LIYIN HE

he.liyin@duke.edu

RESEARCH INTERESTS

My research focuses on understanding the nexus between air, water, and ecosystem in the face of climate change, elevated CO_2, air pollution, and different management practices. I use three main approaches: 1) spatiotemporal data analysis to interpret field and satellite observations; 2) machine learning approaches to generate novel datasets; and 3) process-based terrestrial biosphere models to understand the underlying mechanism. My work encompasses a wide range of scales—from the micro-level interactions within individual plants to macro-level regional and global patterns.

ACADEMIC APPOINTMENTS

Duke University, Durham, NC   Jan 2025 - now
Tenure-Track Assistant Professor | Nicholas School of the Environment

Carnegie Institution for Science, Stanford, CA   Aug 2022 - now
Postdoctoral Research Associate | Department of Global Ecology
Advisor: Dr. Lorenzo Rosa

EDUCATION

California Institute of Technology (Caltech), Pasadena, CA   July 2022
Ph.D. in Environment Science and Engineering | GPA 4.0/4.0
Thesis Committee: Christian Frankenberg (advisor), Paul Wennberg (chair), Yuk Yung and David Schimel
Minor in Applied and Computational Mathematics

Nanjing University, Nanjing, China   June 2016
B.S. in Geographic Information Science | GPA:3.9/4.0
Minor in Financial Engineering
Rank: 1/21 in Department of Geographical Information Science,
        2/80 in School of Geographic & Oceanographic Sciences.

PUBLICATIONS

In preparation
[1] **He, L.** and Rosa, L., Impacts of agricultural adaptation on global crop trade network
[2] **He, L.** et al., Bias of eddy covariance sampling in estimating global terrestrial carbon sink
[3] **He, L.** et al., Unequal exposure of urban heat stresses across different income groups in the United States
Under revision
[4] **He, L.** and Rosa, L., Unequal irrigation expansion in adapting agriculture to climate change
[5] **He, L.**, Ren, C. and Rosa, L., Data-driven projections suggest large potential to expand winter wheat production on abandoned croplands for climate adaptation
First-authored paper

[6] **He, L.,** Rosa, L., Lobell, D.B., Wang, Y., Yin, Y., Doughty, R., Yao, Y., Berry, J.A. and Frankenberg, C., (2023). The weekly cycle of photosynthesis in Europe reveals the negative impact of particulate pollution on ecosystem productivity. ***Proceedings of the National Academy of Sciences***, *120*(49), p.e2306507120.
Featured in This Week in PNAS https://www.pnas.org/doi/10.1073/iti4923120

[7] **He, L.** and Rosa, L., (2023). Solutions to agricultural green water scarcity under climate change. ***PNAS nexus***, *2*(4), p.pgad117.

[8] **He, L.,** Byrne, B., Yin, Y., Liu, J. and Frankenberg, C., (2022). Remote-Sensing Derived Trends in Gross Primary Production Explain Increases in the CO_2 Seasonal Cycle Amplitude. ***Global Biogeochemical Cycles***, *36*(9), p.e2021GB007220.

[9] **He, L.,** Wei, J., Wang, Y., Shang, Q., Liu, J., Yin, Y., Frankenberg, C., Jiang, J.H., Li, Z. and Yung, Y.L., (2022). Marked impacts of pollution mitigation on crop yields in China. ***Earth's Future***, p.e2022EF002936.

[10] **He, L.,** Magney, T., Dutta, D., Yin, Y., Köhler, P., Grossmann, K., Stutz, J., Dold, C., Hatfield, J., Guan, K., Peng, B. and Frankenberg, C., (2020). From the ground to space: Using solar-induced chlorophyll fluorescence to estimate crop productivity. ***Geophysical Research Letters***, *47*(7), p.e2020GL087474.

[11] **He, L.,** Wood, J.D., Sun, Y., Magney, T., Dutta, D., Köhler, P., Zhang, Y., Yin, Y. and Frankenberg, C., (2020). Tracking seasonal and interannual variability in photosynthetic downregulation in response to water stress at a temperate deciduous forest. ***Journal of Geophysical Research: Biogeosciences***, *125*(8), p.e2018JG005002.

[12] **He, L.,** Zeng, Z.C., Pongetti, T.J., Wong, C., Liang, J., Gurney, K.R., Newman, S., Yadav, V., Verhulst, K., Miller, C.E. and Duren, R., (2019). Atmospheric methane emissions correlate with natural gas consumption from residential and commercial sectors in Los Angeles. ***Geophysical Research Letters***, *46*(14), pp.8563-8571.

[13] **He, L.,** Ke, C., Zhou, X., Cui, Y. and Shan, L., (2016). Antarctic sea ice change based on a new sea ice dataset from 1992 to 2008. ***Climate Research***, *71*(2), pp.155-169.

Co-authored paper

[14] Rosa, L. and **He, L.,** 2025. Global multi-model projections of green water scarcity risks in rainfed agriculture under 1.5° C and 3° C warming. ***Agricultural Water Management***, *314*, p.109519.

[15] Ren, C., **He, L.** and Rosa, L., 2025. Integrated irrigation and nitrogen optimization is a resource-efficient adaptation strategy for US maize and soybean production. ***Nature Food***, pp.1-12.

[16] Cen, X., He, N., Van Sundert, K., Terrer, C., Yu, K., Li, M., Xu, L., **He, L.** and Butterbach-Bahl, K., 2025. Global patterns of nitrogen saturation in forests. ***One Earth***, *8*(1).

[17] Wang, Y., Zhang, C., Pennington, E.A., **He, L.,** Yang, J., Yu, X., Liu, Y. and Seinfeld, J.H., 2024. Short-lived air pollutants and climate forcers through the lens of the COVID-19 pandemic. ***Reviews of Geophysics***, *62*(4), p.e2022RG000773.

[18] Gao, L., Guan, K., **He, L.,** Jiang, C., Wu, X., Lu, X. and Ainsworth, E.A., 2024. Tropospheric ozone pollution increases the sensitivity of plant production to vapor pressure deficit across diverse ecosystems in the Northern Hemisphere. *Science of the Total Environment*, *951*, p.175748.

[19] Ren, C., **He, L.,** Ma, Y., Reis, S., Van Grinsven, H., Lam, S.K. and Rosa, L., 2024. Trade-offs in agricultural outcomes across various farm sizes. *Earth Critical Zone*, p.100007.

[20] Byrne, B., Liu, J., Bowman, K., Yin, Y., Yun, J., Ferreira, G., Ogle, S., Baskaran, L., **He, L.,** Li, X., Xiao, J., Davis, K., Quantifying the Impacts of Extreme Events on the Carbon Cycle: A Case Study of the 2019 Midwest Floods, ***Journal of Geophysical Research - Atmospheres***

[21] Wen, Y., Zhang, S., Wang, Y., Yang, J., **He, L.,** Wu, Y., Hao, J., Dynamic traffic data in machine-learning air quality mapping improves environmental justice assessment, *Environmental Science & Technology*

[22] Yin, Y., **He, L.,** Wennberg, P.O. and Frankenberg, C., (2023). Unequal exposure to heatwaves in Los Angeles: Impact of uneven green spaces. *Science Advances*, *9*(17), p.eade8501.

[23] Wang, Y., Liu, J., Wennberg, P.O., **He, L.,** Bonal, D., Köhler, P., Frankenberg, C., Sitch, S. and Friedlingstein, P., (2023). Elucidating climatic drivers of photosynthesis by tropical forests. *Global Change Biology*.

[24] Frankenberg, C., Yin, Y., Byrne, B., **He, L.** and Gentine., P., (2021). Comment on "Recent global decline of CO_2 fertilization effects on vegetation photosynthesis". *Science*, 10.1126/science.abg2947

[25] Wang, Y., Köhler, P., **He, L.,** Doughty, R., Braghiere, R.K., Wood, J.D. and Frankenberg, C., (2021). Testing stomatal models at stand level in deciduous angiosperm and evergreen gymnosperm forests using CliMA Land (v0. 1). *Geoscientific Model Development*, pp.1-35.

[26] Addington, O., Zeng, Z.C., Pongetti, T., Shia, R.L., Gurney, K.R., Liang, J., Roest, G., **He, L.,** Yung, Y.L. and Sander, S.P., (2021). Estimating nitrous oxide (N_2O) emissions for the Los Angeles Megacity using mountaintop remote sensing observations. *Remote Sensing of Environment*, *259*, p.112351.

[27] Peng, B., Guan, K., Zhou, W., Jiang, C., Frankenberg, C., Sun, Y., **He, L.** and Köhler, P., (2020). Assessing the benefit of satellite-based solar-induced chlorophyll fluorescence in crop yield prediction. *International Journal of Applied Earth Observation and Geoinformation*, *90*, p.102126.

[28] Yin, Y., Byrne, B., Liu, J., Wennberg, P.O., Davis, K.J., Magney, T., Köhler, P., **He, L.,** Jeyaram, R., Humphrey, V. and Gerken, T., (2020). Cropland carbon uptake delayed and reduced by 2019 Midwest floods. *AGU Advances*, *1*(1), p.e2019AV000140.

INVITED TALKS

[1] **He, L.** (2025) "Advancing AI and satellite remote sensing to inform climate adaptation", *Environmental Analytics and Modeling Seminar,* Duke University, USA.

[2] **He, L.** (2025) "Ecology Embraces Geoinformatics: Unraveling Carbon-Air-Water Nexus to Guide Climate Adaptation", *Sino-Ecologists Association Overseas (Sino-Eco) Seminar*

[3] **He, L.** (2024) "Empowering Ecology with Geoinformatics: Unraveling Carbon-Air-Water Nexus to Inform Climate Adaptation", *Nicholas School of Environment,* Duke University, USA.

[4] **He, L.** (2024) "Satellite Remote Sensing in Agriculture and Food Security", *College of Life Sciences,* Wuhan University, China.

[5] **He, L.,** Rosa, L., Lobell D., Wang, Y., Yin, Y., Doughty, R., Yao, Y., Berry, J. and Frankenberg, C. (2023) "The weekly cycle of photosynthesis in Europe reveals the negative impact of particulate pollution", *American Geophysical Union Annual Fall Meeting*, San Francisco, USA.

[6] Yin, Y., **He, L.,** Wennberg P. and Frankenberg, C. (2023) "Unequal exposure to heatwaves in Los Angeles", *Sustainable Environment Institute*, Los Angeles Community College, USA.

[7] **He, L.** (2023) "Applications of remote sensing in agricultural science", *School of Earth and Space Sciences*, Peking University, China.

[8] **He, L.** (2023) "Food security under climate change", *School of Geographic & Oceanographic Sciences*, Nanjing University, China.

[9] **He, L.** (2023) "Air pollution and sustainable agriculture", *College of Environmental Sciences and Engineering*, Peking University, China.

[10] **He, L.** (2023) "Agriculture and its role in global carbon cycle", *Center for Water Sciences Research*, Beijing Normal University, China.

[11] **He, L.,** Byrne, B., Yin, Y., Liu, J. and Frankenberg, C. (2022) "Bottom-up derived trends in gross primary production explain increases in the CO_2 seasonal cycle amplitude", *NASA Jet Propulsion Laboratory Carbon Seminar*, USA.

[12] **He, L.** (2022) **"**Agricultural system and its role in global carbon cycle", *Department of Global Ecology Seminar*, Carnegie Institute of Science, USA.

[13] **He, L.,** Magney, T., Dutta, D., Yin, Y., Köhler, P., Grossmann, K., Stutz, J., Dold, C., Hatfield, J., Guan, K. and Peng, B. (2020) "Using Solar-Induced Chlorophyll Fluorescence (SIF) to monitor crop productivity and photosynthetic downregulation during water stress", *NASA Jet Propulsion Laboratory Carbon Seminar*, USA.

[14] **He, L.** (2017) "A New Way to Measure Photosynthesis from Space", *Yuk Lunch Seminar*, California Institute of Technology, USA.

CONFERENCE PRESENTATIONS

[1] **He, L.,** Yin, Y., Shreevastava, A., & Frankenberg, C. (2025) "*Persistent heat exposure disparities from uneven green space distribution in major U.S. cities*", *International Association of Landscape Ecology (IALE) Annual Meeting*, Raleigh, NC, USA. (oral)

[2] **He, L.,** & Rosa, L. (2024) "*Disparities in irrigation expansion for climate adaptation in agriculture*", *American Geophysical Union Fall Meeting*, Washington, D.C., USA. (oral)

[3] **He, L.,** Yin, Y., Shreevastava, A., & Frankenberg, C. (2024) "*Persistent heat exposure disparities from uneven green space distribution in major U.S. cities*", *American Geophysical Union Fall Meeting*, Washington, D.C., USA. (oral)

[4] **He, L.,** Byrne, B., Yin, Y., Liu, J. and Frankenberg, C. (2023) "Remote-sensing derived trends in gross primary production explain increases in the CO_2 seasonal cycle amplitude", *NOAA 51st Global Monitoring Annual Conference*, Colorado, USA. (oral)

[5] **He, L.,** Yin, Y., Liu, J., Byrne, B.K., Yao, Y., Jung, M. and Frankenberg, C. (2022) "Reconcile seasonal discrepancies of net ecosystem exchange estimates between bottom-up and top-down approaches", *American Geophysical Union Annual Fall Meeting*, Chicago, USA. (oral)

[6] Liu, Y., Köhler, P., Zeng, Z.C., **He, L.,** Wang, Y., Pongetti, T., Parazoo, N., Sander, S.P., Miller, C.E. and Yung, Y.L. (2022) "Solar-induced Chlorophyll Fluorescence of Urban Vegetation in the Los Angeles Basin Observed by CLARS-FTS", *American Geophysical Union Annual Fall Meeting*, Chicago, USA. (oral)

[7] Gao, L., Ainsworth, E.A., Guan, K., **He, L.,** Jiang, C., Wu, X. and Lu, X. (2022) "High Tropospheric Ozone Concentration Increases the Vulnerability of Plants to Atmospheric Drought", *American Geophysical Union Annual Fall Meeting*, Chicago, USA. (oral)

[8] **He, L.,** Byrne, B., Yin, Y., Frankenberg, C., Jung, M. and Walther, S. (2021) "Satellite derived NEE estimates capture changes in atmospheric CO2 seasonal cycle", *American Geophysical Union Annual Fall Meeting*, New Orleans, USA. (oral)

[9] **He, L.,** Wei, J., Wang, Y., Shang, Q., Liu, J., Yin, Y., Frankenberg, C., Jiang, J.H., Li, Z. and Yung, Y.L. (2021) "Recent pollution mitigation masks the negative impacts of climate change on crop yields in China", *American Geophysical Union Annual Fall Meeting*, New Orleans, USA. (oral)

[10] **He, L.,** Yin, Y., Byrne, B.K., Frankenberg, C., Martin, J., Koehler, P., Wu, D. and Walther, S. (2020) "Increasing atmospheric CO 2 seasonal amplitude caused by amplified cropland productivity", *American Geophysical Union Annual Fall Meeting*, online, USA. (oral)

[11] **He, L.,** Frankenberg, C., Guan, K., Magney, T., Koehler, P., Humphrey, V., Sun, Y. and Lobell, D.B. (2019) "TROPOMI solar-induced chlorophyll fluorescence improves the monitoring of crop productivity", *American Geophysical Union Annual Fall Meeting*, San Francisco, USA. (oral)

[12] **He, L.,** Magney, T., Dutta, D., Yin, Y., Köhler, P., Grossmann, K., Stutz, J., Dold, C., Hatfield, J., Guan, K. and Peng, B. (2019) "TROPOMI solar-induced chlorophyll fluorescence improves the monitoring of crop productivity", *NASA Terrestrial Ecology Science Team Meeting*, University of Maryland, USA. (oral)

[13] **He, L.,** Frankenberg, C., Wood, J.D. and Sun, Y. (2018) "Solar-induced fluorescence tracks the seasonal and inter-annual variability of gross primary production at a temperate deciduous forest site", *American Geophysical Union Annual Fall Meeting*, Washington, D.C., USA. (oral)

[14] **He, L.,** Frankenberg, C., Wood, J.D. and Sun, Y. (2017) "OCO-2 chlorophyll fluorescence tracks late-summer photosynthesis decrease due to water stress at Missouri Ozark site", *American Geophysical Union Annual Fall Meeting*, New Orleans, USA. (poster)

AWARDS

- National Award for Outstanding Students Abroad (top 1%) 2022
- Resnick Fellow at Caltech (6 graduates/whole school per year) 2018
  Proposal: Global Monitoring of Crop Productivity Using Solar-induced Fluorescence
  https://resnick.caltech.edu/people/liyin-he
- Caltech GPS Fellowship 2016
- Province-Level Outstanding Undergraduate Thesis (top 2%) 2016
- University-Level Outstanding Undergraduate (top 2%) 2016
- National Scholarship (top 1%) 2015

PROFESSIONAL & COMMUNITY SERVICES

Peer Review

Nature, Proceedings of the National Academy of Sciences of the United States of America, Science Advances, Nature Food, Earth System Science Data, Global Change Biology, New Phytologist, Remote Sensing of Environment, Geophysical Research Letters, Agricultural and Forest Meteorology, Journal of Geophysical Research: Biogeosciences, Journal of Geophysical Research: Atmosphere, Environmental Research Letters

Academic Leadership

Session co-convener, (2023) "Global-to-local Solutions for Climate Mitigation and Adaptation in Agriculture"*, American Geophysical Union Annual Fall Meeting*, San Francisco, USA

Judge, (2019) Outstanding Student Poster Award, *American Geophysical Union Annual Fall Meeting*, San Francisco, USA

Community Service

Regional Director at Caltech, Chinese - American Oceanic and Atmospheric Association (COAA) 2018-2022

TEACHING EXPERIENCE

Teaching Assistantships

Caltech ESE 156. Remote Sensing of the Atmosphere and Biosphere (2018, 2020)
Caltech ESE 103. Earth's Biogeochemical Cycles (2019)

Teaching Assistant Section: Liyin He

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		4.67 ± 0.47	4.53	4.70	4.45
Answered questions clearly and concisely		4.83 ± 0.37	4.56	4.62	4.46
Was well prepared for section, office hours or lab		4.80 ± 0.40	4.47	4.62	4.52
Presented material clearly in section or lab		4.60 ± 0.49	4.47	4.72	4.52
Overall teaching effectiveness		4.67 ± 0.47	4.56	4.64	4.46

Guest Lectures
Caltech ESE 110. Seminar in Environmental Science and Engineering (2019)

SELECTED MEDIA OUTREACH
New Scientist: Plants are more productive on weekends thanks to cleaner air
Stanford Highlights: Improved air quality could enhance natural carbon sequestration by plants
Carnegie Science Highlights: Improved air quality could enhance natural carbon sequestration by plants
Caltech Highlights: Natural-Gas Leaks are Important Source of Greenhouse Gas Emissions in Los Angeles