Improving the Dynamic Atmospheric Correction for operationnal altimetry (NRT and RT)

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Introduction

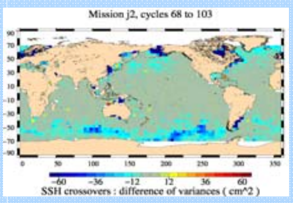
Altimeter measurements are corrected for several geophysical effects in order to isolate the oceanic variability. The dynamic atmospheric correction (DAC) allows for the removal of high frequency variability induced by the atmospheric forcing and aliased by the altimetric measurements.
The high frequency part of the DAC is based on a barotropic model simulation forced by atmospheric pressure and winds (MOG2D; Carrère and Lyard 2003); the low frequency part is an inverse barometer response. A 20-day cutoff-period for the high frequency part was chosen because it corresponds to the Nyquist period of T/P-Jason reference altimeters' sampling and because the variability is mostly barotropic in this high frequency band.

The purpose of the study is to improve the performances of the DAC for users of altimetry, and particularly for operational altimetry. Indeed, some errors remain in the Near Real Time/Real Time DAC corrections due to the use of a degraded filtering window (window decentered in past) or even the use of an IB instead of the DAC for the RT.

MOG2D model forecasts are now generated in RT using ECMWF operational forecasts. These model forecasts are used to improve the quality of the NRT correction, by re-centering the filtering window of the DAC, and to produce a new forecasted DAC which can be used for DUACS-RT products. The impact of these new DAC corrections on altimeter level-2 products has been estimated. The impact on higher levels products has also been investigated and preliminary results are presented

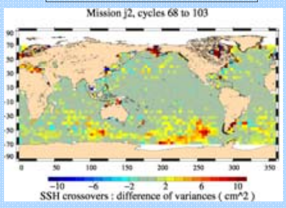
Preliminary impact study made on GDR data (L2 products)

VAR(SSH-DAC_forecast) – VAR(SSH-IB_forecast) in cm²



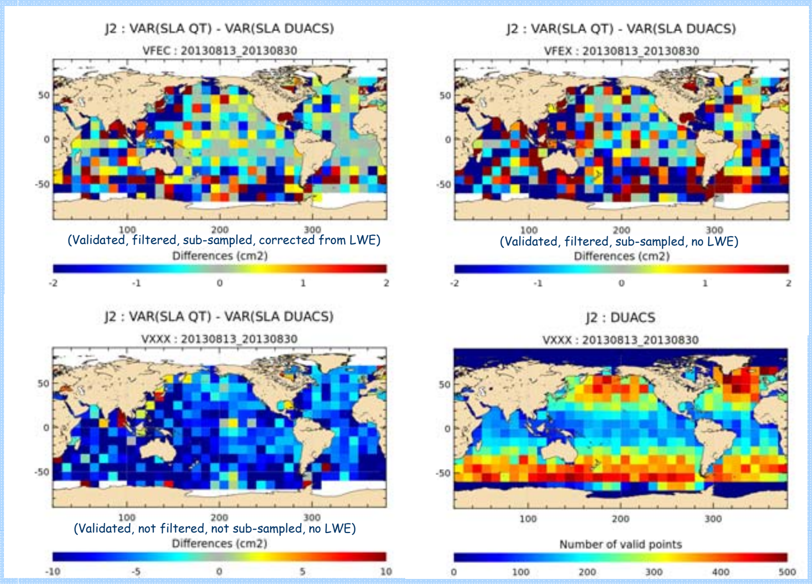
Preliminary analysis has been performed on 1 year of J2 GDR data. Results show a very significant variance reduction when using the improved NRT DAC on one hand and when using the forecasted DAC instead of the IB for OGDR products on the other hand.

VAR(SSH-DAC_IGDR_operational) – VAR(SSH-DAC_IGDR_optimized) in cm²



Analysis of the impact of the new DACs on L3 and L4 products (2)

Maps below show the difference of the variance of the L3 data (along-track SLA) on a 17 days period, using either the new DACs processing (noted QT) or the classic operationnal DUACS processing. Top left panel shows the difference of filtered, sub-sampled and corrected (from LWE) SLA, top right panel shows the difference for filtered and sub-sampled SLA, and bottom left panel shows the difference for the validated SLA (not filtered, nor sub-sampled or corrected). Lower right panel gives the number of points used for the statistics. We note that the new processings tend to reduce the SLA variance (blue areas), although we still see some red spots; but this noise can likely be explained by the short period of analysis. We note that the red values are stronger for SLA not corrected from LWE. Validated residuals show a strong and nearly uniform improvement using new DACs.



Improvement of the DAC for Near Real Time /Real Time products (IGDR and OGDR)

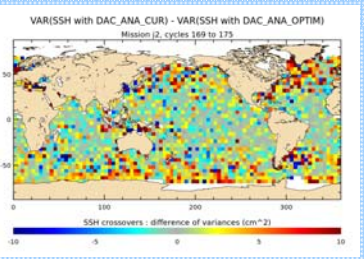
Two new DAC corrections are being performed using ECMWF meteorological forecasts.
2 days of meteo forecasts are received everydays (until J+2, 12h) and allows producing model forecasts and thus DAC forecasts until J+2, 12h.

- We generate an OPTIMIZED DAC for IGDR products : using model forecasts allows improving the NRT 20-days filtering of the DAC
- We also generate a NEW FORECASTED DAC for OGDR products, which can be used in replacement of the forecasted IB.

These new DAC are generated operationnaly since the 4th of September and used in DUACS products.

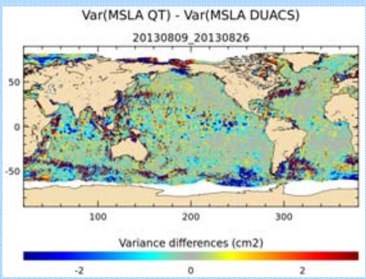
Validation results of the new operational corrections (on L2 products)

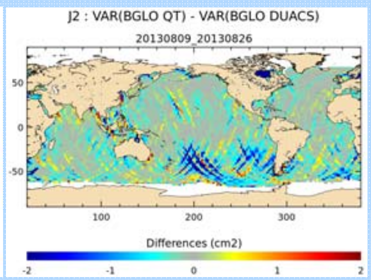
The variance differences at J2 crossovers show the reduction obtained with the optimized DAC (until 5-10 cm² locally). We can notice some variability in the results compared to the preliminary study made on 1 year of GDR data, but this explained by the use of IGDR data which are more noisy on one hand, and the use of a very short analysis period (only 6 cycles) on the other hand.



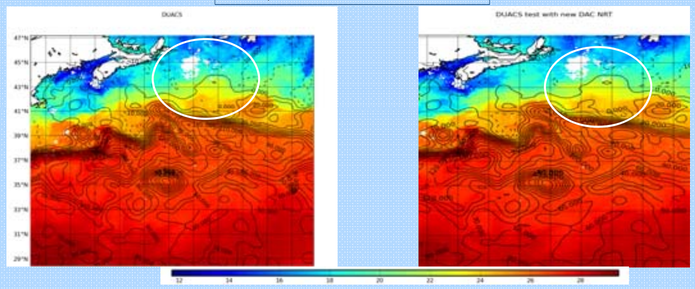
Analysis of the impact of the new DACs on L3 and L4 products (1)

Left map shows the difference of the variance of gridded SLA (MSLA) on a 17 days test period, using either the new DACs processing (noted QT) or the classic operationnal DUACS processing. We note that the new DACs tend to reduce the MSLA variance (blue areas), although we see some noise ; but it can be explained by the short period of analysis. Right map shows the difference of variance of the Long Wavelength Error correction (LWE) applyed on L3 products before mapping when using the new DACs or the classic operational DUACS processing. We clearly see a weaker LWE if using the new DACs, which means that the new DACs have removed more variance than the old operationnal NRT/RT processing.





MSLA differences between operationnal DUACS and DUACS using the new DAC RT/NRT, for one date : 04/09/2013



Conclusions/Perspectives

The DAC has been improved for operational altimetry. Thanks to the use of meteo forecasts the NRT and the RT products have been improved. The impact of these new DAC corrections on altimeter level-2 products has been estimated and is clearly positive. The impact on higher levels products (L3 and L4) has also been investigated, showing a diminution of the LWE when using the new DAC and also a weak impact on ocean circulation.
The impact of these new DAC on high level products should be studied using longer time series to get more reliable statistics.