CGU-HS 2021/2022 Report on Committees

Highlights:

Total of 7 committees

- Annual reports have been requested and some received.
- Only 3/7 committee reports received

2022 CGU-HS Committees Annual Reports:

Committee on 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

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

3bi. Members are Named Partners in the NSERC Permafrost Partnership Network for Canada (PermafrostNet) thaw was awarded 5-years of funding in 2019 and has a goal of boosting Canada's ability to adapt to permafrost thaw;

3bii. Members are involved in the secretariat of the Canadian Permafrost Association;

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

None in 2021.

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

5a. Permafrost Hydrology and Hydrogeology: Interactions, Innovations, and Challenges, Session 8 (29 June 2021), 2021 Annual Meeting of the CGU, June – July, 2021, On-line.

Committee on River Ice Processes and the Environment (CRIPE)

No report.

Northern Research Basins Working Group

No report

Committee on Isotope Tracers

No report

Hydroecology Committee

No report

Canadian Young Hydrologic Society

2022 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.

2021-2022 was the seventh year of the Canadian Young Hydrologic Society (CYHS)

being in operation. This year succeeded in further 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 again organizing a twitter symposium, and by financially supporting the ECR community with additional awards, and workshops presented at the Canadian Meteorological and Oceanographic Society (CMOS) 56th Congress, the Canadian Geophysical Union (CGU) Annual Meeting, and the 78th Eastern Snow Conference (ESC) joint congress. In the 2021-2022 year, the CYHS focused on three main events, our annual twitter symposium where we identified meaningful ways to engage with ECRs through online platforms using financial incentives, financially supporting and promoting the CGU-HS 2022 Student Conference. For this event, the CYHS funded a student award. Finally, the CYHS organized and hosted two workshops during the CMOS-CGU-ESC joint congress.

The 2020-2021 CYHS committee is composed of 9 members:
Co-Chair, GWF liaison: Julia Cantelon, PhD Candidate, Dalhousie University
Co-Chair, Secretary: Sarah Ariano, PhD Candidate, Toronto Metropolitan University
CGU-HS representative: Karl Friesen-Hughes, MSc Candidate, University of Winnipeg
Treasurer: Selsey Stribling, PhD Candidate, McGill University
Social media: Lauren Bourke, MSc Candidate, McMaster University
Communications: Arsh Grewal, PhD Candidate, McMaster University
YHS liaison: Larissa Gospodyn, PhD Student, University of Waterloo
Members at large:
Recruitment: Ignacio Aguirre, MSc Student, University of Saskatchewan
West Coast Recruitment: Sam Anderson, PhD Candidate, University of British Columbia

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 2021-2022 workshop organized for the 2022 CGU meeting were as follows:

Carleton University 1
Dalhousie University 7
Government of Manitoba 1
Institut national de la recherche scientifique 1

McMaster University 6
Simon Fraser University 1
The University of Winnipeg 1
Toronto Metropolitan University 2
University of Ottawa 1
University of British Columbia 1 University of Ottawa 2
University of Saskatchewan 6
University of Toronto 1
University of Waterloo 4
University of Saskatchewan 2
University of Victoria 1
Wilfrid Laurier University 1
York University 1
Other (international) 19

PDF: 4
Graduate Students: 46
Undergraduate Students: 4
Professionals: 7
TOTAL: 61

3. Committee Activities

3a. Major areas of research
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3b. Science-industry collaborations

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

The main activity undertaken by the CYHS in 2021 was a Twitter Symposium. Held between October 6th and 8th, the symposium generated 40 external posts (excluding committee members), generated 357 likes, 61 retweets and 37 new followers. CYHS awarded four participants $100.00 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

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 745 followers (an increase of 199 followers from May 2021 - May 2022) and averages 4,960 tweet impressions (viewership of our tweets and retweets) a month. From May 2021 - May 2022 the CYHS twitter account had 10587 profile visits, 40 mentions, and the tweets were viewed a total of 59,514 times. The month of May 2022 generated the most engagement from our audience (promoting CGU-CMOS-ESC), followed by October 2021 (occurrence of the Twitter symposium).

The CGU 2022 Student Conference was hosted by Carleton University. The event was held over two days (March 4th and 5th). The CYHS supported this initiative through funding a $500.00 student award. The CYHS also supported the conference with advertising. This event has been running for over a decade and the 2022 conference successfully fulfilled the conference mandate of showcasing and fostering student and early career research from Canada.

The CYHS has organized two workshops for the CGU-CMOS-ESC 2022 virtual meeting. Prior to organization, the CYHS gauged student interest in virtual workshops via a survey prior to implementing these activities at the CGU 2022.

Workshop 1, titled *From failure to progress: lessons learned in hydrology* was run on June 1st, 2022. This workshop featured a panel of experts in hydrology discussing lessons learned from apparent failure. Failed field experiments, equipment malfunctions, model crashes, manuscript rejections, and invalidated assumptions, apparent failure in hydrology provided useful insights to move the discipline forward. The panel engaged with participants to think about their personal research failure and about what can be gained from them. Panelists provided short presentations introducing their work, and shared stories about moments that felt like failures, but ended up motivating progress.

Workshop 2, titled *Hands on hydrology: Exploring methods and techniques* was run on June 2nd, 2022. During this workshop, participants were introduced to short videos (10-20 min) featuring skill-building techniques taught by experts. This interactive workshop showcased a broad skill set in hydrology. A diverse range of topics were covered centered around new and exciting field, laboratory, analytical, and data visualization techniques. These short skill-building sessions were followed by a discussion between early-career scientists and session experts.

Workshop participants were introduced to a wide range of tools and techniques applicable to hydrologic research in order to assist them in their endeavors in the field. The skill building videos taught here were uploaded to our new youtube channel!

3d. Regional, national and international advisory efforts

In 2021 the CYHS was involved with the YHS networking and poster session, where the CYHS was showcased as a highly impactful branch of the YHS network. We presented our operation, outreach strategies and funding initiatives with all branches of the YHS. In

2021 we developed a new role (YHS liaison) to support continued collaboration with other branches of the YHS.

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 centers 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 required $500 in support from CGU-HS for the 2021-2022 fiscal year which was used to fully support the CGU-HS student award. Additionally, the cancellation of in-person CGU-2021/2022, has preserved CYHS funds and will be used to support workshop and ECR activities in the future.

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 2022 ECR workshops and resulted in participants from universities which were previously not commonly present at CYHS events. This listserv was also used to gauge interest in CYHS virtual workshops at the CGU 2022 annual meeting.

To achieve a more widespread presence across Canada, the CYHS is establishing collaborations with existing university water-focused networks; we also work to recruit annually, when possible, new committee members from a diverse range of universities. This resulted in the CYHS creating 3 new positions (recruitment, west coast recruitment and YHS-liaison) to expand its reach across Canada and improve collaboration with existing YHS branches.

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 organizations. 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 to organize and participate in ECR-centered symposiums and conferences.

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 organized in collaboration with the Young Earth System community (YESS). Similarly, the CYHS was involved in the organization of the AGU-WCRP Joint Early Career event, organized 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 Zaremehrjardy, 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

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.

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 Wheater (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 Adamwoski 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.
4. CYHS Twitter Symposium, Award for Most Liked and Retweets Twitter Post (4 ECR's awarded)

2021:

1. CGU Student Conference, Grand prize (x2), Honorable mentions (x6) (8 ECR's awarded)
2. CYHS Twitter Symposium, Award for Most Liked and Retweets Twitter Post (4 ECR's awarded)

2022:

1. CGU Student Conference , Grand prize (x1) (1 ECR's awarded)
2. From failure to progress: lessons learned in hydrology, CGU virtual meeting
3. Hands on hydrology: Exploring methods and techniques, CGU virtual meeting

6. Awards received by members

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

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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. $5,095.55 remained in the McGill affiliated funds account after the 2019 CYHS workshop. In 2022, CGU-HS supported the CYHS with an annual contribution of $500. These funds were planned to be used to support workshop activities for CGU 2022. However, the reduction in costs associated with CGU 2020 and 2021 occurring via a virtual format preserved the remaining funds from the 2019 workshop and were used to support a CGU-HS student award.

In 2021/2022 the CYHS awarded a total of $900.00 to students participating in the CYHS Twitter Symposium and CGU-HS 2022 Student Conference. The current CYHS account balance held at McGill is $3,295.55. The McGill-affiliated funders have agreed to have the leftover funds used for future CYHS events.

Current funds held by CGU-HS amounts to $277.64. These funds will be used to support future CYHS award initiatives and CGU 2023.

9. Additional information the committee would like on file.

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Committee on Large Scale Watershed Modelling and Analysis

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Committee on Hydro-climatic Impacts and Adaptation

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, Grad student 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:
 Water journal special issue 2021-2022: Hydrological Extremes in a Warming Climate: Nonstationarity, Uncertainties and Impacts, Special issue editors: R. Shrestha, M. R. Najafi.: 12 articles published

Training/Supervisions:
 Trained 6 students interns at University of Victoria and Sherbrooke.
 Supervised 2 (Raj & Daniel) graduate student, University of Victoria.

Journal Publications
Beltaos S, **DL Peters.** 2021. Naturalizing the freezeup regimes of regulated rivers and exploring implications to spring ice-jam flooding. *Hydrological Processes*, 38: DOI:10.1002/hyp14321
Cannon, A.J., H. Alford, **R.R. Shrestha**, M.C. Kirchmeier-Young, M.R. Najafi. 2022. Canadian Large Ensembles Adjusted Dataset version 1 (CanLEADv1): Multivariate bias-corrected climate model outputs for terrestrial modelling and attribution studies in North America, *Geoscience Date Journal*, doi:10.1002/gdj3.142.
De Coste, M., Li, Z. and **Dibike, Y.**, 2022. Assessing and predicting the severity of mid-winter breakups based on Canada-wide river ice data. *Journal of Hydrology*, *607*, p.127550.
De Coste, M., Li, Z. and **Dibike, Y.**, 2022. Machine-learning approach for predicting the occurrence and timing of mid-winter ice breakups on Canadian rivers. *Environmental Modelling & Software*, *152*, p.105402.
Peters, D.L., D. Watt, K. Devito, W.A. Monk, **R.R. Shrestha**, D.J. Baird. 2022. Changes in geographical runoff generation in regions affected by climate and resource development: a case study of the Athabasca River, *Journal of Hydrology: Regional Studies* 39, 100981. doi.org/10.1016/j.ejrh.2021.100981.
Rideout N, D Lapen, **DL Peters**, DJ Baird. 2022. Ditch the low flow: Agricultural impacts on flow regimes and consequences for aquatic ecosystem functions. *Ecohydrology*, e2364 https://doi.org/10.1002/eco.2364
Shrestha, R.R., M.R. Najafi. 2022. Special issue editorial: hydrological extremes in a warming climate: nonstationarity, uncertainties and impacts, *Water* 14(10), 1658; doi:10.3390/w14101658.
Shrestha, R.R., **Y.B. Dibike**, B.R. Bonsal. 2022. Snowpack driven streamflow predictability under future climate: contrasting changes across two western Canadian river basins, *Journal of Hydrometeorology*, doi:10.1175/JHM-D-21-0214.1.

Book

Diaconescu, E.P., P. Kushner, J. Lukovich, A. Crawford, E. Barrow, L. Mudryk, M. Braun, **R.R. Shrestha**, S. Gruber, S. Déry, S. Howell, and L. Matthews, 2022. *An inventory of historical climate data and climate projections for the Canadian North*, Government of Canada, Canadian Centre for Climate Services, Gatineau, QC, 693p.

Conference Presentations

de Rham, L., **Dibike, Y.**, Beltaos, S., Peters, D., Bonsal, B. and Hartmann, J., 2021. A Compilation of Station Metadata to Inform the Provenance of Water Level Records in the Canadian River Ice Database, CRIPE 2021, Workshop on the Hydraulics of Ice Covered Rivers.

Dibike, Y., Hartmann, J., de Rham, L., Beltaos, S., Peters, D.L. and Bonsal, B., 2021. Exploratory Data Analysis of the Canadian River Ice Database Variables and their Correlations with Seasonal Temperature, CRIPE 2021, Workshop on the Hydraulics of Ice Covered Rivers.

Dibike, Y., L. de Rham, S. Beltaos, **D.L. Peters**, B. Bonsal, 2022. An Assessment of Open vs Ice-affected Peak Water Levels in Selected Canadian Rivers, CMOS-CGU-ESC Joint Congress, Virtual meeting.

Dibike, Y., R. Shrestha, C. Spence, B. Bonsal, L. de Rham, J. Rowley, 2021. Impacts of Beneficial Management Practices on Nutrient Loading in a North American Prairie Watershed, IAGLR'S 64TH Annual Conference on Great Lakes Research.

Peters DL, J Shudian, **Y Dibike**, W Monk, D Baird. 2021. Effects of Climate Change on Navigability Indicators for the Lower Athabasca River. Canadian Meteorological and Oceanographic Association, 55th Congress, CMOS-CGU-ESC Joint Congress, Virtual meeting.

Peters, D.L., D.J. Baird, S. Beltaos, B.R. Bonsal, **Y. B. Dibike**, W.A. Monk, **R.R Shrestha**. 2022. Why are Perched Basins in the Peace-Athabasca Delta in Northwestern Canada Drying? Revisiting the Water Balance, *AGU Fall meeting*, New Orleans.

Peters, D.L., D.J. Baird, S. Beltaos, B.R. Bonsal, **Y. B. Dibike**, W.A. Monk, **R.R Shrestha**, Tharme, R. 2021 The challenges of developing hydrological indicators to support environmental flow frameworks in a large lake-wetland deltaic complex, *AGU Fall meeting*, New Orleans.

Pirani, F.J., S.R. Bakhtiari, M.R. Najafi, **R.R. Shrestha,** Nouri, M.S. 2021. The effects of climate change on flood-generating mechanisms in the Assiniboine and Red River basins, *AGU Fall meeting*, New Orleans.

Rezvani, R., H. Singh, M.R. Najafi, **R.R. Shrestha.** 2021. Projected Rain-on-Snow Events in a sub-Arctic River Basin under Climate Change, *AGU Fall meeting*, New Orleans.

Shrestha, R.R., J. Pesklevits, S. Hoffman. 2022. Stream temperature variability and change across Western Canada, *CMOS-CGU-ESC* Joint Congress.

Shrestha, R.R., **Y. Dibike**, B. Bonsal. 2021 A hybrid process-based machine-learning model for assessing future change in streamflow predictability in relation to snowpack change, *AGU Fall meeting*, New Orleans.