

# ERS-2 Altimeter Data Quality Assessment-Comparison with Envisat

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## Abstract

Almost 14 years after its launch, ERS-2 is still flying and providing altimetric measurements. Due to the loss of the on-board register in June 2003, the altimeter data cover the following regions: the North Atlantic, the Mediterranean Sea, the western coast of North America, the eastern coast of China and around Indonesia, the Southern Ocean in the south of Australia, and the northeaster parts of the Indian Ocean. Since June 2003, the coverage has slightly increased thanks to additional stations.

Its successor, Envisat, launched in 2002, does not only ensure the continuity of the observations provided by ERS-2, it also significantly improves the data quality, allowing Envisat to reach the same high level of accuracy as other precise missions such as T/P and Jason-1/2. Data from these 2 missions are used by a large range of oceanic applications, from real time mesoscale modelling to fine climatology analysis. The quality assessment of these data is routinely performed at the CLS Space Oceanography Division under CNES, ESA and IFREMER contracts.

This paper presents the main results in terms of ERS-2 altimeter data quality and performance: verification of data availability and validity, monitoring of the most relevant altimeter and radiometer parameters, assessment of the altimeter system performances. This work includes a cross-calibration analysis of data between ENVISAT and ERS-2 as part of SALP/CalVal activities. This step is essential to assess data quality and performances, and to allow combination of altimeter datasets as required by applications and operational oceanography

## ERS/Envisat: almost 19 years of ocean altimetry time series

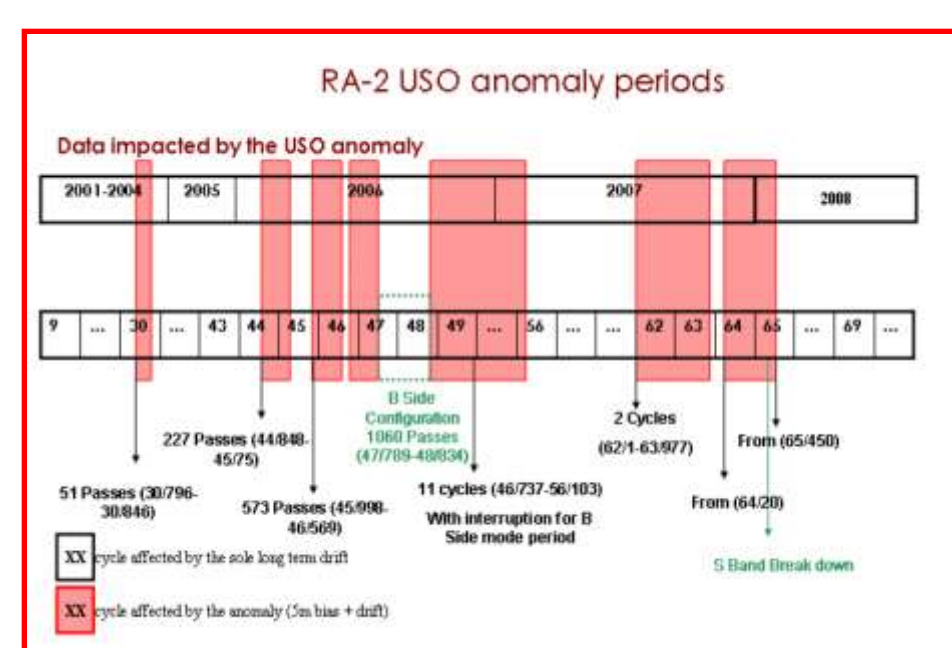
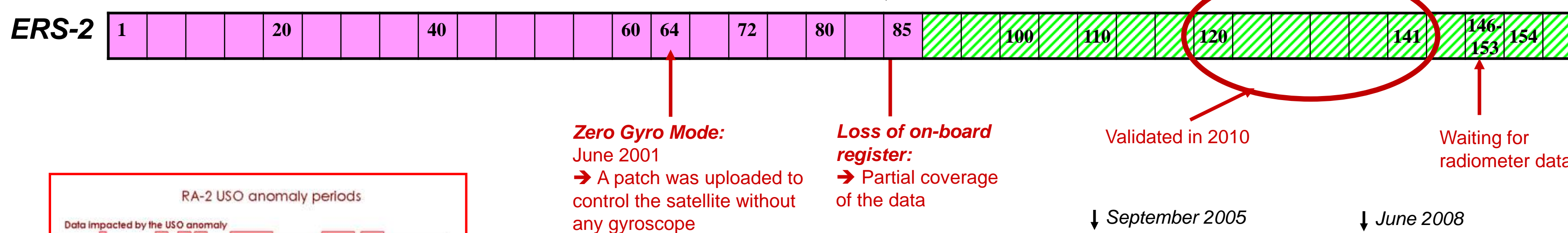
### ERS-2 Status

- ERS-2 is still providing data in a reduced coverage because of the failure of the on-board register in June 2003. The data coverage has slightly increased since then thanks to additional stations. CAL/VAL activities are currently done at CLS on OPRs. The analyses show that the performances of the data are good.
- Envisat will change of orbit in the fall 2010. The current ERS-2 data will then be useful for the computation of SLA maps in the SALP/Duacs products. A study has been performed in order to include the ERS-2 data in the routine products.
- The REAPER ESA project which intends to reprocess the whole ERS altimeter data has begun. It will lead to obtain an homogeneous ERS-1/2/ENVISAT time series. The goal is to obtain products containing retracked ERS-1/2 data (the same retracking as ENVISAT) and up-to-date corrections.



ERS-1 Phase B Phase C Phase D Phases E-F Phase G

- Version 3 / 3-days mission
- Version 6 / 35-days mission
- Version 3 / 168-days mission
- OPR02 full coverage
- OPR02 partial coverage
- GDR-A
- GDR-B
- GDR-B with High Frequency DAC correction and new LPOD 2005 Orbit
- GDR-C



**Zero Gyro Mode:**  
June 2001  
→ A patch was uploaded to control the satellite without any gyroscope

**Loss of on-board register:**  
→ Partial coverage of the data

**Validated in 2010**

**Waiting for radiometer data**

ENVISAT 10 22 30 41 60 65 68 86

The anomaly consists in a bias, superposed with an oscillating signal with an orbital period. Auxiliary files are distributed since mid 2006 allowing the users to correct the range from this anomaly.

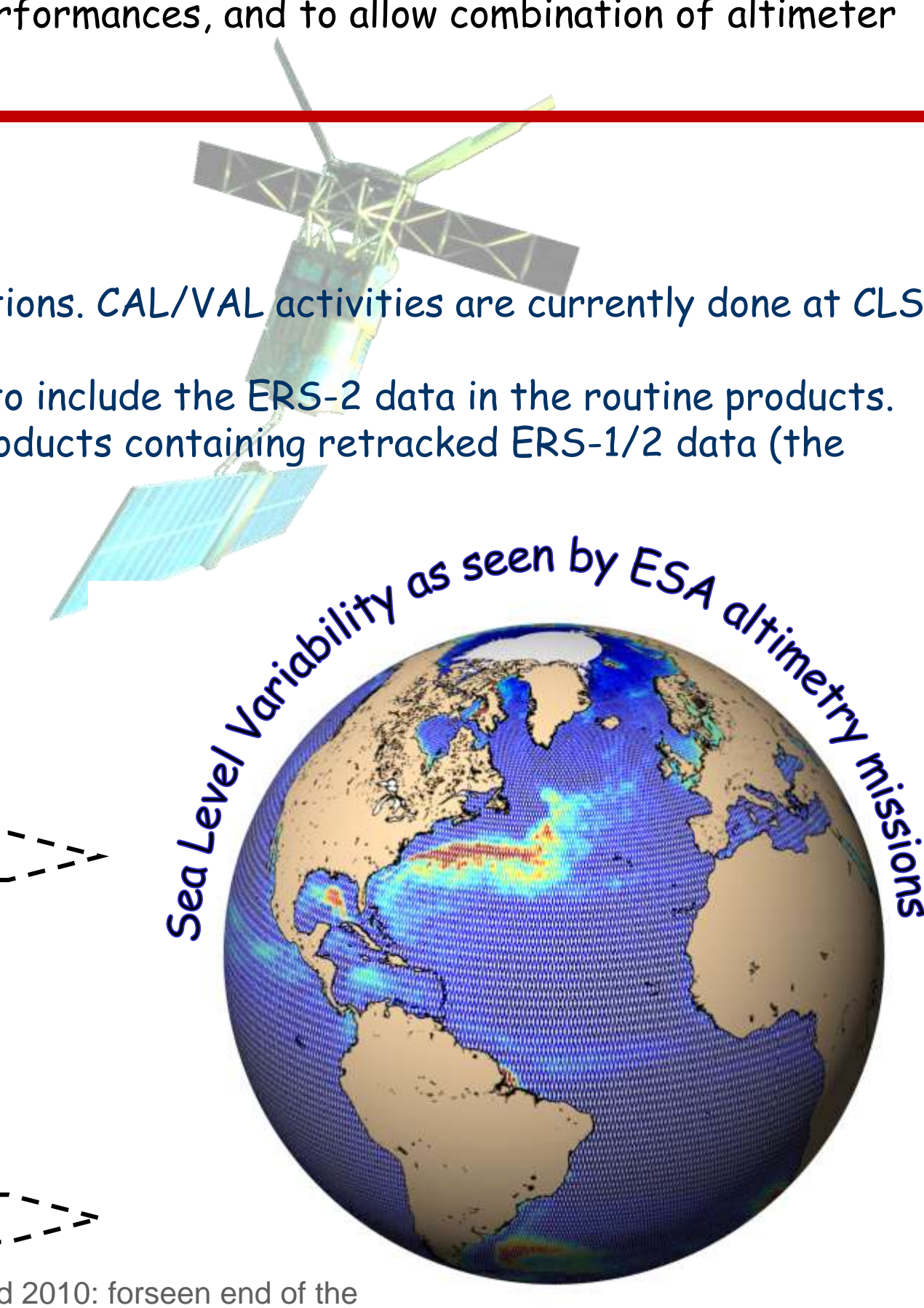
**1st occurrence of USO Anomaly:**  
27th September 2004  
Cycle 30  
→ Use of dedicated correction on the range

**S-Band Anomaly solved:**  
→ No more flag needed

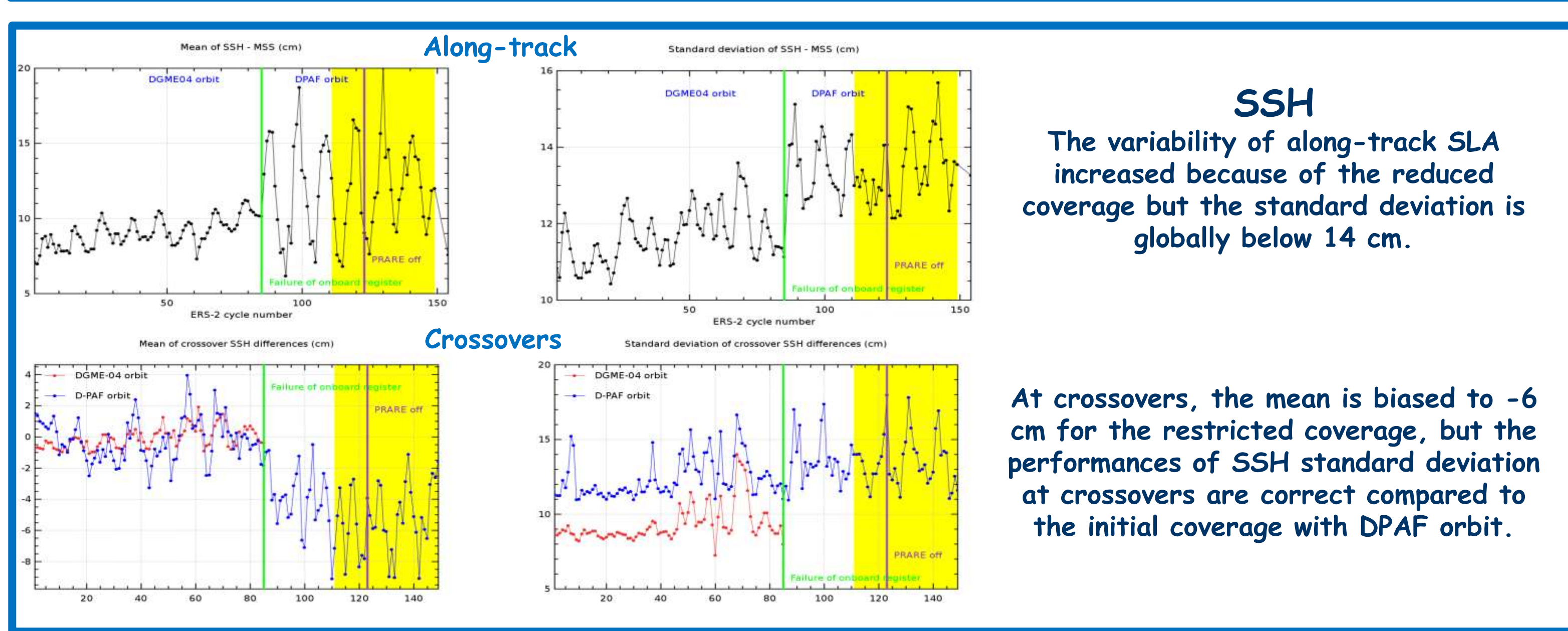
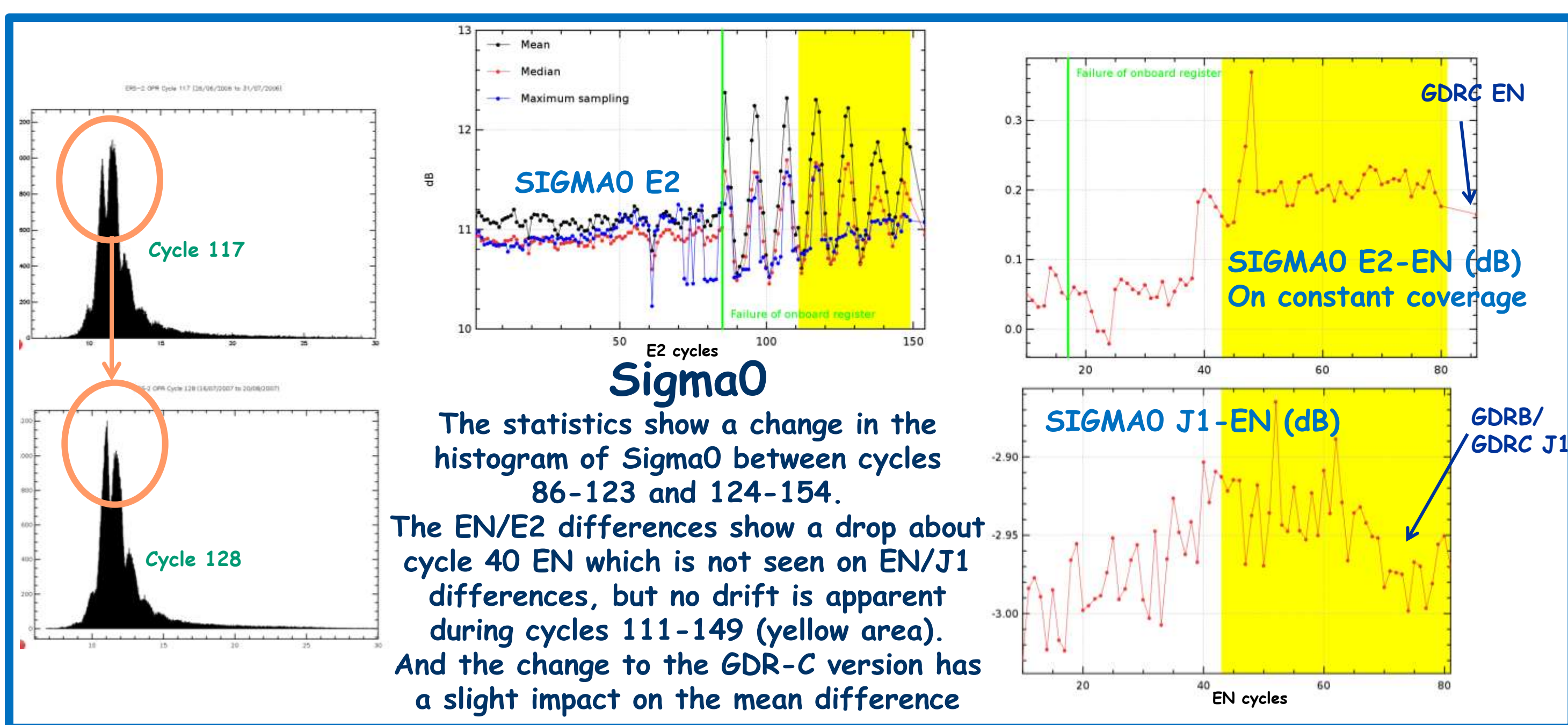
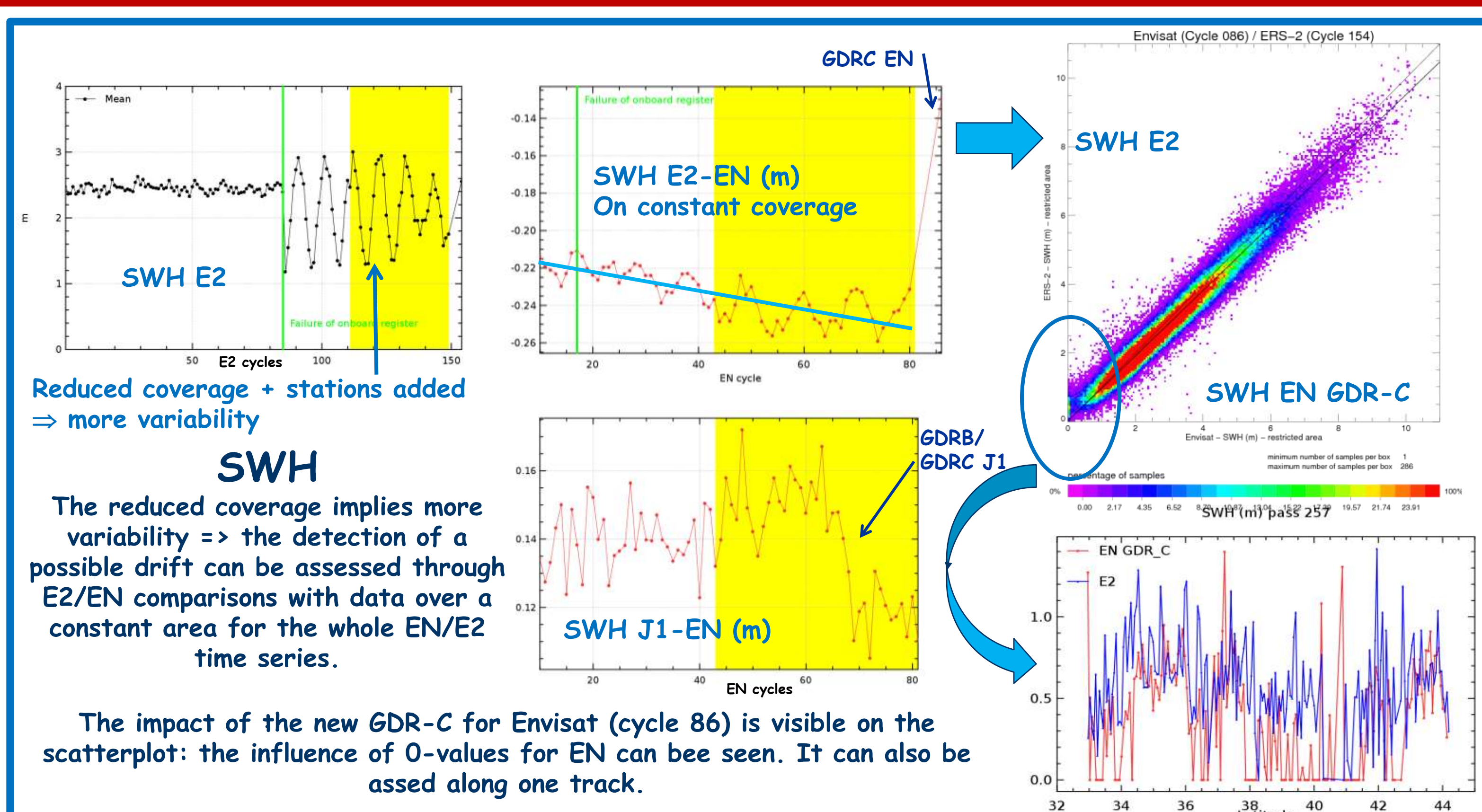
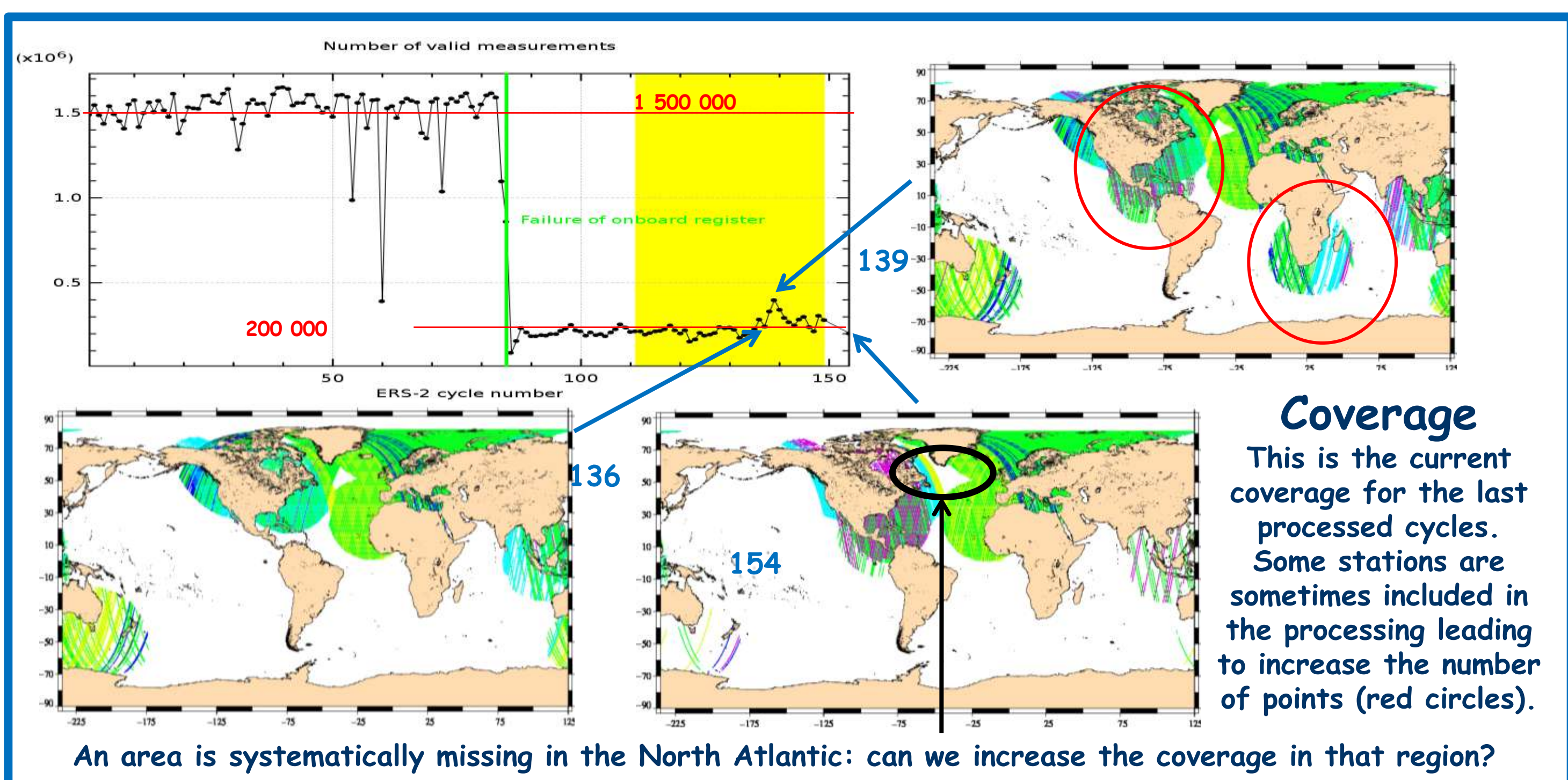
**S-Band Power loss:**  
17th Jan 2008  
Cycle 65  
→ Use of GIM ionospheric correction afterward

**Processed in GDR-C:**  
Use of new standards

End 2010: foreseen end of the repetitive phase: start of the drifting phase.



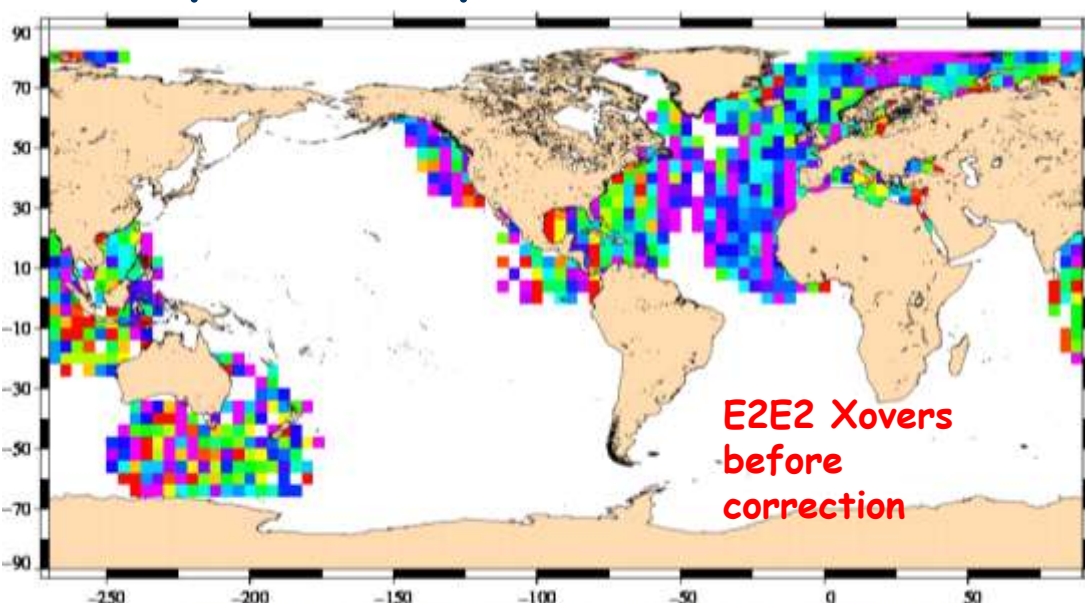
## Cal/Val ERS-2 and comparison to Envisat



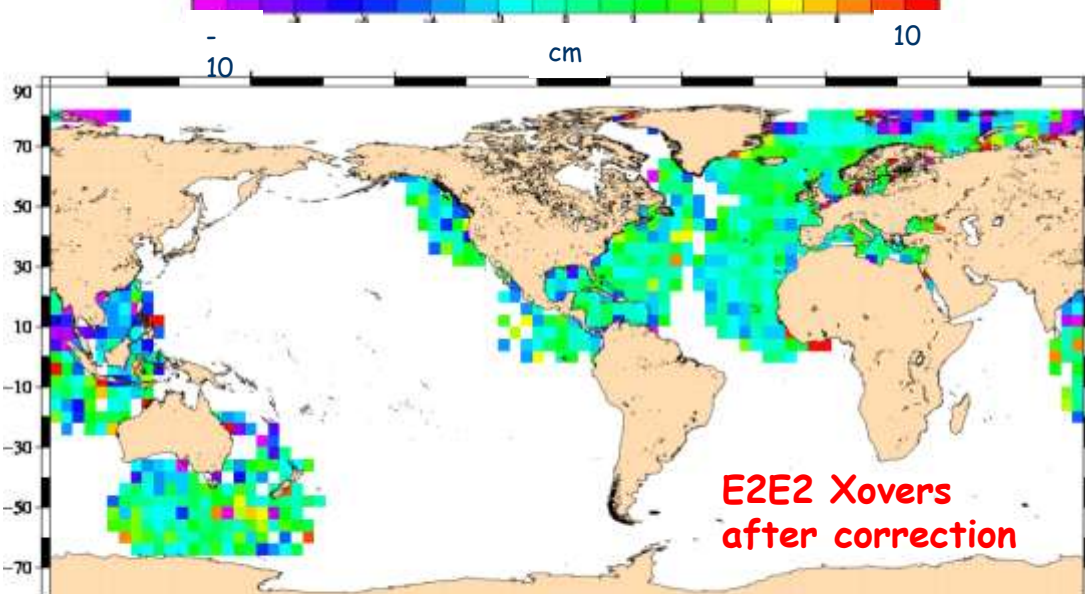
## Use of ERS-2 in the computation of SALP/Duacs maps of SLA

Envisat will change of orbit by the fall 2010. Until AltiKa, ERS-2 will be the only satellite flying on this track. It will be then useful to introduce again ERS-2 data in the computation of maps of SLA produced by SALP/Duacs. The drawback is the performance of SSH compared to other satellites. One eventuality is to improve the performance of the satellite by combining the data with other satellites flying simultaneously.

It is possible to use the method developed by Le Traon and Ogor, 1998: the minimization at crossovers with cubic spline interpolation, and which is used in the Duacs processing before the computation of Maps of SLA.

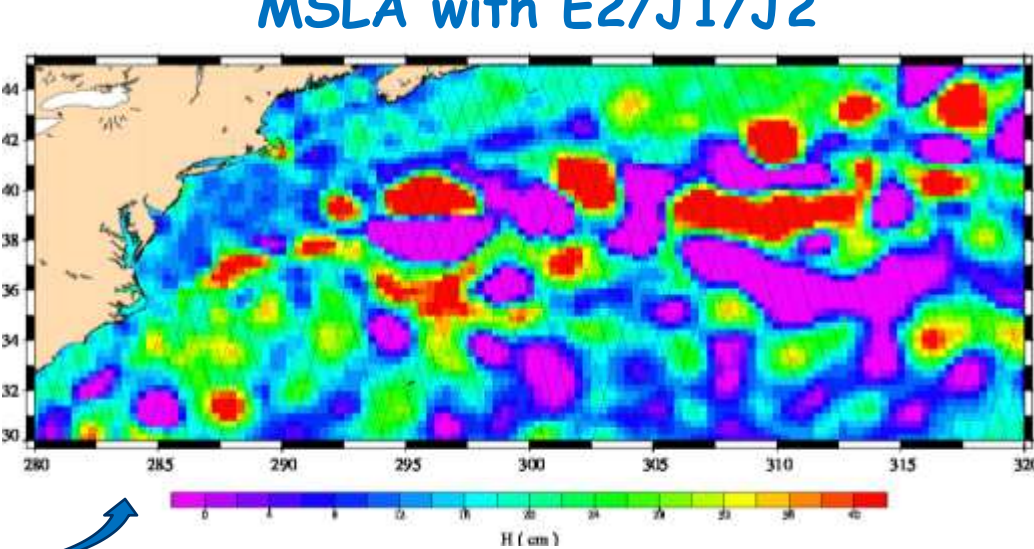


The aim is to improve the E2/E2 crossovers using the other satellites by minimizing simultaneously the crossovers of E2/E2, J1/E2, J2/E2 and EN/E2.

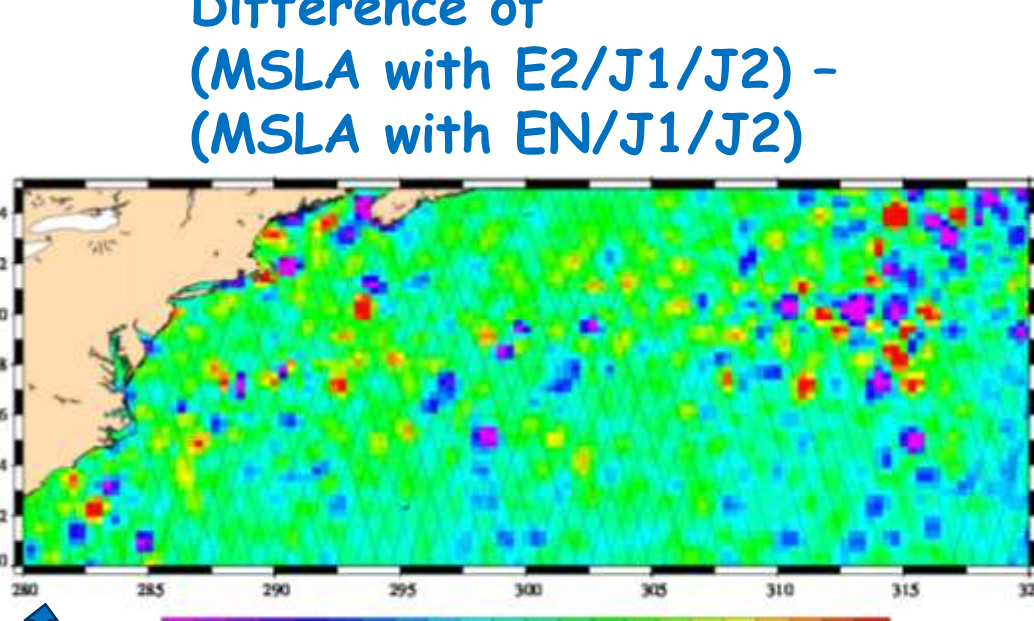


A test on 6 months has been processed: the global crossover standard deviation decreases from 12.9 to 7.6 cm and the map of crossover means shows an improvement

A preliminary result of the computation of the MSLA is given using the corrected E2 data set merged with J1 and J2 data sets. The tracks of E2 have been superimposed: on the East part of the area, there are only ascending passes.



The bottom chart is a comparison of the upper MSLA to the MSLA calculated with EN+J1+J2. The differences are higher where the coverage is not full (in the East part of the area). In the Ouest zone, where the coverage is nominal, there are still some discrepancies.



Such discrepancies should be reduced with the computation of MSLA maps including EN on its new orbit as it is known that MSLAs calculated with 4 satellites increase the resolution of eddies (Pascual et al., 2006)

## Conclusion and perspectives

ERS-2 still measuring the Sea Level Height, though not with a global coverage. The data analysis and distribution is still on-going. The altimetric measurements show good general performances.

In end 2010 ENVISAT will have a new ground track => ERS-2 would be useful for operational oceanography. Nevertheless, it would be of great interest to improve the coverage mainly in North Atlantic Ocean where NRT data are available. This would allow high resolution altimetry data in the Gulf Stream to resolve eddies.

The historical ERS-2 time series is also interesting for studies concerning the Sea Level change.

The ERS-2 and Envisat MSL time series have been gathered as shown on the poster "Mean sea level trend estimated from Envisat altimetry mission: comparison to J1 and In-Situ data" by Y. Faugère et al.

New orbits from GFZ have been produced and should therefore be valuable for improving the reliability of the ERS mission. This will be done within the frame of the ESA CCI project (talk by A. Cazenave and G. Larnicol)

Thanks to ESA REAPER project, the whole ERS 1/2 time series will be updated with standards compatible with Envisat. This should drastically improve the data quality and still increase the interest of these missions (talk by S. Becker).