

Savannah Cooley

Sc4751@columbia.edu

Summary

My strengths: expertise in ecosystem ecology, ecological applications of thermal and LiDAR remote sensing, nature-based climate mitigation solutions, drought resilience and forest regeneration.

Robust quantitative problem-solving skillset including Bayesian statistical modeling, remote sensing, time series analysis, econometrics, dynamical systems modeling with differential equations, and data science; exceptional verbal, written and scientific communication skills; ability to facilitate and collaborate with diverse groups through multi-cultural background and fluency in Spanish and Portuguese; strong User Research & Applied Earth Science background; unique combination of quantitative and systems thinking skills suited for complex transdisciplinary socio-ecological projects.

Education

Columbia University – New York, NY

- Ph.D. candidate, Department of Ecology, Evolution, and Environmental Biology **2020 – present**
Dissertation title: “Ecosystem regeneration as a climate mitigation strategy: an assessment leveraging novel spaceborne lidar, local knowledge, field observations and process modeling”

Clark University – Worcester, MA

- M.Sci. Geographic Information Science **2017**
- B.A. Economics (*magna cum laude*), Minors in Geography and Mathematics **2016**
Concentration in Computational Science

Professional Experience

NASA Jet Propulsion Laboratory | APR Consulting, Inc. — Remote and Pasadena, CA **2022 - 2023**
Research & Applications Scientist II, Carbon Cycle and Ecosystems Group, Earth Science Section

NASA Jet Propulsion Laboratory | Columbus Technologies, Inc. — Remote and Pasadena, CA **2018 – 2022**
Applied Science Systems Engineer, Instrument Software and Science Data Systems Section

Urban 3 Consulting, LLC — Remote position and Asheville, NC **2017**
Remote Sensing & Spatial Statistics Specialist, Office for Data Analytics

NASA Jet Propulsion Laboratory | Clark University — Pasadena, CA and Worcester, MA **2016 - 2017**
Research Intern, ECOSTRESS Mission Applications Team, Earth Science Division

Urban 3 Consulting, LLC — Worcester, MA and Asheville, NC **2015-2016**
GIS & Remote Sensing Student Intern, Office for Data Analytics

Current Projects

Co-Investigator, NASA Research Opportunities in Space and Earth Sciences project funded under Land Cover Land Use Change Program (<https://lcluc.umd.edu/>) **2020 - present**

- NASA LCLUC is an interdisciplinary research program focused on understanding why and how patterns of land-use and land-cover are changing, how they will change in the future and the implications of these changes.
- Our project will enhance our ability to (1) detect and quantify the extent of degraded tropical forest and (2) predict the susceptibility to drought and fire of second growth and degraded forests will expand in the Amazon.
- My work involves developing Bayesian models to quantify the importance of water stress and water use efficiency on the success of regeneration of second growth and degraded forests. I will use thermal remote sensing (ECOSTRESS, MODIS, and VIIRS) and multisource inputs (passive optical Sentinel-2, airborne lidar, GEDI).

Co-Investigator, NASA Research Opportunities in Space and Earth Sciences project funded under SERVIR Amazônia Hub (<https://servirglobal.net/>) **2020 - present**

- SERVIR, a joint initiative of NASA and the U.S. Agency for International Development (USAID), fosters applications of Earth observations to support developing countries in environmental decision-making.
- Our project supports zero deforestation and climate mitigation planning in Peru and Brazil.
- My work involves the modeling and visualization of 3D canopy structure in regenerating forests with NASA's Global Ecosystem Dynamics Investigation (GEDI) mission, a light detection and ranging infrared laser onboard the International Space Station (Cooley et al., *in review*).

Co-Investigator, NASA Research Opportunities in Space and Earth Sciences project funded under Applied Science Water Resources Program (<https://appliedsciences.nasa.gov/>) **2022 - present**

- NASA Water Resources Program helps discover, develop, and demonstrate new practical uses for NASA's Earth observations in the water resources management community.
- Our project partners with New Mexico Office of the State Engineer to integrate remotely sensed evapotranspiration (ET) data into operational water resource management.
- I lead the quantitative impact studies to evaluate the socioeconomic benefits of using ET data in three policy decision contexts: water rights administration, drought response and forest management. Fusing design concepts and novel scenario visualization techniques for User Research and collaborator interview process.

Researcher and Data Scientist, ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) mission (<https://ecostress.jpl.nasa.gov/>) **2019 - present**

- ECOSTRESS is a thermal radiometer that launched on the International Space Station in June 2018 and produces an evapotranspiration (ET) data product at 70-m pixel resolution.
- Through innovative data visualization and statistical modeling, my work addressed ECOSTRESS science objective #1: assess water use efficiency (WUE, ratio of carbon gain quantified as Gross Primary Production (GPP) to water use quantified as ET) in regions where global climate models disagree (Cooley et al., 2022).
- Currently implementing a hierarchical Bayesian modeling study with data from three instruments on the International Space Station (ECOSTRESS, GEDI and OCO-3) to investigate how water stress, variation in photosynthetic activity and WUE impacts long-term aboveground biomass accumulation in tropical forests.
- First author in resulting publications (see publications list below).

Women In Science at Columbia (WISC) Research Scientist Mentor, Columbia University (<https://www.womeninscienceatcolumbia.org/>) **2021 - present**

- Designed a meta-analysis study that focuses on understanding how CO₂, N₂O and CH₄ emissions change across forest regeneration trajectories (Cooley et al., *in prep*). Mentored and lead team of 6 undergraduate students.

Selected Past Projects (see LinkedIn profile for full descriptions)

Planning Committee Member for United Nations Convening of the Parties (COP) 27 special programming,
Columbia University Climate School (<https://www.climate.columbia.edu/cop27>) **2022**

- Contributed to developing program for Columbia Climate School United Nations COP27 event.
- My role was to: (1) co-design and distribute a survey to assess Columbia student knowledge on U.N. climate negotiations and (2) create special programming including climate policy workshops, community-led climate art activism exhibits and guest lectures by internationally renowned climate experts.

Satellite Needs Working Group member, the U.S. GEO, Subcommittee under the White House National Science and Technology Council Committee on Environment, Natural Resources, and Sustainability **2021**

- SNWG provides the first-ever whole-of-government approach to addressing agencies' civil Earth observation satellite needs that inform future NASA budgeting decisions.
- My role was to provide applied science expertise to the SNWG group, particularly in the areas of water resources and climate change mitigation and adaptation.

United Nations GRAF Working Group member, U.N. Global Risk Assessment Framework
(<https://www.undrr.org/>) and NASA Disasters Program (<https://disasters.nasa.gov>) **2020 - 2021**

- United Nations Office for Disaster Risk Reduction established the Global Risk Assessment Framework (GRAF) initiative to reduce systemic risks of disasters at regional, national and international scales.
- My role was to investigate regional nature-based flood risk reduction solutions and synthesize knowledge gaps for future solicitation development with NASA Applied Sciences Disasters Program.
- Contributing author to U.N. Global Assessment Report on Disaster Risk Reduction 2022.

NASA-JPL Disasters Program Coordinator, Applied Sciences (<https://disasters.nasa.gov>) **2018 – 2020**

- The NASA Applied Sciences Disasters Program promotes the use of Earth observations to improve prediction of, preparation for, response to, and recovery from disasters.
- As a Disasters Coordinator at NASA-JPL, I connected JPL data and modeling capabilities with emergency preparedness leaders in support of developing mitigation approaches, such as early warning systems, and provided information and maps to disaster response and recovery teams.

Research to Operations and Impact Lead, NASA Western Water Applications Office, Applied Sciences Program
(<https://wwao.jpl.nasa.gov>) **2018 - 2020**

- My role involved working with WWAO project teams to conduct quantitative impact assessments, refine technical deliverables and develop sustainability plans to transition from research to operations.
- Gained expertise in connecting earth science research with environmental policy, stakeholder engagement and impact strategy implementation based on Theory of Change (ToC) and Value of Information (VOI) methodologies in partnership with the NASA-funded VALUABLES project lead by Resources for the Future.
- First author in peer-reviewed manuscript, where we proposed an expanded conceptualization of the NASA Applied Science's Application Readiness Levels (ARLs) (see publications list).

Applied Science Data Products Lead, Gravity Recovery and Climate Experiment Follow-on mission
(<https://grace.jpl.nasa.gov>) **2018 - 2019**

- Combined three sets of spherical harmonic gravity field solutions (Level 2 data) to minimize the error and bias of the final solution. This involved implementing an iterative Variance Component Estimation algorithm to estimate weights of each solution over time.

- First author in the GRACE-FO Level 3 Data Handbook focused on the GRACE/GRACE-FO science data processing system architecture, featured data applications, as well as a set of reproducible use cases of GRACE-derived Terrestrial Water Storage anomalies.
- Level 3 Data Handbook published on NASA's Physical Oceanography Data Active Archive Center (PO.DAAC).

Remote Sensing & Spatial Econometrics Specialist (Contractor)

Urban 3, LLC — Asheville, NC and remote position

2017

- Estimated infrastructure costs of different development patterns, including dense, mixed-use areas as well as suburban sprawl. Urban3 client Lancaster, CA designed its policy of a development impact fee based on the results of this project.

Student Researcher for ECOSTRESS Applications Team (M.S. Thesis)

NASA-JPL and Clark University — Pasadena, CA and Worcester, MA

2016 - 2017

- Applied simulated ECOSTRESS evapotranspiration (ET) data using the Priestly-Taylor Jet Propulsion Laboratory (PT-JPL) model to improve drought monitoring and assess temporal lags of ecosystem response to drought.
- Used remote sensing-based indicators including ET and the Evaporative Stress Index to estimate vegetation stress across forest, grassland and agricultural areas in case study of Guanacaste, Costa Rica.
- First author in publication in *Ecological Applications* journal (see publications section below).

NASA DEVELOP Research Intern

NASA-JPL and EARTH University — Pasadena, CA & Guanacaste, Costa Rica

Summer 2016

- Simulated Level-2 land surface temperature ECOSTRESS data and delivered data product and presentation to project partner EARTH University in Guanacaste, Costa Rica.
- Created experimental design to demonstrate how ECOSTRESS data can inform precision agriculture irrigation practices and partially replace the need for costly in situ data collection.

Remote Sensing & GIS Research Intern (Honors Thesis in Economics)

Urban 3 and Economics Department, Clark University — Asheville, NC and Worcester, MA

2015-2016

- Developed a spatial econometric model to quantify the economic benefits of dense mixed-use urban development. Worked with data from Urban3 client Lafayette, LA government to predict land value per acre based on network centrality measures, environmental and economic factors.

Research Intern at the UCSB Spatial Center

Geography Department, University of California, Santa Barbara — Santa Barbara, CA

Summer 2015

- Worked with UCSB Map & Imagery Library to establish beta implementation of an online graph database discovery portal that features geospatial data generated by UCSB researchers.
- Co-author in the resulting publication.

Remote Sensing Specialist

Iracambi Research Center — Atlantic Rainforest, Minas Gerais, Brazil

Summer 2014

- Partnered with GIS team to create an interactive web mapping application for conservation areas within and surrounding a state park. It featured data sets showing mining company's bauxite concession zones, water resources, landslide risk, and ideal reforestation areas.
- Met with the regional Brazilian Ministry of Environment and Agriculture to discuss the potential risks of bauxite mining to water resources and farmer livelihoods in Rosario da Limeira.

Skills and Technical Capabilities

- **Fluent in:**
 - (1) Spanish (lived and studied in Mexico for 4 years (2004-2008); Co-Investigator of for two consecutive NASA SERVIR-Amazonia research projects in Peru (2020-present).
 - (2) Portuguese (studied abroad in Brazil for 10 months during junior year of high school (2011); completed a 3-month summer internship as an undergraduate student (2014).
- **Proficient in:** Python and R programming languages.
- **Technical Expertise:** theoretical ecology with differential equation modeling, time series analysis, spatial econometric modeling, spatial statistics, data interpolation, random forests machine learning algorithms, land cover classification, accuracy assessment, ecosystem structure estimation with spaceborne light detection and ranging (lidar), thermal remote sensing, ecosystem evapotranspiration and water use efficiency, tropical forest biogeochemistry (especially carbon and nitrogen cycles), land use stewardship for climate mitigation.

Honors, Recognition and Awards

- Member, New York Academy of Sciences **2022-present**
- One of eight selected Young Scientists presenting at the Centennial Celebration of the American Geophysical Union in “Young Scientists View of the Future” **2019**
- Dean’s List, Clark University **2013-2016**
- Traina Scholar for students in the Sciences, Clark University **2012-2016**

Leadership and Community Engagement

- Elected Ph.D. Student Representative, Columbia University Arts and Sciences Graduate Council **2023**
- Technical Reviewer for NASA Small Business Innovation Research and Technology Transfer (SBIR/STTR) program. Subtopic: Earth science decision support tools for climate mitigation and adaptation **2022**
- Chief Financial Officer for CreateCommunity non-profit organization **2019-present**
- Endorsement Lead for Pasadena-Foothills chapter of Citizens Climate Lobby (CCL) **2017-2020**
 - Manager of successful multi-chapter campaign for endorsement of Energy Innovation and Carbon Dividend Act (H.R. 763) from the LA County Board of Supervisors **2019**
- Facilitator for Alternative to Violence Project workshops in Women’s prison **2018-2020**
- Elected M.S. Student Representative, Clark University Geography Department Faculty **2016**
- Elected Wright Hall Representative, Clark University Undergraduate Student Council **2012-2013**

Selected Publications

- **Cooley, S.S.**, Pinto, N., Vela-Alvarado, J., Fahlen, J., Aguilar, N., DeFries, R., Uriarte, M. & Menge, D. (*in review*). May the forest be with you: combining spaceborne lidar from GEDI with local knowledge in the forest-agriculture interface of Ucayali, Peru. *Conservation Science & Policy*.
- Menge, D.N., Kou-Giesbrecht, S., Taylor, B.N., Akana, P.R., Butler, A., Carreras Pereira, K.A., **Cooley, S.S.**, Lau, V.M. and Lauterbach, E.L. (2023). Terrestrial Phosphorus Cycling: Responses to Climatic Change. *Annual Review of Ecology, Evolution, and Systematics*.
- **Cooley, S.S.**, Fisher, J.B. & Goldsmith, G.R. (2022). Convergence in water use efficiency within plant functional types across contrasting climates. *Nature Plants*. <https://doi.org/10.1038/s41477-022-01131-z>
- **Cooley, S.S.**, Jenkins, A., Schaeffer, B., Abdallah, A., Granger, S., & Friedl, L. (2022). Paths to research-driven decision making in the realms of environment and water. *Technology in Society*.
- Borges, D., Ramage, S., Green, D., ... **Cooley, S.S.**, ..., Lloyd, S., & Blake, C. (2022). Earth Observations into Action: Systemic Integration of Earth Observation Applications into National Risk Reduction Decision Structures. United Nations Global Assessment Report (UNGAR) 2022.
- **Cooley, S.S.**, Pinto, N., Vela-Alvarado, J., Fahlen, J., & Aguilar, N. (2021). Vegetation typology classification and data set generation in Ucayali, Peru (Version 3.0) [Data set]. CaltechDATA. <https://doi.org/10.22002/D1.2318>
- **Cooley, S.S.**, Williams, A., Fisher, J., Perret, J., Halverson, G., & Lee, C. (2019). Improving drought assessment by examining vegetation response with evapotranspiration: a case study in Guanacaste, Costa Rica. *Ecological Applications*. doi: 10.1002/eap.1834.
- **Cooley, S. S.**, & Landerer, F. (2019). Gravity Recovery and Climate Experiment Follow-on (GRACE-FO) Level-3 Data Product User Handbook. *NASA Physical Oceanography Distributed Active Archive Center (PO.DAAC)*. <https://podaac-tools.jpl.nasa.gov/drive/files/allData/gracefo/docs>
- Lafia, S., Jablonski, J., Kuhn, W., **Cooley, S.S.**, & Medrano, F. A. (2016). Spatial discovery and the research library. *Transactions in GIS*, 20(3), 399-412.

Media Coverage

- NASA Western Water Applications Office news release. September, 2022. "Helping Decision-Makers Improve Water Management." [<https://wwao.jpl.nasa.gov/news-insight/articles/improving-water-management-decision-making-agencies/>].
- Nature Portfolio blog. June, 2022. "Behind the paper: ecosystem water use efficiency and the urgent need for climate action." [<https://earthenvironmentcommunity.nature.com/posts/ecosystem-water-use-efficiency-and-the-urgent-need-for-climate-action>].
- Eyes on Earth podcast interview. April, 2022. "New paper uses ECOSTRESS to examine water use efficiency all across the globe: an interview with the lead author." [<https://www.usgs.gov/media/audio/eyes-earth-episode-73-global-water-use>].
- Columbia Climate School news release. April, 2022. "Columbia PhD student publishes paper in Nature Plants on water use efficiency within plant functional types across contrasting climates." [<https://news.climate.columbia.edu/2022/04/14/space-station-instrument-provides-newly-detailed-look-at-plants-drought-resistance/>].
- One of eight selected Young Scientists presenting at the Centennial Celebration of the American Geophysical Union in "Young Scientists View of the Future". December, 2019. "The role of scientists in

catalyzing action on climate change”. [minute ~50 of recording:
<https://www.youtube.com/watch?v=c6MV-O89DC4>].

Selected Presentations

- **Cooley, S.**, Moore, E., Maybach, E., Fahlen, J., Gollerkeri, M., Martinez, M., Vasa, A., Bulter-Hooker, A., Kou-Giesbrecht, S., & Menge D.N.L. (August 2023). Ecosystem regeneration as a climate mitigation strategy: a meta-analysis investigating how and why soil CH₄ and N₂O fluxes change during succession. [PowerPoint presentation]. *Ecological Society of America Annual Meeting*. Portland, OR.
- **Cooley, S.**, Becerra, M., Vela-Alvarado, J., & Pinto, N. (April 2023). Co-production as a tool set for actualizing Environmental Justice: a NASA SERVIR-Amazonia project case study [PowerPoint presentation]. *NISAR Mission Environmental Justice Workshop*. New York City.
- **Cooley, S.**, Fisher, J., & Goldsmith, G. (April 2022). Convergence in water use efficiency within plant functional types across contrasting climates [PowerPoint presentation]. *ECOSTRESS Science Team Meeting*. Virtual.
- **Cooley, S.**, Becerra, M., Pinto, N., & Irigoyen, M. (September 2021). Citizen science with a gender lens: Best practices for participatory land cover mapping in the Peruvian Amazon. [Oral presentation]. *2021 SERVIR-Amazonia Citizen Science and Participatory Mapping Knowledge Exchange*. Virtual.
- **Cooley, S.**, Pinto, N., Aguilar, N., Zutta, B., Estes, L., & Menge, D. (December 2020). Quantifying conservation value in the Amazonia forest-agriculture interface using NASA’s GEDI mission. [Oral presentation]. *2020 Fall Meeting, American Geophysical Union*. Virtual.
- **Cooley, S.** (December 2019). (Invited talk for the Centennial Celebration of the American Geophysical Union). The Role of Scientists in Catalyzing Action on Climate Change [PowerPoint presentation]. *2018 Fall Meeting, American Geophysical Union*. San Francisco, CA. Recording of AGU Centennial Celebration Young Scientists View of the Future [my talk starts at minute 50:00 of the recording]: <https://www.youtube.com/watch?v=c6MV-O89DC4>
- **Cooley, S.**, Fisher, J., & Halverson, G. (December 2019). A First Look at ECOSTRESS Water Use Efficiency [Poster presentation]. *2019 Fall Meeting, American Geophysical Union*. San Francisco, C.A.
- **Cooley, S.**, & Melton, F. (August 2019). NASA Earth Science Applications with Promising Potential for Technology Transfer [PowerPoint presentation]. *2019 NASA WWAO & Western States Water Council Workshop on Research to Operations (R2O) for water management in the Western U.S.* Irvine, C.A.
- **Cooley, S.**, Williams, A., Fisher, J., Perret, J., Halverson, G., & Lee, C. (December 2018). Improving drought assessment by examining vegetation response with evapotranspiration: a case study in Guanacaste, Costa Rica [PowerPoint presentation]. *2018 Fall Meeting, American Geophysical Union*. Washington, D.C.
- **Cooley, S.** (December 2018). Impact Assessment for Data-driven Water Resource Management in the Western U.S. [PowerPoint presentation]. *2018 Fall Meeting, American Geophysical Union*. Washington, D.C.
- **Cooley, S.**, Reager J.T., Landerer, F., & Srinivasan, M. (October 2018). Experimental Development of Value-Added Data Products for GRACE and GRACE-FO [Poster presentation]. *GRACE-FO Science Team Meeting*. Potsdam, Germany.
- **Cooley, S.**, Williams, A., Fisher, J., Perret, J., Halverson, G., & Lee, C. (April 2017). Assessing variable landscape response to drought: a case study in Guanacaste, Costa Rica [PowerPoint presentation]. *NASA Land Cover Land Use Change Annual Meeting*. Washington, D.C.
- **Cooley, S.**, Williams, A., Fisher, J., Perret, J., Halverson, G., & Lee, C. (May 2017). Assessing variable landscape response to drought: a case study in Guanacaste, Costa Rica [PowerPoint presentation]. *ECOSTRESS Science Team Meeting*. Sacramento, CA.
- **Cooley, S.** & Lee, C. (October 2017). Applications of Thermal infrared and evapotranspiration data for improving agricultural water use and land stewardship practices [PowerPoint presentation]. *HyspIRI (Hyperspectral Infrared Imager) Science Team Meeting*. Pasadena, CA.