

# The Nowcasting SAF: satellite derived products on support to Nowcasting. Challenges and opportunities of the new era of EUMETSAT satellites.

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# Outline

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- EUMETSAT SAF Network
- Nowcasting SAF (NWC SAF)
- NWC SAF products
- EUMETSAT new generation of satellites
  - MTG-I and MTG-S: new capabilities
  - EPS-SG-A and EPS-SG-B: new capabilities
- NWC SAF future plans

# EUMETSAT SAF Network

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- EUMETSAT European Organisation for the Exploitation of Meteorological Satellites
- Purpose: to supply weather and climate-related satellite data, images and products to the National Meteorological Services of its Member and Cooperating States in Europe, and other users worldwide.
- EUMETSAT HQ in Darmstadt, Germany.
- SAFs (Satellite Application Facilities):
  - located at Weather Services in EUMETSAT Member and Co-operating States
  - complement production of standard meteorological products at EUMETSAT central facility

# EUMETSAT SAF Network

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SAFs are specialized on topics and themes:

- SAF on Climate Monitoring (CM SAF), <http://www.cmsaf.eu>
- SAF on Support to Operational Hydrology and Water Management (H SAF), [hsaf.meteoam.it/](http://hsaf.meteoam.it/)
- SAF on Land Surface Analysis (LSA SAF), [landsaf.meteo.pt/](http://landsaf.meteo.pt/)
- SAF on Numerical Weather Prediction (NWP SAF), <https://nwpsaf.eu>
- SAF on Ozone and Atmospheric Chemistry Monitoring (O3M SAF), <http://o3msaf.fmi.fi/>
- Ocean and Sea Ice (OSI) SAF, [www.osi-saf.org](http://www.osi-saf.org)
- SAF on Radio Occultation Meteorology, <http://www.romsaf.org/>
- SAF on support to Nowcasting (NWC SAF), [www.nwcsaf.org](http://www.nwcsaf.org)

# NWCSAF concept: objectives

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- ✓ The general objective of the NWC SAF is to provide operational services to ensure the optimum use of meteorological satellite data in Nowcasting and Very Short Range Forecasting by targeted users.
- ✓ To achieve this goal , the NWC SAF is responsible for the development and maintenance of appropriate SW Packages (GEO and POLAR Satellites), as well as of all related tasks for user's support.

# NWC SAF Software Packages

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## Geostationary Satellites:

MSG v2013: available to users since August 2013

Applicable to MSG data

GEO v2016, available after 2016 summer

Continuous monitoring, space resolution and illumination conditions good for low and middle latitudes

## Polar Satellites:

PPS v2014: available to users since October 2014

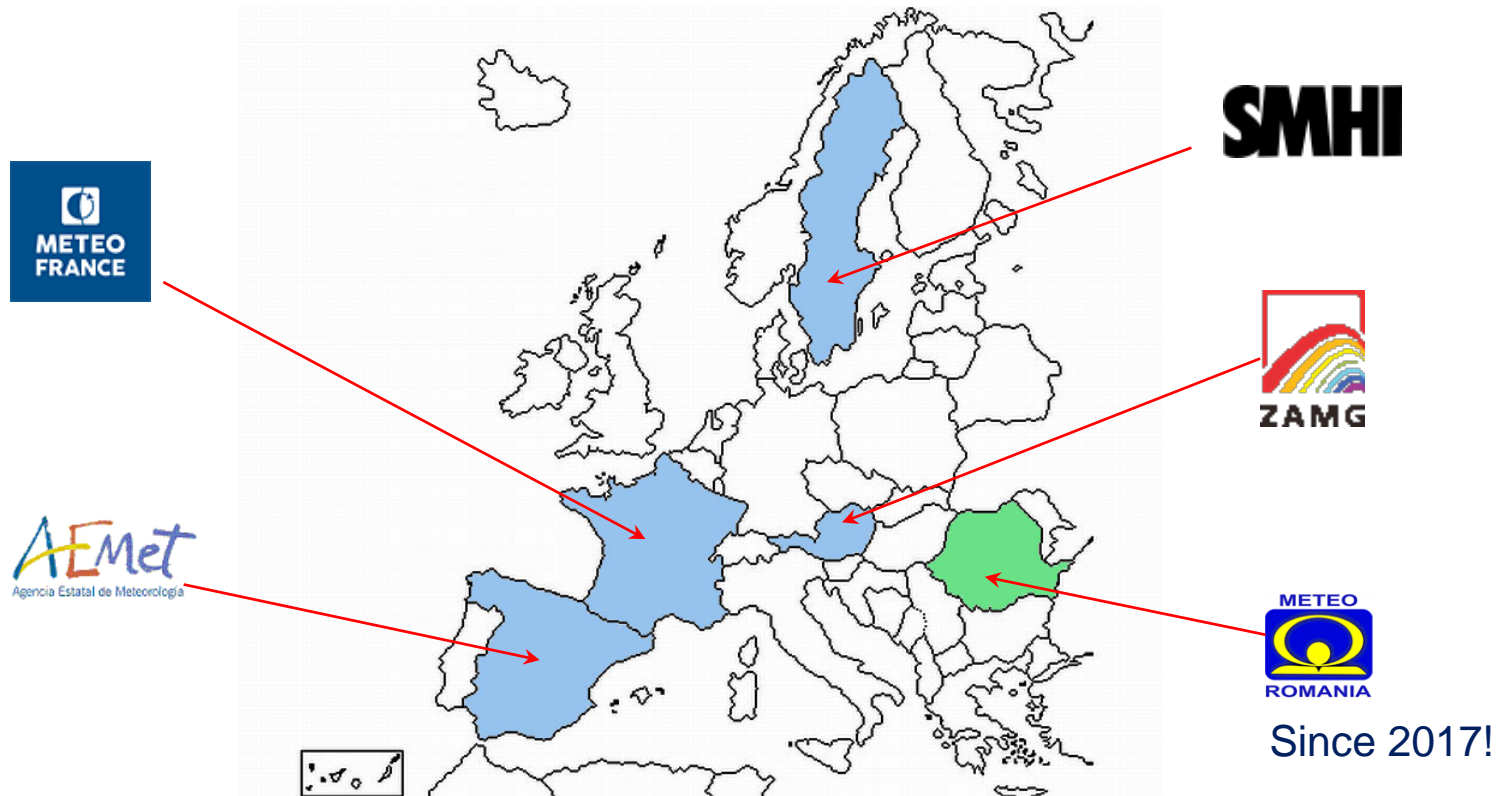
Process data from the joint polar system (EUMETSAT and NOAA polar satellites)

New version planned for 2018

Relatively good coverage for high latitudes

# NWC SAF Consortium

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# NWC SAF Consortium responsibilities

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- **AEMET:**
    - Leading Entity
    - GEO High Resolution Winds, Precipitation and iSHAI (precipitable water and stability products )
  - **MétéoFrance in Lannion:** GEO Cloud products
  - **MétéoFrance in Toulouse:** GEO Convection products ← Presented by J.M. Moisselin in M3A session on Monday
  - **ZAMG:** GEO extrapolation imagery products, automatic recognition of meteorological products
  - **SMHI:** Cloud and precipitation products for polar satellites
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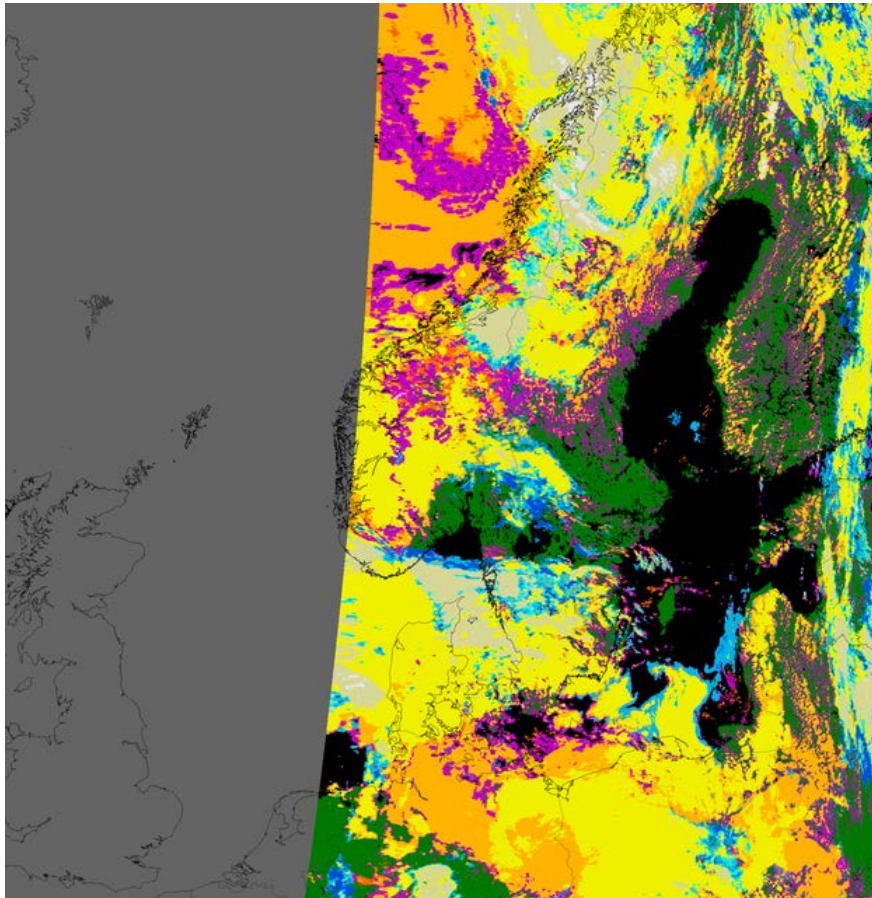
# NWC SAF Software

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The software is distributed freely to registered users of the meteorological community and is used for Nowcasting and as a development and research tool

- The user runs the SW package and generate the products
- Advantage: users can configure the SW to fit their needs ( e.g. the user define the area where the products are generated)
- Potential problem: users need access to EUMETSAT satellite images and a NWP model output

# NWC SAF PPS v2014: Cloud Type

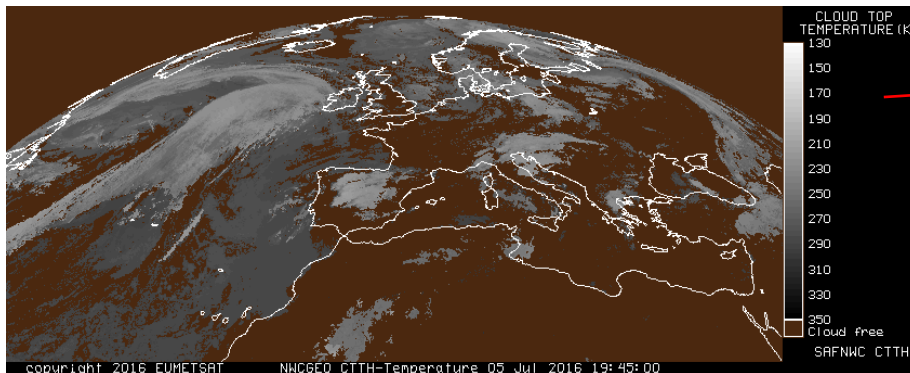
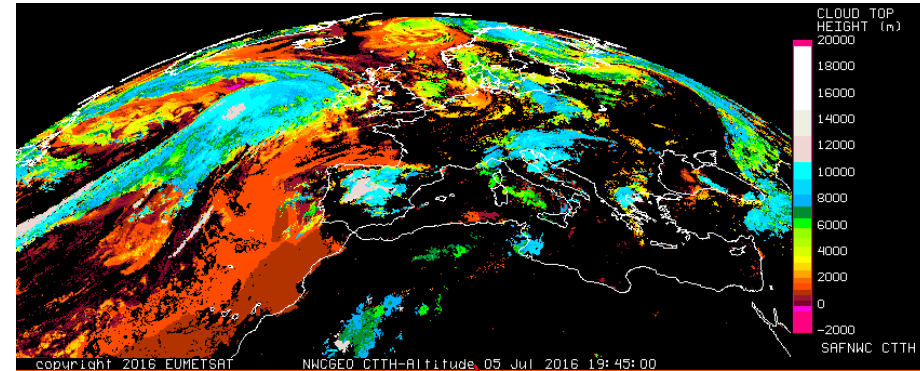
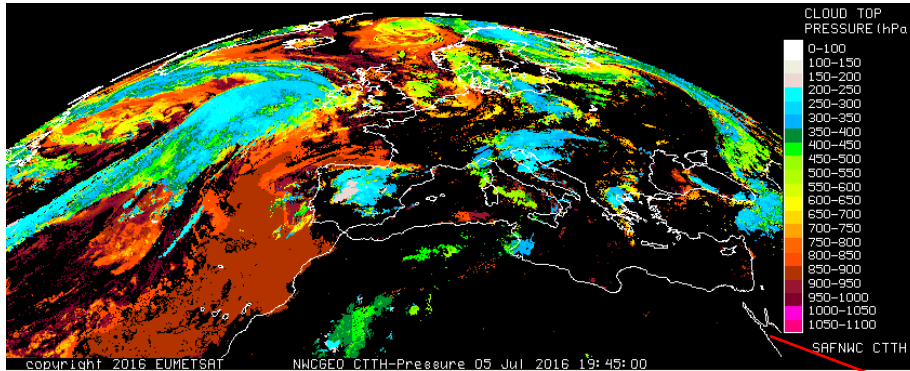


- |              |                  |
|--------------|------------------|
| Cloud free   | Very thin cirrus |
| Cloud free   | Thin cirrus      |
| Snow         | Thick cirrus     |
| Snow/Ice     | Cirrus above     |
| Very low     | Fractional       |
| Low          | Unclassified     |
| Medium level | Unprocessed      |
| High         |                  |
| Very high    |                  |

18 July 2016

# NWC SAF GEO Cloud Top Temperature and Height

Cloud Top pressure is inferred comparing simulated and measured radiances. The process depends on the Cloud Type.



Pressure, Height and Temperature of the Cloud Top

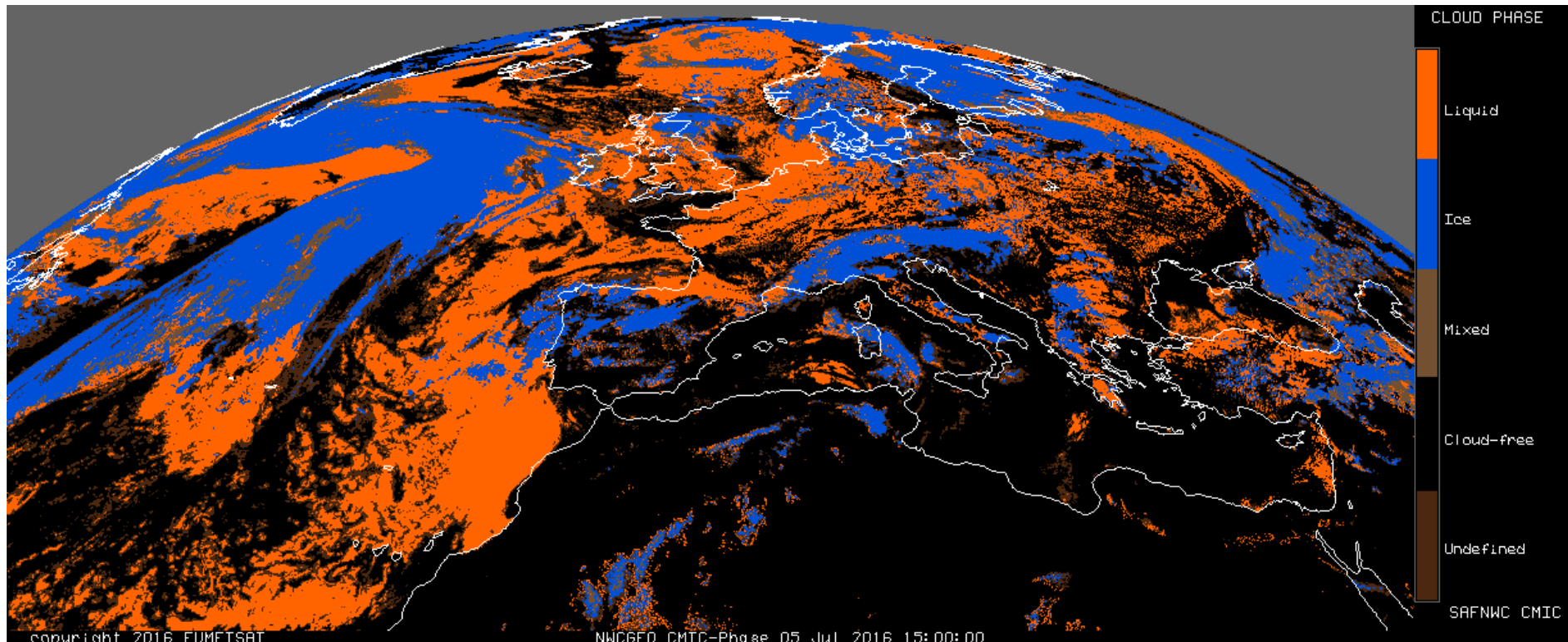
Applications in:  
Aviation forecast  
Input to other products

# NWC SAF Cloud Microphysics (CMIC): Cloud Phase

## Cloud Phase

Empirical used of (T8.7 $\mu\text{m}$  -T10.8 $\mu\text{m}$ ), yT10.8 $\mu\text{m}$ , CT

Complemented during daytime with measured/simulated R0.6 $\mu\text{m}$  y R1.6 $\mu\text{m}$

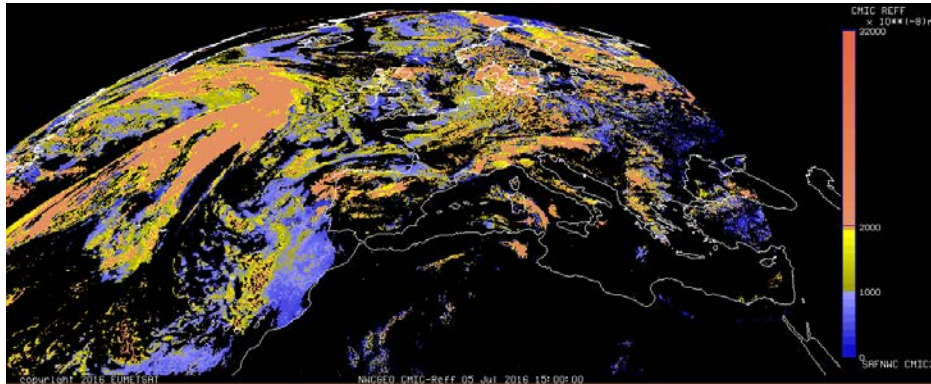


Day and night time product!

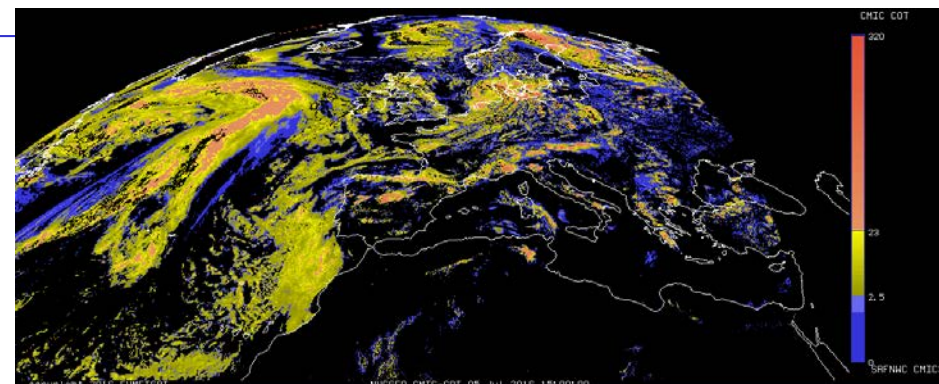
# NWC SAF Cloud Microphysics

New GEO v2016!

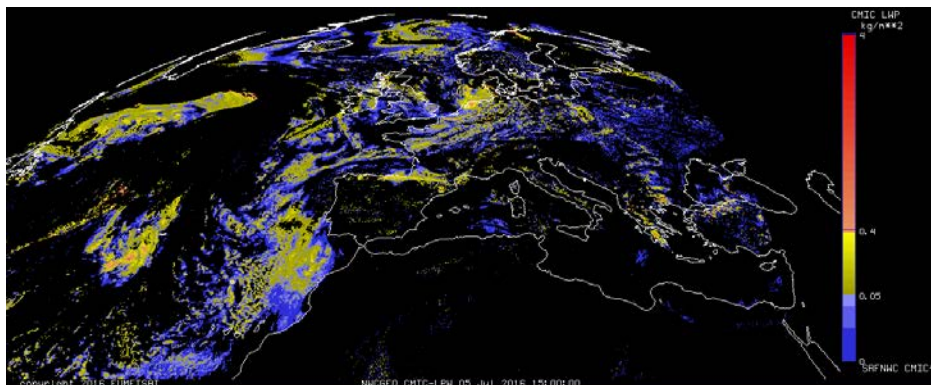
Day time product!



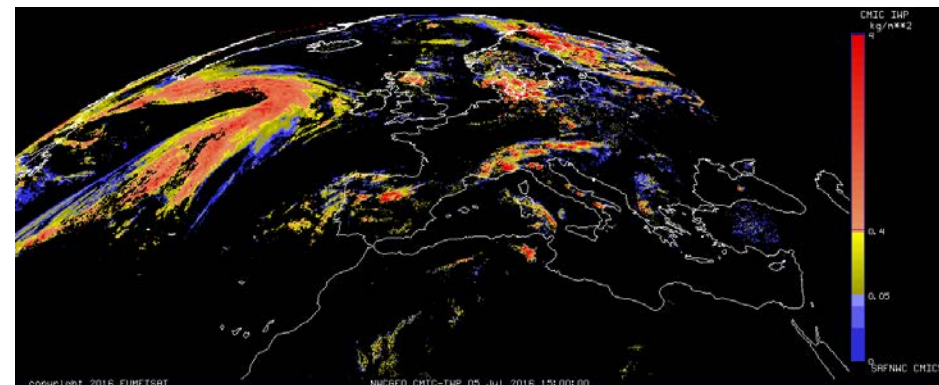
Effective Radius



Cloud Optical Thickness



Liquid Water Path

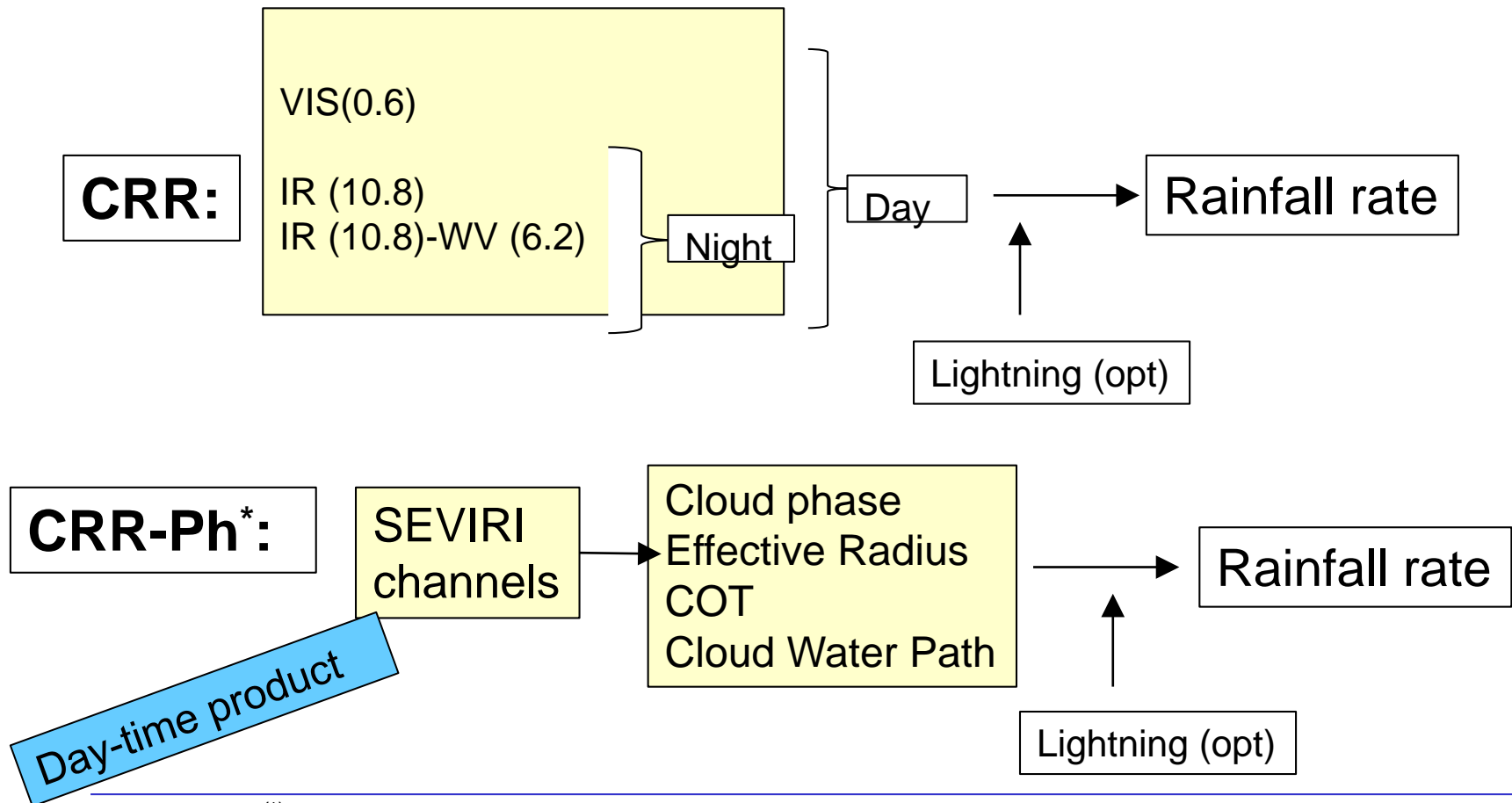


Ice Water Path

5 July 2016 15:00 UTC

# Convective Rainfall Rate. CRR and CRR-Ph

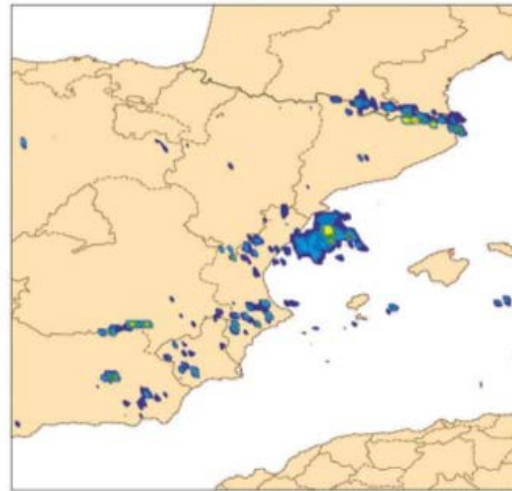
Intensity of precipitation associated to convective systems.



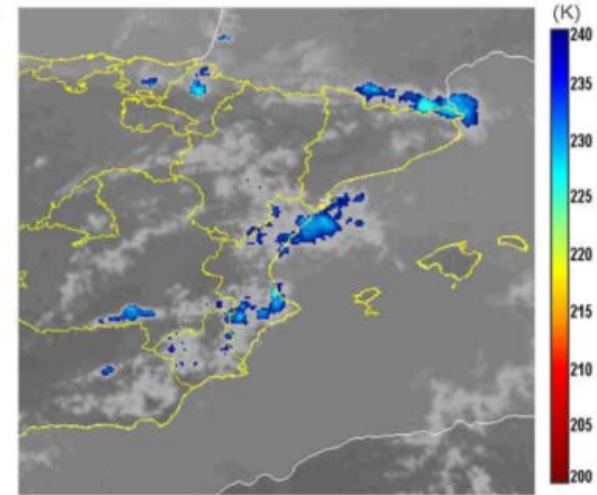
(\*)Based on algorithm from Roebeling, R. A. and I. Holleman, 2009

# Convective Rainfall Rate CRR and CRR-Ph

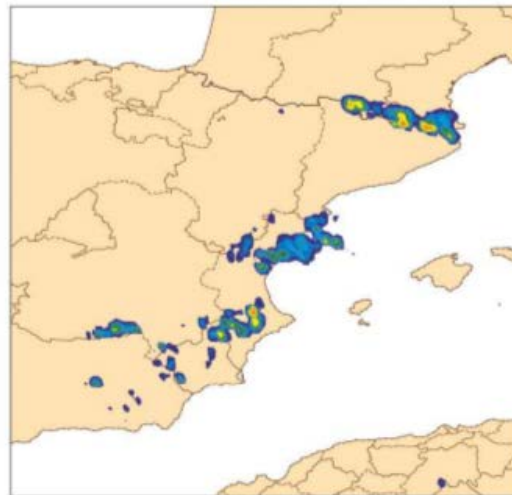
Radar Precip. 11 Aug 2012 at 14:10 UTC



SEVIRI IR10,8 11 Aug 2012 at 14:00 UTC



CRPh Precip. 11 Aug 2012 at 14:00 UTC



CRR Precip. 11 Aug 2012 at 14:00 UTC



Cecilia Marcos,  
AEMET

# iSHAI: imaging Satellite Humidity and Instability.

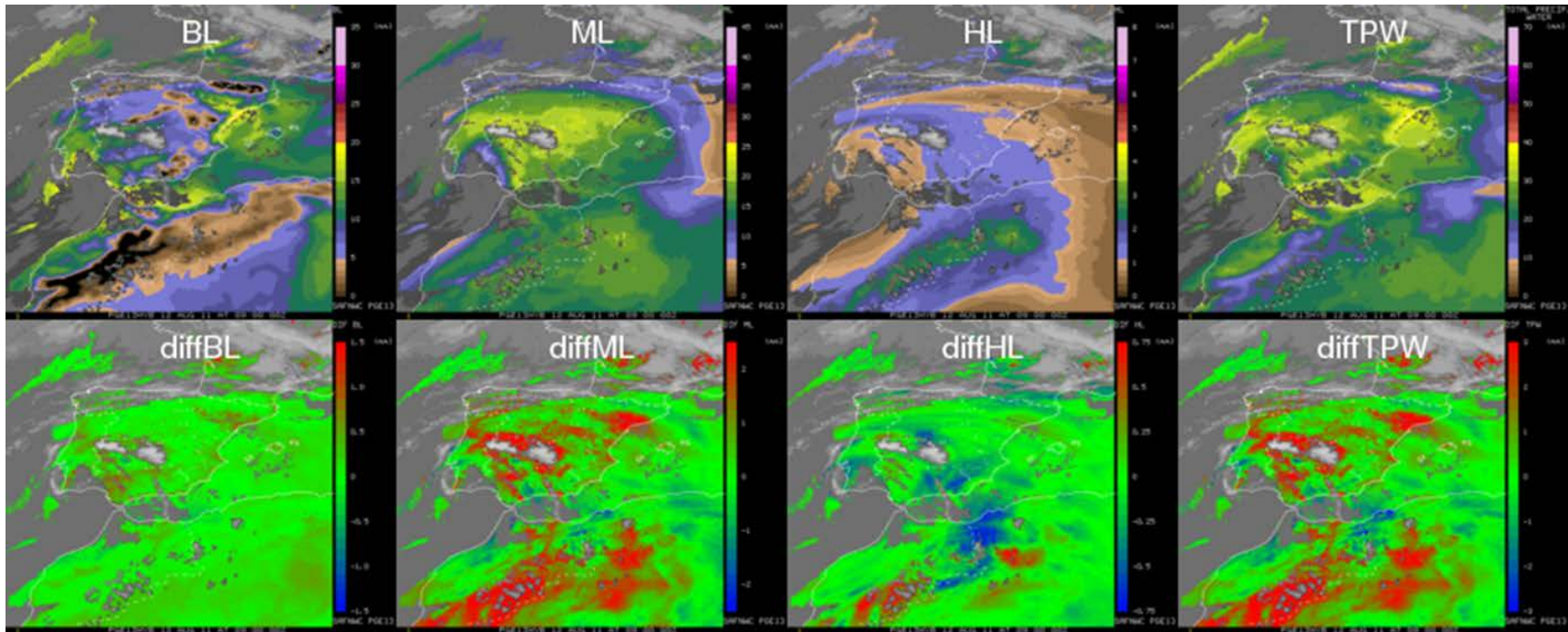
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- Calculated at cloud free pixels
- Application: detection of pre-convective areas
- Specially useful when NWP model does not capture the actual situation



# iSHAI: imaging Satellite Humidity and Instability.

## Outputs: Precipitable water content fields



**BL**  
Precipitable Water in  
Boundary Layer  
(Psf-850hPa)

**ML**  
Precipitable Water  
in Middle Layer  
(850-500 hPa)

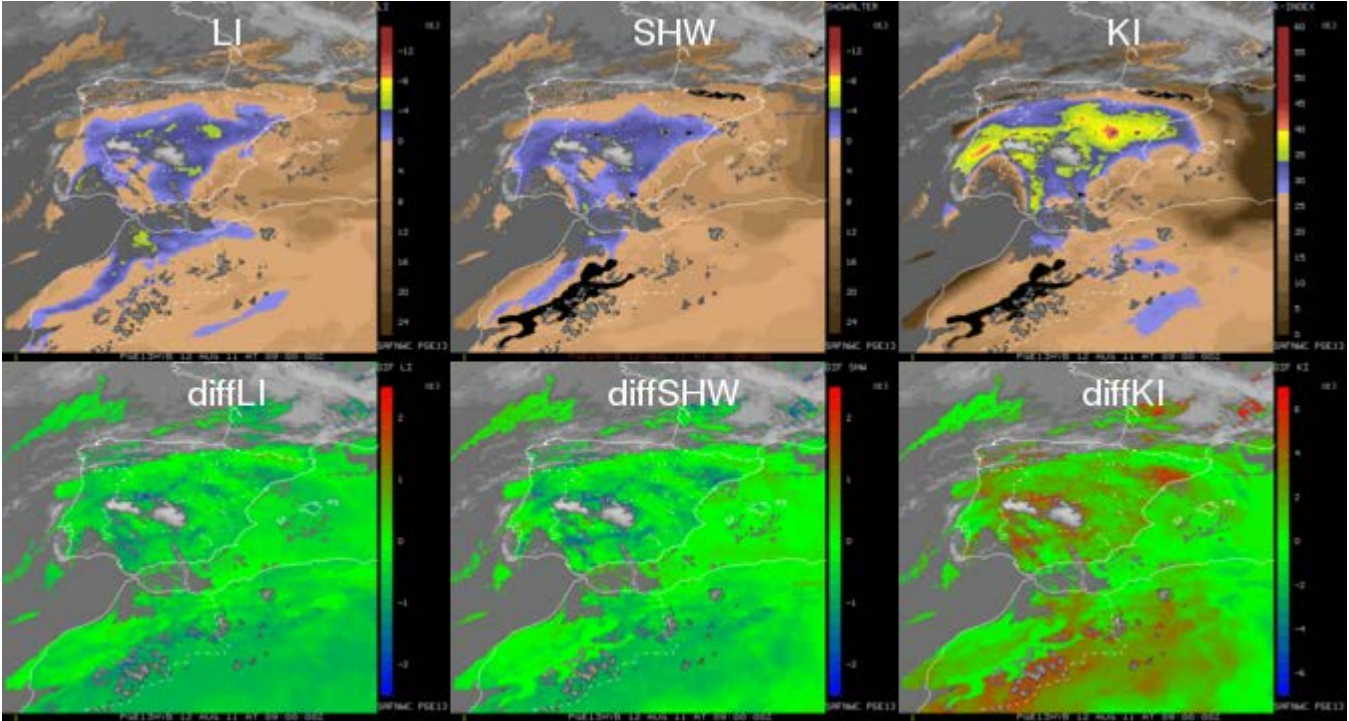
**HL**  
Precipitable Water  
in High Layer  
(500-0.1 hPa)

**TPW**  
Total Precipitable Water in Middle  
Layer  
(Psf-0.1 hPa)

*th*  
12 August 2011 9:00 UTC

# iSHAI: imaging Satellite Humidity and Instability.

## Outputs: instability indices fields



Lifted Index

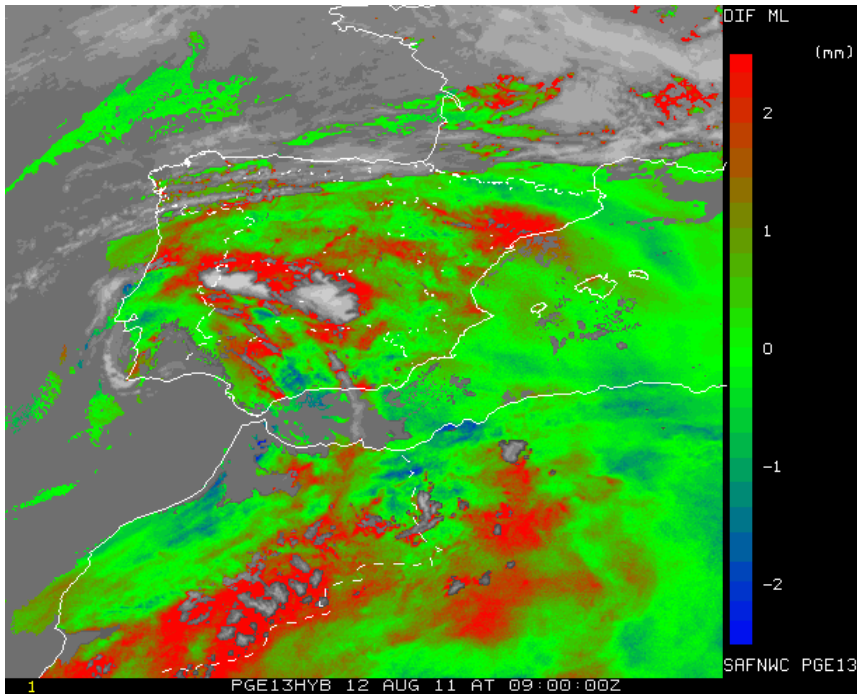
Showalter Index

K Index

12<sup>th</sup> August 2011 9:00 UTC

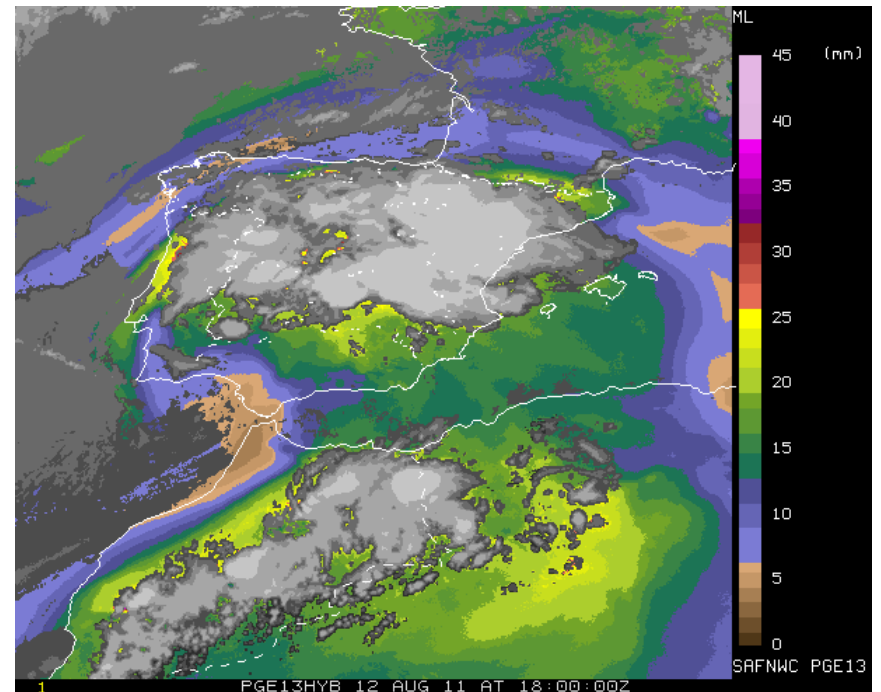
# Difference of precipitable water field in Middle levels

12th August 2011 9:00 UTC



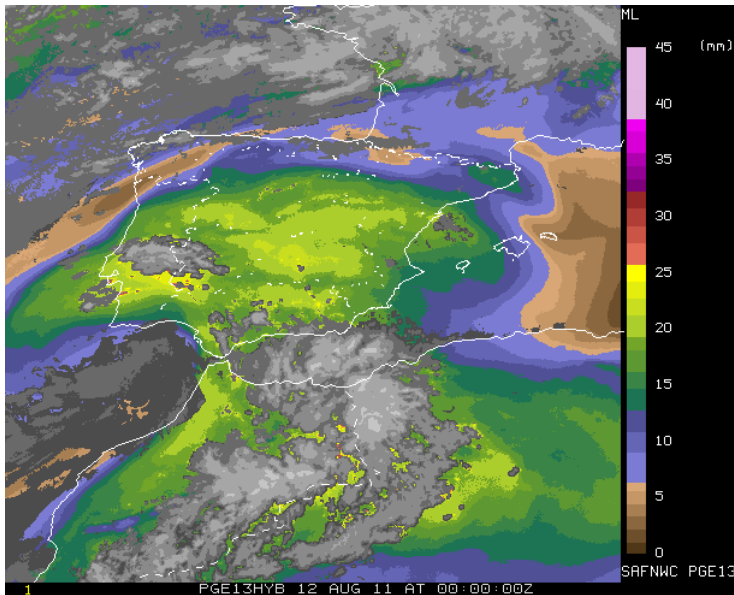
Differences with the NWP model:  
Precipitable Water in Middle Layer  
ML(850-500 hPa)

12th August 2011 18:00 UTC

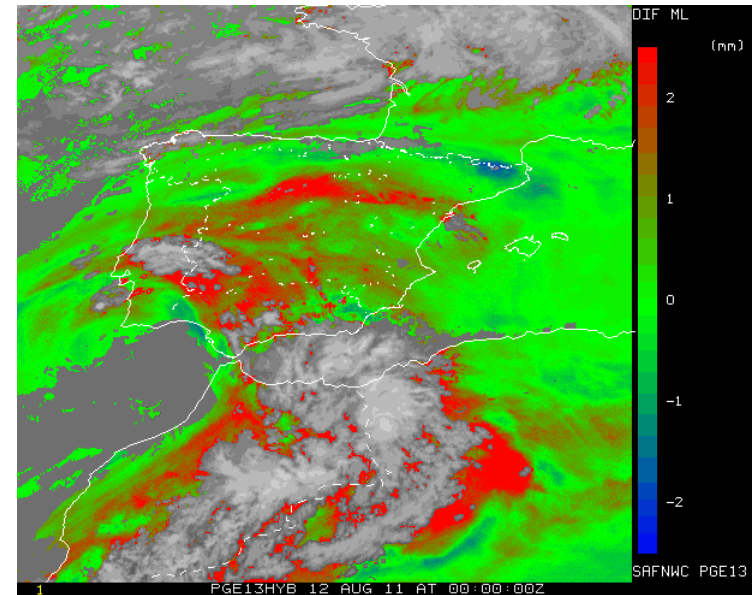


Precipitable Water in Middle Layer  
ML(850-500 hPa)

# Application: identification of pre-convective areas



Precipitable Water in  
Middle Layer  
ML(850-500 hPa)



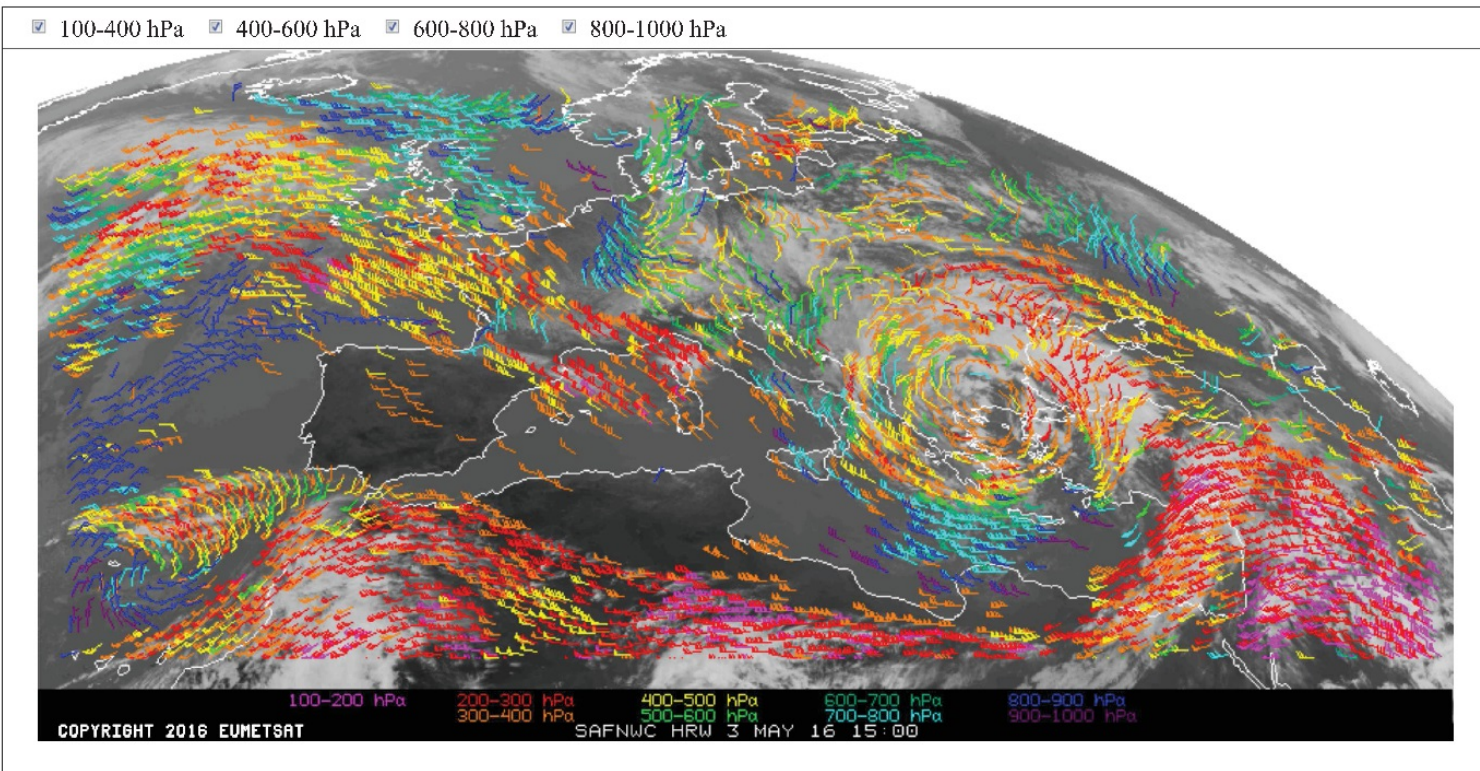
Differences with the  
numerical model:  
Precipitable Water in  
Middle Layer  
ML(850-500 hPa)

12th August 2011

# HRW: calculation of winds at different levels from the tracking of tracers in consecutive satellite images.

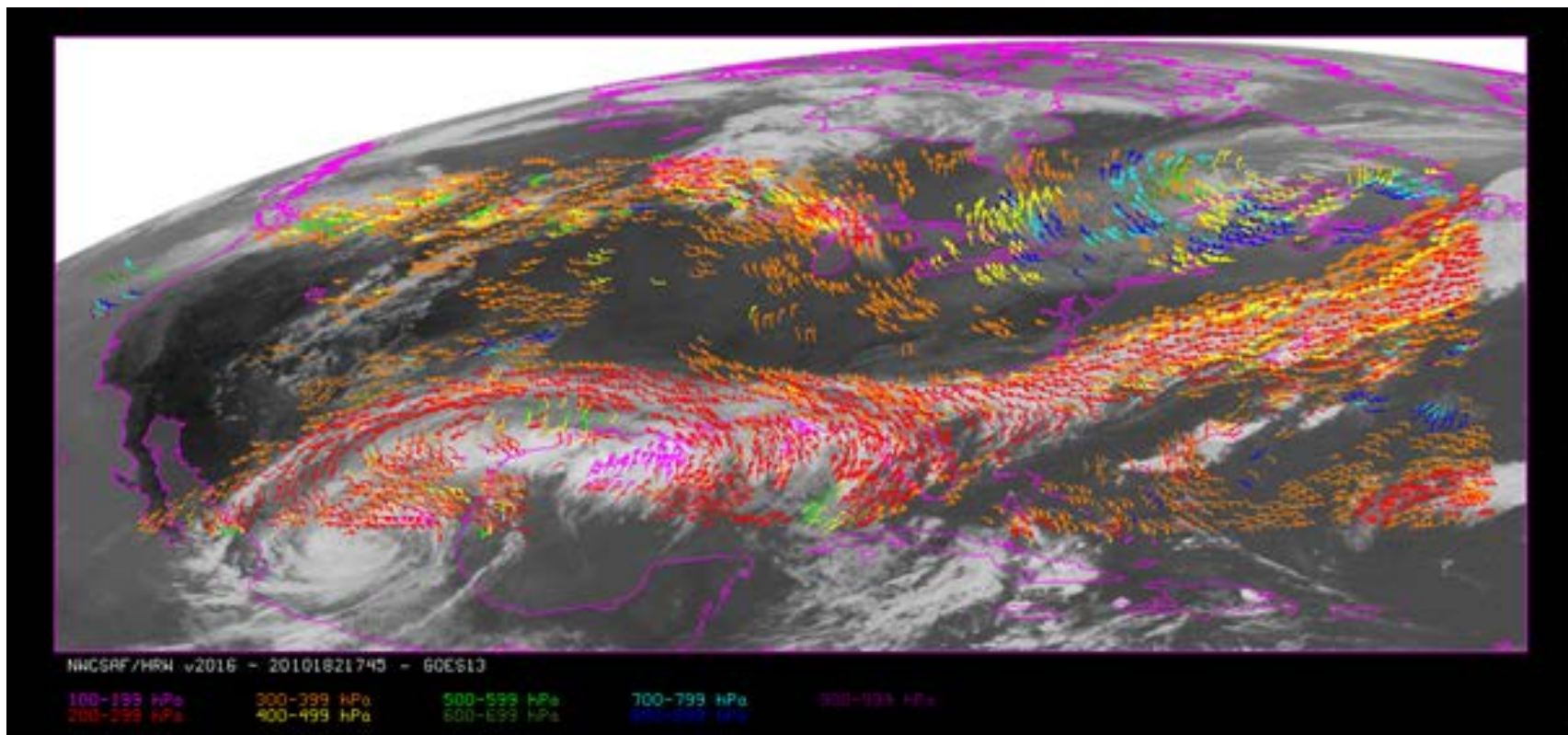
Product assimilated in MetOffice model

- Applications:
- Nowcasting (strong winds, convergence/divergence lines,...)
  - Assimilation in NWP models
  - Aviation



# NWC SAF High Resolution Winds (HRW)

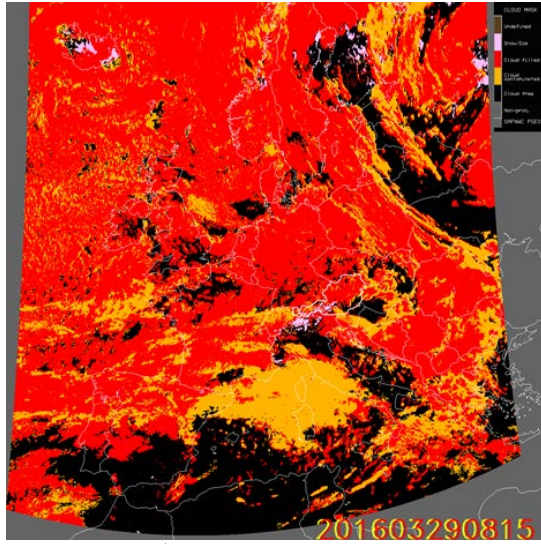
HRW adapted to GOES-N: new in GEO v2016!



*NWC/GEO High Resolution Winds v2016 AMV output  
example in the Continental United States region (1 July  
2010 1745Z, GOES13 satellite),*

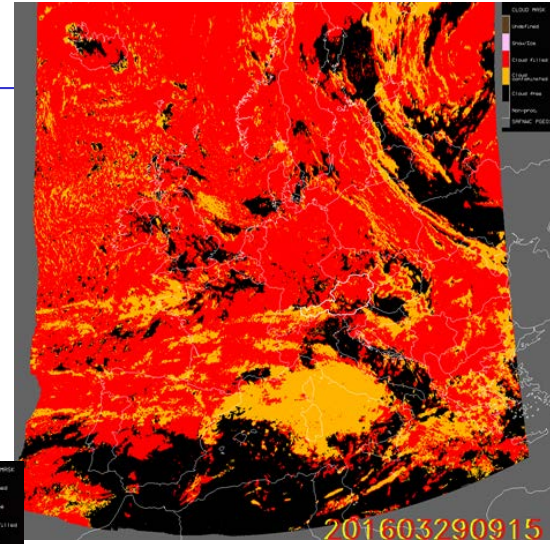
Javier García  
Pereda, AEMET

# Extrapolated Imagery (EXIM): extrapolation of MSG images and NWC SAF products using the NWC SAF HRW winds

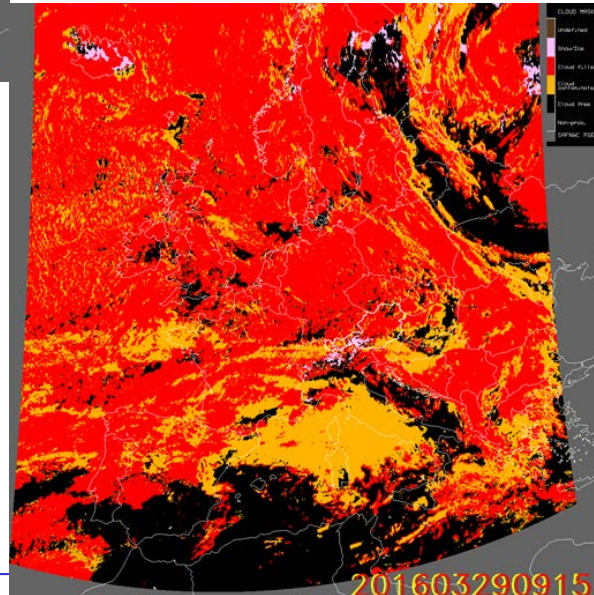


CMa 08:15

Extrapolated product  
08:15 → 09:15



CMa 09:15



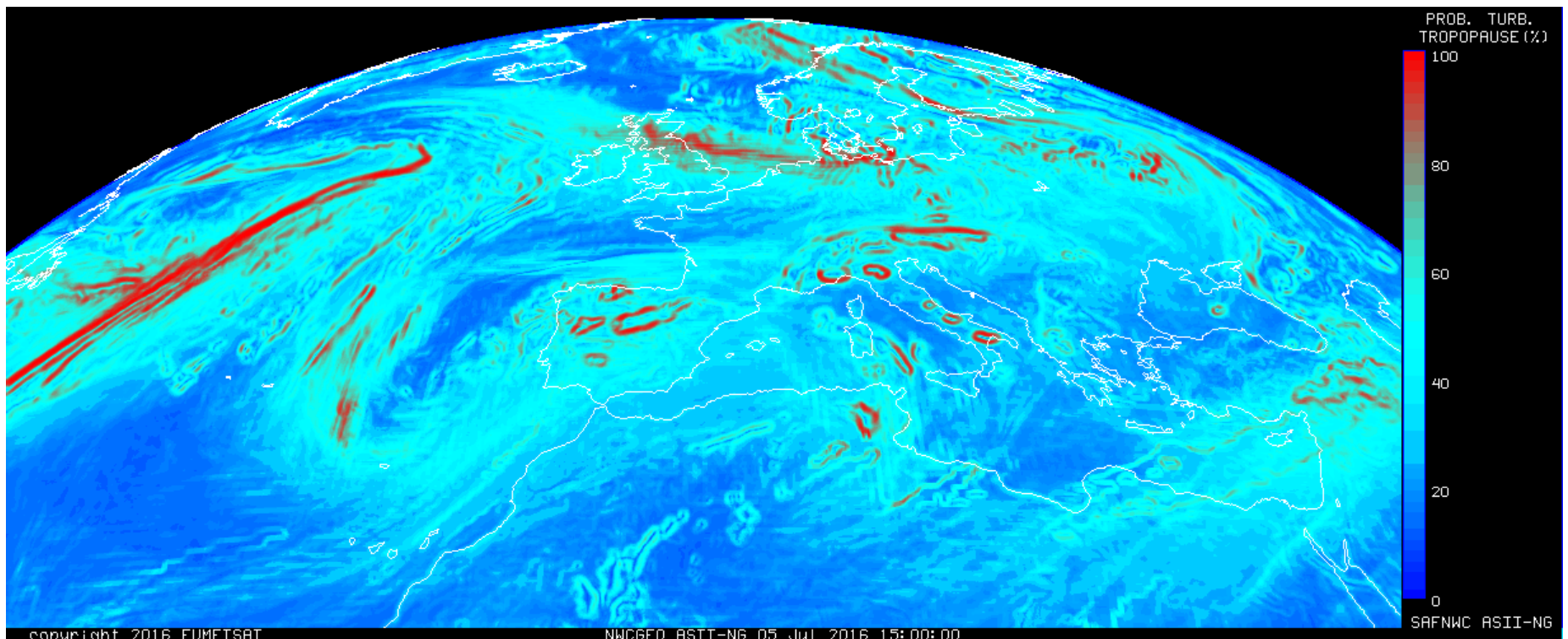
New GEO v2016!  
Pre-operational

# Automatic Satellite Image Interpretation

## New Generation (ASII-NG): probability of occurrence of meteorological phenomena

Probability of occurrence of tropopause folding.  
Next version: mountain waves

**New GEO v2016!**  
**Pre-operational**



5 July 2016 15:00 UTC



# EUMETSAT New Generation of Satellites.

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## Meteosat Third Generation (MTG) Satellites:

- Twin Satellite Concept, based on 3-axis platforms.
  - ✓ Four Imaging Satellites (MTG-I) (20 years of operational services expected)
  - ✓ Two Sounding Satellites (MTG-S) (15.5 years of operational services expected)

# Meteosat Third Generation (MTG) Payload

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## MTG-I

### **The Flexible Combined Imager (FCI)**

Continuity of SEVIRI, with enhanced capabilities: 16 channels (8 solar, 8 thermal), 1-2 km resolution, 10 minutes in the normal scanning mode

### **The lightning imager (LI)**

Total lightning (Intra Cloud (IC) and Cloud to Ground (CG) in NRT.

The LI mission will be able to detect, monitor, track and extrapolate, in time, the development of active convective areas and storm life cycles — critical for nowcasting

# Meteosat Third Generation (MTG) Payload

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## MTG-S

### **The Infrared sounder**

Hyperspectral resolution of 0.625 cm<sup>-1</sup> wave-number, 800 LWIR channels, 920 MWIR channels), spatial resolution of 4 km, repeat cycle 60 min

### **The Ultraviolet sounder**

Spectrometer in the ultraviolet (UV: 305–400 nm), the visible (VIS: 400–500 nm) and the near infrared (NIR: 755–775 nm), spatial resolution of better than 10 km

Designed for geostationary chemistry applications

# EUMETSAT EPS-SG

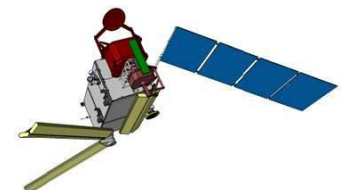
## EPS-SG-a (First Satellite launch in 2021)

- METImage (continuity of AVHRR with enhanced capabilities 6-> 20 channels, better spatial resolution)
- IASI-NG (Doubling of radiometric and spectral resolution of IASI )



## EPS-SG-b

- SCA
- MWI New Instrument!
- ICI New Instrument!



# NWC SAF Future plans:

## Adaptation of NWC SAF products to enhanced instruments in the new era satellites

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MTG-FCI and MTG-LI on board of MTG-I:

General improvement of products due to better spatial and temporal resolution (particular importance for detection and tracking of convection).

New channels will improve quality of Cloud microphysical products.

LI data will contribute to improve convection and precipitation products.

METimage on board of EPS-SG a:

Additional channels and a better spatial resolution

Improvement of PPS Cloud products

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# NWC SAF Future plans:

## Adaptation of NWC SAF products to other satellites (not EUMETSAT)

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- Adaptation of NWC SAF GEO products to Himawari and GOES-R/S. AHI and ABI sensors are similar to MTG-FCI radiometer
- Adaptation of NWC SAF PPS products to Chinese satellites in the Fung Yun 3 series, carrying the MERSI-2. This will considerably improve data coverage at high latitudes.

# NWC SAF Future plans:

## New products from New instruments

- **MTG-LI on board of MTG-I** : Proposed products are (but not limited to): LI tracking, Flash rate tendency, Flash area and Flash energy
- **MTG-IRS on board of MTG-S**: It will provide unprecedented information on horizontally, vertically, and temporally (4-dimensional) resolved water vapour and temperature structures of the atmosphere

New products: qIRS, sSHAI\_ES, sSHAI

← Presented by Dr. Calbet in M2B session on Monday

- **MWI/ICI on board of EPS-SG B**: precipitation and cloud imaging , ice cloud and snowfall imaging

New products: LWP, IWP, PR

*Contact:*

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*[www.nwcsaf.org](http://www.nwcsaf.org)*

*Thanks for your attention!!*