Finding Correlation between Wind Efficiency and Barometric Pressure

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Introduction

Is there a correlation between wind speed & barometric pressure? Do wind speed & barometric pressure correlate with wind efficiency? This study can show weather conditions, ideal climate, and location for maximizing wind energy.

Barometric pressure is useful for predicting short-term changes in the weather. It's useful for other things aside from providing evidence for how Barometric pressure can affect water inside an aquifer, Shih (2018) discovers "The barometric efficiency can be also used as a correction factor to remove barometric effects on water levels in wells during an aquifer test" (p.1).

Furthermore, it's worth noting wind has many strong negative effects in certain regions for turbine placement. For example, Vavrus, S. J., & Alkama, R. (2022) report "Surface winds are also an important element of high-latitude circulation, and they are closely related to cyclones and ocean wave heights" (p.1). Thus, the most efficient location for wind turbines in the world, may not be suitable due to the winds being too strong or contributing to severe weather events.

This study is important because wind is a renewable resource and everyday, more fossil fuels are being burnt. This in turn, creates trouble in our atmosphere which is slowly increasing global warming. Therefore, it's important to understand what effect barometric pressure has on our wind efficiency so that it can be used to its full potential without fear of being depleted as well as not having to rely on fossil fuels so much. There is only so much coal, natural gas, and oil. Some may believe there is an endless supply but there isn't and if society doesn't start cutting back, then our current fossil fuels will become scarce in the future. In a project similar to ours, Schiendelegger & Ray (2014) discovered "Our efforts are limited to the annual mean of the surface pressure tides, while locally strong seasonal modulations (20–30 Pa for S1 over certain landmasses in midlatitudes) await separate treatment in a future publication" (p. 3).

Hypothesis

We believe Location & weather events / storm fronts will have a direct effect on wind speed and barometric pressure because storms create wind fronts. (lower BP causes higher wind speeds)

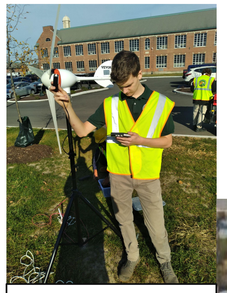
Objective

To find the best conditions to maximize energy production of a wind turbine

Methods

Materials Used: Anemometer, Barometer, Lab Quest, Notebook/Pad, Writing utensils (Preferably 2 pencils/pens).
Step 1: Gather materials and head over to site for data collection.
Step 2: Attach anemometer to Lab Quest for wind speed collection and record your results.
Step 3: Swap out the anemometer with the Barometer for barometric pressure collection and record results
Step 4: Wait for a few minutes before collecting another set of data. (Be sure to collect 3 data sets every day.)
Collect Data between 8:30 AM and 10 AM
Enter Data into globe observer
Use Stats blue website to enter variables.

Barometric Pressure can affect output of a wind turbine. Barometric Pressure can predict wind speed and consistency in a large area.



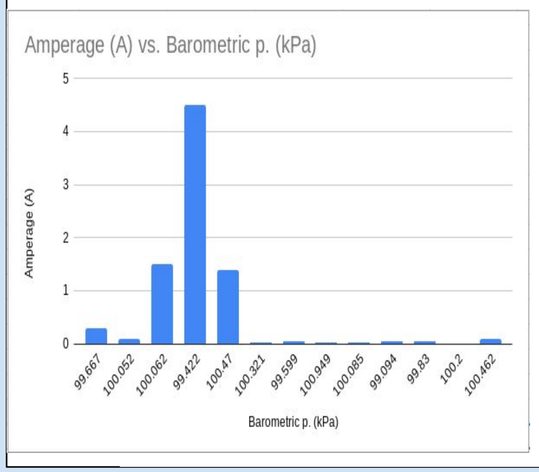
Collecting barometric pressure

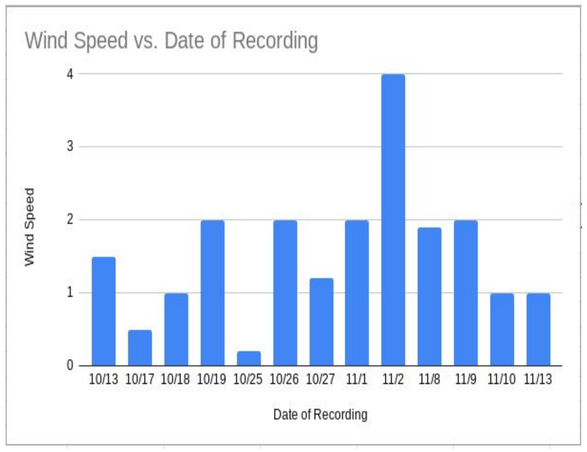
Collecting wind speed

Map of TTA

Green Dot = location of initial test. (data not sufficient or very little wind)

Red Dot = 2nd testing site (used for majority of tests)





References

•Shih, D. C.-F. (2018). Identification of Individual Efficiency for Barometric Pressure and Ocean Tide Load Simultaneously Acted on Deep Aquifers Adjacent to the West Pacific Ocean. *Pure & Applied Geophysics*, *175*(12), 4643–4654

•Vavrus, S. J., & Alkama, R. (2022). Future trends of arctic surface wind speeds and their relationship with sea ice in CMIP5 climate model simulations. *Climate Dynamics*, *59*(5/6), 1833–1848.

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Abstract

Our project was determining whether or not there would be a consistent change between wind speed and barometric pressure on a daily basis. We also investigated whether or not there was any relationship involving changes in weather conditions. In order to investigate these changes, we had to go out everyday between 8:00-10:30. We would then collect data for the wind speed and barometric pressure and record them. The results gathered varied day-by-day; however, different weather conditions, such as whether it was cloudy, rainy, etc. did have an effect on our findings.

Results

The results varied from day to day, but there were slight differences in results as different weather conditions were presented (whether it be months long or short like a few days)

Our research has found an above 50% (64%) correlation between barometric pressure and the amperage of the electricity produced by a wind turbine.

We used two locations to collect data, the first location is represented by the green dot, this location provided weaker results, but the second location (red dot) showed stronger results (probably because it was a wider space.)

We found that when Barometric pressure is lower, Wind speed was higher. And results can be found on the graphs.

(Wind flow through the first area was affected by the building, Thus, we had to move locations to the 2nd spot which was More open and allowed for more reliable results.)

Conclusion

There is a correlation between barometric pressure and the amperage of electricity produced by a wind turbine. Since it's above 50% (64%), it means it's a moderate correlation. One thing we noticed was on days when it was either cloudy or rainy, the barometric pressure remained below 100.

Barometric pressure in the event of storm fronts or cold / warm fronts, creates almost a wave of high pressure air blowing into a low pressure area, which causes wind speed to increase. (Think of an ocean wave being washed up on a beach, the ocean wave has force that causes it to move.)

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