GIWS Annual Magazine 2022





Global Institute for Water Security USASK

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Reconnections: A Message from the Executive Director

Wow. Not exactly business as usual for the Institute. Again. And perhaps that is why I'm so proud of what we've been able to accomplish.

Our members continued to perfect new strategies to fulfill their teaching, supervisory, and research duties. Our management had to devise new ways to continue to build our reputation and keep GIWS on the cutting edge while in a virtual world. Our technicians and post-doctoral fellows showed superb selfmotivation in their research, data collection and publications. And our students needed to work even harder to make progress on projects and theses while not having one another nearby for support.

But we can see the light at the end of the tunnel – the challenges of the past two years can only lead to even greater and a more fulfilling future, and I know how much we all look forward to working and collaborating in-person once again.

While there are so many great accomplishments to talk about, some highlights that you'll come across this year include: the institute's new partnership on corporate water management with CERES; our initiative to build a water-energyfood nexus and strengthen our ties with the Global Institute for Food Security and the Colleges of Agriculture and Bioresources and Engineering; our ongoing work to maintain Water Security as a signature area for USask; the next-decade visioning that was completed in 2021 to guide the future of GIWS; the amazing research and public support of our Covid-19 wastewater testing and website; the success of our What About Water science communication outreach initiative; the tremendous impact that Global Water Futures is having on our country and the planet; and the world-leading research projects led by our members (not to mention some very prestigious awards).

We hope that you'll enjoying flipping through our Annual Magazine because we really enjoyed putting this together – it is amazing to see what this institute is doing.

Sincerely,

Jay tamigliette





Mission & Vision

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

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



Water & Health

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





Sustainable Development of Natural Resources

Assessment and management of environmental risks with emphasis on water

Socio-Hydrology

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





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

Working in a hybrid and virtual world



Michelle Martel-Andre

As another year passes, we take a moment to think about the numerous changes GIWS has faced as an institute since March 2020. We have made adjustments to our personal and professional lives in order to adapt to changing restrictions, policies and procedures to ensure the safety of ourselves, our families, our colleagues and our friends. We reflect on the first days and months of the COVID-19 pandemic, and we are reminded of initial ever-changing platforms to connect with each other and the significant effort of all GIWS members to maintain a sense of normalcy - not just for ourselves, but for one-another. 2021 became a year to grow and embrace new ways of learning and working.

In 2021, the collective effort of all GIWS members did not wane but set a new standard of success. Institute and Program Leadership, Faculty, PI's, Researchers and Staff found innovative and creative ways not only to connect, but to maximize opportunity in a remote and hybrid learning and work-world. Throughout 2021, the GIWS Members continued to deliver outstanding courses using shared best practices and creative ways of teaching and learning. Graduate Student supervision and mentorship was and continues to be formed, maintained and enhanced on the foundational effort of Faculty to engage their students in a most meaningful way possible.

When various online platforms began to expand their capabilities, and through effective research and trial and error testing, GIWS members seized this opportunity and continued to share and promote world-class research in different ways to further enhance the research connectivity of the world. Internal teaching, learning, engagement and professional development was successfully delivered through channels not previously utilized. In 2021, the GIWS community embraced remote and hybrid work arrangements by understanding the various means of successfully remaining connected and working with best options available to achieve that goal.

As we begin 2022 and the doors open once again, GIWS members will continue to thrive in an ever-changing environment by using traditional best practices and newly opened opportunities realized through ingenuity, creativity and perseverance. Methods of working, teaching and learning which were previously unknown have been refined for success, and will contribute to the many ways in which the Institute continues to challenge all obstacles.

water-intensive sectors around the globe the Water Security for Food Security study

• GRACE – Satellite-based detection of groundwater change in the food producing regions of the world

International

Jeffrey McDonnell

research career in water security.

Initiatives & Impact

- Planetary Water Prediction producing continental and global-domain simulations and predictions of hydrological risks with an emphasis on river basins
- International Court of Justice panel members on arbitration for the transboundary conflicts for Chile-Bolivia
- Leadership in Professional Associations President of the Canadian Geophysical Union's Hydrology Section; IAH Vice-President for North America



GIWS engages in international research via three pillars: a) developing local and regional studies—of global significance and linked to global programs, b) addressing key water challenges around the world, and c) global graduate education.

Despite the ongoing travel restrictions, we have continued to bring the world to Usask through the GIWS-GWF Distinguished Lecture series. The Fall 2021 line-up included leaders from the UK, Sweden, Switzerland, Russia, Germany and the USA who gave us their views on the future of water security. We had the Editors of PNAS, Water Resources Research and Hydrological and Earth System as part of this past year's series as well as researchers from both universities and government labs. Each week included an extra hour where speakers met with our GIWS early career group to discuss how to launch and navigate a

We soldiered on with our annual graduate shortcourses at Kananaskis (led by John Pomeroy) and at the University of Birmingham (led by Jeff McDonnell). Our BNU Masters of Water Security (MWS) degree continued through the 2021-22 academic year and some intrepid field workers within that program and within the GIWS managed to get some international field work completed (image above of postdoc Dr. Magali Nehemy in the Amazon in Fall 2021). John Pomeroy attended COP26 in Glasgow and GIWS managed to continue to engage in activities that included selected activities like:

• CERES-USA – science-based research and analysis on industry practices in

• US National Academy Board of Agriculture and Natural Resources – leading

Solving Water Issues through Partnerships and Collaborations

Palash Sanyal

COVID has redefined the spheres of our lives, work, and space. The same is valid for sustaining existing and establishing new partners and partnerships for GIWS, with shifting priorities, challenges, and new opportunities, as we find new ways to connect, value old ways of bonding, and maintain our relationships locally, nationally, and internationally.

Over the past year, we have been able to connect and maintain a strong relationship with the City of Saskatoon officials. The City has multiple priorities and projects that require utilizing GIWS's skill sets and research work. At GIWS, we have two extensive responsibilities: 1) To do the science right, in collaboration with our partners, upholding EDI and training the next generation of water scientists and 2) to communicate our science to decisionmakers, implementers, and in general, to the public. Over the course of the last year, the City has suggested 20+ collaboration opportunities where we can fulfill both responsibilities. Over the next six months, we plan to pursue these projects and apply for funding. We also had conversations with the City of Martinsville and Prince Albert on water issues. GIWS and SENS are now working together to support the Master of Water Security program, its student recruitment process, and building sustainable industry, government, and NGO partners who will host MWS projects.

"Water security is tied to food security and vice-versa. We can't move the needle on water security if we do not have strong relationships with foodproducing regions, companies, and most importantly, the farmers."





Water security is tied to food security and vice-versa. We can't move the needle on water security if we do not have strong relationships with food-producing regions, companies, and most importantly, the farmers. Over the past year, we have built relationships with agricultural industry leads like MNP, Corteva, and Syngenta, to ensure that our science is heard and considered when making impactful decisions. MNP, an accounting company, works with farmers and has data that require attention from water scientists. We have established a strong relationship with Saskatchewan Government's Trade and Export Development (TED) department and with Federal Trade Commissioners based in Europe, Asia, the United States, and Latin America. Both TED and Federal Trade Commissioners are representatives of Canada at the National level and are eager to increase scientific research activity nationally and abroad on water security. For example, Canadian Trade Commissioners ask for more water-related research interests in the Middle East and Bangladesh.

When it comes to big corporations, financial institutions (e.g., insurance companies) are the first believers of climate change, and they realize water and climate change are deeply interconnected. Water is any insurance company's worst nightmare, from drought to flooding, home insurance, and agriculture insurance. There is an appetite for paying attention to water researchers. These institutions are influential and have the financial means to support research and development. Our upcoming Valuing Water Global Assessment Report with CERES will inform investors and asset managers about how industries impact water



and contribute towards water risk. The work will show specific areas of the research gap in water, and we plan to extend the work over the following years.

Internationally, we are in communication to provide our scientific work to organizations like World Economic Forum, World Bank, Asian Development Bank, International Fund for Agricultural Development.

As many of you know and have experienced, relationship 2021 has been meaningful for Usask's Bangladesh building takes time, patience, and, most importantly, trust. initiatives. USask now has a research Centre in Bangladesh Our directions on partnerships from here are clear. We plan that will usher collaborative research between Canada to continue and build sustainable relationships locally and and Bangladesh, including in water security. GIWS internationally, do collaborative research, and provide the has signed two MoUs in Bangladesh (a third one is in science to the decision-makers. process with the Ministry of Water Resources) over the last year. We are witnessing overlapping priorities and collaboration opportunities. Our partners in Bangladesh have research interests in COVID-19, isotope studies, groundwater management, remote sensing, water quality monitoring, and many more. Bangladesh has a 100 year Delta Plan that has allocated 32 billion dollars till 2030. 3-5%, almost a billion-dollar will be invested in water



research. There is a specific training opportunity in the area of remote learning and groundwater management. 50% of the population is less than 30 years old in Bangladesh, and the country is one of the worst affected countries due to climate change. There is a demand to develop capacity in water security within academia and government institutes, which GIWS can aid.







Equity, Diversity and Inclusion in GIWS Water Research



In 2021, GIWS's approach to Equity, Diversity, and Inclusion (EDI) focused on science communication and supporting GIWS scholars to action EDI in grant proposals. The GIWS podcast and film festival 'Let's Talk About Water' transitioned to a new brand identity under the title 'What about Water?' This brand transition became an excellent opportunity to expand EDI in science communication and outreach within the institute. The What About Water? team has excelled at making the podcast accessible through inclusive design principles in marketing and branding, making transcripts available for each episode, and continually growing the diversity of water-related topics covered in the series. The team is committed to sharing inclusive design and communication processes learned last year across the institute and USask in 2022.

Dr. Saman Ravazi's essay, When I encountered language barriers in my career, here's how I broke through, was the most read article in Science's Working Life series in 2021. Dr. Ravazi's essay is a must-read for students and faculty alike committed to building an inclusive lab environment. GIWS continues to sponsor the Women + Water Lecture Series presented by Global Water Futures (GWF); the series reached 1000 registrants in over 26 countries in 2021. Dr.

Andrea Rowe, EDI Specialist (GIWS/GWF), contributed to USask's SURE: Student Undergraduate Research Experience program with an interactive seminar on How to Be a Changemaker: EDI in undergraduate research in addition to her work with GIWS students, faculty, and staff throughout the year.

In March 2022, GIWS will embark on a consultation process to implement the #GWFEDI 2021-2023 Strategy through EDI training and initiatives within the institute. The consultation process will be an opportunity to build on success, identify gaps, and incorporate lived experiences into the institute's approach to actioning protocols for inclusive hiring, events, fieldwork, and more. Stay tuned for more information on the consultation process, including registration dates and times for students, faculty, and staff on the GIWS EDI web page.

Twitter #GIWSEDI



GIWS is dedicated to protect our







"USask water retains #1 spot in Canada for university water resources programs, and, jumps 5 spots, from #20 to #15 globally in the 2021 Shanghai Rankings"

most precious natural resource: water

PUBLICATIONS

| | 2021 | Since 2011 |
|-----------------------------|------|---------------|
| Journal publications | 414 | 2,606 |
| Conference Presentations | 198 | 1,955 |
| Lecture Invitations | 132 | 1,082 |
| Books and Book Chapters | 29 | 134 |

Global Water Futures

John Pomeroy & Corinne Schuster-Wallace



Global Water Futures (GWF) is a \$306M, seven-year programme supported by a 2016 grant from the Canada First Research Excellence Fund. GWF is based at USask in a close partnership with Waterloo, Wilfrid Laurier and McMaster universities. The programme funds 201 professors and employs 1188 researchers across a consortium of 18 Canadian universities to carry out an ambitious plan to transform Canada by addressing the Grand Challenge of finding ways to best forecast, prepare for, and manage our future water in the face of dramatically increasing risks. The overall goal of GWF 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 works with over 450 users and partners to develop transdisciplinary solutions to managing water-related risk in a wide variety of sectors, communities, and regions. The programme has launched 64 transdisciplinary



and transformative projects and teams, implemented a co-developed Indigenous community water research strategy, developed an innovative virtual approach to linking science and art, and is implementing an ambitious EDI strategy. It has helped establish Canadian global leadership in developing water solutions for cold regions and has become the largest and most published grouping of academic water scientists in the world. GWF has improved the scientific underpinning that supports disaster warning from floods, droughts, and water quality degradation episodes and through new code and computer technologies, is delivering state-of-the-art prediction systems. The programme is diagnosing the varied dimensions of changing water futures under climate, water resources development and ecosystem change and has built the models that can predict these futures and that are deployed across Canada and throughout the Americas, Europe, and Asia. GWF research is contributing to inclusive and evidence-informed solutions for achieving water sustainability for Canada and around the world.

2021 marked a year of Milestones, including the launch of the #GWFEDI strategy following consultations with faculty, staff, Young Professionals, and partners. Several virtual events were held, including a series of webinars discussing opportunities and necessities for the Canada Water Agency, the Annual Open Science Meeting with the theme "Achieving Sustainable Water Futures in an Uncertain World", and the annual Operations Meeting. Over 1,000 participants engaged over the three days of the Annual Open Science Meeting from multiple countries.

In 2022, GWF is focussing on synthesizing assessments of water futures including the impacts of changing water on people, the environment, and the economy and has its Annual Open Science Meeting, themed "Knowledge to Action" running online over 16-18 May this year with a series of plenary and parallel sessions and high-level discussion panels and Indigenous cultural activities. The meeting will be organised on three themes: i) Managing and governing water futures, ii) water-related risk reduction, and iii) harnessing data and knowledge to improve water practice. Climate change, modelling, and Indigenous Knowledge and perspectives will be cross cutting themes throughout the meeting. Contributions from all researchers, partners and students aligned with GWF are welcome.

Additional information is available at: globalwaterfutures.ca













Fort McMurray model used to develop ice-jam flood mitigation assessment process Karl Frich-Lindenschmidt

The city of Fort McMurray, Alberta has a lengthy history of flooding. Adjacent to northern rivers, Fort McMurray regularly confronts the expensive problem caused by ice jams during spring ice breakup.

To help combat the issue Karl-Erich Lindenschmidt has developed a novel method to help flood managers assess the feasibility of ice-jam flood mitigation - dredging river sediment at jam-prone sites, artificially breaking up ice using amphibious excavators called Amphibex to shift jams downstream from Fort McMurray, ice control structures to stop ice from flowing into the flood prone area and building dikes.

The findings, based on a sophisticated computer model, evaluated how multiple fluctuating factors such as water flow, ice thickness and backwater levels affected ice jams and flooding.

"Our study differentiates between flood hazardwhich refers to such things as velocity, depth and extent of flooding-and flood risk, which incorporates vulnerabilities such as infrastructure, buildings and contents," he says. "Such a comprehensive risk analysis is much more complex, but it gives you the information needed to assess the expense of a mitigation measure versus ice-jam flood-damage costs."

The Alberta study used hundreds of ice-jam flood hazard maps based on simulated ice-jam water levels to determine flood risk. Flood damage potential was evaluated based on such things as building types and sizes (commercial or residential) and estimated flood depths.

Based on the mitigation measures studied, a dik or an ice control structure have the highest potential to reduce annual flood damage, significantly reducing the number of buildings exposed to flood risk.

The methodology and interactive maps of flood hazard and associated risk developed for this study could be used to design and explore a comprehensive flood protection system for any ice-jam-prone location in Canada says Lindenschmidt.

The Virtual Water Gallery brings together a world of art and science

Louise Arnal

Researchers from the USask, and around the world, have partnered with artists to launch a new online exhibit of art and science. The goal, to inspire and inform about water issues globally.

The Virtual Water Gallery (VWG)—a project led through the pan - GWF program—launched on April 29, 2021. The goal of the project, which is free to the public, is to create a virtual space for artists, water experts, knowledge keepers and the public to co-explore water challenges. The space can be explored at www.virtualwatergallery.ca.

"Art puts us all on a more equal level. Everyone can appreciate art in one of its various forms, either paintings, music, poetry, etc.," said Louise Arnal, post-doctoral fellow and lead curator of the VWG. "Only a very small proportion of the population can actually understand scientific facts and figures. Art can also add an emotional dimension to otherwise cold scientific facts. This can in turn inspire and even instigate action."

As part of this VWG project, artists were paired with teams of GWF scientists to co-explore specific water challenges in various Canadian ecoregions and river basins, including the Arctic, mountains, boreal forests, prairies, farmlands, lakes, rivers, and communities.



The gallery also draws on existing science and art collaborations that began about three years ago when GWF Director and USask Professor John Pomeroy partnered with U.K.-based artist Gennadiy Ivanov for a climate change water project called Transitions. Ivanov's art is now part of the VWG along with over a dozen other artists and art groups.

"Art is such a powerful tool-it isn't a coincidence that people say an image is worth a thousand says Arnal, artist words." and scientist.



virtualwatergallery.ca

Covid monitoring in wastewater providing valuable data for cities during pandemic

Markus Brinkmann John Giesy Kerry McPhedran

Lab shutdown, campus closure, projects years in the making slammed to a grinding halt overnight. For many researchers, this list sounds like a bad dream but to researchers at GIWS it became a very unexpected opportunity. As the fear and spread of the COVID-19 pandemic continued, Markus Brinkmann and colleagues saw a unique chance, the chance to help protect their community.

Equipped with transferable skills, and some of the right lab equipment, they polled their efforts into wastewaterbased epidemiology (WBE). By looking at wastewater, researchers and partners at the City of Saskatoon (CoS) and the Saskatchewan Health Authority (SHA) developed an early warning approach, which tracks the total amount of SARS-CoV-2 virus circulating in the city's wastewater through lab analysis of samples from the municipal wastewater treatment plant.



"We can anticipate the rate of change in cases so that public health measures can be implemented in response," says Brinkmann. "Epidemiologists get more accurate information about prevalence and health officials get a jump-start on allocating resources effectively."

What once started as a small team of passionate researchers has grown. The wastewater surveillance team now provides weekly data updates to the SHA, cities, and the public for the cities of Saskatoon, Prince Albert and North Battleford.

One thing is certain: the application of wastewater-based epidemiology to understand the spread of viruses is in a renaissance and GIWS researchers are excited to be at the forefront of this rapidly evolving field - prepared to back scientists and doctors with science and data for whatever comes next.



Covid wastewater data outreach finds public eager for the latest results

Laura McFarlane Fred Reibin Jesse Witow

Amid the uncertainty, we need information. Information gives us the tools to use when we make decisions.

GIWS teams have worked hard to make that information and tools available over the past 18 months. The research team worked to improve the quality of the wastewater testing data, isolated new variants and shared the information with policymakers. The GIWS communications team began to package this information for the general public. They put together a website with a weekly dashboard of testing results that showed the overall changes in viral load from the previous week.

As the website rolled out, the team was unsure of the level of public interest it would attract. So each week, results were shared through social media. It drew some influential social accounts, including USasks Dr. Alexander Wong, breaking down the data with their followers each week. In addition, the data became a valuable supplement to news reporters wanting to paint





an accurate picture of the most current COVID-19 situation. By 2021, the public interest in COVID wastewater data grew and became the most popular page on the GIWS website. Since April 2021, when the COVID page started, 49.7% of all page views on the entire GIWS site were to the COVID page, and 21,739 people visited the site for the information.

As government policy changed, the provincial public reporting of COVID-19 cases was reduced. As of the beginning of 2022, the GIWS wastewater data is the only source of data being offered to the public, and the demand continues to grow.

This initiative shows the potential impact of combining cutting-edge research and strong public outreach. We look forward to leveraging this type of collaboration more as we forge ahead.

Drought and agriculture in the prairies

Phillip Harder

The Canadian prairies are an extreme semi-arid climate and regularly cycles between wet and dry periods, but even in that context the 2021 drought on the Canadian Prairies was one for the record books.

The region has been entering a dry period for several years - a precipitation deficit has been evident for the past couple of years.

Entering the 2021 water year limited soil moisture reserves, critical to meet growing season crop growth demands, were already limited.

A reasonable snowpack and complete infiltration during spring melt to recharge soil moisture reserves and timely rains early in the growing season provided an optimistic start to the season.

The extent and severity of the lack of precipitation and intensive heat after mid-June, especially in the heat dome event in early July, rapidly changed the story.

The inability of crops to moderate the high water demands, with limited available moisture, and thermal stresses, from the extreme heat, led to accelerated crop maturity and irreversible thermal damage during what should have been peak growth periods.



Crop yields across the region declined by a third compared to 2020. Soil moisture deficits remain high entering winter 2022, wetlands are empty, groundwater tables have declined and overall, the hydrologic connectivity of the region is low.

To better understand and predict prairie drought conditions improved information and models that capture the spatial variability, and interactions between, soil moisture, snow accumulation, snow melt, and melt water partitioning and how agricultural management can influence these dynamics is needed.

This is a focus of our work as we are actively working to couple cold regions hydrology models and crop growth models with explicit representation of agricultural practices to understand and predict feedbacks.

Accurate seasonal forecasting 6 months into the future remains a persistent and challenging hurdle that can be the real game changer to move from to relative understandings to meaningful hydrologic predictions and drought warnings.





Modelling weather and climate using laws of randomness

Simon Papalexiou

New modelling strategy allows realistic simulations in space and time of complex weather phenomena such as precipitation. Physically-based weather or climate simulations demand vast computational resources, typically offering coarse-scale outputs that are not optimal for risk assessment and may need bias correction. Stochastic approaches can bypass such limitations by mimicking observed weather and climatic variability through probabilistic laws.

"Nature cannot escape randomness; we need to better understand and model random fluctuations if we wish to improve risk assessment of extremes," says Simon Papalexiou.

Papalexiou specializes in modelling complex systems in space and time by developing stochastic methods. Yet simplifying assumptions of such methods lead to incomplete representation of reality. To improve simulations Papalexiou and co-authors created a general space-time model that uses spatially varying velocity fields. Such velocity fields are ubiquitous in nature describing movement of air or water across regions. The model was further advanced by adding spatial anisotropy, a common feature in physical processes where properties vary with direction. The model's resolution can be so granular it can simulate storms at the minutes scale and at spatial resolution less than a kilometer.



"We need fine-scale modelling to study pressing climatechange issues and offer reliable assessments to decision makers relevant to our societies. Regional impacts are what, really, people need to know about, isn't it?" he says. "Agricultural areas, small or larger catchments, small cities, large cities "need" reliable fine-scale models...".

"Nature cannot escape randomness; we need to better understand and model random fluctuations if we wish to improve risk assessment of extremes"

The model Papalexiou and co-authors worked on, by combining anisotropy with spatially varying velocity fields, opens new possibilities in simulating complex meteorological phenomena, such as storms moving across a region, spiraling fields resembling weather cyclones, and fields mimicking colliding air masses. Users and readers can explore and apply their model using the freely available CoSMoS R package.

What stronger and more drylines mean for North America

Lucia Scaff

Summer rainstorms, coveted by artists, rubber boot owners, and famers alike, these weather events are a summer treat. But what drives these events? Well, it might be about time that you thanked your local drylines.

Drylines are air boundaries that separate dry air from moist air. Think of the boundary between moist and warm air from Great Prairie Plains encountering the dry cool air from the Rocky Mountains.

The stark difference in humidity between the dry air and the moist air creates an imbalance in the atmosphere. These air masses have a strong density gradient that creates unstable conditions and thus potential for, forming convective clouds and intense precipitation. That is why drylines are so important in the initiation of summer precipitation along landscapes transitions such



as the Rockies/prairies in Canada.

But what does the future of drylines look like? Research suggests that more drylines and stronger drylines are predicted by the state-of-the-art atmospheric computer models. In the Canadian Rockies, drylines at the end of summer will be comparable to those present in the early summer. This means that we will have more potential to produce convection and severe weather in August and September.

The mechanisms to initiate convection are difficult to predict, so knowing more about the dryline behavior in a warmer climate provides valuable insight into potential of severe weather.



Figure: Topographic representation in Canadian Hydrological Model 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.



Saskatchewan water valuation & irrigation project

Patrick Lloyd-Smith

The Lake Diefenbaker irrigation project is a 10 year project investing \$4 billion into the rehabilitation and expansion of around 500,000 acres of irrigated agriculture. This increase would more than double the current number of irrigated acres in the province but irrigation would continue to make up a small part of Saskatchewan's 33 million acres.

As an economist, I am interested in understanding the economic value of water in all its various uses to industry, irrigators, recreationalists, and to the environment. Economics is one lens to view the human-water relationship and can shed insights into how people value trade-offs and make decisions involving water.

There remains many unknowns about the benefits and costs of the project. There are open questions on the on-farm economic benefits of irrigation as well as the broader economic effects a project of this size has on people and the environment in the water basin. An economic impact assessment has been conducted by the government describing how the economy will be affected by the project. These assessments are useful in understanding how the project will impact the number of jobs, tax revenues, and investments, but these types of analyses do not properly account for costs and the downstream impacts to people and the environment.

As far as I know, there has not been a comprehensive benefit cost analysis conducted that would determine if the project's net effects on society is positive or negative. Science tells us that historical climate conditions may not be a good predictor of future scenarios and there are several reasons that the relative returns to irrigation might increase in the future due to increased variability of precipitation, longer growing seasons, and improved irrigation technology lowering costs.

One lesson from research and experiences in other areas of the world is that the benefits and costs of irrigation projects depend on complementary water policies. Irrigation expansion and even irrigation efficiency programs can exacerbate water scarcity if appropriate water allocation rules and limits are not in place. Saskatchewan has an important opportunity to ensure its water policies contribute to the success of the project. GIWS conducted a preliminary assessment of a portion of the larger project and is well positioned to provide interdisciplinary, objective information on the hydrology, agronomy, and economics of irrigation in Saskatchewan

Climate change, adaptation, and water

Margot Hurlbert

Increasing aridity and drought, increasing intense precipitation resulting in floods and associated fires, invasive and endangered species. These are all issues that we're going to need to mitigate and adapt to. However, the most pressing issue is the ever-increasing impact of climate change. The problems associated with climate change are well documented and the groundwork of how specifically we are going to adapt to these impacts has been laid, but more work is needed (IPCC Working Group I report).

Adaptation to the impacts climate change needs to and is happening at levels. On the individual level as well as the community and regional level. Working with people surrounding adaptation and what future adaptation might look like is important to address this gap in climate change adaptation. Covid has made it all the more challenging to ensure community engagement in climate change adaptation. As community researchers, we have adapted to zoom and virtual research. Still, we are missing some of the most vulnerable people to climate change. Those who don't have access to internet services, or a stable internet, and zoom.



"Adaptation to the impacts climate change needs to and is happening at levels. On the individual level as well as the community and regional level."

Even with all the challenges, people are very engaged in learning about and considering how we both adapt to and mitigate climate change. There are great discussions happening surrounding these issues in our universities, communities, and governments. The number of organizations and people working on water issues is exciting. Anyone interested in learning more about water has so many opportunities to reach out and learn, help advance the conversation, and advance our resilience. It's very exciting to be part of this!





A staggering store of water is revealed in Earth's crust Grant Ferguson

More water lies within the Earth's continental crust than previously thought, according to new estimates published in Geophysical Research Letters. Work by Grant Ferguson and co-authors, an international and interdisciplinary group of scientists, indicates that the groundwater is the largest store of water in any form on the planet's continents, larger than ice sheets.

The paper builds on previous work that focused on water held in crystalline rock, the type that makes up the Precambrian shield and accounts for about 72 per cent of the continental crust, and other studies focusing on groundwater down to depths of 1 to 2 km. Ferguson considered the distribution of rock types and their porosity down to a depth of 10 km, the limit of Earth's brittle crust where groundwater flow is possible, to estimate of the total groundwater volume.

Their findings—that crustal groundwater is a larger reservoir than ice sheets—"has important implications in terms of how we think water has been moving around the planet for quite a long time," says Ferguson. It's known





that some of these waters at depths of several kilometres can be millions of years old or, in some cases, more thant a billion or more years old "so it rewrites how we think about how water cycles on our planet."

"so it rewrites how we think about how water cycles on our planet."

The examination of deep groundwater reservoirs has implications for a wide array of challenges: the search for life on Mars, better understanding the origins of life on Earth and extraction of lithium from waters for the use of electric batteries. Not only does it have implications on these many challenges but it may presents opportunities.

Having a more detailed understanding of the water stores forces provides a more realistic and clearer picture of our limited water supply. Which in turn gives us even greater incentive to building sustainable management of groundwater use by the energy and agricultural sectors, past and present.

what about water?

podcast | education films | outreach





PODCAST

LISTENS

60,763

ALL PLATFORMS

13 episodes



Mark Ferguson

and outreach initiative now known as What About Water. At the onset, back in 2019, GIWS had partnered with Let's Talk About Water and worked under that name for nearly two years. The idea to rebrand was something that everyone involved believed would benefit both the outreach potential, but also led to a tremendous rebranding exercise for the staff, such an important part of was coupled with an international forum. good communications.

What About Water? Now, that's the question we all will be asking as we continue to grow.

The initiative can be broken down into four core components: the podcast, films (both festival and Water is geared towards a more generally audience including students from ages 10-18, young academics, concerned citizens, even policy makers and fellow environmental organizations.

In 2021, the podcast gained a considerable audience and during the course of the season, What About Water with Jay Famiglietti regularly cracked the top 10 in the "Earth Sciences" category on popular podcast platforms (such as the Apple Store and Spotify). Guests includes some heavy hitters such as award-winning New York Times journalist Abrahm Lustgarten to talk to Jay about the emerging global climate migration crisis, and Dr. Chelsea Rochman from the University of Toronto who spilled the beans on just how serious plastic contamination in

2021 was a tremendous year for the GIWS-led education our water supply is. The podcast was also awarded the "Water's Next Award" for best education and outreach initiative by Water Canada.

> The 2021 Film Festival was enjoyed by thousands of people with monthly offerings on award-winning short and feature-length films such as Damnation - which

> The Youth Film Prize competition received submissions for over 50 countries and the winners came from all corners of the globe - making the second film prize even more successful than the first.

While the pandemic posed challenges (such as resorting competition), education, and outreach. What About to "virtual" theatres rather than having films shown in a real seated theatre), it did provide an opportunity for the What About Water team to figure out new ways of engaging and educating, and 2022 promises to be even better...

SOCIAL MEDIA FOLLOWERS lin 5 2263 458 1099 122

2,740,649 IMPRESSIONS (ALL PLATFORMS)

COMMUNITY FORUMS 60,000

ATTENDEES

176



70

NUMBER OF COUNTRIES SUBMITTING TO THE WATER FILM LISTENING TO THE PODCAST VISITING

56

24

The podcast won the Water's Next Award for Education and Outreach Programming by Water Canada and is ranked among the **Top 10 Earth Science** podcasts on the Apple Store, Google Play, Stitcher, and Spotify in its second season.

FILM PRIZE VIDEO VIEWS 75.000

WATER FILM PRIZE **250 SHORT FILM ENTRIES**

90 YOUTH PRIZE & 160 INTERNATIONAL FILM PRIZE



WATCHING FILMS ON THE VIRTUAL

THEATRE

92

PARTICIPATING IN THE COMMUNITY 100

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



GIWS YOUNG PROFESSIONALS CURRENT LEADERSHIP AND MANDATE



bridges between science & community (UK-GW4 Water Security Alliance PHD CON2020) and Science Communication (sparkscience.ca), were the remarks of the vear!

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 student body promotes social networking and community engagement as part of their mandate.

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. This year we held all our efforts virtually, and for example, Prof. Jeffrey McDonnell offered the webinar "Navigating an Academic Career" and opened dialogue spaces between young professionals and the participating guests in this year's Distinguished Lecture Series, seeking career advice and sharing



GIWS hosted the People Around the World (PAW 2021) conference and participated in the International Year of Plant Health and International Water Management Institute events. GIWS also held the Distinguished Lecture Series with 10 guests from different institutions and locations, to present the advancement in water related

GIWS Membership, Management & Research Support Staff

Membership

Abdelrasoul, Amira, Assistant Professor, Chemical & Biological Engineering

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Creed, Irena, Professor, nSchool of Environment & Sustainability

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de Boer, Dirk, Professor, Geography & Planning

28

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<u>Student Members</u>

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Chris DeBeer, Science Manager

Laura McFarlane, Outreach Coordinator

Jay Famiglietti, Executive Director

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