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)

We propose to prepare quasi-equilibrium and transient climate simulations in the framework of the Paleoclimate Model Intercomparison Project, phase 4 (PMIP4), that is a major international effort in sampling the uncertainty of climate model simulations and producing a large data set of standardized climate model output. To this end, we will employ the versions of the Alfred Wegener Institute (AWI) Climate Model (ECHAM6.3/FESOM; following named AWI-CM) and the Max Planck Institute (MPI-Met) Earth System Model (MPI-ESM; ECHAM6.3/JSBACH/MPIOM/HAMOCC) that are provided for the sixth iteration of the Coupled Model Intercomparison Project (CMIP6). Our simulations shall support the PMIP4 efforts of the MPI-Met and the Department of Climate Dynamics at AWI, who do not run the full set of simulations proposed for PMIP4. Simulations will be conducted following the PMIP4 protocol (Otto-Bliesner et al., accepted; following referred to as PMIP4 protocol).

In the framework of this project, we propose to create spin-ups, time-slice simulations, sensitivity studies, and a subset of the PMIP4 transient simulations for the Last Interglacial (LIG, 127 ka before present) and the Mid-Holocene (MH, 6 ka before present) with the official CMIP6/PMIP4-versions of the MPI-ESM in low resolution (LR, T63L47/GR15L40), high resolution (HR, T127L47/GR15L40), and of the AWI-CM (ECHAM6.3 T63L40; FESOM L46). In addition, we will prepare two simulations for the early Holocene (9.5 ka and 8.2 ka before present) with the AWI-CM.

Beyond preparation of the climate simulations, analysis of the derived data in the light of climate reconstructions, that are based on proxies from the geologic archive, and comparison of our simulations to those from other PMIP4 models will help us to sample the model-data- and intermodel-uncertainty of the LR- and HR-version of MPI-ESM, as well as of the AWI-CM. This project will provide a unique opportunity to investigate the sensitivity of the models to imposed boundary conditions and climate forcing for two different interglacials. Our simulations will contribute to the derivation of quantitative metrics of the inter-model spread of simulated interglacial climate states.

According to the PMIP4 protocol, the proposed MH, early Holocene, and LIG simulations are to be set up either with a present-day land sea mask, orography, and ocean bathymetry, or only minor changes of the respective boundary conditions shall be considered. This fact allows for ensuring a rapid model set-up and guarantees a low-risk modelling work flow.

The proposed project is of importance for the German climate science community as we will add an additional time slice to the CMIP6/PMIP4 simulations prepared by MPI-Met and AWI at the German Climate Computing Center. To our knowledge, no other climate modelling group considers to provide the proposed climate simulations with the CMIP6 model versions of MPI-ESM-LR, -HR, and AWI-CM to PMIP4. Our work will help to ensure that the repository of CMIP6/PMIP4 simulations of two of the major climate models used at German research institutes is more complete, and that interglacial climate states are strongly represented in the respective simulation ensemble.