# Nowcasting applications

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METEO FRANCE
Toujours un temps d'avance

<u>Outlines</u>

Satellite images
Derived products
•SAFNWC/MSG products (continue)
    •plans for the next 5 years
•SAFNWC/PPS products
•MPEF products for nowcasting purposes
•Automatic/interactive applications in Hungary

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# Satellite images

The main tool for interactive nowcasting applications are the images (single and RGB)
Geostationary satellite        polar satellites (northern latitudes)
There were several presentations about satellite image interpretation,
I will speak about derived products for nowcasting applications.

Where are you from?
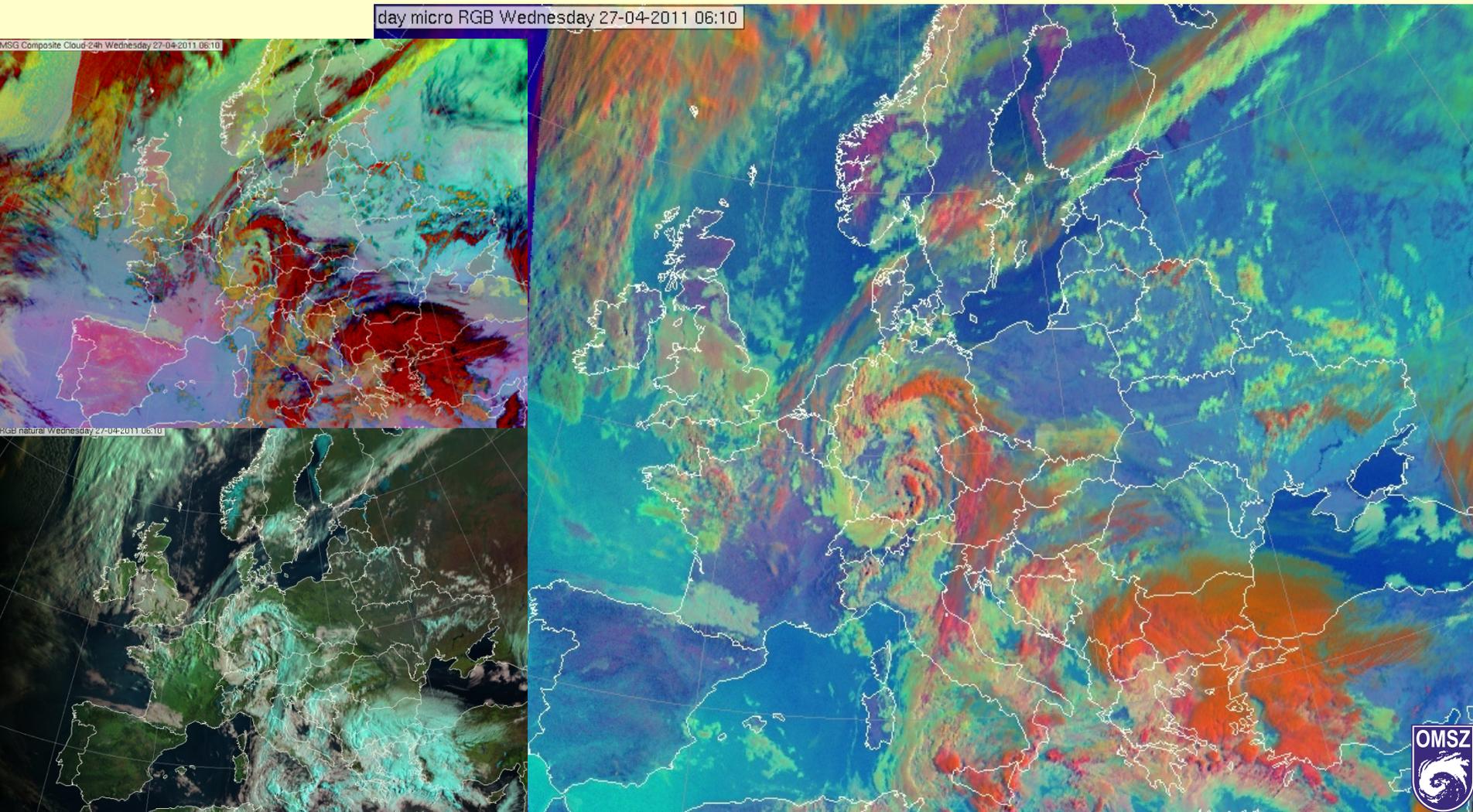
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# Nowcasting SAF

**Satellite Application Facility in support of Nowcasting and Very Short-range Forecasting**

**Objectives:**
- Development of Nowcasting products derived from MSG and Polar satellite systems
- deliver the SW Packages to users
- User's support tasks through Help Desk

**Two software packages to produce products for nowcasting purposes:**
- **SAFNWC/MSG**, to process geo satellites
- SAFNWC/PPS, to process polar satellites

National Meteorological Institute has to run it locally

The products may be used
- as **input to a program** e.g.
  - to an objective meso-scale analysis
    (which in turn may feed a simple nowcasting scheme),
  - as an intermediate product input to other products,
- as a **final image product** for display at a forecaster 's desk, or for case studies.

# Products overview SAFNWC/MSG

| | MSG SW package | |
|---|---|---|
| **Clouds** |  | **Cloud Mask (+ dust, volcanic ash)**<br>**Cloud Type (+ cloud phase)**<br>**Cloud Top Temperature, Pressure, Height** |
| **Precipitation & Convection** |  | **Precipitating Clouds (probability of pr.)**<br>**Convective Rainfall Rate**<br>**Rapidly Developing Thunderstorms** |
| **Clear Air** |  | **Total/layer Precipitable Water**<br>**Stability Analysis Imagery**<br>(Statistical and Physical retrieval)<br>**Air Mass Analysis** |
| **Wind** |  | **High Resolution Winds** |
| **Conceptual Models** |  | **Automatic Satellite Image Interpretation** |
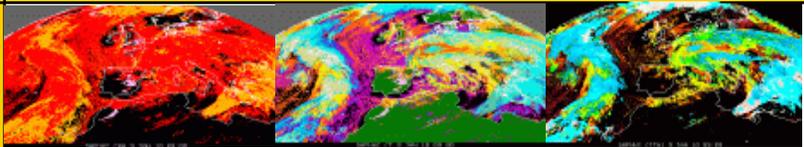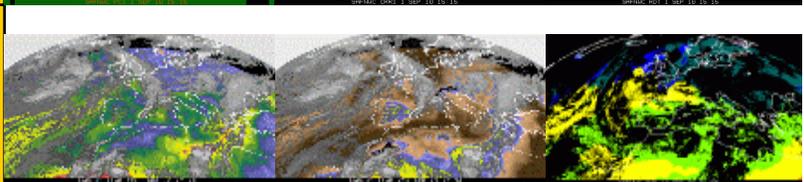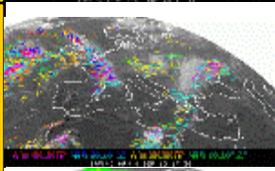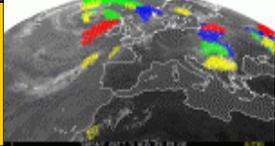
All products can be created from 15- and 5-minute data, except ASII.
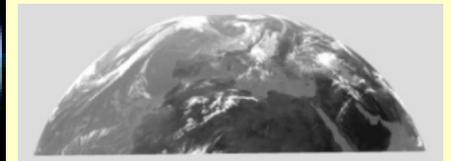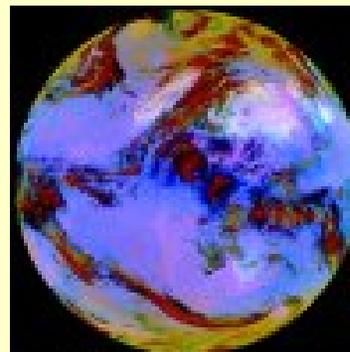
# Cloud products
## Cloud mask (CMa), Cloud Type (CT), Cloud top temp. and height (CTTH)

Cloud mask   (cloudy, not cloudy, partly cloudy) +   dust and volcanic ash cloud detection
Cloud type  (21 classes of cloudy and cloud free)   + cloud phase (ice/water droplets, not class.)
Cloud top temperature, pressure, height, effective cloudiness (cloud amount*emissivity)

5- and 15-minute data processing

**We think these are the <u>most reliable</u> products of the NWC SAF**



Cloud top phase



dust cloud

Cloud Mask, Cloud Type frequently serve as a **basis** for other cloud/surface products.



SEA SURFACE TEMPERATURE
HOURLY FIELD     03/17/2009     1700 UTC

-0.6   1.8   4.2   6.6   9.0   11.4   13.8   16.2   18.6   21.0   23.4   25.8   28.2   30.6   33.0

Eumetsat Ocean & Sea-Ice Satellite Application Facility

**27 April 2011 06:10 UTC**

Cloud Mask

day&night RGB

| | |
|---|---|
| Undefined | |
| snow, ice | |
| cloud filled | |
| cloud cont. | |
| cloud free | |
| not proc | |

NWCSAF CloudMask Wednesday 27-04-2011 06:10

NWCSAF Cloud type Wednesday 27-04-2011 06:10

CloudTopPressure Wednesday 27-04-2011 06:10

**CLOUD TYPE**

| | |
|---|---|
| Undefined | |
| Fractional | |
| Semitransp. above | |
| Semitransp. thick | |
| Sem. meanly thick | |
| Semitransp. thin | |
| Very high opaque | |
| High opaque | |
| Medium | |
| Low | |
| Very low | |
| Sea Ice | |
| Land Snow | |
| Cloud free sea | |
| Cloud free land | |
| Non-processed | |

Cloud Type

Cloud Top Pres.

MSG-SAFNWC-TEST
CloudTopPressure_EU
hPa

0  100  175  250  325  400  475  550  625  700  775  850  925 1000

OMSZ

# Recent improvements
## Use of HRV to earlier detect the small size clouds/ convection



HRV

VIS0.6

CT with HRV

CT without HRV

27/02/2009  13h45 UTC

METEO FRANCE
Toujours un temps d'avance

Cloud Type **v2009**　01.11.2009.  04:55 UTC　HRV fog (IR1.6,HRV,HRV)
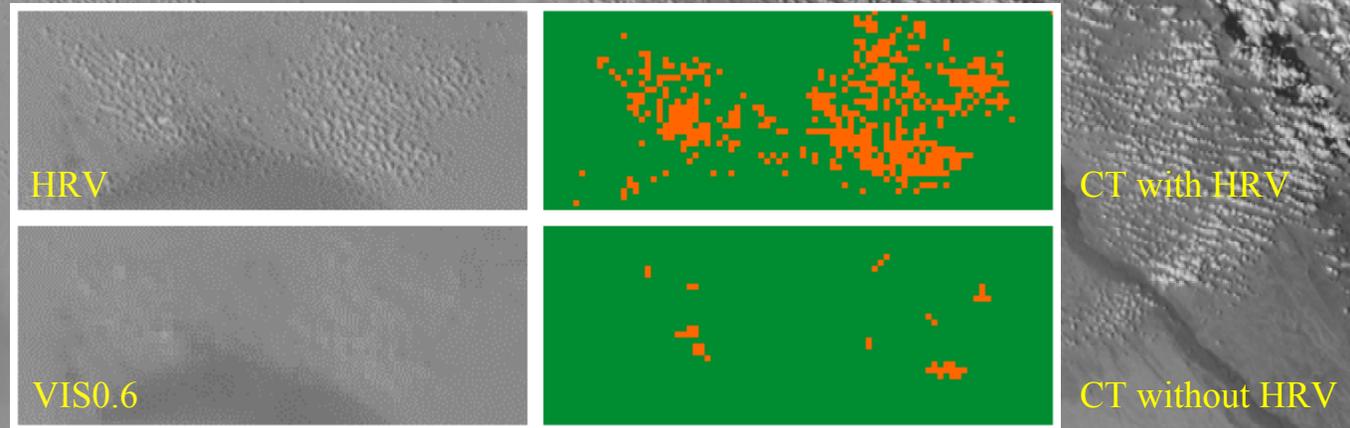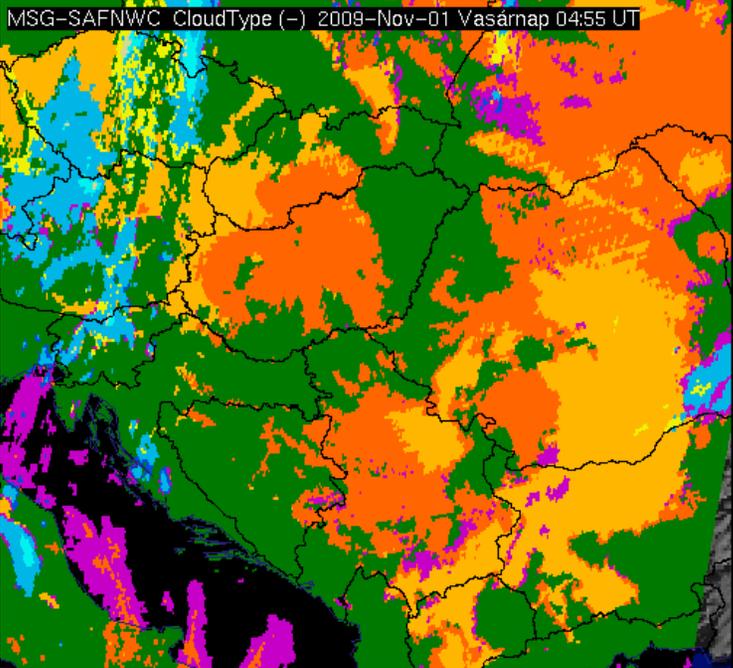
**Improvement in v2009**
**Better detection of the very low clouds/fogs**
**at twilight** (-3º> sun elevation <10º)

Fog - very important in Central-Europe

IR10.8-IR3.9    positive at night,   negative daytime
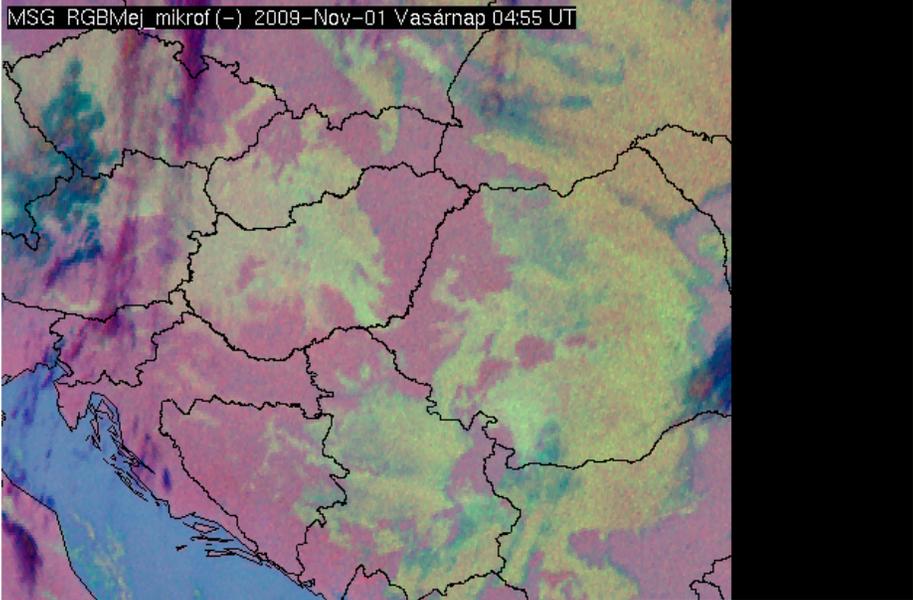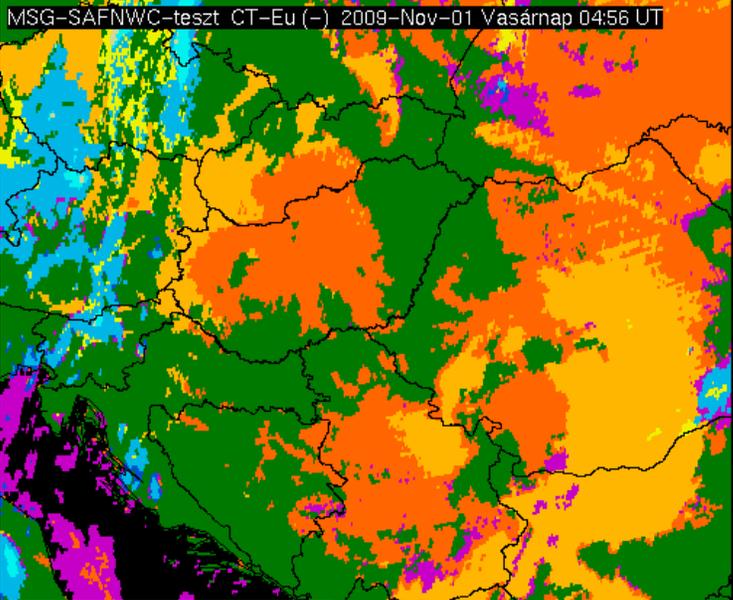
Cloud Type **v2008**　　　　　　　　　　night microph. RGB

Cloud Type **v2009**     05:55 UTC     HRV fog (IR1.6,HRV,HRV)

Cloud Type **v2008**     night microph. RGB

Cloud Type **v2009** · 06:55 UTC · HRV fog (IR1.6,HRV,HRV)

Cloud Type **v2008** · night microph. RGB
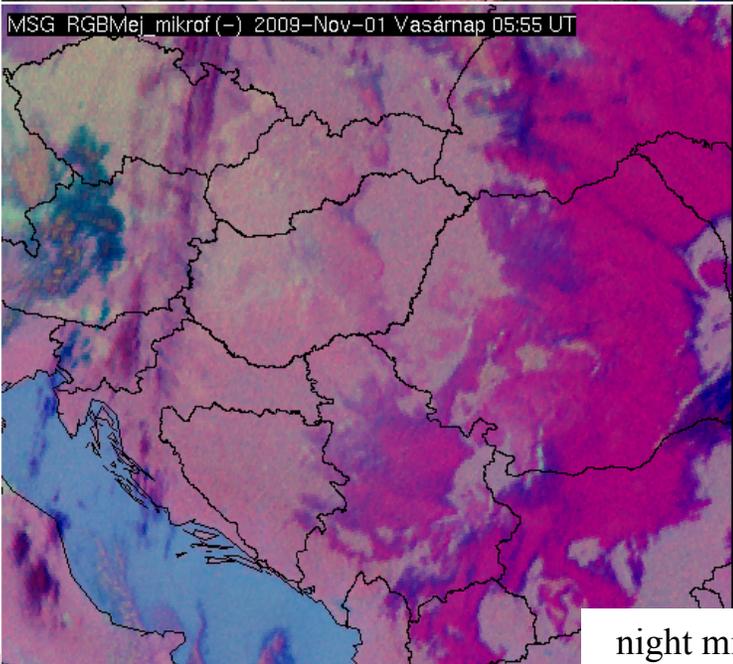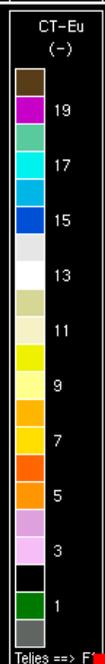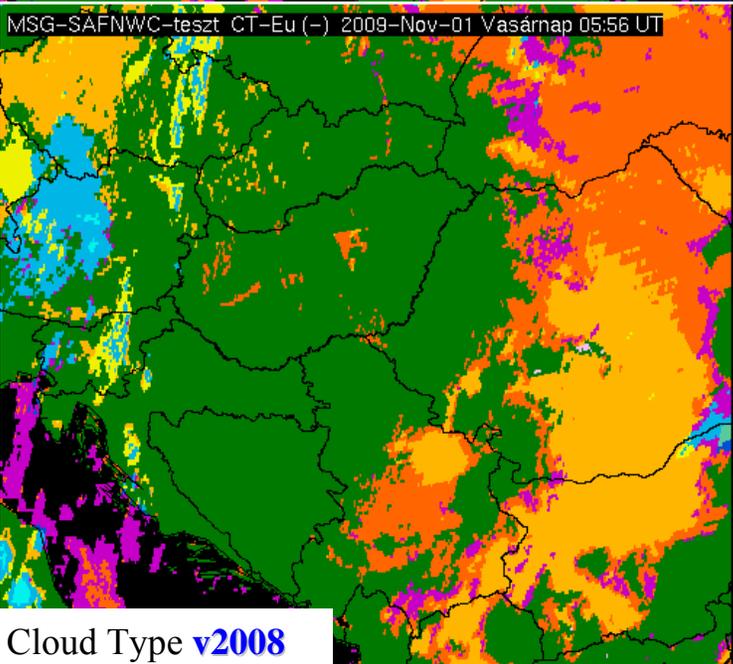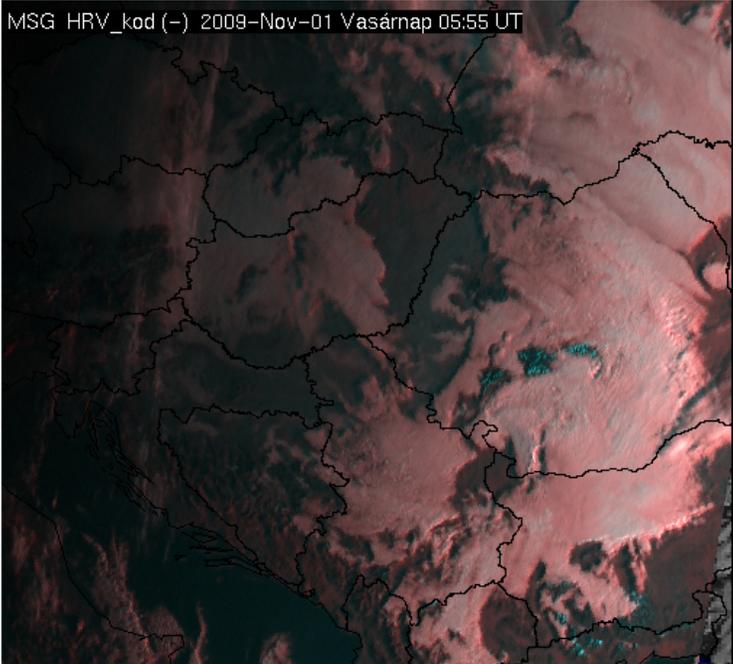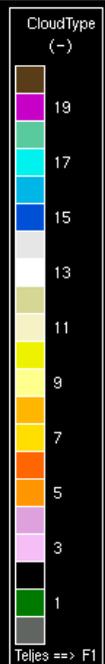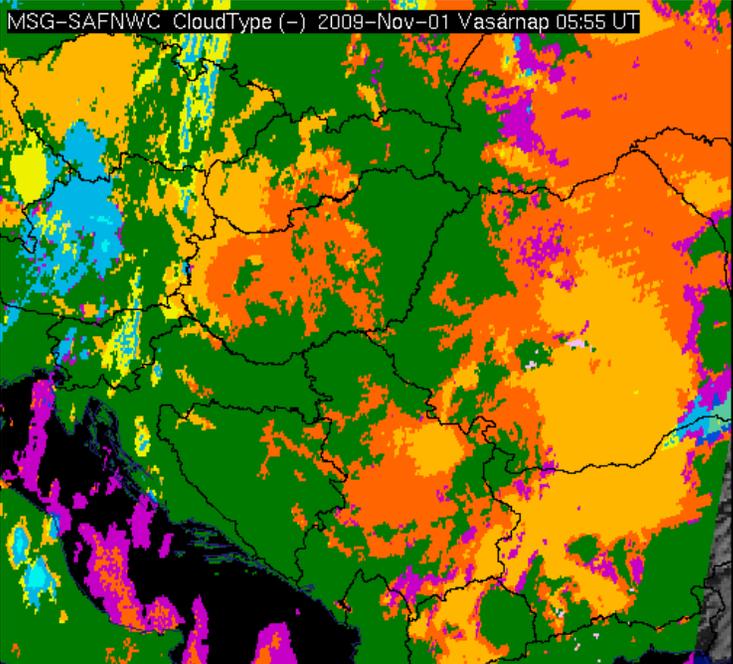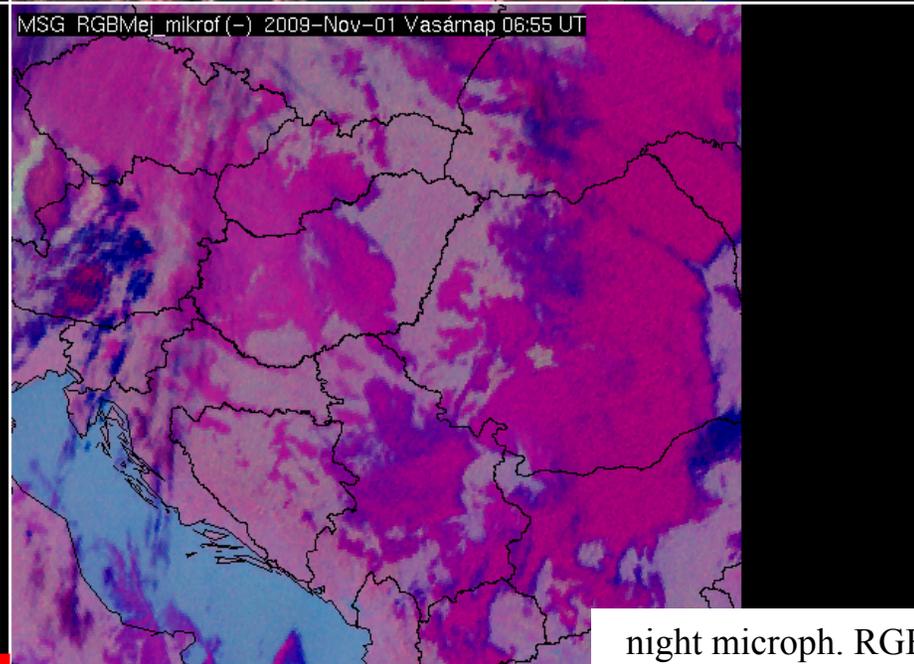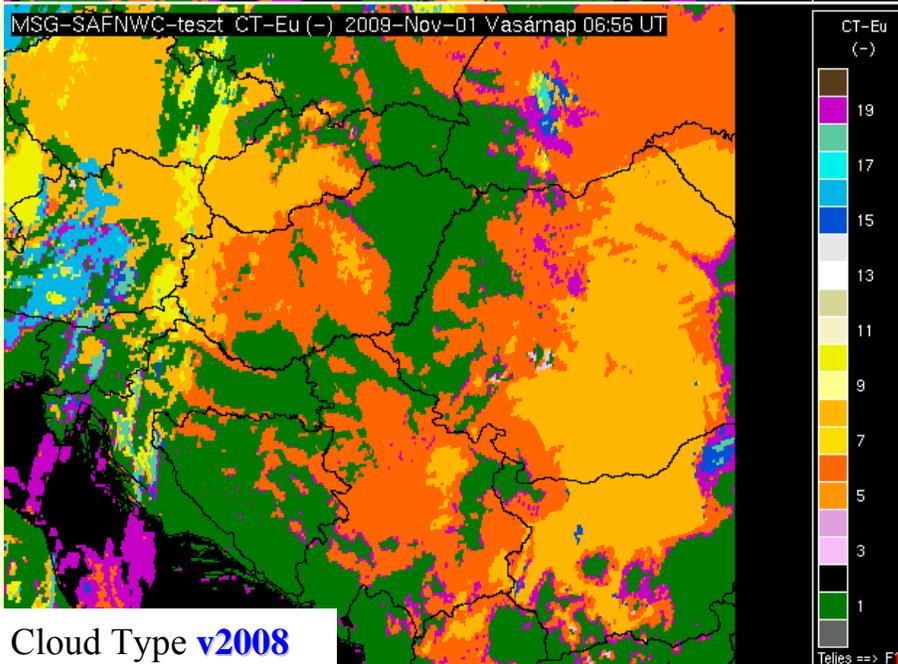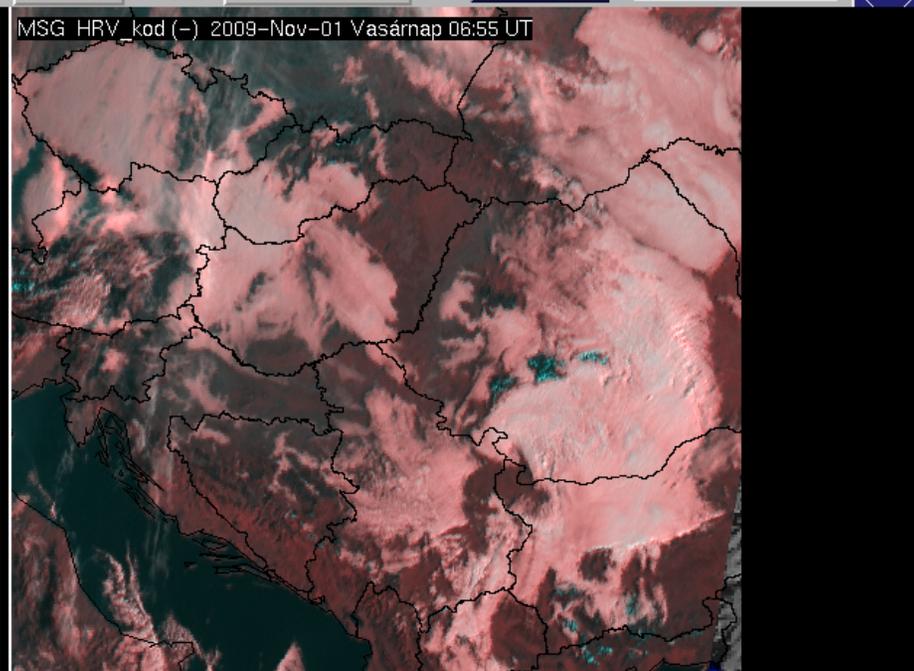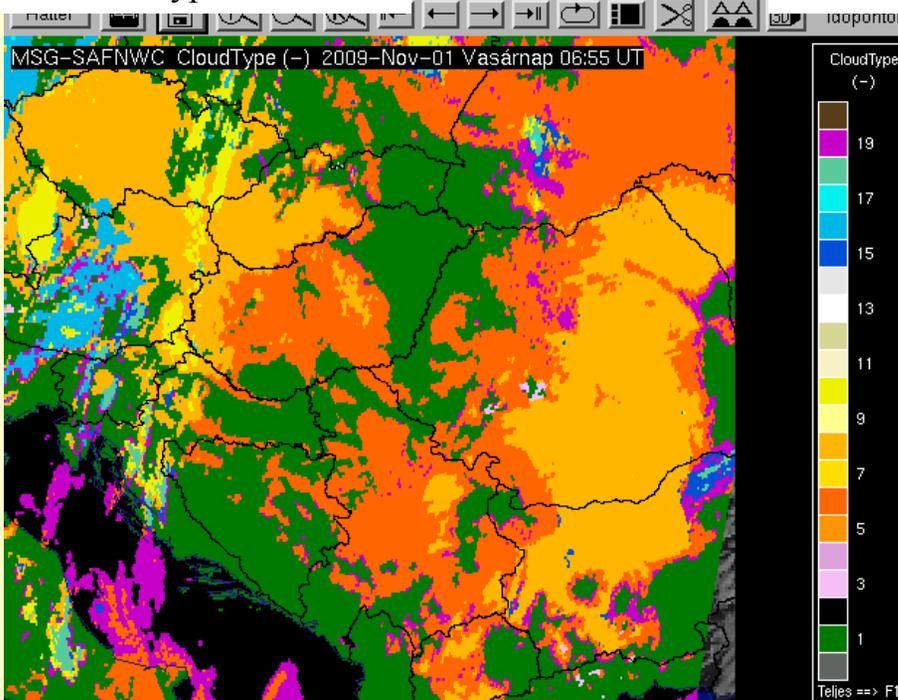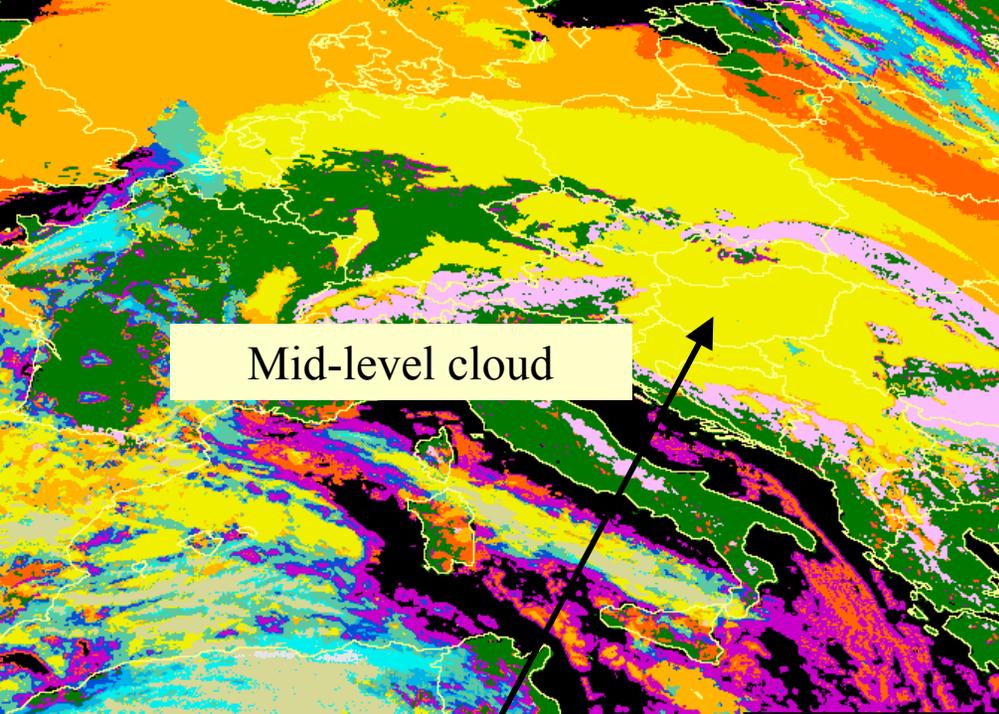
Cloud Type v2009

21 December 2007

Improvement of the CT in cold air pool situation (temperature inversion)

IR8.7-IR10.8:
it is less for low clouds than for mid-level clouds

Mid-level cloud

Low-level cloud

Retrieved cloud top pressure
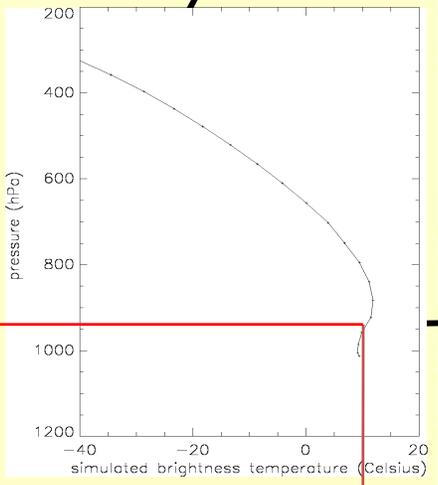
Measured brightness temperature
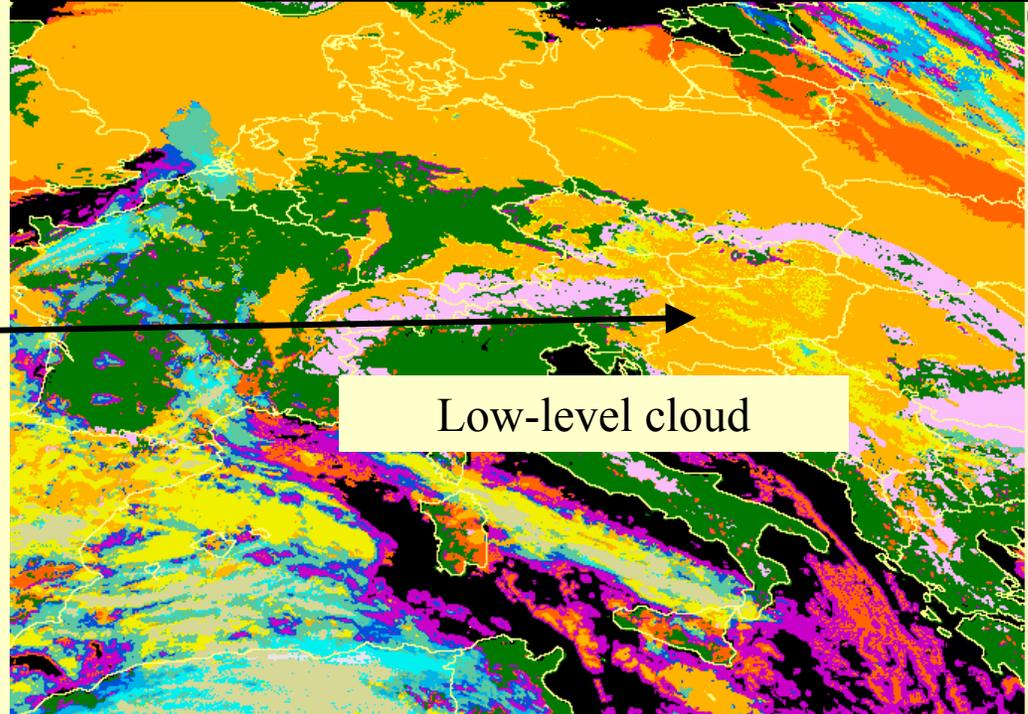
Cloud Type v2010

# Snow at night

Dust RGB, 22.02.2011. 02:55 UTC

Where is snow?
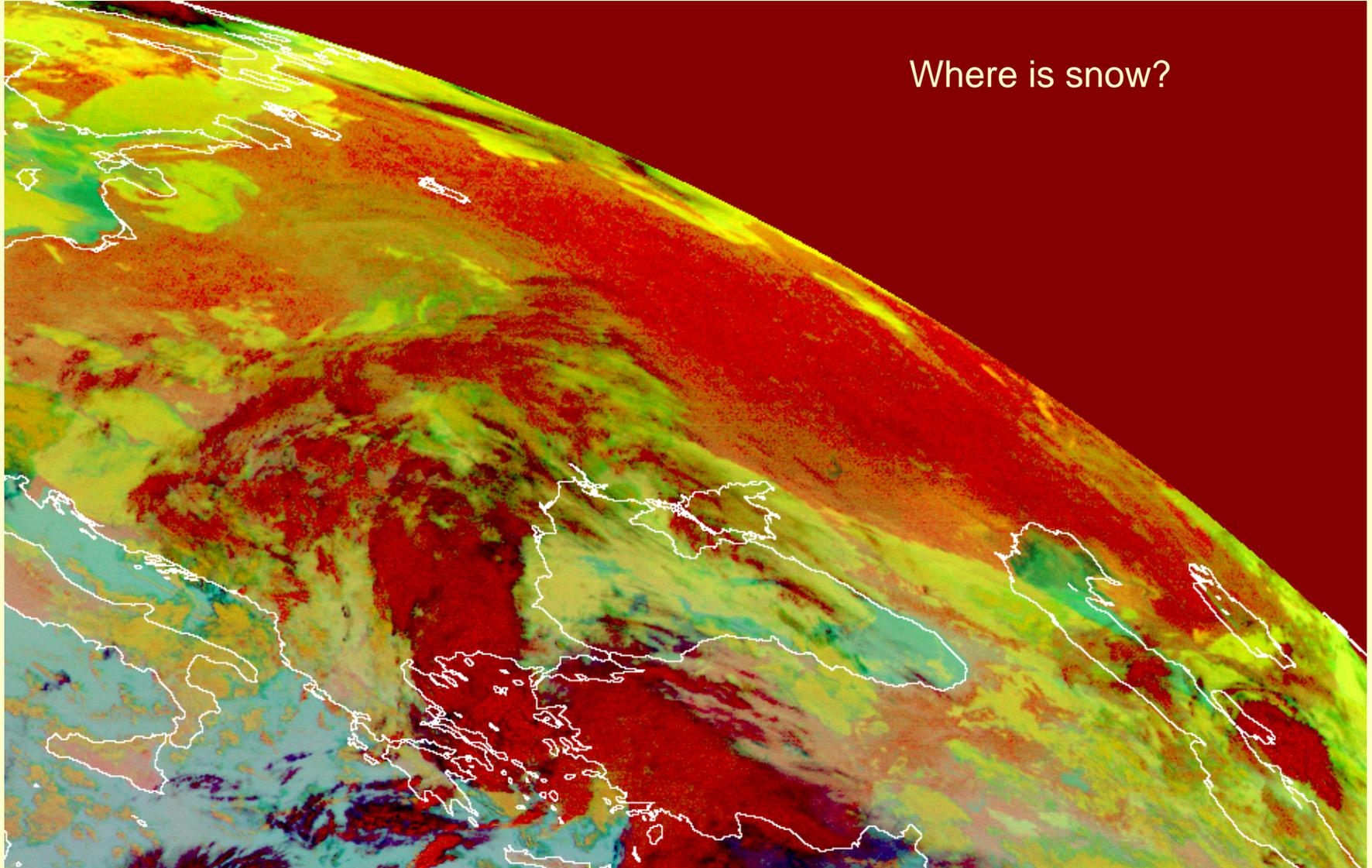
# Cloud detection improvement over cold ground at night

The cloud mask behavior is very sensitive to the NWP model data.

**Snow detection only daytime**
**Key: refl in NIR1.6, IR3.9**
At night   IR108-IR39 and IR108-IR87



**Legend:**
- Not processed
- Clear land
- Clear sea
- Snow land
- Sea ice
- Very low
- Low
- Mid. level
- High opaque
- Very high opaque
- Thin semi transparent
- Meanly thick semi transparent
- Thick semi transparent
- Semi transparent above
- Fractional
- Undefined

22.02.2011

Dust RGB, 02:55 UTC

CT v2011, 08:55 UTC

CT v2010, 02:55 UTC

CT v2011, 02:55 UTC

**Cloudy or cloud-free?**

# Precipitation products

## PC: precipitating clouds (probability of precipitation), CRR: Convective rain rate

1 hour accumulated rain

07 June 2009 14:30/14:25 UTC



radar

IR10.8
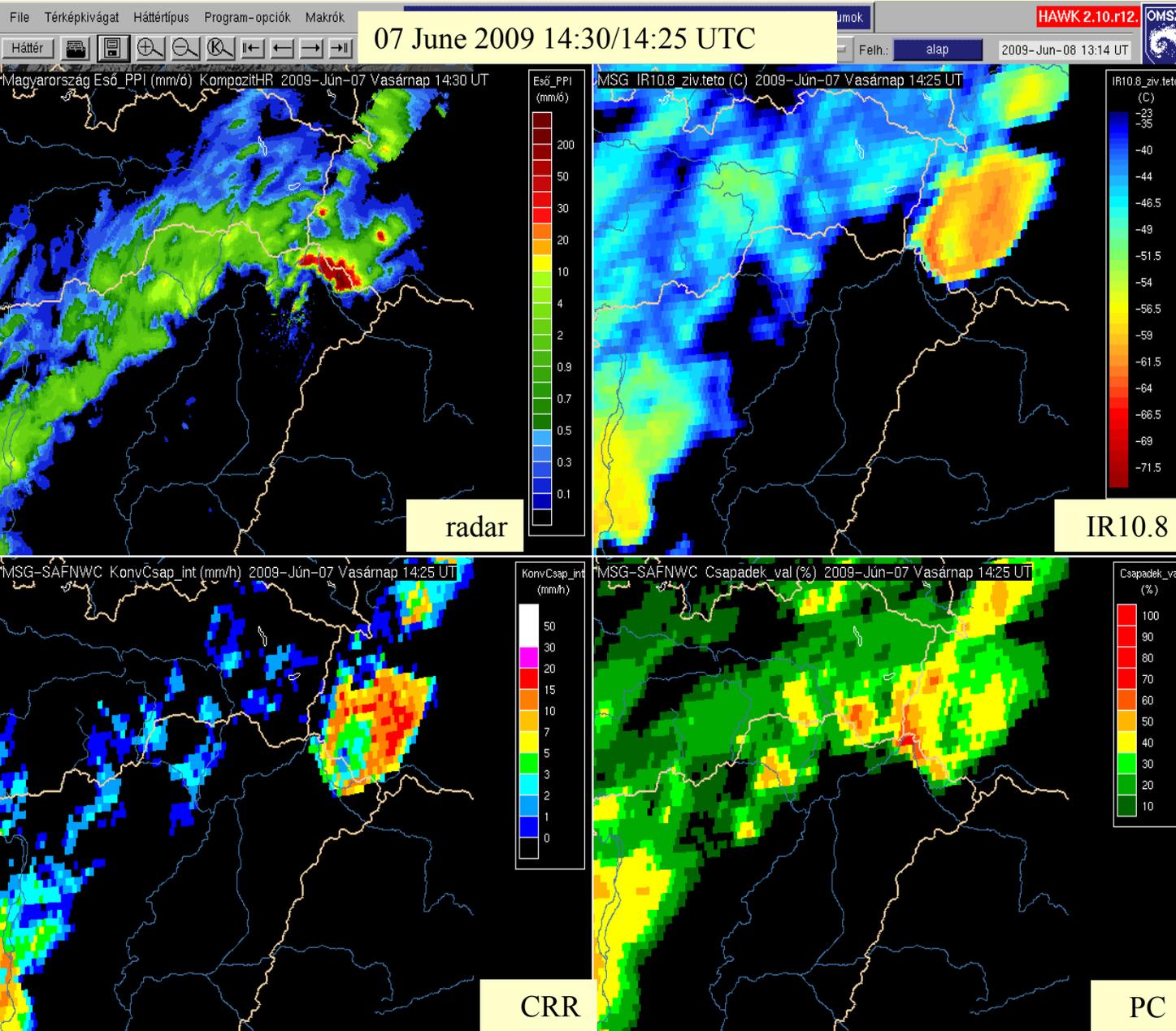
Useful if no radar data are available:
- Over ocean
- Breakdown of radar
- Area not covered by radar

CRR

PC

CRR useful when and where convection is dominant.

# Do you see some interesting cloud top feature?



07 June 2009 14:30/14:25 UTC
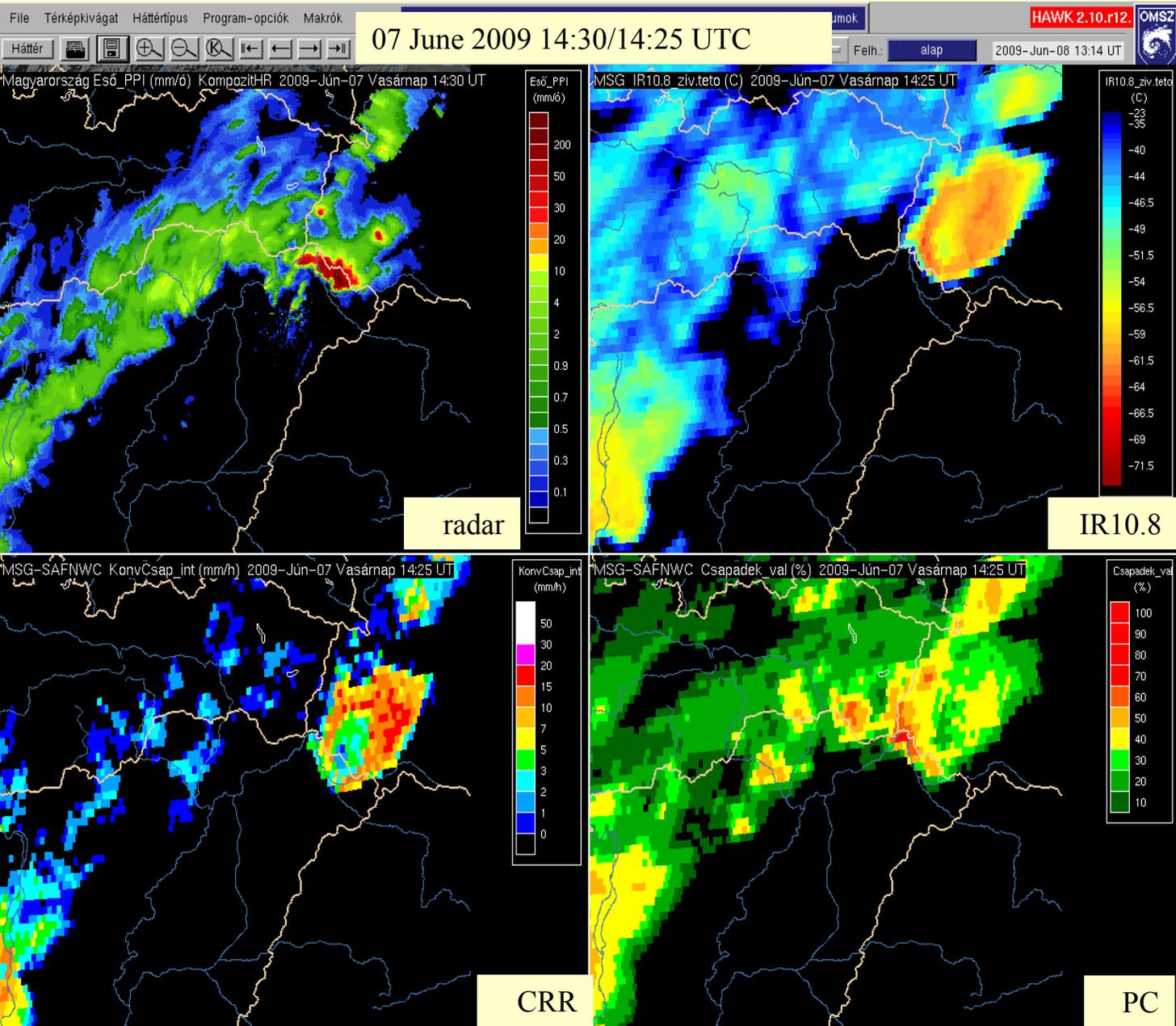
**Comparison of NWCSAF CRR and radar measurements in South Africa**

**19 December 2009 19:00 UTC**

**Data from E. de Coning and C. Marcos**

NWC SAF CRR (mm/h)

CONVECTIVE RAINFALL RATE (mm/h)

CRR gives rather strong precipitation, while radar gives only low signal.

This area is blocked for radars due to the mountains.

2009/12/19 19:00:00 Composite

Radar (Cmax dBz)

Topography
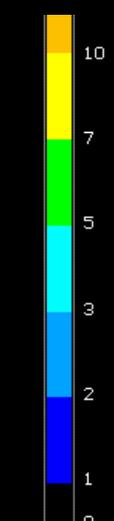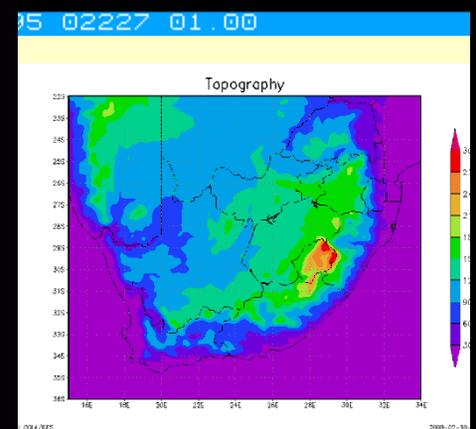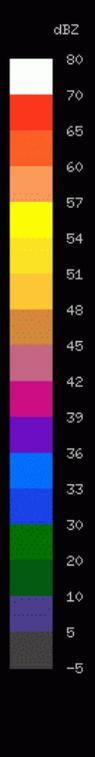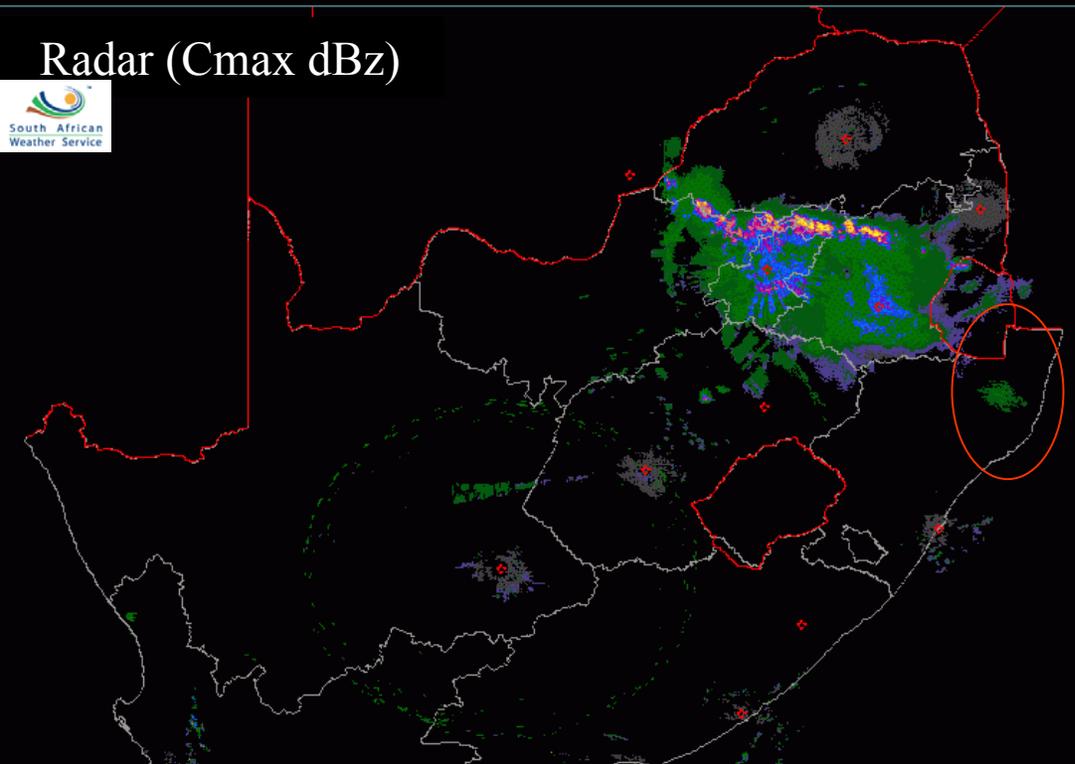
MSG IR10.8 (C) 2011-Ápr-27 Szerda 06:10 UT
NWC-SAF HRW-Basic (conf>60%) (m/s) 850-1050hPa 2011-Ápr-27 Szerda 06:10 UT
NWC-SAF HRW-Basic (conf>60%) (m/s) 700-850hPa 2011-Ápr-27 Szerda 06:10 UT
NWC-SAF HRW-Basic (conf>60%) (m/s) 400-700hPa 2011-Ápr-27 Szerda 06:10 UT
NWC-SAF HRW-Basic (conf>60%) (m/s) 100-400hPa 2011-Ápr-27 Szerda 06:10 UT

**NWCSAF HRW**

**High Resolution Wind**

**27.04.2011. 06:10 UTC**

Red 100-400 hPa

Blue 400-700 hPa

Yellow 700-850 hPa

Green 850- 1050 hPa
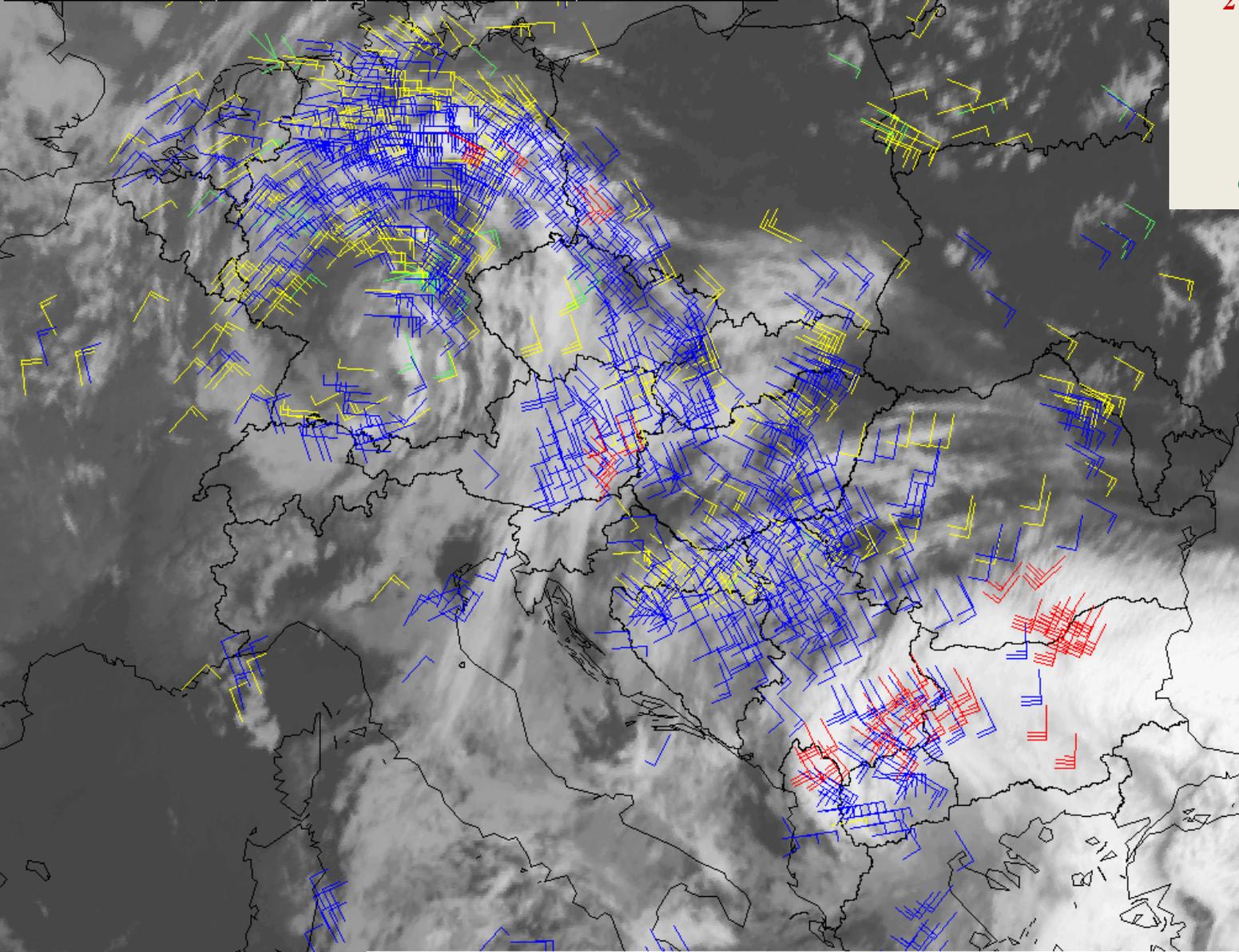
15-min image sequence → cloud motion – wind field, including wind pressure level information, **calculated from HRV and IR10.8 images**

IR10.8 (C)  -70 -56 -48 -40 -32 -24 -18 -14 -10 -6 -2 2 6 10 18 26 34 45

OMSZ
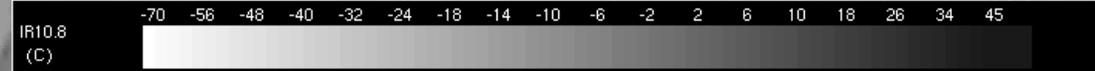
**HRW product can be useful for:**

- **Nowcasting monitoring tasks:**
    * **Flux displacement**
    * **Watch and warning of dangerous strong wind situations**
    * **Convergence & divergence (specially around cloud systems)**
    * **Small scale circulation**
    * **Wind singularities.**

- **Assimilation in:**
    * **Analysis and Forecasting applications (including NWP models).**



SAFNWC/MSG HRW v3.0
COPYRIGHT EUMETSAT 2009
HRVIS 200-400hPa  HRVIS 400-600hPa  HRVIS 600-800hPa  HRVIS 800-1000hPa
IR108 200-400hPa  IR108 400-600hPa  IR108 600-800hPa  IR108 800-900hPa
12 NOV 09 12:00
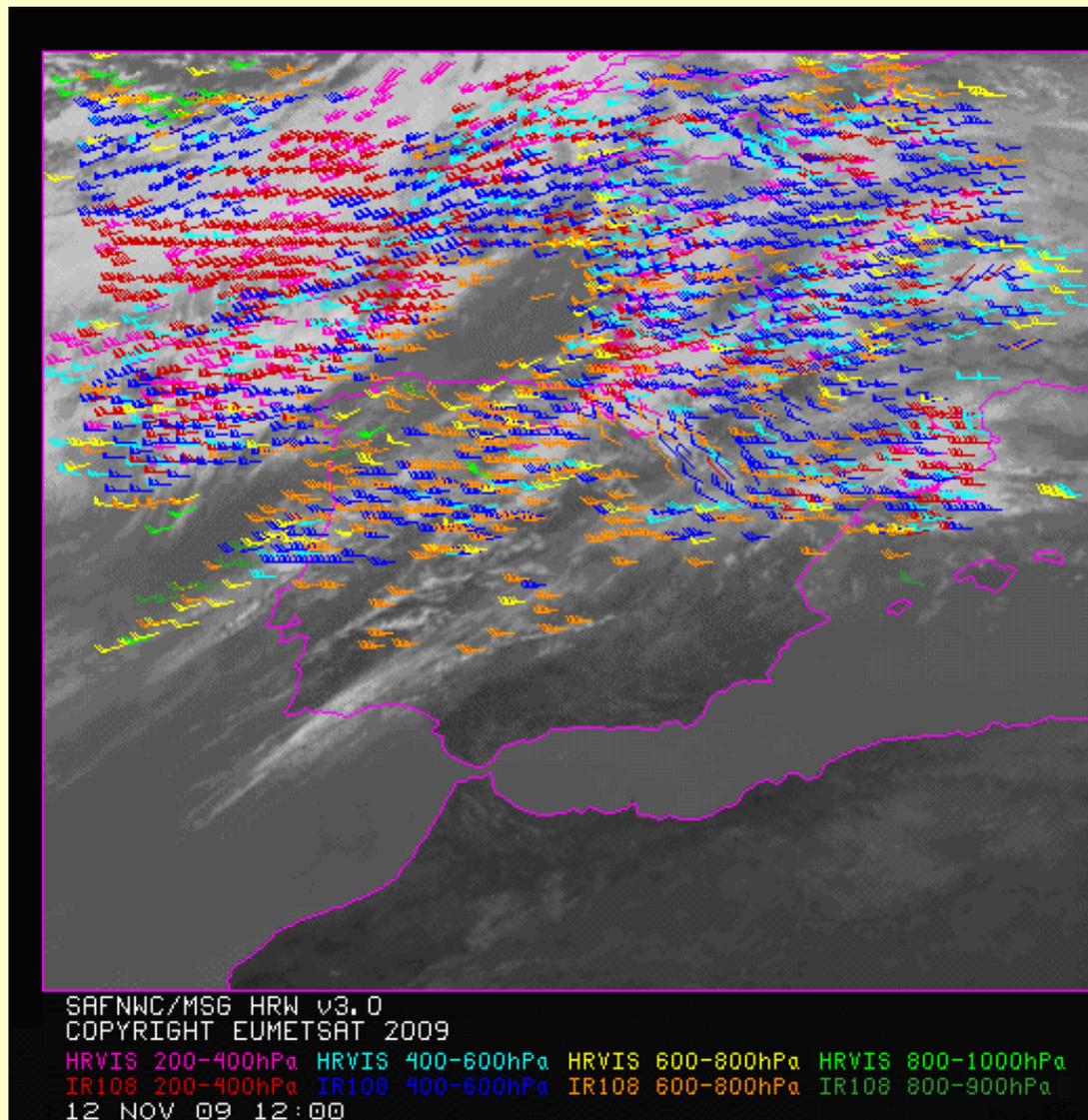
The strongest satellite retrieved winds
(15min mean winds > 89 km/h)
in the 850-1000 hPa layer

Surface wind observation
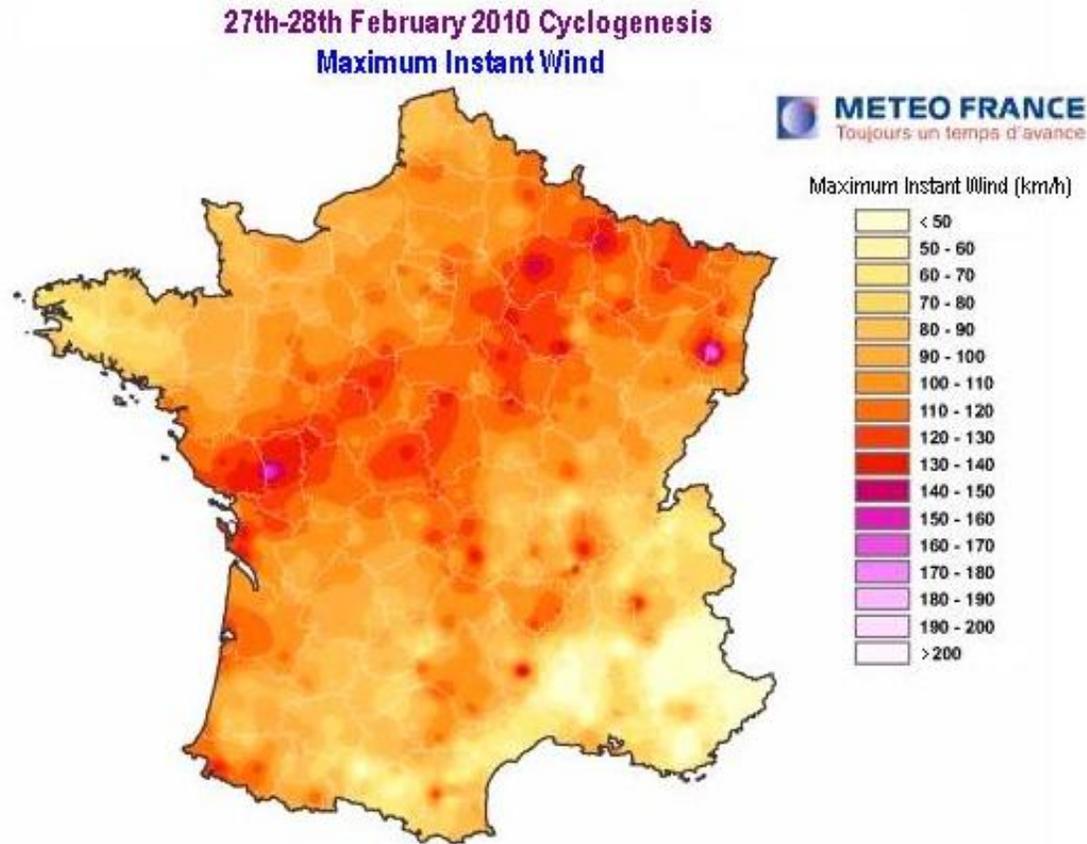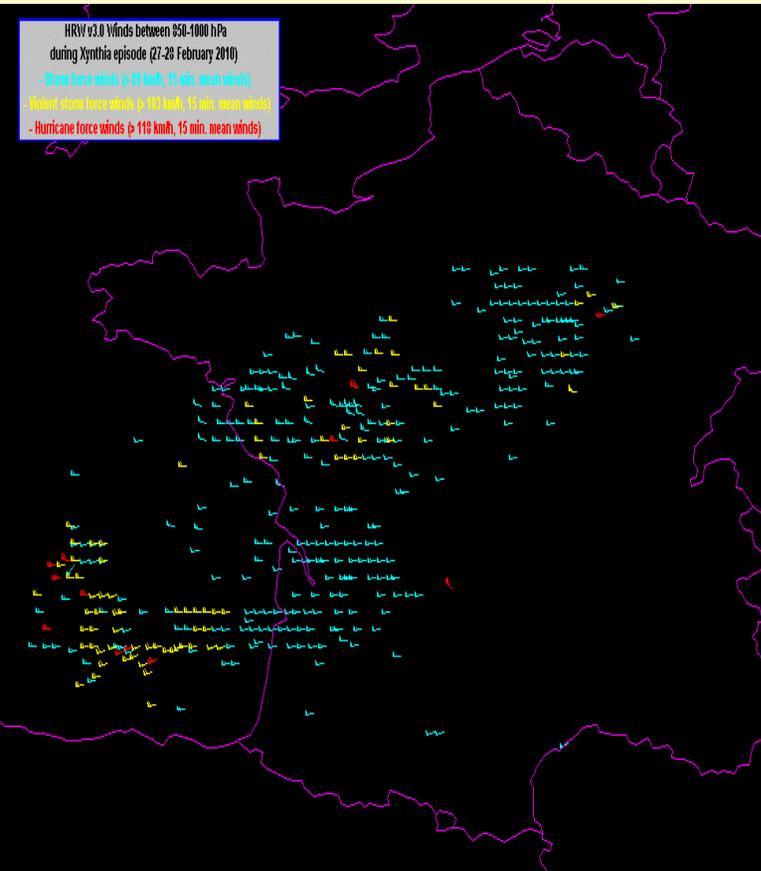


The diagonal path followed by the strongest winds is similar in both figures.
Temporal resolution of HRW is higher than that of the model forecasted winds.
HRW can be helpful for watch and warning tasks.
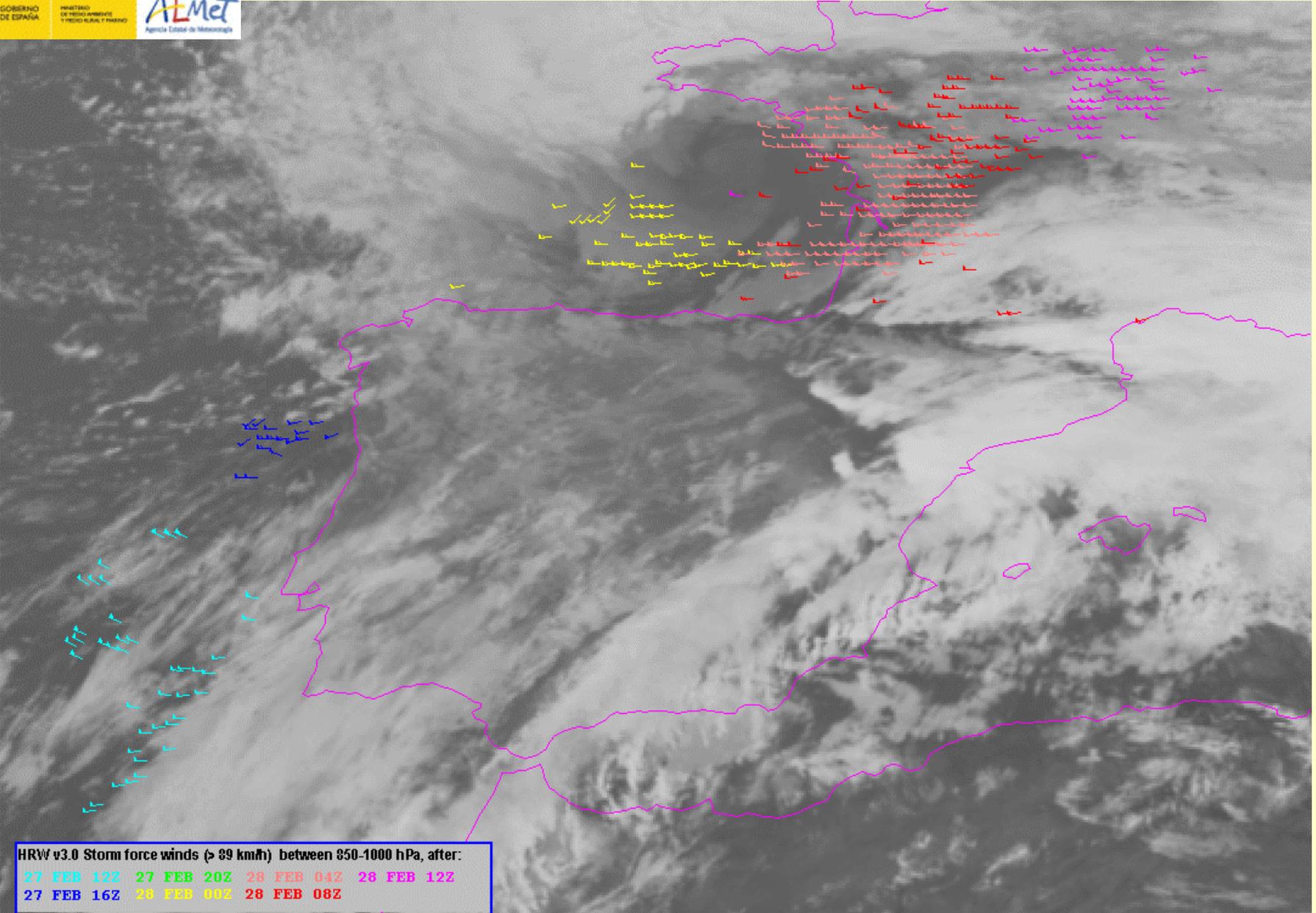
HRW v3.0 Storm force winds (> 89 km/h) between 850-1000 hPa, after:
27 FEB 12Z   27 FEB 20Z   28 FEB 04Z   28 FEB 12Z
27 FEB 16Z   28 FEB 00Z   28 FEB 08Z

**The temporal evolution of HRW winds permits also to identify when the hardest winds are striking.**

# Total and Layered Precipitable Water and Instability Indexes

## NWC SAF Physical Retrieval (SPhR)

IR13.4

IR12.0

HRIT images

IR10.8

WV7.3

WV6.2

PGE01 Cloud Mask

Spatial interpolation

3D grid
- Derived
  - Geopotential @ isobaric
  - Relative humidity @ isobaric
  - Temperature @ isobaric
  - U velocity @ isobaric
  - V velocity @ isobaric
- 2D grid
  - Geopotential @ surface
  - Land–sea mask @ surface
  - N2 metre dewpoint temperature @ surf
  - N2 metre temperature @ surface
  - Skin temperature @ surface
  - Soil temperature level 1 @ layer_between
  - Surface pressure @ surface
  - Total column water vapour @ surface

1000 hPa
925 hPa
850 hPa
700 hPa
500 hPa
400 hPa
300 hPa
250 hPa
200 hPa
150 hPa
100 hPa
70 hPa
50 hPa
30 hPa
10 hPa

**PGE13**
YYYYMMDDhhmm region config_file

Ancillary & coefficients
Lon, lat, zenith
Bias correction, regression, EOF, etc

H5

TPW

BL (sfc-850)

ML (850-500)

HL (500-top)

LI

SHOWALTER

K-INDEX

+ differences
(phy. Ret –NWP)

# Mid-level (850-500 hPa) Layer Precipitable Water    23 June 2005
## IR10.8 on cloudy areas + LPW on cloud-free areas

Time series of IR10.8 : <u>Detection, tracking</u> of cloud systems. <u>Discrimination</u> of convective clouds from non-convective clouds (IR10.8, WV6.2, WV7.3, IR8.7 and IR12.0). It calculates many useful parameters for each tracked cloud system/cell
**+ lightning data** (optional)
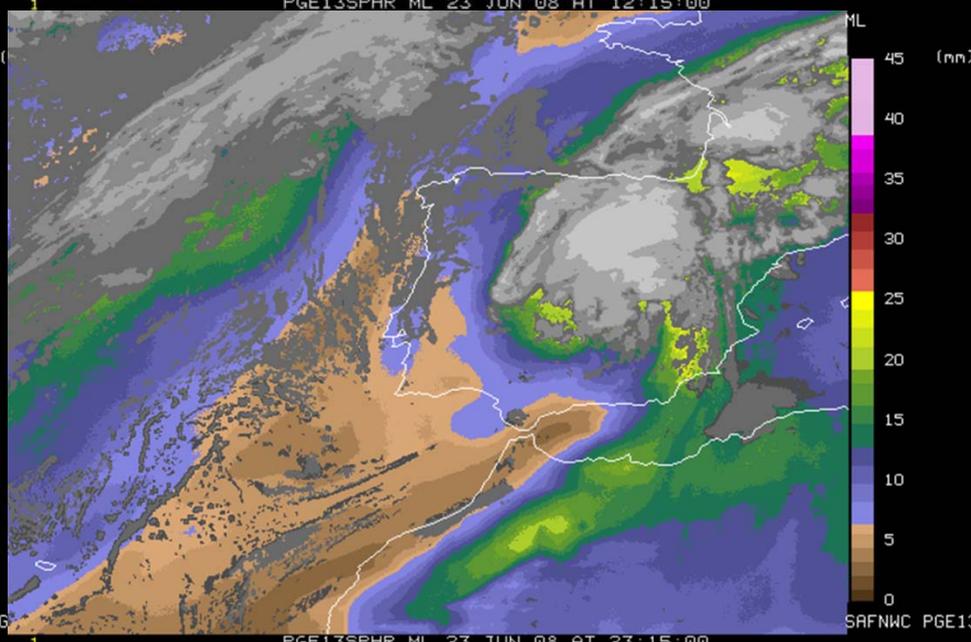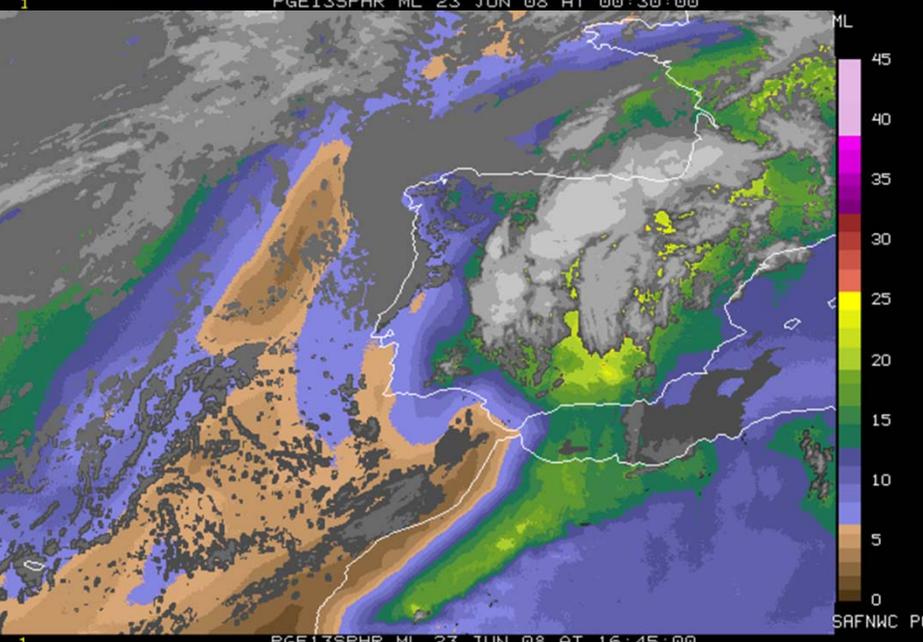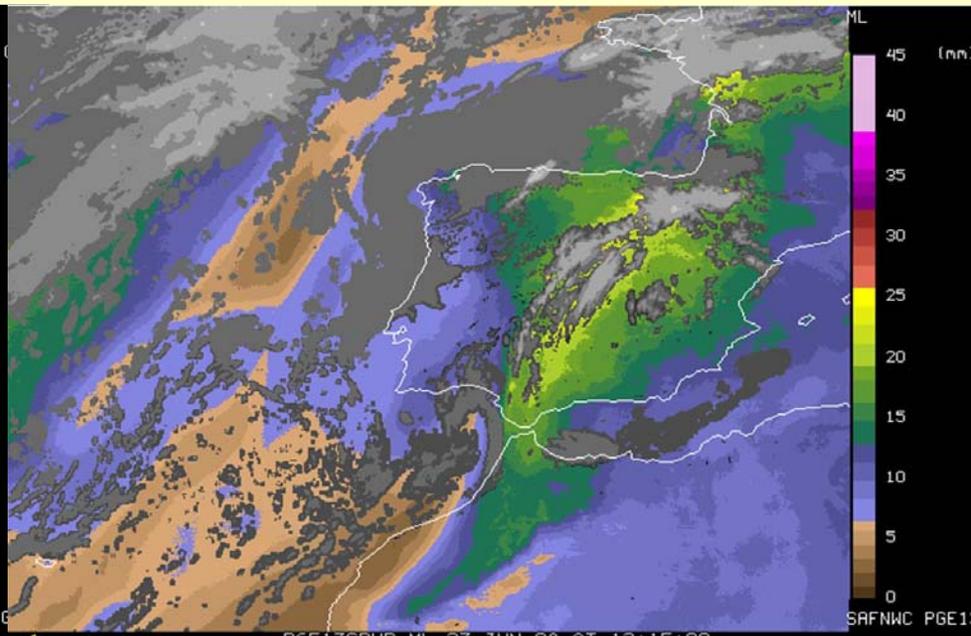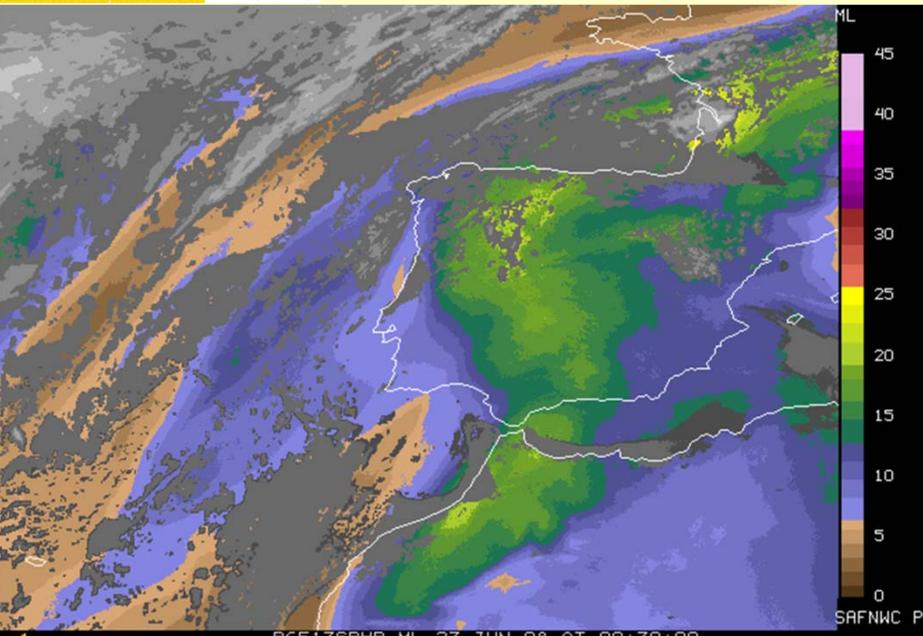
2005-Jún-25 Szombat 18:15 UT

Fi: 50.70
La: 8.35
Állapot: Leépülo cella
Élettartam: 1ó 0p
Minimum T: -50.2 C
Átlagos T: -35.9 C
Hülési seb.: 5.0 K/h
Tágulási seb.: -0.2 %/h
Terület: 7409 km2
Max. terület: 7409 km2
   18:14-kor (0 perce) T=-50 C
Sebesség: 42.2 km/h
Nyomás: 375 hPa
Villám +: 65535
Villám -: 65535
Villám IC: 65535

Tb(C)-Ter.(100 km2) eloszlás

Terület (100 km2) idosor
<=>60C
<=>50C
<=>40C
<=>30C
Akt.

Tb (C) idosor
Átl.
Min.
Kuszob
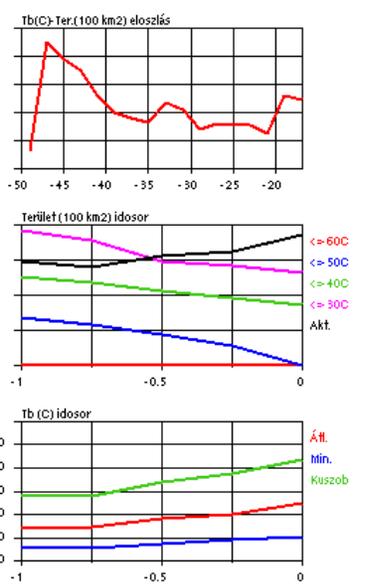
IR10.8 + RDT

Rapid Developing Thunderstorm

2005.06.25.

18:15

Infra(10.8)(C) 2005-Jún-25 Szombat 18:15 UT
SAF RDT 2005-Jún-25 Szombat 18:15 UT

Infra(10.8): -48 - -46 (C)
RDT: Leépülo cella    seb: 42.2 (k/h)   ir: 066   p: 375 (hPa)   m_tb: -50 (C)   a_tb: -36 (C)   exp_r: -0.2 (%/h)   cool_r: 5.0 (K/h)
Infra(10.8)
(C)
Fi: 50.71 La: 8.33

OMSZ

# Rapid Developing Thunderstorm

## 25.05.2009. 09:45 UTC



Time series of lightning strokes / 15mn
- strokes / + strokes / strokes or IC
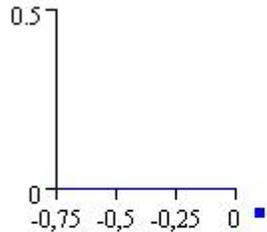
Time series of area (km2)
T <= -61°C   T <= -51°C
T <= -41°C   T <= -31°C
T <= -7°C
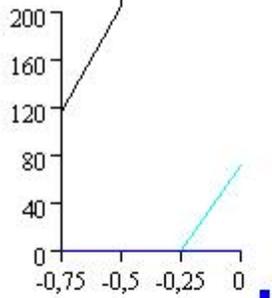
Time series of temperature
Minimum temp.
Threshold temp.

25 May 2009 — RDT 09:41 UTC — Image SAT 09:45 UTC

Case study of the developers

Small cell showing all signs of rapid developing.

Phase : Mature
Threshold temp.   : -7 °C
Minimum temp.    : -41 °C
Temperature change : -55 °C/h
Expansion rate : +31 % / 15 mn (-9 => +233 km2/h)
Duration   : 56 mn
Speed : 5.3 m/s
Lightning + : 0 / 15 mn
Lightning - : 0 / 15 mn
Lightning : 0 / 15 mn
Area : 0.31 (1000)km2
Lat C.G. : 40.72 °
Lon C.G. : -5.92 °

Case studies/automatic applications

# In-build parallax correction tool in the SAFNWC/MSG program package to correct all the 3 km resolution channels + Cloud and PC products

**Nadir view, or surface observations (e.g. radar)**

**Parallax shift**

**Geostationary view**

*Projection of various cloud-top features to surface ("georeferencing" these) strongly depends on their height above ground and on scanning geometry*
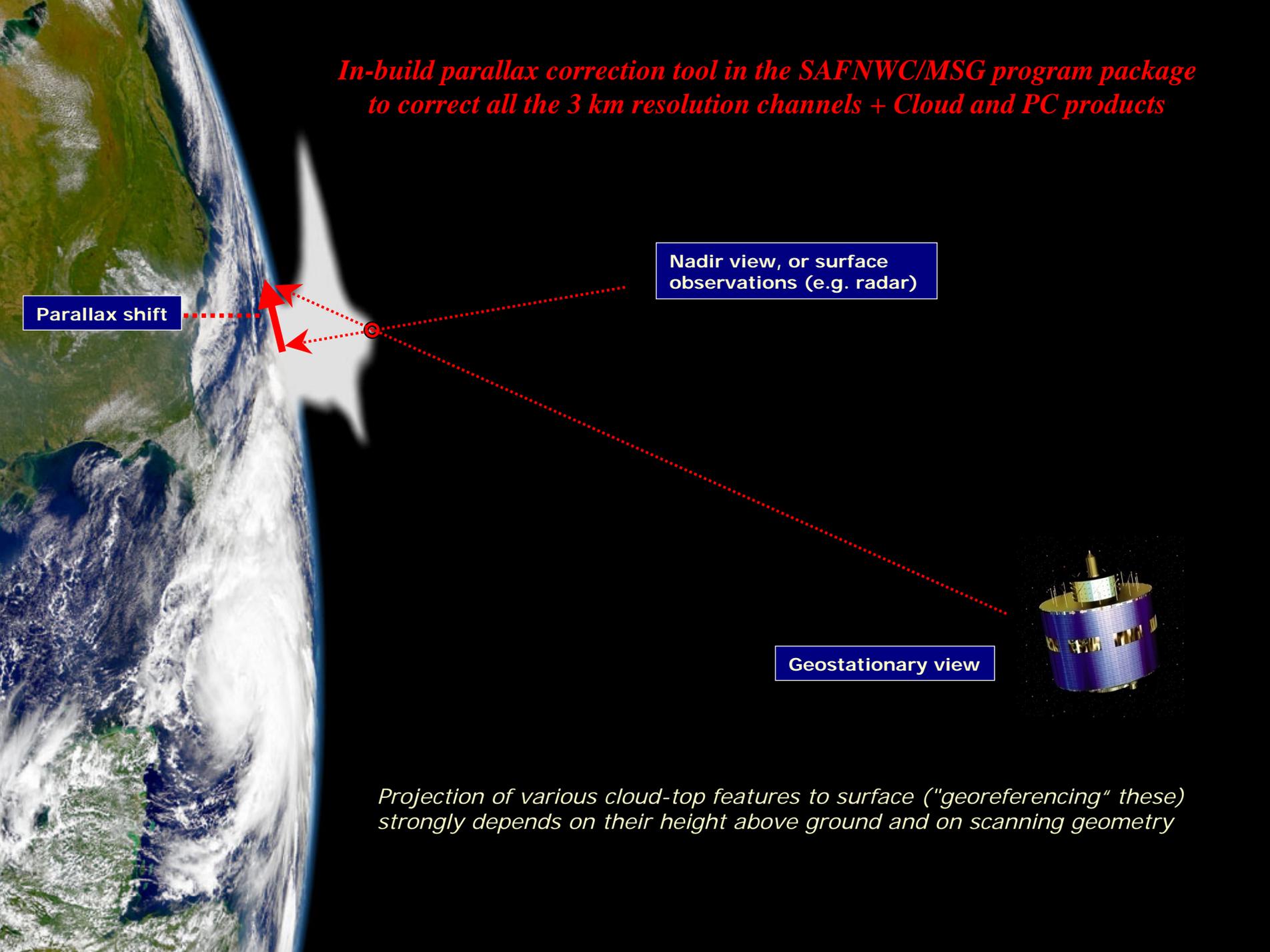
PC with radar
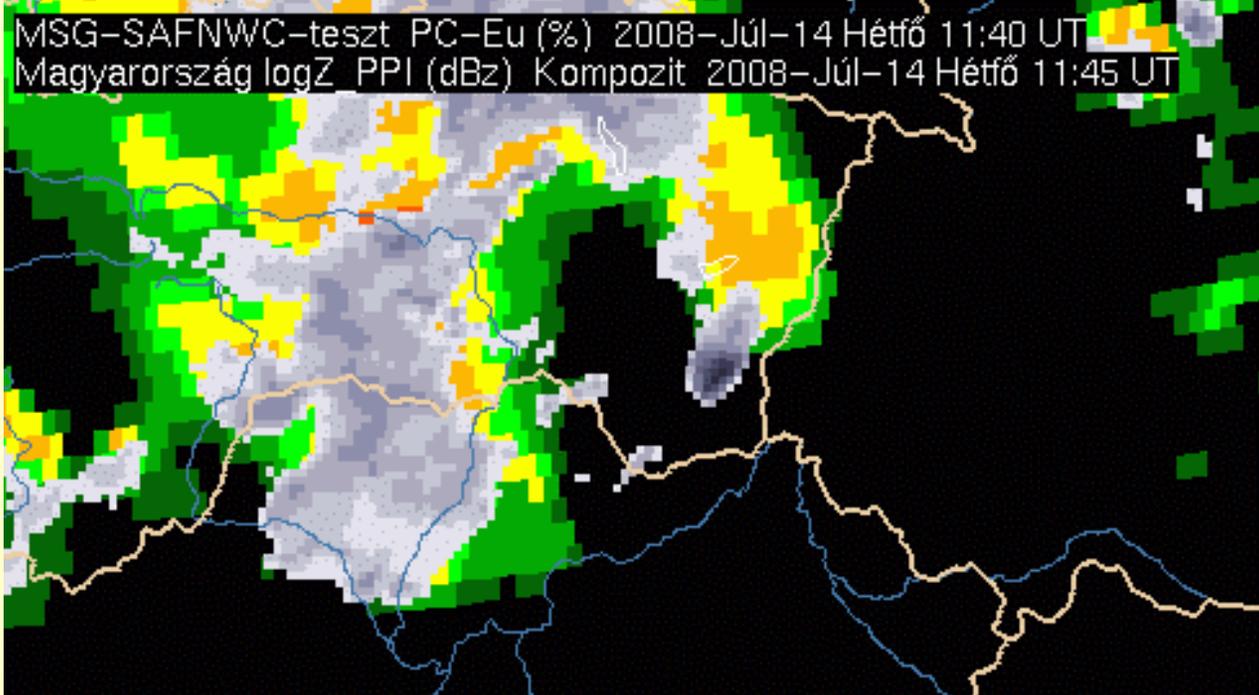
Parallax corrected PC
with radar
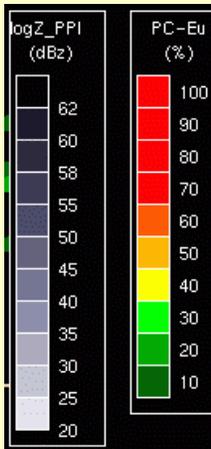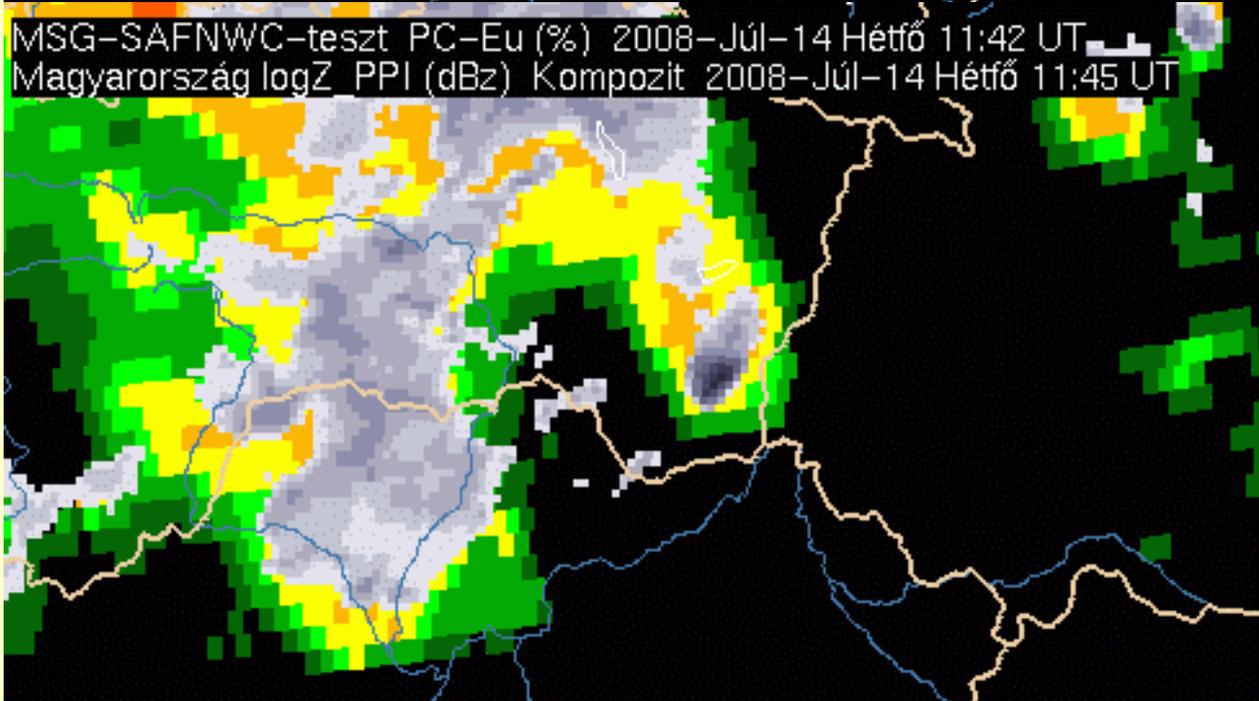
Important at
verification with
radar or with
surface
measurements.

radar
(black&whith)

Outlines

Satellite images
Derived products
- SAFNWC/MSG products (continue)
    - plans for the next 5 years
- SAFNWC/PPS products
- MPEF products for nowcasting purposes
- Automatic/interactive applications in Hungary

# Single software for all geostationary satellites



Cloud Type
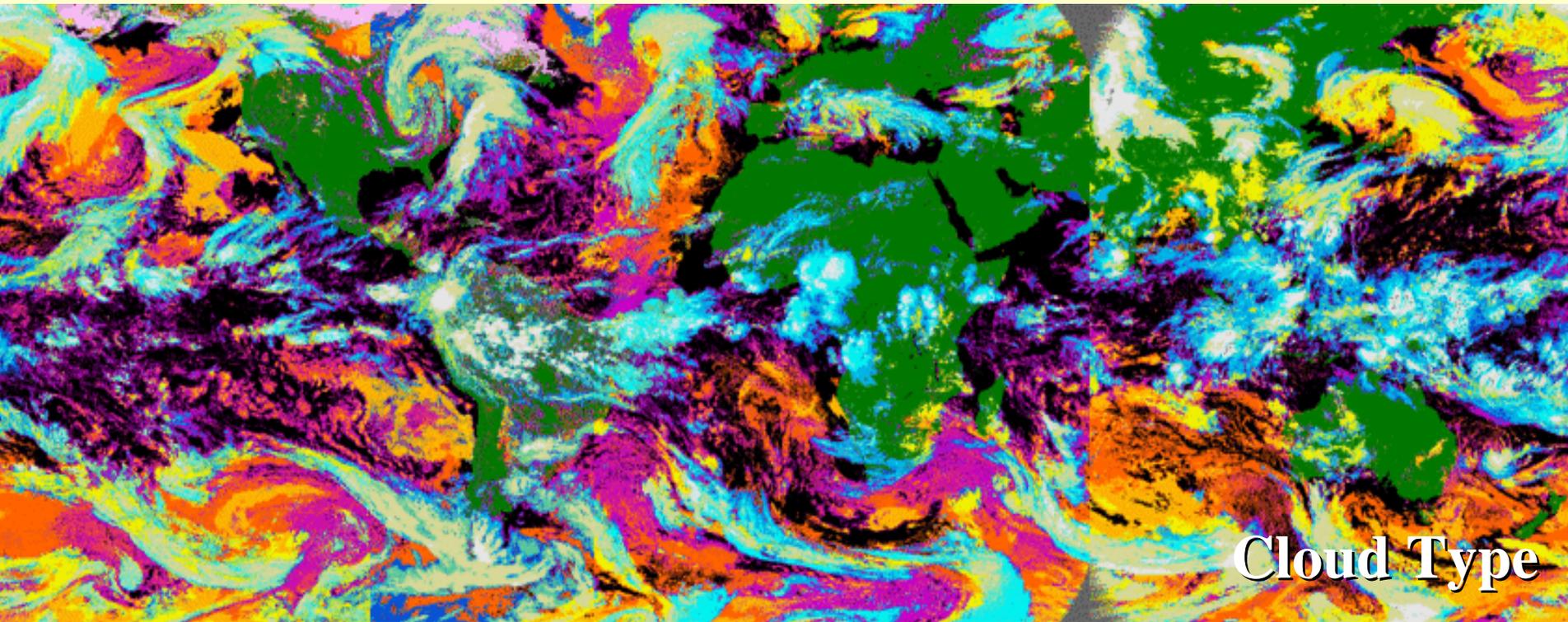
GOES-W          GOES-E          MSG          MTSAT     GOES-W

**SAFNWC package scientifically adapted by Météo-France**

METEO FRANCE
Toujours un temps d'avance

**Ash Flag from volcano Puyehue, Chile**

2011.06. 08 22:30 UTC

extracted from MSG and MTSAT
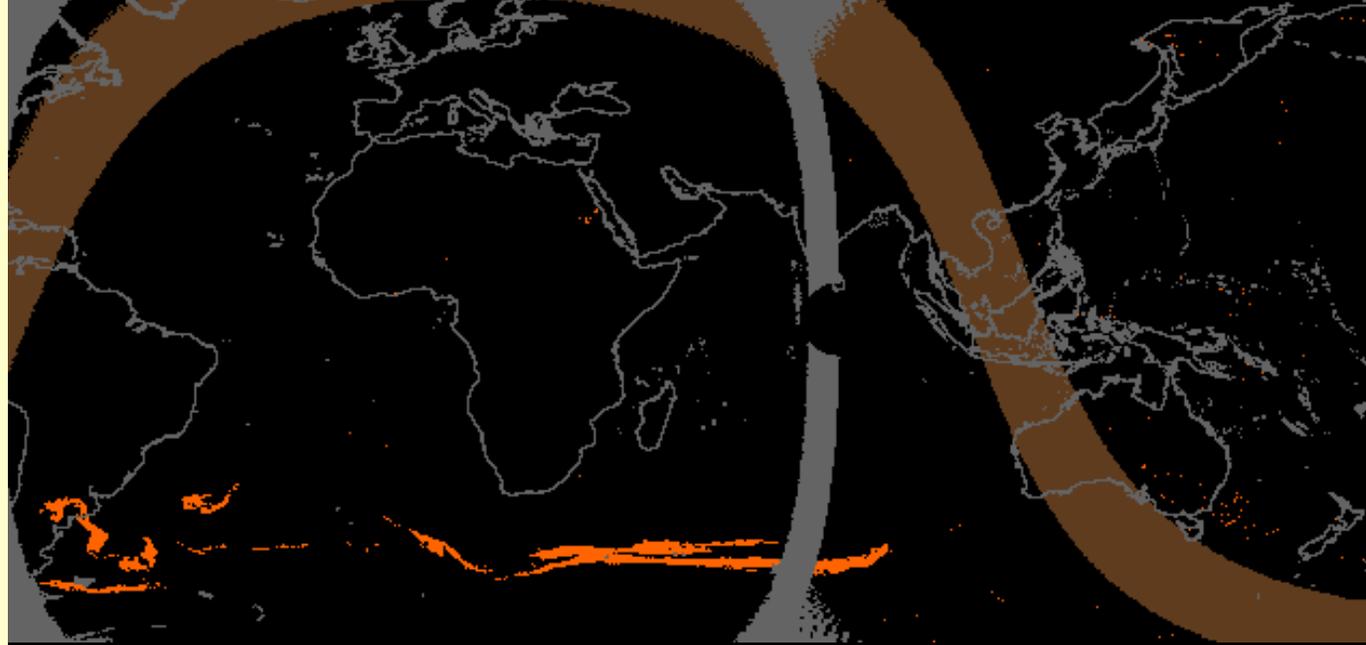
2011.06.09. 22:30 UTC

the dust RGB (MSG) and ash flag (MTSAT)

METEO FRANCE
Toujours un temps d'avance
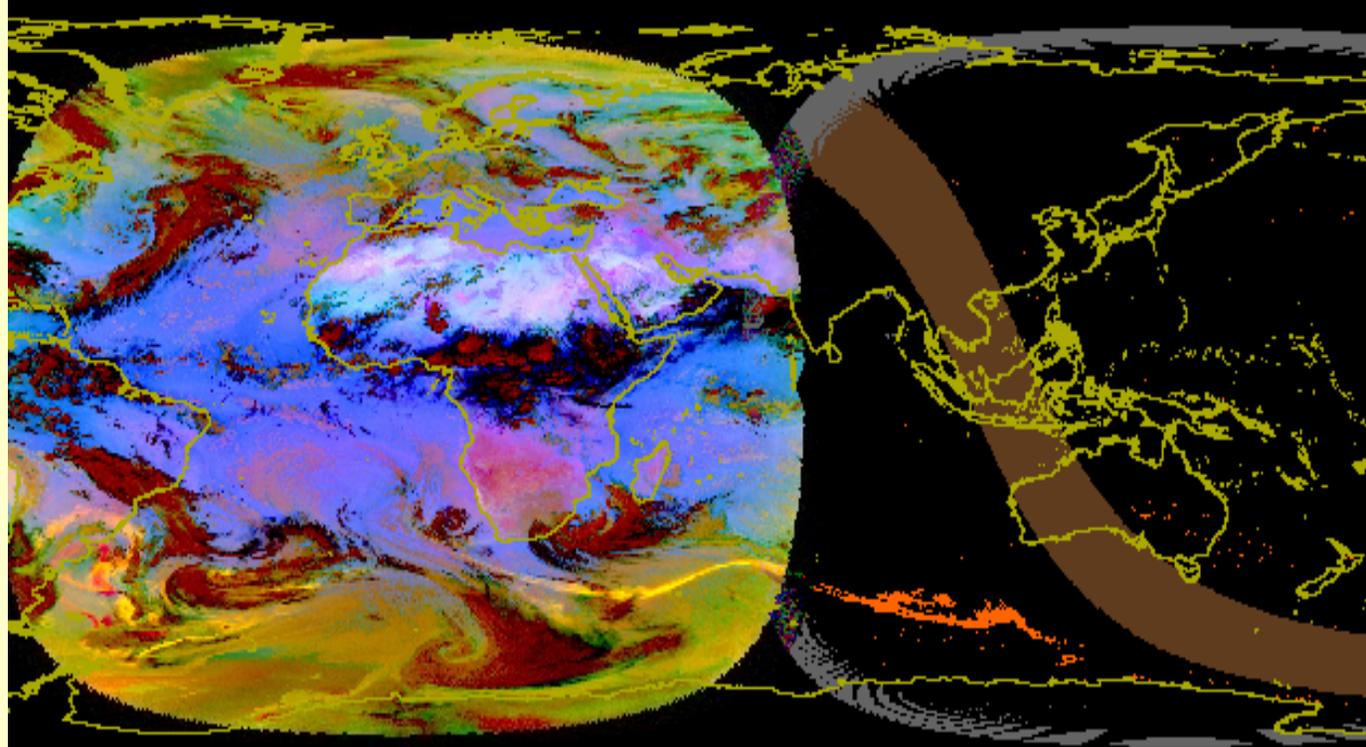
**K-ASII**
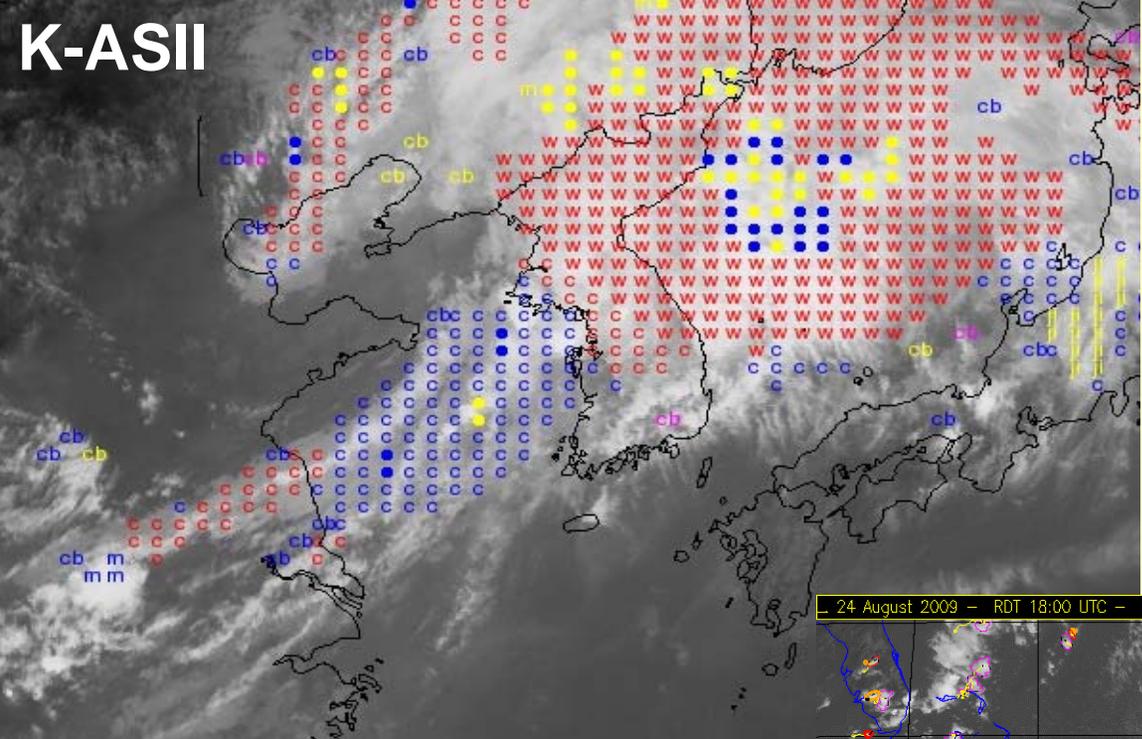
**Adaptation of NWC SAF ASII product to the MTSAT-1R**
Courtesy of Jun-Dong Park, NMSC-KMA (Korea)

**Caribbean**

24 August 2009 − RDT 18:00 UTC − Image SAT 18:00 UTC

**Adaptation of NWC SAF RDT product to the GOES-R**
provided by Yann Guillou, MétéoFrance
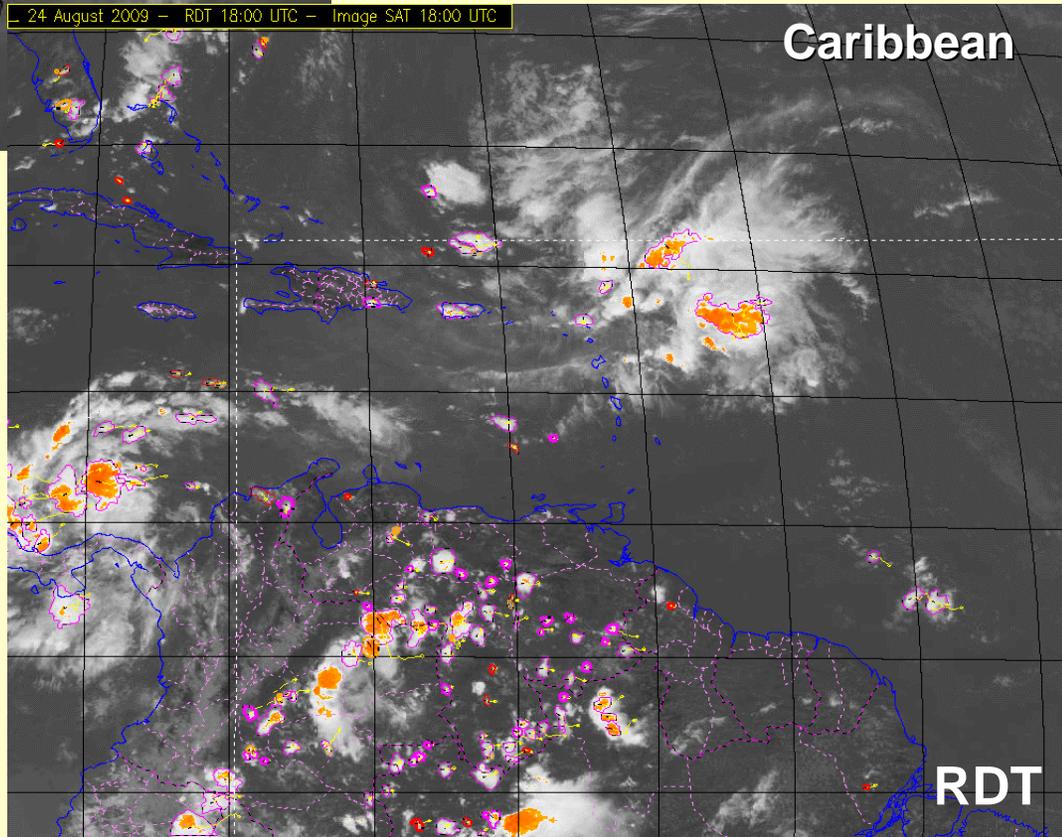
**RDT**

# To develop new products and improve the current ones

Cloud top Microphysics
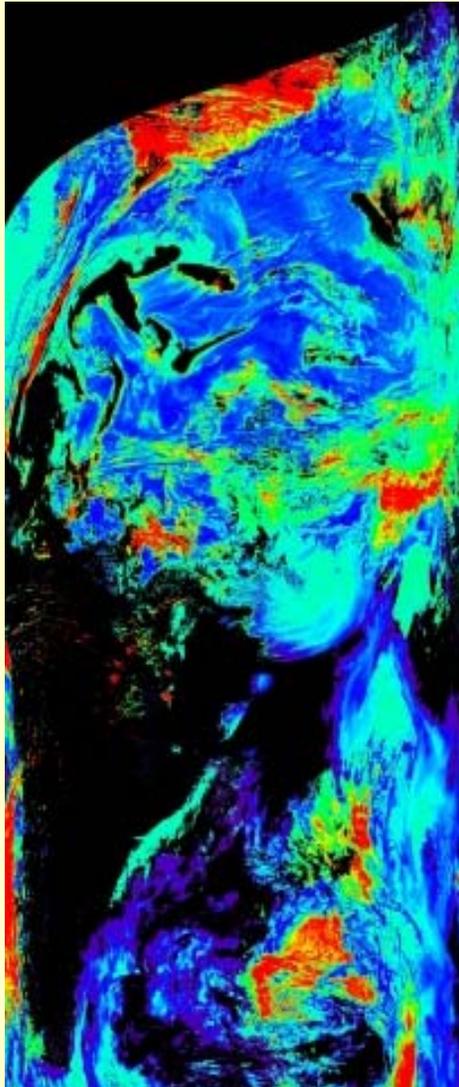
**Cloud phase**  **Effective radius**  **Condensed water path**

# To prepare for MTG and Post-EPS
## MTG-LI application to CRR



Radar (PPI)

Lightning information

CRR without lightning

CRR with lightning
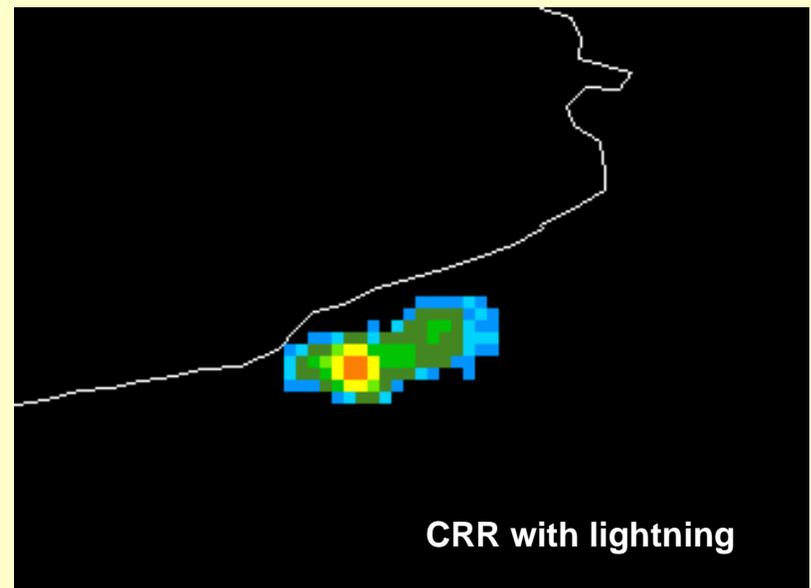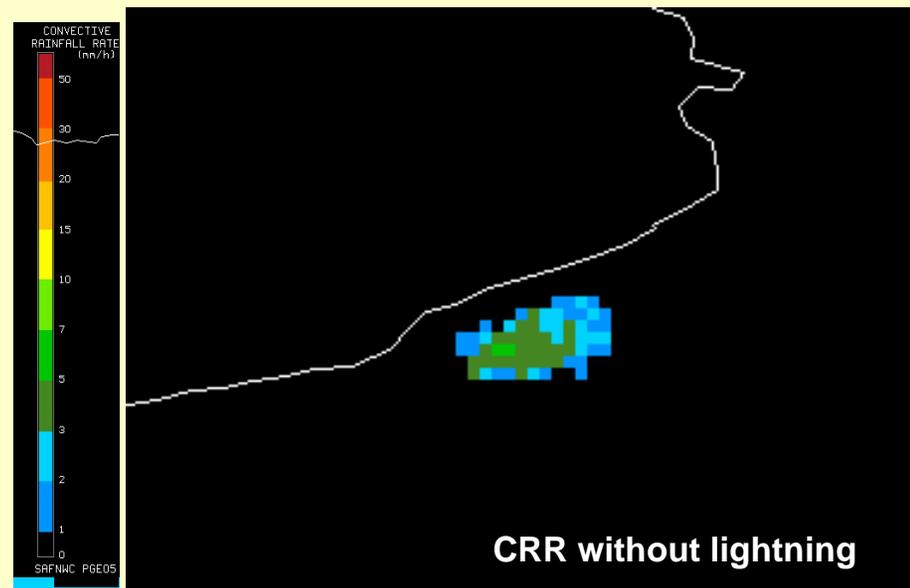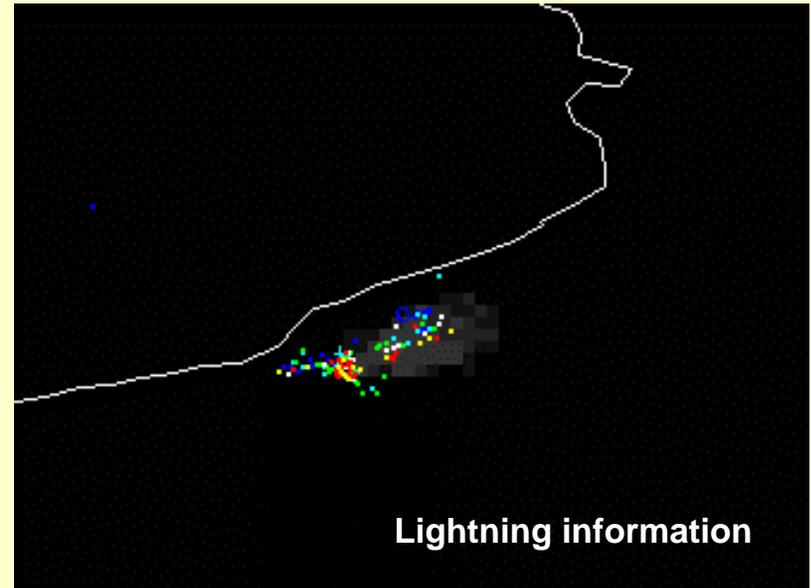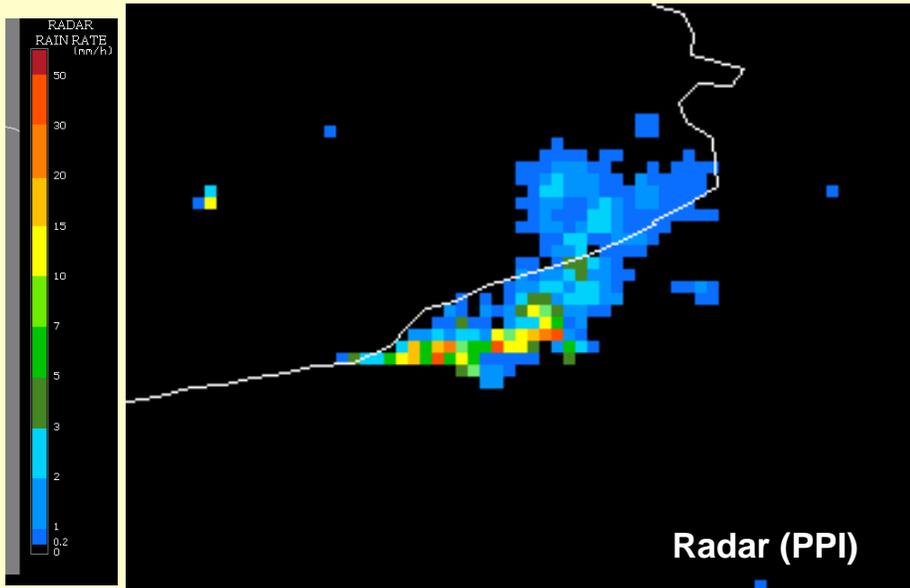
# To prepare for MTG and Post-EPS

**3D wind from MTG-IRS**
**(possibility to calculate wind shear)**

**MTG-IRS application**
**to Lifted Index**



06-12-2002, 2315 UTC
Lifted Index [°C]

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Satellite images
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Do you use data/images of polar satellites?
Are you forecaster?

**NWCSAF/PPS program package** to process the data of the **polar** satellites:
NOAA, METOP/AVHRR + a microwave channel for PC
Near future: EOS/MODIS and NPP/VIIRS data

## Cloud mask
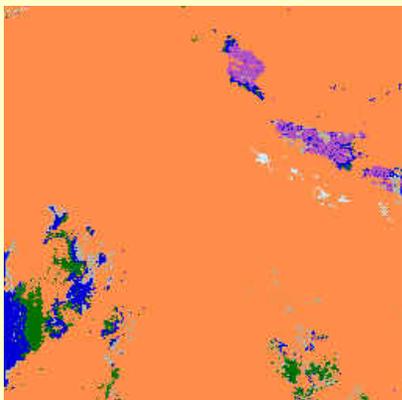
| | |
|---|---|
| ⬛ (dark gray) | Unprocessed |
| 🟩 (green) | Cloud free land |
| 🟦 (blue) | Cloud free sea |
| ▦ (gray-green) | Cloud contaminated |
| 🟧 (orange) | Cloud filled |
| ⬜ (light blue) | Snow/Ice contaminated |
| 🟫 (brown) | Unclassified |
| 🟪 (purple) | Low quality |

## Cloud top temperature and height
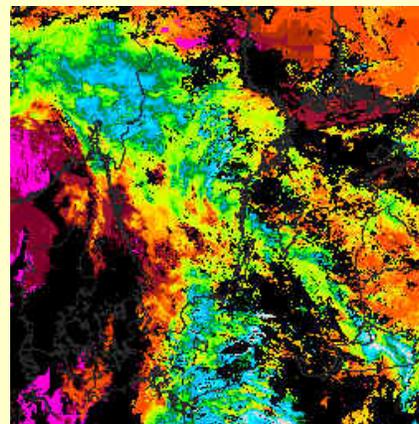
| | |
|---|---|
| ⬛ (black) | Unprocessed |
| 🟪 (magenta) | 0-500m |
| 🟥 (dark red) | 500-1000m |
| 🟥 (red) | 1000-1500m |
| 🟩 (light green) | 4500-5000m |
| 🟩 (green) | 5000-5500m |
| 🟩 (bright green) | 5500-6000m |
| 🟩 (dark green) | 6000-6500m |

## Cloud type
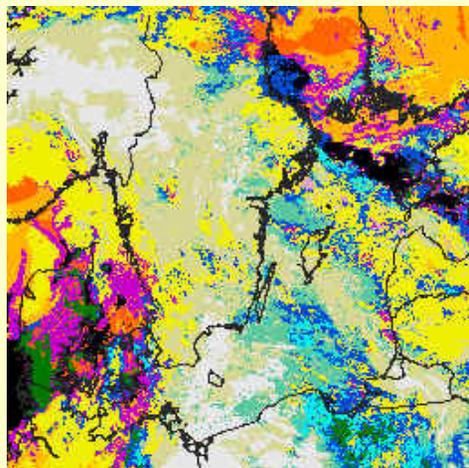
| | | | |
|---|---|---|---|
| 🟩 (green) | Cloud free | ⬜ (white) | Very high |
| ⬛ (black) | Cloud free | 🟦 (blue) | Very thin cirrus |
| 🟪 (pink) | Snow | 🟦 (cyan) | Thin cirrus |
| 🟪 (purple) | Snow/Ice | 🟦 (cyan) | Thick cirrus |
| 🟧 (orange) | Very low | 🟩 (teal) | Cirrus above |
| 🟧 (orange) | Low | 🟪 (magenta) | Fractional |
| 🟨 (yellow) | Medium level | 🟫 (brown) | Unclassified |
| ▦ (tan) | High | ⬛ (gray) | Unprocessed |

## Precipitating clouds *see next slide*

Near future: additional products:
cloud top microphysical parameters:
**Cloud Optical Thickness, Cloud Phase,
Effective Radius** (averaged particle size),
**Liquid/Ice Water path** (how much water
content below!)

NWCSAF webpage
http://www.nwcsaf.org/HD/MainNS.jsp
real time images + description

**SMHI**

**AVHRR RGB (1,2,4)**
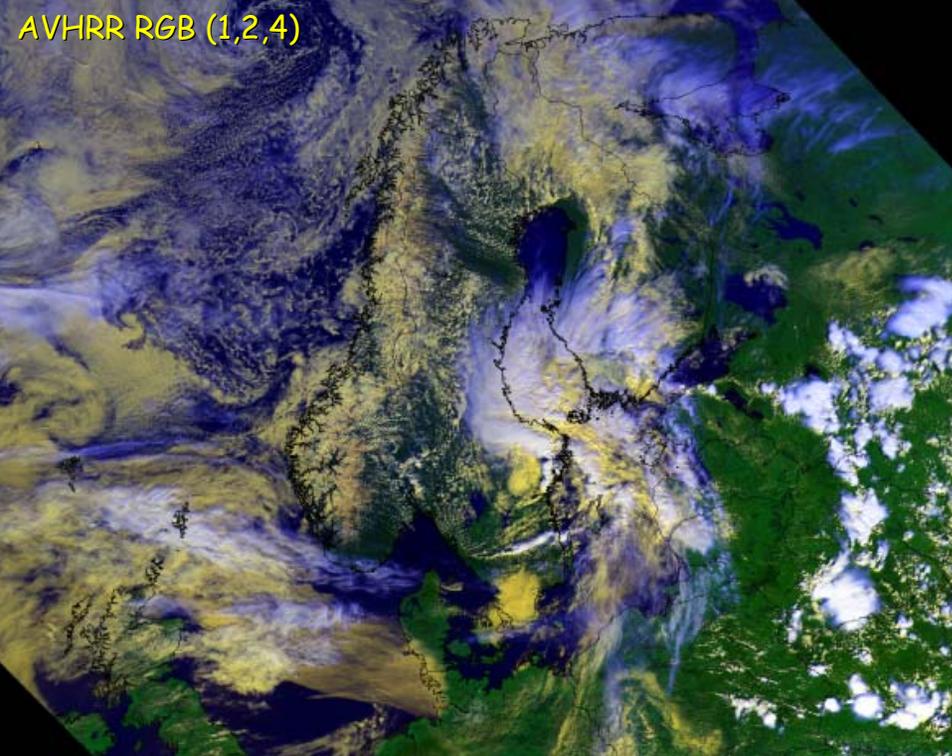
SAFNWC/PPS

Precipitating Clouds (PC)
precipitation likelihood from AVHRR + microwave data.
• No precipitation (rain rate < 0.1 mm/hr)
• light precipitation: 0.1-0.5 mm/hr
• Light/moderate precipitation: 0.5-5.0 mm/hr
• Intensive (convective) precipitation: >5.0 mm/hr

23 May 2010  11:27 UTC

PC  RGB (Red: risk of intense, Green: moderate, Blue: light p.)
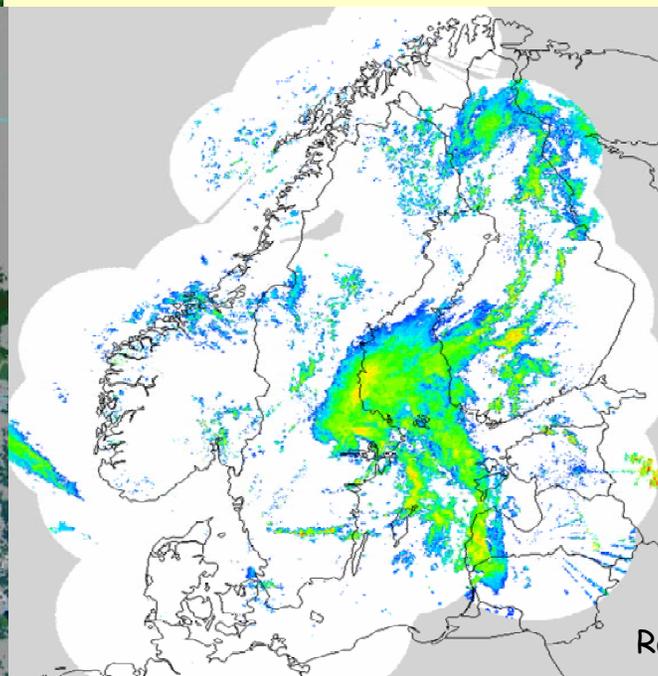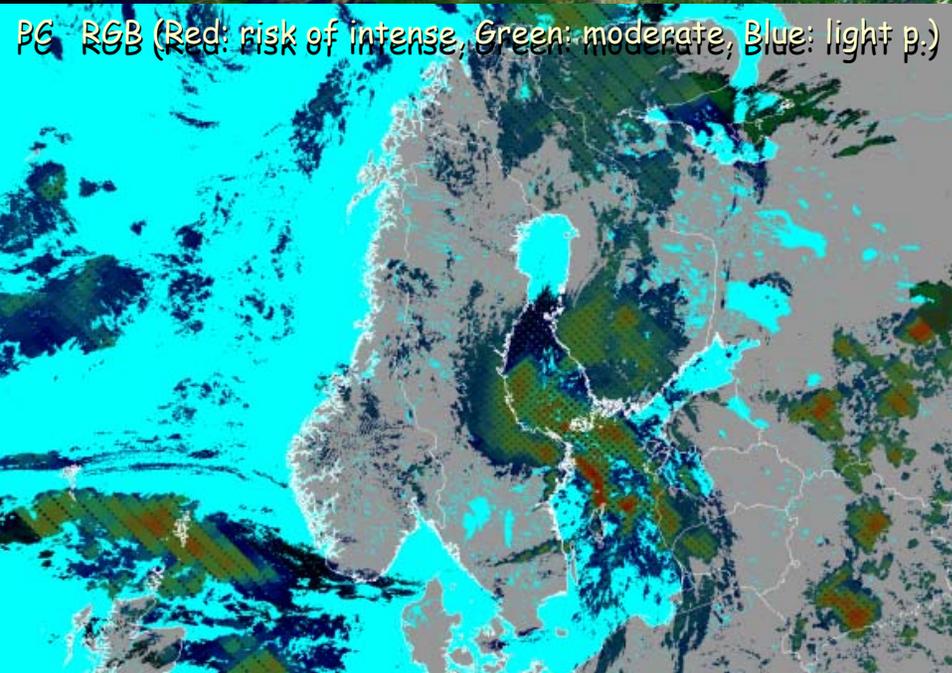
SMHI

Radar 11.30 UTC

SMHI webpage - real time images - global reception METOP-A
http://nwcsaf.smhi.se/displaymetop.php

Also local reception       http://nwcsaf.smhi.se/LocalReception.php
            for some regions all PPS products
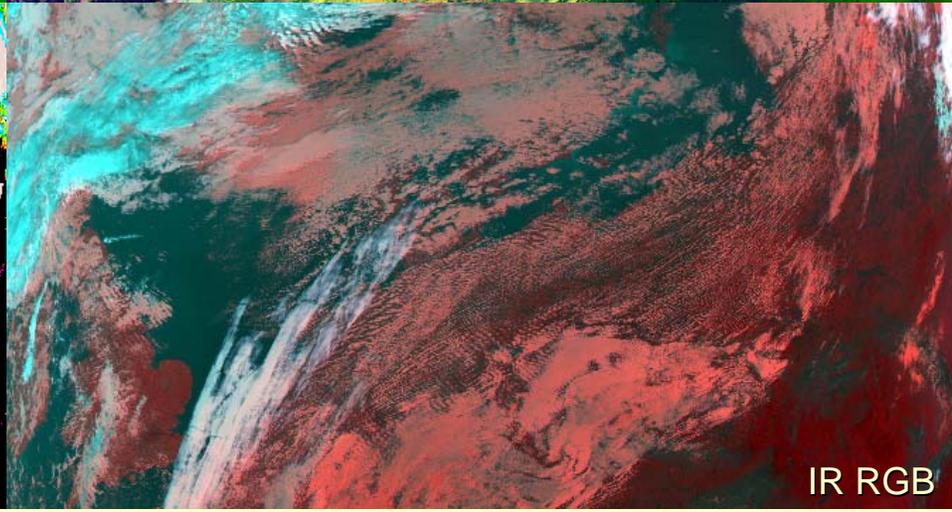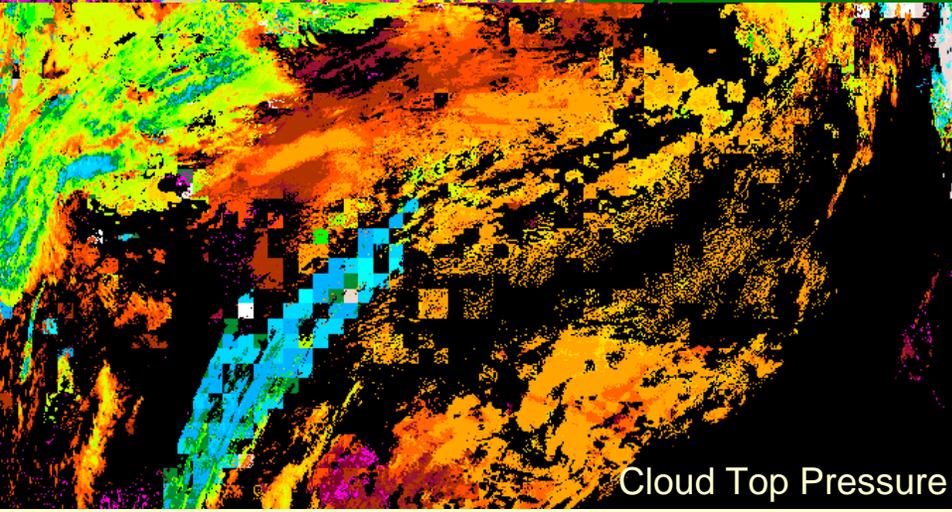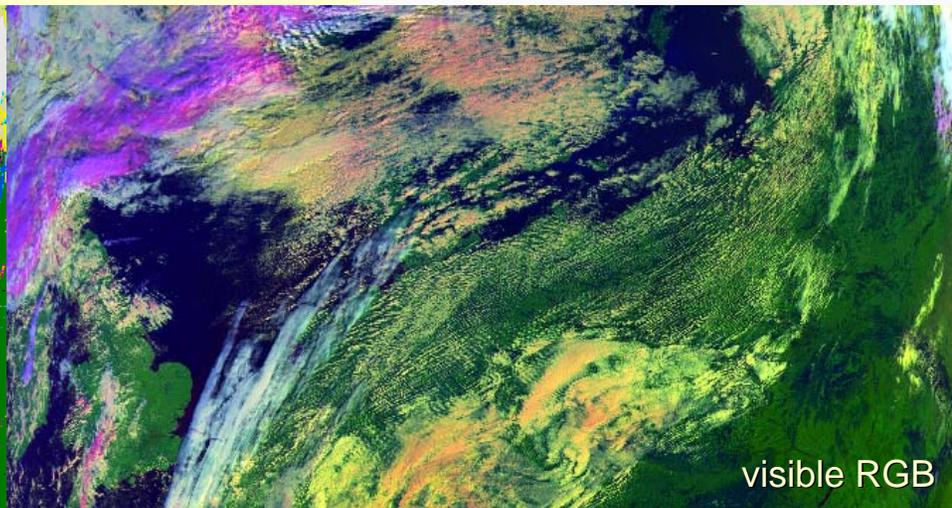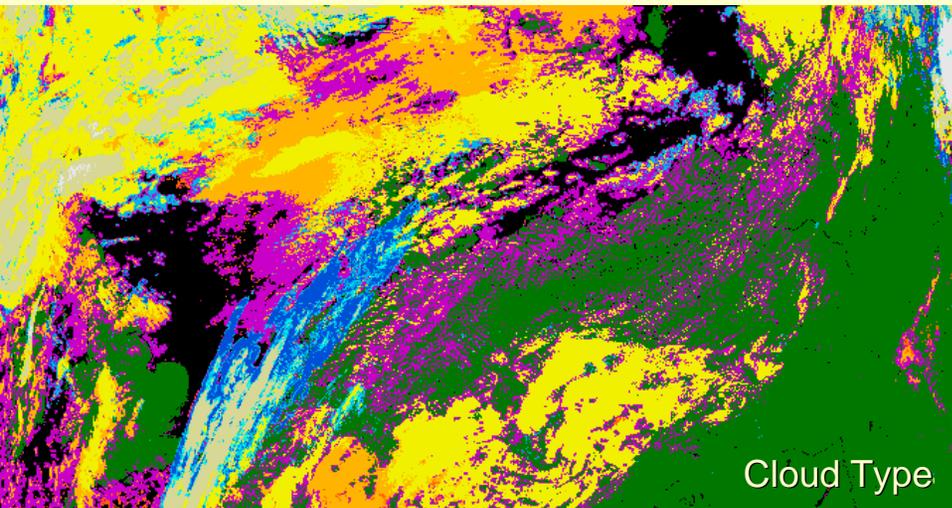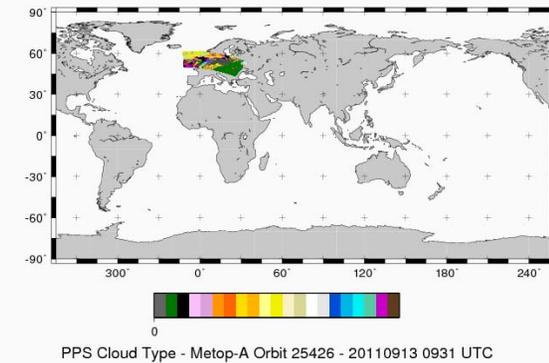
PPS Cloud Type - Metop-A Orbit 25426 - 20110913 0931 UTC

Cloud Type

visible RGB

Cloud Top Pressure

IR RGB

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EUMETSAT

Products
Not software
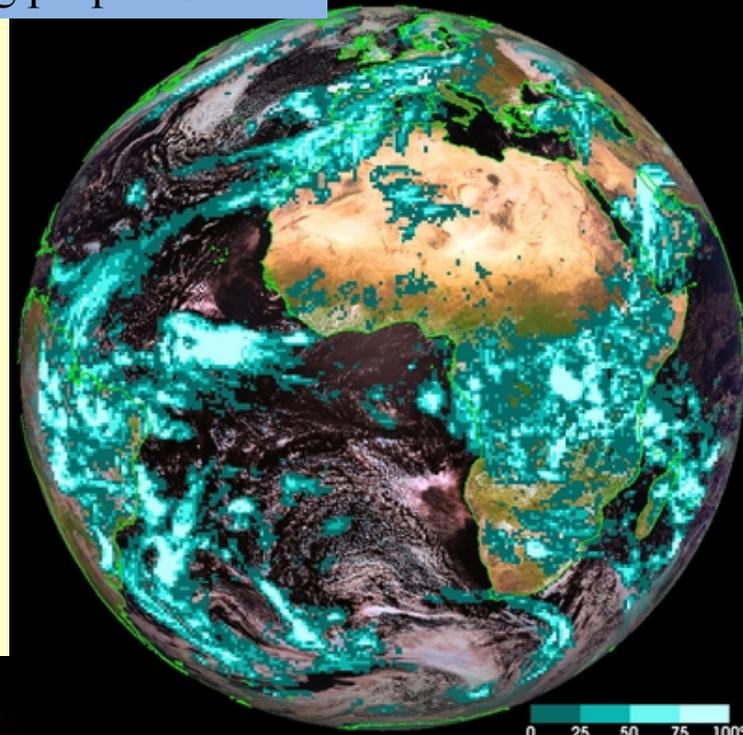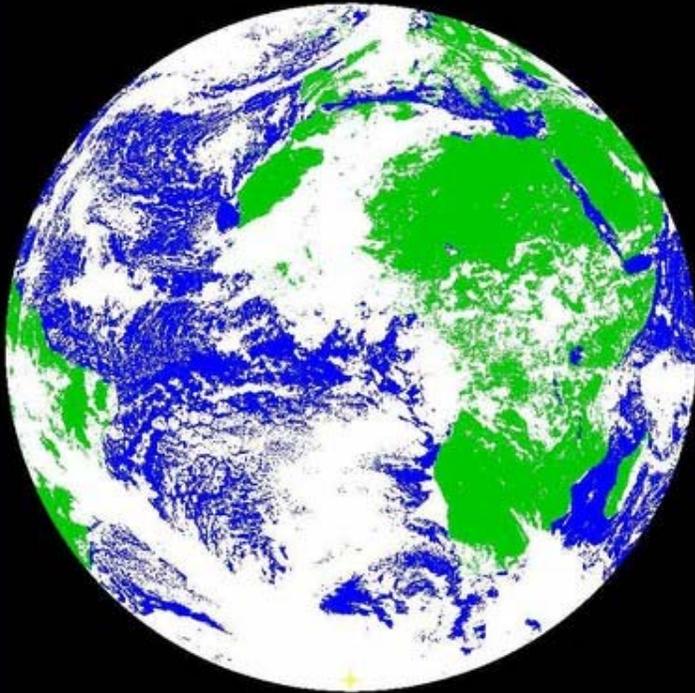
**Cloud Mask**
clear sky over water, clear sky over land, cloud, or not processed.

**Cloud Analysis**
cloud type, coverage, height and temperature

0   25   50   75   100%

**Cloud Top Height**
of highest cloud.
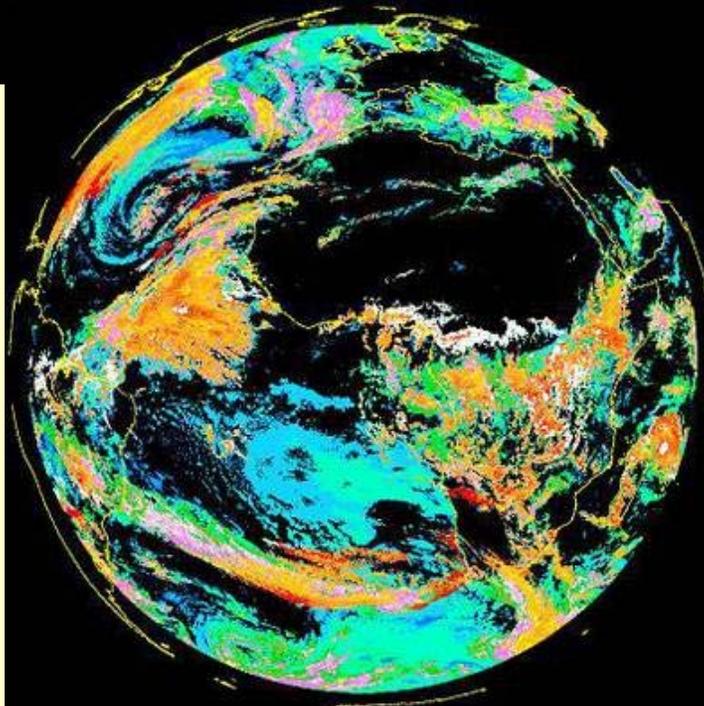
**Volcanic Ash Detection**

**Atmospheric Motion Vectors** derived from VIS0.8, WV6.2, WV7.3, IR10.8 and the HRV, by tracking the motion of clouds /water vapor patterns.
Each AMV is assigned to a height.
(5- and 15-min AMVs)
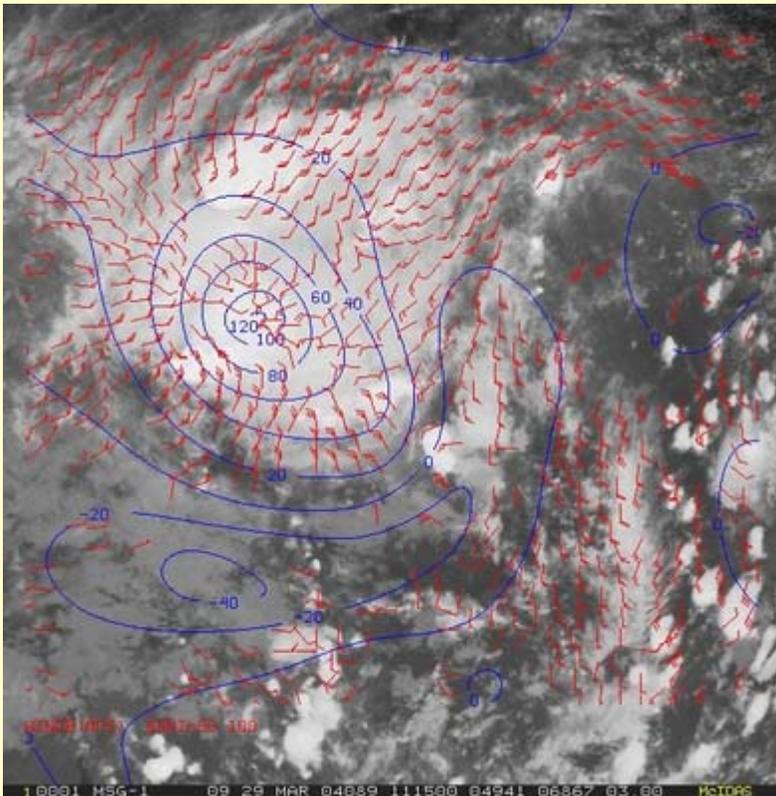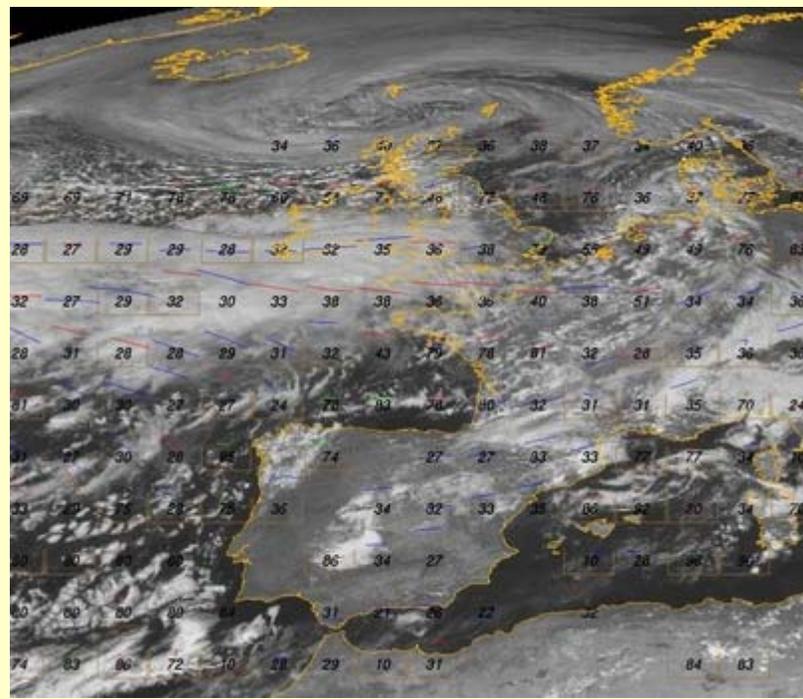


Divergence
The Divergence is calculated from the field of the WV6.2 AMVs. High level (above 400 hPa) vectors are considered. Horizontal Divergence and Relative Vorticity on a 32 x 32 pixel grid.

## Tropospheric Humidity

Relative humidity in mid and upper layers of the troposphere.
Mean RH of ~300-600 hPa layer derived from WV6.2
Mean RH of ~600-850 hPa layer derived from WV7.3
Res. 16x16 pixel


EUMETSAT

## Multi-Sensor Precipitation Estimate

(5- and 15-minute)
rain rates in mm/hr, pixel resolution
Combination of polar orbiter microwave
measurements and IR10.8 channel data.
Most suitable for convective precipitation in areas
with poor or no radar coverage, especially in
Africa and Asia.
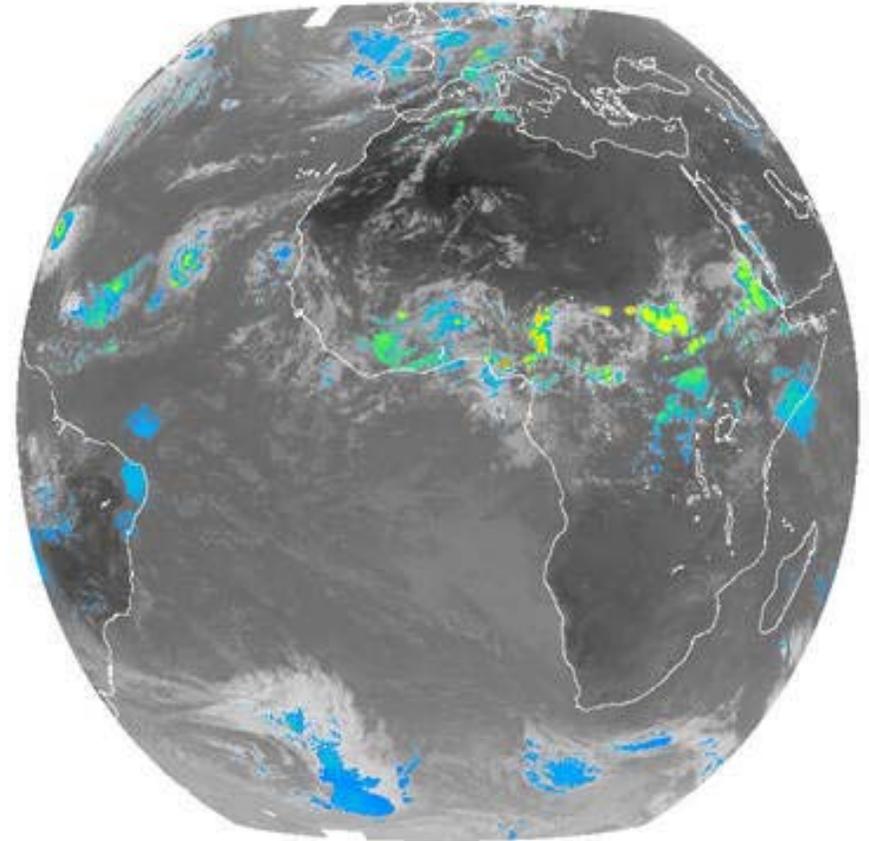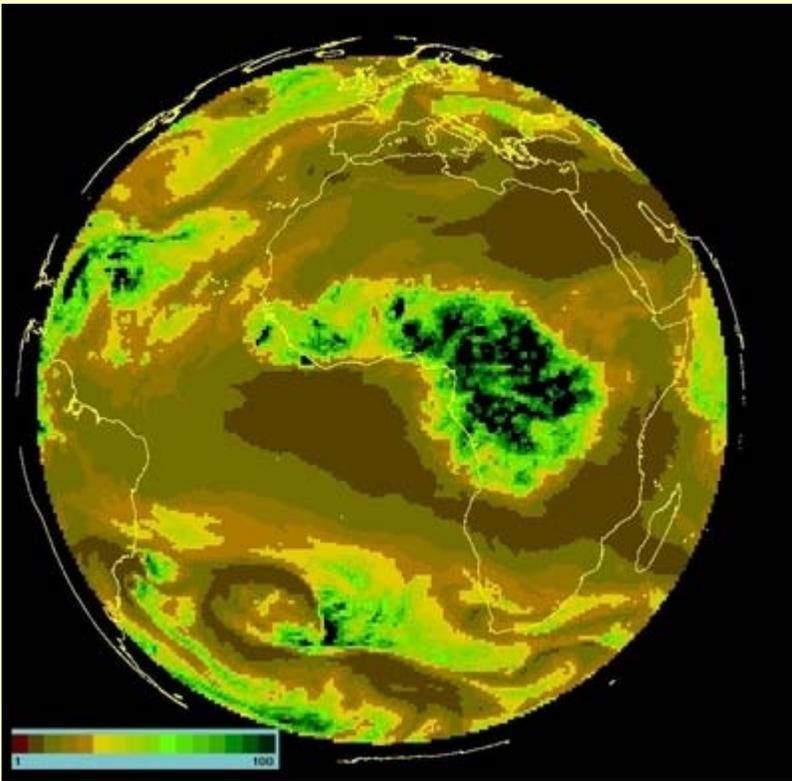


MET9 04 SEP 2008 1515 MPEF MPE 0

Global Instability Index Total Precipitable Water and instability in cloud free areas. 3x3p. RII 5min, 1x1 pixel
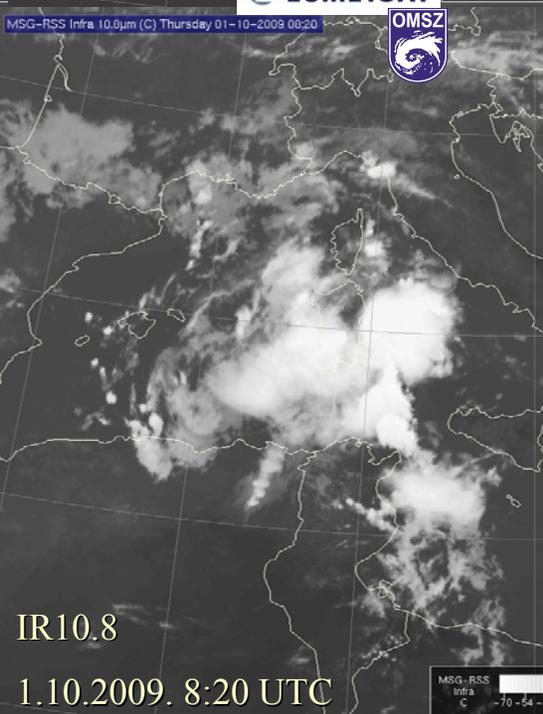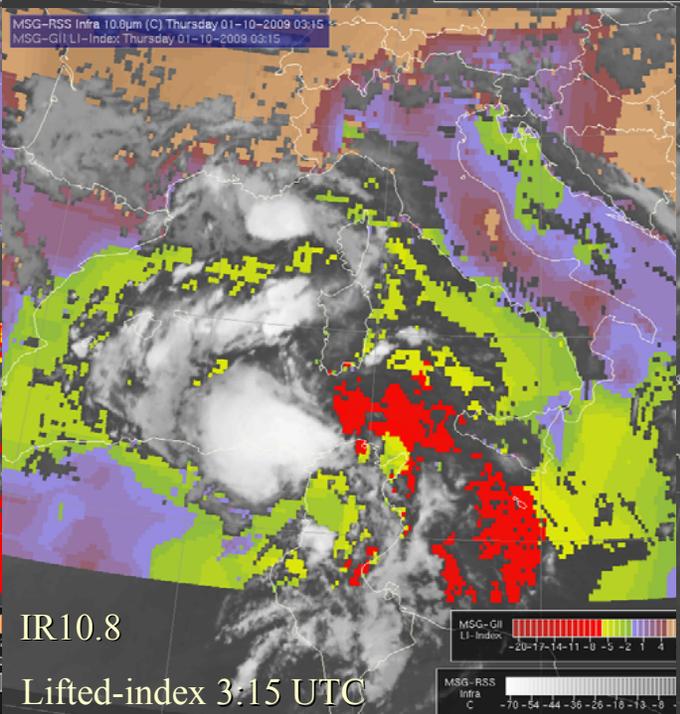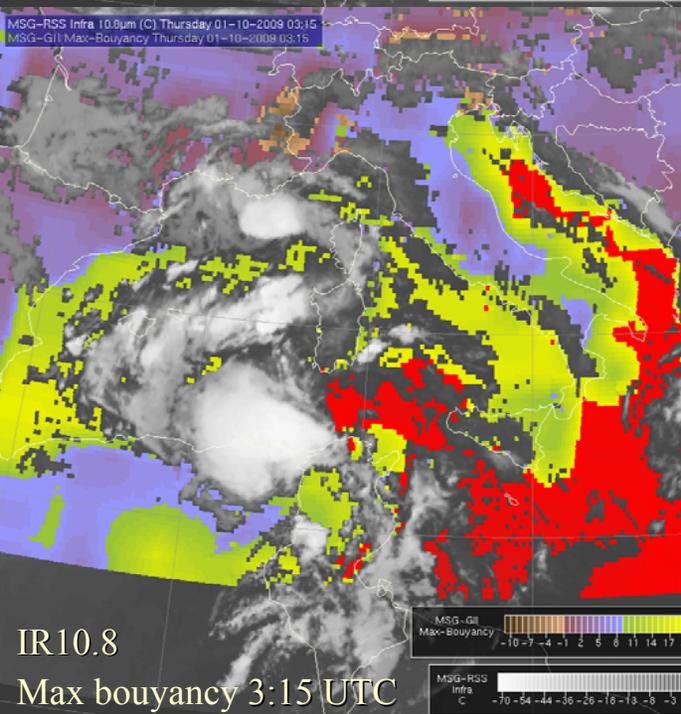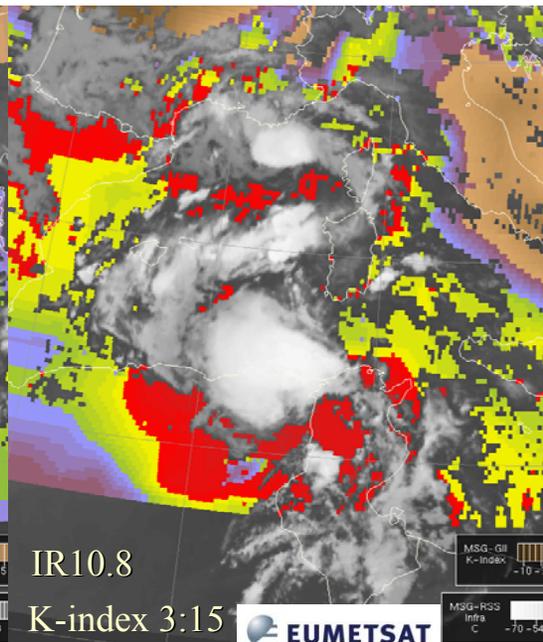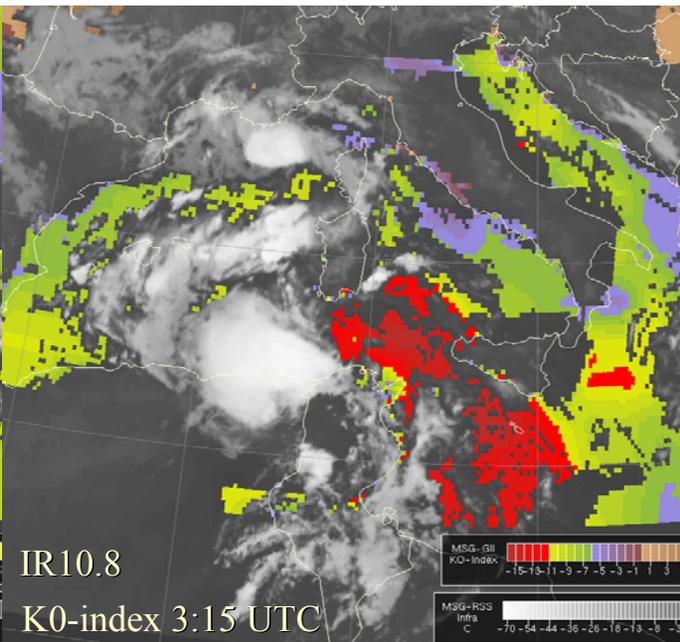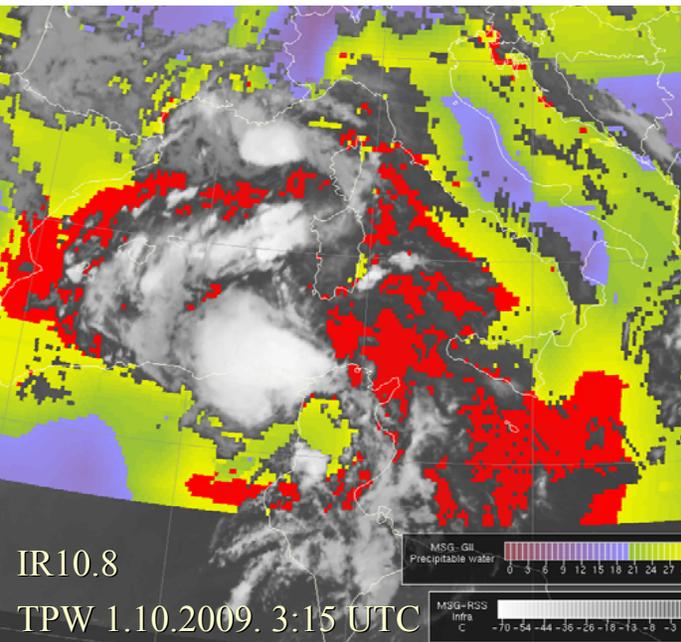
IR10.8
TPW 1.10.2009. 3:15 UTC

IR10.8
K0-index 3:15 UTC

IR10.8
K-index 3:15

IR10.8
Max bouyancy 3:15 UTC

IR10.8
Lifted-index 3:15 UTC

IR10.8
1.10.2009. 8:20 UTC

Outlines

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　　　•plans for the next 5 years
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# **Applications of the NWC SAF/MPEF products at the Hungarian Meteorological Service**

**Interactive applications**    HAWK software  Visualization tool

Visualization for
- the forecasters
- evaluation of case studies
- Verification
    - of the satellite products (eg. with radar)
    - of NWP forecasts, simulations with the satellite images/products

What is visualized regularly?
- 4 single channels + RGBs
- Some of the NWCSAF products (CT, CTTH, RDT, ASII, PC, HRW)
- MPEF RII (GII)
- Cloud amount, 'infra-cloud image'

Most often used products by the duty forecasters:

**Winter period   looking CT mainly to see the foggy areas** (beside RGBs)

**All year        aviation meteorologists use CTTH to see the cloud top height**
                (beside radar cloud top height) (eg. in-cloud icing)

# Automatic applications

**Using at assimilation into the ALADIN/HU** Numerical Weather Prediction Model

Assimilated satellite data/product into the ALADIN/HU

     - MPEF satellite retrieved <u>wind</u> product (AMV)  (plan: SAFNWC HRW)

     - NOAA ATOVS  data

     - brightness temperature (BT) data of some MSG infrared channels

Pre-processing:
**The CT and CTTH products (and their quality flags)**
<u>are used to select the BT pixels to be assimilated.</u>  The
pixels are kept over cloud-free areas and above those
clouds, for which the <u>cloud-top pressure levels are below</u>
<u>the tail of the weighting functions.</u>

Test:

The WV6.2, WV7.3, IR8.7, IR10.8, IR12.0 brightness temperatures
were assimilated into the ALADIN/HU model.

Operational since June 2009

Using only  WV6.2 and WV7.3 channels together with SYNOP data  (T2m
and RH2m)



Standard Mid-Latitude Winter 60°

Ch  4: IR 3.9
Ch  5: WV 6.2
Ch  6: WV 7.3
Ch  7: IR 8.7
Ch  8: IR 9.7
Ch  9: IR10.8
Ch 10: IR12.0
Ch 11: IR13.4

Pressure [hPa]

Normalised Weighting Function
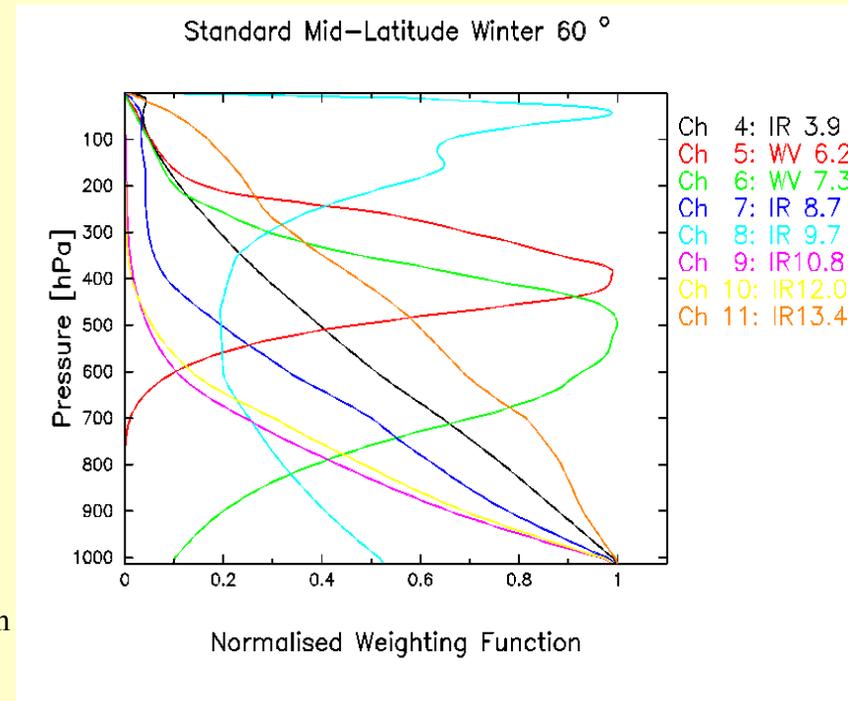
# Automatic applications

## in the Hungarian nowcasting system (MEANDER) + warning system

MEANDER - MEsoscale Analysis, Nowcasting and DEcision Routines

present applications - since 2005

CMa, CT for deriving cloud amount

CT for filtering radar noises on cloud-free areas (+ very thin cirrus + …)

CT for sending warning for potential foggy areas

(using CT + RH analyses, derived low visibility)

CTTH cloud top height (+ radar cloud top height + many other parameters)
estimate the **maximum wind speed in the thunderstorm outflow**

albedo and vegetation fraction (Land SAF) as input in WRF

(forcasted CT)

plans:

--- improve the **fog** module based on **CT** + using the 'Toulouse' algorithm (RH, wind, prec.)

--- using 6 hourly snow cover maps (**CT** + Land SAF Snow Cover product) to assimilate it into WRF model

--- using **RDT** **(with radar cell tracking)**

--- using Land Surface Temperature (Land SAF)

# Creating 'Infra-cloud' images for partners (e.g. Roads admin.)

CT as cloud mask  -- IR10.8 (black&white) on cloudy areas  -- orographic map (colors) on cloud-free areas

21.04.2011. 10:55 UTC



MSG-SAFNWC Cloud type Europe Thu 21-04-2011 10:55
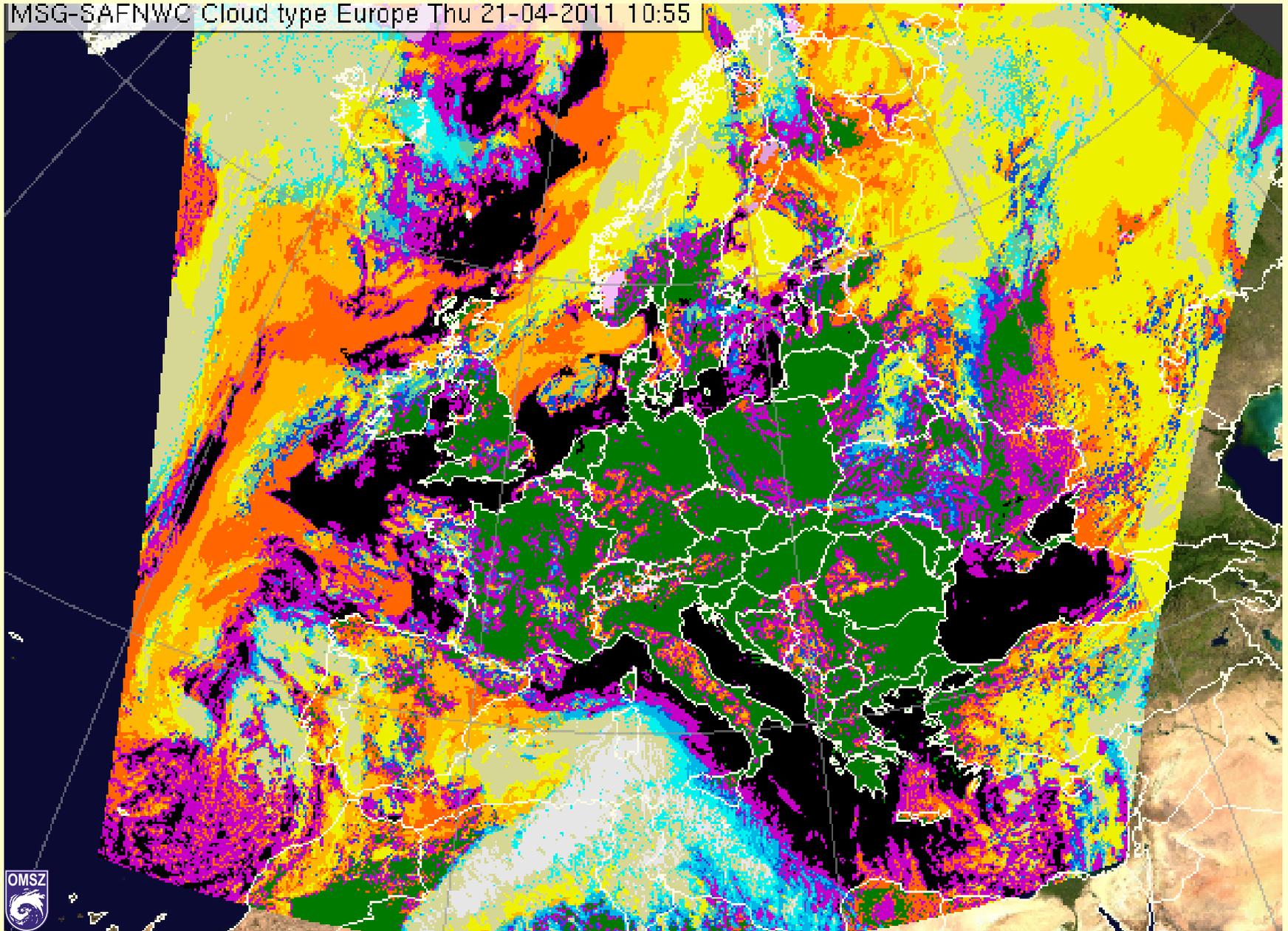
# Creating 'Infra-cloud' images for partners (e.g. Roads admin.)

**CT** as cloud mask  -- IR10.8 (black&white) on cloudy areas  -- orographic map (colors) on cloud-free areas

21.04.2011. 10:55 UTC



MSG Infra 10.8um(mask) (°C) Thu 21-04-2011 10:55
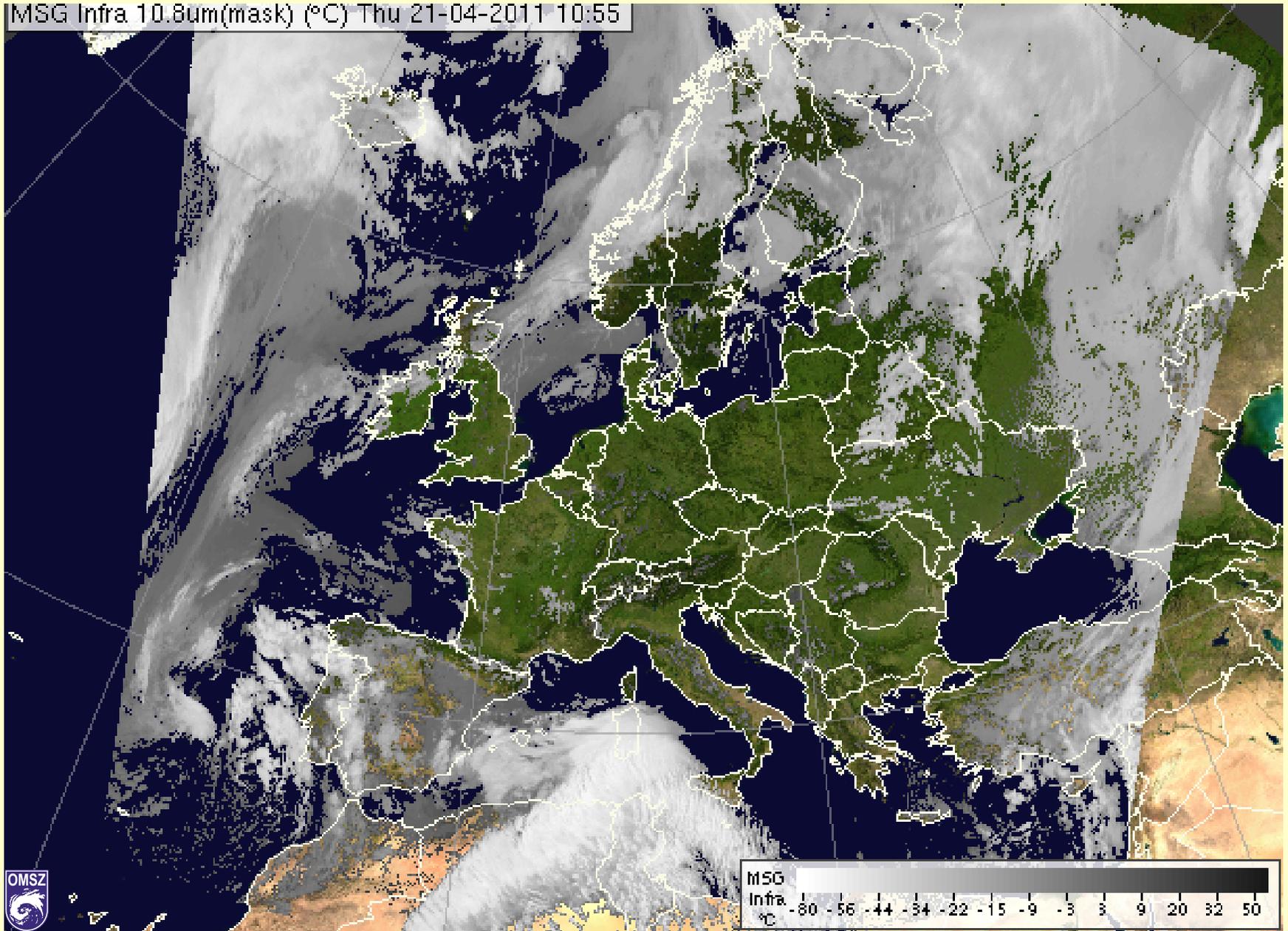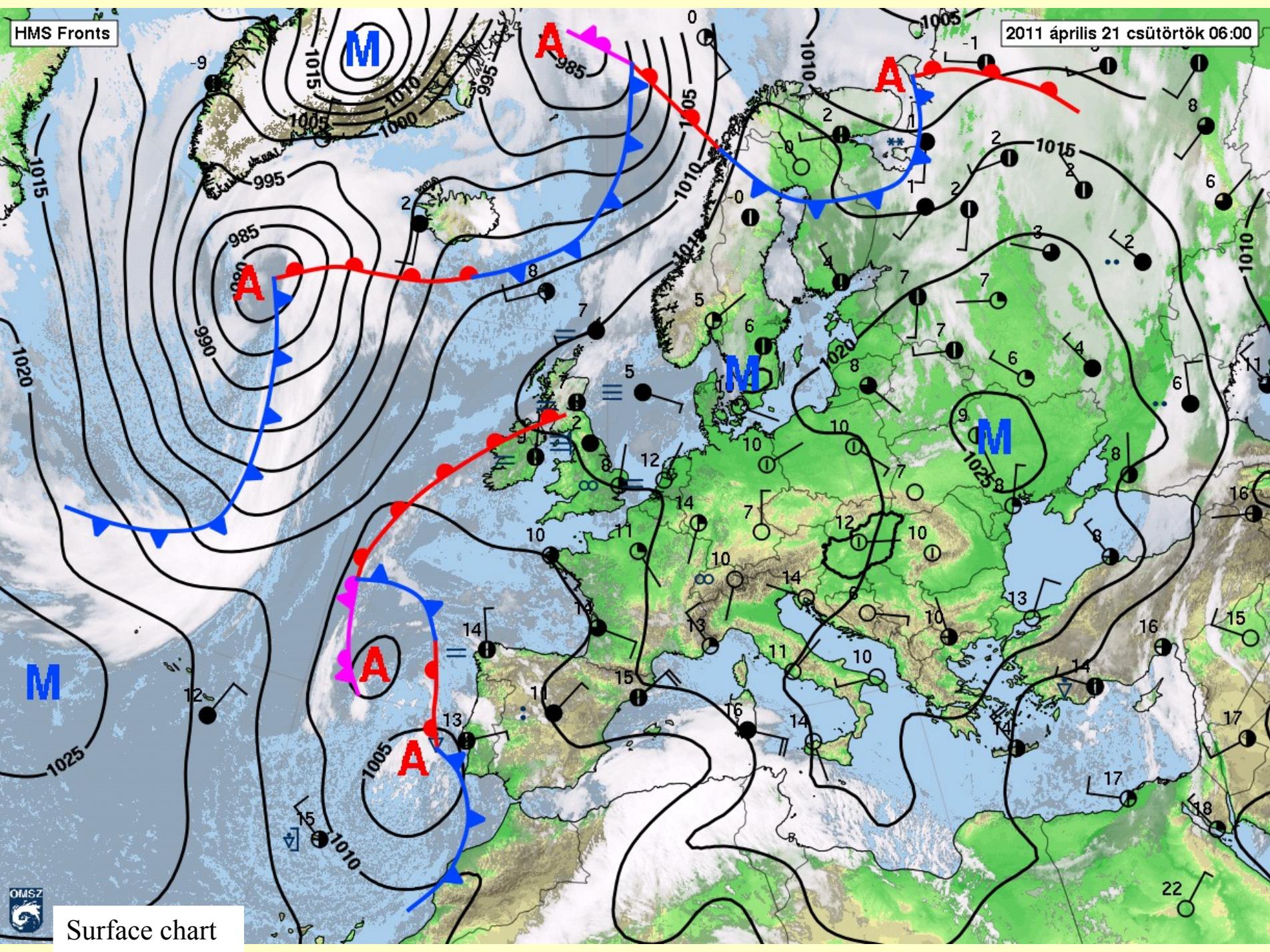
MSG
Infra
°C  -80 -56 -44 -34 -22 -15 -9  -3   3   9   20  32  50

OMSZ

Surface chart

# Automatic application - 'cloud amount' map derived from the CT product

How? - Creating a 'cloud mask' from CT by setting

0 - cloud-free, 0.5 - broken clouds and very thin cirrus, 1 - other cloud types

Smoothing/averaging this image with a 5x5 window



2010.04.12. 13:25 UTC

Cloud Type

MSG-SAFNWC
Cloud type

# Automatic application -   'cloud amount' map derived from the CT product

How? - Creating a 'cloud mask' from CT by setting

   0 - cloud-free,  0.5 - broken clouds and very thin cirrus,  1 - other cloud types

   Smoothing/averaging this image with a 5x5 window

Application: Verifying the forecasted cloud amount by ALADIN/HU (and other) NWP model



2010.04.12. 13:25 UTC

MSG-SAFNWC
Cloudiness
Octa      0  1  2  3  4  5  6  7  8

Cloud amount

OMSZ
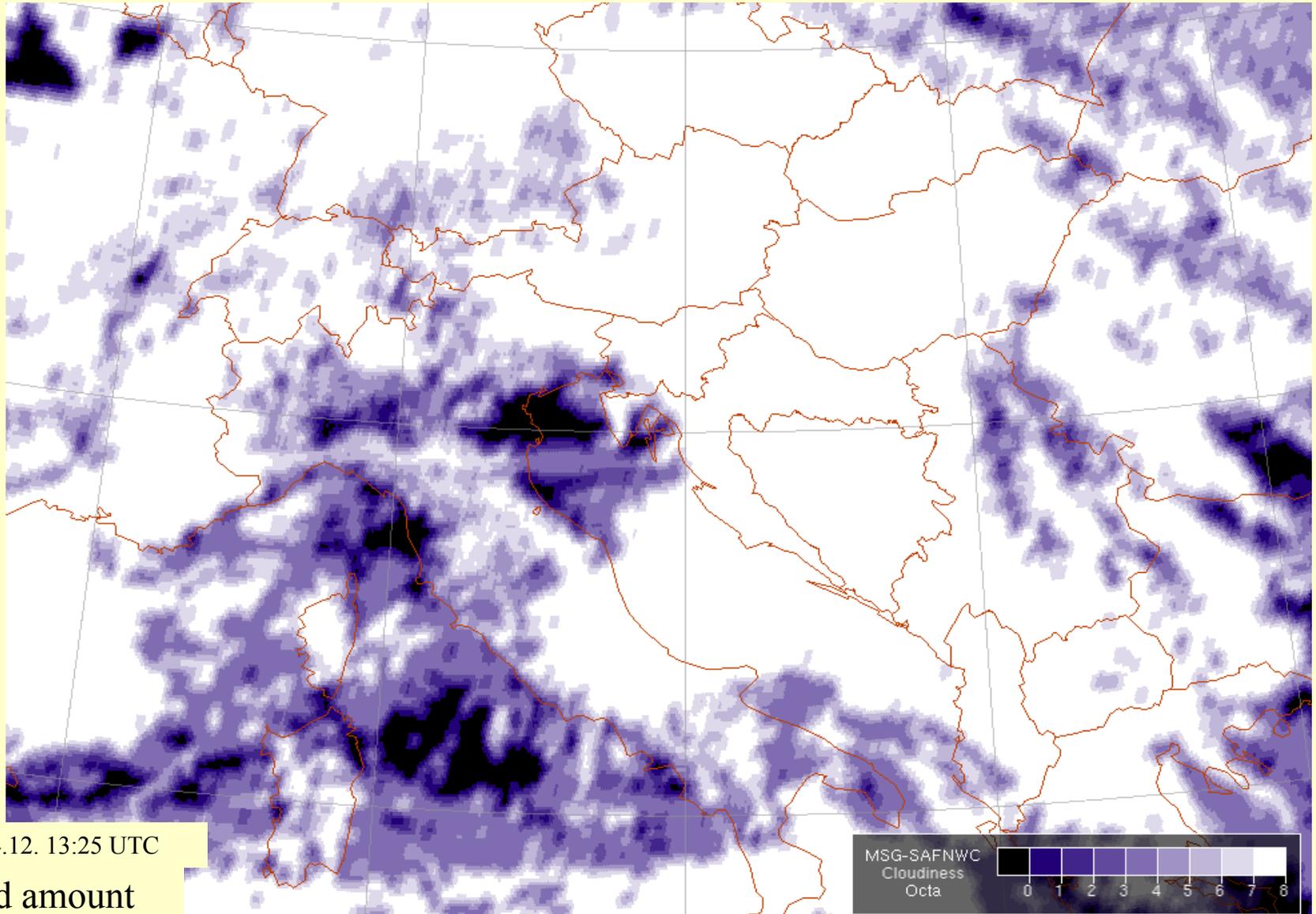
Using satellite data/ products  at developing newer products
- Research
- verification
    - Interactive applications  case studies
    - Automatic applications  program

Thanks for my colleagues helping me!

I. Szenyán

Zs. Kocsis

Thank you for your attention!

putsay.m@met.hu