

Xander Huggins

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🔗 <https://xanderhuggins.github.io>

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Education

- PhD – University of Victoria, Canada** **2018-2024**
Department of Civil Engineering *MASc fast-track to PhD: 05/2020*
Supervisors: Tom Gleeson, James S. Famiglietti
Groundwater-connected systems: A social-ecological framing, global data-driven applications, and sustainability implications
Defended June 2024, external examiner P.A. Ty Ferré
- BEng – University of Guelph, Canada** **2013-2018**
Water Resources Engineering *with Distinction*, Co-operative stream

Professional experience

- Inst. for Resources, Environment, & Sustainability, UBC, Vancouver, Canada** **2024 -**
Postdoctoral Research Fellow, working with Mark Johnson
- High Meadows Environmental Institute, Princeton University, Princeton, USA** **2024 -**
Postdoctoral Research Associate, working with Simon Levin
- International Institute for Applied Systems Analysis, Vienna, Austria** **2023**
Researcher in the Water Security Research Group
- Stockholm Resilience Centre, Stockholm, Sweden** **2023**
Visiting PhD researcher, working with Juan Rocha and Lan Wang-Erlandsson
- International Institute for Applied Systems Analysis, Vienna, Austria** **2022**
Young Scientist Summer Program (PhD) Fellowship
- Global Institute for Water Security, Saskatoon, Canada** **2020 – 2023**
Graduate student member
- City of Hamilton, Hamilton, Canada** **2017**
Student Groundwater Technician
- City of Ottawa, Ottawa, Canada** **2016**
Water Resources Engineering Intern
- G360 Groundwater Research Institute, University of Guelph, Guelph, Canada** **2015**
Undergraduate student research assistant

Publications

12. Jaramillo, F. et al. [including **Huggins, X.**]. The potential of Hydrogeodesy to address water related problems and sustainability challenges. *In revision with [Water Resources Research](#)*.
11. **Huggins, X.**, Gleeson, T., Villholth, K.G., Rocha, J.C., Famiglietti, J.S. Groundwaterscapes: A global classification and mapping of groundwater's large scale socioeconomic, ecological, and Earth system functions. *In revision with [Water Resources Research](#)*. Preprint on EarthArXiv: <https://doi.org/10.31223/X5M382>
10. Rohde, M.M., Albano, C.M., **Huggins, X.**, et al. (2024). Groundwater-dependent ecosystem map exposes global dryland protection needs. *Nature*.

9. Curran, D., Gleeson, T., **Huggins, X.** (2023). Applying a science-forward approach to groundwater regulatory design. *Hydrogeology Journal* 31, 853-871.
8. Xu, L., Ferris, D., **Huggins, X.**, Wong, J.S., Mohan, C., Sadri, S., Chandanpurkar, H.A., Sanyal, P., Famiglietti, J.S. From coarse resolution to practical solution: GRACE as a science communication and policymaking tool for sustainable groundwater management. *Journal of Hydrology* 623, 129845.
7. **Huggins, X.** Gleeson, T., Castilla-Rho, J.C., Holley, C., Re, V., Famiglietti, J.S. (2023). Groundwater connections and sustainability in social-ecological systems. *Groundwater* 61(4), 463-478.
6. Curran, D., Gleeson, T., **Huggins, X.** (2023). Applying a science-forward approach to groundwater regulatory design. *Hydrogeology Journal* 31, 853-871.
5. **Huggins, X.**, Gleeson, T., Serrano, D., Zipper, S., Jehn, F., Rohde, M.M., Abell, R., Vigerstol, R., Hartmann, A. (2023). Overlooked risks and opportunities in watersheds of the world's protected areas. *Nature Sustainability* 6, 855-864.
4. Mohan, C., et al. [including **Huggins, X.**]. (2022) Poor correlation between large-scale environmental flow violations and freshwater biodiversity: implications for water resource management and the water planetary boundary. *Hydrology and Earth Systems Sciences*. 26, 6247–6262.
3. **Huggins, X.**, Gleeson, T., Kummu, M., Zipper, S.C., Troy, T.J., Wada, Y., Famiglietti, J. (2022). Hotspots for social and ecological impacts from freshwater stress and storage loss. *Nature Communications* 13, 439.
2. Diggle, R., Tait, D., Maher, D., **Huggins, X.**, Santos, I. (2019). The role of porewater exchange as a driver of CO₂ flux to the atmosphere in a temperate estuary (Squamish, Canada). *Environmental Earth Sciences* 78, 1-13.
1. **Huggins, X.** Gleeson, T., Eckstrand, H., Kerr, B. (2018). Streamflow Depletion Modeling: Methods for an Adaptable and Conjunctive Water Management Decision Support Tool. *Journal of the American Water Resources Association* 54, 1-15.

Manuscripts in preparation (titles are tentative)

1. **Huggins, X.**, Gleeson, T., & T. Froese. Embedding equity across an undergraduate civil engineering curriculum through environmental justice, sustainability science, and anti-racism modules and program-wide organization.
2. **Huggins, X.**, Gleeson, T., Moore, M.-L. & J.S. Famiglietti. Global groundwaterscape risks comprehensively map groundwater sustainability challenges.
3. **Huggins, X.**, et al. The open data landscape to study groundwater dynamics in social-ecological systems: A scoping collection and review of global datasets and an aspirational future outlook.
4. Pipponnen, J., **Huggins, X.**, et al. Biophysical and socioeconomic drivers of change in global grazing lands.
5. Kummu, M., **Huggins, X.**, et al. Humanscapes: Global, gridded socioeconomic data describe patterns across health, demographic, economic, equality, well-being, and governance dimensions.

Chapters and reports

2. **Huggins, X.** (2022). Global archetypes of groundwater interactions in social-ecological systems. IIASA Young Scientist Summer Program Fellowship Report. [Recipient of Mikhalevich Award.](#)
1. Gleeson, T., **Huggins, X.**, Connor, R., Arrojo-Agudo, P., Vázquez Suñé, E. (2022). Groundwater and Ecosystems, Chapter 6 of *UNESCO Water Development Report 2022: "Groundwater: Making the invisible visible"*.

Grants and scholarships (all values in CAD; total to date: \$431,500)

Canadian Space Agency Postdoctoral Supplement (\$20,000)	2024-2026
Awarded to 5 NSERC PDF award holder who are "involved in a promising research project that is aligned with and that will contribute to the priorities outlined in the Space Strategy for Canada".	
Killam Postdoctoral Research Fellowship (\$120,000) – <i>held in name only</i>	2024-2026
University of British Columbia Fellowship awarded to those "likely to contribute to the advancement of learning or to win distinction in a profession. A Killam scholar should not be a one-sided person... Special distinction of intellect should be founded upon sound character."	
Postdoctoral Fellowship (NSERC PDF) Award (\$140,000)	2024-2026
Natural Sciences and Engineering Research Council of Canada (NSERC) Funding provided to "a core of the most promising researchers".	
President's Research Scholarships (\$15,000, \$5,000/year awarded)	2021-2023
University of Victoria	
Alexander Graham Bell Canada Graduate Scholarship – Doctoral (\$105,000)	2021
Natural Sciences and Engineering Research Council of Canada (NSERC) Federal funding to reward and retain high-calibre doctoral students at Canadian institutions, and awarded through a national competition.	
Alexander Graham Bell Canada Graduate Scholarship – Masters (\$17,500)	2018
Natural Sciences and Engineering Research Council of Canada (NSERC) Master degree funding awarded to students demonstrating a high standard of achievement in undergraduate and early graduate studies.	
Professor Ross W. Irwin scholarship in Water Resources (\$1,000)	2018
University of Guelph Awarded for active involvement in water conservation issues and academic excellence.	
Raymond Theodore Guther Memorial Scholarship (\$2,000)	2018
University of Guelph Awarded for extra-curricular work in water conservation and water resources.	
Undergraduate Student Research Award (\$6,000)	2015
Natural Sciences and Engineering Research Council of Canada	

Awards and recognition

- Mikhalevich Award** (~\$8,000) **2023**
International Institute for Applied Systems Analysis
Awarded to best mathematically and methodologically oriented PhD fellowship report
- Outstanding Student Presentation Award** (\$250) **2019**
American Geophysical Union Fall Meeting
Awarded to top 5% of student presentations at the largest Earth science conference in the world

Conference presentations

11. **Huggins, X.**, Gleeson, T., Villholth, K.G., Rocha, J.C., Famiglietti, J.S. Global groundwater system archetypes: a data-driven typology of social, ecological, and Earth system interactions with groundwater at the global scale. *6th International Research Workshop on Archetypes in Sustainability Research*. Lund, Sweden. (*Oral*) **2023**
10. **Huggins, X.**, Gleeson, T., Villholth, K.G., Rocha, J., Famiglietti, J.S. Global groundwater archetypes: a new typology of groundwater interactions with social and ecological systems and an outlook for sustainable development. *EGU General Assembly*. Vienna, Austria. (*Highlighted oral*) **2023**
9. Xu, L., Famiglietti, J.S., Ferris, D., **Huggins, X.**, Mohan, C., Sadri, S., Sanyal, P. From coarse resolution to realistic resolution: GRACE as a science communication and policymaking tool for sustainable groundwater management. *EGU General Assembly*. Vienna, Austria. (*oral*) **2023**
8. **Huggins, X.**, Gleeson, T., Serrano, D., Zipper, S., Jehn, F., Rohde, M.M., Abell, R., Vigerstol, R., Hartmann, A. Overlooked risks and opportunities for global protected areas revealed by mapping groundwatersheds. *World Water Week*. Stockholm, Sweden. (*Solicited oral*) **2022**
7. **Huggins, X.**, Gleeson, T., Kummu, M., Zipper, S.C., Troy, T.J., Wada, Y., Famiglietti, J.S. Vulnerable basins for global prioritisation: Hotspots for social and ecological impacts from freshwater stress and freshwater storage loss. *EGU General Assembly*. Vienna, Austria. (*Invited oral*) **2022**
6. **Huggins, X.**, Gleeson, T., Castilla-Rho, J.C., Holley, C., Re, V., Famiglietti, J.S. (2022). Groundwater in complex adaptive social-ecological systems. Canadian Water Resources Association National Conference. Canmore, Canada. (*In-absentia poster*). **2022**
5. **Huggins, X.**, Gleeson, T., Famiglietti, J. (2021). An open-access interdisciplinary database to facilitate data science on cross-cutting global groundwater sustainability challenges. Delft International Conference on Sociohydrology. (*Oral, online*). Delft, the Netherlands **2021**
4. Gleeson, T., **Huggins, X.**, & T. Froese. Teaching human- and sustainability-centered design: A civil engineering design spine supported by sustainability muscles and a heart of anti-racism, equity, diversity, and inclusion. (*Pre-recorded oral*). Let's Talk About Teaching. **2021**
3. **Huggins, X.**, Gleeson, T., Kummu, M., Zipper, S.C., Troy, T.J., Wada, Y., Famiglietti, J. (2020). Sustainability hotspots of changing global freshwater availability. Invited lighting talk at the American Geophysical Union Fall Meeting. (*Invited oral, online*). San Francisco, USA. **2020**

2. **Huggins, X.**, Gleeson, T., Zipper, S.C., Troy, T.J., Wada, Y., Famiglietti, J.S. Human dimensions of changing global freshwater availability. *AGU Fall Annual Meeting*. San Francisco, CA. (Oral) [Awarded outstanding student presentation award](#). **2019**
1. **Huggins, X.**, Gleeson, T., Eckstrand, H., Kerr, B. Streamflow depletion modeling: Methods for an adaptable and conjunctive water management decision support tool. *Canadian Water Resources Association Annual Conference*. Victoria, Canada (Oral) **2018**

Conference sessions

Groundwater in the Anthropocene (upcoming). International Association of Hydrogeologists World Groundwater Congress. Davos, Switzerland. **2024**

Invited talks

International Groundwater Resources Assessment Centre, Delft, the Netherlands **2023**
Global groundwater-connected systems: Archetypes, datacubes, and a groundwater sustainability platform.

Geographisches Institut, Johannes Gutenberg University Mainz, Mainz, Germany **2023**
Seeing and studying groundwater through its connections.

Graduate Hydrogeology Course, Arizona State University, Tempe, USA **2023**
Groundwater sustainability in social-ecological systems: putting relationships and system interactions at the center of the discourse

Global Groundwater Group, The Nature Conservancy (online). **2022**
Overlooked risks and opportunities for global protected areas revealed by mapping groundwatersheds.

Water and Development Research Group, Aalto University, Espoo, Finland **2022**
Groundwater connected systems: A new approach for groundwater science and sustainability in social-ecological systems

Water Security Research Group, IIASA, Vienna, Austria and online **2022**
Groundwater-connected systems as complex adaptive social ecological systems

Water Research Roundup, POLIS Water Sustainability Project, Victoria, Canada **2022**
The global vulnerability of humans and ecosystems to insufficient freshwater availability

Curriculum development

Learn and teach green, people-centered civil engineering **2020-2022**

Department of Civil Engineering, University of Victoria.

A co-led initiative to integrate core sustainability science, environmental justice, environmental racism, and EDI concepts across the undergraduate civil engineering curriculum. I led the work of developing targeted curriculum for several courses, including lecture slides, in-class activities, and assignments. In total, the initiative provides >20 lecture decks, and 8 in-class breakout activities to teach how these core sustainability, environmental justice, and EDI concepts interrelate and relative to engineering design and professional engineering practice.

Example initiative resources:

1. **Huggins, X.**, and Gleeson, T. Sustainability Fundamentals for Groundwater Hydrologists (*Lecture slides*)

2. Gleeson, T., and **Huggins, X.** Groundwater Resources and Global Change. (*Lecture slides*)
3. Gleeson, T., Mohan, C., Okibe, S., Horoscoe, N., **Huggins, X.**, Ng, C., Jacoby, A. Environmental Justice Fundamentals for Groundwater Hydrologists. (*Lecture slides*)

Initiative webpage: <https://oac.uvic.ca/civelearningandteaching/>

Teaching assistant positions

Groundwater Hydrology (CIVE 445/545). University of Victoria.	2020, 2021
Hydrology and Hydraulics (CIVE 440/540). University of Victoria.	2020
Fluid Mechanics (CIVE 345). University of Victoria.	2019, 2020
Sustainable Water Resources (CIVE 340). University of Victoria.	2019
<i>Mean teaching assistant effectiveness score of 9.5/10 (n=47 student evaluations)</i>	

Guest lectures

Clustering techniques and hydrological applications. <u>Hydrology and Data Analysis (CIVE 580)</u> . University of Victoria.	2024
Open channel flow, routing, and flooding. <u>Sustainable Water Resources (CIVE 340)</u> . University of Victoria.	2023
Groundwater sustainability in social-ecological systems. <u>Groundwater Hydrology (CIVE 445/545)</u> . University of Victoria.	2023
Engineering for sustainability in a complex world. <u>Capstone Engineering Design (CIVE 400)</u> . University of Victoria.	2022
Open channel flow. <u>Hydrology and Hydraulics (CIVE 440)</u> . University of Victoria.	2019
Groundwater hydrology. <u>Sustainable Water Resources (CIVE 340)</u> . University of Victoria.	2019

Workshops

Environmental Data Science Summit. Participant. Santa Barbara, USA. (<i>in absentia</i>)	2/2024
Global water resilience collective fall workshop. Participant. Helsinki, Finland.	11/2023
Global water resilience mini-workshop. Participant. Stockholm, Sweden.	5/2023
Lakes, peatlands and wetlands: Functions and fate. Participant. Tovetorp, Sweden.	5/2023

Writing for a public audience

- Huggins, X. (November 2, 2022). Ripple effect: As global freshwater basins dry up, the threat to ecosystems and communities grows. *Conversation Canada*. ([Link](#))
- Huggins, X, T. Gleeson & J.S. Famiglietti. (April 29, 2020). Perspective: How does the coronavirus crisis compare to the global groundwater crisis? *Circle of Blue*. ([Link](#))

Media coverage

2023

- Why protected areas must consider what's beneath the surface. *TNC Science Brief*. ([Link](#))
- USask-led research: Majority of world's protected ecosystems vulnerable to groundwater degradation. *USask news*. ([Link](#))
- Groundwater and biodiversity: A new study reveals global gaps in the protection of nature reserves. *Smart Water Magazine*. ([Link](#))
- Exceptional young scientists awarded. *IASA news*. ([Link](#))

2022

- The US is losing some of its biggest freshwater reserves. *Popular Science*. ([Link](#))
- When we run out of water. *The Tyee*. ([Link](#))
- Global water basin hotspots prioritize areas under threat: USask research. *USask news*. ([Link](#))
- Global hotspots mapped out in new water study. *UVic news*. ([Link](#))

Science outreach

Water Day on the Hill	2020
Inaugural event to bring scientists from across Canada to meet with parliamentarians and senior federal officials to raise awareness around water security in Canada.	
Water availability stripes data visualization	2020
A science communication tool to bring awareness to recent trends in water availability in the major basins of the world. The initiative was based on and inspired by Ed Hawkins's global warming stripes data visualization. The water availability stripes have been accessed by tens of thousands of people online, and the initiative is archived here .	
waterunderground blog	2016-2021
Managing editor of the groundwater blog "waterunderground" which is hosted by both the European Geosciences Union and American Geophysical Union's respective blogospheres.	

Journal reviews

15 peer reviews for journals:	Groundwater Water Resources Research Journal of Hydrology Ecology and Society Geophysical Research Letters
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Abilities

Programming Languages:	R, Python, Bash
Software:	Visual MODFLOW, ArcGIS, QGIS, Affinity Designer, Inkscape
Languages:	English (<i>native</i>), French (<i>intermediate</i>)

Open science

GitHub Repositories

Code for: Hotspots for social and ecological impacts from freshwater stress and storage loss. [\[GitHub link\]](#)

Code for: Overlooked risks and opportunities in groundwatersheds of the world's protected areas. [\[GitHub link\]](#)

Code for: Global groundwater system archetypes. [\[GitHub link\]](#)

Data depositions:

Data from: Hotspots for social and ecological impacts from freshwater stress and storage loss. Borealis. <https://doi.org/10.5683/SP3/SLR3GF>

Data from: Overlooked risks and opportunities in Groundwatersheds of the world's protected areas. Borealis. <https://doi.org/10.5683/SP3/P3OU3A>

Preprints (associated paper)

Huggins et al. 2020. [\[link\]](#) (#3)
Huggins et al. 2022a. [\[link\]](#) (#5)
Huggins et al. 2022b. [\[link\]](#) (#7)
Huggins et al. 2023. [\[link\]](#) (#10)