Spencer Alan Hill, Ph.D.

Postdoctoral Research Scientist

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Employment history

Current position

Earth Institute Research Fellow, Columbia University Lamont-Doherty Earth Observatory. Advisors Dr. Michela Biasutti and Dr. Adam Sobel. August 2019-August 2021.

Past positions

- Foster and Coco Stanback Postdoctoral Research Fellow, California Institute of Technology Division of Geological and Planetary Sciences (GPS), and Visiting Assistant Project Scientist, UCLA Dept. of Earth, Planetary and Space Sciences (EPSS). Advisors Prof. Simona Bordoni (Caltech GPS) and Prof. Jonathan Mitchell (UCLA EPSS). September 2018 — August 2019.

- NSF Atmospheric and Geospace Sciences Postdoctoral Research Fellow (NSF award #1624740), UCLA Dept. of Atmospheric and Oceanic Sciences (AOS) and Caltech GPS. Advisors Prof. Simona Bordoni and Prof. Jonathan Mitchell September 2016 — August 2018.

Education

Ph.D. | Princeton University | Program in Atmospheric and Oceanic Sciences

Conferred September 2016 | Advisor Yi Ming | Committee members: Isaac Held, Leo Donner, Ming Zhao

B.S. | UCLA | Dept. of AOS and Dept. of Applied Mathematics

AOS/Applied Mathematics double major | Conferred June 2011 | Magna Cum Laude | Phi Beta Kappa | UCLA College Honors

Publications

In preparation

1. **Hill, Spencer A.**, Natalie J. Burls, and Alexey Fedorov. "Polar amplification's dependence on forcing and anomalous energy transports from decadal to millennial timescales." In preparation for submission to *Journal of Advances in Modeling Earth Systems*.
2. **Hill, Spencer A.**, Simona Bordoni, and Jonathan L. Mitchell. "Modified equal-area and other axisymmetric models of the Hadley cell, and their relevance to Earth's seasonal cycle." In preparation.
3. **Hill, Spencer A.**, Alex Gonzalez, and Juan M. Lora. "Two axisymmetric perspectives on Titan's ITCZ: free troposphere and boundary layer." In preparation.

Submitted/under review/in revision

1. **Hill, Spencer A.**, Simona Bordoni, and Jonathan L. Mitchell. "Axisymmetric Hadley Cell theory with a fixed tropopause temperature rather than height." Revised for *Journal of the Atmospheric Sciences*.
2. Mitchell, Jonathan L. and **Spencer A. Hill**. "Combining Thermodynamic and Dynamic Perspectives of Tropical Circulation to Constrain the Downdraft Width of the Hadley Cell." Under review, *Geophysical Research Letters*. arXiv: http://arxiv.org/abs/1911.05860.

Peer-reviewed

1. (2019) **Hill, Spencer A.** "Theories for past and future monsoon rainfall changes." *Current Climate Change Reports*, **5**, 160-171. doi: 10.1007%2Fs40641-019-00137-8. Online access: `https://rdcu.be/bHFCZ`.
2. (2019) **Hill, Spencer A.**, Simona Bordoni, and Jonathan L. Mitchell. "Axisymmetric constraints on cross-equatorial Hadley cell extent." *Journal of the Atmospheric Sciences*, **76**, 1547-1564. doi: 10.1175/JAS-D-18-0306.1.
3. (2018) **Hill, Spencer A.**, Juan M. Lora, Norris Khoo, Sean P. Faulk, and Jonathan M. Aurnou. "Affordable rotating fluid demonstrations for geoscience education: The *DIYnamics* project." *Bulletin of the American Meteorological Society*, **99**, 2529-2538. doi: 10.1175/BAMS-D-17-0215.1.
4. (2018) **Hill, Spencer A.**, Yi Ming, and Ming Zhao. "Robust responses of the Sahelian hydrological cycle to global warming." *Journal of Climate*, **31**, 9793-9814. doi: 10.1175/JCLI-D-18-0238.1.
5. (2018) Smyth, Jane, **Spencer A. Hill**, and Yi Ming. "Simulated responses of the West African monsoon and zonal-mean tropical precipitation to early Holocene orbital forcing." *Geophysical Research Letters*, **45**, 12,049-12,057. doi: 10.1029/2018GL080494.
6. (2017) **Hill, Spencer A.**, Yi Ming, Isaac M. Held, and Ming Zhao. "A moist static energy budget-based analysis of the Sahel rainfall response to uniform oceanic warming." *Journal of Climate*, **30**, 5637-5660. doi: 10.1175/JCLI-D-16-0785.1.
7. (2017) Brown, Patrick T., Yi Ming, Wenhong Li, and **Spencer A. 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.
8. (2017) Jeevanjee, Nadir, Pedram Hassanzadeh, **Spencer A. Hill**, and Aditi Sheshadri. "A perspective on climate model hierarchies." *Journal of Advances in Modeling Earth Systems*, **9**, 1760-1771. doi: 10.1002/2017MS001038.
9. (2015) **Hill, Spencer A.**, Yi Ming, and Isaac M. Held. "Mechanisms of forced tropical meridional energy flux change." *Journal of Climate*, **28**, 1725-1742. doi: 10.1175/JCLI-D-14-00165.1.
    - Corrigendum: `https://dx.doi.org/10.1175/JCLI-D-16-0485.1`.
10. (2012) **Hill, Spencer A.** and Yi Ming. "Nonlinear climate response to regional brightening of tropical marine stratocumulus." *Geophysical Research Letters*, **39**, L15707, 5 pp. doi: 10.1029/2012GL052064.

PhD thesis

(2016) **Hill, Spencer A.** "Energetic and hydrological responses of Hadley circulations and the African Sahel to sea surface temperature perturbations." PhD Thesis, Princeton University Program in Atmospheric and Oceanic Sciences.

Non peer-reviewed

1. Numerous blog posts for the DIYnamics blog. Available at `https://diynamics.github.io/blog/author/spencer-hill.html`.
2. (2017) **Hill, Spencer A.** and Spencer K. Clark. "What's needed for the Future of AOS Python? Tools for Automating AOS Data Analysis and Management." Invited guest blog post on "PyAOS" blog. URL: `http://pyaos.johnny-lin.com/?p=1546`.
3. (2012) **Hill, Spencer A.** "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.

Software

1. (2018) **Hill, Spencer A.** and Spencer Clark. "`aospy`: automated climate data analysis and management." Version 0.3.1. `https://aospy.readthedocs.io`. doi: 10.5281/zenodo.1490928.
2. (2016) Hoyer, Stephan et al. "xarray: v0.8.0." doi: 10.5281/zenodo.59499.

Research and Professional Experiences

2018 Dec	Co-chair, "Monsoons: Observations, Subseasonal, Seasonal, and Interannual to Decadal Variability, Forecast, Climate Change, and Extremes" session, AGU Fall Meeting, Washington, D.C.
2018 Aug	Participant, 17th Swiss Climate Summer School, "Earth system variability through time", Grindelwald, Switzerland
2017 June	Chair, "Idealized approaches to the atmospheric and oceanic circulation, Part II" session, AMS 21st Conference on Atmospheric and Oceanic Fluid Dynamics, Portland, OR
2016 Dec	Co-chair, "Tropical circulations and their sensitivities to changes in climate" session, AGU Fall Meeting 2016, San Francisco, CA
2016 Nov	Co-chair, "Tropical convection and radiative convective equilibrium" session, WCRP Model Hierarchies Workshop, Princeton, NJ
2015 June-Aug	Organizer, Princeton AOS convection journal club
2013-2015	Organizer, GFDL Climate Sensitivity Journal Club
2012–2013	Organizer, Princeton AOS Student/Postdoc Seminar Series
2012–2013	Princeton AOS Program Student Representative to the Faculty
2012–2013	Member, Princeton Energy and Climate Scholars
2012 July	Participant, GFDL Summer School on Atmospheric Modeling
2011 June-Aug	Research Intern, UCLA California Research Training Program in Computational and Applied Mathematics, Slurry Flows Group
2011 Jan	Invited Student Secretary, International Geosphere-Biosphere Program Workshop on Ecosystems Impacts of Geoengineering, Scripps Institution of Oceanography, UCSD, La Jolla, CA
2010 June-Aug	Research Intern, NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ. Advisor Dr. Yi Ming

Major Honors and Awards

2019 Columbia University Earth Institute Postdoctoral Research Fellowship
2016 NSF Atmospheric and Geospace Sciences Postdoctoral Research Fellowship. NSF Award #1624740
2016 California Institute of Technology Foster and Coco Stanback Postdoctoral Fellowship, deferred to 2018
2013 U.S. Dept. of Defense National Defense Science and Engineering Graduate Fellowship
2012 Princeton University Elliotte Robinson Little '25 Fellowship
2012 American Meteorological Society Climate Change Travel Scholarship, 92nd AMS Annual Meeting
2012 NSF Graduate Research Fellowship Honorable Mention
2009 National Oceanic and Atmospheric Administration Ernest F. Hollings Undergraduate Scholarship
2007 United States Presidential Scholar. Honored by President George W. Bush at the White House as part of the Presidential Scholars National Recognition Week.

Teaching & Mentoring

Princeton Teaching Transcript certification

Administered by the Princeton University McGraw Center for Teaching & Learning. Requirements include two-day teacher training, lectures and workshops on pedagogy, and video recording and subsequent analysis of teaching as a TA. Completed August 2016.

Teaching Assistant

Princeton University, Fall 2014, Geosciences 361, "Physics of Earth: The Habitable Planet." Professor George Philander.

Mentorship

- Advisor to UCLA undergraduate student Micah Kim for independent research course work on the "aospy" software package (Fall 2017)
- Assistant mentor to UCLA undergraduate students for work on the DIYnamics portable rotating tank science outreach project: Norris Khoo (2017), Juliet Olsen (Fall 2016)
- Assistant mentor to summer interns at NOAA GFDL: Jane Smyth (2015), Marjahn Finlayson (2014), Colin Raymond (2013)

Guest lectures

[2018-11-29 Thu] "Thermal wind balance: lab demonstrations" UCLA AOS 200A (graduate level): Introduction to Atmospheric and Oceanic Fluid
[2018-11-15 Thu] "The general circulation of the atmosphere: momentum" UCLA AOS 200A (graduate level): Introduction to Atmospheric and Oceanic Fluid
[2018-11-13 Tue] "The general circulation of the atmosphere: energetics" UCLA AOS 200A (graduate level): Introduction to Atmospheric and Oceanic Fluid
[2014-12-11 Thu] "Climate modeling and climate change projections" Princeton University GEO 361 (upper-division undergraduate): Physics of Earth: The Habitable Planet.
[2014-10-14 Tue] "Weather: From orbital order, atmospheric chaos" Princeton University GEO 361 (upper-division undergraduate): Physics of Earth: The Habitable Planet.

Public Outreach

"DIYnamics" project

Overview

Developing inexpensive, easy-to-assemble rotating tank platforms for use in teaching fundamental principles of Earth science at levels from K-12 science classes to AOS graduate courses. Materials include the kits themselves, PDF assembly instruction, instructional videos, and a website: `https://diynamics.github.io/`

Press

- UCLA press release (`link`)
- Story on UCLA Physical Sciences Division website (`link`)
- Listed on official UCLA Physical Sciences Division Outreach page (`link`)

Outreach events

Organized and/or participated in numerous DIYnamics public outreach events from 2017 onward, all documented on the DIYnamics blog: `https://diynamics.github.io/pages/blog.html`

Outreach activities prior to DIYnamics

[2015-06-19 Fri] "Introduction to climate models." 20 minute presentation to New Jersey Japanese School during their visit to NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ.

[2015-04-10 Fri] "Introduction to weather and climate." 45 minute presentation + Q&A to 7th grade class at Forrestdale Middle School, Rumson, NJ. Co-presented with Sarah Schlunegger.

Software: `aospy`

Overview

Created and actively develop "aospy," an open source Python package for automating computations that use gridded climate or weather data. Enables executing multiple calculations in parallel using the permutation of an arbitrary number of simulations, variables to be computed, date ranges, and many other parameters. Results get saved in a highly organized directory tree as netCDF file. Actively used by researchers at multiple institutions.

Resources

- Documentation: `https://aospy.readthedocs.io`
- Source code: `https://github.com/spencerahill/aospy`

Reviewing

- Proposal reviewer for National Science Foundation and NASA Juno Participating Scientist Program
- Article reviewer for *Nature Climate Change*, *npj Climate and Atmospheric Science*, *Journal of Climate*, *Quarterly Journal of the Royal Meteorological Society*, *Geophysical Research Letters*, *Journal of the Atmospheric Sciences*, *Geoscientific Model Development*, *Climatic Change*, *Climate Dynamics*, *Journal of Geophysical Research - Atmospheres*, and GFDL internal manuscript review.

Presentations

Invited

2020 May	(planned; title TBD) Invited talk in "Atmospheric circulation in the tropical belt: variability, dynamics, evolution from the past to the future and impacts on the environment and societies" session. European Geophysical Union General Assembly. Vienna, Austria.
2020 May	(planned; title TBD) Invited talk in "The global monsoons in current, future and palaeoclimates and their role in extreme weather and climate events" session. European Geophysical Union General Assembly. Vienna, Austria.
[2019-12-10 Tue]	"Toward an analytical, predictive theory for the location of Hadley and monsoonal cell ascending branches." Invited conference talk. American Geophysical Union Fall Meeting. San Francisco, CA.
[2019-01-07 Mon]	"Robust responses of the Sahelian hydrological cycle to global warming." Invited seminar. UCSB Earth Research Institute Monthly Climate Meeting. Santa Barbara, CA.
[2018-11-07 Wed]	"Back to the basics of monsoons, Hadley cells, and rotating tanks." Invited seminar. UCLA AOS formal seminar series.
[2016-11-12 Sat]	"`infinite-diff` and `animal-spharm`: `xarray`-based finite differencing and spherical harmonics." Invited conference talk. Columbia University AOS-Python workshop. New York, NY.
[2016-10-13 Thu]	"The fate of rainfall in the African Sahel under global warming." Invited seminar. Westmont College, Santa Barbara, CA.
[2015-05-21 Thu]	"Towards constraining Sahel rainfall responses to global mean temperature changes." Invited conference talk. Linde Center for Global Environmental Science "Monsoons: Past, Present and Future" workshop, California Institute of Technology, Pasadena, CA.
[2015-03-06 Fri]	"Mechanisms of forced ITCZ shifts and of rainfall responses in the African Sahel to SST warming." Invited seminar. New York University AOS student seminar series.
[2014-10-09 Thu]	"Mechanisms of forced ITCZ shifts and Sahelian drought in GCMs." Invited seminar. Yale University, New Haven, CT.

Non-invited

[2019-12-10 Tue]	"Simulated polar amplification and its causes on decadal to millennial timescales." Poster. AGU Fall Meeting. San Francisco, CA.
[2019-09-11 Wed]	"Towards transient simulation of the Green Sahara onset and demise through idealized modeling of vegetation-land-atmosphere interactions." Poster. Lamont-Doherty Earth Observatory Postdoc Symposium. Palisades, NY.
[2019-06-25 Tue]	"Modernizing Axisymmetric Hadley Cell and Monsoon Theory" Oral. AMS 22nd Conference on Atmospheric and Oceanic Fluid Dynamics. Portland, ME.
[2018-12-13 Thu]	"What sets the locations of the solsticial cross-equatorial Hadley cell edges?" Oral. AGU Fall Meeting. Washington, DC.
[2018-08-28 Tue]	"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.
[2018-04-16 Mon]	"What Determines the ITCZ Position During Solsticial Seasons on Earth and Other Planets?" Oral. AMS 33rd Conference on Hurricanes and Tropical Meteorology. Ponte Vedra, FL.
[2018-02-16 Fri]	"Robust responses of the Sahelian hydrological cycle to global warming." Oral. Columbia University/Lamont-Doherty Earth Observatory formal seminar series. Palisades, NY.
[2018-02-14 Wed]	"What limits the ITCZ's poleward extent during summer?" Oral. NOAA Geophysical Fluid Dynamics Laboratory informal seminar series. Princeton, NJ.
[2017-12-14 Thu]	"Dry Rainbelts: Understanding Boundary Layer Controls on the ITCZ Using a Dry Dynamical Core." Oral. AGU Fall Meeting. New Orleans, LA.

[2017-07-19 Wed] "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.

[2017-06-27 Tue] "Control of convergence zone migrations by planetary parameters." Poster. AMS 21st Conference on Atmospheric and Oceanic Fluid Dynamics. Portland, OR.

[2017-01-24 Tue] "Automate your climate and weather data analysis with aospy." Oral. AMS Annual Meeting, Seattle, WA.

[2017-01-24 Tue] "Energetic and precipitation responses in the Sahel to sea surface temperature perturbations." Oral. AMS Annual Meeting, Seattle, WA.

[2016-12-16 Fri] "Robust drying influence of mean ocean surface warming on The Sahel and implications for constraining future rainfall change." Poster. AGU 2016 Fall Meeting, San Francisco, CA.

[2016-11-09 Wed] "Energetic and precipitation responses in the Sahel to sea surface temperature perturbations." Oral. New York University Center for Atmosphere Ocean Science formal seminar series. New York, NY.

[2016-11-02 Wed] "A hierarchy of perturbation complexites: Case study of Sahel rainfall response to global warming." Poster. WCRP Model Hierarchies Workshop, Princeton University, Princeton, NJ.

[2016-10-26 Wed] "Tropical energetic and precipitation responses to sea surface temperature perturbations: Zonal mean and the African Sahel." Oral. Caltech GPS formal seminar series.

[2016-10-05 Wed] "Tropical energetic and precipitation responses to sea surface temperature perturbations: Zonal mean and the African Sahel." Oral. UCLA AOS formal seminar series.

[2015-12-14 Mon] "Towards constraining future rainfall in the Sahel using the moist static energy budget." Oral. AGU 2015 Fall Meeting, San Francisco, CA.

[2015-03-13 Fri] "Radiative and dynamical controls on the Sahel rainfall response to uniform ocean warming." Oral. Princeton AOS dynamics seminar series.

[2015-01-06 Tue] "Convection scheme, cloud, and stability effects on Sahel rainfall response to uniform warming." Poster. AMS Annual Meeting, Phoenix, AZ.

[2014-12-15 Mon] "Convection scheme, cloud, and stability effects on Sahel rainfall response to uniform warming." Poster. AGU Fall Meeting, San Francisco, CA.

[2014-06-19 Thu] "Mechanisms of forced tropical meridional energy flux change." Poster presentation. Latsis Symposium, ETH Zurich, Zurich, Switzerland.

[2014-02-05 Wed] "Mean and extreme tropical precipitation changes caused by the uniform and spatially varying components of anthropogenic forcing." Oral presentation. AMS 2014 Annual Meeting, Atlanta, GA.

[2013-12-13 Fri] "Mechanisms of forced tropical meridional energy flux change." Oral presentation. AGU 2013 Fall Meeting, San Francisco, CA.

[2013-11-02 Sat] "Mechanisms of forced tropical meridional energy flux change." Oral presentation. Graduate Climate Conference, Woods Hole Oceanographic Institution, Woods Hole, MA.

[2013-07-09 Tue] "Mechanisms of forced tropical meridional energy flux change." Poster presentation. Gordon Research Conference, Colby-Sawyer College, New London, NH.

[2012-02-28 Tue] "Climate response to a geoengineered brightening of subtropical marine boundary clouds." Oral. Princeton AOS Program Student/Postdoc Seminar Series.

[2012-01-22 Sun] "Climate response to a geoengineered brightening of subtropical marine boundary clouds." Poster. 11th Annual Student Conference at the AMS Annual Meeting, New Orleans, LA.

[2011-11-11 Fri] "Climate response to a geoengineered brightening of subtropical marine boundary clouds." Oral. Princeton University Department of Geosciences Graduate Research Symposium, Princeton, NJ.

[2010-12-16 Thu] "Climate response to a geoengineered brightening of subtropical marine boundary clouds." Poster. Session GC31A: "Can We Counteract Global Warming?" American Geophysical Union Fall Meeting. San Francisco, CA.

[2010-10-26 Tue] "Climate response to a geoengineered brightening of subtropical marine boundary clouds." Oral. Special Symposium on Aerosols in Geoengineering at the American Association for Aerosol Research 29th Annual Conference. Portland, OR.

[2010-08-03 Tue] "Investigating climate response to geoengineering using a global climate model." Oral. National Oceanic and Atmospheric Administration Office of Education Science Symposium, Silver Spring, MD.