Great Lakes Observing System
Subsystem Team Members
Updated June 29, 2007

Open Water

Like all large systems, the Great Lakes – St. Lawrence River system requires observations drawn from a network of consistent, fixed stations that can take measurements for comparisons across the region and that will be integrated with nearshore and mobile components. The GLOS open lake observing subsystem will gather meteorological data and sub-surface measurements of chemical, biological, and physical parameters. Specific locations will be determined by operational needs, relevance to scientific data collection, availability of agency and university partners, and relevance to the user groups. The off-shore observing stations need to include power supplies, transmitters and other basic payload to handle a minimum standard sensor array plus additional equipment appropriate to their location. The data hubs will permit controlled access to multi-institutional users through guest ports, allowing them to be used in real-time applications. At the same time, facilities provided by GLOS associates will consolidate region-wide observations for use in other applications. The system will integrate the many existing over-lake information collection efforts, including but not limited to those of NOAA's National Data Buoy Center (NDBC), the Coastal-Marine Automated Network (C-MAN) stations, Great Lakes Environmental Research Laboratory (GLERL), National Weather Service (NWS) Doppler radar, and Acoustic Doppler Current Profilers (ACDPs).

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Science Vessels

The science vessels operating on the Great Lakes serve as mobile research and data collection stations. They travel to and operate at a variety of sites over the course of a research season, which is in marked contrast to buoys and other fixed sensor platforms. While that reduces the time period during which vessel-derived data can be collected, it allows seasonal sampling of sites that could not support or do not justify other sampling methods. It also allows investigation of short-term and localized phenomena detected by remote sensing tools and readings from fixed stations or non-research vessels passing through an area. The subsystem team will coordinate GLOS-related activities in this area with close coordination of groups like the Great Lakes Association of Science Ships (GLASS), GLERL and a variety of Canadian and U.S. federal agencies and universities. Areas of focus will include coordination, fleet modernization, instrument deployment and many others. GLOS will provide a repository or central access point for data collected by these vessels. Database tools and user interfaces developed for the GLOS will improve access to data from multiple vessels and multiple agencies, and will enhance the integration of vessel data with data from other sources.

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Interconnecting Waterways

Flows in the interconnecting waterways of the Great Lakes – St. Lawrence River affect commercial navigation throughout the system, hydropower production for the Great Lakes region and the majority of North America's eastern seaboard, public water supplies and recreational opportunities. While the collection of detailed and timely observations of the hydrologic, hydraulic, chemical, and geologic processes within these highly productive river courses has been extensive in the past, additional observations are warranted. The focus of this subsystem team will include the placement of water level gauges and many other types of information collection devices within these river courses and development and application of hydrodynamic models within these river domains. In a collaborative effort between U.S. and Canadian federal agencies, two-dimensional (2D) hydrodynamic models are being developed for each of the five interconnecting waterways on the Great Lakes. The USACE is taking the lead on developing hydrodynamic models for the St. Mary's River. While models exist for each waterway, they are not run on a real-time basis, nor are they extended to applications for sediment transport studies or oil and toxic spill response support. In addition, there is a constant need for real-time monitoring of flows at key locations in these waterways as acquired by in-situ Acoustic Doppler Current Profilers (ADCPs) or Acoustic Velocity Meters (AVMs). The same technologies are well suited for measuring inflows from all major tributaries to the Great Lakes to improve water balance modeling of the system.

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Nearshore

The U.S. Great Lakes – St. Lawrence River system has over 10,500 km of shoreline, all of it impacted by hydrologic, hydraulic, chemical, and geologic processes. The collection of detailed and timely observations of these processes across the region has a long and storied history. The variety of agencies involved in monitoring these processes attests to their importance, while feedback from those same agencies makes clear the need for coordination and enhancement of the monitoring network throughout the region. Although these water level observation networks appear dense when compared to the other coasts of the U.S., they are not sufficient given the complex hydrodynamics in highly productive embayments and the massive interconnecting waterways, nor are they instrumented to provide all possible observations. These sites could be outfitted to provide subaerial observations of winds, air temperatures, precipitation, relative humidity, solar radiation, meteorology, water temperature, salinity, pH, dissolved oxygen, etc. Other critical nearshore information types include those of geodetic control networks, nearshore wave energy information, nearshore currents, bathymetry and topography. Further, coastal habitats, the most ecologically productive part of the system, are poorly mapped in spatial and temporal detail, impairing our ability to understand the impacts of encroachment by human development and invasive plant species. This subsystem team will assist in coordinating the collection and integration of these diverse information types, as well as identifying critical needs for system upgrades and expansions.

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Remote Sensing

Satellite and airborne remote sensing (RS) technologies allow features in the landscape to be mapped and analyzed, characteristics of the atmosphere, land and water to be determined, compared with previous data to detect change, incorporated into modeling tools to forecast future conditions, and applied to various environmental regulation and response programs. RS technologies provide the ability to monitor the dynamics of the Great Lakes – St. Lawrence River system at a wide range of scales in near real-time. Numerous monitoring programs exist across the basin, some of which directly use of satellite or airborne RS data. All provide valuable input and many are used by multiple agencies, researchers and others due in large part to Internet-based access to outputs and data. However, much can be done to enhance and focus all of this work, and the GLOS will play a number of RS-related roles for the region as RS technologies continue to improve, new data needs are identified and in-situ sampling and monitoring networks become more complete,. These roles include supporting the implementation of new sensor platforms, acquiring and archiving imagery from platforms not otherwise funded for use in the region, supporting calibration efforts related to regional data parameters, developing new tools and data analysis processes, and improving data access, user awareness and distribution of RS-derived products.

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Atmospheric

Atmospheric processes play many roles in the Great Lakes, so meteorologic observations are used in many different types of modeling, forecasting and operational processes.. However, the meteorologic collection network is incomplete, particularly in the northern extreme of the Great Lakes – St. Lawrence River. The atmosphere also transports significant quantities of chemical contaminants to the waters of the Great Lakes. Over the past decade or two, substantial investment has been made in designing, implementing and operating air monitoring networks within the region. However, that system does not include sufficient monitoring over the lakes themselves and does not collect observations of some critical atmospheric substances. GLOS can support expanded monitoring of atmospheric characteristics such as overlake meteorology and contaminant deposition to support improved modeling, much as is described elsewhere for water characteristics, contaminant interactions and contaminant transport via tributaries. Data integration with regional monitoring networks will be a significant part of the GLOS atmospheric subsystem. The Integrated Atmospheric Deposition Network (IADN) has been the central focus of atmospheric persistent bioaccumulative toxins (PBTs) monitoring in the basin. However, numerous chemicals of concern, including dioxins and furans, brominated flame retardants and mercury, are not being monitored adequately and data that do exist are poorly integrated.

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Forecasting/Modeling

Computer-generated models will allow exploration of disparate GLOS datasets and the creation of forecasts and other products for GLOS users. Real-time data from remote and in-situ sensors will be particularly valuable in supporting the development, validation and operation of these models. A variety of modeling approaches (statistical, empirical and theoretical) will be required. Research will be required to provide improved and new techniques for more rapid or accurate sensing of environmental variables, more efficient data management and communications, more accurate estimates of property fields (e.g., sea surface temperature and chlorophyll-a fields), and more accurate hindcasts, nowcasts, or forecasts of the phenomena of interest. Monitoring of several types are needed within the region, including hydrodynamic modeling, ecological modeling and chemical transport modeling. There is also a critical need to integrate model functions among the physical, biological and chemical processes of the Great Lakes system. Among the critical model applications are tracking of pathogens, source water protection, ecological protection, fisheries and wildlife management, chemical mass balance and protection of humans and wildlife from chemical exposures. Modeling in many cases will complement monitoring activities. For example, in the case of chemical transport, models can be used to advance and to track the chemical management and reduction goals of the GLWQA, GLRC, SOLEC and others by adding value to monitoring data that is collected, providing estimates in cases where monitoring data is absent and by offering mechanistic explanations and predictive capabilities.

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Information Integration

Data Management and Communications (DMAC) is one of three broad subsystems identified by Ocean.US for the national Integrated Ocean Observing Systems (IOOS) effort. Both IOOS and the Regional Coastal Ocean Observing Systems (RCOOS) being developed across the country will have DMAC components and responsibilities. In general, DMAC should coordinate and facilitate the distribution of data and information to and from system components, to and from other observing systems, and to end users at all levels. Access to data from components of the Observing Subsystem should be facilitated by DMAC protocols and storage services. DMAC should provide standards and access tools so that outputs from the Modeling and Analysis Subsystem can be made available to scientists, policymakers, educators, the general public and other interested parties. Among the charges of the Information Integration subsystem team are coordinating data collection, data integration, data storage, data certification and data dissemination. By leading in each of these areas, this subsystem supports each of the others and leads to greater ability for interactions between them.

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Education/Outreach

A key intention of the GLOS is that data and information developed and/or shared through the system will be of value to a wide variety of audiences. Scientific research, government/regulatory efforts and commercial activities are obvious user categories, but education also ranks as a high priority. Every aspect of the GLOS, from its institutional framework and participating agencies to the politics and geography in which it operates, from the hardware it sponsors to the current and historical results of its monitoring and modeling efforts, can be packaged for use in curricula and educational materials suited for almost any level — from elementary classrooms, to postgraduate research, to public education and outreach campaigns. The GLOS Education/outreach subsystem team has already been formed and is based on a close partnership between GLOS and the Great Lakes Sea Grant Network.

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