

How Do Cloud Type and Coverage Affect Our Solar Panels?

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Abstract

In this research, we explored how cloud coverage and cloud type influence the efficiency of our solar panels. To collect cloud data, we utilized two different approaches: the first method involved using a mini camera mounted on a kite to capture images, while the second method entailed taking ground-level photographs with an iPad and uploading them to a global platform. The solar data was exclusively sourced from a specialized website that connects with our solar panels. We meticulously arranged these data points in a Google Sheet and created visual graphs to illustrate our results.

Cloud type and coverage affect our solar panels.

Intro

Our project is: How does cloud type and coverage affect our solar panels? In their 2024 study published in *Renewable Energy: An International Journal*, Franklin W. Watt and Paul A. Campbell examine how solar insolation and cloud opacity influence the optimal array size for direct-coupled solar pumping systems. They note that "solar energy has the disadvantage of being intermittent and unpredictable," yet highlight that "photovoltaic water pumping (PVWP) also ensures additional energy security when compared to pumping systems driven by conventional energy sources." This underscores the potential of PVWP systems to enhance energy security despite the inherent variability of solar energy.

Hypothesis

Cloud Coverage is assumed to affect the output, but we think cloud type will also heavily affect our panels.

Objective

It is essential to forecast solar energy production for any given day without relying on a solar irradiance meter.

Methods

Study Focus: Investigated the impact of cloud coverage and cloud type on solar panel performance.

Data Collection Methods:

- Method 1: Captured images using a mini camera attached to a kite.
- Method 2: Took ground-level photographs with an iPad and transmitted them to a global platform.

Solar Data Collection:

- Obtained from a dedicated solar website that connects to our solar panels.

Data Organization:

- Systematically organized data into Google Sheets.
- Generated graphs to visually represent findings.

Cloud Coverage Measurement:

- Used the Globe app and the grid method for data points.

Data Point Note:

- Only one data point for air pictures (1/18) due to instrument loss during flight caused by weather.

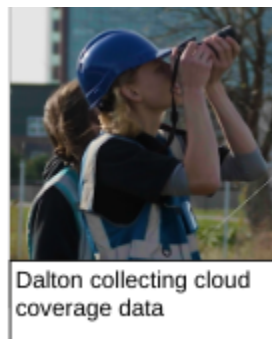
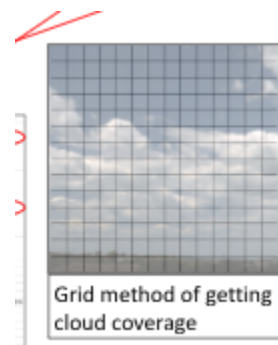
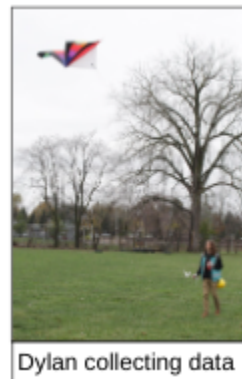
Graph Creation:

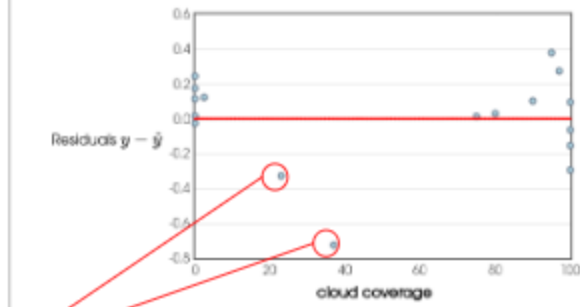
- Data was entered into the StatsBlue website to create the corresponding graphs.

Results

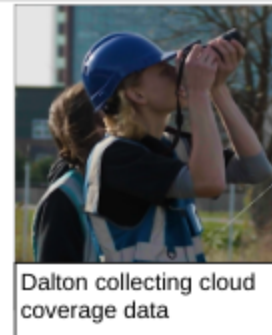
We conclude (using the graphs on the left) that cloud coverage definitely has an effect on our solar panels. The type also has an effect, but due to not being able to separate the clouds and isolate them to take measurements, it was hard to pinpoint which clouds were affecting the panels the most but overcast was the most effective on our panels.

Graphs/ photos/ maps

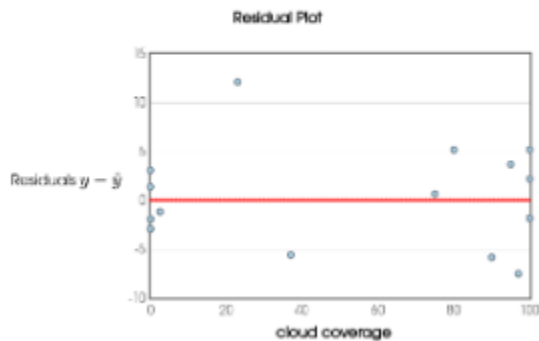




Time	Wind Speed (m/s)	Cloud Coverage (%)	Wind Direction	Cloud Type	Wind Speed (mph)	Wind Direction	Cloud Type
10:00 am	0.880	30	North	Stratus	1.91	North	Stratus
10:10 am	1.28	30	North	Stratus	2.87	North	Stratus
10:20 am	1.28	30	North	Stratus	2.87	North	Stratus
10:30 am	1.28	30	North	Stratus	2.87	North	Stratus
10:40 am	1.28	30	North	Stratus	2.87	North	Stratus
10:50 am	1.28	30	North	Stratus	2.87	North	Stratus
11:00 am	1.28	30	North	Stratus	2.87	North	Stratus
11:10 am	1.28	30	North	Stratus	2.87	North	Stratus
11:20 am	1.28	30	North	Stratus	2.87	North	Stratus
11:30 am	1.28	30	North	Stratus	2.87	North	Stratus
11:40 am	1.28	30	North	Stratus	2.87	North	Stratus
11:50 am	1.28	30	North	Stratus	2.87	North	Stratus
12:00 pm	1.28	30	North	Stratus	2.87	North	Stratus
12:10 pm	1.28	30	North	Stratus	2.87	North	Stratus
12:20 pm	1.28	30	North	Stratus	2.87	North	Stratus
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12:40 pm	1.28	30	North	Stratus	2.87	North	Stratus
12:50 pm	1.28	30	North	Stratus	2.87	North	Stratus
1:00 pm	1.28	30	North	Stratus	2.87	North	Stratus
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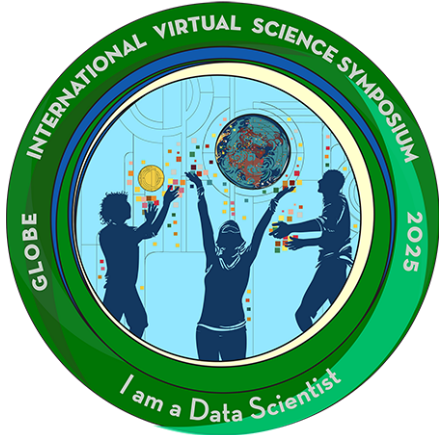
Regression Line: $\text{WIND SPEED} = 0.099 \cdot \text{CLOUD COVERAGE} + 4.922$
 Correlation: $r = 0.689$
 R-squared: $r^2 = 0.475$



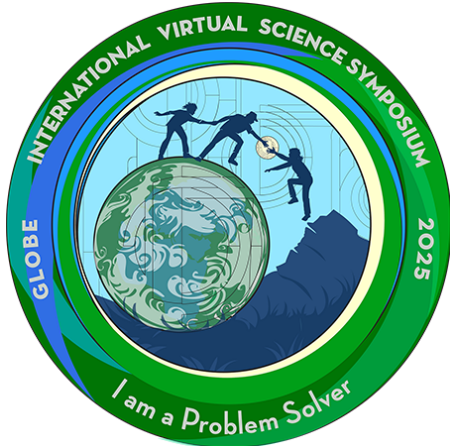
Conclusions

The graphs that were created proved our hypothesis—that the cloud type and coverage would affect our solar panels—true. If we had more time, my group would take the next steps of taking more time with our kite flying and documenting our kite data more accurately. Our message of hope is that solar panel technology is advancing and becoming more efficient, getting rid of some of those problems that make solar panels worse than non-renewable energy.

Badges



We are data scientists because of our extensive research into our research topic and use of data collecting tools.



We are problem solvers due to the fact that we had many setbacks in our data collection and we managed to get past them and finish our projects

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- GLOBE Mission Earth,
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