

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:

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Project title: EC-EARTH4: developing a next-generation European Earth System model based on ECMWF modelling systems
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Project account: SPNLTUNE

Additional computing resources requested for year		2026
High Performance Computing Facility	[SBU]	95.200.000
Graphics Processing Unit Cluster - A	[GBU]	0
Graphics Processing Unit Cluster - B	[GBU]	0
Total DHS Data storage capacity	[GB]	0
EWC resources		
Number of vCPUs	[#]	0
Total memory	[GB]	0
Storage	[GB]	0
Number of vGPUs ³	[#]	0

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

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Technical reasons and scientific justifications why additional resources are needed

We are in the final process of tuning EC-Earth4 for production runs for CMIP7. EC-Earth4 is the next iteration of EC-Earth for CMIP7 that includes OpenIFS-cy48 as its atmospheric component and NEMO-4.2 as the oceanic one.

To comply with the emission-driven CMIP7 protocol, the latest version of EC-Earth4 now includes M7, which represents the aerosol chemistry and the aerosol-cloud interactions inside OIFS. In this way, the model can run with aerosol precursor emissions and compute the aerosol distribution and composition on-the-fly. As a drawback, the M7 version of OIFS is more computationally demanding than the standard version: the final cost is about 7-8 times the one for the standard OIFS in double precision. Recent releases of EC-Earth 4 now can run using single precision, reducing this factor by half to about 3.5 times our initial estimates. Due to this overload, our initially predicted budget turned out to be too short for the needed tuning and spin-up simulations towards CMIP7.

Due to intense activity in terms of tuning runs and the significant increase in the computational requirements, we have already exhausted our allocation at this stage (we are already at 17.7 MSBU above our allocation for this year). Before starting production, we are still trying to tune the model to adjust some important biases, including a strong arctic cold bias, both in present-day and in pre-industrial, possibly associated with ocean heat transport and sea-ice formation. In parallel we are investigating a cooling radiative bias over northern continents in spring associated with LPJG.

CMIP7 production runs need to start as soon as possible (with a target at the end of the year), therefore we need to run at least two simulations in parallel for the rest of the year, one for pre-industrial conditions, one for present-day conditions. We plan to adjust tuning parameters on the fly to avoid too long spin-up times.

Each simulated year with a full configuration of EC-Earth 4 (including LPJG, M7) requires 13 nodes on hpc2020 and we achieve about 11 simulation years per day. The total cost of a single simulation year is about 68000 SBU. Therefore, we plan to simulate around 1400 years until the end of this year with two simulations running in parallel during the coming 3 months (this is a lower-bound conservative estimate assuming that we will have two runs running in parallel 70% of the time, leaving space for stops in the runs and/or availability of the machine). At a cost of 73000 SBU/SY, this would be equivalent to 95.200.000 SBU.