GaiaXus

Citizen Science- Storm Watch

Measuring the effects of a rainstorm on a local creek.

Suitable for GRADES: 8-12

BACKGROUND

Frequent and intense rainstorms are a normal and essential part of the ecosystem on the US East Coast. This region experiences a unique combination of geographical and meteorological factors that make such weather events not only common but also vital for its ecological balance. The East Coast's proximity to the Atlantic Ocean exposes it to moisture-laden air masses, which, when colliding with prevailing weather systems, result in heavy rainfall. These rainstorms replenish freshwater sources, such as rivers and lakes, crucial for both wildlife and human populations. Moreover, they contribute to the natural fertilization of soils and help maintain the lush vegetation that supports diverse ecosystems. In addition, intense rainstorms play a vital role in controlling insect populations, preventing wildfires, and regulating the overall health of the ecosystem by flushing out impurities and aiding nutrient cycling. While they may pose short-term challenges, frequent rainstorms are an integral part of the East Coast's natural rhythm, ensuring its resilience and vitality.

Predictable and frequent rainstorms form a fascinating topic for environmental STEM education and citizen science not just for biology and ecology topics but also for hydrology and urban planning. The importance of local creeks and the rapid changes they are exposed to is the subject of this project.

SAFETY

- All activities near water carry inherent risks, and it is crucial to exercise caution to avoid accidents.
- Stay vigilant by monitoring weather forecasts, and local conditions, and adhering to official guidance.
- Be aware that stormwater surges can develop swiftly and intensify, potentially turning otherwise safe areas into hazardous zones.

Methods

When a significant rainstorm was forecasted, we placed a GaiaXus monitor in a local creek. It was anchored with a weighted bag, positioned approximately 30cm below the water surface and 30cm above the creek flow, ensuring the probe would be in the middle of the streamflow. We tied the probe to a tree root above the projected stormwater line. Before submersion, we set the probe to 'Buoy Mode' and programmed it to record water quality parameters every 5 minutes.

Approximately 24 after the rainstorm passed, the probe was recovered, the recording stopped and the data was uploaded to the GaiaXus cloud and analyzed.

Results

The probe recorded 4 parameters:

- Water temperature in Degrees Celsius
- The depth of the probe in the water. Since the probe was tethered to the bottom of the creek, this value is the height of the water column above the probe. Rising water levels indicate increasing depth.
- Salinity of the water in ppm.
- Turbidity measured by using optical methods with both nephelometry and absorbance values. For absorbance, 3 separate wavelengths were used, 950nm,

810nm, and 670nm. 670nm can be affected by increased chlorophyll load from vegetation or algae.

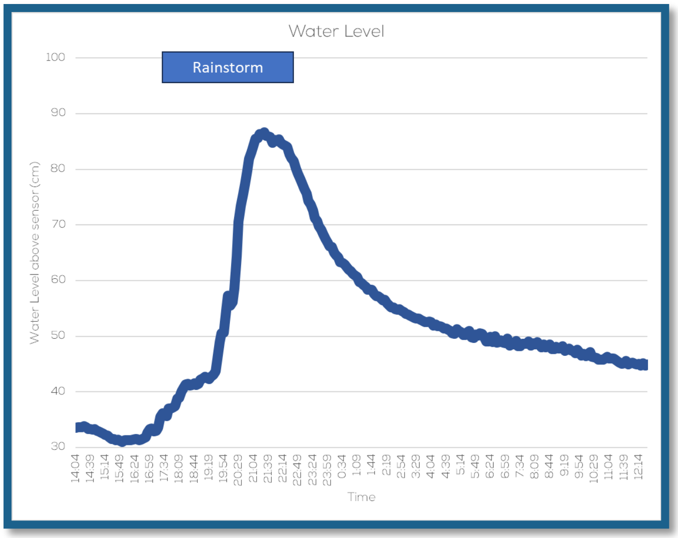

Figure 1. The water level above the probe rose significantly during the rainstorm, submerging the probe at its peak by 90cm, more than 60cm above the starting depth. The sensor was tied to the bottom of the creek with a weight bag and at high flow could theoretically "sway" along its support. Future trials could use a stiffer tethering system, like a single big rock and a shorter tether. Notice that after the rainstorm, a slow "drizzle" rain persisted for several hours.

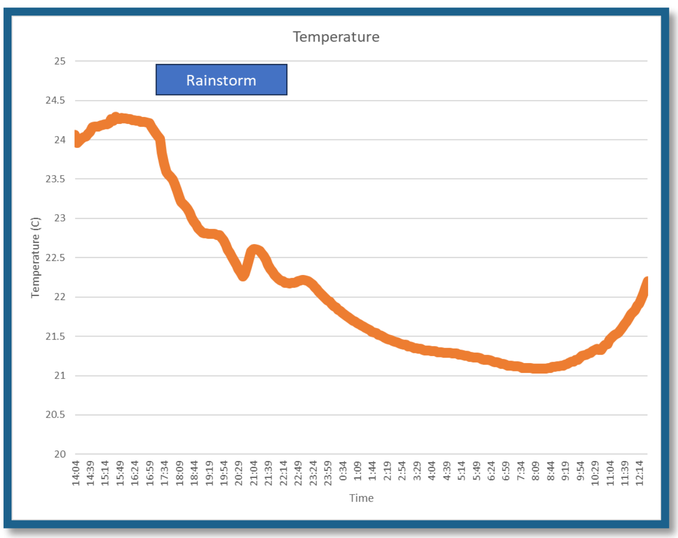

Figure 2. Rainwater lowered the water temperature from 24C to 21C temporarily. Eventually, water flowing into the creek from the saturated soil caused a slower decline in temperature and eventually showed a rise as the soil warmed the draining water.

Changes in the water temperature during a rainstorm are sudden and temporary and highly dependent on the soil's capacity to retain (and warm) water before it drains.

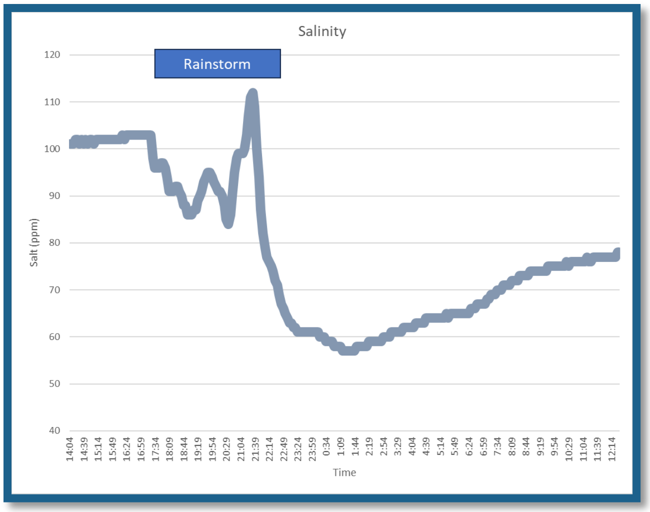

Figure 3. The natural salinity of the creek water fell during the first phase of the rainstorm, dilution of the surface water with nearly salt-free rainwater is likely the cause. The pronounced rise in salinity during the latter phase of the storm is more difficult to explain, it could be that the amount of sediment discharged into the water released salt and thus increased the salinity temporarily before water discharge from the soil again reduced the salinity in the later phases of the storm.

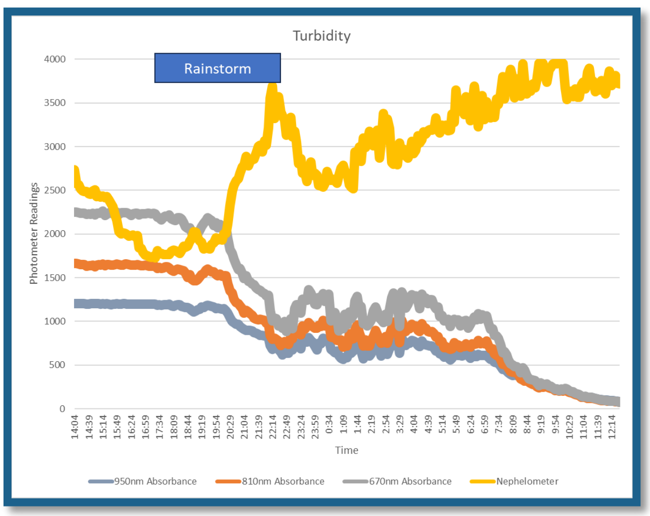

Figure 4. Turbidity was measured both in nephelometric and absorbance methods. Nephelometry values (yellow) increase as particles scatter angled light into the sensor whereas absorbance values reduce as particles pass directly between the light source and the sensor. Interestingly, 670nm absorbance rates were not significantly different in percentage scale than the 950nm and 810nm, indicating that the sediment was not primarily plant matter.

Discussion

This experiment – like all citizen science experiments – cannot replace professional stormwater monitoring and analysis for public safety and long-term environmental monitoring. However, the experiment showed that a simple, low-cost device can accurately record environmental events over a discrete period and generate results that are informative and educational.

The interplay between water flow (as measured by rising water levels), salinity, and turbidity and their response to a sudden and rather violent rainstorm are ordinarily difficult to teach in practice as direct observation is too dangerous or occurs outside of regular STEM classes. As a student project, this exercise allows maximum flexibility for students to decide on the location and time of placement, situational awareness and safety concerns, and environmental data collection and analysis methods that are near those employed by professional field scientists.

Further Reading

To download this guide and others, visit our website at gaiaxus.com

About GaiaXus

GaiaXus Learning Systems is a Maryland-based company developing education tools for environmental STEM education. All presented projects and information are based on pre-released prototypes.

To contact the company, visit gaiaxus.com or email info@gaiaxus.com

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