Network of high-tech buoys to be deployed

By Casey Twanow

In a sprawling workroom at the west end of the Great Lakes WATER Institute (GLWI), multicolored cables in coils and crates crowd the floor space. Metal shelves line the walls, stacked with labeled bins of electronic parts. Workbenches display circuit boards in various stages of rewiring.

Several four-foot tall hazard buoys—white cylinders marked with orange diamonds—stand upright in a clear section of the room. Tall antennas top the buoys; insulated cables and metal mooring lines are stretched on the floor in front of them, along with waterproof housings for electronics.

A watertight canister holding a buoy’s electronics is lowered from the research vessel Neasly.

This is the headquarters for a collaborative effort behind GLUCOS (Great Lakes Urban Coastal Observing System), an array of buoys that will help scientists monitor Lake Michigan.

This month, GLWI scientists will deploy five GLUCOS buoys in and around Milwaukee’s harbor. Each buoy will carry instruments to measure water quality and computer and communication systems to send scientists real-time data.

Real-time data, relayed from instruments on the lake, tells scientists what is happening in the lake right now. This lets scientists respond to interesting events, such as current or temperature changes, by heading out on Lake Michigan, or even by remotely turning on sampling gear positioned in the lake.

Along with real-time data, these buoys offer other advantages over monitoring the lake from a research vessel alone. They can collect data round-the-clock from multiple sites, and provide long-term data sets that give scientists a clearer picture of trends in currents, temperature, and water quality. They can also monitor the lake in conditions too rough for a research vessel.

GLUCOS is at the leading edge of real-time, buoy-based technology. Most buoys maintained on the Great Lakes measure surface-weather conditions, but GLUCOS buoys will provide detailed profiles of water temperature, lake currents, and water quality.

The instruments carried by the buoys can be easily reconfigured, so the GLUCOS network will provide the infrastructure for a variety of Lake Michigan research projects. Scientists can also add buoys in the future to increase the number of sites they monitor.

Scientist Tom Consi says, “We hope to become the center of a Lake Michigan-or Great Lakes-wide buoy network.”

Building the Buoy Network

The GLUCOS network’s success depends on a buoy design robust enough to withstand Great Lakes storms. For this, the collaborating scientists looked to Greg Barske, the GLWI instrument shop coordinator.

Barske machined watertight aluminum canisters to house the buoys’ electronics underwater, safe from rough waves. He also created custom pieces like frames that securely mount radios atop the buoys, and clips that let the scientists easily connect cables to the buoys when launching them from a rocking boat.

The buoys also needed to be versatile enough for a range of research applications. This was achieved with computer software created by GLWI’s information processing scientist Tom Hansen and five UWM engineering undergraduates.

The software allows onboard computers to transmit data from a variety of interchangeable instruments. For the students, Consi says, “It’s been an unparalleled engineering educational experience.”

On trial runs, buoys carried “thermistor strings,” which sense temperatures in the water column at meter intervals, and “sondes.” Each torpedo-shaped sonde contains multiple sensors that record oxygen levels, pH, turbidity, and other water quality measurements.

In early trials, there were problems with the radio link through which the buoys send data, but improvements have extended their radio range from hundreds of yards to several miles.

Two larger, solar-powered buoys are being assembled to expand the GLUCOS network, and will be able to stream data from the lake for months at a time. These buoys will communicate with shore through a wireless internet connection, powerful enough to transmit images from underwater cameras.

Scientists at GLWI will use the cameras to study the nuisance alga that fouls Lake Michigan beaches and the migration and spawning behaviors of fish populations.

Knowledge and technology from GLUCOS will be relevant well beyond Milwaukee. For instance, carbon dioxide sensors attached to the buoys will help scientists understand the Great Lakes’ role in the regional carbon cycle and global climate change. GLUCOS can also serve as a model for real-time buoy networks in coastal areas and large lakes around the world.

The Great Lakes Urban Coastal Observing System (GLUCOS) collaborators are Tom Consi, Greg Barske, Harvey Bouma, Tom Hansen, John Janssen, Val Klump, Rob Padrick, and Jim Waples.

UU-Wisconsin students contributing to the project are Jesse Kipp, Don Mares, Andy Schneider, Ken Verhein, and Josh Zager.

The Great Lakes WATER (Wisconsin Aquatic Technology and Environmental Research) Institute is the largest freshwater academic research institute in the Great Lakes region. More information: gluc.uwm.edu.