SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2024
Project Title:	Enhancing regional ocean data assimilation in high and mid latitude European seas
Computer Project Account:	spitstor
Principal Investigator(s):	Andrea Storto
	……
Affiliation:	CNR ISMAR
Name of ECMWF scientist(s) collaborating to the project (if applicable)	NA ……
Start date of the project:	2022
Expected end date:	2024

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
High Performance Computing Facility	(units)	9.8M	9.8M	5.8M	5.8M
Data storage capacity	(Gbytes)				

Summary of project objectives (10 lines max)

The project develops along with four main research topics that are summarized below: i) Stochastic physics formulation and experiments, mostly using a North Atlantic-Arctic-Mediterranean configuration of NEMO at multiple resolutions (1/4°, 1/12°, and 1/36°) or the global ORCA configuration of NEMO (at 1° or ¼°); ii) Altimetry data assimilation at high latitudes, focussing on the use of high sampling rate (5Hz) altimetry datasets; iii) coupled data assimilation algorithms, using as a target configuration a regional Earth system model; iv) weak-constraint four-dimensional data assimilation algorithms and testing.

Summary of problems encountered (10 lines max)

NA

Summary of plans for the continuation of the project (10 lines max)

In the remaining months of the project, we plan to focus on additional experiments for improving air-sea flux bias correction schemes.

List of publications/reports from the project with complete references

de Toma, V., Ciani, D., Hesham Essa, Y., Yang, C., Artale, V., Pisano, A., Cavaliere, D., Santoleri, R., and Storto, A.: Skin Sea Surface Temperature schemes in coupled ocean-atmosphere modeling: the impact of chlorophyll-interactive e-folding depth, Geosci. Model Dev. Discuss. [preprint], https://doi.org/10.5194/gmd-2024-13, in review, 2024.

Storto, A., Yang, C. Acceleration of the ocean warming from 1961 to 2022 unveiled by large-ensemble reanalyses. Nat Commun 15, 545 (2024). https://doi.org/10.1038/s41467-024-44749-7

Summary of results

Topic iv) Weak-constraint Data Assimilation. This line of investigation has slightly changed from the initial proposal, and we have focussed our research on bias correction methodologies for long-term simulations. Two approaches were investigated: i) using climatologically averaged analysis increments to correct systematic ocean model errors; ii) using neural networks to correct air-sea heat fluxes, whose systematic error is assumed to be state-dependent. The first approach has been tested in detail in conjunction with other bias correction schemes, it is now part of CIGAR reanalysis system (http://cigar.ismar.cnr.it/) and documented in Storto and Yang (2024). A large part of the HPC resources has been used to retune these schemes and run pilot reanalysis experiments. Secondly, we have started preliminary experiments towards the neural network-based correction of air-sea heat fluxes for long ocean model simulations.

Initial results are promising, and indicate the success of the online inference to correct air-sea heat flux, as in SST data-assimilating experiments. We plan to extend these experiments in the remaining months of 2024, and continue this line of research if the project continuation is granted.