THE GREAT LAKES OBSERVING SYSTEM

B L U E P R I N T

A STRATEGY FOR DATA FOR DECISION-MAKING

THE GLOS BLUEPRINT: A STRATEGY FOR DATA FOR DECISION-MAKING

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INTRODUCTION AND BACKGROUND

GLOS collects and aggregates existing physical, chemical, biological and geospatial data about the Great Lakes and St. Lawrence System from its partner organizations and makes that data and information readily and easily accessible to its members and to the general public.

GLOS is one of 11 Regional Associations of the Integrated Ocean Observing System (IOOS). IOOS is a partnership effort across 17 U.S. Federal agencies led by the National Oceanic and Atmospheric Administration (NOAA) working to enhance our ability to collect, deliver, and use ocean information. IOOS is the U.S. contribution to the Global Ocean Observing System (GOOS) as part of the Global Earth Observing System of Systems (GEOSS).

GLOS is unique among the IOOS Regional Associations due to both the region's freshwater ecosystem and to the fact that the region is bi-national (U.S.-Canada). There are several existing treaties and agreements between the two countries dating from the turn of the 20th century, e.g., the Boundary Waters Treaty (1909), the Convention on Great Lakes Fisheries (1955), the Great Lakes Water Quality Agreement (1972, 1978, 1987, 2012), a Joint Strategic Plan for the Management of Great Lakes Fisheries (1981, 1997), and the Great Lakes-St Lawrence River Basin Sustainable Water Resources Agreement (2005). The need for regional data integration has been recognized since at least the mid-1970s with the development of the Great Lakes International Surveillance Plan (GLISP) by the International Joint Commission's Great Lakes Regional Office. Implementation of that vision lagged, however, primarily due to resource and technological limitations.

The need to have a consistent understanding of the ecological health of the Great Lakes using data that are both comparable and compatible is the basis of the bi-national State of the Lakes Ecosystem Conference (SOLEC) process that engages federal, tribal/First Nations, state, provincial, regional and local governments, university-based researchers and non-profit entities. Recently, state and provincial fishery managers who jointly manage international fishery stocks in the Great Lakes have identified the need for aggregated physical, chemical, biological, and geospatial data at the lake, and larger system, level in order to make timely and effective management decisions. Users of Great Lakes water resources, including manufacturers, electric power producers, shipping industry, commercial and sport fishing operators, recreational users, and others, require easy access to the wealth of information available to resource managers and Great Lakes researchers. Given the long history of jointly developing and managing water resources in the Great Lakes region, the Great Lakes Observing System is well-suited to support bi-national resource management efforts requiring integrated and interoperable data.

In 2003, a group of individuals representing federal, state, and regional agencies, organizations, and academic institutions, led by the Great Lakes Commission and supported by funds from NOAA's Coastal Services Center, formed a steering committee to design a regional observing system. Chaired by Dr. David Schwab, a physical oceanographer from NOAA's Great Lakes Environmental Research Laboratory (GLERL), the steering committee assessed the needs of more than 400 potential users of the system, ranging from maritime, environmental, and industry interests, to scientists and educators. The inaugural GLOS Business Plan, released in fall 2004, outlined then-current user needs, available data and information resources, the operational characteristics of an integrated regional system, funding mechanisms to sustain data collection, and the governance structure of a regional association to lead the program into the future.

In 2006, GLOS initiated the transition to independence with the appointment of the first Board of Directors for the Great Lakes Observing System Regional Association. Granted 501(c)(3) status in September 2008, GLOS completed its transition when day-to-day management of the organization transitioned from the Great Lakes Commission to an independent GLOS staff led by Executive Director, Dr. Jennifer Read. On March 31, 2009, the Omnibus Public Lands Management Act of 2009 was signed into law, which included the Integrated Coastal and Ocean Observing System (ICOOS) Act of 2009. The ICOOS Act authorizes the establishment of a national integrated system of ocean, coastal, and Great Lakes observing systems referred to as U.S. IOOS and led by NOAA.

Identified by U.S. IOOS and NOAA as the Regional Association responsible for developing the framework for a coordinated Great Lakes observing system, GLOS enhances and improves existing observation activities by leading the integration of interoperable, easy to access data, products, and related services. GLOS facilitates the cooperation of US federal agencies with US and Canadian federal, state, provincial, and local government, academic, non-profit, and commercial organizations. This bi-national federation of partners represents the interests of Great Lakes observing stakeholders including data collectors, researchers, educators, and various data user groups. Within this network, GLOS coordinates activities and provides resources, products, and services that fill identified information gaps and makes integrated data more widely available. GLOS serves as an advocate for Great Lakes regional interests and needs within the IOOS framework and ensures that regional data integration efforts support larger scales of observing coordination through IOOS, GOOS, and GEOSS.

-*MISSION*-
The mission of GLOS is to link providers and users of data, information, and knowledge in the Great Lakes and St. Lawrence River basin in a way that supports sound decision making in the best interests of the resource and the public.

-*VISION*-
The vision for data, information, and knowledge in the Great Lakes and St. Lawrence basin is that it will be of high quality, reliable, and fully available to all those who need and want it in a user friendly system.

-STRATEGY TO SUSTAIN AND ENHANCE-

Foundational concepts in the GLOS Enterprise Architecture Design Report that have been adopted to shape GLOS' prioritization and planning strategies include:

- **Data management is critical:** The Great Lakes Observing System Regional Association serves an important role in the region through the capacity it provides for data management. GLOS provides a variety of data management and integration services, primarily accessed through www.data.glos.us, an interface for regional stakeholders. GLOS should continue to mature in this role.
- **User needs and observing system enterprise elements necessary to address those needs *vary by scale and time***: The GLOS data management system needs to be flexible to accommodate the collection, compilation, analysis, storage, and communication issues that arise in managing data across different geographic and time scales. GLOS should carefully prioritize implementation strategies that are appropriate given the scale of the need.
- **Existing in-situ, mobile, and remote sensing observing assets can be leveraged to create greater value:** Investments in observing infrastructure have already been made by government and academic entities across the region. However, many components of the system do not have long-term funding, maintenance, or upgrade plans in place. Furthermore, there are opportunities to improve the coordination and use of these platforms and collected data for related monitoring, research, and modeling efforts throughout the basin.

GLOS Enterprise Architecture Design

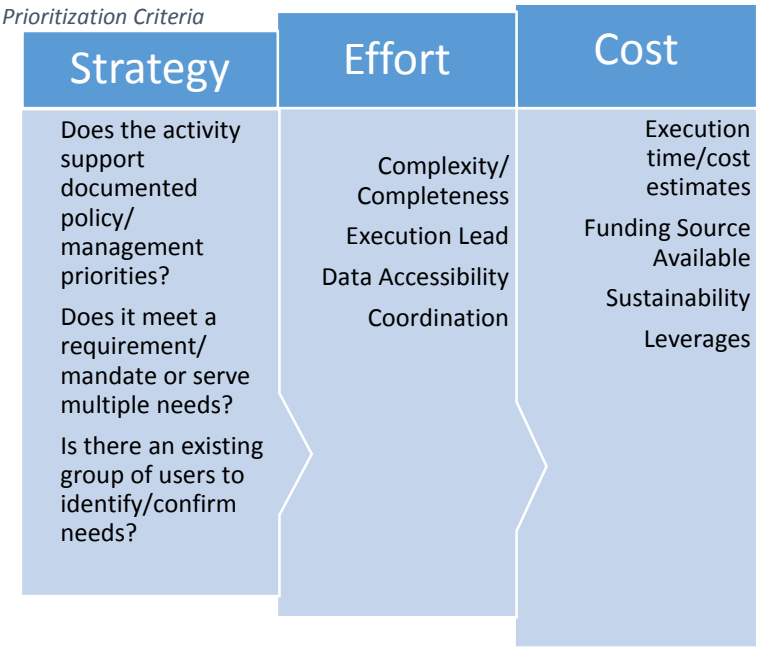
Developed in 2011, the GLOS Enterprise Architecture Design Report (EA Report) serves as a foundational "build-out" plan for an integrated and leveraged observing system enterprise across the Great Lakes region. This comprehensive design and planning effort took place over a nine-month period and was funded through a nearly $1 million grant from the EPA-led Great Lakes Restoration Initiative under the direction of NOAA-GLERL. The study was conducted in collaboration with numerous public and private entities and a broad consortium of partners who provided technical review and support. The EA Report includes a Design Report, Concept of Operations Report, Trade Study Report, and Implementation Plan. The document also includes the results of information-gathering efforts conducted during the study such as a user needs evaluation, asset inventory, and status evaluations of data management systems and modeling efforts.

Based on these concepts and through strategic planning exercises, GLOS takes a strategic approach to sustaining and enhancing the observing system enterprise in a way that is appropriate for GLOS's role in the region. GLOS follows a strategy that:

- Prioritizes data management and stakeholder needs for data access;
- Evaluates and prioritizes support of other activities according to criteria outlined in the diagram below (Figure 1). Other activities could include deployment of new or sustaining existing observing assets, development of decision-support tools or other data products, and enhancing existing modeling or other data analyses;
- Considers that GLOS may not be the right "home" for a dataset, data product, or other observing system project, but that it can provide support to partners in other ways that will help sustain and advance regional data management and data access. In particular, GLOS can help coordinate, facilitate, or provide technical support or advice to partners;

- Conversely, there may not always be a clear owner, lead, or host for a dataset, data product, or other observing system project, but it is recognized by the region as valuable. GLOS can provide temporary or long-term support as it determines appropriate actions that are in line with the prioritization criteria outlined in Figure 1.

Figure 1: GLOS Prioritization Criteria



ORGANIZATIONAL STRUCTURE

GLOS operates as a 501(c)3 tax-exempt organization. Through its bylaws and standard operating procedures, GLOS satisfies applicable legal criteria for accepting and disbursing funds and entering into agreements, establishes measures for addressing issues of accountability and liability, and maintains a governing board that oversees funding priorities.

-Governance and Leadership-

As a 501(c)3, GLOS is governed by an elected, volunteer Board of Directors. New Board members are identified and recruited by the sitting Board and serve 3-year terms that are renewable one time. The Board appoints the Executive Director who, in turn, hires and supervises all other staff.

Figure 2: GLOS Organizational Chart

-STAFF-

GLOS staff are responsible for supporting the growth of the GLOS network and membership through implementation of recruitment, engagement, and communications strategies. Staff work with partners to cultivate integrated projects that meet user needs and provide support, oversight and management of such projects as appropriate.

-MEMBERSHIP-

GLOS is a membership organization comprised of individuals or organizations that wish to support and engage in the GLOS mission directly. Membership is activated through the GLOS website http://glos.us/membership, is annually renewable and lapsed membership is easily re-activated through the website. Membership recruitment and engagement success is determined by tracking attendance at the Annual Meeting, GLOS-hosted meetings and membership enrollment. One of the perks of membership in GLOS is a complementary registration to the GLOS Annual Meeting. Additional benefits are listed in the table below "Categories of Membership." Building a strong and active membership is critical to ensuring that GLOS activities are relevant, proactive, and successful in addressing the observing and information integration needs of the Great Lakes region.

Categories of membership:

Membership Tier	Annual Dues	Member Benefits	Examples
Associate Members	$300 (for-profit entities) $200 (non-profit organizations) $100 (individuals) $50 (students)	-Voting privileges -Acknowledgement on Annual Report -Notification to preview and beta-test data products -Participation on Stakeholder Advisory Committee *Includes 1 complimentary registration to the Annual Meeting	-Non-profit organization -Sole proprietors -Individuals -Principal investigators
Supporting Members	Based on organizational revenue: Under 500k: $1,000 500k-2m: $2,000 Over 2m: $3,000	-Benefits afforded to Associate Members -Ability to include news announcements in the GLOS Newsletter -Opportunity to offer products/services to GLOS listserve *Includes 2 complimentary registrations to the Annual Meeting	-For-profit companies -Academic institutions -Trade associations
Sustaining Members	Based on organizational revenue: Under 500k: $2,000 500k-2m: $5,000 Over 2m: $10,000	-Benefits afforded to Associate and Supporting Members -Acknowledgement at Annual Meeting -Donor events and experiences *Includes 3 complimentary registrations to the Annual Meeting	-For-profit companies -Research institutions -Trade associations
Affiliates	Available for government agencies that are prohibited from paying membership dues		

-NETWORK-

GLOS is a highly networked and leveraged organization taking advantage of investments in observing technologies and activities that have been made directly in the region by federal, state/provincial and local governments as well as indirectly through implementation by the region's academic and non-profit sectors. The GLOS network is a group of dedicated individuals engaged in one or more aspects of GLOS operations, such as observing, data management, modeling or outreach. This group's efforts may be partially or fully supported by GLOS.

FUNCTION AREAS

Through its function areas, GLOS works to efficiently and seamlessly connect: the various platforms that make up the observing system (measurements and transmission of data); the system's data management and communication requirements (organizing, cataloging, and disseminating data and information); and data analysis, applications, and the outreach and education required to develop and promote these products and services (translating data into products in response to user needs and requirements).

-DATA MANAGEMENT-

The priority focus for GLOS operations is on providing data management services which includes implementation of the protocols and processes by which data are retrieved, standardized, stored, and delivered. Data management includes things like:

- Connecting to existing web-accessible datasets via the GLOS Data Portal.
- Helping partners to make their data web-accessible.
- Adding metadata records to the GLOS Data Catalog (GeoNetwork) for datasets where direct access in unavailable.

- Quality control, archiving and otherwise directly curating/managing select datasets as needed.
- Ongoing operations, maintenance, and support for existing data products and tools.

As an IOOS Regional Association, GLOS must follow certain data management requirements of IOOS certification and therefore refers to IOOS as the primary guide for the standards and processes adopted. However, where IOOS guidance does not exist, GLOS refers to other existing and recognized standards for data management or works with data providers and users to develop standards where appropriate. GLOS delivers data in a variety of ways but the primary access point is the GLOS Data Portal: www.data.glos.us. GLOS will continue to enhance the utility of the Data Portal and maintain the data management services it provides.

-OUTREACH-
Outreach includes a combination of stakeholder engagement, needs assessment, promotion, communications, education and training. Outreach activities help GLOS to identify regional needs and facilitate the development of decision-support models, data products and related services. Feedback from stakeholders helps GLOS prioritize gaps and improve data availability. For this reason, outreach is integral to all GLOS operations. GLOS dedicates staff time to strategic communications and promotions, stakeholder engagement, and membership development. GLOS relies on the leveraged outreach and education expertise of partners such as the Great Lakes Sea Grant programs. These partnerships have helped GLOS to: assess data user needs throughout the region, design the Great Lakes Boaters' Forecast, support curriculum development through Great Lakes Lessons, and engage citizen scientists through National Geographic Great Lakes FieldScope. GLOS will continue to support outreach activities that integrate stakeholder engagement into all projects.

-OBSERVATIONS-
GLOS supports observing activities that fill identified observing gaps in the region and enhance existing observing programs. GLOS does not intend to replicate, sustain, or replace existing monitoring and observation activities being conducted by federal, state/provincial, and local government agencies, academic institutions, or other similar initiatives. Instead, GLOS support is available to coordinate, enhance, and better utilize the observing capacity of the region. Examples of the observing activities GLOS has supported include:

- A "nearshore network" of buoys that provide critical real-time information for under observed nearshore areas.
- Improvements in remote sensing algorithms used in interpreting variables such as surface temperature and Harmful Algal Blooms from MODIS imagery.
- Glider missions across the region used in support of the Cooperative Science and Monitoring Initiative and other specialized monitoring projects.

GLOS will continue to support observing activities that fill priority gaps and provide data that meets identified information needs.

-MODEL AND TOOL DEVELOPMENT-
Projects that interpret and analyze data through the use of models or data processing are classified as model and tool development activities. In GLOS operations, tool development includes things like:

- Creating a specialized/customized view of a dataset.
- Running analysis, interpretation, or other processing of data to a format different than what is accessed from the data provider.

- Creating a stand-alone access point (outside of the GLOS Data Portal) to the customized view and/or processed data product.

GLOS relies on the expertise of diverse partnerships and project teams to ensure the models and tools being developed address an identified need and have a user-base actively engaged. Examples of the types of decision-support tools GLOS has supported incudes: the Great Lakes Boaters' Forecast, the Great Lakes Acoustic Telemetry Observing System web viewer, and the Huron-Erie Corridor Waterways Forecast System. *The Enterprise Architecture- Regional Expansion Report* document has identified additional decision-support tools that are needed by regional stakeholders. GLOS will support partnership projects that address these needs and look to coordinate the development of models and tools and/or enhance the functionality and utility of existing data products.

PROGRAM MANAGEMENT AND PLANNING

One critical element needed to advance GLOS organizational maturity is a transparent planning process for developing GLOS priorities and allocating resources. GLOS has adopted a planning process that corresponds with the five year IOOS funding cycle in order to prepare for proposals to IOOS and other potential funders, develop annual work plans, and evaluate programs to identify future funding priorities.

-PLANNING PROCESS-

Program management and planning is primarily the responsibility of the Executive Director with input from the GLOS membership, support from the staff and oversight by the Board of Directors. GLOS uses an adaptive planning process, the Management and Planning Process (MAPP), to prioritize projects. The process ensures that critical data and information gaps are filled through enhanced observations, predictive modeling, data integration services, and data delivery tools. The planning process has four phases: 1) determining priorities, 2) developing strategies, 3) implementation, and 4) evaluation and adaptation. This planning process is used at all levels of program planning, in strategic planning to develop long-term programs, and in specific project planning for short-term projects. With the *Blueprint* as guidance, project scopes of work identify and address management issues related to the GLOS goal areas and have measures in place to monitor and evaluate project progress. Supplementary materials, e.g., presentations, documentation guidelines, templates, or training opportunities are available on the GLOS website (www.glos.us) to ensure staff, partners, and members have a good understanding of this planning process.

-PROCESS IMPLEMENTATION-

The Management and Planning Process is the mechanism that GLOS uses to coordinate membership engagement, stakeholder outreach, strategic planning, project management, program evaluation, and adaptive responsiveness to regional priorities. The overall timing of this process is coordinated with typical IOOS five year cooperative agreement cycles and includes program re-scoping based on annual Federal government budget cycles. Integrated into this process are the GLOS annual meeting and mid-year member outreach webinar, which are used to engage regional stakeholders and collect member input and feedback. Meetings are strategically "themed," as outlined in the table below, to ensure agendas are directed towards appropriate outcomes for the various stages of the planning cycle.

Figure 3: GLOS Planning and Evaluation Cycle

GLOS Planning and Evaluation Cycle					
Month	**Year 1 Implement**	**Year 2 Analyze and Adapt**	**Year 3 Analyze and Adapt**	**Year 4 Set Priorities**	**Year 5 Develop Strategies**
Jan	Finish Previous Cycle Implementation				Release request for pre-proposals
Feb	Re-Scope Yr 1 Annual Plan	Re-Scope Yr 2 Annual Plan	Re-Scope Yr 3 Annual Plan	Re-Scope Yr 4 Annual Plan	Re-Scope Yr 5 Annual Plan
March					
April					Review and select project proposals
May					Develop IOOS proposal for next 5 yr Cooperative Agreement
June	Begin New Cycle Implementation	Progress Updates and Evaluation	Project Evaluation & Strategic Plan Update	Complete Strategic Plan update	Submit IOOS proposal
July					
Aug					
Sep					
Oct					
Nov	Project Presentations	Project Updates	Evaluation & Planning	Promote Strategic Plan	In Review- Success Stories
Dec					
Semi-Annual member webinar (June) and Annual (November) meetings – opportunities for Member, stakeholder and industry to meet/provide input					

As illustrated in Figure 3, update of the strategic plan *The GLOS Blueprint: A Strategy for Data for Decision-Making*, begins in year 3 of 5 of a typical IOOS Cooperative Agreement. This update is based on project evaluations; member, partner, and user feedback; results of prior planning initiatives, and emerging regional and national priorities. This input will be gathered in a variety of ways including staff research, summary and compilation of regional policy and management initiatives; informal and formal member and stakeholder surveys; Annual Meeting and member webinar events; as well as supplementary planning and survey efforts.

Updating of the *Blueprint* is completed by GLOS staff with input and review from GLOS members and approval by the Board of Directors. The *Blueprint*, EA Report, and all other supplemental planning

materials that GLOS uses to inform governance, programming, and operational policies are made available on the GLOS website.

-FUNDING APPROACH-
Typically, priority strategies and related programs and activities for implementation will be clearly identified with appropriate partners and available funding sources as a result of previous initiatives. GLOS will incorporate these activities into regular budget planning for the applicable planning period. In other cases, there will be multiple options or ideas for how to implement individual strategies. In these cases, GLOS will develop a Letter of Intent (LOI), pre-proposal, or Request for Proposal (RFP) solicitation that outlines priorities, expected outcomes, outputs and deliverables for projects based on the *Blueprint* and in accordance with MAPP. The type of solicitation used will depend on the amount, timing and availability of funds. LOIs or pre-proposal mechanisms may also be used to determine priority projects for inclusion in a larger proposal, such as NOAA-IOOS funding opportunities. The Executive Director will coordinate review of proposals by an outside expert review team which will, in turn, make recommendations for project support.

GLOS will implement priority projects using competitive solicitations whenever possible. However, GLOS recognizes that funders and emerging priorities do not always accommodate the time and effort required to conduct thorough evaluation of letters of intent, pre-proposals, or full proposals. In addition, there are baseline operational functions which GLOS is committed to supporting that cannot be easily competed due to the nature of the service.

FOCUS AREAS

GLOS programming is organized to address focus areas which correspond to IOOS Societal Goals and are management issues, identified by members, partners, and users as being important to the Great Lakes. While specific elements of annual workplan programming will be driven by user needs and the value of the related products and services, GLOS will orient its high level strategic planning to address the following goals:

PUBLIC HEALTH AND WATER SECURITY

GOAL: Provide data and information aggregation tools to support policies, planning, and decision making that improves public health and supports Great Lakes water security.

MANAGEMENT AND POLICY DRIVERS: Like most coastal waters, the Great Lakes are used for recreational activities including beach visits and swimming. Unlike the other U.S. coasts, however, the Great Lakes are also a primary drinking water source for the over 40 million residents of the region. This means that water quality and monitoring are an especially important focus of observing system activities in the region.

National and regional management and policy efforts related to public health and water security are:

- National Weather Service forecasting and hazard warning needs
- Great Lakes Beach Association priorities and needs
- Great Lakes Water Quality Agreement
- Local health department, water intake facility, and water department management needs
- Great Lakes Restoration Initiative

PROPOSED ACTIVITY FOCUS:

High priority:

- Support for enhancement and operationalization of existing forecasting and warning data products and tools used by public health and safety managers, local beach managers, health departments, and drinking water utilities.
- Sustaining support for critical, gap-filling observing activities that provide data for targeted use by public health and safety managers.

Medium priority:

- Scoping and development of new data products/tools that improve management and decision-making by public health and safety specialists.
- Purchase and deployment of new observing assets that address critical, gap-filling needs for data used by public health and safety managers.

Other possible activities:

- Enhancement of existing models that are used to address public health and safety data needs.

ECOSYSTEM HEALTH

GOAL: Provide data to support policies and decision-making that result in protection, ecological restoration, and enable multiple sustainable uses of healthy Great Lakes and coastal ecosystems.

MANAGEMENT AND POLICY DRIVERS: Ecosystem health is of significant concern for a wide variety of individuals and organizations focused on the Great Lakes. Ecosystem health is affected by multiple, interacting stressors that range from invasive species, prolonged lake level fluctuation, and the beneficial use impairments identified in the Great Lakes Water Quality Agreement, such as excessive nutrient loading due to human activities, persistent toxics, and degradation of fish and wildlife populations and habitats.

Regional and national management and policy efforts related to ecosystem health include:

- The development of a nearshore framework, the Area of Concern and Lakewide Management and Planning processes, and the State of the Lake Ecosystem Conference indicators under the 2012 Great Lakes Water Quality Agreement
- The research priorities and lake committee management needs identified under *A Joint Strategic Plan for the Management of Great Lakes Fisheries*
- The Great Lakes Blue Accounting Process being implemented by the Council of Great Lakes Governors and Premiers, and the Great Lakes Commission
- International Joint Commission Assessment of Progress Indicators and Adaptive Management activities
- Great Lakes Restoration Initiative and related action planning priorities
- The US IOOS National Animal Telemetry Network
- State compliance/ monitoring and reporting under U.S. Clean Water Act Section 305(b) and 303(d)

PROPOSED ACTIVITY FOCUS:

High Priority:

- Support for data development and acquisition efforts to fill gaps, including geo-referenced data, identified through engagement with end-users, such as natural resource management decision makers, which are supportive of national and regional management and policy drivers.

Medium Priority:

- Support for entities and organizations that are already working with data users, such as natural resource management decision makers, and who are therefore in a position to identify data needs that GLOS could address.

Other Possible Activities:

- Supporting the development and deployment of innovative observing technologies to meet identified data gaps.

MARITIME OPERATIONS

GOAL: Provide data to support safety and efficiency of commercial maritime operations and recreational navigation across the Great Lakes.

MANAGEMENT AND POLICY DRIVERS: Safe and efficient maritime operations are a crucial component of the Great Lakes economy. Both recreational boating, including sport fishing, and commercial navigation employ thousands of individuals directly and contribute billions of dollars to the economy. GLOS aims to ensure that the data needed to facilitate these activities is readily available and that any tools or products developed are robust, reliable, and widely used. GLOS directly serves recreational boaters throughout the Great Lakes and St. Lawrence River through the ongoing support of and improvements to the Great Lakes Boaters Tool. GLOS also supports commercial navigation, in a less direct way, by facilitating and funding buoys that collect data used to generate improved weather forecasts and point-specific environmental intelligence.

National and regional management and policy efforts related to maritime operations include:

- U.S. Army Corps of Engineers Great Lakes Navigation System and Great Lakes St. Lawrence Seaway
- International Joint Commission water level regulation under the *Boundary Waters Treaty*
- US IOOS National Wave Plan
- US IOOS National Surface Currents Plan
- Port Authority infrastructure planning needs
- Recreational boater needs

PROPOSED ACTIVITY FOCUS:

High Priority:

- Support for entities and organizations that are already working with data users, such as charter fishing businesses, other sport fishing groups, the sailing community, and power boat organizations, to scope additional data/information needs for the Great Lakes Boater's Tool.
- Support for enhancements to the Great Lakes Boater's Tool to integrate identified data/information needs.
- Support for entities and organizations that are already working with target groups, such as private planners who support port authority infrastructure development activities, to identify data needs.

Medium Priority:

- Support for data development and acquisition efforts to fill gaps, including geo-reference data, identified through engagement with data users, such as ship masters, U.S. and Canadian pilots, and domestic and international associations of ship owners, and which are supportive of national and regional management and policy drivers.

- Support for a harbor infrastructure analysis system to aid U.S. Army Corps of Engineers assessment and evaluation of harbor infrastructure operation and maintenance status.

Other Possible Activities:

- Support for other data development and acquisition efforts to address emerging user-identified needs including but not limited to: wind energy, search and rescue, ice breaking, and bi-national efforts to improve the resilience of regional maritime commerce to climate impact.

CLIMATE ADAPTATION

GOAL: Provide data to enable analyses and syntheses, tool development, and validation to effectively mitigate natural hazards and support climate adaptation and decision-making.

MANAGEMENT AND POLICY DRIVERS: Climate impacts are experienced in this region as an increase in average temperature and changes to timing, duration, amount, and form of precipitation and ice cover. These impacts have increased uncertainties related to the timing and intensity of extreme events, such as storms, drought, and heat events and have impacted ecology, economy, and social well-being. Climate impacts may affect water levels, temperature ranges, algal blooms, regional population growth and development pressures as people move into our more temperate and water-rich region from other regions of water scarcity and temperature extremes.

Regional and national management and policy efforts related to climate adaptation include:

- International Joint Commission water level regulation under the *Boundary Waters Treaty*
- Regional adaptive management activities, such as under the International Joint Commission, state/provincial and local governments.
- Great Lakes-St Lawrence River Water Resources Compact and Agreement
- Great Lakes Water Quality Agreement
- NOAA Coastal Resilience efforts
- National Ocean Policy/National Ocean Council (NOP/NOC)
- Great Lakes St Lawrence Cities Initiative Resolution 01-2014M: Municipal Climate Adaptation and Resiliency
- NOAA Climate Program Office Regional Integrated Sciences & Assessments (RISA)
- Task Force on Climate Preparedness and Resilience

PROPOSED ACTIVITY FOCUS:

High Priority:

- Support for entities and organizations that are already working with data users, such as public and private planners who work with municipal and industrial decision makers, and who are therefore in a position to identify data needs that GLOS could address.
- Support for data development and acquisition efforts to fill gaps identified through engagement with target groups.

Medium Priority

- Sustaining support for critical, gap-filling observing activities that provide data for implementing key management and policy activities identified above, such as the over-lake evaporation network

Other Possible Activities:

- Enhancement of existing regional-scale models that are used to address climate adaptation needs.

CONCLUSION

According to the process and priorities described in this document, GLOS will execute its mission to link providers and users of data, information, and knowledge in the Great Lakes and St. Lawrence River basin in a way that supports sound decision making in the best interests of the resource and the public. Ultimately, the success of these strategies depends on the strength of the GLOS network and ensuring that activities are relevant, proactive, and successful in addressing the identified data needs of the region. We look forward to cultivating this network of partners and working together to support observing and information integration needs across the Great Lakes.