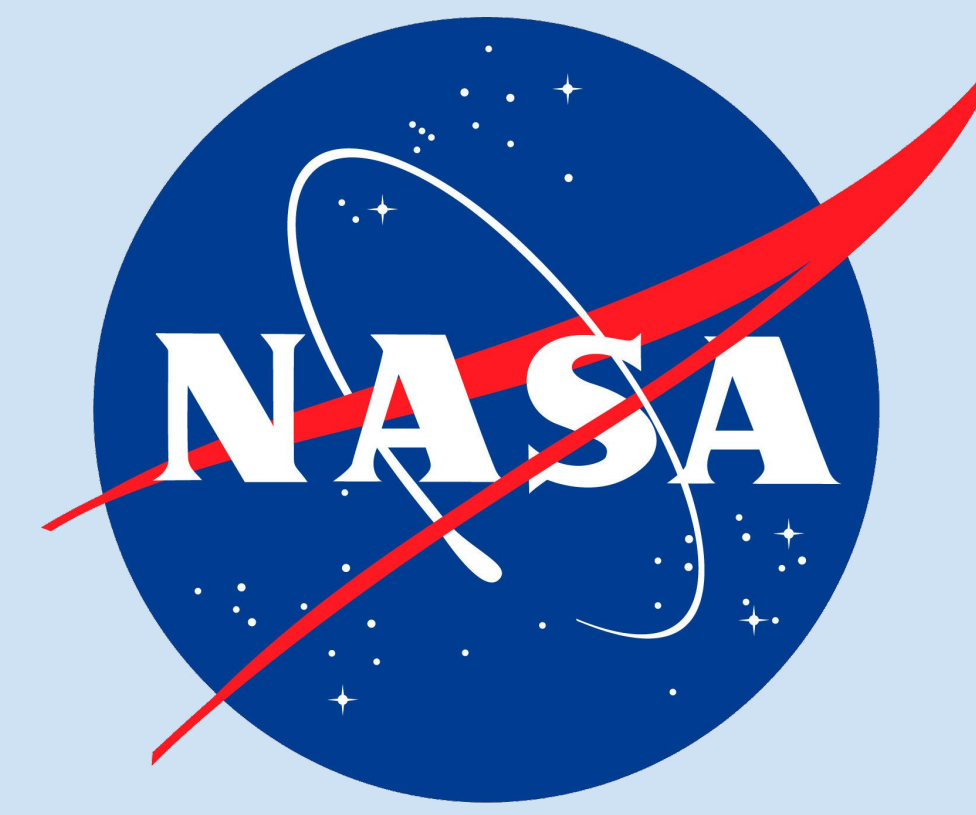


Soil Moisture In Regards to Wind Speed and Precipitation

Jimmiry Lloyd, Jean Mead, Kenny Sattler
Toledo Technology Academy of Engineering



Introduction

Soil moisture, as Peretti et al. put it, “is a key variable of the climate system as it interacts with the atmosphere through complex feedbacks by means of the energy and water balance.” The water content of soil is important to many communities, as it is a key ingredient in growing the food we eat everyday. When talking about what changes soil moisture, Li et al. state, “the sensible heat transferred by the wind...not only exacerbates droughts in areas where precipitation has been significantly reduced, but also causes areas with slightly reduced or even increased precipitation to become drier.” This leads to the question—does wind speed have a direct correlation with soil moisture content. This project aims to explore the impact of wind speed on soil water content, with precipitation being the reset button on the data.

Hypothesis

The hypothesis was wind speed would lower soil water content with precipitation being a reset on the data

Objective

The objective is to find any correlation between precipitation levels, wind speed, and soil moisture.

Methods

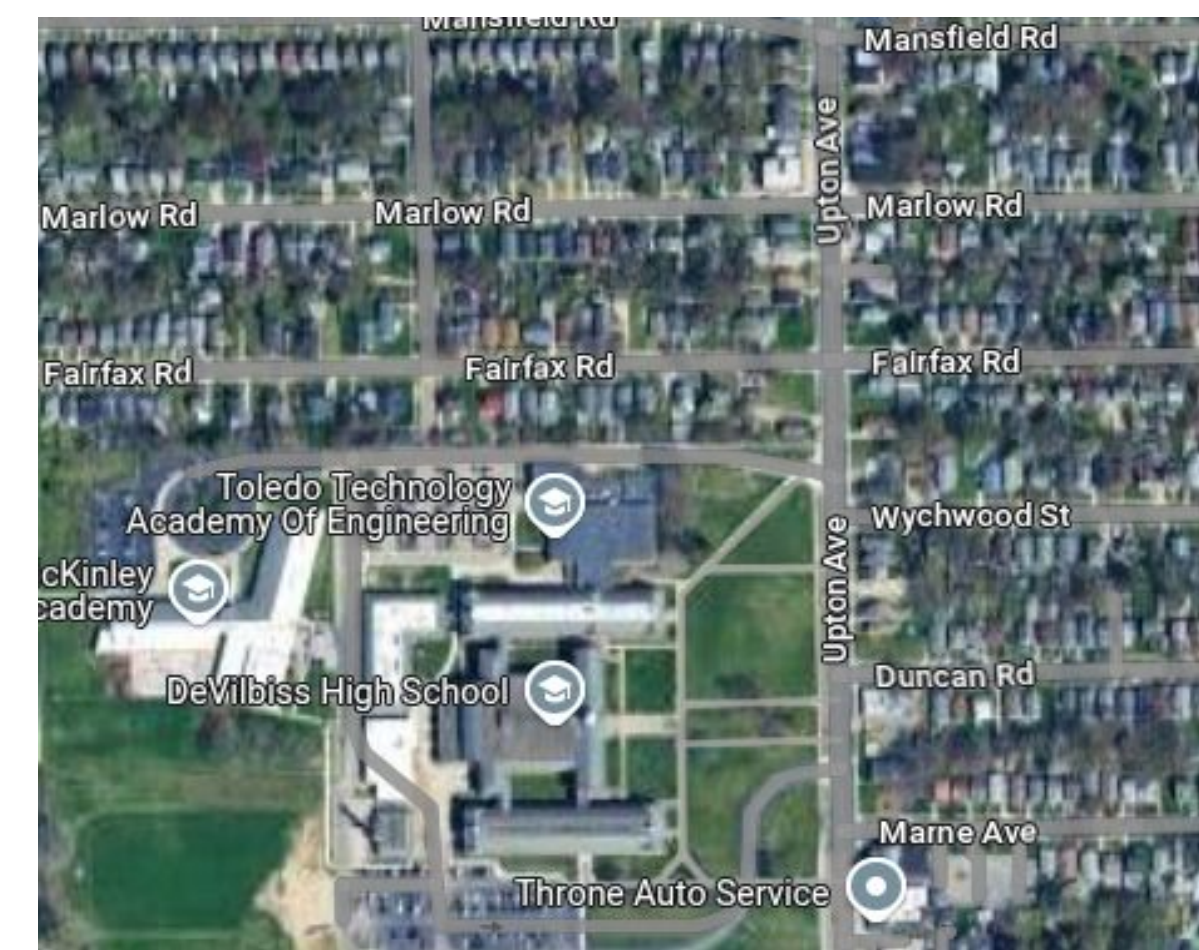
Soil Moisture

- Gather tools; Labquest 3, Rain Gauge, Soil Moisture Sensor, and Shovel and go to site of data collection
- Dig holes 2” for soil moisture collection and follow standard procedure to collect data
- Set up rain gauge on a post in correspondence to GLOBE protocol
- Record soil moisture and rain data in Engineer’s Notebook, following all necessary procedures
- Upload data into the GLOBE website
- Use Stats.Blue website to make graphs to compare data

Wind Speed and Turbine

- Gather tools; Labquest 2 or 3, Anemometer, and Wind Turbine and go to site of data collection.
- Using anemometer, hold facing the wind for a set amount of time of your choosing
- Hook labquest to the wind turbine
- Record V, A, and W from wind turbine and m/s in Engineer’s Notebook
- Upload data to the GLOBE website
- Use Stats.Blue website to make graphs and compare data

Wind speed has a minute effect on the water content in the soil



Surrounding Area



Data Collection Site



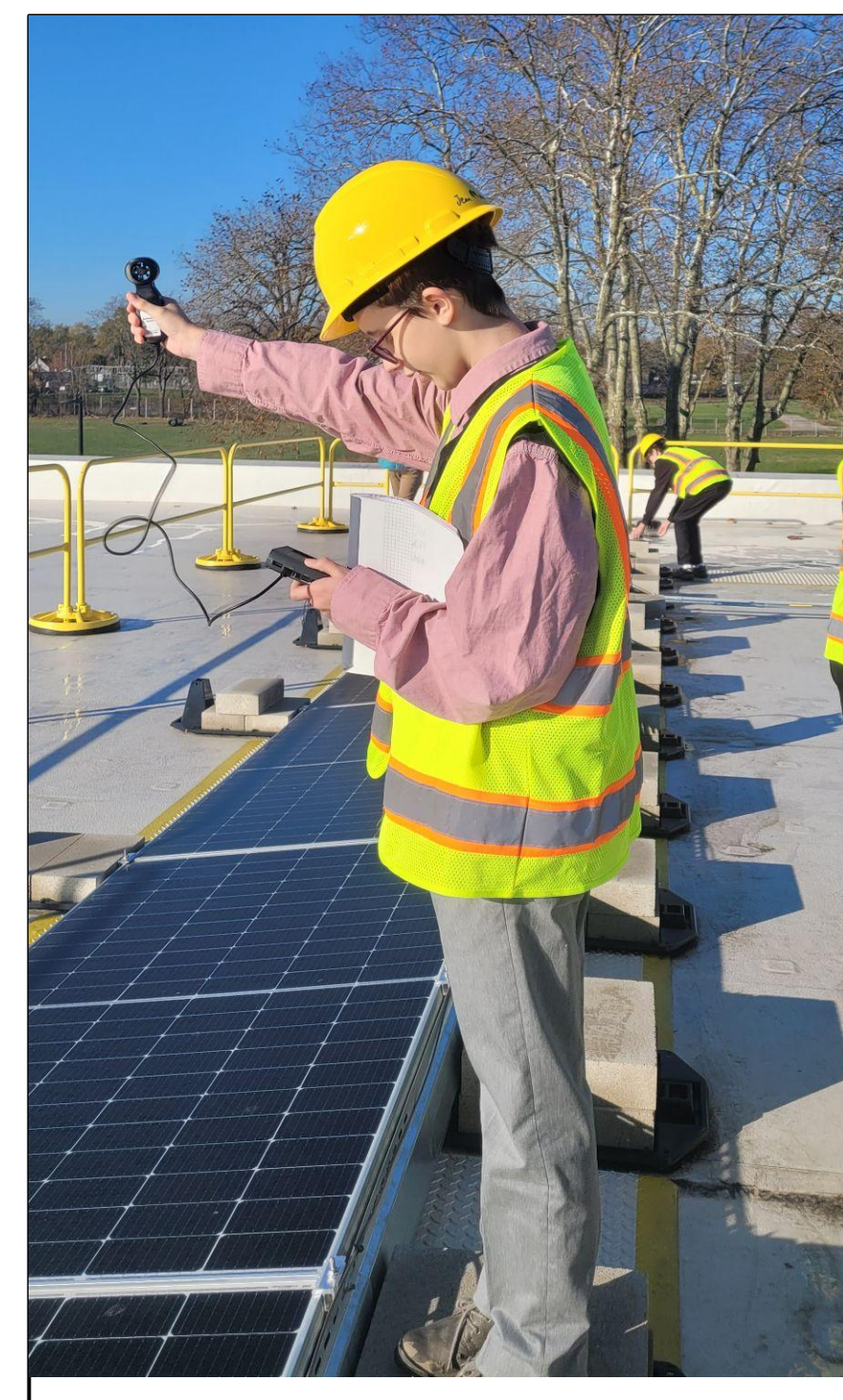
Collecting Soil Moisture Data



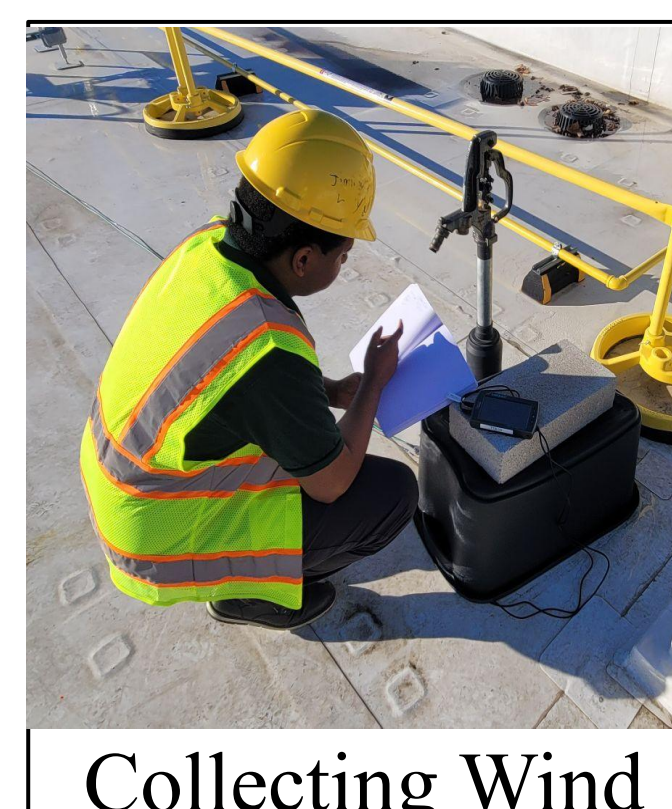
Rain Gauge



Anemometer



Collecting Wind Speed Data

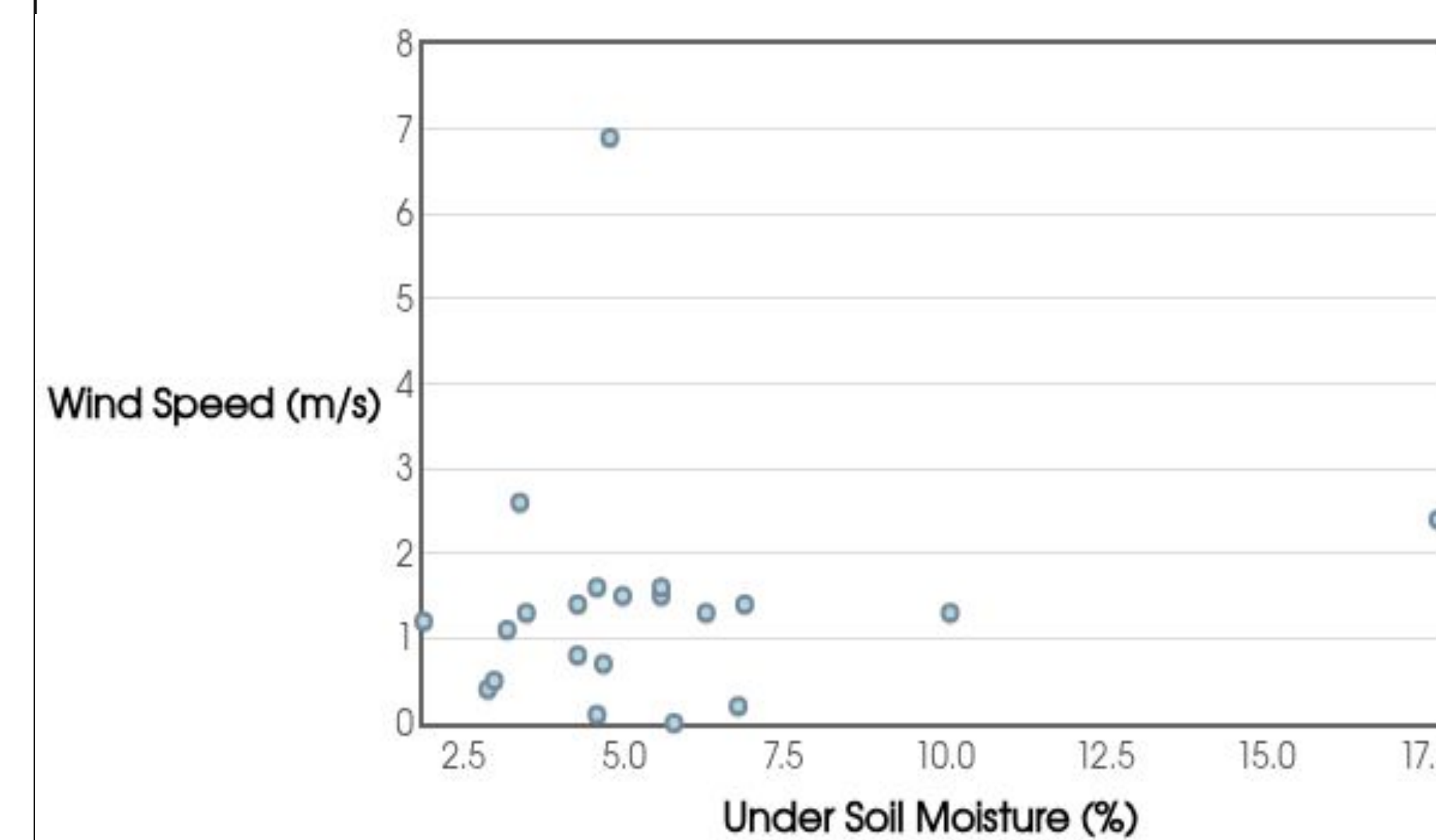


Collecting Wind Turbine Data

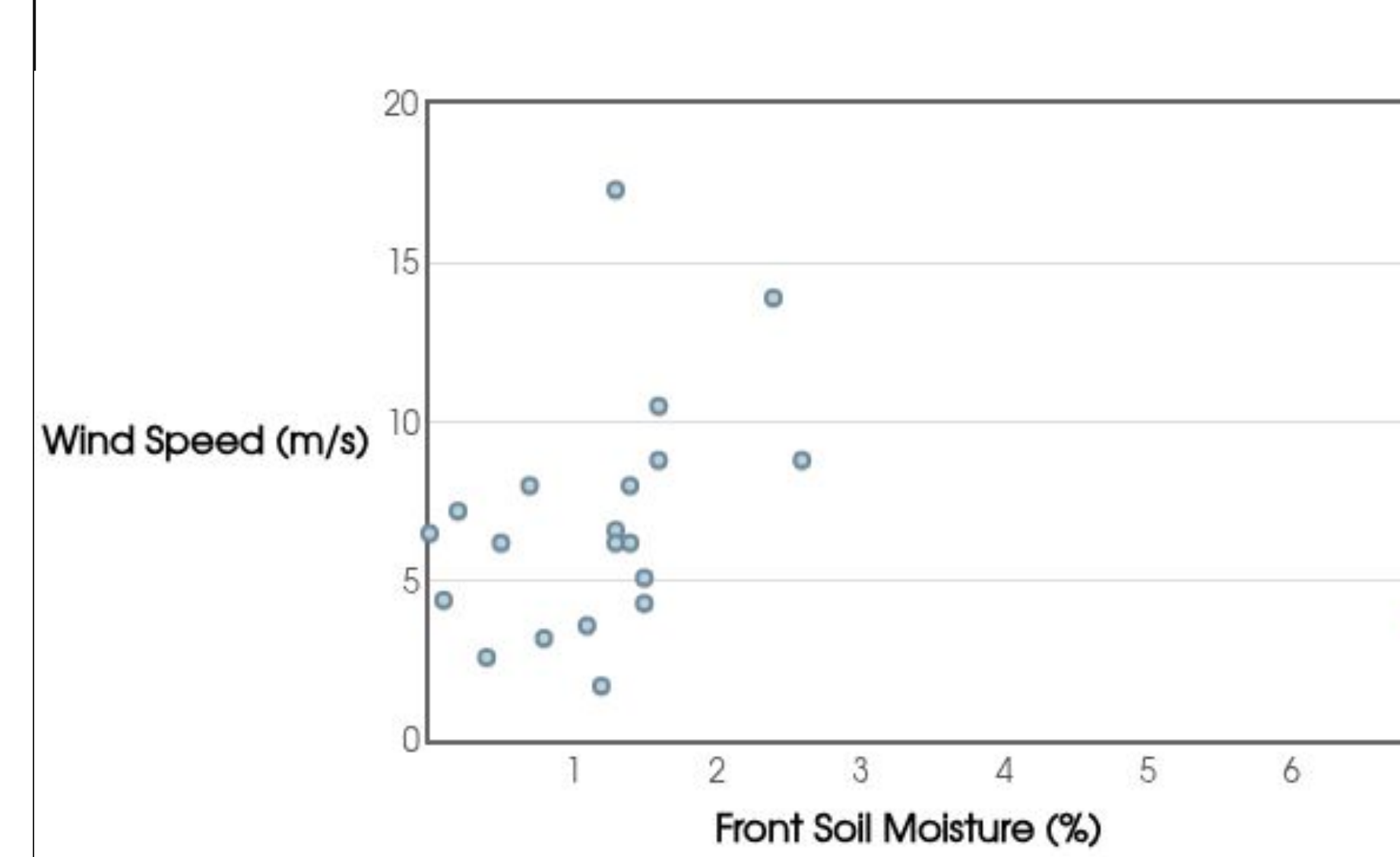
Time:	Date	Soil depth (in)	Infront	Soil Moisture (%)			Wind Speed (m/s)			Wind Wattage (mW)	Wind Amperage (mA)	Wind Voltage (V)	Humidity (%)	Precipitation (cm)
				Under	Behind	Low	High	Low	High					
1 hour	Oct 7, 2024	2	3.2	4.3	4.1	0.7	0.8			0.1	2.8	0.05	51.4	0
1 hour: 10 mins	Oct 8, 2024	2	2.6	2.9	2.3	0.2	0.4			0.1	2.7	0.007	50.3	0
30 mins	Oct 9, 2024	2	1.7	1.9	1.9	0.9	1.2			0.1	2.9	0.05	66.5	0
30 mins	Oct 14, 2024	2	13.9	17.7	22.2	2	2.4			39.1	3.8	0.45	N/A	0
30 mins	Oct 15, 2024	2	8.2	6.9	8.1	1.2	1.4			0.2	4.2	0.05	42	0
30 mins	Oct 16, 2024	2	6.6	6.3	5.5	1	1.3			0.2	3.5	0.3	57.6	0
30 mins	Oct 17, 2024	2	6.5	5.8	8.8	0.61	0.002			0.5	3.7	0.1	N/A	0
30 mins	Oct 18, 2024	2	7.2	6.8	8.9	0.1	0.2			0.5	2.3	0.24	65.4	0
30 mins	Oct 21, 2024	2	4.3	5.6	4.3	1	1.5			0.4	3.2	0.11	48.1	0
30 mins	Oct 23, 2024	2	5.1	5	4.6	1.2	1.5			0.3	2.6	0.09	48.1	0
30 mins	Oct 24, 2024	2	4.4	4.6	5.7	0	0.1			0.2	3.9	0.07	55.6	0
30 mins	Oct 25, 2024	2	6.2	3	5.7	0.1	0.5			0	3.3	0.1	92.4	3.4
30 mins	Oct 28, 2024	2	4	4.8	5	6.7	6.9			4590.5	941	5.09	38.8	0
30 mins	Oct 31, 2024	2	4.3	4.2	5.7	n/a	n/a			n/a	n/a	n/a	71.5	0
30 mins	Nov 1, 2024	2	3.6	3.2	4	0.5	1.1			n/a	n/a	n/a	59.5	0
30 mins	Nov 6, 2024	2	17.3	10.1	20.7	1	1.3			0.1	1.4	0.05	77.3	9.2
30 mins	Nov 8, 2024	2	6.2	3.5	5	1	1.3			0.3	33.2	0.09	N/A	0
30 mins	Nov 11, 2024	2	8.8	4.6	11.3	0.9	1.6			0.1	1.5	0.05	N/A	12.4
30 mins	Nov 12, 2024	2	8	4.3	4.3	1.1	1.4			0.1	1.8	0.06	64.6	0
30 mins	Nov 13, 2024	2	8.8	3.4	9.2	2.2	2.6			0.2	4.7	0.05	59.5	0
30 mins	Nov 14, 2024	2	8	4.7	23	0.5	0.7			0.2	4.2	0.04	88.5	13.2
30 mins	Nov 15, 2024	2	10.5	5.6	14.1	1.3	1.6			0.3	4.7	0.06		2.8

Our Data Table

Wind Speed vs. Under Soil Moisture



Wind Speed vs. Front Soil Moisture



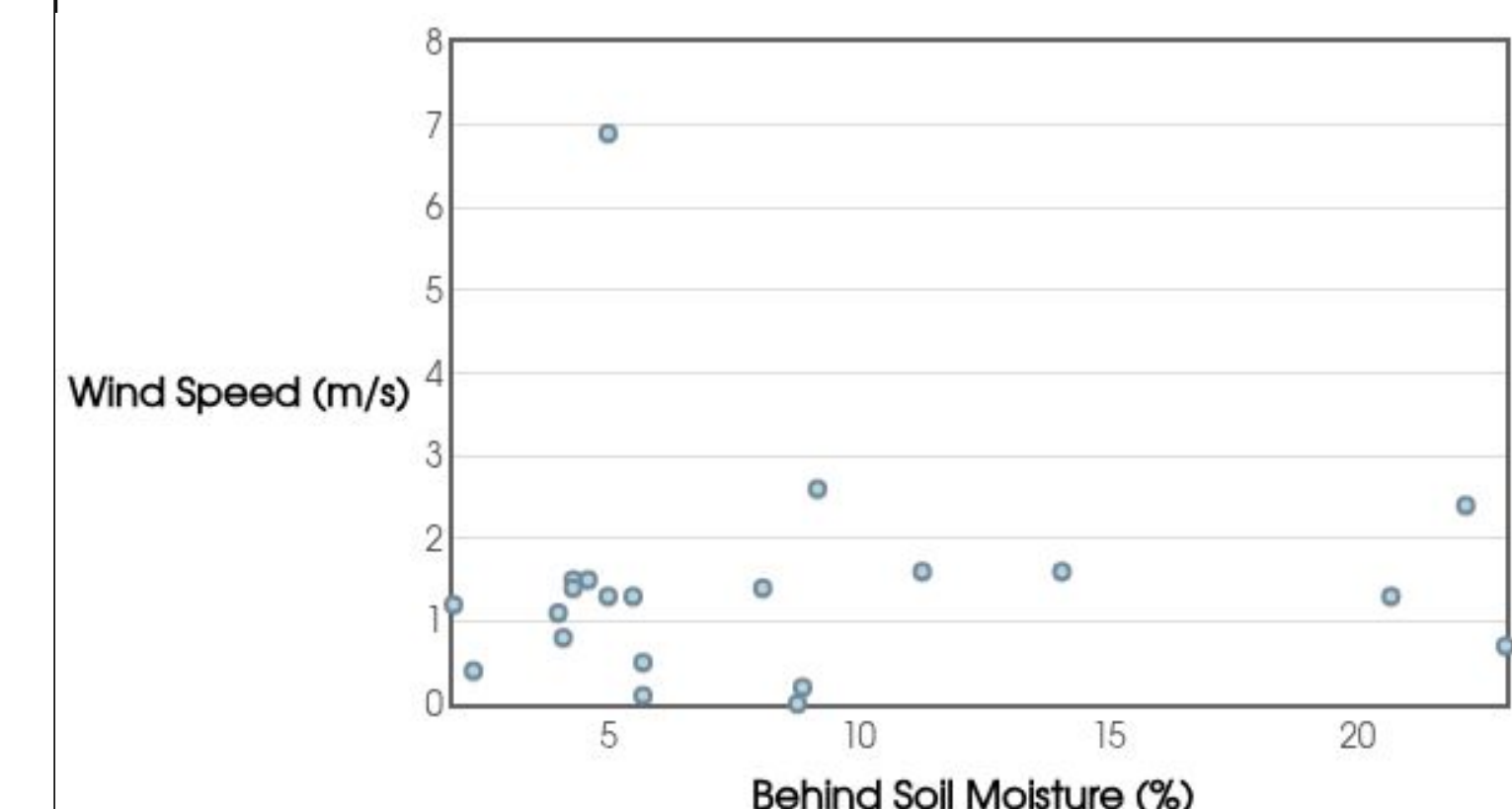
Abstract

To begin the project, the hypothesis was precipitation would heighten soil water content and higher wind speed would lower it. When comparing the data collected on precipitation amounts, wind speed, and soil moisture in three different spots of soil, conclusions were drawn based on the hypothesis. Data shows when the wind speed is higher, the soil moisture drops slightly, but factors like humidity also play a part in these results.

Results

The five weeks of data collection provide many points to look at. For starters, as seen in the *Wind Speed vs. Front Soil Moisture* graph, there isn’t a huge correlation between wind speed(ws) and soil moisture(sm). It seems to mainly have to do with the amount of precipitation in the near past, with wind speed only at extreme highs to make a change to the sm; additionally, where sm was recorded didn’t change the results much, either.

Wind Speed vs. Behind Soil Moisture



Conclusion

Upon conduction of a series of tests near school grounds using wind speed, precipitation, and soil moisture—It was found that wind speed only has a small effect on the amount of soil moisture found in the ground. Precipitation was the middle ground factor that helped determine this result. Along with the small correlation between soil moisture and wind speed, is the belief that this data is able to be used for determining the average moisture in plants for agricultural purposes.

Message of Hope: While weather is changing due to emissions causing climate change, this research contributes to the solution.

Acknowledgments

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References

- Peretti, M., Spennemann, P. C., & Long, M. E. F. (2023). Trends in soil moisture content and water deficits in Argentina and the role of climate contribution. *Theoretical & Applied Climatology*, 152(3/4), 1189–1201. <https://doi.org/10.1007/s00704-023-04428-x>
- Li, X., Ren, G., You, Q., Wang, S., & Zhang, W. (2021). Soil Moisture Continues Declining in North China over the Regional Warming Slowdown of the Past 20 Years. *Journal of Hydrometeorology*, 22(11), 3001–3015. <https://doi.org/10.1175/JHM-D-20-0274.1>