GaiaXus
Water quality monitoring systems
for citizen science & education

Snow, Salt, and Citizen Science: Affordable, Accurate Creek Monitoring in a Winter Storm

Summary

Winter storms don't just bring snow—they also send road salt into local waterways, threatening freshwater ecosystems. Using the **GaiaXus Water Guardian**, a low-cost, portable water sensor, we logged temperature, conductivity, and turbidity **during** a snowstorm, capturing real-time changes as road salt entered the stream.

Despite freezing conditions and ice buildup, the sensor operated for 40+ hours, revealing conductivity spikes linked to road treatment. This experiment proves that **affordable tools empower citizen scientists** to track pollution even in extreme weather, making environmental monitoring more accessible than ever. **Science doesn't stop for the storm, and now, neither do we.**

Watch the Timelapse video https://youtu.be/CbpysR5Ta6Y

Background

Snowstorms are a regular part of Maryland winters, and road salt is essential for keeping roads safe. However, when snow melts, salt washes into nearby streams, **spiking salinity and conductivity** and disrupting freshwater ecosystems. Macroinvertebrates, crucial to aquatic food webs, struggle to regulate their internal balance, leading to stress, dehydration, and even death.

Urban and suburban areas experience the most severe impacts, as rapid salt runoff creates sudden, harmful changes in water quality. Measuring salt levels is essential for understanding its impact on freshwater systems, predicting long-term ecological effects, and informing better road salt management. While conductivity measurements help track contamination, pinpointing the source is difficult since salt often travels downstream before monitoring is possible. **Affordable, accurate tools are needed to capture these rapid changes, empowering citizen scientists to protect local waterways**

Method

To track water quality changes during a snowstorm, we deployed the **GaiaXus Water Guardian**, a compact, battery-powered sensor designed for **affordable, high-frequency monitoring**. This

portable device measures **water depth, conductivity, temperature, and turbidity** at adjustable intervals, making it ideal for capturing rapid environmental changes.

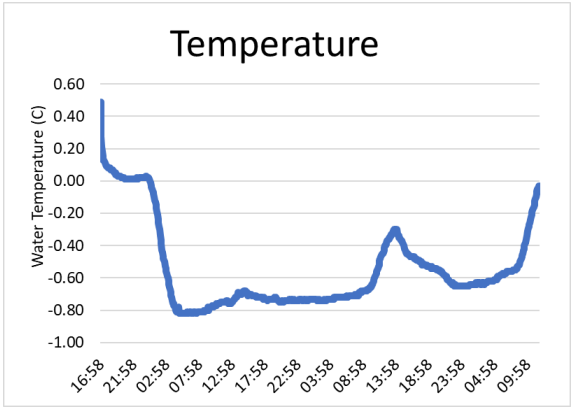
For this experiment, we placed the sensor **360 ft (110 m) downstream** from a highway bridge, where meltwater enters the creek. It was positioned **~60 cm below the surface** to account for ice formation and securely tied to a root for stability. Set to **Buoy Mode**, the Guardian recorded measurements every **five minutes**, ensuring detailed data collection throughout the storm. A **trail camera**, synced to the same timing, documented snowfall and ice buildup. All equipment was placed safely away from the road to minimize risks to pedestrians and road crews.

Location: 39.186409, -77.2156601, ~360m (110m) from a road

Results

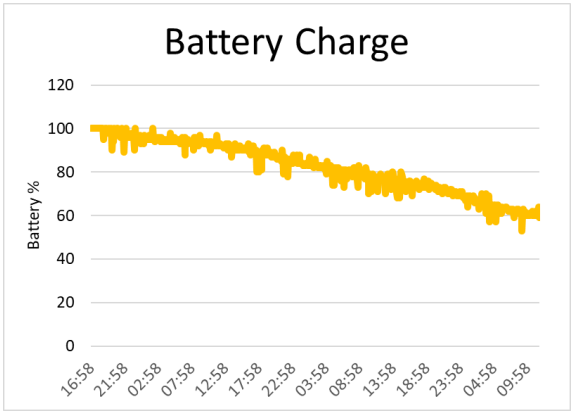
We retrieved the **GaiaXus Water Guardian 40 hours after deployment**, once road conditions were safe. During the storm, approximately **8 inches (20 cm)** of snow fell in two separate events, forming a **1–1.5-inch (3–4 cm)** layer of ice over the creek. Despite being submerged beneath the ice, the Guardian remained **fully operational**, and data was successfully downloaded via our mobile app. The recorded data **clearly reflected the snowfall events**, with corresponding changes in water quality. A nearby **trail camera**, set to capture a time-lapse, provided visual confirmation of the storm's progression.

Water Temperature



The submerged sonde records data at 5 min intervals and the temperature equilibrated after a few minutes. Notice the sudden water temperature drop at night when the first snowfall started, going to approximately 3am the next day. The day was overcast and water temperature stayed steady until midday of the following day when it warmed and then on the morning of the third day.

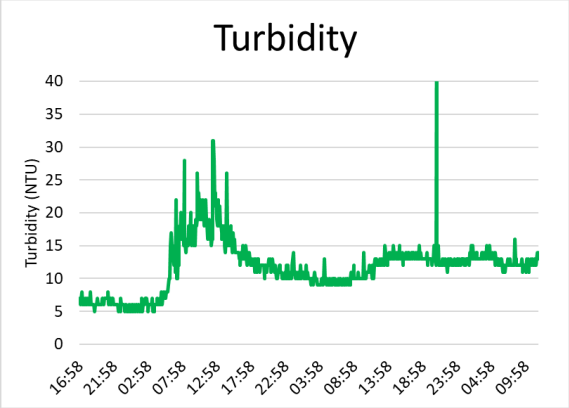
Battery Charge



The GaiaXus Guardian is powered by a rechargeable battery and one of the questions

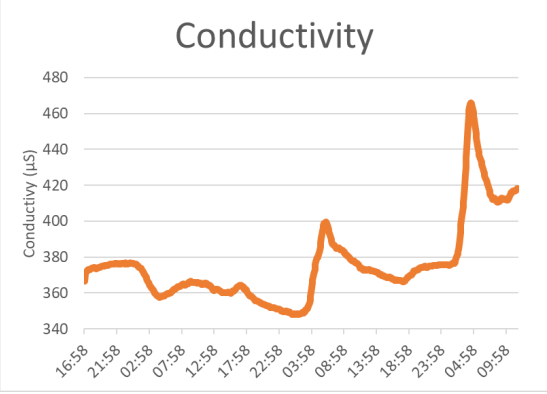
was how well they would hold up under these freezing conditions. After 40h operation below 0C, the sensor still showed >60% battery life, it could have operated for several additional days. Longer intervals can be used, reducing battery consumption even further.

Turbidity



Increased particle load can be an indicator of changing flow patterns moving. As expected, the initial snowfall increased turbidity, with a steady-state reached after the first phase of the storm had passed. Meltwater likely changed the flow pattern, increasing turbidity on the second day, the single sharp spike around 19:00 is an outlier, likely a piece of floating debris.

Conductivity



Measuring conductivity is the standard method to estimate dynamic changes in **salt concentration**. We noticed a distinct rise in conductivity during the second night, likely following to a new round of road treatment with another, temporary increased after the snowstorm had passed. Of note is the transient nature of these spikes, likely the current carries the resulting brine downstream.

Discussion

Extreme weather events pose challenges for environmental monitoring, especially without specialized equipment. Creeks and lakes become hazardous, and road closures often prevent citizen scientists from collecting critical data. Yet, these **transient events** provide key insights into pollution and hydrodynamic changes.

Citizen scientists are vital for large-scale monitoring, bringing local knowledge to data collection. However, they often lack **affordable**, **accurate user-friendly instruments**. In this pilot study, the **GaiaXus Water Guardian** proved **reliable and effective**, operating **unattended under ice** for several days without failure. Its dual function as a data logger and grab-sample Sonde makes it ideal for diverse monitoring needs.

With affordable, accurate sensors, citizen scientists can expand environmental research and community-driven conservation efforts.

GaiaXus team member "Tesla" assisting in the recovery of the Water Guardian

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Safety

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

Further Reading

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

About GaiaXus

GaiaXus LLC is a Maryland-based company developing tools for environmental STEM education and citizen science.

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

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