H10: Catchment hydrological and biogeochemical behaviour in human-dominated landscapes

Conveners: Claire Oswald[1], Merrin Macrae[2] and Christopher Wellen[3]
Co-chairs: Claire Oswald[1], Merrin Macrae[2] and Christopher Wellen[3]

[1]Geography and Environmental Studies Dept., Ryerson University,
Toronto, ON, M5B 2K3
Phone: 416-979-5000 Fax: 416-979-5362, E-mail: coswald@ryerson.ca
[2]Geography and Environmental Management Dept., University of Waterloo,
Waterloo, ON, N2L 3G1
Phone: 519-888-4567 Fax: Email: mmacrae@uwaterloo.ca
[3]Great Lakes Institute of Environmental Research, University of Windsor,
Windsor, ON, N9B 3P4
Phone: 519-253-3000 Fax: 519-971-3616, E-mail: Christopher.Wellen@uwindsor.ca

Session Description
Urban, urbanizing and agricultural landscapes (i.e. where we live and where we get our food from) are ubiquitous across Canada. Alterations to drainage networks and elevated inputs of materials such as nutrients, salts, metals, and organic compounds have fundamentally changed the hydrological and biogeochemical functioning of these areas. The goal of this session is to bring together a broad range of research that examines the impacts of human alterations to the landscape to coupled hydrological and biogeochemical processes. Some themes of interest include, but are not limited to, impacts of extreme weather events on hydro-biogeochemical fluxes, agricultural intensification and the functioning of mixed urban and agricultural basins. Studies that address scaling effects and/or use novel field- and modelling-based approaches to explicitly link water sources and flow pathways to biogeochemical patterns are especially encouraged.

Primary Affiliation: CGU / Hydrology / Biogeoscience

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 H10a

Chairs: C. Oswald, M. Macrae, C. Wellen **Room: EOSC 135**

Monday, May 29th

TIME	AUTHORS	TITLE
11:00	M. Walker, G. Ali, M. Macrae, L. Blunden & K. Vivekananthan	On the importance of preferential flow in agricultural soils: do organic amendments matter?
11:15	V. Kokulan*, M. Macrae, G. Ali & D. Lobb	Climatic controls on activation of runoff pathways in a vertisolic heavy clay soil in an artificially drained near-level landscape
11:30	M. Shafii*, N. Basu, S. Schiff & P. Van Cappellen	Impact of changes in snowmelt dynamics on hydrology and Nitrogen fluxes in the Grand River watershed
11:45	S. Satchithanantham, B. English & H. Wilson	Effect of vegetation type and season on uptake of dissolved nutrients with runoff through riparian buffers in Southwestern Manitoba
12:00	E. Hassanzadeh, G. Strickert, B. Noble, H. Baulch, K.E. Lindenschmidt	Socio-hydrology component of Water Quality Modeling in the Qu'Appelle River Valley
12:15	J. Richardson, L. Garcia, L. Kuglerova, B. Kielstra, A. Chara Serna & I. Pardo	Stream food webs and their ecological functions are compromised by catchment land-use intensity

ORAL SESSION H10b

Chairs: C. Oswald, M. Macrae, C. Wellen **Room: EOSC 135**

Monday, May 29th

TIME	AUTHORS	TITLE
16:00	A. Kayembe* & C.P.J. Mitchell	Determination of the drainage boundaries of a complex urban watershed
16:15	M. Carpenter, C. Oswald, C. Wellen & S. Oni	Modelling the Transport and Retention of Chloride using INCA-Cl in the East Holland Watershed
16:30	C. Ash*, S. Melles & C. Oswald	Geostatistical modeling of road salt contributions to in-stream chloride concentrations across a gradient of urbanization
16:45	M.R. Anis*, A. Pietroniro, M. Elshamy, S. Razavi & H. Wheater	Effects of irrigation on the water and energy balances of the Bow river basin in Alberta, Canada

17:00	I.C. Ilampooranan* & N. Basu	Modeling nitrogen legacies and time lags in agricultural landscapes using Soil Water Assessment Tool (SWAT)
17:15	C. Wellen, N. Basu, W. Sellier, J. Liu, A. To, P. Van Cappellen, M. Mohamed	A meta-analysis and review of the effectiveness of agricultural conservation measures at field and watershed scales

POSTER SESSION H10

Chairs: C. Oswald, M. Macrae, C. Wellen **Room: ESB Atrium**

Tuesday May 30th

Poster No.	AUTHORS	TITLE
P01-B01	C.J. Oswald, S. Melles, M. Macrae & C. Wellen	Untangling the hydrologic and land use/cover drivers of impaired water quality in an agricultural catchment in southern Ontario
P02-B01	A. Kayembe* & C.P.J. Mitchell	Assessing nested and cumulative hydrological and chloride behaviour of a highly urbanized watershed

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SUBMITTED ABSTRACTS

H10-01: On the importance of preferential flow in agricultural soils: do organic amendments matter?

Matthew Walker[1], Genevieve Ali[2], Merrin Macrae[3], Laura Blunden[1], Kokulan Vivekananthan[3]

1: Department of Environment and Geography, University of Manitoba
2: Department of Geological Sciences, University of Manitoba, Phone: (204) 474-7266, Email: genevieve.ali@umanitoba.ca
3: Department of Geography and Environmental Management, University of Waterloo

Abstract
The potential impact of organic amendments on water infiltration rates and preferential flow in soils has not received much attention. The goal of this study was therefore to conduct a tracing experiment to: (i) examine the relative importance of matrix flow and preferential flow in agricultural vertisols; and (ii) evaluate the impact of manure on those dynamics. One control plot and one test plot were chosen on a canola field near Culross, Manitoba. The test plot was sprayed with 5L of liquid pig manure, and brilliant blue dye mixed with deionized water was sprinkled on both plots to simulate a convective storm. In each plot, soil water samples were collected one week before, two hours before and six hours after sprinkling. Both plots were also excavated three days after sprinkling so that vertical soil profiles could be photographed. Soil water samples, the applied manure and the dyed water were tested for δ18O and δ2 H. As for the bluestained soil profile images, they were classified into one of five potential soil water flow types, from homogeneous matrix flow to exclusive macropore flow. Results show that dye stains reached depths of 45 cm and 64 cm for the test and control plots, respectively. Matrix flow was mostly present at shallow depths while macropore flow extended further down. For the control plot, δ18O and δ2 H values in soil water were similar to those in dyed water. For the test plot, however, δ18O and δ2 H values in post-sprinkling soil water were similar to those in soil water from the previous week, suggesting the movement of old water. We therefore hypothesize that the manured soil was dominated by the macropore flow of old water, and we offer suggestions for testing that hypothesis over a large array of agricultural soils with organic amendments.

Presentation type: Oral

H10-02: Climatic controls on activation of runoff pathways in a vertisolic heavy clay soil in an artificially drained near-level landscape

Vivekananthan Kokulan[1*], Merrin Macrae[1], Genevieve Ali[2] and David Lobb[3]

[1]Department of Geography and Environmental Management, University of Waterloo, ON.
Phone: 416-898-1707 E-mail: kvivekan@uwaterloo.ca
[2] Department of Geography, University of Manitoba, MB,
[3] Department of Soil Science, University of Manitoba, MB.

Abstract
Water quality issues are occurring in large lakes across Canada and elsewhere. Land management practices such as tile drainage have the potential to reduce or amplify these issues; thus, the expansion of tile drainage in agricultural settings is controversial. Runoff generating mechanisms have not been investigated in artificially drained agricultural landscapes with vertisolic heavy clay soils that are prevalent in many parts of North America. The objective of this study is to evaluate the role of climate drivers on the activation of overland (OF) and tile (TF) flow in a heavy clay soil in the Red River Valley. On a working farm field in Southern Manitoba, 24 rainfall events were monitored between April-October in 2015 and 2016. OF was observed ahead of TF in 15 out 17 events where both OF and TF were observed. Maximum rainfall intensity significantly affected the timing of OF initiation ($p=0.001$) and TF activation ($p=0.023$), where responses were more rapid with greater intensity rainfall. TF initiation was also affected by 14-day antecedent precipitation ($p=0.001$), where responses occurred more rapidly under wetter conditions. However, when events were split by season, the data suggests that the activation of flow in tiles during spring is mainly controlled by antecedent soil moisture and rainfall intensity. In contrast, high intensity short duration summer thunderstorms often favored the activation of the Hortonion OF and tile activation was delayed. Summer rain appeared to bypass soils through desiccation cracks and tile flow was only initiated when the GW table rose to the tile depth. This work improves scientific understanding of the drivers of runoff activation in tile drainage in heavy clays under a Prairie climate. This work has implications for an improved understanding of the impacts of the expansion of tile drainage on runoff and biogeochemical processes in agricultural landscapes.

Presentation type: Oral Presentation

H10-03: Impact of changes in snowmelt dynamics on hydrology and Nitrogen fluxes in the Grand River watershed

Mahyar Shafii[1*], Nandita Basu[1,2], Sheryy Schiff[1], and Philippe Van Cappellen[1,3]

[1] Dept. of Earth and Environmental Sciences, University of Waterloo, 200 University Av W, Waterloo, ON, N2L3G1 Email: mshafiih@uwaterloo.ca
[2] Dept. of Civil and Environmental Engineering, University of Waterloo
[3] Canada Excellence Research Chair in Ecohydrology, University of Waterloo

Abstract
Winter climate is crucially important in regulating fluxes and sources of Nitrogen leached during snowmelt. As a result, Nitrogen cycling is strongly related to temperature in snowmelt-dominated watersheds. The projected increase of temperatures due to global warming implies future variations of snowmelt dynamics, and therefore, changes in seasonal hydrological and biogeochemical patterns. This study involves using Snow Water Equivalent (SWE) data obtained from satellite imagery, hydrometry data, and multi-year Nitrogen data collected at different locations along the main stream in a macro-scale watershed to understand the impact of snowmelt changes on Nitrogen export. Our focus is on the Grand River Watershed (GRW) located in Southwestern Ontario with the surface area of 7000 km^2. The main objectives of this research are (i) to utilize satellite SWE data to extract the spatio-temporal variability in snowmelt, (ii) to investigate the sensitivity of Nitrogen loss from the watershed to changes in snow dynamics over years, and (iii) to quantify the contribution of snowmelt to water and nutrient exports in GRW. Grand River is a major stream flowing into Lake Erie, and understanding nutrients export from GRW, especially during severe snowmelts, has implications for eutrophication and algal blooms in the lake.

Presentation type: Oral Presentation

H10-04: Effect of vegetation type and season on uptake of dissolved nutrients with runoff through riparian buffers in Southwestern Manitoba

Sanjayan Satchithanantham[1], Blair English[1], and Henry Wilson[1]

[1]Brandon Research and Development Centre, Agriculture and Agri-Food Canada, Brandon, MB
Phone: 204-578-6557 Email: Henry.Wilson@agr.gc.ca

Abstract

Uncertainty remains regarding the potential effectiveness of riparian buffers for retention of nutrients from surface runoff in cold regions, where a high proportion of nitrogen and phosphorus transport may occur with snowmelt and as dissolved rather than particulate forms. In addition, most movement of water through these buffers tends to occur through concentrated surface pathways rather than as sheet flow. In the research presented here the retention of nitrate and dissolved phosphorus were measured using pulsed releases of a conservative tracer and dissolved nutrients to channelized flow at 19 riparian sites in Southwestern Manitoba where upland was primarily agricultural. Vegetation was dominated by either grass or tree species and release experiments were completed during both snowmelt and with simulated rainfall events. Biogeochemical behavior of riparian channelized flows differed from in-stream locations for which nutrient spiraling concepts were developed, so calculation of nutrient spiraling metrics like aerial uptake rate (U) and velocity proved challenging. Release rather than retention was frequently observed. For this reason the mass retention of nitrate and phosphorus as a percentage of tracer input was also calculated. Retention for both nutrients did not differ significantly between grass and treed sites or between snowmelt and summer. Independent of season and vegetation type, rates of nitrate and phosphorus retention were predictable based on background concentration at each site and transport time through the riparian flow path (r^2=0.61 and r^2=0.70). For both nitrate and phosphorus less retention was measured where background concentrations in runoff water were higher, indicating potential for saturation and release. Nitrate retention was higher at sites with longer transport times, but phosphorus release tended to be observed at sites with longer transport time. Overall, there appears to be potential to manage riparian areas in the region to retain nitrate, but release of phosphorus remains a challenge.

Presentation type: Oral Presentation

H10-05: Socio-hydrology component of Water Quality Modeling in the Qu'Appelle River Valley

Elmira Hassanzadeh[1], Graham Strickert[1], Bram Noble[1], Helen Baulch[1], Karl-Erich Lindenschmidt[1]

[1] Global Institute for Water Security, University of Saskatchewan, 11 Innovation Blvd, Saskatoon, SK S7N 3H5, Phone: 306-881-3930, E-mail: elmira.hassanzadeh@usask.ca

Abstract

The Qu'Appelle River Basin in Saskatchewan is an environmentally and socio-economically important water system due to various urban and rural water supplies, environmental, agricultural and industrial water demands as well as flood control and recreational usage. Water quality in this region is, however, under pressure mainly due to nutrient pollution entering the river system from major cities, industrial zones and agricultural areas. Among these stressors, the agriculture sector comprises a significant portion of land use and therefore is considerable and basin-wide. While the extent of agricultural activities is regulated and considered as a part of current water quality management practice, current policies may be insufficient to address the potential risks to watershed health. The dynamics of agricultural impacts on water quality are complex and stem from decisions and activities of two distinct stakeholder groups, namely grain farmers and cattle producers, which have different business plans, values, and attitudes towards water quality. This study aims at integrating grain farmers' and cattle producers' values in water quality modelling and scenario analyses. Such integration is essential to propose effective land management policies to reduce agricultural impacts in the region, which are in-line with stakeholders' values and preferences. An online survey and series of workshops were held with both groups of stakeholders to understand their values, attitudes and priorities with respect to alternative agricultural land use and management policies. A conceptual water quality model was then developed using System Dynamics (SD) based on stakeholders' viewpoints, observed records, and an existing water quality model. The SD model will be used for real-time engagement of stakeholders in simulations to demostrate the potential effects of alternative land management policies on water quality in the Qu'Appelle Valley.

Presentation type: Oral Presentation

H10-06: Stream food webs and their ecological functions are compromised by catchment land-use intensity

John S. RICHARDSON[1], Liliana GARCÍA[2], Lenka KUGLEROVÁ[1], Brian KIELSTRA[1], Ana CHARA SERNA[1], and Isabel PARDO[2]

[1] Dept of Forest and Conservation Sciences, University of British Columbia, 3041 – 2424 Main Mall, Vancouver, BC, Canada V6T 1Z4, Phone: +1 604 822 6585, E-mail: john.richardson@ubc.ca

[2] Departamento de Ecologia y Biologia Animal, Campus Lagoas-Marcosende, Facultad de Biologia, 36310 Vigo, Spain

Abstract

Streams integrate changes in catchment land-use and these changes may compromise ecological functions in ways that diminish or alter the ecosystem services they provide, such as decomposition, nutrient cycling, and primary and secondary production. We have used experiments and catchment-scale studies to investigate impacts of different kinds of land use in British Columbia and Ontario. Our studies included land use effects on hydrology, biogeochemistry and ecology, and interactions between the biological and physical aspects. River networks in agricultural and urban watersheds suffer from conversion of streams to ditches, sewer pipes and tile drainage, which substantially shorten the length of potential river networks up to 80% in urban catchments. Flow regimes of such affected streams changes towards flashier hydrographs with higher rates of erosion and sediment transport and further, altered thermal regimes. Even moderate nutrient enrichment can lead to reduced diversity and density of invertebrates, which can compromise the efficiency of ecosystem functions. Modified watersheds also experience high recruitment of invasive plants along riparian areas, which may provide organic matter sources differing in quality, quantity and timing from those of native plants. Our experiments show leaves of invasive species decompose on average faster than native species, which may result in a short-term flush of production in food webs, but without long-lasting supplies of energy to support consumers through their life cycles. Moreover, effects of stressors resulting from flows from adjacent riparian and catchment land use (sediment, nutrients, pesticides) interact with each other in complex ways. Expensive and marginally effective engineering solutions may reduce some of these effects. However, mitigation of these negative impacts of land-use intensification will largely be by better protection of source areas and maintenance of native vegetation along edges of streams to maintain bank integrity, shading, organic matter sources, moderation of flood effects, and nutrient uptake. [298 words]

Presentation type: Oral Presentation

H10-07: Determination of the drainage boundaries of a complex urban watershed

Aime Kayembe[1*] and Carl P.J. Mitchell[1]

[1] Department of Physical & Environmental Sciences, University of Toronto Scarborough, Toronto, ON, M1C 1A4, Phone: 416-208-2745, Fax: 416-287-7279, E-mail: aime.kayembe@mail.utoronto.ca

Abstract

Urban development significantly alters the landscape by introducing widespread impervious surfaces, which quickly convey surface runoff to streams via stormwater sewer networks, resulting in "flashy" hydrological responses. A better understanding of the impact of impervious surfaces on runoff dynamics could be achieved through better quantification of urban watershed drainage areas. Here, we present the inadequacies of using raster-based digital elevation models (DEMs) and flow-direction algorithms to delineate highly urbanized watersheds and present an approach applied to a highly urbanized Toronto area watershed that accounts for the influence of anthropogenically modified landscape features including roads, stormwater sewer networks, and stormwater management basins; all of which can significantly alter overland flow paths. Our results indicate a moderate net increase in the effective watershed area by 3% relative to a topographically forced method; however differences across three smaller scale subcatchments were greater. Compared to topographic delineation, the effective watershed areas of both the upper and middle subcatchments decrease by 5% and 9% respectively, whereas the lower subcatchment area increases by 12%. When effective subcatchment area is plotted against stream discharge using this method, the coefficient of variation is greater (R^2=0.97), compared to the use of DEM-derived subcatchment areas (R^2 = 0.85). The accurate identification of watershed and subcatchment boundaries should incorporate ancillary data such as roads, stormwater sewer network, and retention basin drainage area to reduce water budget errors in urban systems.

Presentation type: Oral Presentation

H10-08: Modelling the Transport and Retention of Chloride using INCA-Cl in the East Holland Watershed

Mallory Carpenter[1*], Claire Oswald[1], Christopher Wellen[2] and Stephen Oni[3]

[1]Geography and Environmental Studies Dept., Ryerson University, Toronto ON, M5B 2K3, Phone: 613-315-5117, E-mail: mcarpenter@ryerson.ca
[2]Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON, N9B 3P4
[3]Biology Dept., Trent University, Peterborough, ON, K9L 1Z8

Abstract
In four-season environments such as Canada, road salts (97% NaCl in Canada) are used as a de-icing agent to improve winter driving conditions and public safety. The application of road salts, however, contributes to rising chloride (Cl^-) concentrations in surface and groundwater. Long-term chronic and short-term acute exposure to elevated concentrations of Cl^- can be toxic to a range of freshwater organisms. Previous research has reported high summer baseflow Cl^- concentrations in streams and rivers throughout Eastern Canada, which suggests that Cl^- may be retained in shallow or deep groundwater. These findings were based on the conservative nature of the Cl^- ion; however, some research has suggested that Cl^- can be biogeochemically retained in soils with high organic matter content. The Lake Simcoe watershed is one such region where high Cl^- concentrations have been observed year round and if current Cl^- trends continue, concentrations in this lake will exceed national guidelines by 2120. In this study, the Integrated Catchment Model for Chloride (INCA-Cl) is used to model Cl^- transport through the urbanizing East Holland River sub-watershed of the Lake Simcoe watershed. Using the model, we are testing two scenarios; one which assumes conservative transport of Cl^-, and one which assumes some retention of Cl^- due to interaction with soil organic matter. Spatially-explicit land use, meteorological, and chloride input data are used to parameterize sub-watersheds of the East Holland River in INCA-Cl. As well, a series of in-situ electrical conductivity and water level sensors have been placed in each of these sub-watersheds and the data they generate is being used for model calibration. Understanding how stream Cl^- concentrations are linked to road salt application and landscape characteristics that control hydrologic transport will have important implications for the identification of salt vulnerable areas and future salt management within the watershed. [298 words]

Presentation type: Oral Presentation

H10-09: Geostatistical Modeling of Road Salt Contributions to In-Stream Chloride Concentrations across a Gradient of Urbanization

Colin Ash[1,2*], Stephanie Melles[1], Claire Oswald[2]

[1]Environmental Applied Science and Management, Ryerson University, Toronto, ON, M5B 2K3, Phone: 709-727-5117 E-Mail: colin.ash@ryerson.ca
[2]Dept. of Chemistry and Biology, Ryerson University, Toronto, ON, M5B 2K3
[3]Dept. of Geography and Environmental Studies, Ryerson University, Toronto, ON, M5B 2K3

Abstract

Large amounts of chloride are introduced to the Canadian environment through the surface application of over 5 million tonnes of road deicing salt across the country. Elevated chloride concentrations in streams can have chronic and acute toxicological impacts on aquatic ecosystems. The goal of this project is to utilize a Stream Statistical Network Model (SSNM) to study in-stream chloride concentrations for three watersheds within Southern Ontario that span a gradient of agricultural to urban land use. Electrical conductivity (EC) will be used as an analog for chloride concentration, and continuous measurements of instream EC are being collected at headwater and downstream sites within each watershed. High spatial resolution longitudinal surveys are conducted on a quarterly basis to capture EC patterns across each watershed. Manual water samples are collected for each survey to determine the relationship between EC and chloride concentration. Previous geospatial models of riverine systems typically utilized terrestrial methodologies that fail to account for stream network topology and stream flow between sample sites. We aim to account for such stream characteristics to develop a more accurate model to predict in-stream chloride concentrations in unsampled areas and to better understand the spatial relationships between in-stream chloride input, landscape characteristics (e.g. land cover & surficial geology), and in-stream chloride concentrations. Preliminary results from longitudinal EC surveys conducted in the summer, fall and winter show that EC levels within each watershed are elevated beyond expected background concentrations in the summer baseflow period. Elevated in-stream chloride concentrations were the highest in the the most urbanized watershed while the rural watershed has the lowest concentrations. Through analysis of the flow-connected relationship between upstream distance and electrical conductivity the influence of the spatial distribution of land use on in-stream salinity is evident. Results of the utilization of SSN models for each watershed will be presented.

Presentation type: Oral Presentation

H10-10: Effects of irrigation on the water and energy balances of the Bow river basin in Alberta, Canada

Muhammad Rehan Anis[1*], Alain Pietroniro[2], Mohamed Elshamy[1], Saman Razavi[1], and Howard Wheater[1]

[1] Global Institute for Water Security, University of Saskatchewan, Saskatoon, Canada, Phone: 306-966-7226 Fax: 306-966-1193, E-mail: rehan.anis@usask.ca
[2] National Hydrology Research Centre, Saskatoon, Canada, SK, S7N 3H5

Abstract
Land Surface Models (LSMs) are embedded within regional and global circulation models to represent land surface hydrological and thermal processes and feedbacks to the atmosphere. Despite progressive improvements, most LSMs do not include proper representations of agricultural land management, which can significantly influence the climate system and the hydrological cycle. Accurately representing the amount, location, and timing of water applied is essential for simulating irrigation and quantifying its effect on water and energy budgets. In this work, the Canadian Land Surface Scheme (CLASS) is modified to explicitly include an irrigation land cover class and to follow actual irrigation practices in the study area. The Bow River basin (26,200 km^2) supplies about 1.1 km^3/yr to three irrigation districts in southern Alberta: the Eastern, Western, and Bow River irrigation districts. The irrigation module is triggered when the root-zone soil moisture falls below a threshold of 50% of field capacity (FC), then the irrigation requirement is computed to fill the root zone to FC. Irrigation is applied as uniform precipitation at a rate lower than the infiltration capacity of the first soil layer, between 0600 and 1000hrs local time to minimize evaporative losses. The calculation scheme reasonably approximates reported irrigation water application rates. In this experiment, irrigation caused a 15% increase in evapotranspiration, a slight reduction in runoff, and 29% increase in soil moisture averaged over the whole Bow river basin. Local irrigation effects were more extreme: up to 45% increase in evapotranspiration that reduced surface temperatures (0.6 ^oC), causing a maximum increase of 40 Wm^{-2} in latent heat flux during the cropping season (May-Sep). Model results show the relatively large influence of irrigation on the water and energy budgets of the land surface in this region, of potential importance for land–atmosphere interactions and local climate.

Presentation type: Oral Presentation

H10-11: Modeling nitrogen legacies and time lags in agricultural landscapes using Soil Water Assessment Tool (SWAT)

Idhaya Chandhiran Ilampooranan[1*] and Nandita Basu[1]

[1]Civil and Environmental Engineering Dept., University of Waterloo, Waterloo, ON, N2L 3G1, Phone: 519-781-3625, E-mail: idhayachandhiran@gmail.com

Abstract

Massive land use changes and the industrial production of fertilizers have increased food production, but at the cost of significantly altering the global nitrogen (N) cycle. Best management practices implemented to improve water quality have generally met with limited success. We hypothesize that such lack of success can be attributed to increased build up of legacy N stores in the subsurface that act as an additional source even when N inputs have been reduced. Though experimental studies prove nitrogen accumulation in subsurface stores, hydrological modeling has not been attempted so far. Here, we used SWAT to quantify the magnitude of legacy stores and their timescales of depletion in an agricultural watershed in Iowa, US. Since crop management practices affects soil nitrogen levels, we have created rigorous, hypothetical, 55 years long (1949 to 2003) land use patterns using a novel approach. Moreover, corn and soybean yield has increased from 1940s to recent years due to periodic introduction of hybrid crop varieties. This pattern was captured by introducing three different corn and soybean varieties within the simulation period. Changes were made to SWAT's carbon / nitrogen subroutine to capture the legacy N accumulation and depletion trajectories. Multi-objective calibration and validation was done using OSTRICH and calibrated for discharge, nitrate flux, organic nitrogen flux, crop yields (five crops) at annual time steps, to ensure proper simulation of internal watershed processes. Thus, we found, SWAT could capture (i) soil nitrogen accumulation (ii) effects of crop rotation types, HRU slope and percent clay content on soil nitrogen accumulation and (iii) soil nitrogen depletion trajectory and corresponding reduction in stream nitrate concentration with associated time lags under multiple future scenarios. This framework will thus provide a better understanding on legacy N stores, fluxes as well as the time lags to achieve desirable water quality benefits.

Presentation type: Oral Presentation

H10-12: A meta-analysis and review of the effectiveness of agricultural conservation measures at field and watershed scales

Christopher Wellen[1], Nandita Basu[2], William Sellier[2], Joy Liu[2], Avery To[2], Philippe Van Cappellen[2], Mohamed Mohamed[3]

[1] Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON, N9B 3P4
Phone: 64-239-5138 E-mail: christopher.wellen@uwindsor.ca
[2] Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, ON, N2L 3G1
[3] Ontario Ministry of the Environment and Climate Change, Etobicoke, ON, M9P 3V6

Abstract
A number of conservation measures have been devised to control the loss of nutrients from agricultural areas to streams. Demonstrating the efficacy of agricultural conservation measures is a difficult technical challenge, and typically involves intensive measurements at the field scale and application of simulation models at the watershed scale. This talk will present the results of a review and meta-analysis that quantitatively compares the effectiveness of agricultural conservation measures estimated with field scale monitoring data, watershed models, and watershed scale monitoring data. Data from roughly 100 studies published during the past five years have been compiled. Analysis reveals that there are statistically significant differences in conservation effectiveness as estimated by watershed models and field monitoring data. These differences are however of modest magnitude, with model-estimated median nutrient yield reductions of 18% and field data estimated median nutrient yield reductions of 25%. This talk compares modelled and measured efficacy for different types of conservation measures (transport and source controls) and quantifies the relationship of nutrient yield reduction to various other study attributes, including nutrient application rates and crop yield. To conclude, we highlight certain data gaps located and key model uncertainties typically not addressed. [193 Words]

Presentation type: Oral Presentation

H10-13: Untangling the hydrologic and land use/cover drivers of impaired water quality in an agricultural catchment in Southern Ontario

Claire J. Oswald[1], Stephanie Melles[2], Merrin Macrae[3], Christopher Wellen[4]

[1]Geography and Environmental Studies Dept., Ryerson University, Toronto, ON, M5B 2K3, Phone: 416-979-5000, Fax: 416-979-5362, E-mail: coswald@ryerson.ca
[2]Chemistry and Biology Dept., Ryerson University, Toronto, ON, M5B 2K3
[3]Geography and Environmental Management Dept., University of Waterloo, Waterloo, ON, N2L 3G1
[4]Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON, N9B 3P4

Abstract
Innisfil Creek, located in the southeastern region of the Nottawasaga River watershed in Southern Ontario, has long suffered from impaired water quality, including high turbidity and phosphorus levels. Stream water quality changes from unimpaired where it discharges from the headwaters of the Simcoe uplands to impaired as the creek flows down into the Simcoe lowlands and joins the Nottawasaga River. The impacts of elevated turbidity and nutrients from the Innisfil Creek system extend downstream into the Nottawasaga River, through the Minesing Wetlands (a wetland of international significance), and persist all the way to South-Eastern Georgian Bay where they pose a threat to the health of near-shore aquatic ecosystems. Here, we report the findings of a temporally and spatially intensive water quality monitoring project to fully understand the hydrologic- and land use-related drivers of water quality in this system. Continuous water quality measurements at the catchment outlet coupled with synoptic longitudinal water quality surveys during storm events indicate distinct flow driven sediment mobilization from specific tributaries within the Innisfil Creek stream network. Land use management of the near-stream zone in these 'problem areas' may be a first-order control on the watershed-scale sediment and nutrient load. A geospatial model of water quality in relation to landscape characteristics, such as the proportion of agricultural land, presence of a near-stream buffer strip, and the drainage dynamics of wetlands and agricultural ditches is developed to help inform land management practices and initiatives along the creek that could improve stream water quality. [246 words]

Presentation type: Poster Presentation

H10-14: Assessing nested and cumulative hydrological and chloride behaviour of a highly urbanized watershed

Aime Kayembe[1*] and Carl P.J. Mitchell[1]

[1] Department of Physical & Environmental Sciences, University of Toronto Scarborough, Toronto, ON, M1C 1A4, Phone: 416-208-2745, Fax: 416-287-7279, E-mail: aime.kayembe@mail.utoronto.ca

Abstract

Urban development significantly alters the landscape by introducing widespread impervious surfaces, which quickly convey surface runoff to streams via stormwater sewer networks, resulting in "flashy" hydrological responses. Alongside hydrological changes, occurrence of increasing chloride concentrations in urban streams of cold climates has raised concerns about negative impacts on aquatic and riparian biota. The influence that stream hydrology has on chloride behaviour is well documented at the watershed scale (e.g. negatively correlated with total discharge, and positively correlated immediately following deicing application on roads). Still, relatively little is known about the relationships between hydrograph characteristics (average rate of change, duration, magnitude and time to peak) and chloride behaviour. Here, we present an annual chloride budget, obtained from high resolution (hourly) continuous conductivity data, coupled with GIS interpretation of landscape characteristics to investigate the cumulative effect of this pollutant in downstream subcatchments. Additionally, data generated over a 2-year period (May 2015 – May 2017) will be used to investigate the influence of hydrograph characteristics on chloride concentrations and to explain possible variance across three subcatchments. Early results indicate that drainage connection (the fraction of impervious area hydraulically connected to the stream via stormwater sewer networks) explains most of the variance between chloride loads and imperviousness in the three subcatchments. Chloride mass balance also reveals that these three subcatchments have not reached steady state as a significant fraction (> 45%) of chloride applied through road salt remains sequestrated in these catchments. This study takes a different and less-utilized approach to assess nested and cumulative hydrological and chloride hydrochemical behavior in a highly urbanized watershed (Mimico Creek, Ontario). It is also a comparative analysis that allows for a meaningful study of the influence of urbanization on stream hydrology and the fate of chloride in highly urbanized watersheds and their subcatchments.

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