B07: Terrestrial-aquatic interactions: measurement and modelling

Conveners: Murray Richardson[1], and Martin Brummel[2]

Co-chairs: Murray Richardson[1], and Martin Brummel[2]

[1] Department of Geography and Environmental Studies,
Carleton University, Ottawa, ON, K1S 5B6
Phone: 613-520-2600 E-mail: murray.richardson@carleton.ca
[2] Department of Geography and Environmental Management,
University of Waterloo, Waterloo, ON, CANADA N2L 3G1

Session Description

The movement of water, mass and energy through and between ecosystems is a key theme of the biogeosciences section. This session will focus on terrestrial-aquatic interactions and implications for freshwater ecosystems under changing land-use and climate regimes. Specifically, we invite contributions from researchers who focus on measurement and/or modelling of terrestrial landscape processes (e.g. hydrology, biogeochemistry, landscape disturbance), and their implications for the structural and functional characteristics of river, lake and wetland ecosystems. We also encourage contributions in the area of quantitative spatial modelling, and studies that present novel approaches for inferring ecosystem processes from spatial or temporal analysis of information-rich data sources, such as time-series data and remote sensing imagery.

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 B07a

Chairs: Murray Richardson and Martin Brummel **Room: AERL 120**

Wednesday, May 31st

TIME	AUTHORS	TITLE
14:00	A. Jollymore*, M.S. Johnson, & I. Hawthorne	Effects of forest harvest on instream DOC: Insights from high-frequency in situ spectrophotometric measurements of headwater stream biogeochemistry
14:15	B. Branfireun, H.Swanson, & N Zabel	Mercury and methylmercury in tributary inputs to Kluane Lake,Yukon Territory, Canada
14:30	M.A. Gillman*, M.J. Lafrenière, S.F. Lamoureux, & M.K. Hastings	Seasonal dynamics of dissolved inorganic nitrogen along subsurface flow pathways adjacent to a small High Arctic river
14:45	C. Watt*, M. Stone, and U. Silins	Abiotic controls of fine sediment on the mobility of phosphorus in gravel bed rivers
15:00	K. Rasmus*, E. Petticrew & J. Rex	The Seasonal Contribution of Marine Derived Nutrients to the Fine Bed Sediment in the Horsefly River
15:15	D. Tavernini*, T. Hoover, S. Woodman, & S. Rood	Dynamic biophysical interactions in large river ecosystem linkages: a case of leaf litter transport across the terrestrial-aquatic boundary

POSTER SESSION B07

Chairs: Murray Richardson and Martin Brummel **Room: ESB Atrium**

Wednesday, May 31st

Poster No.	AUTHORS	TITLE
P01-B07	M. Strack, V. Daté, F. Nwaishi, R. Andersen & J. Price	Methane emissions from fens in the Athabasca Oil Sands Region, Alberta
P02-B07	M.E. Brummell, L. Tourmel-Courchesne, L. Rochefort, P. Whittington, & M. Strack	Nitrous Oxide emissions at restored, extracted peatland in Manitoba
P03-B07	G. Thiel*, M. Lafrenière, J. Fouché , & S. Lamoureux	Spatial controls on the lability of dissolved organic matter in a High Arctic watershed
P04-B07	J. Vanrobaeys*, D. Lobb & P. Owens	The effectiveness of vegetative buffers for reducing phosphorus losses from agricultural runoff in northern climates
P05-B07	H. Yao, A. Paterson, C. McConnell, R. Ingram, T. Field, A. James, & L. Molot	Non-significant trends in ammonia, nitrate and organic nitrogen at headwater lakes of south-central Ontario under declined loading

P06-B07	M.J. McDowell* & M.S. Johnson	Investigating water balance impacts of Mountain Pine Beetle infestation and forest harvest in British Columbia
P07-B07	K. Kieta &. P. Owens	Phosphorus loss from grass buffer strip species undergoing freezing and thawing

---

SUBMITTED ABSTRACTS

B07-02: Effects of forest harvest on instream DOC: Insights from high-frequency in situ spectrophotometric measurements of headwater stream biogeochemistry

Ashlee Jollymore*[1], Mark S. Johnson[1,2], Iain Hawthorne[2]
*Presenting author (student); ashlee.jollymore@gmail.com; 1-778-838-1845

[1] Institute for Resources, Environment and Sustainability. University of British Columbia, Vancouver, British Columbia, Canada.
[2] Earth, Ocean and Atmospheric Sciences. University of British Columbia, Vancouver, British Columbia, Canada.

Forest harvest has many known impacts on climate and hydrology within affected catchments. Harvest can increase the concentration of instream dissolved organic carbon (DOC) - a water quality parameter critical to ecological function and ecosystem carbon balance that originates primarily from soils within terrestrial-aquatic systems linked through hydrologic pathways. This study investigates how harvest affects the flux and origin of DOC within a small headwater stream by determining DOC concentration and characteristics before and after harvest through extensive clearcutting. In situ absorbance spectrophotometry was used to measure instream DOC at high temporal frequency. DOC concentration was significantly increased within the stream following harvest; such increases in concentration, as well as shifts towards greater runoff (especially within the wet winter months) spurred a significant increase in the DOC flux through the stream. We also measured spectrophotometric proxies for DOC composition, including in situ absorbance as well as discrete measurements of stream fluorescence through highly sensitive 3-D excitation-emission spectra, to track the origin of instream DOC. Dynamics in such proxies suggest a mechanism by which harvest affects the hydrologic pathways that deliver terrestrial organic matter to the stream. Specifically, proxies related to terrestrial, aromatic-like carbon is increased following harvest, suggesting a shift to surficial pathways, especially within wet winter months. DOC characteristics were found to correspond to deeper pathways following harvest, with DOC that was more protein-like in character, suggesting an increased contribution of baseflow pathways. This study illustrates the impact of forest harvest on catchment biogeochemistry mechanistically through both DOC concentration as well as origins, utilizing nearly five years of high frequency in situ measurements (alongside grab sampling) to capture the dynamisms of DOC biogeochemistry before and following forest harvest.

Presentation type: Oral

B07-09: Mercury and methylmercury in tributary inputs to Kluane Lake, Yukon Territory, Canada

Brian Branfireun, [1], Heidi Swanson[2], Nelson Zabel[2]

[1] Dept. of Biology and Centre for Environment & Sustainability, University of Western Ontario, London, Ontario, Canada. 519-661-2111 x 89221 (bbranfir@uwo.ca)
[2] Dept. of Biology, University of Waterloo, Waterloo, Ontario, Canada

Abstract
Kluane Lake is in the Yukon Territory, Canada, and is part of the traditional territory of the Lù'àn Män Ku Dän, the Kluane Lake People who in part depend on Kluane Lake as an important source of subsistence food fishes. Although situated in a relatively remote and pristine region, community interest in contaminant levels in food fishes supported intensive research on mercury (Hg) in the in Kluane Lake, and instigated a pilot-scale investigation of Hg and methylmercury (MeHg) in the waters and sediments of its tributary inputs. We found that total Hg concentrations ([THg]) varied considerably among tributaries (<0.05 to 1.1 ng/L for filtered, and from 0.1 to 25 ng/L unfiltered), with elevated unfiltered [THg] largely reflecting a significant suspended sediment load in some glacier-fed streams. Methyl mercury concentrations ([MeHg]) were below detection (0.006 ng/L) for many streams, but two of the larger tributaries to the lake had measureable MeHg concentrations (0.010 – 0.040 ng/L). The largest inflow to Kluane Lake, the Slims River, had dissolved [THg] and [MeHg] below detection. We found important relationships among [Hg], [MeHg] and the quantity and quality of dissolved organic carbon (DOC) in tributary waters. Dissolved [MeHg] was positively related to [DOC]. There was no relationship between [THg] and [DOC], but [THg] was inversely related to fluorescence measures of organic matter freshness, and positively related to measures of humification, suggesting that dissolved [THg] is being derived from well-humified sources of organic matter. Currently, Kluane Lake has low dissolved [Hg] because the largest, glacially-dominated tributary input has low [Hg] and [DOC]. As the importance of glacier-derived inputs decrease, the importance of other higher [Hg] and [DOC] tributaries will increase. Although all waters in this catchment are dilute, climate-change driven shifts in runoff could drive a shift in lake water chemistry and Hg availability in the future. [300 words]

Presentation type: Oral Presentation

B07-06: Seasonal dynamics of dissolved inorganic nitrogen along subsurface flow pathways adjacent to a small High Arctic river

Matthew A. Gillman[1*], Melissa J. Lafrenière[1], Scott F. Lamoureux[1], and Meredith K. Hastings[2]

[1]Department of Geography and Planning, Queen's University, Kingston, ON, K7L 3N6, Phone: (519) 373-6349, E-mail: m.gillman@queensu.ca
[2]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI, 02912

Abstract
Subsurface flow pathways adjacent to streamflow are an important hydrological control over nutrient cycling and delivery, however, an acute knowledge gap exists regarding these relationships in the High Arctic. The objective of this research is to assess the speciation and concentrations of dissolved inorganic nitrogen (DIN) along hydraulic gradients perpendicular to a small High Arctic river. Water samples from six piezometer transects (~40 sample sites) along a 300m reach were collected during five sampling days spanning July 05 – August 03, 2016. Results show high spatiotemporal heterogeneity in concentrations of nitrate ($[NO_3^-]$) and ammonium ($[NH_4^+]$). $[NO_3^-]$ and $[NH_4^+]$ consistently decreased along flow pathways as inferred by hydraulic gradients at two transects. A third transect showed decreases in $[NO_3^-]$ and increases in $[NH_4^+]$ along the flow pathway, with the exception of one sampling day, on which both DIN species increased along the flow pathway. A fourth transect intersected a former channel in the floodplain, which acted as a subsurface preferential flow pathway (PFP). Within the PFP $[NO_3^-]$ remained relatively low (<0.08 ppm-N) until July 25, after which concentrations increased (>0.2 ppm-N) and remained elevated. Sampling at a final transect, which bisected a water track, began on July 16th and showed generally constant $[NO_3^-]$ and $[NH_4^+]$ values along the flow pathway, with decreases and increases over time, respectively. Results highlight the spatiotemporal heterogeneity of subsurface DIN dynamics and the importance of subsurface hydrology and PFPs as controls. A next step is to assess stable nitrate isotopes to provide insight into sources and cycling processes under varying hydraulic settings and positions along transects. This research is an important step towards improving our understanding of hydrological controls on DIN dynamics in the High Arctic, and how changes associated with increased permafrost thaw and rainfall may progress.

Presentation type:

Oral Presentation (preferred) or Poster

B07-12: Abiotic controls of fine sediment on the mobility of phosphorus in gravel bed rivers

Caitlin Watt[1*], Micheal Stone[1], and Uldis Silins[2]

[1] Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON N2L 3G1 Phone: 519 -888-4567 Ext 33067 E-mail: mstone@uwaterloo.ca
[2] Department of Renewable Resources, University of Alberta, Edmonton, AB, T6G 2H1

Abstract
Land disturbance in forested regions can have a strong and long lasting impact on the form and mobility of sediment associated phosphorus (P) in rivers. The downstream propagation of P is related to the source, transport and fate of fine grained sediment which can act as either a source or sink of dissolved P through biotic and abiotic processes. Little is known about abiotic processes and the geochemical mechanisms that regulate P mobility in gravel bed rivers that drain disturbed forested landscapes in Canada. Abiotic processes can be quantified by determining the equilibrium P concentration at zero net sorption or desorption (EPC). Measurements of EPC can provide a relative assessment of the ability of fine sediment to supply P to the water column especially at low flow conditions. In this study, fine river bed sediment was collected at six locations in a downstream gradient reflecting multiple land uses in the Crowsnest River, Alberta. The abiotic control of this material was determined using batch isotherm experiments and the distribution of dissolved P in the river bed and water column were measured with porewater peepers. Physico-chemical characteristics of the sediment and environmental conditions in the stream bed and water column were assessed to identify factors regulating P release. Sediment pore water concentrations varied with depth and landscape disturbance. Notably higher dissolved P concentrations were observed at a site downstream of a wastewater treatment facility. Measurements of EPC indicate that bed sediments were acting as a source of dissolved P to the water column. Factors that influenced the EPC include particle size, sediment geochemistry, dissolved oxygen and land use. Best management practices that reduce sediment inputs to the river are necessary to control P dynamics and its impacts on stream ecology.

Presentation type: Oral Presentation

B07-10: The Seasonal Contribution of Marine Derived Nutrients to the Fine Bed Sediment in the Horsefly River

Kristy Rasmus[1*], Ellen Petticrew[2] and John Rex[3]

[1] Geography Program, University of Northern British Columbia Prince George, BC, Phone: 250-608-0289 E-mail: rasmus@unbc.ca
[2] Geography Program, University of Northern British Columbia Prince George
[3] Ministry of Forests, Lands, and Natural Resource Operations & Geography Program, University of Northern British Columbia Prince George

Abstract
In the fall of 2014 DFO counted 223,425 sockeye salmon in the Horsefly River in the Central Interior of BC. During and following the active spawn the river received a pulse of marine derived nutrients (MDN) from the metabolic wastes of the live salmon and the decaying carcasses. The value of these nutrients to the functioning of the riverine ecosystem depends on if, where, and for what time period these nutrients are retained in the river system. Understanding the conditions necessary for retention or transport of MDNs is key to future stream management and restoration. Re-suspended fine bed sediment samples were collected at seven sites spaced along the channel during the fall of 2014 and the spring/summer of 2015. Bed sediment was analyzed for the marine derived stable isotopes of nitrogen and carbon ($\delta^{13}C$ and $\delta^{15}N$), the ratio of carbon to nitrogen (C/N), and the ratio of organic to inorganic matter (OMR). Seasonal contribution of the MDNs to the bed sediment was analysed using linear mixed-effects (LME) models and a Bayesian mixing model, mixSIAR (Parnell, 2010). The isotopic signature of the fine bed sediment between 2014 pre-spawn to 2015 post-freshet varied significantly both temporally and spatially at sites where salmon were present. No significant differences existed between seasons at the control site (located upstream of a natural salmon barrier). Correlations suggest that spatial variation may be strongly related to non-salmon nutrient inputs, and temporal variation to river discharge. The isotopic signatures of the bed sediment along with the isotopic signatures from a variety of types of aquatic vegetation, riparian herbaceous vegetation and tree/shrub leaf litter were used as inputs in mixSIAR. The mixing model results from the sites where salmon were present corroborated the LME and correlation results.

Presentation Type: Oral Presentation

B07-01: Dynamic biophysical interactions in large river ecosystem linkages: a case of leaf litter transport across the terrestrial-aquatic boundary

David Tavernini[1*], Trent Hoover[2], Sam Woodman[3], Stewart Rood[3]

[1] Stream and Riparian Research Lab, University of British Columbia, Vancouver, BC, V6T 1Z4

[2] Department of Geography, University of Lethbridge, Lethbridge, AB, T1K 6T5 Phone: (403) 394-3906 Email: trent.hoover@uleth.ca [3] Department of Biological Sciences, University of Lethbridge, Lethbridge, AB, T1K 6T5

Abstract

A suite of processes acts in concert to link riparian and stream ecosystems through the transfer of energy, particularly in the form of leaf litter. In larger streams, direct contributions of leaf litter are generally considered to be of little importance due to the small proportion of channel margin to the size of the channel. However, many of the contemporary models overlook the role of a number of physical processes in the dynamics of terrestrial-aquatic coupling. Using the Oldman River, a large grassland river in Southern Alberta, we conducted a number of experiments to test the effects of leaf morphology and wind speed on leaf litter transport distance. Coupling these data with forest characteristics of the Oldman River valley, we developed a discrete-time biomass transport model to compare leaf litter transport in ambient and gusting wind conditions commonly observed in the region. Our findings indicate the substantial role that various biophysical processes play in the dynamics in riparian-stream coupling. This study emphasizes the need to consider spatio-temporal variation of environmental conditions in the strength of terrestrial-aquatic linkages.

Presentation Type: Oral Presentation (Preferred) or poster

B07-04: Methane emissions from fens in the Athabasca Oil Sands Region, Alberta

Maria Strack[1], Vinay Daté[1], Felix Nwaishi[1], Roxane Andersen[2] and Jonathan Price[1]

[1] Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON, N2J 3W2, Phone: 519-888-4567 x30164, mstrack@uwaterloo.ca
[2] Environmental Research Institute, University of the Highlands and Islands, Thurso, UK

Abstract
Land reclamation following oil sands extraction aims to create ecosystems with equivalent capability to the predisturbance landscape, with recent focus that this capability should be evaluated based on ecosystem function. In order to evaluate the return of any given ecosystem function, the range of this function in reference ecosystems in the region must be quantified. Saturated soils in peatlands result in anoxic conditions and the production and release of methane (CH_4). Fen peatlands dominate the Athabasca oil sands region (AOSR); however, very few studies have quantified fen CH_4flux. We measured CH_4 flux and pore water concentration at triplicate hummocks and hollows in each of four site types across three diverse reference fens in the AOSR from 2011-2014: treed poor fen, open poor fen, treed rich fen and saline fen. Methane production potential was also measured for peat from each fen. Methane flux varied greatly between the sites and study years with total growing season release ranging from close to 0 to >13 g CH_4-C m^{-2}. Over the entire study period mean growing season flux was greatest at the open poor fen and lowest at the saline fen. High sulphate concentration at the saline fen contributed very low CH_4 production potential resulting in low flux in dry years, while in wetter years inundated conditions resulted in CH_4 emissions similar to the poor fen. Overall, CH_4 emission was positively correlated to water table position, but the relationship was significantly different between peatland site types. The high level of interannual variability indicates that multiple study seasons are required to estimate mean CH_4emission for use as reference data for functional evaluation of ecosystem reclamation. [272 words]

Presentation type: Oral Presentation

B07-07: Nitrous Oxide emissions at restored, extracted peatland in Manitoba

Martin E Brummell[1], Laurence Tourmel-Courchesne[2], Line Rochefort[2], Pete Whittington[3], and Maria Strack[1]

[1] Dept. Geography and Environmental Management, University of Waterloo, Waterloo, ON, N2L 3G1, Phone: 519-888-4567, ext. 33551 E-mail: martinbrummell@gmail.com
[2] Université Laval, Quebec City, QC
3 Brandon University, Brandon, MB

Abstract
Nitrous oxide (N_2O) is a powerful greenhouse gas that may be produced or consumed by soil microorganisms as they metabolize organic and mineral nitrogen. In peatlands and other water-saturated, organic-rich soils both the production and consumption of N_2O are possible under conditions of restricted oxygen availability. Few studies have examined emissions of N_2O in Sphagnum extracted peatlands with completely exposed underlying sedge-peat layers or minerotrophic peatlands that have been restored, particularly in Canada. Here we present measurements of N_2O flux in closed chambers at plots throughout a fen peatland complex in eastern Manitoba, Canada, during the growing seasons of 2015 and 2016, with associated measurements of water table position, air and soil temperature, and other parameters. Parts of the studied peatland have been subject to some restoration activities, while others have been recolonized by wetland plants (largely tall sedges) with little human involvement. Across the peatland, N_2O emissions are highly variable, with most measurements indicating zero net flux though with scattered hot spots and hot moments appearing at times throughout the measurement period, including in relatively undisturbed areas as well as bare peat.

Presentation type: Either Oral Presentation or Poster

B07-03: Spatial controls on the lability of dissolved organic matter in a High Arctic watershed

Gillian Thiel[1*], Melissa Lafrenière[1], Julien Fouché [1], and Scott Lamoureux[1]

[1] Department of Geography and Planning, Queen's University, Kingston, ON, K7L 3N6 Phone: 604-364-8442, E-mail: gillian.thiel@queensu.ca

Abstract

Climate warming in the High Arctic enhances permafrost thaw and alters active layer characteristics. Arctic permafrost contains large stores of soil organic matter (SOM), which once thawed or exposed by disturbance, are vulnerable to mobilization and microbial decomposition. Resultant greenhouse gas emissions contribute to the permafrost carbon feedback, thus amplifying climate warming. The fraction of SOM vulnerable to rapid microbial decomposition is characterized as labile. However, controls on permafrost SOM lability are poorly understood. This study investigates the spatial and seasonal variability of dissolved organic matter (DOM) lability at the Cape Bounty High Arctic Watershed Observatory on Melville Island, NU. Water samples were collected from 7 surface water bodies judged to be primarily sustained by subsurface water sources. Each site was sampled between July 12-24th (early-season) and again on August 8th (late-season). Triplicate samples were incubated for 5 different time steps over 28 days: 0, 2, 7, 14, and 28 days. Samples were analyzed for dissolved organic carbon (DOC), total dissolved nitrogen, dissolved inorganic nitrogen species (DIN; $NO3^-$, $NO2^-$, and $NH4^+$), and fluorescence-absorbance properties. Labile DOM was quantified as the concentration of DOC lost over the incubation period. Overall, DOM lability exhibited a positive correlation with specific conductivity (SC; $r=0.749$, $p<0.01$) and DIN concentrations ($r=0.797$, $p>0.05$). Preliminary results indicate that early-season samples contained more labile DOM than late-season samples. However, the highest DOC concentrations and DOC loss (71 ± 18%) were observed in a late-season sample from a pond at the base of a break in slope, characterized by extremely high SC (2459 μS). Results of this study will contribute to a better understanding of the size and spatial variability of subsurface DOM lability which will serve to develop more accurate models of the permafrost carbon feedback and predict the effects of permafrost thaw and disturbance on riverine DOM export. [300 words]

Presentation type: Poster

B07-11: The effectiveness of vegetative buffers for reducing phosphorus losses from agricultural runoff in northern climates

Jason Vanrobaeys[1,2*], David Lobb[2], Phil Owens[3]

[1]Agriculture and Agri-Food Canada, Morden, MB, R6M 1Y5
Phone: (204) 822-7580 Email: Jason.Vanrobaeys@AGR.GC.CA
[2]Dept. of Soil Science, University of Manitoba, Winnipeg, MB, R3T 2N2
[3]Dept. of Natural Resources and Environmental Studies, University of Northern British Columbia, Prince George, BC, V2N 4Z9

Abstract
Vegetative buffers are often promoted as a means to improve water quality in agricultural regions. However, much of the evidence to support their effectiveness has come from warm regions dominated by rainfall driven runoff. In 2015, a study was initiated at Agriculture and Agri-food Canada's Morden Research and Development Centre in Manitoba to assess the performance of vegetative buffers to reduce phosphorus (P) levels in runoff. Three vegetative buffer strips along with three adjacent crop strips were established in drainage channels within a cropped field. Each 20 meter long strip was equipped with a weir or an embankment and outlet pipe to collect runoff samples as they entered and exited each strip. Between October 2015 and October 2016, samples were collected for 20 runoff events, 12 were produced by pumping or releasing water from holding ponds, 7 resulted from rainfall, and 1 from snowmelt. The samples were analyzed for total phosphorus (TP), dissolved phosphorus (DP), and total suspended solid (TSS) concentrations. Soil and vegetation samples were also collected within each strip in the fall of 2015 and in the spring and fall of 2016 and analyzed for P content. The change in P concentration in runoff water entering and leaving the vegetative buffers and crop strips will be presented and key factors affecting buffer performance will be discussed. Implications for designing and managing buffers to treat agricultural runoff in this climate will be explored.

Presentation type: Poster Presentation

B07-05: Non-significant trends in ammonia, nitrate and organic nitrogen at headwater lakes of south-central Ontario under declined loading

Huaxia Yao[1,2], Andrew Paterson[1], Christopher McConnell[1], Ron Ingram[1], Timothy Field[1,2], April James[2], and Lewis Molot[3]

[1] Dorset Environmental Science Centre, Ontario Ministry of the Environment and Climate Change, Dorset, Ontario, P0A 1E0, Phone: 705-766-2413 Fax: 705-766-2254, E-mail: huaxia.yao@ontario.ca

[2] Department of Geography, Nipissing University, North Bay, ON, P1B 8L7

[3] Faculty of Environmental Studies, York University, Toronto, ON, M3J 1P3

Abstract

Concentrations of many chemicals (e.g. base cations, sulphate, phosphorus) have declined significantly in inland lakes within south-central Ontario over the last four decades, due to recovery from acidification, and reduced atmospheric deposition or catchment loading to lakes. However, this has not been the case for nitrogen. To explore the non-significant trends in some forms of lake nitrogen concentrations under declining trends in atmospheric deposition and catchment loading, especially nitrate,, annual mass balance analyses were conducted for each of four nitrogen forms (ammonia NH3/NH4-N, nitrate NO3-N, total organic nitrogen TON, and total nitrogen TN) for three headwater lakes (Harp, Dickie, Red Chalk) in south-central Ontario, using 36-years of monitoring data. Annual deposition onto the lake, loading from catchment runoff, export from the lake, and storage change in lake water were calculated from weekly-to-monthly sampled concentrations and daily measured water flows. An unmeasured portion, representing N losses to sediments and atmosphere, was estimated with a mass balance equation. Among the 12 scenarios examined (i.e., ammonia, nitrate, TON and total N in 3 lakes), nitrogen concentrations did not change significantly in eight. Steady state mass balance considerations suggest that declining runoff (increased residence time) and/or declining N losses to sediments and the atmosphere can explain constant concentrations under declining loads. Since there were no significant trends in lake residence times, the strong declines in loading which would otherwise have led to clear declines in lake concentrations were probably compensated for, or offset, by declines in losses to sediments and the atmosphere. Compensation clearly existed in six of the 12 scenarios. Declines in phosphorus loading, lake phosphorus concentrations, and algal biomass at each lake suggest that decreases in algal uptake of nitrogen resulted in decreased transfer to sediments. [284 words]

Presentation type: Poster Presentation

B07-08: Investigating water balance impacts of Mountain Pine Beetle infestation and forest harvest in British Columbia

Mollie J. McDowell[1*] and Mark S. Johnson[1,2]

[1] Department of Earth, Ocean, and Atmospheric Sciences, University of British Columbia,
Email: mmcdowel@eoas.ubc.ca, Phone: 236-999-5941
[2] Institute for Resources, Environment, and Sustainability, University of British Columbia

Abstract
The mountain pine beetle (MPB) infestation that began in the early 1990s killed 54% (~730 million m^3) of British Columbia's lodgepole pine volume. Studies attribute the severity and extent of the infestation to climatic suitability for outbreak occurrence, particularly milder winters and warmer summers. MPB infestation has begun to extend beyond its historic range, with future climate change expected to exacerbate MPB infestation throughout Canada's boreal forest by reproducing in jack pine. Salvage harvesting efforts of lodgepole pine in the province have aimed to reduce fire risk and provide economic benefits, but environmental impacts of such efforts, such as changes to the regional water balance, require further research. This study investigates spatial and temporal relationships between evapotranspiration (ET), MPB infestation, and forest harvest in British Columbia (BC), Canada over a 14-year period (2000-2014). Datasets used for analysis include the MODIS ET product MOD16A2, the BC Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) product of cumulative pine mortality developed for the BCMPB projection model, and the BC MFLNRO product of harvested areas in BC. We conducted preliminary analyses using the Google Earth Engine (GEE) geospatial processing platform, which facilitates analysis of remotely-sensed imagery. Preliminary results for a watershed in the Kamloops area indicate that MPB-infested areas that were harvested had only slightly lower (4%) mean annual ET than MPB-infested areas that have not been harvested. In this presentation, we evaluate infestation, harvest, and ET dynamics at the provincial level. [240 words]

Presentation type: Poster

B07-09: Investigating water balance impacts of Mountain Pine Beetle infestation and forest harvest in British Columbia

Kristen Kieta[1]* – University of Northern British Columbia
Phil Owens[1] – University of Northern British Columbia

[1]Department of Natural Resources and Environmental Studies,
University of Northern British Columbia, Prince George, BC, V2N 4Z9
Phone: 250-981-5422 Email: kieta@unbc.ca

Abstract
Vegetated buffer strips are a common management practice used in agricultural landscapes because of their effectiveness in reducing the transport of sediments and nutrients, including phosphorus (P), to surface water. In northern climates, these landscapes are prone to numerous freeze-thaw cycles (FTCs) throughout winter and spring, causing plant cells to lyse and release P during the freshet. Greenhouse experiments and field research were undertaken to further understand buffers as a potential P source. Timothy grass was grown in a greenhouse in soil treated with either 80 kg/ha of mono-ammonium phosphate fertilizer (12:61:0) or in un-amended soil. Shoots were harvested 65 days after planting and 3g samples were subjected to 0, 3, or 6 FTCs consisting of 8 hours at +4°C and 16 hours at -20°C. After completion of FTCs, samples were shaken in 100 mL of deionized water and analysed colorimetrically for water extractable P (WEP) after filtration, and for total P (TP) after an alkaline persulfate digestion. Results showed no significant difference in WEP concentrations between soil P treatments, but that WEP concentrations increased significantly with increased FTCs. After 6 FTCs, 67-100% of TP from water extracts was released as WEP, and 19-55% of biomass TP was released as WEP. Field research in Morden, MB, investigated potential P loss from buffer vegetation. Triplicate samples of meadow foxtail shoots were harvested from an established buffer within a 0.50m by 0.50m quadrat. Samples taken in September 2015 and March 2016 were analysed for TP by ICP-OES. Results showed a 24% loss of TP within shoot biomass from September to March, much of which was likely released by lysed cells in the vegetation. Both the controlled experiments and field work indicate that harvesting and removing vegetation could be a P reduction strategy, but additional research to understand potential negative implications is needed.

Presentation type: Poster Presentation