1 CalVal status of Envisat reprocessed GDR cycle - Cycle 85 : 2010/01/11 to 2010/02/15 - J.F. Legeais - N. Granier - Y. Faugere

This cycle is the first GDR cycle entirely reprocessed with the IPF processing chain V6.04 and the CMA Reference Software V9.3_05
A first reprocessing of this cycle occured in April 2010. It revealed an artefact related to the USO correction. It generated anomalous jump and a global drift which had to be solved before distribution of the data to users.

Present and missing measurements :

1002 passes produced over 1002.

No difference on the coverage. The same number of data has been produced after re-processing

Edited measurements :

- Pass 9 edited by stat per track : 08/12/2009 : Statistics on the sea level anomaly are impacted by the maneuver (08-Dec-2009)
No difference between before and after re-processing.
- Passes 26-27, 734-735 edited on the radiometer land flag criteria (no MWR correction : 2009/12/08 from 18 :34 :35 to 20 :12 :24 and 2010/01/02 from 12 :05 :11 to 13 :44 :36).
The radiometer of these 4 passes have been lost after re-processing.

Performances :

Before re-processing
StDev($Crossover, Bathy < -1000m/Var < 20cm/|latitudes| < 50deg$)= 5.41 cm over 11938 crossover
StDev($SSH - MSS, Bathy < -1000m/Var < 20cm/|latitudes| < 50deg$)= 9.33 cm over 987282 validated measurements
After re-processing
StDev($Crossover, Bathy < -1000m/Var < 20cm/|latitudes| < 50deg$)= 5.39 cm over 11686 crossover
StDev($SSH - MSS, Bathy < -1000m/Var < 20cm/|latitudes| < 50deg$)= 9.31 cm over 983347 validated measurements

Similar performances are noticed after re-processing.

2 Particular investigations :

Major changes

Cycle 85 is the first cycle to be reprocessed with the new configuration (IPF version 6.04 and CMA version 9.3_05). Deep investigation of the impact relative to the original processing is analysed on this report.

Instrumental corrections impacting the range

3 Major changes were performed in the new IPF chain :

- The introduction of USO correction directly in the range at the L1b level. This shall not have any impact on the data except that users shall not correct the products afterwards.

- The improvement of the PTR resolution from 3 cm to 1.8 mm. This has 2 impacts on the data :
  - A direct impact on the Calibration factors included in the Level2 Instrumental Corrections :
  o On the range through the Time Delay Calibration Factor.
  o On the sigma0 through the sigma0 calibration factor.
  - An undirect impact on the data through the retracking applied on a slighlty modified waveform :
  o On all retracked parameters (Range through Epoch,SWH through SigmaC2, Wind throught Sigma0, Mispointing, Peakiness)

Changes impacting SWH and SSB correction

2 changes were performed impacting the SSB correction :

- The Sea-State bias table has been recomputed (Labroue, 2007) accounting for the impact of the new orbit and the new geophysical corrections (MOG2D, GOT00 ocean tide correction with the S2 component corrected once only, new wind speed algorithm from Abdalla, 2006). The new SSB correction is shifted in average by +2.0 mm in comparison with the previous one.
- Furthermore, the improvement of the PTR SigmaC estimation has an impact on the SWH value (SWH2 = SigmaP2 + SigmaC2). It is estimated to -13cm with a slight dependence in SWH.

New MWR

Changes were performed on the MWR characterisation files with an impact on :

- Wet Tropospheric correction
- Brightness temperatures

New/Updates quality flags

- Updated Rain flag : In the algorithm the coefficients and look-up tables have been updated, in order to set the value of the flag.
- New Sea-Ice algorithm includes a 2-state sea ice flag (ice-free ocean and sea-ice) and 4 values indicating the membership of the pixel to each class (ice-free ocean, first-year ice, multi-year ice and wet ice). They are provided as percentages between 0 and 100 in the product.

Ocean Tide and Tidal Loading

Evolution from FES2002 to FES2004 : new Ocean Tide and Tidal Loading. This will have no impact on the data provided our SLA is computed with GOT tidal model.

Total bias expected/evaluated on the SLA monitoring

The global impact noticed on the SLA monitoring consists in the sum of :

- Around **-6.4mm** due to the increase of the new PTR resolution (included in the range instrumental correction) - Expected
- Around **-4.3mm** due to the new SSB solution (algorithm part : +2mm and 4 to 5% of 13cm SWH bias part) - Expected

==> Resulting in a **-10.7 mm jump** with geographical patterns (see map of figure 1).

Note that those statistics include the correction of 9mm USO : previously derived from auxiliary files and now directly included in the range.

Impact is also noticed on SWH monitoring :
- Around **-13cm** biais on the SWH due to the PTR width estimation - Expected

Other parameters are not or slighly impacted (weak impact on the range of the MWR new caracterisation files).

Sigma0 : +0.016dB and resolution noise from the sigma0 calibration factor.
At_atmo : +0.016dB
Wind : -0.05m/s
TB2 : +0.9K (0.5K expected on all surfaces)
TB3 : +2.7K (1K expected on all surfaces)
MWR : +0.3mm

3 Geographic and temporal differences of New and Old versions

This part shows the temporal difference of daily statistics. Note that these statistics do not take into account the fact that the number of point might not be the same in both versions. However, the difference is minor and does not affect the statistics in a significant way.
Note that the first and last days of daily differences monitorings are systematically excluded since they are not associated with the same number of data. Moreover, maps of geographic differences are point to point differences.

Impact of IPF/CMA version on Sea Level and range related parameters

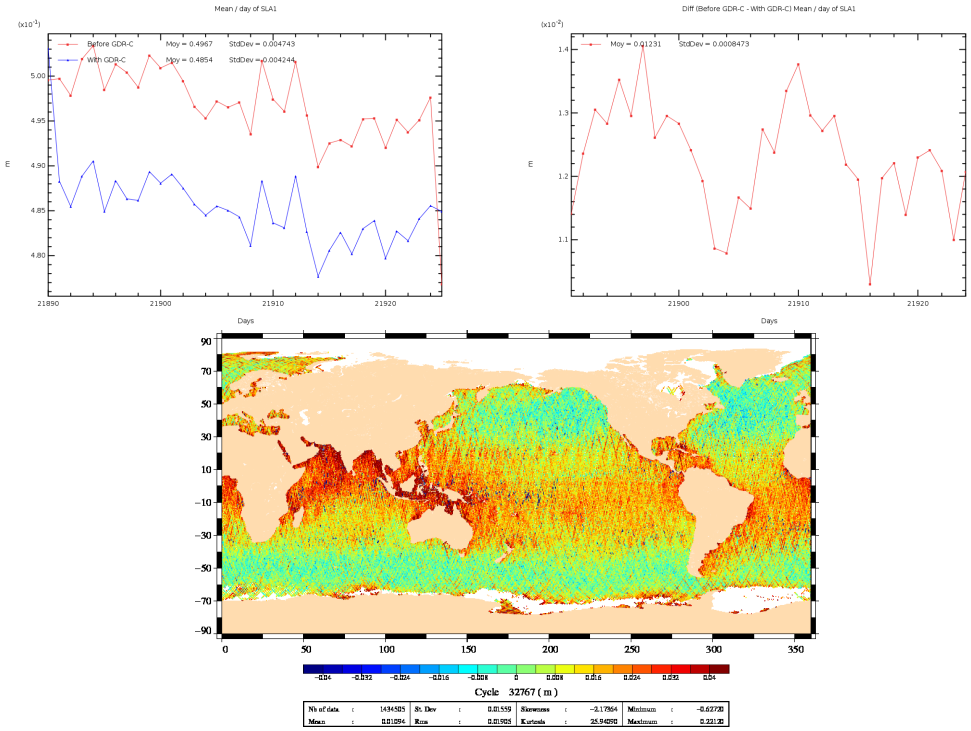

FIG. 1 – **Total Corrected SLA : Monitoring per day of each version (left)/ Difference Old - New version (right). Total of -10.9mm global bias.**

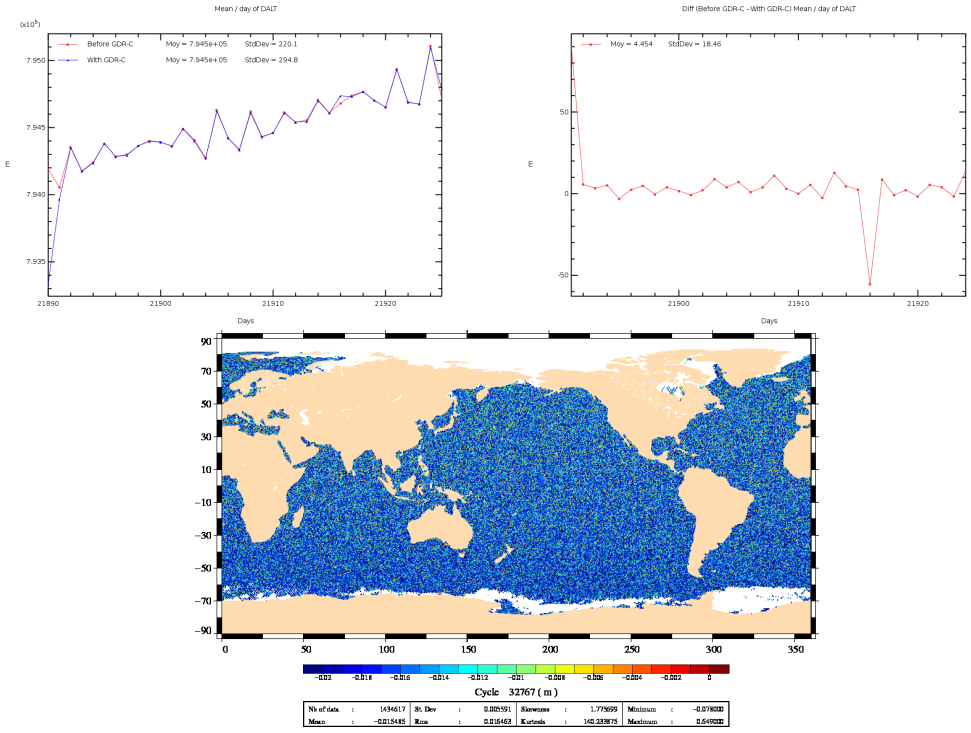

FIG. 2 – **Range : Monitoring per day of each version (left)/ Difference Old - New version (right). Total of 1.5cm global bias.**

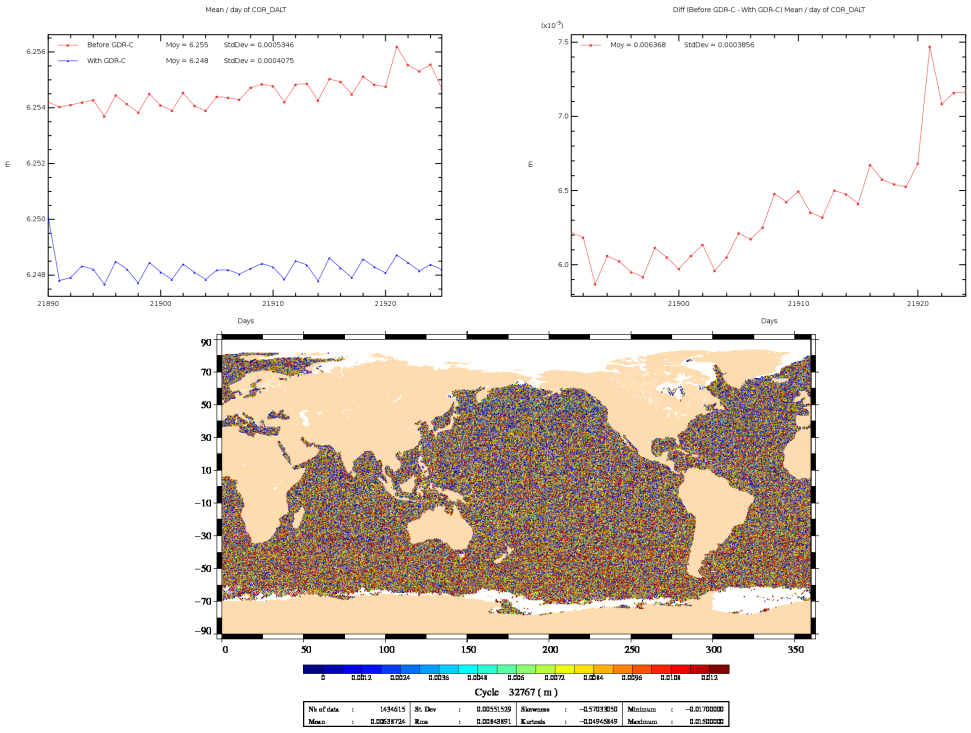

FIG. 3 – **Instrumental Range Correction : Monitoring per day of each version (left)/ Difference Old - New version (right). Responsible for a -6.4mm global bias.**

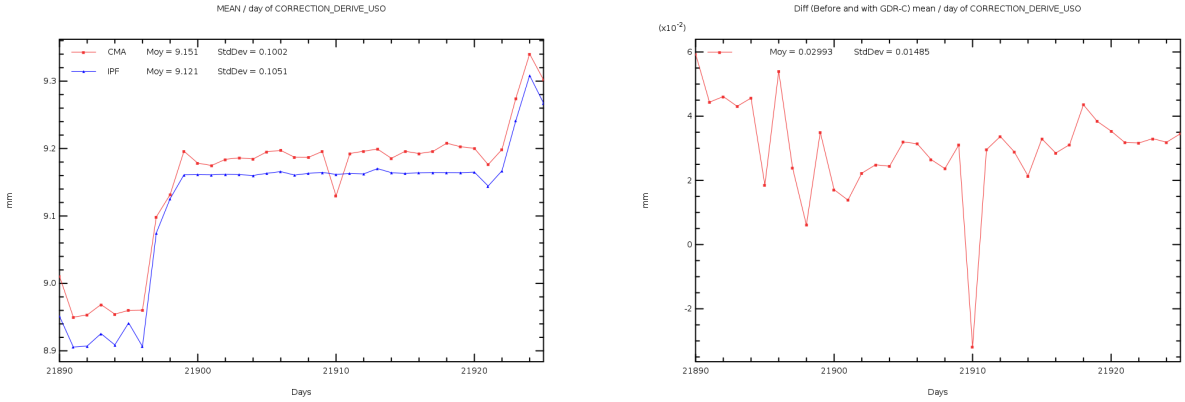

FIG. 4 – *USO Correction : Monitoring per day of each version (left) / Difference IPF - CMA version (right).*

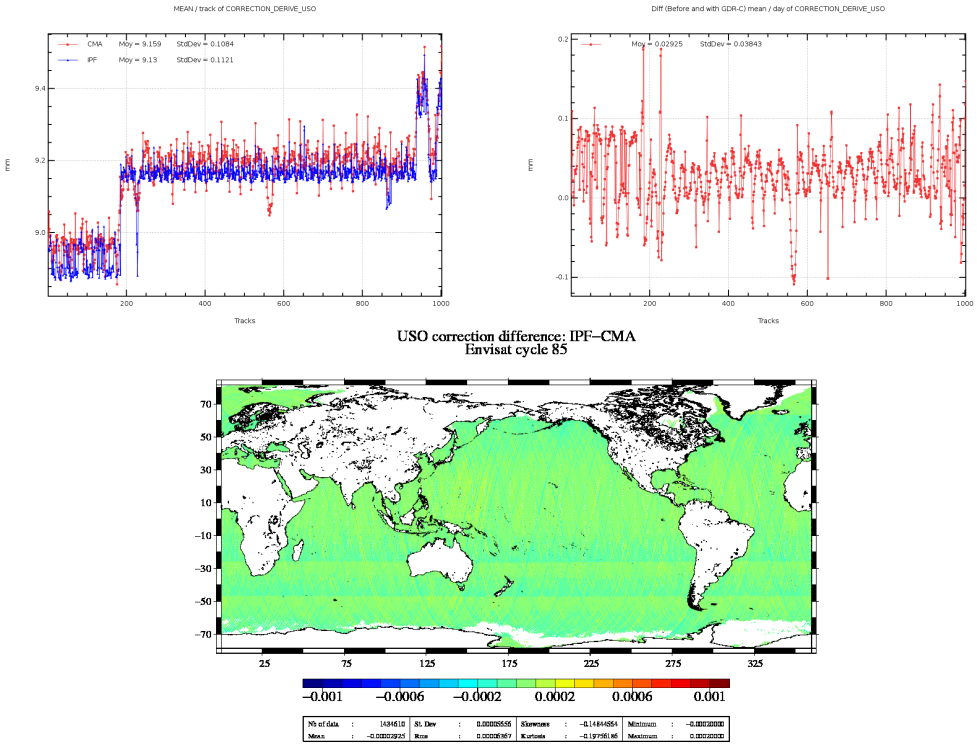

FIG. 5 – **USO Correction : Monitoring per track of each version (left) / Difference IPF - CMA version (right) and map of the correction. Global correction is almost null since it is now directly taken into account in the range and there is no need to correct it anymore.**

With this new IPF/CMA version, even in USO anomaly period, the range is corrected from the proper USO Period. Users shall not correct the products themselves with the auxiliary files anymore.
The small difference observed between CMA and IPF version at day 21910 is much smaller than a millimeter and hence considered negligeable.

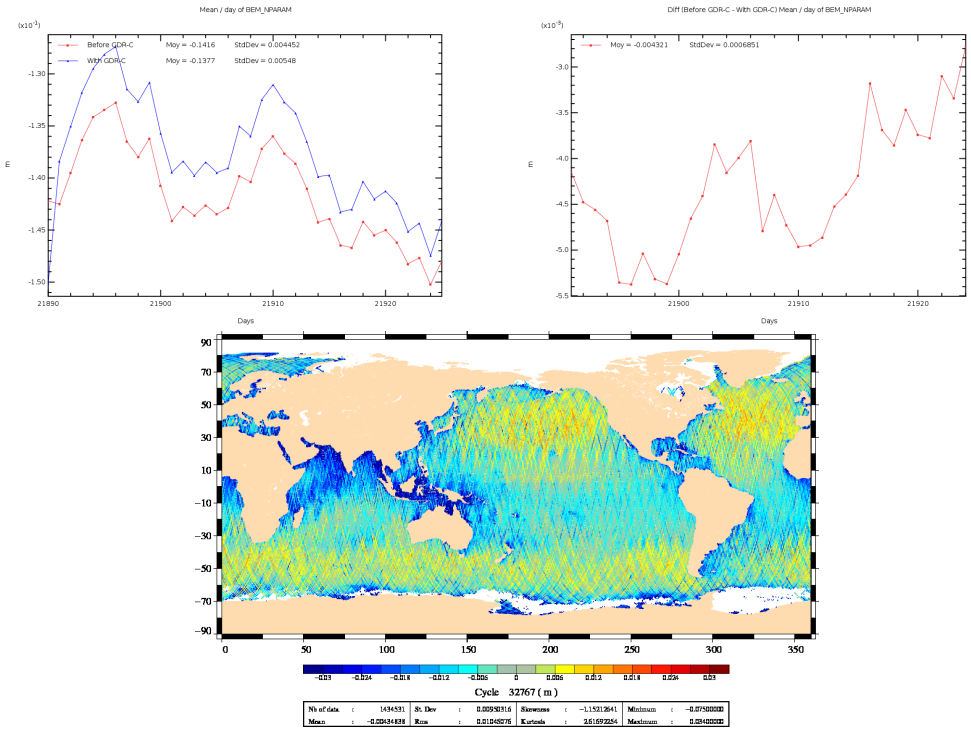

FIG. 6 – **Sea State Bias : Monitoring per day of each version (left)/ Difference Old - New version (right). Responsible for a +4.3mm global bias.**

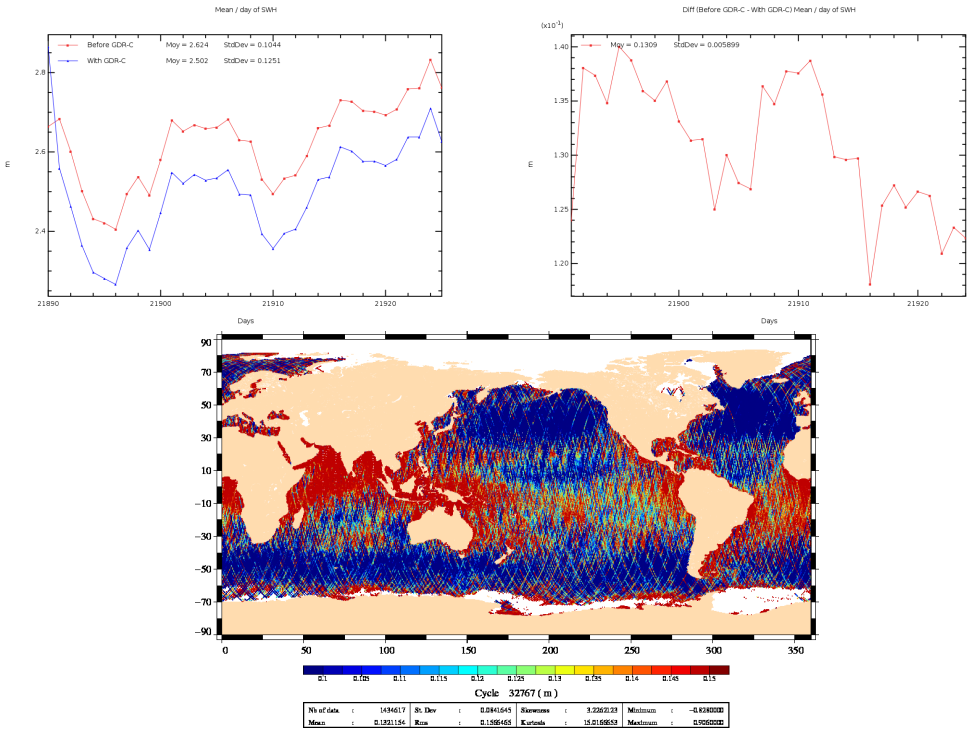

FIG. 7 – **SWH : Monitoring per day of each version (left)/ Difference Old - New version (right). The global -13.2cm bias observed explains a part of the SLA jump through SSB (theoretical 4 to 5% of 13.2cm SWH bias).**

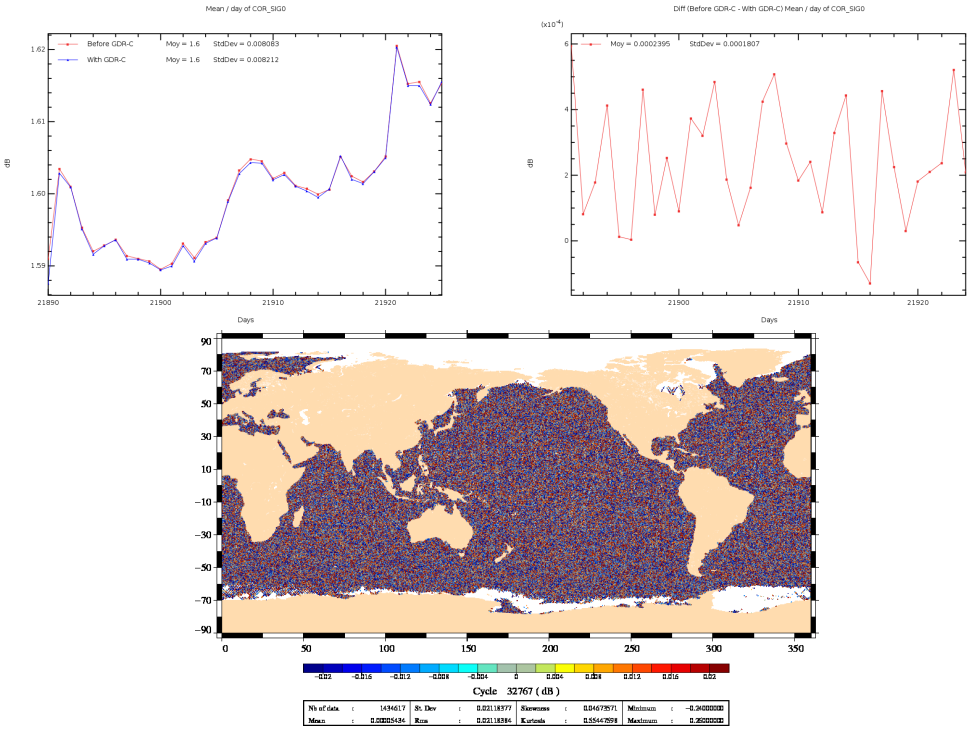

FIG. 8 – **Instrumental Sigma0 corrections : Monitoring per day of each version (left)/ Difference Old - New version (right).No bias detected but the resolution has increased.**

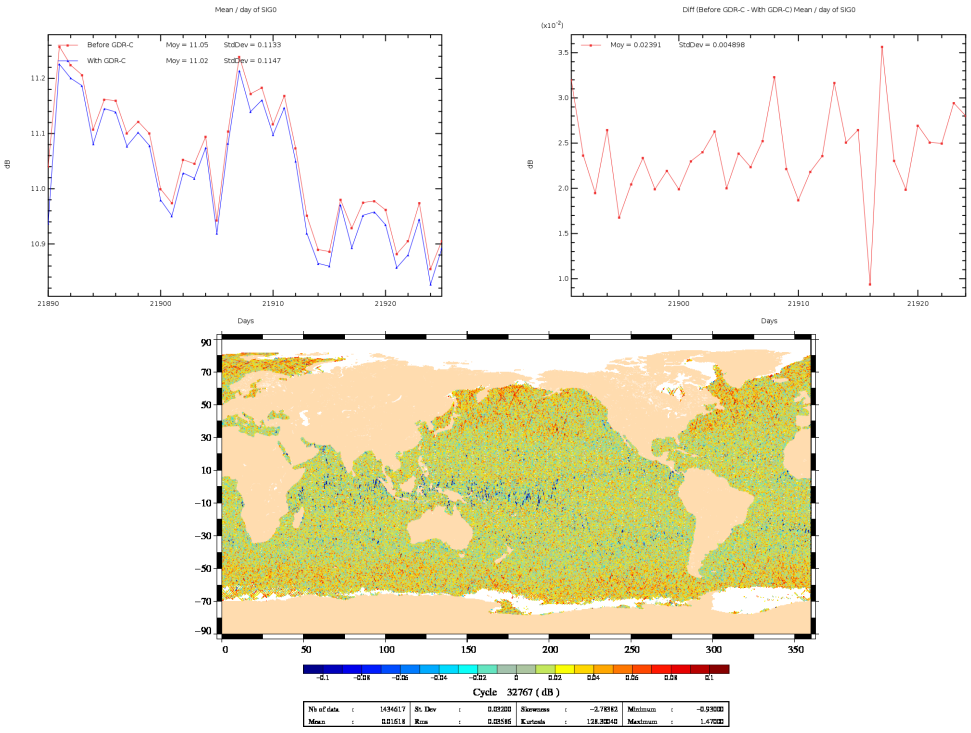

FIG. 9 – **Sigma0 : Monitoring per day of each version (left)/ Difference Old - New version (right).Weak -0.016dB global bias.**

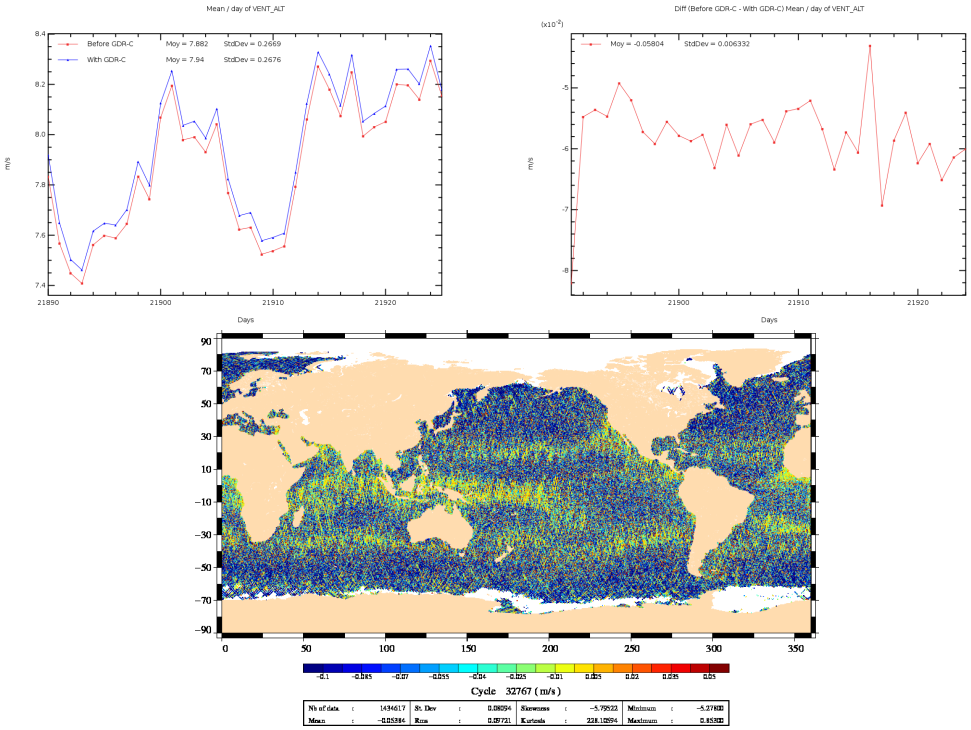

FIG. 10 – **Wind : Monitoring per day of each version (left)/ Difference Old - New version (right).Weak 0.05m/s global bias.**

Note that due to the global reduction of SWH (by 13cm), the population of null SWH increases.
Furthermore, the managing of those null values has slighly changed between the previous and new SSB model.
Users must be advised that this might cause a slight over editing due to the SSB if thresholds are remained unchanged.
Note that this effect can easily be cancelled by relaxing the thresholds on this parameter (ex, for DUACS processing, this threshold was relaxed from [-50cm,0] to [-50cm,1cm]).

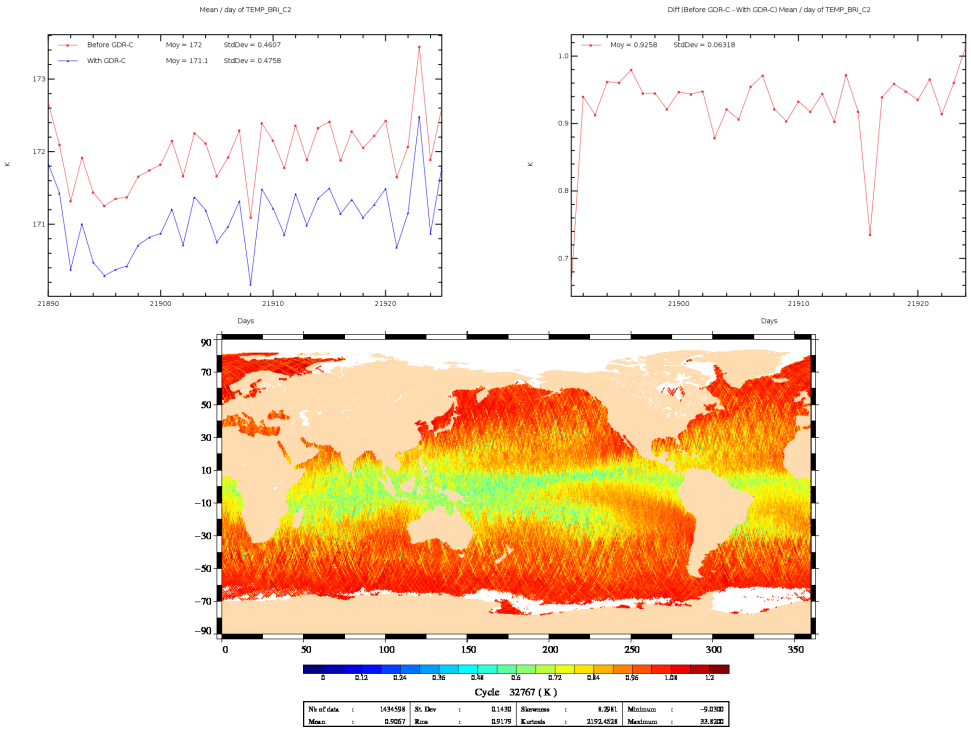

FIG. 11 – **Brightness Temperature 23.8GHz : Monitoring per day of each version (left)/ Difference Old - New version (right). -0.9K global bias (0.5K expected over all surfaces).**

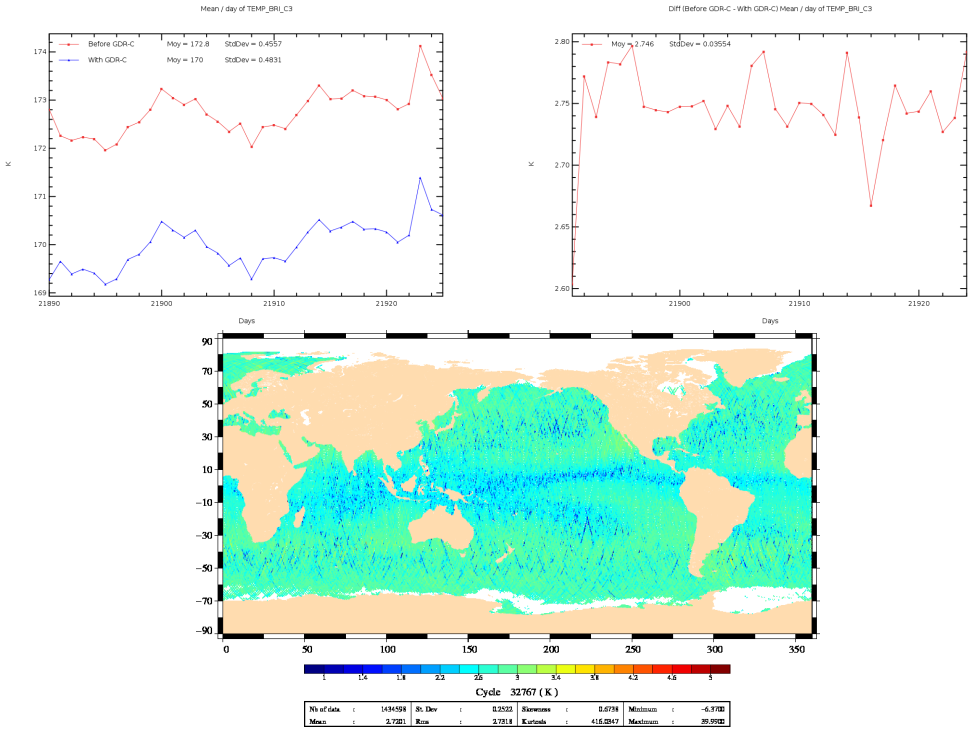

FIG. 12 – **Brightness Temperature 36.5GHz : Monitoring per day of each version (left)/ Difference Old - New version (right). -2.7K global bias (1K expected over all surfaces).**

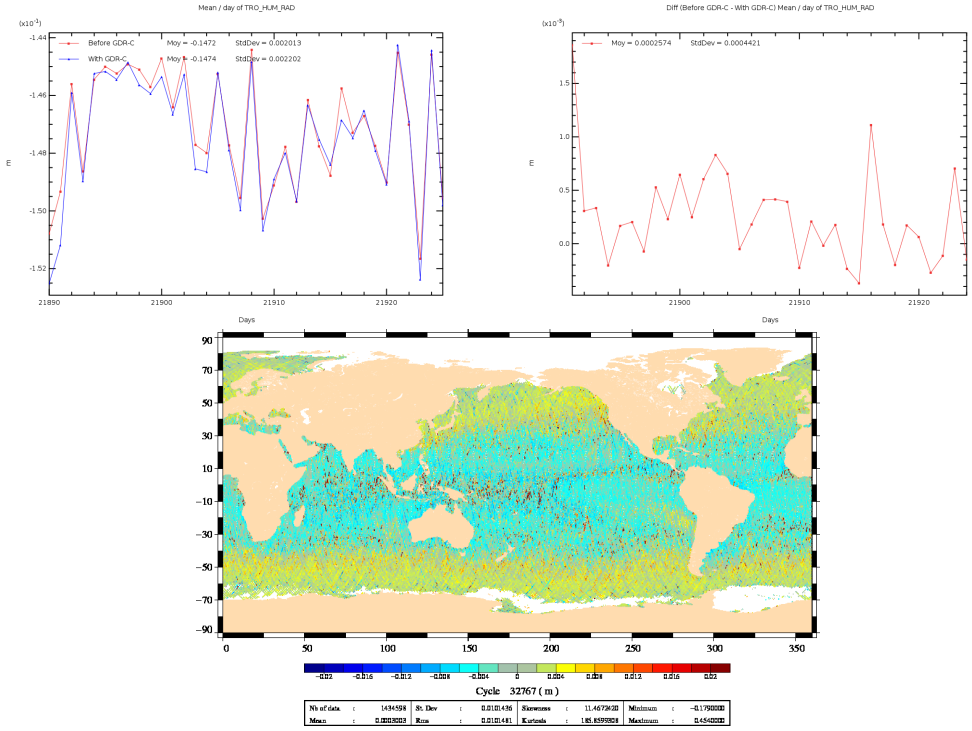

FIG. 13 – **MWR Wet Tropospheric Correction : Monitoring per day of each version (left)/ Difference Old - New version (right). Weak submilimetric global bias (-0.3mm).**

4 Conclusion

The new IPF 6.04 and CMA 9.3_05 versions include many changes compared to the initial version at many levels. Compared with the reprocessed version of April (IPF V6.02L04 and CMA 9.3.02), the only change concerns the USO algorithm (jumps and default values). The anomalous behaviour previously noticed is now solved. This reprocessed cycle is fully certified from Cal/Val point of view.