Benefits from MSG & MTG

Latest developments



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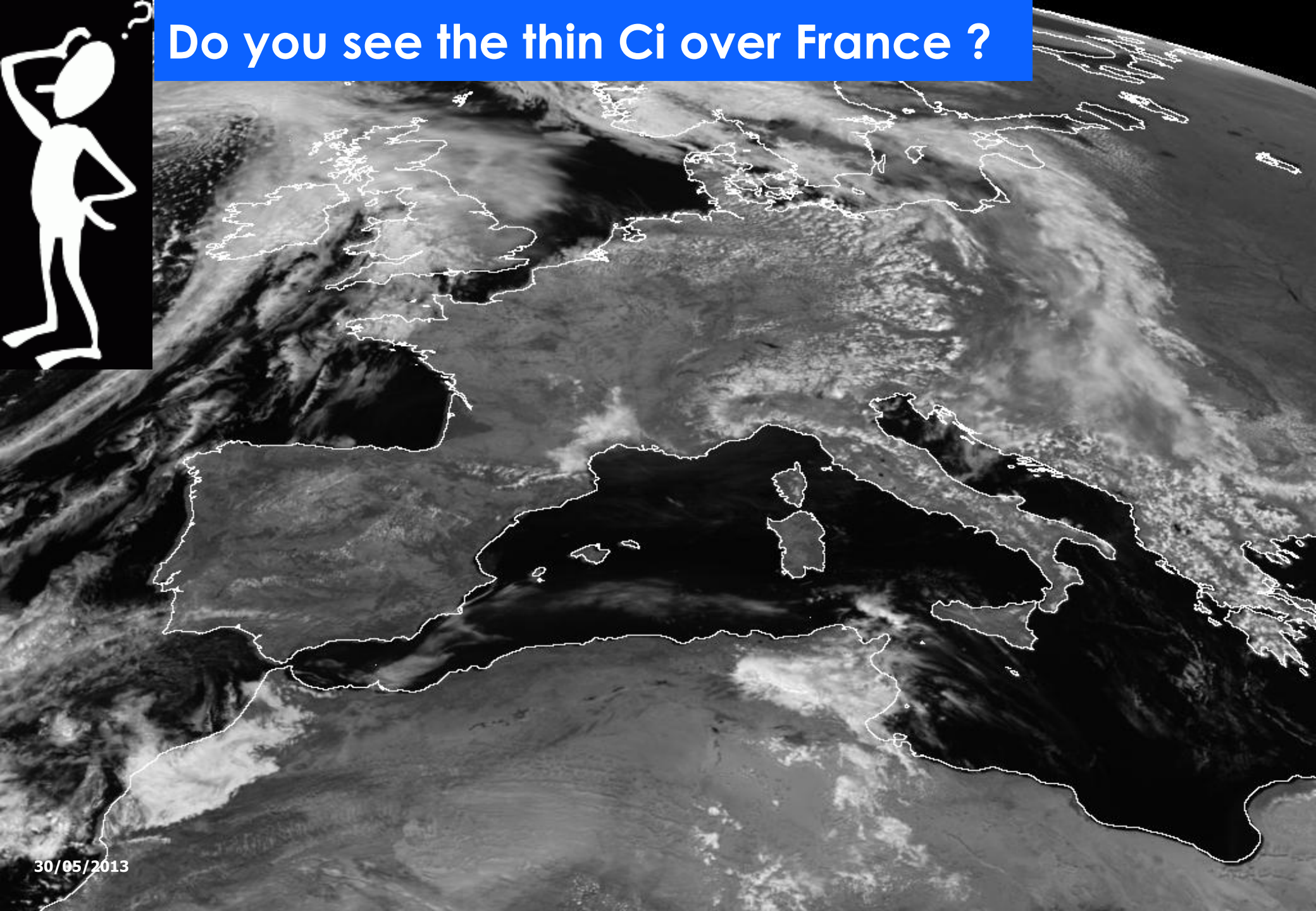
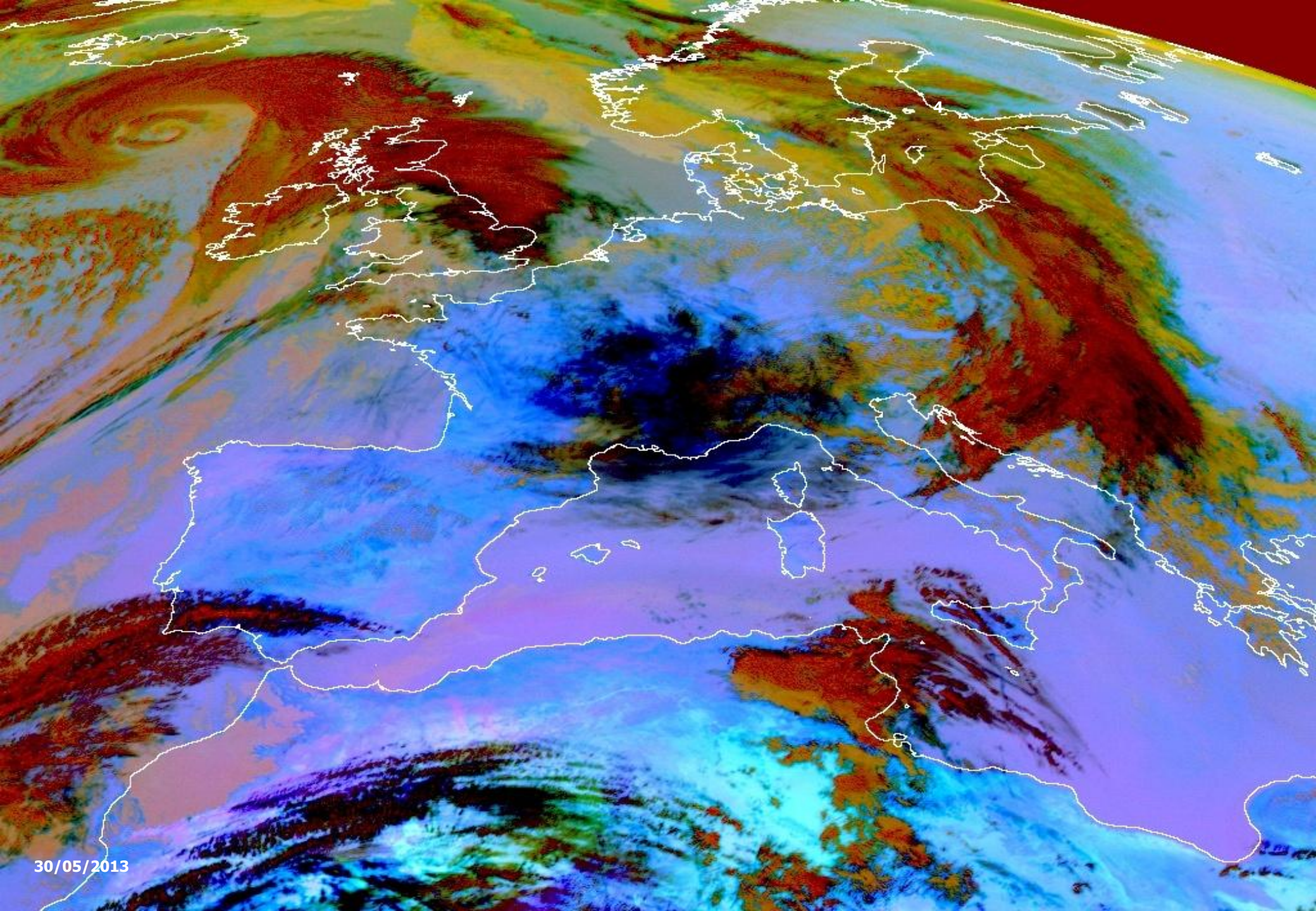
EUMETSAT

Outline

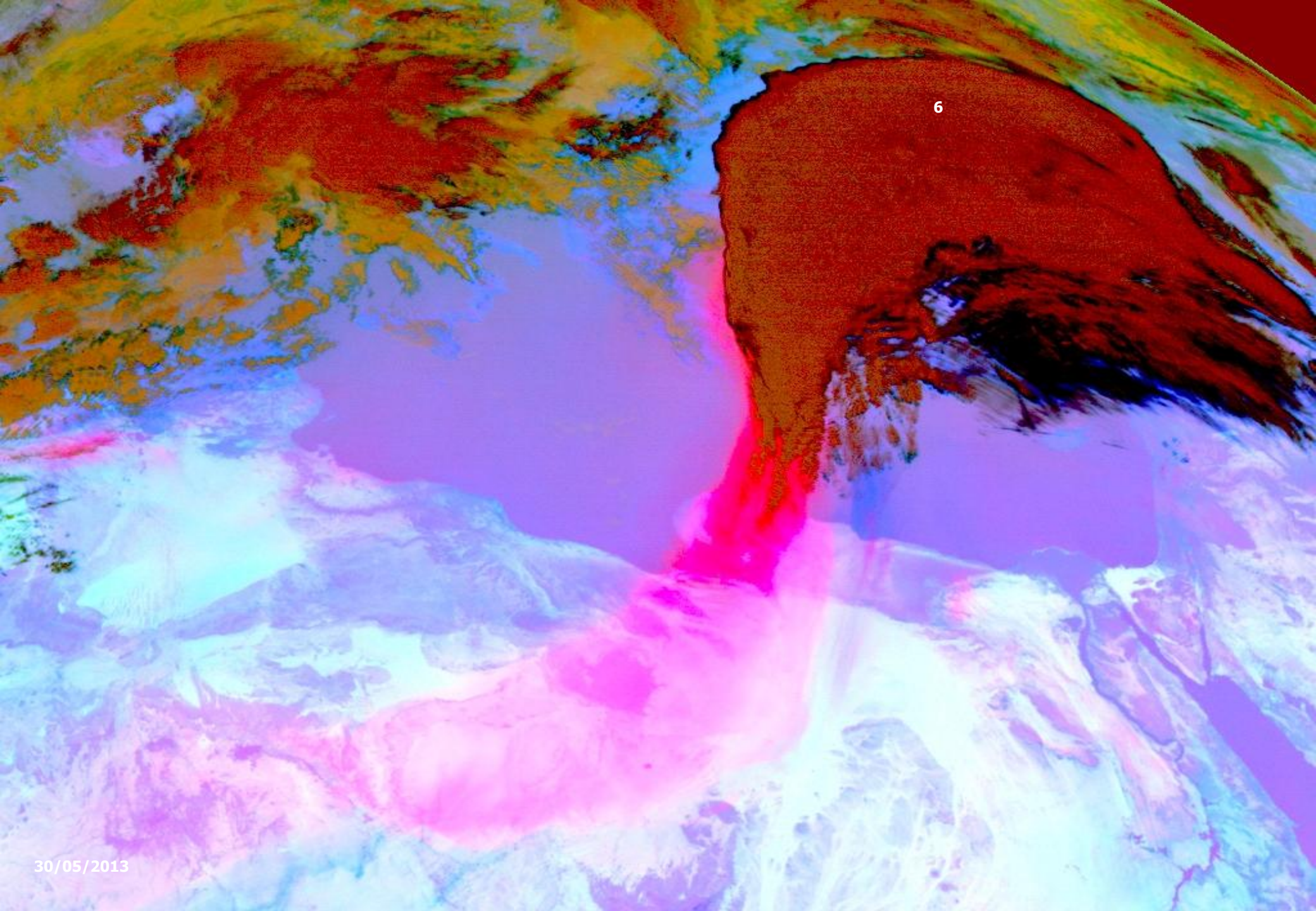
1) EUMETSAT's Current Satellites
2) MSG: Main Improvements
3) RGB Products: Q & A
4) RGB Products: Best Practice
5) EUMETSAT's future satellites

6) MSG: Recent Findings (Dust, Ash, Cloud Properties, Fog, Moisture, Fires, Floods, Snow)

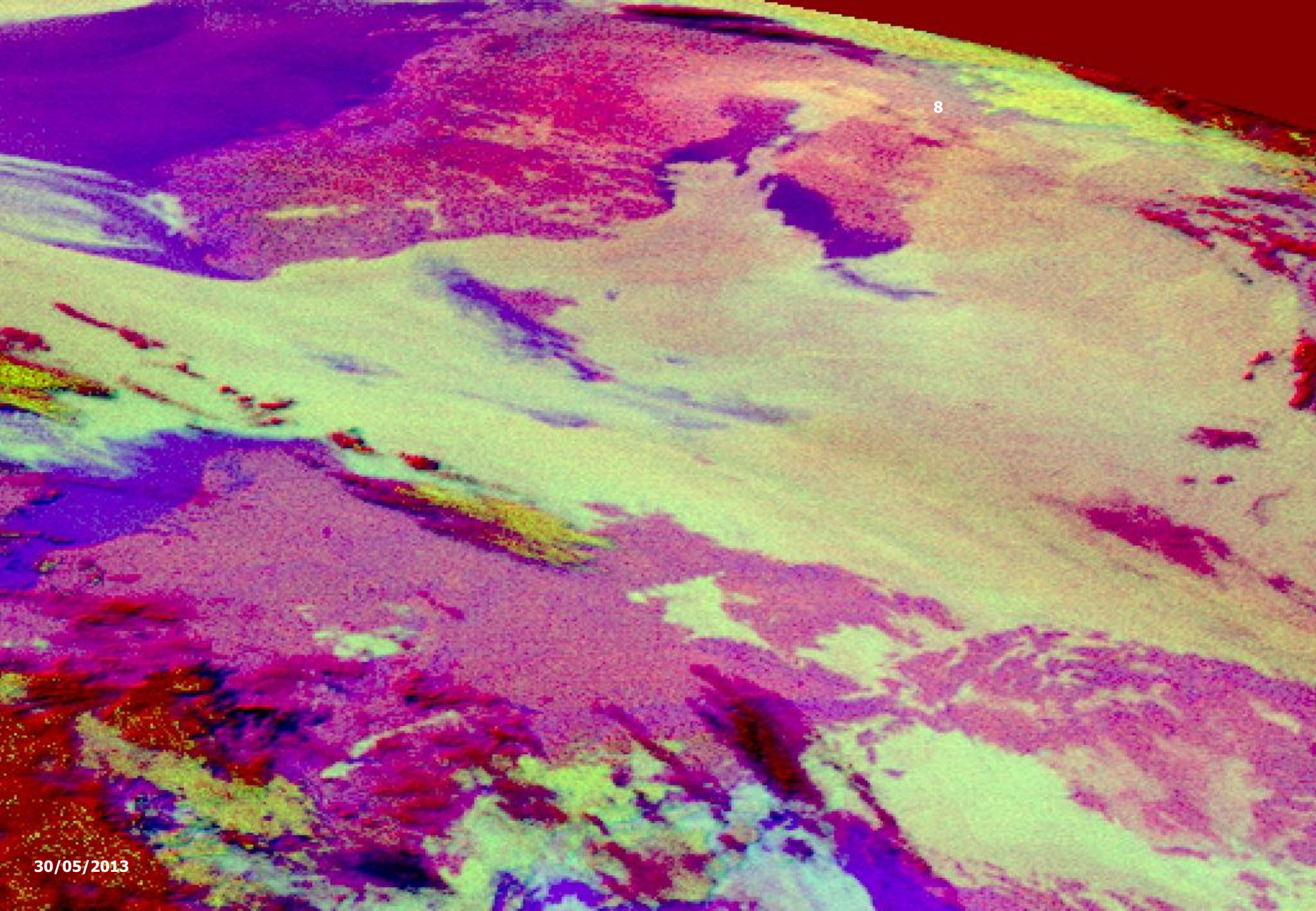

Do you see the thin Ci over France ?
30/05/2013

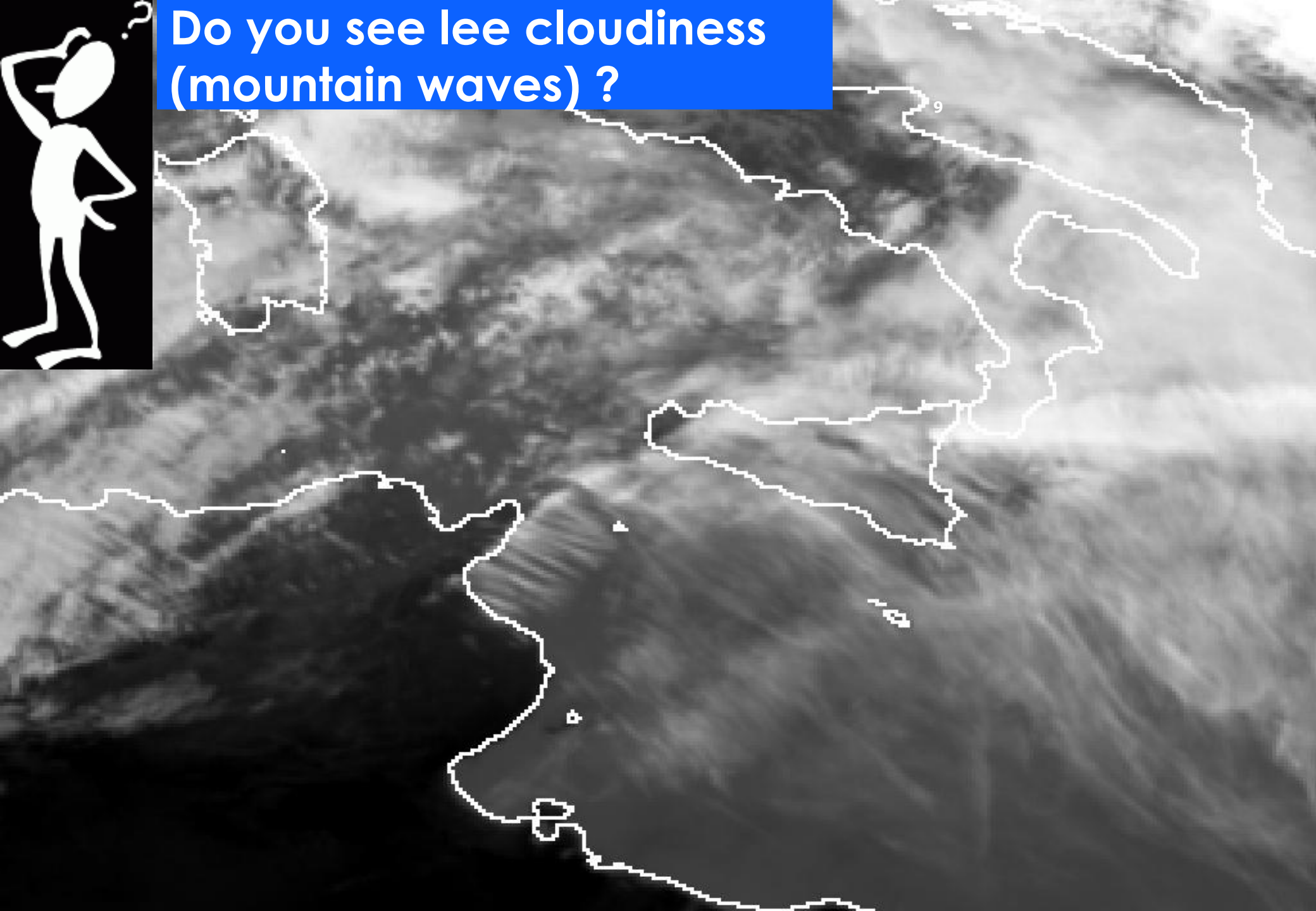

30/05/2013

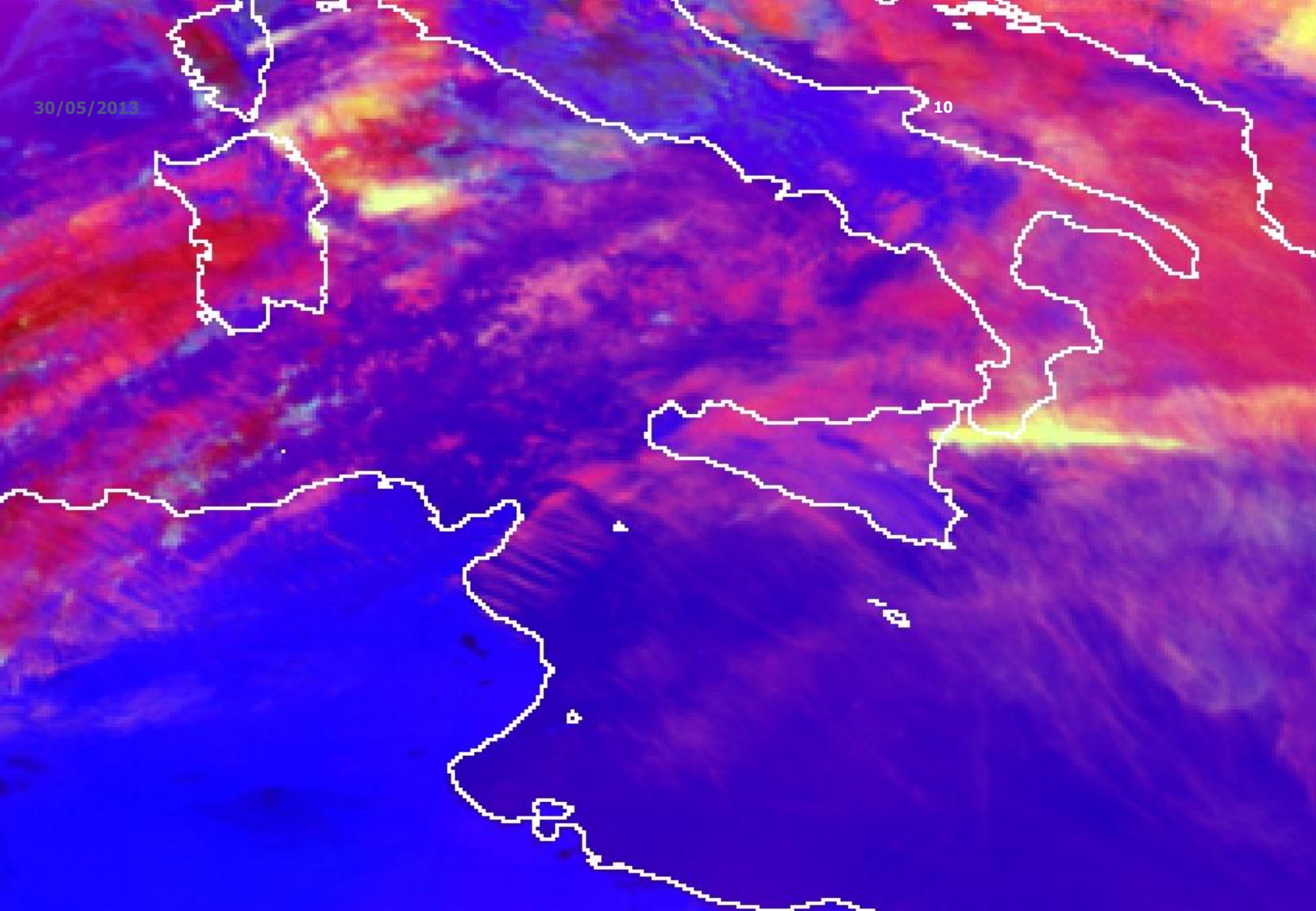
Where is the dust cloud ?


6
30/05/2013

Where is the fog / low stratus?


8
30/05/2013


Do you see lee cloudiness
(mountain waves) ?


30/05/2013
10

EUMETSAT's current satellites

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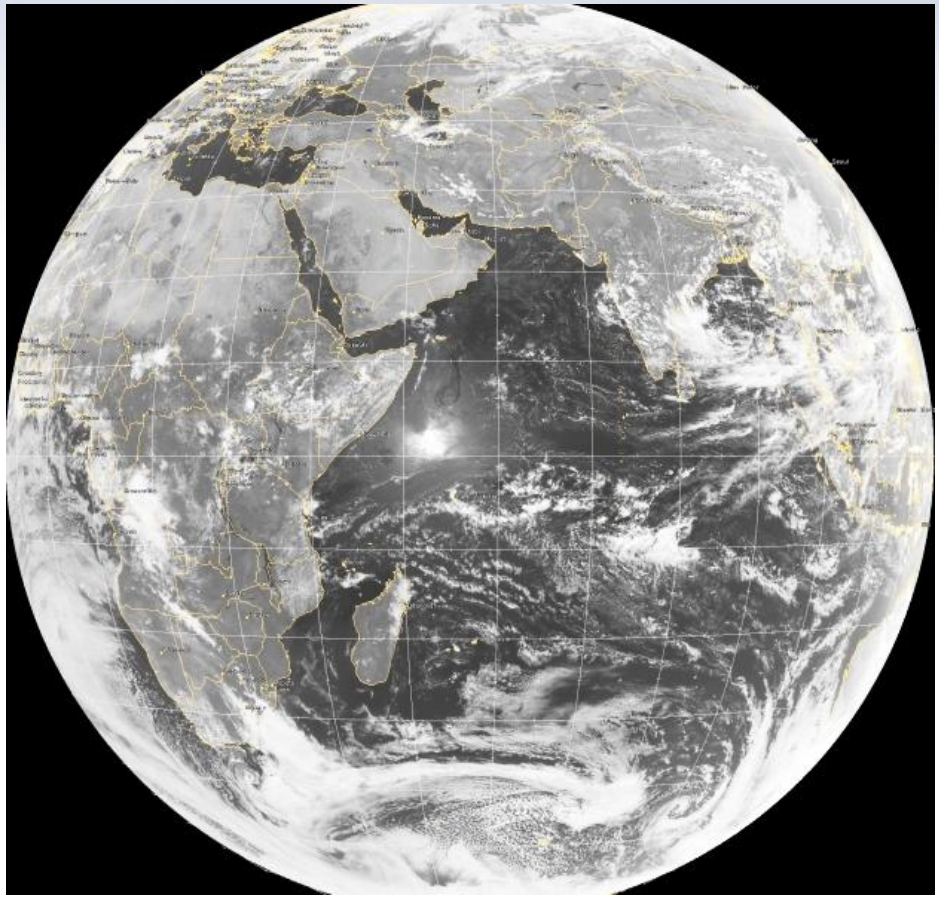
Geostationary satellites

Meteosat First Generation (Meteosat-7)

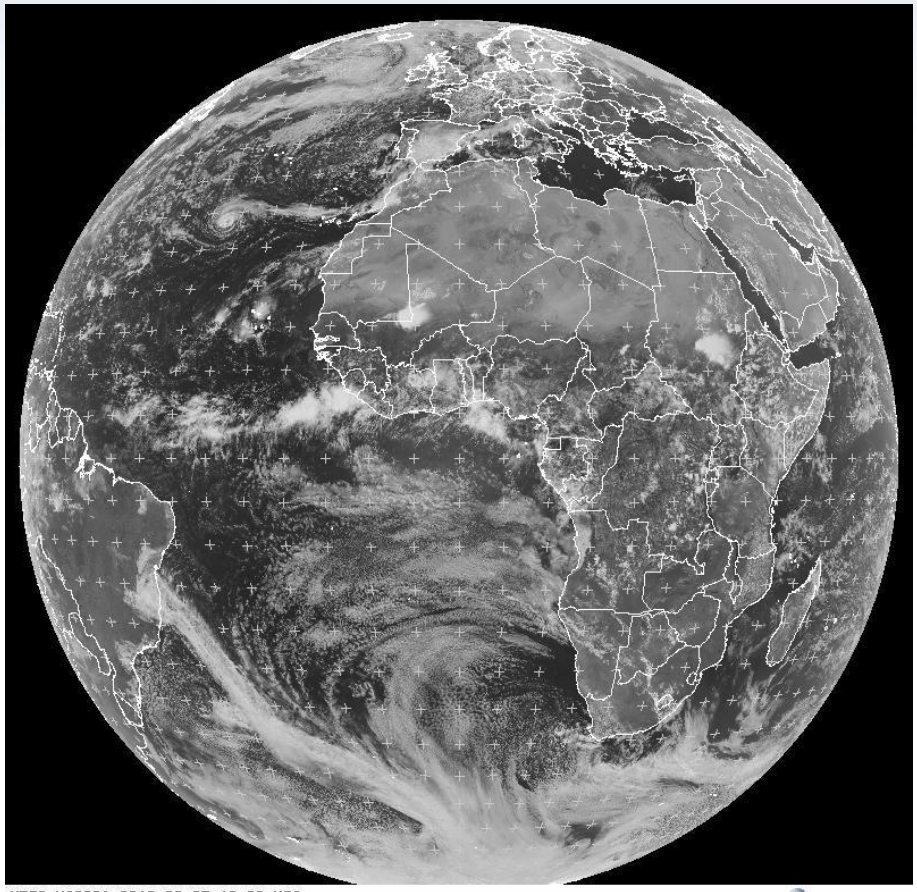


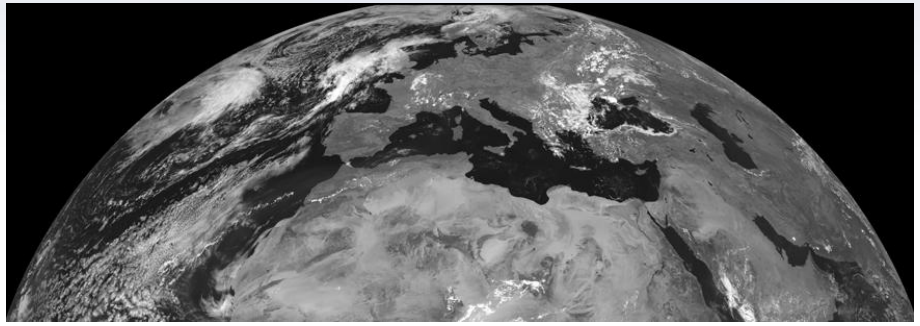
- Positioned over the Indian Ocean: 57.5°E
- 3 Spectral Channels (VIS, WV, IR)
- Sampling: 5 km (IR, WV), 2.5 km (VIS)
- Images every 30 Minutes
- Lifetime 1997-2016

Geostationary satellites

Meteosat Second Generation (MSG) (Meteosat-8, Meteosat-9)

- 12 spectral bands, 3 km horizontal sampling, HRV channel 1 km





- Meteosat-8
- Positioned over 9.5°E
- Images every 5 minutes (Rapid Scan Service)

- Meteosat-9
- Positioned over 0°E
- Images every 15 minutes

Met-8 Wobble

CLICK HERE

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MSG-3 (Meteosat-10) Launch on 5 July 2012

Usage after 21 January 2013:

Met-10 : launched 5 July 2012 and located at 0°. It supports SEVIRI HRIT, Met Products, SEVIRI LRIT, GERB and DCP.

Met-9 : launched 21 Dec 2005 and located at 9.5°E. It supports RSS.

Met-8 : launched 28 Aug 2002 and located at 3.5°East. It is imaging but not disseminating and it is an operational backup for Met-10 and Met-9.

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MSG-3 (Meteosat-10): super rapid scan examples

Overview Loop (MOV)

11 Sep 2012, Austria

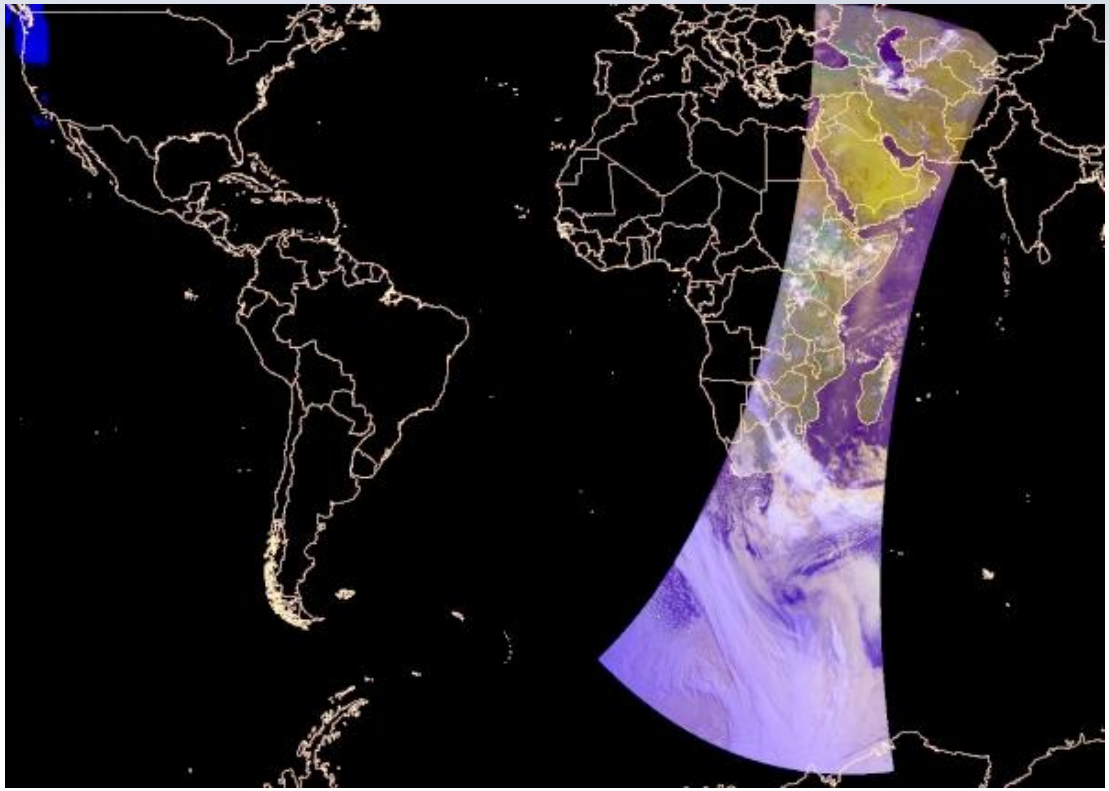
11 Sep 2012, Germany

11 Sep 2012, Italy

12 Sep 2012, Italy

Polar-orbiting satellites

EUMETSAT Polar System (EPS)



Metop-A (in operation since 2007)

- carries imaging and sounding instruments
- direct broadcasting and data collection capabilities

Partners: NOAA

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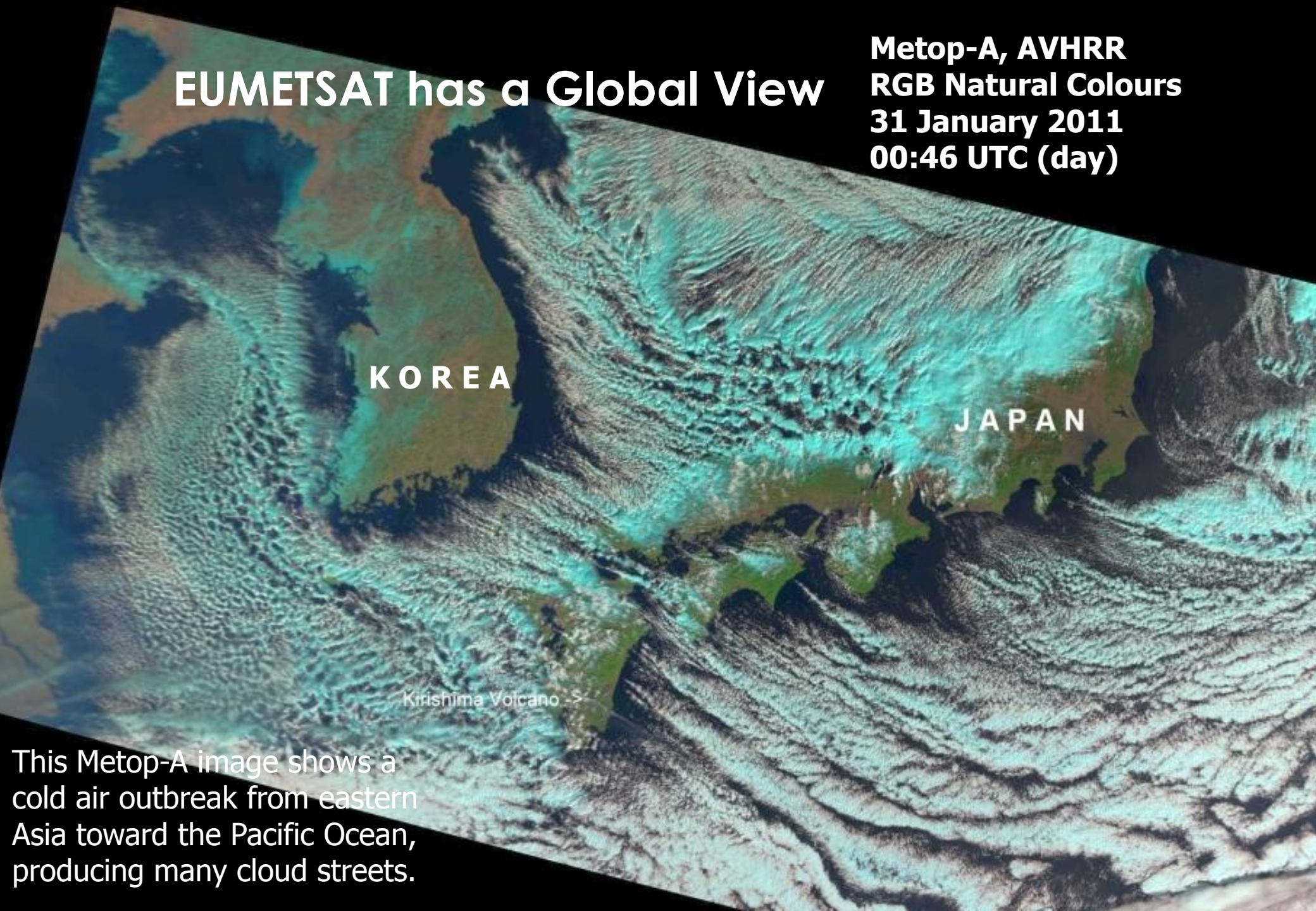
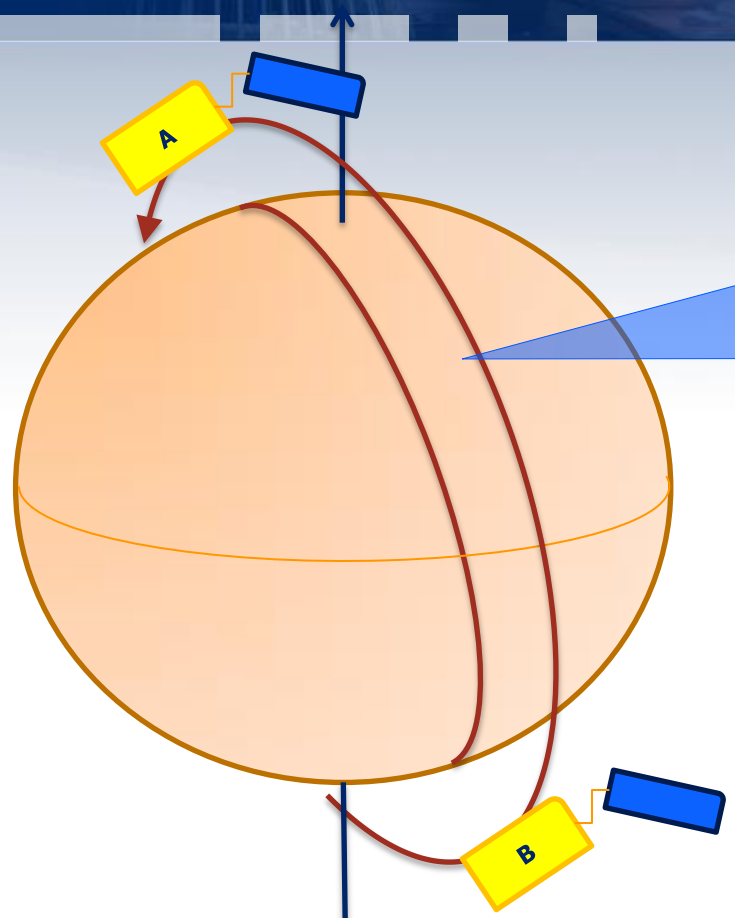
EUMETSAT has a Global View

Metop-A, AVHRR
RGB Natural Colours
31 January 2011
00:46 UTC (day)



This Metop-A image shows a cold air outbreak from eastern Asia toward the Pacific Ocean, producing many cloud streets.

Metop-B Launch on 17 September 2012



Metops will be co-planar, 180 degrees apart

Metop-A/B Target Orbits

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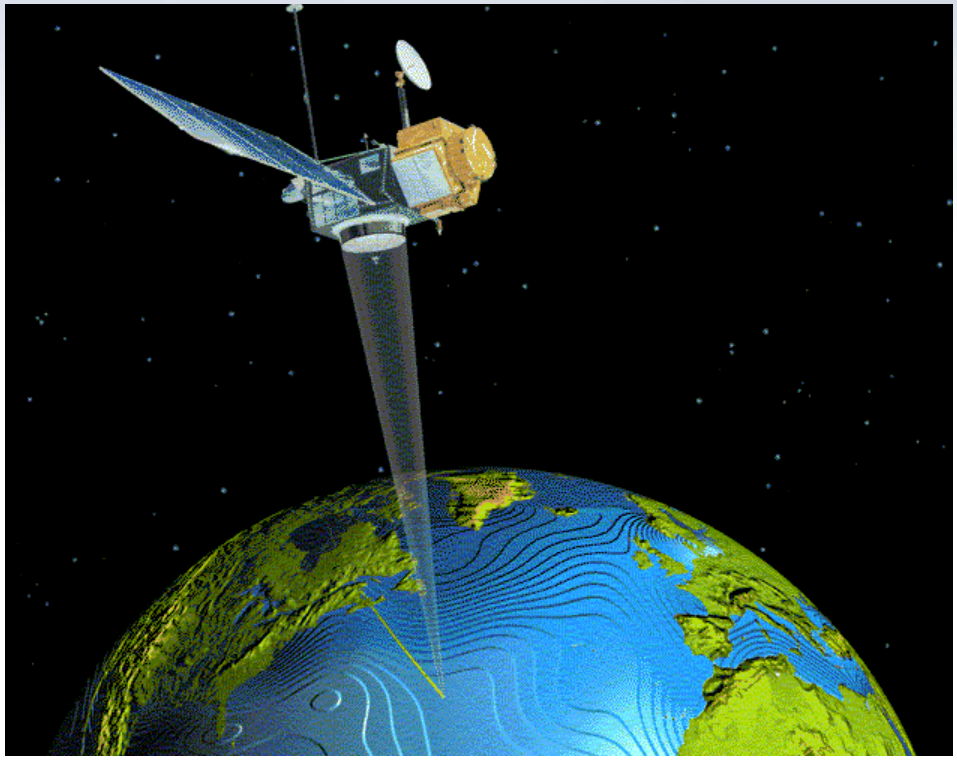
Monitoring the oceans

Jason-2



- launched in June 2008 from Vandenberg, California
- EUMETSAT's first optional programme on ocean altimetry

Partners: cnes NASA NOAA

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Access to EUMETSAT Data & Products

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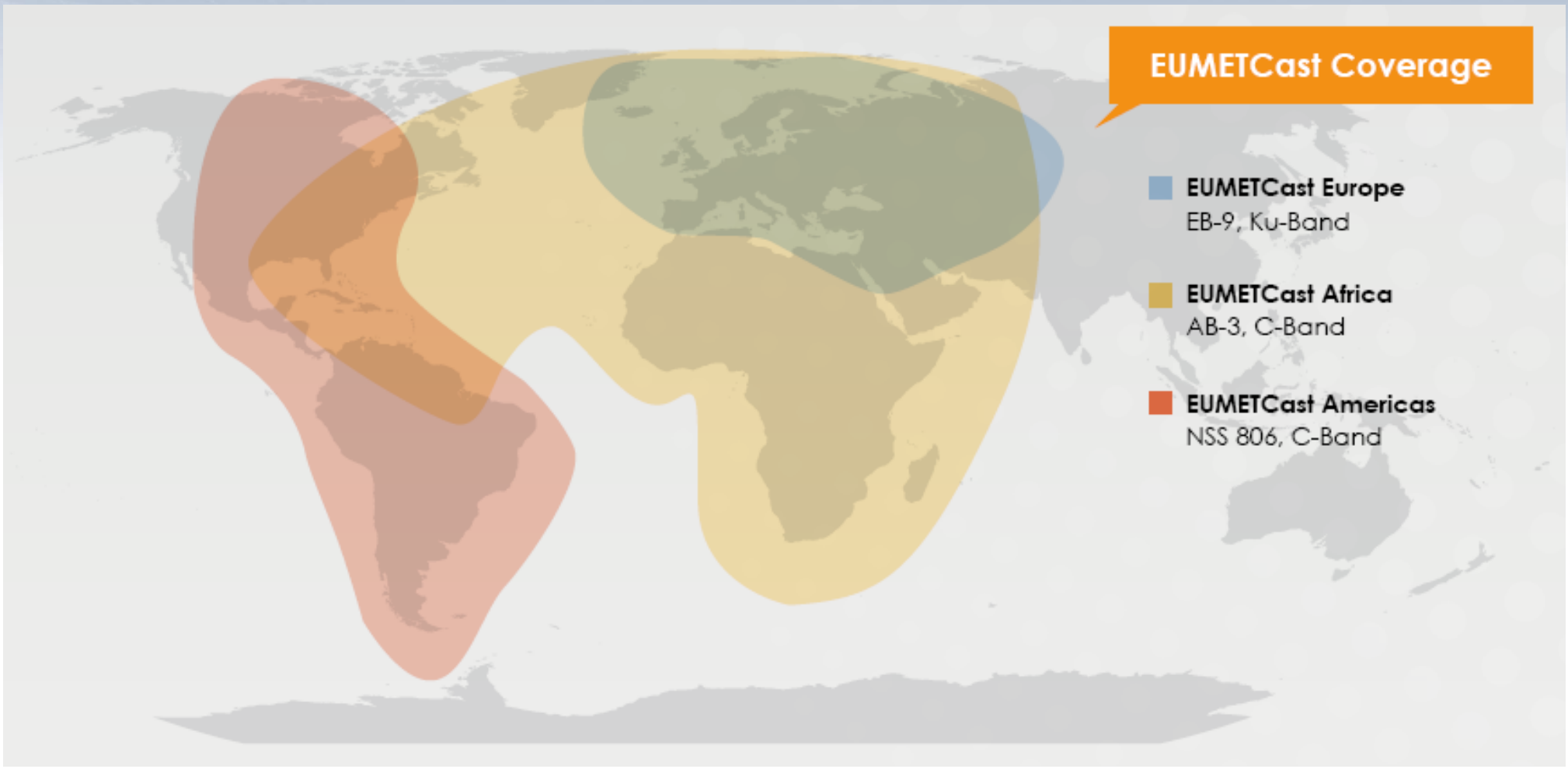
EUMETCast Coverage



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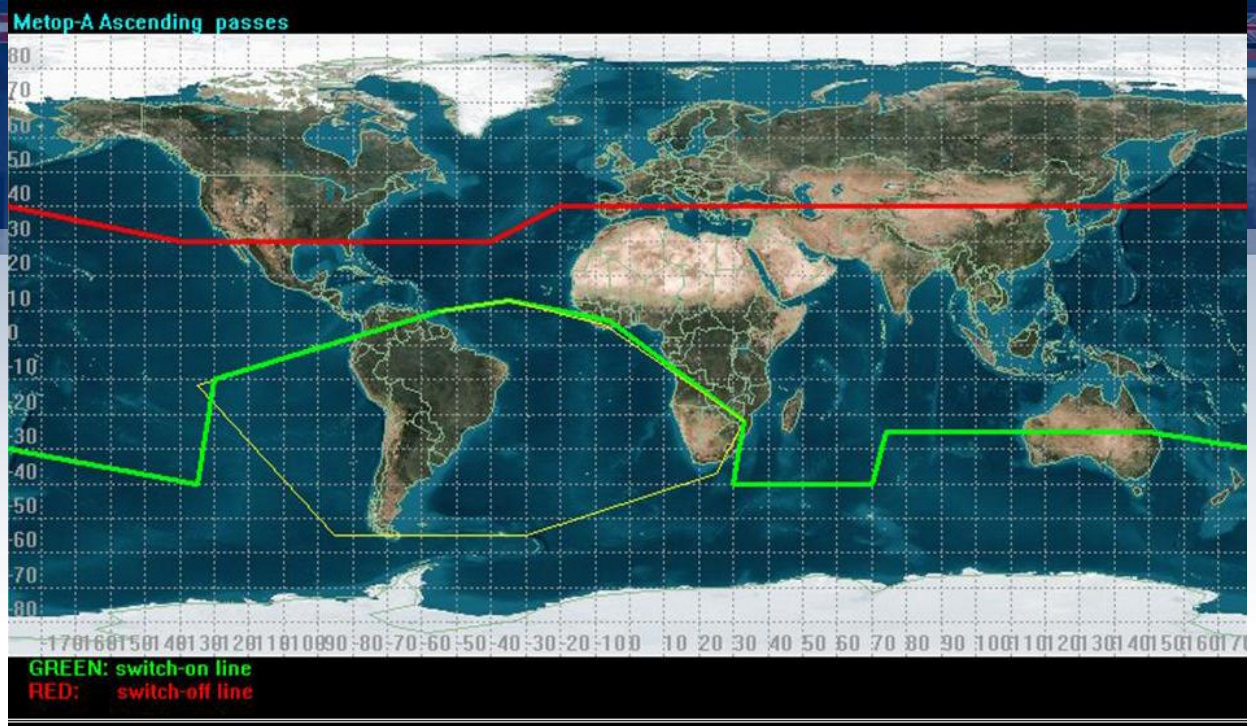
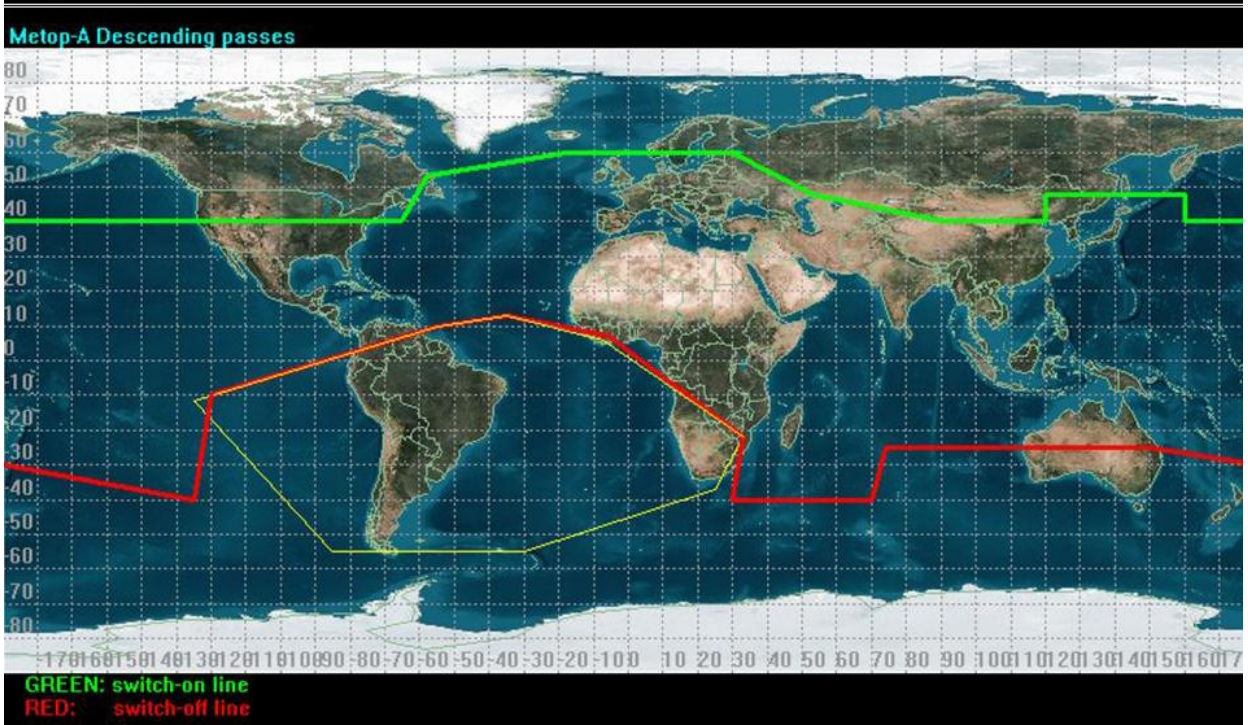
Metop-A Direct Readout Service

Ascending passes



Descending passes



EUMETSAT Data Centre

- Archive dating back to 1981
- Access online (via Data Access menu or via Product Navigator)

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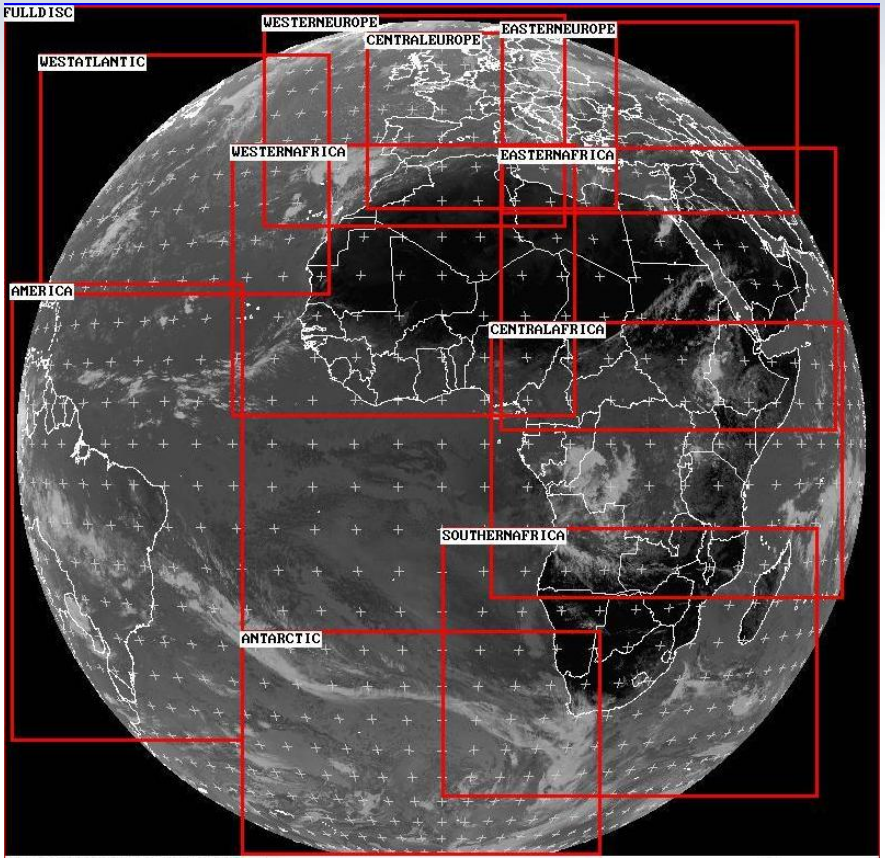
Internet

http://www.eumetsat.int/Home/Main/Image_Gallery/Real_Time_Imagery/index.htm?l=en

- Hourly Single Channel Images: Met-7, Met-9, Metop-A AVHRR
  (not all channels, reduced resolution)

- Hourly RGB Products Met-9: Airmass, Ash, Convection, Dust, Fog, Day Micro, Nat Colour, Fog/Snow, E-view

- Derived Quantitative MPEF Products Met-7 and Met-9: AMV, MPE, FIR, GII, CLA, CLM, CTH, TH



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MSG: Main Improvements

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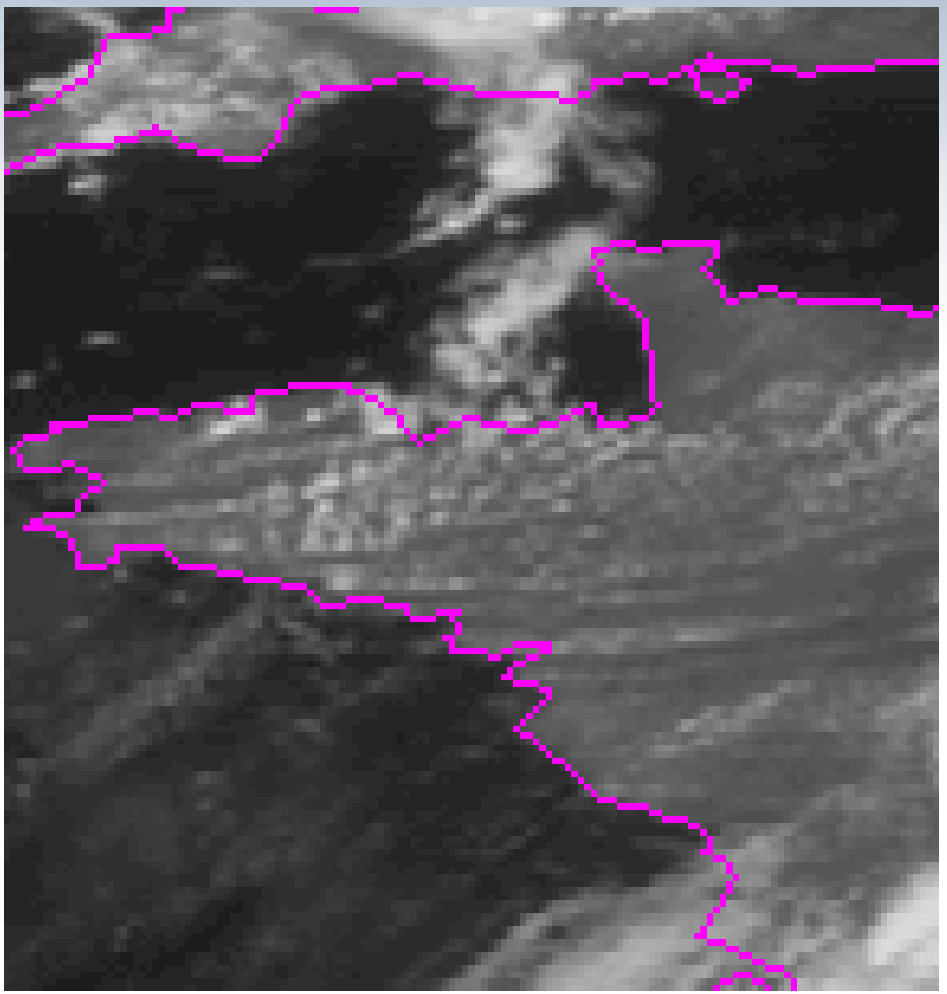
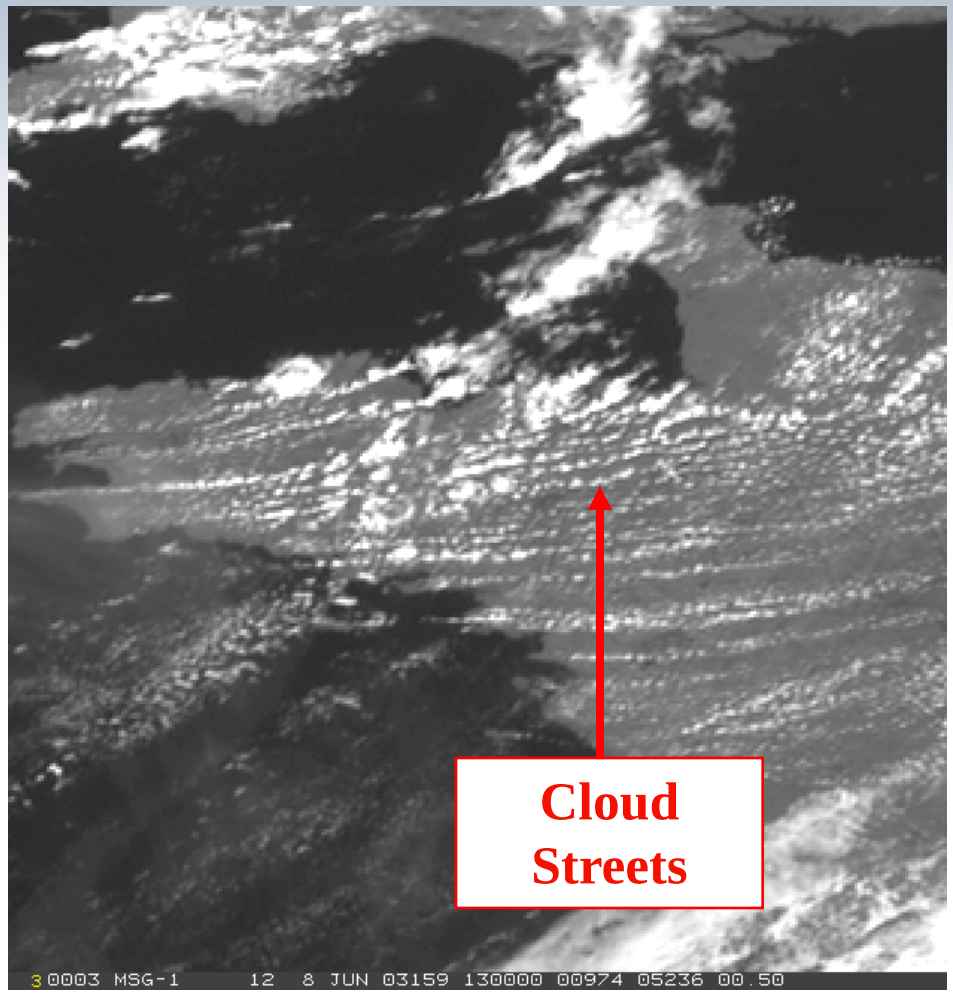
MSG Improvements: HRV (1 km sampling)



MFG VIS Channel



MSG Channel 12 (HRV)

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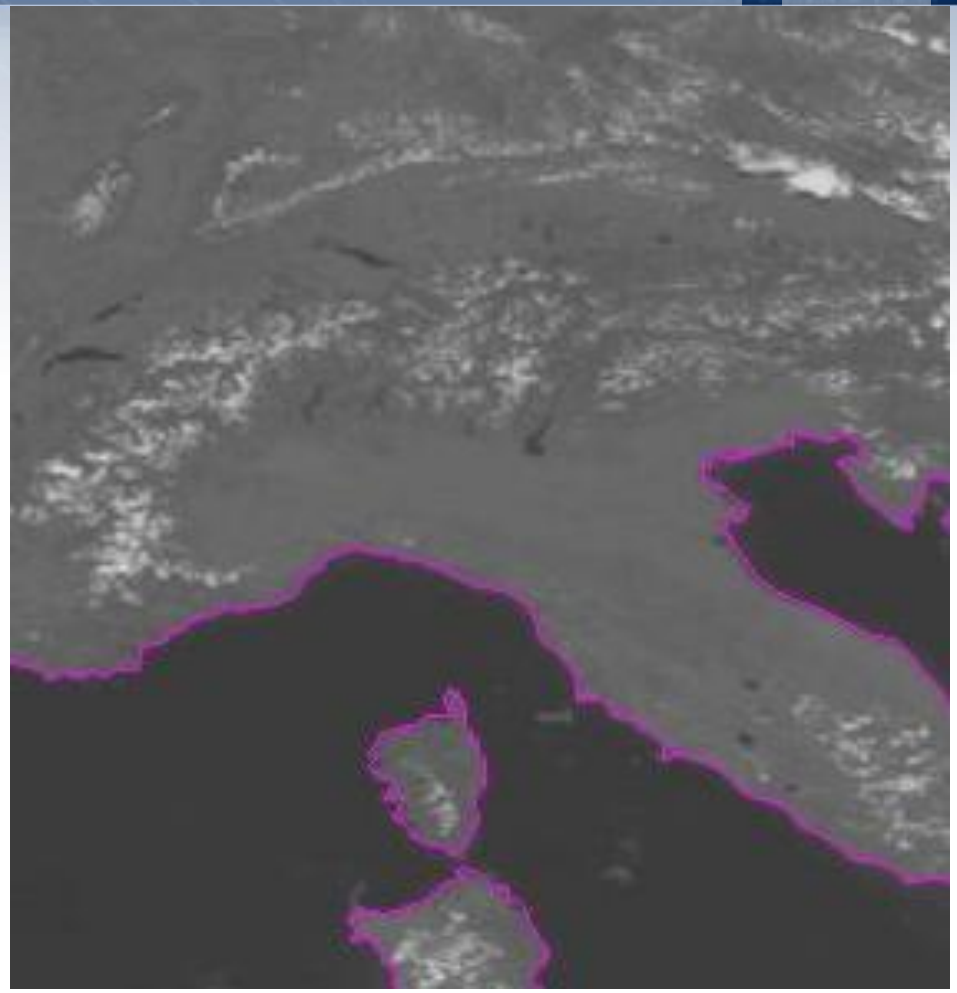
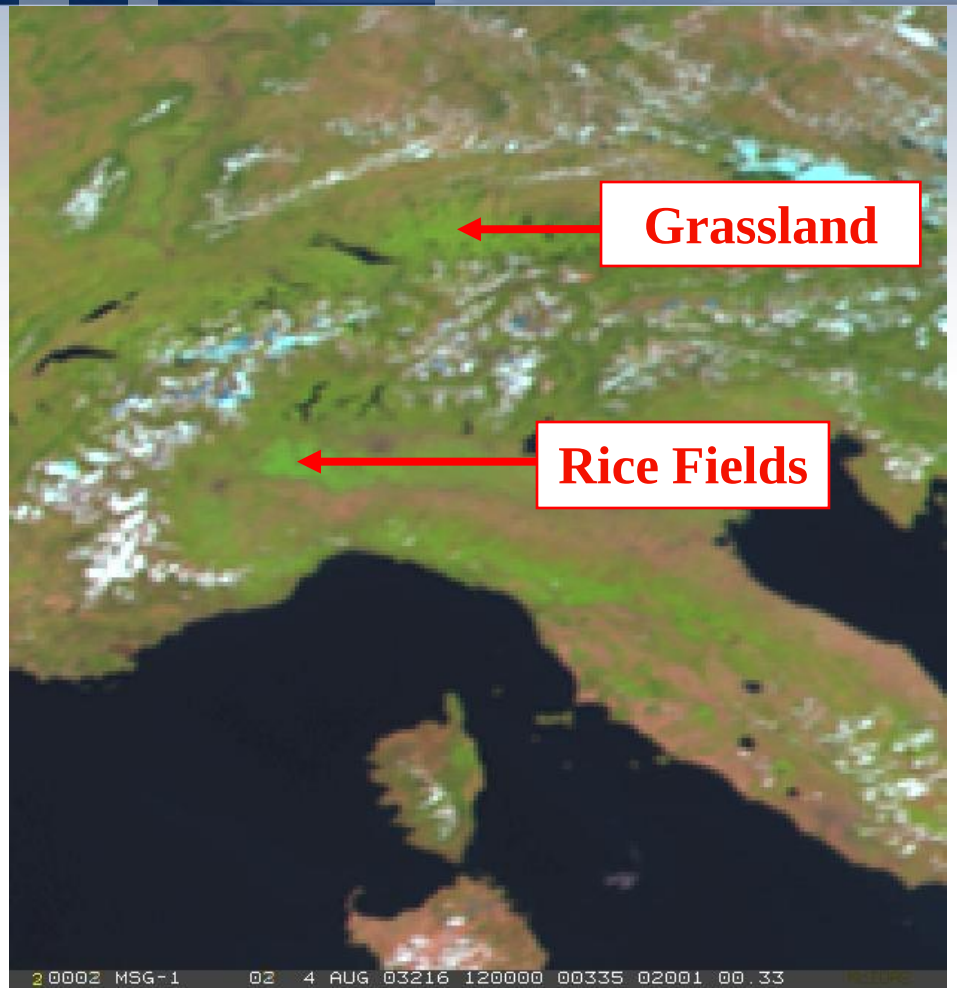
MSG Improvements: Vegetation



MFG VIS Channel



MSG Natural Colours RGB

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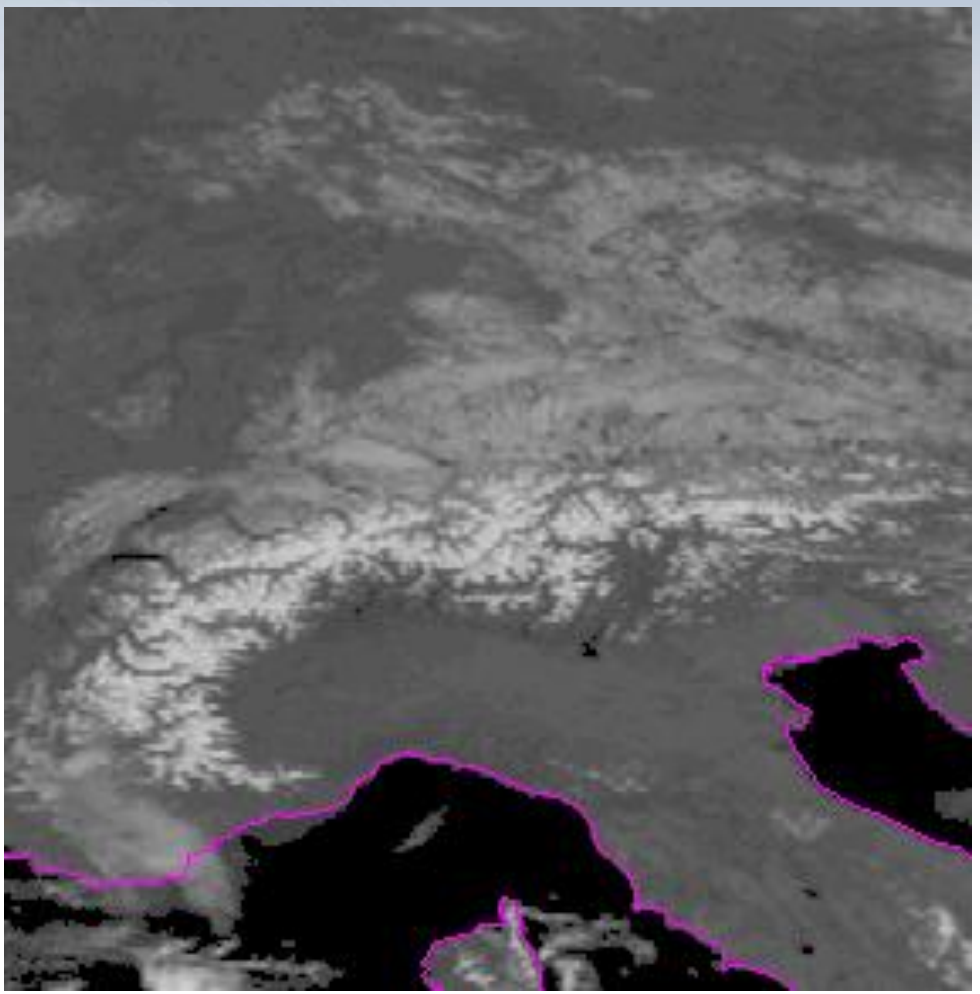
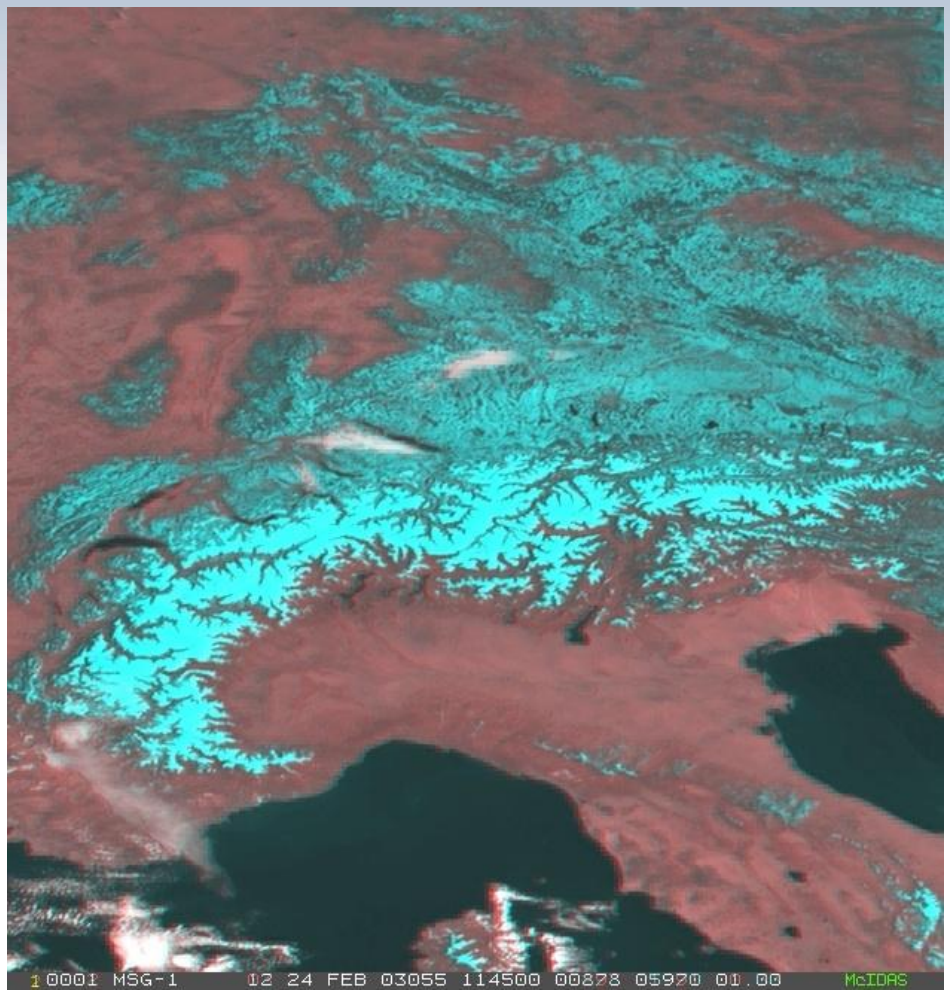
MSG Improvements: Snow

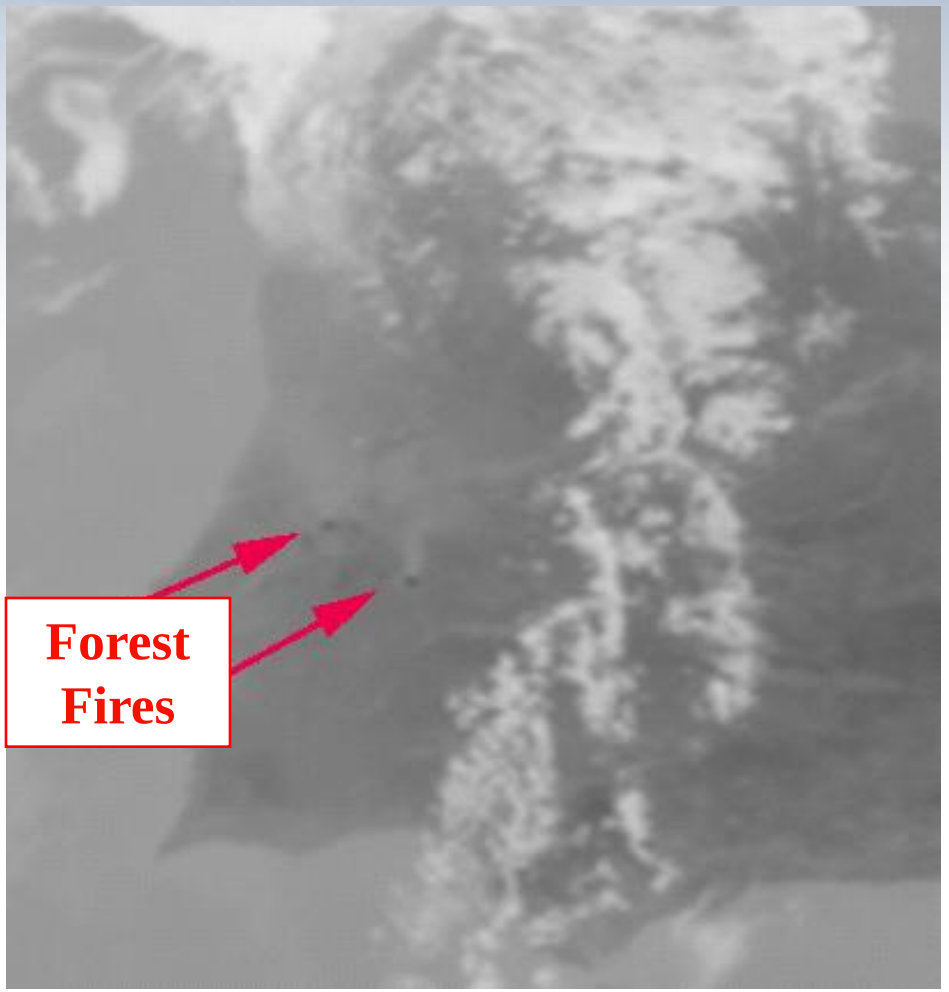


MFG VIS Channel

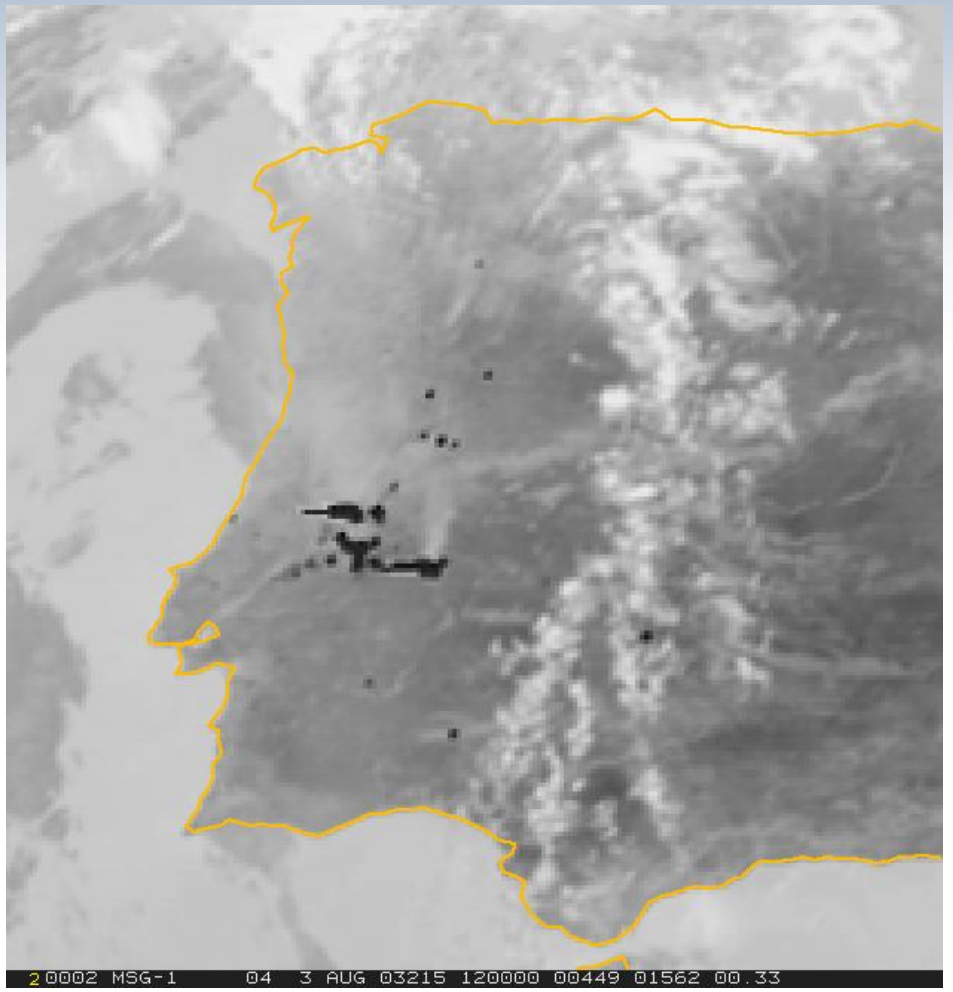


MSG RGB NIR1.6, HRV, HRV

MSG Improvements: Fires



MFG IR Channel



MSG Channel IR3.9

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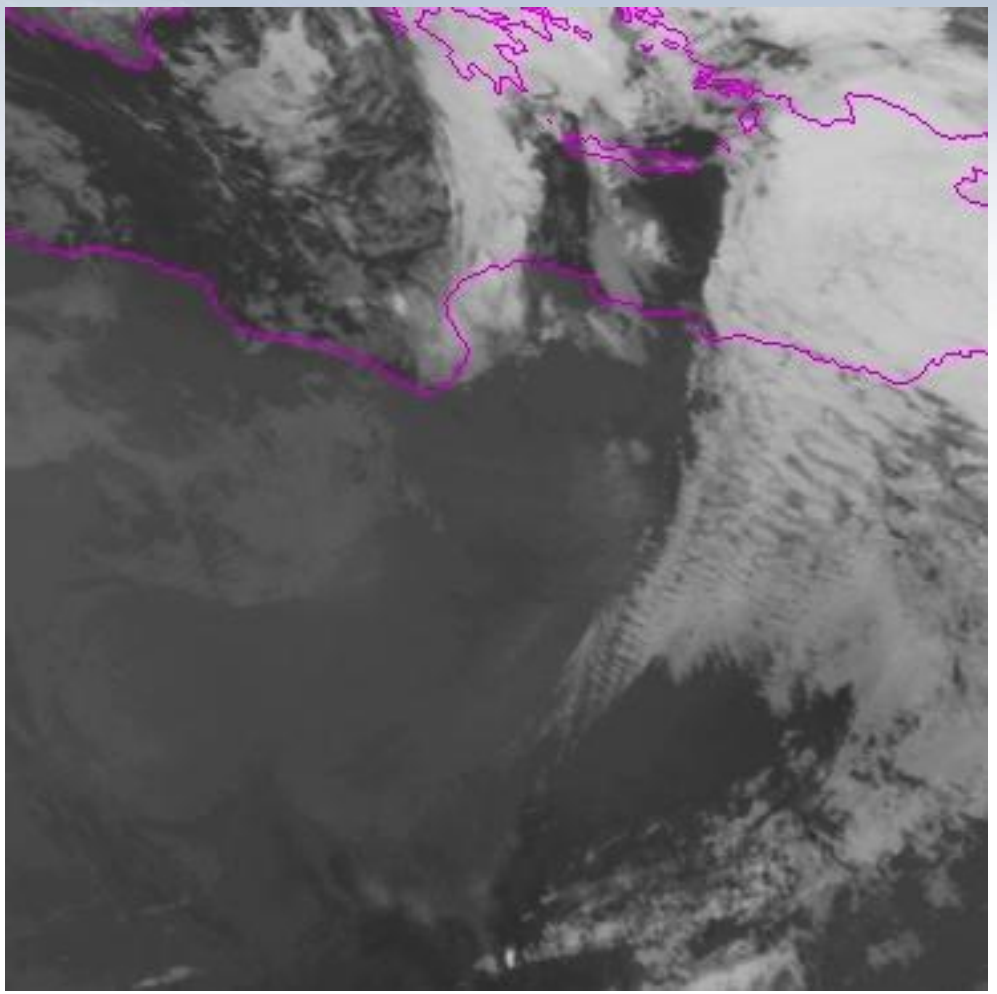
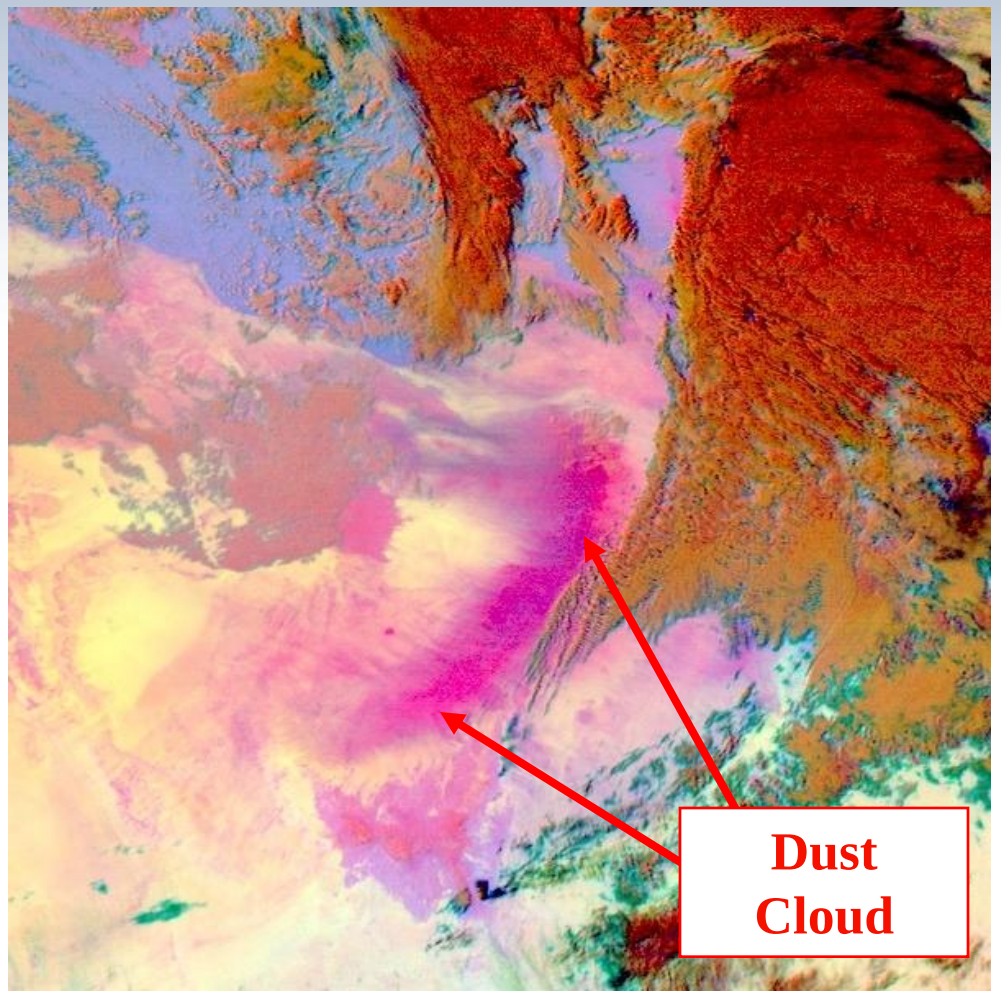
MSG Improvements: Aerosols (Haze, Dust, Ash, Smoke)



MFG IR Channel



MSG Dust RGB

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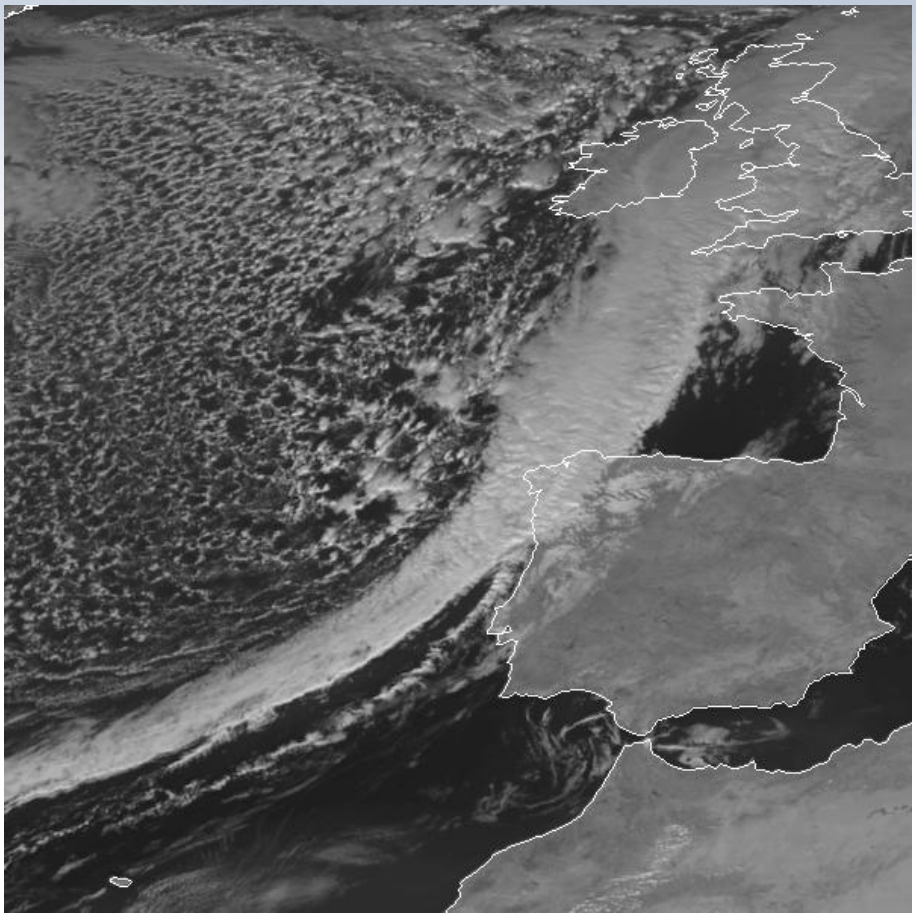
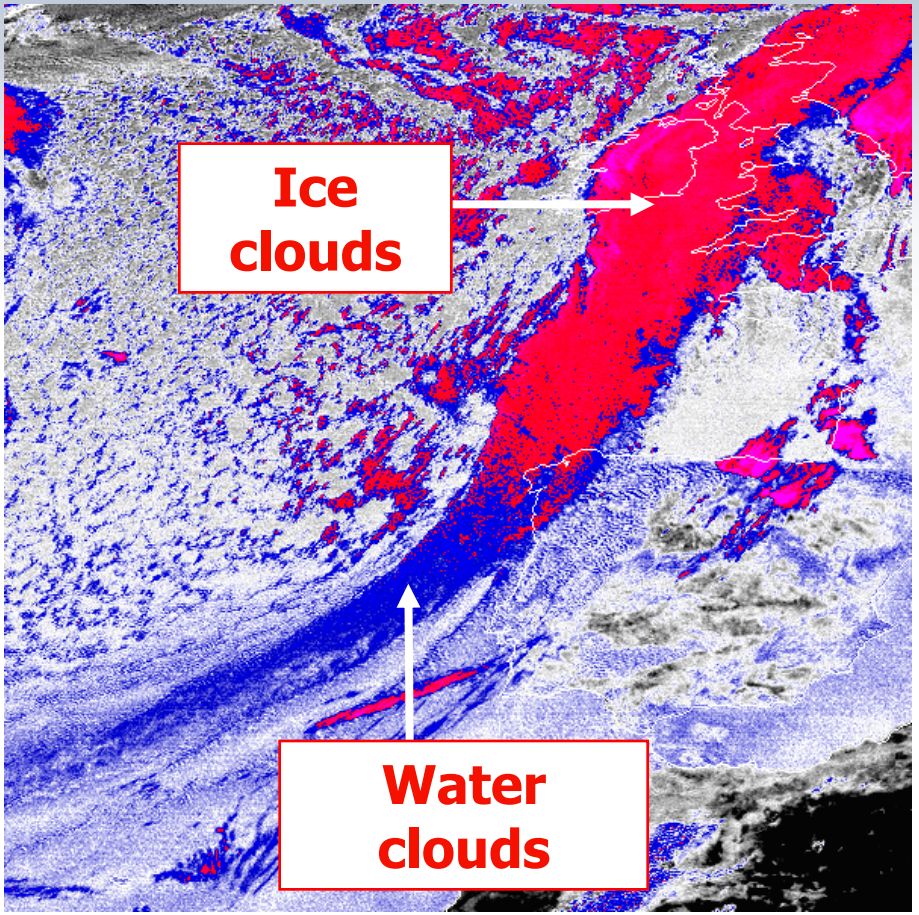
MSG Improvements: Cloud Phase



MSG VIS0.8 Channel



MSG BTD IR8.7 – IR10.8

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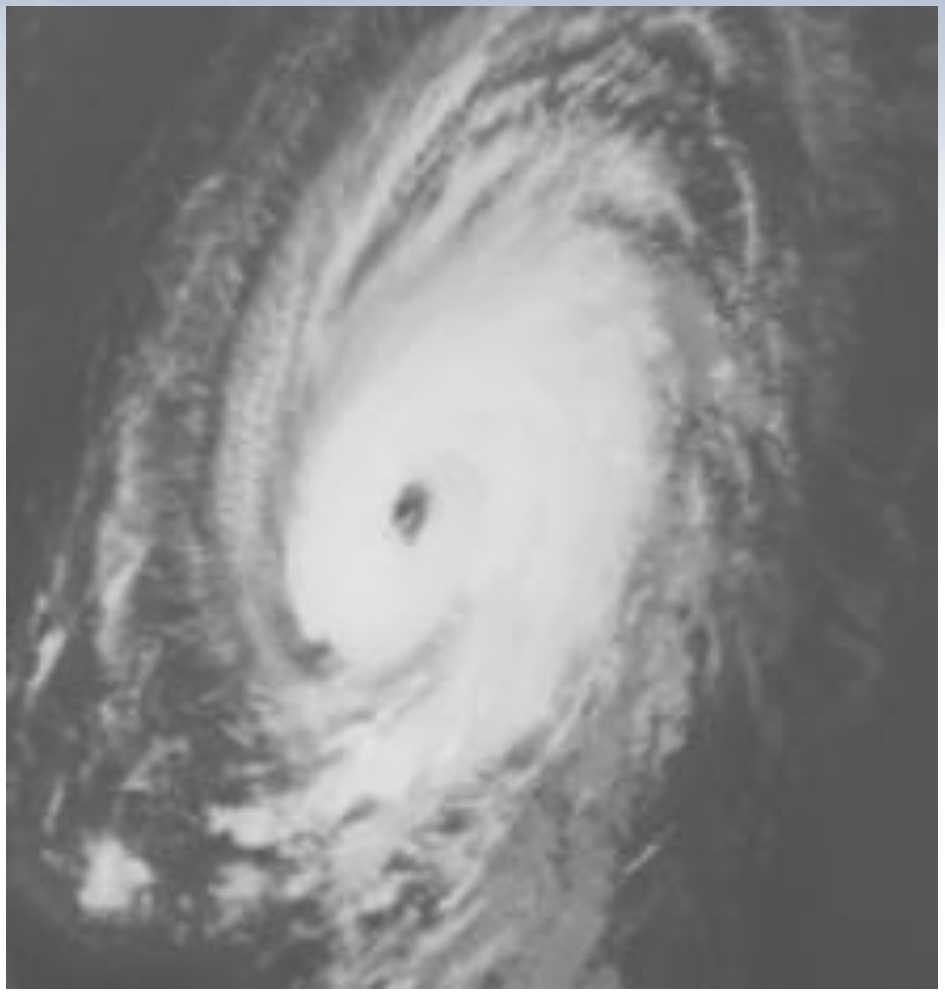
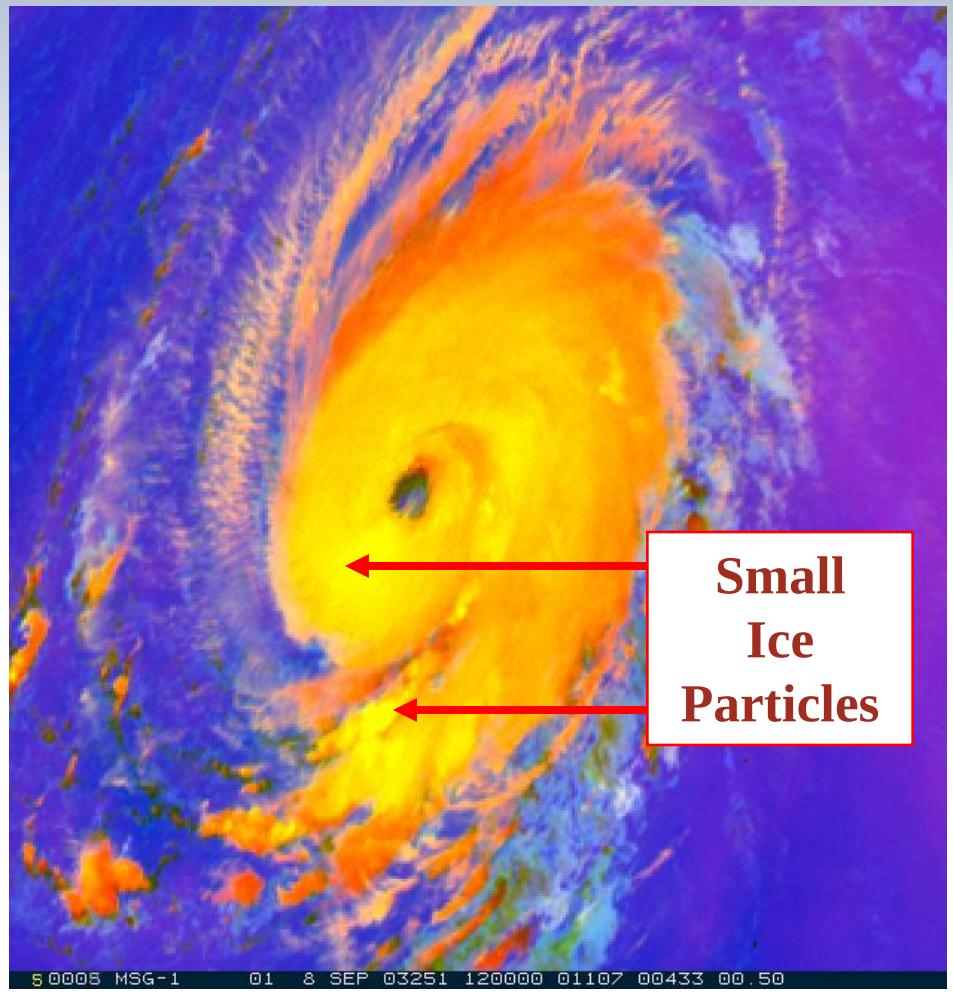
MSG Improvements: Cloud Particle Size



MFG IR Channel



MSG Convection RGB

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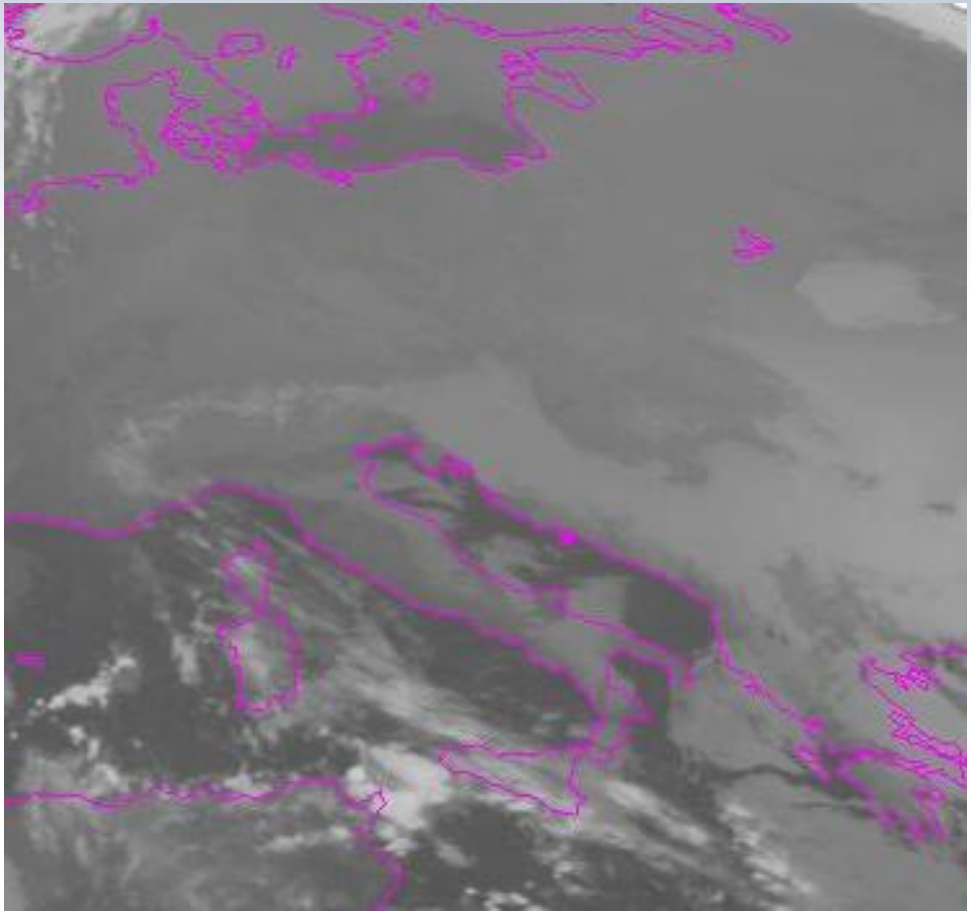
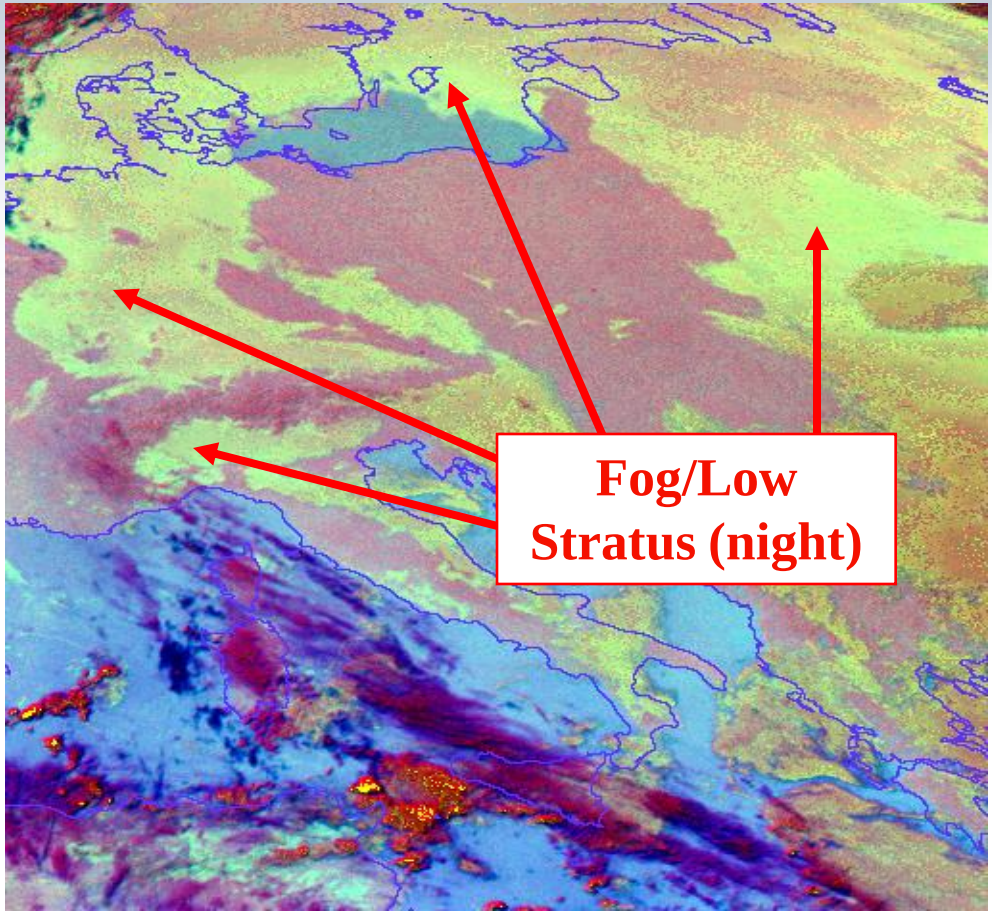
MSG Improvements: Clouds at Night

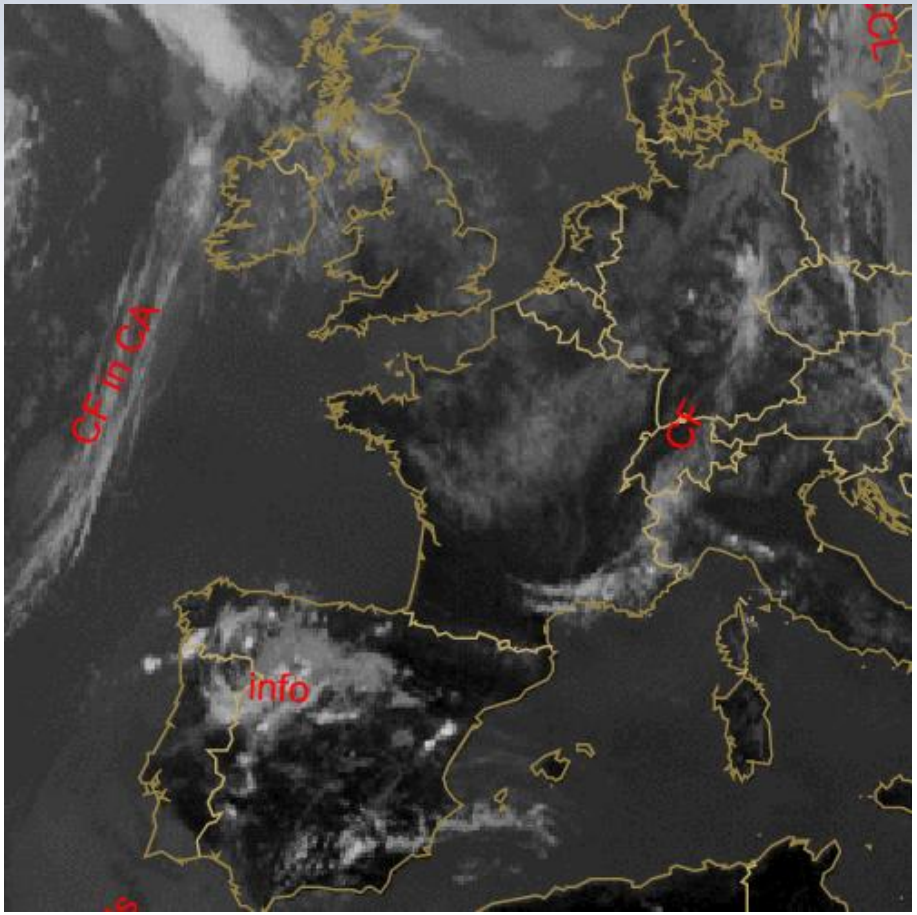


MFG IR Channel

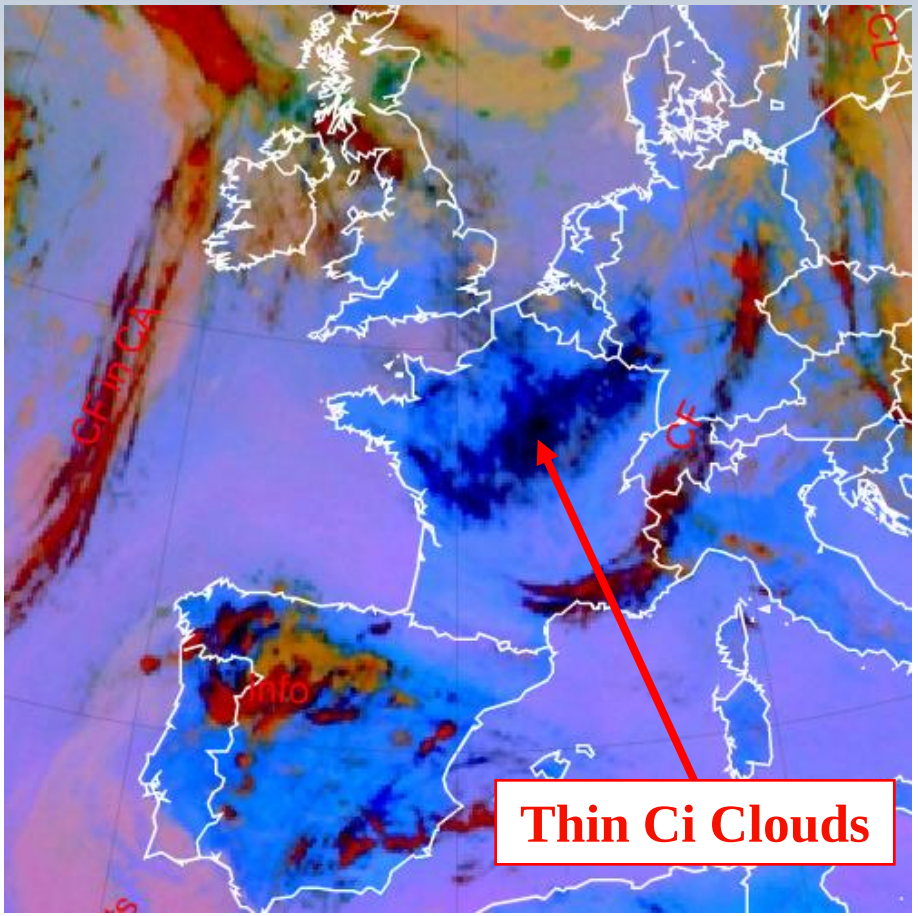


MSG Night Micro RGB

MSG Improvements: Thin Clouds



MSG IR10.8 Channel



MSG Dust RGB

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RGB Products: Questions & Answers

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How easy are the RGB products to use?

How do you know how to interpret them?

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Some study or experience is required to use RGB products correctly. Although some are "intuitive", others are not and can easily be misinterpreted.

<u>Thus, good training for a correct interpretation of RGB products is required !</u>

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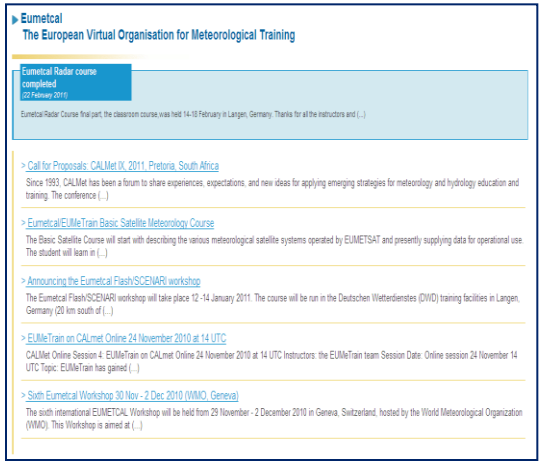
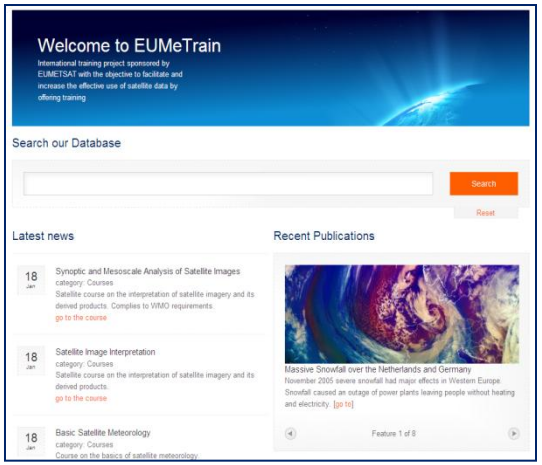


EUMeTrain



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...

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Can different features have the same colour, making them hard to decipher ?

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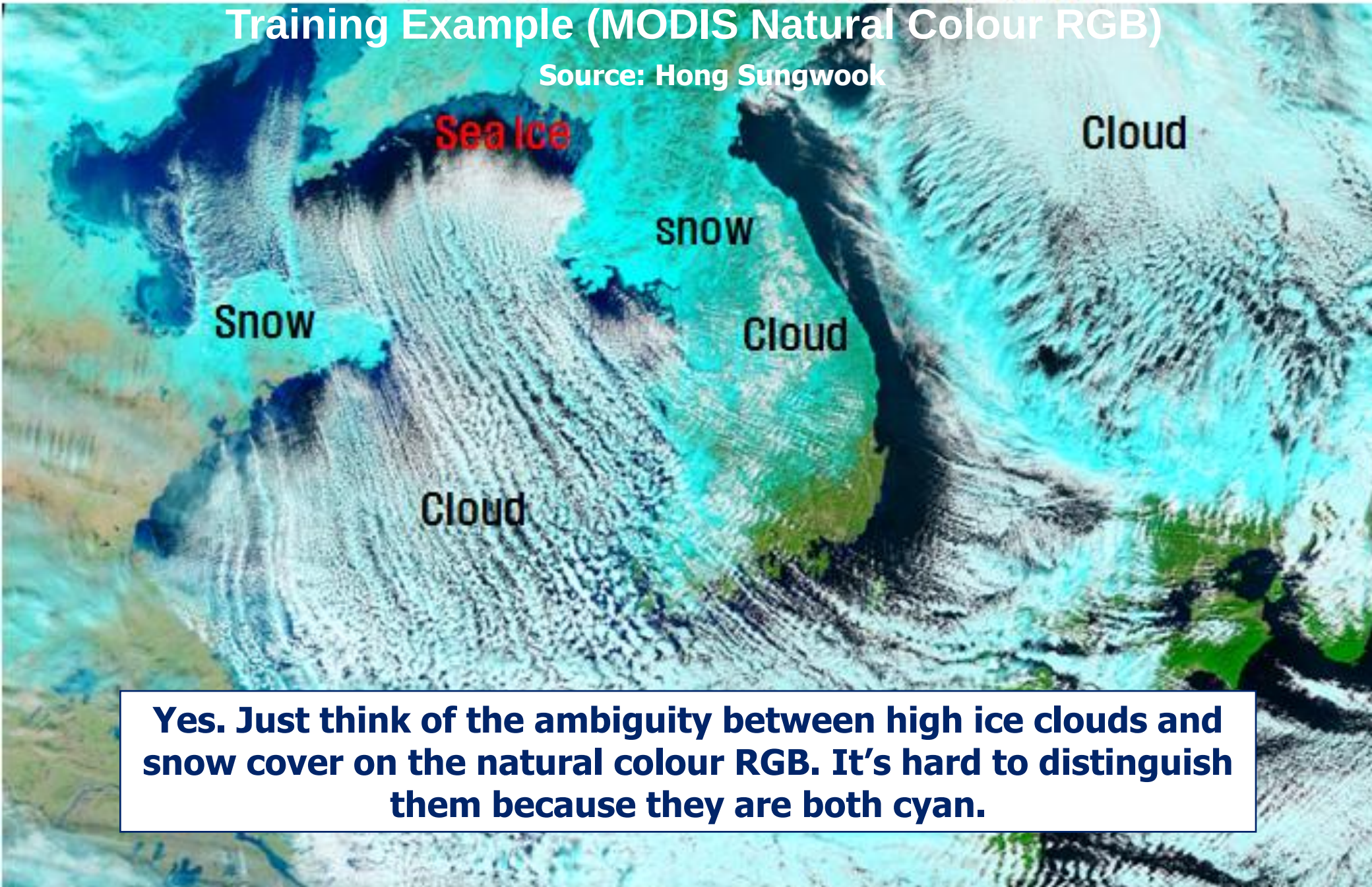
- 한반도 폭설 사례 (2010.01.05 0215 UTC)

Training Example (MODIS Natural Colour RGB)

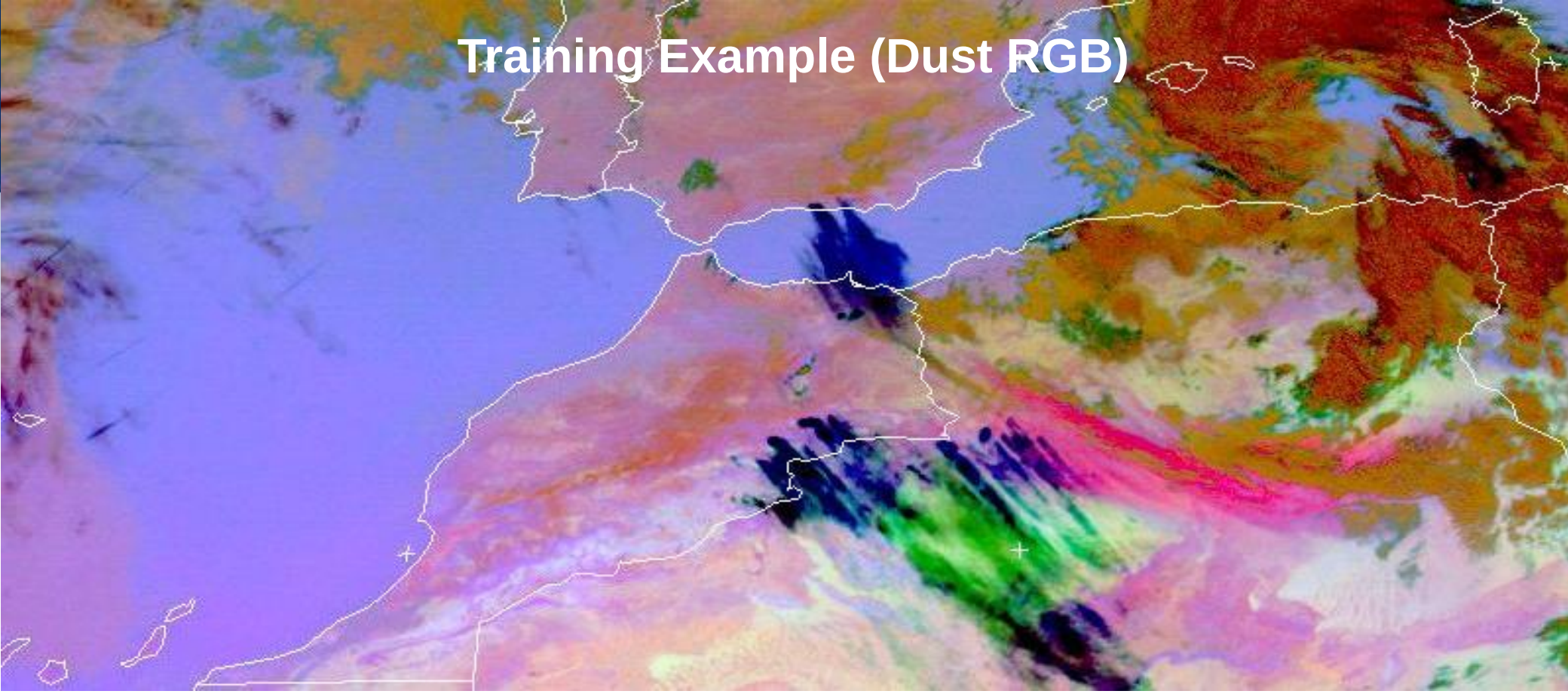
Source: Hong Sungwook



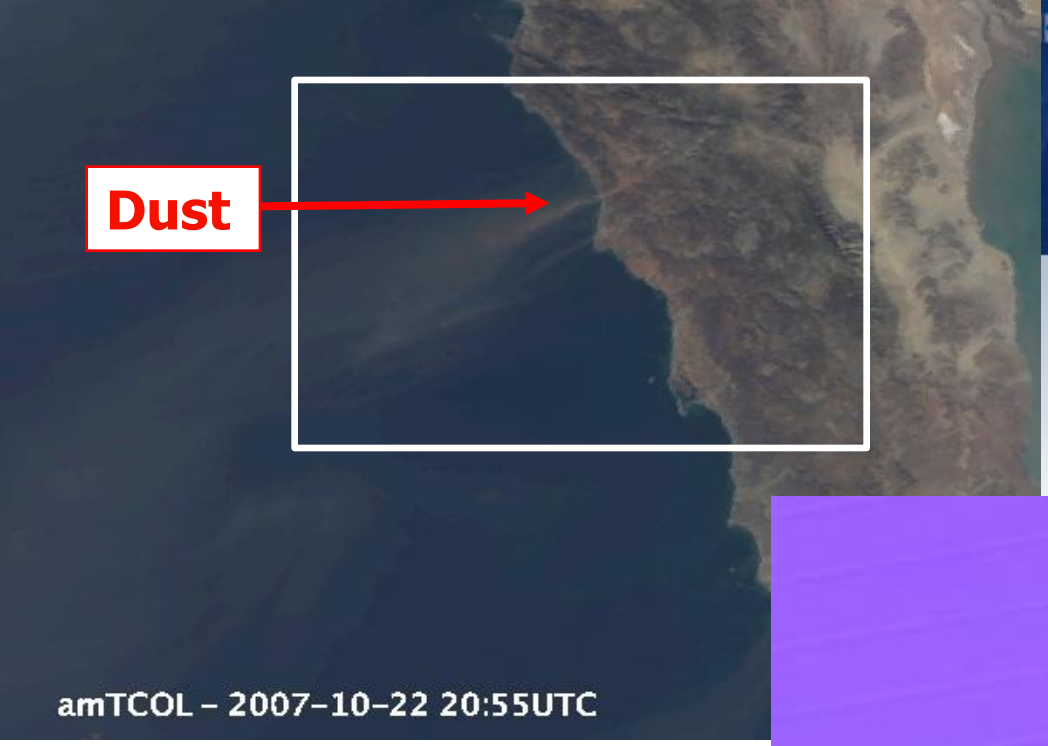
Yes. Just think of the ambiguity between high ice clouds and snow cover on the natural colour RGB. It's hard to distinguish them because they are both cyan.

Can a single and distinct feature appear in different colours in the same RGB image, making RGB interpretation difficult ?

Training Example (Dust RGB)



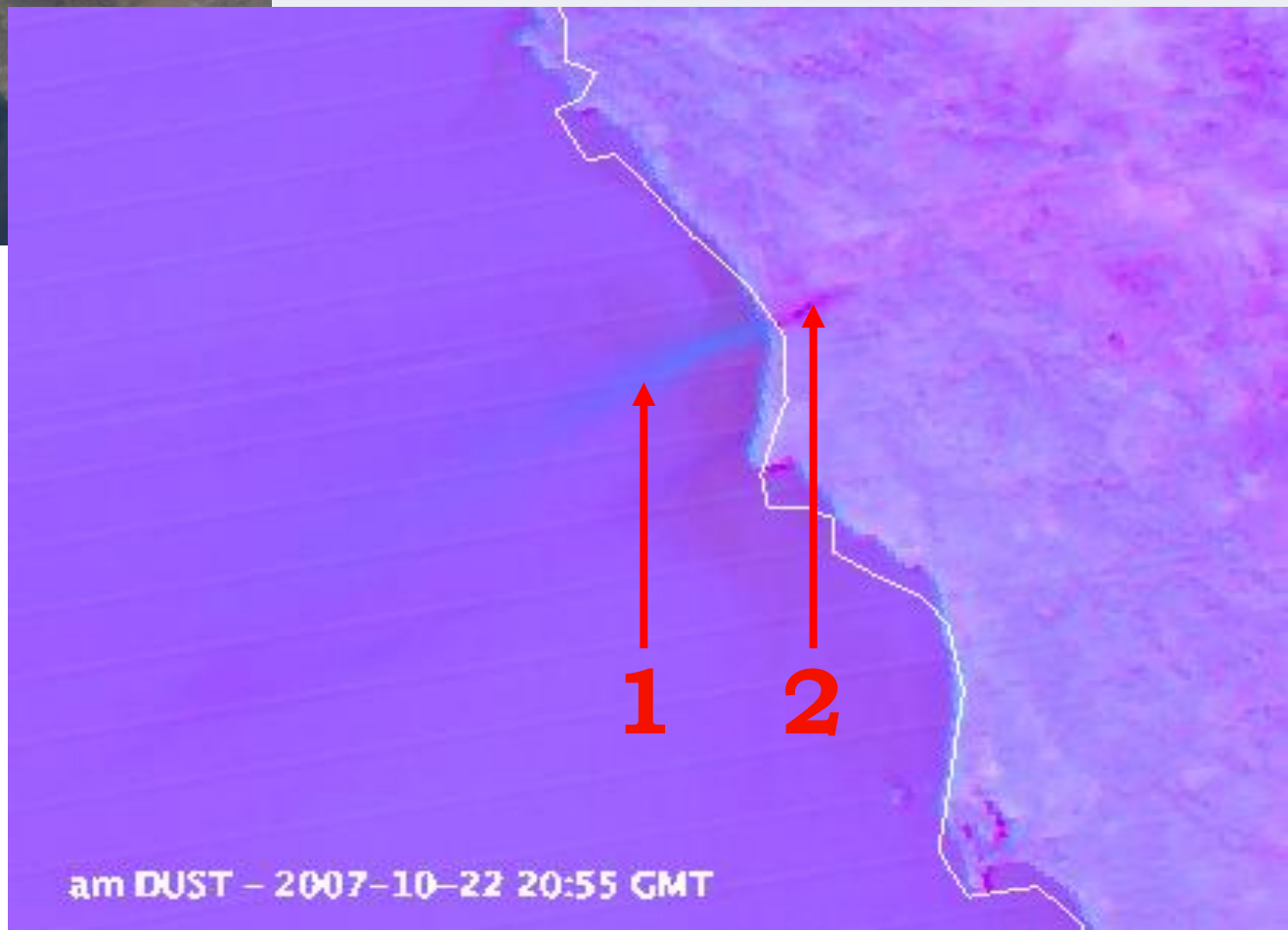
Yes. A good example is the colour of thin cirrus clouds, which depends on the underlying surface, both in the dust RGB and in the natural colours RGB. To take the dust RGB, thin cirrus are usually dark blue to black except over sand desert surfaces where the colour tends to be green.



Training Example (Dust RGB)

Another good example is the colour of low level dust clouds, which depends on the temperature of the underlying surface.

Low level dust clouds are usually magenta (2) except over cold surfaces where the colour tends to be bluish (1).



What is the quality of RGB images?

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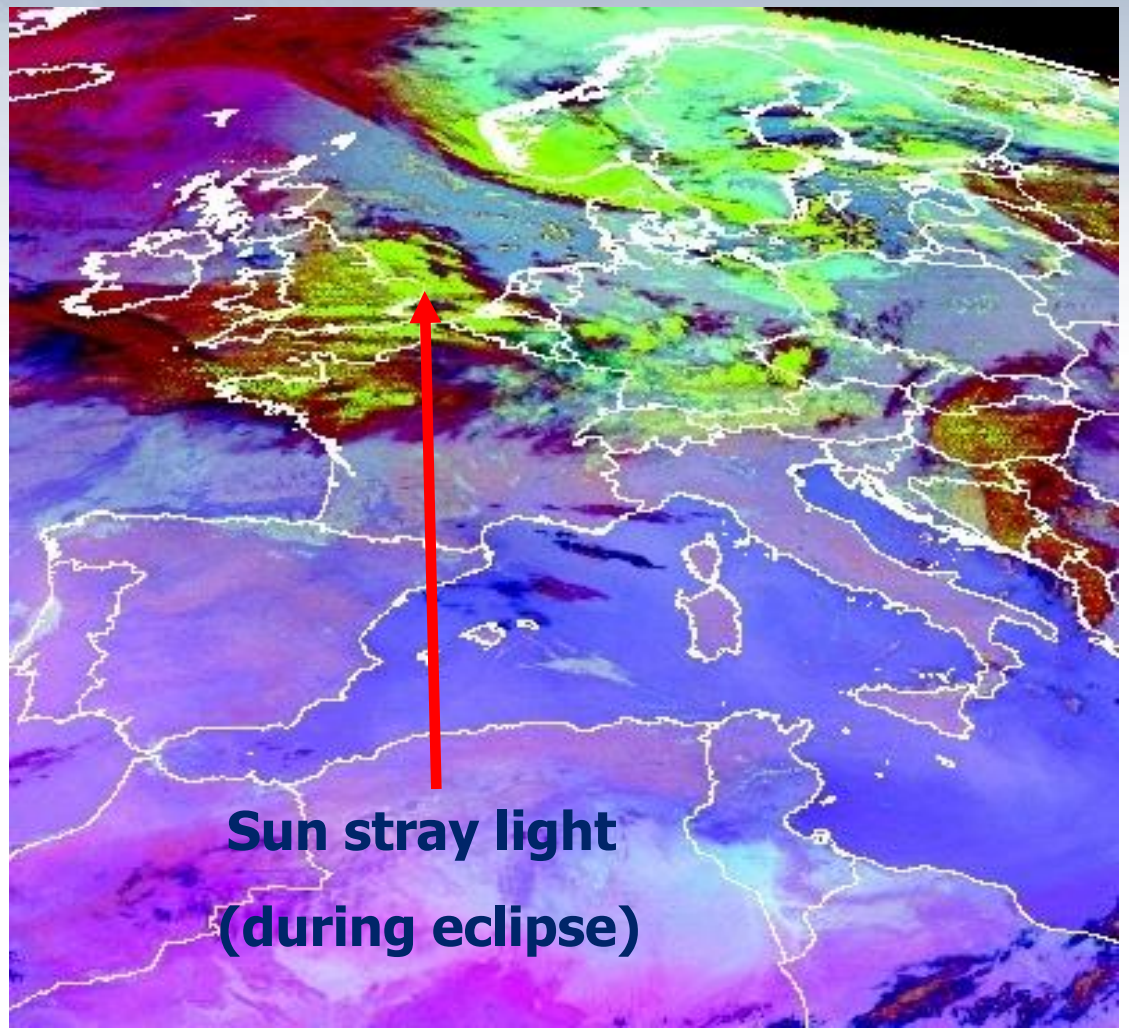
The quality of RGB images is directly (one to one) linked to the quality of the level 1.5 input images. Users should therefore be aware of typical problems with single channel images:

- Sun glint / Sun stray light
- Incorrect calibration
- Incorrect geolocation
- Sensor blinding
- Filter Artifacts
- …

Training Example (Night Microphysics RGB)



One example is the problem with IR3.9 and WV6.2 images during eclipse season, which affects the images around midnight.

The straylight problem of these channels is directly reflected in the RGB images that make use of these channels, namely the Night Microphysics RGB (also called Fog RGB) and the Airmass RGB.

How do RGB products differ from quantitative products?

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Best Practice: combined use of imagery (single channel or RGBs) and derived products

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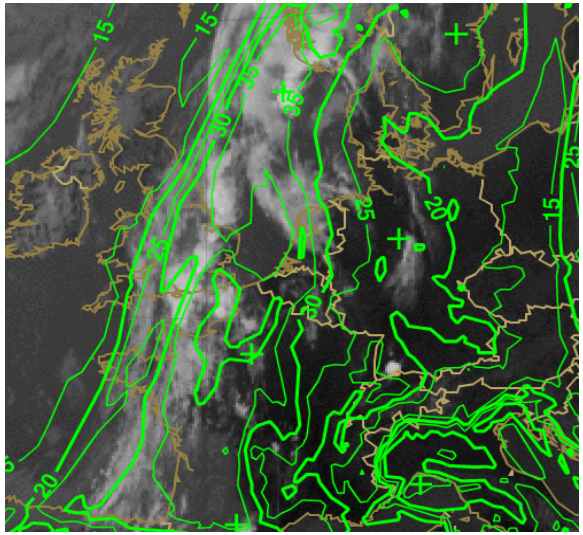
Phil Chadwick (Canada):

CSI = Creative Satellite Interpretation

- **All NWP is *wrong* but some NWP is *useful*…**
- **It may look great but it's not real… don't be seduced!**

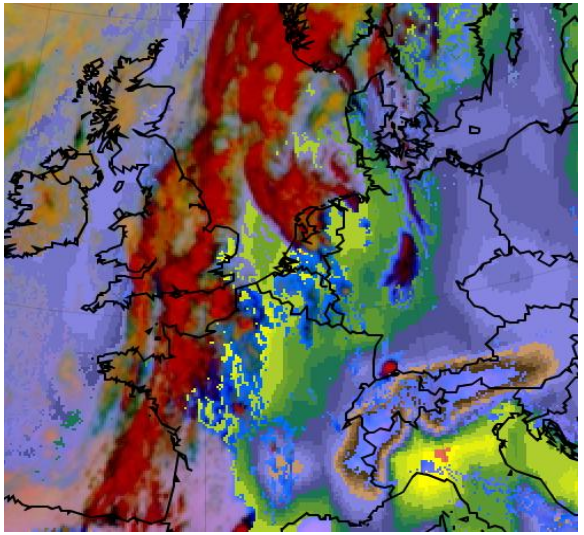
NWP (TPW)

Not Real



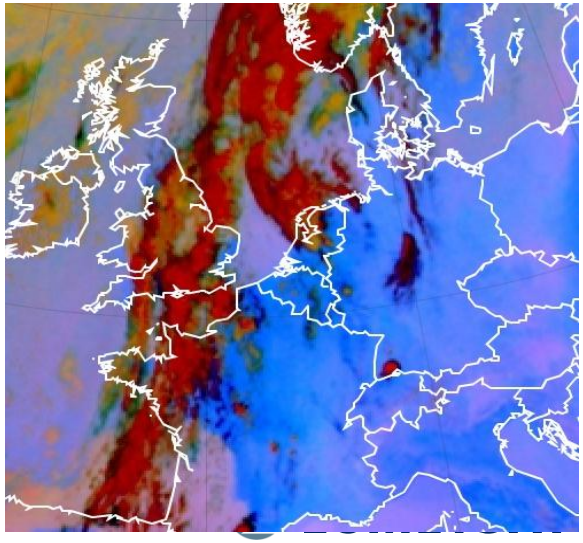
Derived Product (TPW)

"Semi" Real



RGB Image

Real



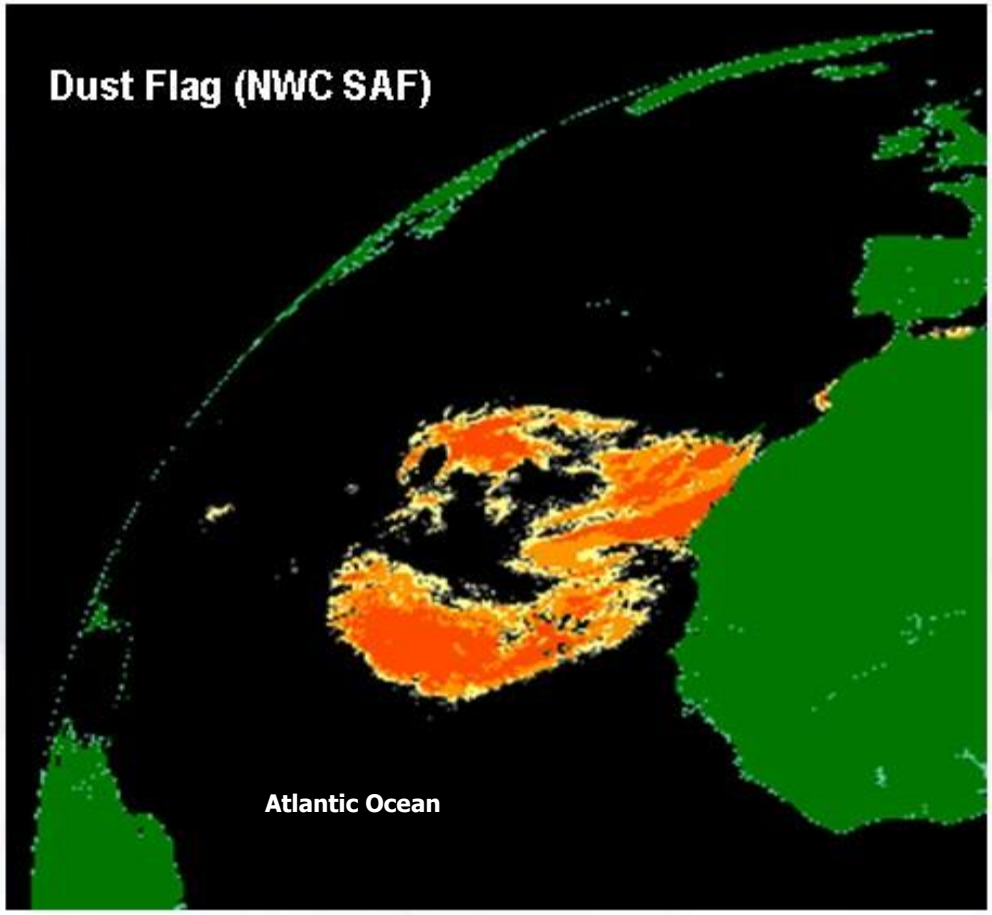
How do RGB products differ from quantitative products?

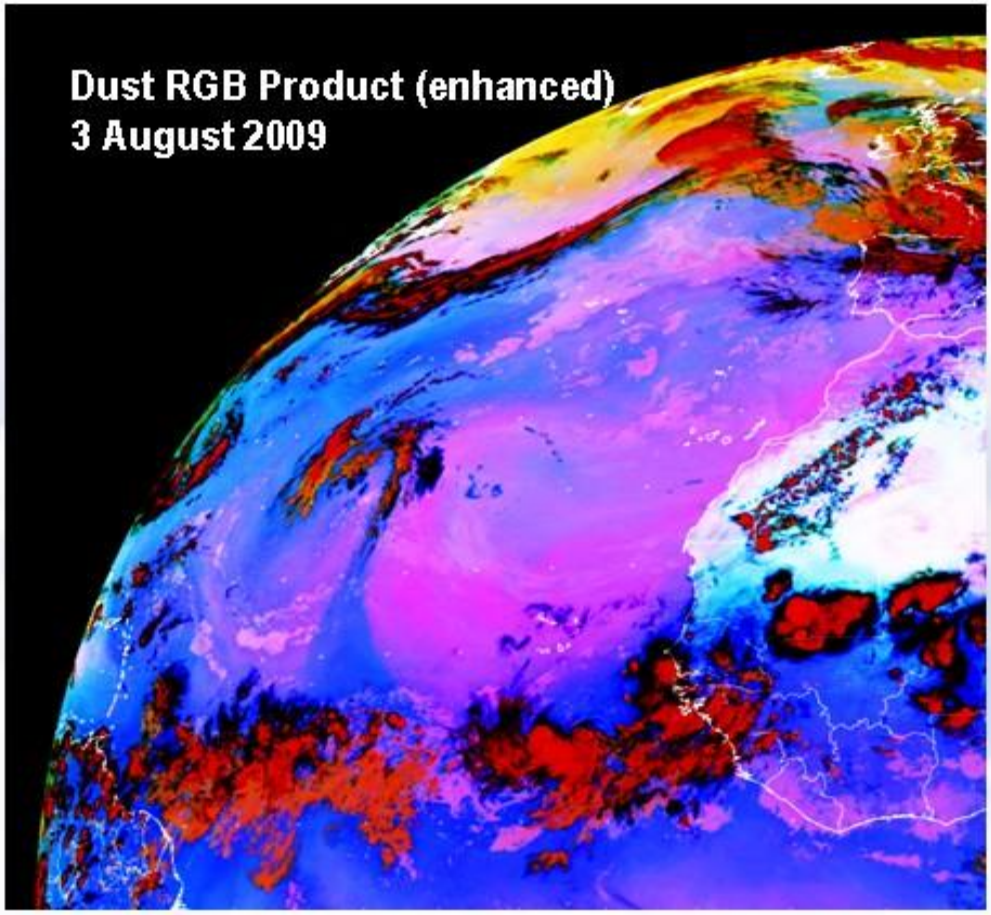
RGB Products	Quantitative (derived) Products
Qualitative info	Quantitative info (if available)
For visible inspection	Also for automatic processing
Only satellite data	Also NWP and ancillary data
One timeslot	Can use multiple timeslots
3 to 6 channels	Uses all suitable channels
Training needed (interpretation)	Less training needed
Viewing effects (e.g. limb cooling)	No viewing effect

How do RGB products differ from quantitative products?

RGB Products	Quantitative (derived) Products
View entire FOV	Limited to 65 or 70° viewing angle
Easy to implement	Difficult to implement
“Natural look” of images	Artifacts, jumps and boundaries
Sees the textures of clouds	Textures often get lost
Original image quality	Depends on quality of algorithm
Smooth animation	Difficult to animate (getting better)
Full resolution	Often reduced horiz./temporal res.
Sees everything (many features)	Focus on one feature
Latency: minimal	Latency: longer delay

Dust Clouds





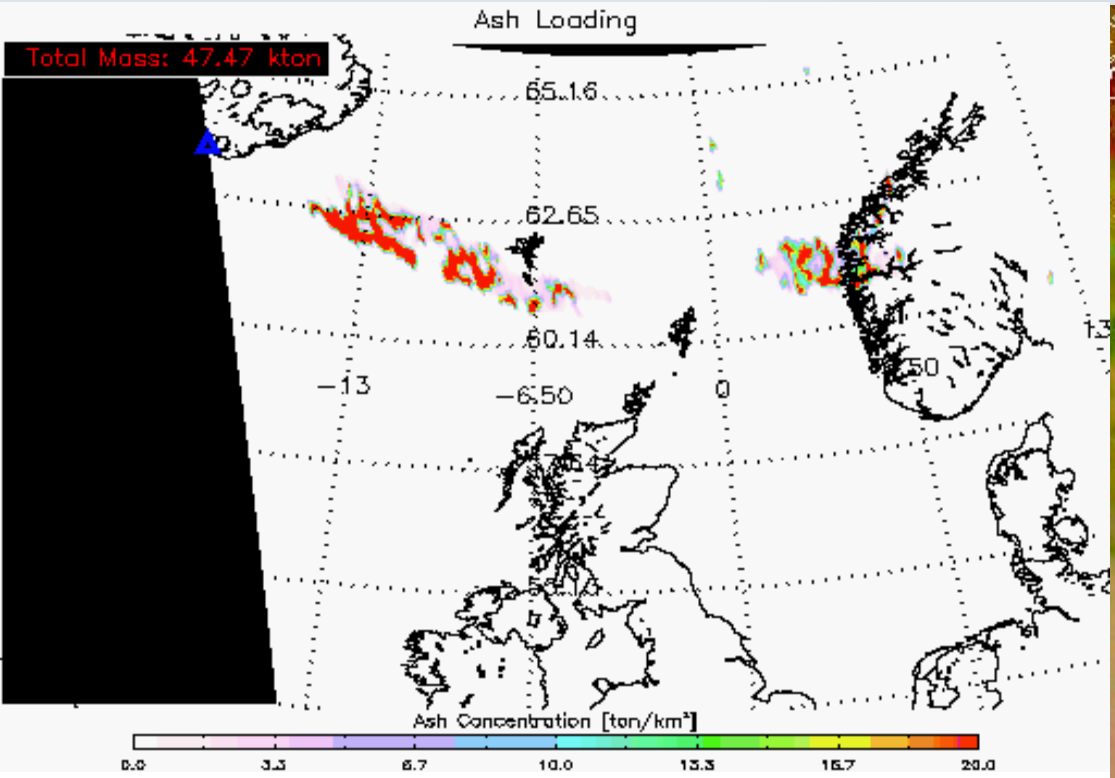
Source: Nowcasting SAF

EUMETSAT

Eruption Eyjafjallajokull
April 2010

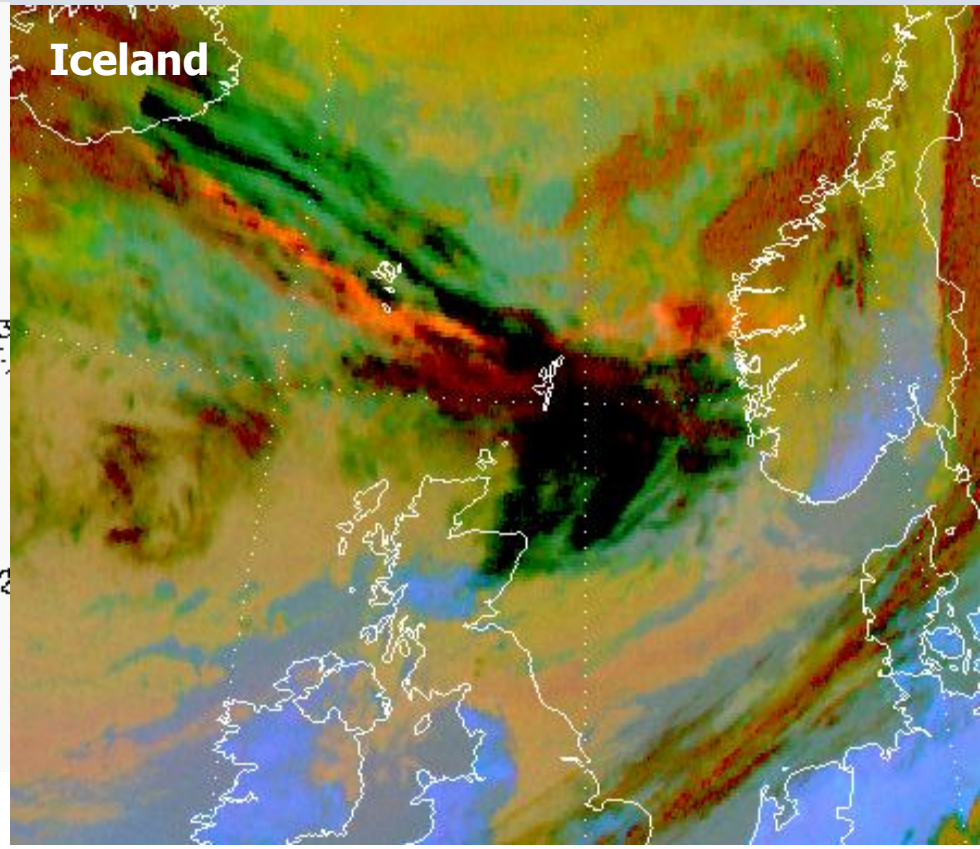
Ash Clouds

SEVIRI Ash Load



Source: M. Pavolonis

Dust RGB

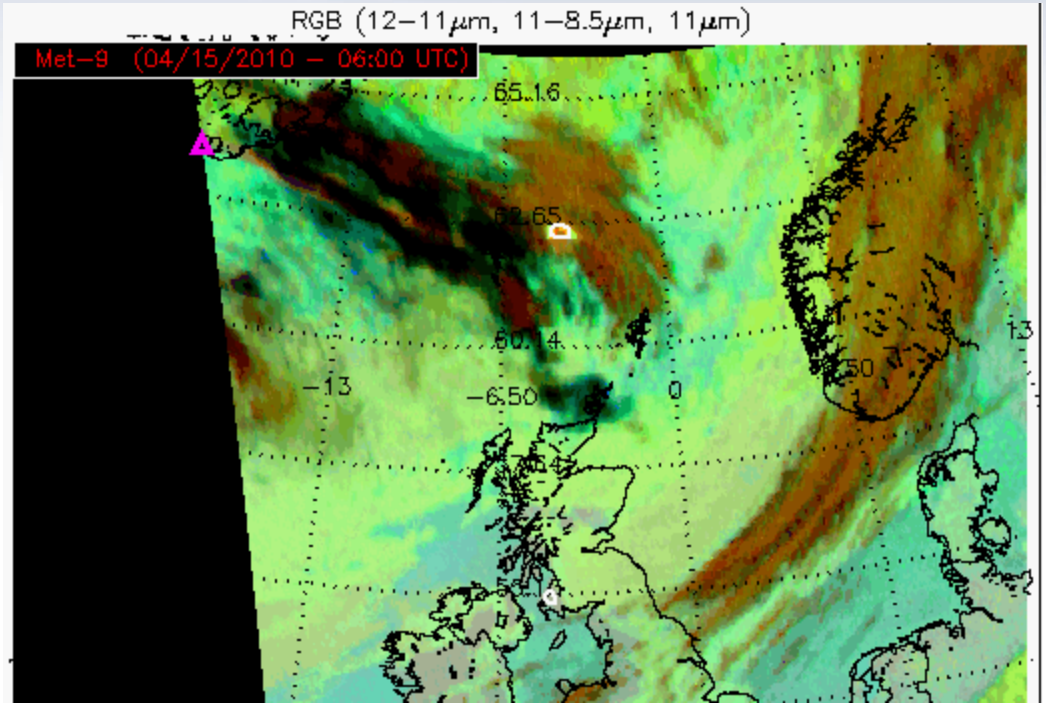


15 April 2010, 09:00 UTC

EUMETSAT

Ash Clouds

SEVIRI Ash Load on Dust RGB background image



CLICK HERE

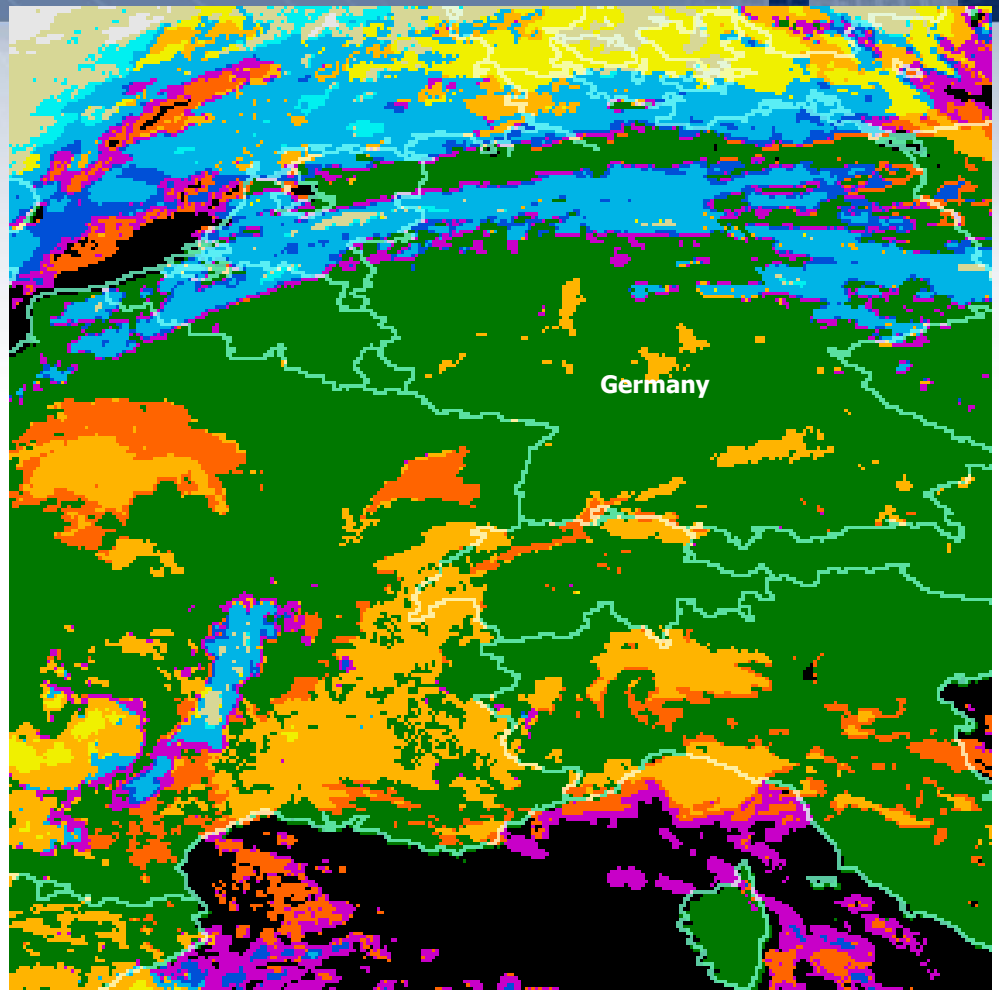
15 April 2010, 09:00-15:00 UTC

Source: M. Pavolonis

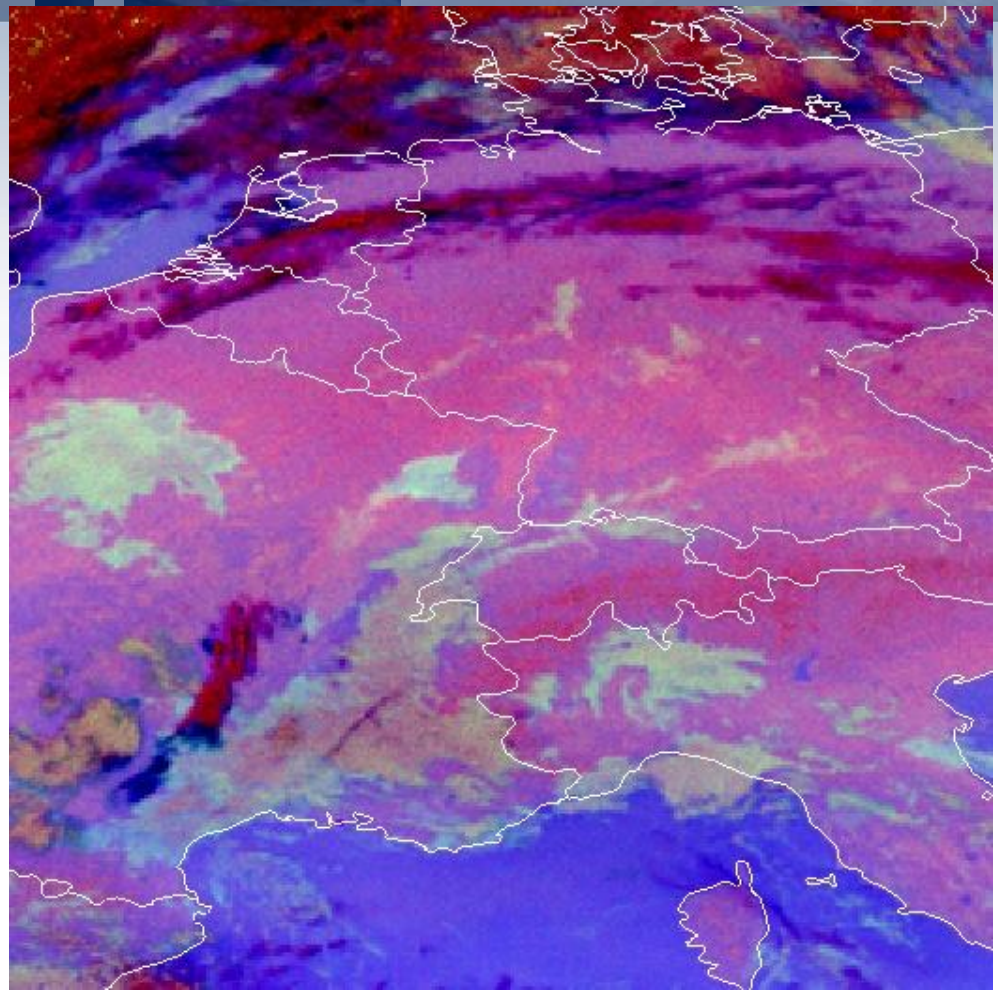
EUMETSAT

Low Clouds / Fog (Night)

Cloud Type Product



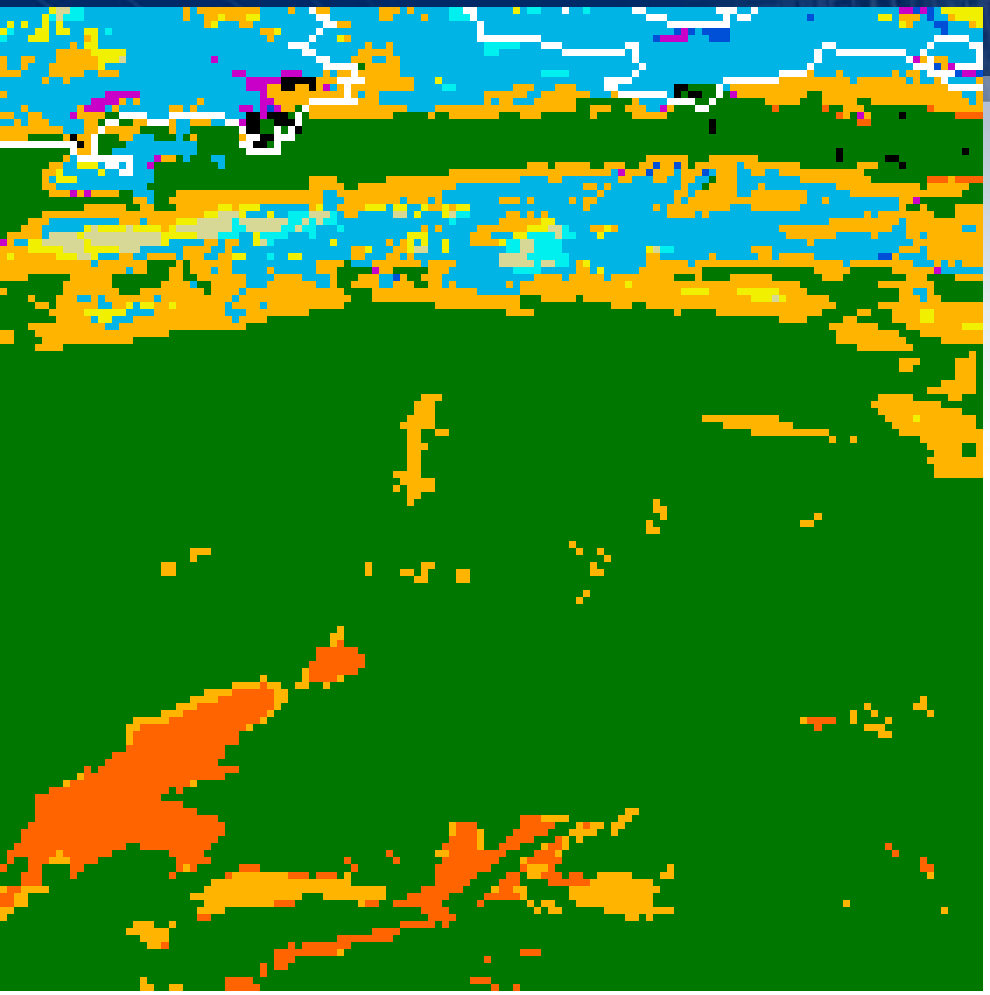
Night Micro RGB



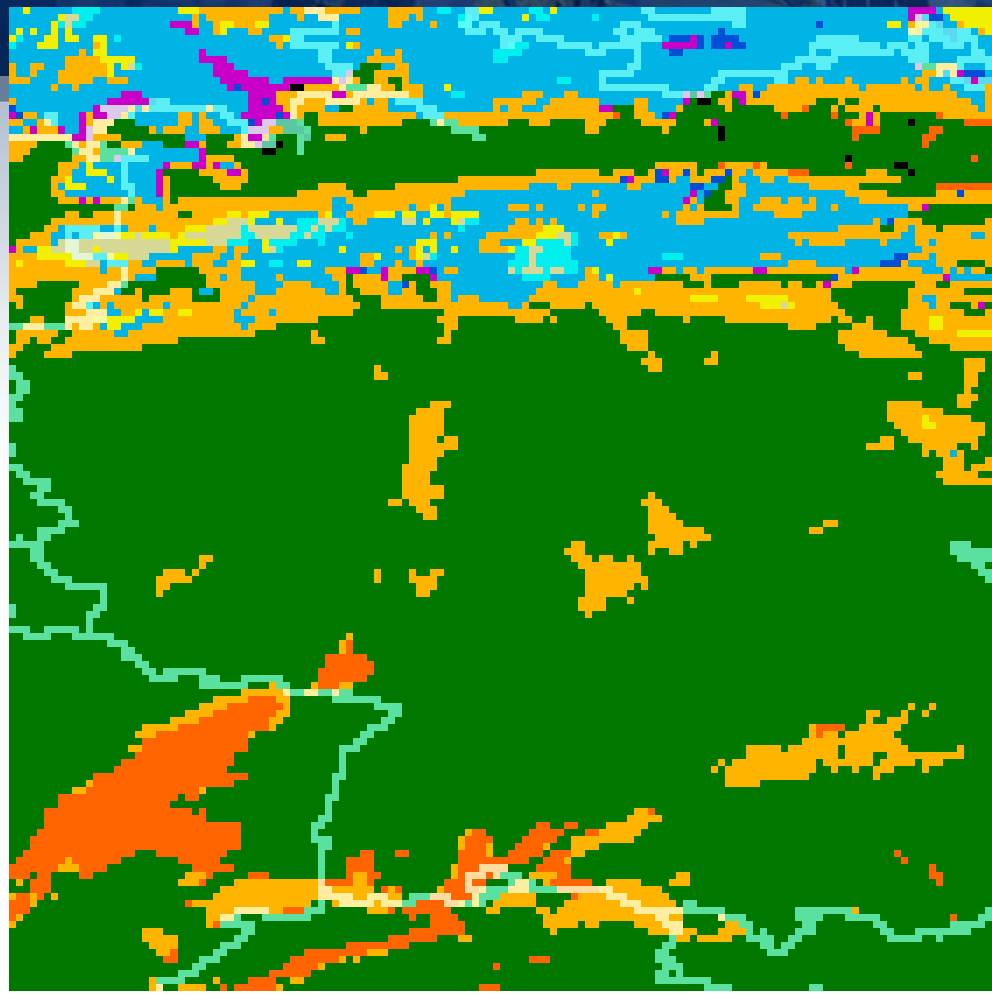
20 October 2008, 05:00 UTC

EUMETSAT

Low Clouds / Fog (Night)



Cloud Type (INM)



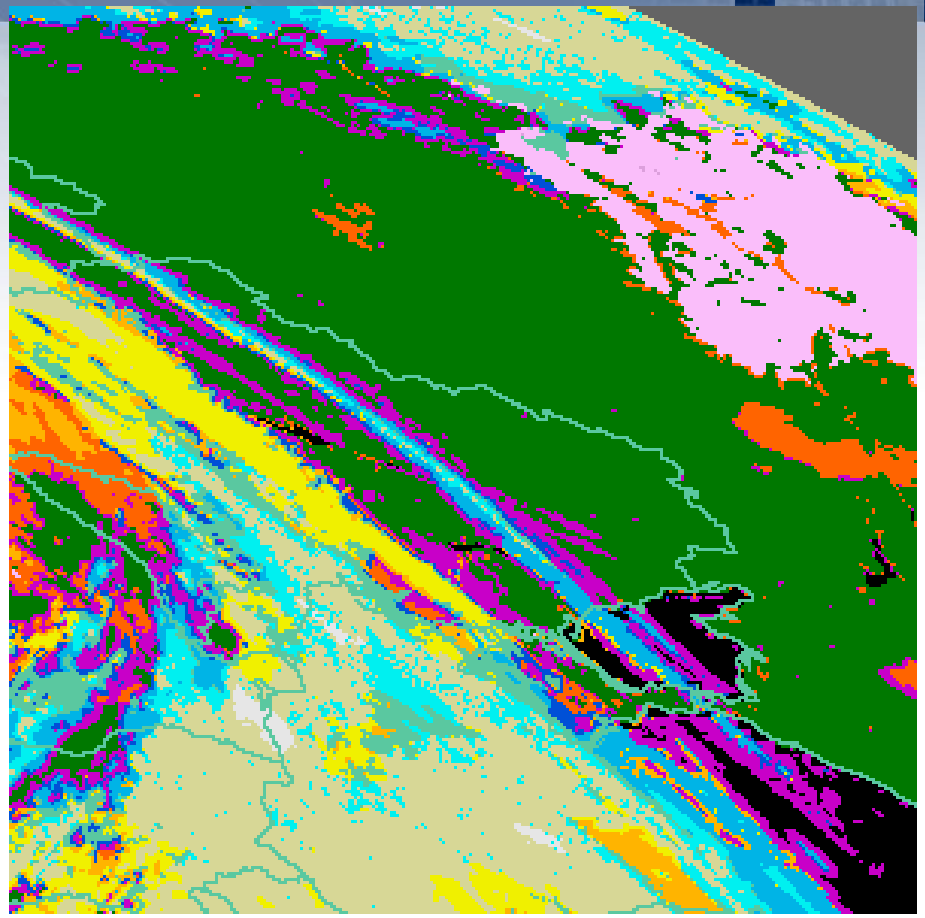
Cloud Type (MF)

20 October 2008, 06:00 UTC

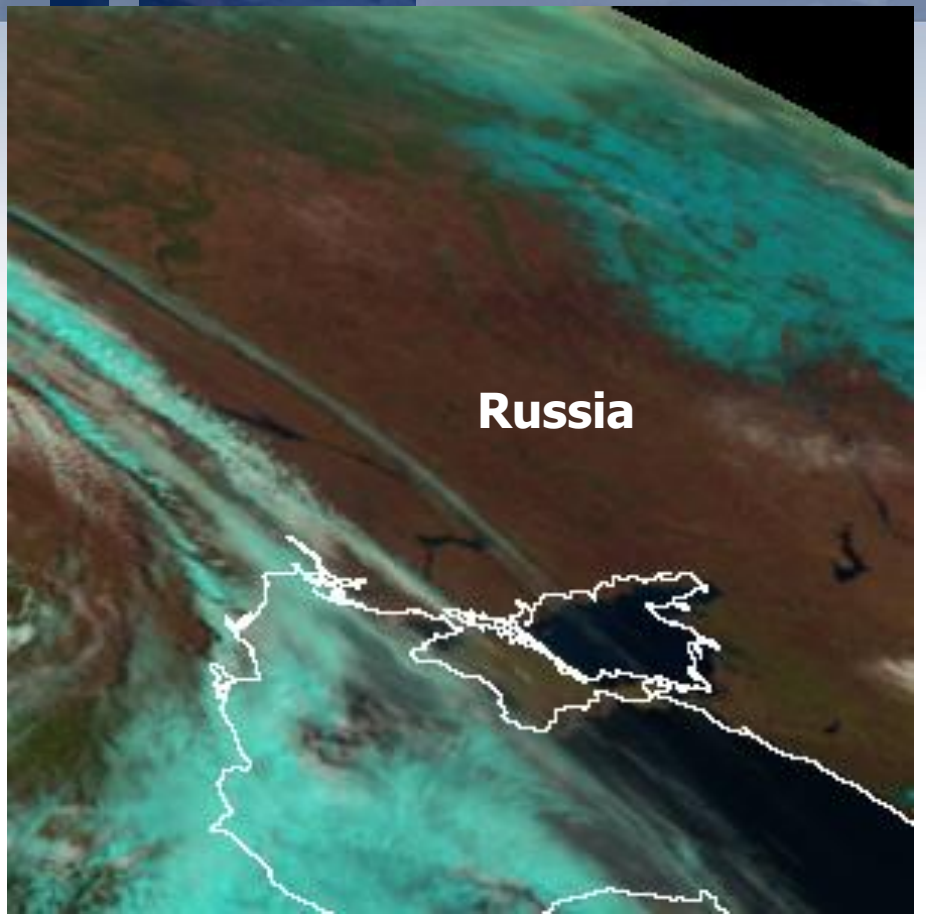
EUMETSAT

Low Clouds / Fog (Day)

Cloud Type Product



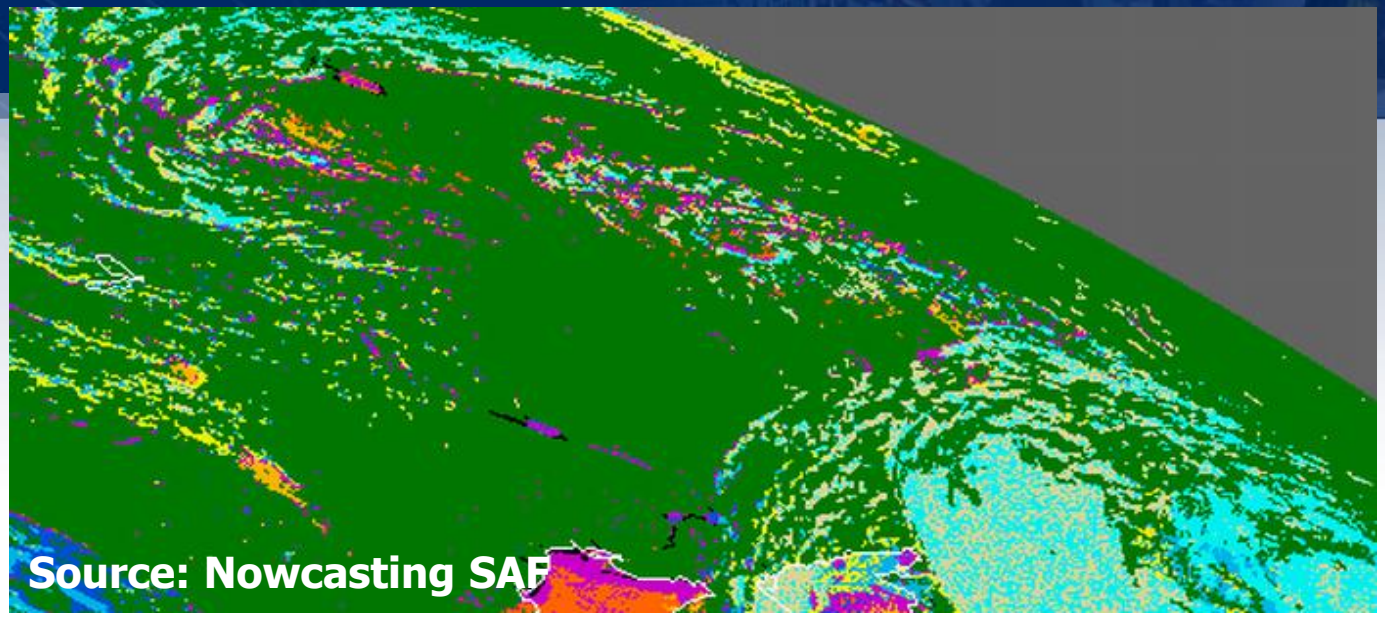
Natural Colour RGB



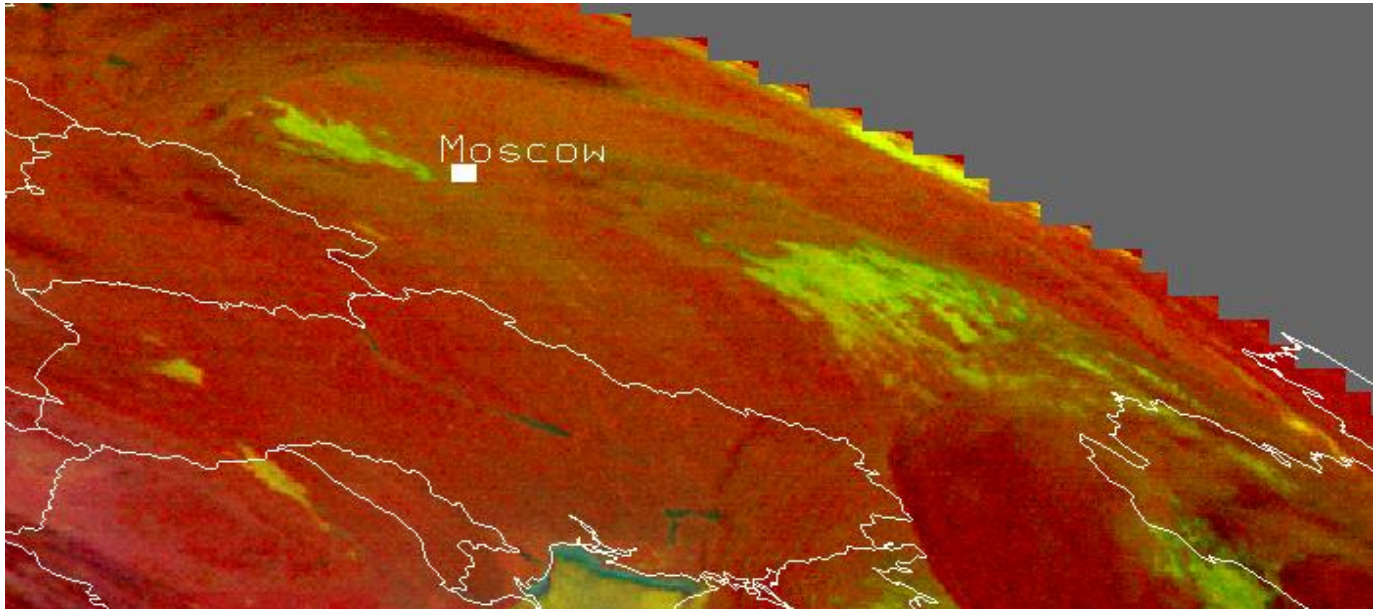
Met-8, 22 March 2007, 09:00 UTC

EUMETSAT

Low Clouds / Fog (Night)

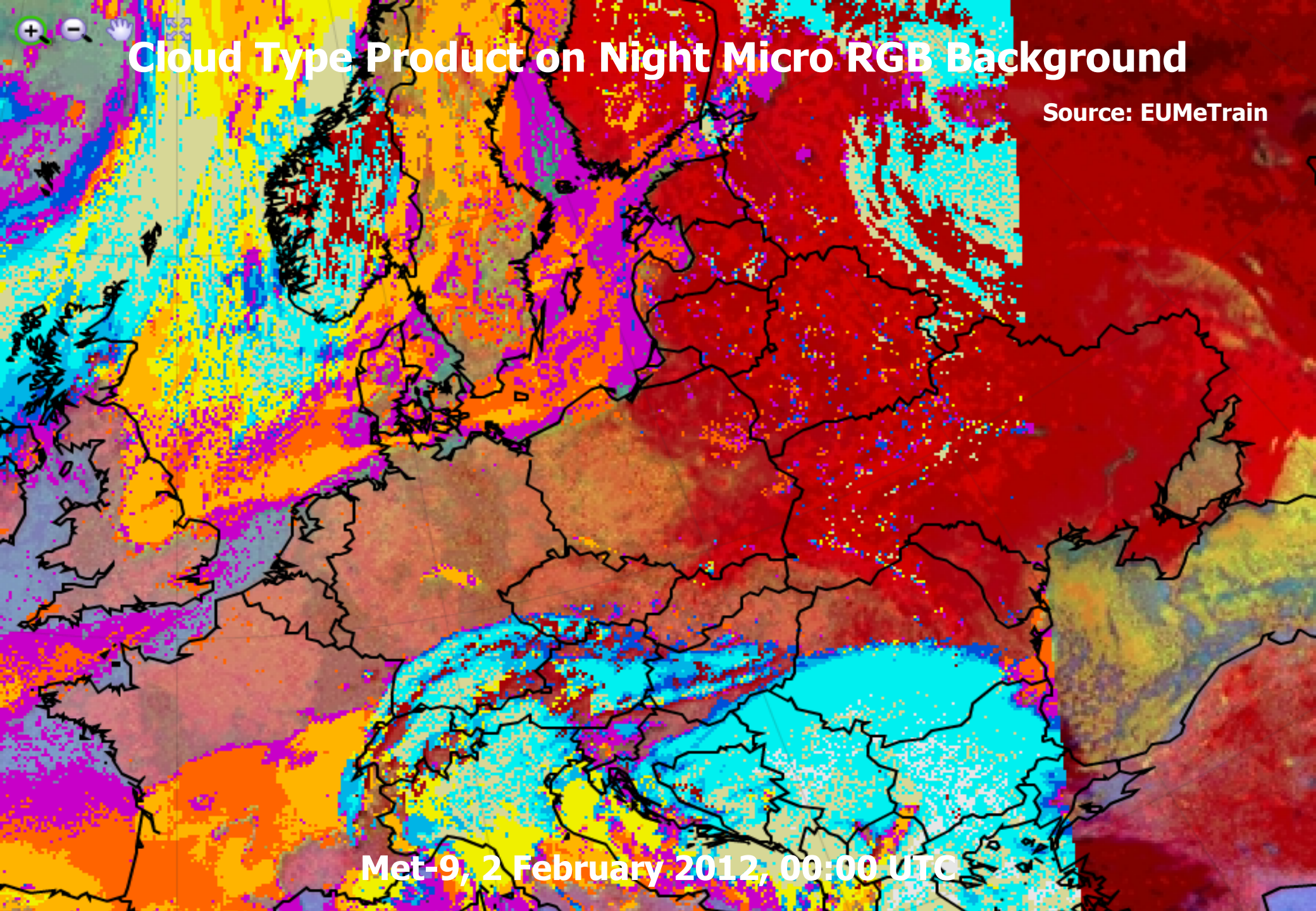


Cloud Type Product



24-h Microphysics RGB

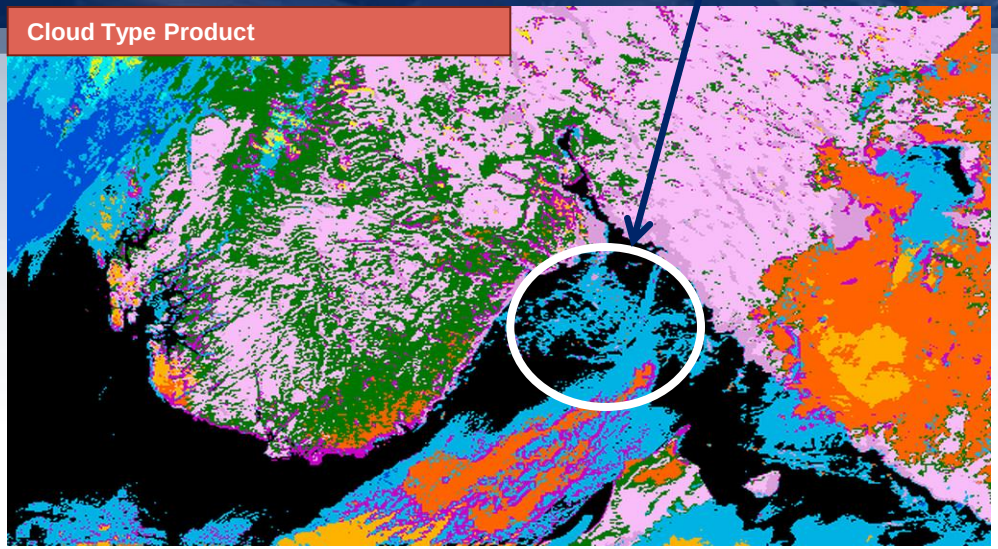
EUMETSAT

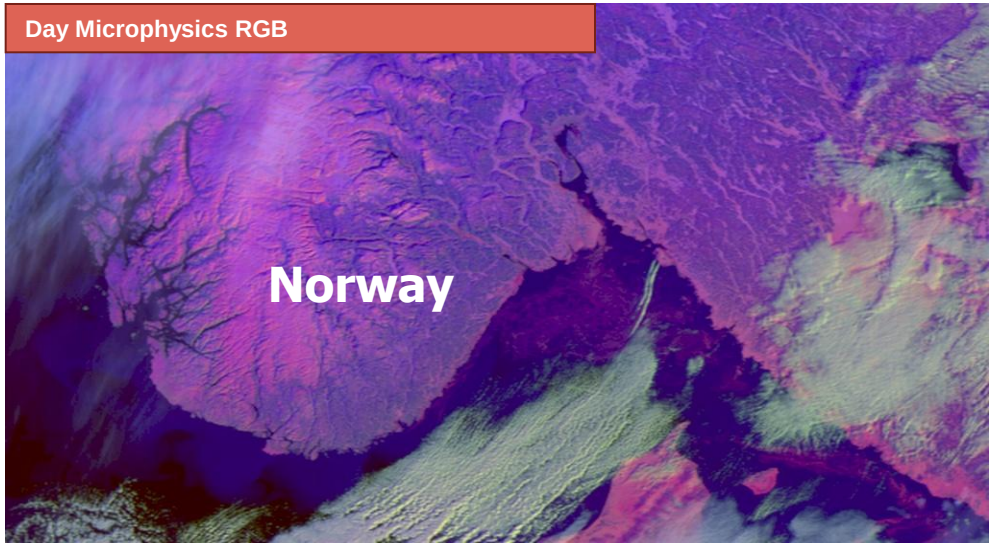

Cloud Type Product on Night Micro RGB Background
Source: EUMeTrain
Met-9, 2 February 2012, 00:00 UTC

Cirrus Clouds / Sea Ice

Cirrus clouds ?

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.





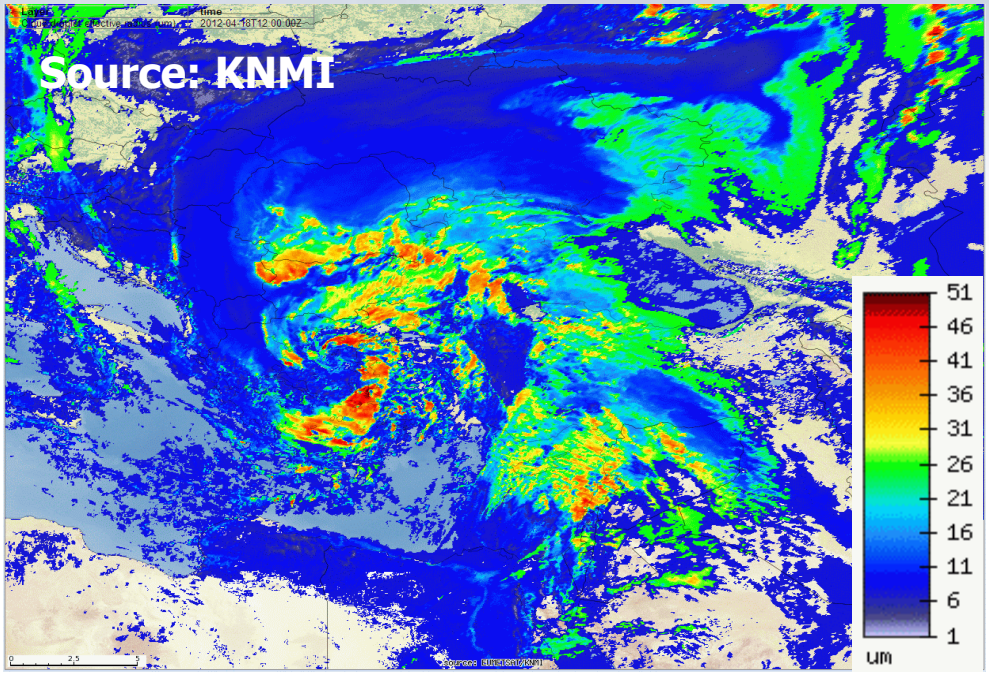
Metop-A, AVHRR

10 February 2010, 09:31 UTC

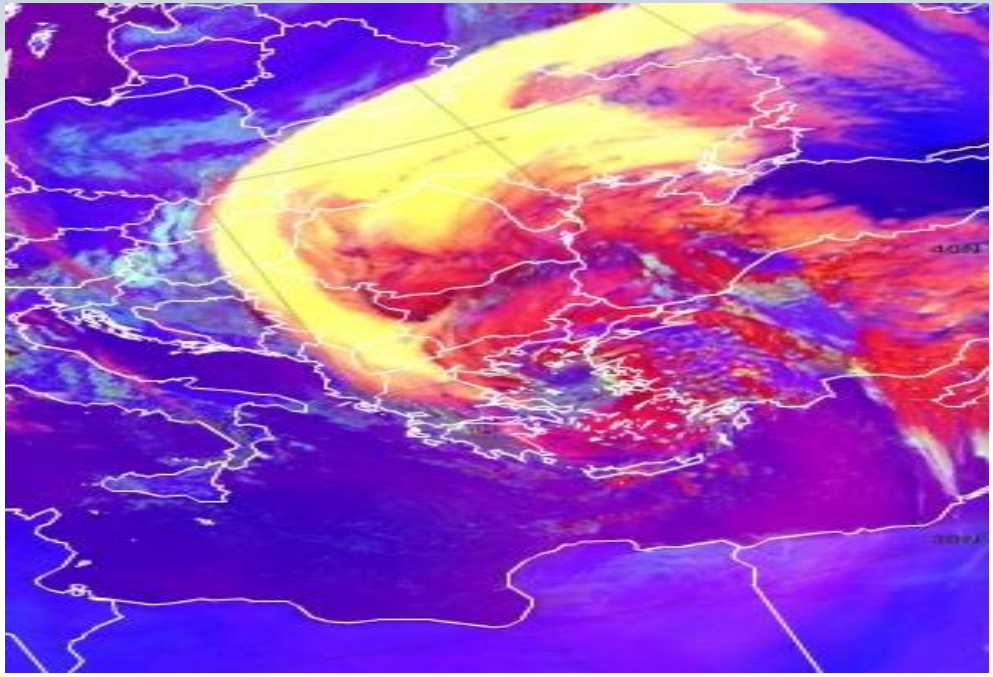
EUMETSAT

Effective Particle Radius

Effective Radius Product



Ice Particle Size RGB



CLICK HERE

http://msgcpp.knmi.nl

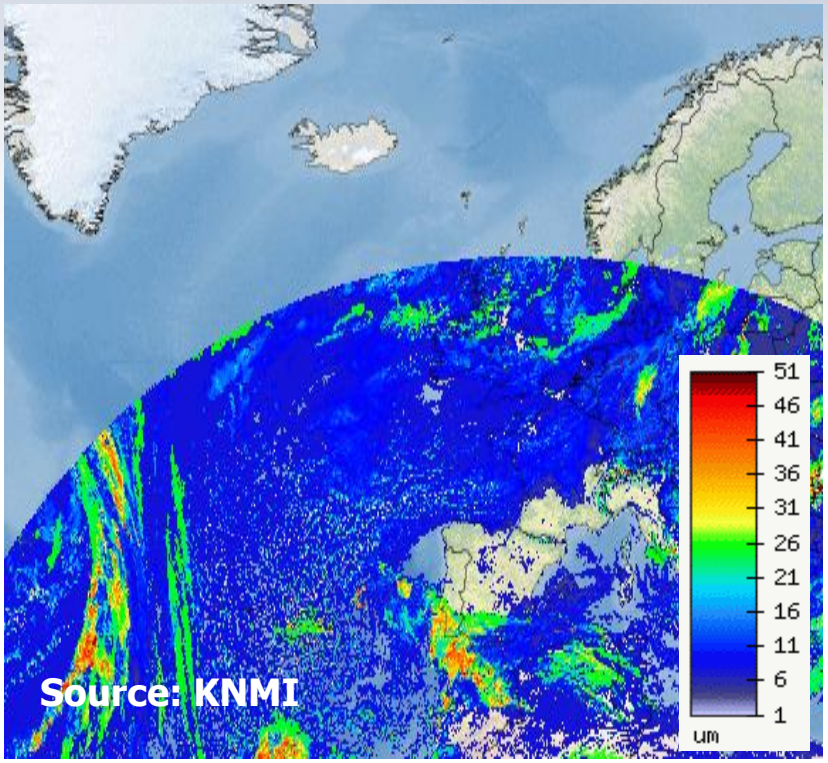
Dust polluted Ice Cloud

18 April 2012, 12:00 UTC

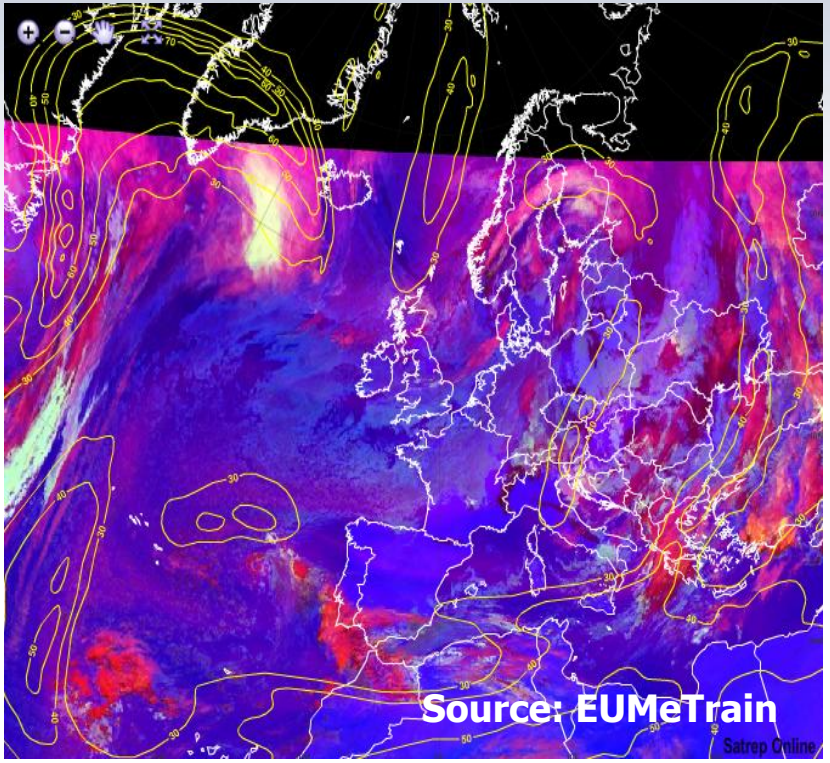
EUMETSAT

Effective Particle Radius

Effective Radius Product



Ice Particle Size RGB



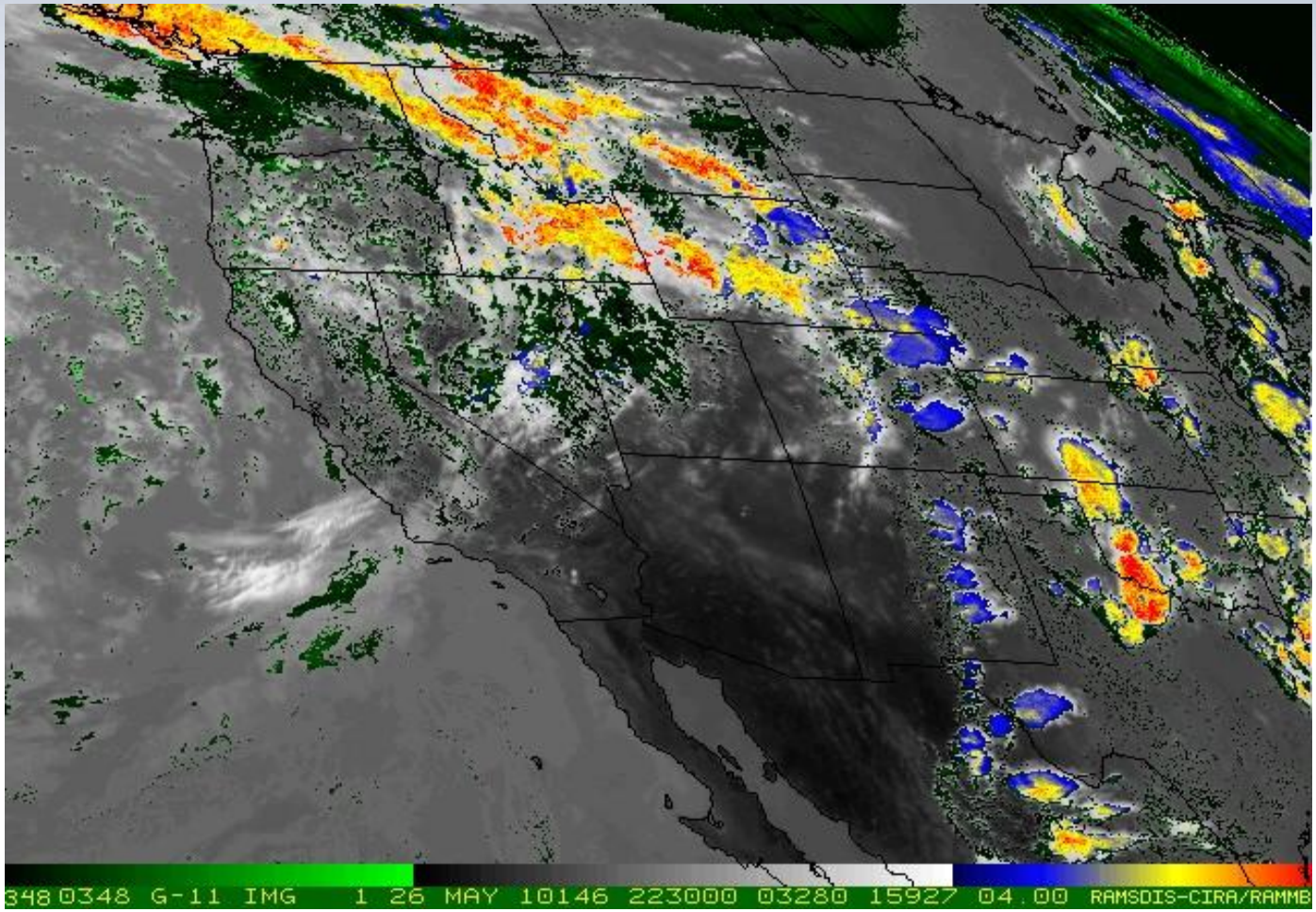
High level wave clouds

24 January 2011, 12:00 UTC

EUMETSAT

Effective Radius Product on Background Image

- Blue colours represent cold cloud tops with small ice particles



GOES-11 3.9 µm Reff (color) – 26 May 2010

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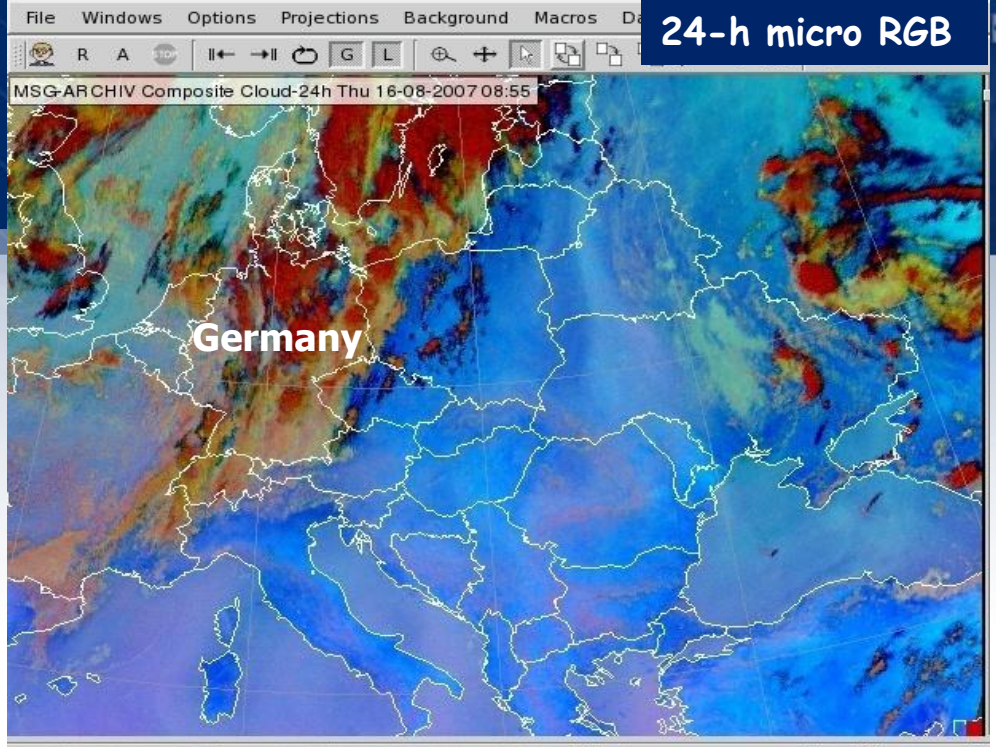
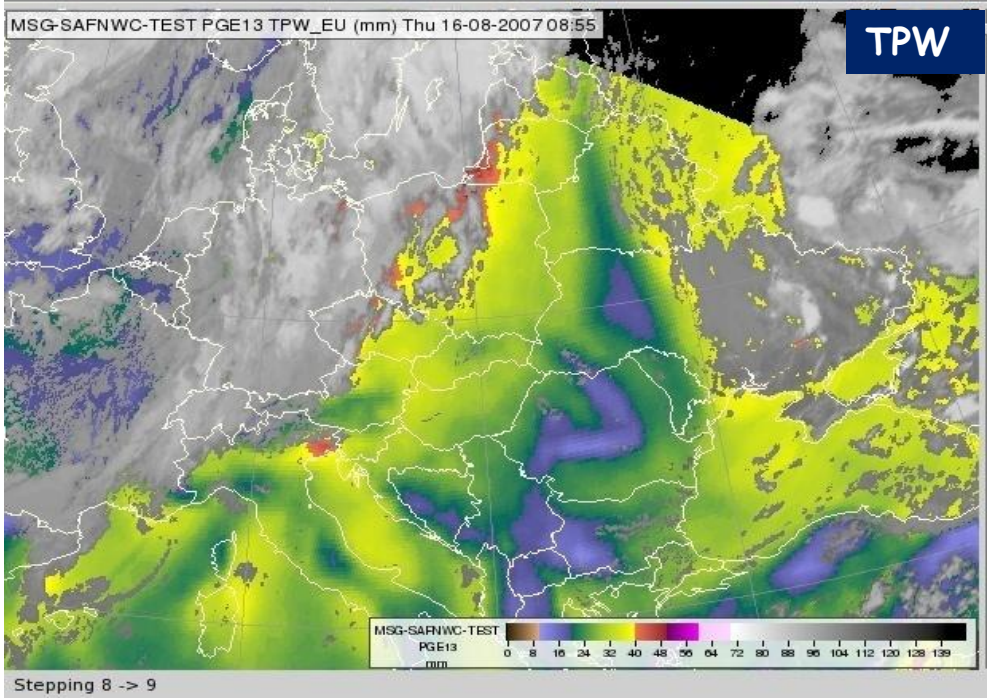
TPW, LPW





16 August 2007, 8:45 UTC

(Source: Maria Putsay)

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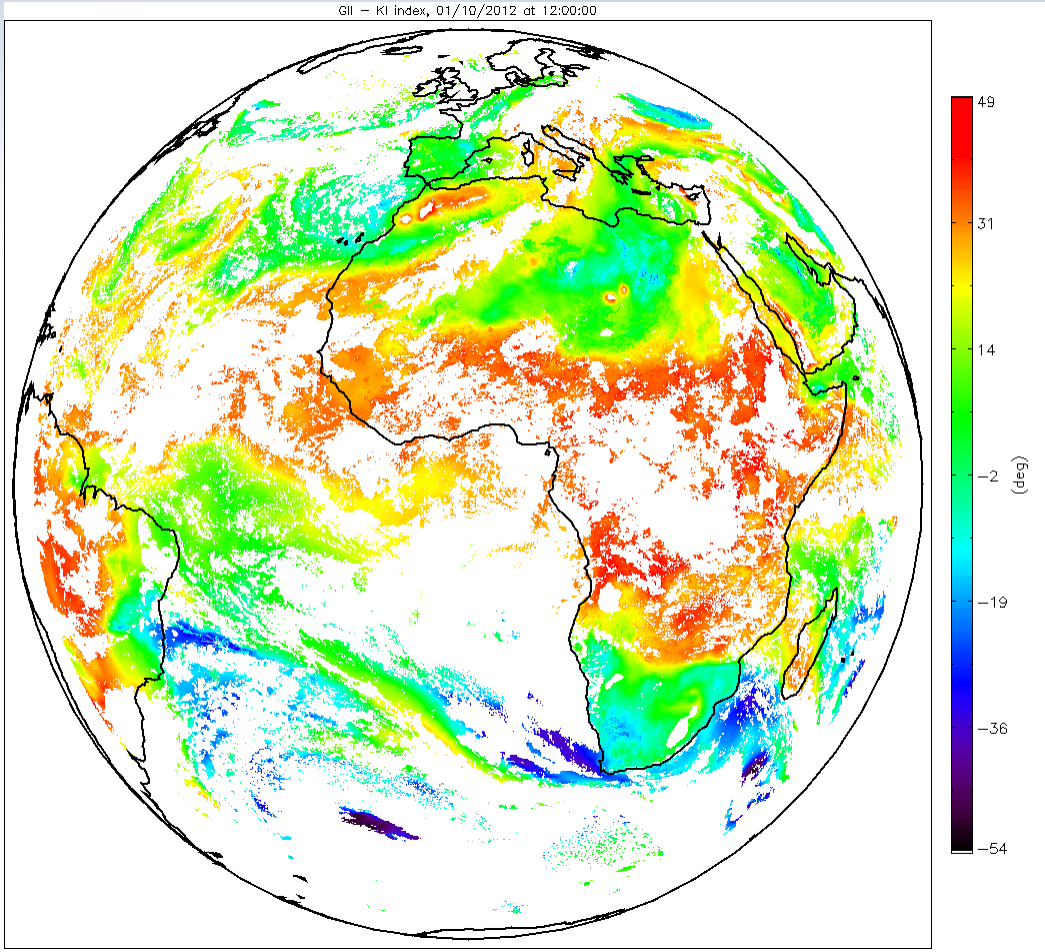
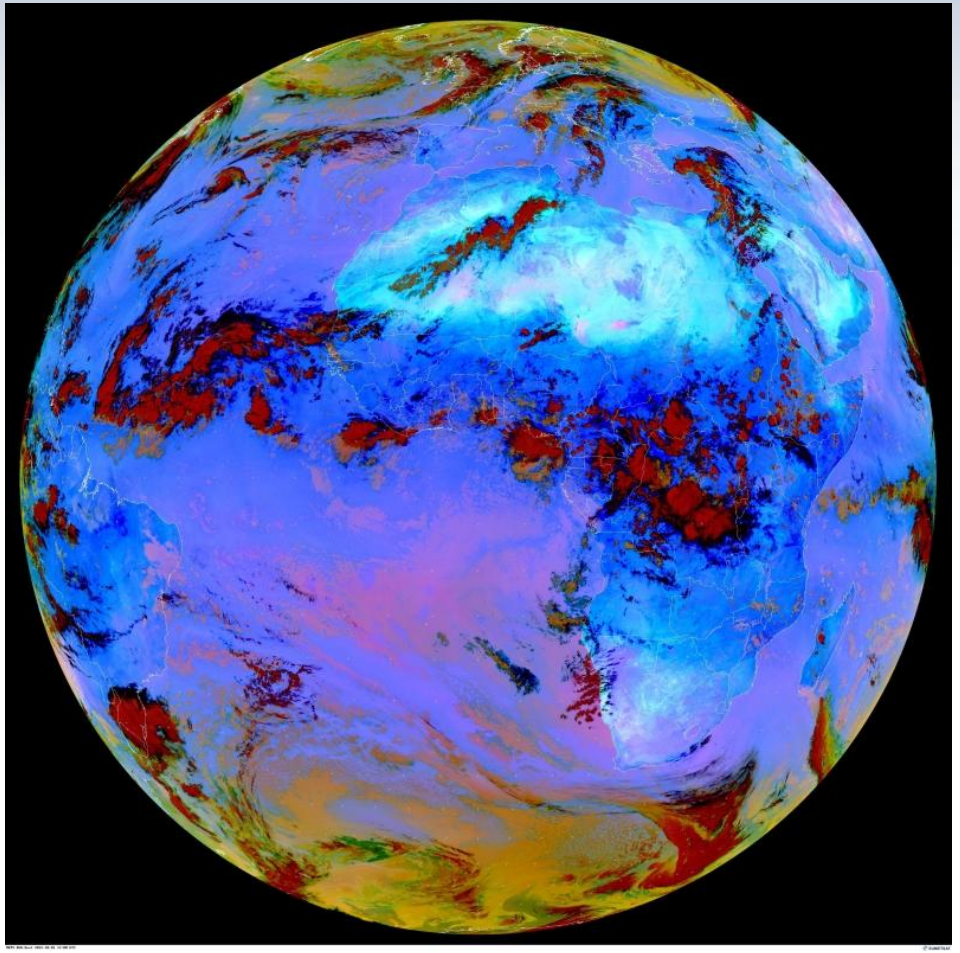
GII: Global Instability Index

GII Product (K Index)



Dust RGB



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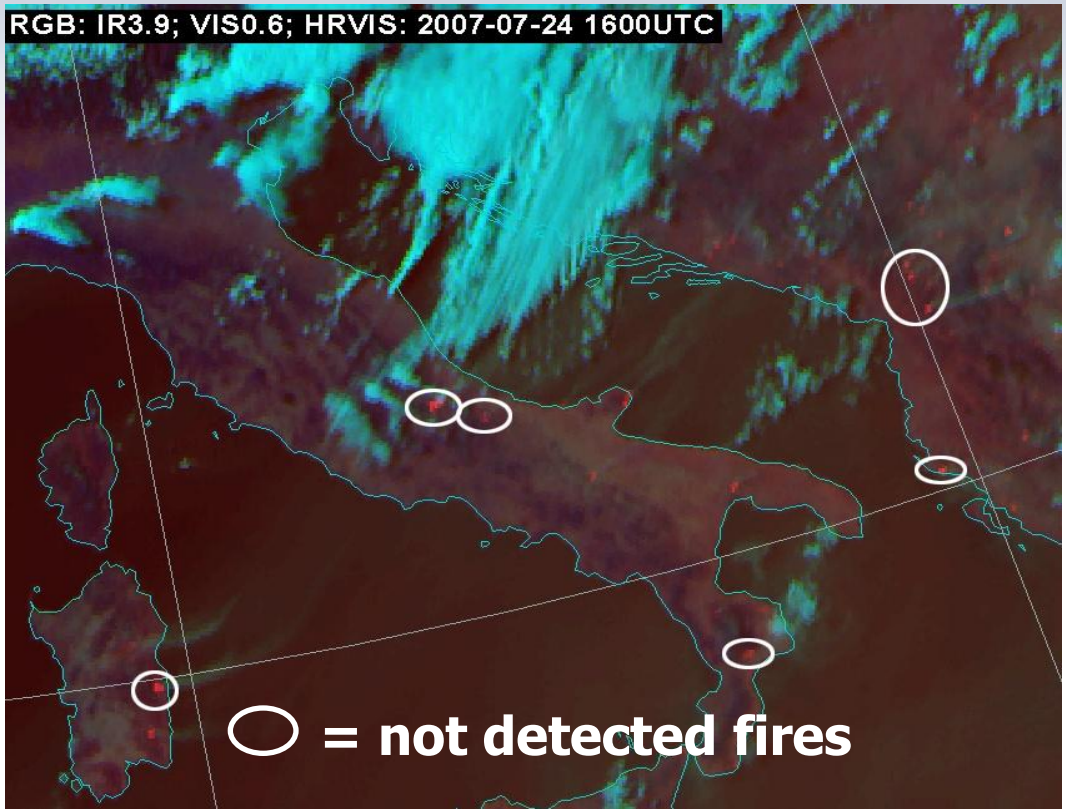
Fires

FIR Product (MPEF)

RGB IR3.9, VIS0.6, HRV



24 July 2007, 16:00 UTC

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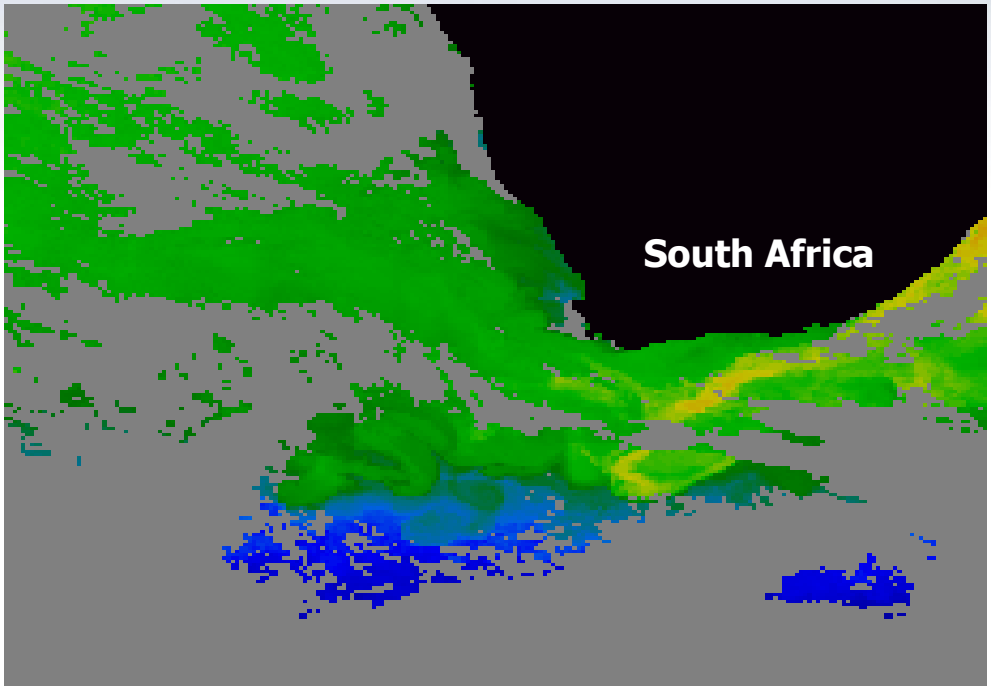
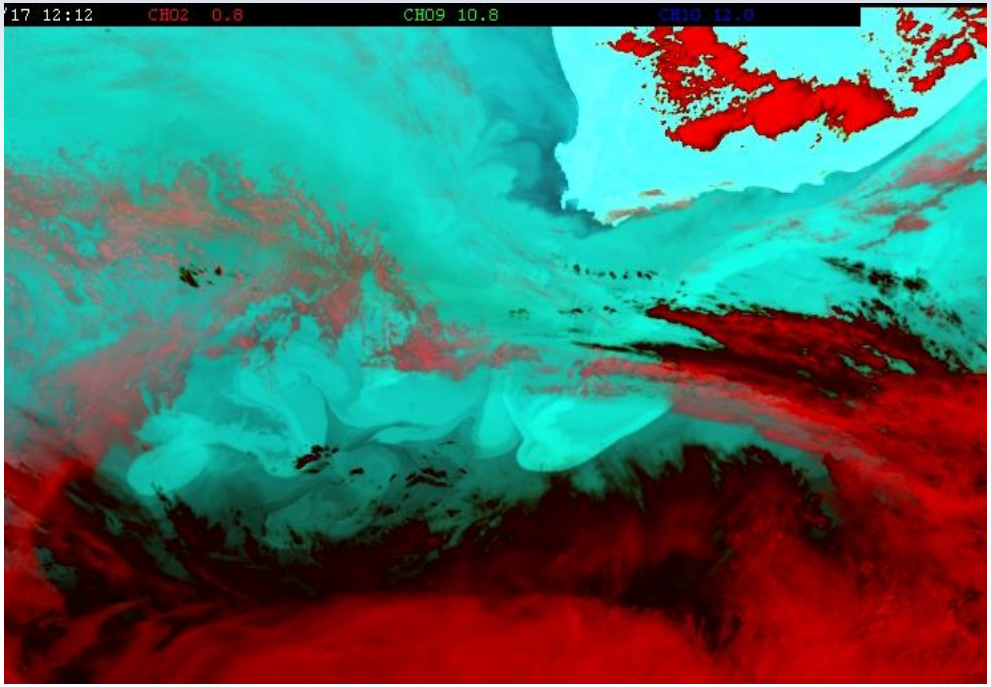
Sea Surface Temperature (SST)

SST Product (OSI SAF)



RGB VIS0.8, IR10.8, IR12.0



17 Jan 2005, 12:00 UTC

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EUMETSAT's future satellites

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Meteosat Third Generation (MTG)

1977 — 2002 — 2018 and 2019

MFG

MSG

MTG-I and MTG-S

Observation mission:
- MVIRI: 3 channels

Spinning satellite
Class 800 kg

Observation missions:
- SEVIRI: 12 channels
- GERB

Spinning satellite
Class 2-ton

Observation missions:
- Flex.Comb. Imager: 16 channels
- Lightning Imager

- Infra-Red Sounder
- UVN

3-axis stabilised satellites
Twin Sat configuration
Class 2,5 - 3 ton

Atmospheric Chemistry Mission (UVN-S4):
via GMES Sentinel 4

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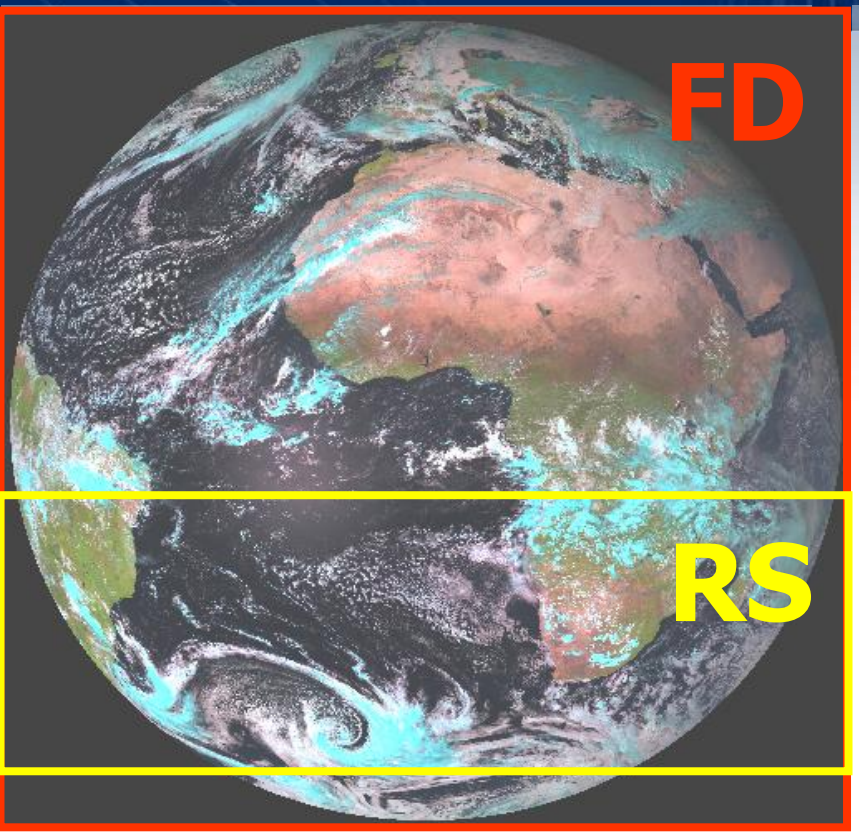
From SEVIRI to the Flexible Combined Imager (FCI)



MTG FCI outbids MSG SEVIRI observations on cloud, aerosol, moisture and fire:

- **by adding new channels**
- **by improving temporal-, spatial-, and radiometric resolution**

	Coverage	Repeat cycle	Spatial sampling
FD mission	18°x18°	10 min	1 km (solar) / 2 km (IR)
RS mission	1/4 FD	2.5 min	0.5 km (solar) / 1 km (IR)

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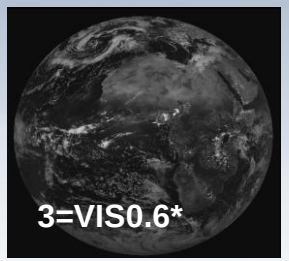
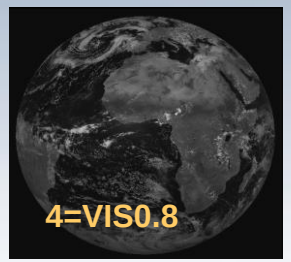
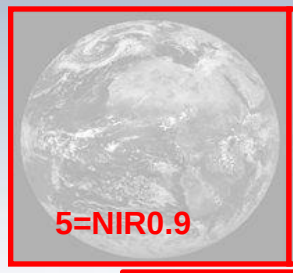
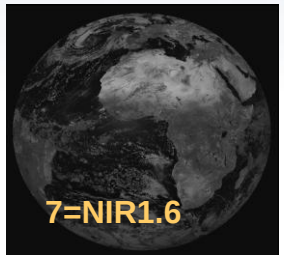
Flexible Combined Imager on MTG

Which SEVIRI channel is missing ?



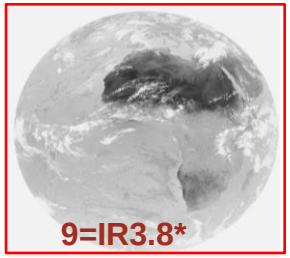


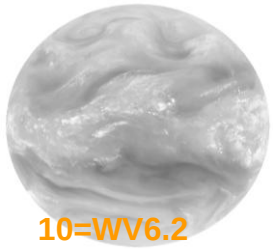


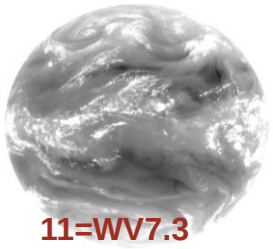


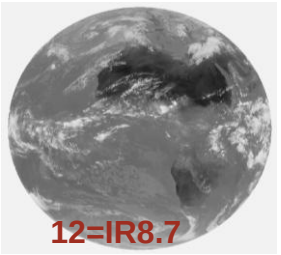
Solar channels

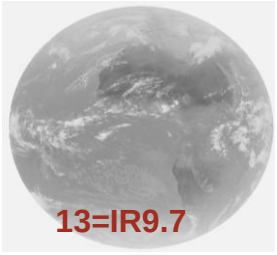
Thermal channels

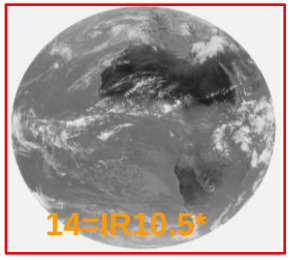


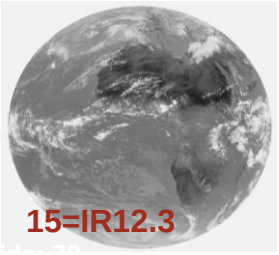


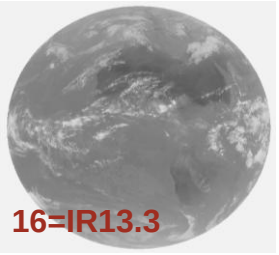












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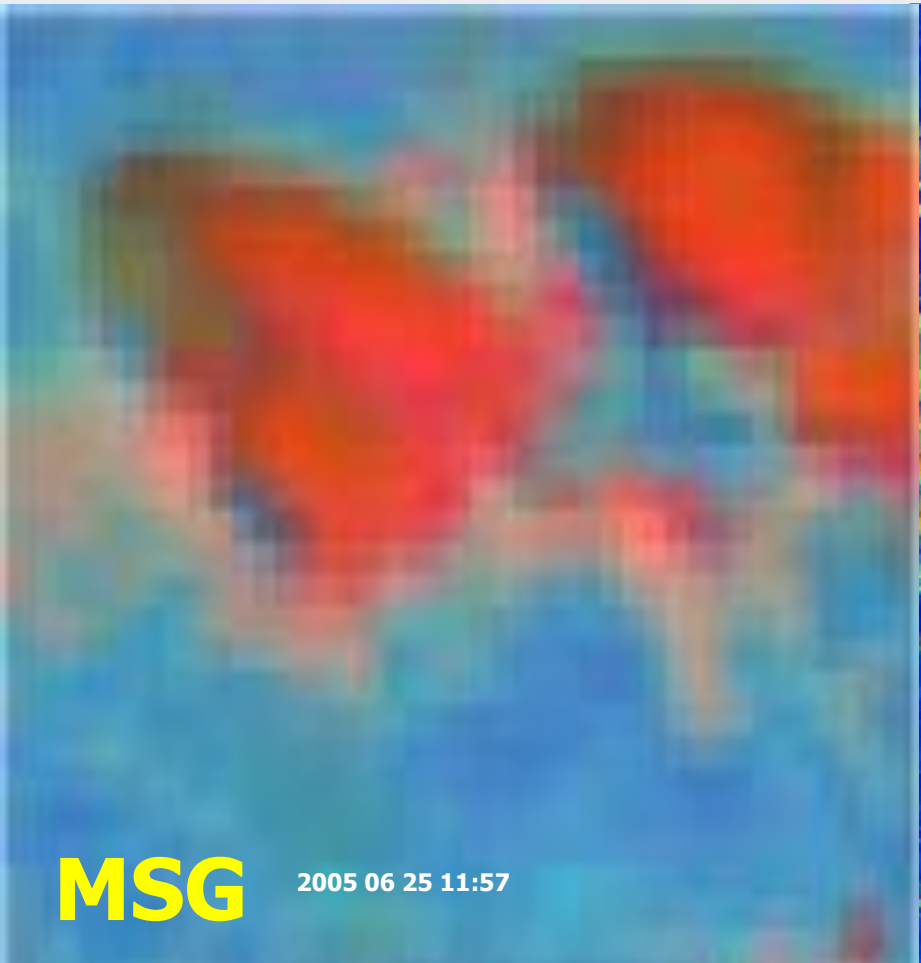
* The channels VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 are delivered in both FD and RS

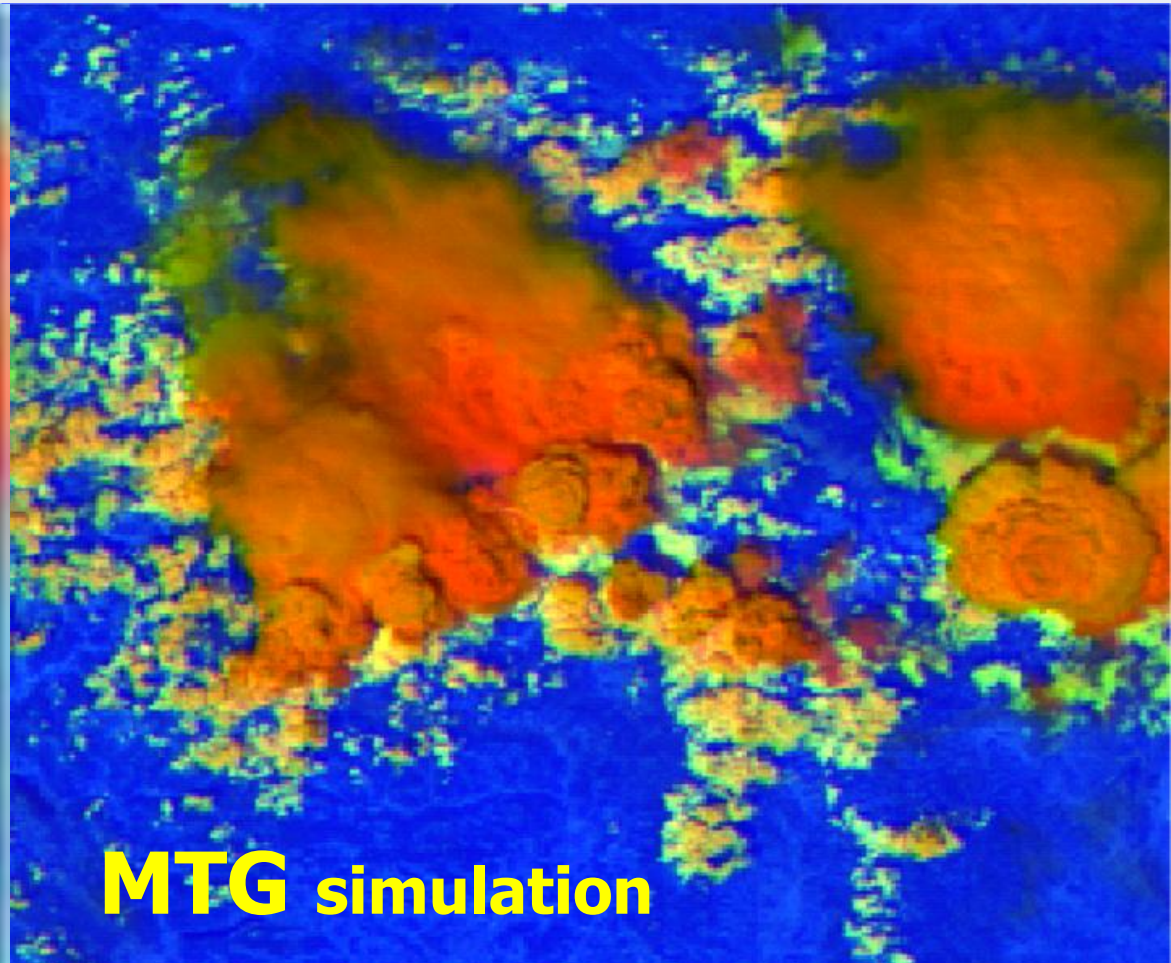
MTG Missions
FCI – Benefits Summary

- The 0.444 µm and the 0.51 µm channels will permit surpassing current aerosol retrievals especially over land – also an important contribution to air quality monitoring.
- The 0.91 µm channel will provide during daytime total column precipitable water especially over land surfaces.
- The 1.375 µm channel will improve detection of very thin cirrus clouds not seen by the current system introducing errors in all clear sky products.
- The 2.26 µm channel will provide the capability for an improved retrieval of cloud microphysics.
- The improved spatial resolution (1 km and 2 km) and the extended dynamical range (from 350 K to 450 K) of the 3.8 µm channel will firstly outbid the fire detection quality of MSG and secondly outbid the quality of products as Fire Radiative Energy.

MTG Improvements: horizontal sampling (0.5 km)

(courtesy D. Rosenfeld)





EUMETSAT's training activities

EUMETSAT

EUMETSAT Precipitation Week

Precipitation Week 2013 Outline

Date: 4-8 February 2013

I VIS/IR Precipitation Estimates

1. Nowcasting SAF: Convective Rainfall Rate (CRR) and Precipitating Clouds (PC) products
   (**Cecilia Marcos, AEMET, Monday, 4 Feb 2013, 09 UTC**)
2. Use of the Hydroestimator in South Africa
   (**Estelle de Coning, SAWS, Monday, 4 Feb 2013, 14 UTC**)
3. Detecting Warm Rain Clouds in Satellite Images
   (**Daniel Rosenfeld, HUJ, Tuesday, 5 Feb 2013, 09 UTC**)

II Microwave Precipitation Estimates

1. Overview of Microwave Precipitation Products
   (**Ralf Bennartz, UWI, Tuesday, 5 Feb 2013, 14 UTC**)
2. Microwave Products and Applications overview
   (**Sheldon Kusselsson, NOAA, Wednesday, 6 Feb 2012, 14 UTC**)
3. Other Precipitation missions: TRMM / Megha-Tropiques / GPM
   (**Remy Roca, LMD, Thursday, 7 Feb 2013, 09 UTC**)

III Multi-sensor Precipitation Estimates

1. The Multisensor Precipitation Estimate (MPE) Product
   (**Thomas Heinemann, EUMETSAT, Thursday, 7 Feb 2013, 14 UTC**)
2. Hydrology SAF Precipitation Products
   (**Vincenzo Levizzani, Friday, 8 Feb 2013, 09 UTC**)

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Monitoring weather and climate from space

EUMETSAT

MSG: Recent Findings

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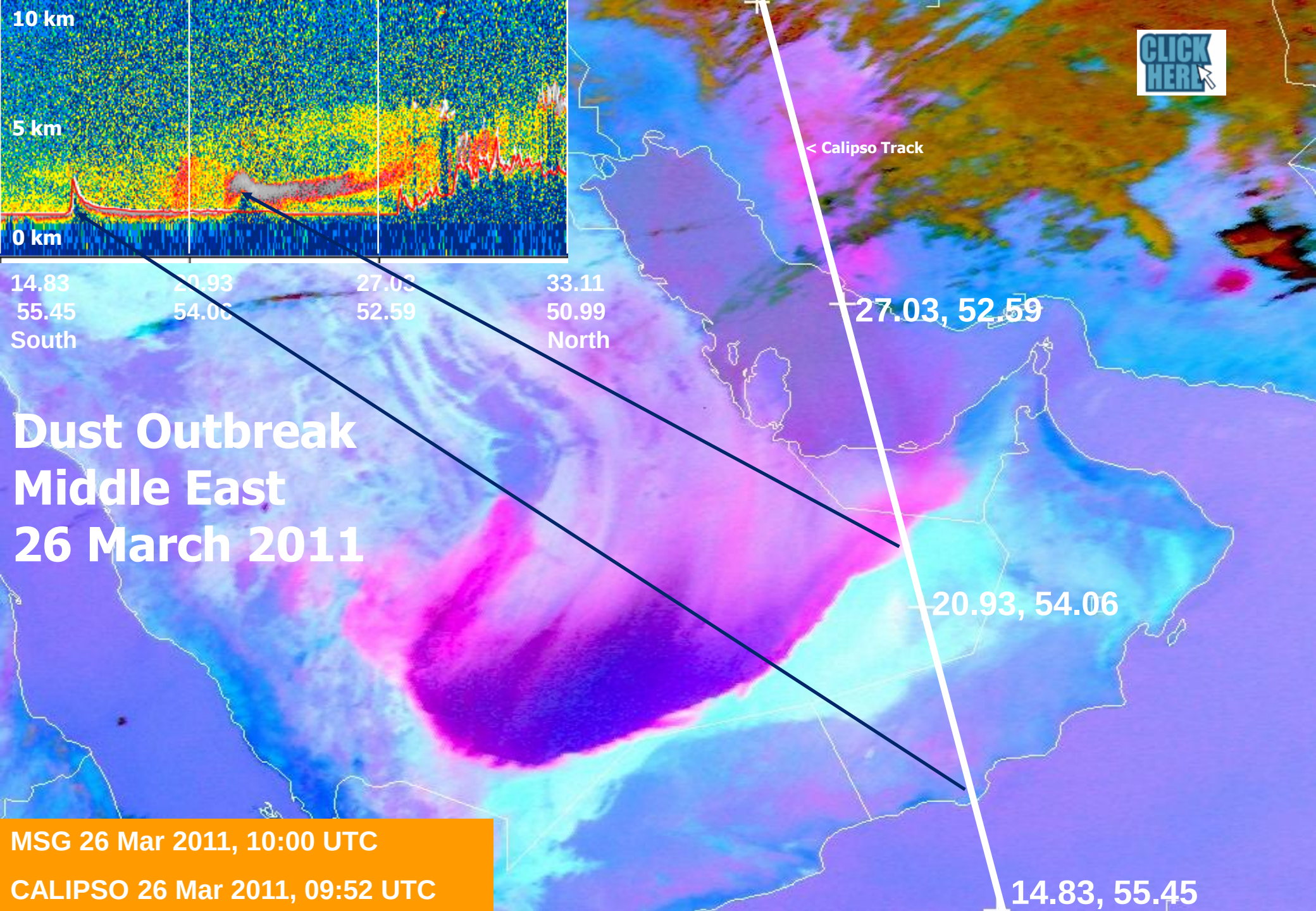
Dust Clouds


10 km
5 km
0 km
14.83
55.45
South
20.93
54.06
27.03
52.59
33.11
50.99
North
< Calipso Track
27.03, 52.59
20.93, 54.06
14.83, 55.45
CLICK HERE
Dust Outbreak
Middle East
26 March 2011
MSG 26 Mar 2011, 10:00 UTC
CALIPSO 26 Mar 2011, 09:52 UTC

Dust height in “Dust RGB” (for thin dust clouds, over land)

larger color spectrum during the night: lila mean lower dust !

No changes during the day, so almost impossible to determine dust level

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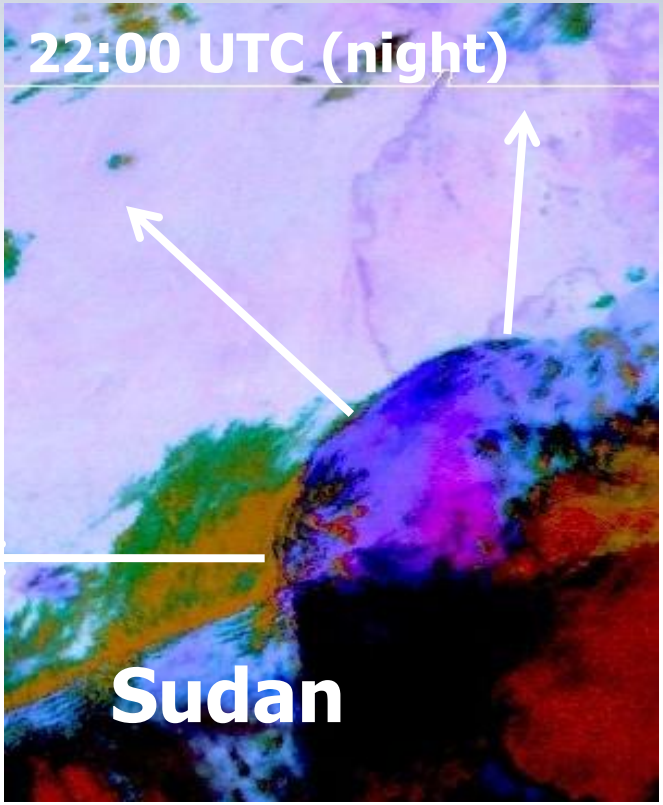
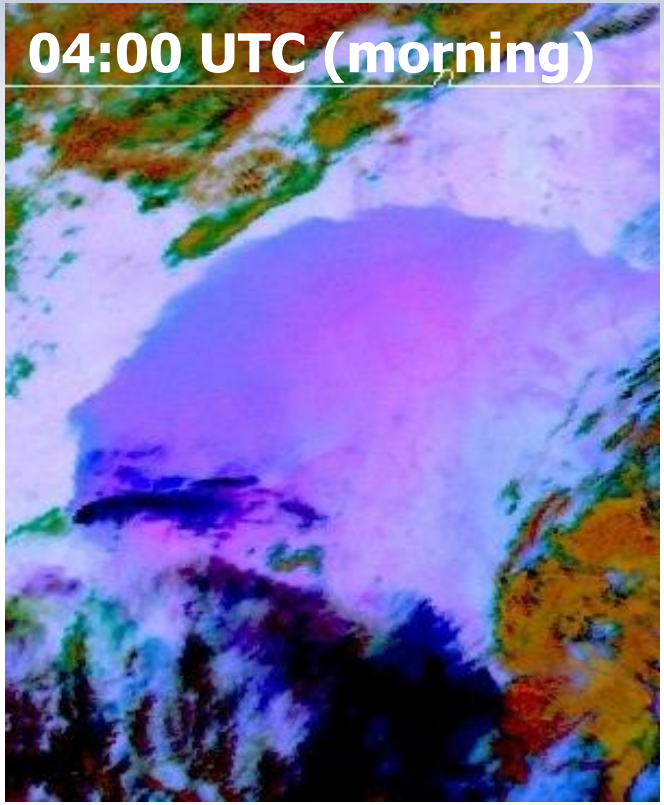
The Dust RGB: Interpretation of Colours
2. Very Thick Dust Clouds

	Night	Day
High (4-5 km)		
Mid (2-3 km)		
Low (0-1 km)		

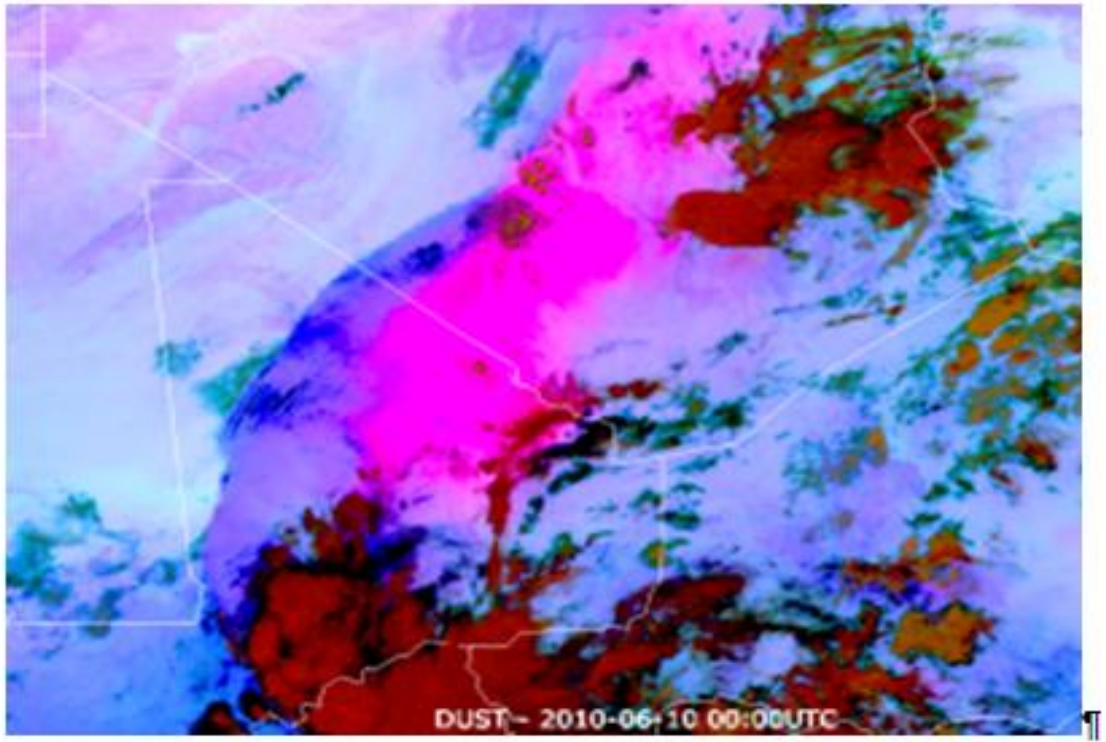
Dust Haboobs can travel fast at night (undular bore?)





Met-8, 29-30 April 2007

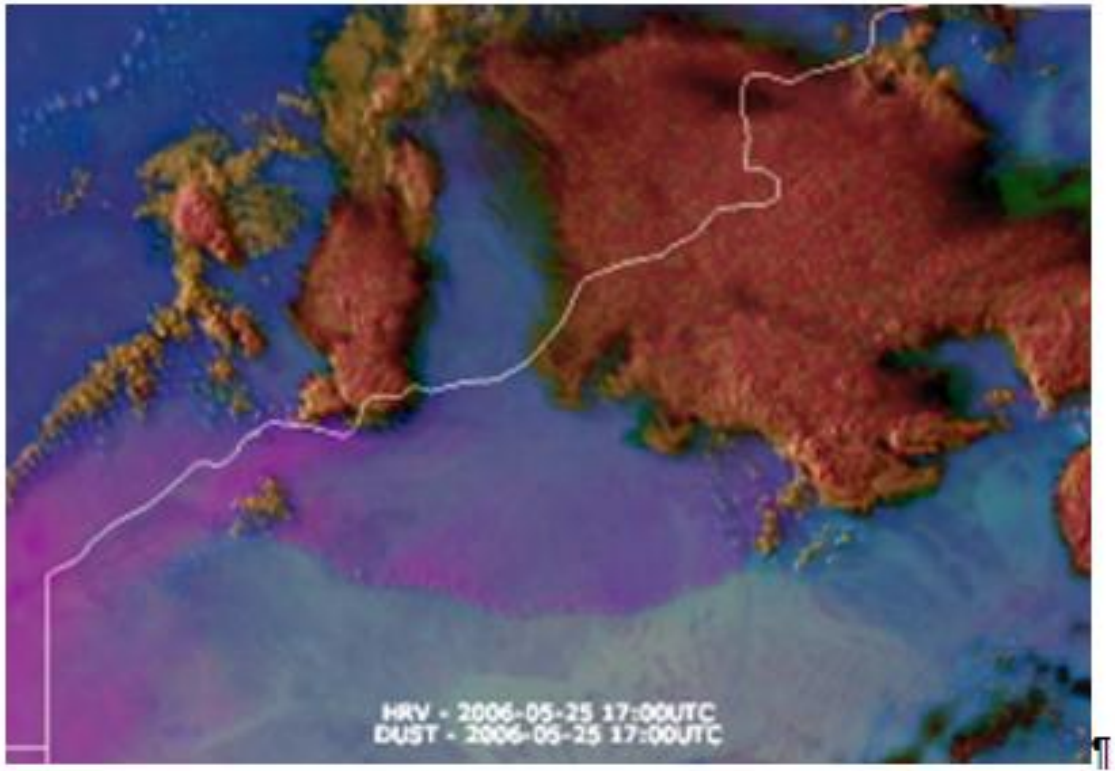
Dust Haboobs can travel long distances



34-hour sequence of MSG (Meteosat-9) Dust RGB products on 9-10 June 2010. Source: EUMETSAT. Images created by HansPeter Roesli.

This MSG Dust RGB sequence shows a large dust squall over Niger, Mali and southern Algeria (highlight), triggered by a thunderstorm system visible in the lower part of the images, that travelled hundreds of kilometers westwards over the Sahara. This shows how long a distance strong haboobs can propagate and how well defined they can be at night. On 9 June, daytime convection lifts part of the low-lying dust higher up - above the boundary layer - where westerly winds carry it back in an easterly direction. The higher level dust can be seen very well in the late afternoon and night hours (highlight) by its bright magenta colour (as compared to the dark magenta colour of the low-level dust squall). Note that towards the end of this animation, the westward propagation of the dust squall slows down as it approaches a deformation zone.

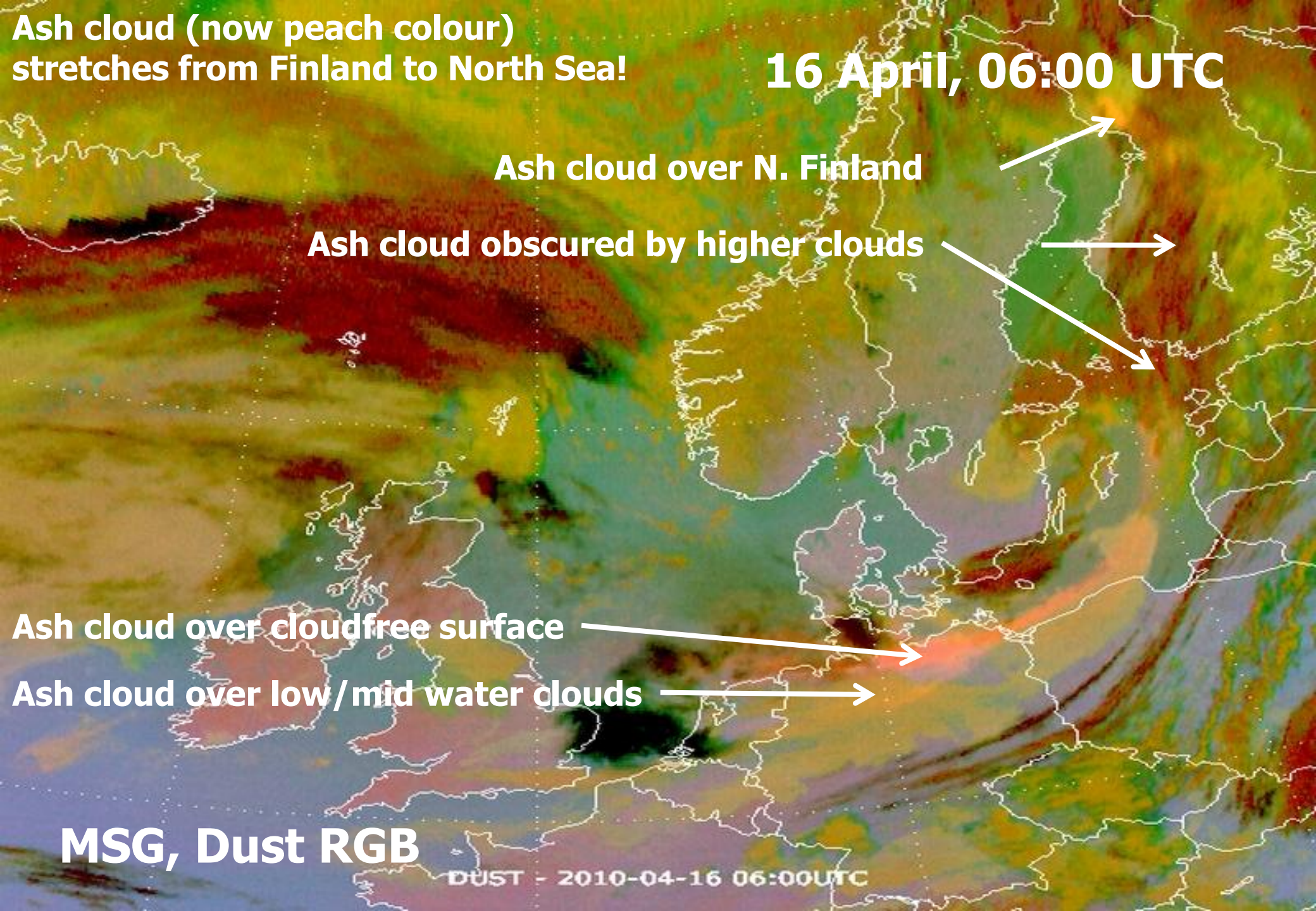
Combination of HRV & Dust RGB

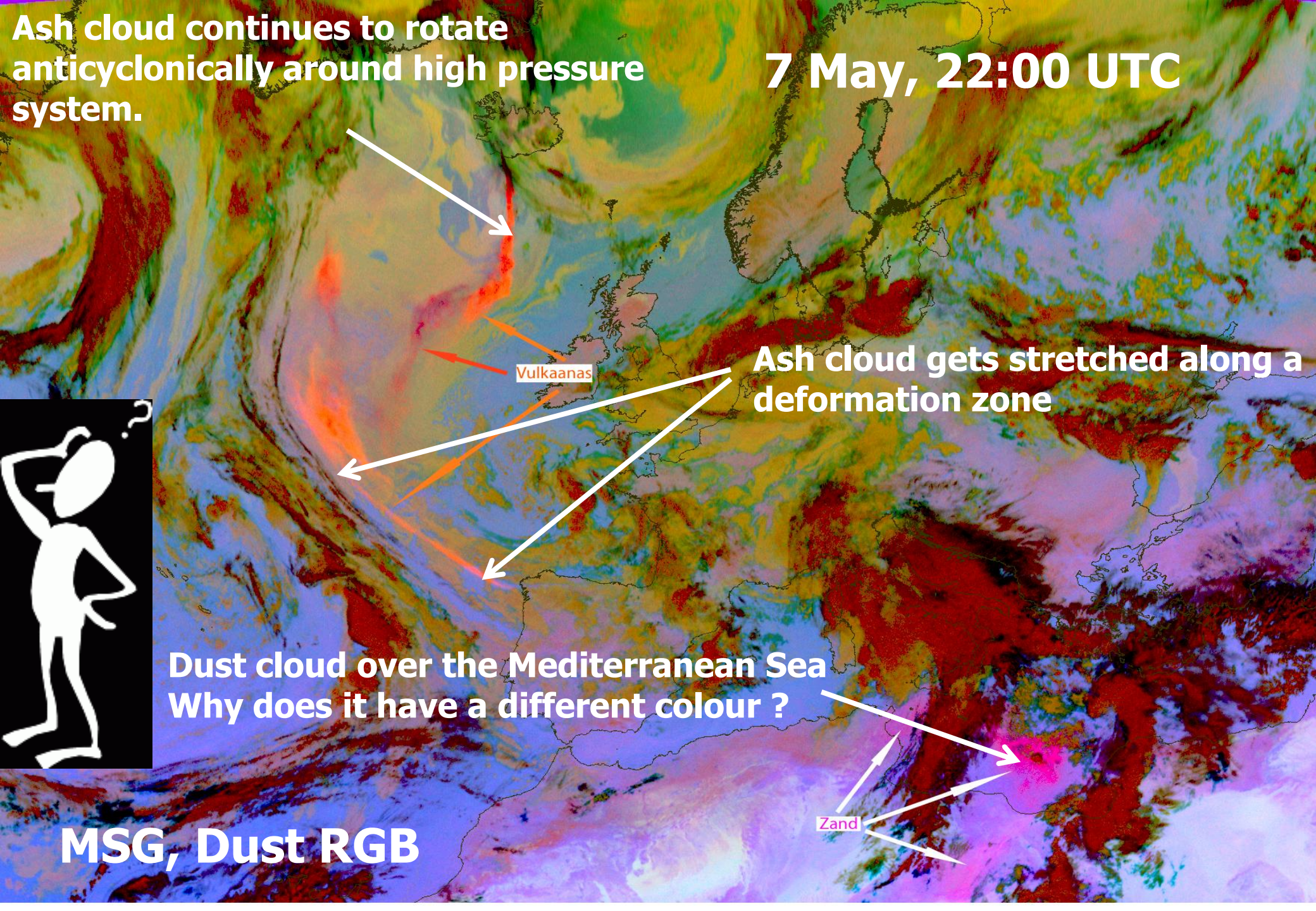


5-hour sequence of MSG (Meteosat-8) blended HRV and Dust RGB products on 25 May 2006 from 12:00 to 17:00 UTC. Source: EUMETSAT. Images created by HansPeter Roesli.

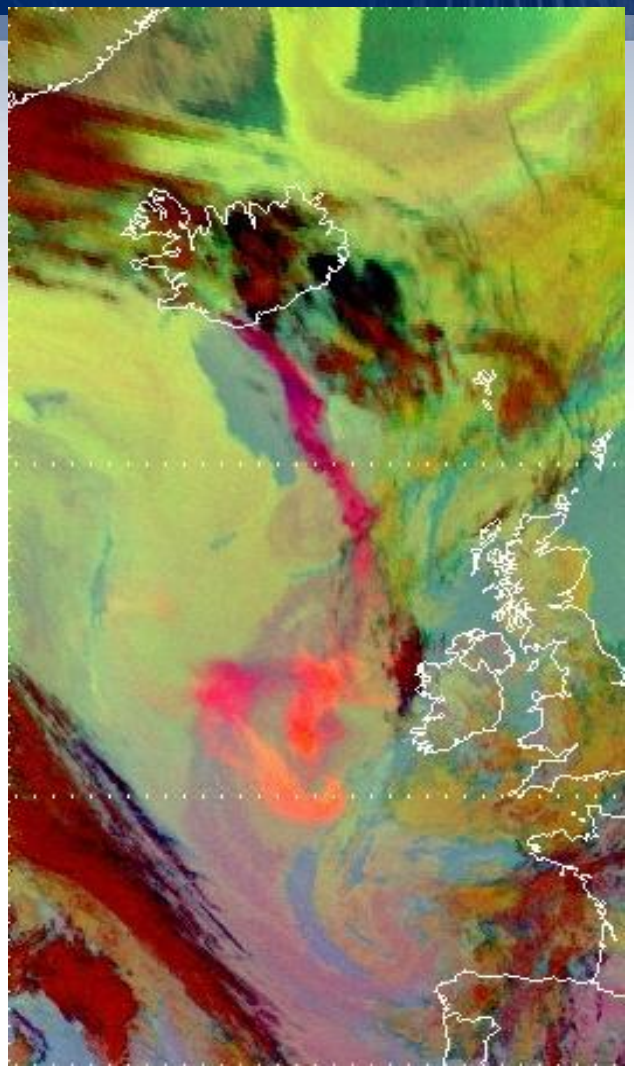
Note that this animation shows the HRV / Dust RGB "sandwich product", which is an image combination of the HRV channel and the Dust RGB product, allowing one to spatially co-locate the cloud features like the storm's overshooting top and outflow boundaries (at high resolution) with the dust clouds seen in the Dust RGB (at lower resolution). During daytime, this blended product is probably the best geostationary satellite product to monitor haboobs.

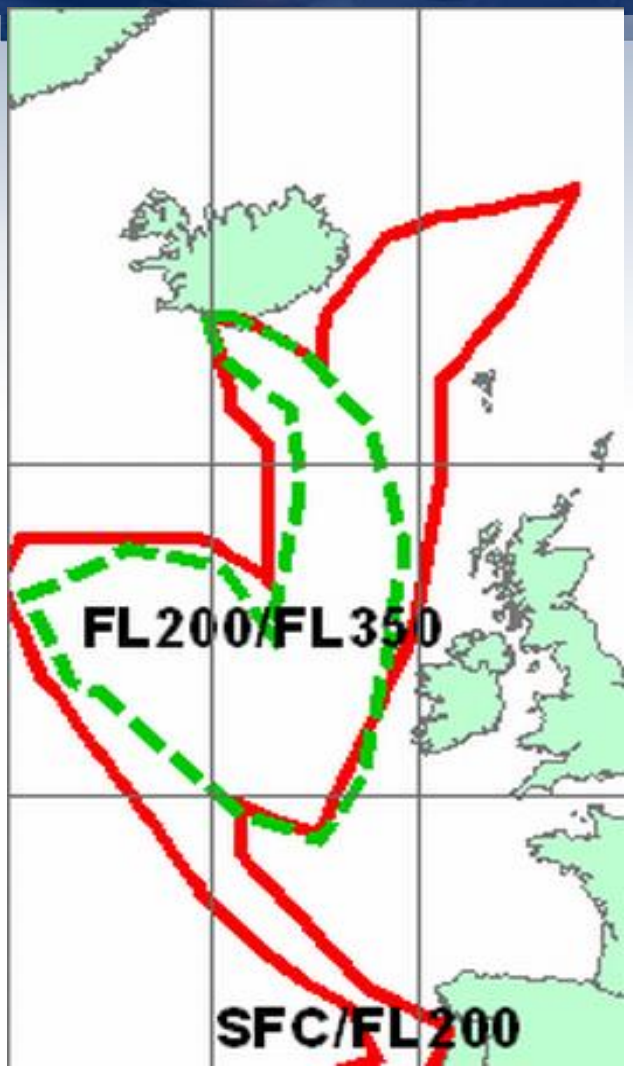
Volcanic Ash & SO2


Ash cloud (now peach colour)
stretches from Finland to North Sea!
16 April, 06:00 UTC
Ash cloud over N. Finland
Ash cloud obscured by higher clouds
Ash cloud over cloudfree surface
Ash cloud over low/mid water clouds
MSG, Dust RGB
DUST - 2010-04-16 06:00UTC


Ash cloud continues to rotate anticyclonically around high pressure system.
7 May, 22:00 UTC
Vulkaanas
Ash cloud gets stretched along a deformation zone
Dust cloud over the Mediterranean Sea
Why does it have a different colour ?
Zand
MSG, Dust RGB

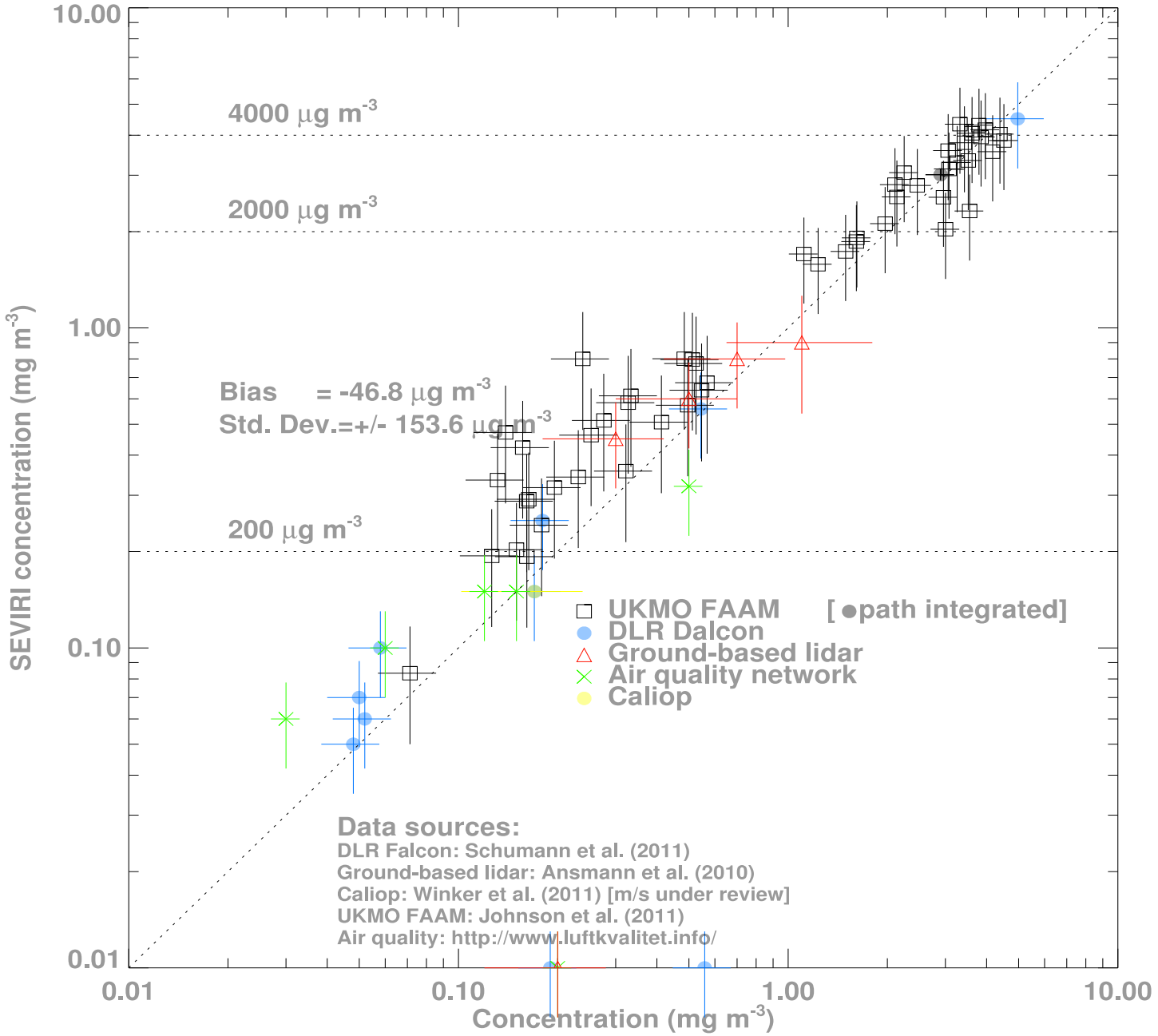
Comparison MSG vs VAAC Forecast



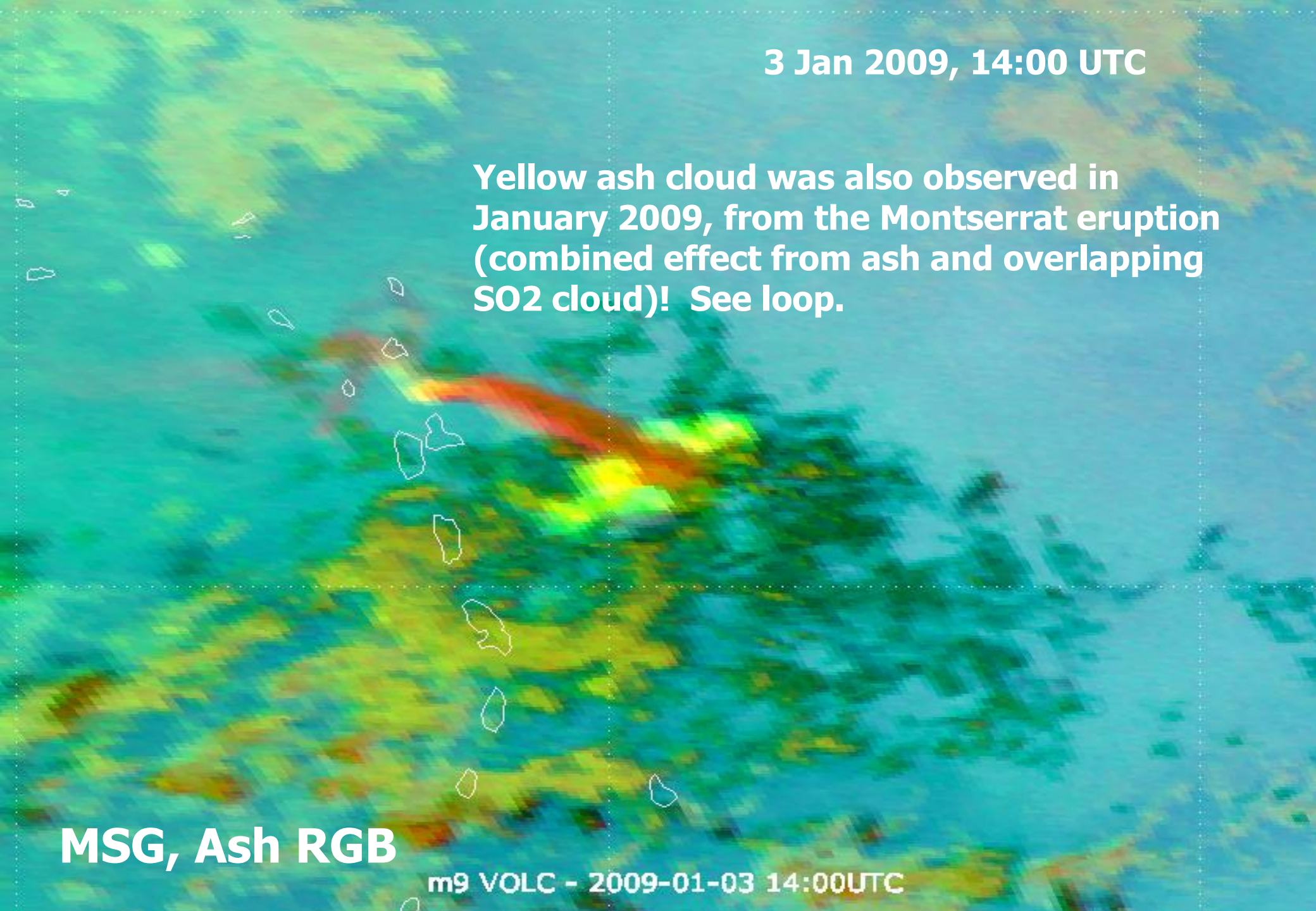


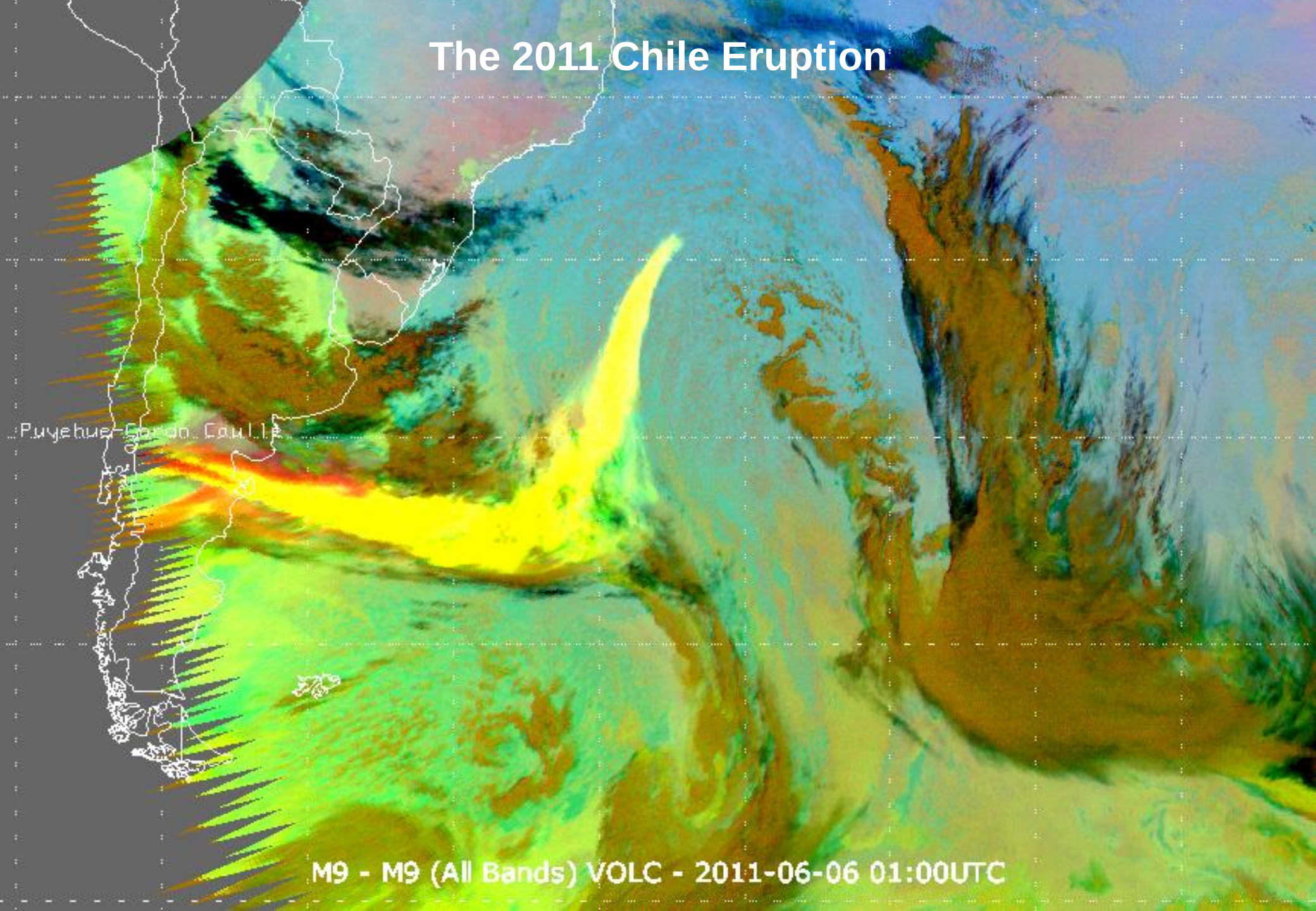
7 May 2010, 6:00 UTC

EUMETSAT



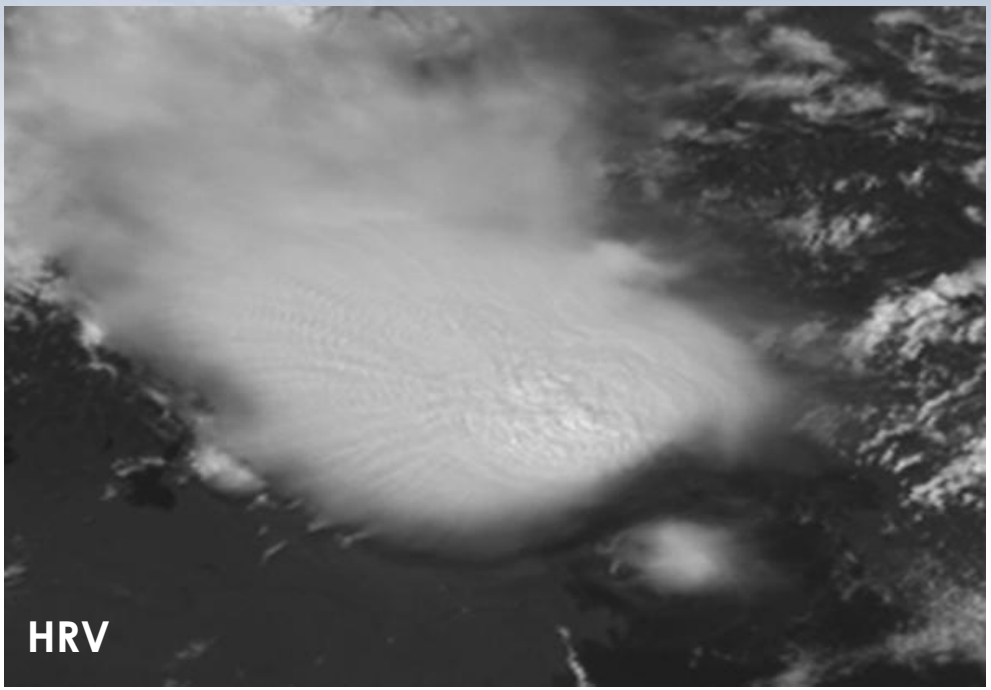
From Fred Prata, NILU

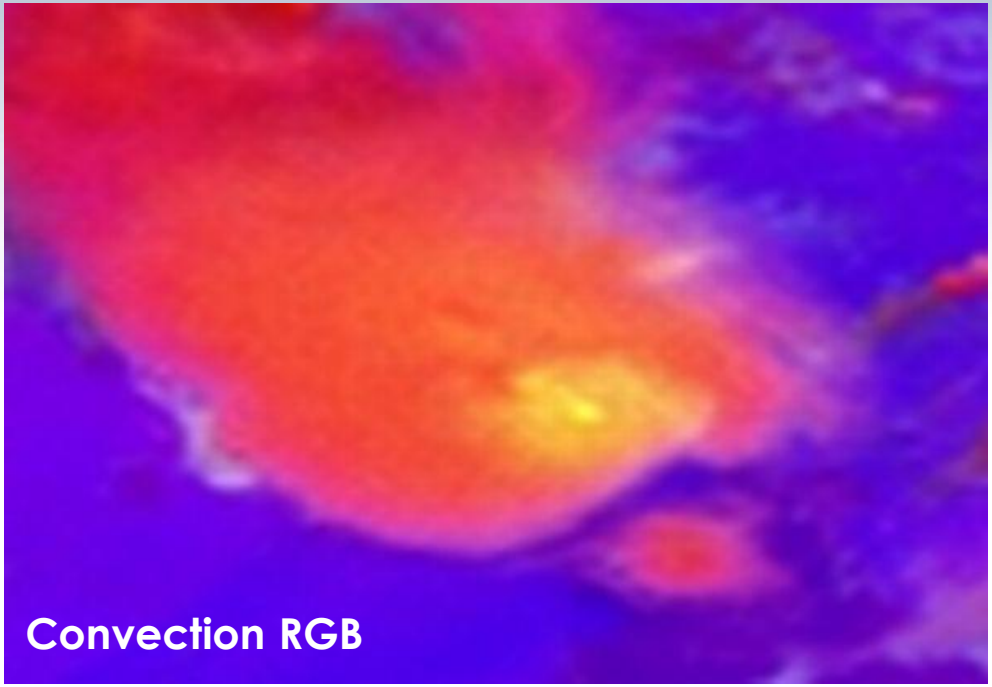

3 Jan 2009, 14:00 UTC
Yellow ash cloud was also observed in January 2009, from the Montserrat eruption (combined effect from ash and overlapping SO2 cloud)! See loop.
MSG, Ash RGB
m9 VOLC - 2009-01-03 14:00UTC


The 2011 Chile Eruption
Puyehue-Cordon Caulle
M9 - M9 (All Bands) VOLC - 2011-06-06 01:00UTC

Cloud Physical Properties
(Thickness, Phase, Particle Size)

Small Ice Particles in severe Cb

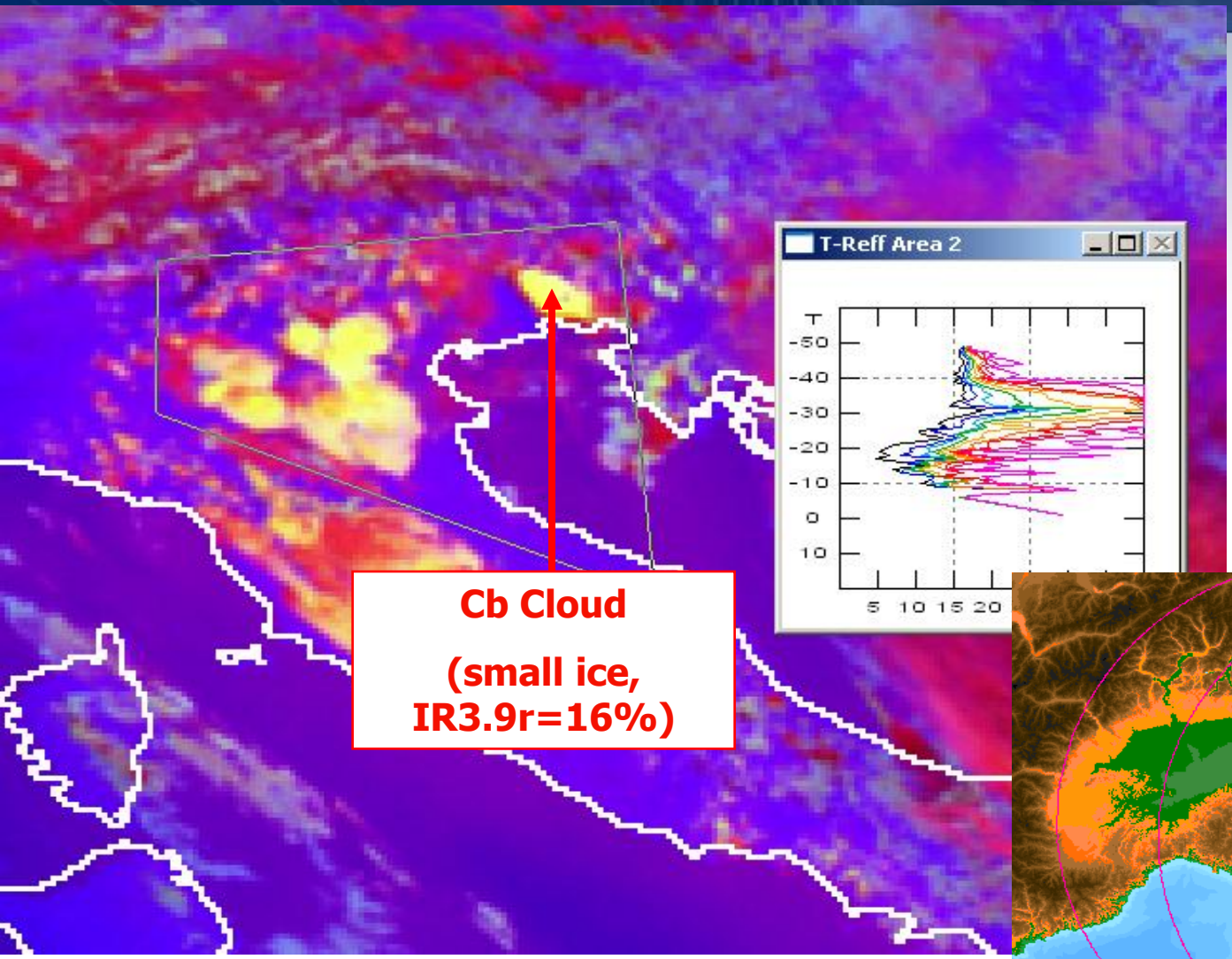


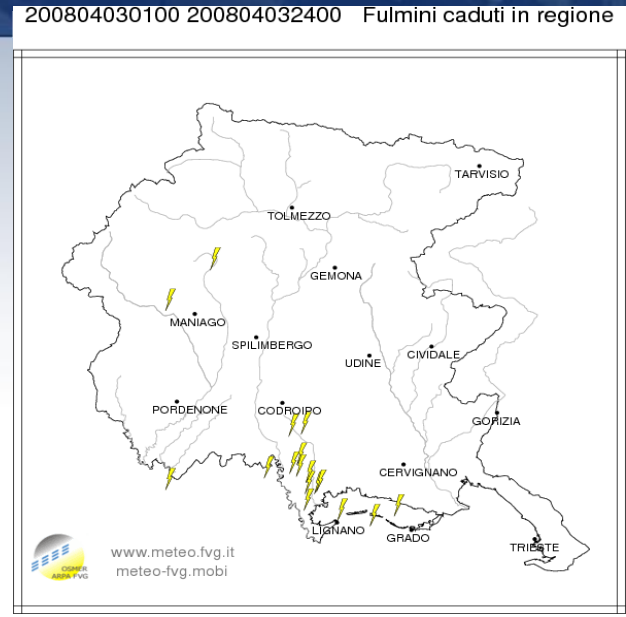


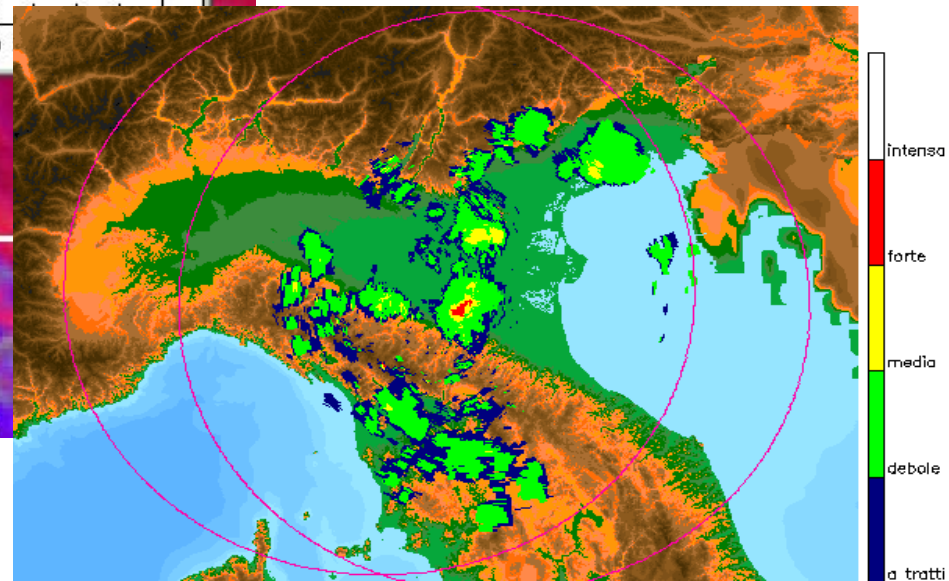
- Small ice (high IR3.9r of 6-7%)
- Long-living storm system
- Convective outflow boundary
- Overshooting tops
- Gravity waves
- Radial Ci

EUMETSAT

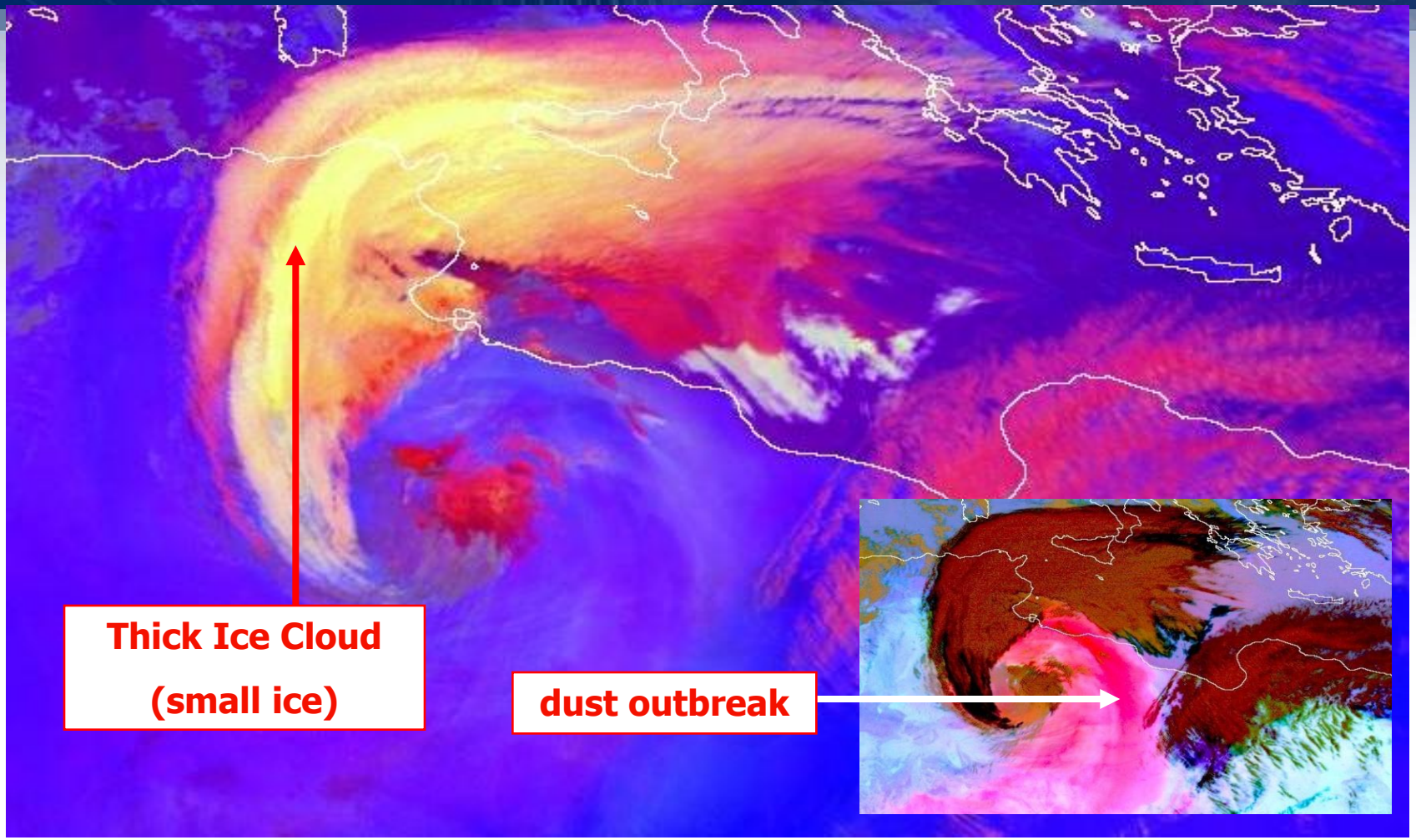
Small Ice Particles in Cb with Cold Base







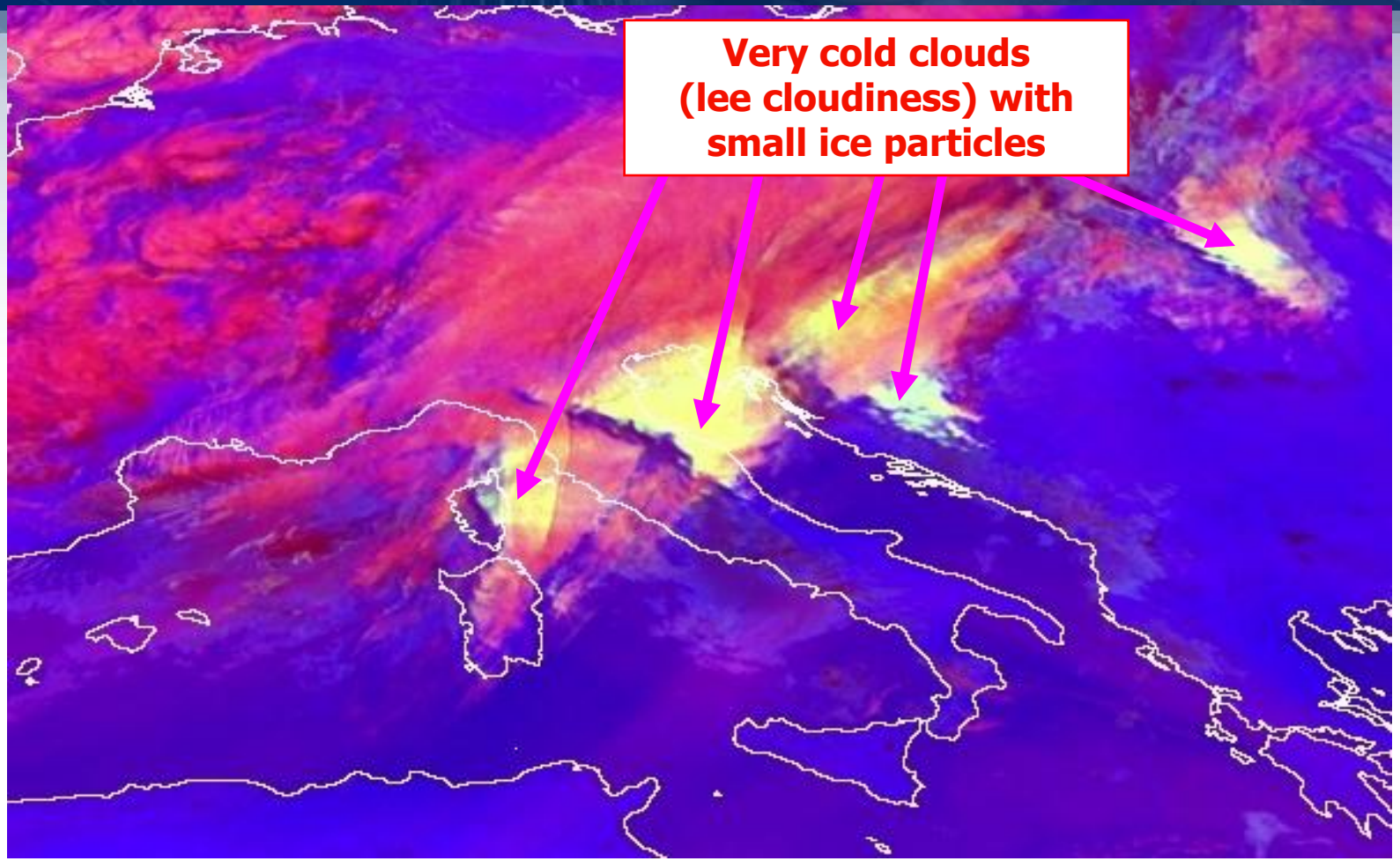
Small Ice Particles in “Polluted” Clouds



MSG-1, 22 February 2007, 12:00 UTC

EUMETSAT

Small Ice Particles in High-level Wave Clouds

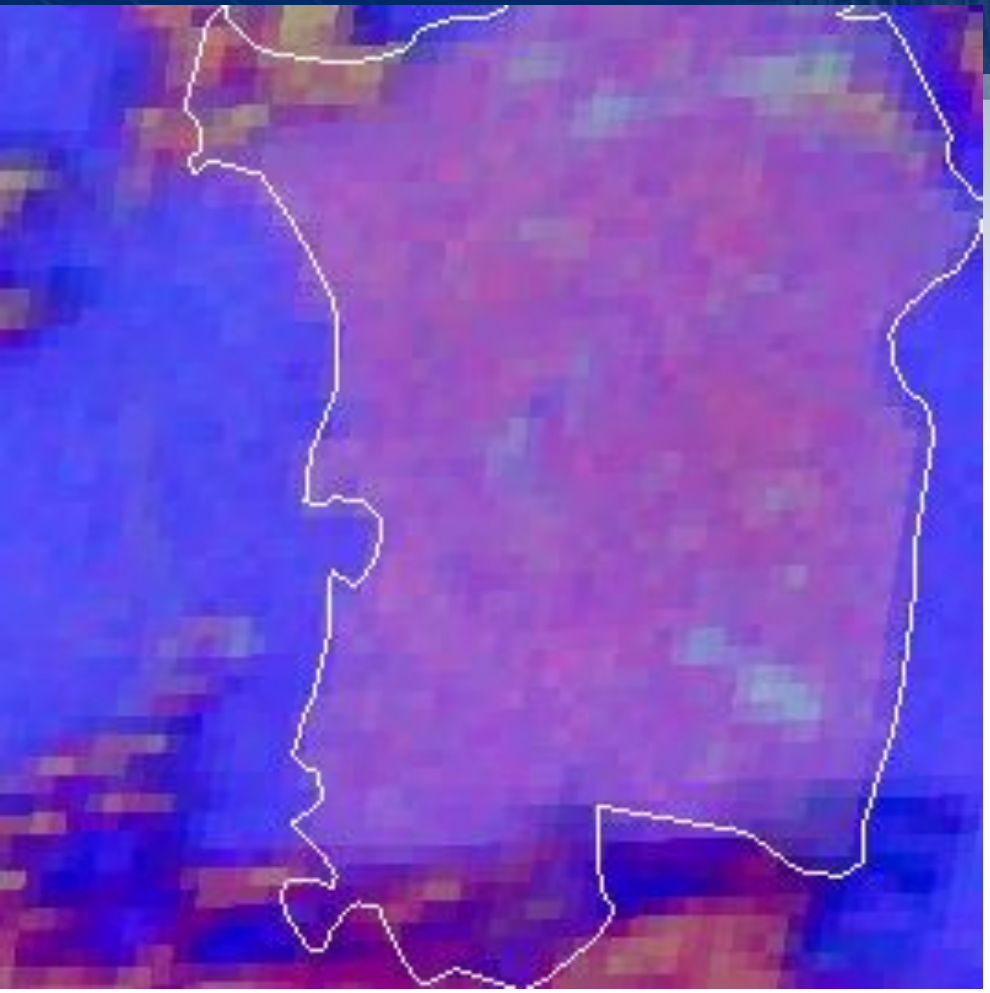


MSG-1, 19 March 2007, 08:00 UTC

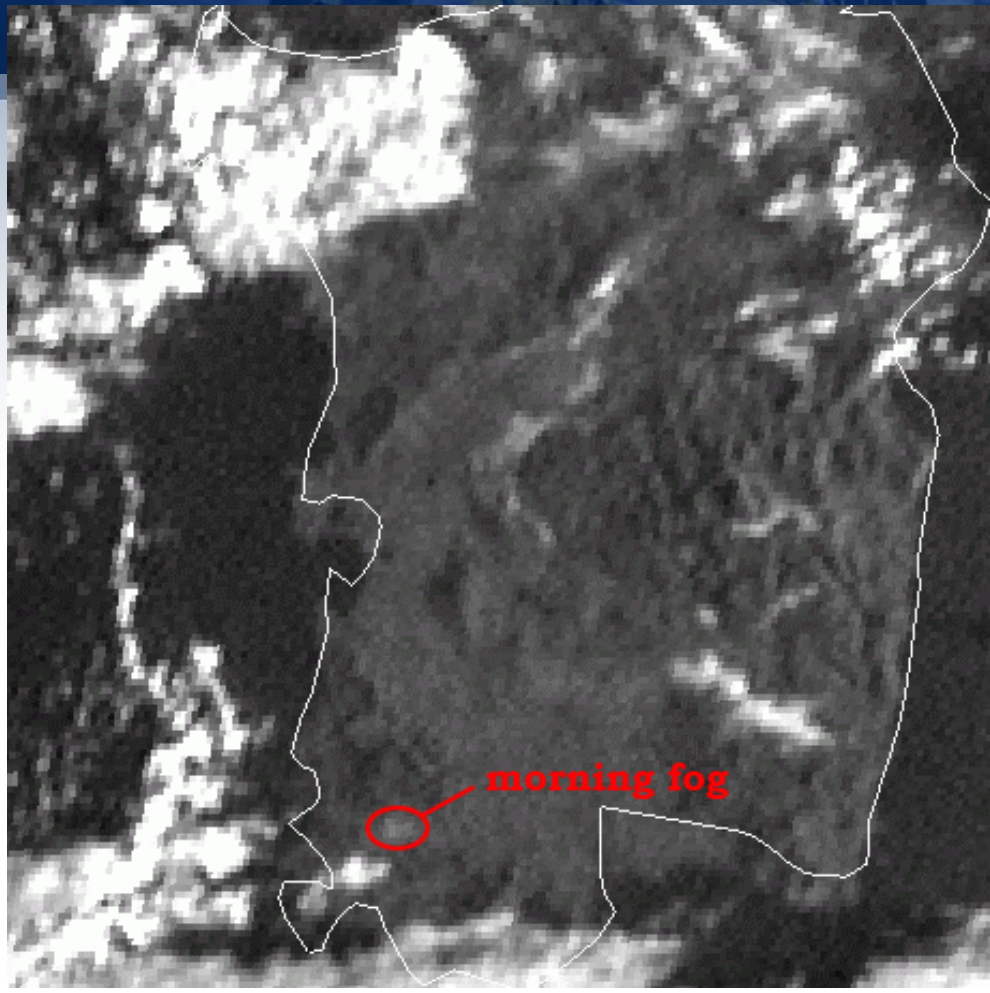
EUMETSAT

Fog & Low Clouds

Fog Sardinia (thickness: 20-30 m, visibility: ???)



Fog RGB, 05:00 UTC

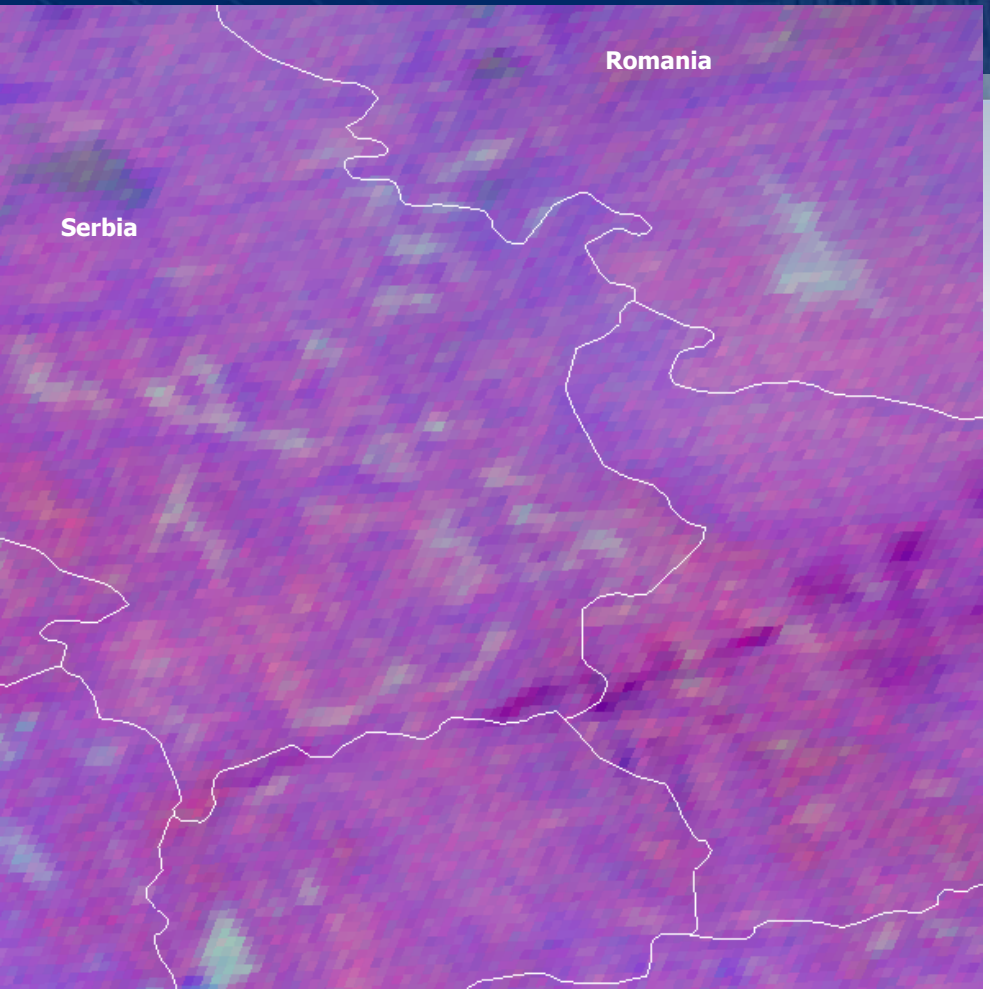


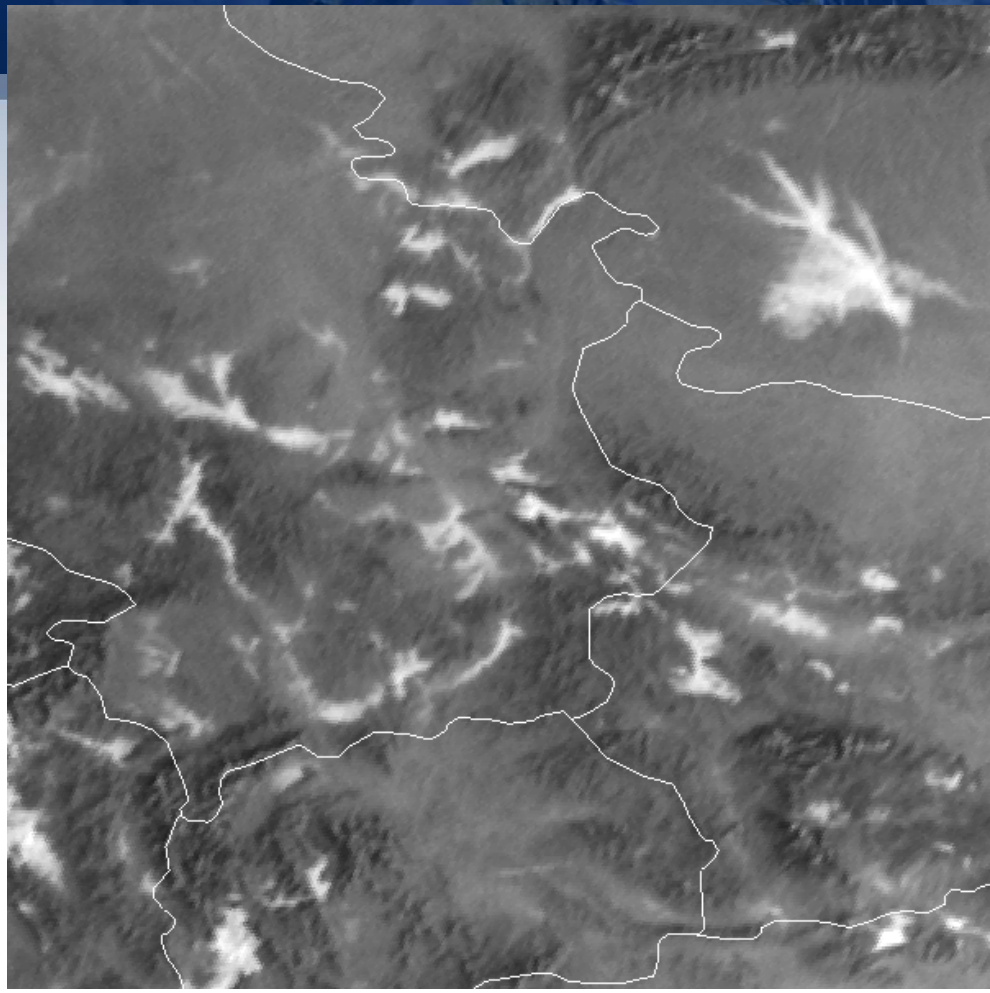
HRV, 05:45 UTC

25 September 2008

EUMETSAT

Valley Fog Serbia (thickness: ???)





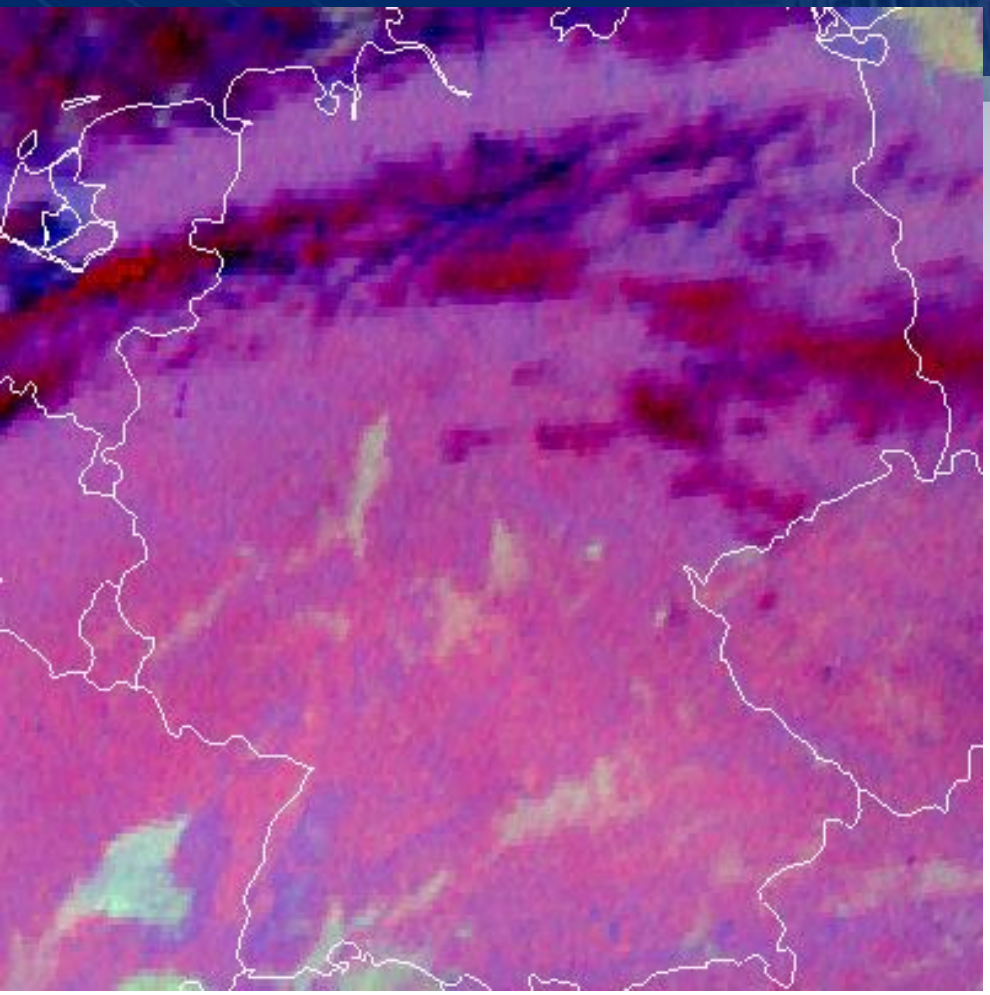
Fog RGB, 04:00 UTC

HRV, 06:00 UTC

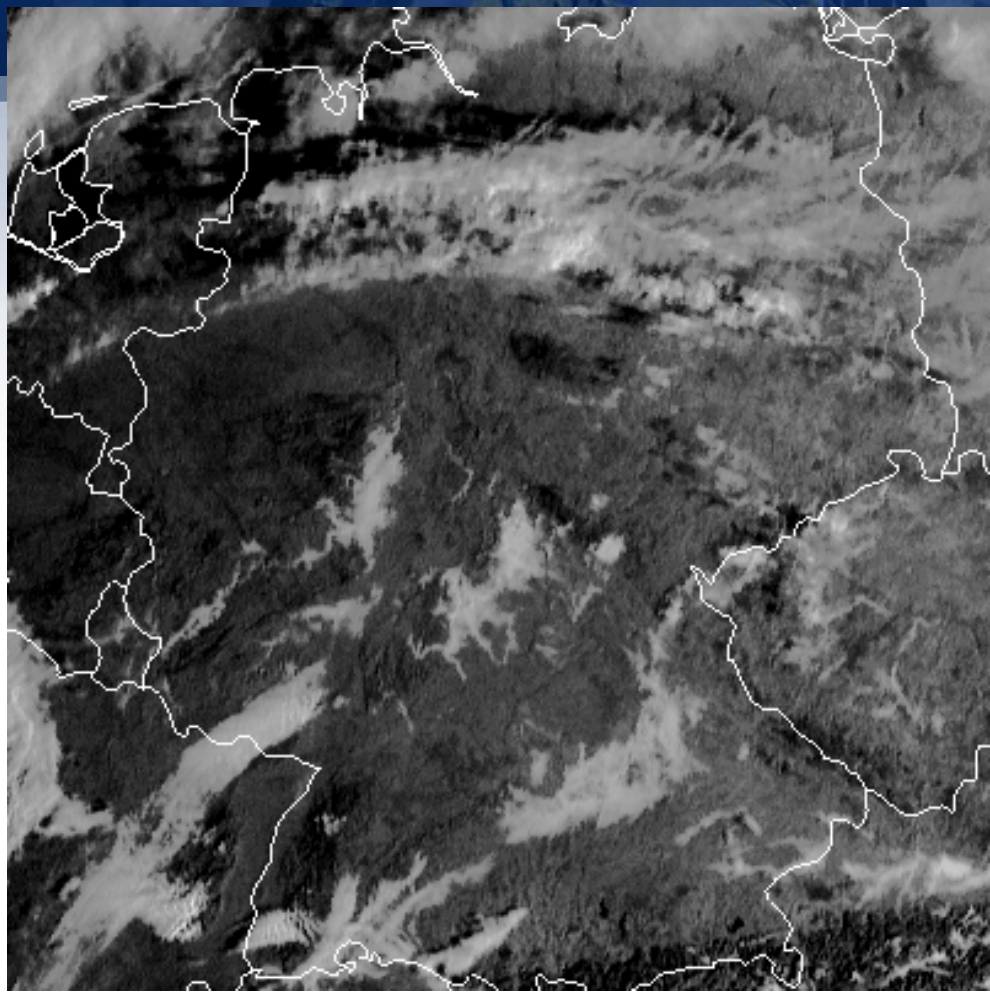
16 October 2008

EUMETSAT

Fog Frankfurt (thickness: 100-200 meters)



Fog RGB, 05:00 UTC

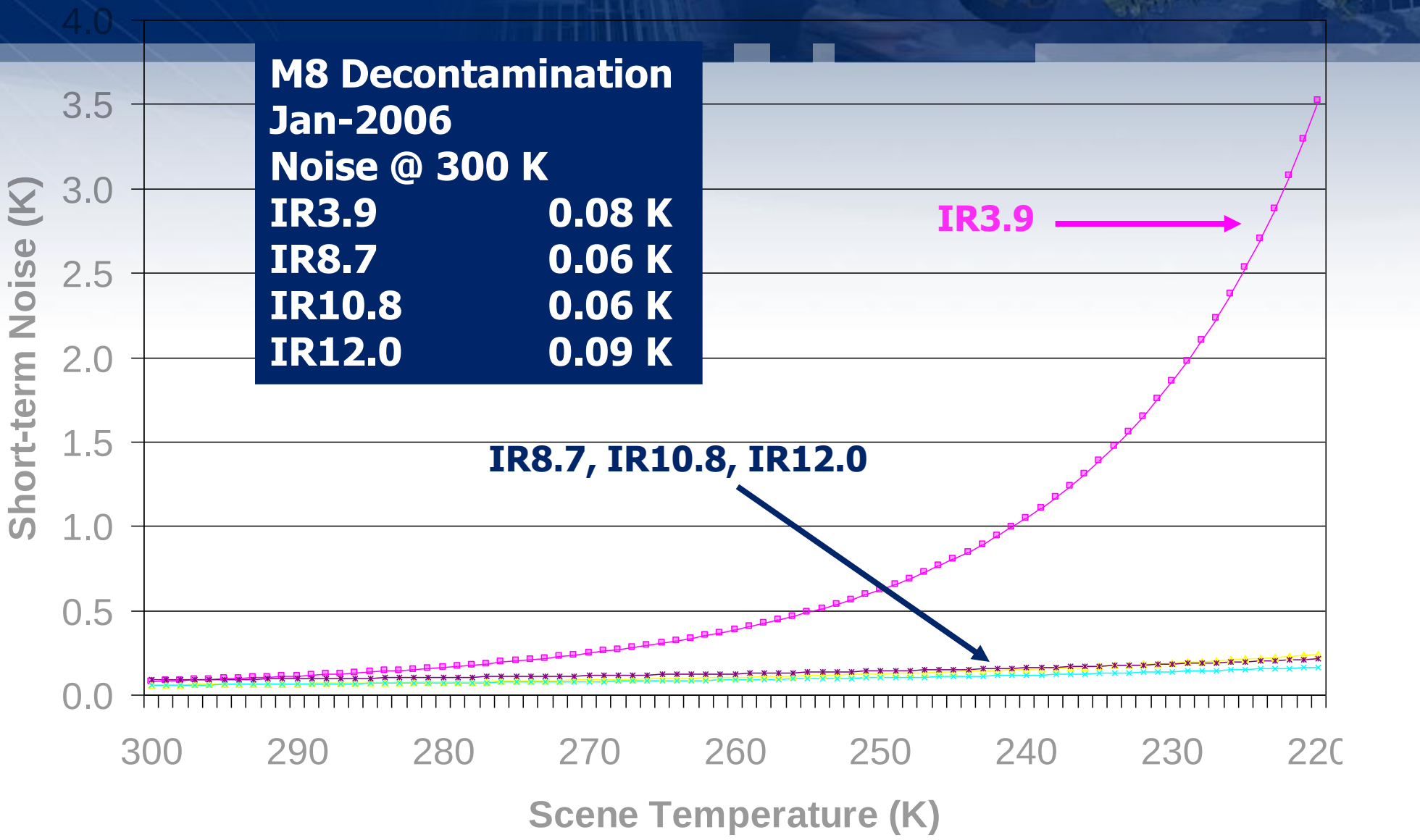


HRV, 07:00 UTC

20 October 2008

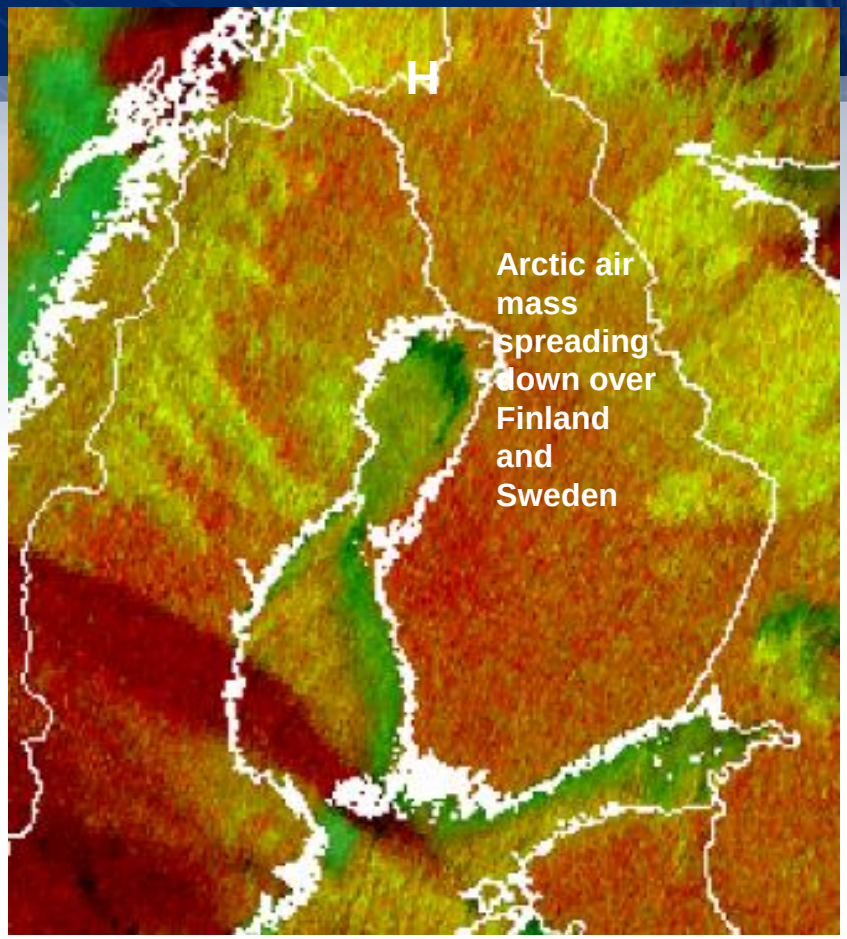
EUMETSAT

Short-term Noise of IR Channels

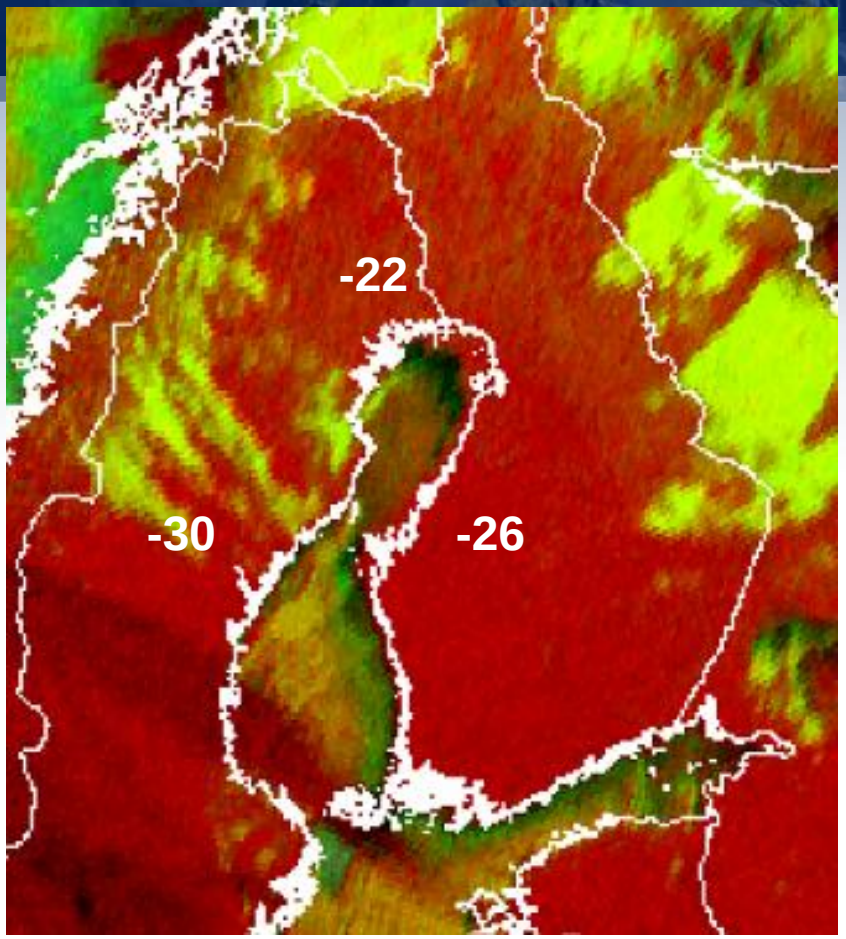


EUMETSAT

Comparison: RGB Night vs RGB 24-hour



RGB Night Microphys. (IR3.9)



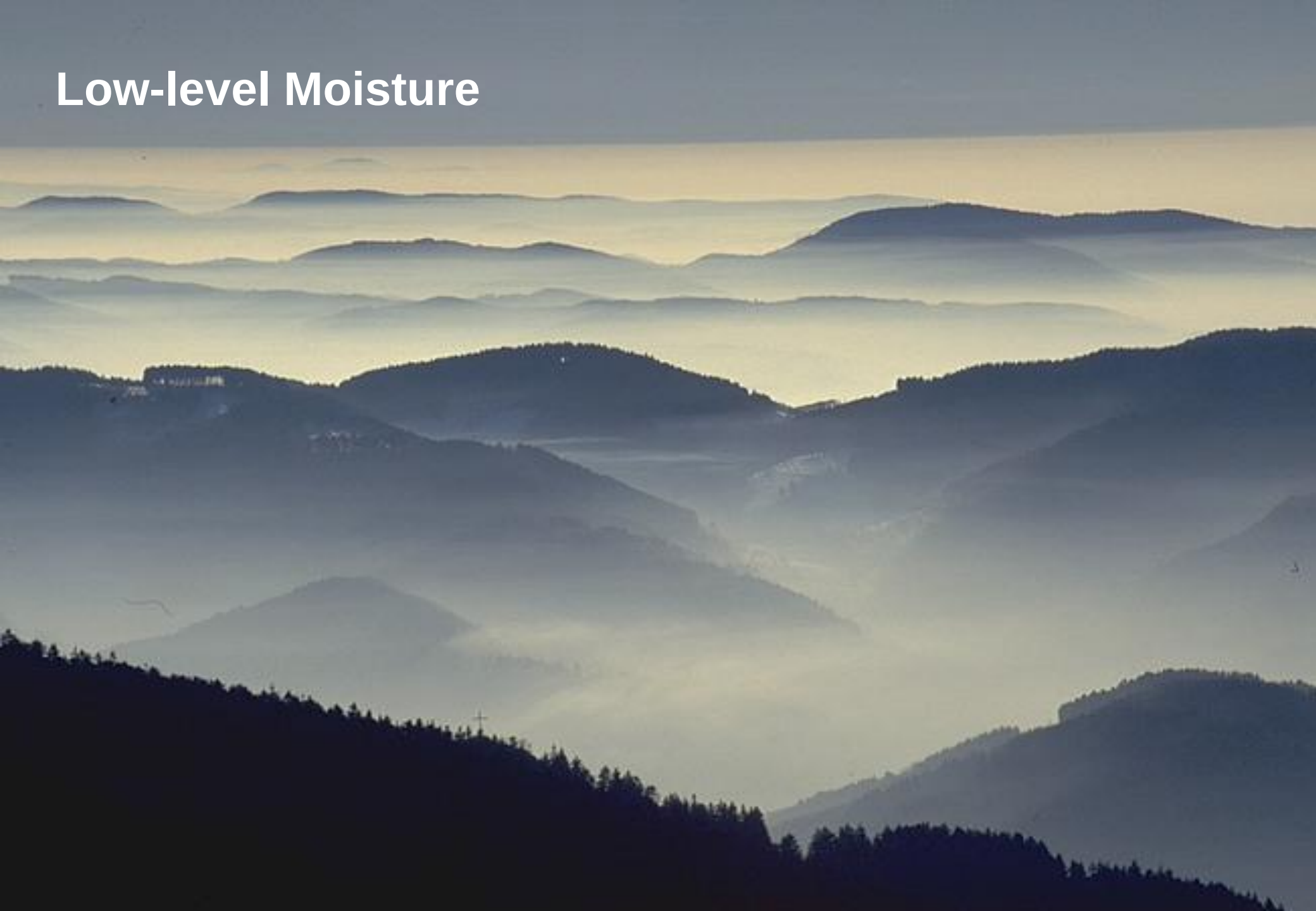
RGB 24-hour Cloud Microphys. (IR8.7)

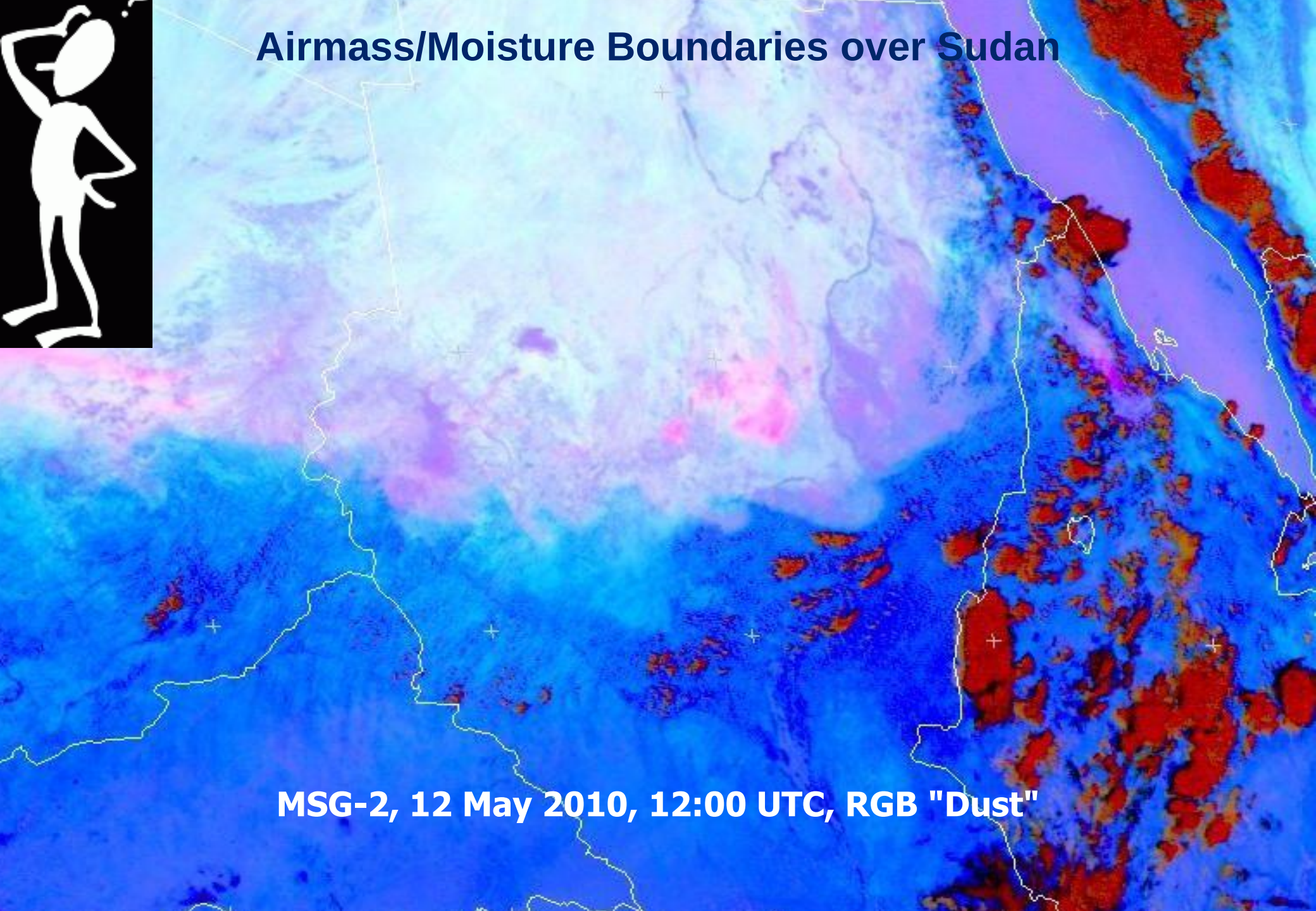
IR3.9

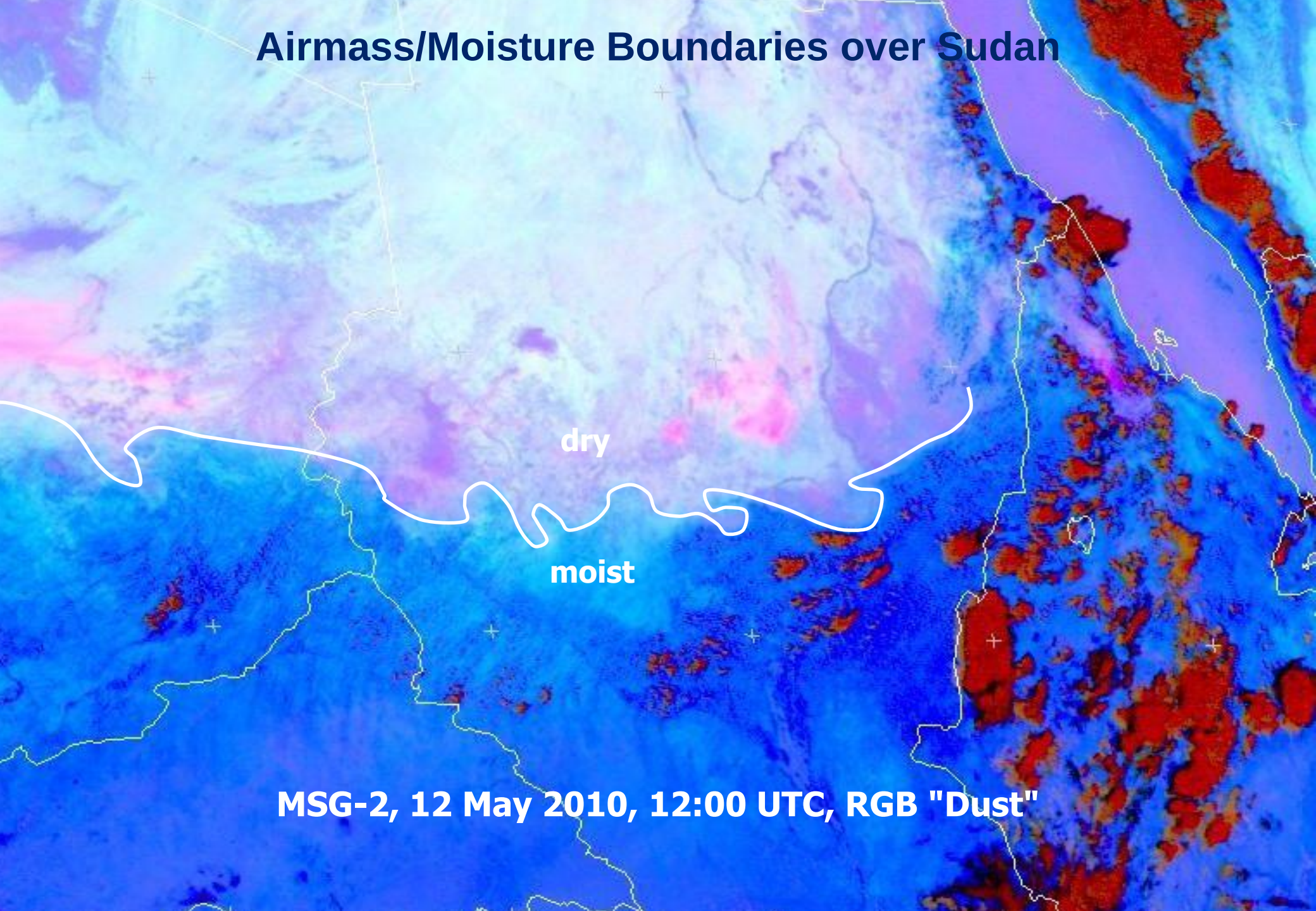
IR8.7

EUMETSAT

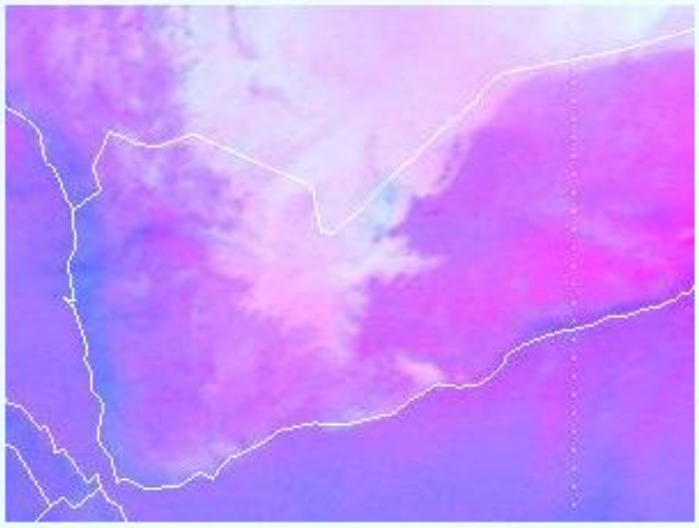
Low-level Moisture



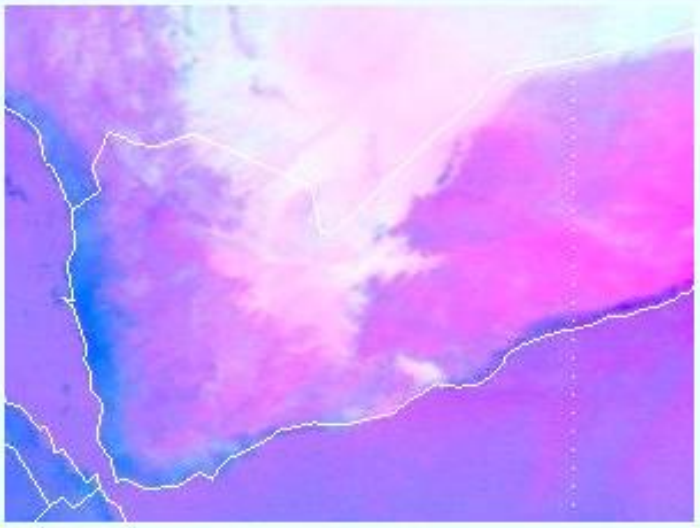

Airmass/Moisture Boundaries over Sudan
MSG-2, 12 May 2010, 12:00 UTC, RGB "Dust"


Airmass/Moisture Boundaries over Sudan
dry
moist
MSG-2, 12 May 2010, 12:00 UTC, RGB "Dust"

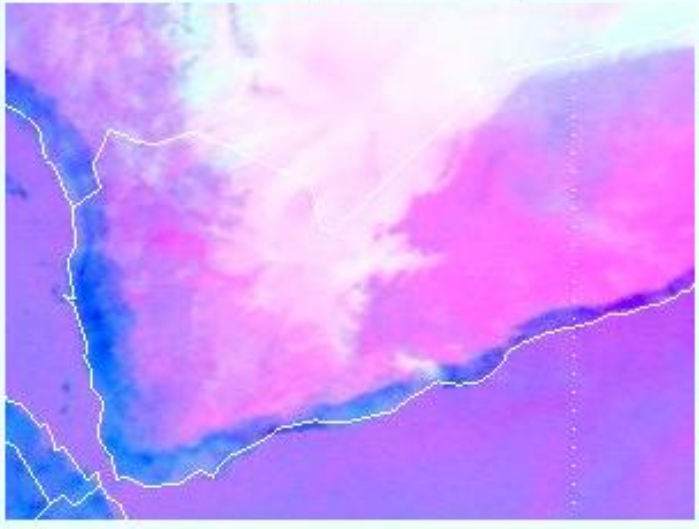
Meteosat-9 Images



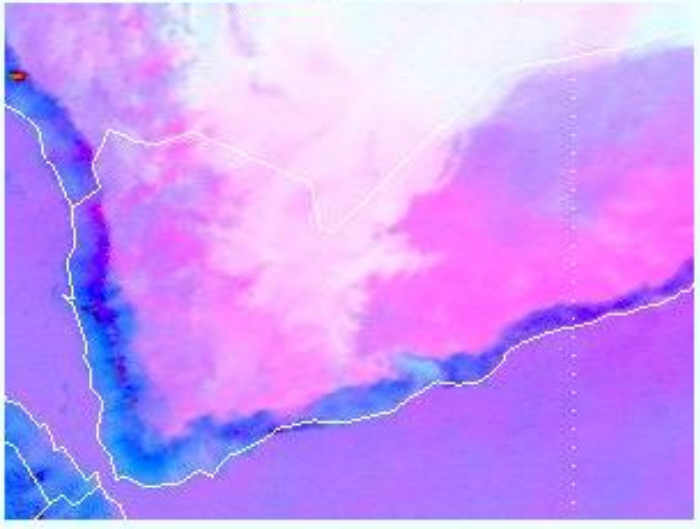
Met-9, 26 May 2012, 05:00 UTC
RGB Composite (Dust RGB)
IR12.0-IR10.8, IR10.8-IR8.7, IR10.8
Large Area (PNG, 740 KB)



Met-9, 26 May 2012, 07:00 UTC
RGB Composite (Dust RGB)
IR12.0-IR10.8, IR10.8-IR8.7, IR10.8
Large Area (PNG, 739 KB)



Met-9, 26 May 2012, 09:00 UTC
RGB Composite (Dust RGB)
IR12.0-IR10.8, IR10.8-IR8.7, IR10.8
Large Area (PNG, 740 KB)



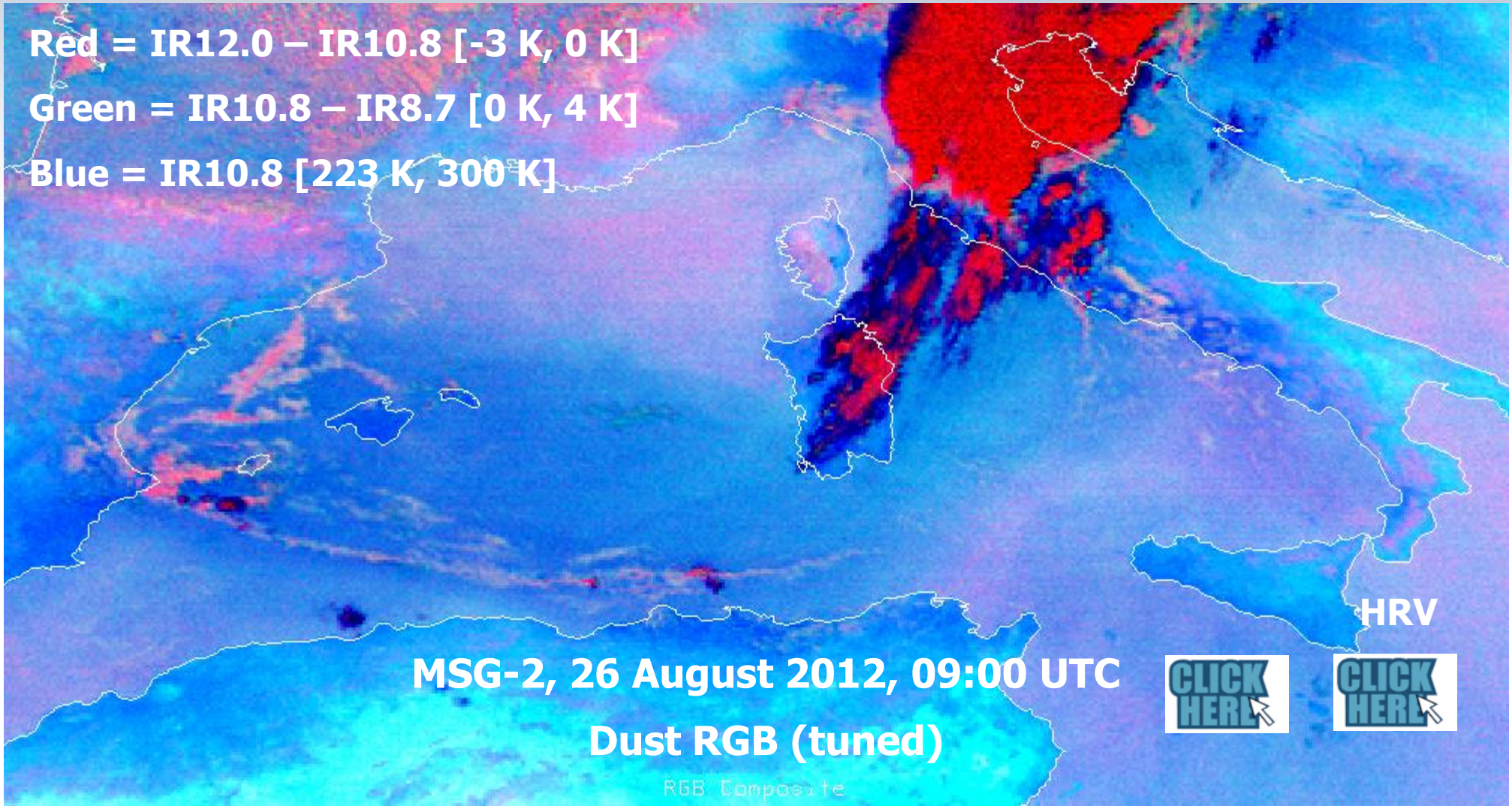
Met-9, 26 May 2012, 11:00 UTC
RGB Composite (Dust RGB)
IR12.0-IR10.8, IR10.8-IR8.7, IR10.8
Large Area (PNG, 748 KB)

Diurnal development of the sea-breeze front in Yemen

CLICK HERE

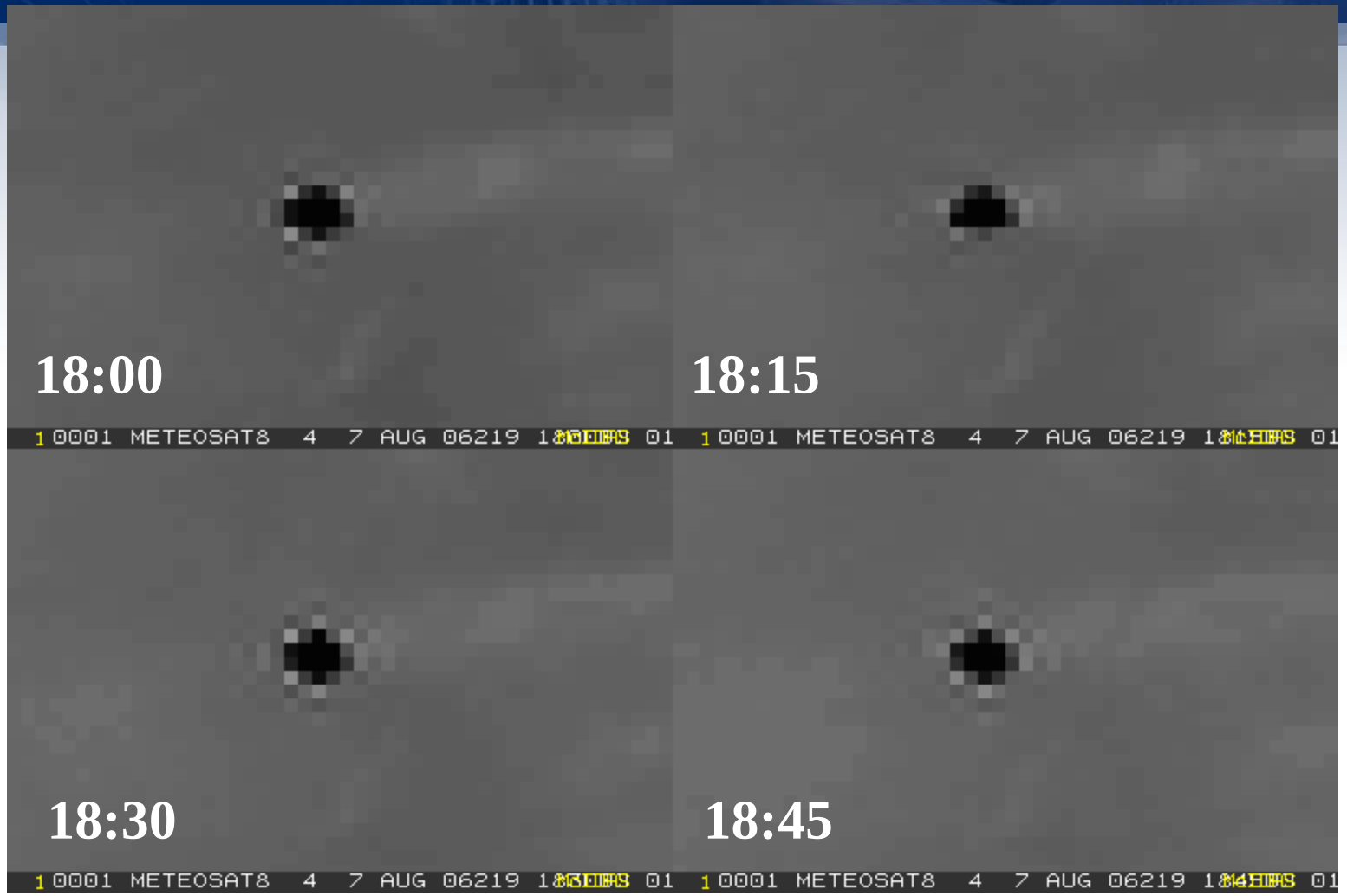
EUMETSAT

Cold Front removes hot/moist air in Italy




Fires & Smoke

Artefacts coming from Digital Filter



MSG-1, 7 August 2006, IR3.9 Channel (inverted)

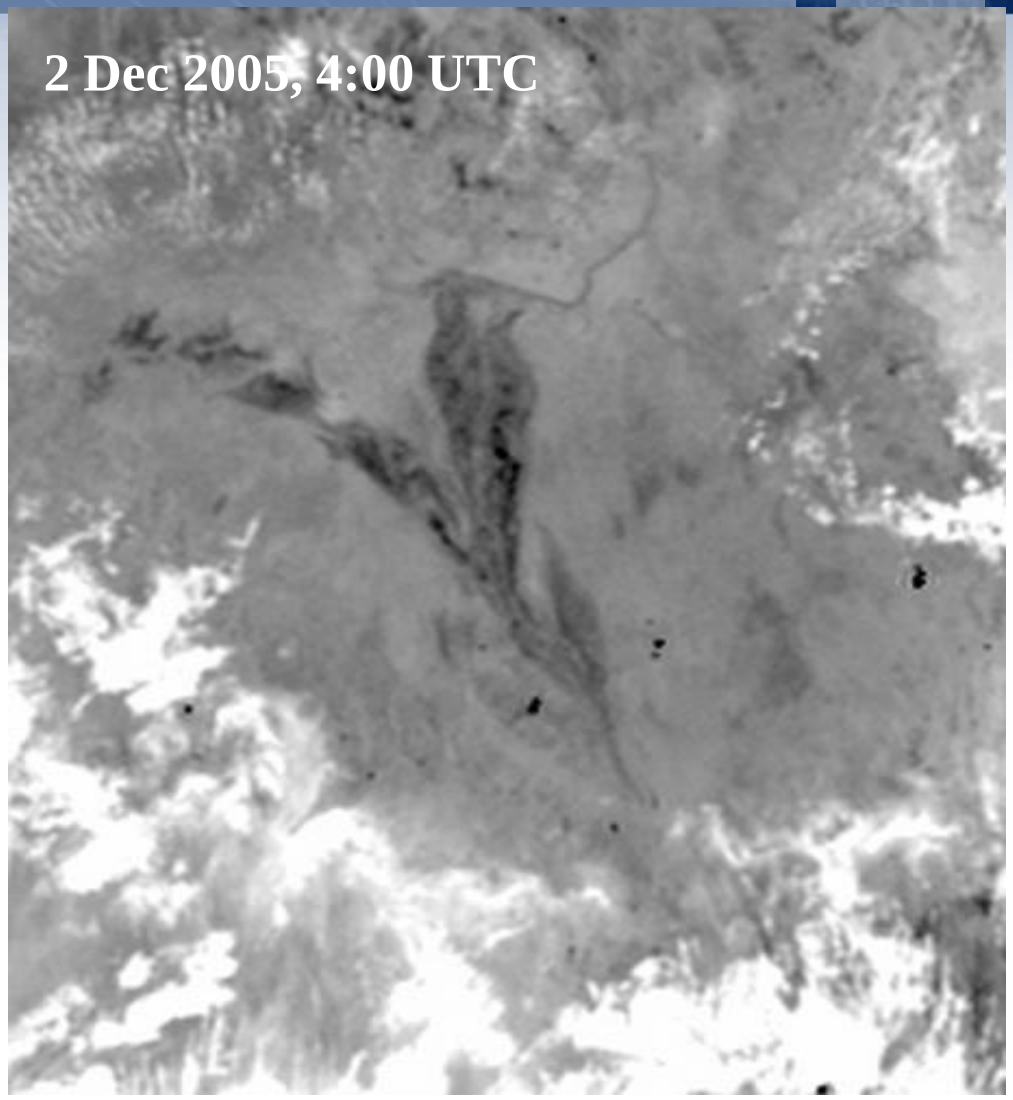
EUMETSAT

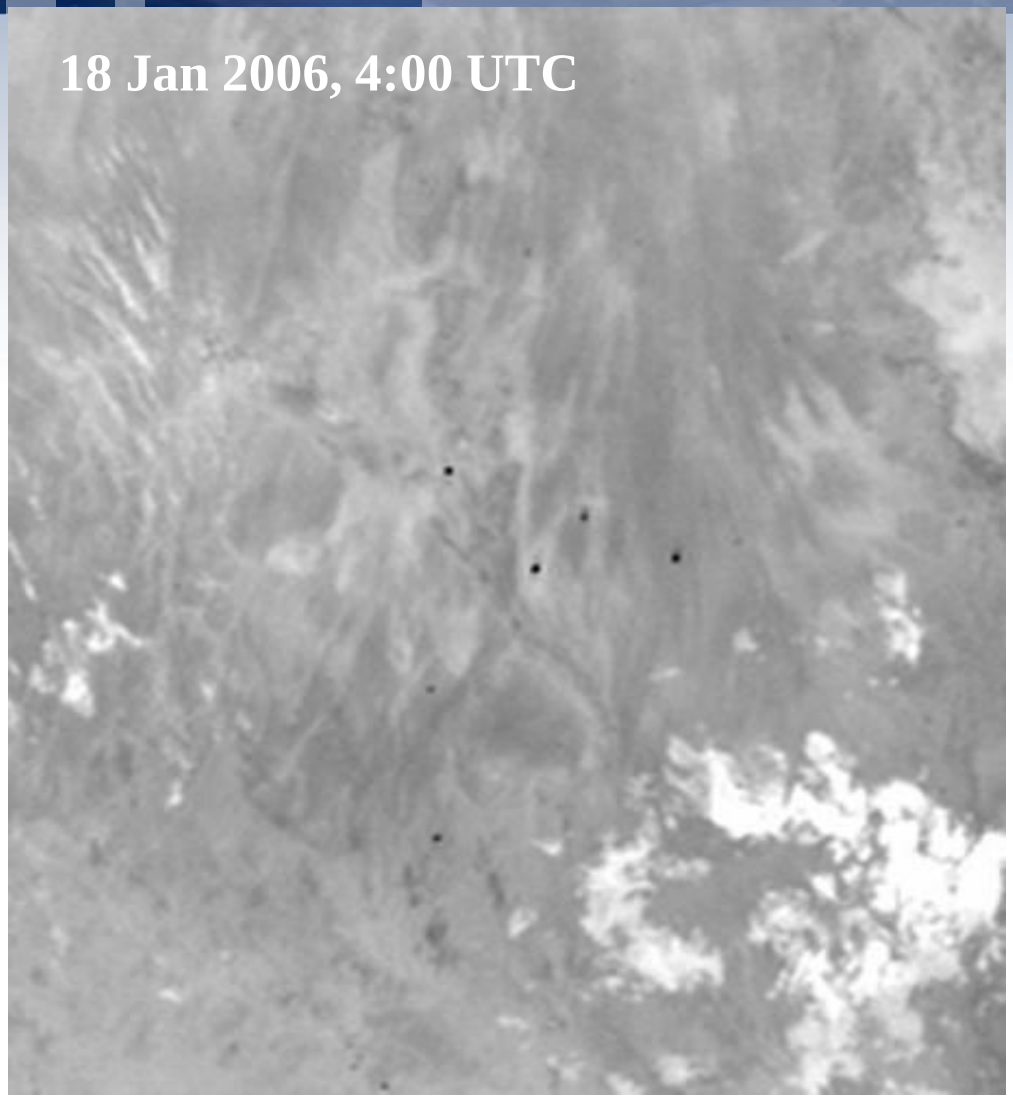

“Blinding” of IR3.9 Channel
280
290
300
310
320
330
340
Blinding can occur for saturated, large fires
IR3.9 Channel
52_Band4_TEMP - 2007_08_03_1745

Met-9, storm sandwich product (source: Z. Charvat)

Floods

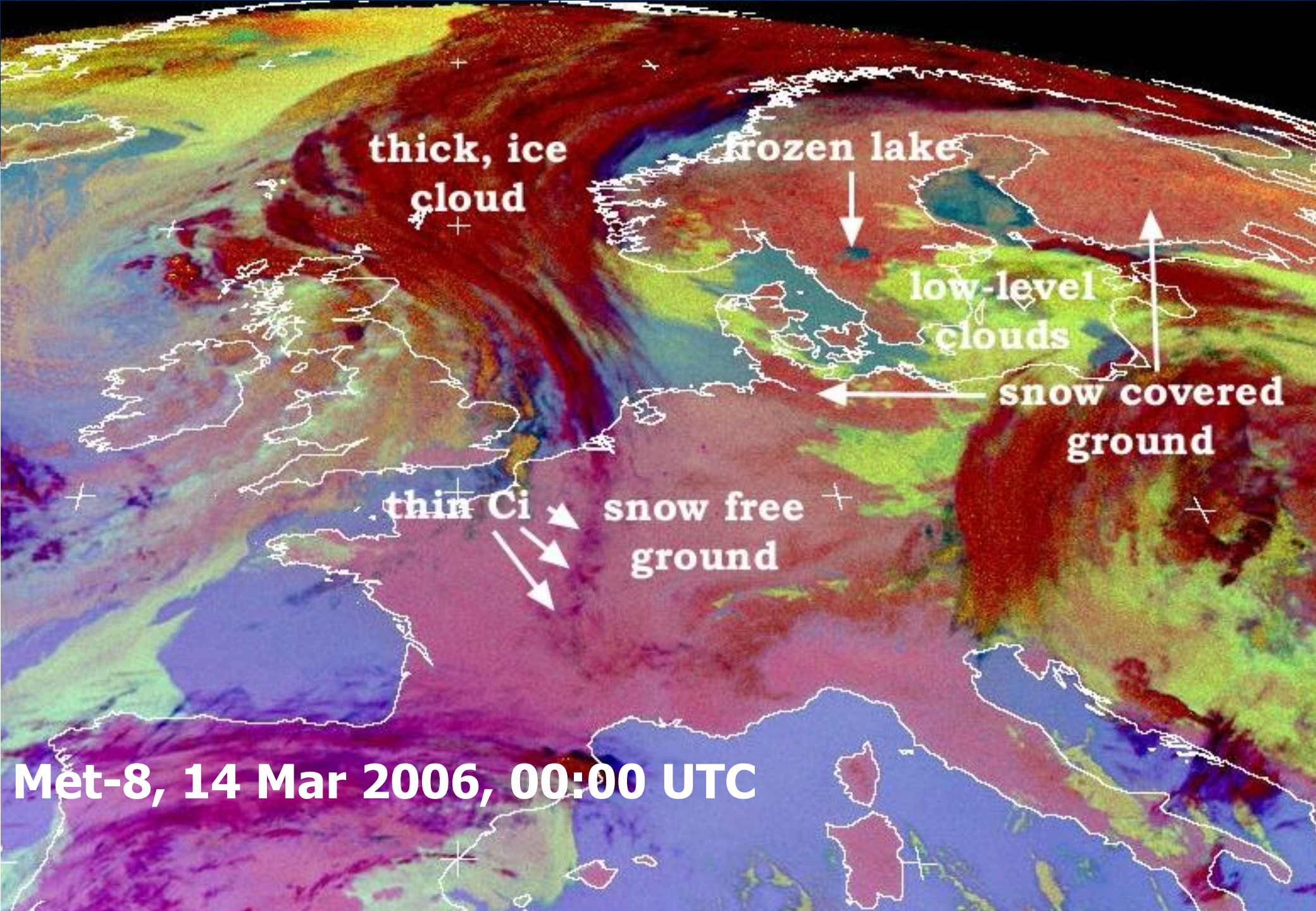
Floods in Sudd Area, Sudan

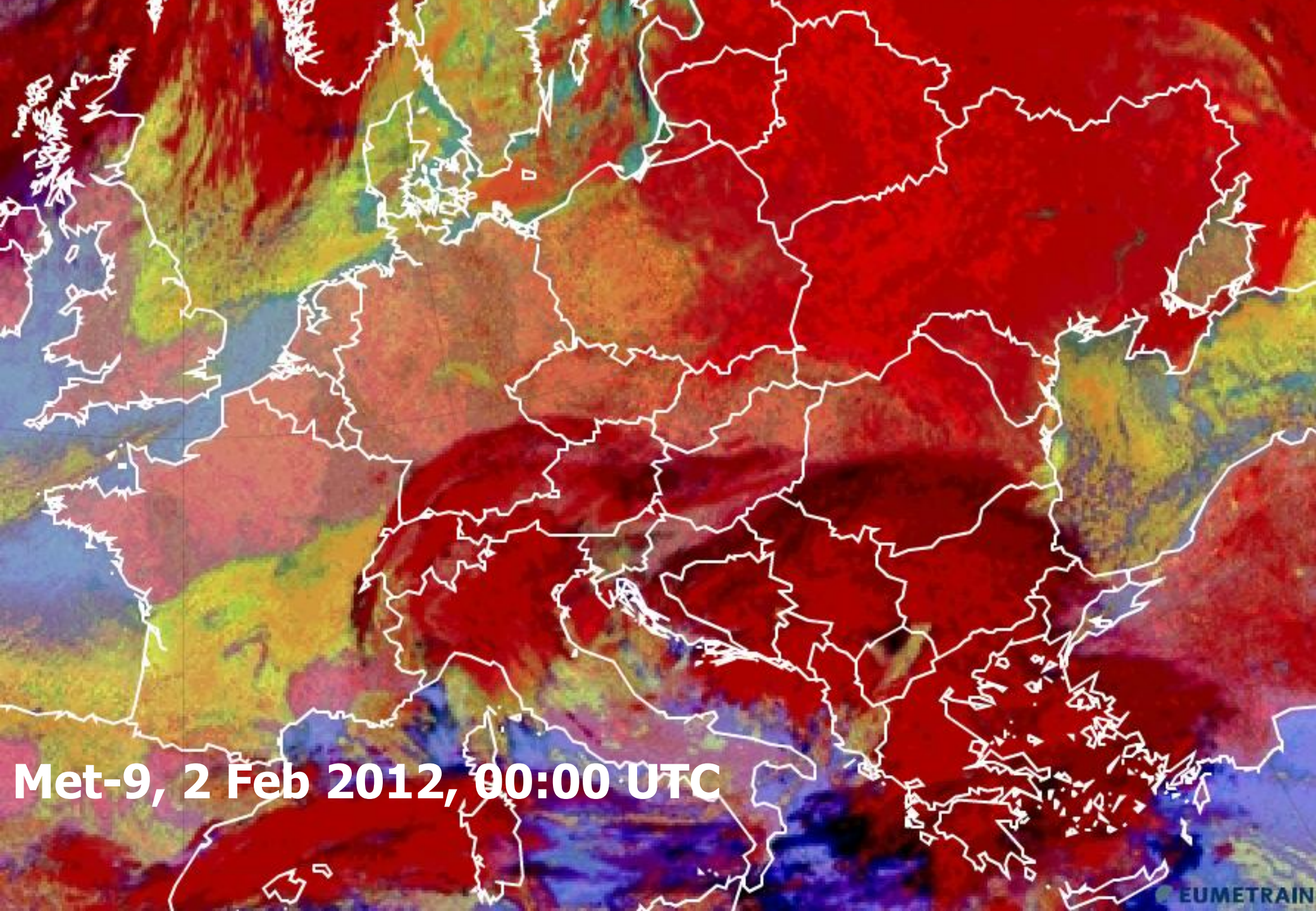




MSG IR3.9 Channel

Snow


thick, ice cloud
frozen lake
low-level clouds
snow covered ground
thin Ci
snow free ground
Met-8, 14 Mar 2006, 00:00 UTC


Met-9, 2 Feb 2012, 00:00 UTC
EUMETRAIN