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Good News for Borehole Climatology

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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 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 climate, but implies that the geological heat flow values have to be interpreted accordingly. Borehole climate reconstructions from these shallow are most probably underestimating past variability due to the diffusive character of the heat conduction process, and the smoothness constraints necessary for obtaining stable solutions of this ill-posed inverse problem.

A simple correction based on subtracting an appropriate prior surface temperature history shows promising results reducing these errors considerably, also with deeper boreholes, where the heat flow signal can not be approximated linearly, and improves the comparisons with AOGCM modeling results.