SOIL PROJECT

December ‘23 / January ‘24

Title

Can Changes in Soil Temperature Indicate Variations in Soil Weight?

Organization: Laura Vicuna School
Students: Eco-Schools/GLOBE Members
Mentors; Miriam Grech, Mariella Camilleri & Francesca Scerri
Report Type: International Virtual Science Symposium Report
Protocols: Pedosphere
Optional Badges: I make an impact, I am a data scientist, I am storyteller
Ages: 6 – 10 years

Summary

Laura Vicuna School is a small school located in the middle of Ghasri Square. We're lucky to be surrounded by green areas and fresh air. We have a couple of green areas also at school.

Fig 1. *The School located at Ghasri Square*

We've been implementing The GLOBE Programme for the past three years and the interest, knowledge and hands-on approach was appreciated by learners and educators alike. This investigation was part of the GLOBE Malta Europe Direct Soil Project for the scholastic year 2023 – 2024. We decided to take a closer look at the soil areas surrounded the school. We selected a patch of soil which is located in our front area of the school and which is not obstructed by any buildings.

Research Question

Through this investigation the students wanted to answer the following questions:

- How does the soil temperature change with the air temperature?
- Does the soil temperature affect the moisture content?
- Is there a relationship between soil temperature and weight?

The project was divided on two areas:

- Daily reading of soil temperature was taken with Infrared Thermometer and together with the Air Temperature, they were inputted in the GLOBE Programme Database.
- A sample was collected at the beginning of the week. The sample was weighed and recorded. Then the sample was left in a sunny area to dry. After a week, the sample is weighed again. One can work out how much moisture was in the soil sample. All the data was also inputted in the GLOBE Programme Database.

The data was collected during the months of November '23, December '23 and January '24.

Soil temperature directly affects air temperature.
Soil temperature can affect air temperature in a few ways. First is the transfer of heat via conduction. Warm air can warm the soil it touches and warm soil can heat the air that is in contact with it.
A greater impact is the transfer of latent heat from soil to air. Water in the soil can be heated by the temperature from the soil. This water can then evaporate, taking the heat energy it received from the soil with it as it rises into the atmosphere. When that water vapor cools, it releases the latent heat stored in it, into the atmosphere as sensible heat.

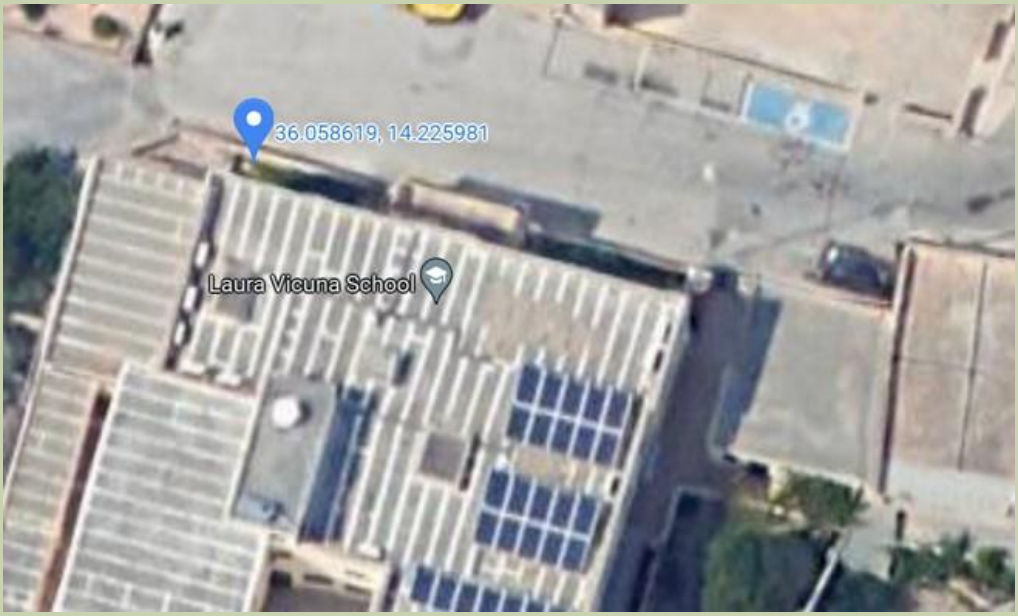


Fig 2. An aerial view of the school and the blue pin points to the area of soil observed

Part 1 of the Investigation: Soil Temperature & Air Temperature

GLOBE students took turns to take the readings of the surface temperature (5cm) and the air temperature was searched online on Maltese Weather Forecast websites.

Fig 3. A young student taking a soil reading using the Infrared Thermometer

In all 46 different entries were logged in the GLOBE Database. Each entry consisted of the surface temperature and the air temperature.

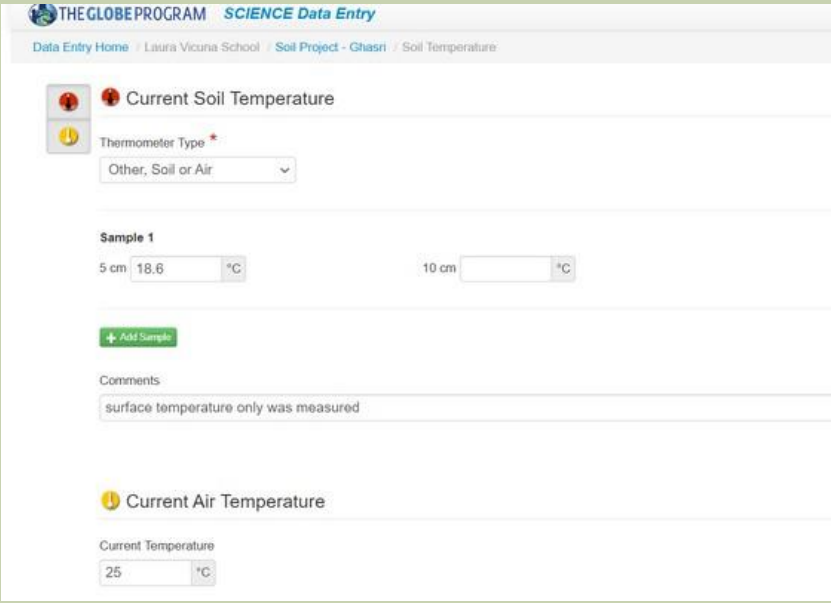
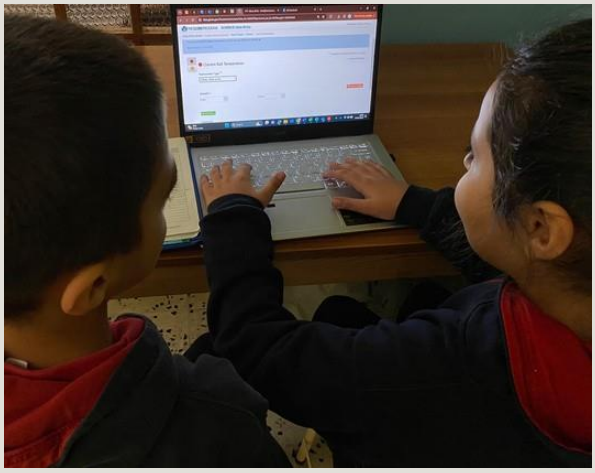


Fig *3. A Sample taken from the Globe Database*



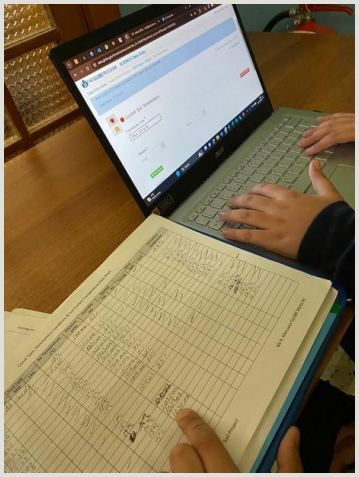


Fig *4. Older Members of EkoSkola inputted the data on the Globe Database*

Once all the data was collected, the average value for the temperatures of each day was used for comparison reasons. The screenshots below show data uploaded on GLOBE website during observation period.

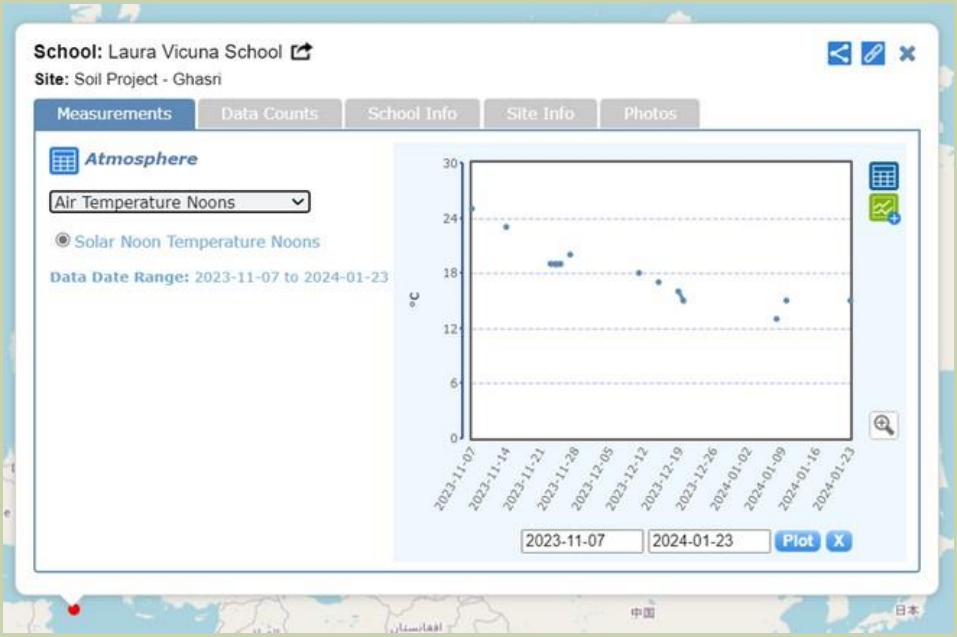


Fig 5. *Air Temperature Noons plot of VIZ GLOBE*

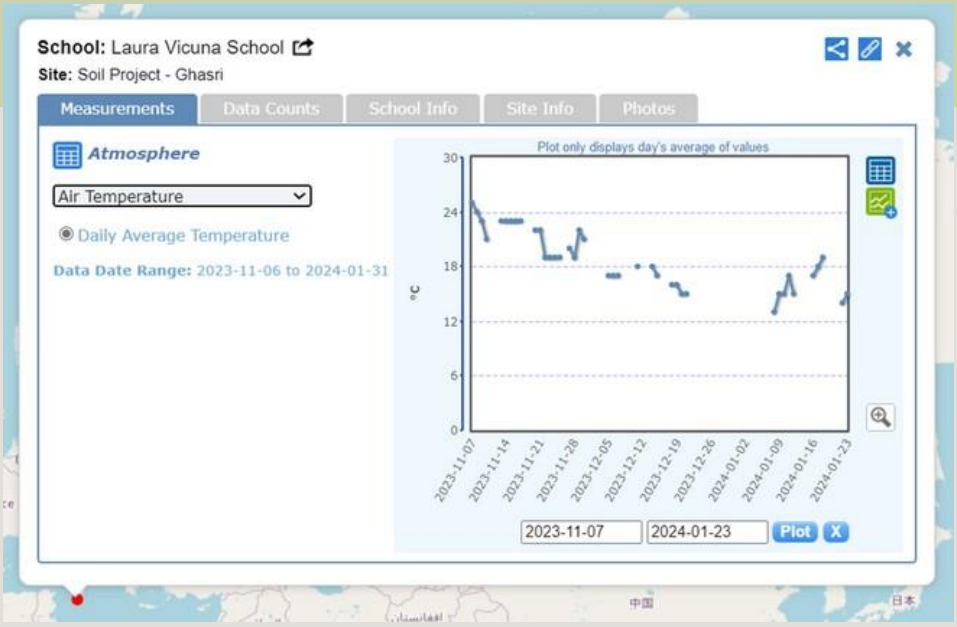


Fig 6 *Air Temperature plot of VIZ GLOBE.*

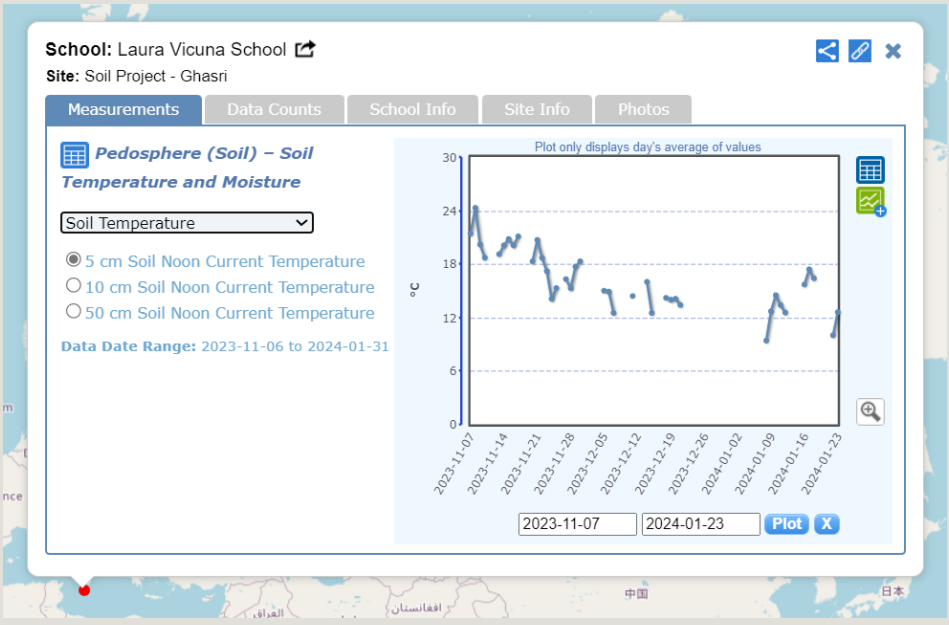


Fig 7 Figure *Soil Temperature plot of VIZ GLOBE*

It was noted that in one day in November, the weather was still warm and the soil was warm too but cooler than the air. For example: if the air temperature was around 25 degrees Celsius, thesoil temperature was 18 degrees Celsius. A few days later, we hadthe first rains of the season. The air was cooler and the soil got wet. For example: the air temperature in December was 17 degrees Celsius and the soil was about 14 degrees Celsius. We can observe that in November there was a difference of 7 degrees Celsius and inthe December when the air is cooler, the difference between the air temperature and soil temperature is only 3 degrees.

Part 2 of the investigation: Soil Moisture

GLOBE students took a sample of around 100 grams of soil every Monday throughout the observation period. Then the soil was spread out evenly in a container and putin a sunny place. The following week, the container sample was weighed again and the difference between the wet and dry soil canbe calculated. On the same day, a new sample of soil was collected and to be re-analyzed the week after.

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Fig 8. EkoSkola Members collecting soil samples for weighing

Results & Analysis

In all, 11 different samples were taken, however only 10 were viable, since one on the sample was destroyed. All the data once again was inputted in the GLOBE Database.

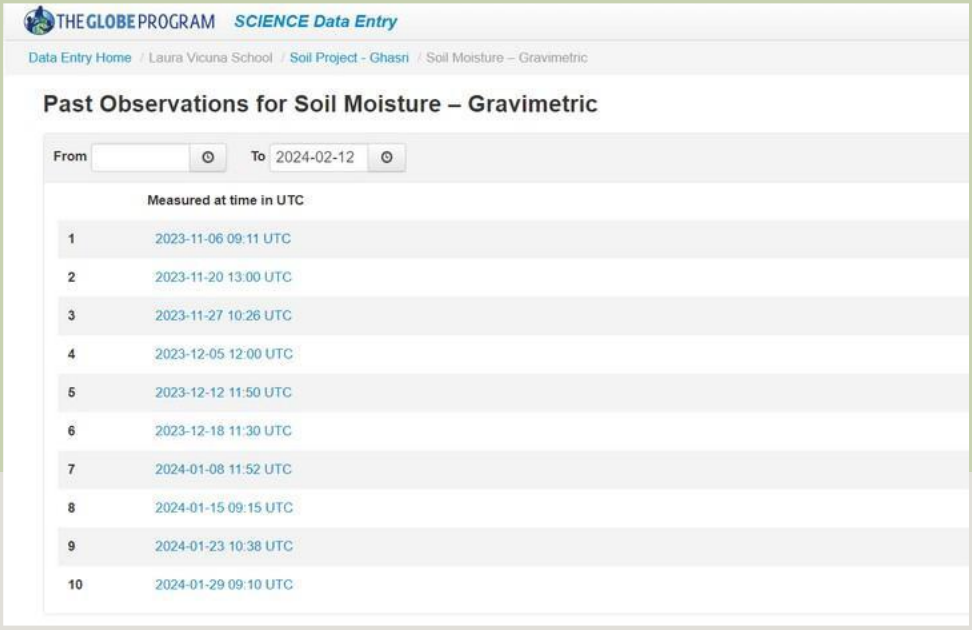


Fig 9. Soil Samples

Sample Number	Date	Time	Soil Weight (in grams) Wet	Dry	Difference
No 1	6/11/2023	10:11	106g	90g	16g
No 2	13/11/2023	13:00	111g	N/A	N/A
No 3	20/11/2023	14:00	97g	89g	8g
No 4	27/11/2023	11:26	102g	86g	16g
No 5	5/12/2023	13:00	103g	87g	16g
No 6	12/12/2023	12:50	103g	83g	20g
No. 7	18/12/2023	11:30	108g	85g	23g
No. 8	08/01/2024	11:52	100g	84g	16g
No. 9	15/01/2024	09:15	104g	82g	22g
No. 10	23/01/2024	10:38	106g	90g	16g
No. 11	29/01/2024	09:10	106g	90g	16g

Fig 10 Comparison between wet and dry soil

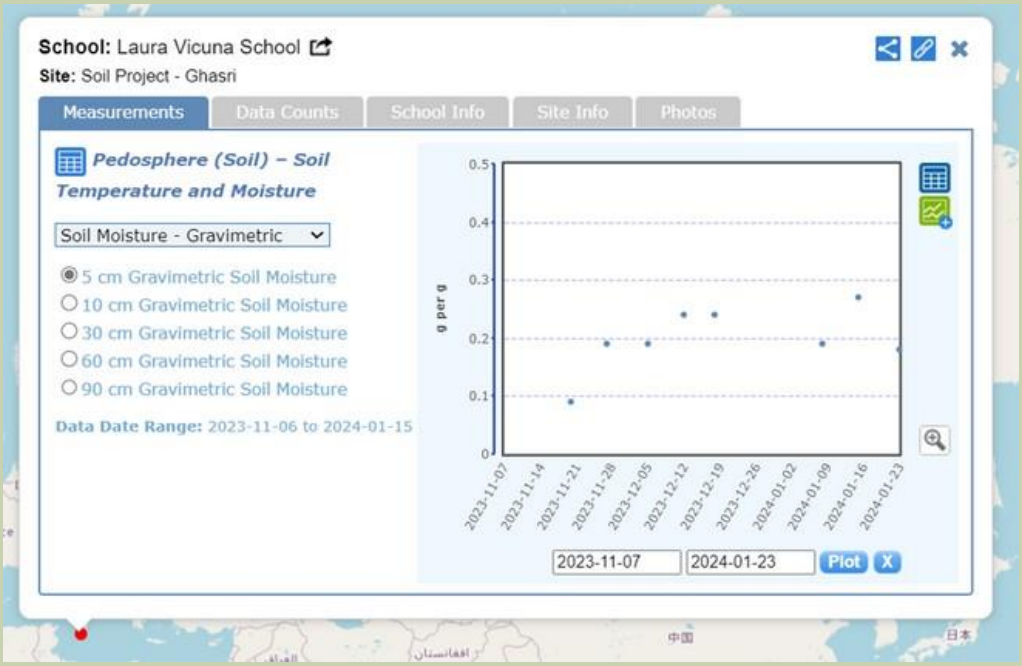


Fig 11.Soil Moisture Gravimetric plot of VIZ GLOBE

Conclusion

One can observe that there is a difference between 16 to 22 grams between the wet soil sample and the dry soil sample. This makes one realize how it is important to have green areas with soil rather than having that amount of water going to waste. As a school we will invest in more plants and compost and set more green areas among the school rather than leaving areas with just soil.

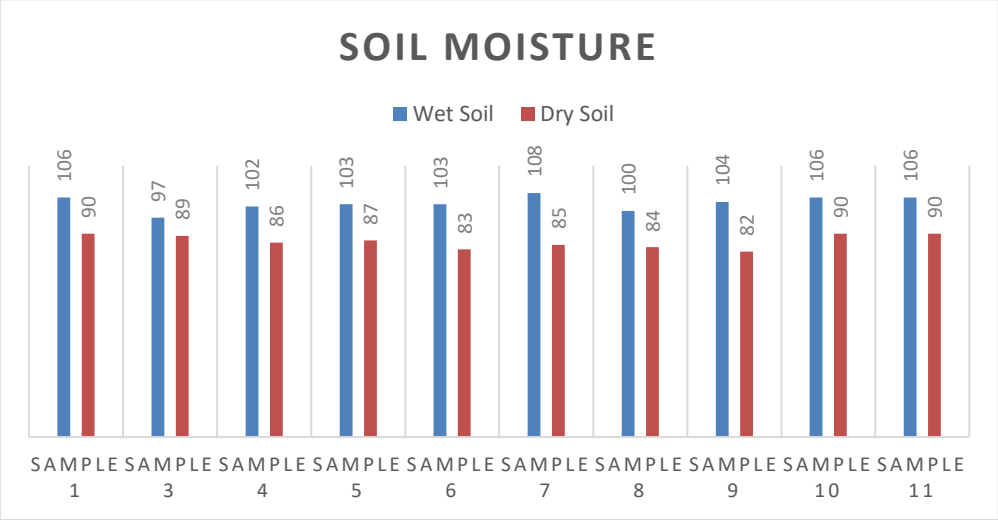
Badge Description

I make an impact

To Keep Soil Moist will be adding compost to the soil areas. Compost can hold several times more moisture than dry soil particles. Adding compost to your soil allows the soil to hold onto more moisture, keeps precious microbiology alive (which helps plants thrive), and feeds your plant low amounts of plant food. Also planting plants/vegetables rather than leaving the soil area bare will help preserve more moisture in the soil.

I am a Data Scientist

Students analysed their own data (from their measurements). They were able to analyse tables to interpret the data. They also became aware of the limitations of the data and could only draw conclusions from the samples studied. From the data analysis, the students answered their research questions.



I am a story teller

Once we had all the data, we created a short video mentioning each stage of the project and shared it with the school community on our Facebook Page. This year we are also taking part in the Let's Talk Farming Programme. Soil is a vital resource for agriculture. This project will be published under Category 3: Awareness Exercise and express the importance of moisture in soil.

References

- IVSS Badges - GLOBE.gov
- GLOBE teacher guide https://www.globe.gov/ (Accessed October 2023)
- GLOBE Vizualisation System https://vis.globe.gov/GLOBE/ (Accessed February 2024)