

EMI R&D PROJECT PROGRESS REPORT

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

Reporting year2026.....

Project Title: Impact of horizontal ocean grid refinement and freshwater fluxes coming from Greenland Ice sheet on AMOC predictability in EC-Earth4

Computer Project Account: ...spdkdevi.....

Principal Investigator(s):
Marion Devilliers
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Affiliation: Danish Meteorological Institute (DMI)

Name of ECMWF scientist(s) collaborating to the project (if applicable) Ilana Schiller-Weiss (DMI), Andrea Gierisch (DMI), Torge Martin (GEOMAR), Tido Semmler (Met Eireann)

Start date of the project: 2026

Expected end date: 2028

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)	0	0	133,000,00	0
Data storage capacity	(Gbytes)	0	0	23,000	0

Summary of project objectives (10 lines max)

The objective of this Special Project is to investigate how regional ocean grid refinement and realistic Greenland Ice Sheet freshwater forcing influence the Atlantic Meridional Overturning Circulation (AMOC) in the next-generation EC-Earth4 climate model. The project combines the AGRIF nested-grid framework with observation-based freshwater fluxes to better represent key processes in the subpolar North Atlantic. Dedicated historical and future ensemble simulations will be used to quantify the impacts of mesoscale ocean dynamics and Greenland meltwater on deep convection, AMOC variability, and future evolution under different climate scenarios. The project also aims to prepare EC-Earth4 for CMIP7 by evaluating the performance and stability of its regional refinement capability and by providing improved understanding of AMOC predictability and associated climate uncertainties.

Summary of problems encountered (10 lines max)

The main delay encountered during the reporting period was related to the availability of the EC-Earth4 development version required for this project. The planned simulations depended on ongoing model tuning and code development, including the integration of the AGRIF coupling framework. The relevant development branch was merged into the EC-Earth4 main codebase only on 18 June 2026 (merge request !77), later than initially anticipated. As a result, the first numerical tests could not be initiated during the current reporting period. The project is now in a position to start the initial stability and performance tests after the summer, followed by the planned spin-up and ensemble simulations.

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

Following the integration of the required AGRIF developments into the EC-Earth4 main codebase, the next phase of the project will focus on setting up and validating the new model configuration. Initial work will include stability tests, verification of the AGRIF coupling, and performance benchmarking on the ECMWF HPC system. Once the configuration has been validated, the planned spin-up simulation will be launched, providing the initial conditions for the historical ensemble experiments. These activities will pave the way for the full set of historical and scenario simulations described in the original project proposal.

List of publications/reports from the project with complete references

No publications or technical reports have yet resulted directly from this project. Publications are expected once the model development, validation, and first simulations have been completed.

Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

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During the first reporting period, the project focused on the technical preparation required to perform the planned EC-Earth4 simulations. The work was closely linked to the ongoing development of the EC-Earth4 model and the integration of the AGRIF regional ocean refinement capability into the main codebase.

The main milestone during this period was the integration of the AGRIF coupling developments into the EC-Earth4 main branch (merge request !77, 18 June 2026), achieved by EC-Earth4 development team. This represents an essential prerequisite for the project, as the proposed simulations rely on this new model capability. During the reporting period, the project team also finalized the experimental design, including the AGRIF domain configuration, the implementation strategy for the Greenland freshwater forcing dataset, and the workflow for the historical and scenario ensemble simulations.

Because the integration of the required model developments occurred later than initially anticipated, the numerical simulations could not yet be started during the present reporting period. The project is now ready to enter the implementation and validation phase. The first activities after the summer will consist of compiling the updated EC-Earth4 version on the ECMWF HPC system, performing stability and performance tests, validating the AGRIF configuration, and launching the spin-up simulation that will provide the initial conditions for the planned historical ensemble experiments.

Overall, the project has successfully completed the preparatory phase and is well positioned to begin the scientific simulation campaign during the next reporting period.