The Dynamic Atmospheric Correction for SWOT mission

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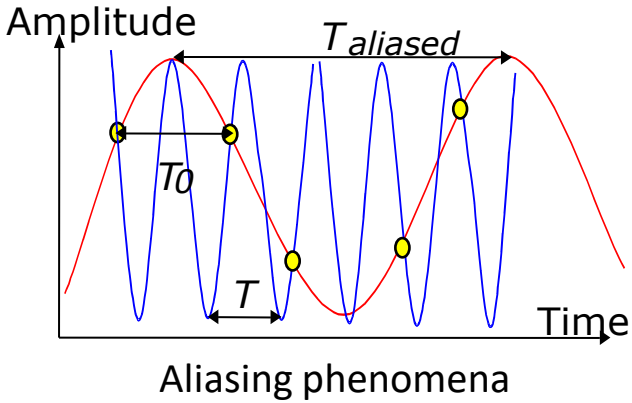
28/06/2022

DAC for what ?

Remove the high frequency ocean signal forced by the atmosphere and aliased into lower frequencies due to the low time sampling of the satellites

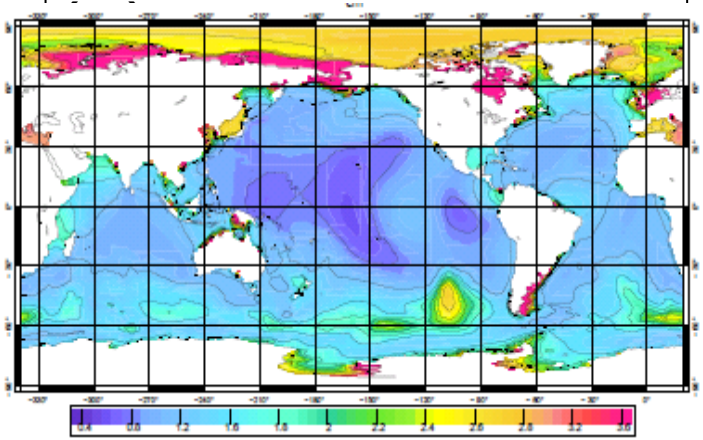
Mandatory correction for climate studies using altimeter data

Some modelers keep this HF signal when their model can handle it

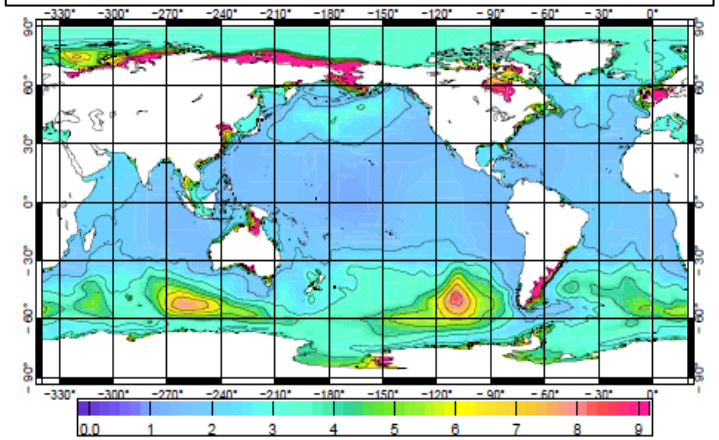


HF dynamic response of ocean to atmospheric forcing - T < 20 days

RMS of IBD: pressure forcing only



RMS of IBD: pressure + wind forcing (cm)



Operational DAC for reference altimeters

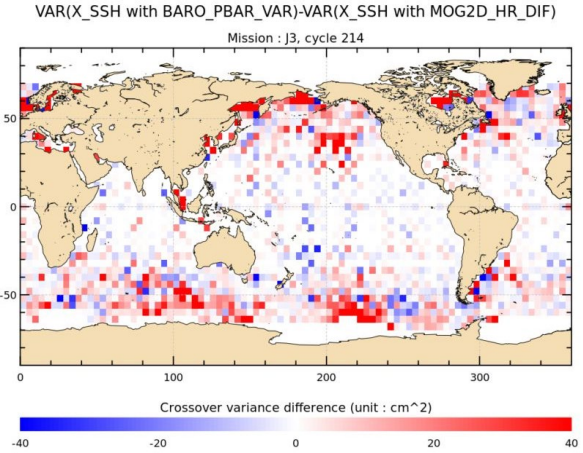
Based on a barotropic model forced by the atmosphere = MOG2D forced by ECMWF analysis (6-hours)

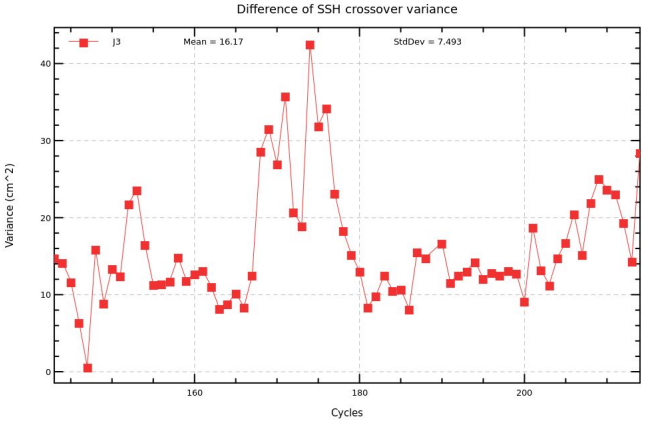
Use historical bathymetric field (2007)

global FE mesh has ~15km resolution in coastal regions (AVISO-HR)

Output grids = ¼°, 6h

Variance reduction for J3 crossovers differences when using DAC instead of IB (cm²)

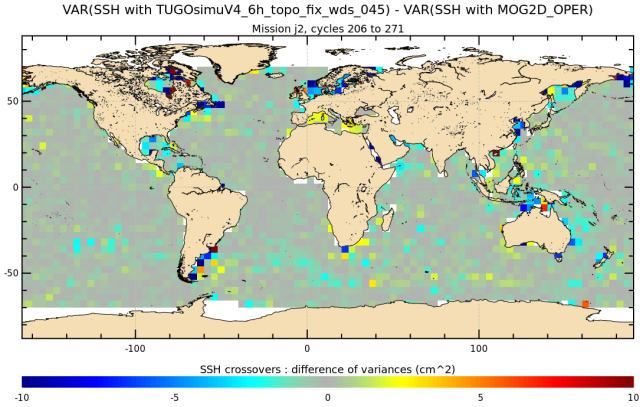


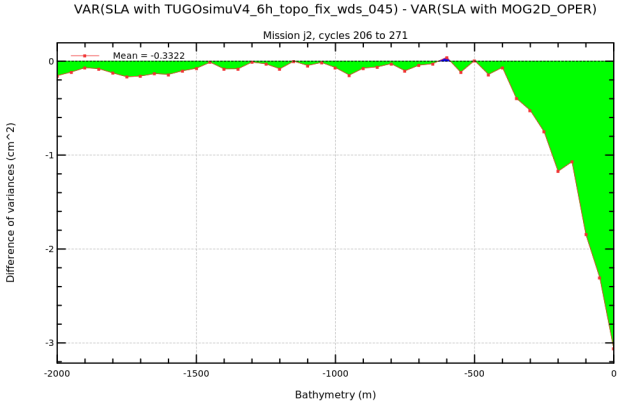


Operational DAC for reference altimeters

⇒ Plan to switch to TUGO and FES2014 bathymetry in 2022 (better results in coastal areas)

Variance reduction for J2 crossovers differences when using new DAC TUGO instead of operational DAC (MOG2D) in cm²





Filtering of the DAC

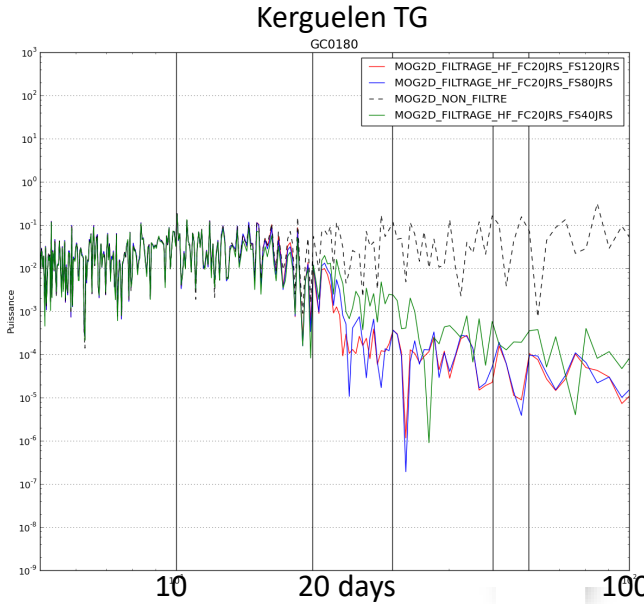
Optimal combination of high frequencies of barotropic model and low frequencies of IB

DAC = MOG2D_HF + IB_LF

HF/LF cut-off frequency = 20 days

DT (GDR) products use an optimal centered filtering window

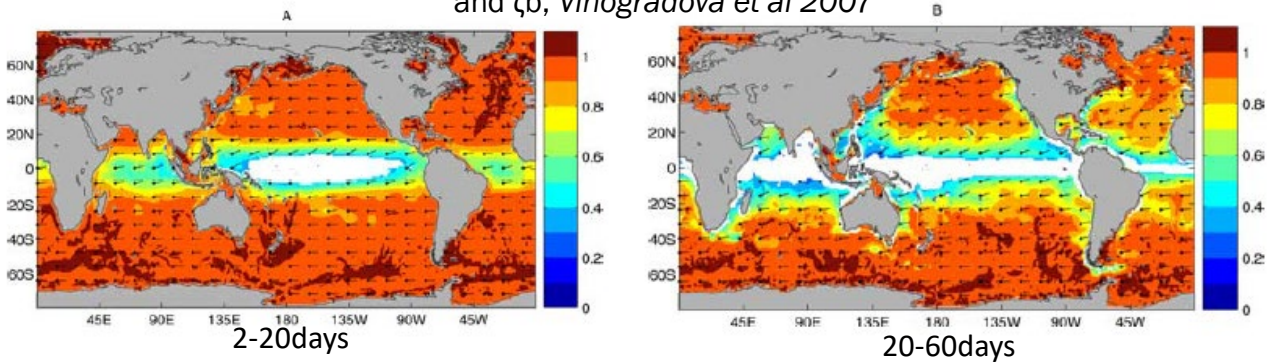
NRT and RT products use a recentered filtering window thanks to the ECMWF/MOG2D 10-days forecasts



Filtering of the DAC

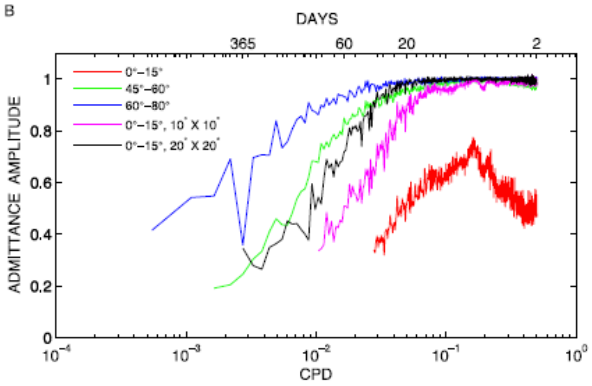
- Cut-off at 20 days =Nyquist period of reference altimeters T/P and Jason (sampling=10 days)
- Ocean signal mostly barotropic for those HF (Fukumori et al. 1998; Vinogradova et al. 2007)
- Even at low latitudes, if considering large scale (> 1000 km), ocean response is mostly barotropic

Amplitude of the admittance between ζ and ζb, *Vinogradova et al 2007*



2-20days

20-60days



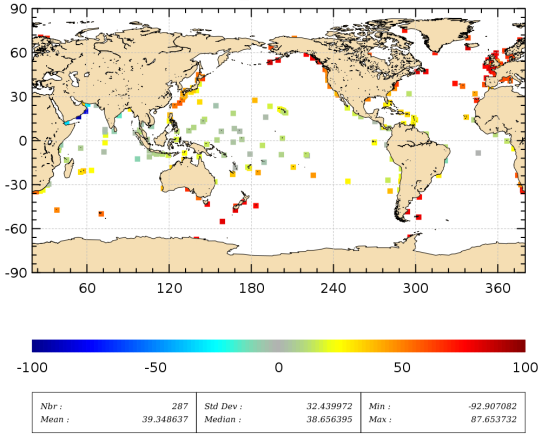
Comparison to in situ data

Comparisons to in situ data and estimation of errors in the Dynamic Atmospheric Correction, OSTST 2013

Variance reduction at TG when using DAC

All freq.

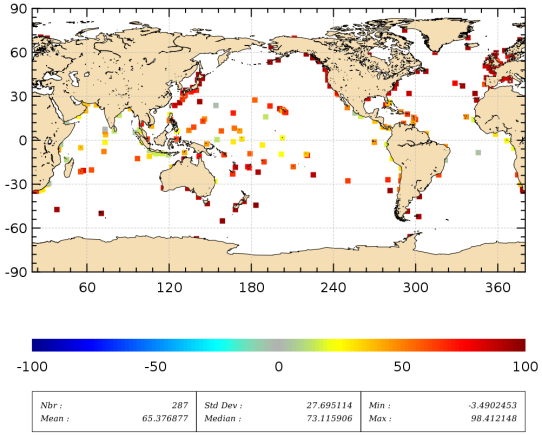
1 - [Var(SLA_DAC)/Var(SLA)] [%]



Nbr :	287	Std Dev :	32.439972	Min :	-92.907082
Mean :	39.348637	Median :	38.656395	Max :	87.653732

T < 20 days

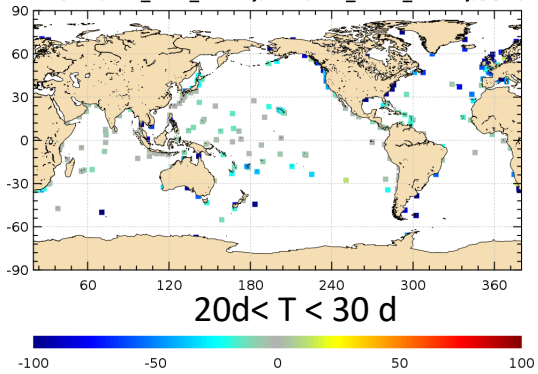
1 - [Var(SLA_DAC_0-20j)/Var(SLA_0-20j)] [%]



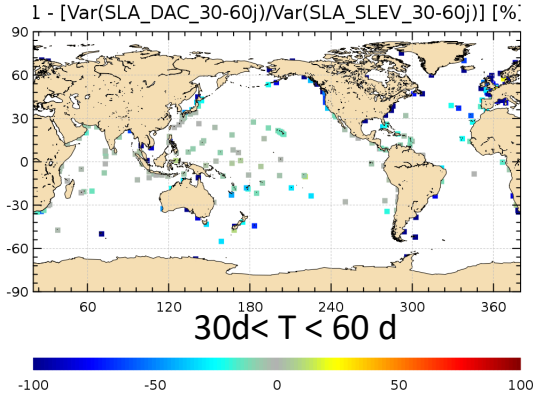
Nbr :	287	Std Dev :	27.695114	Min :	-3.4902453
Mean :	65.376877	Median :	73.115906	Max :	98.412148

Variance reduction at TG when using model SLEV instead of IB, in %

1 - [Var(SLA_DAC_20-30j)/Var(SLA_SLEV_20-30j)] [%]



1 - [Var(SLA_DAC_30-60j)/Var(SLA_SLEV_30-60j)] [%]



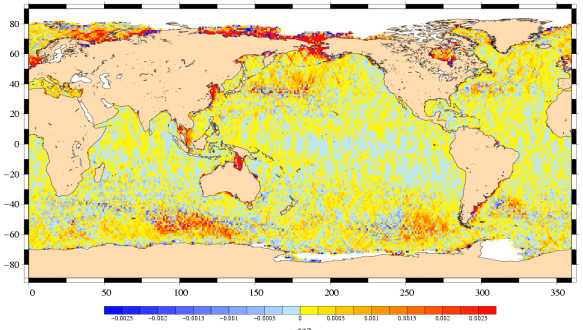
20 days filtering used for operational DAC

We use the same cut-off for all missions to keep homogeneity between missions

The remaining HF signal is removed by LWE for L3 and L4 multi-missions altimeter databases

LWE = Long Wavelength Errors

EN SLA variance reduction when using the 20-days filtered DAC or 70days filtering, in cm²



SLA ENVISAT	Variance (cm²)
SSH	258.6
SSH - IB	129.58
SSH – DAC_20j	125.18
SSH – DAC_70j	123.67

DAC for SWOT – 21 days phase

Plan to use the operational DAC, with 20-days filtering

But the SWOT Nyquist period is 42 days, so some HF aliased signal will remain in L2 data:

- LWE will remove most of this residual aliased signals for L3 and L4
- This residual signal may be a problem for L2 users or not ?
- => is there a need of a dedicated DAC with a 42-days filtering ?

DAC for SWOT - 1-day phase

Operational 20-days filtering DAC not adapted for SWOT-1day phase => **2-days Nyquist period**

We propose to use a 2-days filtering instead:

DAC_2d = MOG2D_hf<2days + IB_lf>2days

A real-time correction demanded for operational SWOT nadir

⇒ Production of NRT/RT DAC_2d using operational model/forcing (MOG2D-TUGO/ECMWF 6h)

A DT correction shall also be computed using TUGO and ERA5 1h forcing, in delayed time

DAC for SWOT - 1-day phase

An analysis is being conducted

1. Quantify the differences between the different filtering : 2d, 20d, 42d
2. Compare 2d DAC using ECMWF or ERA5 forcing (time & spatial res)
3. Variance reduction analysis using TG data or even OSSE (IBI36 , SWOT-1d simulator) …

Ways to improve the spatial resolution of the DAC product for SWOT

1. Use a HR global mesh (FES2022) but not before 2023 at the earliest
2. Regional HR solutions could also be developed

DAC for SWOT

We prepare a survey to gather SWOT users' needs about the DAC :

-which filtering do you need ? 2 days, 20 days, 42 days or other cutoff ?

-do you need a non filtered DAC also ? For which use ?

-do you need HR regional products ? In which areas ?

...

DAC for SWOT

Thanks for your attention ☺