

An Observing System Simulation Experiment to evaluate the impact of SWOT in a regional data assimilation system

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Motivation of our study

- Prepare the assimilation of SWOT in Mercator Ocean analysis and forecasting systems.
- Combine SWOT, nadir altimeter and in-situ data with high resolution models to allow a dynamical interpolation of SWOT data and a description and forecast of the ocean state.
- This is an essential step to develop a wide use of SWOT data both for ocean research and applications.
- Approach based on the development of innovation data assimilation methods and on the use of Observing System Simulation Experiments (OSSEs).



- OSSEs are powerful tools to evaluate the impact of the future observing system.
- OSSEs use two different models. One model is used to perform a "NatRun" run = real ocean. The "NatRun" run is sampled in manner that mimics the future observing system yielding synthetic observations. Observation errors added to these synthetic observations.
- Synthetic observations are simulated into the second model (assimilation run) and the model performances is evaluated by comparing it against the "NatRun" run.
- OSSEs are also important tools to test the capability of data assimilation systems to effectively merge different types of observations with the models to produce improved ocean analyses and forecasts.



- Description of the OSSEs protocol.
- Impact of the assimilation of the SWOT on :
 - ✓ Ocean Forecasts and Analysis
 - ✓ The small mesoscale signal.
 - Dynamical data interpolation.
 - ✓ On the sub-surface fields
- ✤ Impact of the assimilation of the SWOT data on the model with high-resolution (1/36°).
- Conclusions and future works.



(Reduced order Kalman Filter (SEEK formulation))



> Assimilation of SWOT performs much better than the assimilation of 3 altimeters.

- ✓ Reduction of 5-day SSH <u>forecast</u> errors ~25%
- ✓ Reduction of SSH <u>analysis</u> errors ~45%

(see Poster, 28)



Assimilation of SWOT+ 3 Nadir : good representation of the small scales









Zonal Velocity Impact : Section N-S at 16°W; [51°N-55°N]; 08/11/2009...

MERCATOR









SSH and Current : NATL60 vs OSSE (North Atlantic Drift, 30/04/2013)



NatRun (1/60°)

FreeRun (Control, 1/36°)



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SSH and Current : NATL60 vs OSSE (North Atlantic Drift, 30/04/2013)



OCEAN

Assim : SWOT+ J2, S3a, S3b





Conclusions and Perspectives

Improvements due to SWOT data assimilation :

- > Assimilation of SWOT performs much better than the assimilation of 3 altimeters.
- Assimilation of SWOT+ 3 Nadir : good representation of the small scales
- > Better dynamic interpolation through model dynamics
- > Best reconstruction of vertical and horizontal velocity in the deep ocean

Large (potential) impact for ocean analysis and forecasting systems

Perspectives :

- ✓ Develop OSSE with the global model (1/12°)
- ✓ Full use of SWOT simulator (all errors not only Karin).
- Continue improving the data assimilation system (non correlated errors, ...etc)



Thank you for your attention

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Synthetic Observation : JPL Simulator (Observation; Karin Noise, Error...)

15°W

0.03

0.04



40°N

39°N

38°N

37°N

36°N

35°N

34°N

17°W

-0.05 0.00

16°W

0.05

m

0.10 0.15





0.00

0.01

0.02

m



OSSE: <u>2km × 2km</u> Resolution 1.0 Cm Rms in the inner part of the swath to near 3.0 cm on outer edges of swath)