
Academic CV, Shawn J. Marshall

Shawn Marshall

b. December 5, 1967

Department of Geography, University of Calgary

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Education

B.A.Sc. (Honours), Engineering Science (Physics), University of Toronto, 1991.

Ph.D., Geophysics, University of British Columbia, 1996.

Academic Appointments

Professor, Department of Geography, University of Calgary, 2009-present

Associate Professor, Department of Geography, University of Calgary, 2003-2009

Assistant Professor, Department of Geography, University of Calgary, 2000-2003

Canada Research Chair in Climate Change (Tier II), University of Calgary, 2007-2017

Fellow, Institute for Sustainable Energy, Environment and Economy, Univ. Calgary, 2007-2012

Departmental Science Advisor, Environment and Climate Change Canada, 2019-2023

Adjunct Research Professor, Carleton University, Ottawa, 2018-2023

Fellow, Canadian Institute for Advanced Research Earth System Evolution Program, 2001-2015

Visiting Scientist, Institut des Sciences de l'Environnement, Université de Genève, 2013-2014

Visiting Scientist, Department of Earth and Atmospheric Sciences, UQAM, 2006-2007

Postdoctoral Research Associate, Department of Earth and Ocean Sciences, UBC, 1997-1999

Honours

2014,2004 University of Calgary distinguished research award

2011 University of Calgary Undergraduate Student Society teaching award

2009 Fellow, Royal Canadian Geographical Society

2006-2008 W. Garfield Weston Foundation Fellow, Canadian Institute for Advanced Research

2005 Young Scientist Award of the Canadian Geophysical Union

2004 Invited Delegate, "Leaders of Tomorrow" Symposium of the Partnership Group for Science and Engineering Research in Canada (PAGSE), November 2, 2004, Ottawa

2001-2015 Scholar (2001-2005), Associate (2005-2010), and Fellow (2010-2015), Canadian Institute for Advanced Research (CIFAR) Earth System Evolution Program

1999 U.S. National Oceanic and Atmospheric Administration (NOAA) Postdoctoral Fellowship, NOAA Global Climate Change Program, 1999

1998-1999 NSERC Postdoctoral Fellowship, Earth and Ocean Sciences, UBC

1997 NSERC national doctoral thesis prize

1997 Governor General's Gold Medal for highest standing among UBC doctoral graduates

1989-1991 University of Toronto Varsity award, combined athletic and academic performance

Leadership Experience

External Governance Boards

- Chair, Board of Governors, The Rockies Institute (rockiesinstitute.com), Canmore, AB, 2015-2021.
Oversee strategic planning and provide scientific guidance to non-profit organization working with community-based climate change impact and adaptation initiatives.
- Science Steering Committee, U.S. National Center for Atmospheric Research (NCAR) Community Earth System Model, Boulder CO, 2014-2018. Provide input on strategic directions and priorities for the global climate model development at NCAR.
- Board of Directors, Arctic Institute of North America (AINA), Calgary AB, 2008-2016.
Provide guidance to AINA Executive Director on strategic directions, budget, and management. AINA is an Institute within the University of Calgary, but also exists as a federally established non-profit organization, with an independent governance board.
- Interim Executive Director, Arctic Institute of North America, 2011, 2013.
- Associate Director, Arctic Institute of North America (AINA), 2016-2018.
Assist the Executive Director with AINA governance and research initiatives.

University of Calgary

- Member, Interdisciplinary 'SUPPORT' Committee on research chairs and strategic priorities, University of Calgary, 2013-2018. Committee Chair in 2016.
- Graduate Program Director, Geography, University of Calgary, 2008-2010.
Oversaw admission, management, and success of ca. 80 graduate students in the program.

International Scientific Community

- Canadian representative, International Arctic Science Committee (IASC) Cryosphere Working Group, 2016-2021.
- Science Leadership Council, Mountain Research Initiative, Bern, Switzerland, 2000-2022.
- Vice Chair, World Meteorological Organization Cryosphere Study Group, 2020-2022.
- Committee Member, Canadian Science Policy Conference, 2018-2020.
- National Academy of Sciences Panel on Advancing Climate Modeling, Washington DC, 2011-2012.
- Invited contributor, Intergovernmental Panel on Climate Change (IPCC) Workshop on Ice Sheet Contributions to Sea Level Rise, Kuala Lumpur, Malaysia, 2010.
- Lead author, Arctic Council Assessment Report, *The Greenland Ice Sheet in a Changing Climate*, Copenhagen, Denmark, 2007-2009.
- Committee member and contributing author, U.S. Climate Change Science Program Assessment Report on Abrupt Climate Change, Washington D.C., 2007-2008.
- Council Member, International Glaciological Society, 2003-2005.
- Executive Committee, American Geophysical Union (AGU) Cryosphere Section, 2002-2004.
- Chair, American Geophysical Union Snow, Ice, and Permafrost Committee, 2000-2002.
- Member, American Geophysical Union Snow, Ice, and Permafrost Committee, 1998-2000.
- Organizing Committee, AGU Fall Scientific Meeting, San Francisco CA, 2001-2002.

Editorial Appointments

Editor, *Journal of Climate*, 2019-present

Associate Editor, *Canadian Water Resources Journal*, 2012-2019.

Editor, Earth Systems and Environmental Science Reference, Elsevier Press, 2012-2018.

Associate Editor, *The Cryosphere*, 2008-2012.

Associate Editor, *Geophysical Research Letters*, 2004-2006.

Guest Editor, *Annals of Glaciology* special volume on Fast Glacier Flow, 2002.

Guest Editor, *Quaternary International* special volume on Ice Age Inception, 2001.

Review Panels

Review Panel, Earth Sciences, Compute Canada Resource Allocation Committee, 2013-2019.

Committee Member, NSERC Discovery Grant Evaluation Group, Earth Sciences, 2014-2017.

Interdisciplinary Adjudication Committee (IAC), Canada Research Chairs Program, 2013-2017.

Served as IAC Chair, 2017.

Panel Member, NASA Cryosphere Program Review Committee, 2016.

Committee Member, NSERC PGS/PDF Earth Sciences and Ecology Group, 2011-2013.

Grant Reviews for NERC (UK) and the U.S., Austrian, Swiss, Argentinian, and Netherlands National Science Foundations, 2012-2021.

Science Steering Committee, Canadian Polar Continental Shelf Project (PCSP), 2003-2007.

Research Summary

My research group studies glaciers, ice sheets, and ice-climate interactions. How are glaciers and ice sheets responding to climate change, and how quickly will global sea level rise in the coming decades? What are the implications of glacier retreat for regional water resources? How did glaciers interact with the global climate system to give periods of large-scale glaciation in Earth history (i.e. Ice Ages), and what can this tell us about climate system sensitivity and feedbacks? Can we understand these processes and include them in climate models? I examine these questions through field and modelling studies in western Canada, Iceland, the Canadian Arctic, and Greenland. Fieldwork is focused on meteorological conditions and glacier-climate processes and in alpine and polar environments, to inform models of glacier energy and mass balance. This research is relevant to water resource management, climate change impact studies, and to inform mitigation and adaptation strategies in response to climate change and global sea level rise.

Significant Contributions to Research

Modelling Ice Sheet Dynamics. Doctoral and postdoctoral research at UBC centred on the development of a three-dimensional numerical model of ice sheet dynamics. The model is a tool for study of continental ice sheets and ice-climate interactions, which has been used by climate research groups at several institutions (e.g., the University of Victoria, Alberta, McGill, UQAM). This work has facilitated numerous international collaborations, including NSF subcontracts with Oregon State University and the University of California-Berkeley and collaborations with the University of Iceland and the U.S. National Center for Atmospheric Research.

Ice Age Climate Dynamics. I study several aspects of ice age climate dynamics, including the climatic and glaciological patterns of ice sheet nucleation and deglaciation, reconstruction of the Last Glacial Maximum ice sheets in North America, and the role of ice sheets in millennial climate variability. These studies contribute to understanding of the role of ice sheets in the climate system. These papers present a model of ice sheet dynamics and continental surface hydrology during the last glacial cycle. Freshwater runoff impacts ocean stratification and North Atlantic thermohaline circulation, which was erratic during the glaciation. The modelled runoff patterns provide insight into the nature of millennial-scale climate instability, ice sheet-climate interactions and Earth's natural climate variability.

Sea Level Change. Sea level rise is well-documented in recent years, and the amount of sea level rise being caused by glacier melt is a pressing question in for climate science and society. The Greenland Ice Sheet harbours a volume of water equivalent to 7 m of global sea level, enough to wreak havoc on coastal regions should the ice melt back over the next several centuries. To investigate Greenland's sensitivity to increased warmth, Kurt Cuffey (UC-Berkeley) and I examined ice sheet retreat in Greenland during the last interglacial period. Our predictions that the Greenland Ice Sheet caused up to 5 m of sea-level rise during the last interglacial period received global attention, spurring ongoing follow-up work and triggering my involvement in international climate change assessments for the U.S. Climate Change Assessment Program, the Arctic Council, and the IPCC (AR5). I have also served as a consultant on sea level rise with the U.S. Navy and the Government of Singapore.

Glacier-Climate Processes. My main current research objective is the development of improved models of regional-scale icefield dynamics and their sensitivity to climate change. This requires statistical methodologies for terrain characterization and downscaling of climate fields in mountain and polar regions, where weather observations are scarce and the topography is poorly represented in most climate models. This guides my group's field studies of glacier mass balance processes and mesoscale climate variability in western Canada and the Arctic. Our fieldwork is designed to improve climate downscaling strategies. As an example, work on Ellesmere Island has elucidated the seasonal and synoptic variability of surface temperature lapse rates in the Canadian high Arctic, with important implications for modelling of snow/ice melt.

Peer-Reviewed Publications (students and postdoctoral researchers underlined).

Google Scholar Citations: 7686; H-index 39; i10 index 76 [July 2021]

Submitted

Criscitello, A.S., T. Geldsetzer, R. Rhodes, M. Arienzo, J. McConnell, N. Chellman, M.S. Osman, J.J. Yackel and S.J. Marshall, submitted. Marine aerosol records of Arctic sea-ice and polynya variability from new Ellesmere and Devon Island firn cores, Nunavut, Canada. Submitted to *Journal of Geophysical Research – Earth Surface*.

Marshall, S.J. Regime shifts in glacier and ice sheet response to climate change. Submitted to *Frontiers in Climate*, April 2021.

Marshall, S.J. and R. Nath, in revision. Flowband modelling of fluctuations of Athabasca Glacier, Canadian Rocky Mountains, over the last millennium. *Journal of Glaciology*.

Samimi, S., S.J. Marshall, M. MacFerrin and B. Vandecrux. Time-domain reflectometry measurements and modelling of firn meltwater infiltration at DYE-2, Greenland. Manuscript 2021JF006295, submitted to *Journal of Geophysical Research – Earth Surface*, June 2021.

- [1] Buxton, R. et al., 2021. Key information needs to move from knowledge to action for biodiversity conservation in Canada. *Biological Conservation*, 253, 108983, <https://doi.org/10.1016/j.biocon.2021.108983>. This collaboration distills the conclusions from a national workshop on information needs for biodiversity conservation.
- [2] DeBeer, C. et al., 2021. Summary and synthesis of Changing Cold Regions Network (CCRN) research in the interior of western Canada – Part 2: Future change in cryosphere, vegetation, and hydrology. *Hydrology and Earth Systems Science*, 25, 1849-1882, <https://doi.org/10.5194/hess-25-1849-2021>. I am a co-author on this paper through my contributions as a CCRN co-I.
- [3] Ochwat, N.E., S.J. Marshall, B.J. Moorman, A.S. Criscitiello and L. Copland, 2021. Evolution of the firn pack of Kaskawulsh Glacier, Yukon: meltwater effects, densification, and the development of a perennial firn aquifer. *The Cryosphere*, 15 (4), 2021-2040, <https://doi.org/10.5194/tc-15-2021-2021>.
- [4] Adler, C. et al., 2020. Making connections for our changing mountains: future directions for the Mountain Research Initiative (MRI). *Mountain Research and Development*, 40 (3), 1-6, <https://bioone.org/doi/10.1659/MRD-JOURNAL-D-20-00045.1>. I am an author on this paper as part of my contribution to the MRI Science Leadership Council.
- [5] Marshall, S.J. and K. Miller, 2020. Seasonal and interannual variability in melt-season albedo at Haig Glacier, Canadian Rocky Mountains. *The Cryosphere*, 14, 3249-3267, <https://doi.org/10.5194/tc-14-3249-2020>.
- [6] Samimi, S., S.J. Marshall and M. MacFerrin, 2020. Meltwater penetration through temperate ice layers in the percolation zone at DYE-2, Greenland Ice Sheet. *Geophysical Research Letters*, 47 (15), e2020GL089211, <https://doi.org/10.1029/2020GL089211>.
- [7] Vandecrux, B. and 22 others, 2020. The firn meltwater Retention Model Intercomparison Project (RetMIP): Evaluation of nine firn models at four weather station sites on the Greenland ice sheet. *The Cryosphere*, 14, 3785-3810, <https://doi.org/10.5194/tc-14-3785-2020>. PhD student S. Samimi and I are co-authors on this collaborative international research effort.
- [8] Foroutan, M., S.J. Marshall and B. Menounos, 2019. Automatic mapping and geomorphometry extraction technique for crevasses in geodetic mass balance calculations at Haig Glacier, Canadian Rockies. *Journal of Glaciology*, 65 (254), 971-982.
- [9] Pelto, B.M., B. Menounos and S.J. Marshall, 2019. Multi-year evaluation of airborne geodetic surveys to estimate seasonal mass balance, Columbia and Rocky Mountains, Canada. *The Cryosphere*, 13, 1709-1727, <https://doi.org/10.5194/tc-13-1709-2019>.
- [10] Laskin, D.N., G.J. McDermid, S.E. Nielsen, S.J. Marshall, D.R. Roberts and A. Montaghi, 2019. Advances in phenology are conserved across scale in present and future climates, *Nature Climate Change*, 9, 419-425, doi:10.1038.s41558-019-0454-4.
- [11] Marshall, S.J., 2019. Sea Ice; Glaciers and Ice Sheets; Palaeoclimate; Sea Level. Entries in *30-Second Climate* (J.D. Haigh, Ed.), Ivy Press, Brighton, U.K., pp. 62-65, 106-107, 122-123.

- [12] Perroud, M., M. Fasel and S.J. Marshall, 2019. Development and testing of a subgrid glacier mass balance model for nesting in the Canadian Regional Climate Model. *Climate Dynamics*, 53 (3-4), 1453-1476, <https://doi.org/10.1007/s00382-019-04676-6>.
- [13] Roberts, D.R., W.H. Wood and S.J. Marshall, 2019. Assessments of downscaled climate data with a high-resolution weather station network reveal consistent but predictable bias. *International Journal of Climatology*, 39 (6), 3091-3103, doi: 10.1002/joc.6005.
- [14] Wood, W.H., S.J. Marshall, and S.E. Fargey, 2019. Daily measurements of near-surface humidity from a mesonet in the foothills of the Canadian Rocky Mountains, 2005-2010. *Earth System Science Data*, 11, 23-34, <https://doi.org/10.5194/essd-11-23-2019>.
- [15] Holden, W. and S.J. Marshall, 2018. Climate Change and Typhoons in the Philippines: Extreme Weather Events in the Anthropocene. In Samui, P., Kim, D., Ghosh, C., (Eds.), *Integrating Disaster Science and Management: Global Case Studies in Mitigation and Recovery*, pp. 407–421), Elsevier Press, Amsterdam.
- [16] Wood, W.H., S.J. Marshall, T.L. Whitehead and S.E. Fargey, 2018. Temperature records from a mesoscale observational network in the Canadian Rocky Mountains, 2005-2010. *Earth System Science Data*, 10(1), 595-607, <https://doi.org/10.5194/essd-10-595-2018>.
- [17] Samimi, S. and S.J. Marshall, 2017. Diurnal cycles of meltwater percolation, refreezing, and drainage in the supraglacial snowpack of Haig Glacier, Canadian Rocky Mountains. *Frontiers in Earth Science*, 5 (6), 1-15, doi: 10.3389/feart.2017.00006.
- [18] Criscitiello, A.S., S.J. Marshall, M. Evans, C. Kinnard, A.-L. Norman and M.J. Sharp, 2016. Marine aerosol source regions to Prince of Wales Icefield, Ellesmere Island, and influence from the tropical Pacific, 1979-2001. *Journal of Geophysical Research – Atmospheres*, 121 (16), 9492-9507, doi: 10.1002/2015JD024457.
- [19] Ebrahimi, S. and S.J. Marshall, 2016. Surface energy balance sensitivity to meteorological variability on Haig Glacier, Canadian Rocky Mountains. *The Cryosphere*, 10, 2799-2819, doi:10.5194/tc-2016-6.
- [20] Durage, S., S.C. Wirasinghe, J. Ruwanpura, L. Kattan and S.J. Marshall, 2015. Canadian prairie tornadoes – preplanning for warning issuance and initiation of protective measures. *International Journal of Disaster Risk Reduction*, 14(4), 556-563.
- [21] Ebrahimi, S. and S.J. Marshall, 2015. Parameterization of incoming longwave radiation at glacier sites in the Canadian Rocky Mountains. *Journal of Geophysical Research – Atmospheres*, 120 (24), 12,536-12,556, doi:1002/2015JGD023324.
- [22] Wake, L.M. and S.J. Marshall, 2015. Assessment of current methods of Positive Degree Day calculation using in-situ observations from glaciated regions. *Journal of Glaciology*, 55, 138-152.
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- [25] Marshall, S.J., 2014. Glacier retreat crosses a line. *Science*, 345 (6199), 872.
- [26] Marshall, S.J., 2014. Meltwater runoff from Haig Glacier, Canadian Rocky Mountains, 2002-2013. *Hydrology and Earth Systems Science*, 18, 5181-5200, doi:10.5194/hess-18-5181-2014.

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- [28] Rajewicz, J. and S.J. Marshall, 2014. Variability and trends in anticyclonic circulation over the Greenland Ice Sheet, 1948-2013. *Geophysical Research Letters*, 2842-2850.
- [29] Adhikari, S. and S.J. Marshall, 2013. Influence of high-order mechanics on simulation of glacier response to climate change: Insights from Haig Glacier, Canadian Rocky Mountains. *The Cryosphere*, 7, 1527-1541.
- [30] Bamber, J.L., M. Siegert, J. Griggs, S.J. Marshall and G. Spada, 2013. Paleofluvial mega-canyon beneath the central Greenland Ice Sheet. *Science*, 341(6149), 997-999.
- [31] Bitz, C.M. and S.J. Marshall, 2013. Modeling of the cryosphere. *Encyclopedia of Sustainability Science and Technology* (R.A. Meyers, Ed.), Springer, New York, NY.
- [32] Hirose, J.M.R. and S.J. Marshall, 2013. Glacier contributions to streamflow and glacio-meteorological regime in the Illecillewaet River Basin, British Columbia, Canada. *Atmosphere-Ocean*, 51 (4), 416-435, doi:10.1080/07055900.2013.791614p.
- [33] Hurrell, J., M.M. Holland, S. Ghan and 16 others, 2013. The Community Earth System Model: A Framework for Collaborative Research. *Bulletin of the American Meteorological Society*. 94, 1339-1360, doi. 10.1175/BAMS-D-12-00121. I am a co-author on this through my work with the NCAR CESM Science Steering Committee.
- [34] Marshall, S.J., 2013. Solution proposed for Ice Age mystery. *Nature (News and Views)*, 500, 159-160, doi:10.1038/500159a.
- [35] Marshall, S.J., 2013. From white to blue: Climate change in the Arctic. In *Energy Security and Geopolitics in the Arctic: Challenges and Opportunities in the 21st Century* (H. Peimani, Ed.), World Scientific Press, New York, pp. 25-58.
- [36] Marshall, S.J., 2013. Surface Water. In *Earth System and Environmental Sciences* (S. Elias, Ed.), Elsevier Press, Amsterdam, The Netherlands, doi:10.1016/B978-0-12-409548-9.05924-8.
- [37] Adhikari, S. and S.J. Marshall, 2012. Parameterization of lateral drag in flowline models of glacier dynamics. *Journal of Glaciology*. 58 (212), 1119-1132.
- [38] Adhikari, S. and S.J. Marshall, 2012. Glacier volume-area relation for high-order mechanics and transient glacier states. *Geophysical Research Letters*, 39 (16), doi:10.1029/2012GL052712.
- [39] Adhikari, S. and S.J. Marshall, 2012. Modelling dynamics of valley glaciers, Miidla, P. (Ed.), *Numerical Modelling*, InTech Publications, pp. 115-142, doi:10.5772/35474.
- [40] Marshall, S.J., 2012. Evidence of environmental change from the cryosphere. In *The SAGE Handbook of Environmental Change, Vol I* (J.A. Matthews, Ed.), Sage Press, London, pp. 211-238.
- [41] Marshall, S.J., 2012. *The Cryosphere*. In *Princeton Primers in Climate Science*, Princeton University Press, Princeton, NJ, 288 pp.
- [42] National Academy of Sciences, 2012. *A National Strategy for Advancing Climate Modeling*. The National Academies Press, Washington D.C., ISBN 978-0-309-25977-4, 300 pp. I was one of 17 climate scientists co-authoring the report, as Chapter Lead for Chapter 4: Scientific Frontiers.
- [43] Adhikari, S. and S.J. Marshall, 2011. Improvements to shear-deformational models of glacier dynamics through a longitudinal stress factor. *Journal of Glaciology*, 57 (206), 1003-1016.
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- [50] Sinclair, K.E., S.J. Marshall and T.A. Moran, 2011. A Lagrangian approach to modelling stable isotopes in precipitation over mountainous terrain. *Hydrological Processes*, 25 (16), 2481-2491.
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- [53] Gardner, A.S.[‡], M.J. Sharp, R.M. Koerner, C. Labine, S. Boon, S.J. Marshall, D.O. Burgess[‡], and D. Lewis[‡], 2009. Near-surface temperature lapse rates over Arctic glaciers and their implications for temperature downscaling. *Journal of Climate*, 22, 4281-4298.
- [54] Mair, D., D. Burgess, M.J. Sharp, J. Dowdeswell, T. Benham, S.J. Marshall, and F. Cawkwell, 2009. Mass balance of the Prince of Wales Icefield, Ellesmere Island, Nunavut, Canada. *Journal of Geophysical Research*, 114, F02011.
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- [57] Marshall, S.J. and C.J. van der Veen, 2009. Modelling Greenland Ice Sheet dynamics. In *The Greenland Ice Sheet in a Changing Climate*. Arctic Monitoring and Assessment Programme report, Oslo, pp. 45-54.
- [58] Moran, T.A. and S.J. Marshall, 2009. Effects of meltwater percolation on stable isotope stratigraphy in a high Arctic snowpack. *Journal of Glaciology*, 55 (194), 1012-1024.
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- [87] Marshall, S. J., D. Pollard, P. U. Clark, and S. H. Hostetler, 2003. Coupling ice sheet and climate models for simulation of former ice sheets. *Developments in Quaternary Science, Vol. I: The Quaternary Period in the United States*, Gillespie, A., S.C. Porter, and B.F. Atwater (Eds.), Elsevier Press, 105-129.
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- [101] Marshall, S.J. and G.K.C. Clarke, 1999b. Modeling North American freshwater runoff through the last glacial cycle. *Quaternary Research* **52**, 300-315.
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[†] Student of A.B.G. Bush, University of Alberta; [‡] Student of M.J. Sharp, University of Alberta

^{*} Student of G.K.C. Clarke, University of British Columbia; [•] Student of B. Menounos, UNBC

Published Research Datasets (Open Data and Open Source Code)

- [108] Marshall, S.J., 2021. Meteorological data from Kwadacha Glacier, Canadian Rocky Mountains, 2007-2011. Scholars Portal Dataverse, V1, <https://doi.org/10.5683/SP2/QIPI9W>.
- [109] Marshall, S.J., 2021. MATLAB code for firn thermodynamic and hydrological modelling. Scholars Portal Dataverse, V1, <https://doi.org/10.5683/SP2/WRWJAZ>.
- [110] Marshall, S.J., 2020. Daily meteorological data at Haig Glacier, Canadian Rocky Mountains. Scholars Portal Dataverse, V1, <https://doi.org/10.5683/SP2/7CXPPI>.
- [111] Marshall, S.J. and S. Samimi, 2020. Meteorological and firn data from DYE-2, Greenland Ice Sheet, summer 2016. Scholars Portal Dataverse, V1, <https://doi.org/10.5683/SP2/2QY39K>.
- [112] Wood, W.H., S.J. Marshall, S.E. Fargey and T.L. Whitehead, 2018. Near-surface atmospheric humidity data from a mesoscale meteorological network in the foothills of the Canadian Rocky Mountains, 2005-2010. *PANGAEA*, <https://doi.pangaea.de/10.1594/PANGAEA.889435>.
- [113] Wood, W.H., S.J. Marshall, S.E. Fargey and T.L. Whitehead, 2017. Daily temperature data from the Foothills Climate Array Mesonet, Canadian Rocky Mountains, 2005-2010. *PANGAEA*, <https://doi.org/10.1594/PANGAEA.880611>.

Selected Edited Contributions

- [114] Marshall, S.J., 2019. Crossing the bridge from science to science policy. *Canadian Science Policy Magazine*, 1, 26-27.
- [115] Marshall, S.J., 2014. Review of *Fundamentals of Glacier Dynamics*, 2nd Ed., by C.J. van der Veen, *Journal of Glaciology*, 60 (219), 201-202, doi: 10.3189/2014JoG13J214.
- [116] Marshall, S.J. and E.C. White, 2010. Alberta glacier inventory and ice volume estimation. Report for the Alberta Water Research Institute, 55 pp.
- [117] Whitehead, T. and S.J. Marshall, 2008. Rainfall patterns in southwestern Alberta, 2004-2007. Alberta Financial Services Corporation, Lacombe, AB, 43 pp.
- [118] Marshall, S.J., 2007. Review of *The Arctic Climate System* by R. Barry and M. Serreze, *Arctic*, 60 (3), 321-322,
- [119] Sinclair, K.E., N. Schaffer and S.J. Marshall, 2007. *Protocols for monitoring and reporting on Snowpack in Parks Canada's Montane Cordillera Bioregion*. Commissioned report, Parks Canada Ecological Integrity Monitoring Program, Glacier National Park, Revelstoke B.C., 64 pp.
- [120] Marshall, S.J., 2003. Glacier retreat in alpine areas, In *Ecological and Earth Sciences in Mountain Areas* (Taylor, L., K. Martin, D. Hik and A. Ryall, Eds.), Banff Centre Conference Proceedings, Banff AB, pp. 120-123.

Selected Invited Talks

Selected Seminars: University of Geneva, Cambridge, U.Toronto, U.Michigan, Harvard, Princeton, Cal Tech, UBC, UNBC, U.Victoria, U.Calgary, Carleton University, Bremen University, University of Oslo, UNIS-Svalbard, Northumbria University.

Plenary speaker, Canadian Meteorological and Oceanographic Society annual scientific congress, May 31-June 11, 2021, Victoria BC (online).

Plenary speaker, International Arctic Science Committee (IASC) Network of Arctic Glaciology annual scientific meeting, January 21-23, 2021, Obergurgl, Austria (online).

Invited panelist, Canadian Water Agency scientific forum, Canadian Science Policy Centre forum, and Canadian Society for Remote Sensing annual scientific congress, 2021.

Invited speaker, El cerebro científico, International Symposium on Science, Technology, Arts and Mathematics, 2018, Bogotá, Columbia, <https://www.elcerebrocientifico.com/>.

Keynote speaker, European Space Agency CryoSat Meeting, March 20-24, 2017, Banff AB.

Invited speaker, IUGG General Assembly, June 22-July 2, 2015, Prague, Czech Republic.

Invited speaker, Symposium on Northern Hemisphere glacier response to climate change, January 11-13, 2013, Reykjavik, Iceland.

Invited speaker, 'How Climate Works' Symposium, October 12, 2012, Princeton Environmental Institute, Princeton NJ.

Invited speaker, Symposium on The Arctic: Geopolitics, International Relations and Energy Security, April 13-14, 2011, National University of Singapore.

Invited speaker, IPCC Workshop on Ice Sheet Instabilities and Sea Level Rise, June 21-24, 2010, Kuala Lumpur, Malaysia.

Keynote Lecture. UN University for Peace Conference on 'Climate Change: Disaster or Opportunity'. San José, Costa Rica, April 17-18, 2010.

Invited talk on Arctic climate change. 'After Copenhagen' conference. University of Texas, Austin TX, April 6-9, 2010.

Invited session chair, Sea Level Rise session. Japanese-American Kavli Frontiers of Science Symposium, U.S. National Academy of Sciences, Irvine CA, December 5-7, 2008.

Invited speaker, Canadian Embassy International Science and Technology Speaker Series, Washington D.C., October 27, 2008.

Keynote speaker, Second International Conference on Arctic Palaeoclimate and its Extremes (APEX), Durham University, UK, April 1-4, 2008.

Invited speaker, European Science Foundation Conference on The Role of the Arctic in the Global Climate System, Nynashamn, Sweden, October 13-17, 2007.

Invited speaker, Rosenberg International Forum on Water Policy, Banff AB, Sept 6-9, 2006.

Keynote speaker, GSC workshop on North Pacific Climate Variability, Sidney B.C., March 1-3, 2006.

Plenary speaker, Earth System Processes II Meeting, Geological Society of America, Calgary AB, August 8-11, 2005.

Invited lecturer, Grand Combin Summer School on Fundamental Problems in Geophysical and Environmental Fluid Dynamics, Course XI: Paleoclimate Observations and Dynamics, Aosta, Italy, June 16-25, 2003.

Keynote speaker, International Marine Global Changes (IMAGES) Workshop on Ice Sheet-Ocean Interactions, Boulder Colorado. December 2-4, 2002.

Invited speaker, International Geosphere-Biosphere Program Past Global Changes (IGBP-PAGES) Workshop on the Last Interglacial Period in the Arctic, Portland, Maine. October 11-13, 2002.

Plenary address, International Conference on Ecological and Earth Sciences in Mountain Areas, Banff, AB, September 6-10, 2002.

Invited speaker, International School of Geophysics Symposium on Antarctic Ice Sheet Evolution, Erice, Italy. September 7-13, 2001.

Keynote speaker, Swedish Research Council/International Quaternary Association Workshop on Ice Age Inception, Idre Fjäll, Sweden. June 17-21, 2001.

Invited speaker, International Marine Global Changes (IMAGES) Workshop on the Last Glacial Maximum, Mt. Hood, Oregon. October 1-5, 2000.

Invited speaker, European Ice Sheet Modelling Initiative Workshop on the Vatnajökull Ice Cap, Skaftafell, Iceland. June 18-23, 1998.

Invited speaker, European Ice Sheet Modelling Initiative Workshop on Coupling Climate and Ice Sheet Models, Aussois, France. March 12-15, 1998.

Invited speaker, Model Intercomparison Workshop of the European Ice Sheet Modelling Initiative, Grindewald, Switzerland. September 24-27, 1997.

Invited speaker, European Ice Sheet Modelling Initiative Workshop on Former Ice Sheets, Edinburgh, Scotland. March 16-18, 1995.

Invited speaker, European Ice Sheet Modelling Initiative Workshop on Subglacial Processes, Reykjavik, Iceland. August 2-8, 1993.

Invited participant, NATO Advanced Study Institute on Paleoclimate Data and Modelling, Siena, Italy: September 26-October 10, 1992.

Graduate Student Supervision

Rahimian, Z., 2020. Modelling long term ice sheet changes to understand the stability of the Greenland Ice Sheet in a warmer world. M.Sc., University of Calgary, 98 pp.

Ochwat, N., 2019. Characterization of the firn in the accumulation area of Kaskawulsh Glacier, Yukon Territory, Canada. M.Sc., University of Calgary, 162 pp.

Miller, K., 2018, Meltwater chemistry of Haig Glacier, Canadian Rocky Mountains. M.Sc., University of Calgary, 102 pp.

Nath, R., 2018. Flowline modelling of glacier dynamics and Little Ice Age glacier reconstructions in the Canadian Rockies. M.Sc., University of Calgary, 114 pp.

Wood, W.H., 2017. Weather system controls of temperature variability in the Alberta foothills. Ph.D., University of Calgary, 194 pp.

Ebrahimi, S., 2016. Modelling glacier energy balance sensitivity to meteorological variability. Ph.D., University of Calgary, 243 pp.

Foroutan, M., 2016. Transverse aeolian bedforms on Mars and in the Lut desert of Iran. M.Sc., University of Calgary, 144 pp.

Rozek, A., 2016. Climate downscaling for modelling of glacier mass balance. M.Sc., University of Calgary, 144 pp.

Adhikari, S., 2012. Advances in modelling of valley glaciers. Ph.D., University of Calgary, 243 pp.

Hirose, J.M.R., 2012. Glacier contributions to streamflow in Illecillewaet River, Glacier National Park, B.C. M.Sc., University of Calgary, 144 pp.

Bash, E.A.R., 2011. Glacier contributions to streamflow and glacier change forecasts in the Bow River Basin, Alberta. M.Sc., University of Calgary, 196 pp.

Moran, T.A., 2011. Isotopic processes in high Arctic snowpacks and implications for isotope thermometry in melt-affected ice cores. Ph.D., University of Calgary, 156 pp.

Schaffer, N., 2010. A statistical model of air temperatures in the glacier boundary layer. M.Sc. Thesis, University of Calgary, 212 pp.

Losic, M., 2009. On the turbulent heat flux contributions to energy balance at Opabin Glacier, Yoho National Park, Canada. M.Sc., University of Calgary, 152 pp.

- Mattie, R., 2009. Surface temperature as a function of terrain variables in the Rocky Mountain and Foothills Region of Southern Alberta. M.Sc., University of Calgary, 102 pp.
- Sinclair, K.E., 2009. Stable isotope-vapour trajectory relationships in Rocky Mountain snowpacks. Ph.D., University of Calgary, 176 pp.
- Lane, K.E., 2008. Evaluation of climate events that influence the ground transportation industry along the TransCanada corridor: Historical trends and GCM projections. M.Sc., University of Calgary, 258 pp.
- Fargey, S.E., 2007. Spatial evaluation of rain events and growing season rainfall patterns in southwestern Alberta, 2005-2006. M.Sc., University of Calgary, 225 pp.
- Horton, B., 2006. Multivariate classification of Calgary weather systems: exploring trends, variability and synoptic relationships, 1953-2004. M.Sc., University of Calgary, 173 pp.
- Wasiuta, V. 2006. Seasonal patterns and spatial variations of snowpack sulphate isotopes of the Prince of Wales Icefield, Ellesmere Island. M.Sc., University of Calgary, 206 pp.
- Anslow, F.S., 2004. Development and testing of a temperature and radiation based melt model for glaciers in the Canadian Rockies. M.Sc., University of Calgary, 181 pp.
- Shea, J.M., 2004. Synoptic circulation and glacier mass balance in the Canadian Rockies. M.Sc., University of Calgary, 176 pp.

Current Graduate Students

- Samimi, S. (BSc, Univ. of Lahijan, Iran 2011), PhD student (2015-2021), Meltwater refreezing and retention in glaciers and implications for glacier runoff and water resources.
- Hanly, K. (MSc, University of Ottawa, 2020), PhD student (2021-present). Climate change and hydrological impacts and adaptation in communities of the Bow Valley, Canadian Rocky Mountains.

Masters of Geographic Information Science (MGIS) Students Supervised

- Wood, W.H. (2008), Modelling mean monthly temperature in Southwestern Alberta using multiple regression with a focus on the contribution of potential solar radiation.
- Law, T. (2006), Flood hazard modelling for the Rainy River, Fort Frances, Ontario.
- LoVechhio, J. (2004) (co-supervised with D. Draper), The use of Geographical Information Systems (GIS) as a Decision Support System (DSS) for assessing the feasibility of wind energy at the Sunshine Village Ski Resort in Banff National Park, Alberta.
- Geldsetzer, T. (2003), Modelling snow distribution for slab avalanche hazards.
- Aeschlimann, U. (2002), Glacier terrain characteristics in the Canadian Rocky Mountains.

Postdoctoral Research Associates

- Graham McDowell, 2020-2023. Canadian Mountain Assessment.
- David Roberts, 2017-2019. Cryosphere-climate studies at Kluane Lake Research Station, Yukon.
- Kambiz Teimour Najad, 2016-2017. Glacial isostatic modelling in the Community Ice Sheet model.
- Marjorie Perroud, 2014-2016. Current position: Research scientist, University of Geneva.
- Alison Criscitiello, 2014- 2016. Current position: Research associate, University of Alberta.
- Gabrielle Gascon, 2014. Current position: Research scientist, Environment Canada, Edmonton AB.

Leanne Wake, 2010-2012. Current position: Lecturer, Northumbria University, Newcastle, U.K.
Amanda Adams, 2006-2009. Current position: Science officer, U.S. National Science Foundation.
Damon Mathews, 2005-2007. Current position: Associate Professor, Concordia University.
Hester Jiskoot, 2001-2002. Current position: Associate Professor, University of Lethbridge.

I have also been fortunate to work with over 40 talented undergraduate research assistants over the past 18 years, through Honours Thesis projects and as summer employees. Approximately two thirds of these students have gone on to graduate studies (including several in my own research group). It has been rewarding to expose these young students to environmental and climate-change research and to see many of the students find their academic passion and career direction. Environmental and climate concerns are only going to grow in the years ahead, and it is a privilege to contribute to the training of future leaders in this field.

Projects and Operating Funds, 2000-2021. My portion of collaborative project funds is noted.

- Canadian Mountain Assessment, Canadian Mountain Network NCE, 2020-2023: \$75,000/yr
- NSERC Discovery Grant, *Glacier and ice sheet response to climate change*, 2018-2023: \$60,500/yr.
- NSERC Operations and Maintenance Support for Research Infrastructure, *Kluane Lake Research Station*, 2017-2019. Marshall, S. (PI) and 8 others, \$148,500/yr.
- Polar Knowledge Canada, *Cryosphere-Climate Monitoring at Kluane Lake Research Station, Yukon*, 2017-2019. Marshall, S. (PI) and 4 others, \$124,795/yr.
- NSERC Equipment Grant (RTI), *Ice-coring instrumentation for firn studies in western and Arctic Canada*, 2016. Marshall, S. (PI) and B. Menounos, \$149,700.
- U.S. Department of Energy Scientific Discovery Through Advanced Computing (SciDAC) program, Longterm evolution of the Greenland Ice Sheet and sea level rise (B. Otto-Bliesner, U.S. National Center for Atmospheric Research, PI), 2014-2018. \$34,000/yr.
- NSERC Climate Change and Atmospheric Research network, Canadian Regional Climate Modelling (L. Sushama, UQAM, PI), 2013-2018: \$45,000/yr.
- NSERC Climate Change and Atmospheric Research network, Canadian Cold Regions Network (H. Wheeler, U.Sask., PI), 2013-2018: \$24,000/yr.
- NSERC Create Grant, ArcTrain: Processes of Climate Variability and Change in the North Atlantic and Arctic (A. de Vernal, UQAM, PI), 2013-2018: \$15,000/yr.
- Alberta Innovates – Energy and Environment Solutions Grant, Predicting Alberta’s Water Future (G. Goss, U. Alberta, PI), 2014-2016: \$20,000/yr.
- NSERC Discovery Grant, *Glacier and ice sheet response to climate change*, 2009-2018 (four-year extension while serving on the NSERC Discovery Grant committee, 2014-2017): \$64,000/yr.
- NSERC Discovery Accelerator Grant, *Glacier and ice sheet response to climate change*, 2009-2012.
- NSERC Equipment Grant (RTI), *Ice-penetrating radar system for studies of glacier dynamics in western Canada*, 2008. Marshall, S. (PI) and three others at UBC, UNBC and SFU.
- Canada Research Chair (Tier II) in Climate Change, 2007-2017, \$100,000/yr.
- Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), *Western Canadian Cryosphere Network* (B. Menounos, UNBC, PI), 2006-2010, \$28,000/yr.
- Alberta Ingenuity Centre for Water Resources, *Flowing to the Future* (S. Rood, UL, PI), 2006-2009.
- Alberta Ingenuity Centre for Water Resources, *Hydrological Processes in an Alpine Catchment, Lake O’Hara Basin, Yoho National Park, B.C.* (M. Hayashi, Calgary, PI), 2006-2009.

- Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), *Polar Climate Stability Network* (W.R. Peltier, University of Toronto, PI), 2005-2010.
- Climate Change Action Fund (CCAF), *Impact of climate change on freight transport in the TransCanada highway corridor* (C.W. Woudsma, University of Waterloo, PI), 2005-2007.
- NSERC Discovery Grant, *Field and modelling studies of glacier-climate processes*, 2004-2009.
- Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), *A high-resolution ice core for study of sea ice and climate variability over the last millennium in the Canadian Arctic* (Martin Sharp, University of Alberta, PI), 2004-2006.
- CFI New Opportunities/Alberta Innovation Fund (ASRIP), *Foothills Climate Array: Mesoscale Meteorological Processes Studies and Parameterization of Surface-Atmosphere Interactions for Climate Modelling*. CFI awarded, October 2001; ASRIP awarded, June 2002.
- Polar Continental Shelf Project (PCSP), Natural Resources Canada, logistical support for glacier-climate field studies on the Prince of Wales Icefield, Ellesmere Island, 2002-2005, 2007, 2011-2013.
- Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant, *Dynamics and Environmental Controls of Glaciers and Ice Sheets*, 2000-2004.
- NSERC Research Network, Climate System History and Dynamics (CSDH; W.R. Peltier, PI); PI of CSDH subproject *Ice sheet-climate interactions*, 2000-2003.
- NSF Earth System History Program, *Modeling ice sheet evolution on orbital and millennial time scales* (Peter Clark, Oregon State University, PI), 1999-2003.
- NSF Office of Polar Programs, *A new collaborative model of Greenland Ice Sheet dynamics* (Kurt Cuffey, University of California-Berkeley, co-PI), 2000-2002.

Teaching at the University of Calgary, 2000-2021

GEOG 303: Introduction to Climate Change (1)

GEOG 305: Weather and Climate (11)

GEOG 315: Global Water Resources (1)

GEOG 391: Geography Field School (7)

GEOG 415: Physical Hydrology (1)

GEOG 439: Analytical Methods II (Multivariate and Spatial Statistics) (1)

GEOG 503: Climate Change (17)

GEOG 685: Arctic Climate System (5)

GEOG 695: Geographic Research Methods (1)

GEOG 799.04: Numerical Analysis of Environmental Systems (1)

GEOG 799.08: Atmospheric Thermodynamics (2)

GEOG 599.03: Glaciology (6)

GEOG 599.12: Snow Hydrology (1)

GEOG 599.22 : Topics in Oceanography (2)

ENVSCI 502/504: Directed Studies in Atmospheric Sciences & Climatology (5)