Liyuan He

Ph.D.
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RESEARCH INTERESTS

My research focuses on understanding the impacts of soil microbial community on carbon cycle under global change, including climate warming, elevated CO_2, nitrogen deposition, wildfires, plant invasion, and land use change, using a data-model integration approach. The major approaches I used in my research include:

1. Compiling comprehensive datasets for understanding the biogeography of soil microbial community.
2. Generating novel microbial datasets using machine learning and deep learning approaches.
3. Improving ecosystem and Earth system models by incorporating explicit soil microbial mechanisms.
4. Applying the improved ecosystem and Earth system models with explicit soil microbial mechanisms to project carbon cycle under global change and understand the underlying mechanisms.
5. Empowering microbial models with genetic data by informing microbe-mediated biogeochemical processes with high-resolution genome information.

ACADEMIC APPOINTMENTS

Oak Ridge National Laboratory, Oak Ridge, TN — Apr 2024 - Now
Postdoctoral Research Associate | Environmental Science Division
Advisor: Dr. Melanie Mayes

San Diego State University, San Diego, CA — May 2022 - Apr 2024
Postdoctoral Research Associate | Department of Biology
Advisor: Dr. Xiaofeng Xu

EDUCATION

University of California at Davis & San Diego State University, CA — Jun 2022
Doctor of Philosophy in Ecology | GPA: 3.95/4.0
Dissertation: Multi-scale Modeling of Soil Microbial Control on Terrestrial Carbon Cycle

Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China — Jun 2017
Master of Science in Ecology
Thesis: Effects of precipitation change and nitrogen deposition on aboveground net primary productivity in a temperate grassland, Inner Mongolia

Northeast Forestry University, Harbin, China — Jun 2014
Bachelor of Agronomy in Forestry
GPA: 3.98/4.0
Rank: 1/28 in Department of Forestry

PUBLICATION

Leading-author papers

1. **He, L.**, J. L. M. Rodrigues, M. A. Mayes, C. T. Lai, D. A. Lipson, and X. Xu. 2024. Modeling microbial carbon fluxes and stocks in global soils from 1901 to 2016. Biogeosciences **2023**:1-53.
2. **He, L.**, N. Viovy, and X. Xu. 2023. Macroecology Differentiation Between Bacteria and Fungi in Topsoil Across the United States. Global Biogeochemical Cycles **37**:e2023GB007706.
3. Zhao, F., **L. He***[#], B. Bond-Lamberty, I. A. Janssens, J. Wang, G. Pang, Y. Wu, and X. Xu. 2022. Latitudinal shifts of soil microbial biomass seasonality. PNAS Nexus **1**:pgac254. (co-first author & co-corresponding author)
4. **He, L.** 2022. Multi-Scale Modeling of Soil Microbial Control on Terrestrial Carbon Cycle. Ph.D. University of California, Davis, United States -- California.
5. **He, L**., and X. Xu. 2021. Mapping soil microbial residence time at the global scale. Global Change Biology **27**:6484-6497.
6. **He, L.**, C. T. Lai, M. A. Mayes, S. Murayama, and X. Xu. 2021. Microbial seasonality promotes soil respiratory carbon emission in natural ecosystems: A modeling study. Global Change Biology 27:3035-3051.
7. **He, L.**, D. A. Lipson, J. L. Mazza Rodrigues, M. Mayes, R. G. Björk, B. Glaser, P. Thornton, and X. Xu. 2021. Dynamics of Fungal and Bacterial Biomass Carbon in Natural Ecosystems: Site-Level Applications of the CLM-Microbe Model. Journal of Advances in Modeling Earth Systems 13:e2020MS002283.
8. **He, L.**, J. L. M. Rodrigues, N. A. Soudzilovskaia, M. Barceló, P. A. Olsson, C. Song, L. Tedersoo, F. Yuan, F. Yuan, and D. A. Lipson. 2020. Global biogeography of fungal and bacterial biomass carbon in topsoil. Soil Biology and Biochemistry 151:108024.
9. Wang, J., X. Xu, Y. Liu, W. Wang, C. Ren, Y. Guo, J. Wang, N. Wang, **L. He***, and F. Zhao. 2024. Unknown bacterial species lead to soil CO_2 emission reduction by promoting lactic fermentation in alpine meadow on the Qinghai-Tibetan Plateau. Science of The Total Environment **906**:167610. (co-corresponding author)
10. Li, D., **L. He***, J. Qu, and X. Xu. 2022. Spatial evolution of cultivated land in the Heilongjiang Province in China from 1980 to 2015. Environmental Monitoring and Assessment **194**:444. (corresponding author)
11. Hu, H., **L. He***, H. Ma, J. Wang, Y. Li, J. Wang, Y. Guo, C. Ren, H. Bai, and F. Zhao. 2022. Responses of AM fungal abundance to the drivers of global climate change: A meta-analysis. Science of The Total Environment **805**:150362. (co-first author)
12. **He, L.**, Z. Hu, Q. Guo, S. Li, W. Bai, and L. Li. 2015. Influence of nitrogen and phosphorus addition on the aboveground biomass in Inner Mongolia temperate steppe, China. Chinese Journal of Applied Ecology 26.

Co-author papers

13. Guo, Z., J. Liu, **L. He**, J. L. M. Rodrigues, N. Chen, Y. Zuo, N. Wang, X. Zhu, Y. Sun, L. Zhang, Y. Song, D. Zhang, F. Yuan, C. Song, and X. Xu. 2024. Dominant Edaphic Controls on Particulate Organic Carbon in Global Soils. Global Change Biology **30**:e17619.
14. Zuo, Y., **L. He**, Y. Wang, J. Liu, N. Wang, K. Li, Z. Guo, L. Zhang, N. Chen, C. Song, F. Yuan, L. Sun, and X. Xu. 2024. Genome-Enabled Parameterization Enhances Model Simulation of CH4 Cycling in Four Natural Wetlands. Journal of Advances in Modeling Earth Systems **16**:e2023MS004139.
15. Li, J., **L. He**, J. Wang, X. Zhao, J. Chen, C. Ren, J. Wang, Y. Guo, and F. Zhao. 2024. Responses of particulate and mineral-associated organic carbon to temperature changes and their mineral protection mechanisms: A soil translocation experiment. Science of The Total Environment **948**:174689.
16. Zhang, L., X. Zhao, J. Wang, **L. He**, C. Ren, J. Wang, Y. Guo, N. Wang, and F. Zhao. 2024. Antarctic Soils Select Copiotroph-Dominated Bacteria. Microorganisms **12**:1689.

17. Ren, Y., Y. Zao, Y. Zhao, R. Su, G. Yang, X. Li, J. Kang, Y. Shi, Y. Xie, N. Wang, Y. Zuo, K. Li, **L. He**, X. Xu, and L. Zhang. 2024. Association between CH_4 uptake and N_2O emission in grassland depends on nitrogen inputs. Journal of Plant Ecology.
18. Wang, Y., **L. He**, J. Liu, K. A. Arndt, J. L. Mazza Rodrigues, D. Zona, D. A. Lipson, W. C. Oechel, D. M. Ricciuto, S. D. Wullschleger, and X. Xu. 2024. Intensified Positive Arctic–Methane Feedback under IPCC Climate Scenarios in the 21st Century. Ecosystem Health and Sustainability **10**:0185.
19. Wang, J., **L. He**, J. Wang, Y. Liu, C. Ren, J. Wang, Y. Guo, N. Wang, W. Wang, and F. Zhao. 2024. Contrasting potential impact patterns of unique and shared microbial species on nitrous oxide emissions in grassland soil on the Tibetan Plateau. Applied Soil Ecology **195**:105246.
20. Guo, Z., Y. Wang, J. Liu, **L. He**, X. Zhu, Y. Zuo, N. Wang, F. Yuan, Y. Sun, L. Zhang, Y. Song, C. Song, and X. Xu. 2024. Mapping turnover of dissolved organic carbon in global topsoil. Science of The Total Environment **906**:167621.
21. Zhang, L., L. Jia, **L. He**, D. A. Lipson, Y. Wang, S. Wang, and X. Xu. 2023. Homeostatic evidence of management-induced phosphorus decoupling from soil microbial carbon and nitrogen metabolism. Journal of Plant Ecology:rtad035.
22. Chen, L., J. Wang, **L. He**, X. Xu, J. Wang, C. Ren, Y. Guo, and F. Zhao. 2023. Metagenomic highlight contrasting elevational pattern of bacteria- and fungi-derived compound decompositions in forest soils. Plant and Soil.
23. Qiu, T., J. Yu, **L. He**, J. Liu, Q. Cui, Y. Cui, C. Duan, S. Zhao, Y. Wang, and L. Fang. 2023. Slope position mediates the co-utilization of phosphorus by plants and microbes through rhizosphere processes in a phosphorus-limited forest. CATENA **222**:106808.
24. Zhou, S., Y. Li, J. Wang, **L. He**, J. Wang, Y. Guo, and F. Zhao. 2022. Contrasting Soil Microbial Functional Potential for Phosphorus Cycling in Subtropical and Temperate Forests. Forests **13**:2002.
25. Wang, J., **L. He**, X. Xu, C. Ren, J. Wang, Y. Guo, and F. Zhao. 2022. Linkage between microbial functional genes and net N mineralisation in forest soils along an elevational gradient. European Journal of Soil Science **73**:e13276.
26. Li, Y., J. Wang, **L. He**, X. Xu, J. Wang, C. Ren, Y. Guo, and F. Zhao. 2022. Different mechanisms driving increasing abundance of microbial phosphorus cycling gene groups along an elevational gradient. iScience:105170.
27. Wang, Y., F. Yuan, K. A. Arndt, J. Liu, **L. He**, Y. Zuo, D. Zona, D. A. Lipson, W. C. Oechel, D. M. Ricciuto, S. D. Wullschleger, P. E. Thornton, and X. Xu. 2022. Upscaling Methane Flux From Plot Level to Eddy Covariance Tower Domains in Five Alaskan Tundra Ecosystems. Frontiers in Environmental Science **10**.
28. Zhang, J., Y. Zhang, W. Fan, **L. He**, Y. Yu, and X. Mao. 2022. A Modified Two-Steps Three-Stage Inversion Algorithm for Forest Height Inversion Using Single-Baseline L-Band PolInSAR Data. Remote Sensing **14**:1986.
29. Zhou, S., L. Chen, J. Wang, **L. He**, J. Wang, C. Ren, Y. Guo, and F. Zhao. 2022. Stronger microbial decay of recalcitrant carbon in tropical forests than in subtropical and temperate forest ecosystems in China. CATENA **215**:106351.
30. Zhu, X., F. Yuan, **L. He**, Z. Guo, N. Wang, Y. Zuo, J. Liu, K. Li, Y. Wang, Y. Sun, L. Zhang, C. Song, Y. Song, C. Gong, Y. Son, D. Guo, and X. Xu. 2022. Wetland conversion to cropland alters the microbes along soil profiles and over seasons. CATENA **214**:106282.
31. Zuo, Y., Y. Wang, **L. He**, N. Wang, J. Liu, F. Yuan, K. Li, Z. Guo, Y. Sun, X. Zhu, L. Zhang, C. Song, L. Sun, and X. Xu. 2022. Modeling methane dynamics in three wetlands in Northeastern China by using the CLM-Microbe model. Ecosystem Health and Sustainability **8**:2074895.
32. Zhao, F., J. Wang, Y. Li, X. Xu, **L. He**, J. Wang, C. Ren, and Y. Guo. 2022. Microbial functional genes driving the positive priming effect in forest soils along an elevation gradient. Soil Biology and Biochemistry **165**:108498.
33. Zhu, X., L. Zhang, Y. Zuo, J. Liu, J. Yu, F. Yuan, N. Wang, **L. He**, Y. Wang, and Z. Guo. 2021. Wetland reclamation homogenizes microbial properties along soil profiles. Geoderma 395:115075.

34. Guo, Z., Y. Wang, Z. Wan, Y. Zuo, **L. He**, D. Li, F. Yuan, N. Wang, J. Liu, and Y. Song. 2020. Soil dissolved organic carbon in terrestrial ecosystems: Global budget, spatial distribution and controls. Global Ecology and Biogeography 29:2159-2175.
35. Ma, J., H. Duan, **L. He**, M. Tiffany, Z. Cao, T. Qi, M. Shen, T. Biggs, and X. Xu. 2020. Spatiotemporal pattern of gypsum blooms in the Salton Sea, California, during 2000-2018. International Journal of Applied Earth Observation and Geoinformation 89:102090.
36. Xu, X., N. Wang, D. Lipson, R. Sinsabaugh, J. Schimel, **L. He**, N. A. Soudzilovskaia, and L. Tedersoo. 2020. Microbial macroecology: In search of mechanisms governing microbial biogeographic patterns. Global Ecology and Biogeography 29:1870-1886.
37. Gao, L., B. Tao, Y. Miao, L. Zhang, X. Song, W. Ren, **L. He**, and X. Xu. 2019. A global data set for economic losses of extreme hydrological events during 1960-2014. Water Resources Research 55:5165-5175.
38. Wang, Y., F. Yuan, F. Yuan, B. Gu, M. S. Hahn, M. S. Torn, D. M. Ricciuto, J. Kumar, **L. He**, and D. Zona. 2019. Mechanistic modeling of microtopographic impacts on CO2 and CH4 fluxes in an alaskan tundra ecosystem using the CLM-microbe model. Journal of Advances in Modeling Earth Systems 11:4288-4304.
39. Bo, Z., C. You, Z. Hu, Q. Guo, **L. He**, Y. Du, S. Li, and Y. Gan. 2017. Influence of nitrogen and water addition on the biomass in Inner Mongolia temperate steppe, China. Chinese Journal of Applied & Environmental Biology **23**:658-664.

HONORS & AWARDS

National Award for Outstanding Students Abroad (top 1%)	2022
Distinguished Graduate Student Research Award at UC Davis (1 graduate / department)	2022
YANG HANXI Best Student Paper Award by SINO-ECO (top 2)	2021
Travel grant at California State University (5 graduates / 5 campuses)	2020
Travel funding to attend CESM Tutorial Workshop at NCAR	2019
Second Class Scholarship for Outstanding Students at Chinese Academy of Sciences	2016
Second Class Scholarship for Outstanding Students at Chinese Academy of Sciences	2015
First Class Scholarship for Outstanding Students at Chinese Academy of Sciences	2014
Outstanding Graduate Awards at Northeast Forestry University	2014
Certification of Student Research Training Program at Northeast Forestry University	2013
First Class Scholarship for Outstanding Students at Northeast Forestry University	2013
First Class Scholarship for Outstanding Students at Northeast Forestry University	2013
Outstanding Students in Summer Program at Sun Yat-sen University	2013
Outstanding Students in Summer Program at Chinese Academy of Sciences	2012
National Scholarship (top 1%)	2012
First Class Scholarship for Outstanding Students at Northeast Forestry University	2012
First Class Scholarship for Outstanding Students at Northeast Forestry University	2011
National Endeavor Scholarship (top 2%)	2011
Second Class Scholarship for Outstanding Students at Northeast Forestry University	2011
First Class Scholarship for Outstanding Students at Northeast Forestry University	2010

PRESENTATIONS

Invited talks

1. **Liyuan He** (2024) "Multi-scale Modeling of Soil Microbial Control on Terrestrial Carbon Cycle", Environmental Science Division, Oak Ridge National Laboratory, USA.
2. **Liyuan He** (2022) "Multi-scale Modeling of Soil Microbial Control on Terrestrial Carbon Cycle and the Development of Individual-Based Microbial Model", Department of Environmental Science, Policy, & Management, UC Berkeley, USA.
3. **Liyuan He** (2022) "Multi-scale Modeling of Soil Microbial Control on Terrestrial Carbon Cycle", Joint Program of Ecology, UC Davis & San Diego State University, USA.
4. **Liyuan He** (2021) "Site-level data-model integration for fungal and bacterial dynamics", Reducing Uncertainty in Biogeochemical Interactions through Synthesis and Computation (RUBISCO) working group, Department of Energy, USA.
5. **Liyuan He**, Xiaofeng Xu. Global patterns and controls of fungal and bacterial biomass historical dynamics during 1901-2016 as simulated by the CLM-Microbe model. ESA annual Meeting. Aug 6-11, 2023. Portland, Oregon.
6. **Liyuan He**, Qiuming Yao, Kristen M. DeAngelis, Luiz A. Domeignoz Horta, Yang Song, Melanie Mayes. Mechanisms behind warming induced increases of microbial respiration as revealed by the genetic-informed CoMEND model. ESA annual Meeting. Aug 10-15, 2025. Baltimore, Maryland.

Conference presentations

7. **Liyuan He**, Xiaofeng Xu. Growing fungal and bacterial biomass carbon in North America during 1901-2016 as simulated by CLM-Microbe. AGU Fall Meeting. Dec 11-15, 2023. San Francisco, California. (oral)
8. **Liyuan He**, Jorge L. Mazza Rodrigues, Melanie Mayes, Chun-Ta Lai, David A. Lipson, Xiaofeng Xu. Historical dynamics of terrestrial carbon during 1901-2016 as simulated by the CLM-Microbe model. AGU Fall Meeting. December 12-16, 2022. Chicago, Illinois. (poster)
9. **Liyuan He**, Nicolas Viovy, Xiaofeng Xu. Macroecology of soil fungi and bacteria in the United States using a data-model integration approach. AGU Fall Meeting. December 13-17, 2021. New Orleans, LA. (poster)
10. **Liyuan He**, Victoria Broadnax, Xiaofeng Xu. Global biogeography of microbial residence time. Student Research Symposium, CSU. March 19-20, 2021. Online. (oral)
11. **Liyuan He,** David Lipson, Jorge L Mazza Rodrigues, Melanie A Mayes, Robert G Bjork, Bruno Glaser, Peter E Thornton, Xiaofeng Xu. Dynamics of Fungal and Bacterial Biomass Carbon in Natural Ecosystems: Site-level Applications of the CLM-Microbe Model. AGU Fall Meeting. December 1-17, 2020. Online. (oral)
12. Olivia Yang, **Liyuan He**, Xiaofeng Xu. Soil Microbial Community Shift and its Edaphic Control Across the US. The Ecological Society of America. August 2-7, 2020. Online. (poster)
13. Wang, Y., F. Yuan, F. Yuan, B. Gu, M. S. Hahn, M. S. Torn, D. M. Ricciuto, J. Kumar, **L. He**, and D. Zona. Mechanistic modeling of microtopographic impacts on CO_2 and CH_4 fluxes in an alaskan tundra ecosystem using the CLM-microbe model. The Ecological Society of America. August 11-16, 2019. Salt Lake, US. (oral)
14. Jinge Ma, Hongtao Duan, **Liyuan He**, Mary Tiffany, Zhigang Cao, Tianci Qi, Ming Shen, Stuart Hurlbert, Trent Biggs, Xiaofeng Xu. Spatiotemporal Pattern of Gypsum Blooms in the Salton Sea, California, during 2000-2018. Salton Sea Summit, October 17-18, 2019. UC Riverside/Palm Desert Campus, US. (poster)
15. **Liyuan He**. Difference in relationship between vegetation, soil C:N ratio and productivity at site and regional scales. 14th Ecology Conference of China. September 23-25, 2015. Chengdu, China. (oral)

REVIEWER FOR PAPERS

ISME journal, ISME communication, Nature Communications, PNAS, Global Ecology and Biogeography, International Journal of Applied Earth Observation and Geoinformation, Journal of Advances in Modeling Earth Systems, Soil Biology and Biochemistry, Geoderma, Global Change

Biology, Water Resources Research, Science of the Total Environment, Journal of Environmental Management, European Journal of Soil Science, Environmental Microbiology, Environmental Microbiology Reports, NASA Postdoctoral Program.

PARTICIPATED PROJECTS

1. How Microbes and Minerals Make Necromass that Persists (PI: Dr. Kristen DeAngelis)
2. RAPID: Interactive effects of wildfire and severe drought on plants, soil microbes and C storage in a semiarid shrubland ecosystem (PI: Dr. David Lipson)
3. Integrating a Microbial Data System with an Earth System Model for Evaluating Microbial Biogeochemistry (PI: Dr. Xiaofeng Xu)
4. Modeling microbial processes at multiple scales (PI: Dr. Xiaofeng Xu)
5. An Earth System Modeling Framework for Microbial Community Structure on Litter Decomposition (PI: Dr. Xiaofeng Xu)
6. The relationship of terrestrial ecosystem carbon, nitrogen, and water flux and the environmental mechanisms in China (PI: Dr. Zhongmin Hu)
7. Response of grassland ecosystem water use efficiency to altered precipitation regime (PI: Dr. Zhongmin Hu)
8. Allopathy and its mechanisms of extract solution of *Pinus koraiensis* on *Betula platyphylla* (PI: Dr. Lixin Chen)

CONFERENCE CONVENING

- Virginia Rich, **Liyuan He**, Debjani Sihi, Xiaofeng Xu, Cheng Shi. Uncovering novel microbial mechanisms and integrating them into ecosystem models. AGU Fall Meeting. Dec 11-15, 2023. San Francisco, California.

TEACHING EXPERIENCE

- BIO215 Biostatistics (guest lecture, Fall 2023)
- BIO215 Biostatistics (guest lecture, Fall 2022)
- BIOL 354 - Ecology and the Environment (guest lecture, Fall 2022)
- BIOL 354 - Ecology and the Environment (guest lecture, Spring 2022)
- BIOL 354 - Ecology and the Environment (teaching assistant, Spring 2021)

FELLOWSHIP & GRANT WRITING EXPERIENCE

NOAA Climate & Global Change (C&GC) Postdoctoral Program Fellowship	2022
CSUPERB program Student Travel Grant	2020
CESM Tutorial Workshop Student Travel Grant	2019

OUTREACH & VOLUNTEER ACTIVITIES

Annual two-day summer tutorial workshops on CLM-Microbe setup and simulations (Mentor)	2023
Annual two-day summer tutorial workshops on CLM-Microbe setup and simulations (Mentor)	2022
Skype a Scientist, Video Demonstration Online	2019
Graduate Group of Ecology Exhibition on Picnic Day at UC Davis	2019

Demonstration of How to Make Cheese at Smythe Academy Science night for elementary school students, Sacramento, CA 2018

SELECTED MEDIA OUTREACH

- UC Davis highlights: The 2021 Distinguished Graduate Student Award is awarded to Liyuan He
- SDSU Newscenter: Soil Microbes and Carbon Emissions: The Weather Factor
- ScienceDaily: In soil, high microbial fluctuation leads to more carbon emissions
- The Education Magazine: High Microbial Fluctuations in Soil emits more Carbon
- EurekAlert: In soil, high microbial fluctuation leads to more carbon emissions
- Environmental Health News: Combating carbon emissions with soil microbes