GLEON 13 Student Posters Abstracts

Jennifer A. BRENTRUP[1], Kevin C. Rose[2], Taylor H. Leach[1], Craig E. Williamson[1], Janet M. Fischer[3], Jasmine E. Saros[4], Bruce R. Hargreaves[5], Robert E. Moeller[1]

Sentinel Responses to Extreme Precipitation Events in Lakes: Changes in UV Transparency

[1]Department of Zoology, Miami University, Oxford, Ohio, USA
[2]Smithsonian Environmental Research Center, Edgewater, Maryland, USA
[3]Department of Biology, Franklin and Marshall College, Lancaster, Pennsylvania, USA
[4]School of Biology and Ecology & Climate Change Institute, University of Maine, Orono, Maine, USA
[5]Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, Pennsylvania, USA

Extreme precipitation events are increasing in frequency and altering lake ecosystems in many ways. These extreme events may range from short-term heavy rainfall episodes to total cumulative winter snowfall. One of the sentinel responses that lakes exhibit in response to these episodic events is a change in ultraviolet (UV) transparency. UV transparency responses to extreme precipitation events may, however, vary greatly both within and among different geographic regions and across elevation gradients from lowlands to alpine lakes. In eastern Pennsylvania, two nearby low elevation lakes have shown very similar decreases in UV transparency in response to preceding periods of higher rainfall in spite of an order of magnitude difference in their average UV transparencies. In higher elevation subalpine lakes in the Beartooth Mountains, (Montana, USA) high cumulative winter snowfall is similarly correlated with a decrease in UV transparency. In contrast, an alpine lake above treeline in the Canadian Rockies showed its highest UV transparency following an unusually high snowfall year. As environmental changes continue to alter meteorological patterns, lakes will serve as important sentinels of these changes by responding with altered UV transparency that has potentially important biotic consequences. We are interested in working with other GLEON students and scientists in a broader assessment of the relationship between extreme precipitation events and water transparency to UV or visible light where transparency is measured at either routine sampling (e.g. weekly, monthly, or annually) or high frequency sampling (e.g. buoy based measurements).

Ludmila S. BRIGHENTI[1], Laura M. GAGLIARDI[1], Paula C. J. REIS[1], Francisco A. R. BARBOSA[1], and José Fernandes BEZERRA-NETO[1].

Estimates of continuous metabolism in two tropical lakes - Rio Doce, Minas Gerais

[1]Department of General Biology, Federal University of Minas Gerais, Brazil.

Primary production and respiration are the main metabolic pathways by which organic matter is produced and consumed. On a global scale, Gross Primary Production (GPP), Respiration (R) and Net Ecosystem Production (NEP) are useful to understand the global carbon cycling and to define the role of ecosystems as a source or sink of atmospheric carbon. Although tropical aquatic ecosystems are very abundant on a global scale and have unique peculiarities, studies with continuous monitoring of O_2 in these ecosystems are scarce. Therefore, this project aims to: 1. Investigate the dynamics of Carioca and Dom Helvécio Lake's metabolisms, located in a state protected area (Parque Estadual do Rio Doce - Minas Gerais), 2. Assess the influence of morphometric, chemical, trophic, and limnological factors as modulators of GPP, R, NEP and CO_2 emission by these lakes, 3. Determine if these ecosystems present the prevalence of heterotrophy and 4. Develop a conceptual model of temporal emissions of CO_2 (greenhouse gas) in tropical lakes. Measurements of diel "free water" changes in dissolved oxygen concentration (DO), water temperature, wind speed, barometric pressure and irradiance are being made since April/2011 by high-frequency sensors deployed at the deepest spot of the lakes. Measures of concentration of oxygen will be used to calculate the NEP at intervals of 30 minutes. In addition, chlorophyll-a, total nitrogen, total phosphorus, dissolved organic carbon and PAR, UVA and UVB radiation will be measured monthly.

Audrey Campeau [1] and Paul A. Del Giorgio [1]

Seasonality of pCO_2 and pCH_4 in Boreal Fluvial Networks

[1] Département des sciences biologiques, UQAM, Montréal, Québec, Canada

Fluvial systems act as a significant source of GHG, but caused by the lack of large-scale studies and complete year monitoring, they remain a black box in the carbon cycle. So far, no study has addressed simultaneously both dynamics of fluvial CO_2 and CH_4, over a whole year cycle. Moreover, practically no study has covered a large gradient a fluvial systems size in order to represent the entire regional fluvial network. In this context, we have monitored, during a complete year cycle, a variety of fluvial system size in the boreal region of Western Abitibi, Canada. We address the main drivers of temporal variability of fluvial surface water pCO_2 and pCH_4 in order to develop tools for regional up-scaling of whole year CO_2 and CH_4 emissions from fluvial networks. Ultimately, this will provide a better scientific comprehension of boreal fluvial network CO_2 and CH_4 emission in order to incorporate them to regional carbon budgets.

Lucy CROCKFORD[1, 2], Philip Jordan[1], David Taylor[2]

Phosphorus load apportionment in Irish water-bodies

[1] The Agricultural Catchments Programme, Teagasc, Johnstown Castle, Co. Wexford, Ireland
[2] Geography, School of Natural Sciences, University of Dublin, Trinity College, Dublin 2, Ireland

Sustainable use of European (EU) water resources and maintaining a high ecological status in waterbodies are key aims of the EU Water Framework Directive (WFD). A widespread water quality challenge in developed countries is eutrophication from point and diffuse loadings of nutrients, such as phosphorus (P) and nitrogen (N), from land to water.

This project is investigating the recovery period of lakes and rivers in Ireland. The lake element of the project is investigating the role of external and internal P loading to a meso-eutrophic inter-drumlin lake. Seasonal anoxia and wind induced resuspension of sediments are both linked to the ongoing eutrophication of lakes where historical external P loads have accumulated in lake sediments. A database is being built showing the extent of catchment derived P loading (external pressure), wind influences and stratification/mixing (internal pressure). This will be augmented using water column monitoring of algae and ancillary parameters. Preliminary results show that the lake is an unstable dimictic lake with thermal stratification occurring at a depth of 6 m. The lake is also displaying algal blooms and, although the potential for P loading from external sources has been reduced in recent years, there remains a high concentration for chlorophyll *a.* The impact of internal loading as a result of the release of P from anoxic sediments accumulated during historical land use will be analysed and a recovery period for the lake estimated which will ultimately provide policy makers with expectations of recovery from eutrophication episodes against the targets set out in the WFD.

Samuel B. FEY

Can thermal physiology predict the establishment success of non-native species in a warming world?

Department of Biological Sciences, Dartmouth College, Hanover, New Hampshire, USA

Predicting the future distribution of an organism in a warming world presents a challenge for ecologists for the reason that emergent properties of biological systems often complicate seemingly straightforward predictions. I examine the possibility of directly connecting an organism's physiology to its ability to establish within a community through examining the role of thermal performance curves in predicting the establishment success of the exotic crustacean, *Daphnia lumholtzi*.

I observed that both *D. lumholtzi* and native *Daphnia pulex* had similar population growth rates at ~23.5^{0}C, with *D. lumholtzi* out-performing *D. pulex* at higher temperatures, and *D. pulex* out-performing *D. lumholtzi* at lower temperatures. I conducted a field mesocosm experiment to test the hypotheses that increases in temperature above 23.5^{0}C would increase the establishment of *D. lumholtzi* in lakes with existing populations of *D. pulex*, and would decrease the ability of *D. pulex* to establish in lakes with existing populations of *D. lumholtzi*. *D. lumholtzi* was able to establish in ambient temperature (mean ~23.4^{0}C) and heated (mean ~24.7^{0}C) mesocosms, while *D. pulex* was unable to establish in heated mesocosms. Following their introduction into an established community of conspecific competitors, *D. lumholtzi* increased more rapidly in abundance in heated mesocosms.

This study highlights the potential usefulness of thermal performance curves for predicting the establishment of organisms in a rapidly changing thermal environment, and indicates that warmer temperatures expected as a consequence of climate change may favor the future establishment of *D. lumholtzi*, and the potential competitive exclusion of native *Daphnia* species.

Claudia Fernanda Fornerón [1], María Cintia Piccolo [1, 2], Gerardo M. E. Perillo[1,3]

Preliminary statistical analysis of hydrographic data of the Sauce Grande Shallw Lake (Argentina)

[1] Instituto Argentino de Oceanografía (IADO - CONICET). C.C. 804. Bahía Blanca - Buenos Aires, Argentina
[2] Departamento de Geografía y Turismo, Universidad Nacional del Sur (UNS). Bahía Blanca -Buenos Aires, Argentina.
[3] Departamento de Geología, Universidad Nacional del Sur (UNS). Bahía Blanca - Buenos Aires, Argentina
Email: cfforneron@criba.edu.ar

The Sauce Grande shallow lake (38°57' S - 61°24'W) is located in the Southwest of Buenos Aires province (Argentina). The location and morphometry of this natural water body is controlled by a coastal dunes system. The Sauce Grande River discharges into the lake and then continues its flow to the sea. However, since the

region is currently undergoing a strong drought, the sluices connecting the water reservoir to the sea are closed. The actual depth of the lake is 1.4 m.

A buoy was installed on February 2011 in the center of the lake to measure the main meteorological and hydrographical parameters at a 5 min interval. A preliminary statistical analysis of the measured data for the period February - August is presented. The maximum and minimum air temperatures were 33.3 and 0.5 ºC, respectively, typical of summer and winter conditions. Water temperature varied between 28 and 0.5 ºC in the studied period. The Pearson coefficient between both temperatures was significant ($r^2 = 0.87$, $p<0.000001$). Maximum wind velocity reached 62 km/h from the West. A high relationship was found between suspended sediment in the shallow lake and the wind velocity. Electrical conductivity oscillated between 5 y 11 mS/cm. Spectral analysis of temperature time series indicated maximum peaks in diurnal, semidiurnal, 7 and 4.5 h periods. The last two periods correspond to typical synoptic weather situations, which demonstrate the strong influence of the weather on the shallow lake conditions.

Amy Lee HETHERINGTON[1], Rebecca L. Schneider[1], Lars G. Rudstam[1], Heather H. Lee[2], and Michael T. Walter[3]

Evaluating Impacts of Climate Change on the Oneida Lake Ecosystem: Increasing Temperature and Decreasing Oxygen Equal Blue-Green Algal Blooms?

[1]Department of Natural Resources, Cornell University, Ithaca, New York, USA
[2]Department of Animal Science, Cornell University, Ithaca, New York, USA
[3]Department of Biological and Environmental Engineering, Cornell University, Ithaca, New York, USA

Our research focuses on understanding climatic impacts on lake ecosystems as they will affect water supply, recreation, fisheries, and other aspects of aquatic ecosystem health. In particular, warmer temperatures will enhance algal production and potentially the growth of nuisance species, such as blue-green algae or cyanobacteria, decreasing water quality. We are interested in evaluating the impacts of climate change on lake temperature profiles, oxygen availability, and cyanobacteria blooms using field-based monitoring, laboratory analysis, and modeling. This study is being conducted within 207 km^2 Oneida Lake and its 3,500 km^2 watershed located in Central New York, USA. Field data include stream and groundwater temperature loading, weather, and lake temperatures at varying depths. Lake temperature profiles under historic and anticipated climatic conditions are being modeled using DYRESM, a one-dimensional thermodynamics model. Spatially explicit cyanobacteria samples were collected in Summer 2011 continuing through Fall 2011 to assist retrospective analysis of historical data, test hypotheses

generated by the model, and ultimately assess water quality. Solar radiation is a major contributor in this large, shallow lake; however, initial modeling suggests cooler temperatures of tributary and groundwater inflow may exert a significant regulating effect on lake temperatures and stratification in the presence of increasing air temperatures. Preliminary laboratory analysis indicates an upward trend of cyanobacteria biovolume related to higher temperatures and lower dissolved oxygen concentrations at the bottom. The expected results will increase our understanding of the impacts of climate change on the water quality of lake ecosystems in New York.

Emily L. KARA[1] and Katherine D. McMahon[1]

Network analysis of bacterial community composition and long term environmental drivers

[1] Civil and Environmental Engineering Department, University of Wisconsin-Madison, 1550 Linden Dr. Madison, WI, 53706, USA

We evaluated ten years of bacterial community data from Lake Mendota, WI in the context of 32 concurrent environmental variables. Data were collected approximately biweekly period during ice-free season and occasionally under ice. We use the fingerprinting technique ARISA (Yannarell and Triplett, 2005) and local similarity analysis (Ruan et al., 2007) to assess the complex community and environmental time series. Canonical correspondence analysis and analysis of similarity of Bray-Curtis similarity matrices confirm strong seasonal patterns in communities observed previously (Shade et al., 2007). Temperature, dissolved oxygen, dissolved inorganic nitrogen, and several dissolved ions were highly correlated with community composition through time. Local similarity analysis and visualization of networks created for each year indicate a diversity of network characteristics through time, including degree of nested-ness and extent of clustering.

Lesley B. KNOLL[1], William H. Renwick[2], Elizabeth M. Dittman[3], and M.J. Vanni[1,4]

Organic and inorganic carbon budgets in two human-made impoundments are controlled by watershed features and hydrology.

[1] Ecology, Evolution, and Environmental Biology Program, Miami University, Oxford, Ohio, USA
[2] Department of Geography, Miami University, Oxford, Ohio, USA

[3] Department of Chemistry and Biochemistry, Miami University, Oxford, Ohio, USA
[4] Department of Zoology, Miami University, Oxford, Ohio, USA

Lakes and human-made impoundments are important to regional and global carbon budgets, but quantitative studies examining individual systems are lacking. Because their watersheds are large relative to water body size, impoundments can receive large quantities of terrestrial carbon from their watersheds that may ultimately be sequestered in impoundment sediments. At the same time, many freshwaters have been shown to be net heterotrophic (i.e., a source of CO_2 to the atmosphere). It is unclear to what extent impoundments are sources or sinks of carbon after simultaneously accounting for burial into sediments and CO_2 fluxes. It is also unknown the extent to which watershed features and hydrology regulate impoundment net carbon budgets. I examined how watershed features and precipitation affected carbon loading via streams, export via dams, atmospheric CO_2 exchange, and retention in two hard-water, Ohio impoundments of contrasting land use (i.e., agricultural vs. forested). A mass-balance approach was used by employing a high resolution sampling regime over two complete water years. DIC was the dominate carbon form in stream inputs, dam exports, and in the carbon retained in the impoundments. CO_2 results indicate that these fluxes are controlled by chemical conditions associated with high pH and DIC concentrations rather than organic carbon. Further, CO_2 exchange with the atmosphere rarely represented a large flux in the carbon budgets of either impoundment and often represented an efflux. Both impoundments were an overall net carbon sink, but the agricultural impoundment was a larger sink than the forested impoundment.

Alo Laas, Mike Vanni, Yosef Y. Yacobi, Peter Staehr, Kevin C. Rose, and many others.

How comparable are the bioproduction estimates yielded by different methods?

Hydrobiologists often wish to have immediate data on, for example, primary production (PP) or chl a concentration, but direct measurement of those is often difficult, sometimes even impossible. For chl a, it is easy to use new sensors, but often those need a direct calibration with different algal communities. For measuring PP we regularly have to spend hours on lake and in lab but even then true values sometimes remain unknown. As an alternative, indirect methods are used, which have to be evaluated by comparison with an established technique rather than with the true quantity. If the new method agrees sufficiently well with the old one, the latter may be replaced.

In this study we are comparing three different methods used for production measurements along GLEON sites. We estimate production rates with the diel-O_2

method (based on dissolved oxygen changes in the water column) and with an empirical method (based on solar irradiance and light attenuation caused by chl a) and will compare the results with the widely used 14C method. Our objective is to find out how do methods used to measure production compare; do all methods provide similar estimates and under what conditions do they provide dissimilar estimates? We expect that with our analysis we will find out the best and easiest method to describe the lake carbon production.

Taylor H. Leach[1], Jennifer A. Brentrup[1], Craig E. Williamson[1], Kevin C. Rose[2], Janet M. Fischer[3], Eliana L.Rabinowitz[3] and Mark H. Olson[3]

Biotic Consequences of Extreme Precipitation Events in Lakes: Zooplankton Vertical Distribution Responses

[1]Department of Zoology, Miami University, Oxford, Ohio, USA
[2]Smithsonian Environmental Research Center, Edgewater, Maryland, USA
[3]Department of Biology, Franklin and Marshall College, Lancaster, Pennsylvania, USA

Extreme precipitation events have increased in both strength and frequency as a result of global climate change. These episodic events induce important sentinel responses in lake ecosystems including changes in ultraviolet (UV) transparency. These sentinel responses can in turn have important biotic consequences. The *transparency-regulator hypothesis* (Williamson et al. 2011) argues that changes in water transparency alter both the dynamic (UV and predation), and structural (temperature and food distribution) drivers that regulate zooplankton diel vertical migration (DVM). We performed *in situ* experiments to test the link between UV and DVM in two Pennsylvania lakes (high UV Giles and low UV Lacawac), as well as a highly UV transparent alpine lake in the Canadian Rockies (Oesa). Open-bottomed UV-blocking and UV-transparent columns were deployed in the surface waters and zooplankton were allowed to freely migrate in or out of them over night. Columns were retrieved the following midday and the zooplankton counted. Some zooplankton species were more abundant in the UV-blocking columns in the two more transparent lakes, while in Lacawac *Holopedium* were more abundant in the UV exposed columns. We also show survey data from these lakes that demonstrate changes in zooplankton vertical distribution as a function of changes in UV transparency related to a storm event as well as strong interannual variation in climate. We invite other GLEON members with zooplankton vertical distribution and water transparency data to join us in an effort to investigate the biotic consequences of extreme precipitation events on zooplankton vertical distribution.

Christina MAKI[1], Mark Green[1,2] , and Lisa Doner[1]

Monitored sediment loading to a Northwestern Iceland lake

[1] Center for the Environment, Plymouth State University, NH
[2] Northern Research Station, U.S. Forest Service

Metal (Al, Ca Ti, Sr, Mg) concentrations in sediments from several NW Iceland lake cores show ~100-year cycles, hypothesized to arise from long-term North Atlantic Oscillation (NAO) variability (Doner, 2003). To understand the mechanisms responsible for sub-annual-scale transport of metals, and for the apparent decadal cyclicity, in 2011 we began a four-year project monitoring aqueous fluxes in the Vatnsdalsvatn watershed (Fig 1). From May 20-July 20, 2011, we monitored inlet stream turbidity, temperature and specific conductivity at 15-minute intervals. Total suspended sediment samples collected over this interval are applied to turbidity calibrations. Discharge measurements allow us to generate a sediment-rating curve for the Vatnsdalsvatn inlet stream. During the study interval, the NAO index was mostly negative (Fig 1). Cooler than normal air temperatures and very low precipitation created a situation where snowmelt almost entirely drove the discharge rates. Despite minimal surface runoff, we find that turbidity clearly varies with discharge levels and that rain-on-highland snow fields are primary mechanisms for erosion and sediment loading for this interval in the watershed.

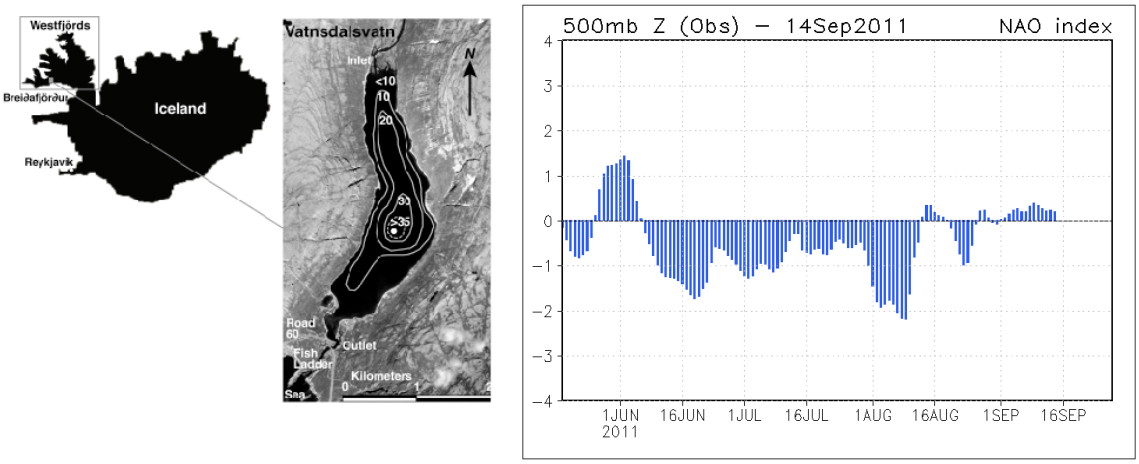

Figure 1. Map of Iceland showing the location of Vatnsdalsvatn (left) and the daily NAO index for the monitoring interval, constructed by projecting daily (00Z) 500mb height anomalies over the Northern Hemisphere onto the loading pattern of the NAO (www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/nao_index.html).

References:

Doner, L., 2003, Late-Holocene paleoenvironments of northwest Iceland from lake sediments: Palaeogeography, Palaeoclimatology, Palaeoecology, v.193, p. 535-560.

Bernard M. Simmonds[1], David P. Hamilton[1], Kohji Muraoka[1]*, Deniz Ozkundakci[1], Susie Wood[2]

Determinants of Deep Chlorophyll Maxima depths

[1] Centre for Biodiversity and Ecologicy Research Research, New Zealand
[2] Cawthron Institute, Nelson, New Zealand
* Corresponding author contact: km112@waikato.ac.nz

Deep chlorophyll maxima (DCMs) involve the occurrence of a peak chlorophyll concentration at a deep location in the water column. They are commonly associated with oligotrophic lakes with high water clarity. DCMs occur when there is sufficient photosynthetically active radiation (PAR) to enable sufficient growth to overcome metabolic and other losses. Lake Okaro is a small, monomictic lake (area = 0.32 km^2, mean depth 12 m) located in the Rotorua region of New Zealand. It has high external nutrient loadings from its intensive pastoral catchment as well as high internal nutrient loadings. Recently nutrient loads have been reduced through construction of an artificial wetland and capping of nutrient releases from bottom sediments. Although the trophic level has remained high, nutrient control has resulted in increasing epilimnion clarity during stratification. As a consequence the hypolimnion receives sufficient PAR to support a DCM similar to what might be expected in a meso or oligotrophic lake. In this study, we used isolume depths to explain the depth of occurrence of the DCM. An isolume value based on surface PAR attenuated according to values of the light extinction coefficient explained DCM depth better than the Secchi disk-derived euphotic depth. The study implies that specific minimum PAR values can be defined for the growth of Lake Okaro phytoplankton community, and the technique should be able to apply for other lakes with DCM observed, leading to potential lake remediation goals.

Vanesa L. PERILLO[1], Alejandro J. Vitale[2,3], Claudia Fernanda Fornerón[2] , María Cintia Piccolo [2,4] , Gerardo M. E. Perillo[2,5]

How might we prevent vandalism at Sauce Grande Shallow Lake (Argentina)?

[1] Instituto de Investigaciones Bioquímicas de Bahía Blanca (INIBIBB – CONICET), CC 857 Bahía Blanca - Buenos Aires, Argentina.
[2] Instituto Argentino de Oceanografía (IADO - CONICET). C.C. 804. Bahía Blanca - Buenos Aires, Argentina.
[3] Departamento de Ingeniería Eléctrica y Computadoras, Universidad Nacional del Sur (UNS). Bahía Blanca -Buenos Aires, Argentina.

[4] Departamento de Geografía y Turismo, Universidad Nacional del Sur (UNS). Bahía Blanca -Buenos Aires, Argentina.
[5] Departamento de Geología, Universidad Nacional del Sur (UNS). Bahía Blanca - Buenos Aires, Argentina
Email: vperillo@criba.edu.ar

On February 17, 2011 an autonomous buoy fully designed and built at IADO was moored at the Sauce Grande shallow lake, Argentina. This is the first buoy ever moored in an Argentinean lake to register long-term data on meteorological and water parameters at 5 min interval. Data is sent to the IADO server every 30 min and updated on a web page http://emac.criba.edu.ar.

On March 23, 2011 (1055 h) connection with the buoy was lost. The buoy was damaged by unknown people and some of the cables and the datalogger were affected. We retrieved it and also installed newly developed sensors and moored it again on April 14th (0825 h). It operated flawless until August 22th (1400 h). On September 20th we confirmed that again a vandalic action basically destroyed the whole buoy. In both cases, the individuals did not take out any of the sensors or cables, but directly destroyed all the outer sensors and the conductivity one.
At present time we are repairing the buoy, but the problem that arises from this is the effect that these disturbances may have on the time series analysis. Repairs will take 4 weeks, resulting in the lost of data during the first month of spring that could be related to the biogeochemical processes and biological activity. As vandalism is common in many places worldwide, we propose the creation of a special GLOEN task committee to look to this problem.

María MORALES-PINEDA[1], Bárbara Úbeda[1], Andrés Cózar[1], and José Ángel Gálvez[1]

Scaling the temporal variability of the carbon dioxide emission from two monomictic Mediterranean reservoirs

[1]Department of Biology, Faculty of Marine and Environmental Sciences, University of Cádiz, SPAIN

Inland waters are important components of the global carbon cycle. Most of these aquatic ecosystems are supersaturated in CO_2, and therefore act as sources to the atmosphere. Reservoirs are particularly important sources of greenhouse gases, emitting about twice the global CO_2 flux of natural lakes to the atmosphere. These flux estimates are usually made from short-term measurements, assuming low temporal variability. Using measurements of pCO_2, we estimated air-water CO_2 exchange with hourly resolution in two reservoirs with different trophic status in

Southern Spain. In addition to differences in CO_2 emissions between reservoirs (fourfold higher in the eutrophic impoundment), a marked temporal variability at daily, biweekly and seasonal scales were observed in both reservoirs. Daily cycles were mainly driven by the daily cycle of physical factors through their influence on planktonic metabolism. At this scale the maximum amplitude in pCO_2 was about 1000 µatm. Likewise, intermittent deepening of the thermocline, caused by sporadic strong wind events resulted in high increases of pCO_2 to the atmosphere along the stratified period, in this case at biweekly scale. Seasonal variability was related to the surface water temperature and the thermal structure of the water column. Our results show that pCO_2 dynamics in freshwater ecosystems can potentially have a pronounced temporal variability which should be considered when assessing the role of inland waters in the global carbon cycle.

Brittany L. POTTER[1], John D. Lenters[1], Kenneth M. Hinkel[2], Martha D. Shulski[1], Nathan C. Healey[1], Ayse Irmak[1], Sandra L. Jones[1] and Yongwei Sheng[3]

Climatic controls on the summertime energy balance of a thermokarst lake in northern Alaska: Short-term, seasonal, and interannual variability

[1]School of Natural Resources, University of Nebraska-Lincoln, Lincoln, NE 68583
[2]Department of Geography, University of Cincinnati, Cincinnati, OH 45221
[3]Department of Geography, University of California-Los Angeles, Los Angeles, CA 90095

Shallow, thermokarst lakes that develop atop permafrost are a prominent landscape feature on the Arctic Coastal Plain (ACP) of northern Alaska. The ACP is vulnerable to ongoing climate change and landscape modification, as thousands of thaw lakes and ponds are impacted by changes in temperature, precipitation, thawing permafrost, and human activity. Although summer in the Arctic is short, incoming solar radiation and lake evaporation are relatively high, and both factors play a significant role in the landscape water balance. Furthermore, lake evaporation is anticipated to increase as the ice-free season lengthens and water temperatures become warmer. To improve our understanding of these processes, we performed a multi-year energy balance analysis of a shallow, thermokarst lake near Barrow, Alaska. Timeseries of net radiation, Bowen ratio, and rates of heat storage in the water and sediments were used to calculate sensible and latent heat fluxes during the 2008-2010 ice-free periods. Results of the energy balance analysis show rapid lake warming immediately following ice-off (due to high insolation), followed by similar increases in sensible and latent heat flux. Lake evaporation averaged around 1.3 mm/day during the ice-free period, which is nearly twice the mean summertime precipitation rate of 0.7 mm/day for Barrow, Alaska. Daily evaporation rates ranged from zero to greater than 4 mm/day, while short-term and seasonal patterns varied

significantly from one year to the next. Much of this variability was associated with changes in cloud cover, water temperature, relative humidity, and wind speed.

Jordan S Read[1], David P Hamilton[2], Ankur Desai[3], Kevin Rose[4], Paul C Hanson[5], Luke A Winslow[5], Ian D Jones[6], Chin H Wu[1], John Lenters[7]

Drivers of gas flux from temperate lakes: Partitioning the energetic contributions of wind and convection in 42 lakes

[1]Civil and Environmental Engineering, University of Wisconsin-Madison, Madison, WI, USA
[2]for Biodiversity and Ecology Research, University of Waikato, Hamilton, New Zealand
[3]Atmospheric & Oceanic Sciences, University of Wisconsin-Madison, Madison, WI, USA
[4]University of Miami-Ohio Ecology, Evolution, and Environmental Biology
[5]University of Wisconsin-Madison Center for Limnology
[6]Centre for Ecology and Hydrology, Lancaster Environment Centre, Lancaster, United Kingdom
[7]School of Natural Resources, University of Nebraska-Lincoln, Lincoln, Nebraska, USA

Estimating the flux of CO_2 from lakes is important to understanding the role of lakes in the global carbon budget. The efflux of partially soluble gasses like CO_2 is controlled by near-surface turbulence. Lakes receive turbulent inputs across the air-water interface via two primary mechanisms, wind shear and negative buoyancy flux (convective cooling). We examined the relative importance of wind and convection in 42 temperate lakes which covered gradients in latitude, size, and water clarity. We calculated the gas transfer velocity (k_{600}) and the turbulent velocity scales for wind (u^*) and convection (w^*) using high-resolution measurements of wind speed, water temperature, and meteorological drivers, as well as lake-specific properties like morphometry and the diffuse attenuation coefficient. We found k_{600} estimates for small and medium sized lakes to be confined between 2 and 3 cm hr^{-1}, the magnitude of which was not strongly related to wind speed. We then compared the daytime u^* with the nighttime w^* and found convection to be of increasing importance as lakes decreased in size (lower u^*/w^*), potentially explaining why efflux during low wind conditions is often unrelated to wind speed.

L. Ryder [1], E. Jennings[1], E. de Eyto[2], M. Dillane[2] and R. Poole[2].

Characterisation of organic carbon pool in Lough Feeagh a humic lake in the west of Ireland

[1]National Centre for Freshwater Research Studies, Dundalk Institute of Technology
[2]Marine Institute, Furnace, Newport, Co. Mayo.

In humic lakes such as Lough Feeagh in the west of Ireland, allochothonous carbon, that is carbon exported from the catchment, can represent an equal if not a more important source of carbon than the in-lake phytoplankton pool. We used scans of fluorescence at a range of excitation and emission wavelengths (Emission Excitation Matrix (EEMS)) to characterise this carbon into humic-like and fulvic-like carbon pools. We assessed how these pools change over both the annual and diel cycles, and during differing river flow regimes, in both the main in-flow to Lough Feeagh and in the lake surface waters.

Silke R. SCHMIDT[1], Rita Adrian[1], and Dieter Gerten[2]

Lakes at risk under climate change: Climate variability matters

[1] Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany
[2] Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany

Background and preliminary results of the project “LakeRisk”, financed by the German Science Foundation (DFG), are presented here. The motivation for our research is that mean temperature changes (averaged over years or seasons) can derive from a multitude of warming patterns from sub-daily to decadal temporal scales; therefore, these are inadequate measures of the changes that ecosystems experience. We analyze the effects of small and long temporal scales variability in the climate on lake physics and plankton communities and try to understand the lake ecosystems’ responsiveness to global warming, particularly to the variability in climate and weather conditions. The focal question is in what ways the detailed seasonal pattern of observed and projected climate warming affects the physical and biological structure of lakes. The overall aim of our research is to find a metric characterizing the impacts of climate variations on lake ecosystems for different lake types of varying climatic zones. The basis of the data presented here are long-term time series of ecological and climatological variables with high to intermediate temporal resolution from the shallow, polymictic, eutrophic Lake Mueggel at Berlin, Germany.

Dominic SKINNER[1,2], Kane Aldridge[1], Justin Brookes[1], Rod Oliver[3], Ilia Ostrovsky[4]

A day in the lake: The role of diurnal wind and stratification on sediment resuspension and chlorophyll dynamics in a shallow, polymictic lake

[1]Department of Ecology and Evolutionary Biology, University of Adelaide, Australia
[2]Department of Infrastructure Engineering, University of Melbourne, Australia (Present Address)
[3]CSIRO Land and Water, Waite, Australia
[4]Israel Oceanographic and Limnological Research Institute, Israel

Sediment resuspension can result in rapid changes to the water quality as concentrations of suspended particulate matter, associated nutrients, light attenuation and chlorophyll increase. In shallow lakes, the interplay between diurnal temperature stratification and wind speed can determine the dynamics of sediment resuspension and its effect on productivity. The composition of suspended sediment can also change over time-frames of less than a day. This study reports results of a three-day field study in Lake Alexandrina, South Australia, a large (580 km^2), shallow (mean depth: 1.3 m), polymictic lake prone to high levels of sediment resuspension. Results suggest that particulate matter composition is highly dependent on both wind speed and temperature stratification, even in a highly mixed system. Decreases in suspended particulate matter and turbidity during short periods of stratification can increase light irradiance in the water column, promoting pelagic productivity and favouring buoyant or motile phytoplankton.

***Hilary A. Smith; Katherine E. White; Terry W. Snell**

Hydroperiod correlates with sexual reproduction and life history traits in Brachionus plicatilis s.l. rotifers

School of Biology, Georgia Institute of Technology, Atlanta, GA 30332-0230, USA

For many aquatic organisms, the short hydroperiod in ephemeral habitats may interrupt activity with a forced dormancy. Monogonont rotifers are cyclically parthenogenetic zooplankton capable of producing desiccation-resistant diapausing embryos via sexual reproduction. We examine the hypothesis that hydroperiod affects evolution of life history traits and reproduction of *Brachionus plicatilis* rotifers. Permanence negatively correlated with hatching frequency of diapausing

embryos from 11 ponds of varying hydroperiod (Spearman's rho= -0.795, *P*=0.006). There was no significant correlation of hydroperiod with asexual fecundity or lifespan, but there were correlations with traits related to sexual reproduction. We found a positive correlation between permanence and the population density required to induce sex (Spearman's rho= 0.236, *P*=0.039); thus populations from more permanent systems must reach higher densities for sex induction. There was a positive correlation of hydroperiod with total diapausing embryo production (Spearman's rho= 0.291, *P*=0.004), but a negative correlation with these embryos' lipid content (Spearman's rho= -0.265, *P*=0.005). Thus hydroperiod not only affects propensity for sex induction, but also the quantity and composition of diapausing embryos. Our findings suggest the evolution of higher investment in sexual reproduction by brachionids from temporary waters.

Karin SPARBER, Catherine Dalton[1], Elvira de Eyto[2]

The dynamics and importance of auto-, mixo- and heterotrophic pelagic communities in a humic and oligo-humic lake in the west of Ireland

[1]Mary Immaculate College, University of Limerick
[2]Marine Institute, Newport, Co. Mayo

An increase in the transfer of organic carbon from long-term terrestrial stores (peat soils) to more labile dissolved forms has been observed in Northern Europe and America. Dissolved organic carbon (DOC) plays an important role in many aquatic ecosystems as it is a source of energy fuelling microbial metabolism. DOC also attenuates solar radiation. The abundance and biomass of picoplankton, phytoplankton (including potentially mixotrophic flagellates), ciliates and heterotrophic bacteria were enumerated fortnightly and monthly for one year in two oligotrophic lakes in the west of Ireland (Feeagh, Co. Mayo and Guitane, Co. Kerry). Feeagh is a humic brown-water lake (water colour 78 - 107 mg l^{-1} Pt/Co, DOC 6.2 – 11.4 mg l^{-1}, TP 5 – 12 µg l^{-1}, TN 200 – 870 µg l^{-1}) and Guitane is an oligo-humic lake (water colour 16 - 26 mg l^{-1} Pt/Co, DOC 1.5 – 6.4 mg l^{-1}, TP 2 – 25 µg l^{-1}, TN 210 – 530 µg l^{-1}). There was poor development of phytoplankton and picoplankton biomass in Feeagh compared to Guitane and this is presumed to be due to the unfavourable light climate, caused by a high concentration of humic substances. A summer peak of mixotrophic flagellates was evident in both lakes, however the abundance of heterotrophic bacteria was three times higher in the humic lake. The results confirm the importance of bacteria in driving production at higher trophic levels in humic lakes.

Kristin E.D. Strock[1], Jasmine E. Saros[1]

Exploring the interactive effects of climate change and declining sulfur deposition as drivers of synchronous changes in water clarity across lakes in Acadia National Park

[1]University of Maine School of Biology and Ecology and Climate Change Institute Orono, Maine, USA

Striking changes in the concentrations of dissolved organic matter (DOM) in lakes have been observed recently in many regions of the Northern Hemisphere, particularly in the northeastern US. Several mechanisms have been proposed to explain these observed increases in DOM, including the widespread decline in sulfur deposition, as well as enhanced organic matter production and/or release as a consequence of global climate change. Here we explore whether there are synchronous changes in both geochemical and biological response variables in lakes throughout Acadia National Park. We analyzed secchi disk, chlorophyll *a*, dissolved organic carbon (DOC), and nutrient data collected monthly since 1985. Synthesis of monitoring data revealed synchronous declines in water clarity across multiple lakes while algal biomass was unchanged. Concentrations of DOC increased while water clarity declined. Paleolimnological inferences from 2 lakes in Acadia reveal little to no lake acidification over the last century, however monitoring data since 1985 suggest regional changes in watersheds. The observed changes in water clarity may be driven by the interactive effects of increased storm severity coupled with reduced sulfur deposition, but the mechanisms remain unclear. Synchronous changes in a biological parameter such as secchi disk transparency as a result of increased mass influx (DOC) is counter to recent work that suggests energy influx (i.e. temperature and wind) is a primary driver of synchronous regional trends. Continued analysis of monitoring data and regional climate records will provide insight into possible drivers for a recent decline in water clarity in these lakes.

Dominic Vachon[1] and Paul A. del Giorgio[1]

Effects of high wind and rain events on lakes CO_2 dynamic

[1]Departement des Sciences biologiques, Universite du Quebec a Montreal, Quebec, Canada

Impact of high wind and rain events on lakes biogeochemistry is not well understood, partly because of the complexity of taking measurements during storms. Nonetheless, these kinds of events could possibly have significant impacts on lakes CO_2 dynamic. High rain and wind events affect the physic, hydrology and the biology of the lake, resulting in a definite shift in CO_2 behaviour and often leading to lake surface pCO_2 increases. In the context of climate changes, these kinds of events could possibly be more frequent and severe, which could have a great influence on lakes CO_2 annual emissions. In this study, we monitored two Canadian Shield lakes in the Quebec province throughout summer 2011 looking at diverse physical, chemical and meteorological variables. Two main storm events were selected according to the particularly high wind and high precipitation observed. Using this high-frequency dataset, we were able to explore the lakes CO_2 dynamic during and several days after the storms.

Vicky VEERKAMP[1], Eleanor Jennings[1], and Suzanne Linnane[1]

Assessing streamside fencing as a management option in the Milltown Lake catchment.

[1] Department of Applied Science and Centre for Freshwater Studies, Dundalk Institute of Technology, Dundalk, Ireland.

Nutrient loadings from agricultural sources is one of the main pressures on Irish freshwater systems. Potential measures to control such nutrient exports include riparian buffer zones and streamside fencing. The Milltown Lake catchment is situated in the drumlin belt of Ireland, an area with hilly topography and intensive cattle farming. Milltown Lake itself is a drinking water source for the local community and has been constantly classified as eutrophic over the last decade. One of the three tributaries on the Drumleek River has been completely fenced along both banks. The current project is assessing the impact of fencing using both field monitoring and dynamic modelling approach. Initial field results indicate a decrease in phosphorus loading along the fenced stream reach.

Luke A Winslow, Jordan S Read, Paul C Hanson, Emily H Stanley

Lakes across America: Grasping the distribution of 6.7 million U.S. lakes

With this poster, we present one of the most comprehensive and spatially extensive enumeration of lakes collected. Extracted from the United States Geologic Survey's National Hydrography Dataset (NHD), this collected includes over 6.7 million lakes across the United States. The data are examined and presented using multiple techniques that help the reader grasp the importance and magnitude of lakes' impact on the landscape of the continent. In addition, we examine how understanding the morphology and distribution of lakes at this scale can help scientists understand and quantify landscape-scale biogeochemical processes.