

DR. RAYMOND M. LEE

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RESEARCH INTERESTS

Terrestrial ecology, hillslope hydrology, terrestrial-aquatic interactions, river corridor science, aquatic ecology, limnology, trophic dynamics, water resources management, land use, land/water/climate interactions, Arctic hydrology, permafrost, plant-microbe interactions, Critical Zone science, numerical modeling, geographical information systems (GIS), data science, data visualization, data sonification, science communication, philosophy of science, science pedagogy

EDUCATION

Virginia Polytechnic Institute and State University (Virginia Tech), Ph.D., 2018. Department of Forest Resources and Environmental Conservation. Principal advisors: Kevin McGuire and Brian Strahm. Dissertation: *Modeling recession flow, fate and transport of NO₃⁻, and coupled nitrification-denitrification dynamics on an experimental hillslope*

San Diego State University, M.S., 2014. Department of Geography; Concentration in Watershed Science. Principal advisor: Trent Biggs. Thesis: *Hydrologic, climatological, and biogeochemical controls on thermal structure and anoxia in four hypereutrophic urban water supply reservoirs*

University of California–Davis, B.S., 2006. Major: Managerial Economics; Concentration in Environmental and Resource Economics.

University of California–Davis, B.A., 2006. Major: Philosophy. Education Abroad Program at University of Delhi, New Delhi, India.

PROFESSIONAL APPOINTMENTS

Assistant Professor, University of Wisconsin–Superior	2023–present
Program Director of GIS, University of Wisconsin–Superior	2023–present
Visiting Assistant Professor, Washington College	2022–23
Postdoctoral Fellow, Brigham Young University	2020–22
Postdoctoral Research Associate, Pacific Northwest National Laboratory	2019–20

REFEREED PUBLICATIONS (*STUDENT ADVISEE; †INVITED)

PUBLISHED

[10] †Lee, R., J. Boll, and S. Kumar. (2023) Editorial: Limits and permanence of modern interventions in the water cycle. *Frontiers in Water* 5: 1179819, doi: 10.3389/frwa.2023.1179819.

[9] †Lee, R. M., B. Shoshitaishvili, R. L. Wood, *J. Bekker, and B. W. Abbott. (2023) The

- meanings of the Critical Zone. *Anthropocene* 42: 100377, doi: 10.1016/j.ancene.2023.100377.
- [8] Lee, R. M., N. Griffin, E. Jones, B. W. Abbott, R. J. Frei, S. Bratsman, M. Proteau, I. M. Errigo, A. Shogren, W. B. Bowden, J. Zarnetske, and Z. T. Aanderud. (2022) Bacterioplankton dispersal and biogeochemical function across Alaskan Arctic catchments. *Environmental Microbiology* 24(12): 5690–5706, doi: 10.1111/1462-2920.16259. Media coverage: <https://lifesciences.byu.edu/byu-researchers-fight-to-preserve-permafrost-and-restore-earths-climate>
- [7] Abbott, B. W., M. Brown, J. Carey, J. Ernakovich, J. M. Frederick, L. Guo, G. Hugelius, R. M. Lee, M. M. Loranty, R. Macdonald, P. J. Mann, S. M. Natali, D. Olefeldt, P. Pearson, A. Rec, M. Robards, V. G. Salmon, *S. S. Sayedi, C. Chadel, E. A. G. Schuur, S. Shakil, A. J. Shogren, J. Strauss, S. E. Tank, B. F. Thornton, R. Treharne, M. Turetsky, C. Voigt, N. Wright, Y. Yang, J. P. Zarnetske, *Q. Zhang, and S. Zolkos. (2022) We must stop fossil fuel emissions to protect permafrost ecosystems. *Frontiers in Environmental Science* 10: 889428, doi: 10.3389/fenvs.2022.889428. Media coverage: <https://www.awi.de/en/about-us/service/press/single-view/tauender-permafrost-beinflusst-das-weltklima.html>
- [6] Jones, E. F., R. J. Frei, R. M. Lee, J. D. Maxwell, R. Shoemaker, A. P. Follett, G. M. Lawson, M. Malmfeldt, R. Watts, Z. T. Aanderud, C. Allred, A. T. Asay, M. Buhman, H. Burbidge, A. Call, T. Crandall, I. Errigo, N. A. Griffin, N. C. Hansen, J. C. Howe, E. L. Meadows, E. Kujanpaa, L. Lange, M. L. Nelson, A. J. Norris, E. Ostlund, N. J. Suiter, K. Tanner, J. Tolworthy, M. C. Vargas, and B. W. Abbott. (2021) Citizen science reveals unexpected solute patterns in semiarid river networks. *PLOS One* 16(8): e025541, doi: 10.1371/journal.pone.0255411.
- [5] Chen, X., R. M. Lee, D. Dwivedi, K. Son, Y. Fang, X. Zhang, E. Graham, J. Stegen, J. B. Fisher, D. Moulton, and T. Scheibe. (2020) Integrating field observations and reactive transport modeling to predict watershed water quality under environmental perturbations. *Journal of Hydrology* 602: 125762, doi: 10.1016/j.jhydrol.2020.125762.
- [4] Lee, R. M., K. J. McGuire, B. D. Strahm, J. D. Knoepp, C. R. Jackson, and R. D. Stewart. (2020) Revisiting the Hewlett and Hibbert (1963) hillslope drainage experiment and modeling effects of decadal pedogenic processes and leaky soil boundary conditions. *Water Resources Research* 56: e2019WR025090, doi: 10.1029/2019WR025090. Media coverage: <https://eos.org/editor-highlights/repeating-famous-hillslope-experiment-provides-new-insights>
- [3] Lee, R. M., T. W. Biggs, and X. Fang. (2018) Thermal and hydrodynamic changes under a warmer climate in a variably stratified hypereutrophic reservoir. *Water* 10(9), doi: 10.3390/w10091284.
- [2] Lee, R. M. and T. W. Biggs. (2015) Impacts of land use, climate variability, and management on thermal structure, anoxia, and transparency in hypereutrophic urban water supply reservoirs. *Hydrobiologia* 745(1): 263–284, doi: 10.1007/s10750-014-2112-1.
- [1] Biggs, T. W., C.-T. Lai, P. Chandan, R. M. Lee, A. Messina, R. S. Leshner, and N. Khatoon. (2015) Evaporative fractions and elevation-isotope relationships of high altitude lakes and streams in the arid Western Himalaya. *Journal of Hydrology* 522: 239–249, doi: 10.1016/j.jhydrol.2014.12.023.

SUBMITTED

- Huggett R. and **R. M. Lee**. Problems and prospects of portmanteau titles and other neologisms for interface disciplines in the Earth and life sciences. Submitted to *Progress in Physical Geography*.
- Gianniny, G., J. M. Stark, B. W. Abbott, **R. Lee**, and J. Brahney. Soil moisture mediates the temperature sensitivity of mountain soil phosphorus export: implications for water quality in mountain watersheds. Submitted to *Science of the Total Environment*.
- Abbott, B. W., K. L. Underwood, E. C. Seybold, D. W. Kincaid, S. D. Hamshaw, **R. M. Lee**, D. M. Rizzo, B. Brown, R. Toolin, J. Chorover, L. Li, *S. S. Sayedi, S. St. Clair, G. Lewis, R. L. Buck, Z. T. Aanderud, J. Brahney, R. S. Nixon, W. Wang, C. Flox, and J. Perdrual. Resistance, recovery, and resilience: rethinking the three Rs of survival in the Anthropocene. Submitted to *Earth's Future*.

IN PREP.

- Lee, R. M.**, G. Lawson, S. Collins, E. Jones, N. Hansen, B. W. Abbott, G. Carling, M. Baker, and Z. T. Aanderud. Nutrient concentrations predict Cyanobacterial abundances in Harmful Algal Blooms across a hydrologically-connected network of freshwater and hypersaline lakes and impoundments. In prep.
- Lee, R. M.**, T. W. Magnusson, J. T. Lennon, D. P. Breakwell, A. R. Harker, Z. T. Aanderud. Hypersalinity stabilizes seasonal activity of lentic bacteria. In prep.
- Lee, R. M.**, *J. Nipko, J. P. Zarnetske, G. T. Carling, and B. Abbott. Terrestrial and aquatic controls on the movement of material transported hydrologically across vast Arctic river basins. In prep.
- Lee, R. M.**, *J. Nipko, N. Pastick, J. O'Donnell, G. T. Carling, Allsup, P., J. Brahney, M. Baker, S. Ewing, and B. Abbott. River nutrient and carbon cycling across all permafrost zones from the Arctic Ocean to the Gulf of Alaska and in the Aleutian Islands. In prep.
- Shoshitaishvili, B. and **R. M. Lee**. Rules of enchantment in a complex timescape. In prep.
- Lee, R. M.** and M. Morison. A topological map of the world representing stoichiometric and ecological process functors between the environment and the scientific literature. In prep.

SELECTED PROFESSIONAL PRESENTATIONS (*STUDENT ADVISEE; †INVITED)

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- Lee, R. M.**, G. Carling, J. Brahney, N. J. Pastick, J. O'Donnell, *J. Nipko, *P. Allsup, M. Baker, S. Ewing, and B. W. Abbott. (2023) Biogeochemical effects of permafrost degradation across Alaska from Prudhoe Bay to Valdez. Oral presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2023.
- Shoshitaishvili, B., and **R. M. Lee**. (2023) Should we expand the Critical Zone? A case for including the atmosphere and oceans. Poster presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2023.
- *Nipko, J., B. W. Abbott, W. B. Bowden, A. J. Shogren, **R. M. Lee**, A. Grose, Z. Aanderud, J. P. Zarnetske, J. O'Donnell, A. Rec, and J. VerSteeg. (2023) Seasonal drivers of carbon processing in Arctic rivers: biodegradation and photodegradation in North Slope, Alaska. Oral presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2023.
- †**Lee, R. M.** (2023) Applications of GIS to Arctic permafrost hydrology and biogeochemistry. Oral presentation, Northern Area GIS User Group Meeting, Washburn, WI. September 2023.

- †**Lee, R. M.** (2023) Applying GIS to fire and ice research. Oral presentation, University of Wisconsin–Superior, Department of Natural Sciences Seminar, Superior, WI. March 2023.
- *Nipko, J., Z. Aanderud, B. W. Abbott, W. B. Bowden, A. Eichert, A. Grose, C. Jones, **R. Lee**, A. Rec, J. A. O’Donnell, G. Shoell, A. J. Shogren, J. VerSteeg, J. P. Zarnetske, and Q. Zhang. (2022) Blinded by the light: seasonal sensitivity of Arctic river carbon to photo- and biodegradation. Poster presentation, American Geophysical Union Annual Meeting, Chicago, IL. December 2022.
- Wehrmeister, H., G. T. Carling, **R. M. Lee**, B. W. Abbott, *J. Nipko, K. Caskey, and A. Thompson. (2022) Seasonal and longitudinal variability in mercury concentrations in Arctic rivers. Poster presentation, American Geophysical Union Annual Meeting, Chicago, IL. December 2022.
- Lee, R. M.**, *Q. Zhang, *J. Nipko, J. P. Zarnetske, G. T. Carling, Z. Aanderud, J. Brahney, and B. Abbott. (2021) Terrestrial and aquatic controls on the movement of material transported hydrologically across vast Arctic river basins. Oral presentation, American Geophysical Union Annual Meeting, New Orleans, LA. December 2021.
- †**Lee, R. M.** (2021) How to break your model and then sell it to other scientists. Oral presentation, BYU Department of Plant and Wildlife Sciences Seminar, Provo, UT. November 2021.
- †**Lee, R. M.**, K. Underwood, E. Seybold, S. Hamshaw, D. Kincaid, D. Rizzo, L. Li, J. Perdrial, and B. Abbott. (2021) Big Data is finally enough to evaluate ecosystem vulnerability in the Anthropocene. Oral presentation, Geological Society of America Annual Meeting, Portland, OR. October 2021.
- Perdrial, J., C. Bristol, M. Ruckhaus, E. Seybold, B. Stewart, B. W. Abbott, D. W. Kincaid, K. Underwood, S. D. Hamshaw, J. B. Shanley, L. Li, D. Rizzo, **R. Lee**, and B. S. Lee. (2021) Assessing ecohydrological resilience across scales: opportunities and challenges for Critical Zone research. Oral presentation, Goldschmidt Conference, Virtual, July 2021.
- Lee, R. M.**, X. Chen, P. Shuai, D. Livingston, and E. Coon. (2019) High-resolution modeling of hydrologic exchange flows in the Columbia River Subbasin at the Hanford Reach. eLightning presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2019.
- †McGuire, K. J., **R. M. Lee**, B. D. Strahm, J. D. Knoepp, R. D. Stewart, and C. R. Jackson. (2019) Revisiting a 50-year-old hillslope drainage experiment at the Coweeta Hydrologic Lab. Oral presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2019.
- McGuire, K. J., **R. M. Lee**, B. D. Strahm, J. D. Knoepp, C. R. Jackson, and R. D. Stewart. (2019) Revisiting the Hewlett and Hibbert hillslope drainage experiment and tracking downslope nitrate transport. Oral presentation, 10th EGU Leonardo Conference: Global change, landscape ageing and the pulse of catchments, Esch-sur-Alzette, Luxembourg. October 2019.
- Lee, R. M.**, B. D. Strahm, K. J. McGuire, and J. Knoepp. (2018) Decoupled water and nitrate transport downslope and across the terrestrial-aquatic interface. Oral presentation, Soil Science Society of America Annual Meeting. San Diego, CA. January 2019.
- Strahm, B. D., **R. M. Lee**, K. J. McGuire, and J. Knoepp. (2018) Decoupled water and nitrate

- transport downslope and across the terrestrial-aquatic interface. Oral presentation, American Geophysical Union Annual Meeting, Washington, D. C. December 2018.
- Lee, R. M., K. J. McGuire, B. D. Strahm, and J. Knoepp. (2016) Modeling reactive nitrogen cycling on a forested hillslope using $^{15}\text{NO}_3$ and D_2O tracers. Poster presentation, Soil Science Society of America Annual Meeting, Phoenix, AZ. November 2016.
- Lee, R. M., K. J. McGuire, and B. D. Strahm. (2015) Modeling relative roles of biogeochemical cycling and hydrologic transport on nutrient export at a forested hillslope. Poster presentation, Gordon Research Conference: Catchment Science: Interactions of Hydrology, Biology, and Geochemistry, Andover, NH. June 2015.
- Lee, R. M. and T. Biggs. (2014) Thermal and oxygen dynamics at four urban water supply Reservoirs. Poster presentation, Water Resources and Policy Initiatives Annual Conference, San Francisco, CA. June 2014.
- Lee, R. M. and T. Biggs. (2013) Thermal and oxygen dynamics in four drinking water Reservoirs. Oral presentation, Association of American Geographers Annual Meeting, Los Angeles, CA. April 2013.
- Biggs, T. W., R. M. Lee, A.T. Messina, and P. Chandan. (2012) Lapse rates for hydrological modeling in the high Himalaya from MODIS and in situ loggers. Oral presentation, American Geophysical Union Annual Meeting, San Francisco, CA. December 2012.

PROPOSALS, GRANTS, AND FELLOWSHIPS

- NSF Office of Polar Programs. Lee, Abbott, Godsey, Li, and Schaedel, *Arctic river networks key to permafrost carbon-climate feedbacks*. \$160,000. **Unfunded**.
- Edna Bailey Sussman Fund. Lee, *Elucidating processes of nutrient export on a forest hillslope*. \$5,910. **Funded**, 2015.
- Virginia Water Resources Research Center. Lee, Strahm, and McGuire, *Relative roles of biogeochemical cycling and hydrologic transport on nutrient export at a forested hillslope*. \$5,000. **Funded**, 2015.
- Edna Bailey Sussman Fund. Lee, *Elucidating processes of biogeochemistry and anoxia in drinking water reservoirs*. \$5,910. **Funded**, 2013.
- California State University Water Resources and Policy Initiatives. Lee and Biggs, *Thermal and oxygen dynamics in four drinking water reservoirs*. \$5,060. **Funded**, 2012.

PATENTS AND COPYRIGHTS

- Copyright, IPID: 31790, Battelle PNNL Inventor for Github repository for SBR-SFA project that contains the codes, documentation, and workflows for doing research, including PFLOTRAN simulation, E4D-PFLOTRAN coupling, ATS simulation, and SWAT modeling

TEACHING AND ADVISING

COURSES TAUGHT

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| Instructor, ENSC100, <i>Environmental Science</i> (UW–Superior) | 2024/Sp |
| Instructor, GEOL120, <i>Our Water Resources</i> (UW–Superior) | |
| Instructor, GEOG343, <i>Fundamentals of GIS II</i> (UW–Superior) | |
| Instructor, GEOG241, <i>Fundamentals of GIS I</i> (UW–Superior) | 2023/Fa |
| Instructor, GEOG442, <i>Advanced Principles of GIS</i> (UW–Superior) | |

Instructor, ENV141, <i>Atmosphere, Ocean, and Environment</i> (Washington College)	2023/Sp
Instructor, ENV294, <i>The Arctic Environment</i> (Washington College)	
Instructor, ENV101, <i>Introduction to Environmental Studies</i> (Washington College)	2022/Fa
Instructor, ENV141, <i>Atmosphere, Ocean, and Environment</i> (Washington College)	
Teaching assistant, FOR2004, <i>Forest Ecosystems</i> (Virginia Tech)	2018/Fa
Teaching assistant, FOR2214, <i>Introduction to Land and Field Measurements</i> (Virginia Tech)	2017/Fa
Teaching assistant, FOR2414, <i>Field Experiences in Forest Resources</i> (Virginia Tech)	2016/Sp
Teaching assistant, FOR4114, <i>Information Technologies for Natural Resources Management</i> (Virginia Tech)	2015/Sp

GRADUATE STUDENTS ADVISED

Paden Allsup (M.S.; BYU; 2023–present; research on Arctic hydrology)
 Sara Sayedi (Ph.D.; BYU; 2020–2022); research on fire ecology; currently a postdoctoral researcher in remote sensing, water security, and climate at William and Mary University
 Qiwen Zhang (Ph.D.; BYU; 2020–2021); field campaign at Toolik Field Station, AK; currently pursuing Ph.D. at Max Planck Institute for Biogeochemistry

UNDERGRADUATE STUDENTS ADVISED

Riley Bruce (B.S.; Washington College; 2022–2023); Senior capstone experience, “The effect of ocean acidification on Blue Crabs (*Callinectes Sapidus*) in the Chesapeake Bay”
 Kyle Stansbury (B.S.; Washington College; 2022–2023); Senior capstone experience, “Environmental costs of the production of sustainable materials compared to non-sustainable materials”; currently pursuing M.S. in Sustainable Engineering at Villanova University
 Jeremy Bekker (B.S.; BYU; 2021–2023); research on Critical Zone science; currently pursuing Ph.D. in Clinical Psychology at BYU
 Jansen Nipko (B.S.; BYU; 2020–2023); field campaign at Toolik Field Station, AK; currently pursuing Ph.D. at West Virginia University
 Robert Sainsbury (B.S.; BYU; 2020–2023); research on fire ecology; currently pursuing M.S. in Biomedical Informatics at the University of Utah

PROFESSIONAL SERVICE

REVIEWER FOR INTERNATIONAL JOURNALS AND FUNDING AGENCIES

Environmental Microbiology (1); Frontiers in Water (1)	2023
International Journal of Environmental Research and Public Health (1); National Science Foundation (2)	2022
Advances in Water Research (1); Hydrological Processes (1); Nature Communications (1); Polar Biology (1)	2021

GUEST EDITOR FOR INTERNATIONAL JOURNALS

Frontiers in Water (Lead editor; “Limits and Permanence of Modern Interventions in the Water Cycle”; <https://www.frontiersin.org/research-topics/30505/limits-and-permanence-of-modern-interventions-in-the-water-cycle>) 2021

JUDGE

CURA Poster Competition (BYU College of Life Sciences)

2021

SKILLS

PROJECT MANAGEMENT

Long-distance collaboration; design and implementation of collaborative field campaigns; and management of synthesis and meta-analysis projects. Experience with diverse stakeholders (academia, national laboratories, local and federal government agencies, and non-governmental organizations) for projects located in southern California, Indian Himalaya, New England, Southern Appalachia, Pacific Northwest, Mountain West, and Arctic Alaska.

FIELD EXPERIENCE

Field manipulation experiments; stable isotope tracers; surveying (land and bathymetric); sampling for water (precipitation, soil water, and rivers), soil (soil, roots, and mycorrhizae), organisms (benthic macroinvertebrates), and gas (soil microbial respiration); and installing and maintaining sensors, data loggers, and telemetry equipment. Experience in permafrost, glacial, desert, forest, and agricultural environments.

LABORATORY EXPERIENCE

Analysis and experimentation including dissolved organic matter bioavailability, elemental analysis CNHS, mass spectrometry, gas chromatography, ion chromatography, dissolved and particulate carbon analysis, fluorometry, and water isotope analysis.

SOFTWARE AND PROGRAMMING

Languages: Linux, C/C++, R, Python, and Fortran. GIS software: ArcGIS and QGIS. Workflow development software: Git, Jupyter Notebook, and Docker. Analyzer software: HOBO and s::can.

STATISTICS AND NUMERICAL MODELING

Mixed-modeling, multiple regression, trend analysis, hydrologic and reactive transport modeling (hillslope soil water, rivers, and reservoirs), and workflow development. Numerical modeling in High Performance Computing and Parallel Computing environments (Lawrence Berkeley National Laboratory and BYU). Models: CE-QUAL-W2, HYDRUS-2D, Amanzi/ATS. Mesh generation software: TINerator, LaGriT, PyLaGriT, ParaView, and VisIt.

PROFESSIONAL MEMBERSHIPS

American Geophysical Union
American Association of Geographers
Northern Area GIS User Group
Northeastern MN GIS User Group