

Lei Song

Department of Geography
University of California, Santa Barbara
Email: lsong@ucsb.edu | +1-774-232-7249
Website: <https://lleisong.github.io/website/>

EDUCATION

- 2023 **Ph.D. Geography**
Clark University, Worcester, MA, USA
Advisor: Lyndon D. Estes
- 2021 **M.A. Geography**
Clark University, Worcester, MA, USA
- 2015 **M.S. Applied Meteorology**
Nanjing University of Information Science & Technology, Nanjing, CHINA
- 2012 **B.S. Geographic Information Science**
Nanjing University of Information Science & Technology, Nanjing, CHINA

APPOINTMENTS

- 2023-Present **Postdoctoral Research Fellow**, Department of Geography, University of California, Santa Barbara, CA, USA.
Supervisor: Amy E. Frazier
- 2023 **Postdoctoral Research Fellow**, School of Geographical Sciences and Urban Planning, Arizona State University, Tempe, AZ, USA.
Transfer with supervisor to UCSB.

RESEARCH INTERESTS

Geospatial Analysis and Remote Sensing
Biodiversity Conservation, Ecosystem Dynamics and Climate change
Machine Learning, Deep Learning, and explainable AI (xAI)

GRANTS, HONORS & AWARDS

- 2020 - 2023 *NASA Future Investigators in NASA Earth and Space Science and Technology (FINESST)*, Combining Spatially-explicit Simulation of Animal Movement and Earth Observation to Reconcile Agriculture and Wildlife Conservation. Award No. 8oNSSC2oK1640. \$135,000. (Role: FI)
- 2018 *The Pruser Dissertation Enhancement Awards*, Clark University
- 2018 *Harvard Design and Map Company Enhancement Award*, Clark University
- 2015 *The First Prize Scholarship*, Nanjing University of Information Science & Technology
- 2011 *The Third Prize Scholarship*, Nanjing University of Information Science & Technology
- 2009 *The First Prize Scholarship*, Nanjing University of Information Science & Technology

PEER-REVIEWED ARTICLES

6. **Song, L.**, Estes, A. B., & Estes, L. D. (2023). A super-ensemble approach to map land cover types with high resolution over data-sparse African savanna landscapes. *International*

Journal of Applied Earth Observation and Geoinformation, 116, 103152.

<https://doi.org/10.1016/j.jag.2022.103152>

5. **Song, L.**, & Estes, L. (2023). ITSDM: Isolation forest-based presence-only species distribution modelling and explanation in R. *Methods in Ecology and Evolution*, 2041-210X.14067. <https://doi.org/10.1111/2041-210X.14067>
4. Estes, L. D., Ye, S., **Song, L.**, Luo, B., Eastman, J. R., Meng, Z., Zhang, Q., McRitchie, D., Debats, S. R., Muhando, J., Amukoa, A. H., Kaloo, B. W., Makuru, J., Mbatia, B. K., Muasa, I. M., Mucha, J., Mugami, A. M., Mugami, J. M., Muinde, F. W., ... Caylor, K. K. (2022). High Resolution, Annual Maps of Field Boundaries for Smallholder-Dominated Croplands at National Scales. *Frontiers in Artificial Intelligence*, 4, 744863. <https://doi.org/10.3389/frai.2021.744863>
3. Elmes, A., Alemohammad, H., Avery, R., Caylor, K., Eastman, J., Fishgold, L., Friedl, M., Jain, M., Kohli, D., Laso Bayas, J., Lunga, D., McCarty, J., Pontius, R., Reinmann, A., Rogan, J., **Song, L.**, Stoyanova, H., Ye, S., Yi, Z.-F., & Estes, L. (2020). Accounting for Training Data Error in Machine Learning Applied to Earth Observations. *Remote Sensing*, 12(6), 1034. <https://doi.org/10.3390/rs12061034>
2. Shi, Y., & **Song, L.** (2015). Spatial Downscaling of Monthly TRMM Precipitation Based on EVI and Other Geospatial Variables Over the Tibetan Plateau From 2001 to 2012. *Mountain Research and Development*, 35(2), 180–194. <https://doi.org/10.1659/MRD-JOURNAL-D-14-00119.1>
1. Shi, Y., **Song, L.**, Xia, Z., Lin, Y., Myneni, R., Choi, S., Wang, L., Ni, X., Lao, C., & Yang, F. (2015). Mapping Annual Precipitation across Mainland China in the Period 2001–2010 from TRMM3B43 Product Using Spatial Downscaling Approach. *Remote Sensing*, 7(5), 5849–5878. <https://doi.org/10.3390/rs70505849>

Preprints

7. Khallaghi, S., Abedi, R., Abou Ali, H., Asipunu, M., Alatisé, I., Ha, N., Luo, B., Mai, C., **Song, L.**, Wussah, A., Xiong, S., Zhang, Q., Estes, L. (2024). Generalization enhancement strategies to enable cross-year cropland mapping with convolutional neural networks trained using historical samples. arXiv preprint <https://arxiv.org/abs/2408.06467>

Manuscripts in review/revision

8. **Song, L.**, Frazier, A. E., Estes, A. B., & Estes, L. D. (Under review). Landscape connectivity informs critical linkage zones for the conservation of African savanna elephant (*Loxodonta africana*) in Tanzania.
9. **Song, L.**, Frazier, A. E., Crawford, C. L., Estes, A. B., & Estes, L. D. (Under review). Optimizing future cropland allocation in a biodiverse savanna by integrating agricultural benefits and ecological costs.
10. Frazier, A. E. and **Song, L.** (Under Review). Artificial intelligence in landscape ecology: recent advances, perspectives, and opportunities.
11. de Alcantara Araujo, D. S., Enquist, B.J., Frazier, A. E., Merow, C., Roehrdanz, P., Moulatlet, G., Zvoleff, A., **Song, L.**, Maitner, B. & Nikolopoulos, E. I. (Under review). Global Future Drought Layers Based on Downscaled CMIP6 Models and Multiple Socioeconomic Pathways.

Manuscript in prep

12. **Song, L.**, Frazier, A. E., Kedron, P., Araujo, D. S. A., Cui, D., Enquist, B. J., Maitner, B., Merow, C., Moulatlet, G. M., Nikolopoulos, E. I., & Roehrdanz, P. R. (In prep). Explainable artificial intelligence to interpret spatially-explicit impacts of future climate change on species distribution.

13. Kedron, P., **Song, L.**, Frazier, A. E., Yang, W. (In prep). Landscape connectivity moderates the effect protected areas have on tropical biodiversity.
14. Bohner, T., Duncanson, L., Nikolopoulos, E. I., Frazier, A. E., Araujo, D. S. A., Brock, C., Hinojo-Hinojo, C., Krieger, J. M., Maitner, B., Merow, C., Moulatlet, G. M., Roehrdanz, P. R., **Song, L.**, & Enquist, B. J. (In prep). Future drought and mortality risk for the world's tallest forests.

TEACHING EXPERIENCE

- 2021 *GEOG 246/346 - Geospatial Analysis with R*, Spring. Clark University (Lecturer). Evaluation: **4.75/5**.
- 2020 *GEOG 246/346 - Geospatial Analysis with R*, Fall. Clark University (Teaching Assistant). Evaluation: **4.92/5**.
GEOG 246/346 - Geospatial Analysis with R, Spring. Clark University (Teaching Assistant). Evaluation: **4.70/5**.
- 2017 *GEOG 293/383 - Introduction to Remote Sensing*, Fall. Clark University (Teaching Assistant).
- 2015 *Principles of Remote Sensing*, Spring. Nanjing University of Information Science & Technology (Teaching Assistant)
- 2014 *IDL programming*, Fall. Nanjing University of Information Science & Technology (Teaching Assistant)

PROFESSIONAL EXPERIENCE

- 2018 – 2020 Graduate Research Assistant, Clark University, Worcester, USA
- *Mapping Africa project*
- 2012 - 2015 Graduate Research Assistant, Nanjing University of Information Science & Technology, Nanjing, CHINA
- *The National Natural Science Fund Project (41471312)*
 - *State key Laboratory of Remote Sensing Science Open Fund Project (OFSLRSS201309)*
 - *The National Natural Science Fund Project (41175077) and Pukou Meteorological Disaster Prevention and Mitigation System of Nanjing*

INVITED TALKS AND PRESENTATIONS

- 2023 **Song, L.**, Combining Earth Observation and Animal Movement to Reconcile Agriculture and Wildlife Conservation. *Center for Spatial Studies and Data Science, University of California, Santa Barbara*. 01 Nov. 2023
- Song, L.**, A super-ensemble approach to map land cover types with high resolution over data-sparse African savanna landscapes. *8th NICFI Satellite Data Program Scientific Research Roundtable*. Online. 01 June 2023

CONFERENCE PRESENTATIONS & POSTERS

- 2024 **Song, L.**, Frazier, A. E., Crawford, C. L., Estes, A. B., & Estes, L. D. (2024). Balancing agricultural benefits and ecological costs: pathways to address the land gap of agriculture in Tanzania. In *AAG Annual meeting, April 2024*.

- 2022 **Song, L.**, & Estes, L. D. (2022, December). Using a Nested Multi-Scale Method to Characterize Landscape Utilization and Conservation Status of African Savanna Elephant. In *AGU Fall Meeting Abstracts* (Vol. 2022, pp. B22D-1486).
Song, L., Estes, L., Estes, A., Using a nested multi-Scale method to characterize landscape utilization and conservation status of African Savanna Elephant, in *NASA Biological Diversity and Ecological Forecasting Team Meeting, September 20-22, 2022*.
Song, L., & Estes, L. *itsdm*: Isolation Forest-based presence-only species distribution modeling and explanation in R. In *2022 ESA Annual Meeting, August 14-19*.
Song, L., Estes, L., Luo, B., Estes, A., A super-ensemble approach to map land cover types with high resolution over data-sparse African savanna landscapes, in *the 4th International Electronic Conference on Remote Sensing, 25-27 January 2022*, online, **Best Poster Award**
- 2021 **Song, L.**, Estes, L., Luo, B., Estes, A., Land cover mapping in data-sparse regions, in *NASA Biological Diversity and Ecological Forecasting Team Meeting, October 19-21, 2021*, online
- 2020 **Song, L.**, Luo, B., Ye, S., Zhang, Q., & Estes, L. D. (2020, December). Using mixed labels and a multi-stage approach to map crop types over smallholder-dominated agricultural systems. In *AGU Fall Meeting Abstracts* (Vol. 2020, pp. GC034-04).
Song, L., & Estes, L. Broad-scale spatial distribution of African bush elephant (*Loxodonta Africana*) using combination of machine learning algorithms. In *2020 ESA Annual Meeting (August 3-6)*. ESA.
- 2019 Estes, L. D., Ye, S., **Song, L.**, Avery, R. B., McRitchie, D., Eastman, R., ... & Caylor, K. K. (2019, December). Improving maps of smallholder-dominated croplands through tight integration of human and machine intelligence. In *AGU Fall Meeting Abstracts* (Vol. 2019, pp. IN42A-04).
- 2018 Avery, R.B., Caylor, K.K., Estes, L.D., Eastman, R., Ye, S., **Song, L.**, Zhang, K., Xiong, S., McRitchie, D. and Woodard, T. (2018, December). A Convolutional Neural Network Approach to Segmenting Smallholder Agriculture. In *AGU Fall Meeting Abstracts* (Vol. 2018, pp. B31I-2597).
Estes, L.D., Debats, S.R., McRitchie, D., Eastman, R., **Song, L.**, Woodard, T., Xiong, S., Ye, S., Zhang, K., Avery, R.B. and Caylor, K.K. (2018, December). Using active learning to quantify how training data errors impact classification accuracy over smallholder-dominated agricultural systems. In *AGU Fall Meeting Abstracts* (Vol. 2018, pp. B22A-05).

TECHNOLOGY AND SOFTWARE DEVELOPMENT

- Lead author **itsdm**: An R package to use an interpretable Isolation Forest model for species distribution modeling.
hrlcm: A high resolution land cover mapping workflow of using ensemble labels, Random Forest, and U-Net.
sentinelPot: A python package to pre-processing Sentinel-1&2 level-1 images.
waspire: A template to build docker image to run WASP (Weighted Average Synthesis Processor) to create cloud-free syntheses with Sentinel-2 level-2A.
cscdc: Crop type detection and classification in Africa using multi-source images.
- Co-author **labeller**: Labelling platform for Mapping Africa active learning project.
learner: Machine learning component of the active learning project.

imager: A repo to prepare PlanetScope images for labelling platform and modeling.

UNIVERSITY & SCHOOL SERVICE

2019 Promotion Committee, Graduate School of Geography, Clark University

KEY TOOLS

| | |
|--------------|--|
| Programming | Proficient in R and Python Familiar with JavaScript and Julia |
| Platforms | Proficient using Amazon Web Services, Git and GitHub, Docker, Google Earth Engine, Colab, and High-performance computing (HPC) |
| Applications | Proficient in ArcGIS Software, QGIS, GRASS GIS, ENVI, DSSAT |

PROFESSIONAL AFFILIATIONS

American Association of Geographers (AAG)
American Geophysical Union (AGU)
The Ecological Society of America (ESA)
British Ecological Society (BES)
International Society for Ecological Modeling (ISEM)
North American Regional Association of the International Association for Landscape Ecology (IALE-NA)

CERTIFICATES AND WORKSHOPS

| | |
|------|---|
| 2018 | Harmonized UAS techniques: Introduction to data acquisition and preprocessing |
| 2018 | Specialization 'Data Science: Foundations using R Specialization' on Coursera |
| 2017 | Specialization 'Python for Everybody' on Coursera |

PEER REVIEWER

Landscape Ecology
Frontiers in Artificial Intelligence, AI in Food, Agriculture and Water