GLEON

global lake ecological observatory network

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Site News & New Site Abstracts

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A new undergraduate education project using GLEON data: The use of high-frequency data to engage students in quantitative reasoning and scientific discourse

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Advances in sensor technology have increased our ability to collect large volumes of data at high temporal frequency and over long time scales. Undergraduate students, i.e., future researchers, citizen scientists, and science advocates, will need quantitative reasoning skills and tools to analyze these large datasets to answer critical research questions and interpret big data for their peers. Our project will develop and test inquiry-based modules that use high- frequency datasets such as those that are available from GLEON and other online sources (e.g., USGS, NOAA). The focus will be on a range of topics such as lake stability, ecosystem metabolism, food web interactions, and climate change. Each module will be designed with a flexible structure that can be adapted to different course levels from non-majors to graduate students. We will assess these modules in different-sized biology, ecology, limnology, geology, hydrology, and environmental sciences courses in large public universities, small state universities, and private liberal arts colleges within the USA. We expect that engagement with authentic data collected from modern sensor systems will strengthen students' quantitative skills as well as lead to an improved ability to develop scientific arguments. This project is funded by the U.S. National Science Foundation. The modules are currently in development and will be tested in our classes this coming academic year. After refinement and finalization, the modules will be disseminated as open-source teaching materials.

2. *Hsiu-Mei Chou[1], Jyh-Horng Wu[1], Fang-Pang Lin[1]*

Earth Science Observation Database in Taiwan

[1]National Center for High-performance Computing, Hsinchu, Taiwan

Natural disasters affect thousands of people every year and result in large-scale loss of life or damage to property. The scale of disasters tends to be more and more intense and complex as the year go on. Responding to the compound disasters Taiwan may face in the future, NARLabs is integrating research resources and forming a data alliance to serve the needs of researches on long term disaster monitoring and prevention. Data in following subject are included:

- satellite remote sensing and weather observations
- ocean observations and submarine surveys
- earthquake engineering research
- atmospheric hydrological modeling
- hi-frequency lake observations
- underwater coral reef monitoring

3. Raoul-Marie COUTURE[1,2], Kari AUSTNES[1], and Heleen DE WIT[1]

Lake Langtjern: long-term ecological monitoring in Norway

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Lake Langtjern (60°37'N; 9°73'E) is a small (0.227 km^2) humic and oligotrophic lake located in central Norway. It has a small catchment (4.8 km^2, elevation 510-750 m) dominated by pine forest, wetlands and bedrock. Yearly precipitation is 750 mm yr^{-1} and the catchment experiences long winters and a stable snowpack. The Lake Langtjern research station has been included in the Norwegian freshwater monitoring program since 1972. It has facilitated the study of acid deposition, carbon and mercury cycling, oxygen and greenhouse gas dynamics, as well as fish and invertebrates ecology. Several notable datasets have emerged from the study of Lake Langtjern: 42 years of ice coverage data, daily discharge, and weekly major ions concentrations; 28 years of weekly total organic carbon (TOC) concentrations; and 4 years of high-frequency buoy data on dissolved oxygen and temperature (Aanderaa Optode 4175). There is also 4 years of high-frequency data from the lake outlet on runoff, temperature, pH, conductivity, UV absorbance (190-360 nm), and coloured DOM fluorescence (ex. 370 nm/em. 460 nm). A local weather station provides air temperature, humidity, radiation and wind, while snapshots from an on-site webcam provide information on lake ice cover. Using in-situ lake data, catchment input data and local weather, we have calibrated processes-based catchment (INCA) and lake (MyLake) models used to study the impact of recovery from acidification and of climate change on lake ice phenology and biogeochemical dynamics.

4. Thomas C. HARMON[1]

SAVI Participants are at GLEON!

[1]School of Engineering & Sierra Nevada Research Institute, University of California Merced, USA

This NSF "science across virtual institutes" (SAVI) project provides bridging interactions between the GLEON and SAFER programs and helps to build research capacity in team science focused on freshwater ecosystems. For example, SAVI provided travel awards to 9 GLEON 16 attendees. The research focuses broadly on quantifying ecosystem process and service changes in the face of changing climate, and on identifying the best adaptation strategies in different socioeconomic and cultural settings. Science, social science and humanist topics are welcome. The SAVI project is increasing research capacity in the above-mentioned areas by offering funding opportunities to U.S. investigators and students with relevant interests through (1) Travel Awards for attending SAFER and GLEON meetings, (2) Access and financial support for Graduate and Early Career Training Programs, and (3) Supplemental Awards to U.S. investigators and graduate students to support international collaborations in support of the SAFER and GLEON missions.

5. *Eleanor Jennings[1]*

NETLAKE – linking lakes and researchers across Europe

[1]Centre for Freshwater and Environmental Science, Dundalk Institute of Technology, Ireland

The NETLAKE Cost Action (Networking Lake Observatories in Europe: www.netlake.org) is a collaborative network for researchers, water managers, local lake groups and policy makers from 26 European countries, and includes the USA, Australia and New Zealand. The funding supports two/three meetings per year, trainings schools, and science exchange visits. NETLAKE is divided into four Working Groups: two focused on the technology of monitoring and analysis of data, and two aimed at bridging communication gaps between scientists and other lake users. Activities in year 2 included population of a metadatabase of lake sites, and work on management-relevant case studies on dissolved organic carbon, algal blooms and mixing events, topics suggested by managers at a special workshop. WG 3 is also in the pilot stages of an outreach schools project. Fourteen Scientific Missions, many involving Early Stage Researchers, have also taken place. Dissemination activities have included the first two publications related to Action work, a webinar to the GEO group, on-going communication over Facebook and regular email noticeboards. Challenges for the coming two years include the collation of information on available data analysis and modelling tools and creating a web-based interface to provide access to these tools.

6. *C. M. O'Reilly[1], P. A. Staehr[2], I. A. Kimirei[3]*

New Site: Lake Tanganyika, East Africa

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[3]Tanzania Fisheries Research Institute, Tanzania

We are excited to announce the first GLEON site on the African continent! Lake Tanganyika is one of the oldest (10 million years), deepest (1.5 km), largest (20% of the world's liquid freshwater) and most biologically diverse lakes. After many years of hard effort to put a buoy on Lake Tanganyika, we have now secured funding through Danida, the Danish Ministry of Foreign Affairs. This new research and capacity development project will involve the collaboration of Danish and Tanzanian researchers and graduate students in the areas of limnology, fisheries, and social science. The focus of the project is to better understand how Lake Tanganyika is responding to climate change and to evaluate how these changes might affect fisheries production. Data we collect on limnology and fish biology will be compared to historic datasets. Over several stages, we expect to eventually implement two buoys with real-time data, which we hope will be used by fishermen to make decisions about when to fish. We will work with fishermen and local schools on outreach and education. We will develop a model of the lake to project into the future to identify the risk due to climate change. The project will provide important information for the riparian countries regarding the impacts of climate change on a lake that is a critical food source for the rapidly growing surrounding communities.

7. *Francesco POMATI[1], Simone Fontana[1], Mridul Thomas[1]*

In-situ integrated sensing tools for understanding the causes and consequences of phytoplankton biodiversity change in Lake Greifen, Switzerland

[1]Department of Aquatic Ecology, Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

We operate an automated lake monitoring system for the characterisation and counting of algal cells, coupled with measurement of the water physics and chemistry and meteorological conditions. The aim of this platform, currently deployed in Lake Greifensee, is to automatically and with high frequency acquire information on abiotic environmental conditions (using multiparametric probes and additional sensors), phytoplankton composition, diversity, abundance, phytoplankton phenotypic traits (using scanning flow-cytometry), and to monitor these parameters over the vertical profile of the water column. To understand the causes and consequences of plankton biodiversity change we study patterns of community dynamics in relation to selection by environmental constraints. We particularly focus on individual level diversity in phytoplankton physio-morphological traits and on small-scale spatial and temporal heterogeneity in limiting resources, which are common features of aquatic systems and allow to study the relationship between changes at the level of individuals, community dynamics and ecosystem processes. For example, our system features new developments for the on-line analysis of nutrients, micronutrients, and other chemical parameters relevant to the carbon cycle. Research questions include which and how environmental variables influence short-term fluctuations in phytoplankton trait-diversity and population dynamics, for instance triggering cyanobacterial blooms.

8. *Lars G. Rudstam[1], Amy L. Hetherington[1], James R. Jackson[1]*

Oneida Lake, new GLEON site with old traditions.

[1]Department of Natural Resources and Cornell Biological Field Station, Cornell University, Ithaca New York, USA

The Cornell Biological Field Station together with New York State has conducted research on food web interactions and the coupling with fisheries on Oneida Lake since 1956. Oneida Lake is a relatively large (200km^2), shallow (max depth 16 m), meso-eutrophic lake in central New York state. The research on the lake may be most known for studies on walleye and yellow perch dynamics, fish-zooplankton interactions, and invasive species in particular zebra mussels.The data collected includes most aspects of the food web from fish eating birds (cormorants) and anglers to phytoplankton and nutrients. Availability of this data set is enhanced with the soon to be published book on the lake and through publicly available data repositories at the knowledge network for biocomplexity. Current research includes the coupling of hydrodynamics, climate change and invasive mussels (quagga mussels), evaluation of new invasives (round goby), importance of an expanded littoral zone associated with increased water clarity, and continued attention to predator-prey interactions. We are looking forward to further collaborations across lakes through continued participation in GLEON.

9. *Jasmine E. Saros[1], William Gawley[2], Nora Theodore[1], Courtney Wigdahl-Perry[1], Alyssa Reischauer[2] and Shannon Wiggin[2]*

A New Site: Jordan Pond, Acadia National Park, US

[1]Climate Change Institute, University of Maine, Orono, Maine
[2]National Park Service, Acadia National Park, Bar Harbor, Maine

The chemistry and water clarity of lakes in the northeastern US have been changing in recent decades, raising the question of how climate change and reductions in sulfur deposition are interacting and driving these changes. In particular, data from the US National Park Service lake monitoring program reveal that water clarity increased in lakes of Acadia National Park (Maine, US) from 1985 to 1997, but has now been declining since 1997. These changes are particularly noteworthy in Jordan Pond, the clearest lake in the park and Maine. Concentrations of dissolved organic carbon have increased since 1997 in Jordan Pond, while no consistent changes in chlorophyll have occurred. To better understand the causes of rapidly changing water clarity in Jordan Pond, we have implemented a new sensor buoy into the lake that collects a suite of physical (temperature, PAR), chemical (CDOM, oxygen, pH, conductivity), and biological (chlorophyll) parameters every 15 minutes from early spring to late autumn. These data are being coupled with those from a weather station mounted nearby to assess drivers of lake response.

10. *Dietmar Straile[1], Frank Peeters[1] and Karl-Otto Rothhaupt[1]*

Long-term ecological research at Lake Constance – from basic research to ecosystem services

[1]Limnological Institute, University of Konstanz, Germany

This new site presentation gives an overview of Lake Constance as a place of limnological research since more than one century. Lake Constance is a large and deep lake bordering Germany, Switzerland and Austria. Limnological research started in the 1890 under the head of François-Alphonse Forel, the founder of limnology. These introductory studies already aimed at a complete limnological overview of the lake including its physics, chemistry and biology. The establishment of 2 limnological stations in the 1920s at the shores of the lake intensified limnological investigations. Recognition of environmental change (eutrophication) after the 1950s resulted in massive investment into sewage plants. As a consequence of sewage plant establishment oligotrophication started in the 1980s and the lake has returned now to phosphorus concentrations typical for the 1950s. The development of the lake has been monitored intensively since the 1950s, which allows in- depth analyses of environmental change effects on plankton communities.

88. Orlane Anneville[1], Gaël Dur[1], Emily Nodine[2], Jason D. Stockwell[2], Bastiaan Ibelings[3], and Sami Souissi[4]

Storm-Blitz: Tracking storm effects on the phytoplankton community using hierarchical clustering and Bayesian probabilities, example from Lake Geneva

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Physical and chemical properties of the pelagic habitat set the requirements of organisms to be able to live or fail. At the scale of the year, temporal changes in these properties induce a change in the pool of species better adapted and likely to outcompete. Consequently, phytoplankton composition evolves according to a pattern that repeats annually. However, this pattern of succession can be disrupted by environmental disturbances associated with changes in meteorological conditions. The present study focus on one of the time series gathered in the framework of the Storm-Blitz project that aims at investigating the impact of storms on phytoplankton communities. We used a method based on hierarchical clustering and Bayesian probabilities to examine long-term (37 years) variability in the seasonal pattern of phytoplankton succession in Lake Geneva. We identified phytoplankton assemblages and analyzed their probability of occurrence to evaluate their temporal dynamic and sensitivity to changes in environmental conditions. We showed that 1) the seasonal patterns of assemblage succession presented important changes over the years in response to both human activity and regional climatic changes, 2) this analytic method underlined mid-term variability in the dynamic of occurrence of phytoplankton assemblages, 3) this mid-term variability reflected the vulnerability of a system where advantages among different species switch continually in responses to changes in habitat opportunities, and finally 4) specific analysis of mid-term variability may help to evaluate the impact of storms on phytoplankton community.

89. *Lisette N. de Senerpont Domis [1], Orlane Anneville[2], Stefan Bertilsson[3], Jennifer Brentrup[4], Justin Brookes[5], Louise Bruce[6], Cayelan Carey[7], Ken Chiu[8], Jesper Christensen[9], David de Motta Marques[10], Elvira de Eyto[11] Evelyn Gaiser[12], Nicole Gallina[13], Sam Fey[14], Paul Hanson[15], Nicole Hayes[4], Amy Hetherington[16], Lindsay Hislop[17], Bas Ibelings[18], Kersti Kangro[19], Lesley Knoll[20], Alo Laas[19], Valerie McCarthy[21], Beth Mette[4], Adam Mulvhill[11] , Kohji Muraoka[22], Emily Nodine[23], Marie Perga[2], Anna Rigosi[5], Jim Rusak[24], Elizabeth Ryder[21] Arianto Santoso[22], Giulia Valerio[25], Chaturangi Wickramaratne[5], Yang Yang[26], and Vicky Veerkamp[21]*

Spring Blitz: Linking changes in water stability to plankton diversity

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[24]Dorset Environmental Science Centre, Canada
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[26]Uppsala University, Sweden

The Spring Blitz is a coordinated effort from researchers around the world to link changes in water stability during the onset of stratification to plankton stability. This project makes use of the GLEON network of lake sensors in lakes differing in stratification regime, testing whether lakes with strong stratification in spring develop higher plankton diversity, due to an enhanced spatial heterogeneity favouring the growth of various species and limiting exclusive competitions. The main aim of this project is to study the role water column stability plays in determining plankton diversity in lakes.

An intensive sampling campaign was undertaken by GLEONites in the northern hemisphere during March – June (2013) and in the southern hemisphere spring blitz from September –November 2013. All total of ten lakes have been sampled just before and after the onset of a stable thermocline, although some European and Canadian sites experienced an unusual prolonged winter. Sampling occurred twice a week, using a standard operational procedure we developed to address the specific questions asked in this study. We will present preliminary data on this huge sampling campaign, covering phytoplankton, zooplankton, microbial plankton and abiotic parameters.

90. Eric O. JOHNSON[1]

How to Form a Form – the Art of Data Collection

[1]University Libraries, Miami University, Oxford, Ohio, USA

Data collection is an important part of our research. Often performed by volunteers, the tools utilized need to be simple and easy to use while at the same time fostering accurate and complete recording.

Focusing on techniques others can use to create or improve data collection forms, this talk will describe principles of design that helped improve the accuracy of both paper and electronic data collection forms used by Craig Williamson's team.

We will then showcase our current data collection software, highlighting specific features that improve collecting accuracy. This software goes beyond typical collection methods, providing color coded interactive, localized guidance and error correction to the data collector. Data collection is also integrated into the research workflow, automatically being validated and uploaded into a central database with metadata, ready for the researchers to analyze.

Students who have been collecting data will share their experiences using the software, suggestions for improvements and be available for questions.

91. Carolyn Maxwell[1], Leon Barmuta[2], Matthew HIPSEY [3]

Monitoring the resilience of the great lakes of Tasmania

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A considerable number of natural and altered lakes exist in the upland region of Tasmania, Australia, and many are connected for the purpose of supporting a substantial hydropower generation scheme. They support a rich biota, but are subject to extensive water level manipulation. Which lakes recover from fluctuations in water level and which do not? Manipulations of water levels in lakes can induce changes in trophic structure and water quality and we will develop robust ways of forecasting how lakes will respond to changes in manipulations of water levels, to minimise extinctions and maintain aesthetics and water quality. This is done through integration of sensor data and models, exemplified for Great Lake and Woods Lake.

92. *Zofia E. TARANU[1], Pierre LEGENDRE[1], Irene GREGORY-EAVES[2], and Marieke BEAULIEU[3]*

Modeling algal toxin concentrations in a changing world: the importance of cross-scale interactions

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Several factors are believed to determine the concentration of cyanobacteria in lakes. In particular, eutrophication and climate warming are suggested to be driving a global expansion of cyanobacteria in freshwater ecosystems. This is cause for concern not only because of the substantial economic loss it entails, but also because cyanobacteria are known to produce harmful neuro- and hepatotoxins. Importantly, although strong local-scale cyanotoxin models have been described, modeling the abundance of microcystin (a group of cyanotoxins), across broader spatial scales has been difficult and production remains highly dynamic through space and time. For instance, at the local scale (southern Québec lakes), 46% of the microcystin variance was explained by explanatory variables, whereas a meta-analysis developed across Canadian lakes explained far less variance (10% explained). Such scale dependencies may be due, in part, to interactions between processes across different spatial scales (defined as cross-scale interactions), where overarching regional drivers cause local-scale relationships to differ. The goal of this project was thus to develop robust microcystin response models that account for these cross-scale interactions. To address this objective, we analyzed a dataset of >1000 randomly selected lakes, ponds, and reservoirs sampled by the U.S. Environmental Protection Agency (USEPA) and applied generalized zero-inflated mixed-effect models, which effectively modeled the large number of sites with microcystin concentrations below the detection limit, allowed for local relationships to vary by region, and tested the cross-scale interactions among environmental drivers.