Relationship between groundwater microtemperature and electrical potential of the vegetation

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INTRODUCTION

It's known that the variation of the temperature of the groundwater at depths of up to 30 meters suffers daily and seasonal interference from the variation of the surface temperature. Beyond this depth thermal impact is very small. However, groundwater microtemperature is clearly affected by vegetation activities. The periodic variation in plant electrical potential has been evidenced in other studies. Atmospheric electricity has long been studied and exhibits seasonal variation. While land and ocean tides are gravitationally controlled, atmospheric tides are mainly thermally controlled.

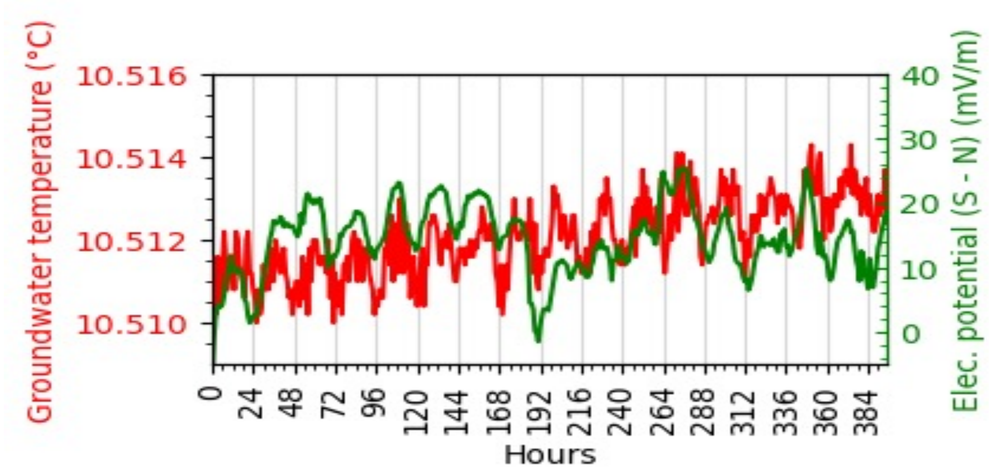

Figure 1 *Relation between groundwater microtemperature and electrical potential difference (S-N).*

METHODOLOGY

For the measurement of the groundwater temperature a high-precision thermometer with a resolution of 0.0002 degrees (www.geotec-instruments.com) was used. The flow of ions within the xylem creates an electrical potential which is measured in a tree of the *Prunus avium* species. The equipment used was LogBox ecoV, from the same company. Two pairs of platinum electrodes were placed in the north and south directions at the stem of the tree. The vertical distance between the pairs is approximately one meter, following the protocol of [1]. In addition to the north and south electrical potentials, measurements of relative humidity, as well as air temperature and pressure near to the electrodes were performed. From the monitoring results, frequency analyses were performed in python software.

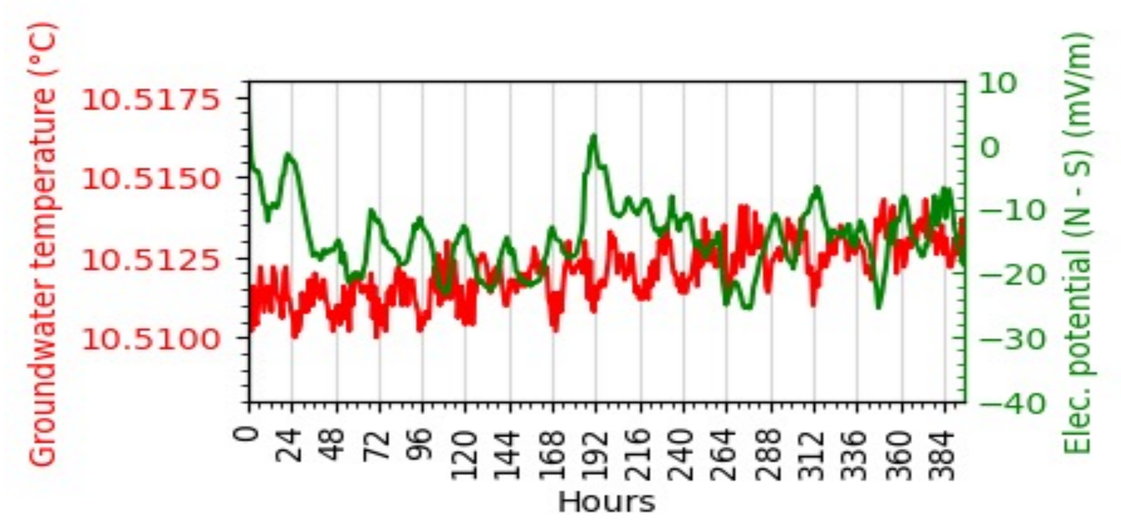

Figure 2 *Relation between groundwater microtemperature and electrical potential difference (N-S).*

RESULTS AND DISCUSSION

Data for groundwater microtemperature as well as the electrical potential are presented in ***Figure 1 and 2***. To eliminate the effect of atmospheric tides, the electrical potential was presented as the subtraction of the north and south potentials. Previous results already indicates a strong relationship with the growing season of the plants [2,3]. In the present data we observe the same relationship during summer. It was also observed that the increase of the electrical potential in plants occurs with increasing surface temperature and decreasing relative humidity. Atmospheric humidity regulates the loss of water from vegetation through transpiration and opening/closing of stomata.

For more detailed comparison, a frequency analysis was performed (***Figure 3***). In general, a diurnal frequency (24 hours) of different magnitude is observed for all parameters. This frequency is directly related to solar radiation. Lower frequencies with larger amplitudes were observed in the results for southern electrical potential and groundwater temperature. These frequencies represent possibly changes in the macro weather situation.

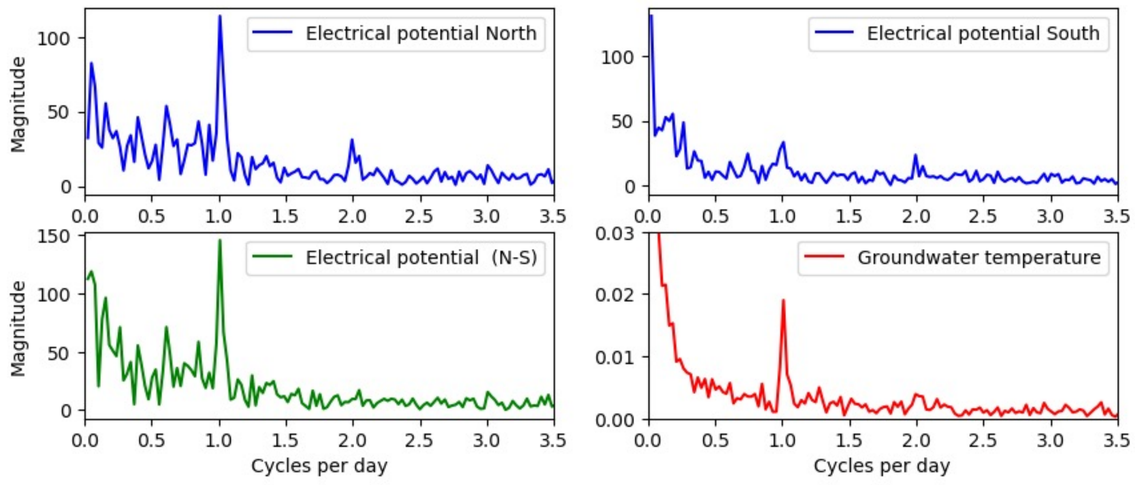

Figure 3 *Frequency analysis of the electrical potential (North, South, and (N-S)) and groundwater microtemperature.*

When it is observed the frequency analysis of the north and south electrical potentials (***Figure 3***), we note a half diurnal frequency (12 hours) and a weak 8-hour amplitude. This frequency is eliminated from the electrical potential with the subtraction of one by the other (***Figure 3***), which means it is originated in the atmosphere.

In our study a half diurnal frequency (12 hours) and a weak 8-hour amplitude were observed in the results of the frequency analysis of the north and south electrical potentials (***Figure 3***). As suggested by [4], they correspond to the atmospheric electricity.

The comparison of the northern and southern electrical potential results with those of groundwater microtemperature (***Figure 4 and 5***), shows that there is a clear relationship between both parameters. The southern electrical potential has, how

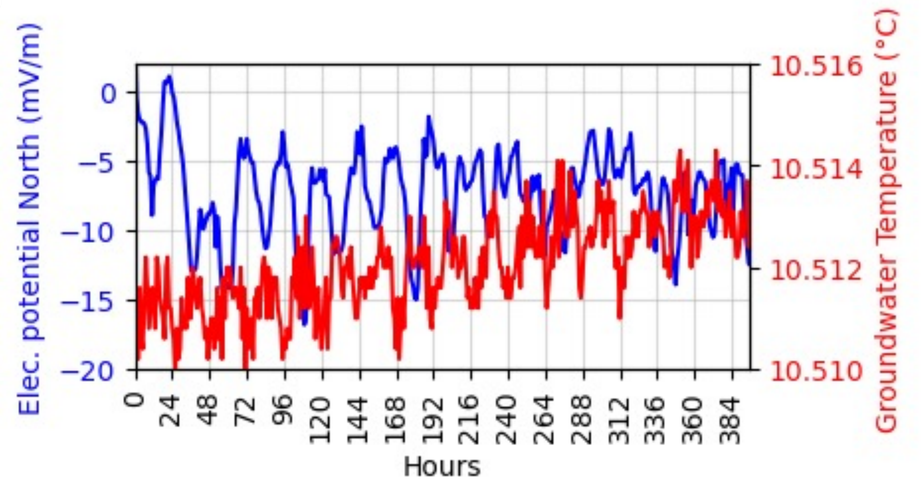

Figure 4 *Relation between groundwater microtemperature and electrical potential North*

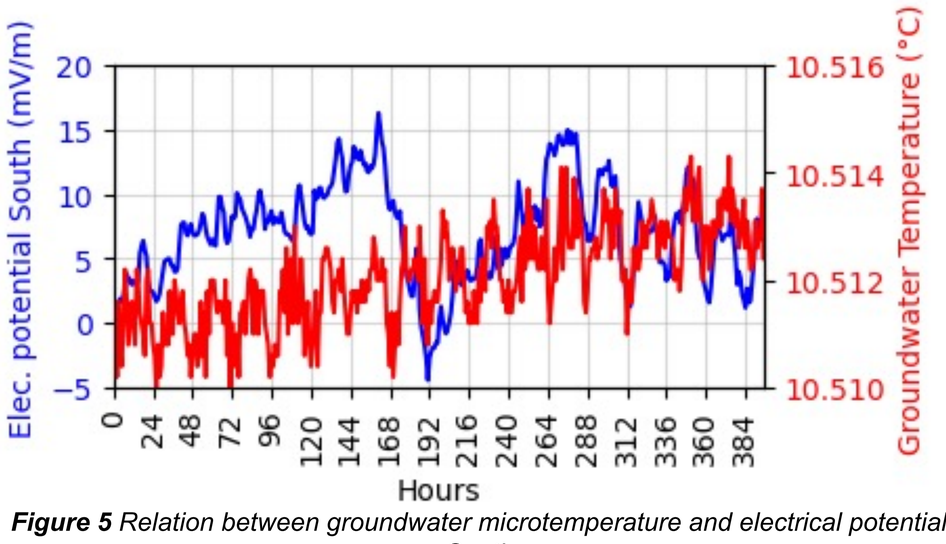

Figure 5 *Relation between groundwater microtemperature and electrical potential South*

CONCLUSION

Understanding the relationships within nature is essential for a sustainable use of soil and water resources. Transpiration from vegetation plays a crucial role in these dynamics by being the connection point between the soil and the atmosphere. As shown, tides, i.e. earth tides and atmospheric tides, affect the growing cycle of trees, and therefore the hydrological cycle. And progress in the resolution of physical properties now allows us to monitor this interaction.

ACKNOWLEDGEMENT

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