CMa & CT
Cloud mask and type

15th June 2004

Madrid

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Plan of CMa & CT presentation

Illustration of algorithms' basis with MSG/SEVIRI

Algorithms' very short description

Some examples

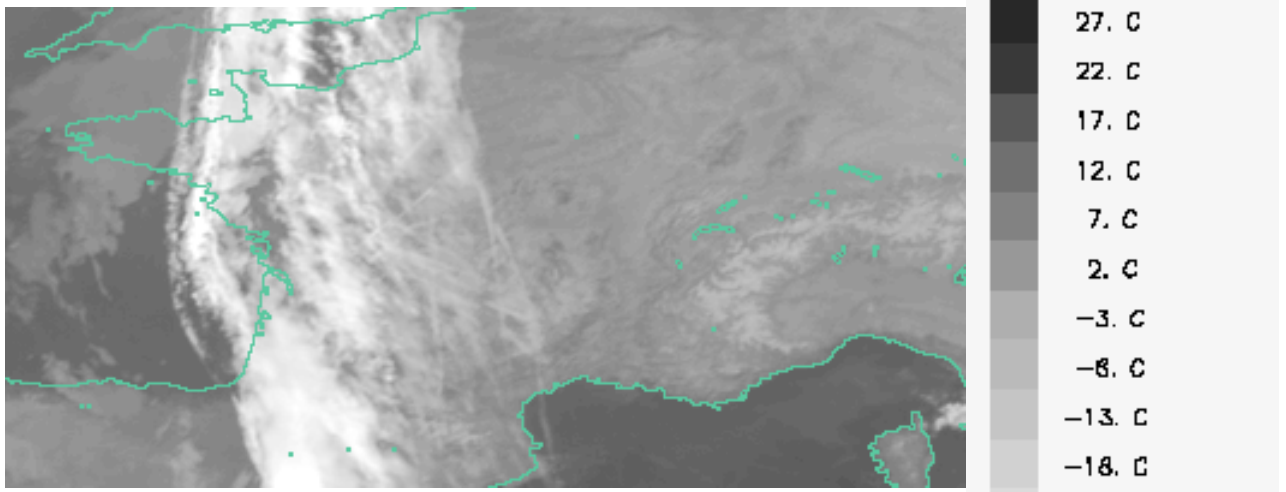
Known problems

Planned activities in 2004

As Meteosat-7

Channel	For cloud detection	Limitations
IR 10.8µm	Clouds colder than surface	Surface temperature depends on: -time and season -geographical location (orography…)
VIS 0.6µm ou 0.8µm	Clouds brighter than surface	Surface reflectance depends on: -geographical location (ex: desert) -illumination conditions (dawn, dusk, sunglint) -presence of snow/ice -présence of aerosol

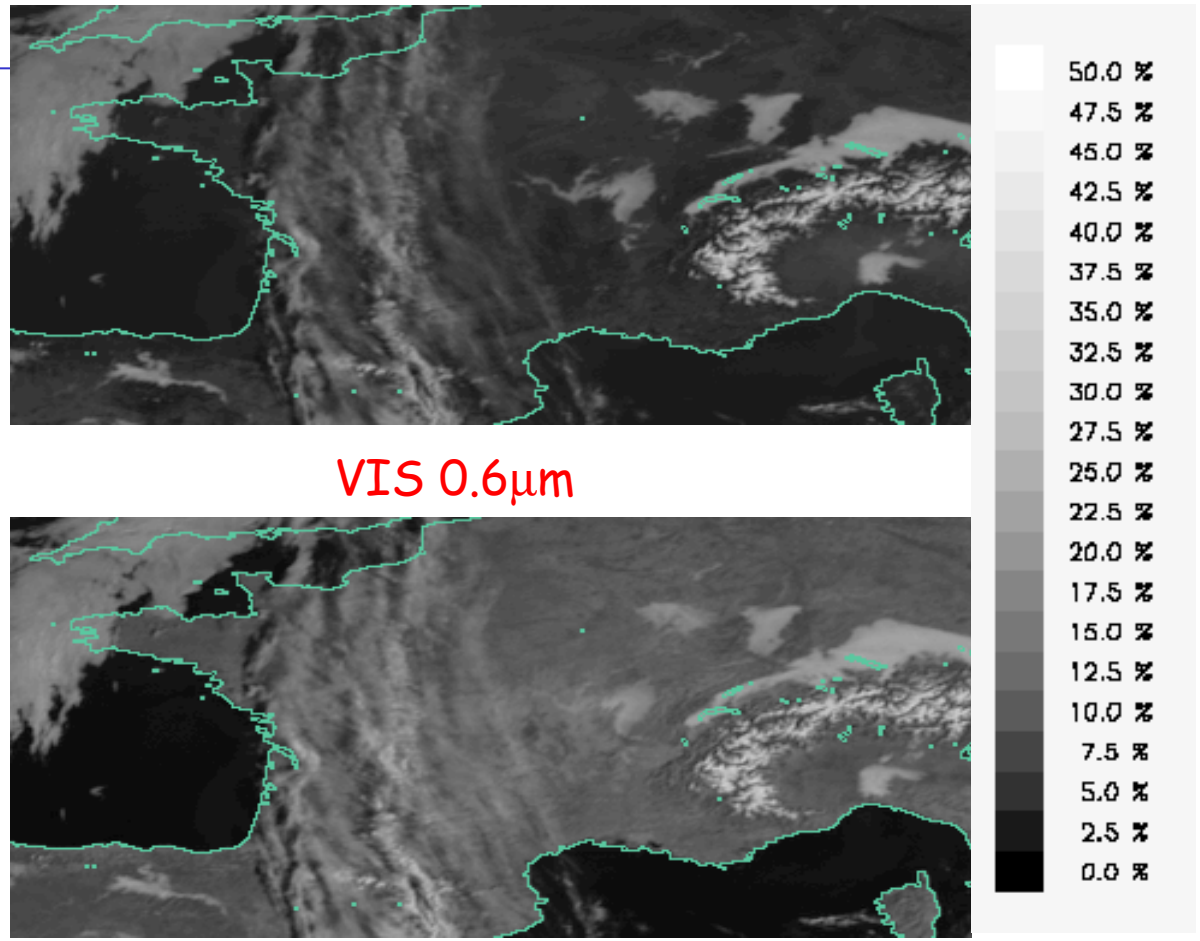
As Meteosat-7



IR 10.8 μm

6th November 2003 05h00

As Meteosat-7



VIS 0.6µm

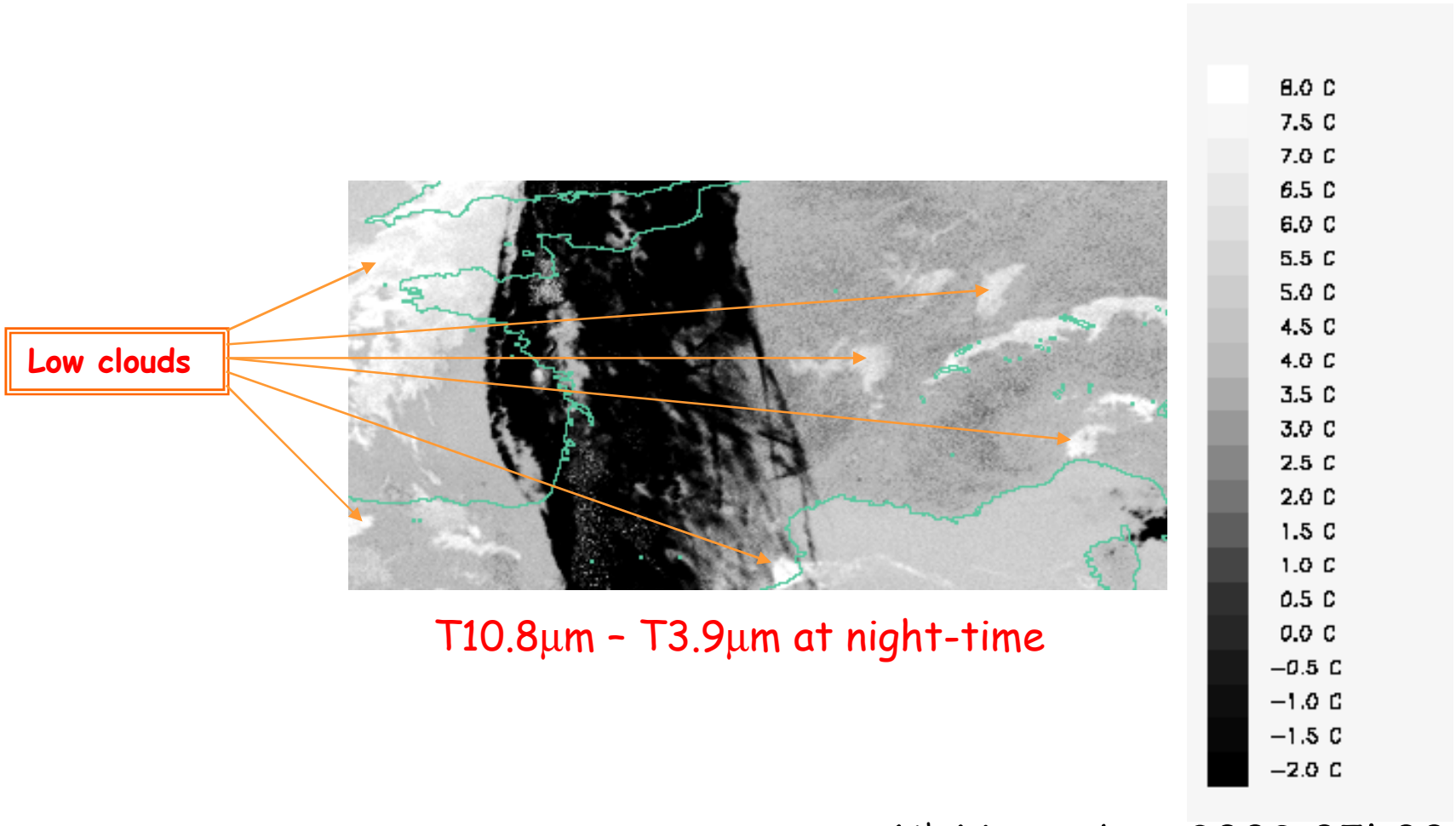
VIS 0.8µm

6th November 2003 09h00

MSG/SEVIRI improvement for low clouds

Channel	For low cloud detection	Limitations
Night-time: 10.8µm-3.9µm	Low clouds have low 3.9µm emissivities ➔Low cloud difference larger than surface's	Surface values depend on -land use, -viewing angle, -atmosphere
Day time: 3.9µm-10.8µm	Low clouds reflects light at 3.9µm ➔ Low cloud difference larger than surface's	Surface values depend on -illumination, -land use, -atmosphere
10.8µm-8.7µm	Low cloud difference larger than surface's	Only for high viewing angle Outside desert

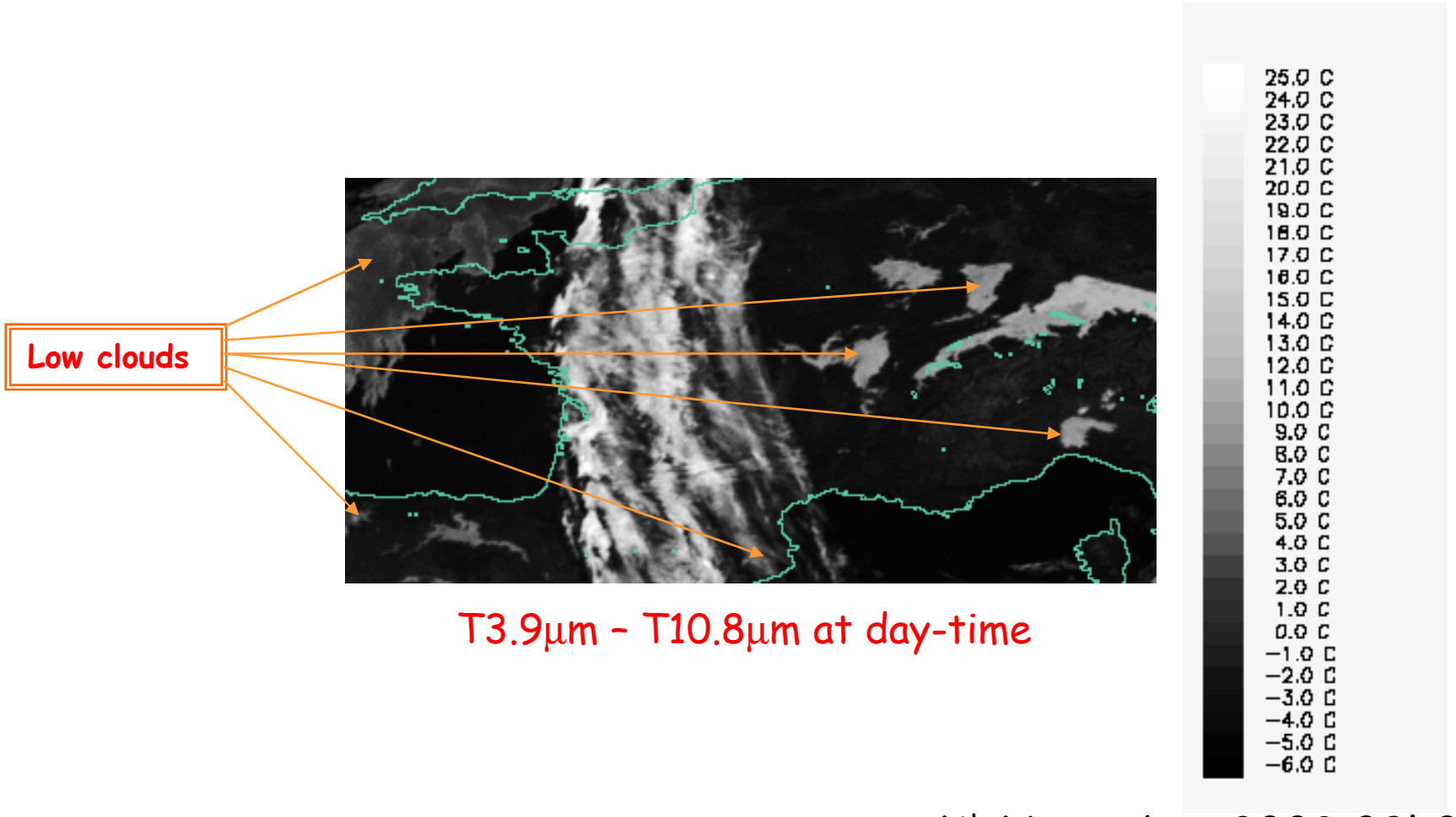
MSG/SEVIRI improvement for low clouds



T10.8µm – T3.9µm at night-time

6th November 2003 05h00

MSG/SEVIRI improvement for low clouds



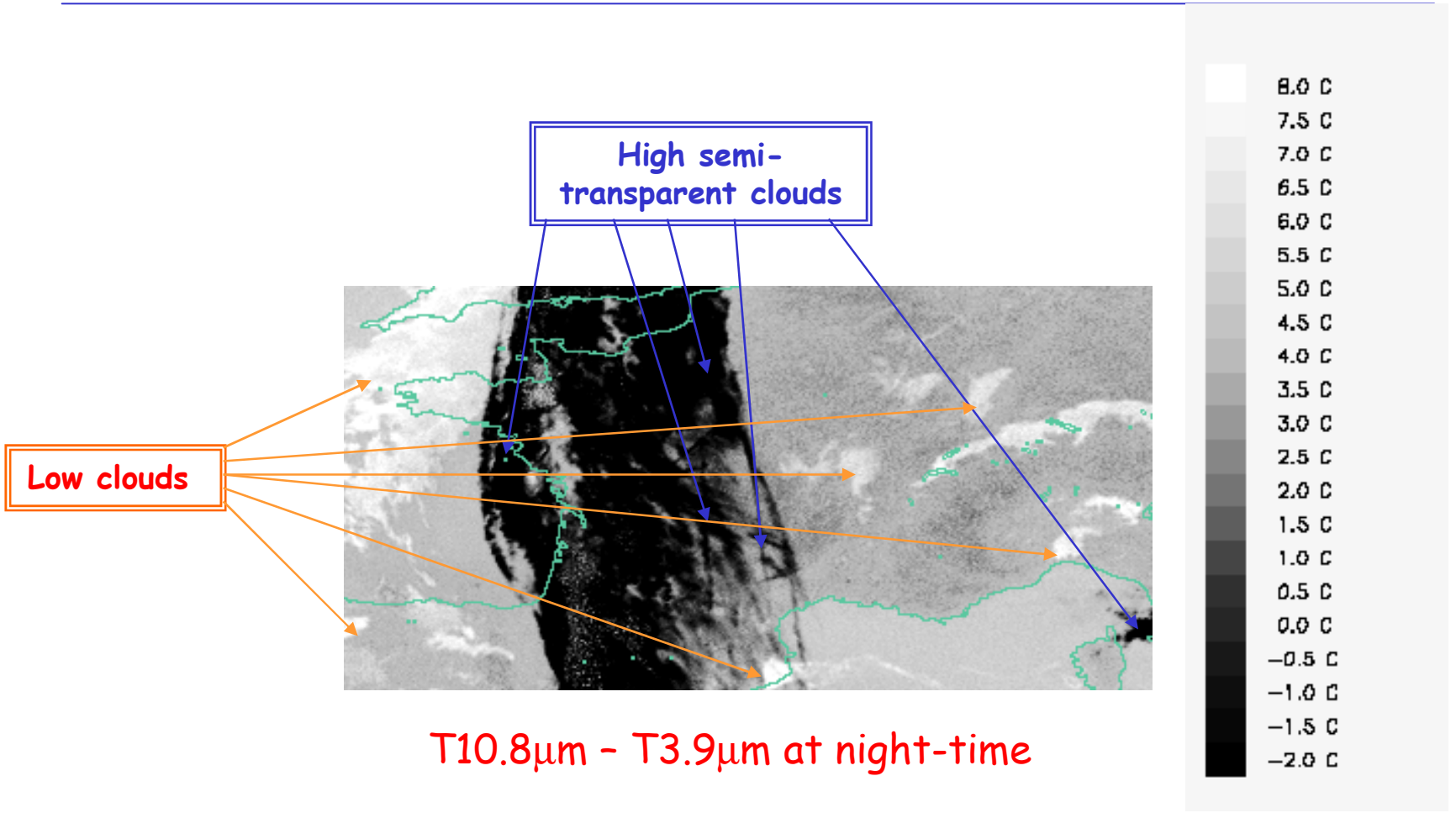
T3.9µm - T10.8µm at day-time

6th November 2003 09h00

MSG/SEVIRI improvement for cirrus

Channel	For high semi-transparent cloud detection	Limitations
8.7µm-10.8µm 10.8µm-12.0µm Night-time: 3.9µm-10.8µm	High semi-transparent cloud difference larger than surface's	Surface values depend on: -atmospheric water content, -surface heating, -viewing angle, -land use.

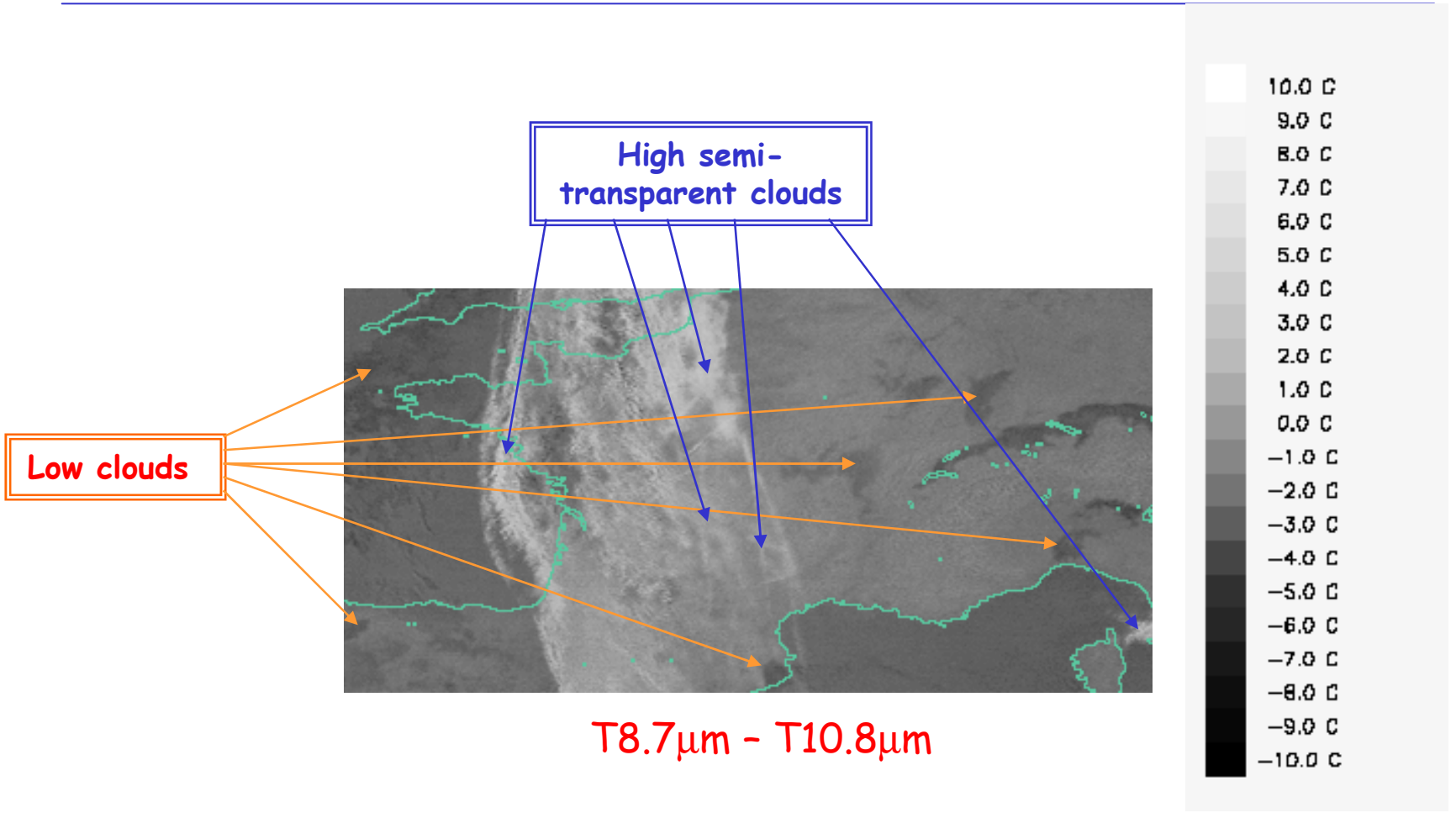
MSG/SEVIRI improvement for cirrus



T10.8µm – T3.9µm at night-time

6th November 2003 05h00

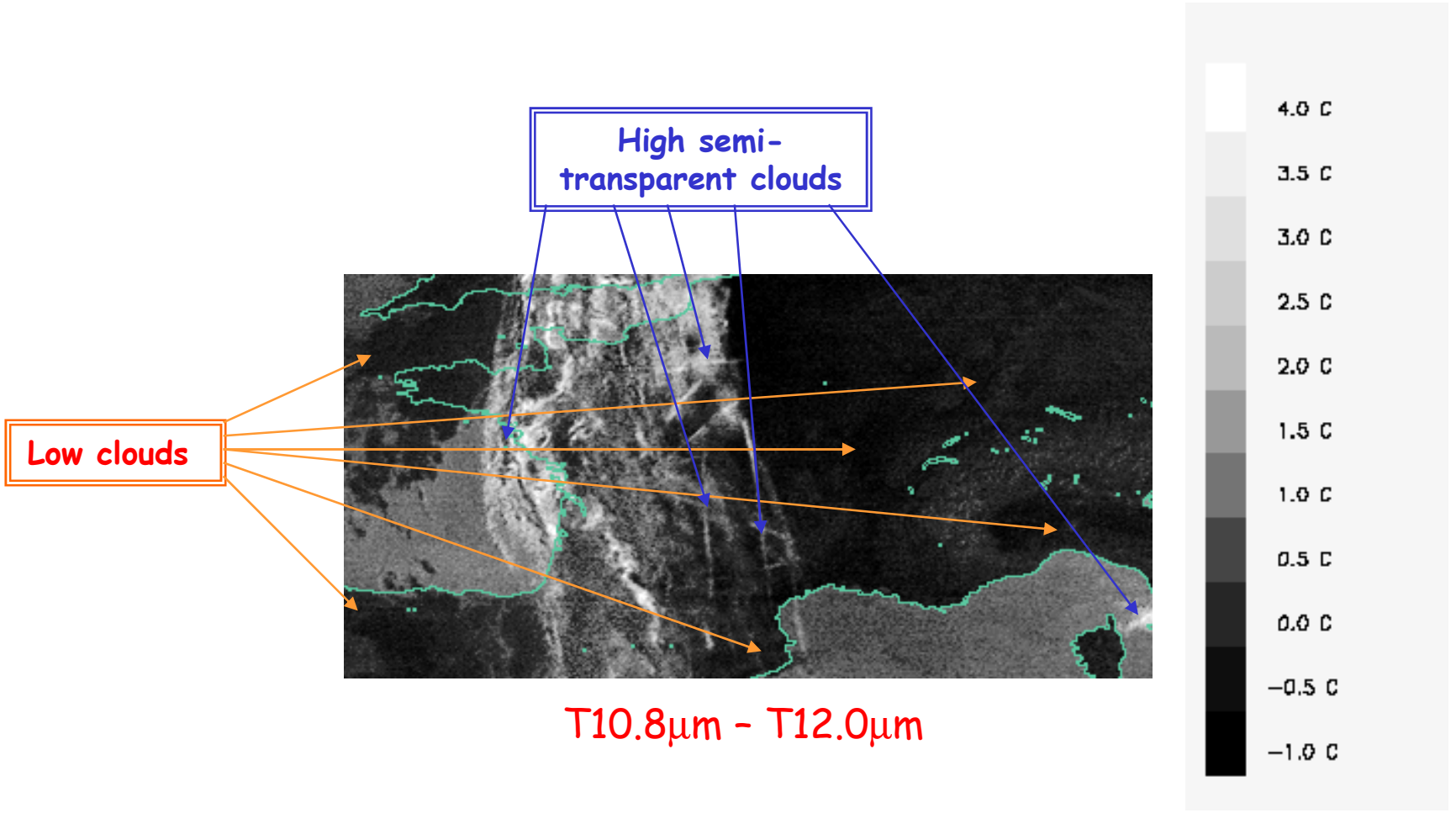
MSG/SEVIRI improvement for cirrus



T8.7μm - T10.8μm

6th November 2003 05h00

MSG/SEVIRI improvement for cirrus



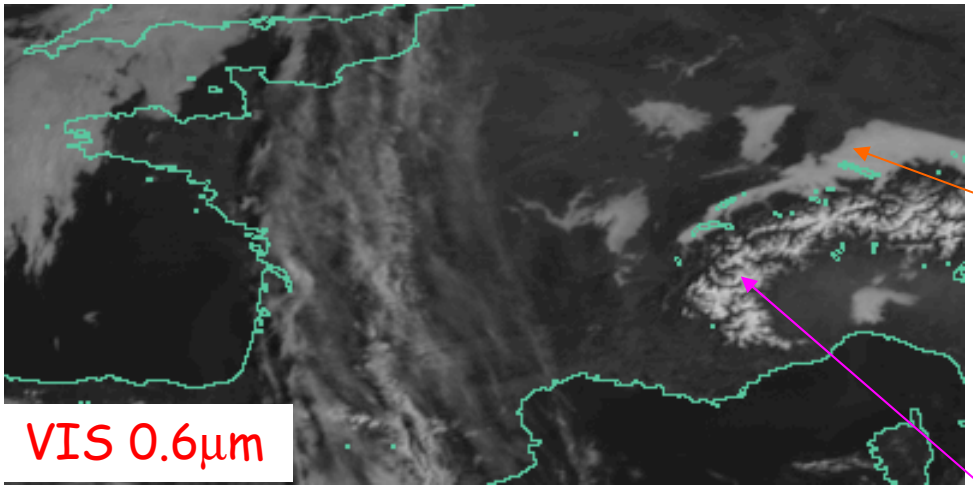
T10.8µm - T12.0µm

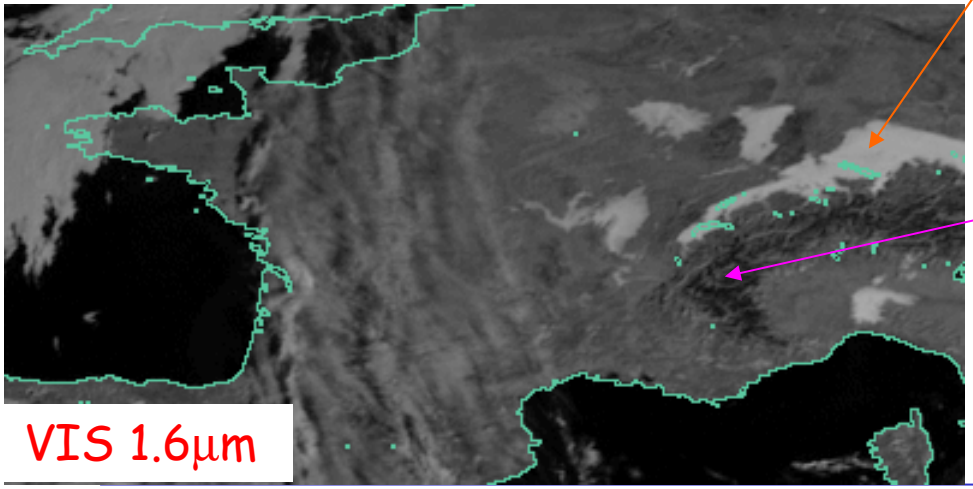
6th November 2003 05h00

MSG/SEVIRI improvement for snow

Channel	For snow characterisation	Limitations
1.6µm	Snow reflection is lower than water clouds or surface's	-Sun reflection depends on illumination conditions -Ice clouds' reflection is also low -Only at day-time
3.9µm-10.8µm	Snow reflection is lower than low clouds or surface's	-Reflection is only estimated from 3.9µm-10.8µm difference

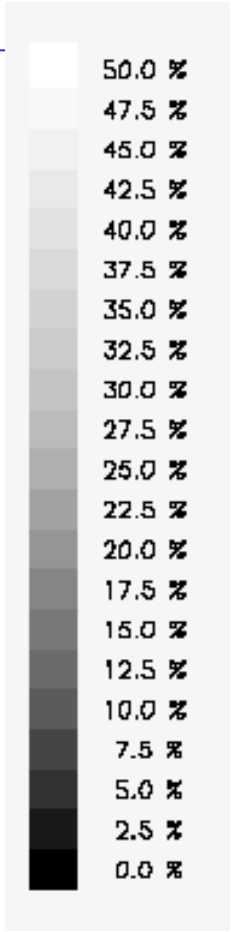
MSG/SEVIRI improvement for snow





Low clouds

Snow



6th November 2003 09h00

Cloud mask (CMa) categories

CMa categories

1 Non-processed (no/corrupt data)
2 Cloud free
3 Cloud contaminated
4 Cloud filled (opaque)
5 Snow/Ice contaminated
6 Undefined

Quality flag:

Illumination conditions
NWP input data availability
SEVIRI data availability
CMa quality itself

Volcanic plume flag

Dust flag

Test Flag Indicates which test was successful in cloud detection

Cloud type (CT) categories

Main categories	
Non-processed Land Sea Snow Sea ice Unclassified	Fractional clouds Low or very low clouds Medium clouds High or very high clouds Semi-transparent high clouds **(3 classes according to thichkness + cirrus above clouds)**
Quality flag: Illumination conditions NWP input data availability SEVIRI data availability CT quality itself	
Cloud phase flag	

CMa algorithm

Clouds and snow are detected in each pixel of the image using multispectral theshold techiques :

✓Thresholds are computed using :

- o Atlas: height map
  land/sea mask
- o Climatological maps: SST
  continental visible reflectance
- o NWP short range forecast data:
  surface temperature,
  integrated atmospheric precipitable water

✓Most thresholds are tuned to radiometer's spectral characteristics with Radiative Transfer Models in cloud free conditions (6S,RTTOV).

CT algorithm

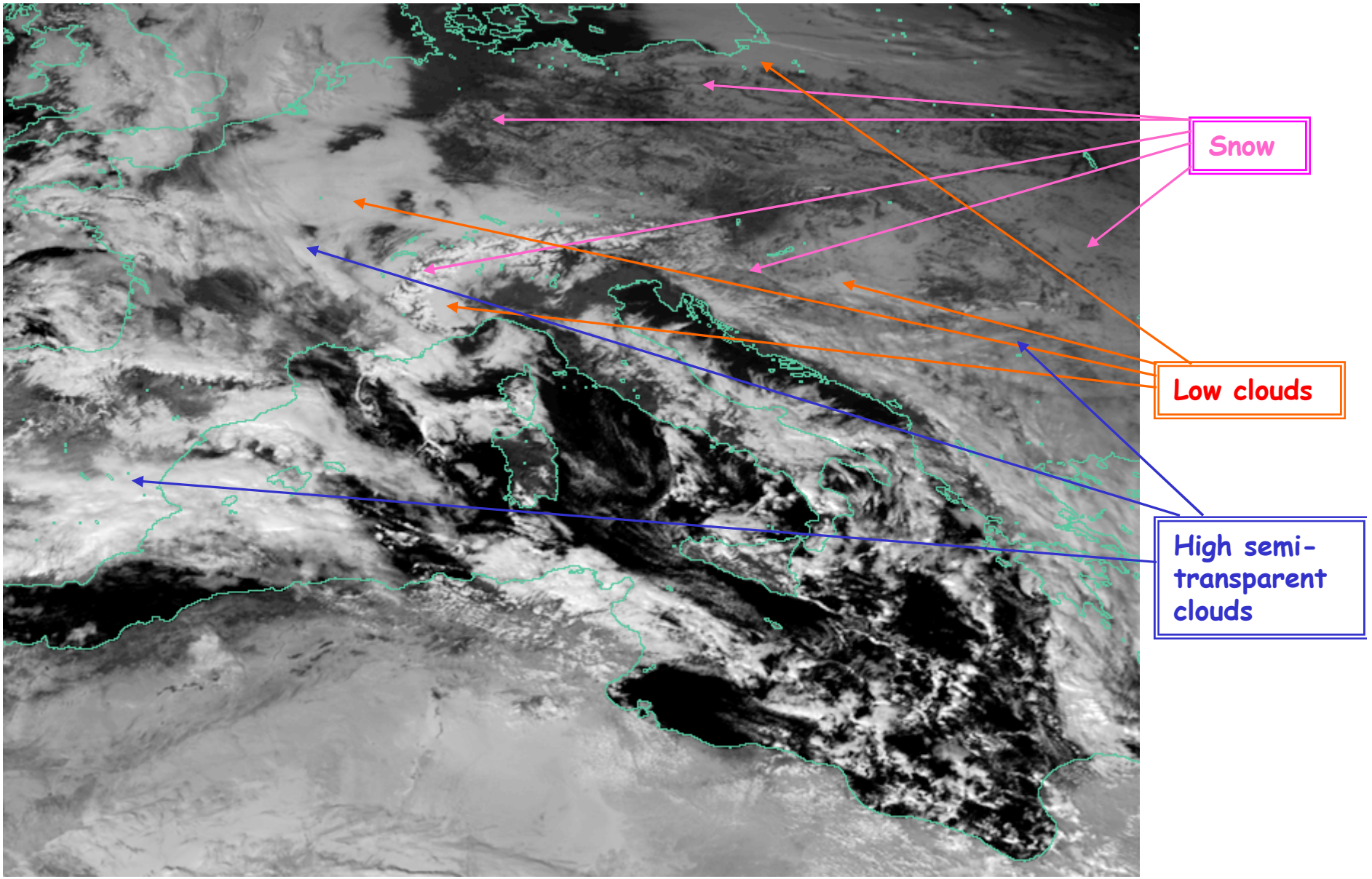
Cloudy pixels are classified according their radiative characteristics:

- ✓**Semi-transparent and fractional clouds** are distinguished from low/medium/high clouds using:
  - o spectral features [T10.8µm-T12.0µm, T8.7µm-T10.8µm T10.8µm-T3.9µm (night) or R0.6µm&T10.8µm (day)]
  - o textural features [local variance of T10.8µm&R0.6µm (day)]
- ✓**Low, medium and high** clouds are then separated by comparing their T10.8µm to combination of NWP forecast temperature at various pressure levels [850, 700, 500 hPa and at tropopause levels].
- ✓Separation between **cumuliform** & **stratiform** not performed.
- ✓**Cloud phase flag** not available

Examples of cloud types

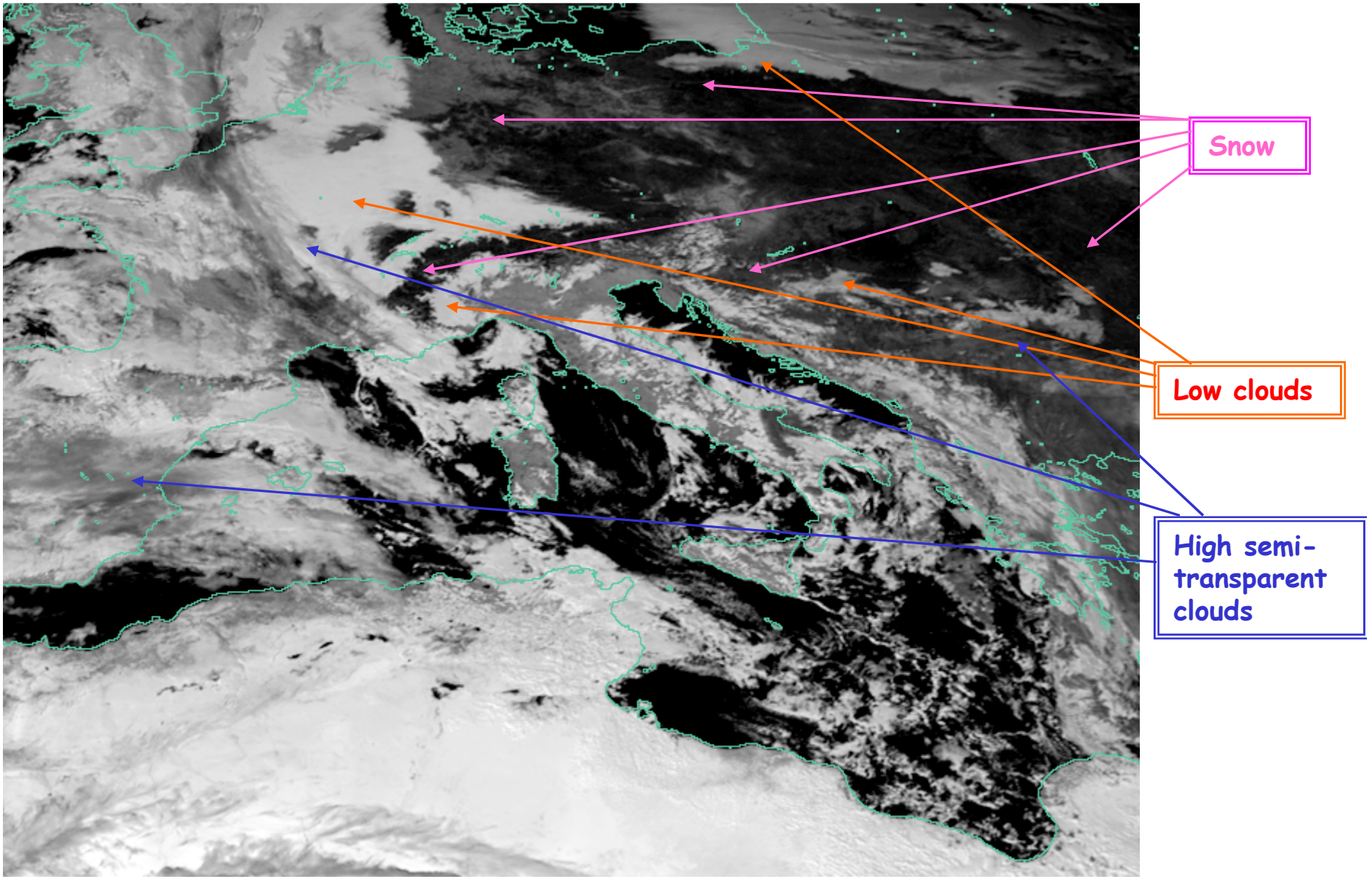
Cloud types are displayed using colour palette available in hdf file:

-First SEVIRI image	12th February 2003 13h30
-Low clouds/fog	5th February 2004 0h & 12h 6th November 2003 5h-9h
-Convective clouds	28th July 2003 12h-16h
-Snow	2nd March 2004 6h-12h



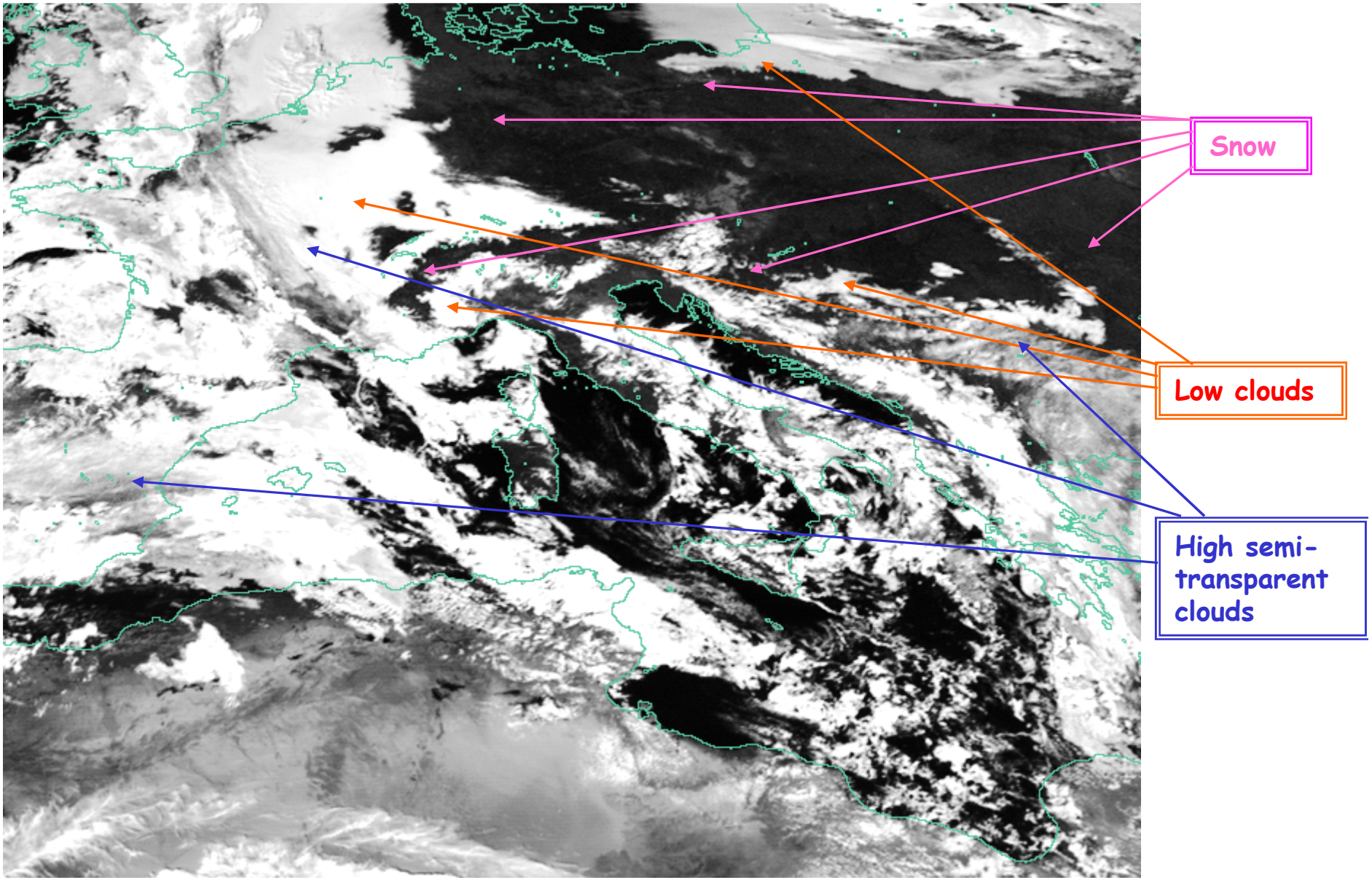
VIS 0.6µm

12 February 2003 13h30



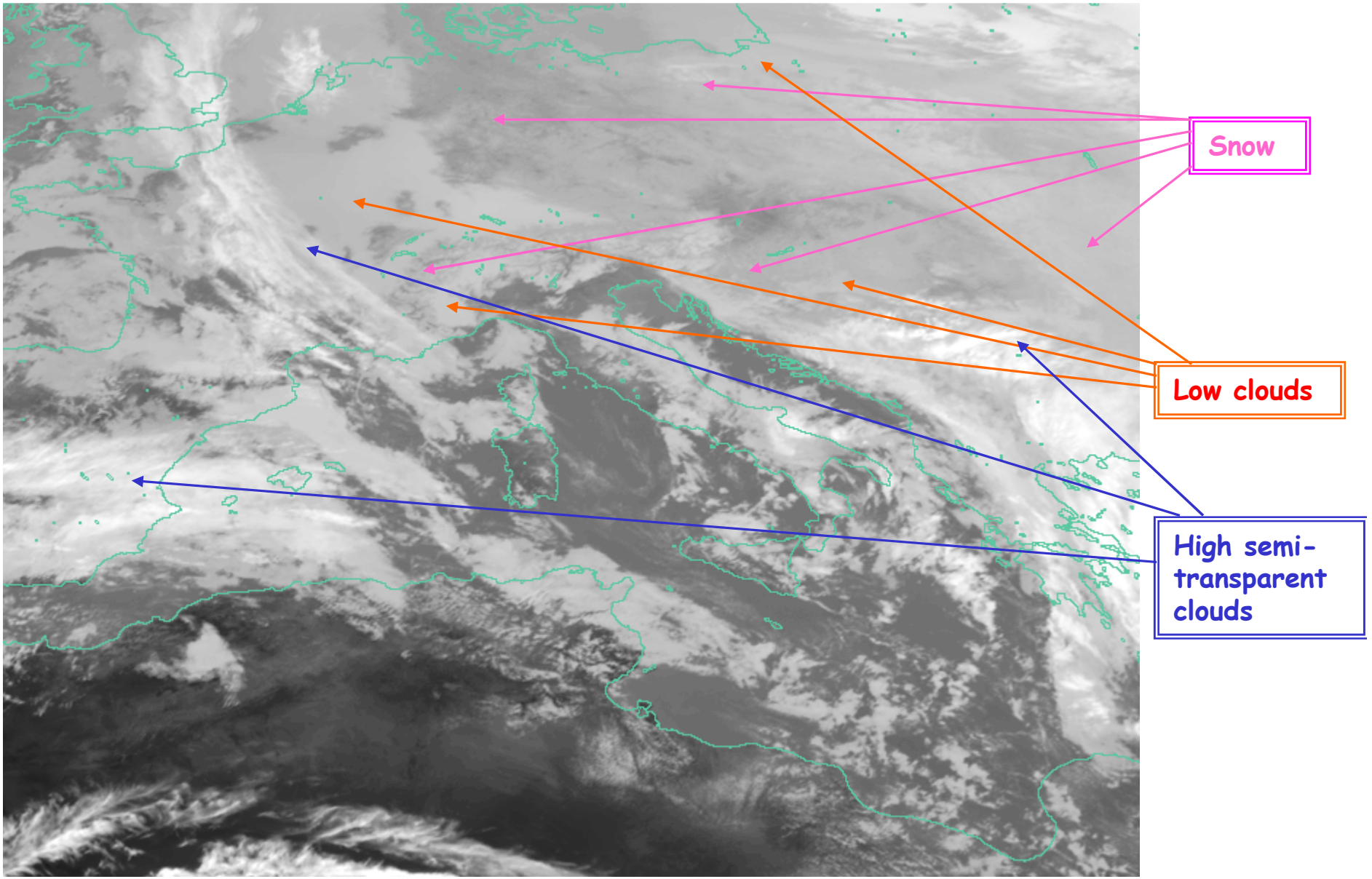
VIS 1.6µm

12 February 2003 13h30



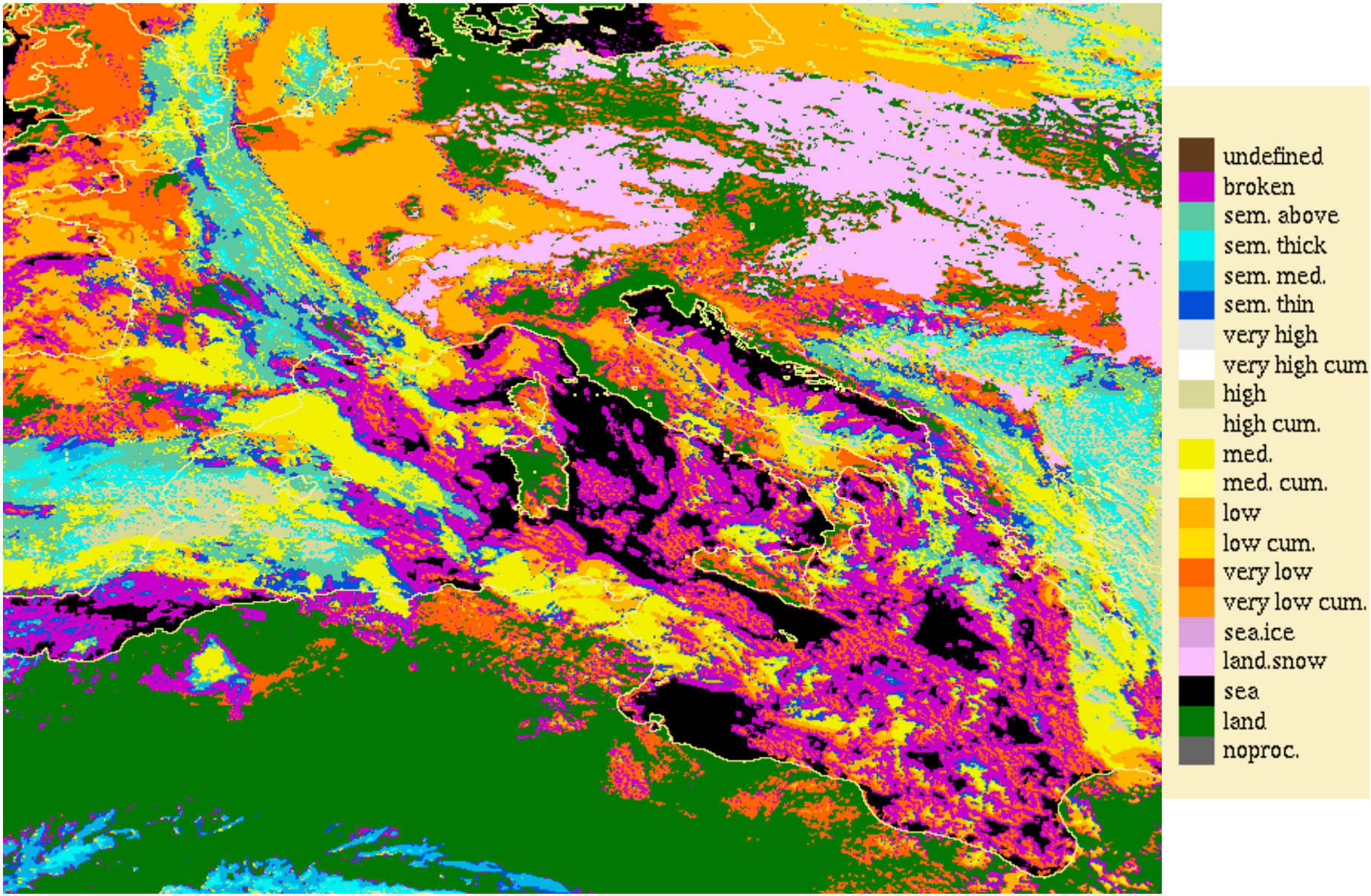
T3.9µm - T10.8µm

12 February 2003 13h30



IR 10.8µm

12 February 2003 13h30



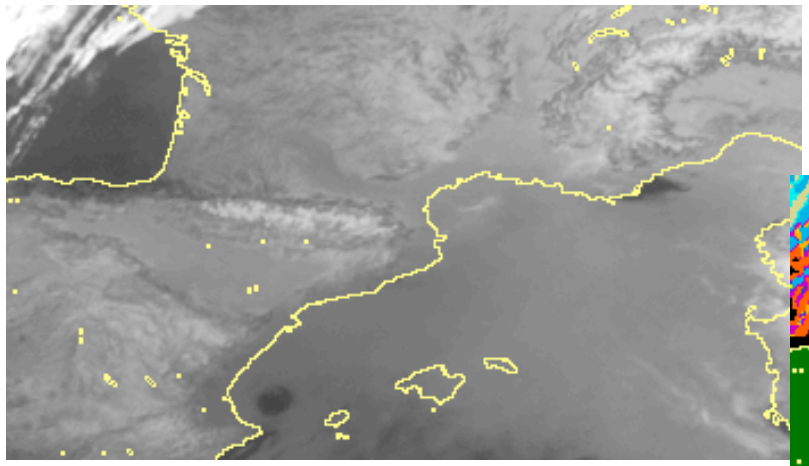
Cloud type

12 February 2003 13h30

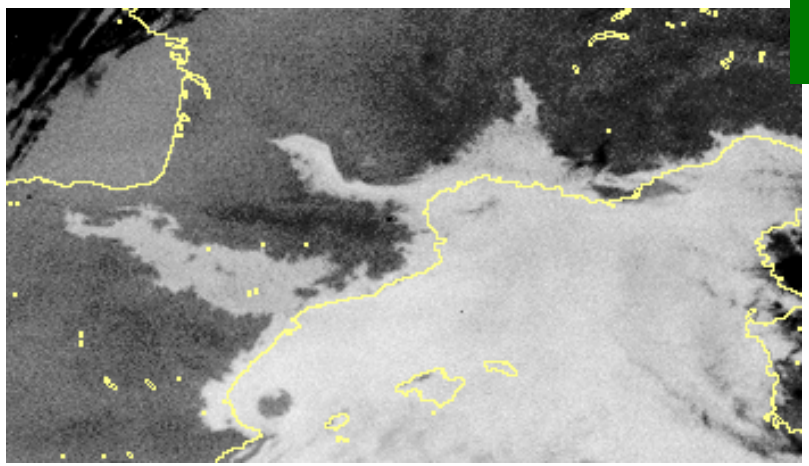
Examples of low clouds/fog

5th february 2004 0h & 12h

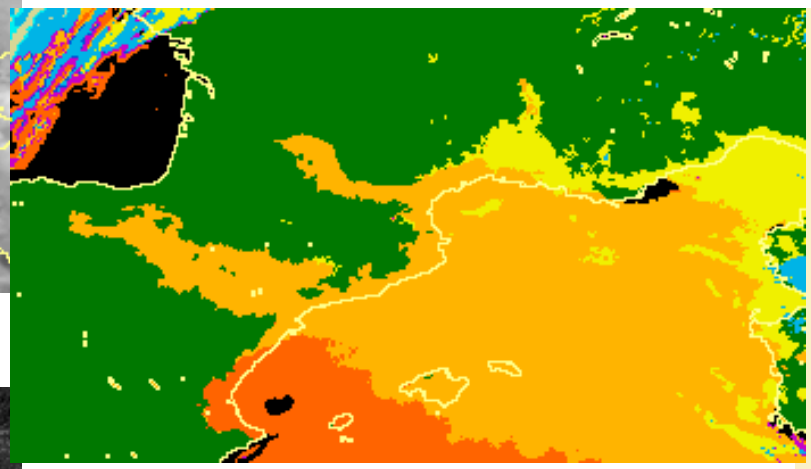
5th February 2004 00h

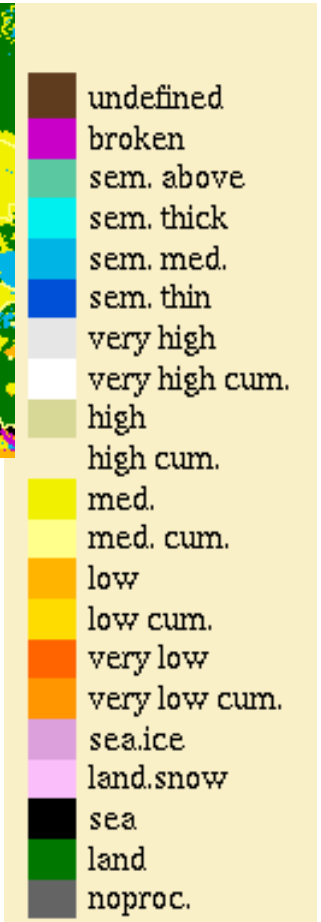


IR 10.8 µm

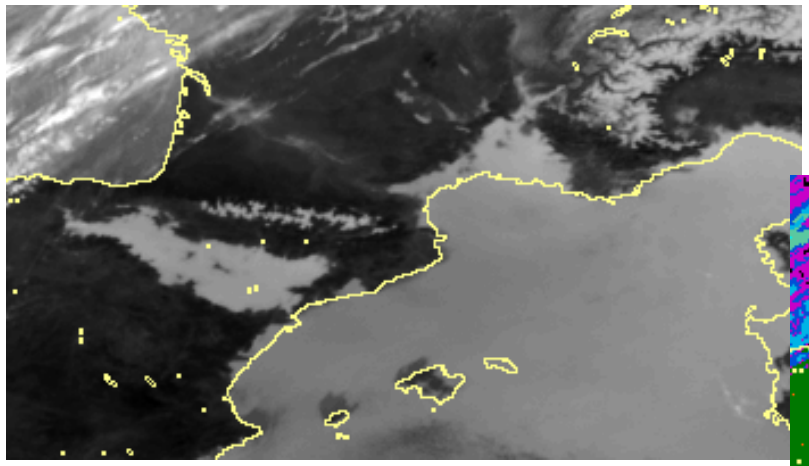


T10.8µm – T3.9µm at night-time

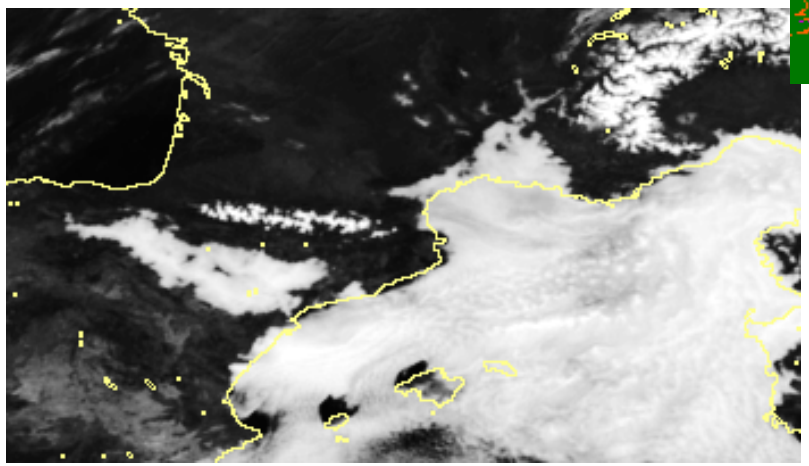




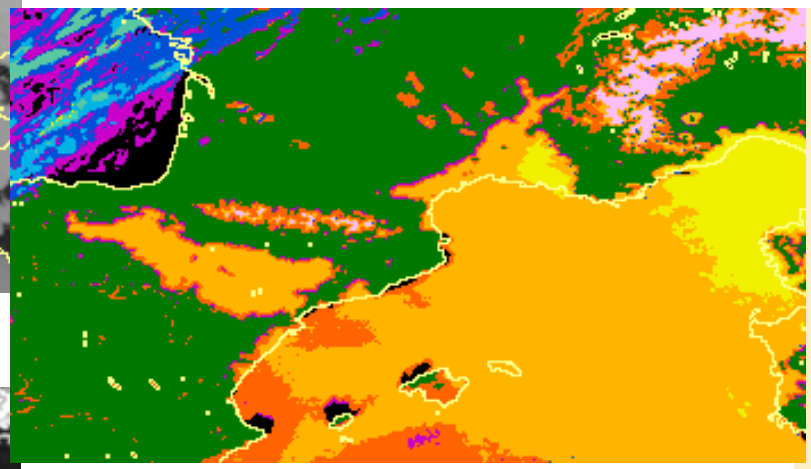
5th February 2004 12h

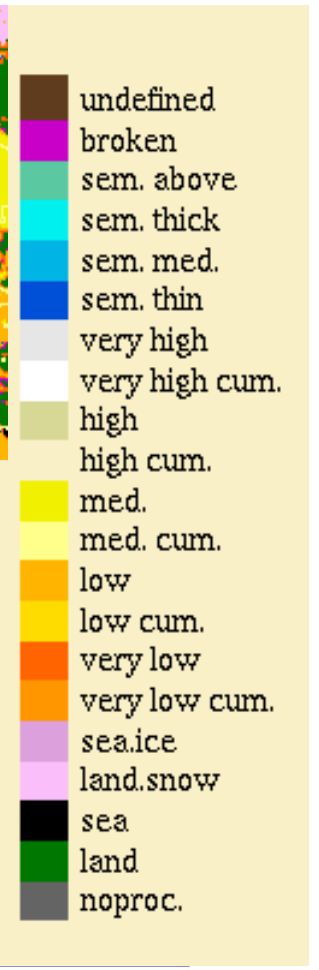


IR 10.8 µm

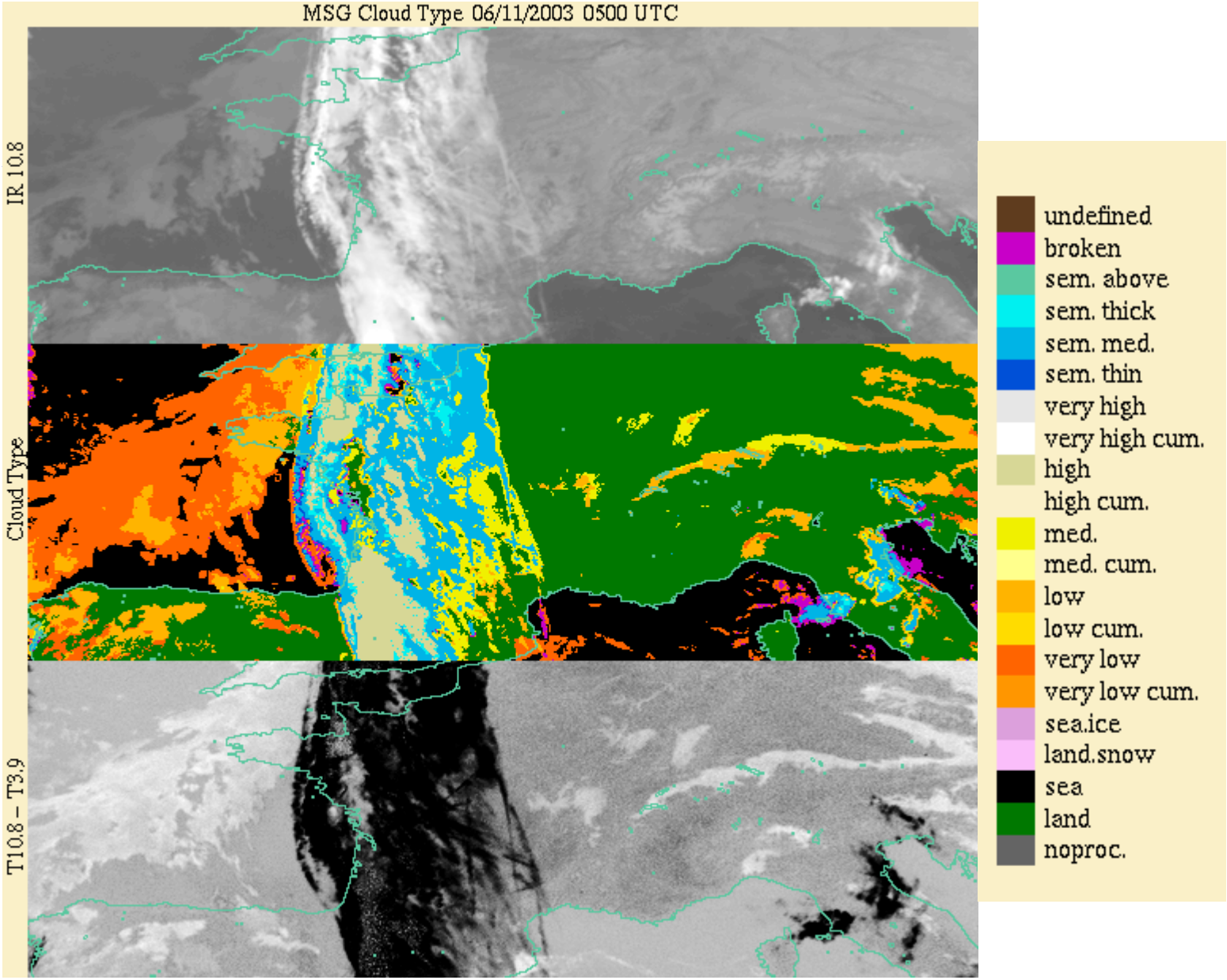


VIS 0.6µm

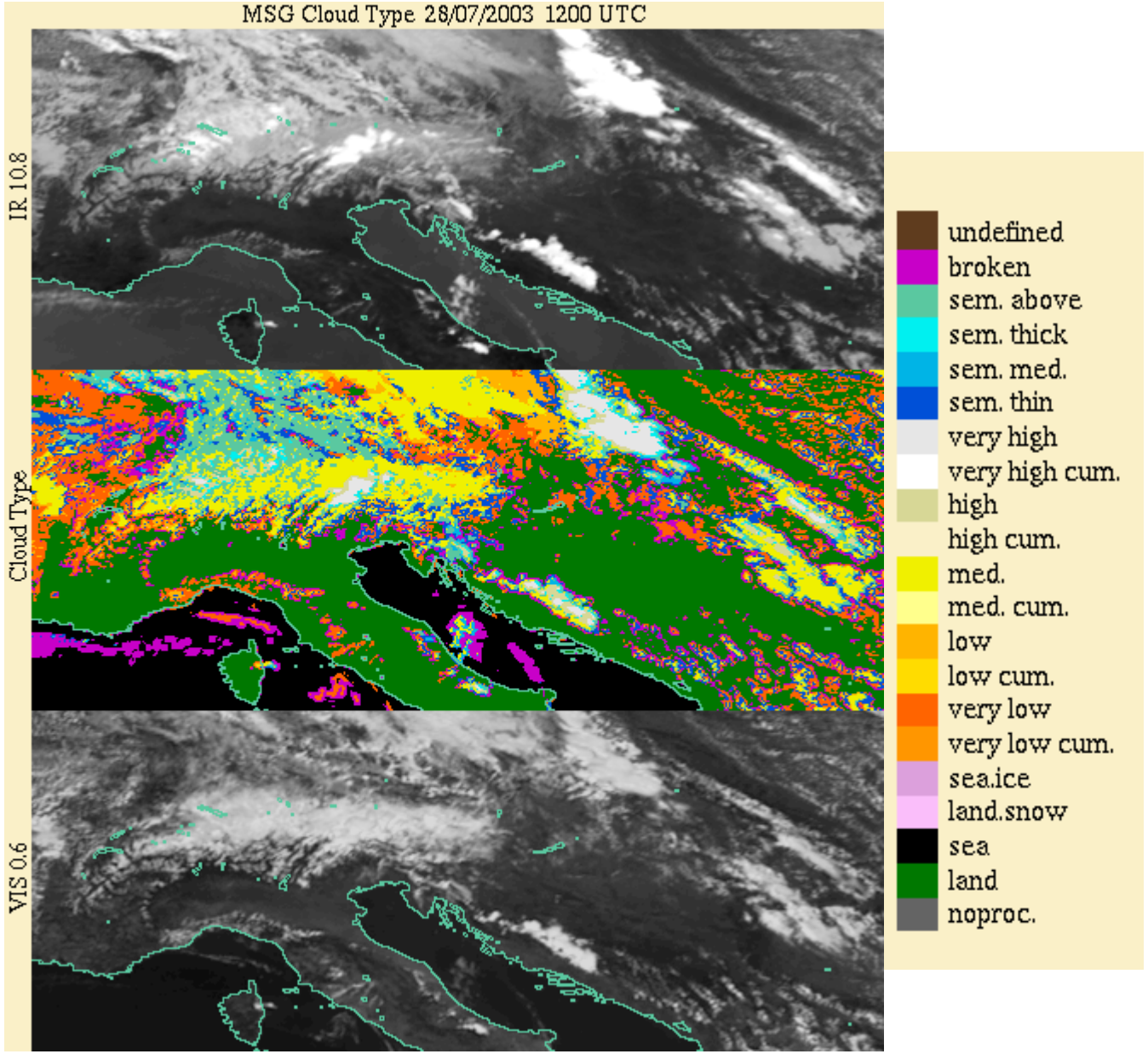




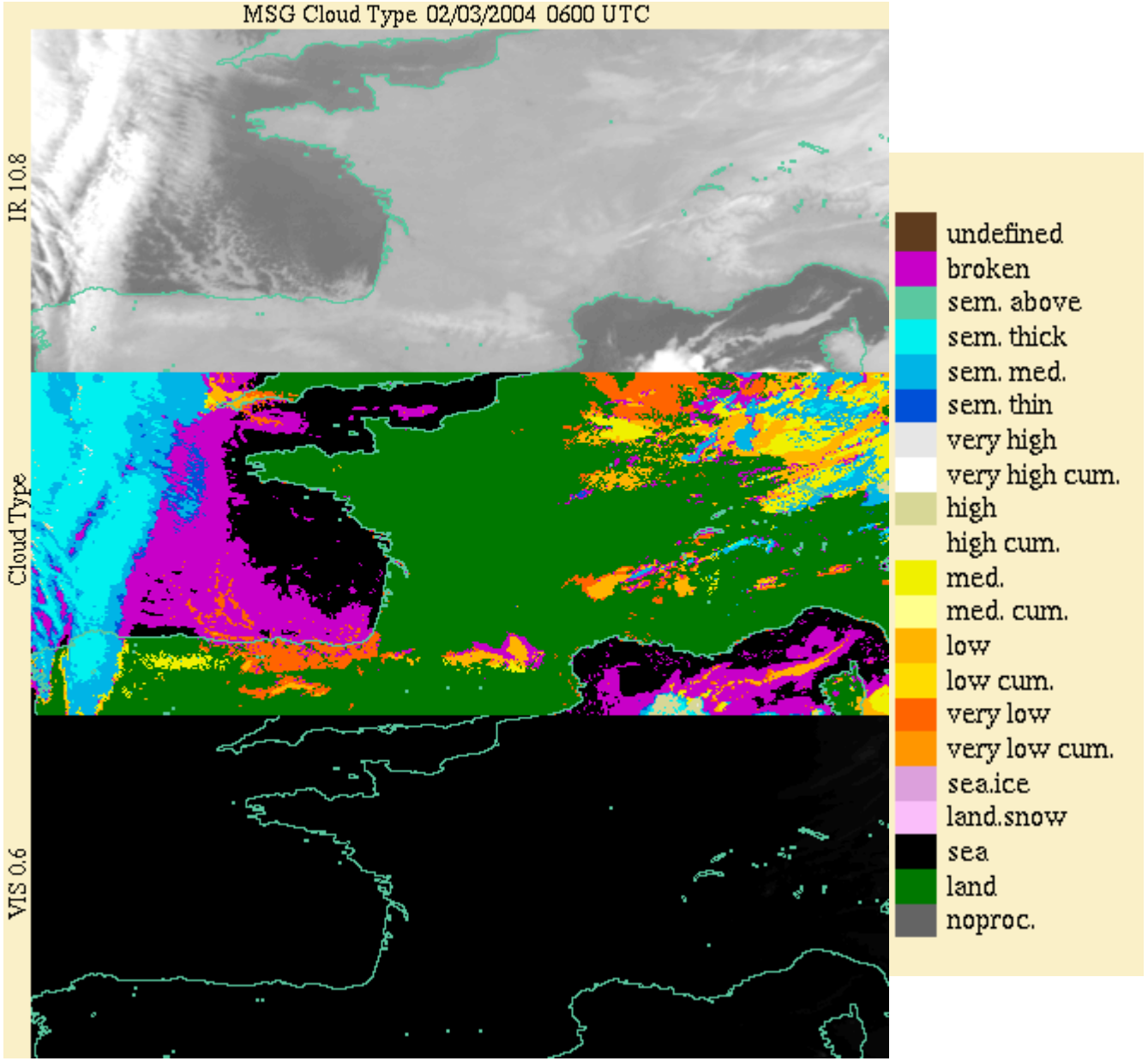
Examples of low clouds/fog:
6th November 2003 5h-9h


MSG Cloud Type 06/11/2003 0500 UTC
IR 10.8
Cloud Type
T10.8 – T3.9
undefined
broken
sem. above
sem. thick
sem. med.
sem. thin
very high
very high cum.
high
high cum.
med.
med. cum.
low
low cum.
very low
very low cum.
sea.ice
land.snow
sea
land
noproc.

Examples of convective clouds:
28th July 2003 12h-16h


MSG Cloud Type 28/07/2003 1200 UTC
IR 10.8
Cloud Type
VIS 0.6
undefined
broken
sem. above
sem. thick
sem. med.
sem. thin
very high
very high cum.
high
high cum.
med.
med. cum.
low
low cum.
very low
very low cum.
sea.ice
land.snow
sea
land
noproc.

Examples of snow:
2nd March 2004 6h-12h


MSG Cloud Type 02/03/2004 0600 UTC
IR 10.8
Cloud Type
VIS 0.6
undefined
broken
sem. above
sem. thick
sem. med.
sem. thin
very high
very high cum.
high
high cum.
med.
med. cum.
low
low cum.
very low
very low cum.
sea.ice
land.snow
sea
land
noproc.

Known problems

CMa :

-Low clouds may be missed at night-time or in case low solar elevation

-Snow is not detected at night-time

CT:

-Very thin cirrus are classified as fractional

-Low clouds may be classified as medium in case strong thermal inversion

-Low clouds surmounted by cirrus may be classified as medium

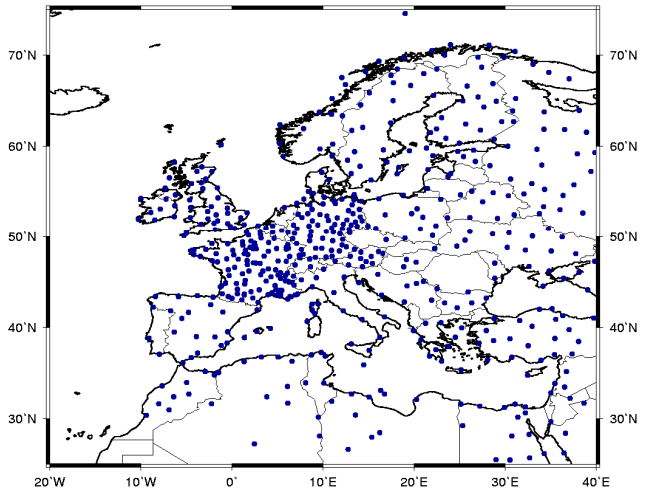
Planned activities in 2004

Improvements to be included in **SAFNWC (v1.2)**

✓ additional tuning where needed

Validation

✓ cloud mask and type with SYNOP



Validation SYNOP Stations