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ANB Sensors, AQ^2 pH Sensor

Field Deployment of a Calibration-Free pH Sensor at a Temporal Waterway

INTRODUCTION

Reliable long-term pH monitoring in natural and semi-natural water bodies remains a challenge due to sensor drift, fouling, and the need for frequent recalibration. This study presents the deployment of an ANB Sensors calibration-free pH sensor at a drainage outfall in the south of England, demonstrating its performance under real-world environmental conditions.

The objective of this deployment was to evaluate:

- Sensor performance in a dynamic field environment
- The impact of intermittent immersion conditions
- The effectiveness of transducer health diagnostics
- Stability over extended deployment periods without maintenance

DEPLOYMENT SITE & METHODOLOGY

The sensor was installed at a drainage outfall discharging into a small field channel. The site is a temporal waterway and is subject to variable flow conditions, periods of drying and rainfall-driven recharge events. These conditions provide a useful test case for assessing sensor robustness in non-ideal and intermittent monitoring environments.

Sensor Configuration

Power supply: External battery
Data logging: Internal SD card

Initial deployment:
    sampling mode: Continuous (5-second interval)
    duration: 6 days

Second deployment:
    sampling mode: 15-minute interval
    duration: 1 month

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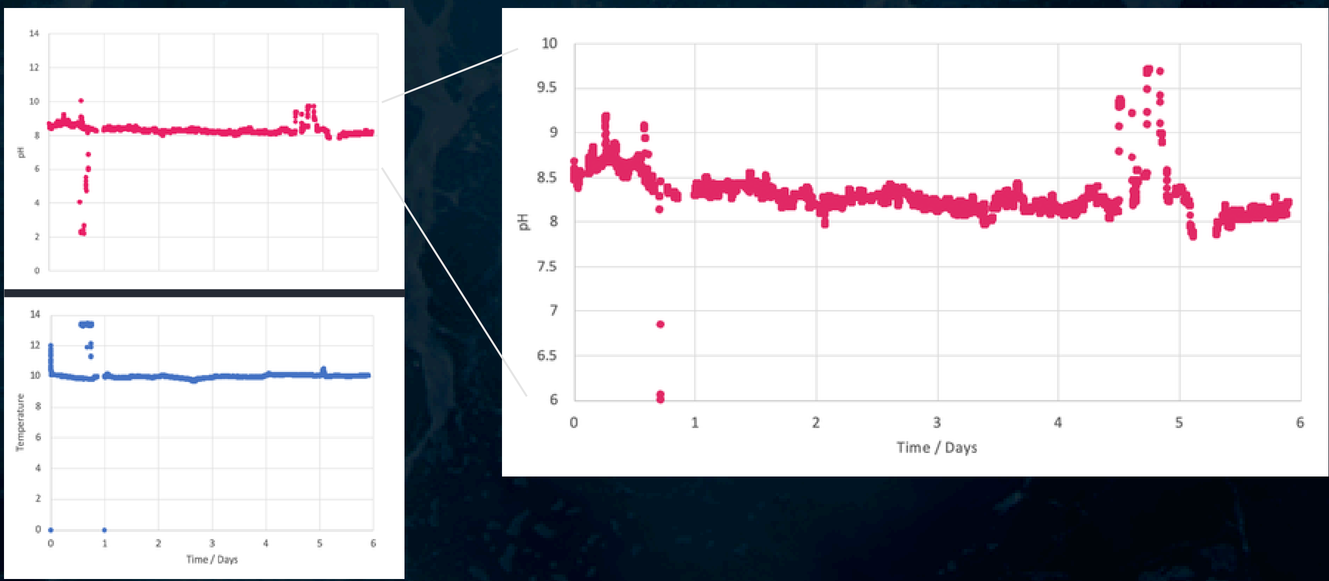
RESULTS & OBSERVATIONS

Initial Deployment

During the initial 6-day deployment, the sensor recorded at 5-second intervals, and the output of both pH and temperature are shown below.



Overall, the dataset performed as expected throughout the deployment. On day 1, several anomalous data points were observed, corresponding with the gradual drying of the drainage channel. As water levels receded, the sensor became only partially immersed due to its installation orientation before eventually becoming fully dry. Following a rainfall event, water levels recovered, and the sensor automatically resumed normal operation without any manual intervention, demonstrating reliable self-recovery under dynamic environmental conditions. A similar sequence occurred during days 5–6, with subsequent rainfall once again restoring normal sensor operation for the remainder of the deployment.

This deployment highlights two key capabilities that distinguish the AQ^2 from traditional glass electrode sensors: its integrated immersion detection and real-time transducer health diagnostics.

The integrated immersion sensor continuously monitors whether the transducer is submerged. If the sensor becomes partially immersed, it automatically enters a low-power standby mode to conserve battery life before periodically checking for re-immersion at five-minute intervals. Once submerged again, the AQ^2 immediately resumes measurement without requiring recalibration or maintenance, delivering uninterrupted long-term monitoring even in environments with highly variable water levels.

In addition, the AQ^2 provides continuous transducer health diagnostics, offering valuable insight into both sensor condition and deployment status. Users can readily determine whether the sensor is fully or partially immersed, identify when maintenance may be required, and better understand the environmental conditions influencing measurement quality. This enhanced operational visibility increases confidence in the collected data while reducing unnecessary site visits and maintenance costs.

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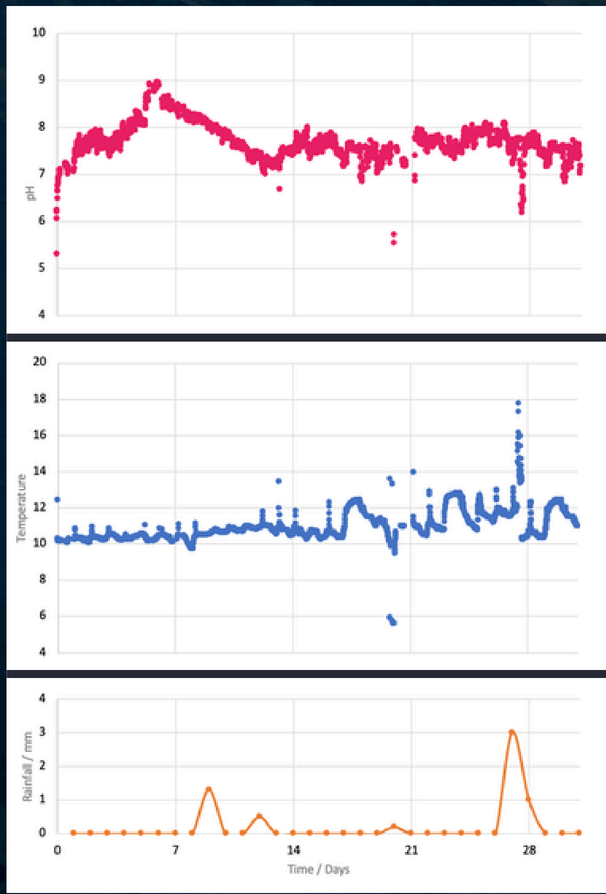
Redeployment & Extended Monitoring

Following the initial deployment, the transducer was replaced to enable ANB to assess the impact of exposure to the highly turbid environment on the sensing surface. Inspection revealed only minimal changes to the transducer surface and no significant change in sensor performance, demonstrating the robustness and durability of the technology in challenging monitoring conditions.

Following transducer replacement, the sensor was redeployed with a reduced sampling interval of 15 minutes. During this second month-long deployment, the AQ^2 delivered stable, reliable pH measurements throughout, requiring no cleaning, recalibration, or other maintenance. The resulting pH and temperature data are presented here, alongside rainfall data from a nearby monitoring station, which serves as a proxy for changes in site conditions and provides context for the observed sensor performance.

The rainfall data shows prolonged periods of dry conditions which align closely with the observed drying and subsequent re-wetting of the drainage channel at the deployment site. Despite this, the AQ^2 stayed operational throughout the entire deployment with no intervention required throughout.



CONCLUSIONS

This field deployment at a temporal waterway in the south of England demonstrates that the sensor can operate reliably in environments where continuous submersion cannot be guaranteed, unlike the glass probe. Recovery following re-immersion is both rapid and fully autonomous. This makes the technology particularly well-suited to applications in episodic flow environments, where water presence is inherently variable. Furthermore, the AQ^2 identifies any periods of measurement interruption and distinguishes between differing environmental conditions and potential measurement degradation. As a result, the risk of misinterpreting compromised data is significantly reduced, providing greater confidence in long-term monitoring datasets.

From an operational perspective, the deployment also demonstrates clear efficiency gains. The sensor required no calibration before or after deployment, and no cleaning or maintenance throughout the month-long period. In addition, redeployment following transducer replacement was straightforward. Together, these factors translate directly into fewer site visits, lower operational costs, and improved overall data reliability.

The results highlight strong potential for deployment across a range of applications, including environmental monitoring, agricultural drainage systems, and remote or hard-to-access sites where reliability and low maintenance are critical. Importantly, the inclusion of Transducer Health diagnostics provides clear traceability of sensor performance, giving users confidence not just in the data, but in the decisions that depend on it.