Project: bm1344

Project title: Horizon EU-project EERIE [**E**uropean **E**ddy-**RI**ch **E**arth System Models]

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Allocation period: 2026-01-01 to 2026-12-31

Achievements in the previous allocation period

MPI-M

In October 2026, we finished all ICON-EERIE (ICON-ESM-ER) phase 2 experiments as planned. This includes two combined historical (1975-2014) and scenario (SSP2-4.5, 2015-2030) experiments. Together with the counterpart of phase 1, all experiments form a three member ensemble for the years 1975 to 2030. The evolution of global mean surface temperature reveals for all three members a coherent global warming signal (not shown). Another coherent feature is the rather stable AMOC at 26N with only moderate tendencies to decline (Figure 1).

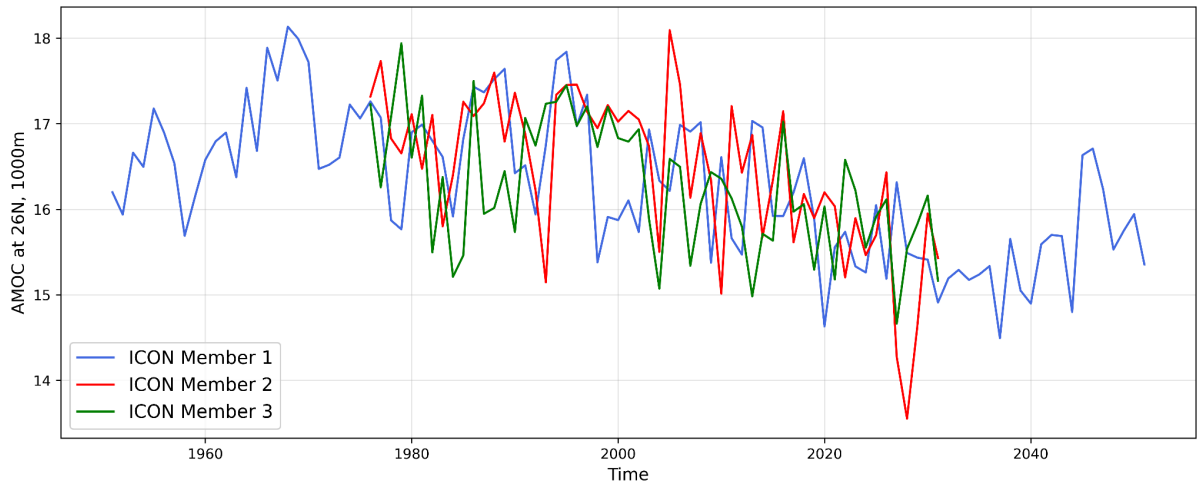


Figure 1: ICON-EERIE phase 2. Evolution of the Atlantic Meridional Overturning Circulation (AMOC) at 26N, 1000m in Sv, time series of annual means of all three three ensemble members.

AWI

In 2026, we completed the IFS-FESOM Phase 2 ensemble with the 9 km atmosphere (TCo1279) and 5 km ocean (NG5) configuration. The two additional members (ens2 and ens3) use the same model version and configuration as the Phase 1 member (ens1). They were started in 1975 from the Phase 1 historical state with a small Gaussian perturbation of the ocean initial conditions, run through the historical period (1975–2014) and continued under SSP2-4.5 forcing until 2050, consistent with the end date of the Phase 1 simulation, so that all three members form a complete set until 2050 for a comprehensive analysis. The control simulation with constant 1950 radiative forcing was completed to its planned length of 101 years.

The Phase 1 scenario simulation (ens1) was further extended under SSP2-4.5 until 2099, beyond the common EERIE target of 2050. The extension keeps the simulation comparable with an end of century simulation from an associated project, and it provides the full SSP2-4.5 pathway needed for the storyline simulations of Destination Earth (DestinE), which AWI has carried out extensively. The extension did not use EERIE computing resources on Levante: it was run on JUWELS within the NIC project ENHANCE, and only its output is hosted on Levante. The simulation follows the observed warming closely over the historical period and reaches about 3 K of global warming by 2084, which makes it a unique km-scale coupled dataset. It has already served several collaborative EERIE activities that required a simulation until the end of the century.

Figure 4 shows the global annual mean 2 m temperature from all simulations together with ERA5. All three members follow the observed warming over the overlapping period, and the control simulation shows minimal drift over its full length.

Because of the reduced allocation on Levante, a large part of the IFS-FESOM simulations was carried out on JUWELS at the Jülich Supercomputing Centre through ENHANCE. Independent of where they were produced, all outputs are hosted and archived on Levante following the EERIE data management approach and are accessible through the EERIE intake catalog. The work carried out on JUWELS will be presented in the proceedings of the 13th NIC Symposium (Jülich, February 2027). The model configuration and the Phase 1 simulations are described in Ghosh et al. (2026, EGUsphere, https://doi.org/10.5194/egusphere-2026-1289), currently under review for GMD.

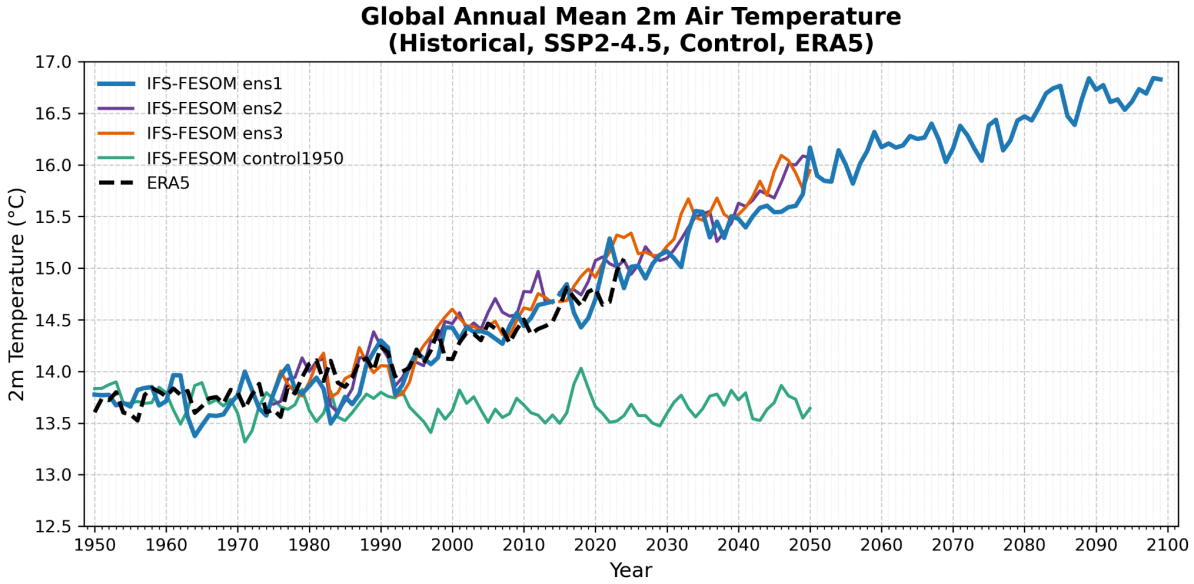


Figure 4: Time series of annual global mean 2 m temperature (°C) in IFS-FESOM (9 km TCo1279 atmosphere, 5 km NG5 ocean): control simulation under constant 1950 radiative forcing (green), the three historical and SSP2-4.5 ensemble members (ens1 1950–2099 in blue; ens2 in purple and ens3 in orange 1975–2050), and ERA5 reanalysis (black).

DKRZ

As EERIE reaches its end, one focus has been on the long-term archiving of secondary products in the World Data Center for Climate. As an example, the experiment climatologies displayed in the EERIE data viewer (García-Díez, 2026) have been standardized and published. Further valuable datasets (eddy statistics) are in the pipeline. A subset of the EERIE ICON output also has been remapped to Healpix and has been published in DKRZ's new data platform 'Waterpark' for increased comparability and from where it will remain available next year.

We successfully applied and further improved the data workflows for the EERIE phase 2 simulations (Fig. X) carried out last year. The datasets are made available to all users through the central EERIE intake catalog. To ensure long-term accessibility and reliability, all datasets have also been, and continue to be, archived to the tape system, which allowed us to free disk space for ongoing simulations. In addition, we regridded all datasets to a regular latitude–longitude grid and kept these regridded versions on Levante's Lustre file system, enabling users to use standard analysis tools designed for regular grids. The total volume of available data exceeds the petabyte scale, underlining that a substantial share of the granted resources is openly accessible to all DKRZ users.

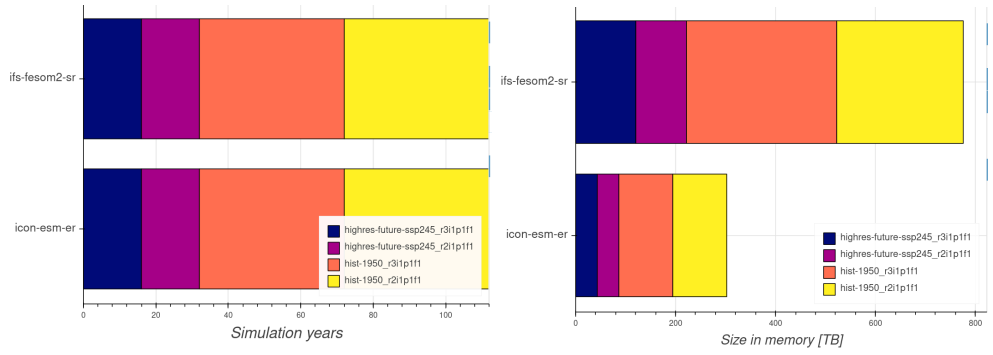


Fig. X: **Phase 2 simulations** - consisting of 2 realizations of a historical (1950) - scenario (ssp 245) mixture experiment from 1975-2030. These sum up to 2 times 100 simulation years or approximately ~1PB of cataloged data. ICON has a share of approximately 300 TB (time slices for 3d and entirely compressed raw output), while IFS-FESOM has a share of approximately 800 TB (compressed and available on both native and regular lat lon grid output).

The regridded datasets are highly valued by the users, as they greatly simplify data handling and intercomparison across models and observations. Therefore, it is crucial to maintain the regridded data on Levante's Lustre file system throughout the duration of the project. In total, this sums up to about 200 TB for both models.

A substantial portion of these regridded datasets has been CMORized and published on the ESGF DKRZ node, ensuring global accessibility and long-term reproducibility. This published data amounts to about 85 TB for IFS-FESOM and 52 TB for ICON, both of which must also be kept on disk to remain accessible. Furthermore, many users have expressed the need to access all regridded model outputs on a single HPC system to simplify the workflow. To meet this demand, it was necessary to transfer roughly 63 TB of data from the ESMs HadGEM and IFS-NEMO.

We created a subproject 1377 and assigned a very small share (~ 2%) of the parent 1344 to it. This subproject is designated for EERIE partner scientists who aim to analyze the data produced in 1344. This separation ensures that only a limited amount of resources can be spent and it helps us to coordinate the system usage, especially for the hackathon activities. The storage space of 1377 is also used by EERIE partners to store additional simulation output important for other work packages.

The eerie.cloud data server provides access to the EERIE data catalog through the standard STAC interface. We have expanded the system to include additional collections, making it part of a larger framework in line with the DKRZ services (https://discover.dkrz.de/?.language=en). With this broader scope, the platform now serves not only the EERIE community but also a wider range of users, showing its interoperability and potential for community-wide data sharing. Additionally, data from eerie.cloud is also made visible and accessible in DKRZ's data infrastructure hub gems.dkrz.de. This shows the well integration of development activities with other major projects around DKRZ.

Reference:

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