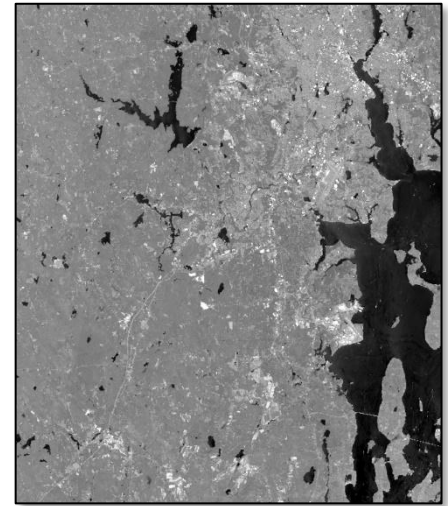


RHODE ISLANDVIEW 2023 - 2024 ACTIVITIES

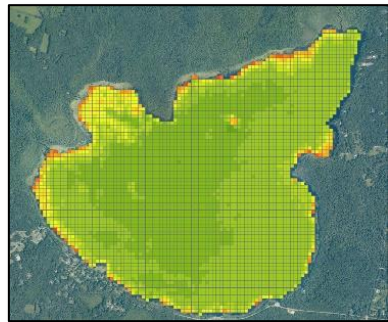
Rhode IslandView study uses satellite imagery to detect algal blooms

Harmful algal blooms (HABs) pose a significant risk to public health and the environment. Early detection of HABs is important for issuing timely advisories to protect public health. In Rhode Island, HAB detection relies on public reporting and site visits by the Department of Environmental Management (DEM). Satellite imagery may provide a more efficient approach for detecting potential HABs and provide timely advisories. In this project, we explored the feasibility of using satellite imagery to detect algal blooms for inland waterbodies in Rhode Island.

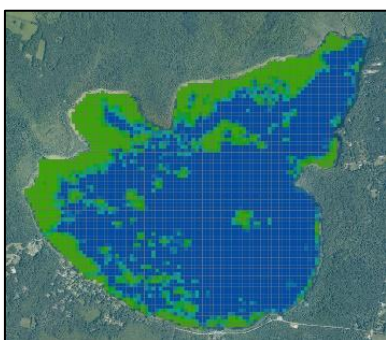
The Landsat and Sentinel-2 satellites provide multispectral imagery at 8-day and 5-day intervals which provides the potential for near real-time monitoring of lakes and ponds throughout the state. These multispectral images allow for the calculation of the Normalized Difference Vegetation Index (NDVI) which is a metric that is particularly effective for detecting green vegetation. Historical HAB advisory notices indicate when ponds have been affected by past algal blooms and served our training and validation data.



The near-infrared band of a Sentinel-2.



NDVI for Worden Pond in South Kingstown, RI on 9/05/18



Plant coverage in Worden Pond

In many ponds, aquatic plants can create high NDVI values that may be mistaken for algal blooms. However, aquatic plants are perennial whereas algal blooms tend to occur only in mid- to late summer and in certain years. To avoid confusing aquatic plants with algal blooms, we established baseline NDVI values using summertime imagery for years when no algal blooms had been reported. Algal blooms would be indicated by higher-than-normal NDVI values compared to the baseline.

Using high-resolution summertime aerial imagery, we found that satellite imagery is effective for detecting surficial aquatic plants. However, work is ongoing to determine the threshold above baseline NDVI that indicates algal blooms. The process is complicated by the difficulty in getting accurate algal bloom locations that correspond to the time of the satellite imagery and the dynamic nature of algal blooms.

This research found some challenges and limitations of using satellite imagery for detecting algal blooms. Some lessons learned in this research include:

- In Rhode Island, cloud-free (<10% cover) images are relatively infrequent in a typical summer which limits real-time detection potential. Cloud masks are imperfect and can cause false aquatic plant and HAB detections.
- Level 1 imagery (i.e. not atmospherically corrected) should be used for water applications to avoid inaccurate NDVI values;
- Harmonized Landsat-Sentinel image datasets seem to exacerbate the “mixed pixel” problem in near shore areas possibly due resampling of the data.

BENEFITS TO RHODE ISLAND

Important implications for the early detection and monitoring of HABs in freshwater systems

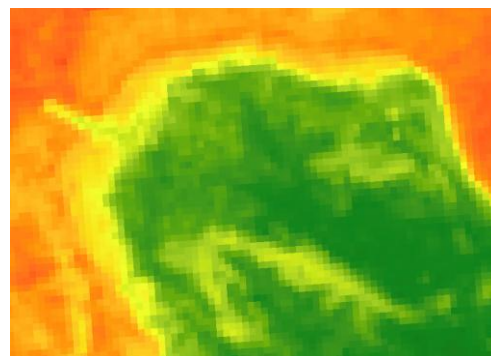
Our work has had important implications for the monitoring of Rhode Island water bodies. As a matter of public health, the efficient detection of HABs by management agencies is of vital concern. Understanding the benefits and limitations of satellite monitoring of HABs will provide guidance for DEM's monitoring efforts.

Future work will explore the use of surrounding land cover, water depth, temperature, and other environmental data to predict HAB occurrences. These efforts are aimed at guiding efforts (e.g. implementing green infrastructure) to mitigate the factors that contribute to HABs.

The Rhode IslandView activities supported one graduate student during the Spring of 2024. The student gained valuable experience in the analysis of remote sensing datasets, the automation of processes using Python, and the analysis of data within geographic information systems. The student also developed skills in interpersonal communication and experimental design. He will continue the research begun in this project as a research associate at the University of Rhode Island.



Aquatic plants in the northwestern corner of Worden Pond, South Kingstown, RI (July 2019).



NDVI derived from a Sentinel-2 image in the same area of Worden Pond (July 2019).

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