

Introduction

- Research Question- How does type and coverage of clouds correlate to wind speed and energy efficiency?

The study aims to investigate the relationship between cloud coverage, high, middle, and low-level clouds, and wind speed. It is important because it can help in better understanding the factors that affect wind speed and the efficiency of turbines. This knowledge can have significant implications for weather forecasting and climate modeling. A brief review of the literature on this subject reveals that previous studies have found a positive correlation between cloud coverage and wind speed. Other studies have also found that high-level clouds can have a significant impact on wind speed and frequency in wind farms. However, there is still much that is not known about the relationship between cloud coverage, high, middle, and low-level clouds, and wind speed, and further research is needed to better understand these complex interactions. According to M.-C. Robles, a NASA scientist, there are no articles directly related to the current research. However, Robles has found articles related to wind farms and stated that the research is groundbreaking.

Hypothesis

When there is a higher percentage of cloud coverage and high-level clouds, there will be higher wind speeds and more frequent because the clouds will cause uneven heating.

Objective

The purpose of their research is to investigate whether the level of cloud coverage can provide insights into wind speed and efficiency when utilizing a wind turbine. The purpose of our research is to see if the amount of cloud coverage can help understand wind speed and efficiency while using a wind turbine.

Methods

To collect their data, they would go out to the same spot and use an anemometer to measure the wind speed, as well as a wind turbine to measure energy production in volts and amps. Furthermore, they also used the Globe Observer app to collect data on the types of clouds and how much cloud coverage there was. They had to take into consideration factors such as whether there was precipitation or if it had already rained or not. Then, the data that was collected was put into Googleheets to help make the charts. They then used Stats Blue for the "Multiple Linear Regression Calculator" to show the impact on watts.

Clouds can have a massive impact on the environment; however, wind is one of the most significant outcomes.



Collecting wind speed data



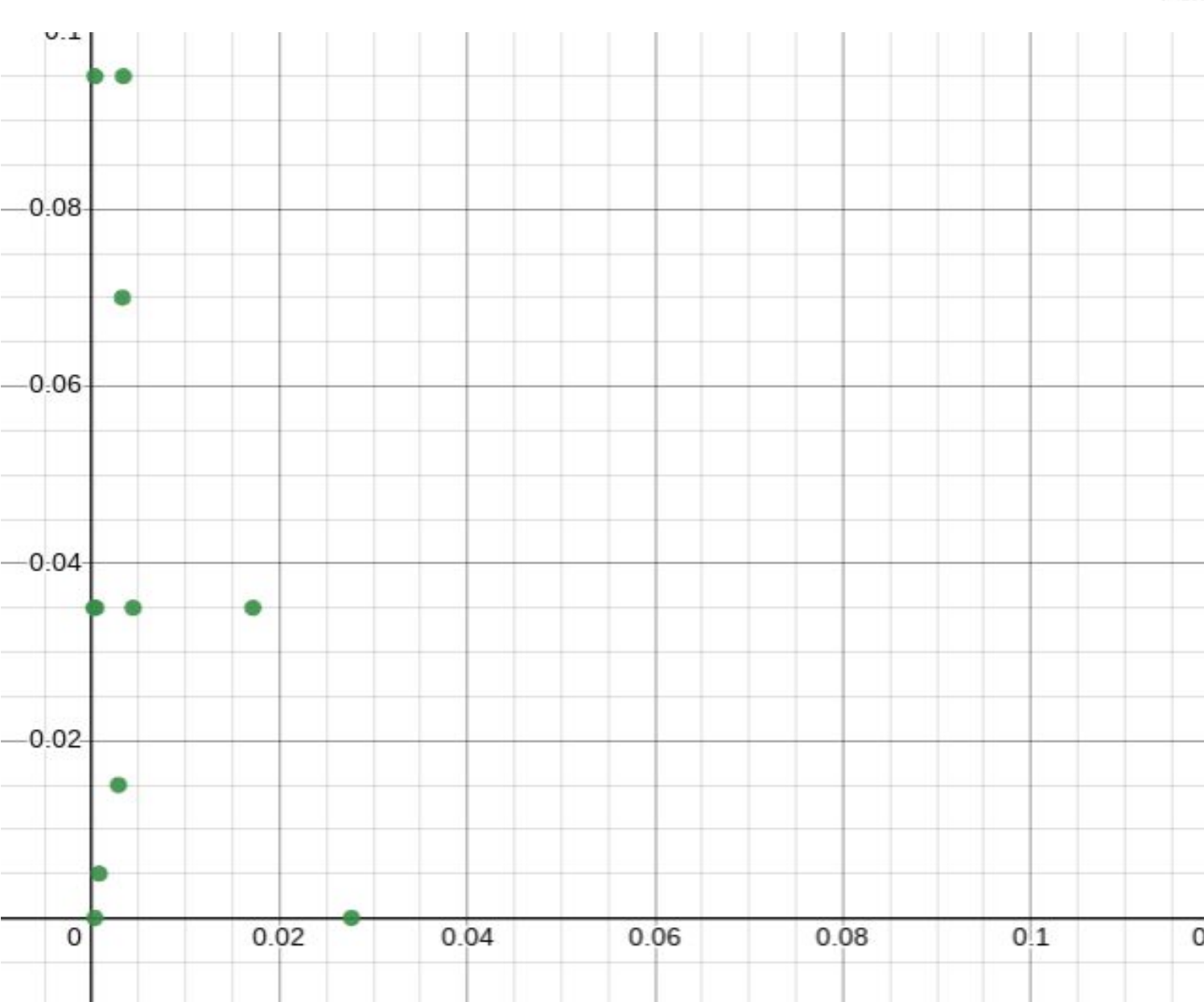
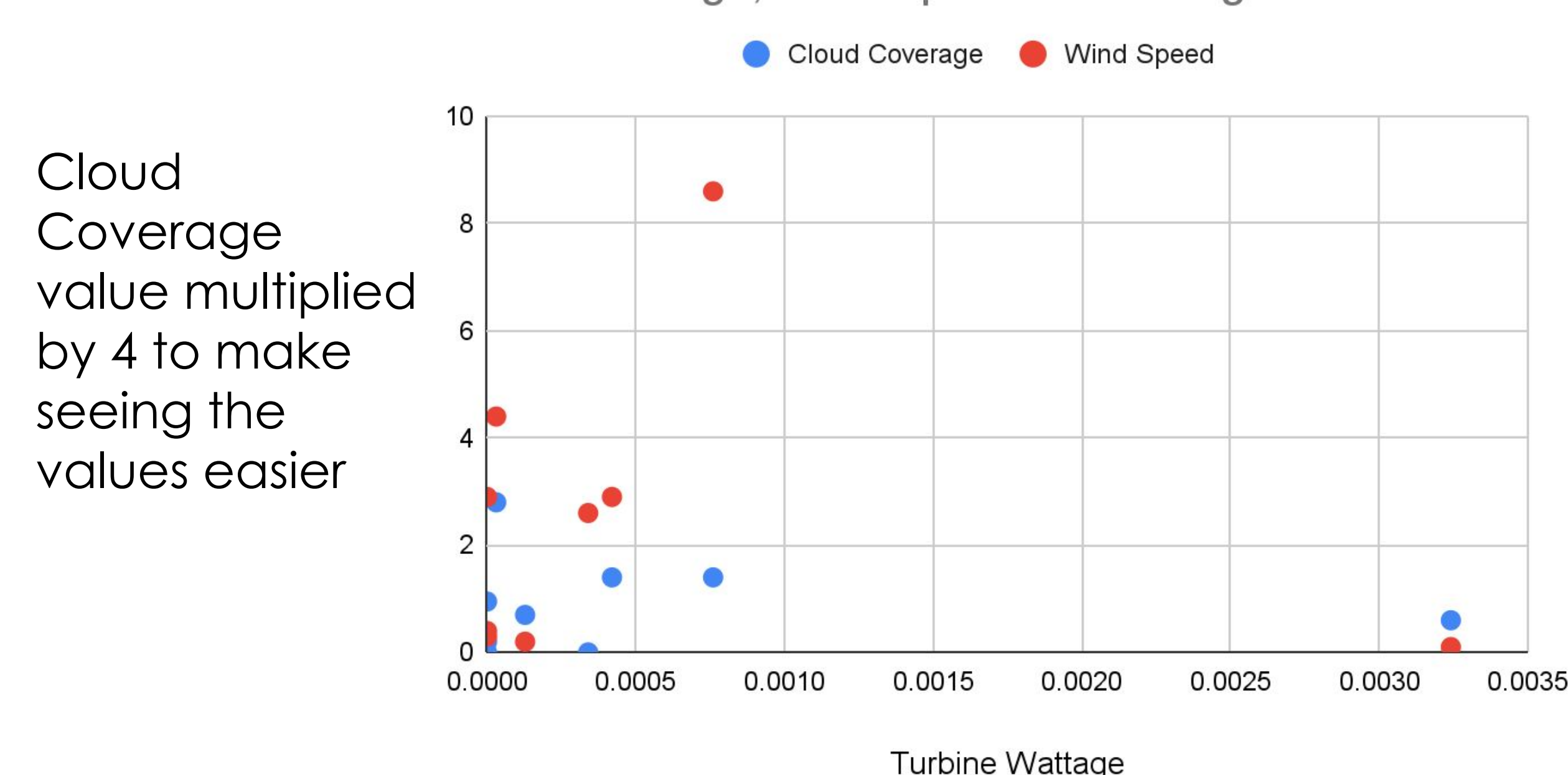
Toledo Technology Academy our research site

★ TTA: The location our research was conducted

Our wind turbine



Cloud Coverage, Wind Speed and Voltage



Graph of Turbine Watts production and cloud cover

X axis- Watts
Y axis- Coverage

Correlation equation:

R-Squared: $r^2 = 0.3815$
Adjusted R-Squared: $r^2_{adj} = 0.2048$
Residual Standard Error: 0.0081 on 7 degrees of freedom.
Overall F-statistic: 2.1587 on 2 and 7 degrees of freedom.
Overall p-value: 0.1861

$$\text{Model: } \text{watts} = 0.0055 + 0 \cdot \text{Surface temp} - 0.0083 \cdot \text{Coverage} + 0.0015 \cdot \text{wind speed}$$

Abstract

This study aims to investigate the relationship between cloud coverage, high, middle, and low-level clouds, and wind speed to better understand the factors that affect wind speed and the efficiency of turbines. The researchers collected data using an anemometer, wind turbine, and Globe Observer app to measure wind speed, energy production, and cloud coverage. However, they found a weak correlation between cloud coverage and wind speed, as well as wind turbine efficiency. Despite the low correlation, the researchers believe that further experiments and research should be done to find any possible correlations between other factors that cloud coverage affects.

Results

According to their research, there is a weak correlation between cloud coverage and wind speed, as well as wind turbine efficiency. The correlation is only around 20%, which is statistically considered to be weak. They used a linear regression calculator to analyze the data but were unable to consider the impact of cloud types on wind speed or turbine efficiency. As per M.C. Robles, (personal communication on December 5, 2023), "This may not be a well-researched topic, but it's still worth exploring to determine whether or not such variables are correlated."

Conclusion

The researchers set out to investigate a possible correlation between cloud coverage and type, wind speed, and turbine efficiency to anticipate future weather patterns. However, they found little correlation between wind speed and cloud coverage. Despite the low correlation, the researchers believe that further experiments and research should be done, looking at many more variables to find any possible correlations between other factors that cloud coverage affects. As Robles said, "It is always good when you have a high correlation; however, just because it's a low correlation doesn't mean it's a fail."

Acknowledgments

We would like to acknowledge the people who helped us on our research.
Mrs. Kubiak
Mr. Richardson
Mrs. Ward
Mr. Best
Sara Mierzwiak (UT, GLOBE Mission Earth)
Marile Colon Robles

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