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North American climate of the last millennium: Model and observation

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In order to quantify the outcome of possible future climate scenarios, the variability and forcing of past climate must be well understood. Through comparison of state-of-the-art General Circulation Model (GCM) simulations with data such as borehole subsurface thermal profiles, the agreement between reality and surrogate reality can be determined. The boreholes of North America were grouped into eight geographical regions, and their thermal profiles averaged to form robust, representative ensembles. The output from 3 distinct integrations of the GCM ECHO-g (two forced runs and a controlled simulation) were likewise averaged for each region. These 1000-year surrogate realities were then forward-modeled to arrive at the expected subsurface thermal profiles resulting from the climatic trends at the surface. These forward-modeled profiles were then compared with the borehole average thermal profile in each region. In 6 of the 8 regions studied, the forcing runs from ECHO-g are in better agreement with borehole thermal profiles than with the control run. This demonstrates that boreholes are sensitive to external forcing factors, most notably greenhouse gas concentrations, as in ECHO-g. Not only are the ECHO-g simulations in better agreement with borehole data when considering variable external forcing factors, ECHO-g also appears to describe long-term climatic trends at regional scales.