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Correcting Borehole Temperature Profiles for the Effects of Postglacial Warming: Field Studies in North America and Eurasia

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Though the investigation of observed borehole temperatures has proved to be a valuable tool for the reconstruction of ground surface temperature histories, there are many open questions concerning the significance and accuracy of the reconstructions from these data. In particular, the temperature signal of the warming after the Last glacial Maximum (LGM) is still present in borehole temperature profiles. It also influences the relatively shallow boreholes used in current paleoclimate inversions to estimate temperature changes in the last centuries. This is shown using Monte Carlo experiments on past surface temperature change, using plausible distributions for the most important parameters, i. e., amplitude and timing of the glacial-interglacial transition, the prior average temperature, and petrophysical properties.

It has been argued that the signature of the last glacial-interglacial transition could be responsible for the high amplitudes of millennial temperature reconstructions. However, in shallow boreholes the additional effect of past climate can reasonably approximated by a linear variation of temperature with depth, and thus be accommodated by a 'biased' background heat flow. This is good news for borehole climatology.

A simple correction based on subtracting an appropriate prior surface temperature history shows promising results reducing these errors considerably, in particular with deeper boreholes, where the warming signal in heat flow can no longer be approximated linearly. We will show examples from North America (Canada) and Eurasia (Kola Peninsula), analyzing the effects of using corrected temperatures, and in particular the vertical gradient in a traditional inversion context, and comparing the temperature gradients reduced by the proposed algorithm with the results from numerical climate modeling results as upper boundary conditions.