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Climate from underground temperatures: The Earth's Selective Long-Term Memory

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Borehole temperature data are now routinely used to reconstruct the long-term trends of climate change during the last millennium. Here we show results from our collaborative efforts to reconstruct global and regional ground temperature and heat flux changes that have been carried out recently, as well as some evidence on the nature of long-term coupling between surface air and ground temperatures. We estimate global ground surface temperature increases of approximately 1 c between 1500 and 2000 C.E. with the vast majority of the change occurring after 1900. Furthermore, estimates of the continental heat gain from subsurface temperatures indicate that all continents (except Antarctica, where we do not have data) have gained about 8×10^{21} J in the last 50 years.. This amount of heat is equivalent within error estimates, to the heat gained by the atmosphere during the same time period.

We also show some preliminary results on the comparison of model simulations of the climate for the last millennium and subsurface temperatures for the northern hemisphere. Finally, we speculate on the possible uses of the documented changes in subsurface temperatures and heat storage as validation fields for state-of-the-art general

circulation models.