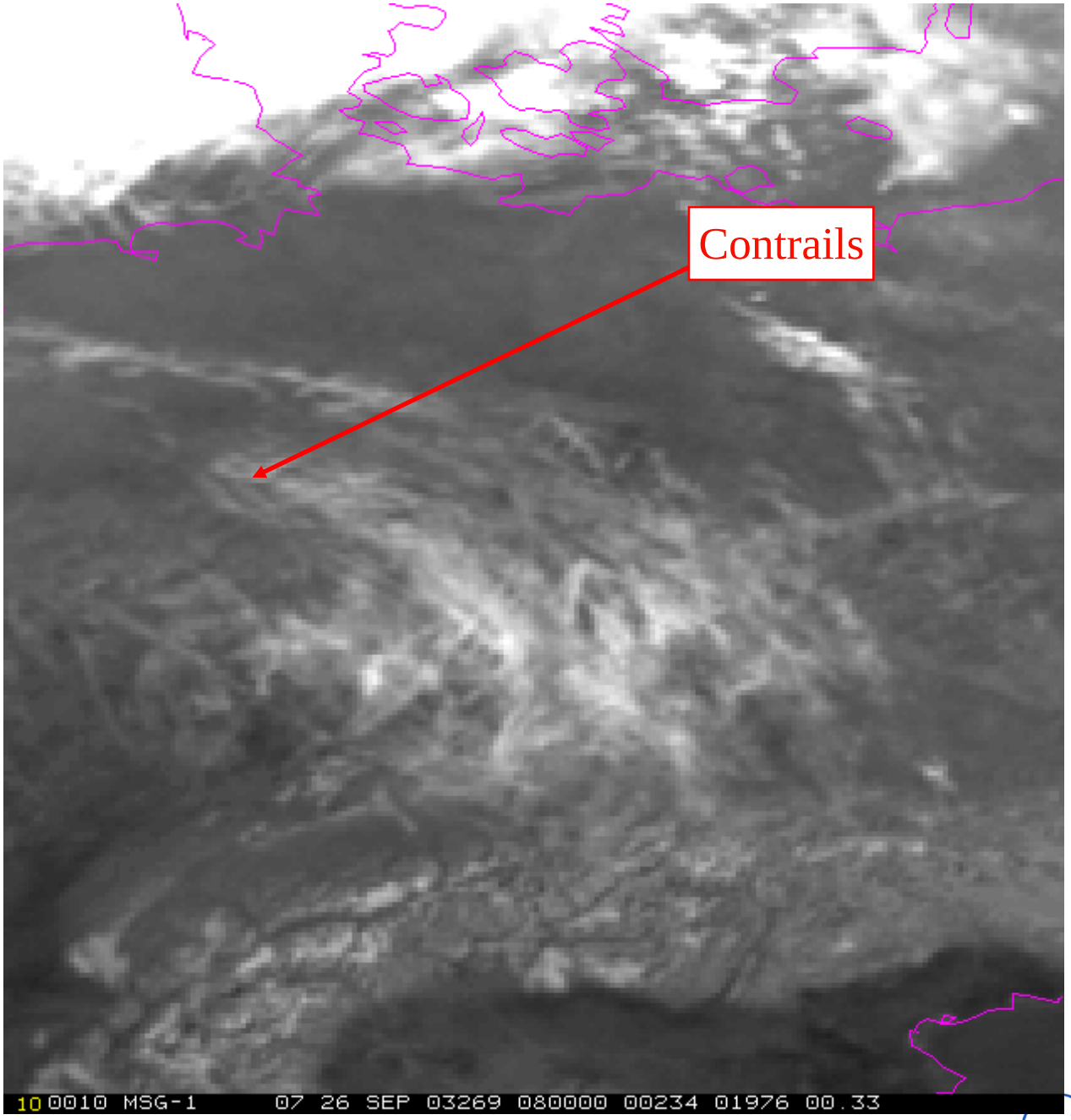


Channel 01 (VIS0.6)



Channel 02 (VIS0.8)

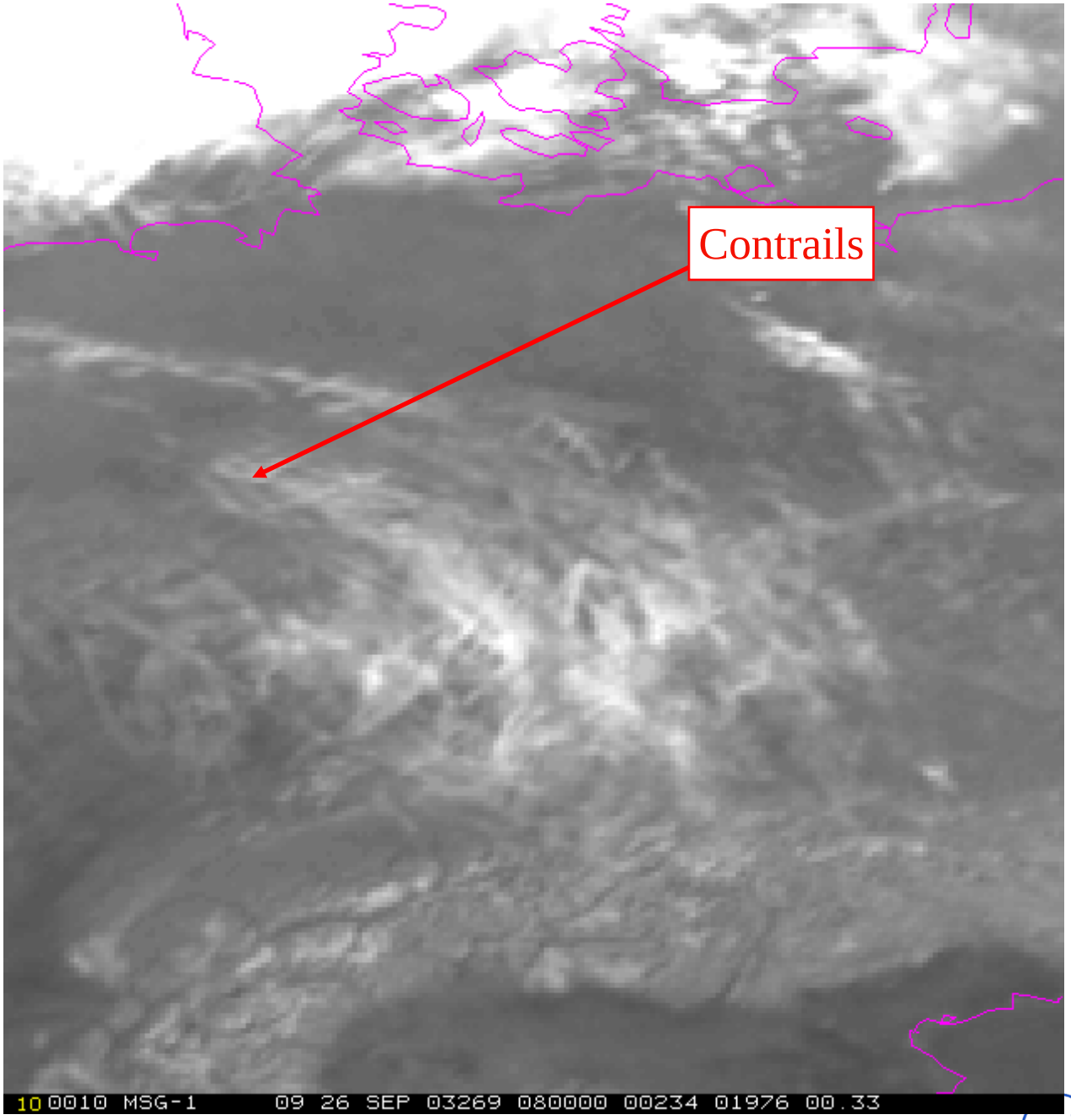
MSG-1, 26 September 2003, 08:00 UTC



Contrails over Southern Germany

MSG-1
26 September 2003,
08:00 UTC

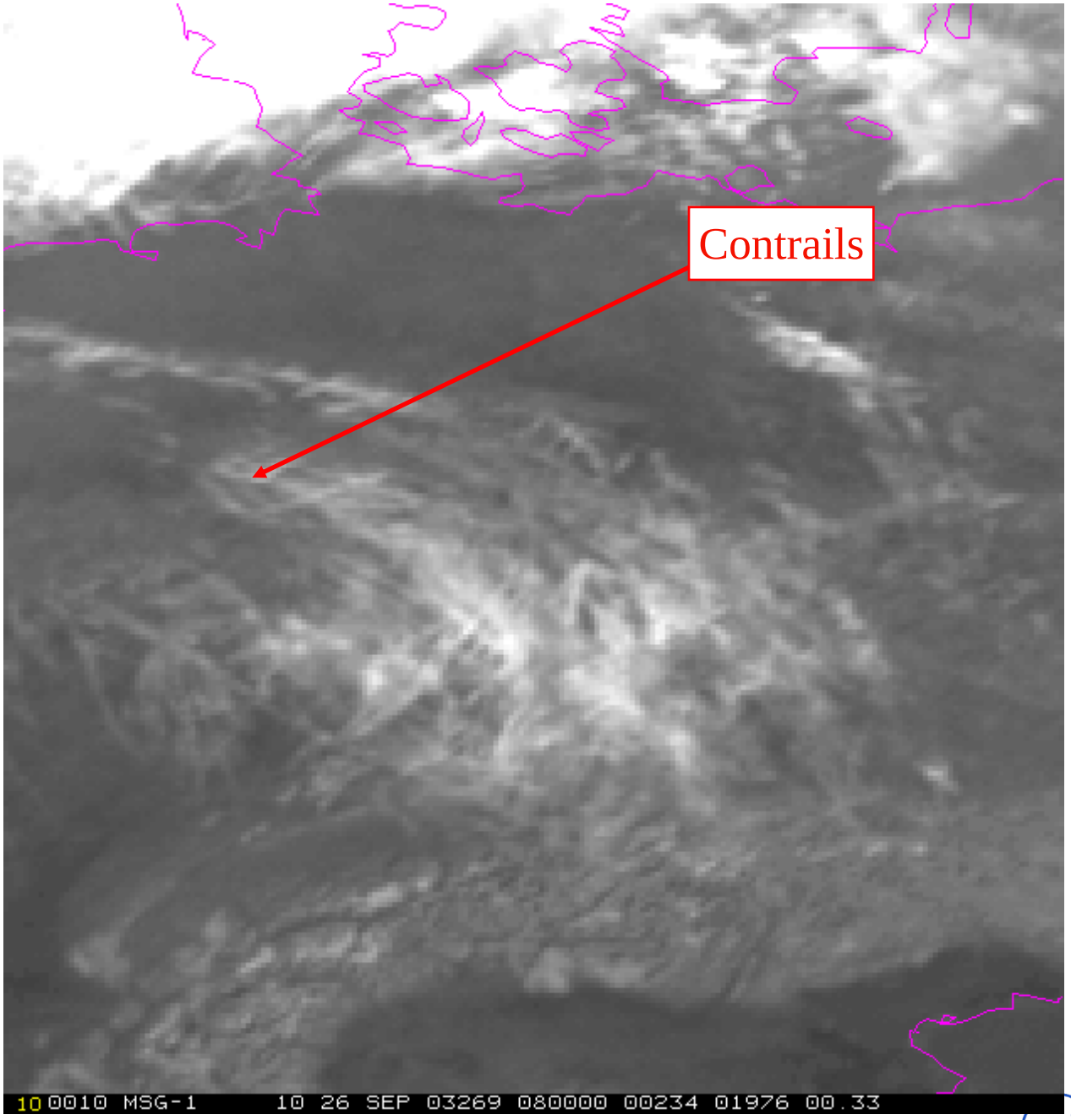
Channel 07 (IR8.7)



Contrails over Southern Germany

MSG-1
26 September 2003,
08:00 UTC

Channel 09 (IR10.8)

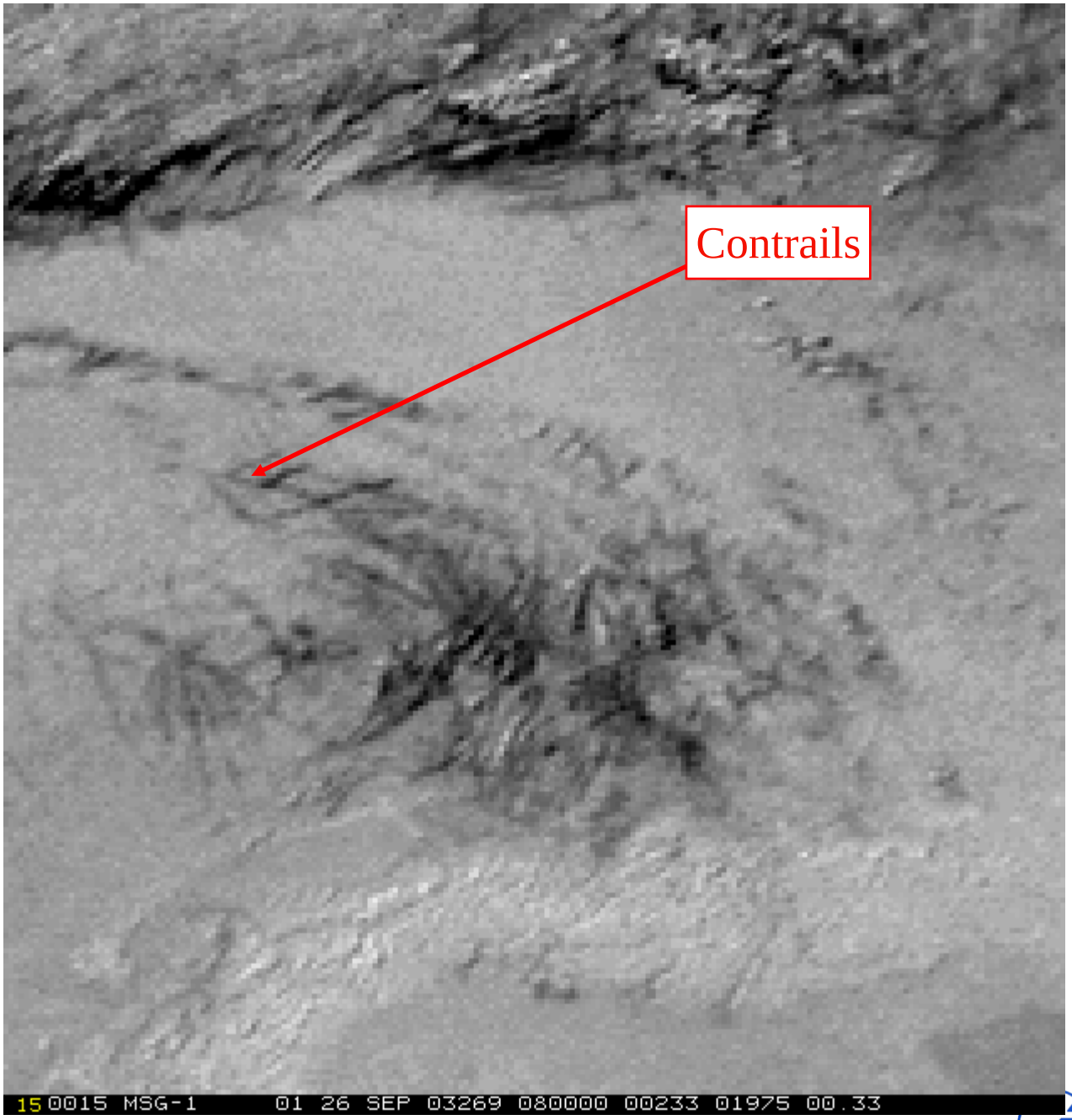


Contrails over Southern Germany

MSG-1
26 September 2003,
08:00 UTC

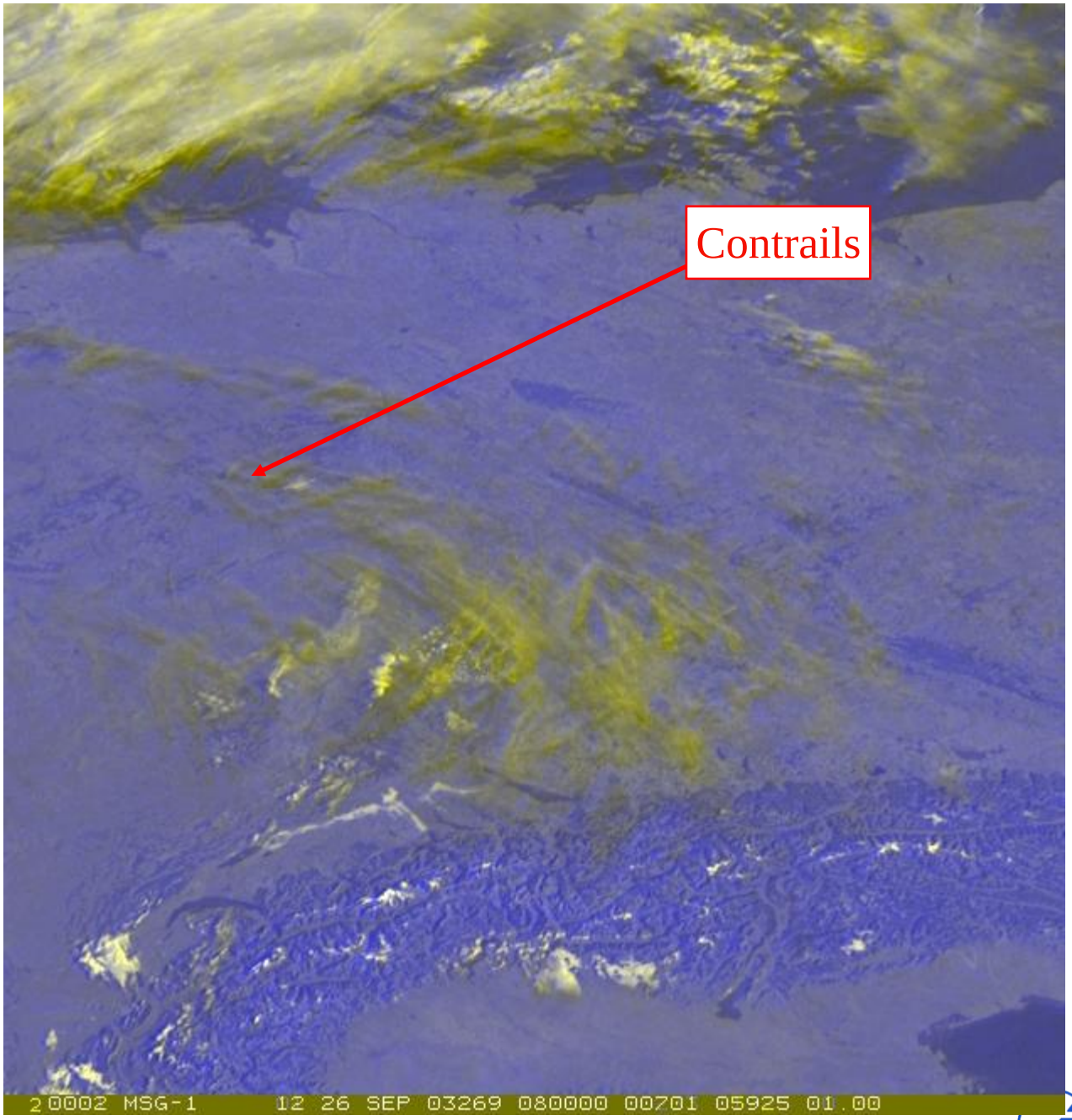
Channel 10 (IR12.0)

Contrails over Southern Germany



MSG-1
26 September 2003,
08:00 UTC
Difference Image
IR12.0 - IR10.8

Contrails over Southern Germany



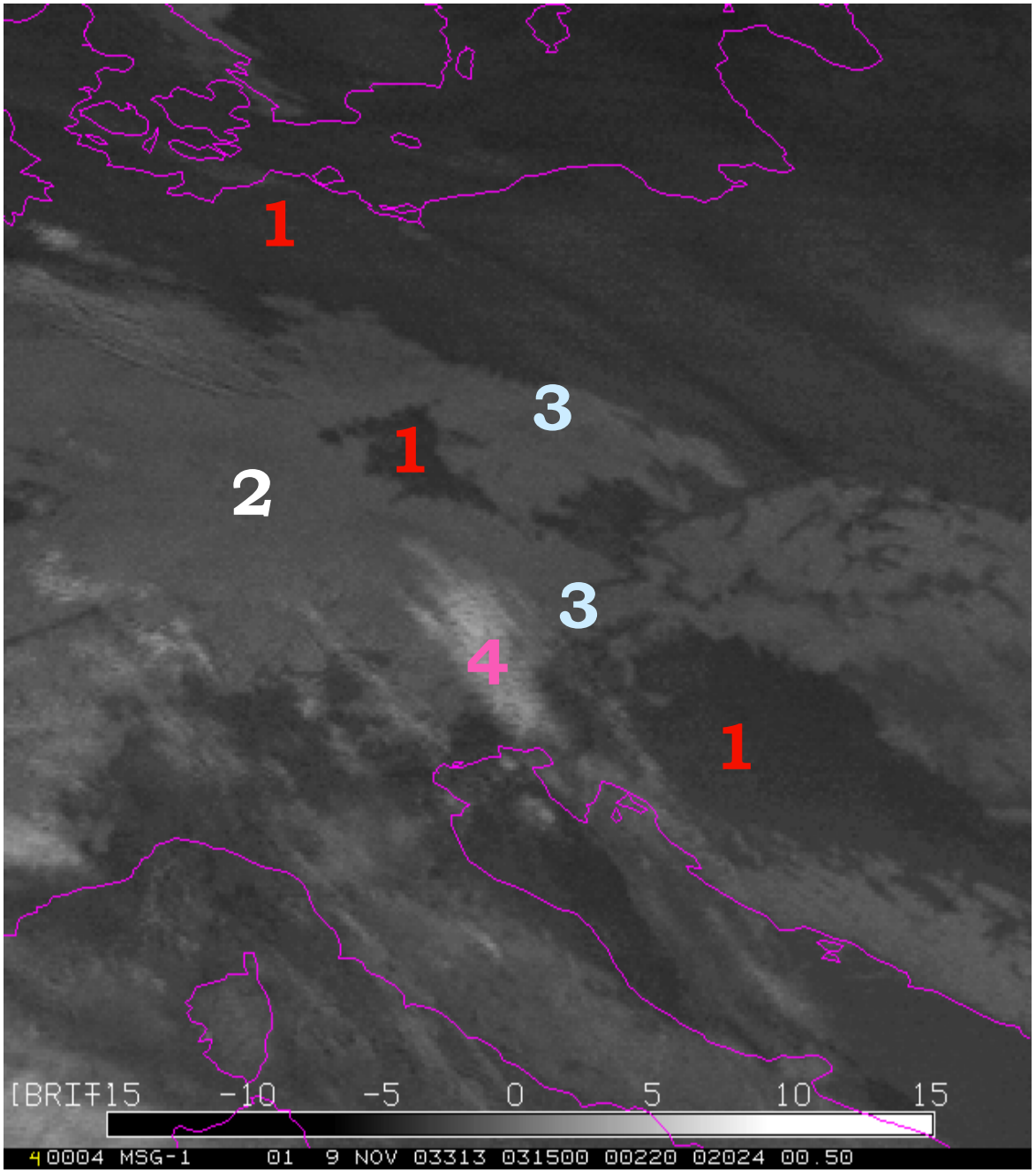
MSG-1
26 September 2003,
08:00 UTC
RGB Composite
12,12,10-09

Detection of Fog/Low Stratus

Detection of Fog/Low Stratus at Dawn/Dusk

In operational applications, the difference IR8.7-IR10.8 may be the best to detect fog/low stratus (day- and night), because of:

- **Less noisy than the difference IR3.9 - IR10.8 (works well also over Scandinavia)**
- **24-hour capability with "constant" colour for fog/low stratus (unlike IR3.9-IR10.8 difference)**
- **High-level Cirrus above fog/low stratus can also be detected (combined with IR12.0-IR10.8 difference)**



Fog at night also visible in difference IR8.7 - IR10.8

Fog: -3/-4 K (black)
Ground: -1/-2 K (grey)

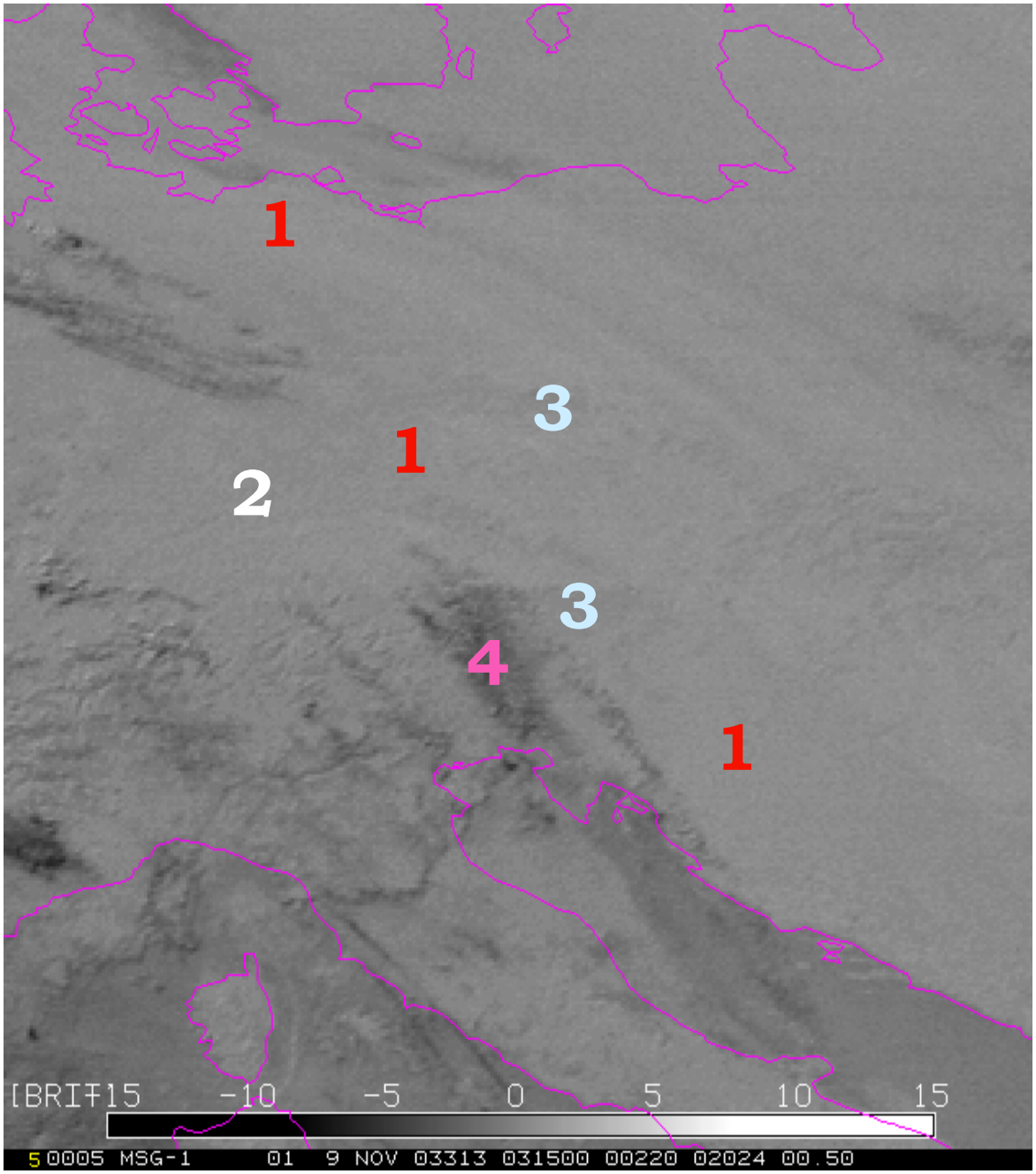
1= low-level fog or stratus

2= cold clear ground

3 = warm clear ground (mountains)

4 = thin, high-level clouds

MSG-1
09 November 2003
03:15 UTC
Difference Image
IR8.7 - IR10.8



Fog at night <u>not</u> <u>visible</u> in difference IR12.0 - IR10.8

Fog: 0/+1 K
Ground: 0/+1 K
Ocean: -1 K

1= low-level fog or stratus

2= cold clear ground

3 = warm clear ground (mountains)

4 = thin, high-level clouds

MSG-1
09 November 2003
03:15 UTC
Difference Image
IR12.0 - IR10.8