

Development of MyOcean2 Global Ocean Reanalysis system



Hao Zuo, Magdalena Alonso Balmaseda, Kristian Mogensen
 European Centre For Medium-Range Weather Forecasts, Reading, U.K. email: Hao.Zuo@ecmwf.int

Abstract

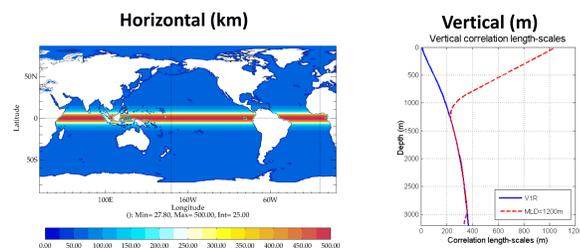
A new global ocean reanalysis system has been developed in ECMWF for the MyOcean2 project. The high resolution ocean model clearly shows some improvements, i.e. in resolving Western Boundary Currents, over the low resolution reanalysis system (ORAS4¹) that was used before. Here we show some preliminary results from the reanalysis run and validation of the data assimilation scheme. Below is a summary of the system setup.

- MyOcean2 Global Ocean Reanalysis (1979-2013)
 - NEMO ocean model (V3.4) in high-resolution (1/4 degree)
 - NEMOVAR data assimilation system (3D-VAR)
 - LIM2 seaice model with ice concentration assimilation
 - ERA-Interim surface forcing with bulk formula
 - Observations being assimilated: EN3 profiles (T/S), AVISO SLA (ref4), and OSTIA Sea-Ice concentration.
 - Bias correction (direct T/S + pressure, online + offline)
 - Wave forcing (Stokes-Coriolis forcing, drag coefficient, wave breaking mixing)

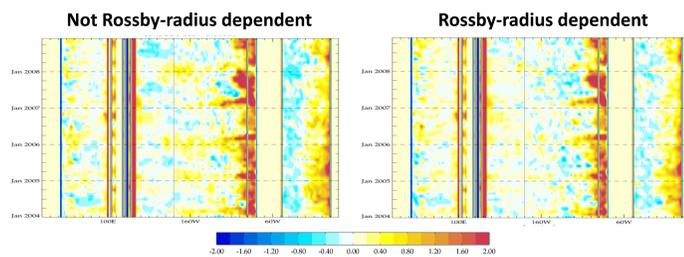
NEMOVAR Setup

For the background error, a horizontal correlation length-scales scheme was developed regarding to the Rossby radius of deformation and a mean gravity wave phase speed of 2.7 m/s. A series of sensitivity experiments demonstrate that the new horizontal scheme reduces the SST bias in the equatorial Pacific Ocean and improves the system performance in SSH in the subtropical Pacific Ocean. A mixed-layer thickness dependent vertical correlation length-scales scheme has also been implemented.

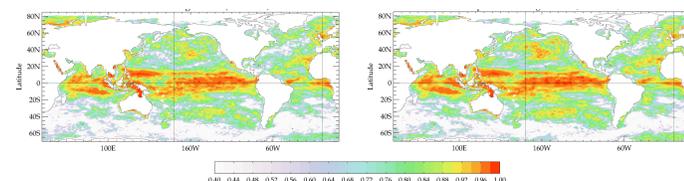
Background error correlation length-scales



Hovmollers of equatorial SST bias (ref Olv2)



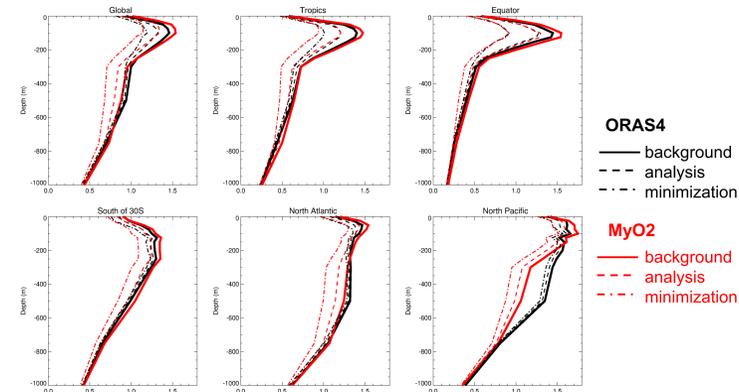
SSH correlation with AVISO data (2004-2008)



Preliminary Results

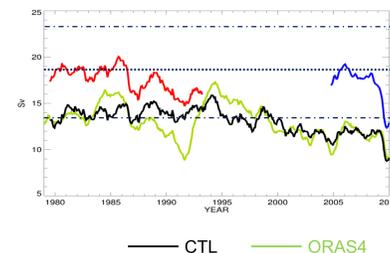
- Comparing the RMS errors of temperature between ORAS4 and MyO2 in different ocean basins shows that MyO2 analysis outperformed ORAS4 in almost every regions, and particularly in the North Atlantic and Pacific Ocean below 200m.

Temperature RMS error (1979-1992)

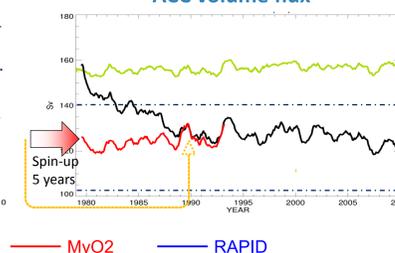


- ORAS4 seems to under-estimate the volume fluxes for Atlantic Meridional Overturning Circulation (AMOC) at 26.5° N (Balmaseda et al., 2013), and to over-estimate the strength of Ant-arctic Circumpolar Current (ACC) across the Drake Passage. The first 15-yr of MyO2 reanalysis results are more consistent with observations (John et al., 2011; Ganachaud 2003; Sloyan and Rintoul 2001) at both locations.

AMOC volume flux



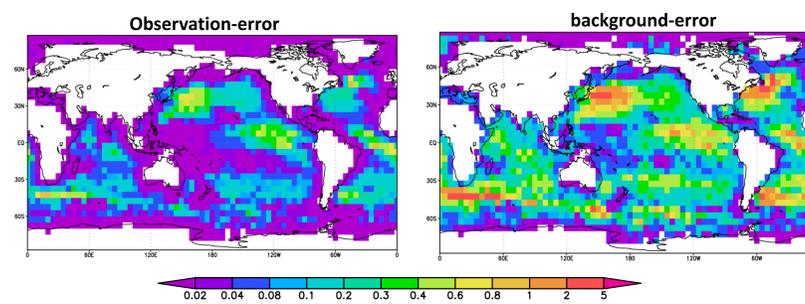
ACC volume flux



NEMOVAR Setup

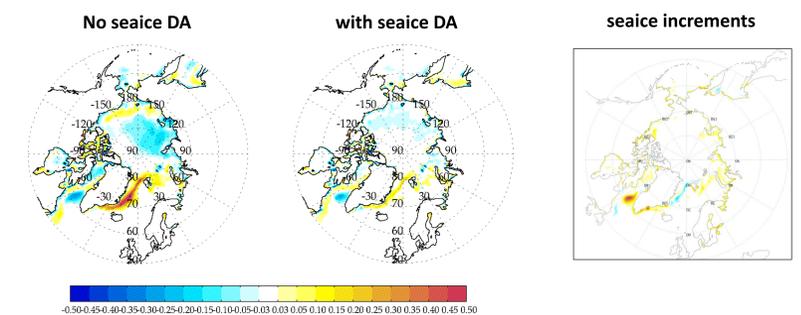
Observation-space assimilation diagnostics (Desroziers et al², 2005) has been carried out for this reanalysis and results show that system specified obs-error variances are generally too large for all data types, while the background-error variance is reasonably well parameterized.

Ratio of diagnosed/specified STD at 50m (1979-1998)



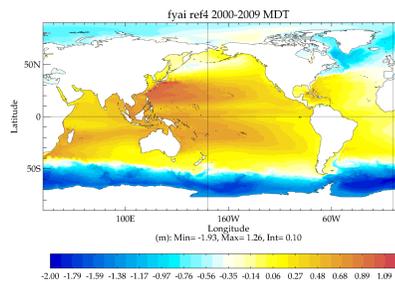
- Gridded sea ice concentration data from OSTIA reanalysis/operational has been assimilated in the NEMOVAR system, using a separated inner loop from all other observations. At the same time a latitude band and thinning algorithm were applied for the sea ice data to reduced the data density and to speed up convergence in the cost function.

Model Bias (ref Olv2) of sea-ice concentration (1993)

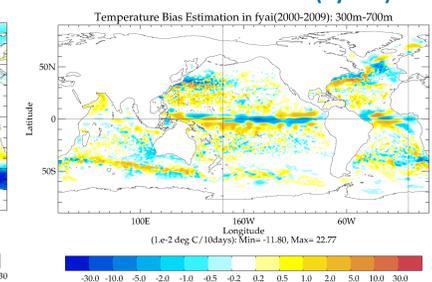


- To assimilate along-track sea-level anomaly data from AVISO, we developed a new method which can calculate the model MDT file with relative to any specified period and based on a ocean reanalysis run when only assimilating T and S data. Bias correction³ has also been applied with the offline bias calculated from the same pre-production analysis run.

MDT file for SLA assimilation



T offline bias correction (hybrid)



Conclusions

- A high resolution (1/4 degree) global ocean reanalysis system has been developed at ECMWF based on NEMO and NEMOVAR.
- Implementation of a new decorrelation length-scales scheme improves system performance in the Pacific Ocean.
- Other components including sea-ice and SLA assimilation, bias correction and a new wave model have been tested in this system.

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References:

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