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David J. Farnham

Education

2018 **Ph.D.**, *Columbia University*, New York, NY
Earth and Environmental Engineering Department

Adviser Upmanu Lall, Columbia Water Center

Thesis *Identifying and modeling spatio-temporal patterns in high dimensional climate and weather datasets with applications to water and energy resource management*

2015 **M.S., Earth Resources Engineering**, *Columbia University*, New York, NY

Concentration Water Resources and Climate Risks

Thesis *Predictive Statistical Models Linking Antecedent Meteorological Conditions and Waterway Bacterial Contamination in Urban Waterways*

2012 **B.S., Civil Engineering**, *SUNY-Buffalo*, Buffalo, NY
Summa Cum Laude, Honors College member

2012 **B.A., Mathematics**, *SUNY-Buffalo*, Buffalo, NY
Summa Cum Laude, Honors College member

Experience

Research

2018–Present **Postdoctoral Research Scientist**, *Working with Dr. Ken Caldeira*, Carnegie Science & Department of Global Ecology, Stanford University, Stanford, CA

2012–2018 **Graduate Student Researcher**, *Working with Dr. Upmanu Lall*, Columbia Water Center & Department of Earth and Environmental Engineering, Columbia University, New York, NY

2012 **Student Researcher**, *Working with Dr. Joe Atkinson*, Department of Civil and Environmental Engineering, SUNY-Buffalo, Buffalo, NY

2012 **Student Researcher**, *Ecosystem Restoration through Interdisciplinary Exchange, NSF IGERT REU*, SUNY-Buffalo, Buffalo, NY

Teaching

2015 **Teaching Assistant & Guest Lecturer**, *Environmental Data Analysis (Graduate level)*, Department of Earth and Environmental Engineering, Columbia University, New York, NY

2015 **Teaching Assistant**, *Better Planet By Design (Undergraduate level)*, Department of Earth and Environmental Engineering, Columbia University, New York, NY

2014–2016 **Lead Module Developer**, *HydroViz Web Modules: Teleconnections Module*, `https://hydroviz.org`, (HydroViz is a web-based, student-centered educational system designed to support active learning in the field of hydrology)

Student Advisement

2020–Present Yash Amonkar (PhD student at Columbia University)

2017–2019 Zeyu Xue, Jianan Cao, Bingquan Wu (master's students at Columbia University)

2016–2017 Caroline Schwab (high school student)

Journal Reviewer

2017–Present Citizen Science: Theory and Practice, Climate Research, Environmental Research Letters, Geophysical Research Letters, Hydrology and Earth System Sciences, International Journal of Geographical Information Science, Journal of Hydrology, Science of the Total Environment, Water Research, and Water Resources Research, Weather, Climate, and Society

Diversity, Equity, and Inclusion

2020–Present **Coordinator**, *Department of Global Ecology*, Facilitated weekly departmental working group discussions to spur initiatives to make the department a more welcoming and supportive environment, particularly for researchers and staff from underrepresented groups

2020 **Training participant**, *Department of Global Ecology*, *Implementing an inclusive search* led by Dr. Stephanie Goodwin (President of Incluxion Works, Inc)

Conferences

2019, 2020 **Outstanding Student Paper Award Judge**, American Geophysical Union Fall Meeting

2019 **Chair & Convener**, *NH51A/NH53B: Emerging Needs and Approaches for Climate Services: Understanding and Developing Innovative Approaches to User-Oriented Climate Services*, American Geophysical Union Fall Meeting, San Francisco, CA

2019 **Chair & Convener**, *H12B/H13J: Advances in Integrated Data Collection, Analyses, and Flood Modeling of Complex Urban Systems*, American Geophysical Union Fall Meeting, San Francisco, CA

Seminar organizing

2018–Present **Seminar Committee Member**, *Department of Global Ecology*, Helped plan and run weekly seminars

Publications and Presentations

Peer-reviewed Journal Articles Published, In Press, or Accepted

[1] Brown, P. T., **Farnham, D. J.**, Caldeira, K., "Meteorology and climatology of historical weekly wind and solar power resource droughts over western North America in ERA5". In: 3.10 (Sept. 2021). DOI: 10.1007/s42452-021-04794-z.

[2] Doss-Gollin, J., **Farnham, D. J.**, Lall, U., Modi, V., "How unprecedented was the February 2021 Texas cold snap?" In: *Environmental Research Letters* (2021). DOI: 10.1088/1748-9326/ac0278.

[3] Henry, C. L., Eshraghi, H., Lugovoy, O., Waite, M. B., DeCarolis, J. F., **Farnham, D. J.**, Ruggles, T. H., Peer, R. A., Wu, Y., de Queiroz, A., Potashnikov, V., Modi, V., Caldeira, K., "Promoting reproducibility and increased collaboration in electric sector capacity expansion models with community benchmarking and intercomparison efforts". In: *Applied Energy* 304 (2021), p. 117745. DOI: https://doi.org/10.1016/j.apenergy.2021.117745.

[4] Hui, Y., **Farnham, D. J.**, Atkinson, J. F., Zhu, Z., Feng, Y., "Circulation in Lake Ontario: Numerical and Physical Model Analysis". In: *Journal of Hydraulic Engineering* 147.8 (2021), p. 05021004. DOI: 10.1061/(ASCE)HY.1943-7900.0001908.

[5] Tong, D., **Farnham, D. J.**, Duan, L., Zhang, Q., Lewis, N. S., Caldeira, K., Davis, S. J., "Geophysical constraints on the reliability of solar and wind power worldwide". In: 12.1 (Oct. 2021). DOI: 10.1038/s41467-021-26355-z.

[6] Doss-Gollin, J., **Farnham, D. J.**, Ho, M., Lall, U., "Adaptation over Fatalism: Leveraging High-Impact Climate Disasters to Boost Societal Resilience". In: *Journal of Water Resources Planning and Management* 146.4 (Apr. 2020), p. 01820001. DOI: 10.1061/(ASCE)WR.1943-5452.0001190.

[7] Ruggles†, T. H., **Farnham†, D. J.** Tong, D., Caldeira, K., "Developing reliable hourly electricity demand data through screening and imputation". In: *Scientific Data* 7.1 (2020), p. 155. DOI: 10.1038/s41597-020-0483-x.

[8] Zeng, P., Sun, X., **Farnham, D. J.,** "Skillful statistical models to predict seasonal wind speed and solar radiation in a Yangtze River estuary case study". In: *Scientific Reports* 10.1 (2020), p. 8597. DOI: 10.1038/s41598-020-65281-w.

[9] Doss-Gollin, J., **Farnham, D. J.**, Steinschneider, S., Lall, U., "Robust Adaptation to Multiscale Climate Variability". In: *Earth's Future* 7.7 (2019), pp. 734–747. DOI: 10.1029/2019EF001154.

[10] **Farnham, D. J.**, Doss-Gollin, J., Lall, U., "Regional Extreme Precipitation Events: Robust Inference From Credibly Simulated GCM Variables". In: *Water Resources Research* 54.6 (2018), pp. 3809–3824. DOI: 10.1002/2017WR021318.

[11] Hamidi, A., **Farnham, D. J.**, Khanbilvardi, R., "Uncertainty analysis of urban sewer system using spatial simulation of radar rainfall fields: New York City case study". In: *Stochastic Environmental Research and Risk Assessment* 32.8 (2018), pp. 2293–2308. DOI: 10.1007/s00477-018-1563-8.

[12] Cooper, C. B., Larson, L. R., Holland, K. K., Gibson, R. A., **Farnham, D. J.**, Hsueh, D. Y., Culligan, P. J., McGillis, W. R., "Contrasting the Views and Actions of Data Collectors and Data Consumers in a Volunteer Water Quality Monitoring Project: Implications for Project Design and Management". In: *Citizen Science: Theory and Practice* 2.1 (2017), pp. 1–14. DOI: 10.5334/cstp.82.

[13] **Farnham, D. J.**, Steinschneider, S., Lall, U., "Zonal Wind Indices to Reconstruct CONUS Winter Precipitation". In: *Geophysical Research Letters* 44.24 (Nov. 2017), pp. 12, 236–12, 243. DOI: 10.1002/2017GL075959.

[14] **Farnham, D. J.**, Gibson, R. A., Hsueh, D. Y., McGillis, W. R., Culligan, P. J., Zain, N., Buchanan, R., "Citizen science-based water quality monitoring: Constructing a large database to characterize the impacts of combined sewer overflow in New York City". In: *Science of The Total Environment* (2016). DOI: 10.1016/j.scitotenv.2016.11.116.

[15] **Farnham, D. J.**, Lall, U., "Predictive statistical models linking antecedent meteorological conditions and waterway bacterial contamination in urban waterways". In: *Water Research* 76 (2015), pp. 143–159. DOI: 10.1016/j.watres.2015.02.040.

"†" indicates equal contribution

Articles In Review

[1] Amonkar, Y., **Farnham, D. J.**, Lall, U., "Inferences on Long Duration Storage Requirements for Wind and Solar Energy from a Novel Space-Time Simulator".

[2] Antonini, E. G. A., Ruggles, T. H., **Farnham, D. J.**, Calderia, K., "Avoiding stranded wind and solar generation in decarbonized electricity systems".

[3] Antonini, E. G. A., Ruggles, T. H., **Farnham, D. J.**, Calderia, K., "Meeting Electricity Demand With Distributed Wind and Solar Generation: System Flexibility Drives Optimal Siting".

[4] **Farnham, D. J.**, Duan, L., Caldeira, K., "Potential cost savings from a globally connected power grid to manage wind and solar variability".

[5] Yuan, S., **Farnham, D. J.**, Lall, U., Modi, V., "Simultaneous increasing electricity demand for heating and reliance on wind energy: Demand side management using heat pumps during extreme cold events".

Articles In Preparation

[1] **Farnham, D. J.**, Caldeira, K., "Availability of solar and wind energy during extreme high heat events".

[2] **Farnham, D. J.**, et al. "Power system transition: Acknowledging uncertainty to limit regrets".

[3] **Farnham, D. J.**, Modi, V., Lall, U., "Interannual to decadal climate variations present risks and opportunities for managing wind/solar power supply".

[4] **Farnham, D. J.**, Waite, B. M., "Pronounced projected changes in the seasonality and magnitude of extreme peak electricity loads throughout the Continental United States under space heating electrification".

Conference Presentations, Posters, and Non-peer-reviewed Papers

[1] Brown, P. T., **Farnham, D. J.,** "Wind and Solar Droughts over western North America". In: *AGU Fall Meeting*. 2020.

[2] Caldeira, K., Lewis, N., Rinaldi, K., Dowling, J. A., Davis, S. J., Tong, D., **Farnham, D. J.**, Ruggles, T., Hauser, M., Henry, C., Tong, F., Yuan, M., Duan, L., "A Macro Energy Modeling Framework For Transparent Investigation Of Fundamental Energy System Properties". In: *AGU Fall Meeting*. 2020.

[3] Ruggles, T., **Farnham, D. J.**, Henry, C., Peer, R., Duan, L., Antonini, E., Hauser, M., Lewis, N., Dowling, J. A., Rinaldi, K., Davis, S. J., Tong, D., Caldeira, K., "Electrofuels and curtailment of wind and solar power". In: *AGU Fall Meeting*. 2020.

[4] Caldeira, K., **Farnham, D. J.**, Davis, S. J., Duan, L., Henry, C., Dowling, J. A., Lewis, N., Peer, R., Rinaldi, K., Ruggles, T., "A Simple Energy Modeling Framework for Transparent Investigation of Fundamental Energy System Properties". In: *AGU Fall Meeting 2019*. AGU. 2019.

[5] **Farnham, D. J.**, Caldeira, K., "Availability of solar and wind energy during extreme high heat events". In: *AGU Fall Meeting 2019*. AGU. 2019.

[6] **Farnham, D. J.**, Caldeira, K., Davis, S. J., Lewis, N., Duan, L., Henry, C., Ruggles, T., Peer, R., Dowling, J. A., Rinaldi, K., Tong, D., "The Macro Energy Model: Characterization and utility of an extremely simple energy model". In: *OpenMod workshop*. NREL. 2019.

[7] **Farnham, D. J.**, Davis, S. J., Lewis, N., Ruggles, T., Caldeira, K., "Constraining projections under deep uncertainty: the future of US electricity generation". In: *AGU Fall Meeting 2019*. AGU. 2019.

[8] Henry, C., DeCarolis, J., **Farnham, D. J.**, Ruggles, T., Queiroz, A., Eshraghi, H., Peer, R., Caldeira, K., "Generating a framework for inter-model comparisons in electricity dispatch modeling". In: *AGU Fall Meeting 2019*. AGU. 2019.

[9] Rinaldi, K., Duan, L., **Farnham, D. J.**, Ruggles, T., Caldeira, K., Lewis, N., "Evaluating a near-zero emissions electricity system for California with a simple energy model". In: *AGU Fall Meeting 2019*. AGU. 2019.

[10] Ruggles, T., Caldeira, K., Duan, L., **Farnham, D. J.**, Henry, C., Peer, R., "Electric Grid Reliability Implications for a Near-Zero Emissions Energy System". In: *AGU Fall Meeting 2019*. AGU. 2019.

[11] Tong, D., Caldeira, K., **Farnham, D. J.**, Duan, L., Lewis, N., Davis, S. J., "Geophysical constraints on the reliability of solar and wind electricity systems worldwide". In: *AGU Fall Meeting 2019*. AGU. 2019.

[12] Doss-Gollin, J., **Farnham, D. J.**, Steinschneider, S., Lall, U., "Robust Adaptation to Multi-Scale Climate Variability". In: *American Geophsyical Union Fall Meeting*. Washington, DC, Dec. 2018. DOI: 10.13140/RG.2.2.28447.20649.

[13] Faranda, D., Messori, G., Doss-Gollin, J., **Farnham, D. J.**, Lall, U., Yiou, P., "Dynamics and Thermodynamics of weather extremes: a dynamical systems approach". In: *European Geosciences Union General Assembly*. 2018.

[14] **Farnham, D. J.**, Lall, U., "Climate induced decadal variations in wind/solar energy generation potential and heating/cooling energy demand". In: *AGU Fall Meeting*. Washington, DC, 2018.

[15] Cao, J., **Farnham, D. J.**, Lall, U., "Spatial-temporal wind field prediction by Artificial Neural Networks". In: vol. abs/1712.05293. 2017. arXiv: 1712.05293.

[16] Doss-Gollin, J., **Farnham, D. J.**, Lall, U., "Designing and operating infrastructure for nonstationary flood risk management". In: *AGU Fall Meeting*. New Orleans, LA, 2017.

[17] Faranda, D., Messori, G., Doss-Gollin, J., **Farnham, D. J.**, Lall, U., Yiou, P., "Dynamics and Thermodynamics of weather extremes: a dynamical systems approach". In: *AGU FAll Meeting*. New Orleans, LA, 2017.

[18] **Farnham, D. J.**, Doss-Gollin, J., Lall, U., "Regional intense precipitation: inference from credibly simulated GCM variables". In: *North East Graduate Student Water Symposium*. Amherst, Mass, 2017.

[19] **Farnham, D. J.**, Steinschneider, S., Lall, U., "Zonal wind indices to reconstruct United States winter precipitation during El Ni\~{n}o". In: *AGU Fall Meeting*. New Orleans, LA, 2017.

[20] Gawthrop, E., **Farnham, D. J.**, Fiondella, F., Owusu, A. S., Thomson, M., Ambani, M., Percy, F., Chung, W., McKeown, K., "Media Analysis: Communication of the 2015/16 El Niño in Kenya". In: *97th American Meterological Society Annual Meeting*. Seattle, WA, 2017.

[21] Doss-Gollin, J., **Farnham, D. J.**, Lall, U., "Global-Local Interactions Modulate Tropical Moisture Exports to the Ohio River Basin". In: *AGU Fall Meeting*. San Francisco, CA, 2016.

[22] **Farnham, D. J.**, Doss-Gollin, J., Lall, U., "Seasonal climate signals and synoptic circulation patterns associated with regional daily intense precipitation in the Ohio River Basin". In: *Workshop on Sub-Seasonal to Seasonal Predictability of Extreme Weather and Climate*. Columbia University, 2016.

[23] **Farnham, D. J.**, Doss-Gollin, J., Lall, U., "Space-time characteristics and statistical predictability of extreme sub-weekly precipitation events in the Ohio River Basin". In: *AGU Fall Meeting*. San Francisco, CA, 2016.

[24] Habib, E., Tarboton, D., Deshotel, M., **Farnham, D. J.,** "Development of Student-centered Modules to Support Active Learning in Hydrology". In: *ASEE Annual Conference & Exposition*. New Orleans, LA, 2016.

[25] Larson, L. R., Cooper, C. B., Krafte, K., Gibson, R., **Farnham, D. J.**, Hsueh, D., Culligan, P., Wade McGillis, "Characterizing citizen scientists based on project engagement: Data generators, data users, and "onlooker effects."" In: *Southeastern Recreation Research Conference*. Asheville, NC, 2016.

[26] **Farnham, D. J.**, Habib, E., Lall, U., "HydroViz: A Web-based Climate Teleconnection Module for Undergraduate and Graduate Water Engineering Students". In: *AGU Fall Meeting*. San Francisco, CA, 2015.

[27] **Farnham, D. J.**, Lall, U., Kwon, H.-H., Doss-Gollin, J., "Moisture Transport and Extreme Precipitation in Mid-latitudes". In: *AGU Fall Meeting*. San Francisco, CA, 2015.

[28] Habib, E., Bodin, M., Taboton, D., Merck, M., **Farnham, D. J.,** "Stimulating Active Learning in Hydrology Using Research-Driven, Web-based Learning Modules". In: *ASEE Annual Conference & Exposition*. Seattle, WA, 2015.

[29] Hsueh, D. Y., **Farnham, D. J.,** Gibson, R. A., McGillis, W. R., Zheng, Y., Buchanan, R., Eddowes, D., Zain, N., Loiselle, S., Butkiewicz, L., "NYC URBAN WATER QUALITY: MONITORING THE FLOW OF CSOS WITH CITIZEN SCIENTISTS". In: *Aquatic Sciences Meeting*. Granada, Spain, 2015.

[30] Hsueh, D., **Farnham, D. J.,** Gibson, R., McGillis, W. R., Culligan, P. J., Cooper, C., Larson, L., Mailloux, B. J., Buchanan, R., Borus, N., Zain, N., Eddowes, D., Butkiewicz, L., Loiselle12, S. A., "Advancing the Potential of Citizen Science for Urban Water Quality Monitoring: Exploring Research Design and Methodology in New York City". In: *AGU Fall Meeting*. San Francisco, CA, 2015.

[31] **Farnham, D. J.,** Atkinson, J. F., "Flow visualization study: Understanding water circulation in Lake Ontario through physical modeling". In: *The 22nd Annual Great Lakes Research Consortium Student-Faculty Conference*. Oswego, NY, 2012.

Invited Presentations

[1] *Climate-related risks and opportunities for 21st century energy systems*. Environmental, Water Resources, Coastal Engineering seminar series, Department of Civil, Construction, and Environmental Engineering. North Carolina State University, Virtual, 2021.

[2] *Bronx Sewershed Water Quality and Citizen Science (with W. McGillis and D. Hsueh)*. Interdisciplinary Workshop on Urban Green Infrastructure: Reports on Monitoring, Modeling, Performance & Design Work. Columbia University, New York, NY, USA, 2015.

[3] *Extreme Rainfall Mechanisms, Prediction, and Simulation at Chonbuk National University in Summer 2015*. NSF EAPSI closing ceremony presentation series at the National Research Foundation of Korea. Seoul, South Korea, 2015.

[4] *NYC Urban Water Quality: Monitoring the Flow of CSOs with Citizen Scientists (with R. Gibson and D. Hsueh)*. Citizens Advisory Committee, New York-New Jersey Harbor & Estuary Program meeting. New York, NY, USA, 2015.

[5] *Water Quality Monitoring: 2013 Citizens' Water Quality Testing Program*. New York City Department of Environmental Protect and New York City Department of Health. New York, NY, USA, 2014.

[6] *Understanding Climate Risks in an Urban Environment (with M. Haraguchi)*. NSF IGERT, Solving Urbanization Challenges by Design summer workshop series. Columbia University, New York, NY, USA, 2013.

[7] *Urban Water Cycle Responses to Climate*. NSF IGERT, Solving Urbanization Challenges by Design Brown Bag seminar series. Columbia University, New York, NY, USA, 2013.

Invited Panel Participation

[1] *2016 Planet Forward Sustainable Cities Summit: Rethinking Water: Solutions for a 21st Century Infrastructure*. George Washington University, Washington DC, USA, 2016.

[2] *Earth Institue Sustainable Development Seminar Series: The Monster El Niño Of 2015-16: What Was Expected? And, What Was Done?* Columbia Univeristy, New York, NY, USA, 2016.

Professional Affiliations

Member, *American Geophysical Union* and *American Meteorological Society*

Select Honors and Awards

2015 **National Science Foundation/National Research Foundation of Korea EAPSI Fellowship**, *National Science Foundation*

2015 **Graduate Research Fellowship Program Honorable Mention**, *National Science Foundation*

2012–2018 **Integrated Graduate Education and Research Traineeship**, *National Science Foundation*

2012 **Best Poster Presentation**, *22nd Annual Great Lakes Research Consortium*

2012 **Garmen Scholarship, Robert P. Apmann Memorial Award, and Undergraduate Research Award**, *SUNY-Buffalo*

Recent Community Involvement

2017–2018 **Volunteer**, *We Run As One Summer Youth Basketball and cultural exchange*, New York, NY
Event set-up, take-down, and score keeping

2014–2018 **Volunteer**, *Student Sponsor Partners*, New York, NY
High school student mentor

2014, 2016, 2017 **Volunteer**, *International Research Institute for Climate and Society*, New York, NY
Facilitator at Lamont Doherty Earth Observatory open house

2013–2014 **Volunteer**, *Citizen's Water Quality Testing Program*, New York, NY
Water quality sampling site coordinator

Select Computer Skills

Languages **R**, Python, Matlab, C++
Communication LaTeX, Markdown, Jupyter
Modeling stan
Reproducibility git

Media Appearances

November 5, 2021 **Work highlighted in: "Wind and solar could power the world's major countries most of the time"**, UCI News
https://news.uci.edu/2021/11/05/wind-and-solar-could-power-the-worlds-major-countries-most-of-the-time/

September 3, 2021 **Interviewed for and quoted in Aarian Marshall and Matt Simon's: "21st-Century Storms Are Overwhelming 20th-Century Cities"**, Wired Magazine
https://www.wired.com/story/21st-century-storms-overwhelming-20th-century-cities

December 12, 2018 **Work highlighted and quoted in Ines Kagubare's: "Study tracks climate variation's impact on green power"**, E&E News
https://www.eenews.net/climatewire/2018/12/12/stories/1060109407

December 11, 2018 **Work highlighted and quoted in Sarah Fecht's: "How climate impacts solar and wind power supply"**, Earth Institute's State of the Planet blog *and* Phys.org
https://blogs.ei.columbia.edu/2018/12/11/climate-solar-wind-power-supply/ *and*
https://phys.org/news/2018-12-climate-impacts-solar-power.html

September 20, 2017 **Quoted in Renee Cho's: "What the U.S. Military is Doing About Climate Change"**, Earth Institute
https://phys.org/news/2018-12-climate-impacts-solar-power.html

April 28, 2016 **Quoted in Mike Hower's: "Sustainable Cities Summit tackles the challenges of urban sustainability"**, Planet Forward
https://www.planetforward.org/2016/04/28/sustainable-cities-summit-tackles-the-challenges-of-urban-sustainability

April 27, 2016 **Quoted in Mike Hower's: "The 5 toughest challenges tomorrow's cities face"**, GreenBiz
https://www.greenbiz.com/article/5-toughest-challenges-tomorrows-cities-face

Blog Posts

March 16, 2021 **How Unprecedented Was the February 2021 Texas Cold Snap?**, Authored with James Doss-Gollin, Upmanu Lall, and Vijay Modi for Earth Institute's State of the Planet blog
https://blogs.ei.columbia.edu/2021/03/16/unprecedented-texas-cold-snap/

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