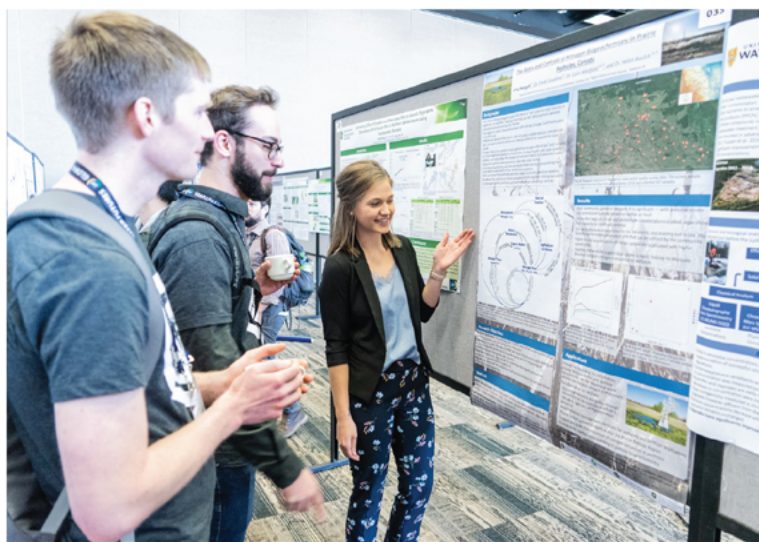


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YEARS
2011-2021

2020 Annual Report



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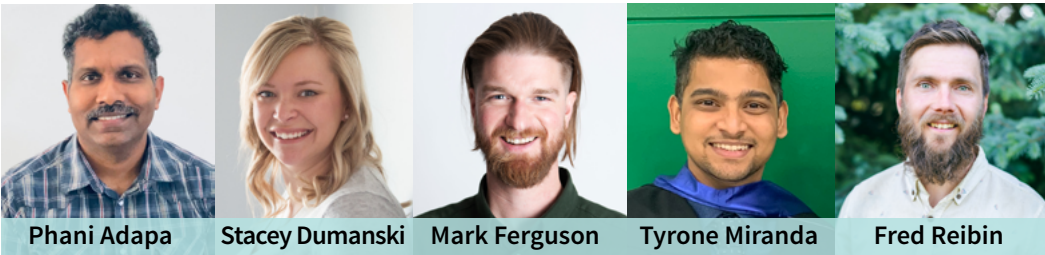
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**Global Institute for
Water Security**

U S A S K

Editorial Team



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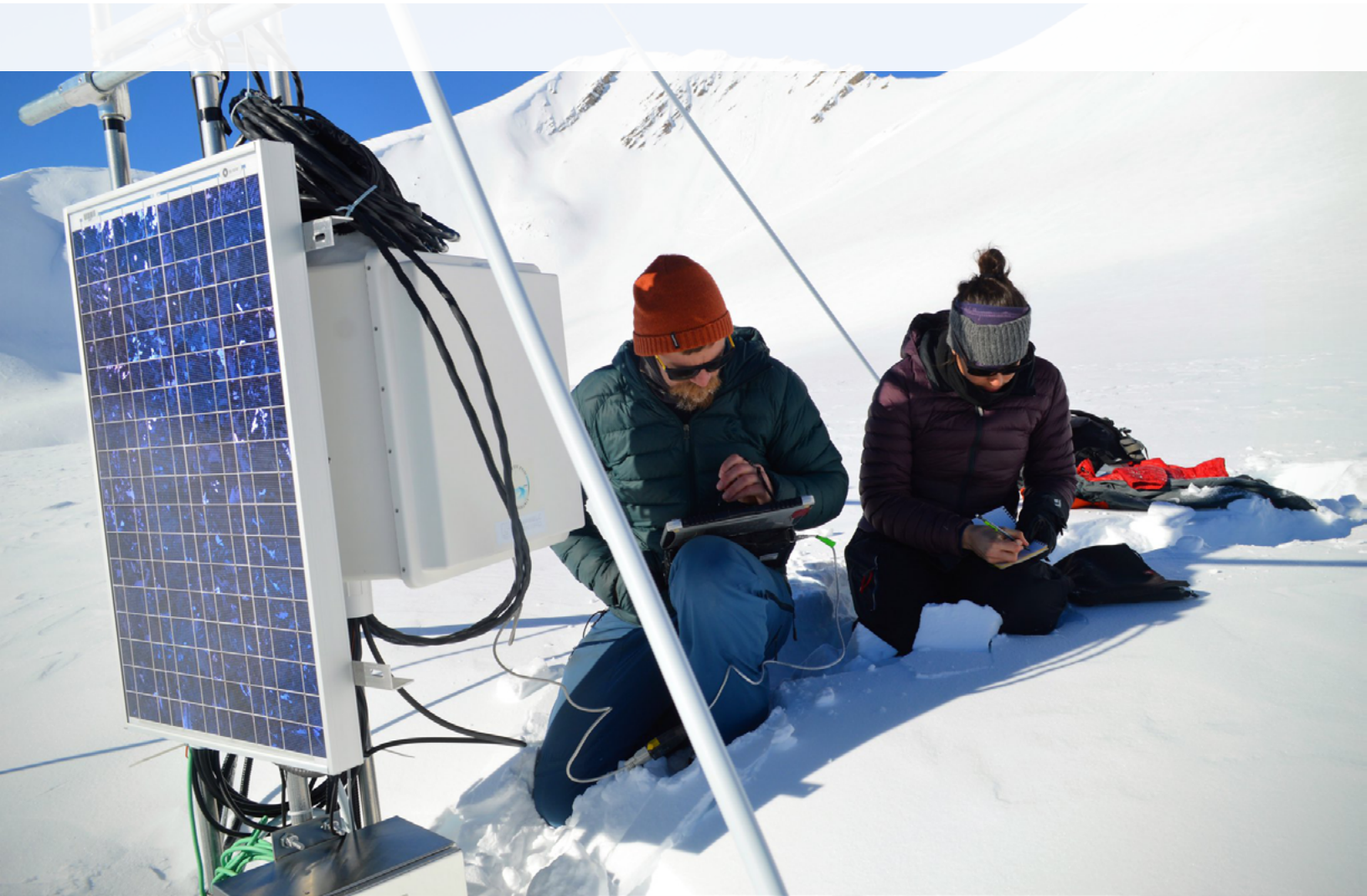


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Taking Stock and Looking Forward: A Message from the Executive Director


As I write this message in early 2021, we remain in the midst of the pandemic. It has been, and it continues to be, a difficult time for all of us. I acknowledge our struggles. I am also proud of how we continue to confront the many obstacles that we've faced over the last year. I truly hope that the pandemic will be behind us at this same time in 2022.

Working from home has given me some time to reflect on everything that's happened over the past 10 years with the Global Institute for Water Security (GIWS). Between our launch under the Canada Excellence Research Chair program led by GIWS Founding Director Howard Wheater in 2011, the selection of our Global Water Futures program under the Canada First Research Excellence Fund competition in 2016, and the 18 top-flight faculty hires they supported, GIWS has rapidly risen to global prominence. I am proud to be a part of these impressive accomplishments over the last decade.

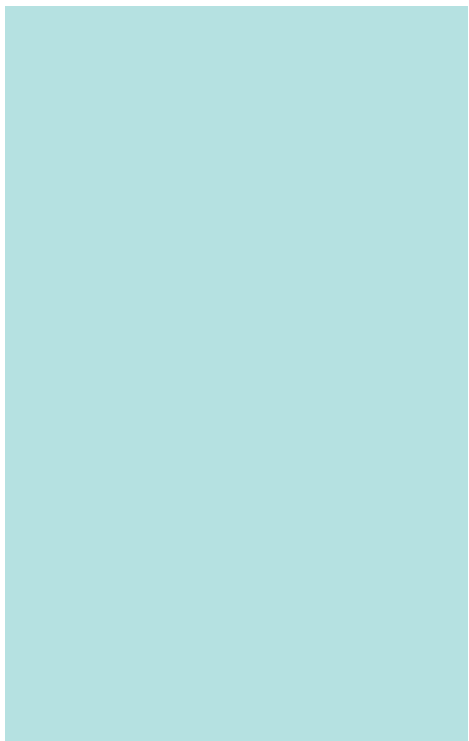
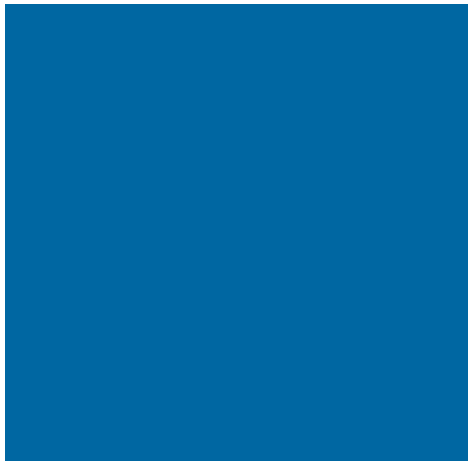
While it is important to acknowledge where we have come from, it is also the perfect time to begin to look ahead to the next 10 years, and to chart the path towards the new heights that GIWS can achieve. Over the course of 2021, our 10th anniversary year, GIWS is engaging in visioning for the next decade. We are rethinking our vision and mission to align ourselves to develop the global water security solutions that the world needs. We are evaluating our strengths and opportunities, and we are actively strategizing on how we can best embed the principles of equity, diversity, and inclusion into the fabric of all that we do at GIWS. Given the importance of the work, along with the realities of what can be accomplished during the pandemic, we are distributing our visioning sessions, workshops, and related activities over the course of the year, which we are calling GIWS@10.

This annual report highlights some of the amazing work that GIWS has conducted since its inception. Next year's report will begin to feature the results of GIWS@10 visioning. Note also that this year we have transitioned from a progress report, to a more readable, annual report that features highlights of your work and successes. Standard metrics of our progress will continue to be available online.

While I wish that we were able to meet in person and to celebrate our 10th anniversary together, I know that both are simply not possible. However, I look forward to continuing our important visioning work and to seeing you all on Zoom. I believe that I am seeing a glimmer of light at the end of the pandemic tunnel, and by the end of the year, I hope that the light is burning brightly.

Warm regards,


Jay



Strategic Drivers

Water security research covers a broad area. To guide our first decade of efforts of GIWS, a set of inter-disciplinary research themes were identified, recognizing the need for deep and broad disciplinary knowledge and dimensions of water security, and address challenges of local, regional and global significance.



Climate Change & Water Security
Understanding and modelling of current and future effects of climate change on hydrology, ecology and water resource systems



Sustainable Development of Natural Resources
Assessment and management of environmental risks with emphasis on water

Land-Water Management & Environmental Change
Effects of agricultural and urban land and water management on water quality and water movement through a watershed



Socio-Hydrology
Encompasses both the human drivers of hydrological change and the social processes to inform decision-makers



Water & Health
Water, sanitation and hygiene, transmission of waterborne and water-related diseases, aquatic pollution and effects on the food chain



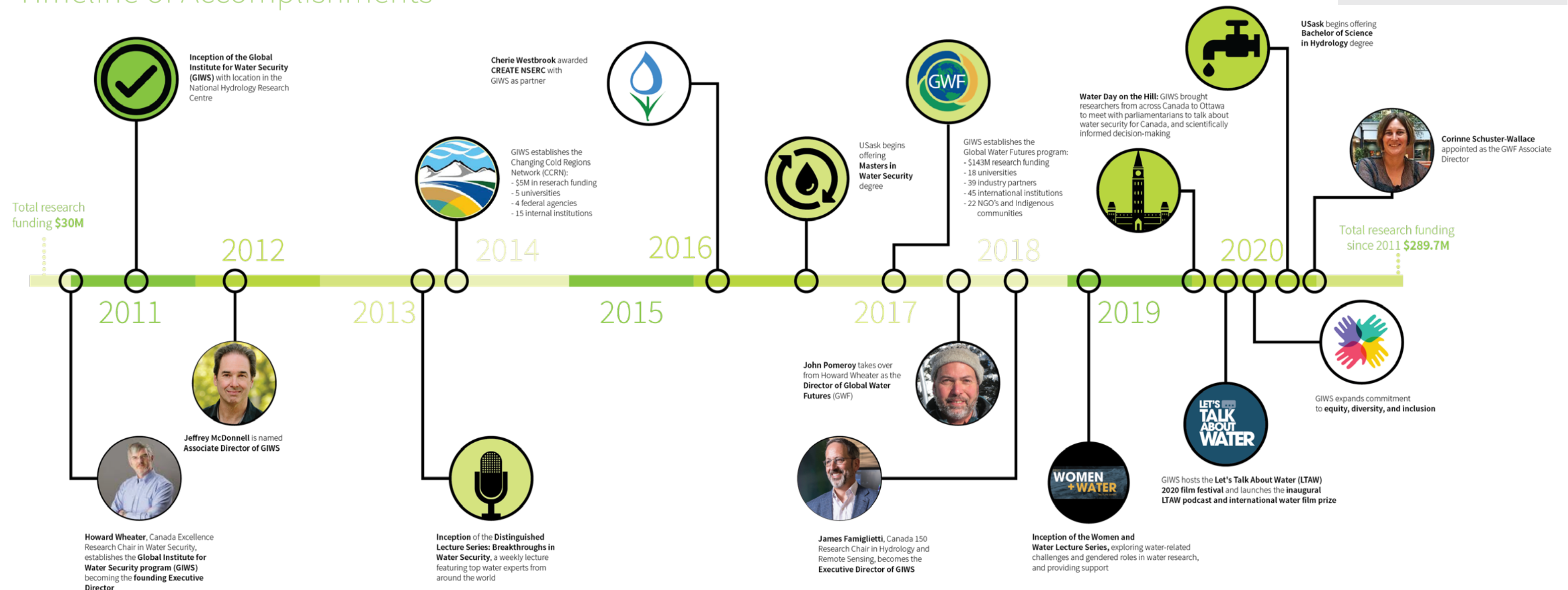
Water & Wastewater Treatment Technologies
Development of advanced water treatment technologies and improved technologies for the treatment of industrial wastes



Groundwater and Hydrogeology
Quantify the extent of groundwater resources and their quality, the natural recharge, the long-term impacts of abstractions and waste disposals

The Global Institute for Water Security (GIWS) is a research-intensive institute at the University of Saskatchewan (USask), which manages individual research programs of more than 91 faculty members from 21 academic units. GIWS works to ensure that society has the understanding and the tools to sustainably manage and protect the world's water resources and ensure that Canada, and the world, has the research and expertise needed to understand our water systems in an era of rapid societal and environmental change. It is the top ranked water resources research institute in Canada and one of the most advanced cold regions hydrology programs in the world. Since 2011, GIWS has successfully recruited 18 core faculty members including Prof. Jay Famiglietti, Executive Director, GIWS, and Canada 150 Research Chair in Hydrology and Remote Sensing, which is roughly equivalent to the creation of a new academic department.

Timeline of Accomplishments



History of Water Security at USask

- 1962 - Division of Hydrology
- 1978 - Toxicology Unit Established
- 1982 - Toxicology Centre
- 1986 - National Hydrology Research Centre
- 2003 - Canada Research Chair in Water Resources and Climate Change
- 2004 - Centre for Hydrology

Impact of COVID-19

Michelle Martel-Andre



In 2020, new challenges were faced by the Global Institute for Water Security due to the impacts of the COVID-19 pandemic. GIWS addressed these challenges by being flexible, adaptable and resilient by implementing new teaching, supervision, communication and outreach platforms, and remote work schedules. The new GIWS policies and procedures ensured the well-being and safety of all personnel, allowing GIWS to thrive in a time of rapid change.

GIWS continues to be a research leader despite significant delays caused by COVID-19. In March 2020, as provinces went into lockdown, field and lab work was subject to a standstill as USask leadership identified the safest way to proceed with critical research. Through an application-based process, on-site research deemed critical to program success was identified and safely implemented through rigorous protocol set out by project and program leaders, and approved by pandemic response personnel.

With the leadership support of academic units across campus, GIWS faculty quickly transitioned to online course delivery. Graduate student supervision also successfully moved to remote communication and continues through frequent online meetings and progress check-ins between supervisors and their students and lab groups.

GIWS leadership, in coordination with USask leadership and the Pandemic Response Team, has and will continue to make the health and safety of all personnel the top priority while ensuring minimal disruption to GIWS activities.



International Leadership

Jeffrey McDonnell

Water Security is one of the greatest challenges for humankind, with global implications. The “Global” in GIWS was purposeful when GIWS was created in 2011. Our goal was to extend beyond leadership in Canada to lead and to be actively engaged in research globally. Accordingly, over the past decade, GIWS has engaged in international research through the following three pillars:

Local and regional studies linked to global programs

- Host of the World Climate Research Program’s (WCRP) only Regional Hydroclimate Project in North America: Global Water Futures
- Host of the WCRP’s Global Hydroclimate Project and UNESCO’s International Hydrological Program, International Network for Alpine Research Catchment Hydrology (INARCH)
- The Canadian node for the Sustainable Water Futures Program along with the Future Earth programme
- Contributing organization to the World Meteorological Organization through the GWF program

Addressing key water challenges around the world

- Ceres – Science-based research and analysis on water-intensive industry practices around the globe
- U.S. National Academy Board of Agriculture and Natural Resources: Leading the Water-Food Security Nexus study
- GRACE – Satellite-based detection of changing global hydrology, freshwater availability and groundwater depletion
- Planetary Water Prediction – producing continental and global-domain hydrological risks models with an emphasis on river basins
- International Court of Justice – panelist mediators for the transboundary conflicts

Global graduate education

- International short courses taught and led by GIWS members (e.g. Annual Catchment Science Summer School at the University of Birmingham, Principles of Hydrology at Kananaskis, Process Hydrological Modelling, etc.)
- Joint Graduate Research Projects in Asia, Africa, Australia, Europe, North America, and South American sub-continent
- Student and Faculty Exchanges: GIWS has hosted visits from 260 scholars in the past decade
- Joint degree program: Masters in Water Security with Beijing Normal University (established 2018) where GIWS members teach a two-week compressed courses at BNU
- Distinguished Lecture Series (DLS): Established in 2013, the DLS has brought 75 world leaders to Saskatoon to network and share breakthroughs in water security from a global perspective to GIWS members and beyond



Solving Water Issues through Partnerships and Collaborations

Palash Sanyal

Water security is a global affair – water knows no political bounds. Through partnerships and collaborations, GIWS recognizes the importance of working together to ensure global water security. Sharing data and research with local, national and international partners plays a critical role in advancing research, contributes to solving global water issues and supports initiatives that promote leadership in sustainability.

GIWS conducts research that is of direct benefit to partners, stakeholders and users (PSU), has direct societal relevance and is useful to inform policy decisions. Accordingly, a majority of research conducted at GIWS is transdisciplinary in nature and is driven by PSU research questions. Researchers work with PSU from project inception to completion, which ensures there is feedback and that the two-way exchange of knowledge, technologies and solutions is a continual process. As evidence, the Global Water Futures program now has more than 478 national and international partners. This extensive partnership makes the program the world’s largest university-based research project.



Figure 1: GIWS Executive Director, Jay Famiglietti is leading a workshop in Bangladesh with government, non-government and academic stakeholders (February 2021)



Sustainable Development Goals

Corinne Schuster-Wallace

Sustainable development refers to the use of natural resources in a way that does not prevent similar use by future generations. Water resources underpin human and environmental health, food security, energy, and industry, as well as being important for recreation and tourism. Climate change is exacerbating changes in land use, population and urbanization that threaten water quality and quantity in many parts of the world, including Canada.

The Global Institute for Water Security (GIWS) at the University of Saskatchewan (USask) has recognized its role in ensuring sustainable management and use of water resources, and is committed to contributing to improved understanding and awareness of drivers of water insecurity locally, regionally, and globally. In November 2019, the Global Water Futures program launched a report, titled [Water Futures for the World We Want](#), on water-related sustainable development goal targets and water in Canada. The report highlighted that

Canada is not a water secure country, despite its global reputation as a water rich country. The report also noted considerable opportunities for Canada to demonstrate global water leadership and export water expertise, knowledge and tools through a commitment to water nationally that can be demonstrated internationally.

In partnership with the Global Institute for Food Security at USask, GIWS has committed to improving food security through the water-food nexus and hosted a joint workshop to map out the research expertise, knowledge gaps and opportunities that exist at USask.

GIWS is also a supporter of the USask’s People Around the World annual conference that brings together expert research, applied knowledge and lived experiences towards stronger, more resilient societies and the realization of the U.N.’s Sustainable Development Goals. In 2020, the conference included an interactive water workshop with discussions and presentations by GIWS faculty.

Locally, GIWS has established strong relationships with the City of Saskatoon, Greater Saskatoon Chamber of Commerce, and the Saskatoon Regional Economic Development Agency (SREDA).





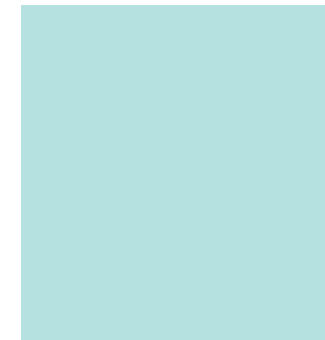
Decolonization & Indigenization

Lori Bradford

At GIWS, researchers and community members are working together to help address the challenging water issues experienced by Indigenous communities across the country. Our work includes both community-led and community-engaged projects that actively support reconciliation.

Communication and acceptance are the first steps in building empathy. Few early projects in GIWS drove the wider acceptance of arts-based knowledge mobilization as a key stream for researchers to empathize and get to know communities affected by water challenges. Our members organized the action-theatre play called *Downstream* in 2014-2015 that shared perspectives of what water security means to those living across the Saskatchewan River Basin. Another project named *Delta Ways Remembered*, showcased a whiteboard animation video, which tells the story of Elders' lived experience with water in the Slave River and Delta. The *Building Bridges* traveling exhibit and our annual GIWS photo contests highlighted our abilities to reflect on our work through different lenses. These projects gained more appreciation and lead us to a path of reconciliation through culturally harmonized artwork and storytelling.

In the past decade, the most important change seen in GIWS is the growing acceptance of epistemological pluralism by faculty trained in the natural sciences. We are finally catching up to social scientists and humanists in recognizing the value of Indigenous knowledge. Our researchers have embraced multiple ways of learning and sharing this knowledge, which has opened the door for others to get on board and accept the validity of this knowledge source.



Looking Forward: Equity, Diversity and Inclusion in GIWS Water Research

Andrea Rowe

In 2020, GIWS embarked on a journey to expand our commitment to equity, diversity and inclusion (EDI). The well-being of people is at the core of our mission to help protect precious freshwater resources. As water researchers, we must be actively engaged in removing systemic barriers to inclusion to address the world's most pressing climate issues.

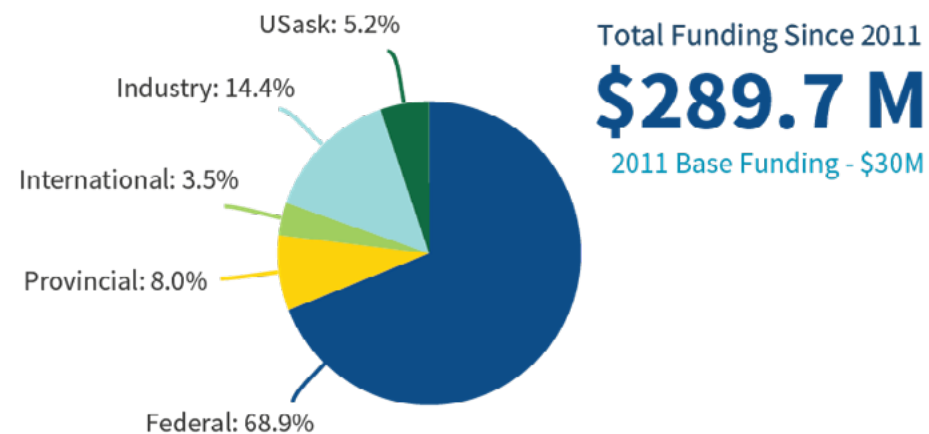
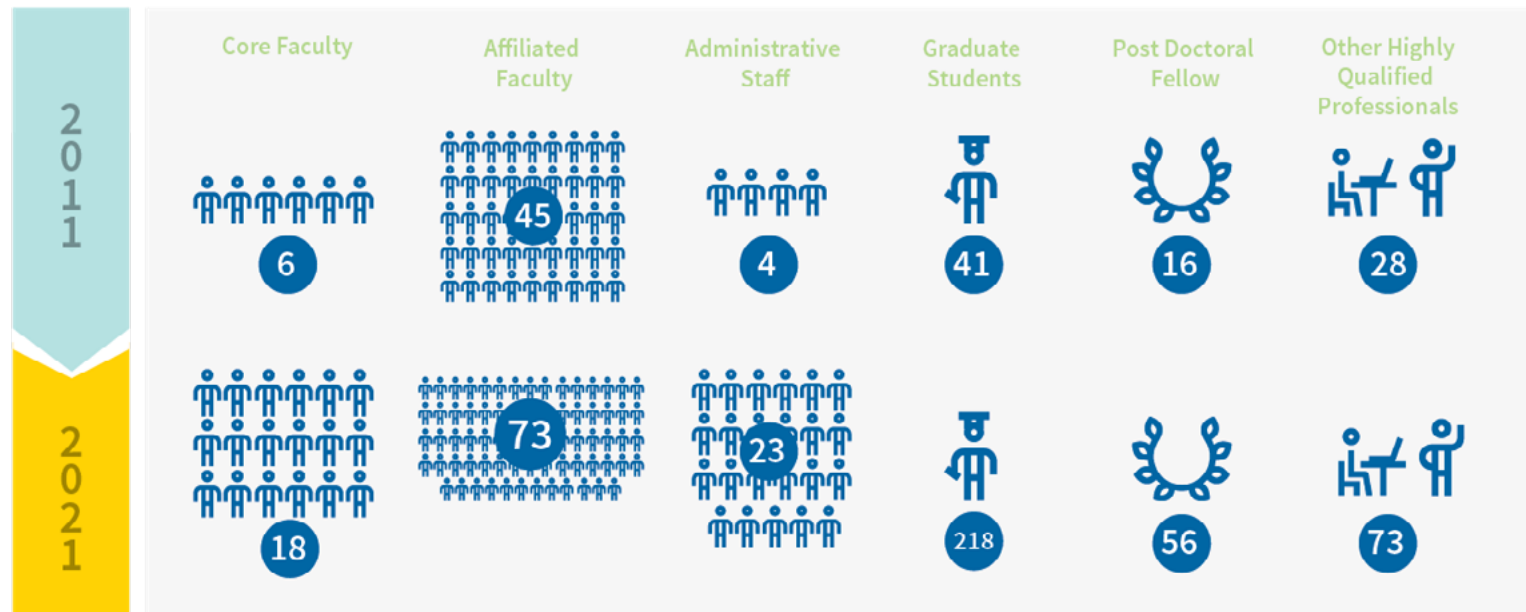
GIWS is committed to working with local, national and international partners and end-users to champion inclusive water research. As part of this commitment, GIWS is also a proud sponsor of the [Women + Water Lecture Series](#).

In 2020, Dr. Ingrid Waldron shared her work on environmental racism on the [Let's Talk About Water Podcast](#) hosted by GIWS Executive Director Dr. Jay Famiglietti. [Dr. Waldron's](#) work highlights the need to train researchers to consider the different ways that systemic racism impacts access to water and health. GIWS is taking action to help water researchers assemble diverse research teams; assess equity, diversity and inclusion in grant proposal development; and remove barriers to hiring talented highly-qualified professionals from all backgrounds.

[Twitter #GIWSEDI](#)

“We are just beginning to realize the positive impact of equity, diversity and inclusion in water research. At GIWS, we are committed to taking the actions necessary to realize these benefits of EDI in theory and practice.”

*- Dr. Jay Famiglietti,
Executive Director GIWS*



Water Policy & Diplomacy

Jay Famiglietti

GIWS strongly believes in science and evidence informing policy, much of which is relevant to several of the U.N. Sustainable Development Goals (SDGs). A significant policy-impacting activity was developing the Water Security for Canadians Initiative that informs the development of a modern national water strategy and related institutional and legal frameworks for water. It proposed that the 50-year-old Canada Water Act should be updated to support implementation of Indigenous inherent, Aboriginal and treaty water rights and roles in water governance and management; and, catalyze increased funding and capacity for freshwater monitoring, prediction, planning and effective management.



GIWS further proposed that federal freshwater activities be centred, funded and coordinated in a new Canada Water Agency.

GIWS has led and participated in numerous other events and activities aimed to impact policy and governance:

- GIWS, in partnership with Canada's Chief Science Advisor, held Water Day on the Hill on March 10, 2020 in Ottawa and met with parliamentarians and senior federal officials to raise awareness about issues around water security for Canada.
- On February 20-21, 2019, GWF co-hosted, with Environment and Climate Change Canada (ECCC) and the Natural Sciences and Engineering Research Council of Canada's Floodnet Network, the first National Flood Forecasting meeting to begin dialogue between provincial and federal flood forecasting professionals in Canada, and to demonstrate the capability of GIWS and ECCC streamflow forecasting systems. GIWS and Natural Resources Canada co-hosted a meeting in Ottawa on November 2018 for federal and GIWS water scientists and signed an memorandum of understanding to further collaboration in water geosciences.
- GIWS leads the development of a transdisciplinary group of academics, researchers, non-profits, non-governmental organizations and government scientists to form a Global Groundwater Coalition. The Coalition seeks to raise awareness of global groundwater depletion and the need for inclusive, equitable and just governance of the world's major groundwater systems.

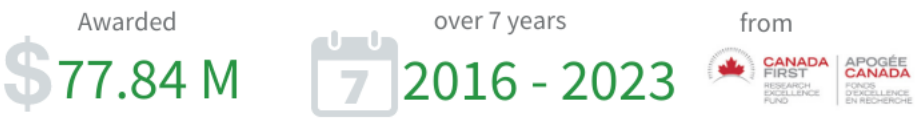
In collaboration with the United Nations University, GWF launched a major report: "Water Futures for the World We Want: Opportunities for Research, Practice and Leadership in Achieving Sustainable Development Goal 6" which is a contribution to the U.N. Water Action Decade of 2019-2028.

Global Water Futures

John Pomeroy



The University of Saskatchewan (USask) is the headquarters of the Global Water Futures program (GWF), funded by the Canada First Research Excellence Fund, and leads it in partnership with the University of Waterloo, McMaster University and Wilfrid Laurier University. The GWF research program is funded in part by a \$77.8-million grant from the Canada First Research Excellence Fund. The overarching goal of the program is to deliver risk management solutions—informed by leading-edge water science and supported by innovative decision-making tools—to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems and the water environment. GWF aims to position Canada as a global leader in water science for cold regions and addresses the strategic needs of the Canadian economy in adapting to change and managing risks of uncertain water futures and extreme events. End-user needs are critical inputs to drive strategy and shape GWF science.



64 Projects & Core Teams

18 Canadian universities

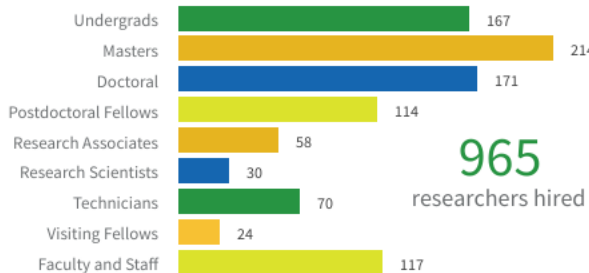
189 faculty investigators

478 partners

786 publications

1852 presentations

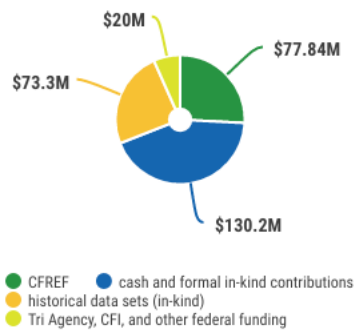
3200 media stories



4 Global Programs



\$301 M in GWF project & core team funding



The GWF network involves more than 478 stakeholders and users, 190 researchers from 18 Canadian universities and 965 research personnel with 64 pan-Canada projects, and core teams including modelling and forecasting, computer science, knowledge mobilization, data and technical teams.

Here at USask, our faculty are leading or co-leading 30 projects and core teams, including the Integrated Modelling Program for Canada (IMPC), FormBloom, Prairie Water, eDNA and Core Modelling.

Additional information is available at: globalwaterfutures.ca





Irrigation into Land Surface Models: When, Where and How Much Water is Needed?

Yanping Li and Zhe Zhang

Irrigation is a human management practice of watering crops by bringing in water from pipes, canals, sprinklers or other man-made means, rather than relying on rainfall alone to improve crop yield and qualities.

Globally, USask researchers, in collaboration with the National Centre for Atmospheric Research, are leading an effort to understand and model how irrigation has played an important role in the energy-water-carbon coupling on the land surface, including the influences on weather and regional climate. For example, simulations have shown that the intensive irrigation in the California Central Valley increases summer precipitation and streamflow in the Colorado River.

The uncertain future of water availability brought on by climate change needs to be dealt with by timely and effective adaptations. Advanced computer models can provide insight into possible mitigation strategies, such as relocating croplands to regions with sustainable irrigation, switching to crops that demand less irrigation and adopting smart irrigation strategies to avoid excess water application. For this to be realistic and successful, there needs to be wider collaboration and mobilization of information among climate scientists, water resource agencies and local farmers.

Globally, ~20% of croplands are irrigated and contribute to 40% of the world's food production.

From a modeling perspective, determining the irrigation methods, location, timing and amount are key aspects representing irrigation processes and study their impacts.

Beavers & Climate Change

Cherie Westbrook

Researchers at GIWS have embarked on a new approach called biomic river restoration to achieve stream restoration and enhance stream resilience to climate change. Biomic river restoration leverages the power of biology to influence stream forms and processes. Beavers are one example and are nature's stream restorers to help build, maintain and adaptively manage habitat, enhancing the self-healing capacity of streams.

Beaver dams change how water, sediment, nutrients and energy flow through stream corridors, enhancing both habitat diversity and landscape connectivity. One concern with using beaver dams to restore stream functioning is the risk that they have a higher likelihood to fail during large rainstorms and worsen flood impacts. GIWS

researchers observed that during the Alberta 2013 floods, beaver dams in Kananaskis Country increased water retention and delayed flow to many streams, showing that this natural and transient floodwater storage solution warrants consideration in regional water management strategies. Moving forward, GIWS researchers will enhance the understanding of the incredible variation in beaver dam structures in a hydrologically meaningful way and develop a greater understanding of the density and distribution of beaver dams needed to restore healthy stream functioning and mitigate downstream flooding under a changing climate.





Deep Groundwater

Grant Ferguson

Groundwater makes up the largest store of liquid freshwater on Earth and, despite the abundance of lakes and rivers, it holds most of Canada's freshwater as well. Researchers have made enormous strides over the past few decades in understanding how surface water and groundwater interact, yet most of this work has really only looked a few metres below the surface and treats the larger, deeper groundwater system as a black box. This led us to explore challenges such as:

- Where is the bottom of a watershed? This bottom of the hydrologic cycle is the maximum depth that groundwater recharge circulating from the surface reaches.
- Understanding the behaviour of deep groundwater systems at the intersect between energy and water resource interests—huge volumes of water have been produced and injected by the oil and gas

industry and storage over the past century, resulting in substantial rearrangement of fluid pressures.

- Groundwater depletion has been documented at the global scale, notably through the GRACE satellite mission led by Jay Famiglietti, and these deep groundwaters may be of strategic importance to address water and food security.
- Deeper groundwater have often been dismissed as non-renewable resources based on metrics such as their age and mean residence times. A recent commentary in *Nature Geoscience* outlines why these metrics can be misleading.

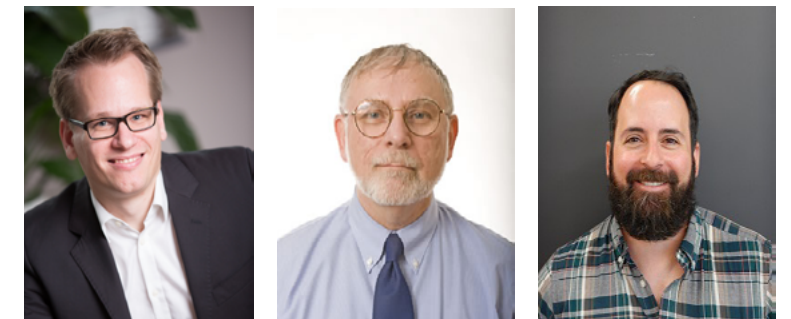
Renewed efforts are needed to facilitate sustainable management of groundwater and facilitate coordination with use of the subsurface by the energy and agricultural sectors, past and present.



Wastewater-Based Surveillance of SARS-CoV-2 in Support of Public Health Decision-Making

Markus Brinkmann
John Giesy
Kerry McPhedran

GIWS researchers, in partnership with the City of Saskatoon and the Saskatchewan Health Authority, have turned to wastewater-based epidemiology (WBE) to monitor wastewater influents for SARS-CoV-2, the virus causing COVID-19. Although individual swab-testing has been adopted globally as the gold standard for acquiring information, swab tests are limited by the fact that symptoms might not appear for as much as five days after infection and do not capture pre-symptomatic or asymptomatic individuals that have the potential to unknowingly infect others and cause severe outbreaks. Infected persons start shedding SARS-CoV-2 within 24 hours of being infected and by using COVID-19 WBE, the viral signal in the wastewater is one of the leading indicators of impending surges in cases numbers



(Figure 1). By using this information, [GIWS researchers and partners have previously warned](#) Saskatoon's population of upcoming increases in positive cases.

Although monitoring of wastewater influents for viral outbreaks is not an entirely new idea, GIWS researchers have adapted and refined methods for quantification of traces of SARS-CoV-2, which can also be applied to screen for new variants of SARS-CoV-2 and inform the prioritization of public health measures during the regular flu and cold seasons.

It has been shown that the viral signal in wastewater was one of the leading indicators of impending surges in case numbers (Figure 1).

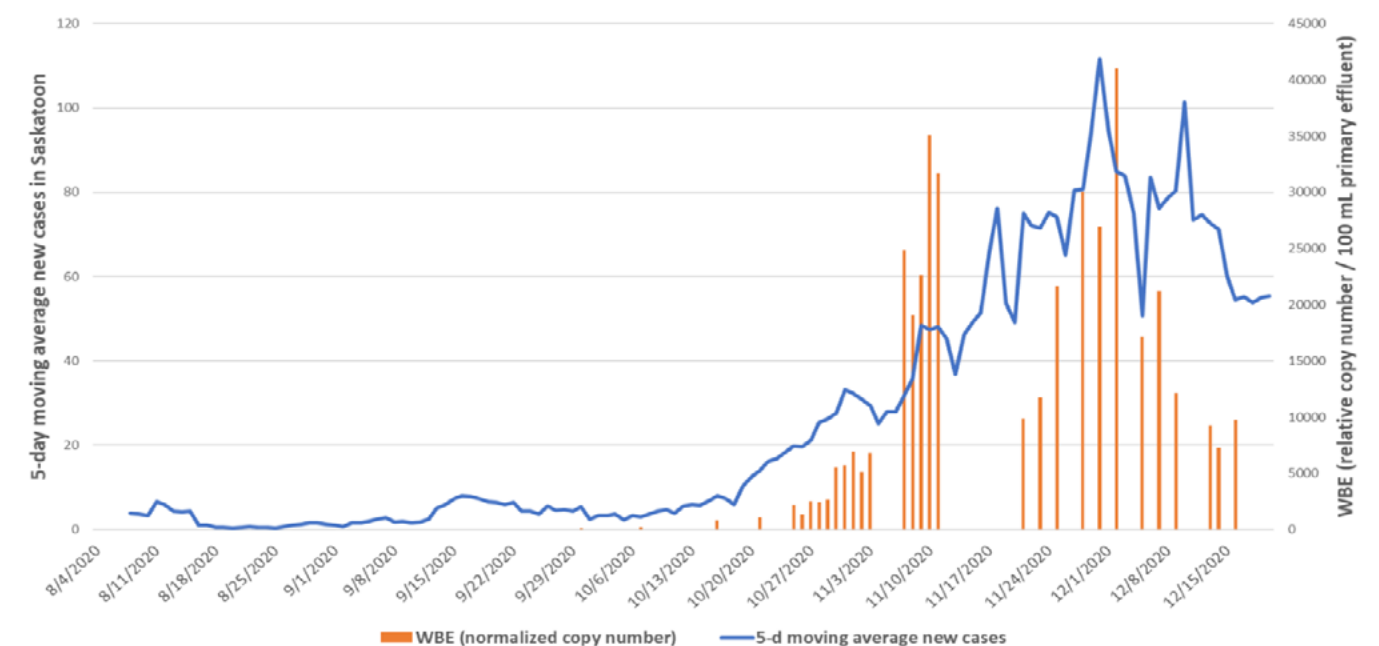


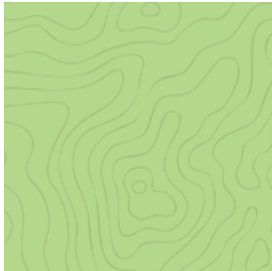
Figure 1: The graph shows the five-day moving average of new COVID-19 cases in Saskatoon (blue line). Data were obtained from Saskatchewan's COVID-19 dashboard. The orange bars are results of the wastewater-based epidemiology, which are expressed as normalized virus loads per 100 milliliters of wastewater as determined using RT-qPCR.

Ceres: Valuing Water

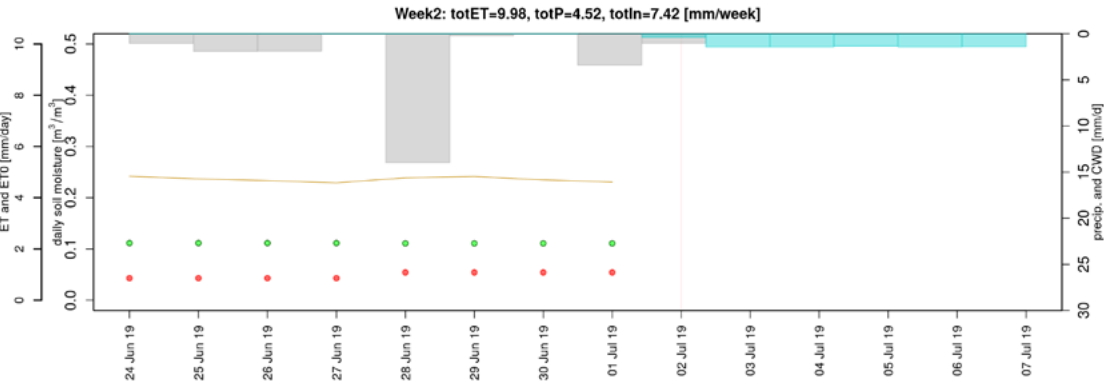
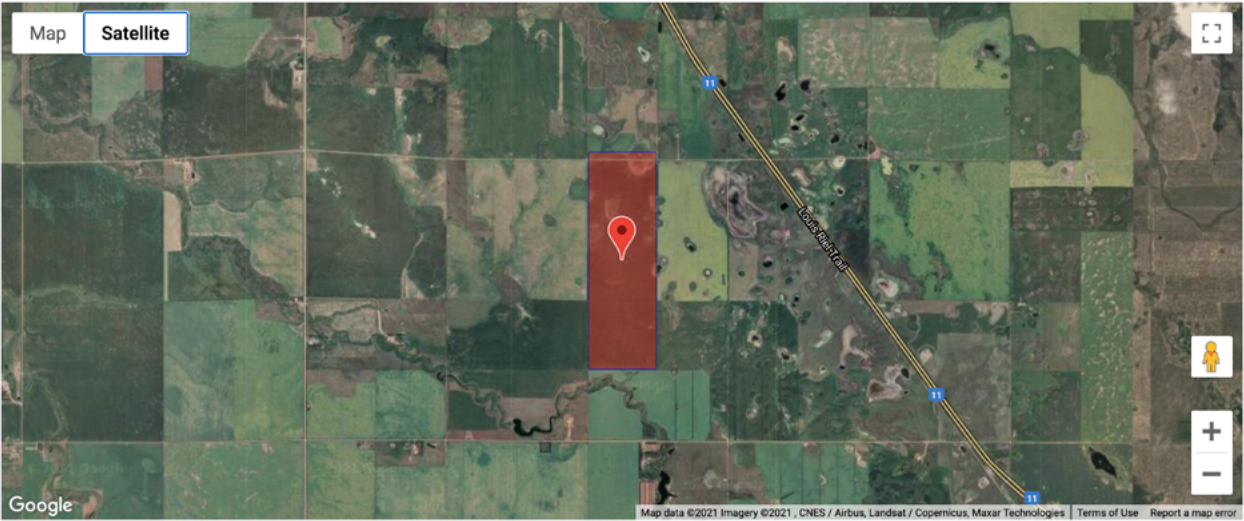
Global Assessment of Industry Impacts on Water

Kerstin Bluhm
Li Xu

The sustainability nonprofit organization, Ceres, has joined forces with the Global Institute for Water Security (GIWS) to draw attention to the strong linkage between unsustainable corporate practices and major threats to our global water supplies. GIWS is conducting science-based research and analysis on water-intensive industry practices that have led to increased water scarcity and pollution, further threatening ecosystems and accessibility in communities around the globe. The global food agribusiness sector—which uses more than 70 percent of the world’s fresh water to grow crops, feed livestock and process ingredients—will be among those industries analyzed. Other sectors include metals and mining; oil, gas and consumable fuels; chemicals; and textiles, apparel and luxury goods.



The findings will be used to inform a new set of leading investor expectations for companies to improve their overall water stewardship in business operations and supply chains. To ensure the research and analysis is relevant to capital market audiences, the effort will also be informed by the ongoing work of the Valuing Water Finance Task Force, an influential group of pension funds and commercial banks.



Farm Irrigation Advisory Project:

Forecasting Crop Water Stress Using NASA’s Near-Real-Time Remote Sensing Data

Sara Sadri

Agricultural water management decisions are usually made based on in-situ measurements, like precipitation, soil moisture. Such approaches are costly, hard to scale, and do not consider available weather forecasts. Recent advances in high-resolution remote sensing and modeling can offer farm-level information with reasonable confidence and with potential for better-informed water resources management. The Farm Irrigation Advisory Project (FIAP) is a new high-resolution forecasting product with seven-day prediction capabilities of spatial and temporal water deficit and stress index for farms in the Canadian Prairies. This project is led by Sara Sadri, a new GIWS research scientist.

FIAP uses near-real-time remote sensing data, representing both atmospheric and soil properties, coupled with the information from the farmer, water balance equation and machine learning (ML). It

generates a high-resolution spatial map of next week’s crop water stress and water deficit or needed irrigation (moisture deficit) as well as historic graphs and data for the farm. Statistical approaches, topography data (from Shuttle Radar Topography Mission), and ML techniques are then used to downscale each covariate into a 70m resolution to understand the distribution of crop water stress over the farm. One unique aspect of this work is that it takes advantage of the information the farmer provides to match crop phenology, crop type and the Food and Agriculture Organization guidelines with the soil moisture depth in the calculations.

Although the tool is still in its preliminary stages of development, the team has achieved promising results to show that it is possible to develop an app to assist farmers in farming sustainably so that they can preserve the environment, improve crop yields and achieve considerable savings in water, fertilizer and electric bills.

Predicting Flood and Freshwater Supplies

Chris Marsh

The melt of the seasonal snowpack can result in the largest discharge of the year and provides a critically important source of fresh water to many downstream uses, including ecosystem, agricultural, industrial and municipal. Due to the significant role mountain snowpacks play in generating streamflow in large rivers around the world, including the Saskatchewan River, there is substantial motivation to provide timely and accurate predictions of snowpack evolution, spring ablation and runoff in these “water towers of the world.” The redistribution of snow by wind, avalanching, and forest canopies controls the volume, rate and timing of snowmelt runoff, yet these processes have not been addressed by most hydrological models.

GIWS researchers, with support from collaborators, developed a new open-source modelling framework,



the Canadian Hydrological Model (CHM). It is the first cold-regions hydrological model to ensure snow processes and redistribution are correctly represented by a preliminary end-user application of CHM. The SnowCast snowpack forecast product is available online. This experimental snowpack forecast runs daily for the Bow River Basin west of Calgary, using Environment and Climate Change Canada’s operational weather prediction as input. SnowCast provides estimates of snow depth and water equivalent which can estimate downstream streamflow estimates. These types of estimates were helpful during the start of the COVID-19 pandemic when researchers were not able to visit field stations and collect data.

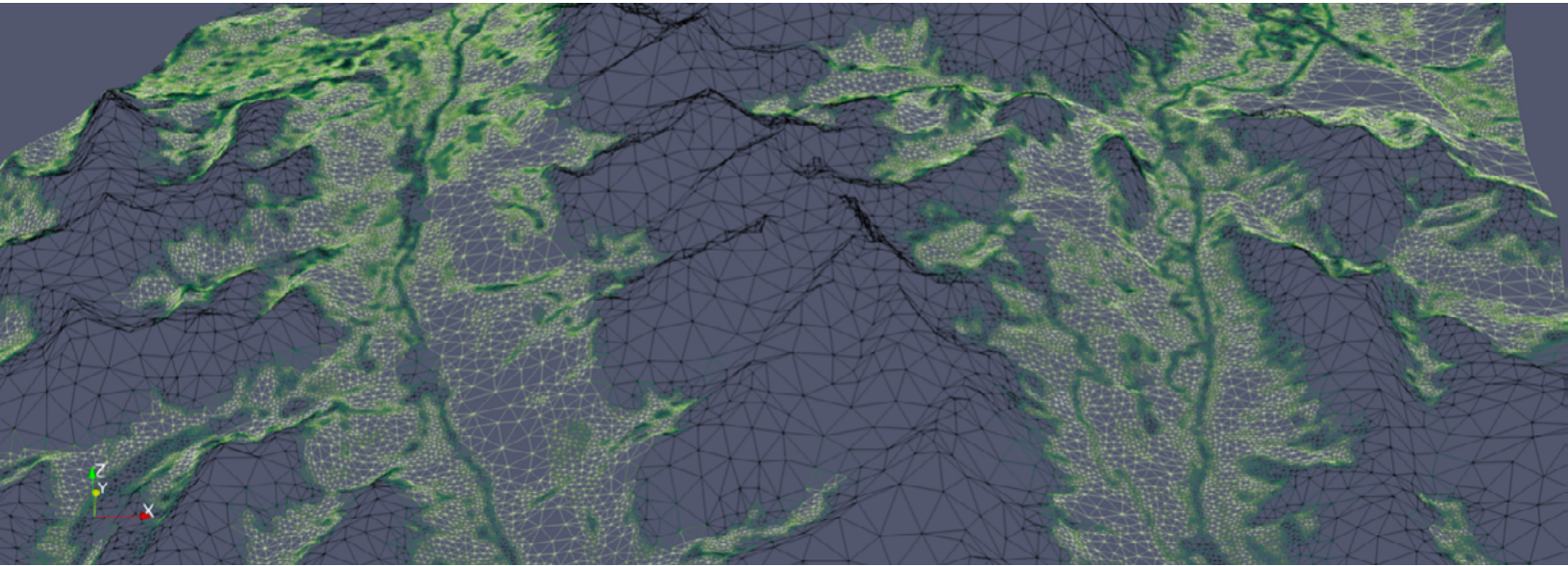


Figure: Topographic representation in CHM showing variably sized model elements. The small triangle areas capture abrupt transitions in in vegetation height (green) from riparian areas in the valley and towards the treeline. The mountain ridges are shown as colourless, hollow triangles.

Art & Science in Collaboration

Merging art and science provides a new avenue to engage in conversations around the environment, and new opportunities and collaborations continue to emerge. Here are few of our ongoing art and science collaborations.

Artist in Residence

Artist in Residence Gennadiy Ivanov began a partnership with GWF scientists in 2019 to develop an art-science project on the impacts of climate change in the circumpolar north. The project continues to evolve as a way to show the linkages between natural systems and societies most at risk around the globe.

Virtual Water Gallery

The Virtual Water Gallery is a GWF-funded science and art project that aims to provide a safe and inclusive space for fully open discussion between artists, water experts, knowledge holders and the public to co-explore water-related challenges. Led by postdoctoral fellow Louise Arnal, the gallery launches spring of 2021 and will continue to evolve.

Impressions of Water

Impressions of Water was created by local Saskatoon artist, Cheryl Buckmaster. The piece was inspired by the topics, conversations and science presented at the Prairie Water Projects third annual partners meeting in early 2020. At the meeting, Elder Roland Duquette provided teachings related to water and its life-supporting nature and these words influenced the artist’s approach and messages contained within the piece. You can see this piece hanging at the National Hydrology Research Centre.





Let’s Talk About Water (LTAW) started with a simple idea: to engender change and awareness around local, regional and global water issues through events and conversations that revolve around public screenings of films and community forums.

The first LTAW event was hosted in the fall of 2009 at the University of California at Irvine by Professor Jay Famiglietti (GIWS), film and picture researcher Linda Lilienfeld (LTAW) and colleagues from the Consortium of Universities for the Advancement of Hydrologic Sciences Inc. (CUAHSI), and featured the documentary film *Flow*. Since then, LTAW film events have taken place around the world on an annual basis.

In 2019, LTAW created a partnership with GIWS dedicated to the communication of water and climate science through an annual film festival, podcast, film prize competition, and community and youth engagement.

Today, the overall goal of LTAW is to be a communication hub for water and environmental science that revolves around a yearly film festival. By combining the power of film with the science of water, LTAW can inform, engage and inspire discussions about water issues and solutions.



Film Festival

LTAW film festivals have been taking place around the world since 2009, but with a scheduled GIWS-led Saskatoon-based event cancelled in 2020 due to the pandemic, organizers looked to the world of online streaming to accomplish their goal of sharing some of the best water films with the general public. A LTAW virtual theatre was created and the festival aired over a dozen films over the course of a month in June 2020. More than 6,000 people attended the online event from 92 countries. In 2021, organizers are using the virtual theatre to reach even more people with monthly screenings airing over the course of six months between January and June.



Podcast

In each episode of the LTAW Podcast, host Jay Famiglietti tackles a global topic, such as environmental racism or First Nations drinking water advisories, and interviews some of the world’s experts on each subject. The podcast is now entering its third season and has gained an audience of thousands of people around the world. The show is produced in collaboration with Canadian news magazine *The Walrus* and can be found on all the standard podcast platforms.

Youth & Community Engagement

With the goal of awareness, education and solutions to water issues, community, youth and industry engagement has become paramount to the success of LTAW. Through community forums, filmmaking workshops, teachers and student activities, and resources on water science and water issues—all hosted through our website and virtual theatre—LTAW is striving to solve global water issues one person at a time.

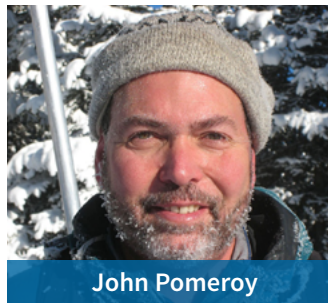


GIWS research excellence is recognized by its peers locally and globally, which is evident by the fact that we have:

1 AGU Hydrologic Science Award



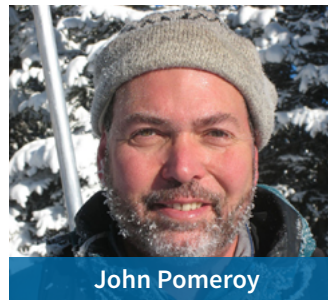
1 Miroslaw Romanowski Medal from the RSC



1 Einstein Professor, Chinese Academy of Science



1 J. Tuzo Medal, Canadian Geophysical Union



2 International Hydrology Award Winners, IAHS/WMO/ UNESCO



2 Prince Sultan Bin Abdulaziz International Prize for Water Winners



8 Royal Society of Canada Fellows

- John Giesy
- Jeffrey McDonnell
- Ingrid Pickering
- John Pomeroy
- Howard Wheeler
- Irena Creed
- Ajay Dalai
- Christy Morrissey

5 American Geophysical Union (AGU) Fellows

- Martyn Clark
- Jay Famiglietti
- Jeffrey McDonnell
- John Pomeroy
- Howard Wheeler

1 Laureate, Canada Excellence Research Chair in Water Security
- Howard Wheeler

1 Canada 150 Research Chair in Hydrology and Remote Sensing
- Jay Famiglietti

3 AGU Horton Research Grants for “best PhD proposal” in hydrology
- Nicholas Kinar, Chris Gabrielli and Magali Nehemy

3 Past-Presidents: AGU Hydrology Section (Jeffrey McDonnell), International Association of Hydrogeologists - Canadian National Chapter (Grant Ferguson), Canadian Geophysical Union (John Pomeroy)

1 CGU PhD Glaciology Award
- Caroline Aubry-Wake

3 Banting Postdoctoral Fellows, Government of Canada
- Markus Brinkmann, Jonathan Challis, Elliott Skierszkan

Futureproofing Our Data Legacy

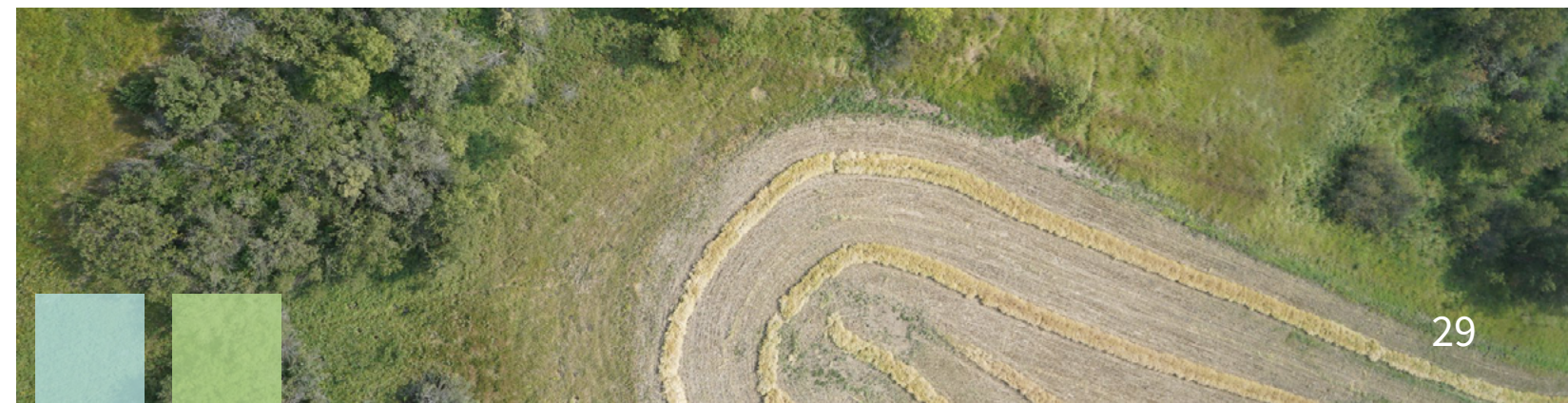
Stephen O’Hearn

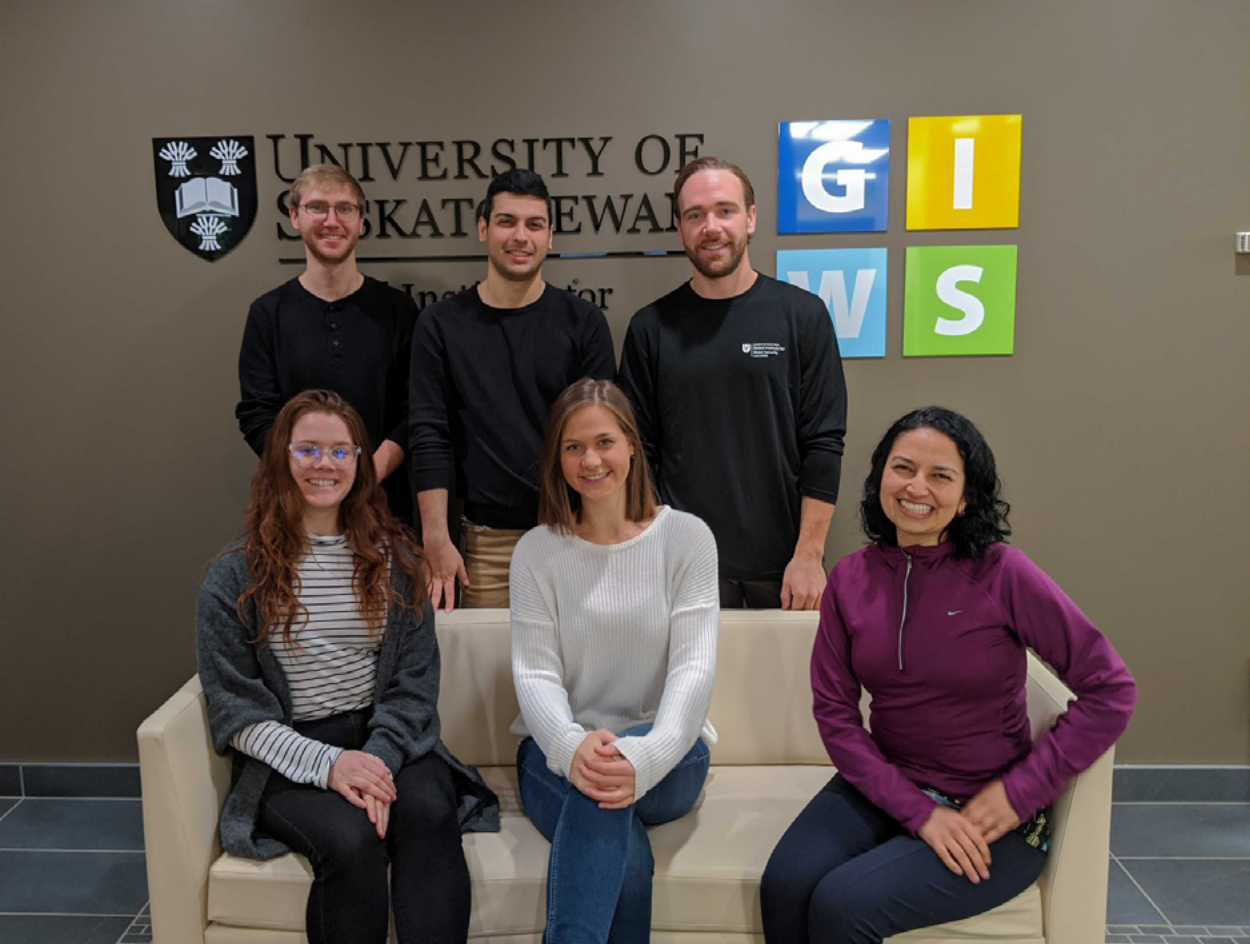
The dynamic nature of water science research—in which approaches to observation, modelling and prediction of Earth systems are continuously evolving—shapes our present data and re-shapes our legacy data collected over many years through reanalysis. Our interactions with well-managed data—past and present—leads us to new discoveries, new made-to-order solutions and a sustainable process of iterative refinement of knowledge and research questions. This process inevitably results in future data which will become tomorrow’s important legacy.

The Global Institute for Water Security is thus steadfastly committed to data stewardship and, to this end, has devised a new template-based form of data catalogue, gwfn.net, capable of incorporating legacy data and future data of a to-be-determined form as easily as it handles data from the present day. Moreover, it enables a variety of information seekers—from the general public to highly specialized scientists—to easily zero in on trails of information to obtain publications, datasets, data, and other related information that delivers context to the results associated with their search including basins, research sites, stations, equipment, model workflows, software, principal investigators, projects. Today’s legacy is tomorrow’s future.



“Our interactions with well-managed data—past and present—leads us to new discoveries, new made-to-order solutions, and a sustainable process of iterative refinement of knowledge and research questions. This process inevitably results in future data which will become tomorrow’s important legacy.”





GIWS Students & Young Researchers

GIWS is committed to offering opportunities for students to join in activities that develop their understanding of the challenges of water security, including an appreciation for the need to bring a wide range of expertise together to address these critical issues. The institute welcomes student members from the natural sciences and engineering, as well as the humanities and social sciences, and encourages them to learn from each other about the many dimensions of water security.

The student body promotes social networking and community engagement as part of their mandate by organizing and participating in game nights, movie nights, social and fundraising events, World Water Day, and elementary and high school science fairs.

GIWS strongly supports the professional development of graduate students and postdoctoral fellows and offers numerous workshops on knowledge mobilization, equity, diversity and inclusion topics, and various research skills. For example, Prof. Jeffrey McDonnell offers a half-day workshop on “The Future Professoriate” to shed light on and facilitate discussions regarding the workings of academia for graduate students and postdoctoral fellows interested in pursuing academic careers.



GIWS Membership, Management & Research Support Staff

Membership

Abdelrasoul, Amira, Assistant Professor, Chemical & Biological Engineering

Achenbach, Sven, Professor, Electrical and Computer Engineering

Barbour, Lee, Professor, Civil and Geological Engineering

Baulch, Helen, Associate Professor, School of Environment & Sustainability

Bedard-Haughn, Angela, Professor and Dean, Agriculture and Bioresources, Soil Science

Belcher, Ken, Professor, Bioresource Policy, Business & Economics

Bharadwaj, Lalita, Professor, School of Public Health

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Clark, Douglas, Centennial Chair and Associate Professor, School of Environment & Sustainability

Clark, Martyn, Professor & Associate Director, Centre for Hydrology & Coldwater Laboratory

Costa, Diogo, Research Scientist, Environment & Climate Change Canada

Creed, Irena, Professor, School of Environment & Sustainability

Dalai, Ajay, Canada Research Chair & Professor, Chemical & Biological Engineering

Davison, Bruce, Research Scientist, Environment & Climate Change Canada

de Boer, Dirk, Professor, Geography & Planning

Doig, Lorne, Research Scientist, Toxicology Centre

Elliott, Jane, Research Scientist, Environment Canada

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Si, Bing, Professor, Soil Science

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Westbrook, Cherie, Professor, Geography & Planning

Wheater, Howard, Professor Emeritus, Founding Director of GIWS

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Wittrock, Virginia, Research Scientist, Saskatchewan Research Council

Yang, Daqing, Research Scientist Emeritus, Environment & Climate Change Canada

Zhao, Ying, Visiting Fellow, College of Resources & Environmental Engineering, Ludong University

View GIWS

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