

RCN Annual Report
24 Feb 2008

Title:

Advancing lake ecology by building an international community to exploit innovations in sensor network technology.

Award Number:

DBI-0639229

Reporting Period:

1 March 2007 – 29 February 2008

Project Participants

Senior Personnel (with the exception of Hanson and Larsen, the support for the other senior personnel comes from other projects)

- Paul Hanson, University of Wisconsin, Contribution: Lead PI
- Tim Kratz, University of Wisconsin, Contribution: Co-PI
- Barbara Benson, University of Wisconsin, Contribution: Co-PI
- Peter Arzberger, University of California, San Diego, Contribution: Arzberger has provided leadership in the overall formation and management of the GLEON and has been instrumental in the foundation of its governance. Arzberger facilitates contacts between GLEON and other organizations and aides members in seeking additional funding.
- Marilyn Larsen, University of Wisconsin, Contribution: GLEON RCN Program Coordinator
- Sameer Tilak, San Diego Super Computer Center, Contribution: Sameer Tilak in the capacity of Open Source Data Turbine team member develops data streaming technology-based solutions for environmental observing systems. Through the GLEON RCN, Sameer communicates technological capabilities to ecologists through workshops held at GLEON meetings and at site information management (IM) installations. Sameer is a part of GLEON IM installation team that visits GLEON sites for IM software installation. Sameer translates ecologists needs into technology solutions by a broad range of activities including system design and architecting, documenting IM site installations, interviewing site personnel, and reporting on the outcome of the installations.

Post-doc

Graduate Student

- Cayelan Carey, Cornell University, Contribution: Cayelan was selected to be Chair of the GLEON RCN Student Organization and to represent students as a member of the GLEON RCN Steering Committee. In these roles, Cayelan has helped define the goals of student participation in GLEON and has developed the process for including students and reaching the goals. Cayelan has presented GLEON student opportunities at international meetings and has recruited participation by NSF personnel in presenting student funding opportunities. For GLEON 6, Cayelan was instrumental in soliciting and reviewing student funding applications and oversaw the activities of 14 students at the meeting.

Undergraduate Student

- James Yuen, University of Wisconsin
- William Pulec, University of Wisconsin
- Daniel Strommen, University of Wisconsin

Technician, Programmer

- Luke Winslow, University of Wisconsin, Contribution: Luke Winslow develops technology solutions for buoy information management in GLEON. Through the RCN, Luke works to communicate advances in technology to member sites and to coordinate use and training of technology. Luke also works as a liaison between technology and science by soliciting end-user requirements for new network technology and implementing requirements in software.

Other Participant

Research Experience for Undergraduates

Organizational Partners

University of Wisconsin, Civil and Environmental Engineering
University of California, San Diego
Cornell University, Ithaca, New York

Other Collaborators or Contacts

SDSC: Tony Fountain and Sameer Tilak from the San Diego Super Computer Center play important roles in interfacing between science and technology. As the leaders of Open Source DataTurbine Initiative, they have expertise in streaming data between sensors and data repositories. They also provide tools for monitoring the status and health of sensor networks. Management of real-time sensor data streams presents major processing, communication and administrative challenges. To that end, Open Source DataTurbine – a streaming data middleware provides a robust platform for doing sensor data acquisition, transport, and dissemination in a scalable and reliable fashion. Continued development of these technologies is informed by their participation in the GLEON RCN, and they, in turn, inform ecologists of the latest developments in data streaming technologies. Streaming data middleware is a critical component of the overall cyberinfrastructure for the environmental observing systems including GLEON.

NCHC: Fang-Pang Lin from the National Center for High Performance Computing (Taiwan) runs EcoGrid, a project that informs technological development within the GLEON. He also is a Steering Committee member of the GLEON RCN.

CENS: The Center for Embedded Networked Sensing is one of six NSF Science and Technology Centers and develops and studies embedded networked sensing systems for scientific and social applications. Collaborations between Tom Harmon of CENS and the GLEON RCN seek to apply CENS expertise to lake sensing experiments in northern Wisconsin, as well as in countries in South America. Experiments are envisioned to optimize sensor placement and/or movement in response to ecosystem variability within the context of lake metabolism science questions. In addition, see the participants in the GLEON 6 available at <http://GLEON.org>.

Activities and Findings

Research and Education Activities: In the first year of the GLEON RCN we have focused our activities on: (1) shoring-up the organizational infrastructure and technology necessary to run an efficient and effective network; (2) expanding the network of people, sites, and data by communicating GLEON RCN opportunities to a broader community and further establishing links with other organizations to attract more and diverse expertise; (3) the first all-hands meeting funded by the GLEON RCN; (4) other exchanges, visits, and activities.

Activities are directed toward achieving the goals set forth in the proposal as follows. **Science Goals:** (a) advance the science that requires a global network of sensor-lakes; (b) articulate the data and metadata standards required to advance the science; (c) develop ecosystem models that maximally exploit information content of sensor data; (d) disseminate to the community the outcomes of the RCN to inform other national sensor network efforts. **Technology Goals:** (a) inform RCN members of recently developed information technologies, and engage them in the development of the requirements for the next generation of information technologies; (b) inform information technologists on new ecological science and modeling directions; (c) identify, prioritize, and develop plans to address common needs; (d) share outputs on requirements and best practices broadly with the community. **Community Goals:** (a) integrate junior scientists (students, postdocs, beginning faculty) in RCN activity to inform, train, and mentor; (b) prepare the next generation of scientists for large, collaborative, international, interdisciplinary science; (c) engage researchers and funding agencies in individual countries to build a diverse international community.

I. Organizational infrastructure: Effective and efficient operation of the network depends on an administrative support staff, a defined set of policies and procedures, and technology for managing and disseminating information. In spring 2007, the RCN Steering Committee met to define its role within the larger GLEON organization and to initiate processes designed to include broader, yet targeted, participation, organize meeting details for the upcoming SIL meeting in Montreal, discuss network publications, and create necessary administrative policy. Marilyn Larsen was appointed as Program Coordinator and delegated responsibilities including document management, meeting organization, and accounting. Furthermore, Marilyn acts as the hub of communication, answering general inquiries or forwarding to the appropriate GLEON members, as well as broadcasting network communiqués.

In the spring 2007, we developed the Web site, GLEON.org and populated it with key information about the organization, lakes that are part of the network (the GLEON Lake Information Database), upcoming events, and products of the network, among other things. The Web site acts as the primary repository of public information about GLEON and its activities and as the connecting point to new technologies developed to support lake ecologists and their sensor networks. The Web site also acts as a virtual “administrative center” for organizing GLEON meetings, allowing us to post meeting agendas, participation, travel logistics, and meeting outcomes. We also created a document management system using OWL technology, which is our repository for all GLEON administrative documents.

The GLEON Lake Information Database contains information on characteristics of GLEON lakes as well as information on measurements and sensors at the lakes. During the past year the interface for entering information was upgraded to permit entry of the measurement/sensor information and to increase ease of use. The information from the database is displayed on the GLEON website at GLEON.org/lakes.

A milestone for the GLEON was the establishment of Operating Principles and Procedures (OPP) and an on-line Membership Application (*see*: GLEON.org/about). The OPP was designed to reflect the grass-roots nature of the GLEON and to articulate the roles and responsibilities of GLEON entities, such as members, institutions, and the Steering Committee. The OPP was developed by members of GLEON (Appendix A), with the leadership of Peter Arzberger, and was ratified at the GLEON 5 meeting in Montreal in August 2007. The OPP is available to the public and may be used as a model for other RCNs, where appropriate. The Membership Application provides a mechanism for individuals and institutions to join the organization, and ascribe to the OPP toward the end of enjoying the benefits the network has to offer while contributing to the network in meaningful ways.

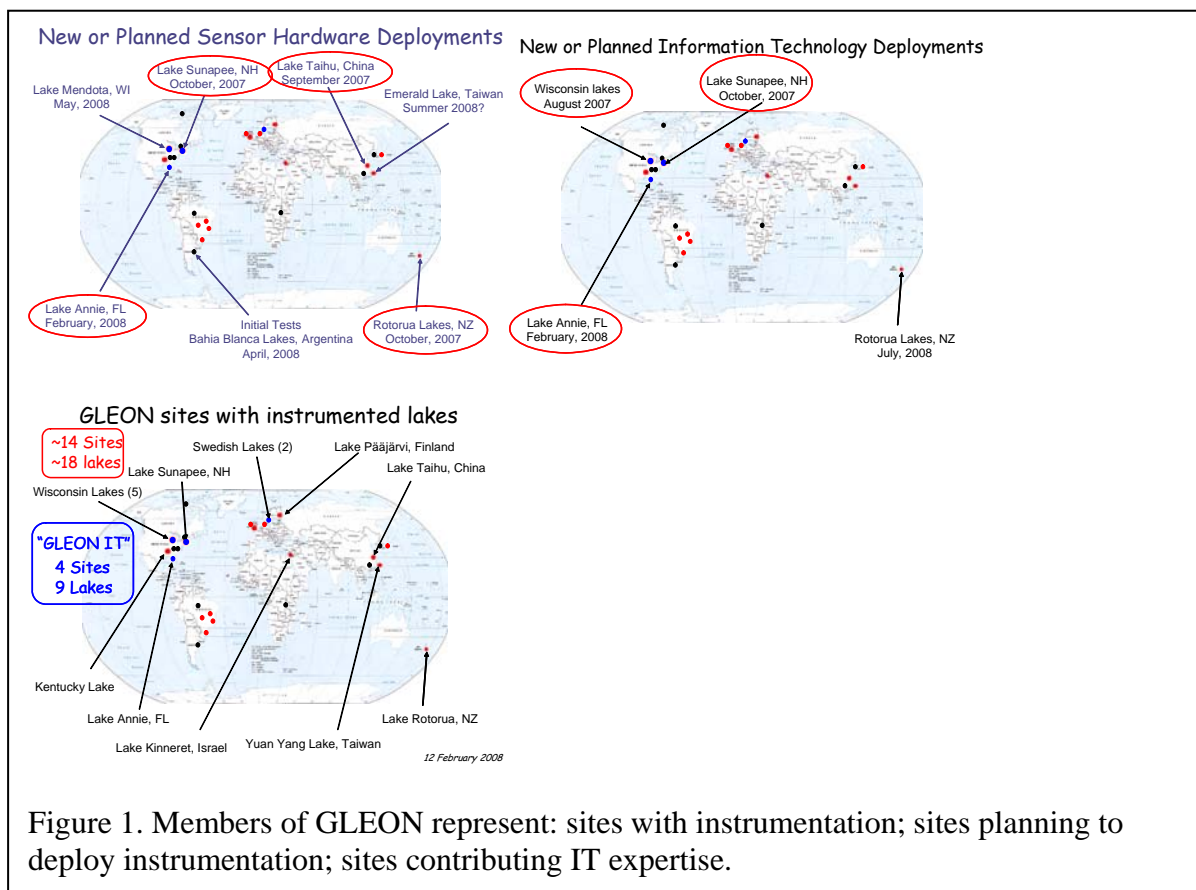


Figure 1. Members of GLEON represent: sites with instrumentation; sites planning to deploy instrumentation; sites contributing IT expertise.

- 2. Expanding the network of people, sites, and data:** An on-going activity of GLEON is to expand and diversify the community through adding members and affiliates, adding science and technology sites, and adding data that are available through the Internet. GLEON now has nearly 60 individual members, 6 site memberships, and 19 sampling sites streaming data

to the network. GLEON has engaged an even broader community through meetings held in 2007 and early 2008, reaching more than 120 scientists from 19 different countries (Fig. 1). For up-to-date information see <http://www.gleon.org/index.php?pr=Membership>. A breakdown of participant diversity of GLEON 6 (February, 2008) follows (Table 1).

Here we describe specific activities in the previous year meant to expand the network and broaden participation. (*see*: Table 2 for a calendar of highlights of GLEON RCN activities).

SIL Student Symposium: In August 2007, Cayelan Carey (Cornell University; Chair of GLEON RCN Student Organization; GLEON RCN Steering Committee member) and other members of the GLEON RCN Steering Committee organized a student informational meeting at the International Society of Limnology (SIL) conference in Montreal. The goals of the student meeting were to: (a) inform students of GLEON RCN opportunities, generate student excitement about GLEON RCN, and gauge how the network might serve students needs; (b) recruit students for the GLEON 6 meeting in Florida in February; (c) inform NSF of GLEON RCN student-related activities and inform students of other NSF student-related opportunities.

The GLEON RCN student meeting at SIL was well received. Approximately 20 students attended, 12 filled out interest forms, and 10 stayed afterwards to discuss potential involvement in GLEON and next steps. The meeting lasted for about an hour, with introductions by Tim Kratz and Paul Hanson, and funding presentations by Pat Brezonik and Bill Chang of the NSF. Of the 12 students who filled out interest forms, 6 were international, representing Canada, Spain, Ireland, Finland and Sweden. Perhaps most interesting is that only 3 students (all Americans) had any prior affiliation to GLEON (2 from UW-Madison, 1 from UC-Santa Barbara). Outcomes of this meeting were used to further inform the development of the Student Organization and to guide student involvement in the GLEON 6 meeting in Florida.

ESA Informational Activity: Carol Brewer (University of Montana; GLEON RCN Steering Committee member) attended the Ecological Society of America (ESA) meeting in San Jose, CA in August 2007 and promoted GLEON RCN, including student opportunities. A poster of GLEON was displayed for general viewing and brochures describing the network were distributed.

Student Travel Award Competition: Following the SIL and ESA meetings, GLEON RCN solicited applications for student travel awards for GLEON 6 to be held at the Archbold Biological Station in Lake Placid, Florida, USA February 11-14, 2008. The solicitation was mailed to all GLEON members and those who had expressed an interest in GLEON RCN student activities through previous meetings. An on-line application was developed for the GLEON Web site and applications were accepted from 7 September 2007 through 15 October 2007. The application consisted of some biographical information and an essay asking about the student's educational background, her or his interest in GLEON and potential GLEON activities she or he would like to develop, and how a GLEON travel fellowship would advance the person's research. A total of 23 students applied, 14 of whom

were awarded travel funding by the GLEON RCN Steering Committee. Approximately half of the student travel costs were funded by the Gordon and Betty Moore Foundation.

Site Installations of Technology: A broader goal of GLEON is to improve the connectivity of lake observatories within the network (Fig. 1, Fig. 2). This can take many forms, including: helping sites select sensor and infrastructure equipment and assisting in configuring that equipment; providing information management (IM) tools that facilitate data streaming, archiving and display within the GLEON network; training site personnel on how to manage the equipment and the IM; and documenting the installation process to use as material in future site installations. Specific activities related to technology development and on-site work are funded by GLEON sources other than the RCN. However, the GLEON RCN plays a pivotal role in establishing the collaborations that lead to these installations and then documenting the process of installation, as well as the outcomes, to further inform other members of the GLEON community and the broader ecological community.

In the present RCN fiscal year, GLEON facilitated three site installations – Lake Erken in Sweden, Lake Sunapee in New Hampshire, and Lake Annie in Florida (as a workshop held immediately prior to the GLEON 6 meeting). Reports from these site installations are available on the GLEON Web site (<http://GLEON.org>, Products/Site installations).



- GLEON 6 – the First GLEON RCN All-hands Meeting:** The first all-hands meeting (GLEON 6, or “RCN 1”) of the GLEON RCN was held at Archbold Biological Station in Lake Placid, Florida, February 11-14, 2008. The meeting was immediately preceded by a three day workshop on buoy configuration and installation at Lake Annie at the same site (*see forthcoming installation report at GLEON.org*). GLEON 6 had community, technology, and science themes, reflecting the overall goals of the organization. An agenda from the meeting, as well as copies of presentations are available on the GLEON Web site.

Community: GLEON 6 had 66 participants from 16 different countries, including 14 students (Table 1). Field biology, ecology, physical modeling, computer science, and information technology fields were represented. Individuals had opportunities throughout the

meeting to showcase their site and to develop inter-site and cross-disciplinary collaborations. Highlights in this area include:

Plenary Presentations: Tim Kratz, (Chair of GLEON) provided an overview of GLEON history and progress to date. Paul Hanson (RCN PI) explained the role of the RCN within GLEON and the RCN-specific goals for the meeting. Kathleen Weathers (GLEON Steering Committee) outlined the overall goals of the meeting and the process for meeting those goals. Liz Blood, Harold Stolberg, and Evan Notman (National Science Foundation) provided perspectives on the importance of network science in ecology and on collaborations with South America. Cayelan Carey (Chair of Student Organization) outlined the goals and process for student participation in the meeting. Several new sites took a few minutes introducing themselves. These plenary activities provided context and set the stage for member-driven activities addressing science and technology issues.

Students: We placed great emphasis on fostering student success at GLEON 6. By broadcasting student opportunities at other venues (i.e., SIL, ESA, email distributions) and through careful planning that included Steering, Planning, and Student committees, we sought to recruit participation by a select number of students who represented diversity in race, gender, fields, and country of origins. Furthermore, we expended extra effort in informing students and other GLEON members of meeting expectations, and we empowered students to help formulate meeting activities and develop future activities of students within the network.

Goals for student participation in GLEON 6: provide students with the opportunity to present their research and meet senior scientists in their field; promote connections between junior and senior scientists, aquatic scientists and information technology experts; integrate junior scientists into the GLEON network by exposing and engaging them in collaborative, international, interdisciplinary science; engage students' participation in scientific working groups (e.g., DO, microbes, etc.); develop student-driven working groups that will plan and execute student activities; facilitate student research within the GLEON network.

Meeting prior to the meeting: During the evening immediately prior to the start of the GLEON 6 plenary presentations, a meeting was held with the graduate students and the GLEON/RCN Steering Committees. This was an opportunity for students to meet face-to-face with people who were responsible for managing the meeting and people responsible for meeting logistics. It also was an opportunity for the RCN PI (Hanson) to reinforce the message that students play a vital role within GLEON and that we, as a network, are facilitating and guiding student development, as well as empowering students to help shape the future of the network.

Student posters: A student poster session was held on the evening of Tuesday, February 12th. All 14 students presented posters, and topics ranged broadly, reflecting the diversity of participants (poster abstracts are available on the GLEON Web site). The poster session provided students the opportunity to focus discussion on their work and how it might relate to broader GLEON activities.

Student outcomes from GLEON 6: Considering that very few of the students knew each other before the meeting, there was remarkable synergy across diverse geographical and disciplinary lines. Collaboration and productivity of the group was impressive. Students met at lunch on Tuesday to discuss site exchanges and then again on Wednesday afternoon more informally. By the end of these two meetings, the 16 students (including the Chair, Cayelan Carey and Vanesa Perillo) had divided themselves into 4 task-oriented groups to organize the site exchanges: funding, site hosts, agreement letters between host/student, and applications. Each of these groups has been tasked to produce a document that will be distributed to the GLEON RCN Steering Committee for review. Once the site-exchange process has been approved, applications can be solicited, perhaps as early as April or May 2008.

Technology: GLEON 6 showcased the integration of technologies developed through other NSF-supported projects and technology developed within the GLEON network (some of which was funded by NSF, as well). Barbara Benson (University of Wisconsin; RCN Steering Committee) presented the upgraded GLEON Lake Information Database interface for entering site information. Barbara Benson and Fang-Pan Lin (NCHC, Taiwan; RCN Steering Committee) described the goals and process for the technology component of the meeting. Sameer Tilak (UCSD) and Luke Winslow (University of Wisconsin) highlighted the integration of technologies from, e.g., data buffering and brokering from Open Source DataTurbine (NSF), system integration and data model design and access from Autoscaling (NSF) and improved deployment of software to establish a GLEON site, which includes a data streaming architecture (DataTurbine) and a data model adapted from CUAHSI (NSF). In general, the Moore Foundation funding (*Building Community Based, Grass-Roots Research Networks: The Cases of Global Lake Ecological Observatory Network (GLEON) and of Coral Reef Ecological Observatory Network (CREON)*) is complementary to the RCN and Autoscaling funding by providing support to harden and deploy software that will create a network of sites with a common data model. This will allow the testing of the science questions on a subset of sites of the broader GLEON network, thus allowing the community to take the initial steps toward testing the network science questions (see below). In addition, the Moore Foundation funding augments support for international participants in the RCN, and in particular for international graduate students.

GLEON 6 also emphasized feedback from the science community in guiding the further development of technology and a prioritized time-line for the development of those technologies. Breakout groups that mixed domain scientists with technologists convened on day two of the meeting to: (a) create interaction between IT and domain scientists to let developers know what the prioritized needs (software, training, etc.) of the scientists are and let the domain scientists know when and in what forms tools will become available; (b) highlight areas of collaboration and synergy between different IT groups; (c) document the needs in order to inform development and guide future publications and proposals. The breakout groups were charged with generating hypothetical research scenarios and to use these as a basis for discussions on querying data, data QA/QC, data access policies, technology training, and the development of new technologies.

The IT working group discussed design issues related to QA/QC and data federation as well as the reports from the discussion sessions with the domain scientists. The IT working group will be a standing GLEON working group and will be co-chaired this year by Barbara Benson and Ken Chiu (SUNY, Binghamton). Several projects were identified as near-term goals: 1) creating an archived email list or wiki for GLEON members to share experiences and information, 2) making the GLEON Lake Information Database searchable, 3) enhancing the buoy IS deployment package by upgrading the user interface, increasing the capacity for remote deployment, and developing new interfaces to instruments and the database, configuration tools, and data quality screening, and 4) requesting database schemas (or file structures) from identified representatives at each GLEON site to inform discussion of data sharing architectures. The IT working group will revisit the reports from the discussions with domain scientists to identify priorities for additional development.

Science: Sessions on advancing ecological science were led by David Hamilton (Waikato University, New Zealand; GLEON Steering Committee) and Thorsten Blenckner (Lake Erken Biological Station, Sweden; GLEON Steering Committee). The rapid growth of GLEON RCN and the diversity of members' interests necessitated the formation of specialist groups to more effectively advance scientific topics of particular interest to GLEON members. These 'Working Groups' are self-organized and focus on the intersection between members' interests and the goals of GLEON RCN. The scientific groups are intended to be persistent and sufficiently well organized to maintain activities within and between GLEON meetings; this need not preclude members from being associated with one or more of the working groups.

The setting up of working group is also designed to more effectively advance the development of products, including, for example: (a) manuscripts for publication; (b) directives or white papers advocating advancement in a particular area of science and/or technology; (c) establishment and documentation of new relationships with other related organizations; (d) grant proposals; (e) training seminars; (f) poster or special sessions at international or funding organization meetings.

As an outcome from our GLEON 6/RCN meeting in Florida (12-14 February), we identified an initial set of six working groups, had members indicate their involvement in these groups, elected leader(s) of each group, and had each group develop an initial plan to advance the activities and products of the group. Commentary on the initial set of six selected working groups is given below.

Defining the kind of science uniquely suited to GLEON: This session was led by Justin Brookes (Adelaide University, South Australia; GLEON Steering Committee) and scribed by Peter Staehr (University of Copenhagen, Denmark). The GLEON combines an array of lake sensors deployed around the globe to address local issues on individual lake ecosystems but also to document changes in lake ecosystems that occur in response to different land-use, latitude and climate. Because many of the modifications to the landscape and climate will be expressed firstly in lake ecosystems, these systems offer a unique opportunity to monitor, analyze and predict future landscape and climate change. By understanding the implications of these changes at a global level, the expected

ecosystem change can be predicted and planned for. Without knowledge of how lakes respond to natural and anthropogenic forcing, planning for future lake management and adaptation to meet community needs and expectations will be compromised.

Planning for the future relies on prediction of the outcome of landscape modification, rain and mixing events, and climate change. Simulation of these events enables this prediction, but it is necessary to inform the development and calibration of models in a range of climatic zones to ensure predictions are broadly valid. GLEON offers an unequalled opportunity to develop and test lake models in a range of climates. The inventory of lakes in GLEON, with common data collection, spans broad gradients in limnological characteristics, landscape and climate settings. As GLEON grows, this wealth of lake data will increase and provide opportunity for interpretation at broader space and time scales. Comparison of lakes across latitude will provide significant insight into how lake ecosystems are likely to be shaped by climate change. Lessons learnt on one lake can be applied globally to ensure sustainable lake ecosystems into the future.

Domains of control: Led by Don Pierson (Uppsala University, Sweden) and Thorsten Blenckner (Lake Erken Biological Station, Sweden; GLEON Steering Committee): Report forthcoming on the GLEON Web site.

DOC/C dynamics and lake metabolism: Led by Tim Kratz (University of Wisconsin): Report forthcoming on the GLEON Web site.

Benthic pelagic interactions: Led by Yvonne Vadeboncoeur (Wright State University) and Erik Jeppesen (National Environmental Research Institute, Denmark): Report forthcoming on the GLEON Web site.

Climate change and lake mixing: Led by Tim Kratz (University of Wisconsin; Chair GLEON) : Report forthcoming on the GLEON Web site.

Lakes as sensors: Led by David Motta Marques (Hydrology Research Institute, Brazil): Organizations, such as GLEON have automated measurements of meteorological, hydrological, and limnological variables that have lead to explosive growth in data quantity and challenges in data assimilation and interpretation, even for a single site. When combined into a network of sites, the analytical demands compound, and the approaches envisioned for one lake do not necessarily scale well to hundreds or thousands of lakes. What is needed is a new intellectual paradigm for understanding how the properties of the great diversity of individual lakes can be generalized to capture the aggregate characteristics as we move from local to global scales. Here we introduce the “Sensor Web of Lakes” paradigm as an extension and modification of the “lakes as sentinels” view. A lake as a sensor has signal output with pattern at multiple space and time scales related to external driving forces mediated by the lake’s fundamental biotic and abiotic structure. A web of lakes may react as a single spatially-dispersed sensor, sensing in one scale and the output signal being the result of permutation of conditions, a synchronous system. Important properties of a sensor lake include sensitivity, resolution, and sensing distance, full scale range, offset, nonlinearity, drift, noise, and hysteresis. The

paradigm leads to an approach consistent with signal processing in computer science and engineering fields; creates a set of meta-characteristics for the lake (sensitivity, resolution, etc.) that are more easily interpretable within the context of solid analytical theory; allows us to take lake characteristics and meld those with measurements from disciplines other than ecology, where we normally would be speaking a different language; clearly define a set of lake characteristics that can be standardized across a network, such as GLEON. The Sensor Web of Lakes provides a conceptual framework for discussing the advancement of science within the context of the federation Global Lakes Ecological Observatory Network which goals include the integration of contemporaneous high hierarchy data from diverse aquatic ecosystems.

Table 1. Demographic breakdown of participants in the first RCN all hands meeting (GLEON 6, Florida).

Country	Female_n	Male_n	Total_n
U.S.A.	11	16	27
China		3	3
Argentina	1	1	2
Brazil		2	2
Denmark		2	2
England		2	2
Ireland	2		2
New Zealand		2	2
Sweden		2	2
Taiwan	1	1	2
Australia		1	1
Finland		1	1
Hungary	1		1
Israel		1	1
Korea		1	1
Switzerland		1	1
Totals	16	36	52
<i>Graduate students</i>			
U.S.A.	3	7	10
Argentina	2	1	3
China	1		1
Totals	6	8	14

- 4. Other Exchanges, Visits:** Collaborations established through the GLEON have led to a number of other meetings, teleconferences, exchanges and site visits (Table 2).

Table 2. Calendar of selected activities for the first fiscal year of GLEON RCN.

Dates	Category	Description
5-Mar-07 -- 8-Mar-07	Meeting	GLEON 4, Lammi, Finland
27-Mar-07	Teleconference	RCN Steering Committee teleconference
3-May-07 -- 10-Sep-07	Teleconference	RCN Steering Committee teleconference
3-Jun-07	Exchange	David Hamilton sabbatical in Wisconsin
3-Jun-07 -- 5-Jun-07	Meeting	RCN Steering Committee
23-Jun-07 -- 28-Jun-07	Workshop	Lake Erken, Sweden, information management install
20-Jul-07	Teleconference	RCN Steering Committee teleconference
11-Aug-07	Meeting	GLEON 5, Montreal, Canada
12-Aug-07 -- 18-Aug-07	Meeting	SIL 2007, Montreal, Canada
14-Aug-07	Meeting	GLEON Student Association informational meeting
5-Sep-07	Teleconference	RCN-CENS collaboration exploration
11-Sep-07 -- 12-Sep-07	Meeting	RCN meeting at US NSF
1-Sep-07 -- 20-Oct-07	Competition	RCN Student travel award competition
3-Oct-07	Teleconference	RCN Steering Committee
1-Dec-07 -- 25-Jan-08	Exchange	Paul Hanson sabbatical in Adelaide, Australia
9-Feb-08 -- 11-Feb-08	Workshop	Lake Annie, FL, information management install
11-Feb-08 -- 14-Feb-08	Meeting	GLEON 6, Archbold Biological Station, FL
14-Feb-08 -- 19-Feb-08	Exchange	Justin Brookes visiting scientist to WI
19-Feb-08 -- 20-Feb-08	Exchange	Zhengwen Liu, Xiaolan Song visiting scientists to WI

Planned meetings, visits, and exchanges: As part of the outcome of GLEON 6 and other first-year activities, there are a number of planned visits and exchanges, some of which we highlight here:

Student exchanges: In April 2008, the GLEON RCN Student Organization will submit a set of recommendations for policy and process in awarding student exchanges among GLEON sites. These recommendations will be considered by the RCN Steering Committee and formalized by April 2008. Exchange applications will be solicited in May and June 2008, and exchanges (up to 5 students total) are expected to commence over the following months.

GLEON 7 in Sweden: GLEON 7 will be hosted by Stephen Bertilsson (Uppsala University, Sweden) in September 2008. An agenda for the meeting will be forthcoming on the GLEON Web site.

GLEON 8 in New Zealand: GLEON 8 will be hosted by David Hamilton (Waikato University, New Zealand) in February 2009. An agenda for the meeting will be forthcoming on the GLEON Web site.

Argentina site visit: Lead by Tim Kratz (University of Wisconsin), researchers, including students, from Wisconsin (Trina McMahon, Ashley Shade), Cornell University (Cayelan Carey), and University of California, Merced (Tom Harmon and students) will visit the research sites of Cintia Piccolo (Instituto Argentino de Oceanografia) to exchange expertise and discuss collaborative opportunities.

Brazil site installation: GLEON will be performing a remote installation of information management for buoys operated by David Motta Marques (Hydrology Research Institute, Brazil) in April 2008. A site visit by Luke Winslow (University of Wisconsin) for training purposes will follow the Argentina site visit described above.

Finland site installation: GLEON will perform a remote installation of information management for buoys managed by Lauri Arvola (University of Helsinki, Finland) in May of 2008.

Presentations

- 2008 Vanesa Y. Bohn Gerardo M.E. Perillo and M.Cintia Piccolo. Instituto Argentino de Oceanografía, CONICET, Argentina. *DISTRIBUTION PATTERN AND MORPHOMETRIC PARAMETERS OF SHALLOW PONDS IN SOUTHERN BUENOS AIRES PROVINCE, ARGENTINA*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Cayelan C. Carey, Kathleen C. Weathers, Kathryn L. Cottingham. Cornell University, Department of Ecology and Evolutionary Biology, Ithaca, New York. *THE CAUSES AND ECOSYSTEM IMPACTS OF GLOEOTRICHIA ECHINULATA BLOOMS IN GLEON SITES IN THE NORTHEASTERN UNITED STATES AND CENTRAL SWEDEN*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Patricia E. García1, Maria C Dieguez and Horacio E. Zagarese. Laboratorio de Fotobiología, Centro Regional Universitario Bariloche, Universidad Nacional del Comahue. *SYNERGIC EFFECT BETWEEN TEMPERATURE AND ULTRAVIOLET RADIATION ON AQUATIC ZOOPLANKTON IN A GLOBAL CLIMATIC CHANGE SCENARIO*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Emilio J. Garibotti; Patricia M. Cervellini; M. Cintia Piccolo. Instituto Argentino de Oceanografía, Argentina. *ZOOPLANKTONIC COMMUNITY AND PHYSICO-CHEMICAL PARAMETERS OF THE UNAMUNO SHALLOW POND DURING THE SPRING*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 David Iwaniec and Daniel Childers. Florida International University, Miami, Florida. *USA CONTROLS ON STABILITY OF MICROBIAL MATS FROM THE FLORIDA EVERGLADES*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Stuart E. Jones. Limnology and Marine Sciences, University of Wisconsin-Madison, Wisconsin, USA. *INFLUENCE OF LIGHT AND ORGANIC MATTER SOURCE ON AQUATIC RESPIRATION*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Rebecca Lawson. and Sally MacIntyre. University of California, Santa Barbara, California, USA. *INSTRUMENTATION TO EVALUATE RESPONSE OF PHYTOPLANKTON TO DISTURBANCES IN STRATIFIED LAKES*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Matthew P. Miller, Diane M. McKnight, Evyan Borgnis. Department of Civil Engineering, Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO. *SOURCES OF DOM TO ALPINE SURFACE WATERS: IN-LAKE VS. WATERSHED PRODUCTION*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Jay Munyon. Florida International University, Florida, USA. *INFLUENCE OF PERIPHYTON ON CARBON DIOXIDE SEQUESTRATION ALONG ENRICHMENT AND HYDROLOGIC GRADIENTS IN EVERGLADES MARSHES*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Jordan S. Read, A. Shade, K.D. McMahon, and C.H. Wu. University of Wisconsin - Madison, Wisconsin, USA. *USE OF PHYSICAL LAKE-SCALE MODELS AS SUPPORT FOR MULTI-POSITIONAL FIELD SENSOR DATA*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Kevin C. Rose and Craig E. Williamson. Miami University, Oxford, Ohio, USA. *ADDING UV TRANSPARENCY AS AN OPTICAL INDICATOR OF ALLOCHTHONY IN LOW DOM LAKES*. Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Ashley Shade, C.Y. Chiu, and K.D. McMahon. University of Wisconsin-Madison, USA.

- LAKE MIXING FROM A MICROBIAL PERSPECTIVE: LINKING INSTRUMENTED BUOY DATA WITH AQUATIC BACTERIAL RESPONSE TO OVERTURN.* Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Amarjeet Singh, Michael Stealey, Maxim Batalin, and others. Electrical Engineering Department, UCLA, Los Angeles, CA. *AUTONOMOUS LAKE MONITORING: SYSTEMS AND EXPERIMENTAL DESIGN FRAMEWORK.* Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Song Xiaolan, Liu Zhengwen, and Chen Yuwei. Graduate School of CAS, Beijing 100049, P. R. China. *CHANGE OF PHYTOPLANKTON COMMUNITIES AND RELATED ENVIRONMENTAL FACTORS UNDER DIFFERENT TEMPORAL SCALES IN MEILIANG BAY OF TAIHU LAKE (CHINA) – A LARGE, SHALLOW SUBTROPICAL LAKE.* Poster presentation at GLEON 6, Lake Placid, FL.
- 2008 Brookes, J. *The River Murray, Lower Lakes and Coorong.* University of Wisconsin, Center for Limnology. Madison, Wisconsin. Invited speaker.
- 2008 Hanson, P.C. *Primary productivity in the Coorong.* Presentation at the ICE WaRM International Liaison Symposium. Adelaide, Australia.
- 2007 Hanson, P.C. *The Global Lake Ecological Observatory Network.* Presentation at the NSF-sponsored workshop, *International Research Network Connections.* Washington, D.C.
- 2007 Hanson, P.C. *The Research Coordination Network within the GLEON organization.* Global Lakes Ecological Observatory Network meeting. Lammi Biological Field Station, Finland.
- 2007 Arzberger P, Hamilton D, Hanson P, Kratz T, Lin FP. *Building the e-science Global Lake Ecological Observatory Network Community.* 5th Taipei International Digital Earth Symposium (TIDES), Taipei, Taiwan.
- 2007 Carey, C.C., Cottingham, K.L., Weathers, K.C., and I. Karlsson-Elfgren. *Bridging GLEON sites with *Gloeotrichia echinulata*.* Oral presentation. The 4th GLEON [Global Lake Ecological Observatory Network] workshop, Lammi, Finland, March 2007.

Talks Highlighting GLEON

- 2008 (28 January) – Arzberger P and many others. *Global Engagement of People Networks: Building Distributed Communities.* National Science Council – National Science Foundation Annual Meeting (vtc)
- 2008 (9 January) – Arzberger P and many others. *Global Engagement of People Networks: Building Distributed Communities.* US State Department (part of International Research Network Connections presentations). Washington DC
- 2007 (4 December) – Arzberger, P and many others. *Building Global Partnerships.* 2nd PRAGMA Institute held in conjunction with 3rd Southeast Asia International Joint Research and Training Program, Hsinchu, Taiwan
- 2007 (10 September) – Arzberger, P and many others. *Global Science Conducted by Virtual Communities Using Cyberinfrastructure: Extending the Horizons of Science and Technology.* Invited Keynote Presentation, High Performance Computing Asia, Seoul Korea
- 2007 (14 March) – Arzberger P, Papadopoulos P, Katz M, Zheng C. *Building international e-communities in cyberinfrastructure, research, and education.* Invited Keynote, Advanced Computing and Applications (ACOMP 2007) Ho Chi Minh City, Vietnam.

Journal Publications

- Coloso, J.J., J.J. Cole, P.C. Hanso, and M.L. Pace. *In press*. Depth-integrated, continuous, estimates of metabolism in a clear-water lake. Canadian Journal of Fisheries and Aquatic Sciences.
- Hanson, P.C. A grassroots approach to sensor and science networks. 2007. *Frontiers in Ecology and the Environment*. 5(7): 343.

Books or Other One-time Publications

- Sameer Tilak, Peter Arzberger, David Balsiger, Barbara Benson, Rohit Bhalerao, Kenneth Chiu, Tony Fountain, David Hamilton, Paul Hanson, Tim Kratz, Fang-Pang Lin, Tim Meinke, and Luke Winslow, "Conceptual Challenges and Practical Issues in Building The Global Lake Ecological Observatory Network," Proceedings of the Symposium on Environmental Sensor Networks, third International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) 2007.
- Ebbe Strandell, Sameer Tilak, Hsiu-Mei Chou, Yao-Tsung Wang, Fang-Pang Lin, Peter Arzberger, and Tony Fountain, "Data Management at Kenting's Underwater Ecological Observatory," Proceedings of the Symposium on Environmental Sensor Networks, third International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) 2007.
- K. Kulkarni, S. Tilak, K. Chiu, T. Fountain, "Engineering challenges in building sensor networks for real-world applications," Proceedings of the Symposium on Environmental Sensor Networks, third International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) 2007.

Web/Internet Site

URL(s):

GLEON.org

<http://www.dataturbine.org>

Description:

GLEON.org is the information center for the RCN GLEON and includes: mission statement; goals; events; tools and publications; member lists; lake information; a portal to network data; and more.

DataTurbine.org gives information about the Open Source DataTurbine Initiative. It contains pointers to DataTurbine source code, mailing lists, documentation, publications, and relevant observing systems domains, and communities.

Other Specific Products

Contributions

Principle discipline(s): GLEON RCN plays a leadership role in the development of ecological sensor networks and in the guidance of new science initiatives that are best addressed by an international network. Examples of initiatives are described in more detail in the Activities and Findings main document and include: lakes as sensors of the landscape; carbon cycling; physical responses to climate change; theoretical work on domains of control. GLEON RCN provides opportunities for participation for ecologists who otherwise would not have the expertise or staff necessary to develop and deploy lake sensor networks and the necessary information management. The extent of these contributions are documented in the outreach sections of this report and in the broad participation by senior and junior researchers and students.

Other disciplines of science and engineering: Technology-related disciplines are an integral part of the GLEON RCN. As described more thoroughly in the Activities and Findings section, GLEON RCN has helped inform the development of data-streaming technologies for sensor networks. Through installations of technology at multiple sites, interacting with site personnel, and conducting information technology training, GLEON has obtained feedback on the design and use of data-streaming technologies, as well as technologies for data model development and data querying and federation. Further input by the ecological community has been facilitated more formally through the GLEON 6 break-out sessions on technology. Reports on all of these activities are available on the GLEON Web site and will be informative documents for the development of other ecology-related sensor networks.

The development of human resources: Through site installations and training workshops, GLEON RCN has reached junior and senior ecologists, members of the private sector, and scientists in technology-related domains. Ecologists, especially, have benefited from learning about sensor networks and learning how to design, install, and operate them. Special emphasis has been placed on including graduate students in all aspects of the GLEON RCN. Students have opportunities to interact with others in the network, help define the future of GLEON RCN, and share control over the training and exchange opportunities provided them through the network. GLEON RCN sees the students it reaches as the future of ecology network science and invests heavily in the development of this next generation.

The physical institution:

Other aspects of public welfare:

Special Requirements

Categories for Which Nothing is Reported

Appendix A

Individuals who were part of the group to develop the GLEON Operating Principles and Procedures Document. Note that this was based in part on the Operating Principles and Procedures developed by another NSF funded activity, the Pacific Rim Application and Grid Middleware Assembly (PRAGMA).

- Thorsten Blenckner, Uppsala U., Sweden
- Justin Brooks, Adelaide, Australia
- Cayelan Carey, Uppsala U., SE and Cornell U., USA (Graduate Student)
- Evelyn Gaiser, Florida International U., USA
- Paul Hanson, U. Wisconsin USA
- Susan Hendricks, Murray State U., USA
- Marko Jarvinen, Lammi Finland
- Bomchul Kim, Kangwon U Korea
- Trina McMahon, U Wisconsin, USA
- Ami Nishri, Oceanographic and Limnological Research, Israel
- Kevin Rose, Miami U of Ohio, USA (Graduate Student)
- Kathie Weathers, IES USA
- Craig Williamson, Miami U of Ohio USA
- Guangwei Zhu, Nanjing Inst., China