WATER AND SOIL TEMPERATURE INVESTIGATION - DISCOVERS RELIABLE CONNECTION

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ABSTRACT

This project investigated **whether water affects**: the oscillations of soil temperature and surface temperature of the surrounding soil; **temperatures of soil at different depths depending on the season**; correlation between air temperature and soil surface temperature in the autumn period. We confirmed that water affects the oscillation of soil temperature; the temperature in autumn is higher at greater depths, opposite in winter; the proximity of the lake affects the surface temperature of the soil. We also confirmed that the surface soil temperature is higher than the air temperature in the autumn, but we did not confirm the opposite in the winter.

REASEARCH QUESTIONS:

RQ 1. Does water in the soil affect soil temperature oscillations?
RQ 2. Is there a difference in soil temperature at depths of 5, 10 and 20 cm depending on the season?
RQ 3. Does the proximity of the lake affect the surface temperature of the surrounding soil?
RQ 4. What is the correlation between air temperature and soil surface temperature in the autumn period?

INTRODUCTION

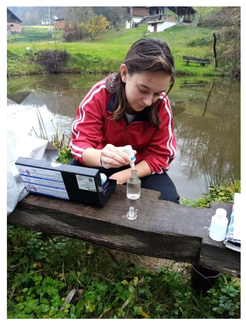
While studying our previous projects we discovered the subject of research often was water. Therefore, we studied protocols in hydrology, our database as well as the GLOBE's and DHMZ's.
We also learned almost every project was related to human health. Human body is like Earth, mostly fluids. From former projects we discover the intention to remove water bodies from urban areas. But, Microcosmos has to be self-sustaining in order for life as a whole to be sustainable. Therefore, we believe that every natural habitat should be preserved because it serves the whole system of life. We decided to investigate the relationship between water and soil temperature.

RESEARCH METHODS

Planning Investigations and Carrying Out Investigations

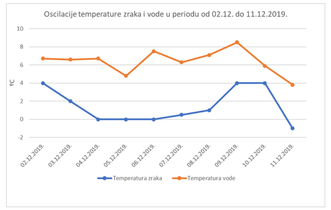
In our work, we used varoius GLOBE protocols (Rivers and Lakes Protocol Bundle, Relative Humidity; Soil bundle Atmospheric Protocols: air temperature + Pedosphere Protocols: soil temperature; The Urban Bundle Protocol: Pedosphere) for measuring water, air, soil temperature at depths of 5, 10 and 20 cm and surface temperature. We also used DHMZ data for Maksimir station. DHMZ - Maksimir station, unlike our station by the lake, is not located in the immediate vicinity of the water body, so it serves as a station for comparing data.
Measuring stations along the natural lake are located in Veliko Trgovišće, Hrvatsko Zagorje, 45.9868 N and 15.8329 E at 160 m altitude (Google Earth). MUC Descrption is Cultivated Land around the lake, but near the lake is Woodlenad, Mainly Deciduous.

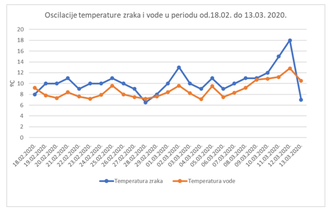
The climatic area of this area according to Koeppen is characterized as“ Cfb moderately warm humid climate with warm summers“2. Maksimir station is in the eastern part of Zagreb, 45.8211 N and 16.0334 E at 130 m altitude (Google Earth) and this area is climatically characterized the same as the area of Veliki Trgovišće. We collected data in 2 periods, in the autumn from 2.12. to 11.12.2029. (10 days) and winter from 18.02. to 13.03.2020. (24 days). Measurement was performed once a day between 16.00 and 17.00 p.m.



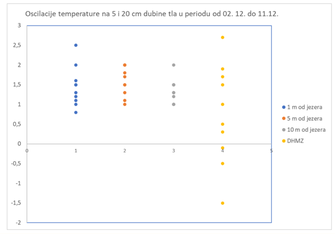
Results

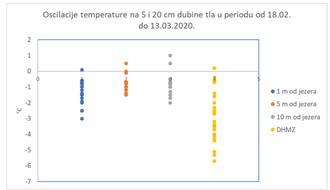
Comparing the relationship between water temperature and air temperature in Figures 1 and 2, it can be seen how slowly the water temperature changes even when there are large differences in air temperature from day to day in both measurement periods.



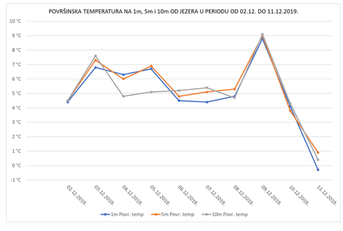


The charts below show the oscillations in the soil temperature and how it varies the most at the DHMZ - Maksimir station, which has no water surface near it. Some colors indicate the distance of our stations from the lake.





We confirmed that the proximity of the lake affects the surface temperature of the soil, ie the surface temperature of the soil is lower at the station closer to the lake in autumn and higher in winter compared to the values in those periods measured on other stations further away from the water



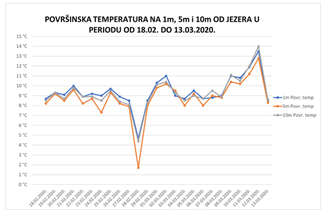
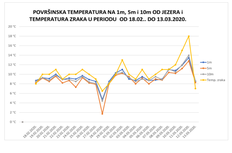


Figure shows that the values of soil surface temperature are lower than the values of air temperature in winter.



Discussion - Interpreting Data

We must note that in the winter we had a longer continuous measurement period, 24 days. The autumn period was shorter for us, 10 days. This was our first period after which we concluded that we needed to increase the number of days we would measure for the data to be relevant to us. This is one of the methodological limitations that we did not anticipate. We predicted that we would lack the surface temperature at the Maksimir station, which is not measured there, and data on relative soil moisture, which we are not able to perform due to the complexity of the measurement procedure. In addition to these limitations, which we were aware of at the beginning of the work, our research, ie data collection (spring measurement period), was interrupted by an epidemic that caused school closures and made it difficult for live teamwork in the field. All our activities continued by holding meetings online and trying to compare the individual results of each team member (3). We communicated with the mentors in the same way. We also recorded video clips from the field individually, so we compared them, and then exchanged our ideas at video meetings and thus came to common conclusions.We also discovered that our GLOBE teamwork is good for mental health. Our daily contact with our mentors helped us through the social isolation. They also encourage us to make some additional efforts in other directions.

Conclusions

With H 1 For both measurement periods, it is evident how much slower the water temperature changes even when there are large differences in air temperature from day to day, which is the effect of high specific water capacity. We also proved using the difference in soil temperature at 5 and 20 cm for each day that there are less oscillations of soil temperature near the water than at the station DHMZ - Maksimir, which has no water surface.
H 2 and H 3. We confirmed that in the autumn part of the year at the greatest soil depth (20 cm) the values of soil temperature at our station and at the DHMZ - Maksimir station will be higher than at smaller soil depths (5 cm and 10 cm). In the winter part of the value of soil temperature at the maximum soil depth of 20 cm lower than the value of soil temperature at 10 cm and 5 cm at both stations.
H 4 we confirmed because in the autumn period the surface temperature values are higher than the air temperature values while in the winter period the air temperature values are higher than the surface surface temperature values. We expected this result due to the difference in the amount of water in the soil and air that affects their temperature. Because the soil has more water than air, it cools more slowly in autumn, but also heats more slowly in winter.

GLOBE BADGES

1. Be a Collaborator
All team members are listed along with clearly defined roles, how these roles support one another, and descriptions of each student’s contribution. The descriptions clearly indicate the advantages of the collaboration.
2. Be a Data Scientist
The report includes in-depth analysis of students’ own data as well as other data sources. Students discuss limitations of these data, make inferences about past, present, or future events, or use data to answer questions or solve problems in the represented system. Consider data from other schools or data available from other databases.
3. Be a STEM Professional
The report clearly describes collaboration with a STEM professional that enhanced the research methods, contributed to improved precision, and supported more sophisticated analyses and interpretations of results.

Bibliography

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3 - Šporer Z. , Kuntarić A., (1986) Repetitorij fizike, Šk.knjiga, Zagreb
DHMZ (Croatian Meteorological and Hydrological National Service) website and data base -2 https://meteo.hr/podaci.php?section=podaci_agro&param=agro_tz&el=saznajte_vise#sec1(23.02. 2021.)
Rivers and Lakes Protocol Bundle
The Urban Bundle Protocol
Soil Bundle
GLOBE review
http://www.ss-medicinske-vrapce-zg.skole.hr/izvannastavne_izvanucionicne_izvanskolske_aktivnosti/globe/globe-vremeplov.pdf
Educational video about water measurment (student Petra Marec)
https://drive.google.com/file/d/13V9t0E7bt7FvvmArimpyGMAm9mTo845B/view?usp=sharing
Promotional video „Why am I in GLOBE program?“ (student Gabrijela Ambriš)
Euroasia Regioal Meeting, October, 2020.
https://drive.google.com/file/d/1V7fMKmOkwmbh5AR4YVPAriNqxsb9NdA4/view?usp=sharing