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Borehole temperatures and ECHO-g paleoclimatic simulations: developing comparison strategies

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Subsurface temperatures obtained from boreholes yield a direct, diffused record of past temperatures at local scales. When grouped into ensembles, average subsurface temperature profiles provide robust representations of the climate of the last millennium for large regions. Millennial-scale general circulation model (GCM) simulations of past climate now exist, and direct comparison between borehole temperature profiles and forward-modeled GCM paleotemperatures is now a feasible reality. The standard method for comparing two temperature profiles, whether observed or simulated, is by calculating their root mean square (RMS) difference. This comparison weights all depth data equally, even though heat diffuses non-linearly with depth. Here we present two new values to be used as supplemental criteria for comparison: the depth of major temperature trend reversal (τ), and the magnitude of temperature change seen above (since) this trend reversal point (δ). In most of the regions studied, the agreement between borehole data and simulated temperatures from the GCM ECHO-g is strengthened by the inclusion of these new parameters. Since this model-data agreement hinges on the absolute temperature state prior to both run execution and borehole observation, and this temperature state is unknown, the implications of selecting an initial climate reference state (or range of states) are discussed.