Current physical, chemical, and biological technologies for managing HABs have unintended adverse impacts on the surrounding ecosystem, limited deployability and scalability, and often require personnel to come into close proximity of HABs.

Objective

Validate and optimize the performance of an ultraviolet (UV) light-based mitigation technology that does not require the use of chemicals, and assess its potential for integration with remotely operated vehicle (ROV) UV-C enabled boat technology for safe and effective, large-scale HAB mitigation.

Approach

1) Perform bench scale studies to verify and optimize the UV dose requirements for inactivation of cyanobacteria and degradation of cyanotoxins as a function of ambient water quality; 2) Evaluate the degradation of cyanotoxin microcystin-LR (MC-LR); 3) Assess whether degradation of cyanotoxins by UV-C radiation produces harmful byproducts; 4) Evaluate and demonstrate the performance of a UV-equipped ROV remotely operated vehicle (ROV) at pilot scale; and 5) Assess performance, required enhancements, scalability, applicability, and environmental impact of a UV-C enabled boat system.

Results

Our preliminary bench-scale studies focused on assessing the effect of UV-C irradiation at 254nm to control algal growth using field-collected water samples. The results suggested that UV-C irradiation at 40mJ/cm² can suppress cyanobacteria growth in a dose-dependent manner. In addition, we investigated the capability of UV radiation at 254nm to degrade cyanotoxin microcystin-LR (MC-LR). Results showed the quantum yield for direct photolysis at 254nm was 0.53.
This project will leverage with the Aquatic Nuisance Species Research Program Project entitled "Mitigation of HABs Toxins Using Deployable 3D Printed Photocatalytic Devices" (PI-Alan Kennedy) by using 3D printed devices as a polishing step to reduce microcystin concentrations after UV-C inactivates the cells.

The UV-C enabled boat may give USACE water managers confronted with a HAB the ability to rapidly and safely “pause” a bloom for an extended period or destroy it, all remotely, so that personnel are kept out of harm’s way. The technology may also enable effective inactivation of cyanobacteria and reduction of cyanotoxins without causing deleterious, off-target ecological effects.

**Value to USACE Mission**

**Partnership/Leveraging Opportunities**

This project will leverage with the Aquatic Nuisance Species Research Program Project entitled "Mitigation of HABs Toxins Using Deployable 3D Printed Photocatalytic Devices" (PI-Alan Kennedy) by using 3D printed devices as a polishing step to reduce microcystin concentrations after UV-C inactivates the cells.