

Spencer Alan Hill

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EDUCATION

2016	Ph.D.	Atmospheric and Oceanic Sciences	Princeton University
2011	B.S.	Atmospheric and Oceanic Sciences; Applied Mathematics	UCLA

PROFESSIONAL APPOINTMENTS

2021-	Associate Research Scholar, Program in Atmospheric and Oceanic Sciences, Princeton University
2021-	Adjunct Associate Research Scientist, Lamont-Doherty Earth Observatory, Columbia University
2021	Associate Research Scientist, Lamont-Doherty Earth Observatory, Columbia University
2019-21	Postdoctoral Research Scientist, Lamont-Doherty Earth Observatory, Columbia University
2016-19	Postdoctoral Research Scientist, dual appointment, Division of Geological and Planetary Sciences, California Institute of Technology, and Dept. of Atmospheric and Oceanic Sciences, UCLA
2011-16	Graduate Research Assistant, Program in Atmospheric and Oceanic Sciences, Princeton University

GRANTS

2021	“How do energy fluxes link precipitation variability across the tropical weather-climate continuum?” Principal Investigator. 3 yr, \$682,038, commenced 2021/12/01. NSF Climate and Large-Scale Dynamics.
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AWARDS AND FELLOWSHIPS

2021	Columbia University Nominee, Blavatnik Regional Award for Young Scientists
2019	Columbia University Earth Institute Postdoctoral Research Fellowship (2019-21)
2016	California Institute of Technology Foster and Coco Stanback Postdoctoral Research Fellowship (deferred to 2018-19) NSF Atmospheric and Geospace Sciences Postdoctoral Research Fellowship (2016-18)
2013	Dept. of Defense National Defense Science and Engineering Graduate Research Fellowship (2013-16)
2012	Princeton University Elliott Robinson Little '25 Fellowship
2011	American Meteorological Society Annual Meeting Climate Change Travel Scholarship NSF Graduate Research Fellowship Honorable Mention UCLA Magna Cum Laude and College Honors graduation distinctions
2009	National Oceanic and Atmospheric Administration Ernest F. Hollings Undergraduate Scholarship
2007	United States Presidential Scholar, conferred by the U.S. Dept. of Education Commission on Presidential Scholars

PUBLICATIONS

Refereed journal articles

- 2022 17. Hill SA, NJ Burls, A Fedorov, and TM Merlis. "Symmetric and antisymmetric components of polar-amplified warming." Accepted, *J. Climate*. doi: 10.1175/JCLI-D-20-0972.1.
16. Hill SA, S Bordoni, and JL Mitchell. "Toward a unified theory for the Hadley cell descending and ascending edges." Accepted, *J. Atmos. Sci.* doi: 10.1175/JAS-D-21-0328.1.
15. Biasutti M, SA Hill, and A Voigt. "The Effect Of An Equatorial Continent On The Tropical Rain Belt. Part 2: Summer Monsoons." *J. Climate*, **35**, 3091–3107. doi: 10.1175/JCLI-D-21-0588.1
14. Hill SA, AH Sobel, M Biasutti, and MA Cane. "On the all-India rainfall index and sub-India rainfall heterogeneity." *Geophys. Res. Lett.*, **49**, e2021GL096541, 10 pp. doi: 10.1029/2021GL096541.
- 2021 13. Hill SA, S Bordoni, and JL Mitchell. "Solsticial Hadley Cell ascending edge theory from supercriticality." *J. Atmos. Sci.*, **78**, 1999–2011. doi: 10.1175/JAS-D-20-0341.1.
12. Mitchell, JL and SA Hill. "Constraints from invariant subtropical vertical velocities on the scalings of Hadley cell strength and downdraft width with rotation rate." *J. Atmos. Sci.*, **78**, 1445–1463. doi: 10.1175/JAS-D-20-0191.1
- 2020 11. Hill SA, S Bordoni, and JL Mitchell. "Axisymmetric Hadley Cell theory with a fixed tropopause temperature rather than height." *J. Atmos. Sci.*, **77**, 1279–1294. doi: 10.1175/JAS-D-19-0169.1.
- 2019 10. Hill SA. "Theories for past and future monsoon rainfall changes." *Curr. Clim. Change Rep.*, **5**, 160–171. doi: 10.1007/s40641-019-00137-8.
9. Hill SA, S Bordoni, and JL Mitchell. "Axisymmetric constraints on cross-equatorial Hadley cell extent." *J. Atmos. Sci.*, **76**, 1547–1564. doi: 10.1175/JAS-D-18-0306.1.
- 2018 8. Hill SA, JM Lora, N Khoo, SP Faulk, and JM Aurnou. "Affordable rotating fluid demonstrations for geoscience education: The *DIY*namics project." *Bull. Am. Met. Soc.*, **99**, 2529–2538. doi: 10.1175/BAMS-D-17-0215.1.
7. Hill SA, Y Ming, and M Zhao. "Robust responses of the Sahelian hydrological cycle to global warming." *J. Climate*, **31**, 9793–9814. doi: 10.1175/JCLI-D-18-0238.1.
6. Smyth J, SA Hill, and Y Ming. "Simulated responses of the West African monsoon and zonal-mean tropical precipitation to early Holocene orbital forcing." *Geophys. Res. Lett.*, **45**, 12,049–12,057. doi: 10.1029/2018GL080494.
- 2017 5. Hill SA, Y Ming, IM Held, and M Zhao. "A moist static energy budget-based analysis of the Sahel rainfall response to uniform oceanic warming." *J. Climate*, **30**, 5637–5660. doi: 10.1175/JCLI-D-16-0785.1.
4. Brown PT, Y Ming, W Li, and SA Hill. "Change in the magnitude and mechanisms of unforced low-frequency surface temperature variability in a warmer climate." *Nature Climate Change*, **7**, 743–748. doi: 10.1038/nclimate3381.
3. Jeevanjee N, P Hassanzadeh, SA Hill, and A Sheshadri. "A perspective on climate model hierarchies." *J. Adv. in Mod. Earth Sys.*, **9**, 1760–1771. doi: 10.1002/2017MS001038.
- 2015 2. Hill SA, Y Ming, and IM Held. "Mechanisms of forced tropical meridional energy flux change." *J. Climate*, **28**, 1725–1742. doi: 10.1175/JCLI-D-14-00165.1.
- Corrigendum: <https://dx.doi.org/10.1175/JCLI-D-16-0485.1>.
- 2012 1. Hill SA and Y Ming. "Nonlinear climate response to regional brightening of tropical marine stratocumulus." *Geophys. Res. Lett.*, **39**, L15707, 5 pp. doi: 10.1029/2012GL052064.

Book reviews

- 2012 Hill SA "A head in the clouds elucidates climate" (book review of *Atmosphere, Clouds, and Climate* by David Randall). *Science*, **337**, 1 pp., doi: 10.1126/science.1225615.

Other publications

- 2017- Numerous blog posts for the DIYdynamics blog. Available at
<https://diydynamics.github.io/blog/author/spencer-hill.html>.

INVITED COLLOQUIA AND SEMINARS

- 2022 Dept. of Earth & Atmospheric Sciences seminar series, City College of New York, date TBD.
 Equilibrium Climate Sensitivity & Cloud Feedback Virtual Symposium, Mar. 24th.
- 2021 Atmosphere, Ocean, and Climate Dynamics seminar series, Yale University, Feb. 25th.
 Meteorology Seminar Series, Dept. of Earth, Atmospheric, and Oceanic Sciences, Florida State University, Feb. 18th.
- 2019 Earth Research Institute Monthly Climate Meeting, University of California – Santa Barbara, Jan. 7th.
- 2018 Division of Ocean and Climate Physics Seminar Series, Lamont-Doherty Earth Observatory, Feb. 16th.
 NOAA Geophysical Fluid Dynamics Laboratory informal seminar series, Feb. 14th.
- 2016 Center for Atmosphere Ocean Science, New York University, Nov. 9th.
 Gaede Institute for the Liberal Arts, Natural and Behavioral Sciences Lecture, Westmont College, Oct. 13th.
- 2015 New York University, Courant Institute of Mathematical Sciences, Center for Atmospheric and Oceanic Sciences, Student seminar series, New York, NY
- 2014 Dept. of Geophysics, Yale University, Oct. 9th.

CONFERENCE ACTIVITIES

Workshops organized

- 2022 “Teaching atmosphere, ocean, and planetary fluid dynamic fundamentals vividly with rotating tanks.” Earth Educators Rendezvous, Twin Cities, MN, Jul. 14-15th.

Chaired sessions

- 2022 “Monsoon Dynamics: Variability, Change, and Impacts. Part I” AMS Annual Meeting (virtual), Jan. 26th.
 “Monsoon Dynamics: Variability, Change, and Impacts. Part II” AMS Annual Meeting (virtual), Jan. 27th.
- 2018 “Monsoons: Observations, Subseasonal, Seasonal, and Interannual to Decadal Variability, Forecast, Climate Change, and Extremes III.” AGU Fall Meeting, Washington, D.C., Dec. 11th.
- 2017 “Idealized approaches to the atmospheric and oceanic circulation II.” American Meteorological Society 21st Conference on Atmospheric and Oceanic Fluid Dynamics, Portland, OR, Jun. 26th.
- 2016 “Tropical circulations and their sensitivities to changes in climate I.” AGU Fall Meeting, San Francisco, CA, Dec. 16th.
 “Tropical convection and radiative convective equilibrium.” World Climate Research Programme Model Hierarchies Workshop, Princeton, NJ, Nov. 3rd.

Invited Conference Talks

- 2022 “Indian summer monsoon rainfall interannual variability: seasonal-mean and daily extremes.” Continental Climate Change Workshop, St. Andrews, Scotland, Jun. 8th.
 “Symmetric and antisymmetric components of polar-amplified warming.” ECS & Cloud Feedback Virtual Symposium, Mar. 24th.
- 2019 “Toward an analytical, predictive theory for the location of Hadley and monsoonal cell ascending branches.” AGU Fall Meeting, San Francisco, CA, Dec. 10th.
- 2016 “infinite-diff and animal-spharm: xarray-based finite differencing and spherical harmonics.” Columbia University Python and Atmospheric and Oceanic Sciences Workshop, New York, NY, Nov. 12th.
- 2015 “Towards constraining Sahel rainfall responses to global mean temperature changes.” Linde Center for Global Environmental Science, California Institute of Technology, Monsoons: Past, Present and Future workshop, Pasadena, CA, May 21st.

Other Conference Presentations

- 2022 “Hadley cell extent across seasons and the solar system.” Talk. AMS Atmospheric and Oceanic Fluid Dynamics Meeting. Breckenridge, CO. Jun. 17th.
 “On the All-India Rainfall Index, Sub-India Rainfall Heterogeneity, ENSO, and Teleconnections from the Indian Ocean” Talk. AMS Annual Meeting (virtual). Jan. 26th.
 “Symmetric and Antisymmetric Components of Polar-Amplified Warming.” Talk. AMS Annual Meeting (virtual). Jan. 26th.
- 2021 “New scalings for the ascending and descending branch positions of the solsticial Hadley cells in planetary atmospheres including Titan” Poster. AGU Fall Meeting. New Orleans, LA. Dec. 16th.
 “On the all-India rainfall index, sub-India rainfall heterogeneity, ENSO, and teleconnections from the Indian Ocean” Talk. AGU Fall Meeting. New Orleans, LA. Dec. 15th.
 “Connecting sub-India, sub-seasonal monsoon rainfall variability with all-India, all-summer monsoon rainfall.” AMS Annual Meeting (virtual). Talk. Jan. 14th.
- 2020 “Sub-India summer monsoon rainfall variability and its implications for all-India summer monsoon rainfall prediction.” AGU Fall Meeting (virtual). Poster. Dec. 1st-17th.
- 2019 “Simulated polar amplification and its causes on decadal to millennial timescales.” Poster. AGU Fall Meeting. San Francisco, CA. Dec. 10th.
 “Modernizing Axisymmetric Hadley Cell and Monsoon Theory.” Talk. AMS 22nd Conference on Atmospheric and Oceanic Fluid Dynamics. Portland, ME. Jun. 25th.
- 2018 “What sets the locations of the solsticial cross-equatorial Hadley cell edges?” Talk. AGU Fall Meeting. Washington, DC. Dec. 13th.
 “Towards transient simulation of the Green Sahara onset and demise through idealized modeling of vegetation-land-atmosphere interactions.” Poster. 17th Swiss Climate Summer School: Earth system variability through time. Grindelwald, Switzerland. Aug. 28th.
 “What Determines the ITCZ Position During Solsticial Seasons on Earth and Other Planets?” Talk. AMS 33rd Conference on Hurricanes and Tropical Meteorology. Ponte Vedra, FL. Apr. 16th.
- 2017 “Dry Rainbelts: Understanding Boundary Layer Controls on the ITCZ Using a Dry Dynamical Core.” Talk. AGU Fall Meeting. New Orleans, LA. Dec. 14th.
 “Towards transient simulation of the Green Sahara onset and demise through idealized modeling of vegetation-land-atmosphere interactions.” Poster. Gordon Research Conference on Radiation and Climate. Bates College, Lewiston, ME. Jul. 19th.
 “Control of convergence zone migrations by planetary parameters.” Poster. AMS 21st Conference on Atmospheric and Oceanic Fluid Dynamics. Portland, OR. Jun. 27th.
 “Automate your climate and weather data analysis with aospy.” Talk. AMS Annual Meeting, Seattle, WA. Jan. 24th.
 “Energetic and precipitation responses in the Sahel to sea surface temperature perturbations.” Talk. AMS Annual Meeting, Seattle, WA. Jan. 24th.
- 2016 “Robust drying influence of mean ocean surface warming on The Sahel and implications for constraining future rainfall change.” Poster. AGU Fall Meeting, San Francisco, CA. Dec. 16th.
 “A hierarchy of perturbation complexities: Case study of Sahel rainfall response to global warming” Poster. WCRP Model Hierarchies Workshop, Princeton University, Princeton, NJ. Nov. 2nd.
- 2015 “Towards constraining future rainfall in the Sahel using the moist static energy budget.” Talk. AGU Fall Meeting, San Francisco, CA. Dec. 14th.
 “Convection scheme, cloud, and stability effects on Sahel rainfall response to uniform warming.” Poster. AMS Annual Meeting, Phoenix, AZ. Jan. 6th.
- 2014 “Convection scheme, cloud, and stability effects on Sahel rainfall response to uniform warming.” Poster. AGU Fall Meeting, San Francisco, CA. Dec. 15th.
 “Mechanisms of forced tropical meridional energy flux change.” Poster. Latsis Symposium, ETH Zurich, Zurich, Switzerland. Jun. 19th.
 “Mean and extreme tropical precipitation changes caused by the uniform and spatially varying components of anthropogenic forcing.” Talk. AMS Annual Meeting, Atlanta, GA. Feb. 5th.

- 2013 “Mechanisms of forced tropical meridional energy flux change.” Talk. AGU Fall Meeting, San Francisco, CA. Dec. 13th.
- “Mechanisms of forced tropical meridional energy flux change.” Talk. Graduate Climate Conference, Woods Hole Oceanographic Institution, Woods Hole, MA. Nov. 2nd.
- “Mechanisms of forced tropical meridional energy flux change.” Poster presentation. Gordon Research Conference, Colby-Sawyer College, New London, NH. Jul. 9th.
- 2012 “Climate response to a geoengineered brightening of subtropical marine boundary clouds.” Poster. 11th Annual Student Conference at the AMS Annual Meeting, New Orleans, LA. Jan. 22nd.
- 2010 “Climate response to a geoengineered brightening of subtropical marine boundary clouds.” Poster. San Francisco, CA. Dec. 14th.
- “Climate response to a geoengineered brightening of subtropical marine boundary clouds.” Talk. Special Symposium on Aerosols in Geoengineering at the American Association for Aerosol Research 29th Annual Conference. Portland, OR. Oct. 26th.
- “Investigating climate response to geoengineering using a global climate model.” Talk. National Oceanic and Atmospheric Administration Office of Education Science Symposium, Silver Spring, MD. Aug. 3rd.

CAMPUS AND DEPARTMENTAL TALKS

- 2022 Princeton University Program in Atmospheric and Oceanic Sciences GFDL Tutorial Series for summer interns. Jun. 21st.
- 2019 Lamont-Doherty Earth Observatory Postdoc Symposium (poster). Sep. 11th.
- 2018 Dept. of Atmospheric and Oceanic Sciences, UCLA. Nov. 7th.
- 2016 Division of Geological and Planetary Sciences, California Institute of Technology. Oct. 26th.
- Dept. of Atmospheric and Oceanic Sciences, UCLA. Oct. 5th.
- 2015 Dynamics Seminar Series, Program in Atmospheric and Oceanic Sciences, Princeton University. Mar. 13th.
- 2012 Student/Postdoc Seminar Series, Program in Atmospheric and Oceanic Sciences, Princeton University. Feb. 28th.
- 2011 Graduate Research Symposium, Dept. of Geosciences, Princeton University. Nov. 11th.

UNDERGRADUATE RESEARCH ADVISING

As primary advisor

- 2021 Destiny Zamir Meyers, Columbia University
- Matthew Donahue, Columbia University
- 2020 Valentina Rojas-Posada, Barnard University (partial funding awarded by competition from Columbia University Earth Institute)
- 2017 Norris Khoo, UCLA
- Micah Kim, UCLA
- 2016 Juliet Olsen, UCLA

Summer interns, as co-advisor

- 2022 Rea Restugi, NOAA Geophysical Fluid Dynamics Laboratory
- 2015 Jane Smyth, NOAA Geophysical Fluid Dynamics Laboratory
- 2014 Marjahn Finlayson, NOAA Geophysical Fluid Dynamics Laboratory
- 2013 Colin Raymond, NOAA Geophysical Fluid Dynamics Laboratory

TEACHING ACTIVITIES

Teaching Assistant

- 2014 “Physics of Earth: The Habitable Planet.” Upper-division undergraduate course. Dept. of Geosciences, Princeton University.

Certifications

- 2016 Teaching Transcript Certification, McGraw Center for Teaching and Learning, Princeton University.

Guest Lectures

- 2018 Three lectures for “Introduction to Atmospheric and Oceanic Fluids,” graduate-level course, Dept. of Atmospheric and Oceanic Sciences, UCLA.
“The general circulation of the atmosphere: Energetics.” Nov. 13th.
“The general circulation of the atmosphere: Momentum.” Nov. 15th.
“The general circulation of the atmosphere: Lab.” Nov. 29th.
- 2014 Two lectures for “Physics of Earth: The Habitable Planet,” upper-division undergraduate course, Dept. of Geosciences, Princeton University.
“Climate modeling and climate change projections”
“Weather: From orbital order, atmospheric chaos”

SCIENCE OUTREACH AND MEDIA

- 2021 “Ask Me Anything” virtual Q+A session, “AMA Session on Climate Action,” Presidential Scholars Alumni Association. Oct. 28th.
Interview in *The Medallion* (Newsletter of the Presidential Scholars Alumni Association). “Scholars in Climate Science: Observations from the Field.” Sep. 27th.
U.S. Presidential Scholars Foundation roundtable on human and planetary health, Jul. 21st.
“You Spin Me Right Round.” Zoom-based presentation on planetary fluid flows for K-12 students, part of the EI Live K12 series, Earth Institute, Columbia University. Feb. 11th.
<https://www.earth.columbia.edu/videos/view/you-spin-me-right-round>
- 2017- Co-founder and Co-Director, *DIY*namics (organization advancing rotating tank-based geoscience teaching; <https://dynamics.github.io>).
- 2015- Volunteer at 10+ science outreach events either open to the public or presented at middle schools.

SERVICE ACTIVITIES

Professional

Special Topic Editor, “Regional Variability of the Tropical Rain Belt in a Changing Climate,” *Frontiers in Climate*
Review Editor, Editorial Board of Predictions and Projections, *Frontiers in Climate*
Proposal referee, NSF Climate and Large-Scale Dynamics, NSF EarthCube, NASA Juno Participating Scientist Program
Article referee, *Nature Climate Change*, *Nature Communications*, *npj Climate and Atmospheric Science*, *Journal of Advances in Modeling Earth Systems*, *Journal of Climate*, *Current Climate Change Reports*, *Quarterly Journal of the Royal Meteorological Society*, *Geophysical Research Letters*, *Journal of the Atmospheric Sciences*, *Paleoceanography and Paleoclimatology*, *Geoscientific Model Development*, *Climatic Change*, *Climate Dynamics*, *Journal of Geophysical Research - Atmospheres*, *International Journal of Climatology*
Developer and maintainer, aospy open-source Python software package for automating analyses of climate datasets (<https://aospy.readthedocs.io>)
Code contributor, xarray package for labeled multidimensional arrays in Python

Departmental/University

- 2015 Organizer, Convection Journal Club, Program in Atmospheric and Oceanic Sciences, Princeton University
- 2013-15 Organizer, Climate Sensitivity Journal Club, NOAA Geophysical Fluid Dynamics Laboratory
- 2012-13 Organizer, Student/Postdoc Seminar Series, Program in Atmospheric and Oceanic Sciences, Princeton University
- 2012-13 Representative to the faculty, Program in Atmospheric and Oceanic Sciences, Princeton University

ADDITIONAL TRAINING

- 2021 Workshop on Inclusive and Culturally Competent Teaching Strategies in the Earth Sciences, Columbia University, Jan. 8th
- 2020 Racial Sensitivity Workshop, Columbia University Earth Institute, Jun. 30th
- 2018 17th Swiss Climate Summer School, “Earth System Variability Through Time,” Grindelwald, Switzerland
- 2012-13 Member, Princeton University Energy and Climate Scholars
- 2012 NOAA Geophysical Fluid Dynamics Laboratory Summer School on Atmospheric Modeling

PROFESSIONAL MEMBERSHIPS

- 2010- American Geophysical Union
- 2011- American Meteorological Society
- 2021- National Association of Geoscience Teachers