

Michael J. Puma

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Director, Center for Climate Systems Research*

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Research Overview

Professor Puma directs the Center for Climate Systems Research at Columbia University's Climate School and leads a collaborative research enterprise with NASA's Goddard Institute for Space Studies, overseeing 40 scientists and staff in advancing fundamental research across climate science, space studies, and climate impact analysis. His scientific leadership extends to serving as Editor of *Earth's Future* (AGU), where he guides publication of cutting-edge research on global environmental challenges.

Prof. Puma's research program establishes new theoretical foundations at the intersection of Earth system science, human decision-making theory, and complex adaptive systems. His work is pioneering the integration of quantum theoretical frameworks with social science applications, developing novel approaches to understanding human behavior under extreme uncertainty. This includes advancing theoretical extensions to Kahneman's System 1/System 2 framework by incorporating quantum mechanics principles for decision-making analysis, creating next-generation food system vulnerability assessment methodologies with a novel "Richter scale" for quantifying global disruptions, and developing sophisticated agent-based models for refugee movement that integrate dual process theory and network dynamics.

His research addresses fundamental questions in Earth system science while establishing new methodological approaches for understanding coupled human-natural systems. Prof. Puma's work spans from hydroclimatology and land-atmosphere interactions to complex systems modeling of global food networks, with particular emphasis on shock propagation and resilience mechanisms. This interdisciplinary approach has attracted substantial support from agencies including DARPA, NASA, NSF, and the Department of Defense, reflecting the scientific significance and policy relevance of his research contributions.

Education

- 2006 **Ph.D., Civil Engineering**, *Princeton University*, Princeton, NJ
Environmental Engineering & Water Resources
- 2003 **M.A., Civil Engineering**, *Princeton University*, Princeton, NJ
Environmental Engineering & Water Resources
- 1999 **Master of International Affairs**, *Columbia University*, New York, NY
Environmental Policy Studies
- 1998 **Bachelor of Science, Civil Engineering**, *Columbia University*, New York, NY
Environmental Eng. & Water Resources
- 1994 **High School Diploma**, *Regis High School*, New York, NY

Current Positions

- 2025–present **Professor of Climate**, *Columbia Climate School*, Columbia University
Research, teaching, and service in climate science and Earth system dynamics.
- 2017–present **Director**, *Center for Climate Systems Research*, Columbia University
Leading complex multi-institutional research enterprise with NASA Goddard Institute for Space Studies, managing 40+ scientists and staff across climate science, space studies, and impact analysis. Executive responsibilities include: strategic budget management through federal funding uncertainties and government shutdowns; personnel oversight including faculty/staff appointments, reappointments, and terminations; facilities management including coordination of building relocations and infrastructure transitions; inter-institutional relationship management between NASA and Columbia University schools; conflict resolution and complex problem-solving in high-stakes research environment.
- 2025–present **Co-Director**, *Climate School Postdoctoral Research Program*, Columbia University
Overseeing postdoctoral training and career development across Columbia Climate School, coordinating with multiple departments and external partners.
- 2025–present **Editor**, *Earth's Future*, American Geophysical Union
Managing editorial decisions for premier interdisciplinary journal focusing on global environmental challenges, overseeing peer review process, setting editorial direction for emerging research areas.

Professional Experience

Columbia University

- 2023–2024 **Senior Research Scientist**, *Center for Climate Systems Research*
- 2016–2023 **Research Scientist**, *Center for Climate Systems Research*
- 2016–2019 **Climate and Life Fellow**, *Center for Climate and Life*
- 2010–2016 **Associate Research Scientist**, *Center for Climate Systems Research*
- 2007–2010 **Postdoctoral Research Scientist**, *Center for Climate Systems Research*

Teaching Appointments

- 2010–2024 **Adjunct Lecturer**, *School of Professional Studies*, Columbia University
- 2017–2018 **Adjunct Associate Professor**, *School of Int'l and Public Affairs*, Columbia University
Summers
- 2010–2016 **Adjunct Assistant Professor**, *School of Int'l and Public Affairs*, Columbia University
Summers

Other Positions

- Spring 2018 **Haub Visiting Scholar**, *Pace University*, Elisabeth Haub School of Law
- 2006–2007 **Research Associate**, *Princeton University*
National Center for Earth-Surface Dynamics
- 2001 **Environmental Engineer**, *Dvirka & Bartolucci Consulting Engineers*
- 1999–2000 **Project/Field Environmental Engineer**, *URS Corporation*
- 1998 **Intern**, *United Nations Secretariat*, Dept. of Economic & Social Affairs
- 1998 **Research Intern**, *United Nations Development Programme*, Office to Combat Desertification & Drought
- 1997 **Intern**, *Inform, Inc.*, under Dr. Nevin Cohen

Grants and Funding

Current Funding

- 2021–2025 **\$414,560**, *Human History of Marine Life Extraction*, European Commission, Co-Investigator
B1-ERC Synergy Grant through Trinity College Dublin
- 2024–2025 **\$80,000**, *A KAUST Economy and Nature Model*, King Abdullah University, Columbia Subaward
PI
KAUST collaboration
- 2022–2025 **\$967,357**, *South-North Migration Drivers Study*, US Department of Defense, Co-Investigator
PI: Alex de Sherbinin
- [Select Past Funding](#)
- 2018–2023 **\$3,085,318**, *Agent-Based Network Platform for Risk Mitigation*, DARPA I2O, Principal
Investigator
Symbiotic expert-ML system
- 2018–2024 **\$5,135,720**, *Multi-Scale Human Mobility Theory*, US Department of Defense, Co-Investigator
PI: Rachata Muneeppeerakul
- 2021–2024 **\$849,494**, *Modeling forest physiological responses*, NASA Modeling Analysis, Co-Investigator
PI: Ensheng Weng
- 2022–2023 **\$86,719**, *Satellite Monitoring of Settlement Dynamics*, NASA RAPID, Co-Investigator
PI: Jamon Van Den Hoek
- 2019–2021 **\$1,038,094**, *Environmental Change and Migration*, National Science Foundation, Co-Investigator
Award #1934978, PI: Richard Seager
- 2016–2019 **\$182,035**, *Global Food System Resilience*, Center for Climate and Life, Principal Investigator
Columbia University
- 2010–2014 , *Climate information and modeling*, UN Development Programme, Principal Investigator
Technical advisory role
- 2017–2021 **\$191,607**, *Drought and heat wave forcing*, NASA, Co-Investigator
PI: BI Cook

Publications Summary

Google Scholar	7000+ citations, h-index: 35, i10-index: 49
ORCID iD	0000-0002-4255-8454
Peer-reviewed	55 journal articles
In preparation	15 manuscripts under review, in revision, or in preparation
Popular science	10 lay audience publications (including New York Times Op-Ed, 2022)
Reports & chapters	20 reports, book chapters, or proceedings
Books	1 published book (UNDP); 1 in development

Publications Under Review / In Revision / In Preparation

- 1., Cutuli, A., Lall, U., Puma, M. J., Esmaili, E., & Muneeppeerakul, R.
A Bayesian hierarchical framework for capturing preference heterogeneity in migration flows. *Journal of Demographic Economics*. **In revision.**
- 2., Johnson JC, Traff J, Hood J, Zurek-Ost M, Puma MJ, and Muneeppeerakul R.
Network Models Reveal Food Vulnerability as a Key Factor in Migration Across African Regions. *Global Environmental Change*. **In review.**

- 3., **Puma MJ**, Hall J, Verschuur J, Otto C, Kuhla K, Konar M.
Rethinking agricultural systems models for a polycrisis world. *Nature Food*. **In preparation.**
- 4., **Puma MJ**, Chon S, Wada Y, Cook BI, Nordbotten JM, Falkendal, T, Otto C.
A Richter scale reveals the magnitude of global food disruptions. *Nature*. **In preparation.**
- 5., **Puma MJ**, Bangun PH, Verschuur, J, Hall J.
Port-to-port data reveals diverse impacts of Ukraine war on grain supplies. **In preparation.**
- 6., **Puma MJ**, Wu E, Groen D, Suleimenova D.
Integrating fast and slow decision making into an agent-based framework of refugee movement. **In preparation.**
- 7., Lall U, Palandri C, Concha Larrauri P, **Puma MJ**, Gelman A.
A Multilevel Bayesian Framework to Analyze Climate-Fueled Migration and Conflict. **In preparation.**
- 8., Kuhla K, Jonas J, **Puma MJ**, Otto C.
Climate change-driven shifts of global and regional food security risks throughout the 21st century. **In preparation.**
- 9., Esmaili E, Cutuli A, Lall U, **Puma MJ**, Muneeppeerakul R.
Modeling migration flows with Non-Homogeneous Hidden Markov Models. **In preparation.**
- 10., Esmaili E, **Puma MJ**, Ludlow F, Jobbová E, and Holm P.
Warfare Ignited Price Contagion Dynamics in Early Modern Europe. **In preparation.**
- 11., Esmaili E, **Puma MJ**, Ludlow F, Jobbová E, and Kumar J.
ENSO increases likelihood of famine in early modern Europe. **In preparation.**
- 12., Suleimenova D, Groen D, Mezuman K, Bardot, **Puma MJ**.
Modeling internal displacement in an agent based model of human mobility. **In preparation.**
- 13., Cottier F, Nébié E, Seager R, Schlenker W, McDermid S, **Puma MJ**, Morris CA, de Sherbinin A, Anderson W, Bell AR.
Migration within and out of West Africa: recent trends and drivers. **In revision.**
- 14., Zurek-Ost M, Johnson JC, Traff J, **Puma MJ**, and Muneeppeerakul R.
Toward an Expanded Typology of Global Migration Networks and Their Environmental-Conflict Dimensions. *Environmental Research Letters*. **In preparation.**
- 15., Otto C, Schewe J, **Puma MJ**, Frieler K.
Combating extremes in global food prices with an international wheat reserve. **In preparation.**

Peer-Reviewed Publications (Complete List)

- 1., Best, M.J., A.P. Lock, G. Balsamo, E. Bazile, I. Beau, J. Cuxart, M.B. Ek, K. Findell, A. Fridlind, A.A.M. Holtslag, W. Huang, M.A. Jiménez, S. Kumar, D. Lawrence, S. Malyshev, P. Le Moigne, **M. Puma**, R. Ronda, J.A. Santanello, I. Sandu, X. Shen, G.-J. Steeneveld, G. Svensson, P.A. Vaillancourt, W. Wang, A. Zadra, and W. Zheng, 2025
Rolling DICE to advance knowledge of land-atmosphere interactions. *Q. J. Roy. Meteorol. Soc.*, early on-line, doi:10.1002/qj.4944.
- 2., Konar M, Fisher-Vanden K, Grogran D, Haqiq I, Mejia A, **Puma MJ**, 2025
Groundwater and trade: Towards an interdisciplinary consensus and roadmap for future research. *Environmental Research Letters*. In press.

3., Kuhla, K., M.J. Puma, and C. Otto, 2024

International cooperation was key to stabilize wheat prices after the Russian invasion of Ukraine. *Commun. Earth Environ.*, 5, no. 1, 481, doi:10.1038/s43247-024-01638-7.

4., Nakamura, J., R. Seager, H. Liu, F. Cottier, M.J. Puma, D.J. Wrathall, B. Katz, A. de Sherbinin, and S.B. Adamo, 2024

Recent trends in agriculturally relevant climate in Central America. *Int. J. Climatol.*, 44, no. 8, 2701-2724, doi:10.1002/joc.8476.

5., Muneeppeerakul, R., J. Johnson, M. Puma, and M. Zurek, 2024

Triadic signatures of global refugee and migrant flow networks. *PLOS ONE*, 19, no. 2, e0298876, doi:10.1371/journal.pone.0298876.

6., Karakoc, D.B., M. Konar, M.J. Puma, and L.R. Varshney, 2023

Structural chokepoints determine the resilience of agri-food supply chains in the United States. *Nat. Food*, 4, no. 7, 607-615, doi:10.1038/s43016-023-00793-y.

7., Heino, M., P. Kinnunen, W. Anderson, D.K. Ray, M.J. Puma, O. Varis, S. Siebert, and M. Kummu, 2023

Increased probability of hot and dry weather extremes during the growing season threatens global crop yields. *Sci. Rep.*, 13, 3583, doi:10.1038/s41598-023-29378-2.

8., Griffith, D., R. Muneeppeerakul, G. Guerry, A.C. Cabrero, J.C. Johnson, R. Munoz-Carpena, M. Puma, U. Lall, and M. Homayounfar, 2023

Migration and livelihood constellations: Assessing common themes in the face of environmental change in Somalia and among Agro-Pastoral peoples. *Int. Migr.*, early on-line, doi:10.1111/imig.13122.

9., Weng, E., I. Aleinov, R. Singh, M.J. Puma, S.S. McDermid, N.Y. Kiang, M.A. Kelley, K. Wilcox, R. Dybzinski, C.E. Farrior, S.W. Pacala, and B.I. Cook, 2022

Modeling demographic-driven vegetation dynamics and ecosystem biogeochemical cycling in NASA GISS's Earth system model (ModelE-BiomeE v.1.0). *Geosci. Model Dev.*, 15, no. 22, 8153-8180, doi:10.5194/gmd-15-8153-2022.

10., McDermid, S.S., E. Weng, M. Puma, B. Cook, T. Hengl, J. Sanderman, G.J.M. De Lannoy, and I. Aleinov, 2022

Soil carbon losses reduce soil moisture in global climate model simulations. *Earth Interact.*, 26, no. 1, 195-208, doi:10.1175/EI-D-22-0003.1.

11., De Sherbinin, A., K. Grace, S. McDermid, K. Van Der Geest, M.J. Puma, and A. Bell, 2022

Migration theory in climate mobility research. *Front. Clim.*, 4, 882343, doi:10.3389/fclim.2022.882343.

12., Nazarenko L and 45 others including MJ Puma, 2022

Future climate change under SSP emission scenarios with GISS-E2.1. *J. Adv. Model Earth. Syst.*, 14, no. 7, e2021MS002871, doi:10.1029/2021MS002871.

13., Lehtikoinen, E., P. Kinnunen, J. Piipponen, A. Heslin, M.J. Puma, and M. Kummu, 2021

Importance of trade dependencies for agricultural inputs: A case study of Finland. *Environ. Res. Commun.*, 3, no. 6, 061003, doi:10.1088/2515-7620/ac02d0.

14., Schon, J., K. Mezuman, A. Heslin, R.D. Field, and M.J. Puma, 2021

How fire patterns reveal uneven stabilization at the end of conflict: Examining Syria's unusual fire year in 2019. *Environ. Res. Lett.*, 16, no. 4, 044046, doi:10.1088/1748-9326/abe327.

- 15., McDermid, S.S., B.I. Cook, M.G. De Kauwe, J. Mankin, J.E. Smerdon, A.P. Williams, R. Seager, **M.J. Puma**, I. Aleinov, M. Kelley, and L. Nazarenko, 2021
Disentangling the regional climate impacts of competing vegetation responses to elevated atmospheric CO₂. *J. Geophys. Res. Atmos.*, 126, no. 5, e2020JD034108, doi:10.1029/2020JD034108.
- 16., Falkendal, T., C. Otto, J. Schewe, J. Jägermeyr, M. Konar, M. Kummu, B. Watkins, and **M.J. Puma**, 2021
Grain export restrictions during COVID-19 risk food insecurity in many low- and middle-income countries. *Nat. Food*, 2, no. 1, 11-14, doi:10.1038/s43016-020-00211-7.
- 17., Miller, J.R., J.E. Fuller, **M.J. Puma**, and J.M. Finnegan, 2021
Elevation dependent warming in the Eastern Siberian Arctic. *Environ. Res. Lett.*, 16, no. 2, 024044, doi:10.1088/1748-9326/abdb5e.
- 18., Miller, R.L., G.A. Schmidt, L. Nazarenko, S.E. Bauer, M. Kelley, R. Ruedy, G.L. Russell, A. Ackerman, I. Aleinov, M. Bauer, R. Bleck, V. Canuto, G. Cesana, Y. Cheng, T.L. Clune, B. Cook, C.A. Cruz, A.D. Del Genio, G.S. Elsaesser, G. Faluvegi, N.Y. Kiang, D. Kim, A.A. Lacis, A. Leboissetier, A.N. LeGrande, K.K. Lo, J. Marshall, E.E. Matthews, S. McDermid, K. Mezuman, L.T. Murray, V. Oinas, C. Orbe, C. Pérez García-Pando, J.P. Perlwitz, **M.J. Puma**, D. Rind, A. Romanou, D.T. Shindell, S. Sun, N. Tausnev, K. Tsigaridis, G. Tselioudis, E. Weng, J. Wu, and M.-S. Yao, 2021
CMIP6 historical simulations (1850-2014) with GISS-E2.1. *J. Adv. Model. Earth Syst.*, 13, no. 1, e2019MS002034, doi:10.1029/2019MS002034.
- 19., Kakinuma, K., **M.J. Puma**, Y. Hirabayashi, M. Tanoue, E.A. Baptista, and S. Kanae, 2020
Flood-induced population displacements in the world. *Environ. Res. Lett.*, 15, no. 12, 124029, doi:10.1088/1748-9326/abc586.
- 20., Krakauer, N.Y., B.I. Cook, and **M.J. Puma**, 2020
Effect of irrigation on humid heat extremes. *Environ. Res. Lett.*, 15, no. 9, 094010, doi:10.1088/1748-9326/ab9ecf.
- 21., Cook, B.I., S.S. McDermid, **M.J. Puma**, A.P. Williams, R. Seager, M. Kelley, L. Nazarenko, and I. Aleinov, 2020
Divergent regional climate consequences of maintaining current irrigation rates in the 21st century. *J. Geophys. Res. Atmos.*, 125, no. 14, e2019JD031814, doi:10.1029/2019JD031814.
- 22., Heslin, A., **M.J. Puma**, P. Marchand, J.A. Carr, J. Dell'Angelo, P. D'Odorico, J.A. Gephart, M. Kummu, M. Porkka, M.C. Rulli, D. Seekell, S. Suweis, and A. Tavoni, 2020
Simulating the cascading effects of an extreme agricultural production shock: Global implications of a contemporary US Dust Bowl event. *Front. Sustain. Food Syst.*, 4, 26, doi:10.3389/fsufs.2020.00026.
- 23., Jägermeyr, J., A. Robock, J. Elliott, C. Müller, L. Xia, N. Khabarov, C. Folberth, E. Schmid, W. Liu, F. Zabel, S.S. Rabin, **M.J. Puma**, A.C. Heslin, J. Franke, I. Foster, S. Asseng, C.G. Bardeen, O.B. Toon, and C. Rosenzweig, 2020
A regional nuclear conflict would compromise global food security. *Proc. Natl. Acad. Sci.*, 117, no. 13, 7071-7081, doi:10.1073/pnas.1919049117.
- 24., Kinnunen, P., J.H.A. Guillaume, M. Taka, P. D'Odorico, S. Siebert, **M.J. Puma**, M. Jalava, and M. Kummu, 2020
Local food crop production can fulfil demand for less than one-third of the population. *Nat. Food*, 1, no. 4, 229-237, doi:10.1038/s43016-020-0060-7.

- 25., Kelley, M., G.A. Schmidt, L. Nazarenko, S.E. Bauer, R. Ruedy, G.L. Russell, A.S. Ackerman, I. Aleinov, M. Bauer, R. Bleck, V. Canuto, G. Cesana, Y. Cheng, T.L. Clune, B.I. Cook, C.A. Cruz, A.D. Del Genio, G.S. Elsaesser, G. Faluvegi, N.Y. Kiang, D. Kim, A.A. Lacis, A. Leboissetier, A.N. LeGrande, K.K. Lo, J. Marshall, E.E. Matthews, S. McDermid, K. Mezuman, R.L. Miller, L.T. Murray, V. Oinas, C. Orbe, C. Pérez García-Pando, J.P. Perlwitz, **M.J. Puma**, D. Rind, A. Romanou, D.T. Shindell, S. Sun, N. Tausnev, K. Tsigaridis, G. Tselioudis, E. Weng, J. Wu, and M.-S. Yao, 2020
GISS-E2.1: Configurations and climatology. *J. Adv. Model. Earth Syst.*, 12, no. 8, e2019MS002025, doi:10.1029/2019MS002025.
- 26., Del Genio, A.D., M.J. Way, N. Kiang, I. Aleinov, **M.J. Puma**, and B. Cook, 2019
Climates of warm Earth-like planets III: Fractional habitability from a water cycle perspective. *Astrophys. J.*, 887, no. 2, 197, doi:10.3847/1538-4357/ab57fd.
- 27., Cook, B.I., R. Seager, A.P. Williams, **M.J. Puma**, S. McDermid, M. Kelley, and L. Nazarenko, 2019
Climate change amplification of natural drought variability: The historic mid-twentieth century North American drought in a warmer world. *J. Climate*, doi:10.1175/JCLI-D-18-0832.1.
- 28., McDermid, S.S., C. Montes, B.I. Cook, **M.J. Puma**, N.Y. Kiang, and I. Aleinov, 2019
The sensitivity of land-atmosphere coupling to modern agriculture in the northern mid-latitudes. *J. Climate*, 32, no. 2, 465-484, doi:10.1175/JCLI-D-17-0799.1.
- 29., Singh, D., S.P. McDermid, B.I. Cook, **M.J. Puma**, L. Nazarenko, and M. Kelley, 2018
Distinct influences of land-cover and land-management on seasonal climate. *J. Geophys. Res. Atmos.*, 123, no. 21, 12017-12039, doi:10.1029/2018JD028874.
- 30., **Puma, M.J.**, S.Y. Chon, K. Kakinuma, M. Kummu, R. Muttarak, R. Seager, and W. Wada, 2018
A developing food crisis and potential refugee movements. *Nature Sustain.*, 1, 380-382, doi:10.1038/s41893-018-0123-z.
- 31., Torreggiani, S., G. Mangioni, **M.J. Puma**, and G. Fagilo, 2018
Identifying the community structure of the international food-trade multi network. *Environ. Res. Lett.*, 13, no. 5, 054026, doi:10.1088/1748-9326/aabf23.
- 32., Heino, M., **M.J. Puma**, P.J. Ward, D. Gerten, V. Heck, S. Siebert, and M. Kummu, 2018
Two-thirds of global cropland area impacted by climate oscillations. *Nat. Commun.*, 9, 1257, doi:10.1038/s41467-017-02071-5.
- 33., Dalin, C., Y. Wada, T. Kastner, and **M.J. Puma**, 2017
Groundwater depletion embedded in international food trade. *Nature*, 543, no. 7647, 700-704, doi:10.1038/nature21403.
- 34., Seekell, D.A., J. Carr, J. Dell'Angelo, P. D'Odorico, M. Fader, J.A. Gephart, M. Kummu, N. Magliocca, M. Porkka, and **M.J. Puma**, 2017
Resilience in the global food system. *Environ. Res. Lett.*, 12, no. 2, 025010, doi:10.1088/1748-9326/aa5730.
- 35., Krakauer, N.Y., **M.J. Puma**, B.I. Cook, P. Gentine, and L. Nazarenko, 2016
Ocean-atmosphere interactions modulate irrigation's climate impacts. *Earth Syst. Dyn.*, 7, 863-876, doi:10.5194/esd-7-863-2016.
- 36., Marchand, P., J.A. Carr, J. Dell'Angelo, M. Fader, J.A. Gephart, M. Kummu, N.R. Magliocca, M. Porkka, **M.J. Puma**, and Z. Ratajczak, 2016
Reserves and trade jointly determine exposure to food supply shocks. *Environ. Res. Lett.*, 11, no. 9, 095009, doi:10.1088/1748-9326/11/9/095009.

37., Fader, M., M.C. Rulli, J. Carr, J. Dell'Angelo, P. D'Odorico, J. Gephart, M. Kummu, N. Magliocca, M. Porkka, C. Prell, **M.J. Puma**, Z. Ratajczak, D.A. Seekell, S. Suweis, and A. Tavoni, 2016

Past and present biophysical redundancy of countries as a buffer to changes in food supply. *Environ. Res. Lett.*, 11, no. 5, 055008, doi:10.1088/1748-9326/11/5/055008.

38., Van den Hurk, B., H. Kim, G. Krinner, S.I. Seneviratne, C. Derksen, T. Oki, H. Douville, J. Colin, A. Ducharne, F. Cheruy, N. Viovy, **M. Puma**, Y. Wada, W. Li, B. Jia, A. Alessandri, D. Lawrence, G.P. Weedon, R. Ellis, S. Hagemann, J. Mao, M.G. Flanner, M. Zampieri, R. Law, and J. Sheffield, 2016

LS3MIP (v1.0) contribution to CMIP6: The Land Surface, Snow and Soil moisture Model Intercomparison Project — Aims, setup and expected outcome. *Geosci. Model. Dev.*, 6, 2809-2832, doi:10.5194/gmd-9-2809-2016.

39., Kim, Y., P.R. Moorcroft, I. Aleinov, **M.J. Puma**, and N.Y. Kiang, 2015

Variability of phenology and fluxes of water and carbon with observed and simulated soil moisture in the Ent Terrestrial Biosphere Model (Ent TBM version 1.0.1.0.0). *Geosci. Model Dev.*, doi:10.5194/gmd-8-3837-2015.

40., **Puma, M.**, S. Bose, S.Y. Chon, and B. Cook, 2015

Assessing the evolving fragility of the global food system. *Environ. Res. Lett.*, 10, no. 2, 024007, doi:10.1088/1748-9326/10/2/024007.

41., Nazarenko, L., G.A. Schmidt, R.L. Miller, N. Tausnev, M. Kelley, R. Ruedy, G.L. Russell, I. Aleinov, M. Bauer, S. Bauer, R. Bleck, V. Canuto, Y. Cheng, T.L. Clune, A.D. Del Genio, G. Faluvegi, J.E. Hansen, R.J. Healy, N.Y. Kiang, D. Koch, A.A. Lacis, A.N. LeGrande, J. Lerner, K.K. Lo, S. Menon, V. Oinas, J.P. Perlwitz, **M.J. Puma**, D. Rind, A. Romanou, M. Sato, D.T. Shindell, S. Sun, K. Tsigaridis, N. Unger, A. Voulgarakis, M.-S. Yao, and J. Zhang, 2015

Future climate change under RCP emission scenarios with GISS ModelE2. *J. Adv. Model. Earth Syst.*, 7, no. 1, 244-267, doi:10.1002/2014MS000403.

42., Cook, B.I., S.P. Shukla, **M.J. Puma**, and L. Nazarenko, 2015

Irrigation as an historical climate forcing. *Clim. Dyn.*, 44, no. 5-6, 1715-1730, doi:10.1007/s00382-014-2204-7.

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Pre-Columbian deforestation as an amplifier of drought in Mesoamerica. *Geophys. Res. Lett.*, 39, L16706, doi:10.1029/2012GL052565.
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Implications of rainfall temporal resolution for soil-moisture and transpiration modeling. *Transp. Porous Media*, 68, 37-67, doi:10.1007/s11242-006-9057-4.
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Functional relationship to describe temporal statistics of soil moisture averaged over different depths. *Adv. Water Resour.*, 28, 553-566, doi:10.1016/j.advwatres.2004.08.015.

Honors & Awards

- 2016–2019 **Fellow, Center for Climate and Life, Columbia University**
- 2018 **Haub Visiting Scholar, Pace University, Elisabeth Haub School of Law**
Delivered keynote Lloyd K. Garrison Lecture: "De-risking the global food system in a changing climate"
- 2010–2021 **NASA GISS Publication Honors, NASA Goddard Institute, By vote of scientific staff**
- 2010: Lead author, Best Popular Science Brief
 - 2014: Coauthor, Best Publication Award (CMIP5 historical simulations)
 - 2018: Lead author, 3rd Best Publication (food crisis and refugee movements)
 - 2020: Coauthor, Best Publication Award (GISS-E2.1 configurations)
 - 2021: Coauthor, Best Publication Award (CMIP6 historical simulations)
- 2004–2006 **Graduate Fellowships, Princeton University**
William Clay Ford Jr. Graduate Fellowship (2004-2005), Princeton Environmental Institute Fellowship (2002-2003, 2005-2006)

1998 **King's Crown Awards**, *Columbia University*, Gold Crown
Outstanding leadership and service to Columbia community

Teaching Experience

Current Courses

Fall 2025 **Global food trade, shocks and migration**, *Columbia Climate School*
In development

2013–present **Water Governance**, *School of Professional Studies*, Columbia University
Fall semester, Adjunct Lecturer

Past Courses

2011–2018 Hydrology (Summers), School of Int'l and Public Affairs, Columbia

2009–2012 Various water and sustainability courses, Columbia

2005–2007 Assistant Instructor, Princeton University (Hydrology, Environmental Science)

2021 Guest lecturer, Cheikh Anta Diop University, Dakar (Climate Risk Management for Nutrition)

Student Advising

Current Students

Master's Students Erika Wu (agent-based modeling), Clara Bardot (displacement theory), Samuel Rager (quantum modeling), Primanta Bangun (Ukraine war grain analysis), Janavi Kumar (ENSO-famine connections)

Past Supervision

Postdocs Keren Mezuman (2019–2022), Alison Heslin (2018–2020), Kaoru Kakinuma (2016–2018)

PhD Committees Deniz Berfin Karakoc, University of Illinois Urbana-Champaign (2022–2024); Alvaro Carmona Cabrero, University of Florida-Gainesville (2021–2022); Lisa Thalheimer, Oxford University, Christ Church (External Examiner, 2021); Madeleine Pascolini-Campbell, Columbia University (2018)

PhD Ongoing Miriam Nielsen, Columbia University (2024–present)

Master's Thesis Michael DeMichiei, Columbia Southern Asian Institute (2019); Aïcha Diongue, Cheikh Anta Diop University of Dakar (2022)

NASA Interns Nonnie Woodruff (Summer 2019), Roland Maio (Spring 2017), Morgan DiCarlo (Summer 2016)

Master's Advising 10 students per year (2013–2025), School of Professional Studies

Professional Service & Leadership

Editorial Service

2025–present **Editor**, *Earth's Future*, American Geophysical Union

2023–2024 **Guest Editor**, *Proceedings of the National Academy of Sciences*

2020–2021 **Associate Editor**, *CABI Agriculture and Bioscience*

University Service

Columbia Climate School Faculty member, PhD Planning Committee, Graduate Admissions, Appointments & Promotions Committee (2024–present)

University-wide AI Working Group, Earth Institute Faculty, Committee on Forced Migration

Conference Organization

- Co-Organizer** Global food system vulnerabilities relevant to US institutions in a changing climate (January 31, 2019), Thomson Reuters Building, New York City
- Co-Organizer** Systemic Risk in Global Agriculture – A Princeton-Columbia Joint Conference (October 24–25, 2014), Princeton University
- AGU Session Convener** Fall Meeting Session Convener/Co-Convener (2014–2024):
- 2014: The Effects of Anthropogenic Land-Use and Land-Cover Change on Local to Global Climate (GC22F)
 - 2014: Global and Regional Food and Water Security Under Increasing Socioeconomic Pressure and Changing Climate (GC24A)
 - 2015: Global and Regional Water-Food-Energy Security under Changing Environments I–III (GC31H, GC32B, GC33C)
 - 2016: Global and Regional Water-Food-Energy Security under Changing Environments I–III (GC41G, GC42B, GC43C)
 - 2019: Environmental Changes and Human Migration: Advances in Data, Modeling, and Analysis I–II (GC11A, GC13G)
 - 2020: Food System, Food Security, and Food-Related Human Health Responses to COVID-19 and Other Pandemics (GH011-II)
 - 2020–2024: Environmental Changes and Human Migration: Advances in Modeling and Analysis
 - 2023: Agrifood Supply Chain Resilience and Sustainability with a Focus on Human Impacts on Forest Ecosystems

Review Service

Funding Agencies National Science Foundation (proposals and fellowships)

Journals Nature, Nature Climate Change, Proceedings of the National Academy of Sciences, Global Food Security, Geophysical Research Letters, Environmental Research Letters, PLOS ONE, Journal of Climate, International Journal of Climatology, Journal of Hydrometeorology, Water Resources Research, Journal of Water Resources Planning and Management, African Journal of Environmental Science and Technology, African Journal of Agricultural Research, Journal of Environmental Studies and Science, Transport in Porous Media, Ecohydrology

Select Recent Invited Talks & Presentations

- March 5, 2025 **Invited Talk**, *Johns Hopkins Bloomberg Center*, Washington DC
Climate to conflict: advancing multiscale models of human mobility and displacement. "From Data to Action: Addressing the Nexus of Climate, Health, Conflict & Displacement Across Diverse Contexts"
- Feb 6, 2025 **Invited Class Talk**, *Prof. Lewis Ziska's Class*
Towards an understanding of human mobility. "Environmental Health Sciences Public Health Impacts of Climate Change"

- Sept 25–27, 2024 **Invited Panel**, *Climate Migration Modeling Intercomparison Workshop*, Princeton University
Panel member: "Validating Model Outputs" - best practices for model validation with limited data, metrics prioritization, statistical inference role
- April 11, 2024 **Invited Talk**, *5th Global Food Security Conference*, Leuven, Belgium
Strategically Transforming Food Systems for Robustness and Resilience. "Towards equitable, sustainable and resilient food systems"
- April 3, 2024 **Invited Talk**, *The Future of Food Forum*, University of Florida, Gainesville
Reducing Global Food System Vulnerability to Unpredictable Events
- March 22, 2024 **Invited Talk**, *World Water Day*, Arizona State University Walton Center
Global human migration and trade impacts of water and climate disruptions. "Water Futures – Adaptation & Innovation"
- May 13, 2022 **Invited Talk**, *Museum of Food and Drink (MOFAD)*, New York
The Impact of War on Food Security

Published Conference Abstracts

- 2023 **Esmaili E, Cutuli A, Lall U, Puma MJ, Muneeppeerakul R.**, *Fall Meeting 2023. AGU*, Modeling Migration Flows with Non-Homogeneous Hidden Markov Models
- 2023 **Cutuli, A., Lall, U., Puma, M. J., Esmaili, E., & Muneeppeerakul, R.**, *Fall Meeting 2023. AGU*, A Bayesian Hierarchical Framework for Modeling Migration Flows
- 2023 **Puma MJ, Rose B, Kalro AM, Printz M, Marsh K, Barnett E, Samson D, Mezuman K, Suleimenova D, Groen D, Muneeppeerakul R.**, *Fall Meeting 2023. AGU*, A comparative assessment of top-down and bottom-up approaches to modeling refugee movement in the Russo-Ukrainian War
- 2022 **Puma, M. J., Rose, B., Printz, M., Marsh, K., Barnett, E., Kalro, A. M., et al.**, *Fall Meeting 2022. AGU*, A Parsimonious Model to Simulate Refugee Movement Due to the Russian Invasion of Ukraine
- 2022 **Johnson, J., Zurek-Ost, M., Hood, J., Puma, M. J., & Muneeppeerakul, R.**, *Fall Meeting 2022. AGU*, Network Models of Possible Climate Drivers to Refugee Flows: Regional Scale Comparisons
- 2021 **MJ Puma, K Mezuman, H Arabnejad, D Groen, A Jahani, U Lall, P Concha Larrauri, R Muneeppeerakul, G Suarez, D Suleimenova.**, *AGU Fall Meeting 2021. AGU*, Assessing operational insights gained from simulation of refugee movements with an agent based model
- 2021 **J Johnson, J Hood, J Schon, MJ Puma, E Smith.**, *AGU Fall Meeting 2021. AGU*, The Transformation of Global Network Migrant and Refugee Flows: Examining the Potential Emergence of Climate Drivers
- 2021 **MJ Puma, M Thomas.**, *AGU Fall Meeting 2021. AGU*, Harnessing causal linkages between climate and food prices to address nutrition concerns in Senegal
- 2021 **M Heino, P Kinnunen, WB Anderson, DK Ray, MJ Puma, O Varis, S Siebert, M Kumm.**, *AGU Fall Meeting 2021. AGU*, Hot and dry weather extremes pose an increasing threat to global crop yields
- 2021 **R Muneeppeerakul, J Johnson, MJ Puma, U Lall.**, *AGU Fall Meeting 2021. AGU*, Network character of global refugee flows and its evolution
- 2020 **Puma, M. J., Falkendal, T., Otto, C., Schewe, J., Jägermeyr, J., Konar, M., et al.**, *AGU Fall Meeting 2020. AGU*, Safeguard global supply chains to protect food security during the COVID-19 pandemic

- 2020 **Cottier, F., Ilboudo-Nébié, E., Morris, C.A., Puma, M.J., Seager, R., de Sherbinin, A.M.,** *AGU Fall Meeting 2020. AGU*, Disentangling the drivers of regional migration in West Africa: The impact of food (in) security on migration
- 2019 **Puma, M.J. and Heslin, A.,** *AGUFM, 2019*, Assessing potential cascading effects of a US Dust Bowl event on food security and human migration. GC13G-1232
- 2018 **Puma MJ, Wada Y, Cook BI, Nordbotten JM.,** *AGU Fall Meeting, 2018*, A Richter scale reveals the magnitude of global food disruptions Abstract PA12B-01
- 2018 **Jaegermeyr J, L Xia, MJ Puma, JW Elliott, C Mueller, and A Robock.,** *AGU Fall Meeting Abstracts. 2018*, A regional nuclear conflict has global implications for food security
- 2016 **Puma MJ, Wada Y, Chon S, Cook BI, Nordbotten JM.,** *AGU Fall Meeting, 2016*, Global and country-level fragility to major disruptions in crop production. Abstract GC43C-1169
- 2015 **Puma MJ, Compton T.,** *AGU Fall Meeting, 2015*, Advances in remote sensing for vegetation dynamics and agricultural management. Abstract GC31H-02
- 2014 **Puma MJ, Cook BI.,** *AGU Fall Meeting, 2014*, Impacts of irrigation on surface temperature and precipitation distributions in the United States. Abstract GC13J-0815
- 2013 **Puma MJ, Bose S, Chon S, Cook BI.,** *AGU Fall Meeting, 2013*, Increasing susceptibility of the global food trade network to disturbances. Abstract GC11D-1038

Professional Membership & Service

- 2003–present **Member,** *American Geophysical Union*
- 2016 **Travel Grant Reviewer,** *Columbia Earth Institute*
- 2012–2013 **Publicity Ambassador,** *Baekje Cultural Festival (백제문화제),* Gongju, South Korea
International cultural promotion and academic exchange
- 2010–2012 **Co-founder/Lead Organizer,** *Columbia University Hydrology Consortium*
Promoting cross-disciplinary water research
- 2003–2004 **Co-Organizer,** *Princeton Environmental Engineering & Water Resources Seminar Series*

Research Methods and Computational Expertise

- Programming** Python, R, Fortran, Matlab
- Statistical Methods** Bayesian inference, statistical physics, machine learning, network analysis
- Modeling Frameworks** Climate models (GISS ModelE), agent-based models (FLEE), complex systems modeling, quantum theoretical frameworks
- Computational Infrastructure** High-performance computing systems, NASA GISS computing resources, distributed computing
- Tools & Platforms** GitHub, AI/ML frameworks, Dojo (DARPA World Modelers program), Inkscape, collaborative research platforms