Esther Rolf

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Research focus: *statistical and geospatial ML, with applications in environmental monitoring. I blend methodological and applied techniques to build and analyze ML systems, emphasizing efficiency, fairness and usability.*

Education

Ph.D. Computer Science, University of California, Berkeley, 2022.
B.S.E. Computer Science and Engineering, Princeton University, 2016. *Summa cum laude.*

Academic Positions

Assistant Professor, University of Colorado Boulder Computer Science	2024-
Postdoctoral Fellow, Harvard University Data Science Initiative & Harvard Center for Research on Computation and Society	2022-2024

Affiliations

AI/ML Lead, Environmental Data Science Innovation and Impact Lab (ESIIL)	2025-
Scientific Director, Togo Data Lab	2024-

Honors & Awards

Best Student Paper Award (Arjun Rao), ML for Remote Sensing Workshop (ICLR)	2025
SDG Digital Gamechangers Award, United Nations Development Programme and the International Telecommunication Union	2023
Rising Star in AI for Social Good Harvard Center for Research on Computation and Society	2021
Best Paper Award NeurIPS Joint Workshop on AI for Social Good	2019
Best Paper Award International Conference of Machine Learning (ICML)	2018

Grants & Fellowships

CU Boulder Research and Innovation Office New Frontiers Planning Grant	2025
"New Frontiers in Physically-Grounded Geospatial AI for Understanding Complex Global Phenomena with Multi-Modal Data"	
Harvard Data Science Initiative Postdoctoral Fellowship	2022
Harvard Center for Research on Computation and Society Postdoctoral Fellowship	2022
Google PhD Fellowship	2020
National Science Foundation Graduate Fellowship (NSF GRFP)	2016
Berkeley Stonebreaker Fellowship	2016

Conference and Journal Articles

∗ → Equal contribution

1. Betti, L., Sanni, F., Sogoyou, G., Agbagla, T., Molitor, C., Carleton, T. & **Rolf, E.** Mapping on a Budget: Optimizing Spatial Data Collection for ML. in *Proceedings of the AAAI Conference on Artificial Intelligence* (2025).

2. Klemmer, K., **Rolf, E.**, Robinson, C., Mackey, L. & Rußwurm, M. SatCLIP: Global, general-purpose location embeddings with satellite imagery. in *AAAI Conference on Artificial Intelligence* (2025).

3. Gordon, L., **Rolf, E.** & Tambe, M. Combining diverse information for coordinated action: Stochastic bandit algorithms for heterogeneous agents. in *European Conference on Artificial Intelligence (ECAI)* (2024).

4. **Rolf*, E.**, Klemmer, K., Robinson, C. & Kerner*, H. Position: Mission critical–Satellite data is a distinct modality in machine learning. in *International Conference on Machine Learning (ICML)* (2024). ★ **Spotlight designation (3.5% acceptance rate)**.

5. Rolnick, D., Aspuru-Guzik, A., Beery, S., Dilkina, B., Donti, P. L., Ghassemi, M., Kerner, H., Monteleoni, C., **Rolf, E.**, Tambe, M., *et al.* Application-driven innovation in machine learning. in *International Conference on Machine Learning (ICML)* (2024).

6. Rußwurm, M., Klemmer, K., **Rolf, E.**, Zbinden, R. & Tuia, D. Geographic location encoding with spherical harmonics and sinusoidal representation networks. in *International Conference on Learning Representations (ICLR)* (2024). ★ **Spotlight designation (5% acceptance rate)**.

7. Aiken*, E., **Rolf*, E.** & Blumenstock, J. E. Fairness and representation in satellite-based poverty maps: Evidence of urban-rural disparities and their impacts on downstream policy. in *International Joint Conference on Artificial Intelligence (IJCAI)* (2023).

8. **Rolf*, E.**, Malkin*, N., Graikos, A., Jojic, A., Robinson, C. & Jojic, N. Resolving label uncertainty with implicit posterior models. in *Uncertainty in Artificial Intelligence (UAI)* (2022). ★ **Oral Presentation (5% acceptance rate)**.

9. **Rolf, E.**, Worledge, T. T., Recht, B. & Jordan, M. Representation matters: Assessing the importance of subgroup allocations in training data. in *International Conference on Machine Learning (ICML)* (2021).

10. **Rolf*, E.**, Proctor*, J., Carleton*, T., Bolliger*, I., Shankar*, V., Ishihara, M., Recht, B. & Hsiang, S. A generalizable and accessible approach to machine learning with global satellite imagery. *Nature Communications* (2021).

11. Hsiang, S., Allen, D., Annan-Phan, S., Bell, K., Bolliger, I., Chong, T., Druckenmiller, H., Huang, L. Y., Hultgren, A., Krasovich, E., Lau, P. L., Lee, J., **Rolf, E.**, Tseng, J. & Wu, T. The effect of large-scale anti-contagion policies on the COVID-19 pandemic. *Nature* (2020).

12. **Rolf, E.**, Jordan, M. I. & Recht, B. Post-estimation smoothing: A simple baseline for learning with side information. in *International Conference on Artificial Intelligence and Statistics (AISTATS)* (2020).

13. **Rolf, E.**, Simchowitz, M., Dean, S., Liu, L. T., Bjorkegren, D., Hardt, M. & Blumenstock, J. Balancing competing objectives with noisy data: Score-based classifiers for welfare-aware machine learning. in *International Conference on Machine Learning (ICML)* (2020).

14. **Rolf*, E.**, Fridovich-Keil*, D., Simchowitz, M., Recht, B. & Tomlin, C. A successive-elimination approach to adaptive robotic source seeking. *IEEE Transactions on Robotics* (2020).

15. Liu, L. T., Dean, S., **Rolf, E.**, Simchowitz, M. & Hardt, M. Delayed impact of fair machine learning. in *International Conference on Machine Learning (ICML)* (2018).
    ★ **Best Paper Award**.

Workshop Papers

1. Nair, R., Tokas, B., Tseng, G., **Rolf, E.** & Kerner, H. Classification Drives Geographic Bias in Street Scene Segmentation. in *Proceedings of the Computer Vision and Pattern Recognition Conference* (2025).

2. Purohit, M., Muhawenayo, G., **Rolf, E.** & Kerner, H. How Does the Spatial Distribution of Pre-training Data Affect Geospatial Foundation Models? *Good Data for Generative AI Workshop at AAAI 2025* (2025).

3. Rao, A. & Rolf, E. Using Multiple Input Modalities Can Improve Data-Efficiency and OOD Generalization for ML with Satellite Imagery. *PMLR*, *Terrabytes Workshop at ICML* (2025).
   ★ Earlier version received **Best StudentPaper Award** at the ICLR 2025 Workshop on Machine Learning for Remote Sensing.

4. **Rolf, E.** Evaluation challenges for geospatial ML. *Machine Learning for Remote Sensing (ML4RS) Workshop at the International Conference on Learning Representations (ICLR)* (2023).

5. **Rolf, E.**, Packer, B., Beutel, A. & Diaz, F. Striving for data-model efficiency: Identifying data externalities on group performance. *Workshop on Trustworthy and Socially Responsible Machine Learning at the Conference on Neural Information Processing Systems (NeurIPS)* (2022).

6. Soman, S., Aiken, E., **Rolf, E.** & Blumenstock, J. Can Strategic Data Collection Improve the Performance of Poverty Prediction Models? *Artificial Intelligence for Humanitarian Assistance and Disaster Response Workshop at the Conference on Neural Information Processing Systems (NeurIPs)* (2022).

7. **Rolf, E.**, Simchowitz, M., Dean, S., Liu, L. T., Björkegren, D., Hardt, M. & Blumenstock, J. Balancing Competing Objectives for Welfare-Aware Machine Learning with Imperfect Data. *AI for Social Good workshop at the Conference on Neural Information Processing Systems (NeurIPS)* (2019).
   ★ **Best Paper Award**.

8. Bolliger, I., Carleton, T., Hsiang, S., Kadish, J., Proctor, J., Recht, B., **Rolf, E.** & Shankar, V. Ground Control to Major Tom: the importance of field surveys in remotely sensed data analysis. *Bloomberg Data for Good Exchange* (2017).

Extended Abstracts

1. **Rolf, E.**, Klemmer, K. & Rußwurm, M. Earth Embeddings: Harnessing the Information in Earth Observation Data with Machine Learning. in *Proceedings of the Special Interest Group on Computer Graphics and Interactive Techniques Conference Frontiers* (2025), 1–2.

News and Editorials

1. Klemmer, K. & **Rolf, E.** Satellite images reveal untracked human activity on the oceans. *Nature News and Views* (2024).

White Papers, Preprints, and Works in Submission

1. Christensen, D., Carleton, T., **Rolf, E.**, Molitor, C., Biswas, S., Yan, K. & Blair, G. *Estimating the Footprint of Artisanal Mining in Africa* tech. rep. (National Bureau of Economic Research, 2025).

2. Rao, A., Rußwurm, M., Klemmer, K. & **Rolf, E.** Measuring the Intrinsic Dimension of Earth Representations. *arXiv preprint arXiv:2511.02101* (2025).

3. Elger, K., Kingsley, D., Inadomi, B., Raia, N., Rao, Y., **Rolf, E.**, Schuster, D. & Shingledecker, S. Preserving open data as a world heritage to secure our future. *Authorea Preprints* (2024).

4. **Rolf, E.**, Gordon, L., Tambe, M. & Davies, A. Contrasting local and global modeling with machine learning and satellite data: A case study estimating tree canopy height in African savannas. *In submission to the Journal of Machine Learning Research, special issue on ML addressing problems of climate change. arXiv preprint arXiv:2411.14354* (2024).

5. Xu*, Lily and **Rolf*, E.** *et al.* Reflections from the Workshop on AI-Assisted Decision Making for Conservation. *arXiv preprint arXiv:2307.08774* (2023).

Invited Talks

2025	CU Boulder Sustainability Research Initiative AI & Data Centers Workshop (keynote)
	CMCC Workshop on Artificial Intelligence for Carbon
	Oregon State University AI Seminar
	SIGGRAPH Frontiers talk
	University of British Columbia, Seminar
	Maxar Technologies, Seminar
	CU Boulder MathGeo Seminar
	CU Boulder EBio Seminar
2024	NeurIPS workshop on Bayesian Decision-making and Uncertainty
	NeurIPS 2024 Workshop on Tackling Climate Change with Machine Learning (keynote)
	CU Boulder Earth Lab Environmental Data Science Seminar Series
	Harvard Salata Institute for Climate and Sustainability Scholar Seminar Series
	Harvard GeoAI Conference
2023	Boston University Center for Computing and Data Sciences Machine Learning Seminar
	Harvard Center for Geographic Analysis Seminar Series
	Google Responsible ML reading group
2022	Summer at Census (virtual) Workshop
	Microsoft New England ML Ideas Seminar
2021	United States Census Bureau
	Berkeley School of Information Data Science Immersion Experience
	Harvard Center for Research on Computation and Society Rising Star Speaker Series
2020	CGIAR Big Data in Agriculture: Digital Dynamism for Adaptive Food Systems
2019	ImageXD Conference at Berkeley Institute of Data Science
	Sigmetrics: highlights beyond Sigmetrics

Teaching

CSCI 5622: Machine Learning, CU Boulder, Spring 2025 & Spring 2026.
CSCI 7000: Current Topics in CS: Geospatial and Statistical ML, CU Boulder, Fall 2024 & Fall 2025.
DS 102: Data, Inference, and Decisions: UC Berkeley, Fall 2019. (graduate student instructor)
CS 189/289A: Introduction to ML, UC Berkeley, Fall 2018. (graduate student instructor)
CS 340: Reasoning about Computation, Princeton, Fall 2015, Spring 2016. (undergrad TA and grader)

Research Advising

Levi "VeeVee" Cai, ESIIL AI and Environment Postdoctoral Fellow, 2025-
Livia Betti, CU Boulder Computer Science PhD Program, 2024-
  Recipient of CU Boulder Chancellor's Fellowship and NSF GRFP Fellowship
Arjun Rao, CU Boulder Computer Science PhD Program, 2024-2025
Ian Christie, CU Boulder Computer Science Master's, 2025-2026
Lucia Wittiko, CU Boulder Computer Science Master's, 2025-2026
Arjun Rao, CU Boulder Computer Science PhD Program, 2024-
Theodora Worledge, UC Berkeley Undergraduate, 2019-2021
  Currently Ph.D. at Stanford Computer Science, NSF GRFP recipient

Academic Service

Advisory & Task Panels

American Geophysical Union (AGU) Data Position Statement Panel, 2023-2024
  - Updated the Data Position Statement of the American Geophysical Union.

Academic and Professional Panels

2024   SatCamp Conference
        CU Boulder AI Community of Practice AI Showcase
        CVPR Earthvision
        Data.org Accelerate Conference

Peer Reviewing

Journals   Science, Environmental Data Science, IEEE Robotics and Automation Letters
Conferences   NeurIPS, ICML, ICLR, AAAI, AISTATS, EAMMO, UAI
Workshops   ML for Remote Sensing, NeurIPS AI + Humanitarian Assistance and Disaster Relief,
              Consequential Decision Making in Dynamic Environments, Climate Change AI

Workshop Organization

2026   International Society for Photogrammetry and Remote Sensing (ISPRS) Thematic Session on
        "Earth embeddings"
2026   ICLR Workshop on Machine Learning for Remote Sensing, lead organizer
2025   ICLR Workshop on Machine Learning for Remote Sensing
2022   Harvard CRCS Workshop on AI-Assisted Decision-Making for Conservation
2021   NeurIPS Workshop on AI for Humanitarian Assistance and Disaster Response
2020   Good Data Seminar (UC Berkeley cross-disciplinary research seminar)
2019   Good Data Seminar (UC Berkeley cross-disciplinary research seminar)
2018   Good Data Seminar (UC Berkeley cross-disciplinary research seminar)

Industry Research Internships

Research Intern, Google Research, November 2021 - January 2022.
Research Intern, Microsoft Research, May 2021 - July 2021.

Last updated: December 7, 2025