



Comparing the Effects of Select Atmospheric Variables on Artificial Light Pollution at Night

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Abstract

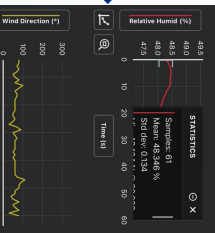
During the winter of 2023, a group of researchers from Creswood High School in Dearborn Heights, Michigan, collected data in two specific locations to measure the amount of light pollution in suburban regions. Using the Unihedron Sky Quality Meter (SQM), Vernier Go Direct Weather Device, and observational skills, the group recorded the night sky brightness (NSB), various atmospheric parameters, and ground-weather conditions, respectively. The Unihedron SQM measured NSB in magnitudes per arcsecond. The collected data from the Vernier Weather Device was then compared with atmospheric data from a research-grade Weather Network HD CCD Video Camera (Weather Station) located on the roof of the school building. Atmospheric protocols collected and included barometric pressure, relative humidity, and air temperature. Lastly, the researchers recorded weather conditions, including precipitation, such as snowfall. The data mentioned above was collected each day at approximately two hours after sunset from 20 November 2023 to 19 December 2023. Comparing trends in NSB with those in atmospheric data allowed the group to correlate the relationship between light pollution and weather conditions. Furthermore, the usage of both the Vernier Weather Device and the Weather Station allowed for the testing of the accuracy of the Vernier Weather Device. Moving forward, the researchers intend to share and analyze the collected data with local environmentalists and community members. Additionally, the group recommends the usage of the Vernier Weather Device by citizen scientists around the world for atmospheric data collection.



Discussion

The researchers both confirm and reject certain conditions within the first null hypothesis, which states that atmospheric and meteorological variables do not affect artificial light pollution. Specifically, the atmospheric variable of humidity is shown to have a significant, inverse relationship with the amount of light pollution present at any given point, as illustrated in Figures 13 and 14. Each peak of relative humidity in the atmosphere is coupled with a dip in light pollution. Furthermore, we reject the second null hypothesis, which states that snow, among other weather conditions, does not significantly affect light pollution. Finally, the researchers reject the null hypothesis that the Vernier Go Direct Weather Device cannot be used effectively and accurately. While there does appear to be a significant difference between the air temperatures and wind speeds measured by the Vernier Go Direct Weather Device and the Weather Station, this discrepancy can be explained by the fact that measurements taken by the Vernier Device were taken 1 meter off the ground, while the Weather Station is located on top of the Creswood High School building several meters off the ground.

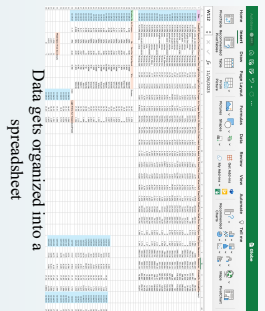
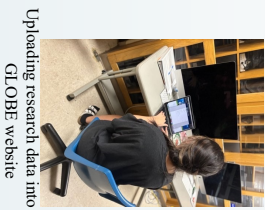
Methodology



Using Vernier Go Direct Weather Device to measure atmospheric conditions

Data automatically uploads as graphs onto the cellular device

Using the Sky Quality Meter to measure night sky brightness

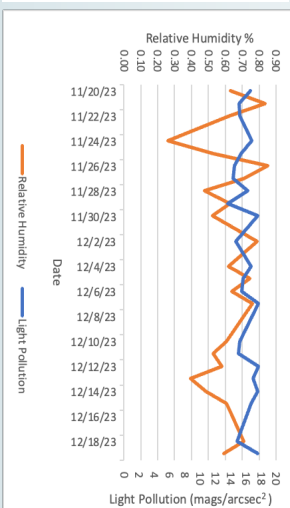
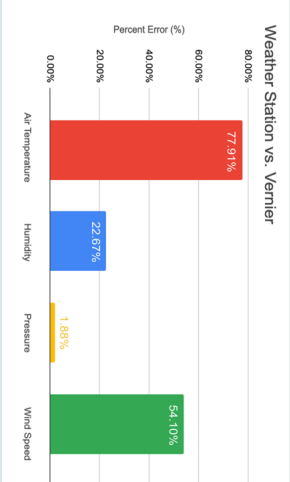


Uploading research data into the GLOBE website

Data gets organized into a spreadsheet

Atmospheric data was collected from the local Weather Network HD CCD Video Camera

Results

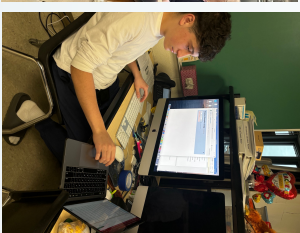
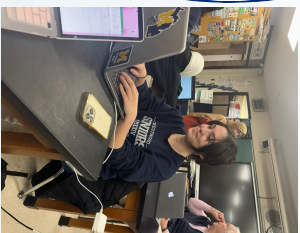


The graph above shows the percentage error of air temperature, humidity, pressure, and wind speed between the Weather Station and the Vernier Go Weather Direct Device in Dearborn Heights, Michigan. Disparities between the two devices can be attributed to differences in altitude levels of measurements.

There is some variation in relative humidity between locations and a significant amount of variation in each location from day to day. Light pollution and relative humidity appear to have an inversely proportional relationship.

Conclusion

In future studies, this research may be expanded to locations across the globe to allow for an expanded comprehension of the impact of atmospheric conditions on the intensity of artificial light pollution at night. Additionally, for future reference, similar data should be collected over extended periods and span more than one season to draw more correlations between weather and the intensity of artificial light pollution at night. Also, to ensure that differences in elevation are accounted for, ground-level data should be taken simultaneously with daily reports from a Weather Station to have the highest accuracy and applicability of the data.



Acknowledgements

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Citations

Azman, M. L., et al. "A Brief Overview on Light Pollution." *ICP Conference Series: Earth and Environmental Science*, vol. 269, no. 1, July 2019, p. 012014. <https://doi.org/10.1088/1755-1315/269/1/012014>.
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