

Christopher Marsh

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chrismarsh.ca

Interests

Cryosphere-hydrology, numerical modelling, field work, programming, high-performance computing, the outdoors

Education

2012–2019

Ph.D. in Physical Geography

University of Saskatchewan, Saskatoon, SK

Supervisors: Dr. John Pomeroy, Dr. Howard Wheeler

Multi-Scale Modelling of Cold Regions Hydrology

2009–2012

M.Sc. Physical Geography

University of Saskatchewan, Saskatoon, SK

Supervisors: Dr. John Pomeroy, Dr. Raymond Spiteri

Implication Of Mountain Shading And Topographic Scaling On Energy For Snowmelt

2005–2009

B.Sc. Honours Physical Geography, Minors: Math and Comp. Sci.

University of Saskatchewan, Saskatoon, SK

High Resolution Radiation Modelling In Complex Terrain

Awards & Grants

2021	STIC SREDA finalist Saskatoon Regional Economic Development Authority
2020	Graduate Thesis Award for PhD University of Saskatchewan
2016	AGU Flash Freeze competition American Geophysical Union
2016	AGU Outstanding Student Paper Award in Cryosphere American Geophysical Union, student presentation
2014–2016	NSERC Alexander Graham Bell Natural Sciences and Engineering Research Council of Canada (NSERC)
2014	CGU Stan Patterson award in Glaciology Canadian Geophysical Union
2014	Saskatchewan Innovation and Opportunity University of Saskatchewan and Gov. Saskatchewan research in a signature area
2013	J.H. Richards Graduate Award University of Saskatchewan, highest average
2012	AGU Outstanding Student Paper Award in Cryosphere American Geophysical Union, student presentation
2011	D.M. Gray Hydrology Award CGU-HS, top student paper and presentation
2009–2012	Graduate Student Scholarship University of Saskatchewan, academic performance
2009	Canadian Association of Geographers Most distinguished geography undergraduate
2008	Honours scholarship University of Saskatchewan, academic performance

Research Experience

- 2019–present **Postdoctoral Fellow**
Development of the Canadian Hydrological Model (CHM) to meet the needs to the next-generation hydrological modelling group with Global Water Futures.
University of Saskatchewan
- 2012–2019 **Research assistant**
Coordinated purchases, configuration, and on-going support of the shared workstations used for numerical simulations
Center for Hydrology, University of Saskatchewan
- 2012–2019 **Field work for PhD.**
Canmore, AB; Whitehorse, YK
Snow surveys, meteorological site maintenance, ground control of historical sites
- 2012 **CRHM Tools developer**
Supervisor: John Pomeroy
Lead developer on the Cold Regions Hydrological Model (CRHM) Tools project at the University of Saskatchewan
- 2009–2012 **Field work for M.Sc.**
Canmore, AB
Installing radiometers and time lapse cameras, snow surveys, and meteorological site maintenance
- 2009 **MITACS summer employment with Environment Canada**
Supervisor: Bruce Davison and Raymond Spiteri
Improved MESH efficiency via parallelization and code optimization
- 2008 **Modelling with the Cold Regions Hydrological Model (CRHM) for work in ungauged basins**
Supervisor: John Pomeroy
- Spring 2008 **International Polar Year**
Inuvik, NWT
Field assistant for instrument installation (water level recorders, snow surveys, vegetation surveys, and surveying (Total Station))
- Spring 2006 **NHRC, Environment Canada**
Inuvik, NWT
Field assistant for instrument installation of water level recorders and surveying

Teaching experience

2022	Lecturer Geography 825, University of Saskatchewan Delivered lecture on hydrological modelling and high performance computing paradigms
2021	Lecturer Computer Science 851, University of Saskatchewan Delivered lecture on high performance computing for research code
2016–2019	Lecturer Geography 290, University of Saskatchewan Delivered lectures for two weeks on remote sensing and GIS. Prepared material and taught the associated labs, as well as providing 1-on-1 teaching
2016	Teaching assistant Geography 225, University of Saskatchewan 2nd year general hydrological course. Lead labs and provided 1-on-1 teaching
2016	Teaching assistant Geography 290, University of Saskatchewan 2nd year introduction to field methods. Assisted in the field with students
2014	Teaching assistant Geography 225, University of Saskatchewan 2nd year general hydrological course. Lead labs and provided 1-on-1 teaching

Other Experience

2006–2009	Salesperson and customer service Saskatoon, SK Boomtown Outfitters
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Scientific service

2016–2017	Young Hydrologic Society (YHS) Canada branch Chair and founding member
2021–present	CRYOLIST.org Owner and manager of the listserv
2010–2021	CRYOLIST.org Co-manager of the listserv
2012–2018	Global Institute for Water Security (GIWS) student group Founding member and committee member University of Saskatchewan

Peer review

- Atmosphere-Ocean
- Computers and Geoscience
- The Cryosphere
- Journal of Hydrology
- Water Resources Research (WRR)
- Geoscientific Model Development (GMD)
- Hydrology and Earth System Sciences (HESS)
- Journal of Glaciology
- Big Earth Data
- Environmental Processes
- Hydrological Processes

Skills

Languages

- Native English
- French immersion (Grade 12)

Technical skills

- Programming: C, C++, R, Matlab, Python, OpenMP, MPI, git
- GIS: ArcGIS, SAGA GIS, QGIS, GDAL
- Office: MS Office, Photoshop, L^AT_EX
- OS: Linux (Fedora, Ubuntu), Windows, MacOS

Field work

- Dataloggers
- Site maintenance
- Meteorological site installation
- Snow surveys

Instruction

- CRCA Canoe Moving Water Level 1 and 2
- CRCA Canoe Moving Water 1 Instructors
- CSIA Downhill Skiing Level 1 Instructors

Safety

- Rescue 3 International SwiftWater Rescue Technician Unit 1
- OHS Standard Level First Aid and CPR Level C
- Over 20 years of extensive remote outdoor experience such as wilderness camping and canoeing

Publications

Peer-reviewed journal

- Knoben, W. J. M., M. P. Clark, J. Bales, A. Bennett, S. Gharari, **Marsh, C. B.**, B. Nijssen, A. Pietroniro, R. J. Spiteri, G. Tang, D. G. Tarboton, and A. W. Wood (2022), Community Workflows to Advance Reproducibility in Hydrologic Modeling: Separating Model-Agnostic and Model-Specific Configuration Steps in Applications of Large-Domain Hydrologic Models, *Water Resources Research* 58(11), DOI: 10.1029/2021wr031753.
- Pomeroy, J.W., T. Brown, X. Fang, K.R. Shook, D. Pradhananga, R. Armstrong, P. Harder, **Marsh, C. B.**, D. Costa, S.A. Krogh, C. Aubry-Wake, H. Annand, P. Lawford, Z. He, M. Kompanizare, and J.I. Lopez Moreno (2022), The cold regions hydrological modelling platform for hydrological diagnosis and prediction based on process understanding, *Journal of Hydrology* 615(Hydrology and Earth System Science 26 21 2022), p. 128711, DOI: 10.1016/j.jhydro1.2022.128711.
- Marsh, C.B.**, K. R. Green, B. Wang, and R. J. Spiteri (2021a), Performance improvements to modern hydrological models via lookup table optimizations, *Environmental Modelling & Software*, p. 105018, DOI: 10.1016/j.envsoft.2021.105018.
- Vionnet, V., **Marsh, C.B.**, B. Menounos, S. Gascoin, N.E. Wayand, J. Shea, K. Mukherjee, and J.W. Pomeroy (2021), Multi-scale snowdrift-permitting modelling of mountain snowpack, *The Cryosphere* 15, pp. 743–769, DOI: 10.5194/tc-15-743-2021.
- Leroux, N.R., **Marsh, C.B.**, and J.W. Pomeroy (2020), Simulation of Preferential Flow in Snow with a 2D Non-Equilibrium Richards Model and Evaluation against Laboratory Data, *Water Resources Research* 56.
- Marsh, C.B.**, J.W. Pomeroy, R.J. Spiteri, and H.S. Wheeler (2020a), A Finite Volume Blowing Snow Model for Use With Variable Resolution Meshes, *Water Resources Research* 56(2), DOI: 10.1029/2019wr025307.
- Marsh, C.B.**, J.W. Pomeroy, and H.S. Wheeler (2020), The Canadian Hydrological Model (CHM) v1.0: a multi-scale, multi-extent, variable-complexity hydrological model – design and overview, *Geoscientific Model Development* 13(1), pp. 225–247, DOI: 10.5194/gmd-13-225-2020.
- Marsh, C.B.**, R.J. Spiteri, J.W. Pomeroy, and H.S. Wheeler (2018), Multi-objective unstructured triangular mesh generation for use in hydrological and land surface models, *Computers & Geosciences* 119, pp. 49–67, DOI: 10.1016/j.cageo.2018.06.009.
- Wayand, N.E., **Marsh, C.B.**, J.M. Shea, and J.W. Pomeroy (2018), Globally scalable alpine snow metrics, *Remote Sensing of Environment* 213, pp. 61–72, DOI: 10.1016/j.rse.2018.05.012.
- Marsh, C.B.**, J.W. Pomeroy, and R.J. Spiteri (2012b), Implications of mountain shading on calculating energy for snowmelt using unstructured triangular meshes, *Hydrological Processes* 26(12), pp. 1767–1778, DOI: 10.1002/hyp.9329, URL: <http://doi.wiley.com/10.1002/hyp.9329>.

Conferences (Oral presentation)

- Marsh, C.B.**, Kevin Green, Raymond J. Spiteri, Zhibang Lv, Vincent Vionnet, and John W. Pomeroy (2022a), New developments in the Canadian Hydrological Model (CHM) and large-extent simulations, International Network for Alpine Research Catchment Hydrology (INARCH; October 18–20; Baños de Panticosa, Spain).
- Marsh, C.B.**, Vincent Vionnet, Kevin Green, Raymond J. Spiteri, Zhibang Lv, and John W. Pomeroy (2022b), SnowCast: Daily forecasts of mountain snowpack using a snowdrift-permitting model, Canadian Water Resources Association (CWRA); June 5-8; Canmore, Alberta, Canada).
- Marsh, C.B.**, Vincent Vionnet, Kevin Green, Raymond J. Spiteri, Martyn P. Clark, and John W. Pomeroy (2021b), Development of the Canadian Hydrological Model (CHM) for multi-scale snow simulations, International Network for Alpine Research Catchment Hydrology (INARCH; October 18–20; Online).
- Marsh, C.B.**, V. Vionnet, K. Green, R. Spiteri, N. Wayand, H. Wheeler, and J.W. Pomeroy (2019a), Multiscale snow hydrology modelling, IUGG-CGU (invited speaker); July 8-18; Montreal, Quebec, Canada.
- (2019b), Segment 5 intervention for: Diagnostic, coupled atmospheric-cryospheric-hydrological models operating at “snowdrift resolving scales” are needed in mountains in order to resolve the processes forming avalanches, glaciers and snow patches that control mountain streamflow generation, cryospheric features and hazards. WMO High Mountain Summit (invited speaker); Oct 29-31; Geneva, Switzerland.

- Marsh, C.B.** (2017), Simulating Complex, Cold-region Process Interactions Using a Multi-scale, Variable-complexity Hydrological Model (OSPA Invited), AGU; Dec 11-15; New Orleans, LA, USA.
- Marsh, C.B.**, J.W. Pomeroy, H. Wheeler, N. Wayand, and R. Spiteri (2017a), Simulating blowing snow with the Canadian Hydrological Model, AGU; Dec 11-15; New Orleans, LA, USA.
- (2017b), Simulating steady-state blowing snow with the Canadian Hydrological Model, CGU-HS; May 29-31; Vancouver, BC, Canada.
- Marsh, C.B.**, N. Wayand, R. Spiteri, J.W. Pomeroy, and H. Wheeler (2017c), Towards Large-Scale Simulations in the Yukon with the Canadian Hydrological Model, Wolf Creek Research Basin 25th Anniversary Science Summit; September 28-29; Whitehorse, Yukon, Canada.
- Marsh, C.B.**, J.W. Pomeroy, and H. Wheeler (2016), Testing warranted model complexity using a multi-scale, variable-complexity hydrological model, CGU-HS; May 29-June 2; Fredericton, NB, Canada.
- Marsh, C.B.**, N. Wayand, J.W. Pomeroy, and H. Wheeler (2016a), The Canadian Hydrological Model: a Multiscale, Multiphysics, Variable Resolution Mesh Simulation System for Cold Regions, AGU; Dec 12-16; San Francisco, CA, USA.
- (2016b), The Canadian Hydrological Model: a Multiscale, Multiphysics, Variable Resolution Mesh Simulation System for Cold Regions, AGU Flash Freeze; Dec 12-16; San Francisco, CA, USA.
- Marsh, C.B.**, J.W. Pomeroy, and H. Wheeler (2015), Robustness in the spring surface energy balance in a mountain basin, CGU-HS; May 3-7; Montreal, QC, Canada.
- (2014), Impacts of spatial scaling of unstructured meshes on calculating surface irradiance, CGU-HS; May 4-8; Banff, AB, Canada.
- Marsh, C.B.**, J.W. Pomeroy, R.J. Spiteri, D. Marks, M. Hayashi, S. Munro, M. Demuth, and H. Wheeler (2013), Impacts of spatial scaling of unstructured meshes on calculating surface irradiance, CGU-HS; May 27-30; Saskatoon, SK, Canada.
- Marsh, C.B.**, J.W. Pomeroy, and R.J. Spiteri (2012a), Implication of mountain shading and topographic scaling on energy for snowmelt, AGU Dec 3-7 (invited speaker); San. Francisco, Calif. , USA.
- (2011a), Implication of mountain shading and topographic scaling on energy for snowmelt, CGU-HS student conference Jan 29; Calgary, Alberta, Canada.
- (2011b), Implication of mountain shading and topographic scaling on energy for snowmelt, CGU-HS May 15-18; Banff, Alberta, Canada.

Conference session convenor

- 419 - Emphasizing F, I, and R in FAIR Hydrology: Bottlenecks and Solutions to Making Hydrologic Science More Reproducible | Hybrid Panel (2022), Frontiers in Hydrology Meeting 2022; June 19-24 2022; San Juan, Puerto Rico + Online.
- Cold regions hydrology (2021a), Canadian Geophysical Union (CGU); June 24th; Online.
- Observation and modelling of snow processes: integrating legacy and new tools to advance snow science (2021b), Canadian Geophysical Union (CGU); 1-3 June 2022 and 6-8 June 2022.; Online.
- IN016 - A Call to Action for FAIR, Reproducible, and Transparent Science: Analytical Code, Workflows, Services, Models, and Conclusions eLightning (2020), American Geophysical Union (AGU); Online.
- Canadian Geophysical Union Hydrology Section (CGU-HS) student conference (2012), University of Saskatchewan, Saskatoon, Canada.

Conferences (Posters)

- Marsh, C.B.**, Vincent Vionnet, Kevin Green, Raymond J. Spiteri, and John W. Pomeroy (2021c), Daily forecasts of mountain snowpack using a snowdrift-permitting model, Eastern Snow Conference; 9 June; Online.
- Marsh, C.B.**, Vincent Vionnet, Kevin Green, Raymond J. Spiteri, Brian Menounos, and John W. Pomeroy (2020b), Multi-objective unstructured meshes for improved mountain snow hydrology with the Canadian Hydrological Model (CHM), AGU Dec 1-17 2020; San Francisco, California, USA.

Marsh, C.B. and J.W. Pomeroy (2018), PBSM3D: A complex terrain blowing snow model for use with variable resolution meshes, International Network for Alpine Research Catchment Hydrology (INARCH) February 8-9; Environmental Research Station Schneefernerhaus, Germany.

Headstrom, N., R. Granger, S. Miller, M. Marsh, and **Marsh, C.B.** (2013), Effect of Buoy Motion on Eddy Flux Measurements over Lakes, CGU-HS May 27-30; Saskatoon, SK, Canada.

Marsh, C.B. and J.W. Pomeroy (2013), Automated Hydrological Response Unit create for use with CRHM, CGU-HS May 27-30; Saskatoon, SK, Canada.

Marsh, C.B., J.W. Pomeroy, and R.J. Spiteri (2011c), Implication of mountain shading and topographic scaling on energy for snowmelt, CGU-HS Student conference, Jan 29; Calgary, Alberta, Canada.

Marsh, P., S. Endrizzi, C. Derksen, M. Russell, C. Onclin, H. Wilson, J. Pomeroy, and **Marsh, C.B.** (2010), Factors controlling the spatial variability in end of winter snowcover and spring melt at an arctic tundra site, AGU Dec 13-17; San Francisco, California, USA.

Marsh, C.B., R.J. Spiteri, and B. Davison (2009a), Improved MESH efficiency via parallelization and code optimization, P3/WC2N Annual conference, Oct 14-17; Lake Louise, Alberta, Canada.

Marsh, C.B., S. Pohl, and G.E. Liston (2007), Impact of increased shrub density on snow accumulation and melt in the Arctic tundra, IUGG; Perugia, Italy.

Thesis

Marsh, C.B. (2019), Multi-Scale Modelling of Cold Regions Hydrology, Ph.D, University of Saskatchewan.

– (2012), Implications of mountain shading on calculating energy for snowmelt using unstructured triangular meshes, M.Sc. University of Saskatchewan.

Technical report

Marsh, C.B., R.J. Spiteri, and B. Davison (2009b), Improved MESH efficiency via parallelization and code optimization, tech. rep., Department of Computer Science, The University of Saskatchewan, URL: <http://www.cs.usask.ca/content/researchinfo/techreports/2009/TR-2009-02.pdf>.