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The effects of de-reforestation on geothermal data: correction model calibration

D. Nitoiu (1), H. Beltrami (1), J.F. Gonzales-Rouco (2)

(1) Environmental Sciences Research Centre, St. Francis Xavier University, Antigonish, Nova Scotia, Canada, B2G 2W5 (hugo@stfx.ca), (2) Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain.

The borehole method of past climate reconstruction has been widely used to bring new evidence on the magnitude and spread of the last century's continental surface temperature increase and heat gain. Although the Earth's response to the energy transfer at the air-ground interface is related to the surface air temperature (SAT), the ground surface temperature history (GST) obtained from borehole data is an integral of the effects of processes such as vegetation, snow cover, and solar radiation changes at the soil surface. These processes and associated contributions to the variation of the ground surface energy balance are recorded by the ground and appear superimposed on the subsurface signature of climatic changes. One of the most important of these processes is deforestation because it affects the surface and underground temperature field, causing a decoupling of GST from SAT, due to increased solar radiation on the ground surface, and decreased evapotranspiration. The forest floor organic matter layer (FFOML) acts as a thermal insulator and moisture-retaining layer covering the ground. The integrated transient thermal signals caused by the rearrangement of the energy budget at the air-ground interface and by the variation of the FFOML after deforestation are propagated and recorded in the subsurface. The land-use history at the site of each borehole temperature data should be considered as a source of noise, and whenever possible, corrected when including these data in climatological studies. Nitoiu and Beltrami (2005) proposed a one-dimensional model, based on Covington's curve (Covington, 1981) to correct borehole data for deforestation effects. Here we use geothermal data from Weston, Vermont, measured in 1964 and re-logged in 1992, together with SAT data from the closest meteorological station to calibrate the model proposed by Nitoiu and Beltrami (2005). This study shows that deforestation and re-

forestation respectively, have an important influence on the subsurface temperature profile, with the greatest perturbation in the upper 150m, depth range that coincides with the part affected by the last century warming.

Covington, W. W., Changes in the forest floor organic matter and nutrient content following clear cutting in northern hardwoods, Ecology, 62, 41-48, 1981.

Nitoiu, D., and H. Beltrami, Subsurface thermal effects of land use changes, J. Geophys. Res., 110, F01005, doi:10.1029/2004JF000151, 2005.