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Ensemble assimilation of JASON/ENVISAT and JASON/AltiKA altimetric observations with stochastic parameterization of the model dynamical uncertainties

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The objective of this study is to explicitly simulate and quantify the uncertainty related to sea-level anomalies diagnosed from eddy-resolving ocean circulation models, in order to develop advanced methods suitable for addressing along-track altimetric data assimilation into such models. This work is carried out jointly with the MyOcean and SANGOMA (Stochastic Assimilation for the Next Generation Ocean Model Applications) consortium, funded by EU under the GMES umbrella over the 2012-2015 period.

In this framework, a realistic circulation model of the North Atlantic ocean at 1/4° resolution (NATL025 configuration) has been adapted to include effects of unresolved scales on the dynamics. This is achieved by introducing stochastic perturbations of the equation of state to represent the associated model uncertainty. Assimilation experiments are designed using altimetric data from past and on-going missions (Jason-2 and Saral/AltiKA experiments, and Cryosat-2 for fully independent altimetric validation) to better control the Gulf Stream circulation, especially the frontal regions which are predominantly affected by the non-resolved dynamical scales. An ensemble based on such stochastic perturbations is then produced and evaluated -through the probabilistic criteria: the reliability and the resolution- using the model equivalent of along-track altimetric observations. These three elements (stochastic parameterization, ensemble simulation and 4D observation operator) are used together to perform optimal 4D analysis of along-track altimetry over 10-day assimilation windows.

In this presentation, the results show that the free ensemble -before starting the assimilation process- well reproduces the climatological variability over the Gulf Stream area: the system is then pretty reliable but no informative (null probabilistic resolution). Updating the free ensemble with altimetric data leads to a better reliability and to an improvement of the information (resolution), meaning the uncertainty associated with the ocean circulation is reduced (in terms of sea-level anomalies). Looking at the temperature and salinity profiles, the stochastic perturbations also show a clear impact on these variables, but the probabilistic diagnoses provide more contrasted results when the free and updated ensembles are compared.