The EUMETSAT Network of Satellite Application Facilities

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

AEMet
Agencia Estatal de Meteorología

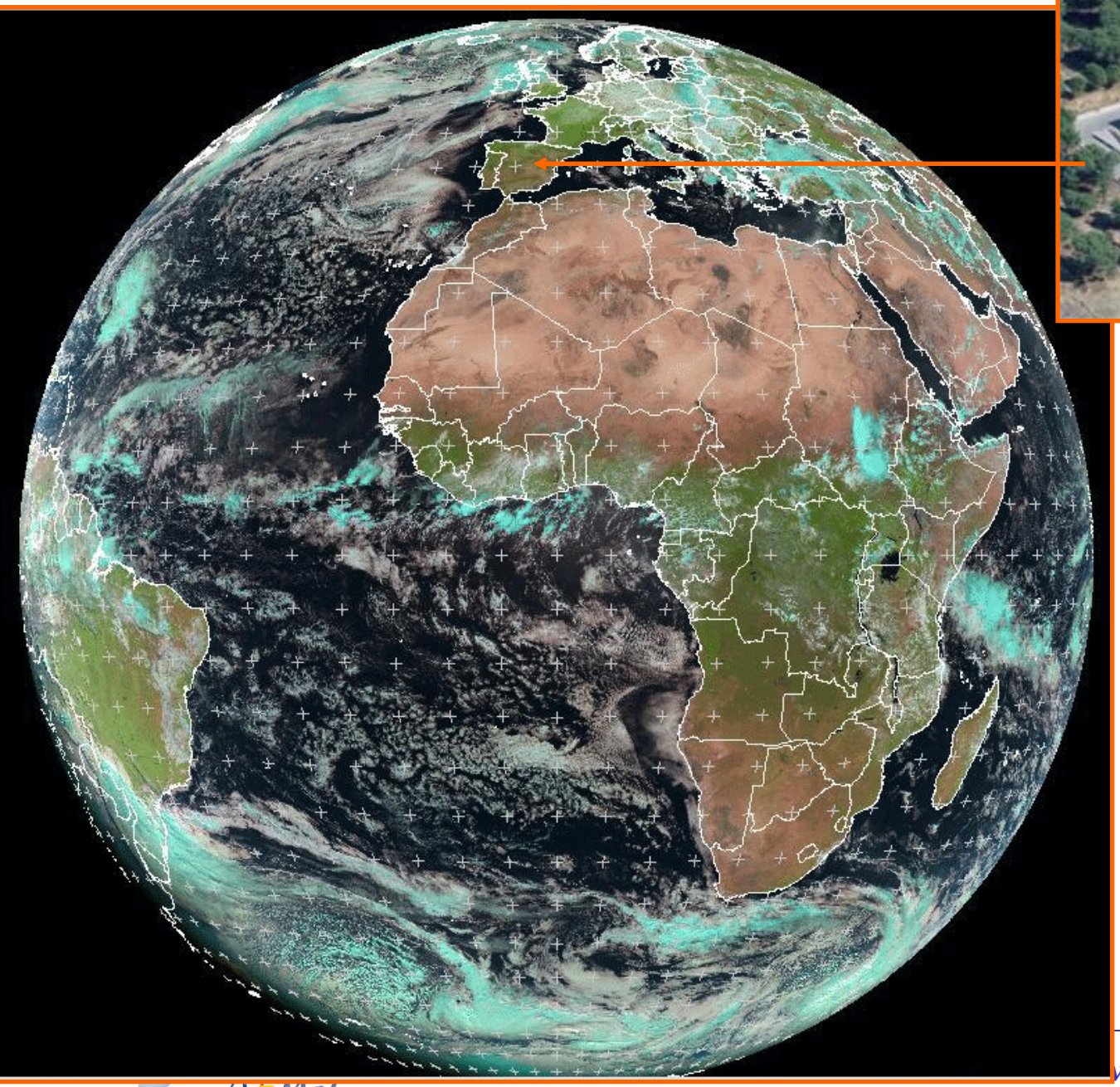
EUMETSAT

Nowcasting SAF: Convective Rainfall Rate (CRR) and Convective Rainfall Rate from Cloud Physical Properties (CRPh) products

Convection – Event Week 2015

8 – 12 June 2015

Cecilia Marcos



Cecilia Marcos
AEMET
NWCSAF

NWC SAF AEMET Agencia Estatal de Meteorología

Overview

I. Introduction to EUMETSAT Nowcasting SAF

II. Convective Rainfall Rate (CRR)

- ✓ Algorithm description
- ✓ Applications, limitations and visual examples

III. Convective Rainfall Rate from Cloud Physical Properties (CRPh)

- ✓ Algorithm description
- ✓ Applications, limitations and visual examples

IV. Comparison of Convective Rainfall Rate products (CRR and CRPh): visual examples

Introduction to EUMETSAT NWCSAF

The Nowcasting Satellite Application Facility was established in 1996 between Eumetsat and INM (Instituto Nacional de Meteorología).

Consortium:

AEMet Agencia Estatal de Meteorología · METEO FRANCE Toujours un temps d'avance · SMHI · ZAMG

Objectives:

- ✓ **Development of Nowcasting products derived from both GEO and PPS satellite systems**
- ✓ **To be delivered to users as SW Packages**

Responsible for

- ✓ **Development and maintenance of the NWC products**
- ✓ **Development and maintenance of the SW Packages**
- ✓ **User's support tasks made through dedicated Help Desk (training)**

Introduction to EUMETSAT NWCSAF

Products are generated in the users' premises

Features of the products:

- **Near Real Time (NRT)**
- **Full resolution**
- **Frequency to be selected by the user (default every repeat cycle)**
- **Region to be selected by the user**

More information on the project is available at Nowcasting SAF Web site:

http://www.nwcsaf.org

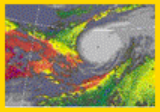
Introduction to EUMETSAT NWCSAF

Help Desk

NWC SAF

Home

Topical Images Gallery



SAFNWC General Information
Scientific Documentation
Visiting Scientist Activities
VSA Announcements
VSA Reports
SW Delivery Conditions
Workshops, Surveys & Training

Sign in

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News

PPS v2014 patch in SW Packages & Patches
14/04/2015

Registration for NWCSAF/PPS Engineering Workshop
16/01/2015

NWCSAF 2015 Users Workshop Second

The EUMETSAT Network of Satellite Application Facilities

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

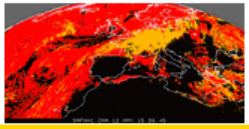
EUMETSAT

MAIL

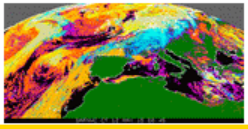
MSG	PPS

MSG Cloud Products

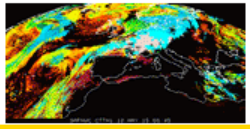
Cloud Mask (Description)



Cloud Type (Description)

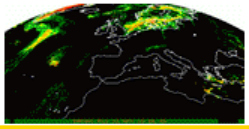


Cloud Top Temperature and Height (Description)



MSG Precipitation Products

Precipitating Clouds (Description)

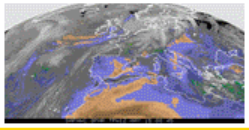


Convective Rainfall Rate (Description)

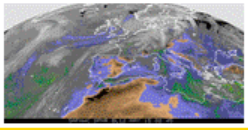
Prec. Prod. Cloud Physical Properties (Description)

MSG Clear Air Products Physical Retrieval

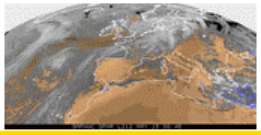
Total Precipitable Water (Description)



Layer Precipitable Water (Description)

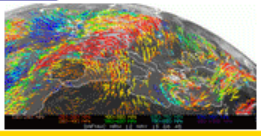


Stability Analysis Imagery (Description)

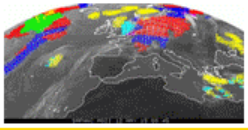


MSG Winds, Conceptual Model and Convection Products

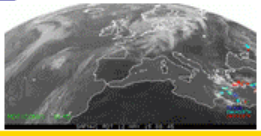
High Resolution Winds (Description)



Automatic Satellite Image Interpretation (Description)



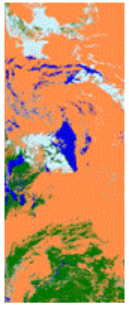
Rapid Development Thunderstorms (Description)



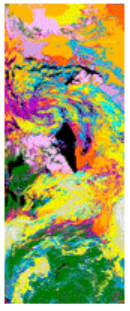
PGEs Execution Time

- The general input data for running NWCSAF software are :
  - MSG package: MSG SEVIRI data and NWP (in some of them).
  - PPS package: AVHRR/3 data and NWP (in some of them).
- The user should be aware that using old NWP data might reduce the quality of the product.

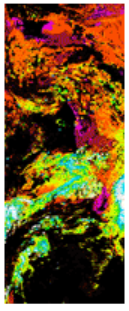
Cloud Mask (Description)



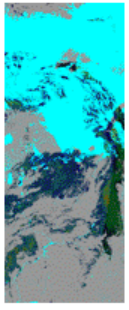
Cloud Type (Description)



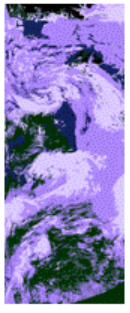
Cloud Top Temperature and Height (Description)



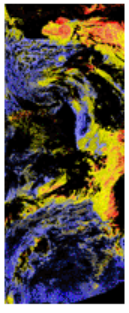
Precipitating Clouds (Description)



Cloud Physical Properties (CPh) (Description)



Cloud Physical Properties (LWP) (Description)



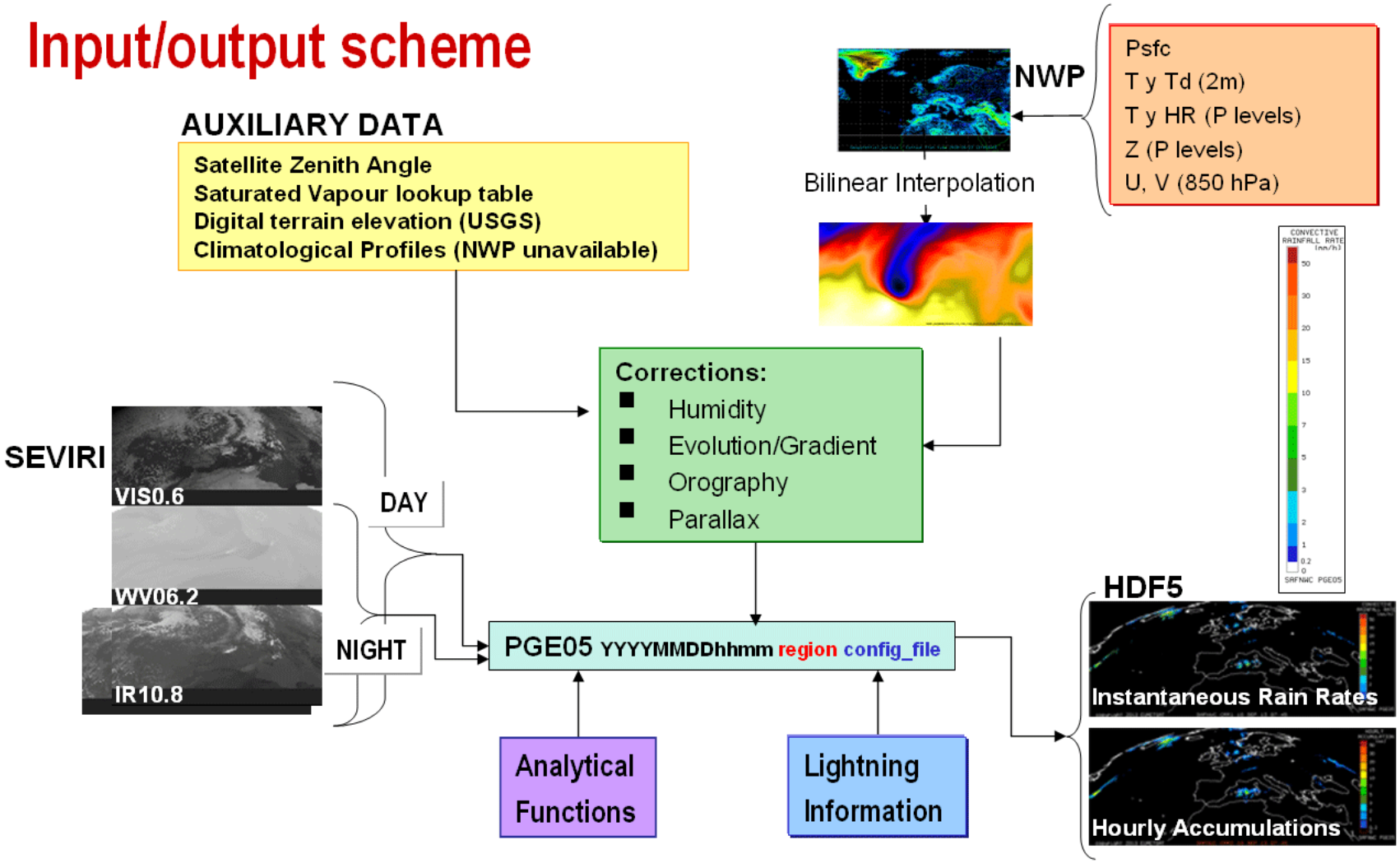
Convective Rainfall Rate (CRR)

INTRODUCTION:

The CRR goal is to estimate rainfall rates from convective systems, using IR, WV and VIS MSG SEVIRI channels and lightning information (as optional input).

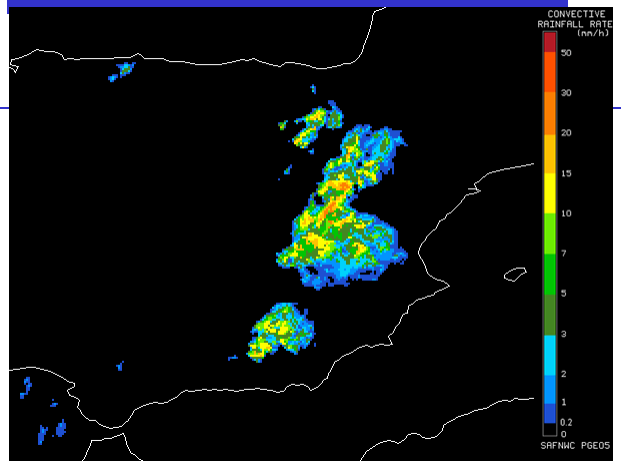
Convective Rainfall Rate (CRR)

Input/output scheme

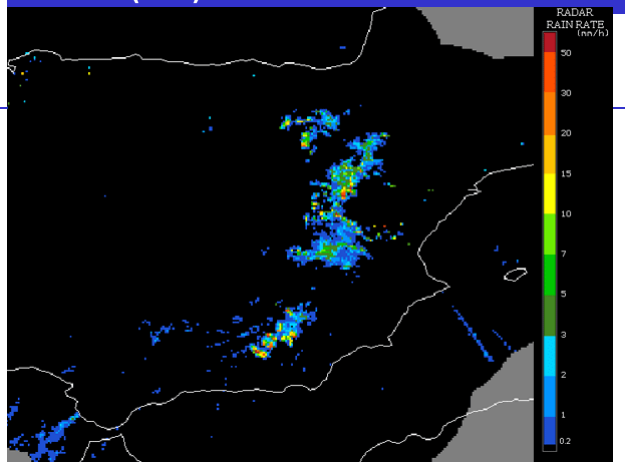


Convective Rainfall Rate (CRR)

CRR - 10th June 2014 – 17:00 UTC



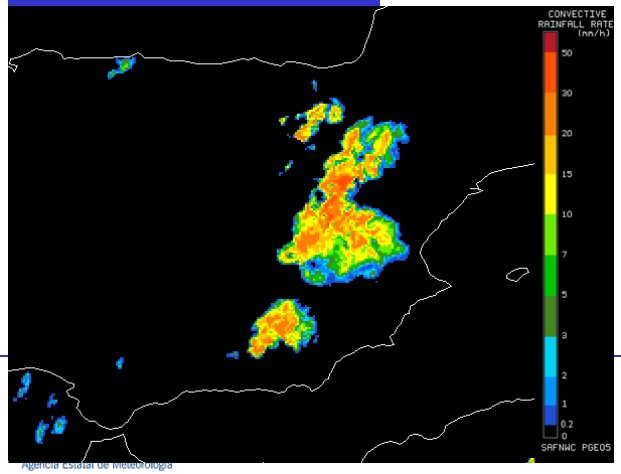
Radar (PPI) - 10th June 2014 – 17:10 UTC



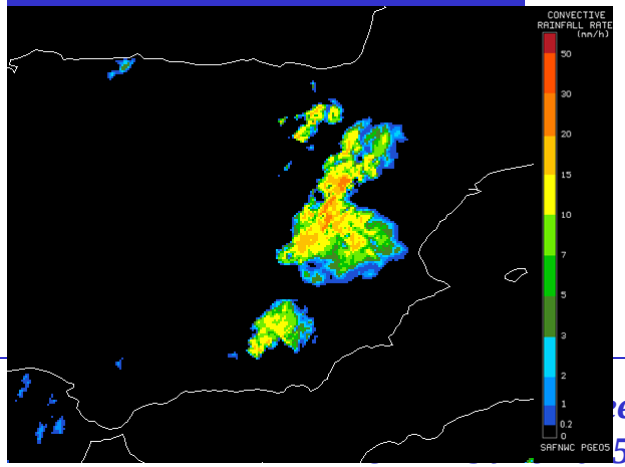
Moisture Correction : (PWRH)

Depends on total precipitable water (surface- 500 hPa) and relative humidity

No corrections applied



Only Moisture correction applied



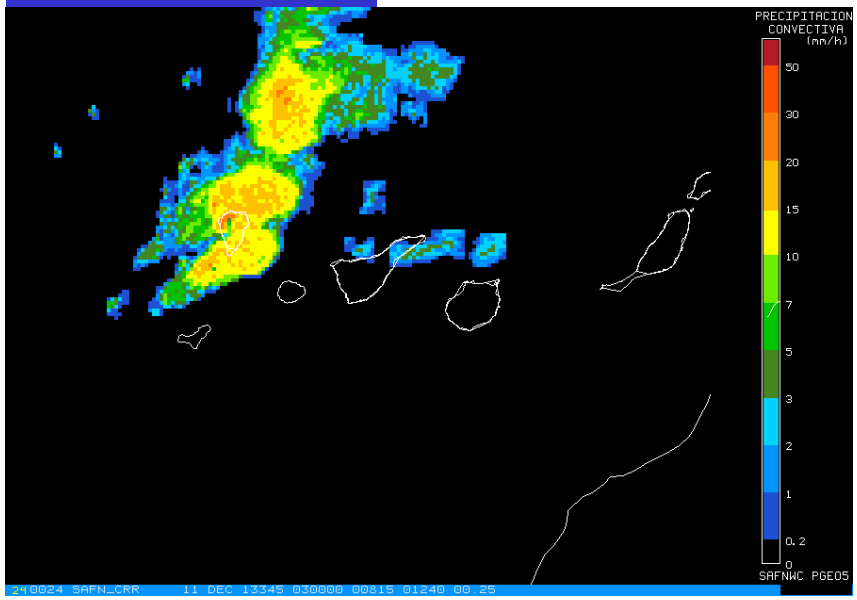
Convective Rainfall Rate (CRR)

11th Dec 2013 – 03:00 UTC

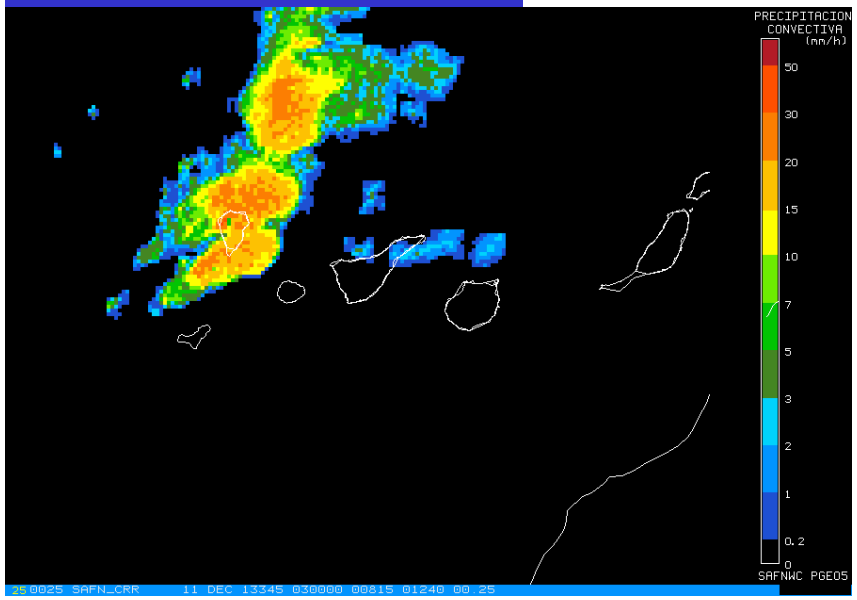
Moisture Correction : (PWRH)

Depends on total precipitable water (surface- 500 hPa) and relative humidity

No corrections applied



Only Moisture correction applied



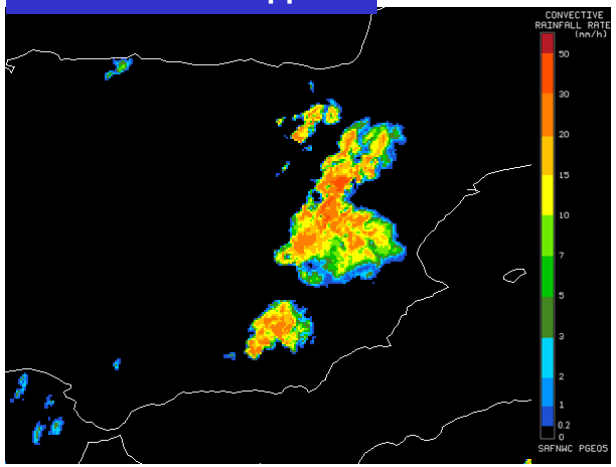
Convective Rainfall Rate (CRR)

Evolution Correction / Gradient Correction :

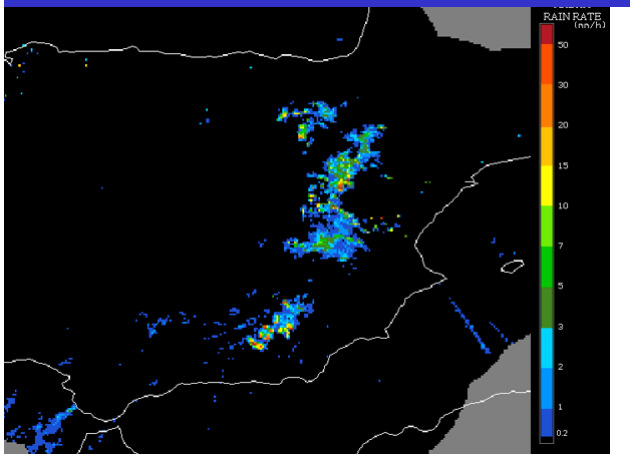
Evolution Correction:
Rain rate decreases if the analysed pixel becomes warmer in the second image

Cloud-top Temperature Gradient Correction:
Rain rate decreases if the analysed pixel has a temperature maximum, which indicates that this pixel is warmer than its surroundings

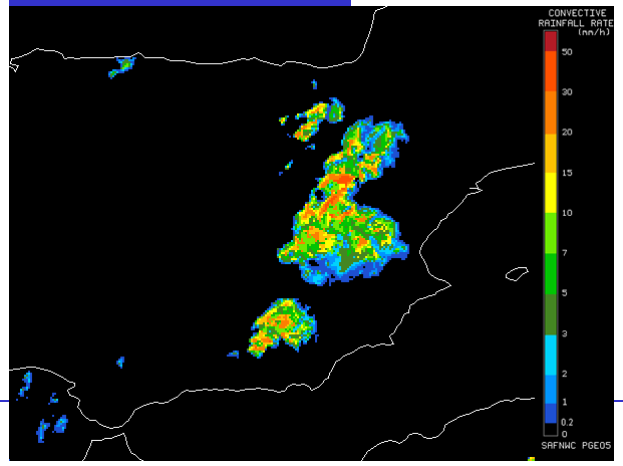
No corrections applied



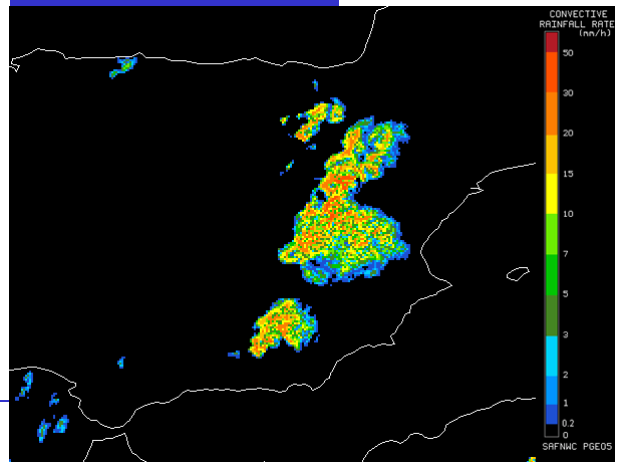
Radar (PPI) - 10th June 2014 – 17:10 UTC



Evolution Correction



Gradient Correction



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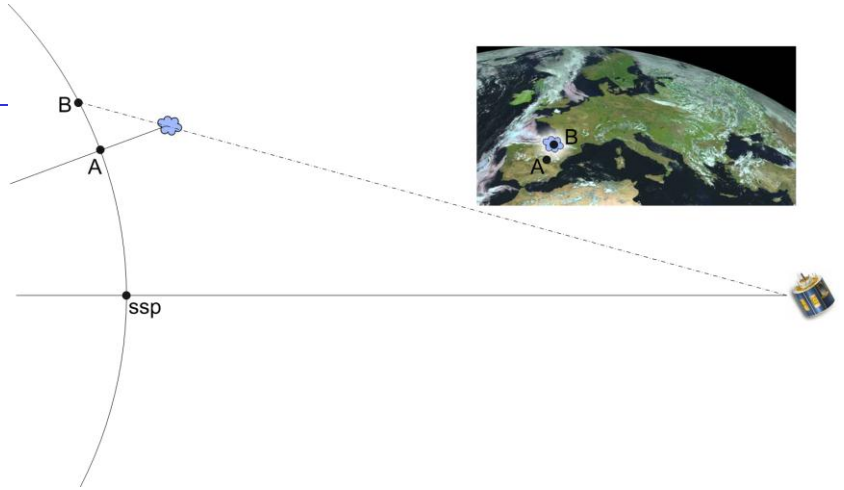
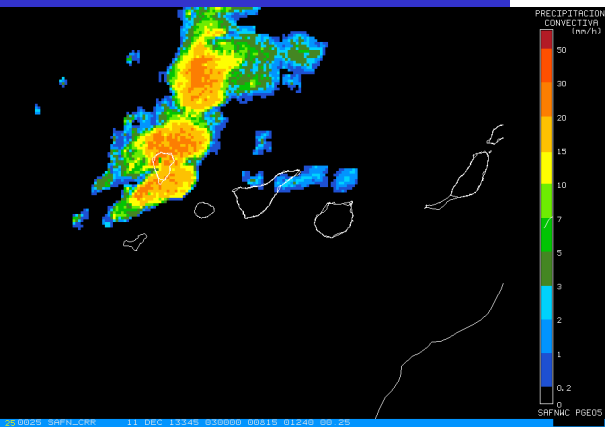
Convective Rainfall Rate (CRR)

Parallax correction:

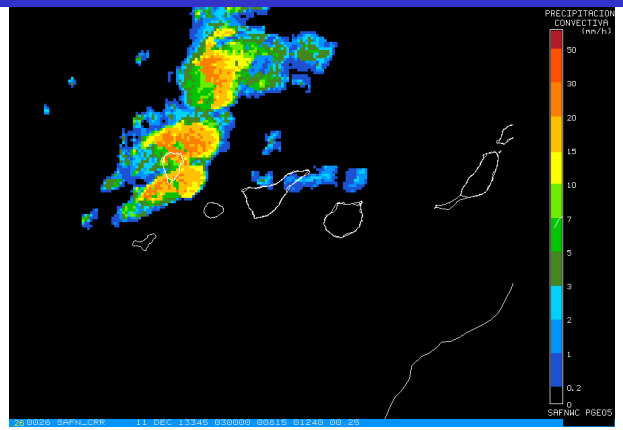
A spatial shift is applied to every pixel with precipitation according the basic CRR value



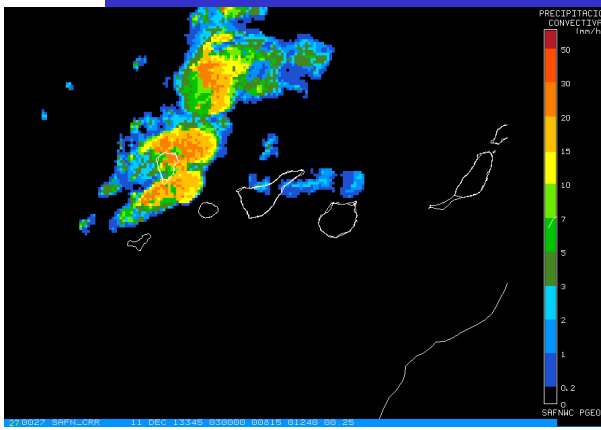
Only Moisture correction applied



Moisture + Evolution corrections applied



Moisture + Evolution + Parallax corrections applied



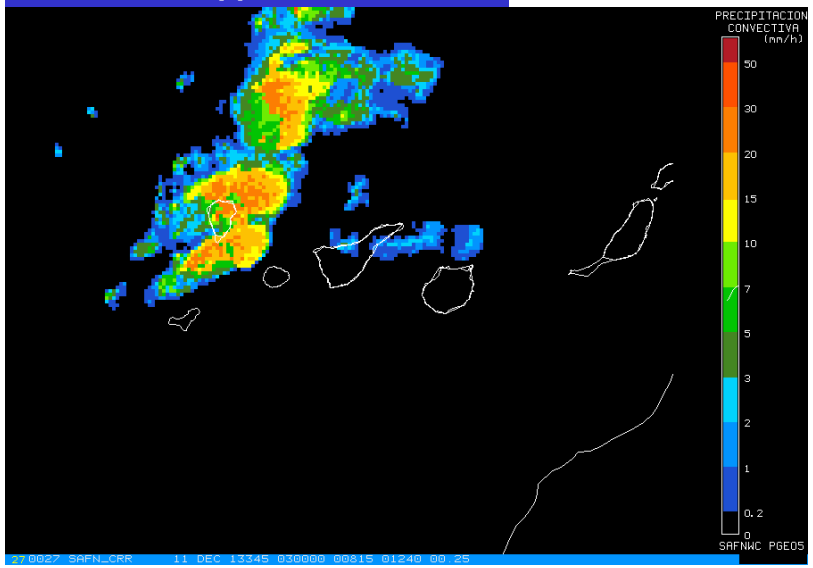
11th Dec 2013 – 03:00 UTC

Convective Rainfall Rate (CRR)

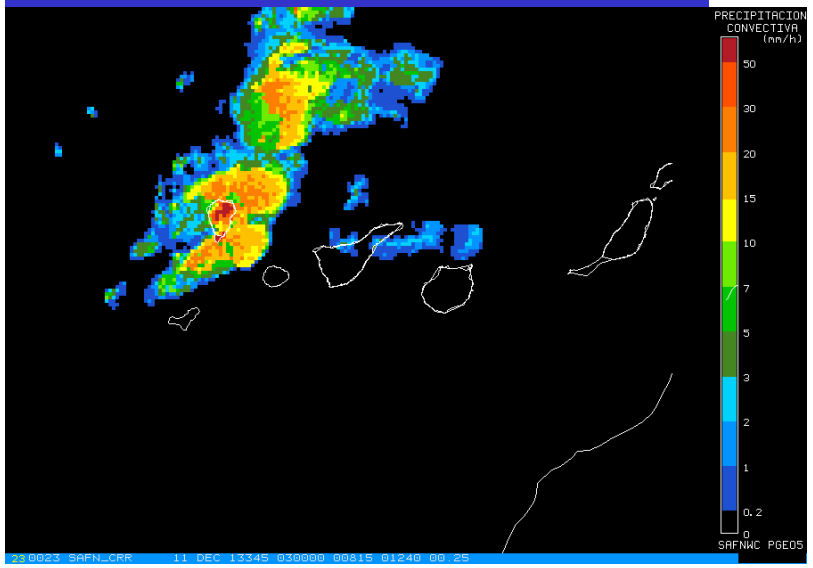
Orographic correction:

This correction uses the interaction between the wind vector (taken from the 850 hPa. numerical model) and the local terrain height gradient in the wind direction to create a multiplier that enhances of diminishes the previous rainfall estimate, as appropriate.

Moisture + Evolution + Parallax corrections applied



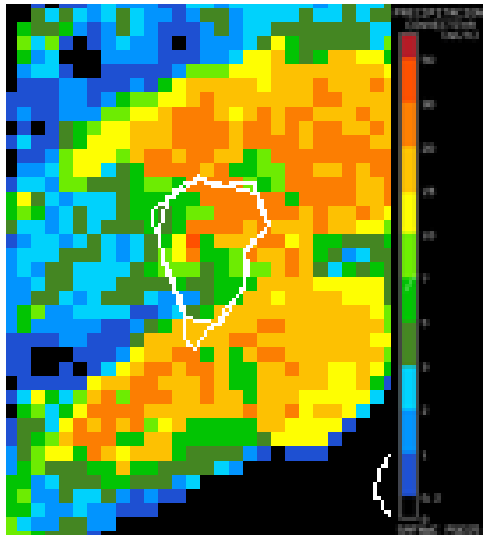
Moisture + Evolution + Parallax + Orographic corrections applied

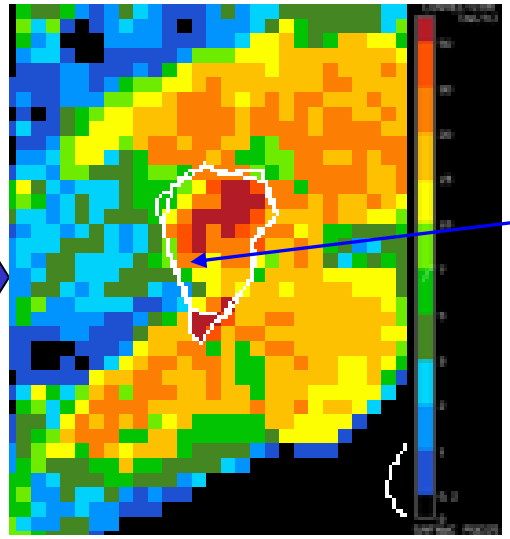


11th Dec 2013 – 03:00 UTC

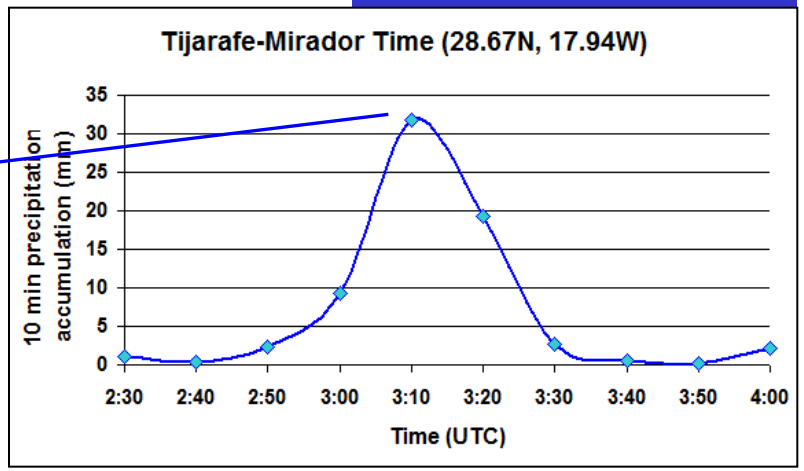
Convective Rainfall Rate (CRR)

Orographic correction



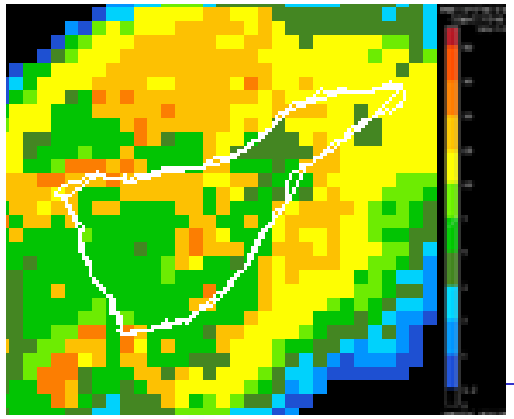


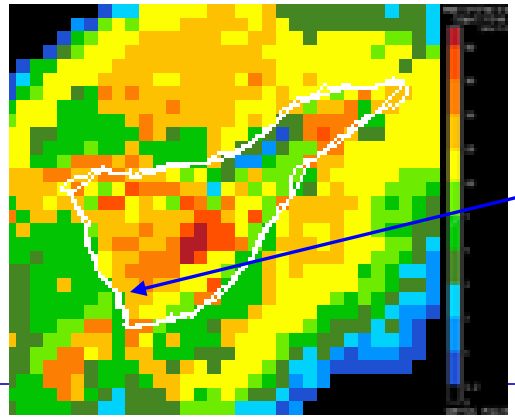
11th Dec 2013 – 03:00 UTC



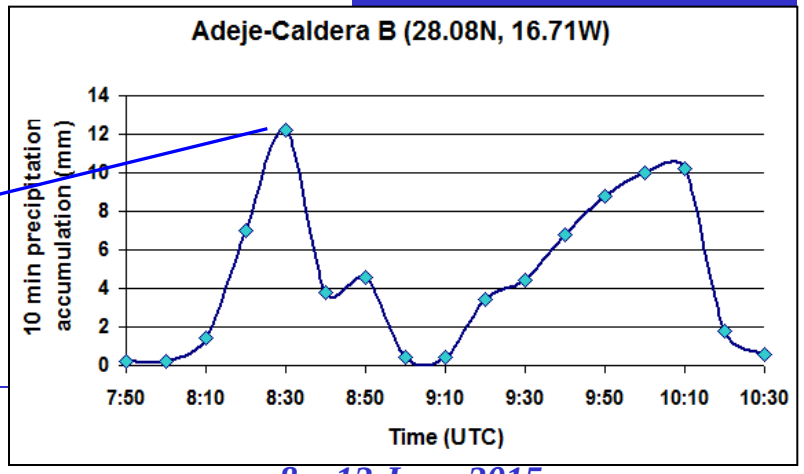
Moisture + Evolution + Parallax corrections applied

Moisture + Evolution + Parallax + Orographic corrections applied





11th Dec 2013 – 08:30 UTC



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8 – 12 June 2015

Convective Rainfall Rate (CRR)

LIGHTNING ALGORITHM:

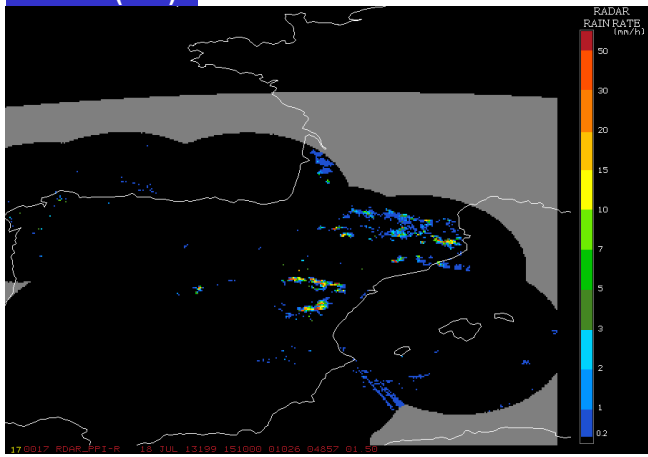
18 July 2013 – 15:00 UTC

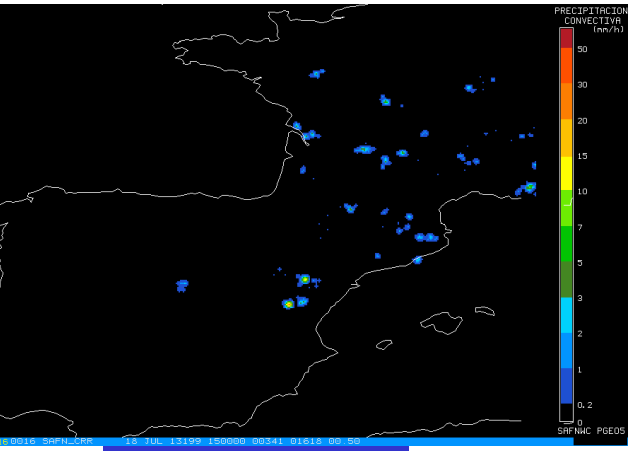
- The Lightning algorithm assumes that the higher are the spatial and temporal density of lightning, the higher are the probability and the intensity of convective precipitation.

- The rain rates assigned to every lightning takes into account:
  - the time distance between the lightning event and scanning time of the processing region centre.
  - the location of the lightning.
  - the spatial density of lightning in a time interval.

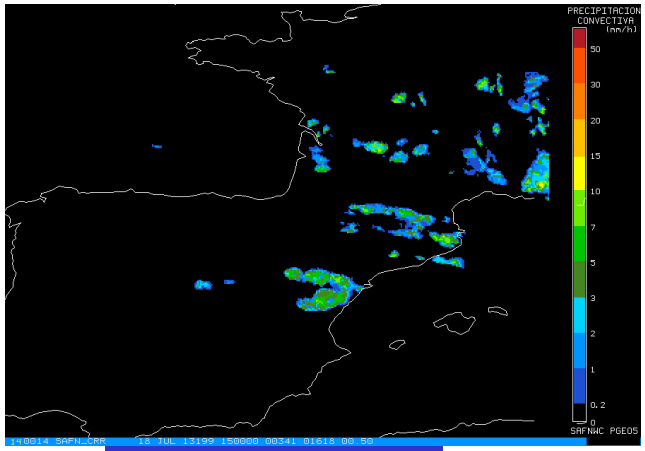
- Only Cloud-to-Ground lightning flashes are used by this algorithm.

Radar (PPI)

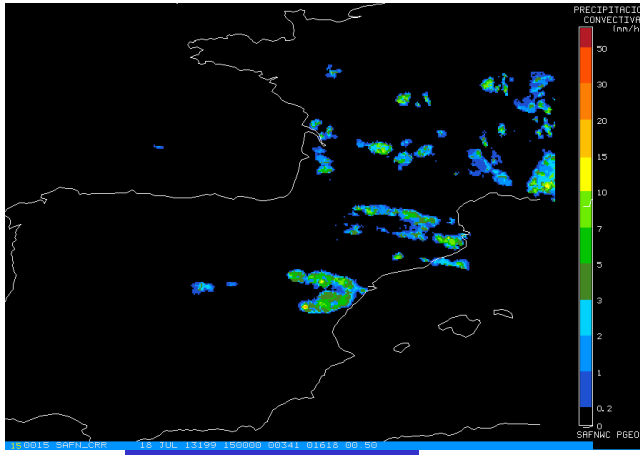




Lightning algorithm



CRR without lightning



CRR with lightning

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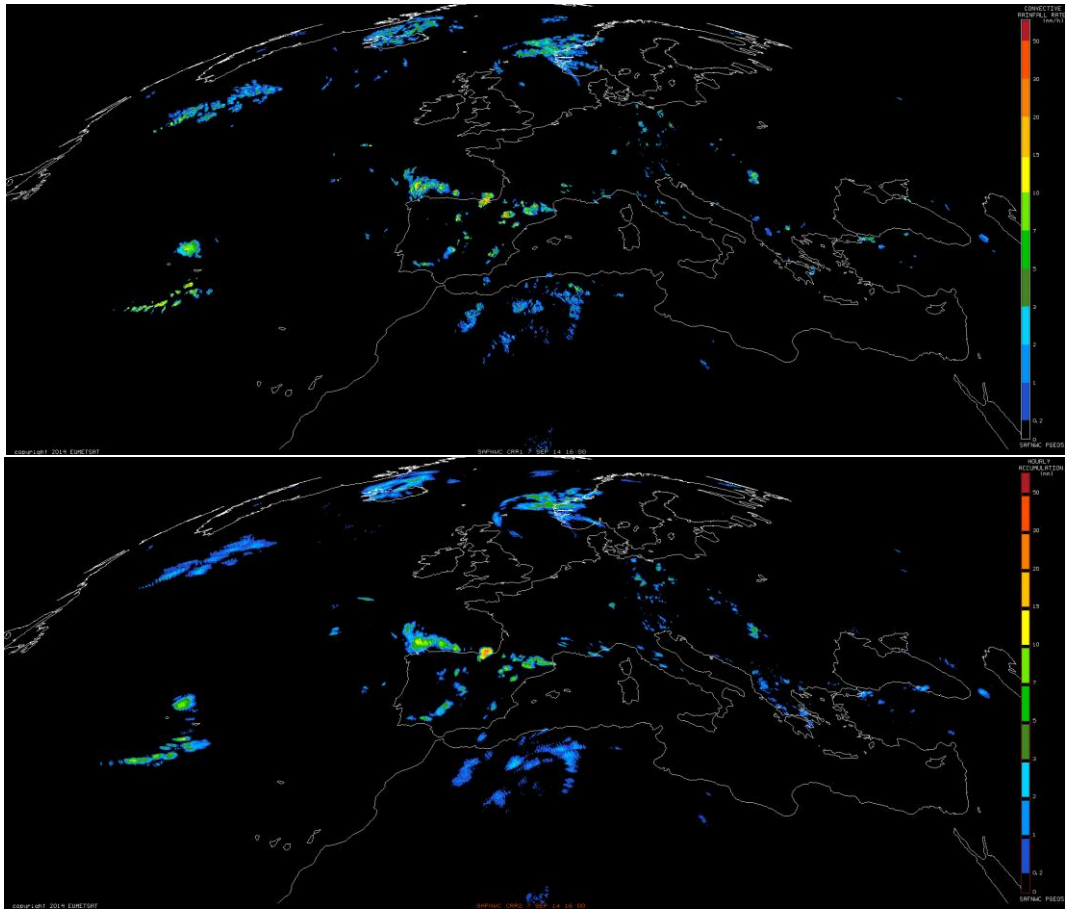
Convective Rainfall Rate (CRR)

OUTPUTS:

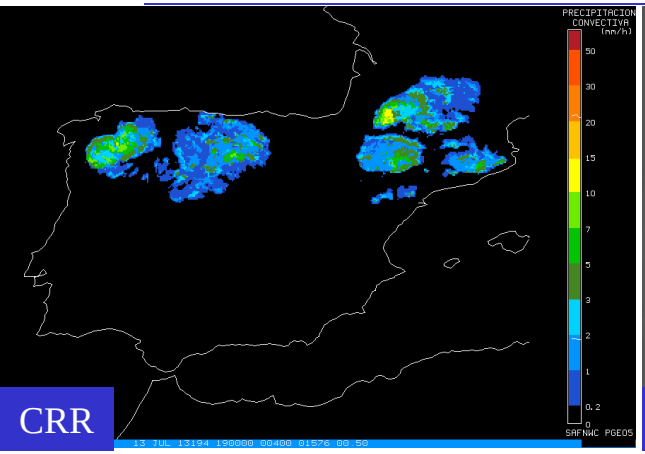
- CRR rainfall rates expressed in classes
- CRR rainfall rates expressed in mm/h *(required for hourly accumulations)*
- CRR Hourly Accumulations
- CRR-QUALITY
- CRR-DATAFLAG

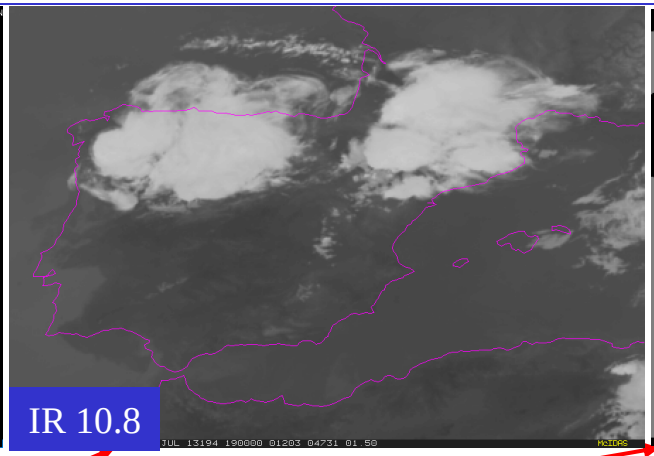


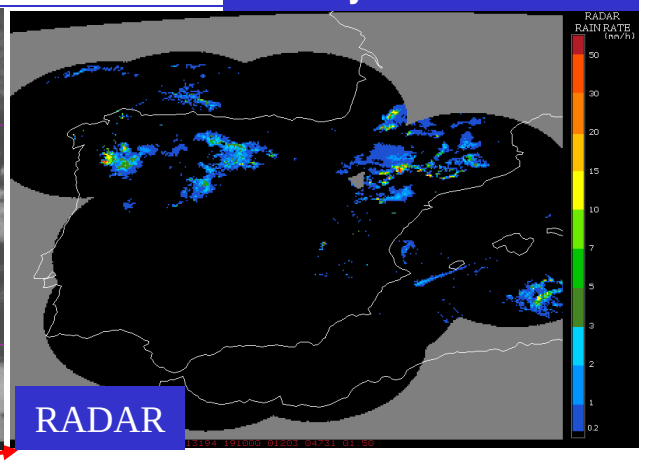
Convective Rainfall Rate (CRR)

Problems:

13th July 2013 - 19:00 UTC

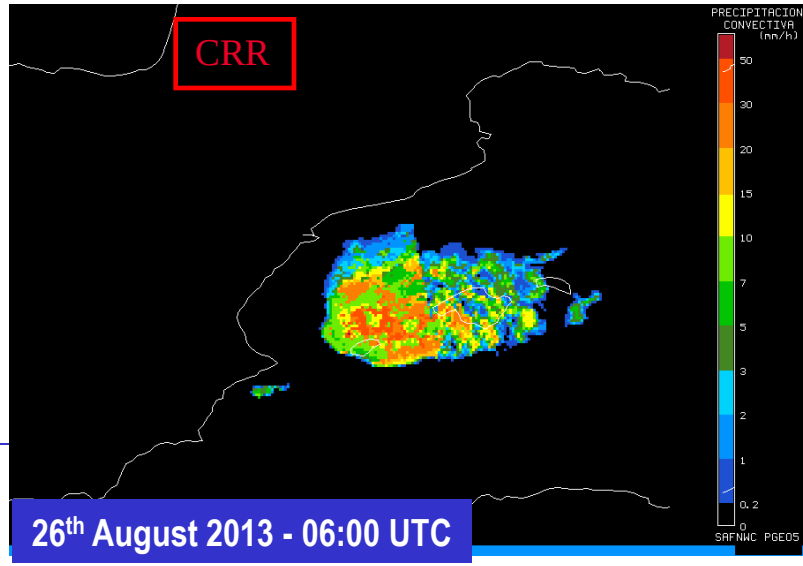






- Similar to the cloud tops
- Too big estimated precipitation area and lower rain rates than Radar

Different result for day and night



NWC SAF

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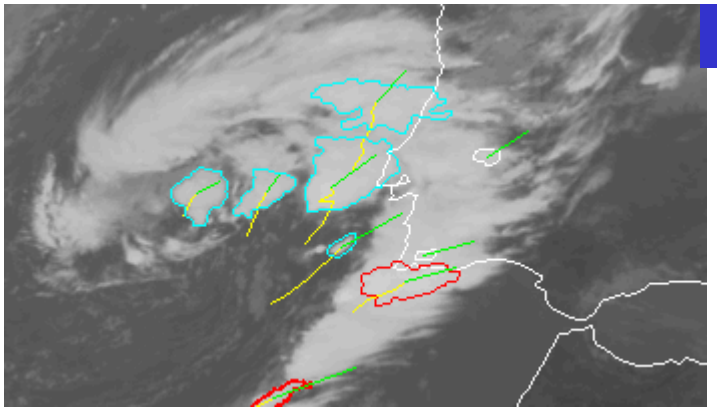
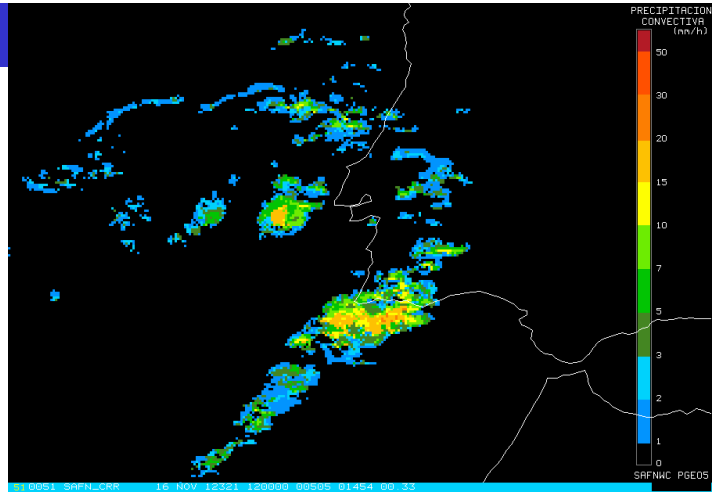
Convective Rainfall Rate (CRR)

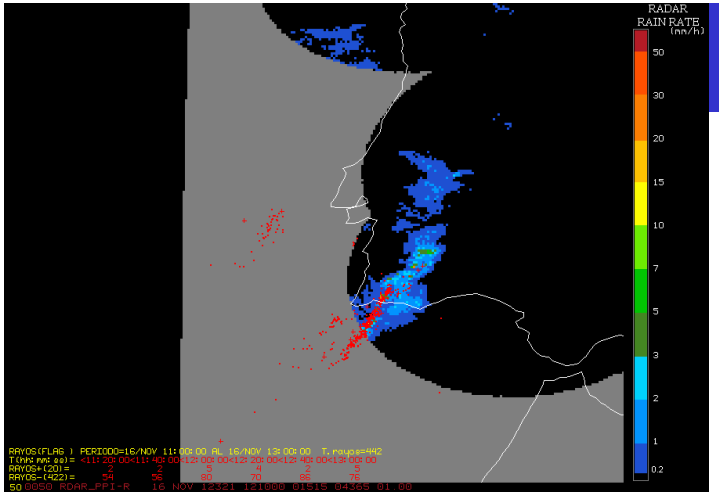
Applications: Estimation of rain rates for convective events over extensive areas, out of the radar coverage or as a radar compliment.



RDT

CRR





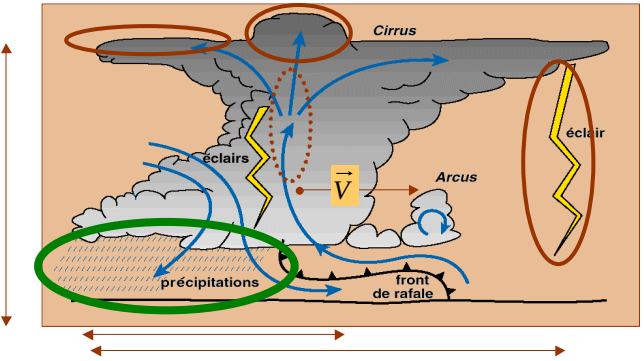
RADAR + Lightning info

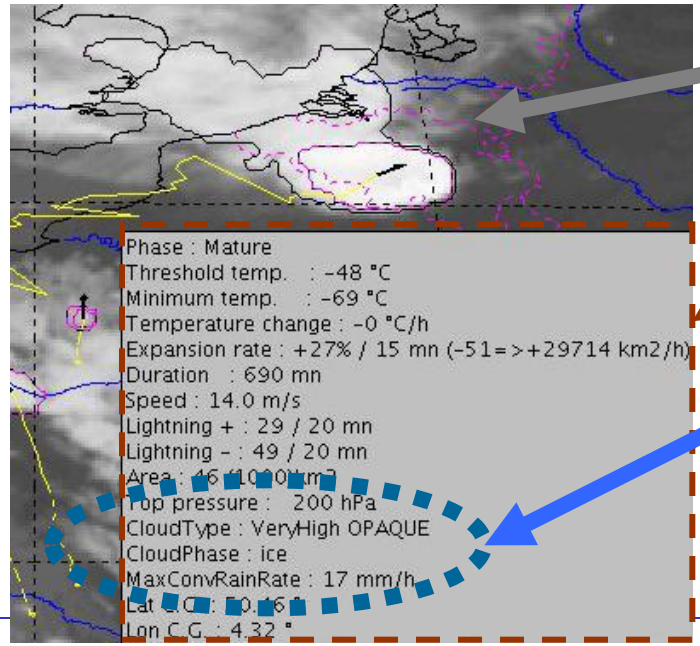
Links between SAF/NWC products

Use of CRR in RDT (Rapid Development Thunderstorm)–Implemented in v2012

RDT takes advantage of CRR data and different **options** are proposed to the users

- **CRR** can be used to identify maximum **convective rain rate under cloud cell**
- **High CRR values** can help to qualify a cloud cell as **significant** and thus to encode this cell in BUFR output (only for the last BUFR version)
- **Very high CRR values** can be used to set diagnosis of **convection to « YES »** (only fot the last BUFR version)





RDT main outlines

Attributes

Attributes coming from other NWC SAF products : Cloud Top Pressure, Cloud Type, Cloud Phase, **Convective Rain Rate**

Precipitation products from Cloud Physical Properties (PPh)

INTRODUCTION:

Two products generated:

- Precipitating Clouds from Cloud Physical Properties – PCPh

  PCPh provides estimation on the probability of precipitation (PoP) occurrence.

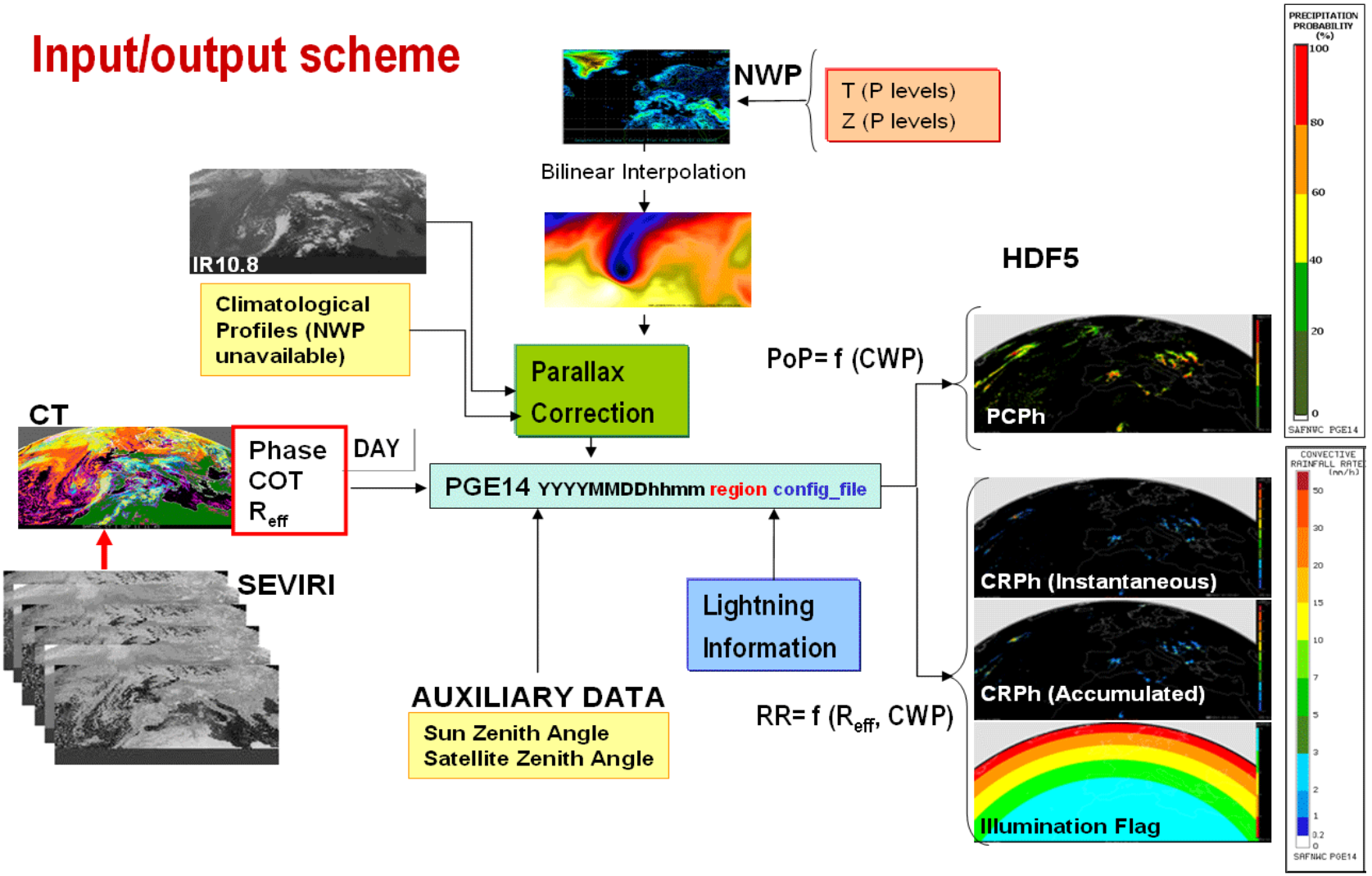
  PoP is defined as the instantaneous probability that a rain rate greater than or equal to 0.2 mm/h occurs at the pixel level.

- Convective Rainfall Rate from Cloud Physical Properties – CRPh

  CRPh provides information on convective, and stratiform associated to convection, instantaneous rain rates and hourly accumulations.

Convective Rainfall Rate from Cloud Physical Properties (CRPh)

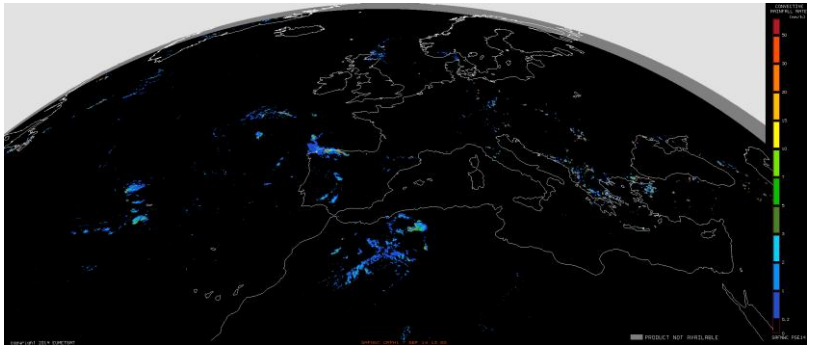
Input/output scheme

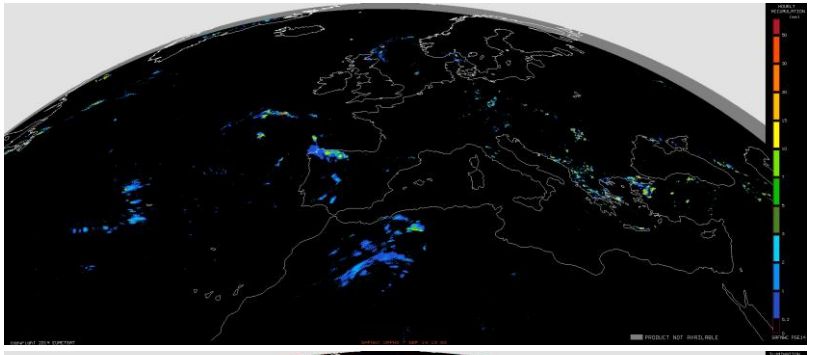


Convective Rainfall Rate from Cloud Physical Properties (CRPh)

CRPh OUTPUTS:

- Rainfall rates from 0.0 to 51.0 mm/h with a step of 0.2 mm/h.
- CRPh Hourly Accumulations
- CRPh Illumination Quality Flag
- CRPh _QUALITY
- CRPh_DATAFLAG





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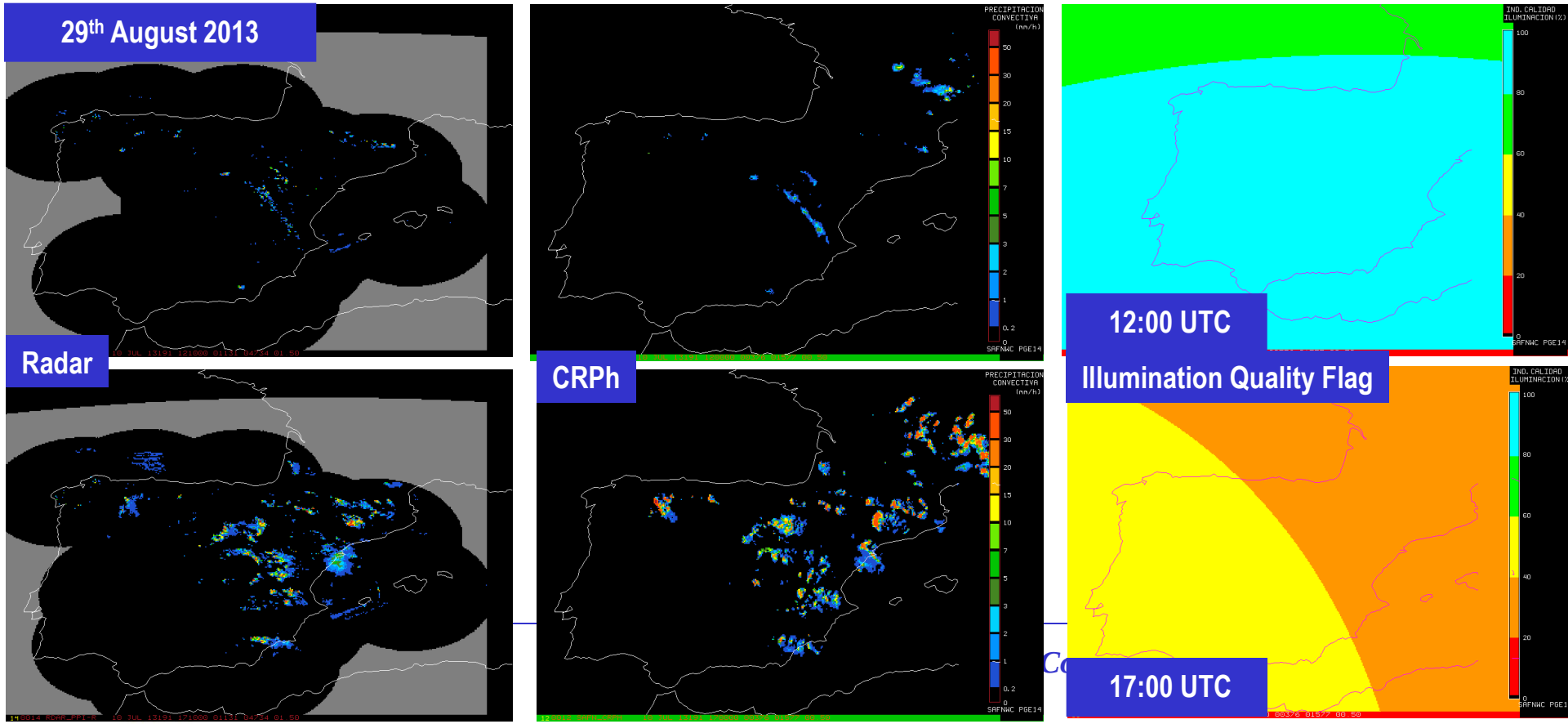
Convective Rainfall Rate from Cloud Physical Properties (CRPh)

Limitations:

Only day time

Only for estimated phase

High dependance on illumination conditions → **Illumination Quality flag**

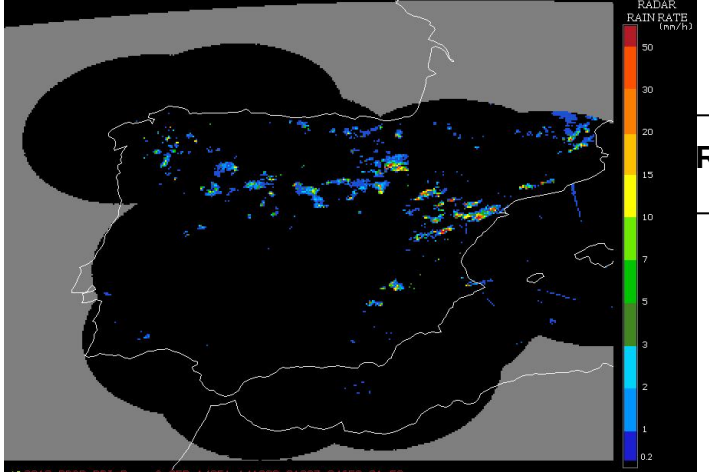


Comparison of Convective Rainfall Rate products (CRR and CRPh)

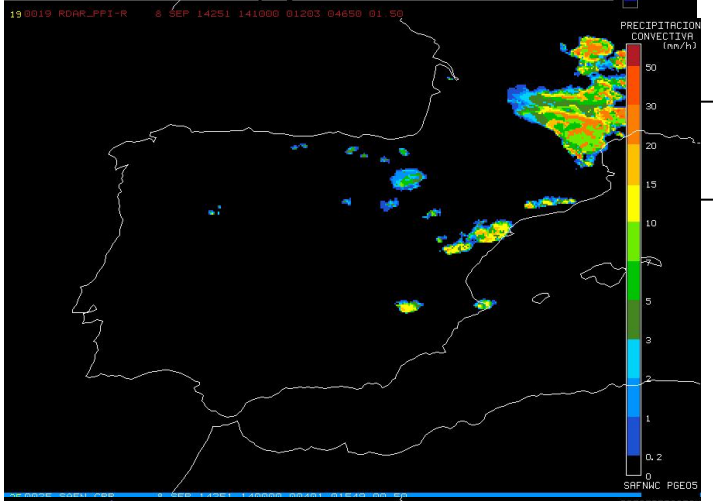
CRPh cons and pros with respect to CRR:

CONS:
- Only day time
- Only for estimated phase
- High dependance on illumination conditions

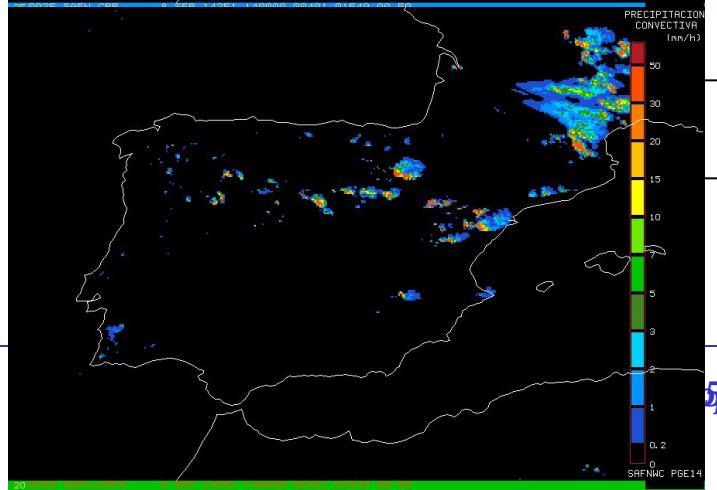
PROS:
- Precipitation areas and intensities closer to the radar ones
- Improvement of the Cold Rings problem
- Detection of smaller precipitation nuclei
- Detection of precipitation for warm top clouds



Radar (PPI)



CRR



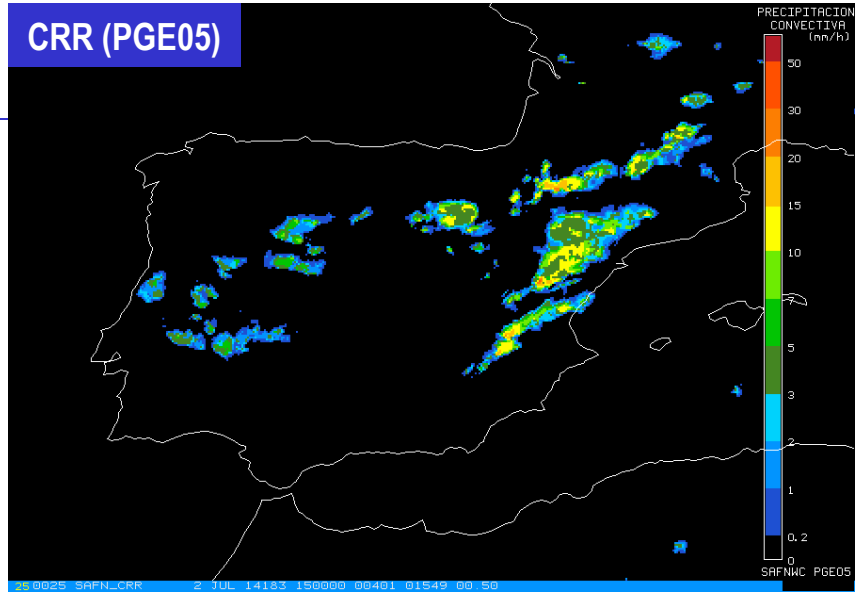
CRPh

Comparison of Convective Rainfall Rate products (CRR and CRPh)

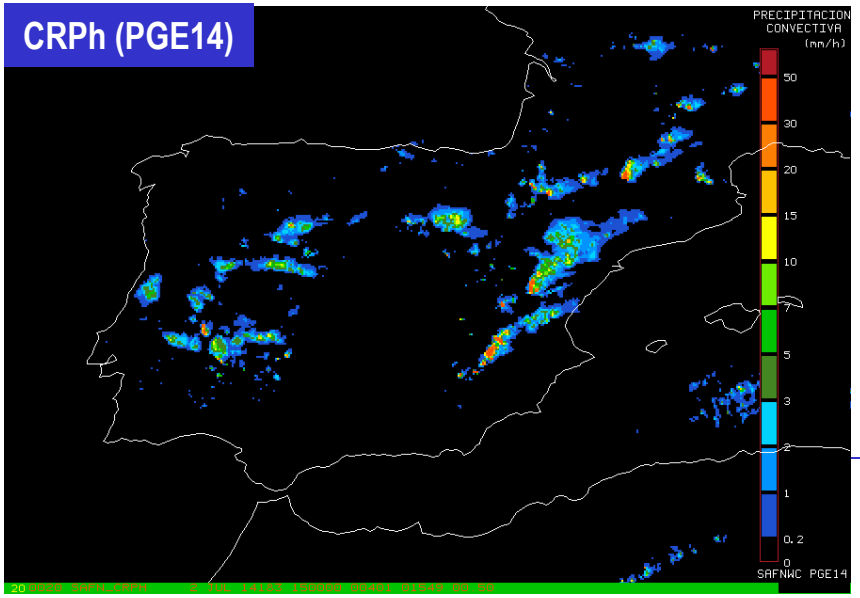
Precipitation areas and intensities closer to the radar ones

2 July 2014
15:00 UTC

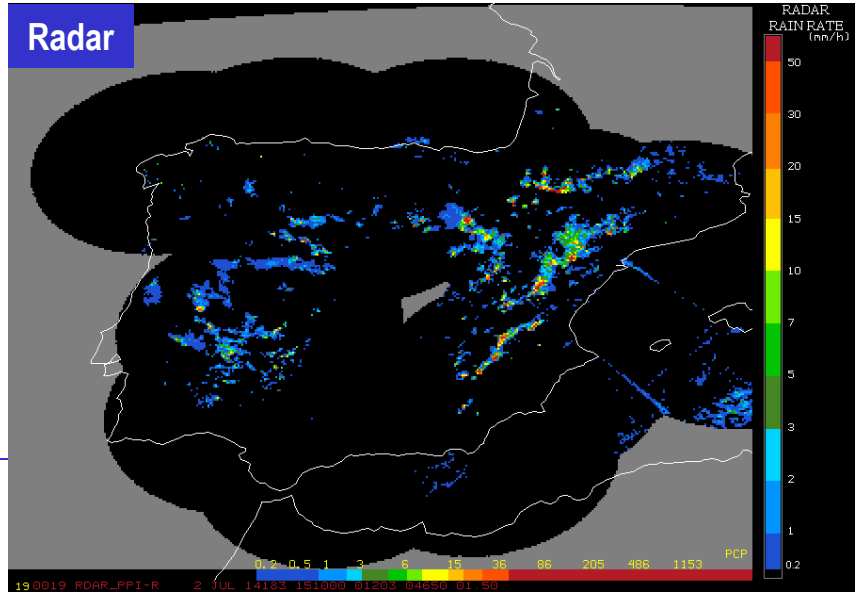
CRR (PGE05)



CRPh (PGE14)

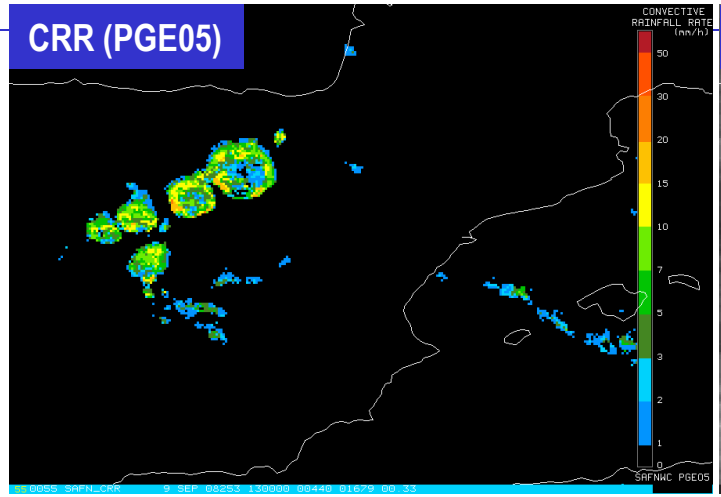


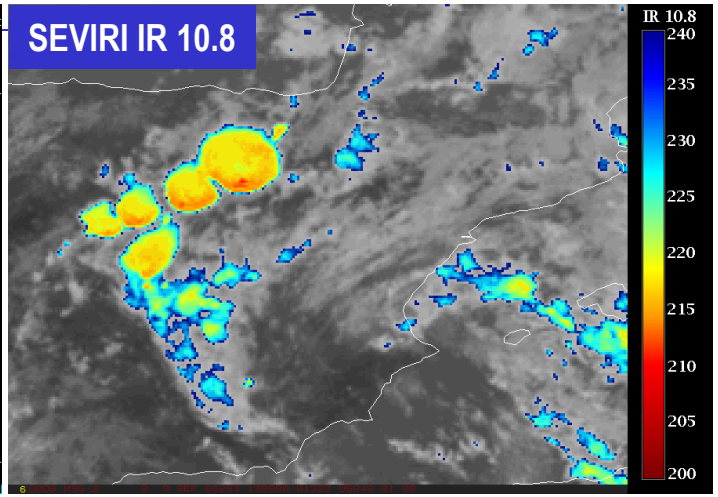
Radar

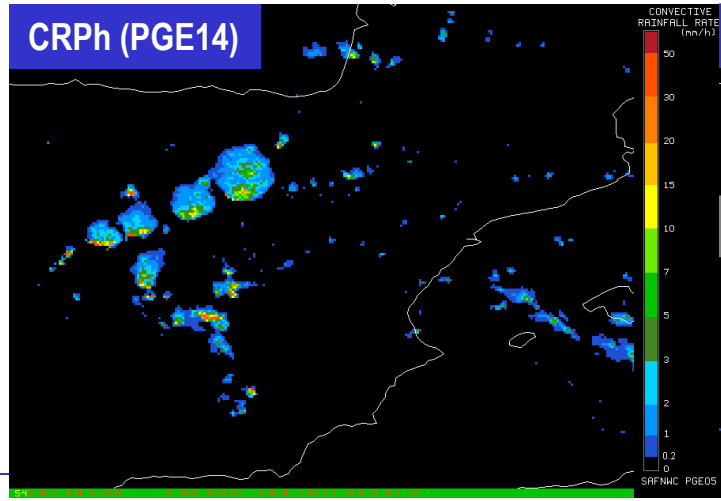


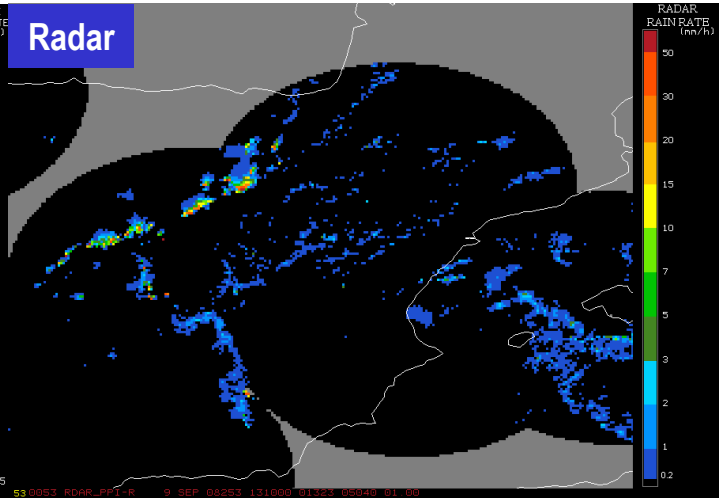
Comparison of Convective Rainfall Rate products (CRR and CRPh)

No Cold Rings and detection of smaller precipitation nuclei









9th September 2008
13:00 UTC

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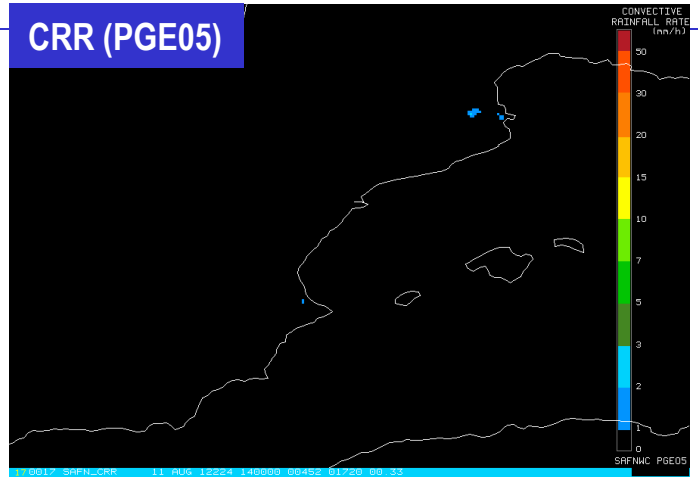
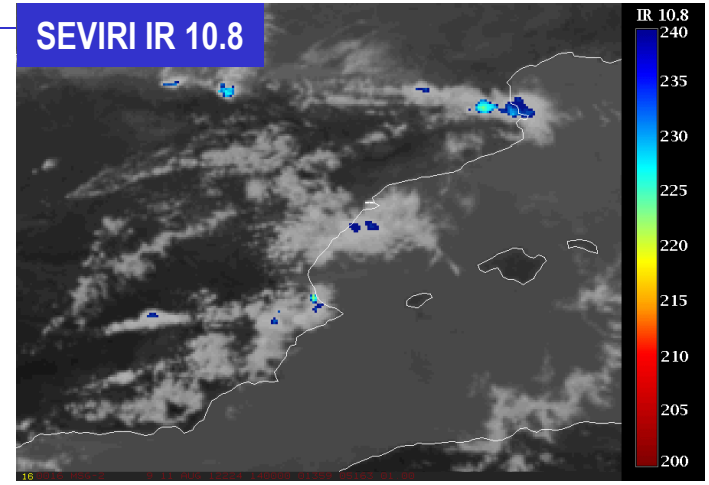
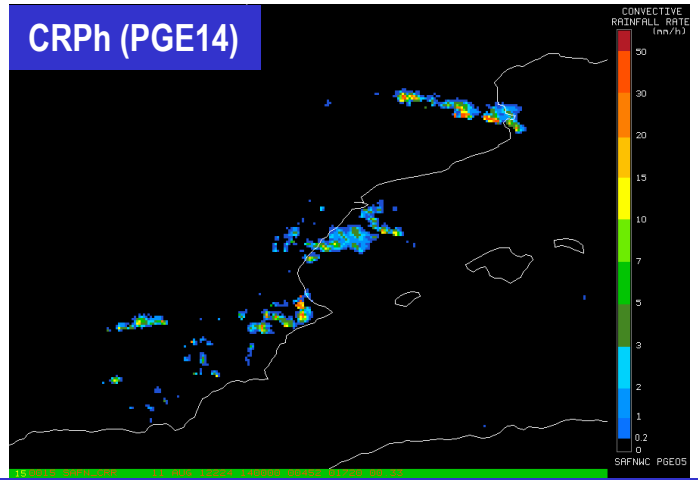
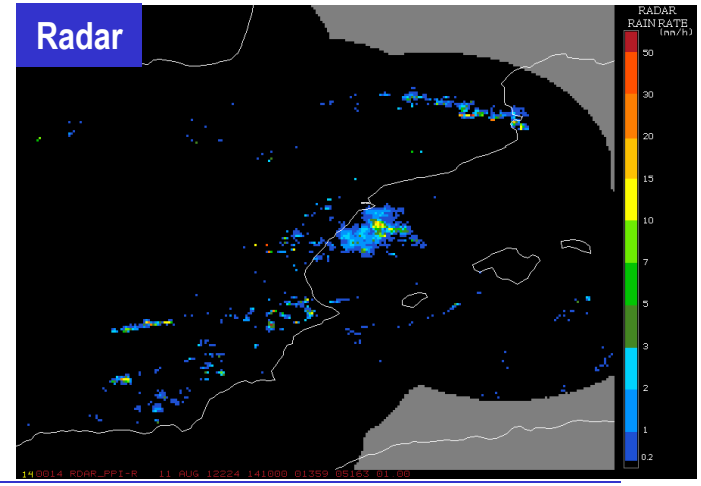
Comparison of Convective Rainfall Rate products (CRR and CRPh)

Detection of precipitation for warm top clouds







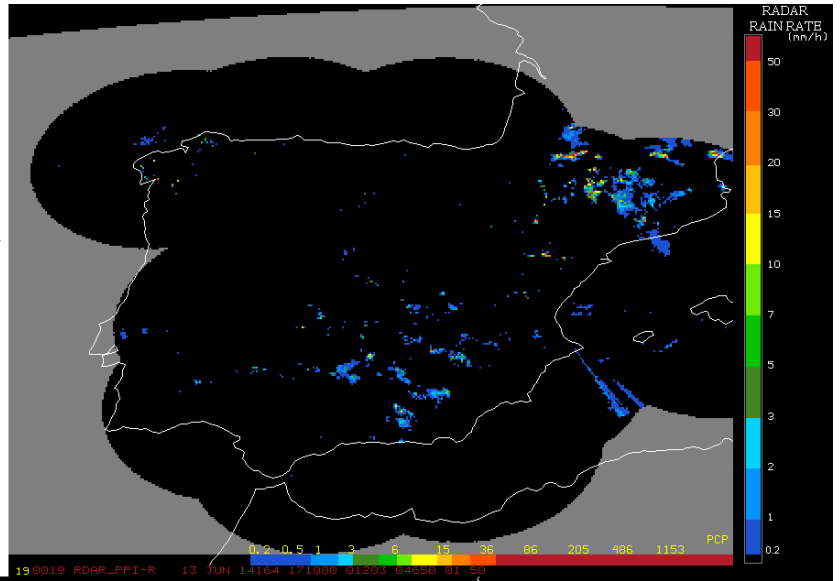


11th August 2012
14:00 UTC

Comparison of Convective Rainfall Rate products (CRR and CRPh)

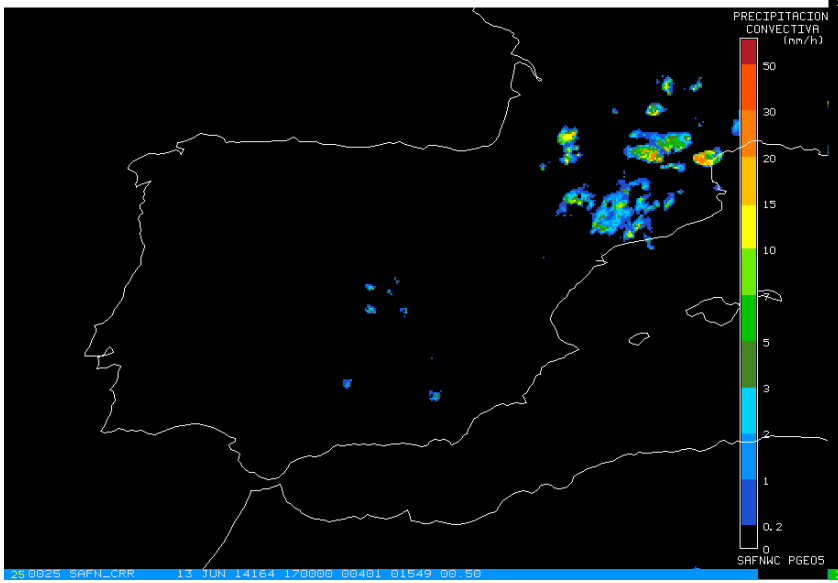
13th June 2014
17:00 UTC

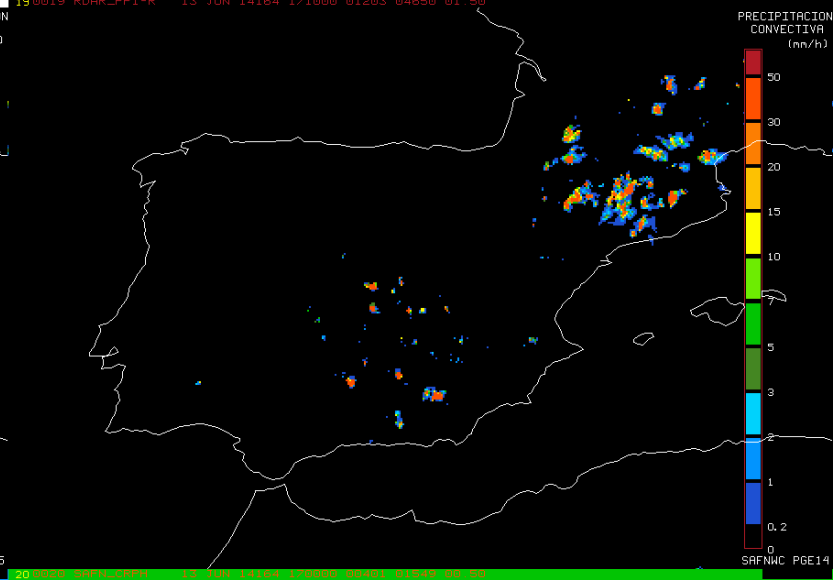
Radar (PPI) →



CRR ↓

CRPh ↘





Thanks for your attention!!