

## LATE REQUEST FOR A SPECIAL PROJECT 2025–2027

**MEMBER STATE:** Italy

**Principal Investigator<sup>1</sup>:** Katinka Bellomo

**Affiliation:** Università di Padova

**Address:** 35133 Padova (Italy)

**Project Title:** Disentangling AMOC weakening impacts in idealized simulations of future climate change

To make changes to an existing project please submit an amended version of the original form.)

If this is a continuation of an existing project, please state the computer project account assigned previously.	SPITBELL	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2026	
Would you accept support for 1 year only, if necessary?	YES	

<b>Computer resources required for project year:</b>	2025	2026	2027
High Performance Computing Facility [SBU]		20,000,000	
Accumulated data storage (total archive volume) <sup>2</sup> [GB]		50TB	

<b>EWC resources required for project year:</b>	2025	2026	2027
Number of vCPUs [#]			
Total memory [GB]			
Storage [GB]			
Number of vGPUs <sup>3</sup> [#]			

*Continue overleaf.*

<sup>1</sup> The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.

<sup>2</sup> These figures refer to data archived in ECFS and MARS. If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

<sup>3</sup> The number of vGPU is referred to the equivalent number of virtualized vGPUs with 8GB memory.

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## Extended abstract

All climate models project a weakening of a critical component of the Earth system, namely the Atlantic Meridional Overturning Circulation (AMOC) by the end of the 21<sup>st</sup> century (Weijer et al. 2020). However, the effects of AMOC weakening compete with other direct and indirect effects of greenhouse gas forcing. Standard future projections (e.g., SSPs) do not allow for a clean separation of these effects from the impacts of AMOC weakening, thus ad-hoc model simulations need to be carried out.

Previous model experiments with EC-Earth3 under special project SPITBELL 2023-2025 allowed the PI and colleagues to explore several aspects of climate change impacts associated to AMOC weakening. The results are published in several papers: Bellomo and Mehling (2024), Vacca et al. (2025), Cerato et al. (2025), Hahn et al. (2025), and more are in papers under review.

The PI asks for additional resources to be used in 2026 to continue some of these runs. Extensions of these runs are justified by the need to explore the signal to noise ratio and modes of internal climate variability. Both of these efforts require longer integrations of the existing simulations. The PI has also recently obtained funding through the Italian funding scheme FIS. These runs will directly contribute to the research to be carried out in that project.

### Model experiments

The PI will carry out model experiments using the EC-Earth3 climate model, with modifications to implement water hosing (i.e., modify the salinity budget in selected regions), as documented in previous publications (Bellomo et al. 2023, Jackson et al. 2023, Bellomo and Mehling 2024). The experiments to be carried out will include both increasing concentrations of carbon dioxide following the CMIP6 protocol as well as water hosing to either strengthen AMOC in warm climate states. The model setup for EC-Earth3 will be the same as in the previous publications, that is, T255L91-ORCA1L75. Previous on Atos have determined that the most effective setup for this configuration of EC-Earth3 is five nodes. These nodes consist of 490 cores for IFS, 148 cores for NEMO, one core each for the runoff mapper and the XIOS server. I estimate that for one model year, I will consume roughly 20,000 SBU. I request to run an additional total 500 years, which adds up to 20 MSBU over one year. To store temporary data, based on previous runs, I estimate about 100 GB per model year. Hence I request 50 TB of storage space.

Specifically, the runs to be carried out are as follows:

- Control abrupt-4xCO<sub>2</sub>: 250 years
- 4xCO<sub>2</sub>+0.6Sv (4xCO<sub>2</sub> plus reversed water hosing): 250 years

### References

Bellomo, K., Meccia, V.L., D'Agostino, R. et al. Impacts of a weakened AMOC on precipitation over the Euro-Atlantic region in the EC-Earth3 climate model. *Clim Dyn* 61, 3397–3416 (2023). <https://doi.org/10.1007/s00382-023-06754-2>

Bellomo, K., & Mehling, O., 2024: Impacts and state-dependence of AMOC weakening in a warming climate. *Geophysical Research Letters*, 51, e2023GL107624. <https://doi.org/10.1029/2023GL107624>

Cerato G., K. Bellomo, J. von Handenberg, 2025: Summer drought predictability in the Euro-Mediterranean region in seasonal forecasts. *Journal of Hydrometeorology*. <https://doi.org/10.1175/JHM-D-25-0039.1>

Hahn L.C., I. Eisenman, N.J. Lutsko, V. Meccia, O. Mehling, K. Bellomo: Large Uncertainty in Arctic Warming Driven by the Atlantic Meridional Overturning Circulation. *Geophysical Research Letters*, 52, e2025GL119720. <https://doi.org/10.1029/2025GL119720>

Jackson, L. C., Alastrué de Asenjo, E., Bellomo, K., Danabasoglu, G., Haak, H., Hu, A., Jungclaus, J., Lee, W., Meccia, V. L., Saenko, O., Shao, A., and Swingedouw, D., 2023: Understanding AMOC stability: the North Atlantic Hosing Model Intercomparison Project, *Geosci. Model Dev.*, 16, 1975–1995, <https://doi.org/10.5194/gmd-16-1975-2023>

Vacca A., K. Bellomo, F. Fabiano, J. von Hardenberg, 2025: On the role of AMOC weakening in shaping wintertime Euro-Atlantic atmospheric circulation. *Climate Dynamics*, 63, 273 <https://doi.org/10.1007/s00382-025-07747-z>

Weijer, W., Cheng, W., Garuba, O. A., Hu, A., & Nadiga, B. T., 2020: CMIP6 models predict significant 21st century decline of the Atlantic Meridional Overturning Circulation. *Geophysical Research Letters*, 47, e2019GL086075. <https://doi.org/10.1029/2019GL086075>