Keith N. Musselman, Ph.D. [updated Jan. 28, 2024]

Email: keith.musselman@colorado.edu

EDUCATION

University of California Los Angeles Los Angeles, California
Doctor of Philosophy in Civil Engineering 2012

- Minor in Atmospheric Sciences
- Emphasis in Hydrology & Water Resources
- NASA Earth System Science Fellowship Recipient

University of Arizona Tucson, Arizona
Master of Science in Hydrology & Water Resources 2006

- Emphasis in Surface Hydrology

University of Vermont Burlington, Vermont
Bachelor of Science in Geology 2003

- Emphasis in Surface Hydrology

PROFESSIONAL EXPERIENCE

Department of Geography Boulder, Colorado
University of Colorado Boulder
Assistant Professor
August 2023 – Present (100% Appointment)
January 2023 – August 2023 (50% Appointment)

Institute of Arctic and Alpine Research Boulder, Colorado
University of Colorado Boulder
Research Assistant Professor, Fellow
January 2023 – August 2023 (20 hrs/week)
December 2021 – January 2023 (40 hrs/week)

- Lead Principal Investigator on multiple large, multidisciplinary National Science Foundation projects. Assess terrestrial hydrologic change in the Arctic and the potential impacts on rivers, fisheries, and Indigenous communities. Assess ecosystem response to climate change and population pressures in Colorado. Coordinate stakeholder engagement. Co-founded an Indigenous Advisory Council. Lead PI on a NOAA Climate Program Office project to assess projected future changes in snowpack, precipitation, soil moisture and flood risk.

Research Associate
October 2017 – December 2021 (40 hrs/week)

- Analyzed the agricultural water supply-demand imbalance during the California drought using novel NASA satellite data, snow models, lidar, and GPS data. Oversee operational snowpack reports to California DWR and stakeholders. Reanalysis of 2017 Oroville Dam flood disaster using diverse gridded historical weather, snowpack, and climate data. Supervise and mentor three graduate and three undergraduate students.
- Published two high impact papers in *Nature Climate Change* on future rain-on-snow

flood risk and the use of winter snowmelt trends as an indicator of warming and risk to snow water resources across western North America.

National Center for Atmospheric Research Boulder, Colorado
Advanced Study Program Fellowship - Postdoctoral
October 2015 – October 2017 (40 hrs/week)

- Independently pursued research that collaboratively leveraged NCAR's world-class climate modeling capacity and multidisciplinary hydrologic team expertise. Analyzed high-res RCM output and led a high-impact paper in *Nature Climate Change* that alters conventional thought of how water resources may respond to climate change.
- Advanced the capability of hydrologic models to simulate dominant cold region processes in Alaska. As a member of a collaborative team, built propensity for research techniques using a model to achieve the Mission's goal of advancing hydrological model capacity and uncertainty characterization.

University of Saskatchewan Kananaskis, Alberta
Postdoctoral Fellow
October 2012 – October 2015 (40 Hours/Week)

- Developed new parsimonious model capacity of snow and forest hydrology to evaluate cold region process sensitivity to changes in land cover and climate. Creative use of technology (computational fluid dynamics, ray tracing) in solutions of challenging problems related to fine-scale numerical modeling of Earth System processes.
- Conducted and supervised a field campaign to evaluate how forest vegetation structure controls snowfall, melt, water and energy availability. Mentored and developed graduate students, student interns, and supervised two technicians.

University of California Los Angeles Los Angeles, California
NASA Earth System Science Graduate Fellow
September 2008 – September 2012

- Conduct independent research using detailed field measurements and numerical modeling to analyze snow accumulation and melt dynamics in the Sierra Nevada.
- Designed and supervised ten basin-scale snow surveys with five or more researchers including undergraduate and graduate students in the remote Sierra Nevada, California.
- Build future capabilities leveraging state-of-the-art lidar technology to estimate high-resolution solar radiation beneath a forest canopy in Sequoia National Park with a novel approach that remains an example of technical excellence.

Classroom Teaching Experience

University of Colorado Boulder Boulder, Colorado
Professor Fall Semester, 2023

- Lecture two days per week to a class of 29 undergraduate students in Geography course *Introduction to Hydrology*; design lectures, homework, and exams. Supervise a teaching assistant who held weekly labs.

Professor Spring Semester, 2023

- Lecture two days per week a mixed class of 22 undergraduate and five graduate students in Geography course *Snow Hydrology*; design lectures, homework, and exams. Supervise a teaching assistant who held weekly labs.

Lecturer Spring and Fall Semesters, 2019

- Lecture three days per week a class of 160 undergraduates in Geography course *Environmental Systems: Landscapes and Water*; plan field excursions, design lectures, homework, and exams. Supervise three teaching assistants who held weekly labs.

Lecturer Spring Semester, 2022

- Lecture two days per week a mixed class of 22 undergraduate and six graduate students in Geography course *Snow Hydrology*; design lectures, homework, and exams. Supervise a teaching assistant who held weekly labs.

University of California Los Angeles Los Angeles, California
Teaching Assistant (TA) Fall Semester, 2009

- Lead weekly discussion sessions, designed homework and held office hours for class of 100+ in Civil Engineering course 150 *Introduction to Hydrology*. Prof. S. Margulis

WORKSHOPS & FIELD COURSES TAUGHT

Ecosystem Resilience Project, Stakeholder Luncheon; 12 attendees (2023)
Arctic Rivers Summit, 100 Attendees; 50% Indigenous (2022)
UCB Science Discovery, Family Engineering Day; 1000+ attendees (2020)
NSF-funded workshop LiDAR Applications in Critical Zone Sciences (2014)
TA for *Advanced Field Methods in Snow Science*, Prof. Noah Molotch (2011)
TA for *Snow Hydrology and Field Camp*, Prof. Paul Brooks (2006)

FUNDING

- (Pending) **NASA, Earth System Explorer (Snow Satellite Mission)** 2024-2035
  "SnowOp-SAR: A signal of opportunity synthetic aperture radar satellite constellation to monitor global snow water equivalent at high resolution*"* (role: ***Senior Personnel, CU Award $1.23M; Total $310M***)
- (Awarded) **New Zealand Endeavor Fund, NIWA,** "Better runoff and hazard predictions through national-scale snowmelt forecasting" (role: ***International Advisor, $4.5K)*** 2023-2026
- (Awarded) **NSF, Navigating the New Arctic Program, supplemental** 2023-2024
  Supplemental funding of ongoing project (role: ***PI, CU: $346K; $600K total***)
- (Pending) **Bureau of Reclamation, Science and Technology** 2022-2025
  "Assessing historical and projected future flood mechanisms for headwater basins of the western U.S." (role: ***PI, $200k***)
- (Awarded) **NSF, Hydrological Sciences** 2022-2025
  "Estimating the "time of emergence" of the anthropogenic warming signal in snow water resource metrics for western US headwaters" (role: ***PI, $700K***)
- (Awarded) **NASA, Water Resources** 2022-2025
  "Advancing domestic and international water management capabilities with a global daily snow cover and albedo product" (role: ***co-PI, $777K;*** *total* ***$1.3M***)
- (Awarded) **NSF, Growing Convergence Research** 2021-2026

"Collaborative Research: GCR: Co-defining climate refugia to inform the management of mountain headwater systems" (role: ***PI, $1.8M***)

- (Awarded) **CU Boulder, Office of Outreach & Engagement** 2021-2022
  Microgrant – "Facilitating Co-production and Indigenous Community Engagement" (role: ***PI, $1K***)
- (Awarded) **NSF, Navigating the New Arctic Program, supplemental funding** 2021
  Supplemental – Research Experience for Undergraduates (REU) (role: ***PI, $9K***)
- (Awarded) **National Park Service, CESU** 2021-2023
  "Alaska Glacier Status and Trends 2.0; Hydrologic Modeling" (role: ***PI, $67K***)
- (Past Award) **NASA, Applied Sciences** 2021-2022
  "Satellite-based Snowpack Information: COVID-19 impacts on water resources" (role: ***co-PI, $21K***)
- (Awarded) **NSF, Navigating the New Arctic Program** *2020-2024*
  "The climate impacts on Alaskan and Yukon rivers, fish, and communities as told through co-produced scenarios" (*role: **PI, $3M)***
- (Awarded) **NOAA, Climate Program Office** *2019-2021*
  "Assessing the predictability and probability of 21st century rain-on-snow flood risk for the conterminous U.S." (*role: **PI, $200K)***
- (Past Award) **NASA, GEO, supplemental funding** *2019*
  "Optimizing the Indus Basin Irrigation System and reservoir operations using remotely sensed snow surface properties in the ParBal model" (*role: **co-I, $22K)***
- (Past Award) **National Science Foundation, Hydrologic Sciences** *2018-2020*
  "Extending the vadose zone: characterizing the role of snow for liquid water storage and transmission in streamflow generation" (*role: **co-PI, $142K)***
- (Past Award) **University of Colorado Outreach Award** *2019-2020*
  "Past, Present, Future: Exploring Boulder's Natural Environment" (*role: **co-I, $24K)***
- (Past Award) **NCAR Advanced Study Program Fellowship** *2015-2017*
  *"Slower snowmelt in a warmer world" **($136K)***
- (Past Award) **NASA Earth and Space Science Fellowship Program** *2008-2012*
  *"Remote Sensing and Ground Data Assimilation Using A Basin-Scale Snow Water Equivalent Reconstruction Method" **($90K)***

STUDENT AND POSTDOC MENTORSHIP

Postdoc Co-Advisor

Dr. Peyton Thomas

Graduate Student Co-Advisor

Dylan Blaskey, Ph.D. Student, Civil Engineering, CU Boulder
Nicolas Tarasewicz, Ph.D. Student, Geography, CU Boulder

Ph.D. Committee Member

Jennifer Morse, University of Colorado, Boulder
Millie Spencer, University of Colorado, Boulder
Nicolas Tarasewicz, University of Colorado, Boulder
Dylan Blaskey, University of Colorado, Boulder

[past]

Kehan Yang, University of Colorado, Boulder

Hamideh Safa, University of Nevada, Reno
Katherine Hale, University of Colorado, Boulder
John Bryan Curtis, University of Colorado, Boulder

Masters Committee Member

Denise Mondragon, University of Colorado, Boulder

[past]

Eric Kennedy, University of Colorado, Boulder
Natasha Harvey, University of Colorado, Boulder

Undergraduate Research Mentor

Julia Ronchi, University of Colorado, Boulder
Brandilyn Voelk, RECCS, University of Alaska, Juneau

[past mentees]

Jada Gray, RECCS, University of Colorado, Boulder
Kyla Christopher-Moody, University of Colorado, Boulder
Siobhan Ciafone (Honor Thesis), University of Colorado, Boulder
Ella Hall, University of Colorado, Boulder
Allyson Fitts, University of Colorado, Boulder
Kyla Elise Christopher-Moody, University of Colorado, Boulder
Haley Nolde, University of Nebraska, Lincoln

AWARDS RECEIVED

Outstanding Mentor Award
Undergraduate Research Opportunities Program *2021*
University of Colorado, Boulder

Best Presentation
Western Snow Conference Annual Meeting, Reno, NV *2019*

Best Student Poster Presentation
Eastern Snow Conference Annual Meeting, Montreal, Quebec *2010*

Graduate College Fellowship Award (merit-based)
University of Arizona *2005 and 2006*

David Hawley Undergraduate Research Scholarship
University of Vermont *2003*

REFEREED PUBLICATIONS

37+ Peer-reviewed publications | *H*-index of 23+

In Review | In Press

Zlotnick, O.B., **Musselman, K.N.**, and Levy, O. Deforestation poses deleterious effects to tree-climbing species under climate change. In Press, Nature Climate Change.

Harvey, N., S.P. Burns, **K.N. Musselman**, H. Barnard, and P.D. Blanken. Testing Methods to Assess Snow Interception at a Continental Forested Site, In Review, Water Resources Research.

Scaff, L., Krogh, S., **Musselman, K.N.**, Harpold, A., Lillo-Saavedra, M., Oyarzún, R., Li, Y. and Rassmusen, R., 2023. Winter Warm Spells and snowpack ablation in western North America. In Review, Water Resources Research.

Blaskey, D., Gooseff, M.N., Cheng, Y., Newman, A.J., Koch, J.C., and **Musselman, K.N.**, A high-resolution, daily hindcast (1990-2021) of Alaskan river discharge and temperature from coupled and optimized physical models. In Review, Water Resources Research.

Published

[37] Herman-Mercer, N.M., Andre, A., Buschman, V., Blaskey, D., Brooks, C., Cheng, Y., Combs, E., Cozzetto, K., Fitka, S., Koch, J., Lawlor, A., Moses, E., Murray E., Mutter, E., Newman, A.J., Prince, C., Salmon, P., Tlen, J., Toohey, R., Williams, M., and **Musselman, K.N.**, (2023), The Arctic Rivers Project: Using an Equitable Co-Production Framework for Integrating Meaningful Community Engagement and Science to Understand Climate Impacts. *Community Science*, *2*(4), p.e2022CSJ000024.

[36] Yang, K., Rittger, K., **Musselman, K. N.**, Bair, E. H., Dozier, J., Margulis, S. A., Painter, T.H., and Molotch, N. P. (2023). Intercomparison of snow water equivalent products in the Sierra Nevada California using airborne snow observatory data and ground observations. *Frontiers in Earth Science*, *11*, 1106621.

[35] Hale, K.E., Jennings, K.S., **Musselman, K.N.**, Livneh, B. and Molotch, N.P., (2023). Recent decreases in snow water storage in western North America. *Communications Earth & Environment*, *4*(1).

[34] Blaskey, D., Koch, J. C., Gooseff, M., Newman, A. J., Cheng, Y., O'Donnell, J., & **Musselman, K.N.** (2023). Increasing Alaskan river discharge during the cold season is driven by recent warming. *Environmental Research Letters*. 10.1088/1748-9326/acb661

[33] Cheng, Y., **Musselman, K.N.**, Swenson, S., Lawrence, D., Hamman, J., Dagon, K., Kennedy, D. and Newman, A., (2023) Moving land models towards more actionable science: A novel application of the Community Terrestrial Systems Model across Alaska and the Yukon River Basin. *Water Resources Research*, p.e2022WR032204.

[32] Seybold, E.C., Dwivedi, R., **Musselman, K.N.**, Kincaid, D.W., Schroth, A.W., Classen, A.T., Perdrial, J.N. and Adair, E.C., (2022). Winter runoff events pose an unquantified continental-scale risk of high wintertime nutrient export. *Environmental Research Letters*, *17*(10), p.104044.

[31] Yang, K., **Musselman, K.N.**, Rittger, K., Margulis, S. A., Painter, T. H., & Molotch, N. P. (2022). Combining ground-based and remotely sensed snow data in a linear regression model for real-time estimation of snow water equivalent. *Advances in Water Resources*, *160*, 104075.

[30] Wieder, W.R., Kennedy, D., Lehner, F., **Musselman, K.N.**, Rodgers, K.B., Rosenbloom, N., Simpson, I.R. and Yamaguchi, R., (2022). Pervasive alterations to snow-dominated ecosystem functions under climate change. *Proceedings of the National Academy of Sciences*, *119*(30), p.e2202393119.

[29] Webb, R. W., **K.N. Musselman**, S. Ciafone, K.E. Hale, & N.P. Molotch (2022). Extending the vadose zone: Characterizing the role of snow for liquid water storage and transmission in streamflow generation. *Hydrological Processes*, *36*(3), e14541.

[28] Hale, K., A. Wlostowski, A.M. Badger, **K.N. Musselman**, B. Livneh, and N.P. Molotch, (2022). Modeling streamflow sensitivity to climate warming and surface water inputs in a montane catchment. *Journal of Hydrology: Regional Studies*, *39*, p.100976.

[27] **Musselman, K.N.**, N. Addor, J.A. Vano, and N.P. Molotch, (2021), Winter melt trends portend widespread declines in snow water resources. Nature Climate Change 11, 418–424.

[26] Ikeda, K., R. Rasmussen, C. Liu, A. Newman, F. Chen, M. Barlage, E. Gutmann, J. Dudhia, A. Dai, C. Luce and **K.N. Musselman** (2021). Snowfall and snowpack in the Western US as captured by

convection permitting climate simulations: current climate and pseudo global warming future climate. Climate Dynamics, pp.1-25.

[25] Mendoza, P.A., T.E. Shaw, J. McPhee, **K.N. Musselman**, J.R. Revuelto, and S. MacDonell (2020), Seasonal and annual variability of snow depth fractal behavior in a sub-alpine catchment. Water Resources Research. 56(7), e2020WR027343

[24] Uecher, T.M., S.D. Kaspari, **K.N. Musselman** and S.M. Skiles (2020), The post-wildfire impact of burn severity and age on black carbon snow deposition and implications for snow water resources, Cascade Range, Washington, USA. Journal of Hydrometeorology. *21*(8), 1777-1792.

[23] Henn, B., **K.N. Musselman**, L. Lestak, F.M. Ralph, and N.P. Molotch (2020), Extreme runoff generation from atmospheric river driven snowmelt during the 2017 Oroville Dam spillways incident. Geophysical Research Letters, 47(14).

[22] Mendoza, P.A., **K.N. Musselman**, J.S. Deems, J.R. Revuelto, I. Lopez-Moreno, and J. McPhee (2020), Seasonal and annual variability of snow depth fractal behavior in a sub-alpine catchment. Water Resources Research, 55(7).

[21] Girotto, M., **Musselman, K.N.**, and Essery, R.L. (2020), Data Assimilation Improves Estimates of Climate-Sensitive Seasonal Snow. Current Climate Change Reports, 6, 81–94.

[20] **Musselman**, **K.N.**, F. Lehner, K. Ikeda, M.P. Clark, A.F. Prein, C. Liu, M. Barlage and R. Rasmussen (2018), Projected increases and shifts in rain-on-snow flood risk over western North America. Nature Climate Change, 8, 808-812.

[19] Isabelle, P.E., D.F. Nadeau, M.H. Asselin, R. Harvey, **K.N. Musselman**, A.N. Rousseau, F. Anctil (2018), Solar radiation transmittance of a boreal balsam fir canopy: Spatiotemporal variability and impacts on growing season hydrology, Agricultural and Forest Meteorology, 263, 1-14.

[18] **Musselman**, **K.N.**, M. P. Clark, C. Liu, K. Ikeda and R. Rasmussen (2017), Slower snowmelt in a warmer world. Nature Climate Change, 7(3), 214-219.

[17] **Musselman**, **K.N.**, N.P. Molotch, and S.A. Margulis, Snowmelt response to simulated warming across a large elevation gradient, southern Sierra Nevada, California. (2017) The Cryosphere, 11(6) 2847-2866.

[16] López-Moreno, I., S. Gascoin, J. Herrero, E. Spoles, M. Pons, E. Alonso, J. Sickman, **K.N. Musselman**, A. Boudhar, L. Hanich, N. Molotch, J. Pomeroy (2017), Different sensitivities of snowpack to warming in Mediterranean climate mountain areas. *Env. Research Letters*, 12(7), 074006.

[15] **Musselman**, **K.N.** and J.W. Pomeroy (2017), Estimation of needleleaf canopy and trunk temperatures and longwave contribution to melting snow. Journal of Hydrometeorology. 18, 555-572.

[14] **Musselman**, **K.N.,** J.W. Pomeroy, R. Essery, and N. Leroux (2015), Impact of windflow calculations on simulations of alpine snow accumulation, redistribution and ablation. Hydrological Processes, 29(18), 3983-3999.

[13] **Musselman**, **K.N.,** J.W. Pomeroy, and T.E. Link (2015), Variability inshortwave irradiance caused by forest gaps: Measurements, modelling, and implications for snow energetics. Agricultural and Forest Meteorology, 207, 69:82.

[12] Harpold, A.A., J.A. Marshall, S.W. Lyon, T.B. Barnhart, B. Fisher, M. Donovan, K.M. Brubaker, C.J. Crosby, N.F. Glenn, C.L. Glennie, P.B. Kirchner, N. Lam, K.D. Mankoff, J.L. McCreight, N.P. Molotch, **K.N. Musselman**, J. Pelletier, T. Russo, H. Sangireddy, Y. Sjöberg, T. Swetnam, and N. West (2015), Laser Vision: LiDAR as a Transformative Tool to Advance Critical Zone Science. Hydrology and Earth System Sciences. 19, 2881–2897.

[11] Meromy, L., N.P. Molotch, M. Williams, **K.N. Musselman**, and L. Kueppers (2015), Snowpack-

climate manipulation using infrared heaters in subalpine forests of the Southern Rocky Mountains, USA. Agricultural and Forest Meteorology, 203, 142-157.

[10] Harpold, A.A., N.P. Molotch, **K.N. Musselman**, R.C. Bales, P.B. Kirchner, M. Litvak, and P.D. Brooks (2015), Snowmelt infiltration in mixed conifer subalpine forests. Hydrological Processes, 29(12), 2782-2798.

[9] Harpold, A.A., Q.Guo., N. Molotch, P.D. Brooks, R. Bales, J.C. Fernandez- Diaz, **K.N. Musselman**, T.L Swetnam, P. Kirchner, M. Meadows, J. Flanagan, and R. Lucas (2014), LiDAR-derived snowpack datasets from mixed conifer forests across the Western U.S., Water Resources Research. 50(3), 2749-2755.

[8] Perrot, D.O., N.P. Molotch, **K.N. Musselman**, and E.T. Pugh (2014), Modeling the effects of the Mountain Pine Beetle on snowmelt rates in a subalpine forest. Ecohydrology. 7(2), 226-241.

[7] **Musselman, K.N.**, S.A. Margulis, and N.P. Molotch (2013), Estimation of solar direct beam transmittance of conifer canopies from airborne LiDAR. Remote Sensing of Env. 136, 402-415.

[6] Huang, C., S.A. Margulis, M.T. Durand, and **K.N. Musselman** (2012), Assessment of snow grain-size model and stratigraphy representation impacts on snow radiance assimilation: Forward Modeling Evaluation, IEEE Transactions on Geoscience and Remote Sensing. 50(11) 4551 – 4564.

[5] López-Moreno, J.I., S.R. Fassnacht, J.T. Heath, **K.N. Musselman**, J. Revuelto, J. Latron, E. Morán-Tejeda, T. Jonas (2012), Small scale spatial variability of snow density and depth over complex alpine terrain: Implications for estimating snow water equivalent, Advances in Water Res., 55, 40-52.

[4] **Musselman, K.N.**, N.P. Molotch, S.A. Margulis, M. Lehning, and D. Gustafsson (2012), Improved snowmelt simulations with a canopy model forced with photo-derived direct beam canopy transmissivity, Water Resources Research, 48(10).

[3] **Musselman, K.N.**, N.P. Molotch, S.A. Margulis, P.B. Kirchner, and R.C. Bales (2012), Influence of canopy structure and direct beam solar irradiance on snowmelt rates in a mixed conifer forest. Agricultural and Forest Meteorology, 161, 46 – 56.

[2] Molotch, N.P., P.D. Brooks, S.P. Burns, M. Litvak, R.K. Monson, J.R. McConnell, and **K.N. Musselman** (2009), Ecohydrological controls on snowmelt partitioning in mixed-conifer sub-alpine forests, Ecohydrology, 2, 129–142.

[1] **Musselman, K.N.**, N.P. Molotch, and P.D. Brooks, (2008), Effects of vegetation on snow accumulation and ablation in a mid-latitude sub-alpine forest, Hydrological Processes, Vol 22 (15), 2767-2776.

Conference Proceedings

Musselman, K.N., A.J. Newman, Y. Cheng, D. Blaskey, K. Cozzetto, C. Brooks, P. Thomas, and N. Herman-Mercer, The Arctic Rivers Project: Combining Monitoring, Modeling, and Indigenous Knowledge, CESM Workshop, Actionable Science, National Center for Atmospheric Research, Boulder, CO, June 2023.

Margulis, S.A., Yueh, S., Deeb, E., Dozier, J., Elder, K., Entekhabi, D., Girotto, M., Gutmann, E.D., Harpold, A., Hughes, M.R., **Musselman, K.N.**, and Lettenmaier, D.P., 2023, January. Measuring Mountain Snow from Space: A Mission Concept Using P-band Signals of Opportunity. In *103rd AMS Annual Meeting*. AMS, Denver, CO.

Scaff, L., Krogh, S., **Musselman, K.N.**, Harpold, A., Lillo-Saavedra, M., Oyarzún, R., Li, Y. and Rassmusen, R.. *Winter Warm Spells and snowpack ablation in western North America* (No. EGU23-6903). Presented at the European Geophysical Union Annual Meeting, Vienna, Austria. 2023

Musselman, K.N., P. Blanken, B. Buma, A. Carrico, E. Hinkley, K. Kelsey, J. Knowles, F. Lehner, E. Oladeji, A. Parsekian, L.J. Schwebs, N. Tarasewicz, W. Wieder, and E. Woolner, 2022, The Front

Range Ecosystem Resilience Project – Co-defining climate refugia to inform effective management of mountain headwater systems. Poster presented at CIRMOUNT MtnClim, Gothic, CO, Sept. 2022.

Musselman, K.N., A.J. Newman, Y. Cheng*, D. Blaskey, K. Cozzetto, C. Brooks, and N. Herman-Mercer, 2022, Informing climate and land surface model decisions with Indigenous guidance. Oral presentation at AGU *Frontiers in Hydrology Meeting*, Puerto Rico.

Cheng, Y., A. Newman, **K.N. Musselman**, A. Craig, N. Herman-Mercer, K. Cozzetto, C. Brooks, D. Blaskey, J. Hamman, S. Swenson, D. Lawrence, 2022. Actionable earth-climate science: high-resolution coupled land-atmosphere modeling for Alaska informed by knowledge co-production (invited talk), *CESM workshop 2022*, Boulder, CO

Cheng, Y., A. Newman, S. Swenson, D. Lawrence, **K.N. Musselman**, J. Hamman, D. Kennedy, K. Dagon, 2022. Moving complex land-surface models towards actionable science: A novel application of the Community Terrestrial Systems Model across Alaska and the Yukon River Basin (oral), *NCAR Land Model Working Group 2022*, virtual

Cheng, Y., A. Newman, **K.N. Musselman**, A. Craig, D. Lawrence, S. Swenson, J. Hamman, 2022. High-resolution coupled land-atmosphere modeling cross Alaska and the Yukon River Basin (oral), *102nd American Meteorological Society Annual Meeting*, Virtual

Newman, A. J., Y. Cheng, **K.N. Musselman**, A. Craig, J. Hamman, S. Swenson, D. Lawrence, K. Dagon, D. Kennedy, and the Arctic Rivers Research Team, 2022. Hydrometeorology and terrestrial hydrology across Alaska: a high-resolution coupled land-atmosphere modeling system guided by knowledge co-production (oral). WCRP km-scale workshop, Boulder, CO, 3-7 October.

Newman, A. J., A. Wood, E. Gutmann, Y. Cheng, N. Lybarger, A. Smith, **K.N. Musselman**, C. Frans, and J. Arnold, 2022. Challenges and opportunities for water resource focused actionable Earth System Science (invited oral). American Geophysical Union Fall Meeting, Chicago, IL, 12-16 December.

Blaskey, D., Koch, J., Gooseff, M., Newman, A., Cheng, Y., and **Musselman K.N.**, 2022. Developing a High Resolution Model of Historic (1990-2020) Alaskan River Temperatures. Oral presentation, American Geophysical Union Fall Meeting, Chicago, IL, 12-16 December.

Cheng, Y., A. Newman, **K.N. Musselman**, N. Herman-Mercer, A. Craig, J. Hamman, 2022. Climate impacts on terrestrial hydrology and hydrometeorology in Alaska and Yukon River Basin: a modeling effort guided by Indigenous Knowledge (virtual poster), *NNA Annual Community Meeting*, virtual

Cheng, Y., A. Newman, **K.N. Musselman**, S. Swenson, D. Lawrence, J. Hamman, K. Dagon, D. Kennedy, 2022. Moving land models towards actionable science: A novel application and multi-objective optimization of the Community Terrestrial Systems Model across Alaska and the Yukon River Basin (oral), *WCRP km-scale workshop*, Boulder, CO

Cheng, Y., A. Newman, **K.N. Musselman**, A. Craig, J. Hamman, 2022. Climate impacts on Alaska and Yukon hydrometeorology: a modeling effort guided by Indigenous Knowledge (poster), *AGU Chapman Conference on Water Availability*, Golden, CO.

Newman, A.J., Wood, A., Gutmann, E.D., Cheng, Y., Lybarger, N.D., Smith, A., Lehner, F., **Musselman, K.N.**, Frans, C.D. and Arnold, J.R., 2022, December. Challenges and opportunities for water resource focused actionable Earth System Science. In *Fall Meeting 2022*. AGU.

Rittger, K., **Musselman, K.N.**, Skiles, M., Stillinger, T., Bair, N., Serreze, M.C., Brodzik, M.J. and Mankoff, K.D., 2022, December. Advancing domestic and international water management capabilities with a global daily snow cover and albedo product. In *Fall Meeting 2022*. AGU.

Schwebs, L., Parsekian, A., Tarasewicz, N. and **Musselman, K.N.**, 2022, December. Time-Lapse Electrical Resistivity Tomography Characterization of the Vadose Zone in a Montane Watershed. In *Fall Meeting 2022*. AGU.

Cheng, Y., Newman, A.J., **Musselman, K.N.**, Craig, A., Hamman, J. and Bennett, A., 2022, December. Hydrometeorology and terrestrial hydrology in Alaska and Yukon River Basin: a high-resolution coupled land-atmosphere modeling (1990-2020) informed by knowledge co-production. In *Fall Meeting 2022*. AGU.

Musselman, K.N., F. Lehner, T. Eidhammer, A. Pendergrass, and E. Gutmann (2021), Assessing the predictability and probability of 21st century rain-on-snow flood risk for the conterminous U.S., AGU Fall Meeting.

Newman, A., Cheng, Y., **Musselman, K.N.**, Craig, A., Swenson, S., Hamman, J., & Lawrence, D. (2021). High-Resolution Regional Climate Simulations of Arctic Hydroclimatic Change. American Geophysical Union Fall Meeting.

Livneh, B., N.R. Bjarke, K. Marvel, A. Pendergrass, J.J. Barsugli, E.D. Gutmann, P. Williams, K.N. Musselman, F. Lehner, K.M. Grise, D. Schmidt, and M.P. Hoerling (2021), The primary drivers of climate change impacts on the terrestrial water cycle, AGU Fall Meeting.

Cheng, Y., A.J. Newman, S.C. Swenson, D.M. Lawrence, K.N. Musselman, and J. Hamman (2021), A novel application and multi-objective optimization of CTSM: Arctic hydrology in Alaska and Yukon River Basin, AGU Fall Meeting.

Rittger, K., M.C. Serreze, M.J. Brodzik, **K.N. Musselman**, T. Stillinger, N. Bair, M. Skiles (2021), Snow Today at the National Snow and Ice Data Center, AGU Fall Meeting.

Hale, K., **K.N. Musselman**, K.S. Jennings, and N.P. Molotch (2021), Changes in snow water storage and hydrologic partitioning across the Western United States, AGU Fall Meeting.

Yang, K., **K.N. Musselman**, K Rittger, SA Margulis, TH Painter, and NP Molotch (2021) Improving the estimation of snow water equivalent in a Linear Regression Model using remotely sensed snow cover data, AGU Fall Meeting.

Herman-Mercer, N., Cozzetto, K., & **Musselman, K.N.** (2021). *Working with an Indigenous Advisory Council to facilitate effective communication and collaboration between researchers and Arctic communities* (No. EGU21-16368). European Geophysical Union Annual Meeting.

Newman, A., Cheng, Y., **Musselman, K.N.**, Craig, A., Swenson, S., Hamman, J., & Lawrence, D. (2021). *High-Resolution Regional Climate Simulations of Arctic Hydroclimatic Change* (No. EGU21-6085). European Geophysical Union Annual Meeting.

Musselman, K.N. (2021) The Arctic Rivers Project: A Co-produced Assessment of the Climate Sensitivity of Rivers, Fish and Communities, 50th Arctic Workshop. Virtual.

Musselman, K.N., N. Addor, J.A. Vano, and N.P. Molotch, (2020), Melting winter snowpack signals a growing threat to water security not captured by operational metrics. *AGU Fall Meeting 2020*.

Vano, J.A., J.R. Arnold, M.P. Clark, B. Nijssen, E.D. Gutmann, A.W. Wood, F. Lehner, **K.N. Musselman**, J. Hamman, N. Addor & A.J. Newman (2020, December), Dos and Don'ts for navigating model selection in climate change work for water planning and management, In *AGU Fall Meeting 2020*.

Safa, H., **Musselman, K. N.**, Krogh, S.A., & Harpold, A.A. (2020, December). How well do we melt snow? A multi-model intercomparison project (MuMIP) illustrates the challenges of hydrological prediction. In *AGU Fall Meeting 2020*.

Yang, K., **Musselman, K. N.**, Jennings, K. S., & Molotch, N. P. (2020, December). Climate and topographic controls on the variability of snow water equivalent and snowmelt in a continental alpine watershed. In *AGU Fall Meeting 2020*.

Hale, K., Molotch, N.P., & **Musselman, K.N.** (2020, December). Water Towers of the West: Where are they and how have they changed? *AGU Fall Meeting 2020*.

Kaspari, S., Uecker, T.M., **Musselman, K.N.**, & Skiles, M. (2020, December). The Post-Wildfire Impact of Burn Severity and Age on Black Carbon Snow Deposition and Implications for Snow Water Resources, Cascade Range, Washington, USA. In *AGU Fall Meeting 2020*.

Webb, R., **Musselman, K.N.**, Hale, K., Ciafone, S., & Molotch, N.P. (2020, December). Characterizing a Snowpack's Ability to Store Liquid Water at the Small Catchment Scale–A Comparison of Ground-Based Remote Sensing Observations and Hydrologic Modeling. In *AGU Fall Meeting*.

Webb, R., **Musselman, K.N.**, Hale, K., & Molotch, N. (2020, November). Monitoring a snowpack's ability to store liquid water at the small catchment scale. In *18th Int'l Conference on Ground Penetrating Radar* (pp. 101-104). Society of Exploration Geophysicists.

Pinto Escobar, F., Mendoza, P. A., Shaw, T. E., Revuelto, J., **Musselman, K.N.**, & McPhee, J. (2020, May). Wind effects on the spatial distribution of snow and seasonal water balance in two Mediterranean basins. In *EGU General Assembly Conference Abstracts* (p. 10994).

Mendoza, P., Shaw, T., Pinto, F., Lagos, M., Revuelto, J., **Musselman, K.N.**, MacDonell, S. & McPhee, J., (2020, May). Scaling behavior of lidar-derived snow depth across the semi-arid Chilean Andes. In *EGU General Assembly Conference Abstracts* (p. 11313).

Yang, K., **Musselman, K. N.** & Molotch, N. P. (2019, December). Bias Correction of Snow Water Equivalent Estimates in near real-time over the California Sierra Nevada. *AGU Fall Meeting 2019*.

Ackroyd, C., M. Skiles, K. Rittger, S. Supper, **K.N. Musselman** (2019, December). A Comparison of WorldView and MODIS in Detecting Fractional Snow Cover over High Mountain Asia. *AGU Fall Meeting 2019*.

K. Rittger, **K.N. Musselman**, A.L. Dugger, M.J. Brodzik, B. Rajagopalan, W. Kleiber, K.J. Bormann, H.G.V. Chan, W.P. Doan, & T.H. Painter (2019, December). Multi-platform, multi-sensor snow surface properties for energy balance and model validation. AGU Fall Meeting 2019.

Musselman, K.N., H.T. Berglund, K. Yang, & N.P. Molotch (2019, December). Monitoring the Sierra Nevada's water balance and deficits using GPS-derived vertical displacement time series data. AGU Fall Meeting 2019.

Musselman, K.N., A.J. Newman, & F. Lehner (2019, December). Projected end-of-century changes in water available for runoff across mountain basins of western North America. AGU Fall Meeting 2019. Invited.

Vano, J.A., J.R. Arnold, M.P. Clark, B. Nijssen, E.D. Gutmann, A.W. Wood, F. Lehner, J. Hamman, N. Addor, A.J. Newman & **K.N. Musselman** (2019, December). Dos and Don'ts for Supporting Better Water Management in a Changing Climate, In *AGU Fall Meeting 2019*. Invited.

Musselman, K.N., N. Addor, J. Vano, & N.P. Molotch, (2019, April) Reconsidering the utility of the April 1st snow water equivalent metric for water resource applications. Oral presentation at the Western Snow Conference, Reno, NV.

Yang, K., **K.N. Musselman**, K. Rittger, & N.P. Molotch (2019 April), Bias correction of SWE estimates with the NASA Airborne Snow Observatory SWE data. Oral presentation at the Western Snow Conference, Reno, NV.

K.N. Musselman, B. Henn, F.M. Ralph, L. Lestak, and N.P. Molotch (2018), The role of atmospheric river rain-snow levels and antecedent snowpack in the 2017 Oroville Dam crisis. Oral presentation at the American Meteorological Society Mountain Meteorology Conference, Santa Fe, NM.

Musselman, K.N., N. Addor, J. Vano, J. Berggren, and N. Molotch, (2018) Reconsidering the utility of the April 1st snow water equivalent metric. Oral presentation at the Eastern Snow Conference, College Park, MD.

Mendoza, P.A., **K.N. Musselman**, I. López-Moreno, R. Essery, N.P. Molotch, and J. McPhee, (2018), The effects of geospatial decisions on the accuracy of a distributed blowing snow model, Oral presentation at the European Geophysical Union General Assembly, Vienna, Austria.

Musselman, **K.N.**, F. Lehner, K. Ikeda, M.P. Clark, A. Prein, C. Liu, M. Barlage and R. Rasmussen (2018), Projected increases and shifts in rain-on-snow flood risk over western North America. Oral presentation at the Western Snow Conference, Albuquerque, NM.

Henn, B., **K.N. Musselman**, F.M. Ralph, L. Lestak, and N.P. Molotch (2018), The role of atmospheric river rain-snow levels and antecedent snowpack in the 2017 Oroville Dam crisis. Oral presentation at the Western Snow Conference, Albuquerque, NM.

Musselman, K.N., M.P. Clark, B. Nijssen and J. Arnold (2017), Challenges in land model representation of heat transfer in snow and frozen soils. Oral presentation at the American Geophysical Union Fall Meeting, New Orleans, LA.

Musselman, **K.N.**, F. Lehner, K. Ikeda, M.P. Clark, A. Prein, C. Liu, M. Barlage and R. Rasmussen (2018), Large projected increases in rain-on-snow flood potential over western North America. Oral presentation at the American Geophysical Union Fall Meeting, New Orleans, LA. Invited.

Musselman, **K.N.**, F. Lehner, K. Ikeda, M.P. Clark, A. Prein, C. Liu, M. Barlage and R. Rasmussen (2017), Projected increases in rain-on-snow flood potential over western North America. Annual Meeting of the Rocky Mountain Hydrologic Research Center, Boulder, Colorado.

Musselman, K.N., M.P. Clark, Changhai Liu, Kyoko Ikeda, and R. Rasmussen (2017), Slower snowmelt in a warmer world. Oral presentation at the European Geophysical Union General Assembly, Vienna, Austria.

Musselman, K.N., M.P. Clark, A. Endalamaw, W.R. Bolton, B. Nijssen and J. Arnold (2017), Assessing the effects of modeling decisions on cold region hydrologic model performance. Interactive Poster presentation at the European Geophysical Union General Assembly, Vienna, Austria.

Musselman, K.N., M.P. Clark, Changhai Liu, Kyoko Ikeda and R. Rasmussen (2016), Slower snowmelt in a warmer world. Oral presentation at the American Geophysical Union Fall Meeting, San Francisco, CA. Invited.

Musselman, K.N., M.P. Clark, A. Endalamaw, W.R. Bolton, B. Nijssen and J. Arnold (2016), Effects of model decisions on cold region hydrologic model performance: snow, soil and streamflow. Poster presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Monaghan, A.J., M.P. Clark, J.R. Arnold, A.J. Newman, **K.N. Musselman**, M.J. Barlage, L. Xue, C. Liu, E.D. Gutmann and R. Rasmussen (2016), High resolution regional climate change simulations over Alaska. Poster presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, **K.N.**, M.P. Clark, Changhai Liu, Kyoko Ikeda and R. Rasmussen (2016). Evidence for slower snowmelt in a warmer world. Oral presentation at the Mountain Climate Conference, Leavenworth, Washington.

Musselman, K.N., M.P. Clark, A. Endalamaw, W.R. Bolton, B. Nijssen (2016), A Multi-Decadal Analysis of Cold Region Hydrological Model Performance and Challenges at the Caribou – Poker Creeks Research Watershed. Oral presentation at the American Water Resources Association Spring Specialty Conference 'Water – Energy – Environment', Anchorage, Alaska

S. Gascoin**,** J.I. López-Moreno, J. Herrero, E. Sproles, L. Hanich, A. Boudhar, M. Pons, E. Alonso-González, and **K.N. Musselman** (2016), Spatio-temporal variability of the snow cover in different Mediterranean mountain regions from in situ and remote sensing data, oral presentation at the European Geosciences Union General Assembly, Vienna, Austria.

Musselman, K.N., N.P. Molotch, and S.A. Margulis (2015), Snowpack response to warmer temperatures: a southern Sierra Nevada case study, invited oral presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N. and J.W. Pomeroy (2015), The influence of tree temperatures on potential snowmelt energy in a discontinuous coniferous forest, poster presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Arnold, J., M. Clark, J. Cherry, T. Giambelluca, E. Gutmann, G. Liston, M. Sturm, A. Monaghan, **K.N. Musselman**, A. Newman, R. Rasmussen, and A. Wood (2015), New tools and data to understand and adapt to hydroclimatic variability and change in Alaska and Hawaii, poster presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N. and J.W. Pomeroy (2015), A snow – canopy energy balance model for disturbed forested environments, oral presentation at the Joint Canadian Geophysical Union and American Geophysical Union Spring Meeting, Montreal.

Musselman, K.N., N.P. Molotch, and S.A. Margulis (2014), Snowmelt sensitivity to warmer temperatures: a field-validated model analysis, southern Sierra Nevada, California, California, poster presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N. and J.W. Pomeroy (2014), Ray trace modeling to determine optimal forest canopy gap size for reduced solar irradiance during snowmelt: field verification and continental scale application, invited oral presentation at the American Geophysical Union Fall Meeting, San Francisco, CA.

Leroux, N., J.W. Pomeroy, and **K.N. Musselman** (2014), Modelling windflow over the Canadian Rockies, poster presentation at the Canadian Geophysical Union Annual Meeting, Banff, Alberta.

Musselman, K.N. and J.W. Pomeroy (2014), Complexities in seasonal snowpack development, melt rates, and hydrological partitioning across a forest-gap continuum, oral presentation at the Canadian Geophysical Union Annual Meeting, Banff, Alberta.

Musselman, K.N., J.P. Pomeroy, N. Leroux, R. Essery (2013), Uncertainty in alpine snow mass balance simulations due to snow model parameterization and windflow representation, poster presentation at American Geophysical Union Annual Fall Meeting, San Francisco, California.

Musselman, K.N., J.P. Pomeroy, N. Leroux, R. Essery (2013), Simulating snow distribution and melt in alpine and forested terrain, oral presentation at the Davos Atmosphere and Cryosphere Assembly, Davos, Switzerland.

Musselman, K.N., J.P. Pomeroy, N. Leroux, R. Essery (2013), Evaluation of alpine snow processes simulated by snow and windflow models, oral presentation at the Canadian Geophysical Union, Saskatoon, Saskatchewan.

Musselman, K.N., S.A. Margulis, and N.P. Molotch (2012), Seasonal and inter-annual snowmelt patterns in the southern Sierra Nevada, California, invited oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., S.A. Margulis, and N.P. Molotch (2012), Integration of airborne LiDAR data and voxel-based ray tracing to determine high-resolution solar radiation dynamics at the forest floor: implications for improving stand-scale distributed snowmelt models, oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Molotch, N.P., **Musselman, K.N.**, P.B. Kirchner, R.C. Bales, and P.D. Brooks (2012), Effects of forest structure on snow accumulation and melt derived from ecohydrological instrument clusters across the Western US, invited poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Kirchner, P.B., R.C. Bales, **Musselman, K.N.**, and N.P. Molotch (2012), Under-canopy snow accumulation and ablation measured with airborne scanning LiDAR altimetry and in-situ instrumental measurements, southern Sierra Nevada, California, oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., N.P. Molotch, S.A. Margulis, P.B. Kirchner, and R.C. Bales (2011), Inter-annual snow accumulation and melt patterns in a sub-alpine mixed conifer forest: results from a distributed physically based snow model, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Kirchner, P.B.; R.C. Bales, J. Flanagan, **K.N. Musselman**, and N.P. Molotch (2011), Mountain front precipitation accumulation over a 3300 m elevation gradient from scanning LiDAR snow depth and in-situ instrumental measurements, southern Sierra Nevada, California, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Molotch, N.P., E. Trujillo, and **K.N Musselman** (2011), Vegetation-snowpack feedbacks from plot to regional scales, oral presentation at Western Snow Conference Annual Meeting, Stateline, NV.

Kirchner, P.B., R.C. Bales, R.R. Rice, **K.N. Musselman**, and N.P. Molotch (2011), Measuring and modeling under-canopy snow ablation in southern Sierra Nevada subalpine red-fir forest, oral presentation at Western Snow Conference Annual Meeting, Stateline, NV.

Molotch, N.P., **K.N. Musselman**, E. Trujillo, P.D. Brooks, J.R. McConnell, and M.W. Williams (2010), Ecohydrological response to snowmelt dynamics from plot to regional scales, invited oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., N.P. Molotch, S.A. Margulis, M. Lehning, P.B. Kirchner, and R.C. Bales (2010), Simulating plot-scale variability of snowpack states in conifer forests using hemispherical photography and a process based one-dimensional snow model, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Perrot, D.O., N.P. Molotch, **K.N. Musselman**, and E.T. Pugh (2010), Modeling the effects of the mountain pine beetle on snowmelt rates in a subalpine forest, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Kahl, A., A. Winstral, D. Marks, J. Dozier, and **K.N. Musselman** (2010), Heterogeneity of Snow Water Equivalent Derived from MODIS Imagery and the ISNOBAL Snowmelt Model, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Kirchner, P.B., R.C. Bales, R. Rice, **K.N. Musselman**, and N.P. Molotch (2010), Estimating under-canopy ablation in a subalpine red-fir forest, southern Sierra Nevada, California, poster presented at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., N.P. Molotch, and S.A. Margulis (2010) A physically-based approach to improving estimates of snow states and fluxes in a conifer forest of Sequoia National Park, poster presented at Eastern Snow Conference, Hancock, MA.

Kirchner, P.B., R.C. Bales, **K.N. Musselman**, and N.P. Molotch (2009), Multi-scale observations and modeling of the snowpack in a forested Sierra Nevada catchment, oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., N.P. Molotch, S.A. Margulis, P.B. Kirchner, and R.C. Bales (2009), A mechanistic approach for estimating snowpack dynamics in a conifer forest, oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Margulis, S.A., C. Huang, **K.N. Musselman**, and M.T. Durand (2009), Examination of the implications of snow model complexity, stratigraphy, and grain-size representation on SWE estimation via passive microwave radiance data assimilation, invited oral presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., N.P. Molotch, and S.A. Margulis (2008), Spatial, Seasonal, and Interannual Variability of Snow Accumulation Control Mechanisms in two Neighboring Alpine and Sub-alpine Catchments in California's Seasonally Snow-covered Southern Sierra Nevada; poster presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Brooks, P.D., N.P. Molotch, **K.N. Musselman**, E. Small, J. McConnell, R. Bales, and A. Rinehart (2006), The effects of forest vegetation on snow accumulation, ablation, and meltwater routing, Valles Caldera National Preserve, NM, oral Presentation at American Geophysical Union Fall Meeting, San Francisco, CA.

Musselman, K.N., B. Wemple, P. Bierman, and J. Shanley (2003), Analysis of Spatial Variability of Precipitation and Snow Accumulation on Mount Mansfield, Stowe, Vermont, poster presentation at the American Geological Society Annual Meeting, Seattle, WA.

PROFESSIONAL AFFILIATIONS & SERVICE ACTIVITIES

Peer Reviewer

- NASA Terrestrial Hydrology
- NASA Applied Sciences Program
- NSF Office of Polar Programs
- NSF Hydrologic Sciences

Primary Session Convener, American Geophysical Union Fall Meeting (2019)

- Blue and Green Water in the Mountains: Water Supply, Extreme Events, and Ecological Responses in Snow- and Glacier-Fed Catchments

Journal Peer Review

- Advances in Water Resources
- Agricultural and Forest Meteorology
- Arctic, Antarctic, and Alpine Research
- Bulletin of the American Meteo. Society
- Earth System Science Data
- Ecohydrology
- Frontiers of Earth Science
- Geophysical Research Letters
- Hydrological Processes
- Hydrology Research
- iScience
- J. of Applied Met. and Climatology
- J. Advances Modeling Earth Systems
- JGR – Atmospheres
- Journal of Hydrology
- Journal of Hydrometeorology
- Nature Climate Change
- Nature Communications
- Remote Sensing of Environment
- Science Advances
- The Cryosphere
- Water Resources Research

Society Member:

- American Geophysical Union (2006-present)
- Canadian Geophysical Union (2013-2015)
- European Geophysical Union (2017)
- American Meteorological Society (2017)
- USGS Rocky Mountain Hydrologic Research Center
- Sigma Gamma Epsilon Earth Sciences Honor Society
- Changing Cold Regions Network

Committee Member:

- Directorate Member & Fellow, INSTAAR, CU Boulder
- Executive Committee Member, INSTAAR, CU Boulder

- Executive Board Member, Western Snow Conference
- NOAA CMIP6 Climate Change Task Force
- Data Acquisition Round Table (DART) committee for the California Cooperative Snow Survey (CA DWR)

Fieldwork Experience

2021 - present	EcoTram: Monitoring water, energy, and vegetation productivity, Como Creek, CO
2019 - 2020	NASA SnowEx field campaign, Niwot Ridge, Colorado
2019	Snow distribution in a forested South American Catchment, Valle Hermoso, Chile
2019	Snowmelt pathway study, Niwot Ridge Long Term Ecological Observatory, Colorado
2017	NASA SnowEx field campaign, Grand Mesa, Colorado
2016	Photogrammetric monitoring of SNOTEL sites snow depth dynamics, Colorado
2013 - 2015	Terrestrial laser survey of 4-D snowpack dynamics, Rocky Mountains, Canada
2012 - 2015	Hydrometeorological impacts of forest clearings, Kananaskis, Alberta, Canada
2011	NASA Goddard grain size measurement campaign, Steamboat Springs, Colorado
2010	NASA JPL vegetation biomass survey, Grand Mesa, Colorado
2010	Basin scale variability of snow properties, Pyrenees, Spain and France
2007 - 2009	Plot and basin scale snow surveys, Sequoia National Park, California
2005 - 2006	Snow-vegetation interactions, Valles Caldera, NM
2002 - 2003	Precipitation gauge deployment and maintenance, Stowe, VT

Invited Talks

Title: Mountains of change: Assessing climate change impacts on water resources and informing potential adaptation strategies; CW3E, Scripps Institute of Oceanography, University of California San Diego, CA, November, 2022.

Title: Mountains of change: Assessing climate change impacts on water resources and informing potential adaptation strategies; Van Tuyl Lecture, Colorado School of Mines, Golden, CO, October, 2022.

Title: Emerging models, measurements, and theory of climate impacts in headwater basins; Yampa Basin Rendezvous, Steamboat Springs, CO, September, 2022

Title: Co-defining climate change refugia to inform management of mountain headwater systems; Panelist, DOE Integrated Mountainous Hydroclimate Workshop, January 2022.

Title: Investigating impacts to ecosystem services tied to declining snow water resources; DOE Watershed Function Science Community Call, January 2022.

Title: Forest impacts on snow water resources: Management and climate adaptation possibilities; USGS North Central Climate Adaptation Science Center Seminar, October 2021

Title: Winter melt trends portend widespread declines in snow water resources
Pacific Northwest Drought Early Warning System Webinar, February 2021
NOAA National Integrated Drought Information System

Title: Mountains of change: Models, measurements, theory, and Indigenous perspectives of climate change impacts in headwater basins; Earth and Atmospheric Sciences Seminar, April 2021, Cornell University, Ithaca, NY

Title: Forest impacts on snow water resources: management and climate adaptation possibilities, Geography Colloquium, April 2021, University of Colorado Boulder

Title: Snow water resources in a warmer American West; Department of Civil Engineering, July 2019, Universidad de Chile, Santiago, Chile

Title: Snow water resources in a warmer American West; Rocky Mountain Association of Professional Geologists, Fall 2018, Denver, Colorado

Title: The Feb. 2017 Oroville Dam Atmospheric River Event: the role of rain-on-snow.
Earth System Research Laboratory, Spring 2018
NOAA, Physical Sciences Division, Boulder, Colorado

Title: *The science of snow and snow-cover persistence*
Cross Country Ski Area Association, Spring 2018
Snow Mountain Ranch, Granby, Colorado

Title: *Applications in mountain and forest hydrology: Observation, models, and advances*
Engineering Hydrology CVEN 4333, Fall 2017
Dept. of Civil, Environmental & Architectural Engineering
University of Colorado, Boulder

Title: *Slower snowmelt in a warmer world: Using observations and modeling to develop a new theory of hydrologic change*
Hydrology & Water Resources Seminar, Winter 2017
Dept. of Civil, Environmental & Architectural Engineering
University of Colorado, Boulder

Title: *Slower snowmelt in a warmer world*
Geology Visiting Lecture Series, Winter 2016
University of Vermont

Title: *LiDAR: a transformative tool for hydrological sciences*
Canadian Society for Hydrological Sciences, Short Course Principles of Hydrology, 2015
University of Saskatchewan
Held in the Canadian Rockies, Alberta

Title: *Snow Measurements*
Canadian Society for Hydrological Sciences, Short Course Principles of Hydrology, 2014
University of Saskatchewan, Canadian Rockies, Alberta

Title: *Hydrology and Landscape Processes in Kananaskis*
Ecology 413: Field Ecology. Summer 2013 University of Calgary, Alberta, Canada

Title: *Snow and Forest Hydrology*
4th-year Ecology course. Spring 2013
University of Calgary, Alberta, Canada

Title: Water and the Atmosphere
Geography 1001: Climate and Vegetation. Spring 2011
University of Colorado, Boulder

Title: Physically based snow modeling
Geography 5241: Advanced Field Methods in Snow Science. Spring 2011
University of Colorado, Boulder; course held in Steamboat Springs, CO

Title: Snow Hydrology
Civil Engineering 150: Introduction to Hydrology. Fall 2009
University of California Los Angeles