Harmful Algal Bloom Detection System (2025-015)

Novel method for harmful algal bloom detection through leveraging AI and Data Assimilation

Market Overview

Harmful Algal Blooms (HABs), typically found in warm water of aquatic ecosystems such as rivers, lakes, and ponds, pose significant threats to ecosystems by affecting livestock, pets, animals, food systems and humans. The economic impact of HABs is estimated at $10-100 million in the United States alone. Traditional methods for detection rely on manual water sampling, sensor data, and satellite imagery. As these methods can be limited by availability, issues with sensors and image resolution, there is a need for effective monitoring of HABs that takes into account their complex dynamics that can lead to widespread ecological disruption. Clemson University researchers has developed a technology that effectively monitors an indicator for HAB occurrences. By coupling AI models such as deep learning tools and data assimilation techniques, this technology can accurately detect HABs and predict concentrations through real-time data processing. This methodology facilitates timely responses to outbreaks, while minimizing costs compared to current detection methods by reducing reliance on continuous sensor data and reducing maintenance and energy needs.

Technical Summary

The proposed HAB detection method introduces data assimilation into two deep learning models to detect chlorophyll-a concentrations, a known indicator for HABs growth. By implementing a filter approach, real-time observations can be integrated into the framework to estimate the evolving state of HABs, leading to a predictive element Additionally, this technology refines previously developed deep learning models for improved accuracy of detection.

Application

Environmental Science, Water Monitoring, Harmful Algal Bloom Detection

Development Stage

TRL 2/3

Advantages

- **Innovative** – Combination of deep learning and data assimilation for HAB detection
- **Efficient** – Provides accurate detection of HABs through monitoring chlorophyll-a concentrations
- **Predictive-** Data tools permit real-time prediction of HABs

About the Inventors

Dr. Debabrata Sahoo

Associate Professor, Sustainable Water Resources Engineering

Dr. Debabrata Sahoo earned his Ph.D. in Biological and Agricultural Engineering from the University of Texas A&M. Dr. Sahoo's research is focused on developing strategies for sustainable water resources for contrasting and competing users (e.g., MS4s, agricultural community) broadly around water quality issues in streams, lakes and ponds utilizing a combination of field observations, sensing technologies, experimental research, laboratory analysis and advanced computational modeling in the State of South Carolina and beyond. Dr. Sahoo works collaboratively with the water agents spread across the state. In the past, Dr. Sahoo has participated in educating K-12 students, homeowners, farmers, local governments, and professionals on different aspects of water engineering in South Carolina

Dr. Ibrahim Busari

Graduate Research Assistant, Clemson University

Dr. Busai graduated with his Ph.D in December 2024 with research focusing on utilizing machine learning models for the prediction of Harmful Algal Blooms (HABs). His research interests revolve around water quality modeling, ecosystem analysis using machine learning techniques, and watershed modeling.

For more information on this technology contact:

Pushparajah Thavarajah
Business Development Associate
E: pthavar@clemson.edu
P: (864) 656-5708