Project: 965
Title: Our way to Europe - Palaeoclimate and Palaeoenvironmental reconstructions
Report for period 01.01.2017-31.12.2017

During the year 2017, different research questions have been addressed by using computing time in the granted project. One peer-reviewed publication in a scientific journals (GRL) was published and another publication is close to submission. Additionally, a collaboration with people from PALMOD was initiated.

a) Impacts of surface boundary conditions on regional climate model simulations of European climate during the Last Glacial Maximum

The influences of North Atlantic sea surface temperatures (SSTs) and vegetation on regional climate simulations over Europe during the Last Glacial Maximum (LGM) was examined with the regional WRF model. Simulated regional temperature and precipitation patterns over Europe are considerably improved when using revised SSTs based on proxy data (WRF-MARGO; MARGO Project Members, 2009). Likewise, the simulated permafrost is more accurately reproduced with the SST modifications. These improvements are partially related to the changed regional atmospheric circulation due to the revised SSTs, leading to colder and drier conditions over Western Europe. Further sensitivity tests with prescribed vegetation for LGM conditions provide evidence of the sensitivity of the simulated glacial climate. This study reveals the importance of considering more realistic SST and vegetation boundary conditions for a more accurate representation of regional climate variability under glacial conditions.

Ludwig, P., J. G. Pinto, C. C. Raible, and Y. Shao (2017), Impacts of surface boundary conditions on regional climate model simulations of European climate during the Last Glacial Maximum, Geophys. Res. Lett., 44, 5086–5095, doi:10.1002/2017GL073622.

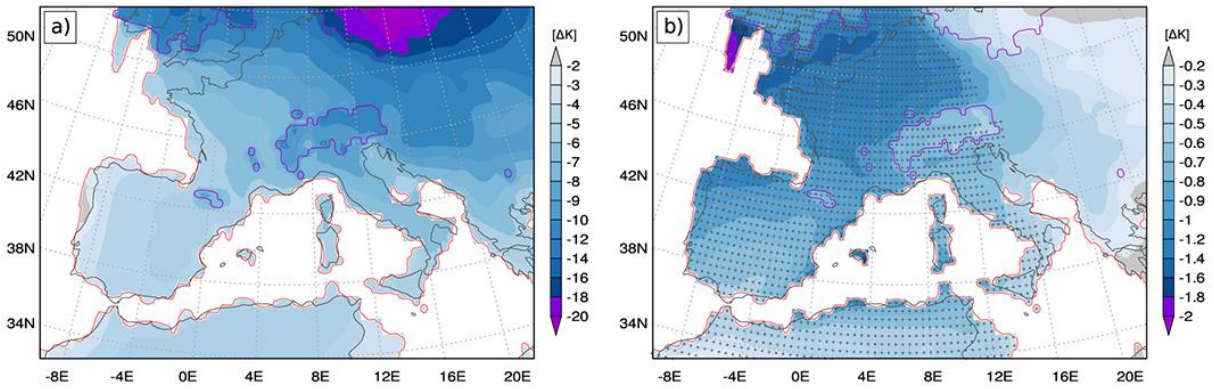

Figure: Results of WRF simulations (a) Temperature difference [K] between WRF-LGM and PI run; (b) Temperature difference [K](significant changes by two-sided Student's t test, 90% confidence interval, indicated by plus symbol) between WRF-MARGO and LGM run (note different color scaling. Grey shades: LGM glacier extend, red line: LGM coastline.

Ref.: MARGO Project Members (2009), Constraints on the magnitude and patterns of ocean cooling at the Last Glacial Maximum, Nat. Geosci., 2, 127–132, doi:10.1038/ngeo411.

b) The Last Glacial Maximum and Heinrich Event I on the Iberian Peninsula

This is ongoing work that already started in 2016. The Last Glacial Maximum (LGM) and the following Heinrich Event 1 (H1) were characterized by very cold and dry conditions over Europe. Thus, this time

period (approx. 23ky – 16ky ago) played an important role for population dynamics at the end of the Pleistocene. In this study we focus on the population dynamics and distribution of settlement areas during LGM and H1 in the Iberian Peninsula (IP). Global paleoclimate model data form the MPI-ESM-P LGM experiment is used as boundary conditions for a dynamical downscaling approach to obtain climate data (30 years of RCM simulations) with a horizontal resolution of 12.5km over the IP. The regional climate modeling approach reveals that changed climate conditions between LGM and H1 might have played a crucial role on the population dynamics in the IP. Modelling results for H1 suggest colder and much drier conditions compared to LGM particularly over southeastern parts of the IP. This leads to an increase of aridity in this region, which corresponds to a decrease of archaeological sites (and thus population density) for the H1 period.

Ludwig, P., Kehl, M., Weniger, G.-C., and Shao, Y.: The Last Glacial Maximum and Heinrich Event I on the Iberian Peninsula: A regional climate modelling study to understand different settlement patterns (in preparation).

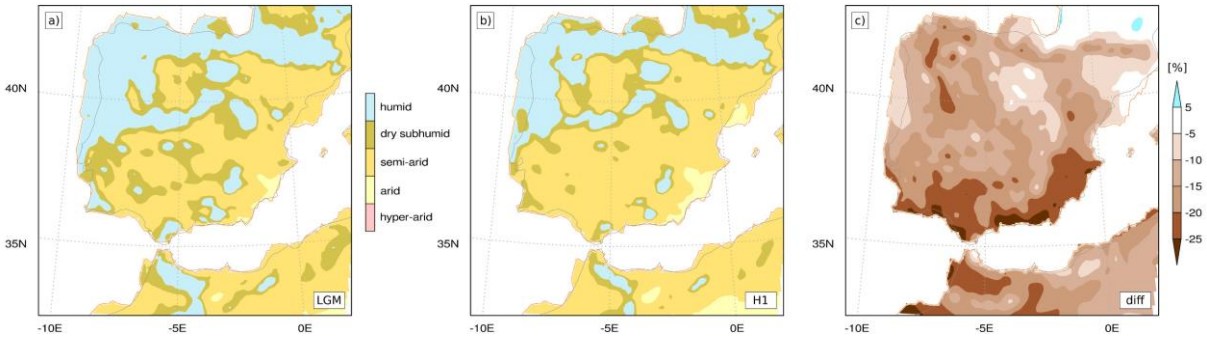

Figure 2. UNEP aridity index for (a)regional climate simulation for LGM and (b)for Heinrich I event. (c)shows the relative change of aridity index, revealing much drier conditions especially over southern parts of the IP.

c) Response of ice-sheet dynamics based on different regional climate model simulations

In cooperation with M. Prange (MARUM, Palmod project WP 1.1), we created a small ensemble of 30-year time slices of LGM-like climate conditions over the Fenno-Scandian ice sheet. The simulations were forced by different boundary conditions and serve as input data for the ice-sheet model at MARUM to evaluate the influence of different climate conditions on ice-sheet dynamics. Results are not yet available but will be addressed in the report next year.