

# Feng Tao, Ph.D.

## Postdoctoral Associate

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## EDUCATION

- Ph.D. **Tsinghua University**, Department of Earth System Science, Beijing, China, 2023  
Joint Ph.D. at Max Planck Institute for Biogeochemistry, Jena, Germany (September 2021–December 2022)
- B.Sc. **Sun Yat-sen University**, School of Environmental Science and Engineering, *with Honors*, Guangzhou, China, 2018  
Exchange at The University of Hong Kong, Hong Kong SAR, China (September–December 2016)

## ACADEMIC APPOINTMENTS

- 2023– **Cornell University**, Ithaca, NY, United States  
Schmidt AI4Science Postdoctoral Associate advised by Prof. Benjamin Z. Houlton, Department of Ecology & Evolutionary Biology  
*AI for scalable enhanced rock weathering to remove carbon dioxide*
- 2018–2023 **Tsinghua University**, Beijing, China  
Research Assistant of Profs. Yiqi Luo (at NAU/Cornell) & Xiaomeng Huang (at Tsinghua)  
*Soil carbon cycle study with data assimilation and deep learning*
- 2021–2022 **Max Planck Institute for Biogeochemistry**, Jena, Germany  
Joint Ph.D. student advised by Profs. Markus Reichstein & Marion Schrumpf  
*Global soil carbon sink using multi-source soil carbon ( $^{12}\text{C}/^{14}\text{C}$ ) data*
- 2019 **Food and Agriculture Organization of the United Nations**, Rome, Italy  
Visiting Fellow of Global Soil Partnership (July–November)  
*Global soil organic carbon sequestration potential mapping*
- 2017 **University of British Columbia**, Vancouver, Canada  
Research Intern of Dr. Heather Trajano (June–September)  
*Microbial Fuel Cells (MFC)*

## RESEARCH INTERESTS

Soil organic carbon: formation, stabilization, and responses to climate change

Enhanced rock weathering for scalable carbon dioxide removal

Artificial intelligence (AI) for mechanism discoveries in biogeochemistry

## GRANTS AND AWARDS

### Awards and Honors

- 2023 27th “Xueshu Xinxu” (Ten Outstanding Graduate Researchers) of Tsinghua University
- 2023 Honors PhD Graduate of Tsinghua University
- 2023 Outstanding PhD Thesis of Tsinghua University

- 2023 Best Student Paper Award of Sino-Ecologists Association Overseas (Sino-Eco) for the paper *Microbial carbon use efficiency promotes global soil carbon storage* (Nature)
- 2021 Early Career ISMC (International Soil Modelling Consortium) Presentation Award
- 2018 Honors Bachelor Graduate of Sun Yat-sen University
- 2018 Outstanding Bachelor Thesis of Sun Yat-sen University

## Fellowships

- 2023– Schmidt AI in Science Postdoc Fellowships at Cornell University, funded by Schmidt Futures
- 2020 Chinese Government Scholarship, as visiting PhD student, funded by China Scholarship Council
- 2019 International Organization Internship, funded by China Scholarship Council
- 2017 Third Class Scholarship of Sun Yat-sen University
- 2017 Mitacs Globalink Research Internship Award, funded by Mitacs of Canada and China Scholarship Council
- 2017 Fung Scholarship (at HKU), funded by Victor and William Fung Foundation Limited
- 2016 First Class Scholarship of Sun Yat-sen University
- 2016 China National Scholarship, awarded by Ministry of Education of P. R. China
- 2015 First Class Scholarship of Sun Yat-sen University
- 2015 China National Scholarship, awarded by Ministry of Education of P. R. China

## PUBLICATIONS

### First-Authored Journal Articles

- 2024 **Tao, F.**, B. Z. Houlton, Y. Huang, Y.-P. Wang, S. Manzoni, B. Ahrens, U. Mishra, L. Jiang, X. Huang, and Y. Luo. 2024. Convergence in simulating global soil organic carbon by structurally different models after data assimilation, *Global Change Biology*, Accepted.
- 2024 **Tao, F.**, J. Lehmann, Y.-P. Wang, L. Jiang, B. Ahrens, K. Viatkin, S. Manzoni, B. Z. Houlton, Y. Huang, X. Huang, and Y. Luo. 2024. Reply to “Beyond microbial carbon use efficiency”, *National Science Review*, Volume 11, Issue 4, April 2024, nwae058, <https://doi.org/10.1093/nsr/nwae058>
- 2024 **Tao, F.**, B. Z. Houlton, S. D. Frey, J. Lehmann, S. Manzoni, Y. Huang, L. Jiang, U. Mishra, B. A. Hungate, M. W. I. Schmidt, M. Reichstein, N. Carvalhais, P. Ciais, Y.-P. Wang, B. Ahrens, G. Hugelius, T. D. Hocking, X. Lu, Z. Shi, K. Viatkin, R. Vargas, Y. Yigini, C. Omuto, A. A. Malik, G. Peralta, R. Cuevas-Corona, L. E. Di Paolo, I. Luotto, C. Liao, Y.-S. Liang, V. S. Saynes, X. Huang, and Y. Luo. 2024 Reply to: Model uncertainty obscures major driver of soil carbon. *Nature* 627, E4-E6 (2024). <https://doi.org/10.1038/s41586-023-07000-9>
- 2024 **Tao, F.**, and B. Z. Houlton. 2024 Inorganic and organic synergies in enhanced weathering to promote carbon dioxide removal. *Global change biology* 30:e17132.
- 2023 **Tao, F.**, Y. Huang, B. A. Hungate, S. Manzoni, S. D. Frey, M. W. I. Schmidt, M. Reichstein, N. Carvalhais, P. Ciais, L. Jiang, J. Lehmann, Y.-P. Wang, B. Z. Houlton, B. Ahrens, U. Mishra, G. Hugelius, T. D. Hocking, X. Lu, Z. Shi, K. Viatkin, R. Vargas, Y. Yigini, C. Omuto, A. A. Malik, G. Peralta, R. Cuevas-Corona, L. E. Di Paolo, I. Luotto, C. Liao, Y.-S. Liang, V. S. Saynes, X. Huang, and Y. Luo. 2023. Microbial carbon use efficiency promotes global soil carbon storage. *Nature* 618, 981-985 (2023). <https://doi.org/10.1038/s41586-023-06042-3>  
**Media Highlights:** [Phys.org](#), [TechnologyNetworks](#), [VBiO \(German\)](#), [Forskning.se \(Swedish\)](#), [Science & Technology Daily \(Chinese\)](#)  
**Best Student Paper of Sino-Ecologists Association Overseas (Sino-Eco) 2023**

- 2019 **Tao, F.**, Z. Zhou, Y. Huang, Q. Li, X. Lu, S. Ma, X. Huang, Y. Liang, G. Hugelius, L. Jiang, R. Doughty, Z. Ren, and Y. Luo. 2019. Deep Learning Optimizes Data-Driven Representation of Soil Organic Carbon in Earth System Model Over the Conterminous United States. *Frontiers in Big Data*, 3(17).  
<https://doi.org/10.3389/fdata.2020.00017>

### Co-Authored Journal Articles

- 2024 Huang, Y., X. Song, Y.-P. Wang, J. G. Canadell, Y. Luo, P. Ciais, A. Chen, S. Hong, Y. Wang, **F. Tao**, W. Li, Y. Xu, R. Mirzaeitalarposhti, H. Elbasiouny, I. Savin, D. Shchepashchenko, R. A. V. Rossel, D. S. Goll, J. Chang, B. Z. Houlton, H. Wu, F. Yang, X. Feng, Y. Chen, Y. Liu, S. Niu, and G.-L. Zhang. 2024. Size, distribution, and vulnerability of the global soil inorganic carbon. *science* 384:233-239. <https://doi.org/doi:10.1126/science.adi7918>  
**Media Highlights:** [Phys.org](#), [The Conversation](#), [People's Daily](#)
- 2023 Liao, C., X. Lu, Y. Huang, **F. Tao**, D. M. Lawrence, C. D. Koven, K. W. Oleson, W. R. Wieder, E. Kluzek, X. Huang, and Y. Luo. 2023. Matrix Approach to Accelerate Spin-Up of CLM5. *Journal of Advances in Modeling Earth Systems*, 15(8), e2023MS003625. <https://doi.org/https://doi.org/10.1029/2023MS003625>
- 2023 Ma, S., L. Jiang, R. M. Wilson, J. Chanton, S. Niu, C. M. Iversen, A. Malhotra, J. Jiang, Y. Huang, X. Lu, Z. Shi, **F. Tao**, J. Liang, D. Ricciuto, P. J. Hanson, and Y. Luo. 2023. Thermal acclimation of plant photosynthesis and autotrophic respiration in a northern peatland. *Environmental Research: Climate*, 2(2), 025003.  
<https://doi.org/10.1088/2752-5295/acc67e>
- 2023 Hou, E., S. Ma, Y. Huang, Y. Zhou, H.-S. Kim, E. López-Blanco, L. Jiang, J. Xia, **F. Tao**, C. Williams, M. Williams, D. Ricciuto, P. J. Hanson, and Y. Luo. 2023. Across-model spread and shrinking in predicting peatland carbon dynamics under global change. *Global change biology* 29:2759-2775.
- 2022 Liao, C., W. Huang, J. Wells, R. Zhao, K. Allen, E. Hou, X. Huang, H. Qiu, **F. Tao**, L. Jiang, M. Aguilos, L. Lin, X. Huang, and Y. Luo. 2022. Microbe-iron interactions control lignin decomposition in soil. *Soil Biology and Biochemistry* 173:108803.
- 2022 Luo, Y., Y. Huang, C. A. Sierra, J. Xia, A. Ahlström, Y. Chen, O. Hararuk, E. Hou, L. Jiang, C. Liao, X. Lu, Z. Shi, B. Smith, **F. Tao**, and Y.-P. Wang. 2022. Matrix approach to land carbon cycle modeling. *Journal of Advances in Modeling Earth Systems*:e2022MS003008.
- 2022 Liao, C., W. Huang, J. Wells, R. Zhao, K. Allen, E. Hou, X. Huang, H. Qiu, **F. Tao**, L. Jiang, M. Aguilos, L. Lin, X. Huang, and Y. Luo. 2022. Microbe-iron interactions control lignin decomposition in soil. *Soil Biology and Biochemistry* 173:108803.
- 2021 Zhang, Z., H. Zhang, Z. Cui, **F. Tao**, Z. Chen, Y. Chang, V. Magliulo, G. Wohlfahrt, and D. Zhao. 2021. Global consistency in response of terrestrial ecosystem respiration to temperature. *Agricultural and forest meteorology* 308-309:108576.
- 2018 Zhang, Z., W. Wang, J. Qi, H. Zhang, **F. Tao**, and R. Zhang. 2019. Priming effects of soil organic matter decomposition with addition of different carbon substrates. *Journal of Soils and Sediments* 19:1171-1178.
- 2018 Zhang, Z., R. Zhang, Y. Zhou, A. Cescatti, G. Wohlfahrt, M. Sun, H. Zhang, J. Qi, J. Zhu, V. Magliulo, **F. Tao**, and G. Chen. 2018. A temperature threshold to identify the driving climate forces of the respiratory process in terrestrial ecosystems. *European Journal of Soil Biology* 89:1-8.

### Book Chapters

- 2022 **Tao, F.** Bayesian statistics and Markov chain Monte Carlo method in data assimilation. In Y. Luo & B. Smith (Eds.), *Land Carbon Cycle Modeling: Matrix Approach, Data Assimilation, and Ecological Forecasting*. Taylor and Francis.
- 2022 **Tao, F.**, and Y. Luo. PROcess-guided deep learning and DATA-driven modelling (PRODA). In Y. Luo & B. Smith (Eds.), *Land Carbon Cycle Modeling: Matrix Approach, Data Assimilation, and Ecological Forecasting*. Taylor and Francis.

- 2022 **Tao, F.** Practice 10, Deep learning to optimize parametrization of CLM5. In Y. Luo & B. Smith (Eds.), *Land Carbon Cycle Modeling: Matrix Approach, Data Assimilation, and Ecological Forecasting*. Taylor and Francis.

## PRESENTATIONS

- 2023 **Tao, F.**, Y. Huang, B. A. Hungate, S. Manzoni, S. D. Frey, M. W. I. Schmidt, M. Reichstein, N. Carvalhais, P. Ciais, L. Jiang, J. Lehmann, Y.-P. Wang, B. Z. Houlton, B. Ahrens, U. Mishra, G. Hugelius, T. D. Hocking, X. Lu, Z. Shi, K. Viatkin, R. Vargas, Y. Yigini, C. Omuto, A. A. Malik, G. Peralta, R. Cuevas-Corona, L. E. Di Paolo, I. Luotto, C. Liao, Y.-S. Liang, V. S. Saynes, X. Huang, and Y. Luo. Microbial carbon use efficiency promotes global soil carbon storage. 2023 AGU Fall Meeting, 11-15 December 2023, San Francisco, CA, Poster.
- 2023 **Tao, F.**, B. Z. Houlton, Y. Huang, Y.-P. Wang, S. Manzoni, B. Ahrens, U. Mishra, L. Jiang, X. Huang, and Y. Luo. 2024. Convergence in simulating global soil organic carbon by structurally different models after data assimilation, 2023 AGU Fall Meeting, 11-15 December 2023, San Francisco, CA, Poster.
- 2023 **Tao, F.** Microbial carbon use efficiency promotes global soil carbon storage. CCBB Journal Club. September 29, 2022, Tennessee State University via Zoom.
- 2023 **Tao, F.** Microbial carbon use efficiency promotes global soil carbon storage. Sino-Eco Talks. July 10, 2022, via Zoom.
- 2022 **Tao, F.**, Ahrens, B., Yang, H., Schrumpf, M., Carvalhais, N., Reichstein, M., Huang, X. and Luo, Y., 2022. Historical fate of global soil organic carbon in the past century. 2022 AGU Fall Meeting, 12 - 16 December 2022, Chicago, USA, Talk.
- 2022 **Tao, F.** and Luo, Y., Quantifying soil carbon sequestration by multi-source constraints. 2022 EGU Meeting, 23 - 27 May 2022, Vienna, Austria, Talk (highlighted)
- 2021 **Tao, F.** and Luo, Y., Using Multi-source Constraints to Quantify Soil Carbon Sequestration. 2021 AGU Fall Meeting, 13 - 17 December 2021, Virtual, Poster
- 2021 **Tao, F.**, Huang, Y., Hungate, B., Lu, X., Hocking, T. D., Mishra, U., Hugelius, G., Huang, X., Luo, Y., PROcess-guided deep learning and DATA-driven modelling (PRODA) to uncover key patterns and mechanisms in global soil carbon cycle at OOS 25: Using Machine Learning to Quantify and Improve Earth System Predictions, 2021 ESA Annual Meeting, 2 - 6 August 2021, Virtual, Talk
- 2021 **Tao, F.** and Luo, Y., PROcess-guided deep learning and DATA-driven modelling (PRODA) uncovers key mechanisms underlying global soil carbon storage, 2021 3rd ISMC Conference, 18 - 22 May 2021, Virtual, Invited Talk, Highlights Talk
- 2021 **Tao, F.** and Luo, Y., Big data-driven modelling in CLM5 reveals microbial carbon use efficiency as the key mechanism underlying global soil organic carbon storage, 2021 NCAR CESM Land Model and Biogeochemistry Working Group Meeting, 23 - 25 February 2021, Virtual, Talk
- 2020 **Tao, F.**, Huang, X., Mishra, U., Hugelius, G. and Luo, Y., Big data-driven modelling reveals key mechanisms underlying soil organic carbon stabilization. 2020 AGU Fall Meeting, 1 - 17 December 2020, Virtual, Talk
- 2020 **Tao, F.**, Huang and Luo, Y., Deep learning and constrained modelling from big data jointly reveal key mechanisms in soil organic carbon stabilization at Symposium SYMP7: Combining Deep Learning and Process-Based Modeling to Advance Ecological Forecasting. 2020 ESA Annual Meeting, 3 - 6 August 2020, Virtual, Invited Talk
- 2020 **Tao, F.** Improving representation of soil organic carbon: process-guided data driven deep learning modeling. 3rd Training Course on New Advances in Land Carbon Cycle Modeling, 21 - 30 July 2020, Virtual meeting hosted by Northern Arizona University, Flagstaff, Arizona, USA. Talk.
- 2019 **Tao, F.**, Zhou, Z., Huang, Y., Li, Q., Lu, X., Ma, S., Huang, X., Liang, Y., Hugelius, G., Jiang, L., Doughty, R., Ren, Z. and Luo, Y., Deep learning optimizes data-driven representation of soil organic carbon in Earth system

- model over the conterminous United States. 2019 AGU Fall Meeting, 9 - 13 December 2019, San Francisco, USA. Poster
- 2019 **Tao, F.**, Soil organic carbon sequestration potential: process-oriented model approach. 5th Working Session of the International Network of Soil Information Institutions (INSII), 21 - 23 October 2019, FAO Headquarters, Rome, Italy. Oral report on behalf of Global Soil Partnership (GSP) secretariat of FAO.
- 2018 **Tao, F.**, Luo, Y., Zhou, Z., Huang, Y., Big-data-big-model fusion to improve prediction of global soil carbon dynamics with Earth System Model. 2018 AGU Fall Meeting, 10 - 14 December 2018, Washington, D.C., USA. Poster

## SERVICES

### Academic Journal Peer Review

Review papers for *Global Change Biology* (GCB), *GCB-Bioenergy*, *New Phytologist*, *Journal of Advances in Modeling Earth Systems* (JAMES), *Scientific Data*, *Ecological Processes*, *Soil Science Society of America Journal*, *Catena*

### Mentorship

Natalia Butler (2024), Ph.D. student at Cornell, on ten-week rotation training on modeling enhanced rock weathering in Houlton Lab

Haodi Xu (2023-), Ph.D. student at Cornell (Luo Lab), on Biogeochemistry-Informed Neural Network (BINN)

## TEACHING

### Cornell University

Two-week Training Course on New Advances in Land Carbon Cycle Modeling, as Lecturer and Instructor (2022-)

### Northern Arizona University

Two-week Training Course on New Advances in Land Carbon Cycle Modeling, as Lecturer and Instructor (2019-2021)

### Tsinghua University

Ecological Modelling, as Guest Lecturer (2021-2022)

## ADDITIONAL INFORMATION

Languages: Mandarin (Native), English (IELTS 7.0), German (Basic)

Programming: Proficient at MATLAB, R and Python. Familiar with FORTRAN (MPI)

Laboratory Skills: Laboratory skills in chemical and biological analysis. e.g. HPLC, XRD, SEM, etc.