



# A Seasonal Study Comparing How Cloud Coverage Affects Surface Temperature on Student Practice Fields

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## Abstract

The relationship between various surface temperatures and cloud coverage is essential for schools that value outdoor activities to understand fully. These researchers collected surface temperature data using the **Etekcity Lasergrip 774 Infrared Thermometer** and cloud coverage data using the GLOBE Observer app cloud protocols. This data allowed the researchers to assess how different cloud conditions, seasons, and different surface types (**natural grass**, **synthetic turf**, and asphalt track) affect **surface temperatures**. A negative correlation was found between **cloud coverage** and **surface temperature**, a higher percentage of cloud cover resulted in lower **surface temperatures**. The researchers found that the different surface types had different heat retention, the track; which is made of asphalt, usually had the highest temperatures, while the **synthetic grass** on the turf had lower temperatures than the band practice field; made of **natural grass**, which consistently had higher temperatures in comparison to the turf. Different seasons led to different results; In the summer there was less **cloud coverage**, leading to an increased **surface temperature**, and in the fall there was a higher percentage of **cloud coverage** which led to lower temperatures. The researchers highlighted the importance of understanding the relationship between **cloud coverage** and **surface temperature** on student practice fields for the safest and most comfortable conditions.

## Introduction

Researchers collected surface temperatures daily on the Band Practice Field and CHS Athletic complex at Crestwood High School in Dearborn Heights, MI. This study aimed to inform athletes and students about cloud coverage effects on surface temperature, impacting performance and comfort. Students use these locations for athletics, band, and clubs during fall and summer. In summer, increased student activity raises concerns about heat exposure affecting performance and safety. High surface temperatures on synthetic fields can cause dehydration, burns, blisters, and heat stroke (Myrick, 2019). Physiologically, heat stress affects athlete performance. Synthetic turf surfaces elevate air and surface temperatures, increasing heat-related illness risks (Singh et al., 2024). Heat stress on synthetic grass can cause dizziness and strokes (Jastifer et al., 2019). Grass fields retain less heat due to transpiration, rarely exceeding 100° F, while turf fields frequently surpass 100° F (Myrick, 2019). Cloud coverage affects solar radiation reaching the surface. Low-altitude clouds cool temperatures, while high-altitude clouds trap heat, increasing surface temperatures (Sellers & McGuffie, 2012). Cloud coverage also influences sports attendance. Higher cloud coverage correlates with lower attendance and reduced team performance (Paul, Ehrlich, & Losak, 2020). This issue impacts athlete performance and safety, especially during hot months. Synthetic turf, widely used in US high schools, poses significant heat-related health risks. Understanding these risks helps coaches, athletes, and administrators create safer environments. In the Crestwood community, increased athletic participation heightens health risks, making informed decision-making by administrators crucial for student safety.

## Null Hypothesis

1. There is no significant difference between cloud coverage and surface temperatures at various sites.
2. There is no significant difference between the correlation of the overcast condition and other cloud conditions and surface temperature.
3. There is no significant difference between the cloud coverages affecting surface temperatures in different seasons.
4. There is no significant difference between the temperatures for the Band Practice Field and the New CHS Athletic Complex.
5. There is no significant difference between temperatures for natural grass and synthetic grass.

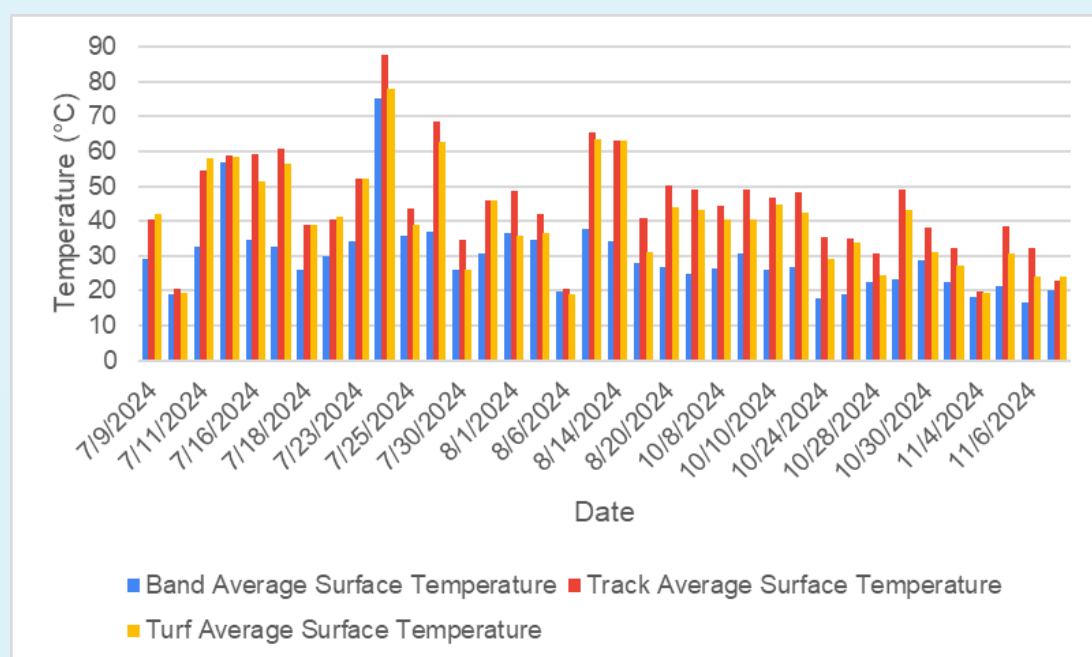
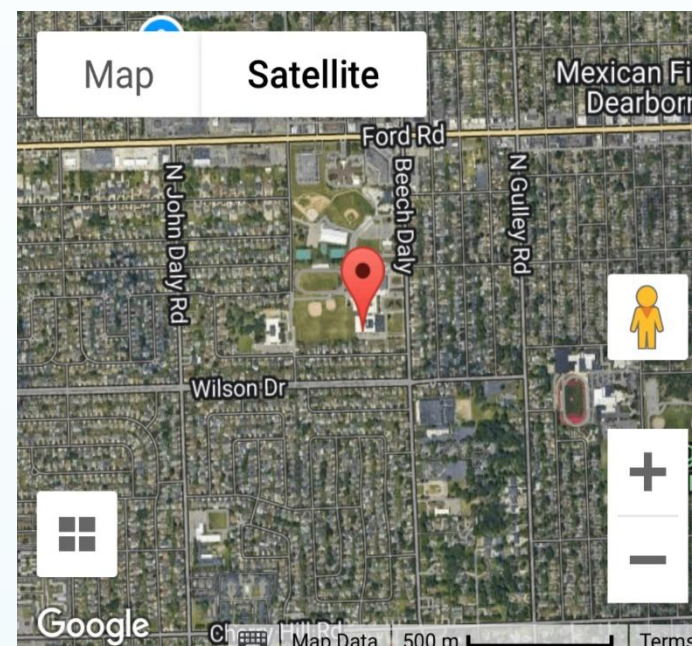


Figure 1. The band practice field, which is made up of natural grass, has lower average surface temperatures than the track and turf.

## Methodology



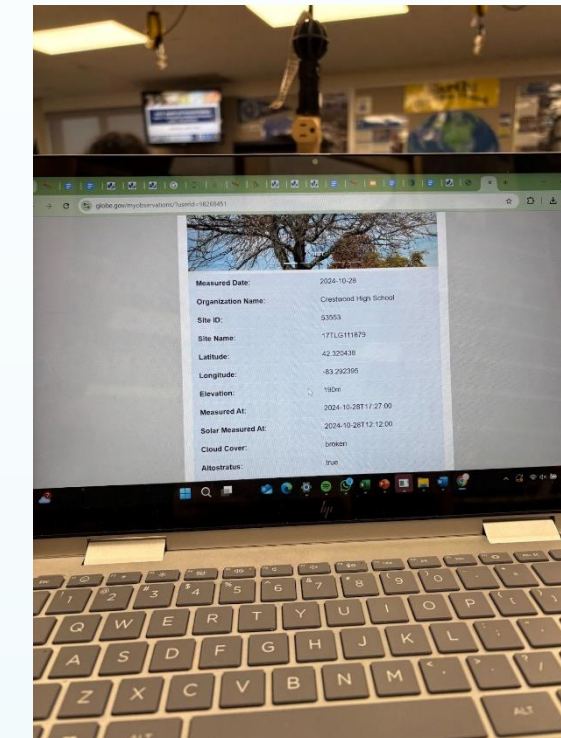
This image is a satellite picture of Crestwood High School's band practice field



A student researcher holds up the infrared thermometer on the Crestwood track (site 3).



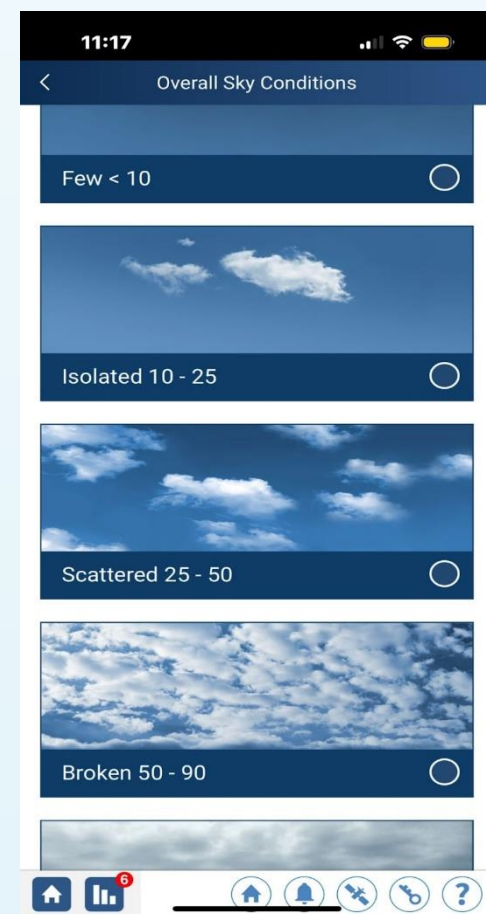
A student researcher holds up the infrared thermometer on the Crestwood band practice field (site 1).



Researchers retrieved the surface temperature data after they input the data.



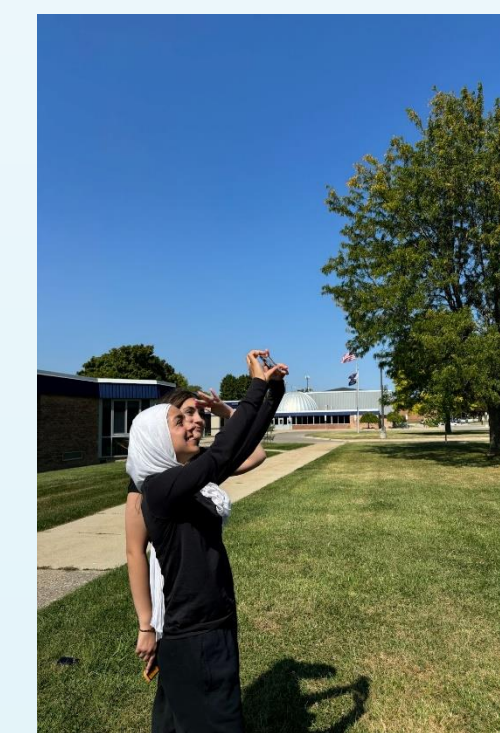
The student researchers input surface temperature data into the GLOBE Observer website.



A screenshot from the GLOBE Observer app where the researchers interpreted the cloud coverage.



The researchers used the clouds protocol from the GLOBE Observer app.



The researchers taking data on the cloud coverage.

## Results

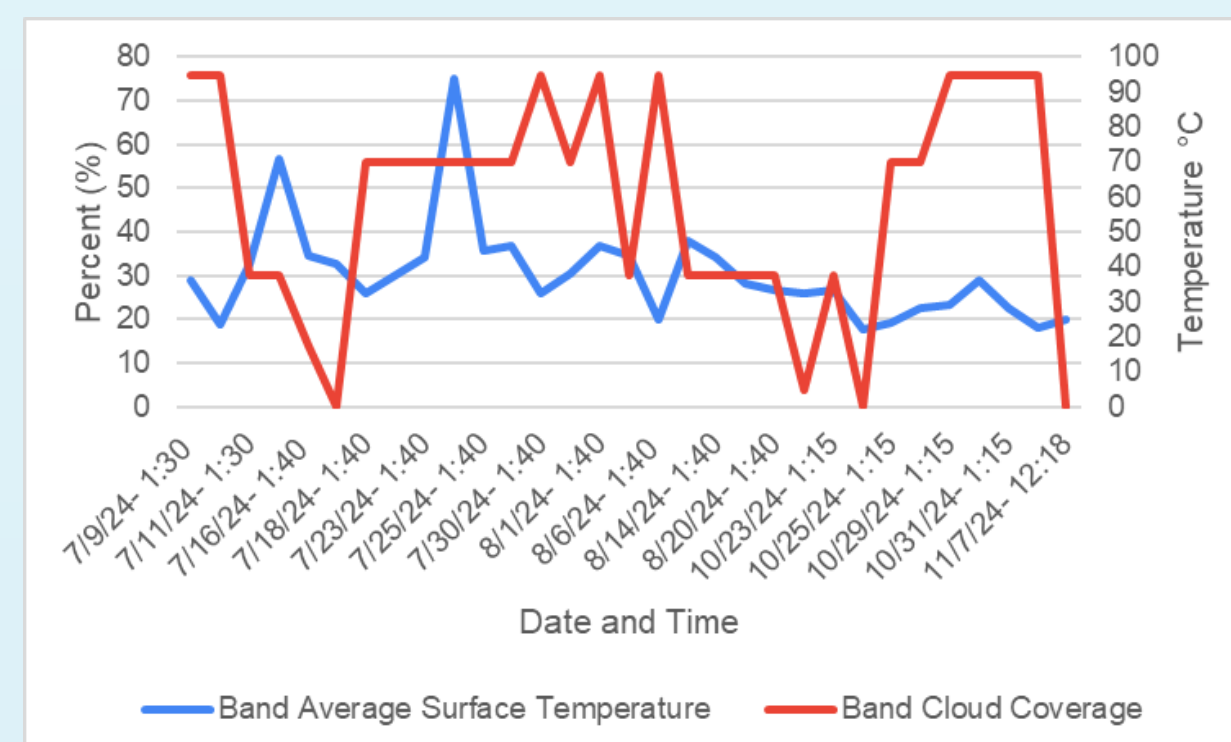


Figure 2. Surface temperature and cloud coverage on the band practice field have an inverse relationship between each other.

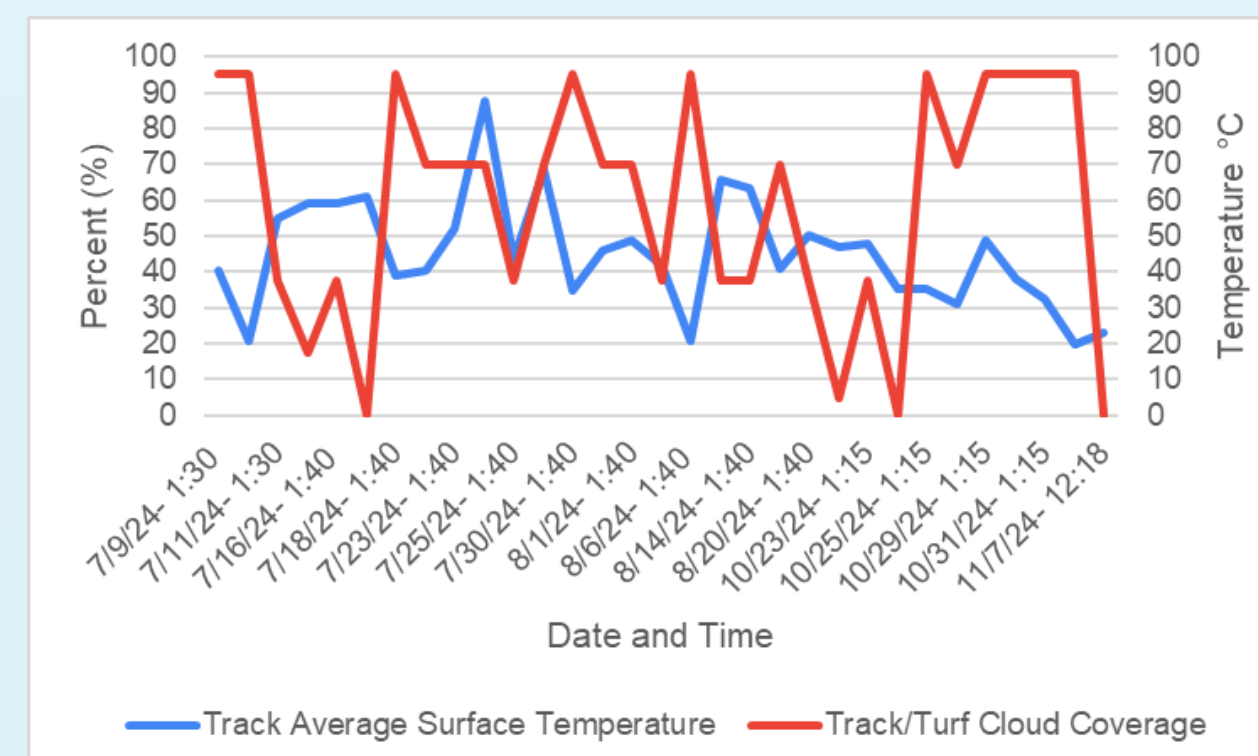


Figure 3. Similar to the band practice field, there is an inverse relationship between the surface temperature on the track and the cloud coverage above the track.

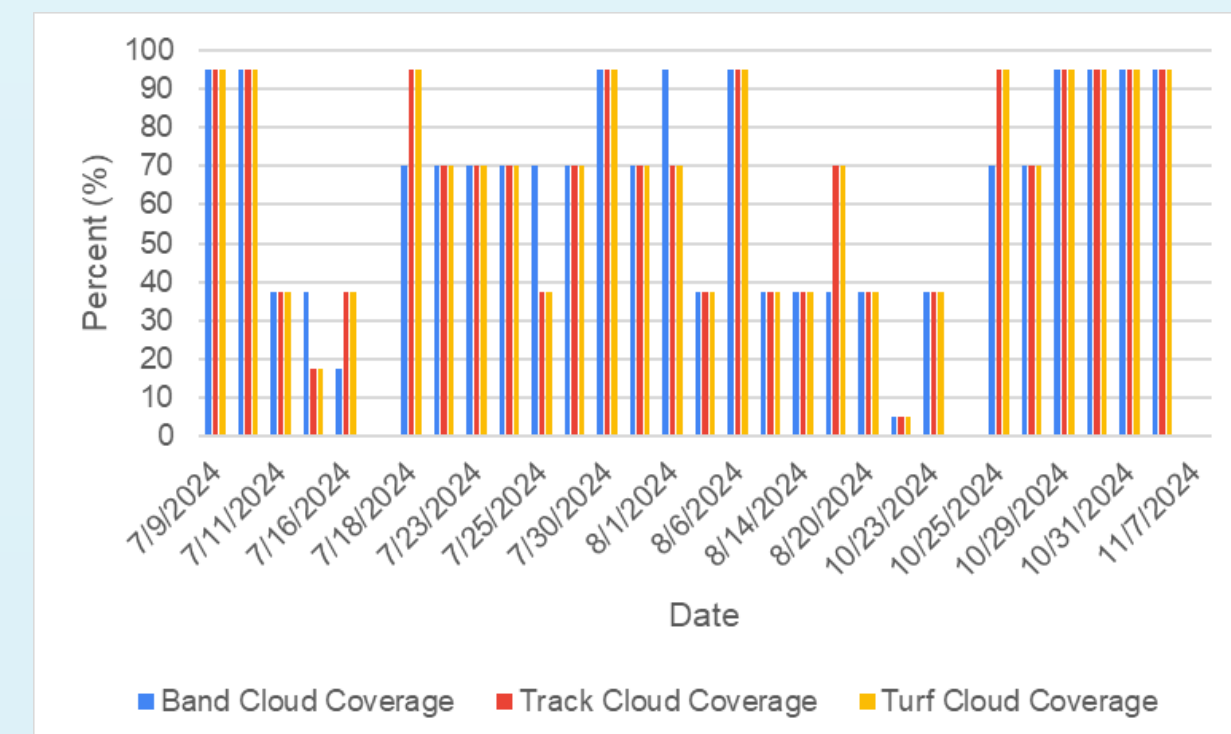


Figure 4. The cloud coverage between the three sites is the same the majority of the time, proving the researchers to be efficient.

## Discussion

There was found to be a negative correlation between cloud coverage and surface temperature at CHS's Band Practice Field and the new CHS Athletic Complex. Clouds have a high albedo, which causes them to reflect sunlight. When there are a great amount of clouds, like overcast conditions, the surface temperature at all three sites is lower than if there is a condition like cirrus clouds, which trap heat. The track had the highest surface temperatures every time data was measured, as asphalt absorbs and stores heat. The Band Practice Field had the lowest surface temperatures because the natural grass makes it easier for heat to be evaporated. The cloud data from the track and turf were closely related, though the track had higher temperatures. The researchers also found data varied by season, with more consistent overcast conditions in October and November with lower surface temperatures. One potential source of error could include pollution from Dearborn Heights vehicles, which emit greenhouse gases like nitrous oxide and carbon dioxide. The Etekcity Lasergrip 774 Infrared Thermometer also may have had calibration errors. Despite this, the researchers took nine measurements at each site daily and averaged the results to obtain accurate data. Although the researchers tried to take data when no students were on the field, student activity during solar noon may have caused higher surface temperatures.

## Conclusion

The researchers concluded that there is an inverse relationship and negative correlation between surface temperature and cloud coverage at Crestwood High School's Band Practice Field and the New CHS Athletic Complex track and turf field. The Band Practice Field, made of natural grass, consistently had cooler surface temperatures than the synthetic turf field. More cloud coverage led to lower surface temperatures due to the low albedo of clouds. Stratus clouds resulted in the lowest temperatures, while cirrus clouds led to higher temperatures. Cloud coverage increased in the fall, lowering temperatures. Data was collected from July to November using the Etekcity Lasergrip 774 Infrared thermometer and the GLOBE Observer app. The researchers reported potential issues like calibration errors with the Infrared Thermometer and nearby pollution as external factors. The dark navy track absorbed more heat due to its low albedo, while the synthetic turf, with dark fibers, also absorbed more heat. The Band Practice Field's natural grass had higher albedo, keeping temperatures cooler. Future research could include additional surfaces like metal stands or factors like wind or humidity to better understand the relationship between cloud coverage and surface temperature.

## Acknowledgements/Bibliography

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