Geophysical Research Abstracts
Vol. 17, EGU2015-3987, 2015
EGU General Assembly 2015

Ground surface temperature and continental heat gain: Uncertainties from underground.

Hugo Beltrami (1), Gurpreet S. Matharoo (1), and Jason E. Smerdon (2)

(1) Climate & Atmospheric Sciences Institute, St. Francis Xavier University, Antigonish, Canada (hugo@stfx.ca), (2) Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA

Temperature changes at the Earth's surface propagate and are recorded underground as perturbations to the equilibrium thermal regime associated with heat flow from the Earth's interior. Interpretation of these downward propagating subsurface temperature anomalies in terms of surface climate is the central role of Borehole Climatology. Robust determination of the steady-state geothermal regime is nevertheless crucial for these efforts, because it is the reference against which climate induced subsurface temperature anomalies are estimated. Here we examine the effects of data noise on the determination of the subsurface steady-state geothermal regime and the subsequent impact on estimates of ground surface temperature (GST) history and heat gain. We perform sets of Monte Carlo experiments using 1000 Gaussian noise realizations and depth sections of 100 and 200 m as depth intervals for steady-state estimates, as well as a range of data sampling intervals from 10 m to 0.02 m. Results indicate that typical uncertainties for 50-year averages are on the order of +/- 0.02 K for the most recent 100-year period. These uncertainties grow with decreasing sampling interval reaching about +/- 0.1 K for a 10-m sampling interval under identical conditions and target period. Uncertainties increase for progressively older periods, reaching +/- 0.3 K at 500 years before present for a 10-m sampling interval. The uncertainties in reconstructed GST histories for the Northern Hemisphere for the most recent 50-yr period can reach a maximum of +/- 0.5 K in some areas. We suggest that continuous logging should be the preferred approach when measuring geothermal data for climate reconstructions, and that for those using the International Heat Flow Commission database for borehole climatology, the steady-state thermal conditions should be estimated from boreholes as deep as possible and using a large fitting depth range ($\sim$100 m).