
Nowcasting SAF products and applications

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Using ECMWF's Forecasts UEF2017
Workshop: Satellite – based storm monitoring and observational input to NWP
12-16 June 2017, ECMWF, Reading, UK

Outline

- Introduction to EUMETSAT SAF Network
- Introduction to Nowcasting SAF (NWC SAF)
- NWC SAF products
 - ✓ Monitoring storms
 - ✓ As input to NWP models
- Conclusions

EUMETSAT SAF Network

- **EUMETSAT European Organization 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**
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EUMETSAT SAF Network

SAFs are specialized on topics and themes:

- SAF on Climate Monitoring (CM SAF), cm-saf.eumetsat.int
- SAF on Support to Operational Hydrology and Water Management (H SAF), h-saf.eumetsat.int
- SAF on Land Surface Analysis (LSA SAF), lsa-saf.eumetsat.int
- SAF on Numerical Weather Prediction (NWP SAF), nwp-saf.eumetsat.int
- SAF on Atmospheric Chemistry Monitoring (AC SAF), ac-saf.eumetsat.int
- Ocean and Sea Ice (OSI SAF), osi-saf.eumetsat.int
- SAF on Radio Occultation Meteorology, rom-saf.eumetsat.int
- SAF on support to Nowcasting (NWC SAF), nwc-saf.eumetsat.int

NWCSAF concept: objectives

- ✓ 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.
 - ✓ The NWC SAF SW allows the user to generate satellite derived products with a direct application in Nowcasting
-

NWC SAF Software

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

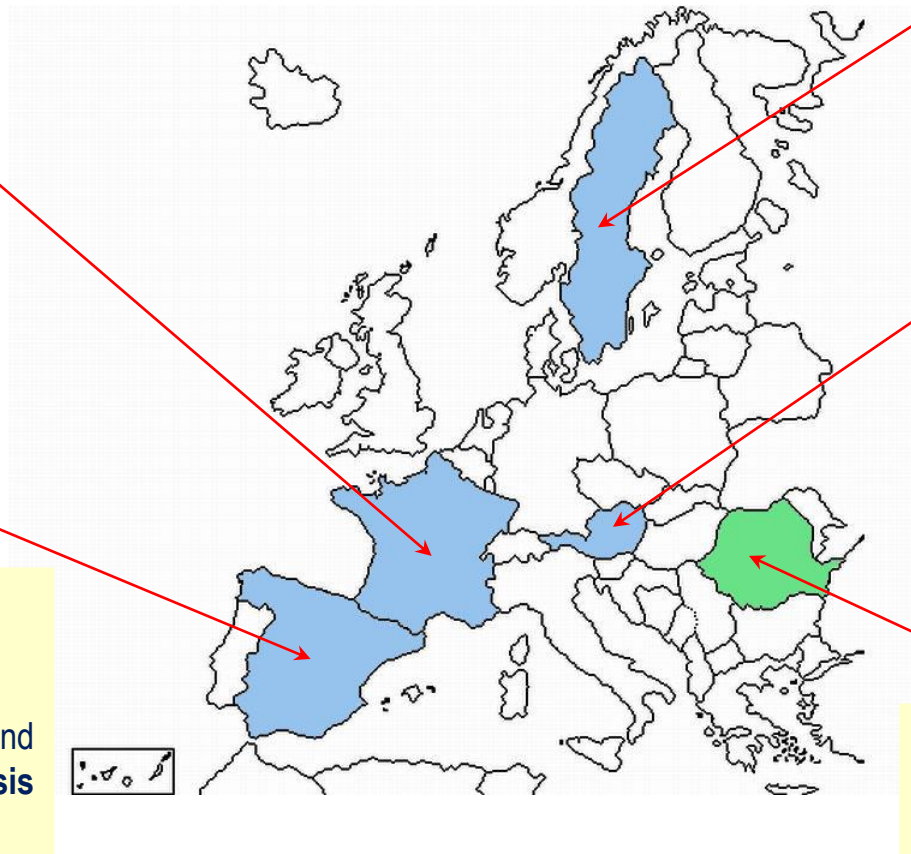
NWC SAF Consortium



Cloud products and convection products for geostationary satellites



Leading Entity
High Resolution winds
Precipitation products
Precipitable water and stability analysis product



Cloud and precipitation products for polar satellites

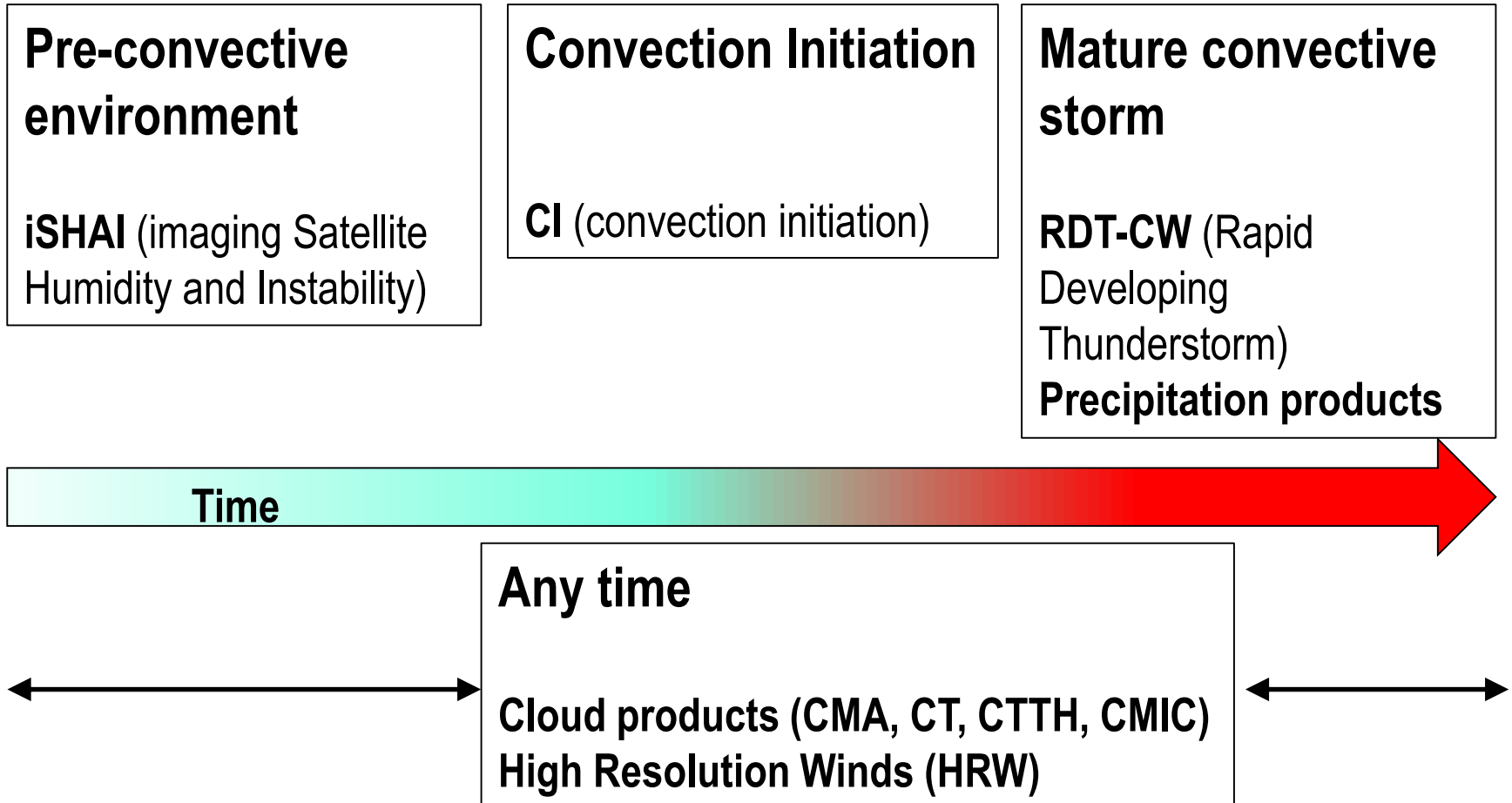


GEO extrapolation imagery products
automatic recognition of meteorological phenomena



Since March 2017!
quality assessment and prototype products for MTG-LI

NWCSAF Products: storms monitoring at different development stages



Preconvective environment

iSHAI: imaging Satellite Humidity and Instability.

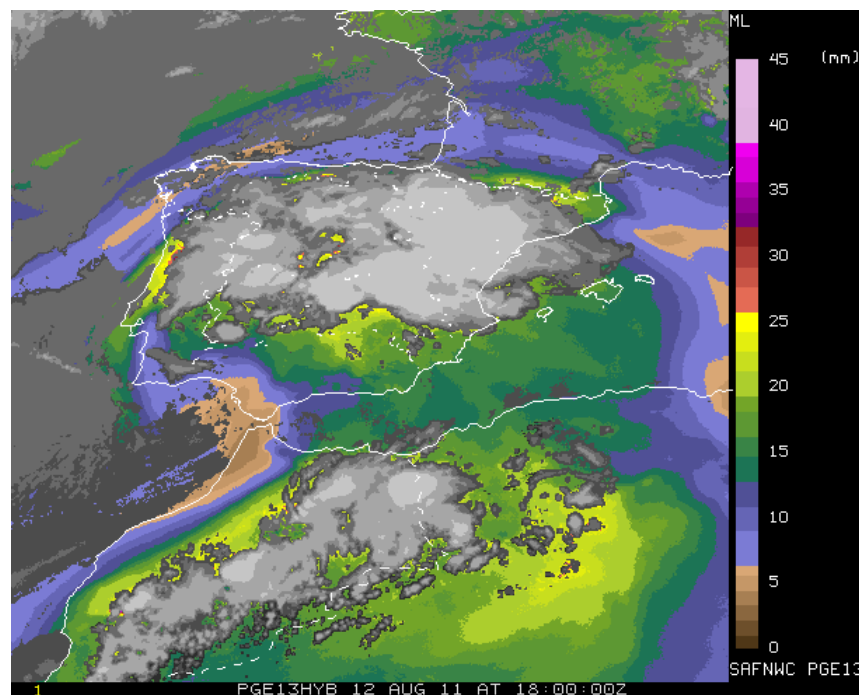
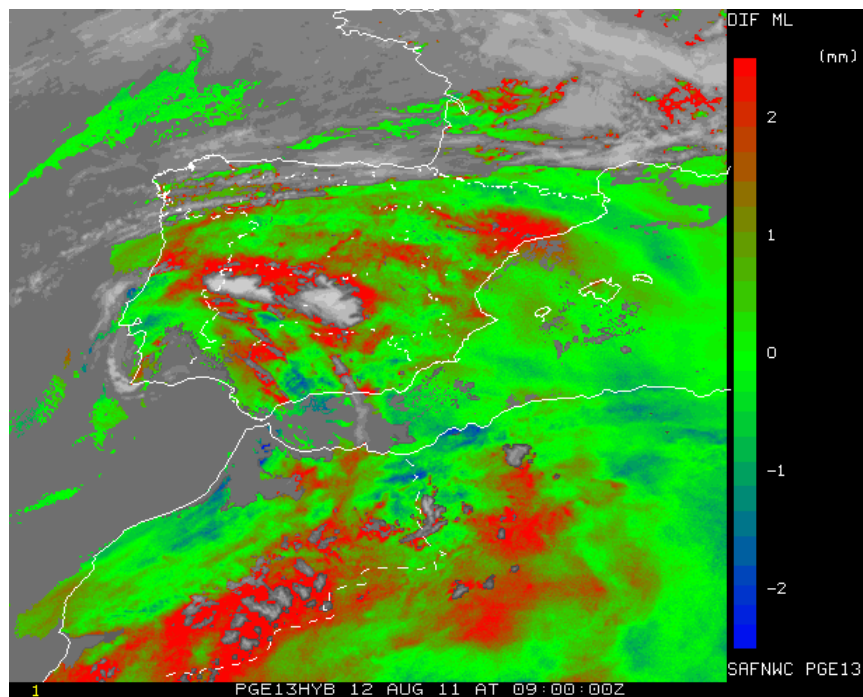


- Calculated at cloud free pixels
- Stability indices (KI, LI, SHW) and Precipitable water (total column and at different layers)
- Application: detection of pre-convective areas
- Specially useful when NWP model does not capture the actual situation

Application: identification of pre-convective areas

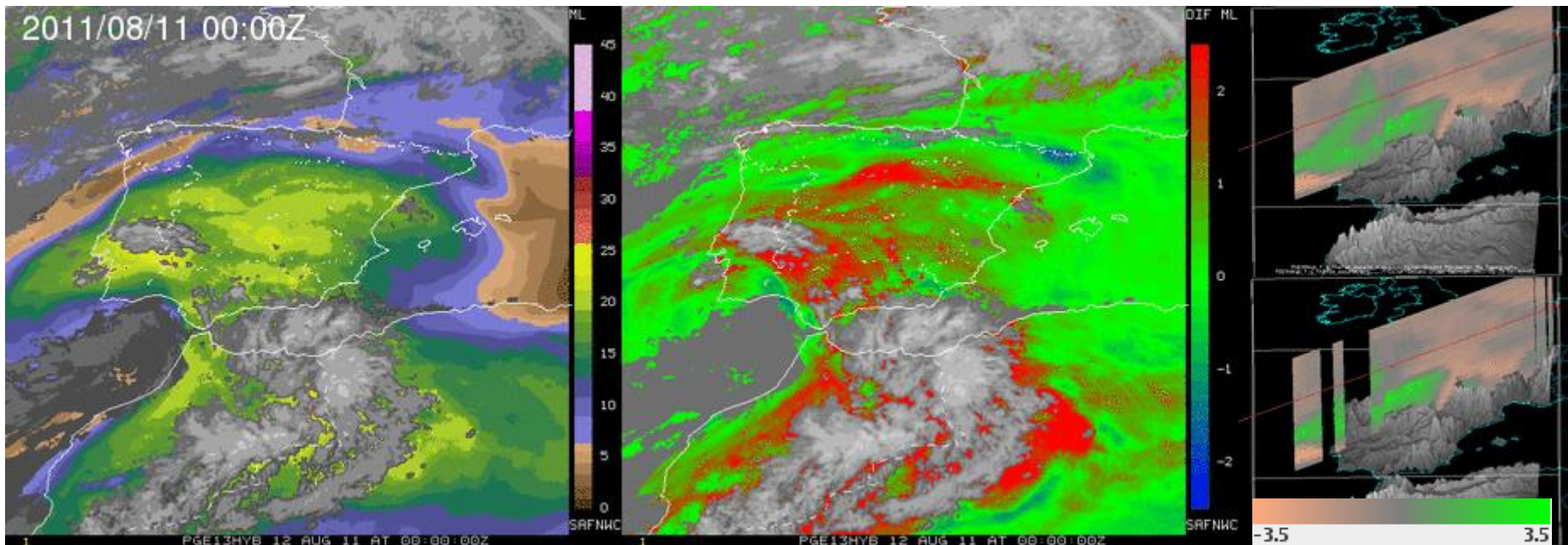
12th August 2011 9:00 UTC

12th August 2011 18:00 UTC



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

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



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

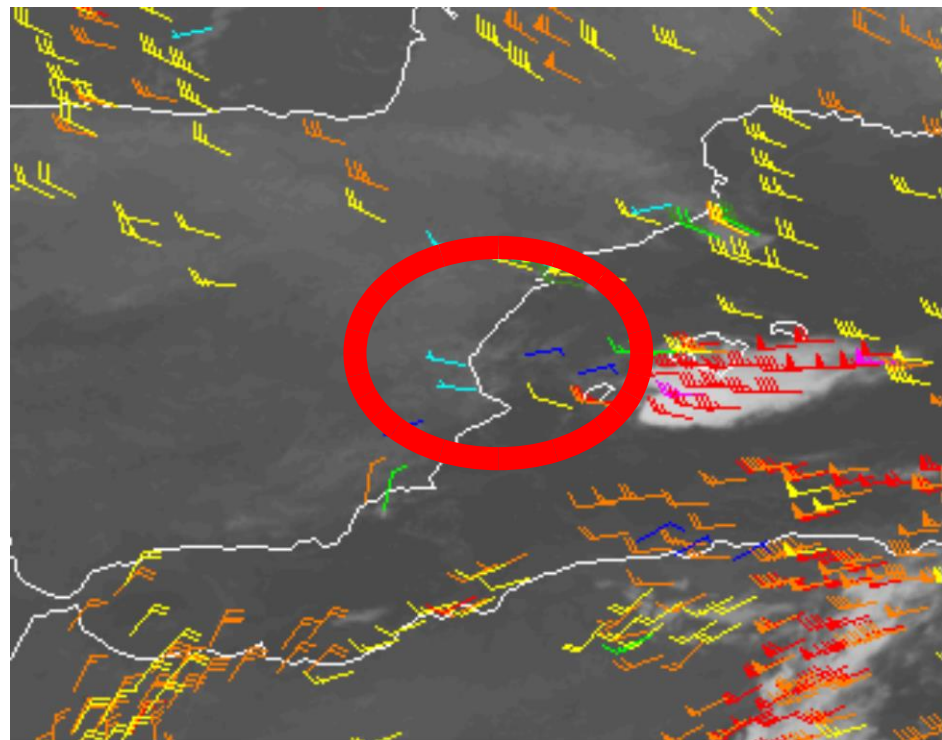
Differences on Precipitable Water in Middle Layer
ML(850-500 hPa) with NWP

Vertical cross sections of normalized q at every level
(top) ECMWF
(bottom) iSHAI

HRW. Example Pre-convective environment 19 August 2015

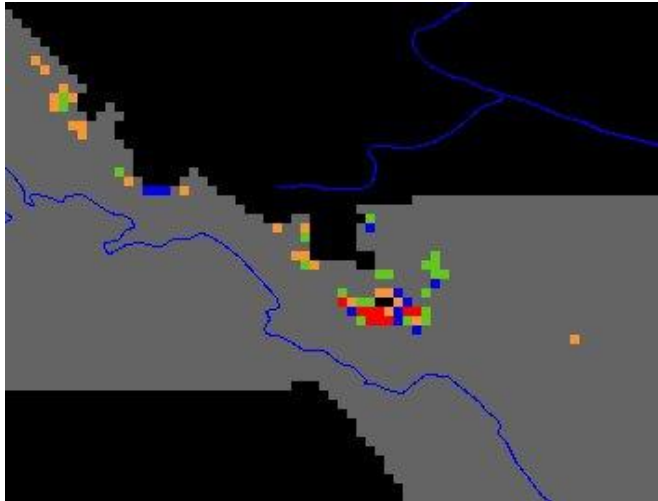
4:00 am HRW Winds at different levels
(low levels in blue)

HRW showing
convergence in the region
of interest at **4:00 am**,
while **RDT** shows cell at
5:15 am and **Intense**
precipitation at **07:00 am**



New GEO v2016 product Convection Initiation

CI: Probability of a warm cloud to become a thunderstorm in the near future (30 minutes).



Visualization as
a field of probabilities:

■ No convection initiation

Probability of convection for
pixels:

■ 0-25% ■ 25-50%
■ 50-75% ■ >75%

Delivered as a demonstrational product in GEO v2016.

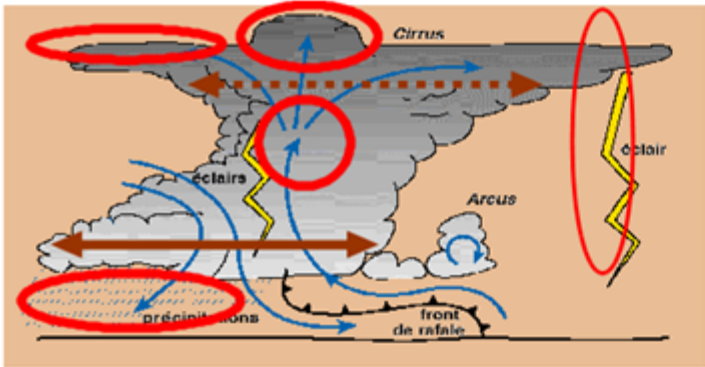
A major improvement is expected in GEO v2018, due to new tuning, use of microphysics, improvement of tracking.

Mature stage. RDT-CW

RDT-CW - Rapid Developing Thunderstorm, convective warning

Each “Convection cell” identified with its specific characteristics:

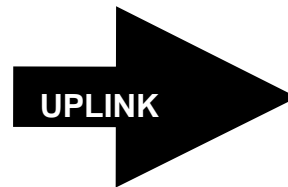
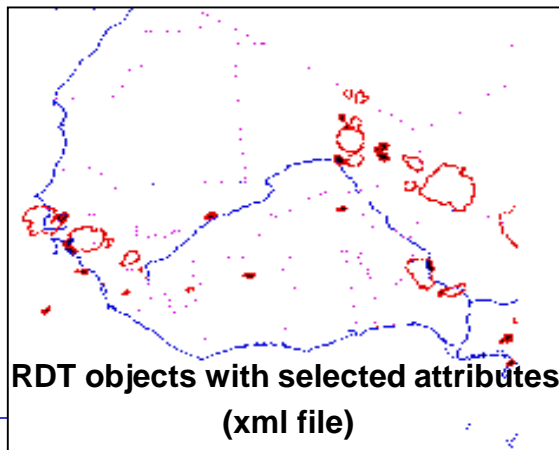
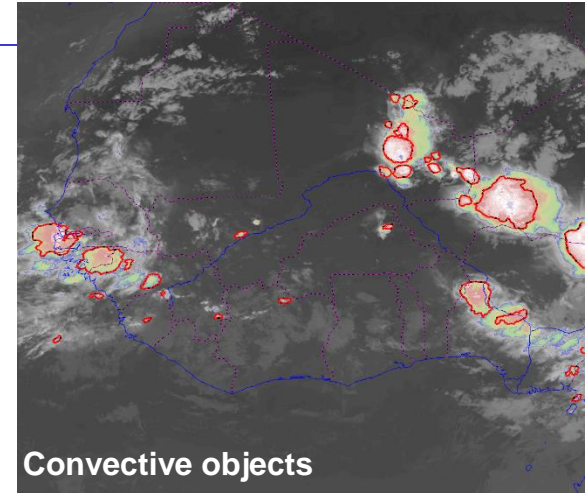
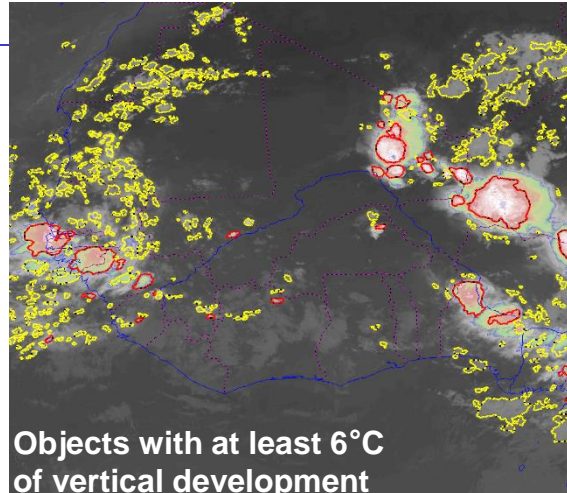
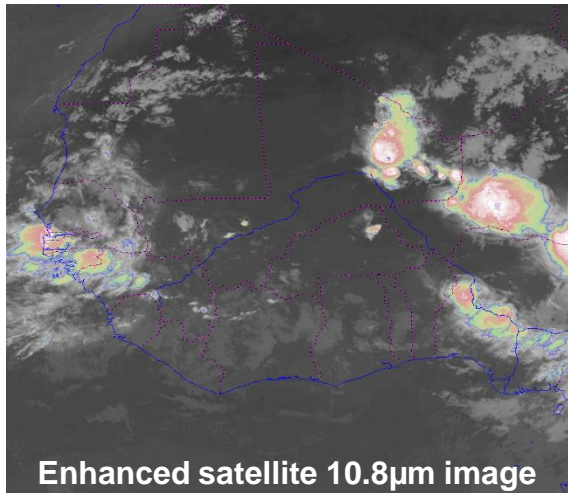
Multilevel Description Of Convection



YES/NO Convection + Attributes of cells

- Position
- Surface
- T
- Gap to tropopause
- Cloud type and phase
- Cloud top pressure
- Lightning Activity
- Overshooting Tops
- Rainfall Activity
- Convective Index
- Severity Index
- Displacement
- Relevant trends (T, area)

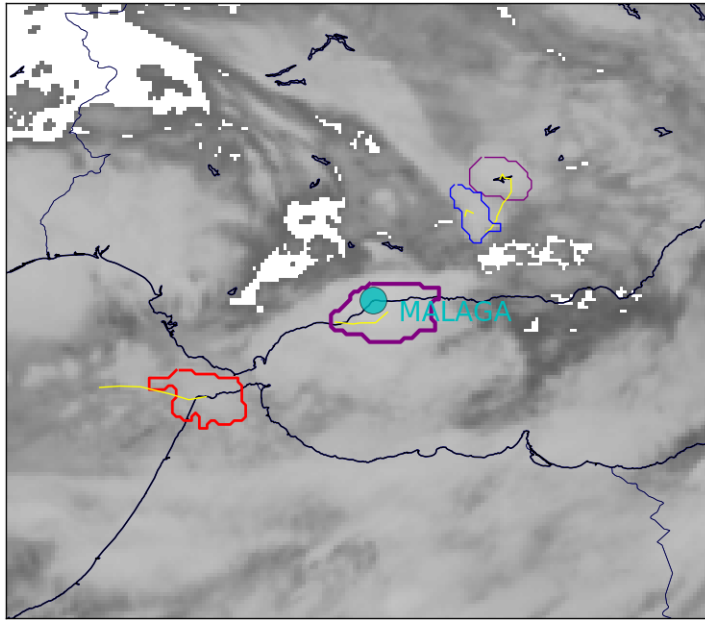
Some characteristics can be very useful for some specific users. Aeronautical users.



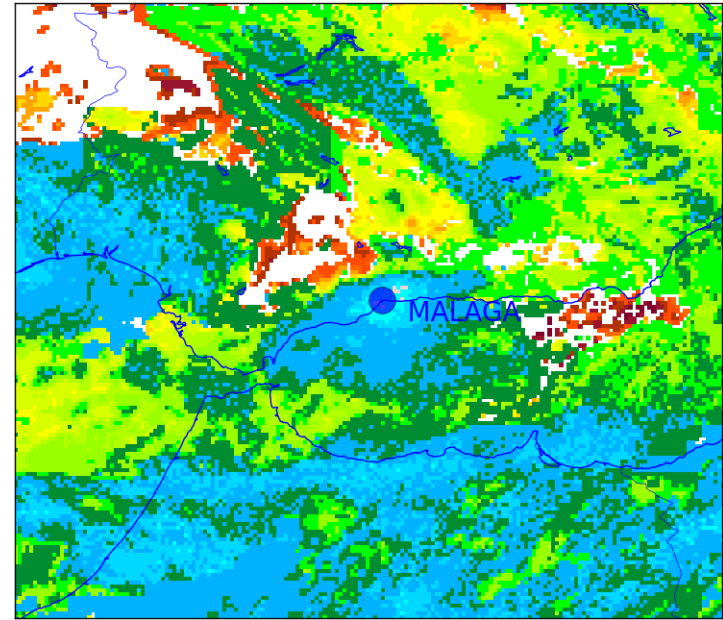
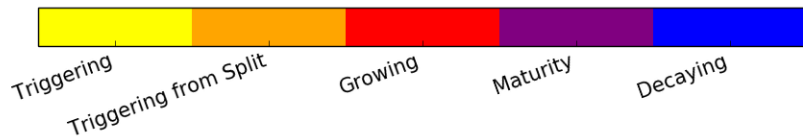
19 February 2017. City of Málaga affected by highly localized and stationary thunderstorms

S_NWC_RDT-CW_MSG3_Europe-VISIR_20170219T030000Z

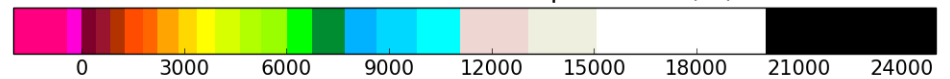
S_NWC_CTTH_MSG3_Europe-VISIR_20170219T030000Z



RDT-CW



NWC GEO CTTH Cloud Top Altitude (m)



**CTTH shows Cloud tops up to 12Km,
Echotops max 9 Km**

Convective Rainfall Rate. CRR and CRR-Ph

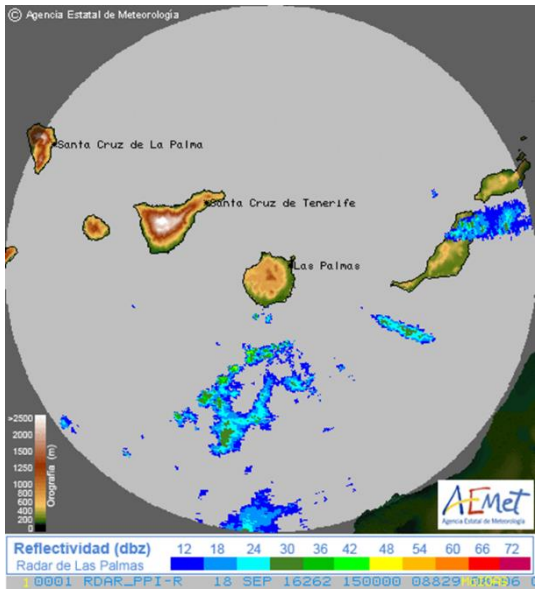
Both products generate

- Intensity of precipitation associated to convective systems
- Precipitation accumulated in the last hour

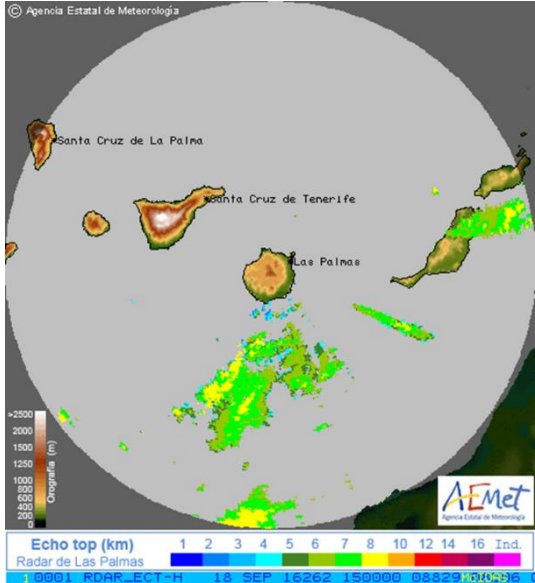
CRR: precipitation empirically derived from VIS(0.6), IR (10.8) and [IR (10.8)-WV(6.2)] SEVIRI channels. Available day and night

CRR-Ph: precipitation derived from Cloud microphysical properties (CMIC).
Only available at day time.

18 September 2016 15:00 UTC. Convection in the Canary Islands Region

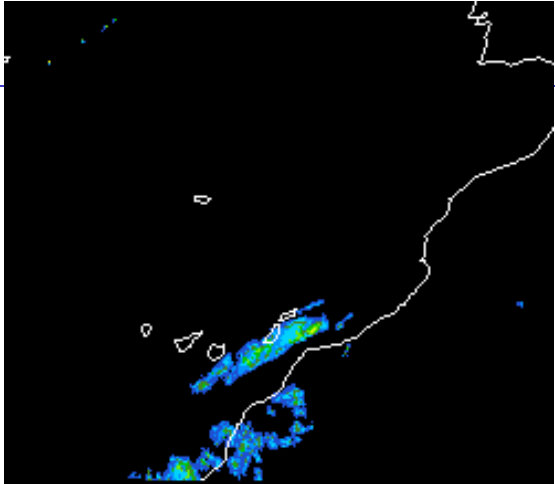


Reflectivity

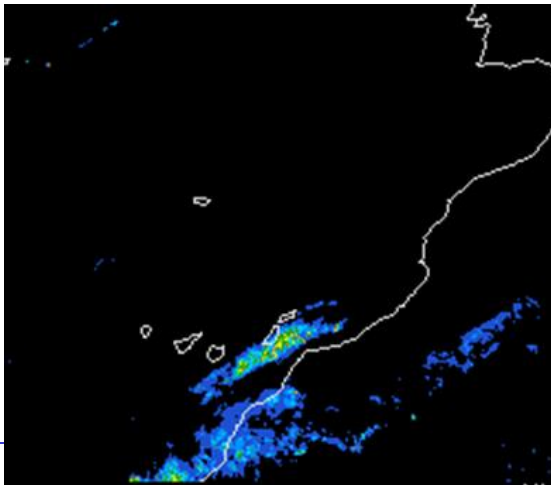


Echo Tops

CRR



CRR-Ph



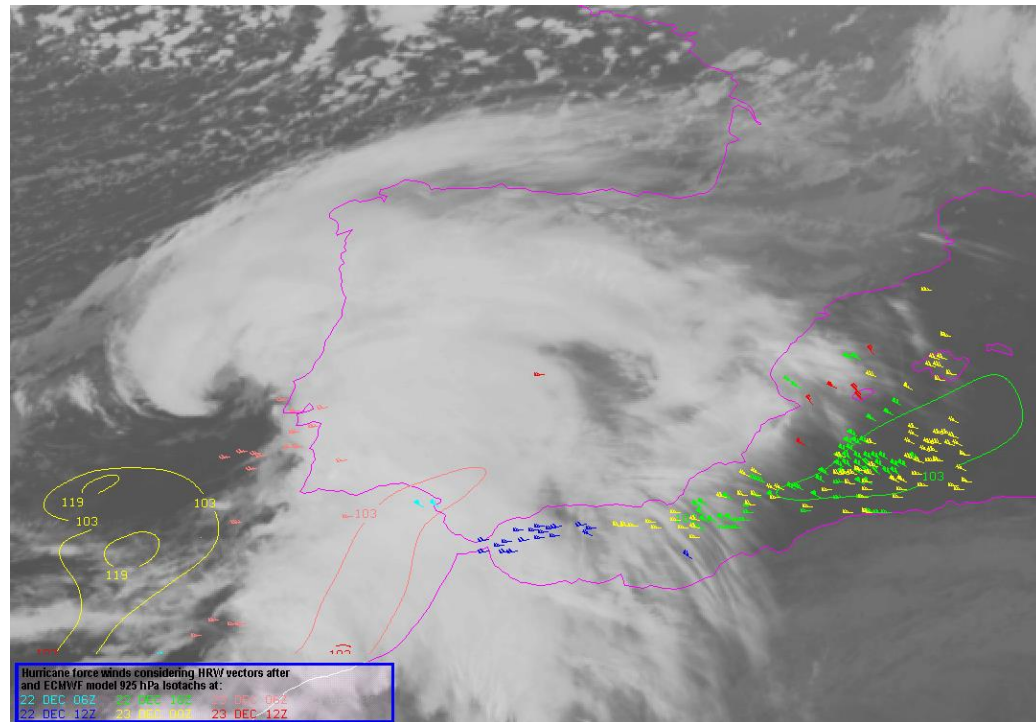
Convective Rainfall Rate. CRR and CRR-Ph

- Indirect measurements of the precipitation
- Radar data is more reliable than these satellite derived products
- CRR and CRR-Ph are very useful:
 - ✓ In areas without radar coverage
 - ✓ When a radar is down
 - ✓ In areas that are “hidden” to the radar

Explosive Cyclogenesis entering Portugal from the Atlantic Ocean in the night of 22-23 December 2009

HRW product identifies a narrow band of hurricane winds between 850-1000 hPa,
which fits very well with the affected area (mean winds in 15 min. of 125-150 km/h)

These winds were not identified by the ECMWF model used for calculation of HRW,
and so HRW proves it can provide additional elements useful for the forecasting.



NWC SAF products: Other applications.

Observational input to NWP

- **Assimilation in NWP models. HRW product is assimilated in mesoscale model of the MetOffice since some years**
- **NWC SAF could be used for verification of models (especially over areas with sparse observation network)**
 - **Cloud products**
 - **HRW**
 - **RDT product**
- **Bogusing/analysis improvement (RDT)**

CONCLUSIONS

- **NWC SAF products have proved to be useful for monitoring storms at different development stages**
- **We are preparing a short practical guide how to use the NWC SAF products (main applications and limitations)**
- **User feedback on the use of the NWC SAF products is very welcome**
- **The products are currently being tested in the ESSL Testbed**
- **Products will be adapted to the new generation satellites (MTG, Himawari, GOES-R)**
- **We will generate products for the new satellite missions (MTG-LI, MTG-IRS, EPS-SG B MW sensors)**
- **NWC SAF can be used as input to NWP models**

More information:

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Thank you very much for your attention!