VALIDATION OF THE CRR PRODUCT OF THE NWCSAF SOFTWARE PACKAGE VERSION 2010

Cecilia Marcos*, Antonio Rodríguez
AEMET, SPAIN

INTRODUCTION:

The Convective Rainfall Rate (CRR) algorithm developed within the context of the SAF on Support to Nowcasting and Very Short Range Forecasting (SAFNWC), estimates rainfall rates from convective systems, using data from IR, WV and VIS MSG SEVIRI channels.

As lightning activity is related to convection, this information has been included in the current version of the product. In order to test the possible improvements of the product when using lightning information, a validation process that compares current version and the previous one, has been carried out. This validation includes two different studies, a subjective validation against radar and an objective validation over the whole year 2008.

An objective validation over Hungary has also been performed in order to test the value of the product out of the calibration region.

VALIDATION METHOD:

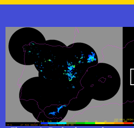

Figure 1. Radar image in Lambert projection

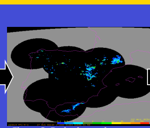

Figure 2. Radar image in Satellite projection

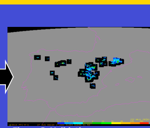

Figure 3. Validation area

Radar rain rates have been used as truth data in the validation process. This objective validation process has been based on grid boxes.
Both radar rain rates and ECHOTOP radar products have been used in the process in order to select the validation area.
First of all, radar datasets, which are in Lambert projection (Figure 1), have been re-projected to the satellite projection (Figure 2). Then, ground echoes have been removed. Only images with convective echoes have been selected but these images can also include non convective echoes. In order to validate only the convective ones, a validation area has been selected taking into account the convective area that has been calculated in each image (Figure 3). To do that, radar rain rates and ECHOTOP images have been used.
In the last step a smoothing process takes place. A 3 by 3 average centered on each pixel has been applied. So, one out of every three pixels of the radar image located in the validation area has been matched with the corresponding one in the CRR image.
Accuracy and categorical statistics have been calculated with those pairs of values.
Statistics scores have been calculated for instantaneous rates as well as for accumulations. As the results are quite similar only the instantaneous rain rates results are presented in this poster

OBJECTIVE VALIDATION OVER SPAIN:

The objective validation over Spain compares the CRR product version 2009 to version 2010 which can use the lightning information as an optional input. This validation has two aims. On one hand, testing if there is an added value on using the lightning information and, on the other hand, checking the product results out of the calibration period.

85 days with convective events occurred along the year 2008 have been validated. The radar products used to compare in the validation process have been:
- ♣ Instantaneous rates obtained from PPI reflectivities.
- ♣ Hourly accumulations obtained from CAPPI at 500 m over each radar site.

The PPI reflectivities have been converted into rain rates through the Marshall-Palmer Z-R relationship.
The CRR values have been obtained by using all the corrections with the default values.

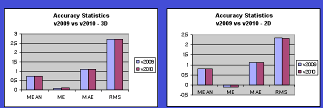

Figure 4. Instantaneous rates validation. Distribution of accuracy statistics in versions 2009 and 2010 for 3D and 2D calibrations

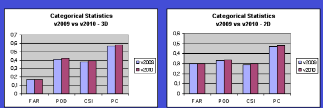

Figure 5. Instantaneous rates validation. Distribution of categorical statistics in versions 2009 and 2010 for 3D and 2D calibrations

CONCLUSION:

Regarding the accuracy statistics, median error is very close to zero in both cases 3D and 2D calibration, and the differences between both versions are very small. Due to the intrinsic characteristics of 2D calibration, in the case of the highest rates, the rain rates usually assigned by 2D calibration are lower than the ones assigned by the 3D calibration. This fact leads to an RMS error in 2D calibration smaller than in 3D case.

The categorical statistics show that POD is higher than FAR above all in 3D calibration. Version 2010 shows a light increase in the POD.

The use of lightning data has very low impact in statistics scores although they are a bit better in the new version.

OBJECTIVE VALIDATION OVER HUNGARY:

The Hungarian meteorological service (OMSZ) performed last year within the framework of SAFNWC Visiting Scientist Activities a validation work including a subjective validation against Hungarian radar data and an objective validation against Hungarian rain gauges for the period 15 May to 15 September 2009.

In order to complement the OMSZ work, a parallel validation has been carried out using radar data for the same period and region. The radar products used to compare were the Maximum reflectivity in the vertical and Hourly accumulations.

CONCLUSION:

The accuracy statistics show similar results for both regions. Over Hungary higher values of MAE and RMS error were obtained because the precipitation measured was greater.

Regarding the categorical statistics, better results were obtained over Hungary. The reason could be that Maximum reflectivity in the vertical radar product correlates better to cloud features than PPI (first radar elevation).

In general, similar results were obtained for both validations over Spain and over Hungary against radar data

To be able to compare results obtained over Hungary and over Spain, statistics using results of the validation over Spain for the same period (15 May to 15 September 2008) has been computed.

The CRR values have been obtained by using all the corrections with the default values. Lightning information has not been used in this case.

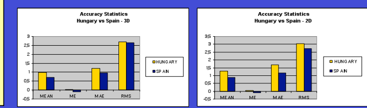

Figure 6. Instantaneous rates validation. Distribution of accuracy statistics for Hungary and Spain for 3D and 2D calibrations

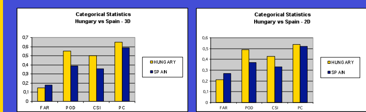

Figure 7. Instantaneous rates validation. Distribution of categorical statistics for Hungary and Spain for 3D and 2D calibrations

SUBJECTIVE VALIDATION OVER SPAIN:

Convective Rainfall Rate product is thought to be used by forecasters. Besides the intensity of precipitation it is also important monitoring the precipitation pattern as well as its evolution. In order to check this kind of information, a subjective validation has been carried out.

In version 2010, CRR product can also use the lightning information. This subjective validation compares the radar precipitation pattern with CRR one obtained with and without lightning information. This validation has been performed over Spain.

Three images of the same event at different times are shown below. All of them took place during the night so 2D calibration was used. This examples show the added value of the lightning information in the time evolution of the convective event during the night. Figure 8 shows the situation occurred on the 29th Jun 2008 at 19:00 UTC. At this time CRR shows the overall pattern of the radar, but with a lower intensity. There is a high density of lightning in those areas where the radar shows higher intensity of precipitation. This fact allows CRR version 2010 to catch the maxima of precipitation according to the radar with both more accurate localization and more accurate intensity. Figure 9 shows the same event two hours later, at 21:00 UTC. It can be seen how CRR pattern is weakening but density of lightning is still high. This fact allows CRR version 2010 to catch the radar maxima in an accurate way and also to catch new nuclei that CRR by itself was missing in version 2009. Figure 10 shows how two hours later the convective system is decaying. At this stage CRR version 2009 misses the entire precipitation pattern but CRR version 2010 shows precipitation nuclei according to the radar. This precipitation pattern showed by CRR has been entirely computed using the lightning information.

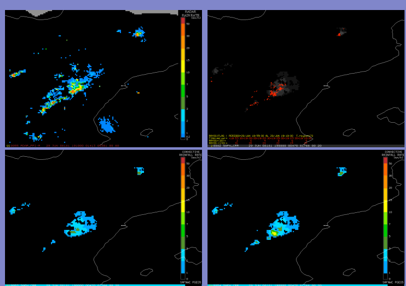

Figure 8. Instantaneous radar rates corresponding to 29-06-2008 at 19:10Z (top left). CRR instantaneous rates in version 2009 the 29-06-2008 at 19:00Z without colour scale plus lightning activity from 18:55 to 19:10Z on the 29-06-2008 (top right). CRR instantaneous rates in version 2009 the 29-06-2008 at 19:00Z (bottom left). CRR instantaneous rates in version 2010 the 29-06-2008 at 19:00Z (bottom right).

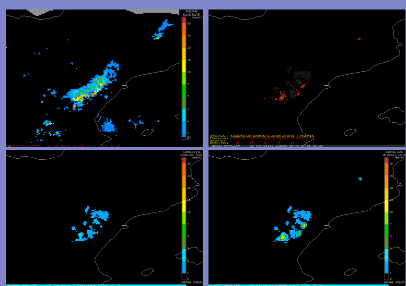

Figure 9. Instantaneous radar rates corresponding to 29-06-2008 at 21:10Z (top left). CRR instantaneous rates in version 2009 the 29-06-2008 at 21:00Z without colour scale plus lightning activity from 20:55 to 21:10Z on the 29-06-2008 (top right). CRR instantaneous rates in version 2009 the 29-06-2008 at 21:00Z (bottom left). CRR instantaneous rates in version 2010 the 29-06-2008 at 21:00Z (bottom right).

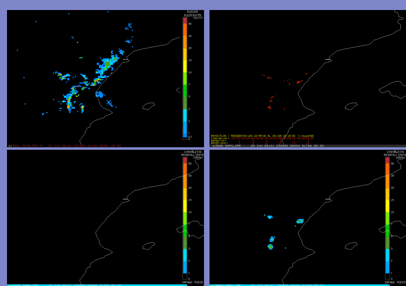

Figure 10. Instantaneous radar rates corresponding to 29-06-2008 at 23:10Z (top left). CRR instantaneous rates in version 2009 the 29-06-2008 at 23:00Z without colour scale plus lightning activity from 22:55 to 23:10Z on the 29-06-2008 (top right). CRR instantaneous rates in version 2009 the 29-06-2008 at 23:00Z (bottom left). CRR instantaneous rates in version 2010 the 29-06-2008 at 23:00Z (bottom right).

In this case, where CRR have to use the 2D Calibration matrices and is not able to catch the maximum of precipitation, the lightning information is very helpful and provides very good results.

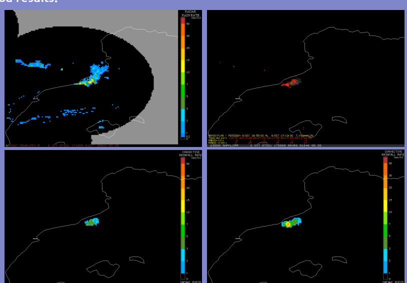

Figure 11. Instantaneous radar rates corresponding to 8-10-2007 at 17:10Z (top left). CRR instantaneous rates in version 2009 the 8-10-2007 at 17:00Z without colour scale plus lightning activity from 16:55 to 17:10Z on the 8-10-2007 (top right). CRR instantaneous rates in version 2009 the 8-10-2007 at 17:00Z (bottom left). CRR instantaneous rates in version 2010 the 8-10-2007 at 17:00Z (bottom right).

CONCLUSION:

When CRR is using the 3D Calibration, lightning information can help to fill better the precipitation pattern and sometimes to catch more accurately some maximum of precipitation. In general there are no big differences using or not the lightning information with the 3D Calibration.

Lightning information is very helpful when CRR is working with the 2D Calibration. CRR with 2D Calibration provides less quality results than CRR with 3D Calibration. In this respect lightning information helps CRR when using 2D Calibration to provide better quality information. In these cases more precipitation nuclei are caught, the quantifying of precipitation is more adjusted to the one measured by the radar and the convective situations are better detected.

In this case CRR has been run with the 3D calibration matrices. Lightning information fills the CRR pattern in an appropriate way and lets CRR show more accurate maxima according to the radar.

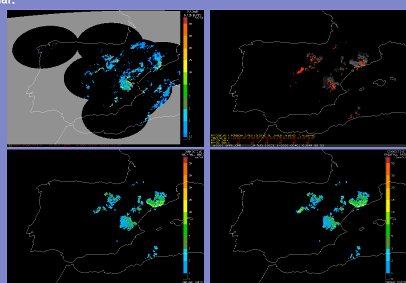

Figure 12. Instantaneous radar rates corresponding to 19-08-2010 at 14:10Z (top left). CRR instantaneous rates in version 2009 the 19-08-2010 at 14:00Z without colour scale plus lightning activity from 13:55 to 14:10Z on the 19-08-2010 (top right). CRR instantaneous rates in version 2009 the 19-08-2010 at 14:00Z (bottom left). CRR instantaneous rates in version 2010 the 19-08-2010 at 14:00Z (bottom right).

*cmarcosm@aemet.es