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

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EGU General Assembly 2021

Aim of this work

Studying **subsurface heat propagation** and **thermal structure** at some sites **in Sierra de Guadarrama** (Central Spain). This is achieved assuming surface air temperature (SAT) anomalies penetrate into depth by vertical **heat conduction**:

$$T(z,t) = A_0 e^{-z\sqrt{\pi f/\alpha}} \cdot cos(\phi_0 - z\sqrt{\pi f/\alpha})$$

Database

Subsurface temperatures (ST) coming from **2 m** and **20 m depth boreholes** (sensors embedded in a casing), and a **1 m depth trench** (sensors buried) at **6 sites**.

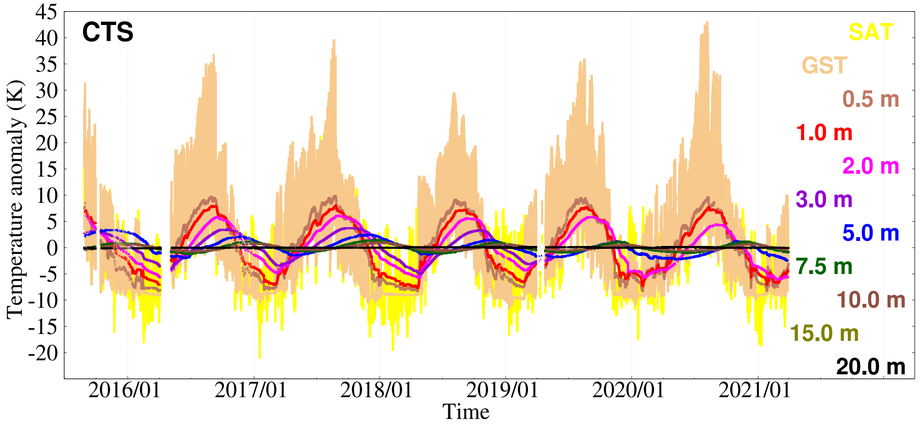
Methods

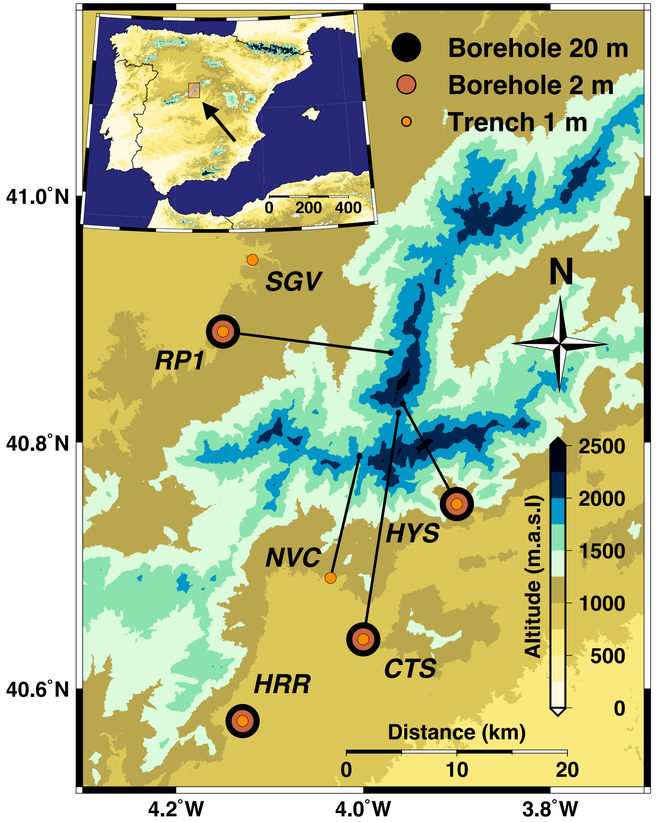
Thermal diffusivity (α) is retrieved by:

1) Assessing **amplitude exponential attenuation** and phase shift of the annual wave with depth (classical approach).

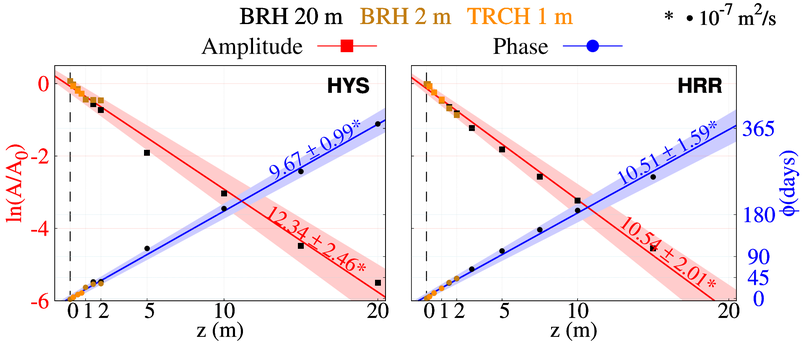
2) **Attenuation curves** of spectra at different time resolutions.

SAT & 10 ST time series at CTS

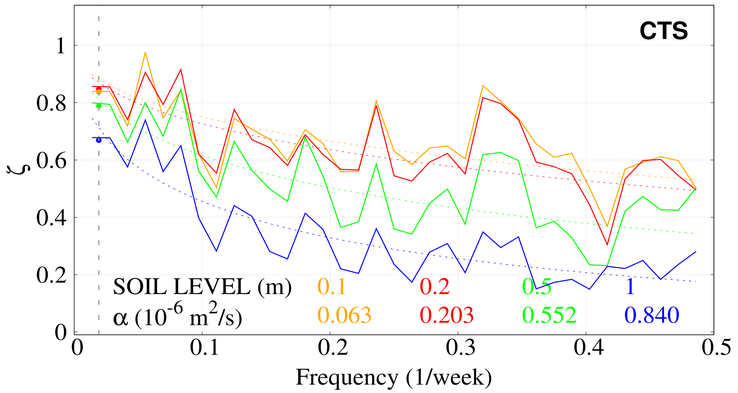




Classical method: amplitude logarithm vs. phase shift with depth



Spectral method: attenuation curves and exponential best fit



This work makes use of **GuMNet** database Vegas et al. (2020) Published in ***Atmosphere***

Conclusions

1) Effective thermal diffusivity is strongly determined by the **composition** of the subsurface layer. Major changes occur mostly at **soil-bedrock transition**, at 5-8 m depending on the site.

2) **Diffusivity increases** with depth at every site. This result is backed up by the two methods.

3) New **spectral approach** permits exploring **diffusivity changes in intra-annual scales**. These changes are expected to be **related to changes in soil moisture**.

Related works: EGU21-6358, EGU21-7457, and EGU21-10351