Zhenhai Liu

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RESEARCH INTERESTS

My research aims to enhance our understanding of terrestrial carbon cycling in response to long-term climate warming, short-term extreme events, and anthropogenic activities. I focus on ecologically vulnerable systems, particularly permafrost regions, mangroves, and agroecosystems. My approach integrates multi-source data, from *in-situ* observations and remote sensing to process-based and machine learning models, with the goal of not only characterizing spatial-temporal patterns but also advancing the modelling process.

EDUCATION

Ph.D. (2022–now) | Ecology
Institute of Geographic Sciences and Natural Resources Research, University of Chinese Academy of Sciences, Beijing, China.
Advisor: Dr. Shaoqiang Wang

Visiting Student (May 2024–Oct. 2025)
Michigan State University, East Lansing, USA.
Advisor: Dr. Jiquan Chen

M.S. (2019–2022) | Geography
China University of Geosciences, Wuhan, China.
Advisor: Dr. Shaoqiang Wang

B.S. (2015–2019) | Physical Geography and Resources Environment
Shanxi University, Taiyuan, China.
Advisor: Dr. Hong Zhang

PUBLICATIONS

In preparation

[1] **Liu, Z.,** et al. Disentangling photosynthesis and respiration uncertainty: spatially-explicit carbon flux partitioning with graph neural networks.

[2] **Liu, Z.**, Chen, J., Su, Y.-J., Robertson, G. P., et al. A long-term record (2009–2025) of ecosystem-atmosphere fluxes and meteorology from a network of agricultural ecosystems in Southwest Michigan. ***Earth System Science Data***.

[3] Dai, J., Chen, J., **Liu, Z.**, Abraha, M., et al. Long-term carbon fluxes of bioenergy crops on contrasting land use histories. ***Ecological Monograph***.

In review

[4] Wang, J., Chen, J., Fan, P., Myintc, S. W., **Liu, Z.**, Qi, J., Jaind, A. K., Setoe, K., Zhu, Y. Asymmetric urban-rural continuums (URCs) of Southeast Asian cities. ***Environmental Research Letters***.

[5] Bai, R., **Liu, Z.**, et al. The impact of geographical indications for agricultural products on farmers' income. ***Economic Geography***. (in Chinese)

First-authored and corresponding paper

[6] **Liu, Z.**, Chen, J., Chen, B., & Wang, S. (2025). Temperature constraints of terrestrial ecosystem respiration in global biomes. ***Functional Ecology***, 39(8), 2135–2148. [DOI] [Preview]

[7] **Liu, Z.**, Chen, B., Wang, S., Xu, X., Chen, H., Liu, X., He, J.-S., Wang, J., Wang, J., Chen, J., Wang, X., Zheng, C., Zhu, K., & Wang, X. (2024). More enhanced non-growing season methane exchanges under warming on the Qinghai-Tibetan Plateau. ***Science of The Total Environment***, 917, 170438. [DOI] [Preview]

[8] Li, X., **Liu, Z.**, Wang, S., Li, F., Li, H., Zhu, T., Qian, Z., Tu, Y., Liu, Y., Wang, X., Wang, Q., Shi, W., & Li, D. (2022). Spatial characteristics of the stability of mangrove ecosystems in freshwater and seawater floods in Southeast Asia. ***Journal of Geographical Sciences***, 32(9), 1831–1846. [DOI] [Preview]

[9] **Liu, Z.**, Chen, B., Wang, S., Wang, Q., Chen, J., Shi, W., Wang, X., Liu, Y., Tu, Y., Huang, M., Wang, J., Wang, Z., Li, H., & Zhu, T. (2021). The impacts of vegetation on the soil surface freezing-thawing processes at permafrost southern edge simulated by an improved process-based ecosystem model. ***Ecological Modelling***, 456, 109663. [DOI] [Preview]

[10] **Liu, Z.**, Wang, S., Chen, B. (2021). Spatial and temporal variations of frozen ground and its vegetation response in the eastern segment of China-Mongolia-Russia economic corridor from 2000 to 2015. ***Acta Geographica Sinica***. 76(5): 1231-1244. (in Chinese) [DOI] [Preview]

Co-authored paper

[11] Ni, C., Zhang, Z., Zhu, B., **Liu, Z.**, & Wang, S. (2025). High carbon emission simulated in the permafrost degradation regions of the Qinghai–Tibet Plateau by remote sensing and deep learning modules. ***IEEE Transactions on Geoscience and Remote Sensing***, 63, 1–12. [DOI]

[12] Qian, Z., Chen, S., Li, X., Wang, S., **Liu, Z.**, Chen, X., & Darjee, A. (2025). The response of vegetation productivity to the El Niño-Southern Oscillation in Southeast Asia. ***Journal of Geophysical Research: Biogeosciences***, 130(7), e2024JG008606. [DOI]

[13] Chen, B., Xu, X., Wang, S., Yang, T. **Liu, Z.**, & Falk, S. (2024). Carbon dioxide fertilization enhanced carbon sink offset by climate change and land use in Amazonia on a centennial scale. ***Science of The Total Environment***, 955(3), 176903. [DOI]

[14] Li, H., Wang, X., Wang, S., Liu, J., Liu, Y., **Liu, Z.**, Chen, S., Wang, Q., Zhu, T., Wang, L., & Wang, L. (2024). ChinaRiceCalendar – seasonal crop calendars for early-, middle-, and late-season rice in China. ***Earth System Science Data***, 16(4), 1689–1701. [DOI]

[15] Chen, B., Li, Y., Wang, S., Chen, J., Zhang, X., **Liu, Z.**, & Croft, H. (2024). Integrating leaf functional traits improves modelled estimates of carbon and water fluxes at a subtropical evergreen conifer forest. ***Ecological Modelling***, 488, 110593. [DOI]

[16] Chen, S., Li, X., Qian, Z., Wang, S., Wang, M., **Liu, Z.**, et. al. (2024). Drought trend and its impact on ecosystem carbon sequestration in Lancang-Mekong River Basin. ***Acta Geographica Sinica***. 79(3), 747–764. (in Chinese) [DOI]

[17] Chen, B., Wang, P., Wang, S., Ju, W., **Liu, Z.**, et al. (2023). Simulating canopy carbonyl sulfide uptake of two forest stands through an improved ecosystem model and parameter optimization using an ensemble Kalman filter. ***Ecological Modelling***, 475, 110212. [DOI]

[18] Wang, Q., Mei, M., Wang, S., Chen, B., **Liu, Z.**, et al. (2023). Evaluation of the impacts of ozone on the vegetation productivity of woodland and grassland ecosystems in China. ***Ecological Modelling***, 483, 110426. [DOI]

[19] Chen, S., Chen, B., Wang, S., Sun, L., Shi, H., **Liu, Z.**, et al. (2023). Spatiotemporal variations of atmospheric nitrogen deposition in China during 2008–2020. ***Atmospheric Environment***, 315, 120120. [DOI]

[20] Zhu, T., Wang, S., Li, H., Li, X., **Liu, Z.**, et al. (2022). Variation characteristics and correlation between vegetation phenology and extreme precipitation in Indo-China Peninsula. ***Tropical Geography***. 43(3): 532-544. (in Chinese) [DOI]

[21] Li, H., Zhu, T., **Liu, Z.**, Li, X., Wang, S., et al. (2022). Stability differences of coastal and inland vegetation to flood events in Southeast Asia. ***Acta Ecologica Sinica***. 42(16): 6745-6757. (in Chinese) [DOI]

[22] Tu Y., Wang S., Huang M., Zhang, H., Chen, B., **Liu, Z.**, et al. (2022). Optimization and Adjustment of Forestry Industrial Structure in Fujian Province. ***Forest Inventory and Planning***. 47(1): 135-140. (in Chinese) [DOI]

[23] Chen, B., Lu, X., Wang, S., Chen, J.M., Liu, Y., Fang, H., **Liu, Z.**, et al. (2021). Evaluation of Clumping Effects on the Estimation of Global Terrestrial Evapotranspiration. ***Remote Sensing***, 13(20), 4075. [DOI]

[24] Chen, B., Arain, M.A., Chen, J.M., Wang, S., Fang, H., **Liu, Z.**, et al. (2020). Importance of Shaded Leaf Contribution to the Total GPP of Canadian Terrestrial Ecosystems: Evaluation of MODIS GPP. ***Journal of Geophysical Research: Biogeosciences***, 125(10), e2020JG005917. [DOI]

[25] Cheng, Y., Zhang, H., **Liu, Z.**, et al. (2019). Hybrid algorithm for short-term forecasting of PM2.5 in China. ***Atmospheric Environment***, 200, 264–279. [DOI]

SOFTWARE COPYRIGHT

[1] **2023**. **Liu Z.**, Chen B., Wang S. Hourly frozen soil profile heat transfer simulator. 2023SR1792669.

[2] **2021**. Li H., Wang S., **Liu Z.**, Zhu T. Extreme climate index Sen+Mann-Kendall trend analysis system software. 2021SR0638388.

FELLOWSHIPS & AWARDS

[1] **2024**, AmeriFlux Annual Meeting 2024 Travel Stipend, Organizing Committee, $1000 USD

[2] **2024**, The 12 th International Conference on Permafrost (ICOP 2024) Travel Fund, IAG Grant, €500

[3] **2024**, ICOP 2024 Registration Financial Assistance, International Permafrost Association (IPA), $578 CAD

[4] **2024–2025**, Joint PhD Training Program of the University of Chinese Academy of Sciences, $22,800 USD

[5] **2021**, National Scholarship for Postgraduates, CN¥20,000

[6] **2019**, Academic Search Challenge for all Universities in Hubei Province, First Prize of Hubei Province NEWS

[7] **2019**, “Challenge Cup” National College Student Curricular Academic Science and Technology Works Competition, First Prize of Shanxi Province

PRESENTATIONS & POSTERS

[1] **2024**, AGU Annual Meeting 2024, Washington, D.C. US. Asymmetric warming effects on carbon fluxes in the Tibetan Plateau alpine ecosystems. (Poster) [PDF]

[2] **2024**, AmeriFlux Annual Meeting 2024, Berkeley US. The high-temperature shifts ecosystem respiration: Underestimated temperature dependence and overestimated trending. (Poster) [PNG]

[3] **2024**, The 12 th International Conference on Permafrost (ICOP 2024), Yukon Canada. Frostbyte. [YouTube]

[4] **2023**, AsiaFlux Conference 2023, Jeju Korea. More enhanced non-growing season methane exchanges under warming on the Qinghai-Tibetan Plateau. (Oral) [PDF]

[5] **2023**, The 7th Symposium of Young Scholars on Terrestrial Ecosystems, Linzhi Tibet China. Seasonal differences in response of methane flux to soil temperature over the Qinghai-Tibet Plateau. (Oral, in Chinese) [PDF]

[6] **2021**, International Symposium on Coastal Ecosystems and Global Change, Xiamen Fujian China. Potential impacts of the increasing coastal flooding on mangrove forest ecosystem. (Oral) [PDF]

[7] **2020**, The 6th Symposium of Young Scholars on Terrestrial Ecosystems, Nanjing Jiangsu China. Spatial and temporal variations of frozen ground and its vegetation response in the eastern segment of China-Mongolia-Russia economic corridor. (Oral, in Chinese) [PDF]

[8] **2020**, The 2nd Symposium on Greenhouse Gas Monitoring in China. Spatial and temporal variations of frozen ground and its vegetation response in the eastern segment of China-Mongolia-Russia economic corridor. (Oral, in Chinese, Online) [PDF]

[9] **2020**, The 19th Chinese Ecological Congress. Spatial and temporal variations of frozen ground and its vegetation response in the eastern segment of China-Mongolia-Russia economic corridor. (Poster, in Chinese, Online) (Excellent Poster Award) [PDF]

ACADEMIC SERVICES

[1] **2026**, Early Career Researcher (ECR) activities coordinator, Asian Conference on Permafrost (ACOP).

[2] **2024–2026**, Permafrost Young Researchers Network (PYRN), Executive Committee [WEB]

TECHNICAL SKILLS

[1] **Eddy Covariance Systems**: Skilled in EC flux tower operations, from tower construction, Campbell Sci. datalogger programming, and sensor maintenance to the subsequent data processing (quality control, flux partitioning, and analysis of network data like FLUXNET/AmeriFlux).

[2] **Geospatial Data Analysis**: Adept at processing and analyzing multi-source spatial-temporal datasets, including satellite remote sensing products (e.g., MODIS, Sentinel, Fengyun geostationary satellite), Earth System Model outputs, and atmospheric reanalysis data.

[3] **Ecosystem & Machine Learning Modeling**: Experienced in applying process-based ecosystem models (e.g., BEPS) and machine learning algorithms (e.g., Random Forest, ANN) for ecosystem simulation and spatial-temporal prediction.

[4] **Programming**:
- Proficient: Python, C (desktop and HPC environments)
- Familiar: MATLAB, R