Barometric Pressure's Effect on Cloud Coverage and Solar Output

Corinne Blake and Liam Close
Toledo Technology Academy of Engineering

Introduction

With the threat of climate change, it's becoming increasingly obvious that a cleaner and safer way to generate power is needed. So, people are now turning to renewable sources. One of the major sources of renewable energy is solar. In *Energies*, Sanzana Tabssum et al., authors of "Solar Energy in the United States: Development, Challenges and Future Prospects" write, "PVs are widespread and versatile as they can be installed on the rooftop of residential and commercial buildings, as well as in utility-scale power plants." There is one challenge to implementing Solar energy, it needs the sun. In a previous study, written in the *International Review of Electrical Engineering*, authors Cheiw Y. Lau et al. of "A Review on the Impacts of Passing-Clouds on Distribution Network Connected with Solar Photovoltaic System" explain, "Passing-cloud over a PV array will cause partial shading and cause various losses." In order to see if altitude and barometric pressure had correlations with cloud coverage, the comparison between barometric pressure and cloud coverage was added to the new procedure alongside cloud coverage's effect on solar output. With this project, the effects of barometric pressure and clouds on solar energy can be seen—which will further the advancement of renewable energy placement and energy production.

Hypothesis

When barometric pressure is higher there will be a higher percentage of cloud coverage, and a higher cloud coverage percentage will cause a lower amount of power produced by the solar panels.

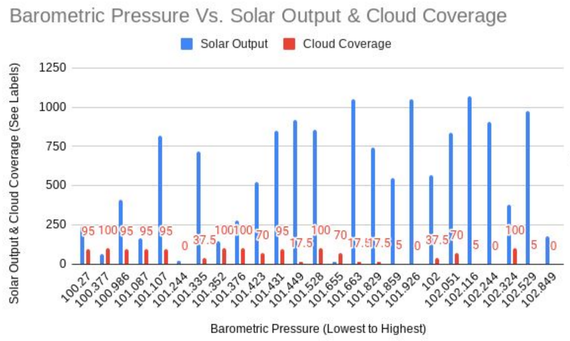
Objective

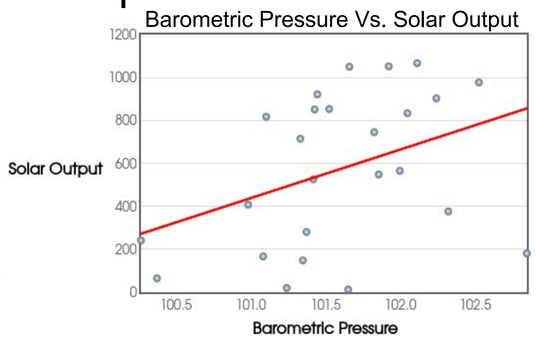
To find a correlation between barometric pressure and cloud coverage and their effects on solar output in order to find locations with good solar coverage to build solar farms on.

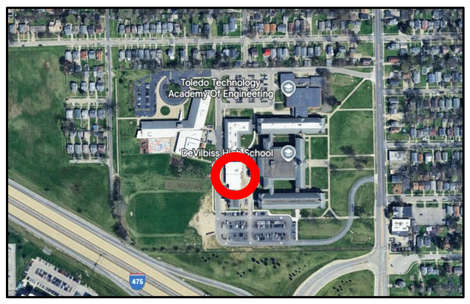
Methods

- On the roof of the EV lab, place the barometer against the wall vertically.
- Record three points of data with 2 minutes between intervals; data will be shown on the Labquest 2 (Ex. 10:00, 10:02, 10:04)
- Record data in your engineer's notebook
- In the middle of the roof, use an iPad and GLOBE Observer App to record the cloud coverage and type
- Record data in your engineer's notebook
- Using the Apsystems Ema website, collect 3-5 data points of solar output around the time of barometric pressure collection
- Record data in your engineer's notebook
- Transfer all data from your engineer's notebook onto a Google Sheet
- Transfer barometric pressure and cloud data to the GLOBE website
- Repeat the previous steps for all data collection
- Put data into the Stats Blue website and Google Sheets to create graphs

Barometric pressure affects the amount of clouds in the atmosphere which affects the solar panels' electrical output.



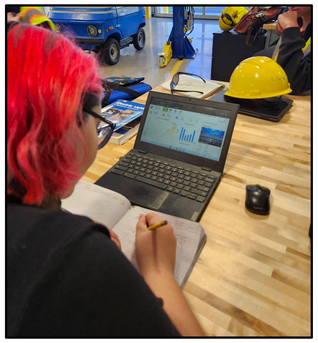




Map of data collection area on the Ev Lab roof.

Time	Solar Output	Cloud Coverage	Barometric Pressure	Baro least to most
9:45	922	17.5	101.449	100.27
9:44	565.6	37.5	102	100.377
9:51	1050.34	17.5	101.663	100.986
10:22	715.3	37.5	101.335	101.087
8:43	20.2	0	101.244	101.107
10:19	1052.5	0	101.926	101.244
10:14	817.5	95	101.107	101.335
10:08	851.8	95	101.431	101.352
10:10	1067.3	5	102.116	101.376
10:04	977.5	5	102.529	101.423
8:47	181	0	102.849	101.431
10:16	903.5	0	102.244	101.449
10:08	408.3	95	100.986	101.528
10:37	148.5	100	101.352	101.655
10:19	745.8	17.5	101.829	101.663
10:22	167	95	101.087	101.829
9:19	13	70	101.655	101.859
10:18	853.8	100	101.528	101.926
10:11	526.5	70	101.423	102
9:25	549	5	101.859	102.051
10:28	241.5	95	100.27	102.116
9:57	376.5	100	102.324	102.244
10:01	834.5	70	102.051	102.324
10:18	65	100	100.377	102.529
10:09	281	100	101.376	102.849

Data Table



Solar Data Collection

Barometric Pressure Data Collection

Cloud Data Collection

Abstract

Due to the need for renewable energy sources with large expenses associated with them, properly picking out a good location for solar farms is important in maximizing efficiency. In order to pick an adequate location, research was conducted into the relationship between barometric pressure and cloud coverage and their effect on solar energy output. Data was collected with a barometer and the GLOBE Observer app on the roof of the TTA Electrical Vehicle Lab—over the span of 6 weeks. The data resulted in a correlation between barometric pressure and cloud coverage which affected solar energy output.

Results

According to the data, there are correlations between barometric pressure, cloud coverage, and solar output. Barometric pressure and cloud coverage are shown to have a negative linear relationship, with cloud coverage being lower when barometric pressure is higher. Additionally, cloud coverage and solar output have a negative linear relationship; solar output increases when cloud coverage decreases. Because of these relationships, barometric pressure and solar output have a positive linear relationship, increasing with the other variable. When it comes to the time of day when data was collected, there is some correlation between the time data was collected and the value of the data. The largest correlation would be between cloud coverage and time; the earlier in the day the more clouds there are (as seen in the data table). In addition, the correlation between time and solar output is a positive linear relationship with more energy production later in the day. With this information, it can concluded that there is a correlation between barometric pressure and cloud coverage and that they do affect solar energy output.

Conclusion

As a result of our research, we found a negative correlation between barometric pressure and cloud coverage, which affects solar output—making our hypothesis correct. Additionally, barometric pressure data allows for predictions of the next day's cloud coverage; consequently, you can make a decently accurate prediction of the future's solar output. The higher the barometric pressure, the higher the solar output. In the future, it would be beneficial to make sure more consecutive days were recorded to get a map of data to maximize prediction accuracy. In addition, the project could be expanded to see barometric pressure's effect on cloud type, weather, and precipitation. By studying these correlations, we can better select the best locations for solar farms and maximize renewable energy over fossil fuels, resulting in the reduction of greenhouse gas emissions and minimizing the effects on the climate.

Acknowledgments

Laura Kubiak - Helped with data, editing, support, etc.
Gladwyn Richardson - Helped with data, editing, support, etc.
Timothy Best - Helped with editing and bibliography.
Kris Kania - Helped with data formatting and mathematics
Grant Wilson - Was our University of Toledo mentor and helped with data collection and editing.
Geoff Bland - NASA scientist who helped with research goals, ideas, and data collection.

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