Real-time Continuous Nitrate Monitoring Provides a Window on Nutrient Loading in Lake Pontchartrain

Louisiana's Lake Pontchartrain Basin lies at the mouth of the Mississippi Delta and squarely in the sights of water quality experts from around the world. The Lake Pontchartrain Basin is an estuarine system that has been significantly disturbed by the construction of the Mississippi River Gulf Outlet (MRGO) in the 1960s – a shortcut for ships headed to and from the Gulf, which bypasses the lake and deprives it of fresh water and sediment – as well as agriculture, logging and development in the area. The lake's increasing salinity and shrinking wetlands have garnered significant attention, as has the nitrate-laden water rushing past the basin through the MRGO just below Pontchartrain's southern shore.

Complicating matters, the basin's own wetlands contribute nutrients, and the lake's high salinity complicates measurement of many water quality parameters. Meanwhile, tidal effects, the Gulf Coast's flashy storm events, and the lake's 625-square-mile size have made reliable grab-sample data collection during storm events extremely difficult. So while recreational users, shrimp boat captains, wildlife conservationists and regulators grapple with the impacts, Dennis Demcheck and Kevin Grimsley of the U.S. Geological Survey's Louisiana Water Science Center in Baton Rouge are using cutting-edge technology to collect data that could help guide decision-making in the basin.

"This is the first study ever to get real-time loadings into the lake," explains Demcheck, as he describes an 18-month study of nutrient loadings in the lake. "There have been models, but they have been estimates based on a limited number of samples. We can finally document and quantify the short-term events we couldn't quantify. We've gone from estimating general principles we knew to finally being able to get data to refine our models based on real-life information."

The team developed four data gathering stations around the lake in April 2004, says Grimsley, one in each of the major arteries feeding the lake. Each station features cable-mounted monitoring equipment – a YSI 9600 Nitrate Monitor, a YSI 6600 Extended Deployment System (EDS) multiparameter sonde, and a SonTek SL Acoustic Velocimeter – configured to measure 10 water quality parameters in real-time. The monitoring units were connected to a Vaisala 555A datalogger with satellite telemetry hookups, broadcasting data back to Grimsley and Demcheck in Baton Rouge and updating the team's web site with real-time data.

"The four sites capture the great majority of the contributions to the lake," says Demcheck. "We put the stations as far down the stream as possible to capture as much nitrate as possible coming into the lake."

The flood of data – stage, direct velocity, temperature, specific conductivity, salinity, pH, dissolved oxygen (DO), dissolved oxygen percent saturation, turbidity and nitrate – proved so massive at a sampling interval of one hour that the USGS team backed off its interval to two hours, says Demcheck. The longer interval had other practical benefits, he adds. "We found that we could conserve our reagents using two-hour intervals and we weren't missing anything," he notes.

Although use of the monitor does not imply endorsement by the USGS, Demcheck is fully satisfied with the accuracy of the flow injection/chemical reaction technology of the YSI 9600 Nitrate Monitors, which mixes sample water with reagents to create a colored solution. The monitor uses an LED and a photodiode sensor to read the intensity of the color, which corresponds to nitrate concentration in the sample. Demcheck says the flow injection system in the 9600 outperforms ion probe monitoring, especially in saline conditions, which opened the world of real-time data monitoring for nitrates to saltwater systems like Lake Pontchartrain.

Deployment of the YSI 9600 at Pass Manchat, Turtle Cove near Ponchatoula, Louisiana.

(continued)

"An ion probe does not work well in this environment is useless in our kind of work," he explains. "Ion probes can give false positives in estuarine systems, caused primarily by chlorides. By using wet chemistry [in the 9600], we're able to get concentrations we can have confidence in. We routinely look at environmental concentrations of 0.5 mg/L and lower, as low as 0.05 mg/L. Ion probes can't read at 0.2 or below reliably."

For all the cutting-edge science represented by the monitoring stations, the equipment turned out to be quite reliable, says Grimsley – at least after the inevitable challenges of getting four monitors to feed volumes of data through another manufacturer's telemetry system. "With something collecting this many parameters, we had to work through some communications protocol issues – how the datalogger talks to the equipment and vice-versa," Grimsley notes. "But it's nice when you get going – we've gotten a lot of really good data, and the nitrate monitor is simpler to use than I expected."

Grimsley notes that the nitrate monitor self-calibrates every 12 hours in the field, so maintenance is limited to replacing reagent and waste bags, then running a pre-deployment test. He says the secret to easy monthly maintenance visits is doing as much as possible in the lab rather than in the field.

"I don't try to do any of the reagent filling and cadmium column activation in the field – we do all of that in the office," he explains. "When you get out into the field, it's just a matter of switching out the bags and resetting the machine, and basically you've got a brand-new machine."

Regular maintenance is a must for equipment deployed in the challenging environment of an estuary, Demcheck adds. "It needs to be re-emphasized that as with all water quality instrumentation, biofouling is a serious issue," he says. "This is particularly true in estuarine systems. The hardware performs well, but fouling of intake ports and a general buildup of biological growth requires a continuing commitment to maintenance."

Biofouling on a YSI 9600 after deployment at Rigolets, Highway 90 near Slidell, Louisiana.

After putting the suite of real-time monitors to the test in Lake Pontchartrain, Demcheck has set his sights on a real-time monitoring study of perhaps the highest-profile question in nutrient loading in the region – nitrates in the Mississippi River as it feeds into the Gulf of Mexico and its infamous hypoxic zone. The findings, now technologically within reach, could shape the debate on the health of the Mississippi and have consequences from Minnesota to the mouth of the river.

"An important long-term monitoring goal is to have the Mississippi/Atchafalaya system instrumented wired in this manner, with the goal of monitoring and ultimately predicting the size of the hypoxic zone," he says. "We know there is a lot of nitrate in the Mississippi and it's going out into the Gulf – we've had monthly samples in the Mississippi for decades that show nitrates at median concentrations of 1.4 to 1.6 mg/L. But the amount of nutrient processing in the swamps is the subject of a lot of debate. By having unbiased data collected for everyone to use, there theoretically would finally be some consensus – we could determine whether wetland processing could really reduce the amount of nutrients going into the Gulf. Can there be processing at the end of the pipe, or must it all be managed up in the center of the country? This would have national implications."

For additional information on the ***Lake Pontchartrain Study****, please visit http://waterdata.usgs.gov/la/nwis/qw*

NOTE: The reference of the USGS in this application note does not constitute U.S. government endorsement of this product.

For additional information please contact
YSI Environmental
Tel.+1 937 767 7241
US 800 897 4151
Fax +1 937 767 1058
Email. environmental@ysi.com
Web. www.ysi.com