REQUEST FOR A SPECIAL PROJECT 2020–2022

MEMBER STATE: Vasily Korabel…..……...…

Principal Investigator:

Affiliation: Danish Meteorological Institute

Address: Danish Meteorological Institute
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Other researchers: ……..……

……..……

Project Title:

Development of the upgraded reanalysis system for the BALMFC in CMEMS

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** _____	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2020	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2020-2022:
(To make changes to an existing project please submit an amended version of the original form.)

		2020	**2021**	**2022**
High Performance Computing Facility	(SBU)	7 million	7 million	9 million
Accumulated data storage (total archive volume)[2]	(Tb)	60	80	100

Continue overleaf

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Extended abstract

The completed form should be submitted/uploaded at https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission.

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF as well as the Scientific Advisory Committee. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages). Large requests asking for 10,000,000 SBUs or more might receive a detailed review by members of the Scientific Advisory Committee.

The Danish Meteorological Institute as the part of the EU's Copernicus Marine Sevice center is taking a responsibility in coming years (2019-2021) of delivering an upgraded 26-years ocean reanlysis product for the Baltic Sea region for the period 1993 - 2018. The new reanalysis system will superceed the existing NEMO3.6-LIM3-SCOBI system developed by SMHI, Sweeden.

The new reanalysis system will feature several important upgrades such as:

(i) It will be based on the state-of-the-art ocean model Nemo4.0 coupled to the new ice model IC3,

(ii) will include the new data assimilation scheme (LESTKF) from PDAF package developed by AWI, Germany.

(iii) The ocean model also will be 1-way online coupled to the biological ERGOM model (developed in collaboration with BSH, Germany).

(iv) The biological ERGOM model, previously used operationally in the BALMFC for several years, will also have several upgrades, such as: implemented full carbon cycle and several new output variables added: Net Primary Production, pH, pCO2.

(v) The new system will be featuring a twofold increase in the model horizonal resolution compared to the currently used reanalysis system (1 nm vs 2nm). This high resolution is crutial for the proper modeling of salt transport through Danish Straights into the Baltic Sea.

The reanalysis system will have the model setup which is as close as possible to the new BALMFC operational model, but differ in the atmospheric forcing and open boundary conditions. This will ensure non-degradation of product quality of the new system to existing system from one hand and will result in better consistency between the reanalysis product and near-real time product from the other hand.

The outputs of the physical ocean model will be used for the 1-way offline coupling with WAM model (developed in collaboration with FMI, Finland), provining ice coverage and currents to the wave model.

Given this, the project presents a quite significant computational load on the current computer systems at DMI.

As the part the project plan we will :

(1) perform a 10-year hindcast run of the coupled ocean-ice-bio system to tune the models. This hindcast run will be also used to evaluate the covariances in the PDAF ensemble-based assimilation system. Estimated amount of disk space for this task is approximately 60 Tb and 7 million SBU.

(2) perform several tests to evaluate the preformance of the data assimilation system and specifically tests will be performed to evaluate the optimal assmilation frequency for the surface observations (SST, sea ice concentration) and for in-situ observations (T/S profiles), which is set currently to 72 hours for both surface and in-situ observations in the present reanalysis system.

(3) Data assimilation experiments will be performed to evaluate the performace of the biological data assimilation of the nutrient profiles and determine the optimal strategy of the assimilation of biological variables.

(4) Perform a final pre-production multi-year run and extract the data for the quality control group.

Tasks (2) and (3) as an estimate will need apporoximately 10 Tb each and 3,5 million SBU each. Task (4) will require another 20 Tb of disk space and 9 million SBU.

Grating the requested ECMWF computer resourses will allow us to complete task in quite limited time frame but at the same time keeping high scientific standards.

References:

1. Liu, Y., Meier, H. E. M., and Axell, L.: Reanalyzing temperature and salinity on decadal time scales using the ensemble optimal interpolation data assimilation method and a 3-D ocean circulation model of the Baltic Sea, J. Geophys. Res.-Oceans, 118,5536–5554, 2013.

2. Nerger, L., W. Hiller, and J. Schröter, 2005a: A comparison of error subspace Kalman filters. Tellus, 57A, 715–735.

3. Nerger, L., W. Hiller, and J. Schröter, 2005b: PDAF—The Parallel Data Assimilation Framework: Experiences with Kalman filtering. Use of High Performance Computing in Meteorology—Proceedings of the 11th ECMWF Workshop, W. Zwieflhofer and G. Mozdzynski,

Eds., World Scientific, 63–83.