

2020 CGU-HS Committees Annual Report

Committee name: Permafrost-Hydrogeology Interactions

1. Committee Description, Background and Objectives

Permafrost – Hydrogeology Interactions committee of the Canadian Geophysical Union - Hydrology Section facilitates scientific advancement, interdisciplinary collaboration and knowledge transfer with respect to the relations between permafrost and hydrogeology in varying circumpolar landscapes, and the responses with climate change. These poorly understood relations are critical knowledge gaps, as climate change impacts on permafrost are likely to alter hydrologic cycles, groundwater flow networks, and surface water supplies in Canada's North. Communities, governments, regulators, industry, and academics are noting process changes in northern Canada. Regulators need guidance on how to scope groundwater and permafrost issues as they affect economic development, and Northern capacity is needed to address issues facing Northern communities. The knowledge must come through extended collaborations and engagement. The committee was established according to consensus at a meeting of 27 government, academic, and industry researchers and practitioners held to address these issues in Yellowknife, NT, 14 November 2016 (Morse, 2017).

Objectives:

1. Establish a collaborative research and development network to improve knowledge transfer and educational opportunities by facilitating scientific sessions and short courses in association with the Canadian Geophysical Union annual meeting and other with other scientific societies.
2. Prepare a White Paper synthesizing pan-Canadian perspectives on the state of knowledge of permafrost-hydrogeology interactions. Use this White Paper to develop a conceptual framework to guide future Canadian research.
3. Collate this White Paper with case studies and process research to publish a special journal issue on permafrost – hydrogeology interactions.
4. Report annually on progress to the Canadian Geophysical Union – Hydrology Section.
5. Follow-up on the conceptual framework and special issue by facilitating subsequent scientific sessions in association with the Canadian Geophysical Union annual meeting and other with other scientific societies.

2. Committee Membership. Please list using the following format School/Institution: CRCs:#, Profs: #, PDFs: #, PhD: #, MSc #, HonBSc: #. e.g. Waterloo; CRC:1, Profs: 5, PDFs: 2, MSc: 4, HonBSc: 2, RAs: 1

Geological Survey of Canada: Research Scientist: 1
Environment and Climate Change Canada: Research Scientist: 1

3. Committee Activities

3a. Major areas of research

- 3ai. Permafrost control on hydrogeology;
- 3aii. Permafrost control on surface - subsurface linkages;
- 3aiii. Implications of climate change on permafrost extent and subsequent impacts on water resources;
- 3aiv. Implications for northern communities

3e. Summary of areas of challenges and achievements (progress on issues and objectives)

- 3ei. Members are Named Partners in the NSERC Permafrost Partnership Network for Canada (PermafrostNet) that was awarded 5-years of funding in 2019 and has a goal of boosting Canada's ability to adapt to permafrost thaw;
- 3eii. Members are involved in the secretariat of the Canadian Permafrost Association;
- 3eiii. Members are involved in the secretariat of the Federal Permafrost Network.

4. Major Publications. Please list by: Peer Reviewed Journals; Invited Commentaries; Technical Reports. Indicate student authors with bolded font

- 4e. Chris Spence, Maggie Norris, Greg Bickerton, Barrie Bonsal, Robert Brua, Joseph M. Culp, Yonas Dibike, Stephan Gruber, Peter Morse, Daniel L. Peters, Rajesh Shrethra, Stephen Wolfe. 2020. The Canadian Water Resource Vulnerability Index - Permafrost Thaw (CWRVIPT). *Arctic Science*, <https://doi.org/10.1139/AS-2019-0028>
(Presents a new index to assess water resource vulnerability to permafrost loss)
- 4f. Timothy Ensom, Olga Makarieva, Peter Morse, Douglas Kane, Vladimir Alekseev, Philip Marsh. 2020. The distribution and dynamics of aufeis in permafrost regions. Special Issue Paper, Transactions of the International Permafrost Association. *Permafrost and Periglacial Processes*, <https://doi.org/10.1002/ppp.2051>
(An invited review paper on aufeis research conducted in the northern hemisphere)

5. Scientific conferences/workshops/sessions hosted by members; attended by members (in Canada, and abroad)

- 5e. None in 2019 due to CGU-IUGG partnership. A session was planned for 2020.



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

June 1st, 2020

CRIPE OBJECTIVES

The main objectives of CRIPE are:

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

CRIPE MEMBERSHIP

CRIPE currently has 17 Canadian members from various universities, hydro-electric facilities and government organizations, as well as 4 international members and 12 affiliate members.

Members

Shawn Clark, (Chair) University of Manitoba
Martin Jasek, (Vice-Chair) BC Hydro
Joel Evans, (Treasurer) BC Hydro
Benoit Turcotte, (Secretary) Yukon Government
Robyn Andrishak, AMEC Earth & Environmental
Brian Burrell, R.V. Anderson Associates Limited
Yves Gauthier, INRS-ETE, Quebec
Nadia Kovachis, Government of Alberta
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
Bernard Trevor, Government of Alberta
Mike Morris, Manitoba Hydro
Soheil Zare, Hatch

International Members

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

Affiliate Members

Spyros Beltaos, Environment Canada
Rick Carson, KGS Group
Steven Daly, retired from ERDC/CRREL
Evan Friesenhan, Government of Alberta
Dan Healy, Northwest Hydraulic Consultants
Jennifer Nafziger, Government of Alberta
Chris Katopodis, Katopodis Ecohydraulics Ltd.
Brian Morse, Université Laval
Terry Prowse, Environment Canada
Hung Tao Shen, Clarkson University
Colin Rennie, University of Ottawa
Fuad Curie, KGS Group

RECENT ACTIVITIES

CRIPE held its bi-annual workshop from May 14-16, 2019 in Ottawa, ON. Prior to the conference CRIPE held its annual meeting which was attended by 17 CRIPE members/international members/affiliate members. The conference was well attended (about 100 participants) and considered very successful. As with all conference proceedings since 1980, the papers can be found online at www.cripe.ca. Awards were distributed at the workshop banquet.

Once again CRIPE sponsored student travel/shared accommodations at the conference and provided awards to the best student paper and poster.

A very successful short course on Reducing Ice Jam Flood Risks was held immediately after the workshop on May 17th, in Gatineau, QC.

Our financial position was reported and we have sufficient funds to support ongoing activities.

In fall 2019 CRIPE submitted a successful bid to host the 2022 IAHR International Symposium on Ice. A committee structure has been organized and planning was started. This has since been put on hold due to the COVID-19 pandemic.

FUTURE ACTIVITIES

CRIPE has several internal working groups to address specific issues related to river ice. Currently there are four working groups examining Flood Risk Delineation under the Influence of Ice (this working group has produced several scientific journal and conference papers), Effects of Climate Variability on River Ice, River Ice Safety and Education.

The 2020 CRIPE meeting was supposed to be held at the 2020 IAHR International Symposium on Ice in June, however, this conference has been postponed. We will adjust our committee meeting time once the IAHR organizing committee finalizes their decision on if/when they will hold their conference. This decision should come by the end of June 2020.

The next CRIPE Workshop is currently planned for June 2021. It will be held in Saskatoon, SK. The conference chair is Karl-Erich Lindenschmidt, active member of CRIPE.

Report to CGU-HS on the Activities of the Northern Research Basins

Prepared by W. Quinton
Wilfrid Laurier University
2 June, 2020

1. Committee Description, Background and Objectives

In 1975, the International Hydrological Program (IHP) National Committees of Canada, Denmark/Greenland, Finland, Norway, Sweden, the United States of America, and the Union of Soviet Socialist Republics (USSR) established the IHP Working Group on Northern Research Basins, now called the “NRB Working Group”. In 1992, Iceland joined the group and Russia took over the responsibilities of the former USSR.

The overall objective of the NRB Working Group is to encourage research in hydrological basins in cold regions where snow, ice and frozen ground have a dominant role in the hydrological cycle. Over the years, the objectives of the NRB Working Group have evolved to include the following:

1. Gain a better understanding of hydrological processes, particularly those in which snow, ice, and frozen ground have a major influence on the hydrological regime, and to determine the relative importance of each component of the water balance.
2. Provide data for the development and testing of transposable models which may be applied to regional, national, and international water and land resource programmes.
3. Relate hydrological processes to the chemical and biological evolution of northern basins.
4. Assess and predict the effect of human activities on the hydrological regime in northern environments.
5. Encourage the exchange of personnel (technicians, scientists, research officers, students, and others) among participating countries.
6. Provide information for the improvement and standardisation of measurement techniques and network design in northern regions.
7. Encourage exchange of information on a regular basis, and
8. Set up task forces to promote research initiatives on topics of special interest to northern research basins.

2. Committee Membership:

The NRB is an organisation with its roots as a UNESCO working group. Its membership comprises the 8 circumpolar nations each of which are represented by a delegation of researchers which meet every two years at a symposium hosted by one of the member nations. In addition to the member nations, other nations (e.g. Japan, UK, Germany and others) have observer status.

3. Committee Activities

The NRB Symposium and Workshop is hosted by one of the 8 member countries every other year. In 2019, the NRB meeting took place in Yellowknife, NWT in the week of 18-23 August,

2019. This 22nd NRB was co-hosted by the Canadian Delegation of the NRB and the Government of the Northwest Territories: <https://conferences.wlu.ca/22ndnrp/>. Delegations of researchers from each circum-polar nation participated along with members of Indigenous organisations from across northern Canada. This was also a public event and included panel discussions of current GNWT ministers and former premiers, Chiefs and Grand Chiefs and other leaders of indigenous organisations, indigenous youth and university students and researchers. The NRB included several field trips and excursions, including a field trip (tour and picnic) to the Scotty Creek Research Station, hosted by the Grand Chief of the Dehcho First Nations on the day following the NRB.

The goal of the 22nd NRB was to provide a forum for researchers and Indigenous community members to come together as “partners in learning” to exchange experiences and ideas, co-develop new knowledge and understanding, and to promote new collaborations between scientists and Indigenous knowledge holders. As such, contributions that shed light on the growing challenges facing Indigenous populations in the cold regions of the world as a result of climate warming impacts on hydrology and water resources were especially welcome.

The workshop included oral presentations, panel and open discussions, and off-site activities all focussed on major themes and challenges in cold regions hydrology and water resources. All activities were intended to generate and share scientific and Indigenous knowledge from throughout the circumpolar region so that a greater understanding of climate warming impacts on northern water resources and the human communities that depend on them can be attained.

CGU-HS Committee on Isotopic Tracers Annual Report (2018-19)

Committee Directorship

Trish Stadnyk (Chair), University of Calgary

Jean Birks (past Chair), Alberta Innovates- Technology Futures, 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 are active in the promotion and advancement of the understanding and application of isotopic tracer techniques in hydrology and related sciences. Two key initiatives have helped to promote the application and use of isotope tracers in Canada, which committee Directors and membership have been involved in:

National: Water Survey of Canada Isotope Network

The Water Survey of Canada, in cooperation with the University of Manitoba, University of Victoria, and Innotech Alberta, 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.

A wrap up report for the pilot phase was submitted to Environment and Climate change Canada in September 2018, and a recent set of publications was submitted to the *Journal of Hydrology: Regional Studies*¹ and *Data in Brief*² to publish these data and provide a preliminary analysis. Efforts are on-going to secure a permanent network, as part of the hydrometric database and

¹ Gibson, J.J., Gibson, J.J., Holmes, T., Stadnyk, T.A., Birks, Pietroniro, A. ¹⁸O and ²H in streamflow across Canada. Submitted to *J. Hydrol.: Regional Studies*. EJRHS-20-00128

² Gibson, J.J., Eby, P., Stadnyk, T.A., Pietroniro, A. Surveys of ¹⁸O and ²H in streamflow across Canada: a national resource for tracing water sources, water balance and predictive modelling. Submitted to *Data in Brief*.

CGU-HS Committee on Isotopic Tracers Annual Report (2018-19)

hydrologic services. 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.

Also on-going are efforts to re-establish the Canadian Network for Isotopes in Precipitation. For the past three years, the network has been run through a pilot program with the IAEA and Health Canada's radiation network. The goal is to find a permanent program to support the CNIP network since it is a valuable part of the IAEA's GNIP program. For further information please contact John Gibson, jjgibson@uvic.ca

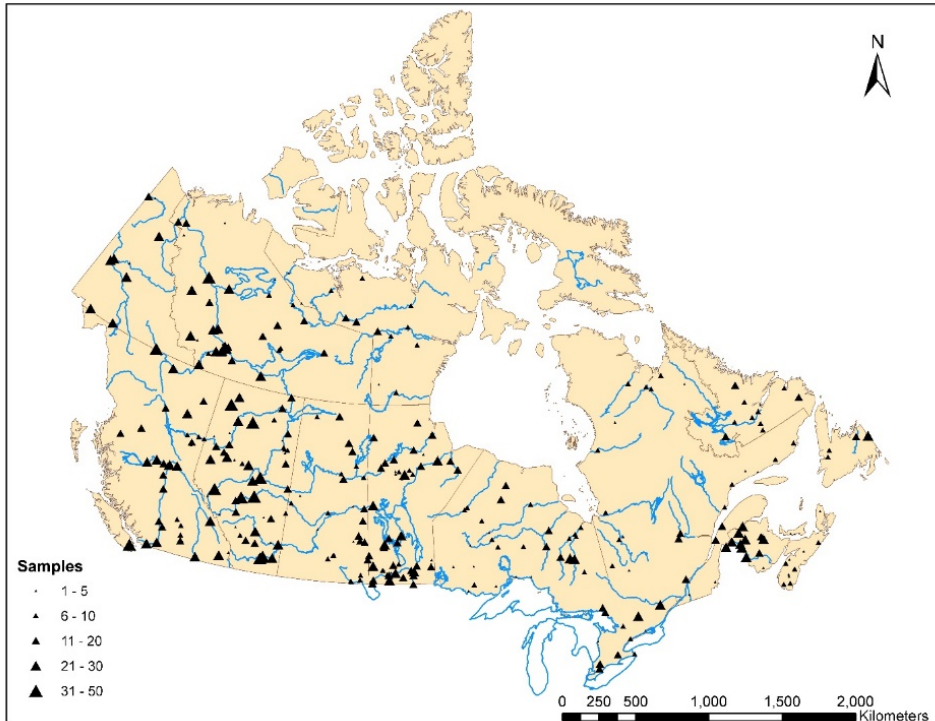


Figure 1. CNIP and CNIR network, indicating number of samples at various locations in Canada

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. 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 (2018-19)

ENVS 898 – Isotope Tracers in Catchment Hydrology Graduate Course

The course once again ran successfully from May 9-13, 2020 in a totally online, live format. With more than 150 participants world-wide (20 of which were registered students), the course format was successfully migrated to online only format during COVID19. Talks with the Canadian Society for Hydrological Sciences and the Canadian Water Resource Association are on-going to consider adding this course to their core National courses and professional certifications. The course remains available to graduate students from outside U of S via the Western Canadian Dean's Agreement (<http://wcdgs.ca/western-deans-agreement.html>). For more information, or if you are interested, contact Jeff McDonnell (jeffrey.mcdonnell@usask.ca).

Conference Sessions

Due to COVID19, no formal sessions were held as part of national or international conferences. We will resume with special sessions when conference activity resumes.

Committee Coordination

Though progress is being made on National scale networks and collaborations, the committee would like to hold more formal activities beginning in 2020-21. Anyone interested in being a part of the executive should contact tricia.stadnyk@ucalgary.ca. The executive will reach out to committee membership in 2019-20 to decide what directions the membership would like to proceed in.

Hydroecology Committee Report for 2018-2020 Period

Chairs:

Daniel Peters (Environment and Climate Change Canada, University of Victoria) and Wendy Monk (Environment and Climate Change Canada, University of New Brunswick).

Background:

Established May 2015 to support and facilitate information exchange, as well as work towards bridging multidisciplinary research carried out by aquatic ecologists and hydrologists within Canada and internationally.

Objective:

To promote and advance the understanding of linkages between hydrology and ecology in wetland, lake and river systems across Canada.

Activities:

The Hydroecology committee continued to be active in the promotion and advancement of understanding the linkages between aquatic ecology, water quality and hydrology.

Provided expertise and contributed to Development of a multi-jurisdiction Action Plan to protect the World Heritage Values of Wood Buffalo National Park (WBNP) <https://www.pc.gc.ca/en/pn-np/nt/woodbuffalo/info/action>

Provided expertise to Canadian Environmental Assessment Agency – e.g., Frontier Oil Sands Mine Project <https://iaac-aeic.gc.ca/050/evaluations/proj/65505>

Organized/Led “Development of an Environmental Flows Framework for the Peace-Athabasca Delta” Workshop 1: Knowledge gathering, ecosystem components, and broad habitat types in support of the: Environmental Flows and Hydrology Theme of the WBNP Action Plan. Edmonton, Alberta on March 13-14, 2019

Publication of peer reviewed manuscripts, scientific reports, book chapters, etc.

Select Recent Publications:

Monk WA, Armanini DG, Orlofske JM, Crocker JB, DL Peters and DJ Baird. 2018. Flow-ecology thresholds in Canadian rivers: a comparison of trait and taxonomy-based approaches. *Freshwater Biology*, Vol. 63:891-905, DOI:10.1111/fwb.13030

Rokaya P, DL Peters, B Bonsal, H Wheeler, K-E Lindenschmidt. 2019. Modelling the effects of flow regulation on ice-affected backwater staging in a large northern river. *River Research and Application*, 35:587-600, <https://DOI:10.1002/rra.3436>

Siles G, M Trudel, DL Peters, R Leconte. 2020. Hydrological monitoring of wetlands of the Peace Athabasca Delta from high-resolution space-borne D-InSAR. *Remote Sensing of the Environment*, 236, <https://DOI:10.1016/j.rse.2019.111444>

Rokaya P, DL Peters, M. Elshamy, K-E Lindenschmidt. 2020. Impacts of future climate on the hydrology of a northern headwater basin and its implications for a downstream deltaic ecosystem. *Hydrological Processes* 34: 1630-1649, <https://DOI:10.1002/hyp.13687>

Bush A, WA Monk, ZG Compson, TM Porter, M Hajibabaei, DL Peters, DJ Baird. 2020. DNA Metabarcoding Reveals Metacommunity Dynamics in a Threatened Boreal Wetland Wilderness. *Proceedings of the National Academy of Sciences* Mar 2020, 201918741; DOI: 10.1073/pnas.1918741117

Beltaos S, DL Peters. 2020. Naturalized flow regime of the regulated Peace River during spring

- breakup of the ice cover. *Cold Regions Science and Technology*, 172
<https://doi.org/10.1016/j.coldregions.2020.103005>
- Chasmer L, C Mahoney, K Millard, K Nelson, C Hopkinson, M Merchant, DL Peters, O Niemann, J Montgomery, B Brisco, K Devito, D Cobbaert. 2020. Remote Sensing of Boreal Wetlands 2: Methods for Evaluating Boreal Wetland Ecosystem State and Drivers of Change. *Special Issue Wetland Landscape Change Mapping Using Remote Sensing, Remote Sensing* 12: 1321 doi:10.3390/rs12081321 – early access April 2020
- Chasmer L, C Mahoney, K Nelson, B Brisco, K Devito, C Hopkinson, M Merchant, K Millard, J Montgomery, O Niemann, DL Peters, D Cobbaert. 2020. Remote Sensing of Boreal Wetlands 1: Data Use for Policy and Management. *Special Issue Wetland Landscape Change Mapping Using Remote Sensing, Remote Sensing* 12: 1320; doi:10.3390/rs12081320 – early access April 2020
- Chengwei W, JJ Gibson, DL Peters. 2020. Evaluating water balance of lakes disturbed by permafrost degradation in Mackenzie delta region, NWT, Canada. *State of the Total Environment*, <https://doi.org/10.1016/j.scitotenv.2020.139176> Accepted April 2020
- Spence C, M Norris, G Bickerton, B Bonsal, R Brua, J Culp, Y Dibike, S Gruber, P Morse, DL Peters, R Shrestha, S Wolfe. 2020. The Canadian Water Resource Vulnerability Index - Permafrost Loss (CWRVI_{PL}). *Arctic Science* <http://dx.doi.org/10.1139/AS-2019-0028>
- Orr, J.A., Vinebrooke, R.D., Jackson, M.C., Kroeker, K.J., Kordas, R.L., Mantyka-Pringle, C., Van den Brink, P.J., De Laender, F., Stoks, R., Holmstrup, M., Matthaei, C.D., Monk, W.A., Penk, M.R., Leuzinger, S., Schäfer, R.B. and J.J. Piggott. 2020. Towards a unified study of multiple stressors: divisions and common goals across research disciplines. *Proceedings of the Royal Society B*. 28720200421
- White, C.F.H., Gray, M.A., Kidd, K.A., Duffy, M.S., Lento, J. and W.A. Monk. 2020. Prevalence and intensity of *Salmincola edwardsii* in Brook Trout in Northwest New Brunswick. *Canadian Journal of Aquatic Animal Health*. 32: 11-20.
- Makiola, A., Compson, Z.G., Baird, D.J., Barnes, M.A., Boerlijst, S.P., Bouchez, A., Brennan, G., Bush, A., Canard, E., Cordier, T., Creer, S., Curry, R.A., David, P., Dumbrell, A.J., Gravel, D., Hajibabaei, M., Hayden, B., van der Hoorn, B., Jarne, P., Jones, J.I., Karimi, B., Keck, F., Kelly, M., Knot, I.E., Krol, L., Massol, F., Monk, W.A., Murphy, J., Pawlowski, J., Poisot, T., Porter, T.M., Randall, K.C., Ransome, E., Ravigné, V., Raybould, A., Robin, S., Schrama, M., Schatz, B., Tamaddon-Nezhad, A., Trimbos, K.B., Vacher, C., Vasselon, V., Wood, S., Woodward, G. and D.A. Bohan. 2020. Key questions for Next-Generation Biomonitoring. *Frontiers in Environmental Science*, 7.
- Compson, Z.G., Monk, W.A., Hayden, B., Bush, A., O'Malley, Z.G., Hajibabaei, M., Porter, T.M., Wright, M.T.G., Baker, C.J.O., Al Manir, S.M., Curry, R.A., and D.J. Baird. 2019. Network-based biomonitoring: Exploring freshwater food webs with stable isotope analysis and DNA metabarcoding. *Frontiers in Ecology and Evolution*. 7: 395.
- Nguyen, H.Q., Curry, R.A., Monk, W.A., Culp, J. and T. Linnansaari. 2019. Seasonal differences in plankton community structure are more pronounced than spatial patterns in the headpond and downstream portions of a large impounded river. *Inland Waters*. 9: 348-361
- Monk, W.A., Compson, Z.G., Choung, C.B., Korbek, K.L., Rideout, N.K. and D.J. Baird. 2019. Urbanisation of floodplain ecosystems: Weight-of-evidence and network meta-analysis elucidate multiple stressor pathways. *Science of The Total Environment*. 684: 741-752.
- Van den Brink, P.J., Bracewell, S.A., Bush, A., Chariton, A., Choung, C.B., Compson, Z.G., Dafforn, K.A., Korbek, K., Lapen, D.R., Mayer-Pinto, M., Monk, W.A., O'Brien, A.L., Rideout, N.K., Schäfer, R., Sumon, K.A., Verdonschot, R.C.M. and D.J. Baird. 2019. Towards a general framework for the assessment of interactive effects of multiple stressors on aquatic ecosystems: Results from the Making Aquatic Ecosystems Great Again (MAEGA) workshop. *Science of The Total Environment*, 684: 722-726.
- Compson, Z.G., Monk, W.A., Hayden, B., Bush, A., O'Malley, Z., Hajibabaei, M., Porter, T.M., Wright, M.T.G., Baker, C.J.O., Al Manir, M.S., Curry, R.A. and D.J. Baird. 2019. Network-

- based biomonitoring: exploring freshwater food webs with stable isotope analysis and DNA metabarcoding. *Frontiers in Ecology and Evolution*. 7: 395.
- Compson, Z.G., Monk, W.A., Curry, C.J., Gravel, D., Bush, A., Baker, C.J.O., Al Manir, M.S., Riazanov, A., Hajibabaei, M., Shokralla, S., Gibson, J.F., Stefani, S., Wright, M.T.G., and D.J. Baird. 2018. Chapter Two - Linking DNA metabarcoding and text mining to create network-based biomonitoring tools: A case study on Boreal wetland macroinvertebrate communities. In Bohan, D.A., Dumbrell, A.J., Woodward, G., and Jackson, (Eds). *Advances in Ecological Research*. 59:33-74.
- Culp JM, Droppo IG, di Cenzo P, Alexander-Trusiak A, Baird DJ, Beltaos S, Bickerton B, Bonsal B, Brua RB, Chambers PA, Dibike Y, Glozier NE, Kirk J, Levesque L, McMaster M, Muir D, Parrott J, Peters DL, Pippy K, Roy J. 2018. Synthesis Report for the Water Component, Canada-Alberta Joint Oil Sands Monitoring: Key Findings and Recommendations. Oil Sands Monitoring Program Technical Report Series No. 1.1, 46 p. ISBN 978-1-4601-4025-3
- Culp JM, Glozier NE, Baird DJ, Wrona FJ, Brua RB, Ritcey AL, Peters DL, Casey R, Choung C, Curry C, Halliwell D, Keet E, Kilgour B, Kirk J, Lento J, Luiker E, Suzanne C. 2018. Assessing Ecosystem Health in Benthic Macroinvertebrate Assemblages of the Athabasca River Mainstem, Tributaries and Peace-Athabasca Delta. Oil Sands Monitoring Program Technical Report Series No. 1.7, 82 p ISBN 978-1-4601-4031-4
- Monk, W.A., Z. Compson, D. Armanini and A. Idigoras Chaumel. 2018. Proposed holistic environmental flows framework for the Saint John River with a focus on operations at the Mactaquac Generating Station. Submitted to New Brunswick Power. 115pp.
- Bonsal BR, DL Peters, F Seglenieks, A Rivera, A Berg. 2019. Changes in Freshwater Availability Across Canada. Chapter 6 in: *Canada's Changing Climate Report*, E. Bush and D Lemmen (Editors), Government of Canada, Ottawa, Ontario, Canada, p. 261-342. ISBN: 978-0-660-30222-5

2020 CGU-HS Committees Annual Report

Urban Hydrology Committee

1. Committee Description, Background, Objectives

The Urban Hydrology committee was formed in 2016 to promote and advance understanding of the importance and role of hydrology in urban environments.

2. Committee Membership

Ryerson: Profs: 2, PhD: 2, Masters: 3, Undergraduate: 3

University of Toronto Mississauga: Prof: 1, Masters: 1, Undergraduate: 1

University of Toronto Scarborough: Prof: 1, PhD: 1, Masters: 3

3. Committee Activities

a. Major areas of research

Urban hydrological processes, urban isotope hydrology, urban water quality (chloride, contaminants of emerging concern, nutrients), urban geospatial landscape analysis

b. Science-industry collaborations

None directly related to this committee

c. Training and networking initiatives geared towards young and emerging scientists

The faculty members of this committee are active supporters of the CYHS and supervise many of its members.

The Ryerson Urban Water research centre is hosting an internal online student seminar series in summer 2020.

d. Regional, national and international advisory efforts

One member participates in the Lake Simcoe and Region Conservation Authority road salt working group and WWF Canada's chloride working group.

e. Summary of areas of challenges and achievements (progress on issues and objectives)

Typically, this committee organizes a special session (urban(izing) and/or human-dominated landscapes focus) at the annual conference each year. Our session that was supposed to take place in May 2020 in Banff will be re-submitted to the 2021 conference.

One of our major challenges is developing initiatives outside of the special session. Last year we discussed collaborating on a review paper focused on water quality in urban environments.

4. Major Publications (students indicated with bold font)

a. Peer-reviewed journals

Morales, K. and Oswald, C.J. (2020) Water age in stormwater management ponds and stormwater management pond treated catchments. *Hydrological Processes*, 34(8), 1854-1867, doi: 10.1002/hyp.13697.

Mohamed N. Mohamed, Christopher Wellen, Chris T. Parsons, William D. Taylor, George Arhonditsis, Krista M. Chomicki, Duncan Boyd, Paul Weidman, Scott O. C. Mundle, Philippe Van Cappellen, Andrew N. Sharpley, and Douglas G. Haffner (2019) Understanding and managing the re-eutrophication of Lake Erie: Knowledge gaps and research priorities, *Freshwater Science*, 38(4), 675-691.

b. Invited commentaries

n/a

c. Technical reports

n/a

5. Scientific conferences/workshops/sessions hosted by members; attended by members (in Canada, and abroad)

Oswald and Wellen: Co-conveners of 'Freshwater Salinization: Causes, Effects and Working Towards Solutions' at the SETAC Toronto Conference, Toronto, November 2019.

Oswald: American Geophysical Union, San Francisco, December 2019.

Wellen: Application of HYPE at headwater to regional scales: what do we learn about nutrient losses? Integrated Lake-Watershed Modelling Workshop. Waterloo, Canada. 2019

6. Other major achievements

a. Awards

Oswald and team - Julia Hanigsberg Make Your Mark Staff Award for Sustainability; Ryerson University; March 2019; for academic role in the Ryerson Road Salt Reduction Project

b. Research funding

"High-Frequency Examination of Nutrient Loading, Transport and Transformation During Event Flows Using Sensor-Based Technologies", Canada-Ontario Agreement on Great Lakes (Ontario Ministry of Environment, Conservation and Parks (PI: Oswald, Wellen)

"Restoration Opportunities for the Lost Creeks of South Etobicoke", Mitacs Accelerate (PI: Oswald)

“Ryerson University Road Salt Reduction Demonstration Project”, World Wildlife Fund Canada Go Wild Grant (PI: Oswald)

“Chloride Retention in Urban Soils: Exploring Processes and Implications.”, Natural Sciences and Engineering Research Council of Canada (NSERC) USRA Grant (PI: Wellen)

“Hydrological and Water Quality Benefits of a Low Impact Design Construction for Highland Creek at Military Trail near Highcastle Road”, City of Toronto Transport Services Research Agreement (PI: Mitchell)

“Enhancing Water Balance Criteria to Protect Wetlands from Urban Stormwater and Climate Change”, MITACS Accelerate (PI: Mitchell)

"Hydrological control points of biogeochemical cycling in suburbanizing stream corridors", NSERC Discovery Grant (PI: Duval)

"Urban stream sediment fingerprinting", UTM Internal Award (PI: Duval)

7. Budget/Finances

Nothing to report.

8. Additional information the committee would like on file.

Nothing to report.

2020 CGU-HS CYHS annual report

1. Committee Description, Background and Objectives

The Canadian Young Hydrologic Society (CYHS), founded in 2015, aims to engage early career researchers by organizing workshops and activities to stimulate meaningful interaction and exchange between research groups across Canada. It is the Canadian branch of the wider Young Hydrologic Society (YHS), an international initiative that facilitates the interaction of young hydrologists within the hydrological community. These activities include pop-up sessions at large national conferences, seminars, workshops, and social nights.

2019-2020 was the fifth year of the Canadian Young Hydrologic Society (CYHS) being in operation. This year succeeded in establishing the CYHS in the Canadian hydrology community as a national branch of the international YHS and as a staple of the CGU-HS by organizing a pre-conference workshop, social event and within-conference seminars. In the 2019-2020 year, the CYHS focused on two events: a 3-day early-career workshop held at the CGU-IUGG meeting and a twitter symposium.

The 2019-2020 CYHS committee is composed of 9 members:

Chair: Caroline Aubry-Wake, PhD Candidate, Centre for Hydrology, University of Saskatchewan
(Additional role: YHS-YESS ECR workshop organiser)

Secretary: Cody Ross, PhD Candidate, Centre for Earth Observation Science, University of Manitoba

Treasurer: Sarah Ariano, PhD Candidate, Department of Geography and Environmental Studies,
Ryerson University

Social media/Communications: Kayla Wong, Ryerson Alumni, and Lauren Somers, Dept. Earth and
Planetary Sciences McGill university (additional role: YHS-YESS ECR workshop organiser)

ECR collaboration: Kelly Biagi, PhD Candidate, School of Geography and Earth Sciences, McMaster
University

Members at large:

Pierrick Lamontagne-Hallé, PhD Candidate, Dept. Earth and Planetary Sciences, McGill University

Sophie Wilkinson, PhD Candidate, School of Geography and Earth Sciences, McMaster University

Jason KarisAllen, MASc Candidate, Centre for Water Resources Studies, Dalhousie University

2. Committee Membership. Please list using the following format School/Institution: CRCs: #, Profs: #, PDFs: #, PhD: #, MSc #, HonBSc: #. e.g. Waterloo; CRC:1, Profs: 5, PDFs: 2, MSc: 4, HonBSc: 2, RAs: 1

CYHS does not have an annual membership but we do keep track of workshop/seminar attendees. Numbers for 2019-2020 early-career workshop organized ahead of the 2020 CGU meeting are as follows:

McGill University: 7

University of Alberta : 2

Simon Fraser University: 1

University of Saskatchewan: 3

University of Waterloo: 5

Ryerson University: 1

University of Calgary: 1

University of Toronto Mississauga: 1

Guelph University: 4

McMaster University: 3
University of Manitoba: 1
Dalhousie University: 1
Ecole de Technologie Supérieure: 2

PDF: 4
PhD: 17
MSc/MSA: 10
Professionals: 1
TOTAL: 32

3. Committee Activities

3a. Major areas of research

[blank]

3b. Science-industry collaborations

[blank]

3c. Training and networking initiatives geared towards young and emerging scientists

The main activity undertaken by the CYHS in 2019 was a three-day workshop for early career researchers (ECRs) in hydrology from July 4th to 6th, ahead of the IUGG General Assembly in Montreal. The goal of the workshop was to bring Canadian hydrology ECRs together to discuss common challenges and ways forward in their field and synthesize those discussions into a piece for publication. The discussions were centered on research gaps, recent advances and challenges in hydrology, divided between three themes: hydrology subdisciplines, research methodologies and engagement with society. 32 graduate students, postdocs and young professionals from all across Canada attended the workshop. The workshop featured 2 invited talks by Prof. Nigel Roulet and Prof. Jan Adamowski as well as a field visit to the McGill hydrology research station at Mont St-Hilaire with Prof. April James.

Additionally, the CYHS held a Twitter Symposium. Held between October 2nd and 4th, the symposium generated 23 external posts (excluding committee members), generating 217 likes, 15 retweets and four new followers. CYHS awarded four participants \$50.00 for engaging in the event and receiving the Award for Most Liked and Retweets Twitter Post. The most popular tweet was assessed through Twitter Analytics, identifying participants with the greatest number of retweets and highest engagement rate. The full CYHS executive committee was excluded from competing.

The CYHS Twitter account is used as a platform to facilitate the distribution of information, news, resources, and support relevant to early career hydrologists. The account currently reaches 409 followers (an increase of 111 followers from May 2019 - May 2020) and averages 3,813 tweet impressions (viewership of our tweets and retweets) a month. From May 2019 - May 2020 the CYHS twitter account had 813 profile visits, 110 mentions, and the tweets were viewed a total of 49,566 times. The month of October generated the most engagement from our audience which was a result of the Twitter Symposium.

In November, CYHS awarded one participant at McMaster Water Week the CYHS McMaster Water Week Most Innovative Poster Award. The winner was chosen based on a selection criterion including the ability to outline the originality of the research approach, overall knowledge of the subject area, and ability to justify and explain the content. This award was assessed by a panel of judges and amounted to \$150.00. The full CYHS executive committee was excluded from competing.

On December 7, 2019, the Young Earth System Scientists (YESS), the Young Hydrologic Society (YHS), with the Canadian branch (CYHS), and The the Association of Polar Early Career Scientists (APECS) held a Joint Early Career Researcher (ECR) Workshop entitled “Water Cycle in a 1.5°C Warmer World: Interdisciplinary Approaches”, prior to the 2019 American Geophysical Union (AGU) Fall Meeting. The 4-hour workshop brought together 46 early career researchers from different countries and career backgrounds for an interdisciplinary discussion on 1) a joint perspective on the water cycle and governance under climate change, from the fundamental processes to societal impacts; 2) how the science of the upcoming generation of researchers can be integrated in the new World Climate Research Programme (WCRP) Strategic Plan and future directions; and 3) how the various ECR networks can work in a more integrative manner, benefit from each other, and improve their communication channels.

The CYHS had planned a series of events for the CGU 2020 meeting in Banff, but these events were canceled due to the ongoing COVID-19 pandemic. The planned events featured a morning social hike, an afternoon workshop featuring talks and panel discussion on the topic “From failure to progress: lessons learned in hydrology”, featuring four speakers at different career stages. This would have been followed by a social event. A lunch-time discussion of data management was also planned, as well as a short presentation by a NSERC representative to present and explain funding available to students. The CYHS was also helping in the organization and promotion of a Python modelling course to be held at the end of the conference in Canmore. The activities will hopefully be implemented at the CGU 2021 meeting or in a virtual format during the 2020 online conference.

3d. Regional, national and international advisory efforts

[blank]

3e. Summary of areas of challenges and achievements (progress on issues and objectives)

Challenge/Achievement 1: Funding

Funding has been the primary challenge to provide a high quality workshop in conference centres with high catering costs or in cities with expensive venues for social events, leading to concerns that CYHS workshops are not self-sufficient with costs fluctuating between years as the scope of workshops, venue/location and attendance varies. In past years, CYHS has kept workshops economical and has primarily relied on funding from CGU-HS, external funding from individual lab groups (2018), contributions from universities, or cooperation with other early career researcher (ECR) organizations (2018, 2019).

This changed in 2019, when CYHS secured \$12,000 in funding to support a 3-day workshop. Residual funds and workshop fees acquired from hosting the workshop in Montreal will be used to support future ECR initiatives. Future fundraising activities including workshops will promote CYHS to be self-sustaining. CYHS will likely require no support from CGU-HS for the 2020-2021 fiscal year. Additionally, the cancellation of CGU-2020, has preserved CYHS funds and will be used to support workshop and ECR activities during 2020 and CGU 2021.

Challenge/Achievement 2: Wide-spread recruitment/advertisement in Canada

Ongoing goals are to recruit participants from a wider range of Canadian universities. The main advertisement of CYHS events seems to be from word-of-mouth. To this end, we compiled a list of all physical geography, hydrology and engineering departments with graduate programs in Canada to build an email list to advertise events. This list was used to promote the 2019 ECR workshop and resulted in participants from universities which were previously not commonly present at CYHS events.

To achieve a more widespread presence across Canada, the CYHS is establishing collaborations with existing university water-focused networks, We also work to recruit, when possible, new committee members from a diverse range of universities.

Challenge/Achievement 3: Grow the reach of CYHS as an early career network

By publishing papers, the CYHS has expanded its audience by enhancing significance as an early career network. By participating in international ECR initiatives, we have enhanced the expertise of CYHS members and shared our experiences with other ECR organisations. The connections we have made during these last few years have been important for our personal and professional development and for the success of our organized workshops. We also realized that the challenges we are facing as ECRs and as members of an ECR organization are similar. This was one of the many motivations that led us to organize the 2019 ECR workshop.

Additionally, the CYHS is aiming to strengthen its presence as an active early-career network. To do so, the CYHS was involved with two main early-career workshops in the last 2 years. The first workshop was in Canmore, Alberta, was supported by the World Meteorological organization, The World Climate Research program and the Global Energy and water Exchange network, and it was organised in collaboration with the Young Earth System community (YESS). Similarly, the CYHS was involved in the organisation of the AGU-WCRP Joint Early Career event, organised by APECS, YHS and YESS.

4. Major Publications. Please list by: Peer Reviewed Journals; Invited Commentaries; Technical Reports. Indicate student authors with bolded font.

Two publications emerged from early-career workshops organized and hosted by or in partnership with the CYHS.

Peer-reviewed Journals:

Langendijk, G., C. Aubry-Wake, M. Osman, C. Gulizia and 18 others (2019) Three Ways Forward to Improve Regional Information for Extreme Events: An Early Career Perspective. *Front. Environ. Sci.* 7:6. doi: 10.3389/fenvs.2019.00006

Invited Commentary:

Aubry-Wake, C., Somers, L.D., Alcock, H., Anderson, A.M., Azarkhish, A., Bansah, S., Bell, N.M., Biagi, K., Castaneda-Gonzalez, M., Champagne, O., Chesnokova, A., Coone, D., Gauthier, T.-L.J., Ghimire, U., Glas, N., Hrach, D.M., Lai, O.Y., Lamontagne-Hallé, P., Leroux, N.R., Lyon, L., Mandal, S., Nasri, B.R., Popović, N., Rankin, T.E., Rasouli, K., Robinson, A., Sanyal, P., Shatilla, N.J., Van Huizen, B., Wilkinson, S., Williamson, J. and Zaremehrdjard, M. (2020), A new flow for Canadian young hydrologists: Key scientific challenges addressed by research cultural shifts. *Hydrological Processes*, 34: 2001-2006. doi:[10.1002/hyp.13724](https://doi.org/10.1002/hyp.13724)

5. Scientific conferences/workshops/sessions hosted by members; attended by members (in Canada, and abroad).

A list of presentations, workshops and events organized by or in partnership with the CYHS is provided:

Conferences presentation:

2018:

Aubry-Wake, C., Biagi, K. M., Lamontagne-Hallé, P., Ross, C., Shatilla, N., Somers, L., & Wilkinson, S. (2018). The Canadian Young Hydrologic Society: the growth and development of a national YHS branch. AGU 2018: Washington D.C.

2019:

Participation in EGU Early Career Scientists' Forum, EGU General Assembly 2019, Vienna, April 10th 2019. Conveners: Stephanie Zihms, Raffaele Albano and Hazel Gibson.

2020:

Aubry-Wake, C., Somers, L., Ariano, S., Biagi, K. M., Lamontagne-Hallé, P., KarisAllen, J., Ross, C., Wong, K., & the workshops participants (*cancelled*). A new flow for Canadian young hydrologists: Key scientific challenges addressed by research cultural shifts. Poster abstract submission for the cancelled 2020 CGU Annual Meeting.

Organized Workshops and Events:

2016:

1. "Challenges and opportunities in Canadian hydrology" workshop, CGU Fredericton, NB
 - Invited Workshop Speakers: Dr. Genevieve Ali, Dr. Sean Carey, Dr. Merrin Macrae, Dr. Phil Marsh, Dr. Claire Oswald & Dr. Howard Wheeler (attendance: 50 ECRs)
 - Social event held after the workshop at a local pub where 75 ECRs attended.

2017:

1. "Progression of a scientific career in academia" seminar, CGU, Vancouver, BC
 - Invited Workshop Speakers: Dr. Nora Casson, Dr. Andrew Ireson, Nicola Jones, Dr. Barret Kurylyk, Dr. Jeff McKenzie & Dr. Ming-ko (Hok) Woo (attendance: 65 ECRs).
 - A social event was held in the evening after the workshop on the UBC campus where we had 100 attendees.

2018:

1. "Careers in hydrology: Options and insights" workshop and panel discussion, CGU, Niagara Falls, On
 - Invited Speakers: Simon Gautrey, Dr. Christa Kelleher, Dr. Joseph Shea & Dr. Chris Spence (attendance: 45 ECRs). A social event was held in the evening after the workshop in Niagara Falls where we had 100 attendees.
2. "Tips and tricks for publishing in hydrology" workshop.
 - Invited Speakers: Dr. Laura Lautz & Dr. Mike Waddington (attendance: 47 ECRs)
3. Inaugural GWF Young Professionals workshop and social events (GWF Annual Science Meeting in collaboration with GWF YP group)
 - Invited Speaker: Dr. Jeff McDonnell ‘
4. Professional Development Workshop: 'The Art of Scientific Investigation' (attendance: ~80 ECRs).
 - Invited Speaker: Dr. John Pomeroy 'Role of YPs Within Larger GWF Context' (attendance: 90 ECRs)
5. Water Week Poster Session and award for "Most Innovative Research" awarded to Anjali Narayanan (Undergraduate student)
6. Joint YESS-YHS Early Career Researcher (ECR) Workshop. "Towards Regional Information to Improve Our Understanding on Weather, Water, and Climate Extreme Events" at the 2018 GEWEX Open Science Conference, 3-5 May, 2018.

2019:

1. “Opportunities and Challenges in Canadian hydrology: a early-career perspective” workshop at IUGG-CGU 2020. 32 participants.
 - Invited speakers: Professor Nigel Roulet, Prof. Jan Adamowski and Prof. April James.
2. Joint WCRP-AGU workshop, Water Cycle in a 1.5° Warmer World: Interdisciplinary Approaches, AGU Fall Meeting, Dec. 7, 2019. Co-organized by APECS, YESS and YHS/CYHS
3. McMaster Water Week, CYHS: McMaster Water Week Most Innovative Poster Award (1 ECR Awarded)
4. CYHS Twitter Symposium, Award for Most Liked and Retweets Twitter Post (4 ECR’s awarded)

2020 (Cancelled):

1. From failure to progress: lessons learned in hydrology, CGU meeting in Banff
2. Applied data management best practices for young hydrologists, CGU meeting in Banff
3. Python Hydrological Modeling Workshop, CGU meeting in Banff, on Thursday 7th May.

6. Awards received by members

[Blank]

7. Other major achievements (Complete and ongoing scientific projects; Institutional relations/cooperation)

[blank]

8. Budget/Finances

Previous years funding was secured from the Canadian Geophysical Union-Hydrology Section (\$5000), McGill Department of Earth and Planetary Sciences (\$3000), McGill Geography (\$2000) and McGill Science (\$2000), to support the 2019 CYHS workshop and amounted to \$12,000. Global Water Future-Young Professional provided 6 travel grants to GWF-affiliated participants (3000\$), payment have been processed for transportation costs and for the 2019 field site visit at Mont St-Hilaire (\$488). All payments from preceding workshops have now cleared accounts, this includes funds spent on room rental and catering (\$4306), travel awards (\$2500) and thank you gifts for the speakers (\$98). The current CYHS account balance held at McGill is \$5095.55. The McGill-affiliated funders have agreed to have the leftover funds used for future CYHS events.

The McGill affiliated funds were planned to be used to support workshop activities for CGU 2020 in Banff. Planned funds to be allocated amounted to \$2700.00 to support workshop room bookings, meals and booking fees for a Sunday Social. CYHS was also planning to offer top-up awards for students including a Campbell Poster, 2nd and 3rd place award and a Don Gray Paper 2nd and 3rd place award. It is the intention of CYHS that funding secured (\$800) for top-up awards will still be allocated to students after the virtual CGU-HS 2020 sessions.

Current funds held by CGU-HS amounts to \$277.64. 2019-2020 funds were used to support two ECR awards, the McMaster Water Week Most Innovative Poster Award and the series of CYHS Twitter Symposium Awards. These funds will be used to support future CYHS award initiatives and CGU 2021.

9. Additional information the committee would like on file.

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Hydro-climatic Impacts and Adaptation Committee Report 2019-2020

Chairs:

Rajesh Shrestha, Yonas Dibike, Daniel Peters (Environment and Climate Change Canada, University of Victoria).

Background:

Established in May 2016 to provide a platform for researchers engaged in hydro-climatic, hydrologic and hydro-ecological impacts and adaptation, and promote the development of new methods and tools to address the challenges.

Objective:

To advance the development of methods and tools for better understanding of the hydrologic and aquatic ecosystem impacts of climate variability and change, and developing adaptation measures to mitigate the potential impacts.

Committee Memberships:

Government Scientists: 3, Profs. 1, PDFs: 1

Committee Activities:

The **Hydro-climatic Impacts and Adaptation** committee is active in the advancement of knowledge on the implications of climate variability/change on planning, allocation and operations of water resources, and adaptation/mitigation measures that address the potential impacts. Engagement of multidisciplinary scientists included organizing special sessions conferences, special issues for journals, and giving invited webinar presentations. These include:

- **AGU-2019 Session:** Implications of Changing Snow Regimes on Hydrologic Extremes in Alpine Dominated Watersheds, American Geophysical Union Fall meeting 2019, Conveners: **Y. Dibike, R. Shrestha**, C. Spence, P. Coulibaly.
- **IAGLR-2020 Session:** Climate Impacts on Great Lakes and Watersheds: Model Applications, International Association of Great Lakes Research Conference 2020, Conveners: **R. Shrestha, Y. Dibike**, Barrie Bonsal.
- **Invited Webinar-2019:** Canadian Water Resources Association, Hydrologic changes in Western Canada under a warming climate: from impacts to uncertainties: understanding impacts and uncertainties, Presenters: **R. Shrestha, Y. Dibike**.
- **Water journal special issue 2020-2021: Hydrological Extremes in a Warming Climate: Nonstationarity, Uncertainties and Impacts**, Special issue editors: **R. Shrestha, M. R. Najafi**.
- **Water journal special issue 2020-2021: Past and Future Trends and Variability in Hydro-Climatic Processes**, Special issue editors: **B. Bonsal, Y. Dibike, D. Peters, R. Shrestha**.
- Contributed to **Canada's Changing Climate Report, Chapter 6: Changes in Freshwater Availability Across Canada**. Authors: **B. Bonsal, D. Peters, F. Seglenieks, A. Rivera, and A Berg**.

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Training/Supervisions:

- Trained 6 co-op students in geography and engineering departments, University of Victoria.
- Supervised 2 graduate students, University of Victoria.

Journal Publications

- Shrestha, R.R.**, B. Bonsal, A. Kayastha, **Y. Dibike**, C. Spence. 2020. Snowpack response in the Assiniboine-Red River basin associated with projected global warming of 1.0°C to 3.0°C, *Journal of Great Lakes Research*, doi:10.1016/j.jglr.2020.04.009.
- Spence, C, M. Norris, G. Bickerton, B. Bonsal, B. Brua, J. Culp, **Y. Dibike**, S. Gruber, P, Morse, **D. Peters**, **R.R. Shrestha**, S. Wolfe, 2020. The Canadian water resource vulnerability index - permafrost thaw (CWRVI_{PT}), *Arctic Science*, doi:10.1139/AS-2019-0028.
- Shrestha, R.R.**, A.J. Cannon, M.A. Schnorbus, H. Alford. 2019. Climatic controls on future hydrologic changes in the subarctic river basin in Canada, *Journal of Hydrometeorology* 20(9), 1757-1778, doi:10.1175/JHM-D-18-0262.1.
- Shrestha, R.R.**, T.D. Prowse, L. Tso. 2019, Modelling historical variability of phosphorus and organic carbon fluxes to the Mackenzie River, Canada, *Hydrology Research* 50(5), 1424-1439, doi:10.2166/nh.2019.161.
- Ahmed, R., T/ Prowse, **Y. Dibike**, B. Bonsal, H. O'Neil. 2020. Recent Trends in Freshwater Influx to the Arctic Ocean from Four Major Arctic-Draining Rivers. *Water*, 12, 1189
- Eum, H.I., A. Gupta, **Y. Dibike**. 2020. Effects of univariate and multivariate statistical downscaling methods on climatic and hydrologic indicators for Alberta, Canada. *Journal of Hydrology*, p.125065.
- Dibike, Y.**, H.-I. Eum, P. Coulibaly, J. Hartman, 2019 Projected Changes in the Frequency of Peak Flows along the Athabasca River: Sensitivity of Results to Statistical Methods of Analysis, *Climate*, 7(7), p.8.
- Rokaya P., **D.L. Peters**, B. Bonsal, H. Wheeler, K.-E. Lindenschmidt. 2019. Modelling the effects of flow regulation on ice-affected backwater staging in a large northern river. *River Research and Application*, 35:587-600, <https://DOI:10.1002/rra.3436>
- Rokaya P., **D.L. Peters**, M. Elshamy, K.-E. Lindenschmidt. 2020. Impacts of future climate on the hydrology of a northern headwater basin and its implications for a downstream deltaic ecosystem. *Hydrological Processes* 34: 1630-1649, <https://DOI:10.1002/hyp.13687>
- Beltaos S., **D.L. Peters**. 2020. Naturalized flow regime of the regulated Peace River during spring breakup of the ice cover. *Cold Regions Science and Technology*, 172 <https://doi.org/10.1016/j.coldregions.2020.103005>

Chengwei W., J.J. Gibson, **D.L. Peters**. 2020. Evaluating water balance of lakes disturbed by permafrost degradation in Mackenzie delta region, NWT, Canada. *State of the Total Environment*, <https://doi.org/10.1016/j.scitotenv.2020.139176>

Conference Presentations

- Shrestha, R.R.**, B. Bonsal, A. Kayastha, **Y. Dibike**, C. Spence, 2020. Projecting snowpack response in the Lake Winnipeg watersheds under global warming, *International Association of Great Lakes Research Annual Conference*, Winnipeg, MB.
- Dibike, Y.**, A. Muhammad, **R.R. Shrestha**, L. de Rham, J. Rowley, C. Spence, B. Bonsal, G. Evenson, T. A. Stadnyk. 2020. Variable contributing area dynamics for modelling the hydrologic response of the Assiniboine River basin to a Changing Climate, *International Association of Great Lakes Research Annual Conference*, Winnipeg, MB.
- Dibike, Y.**, Newton, B, **R.R. Shrestha**, B. Bonsal, C. Johnson, 2019. Spatial Variation in Hydro-climatic Control of Annual Peak Flows in Western Canadian Watersheds, **AGU Fall Meeting**, San Francisco.
- Shrestha, R.R.**, J.M. Bonnyman, A.J. Cannon, B.R. Bonsal, M.R. Najafi, 2019. Projected Changes in Snow and Runoff Regimes over Northwestern North America under 1.5°C, 2°C and 3°C Global Warming, **IUGG General Assembly**, Montreal, Quebec.
- Dibike, Y.**, A. Muhammad, G. Evenson, **R.R. Shrestha**, J. Rowley, L. de Rham, C. Spence, B. Bonsal, T. Stadnyk, 2019. Evaluating the Performance of a Dynamic Contributing Area Approach in Large Scale Hydrological Modeling of a North American Prairie Watershed, **IUGG General Assembly**, Montreal, Quebec.
- Spence, C, M. Norris, G. Bickerton, B. Bonsal, B. Brua, J. Culp, **Y. Dibike**, S. Gruber, P, Morse, **D. Peters**, **R. Shrestha**, 2019. The Canadian water resource vulnerability index - permafrost Degradation (CWRVI-PD), **IUGG General Assembly**, Montreal, Quebec.
- Siemens, K., **Y. Dibike**, T. Prowse. 2019. Assessment of Climate Change Impacts on the Upper Athabasca River Flow: Application of a Snowmelt Runoff Model, poster presentation at the **AGU 2019 Fall Meeting**, San Francisco, California, USA, December 9-13, 2019.
- Peters D.L.**, W.A. Monk, D.J. Baird. 2019. Cold Regions Hydrological Indicators of Change for Assessment of Environmental Flows and Climate Change in the Arctic. **European Geophysical Union**, Vienna Austria April 8-12 2019.