Project: 965
Title: Our way to Europe - Palaeoclimate and Palaeoenvironmental reconstructions
Report for allocation period 01.01.2022-31.12.2022

During the year 2022, different research questions have been addressed by using computing time in the granted project. Several publications (accepted, in review) benefit from resources in project bb0965; additional publications are currently in preparation. Collaborations with people from MPI and AWI as well as external partners (University of Cologne, University Koblenz, University Budapest) are ongoing concerning different aspects of regional paleoclimate simulations.

a) Assessing Climatic Impact on Transition from Neanderthal to Anatomically Modern Human Population on Iberian Peninsula: a Macroscopic Perspective

The Iberian Peninsula is of particular interest for the Neanderthal (NEA) to anatomically modern human (AMH) population transition. The transition took place in the earlier part of the Marine Isotope Stage 3 (60-27~ka BP) as profound climate changes challenged the population stability. We combine climate data based on ***regional climate model simulations*** on *mistral* with archaeological-site data to reconstruct the Human Existence Potential, a measure of the probability of human existence, for both the NEA and AMH populations in the Greenland Interstadial 11-10 (GI11-10) and Stadial 10-9/Heinrich event 4 (GS10-9/HE4) times. We found that during GS10-9/HE4, large parts of the peninsula became unsuitable for NEA human existence and the NEA settlement areas contracted to isolated coastal hot spots. Consequently, the NEA networks became unstable, triggering the final collapse of the population. The AMHs arrived in Iberia in GI10 but were confined to patches in the northern most strip of the peninsula. They were soon facing the much colder climate of GS10-9/HE4, which prevented their further expansion or caused a contraction of their settlement areas. It is unlikely that the NEAs and AMHs coexisted in extensive areas and the AMHs had a significant influence on the demography of the NEAs.

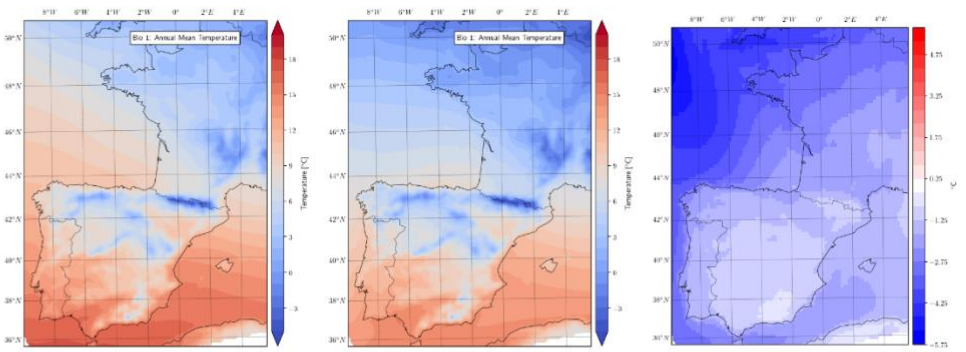

Fig. B3 Annual mean temperature (Bio1). Left, GI11-10; Middle, GS10-9/HE4; Right, GS10-9/HE4-GI11-10

K. Klein, G.-C. Weniger, P. Ludwig, C. Stepanek, X. Zhang, C. Wegener and Y. Shao (2022): Assessing Climatic Impact on Transition from Neanderthal to Anatomically Modern Human Population on Iberian Peninsula: a Macroscopic Perspective. Communications Earth & Environment (in review)

b) Last Glacial Maximum active layer thickness in Western Europe, and the issue of 'tundra gleys' in loess sequences

Late Marine Isotope Stage (MIS) 3 and MIS 2 loess–palaeosol sequences in Western Europe comprise alternating loess layer and 3- to 30-cm-thick bleached soil horizons with Fe–Mn oxide precipitations, which are usually interpreted as waterlogged active layers and referred to as 'tundra gleys'. Active layer thickness data derived from a ***regional climate model simulation*** performed at the DKRZ and the fossils (shells, earthworm granules) found in 'tundra gleys' argue against such an assumption. Most of these horizons better correspond to Fe-depleted, slightly humic topsoil horizons or subsurface eluvial horizons and should be referred to as (incipient) Ag or Eg horizons. They formed during climate ameliorations associated with vegetation (cryptogams, herbs) development, possibly limited by long-lasting snow cover. Strong mixing usually occurred in these horizons due to the activity of anecic earthworms and frost activity.

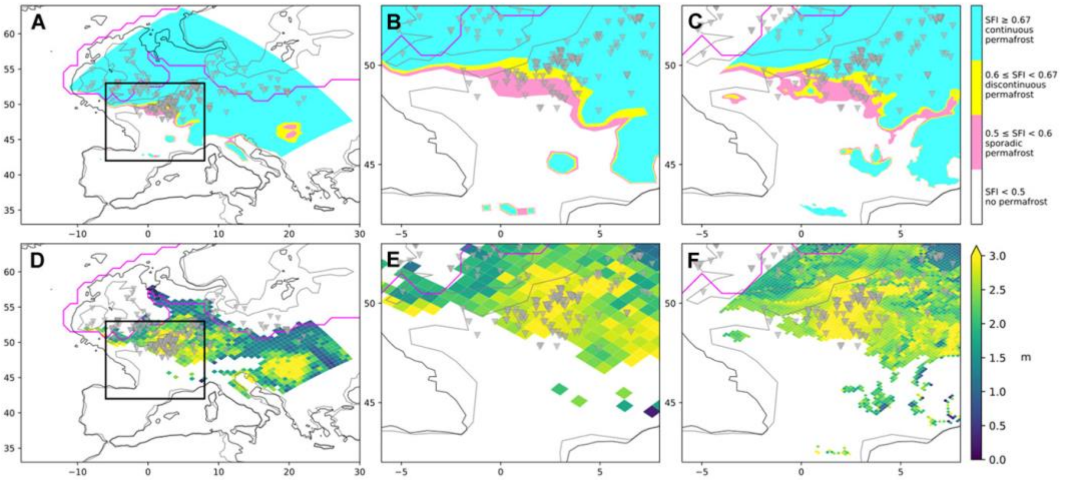

Figure: Permafrost (A–C) and ALT (D–F) distribution derived from the regional WRF simulation with 50-km horizontal resolution (A, B and D, E) and 12.5-km horizontal resolution (C, F). The solid rectangle marks the area of subfigures B, C and E, F. Thick black lines denote the LGM coastline, while pink lines denote the LGM ice sheet. Ice-wedge pseudomorphs from Andrieux et al. (2016) and Isarin et al. (1998) are highlighted with grey triangles

Bertran, P., Stadelmaier, K.H. and Ludwig, P. (2022): Last Glacial Maximum active layer thickness in Western Europe, and the issue of 'tundra gleys' in loess sequences. J. Quaternary Sci. https://doi.org/10.1002/jqs.3434.

c) Atmospheric Circulation during GI-11 and GS-9 over the North Atlantic realm

In this project, we want to investigate the differences of the atmospheric circulation over the North Atlantic during stadial and interstadial conditions analyze the impacts on the climate in Europe by comparing ***regional climate model experiments*** with proxy data (in collaboration with G. Ujvari, Hungary). With this aim, we will downscale coarse (2.5°) global simulations by colleagues from AWI with the WRF model to much higher resolution (~0.8°) over the North-Atlantic realm. This allows for a much better representation of the Laurentide and Scandinavian Ice Sheets, which may significantly alter the atmospheric circulation. However, in the coarse grid AWI simulations, their height and extend is underrepresented and thus their effect on the tropospheric circulation might not be fully captured. First test simulations have been initiated this year; full set of simulations is planned for 2023 (see application for 2023).

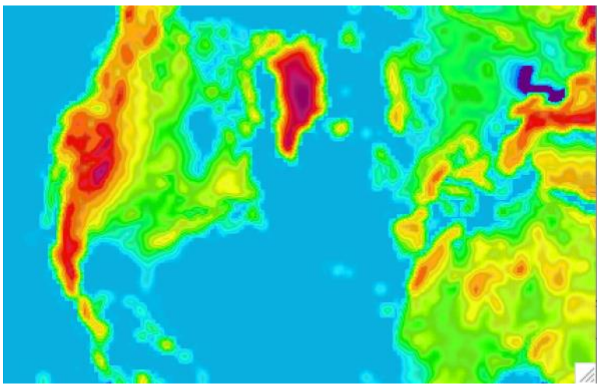

Figure: Prospective simulation domain for GI-11 and GS-9 simulations showing present day topography over the North Atlantic realm.