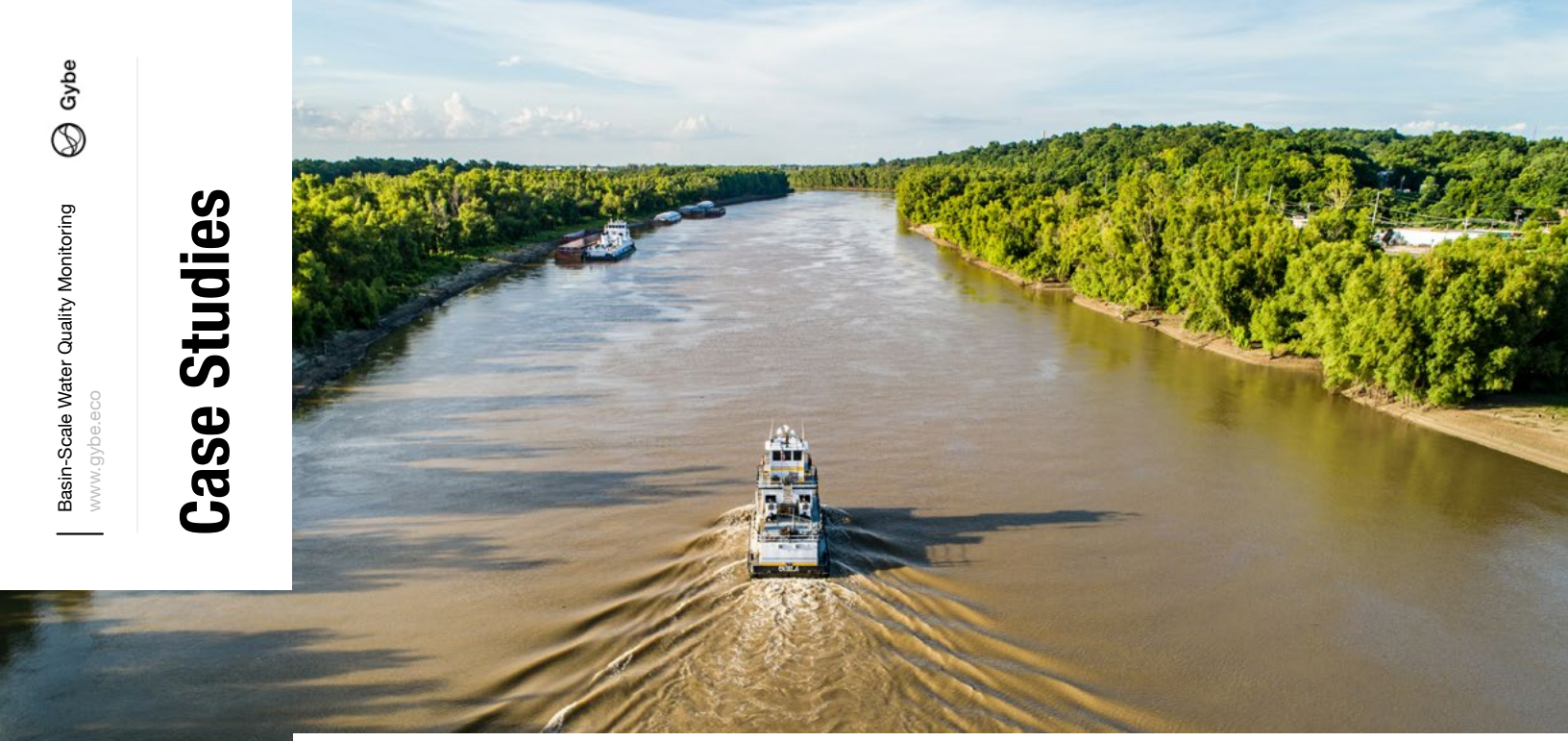

Gybe + TNC Mississippi

Louisiana Chapter, USA

Bryan Piazza,
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Our goal is to enable large-scale nutrient measurement along rivers, to accelerate the progress of nutrient load reduction across the basin.

TNC Goal

Enable large-scale nutrient measurement along rivers, in order to track the ecological impact of projects related to nutrient load reduction within the basin. Starting from small and local monitoring efforts, TNC wants to scale up nutrient monitoring across the entire Mississippi river basin in order to accelerate the impact tracking of cumulative effects across a range of projects and disparate agricultural practices aimed at reducing agricultural nutrient pollution This will allow TNC and a range of partners to significantly accelerate the progress of nutrient load reduction across the basin.

In the Mississippi River Basin, TNC is working to reduce nitrates in the river by improving the sustainability of agricultural practices and enhancing the ecosystem's natural filtration capacity. Through a combination of science and policy expertise and on-the ground projects, TNC has activated 17 business units, over 100 staff members, and over $2-million annually into a cohesive team that is working with a large number of important partners and relationships across the basin, all dedicated to a healthy Mississippi River Basin. Together, we are working with agricultural producers, suppliers, and retailers to grow more food with less fertilizer and reduce fertilizer runoff. We are also working with landowners and agencies to protect and restore floodplain wetlands – the river's "kidneys" – to remove excess nitrates already in the water, while also creating healthy habitat for fish and wildlife.

A fundamental shift from local to basin-scale monitoring.

Waterbody Overview

The Mississippi river watershed is the fourth largest watershed in the world. Often divided into upper, middle and lower basin.

Context

The Mississippi basin is one of the largest river basins in the world, with a total drainage basin area of 1,151,000 sq mi (2,980,000 km^2). One of the most productive agricultural regions on Earth, the basin is used primarily for high-intensity agriculture. The area is known as the nation's "breadbasket," with 65% farmland and 25% harvestable cropland, strongly dominated by large scale monocultures of corn, soybeans, and wheat.

State of the basin

In the Mississippi Basin there has been a tremendous increase in food production (a positive increase in an important ecosystem service), coupled with simultaneously degrading water quality, natural habitats, and biological diversity (a decline in ecosystem goods and services).

Water type

Highly turbid, complex water profile due to mixing of many tributaries.

Key pollution sources

Agricultural runoff (fertilizer and pesticides), and industrial and urban waste and runoff. Monitoring data will be used to help evaluate the impact of specific policies or practices aimed at reducing nitrates, e.g., floodplain restoration, sustainable agricultural practices, urban water management.

The Challenge

Pollution in the Mississippi river is a large-scale problem. Pollution accumulates downstream, carries over across state lines, and ultimately culminates in a large and growing dead zone in the gulf of Mexico. Tackling such a problem requires an ambitious, collaborative effort of many conservation projects across the river basin, and an innovative way of tracking how these efforts impact water quality. Water quality across the river basin needs to be tracked as an ecological whole, rather than in sections.

The TNC team needs a big picture view of the entire river system, to help set a clear baseline and understand expected variation, to effectively gauge changing water quality against this baseline over time.

Monitoring water quality in rivers is currently difficult. Gauges are very expensive, require significant maintenance, and only offer a limited view of a specific location along the river. USGS is the most widely available source of water quality information in the basin, but even so, continuous longer-term nitrate monitoring is available at only about 10~15 locations. This doesn't correspond well to how rivers function: river water is complex, water quality can be vastly different from one place to the next, and spatial patterns are invisible, even to a series of sondes. In short, current monitoring systems do not offer a comprehensive view on the behavior of water quality in the river, are much too expensive, and are insufficient to measure progress.
TNC wants to shift from measuring progress locally, to measuring it on a much larger, basin-wide scale. Additionally, TNC uses Gybe's approach locally, at large floodplain restoration projects, to monitor remotely, further decreasing project costs and also allowing monitoring in remote areas that would otherwise be difficult to reach.

Mapping Nitrates along the river system

The Solution

In August 2019, TNC and Gybe started working together in the lower Mississippi as a first pilot project.

In about one day, both Gybe sensors were installed in two locations along the Atchafalaya and Mississippi rivers.

Next, nitrate models were created with a combination of satellite and GybeSensor data inputs.

Results show excellent predictability of nitrate levels based on Gybe's data, within a broad range variation in Nitrate levels, as well as broad changes in pigment, discharge, and sediment conditions. The next step is to investigate to what extent the model is applicable across a broader area.

TNC has access to Gybe's data via our GybeMaps WebApp, a no-install web browser application that is automatically updated with the latest data streams.

First Pilot Project

Coverage: Lower Mississippi river area, and Atchafalaya river basin and wetland, about 200km of river coverage, in the state of Louisiana, USA

Gybe sensors: 2 sensors installed: one at the Water Institute of the Gulf on the Mississippi river, and one on the Atchafalaya River.

Key Water Quality Parameters of interest: Turbidity, Sediments and Nitrates

Historical data range: January 2017 - present

Project timeline: August 2019 - present

Expansion potential: Mississippi basin-wide, and global expansion potential WebApp, a no-install web browser application that is automatically updated with the latest data streams.

Results

The solution substantially lowers the installation and operational cost of monitoring compared to market leading alternatives. For example, USGS stations cost $100k per year (per site), and YSI sondes cost $10k~$50k each depending on the sonde. This represents only 2~12% of total costs of monitoring (according to the EPA [1]), as most of the costs are in manual labor to deploy sondes, maintain them, and analyze the data. Simultaneously, information visibility is vastly extended, from just a specific location along the river, to coverage of 100's of kilometers of river. Even with multiple sonde deployments, this level of coverage is impossible to achieve.

GybeMaps provides TNC with orders of magnitude more data, helping TNC to more completely understand the water dynamics in the Atchafalaya and lower Mississippi rivers, and the ecological impacts of their conservation efforts on water quality. This helps TNC understand what types of conservation efforts work best under which conditions, and helps prioritize and optimize the effectiveness of future projects. It also helps TNC ensure the long term viability of these projects by demonstrating clear positive impact to their donors.

[1] https://www.epa.gov/sites/default/files/2016-06/documents/chapter_9_may_2016_508.pdf

"We now have the potential to get never before seen insight about nutrient distributions across a watershed, and begin to accurately assess the impact conservation efforts are having to improve water quality."

Bryan Piazza
Director of Freshwater and Marine Science
Louisianna Chapter
The Nature Conservancy

How?

Data at the landscape scale

By proividing an order of magnitude more information, Gybe enables TNC to automatically track what is happening across the surface of the entire water body.

New Insights + Data Visualisation

Gybe visualises and analyses TNC data, enabling the discovery of new insights, and easier internal and external communication about the meaning of the data.

A fraction of the cost

Gybe's fully automatic system continuously updates the data, helping TNC spend more time on conservation work, and less time gathering data and maintaining sondes.

Performance

Satellite Data

Spatial resolution:10-20m
Data frequency: New map images every 5 days on average
Historical data: Back to 2016

524
DataMaps Generated

$R^2 = 0.46$
Nitrate model, Satellite data only, compared to USGS data.

Sensor Data

Data frequency: New data reading every 15 min, updated in GybeMaps™ daily. Data generated continuously during daylight hours.

10,075
Sensor datapoints generated:
Atchafalaya Sensor (2241)
Baton Rouge Sensor (7834)

$R^2 = 0.73$
Nitrate model, Sensor data only, compared to USGS data.

What's next?

Expansion into new river systems across the Mississippi basin, and improvements to the nitrates model: prove the extensibility of the nitrates model across gauged and ungauged stretches of river, for different water types across the basin.

This will lead into the generation of river-wide nitrate data maps, and demonstrating an application for monitoring conservation impact in a specific TNC project area.

Find out how our solutions can work for you.

Get in touch at info@gybe.eco