

Nicholas Silverman

Water, Climate, & Agriculture Scientist

Education

- 2010–2014 **PhD**, *University of Montana*, Missoula, MT.
Regional Hydroclimatology
Dissertation: A Study of Hydroclimatic Dynamics in Mountain Landscapes
- 2001–2004 **MS**, *University of Washington*, Seattle, WA.
Mechanical Engineering
- 1997–2001 **BS**, *Washington and Lee University*, Lexington, VA, *Cum Laude*.
Physics and Engineering

Computer Skills

- OS and Cloud Linux, Unix, Windows, AWS
VC Git
Languages Python, SQL, R, Javascript, and Google Earth Engine
Modeling HEC-RAS, WRF, HEC-HMS, and various land-surface and climate models

Technical Expertise

- Data Science, Analysis, and Machine Learning
Remote Sensing
Physics-based and Statistical Modeling
Bayesian Statistics
Data Assimilation
Uncertainty and Sensitivity Analyses

Experience

Research

- 2017–2019 **Research Scientist**, *Numerical Terradynamic Simulation Group*, Missoula, MT.
Evaluated water resources and management practices for the Sage Grouse Initiative in the Western USA using remote sensing and Google Earth Engine.
- 2014–2016 **Research Scientist**, *Montana Climate Office*, Missoula, MT.
Worked to improve climate products and research for the state of Montana.
- 2014–2015 **Post-Doctoral Researcher**, *Montana State University*, Bozeman, MT.
Studied the impacts of precipitation and temperature on nitrogen fertilizer management.
○ Developed weather forecasting opportunities for farmers to enable optimization of fertilizer application.

- 2011–2014 **Research Assistant**, *University of Montana, Geosciences*, Missoula, MT.
Research focused on trends in regional scale hydrology and climatology.
- Compared statistical and dynamical precipitation estimates in complex terrain.
 - Evaluated spatial patterns of uncertainty in winter precipitation measurements within mountain landscapes.
 - Developed methodology to disentangle stream flow trends driven by land cover change from those driven by climate change.

Hydrology and Water Resources Engineering

- 2014–present **Principal and Owner**, *Adaptive Hydrology*, Missoula, MT.
Started company to provide dynamic solutions that conserve, sustain, and balance water resources.
- Climate and land-surface modeling.
 - Precision agriculture,
 - Scientific monitoring,
 - Drought and adaptive management,
 - Conservation sciences
 - Climate vulnerability and resiliency,
- 2004–2014 **Water Resources Engineer**, *Natural Systems Design*, Seattle, WA.
River restoration design engineer on projects around the Pacific Northwest region.
- Climate impact analysis on fluvial systems,
 - Sediment transport and hydraulics modeling,
 - Design of stream systems, large woody debris structures, fish passage through culverts, riparian landscape, integrated stormwater management facilities, and wetlands.
 - Construction supervision of hand and machine installed in-stream structures.
- ### Teaching
- 2019 **Adjunct Professor**, *University of Montana*, Missoula, MT.
Natural Resources Science and Management 491: Ethics and Sustainability - Building Circular Economies
- 2017 **Adjunct Professor**, *University of Montana*, Missoula, MT.
Natural Resources Science and Management 201: Soils, Water, and Climate
- 2007–2018 **Instructor**, *University of Washington, Engineering Professional Programs*, Seattle, WA.
Fundamentals of Engineering review course - ethics section.
- Lecture covers engineering ethics for the Engineer-In-Training (EIT) exam.
- 2011–2013 **Co-Instructor**, *UNESCO-IHE Institute for Water Education*, Delft, The Netherlands.
River Restoration and Rehabilitation short course.
- Worked with instructors from The Netherlands to develop and teach a one-month intensive course on river rehabilitation for graduate students and mid-career water resource professionals.
 - Focus areas include: river morphology, morphodynamics, hydrology, and ecology; problem analysis, objective setting, and stakeholder involvement; and rehabilitation techniques and strategies.
- 2006–2007 **Assistant Instructor**, *University of Washington, Engineering Prof. Programs*, Seattle, WA.
Regional Road Maintenance ESA Training - BMPs for In-Water Work
- Field course in techniques for in-water maintenance around the state of Washington.
- 2005 **Assistant Instructor**, *AGC of Washington*, Seattle, WA.
Construction BMPs Field Training
- Field course on the installation and efficacy of standard Best Management Practices for storm water runoff.
- 2003–2004 **Teaching Fellow**, *NSF GK-12 Fellowship Program*, Seattle, WA.
Taught math to middle school students using inquiry-based teaching methods
- 2001–2011 **Teaching Assistant**, *University of Washington & Montana*, Seattle, WA & Missoula, MT.
Assisted in teaching mechanics of materials and introduction to geology lab

Scientific Grants and Fellowships

- 2016 **USDA/NIFA/AFRI: Water for Agriculture Challenge Area**, *Improving Efficacy of Climate Information for Water Use Decisions*, Yung, L., Metcalf, L., Jenco, K., Silverman, N., Bauer, B., Sweet, M., \$499,201.
- 2016 **USGS: Water Resources Research Grant**, *Improving Climate Information to Enhance Drought Preparedness for Montana Agricultural Producers*, Yung, L., Metcalf, L., Jenco, K., Silverman, N., Bauer, B., Sweet, M., \$75,186.
- 2012 **University of Montana Bertha Morton Fellowship**, *Graduate student research award*, \$3,000.
- 2011 **U.S. Environmental Protection Agency Science To Achieve Results (STAR) Fellowship**, *Water Resource Management Strategies for Mountainous Forest Catchments Under Climate Change Scenarios: An Ecohydrologic Approach*, Silverman, N.L., \$126,000.
- 2011 **NASA Montana Space Grant**, *Calibration of Vegetation Parameters within an Ecohydrologic Model using Remote Sensing Techniques*, Silverman, N.L., \$20,000.
Awarded but declined
- 2010 **Montana River Center Scholarship**, *Graduate student research scholarship in water resources*, \$2,500.
- 2003 **National Science Foundation GK-12 Graduate Student Fellowship**, *Physics teaching fellowship*, \$50,000.

Publications (refereed and non-refereed)

Articles

J.P. Donnelly, S.L. King, N.L. Silverman, D.P. Collins, E.M. Carrera-Gonzalez, A. Lafón-Terrazas, and J.N. Moore. Climate and Human Water Use Diminish Wetland Networks Supporting Continental Waterbird Migration. *Global Change Biology*, 2020.

P.M. Wurster, M.P. Maneta, Z. Holden, S. Begueria, P. Gardner, K. Jenco, N.L. Silverman, S. Ewing, B. Maxwell, K. Cobourn, J. Kimball, and S. Vicente-Serrano. Characterizing the Impact of Climatological Anomalies on Agrosystems. *Agriculture and Forest Meteorology*, 2019.

D. Maneta, E. Thompson, A. Cilimburg, and N.L. Silverman. Missoula Vulnerability Assessment. Technical report, Missoula County, May 2019.

D. Maneta, N.L. Silverman, A. Cilimburg, C. Jones, E. Thompson, and C. Brust. Missoula County-Wide Climate and Community Primer. Technical report, Missoula County, December 2018.

J.P. Donnelly, B.W. Allred, D. Perret, N.L. Silverman, J.D. Tack, V.J. Drietz, and D.E. Naugle. Seasonal drought in North America's sagebrush biome structures dynamic mesic resources for sage-grouse. *Ecology and Evolution*, 2018.

N.L. Silverman, B. Allred, P. Donnelly, T. Chapman, J. Maestas, J. Wheaton, J. White, and D. Naugle. Low-tech riparian and wet meadow restoration increases vegetation productivity and resilience across semi-arid rangelands. *Restoration Ecology*, 2018.

B. Maxwell, P. Hegedus, A. Bekkerman, R. Payn, J. Sheppard, N. Silverman, and C. Izurieta. Can optimization associated with on-farm experimentation using site-specific technologies improve producer management decisions? *Proceedings of the International Conference on Precision Agriculture*, 2018.

B. Maxwell, P. Hegedus, P. Davis, A. Bekkerman, R. Payn, J. Sheppard, N. Silverman, and C. Izurieta.

On-farm experimentation with site-specific technologies. *Proceedings of the International Conference on Precision Agriculture*, 2018.

C. Whitlock, W. Cross, B. Maxwell, N. Silverman, and A. Wade. The Montana Climate Assessment: Stakeholder Driven, Science Informed. *Montana Institute on Ecosystems*, 2017.

B. Bauer, S. McKenzie, F. Menalled, J. Mangold, G. Pederson, and N. Silverman. Climate Science 101 for Montana. *Montana Agricultural Extension: MontGuide*, 2016.

N.L. Silverman and M.P. Maneta. Detectability of change in winter precipitation within mountain landscapes: Spatial patterns and uncertainty. *Water Resources Research*, 2016.

M.P. Maneta and N.L. Silverman. A Spatially Distributed Model to Simulate Water, Energy, and Vegetation Dynamics Using Information from Regional Climate Models. *Earth Interactions*, 17(11):1–44, August 2013.

N.L. Silverman, M.P. Maneta, S. Chen, and J.T. Harper. Dynamically downscaled winter precipitation over complex terrain of the Central Rockies of Western Montana, USA. *Water Resources Research*, 49(1):1–13, 2013.

N.L. Silverman, A. Johnson, and K. Andrews. Littlebrook Creek Restoration Assessment. Technical report, May 2010. White Paper for Friends of Littlebrook Creek.

B.T. Schowengerdt, E.J. Seibel, N.L. Silverman, and T.A. Furness. Stereoscopic retinal scanning laser display with integrated focus cues for ocular accommodation. In *Proc. SPIE*, 5291, pages 366–376, 2004.

N.L. Silverman and B.T. Schowengerdt. Engineering a Retinal Scanning Laser Display with Integrated Accommodative Depth Cues. In *Symposium Digest of SID 03*, number 224, pages 1538–1541, 2003.

B.T. Schowengerdt, E.J. Seibel, N.L. Silverman, T.A. Furness, and J.P. Kelly. Binocular retinal scanning laser display with integrated focus cues for ocular accommodation. *Displays and Virtual*, pages 366–376, 2003.

S.M. Klotz, N.L. Silverman, and D.W. Sukow. A Study of Nonlinear Laser Dynamics Using a Circuit Analog. *Washington and Lee Journal of Science*, pages 50–51, 2001.

N.L. Silverman, S.M. Klotz, and D.W. Sukow. Analog Computer Simulation of Nonlinear Laser Dynamics. *Virginia Journal of Science*, page 81, 2001.

Selected Presentations

- Feb 2018 **The grass is always greener: Quantifying outcomes of low-tech riparian and wet meadow restoration using remote sensing**, *Silverman, N.L.*, Society for Range Management Annual Conference, Reno, NV. **Oral.**
- Mar 2017 **Montana Climate Change**, *Silverman, N.L.*, USFS Drought Workshop: Improving Drought Resilience - Forest to Valley Bottom, Choteau, MT. **Keynote: Oral.**
- Oct 2016 **Building Montana Water Resource Resiliency through Information Gathering and Communication at Multiple Space and Time Scales**, *Silverman, N.L. and Jencso, K.*, Montana American Water Resources Association Conference, Fairmont Hotsprings, MT. **Keynote: Oral.**
- Dec 2015 **An Introduction to Montana Climate Science**, *Silverman, N.L.*, Montana Agriculture Extension Climate Conference, Bozeman, MT. **Oral.**

- Dec 2014 **Disentangling the driving mechanism of streamflow trends using runoff sensitivity to land use and climate change**, *Silverman, N.L., Moore, J.N., Maneta, M.P.*, American Geophysical Union Fall Conference, San Francisco, CA. **Oral**.
- Dec 2014 **Ecohydrological and topographical controls on soil moisture and soil temperature for a snow-dominated watershed in the Pacific Northwest of North America**, *Chatanantavet, P., Maneta, M.P., Wilcox, A., Silverman, N.L.*, American Geophysical Union Fall Conference, San Francisco, CA. **Poster**.
- Dec 2014 **Attribution of hydrologic trends using integrated hydrologic and economic models**, *Maneta, M.P., Brugger, D., Silverman, N.L.*, American Geophysical Union Fall Conference, San Francisco, CA. **Poster**.
- Mar 2014 **Evaluating Streamflow Trends Using Runoff Sensitivity to Land Use and Climate Change**, *Silverman, N.L., Moore, J.N., Maneta, M.P.*, Northwest Scientific Association Conference, Missoula, MT. **Poster**.
- Dec 2013 **Changes in Winter Precipitation within Mountain Landscapes: Spatial Patterns and Uncertainty**, *Silverman, N.L., Maneta, M.P.*, American Geophysical Union Fall Conference, San Francisco, CA. **Poster**.
- Dec 2013 **Linked Modeling Approach to Assess Climate Change Effects on Hydrogeomorphic Processes and Aquatic Ecosystems: Example for a Watershed in Western Montana**, *Chatanantavet, P., Wilcox, A., Maneta, M.P., Silverman, N.L.*, American Geophysical Union Fall Conference, San Francisco, CA. **Poster**.
- Sep 2013 **Measuring future changes in winter precipitation within mountainous regions**, *Silverman, N.L., Maneta, M.P.*, American Water Resources Montana State Chapter Conference, Bozeman, MT. **Poster**.
- July 2013 **A Bayesian assessment of the spatial bias in the estimation of winter precipitation over regions of complex terrain**, *Silverman, N.L., Maneta, M.P.*, CUAHSI Conference on Hydroinformatics, Logan, UT. **Poster**.
- Apr 2013 **Downscaling and Correcting Climate Data Over Complex Terrain**, *State Meeting on Water Resources*, Silverman, N.L., Maneta, M.P., Helena, MT. **Invited talk**.
- Dec 2011 **Evaluation of a WRF dynamic downscaling simulation over Western Montana**, *Silverman, N.L., Maneta, M.P.*, American Geophysical Union Fall Conference, San Francisco, CA. **Poster**.
- Apr 2011 **Ecohydrologic model validation using remote sensing techniques**, *Silverman, N.L., Maneta, M.P.*, University of Montana Graduate Student and Faculty Research Conference, Missoula, MT. **Poster**.
- Apr 2011 **Validation of a spatially distributed ecohydrologic model using remote sensing techniques**, *Silverman, N.L., Maneta, M.P.*, Montana Space Grant Consortium Student Research Symposium, Bozeman, MT. **Poster**.
- Oct 2010 **A spatially distributed ecohydrologic model for forested catchments**, *Silverman, N.L., Maneta, M.P.*, American Water Resources Association Montana Conference, Helena, MT. **Poster**.
- Jun 2003 **Engineering a retinal scanning laser display with integrated accommodative depth cues**, *Silverman, N.L., Schowengerdt, B., Seibel, E.*, Society for Information Displays Conference, Baltimore, MD, **Oral**.

Selected Project Experience

- 2019 **Statistical Modeler and Decision Support Developer**, *Arable Labs*, San Francisco, CA.
 Worked directly with the founder of AgTech startup to research and develop decision support tools for farmers. Developed web application using Python Flask and Amazon Web Services.

- 2018 **Hydrologic Data Management Framework**, *SciGaia, LLC*, Bozeman, MT.
 Provided novel tools and algorithms for calculating soil water enhancement potential and crop water use from satellite remote sensing. Aided in climate and water resources data acquisition.
- 2017 **On-Farm Precision Agriculture Experimentation**, *Montana State University*, Missoula, MT.
 Worked with farmers, researchers, and economists to develop statistical and machine learning algorithms for maximizing profit through variable rate fertilizer optimization in winter wheat.
- 2017 **Montana State Climate Assessment**, *Institute on Ecosystems*, Missoula, MT.
 Climate sector lead for the Montana statewide climate impact assessment. Providing high-resolution climate projections and historical trends to evaluate future forestry, water, and agriculture impacts across the state.
- 2014 **Optimizing Fertilizer Application in Winter Wheat using Seasonal Forecasting**, *Montana Fertilizer Advisory Committee*, Missoula, MT.
 Developed a simple web application for growing season precipitation and temperature forecasts using ENSO indices.
- 2015 **Beaver Habitat Suitability Model**, *Clark Fork Coalition and Lolo National Forest*, Missoula, MT.
 Developed statistical model to predict beaver habitat suitability within Lolo National Forest. Model was based on a habitat suitability index (HSI) which was calculated using extensive field data.
- 2014 **Hydroclimatic Trends in Mountain Landscapes**, *Univ. of Montana, PhD Thesis*, Missoula, MT.
 Used state-of-the-art climate, land-surface, and statistical models to evaluate changes and uncertainty of hydroclimatic conditions in Western Montana.
- 2013 **Rangeland Sustainability Assessment**, *Private Ranch*, Paradise Valley, MT.
 Project manager and lead Hydrologist on a team of four scientist working to develop a conservation base-line assessment for a 15,000 acre private ranch in Paradise Valley, MT. Assessment included in-depth analysis of agriculture, hydrology, forestry, wildlife, rangeland, and facility operations.
- 2010 **Littlebrook Creek Habitat Assessment**, *Friends of Littlebrook Creek*, Seattle, WA.
 Evaluated salmonid habitat throughout Littlebrook Creek, an urban watershed within the City of Seattle. Developed a multi-phase restoration plan for over a mile of stream channel.

Workshops and Training

- 2016 **U.S. National Soil Moisture Monitoring Workshop**, Boulder, CO, Invited to participate in a 3-day workshop identifying the existing gaps in a nationwide soil moisture monitoring network..
- 2013 **Software Carpentry Bootcamp**, Logan, UT, Two-day workshop on optimizing scientific programming.
- 2011 **NCAR Command Language (NCL) Workshop**, Laramie, WY, Four-day workshop taught by NCAR NCL developers.
- 2011 **Weather Research & Forecasting (WRF) Model Workshop**, Boulder, CO, One-week training taught by NCAR model developers.
- 2009 **Hec-Ras Open Channel Flow Modeling and Sediment Transport**, Tacoma, WA, Five-day training course through River Restoration Northwest.
- 2007 **Fluvial Geomorphology for Engineers**, Asheville, NC, Taught by Dr. Richard Hey and Wildland Hydrology, Inc..

Organizations and Professional Licensure

- **MT Health Professionals for a Healthy Climate**, Founding Board Member
- **Climate Smart Montana**, Founding Board Member
- **South North Nexus**, Founding Board Member
- **Professional Water Resources Engineer**, State of Washington, #44272
- **Professional Water Resources Engineer**, State of Montana, #20297

Personal Projects

- Spring 2017 **Challenges Faced in Managing Public and Private Land**, Steens Mountain, OR.
Explored the intersection of public and private land in southeast Oregon through a backcountry ski adventure up Steens Mountain. Provided scientific background and editing for article published in Mountain Magazine.
- Summer 2012 **Mountain Mysteries and Climate Change**, Glacier Nat'l Park, MT.
As part of a week-long adventure through three of the major watersheds of North America I hiked across Glacier National Park and paddled out one of its drainages in order to draw attention to the complexities of mountains and climate change. The adventure has been published in Mountain Magazine.
- Spring 2010 **USAID Global Water for Sustainability and MaraFlows Program**, Kenya, Africa.
Traveled through Mara River Basin in Eastern Africa with local and international scientists coordinating strategies for upcoming hydrologic research within the basin. Attended workshops on Payment for Ecosystem Services (PES) schemes, Environmental Flow Assessments, and rural water resource development.
- Fall 2009 **www.Chattahoochee.Wordpress.com**, Southeast U.S.A.
Technical advisor on river conservation and website map layout for professional writer and photographer traveling by canoe from source to sea on the Chattahoochee River in Georgia, Alabama, and Florida.
- 2006-2008 **www.TheSourceLoop.Blogspot.com**, North and South America.
Created a "thoughtful adventure" blog with colleagues to study and educate readers on the source of various American amenities, including: Amazon River oil production in Ecuador, Hydroelectric exploration on the Futaleufu River in Chile, and gold mining in the Atacama Desert of Argentina.