Warm and rainy: what happened to Lake Superior?

Team Superior

Marquette High School and North Star Academy

Summary

- Problem: Summer time warm fronts can alter the physical and chemical properties of Lake Superior.
- Question: How does a warm front rain event impact the water quality of Lake Superior?
- Procedure: Measure Physical and Chemical qualities of Lake Superior using GLOBE protocols before and after a warm-front rain event. Analyze the data using a pre/post test approach.
- Conclusions: Water clarity remained unchanged, pH decreased very slightly, and DO increased by 2 mg/L.

Research Question

How does a warm front rain event impact the water quality of Lake Superior?

Those of us who live near the shores of Lake Superior notice a daily change in the lake. Some days the lake is calm and a vibrant blue color and other days the lake is turblent and gray, depending on the weather. We wondered if physical and chemical aspects of water quality of the lake also change with weather events.

Introduction

Content Knowledge

On day three of measuring GLOBE protocols in Lake Superior at our Marquette site, a warm front moved through and the area experienced drizzle/rain the previous evening and during our measurements. Along with the rain was an onshore wind and wave heights of 2 - 3 feet. Click here for the wind and temperature for 8am on 7/21, and click here for wind and temperature at 8am on 7/22. We noticed an interesting difference between a few of the protocols as a result of that weather. We know that aquatic life exists under a certain set of circumstances, and some are particularly sensitive to changes in their environment (especially dissolved oxygen, pH, and turbidity).

Research Methods

Planning Investigations

- Presque Isle is a small peninsula within the City of Marquette, MI that extends into Lake Superior. The study site included the land and shoreline near the gazebo along Peter White Drive at Presque Isle. The site was comprised of mowed grass, trees, rocky shoreline, and water.
- Water quality was measured using GLOBE Hydrology protocols including turbidity, pH, and dissolved oxygen (DO). Each measurement was taken twice on two different days, the first day being overcast and dry and the second being the warm front rain event.
- Data were entereed into the GLOBE system before being analyzed.

Fig. #1: Location of Marquette, MI within the Great Lakes region

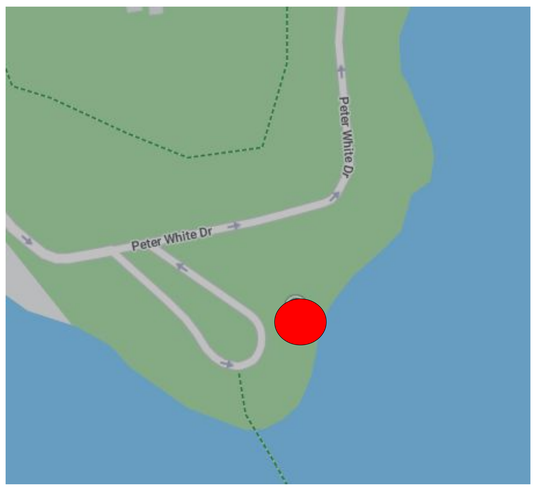

Fig. #2: Location of the study site within Presque Isle park

Results

Analyzing Data

- GLOBE Data:
  - Data 7/21/20
  - Data 7/22/20

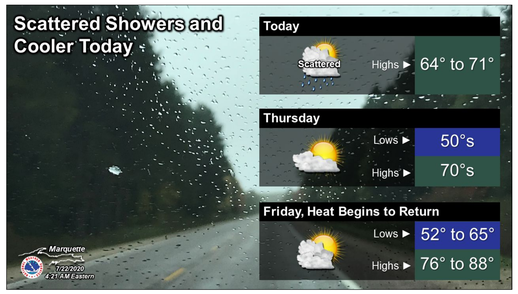

Fig. #3: Graphic showing the forecast for 7/22/20 from the NWS Marquette (NWS Marquette, 2020)

Parameter	Before	After
pH	6.2	6.1
Dissolved Oxygen (ppm)	7	9
Turbidity (cm)	> 120	> 120

Table #1: Lake Superior water quality measurements before and after a warm front rain event

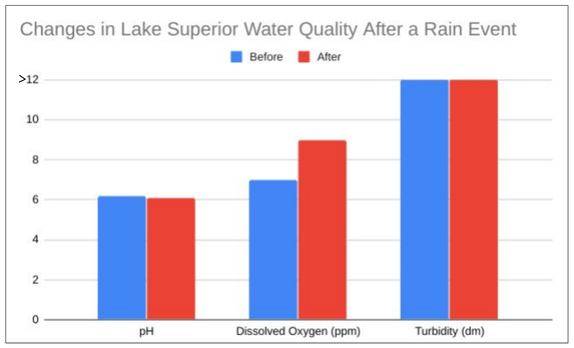

Fig. #4: Water quality measurements before and after a warm front rain event

Conclusions

Drawing Conclusions & Next Steps

- In a comparison between data prior to the warm front with precipitation and during/after, we noticed an increase in dissolved oxygen, a decrease in pH, and no measurable change in turbidity.
- On 7/21 we measured a pH of 6.2, dissolved oxygen of 6.3 mg/L, and a transparency of more than 120 cm on the transparency tube. On 7/22 we measured a pH of 6.1, dissolved oxygen of 9 mg/L, and a transparency of greater than 120 cm on the transparency tube.
- One of the primary ways that dissolved oxygen levels in water increases is through an increase in physical action of a body of water (e.g. waves), so the increase in dissolved oxygen from 6.3 mg/L to 9mg/L was not a surprise; although the amount of increase was interesting. Perhaps researching a correlation between wave height and amount of increase in dissolved oxygen could be a good next step. The decrease of pH from 6.2 to 6.1 was small, but noticeable, and we currently do not have much background knowledge to explain that change. Perhaps more information about pH of rain could help fill in the gap there. The lack of change in turbidity was especially interesting. While Lake Superior is well known as the clearest of the Great Lakes, one can also reasonably expect an increase physical action (e.g. more intense waves, faster flow volume, etc.) to a greater presence of particulate in suspension, or higher turbidity. We did not see a change in that regard, however, and the turbidity stayed at greater than 120 cm before and after the weather event. Continued monitoring with close attention on comparing data before and after weather events of varying intensity might add insight into this phenomenon.

Fig. #5: Using a turbidity tube

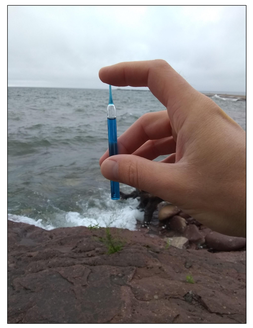

Fig. #6: Measuring DO

References

- The GLOBE Program (2020, July 7). Get Trained. Retrieved from https://www.globe.gov/get-trained
- https://earth.nullschool.net/
  - Hydrosphere Investigation
  - Atmosphere Investigation
  - Macroinvertebrates
- NWS Marquette (NWSMarquette). (2020, July 22). Cool and cloudy conditions expected today, with lingering showers through much of the day. Temperatures gradually warm through the end of the work week, with even warmer and more humid conditions expected this weekend. #906wx. [Tweet]. Retrieved from https://twitter.com/NWSMarquette/status/1285877244662030337