

Project: **1066**

Project title: **Simulations of the Last Interglacial and of the Mid-Holocene with MPI-ESM and AWI-CM in the framework of the Paleoclimate Model Intercomparison Project, phase 4 (PMIP4)**

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

We report on project progress during the first 10 months of allocation period 2025 in the framework of simulations for the Paleoclimate Model Intercomparison Project, that is related to the Climate Model Intercomparison Project.

The allocation period 2025 has seen major activity in the preparation of the final model version of AWI-ESM3 for AWI's activities within the framework of the CMIP7 Assessment FastTrack. While it had been foreseen that the model would already be available for first simulations and scientific analysis towards CMIP7 and PMIP7, the inclusion of the dynamic vegetation module, upgrades to both atmosphere and ocean components of AWI-ESM3, and related model tuning took most of the time of the allocation period. We also note that provision of the final CMIP7 forcings and boundary conditions has been ongoing for most of 2025, for much longer than expected, and is still not completely finished for all simulations. The piControl forcing data sets, that are of particular relevance to the modelling protocols of PMIP, have been made available on 8th of September 2025, enabling setting up the CMIP7/PMIP7 production version of AWI-ESM3. Our simulation plans were therefore shifted back.

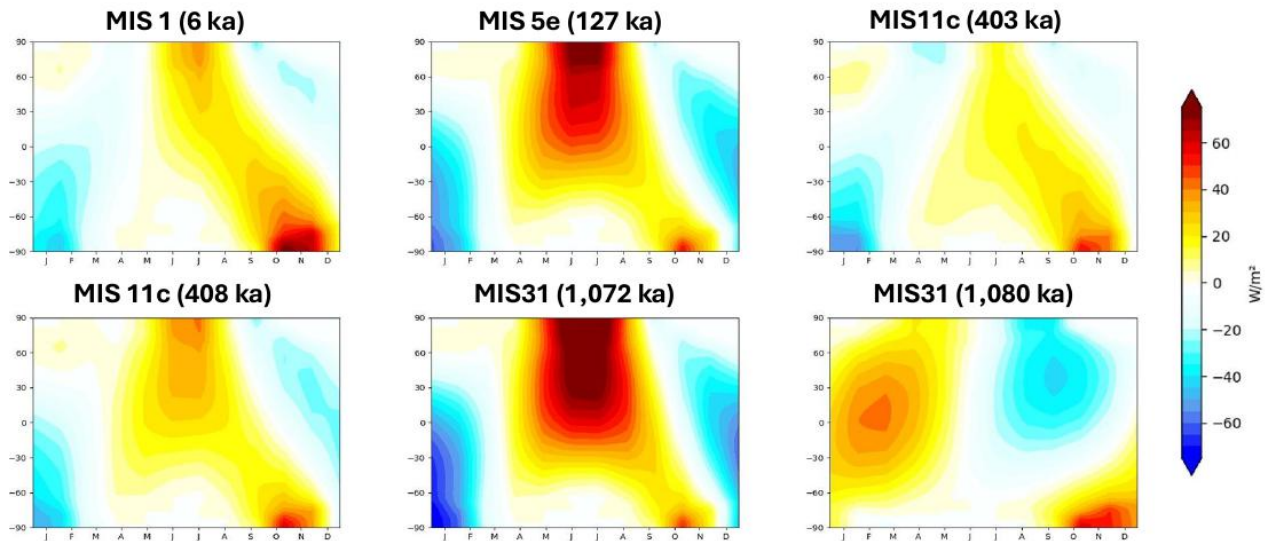


Figure 1: Top of the atmosphere insolation anomaly of six time periods during four different interglacials of the Quaternary with regard to today. Insolation anomaly has been computed following Berger and Loutre (1991) based on the solution of the evolution of Earth's orbital parameters by Laskar et al. (2004). Shown is the anomaly in insolation across time of the year (x-axis) and latitude (y-axis). Mid-Holocene (6 ka) and Last Interglacial are already part of the PMIP4/PMIP7 curriculum. Modelling protocols for MIS11c and MIS31 are currently being refined and will be addressed in upcoming allocation periods.

Consequently, we focused on further refining of modeling protocols that lead to submission for review of the first of them (Sime et al., 2025). Furthermore, we continued analyses of the previously produced simulations towards informing the development of modelling protocols for new time periods, involving MIS31 and MIS11c. For MIS31 we find that the stronger orbital forcing anomaly with respect to today (Fig. 1) leads to an even larger impact on climate in particular at high latitudes of the Northern Hemisphere than the currently strongest insolation forcing employed for Quaternary interglacial time slice simulations in lig127k and abrupt-127k (Fig. 2). This commends further exploration of the MIS31 climate in PMIP. Respective definitions of modelling protocol are underway and will probably lead to additional simulations with AWI-ESM3-LR (possibly also AWI-ESM-HR) in allocation periods after 2026.

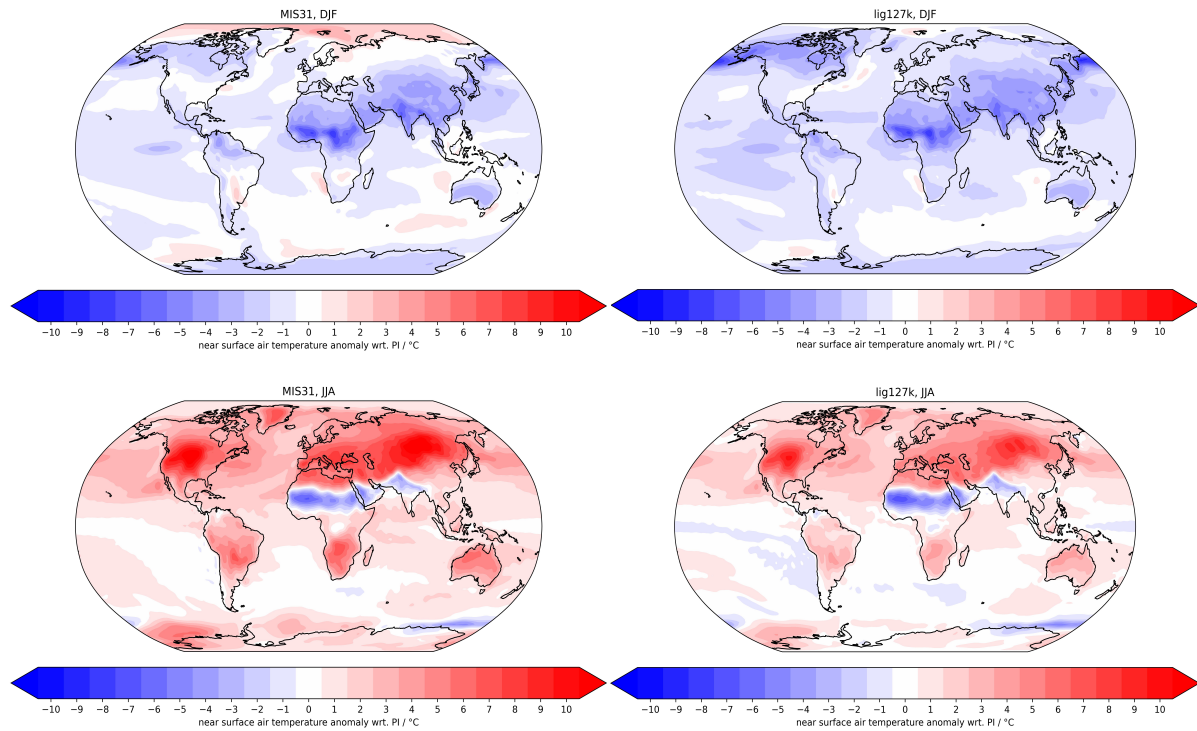


Figure 2: Near surface air temperature anomaly (°C) simulated with AWI-ESM for MIS31 (left) and Last Interglacial (right), for boreal winter (top) and boreal summer (bottom). Spatial patterns of temperature anomalies are similar between MIS31 and Last Interglacial, but much more pronounced in the former as a result of the much higher top of the atmosphere insolation anomaly. The time period of MIS31 therefore suggests itself for further study of processes in a rapidly warming Arctic, which is planned to feature in the scientific work plan of PMIP7.

For 2026 we have completely restructured our modelling approach. The main CMIP7 Assessment FastTrack modelling work is performed by DKRZ project bb1469 (CAP7). Our task in project ba1066 is to support their work by producing the PMIP-sponsored Assessment FastTrack simulation abrupt-127k, that is an important component of the CMIP7 Assessment FastTrack simulations (Dunne et al., 2025) but has not been included into the curriculum of project bb1049. Furthermore, we produce those PMIP7 Tier1 simulations for which modelling protocols already exist towards supporting characterization and evaluation of the model from the viewpoint of paleoclimatology. We benefit from project bb1469 in that we can reuse their piControl spinup and produced data for our own simulation efforts and scientific analysis. As a result, the planned simulation portfolio has been substantially changed from the initial plans for allocation period 2025.

References:

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