B08: General Biogeosciences

Conveners: Murray Richardson[1], and Carl Mitchell[2]

Co-chairs: Murray Richardson[1], and Carl Mitchell[2]

[1]Geography and Environmental Studies, Carleton University, Ottawa, ON, K1S 5B6

Phone: 613-520-2600 ext. 2574, E-mail: murray.richardson@carleton.ca

[2]Physical & Environmental Sciences, University of Toronto Scarborough, Toronto, ON, M1C 1A4 Phone: 416-208-2744, E-mail: carl.mitchell@utoronto.ca

Session Description

This session will highlight the diversity of research investigating the biogeoscience/biogeochemical functioning of ecosystems. Presentations discussing all aspects of biogeosciences research from recent advances in understanding the fundamental mechanisms underlying processes shaping landscapes to novel methods for modelling them and approaches for monitoring them via both field and remote techniques are encouraged. Sample topics include integrative approaches to describe biogeoscience processes in both natural and managed ecosystems; characterizing measurement and modelling uncertainty in complex and heterogeneous landscapes; scaling linked water/nutrient/element/sediment exchange processes; determining the impacts of changing climate or land use on water/nutrient/element/sediment exchange processes across ecosystems; identifying and evaluating the effects of drought and other extreme weather phenomena on ecosystem form and function; developing novel and improved sensor systems and measurement techniques; and, diagnosing the effects of biota on driving change in landscape form or hydro-biogeochemical functioning.

Primary Affiliation: Biogeosciences

NOTE: THIS DOCUMENT CONTAINS INFORMATION FOR ALL SESSION SUB-SECTIONS. PRESENTER ABSTRACTS ARE FOUND AT THE END OF THE DOCUMENT.

SCHEDULE MAY BE SUBJECT TO CHANGE.

ORAL SESSION B08a

Chairs: Murray Richardson and Carl Mitchell **Room: AERL 120**

Wednesday, May 31st

TIME	AUTHORS	TITLE
11:00	S. Morgan, M. Oelbermann & L. Echarte	Impact of elevated CO_2 and temperature on soil carbon and nitrogen dynamics in cereal-legume intercrops and sole crops
11:15	R. Muneepeerakul, E. Bertuzzo, A. Rinaldo, & I. Rodriguez-Iturbe	Evolving biodiversity patterns in evolving river networks
11:30	D. Beaulne*, G. Fotopoulos, & S. C. Lougheed	Effect of errors in LiDAR measurements and processing techniques on the correlation between natural landscape and genetic data
11:45	C. Murray, C. Whitfield	Steady-state critical loads of acidity and nutrient nitrogen under a changing climate in northern Saskatchewan
12:00	N. De Carlo, M. Oelbermann & A. Gordon	Impact of soil microclimate and available nitrogen on greenhouse gas spatial variation in a rehabilitated and natural riparian forest
12:15	C.P.J. Mitchell & R.J. Strickman	Methylmercury production in urban created wetlands and stormwater ponds

POSTER SESSION B08
Chairs: Murray Richardson and Carl Mitchell **Room: ESB Atrium**

Wednesday, May 31st

Poster No.	AUTHORS	TITLE
P01-B08	A. Schevers*, S. Lamoureux, & M. Lafrenière	Long-term dissolved inorganic nitrogen fluxes from paired watersheds in the Canadian High Arctic
P02-B08	D.M. Stewart*, U. Silins, M. Emelko, & M. Stone[3]	Regulation of post-logging N turnover and mobile N by solar insolation in a steep mountainous Rocky Mountain watershed
P03-B08	M.A. Haque*, C. Ross, A. Schmall, S. Bansah, M. Macrae & G. Ali	Phosphorus sorption dynamics in geographically isolated wetlands in the Prairie Pothole Region
P04-B08	F. Jalilian, Z. Xu*, C. Valeo, R.B. Bhiladvala, A. Chu, & J. He	Biofilm monitoring in situ of bioretention cells
P05-B08	R. Thomas*, C. Valeo, & U.T. Khan	Fuzzy set theory applied to spatial interpolation and modelling of dioxins and furans in marine sediments
P06-B08	K. Xu*, Z. Xu, C. Valeo, J. He	Influence of rainfall and temperature on the distribution of bacterial contaminants in nearshore areas of the southern Vancouver Island
P07-B08	M. Ricord, M. Oelbermann, L. Phillips, B. Seuradge, & L. Echarte	Impact of cereal-legume intercropping on greenhouse gas emissions and microbial functionality

---

SUBMITTED ABSTRACTS

B08-01: Impact of elevated CO_2 and temperature on soil carbon and nitrogen dynamics in cereal-legume intercrops and sole crops

Svenja Morgan[1], Maren Oelbermann[1] and Laura Echarte[2]

[1] School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, ON, N2L 3G1, Phone: 519-888-4567, E-mail: moelbermann@uwaterloo.ca
[2] Instituto Nacional de Tecnología Agropecuaria, Balcarce, Argentina

Abstract
The effect of climate change on soil carbon (C) and nitrogen (N) dynamics remains uncertain. This study quantified soil chemical and biological characteristics and greenhouse gas emissions (GHG) from a cereal-legume intercrop, soybean sole crop and maize sole crop after 84 days of exposure to different climate scenarios [current ambient temperature (AMB), elevated temperature (TEMP), elevated ($_eCO_2$) and a combination of elevated ambient temperature and eCO_2 ($_eCO_2$xTEMP)]. Soil organic carbon (C) and total nitrogen (TN) were significantly lower ($p<0.05$) in TEMP and $_eCO_2$xTEMP treatments in all crop systems. However, the quantity of C derived from the C_3 and C_4-C fraction was significantly lower ($p<0.05$) in the TEMP and $_eCO_2$xTEMP treatments in all crop systems. Soil ammonium was significantly greater ($p<0.05$) in the AMB treatment for all crop systems, whereas nitrate was significantly lower ($p<0.05$) in the AMB and $_eCO_2$ treatments. Soil microbial biomass C and N, and quantity of C derived from the C^3 and C_4-C fraction in the SMB were not significantly different ($p<0.05$). After 84 days, CO_2 emissions varied significantly ($p<0.05$) among crop types and treatment types. Where CO_2 emissions were lower under AMB, TEMP and $_eCO_2$xTEMP treatments for the intercrop, but greatest in the $_eCO_2$ treatment in the intercrop. The proportion of C derived from the C_3-C fraction was significantly greater ($p<0.05$) in the climate change treatments, however the proportion of C derived from the C_4-C fraction was significantly lower ($p<0.05$) in the climate change treatments. N_2O emissions were significantly different among crop systems and treatments where the intercrop had the lowest N_2O emissions in the AMB and $_eCO_2$xTEMP treatments. The potential microbial activity was significantly different ($p<0.05$) among crop systems and climate treatments. The Shannon-Weaver index of diversity (H_s) and community richness (R) varied in the soybean and maize sole crops, whereas in the intercrop H_s and R were not significantly different ($p<0.05$) in the climate change treatments when compared to AMB conditions.

Presentation type: Oral

B08-02: Evolving Biodiversity Patterns in Evolving River Networks

Rachata Muneepeerakul[1], Enrico Bertuzzo[2], Andrea Rinaldo[3], and Ignacio Rodriguez-Iturbe[4]

[1]Agricultural and Biological Engineering Dept., University of Florida, Gainesville, FL 32611, USA. Phone: +1-352-392-1864, Fax: +1-352-392-4092, E-mail: rmuneepe@ufl.edu. [2]University of Venice, Venice, Italy. [3]Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [4]Texas A&M University, College Station, TX, USA

Abstract

Biodiversity patterns are governed by, among other things, landscape structure and dispersal behaviors of organisms that live in it. Landscape, however, evolves, and organisms evolve their dispersal behaviors with it. It is unclear how these biological and geomorphological changes interplay to affect biodiversity patterns. To shed light on this question, we develop neutral metacommunity models that allow for dispersal evolution and implement them, in different settings, in river networks with different structures that mimic the geomorphological evolution of a fluvial landscape toward an optimal channel network. The results show that, for a given dispersal kernel, a more compact network structure—where local communities are closer to one another—produces a more well- mixed environment that results in greater local species richness, more dominance of common species, lower total species richness, and more similarity in species compositions across local communities. However, when dispersal evolution is present, organisms adopt more local dispersal strategies in a more compact network, counteracting the effects of the more well-mixed environment. The combined effects lead to lower local species richness, lower total species richness, more dominance of common species, and greater overall similarity in species compositions in a more compact network—symptoms that are quite different from those in the fixed dispersal setting. These findings emphasize the importance of understanding the nonlinear interplay between evolutions of dispersal, fluvial landscape, and biodiversity patterns, which would be useful in anticipating how biodiversity patterns might change in a changing landscape.

Presentation type: Oral

B08-03: Effect of errors in LiDAR measurements and processing techniques on the correlation between natural landscape and genetic data

Danielle Beaulne[1,2*], Georgia Fotopoulos[1], Stephen C. Lougheed[2]

[1] Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, ON, K7L 3N6
[2] Department of Biology, Queen's University, Kingston, ON, K7L 3N6 Phone: 647-808-5677, E-mail: danielle.beaulne@queensu.ca

Abstract
This study quantifies the effects that typical airborne light detection and ranging (LiDAR) data modeling options such as tile versus flight-strip input, pixel versus point cloud-based analysis and pixel-based versus object-based classification have on the final land cover classification scheme. Airborne LiDAR data at a resolution of 1pt/m2 were acquired over Queen's University Biological Station (QUBS), a 34km2 near-pristine landscape in Eastern Ontario. QUBS includes areas of open water, marshlands, fields, forests, trails, roads, and scattered infrastructure. The focal species for this study is *Pseudacris crucifer*, a small woodland frog which breeds in wetlands during the spring and spends the rest of the year in forested areas. The dispersal of this species is thought to be influenced by the landscape, a hypothesis informed by previous genetic data. This is in contrast to the neutral expectation for individuals and/or populations to be limited by Euclidean geographic distances between them. This airborne LiDAR data were processed to extract land cover classification information, which is used as input into a landscape resistance model for a genetic study of *Pseudacris crucifer*. These landscape resistance models were assessed in their relative correlation to genetic structuring in *Pseudacris crucifer*. Simulations were conducted to determine the level of errors that affect the interpretation of genetic structure. Landscape resistance models represent each land cover class as a degree of resistance to movement of a focal species, and are used to explain the potential for interaction between organisms or groups of organisms and their environment.

Presentation type: Oral □

B08-04: Steady-state critical loads of acidity and nutrient nitrogen under a changing climate in northern Saskatchewan

Carolyn Murray[1], Colin Whitfield[2]

[1] Global Institute for Water Security, University of Saskatchewan, Saskatoon, SK S7N 3H5
[2] School of Environment and Sustainability & Global Institute for Water Security, University of Saskatchewan, Saskatoon, SK S7N 3H5, Phone: 306-966-2655 , E-mail: colin.whitfield@usask.ca

Abstract
Northern Saskatchewan, Canada is a relatively remote region with low population and few anthropogenic disturbances. Atmospheric deposition of sulphur (S) and nitrogen (N) are elevated in the region, however, and may increase further in the future. Associated impacts of these pollutants could include acidification or eutrophication of the forested upland ecosystems that dominate the landscape. A novel approach for estimating the release of base cations via mineral weathering has been developed and used to calculate steady-state critical loads of acidity (S and N) at 200 upland forest sites in boreal and taiga regions of the province. Weathering rates are extremely low for boreal shield sites, and critical loads of acidity suggest widespread acid-sensitivity, particularly in the northwest. Acid-sensitivity is expected to change in response to projected changes in temperature and water transmission through the rooting zone. Uncertainty-based critical loads of nutrient N determined for forested upland boreal and taiga ecoregions of the province generally decrease from south to north, coincident with the pattern of N deposition. At current N deposition levels, a small number of sites in the southernmost ecoregion are exceeded under both forest harvesting and forest fire disturbance regimes, suggesting a risk of eutrophication over the long-term. Nonetheless, projected increases in water availability and temperature during the 21st century could lead to increases in critical loads of nutrient N owing in part to larger N sinks, lessening the risk of eutrophication.

Presentation type: Oral

B08-05: Impact of soil microclimate and available nitrogen on greenhouse gas spatial variation in a rehabilitated and natural riparian forest

Nathan De Carlo[1], Maren Oelbermann[1], and Andrew M. Gordon[2]

[1] School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, ON, N2L 3G1
Phone: 519-888-4567, E-mail: moelbermann@uwaterloo.ca
[2] School of Environmental Sciences, University of Guelph, Guelph, ON, N1G 2W1

Abstract
Rehabilitation of riparian ecosystems usually occurs in agriculturally dominated areas and can have major impacts on soil microclimate and nitrogen cycling. It was suggested that riparian ecosystems act as greenhouse gas (GHG) hotspots and have large spatial variation in emissions. This study quantified year-around and seasonal soil physical and chemical characteristics, as well as CO_2 and N_2O emissions to determine spatial their variation in a rehabilitated (RH) and undisturbed natural (UNF) riparian forest in southern Ontario, Canada. Three transects were used to set up locations perpendicular to the stream (closest, middle, farthest) to determine how hydrology impacts soil characteristics and GHG emissions. Soil temperature was significantly higher ($p<0.05$) closer to the stream in the RH site during the summer. Soil moisture (%vol) was lowest at the closest location in the RH site ($p<0.05$) and increased with increasing distance from the stream for all seasons. Soil NO_3^- concentration was significantly lower at the closest location than the middle and farthest for the both sites ($p<0.05$), with the exception of the spring in the RH site. Soil NH_4^+ concentration (g N kg_{soil}^{-1}) showed a positive trend with distance for the full year and spring for both land-uses, as well as during the summer in the UNF site. Soil CO_2 emissions were significantly lower at the farthest location ($p<0.05$) during the fall and year-round for the RH site, and were significantly higher ($p<0.05$) at the farthest location for the summer and winter in the UNF site. However, soil N_2O emissions only varied spatially during the summer in the UNF site, where emissions increased with distance ($p<0.05$). These results suggest that soil microclimate plays a large role in soil respiration, whereas N_2O emissions seemed to be driven by available nitrogen and ideal soil conditions for denitrification.

Presentation type: Oral

B08-06: Methylmercury production in urban created wetlands and stormwater ponds

Carl P.J. Mitchell[1] and Rachel J. Strickman[1*]

[1] Department of Physical & Environmental Sciences, University of Toronto Scarborough, Toronto, ON, M1C 1A4
Phone: 416-208-2744 Fax: 416-287-7279, E-mail: carl.mitchell@utoronto.ca

Abstract
When mercury accumulates in aquatic sediment, it may be methylated through the activity of a variety of anaerobic bacteria. The produced methylmercury is the most bioaccumulative mercury form and may biomagnify in some ecosystems to levels that adversely affect consumers of aquatic biota. Wetlands are known "hot spots" of methylmercury production, but relatively little is known about this biogeochemical process in artificial, created wetland systems. Here, we present two years of data where we investigate potential methylmercury production rates using enriched stable isotope assays, mercury concentrations and a variety of ancillary biogeochemical measurements in sediment across multiple stormwater ponds and created habitat wetland systems in urban and suburban landscapes. We additionally tracked these variables across stormwater pond systems before and after dredging, which is a management intervention performed approximately every 10-15 years. Both stormwater ponds and created habitat wetlands produce significant amounts of methylmercury *in situ*, although potential rates are nearer the lower end of observations in other natural wetland systems. Methylmercury production and concentrations are related to wetland age in both types of artificial wetlands, but with opposite trends that are co-related to the accumulation of organic matter (initially much higher in habitat wetland sediment than in stormwater ponds). The methylation capabilities in sediment of stormwater ponds are resilient to dredging, with methylmercury concentrations quickly returning to pre-dredging levels, although with much more spatial variability, within one year. Although these artificial wetlands differ from reservoirs in a number of ways, we find and will discuss some analogies related to the current debate about organic matter removal in hydroelectric reservoirs prior to flooding (e.g., Muskrat Falls, Labrador).

Presentation type: Oral

P01-B08: Long-term dissolved inorganic nitrogen fluxes from paired watersheds in the Canadian High Arctic

Amanda Schevers[1*], Scott Lamoureux[1], Melissa Lafrenière[1]

[1] Department of Geography and Planning, Queen's University, Kingston, ON, K7L 3N6, Phone: 613-533-6000 x75914, E-mail: amanda.schevers@queensu.ca

Abstract

Warming of the Arctic is expected to increase thaw depths, change hydrological flowpaths, and change permafrost. Together these changes can alter nutrient export from watersheds. Permafrost disturbances have been found to increase the export of dissolved inorganic nitrogen (DIN) from High Arctic watersheds by enhancing the nitrification and mobilization of nitrogen previously stored in permafrost soils. This study explores DIN concentrations and fluxes between 2003 to 2016 from two watersheds at the Cape Bounty Arctic Watershed Observatory, Nunavut. Despite similar landscape characteristics, the watersheds, unofficially named East and West, produce substantially different hydrological responses, with the East river typically drying during baseflow conditions. Additionally, extensive physical disturbances occurred in the catchments at the end of July 2007 in response to summer thaw. DIN concentrations and fluxes were divided into nival, baseflow, and stormflow periods to differentiate the timing of DIN export through the season. Concentrations and fluxes are similar, and follow the same general trends in the East and West rivers. During snowmelt, nitrate (NO_3^-) concentrations are low with little inter-annual variability, whereas ammonium (NH_4^+) values are low until 2010 and increase post-2012. Substantial differences between years are evident for baseflow and rainfall periods. In 2008, a large increase in NO_3^- occurred in both rivers following widespread landscape disturbance in the West catchment in July 2007. 2012 is the only year with elevated concentrations of NO_3^- and NH_4^+ during baseflow and rainfall, and coincides with the warmest year that sampling took place (and one of the warmest years on record in the region). By contrast, 2014 was cool, dry, and characterized by abnormally high NH_4^+ and average NO_3^- concentrations. Spatial analysis of 2016 DIN concentrations along the rivers do not show a distinct downstream pattern throughout the season, but rather indicates a complex interaction of inputs, dilutions, and biogeochemical transformations.

Presentation type: Poster

P02-B08: Regulation of Post-Logging N Turnover and Mobile N by Solar Insolation in a Steep Mountainous Rocky Mountain Watershed

David M. Stewart[1*], Uldis Silins[2], Monica Emelko[1], and Micheal Stone[3]

[1]Department of Civil and Environmental Engineering, University of Waterloo, Waterloo, Canada N2L 3G1, Phone: 587-557-5037 E-mail: d.michaelstewart@gmail.com
[2]Department of Renewable Resources, University of Alberta, Edmonton, Canada T6G 2R3
[3]School of Planning and Department of Geography, University of Waterloo, Waterloo, Canada N2L 3G1

Abstract
Although forest harvesting effects on nitrogen (N) cycling and watershed nitrogen export are largely well documented, the factors that govern variation in post-disturbance watershed export of N after forest disturbance across different hydro-climatic regions as less well understood. Specifically, factors that regulate the coupling of N dynamics on hillslopes with receiving streams are not well understood in steeper mountainous terrain where strong spatial variation in radiation, temperature, and nutrient turnover govern post-disturbance catchment exports of N. The objectives of this study were to explore the relative influence of variation in hillslope position (upper vs lower) and radiation load among contrasting south- and north-facing hillslope positions (high and low solar energy gain) in regulating soil nitrogen turnover and mobile nitrogen (NO^-_3) after clear-cut logging in the Rocky Mountains of south-west Alberta, Canada. A combined approach employing replicated measurement of key soil N species in soil solution (using ion exchange membranes) and shallow hillslope pore water N (using suction lysimeters) was used to explore how variation in hillslope position (upper/lower) and radiation load (S/N facing) after clear-cut logging of a Lodgepole pine dominated Rocky Mountain watershed in southwest Alberta. These were compared to parallel measurements in unharvested (reference) hillslopes in the same watershed. Logging was completed in 2015 with measurements of soil and shallow groundwater N at ~6 week intervals from April to Oct. 2016. Compared to other types of forest disturbance (i.e. wildfire) common in this region, clear-cut harvesting did not produce a large impact on both surface and deeper soil solution nitrate with median supply rates of 3.04 and 2.92 [$\mu g/10cm^2$/25-weeks] for reference and harvested stands respectively. Results provide important insights into how disturbance effects on mobile N production among hillslopes of contrasting energy gain, soil moisture, and thermal regimes interact in driving post-disturbance N export in steep, mountainous terrain.

Presentation type: Poster

P03-B08: Phosphorus sorption dynamics in geographically isolated wetlands in the Prairie Pothole Region

Md Aminul Haque[1,2,3*], Cody Ross[1,2,3], Adrienne Schmall[1,2,3], Samuel Bansah[1,2,3], Merrin Macrae[4] Genevieve Ali[1,2,3]

[1] Department of Geological Sciences, University of Manitoba, Winnipeg, Manitoba, R3T 2N2 Canada, Phone: (204) 951-9197, E-mail: haquema@myumanitoba.ca
[2] Manitoba's Watershed Systems Research Program, Winnipeg, Manitoba, R3T 2N2 Canada
[3] Center for Earth Observation Science, University of Manitoba, Winnipeg, Manitoba, R3T 2N2 Canada
[4]Dept. of Geography and Environmental Management, University of Waterloo, Waterloo, ON, Canada, N2L 3G1

Abstract
Wetlands can either act as sinks for nutrients, especially phosphorus (P), or mobilize stored P via various processes. The balance between storage and mobilization processes determines the source versus sink behaviour of a wetland, and is significantly controlled by different biogeochemical factors, including wetland soil properties. Those biogeochemical factors have not been extensively studied in all wetland settings, especially in Prairie pothole wetlands. As pothole wetlands are geographically isolated wetlands (GIWs) and hydrologically different from floodplain wetlands, it is unclear how different P sorption/desorption processes are between these systems. This study therefore aimed to examine physical wetlands characteristics, including wetland soil properties, and the chemistry of wetland water to gain insights into P sorption/desorption processes in pothole wetlands. Ten intact and three consolidated pothole wetlands were selected for study in Broughton's Creek Watershed (Manitoba, Canada). Bi-weekly grab samples of wetland water were collected over a two-year period and tested for soluble reactive phosphorus (SRP). Soil cores were also collected from each of the selected wetlands and analyzed for their particle size distribution, organic matter content, total carbon content, and P sorption properties. Initial analyses show considerable spatial and temporal variations of SRP concentrations in wetland water, with values ranging from 0.0 to 6.06 mg/L. Equilibrium phosphorus concentrations (EPC) of wetland soil ranged from 0 to 2.05 mg/L. For some wetlands, SRP concentrations in wetlands water were always higher than EPC value, suggesting the wetlands act as P sink. However, a few wetlands intermittently showed lower SRP concentration in their water compared to the EPC of their soil, thus fluctuating between a sink and source of P. Initial analyses also show considerable spatial variability in wetland soil properties. Future analyses will focus on establishing the link between those soil properties and the source versus sink behaviour of pothole wetlands.

Presentation type: Poster.

P04-B08: Biofilm Monitoring In Situ of Bioretention Cells

Farhad Jalilian[1], Zhiying Xu[1*], Caterina Valeo[1], Rustom B Bhiladvala[1], Angus Chu[2], Jianxun He[2]

[1]Dept. of Mechanical Engineering, University of Victoria, Victoria, BC, V8W 2Y2, Phone: 250-721-7686, Fax: 250-721-6051, E-mail: farhadj@uvic.ca
[2]Civil Engineering, Schulich School of Engineering, University of Calgary, 2500 University Drive NW, Calgary, AB, T2N 1N4

Abstract
Bioretention cells, also known as rain gardens, retain and treat stormwater quality through a variety of processes including biological. The communities of bacterial biofilm that form around and on plant roots of bioretention cells play an important role in biological water treatment in such vegetated systems. Although the overall process of biofilm establishment is understood, the exact growth profile and timeline is still not well-determined. Having an accurate understanding of biofilm formation and growth helps researchers to make proper design changes in order to reach the highest treatment efficacy. The objective of this research is to develop an inexpensive and informative monitoring system to assess biofilm development and interaction with plant roots that can provide insight into the biological processes occurring in situ. Different monitoring methods such as spectral induced polarization, microscopical, and electrochemical systems have been developed, each with its own advantages and disadvantages. This poster provides a synopsis of the pros and cons of each method and the development of a hybrid system that utilizes aspects of each method for assessing in situ, field scale parameters of biofilm formation relevant to stormwater treatment. The hybrid method is then assessed in an experimental program for in situ monitoring of a bioretention cell experimental site at the University of Victoria. The assessment is conducted in terms of biofilm formation and activity with respect to treatment performance. The assessment is made in comparison with the microscopical method (considered the basis of comparison) and the feasibility of scaling microscale information to the macroscale for an eventual model of biofilm activity in field scale bioretention cells.

Presentation type: Poster

P05-B08: Fuzzy Set Theory Applied to Spatial Interpolation and Modelling of Dioxins and Furans in Marine Sediments

Rob Thomas[1*], Caterina Valeo[1], and Usman T. Khan[2]

[1] Dept. of Mechanical Engineering, University of Victoria, Victoria, BC, V8W 2Y2, Phone: 250-721-8990 Fax: 250-721-6051, E-mail: thomas.rwc@gmail.com
[2] Dept. of Civil Engineering, Lassonde School of Engineering, Toronto, ON, M3J 1P3

Abstract
Dioxins and Furans are persistent environmental pollutants with known toxic effects to human health and are the product of industrial activities in working harbours. The historical nature of working harbours on Vancouver Island and B.C.'s coast indicates that unsafe concentrations of dioxins and furans may be present. In order to remediate these contaminated sediments, specific concentrations and spatial extents must be determined. Currently, the extremely high cost of sample analysis for dioxins and furans may be cost-prohibitive for remediation projects. Current remediation strategies require a high sample density and the use of a Geographic Information Systems (GIS) in conjunction with a chosen method of spatial interpolation. In this research, fuzzy set theory is used to analyze concentration data and perform spatial interpolation. Fuzzy set based methods have the benefit of being able to assist in modelling systems where data is scarce and highly uncertain. Furthermore, these methods allow for a continuous representation of concentrations in a system. Current methods of fuzzy spatial interpolation of geochemical data generally employ the fuzzy c-means method to generate continuous classes from sample data, which are then spatially interpolated using a method such as kriging. Several different methods of fuzzy spatial interpolation are investigated to determine if fuzzy set methods can effectively use lower sample density, thereby lowering remediation costs. To determine the validity of a fuzzy approach with fewer samples, gridded soil geochemical data from a gold exploration project are used to test different fuzzy-spatial methods. To fully characterize dioxin and furan concentration in near-shore coastal environments subsequent fuzzy modelling of contaminated harbour sediments will be required.

Presentation type: Poster

P06-B08: Influence of Rainfall and Temperature on the Distribution of Bacterial Contaminants in Nearshore Areas of the Southern Vancouver Island

Kaifeng Xu[1]*, Zhiying Xu[1], Caterina Valeo[1], Jianxun He[2]

[1]Dept. of Mechanical Engineering, University of Victoria, Victoria, BC, V8W 2Y2, Phone: 250-721-7686 Fax: 250-721-6051, E-mail: kaifengxu@uvic.ca
[2]Civil Engineering, Schulich School of Engineering, University of Calgary, 2500 University Drive NW, Calgary, AB, T2N 1N4

Abstract
The Capital Regional District (CRD) of southern Vancouver Island is a government body representing 13 municipalities and three electoral areas. Assisting these municipalities in developing their stormwater management plans and infrastructure is one of the many services CRD provides and water quality monitoring is one vital aspect of this service. The CRD collects pollutant levels within stormwater pipes, streams and nearshore areas throughout the CRD, including fecal coliforms, with an interest in identifying hotspots and remediating those areas of highest priority. Currently, the sampling frequency is regulated primarily by cost and capacity but increased sampling strategies are advised for locations observed above a certain threshold. However, it is known that fecal coliform contamination in stormwater runoff is directly influenced by rainfall intensities and inter-event durations. A regular sampling scheme that does not consider climate and weather will likely miss peaks in contamination. This research conducts a spatial and temporal analysis of the distribution of fecal coliform throughout the CRD region with attention to the municipalities of Esquimalt, Victoria and Saanich. ARCGIS is used to map the logarithm of the geometric mean of fecal coliform data collected within and adjacent to nearshore areas to identify peaks above a regulated threshold. These data are then correlated to several hydro-climatological parameters calculated at each location: 7, 3, 2 and 1 day rainfall totals, maximum rainfall intensity, degree day, maximum temperature, and antecedent dry period length. In addition, the time of concentration for the drainage area for each sampling location is computed as well. Then a combined regression analysis (using selected parameters) coupled with a simple bacterial growth-decay as a function of time and temperature is developed, calibrated and validated with the observations. This will help to provide insight into better sampling strategies.

Presentation type: Poster

P07-B08: Impact of cereal-legume intercropping on greenhouse gas emissions and microbial functionality

Marianne Ricord[1], Maren Oelbermann[1], Lori Phillips[2], Brent Seuradge[2], and Laura Echarte[3]

[1] School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, ON, N2L 3G1, Phone: 519-888-4567, E-mail: moelbermann@uwaterloo.ca
[2] Agriculture and Agri-Food Canada, Government of Canada, Harrow, ON, N0R 1G0
[3] Instituto Nacional de Tecnología Agropecuaria, Balcarce, Argentina

Abstract
Agricultural soils are the main contributor to increased atmospheric N_2O concentrations, with negative impacts on global climate. Enhanced atmospheric N_2O emissions are due to our dependence on nitrogen (N) fertilizers to enhance crop productivity. Sustainable and resilient practices as alternatives to maintain crop production while reducing N_2O emissions are required. We used a short-term incubation study to determine the resilience of a cereal-legume intercrop to N_2O emissions under nitrifying (60% WHC) and denitrifying (80% WHC) conditions, compared to a legume and cereal sole crop. Microbial functional responses were evaluated by measuring bacterial and archaeal nitrification (*amoA*) and denitrification (*nirk*) genes. Results show that N_2O emissions were similar among crop treatments (control) but increased significantly under conditions favoring nitrification. Under conditions favoring nitrification, N_2O emissions were significantly lower ($p<0.05$) in the intercrop compared to the sole crops. Results show that N_2O emissions were significantly greater ($p<0.05$) in the soybean sole crop compared to the other crop systems under control treatments prior to changing conditions favoring denitrification. Under conditions favoring denitrification, N_2O emissions were significantly greater in the maize sole crop, followed by the soybean sole crop and were lowest in the intercrop. The maize sole crop had a greater NH_{4+}concentration during nitrification (5.82 g N g_{dw}^{-1}) and denitrification (2.60 g N g_{dw}^{-1}) than the intercrop [5.51 g N g_{dw}^{-1} (nitrification); 2.56 g N g_{dw}^{-1} (denitrification)]. Nitrate concentrations under nitrification were the lowest in the intercrops (1.18 g N g_{dw}^{-1}) and the highest in soybean sole crop (1.27 g N g_{dw}^{-1}). Evaluation of *nirk*; and *amo* for archaea, and bacteria to understand the microbial community functionality is currently underway. Preliminary results from this research show that under conditions of nitrification and denitrification, the intercrop system had lower N_2O emissions and therefore showed greater resilience to the production of this greenhouse gas.

Presentation type: Poster