**PalMod is the BMBF-funded project** focused on understanding climate system dynamics and variability during the last glacial cycle. Specific topics are: i) to identify and quantify the relative contributions of the fundamental processes which determined the Earth’s climate trajectory and variability during the last glacial cycle, ii) to simulate with comprehensive Earth System Models (ESMs) the climate from the peak of the last interglacial (the Eemian warm period) up to the present, including the changes in the spectrum of variability, and iii) to assess possible future climate trajectories beyond this century during the next millennia with sophisticated ESMs tested in such a way.

The envisioned approach is innovative in three respects. First, the PalMod consortium aims at simulating a full glacial cycle in transient mode and with comprehensive ESMs which allow full interactions between the physical and biogeochemical components of the Earth system, including ice sheets. Second, we shall address climate variability during the last glacial cycle on a large range of time scales, from interannual to multi-millennial, and attempt to quantify the relative contributions of external forcing and processes internal to the Earth system to climate variability at different time scales. Third, in order to achieve a higher level of understanding of natural climate variability at time scales of millennia, its governing processes and implications for the future climate, we bring together three different research communities: the Earth system modeling community, the proxy data community and the computational science community. The research is intended to be conducted over a period of 10 years, but with shorter funding cycles.

Expected major outcomes of the first (4-yr) phase are:
1. Transient simulations of the last termination with ESMs (Palmod 1.1 - 1.3)
2. Transient simulations of biogeochemistry through the last deglaciation using ESMs including dust sources and transport models (PalMod 2.1–2.4)
3. Comprehensive data synthesis of paleoclimatic conditions during the last glacial cycle (PalMod 3.1-3.3)
4. Improved run-time performance of ESMs (PalMod 4.1-4.4)
**Palmod2.2:** The main task of this project is to take care about MPI-ESM simulations of terrestrial processes during deglaciation. The first goal is to simulate vegetation cover dynamics through the deglaciation and to evaluate it against land archives. Because of biophysical feedbacks to climate through heat and moisture fluxes, this work is also an intrinsic part of the physical climate modelling with MPI-ESM (Palmod 1.1). In addition, this sub-project will provide an estimate for the changes in terrestrial carbon storages incl. permafrost carbon and their effect on the atmospheric CO$_2$ concentration. The 2$^{nd}$ goal is to provide an improved module of terrestrial weathering processes, the long-term biogeochemical component, which is missing in the current biogeochemical setup of ESMs.

**Palmod2.3:** This project is focused on interactive simulation of atmospheric CH$_4$ concentration. For this, the models of dynamic wetland extent in MPI-ESMs and EMICs will be tested against present-day observations of wetlands and peatland and applied for the glacial and deglaciation conditions. The module of wetland CH$_4$ emissions will be used to simulate interactive changes in CH$_4$ sources during transient deglaciation simulation, with a particular focus on changes in CH$_4$ emissions during periods of abrupt climate changes. The model of atmospheric chemistry in adaptive mode will be utilized to simulate changes in atmospheric lifetime of methane.