Project: **1407**

Project title: **Digital Twin for Paleoclimate**

Principal investigator: **Gerrit Lohmann**

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

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

In the previous reporting period (2024) the model version was successfully tested in the low-resolution configuration (LR) under mid-Holocene boundary conditions. In response to the reviewer's question, we include here Fig. 1, showing close resemblance of these low-resolution simulations to the multi-model mean of the Paleoclimate Modeling Intercomparison Project (PMIP4) with low-latitude cooling and northern hemisphere summer warming in response to orbital forcing differences compared to the pre-industrial period. The application of the same mid-Holocene forcing to the high-resolution (XR) configuration was the focus during the ongoing allocation period (2025). With continuous evaluation, it was possible to run 30 years of simulations so far (as of mid-October; the simulations are being currently continued). Whilst a spinup time of ~50 years is expected to be necessary to limit model drift to reasonable values for surface ocean and atmospheric analyses, preliminary climatology after the 30 years completed so far, shows similar large-scale response as the low-resolution version (Fig. 2). This includes an overall cooling caused by the decreased greenhouse gas concentrations and a shortwave-forced northern hemisphere summer and early autumn warming.

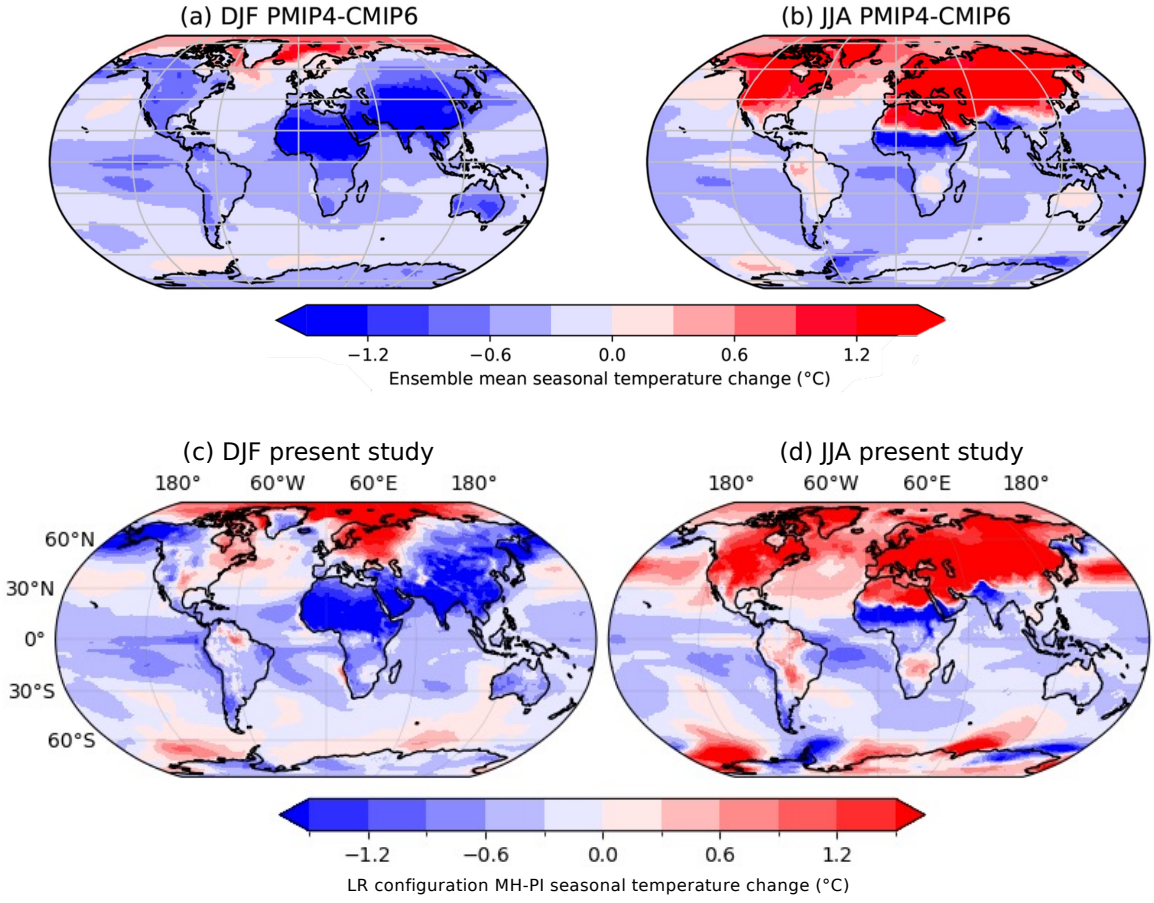

Fig. 1: Comparison of the PMIP4 multi-model mean surface temperature response (top panels, taken from Brierley et al., 2020) with the LR configuration of AWI-CM3 used in this project (bottom panels) for DJF (a, c) and JJA (b, d).

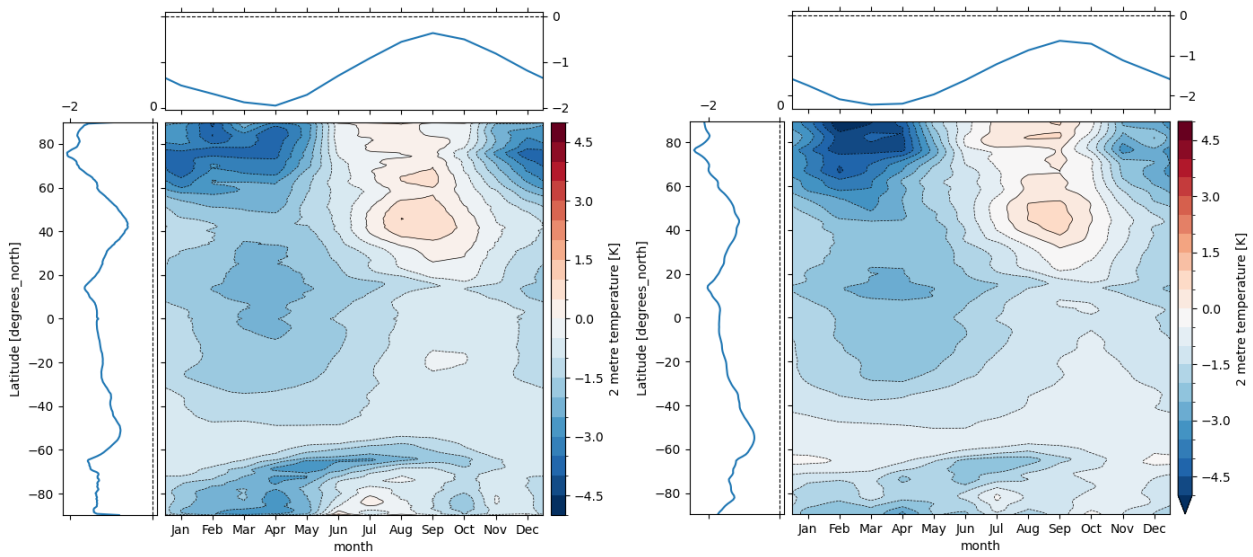

Fig. 2: Comparison of the large-scale response to mid-Holocene forcing between the XR configuration (left panels) and the LR configuration (right panels) as they are employed in this project. The quantity shown in the contour plots is the anomaly with respect to simulated present-day (1985-2014) conditions of zonally averaged 2m air temperature as a function of latitude and calendar-corrected time of year. The top and left line plots show globally averaged and annual means of the anomaly, respectively.

References

Brierley, C.M., Zhao, A., Harrison, S.P., Braconnot, P., Williams, C.J.R., Thornalley, D.J.R., Shi, X., Peterschmitt, J.-Y., Ohgaito, R., Kaufman, D.S., Kageyama, M., Hargreaves, J.C., Erb, M.P., Emile-Geay, J., D'Agostino, R., Chandan, D., Carré, M., Bartlein, P.J., Zheng, W., Zhang, Z., Zhang, Q., Yang, H., Volodin, E.M., Tomas, R.A., Routson, C., Peltier, W.R., Otto-Bliesner, B., Morozova, P.A., McKay, N.P., Lohmann, G., Legrande, A.N., Guo, C., Cao, J., Brady, E., Annan, J.D., Abe-Ouchi, A., 2020. Large-scale features and evaluation of the PMIP4-CMIP6 midHolocene simulations. Climate of the Past 16, 1847–1872. https://doi.org/10.5194/cp-16-1847-2020