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	2025
Project Title:	Earth system modeling of PaleOClimatic HyperthermALs (EPOCHAL)
Computer Project Account:	Spitnuri
Principal Investigator(s):	Matteo Nurisso
Affiliation:	CNR-ISAC
Name of ECMWF scientist(s) collaborating to the project (if applicable)	
Start date of the project:	01/01/2025
Expected end date:	31/12/2026

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)			9,000,000	27,229
Data storage capacity	(Gbytes)			20,000	0

Summary of project objectives (10 lines max)

Final objective of the project is to investigate the characteristics of the Early Eocene climate and the mechanism of hypertermals. In order to achieve this objective, we are developing a low-resolution and high-efficiency version of the Earth System Model EC-EARTH4, called EC-EARTH Fast (ECE-FAST). The model will be tuned separately from the EC-EARTH4 standard resolution model. Orography, bathymetry and all boundary conditions are under adaptation to allow simulations of the required paleoclimate period.

Summary of problems encountered (10 lines max)

EC-EARTH4 is a model currently under development targeting CMIP7 simulations. While this allow for efficient collaboration with the developers of the main code, it has also exposed the ECE-FAST development to some delay due to important changes in the components of the code (such as the replacement of OIFS cycle43r3 with cycle48r1). This requires continuous porting of new updates and despite being sustainable for the rest of the project will remain a potential bottleneck.

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

The ECE-FAST model can be tuned with the present day orography and bathymetry in order to then produce the CMIP6 DECK simulations (called CORE simulations in the original proposal).
The modifications of the orography and the bathymetry will be completed in order to enable the model to run also the simulations of paleoclimate interest (called EPOCHAL simulations in the original proposal).

List of publications/reports from the project with complete references

N/A

Summary of results

The ECE-FAST model has been developed and it is available and supported in the latest release of EC-EARTH4 v4.1.0. The ECE-FAST current configuration is TL63L31 as OIFS grid and ORCA2L31 for the NEMO component. It achieves around 200 SYPD for 16 CHPSY in coupled mode, with results encouraging for the planned Paleoclimatic applications. Further improvements associated with single precisions are expected to be included in next months.
Multi-decadal control run simulations have been run with the present day orography in order to allow the tuning of the model to start. In order to have a complete monitoring of the tuning simulations the open source code AQUA[1] has been adapted to run with the available EC-EARTH4 configurations, ECE-FAST included.
Parallel to the tuning task, a version of the land sea mask adapted to the Eocene is technically working and we are working to the implementation of the Eocene bathymetry. In order to achieve such a modification, ECE-FAST has been tested with a modified version of the ORCA2 NEMO grid, called PaleORCA2[2], which allows to shift the singularity point of the tripolar grid ORCA2 in regions which are suitable for paleoclimate simulations.

[1] https://doi.org/10.5281/zenodo.14906075

[2] https://doi.org/10.5194/gmd-13-3011-2020