



Simulated Subsurface Thermal Effects of Deforestation from a Climate Model Experiment.

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Temperature anomalies under the ground provide an integrated low-frequency record of the history of the energy balance and temperature change at the ground surface. A longstanding problem affecting borehole temperature data is related to the subsurface noise of non-climatic origin such as land-use changes. Here we conducted a series of model experiments using a land surface scheme with a 250m deep bottom boundary to explore the effect of deforestation and forest recovery on subsurface temperatures over centennial time scales. Simulated deforestation is imposed globally at 99, 90, 70, and 50% of the grid cell area. We find that the change in subsurface temperature depends on the competing surface energy balance effects of an increase in surface albedo, decrease in surface roughness length, and a decrease in water availability induced by deforestation. The magnitude of the thermal effect due to deforestation is spatially variable. While some areas exhibit subsurface cooling, others can gain energy with subsurface temperatures increasing by as much as 3 K at 23 m depth in the decades following deforestation and forest recovery. We find that subsurface heat flux from deforestation can be of the same order of magnitude as the heat flux estimated from borehole temperature profiles for the second half of the 20th century. Our results suggest that to avoid the uncertainties associated with deforestation and recovery cycle data at these locations should be sampled within the first fifteen years after deforestation.