REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING EMI R&D PROJECT

Please submit the completed form via https://www.ecmwf.int/en/support (choose *Software and Computing*, then *Gain access to computing resources (create ticket)*) or send to special_projects@ecmwf.int

Country/Organisation: Denmark

Principal Investigator[1]: Chongyang Zhang

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Address: Frederiksborgvej 399
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Denmark

Project title: The anatomy of Arctic impact on European climate change

Project account: SPdkzhan

Additional computing resources requested for year		**2026**
High Performance Computing Facility	[SBU]	45,000,000
Graphics Processing Unit Cluster - A	[GBU]	
Graphics Processing Unit Cluster - B	[GBU]	
Total DHS Data storage capacity	[GB]	
EWC resources		
Number of vCPUs	[#]	
Total memory	[GB]	
Storage	[GB]	
Number of vGPUs[3]	[#]	

Continue overleaf

[1] The Principal Investigator is the contact person for this EMI R&D Project

Technical reasons and scientific justifications why additional resources are needed

These additional resources are requested based on the experience gained during the first phase of the project and the behavior of the coupled model. As originally proposed, the project requested a total of 30 million SBU over two years to perform a series of fully coupled EC-Earth3 simulations investigating the atmospheric response to Arctic sea-ice changes. To date, we have completed approximately 210 years of the fixed-GHG control integration, which provides the initial conditions for the ensemble sensitivity experiments. In parallel, we have developed a hybrid sea-ice nudging methodology in EC-Earth3 that simultaneously constrains both sea-ice concentration and sea-ice volume towards prescribed target states. This represents an important technical improvement over the original model configuration and provides a more realistic representation of Arctic sea-ice anomalies.

Building on this framework, we have carried out a series of high-ice and low-ice sensitivity experiments, including experiments with different magnitudes of sea-ice reduction and different gravity-wave parameterization schemes. These preliminary simulations confirm that the experimental design is functioning as intended. However, the atmospheric response to Arctic sea-ice forcing in EC-Earth3 is weaker than anticipated, consistent with the well-known low signal-to-noise ratio of Arctic–midlatitude interactions reported in previous studies. Although the expected qualitative response is reproduced, the differences between the high-ice and low-ice ensembles are not yet sufficiently robust for several key diagnostics. Increasing the ensemble size is therefore essential to better separate the forced response from internal atmospheric variability and to obtain statistically robust estimates of the atmospheric circulation response. To support these additional ensemble simulations, the control integration must also be extended to provide a sufficient number of independent initial conditions. The need for larger ensembles was not fully apparent at the proposal stage because the magnitude of the atmospheric response and the associated signal-to-noise ratio could only be reliably assessed after the first set of coupled sensitivity experiments had been completed.