Identifying and Forecasting CyanoHABs in Marion Reservoir

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Motivation

Marion Reservoir, a 6,200-acre lake in Marion County, Kansas, serves as the primary drinking water source for its residents. Since the late 1990s, the reservoir has seen a significant rise in cyanobacteria concentrations[1]. Notably, in 2003, the first **Cyanobacterial Harmful Algal Bloom** (CyanoHAB) was reported. These blooms can **manifest rapidly,** demanding the **urgent attention of water resource managers**. Addressing a CyanoHAB in a timely manner is crucial to **mitigate both public health risks and water treatment expenses**. Given these challenges, it is essential for Kansas to shift from a reactive to a proactive approach in managing CyanoHABs.

When an **unforeseen bloom** takes place, it adversely affects the taste and smell of the county's drinking water. Treating the water during a bloom can **double the plant's operational costs** and may **still take up to two days** for full resolution.

This study aims to design a forecast model for predicting CyanoHAB occurrences at Marion Reservoir. Accurate predictions will facilitate proactive water treatment measures, resulting in cost savings and ensuring the community receives palatable drinking water. The findings from this forecast will be showcased on a public-access website in a user-friendly manner.

Study Site

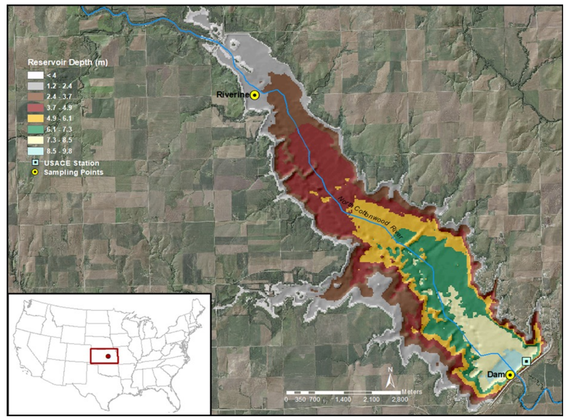


Fig. 1 – Depth chart of Marion Reservoir, Marion County, KS. Marion is a relatively-shallow lake, with a mean depth of 10 feet and a maximum depth of around 30 feet.

CyanoHAB Forecast

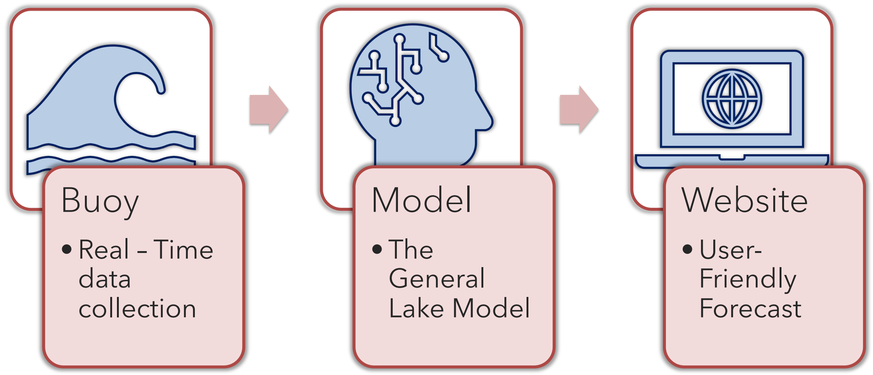


Fig. 2 – A simplified conceptual flowchart of buoy-to-forecast process.

Hourly data collected by the buoy **(fig. 3)** will be wirelessly transmitted to KU in real time. This data will then be run in the General Lake Model (GLM) **(fig. 4)**. This model will output a water quality prediction, which will then be uploaded to a website. This website will be available to the water treatment facility, governing bodies, and greater population.

Fig. 3 – A buoy **(A)** is deployed near the dam to record water quality parameters using a water quality probe **(B)**. This buoy transmits the data to KU on an hourly basis.

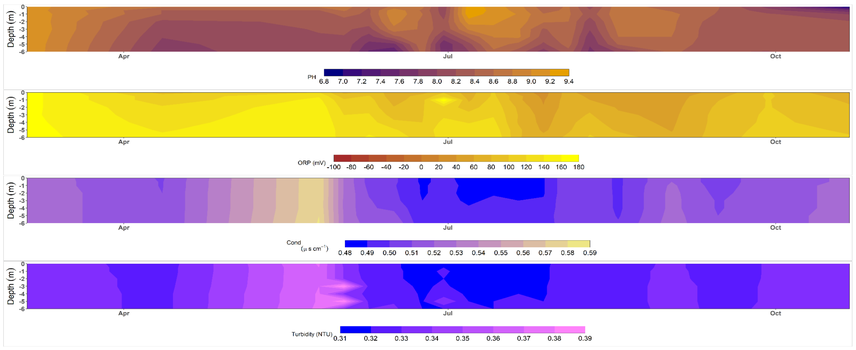


Fig. 4 – Sample results of the General Lake Model from Marion dam. From top to bottom: pH, ORP (mV), Cond. (µ s cm^{-1}), Turbidity (NTU).

Remote Sensing

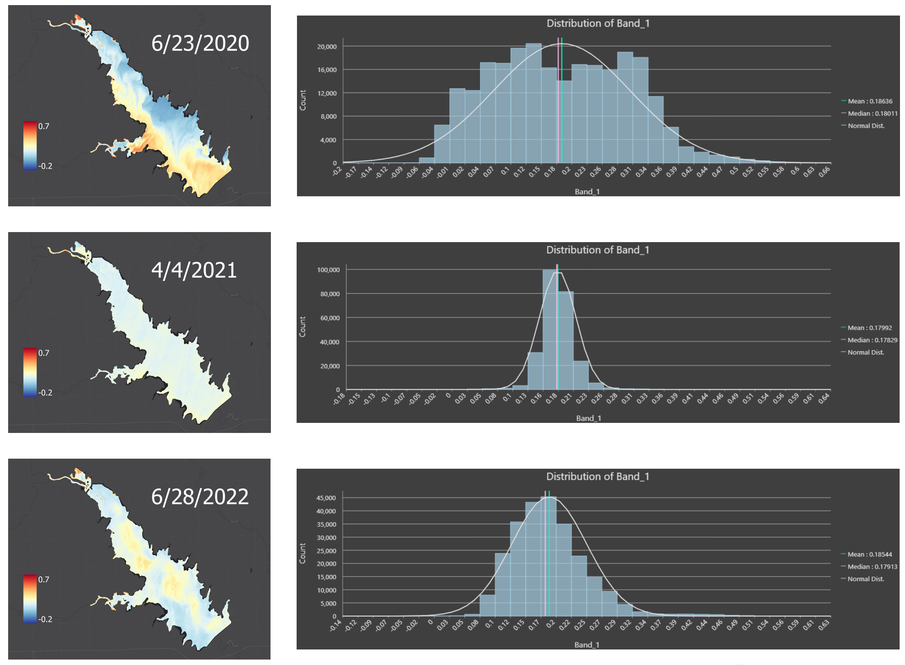
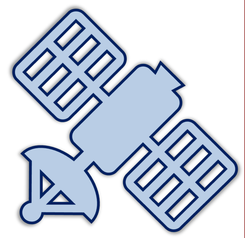


Fig. 5 – Results from the Normalized Difference Chlorophyll Index (NDCI) using Sentinel-2 data on Marion Reservoir. The NDCI can be used to estimate chlorophyll-a concentrations[2].

In addition to the General Lake Model, the website will also feature the latest Sentinel-2 NDCI image to provide users with a spatial reference of current CyanoHABs.



Summary & Future Work

Cyanobacterial counts in Marion Reservoir have greatly increased over the last twenty years. This has led to an increase in harmful algal blooms, or CyanoHABs.

A buoy to capture real-time data will be deployed on Marion Reservoir in the spring. This buoy will send water quality data to KU to be automatically input into a model, the General Lake Model. A forecast will be developed from the model and shared with the public on a user-friendly website. The latest remote sensing images will also be displayed on the website to inform people of the spatial extent of the CyanoHAB.

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[1]Harris, T. D. et al. Phytoplankton and water quality in Marion and Keith Sebelius Reservoirs: Results of paleolimnological sediment core and historical data analyses. *Kansas Biol. Survey* **198**, (2020)
[2]Mishra, S. & Mishra, D. R. Normalized difference chlorophyll index: A novel model for remote estimation of chlorophyll-a concentration in turbid productive waters. *Remote Sensing of Environment* **117**, 394–406 (2012).