Improving the dynamic atmospheric correction for delayed-time and operational applications of altimetry

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Introduction

The dynamic atmospheric correction (DAC) is a geophysical correction allowing 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; Carrere and Lyard 2003); the low frequency part is an inverse barometer response. A 20-day cutoff-period 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.

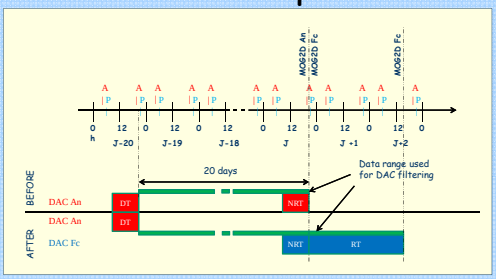
The purpose of the study is to improve the performances of the DAC for all users of altimetry for Delayed-Time (DT), Near Real Time (NRT) and Real Time (RT) delivery modes.
A recent study has shown that using a few MOG2D forecasts (until D+2days, 12h) already allowed improving the quality of the NRT correction. In this study, operational meteorological forecasts until D+10 days have been used, showing a significantly greater improvement on altimeter level-2 products.
The filtering and optimal combination of MOG2D and IB at the cutoff-period of 20 days is also checked compared to in situ and altimeter data.
Last improvement concerns the high latitudes, where a real-time ice cover forcing is being implemented in MOG2D model.

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

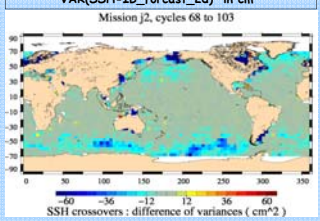
For IGDR, DAC uses a decentred filtering window for the 20-days filtering (no data available in the future).
For OGDR, no DAC is presently available.
Two new DAC corrections are now performed using ECMWF meteorological forcasts:

- We generate an OPTIMIZED NRT DAC : using model forcasts allows improving the NRT 20-days filtering of the DAC.
- We also generate a NEW FORCASTED DAC, which could be used in replacement of the forcasted IB, for OGDR products.

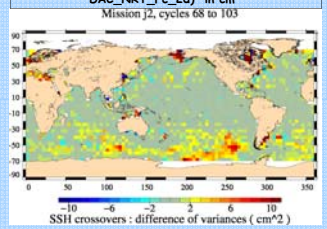
Using 2 days of meteo forcasts – impact on L2 products



Impact for OGDR: VAR(SSH-DAC_forcast_2d) - VAR(SSH-IB_forcast_2d) in cm²



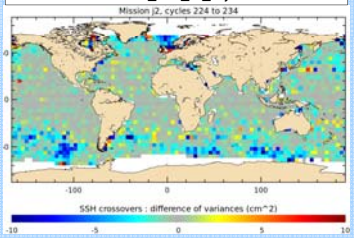
Impact for IGDR: VAR(SSH-DAC_NRT_operationnal) - VAR(SSH-DAC_NRT_Fc_2d) in cm²



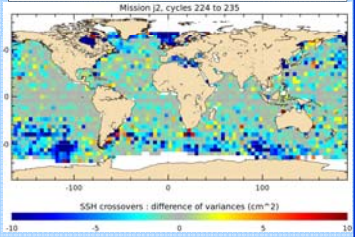
Currently 2 days of meteo forcasts are received daily (until J+2, 12h) and allows producing model forcasts and thus DAC forcasts until J+2, 12h.
Peformance analysis shows a very significant variance reduction when using the improved NRT DAC on one hand and when using the forcasted DAC instead of the IB for OGDR products on the other hand.
These new DAC are generated operationnally since the 4th of September 2013 and used in DUACS products.
The optimized NRT DAC should also be available in IGDR products soon.

Using 10 days of meteo forcasts - impact on IGDR L2 product and high latitudes

VAR(SSH with DAC_NRT_Fc_10d) - VAR(SSH with DAC_NRT_Fc_2d)

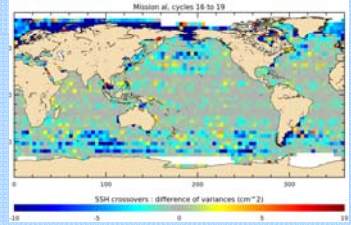


VAR(SSH with DAC_NRT_Fc_10d) - VAR(SSH with DAC_NRT_OP)

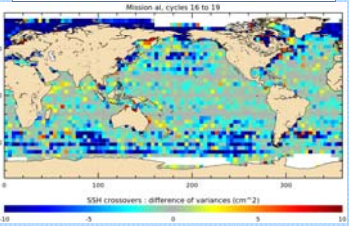


As 10 days of ECMWF meteorological forcasts are available daily, we have tested the impact of using all these forcasts to improve the new optimized NRT DAC for IGDR products. Results Jason-1 and AltiKa missions show a strong improvement when using all forcasts available: more than 10 cm² of variance reduction in DAC high variability regions (southern high latitudes and shallow waters). A strong improvement can also be pointed out in the Arctic Ocean, for AltiKa data.
We thus recommend using the 10 days forcasts to produce the improved NRT DAC.

VAR(SSH with DAC_NRT_Fc_10d) - VAR(SSH with DAC_NRT_Fc_2)



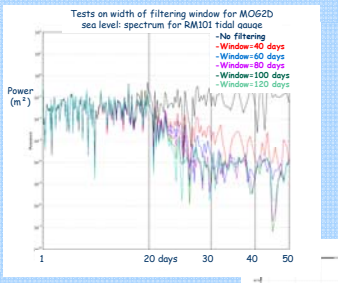
VAR(SSH with DAC_NRT_Fc_10d) - VAR(SSH with DAC_OP)

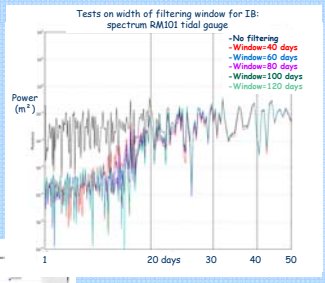


Working on DAC filtering - On going work

Several issues are raised about the optimal DAC filtering, concerning the filter algorithm itself, and the optimal combination of the MOG2D sea level and the IB at 20-days frequency:

- a Lanczos filter is used operationnally to perform all DAC corrections. Questions are: is this filter enough efficient ? Can we improve the filter while changing the filtering window or even changing the algorithm ? => **preliminary results on some tidal gauges show better filtering using a window of at least 80 days or even 120 days.**
- combination of MOG2D sea level and IB : currently both components are filtered with a cut-off wavelength of 20 days, but is it enough realistic ?





Real-time ice cover forcing in DAC – On going work within PEACHI project

In order to improve DAC at high latitudes, a real-time ice-cover forcing is currently being included in DAC forcing.
Two different ice-cover datasets are available:

- ice-concentration field computed by ECMWF: 6-hours grids available daily on the meteorological gaussian grid, as other DAC forcings
- ice-concentration field performed by OSI-SAF: two grids on north and south poles available daily on a high-resolution stereographic polar grid.

Both datasets are compared and one will be used in DAC. Simulation results are planned for the end of 2015.