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Global variability of heat storage sensitivity to bottom boundary placement in climate models

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Climate models require the imposition of an appropriately deep bottom boundary condition placement (BBCP) in order for the subsurface to store a realistic quantity of heat. Previous work has shown that a 10m deep BBCP can deprive the subsurface of 4.5 to 5.5 times the heat otherwise stored during a 110-year future climate scenario with a causally detached BBCP. To ascertain the spatial dependence of this phenomenon, future temperature projection from the 1104 non-glaciated land grids of the state-of-the-art general circulation model (GCM) ECHO-g are each used to drive an independent land-surface model (LSM). These future projections were simulated using the guidelines determined by the IPCC SRES A2 and B2 scenarios. In addition to these two surface boundary conditions, two bottom boundary conditions are imposed: a zero-flux condition, and a globally interpolated data set of geothermal fluxes. These 4 permutations of surface and bottom boundary conditions are used to examine subsurface heat discrepancies in climate models under a set of realistic conditions that includes ECHO-g soil moisture data, and latent heat exchanges in areas dominated by seasonal freeze/thaw events and permafrost. Results show a spatial dependence of heat storage on BBCP, and that this dependence may be used to quantify regional climatic effects. These results further underscore the importance of appropriate boundary conditions for producing plausible estimations of past or future climate on a global scale