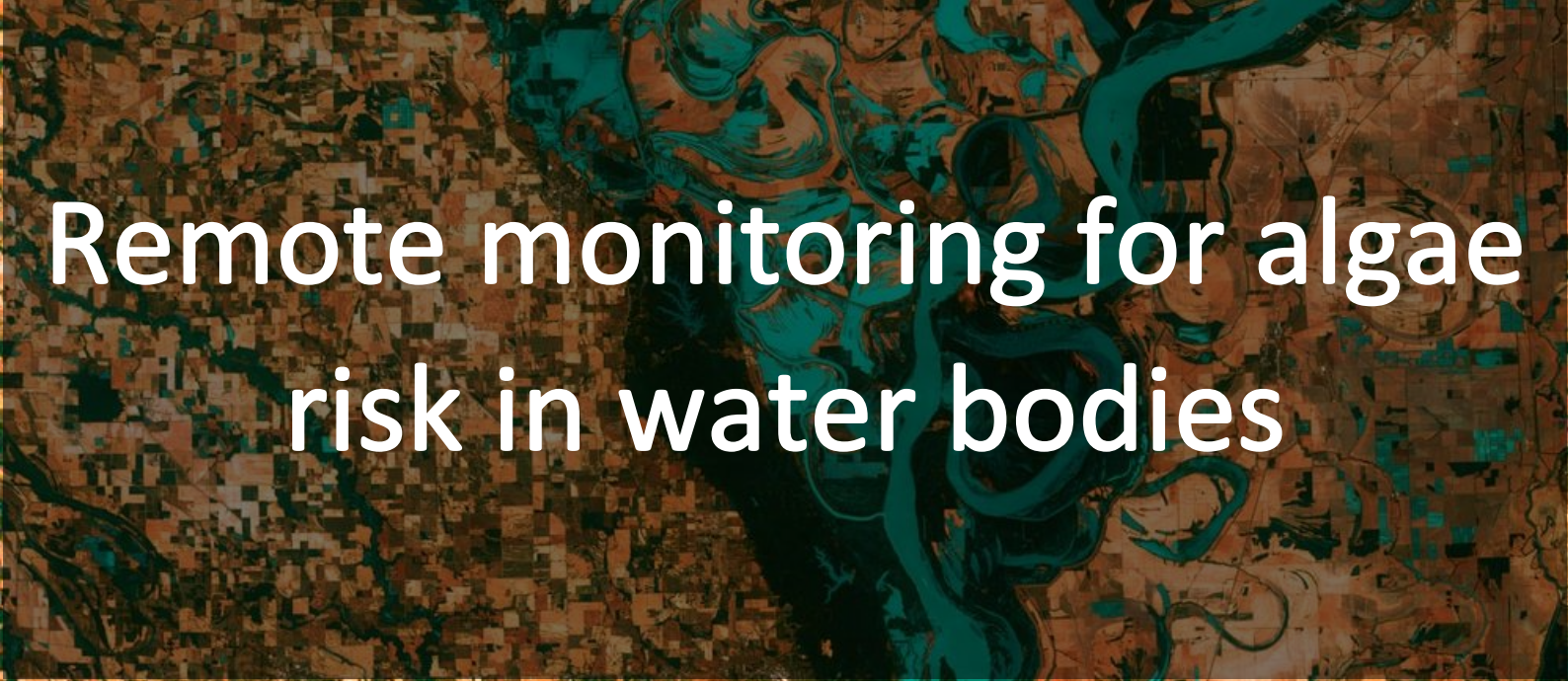

Remote monitoring for algae risk in water bodies

DETAILS

SECTOR | Water

STAGE | Strategy and Planning, Operations and Maintenance

TECHNOLOGIES | Sensors / IoT, Satellite, UAVs (e.g. Drones), Data & Analytics

SUMMARY

Remote monitoring involves using one or a combination of remote sensors, UAVs and satellite technology to monitor water bodies for precursors to algal blooms. Satellite technologies allow for monitoring of wide areas to optimise monitoring activities, leading to a significantly improved ability to manage and mitigate the harmful effects of potentially toxic algal blooms.

Monitoring the risk of algal blooms is labour intensive and can involve sending crews to remote and hard to access water bodies to collect physical samples. For health and environmental authorities, it is not feasible to manually monitor potentially hundreds of water bodies. Remote monitoring is providing a cost-effective way to monitor algae risk in real-time.

Algal blooms are usually triggered by high-nutrient conditions in water, which are emitted by agriculture and industry or other human activities. These blooms disrupt the natural ecosystem by blocking sunlight and depleting oxygen in water bodies and release toxic compounds. This can cause significant environmental and social harm in the form of increased health risks for humans and wildlife in contact with water. Freshwater lakes and coastal regions effected by algal blooms are often tourist and recreational areas. Blooms cause discoloration, high volumes of foam and noxious odours and increase the requirements for infrastructure in water treatment plants to remove algae related compounds.

Increased monitoring, bloom identification and predictive risk modelling will assist in improving management and mitigation activities by focusing resources in high risk areas and providing timely alerts to decrease health risks to the general public.

As satellite technology becomes more advanced, they will be able to provide higher resolution data capture and allow the monitoring of smaller water bodies and river systems that are not currently feasible. The higher resolution data will also enable more robust analysis improving bloom prediction capabilities. There may be future potential to fully automate the bloom management and mitigation process to remotely treat and prevent blooms without the need for human intervention. This solution will need monitoring technologies to be merged with effective algae treatment technologies.

VALUE CREATED

Improving efficiency and reducing costs:

- Reduce time and costs of labour-intensive manual monitoring programs.
- Decrease cost of treating algae related taste and odour compounds.

Enhancing economic, social and environmental value:

- Improves frequency and detail of monitoring programs enabling better mitigation and management of algal blooms
- Decrease health risks for the general public using waters for drinking or recreational activities.

POLICY TOOLS AND LEVERS

Legislation and regulation: Regulations are needed to register and monitor industrial and agricultural land use upstream of water bodies to assist in finding the root cause of blooms identified by monitoring technologies. Strict run-off and pollution laws are needed to mitigate industrial and agricultural pollution into waterways. UAV and regulations also need to be developed and implemented to ensure effective use of the vehicles within the law (see also the *Drones for Monitoring, Surveillance and Inspection Use Case*).

Transition of workforce capabilities: An increase in drone usage for remote sensing will also increase the need for drone pilots and data related staff. There will be a need for experienced algae management professionals verify results as well as manage and respond to insights from data analysis of remote sensing equipment.

Funding and financing: Collaboration between government agencies such as water utilities, public health and environmental protection is needed to ensure data generated can be utilised by all stakeholders and enable funding from all agencies to share financing risks and rewards.

IMPLEMENTATION

Ease of Implementation

Depending on the degree of remote monitoring. For satellite-based programs, implementation is relatively simple with access to historical data being the most important factor. For remote sensors and UAVs, installation and drone piloting need to be considered. Effective avenues for alerting the right agencies, industries and the general public of bloom risks need to be developed.

Cost

Cost of remote monitoring will depend on the resolution required. Satellite technologies are cost effective for large areas. For higher resolution data, in-field sensors or piloted UAVs and drones are needed. With rapid development, the cost of drones has decreased over the past few years. The main cost of drone surveillance programs will be in training operators and pilots as well as optimised strategies and methods for data collection.

Country Readiness

Need the technical expertise to manage and respond to data analysis. Monitoring is only effective if there are existing management and mitigation procedures in place such as tracking of and communication with upstream commercial and agricultural land users to prevent bloom-causing nutrients entering waterways.

Technological Maturity

Current satellite technologies are limited to monitoring coastal regions and large lakes due to their limited resolution. Machine learning methods of analysing drone, satellite and sensor data is also still developing, as more data and higher resolution data is collected algal bloom identification and prediction with become more accurate.

RISKS AND MITIGATIONS

Implementation / social / economic risk

Risk: Accuracy of bloom identification and prediction is critical for a successful remote monitoring program. Poor data and predictions result in false positives which can lead to unnecessary closures of recreation waters leading to poor public reputation. While false-negative results can lead to increased health risks for water users.

Mitigation: Data collection and analysis technologies need to be robust and provide confidence of identification and prediction results. While monitoring technologies are still developing, experienced algae management professionals are needed to action and verify results. Clear management process of acceptable economic and health risks is needed.

Safety and (Cyber)security risk:

Risk: Higher resolution satellite and drone imagery also means potential privacy concerns when individuals and their property can be easily identified. Though remote monitoring of water bodies is a lower risk activity as these are generally outside populate areas, there is still an element of risk for the public in the area. Outdated government policies and regulations may not have considered the significant satellite technology leap and are not be suited to address these concerns.

Mitigation: Policies and regulations need to be updated to address potential privacy concerns of a rapidly evolving technology. Collaboration between the satellite industry, data users, the public and government agencies is needed to create legislation that does not put privacy at risk.

EXAMPLES

Example	Implementation	Cost	Timeframe
Cyanolakes	EONEMP project in South Africa to integrate remotely sensed estimates of cyanobacteria (algal) blooms into the national water management database for near real time monitoring purposes.[1]	Study has lowered the risk posed from cyanobacteria blooms and water pollution to recreational water users and animals, while also educating the public.	EONEMP was a three year project (2015-2018) funded by the South African Water Research Commission, collaborating with the Department of Water and Sanitation, the Council for Scientific and Industrial Research and the South African National Space Agency.
NASA	CyAN is a multi-agency project among EPA, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the United States Geological Survey (USGS) to develop an early warning indicator system to detect algal blooms in U.S. freshwater systems.[2]	Payback is in the form of making faster and better-informed management decisions related to cyanobacterial blooms.	This is an ongoing research project.

[1] The Earth Observation National Eutrophication Monitoring Program. Cyanolakes. Accessed 15 April 2020.
[2] Cyanobacteria Assessment Network (CyAN). United States Environmental Protection Agency. Accessed 17 April 2020.