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# Surface temperature variations and their frequency-dependent subsurface effects on the Romanian territory

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The propagation of the surface thermal signal into the Earth's subsurface is studied at several temporal scales (diurnal, seasonal, inter-annual, decadal, inter-decadal, centennial), using geothermal measurements in selected boreholes and appropriate sets of data provided by the Romanian meteorological and agro-meteorological networks. Conduction models applied to SAT and GST data, checked against measured temperatures in the depth ranges 0-1 m (10 stations) and 80-500 m (7 boreholes) show that: - GST track SAT data at inter-annual scale, the mean difference GST-SAT ranging between 0.5 and 2.0 K; - the effective thermal diffusivity for the first meter of ground shows seasonal variations, induced by non-conductive thermal processes at surface and in the first 20-50 cm of soil. Such processes are important at the daily time scale; - the annual and inter-annual surface thermal variations propagate in the first meter of soil by conduction; however, a variable effective thermal diffusivity 20 cm surficial layer might prove necessary in modeling; - the general trend of the deep subsurface effect of surface temperature variations is controlled by the long-term (centennial) component of the temperature record in a conductive SAT+POM model. Thermal effects of the inter-decadal and decadal surface temperature variations affect the first 30 m of the subsurface, while those of inter-annual and annual variations are visible at depths smaller than 10-15 m. Inversion of measured borehole temperatures supports these conclusions; - temperature in short boreholes ($<$250 m) can constrain only one-step POM. Multi-step pre-observational temperature models for the last few thousands years are necessary to explain available ˜500 m long vertical temperature profiles.