APPLICATIONS OF METEOSAT SECOND GENERATION (MSG)

METEOROLOGICAL USE OF THE SEVIRI IR3.9 CHANNEL

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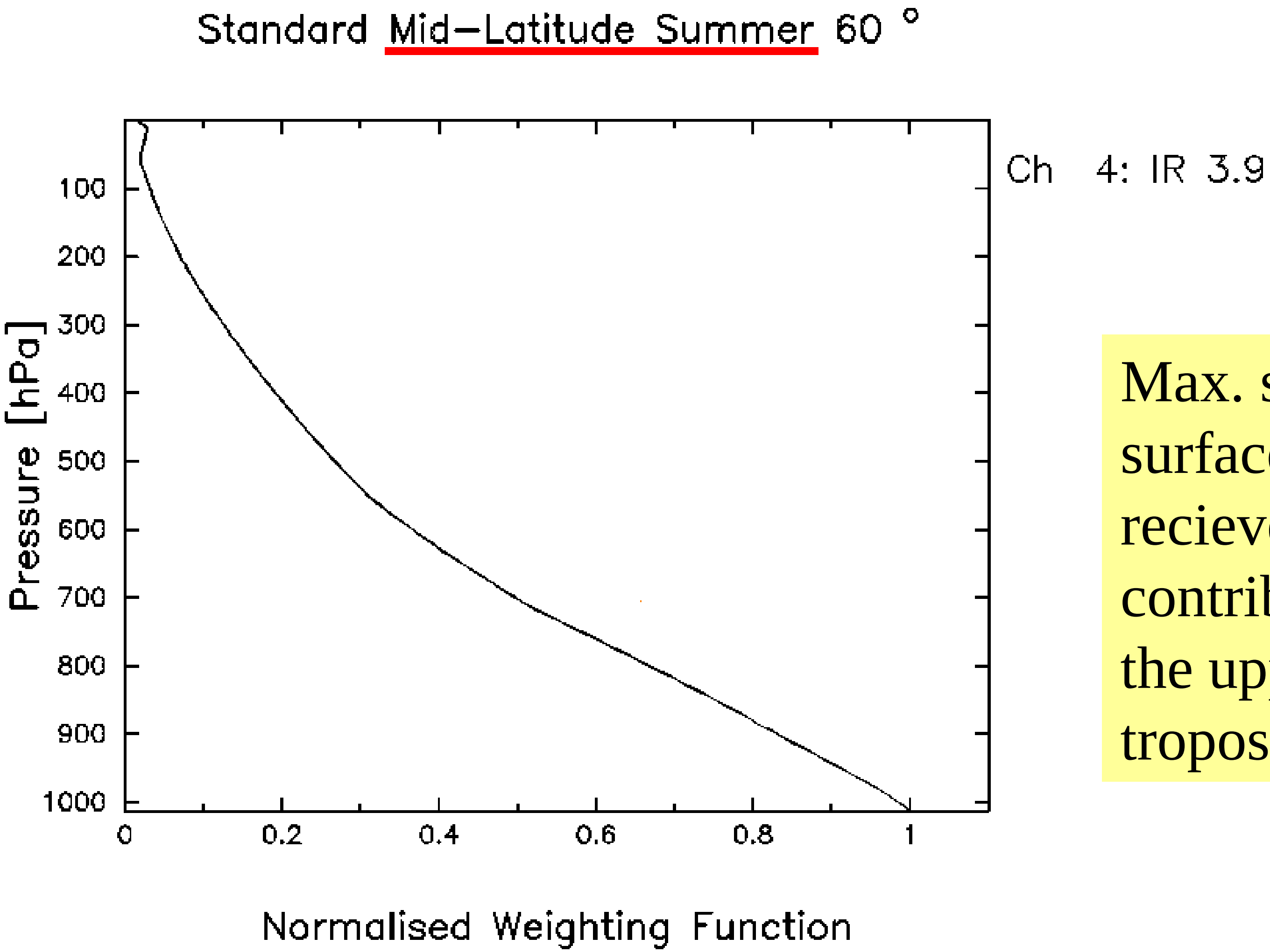
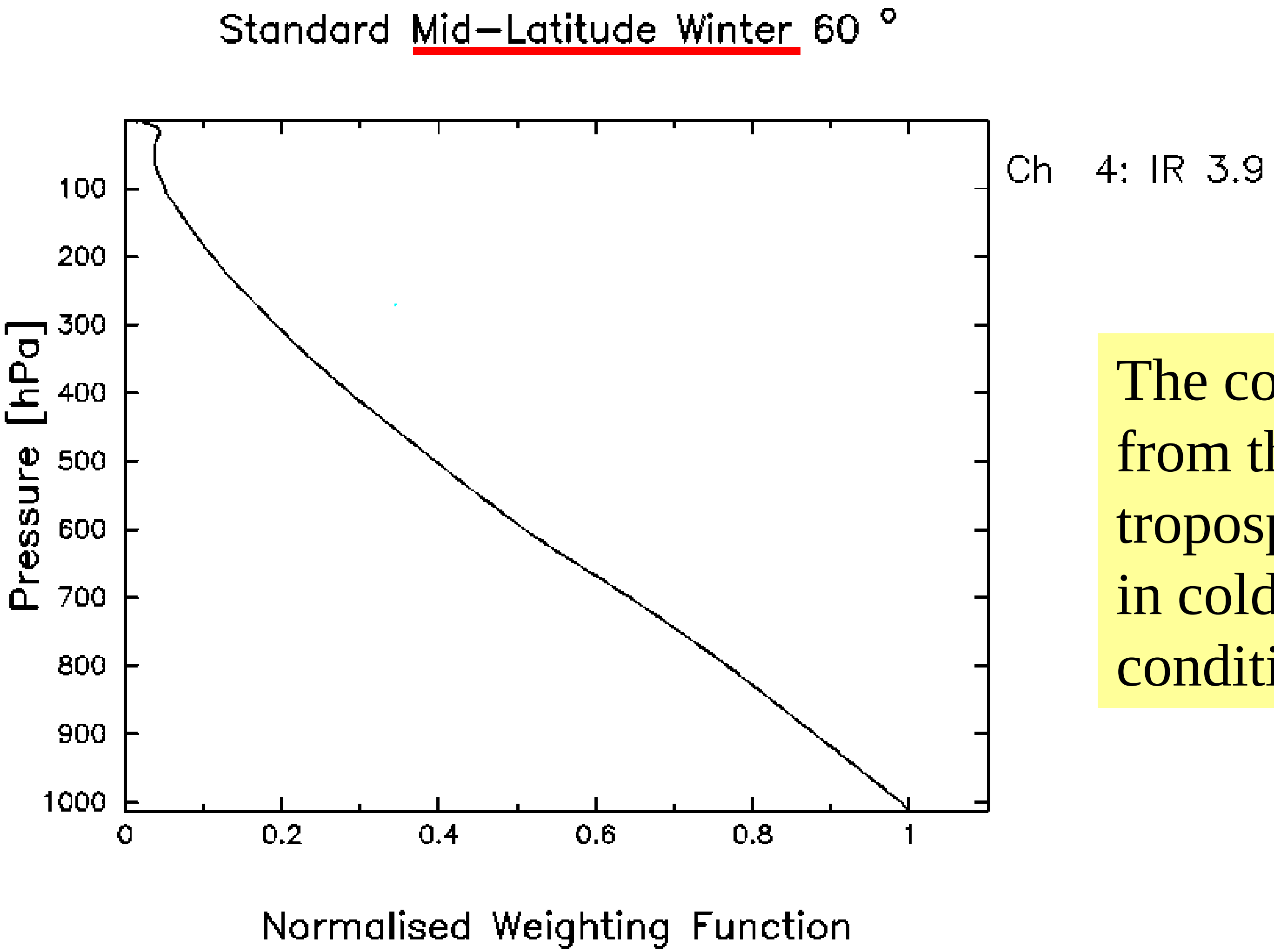
IR3.9: WEIGHTING FUNCTIONS

IR3.9 Weighting Function



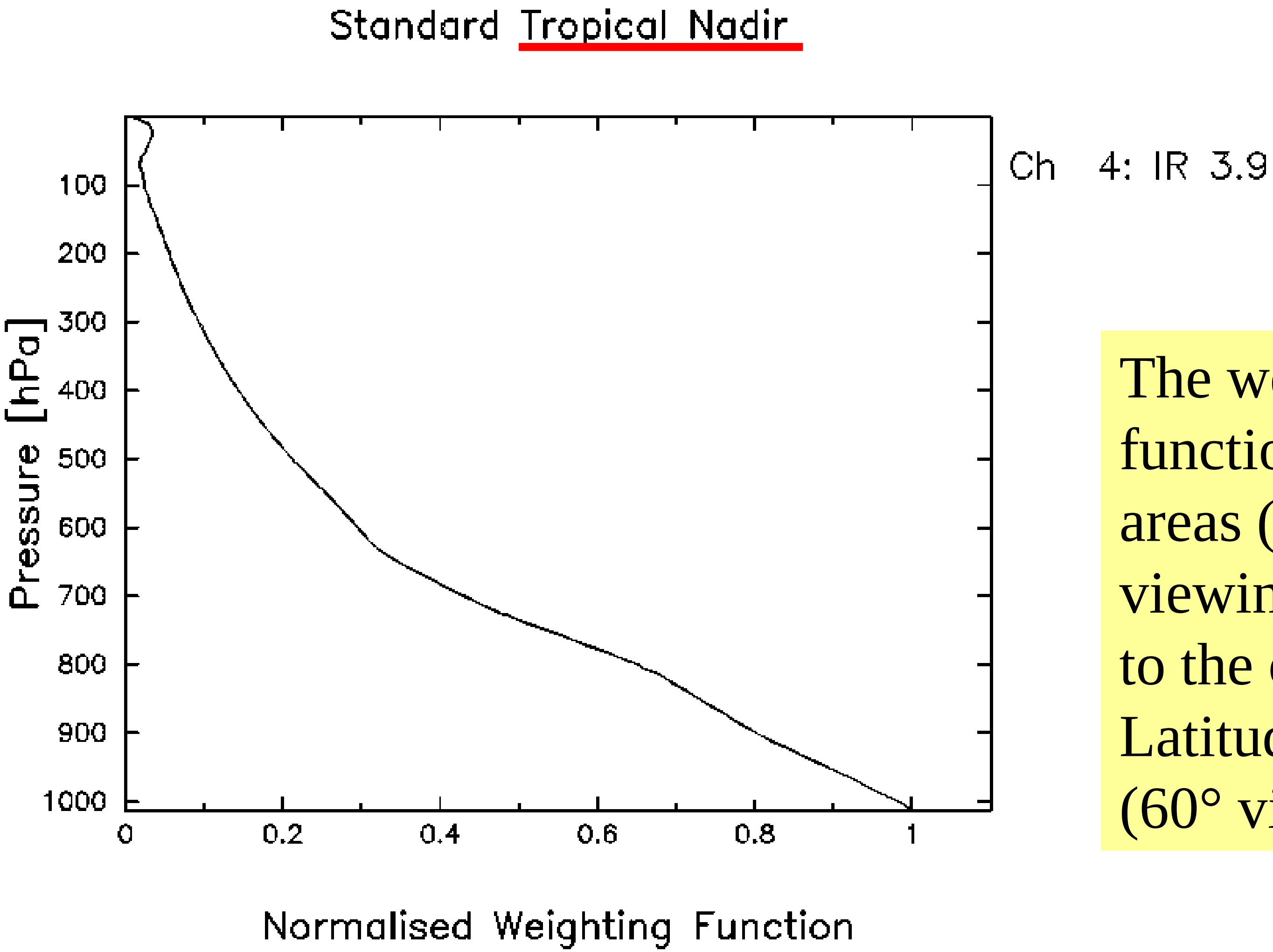
Max. signal from the surface, but IR3.9 recieves substantial contribution from the upper troposphere

IR3.9 Weighting Function



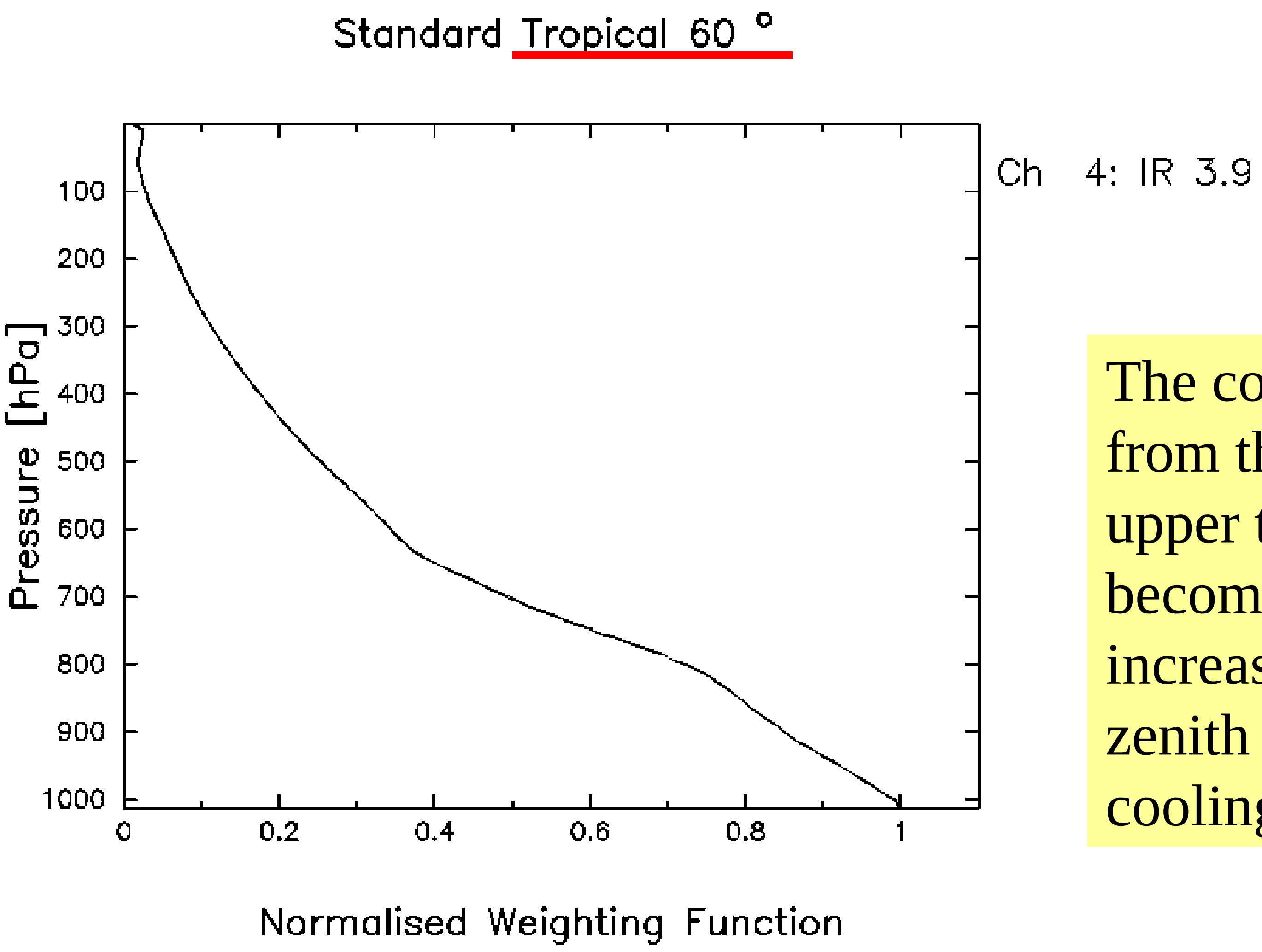
The contribution from the upper troposphere is larger in cold, winter conditions

IR3.9 Weighting Function



The weighting function for tropical areas (Nadir viewing) is similar to the one for Mid Latitudes Summer (60° viewing)

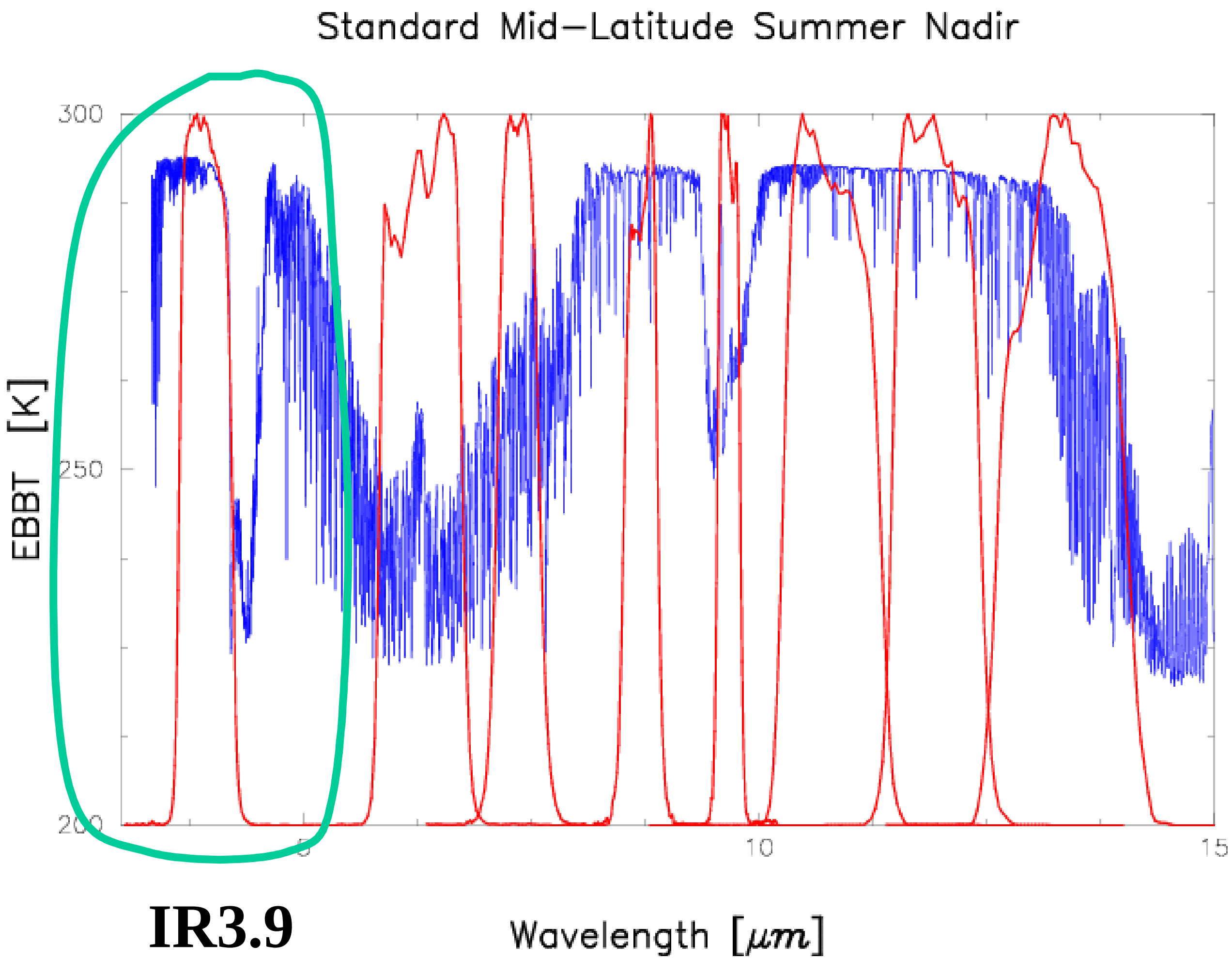
IR3.9 Weighting Function



The contributions from the mid and upper troposphere become larger with increasing satellite zenith angle ("limb cooling")

IR3.9: CO_2 ABSORPTION

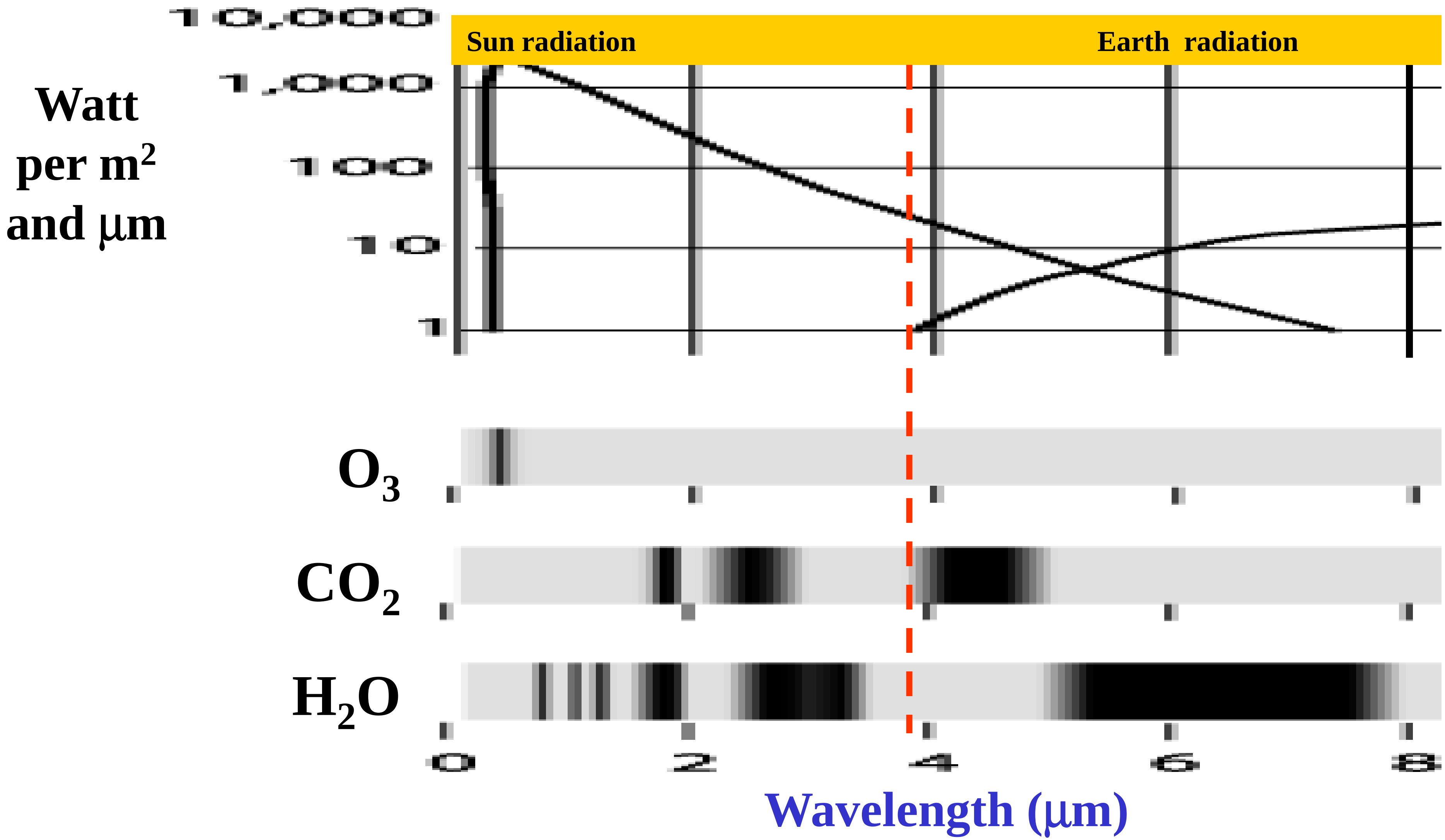
Energy spectrum



IR3.9

The IR3.9 channel is a window channel but close to the CO_2 absorption band at 4-5 microns

SEVIRI CHANNELS: IR3.9 μm



CO2 Effect on Brightness Temperature of Channel IR3.9

The "cooling" effect (ΔT_CO2) of the CO2 absorption on channel IR3.9 depends on:

I. Surface temperature and lapse rate in the lower troposphere (ΔT_CO2 is large for hot desert surfaces during daytime)

II. Height of the cloud (ΔT_CO2 is small for high clouds)

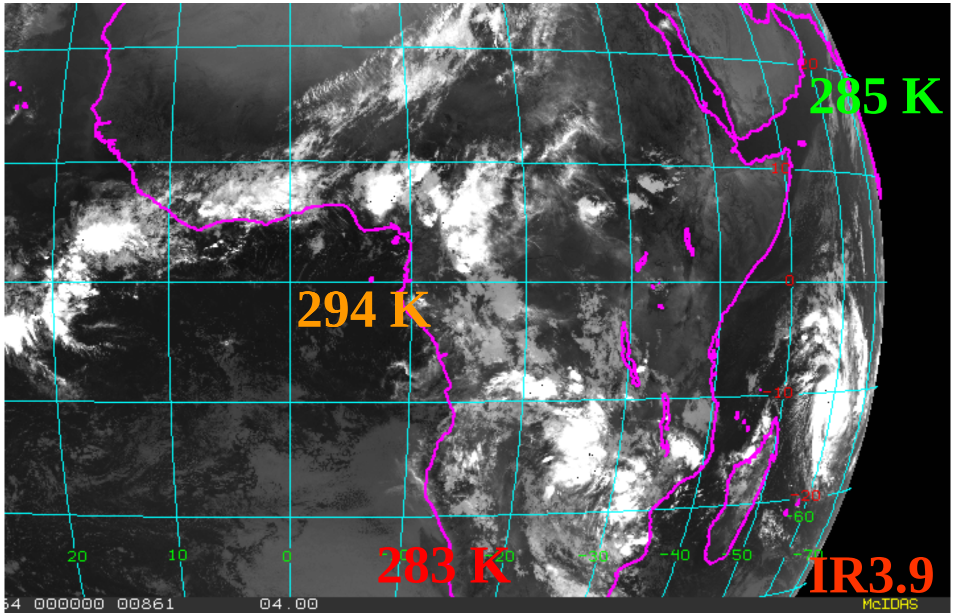
III. Satellite viewing angle (so called "limb cooling" effect, ΔT_CO2 is large for large satellite viewing angles)

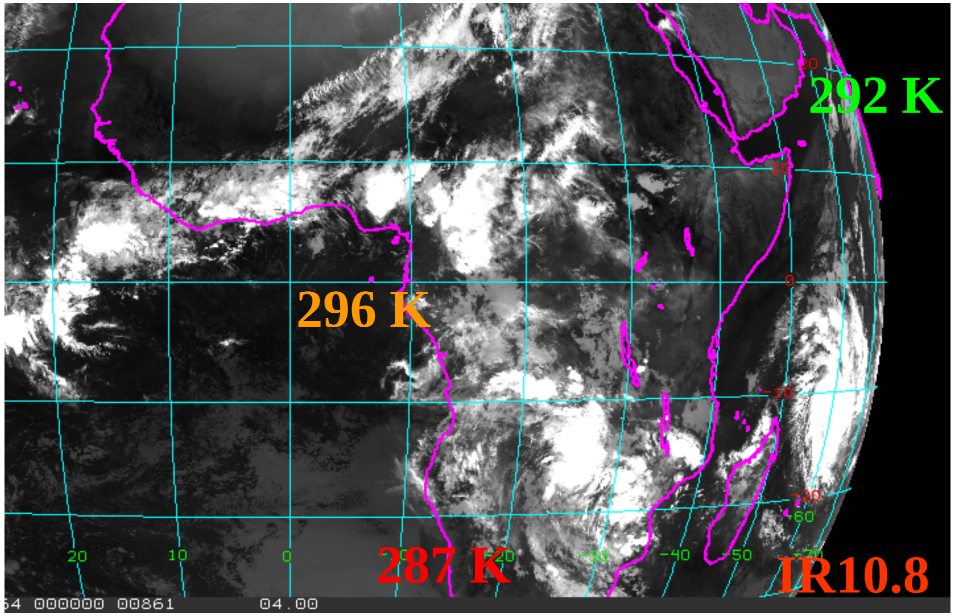
MSG-1, 04 March 2004, 00:00 UTC Brightness Temperatures Differences (BTD) for Cloud-free Ocean Targets

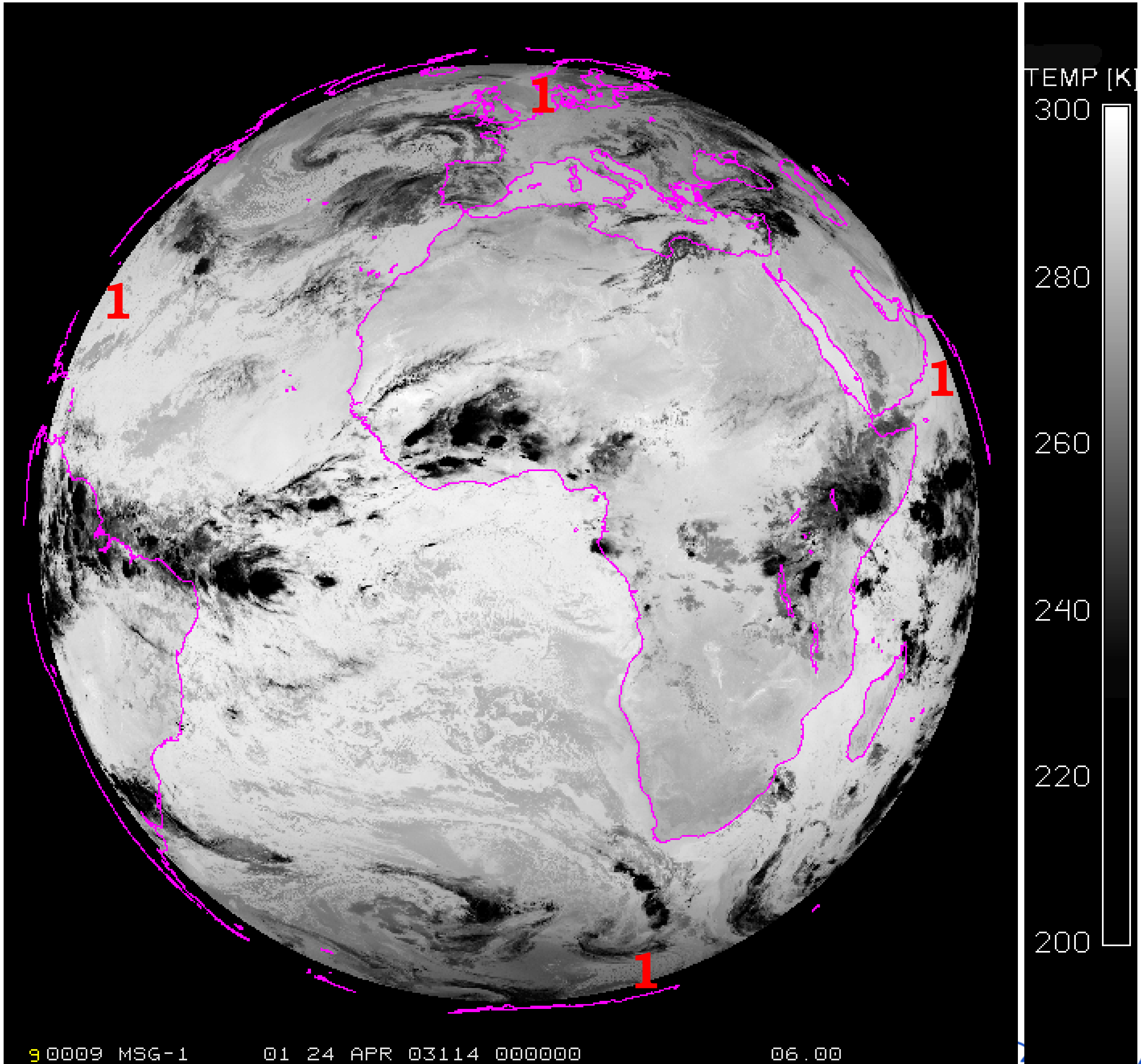
Tropical, moist atmosphere,
Small sat. viewing angle:
IR3.9 - IR10.8 = -2K

Sub-tropical, dry atmosphere,
Medium sat. viewing angle:
IR3.9 - IR10.8 = -4 K

Sub-tropical, dry atmosphere,
Large sat. viewing angle:
IR3.9 - IR10.8 = -7 K



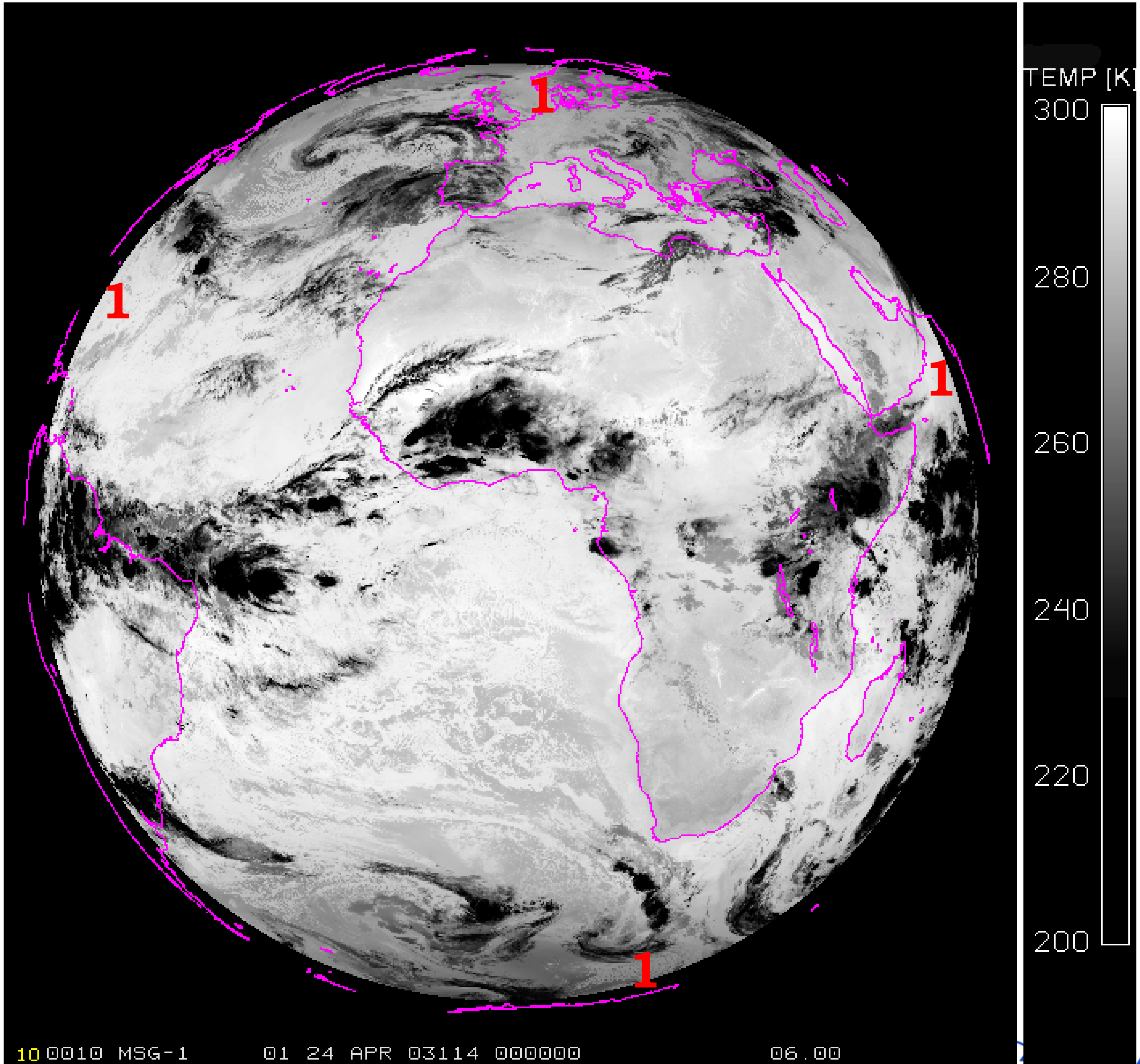




1 = Limb cooling in the IR3.9 channel; little cooling at western limb because of sat. position at 10°W.

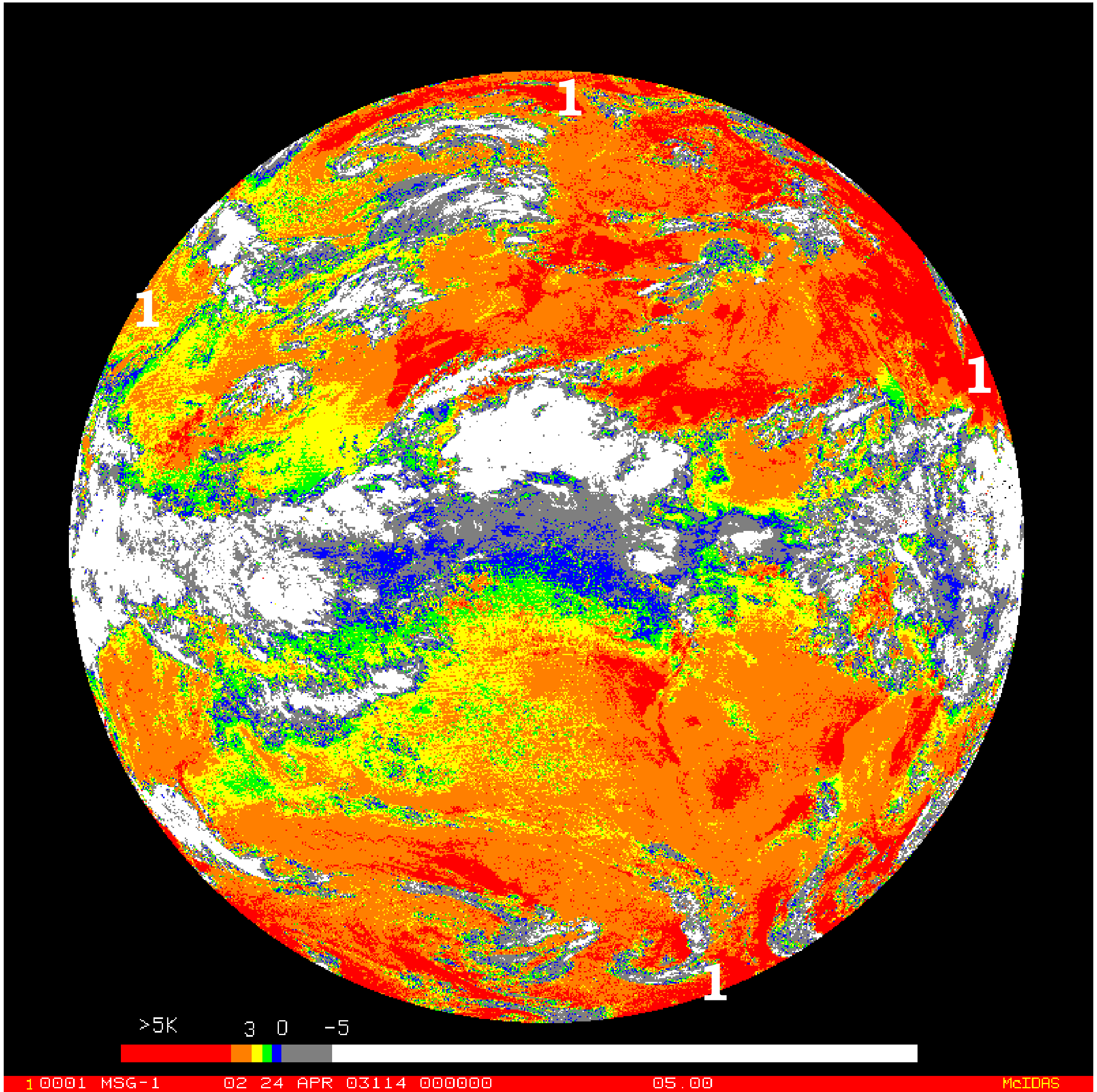
Toggle this and the next slide !

MSG-1
24 April 2003
00:00 UTC
Channel 04
IR3.9



1 = Limb cooling in the IR3.9 channel; little cooling at western limb because of sat. position at 10°W.

MSG-1
24 April 2003
00:00 UTC
Channel 09
(IR10.8)

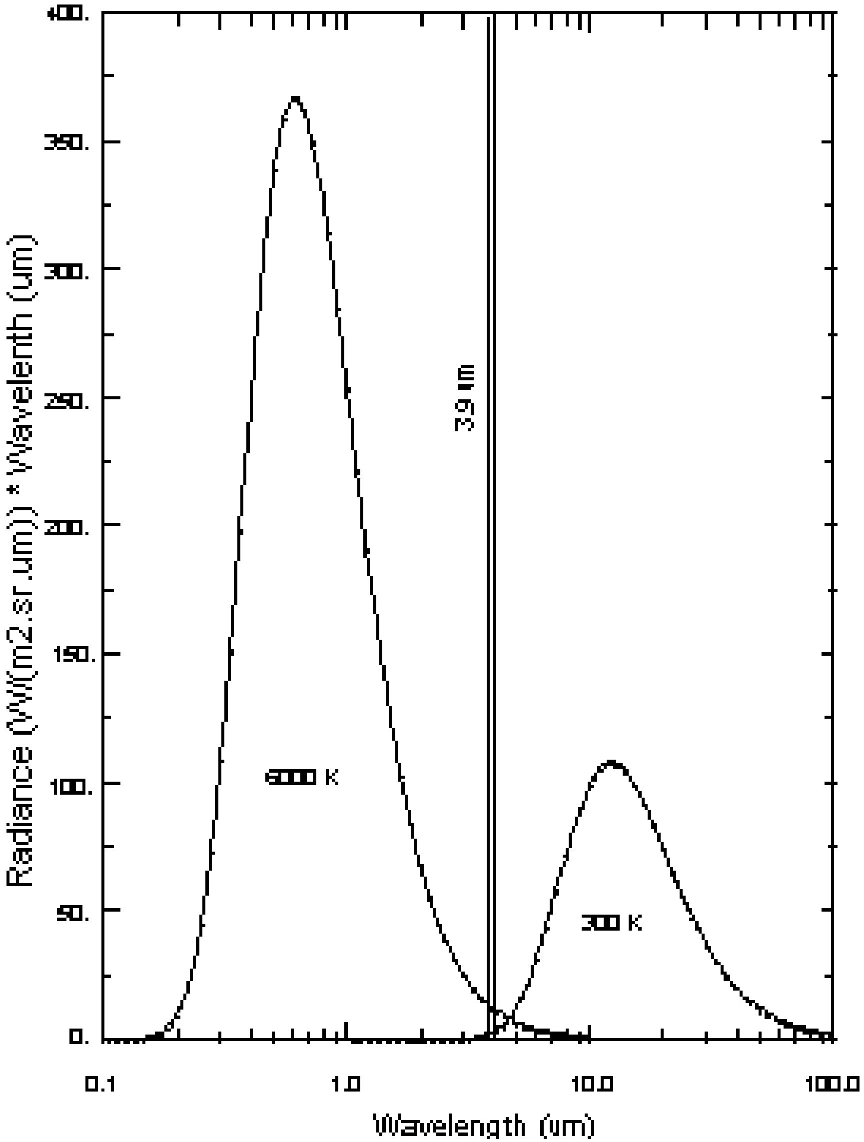


1 = Limb cooling in the IR3.9 channel; little cooling at western limb because of sat. position at 10°W.

Larger differences in cloud-free limb areas (lower IR3.9 brightness temperatures)

MSG-1
24 April 2003
00:00 UTC
Difference Image
IR10.8 - IR3.9

IR3.9: SOLAR AND THERMAL CONTRIBUTION



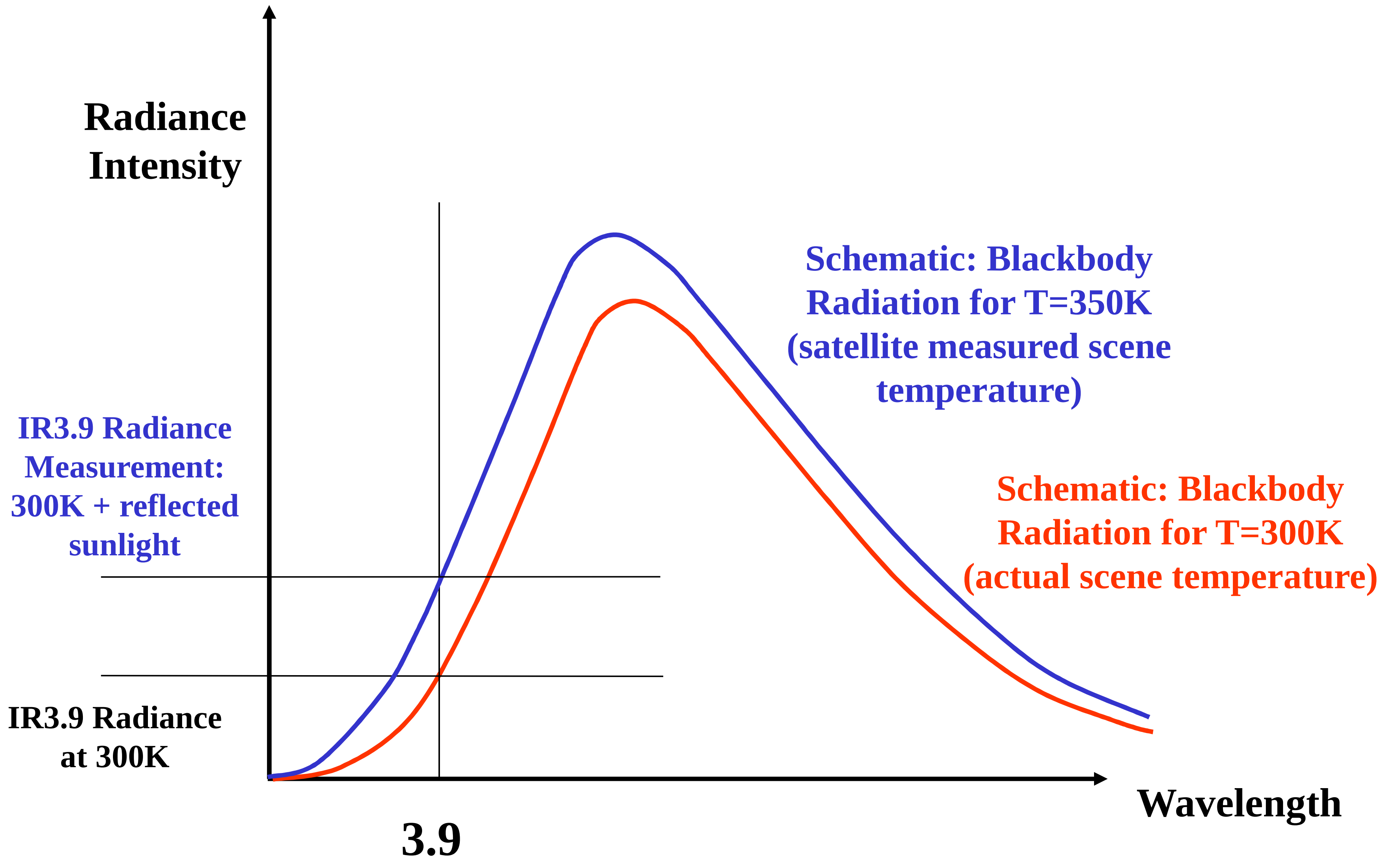
Planck blackbody radiance curves

SEVIRI CHANNELS: IR3.9 µm

Signal in IR3.9 channel comes from reflected solar and emitted thermal radiation !

Consequence for Planck relation between radiance and temperature:

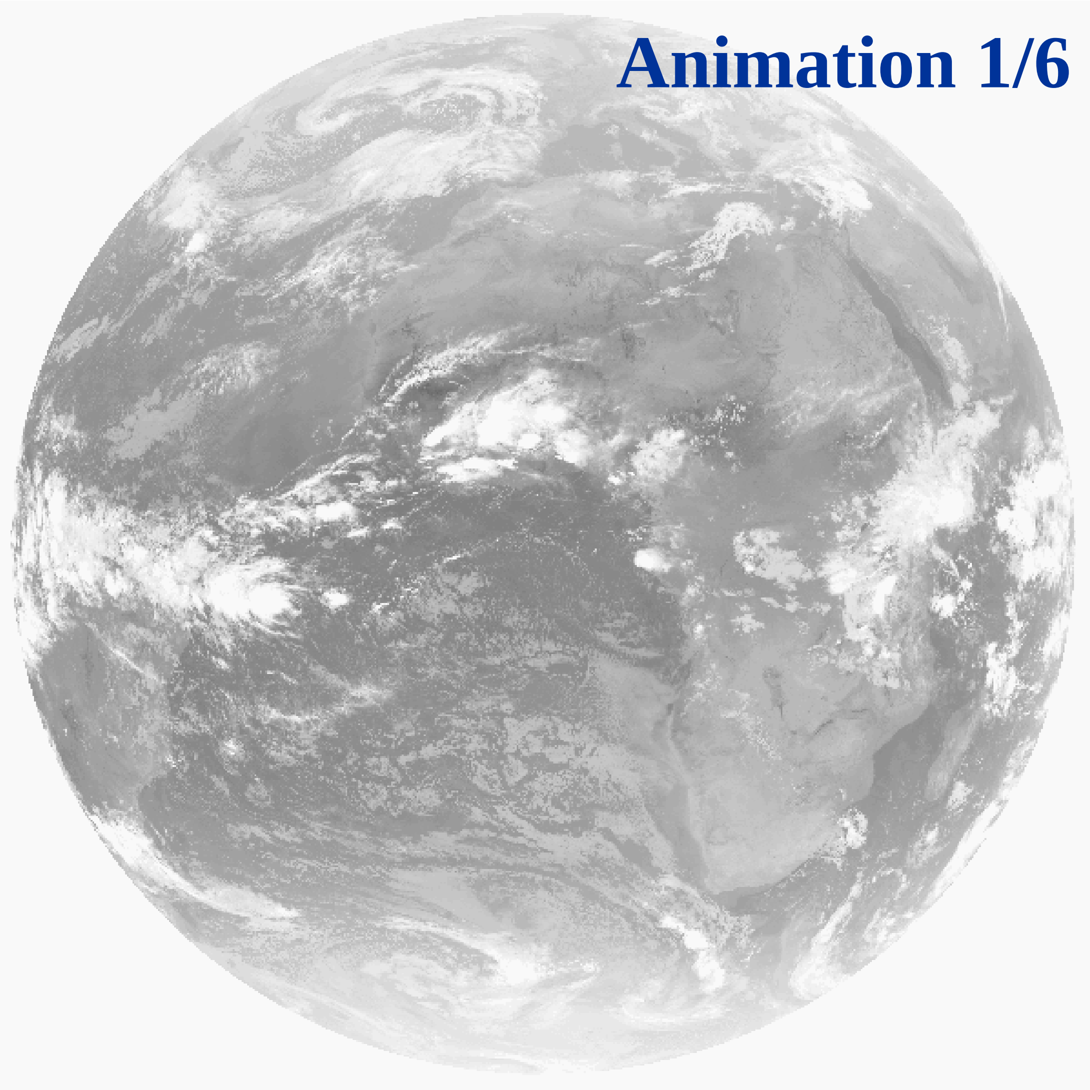
during day-time, temperature is not representative of any in situ temperature (see next slide) !


Radiance
Intensity
Schematic: Blackbody
Radiation for T=350K
(satellite measured scene
temperature)
IR3.9 Radiance
Measurement:
300K + reflected
sunlight
Schematic: Blackbody
Radiation for T=300K
(actual scene temperature)
IR3.9 Radiance
at 300K
Wavelength
3.9

3.9 μm Imagery Presentation

Should IR3.9 be displayed as visible or infrared image ?

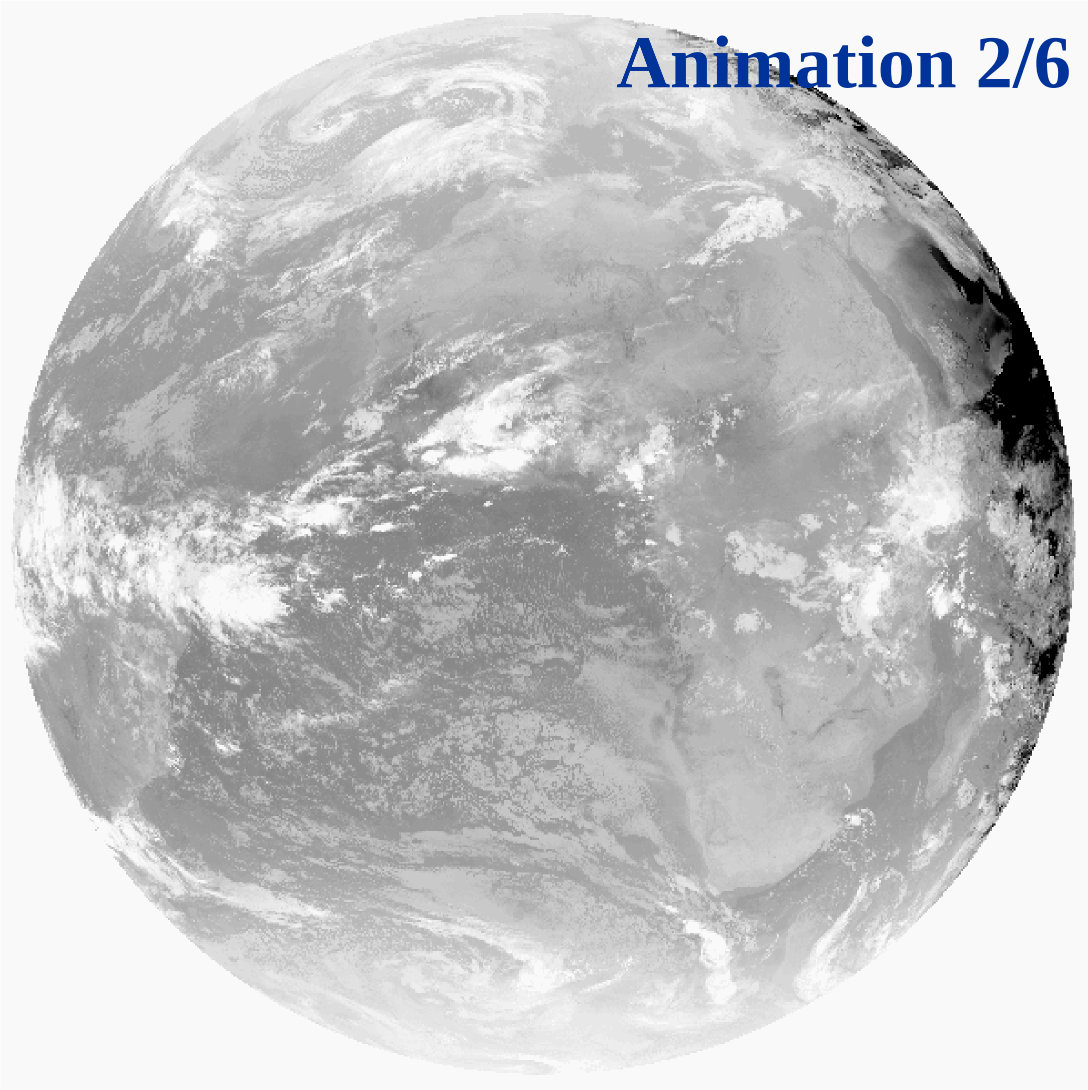
- In the GOES IR3.9 Channel Tutorial, the 3.9 um imagery is presented in terms of energy vs grey scale, i.e. cold clouds appear dark, warm surfaces appear light-to-bright
- In order to better compare with the other IR channels, in this presentation the display as infrared image is preferred, i.e. cold clouds appear bright, warm surfaces appear dark



Solar & Thermal Contributions of Channel 04

During night-time channel 04 has only the emitted thermal contribution

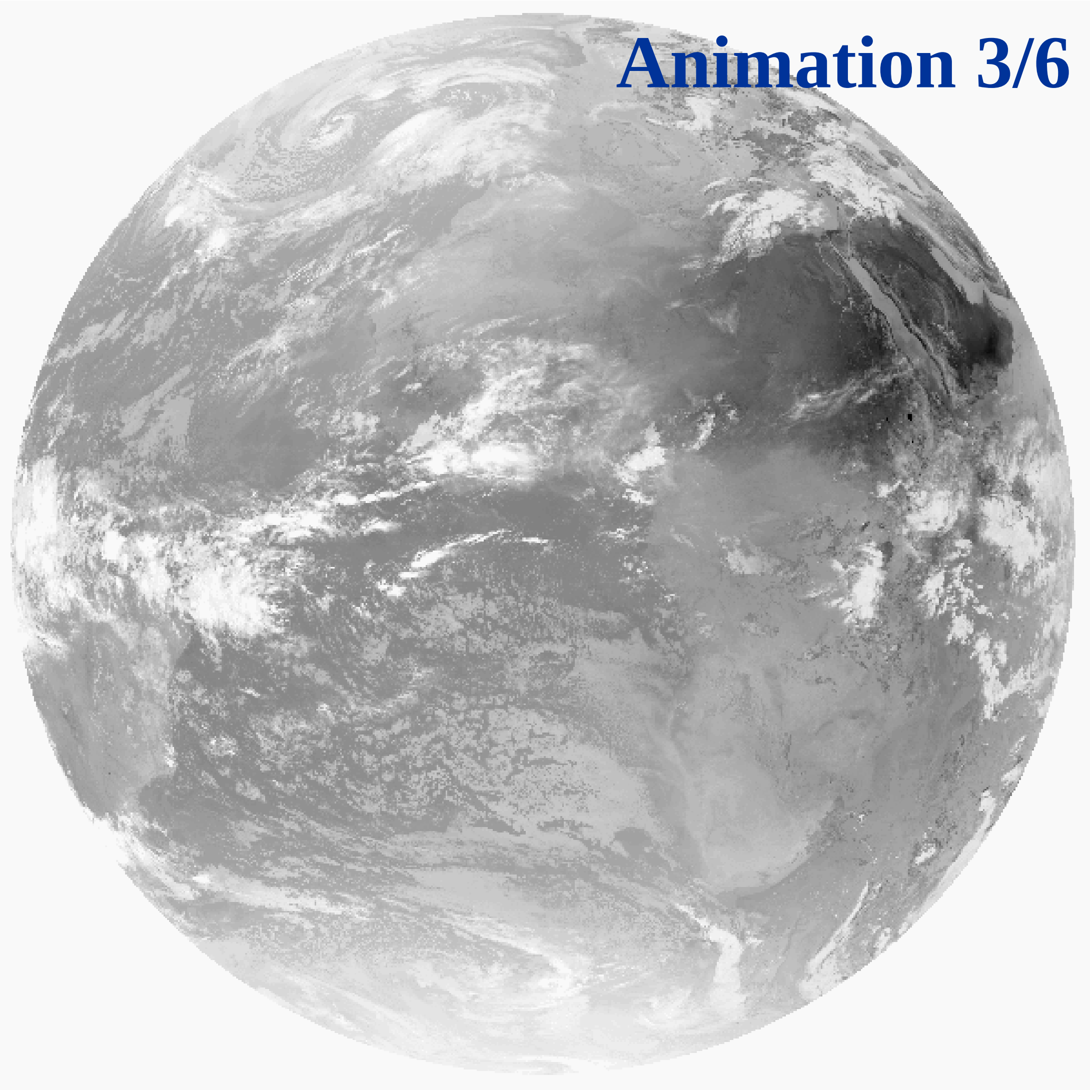
MSG-1, 24 April 2003, 00:00 UTC
Channel 04 (3.9 µm)



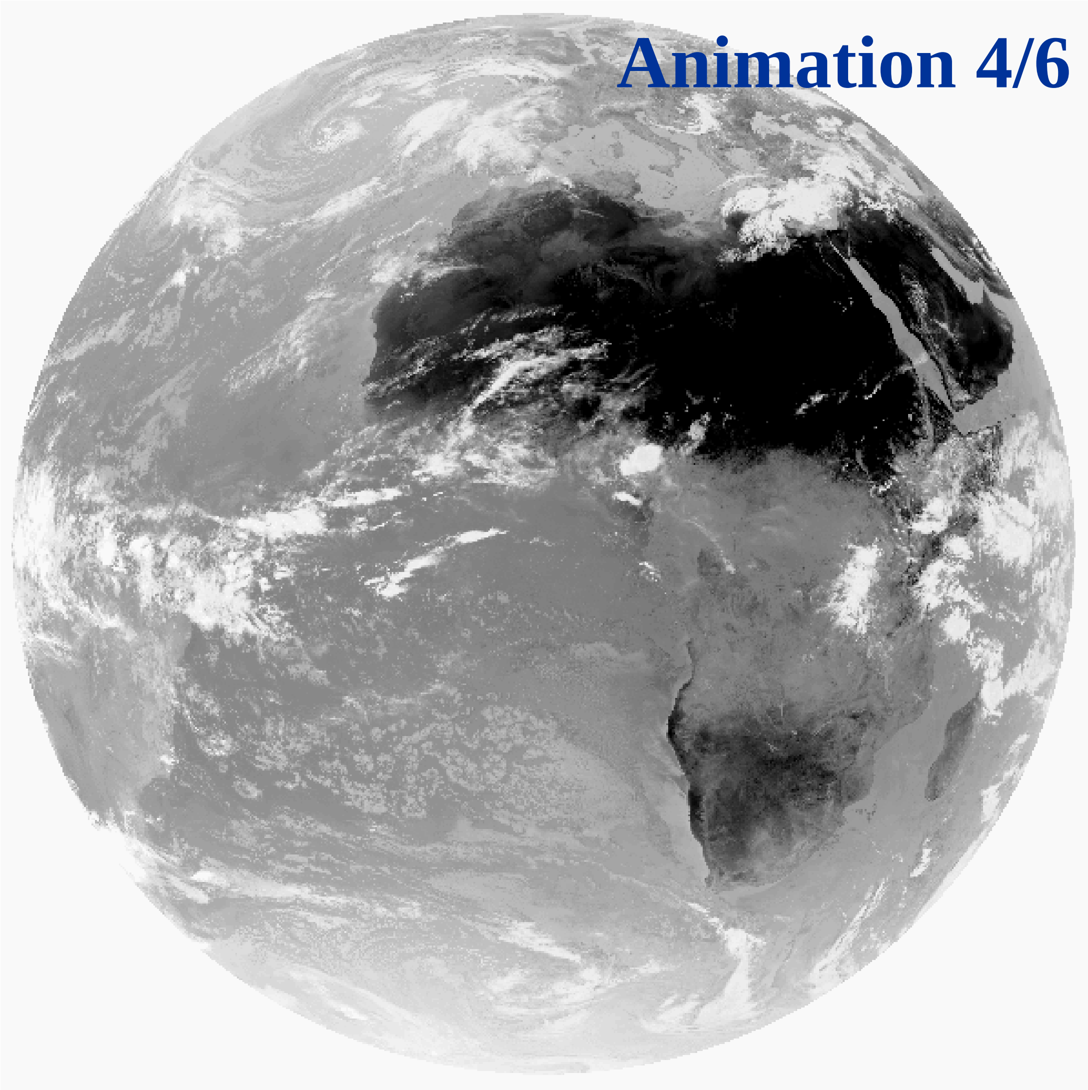
Solar & Thermal Contributions of Channel 04

MSG-1, 24 April 2003, 03:00 UTC
Channel 04 (3.9 µm)

Solar & Thermal Contributions of Channel 04



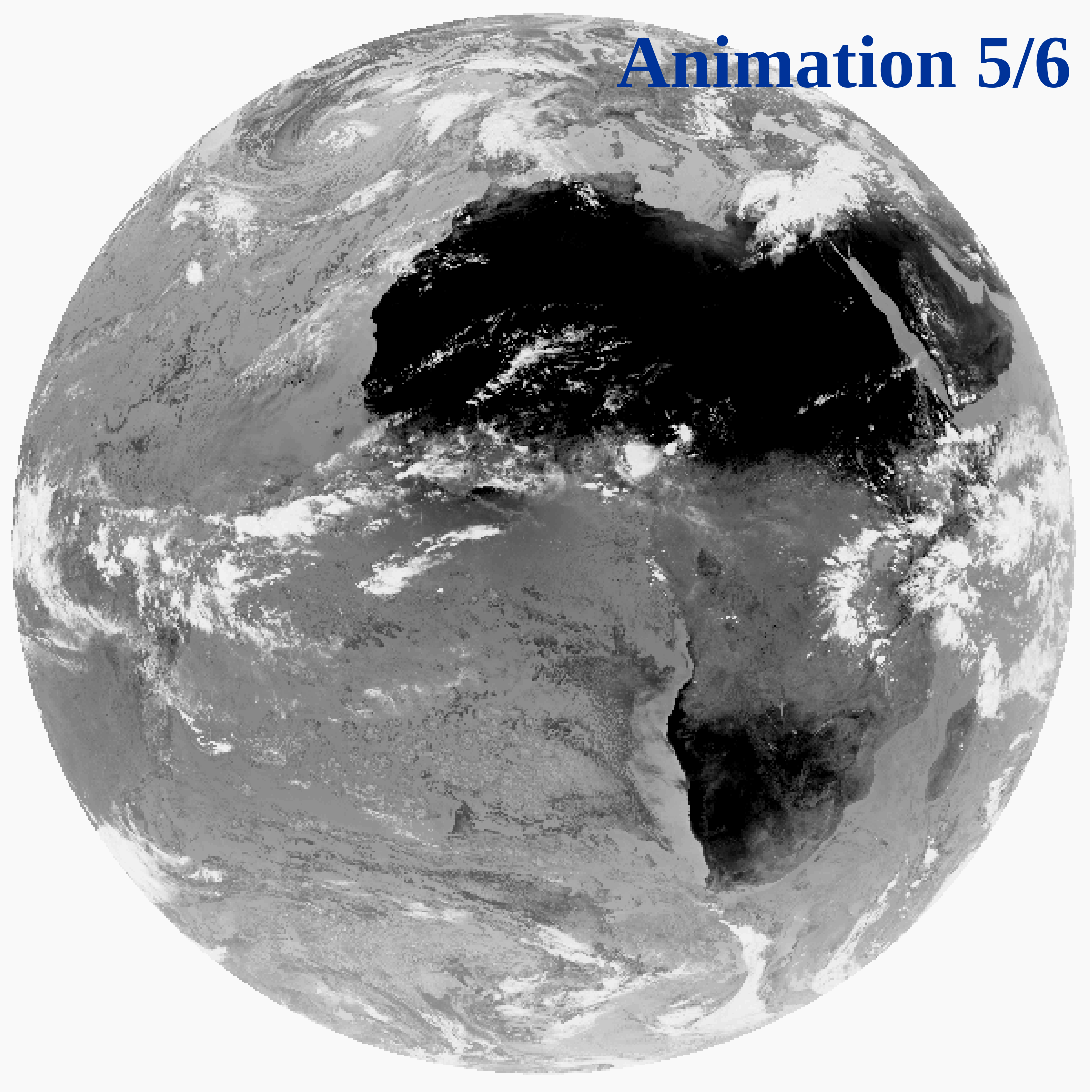
MSG-1, 24 April 2003, 06:00 UTC
Channel 04 (3.9 µm)



MSG-1, 24 April 2003, 09:00 UTC
Channel 04 (3.9 µm)

Solar & Thermal Contributions of Channel 04

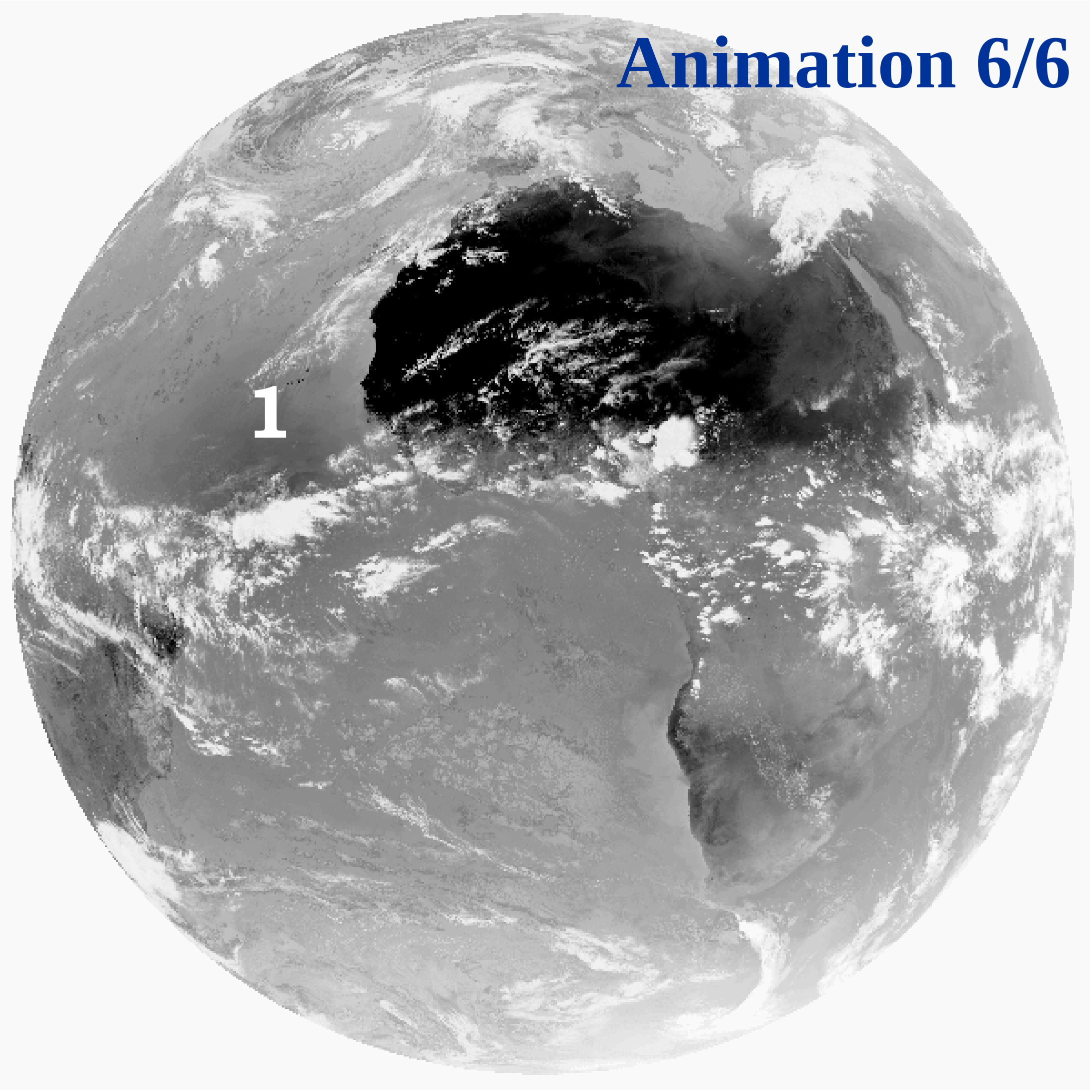
During day-time this channel has a thermal and a solar contribution. Therefore, applications and algorithms are different for night- and day-time !



Solar & Thermal Contributions of Channel 04

MSG-1, 24 April 2003, 12:00 UTC
Channel 04 (3.9 µm)

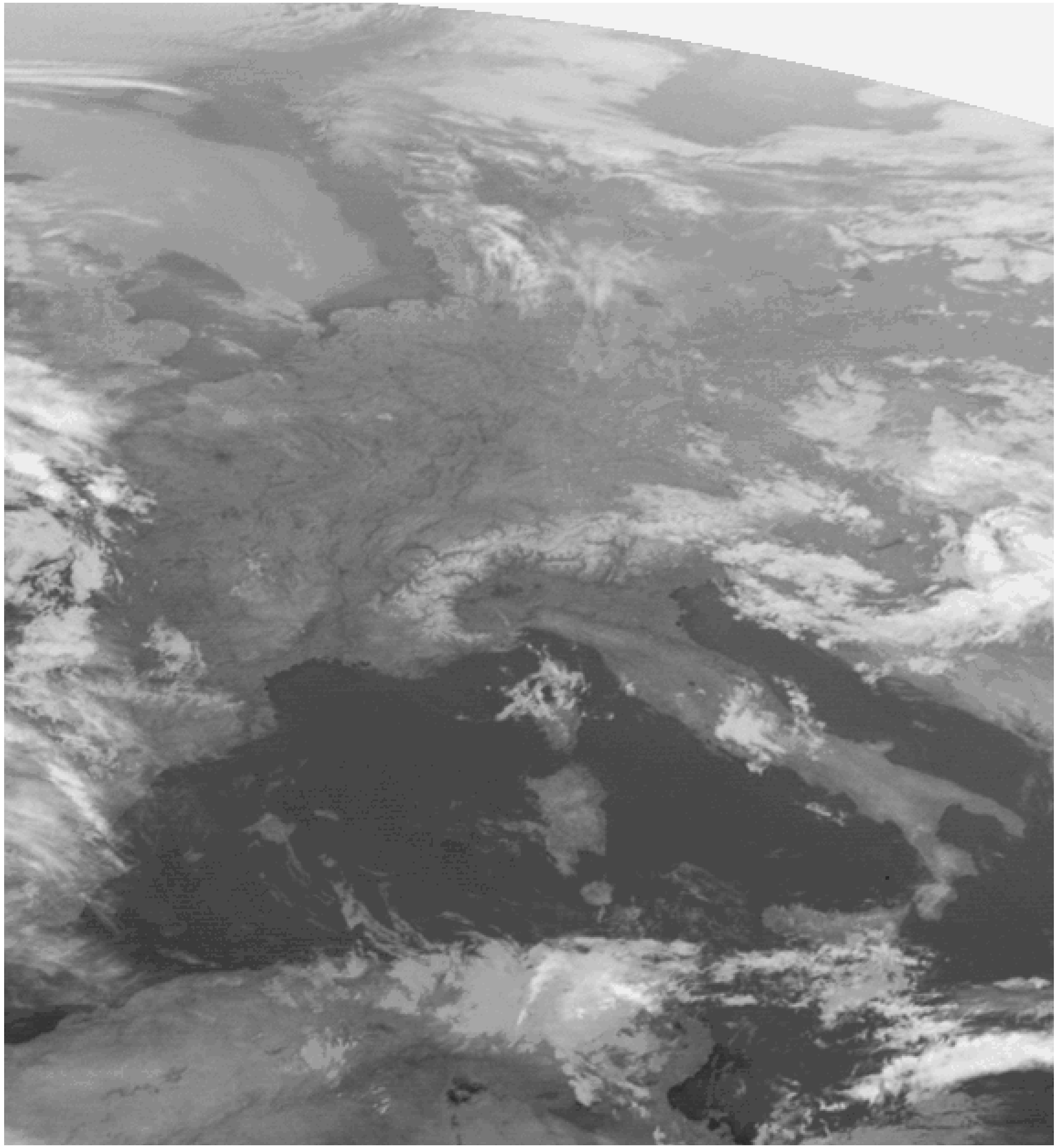
Solar & Thermal Contributions of Channel 04



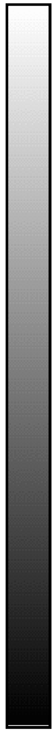
1 = sunglint
(see also 03:00 UTC)

MSG-1, 24 April 2003, 15:00 UTC
Channel 04 (3.9 µm)

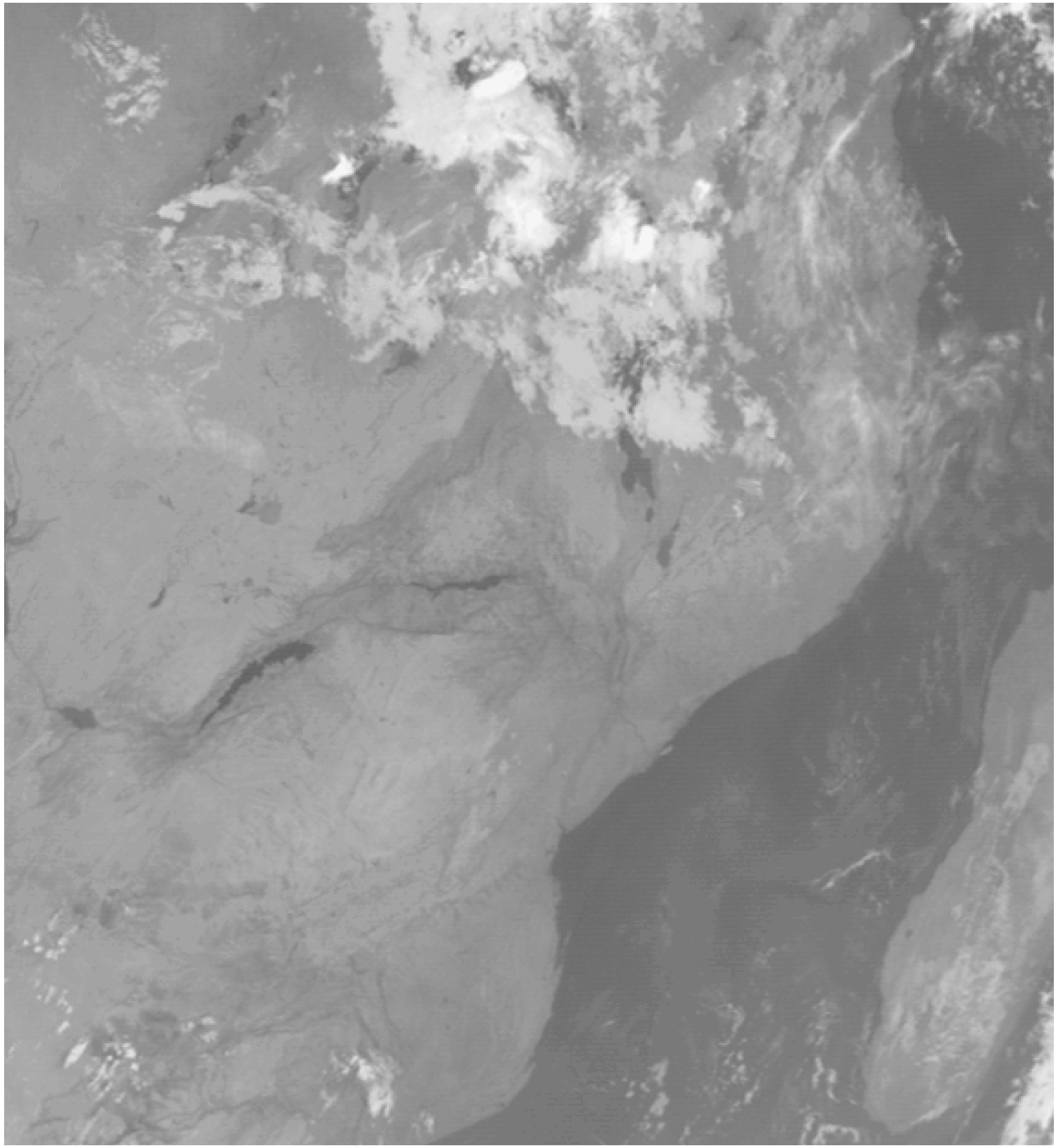
IR 3.9 μm Nighttime



MSG-1, 24 April 2003, 00:00 UTC, Channel 04

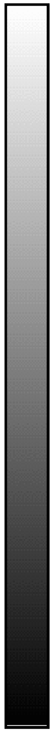


Only thermal contribution: clouds are brighter (colder) than ocean surfaces

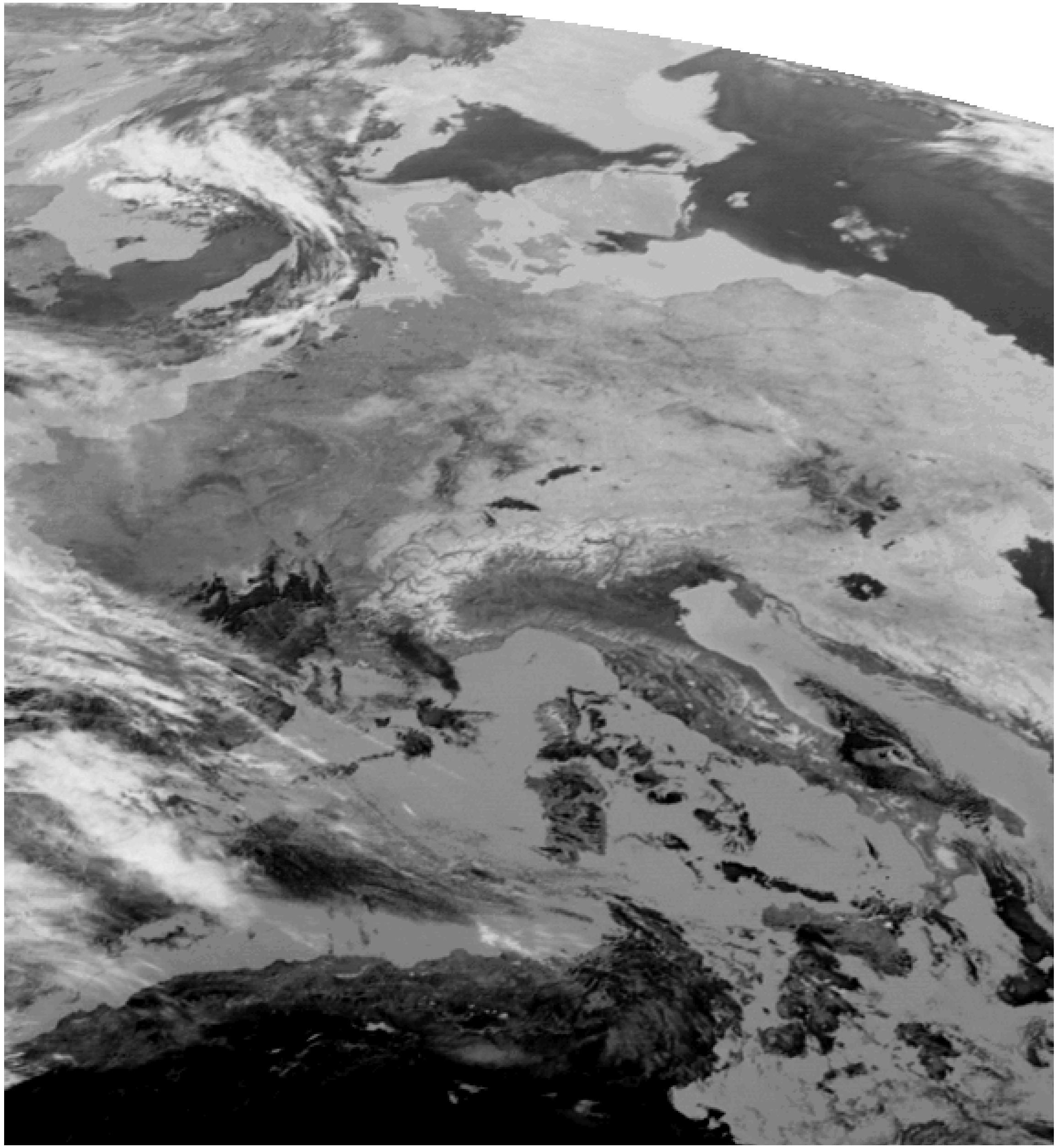


MSG-1, 24 April 2003, 00:00 UTC, Channel 04

IR 3.9 μm Nighttime



Only thermal contribution: clouds are brighter (colder) than ocean surfaces



MSG-1, 24 Feb 2003, 11:00 UTC, Channel 04

IR 3.9 μm Daytime

Low reflectance / Cold

high-level ice clouds

snow surfaces

ocean, sea

cold land surfaces

warm land surfaces

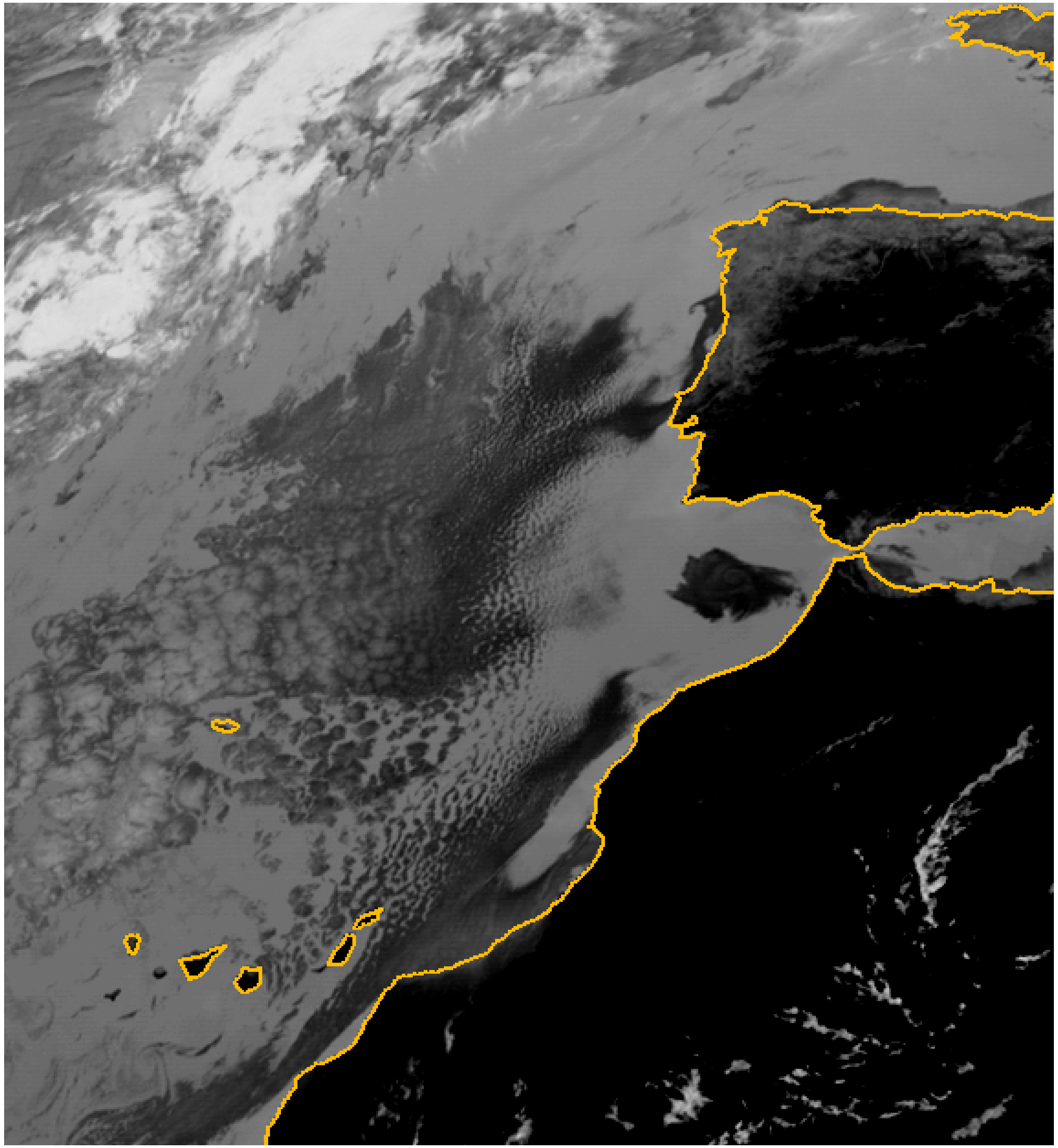
low-level water clouds

hot land surfaces

High reflectance / Warm

Thermal and solar contribution: low clouds are darker than ocean surfaces

IR 3.9 µm Daytime



MSG-1, 07 July 2003, 11:00 UTC, Channel 04

Low reflectance / Cold

high-level ice clouds

ocean, lakes

low-level water clouds

hot land surfaces

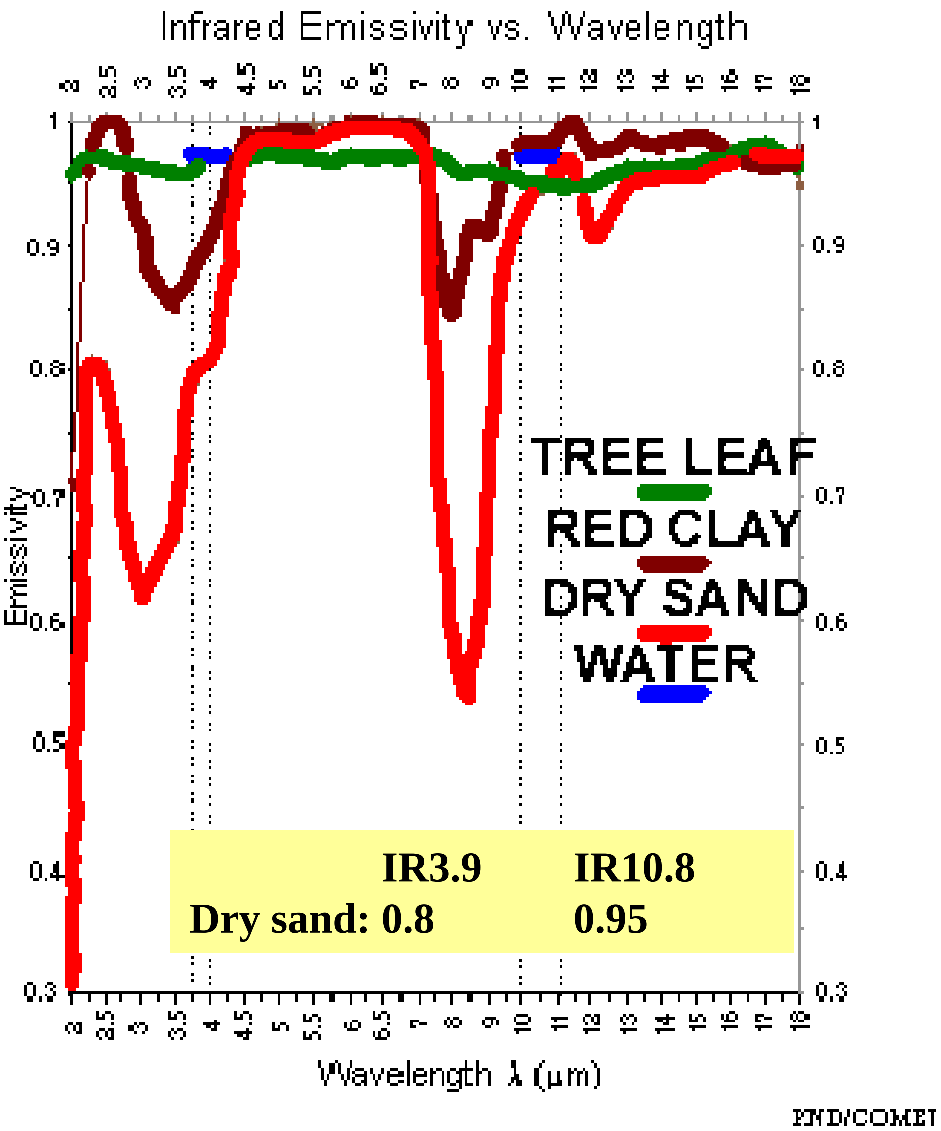
fires, sunglint areas

High reflectance / Warm

Thermal and solar contribution: low clouds are darker than ocean surfaces

IR3.9: INFLUENCE OF SURFACE EMISSIVITY

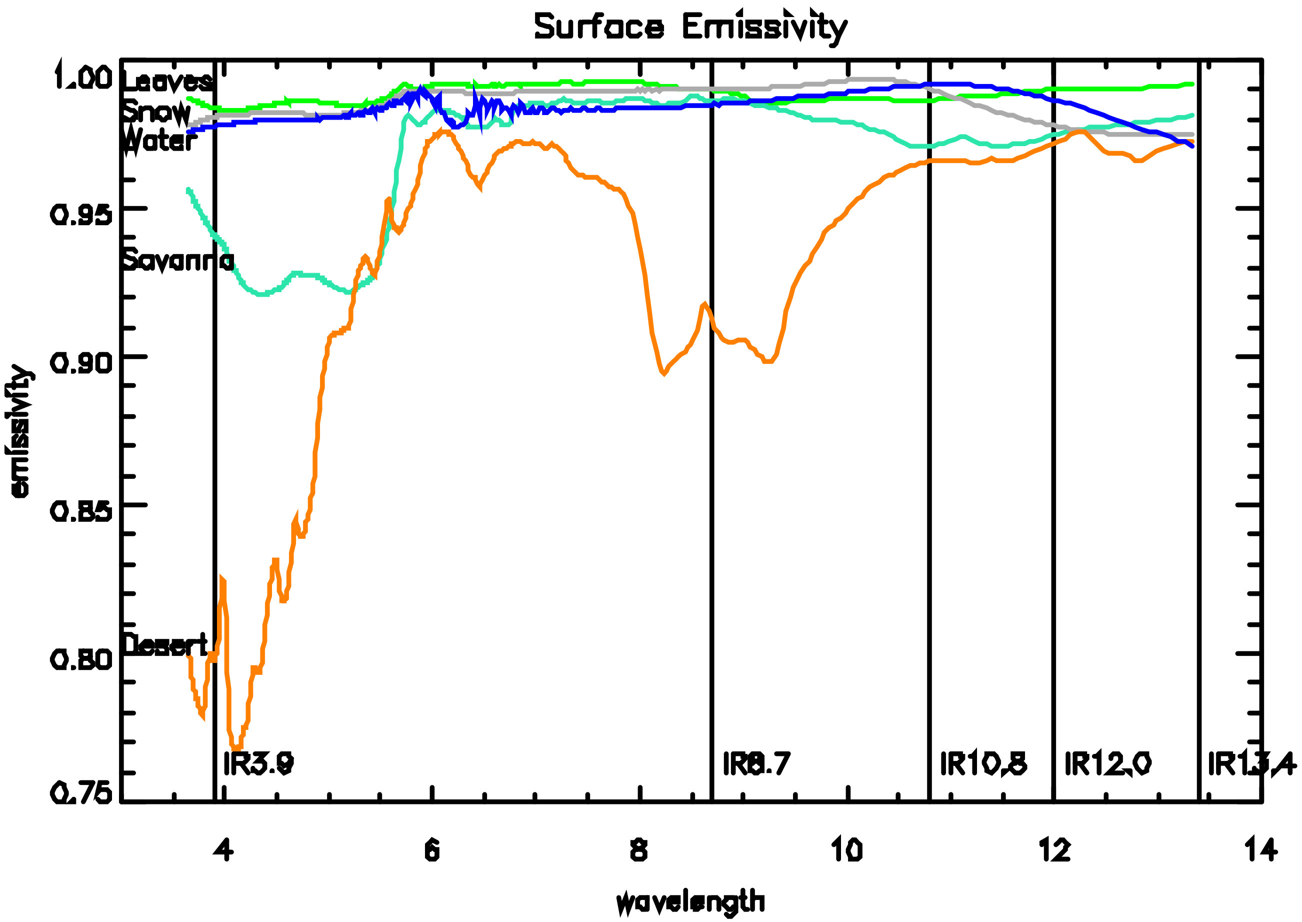
SEVIRI CHANNELS: IR3.9 µm



Emissivity as a function of wavelength and surface type: figure 01

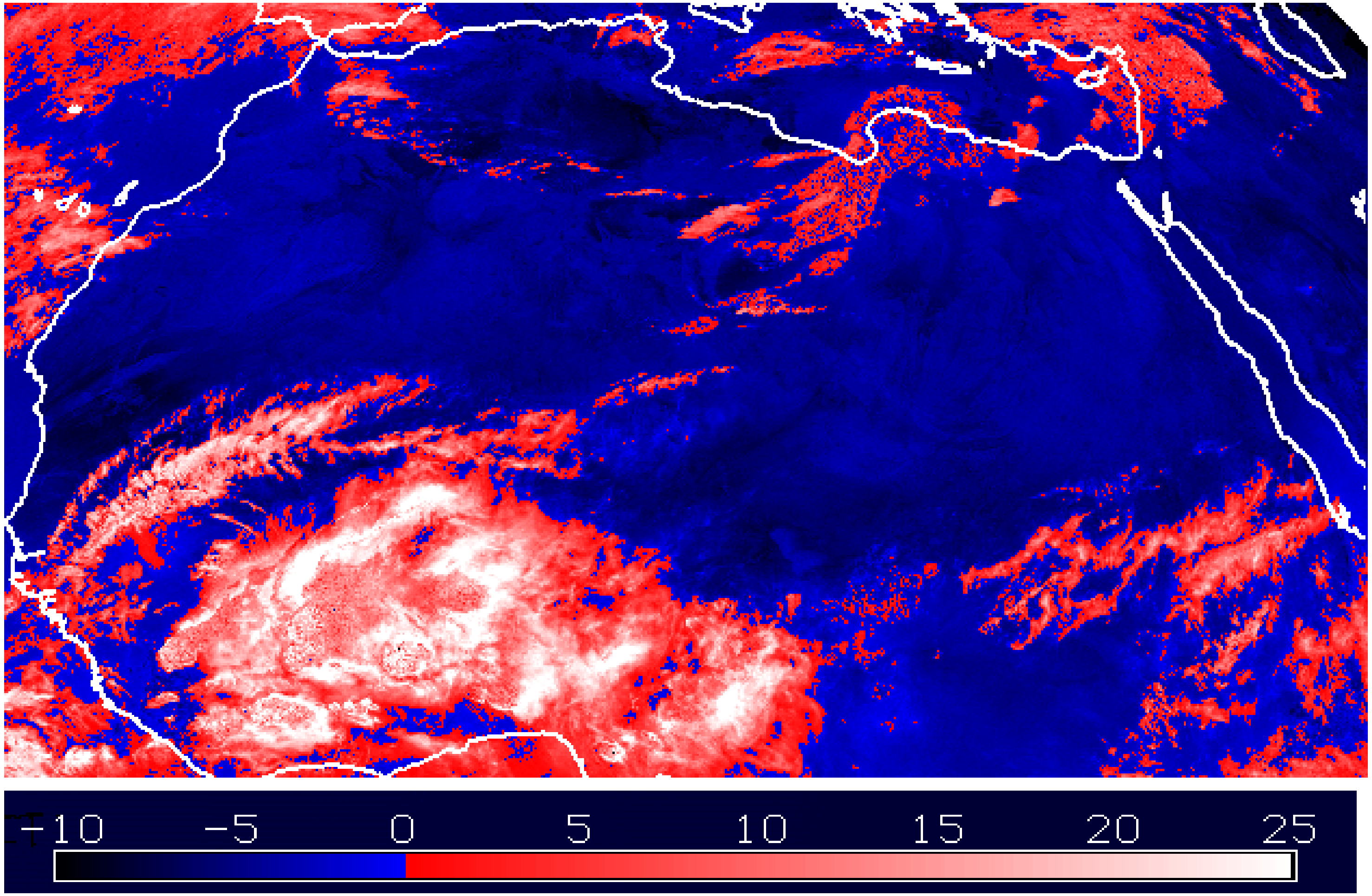
- Emissivity more variable near 3.9 µm
- Sandy areas appear 5-10 K cooler at IR3.9 than at IR10.8 (at night, dry atmosphere)
- Different appearance of land surfaces during daytime, depending on surface type

SEVIRI CHANNELS: IR3.9 μm



Emissivity as a function of wavelength and surface type: figure 02

SEVIRI CHANNELS: IR3.9 µm



MSG-1, 24 April 2003, 00:00 UTC, difference 3.9 µm - 10.8 µm [K]
Sandy areas appear 5 - 10 K cooler at IR3.9 than at IR10.8

IR3.9: APPLICATIONS

METEOROLOGICAL USE OF THE SEVIRI IR3.9 CHANNEL

- Detection of low clouds and fog [day and night]
- Detection of thin Cirrus [day and night] and multi-layer clouds [day]
- Cloud phase & particle size [day and night]
- Sea and land surface temperature [night]
- Detection of forest fires [day and night]
- Urban heat island [night]
- Super-cooled clouds [day and night]
- Cloud top structures (overshooting tops) [day]
- Sunglint [day]

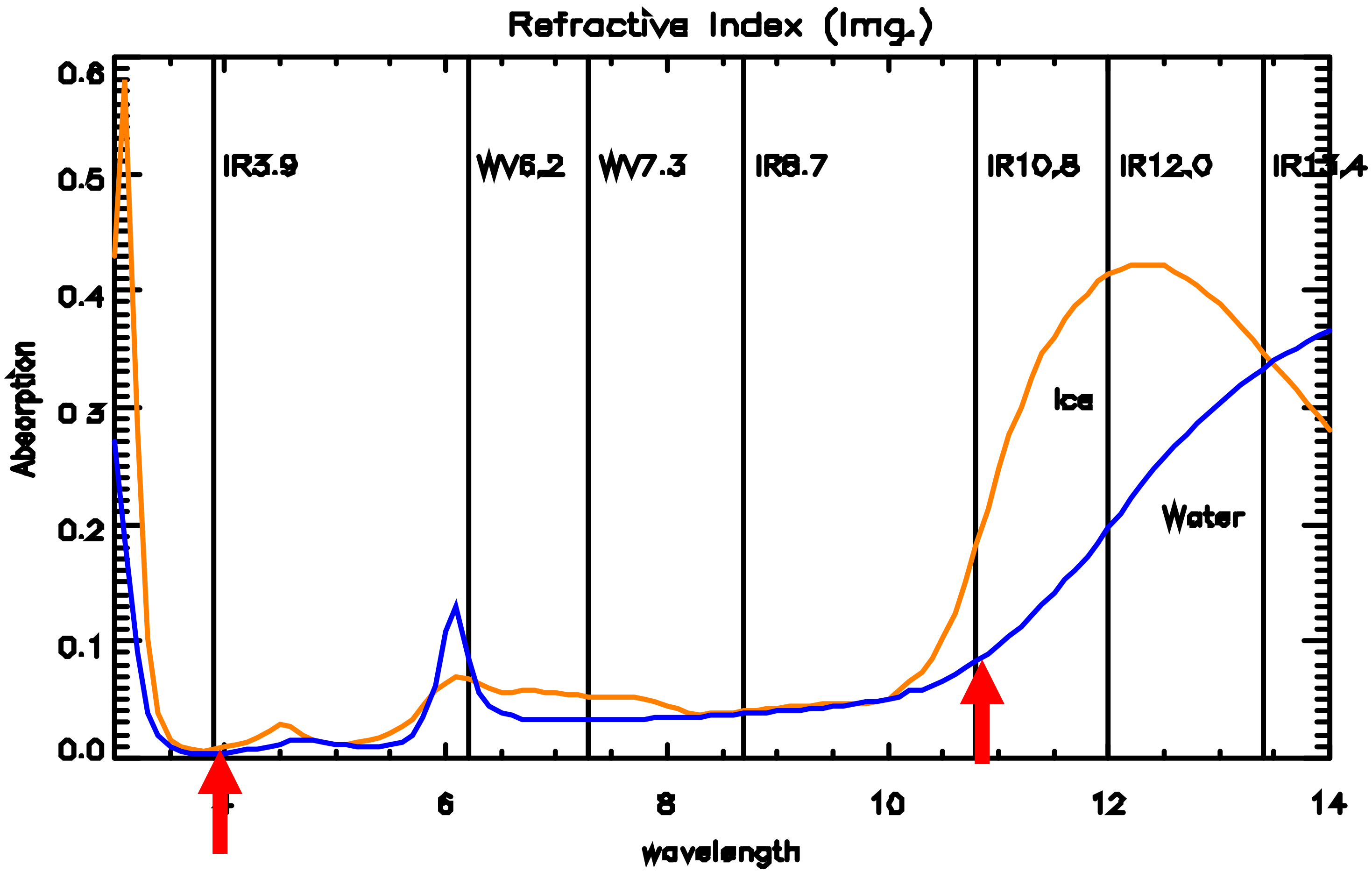
Similar channel on AVHRR, ATSR and MODIS

IR3.9: DETECTION OF FOG / LOW STRATUS (DAY AND NIGHT-TIME)

Fog and Low Stratus/Sc

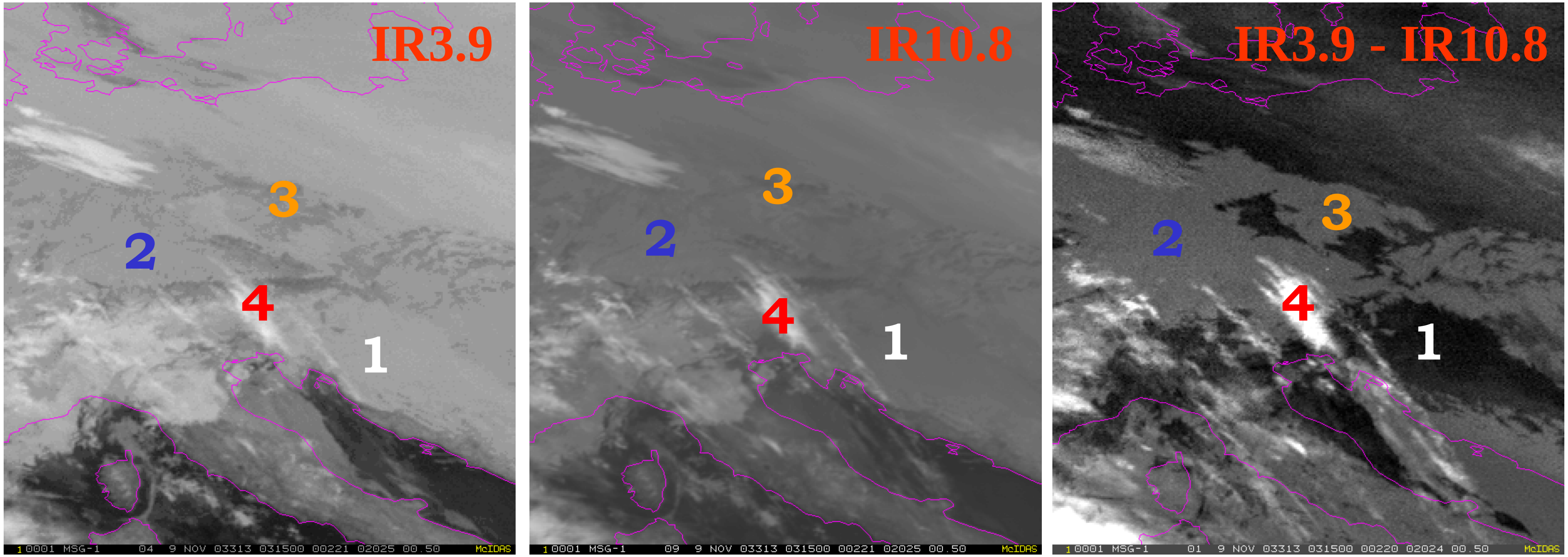
- The identification of fog and stratus at night is the main application of the IR3.9 channel
- The technique is based on the principle that the emissivity of water cloud at 3.9 µm is less than at 10.8 µm: IR3.9 shows more reflection of cold atmosphere above. This is not the case for cloud free surfaces (except sandy desert surfaces).
- Evolution of night-time fog and low-level stratus clouds is easily observed by viewing the animation

Fog and Low Stratus/Sc



Emissivity of water cloud at 3.9 µm is less than at 10.8 µm: IR3.9 shows more reflection of cold atmosphere above

MSG-1, 09 November 2003, 03:15 UTC



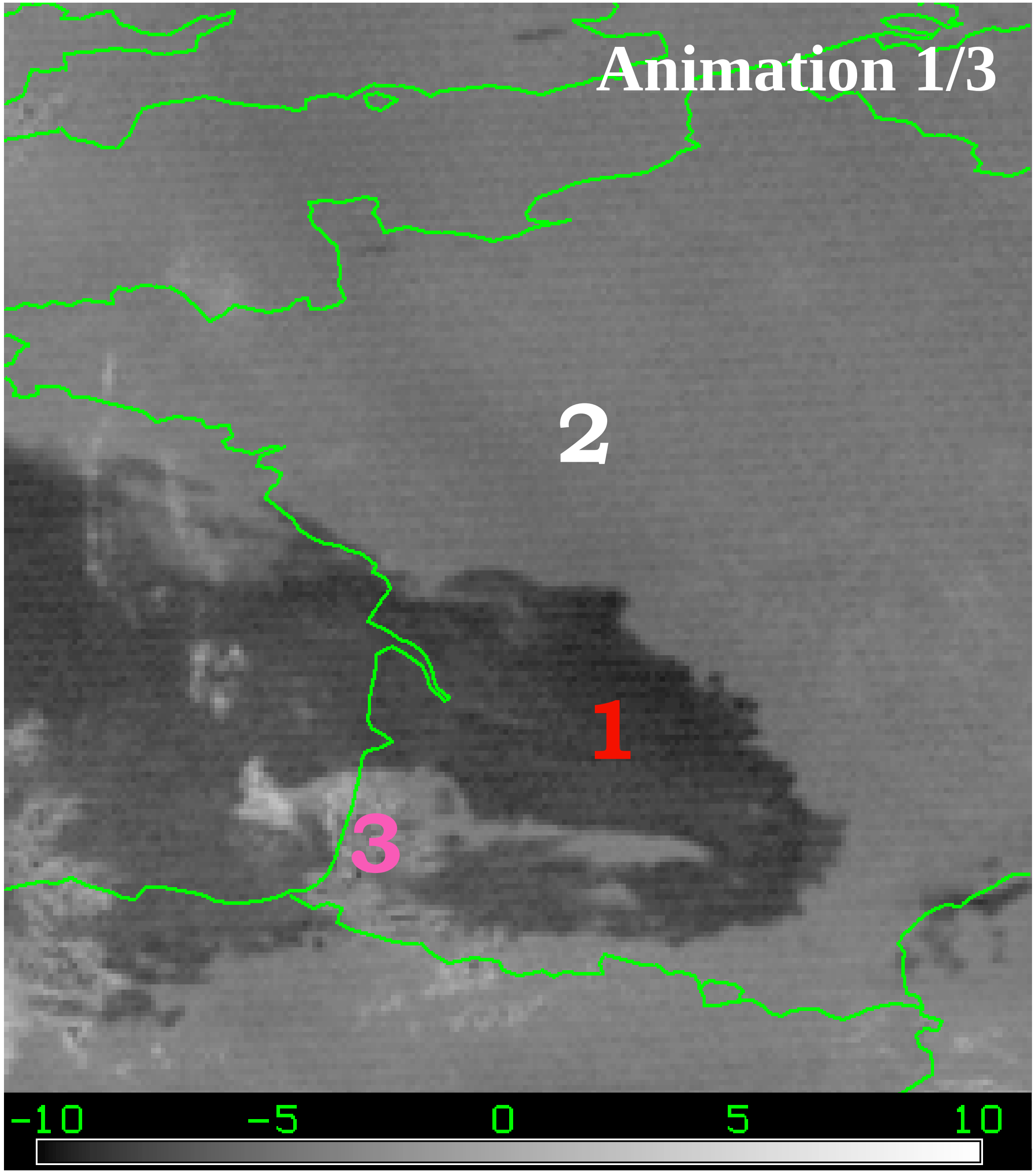
Fog at night visible in IR3.9 - IR10.8 brightness temperature difference images

1= low-level fog or stratus

2= cold clear ground

3 = warm clear ground (mountains)

4 = thin, high-level clouds



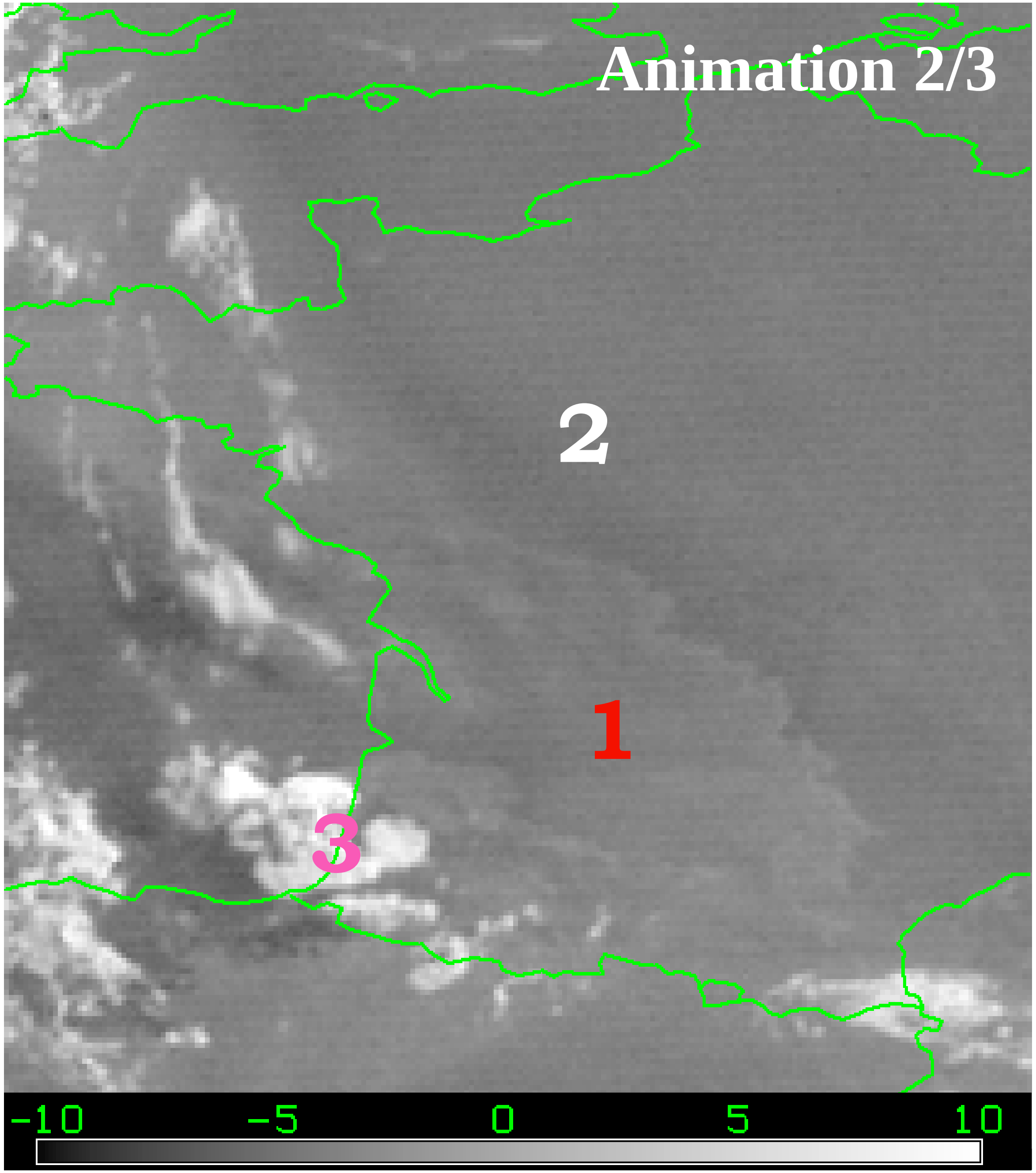
Fog at night visible in IR3.9 - IR10.8 brightness temperature difference images

1= low-level fog or stratus

2= clear ground

3= high-level clouds

MSG-1
14 July 2003
03:00 UTC
Difference Image
IR3.9 - IR10.8



Fog at dawn/dusk <u>not visible</u> in IR3.9 - IR10.8 brightness temperature difference images

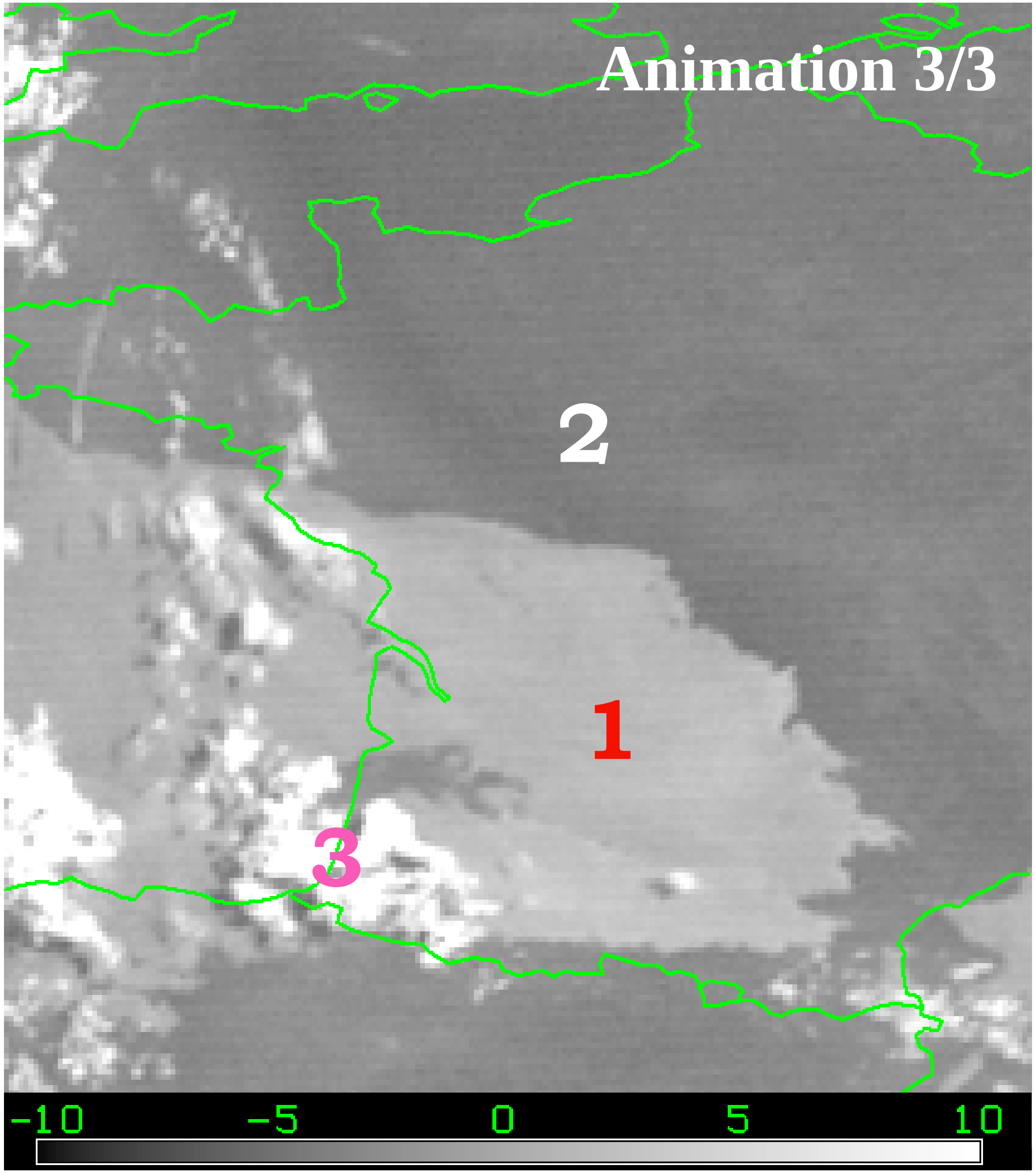
1= low-level fog or stratus

2= clear ground

3= high-level clouds

MSG-1
14 July 2003
05:00 UTC
Difference Image
IR3.9 - IR10.8

EUMETSAT



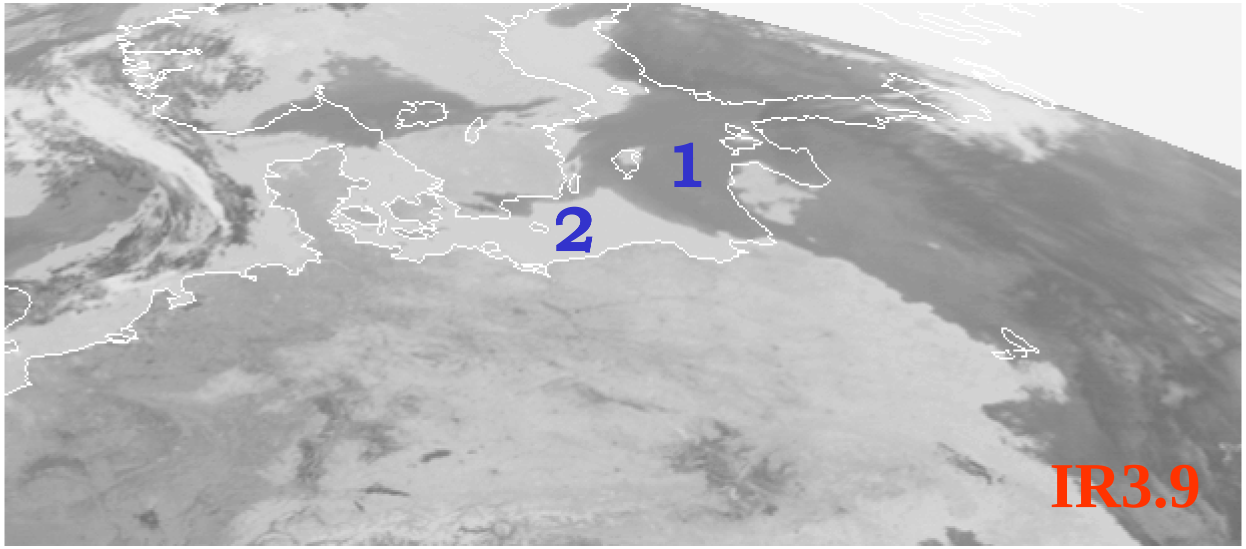
Fog at day visible in IR3.9 - IR10.8 brightness temperature difference images

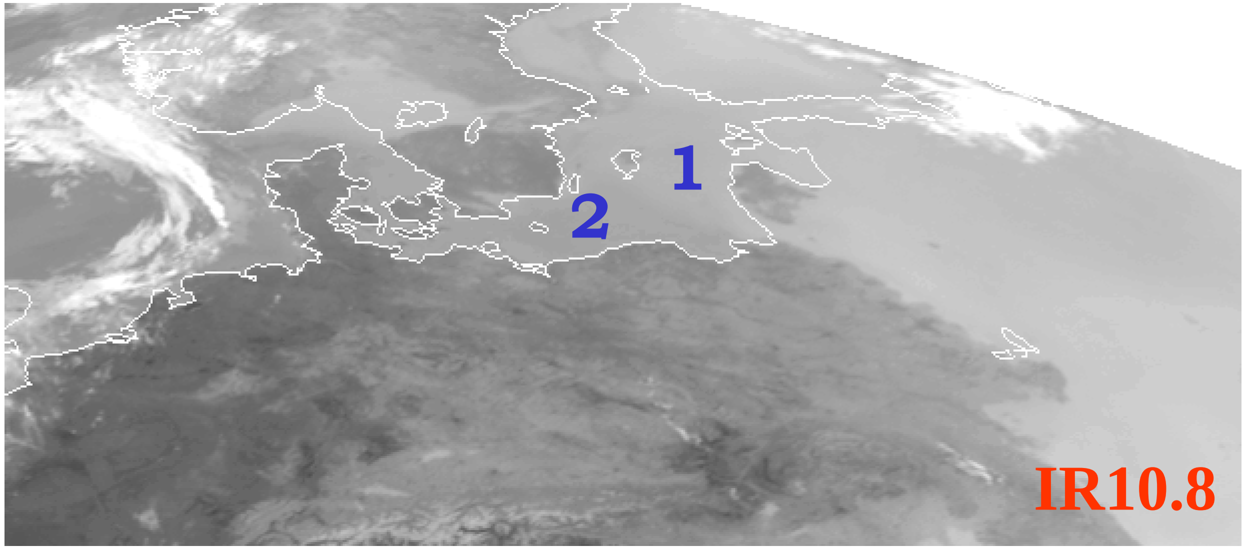
1= low-level fog or stratus

2= clear ground

3= high-level clouds

MSG-1
14 July 2003
06:00 UTC
Difference Image
IR3.9 - IR10.8





note: IR10.8 imagery is already strongly enhanced in this example

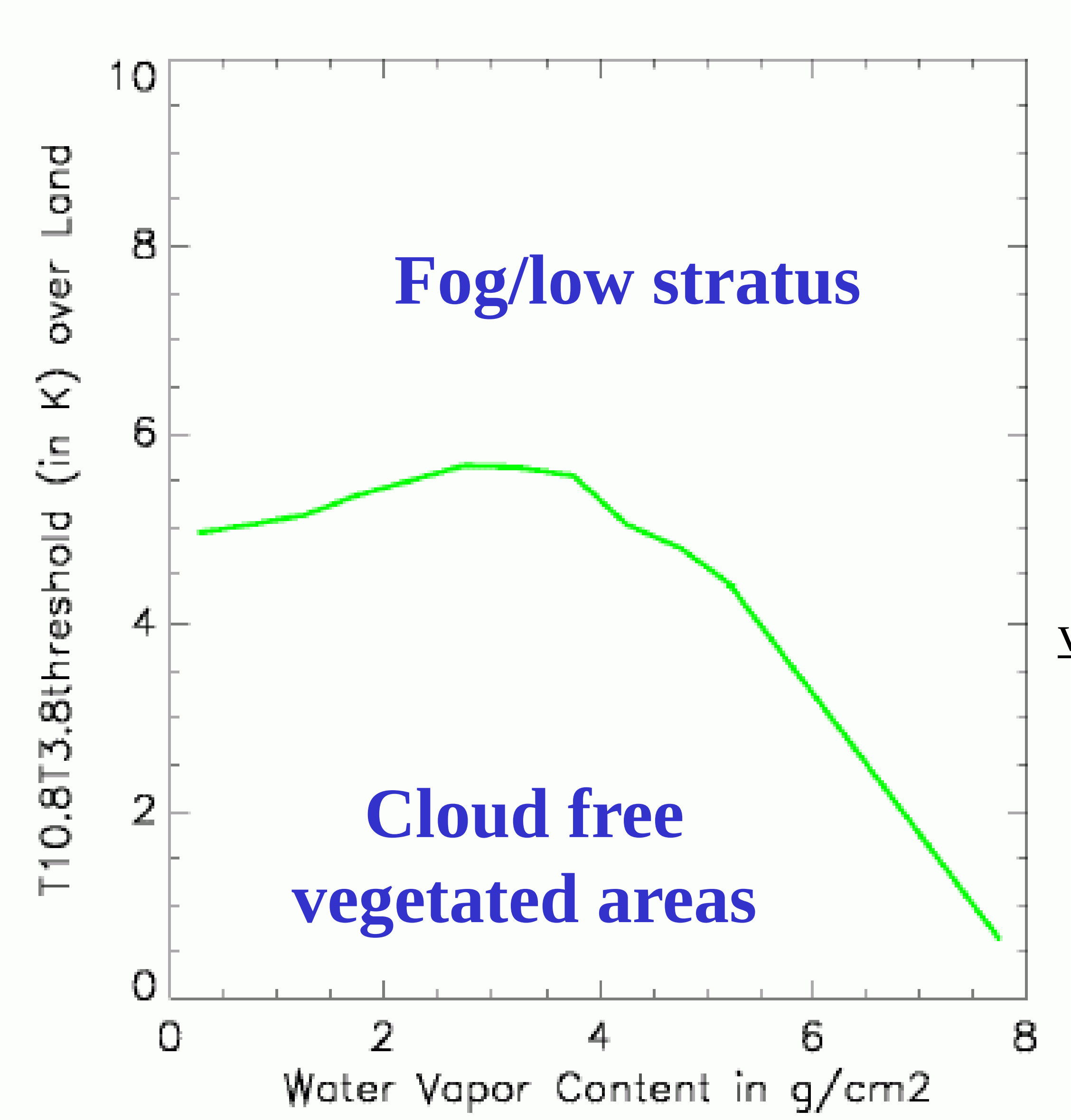
Fog at day visible in IR3.9 images

1= low-level fog or stratus
BT(IR3.9)=290.1 K
BT(IR10.8)=267.0 K

2= cloud-free ocean
BT(IR3.9)=267.3 K
BT(IR10.8)=270.6 K

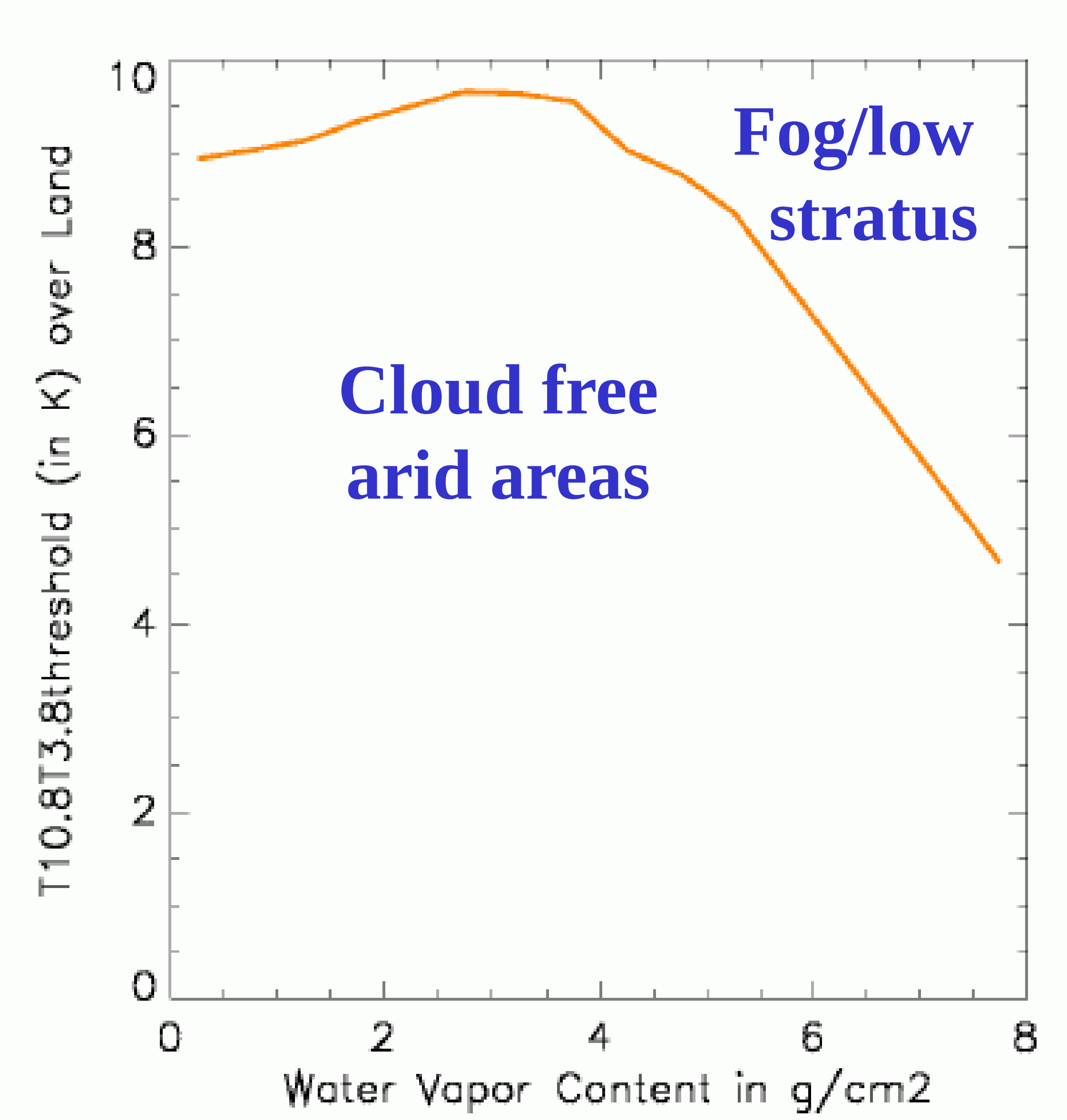
MSG-1
24 February 2003
12:00 UTC

Detection of Fog & Low Stratus/Sc at Night-time



Threshold (in K) for the IR10.8-IR3.9 brightness temperature difference to discriminate between fog/low stratus and cloud free vegetated areas as a function of total water vapour content for a satellite zenith angle of 48 degrees.

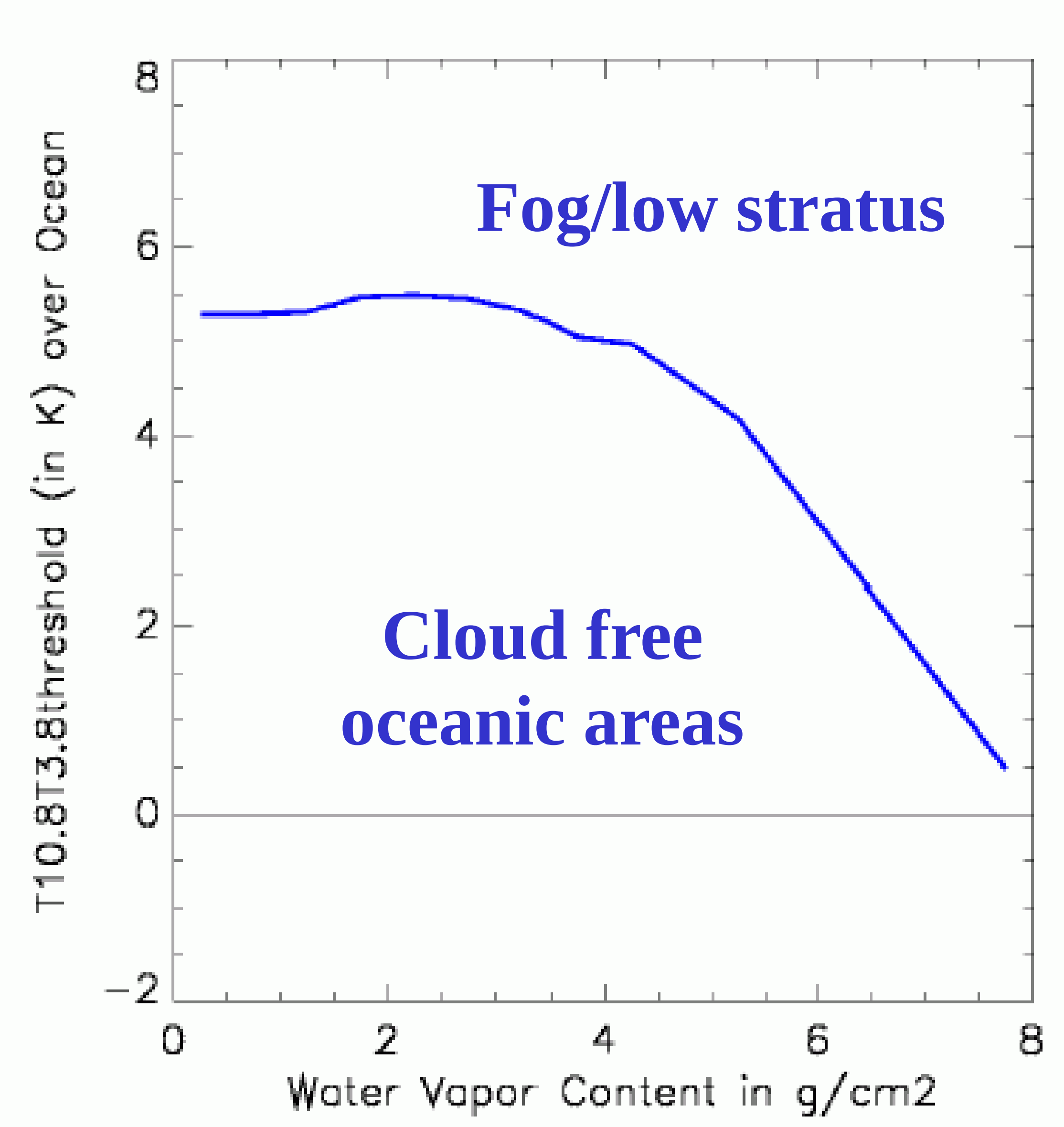
(from Nowcasting SAF, Météo-France)



Detection of Fog & Low Stratus/Sc at Night-time

Threshold (in K) for the IR10.8-IR3.9 brightness temperature difference to discriminate between fog/low stratus and cloud free arid areas as a function of total water vapour content for a satellite zenith angle of 48 degrees.

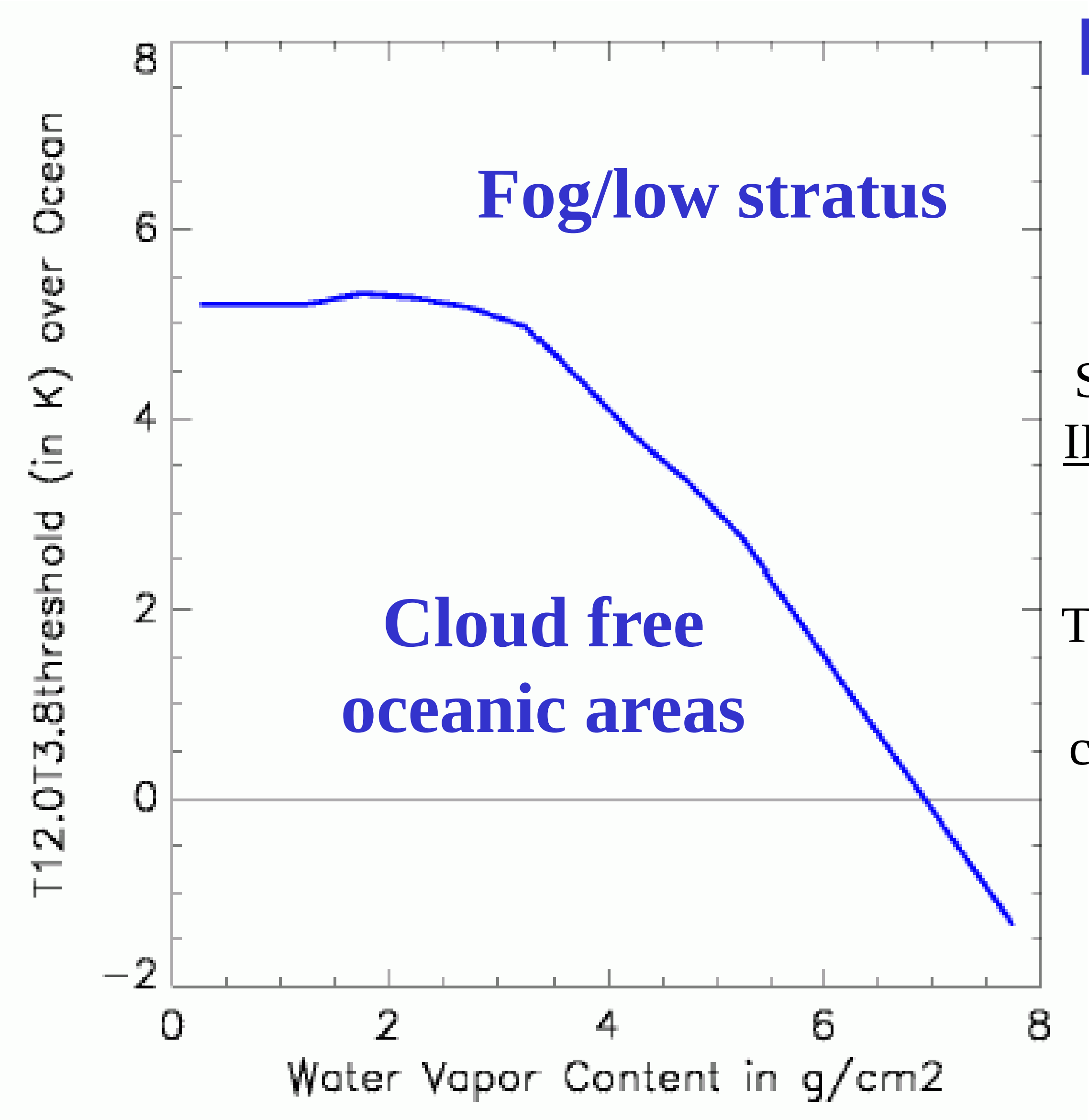
(from Nowcasting SAF, Météo-France)



Detection of Fog & Low Stratus/Sc at Night-time

Threshold (in K) for the IR10.8-IR3.9 brightness temperature difference to discriminate between fog/low stratus and cloud free oceanic areas as a function of total water vapour content for a satellite zenith angle of 48 degrees.

(from Nowcasting SAF, Météo-France)

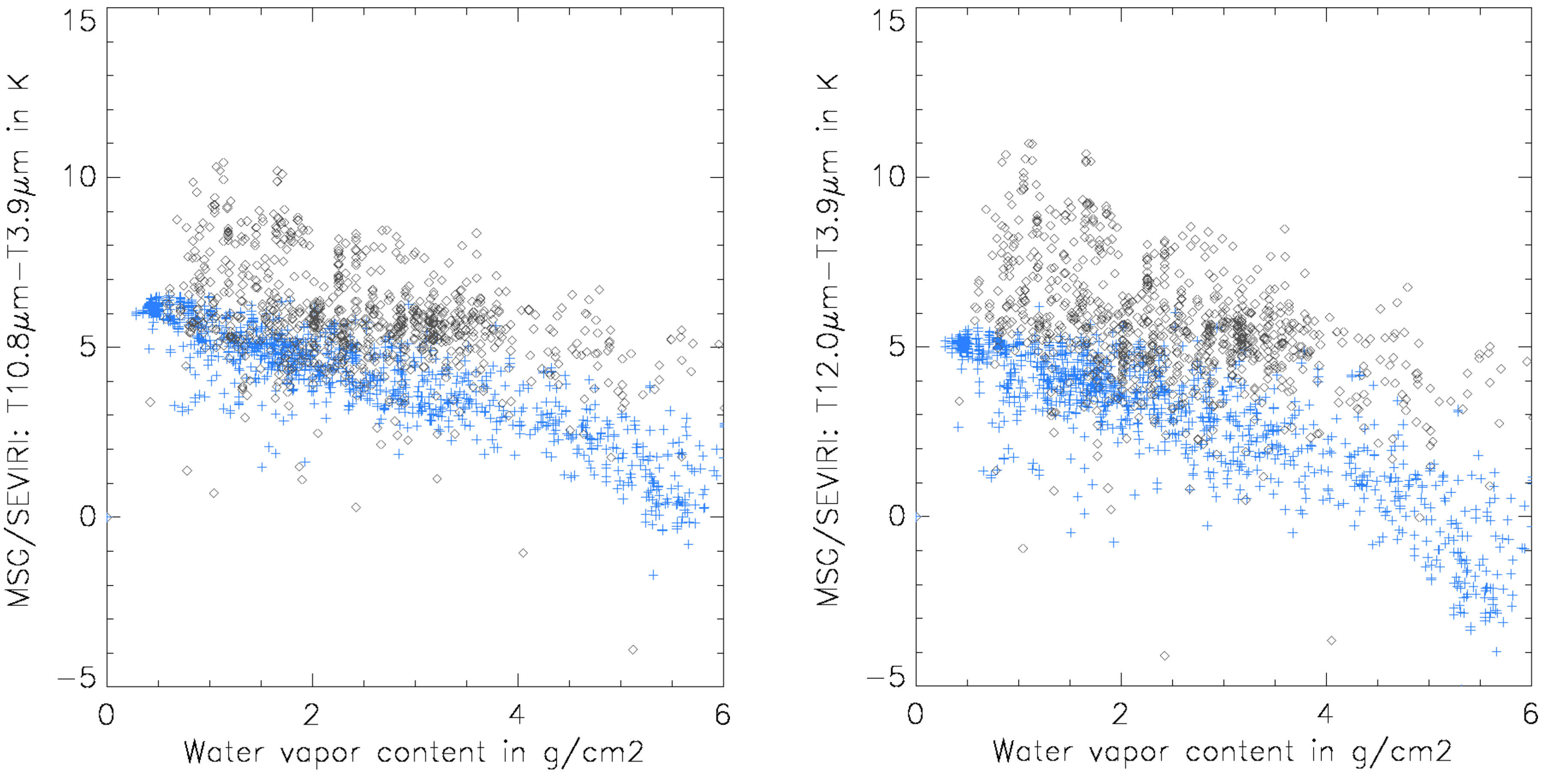


Detection of Fog & Low Stratus/Sc at Night-time

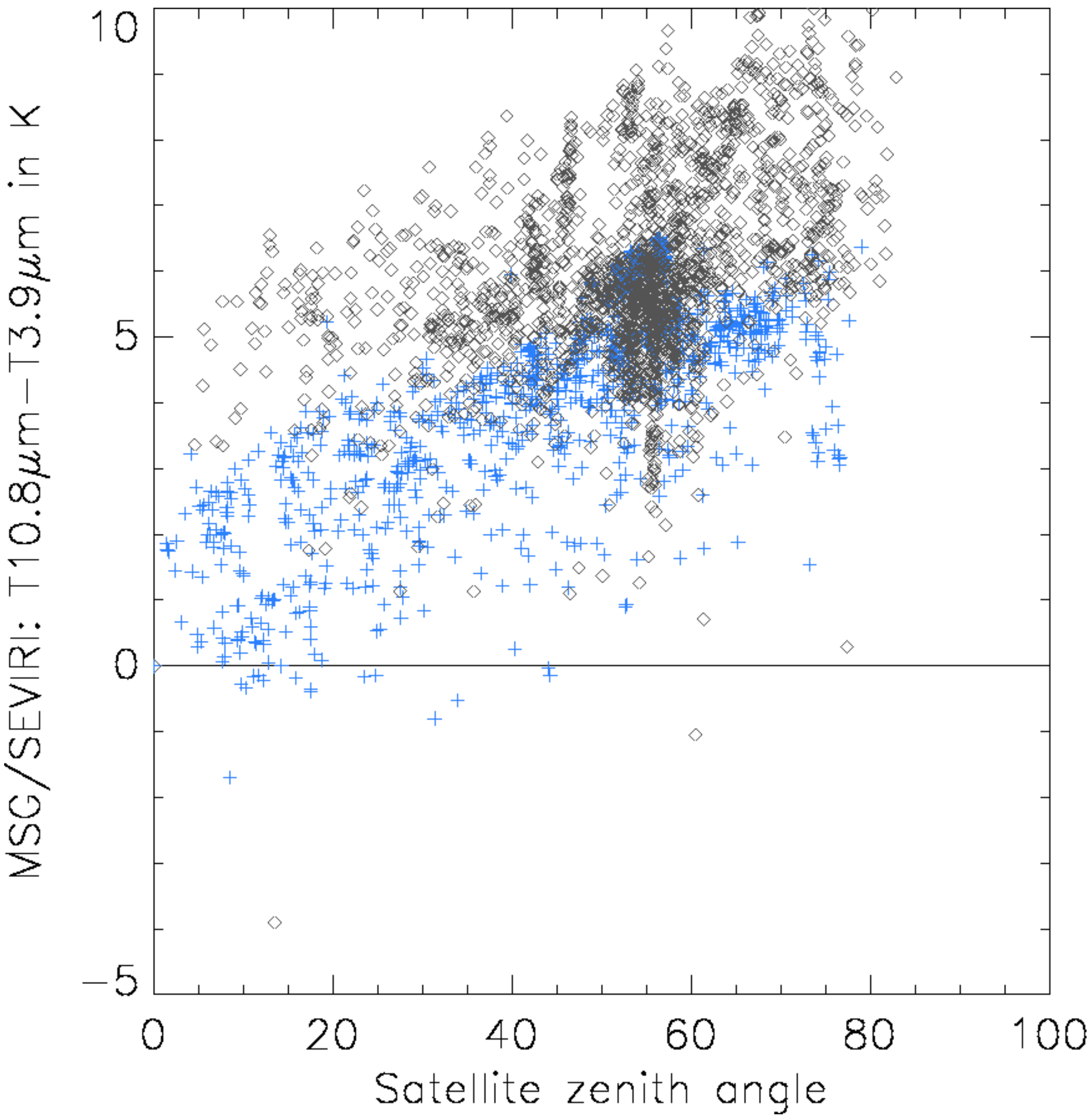
Same as previous figure, but for the IR12.0-IR3.9 brightness temperature difference.

This test is more efficient over ocean due to a higher contrast between cloud free areas and low clouds (see next slide).

(from Nowcasting SAF, Météo-France)



Night-time IR10.8-IR3.9 (left) and IR12.0-IR3.9 (right) brightness temperature difference for cloud free oceanic targets (blue +) and low clouds (black diamond). (from Nowcasting SAF, Météo-France)

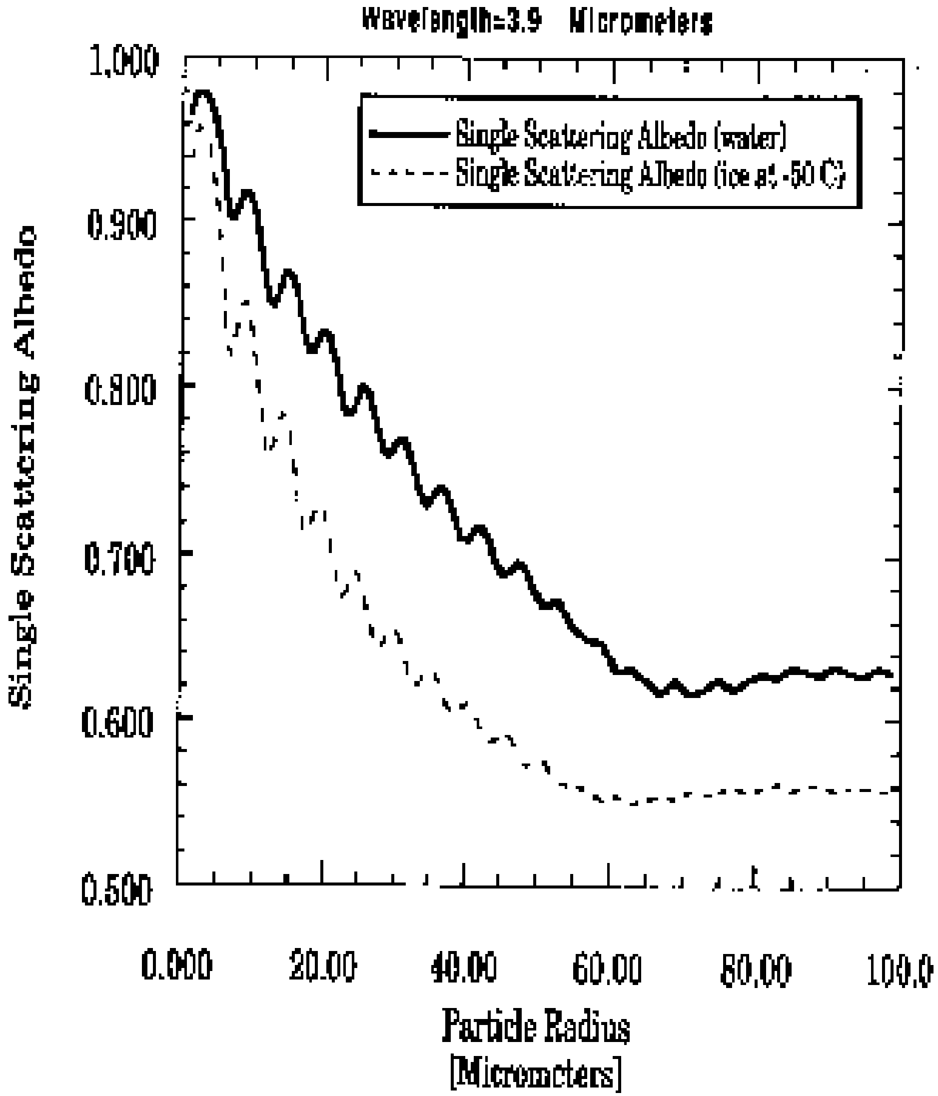


Night-time IR10.8-IR3.9 brightness temperature difference for cloud free oceanic targets (blue +) and low clouds (black diamond) as a function of satellite zenith angle.

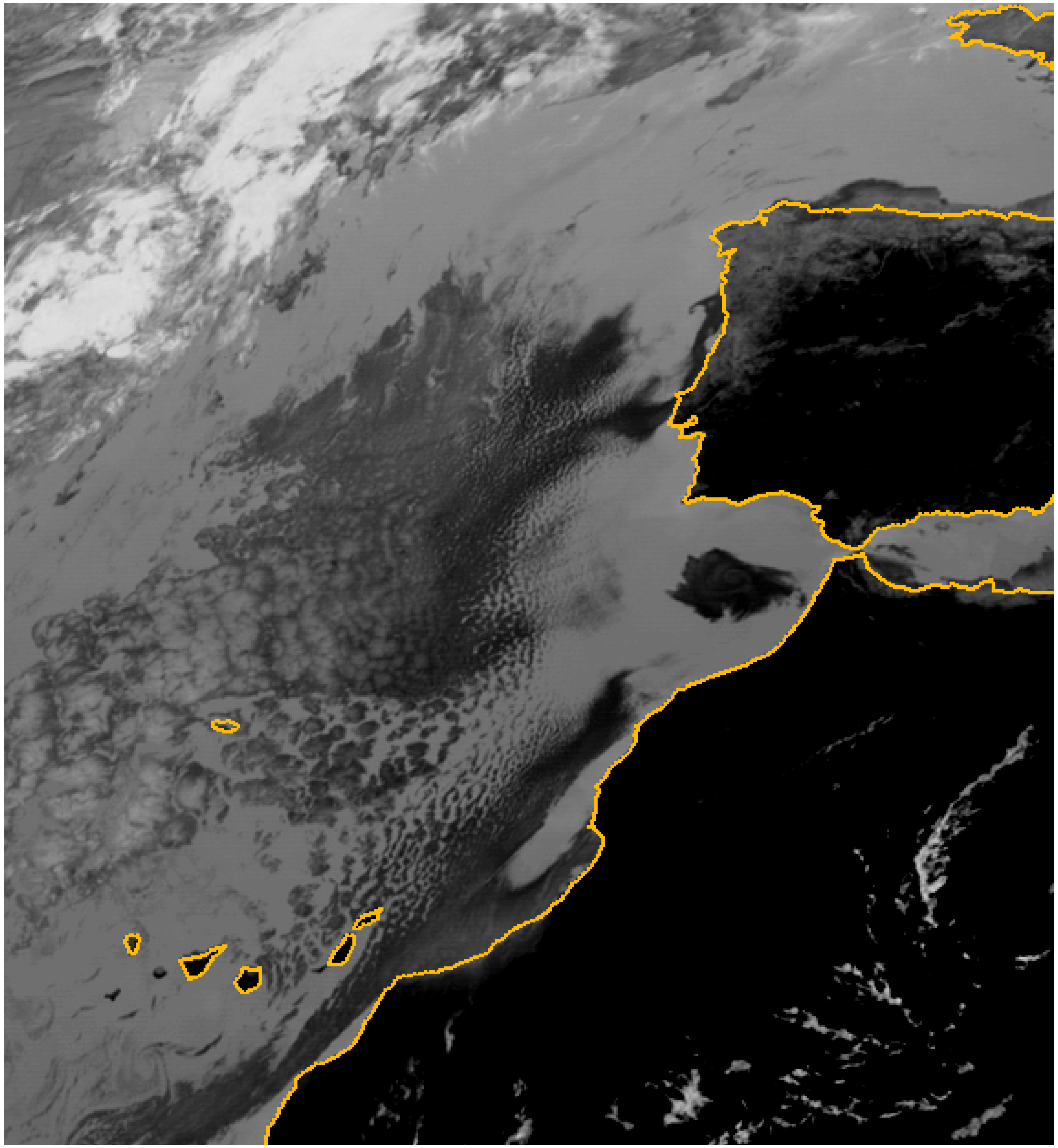
(from Nowcasting SAF, Météo-France)

IR3.9: CLOUD PHASE AND PARTICLE SIZE (MAINLY DAY-TIME)

Reflection of Solar Radiation at IR3.9



- Reflection at IR3.9 is sensitive to cloud phase and very sensitive to particle size
- Higher reflection from water droplets than from ice particles
- During daytime, clouds with small water droplets (St, Sc) are much darker than ice clouds
- Marine Sc (large water droplets) is darker than Sc over land

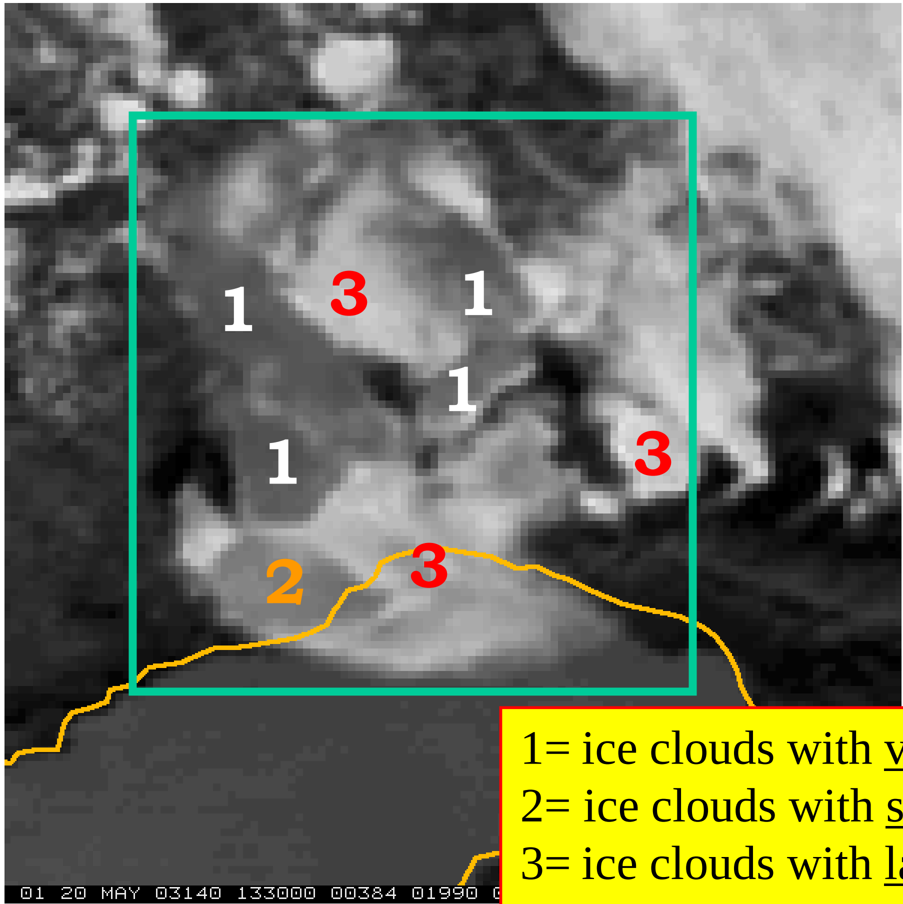


MSG-1, 07 July 2003, 11:00 UTC, Channel 04

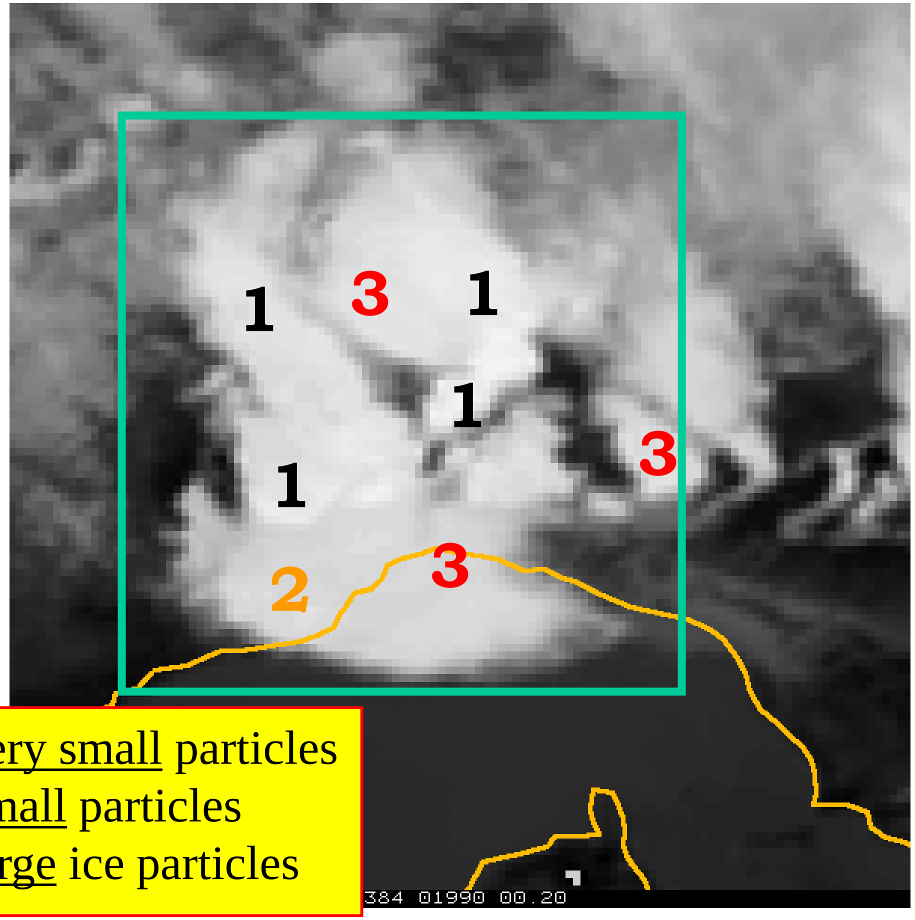
IR3.9: Cloud Phase

Due to the high reflection from water droplets at IR3.9, low-level water clouds are much darker than high-level ice clouds (during day-time)

IR3.9 shows much more cloud top structures than IR10.8 (very sensitive to particle size)



Channel 04 (IR3.9)

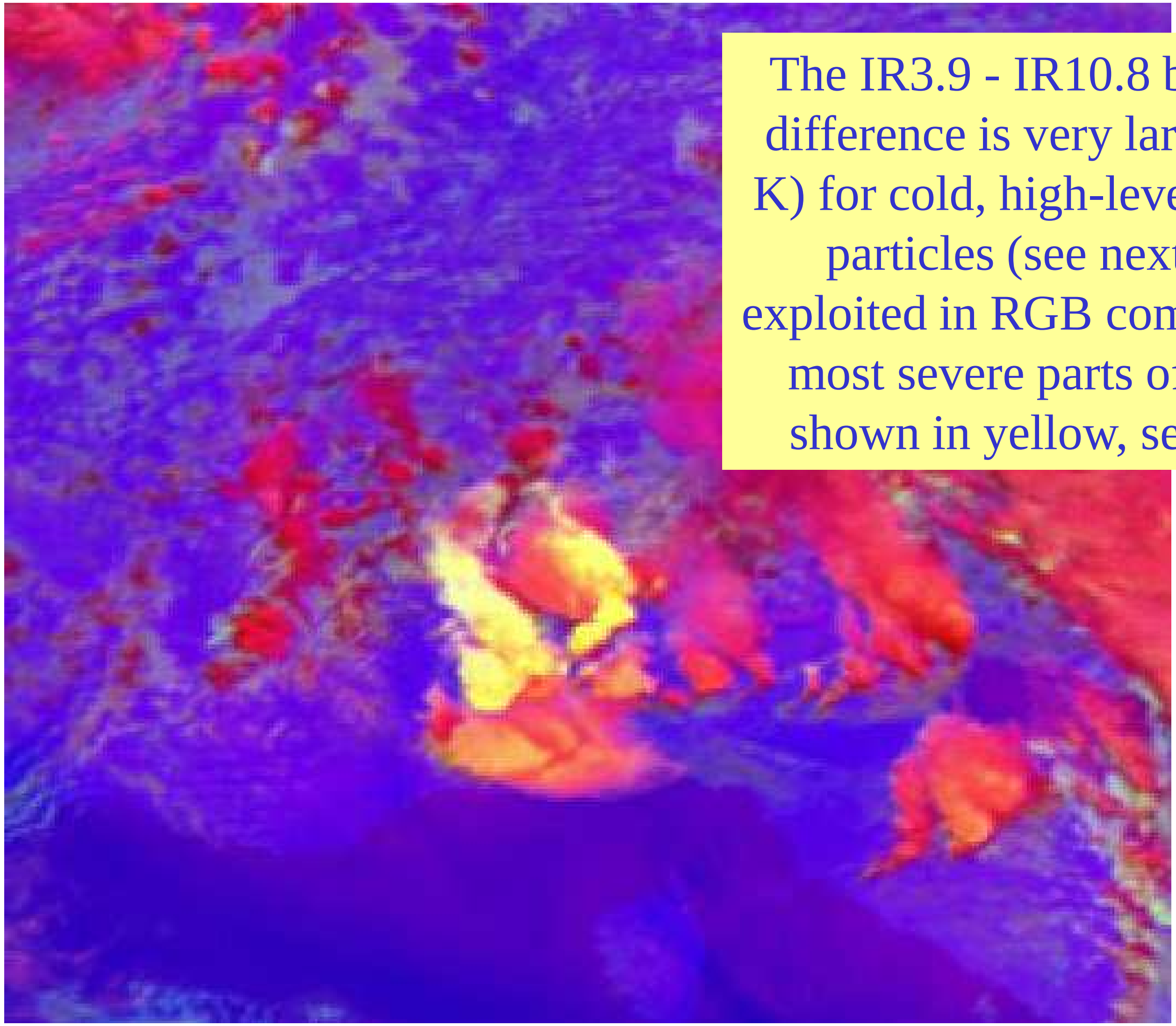


Channel 09 (IR10.8)

1= ice clouds with <u>very small</u> particles
2= ice clouds with <u>small</u> particles
3= ice clouds with <u>large</u> ice particles

MSG-1, 20 May 2003, 13:30 UTC

IR3.9: Cloud Particle Size



The IR3.9 - IR10.8 brightness temperature difference is very large (around +50 to +60 K) for cold, high-level clouds with small ice particles (see next slide). This can be exploited in RGB composites to highlight the most severe parts of thunderstorms (here shown in yellow, see also RGB tutorial).

MSG-1
20 May 2003
13:30 UTC
RGB Composite
R = WV6.2 - WV7.3
G = IR3.9 - IR10.8
B = NIR1.6 - VIS0.6

IR3.9 - IR10.8 Brightness Temperature Differences for Opaque Clouds

IR3.9 Albedo	cloud at 200 K	cloud at 250 K	cloud at 300
5	90	43	12
4	85	38	10
3	78	33	8
2	70	26	5
1	57	16	3
0	0	0	0

For cold clouds, the IR3.9 - IR10.8 BTD is very sensitive to albedo (i.e. cloud particle size)

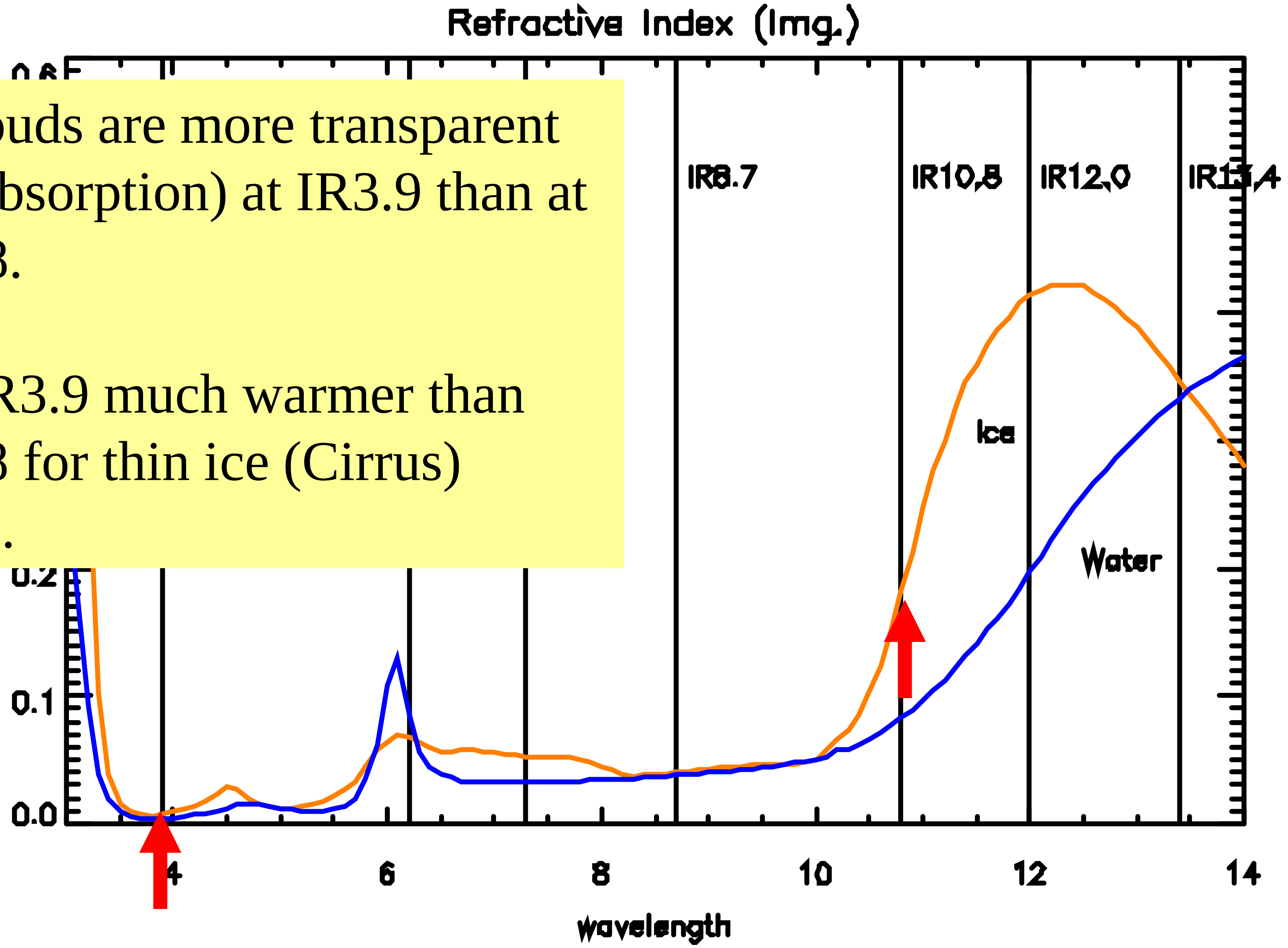
the cloud.

IR3.9: DETECTION OF THIN CIRRUS CLOUDS (DAY AND NIGHT-TIME)

Thin Cirrus Clouds

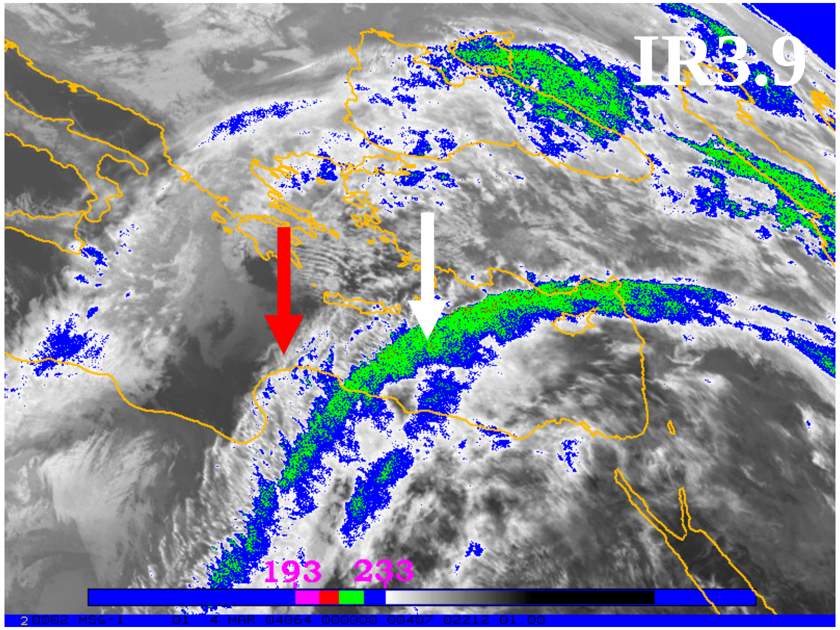
- Cirrus clouds are more transparent at 3.9 µm than at 10.8 µm because of the stronger response at 3.9 µm to the warm radiation from below
- In addition, thin cirrus is often patchy and only partially fills a FOV (Field of View), further enhancing response at 3.9 µm
- Therefore, in 3.9-10.8 difference images, thin Cirrus can be easily detected (large positive difference)

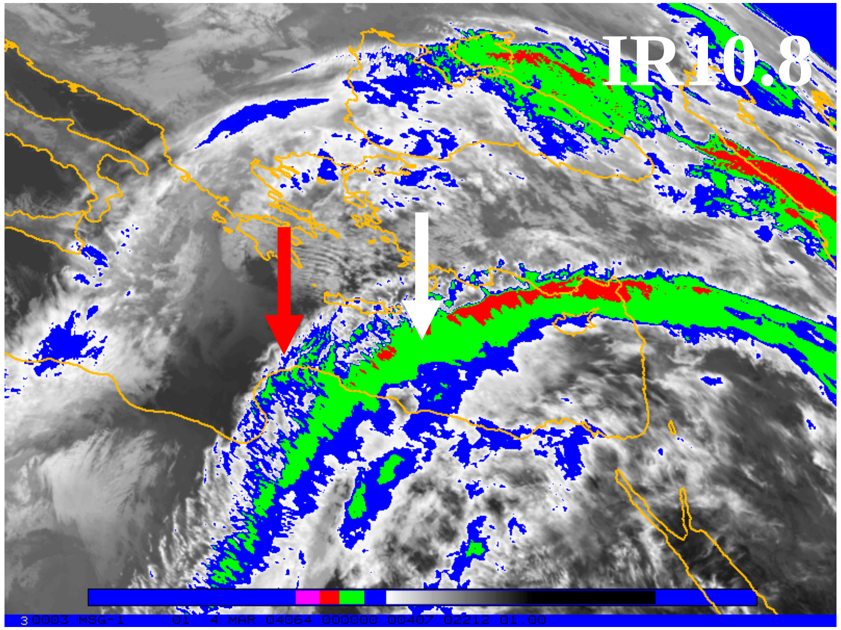
Thin Cirrus Clouds

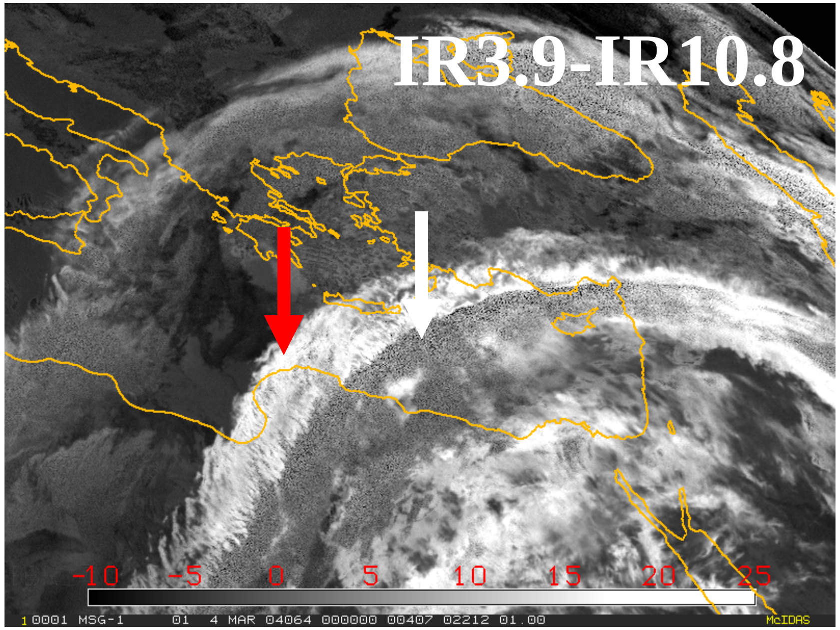


Ice clouds are more transparent (less absorption) at IR3.9 than at IR10.8.

==> IR3.9 much warmer than IR10.8 for thin ice (Cirrus) clouds.





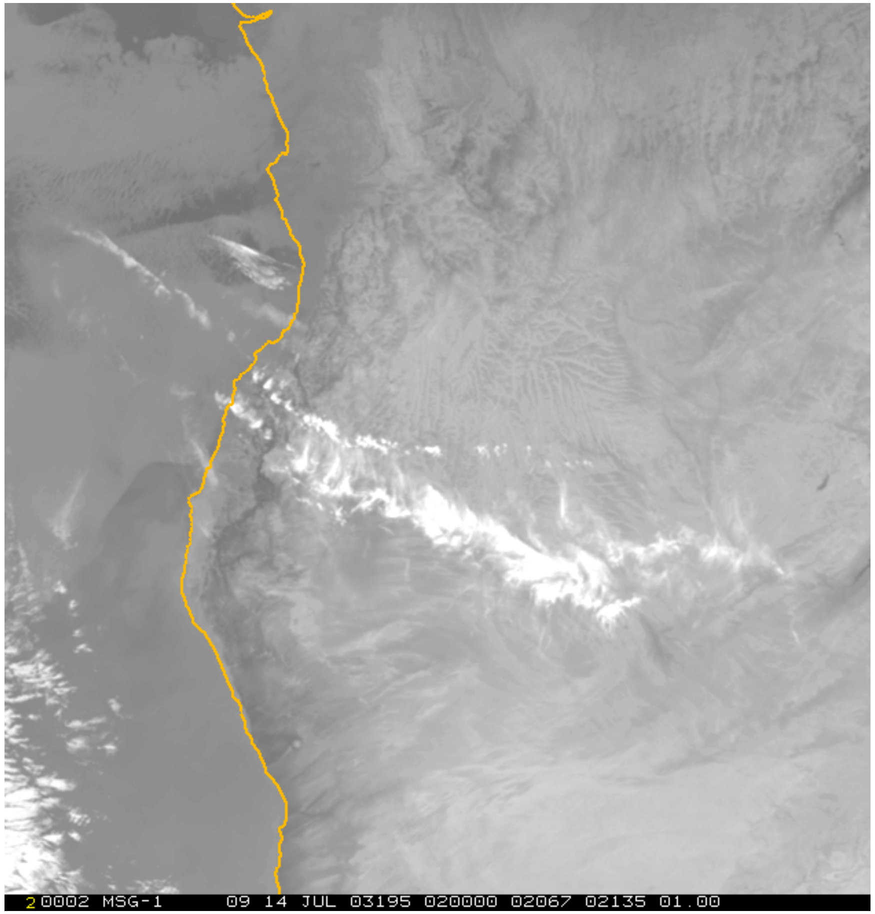


MSG-1, 4 March 2004, 00:00 UTC

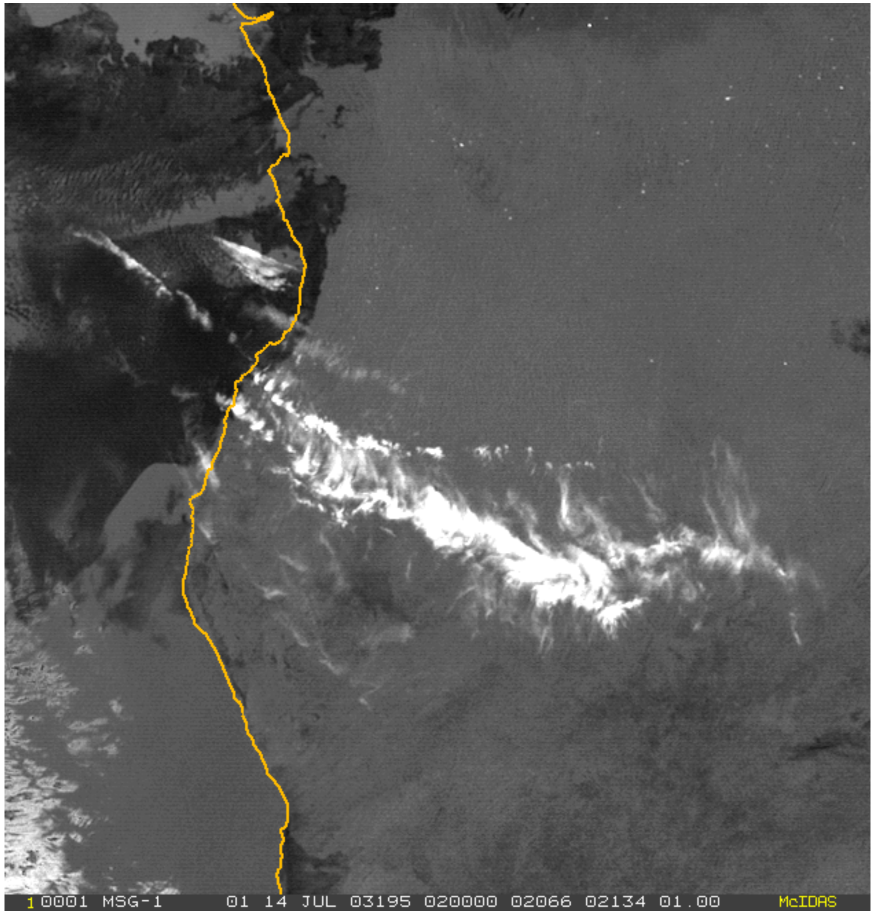
Cirrus clouds
optically thin (transparent)
IR3.9 = 258 K; IR10.8 = 240 K
IR3.9 - IR10.8 = +18 K

Cirrus clouds
optically thick
IR3.9 = 222 K; IR10.8 = 219 K
IR3.9 - IR10.8 = +3 K

Thin Cirrus Clouds (Night-time)



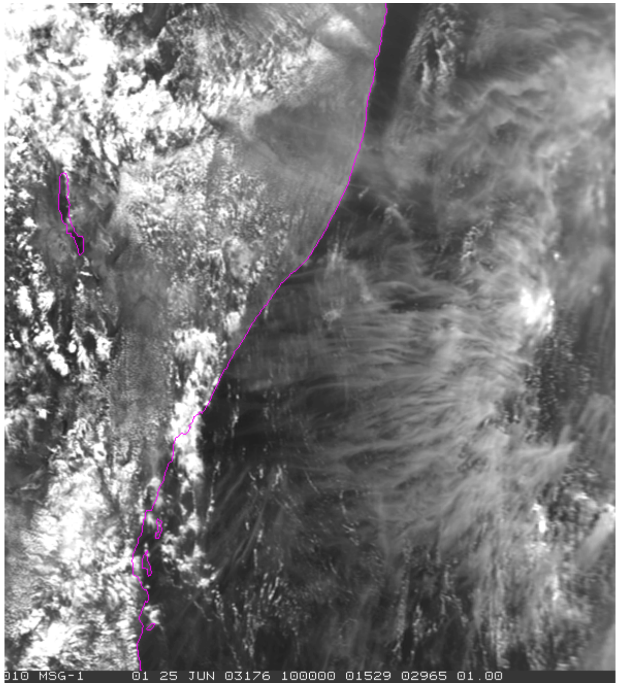
Channel IR10.8



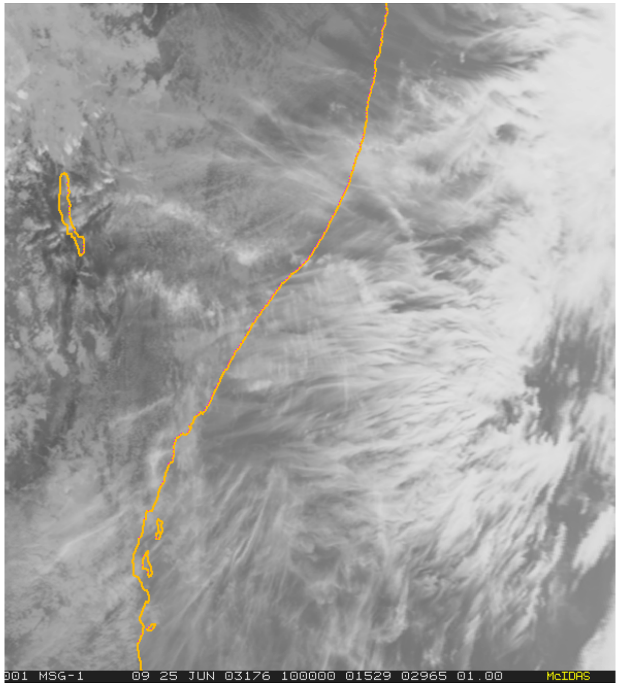
difference IR3.9 - IR10.8

MSG-1, 14 July 2003, 02:00 UTC

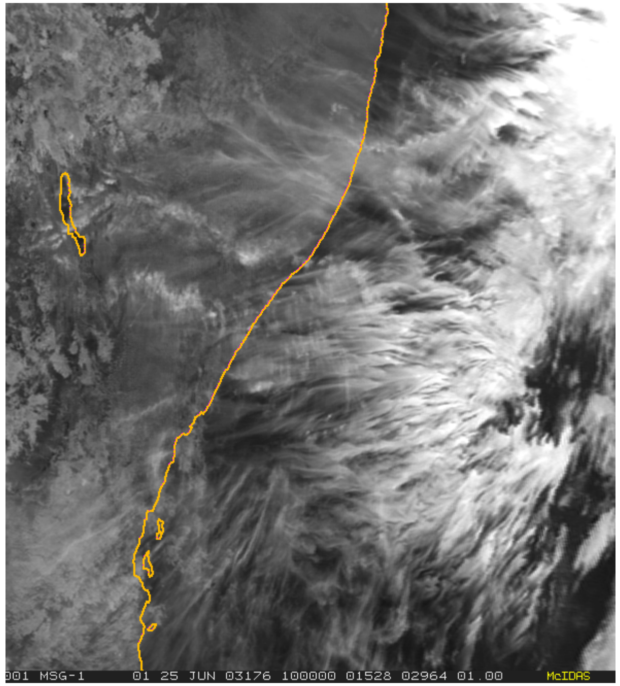
Thin Cirrus Clouds (Day-time)



Channel VIS0.6



Channel IR10.8



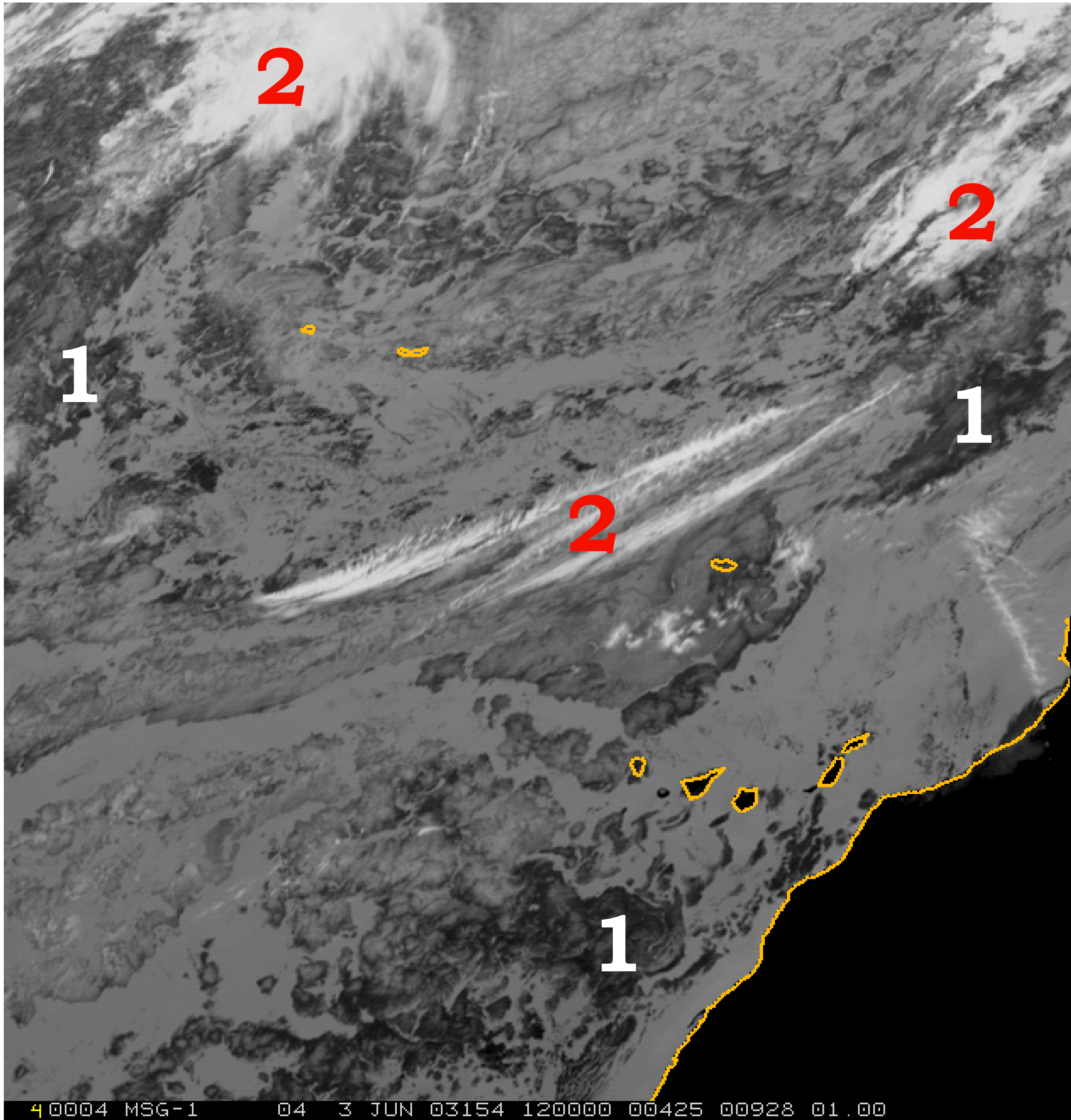
diff. IR3.9 - IR10.8

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

IR3.9: DETECTION OF MULTI-LAYER CLOUDS (DAY-TIME)

Multi-layer Clouds

- During daytime, low-level water clouds, with their higher reflectivity, appear much darker ("warmer") than high-level ice clouds
- Low-level water clouds can easily be detected at 3.9 um, even below Cirrus clouds

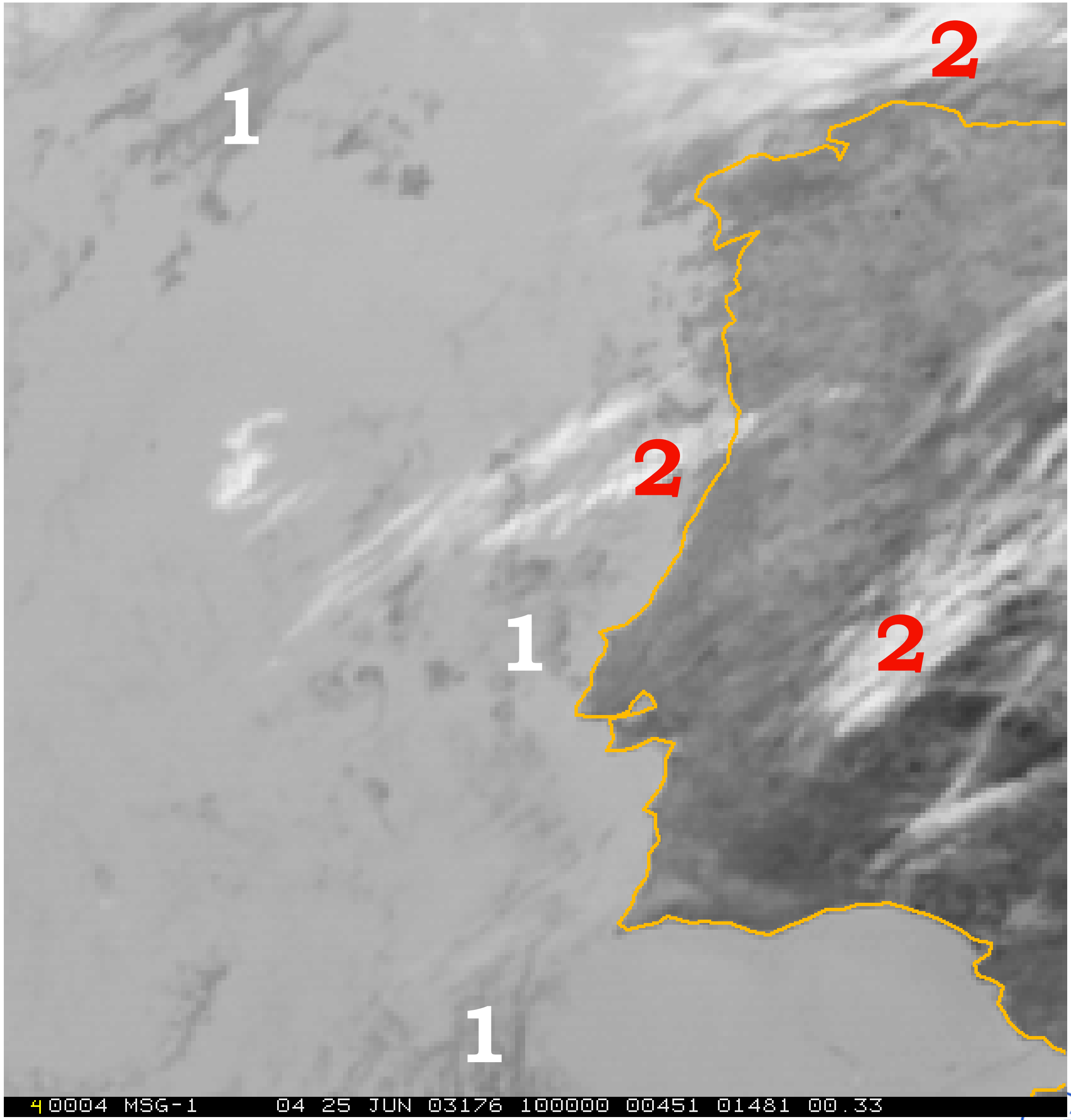


Multi-layer Clouds

1= low-level water clouds

2= high-level ice clouds

MSG-1
3 June 2003
12:00 UTC
Channel 04 (3.9 µm)

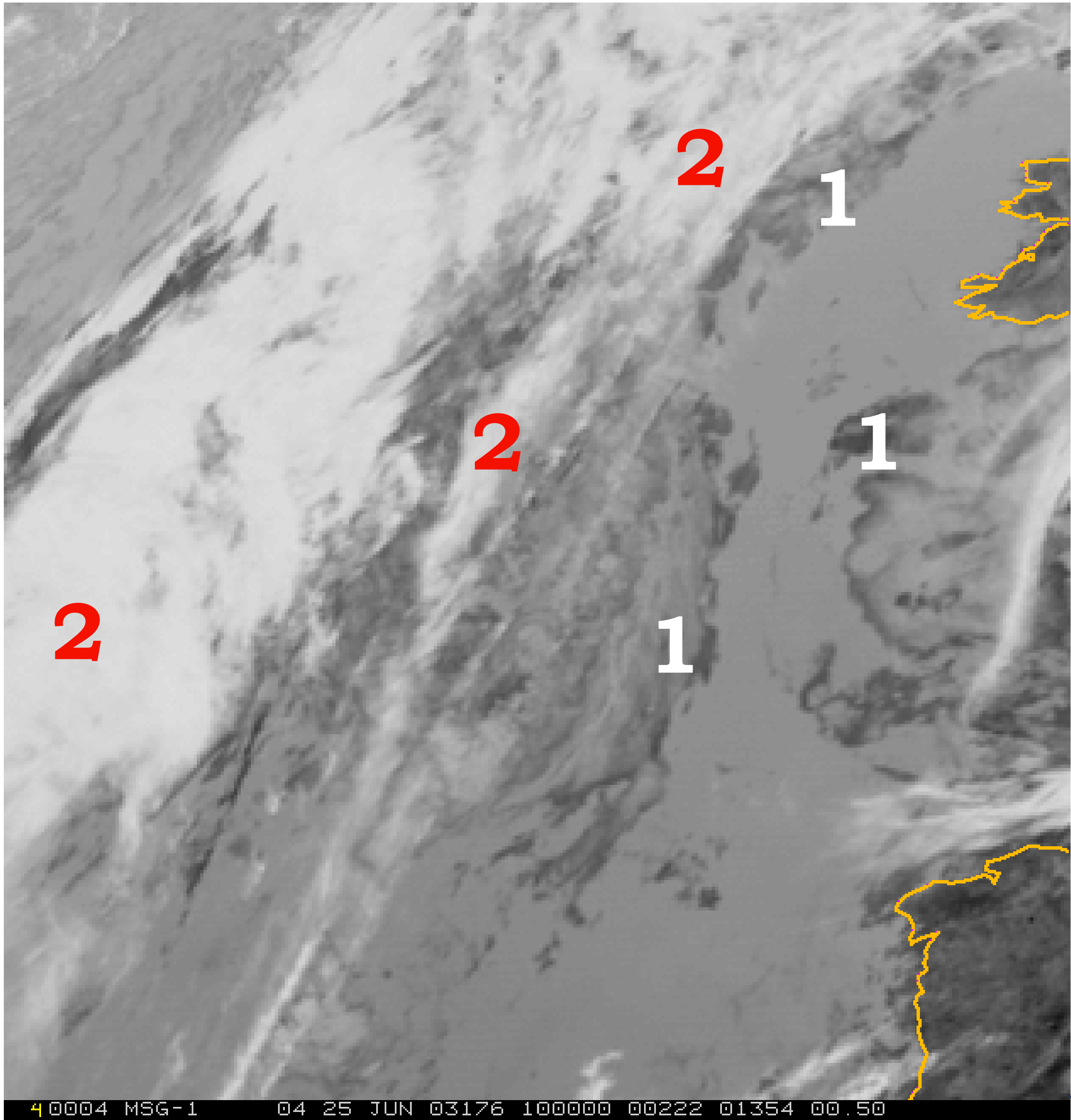


Multi-layer Clouds

1= low-level water clouds

2= high-level ice clouds

MSG-1
25 June 2003
10:00 UTC
Channel 04 (3.9 µm)



Multi-layer Clouds

1= low-level water clouds

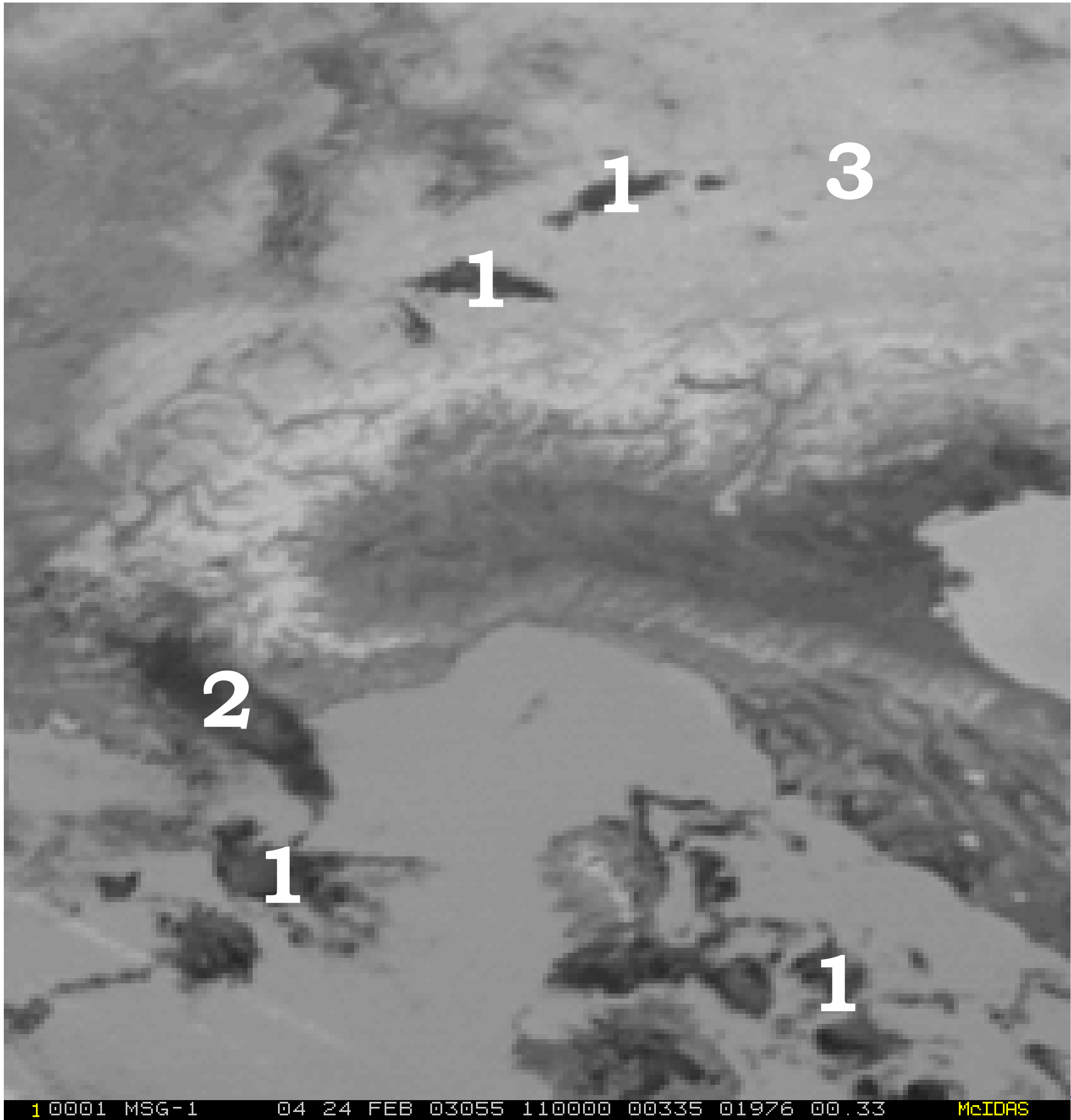
2= high-level ice clouds

MSG-1
25 June 2003
10:00 UTC
Channel 04 (3.9 µm)

IR3.9: DETECTION OF SUPERCOOLED CLOUDS (DAY AND NIGHT-TIME)

Supercooled Clouds (Day-time)

- Cloud tops consisting of supercooled water droplets may be located by using:
  - the 3.9 µm imagery to identify phase: supercooled water clouds have high reflection and appear dark.
  - the 10.8 µm imagery to determine cloud top temperature: supercooled water clouds have a top temperature between 0°C and -40°C.



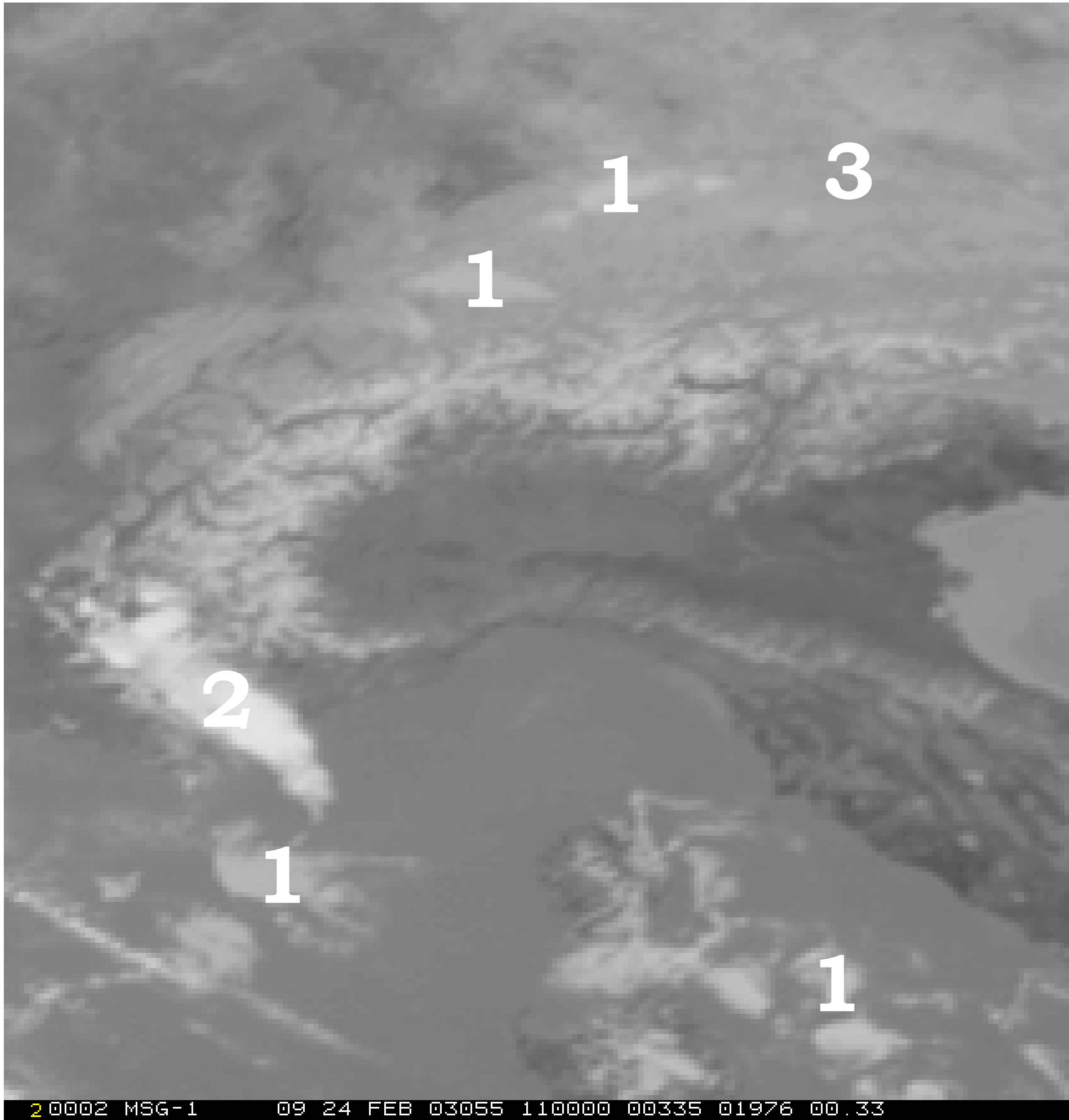
Supercooled Clouds (Day-time)

1= low-level water clouds
(top temp. -5°C)

2= mid-level water clouds
(top temp. -20°C)
(suppercooled cloud)

3= snow

MSG-1
24 February 2003
11:00 UTC
Channel 04 (3.9 µm)



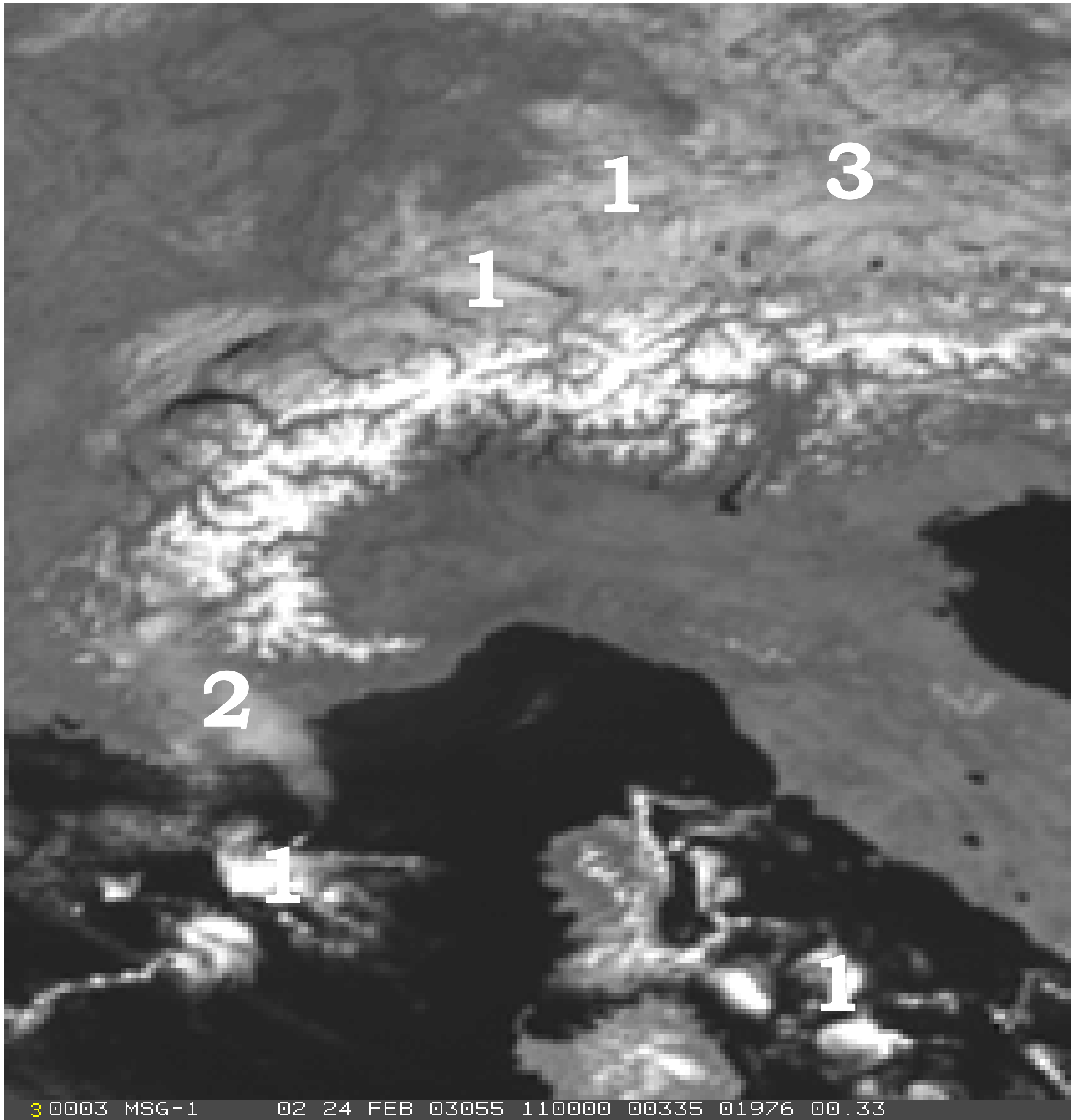
Supercooled Clouds (Day-time)

1= low-level water clouds
(top temp. -5°C)

2= mid-level water clouds
(top temp. -20°C)
(suppercooled cloud)

3= snow

MSG-1
24 February 2003
11:00 UTC
Channel 09 (10.8 µm)



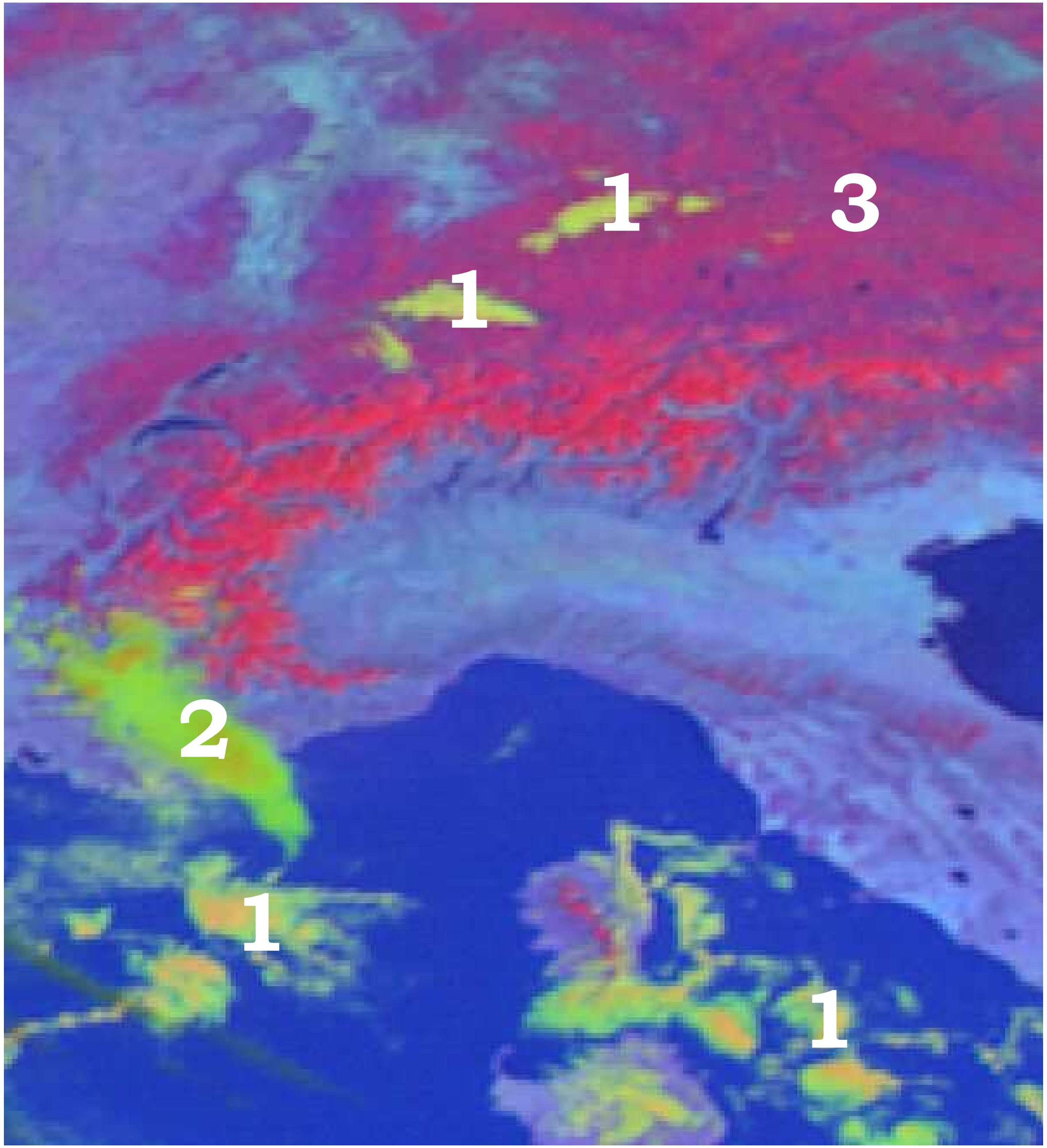
Supercooled Clouds (Day-time)

1= low-level water clouds
(top temp. -5°C)

2= mid-level water clouds
(top temp. -20°C)
(suppercooled cloud)

3= snow

MSG-1
24 February 2003
11:00 UTC
Channel 02 (0.8 µm)



Supercooled Clouds (Day-time)

In RGB 02-04r-09 composites, supercooled clouds appear in greenish-yellowish colours (greenish for thin clouds; yellowish for thick clouds)

MSG-1
24 February 2003
11:00 UTC
RGB Composite
R = VIS0.8
G = IR3.9r
B = IR10.8

Supercooled Clouds (Nighttime)

- During the night-time hours, water clouds can also be distinguished from ice clouds by using the "fog product" (difference IR3.9 - IR10.8).

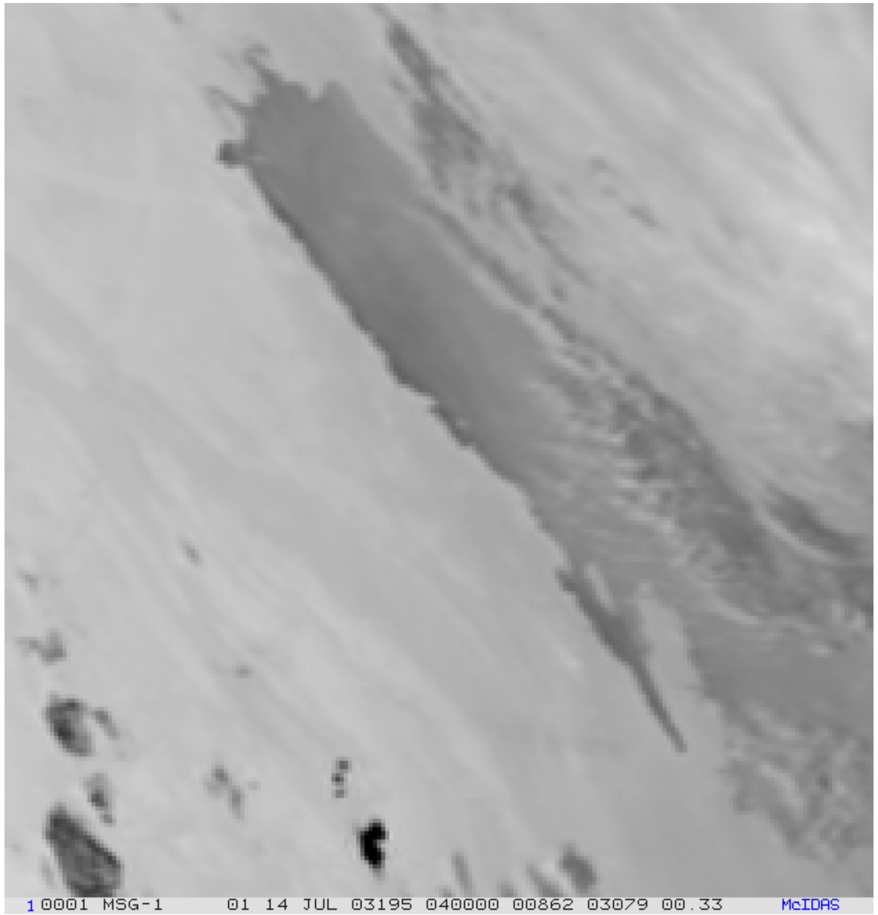
- Similar to the day-time application, the "fog product" and the 10.8 µm imagery can be used together to locate cloud tops consisting of supercooled water at night.

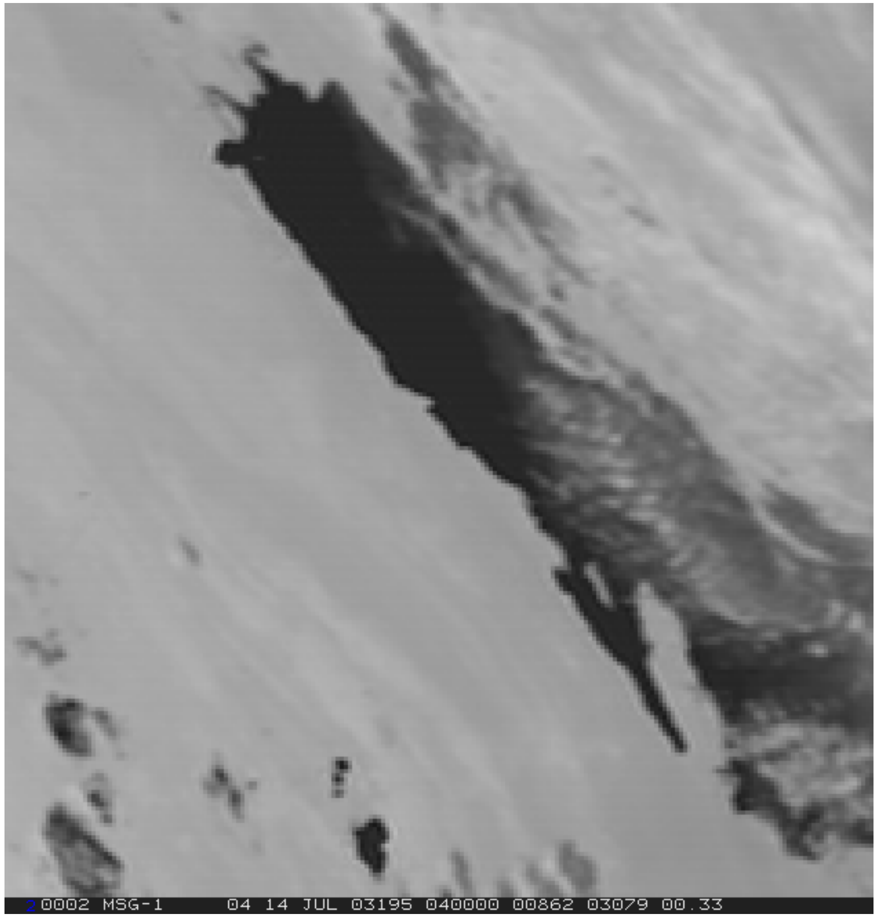
IR3.9: SUN GLINT (DAY-TIME)

Sun Glint

- There is very strong reflection of solar radiation at 3.9 µm
- This causes sun glint to be very bright in the 3.9 µm imagery and, at low solar angles, the sensor (and thus the image) becomes saturated
- Possible application: wind speed and direction, oil spills ...

Sun Glint

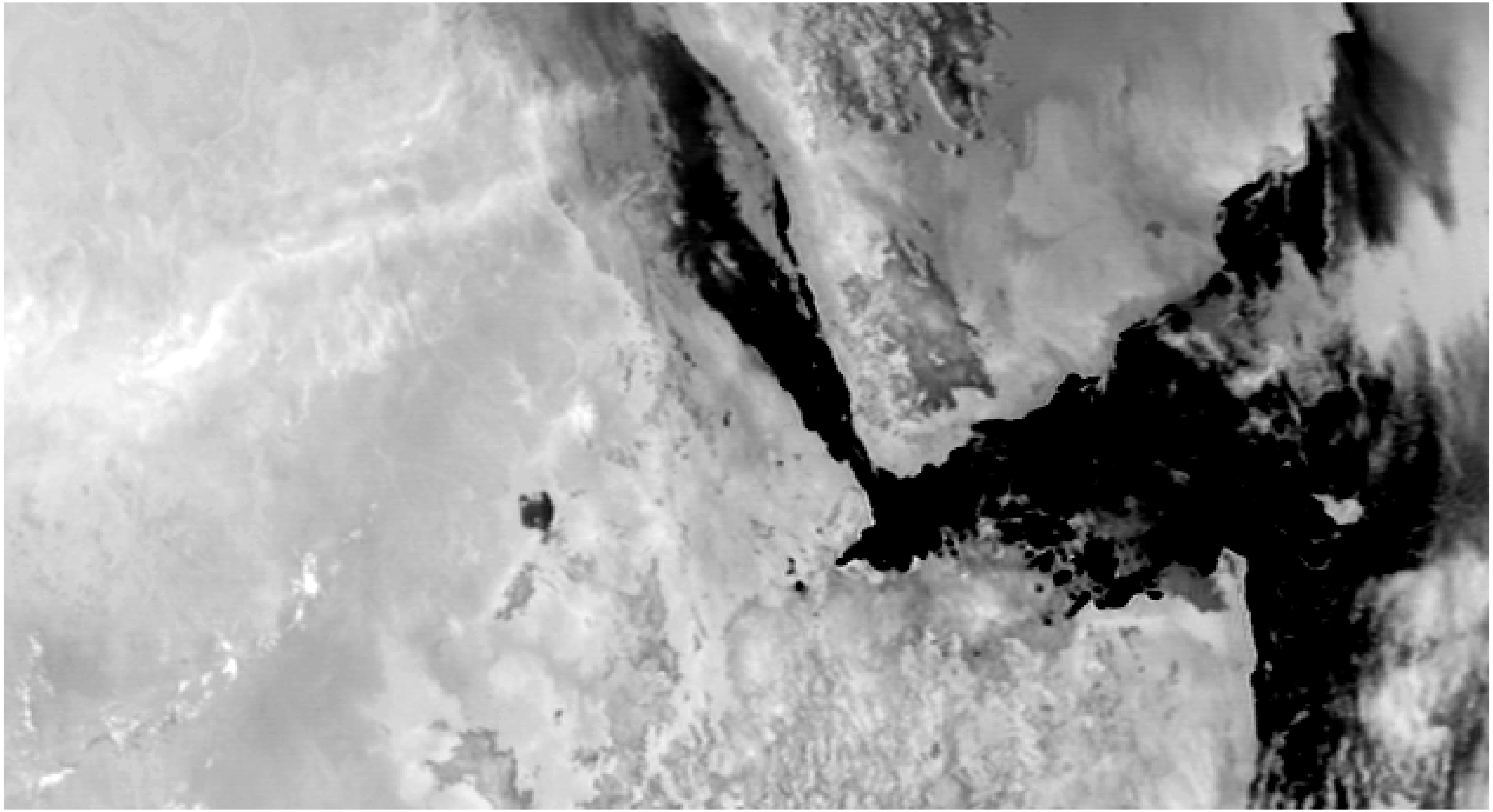




Channel VIS0.6 (inverted) **Channel IR3.9**

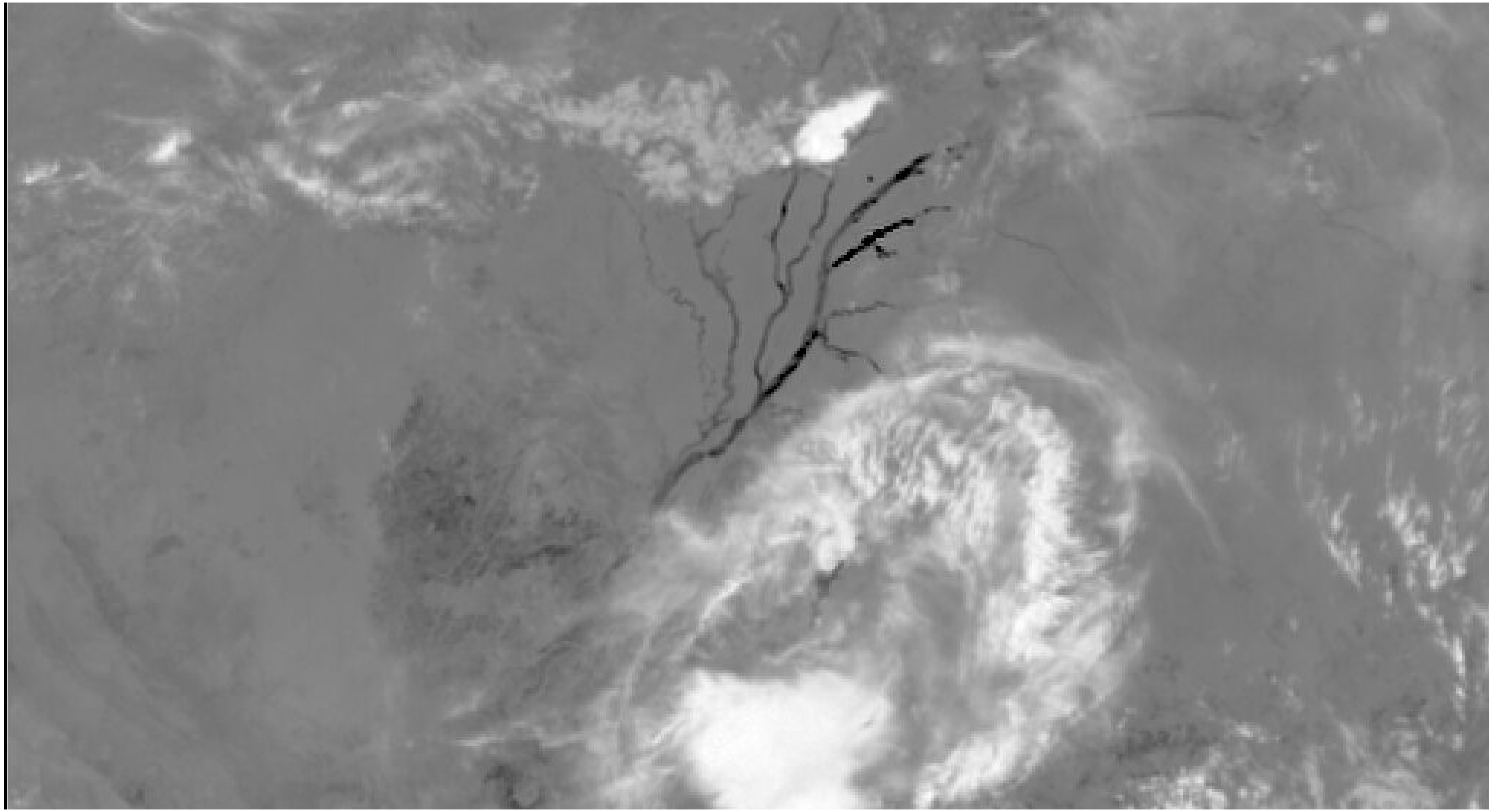
Early morning sun glint over the Gulf of Arabia
MSG-1, 14 July 2003, 04:00 UTC

Sun Glint



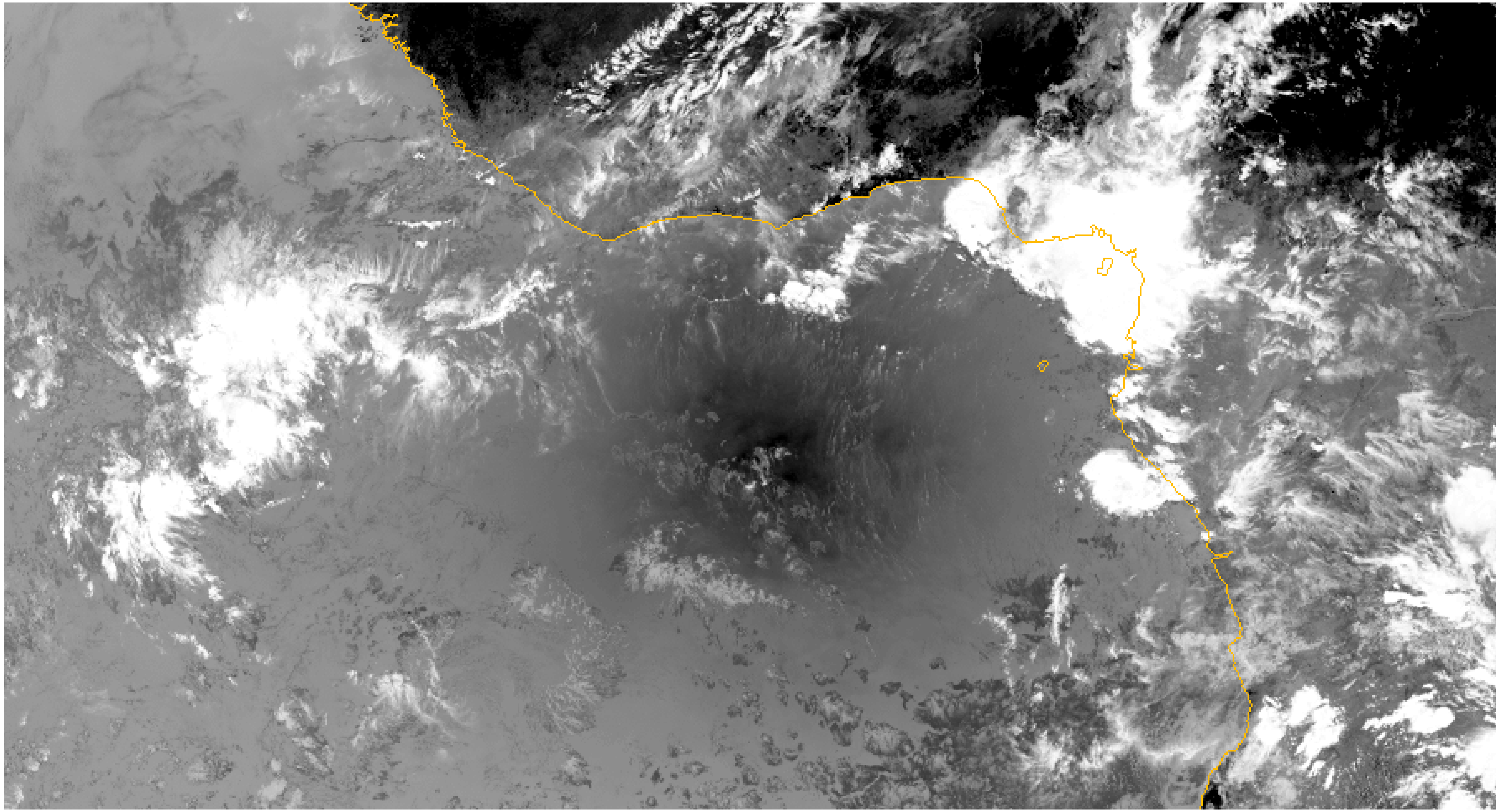
Early morning sun glint over the Arabian & Red Sea
MSG-1, 24 April 2003, 4:15 UTC, Channel 04 (3.9 μm)

Sun Glint



Midday sun glint over the Kongo river
MSG-1, 24 March 2004, 09:00 UTC, Channel 04 (3.9 µm)

Sun Glint

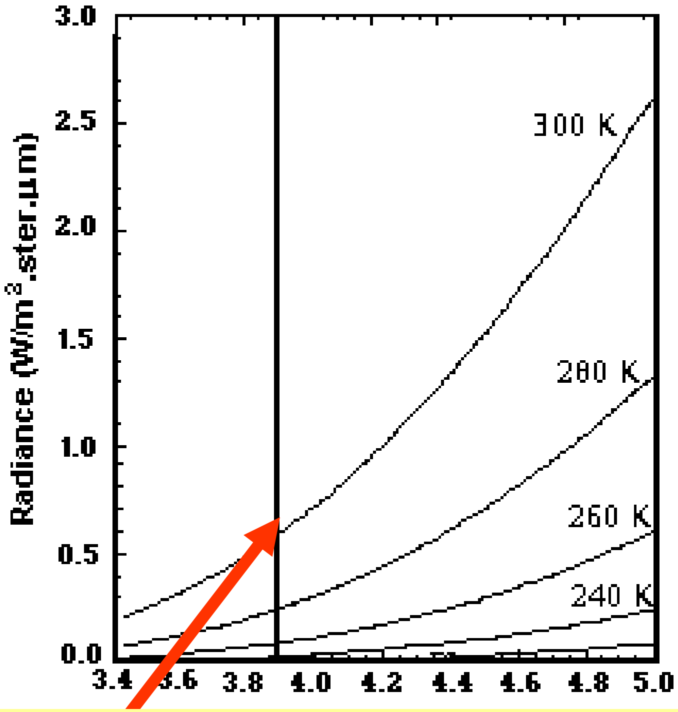


Afternoon sun glint over the Atlantic
MSG-1, 04 March 2004, 12:00 UTC, Channel 04 (3.9 µm)

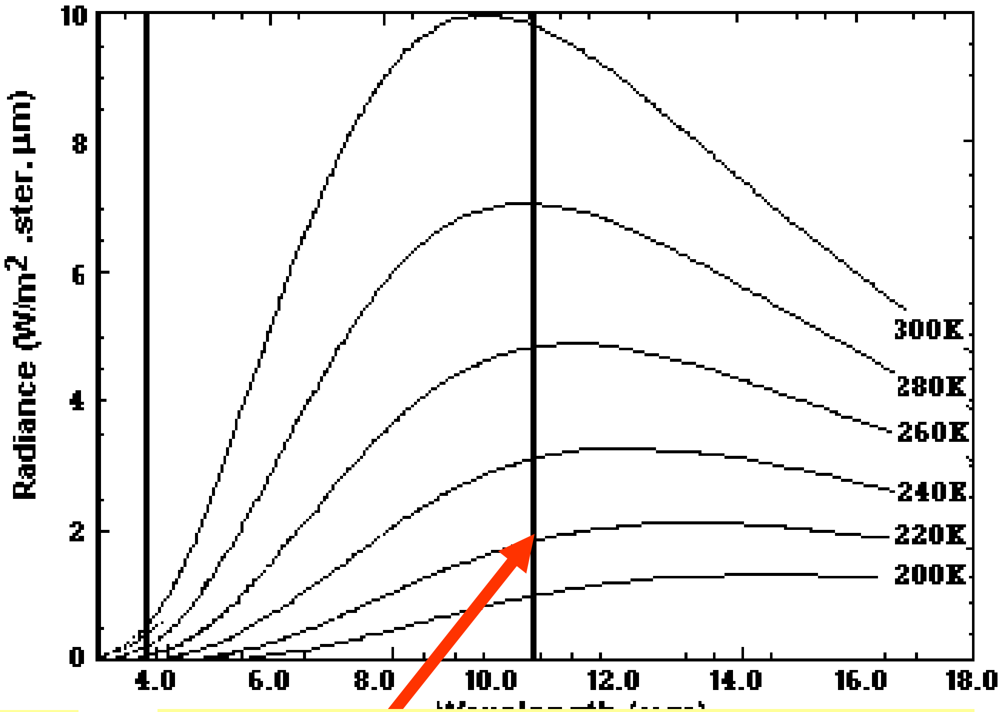
SUB-PIXEL RESPONSE OF IR3.9 CHANNEL

IR3.9 Channel: Sub-pixel response

- Radiance is not linear with temperature: $B = T^{\alpha/\lambda}$
- The response to changes in scene temperature is much larger at shorter wavelengths



Strong non-linear increase of radiance with increasing temperature



More "linear" increase of radiance with increasing temperature

IR3.9 Channel: Sub-pixel response

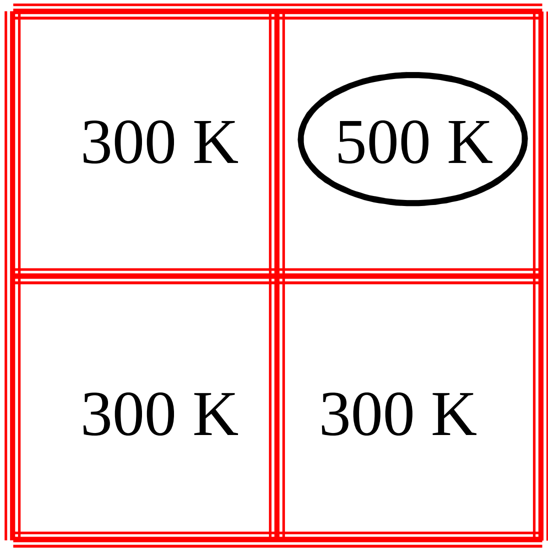
If there is variability within a field-of-view (FOV), then the radiance for that FOV is a linear combination of the separate radiances (**not** their temperatures)

IR3.9: B = $T^{13.6}$

B=(B1+B2+B3+B4)/4

$T=B^{1/13.6}$

T = 451 K



example: “hot” spot within one pixel observation

IR10.8.9: B = $T^{4.8}$

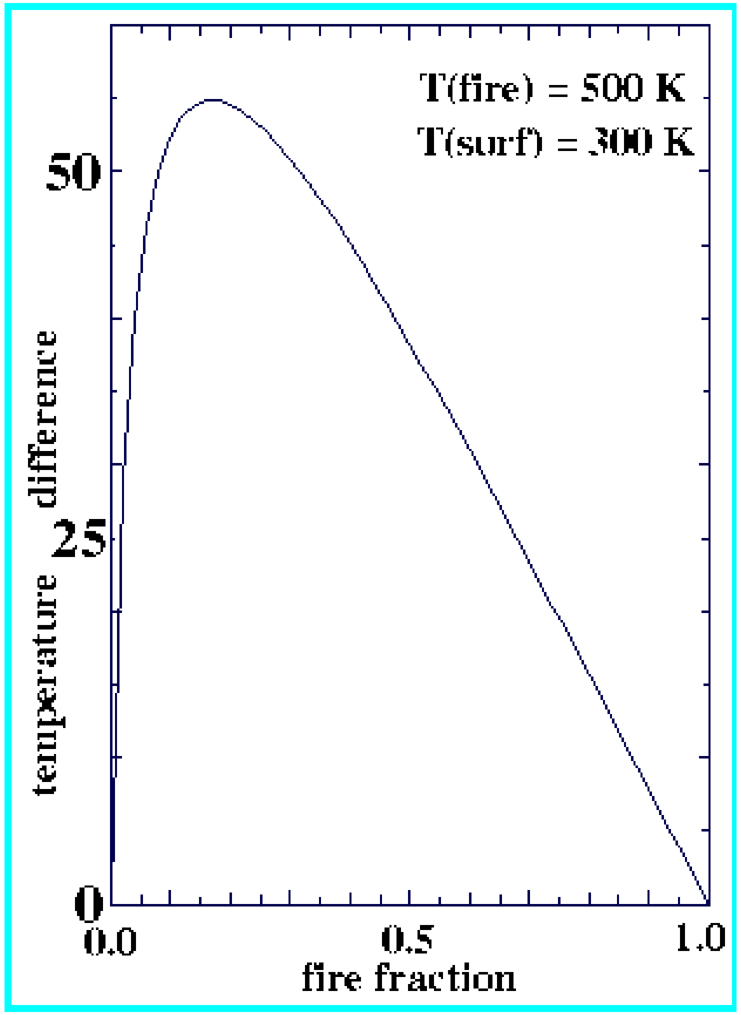
B=(B1+B2+B3+B4)/4

T = $B^{1/4.8}$

T = 392 K

IR3.9: DETECTION OF (FOREST) FIRES (DAY AND NIGHT-TIME)

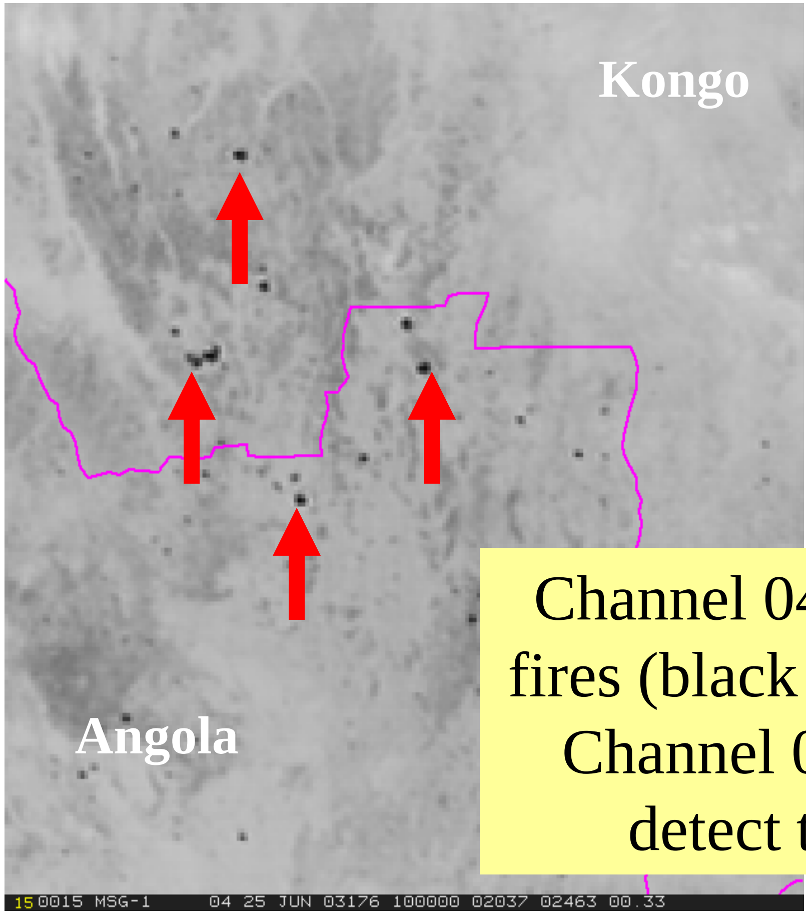
IR3.9 Channel: Sub-pixel response



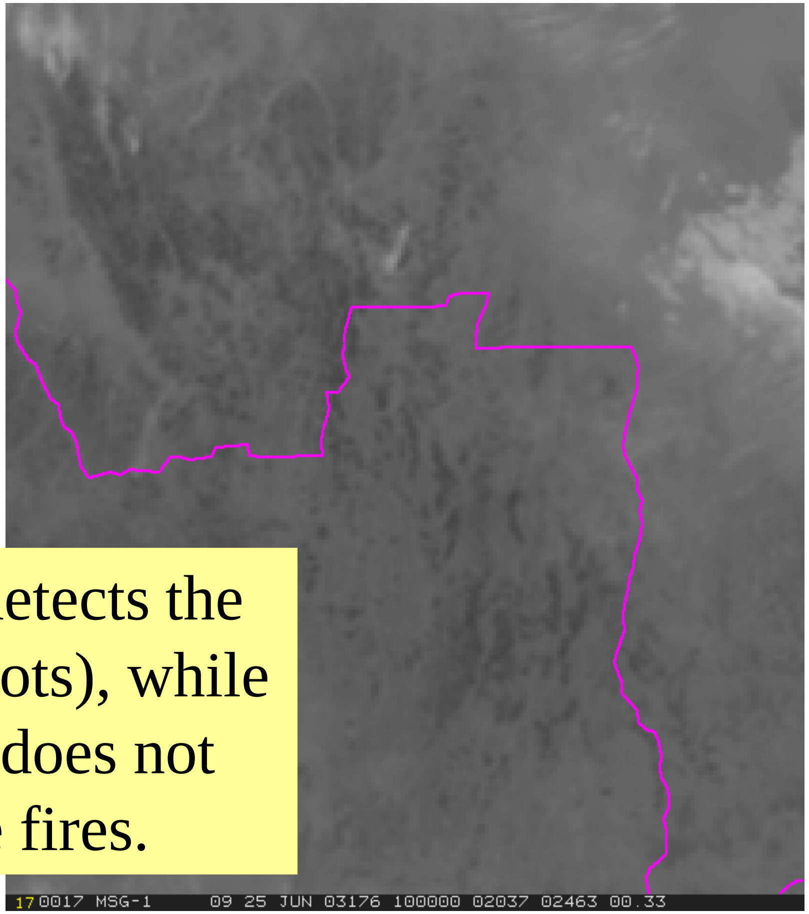
TB (3.9 µm) - TB (10.8 µm)

- Its strong sensitivity to sub-pixel "hot areas" makes the IR3.9 channel very useful in fire detection.
- If only 5% of the pixel is at 500 K, the IR3.9 channel measures 360 K, while the IR10.8 measures less than 320 K.
- If large fractions of the pixels are covered by fire, both channles can easily detect the fire.

Fires over Angola and Kongo



Channel 04 (3.9 µm)

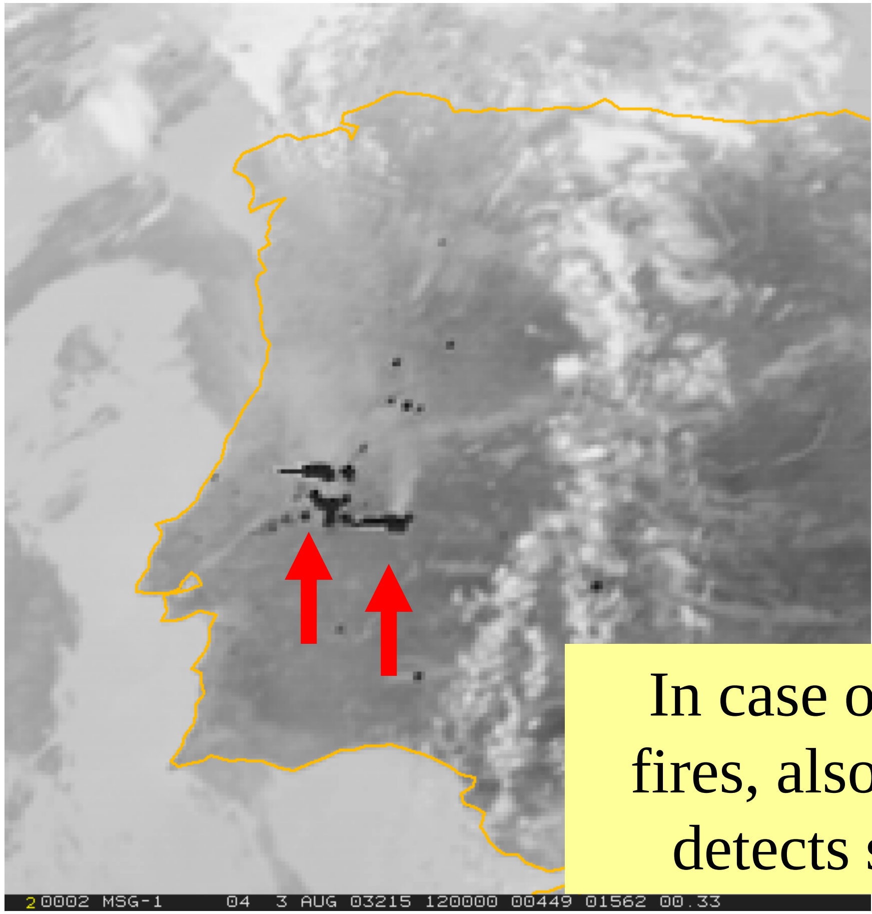


Channel 09 (10.8 µm)

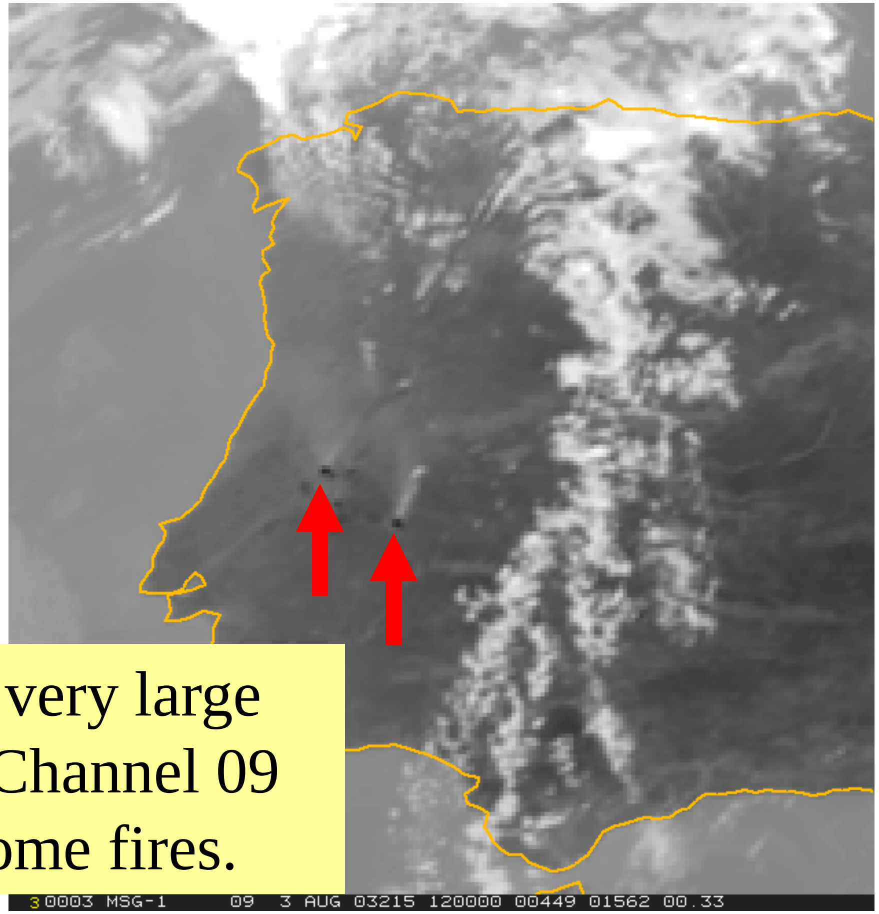
Channel 04 detects the fires (black spots), while Channel 09 does not detect the fires.

MSG imagery on 25 June 2003 at 10:00 UTC

Fires over Portugal and Spain



Channel 04 (3.9 µm)



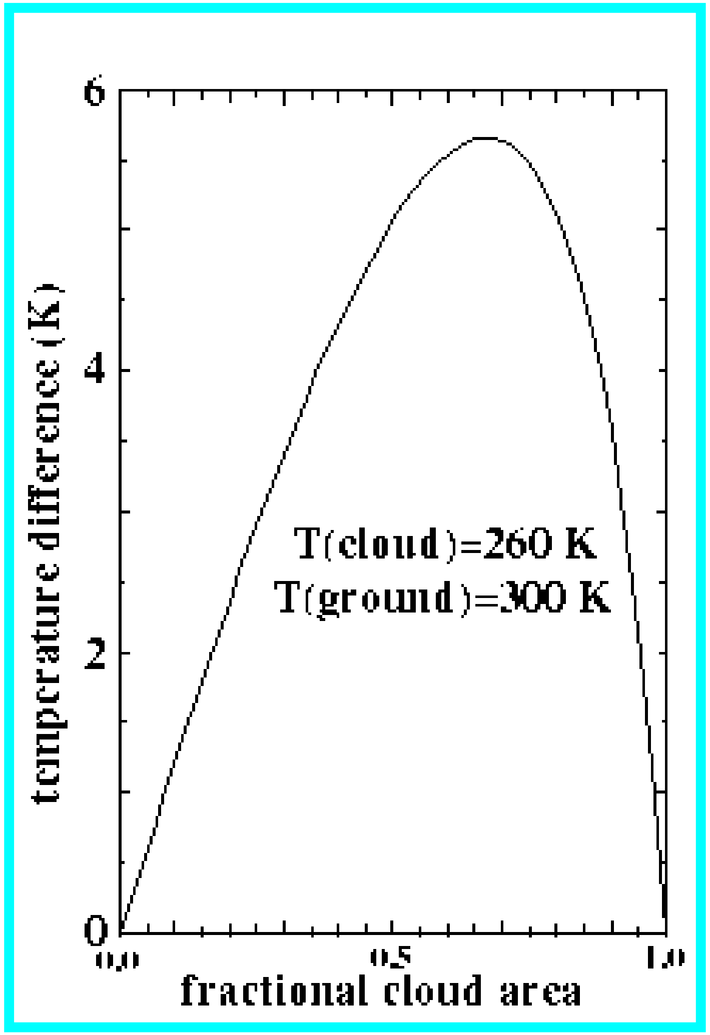
Channel 09 (10.8 µm)

In case of very large fires, also Channel 09 detects some fires.

MSG imagery on 3 August 2003 at 12:00 UTC

IR3.9: DETECTION OF BROKEN CLOUDS (DAY AND NIGHT-TIME)

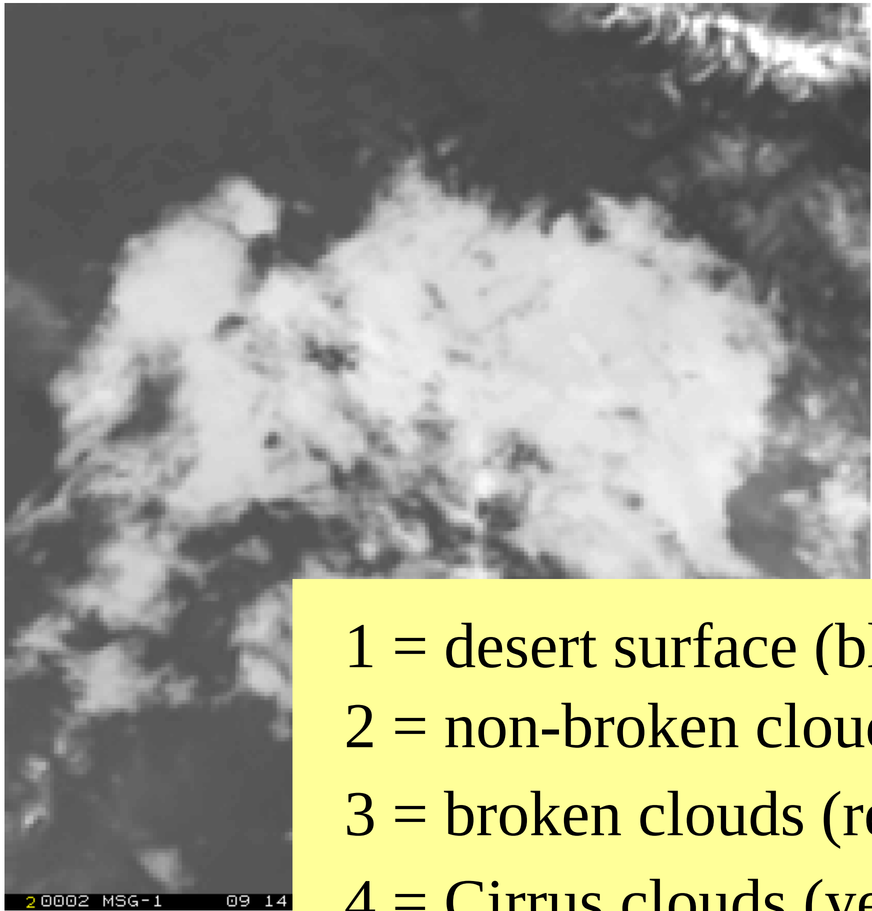
IR3.9 Channel: Sub-pixel response

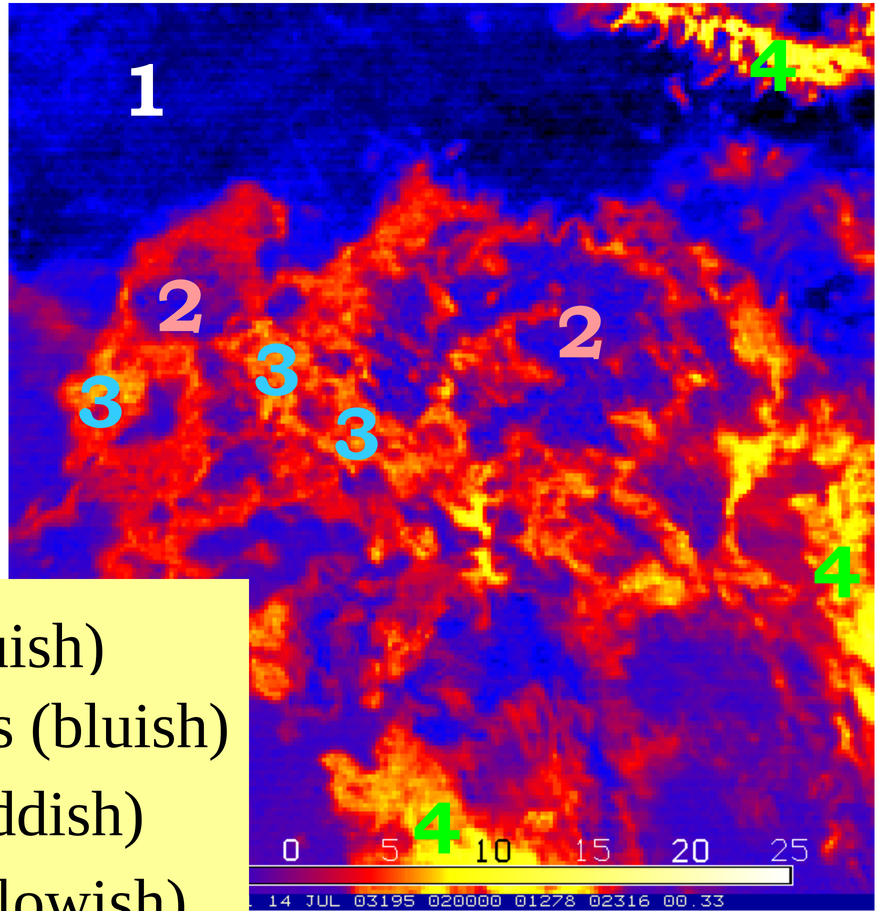


TB (3.9 µm) - TB (10.8 µm)

Its strong sensitivity to sub-pixel variations makes the IR3.9 channel also useful for fractional cloud cover (if the effects of emissivity and atmospheric moisture can be ignored)

Detection of Broken Clouds





1 = desert surface (bluish)
2 = non-broken clouds (bluish)
3 = broken clouds (reddish)
4 = Cirrus clouds (yellowish)

Cha… …erence IR3.9 - IR10.8

MSG-1, 14 July 2003, 2:00 UTC

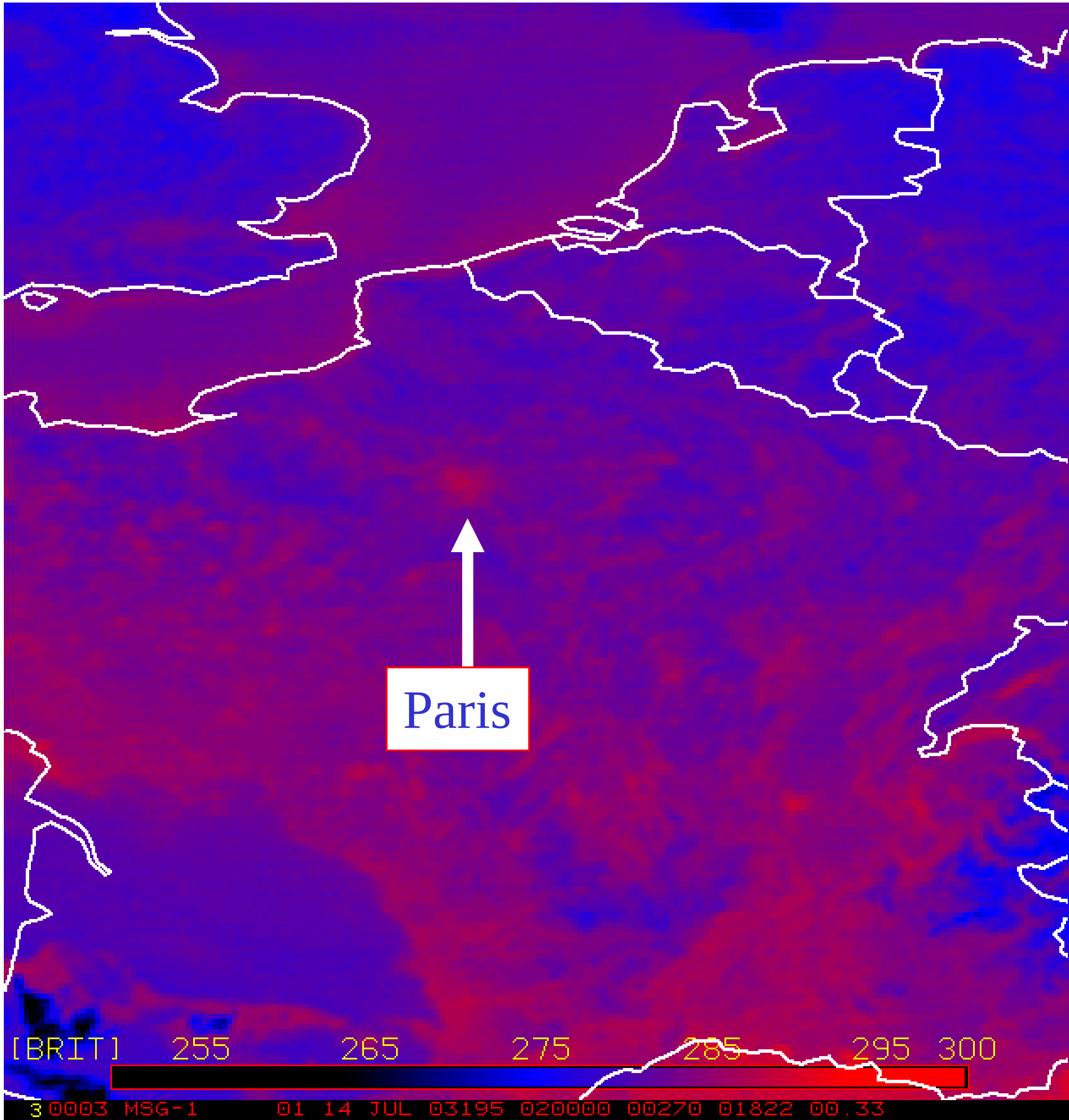
a lot more cloud structure is visible in the difference image

IR3.9: DETECTION OF URBAN HEAT "ISLANDS" (DAY-TIME)

Urban Heat "Islands"

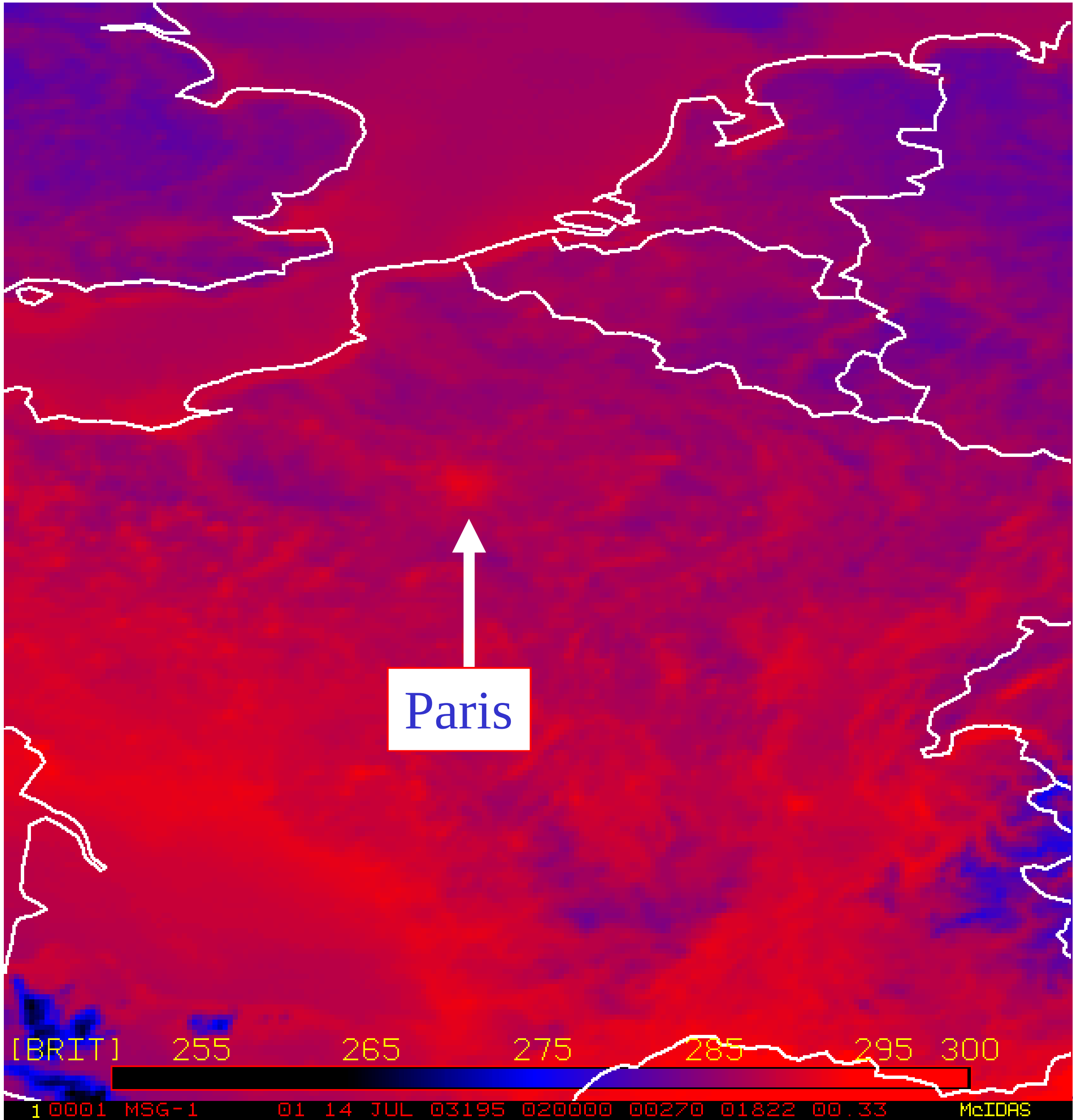
- MSG IR imagery makes it possible to locate urban heat "islands" under clear sky conditions
- The IR3.9 channel is better than IR10.8 better because of high sensitivity to sub-pixel temperature variations (warm areas in cities are like little fires)
- Stronger signal (temperature difference city - surroundings) in IR3.9 than in the other IR channels

Urban Heat "Islands"



MSG-1
14 July 2003
02:00 UTC
BT Channel 04 (3.9 µm)

Paris: 287 K
Surrounding: 281 K

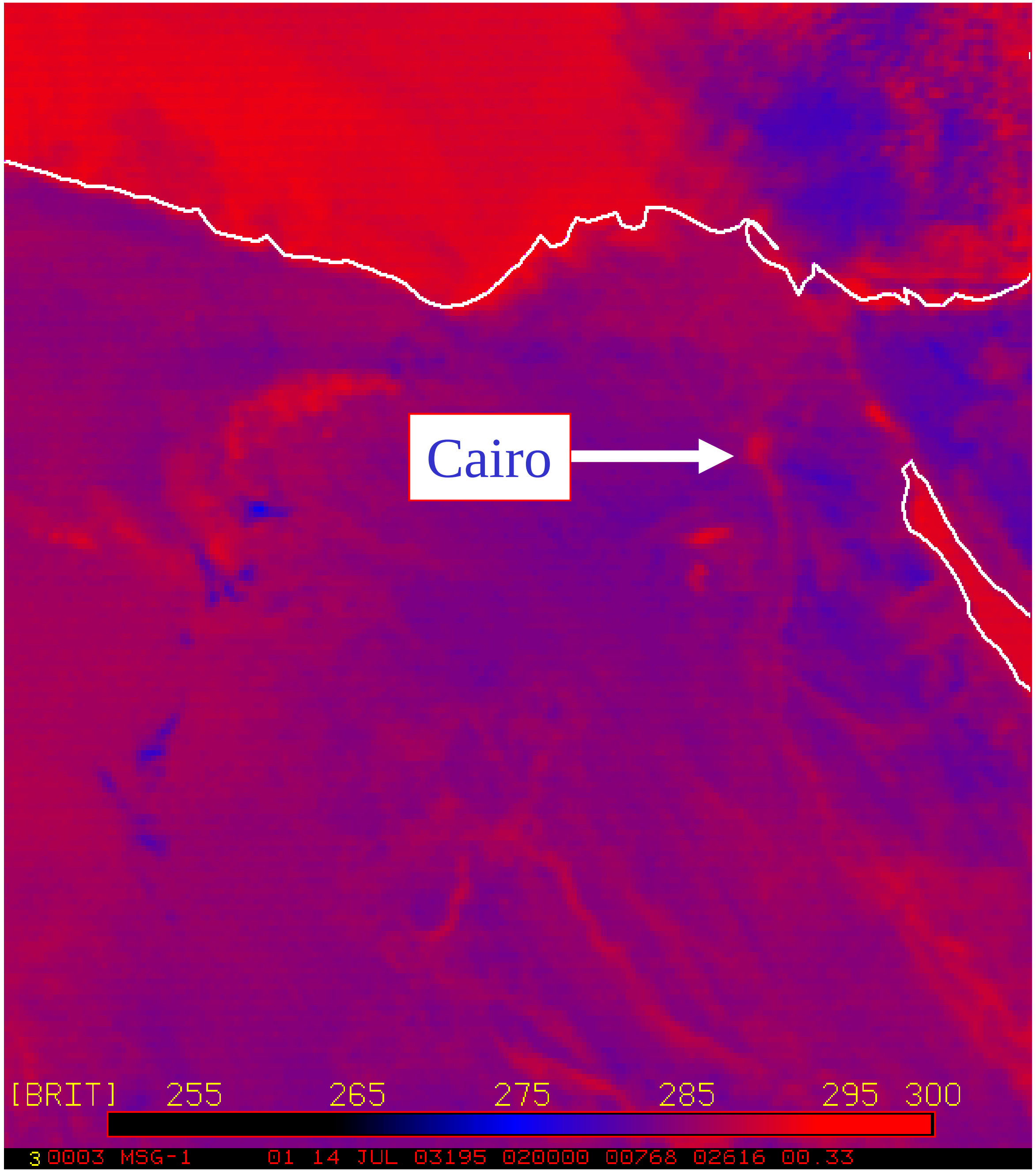


Urban Heat "Islands"

MSG-1
14 July 2003
02:00 UTC
BT Channel 09 (10.8 µm)

Paris: 291 K
Surrounding: 286 K

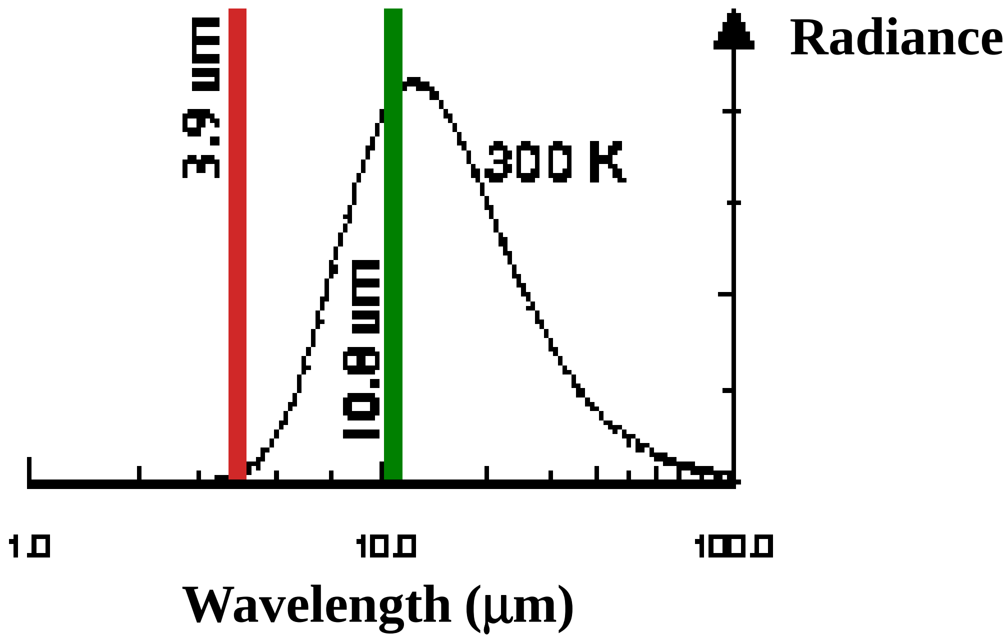
Urban Heat "Islands"



MSG-1
14 July 2003
02:00 UTC
BT Channel 04 (3.9 µm)

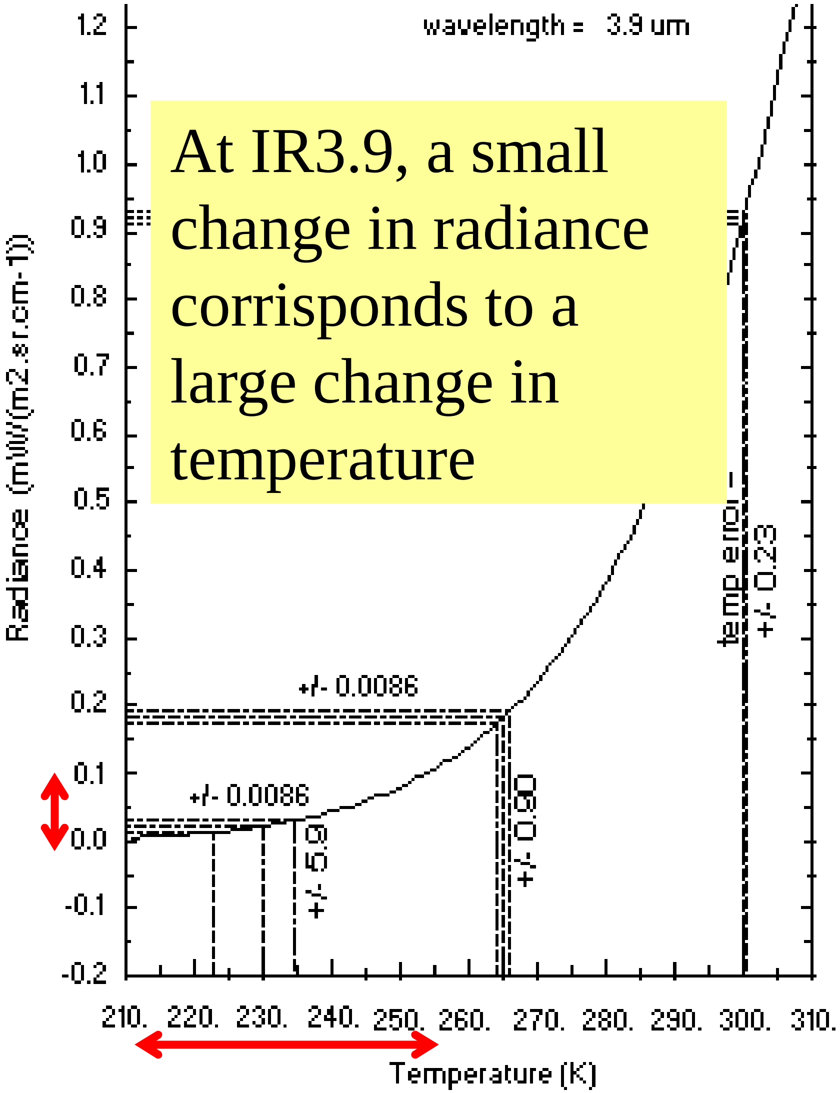
NOISE IN THE IR3.9 CHANNEL

Noise in the IR3.9 Channel

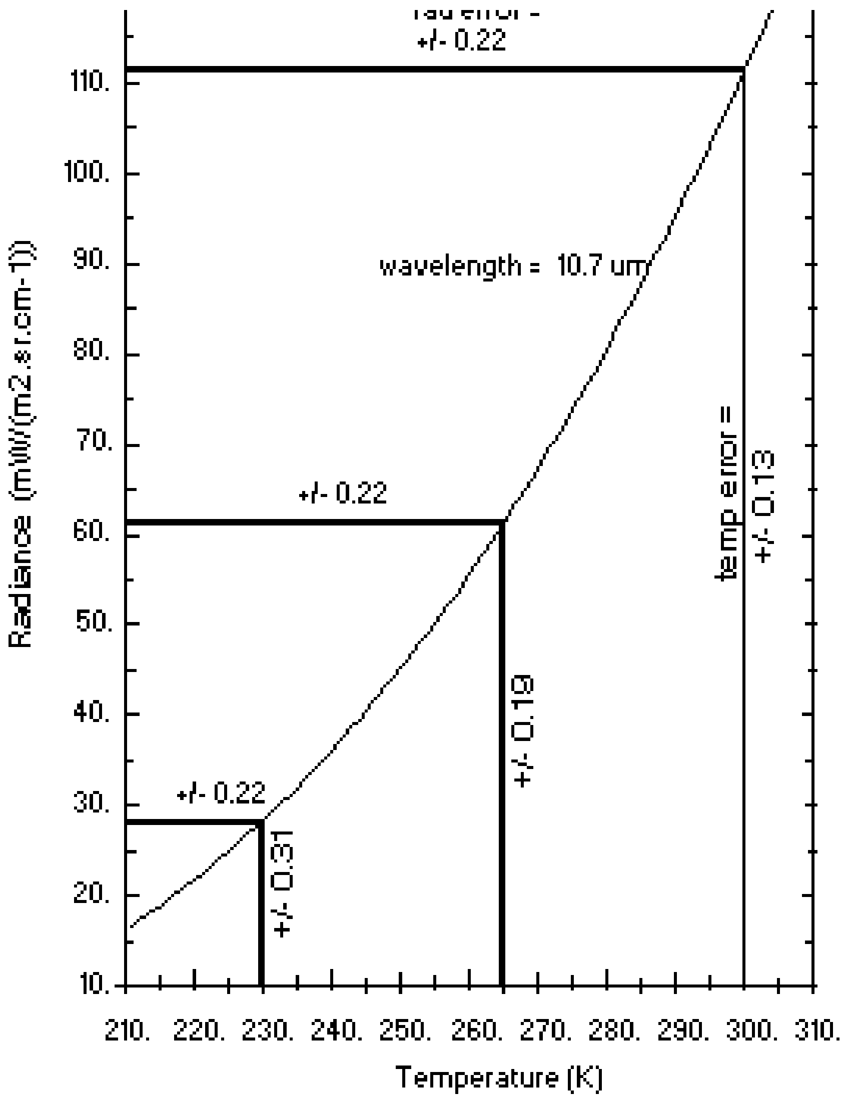


- At IR10.8, equivalent brightness temperatures can be determined very accurately at both warm and cold scene temperatues
- At IR3.9, the radiance increases rapidly with increasing temperature (see next slide)
- Since measurement accuracy is constant, the result is a much less accurate temperature measurement at cold scene temperatures in the IR3.9 channel

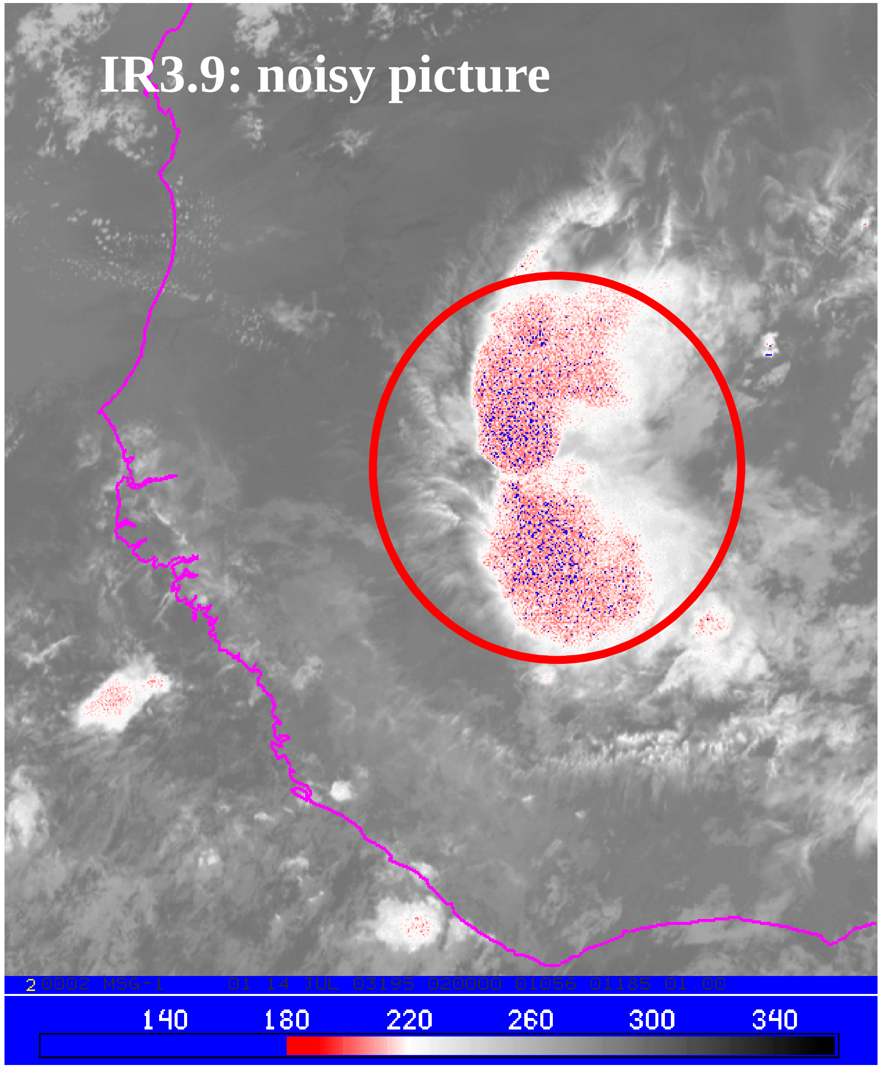
Noise in the IR3.9 Channel



At IR3.9, a small change in radiance corrisponds to a large change in temperature



Noise in the IR3.9 Channel: Example



MSG-1, 14 July 2003, 02:00 UTC, IR3.9

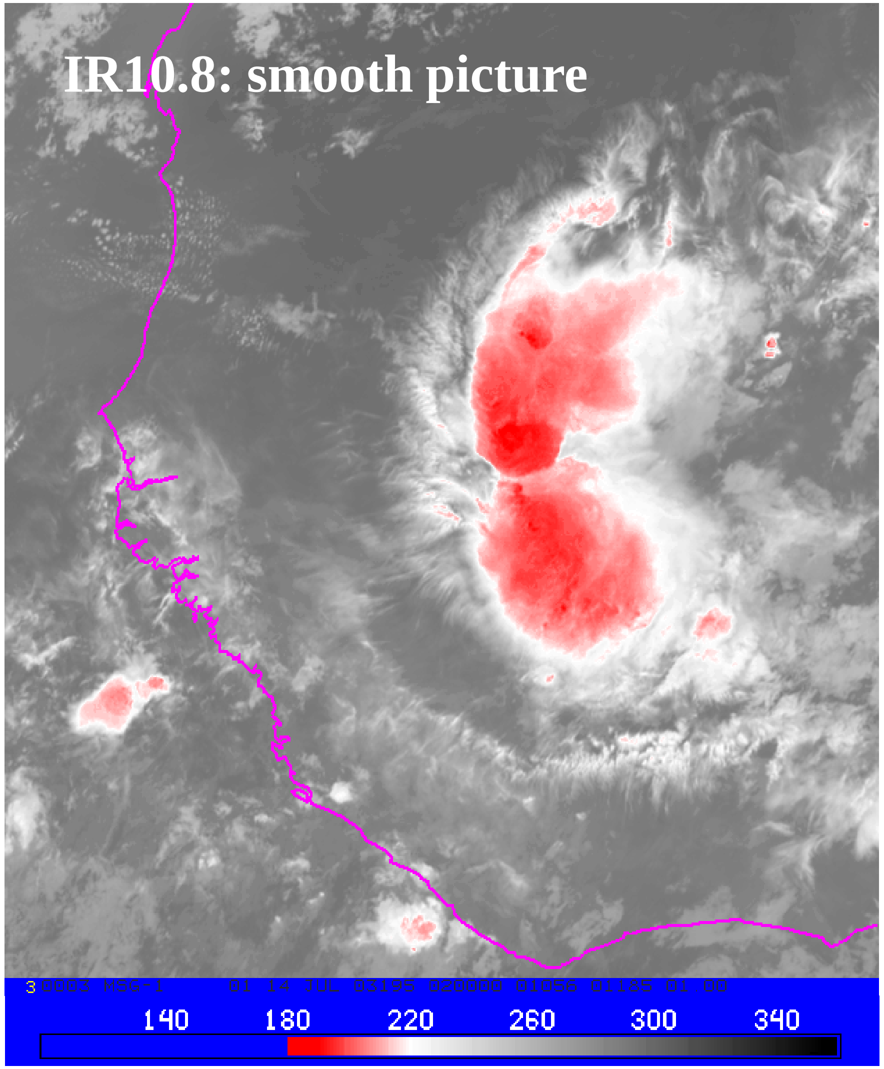
During the night, the IR3.9 channel cannot be used for cold cloud tops.

Below BTs of 220 K the IR3.9 channel is very noisy (radiances close to zero).

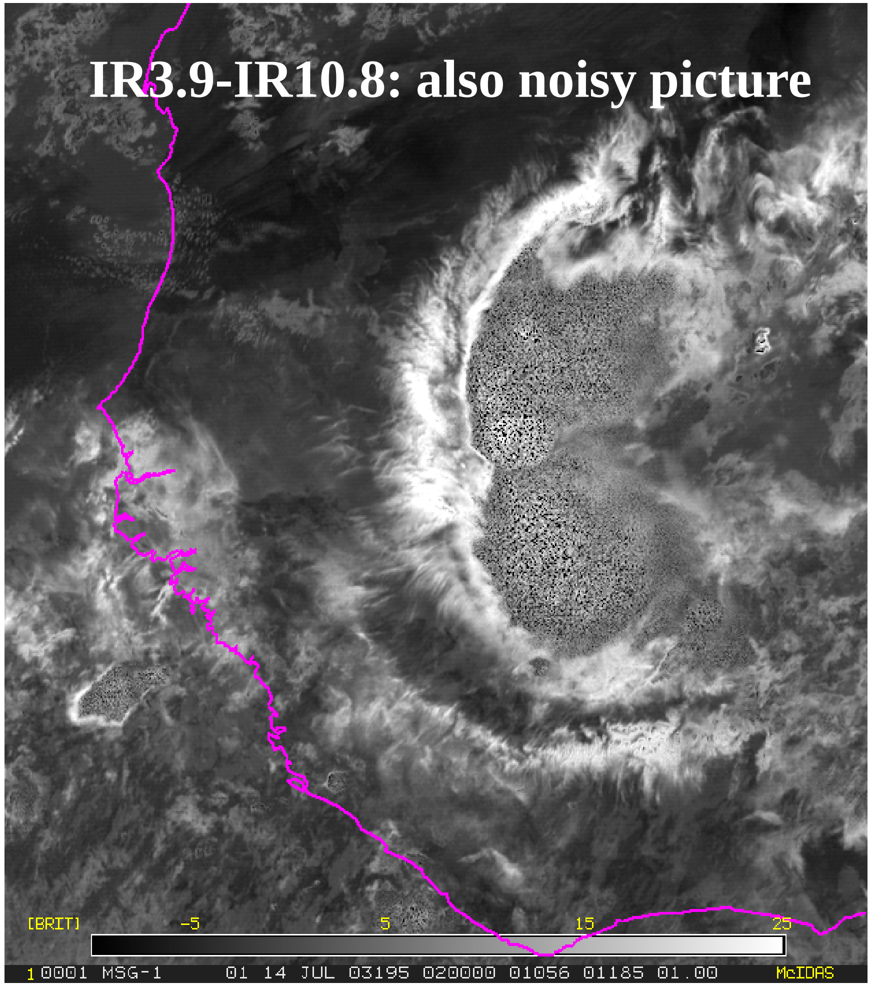
RAW [count]	RAD [mW/m^2]	TEMP [K]
54	0.01	218
53	0.01	213
52	0.00	205
51	0.00	131

Interpretation: IR3.9 imagery does a fine job for warm scene temperatures, but at night it is not useful for cold scenes like thunderstorm tops.

Noise in the IR3.9 Channel: Example



MSG-1, 14 July 2003, 02:00 UTC, IR10.8

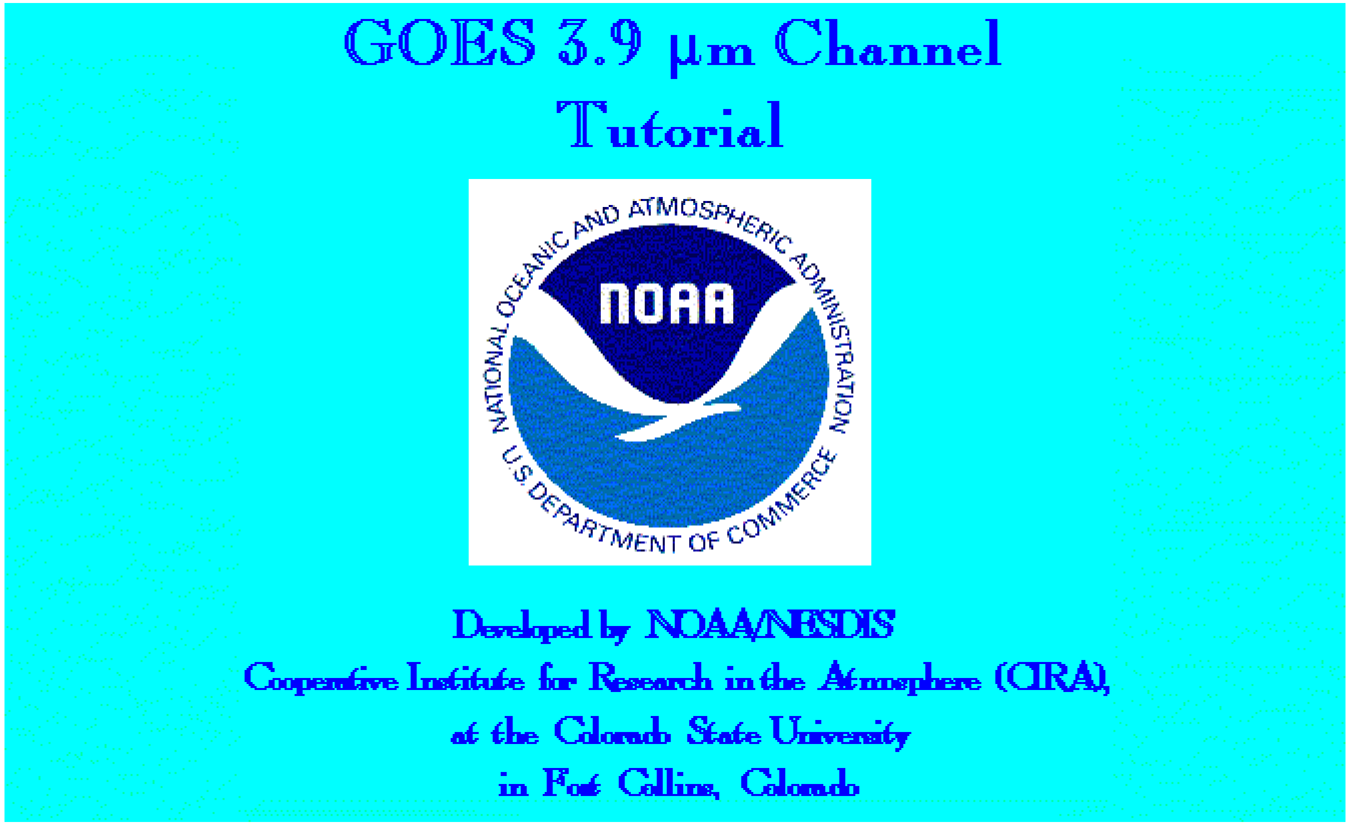


MSG-1, 14 July 2003, 02:00 UTC, IR3.9 - IR10.8

SUMMARY

Comparison IR3.9 vs IR10.8

- IR3.9 has solar contribution [daytime]
- IR3.9 is not a pure window channel (CO_2 band) ➨ Limb cooling
- Emissivities in IR3.9 differ from IR10.8
- IR3.9 is very sensitive to sub-pixel temperature variations
- Noise in IR3.9 makes it useless for T < 220 K
- Strong sun glint in IR3.9



http://www.cira.colostate.edu/ramm/goes39/cover.htm