

# Implementation of the Great Lakes Observing System, 2011-15

Jennifer Read, PhD  
229 Nickels Arcade, Ann Arbor, MI 48104  
Phone: (734) 332-6101 E-mail: [jread@glos.us](mailto:jread@glos.us)

Award Number: *(NA11NOS0120041 CFDA No.11.012)*  
<http://www.glos.us>

## LONG-TERM GOALS

Overarching GOAL: A fully integrated Great Lakes Observing System that provides products and services to decision-makers, resource managers and other data users with input from members and partners, to foster understanding and inform decision-making related to the Great Lakes and St. Lawrence River System.

## OBJECTIVES

- 1) Program Planning and Management: Data and information needs of regional resource managers and policy makers are addressed through the coordination, management and governance of GLOS.
- 2) Data Management and Integration: GLOS users have ready access to high quality, interoperable data and associated products that meet IOOS criteria.
- 3) Observations: GLOS users benefit from timely, reliable and sustained observations that meet regional needs and priorities.
- 4) Model and Tool Development: GLOS provides its users with specific products and services that are efficient, accurate, cost effective and capable of future expansion.
- 5) Outreach and Education: Input from identified major stakeholders – users, members and partners – is systematically and routinely integrated into program planning and evaluation.

## APPROACH AND WORK PLAN

### Program Management and Planning

GLOS staff process and manage all sub-awards and contracts, including partner coordination, program management, and reporting activities. Staff continues to participate in partner initiatives, e.g., IOOS and NFRA committees, the Can-Am GEO Great Lakes Testbed and related efforts in order to ensure that programmatic planning is in line with the standards and priorities of regional and IOOS community partners, and to foster organizational maturity.

The Executive Director, and other staff as needed, facilitate the GLOS RA Board of Directors monthly conference calls that set policy direction for the organization. The GLOS Board seeks to replicate itself with members who are geographically, sectorally and nationally representative.

### Data Management

The DMAC Team is building on progress made in 2011 to update existing databases and integrate data delivery through the development of the GLOS Data Portal. The DMAC team tracks and reports on established performance metrics; integrates existing priority data sets into the GLOS DMAC system; and identifies opportunities for advancing work on data standards, quality management processes, and protocol development. Activities have been divided into the following categories:

- 1) DMAC System Planning, Management, and Coordination
- 2) Operations & Maintenance
- 3) Portal Integration

#### Observations

The Observations team ensures that resources and plans are in place for ongoing operation of existing GLOS assets and continued management of the GLOS Observing Subsystem in accordance with IOOS standards and protocols. Observations are being conducted via partnership with regional universities through the Cooperative Institute for Limnology and Ecosystem Research (CILER) and with NOAA's Great Lakes Environmental Research Lab (GLERL). Funds for this activity are distributed by IOOS to these program partners on GLOS behalf.

#### Models and Tools

GLOS staff serves as secretariat and facilitator of the Ecosystem Forecasting Modeling Framework Pilot for Lake Michigan. The working group is comprised of federal agencies (NOAA, USACE, USGS, USDA and USEPA) and state water quality and fishery management agency representatives from each state around Lake Michigan – Michigan, Indiana, Illinois and Wisconsin. In 2012, the group will finalize a concept of operations and develop an initial set of modeling priorities. In addition to quarterly check-in calls, the working group will meet in-person twice during the project year. We will also examine the feasibility of expanding the effort to another lake during the year. Work with the Ecosystem Forecasting working group will enable GLOS to continue developing the content of the Great Lakes Model Inventory. In 2012 GLOS will also assess how best to implement results of two user needs assessments. One is currently being conducted by the Great Lakes Sea Grant network with AOC and LaMP managers and, in conjunction with work that GLOS is also conducting with AOC managers through another grant, staff will determine the best way to enhance data and information for use by these resource managers.

#### Outreach and Education

The Outreach and Education team identifies priority targets for membership, evaluates existing tools, and conducts promotion and engagement activities. GLOS staff develop and maintain website content, including quarterly newsletters, updates on meetings and events, and when appropriate, news stories that highlight specific GLOS projects. Michigan Sea Grant will coordinate efforts among project partners in the region to promote the use/awareness of the Teaching with Great Lakes Data website that includes Great Lakes data, lessons and information about monitoring systems. Project components include regional coordination, professional development for K-12 educators and evaluation of the Teaching with Great Lakes Data website.

### **WORK COMPLETED**

#### **I. PROGRAM PLANNING AND MANAGEMENT**

GLOS ED and staff processed contracts and sub-awards as needed. All anticipated first-year contracts have been finalized with the exception of education and outreach (see below). GLOS received two supplemental awards during this reporting period. One, from NOAA's Coastal Storms Program which has been processed and activities have been initiated (more information below). The other, from NOAA-GLERL GLRI funds, is currently in process.

GLOS ED and staff continued participation in partner initiatives such as IOOS and NFRA committees, Canadian-American Great Lakes Testbed activities, NOAA Great Lakes Regional Collaboration Team, International Upper Great Lakes Study. The Executive Director conducted monthly conference calls with the Board of Directors to update on progress towards milestones and strategic planning.

The GLOS Annual Meeting was held on March 21-22, 2012 in Cleveland, OH. The meeting featured updates on program progress as well as panel sessions on certification and stakeholder needs. The meeting received positive feedback from attendees.

## **II. DATA MANAGEMENT**

GLOS DMAC team participated in technical and outreach meetings and teleconferences to expand the depth and breadth of DMAC services including: GLOS PI and Annual Meetings, IAGLR, IOOS DMAC Coordination Calls, GEOSS Great Lakes Testbed, Beach Health Interagency Coordination Team, Great Lakes Aquatic Habitat Framework.

### **Operations and Maintenance**

- Continued ingestion of data from deployed buoys.
- Verified correct operation of Upgraded RAM on newly purchased server and installed in hosted rack space.
- Deployed test services and virtual machines on new server.
- Developed recommendations for and implemented set of operational metrics to improve understanding of system and awareness of operational issues
- Developed initial recommendations of programmatic metrics to assess state of enterprise architecture
- Recommended, purchased and installed new, faster switch for rack interconnect.
- Developed recommendations for additional hardware purchases including KVM, IP-addressable power strip, and drawer/shelf monitor for improved maintainability of servers.
- Addressed issues with existing products (HECWFS) and supported integration of new services into GLOS website (GLATOS, St. Lawrence River Boaters Tool)
- Assisted International Upper Great Lakes Study with editing of metadata stored in GLOS GeoNetwork metadata catalog.
- Registered GLOS GeoNetwork metadata catalog in Global Earth Observatory System of Systems.

### **Data Portal Enhancement**

- Reviewed datasets currently in GLOS data portal and desirable datasets
- Reviewed desired functionality
- Reviewed IOOS and other RA guidance and approaches
- Developed specification and schedule (coordinated with IOOS deployment of SOS services)
- Implemented alpha version of enhanced data portal

## **III. OBSERVATIONS**

The annual OBS PI meeting took place January 24 -25, 2012 in Ann Arbor, MI. The meeting provided an opportunity for the leads of GLOS funded observation projects to demonstrate project accomplishments and lessons learned from field experiences in 2011 and plan for the coming 2012 field season. The Observations (OBS) team shared lessons learned from previous deployments and

continued to coordinate activities with upcoming GLRI activities as well as the Cooperative Science Monitoring Initiative. The team also worked with the new DMAC contractors to discuss opportunities for improved data exchange and continued refinement of the Quality Management Plan.

Note: Funds for Observation work are “bopped” to the Cooperative Institute Program and thence to the Cooperative Institute for Limnology and Ecosystem Research. The following is intended as a summary update on that activity only.

### **University of Michigan (CILER and Ocean Engineering Lab)**

Buoy maintenance and deployment:

- The Ludington and Little Traverse Bay (LTB) buoy temperature strings repaired, reconditioned and were calibrated.
- Software updated for all buoys and cellular provider and modem for the Ludington buoy was changed from Verizon to AT&T giving the buoy more consistent coverage. This made it possible to discontinue use of the external amplifier that was the root cause of power budget problems in the shorter solar charging days of Fall 2011.
- New anchor and mooring system were designed fabricated, and deployed for the Ludington, LTB and MTU’s north entry Buoys. Ludington and LTB were deployed and became fully operational in early May, 2012.
- The UMBS buoy was deployed by UMBS personnel with remote assistance from CILER.

Glider/AUV Surveys :

- Sidescan sonar survey of Muskegon LTER transect completed in support of NOAA GLERL Recon program.
- ROV survey from 50m to 30m sites on Thunder Bay transect in support of mussel collection efforts for Lake Huron CSMI.
- Preparations for AUV Fox River plume survey during expected summer hypoxic conditions – to support modeling effort. Trial glider run initially planned for April/May in Lake Charlevoix will be performed in Lake Michigan off Muskegon later in summer. Glider profiling transect across Lake Michigan (Muskegon-Milwaukee) will be performed pending successful initial trial.

Other:

- Guy Meadows retired from the University of Michigan and has moved to MTU. He is still very active in the program. Tom Johengen is Principle Investigator at U of M.
- U-GLOS website transfer to MTU was completed.
- Partner temperature strings for UMBS, MTU (45023 & 45025) and LTI (45026) were also repaired, reconditioned and calibrated.

### **University of Wisconsin-Milwaukee**

- Great Lakes WATER Institute (GLWI) Nearshore 10 meter Endurance Buoy: This buoy was re-deployed in late April 2012, and it is collecting data on surface meteorology, lake surface temperatures, dissolved O<sub>2</sub>, conductivity, turbidity, algal fluorescence, and CO<sub>2</sub> concentrations in the lake and atmosphere. Damage to a transmitter has prevented real-time data collection, but the system is collecting data and being downloaded every 1-2 weeks. The transmitter is expected to be repaired by June 1. The Wisconsin Department of Natural Resources has provided some funds that will allow a technician to visualize and analyze data from this station, along with data from a WDNR nearshore monitoring station near Kewaunee and a National Park Service nearshore monitoring station at Sleeping Bear Dunes National Lakeshore.

- Enhanced GLOS 20 meter Nearshore Buoy: This buoy was also deployed in Lake Michigan, several km northeast of Milwaukee at a depth of 20 m in late April 2012. We are currently working with GLOS, LimnoTech, and the vendor to streamline data transfer to GLOS. Following deployment, damage was observed in several of the temperature sensors. We have worked with the vendor to repair these. Other problems encountered in 2011 (bending of frame and solar panels) were repaired over the winter. There are still some outstanding issues with respect to the wave sensor data that are being looked at. The temperature sensors have been reinstalled and are now working properly, but the weather station has been providing inaccurate measurements and must be sent back to the manufacturer for repair. Assuming we can transfer real-time buoy data without the weather station measurements, we should be able to finish setting up the data transfer to GLOS and NDBC shortly.
- Lake Express High-Speed Ferry: The high speed ferry monitoring system was reinstalled in April and monitoring began the first week of May. The system has been working well. All data collected since 2007 have been analyzed. Some of these data are currently being used in the calibration and validation of a Lake Michigan carbon model, which was initiated in the fall of 2011.

### **Great Lakes Research Collaboration-SUNY ESF**

- Hut system was collecting and transmitting data throughout this reporting period. Grab sampling at the hut was on-going.
- Buoy mooring system has been redesigned to (hopefully) allow for easier retrieval in fall. Buoy was deployed to marina for towing to open lake site during first week of May. However, over-winter anchor marker was lost and attempts (diving, underwater camera) to locate anchor were unsuccessful. New buoy site was chosen to minimize the loss of marker buoys due to large ship traffic. Permit to USCG is under review. New anchor and buoy deployment, scheduled for May, will not take place until June 15th, with the assistance of USGS
- Data management person is working on the transfer of data to GLRC website and to GLOS.

### **University of Minnesota-Duluth**

- Meteorological buoy LLO2 (NDBC 45028) deployed on 22 May 2012.
- Deployment of 45027 has been delayed due to vendor delay providing a new thermistor string to replace faulty string.
- Deployment of LLO autonomous glider in western Lake Superior. Deployment was an unqualified success. Traversed thermal bar seven times in a 1-week period. Collected unprecedented dataset on the structure of the thermal bar from physical and biogeochemical perspective. This is the earliest in the year we have ever deployed the glider, specifically for the purpose of investigating thermal bar (see attached figures)
- Submission of manuscript to Limnology and Oceanography on near-inertial wave climate of Lake Superior. Used GLOS meteorological data.
- Synergistic activity: took delivery of two NSF-funded autonomous profilers for use in large lakes. This technology will (eventually) directly benefit GLOS's open-water mission.

Preparations for summer activities:

- Installation of new thermistor string on 45027 and its deployment
- Continued glider deployments (June, July, August)
- Glider mentoring of UM group by technician Matt James

### **Michigan Technological University and Michigan Tech Research Institute (MTRI)**

- Installed I-button temperature sensors at north and south entrances of Kewanee Waterway.
- Installed Ranger III instrumentation (In operation each transit to Isle Royale).
- Placed new mooring block at north buoy site.
- Installed north buoy (operational 6-8-2012).
- Presented at IYGLR '12' paper on MODIS derived temperatures compared to South and North buoy in situ observations.
- Inspected mooring block and recovered line at south buoy location.
- Scheduled deployment of south buoy for week of June 11, 2012.
- Transferred UGLOS website from University of Michigan to Michigan Tech server and updated its functionality.

#### **MTRI - GLOS Remote Sensing Activity**

- Presented GLOS funded remote sensing results at IAGLR '12' (Satellite-Derived Primary Productivity Estimates for Lake Michigan; Generation of an Operational Algorithm to Retrieve Chlorophyll, Dissolved Organic Carbon, and Suspended Minerals from Satellite Data of the Great Lakes; Comparisons of MODIS-Derived Lake Surface Temperature with Coincident MTU/GLOS Buoy Data in Lake Superior; Mapping Harmful Algae Blooms (HABs) in the Great Lakes Using MODIS and MERIS Satellite Data; and A Satellite Algorithm for River Plume Mapping within the Great Lakes Basin).
- Developed with Dr. Gary Fahnenstiel (NOAA/GLERL) a MODIS specific algorithm to locate and map the extent of HABs.
- Mapped using MODIS satellite data as input estimates of optical water properties (clarity, K<sub>d</sub>, Photosynthetically Active Radiation (PAR) and photic zone) for Lake Michigan.
- Continued to update the Great Lakes inherent Optical Properties Geospatial Database (GLIOPGD).
- Provided test remote sensing products the GLOS DMAC team.

#### **IV. MODELS AND TOOLS**

The preliminary meeting of the Ecosystem Modeling and Forecasting Working Group for Lake Michigan was held on Jan 11 and 12, 2012 in Ann Arbor, MI. Representatives of state, federal and tribal agencies/organizations were in attendance. Based on workshop findings, the working group began developing operational principles which define the group's organizational structure, process for making decisions, relevant member organizations, and secretariat support, among other topics. Since the workshop, a Resource Management Advisory Committee has formed which is comprised of state/tribal level participants.

The members of the working group have begun developing a Lake Michigan modeling matrix. The matrix is organized by Lake Michigan resource management issue area and the final product will include the identification of relevant models that are currently used by resource managers as well as future opportunities for model development. To date, members have identified relevant resource management issues and the resource management advisory committee will begin identifying current resource management decision points.

#### **V. OUTREACH AND EDUCATION**

##### **GLOS Education - Teaching with Great Lakes Data, Observing System Education**

Michigan Sea Grant developed a new lesson about marsh restoration and work continues with Wisconsin and Minnesota partners on additional lesson materials that will be published by June 30.

- New Lesson: *About Phragmites: Restoration of Great Lakes Marshes*, piloted April 30, 2012.
- Forums: Teacher participants have participated in forums online to provide feedback about lessons, data sets and other materials.
- Data sets: Newly revised data sets are being published on the Teaching with Great Lakes Data website weekly.

Great Lakes educators conducted four workshops in three states during this project period.

1. Madison, Wisconsin (May 7, 2012): Collaborative effort with Minnesota and Wisconsin Sea Grant (15)
2. Duluth, Minnesota (March 3, 2012): in conjunction with Minnesota Science Teacher's Association (12)
3. Lansing Michigan: (March 8, 2012) Teaching with Great Lakes Data workshop, in conjunction with the Michigan Science Teachers Association (35)
4. Detroit, Michigan (April 30, 2012): Featured new lesson about invasive Phragmites, in conjunction with Marsh restoration project (30).

### **Website/Newsletter**

GLOS staff has continued to regularly update website content. Updates include but are not limited to:

- Release of Great Lakes Acoustic Telemetry Observation (GLATOS) tool - development of a launch page, content and featured tool on home page (note, development work on GLATOS was supported by another grant and is reported there),
- News and events pages (eg: new position announcement, Coastal Storms Program RFP, International Association of Great Lakes Research, etc.)
- 2011 GLOS Annual Meeting updates and registration,
- Updated Board of Directors and staff page,
- Updated greatlakeslessons.com content,
- St. Lawrence Web content for tool release in June
- A GLOS quarterly newsletter was sent out on March 15, 2012 and content was developed for two NFRA newsletters on GLOS projects - the GLATOS tool and the Cleveland Water District water quality story.

### **Outreach**

Staff continues to consider an RFP for evaluating existing climate change needs assessment work relative to municipal, regional and infrastructure planners in addition to identifying emerging data and information needs. Staff is ensuring that the RFP will support both GLOS needs as well as build upon existing efforts in the Great Lakes, including the NOAA Coastal Storms Program, International Upper Great Lakes Study, among others. While a Program Coordination transition has slowed the finalization and release of this RFP somewhat, the reality is that this issue is moving quickly in the region and GLOS staff wish to ensure the best utility of the final product.

Participated in the following meetings/workshops/projects:

- The TNC biodiversity Conservation Strategy workshop in Chicago, IL,
- The Great Lakes Aquatic Habitat Framework Workshop in Ann Arbor, MI,
- South East Area Committee meeting in Detroit, MI – spill response
- Participated in NFRA education and outreach monthly phone calls, including monthly/bi-weekly calls for the IOOS Video subcommittee,

- Presented at a buoy webinar featuring GLOS observations team members,
- Synthesized and analyzed congressional outreach targets and developed congressional outreach materials in coordination with other RAs in the NFRA education and outreach committee,
- Developed St. Lawrence Boaters Communications strategy and web content in preparation for tool release at the end of June.

## **RESULTS**

The Great Lakes-St. Lawrence River region is home to over 44 million US and Canadian citizens within eight U.S. states and two Canadian provinces. With a coastline totaling nearly 11,000 miles, the region encompasses the largest surface freshwater system on Earth, comprising nine-tenths of the U.S. surface freshwater supply and one fifth of the global supply. The resource is extensively- and intensively- used by a diverse group of stakeholders whose environmental health, economic well-being and quality of life is fundamentally dependent upon the informed use, protection and management of the region's water and related natural resources. The Great Lakes Observing System (GLOS) sees the region's uniqueness as an opportunity to showcase and demonstrate the interoperability of the Integrated Ocean Observing System (IOOS) while contributing to national and regional priorities that include supporting ecosystem restoration and protection; reducing public health risks; improving safety and efficiency of maritime operations; increasing effective mitigation of natural hazards; and improving understanding of climate change and supporting the development of adaptation strategies.

Over the course of this reporting period, GLOS and its sub-contractors have continued to advance observing and data management activities in the region. In addition to addressing issues similar to other IOOS regions (e.g., spill response, search and rescue, beach quality, beach hazards such as rip and channel currents), GLOS is also positioned to address unique regional issues resulting from its freshwater composition and geography. These issues include source water protection; providing baseline data to managers of Great Lakes Areas of Concern (AOCs) and Lakewide Management Plans (LaMPs); identifying, collecting and integrating key fishery and associated environmental (physical, chemical and biological) observations to support state and provincial fishery managers; understanding the impacts of climate change upon net basin water supplies; assisting municipal/regional planners in adapting to climate change; and prioritizing maintenance funds for key port and harbor infrastructure.