Project: **1469**

Project title: **CAP7 -- The German Contribution to the 7th Coupled Model Intercomparison Project (CMIP7)**

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Report period: **2024-11-01 to 2025-10-31**

Maximum of 2 pages including figures. 9 pt minimum font size.

In its first year CAP7 has made good progress with finalizing and configuring the CAP7 models, ICON-XPP, AWI-ESM3, and AWI-CM3. ICON-XPP now simulates much reduced biases versus its performance one year ago (figure 1). The tuning process is not complete, explaining the current usage of most of the allocated CPU resources but hardly any of the allocated storage. The project is on course to meet deadlines imposed by the CMIP7 leadership to contribute simulations to the “FastTrack” set of experiments.

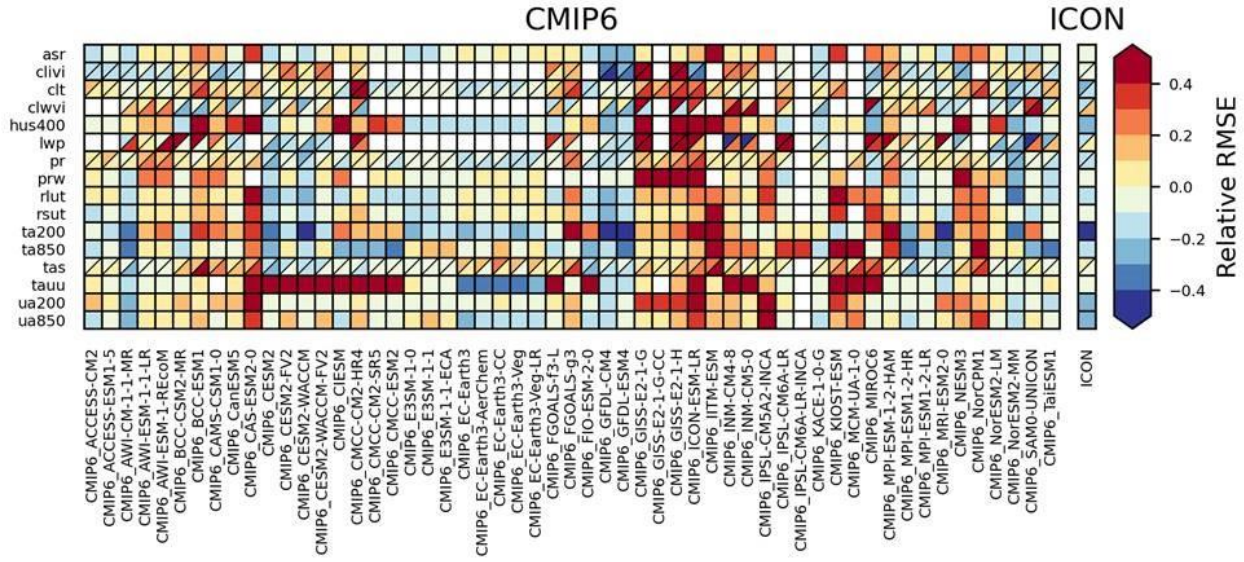

Figure 1: Performance of ICON-XPP for 16 atmospheric metrics versus selected CMIP6 models. Blue means better performance than the CMIP6 median. ICON-XPP (right column) is comparable for these metrics with the best CMIP6 models (GFDL-CM4, NorESM2-MM, AWI-CM1.1)

Specifically, after an imminent code freeze the ICON-XPP code base to be used for CMIP7 will be final. Afterwards final tuning will be applied, including to the land and ocean carbon cycle components, and spin-up preindustrial simulations will be started. Code freeze for AWI-ESM3 will be in December 2025, in line with the code freeze at EC-Earth, where the model (with the exception of the FESOM2 ocean component) is hosted.

The current status is that CAP7 will exhaust the CPU allocation on Levante for 2025 before the end of the year, so will require a moderate top-up. For 2026 the project will switch into production mode, with several production simulations running in parallel. This will produce substantial amounts of data and will also occupy a larger fraction of Levante than was typical for 2025. We request the same resources as noted in the Konsortialprojekt proposal despite some increases in anticipated usage (Table 1; see below). We will schedule concentration-driven experiments to occur before emission-driven ones for ICON-XPP.

Table 1: Summary of requested resources for 2026

CPU hours: 1.242.000

GPU hours: 0

Tape storage: 27 PByte

Disk storage: 7 PByte (25% of tape storage)

We anticipate that during the whole year we will work at the limit of capacity of Levante. Therefore

an even spread of allocated CPU hours across the four quarters might be optimal.

There are three reasons for the increased anticipated usage:

(a) Condensed schedule

We now anticipate that to comply with the CMIP7 schedule, as many production simulations as possible need to be completed in 2026. This means resources originally scheduled to be used in 2027 will now be used in 2026. We do not know which resource limitations we will encounter in 2026, so it is possible that some ensemble members of the ScenarioMIP experiments (or even of the “historical” and “esm-hist” DECK experiments) cannot be completed in 2026. This will be reflected in our resource application for 2027.

(b) Delays versus the condensed schedule of the availability of the land surface module QUINCY

The QUINCY model, at the time of the code freeze of ICON-XPP, has not fully reached maturity because of the condensed CMIP7 schedule. We have therefore decided to proceed with two model variants for ICON-XPP: The no-interactive carbon model (ICON-XPP) uses the JSBACH4 land surface model with some minor adjustments to make it more similar to QUINCY. The interactive-carbon model (ICON-XPP-IC) uses QUINCY, with these simulations starting when QUINCY is ready. Contributing thus these two model variants requires us to duplicate some DECK simulations, increasing the cost. The ScenarioMIP simulations will not be duplicated as they are specifically designed as either concentration- or emission-driven, depending on the scenario.

(c) Several ICON-XPP and all ICON-XPP-IC simulations include the HAMOCC ocean biogeochemistry model. This model is quite computationally intensive, roughly 3-folding the cost versus an ICON-XPP simulation without HAMOCC. This had not been fully factored into the earlier application. We will often operate ICON-XPP with HAMOCC in a diagnostic capacity (i.e. without feeding back to the atmosphere). This is required for calculating carbon fluxes across the ocean-atmosphere interface that will be used to tune HAMOCC.