Mass balance modeling and Pleistocene paleo-climate of the central European uplands

Barbara M. Hauzenberger and Jakob Heyman

Department of Earth and Atmospheric Sciences
Purdue University, West Lafayette, IN

bhauzenb@purdue.edu; heyman@purdue.edu

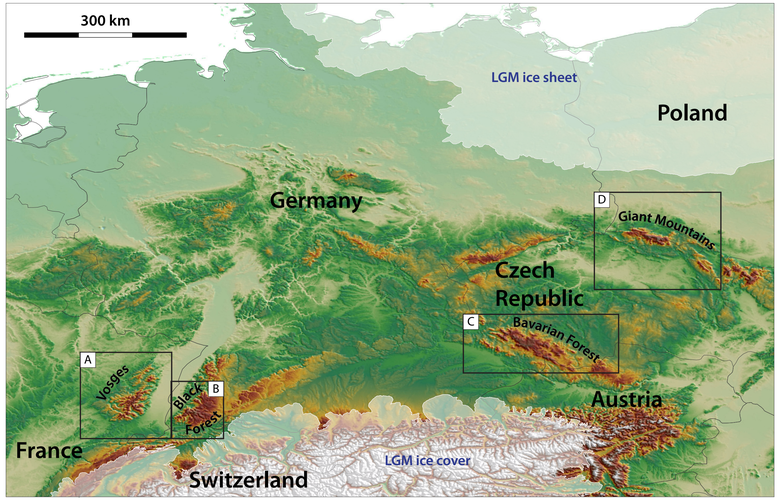

Figure 1: *Map of central Europe with marked model domains. The four study regions are located in between the LGM Fennoscandian ice sheet and the Alps' glaciation (LGM ice cover according to Ehlers and Gibbard 2004).*

INTRODUCTION

During the last glacial maximum (LGM) the highest mountains of the central European uplands were covered by glaciers. Glacier modeling enables constraining the terrestrial climate during the glacial stage. The aim of this study is to quantify changes in temperature and precipitation required to reproduce reconstructed paleo-glaciers for four mountain regions of the central European uplands.

METHODS

We model the mass balance with a positive degree day model (Braithwaite, 2008), using a high resolution (30 seconds; c. 1 km) present-day mean monthly temperature and precipitation dataset (Hijmans et al., 2005). To quantify the climate perturbations required for glaciation, we shift the present-day climate to derive positive mass balance for 50% of reconstructed LGM glaciated area.

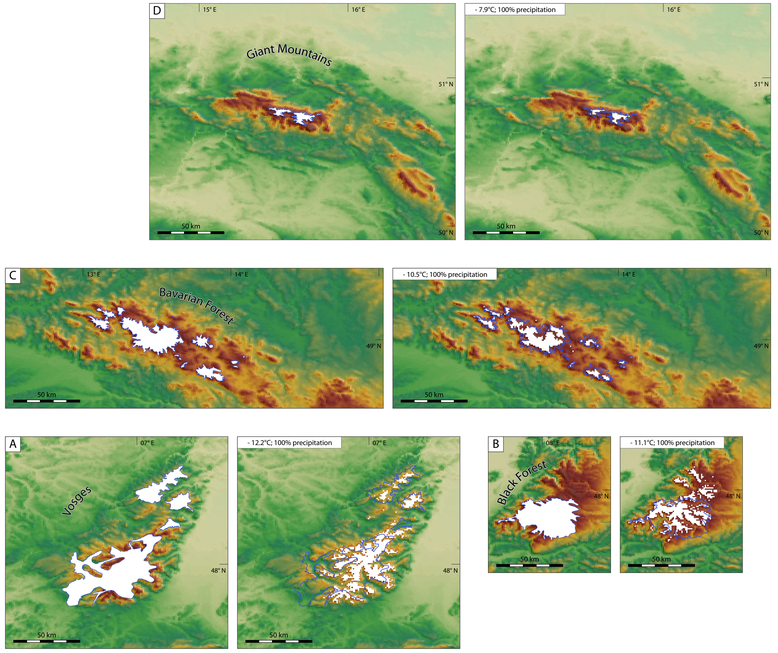

Figure 2: *Reconstructed LGM glacial extent (left) and modeled accumulation area (right) for each of the four domains. D) Giant Mountains: Reconstruction from Partsch (1894); C) Bavarian Forest: Reconstruction from Ergenzinger (1967); A) Vosges:: Reconstruction from Ehlers and Gibbard (2004); B) Black Forest: Reconstruction from Ehlers and Gibbard (2004).*

CONCLUSIONS

Assuming a drier climate by 0–75% during the LGM, the model indicates cooling of 7.9°C to 14.0°C.

The eastern regions require up to 4.5°C less cooling than the western regions to reproduce LGM glaciations; this might indicate a more intense west-east climate gradient during the last glaciation than today.

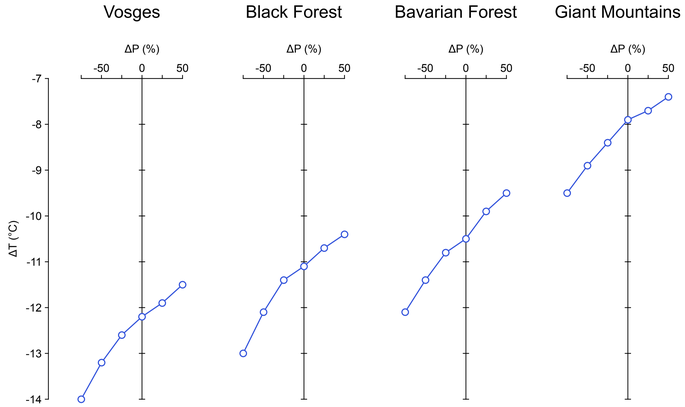

Figure 3: *Individual temperature and precipitation perturbations to meet the target accumulation areas. The temperature perturbations range from -7.4°C to -14°C with more intense cooling required for the western domains.*

REFERENCES

Braithwaite, R.J. 2008: Temperature and precipitation climate at the equilibrium-line altitude of glaciers expressed by the degree-day factor for melting snow. *Journal of Glaciology*, 54, 437-444.

Ehlers, J. and Gibbard, P. 2004. Quaternary Glaciations – Extent and Chronology. Part I: Europe. Elsevier Science.

Ergenzinger, P. 1967: Die eiszeitliche Vergletscherung des Bayerischen Waldes. *Eiszeitalter und Gegenwart*, 18, 152-168.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G., Jarvis, A. 2005: Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25, 1965-1978.

Partsch, J. 1894: Die Vergletscherung des Riesengebirges zur Eiszeit. *Forsch. Deutsch. Landes- und Volkskunde*, VIII/2, 103-194.

PURDUE UNIVERSITY