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Ground Heat Flux within the PMIP3/CMIP5 Last Millennium Simulations and Estimates from Geothermal Data

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The proper simulation of the energy partitioning at the surface, both as storage within the ground and energy fluxes from the surface, is crucial for the accurate representation of land-surface processes and related climate feedback mechanisms (e.g. permafrost thaw and soil carbon stability). We analyze the changes in ground heat flux over the last millennium as simulated by the PMIP3/CMIP5 General Circulation Models (GCMs). The following three methods were used to estimate ground heat flux: 1) using the surface energy balance, that is from the difference between net-radiation, latent and sensible heat fluxes, 2) calculations based on Surface Air Temperature (SAT), Surface Temperature (ST) and Ground Surface Temperature at 0.5m and at 1m (GST), and 3) inferences from temperature at two soil depths (GST at 0.5m and GST at 1m). Results show large regional variability among models and methods. Global estimates of ground heat flux from the surface energy balance differ significantly from values obtained from geothermal data over the second half of the last century. Such disagreement may be indicative of a change in the partitioning of the energy within historical simulations of the PMIP3/CMIP5 GCMs. The lack of observational data and the challenges of measuring soil fluxes highlight the value of geothermal database as a potentially valuable source of information for evaluating long-term models performance.