An analysis of Autumn Cloud, Land and Water Measurements at a Campus in Southeastern Michigan

Fadl El Fadl, Elissa Hadla, Renee Harp

Crestwood Highschool, Dearborn Heights, MI

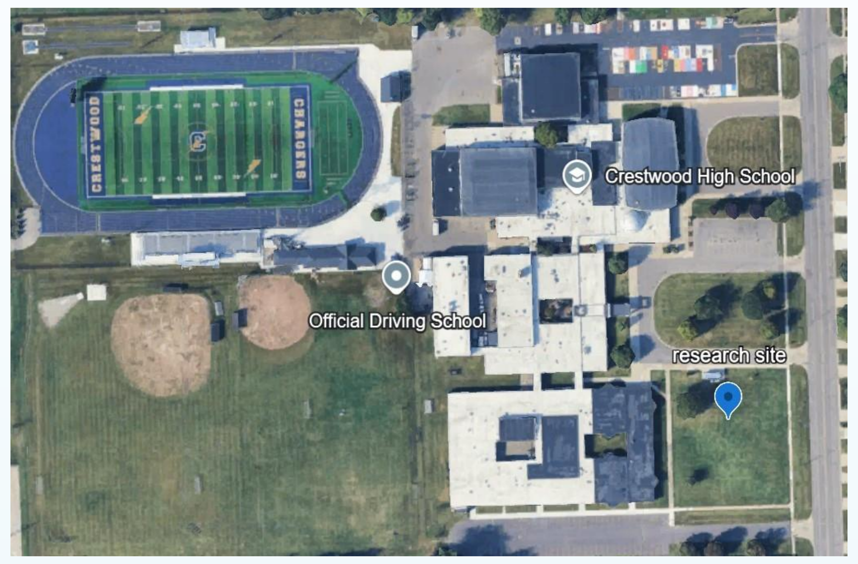
Abstract

In this research, the researchers examined the relationship between **surface temperature**, **water temperature**, **cloud coverage**, and other atmospheric parameters in Dearborn Heights, Michigan. Researchers collected daily **surface temperature** measurements at two school campus sites using an **infrared thermometer**, while **water temperature** was recorded in a courtyard pond using a **Vernier temperature probe**. The other parameters such as air temperature, barometric air pressure, and humidity, was gathered using the WeatherBug app. Over 74 days, trends indicated a steady decrease in surface and water temperatures as the season shifted from late summer to winter. **Surface temperature** and **water temperature** showed a direct correlation, with water cooling at a slower rate due to its higher heat capacity. A strong relationship was also found between **surface temperature** and ambient air temperature. However, no significant correlation was observed between **cloud coverage** and **surface temperature**, suggesting other environmental factors play a more dominant role. Humidity and **cloud coverage** demonstrated a complex relationship, with high **cloud coverage** generally corresponding to increased humidity, but varying patterns when **cloud coverage** was low. Potential errors in data collection included environmental variability, sensor placement, and occasional gaps in daily measurements. This data leads to understanding seasonal climate variations on a local scale and highlight the need for further research to refine methods and expand study periods.

Discussion

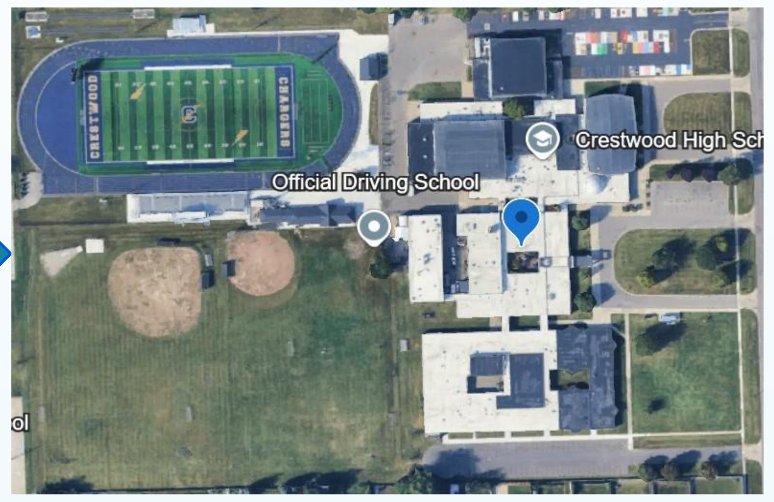
This research provides evidence regarding how surface temperature, water temperature, cloud coverage, and atmospheric conditions interact during the change from late summer to winter in southeastern Michigan. By analyzing these parameters, the researchers developed a better understanding of seasonal changes on a local micro level scale. To improve data accuracy and validity, several adjustments should be made. Extending data collection through winter and spring would provide a more complete view of seasonal trends, for example, when does fall begin each year and when does it end (in terms of weather conditions?). Collecting data at multiple times during the day, other than only at 2:30 PM local time, could document temperature fluctuations in greater detail. Expanding data collection beyond the school campus to other local could allow for comparisons between varying environments. Multiple recording sites could highlight how different land might impacts temperature changes. More unique measuring tools, such as pyranometers for solar radiation and anemometers for wind speed, could provide additional data to explain temperature and cloud variations more thoroughly. Observing night temperature patterns would also provide insights into how clouds influence heat retention. The findings of this study have some applications beyond the classroom. Understanding local climate variations can help communities prepare for seasonal changes and address climate-related challenges such as the flooding some cities experience during intense rainfall events. These results may help urban planners develop strategies to address urban heat island effects by planting more vegetation and install more permeable surfaces. Insights on how water bodies regulate temperature could aid environmental management, especially for aquatic ecosystems. Colder water holds more dissolved oxygen which is required for more desirable aquatic organisms like trout and salmon. Future research could expand on these findings in several ways. Studying how snow affects surface and water temperatures would provide more seasonal insights. A multi-year study could reveal long-term climate trends in Michigan. Comparing areas with different vegetation levels could show how plants regulate temperature. Expanding the study to other regions and climates would determine if these patterns are unique to Michigan. Researching how air pollution affects cloud coverage and temperature trends could offer insight into urban environmental factors. Lastly, examining land use and industrial activity could help identify human-driven climate impacts. This study effectively demonstrated the relationships between land and water temperatures, cloud coverage, and atmospheric conditions throughout autumn. However, refining data collection methods and expanding research areas could overall enhance the research data. By expanding the study's view and adding other techniques, future research can deepen our understanding of local and global climate patterns.

Methodology



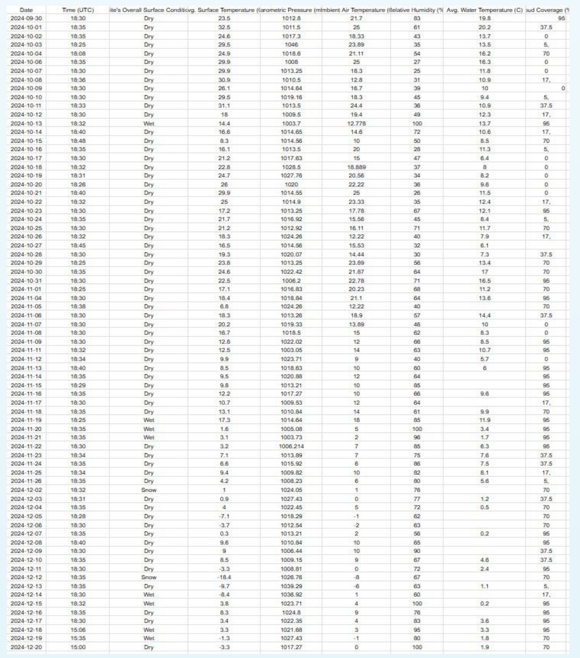
Satellite image of data collection site 1, Crestwood High School

Researchers used the Infrared Thermometer to measure surface temperature measurements

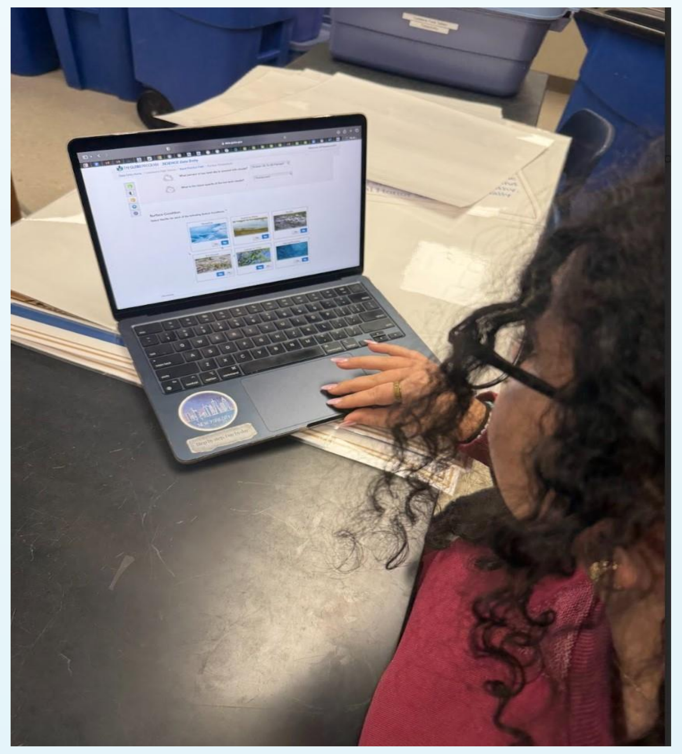


Satellite image of data collection site 2, Crestwood High School

The researcher is using the Vernier Temperature Probe to measure water temperature measurements

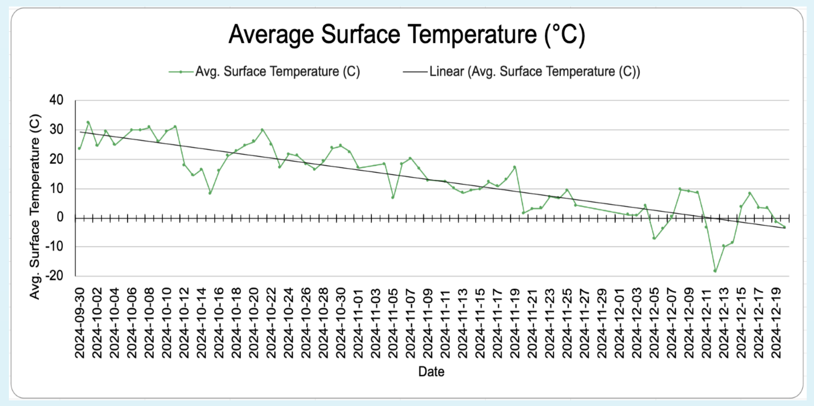


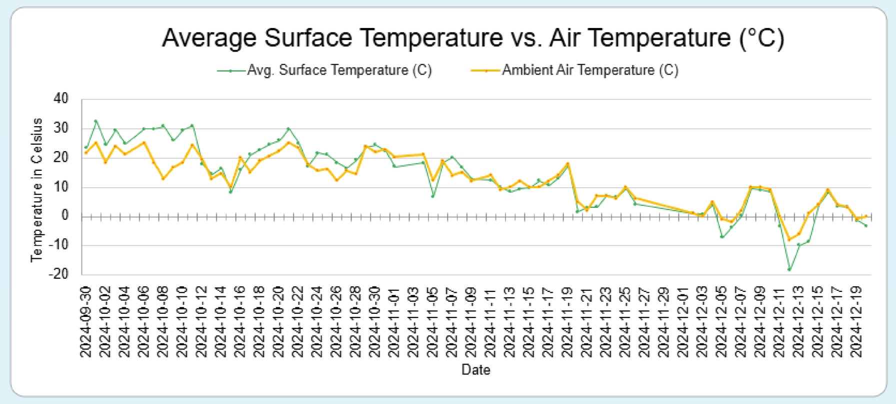
Data collected gets exported into a spreadsheet and visualized

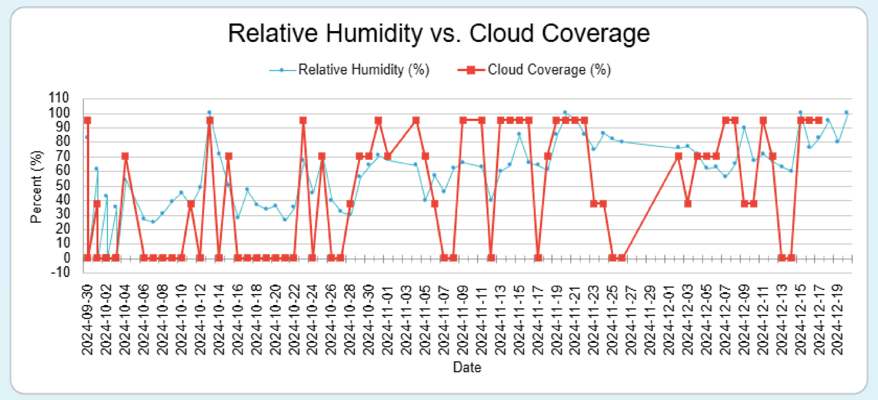


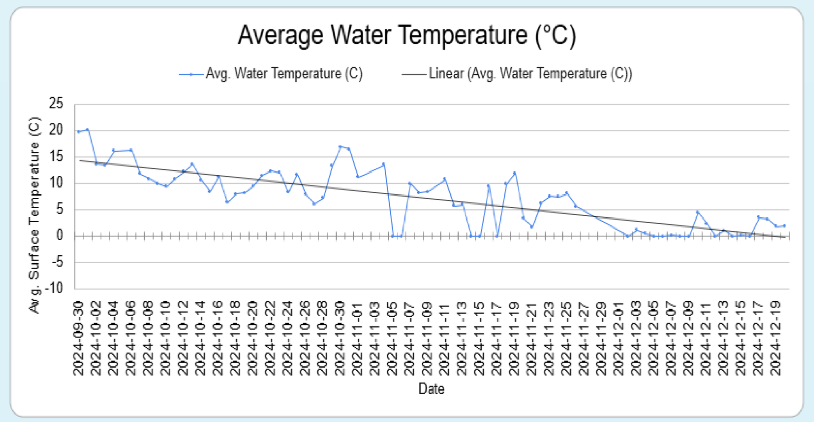
Student researching sending data to GLOBE

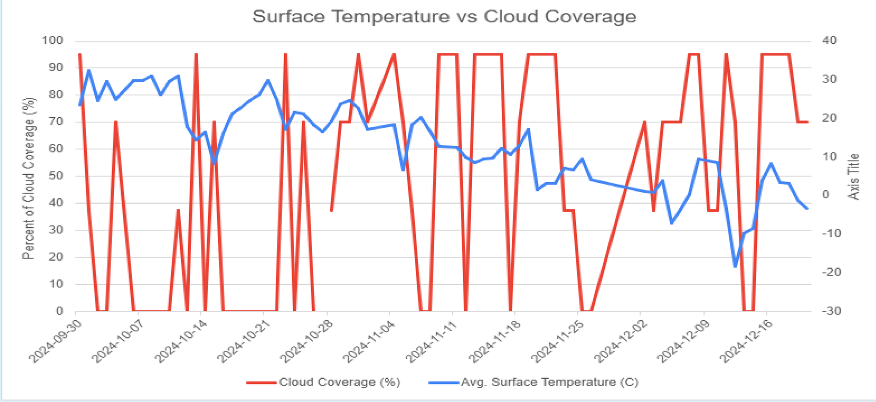
Results

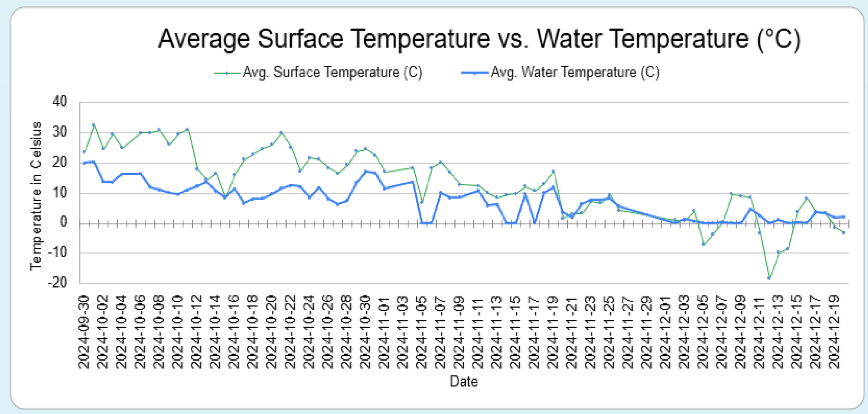












Conclusion

Using an Infrared Thermometer and a Vernier Temperature Probe, the researchers were able to collect land surface and water surface temperatures. With the data collected researchers were able to observe the gradual decrease in temperatures from the fall to winter seasons. After gathering data, researchers concluded that from late summer to late fall, land surface and water temperature both experience a decline in temperature. These declines in temperature, originate from a decrease in altitude of the sun due to the sun rising further south of east as autumn progresses, resulting in gradual decrease in angle of insolation Michigan receives. As we enter the fall the decrease in direct sunlight causes a significant decrease in surface temperatures due to longer nights and shorter daylight, resulting in longer cooling periods. Water temperatures start to show a decrease slower than surface temperature due to waters higher heat holding capacity. This data is supported by the following: "As water bodies have a greater specific heat capacity compared to other physical objects, its warming-up rate is slower than other materials, resulting in the cool island effects during the daytime" (Wu and Zhang, 2019). In addition, the researchers found that as the season changed from late summer to fall, surface temperatures began to decrease. This observation is supported by the following: "The ongoing changes in the Earth's climate have been associated with changes in the timing and duration of the seasons, and many ecological and physical systems have been disrupted" (Alghamdi, 2023). Increased cloud coverage affects surface temperature in the fall by limiting the intensity of sunlight reaching Earth's surface during the day. Over time, surface temperature and ambient air temperature vary daily throughout the fall. Gradually over time cooler temperatures result in an overall decline in temperature. Surface temperatures are generally affected more than ambient air temperatures throughout the fall due to the primary source of surface temperature coming from solar radiation. Ambient air temperatures are changed more drastically by weather conditions than by the amount of sunlight Earth is receiving. Further research should be conducted to more fully understand the impact changes in seasons have on surface and water temperatures. This research could be improved by expanding our study period and taking data multiple times throughout the day rather than one specific time.

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Citations

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