Lessons learned from the Global Lake Ecological Observatory Network

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An international grass-roots, collaborative network of limnologists, ecologists, information technology experts and engineers that collects and synthesizes high-frequency data from lakes worldwide to sense and forecast change.
... a network of people

GLEON has > 350 individual members
... a network of observatories

More than 60 lakes across 6 continents and 34 countries
... and a network of data.

This model leads to high productivity

More than 100 publications and more than 200 presentations
GLEON Data-driven Publications

Of the ~50 pubs that would not have happened without a GLEON

- Total Pubs
- Data from 1 site
- Data from >1 site

~2 year lag from inception to product

Slide courtesy of Tim Kratz
Adopt other disciplines
Innovate for ecosystems
Numerical simulation

New measurements
Larger gradients
More scales

Community, cyber infrastructure, data, models can be leveraged to advance scientific understanding
What Keeps Us Together and Helps Shape the Science?
All-Hands’ Meetings and Workshops (Working Groups)
Data Sharing
GLEON Student Association/Student Leadership
Governance Structure
Collaborative Climate Committee
GLEON MEETINGS

GLEON 15: November 2013 (Bahia Blanca, Argentina)

GLEON 14: 15-19 October 2012 (Mulranny, Ireland)

GLEON 13 10-14 October 2011 (Lake Sunapee, New Hampshire, USA)

GLEON 12 4-8 April 2011 (Lake Kinneret, Israel)

GLEON 11 17-22 October 2010 (Nanjing, China)

GLEON 10 9-14 May 2010 (Torres, Brazil)

GLEON 9 12-15 October 2009 (Boulder Junction, Wisconsin, USA)

GLEON 8 2-6 February 2009 (Hamilton, New Zealand)

GLEON 7 29 September - 1 October 2008 (Norrtalje, Sweden)

GLEON 6 11-14 February 2008 (Lake Placid, Florida, USA)

GLEON 5 11-14 August 2007 (Montreal, Quebec, Canada)

GLEON 4 2-5 March 2007 (Lammi, Finland)

GLEON 3 2-4 October 2006 (Hsinchu, Taiwan)

GLEON 2 29-31 March 2006 (Townsville, Queensland, Australia)

GLEON 1 7-9 March 2005 (San Diego, California, USA)
GLEON: Lessons Learned, Opportunities, and Challenges

• **Scientific networks are people networks**
  – **Opportunity**: GLEON has evolved into a grassroots “learning organization” that is actively doing science
  – **Challenge**: how to maintain the people, sensor, data network over the long-term

• **Scientists around the world are eager to collaborate**
  – **Opportunity**: GLEON attracts increasing numbers of experts from around the world and provides a new model for collaboration
  – **Challenge**: how best to understand, guide, and manage this growth and collaboration
Lessons Learned, Opportunities, and Challenges (cont.)

• **Students are central to vibrancy of the network**
  – **Opportunity**: GLEON students and early career scientists are eager to join, engage, and help lead
  – **Challenge**: to create and implement the model(s) to best train next generation of global, network scientists

• **Public is eager to engage with local science if it is placed in a global context**
  – **Opportunity**: GLEON engagement with the public is increasingly leading to local community support and growth opportunities
  – **Challenge**: to find best models for engagement
Lessons Learned, Opportunities, and Challenges (cont.)

• Data sharing, both conceptually and technically, requires long-term sustained efforts
  – **Opportunity**: GLEON can learn from and inform CI development for network science
  – **Challenge**: to harmonize globally diverse approaches to CI and data sharing
Local point of presence (POP)
CI – What is working...

• Site-level CI (from sensor to POP)
• More sites coming online
• Visualization at the local level
• A technology for storing large data sets
• Data analysis of large data sets
• Community development
• Partnering
• Science is getting done
What isn’t working...

- Centralization: central repository not used for science
- Persistence: little on-going contribution to centralized system
- Data discovery: rarely used
- QA/QC: at all levels
- Sharing: strings are attached
- Efficiency: it is not
Why is it so challenging?

• Ecology today:
  – Data were collected for a specific experiment
  – Incentives for anonymous sharing are not compelling to many
  – Online data discovery is not used much in ecology
  – Ecologists have been slow to adopt standardization
  – General culture of “do it yourself”

• Ecology tomorrow:
  – Address cultural and technological set of issues
  – New paradigm may require a new belief system and/or new accepted practice (more of a market system?)
  – Science drivers and learning by doing
  – Community is eager to experiment
  – PRAGMA expedition
GLEON-enabled science: a research sampler and case study of the data-driven approach to global limnology

Cayelan Carey
Center for Limnology
University of Wisconsin
GLEON Working Group Structure
Microbial communities reset after typhoon events

Yuan Yang Lake, Taiwan

Monitoring episodic storm events

How do production rates compare among lakes?
Spatially extensive…

• What is the continental extent of lakes and shoreline in the U.S.?

• How much carbon is imported into aquatic systems, and how is that flux distributed spatially and across different size and types of systems?

• What scaling laws can we use to determine the distribution of lake ecosystems and biogeochemical processes across the landscape?

Luke Winslow et al. (In prep.)
Challenges and opportunities to look outside the GLEON box…

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<thead>
<tr>
<th>Challenge</th>
<th>Opportunity</th>
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<tr>
<td>Individual data management, resulting in redundancy and inefficiency</td>
<td>Are there data standards and workflows that we should be adopting across the network?</td>
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<tr>
<td>Traditional data management approaches (emailed Excel spreadsheets) are common</td>
<td>How do handle curated datasets? QA/QC? Need more training, standardized code and data formats; need incentive to do this</td>
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<tr>
<td>Not all data are equal</td>
<td>Should we be publishing “high value” datasets so that providers can receive credit?</td>
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<td>Discussing, developing, and reiterating authorship policies is important</td>
<td>For us to collaborate on an equal playing field, we need to keep data providers engaged during every step of the project. Improves the science, strengthens the perspectives, and maintains data-sharing</td>
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<td>“Big data” management and analysis skills are in great demand but low supply</td>
<td>Improved training (workshops, tutorials) that are accessible to the community Connecting projects that need certain skills with skill sets</td>
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<td>Difficulty in finding and accessing data needed for a project</td>
<td>Improved community interactions</td>
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<td>Dominated by one or two disciplines</td>
<td>Collaborate across networks and organizations to apply our shared knowledge</td>
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<td>People network is driving the science network; science is limited by availability and access of data</td>
<td>Does this need to change?</td>
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GloboLakes-GLEON Connect Points

- “Virtual expeditions” could be used to engage GLEON resources in Globo science
- Synergies in connecting lakes to their landscapes
- GLEON provides another mechanism for reaching the broader science community (expanding the effort and reach)
- Organizational infrastructure
Thank you!

(G14 in Mulranny, Ireland)
Table 1. GLEON students who have graduated recently or whose graduation is imminent.

2012: Alo Laas, Ph.D., Estonia University of Life Sciences (Estonia)
2012: Karin Sparber, Ph.D., University of Limerick (Ireland)
2012: Jordan Read, Ph.D., University of Wisconsin
2012: Emily Kara, Ph.D., University of Wisconsin
2012: Luke Winslow, M.S., University of Wisconsin
2012: Cayelan Carey, Ph.D., Cornell University
2012: Yangqing Ding, Ph.D., Nanjing Institute of Geography & Limnology, Chinese Academy of Sciences (NIGLAS; China)
2012: Shujun Dai, M.S., NIGLAS
2011: Lesley Knoll, Ph.D., Miami University (Ohio)
2011: Kevin Rose, Ph.D., Miami University, Ohio
2011: Steven Sadro, Ph.D., UC Santa Barbara
2011: Marla Lima, M.S., IPH-Universidade Federal do Rio Grande do Sul, Brazil.
2011: Mino Sorribas, M.S., IPH-Universidade Federal do Rio Grande do Sul, Brazil.
2011: Linlin Cai, M.S., NIGLAS
2011: Linlin Zhao, M. S., NIGLAS and Hohai University
2010: Yan (Larry) Shen, M.S., NIGLAS
2010: Robyn Smyth, Ph.D., UC Santa Barbara
2010: Ina Bloch, Uppsala University (Sweden)
Summary

• Ecologists are eager to share data
  – Incentives need to match value system
  – Bar needs to be very low
  – We can learn from (or collaborate with!) others
• Entering a new era of science, in which ecologists are exploring new scales, technologies, new collaborations
  – A new kind of ecology?
  – A new kind of ecologist?
• Learning by doing – entering a new ‘science space’
• Work has already begun!
GLEON provides a new model for doing science
People, Sensors, Data