REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

MEMBER STATE: Greece, France

Principal Investigator[1]: Vassilios D. Vervatis (1), Pierre De Mey-Frémaux (2)

Affiliation: (1) National Kapodistrian University of Athens (UoA)
(2) Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS)

Address: 1) Ocean Physics And Modelling group (OPAM), Faculty of Physics, Division of Environmental Physics and Meteorology, Campus Building PHYS-V, 15784 Athens, Greece
(2) LEGOS/CNES 18, av. Edouard Belin, 31401 Toulouse cédex 9, France

E-mail: (1) vervatis@oc.phys.uoa.gr
(2) pierre.de-mey@legos.obs-mip.fr

Other researchers: Sarantis Sofianos (1), Nadia Ayoub (2), Bénédicte Lemieux-Dudon (2)

Project title: Stochastic Coastal/Regional Uncertainty Modelling 2: consistency, reliability, probabilistic forecasting, and contribution to CMEMS ensemble data assimilation

Project account: **SPGRVER2**

Additional computer resources requested for	**2019**
High Performance Computing Facility (units)	13 MSBU
Data storage capacity (total) (Gbytes)	8+16=24 TB

Continue overleaf

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

This is a technical report requesting additional resources for the year 2019, following the Ensemble simulations carried out within this Special Project named SPGRVER2.

The computational resources of this SP are used in a joint Copernicus Marine Environment Monitoring Service (CMEMS) project named SCRUM2 (Stochastic Coastal/Regional Uncertainty Modelling 2) in the framework of the Service Evolution call (https://www.mercator-ocean.fr/en/portfolio/scrum2/). The work proposed here builds upon, and expands, the previous Service Evolution SCRUM project, as well as the previous ECMWF-SP named SPGRVERV (https://www.ecmwf.int/en/research/special-projects/spgrverv-2016/). It is based on stochastic modelling of ocean physics and biogeochemistry in the Bay of Biscay, in the context of coastal/regional Ensemble Data Assimilation forecasting systems, and includes methods suitable to assess the reliability of Ensembles in probabilistic assimilation systems. The work implements a strategy to generate and validate Ensembles from the perturbation of physically- and biogeochemically-relevant ocean parameters. Those Ensembles are to be shared within the CMEMS and NEMO communities, and more broadly. With this additional resources request, we ask for the means to finish that work.

In the first year of the project we have estimated the SP computational resources on the basis of Ensemble simulations as per the CMEMS SCRUM2 proposal. A 7-month seasonal-range Ensemble of 50 members named Ens4 was performed during the first year of the SP in 2018, forced by ECMWF Ensemble Prediction System (EPS) atmospheric fields. On the basis of those simulations and analysing preliminary results from Ens4, we have designed new Ensemble experiments to investigate further the impact of the ECMWF-EPS on ocean model uncertainties. These new Ensembles were not planned initially in the SP nor the CMEMS project, but in our opinion are scientifically important for the continuation of both projects. Below we give an overview of the computational resources and the storage requirements, as well as the scientific justifications to perform new Ensembles.

So far in 2019, we have performed three new Ensemble simulations named Ens5, Ens6 and Ens7, that are incomplete in terms of number of Ensemble members. In Table 1, we summarize the number of members performed up to now for each new experiment. The goal is to have a total number of 50 members for all three Ensembles, as it is the case for the ECMWF-EPS, performing simulations for the same 7-month period as in Ens4.

The production of these new Ensembles follows the NEMO Ensemble capabilities with MPI double parallelization implementation, performing stochastic approaches based on SPPT and SPUF methods, as well as incorporating atmospheric Ensembles (i.e. ECMWF-EPS). For this, we have made extensive changes in the STO/ directory and in fldread.F90 module inside the NEMO trunk. For the stochastic approach we use an increased uncertainty for the wind from 0.3 to 0.4 st.dev., and for the SMS(C) from 0.6 to 0.8 st.dev., in order to deliberately inflate the Ensemble spread with respect to the previous Ensembles in SPGRVERV. For the same reason, we use simultaneously the SPUF stochastic method sampling gradients from the T/S state vector performing random walks. More in details, the Ens5 is the new Ensemble perturbing several kinds of parametrised variables in the ocean model. The Ens6 merges the two methods using simultaneously the stochastic protocol in Ens5 and the ECMWF-EPS atmospheric forcing. Finally, the Ens7 experiment uses only the ECMWF-EPS as in Ens4, but with a different initialization technique explained in the paragraph below and illustrated in Fig.1.

The batch job of these new three Ensembles are organized per 10 members in the form of time-chunks spanning a 30-day simulation period. Between each time-chunk there is an overlapping period of 10 days, as in Fig. 1, to mimic operational forecasting practices. There is a total of 10

time-chunks (partially overlapped) for a period of 7 months. In Table 2, we present the SBUs required to perform 10 members for a 30-day simulation (i.e. 1 time-chunk) and the total SBUs to reach a total number of 50 members for each Ensemble experiment. Similarly, in Table 3 we present the data storage requirements per grid file, per 10 members and per time-chunk.

Table 1. Additional new Ensembles and number of members up to now, and to be performed

Ensemble Experiment	Number of Ensemble members up to now	Remaining number of Ensemble members to be performed, in order to reach a total of 50 members
Ens5	20	30
Ens6	20	30
Ens7	10	40

Table 2. Additional resources requested for 2019 (in MSBU)

Ensemble Experiment	SBUs per 30-day simulation (i.e. 1 time-chunk) and per 10 members	SBUs to reach a total of 50 members per experiment and a total of 10 time-chunks
Ens-5	150.000	3*10*150.000 = 4.500.000
Ens-6	135.000	3*10*135.000 = 4.050.000
Ens-7	100.000	4*10*100.000 = 4.000.000
Additional resources requested for 2019		12,55 MSBU ~ **13MSBU**

Table 3. Additional data storage requested for 2019 (in TB)

files per grid types	data storage per 30-day simulation (i.e. 1 time-chunk) and per 10 members	data storage to reach a total of 50 members per experiment and a total of 10 time-chunks
1d_gridCHL	38,1 GB	159 GB*(3+3+4)*10=15,9 TB ~ **16 TB** (restarts won't be archived)
3d_gridBGC	61,9 GB	
1d_grid2D	6,32 GB	
1d_gridTS	26,09 GB	
1d_gridUV	26,59 GB	
Sum	159 GB	

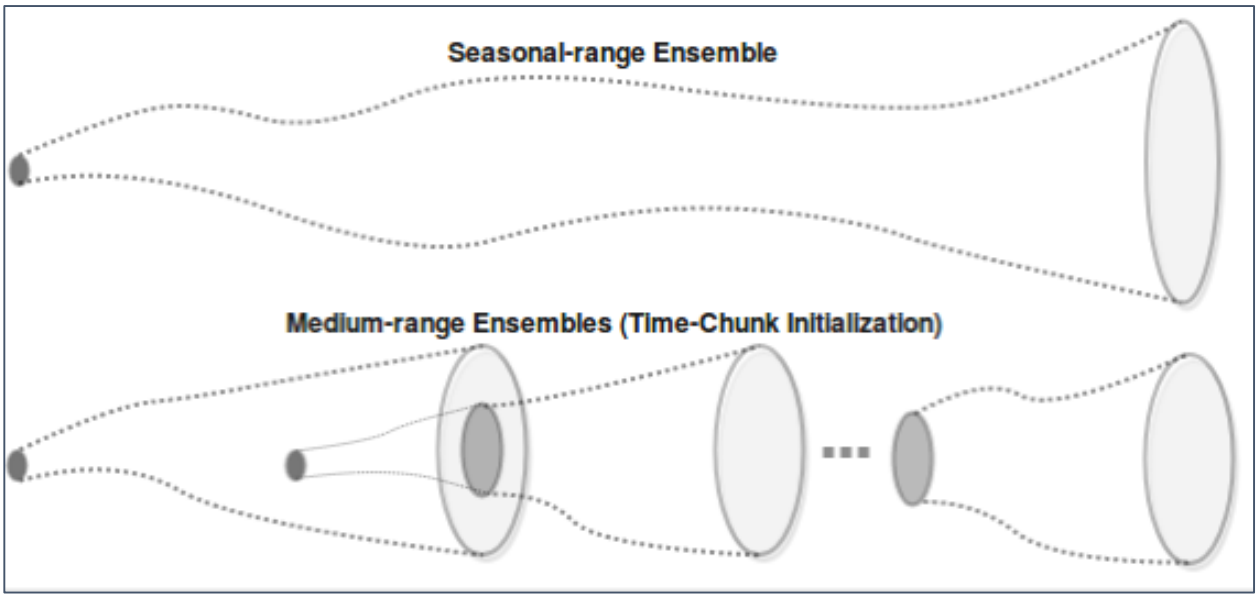

Fig. 1. Schematic of a seasonal-range Ensemble and short/medium-range Ensembles in the form of the time-chunk initialization.