Hot or cold? But why? Really?! Hmmm …

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Abstract

This study investigates how different surfaces at our school absorb heat and why their temperatures vary. Students measured surface temperatures in three areas: concrete, synthetic turf, and an orchard, using GLOBE protocols and infrared thermometers. Data was collected over two weeks at the same time each day. Our pupils' everyday observations are that certain parts of our school feel warm, or at times even hot while others remain relatively cold. It seems that this trend is persistent throughout the year, though to various degrees, depending on the season. These findings highlight the importance of green spaces in reducing temperature and improving comfort. Students shared their results with local councils, advocating for more greenery in urban areas. They also explored the link between rising temperatures and reduced rainfall.

Research Questions

The main research question seeks to explain the temperature difference over a large swathe of land, constituting our school's whole area. Some pertinent questions include the following:

- Why do surfaces have different temperatures at the same time of day or year?
- What causes such a temperature difference?
- What can one do differently to avoid the extreme temperatures?
- What lessons can we draw from these observations?
- Are our observations similar or different from those of other places on earth? And if so, why?

Research Methods

Three sites on the school grounds (Figure 1) were chosen for this study as follows:

- Site A had a concrete surface.
- Site B had an artificial turf surface.
- Site C was in the school's orchard.

Figure 1 Study sites on an aerial view of the school

Data Collection

Students were trained in GLOBE protocols, learning to use an infrared thermometer correctly and operate a data logger to measure humidity, air temperature, and air pressure. Speed and accuracy were emphasized to ensure efficient data collection.

- Two reading sessions conducted over two weeks, with a few days in between.
- Readings taken at approximately 12:30 PM to account for sunlight duration and sun position.
- Consideration of climatic conditions, as atmospheric patterns have become more uniform.
- Comparing data from different time spans allowed for a more comprehensive study of environmental variations.

Results

After the observation period, all data was uploaded to the GLOBE database base. The screenshots below show data uploaded on the GLOBE website during the observation period (Figures 2, 3 and 4). The data presented was quite impressive and interesting.

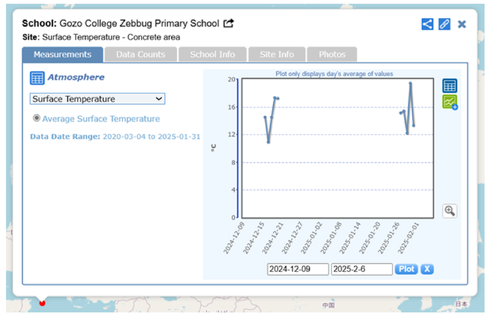

Figure 2 Surface Temperature (Concrete) plot of VIZ GLOBE

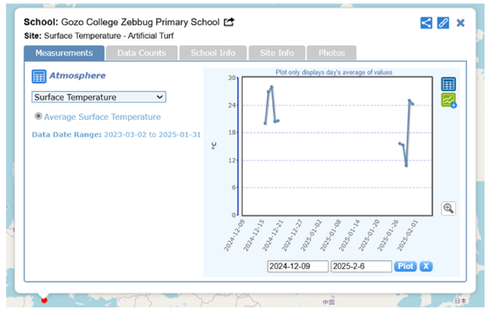

Figure 3 Surface Temperature (Artificial Turf) plot of VIZ GLOBE

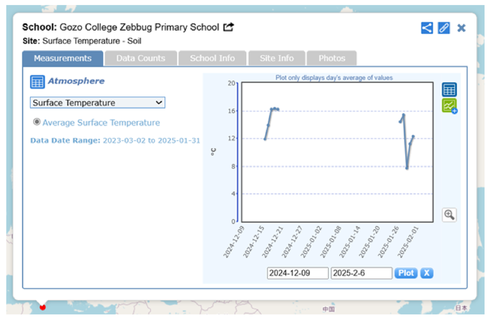

Figure 4 Surface Temperature (Soil) plot of VIZ GLOBE

Conclusion

Key Findings:

- Concrete: When wet, temperature variation was minimal. When dry, fluctuations were observed on certain days.
- Soil: Maintained a relatively uniform temperature, remaining the coolest surface.

•Artificial Turf: Higher temperatures recorded, especially in areas with more black rubber granules, confirming that darker surfaces absorb more heat.

Pupils highlighted the importance of green spaces to mitigate rising temperatures. They proposed increasing urban greenery to local councils to create cooler, more comfortable environments. Observations linked to rain and flooding showed that drier land contributes to higher temperatures, requiring further study.

Follow-on research & actions

A practical result even on a small scale is the glacier-ripple effect. This consists of installing small-sized mirrors on the soil so that heat is reflected in the atmosphere. Hence, this helps cool down the earth, offsetting the greenhouse effect generated by the Carbon Dioxide in the atmosphere. We will be replicating the effect glaciers have in contributing to a lowering of the earth's temperature. Sadly enough, glaciers are retreating due to global warming, and this will be a small contribution to the whole world. We hope that this movement gains momentum so that other people join in and the little of the many, will result in big changes.

References

GLOBE teacher guide https://www.globe.gov/ (Accessed October 2024)

GLOBE Science Data Visualization https://vis.globe.gov/GLOBE/ (Accessed February 2025)