

The Effect of Particulate Matter on Solar Energy

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Introduction

How does particulate matter affect solar panel efficiency? The purpose of this research project is to find the relationship between air quality and solar panel outputs. One of the best sources showed that there is an effect of particulate matter deposition on solar panel efficiency (Kim, 2024). Air pollutants have become a serious environmental problem in recent years. Not only does it affect living creatures, but it also impacts the energy output of solar panels. Due to a rise in the amount of air pollutants, due to increased carbon emissions. The particulate matter in the air is acting as a barrier, blocking sunlight from reaching the panels. This issue can cause a lot of energy to be wasted because of the increase in carbon emissions (Chandler, 2019).

Hypothesis

Air quality, specifically particulate matter, will have a negative effect on the output of solar panel arrays. This will occur because the particulate matter will deposit onto the panels and block light from reaching the lower levels of the panel (Roumpakias, Stamatelos, 2020).

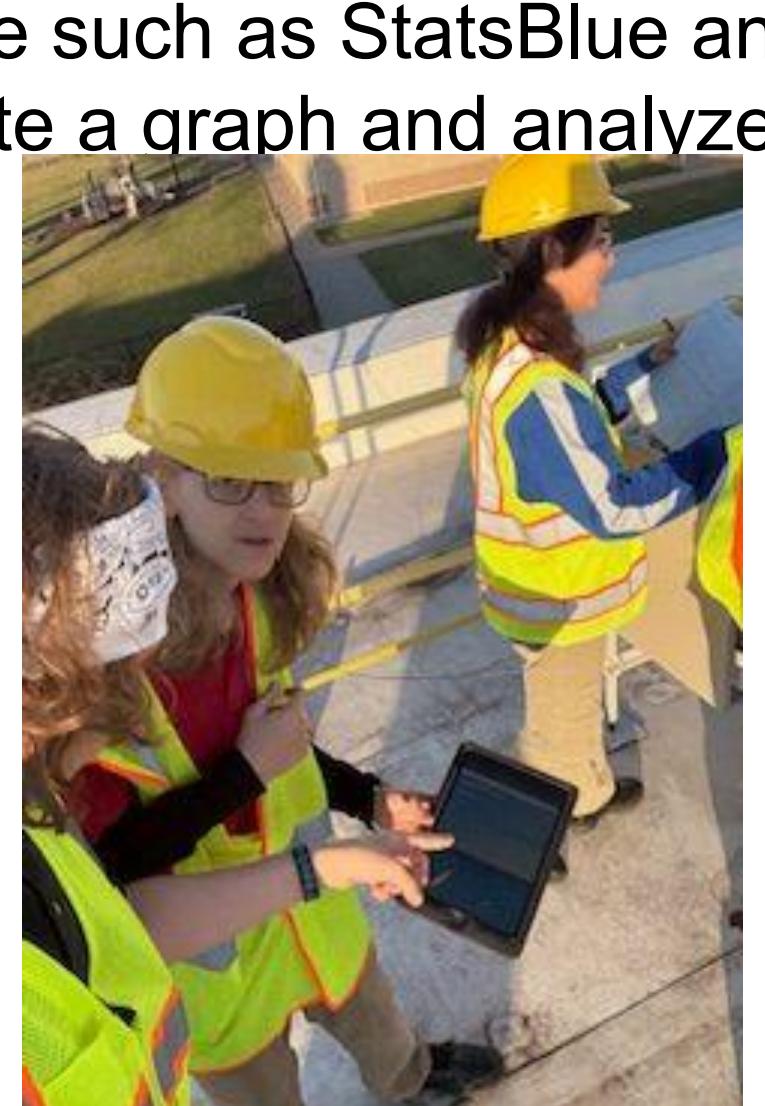
Objective

To find the relationship between particulate matter and the output of solar panels in kWh.

Methods

- Bring the iPad and engineers notebooks to record data.
- Go onto the roof for a good connection with the sensors and to check on the sensors and solar panel array, done at 9-10 AM.
- Use the Davis app and Purple Air website to get PM1, PM2.5, PM5, and PM10.
- Use the APsystems website to get kWh data from the solar panel array output.
- Ensure the data is accurate and correct.
- Use a graphing website such as StatsBlue and graphs on Google Sheets to create a graph and analyze the data that was collected.

Utilizing the Ipad and Davis weather app

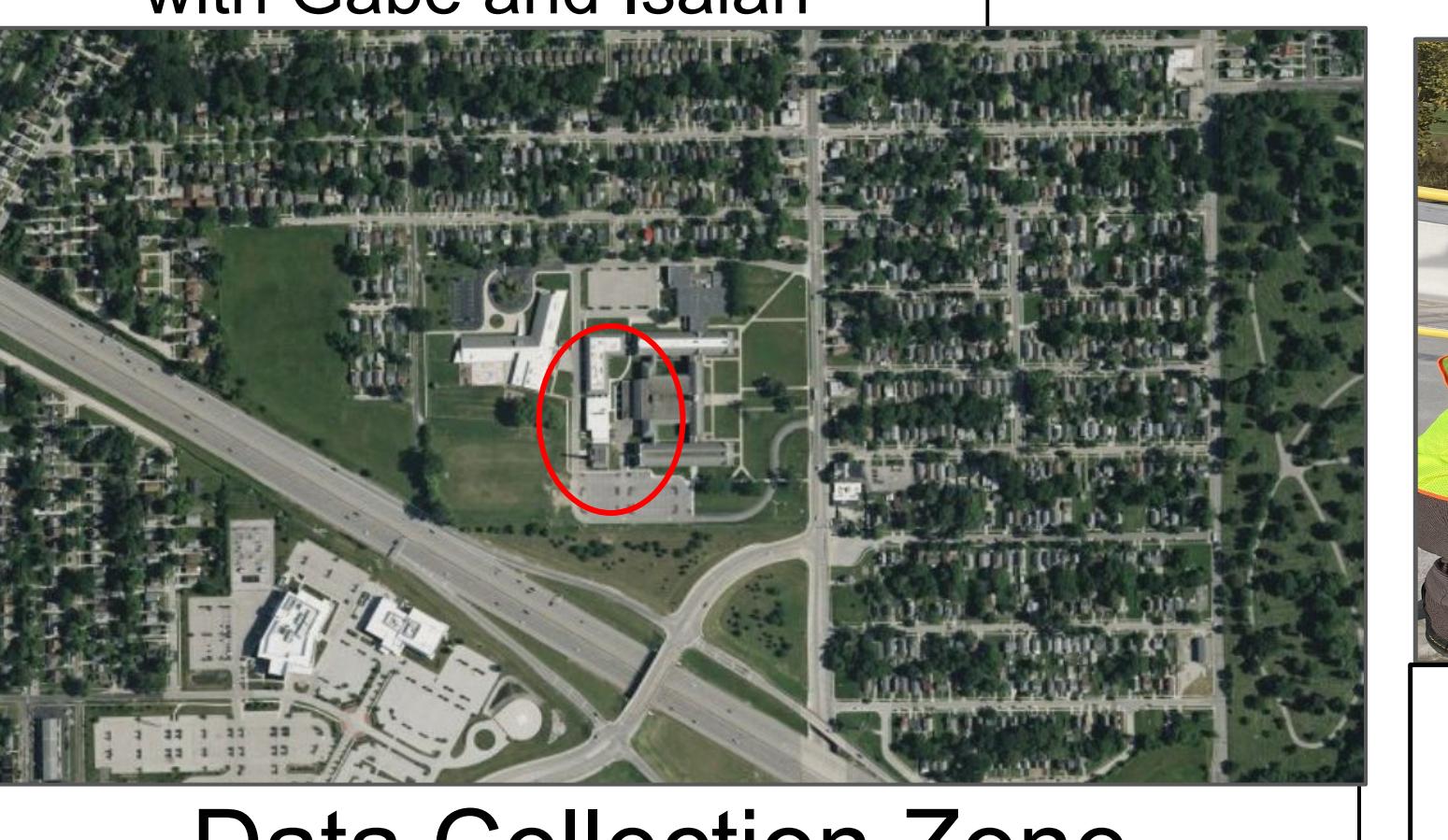


Raw Data

Date	Time	PM2.5_AVG	PM5_AVG	PM10_AVG	PM1_AVG	PM0.5_AVG	PM0.1_AVG	Daily_kWh	Daily_kWh_AVG
2029-09-01	12:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	12:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	12:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	12:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	13:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	13:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	13:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	13:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	14:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	14:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	14:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	14:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	15:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	15:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	15:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	15:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	16:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	16:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	16:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	16:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	17:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	17:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	17:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	17:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	18:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	18:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	18:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	18:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	19:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	19:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	19:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	19:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	20:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	20:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	20:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	20:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	21:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	21:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	21:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	21:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	22:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	22:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	22:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	22:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	23:00	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	23:15	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	23:30	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	23:45	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00
2029-09-01	23:59	0.99	0.20	0.00	0.00	0.00	0.00	0.00	0.00



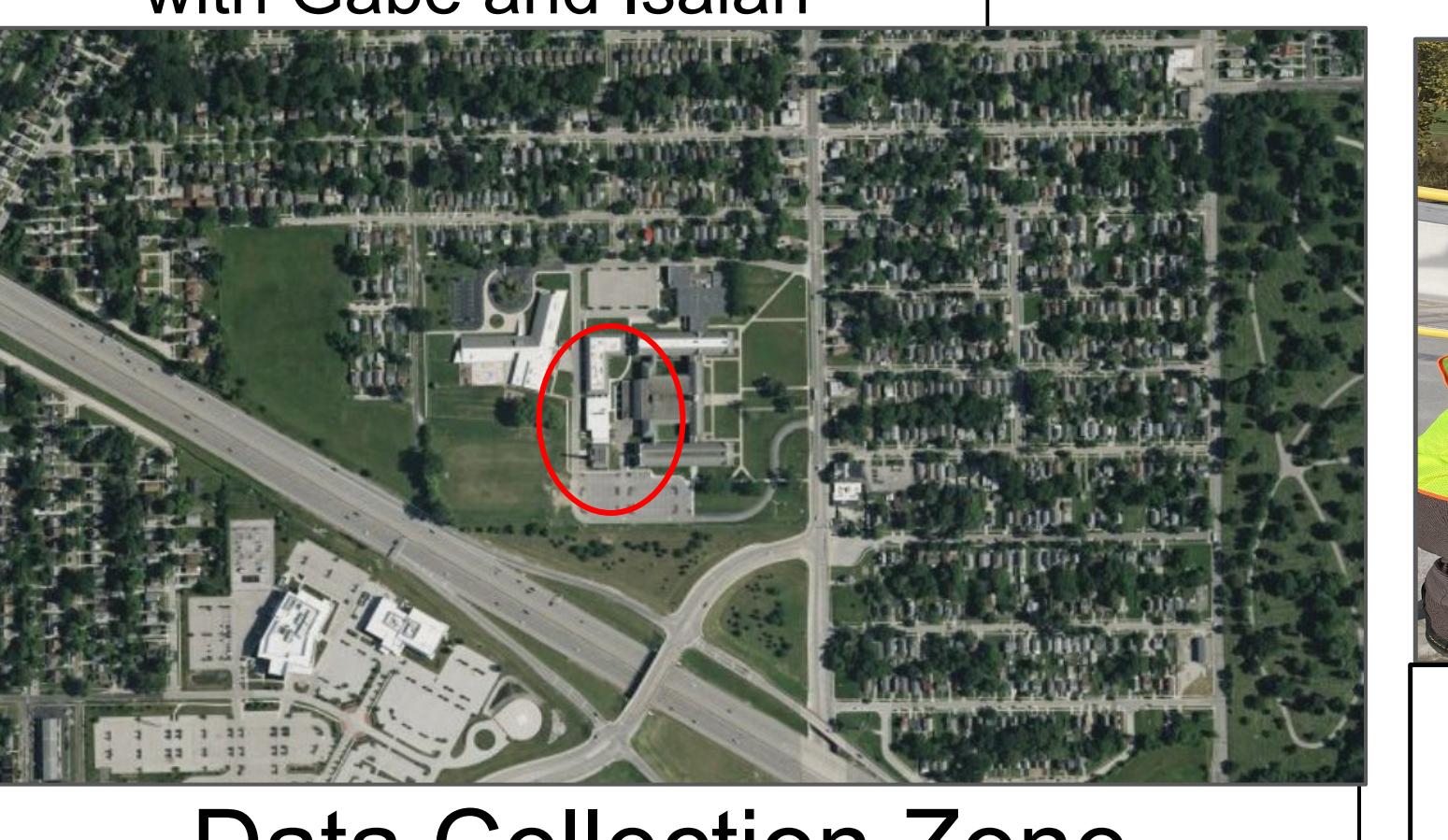
Davis sensor and collaboration with Gabe and Isaiah



Data Collection Zone



Collaboration with EPA and Dietrich's group at our air sensor



Purple Air Sensor

References

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Roumpakias, E., & Stamatelos, T. (2020). Surface Dust and Aerosol Effects on the Performance of Grid-Connected Photovoltaic Systems. *Sustainability*, 12(2), 569. <https://doi.org/10.3390/su12020569>

Abstract

This GLOBE project investigates the effect of PM (particulate matter) on solar panel output. Based on the listed graphs, there is a weak correlation between PM 2.5 and solar output. PM 5.0 has a correlation of 0.3, which is weak, and in PM10, it is apparent that 0.23 is the correlation, which is also weak. Though there was little correlation seen between PM and kWh, this does not mean there isn't one. The purple air was stationed on a roof, so there is a chance it did not gather all the larger PM due to larger PM being heavier and residing closer to the ground.

Results

There appears to be a weak correlation between particulate matter and kWh of solar energy. The PM2.5 likely does not affect the solar panels unless it is at a very high level. PM5 or PM10 appear to have a weak correlation of around 0.23 - 0.3, this is likely because they are larger particles. The particulate matter levels around the school appear to be low enough to not deposit a significant amount of particulate matter onto the panels or block the sunlight. Some parameters, such as temperature, humidity, and clouds, might have a larger and more noticeable effect on the solar output than particulate matter does (Shaik, et al, 2025).

Conclusion

Although there was no strong correlation between the parameters, that does not mean there is no correlation. The effect