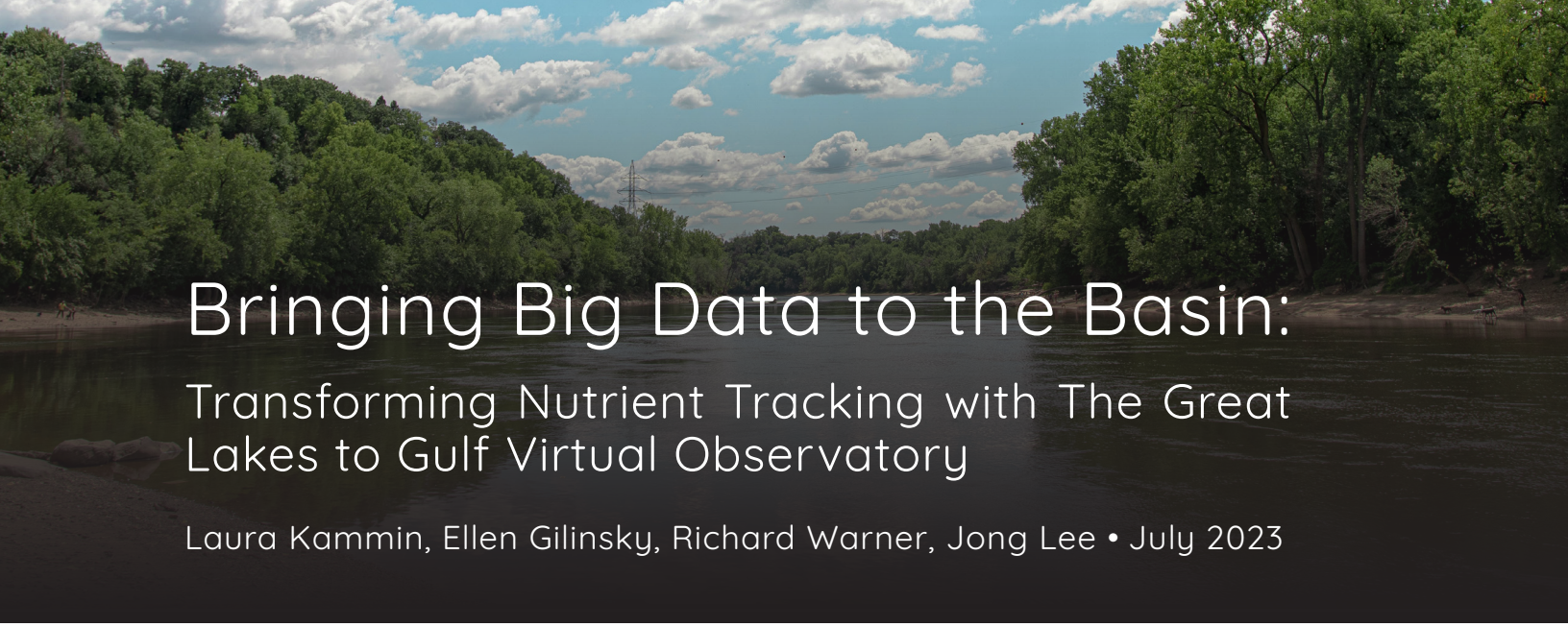

Bringing Big Data to the Basin:

Transforming Nutrient Tracking with The Great Lakes to Gulf Virtual Observatory

Laura Kammin, Ellen Gilinsky, Richard Warner, Jong Lee • July 2023

Nutrient management in the Mississippi-Atchafalaya River Basin is a complicated undertaking. Excess nitrogen and phosphorus from various point and non-point sources contribute to the hypoxic zone in the Gulf of Mexico as well as to local hot spots of excess nutrients throughout the Basin. The 12 mainstem Mississippi River states that form the federal/state Gulf of Mexico Hypoxia Task Force are working to improve water quality and show a measured reduction in the size of the hypoxic zone. Tracking progress on nutrient loss reduction is not an easy task, and that is where the Great Lakes to Gulf Virtual Observatory (GLTG) can help. An interactive GIS-based tool that integrates water quality data with land use and conservation practices information, GLTG is a one-stop-shop for policy makers and stakeholders to access water quality data and guide their decision-making to improve water quality in the Mississippi River Basin.

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REDUCING THE SIZE OF THE HYPOXIC ZONE

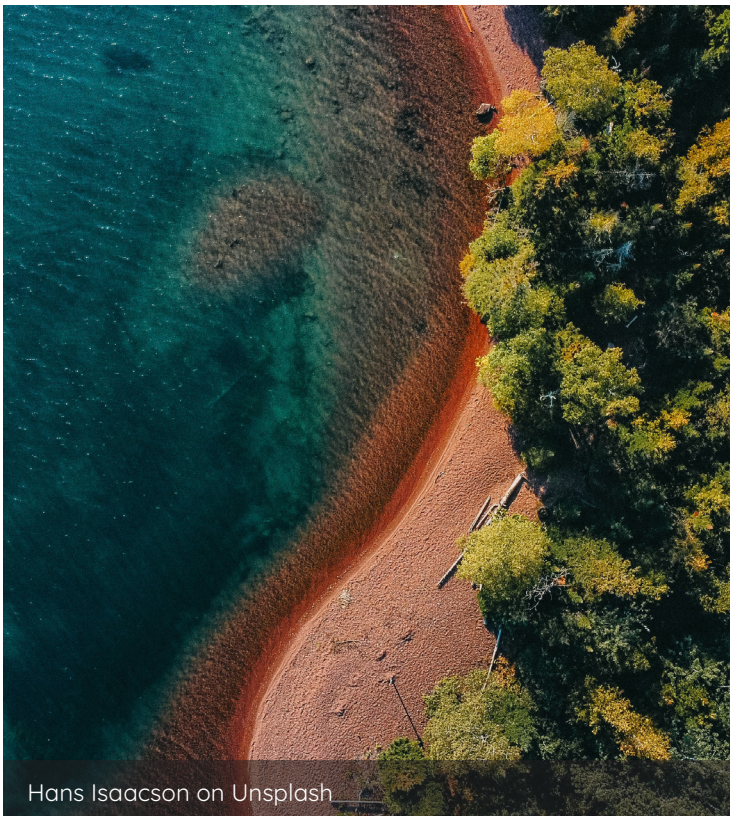
To truly demonstrate progress on nutrient reduction, it is useful to visualize water quality information from each state and relate these data to on-the-ground nutrient reduction efforts by analyzing long term trends. But each state has different methods of reporting and tracking progress on nutrient reductions, and some even use a combination of tracking methods which include monitoring and modeling. Because each state's methods are different, the outcomes are difficult

to compare across states. To accurately see where each state is at in reaching their reduction goals and ultimately contributing to better water quality, a unified method of comparing watersheds is needed.

The Great Lakes to Gulf Virtual Observatory allows stakeholders to visualize and compare current and historic water quality conditions in rivers and streams in the Basin and to analyze and graph specific parameters. Furthermore, GLTG allows our scientists to look further into the water quality data to harmonize methods and assemble comparable data over a long time period to relate trends in water quality parameters to nutrient reduction practices across the landscape.

GETTING TO KNOW THE GREAT LAKES TO GULF OBSERVATORY

GLTG is built on Geodashboards, an open-source web technology that lets site visitors interact with and visualize geospatial data. The data are drawn from more than 1,300 water quality sensor sites covering 122,233 contributing waterways. We're talking big data—more than 42,000,000 data points (and counting). Currently, the platform includes sites with five or more years of discreet nutrient data in the main stem of the Mississippi River watershed, along with nutrient data for selected small watersheds (HUC 8 or smaller) in 12 states in the Mississippi-Atchafalaya River Basin.


Hans Isaacson on Unsplash

And in the coming months, the National Great Rivers Research and Education Center and the National Center for Supercomputing Applications will add long term (1990-2020) flow-normalized annual nitrogen and phosphorus loads for about 40 sites throughout the Basin to GLTG, with approximately 300 more sites that contain information for a significant portion of that time period. As part of our trends analyses, we are harmonizing and screening a heterogenous water quality dataset and developing a streamflow dataset to be used in the trend analysis method known as the Weighted Regression on Time, Discharge, and Season for nitrogen and phosphorus data as well as the calculation of nutrient loads.

DATA DASHBOARDS TO FACILITATE EXPLORATION AND ANALYSIS

The GeoStreaming Dashboard is the powerhouse of the site and allows users to explore, analyze, and download the data they are most interested in. There are currently 13 data sources from which to choose, including information from the Water Quality Data Portal as well as other data from the U.S. Geological Survey, National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency, and other organizations. In addition to forms of nitrogen and phosphorus, the dashboard facilitates exploration of other parameters such as dissolved oxygen, water acidity, turbidity, water temperature, and much more. Users can analyze the data by selecting the parameters of interest along with changing the calculation settings and selecting the threshold value and the region of interest. Or they can download the data and run their own analyses. Additionally, the Geostreaming Dashboard has other layers to delve into such as the USGS SPARROW model (2002 and 2012), the extent of the Gulf of Mexico Hypoxic Zone each year from 2005 to 2021, a Congressional districts layer, watershed boundaries, river reaches, USDA CropScape frequency data, and a large river layer.

"Our goal is to make nutrient data easy to visualize so that soon it will be simple for stakeholders to track nutrient trends throughout the Mississippi-Atchafalaya River Basin, helping them move from data to decision making."

The State Portals Dashboard allows site users to review data and trends specific to individual states. Information and links are currently available for Illinois, Arkansas, Indiana, and Iowa, with Tennessee and Missouri coming soon. Our goal is to have data from all 12 states participating in the Hypoxia Task Force available on the site by early 2024.

The Conservation Practices Dashboard provides visualizations of the impact that agricultural conservation practices have had from 1989 to 2020. Users can search by conservation programs (CSP and EQIP), program funding, area treated, nutrients (nitrogen and phosphorus), and the Top 10 Practices by area treated. Information is available by state and HUC 8.

PUTTING IT ALL TOGETHER

The Great Lakes to Gulf Virtual Observatory is designed to be accessible to multiple audiences from community members to environmental managers, to government officials and scientists. Its utility lies in robust databases that can be easily accessed and analyzed. Our goal is to make nutrient data easy to visualize so that soon it will be simple for stakeholders to track nutrient trends throughout the Mississippi-Atchafalaya River Basin, helping them move from data to decision making.

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