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An assessment of the subsurface thermal diffusion regime at some sites in the Sierra de Guadarrama

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An analysis of the subsurface thermal structure of Sierra de Guadarrama, in central Spain, is provided. The question addressed herein is how the temperature perturbations at the land-atmosphere interface propagate into the subsoil and change with depth. To respond, we analyse subsoil temperature data coming from four monitoring stations belonging to Guadarrama Monitoring Network (GuMNet; https://www.ucm.es/gumnet/), which cover a vertical slope ranging from 900 to 2200 m.a.s.l and a depth profile from ground surface down to 20 m. Time series span from 2015 to 2020, with some missing periods. Thermal diffusivity values are estimated from them under the assumption of heat downward propagation according to the one-dimensional heat conduction model solution, by considering the annual cycle attenuation and phase shift with depth. In addition, the aforementioned estimation is also accomplished from adjusting amplitude attenuation curves between temperature spectra at different depths to the theoretical spectral attenuation solution for one-dimensional heat conduction, which is a negative exponential function of frequency.

Preliminary results show that thermal diffusivity increases with depth at every site. Major changes take place in the soil-bedrock transition, which is found between 5-8 m deep, depending on the site. Some material samples extracted show that bedrock consists mainly of gneiss at three sites, and granite at the other one. Mean values calculated through the whole profiles lie within 1-1.4 10^{-6} m^2/s, which are in the range of diffusivity coefficients of gneiss and granite.