The EUMETSAT Network of Satellite Application Facilities

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

AEMet
Agencia Estatal de Meteorología

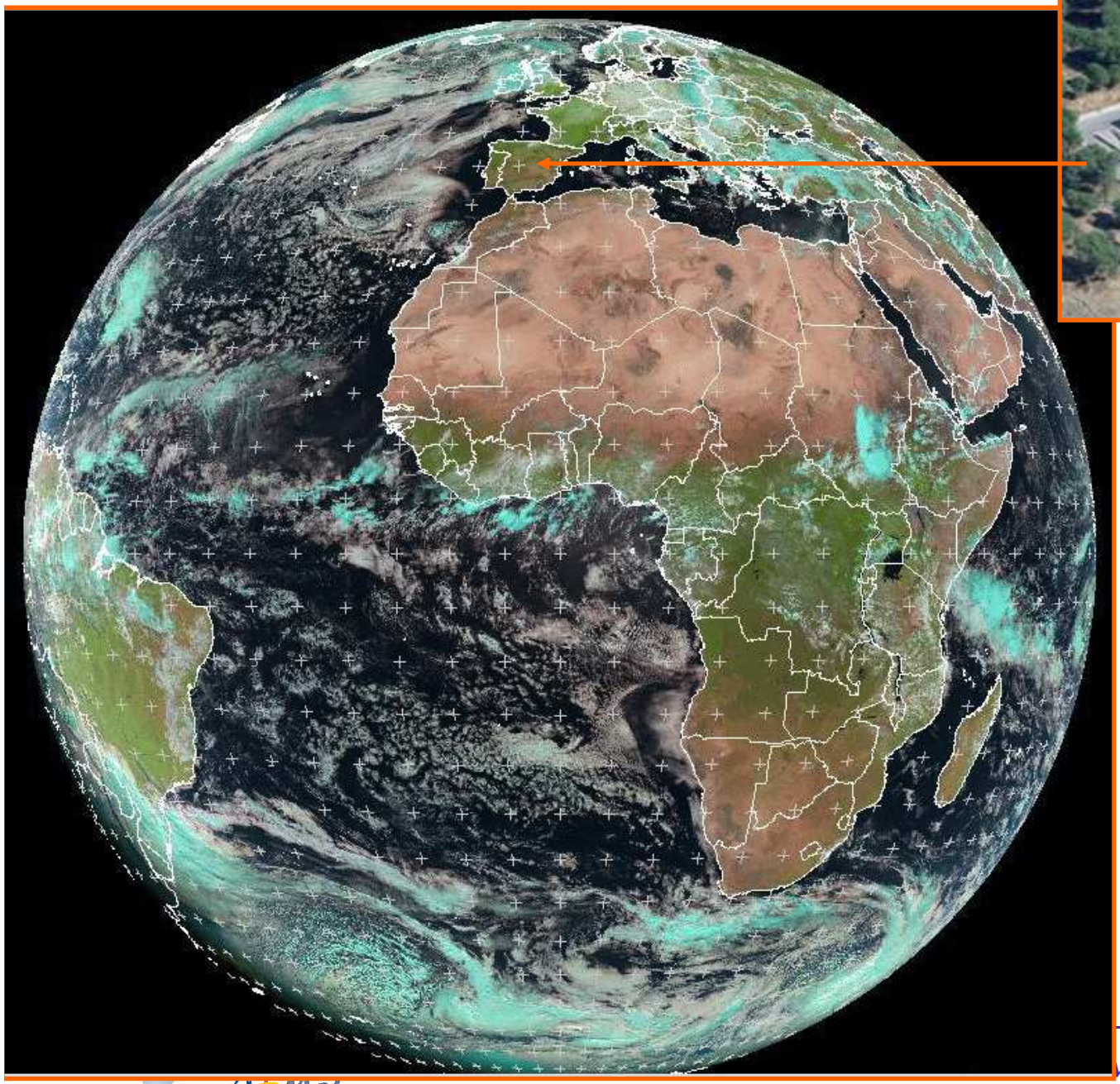
EUMETSAT

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

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

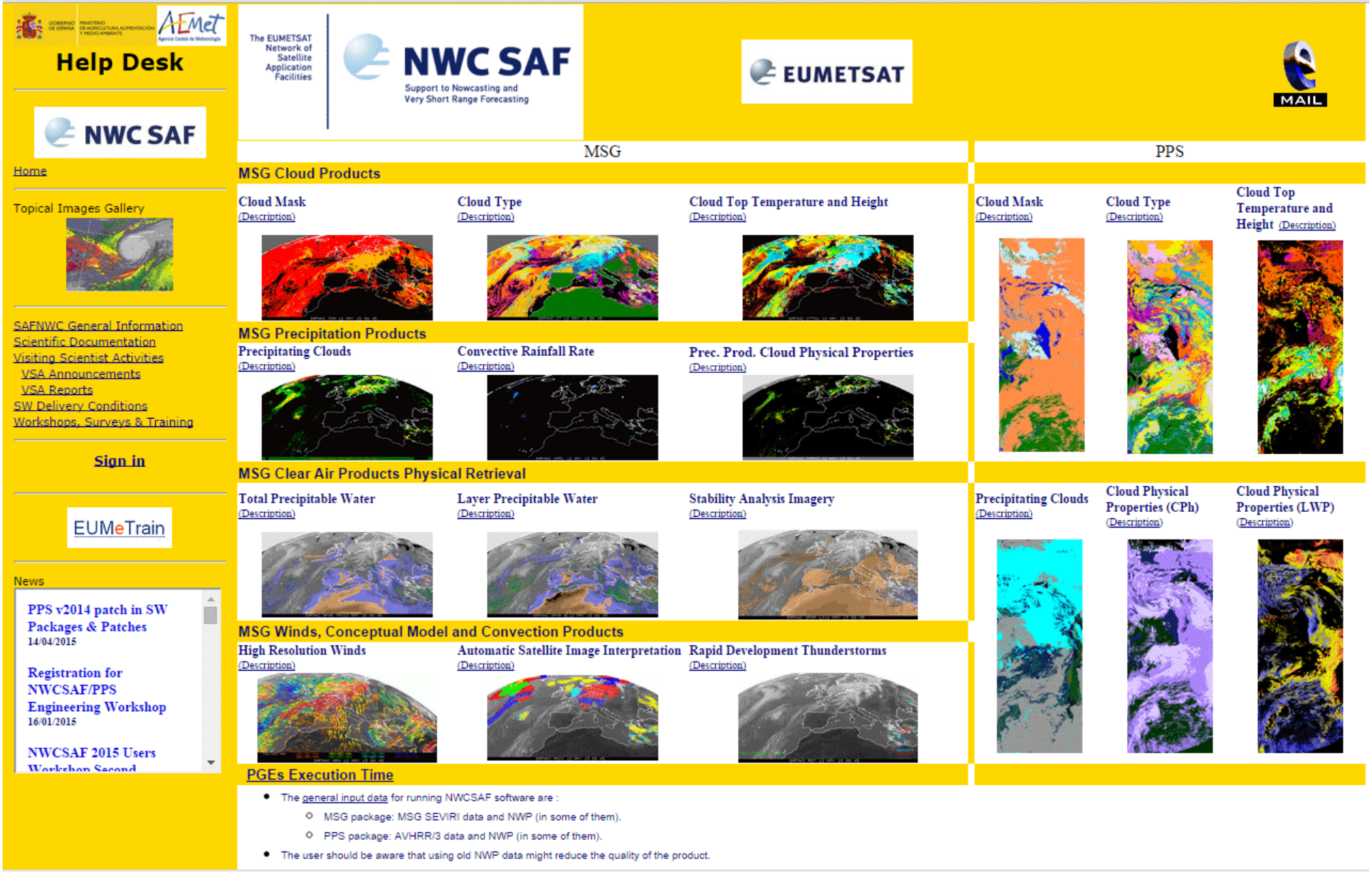
Features of the products:

- **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



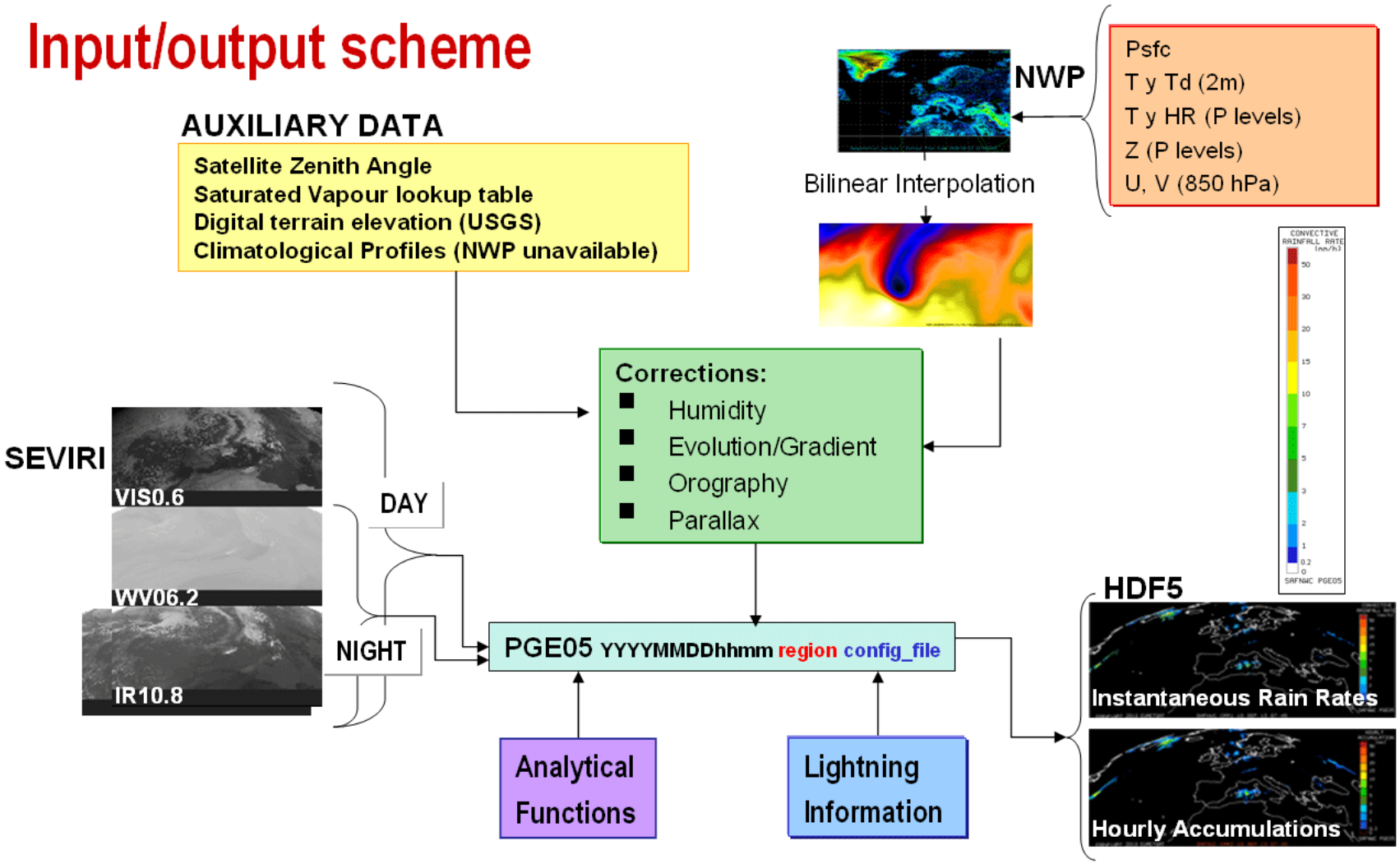
Convective Rainfall Rate (CRR)

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).

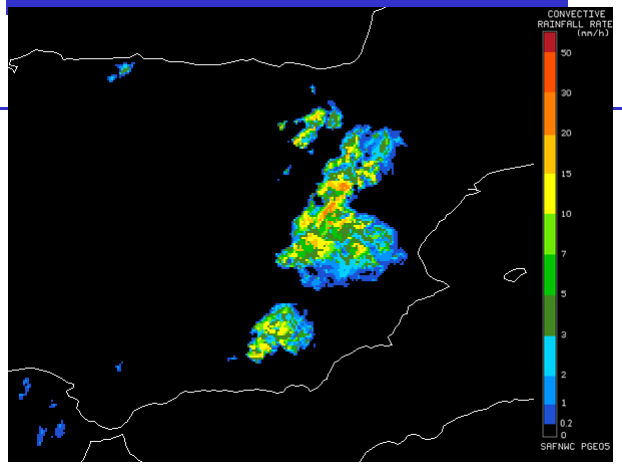
Convective Rainfall Rate (CRR)

Input/output scheme

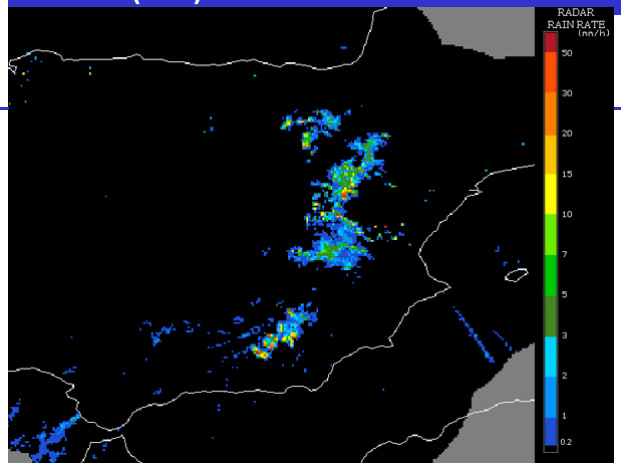


Convective Rainfall Rate (CRR)

CRR - 10th June 2014 – 17:00 UTC



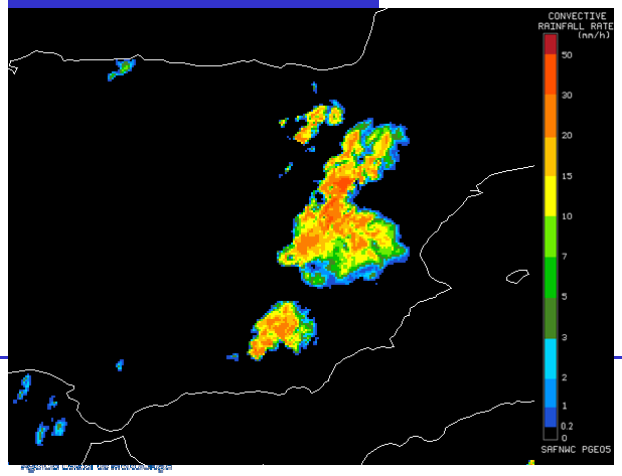
Radar (PPI) - 10th June 2014 – 17:10 UTC



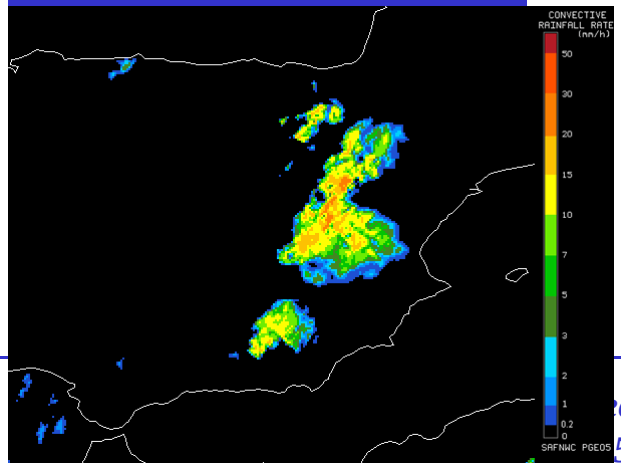
Moisture Correction : (PWRH)

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

No corrections applied



Only Moisture correction applied



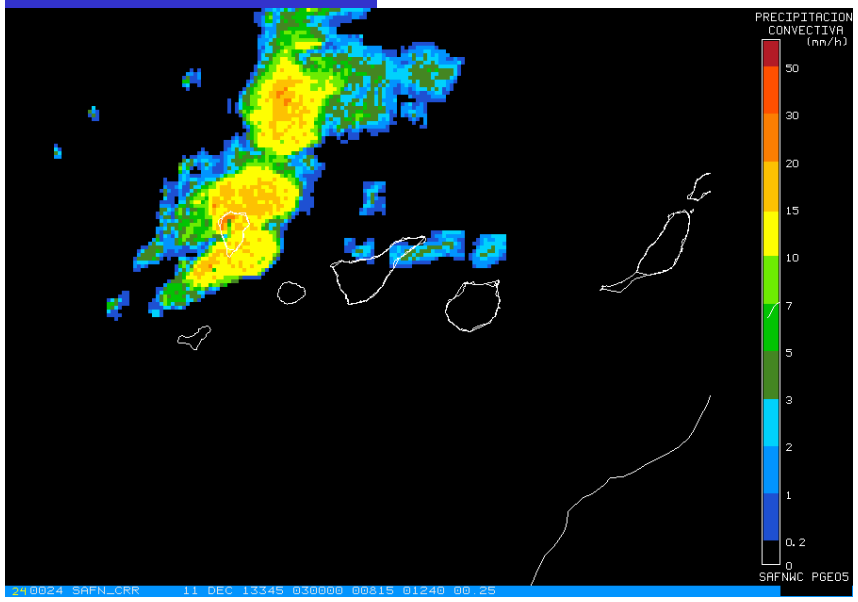
Convective Rainfall Rate (CRR)

Moisture Correction : (PWRH)

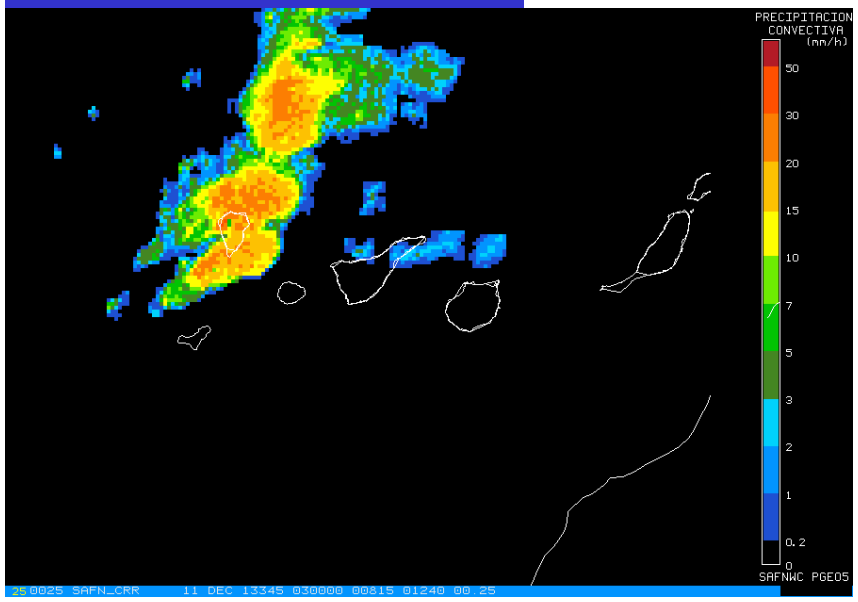
11th Dec 2013 – 03:00 UTC

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

No corrections applied



Only Moisture correction applied



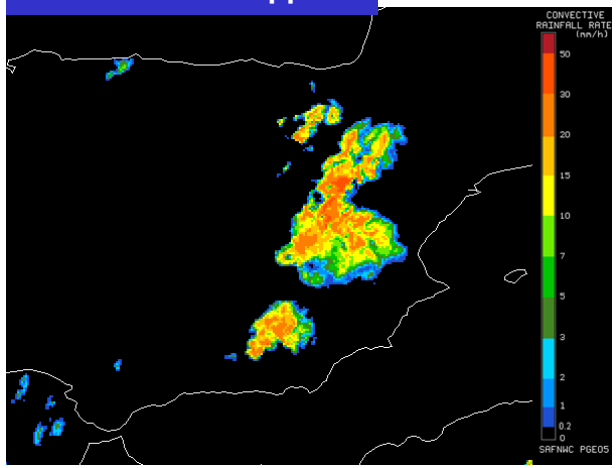
Convective Rainfall Rate (CRR)

Evolution Correction / Gradient Correction :

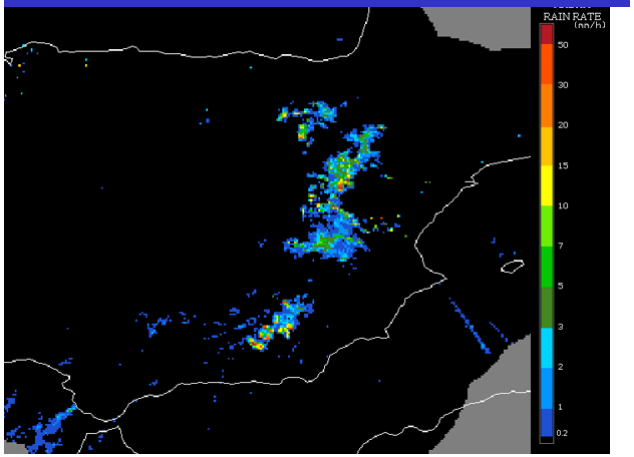
Evolution Correction:
Rain rate decreases if the analysed pixel becomes warmer in the second image

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

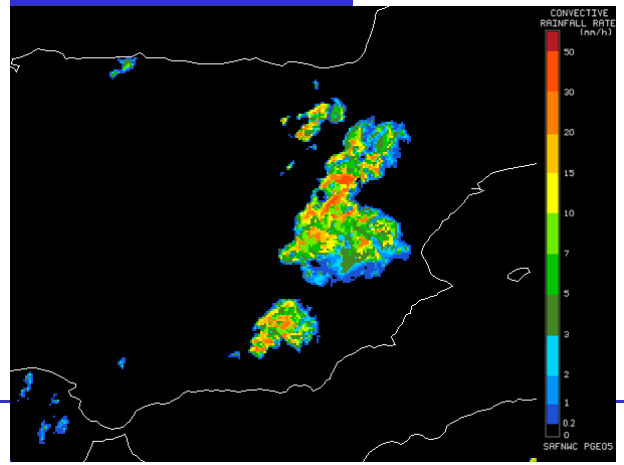
No corrections applied



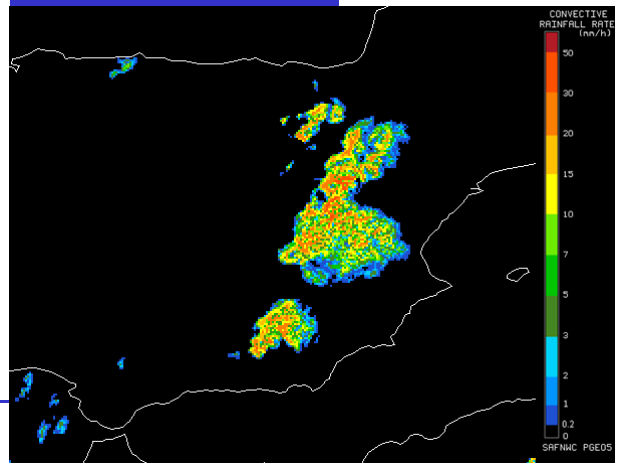
Radar (PPI) - 10th June 2014 – 17:10 UTC



Evolution Correction



Gradient Correction



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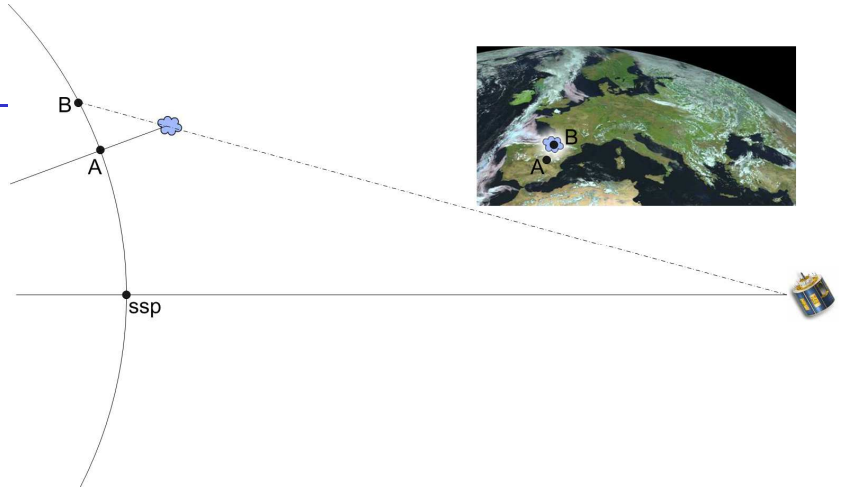
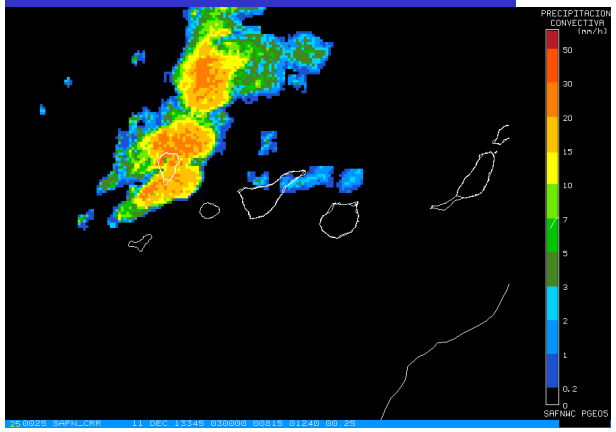
Convective Rainfall Rate (CRR)

Parallax correction:

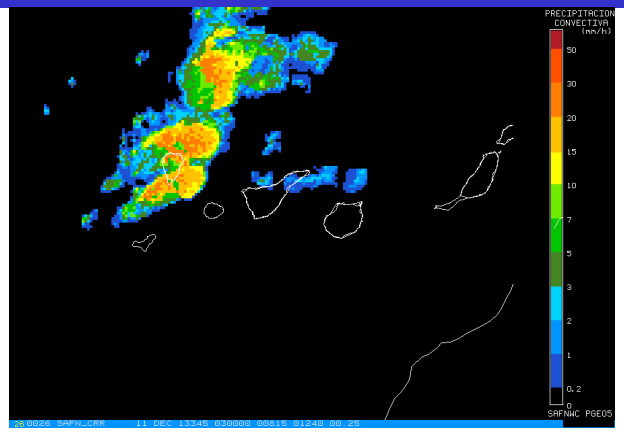
A spatial shift is applied to every pixel with precipitation according the basic CRR value



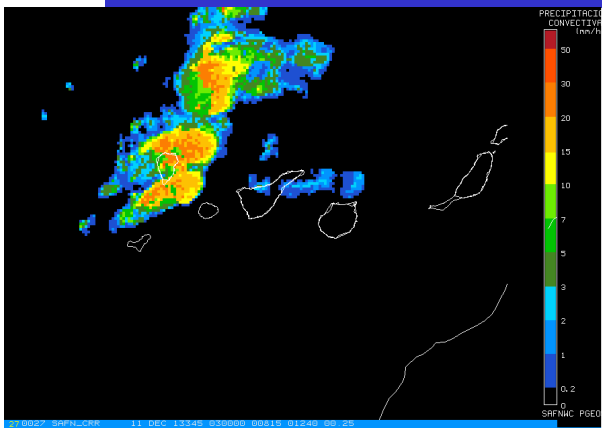
Only Moisture correction applied



Moisture + Evolution corrections applied



Moisture + Evolution + Parallax corrections applied



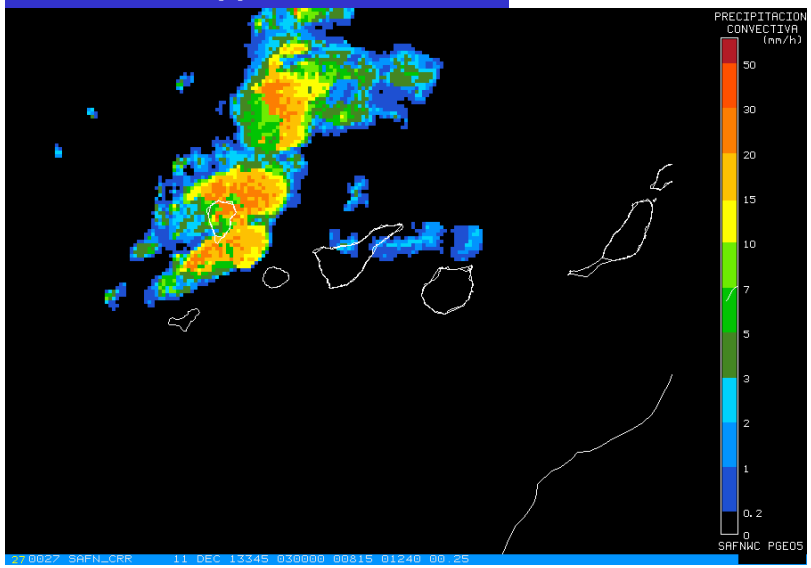
11th Dec 2013 – 03:00 UTC

Convective Rainfall Rate (CRR)

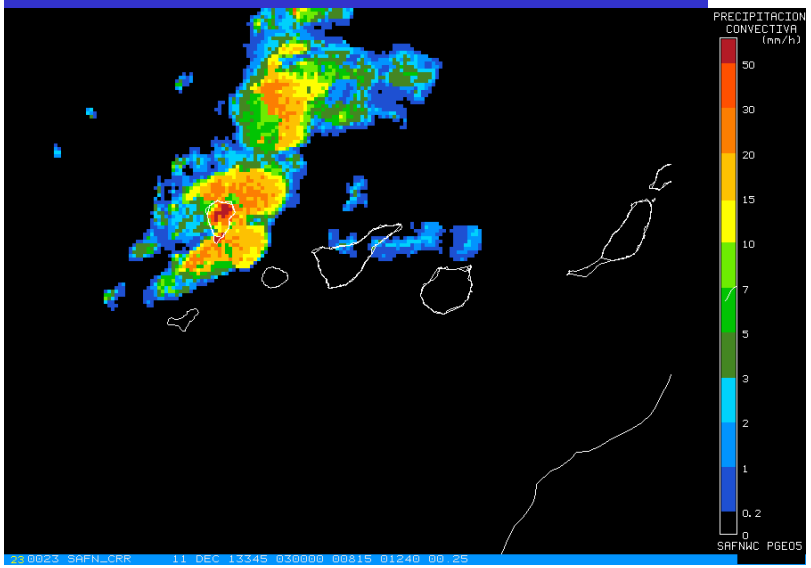
Orographic correction:

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



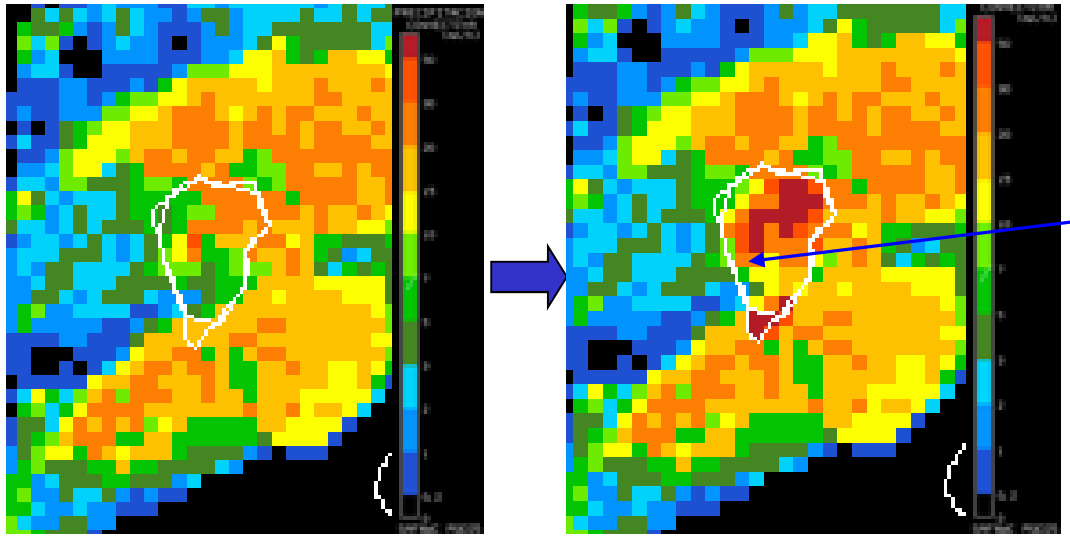
Moisture + Evolution + Parallax + Orographic corrections applied



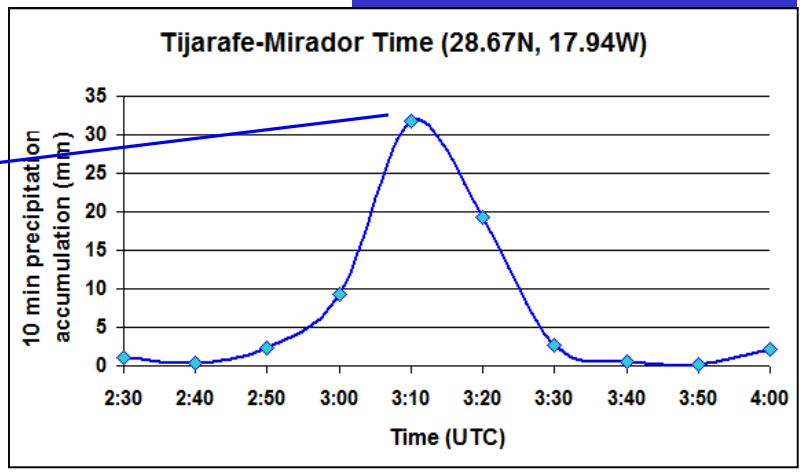
11th Dec 2013 – 03:00 UTC

Convective Rainfall Rate (CRR)

Orographic correction

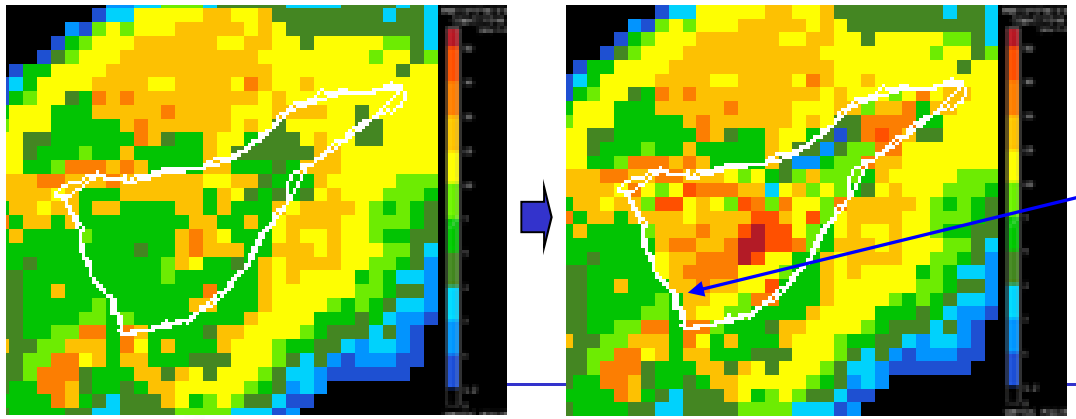


11th Dec 2013 – 03:00 UTC

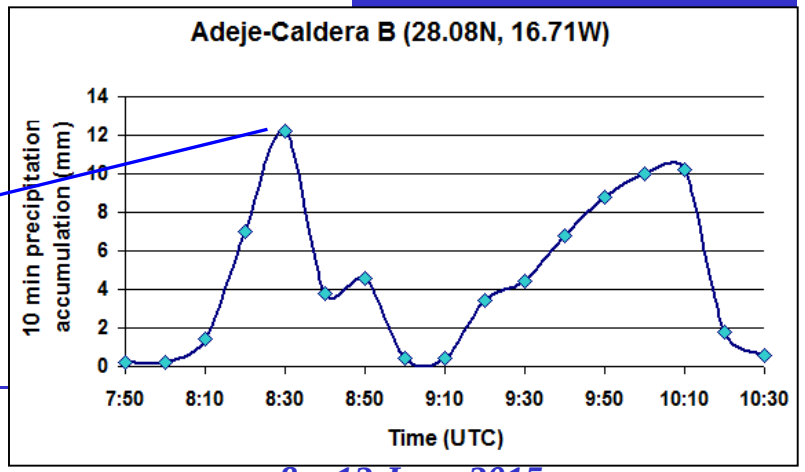


Moisture + Evolution + Parallax corrections applied

Moisture + Evolution + Parallax + Orographic corrections applied



11th Dec 2013 – 08:30 UTC



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Convective Rainfall Rate (CRR)

LIGHTNING ALGORITHM:

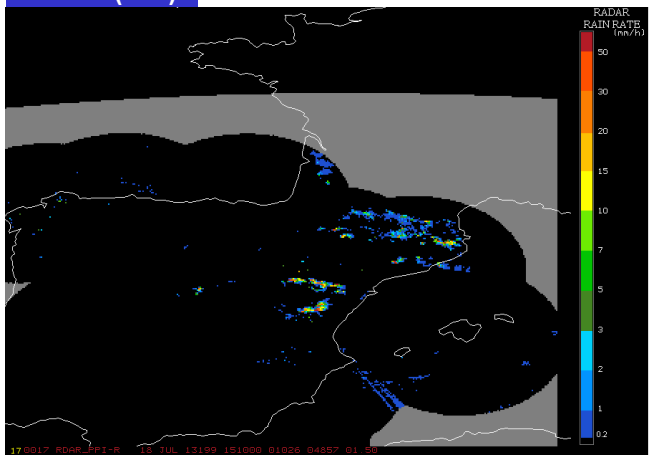
- The Lightning algorithm assumes that the higher are the spatial and temporal density of lightning, the higher are the probability and the intensity of convective precipitation.

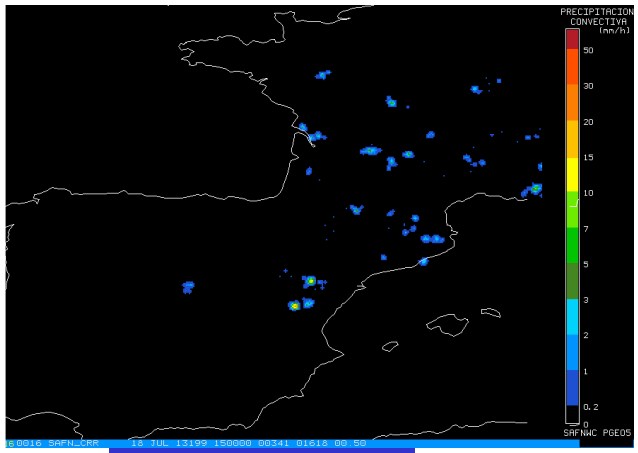
- The rain rates assigned to every lightning takes into account:
  - the time distance between the lightning event and scanning time of the processing region centre.
  - the location of the lightning.
  - the spatial density of lightning in a time interval.

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

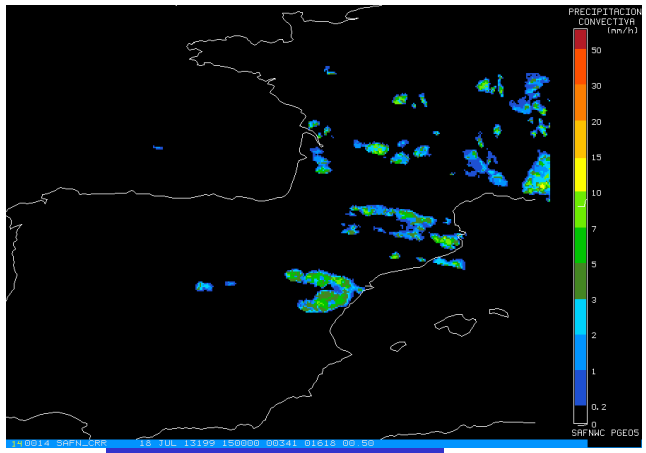
18 July 2013 – 15:00 UTC

Radar (PPI)

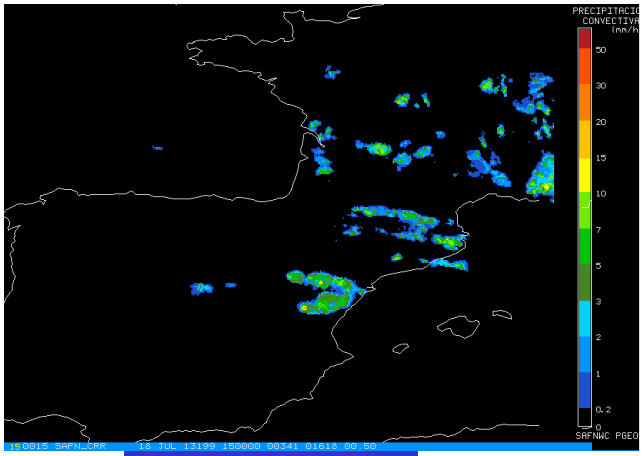




Lightning algorithm



CRR without lightning

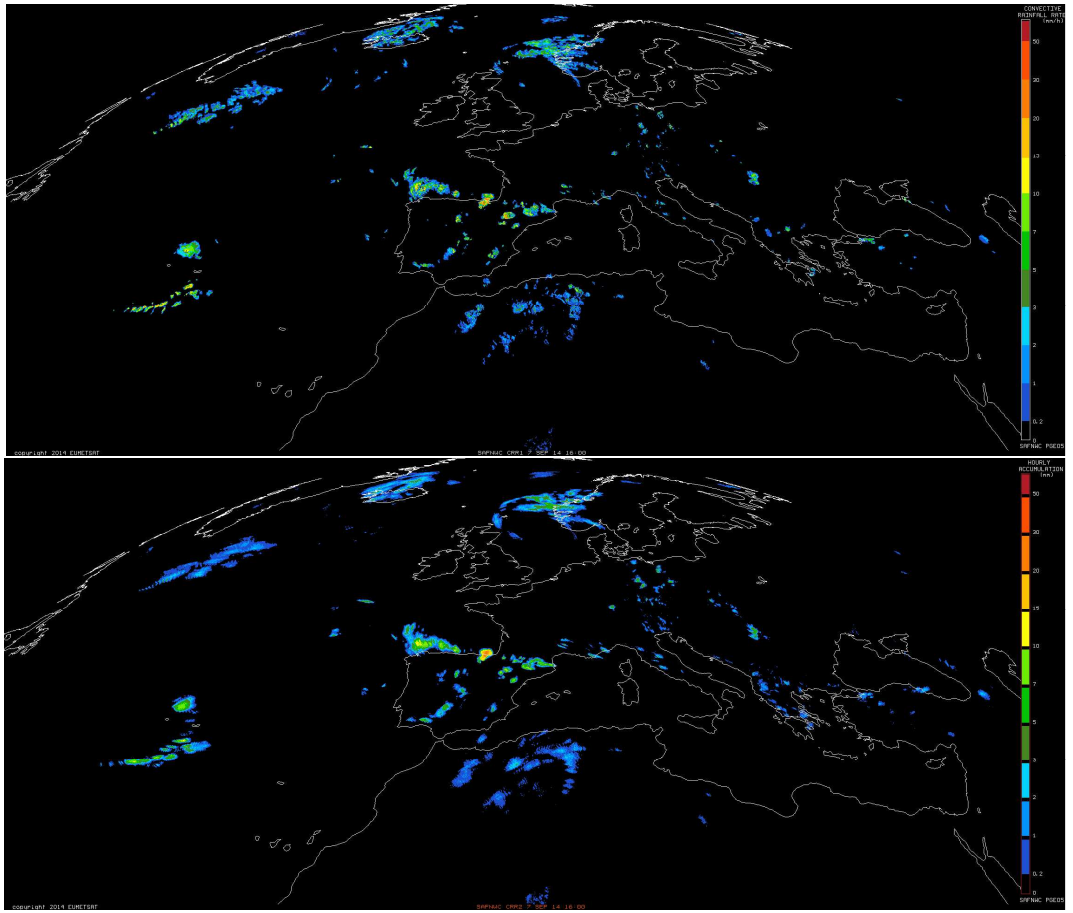


CRR with lightning

Convective Rainfall Rate (CRR)

OUTPUTS:

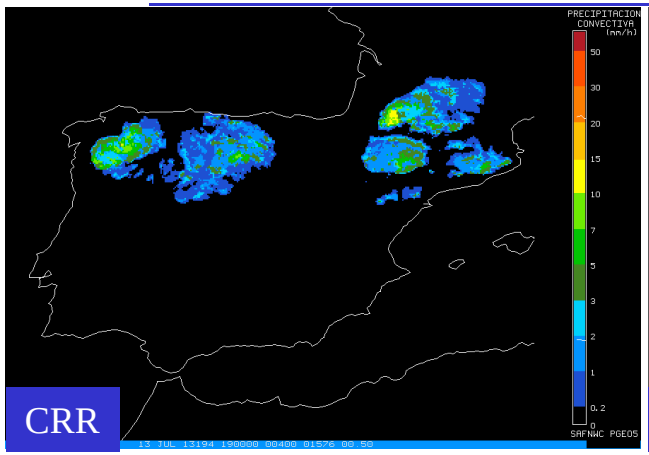
- CRR rainfall rates expressed in classes
- CRR rainfall rates expressed in mm/h *(required for hourly accumulations)*
- CRR Hourly Accumulations
- CRR-QUALITY
- CRR-DATAFLAG

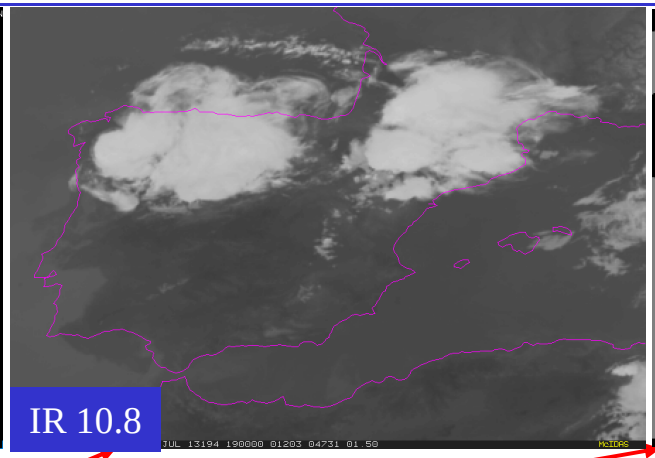


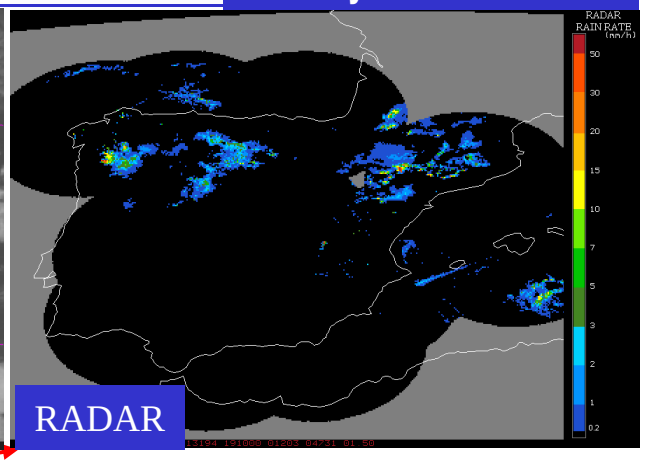
Convective Rainfall Rate (CRR)

Problems:

13th July 2013 - 19:00 UTC

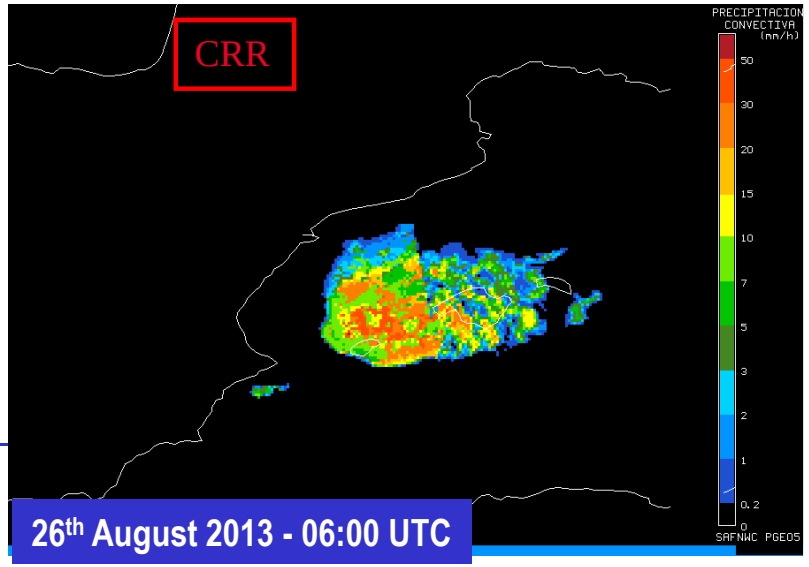






- Similar to the cloud tops
- Too big estimated precipitation area and lower rain rates than Radar

Different result for day and night



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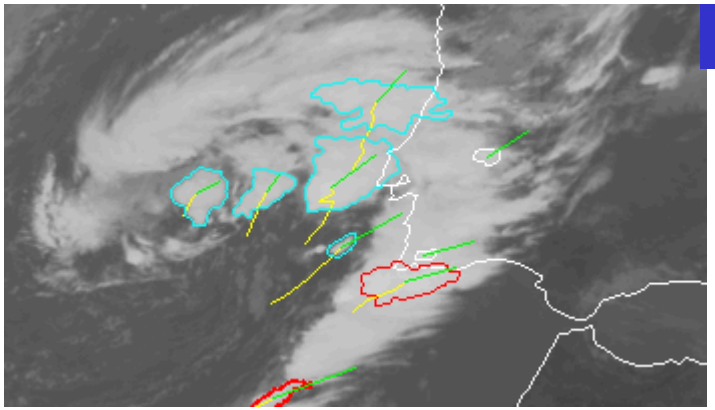
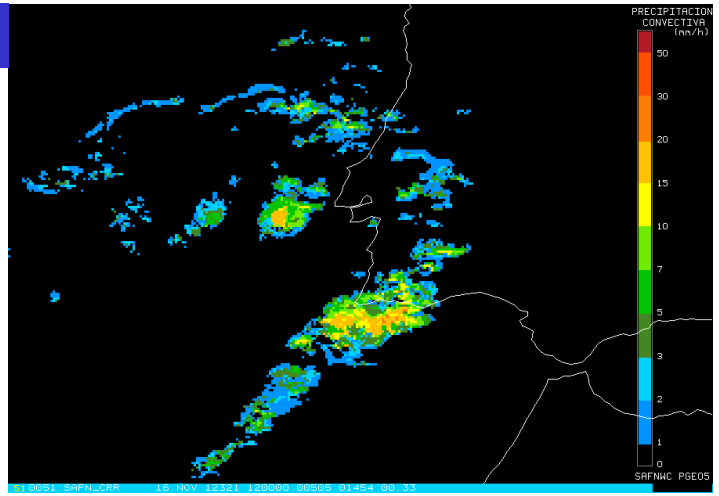
Convective Rainfall Rate (CRR)

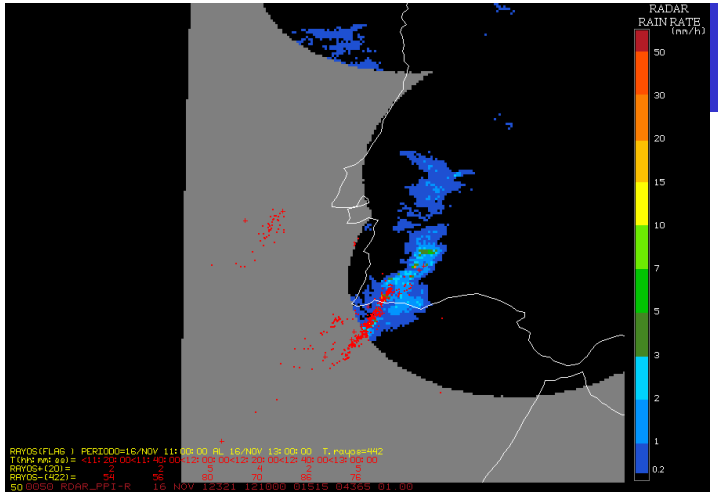
Applications: Estimation of rain rates for convective events over extensive areas, out of the radar coverage or as a radar compliment.



RDT

CRR





RADAR + Lightning info

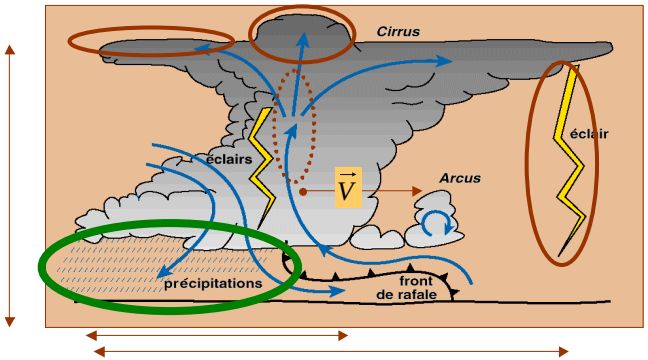
Slide courtesy of Jean-Marc Moisselin

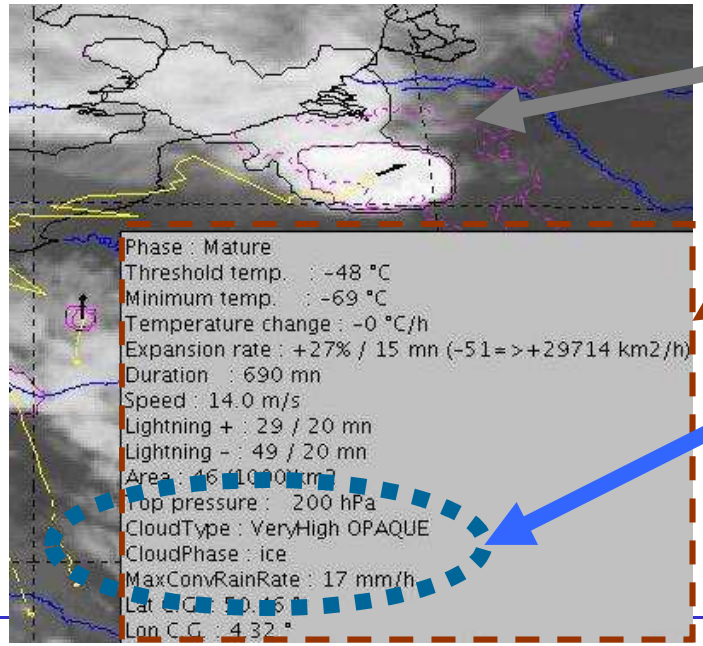
Links between SAF/NWC products

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.

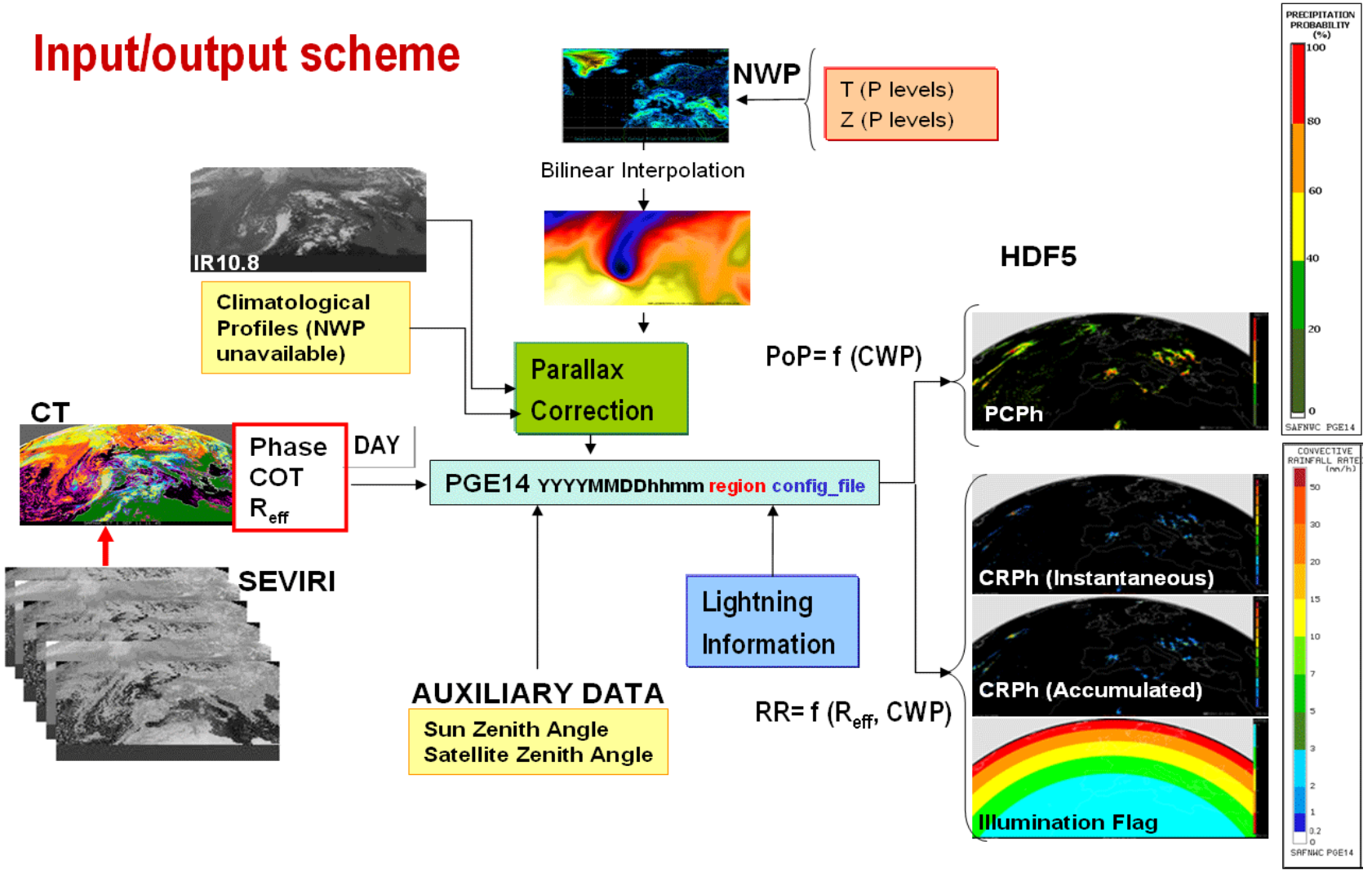
  PoP is defined as the instantaneous probability that a rain rate greater than or equal to 0.2 mm/h occurs at the pixel level.

- 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)

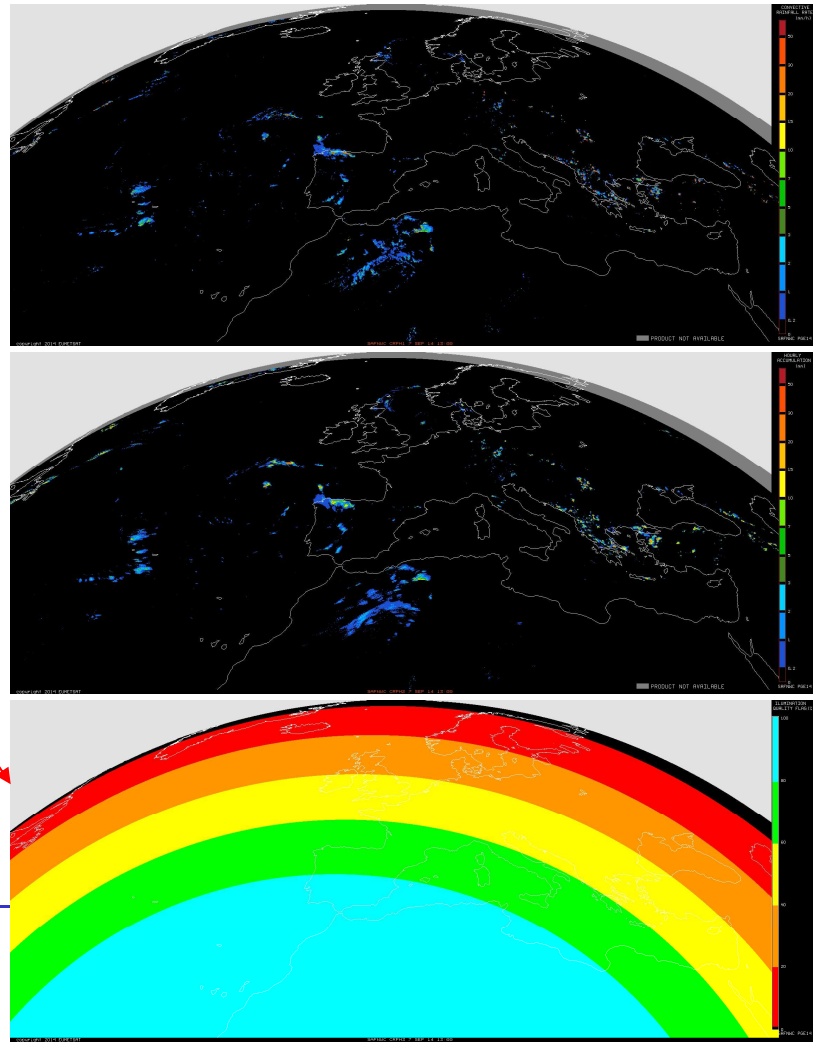
Input/output scheme



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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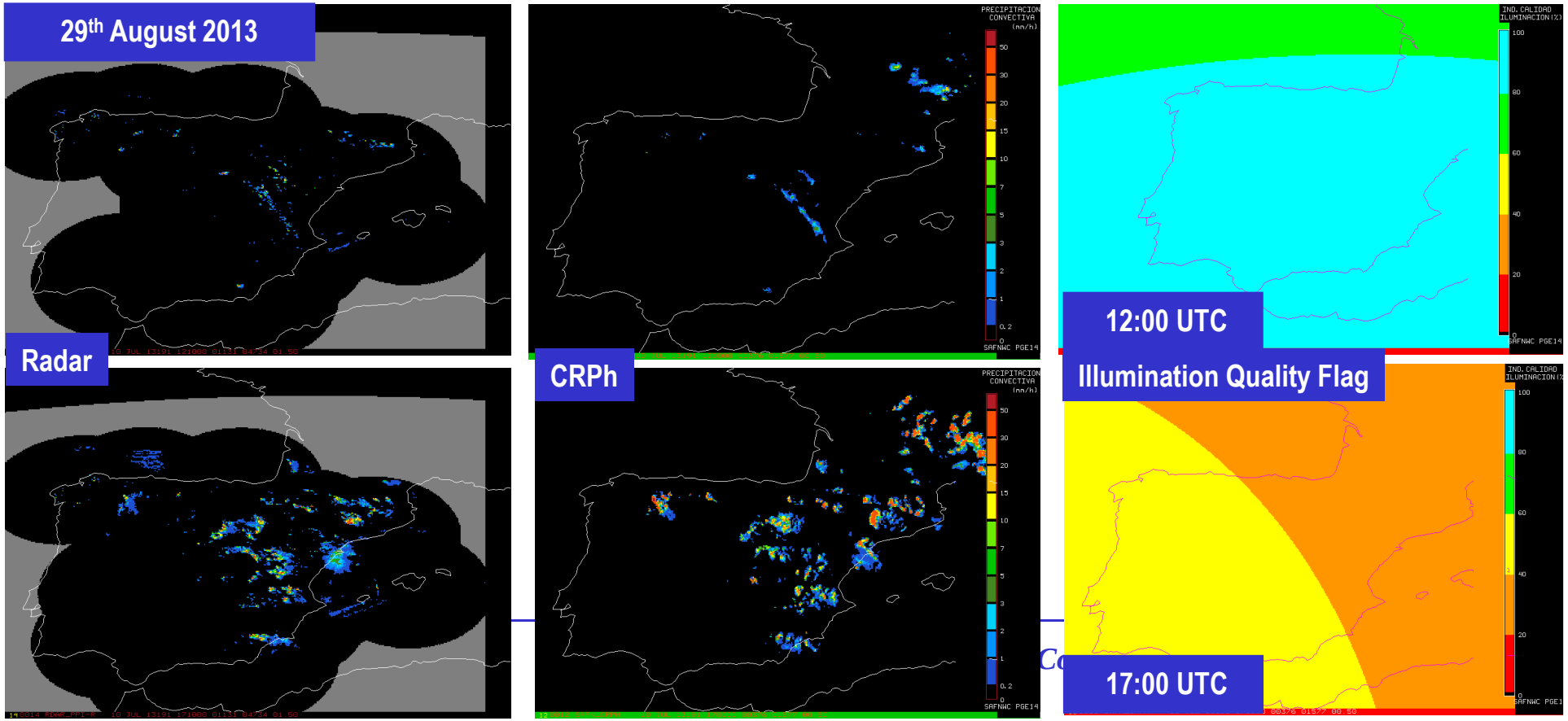
Convective Rainfall Rate from Cloud Physical Properties (CRPh)

Limitations:

Only day time

Only for estimated phase

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

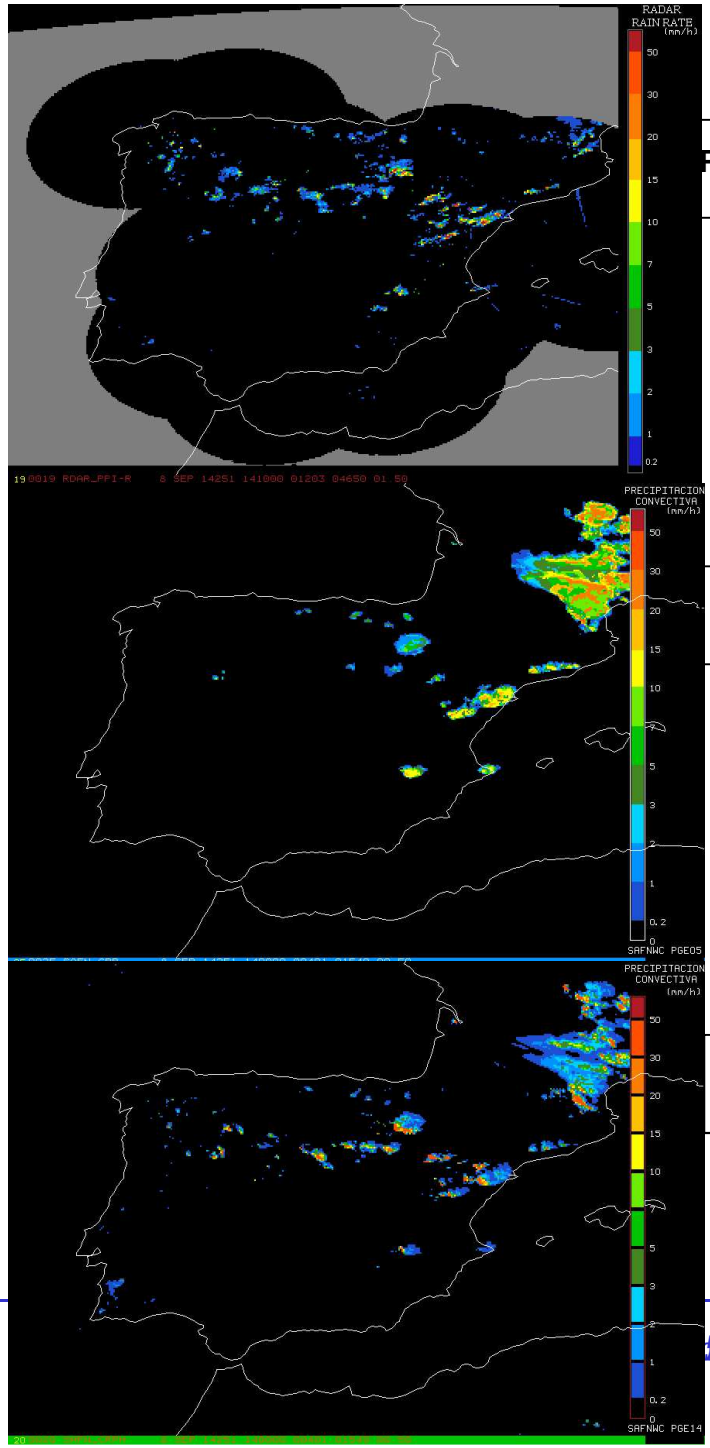


Comparison of Convective Rainfall Rate products (CRR and CRPh)

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)

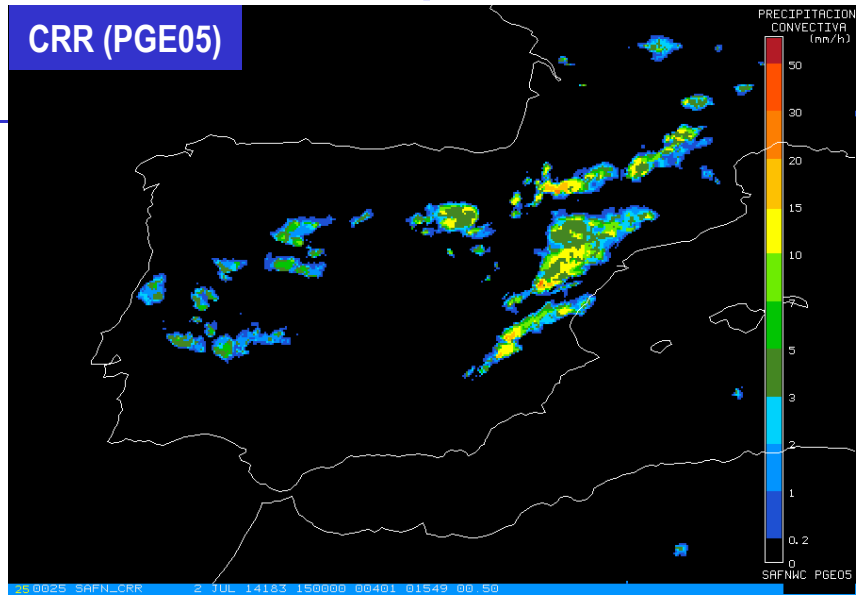
CRR

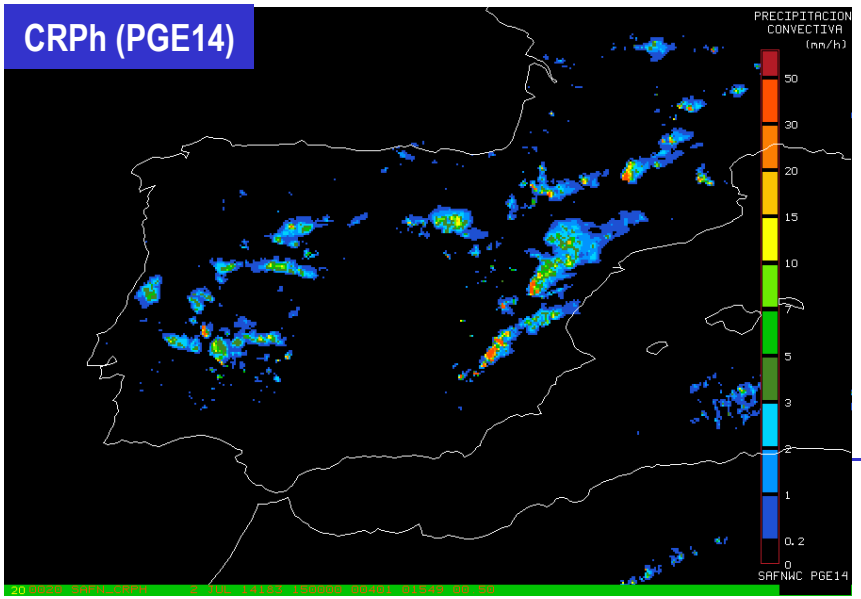
CRPh

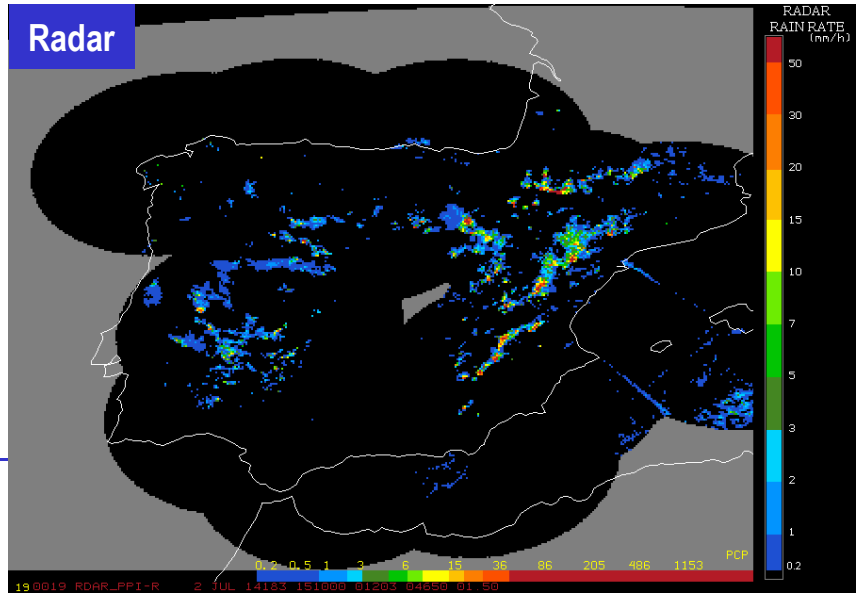
Comparison of Convective Rainfall Rate products (CRR and CRPh)

Precipitation areas and intensities closer to the radar ones

2 July 2014
15:00 UTC

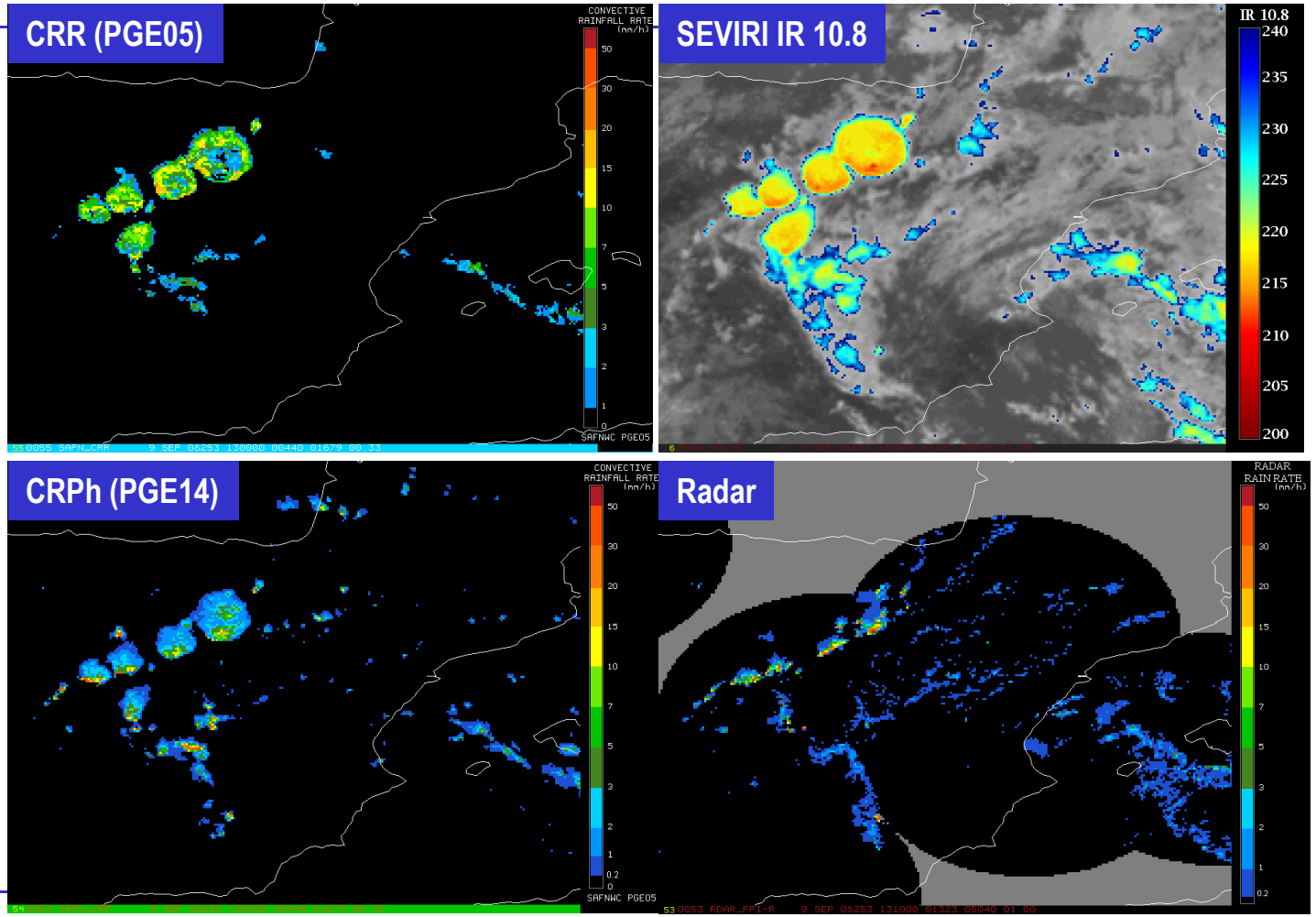






Comparison of Convective Rainfall Rate products (CRR and CRPh)

No Cold Rings and detection of smaller precipitation nuclei



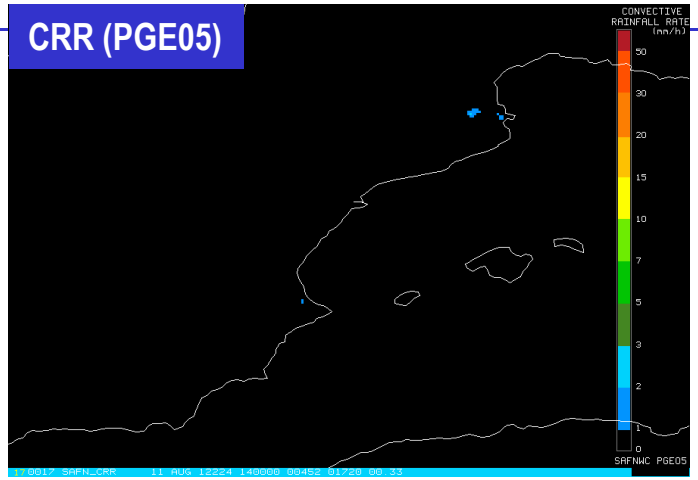
9th September 2008
13:00 UTC

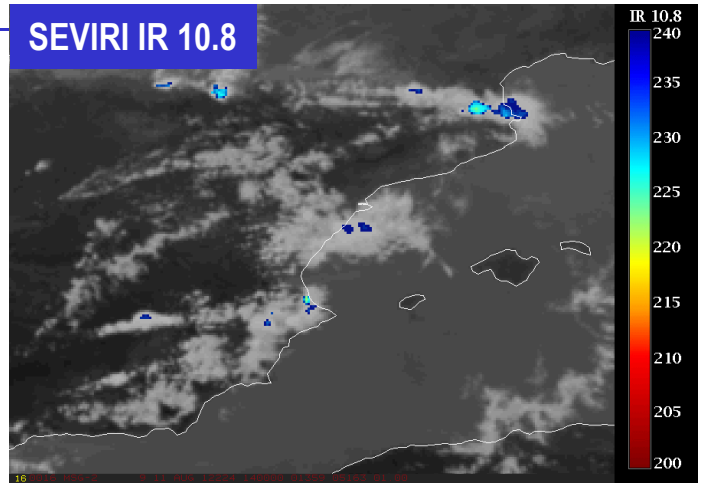
NWC SAF

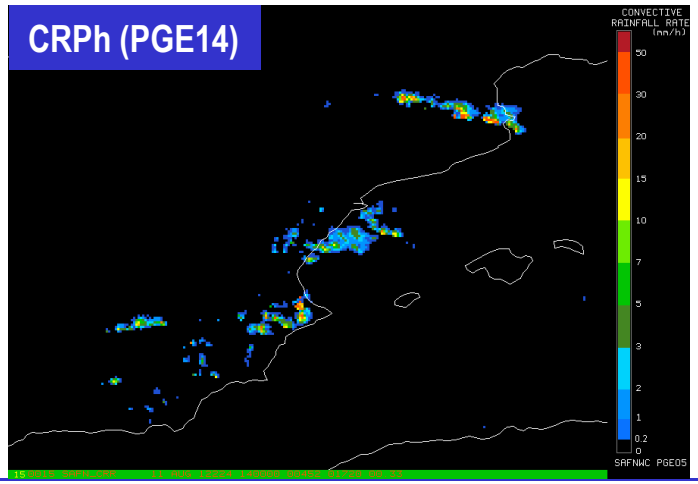
AEMet Agencia Estatal de Meteorología

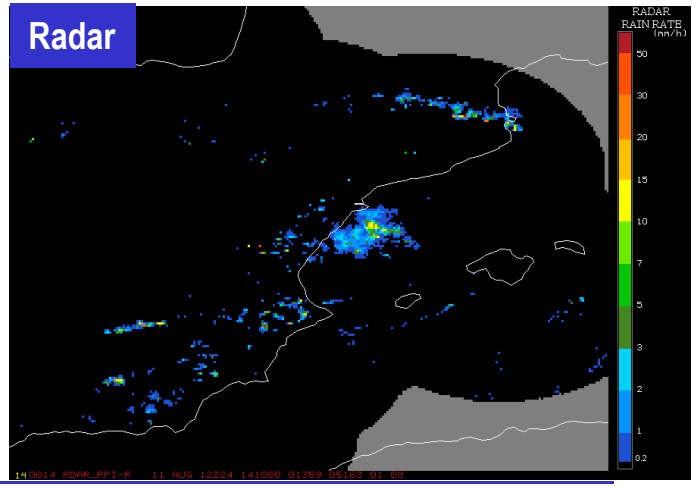
Comparison of Convective Rainfall Rate products (CRR and CRPh)

Detection of precipitation for warm top clouds









11th August 2012
14:00 UTC

NWC SAF

AEMet Agencia Estatal de Meteorología

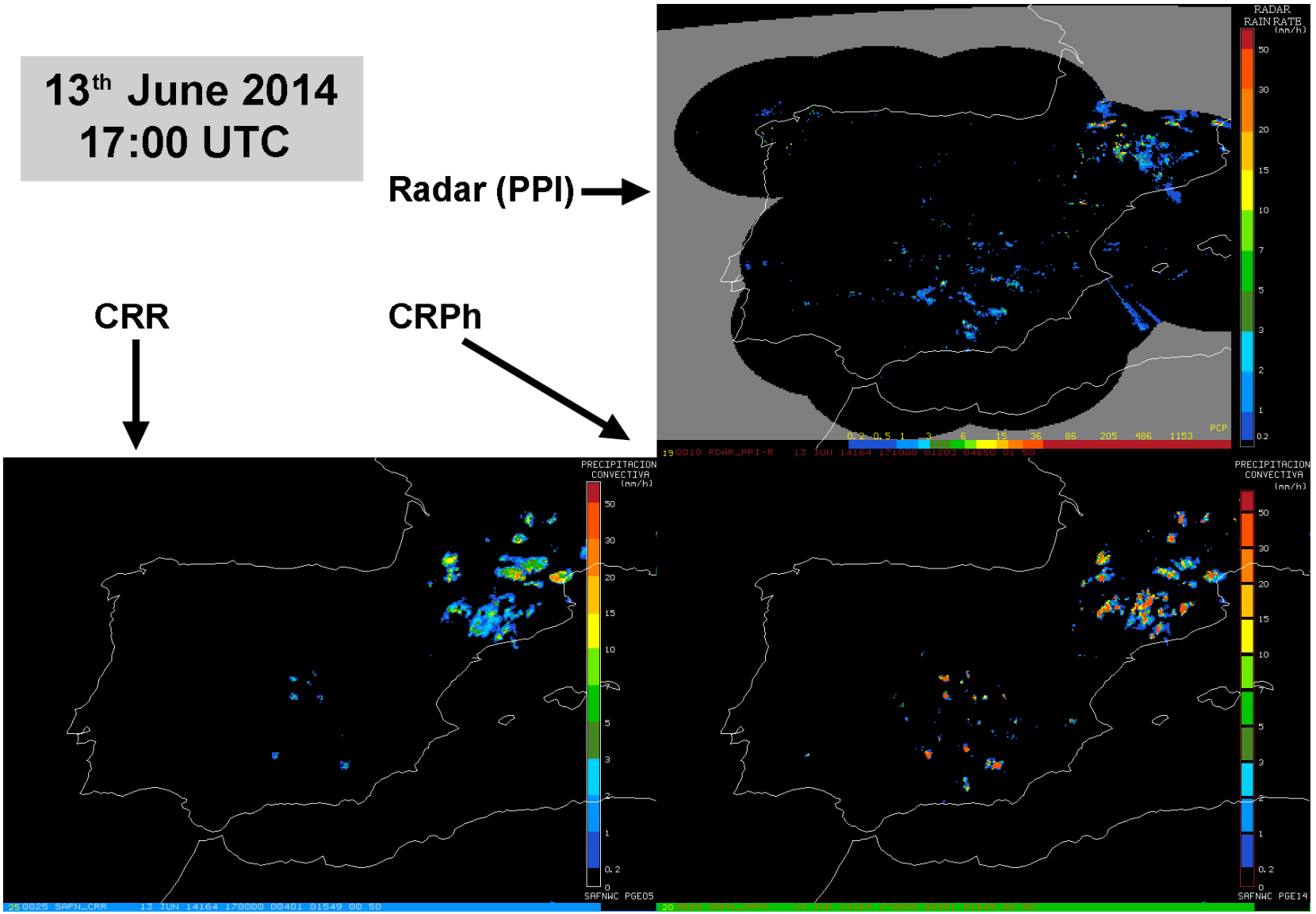
Comparison of Convective Rainfall Rate products (CRR and CRPh)

13th June 2014
17:00 UTC

Radar (PPI)

CRR

CRPh



Thanks for your attention!!