GLEON 14 Poster Session

Tuesday 16th October

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ARTHUR - Aquatic Resource Tool for High-frequency Underwater Research: assessing sentinel responses of lakes to climate change.

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Automated sensor platforms are becoming increasingly valuable tools to understand the sentinel responses of lakes to climate change. Based on the recent development of a novel, small, portable buoy, we have designed a profiling buoy that can be deployed in the smaller lakes that dominate the distribution of lakes worldwide. A new winch system, which uses a single lay wheel, relies on wireless technology to allow a suite of sensors to collect high frequency data at multiple depths without requiring an additional electric cable. The instrument array includes sensors capable of capturing phytoplankton community indicators, dissolved organic carbon dynamics, changes in transparency, mixing processes, and oxygen depletion, as well as sensors aiding in the calculation of heat fluxes and water budgets. This unique integration of different sensors advances the field by seeking to use the latest technology to study some of the many interconnected processes that occur in lakes.

During the summer and fall of 2012, ARTHUR, the profiling buoy, was deployed in Lake Lacawac, a moderately dystrophic lake in northeastern Pennsylvania. Preliminary data show the advantage of night profiles to avoid non-photochemical quenching, often an issue when using fluorescence sensors. The automated profiling also allows for storm event monitoring where abrupt changes in the micro-stratification of lakes can have significant impacts on aquatic organisms. Advanced sensor technologies that enable full vertical profiling are necessary to fully characterize the response of lakes to climate change and other natural or human disturbances.

Now what? – What can be done for correction of sensors errors?

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With technological advances, equipment for remote monitoring of environments that are able to collect and store high-frequency data have become broad spread. The large amount of automated data requires increasingly care about the QA/QC protocols. The large datasets generated make difficult to visualize errors / outliers. Two factors that combined to lack of training and of knowledge of the functioning of the sensors may result in delay in the perception of flaws. It leads to questions: Does data can be corrected after collection? It would be scientifically valid to use mathematical and statistical tools to recalibrate the values already measured? How to do this? In a Brazilian lake, some temperature sensors deployed on instrumented buoys began to show different values than expected. But these errors were noticed only after a few months of data collection. The analysis of what happened was made by comparing the values measured by the problematic sensors and profiles made monthly with the Hydrolab probe. It was observed that, despite differences in the absolute values, patterns over time are similar. Based on these observations, our proposal is to evaluate whether the sensor error can be estimated from the monthly data from the Hydrolab and from a recalibration. For that, the sensors will be placed in stable conditions with different known temperature values and the difference between the measured value and the actual value, along with the differences from the measurements with the Hydrolab will be used to establish a correction factor of the data.

The use of whole lake metabolism can enhance our understanding of algae composition and the nature of blooms - a case study of lake restoration and metabolism

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After centuries of pollution with nutrients and decades of decreasing nutrient loadings a hypereutrophic Danish lake was restored using phosphorus precipitation and biomanipulation. Phosphorous concentration and planktivore fish was significantly reduced after the treatment but due to a warm summer the following year there was no significant improvement in summer Secchi depth (mean 0.6 m) while the lake was still dominated by cyanobacteria. Two years before and 3 years after the restoration the lake was intensively monitored with high frequency measurements of dissolved oxygen, temperature and weather while nutrients and chlorophyll was measured biweekly. The combination of these data made it possible to analyze which biotic and abiotic parameters that had the greatest impact on chlorophyll concentrations and showed that the phosphorous precipitation had been insufficient and hence changes in TP only had insignificant effect on chlorophyll a concentration. On the other hand water column stability, species composition and most likely biomanipulation had a significant effect on the chlorophyll level. A semi-quantitative estimate of loss rates of primary producers to higher trophic levels or sedimentation showed that stable water column enhanced the dominance of K/S strategists with low loss rates while unstable water column in general gave dominance of r strategists with high loss rates and hence lower biomass and improved Secchi depth.

Global warming or eutrophication, which should be blamed in Lake Taihu?

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Recently, climate change has also been found to be associated with blooms. To elucidate the contributions of both eutrophication and climate change to the events of cyanobacterial blooms (i.e., the onset time, magnitude and annual duration), we assessed the contributions of climate variables to the events of blooms using several kinds of models. Climate variables included mean spring air temperature, accumulated water temperature in spring and hot and calm days (HCDs) in a specific year. Results of General Linear Models show that the phenological changes of blooms at an inter-annual scale are more strongly linked to mean spring air temperature than mean spring total nitrogen concentrations during last two decades. Additive models indicated that accumulated water temperature in spring contributed more than mean nutrients concentrations to Microcystis biovolume and its relative dominance in spring. However, HCDs and annual total nitrogen concentrations contribute roughly equally to blooms durations. Our results indicated that global warming, in particular warming spring, contributes more to blooms phenology in eutrophic lakes in subtropical area. Climate change, in particular decreasing wind speed, and eutrophication may extend the duration of blooms equally. The reason might be that warming tolerances for Microcystis is very low in subtropical zone in spring. Hence, they were more sensitive to climate change when nutrients were not limited. As nutrients are prerequisite for heavy cyanobacterial blooms, nutrient concentrations may have to be reduced substantially from present values in many lakes if cyanobacterial dominance is to be controlled in a future warmer climate.

Keywords: climate change; cyanobacterial blooms; spring; accumulated water temperature;

Linking surface pCO_2 and total CO_2 mass temporal dynamic to morphometry and weather events in two boreal lakes

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Worldwide lakes are known to be supersaturated in carbon dioxide (CO2) with respect with the atmosphere. To date, this excess CO2 is assumed to be mostly produced by the biological processing of terrestrial organic carbon. Temporal CO2 dynamics have, on the other hand, showed different patterns within lakes along the seasons. Spring and autumn mixing usually causes higher fluxes to the atmosphere, releasing CO2 that was either accumulated under ice or in the summer hypolimnion. However, environmental driver like hydrological summer events are likely to reshape those known patterns. This study aimed to clarify the short-term response of CO2 dynamic and its related flux to the atmosphere to environmental drivers in two morphologically different boreal lakes. Using automated measurements together with punctual profiles, we reconstructed time-series of both surface pCO2 and lake total CO2 mass from July to October 2011. We observed a rapid increase of total CO2 mass in response to hydrological events in the shallow lake but no clear response in the deeper lake. Our results suggest that shallow and unstable lakes seem to be more sensitive to hydrological events, bringing additional CO2 for the catchment, thus increasing total CO2 mass and fluxes to the atmosphere. Deeper and more stable lakes seem to be less sensitive to those events, retaining its CO2 in the hypolimnion throughout summer, and resulting in constant but lower CO2 fluxes to the atmosphere.

The daily variation of metabolism in the littoral and pelagial zones of an eutrophic lake

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The study was conducted on Kortowskie Lake located in the city of Olsztyn (Masurian Lake District, Poland), in thirteen-day cycles during summer 2010 year in the littoral zone and in the deepest part of the lake – in the pelagial zone. Primary production and respiration was determined by light and dark bottles, physico-chemical parameters of water according to Standard Methods.The results showed a daily variation of metabolism in both zones, but the dynamic of changes in the pelagial was higher. The high statistical correlation between the metabolism and the organic carbon concentrations was found in the pelagial zone. Organic carbon content was inversely proportional to the diurnal fluctuations in primary production. The large amount of organic matter as a result of increased activity of phytoplankton observed in the early days of the experiment caused the increase in the TOC and POC concentrations in consecutive days. The newly produced organic matter was rapidly mineralized, which was confirmed by the cyclical decline in organic carbon concentrations. CO2 as a product of these changes re-intensified the photosynthesis processes, which was indicated by the increase in production simultaneously with the decrease in TOC in the last days of the survey period. Processes of production and decomposition of organic matter in the pelagial zone were cyclical (changes took place every 5 days). A similar relationship was not detected in the littoral.

This study was financially supported by the NCN (grant No N N 523 613739).

Effect of a different aluminum coagulants on phosphorus inactivation in water of hypertrophic lake - experimental studies

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The study was conducted by using a system of 6 experimental glass containers filled with 21 L of lake water each. One container was treated as a control sample (without coagulants), whilst the coagulants were dosed to the others. Different types of aluminum coagulants (PAX 25, PAX XL 60, PAX XL 19H, PAX 18, ALCAT) applied around the world were used in the experiment. Coagulant dose was calculated according to the literature data and preliminary experimental studies. The volume of an added coagulant was converted into an equivalent aluminum dose (7.5 mg Al 3+/ L). The experiment was conducted in two five-day cycles: aerobic phase (with using the surface water from the hypertrophic lake) and anaerobic phase (water from the anaerobic hypolimnion). The experiment was carried out in 3 replications. The experiment results have shown a variation in the rate and ability phosphorus binding depending on the coagulant type, and the research phase. The best properties of the phosphorus precipitation have had ALCAT and PAX XL 19H coagulants. Additionally, in both cases, the pH values were stable during the experiment. It is very important element for proper coagulant dosage into lake water in the technical scale. ALCAT also caused the greatest turbidity reduction during aerobic phase and similar to PAX XL19H was characterized by a rapid rate of flocs formation and its sedimentation. Both types of coagulants - ALCAT and PAX XL19H can be used for effective phosphorus elimination from the water column of analyzed hypertrophic lake.

Temperature mediated biotic interactions strengthen enemy release of non-native species in warming environments

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Climate change and the success of non-native species are among the most economically and ecologically consequential threats to global biodiversity and ecosystem services, yet the nature of their relationship remains unclear. Invading species often suffer to a lesser degree than native species from interactions with pathogens, parasites, herbivores, or predators due to a lack of shared coevolutionary history. Here, we develop a theoretical model to evaluate the extent to which the "enemy release" experienced by invaders depends on temperature. We found that increasing temperatures strengthen the benefits of enemy release for an invading species when 1) a shared enemy has a higher thermal sensitivity than its resources, 2) the enemy's thermal maximum for consumption is higher than resources' maxima for growth, or 3) the invading resource has a higher thermal maximum for growth than its native competitor. Using a mesocosm warming experiment, we empirically tested model predictions for a system where enemy release exists and which satisfies model criteria: the invasive crustacean zooplankter, Daphnia lumholtzi experiences reduced predation from juvenile Lepomis sunfish relative to native Daphnia pulex due to morphological defenses. Mesocosm results supported model predictions that D. lumholtzi would benefit more strongly from the presence of Lepomis predators as temperatures increase. Given these corroborating empirical results, this study indicates that climate change can directly enhance the success of certain non-native species due to an increase in enemy release and generates a predictive framework for forecasting the community consequences of biological invasions in a warming world.

Sauce grande shallow lake water temperature estimation using satellite data

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A high number of shallow lakes characterize the Pampean plain of the Buenos Aires province (Argentina). Sometimes it is difficult to access to them in order to obtained simultaneously measurements. Therefore, alternative tools are needed to obtain a systematization of the data that will allow the study of spatial dynamics. In the literature many works prove that satellite data is an exceptional tool for acquiring information about lakes parameters with an adequate spatial, spectral and temporal resolution. The aim of this study is to estimate and validate the temperature of the water in the Sauce Grande shallow lake from Enhanced Thematic Mapper Plus (ETM +) and Thematic Mapper (TM) sensors and in situ measurements recorded with a buoy. Eight satellites images were used to calculate the Sauce Grande water temperature using the radiative transfer equation estimating atmospheric parameters (transmissivity, up and down radiance emitted by the atmosphere) with the MODTRAN 4.0 code. The results showed a BIAS of -0,7 ° C and a standard deviation of 0,8 ° C for combination TM / ETM +. The correlation between the measured water temperate from the buoy and the temperature calculated from satellite sensors were high. An equation was obtained for the Sauce Grande shallow lake to estimate water temperature from satellite data.

Keywords: water temperature, Landsat, buoy, Sauce Grande shallow lake.

Aquatic metabolism in tropical lakes using high-frequency data.

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The most studies about lakes metabolism and their drivers are related to temperate regions. This research aims to assess the tropical lakes metabolism and to evaluate how morphological, limnological and catchment aspects affect them. For this we chose 11 lakes in the middle Rio Doce basin. Six of these lakes are located within the environmental protection area Parque Estadual do Rio Doce (PERD) and their catchment areas are formed by Atlantic forest. The catchment area of others 5 lakes are formed by eucalyptus and pastures. For this, a buoy was installed in the central portion of 11 lakes with oxygen sensor and temperature, performing measurements of these parameters every 15 minutes in the mixed layer. The buoy is left in the lakes for 6 days during two rainy and dry seasons. We also measure Dissolved oxygen, pH, conductivity, turbidity and temperature profiles with the Hydrolab probe and evaluate the nutrients, dissolved organic carbon, chlorophyll-a and suspended solids concentration. Until now we made two fieldworks. For the rain season, most lakes presented heterotrophy liquid, specially the lakes with impacted catchment areas. Although we observed a trend of difference in metabolism between the lakes located within the PERD and the others, is too early to assert their trophic state and the factors responsible for its metabolism. With the realization of the analysis of physical, chemical and morphological parameters we expected to have more robust responses to the issues raised in the project.

Will Lake Geneva turn “red” in the future? A possible scenario for the development of the cyanobacterium Planktothrix rubescens

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Among the multiple forms of cyanobacteria, the phycoerythrin-rich species Planktothrix rubescens is well adapted to temperate, deep and large lakes. In Lake Geneva (the largest lake of Western Europe), the biomass of this filamentous and microcystin-producing species has become the dominant cyanobacteria species during the last decade. Air as well as water temperature influences on the occurrence and development of cyanobacteria are also particularly relevant to consider in the context of the climate global change, which may be particularly marked for lakes in the Alpine region, with a rate of warming twice as large as the global average. The impact of climate change on the cyanobacteria, especially P. rubescens, was analysed through two different approaches, by using extreme air temperature events as a proxy for future climate and the Multi Adaptive Regresssion Splines (MARS) model to predict future P. rubescens biomass. These methods allowed us to figure out whether Lake Geneva will turn red (owing to the color of P. rubescens) by the end of this century. The outcomes strongly suggest that cyanobacteria may gain in contribution by respect to the total phytoplankton community. Moreover, following expected temperature increase, the biomass of P. rubescens could be 30% more important by the end of this century, provided nutrients remain in the same range level. Additionally, the results point out that spring is the key season, during which air temperature and nutrients become the determinant factors for cyanobacteria outbreaks for the following seasons.

Preliminary performance assessment of ARTHUR – Aquatic Resource Tool for High-Frequency Underwater Research for assessing sentinel responses of lakes to climate change.

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We report tests of a new solar-powered profiling buoy (described by Brentrup et al.) that can be deployed in the small lakes and reach 15m depth. Our objective is to track lake ecosystem response to both storm events and gradual changes with high spatial and temporal resolution.

The surface buoy package includes a "smart winch", radio, meteorology sensors, radiation sensors (incident LI-COR PAR + Kipp & Zonen NR-lite net LW+SR radiation). Attached to the buoy is a string of T sensors and a vented P sensor (Design Analysis H310) anchored on the bottom. The underwater instrument package includes a YSI sonde, Turner Designs C6, and LI-COR PAR sensors. This unique combination of physical, chemical, and biological sensors enables studies of energy & water budgets, mixing, metabolism, phytoplankton community properties, and DOC dynamics in aquatic ecosystems.

Data from Lake Lacawac in northeastern Pennsylvania since June 2012 are compared with an existing long term monitoring platform on the lake (excellent agreement, although some temperature sensors are locating at non-matching depths). We are still working to determine if power, bandwidth, or data storage are limiting the vertical resolution (currently 1m intervals but 0.1m would be better). We must be able to validate signals from slow sensors (pH & dissolved O2) by recording time series at selected depths. To use underwater PAR sensors for KdPAR and as a proxy for UV transparency in combination with CDOM fluorescence, we need to match readings from the incident PAR sensor with the pair of underwater PAR sensors.

Comparing nutrient limitation in chlorophytes and cyanobacteria under contrasting conditions of nutrient supply, nutrient ratios and light

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Eutrophication has been linked to increased concentrations of cyanobacteria toxins, taste and odor problems in drinking water, decreased shoreline property value, surface scums that lessen aesthetic value, and bottom water hypoxia that causes fish kills. Minimizing the damages of eutrophication by controlling nutrient inputs will re-structure phytoplankton communities. We were interested in how the relative supply of nitrogen (N) and phosphorous (P) affects phytoplankton community composition, and nutrient limitation of the assemblage as a whole, and of two taxonomic groups (chlorophytes and cyanobacteria). To address this, we manipulated P supply rates, N:P ratio, and light levels in a 6-week mesocosm experiment and quantified the effects on phytoplankton community. We also measured nutrient limitation with short-term bioassays, after the communities had responded to the experimental treatments. We hypothesized that phytoplankton biomass would be highest under high P-supply, N limitation would be strongest under low light, high P, and low N:P, and that cyanobacteria would be less N limited than chlorophytes.

Phytoplankton biomass was higher under elevated P-supply than low P-supply ($p<0.001$). Light had main and interactive effects on cyanobacteria biomass, with reduced abundance in high light, low nutrient treatments during the final week of the experiment. Chlorophytes comprised the majority of the phytoplankton community, and their response to nutrient limitation was similar to the whole community response. Contrary to predictions, chlorophytes were not more N limited than cyanobacteria. Light, P supply, and N:P ratio had measurable and group-specific effects on nutrient limitation.

Nowcast now! Use of High- Resolution Sensor Data for Nowcasting Escherichia coli Beach Contamination Above Regulatory Limits at Hourly Time- Scales

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Lake Michigan, one of the five Great Lakes of North America, is the only Great Lake located entirely within the United States. The multi-billion dollar annual economic contribution of the lake is largely hinged on the continued health of its fisheries, beaches, and continued use as a drinking water source for many lakeshore communities. Unfortunately, some of Lake Michigan's beaches are annually ranked as having the highest levels of Escherichia coli in the country by the National Resources Defense Council. Through a multi-institutional partnership, we sought to examine E. coli variability in near-shore waters of some of the most popular recreational beaches in Milwaukee, Wisconsin for purposes of testing a recently developed Nowcast model. Composite water samples were collected daily, June – August 2012 at three City of Milwaukee designated public beaches -Bradford Beach, McKinley Beach, and South Shore Beach. Beach sanitary condition surveys were conducted simultaneously according to USEPA specifications. As required by USEPA, E. coli was enumerated using Standard Methods 8001, which requires an 18-hour incubation period. A total of approximately 180 samples were taken from the three beaches. Bacteriological results showed significant temporal variability in E. coli concentrations at each beach on a daily basis (coefficient of variation >1). Furthermore, results from sub- daily sampling show E. coli concentrations may vary by orders of magnitude between morning, mid-afternoon, and evening periods. Given this variability, the Nowcast model was tested to predict E. coli levels at Bradford Beach using automated land- based and buoy weather station data as model input drivers. The results suggest that hourly predictions of E. coli levels at beaches above regulatory limits may be possible, particularly if accomplished in conjunction with same-day molecular tests such as the quantitative Polymerase Chain Reaction method. The use of Nowcast could potentially assist public health agencies and local jurisdictions in assessing beach water conditions more accurately including improving timely posting of water quality advisories if necessary.

Modeling climate change impacts on the thermodynamics of Oneida Lake: Applications of a Dynamic Reservoir Simulation Model

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Substantial change in climate is predicted to occur across the globe this century. Understanding climatic impacts on lake ecosystems is highly relevant as they will have important effects on eutrophication, ecosystem processes, and aquatic biodiversity. Field-based monitoring and modeling were used to evaluate the impacts of predicted climate change on Oneida Lake temperature profiles and stratification. Oneida Lake is a 207 km2 shallow, polymictic lake located in the center of an extensive 3,500 km2 watershed in Central New York, USA. Field data were collected on stream and groundwater temperature loading, weather, and lake temperatures at varying depths. Downscaled climate data from three general circulation models and two emissions scenarios and maximum projections were used to assess the impacts of different anticipated climate scenarios on the lake for 2050 and 2099. Lake temperature profiles under historic and anticipated conditions were modeled using a deterministic, one-dimensional model, DYRESM. The sensitivity analysis confirmed the importance of meteorological variables, including solar radiation and wind speed, as drivers to the thermal regime of the lake. Climate change analyses indicated 2m and 10 m temperatures and length of stratification will increase from between 2.5°C to 6.2°C and 13 to 15 days by the end of the century depending on the scenario. This study contributes to our understanding of the thermal regime of Oneida Lake in a warmer world and provides a starting point for broad-scale predictions of the effects of climate change on the thermal structure of the majority of global freshwater lakes.

Spatial and Temporal Variability of Lake Ecosystem Metabolism in Large and Shallow Temperate Lake

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The aim of the current study was to comprehensively characterize spatial and temporal variability of net ecosystem production (NEP), gross primary production (GPP) and community respiration (CR) over year 2011 ice-free season in large and shallow Lake Võrtsjärv (Estonia) using high-frequency measurements. Based on chemical, physical and phytoplankton data collected from 10 monitoring points, Võrtsjärv can be divided into two distinct parts: the narrow southern part (forming only 2% of the lake's total area) and the homogeneous Võrtsjärv Proper.

Data for this study were collected from these two different parts of the lake. Our buoy (centre station - CT) measures chemical and physical parameters as well as weather parameters near the deepest point of lake, which is characterised by the lowest average variability in long term monitoring and being representative for more than 90% of the lake aquatory. Monitoring platform (south station - ST) for metabolis studies was placed to the narrow southern part of the lake.

Mean pelagic NEP in CT was estimated to be 0,23 mmol O2 m–3 d–1 and -3,08 mmol O2 m–3 d–1 in ST. There were no high differences in seasonal NEP between the two parts of the lake . However calculated rates of metabolism varied strongly: mean GPP in CT was estimated to be 44,43 mmol O2 m–3 d–1 and 64,14 mmol O2 m–3 d–1 in ST; mean pelagic CR in CT was 44,21 mmol O2 m–3 d–1 and 67,22 mmol O2 m–3 d–1 in ST. Therefore mean seasonal GPP and CR for norrow southern part of the lake were for 1/3 higher than the seasonal means of Võrtsjärv Proper.

A regional analysis of the effects of Tropical Cyclone Irene on lake ecosystems across northeastern North America

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Tropical cyclones are known to disrupt thermal structure and biological production in individual lakes and estuaries, but little is known about the immediate ecological impacts in lakes across the landscape. This study presents the regional impact of Tropical Cyclone Irene on thermal structure and ecosystem metabolism in nine lakes affiliated with GLEON. The lakes span a gradient of lake morphometry and watershed characteristics. We show that thermal stability declined 9-100% in all lakes within 48 hours after the storm. The magnitude of change was related to storm intensity, measured as minimum barometric pressure, but also to the total amount of rainfall that fell in the watershed relative to the lake's volume (potential volume replacement) suggesting that loading of water to lakes from the watershed was an important driver of the change in stability. Storm impacts on respiration and net ecosystem production were not related to storm magnitude or lake characteristics. However, across lakes, several patterns suggest that after Irene, terrestrially-derived material increased in importance as a carbon source for metabolism. Climate models predict that this region will experience an increase in intense rain events and results from this study suggest that mitigation of and adaptation to extreme events must take into account catchment and lake characteristics when estimating the timing, magnitude, and potential influences of water and other material fluxes into aquatic ecosystems.

Acoustic detection of diel vertical migration of freshwater zooplankton: integrating automated acoustic technology with current buoy platforms.

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Automated buoys with advanced sensors in lakes generally focus on characterizing physical and chemical variables, or some measure of biological presence or activity such as chlorophyll or dissolved organic matter. Yet higher trophic levels can have important effects on aquatic ecosystems. Zooplankton diel vertical migration is a well-described and ecologically important phenomenon. Traditionally, zooplankton diel vertical migration has been studied using net tows and other direct sampling techniques. While providing valuable information on the species composition and densities of the zooplankton in the water column these techniques only provide a snapshot of zooplankton vertical position. We used a 710 kHz transducer to observe real-time in situ vertical migration of zooplankton in a small freshwater lake in Eastern Pennsylvania, USA. Acoustic backscatter corresponded well to biovolume measurements of samples collected with zooplankton net tows. We were able to observe the movement of the zooplankton population from an aggregation deep in the water column to a more uniform distribution at night with a majority of the population moving towards the surface. Acoustic transects of the lake also showed a high degree of horizontal heterogeneity of the zooplankton population and could be used to shed light on horizontal movements of zooplankton populations. Automated, continuous or semi-continuous acoustic sampling is often employed in marine systems and our results suggests that this technology may be integrated into current high frequency freshwater data collection either through a buoy or bottom-mounted acoustic transducer, options that we discuss here.

Functional heterogeneity of heterotrophic microbial communities in a subtropical shallow lake

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Aquatic microbial communities are important components of aquatic metabolism, being able to transform net primary production and transfer nutrients via microbial loop. We evaluated the functional diversity of heterotrophic microorganisms to understand how environmental changes (seasonal and on the vertical profile of the lake) could affect these communities in a coastal and large subtropical shallow lake located in southern Brazil. Functional diversity was defined as consumption patterns of known carbon sources. Environmental variables and functional traits of the heterotrophic microbial community differed among seasons, but not along the vertical profile. The seasonality of functional traits was marked by different indicator substrates in each season. In this way, seven carbon sources, mainly carbohydrates, were significantly associated to summer, while six indicator substrates of several biochemical guilds were associated to winter. Finally, two carboxylic acids and one polymer where related to autumn. The redundancy analysis showed that the indicator substrates were significantly related to environmental characteristics of each season. That is, the pattern of seasonal use of substrates was related to environmental variables such as temperature, chlorophyll a, dissolved organic carbon, pH, humic substances ratio and nutrients. The use of substrates be related to environmental changes suggests that the functional heterogeneity was a result of the seasonal changes shaping the microbial communities to change their functional traits as an alternative to adapt in the environment.

Wind force – stratification interaction time lag depends on lake morphology

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Density stratification in lakes influences an array of biogeochemical processes. The effect of wind energy on stratification usually involves a time lag. The mechanisms responsible for this concept are generally accepted, but have not been well quantified. This study examined on wind shear stress with emphasis on determination of the relationship between lake morphology and the scale of wind driven energy inputs. High frequency (< 1 hour interval) thermistor measurements from five lake were investigated; Lakes Feeagh (42 m depth, 3 km^2 surface area, the USA), Rotoehu (13.5 m, 7 km^2, NZ), Rotorua (26 m, 47 km^2, NZ), Taupo (160 m, 616 km^2, NZ) and Sparkling (20 m, 0.6 km^2, Ireland). The Lake Analyzer software applied to calculate lake physical stability metrics, Schmidt Stability using temperature and hypsographic curve. Schmidt stability was used as the response variable of the wind stresses. Unique sensitivity analysis was carried out for both scale of wind speed and scale of temporal representation of wind speed. We found that the morphological feature of the lakes was correlated with the time required to weakening of the stratification as described by Schmidt stability decline.

Phytoplankton primary production: a tale of two methods

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High-frequency lake sensor measurements allow for comparisons between traditional versus new limnological methods that incorporate variation at finer time scales. Phytoplankton primary production (PPr) is commonly quantified to understand processes such as eutrophication and food chain efficiency. We compared net primary production (NPP) using high-frequency sonde data (every 15 minutes) versus traditional methods (14C uptake, biweekly) in a hypereutrophic reservoir (2010-2012). We estimated gross primary production (GPP) using the free-water dissolved oxygen method and used estimates of phytoplankton respiration to convert GPP to NPP. We also evaluated whether phytoplankton community composition explains production:phytoplankton biomass using weekly spectrofluoroprobe measures of composition. NPP from the two methods was highly correlated at the daily, weekly, and monthly scale ($p<0.0001$), with much variability at the daily scale. Since the free-water method uses frequent measurements, it is able to capture fine scale variability that biweekly measurements of 14C PPr miss. However, with weekly means much of this variation disappeared, and the trends largely mirrored those of 14C PPr, suggesting that in many cases biweekly 14C measurements sufficiently describe overall trends in production. Although PPr was significantly correlated with total phytoplankton biomass, there was much variation in this relationship ($r2=.25$, $p=0.0144$). The community composition of the phytoplankton impacted this variation, with % composition of chlorophytes affecting 18% this observed variation ($p=0.04$). These results suggest that although we miss the fine scale variability with biweekly measures of PPr, these measures still give a good overall picture of production trends.

Diatom community assemblage changes following Tropical Storm Debby in a southwest Florida watershed: applications to understanding long-term tropical cyclone dynamics

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Florida coastal ecosystems are highly sensitive to changes in fresh water influx driven by tropical cyclone activity, changing climate cycles such as the Atlantic Multidecadal Oscillation and El Nino, and water management practices. Changes in freshwater flow drive changes in water chemistry that affect the composition of diatom communities because different species have different tolerances for environmental variables like salinity and nutrient availability. The goal of this research is to identify changes in diatom community dynamics that can be used as a signal of tropical storm activity and detected in long-term sediment records.

Phytoplankton and water samples were collected across the Charlotte Harbor watershed, on Florida's southwest gulf coast, to capture the gradients of environmental conditions found in the watershed. Samples were collected from 50 sites during the dry season following several years of little tropical storm activity, and again from a subset of sites that capture much of the variability in the watershed after Tropical Storm Debby of June 2012. TS Debby dropped as much as 20 inches of rain in parts of Florida and caused substantial flooding. Diatom community responses were highly variable across sites, but generally storm-induced changes are discernible. These results will be applied to long-term analysis using sediment cores from Charlotte Harbor to detect past tropical storm activity.

The Global Lake Temperature Collaboration (GLTC)

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The "Global Lake Temperature Collaboration (GLTC)" – similar to GLEON – is a grassroots network of limnologists, climatologists, and remote sensing scientists that are working toward the common goal of better understanding our world's lakes. GLTC research focuses on the patterns, mechanisms, and impacts of long-term changes in lake temperature, as recorded by satellite and in situ sensor networks. The motivation for the collaboration stems from recent studies that have found lakes to be warming rapidly – some at a greater rate than that of the ambient air temperature. The GLTC initiative was launched in the fall of 2010 with the recruitment of participants and lake datasets. Since that time, the group has grown to over 50 collaborators from 15 countries, and an all-scientists workshop was held in June of 2012 at the University of Nebraska-Lincoln to analyze datasets and discuss project goals, publications, and education / outreach activities. This poster will provide an introduction to the GLTC project, as well as outcomes from the recent workshop. Currently, 17 GLEON members are participating in the GLTC effort, and we encourage other GLEONites to join us and contribute ideas and datasets to this exciting, new initiative.

Temporal and spatial heterogeneity of plankton and fish communities in a coastal subtropical lake

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Biological communities change in time and space following driving pressures from differences in habitat structure, resource availability, interspecific competition, predation and other factors. As such processes, communities change along and patterns are created in time and space. In this study we analyzed changes in the temporal dynamic of plankton and fish communities in a subtropical lake, focusing on the spatial and temporal distribution, species composition and biomass of plankton and fish. Mangueira is a large shallow subtropical lake (90 km long; 820 km2) in Southern Brazil coastal plains. Limnological and biological data were collected in two sampling points located in northern (N) and southern (S) extremes of Mangueira lake, both in the littoral zone. Secchi transparency, DOC and chla were driving factors related to this spatial heterogeneity. Plankton biomass (chla, bacterioplankton and zooplankton) and fish captures were different seasonally in north, while in south, only chl a presented a seasonal significant variation. Important differences in fish structure of Mangueira Lake were identified. Invertebrate eaters were the dominant feeding guild in both the North and South. However, it is interesting to note that the dominant main invertebrate eaters were different in both sides of lake. In the northern sampling site Oligosarcus jenynsii (Characidae) was the dominant invertebrate eater, feeding mainly crustaceans (Aegla sp. and Palaemonetes argentinus). In contrast, the dominant invertebrate eater of the southern sampling site was Odontesthes humensis (Silversidae) consuming mainly mollusks (Heleobia sp. and Corbicula sp.). As identified, Mangueira lake presented a clear longitudinal gradient, both of biotic and abiotic factors. Northern site presents more turbid water, muddy sediments, increased chl a concentration and greater bacterioplankton, zooplankton and fish biomass, while southern site was characterized by increased water transparency, less chl a concentration and more PVI of submerged macrophytes, demonstrating the strong spatial heterogeneity of ecosystem.

Assessing the export of dissolved organic carbon and particulate organic carbon from a peatland catchment in the west of Ireland.

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There is evidence that catchment carbon export, specifically in peatland catchments, is increasing, which will have significant impacts on river and lake functioning. There is therefore a clear need for research which quantifies carbon availability under current and future climatic conditions, and assesses the drivers of export.

Instrumented platforms positioned on a river site in a west of Ireland catchment have allowed the quantification of both dissolved and particulate carbon export and assessment of some of the drivers of changes in export from the catchment. The annual estimated export of dissolved organic carbon (DOC) was 9.75t C km2 for 2010 and 12.64t C km2 for 2011 and the export of particulate organic carbon (POC) was 7.51t C km2 in 2010 and 16.42t C km2 in 2011. The availability of reliable and accurate data on current carbon pools will provide a robust basis for forecasting future responses of terrestrial carbon stores to change in climate.

Ice on and off in NY City drinking water reservoirs - a mediator of climate change impacts on lake eco-hydrodynamics

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The timing of ice on and off dates and ice cover duration in lakes and reservoirs will modulate the impact of regional weather conditions on lake thermal structure and mixing, since heat and momentum transfer into the water column is greatly reduced by the presence of ice cover. Changes in the duration and timing of ice cover are well documented effects of climate change that are expected to continue into the future. Long-term simulations of ice conditions/duration on lakes and reservoirs are essential to understand the mechanics through which ice cover mediates the effects of climate on lake thermal structure and mixing, and how changing ice cover may ultimately influence phytoplankton succession and trophic status of a lake. In the present study, a simple one dimensional model that predicts the onset, loss and duration of ice cover is modified and applied to several New York City water supply reservoirs. The model is driven by daily or hourly air temperature and wind speed as these are the most important factors influencing ice breakup and formation. Even though this simple model does not make detailed calculations of the ice cover energy budget, ice-on and off days are well reproduced for these drinking water reservoirs. .

Key words: Ice model, ice-on and off, ice cover, Drinking water reservoirs, climate change

Greenhouse gas emission from Rotorua lakes, North Island, New Zealand: A preliminary estimation and its outlook study

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Recent synthesis suggested that better understanding of greenhouse house gas (GHG) dynamics in inland waters should be placed since these ecosystems might have a substantial contribution to regulate global carbon cycle. Our study is focusing to quantify GHG emission in Rotorua lakes, New Zealand, and identify factors that control the emission. So far, emissions of CO2 and N2O from 11 Rotorua lakes have been computed using boundary layer model. Dissolved CO2 concentration in the water column was estimated based on its dissociation at a given temperature, total alkalinity and pH. N2O concentration was roughly estimated as 1% of total NO3 concentration. We estimated that Rotorua lakes, excluding Lake Rotomahana, emitted -6 – 320 g CO2 m-2 y-1, while Lake Rotomahana alone emited 2400 – 3800 g CO2 m-2 y-1. N2O emission from Rotorua lakes was estimated to be at very low rates, - 0.1 to 0.02 mg N2O m-2 y-1. Temporal variations of GHG emissions were captured in our calculation thus suggesting that seasonal dynamics of lake metabolism might affect the variability of GHG emissions in lakes. Future work will involve water quality and gas sampling to validate the calculated emission estimates. A hydrodynamic-ecological model (DYRESM-CAEDYM) will also be used to better understand the interactions of hydrodynamics and biogeochemistry in GHG emissions from lakes.

The change in the lake environmental conditions in HalaHu, Qinghai, China, based on the analysis of biomarker

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The Hala Hu basin is located at northern part of Tibetan Pleateau (97°24'- 97°47'E, 38°12'-38°25'N). The ca. 590 km2 large closed basin can be regarded as a key-site, as it is located at the northern transitional zone of major atmospheric circulation patterns: the warm-moist East Asia summer Monsoon (EASM), the cold-dry Winter Monsoon (WM) and the high-latitude Westerly air masses (WAM). Therefore, it is an excellent site to study the interrelation between lake formation, glacier development and related fluvial processes throughout the Late Quaternary history by means of geo-morphological and sedimentary approaches.

Lake sediment records on the environment have advantages of continuity and temporal high resolution. Scientist have applied multiple proxies (pollen, ostrocod, diatom, biomarker, etc.) from lake sediment to reconstruct hydrological changes and climate development. In this study, we focus on biomarker (n-alkane, alkenone) as proxies to get better understanding of the ecological background changes in Hala basin.

We collected two long cores H7 and H8 from the center of the lake (65 m water depth) and from the western near-shore location (20 m water depth). Based on the calibrated ages, the cores cover the sedimentary history of the last 24 kyr BP. We find great abundances of C17 n-alkane (origin from algae),C23-25 n-alkane (origin from aquatic plant), C27-31 n-alkane (origin from terestrial plant), and also C37 alkenones with different unsaturations in the core samples.

Why bother about depth? Relevance of metabolism below the upper mixed layer in lakes

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Recent advances in the application of the diel dissolved oxygen (DO) technique to determine rates of gross primary production (GPP), net ecosystem production (NEP) and respiration (R), suggest significant vertical variability in ecosystem metabolism associated with changes in the depth of the mixed layer (Zmix) and the photic zone (Zeu). Here we present results from a newly developed method to determine depth specific rates of GPP, NEP and R using frequent automated profiles of DO and temperature. Metabolic rate calculations were made for three lakes of different trophic status using a diel DO methodology that integrates rates across the entire depth profile and enables in situ evaluation of the photoacclimative response of the aquatic autotrophs to changes in light conditions. We show that not taking account of vertical differences in metabolism will generally underestimate GPP and R and lead to the erroneously conclusion of areal NEP > 0 during stratification. The deviation of areal metabolic estimates using the traditional single sonde approach was up to 60% for GPP and 90% for R when Zeu > Zmix. Vertical variability in NEP was strongly related to available light in epi- and metalimnion, and followed a hyperbolic light function. Coupling between GPP and R was surprisingly low, indicating high background R in all layers. The strongest relationship between GPP and R was observed in the productive epilimnion. Light utilization efficiency was significantly higher under low light conditions, indicating significant photophysiological optimization to decreasing light conditions with depth. in the water column.

Pairing high-frequency sensor data and paleolimnological techniques to better understand climate-mediated changes in lake thermal stratification

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Climate-driven increases in surface water temperature have been observed in over 100 large lakes around the world. Despite the prevalence of observed increases in water temperatures, long-term trends in lake mixing remain unclear. In this study, we use a new diatom-based model to reconstruct lake mixing from fossil sediment records. A reconstruction from Siskiwit Lake, a boreal ecosystem in the Midwestern United States, revealed that the depth of the mixed layer has more than doubled over the 20th century as ambient air temperature and wind strength increased. However, it remains unclear whether these regional changes in heat and wind are: 1) altering lake mixing synchronously across lakes in the area, and 2) affecting biological communities and lake processes. To address these questions, diatom-based mixing depth reconstructions and fossil algal pigment records were compared across lakes for the past 200 years. Sensor arrays were paired with sediment traps in multiple lakes to better understand how seasonal changes in mixing vary across systems and how these changes are preserved in the sediment record. In larger (>500 ha), less productive lakes, coherent increases in mixing depth were observed as wind strength increased in the last century. This is in contrast to several projections that suggest increasing air temperatures will lead to enhanced stratification and shallower mixing across lake ecosystems. Understanding how paleolimnological records of climate-mediated change vary across a landscape and the range of biological response to these changes are key to interpreting long-term trends in lake response to climate.

Primary production and respiration of phytoplankton in the littoral zone of an eutrophic lake (Lake Kortowskie)

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The aim of this study was the characteristic of phytoplankton primary production and respiration in the littoral zone of an eutrophic lake (Lake Kortowskie, northeastern Poland). The research was conducted in the spring, summer and autumn at eight sites of littoral zone with a different level of the direct catchment area development: two sites (1, 2) in the western part of the lake, which is dominated by forests, three sites (3, 4, 5) in the northern part of the basin, dominated by wasteland and private recreational areas, two sites (6, 7) in the eastern, the most transformed by man and one site (8) located in the southern part of the lake near the outflow. The production volume of the primary and respiration were determined by the change of the oxygen concentration in water using the method of "light and dark bottles" exposed for 24 hours in the surface layer of water. The lake primary production was significantly lower in the littoral parts shaded by forest than in sites exposed to the sun, occurring in the northern part of the lake. The highest primary production with simultaneously high phytoplankton biomass was found at the site in the north. The additional factor intensifying the primary production was the nutrient inflow from the recreationally used land. The highest rate of respiration was recorded in not forested sites, located in the northeastern part of the lake, where the autochthonic and allochtonic organic matter was reduced to CO2. The results indicate a dual role of littoral in the metabolism of Lake Kortowskie. On the one hand, the littoral zone supplies the basin in autochthonic organic matter, on the other hand reduces the organic matter which was produced in the water column and was supplied from the catchment.

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Metabolic modulations of ecosystem to episode dry weathers in lakes of contrasting trophic state

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Climate changes, such as changes in precipitation intensity and distribution, have the potential to affect ecological processes in lakes such as mixing, nutrient loading and cycling, and lake metabolism. We investigate how the ecosystem metabolism responds to two episodic dry weather conditions in two lakes of contrasting trophic status, Yuanyang Lake (YYL, oligotrophic) and Tsuifen Lake (TFL, eutrophic) in Taiwan. We find that autotrophication (NEP>0) occurred in both of eutrophic and oligotrophic lakes under dryer weather condition, which resulted from the greater decline in ecosystem respiration instead of stimulating the primary production.

In eutrophic lake, the GPP was declined by the stronger photoinhibition and lower underwater light availability (i.e., higher kd) due to the condensation of spring algal blooms during dry periods. This leaded to the lower production of endogenous carbon to support ecosystem R. By comparison, lower inputs of colored allochthonious carbon leaded to the decline of R and slightly increased the GPP in oligotrophic lakes. Overall, decreases in seasonal precipitation patterns appeared to alter metabolic processes through lowering the light availability for primary producers and the amount of preferable DOC sources for fueling heterotrophic processes. All of these processes were shaped by interactions between surrounding forest compositions and rain-induced variations in exogenous carbon input and retention that controlled by precipitation-induced changes in lake physics and hydrology. The autotrophy of lakes during dry weathers did not imply more atmospheric carbon fixed within the lake, but rather from a greater decline in rates of heterotrophic process under low-rain conditions.

Modeling the multiannual thermal dynamics of lake iseo: a 1-d approach

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Lake Iseo is a deep prealpine lake that, with its 8 billion cubic meter of fresh water over 250m of maximum depth, constitutes a strategic environmental and economic resource for Italy.

A good understanding of heat distribution in this fragile ecosystem is a prerequisite for investigating the interactions between physical and ecological components and for forecasting its evolution. As a fundamental step in this direction, experimental and modelling activities have been accomplished to simulate the dynamics of temperature distribution over a period of 15 years using the one-dimensional hydrodynamic model DYRESM. The model was initially calibrated for 2010, when meteorological forcing variables and temperature data were properly measured on the lake, and hence validated for the previous 15-years, properly using the historical data set available for this site.

The hydrodynamic model proved effective in simulating the thermal structure of the lake over the last 15 years, reproducing both the seasonal trend of the surface layers and some important aspects of the deep water interannual dynamics. The discrepancies between the observed and simulated temperatures are probably due to an insufficient modelling of internal mixing, and a reduced heat penetration under the thermocline. The careful analysis of the meteorological data and the model sensitivity on these forcings have shown for the first time that interflow dominates Iseo affluents regime during most of the year, so becoming an important regulator of lake thermal regimes. Besides, these results highlighted the key-role played by the wind for water temperature distribution.

The Effect of Cross-scale Interactions (CSIs) on Lake Ecosystem State Across Space and Time

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Understanding cross-scale interactions (CSIs) is a critical research frontier in macrosystems ecology that extends across all environmental sciences. A CSI exists where or when a driver at one scale, such as local land use, interacts with a driver at another scale, such as regional climate. These CSIs can lead to nonlinear and often unexpected relationships between drivers and responses. Unfortunately, general properties of CSIs, such as the conditions in which they occur, are largely unknown, partly because they have been quantified in only a few instances. We use lakes and their major nutrients (phosphorus, nitrogen, and organic carbon) as a model system because lakes are affected by many of the classes of drivers postulated to be a part of CSIs (e.g., connectivity, land use, and climate), and because there is a wealth of existing data and knowledge from small-scale studies regarding possible mechanisms through which drivers could interact across scales. Our overall research strategy is to: (1) use the landscape limnology conceptual framework to guide research; (2) assemble a lake nutrient and multi-scaled landscape database that has unprecedented spatial and temporal coverage (~5,000 lake ecosystems in 18 U.S. states across 25 yrs); and (3) use robust statistical approaches to quantify relationships across scales and integrate the spatial and temporal domains. One of the analytical approaches we will use is multi-level (i.e., hierarchical) modeling. This approach quantifies CSIs, allows for explicit testing of alternative potential drivers responsible for CSIs, and facilitates the effective communication of these complex dynamics driving ecosystem state.

Scales of Variability in Microcystin Concentrations Related to Limnological Variables in Lake Winnebago

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Lake Winnebago, Wisconsin's largest inland lake, is culturally and economically important for surrounding communities. Unfortunately, this lake is also plagued by high nutrient loading and toxic cyanobacterial blooms. We seek to understand factors that promote cyanobacterial toxin production in this lake. Surface samples were collected at three locations throughout the summer of 2012; 1) near the intake pipe for a water filtration plant providing drinking water to nearby populations, 2) near a buoy anchored by the U.S. Geological Survey in the center of the lake, and 3) near a second buoy anchored by UW-Milwaukee in the southern portion of the lake. Microcystins-LR, -RR, -YR, –LA and nodularin were extracted from replicate samples using 15N-labeled MC-LR as an internal standard. The extracted hepatotoxins were detected using tandem mass spectrometry with electrospray ionization following liquid chromatography separation. Hepatotoxins were detected in 83% of samples (N=24) and varied among the three locations, exceeding the WHO recommended drinking water limit of 1 μg/L. Scales of variability in high-resolution fluorometric measurements of cyanobacterial pigments (chlorophyll and phycocyanin) were compared to Microcystin levels to determine if pigment fluorescence is a suitable predictor for Microcystin production. Similarly, trends in total hepatotoxin concentrations were compared to physical lake metrics produced by Lake Analyzer. The data indicate that phycocyanin is a poor indicator for toxin production and that higher spatial and temporal sampling of cyanobacterial toxins is required to adequately assess drivers of toxin production in this lake.

Everylake USA: If every lake in the United States were combined into a single lake, how would it look?

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The biogeochemical role of lakes at continental scales is not well understood and is an area of active research. Estimating material storage, processing, and flux through lakes is a challenging task. Part of the challenge includes quantifying and understanding the scale of aquatic systems at such a large and non-human spatial scale (thousands to millions of km2). While we can easily communicate the raw numbers (6.7 Million lakes, 183,000 km2), their meaning is difficult to convey. With this poster, I use data from lakes in the US to help paint a more intuitive picture of lakes at a continental scale. By using a collection of lakes to create a virtual average, combined, and scaled lake, we can begin to more intuitively conceptualize the large number of lakes on our world.

A novel method for detecting the onset of thermal stratification from surface water temperature measurements in temperate lacustrine systems.

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Thermal stratification is a standard feature of many lakes that has a major effect on lake ecology. It is usually characterised from temperature measurements with depth, but here we asses if it can be determined from time series of surface measurements alone. The common mode of variability was assessed for surface water temperature measurements for 21 annual data series from lakes situated in northern and southern temperate zones. Continuous wavelet analysis identified the 24 hour period as the significantly dominant mode of variability among all lakes. The strength and significance of the 24 hour periodicity followed a seasonal cycle, being greater in summer when the lakes were thermally stratified and reduced in winter when the lakes were mixed. The significance of the 24 hour periodicity fluctuated coherently with the depth of the surface mixed layer where periods of decreased mixed layer depth resulted in an increase in the significance of the 24 hour periodicity. The onset of thermal stratification, defined according to the stratification criterion, of a > 1 °C temperature difference with depth, was accurately detected from the 24 hour periodicity, where the onset of thermal stratification and the significance of the 24 hour periodicity occurred simultaneously. This study shows great potential for current and future research and will be of direct interest to national agencies whose temperature measurements are restricted to surface water temperature. A future potential lies within the field of remote sensing where continuously increasing satellite observational powers will eventually result in surface water temperatures being measured at a relatively high temporal resolution at the spatial scales of small lakes (<5 km2).

Searching for Equations of Metabolism: Preliminary Results

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Large, high-frequency data sets are becoming increasingly prevalent in the Gleon community, and as they do, our questions about the meaning of the data and its relation to the nature of the system become increasingly complex. A reachable milestone is the ability to explain 80% of the variability in data sets collected from buoys.

We apply Symbolic Regression, a tool for mining equations directly, to high-frequency buoy measurements. This tool produces differential equations which capture a variable's rate of change over time in relation to the other variables. Our preliminary results, from analyzing multiple lakes over one year, and one lake over multiple years, are presented here.

Investigation of phytoplankton community seasonal development and its related environmental factors in Lake Erken

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Phytoplankton community succession is a well-investigated phenomenon in aquatic ecology. The structure of phytoplankton community includes both the species composition and the abundance (species diversity index) could provide essential information for the assessment of the trophic status, the water quality and the ecosystem health status of lakes. In this study, four year monitoring, from 2008 to 2011, of physical, chemical and biological factors of Lake Erken were statistically analyzed in order to profile the phytoplankton community development and probe the driving forces for the its seasonal succession. It was observed that in winter and spring, Chlorophyll a was identified positively related with the nutrient concentration, in spring, especially the silica, and negatively related with pH and temperature. But in summer and autumn, the factors in this analysis did not show significant relationship with Chlorophyll a, it means that there are other unknown factors limiting the phytoplankton biomass. Results indicate that Chlorophyll a concentration, which is used as the indicator for phytoplankton biomass, and community composition shows seasonal periodicity, this could pave the way for further research about the mechanisms of phytoplankton community seasonal succession.

The Argentinean network for the assessment and monitoring of Pampean shallow-lakes (PAMPA²): Five new sites for GLEON

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The Pampa region of Argentina is an extensive wetland containing nearly 200,000 shallow-lakes. The region is under increasing agricultural pressure resulting from climate change (increased temperature and precipitation) and the substitution of cattle breeding and traditional cultures by transgenic soy. Among the many services that they provide, shallow-lakes are highly responsive to changes in climate and land use. Therefore, long-term studies of shallow-lakes provide useful clues to understand and track changes occurring in their complex watersheds. PAMPA2 is a recently funded, long-term network project, with wide geographic coverage, aimed at studying Pampean shallow-lakes. Thirteen network sites (i.e., shallow lakes) occurring along the precipitation gradient (from < 300 mm y-1 to > 1000 mm y-1) form the core of the project. The network integrates various research teams from eight universities and research centers, with a strong multidisciplinary component. The approaches combine traditional sampling; high-rate monitoring using automated sensors; and remote sensing. The network develops and manufactures most the instruments, including automated buoys and unmanned aircrafts. In this presentation, we will provide details on the structure and state of development of the PAMPA2 network. Five shallow lakes will be instrumented with autonomous buoys. Two of them: La Salada and Otamendi buoys are already installed and measuring, the rest of the buoys will be moored before the end of 2012.

Lake hydrology determines organic carbon sources and retention in a small northern seepage lake

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Summertime water and organic carbon (OC) budgets were constructed for a small seepage lake (Long Lake) in the northern temperate forest of Michigan to better understand the variable pathways of allochthonous OC to lakes. We calculated the various fluxes of water and OC to Long Lake using a combination of empirical data and modeling. The majority of allochthonous OC was supplied as dissolved organic carbon (DOC) entering through a seasonal inlet stream located in the east basin of Long Lake (mean = 23.4 mg C m-2 day-1). Airborne particulate organic carbon (POC) loading to lakes varies with distance from shore and weather events (i.e. strong wind and heavy rain) and had a modeled mean input of 9.9 mg C m-2 day-1 for Long Lake, composing about one-quarter of the allochthonous OC budget. The hydraulic residence time of Long Lake was 860 days, calculated from data collected from piezometers, a permanent staff gauge, and an evaporation model. Imposing a simple mass balance from the quantified water imports and exports, we found that very little carbon was exported from the lake through seepage and outflow (~19%) and, therefore, a majority of DOC was mineralized or lost to sedimentation in the lake. This study highlights the importance of lake hydrology in determining sources of and fates of organic carbon in lentic systems.