

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 (1st year of the project)

Project Title: Deep ocean heat uptake on equilibrating time scales (DEEPNESS)

Computer Project Account: spitvent

Principal Investigator(s): Ventrucci Chiara

Affiliation: University of Bologna, Department of Physics and Astronomy (DIFA)
National Research Council, Institute of Atmospheric Sciences and Climate (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) | - | - | 12200000 | 17,153 |
| Data storage capacity | (Gbytes) | - | - | 16900 | 0 |

Summary of project objectives (10 lines max)

This project aims to study the equilibrium response of Earth's climate system to the increase of greenhouse gases concentration in the atmosphere. We will run and analyse some idealized experiments with the general circulation model EC-Earth4. We choose to work with a low-resolution version of the model to compare multiple scenarios at a significantly smaller computational cost. Experiment setup includes both a change in the external forcing and in the structure of the ocean. Indeed, the focus of this project is on the oceanic component of the equilibrium response, as two key factors shaping the warming pattern and the associated climate feedbacks are the added and redistributed heat, respectively stored in the ocean according to background ventilation pathways and to changes in ocean circulation. Regions of interest for our analysis are the Southern Ocean and the North Atlantic.

Summary of problems encountered (10 lines max)

None so far

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

For the remaining months of 2025, we plan on performing the first part of the simulations proposed for this project. We choose to start from the hypothesized Q2 of the project (What is the role of ocean circulation and ocean stratification in determining the deep ocean uptake?) as more interesting for actual scientific debate on ocean heat uptake. We will start with testing the sensitivity of the ocean properties to parametrization parameters. Playing with the tuning of the model, we will be able to highlight the role of some transport mechanisms, especially relevant to the structure of the ocean (e.g., diffusion for stratification patterns).

List of publications/reports from the project with complete references

None so far

Summary of results

The first months of 2025 have been dedicated to the installation of the required version of the model. As EC-Earth4 at low resolution has been developed just recently, some effort has been necessary to be able to run the first test simulations. Lastly, we managed to do it successfully.

We also learned how to activate a diagnostic for printing as output the decomposed transport components, useful for the analysis. These include, among the others, the three components of advection, isopycnal and vertical diffusion.

We are currently evaluating the final set of needed variables.