Analysis of Turbidity and Water Temperature with Wind Speeds at Sedge Island Natural Resource Education Center

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Abstract:

Even though wind is thought to just be a part of the shore, it plays a bigger role in water quality. It can affect turbidity, the measure of the clarity of the water. Wind is hypothesized to also have this effect on water temperature. Water temperature is important for dissolved oxygen levels and other features. This study studied these parameters at the Sedge Island Natural Resource Education Center (Sedge Island) and sampled every four hours, six times. Every parameter was collected three times (except for wind speed). Collected samples and data with drop chambers, a fluorometer, a weather meter, and thermocouple with reader. T-tests were done on surface and depth for both turbidity and water temperature. There were no significant differences. The channel of this experiment was very shallow, leading to small deviations. There was a weak correlation with wind speed and surface turbidity. However, there was a strong correlation between wind speed and depth turbidity due to the sediment on the bottom of the channel. There were weak correlations between water temperature and wind speeds due to how water temperature actually creates these winds through a temperature difference .between the water and land.

Introduction:

A sweet summer breeze. That is the most thought the average person gives to wind. However, in small localized bay systems like Barnegat Bay, winds play a more complex role when it comes to water quality parameters. (Goa et al., 1998). One such factor is turbidity. Turbidity is a measure of the clarity of the water; how hazy or cloudy a sample is. It is used to monitor water quality and is measured in NTU (Nephelometric Turbidity Units) (Daoliang, 2019). Turbidity is measured by a calculation of how the particles block light. It is also used as a quick indicator of harmful pathogens. Turbidity fluctuates dramatically with different wind speed, direction, and duration. (Yao and Zeng, 2025).

Another water quality parameter is the temperature of the water itself. It affects dissolved oxygen levels, vital to the survival of aquatic life, as it is the amount of oxygen present in the water, the biological makeup of the body of water due to different preferences, and more.

(Daoliang, 2019). It is hypothesized that wind will also have an impact on water temperature values.

Methodology:

Study Site:

Students from the MATES research class collected water temperature, turbidity levels (both at surface and depth), and wind speeds every four hours for a total of six sampling times. (n = 90). At each sampling time, sampling was done three times, except for wind speeds. Samples were collected from Sedge Island Natural Resource Education Center (Sedge Island), starting from 12:00 PM May 14 to 8:00 AM May 15, 2026. **(Figure 1):**

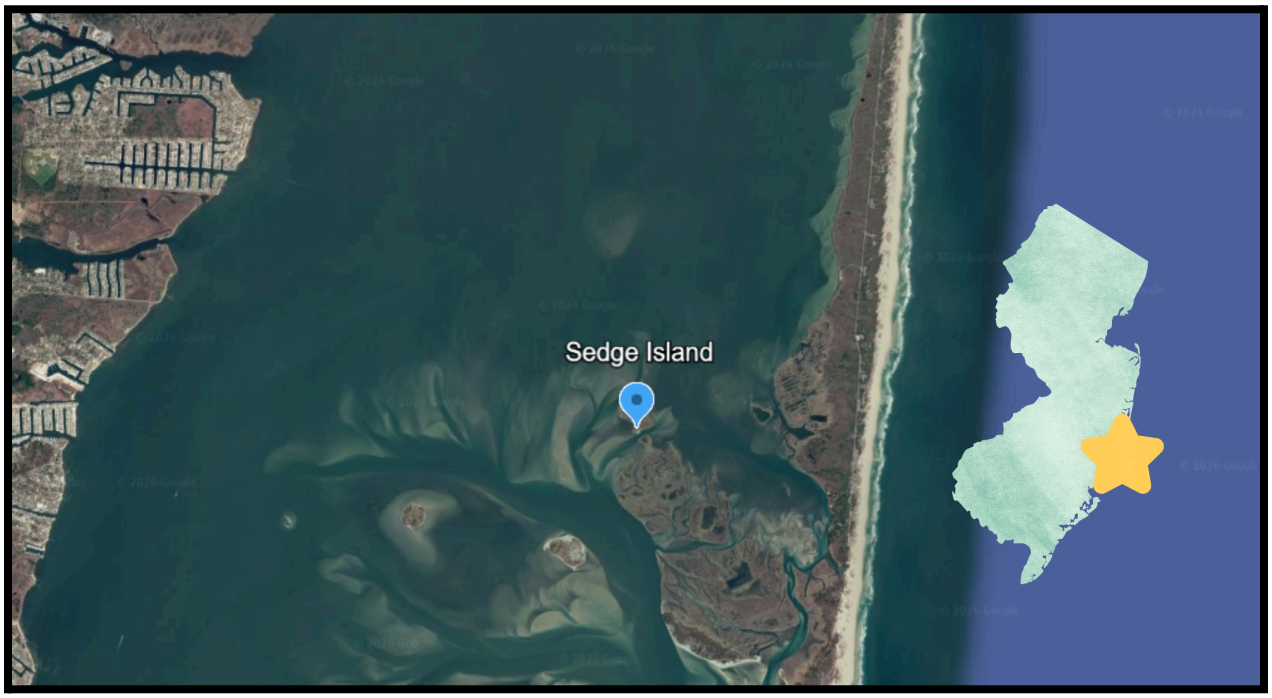


Figure 1: Water Quality Sample Site at Sedge Island.

Wind:

- Measured with a Kestrel 3000 Pocket Weather Meter **(Figure 2):**
  - Turn on the meter and switch to average wind speed mode
    - Measured in knots.
  - Hold at shoulder height pointed toward the incoming wind (incoming direction is the wind direction) and stand still for 2-3 minutes to get average speed.



Figure 2: Kestrel 3000 Pocket Weather Meter

Depth Water Samples:

- Collected using a drop chamber dropped into the water with a bottle inside to collect sample water.

Turbidity:

- Measured with an Aquafluor Handheld Fluorometer **(Figure 3):**
    - For surface and depth measurements:
        - Rinse the plastic cuvette in sample water three times to avoid cross-contamination. Fill the cuvette to the line with sample water before doing the same with distilled water in another cuvette.
        - Test the blank by cleaning it with a Kimwipe and inserting it into the fluorometer and running the blank.
            - Do the same with the sample water cuvette.



Figure 3: Aquafluor Handheld Fluorometer

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Water Temperature:

- Measured with a thermocoupler:
    - For surface and depth measurements:

- The meter is turned on and left running for a minute to warm up.
    - Switch the meter to °C.
- The exposed wires of the meter are dipped into the sample.

Statistical analysis:

- Single Variable Linear Regression was performed to analyze the data and determine if there is a significant correlation between water temperature and wind speed, as well as turbidity and wind speed.
- Paired T-Tests were performed to find statistically significant differences among the surface and depth samples of water temperature and turbidity.
- For correlations with wind, the means of turbidity and water temperature are found for both surface and depth. **(Table 2)**
- All tests were run with an alpha value of 0.05 or a 95% confidence level to determine significance.

Results:

Wind speed ranged from 0.5 to 6.6 knots, surface turbidity ranged from 2.614 to 6.446 NTU, depth turbidity ranged from 2.465 to 5.989 NTU, surface water temperature ranged from 10.40 to 16.10 °C, and depth water temperature ranged from 10.80 to 16.80 °C. **(Table 1)**.

Table 1: Surface and depth parameters from Sedge Island in 24-hour format.

Time:	Wind Avg (knots)	Turbidity (Turbidimeter NTU)		Water Temp (°C)	
		Surface	Depth	Surface	Depth
12:00	1.4	3.425	4.960	16.10	16.70
		3.090	5.023	16.00	16.80
		3.244	5.513	16.00	16.70
16:00	0.8	4.008	4.869	15.90	15.40
		3.809	5.316	15.90	15.40
		3.835	4.770	15.90	15.40
20:00	6.1	4.678	2.465	11.40	11.10
		4.492	3.050	11.70	11.10
		2.614	3.397	11.50	11.10
24:00:00	1.4	4.702	5.962	13.30	14.30
		6.446	5.162	13.30	14.20
		5.934	5.989	13.40	13.20
4:00	0.5	5.120	4.402	13.20	12.70
		4.796	4.218	13.20	12.70

		5.207	5.167	13.20	12.70
8:00	6.6	3.506	2.821	10.40	11.30
		3.640	4.022	10.90	10.80
		2.835	3.876	10.40	10.90

Table 2: Mean surface and depth parameters for Sedge Island in 24-hour format.

Time:	Wind Avg (knots)	Mean Turbidity (NTU)		Mean Water Temp (°C)	
	Surface	Surface	Depth	Surface	Depth
12:00	1.4	3.253	5.165	16.03	16.73
16:00	0.8	3.884	4.985	15.90	15.40
20:00	6.1	3.928	2.971	11.53	11.10
24:00:00	1.4	5.694	5.704	13.333	13.900
4:00	0.5	5.041	4.596	13.20	12.70
8:00	6.6	3.327	3.573	10.57	11.00

When comparing surface and depth turbidity, as well as surface and depth water temperature, neither T-Test was statistically significant ($p > 0.05$). When comparing average wind speed and mean surface turbidity, there is a weak negative correlation of $R^2 = 0.2147$ ($p > 0.05$) **(Figure 4)**. However, average wind speed and mean depth turbidity, there is a strong negative correlation of $R^2 = 0.7451$ ($p = 0.02679$) **(Figure 5).**

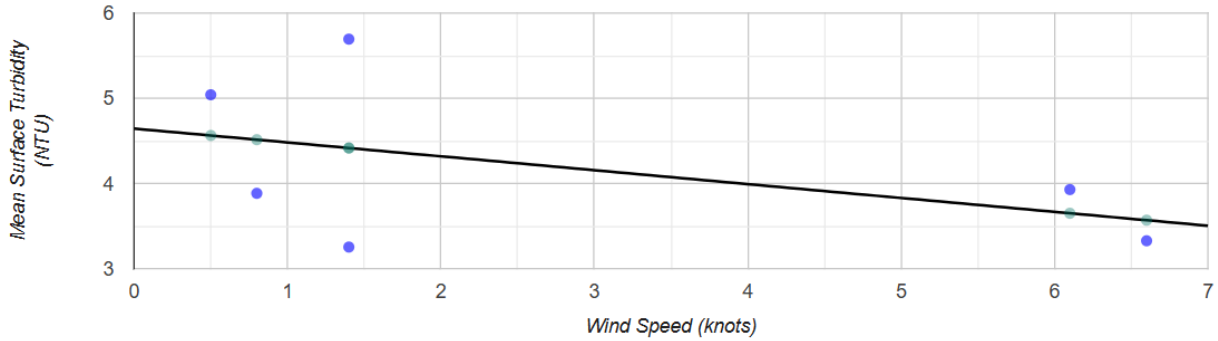


Figure 4: Wind Speed (knots) vs Mean Surface Turbidity ($R^2 = 0.2147$, $p = 0.3547$)

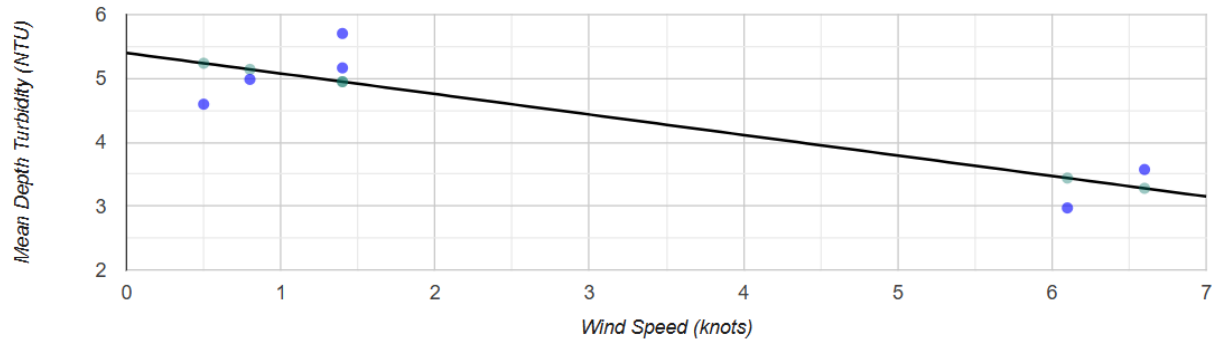


Figure 5: Wind Speed (knots) vs Mean Depth Turbidity ($R^2 = 0.7451$, $p = 0.02679$)

When comparing average wind speed and mean surface water temperature (°C), there is an inverse correlation of $R^2 = 0.659$ ($p < 0.05$) **(Figure 6).** But in average wind speed and mean depth water temperature (°C), there is an inverse relationship of $R^2 = 0.5783$ ($p < 0.05$) **(Figure 7).**

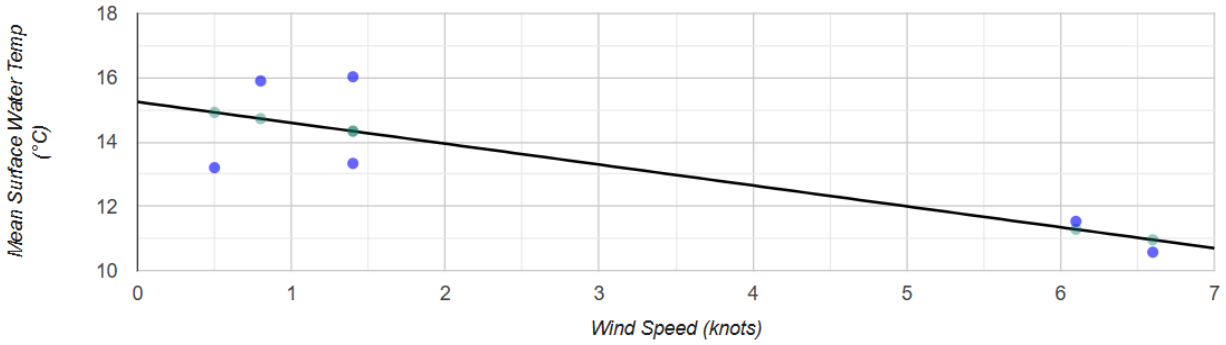


Figure 6: Wind Speed (knots) vs Mean Surface Water Temperature (°C) ($R^2 = 0.659$, $p = 0.0498$)

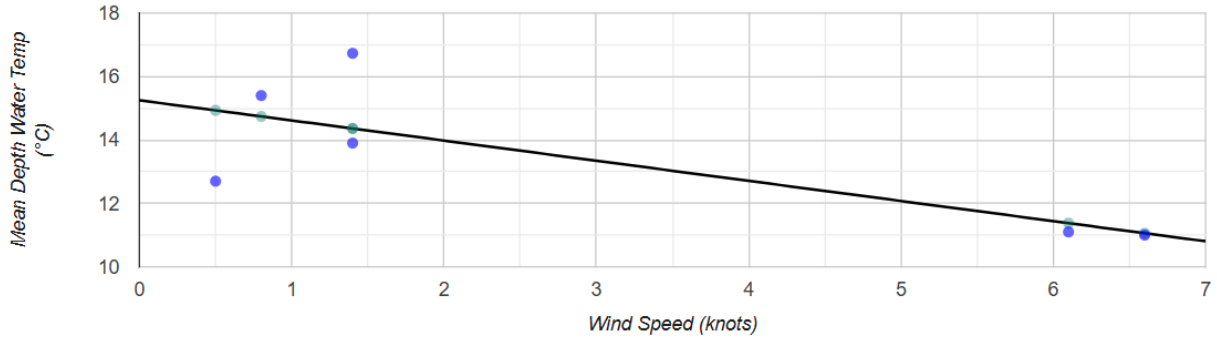


Figure 6: Wind Speed (knots) vs Mean Depth Water Temperature (°C) ($R^2 = 0.5783$, $p = 0.07919$)

Discussion:

When comparing surface and depth for both turbidity and water temperature, there is no significant difference. The entire depth of the channel where data was collected was ~2.997 meters. However, this is considered a shallow channel, so there would not be a large difference in water quality. A shallow channel is classified as less than 3,000 meters. ("Shallow, mid to ultra deepwater", 2018). When comparing wind speed and surface turbidity, there is a weak correlation. However, depth shows us a different story; there is a strong correlation. When wind blows on water, it will mix up the sediment on the bottom of the body of water. Thus, the turbidity towards the bottom of the channel increases more. (Qtan 2019). Water temperature in general and winds have a weak correlation. This is because they operate a little differently. Water temperatures affect wind speeds, not the other way around. Places like Barnegat Bay do not have "trade winds", but instead continuous onshore/offshore winds. These winds are created by the difference in temperature of water and land. (Qu et al., 2012).

Conclusion:

There were no statistical differences between surface and depth turbidity or water temperature. Turbidity was more affected by winds in depth samples than in surface samples. Water temperature actually affects wind speed and not the other way around; the difference in temperature with the land creates the local onshore and offshore winds around Barnegat Bay.

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