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 year	2026
Project Title:	LiquidIce: Dual hemispheric ice sheets in EC-Earth
Computer Project Account:	spdkrode
Principal Investigator(s):	Christian Rodehacke
Affiliation:	Danish Meteorological Institute
Name of ECMWF scientist(s) collaborating to the project (if applicable)	N/A
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)			17,000,000	9,195,145
Data storage capacity	(Gbytes)			20,000	

Summary of project objectives (10 lines max)

This project aims to develop a coupled model system comprising EC-Earth 4 and the Parallel Ice Sheet model (PISM), in contribution to the European project LiquidIce. The model framework will include two-way interactions between the atmosphere and ocean components of the GCM and the Greenland and Antarctic ice sheets. In addition, it aims to improve the representation of surface mass balance (SMB) over the ice sheets through coupling the CISSEMBEL surface mass balance model to the atmospheric component of EC-Earth 4, OpenIFS. This coupled model system will then be used to perform future climate simulations that will adhere and contribute to the upcoming Ice Sheet Model Intercomparison Project 7 (ISMIP7).

Summary of problems encountered (10 lines max)

Progress in this project depends on the status of the EC-Earth 4 model which is still under development and needs to undergo tuning. Only once this final tuned version is ready can we spin up our models and perform the required simulations.
Current progress in coupling CISSEMBEL is hindered by it's lack of capability to run over more than one domain in one instance of the model code, thus work will need to be done to enable more than one instance to be run at once, otherwise significant changes to CISSEMBEL's code will be required.

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

The technical coupling of EC-Earth 4 and PISM for Greenland and Antarctica is now complete and a part of the current release of EC-Earth 4. Ongoing work includes the integration of CISSEMBEL within the framework, enabled for both ice sheet domains. Once the new EC-Earth 4 model has been tuned, we will perform ice sheet model and coupled model spin-ups and evaluate the performance of the ECE-PISM and ECE-PISM-CISSEMBEL systems. Following this, we will produce a technical model development paper or report describing this new framework. This model system will then be used to perform several simulations under different climate forcings following the ISMIP7 protocol for ESM-ISM models, and thus contribute to the MIP.

List of publications/reports from the project with complete references

N/A

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.

Since the start of this project, we have achieved integrating interactive ice sheets within EC-Earth 4 through coupling PISM to the atmospheric and oceanic components. The atmosphere-ice sheet interaction has been achieved through adding a component called the ISM-mapper which exchanges fields (SMB, surface temperature, topography, runoff), via the OASIS coupler, with OIFS. The ocean-ice sheet interaction includes exchanging ocean temperature and salinity and discharge fields, and is facilitated by the Runoff-mapper. A python script prepares the fields output after one leg of EC-Earth simulation as required to force the subsequent PISM simulation. It then creates and runs the PISM batch job and processes the PISM output to be read back by EC-Earth for the next leg. This framework is flexible and allows for any number of ice covered domains to be specified at any resolutions. The ISM can also be run for an accelerated number of years for each climate model leg. CISSEMBEL has been coupled to OIFS over a single region although tests are still ongoing.