

# Dr. Shuang Song

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## EDUCATION BACKGROUND

<b>Ph.D. in Physical Geography</b> <i>Beijing Normal University, Beijing, China, 100875.</i>	01/09/2018 - 30/06/2023
<b>Study of History (The Second Major)</b> <i>Sun Yat-sen University, Guangdong, China, 510275.</i>	01/09/2014 - 30/06/2018
<b>B.S. of Science, Physical Geography</b> <i>Sun Yat-sen University, Guangdong, China, 510275.</i>	01/09/2014 - 30/06/2018

## PROFESSIONAL EXPERIENCE

<b>Postdoctoral Researcher</b> <i>Department of Co-evolution of Land Use and Urbanisation &amp; Department Structural Changes of the Technosphere, Max Planck Institute of Geoanthropology, Jena, Germany, 07745.</i>	01/10/2024 - Present
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Working closely with Prof. Patrick Roberts and Prof. Jürgen Renn at the Max Planck Institute of Geoanthropology, my research primarily uses water as a link to study the interaction and co-evolution between human society and hydrosphere. Based on my interdisciplinary background in Physical Geography and the Study of History, I currently focus on the long-term evolution of water management and its impact on human society in major river basins. I also examine how institutions can influence human-water interaction by changing human society's adaptation and resilience to environmental changes, thereby contributing to sustainable development.

<b>Postdoctoral Researcher</b> <i>School of Environment &amp; RDC for Watershed Environmental Eco-Engineering, Beijing Normal University, Beijing, China, 100875.</i>	01/07/2023 - 31/03/2025
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In collaboration with Professors Shuai Wang, Shiliang Liu, I developed an agent-based model (ABM) aimed at simulating agricultural irrigation decision-making within the Yellow River Basin. This model was integrated with our research team's hydrological (CWatM) and system dynamics models to create a coupled human-environment framework, providing a comprehensive understanding of water resource allocation. Using high-performance computing, we simulated farmers' irrigation decisions under varying climate change scenarios and water resource management systems. The outcomes of these simulations have directly informed decision-making processes at the Yellow River Water Resources Commission, showcasing the model's practical application in real-world water management. This project closely aligns with my ongoing work in socio-hydrological modelling, further refining ABM techniques to simulate human-environment interactions over time.

<b>Doctoral Researcher</b> <i>State Key Laboratory of Earth Surface Processes and Resource Ecology, Faculty of Geography, Beijing Normal University, Beijing, China, 100875.</i>	07/10/2017 - 30/06/2023
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Under the guidance of Chief Scientist Bojie Fu and Professor Shuai Wang, I conducted advanced analysis of climate, hydrological, and socio-economic data from the Yellow River Basin. Using GIS, remote sensing, machine learning, and complex network modeling, I improved and applied a socio-hydrological model to investigate the "levee effect" and its long-term impact on flood risks and urban resilience. I also utilized historical records and sediment data to reconstruct historical human-water interactions and identify regime shifts in the basin's socio-ecological system. As part of a National Major Research Plan (NSFC, 17 million CNY), I helped compile a human-water system dataset, contributing significantly to our understanding of sustainable water management in the region. My role included organizing and conducting extensive field research within the Yellow River Basin, providing me with deep practical insights into the region's environmental and socio-hydrological challenges.

<b>Teaching Assistant of Landscape Ecology</b> <i>Faculty of Geography, Beijing Normal University, Beijing, China, 100875.</i>	01/09/2019 - 10/01/2020
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Under the mentorship of Professors Bojie Fu, Shuai Wang, and Wenwu Zhao, I served as a teaching assistant for a graduate-level Landscape Ecology course. I was responsible for preparing lectures, facilitating discussions, and coordinating coursework for approximately 50 students. This role strengthened my ability to communicate complex environmental science topics and fostered my teaching and academic mentoring skills.

## FUNDED SCIENTIFIC PROJECTS

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### *[Principal Investigator]* **Simulation and Optimization of Agricultural Irrigation Water Use in the Yellow River Basin by Agent-based Modeling**

*NSFC Young Scientists Fund (Grantee: Shuang Song, 300,000 CNY)*

*2024-Present*

This project focuses on developing an agent-based model to simulate agricultural irrigation under various climate and policy scenarios. By integrating agent adaptability and public goods theory, we aim to identify the key drivers of water usage changes and predict future irrigation demands in response to climate shifts. This work builds on my previous experience with human-environment system modeling, directly contributing to future water management strategies in the basin.

### *[Participate]* **Human Management of the Water Cycle in a Global Comparative Perspective**

*Joint Funded by Max-Planck Society (Grantee: Jürgen Renn, 200,000 ERU)*

*2024-Present*

The research plan operates across three integrated focus areas: geoanthropology, real-time data integration, and water scarcity. This project aims to establish a global network of partners for global comparative studies. In this project, I collect water resource management case studies from around the world, create data visualisations, and network international partners.

### *[Participate]* **Coordination mechanism and regulation strategy of multiple processes of water-sediment-ecology-economy system in the Yellow River Basin**

*NSFC Joint Funds & Yellow River Water Science Funds (Grantee: Enhui Jiang, 11,720,000 CNY) 2023-Present*

As a key participant in this interdisciplinary project, I contributed to developing a coordinated strategy to manage the interconnected water-sediment-ecology-economy system of the Yellow River Basin. My role included research design, data collection, analysis, and drafting reports. The project explores the feedback mechanisms between environmental changes and socio-economic dynamics, with implications for long-term sustainable development in the region.

### *[Participate]* **Mechanisms of human-natural system coupling and optimization of the Yellow River Basin**

*NSFC National Major Research Plan (Grantee: Bojie Fu, 17,000,000 CNY)*

*2021-2024*

This large-scale project investigates the coupling mechanisms between human and natural systems, focusing on optimization strategies for sustainable development in the Yellow River Basin. My contributions spanned data analysis, report writing, and project coordination. The research outcomes have been instrumental in improving socio-hydrological models and enhancing our understanding of long-term water resource management.

### *[Participate]* **Sustainability of the socio-hydrological system**

*NSFC Excellent Young Scientists Fund (Grantee: Shuai Wang, 1,300,000 CNY)*

*2017-2020*

This project aimed to improve mathematical models of socio-hydrology by examining the dynamic interactions between human activities and water systems in the Yellow River Basin. I was involved in the project's theoretical and empirical aspects, including data collection, model development, and the publication of findings. This experience directly supports my current research on the long-term resilience of human-environment systems.

## OUTREACH PROJECT EXPERIENCE

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### *[Participate]* **Ecosystem services in Bayannur City**

*Inner Mongolia Key Scientific Project (Grantee: Prof. Shuai Wang, 300,000CNY)*

*2021-2023*

In this project, we delve into the Inner Mongolian grassland communities to explain the dangers of ecological degradation. I have gone deep into the grasslands four times to conduct interviews and research with local herders to understand ecological issues.

**[Personal Project] Popular Blogs: A geographer who also travels**Monthly publish articles on <https://songshgeo.com/>

2018-present

In this series of writings, I position myself as "A Geographer who also travels." I write in Chinese, combining geographic knowledge, academic concepts, and travel experiences, conveying it to the public in an easy-to-understand language. I have earned 4,688 CNY tips for this blog, with 812 subscriptions and readership. The webpage has around 4,000 visitors.

**PUBLICATIONS**

Dr. Shuang Song has submitted or published 22 papers (9 of which are first-authored) in the leading journals, such as *Water Resources Research*, *Journal of Hydrology*, *Hydrology and Earth System Science*, and *Nature Sustainability*.

- [1] Wu, X., Yan, Z., Yang, H., Wang, S., Zhang, H., [...], **Song, S.**, et al. **2025**. "Ecological restoration in the Yellow River Basin enhances hydropower potential". en. In: *Nature Communications* 16.1, p. 2566. DOI: 10.1038/s41467-025-57891-7.
- [2] Jiao, C., Wu, X., **Song, S.**, Wang, S., Xiang, B., et al. **2024a**. "River stabilization reshaped human-nature interactions in the Lower Yellow River floodplain". en. In: *Journal of Environmental Management*.
- [3] **Song, S.**, Wang, S., Jiao, C., and Ibarra, E. J. M. **2024b**. "ABSESpy: An agent-based modeling framework for social-ecological systems". en. In: *Journal of Open Source Software* 9.96, p. 6298. DOI: 10.21105/joss.06298.
- [4] **Song, S.**, Wen, H., Wang, S., Wu, X., Cumming, G. S., et al. **2024d**. "Quantifying the effects of institutional shifts on water governance in the Yellow River Basin: A social-ecological system perspective". en-US. In: *Journal of Hydrology* 629, p. 130638. DOI: 10.1016/j.jhydrol.2024.130638.
- [5] Jiao, C., Wang, S., **Song, S.**, and Fu, B. **2023a**. "Long-term and seasonal variation of open-surface water bodies in the Yellow River Basin during 1990–2020". en. In: *Hydrological Processes* 37.3, e14846. DOI: 10.1002/hyp.14846.
- [6] **Song, S.**, Wang, S., Wu, X., Wei, Y., Cumming, G. S., et al. **2023c**. "Identifying Regime Transitions for Water Governance in the Yellow River Basin, China". en. In: *Water Resources Research* 59.12, e2022WR033819. DOI: 10.1029/2022WR033819.
- [7] Wu, X., Fu, B., Wang, S., **Song, S.**, Lusseau, D., et al. **2023d**. "Bleak prospects and targeted actions for achieving the Sustainable Development Goals". en-US. In: *Science Bulletin* 68.22, pp. 2838–2848. DOI: 10.1016/j.scib.2023.09.010.
- [8] Chen, P., Wang, S., **Song, S.**, Wang, Y., Wang, Y., et al. **2022a**. "Ecological restoration intensifies evapotranspiration in the Kubuqi Desert". en. In: *Ecological Engineering* 175, p. 106504. DOI: 10.1016/j.ecoleng.2021.106504.
- [9] **Song, S.**, Wang, S., Wu, X., Huang, Y., and Fu, B. **2022b**. "Decreased virtual water outflows from the Yellow River basin are increasingly critical to China". English. In: *Hydrology and Earth System Sciences* 26.8, pp. 2035–2044. DOI: 10.5194/hess-26-2035-2022.
- [10] Wang, Y., Liu, Y., **Song, S.**, Yao, Y., and Fu, B. **2022c**. "A review of community-based social-ecological system adaptation pathways". zh-CN. In: *Progress in Geography* 41.5, pp. 935–944.
- [11] Wu, X., Fu, B., Wang, S., **Song, S.**, Li, Y., et al. **2022d**. "Decoupling of SDGs followed by re-coupling as sustainable development progresses". en. In: *Nature Sustainability*. DOI: 10.1038/s41893-022-00868-x.
- [12] Gao, D., Wang, S., Li, Z., Wei, F., Chen, P., **Song, S.**, et al. **2021a**. "Threshold of vapour–pressure deficit constraint on light use efficiency varied with soil water content". en. In: *Ecohydrology*. DOI: 10.1002/eco.2305.
- [13] Li, Z., Wang, S., **Song, S.**, Wang, Y., and Musakwa, W. **2021b**. "Detecting land degradation in Southern Africa using Time Series Segment and Residual Trend (TSS-RESTREND)". en. In: *Journal of Arid Environments* 184, p. 104314. DOI: 10.1016/j.jaridenv.2020.104314.
- [14] **Song, S.**, Du, J., Wu, Q., Ni, M., Wang, Y., et al. **2021c**. "The responses of *Spinifex littoreus* to sand burial on the coastal area of Pingtan Island, Fujian Province, South China". en. In: *Écoscience*, pp. 1–10. DOI: 10.1080/11956860.2021.1888523.
- [15] **Song, S.**, Wang, S., Fu, B., Dong, Y., Liu, Y., et al. **2021d**. "Improving representation of collective memory in socio-hydrological models and new insights into flood risk management". en. In: *Journal of Flood Risk Management* 14.1. DOI: 10.1111/jfr3.12679.

- [16] Wang, S., **Song, S.**, Zhang, J., Wu, X., and Fu, B. **2021e**. “Achieving a fit between social and ecological systems in drylands for sustainability”. en-US. In: *Current Opinion in Environmental Sustainability* 48, pp. 53–58. DOI: 10.1016/j.cosust.2020.09.008.
- [17] Wang, Y., Liu, Y., **Song, S.**, and Fu, B. **2021f**. “Research progress of the water-food-energy-ecosystem nexus”. zh-CN. In: *Advances in earth science* 36.07, pp. 684–693.
- [18] Yao, Y., Fu, B., Liu, Y., Wang, Y., and **Song, S.** **2021g**. “The contribution of ecosystem restoration to sustainable development goals in Asian drylands: A literature review”. en. In: *Land Degradation & Development*, ldr.4065. DOI: 10.1002/ldr.4065.
- [19] **Song, S.**, Wang, S., Fu, B., Liu, Y., Wang, K., et al. **2020**. “Sediment transport under increasing anthropogenic stress: Regime shifts within the Yellow River, China”. en-US. In: *Ambio* 49.12, pp. 2015–2025. DOI: 10.1007/s13280-020-01350-8.
- [20] **Song, S.**, Wang, S., Fu, B., Chen, H., Liu, Y., et al. **2019a**. “Study on adaptive governance of social-ecological system: Progress and prospect”. zh-CN. In: *Acta Geographica Sinica* 74.11, pp. 2401–2410.
- [21] Zhang, M., Wang, S., Fu, B., Wei, X., Wang, C., **Song, S.**, et al. **2019c**. “Structure Disentanglement and Effect Analysis of the Arid Riverscape Social-Ecological System Using a Network Approach”. en. In: *Sustainability* 11.19, p. 5159. DOI: 10.3390/su11195159.
- [22] Yang, X., Du, J., Qin, J., Chen, Z., Yang, L., and **Song, S.** **2017**. “Diurnal variation characteristics of leaf water potential of *Spinifex littoreus* on the nebkhas in different succession periods on the coast of Pingtan Island, Fujian Province, China”. zh-CN. In: *Chinese Journal of Applied Ecology* 28.10, pp. 3260–3266.

## PROFESSIONAL PRESENTATIONS

- [Invited Presentation] **Research on the Long-term Co-evolution of Human Ecology and Water Environment Based on Model Simulation.**  
Shanxi Normal University, Xi'an, China 31/03/2025
- [Invited Presentation] **Co-evolution between Hydro-system and Historical cities.**  
Harbin Institute of Technology (Shenzhen Campus), Shenzhen, China 17/03/2025
- [Oral Presentation] **The Evolution Process and Driving Mechanisms of the Human-Water Relationship in the Yellow River from the Perspective of Watershed Governance.**  
Ningxia University, Ningxia, China 19/07/2024
- [Oral Presentation] **The Evolution Process and Driving Mechanisms of the Human-Water Relationship in the Yellow River from the Perspective of Water Governance. (In Chinese)**  
1st Hydrological Process Forum, Shenzhen, China 26/04/2024
- [Oral Presentation] **Empowering Human-Water System Analysis through ABSESpy: An Agent-Based Modeling Framework of SES.**  
European Geosciences Union Assembly 2024, Vienna, Austria 19/04/2024
- [Oral Presentation] **Research on a coupling model of Human-Earth system -A case study of agent-based model**  
EGU General Assembly 2023, Vienna, Austria 25/04/2023
- [Oral Presentation] **Analysis of the Complexity of Virtual Water Transfer in the Yellow River Basin**  
Academic Forum on Ecological Civilization and Sustainable Development, China 22/11/2021
- [Oral Presentation] **Study on human-water relationship change in the Yellow River Basin**  
Conference of State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing, China 19/06/2021
- [Oral Presentation] **Sediment Transport under Increasing Anthropogenic Stress: Regime Shifts Within the Yellow River, China.**  
AGU Fall Meeting 2019, San Francisco, USA 10/12/2019

## HONORS AND AWARDS

- Beijing Excellent Doctoral Thesis 07/2024
- Excellent Doctoral Thesis (Top 1 in Geography) 04/2024
- 2nd in the 8th National Disaster Reduction and Emergency Management Academic Competition 05/2020

<i>1st &amp; Best Lecturer in the Third Academic Speech Competition of Beijing Normal University</i>	05/2019
<i>1st in the 10th Experimental Science Championship of Systems Science</i>	11/2018
<i>Outstanding graduate thesis (Top 1 in Physical Geography)</i>	06/2018
<i>Outstanding Project in National College Student Innovation Funding</i>	04/2017
<i>1st &amp; Best Lecturer in the 3rd China University Geography Science Presentation Competition</i>	09/2017
<i>1st &amp; Most Novel Topic in the 2nd China University Geography Science Presentation Competition</i>	11/2016

## GRANTS AND SCHOLARSHIPS

<i>Postdoctoral Scholarship from Max-Planck Society (15,000 EUR)</i>	10/2024 - 03/2025
<i>Young Scientist Fund of NSFC (300,000 CNY)</i>	08/2024
<i>Beijing Normal University Scholarships (Four-time 1st &amp; once 2nd prize, 58,000 CNY)</i>	12/2018 - 12/2022
<i>Graduate Student Academic Ability Competition (Twice 1st &amp; Once 2nd, 8,000 CNY)</i>	12/2018 - 12/2022
<i>Chinese National Scholarship (Top 5%, 20,000 CNY)</i>	12/2020
<i>Sun Yat-sen University Scholarships. (Twice 1st, 10,000 CNY)</i>	12/2014 - 12/2018
<i>“1987” Economic Geography Scholarship (1,500 CNY)</i>	12/2018
<i>Guanghua Education Scholarship (3,000 CNY)</i>	12/2017
<i>Chinese National Scholarship (Top 5%, 8,000 CNY)</i>	11/2016
<i>National College Student Innovation Funding (10,000 CNY, Excellent enclosed)</i>	11/2016

## ACADEMIC SERVICES

Reviewer for Academic Journals:

• <i>Quaternary International</i>	09/2024
• <i>Hydrology and Earth System Science</i>	05/2024
• <i>Journal of Hydrology</i>	03/2024
• <i>Journal of Environmental Management</i>	11/2023
• <i>Geography and Sustainability</i>	06/2023
• <i>People and Nature</i>	05/2021
• <i>Water Research</i>	07/2021
• <i>AMBIO: A Journal of the Human Environment</i>	05/2020
• <i>Journal of Clean Production</i>	12/2019

Professional consultations for:

• <i>Urat Center banner Grassland Ecological Research Association</i>	03/2024-Present
• <i>Yellow River Institute of Hydraulic Research, Yellow River Conservancy Commission</i>	08/2022

## OUTREACH SPEECH

<i>[Lecture] Research on coupling model of Human-Earth system - A case study of agent-based model</i>	
<i>Graduate course, Faculty of Geography, Beijing Normal University, Beijing, China</i>	23/04/2024
<i>[Invited Presentation] Coupled human and water in the Anthropocene: Social-ecological system (SES) modeling approach</i>	
<i>Annual Academic Conference of Faculty of Geography, Beijing Normal University, Beijing, China</i>	24/12/2023

- [Invited Lecture] **ABSESpy, Agent-Based Social-ecological systems Modelling Framework in Python**  
Sun Yat-sen University, Guangzhou, China 20/11/2023
- [Invited Lecture] **Coupled human and water in the Anthropocene: Social-ecological system (SES) modeling approach**  
Universidad San Francisco de Quito, Quito, Ecuador 15/09/2023
- [Invited Lecture] **Experience sharing in scientific data visualization**  
Yellow River Conservancy Research Institute, Zhengzhou, China 17/07/2023
- [Seminar] **Evolution and driving mechanisms of human-water relationship in the Yellow River from the perspective of basin governance**  
Graduate course, Faculty of Geography, Beijing Normal University, Beijing, China 23/04/2023
- [Seminar] **Flooding Collective Memory Resilience**  
International Institute for Applied Systems Analysis: IIASA, Vienna, Austria 04/04/2023
- [Invited Lecture] **Look for interdisciplinary imagination**  
Outstanding Student Research Experience Sharing Conference, Beijing Normal University 25/05/2022
- [Invited Lecture] **Research Methods for Complex System Management: Application of Agent-based Modeling in Groundwater Resource Management**  
Virtual Lecture at Seminar of Wisdom Lab, 100+ Audiences, China 22/12/2021
- [Invited Lecture] **Interdisciplinary and Problem-Oriented Sustainability Science**  
Renmin University of China, Beijing, China 22/05/2021

## SOFTWARE DEVELOPED

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- [Leading developer] **ABSESpy: An agent-based modeling framework for social-ecological systems**  
Open-sourced software on GitHub: <https://github.com/ABSESpy/ABSESpy> 23/12/2022-Present
- It is based on the popular Python language and the general Mesa framework, enabling it to simulate complex interactions between agents and their environment. It has significantly improved in supporting real-world simulations.
- [Team Leader] **PaperBell: Research, to be connected.**  
Open-sourced software on GitHub: <https://github.com/PaperBell-Org/Obsidian-PaperBell> 2024-present
- I developed this ecosystem that provides researchers with an automatic academic note-taking workflow. This open-source project currently has 216 stars on GitHub and an active community.

## OTHER EXPLORATIONS

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- [Participated] **Zambezi River Basin Water Resources Management Survey**  
NSFC funded exploration 06/04/2025-15/04/2025
- [Organized] **Andes Mountains, Amazon Rainforest, and Galápagos Islands**  
Personal exploration 08/2023-10/2023
- [Participated] **The Second Chinese Scientific Expedition to the Qinghai-Tibet Plateau**  
National funded exploration 07/2021-09/2021
- [Participated] **Investigation of Grassland Ecological Degradation in Inner Mongolia**  
Inner Mongolia Government funded exploration Four times from 07/2020 to 09/2022