Identifying Clouds at Night Using HD Technology and NOAA Satellite

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Abstract

This research project aims to investigate the comparability of cloud observations acquired from the Weather Network HD Camera and NOAA Satellite images taken specifically during nighttime conditions. Cloud-related parameters including type, opacity, and coverage were recorded using both the Weather Network HD Camera and the NOAA Satellite. The study site was at Crestwood High School in Dearborn Heights, in Southeastern Michigan. Observations were systematically conducted twice daily, at 8:00 UTC and 11:00 UTC for 6 days, to capture variations over time. By analyzing cloud data collected from both sources, our objective is to evaluate the consistency and reliability of the observations, thereby showcasing the potential strengths and limitations of utilizing the Weather Network HD Camera for nighttime cloud observations in comparison to satellite-derived data. This comparative analysis holds significant implications for research projects conducted at night by schools. This preliminary research found that nighttime Weather Network HD Camera cloud observations are accurate for nighttime observations since the Weather Network HD Camera overall detected many of the same clouds as the NOAA satellite.

Discussion

We could improve the project by collecting data over a longer time. The longer time span would allow more variations in cloud types and coverages to be analyzed in more accurate results. The project could also be done in different seasons to see if there is a variance in results. The results of this project show that the Weather Network HD Camera is extremely accurate and sometimes spots low clouds that the NOAA Satellite imagery does not. This means using this type of camera would allow research groups to take cloud observations during nighttime as opposed to only during the day. These observations could be used for research during the night as opposed to only during the day. Nighttime observations could also be used to study vocalization patterns in birds and amphibians. If this research were to be continued more data points per day should be taken. We took data at 8:00 UTC and 11:00 UTC to strengthen the project data to be taken at 5:00 UTC. The research should also span a longer time span to minimize errors.

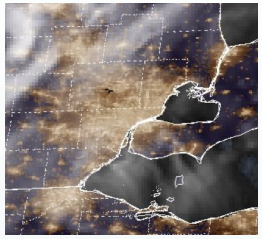
A similar study conducted by Yu-Tai Hou, Kenneth A. Campana, Kenneth E. Mitchell, Shi-Keng Yang, and Larry L. Stowe found that clouds observations are extremely valuable in predicting weather. They stated that "The important role of clouds in long-range climate study and in short-range and medium-range forecasting has been recognized over the past several decades by many atmospheric researchers" (Calbó 7). This supports our conclusion that the Weather Network HD Camera can be used at night for further research projects.

Acknowledgements

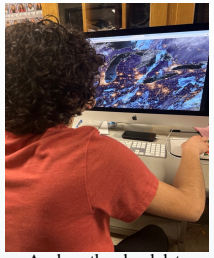
Throughout our project we worked with our former AP Environmental Science teacher and our GLOBE/science club advisor Diana Johns. Mrs. Johns helped train us in identifying cloud types and cloud coverage. Mrs. Johns also helped train us to read the NOAA satellite view of the clouds. She also advised us while we wrote our research paper. This improved the quality of our research and conclusions. We would also like to thank Dr. Michael Notaro from the University of Wisconsin-Madison for allowing us to visit their meteorological center on campus in April 2023 as part of the Midwest SRS. We were inspired to investigate clouds at night because of our visit. We would also like to thank them for providing instructions on how to read satellite cloud imagery.

Methodology

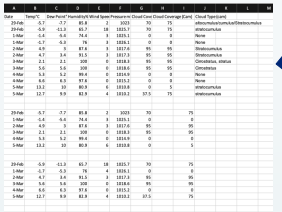
Capture clouds with the Weather Network HD Camera



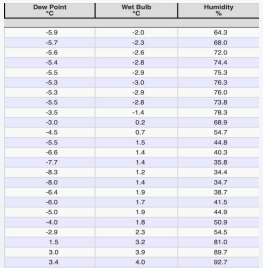
Capture clouds with the NOAA satellite of the corresponding time



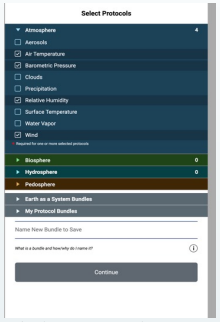
Analyze the cloud data



Input the cloud data into an Excel sheet

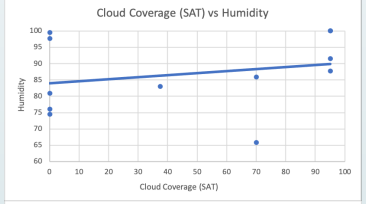


Get atmospheric parameters from Weather Network

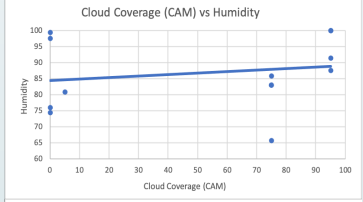


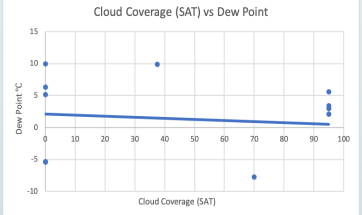
Input atmospheric parameters into GLOBE website

Results

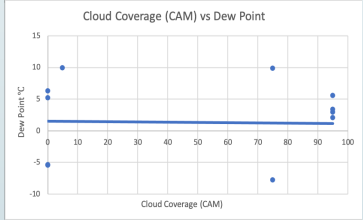


The top left and right graphs indicate that as cloud coverage increases, humidity slightly increases





The bottom left and right graphs indicate that as cloud coverage increases, dew point slightly decreases.



Conclusion

From the data we collected, we saw significant results and answered our two research questions. The Weather Network HD Camera had similar results compared to the NOAA satellite. For two data points where they had different results, the Weather Network HD Camera saw lower height clouds than the Satellite did not see. On February 29 at 8:00 am UTC we saw altocumulus, stratocumulus, and cumulus clouds on the camera. On the satellite we saw altocumulus clouds and stratocumulus clouds but not cumulus clouds. On March 3 at 8:00 am UTC we saw cirrostratus and stratus clouds on the camera. On the satellite we saw cirrostratus clouds but not stratus clouds. The satellite did not locate those lower clouds due to them being covered by higher level clouds. On March 2 at 11 UTC, the Weather Network HD Camera saw stratocumulus clouds, while the NOAA satellite saw altocumulus and Stratocumulus clouds. The Weather Network HD Camera missed the altocumulus clouds, due to the camera facing upwards. The lower level clouds blocked the higher clouds in the area.

The researchers found that there is a weak correlation between cloud coverage and humidity, temperature, dew point, windspeed, and barometric pressure. The correlation between cloud coverage and humidity from the NOAA Satellite and from the Weather Network HD Camera was weak. The correlation between cloud coverage and temperature from the NOAA satellite and the Weather Network HD Camera was weak. The correlation between cloud coverage and dew point from the NOAA satellite and the Weather Network HD Camera was also weak. The correlation between cloud coverage and wind speed from the NOAA satellite and the Weather Network HD Camera was weak. The correlation between cloud coverage and barometric pressure from the NOAA satellite and the Weather Network HD Camera was weak. The weak correlation between cloud coverage and all these parameters is because the sun isn't out during the nighttime. Through our findings we reject the null hypothesis that states the Weather Network HD Camera won't be as accurate as the NOAA satellite on reading cloud coverage and types. There is clear evidence that the Weather Network HD Camera is as accurate as the NOAA satellite in certain cases since most the time it identified many of the same clouds. We also reject the null hypothesis that the Weather Network HD Camera will not be more accurate at observing low level clouds than the NOAA Satellite. There is clear evidence the Weather Network HD Camera is only more accurate sometimes at detecting lower level clouds.

Citations

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