Seth Goodman, PhD

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Research scientist & data engineer specializing in the design and operationalization of research and analysis utilizing geospatial data, machine learning, and distributed computing.

Current Position

2021 - Present   **Research Scientist & Data Engineer, AidData at William & Mary - Williamsburg, VA**

Academic History

PhD, Computational Geography   **2021**   **William & Mary, Department of Applied Science**
  Dissertation- *Filling in the Gaps: Applications of Deep Learning, Satellite Imagery, and High Performance Computing for the Estimation and Distribution of Geospatial Data*
Master of Science, Applied Science   **2019**   **William & Mary**
Master of Science, Electrical Engineering   **2012**   **Villanova University**
Bachelor of Science, Electrical Engineering   **2011**   **Villanova University**

Research

Research Grants & Other Funding

- DoD STTR (Phase 2): Public Observatory for Integrated Population Migration Data and Modeling. 2023-2025. Subaward: $519,046 (Co-PI)
- William & Mary Faculty Summer Research Grant. Developing Data Pipelines for Research and Analysis. Summer 2023. Total: $5,000 (PI)
- USAID/DAI Digital Frontiers - Equitable AI Challenge. Evaluating Gender Bias in AI Applications Using Household Survey Data. 2022-2023. Total: $132,900 (PI)
- DoD STTR (Phase 1): Public Observatory for Integrated Population Migration Data and Modeling. 2022-2023. Subaward: $103,206 (Senior Personnel)
- William & Mary Higher Education Equipment Trust Fund. 2021-2022. Total: $93,181 (PI)
- William & Mary Global Research Institute. Funding for 2-Year PostDoc for Academic Diversity. 2022-2024. Total: $221,600 (Co-PI)
- German Institute for Development Evaluation (DEval). Evaluation of interventions for climate change adaptation – A geospatial impact evaluation of irrigation interventions in Mali. 2021. Total: $211,863 (Senior Personnel)
- Commonwealth Center for Energy and Environment. Exploring the Impacts of Accessible Geospatial Data. 2021. Total: $5,000 (PI)
- AI for Earth Microsoft Azure Compute Grant. Advancing next generation outcome measures: Using machine learning to identify data gaps in measuring the impacts of Climate Change, Water, and Agricultural Policy. 2020-2022. Total: $15,000 (Co-PI)
- Patrick J. McGovern Foundation Data4Change Grant. GeoQuery. 2019-2022. Total: $1,152,000 (Co-PI)

- USAID Global Development Lab - Operational Innovations. Neural-network Based Approaches to Spatial Estimation of State Fragility. 2018-2020. Total: $499,592 (Senior Personnel)
- Global Environment Facility. Geospatial Impact Evaluation in the Context of GEF Projects - On-site Training. 2018. Total: $35,263 (Co-PI)

Peer-Reviewed Academic Publications

- *Under Review:* Goodman, S., BenYishay, A, Runfola, D. *Spatiotemporal Prediction of Conflict Fatality Risk Using Convolutional Neural Networks and Satellite Imagery.*
- *Under Review:* Goodman, S., Zhang, S., Malik, A., Parks, B., Hall, J. *AidData's Geospatial Global Chinese Development Finance Dataset.*
- BenYishay, A., Glenn, C., Goodman, S., Trichler, R. *Rebuilding Irrigation Infrastructure and Institutions: Evidence from Afghanistan*. **Economic Development and Cultural Change**. Forthcoming.
- BenYishay, A., Sayers, R., Singh, K., Goodman, S., Walker, M., Traore, S., Rauschenbach, M., Noltze, M. 2024. *Irrigation Strengthens Climate Resilience: Long-term Evidence from Mali using Satellites and Surveys.* **PNAS Nexus.**
- Goodman, S, BenYishay, A, Runfola, D. 2020. *A convolutional neural network approach to predict non-permissive environments from moderate-resolution imagery*. **Transactions in GIS**.
- Prakash, M., Ramage S., Kavvada, A., Goodman, S. 2020. *Open Earth Observations for Sustainable Urban Development*. **Remote Sensing**, Special Issue: EO Solutions to Support Countries Implementing the SDGs.
- Runfola, D., Anderson A., Baier H., Crittenden M., Dowker E., Fuhrig S., Goodman S., Grimsley G., Layko R., Melville G., Mulder M., Oberman R., Panganiban J., Peck A., Seitz L., Shea S., Slevin H., Youngerman R., Hobbs L.. 2020. *geoBoundaries: A Global Database of Political Administrative Boundaries*. **PLOS ONE**.
- Runfola, D., Baatra, G., Anand, A., Way, A., Goodman, S. 2020. *Exploring the Socioeconomic Co-benefits of Global Environment Facility Projects in Uganda using a Quasi-experimental Geospatial Interpolation (QGI) Approach*. **Sustainability**, Special Issue: Environment-Poverty Nexus and Sustainable Development.
- Goodman, S., BenYishay, A., Lv, Z., Runfola, D. 2019. *GeoQuery: Integrating HPC systems and public web-based geospatial data tools*. **Computers & Geosciences**.
- Marty, R., Goodman, S., LeFew, M., Dolan, C., BenYishay, A., Runfola, D. 2019. *Assessing the Causal Impact of Chinese Aid on Vegetative Land Cover in Burundi and Rwanda Under Conditions of Spatial Imprecision*. **Development Engineering**.
- Runfola, D., BenYishay, A., Tanner, J., Buchanan, G., Nagol, J., Leu M., Goodman, S., Trichler, R., Marty, R. 2017. *A Top-Down Approach to Estimating Spatially Heterogeneous Impacts of Development Aid on Vegetative Carbon Sequestration*. **Sustainability**.

Other Reports, Computer Code, and Data Products

- Goodman, S., Nolan, K., Sayers, R., BenYishay, A., Hall, J., Zupork Dome, M., and Selormey, E. 2023. [Evaluating Gender Bias in AI Applications Using Household Survey Data](#). Williamsburg, VA and Accra, Ghana: AidData at William & Mary and Ghana Center for Democratic Development.
- Parks, B. C., Malik, A. A., Escobar, B., Zhang, S., Fedorochko, R., Solomon, K., Wang, F., Vlasto, L., Walsh, K. & Goodman, S. 2023. Belt and Road Reboot: Beijing's Bid to De-Risk Its Global Infrastructure Initiative. Williamsburg, VA: AidData at William & Mary.
- BenYishay A., S. Goodman, R. Sayers, K. Singh, M. Walker, M. Rauschenbach and M. Noltze (2023), Does Irrigation Strengthen Climate Resilience? A Geospatial Impact Evaluation of Interventions in Mali, DEval Discussion Paper 1/2023, German Institute for Development Evaluation (DEval), Bonn.
- Goodman, S. *reproj* Python package. 2023. https://pypi.org/project/reproj/

- Malik, A., Parks, B., Russell, B., Lin, J., Walsh, K., Solomon, K., Zhang, S., Elston, T., and <u>Goodman, S</u>. (2021). Banking on the Belt and Road: Insights from a new global dataset of 13,427 Chinese development projects. Williamsburg, VA: AidData at William & Mary.
- <u>Goodman, S.</u> *distance-rasters* Python package. 2021. https://pypi.org/project/distancerasters/
- <u>Goodman, S.</u> *polygon-grid* Python package. 2021. https://pypi.org/project/polygongrid/
- Prakash, M., Ramage, S., <u>Goodman, S.</u> 2020. Open Earth observations for sustainable urban development. Williamsburg, VA: AidData at William & Mary
- BenYishay, A., <u>Goodman, S</u>., Lv, M., Runfola, D. 2019. Endline Report: Impact Evaluation of Road Improvement in Tanzania. Millennium Challenge Corporation / Mathematica. Annex C7.
- BenYishay, A., <u>Goodman, S</u>., Runfola, D., Lv, M. 2019. Final Report: Evaluation of investments in the road infrastructure of Ghana. Millennium Challenge Corporation / Mathematica. Annex E7.
- Batra, G., Anand, A., <u>Goodman, S.</u>, Runfola, D., 2019. Value for Money Analysis of GEF Interventions in Support of Sustainable Forest Management. GEF/ME/C.56/Inf.02 . https://www.thegef.org/council-meeting-documents/value-money-analysis-gef-interventions-support-sustainable-forest
- <u>Goodman, S.</u>, Runfola, D.M. 2019, Global Carbon Dioxide Concentration: 2015-2018. http://geolab.wm.edu/data.
- BenYishay, A., Glenn, C., Runfola, D., <u>Goodman, S</u>., Trichler, R. 2018. Final Report: Evaluation of the On-Farm Water Management Program. Williamsburg, VA: AidData at William & Mary. https://www.aiddata.org/publications/final-report-evaluation-of-the-on-farm-water-management-program
- BenYishay, A., Trichler, R., Runfola, D., <u>Goodman, S</u>. 2018. Final Report: Evaluation of the Infrastructure Needs Program II. Williamsburg, VA: AidData at William & Mary. https://www.aiddata.org/publications/evaluation-of-usaid-west-bank-gaza-infrastructure-needs-program
- BenYishay, A., Runfola, D., Trichler, R., Dolan, C., <u>Goodman, S.</u>, Parks, B., Tanner, J., Heuser, S., Batra, G., Anand, A. 2017. A Primer on Geospatial Impact Evaluation Methods, Tools, and Applications. AidData Working Paper #44. Williamsburg, VA: AidData.
- BenYishay, A., Rotberg, R., Wells, J., Lv, Z., <u>Goodman, S</u>., Kovacevic, L., Runfola, D. 2017. Geocoding Afrobarometer Rounds 1 - 6: Methodology & Data Quality. AidData. Available online at http://geo.aiddata.org.
- <u>Goodman, S</u>., BenYishay, A., Runfola, D., 2017. Overview of the geo Framework. AidData. Available online at http://geo.aiddata.org/. DOI: 10.13140/RG.2.2.28363.59686
- Runfola, D., Marty, R., <u>Goodman, S.</u>, Lefew, M., BenYishay, A. 2017. geoSIMEX: A Generalized Approach To Modeling Spatial Imprecision. AidData Working Paper #38. Williamsburg, VA: AidData.
- Batra, G., Anand, A., <u>Goodman, S</u>., BenYishay, A., Nyoteshwar, J., Runfola, D., 2017. A Value for Money Analysis of GEF Interventions in Land Degradation and Biodiversity, http://www.gefieo.org/evaluations/value-money-analysis-gef-interventions-land-degradation-and-biodiversity

Scholarly Presentations / Invited Talks

- <u>Goodman, S</u>. *Accessible Geospatial Data for Geospatial Impact Evaluations - GeoQuery Training*. GeoField Convening. Virtual. September 2023.
- <u>Goodman, S.</u>, Dome, M.Z. *Gender Bias & AI Poverty Estimates*. USAID Equitable AI Community of Practice Workshop. Virtual. August 2023.

- Goodman, S. *Irrigation Strengthens Climate Resilience: Long-term Evidence from Mali using Satellites and Surveys*. GeoField Convening. Virtual. May 2023.
- Goodman, S. Nolan, K. *Evaluating Gender Bias in AI Applications Using Household Survey Data*. W&M Global Research Institute's Research in Progress Seminar. May 2022.
- Davis, C., Alemohammad, H., Goodman, S. *Geospatial Data to Drive Climate Action*. Patrick J. McGovern Foundation Accelerator Peer Learning Series. Virtual. April 2022.
- Goodman, S. BenYishay, A. *Measuring local economic impacts using machine learning and geospatial data: a case study in the Philippines*. W&M Global Research Institute's Research in Progress Seminar. Virtual. June 2021.
- Goodman, S. *GeoQuery: Making Geospatial Data Accessible for All.* GeoConvergence Workshop Lightning Talk. Virtual. May 2021.
- Goodman, S. (moderator), Patterson, S., Walsh, K., Fuhrig, S. *Empowering Insight with Open Geospatial Data*. Open Data Week. Virtual. March 2021.
- Goodman, S., BenYishay, A., Runfola, D. Predicting Non-Permissive Environments in Nigeria. USAID Office of Security and the Global Development Lab. Virtual Presentation. October 2020.
- Goodman, S. *Predicting Non-Permissive Environments in Nigeria*. VIMS GIS User Group Invited Talk. Virtual Presentation. September 2020.
- Goodman, S., Runfola, D. *Predicting Non-Permissive Environments in Nigeria*. USAID. Virtual Presentation. August 2020.
- Goodman, S., Yelverton, E., Kinsella, B. *Using Open Data to Empower Mission-Driven Organizations*. Open Data Week. New York, NY. March 2020.
- Goodman, S., BenYishay, A., Juech, C., Benjamin S., Hellen, S. *Using Spatial Data for Development*. Nethope Summit. San Juan, Puerto Rico. October 2019.
- Goodman, S. *Improving the Efficacy of Convolutional Neural Networks for Applications in International Development*. GeoAI and Deep Learning Symposium, American Association of Geographers Annual Meeting. Washington, DC. April 2019.
- Goodman, S., Parks, B., Patterson, S. Geospatial impact evaluation: methods, tools, and applications. French Development Agency (AFD). Paris, France. January 2019
- Goodman, S. *Machine Learning Techniques for Project Evaluation: Measurement, Evaluation and Transparency*. Green Climate Fund (GCF) Independent Evaluation Unit (IEU) Lunch Talk. Incheon, South Korea. December 2018.
- Runfola, D., Goodman, S., Desai, H. Novel Applications of Geospatial Data and Methods: Source Collection and Analysis at AidData. Open Source Center, U.S. Central Intelligence Agency (CIA). Langley, Virginia. October 2018
- Runfola, D., Goodman, S. *Geospatial Impact Evaluation for International Aid*. Norwegian University of Life Sciences (NMBU). Ås, Norway, Spring 2018.
- Goodman, S., Runfola, D., *Geospatial Data and Tools to Evaluate and Target Aid: Examining the Impacts of The Global Environmental Facility's Land Degradation Projects*. Innovators Forum 2018: Digital Futures. International Civil Society Centre. Berlin, Germany. February 2018.
- Runfola, D., Baatra, G., Goodman, S., BenYishay, A., Trichler, R., Rottberg, R., Kemper, P., Zhao, J. *Recursive Partitioning to identify Heterogeneous Causal Impacts of Environmental Development Projects*. Global Environmental Facility. Washington, DC. Fall 2017.
- Runfola, D., Goodman, S., Lv, M., *Practical Spatial Data Analysis for Everyone: Introducing GeoQuery*. World Bank. Washington, DC. Fall 2017.

- Goodman, S., Runfola, D., Lv, M., *High Performance Computation for Everyone: Integrating Web-portals and HPC.* GeoComputation '17. Leeds, UK. September 2017.
- Runfola, D. Goodman, S., Lv, M., BenYishay, A.. *Machine Learning and Heterogeneity in Impact Effects: A Case Study of the GEF*. GeoComputation '17. Leeds, UK. September 2017.
- Runfola, D., BenYishay, A., Goodman, S., *Geospatial Analysis of the Causal Impacts of Aid: Prediction vs. Causation.* Meta Analysis of Climate Change Working Group, CIESIN, Spring 2017.
- LeFew, M., Marty, R., Goodman, S., Runfola, D., A. *Modeling Geographic Uncertainty in Aid Allocation for Linear Causal Inference*, Association of American Geographers, April 2017.
- Marty, R., Runfola, D., Goodman, S., LeFew, M., BenYishay, A. *geoSIMEX: A Generalized Approach to Modeling Spatial Imprecision*, International Studies Association 58th Annual Convention, February 2017.

Workshops / Teaching

- *Geospatial Impact Evaluation Training*. (Virtual workshops) Food and Agriculture Organization of the United Nations. September and October 2022.
- *Using Big Data to Measure Development*. (Guest lecture) ICT4D at Penn Global. January 2021.
- *Speed Data-ing - Match a Data Expert to Your Data Challenges*. (Workshop) Nethope Summit. San Juan, Puerto Rico. October 2019.
- *Introduction to GIS and Geospatial Data*. (1 credit course) William & Mary. Summer 2019.
- *Using GeoQuery and QGIS*. (Workshop) French Development Agency (AFD). Paris, France. January 2019
- *Applications of Spatial Data in International Development*. (Workshop) Green Climate Fund (GCF) Independent Evaluation Unit (IEU). Incheon, South Korea. December 2018.
- *Geospatial Impact Evaluation Methods, Tools & Applications*. (Workshop) Global Environmental Facility (GEF). Washington, DC. May 2018.

Blog Posts and Other Content

- [AidData partnership works to promote gender-equitable AI applications.](#) AidData. 2023
- [AidData wins award from USAID's Equitable AI Challenge for project on gender bias in AI-created poverty measures](#). AidData. 2023.
- [The largest update yet to GeoQuery, AidData's free spatial data platform](#). AidData. 2021.
- [A "new" type of data for development](#). AidData. 2020.
- [Unlocking geospatial data for global development](#). AidData / McGovern Foundation. 2019.
- [Breaking Boundaries](#). AidData. 2018.
- [AidData-Afrobarometer partnership produces geocoded public-attitude survey data for 37 African countries](#). AidData. 2017.

Extramural Service and Memberships

- *Journal Reviewer:* BMJ Global Health; Development Engineering; Sustainability; Remote Sensing; Land; Environment, Development and Sustainability; Transactions in GIS; ISPRS International Journal of Geo-Information; PLOS ONE; Knowledge; Agronomy; Information;
- American Association of Geographers, Member

Press Coverage

- Humanitarian AI Today ([podcast interview](#)). 2020.
- Group on Earth Observations, 2020. [Open Earth observations for sustainable urban development.](#)

- Patrick J. McGovern Foundation Blog, 2020. *Reflections on 'Speed Data-ing'*.
- HPC Wire, 2018. *What's New in HPC Research: Thrill for Big Data, Scaling Resilience and More*
- Brookings, 2018. *A quiet revolution in impact evaluation at USAID.*
- The Washington Post, 2015. *Here's how broke college students are helping Nepal recover from disaster.*
- Williamsburg-Yorktown Daily, 2015. *W&M Students, AidData Crowdsource Maps for Nepal Relief Efforts*.

Professional Activities

AidData at William & Mary
  Research Scientist & Data Engineer (2021 - Present)
  Data Engineer / Senior Data Specialist (2019 - 2021)
  Data Engineer / Data Specialist (2016 - 2019)
- Designed and implemented machine learning pipelines utilizing satellite imagery and other geospatial data to estimates [development metrics](#)
- Developed [tools](#), infrastructure, and data pipelines to manage over 50TB of data utilized by thousands of researchers around the world
- Conducted extensive outreach and advancement efforts through academic [publications](#), presentations, workshops, funding proposals, and [more](#).

Independent Consultant
- *The World Bank Group (GEF IEO) (2019)* - Implemented data and analysis pipelines for an impact evaluation of aid projects on deforestation
- *The Center for Conservation Biology (2019)* - Updated GIS web application backend following system migration

AidData at William & Mary
  Junior Data Analyst (2015 - 2016)
  Technical Associate (2014 - 2015)
- Analyzed geospatial data using a variety of geospatial software and techniques including QGIS, ArcGIS, R, Python and web mapping tools
- Supported research projects through collection and processing of geospatial datasets
- Created data-driven application prototypes that allow users to query, visualize and analyze geospatial datasets

Independent Study (2012 - 2014)
- Worked with web development languages (HTML, CSS, JavaScript, PHP, SQL) as well as scripting languages including Lua and Visual Basic for Applications
- Audited graduate neuroscience courses & laboratory work at The College of William & Mary
- Utilized Quantum GIS and a variety of open source educational materials to enhance GIS skills

Project Documentation Editor, Institute of Electrical and Electronics Engineers (2011 - 2012)
- Conducted research, analyzed data from field reports, and collaborated with project volunteers to produce comprehensive documentation for the Data Connectivity portion of the IEEE Humanitarian Technology Challenge

Project Leader, Villanova Capstone Design Project (2010 - 2011)
- Produced a simulation for a solar power system that was used to design an alternative energy power supply for a rural health clinic in Tanzania. incorporated local weather data and load analysis data to calculate power generation potential and system sustainability.

Intern, ASEE Naval Research Enterprise Internship Program (Summer 2009 & 2010)
- Developed a data collection system for a hybrid power system test site and modeled behavior of advanced batteries for use in system simulations
- Built systems for an autonomous vehicle which managed processing data from sensors and data communications between components

Technical Skills

Programming:
Python   Shell/Bash   R   Javascript   PHP   Matlab

Machine Learning:
PyTorch   Scikit-Learn   Azure ML

GIS:
Python (rasterio, shapely, fiona, geopandas, pyproj)   Javascript (turf)   GDAL   Quantum GIS   ArcGIS

Distributed/Parallel Computing:
MPI   mpi4py   Python Multiprocessing   Hadoop/Spark   Dask

Databases:
NoSQL   MongoDB   HBase   SQL

Other:
Git   LaTeX/Overleaf   Linux   HTML/CSS   Web Servers   Node   Cloudera CDH   Virtual Environments   Conda   Python Packaging