Exploring the World Beneath Our Feet: Cement vs Soil

GLOBE students:
Mikela Apap, Elinor Loz, Maya Felice, Jack Joseph Borg, Isaac Cassar, Geordie Micallef, Daniel Aquilina, Mia Micallef, Elisa Marie Formosa, Giuseppi Falzon, Dave Said, Jasmine Cassar, Julia Caruana.

GLOBE teacher:
Ms Sharon Muscat

Gozo College Karmni Grima Għarb Primary School, Gozo
Malta

27th February 2025

Summary

This project investigates the temperature differences between cement surfaces and areas under trees, focusing on how different surfaces affect heat levels. The research question addresses whether trees help in lowering temperatures. With Malta's hot summer temperatures, the objective was to explore natural solutions for cooling down outdoor spaces. The project involved measuring surface temperatures on cement and under tree canopies over time. The results showed that trees do provide shade, and temperatures were consistently lower under the trees compared to exposed cement surfaces in the sun. The conclusion highlights that trees can effectively reduce heat and offer a natural method to help lower temperatures in hot environments like Malta.

Keywords: Surface temperatures, Temperature differences, Tree canopies, urban heat

Research Questions

This project aimed to explore the temperature differences between cement surfaces and shaded areas under trees, focusing on whether trees can help in lowering temperatures. The research question at the heart of the project was: Do trees help in lowering temperatures compared to hard, artificial surfaces like cement? This question is scientifically significant because it addresses the impact of urbanization on local climates, especially in hot regions like Malta, where summer temperatures can reach extreme levels. Understanding how natural elements like trees interact with their environment to reduce heat can provide valuable insights into urban planning and climate adaptation strategies.

The research question is of both local and global concern. On a local scale, Malta experiences high summer temperatures, and finding natural ways to mitigate this heat is essential for improving outdoor comfort and energy efficiency. Globally, this question ties into broader environmental issues such as urban heat islands, climate change, and the need for sustainable solutions in cities. The ability of trees to cool their surroundings by providing shade and reducing surface temperatures has implications for sustainable urban development worldwide.

Research Methods

To answer the research question, we measured the temperatures of cement surfaces and areas under trees on the school grounds over an extended period (see Figure 1). Għarb Primary School is located in the western side of Gozo and it is situated on a very quiet street in the heart of Għarb.

Figure 1 Aerial view of our school with study sites marked in red

Materials used

- Infrared Thermometer
- 2 Datasheets, one for each study site (see Appendix)
- Clipboard and pen

The GLOBE Atmosphere Protocol was used to collect surface temperature. This includes a standardised methods for measuring the surface temperatures. The students visited the study site for a whole week in October and December 2024 and again in January 2025. Using an infrared thermomenter they measured 9 readings from each site (see Figures 2 and 3) and data was recorded on the datasheets. The students also observed and recorded the surface conditions, wert or dry, of the study site. After the observation period, all data was uploaded to the GLOBE database base (see Figure 4).

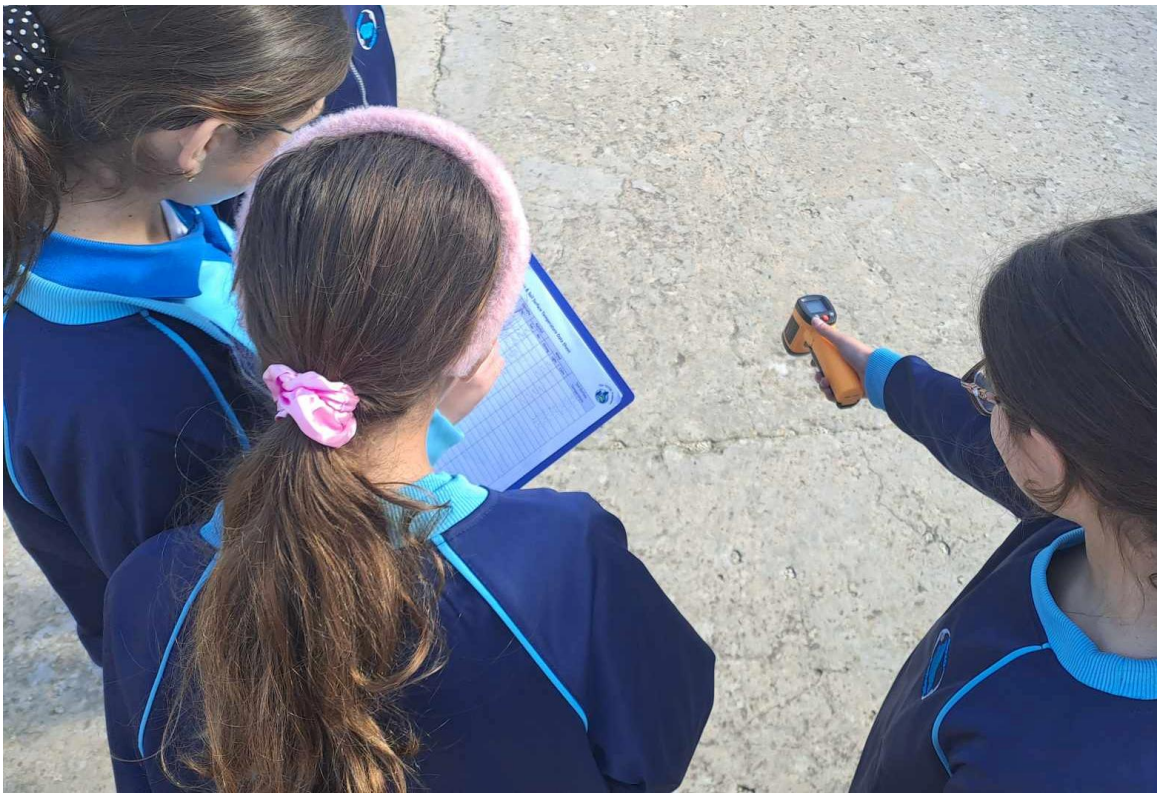

Figure 2 GLOBE students measuring surface temperature from cement study site

Figure 3 GLOBE students measuring surface temperature from the soil study site

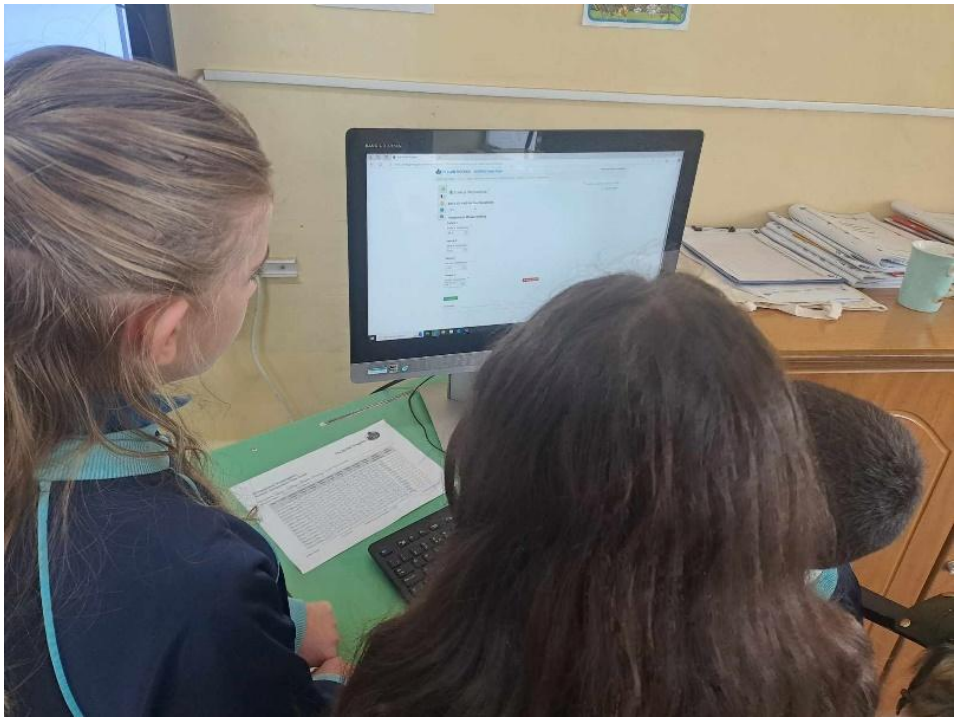

Figure 4 GLOBE students uploading data to the GLOBE database

Conclusion:

The screenshots below show data uploaded on the GLOBE website during the observation period between October, December 2024 and January 2025 (Figures 5 & 6).

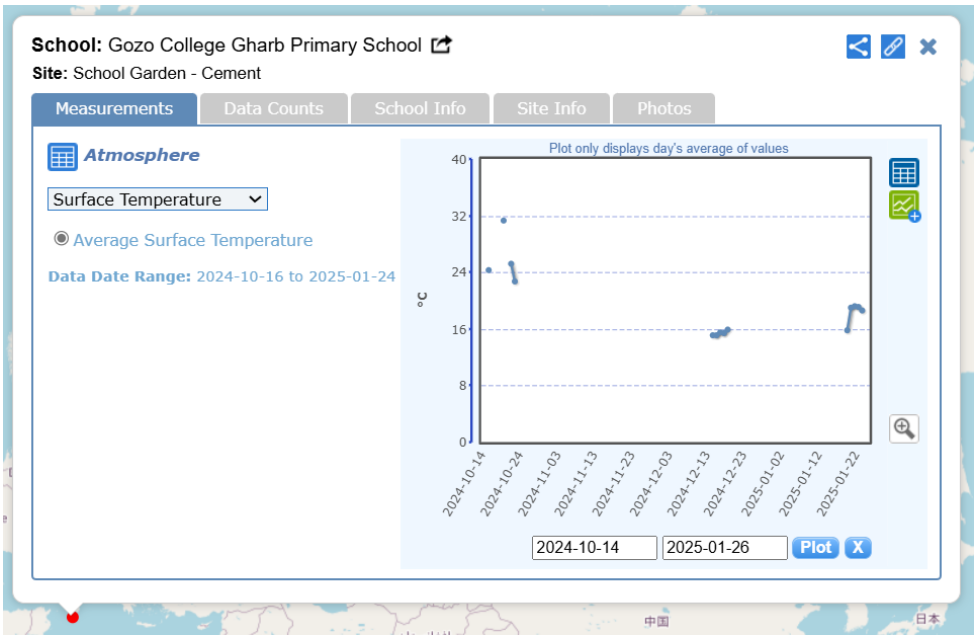

Figure 5 Surface Temperature (Cement) plot of VIZ GLOBE

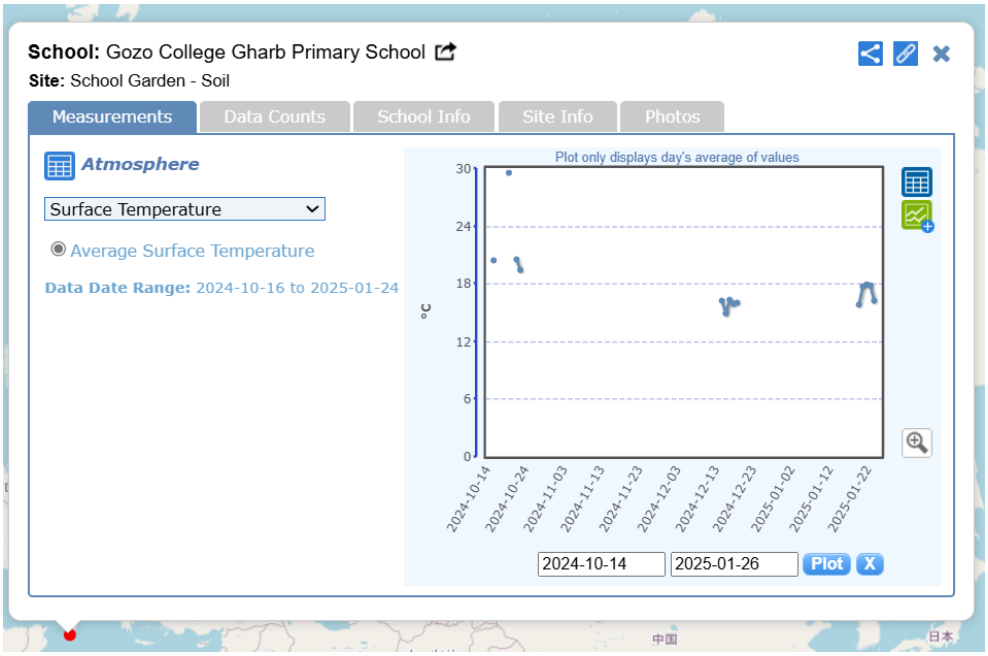

Figure 6 Surface Temperature (Soil) plot of VIZ GLOBE

This data provided measurable insights into the cooling effects of trees. The findings confirmed that trees did indeed lower temperatures under their canopies, showing that trees can play a crucial role in mitigating heat, especially in urban areas. These temperatures were uploaded on the GLOBE website as well. However, it indicated when it was a rainy day, the temperatures on the cement and that of the soil were very similiar to each other, ranging with a difference of approxiamtely one degree. But on the other hand, the temperatures varied on sunny days, sometimes even a difference of three and four degrees was evident. As an example on 16th October 2024, the temperatures on cement was 24.6 degrees, while that on soil was 20.6 degrees. What a difference!

This project not only provided valuable insights into temperature regulation but also highlighted the importance of conducting thoughtful, evidence-based scientific research to address real-world environmental issues.

In conclusion, this project, which measured temperatures on cement ground and under trees over the course of a week in October, December, and January, provided insightful data on how different surfaces and environmental conditions affect temperature. The consistent pattern observed was that temperatures under the trees were consistently lower than those on the cement ground. This finding can be attributed to the natural cooling effects of trees, which provide shade and facilitate evapotranspiration, a process in which moisture from the tree's leaves evaporates, leading to a cooling effect.

Despite some rainy days, the trend remained constant, indicating that the influence of trees in providing a cooler microclimate outweighed the temporary cooling effect of rainfall on the cement. Cement, being a highly reflective and heat-retaining surface, tends to absorb and retain heat, causing temperatures on the cement ground to remain higher, especially on sunny days.

This project highlights the importance of green spaces in urban environments, particularly in the context of climate change and rising urban temperatures. The data suggests that trees can play a vital role in mitigating heat in cities by offering a natural and effective cooling solution. Additionally, this project reinforced our ideas to continue to plant trees in our school area. For future studies, it would be interesting to explore the temperature variations over longer periods or across different seasons, as well as compare more surface types. Ultimately, the findings underscore the need to integrate nature-based solutions to help manage heat in urban areas, promoting cooler and more sustainable environments.

GLOBE Program

Atmosphere Investigation
Surface Temperature Data Sheet

School Name: _____ Site coordinates: _____

Observers Name: _____

Date	Time	Surface Temp. 1	Surface Temp. 2	Surface Temp. 3	Surface Temp. 4	Surface Temp. 5	Surface Temp. 6	Surface Temp. 7	Surface Temp. 8	Surface Temp. 9	Surface Condition (Wet or Dry)	Data uploaded

Badge Descriptions/Justifications

I am a data scientist

Students analysed their own data (from their measurements). They were able to analyse graphs to interpret the data. From the data analysis, the students answered their research questions and came up with their conclusions of the study.

I make an Impact

The project helped students and the school community recognise the effect of difference surface on the air temperature. The students wanted to bring change and came up with the idea of planting more trees in the school garden and the village of Gharb. Thanks to the support of the Head of the school, Ms Marthese Attard and the mayor of Gharb, Mr David Apap, 8 new trees were planted at school and another 4 in the locality.

I am a STEM Storyteller

In addition to taking measurements at school, students also shared their knowledge among family and friends. The project and their findings were shared with the school and wider community through morning assemblies, GLOBE noticeboard, and the school Facebook page.