

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

Committee Directorship

Trish Stadnyk (Chair), University of Manitoba

Jean Birks (past Chair), Alberta Innovates- Technology Futures, University of Waterloo

Tom Edwards, University of Waterloo

John Gibson, Alberta Innovates- Technology Futures, University of Victoria

Claude Hillaire-Marcel, GEOTOP-UQAM

Bernhard Mayer, University of Calgary

Fred Michel, Carleton University

Brent Wolfe, Wilfrid Laurier University

Background:

The CGU - HS Committee on Isotopic Tracers was originally established in 1997 to support and facilitate information exchange between isotope specialists and hydrologists both within Canada and internationally, and to address issues of importance to isotopic investigations including integration within broadly-based hydroscience research programs. In 2014, CGU Hydrology Section dissolved all sub-committees, and re-established only those who were active, including the Isotope Tracer Committee. Recognizing and supporting promising applications of isotopic tracers, promoting cooperative research, providing information resources, and articulating research and educational needs to government agencies, universities, and the general hydrology community are the fundamental aims of the Committee.

Objectives and Activities:

The long-term objectives of the committee are to:

- promote and advance the understanding and application of isotopic tracer techniques in hydrology and related sciences
- initiate and participate in research and education programs, maintain contact with relevant organizations, report on national and international research activities, information sources, isotope monitoring networks, and databases
- establish working groups and/or subcommittees to assess specific, high-priority topics for research, monitoring and/or development, and
- disseminate current research and important findings to the scientific community via discussion, meetings and conferences, and publications

Progress on Issues and Objectives:

Tracer committee members continue to be active in the promotion and advancement of the understanding and application of isotopic tracer techniques in hydrology and related sciences. Of particular interest are the applications of isotope tracers to hydrometrics (Water Survey of Canada), in understanding precipitation processes and for global networks that serve to build scientific capacity for tracer-based research. It should be noted that Committee Chair (Tricia Stadnyk) was on maternity leave from Aug 2015 until May 1 2016, therefore less coordinated efforts were undertaken in the 2015-16 year. Some highlights from 2015-16 include:

National: Water Survey of Canada Isotope Network

The Water Survey of Canada, in cooperation with the University of Manitoba, University of Victoria, and Alberta Innovates Technology Futures, continues to support the national pilot of an operational isotope network in conjunction with their hydrometric network, similar the existing isotope-hydrometric network in the United States. The goal is to demonstrate the value in systematic collection of river discharge in tandem with analysis for oxygen-18 and deuterium across Canada.

Stable water isotopes are being collected at selected Water Survey of Canada gauging stations across the country (Figure 1) during 2015-2017 to gain insight into the sources of streamflow (rain, snow, groundwater, wetlands, glaciers etc.) and their spatio-temporal variability, to characterize open-water evaporation losses and to partition evapotranspiration, to assist in parameterization of isotope-capable hydrological models such as WATFLOOD (Stadnyk *et al.*,

2013), and to assist in water quality, ecological studies, and net primary productivity estimation. The activities form part of Canada's contribution to the Global Network of Isotopes in Rivers, a network coordinated by the International Atomic Energy Agency. To date approximately 2500 water samples from 235 stations have been analyzed for oxygen-18 and deuterium isotopes, which are incorporated within the water molecule. Isotopic variations provide information on hydrological processes operating in watersheds and are also being used to quantify evaporation losses and water residence times. A recent article demonstrates some of the basic processes controlling isotopic distribution in Canada's oil sands region (Gibson et al. 2016).

Gibson, J.J., Yi, Y., Birks, S.J., 2016. Isotope-based partitioning of streamflow in the oil sands region, northern Alberta: towards a monitoring strategy for assessing flow sources and water quality controls. *Journal of Hydrology: Regional Studies* 5: 131-148, <http://dx.doi.org/10.1016/j.ejrh.2015.12.062>. For further information please contact John Gibson, jjgibson@uvic.ca



Figure 1. Water Survey of Canada Isotope Network: A contribution to the Canadian Network for Isotopes in Rivers

International: Isotope Tracing of Human Impacts on Water Balance and Nutrient Dynamics of Large Canadian River Basins

A team of members of the Isotope Tracer Committee of the Canadian Geophysical Union is participating in an International Atomic Energy Agency (IAEA) Coordinated Research Project (CRP F33021) entitled: Application and Development of Isotope Techniques to Evaluate Human Impacts on Water balance and Nutrient Dynamics of Large River Basins. The Canadian project, initiated in April 2014 and entitled *Isotope Tracing of Human Impacts on Water Balance and Nutrient Dynamics of Large Canadian River Basins*, is Coordinated by Jean-François Hélie (Geotop-UQAM) and supported by John Gibson (University of Victoria & AITF). Six teams from across Canada support this Canadian CRP and are led respectively by Jean-François Hélie (Eastern), John Gibson (Western), Trish Stadnyk (Prairies), Ian Clark (Northern), Fred Longstaffe (Great Lakes) and David Soto (Maritimes). The CRP aims at coordinating Canadian efforts in assessing human impacts on large river systems using isotope tracers.

Progress in the past year by each team is summarized as follows:

1- Eastern team: Jean-François Hélie has secured weekly sampling of $\delta^{18}\text{O}$ & $\delta^2\text{H}$ of water from the St. Lawrence River at Montreal (water from the Great Lakes) and Lévis (outlet to the estuary) drinking water plant indefinitely in 2016. Also, Jeff Ridal has provided weekly samples of the St. Lawrence River at Cornwall (upstream of Montreal), above and below the dam for $\delta^{18}\text{O}$ & $\delta^2\text{H}$ of

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

water since the summer of 2014. Discussions are still ongoing regarding the possibility of sampling the La Grande (heavily dammed) and Great Whale (pristine) rivers. We are also testing $\delta^{13}\text{C}$ -DIC preservation methods. We hope to be able to find a suitable method for long term storage in remote locations. A PhD student was just hired to study the residence time of suspended sediments, DOC and POC in a medium sized northern Quebec watershed.

2- Western team: The extensive sampling network that was funded in 2014 is now operational and sampling has begun. John Gibson's team have 2131 $\delta^{18}\text{O}$ and $\delta^2\text{H}$ analyses from 235 stations across Canada, to date from the National WSC network. That's about 9 samples per station (max of 6 per year). Their plan is to keep this going for several more years. They also have a network in Alberta which has provided 1046 river samples from 10 stations, on monthly time-step. The latter network will expand to the whole province of Alberta (~25 stations) beginning this summer.

3- Prairies team: Trish Stadnyk's team continues to focus on data collection in the lower Nelson River basin, including the Nelson River main stem and a combination of unregulated and regulated tributaries. Sampling began in 2010 and, to date, nearly 3,000 samples have been collected and analyzed for $\delta^{18}\text{O}$ & $\delta^2\text{H}$ from river discharge (including ice on periods), groundwater, evaporation pans, and precipitation (snow and rain). Samples are collected approximately 6 times per year from most locations, however some locations remain priority and are sampled bi-weekly. Several students (1 MSc, 1 PhD and 1 PDF) are advancing work on isotope-enabled hydrologic modelling using this dataset (Smith et al., 2016; Smith et al., 2015; Stadnyk et al., 2013). Trish Stadnyk was on maternity leave for most of the 2015-16 season; she returned to work on May 1, 2016.

4- Northern team: Ian Clark's team is moving forward on two fronts. They have students involved in looking at monthly variations in geochemistry/isotopes of selected catchments to look at processes (Ogilvie River, North Klondike River). Martin Suchy, with Environment Canada, has initiated a program where they can get samples from their regular monitoring network in the Arctic. This has just begun and so they will only have their first batch of samples to analyze in the coming weeks.

5- Great Lakes team: This team's main objective is to characterize southwestern Ontario inputs into the lower Great Lakes, and hence the flow-through impact on discharge to the St. Lawrence, and to build a long-term $\delta^{18}\text{O}$ & $\delta^2\text{H}$ database for each of the Great Lakes themselves (Michigan sadly excluded). On-going activities include: (i) Monthly water sampling for $\delta^{18}\text{O}$ & $\delta^2\text{H}$ from 2 rivers draining into Lake Huron (Ausable River and Old Ausable River Channel) and Lake Huron. (ii) Opportunistic sampling for $\delta^{18}\text{O}$ & $\delta^2\text{H}$ from Lake Erie and the Detroit River (link between Lake Huron and Lake Ontario), including some winter cruises. (iii) Beginning May 2016 stations on the Thames River and Sydenham Rivers will be collected and analyzed for water isotopes ($\delta^{18}\text{O}$ & $\delta^2\text{H}$), DIC ($\delta^{13}\text{C}$), DOC ($\delta^{13}\text{C}$), nitrates ($\delta^{18}\text{O}$ & $\delta^{15}\text{N}$), and water quality properties (iv) organized water sampling in the Great Lakes during 2016, with timing and lakes depending on their ability to piggyback on existing schedules.

6- Maritimes team: Sampling has begun in 2014 on the St. John River at Fredericton and samples are analyzed for $\delta^{18}\text{O}$ & $\delta^2\text{H}$ of water. This team has also implemented a precipitation collector. River data are from the ice-free season.

Now that almost all the respective networks are operational, we hope to expand from tier 1 to tier 2 sampling in the coming months for some targeted sites. We also hope to strengthen the interactions between the teams by organizing an informal meeting and create a database of published Canadian river isotopic data.

For information contact Jean Francois Hélie (helie.jean-francois@uqam.ca).

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

International: Canadian Atmospheric and Precipitation Monitoring Network (CAPMoN) Data Added to GNIP

Tom Edwards of our CGU Isotope Tracer Committee Directorship over the past year has worked to finalize the addition of precipitation data collected from 1997-2010 under the CAPMoN program to the IAEA/WMO GNIP (Global Network for Isotopes in Precipitation) database. Data was carefully QA/QC'd for known problems prior to submission. Thank you Tom!

Regional Research Initiatives

We are pleased as a committee to congratulate one of our own, Dr Scott Jasechko, on receiving this years CGUs early Career Award. Congratulations Scott!

The Geotop-UQAM research group has specifically been working on several projects, including: (i) the analysis protocols and use of $\delta^{18}\text{O}$ of PO_4 to trace dissolved P sources (a paper will be submitted this summer). (ii) groundwater dating with 2 international projects related to ages of "Evian" and "Badoit" waters (one PdF). A PhD student just started his project related to water ages stratification and water supply boreholes protection. (iii) A network for isotopes in precipitation over the Quebec. Assisting with research, a new PhD will start this summer on the quantification of groundwater recharge using poral stable isotope (water) signal in the vadose zone; and a PhD will end next winter on the quantification of groundwater flow through Kettle lakes. For more information, please contact Florent Barbecot (barbecot.florent@uqam.ca).

The Wilfrid Laurier team continues to employ isotope tracers in water ($\delta^{18}\text{O}$, $\delta^2\text{H}$), dissolved inorganic carbon ($\delta^{13}\text{C}$) and sediment ($\delta^{13}\text{C}_{\text{organic matter}}$, $\delta^{15}\text{N}$, $\delta^{18}\text{O}_{\text{cellulose}}$) of lakes and rivers in northern lake-rich thermokarst landscapes to identify the consequences of climate change and increasing avian populations on aquatic ecosystems. Water isotope tracers are also being used as a foundational hydrological monitoring tool for a new research initiative focused on the Peace-Athabasca Delta (PAD), northern Alberta. Research will 1) track relations among climate, river flow and lake hydrological conditions in the delta, and 2) link the spatial distribution of contaminants (polycyclic aromatic compounds, metals) and their toxicity characteristics in the delta with hydrological pathways and limnological conditions. Isotope tracers in water ($\delta^{18}\text{O}$, $\delta^2\text{H}$) and sediment ($\delta^{13}\text{C}_{\text{organic matter}}$, $\delta^{15}\text{N}$, $\delta^{18}\text{O}_{\text{cellulose}}$) are being utilized in a new research project to complement the Marian Watershed Stewardship Program (MWSP). For more information, please contact Dr. Brent Wolfe (bwolfe@wlu.ca).

From the University of Manitoba Water Resources Engineering (Hydrology) group, our work on North American isoscapes (Delavau et al., 2015) continues, with a study comparing isotope in precipitation forcing and uncertainties related to isotope-enabled hydrologic modelling wrapping up Fall 2016. Regional isotope monitoring is on-going in lower Nelson River basin, with 2,946 samples collected to date (2010-present) and analyzed for $\delta^{18}\text{O}$ and $\delta^2\text{H}$, along with precipitation and groundwater sources, all of which will be made available through the IAEA GNIR project database. Development work on isotope-enabled catchment process-based hydrologic models continues (Smith et al., 2016). Most recently, $\delta^2\text{H}$ was added to isoWATFLOOD enabling the simulation of continuous in time isotopic frameworks at the regional scale. The research group is currently looking to recruit 1 MSc student and 1 PhD student for on-going projects focused on isotope hydrology and multi-objective model optimization using isotope tracers. For more information, contact Dr. Trish Stadnyk (tricia.stadnyk@umanitoba.ca).

Jeff McDonnell from University of Saskatoon has developed a course in conjunction with Carol Kendall (with participation from many other CGU HS Isotope committee members). They will offer a 4-day shortcourse "Isotope Tracers in Catchment Hydrology" Nov 7-10 2016 at the Global Institute for Water Security / National Hydrology Research Centre. The course will be limited to 30 participants and filled on a first come, first served basis. Graduate students from outside U of S

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

can take it for credit via the Western Canadian Dean's Agreement (<http://wcdgs.ca/western-deans-agreement.html>). A web site for this class will be up and running next month. For more information, or if you are interested, contact Dr. Jeff McDonnell (jeffrey.mcdonnell@usask.ca).

Recent (2015-16) Publications by Committee membership:

- Allen, S.T., R.F. Keim, and J.J. McDonnell. 2015. Spatial patterns of throughfall isotopic composition at the event and seasonal timescale, *Journal of Hydrology* 522: 58-66.
- Ameli, A., J.J. McDonnell and K. Bishop, 2016. The exponential decline in saturated hydraulic conductivity with depth and its effect on water flow paths and transit time distribution. *Hydrological Processes*, DOI: 10.1002/hyp.10777.
- Aquilina, L., Vergnaud-Ayraud, V., Armandine Les Landes, A., Pauwels, H., Davy, P., Pételet-Giraud, E., Labasque, T., Roques, C., Chatton, E., Bour, O., Ben Maamar, S., Dufresne, A., Kaskha, M., Le Gal La Salle, C., Barbecot, F., 2015. Impact of climate changes during the last 5 million years on groundwater in basement aquifers. *Scientific Reports* 5, 14132; doi: 10.1038/srep14132.
- Balasubramaniam AM, RI Hall, BB Wolfe, JN Sweetman and XA Wang. 2015. Source-water inputs and catchment characteristics regulate limnological conditions of shallow Arctic lakes (Old Crow Flats, Yukon, Canada). *Canadian Journal of Fisheries and Aquatic Sciences* 72: 1058-1072.
- Burt, T.P. and J.J. McDonnell. 2015. Whither field hydrology? The need for discovery science and outrageous hydrological hypotheses, *Water Resources Research* 51:5919-5928, doi:10.1002/2014WR016839.
- Coles, A.E., C.E. Wetzel, N. Martinez-Carreras, L. Ector, J.J. McDonnell, J.J. Frentress, J. Klaus, L. Hoffmann and L. Pfister. 2015. Diatoms as a tracer of hydrological connectivity: are they supply limited? *Ecohydrology*, DOI: 10.1002/eco.1662.
- Costelloe, T. J., Peterson, K., Halbert, A. W., Western, and J. J., McDonnell. 2015. Groundwater surface mapping informs sources of catchment baseflow. *Hydrology and Earth System Science*, 19: 1599-1613.
- Delavau C, Chun KP, Stadnyk T, Birks SJ, Welker JM (2015). North American precipitation isotope ($\delta^{18}\text{O}$) zones revealed in time series modelling of precipitation ^{18}O across Canada and the northern United States. *Water Resour. Res.*, 51(2): 1284-1299. doi: 10.1002/2014WR015687
- Delbart, C., Valdés, D., Barbecot, F., Tognelli, A., Couchoux, L., 2016. Spatial organization of the impulse response in a karst aquifer. *Journal of Hydrology* 537, 18-26.
- Du, E., C.R. Jackson, J. Klaus, J.J. McDonnell, N.A. Griffiths, M.F. Williamson, J. Greco, and M. Bitew. 2016. Interflow behavior in low-angle terrain. *Hydrological Processes*, in press.
- Eby, P., Gibson, J.J., Yi, Y., 2015. Suitability of selected free-gas and dissolved-gas sampling containers for carbon isotopic analysis. *Rapid Communications in Mass Spectrometry*. 29: 1215-1226, <http://dx.doi.org/10.1002/rcm.7213>.
- Elmes MC, JA Wiklund, SR Van Opstal, BB Wolfe and RI Hall. 2016. Characterizing baseline concentrations, proportions and processes controlling deposition of river-transported bitumen-associated polycyclic aromatic compounds at a floodplain lake (Slave River Delta, Northwest Territories, Canada). *Environmental Monitoring and Assessment* 188:282 (15pp).

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

- Evaristo, E., J.J. McDonnell, M. Scholl, L.A. Bruijnzeel and K.P. Chun, 2016. Insights into plant water uptake from xylem-water isotope measurements in two tropical catchments with contrasting moisture conditions. *Hydrological Processes*, in press.
- Evaristo, J., S. Jasechko, and J.J. McDonnell. 2015. Global separation of plant transpiration from groundwater and streamflow, *Nature* doi: 10.1038/nature14983.
- Geris, J., D. Tetzlaff, J.J. McDonnell and C. Soulsby. 2015. The relative role of soil vs tree cover on water storage and transmission in northern headwater catchments. *Hydrological Processes*, 29: 1844-1860. DOI: 10.1002/hyp.10289.
- Geris, J., D. Tetzlaff, J.J. McDonnell, J. Anderson, G. Paton and C. Soulsby. 2015. Ecohydrological separation in wet, low energy northern environments? A preliminary assessment using different soil water extraction techniques. *Hydrological Processes*, 29, DOI: 10.1002/hyp.10603
- Gibson, J.J., Birks, S.J., Yi, Y., 2015. Stable isotope mass balance of lakes: a contemporary perspective. *Quaternary Science Reviews* 131 (B): 316-328, <http://dx.doi.org/10.1016/j.quascirev.2015.04.013>.
- Gibson, J.J., Birks, S.J., Yi, Y., 2016. Higher tritium concentrations measured in permafrost thaw lakes, northern Alberta, *Hydrological Processes* 30: 245-249, <http://dx.doi.org/10.1002/hyp.10599>.
- Gibson, J.J., Birks, S.J., Yi, Y., Moncur, M.C., McEachern, P.M., 2016. Stable isotope mass balance of fifty lakes in central Alberta: assessing the role of water balance and climate in determining trophic status and lake level. *Journal of Hydrology: Regional Studies* 6: 13-25, <http://dx/doi.org/10.1016/j.ejrh.2016.01.034>.
- Gibson, J.J., Birks, S.J., Yi, Y., Vitt, D., 2015. Runoff to boreal lakes linked to land cover, watershed morphology and permafrost melt: a 9-year isotope mass balance assessment. *Hydrological Processes* 29, 3848-3861, <http://dx.doi.org/10.1002/hyp.10502>.
- Gibson, J.J., Yi, Y., Birks, S.J., 2016. Isotope-based partitioning of streamflow in the oil sands region, northern Alberta: towards a monitoring strategy for assessing flow sources and water quality controls. *Journal of Hydrology: Regional Studies* 5: 131-148, <http://dx/doi.org/10.1016/j.ejrh.2015.12.062>.
- Graham, J. A., Hartsock, J. A., Vitt, D. H., Wieder, R. K., Gibson, J. J., 2015. Linkages between spatio-temporal patterns of environmental factors and distribution of plant assemblages across a boreal peatland complex. *Boreas*, <http://dx.doi.org/10.1111/bor.12151>. ISSN 0300-9483.
- Griffiths, N., C.R. Jackson, J.J. McDonnell, J. Klaus, E. Du and M. Bitew. 2016. Dual nitrate isotopes clarify the role of biological processing and hydrologic flowpaths on nitrogen cycling in humid sub-tropical low-gradient watersheds. *Biogeochemistry*, in press.
- Hale, C. and J.J. McDonnell. 2016a. Effect of bedrock permeability on mean transit time scaling relations (1) A multiscale catchment intercomparison. *Water Resources Research*, in press.
- Hale, C., J.J. McDonnell, M. Stewart, K. Solomon, J. Light, G. Ice. 2016b. Effect of bedrock permeability on mean transit time scaling relations (2) Process study of storage and release. *Water Resources Research*, in press.
- Humez, P., Mayer, B., Nightingale, M., Ing, J., Becker, V., Jones, D., Lam, Vien, 2016. An 8-year record of gas geochemistry and isotopic composition of methane during baseline sampling at a groundwater observation well in Alberta (Canada). *Hydrogeol. J.* 24:109-122.

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

- Jackson, R., E. Du, J. Klaus, N. Griffiths, M. Bitew and J.J. McDonnell, 2016. Interactions among hydraulic conductivity distributions, subsurface topography, and transport thresholds revealed by a multi-tracer hillslope irrigation experiment. *Water Resources Research*, in press.
- Jasechko, S., J. Kirchner, J. Welker and J.J. McDonnell. 2016. Substantial portion of global river discharge less than 3 months old. *Nature (Geosciences)*, DOI: 10/1038/NGEO.2636.
- Jautzy JJ, JME Ahad, RI Hall, JA Wiklund, BB Wolfe, C Gobeil and MM Savard. 2015. Source apportionment of background PAHs in the Peace-Athabasca Delta (Alberta, Canada) using molecular level radiocarbon analysis. *Environmental Science and Technology* 49: 9056-9063.
- Klaus, J., J.J. McDonnell, C.R. Jackson, E. Du, and N. Griffiths. 2015. Where does streamwater come from in low relief forested watersheds? A dual isotope approach. *Hydrology and Earth System Science*, 19, 125-135.
- Klaus, J., K. Chun, K. McGuire and J.J. McDonnell. 2015. Temporal dynamics of catchment transit times from stable isotope data. *Water Resources Research*, 51, 4208–4223, doi:10.1002/2014WR016247.
- Lefebvre, K., Barbecot, F., Larocque, M., Gillon, M., 2015. Combining isotopic tracers (^{222}Rn and $\delta^{13}\text{C}$) for improved modelling of groundwater discharge to small rivers. *Hydrological Processes* 29 (12), 2814-2822.
- MacDonald LA, JA Wiklund, MC Elmes, BB Wolfe and RI Hall. 2016. Paleolimnological assessment of riverine and atmospheric pathways and sources of metal deposition at a floodplain lake (Slave River Delta, Northwest Territories, Canada). *Science of the Total Environment* 544: 811-823.
- Martinez-Carreras, N., C.E. Wetzel, J.J. Frentress, L. Ector, J.J. McDonnell, L. Hoffmann and L. Pfister. 2015. Hydrological connectivity inferred from diatom transport through the riparian-stream system. *Hydrology and Earth System Science*, 19, 3133-3151.
- McGuire, K. and J.J. McDonnell, 2015. Tracer advances in catchment hydrology. *Hydrological Processes*, in press.
- Meyzonnat, G., Larocque, M., Barbecot, F., Pinti, D.L., Gagné, S., 2016. The potential of major ion chemistry to assess groundwater vulnerability of a regional aquifer in southern Quebec (Canada). *Environmental Earth Sciences* 75 (1), art. no. 68, 1-12.
- Moncur, M.C., Paktunc, D., Birks, S.J., Ptacek, C.J., Welsh, B., Thibault, Y., 2015. Source and distribution of naturally occurring arsenic in groundwater from Alberta's Southern Oil Sands Regions. *Applied Geochemistry*, 62, 171-185.
- Moncur, M.C., Ptacek, C.J., Blowes, D.W., Peterson, R.C., 2016. Occurrence and implications of efflorescent sulfate minerals from the former Sherritt-Gordon Zn-Cu mine. *Canadian Mineralogist In Press*.
- Muñoz-Villers, L., D. Geissert, F. Holwerda and J.J. McDonnell. 2016. Stream water transit times in tropical montane watersheds: catchment scale and landscape influences. *Hydrology and Earth System Science*, in press.
- Munoz-Villers, L., F. Holwerda, M. Alvarado-Barrientos, D. Giessert, B. Marin-Castro, A. Gomez-Tagle, J.J. McDonnell, H. Asbjornsen, R. Dawson, L. Bruijnzeel. 2015. Hydrological effects of cloud forest conversion in Veracruz, Mexico. *Ecohidrologia, bosque y uso del suelo*, in press (in Spanish).
- Orlowski, N, D. Pratt and J. J. McDonnell, 2016. Intercomparison of soil pore water extraction methods for stable isotope analysis. *Hydrological Processes*, in press.

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

- Orlowski, N., L. Breuer and J.J. McDonnell, 2015 Critical issues with cryogenic extraction of soil water for stable isotope analysis. *Ecohydrology*, doi:10.1002/eco.1722.
- Pfister L., C. Wetzel, N. Martínez-Carreras, J. Iffly, J. Klaus, L. Holko and J.J. McDonnell. 2015. Examination of aerial diatom flushing across watersheds in Luxembourg, Oregon and Slovakia for tracing episodic hydrological connectivity. *Journal of Hydrology and Hydromechanics*, 63 (3):235-245.
- Razafindratsima, S., Péron, O., Piscitelli, A., Gégout, C., Schneider, V., Barbecot, F., Giffaut, E., Robinet, J.C., LeCointe, P., Montavon, G., 2015. Transport properties of iodide in a sandy aquifer: Hydrogeological modelling and field tracer tests. *Journal of Hydrology* 520, 61-68.
- Rosa, É., C. Hillaire-Marcel, J.-F. Hélie and A. Myre. 2016. Processes governing the stable isotope composition of water in the St. Lawrence river system, Canada. *Isotopes in Environmental and Health Studies*, DOI: 10.1080/10256016.2015.1135138.
- Saby, M., Larocque, M., Pinti, D.L., Barbecot, F., Sano, Y., Castro, M.C., 2016. Linking groundwater quality to residence times and regional geology in the St. Lawrence Lowlands, southern Quebec, Canada. *Applied Geochemistry* 65, 1-13.
- Seibert, J. and J.J. McDonnell. 2015. Gauging the ungauged basin: relative value of soft and hard data. *Journal of Hydrologic Engineering*, 20(1), 10.1061/(ASCE)HE.1943-5584.0000861, A4014004.
- Shanley, J., S. Sebestyen, J.J. McDonnell, B McGlynn and T. Black. 2015. A review of runoff process research at the Sleepers River watershed. *Hydrological Processes*, in press.
- Skrzypek G., Mydłowski A., Dogramaci S., Hedley P., Gibson J., Grierson P., 2015, Estimation of evaporative loss based on the stable isotope composition of water using "Hydrocalculator". *Journal of Hydrology* 523 (2015) 781–789, <http://dx.doi.org/10.1016/j.jhydrol.2015.02.010>.
- Smith A, Delavau C., Stadnyk TA (2015). Hydrologic Assessment of the lower Nelson River basin using stable water isotope investigations. *Can. Water Resour. J.*,40(1): 23-25. doi: 10.1080/07011784.2014.985512
- Smith, A., T.A. Stadnyk (2016). Assessment of a lumped coupled flow-isotope model in data scarce Boreal catchments. Accepted by *Hydrol. Processes*. doi: 10.1002/hyp.10835.
- Smith, L.J.D., Ptacek, C.J., Blowes, D.W., Groza, L.G., Moncur, M.C., 2015. Perchlorate in lake water from an operating diamond mine. *Environmental Science and Technology* 49, pp. 7589-7596.
- Stadnyk TA, Gibson JJ, Longstaff F (2015). Basin-scale Assessment of Operational Baseflow Separation Algorithms. *J. Hydrol. Eng.*, 20(5). doi: 10.1061/(ASCE)HE.1943-5584.0001089, 04014074.
- Stockinger, M.P., A. Lücke, J.J. McDonnell, B. Diekkrüger, H. Vereecken, and H. R. Bogen. 2015. Interception effects on stable isotope driven streamwater transit time estimates, *Geophysical Research Letters* 42, 5299–5308, doi:10.1002/2015GL064622.
- Tribovillard, N., Hatem, E., Averbuch, O., Barbecot, F., Bout-Roumazelles, V., Trentesaux, A., 2015. Iron availability as a dominant control on the primary composition and diagenetic overprint of organic-matter-rich rocks. *Chemical Geology* 401, 67-82.
- Untereiner, E., G. Ali, T.A. Stadnyk (2015). Spatiotemporal Variability of Water Quality and Stable Water Isotopes in Intensively Managed Prairie Watersheds. *Hydrol. Processes* 29(18): 4125-4143.

CGU-HS Committee on Isotopic Tracers Annual Report (2015-16)

Vautour, G., Pinti, D.L., Méjean, P., Saby, M., Meyzonnat, G., Larocque, M., Castro, M.C., Hall, C.M., Boucher, C., Roulleau, E., Barbecot, F., Takahata, N., Sano, Y., 2015. $3\text{H}/3\text{He}$, 14C and $(\text{U-Th})/\text{He}$ groundwater ages in the St. Lawrence Lowlands, Quebec, Eastern Canada. *Chemical Geology* 413, art. no. 17661, 94-106.

Yi, Y., Birks, S.J., Cho, S., Gibson, J.J., 2015. Characterization of organic composition in snow and surface waters in the Athabasca oil sands region, using ultrahigh resolution Fourier transform mass spectrometry, *Science of the Total Environment*, 518–519 (2015) 148–158, <http://dx.doi.org/10.1016/j.scitotenv.2015.02.018>.



Committee on River Ice Processes and the Environment (CGU-HS)

May 19th, 2016

Barret Kurylyk
Member-at-Large
CGU-Hydrology Section

CRIPE 2016 ANNUAL REPORT TO THE CGU-HYDROLOGY SECTION

Dear Dr. Kurylyk,

The Committee on River Ice Processes and the Environment is pleased to submit our annual CRIPE report to the CGU Hydrology Section.

CRIPE OBJECTIVES

The main objectives of CRIPE are:

- To identify specific high-priority river ice topics for research and development and promote the undertaking of relevant research programs;
- To facilitate information dissemination and exchange of ideas on river ice among practitioners, researchers, and resource managers; and
- To encourage the incorporation of pertinent river ice lectures or courses in undergraduate and graduate studies at Canadian Colleges and Universities.

RECENT ACTIVITIES

In Aug 2015, CRIPE hosted its biennial workshop on river ice processes in Quebec City. The workshop was well attended with 85 participants, 32 papers and 12 posters presented. CRIPE is very supportive of students and provides free travel and workshop registration for any student presenting a paper or a poster. At each workshop, there are also student awards for the top student paper and poster. This year, CRIPE also held a 1-day short course on river ice modelling after the workshop. This short course consisted of 7 invited speakers discussing practical examples of several different ice modelling tools.

CRIPE members also meet once a year. In the years without a workshop, the committee meets for 1-2 days to discuss administrative topics and also sets aside time for technical discussions and presentations. This year the committee will be meeting in Ann Arbor Michigan as most members will also be attending the IAHR Ice Symposium. Several members will also be attending the joint annual Canadian Geophysical Union meeting.

CRIPE also takes on special initiatives. In 2013, the committee published a book entitled "River Ice Formation" edited by CRIPE member Spyros Beltaos. CRIPE has also published a special issue of the Canadian Journal of Civil Engineering on River Ice Engineering.

FUTURE ACTIVITIES

CRIPE has several internal working groups to address specific issues related to river ice. Currently there are three working groups examining Flood Risk Delineation under the Influence of Ice, Effects of Climate Variability on River Ice, and River Ice Safety. While working on Flood Risk Delineation under the Influence of Ice, the committee recognized the need to inform/educate other scientific and government organizations about the significant influence that river ice can have on various river related topics. Members also participated in Natural Resources Canada's risk project survey to ensure that river ice related risks were highlighted.

CRIPE MEMBERSHIP

CRIPE currently has 15 Canadian members from various universities, hydro-electric facilities and government organizations, as well as 3 international members and 9 affiliate members.

Members

Mike Morris, (Chair) Manitoba Hydro
Martin Jasek, (Treasurer) BC Hydro
Benoit Turcotte, (Secretary) Université Laval
Robyn Andrishak, AMEC Earth & Environmental
Amir Ali Khan, Gov't of Newfoundland and Labrador
Brian Burrell, R.V. Anderson Associates Limited
Nadia Kovachis, Government of Alberta
Shawn Clark, University of Manitoba
Karl-Erich Lindenschmidt, Univ. of Saskatchewan
Karen Dow, University of Manitoba
Mark Loewen, University of Alberta
Joe Groeneveld, Hatch Energy
Yuntong She, University of Alberta
Dan Healy, Northwest Hydraulic Consultants
Bernard Trevor, Government of Alberta

International Members

Knut Alfredsen, Norwegian Univ. of Science and Tech.
Mikko Huokuna, Finnish Environment Institute
Edward Kempema, University of Wyoming

Affiliate Members

Faye Hicks, retired from University of Alberta
Spyros Beltaos, Environment Canada
Brian Morse, Université Laval
Steven Daly, retired from ERDC/CRREL
Hung Tao Shen, Clarkson University
Rick Carson, KGS Group
Evan Friesenhan, Government of Alberta
Terry Prowse, Environment Canada
Chris Katopodis, Katopodis Ecohydraulics Ltd.

I hope this communication will satisfy the requirement of our 2016 committee report. If additional information is required, please do not hesitate to contact me.

Yours truly,



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Northern Research Basins Committee

The main activities of the CGU-HS Northern Research Basins Committee during 2015 revolved about the organization of the 20th Northern Research Basins Symposium and Workshop which was held in Kuusamo, Finland, August 16 – 21, 2015. The main conference theme was “Value of Hydrological Information”. Details of the meeting, including proceedings, and minutes of the Task Force and Chief Delegates Meetings, can be found on the 20th NRB website: <http://www.syke.fi/20thnrb>

As outlined in the NRB Mandate and the Canadian NRB Terms of Reference, a maximum of 10 Canadian delegates invited by the Canadian Chief Delegate and approved by the CGU-HS Executive may participate in the symposium. It is desirable to have a delegation which is able to represent Canadian interest and expertise in cold regions hydrology. The Chief Delegate at the 20th NRB was Richard Janowicz. While unable to participate in the meeting the Deputy Chief Delegate is currently William Quinton.

The Canadian delegation at the 20th NRB included:

- Richard Janowicz, Yukon Department of Environment
- Sean Carey, McMaster University
- Terry Prowse, Environment Canada
- Ming-ko Woo, McMaster University
- David Barrett, University of Victoria
- Brandi Newton, University of Victoria

The 35 papers presented covered a wide range of topics associated with cold regions hydrology including process study results, modelling and climate change. One task force report was presented. Richard Janowicz (Canada) presented the results of the Measurement of Solid Precipitation working group. The results have been submitted to the NRB special issue of Hydrology Research for publication. Two other potential task forces were discussed. The Integration of Cold Regions Science for Societal Needs task force was proposed in 2011 but has not made any progress and will not continue. The Economic Value of Hydrological Information task force was proposed in 2013 also has not made much headway but will be revitalized with new members.

The 21st NRB will be held in Yakutsk, Russia in August 2017. Information on the symposium and workshop can be found on the website: www.coldhydro.ru.

2016-May-26
Urban Water Committee Report 2015-2016
Prepared by Claire Oswald

The urban hydrology committee of the CGU-HS was formed at the 2015 annual meeting in Montreal with the goal of promoting urban hydrological research in Canada. Initial membership on the committee includes the following individuals:

Dr. Claire Oswald (Department of Geography and Environmental Studies, Ryerson University)
Dr. Carl Mitchell (Department of Physical and Environmental Sciences, University of Toronto Scarborough)
Dr. Christopher Wellen (Great Lakes Institute of Environmental Research, University of Windsor)

The activities of the committee in 2015-16 have been mainly focused on the organization of a session on 'Urban Water in Canada' for the 2016 joint CGU-CMOS conference in Fredericton. Despite earnest efforts, we only attracted 7 abstract submissions (2 poster, 5 oral) to our session. We were granted a 'half-session' (3 oral and remaining posters) by the CMOS organizers. Oswald and/or Mitchell will be chairing this session.

In addition to the session, Oswald will be making a presentation to the CGU Young Hydrology Society on urban hydrological research in Fredericton.

The committee will be meeting at the Fredericton meeting to discuss new initiatives and opportunities to grow their membership in 2016-17.

Hydroecology Committee

Chairs: Daniel Peters (Environment and Climate Change Canada, University of Victoria) and Wendy Monk (Canadian River Institute, University of New Brunswick).

The Hydroecology Committee was established in May 2015 at the Joint Annual Meeting with AGU and GAC-MAC in Montreal, QC. The broad objective of the committee is to promote and advance the understanding of the linkages between hydrology and ecology in wetland, lake and river systems across Canada. The Chairs of the committee are convening a special session entitled "Advances in Hydroecology in Canada at the upcoming 2016 CMOS-CGU Joint Annual Meeting in Fredericton, NB. Although in its early days, members of the Hydroecology Committee have been involved in the publication of a special journal issue on Floods in Canada in the Canadian Water Resources Journal (Volume 41, Issue 1-2, 2016). Notably, the special issue contains an overview paper entitled "An Ecological Perspective on Floods in Canada" by DL Peters, D. Cassie, WA Monk, SB Rood and A St-Hilaire (DOI:10.1080/07011784.2015.10706940).