

# SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

**Reporting year** 2017

**Project Title:** Optimization of the OceanVar oceanographic data assimilation system for high-resolution applications  
 .....

**Computer Project Account:** spitstor

**Principal Investigator(s):** Andrea Storto  
 .....

**Affiliation:** CMCC

**Name of ECMWF scientist(s) collaborating to the project (if applicable)** .....  
 .....

**Start date of the project:** 27/6/2015

**Expected end date:** 30/6/2017

**Computer resources allocated/used for the current year and the previous one**  
 (if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
<b>High Performance Computing Facility</b>	(units)	150000	0	150000	3000
<b>Data storage capacity</b>	(Gbytes)	500	0	500	20

## **Summary of project objectives**

(10 lines max)

The project aims at optimizing the OceanVar variational ocean data assimilation scheme. We aim at improving the memory consumption and computational resources required by OceanVar and increasing its scalability focussing on the optimization of the horizontal operator that models horizontal background-error correlations. An improved version of the recursive filter operator that model horizontal correlations will be implemented in global high-resolution (eddy-resolving) configuration. Such an improved operator will take advantage of a rigorous newly formulated mathematical framework, thanks to which we are able to avoid the use of extension zones in the west-east wrapping and inland ghost points to impose cyclic and land-sea lateral boundary conditions, respectively. Furthermore, the OceanVar 3DVAR scheme is being extended to a hybrid (ensemble/variational) 4DVAR formulation, and the ECMWF HPC resources are used to assess and enhance the computational performances of such a new scheme.

## **Summary of problems encountered (if any)**

(20 lines max)

Contrary to what was expected, we have been using local computing resources for testing the new filter formulation that led to the scientific publication of Mirouze and Storto (2016) (see below the reference). Furthermore, we used part of the resources allocated for the current year to test parallel performances of new extension of the OceanVar data assimilation system. Resources were under-used, due to the fact that they were enough only to run small tests and not full experiments.

## **Summary of results of the current year (from July of previous year to June of current year)**

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

We used part of the resources allocated for the current year to test parallel performances of new extension of the OceanVar data assimilation system, which now allow for a simplified four-dimensional hybrid formulation (ensemble/variational) of the variational data assimilation problem. Measuring performances appears crucial, as the new 4dvar scheme is about 20 times more expensive than the previous 3dvar scheme. In particular, as the system is hybrid MPI-OpenMP parallel, we tested different configurations of processes / threads. These tests were performed for a coarse resolution configuration (global 2x2 degrees of horizontal resolution, with 31 vertical levels) of the 4dvar data assimilation scheme. We found out that on cca, hyperthreading can save around 10% of wall-clock time for our hybrid parallelization, while further increase of threads is detrimental to the final computational time.

## **List of publications/reports from the project with complete references**

Mirouze, I. and Storto, A. (2016), Handling boundaries with the one-dimensional first-order recursive filter. Q.J.R. Meteorol. Soc.. doi: 10.1002/qj.2840

In preparation: Storto et al., OceanVar 2: extending an oceanographic data assimilation system with support for hybrid and four-dimensional formulations. Planned for submission to Geoscientific Model Development

## **Summary of plans for the continuation of the project**

(10 lines max)

Not Applicable