

Nicholas C. Parazoo, Ph.D.

Jet Propulsion Laboratory
4800 Oak Grove Drive, Pasadena, CA, 91109
Phone: 818-354-2973; Email: nicholas.c.parazoo@jpl.nasa.gov

Current Professions

- **Research Scientist IV (329G)**, Jet Propulsion Laboratory, 2016-present
- **Associate Project Scientist III (3392)**, Joint Institute for Regional Earth System Science and Engineering, University of California Los Angeles, 2014-present
- **Discipline Program Manager for Carbon Cycle and Ecosystems (8314)**, Jet Propulsion Laboratory, 2023-present

Research Summary

My main research interests include ecosystem physiology, carbon and water cycles and their interactions with the global terrestrial biosphere, and feedbacks between climate variability and ecosystem function. My research spans natural and managed ecosystems in the Arctic, tropics, and in urban areas. My current research combines carbon cycle models with tower, airborne and satellite observations in a data integration approach to quantify exchanges of carbon, water, and energy between the land and atmosphere, to better understand and predict changes in the Earth's climate, and to provide actionable information to help mitigate climate change impacts on vegetation and water resources.

Education

Ph.D., Department of Atmospheric Science, Colorado State University, Fort Collins, CO (2007-2011)

Concentration: Land-Atmosphere Interactions

Thesis: Moist Synoptic Transport of CO₂ along Midlatitude Storm Tracks, Transport Uncertainty, and Implications for CO₂ Flux Estimation

Advisor: A. Scott Denning

Committee members: David A. Randall, Eric D. Maloney, Randy Kawa & Keith Paustian

M.Sc., Department of Atmospheric Science, Colorado State University, Fort Collins, CO (2004-2007)

Concentration: Land-Atmosphere Interactions

Thesis: Investigating Synoptic Variations in Atmospheric CO₂ Using Continuous Observations and a Global Transport Model

Advisor: A. Scott Denning

Committee members: David A. Randall, Niall Hanan

B.S., College of Oceanic and Atmospheric Science, Oregon State University, Corvallis, OR (2000-2004)

Concentration: Environmental Science, Atmospheric Processes (Magna Cum Laude)

Advisor: Steve Esbenson

Professional Experience

- **Research Affiliate**, Joint Institute for Regional Earth System Science and Engineering, University of California Los Angeles, 2014-2016
- **Postdoctoral Research Scientist**, Joint Institute for Regional Earth System Science and Engineering, University of California Los Angeles (2011-2014)
- **Graduate Research Assistant**, Department of Atmospheric Science, Colorado State University (2004-2011)
- **Research Assistant**, Coastal Imaging Lab, Oregon State University (2002-2004)
- **Undergraduate Internship**, Oregon Climate Service, Oregon State University (2001-2002)

Honors/Awards

- NASA Early Career Achievement Medal, Fluorescence Product (2022)
- NASA Group Achievement Award, OCO-2 Science Team (2020)
- NASA Group Achievement Award, OCO-2 Science Team (2018)
- Herbert Riehl Memorial Award, Best Paper Submitted for Publication, Colorado State University (2008)
- NASA Center for the Earth Atmosphere Studies (CEAS) Fellowship, Colorado State University (2007-2010)
- Programs of Research and Scholarly Excellence (PRSE) Fellowship, Colorado State University (2005)

External Grants/Projects

- **NASA: LCLUC**

Title: *Land Cover and Land Use Feedbacks to the Development of Flash Drought*

Grant Number: 24-LCLUC24_2-0029

POP: May 2025 – Apr 2028

Award Amount and Effort: \$0.823M/3yr, 0.10 FTE

Objective: This aim of this project is to determine land cover and land use impacts on short-range and sub-seasonal weather. Our main objectives are to (1) Develop a prototype land digital twin for land cover and land use impacts on flash drought development, (2) Perform and evaluate land cover and land use sensitivity experiments, and (3) Identify dominant atmospheric and land cover and land use flash drought drivers across different case studies and irrigation scenarios.

Principal Investigator

- **NASA: Ocean Biology and Biogeochemistry (OBB)**

Title: *Quantifying Marine Ecosystem Tipping Points*

Grant Number: 24-OBB_24-0012

POP: Jan 2025 – Dec 2027

Award Amount and Effort: \$0.920M/3yr, 0.16 FTE

Objective: This project uses ocean model experiments and spaceborne remote sensing data to test the hypothesis that cascading regional-scale tipping points have disruptively altered Arctic marine ecosystems and that this transformation — and additional tipping points — will continue as Arctic marine environments transition to an ice-free state.

Co Investigator (PI Charles Miller, JPL)

- **NSF Macrosystems Biology (MSB)**

Climate legacies and timescales of influence on carbon cycle processes in drylands

Sep 2022 – Aug 2027, 5M/5yr, 0.18 FTE

Co Investigator (PI Kiona Ogle, NAU)

- **NASA Earth Surface and Interior**

Title: *Measuring Heating in Urban Areas and its Impact – An Inherently Geological Problem*

Grant Number: 22-ESI22-0012

POP: Jan 2023 – Dec 2025

Award Amount and Effort: 0.7M/3yr, 0.1 FTE

Objective: This project uses high spectral and spatial resolution emissive data from HyTES together with high spatial resolution visible near infrared data from Planet Labs to determine the properties of the Earth's surface at the street scale of urban areas and generate an Urban Compositional Map. This work will include laboratory and field measurements of urban materials. These data will be combined with temperature information from ECOSTRESS to evaluate heat mitigation efforts underway that involve changing the properties of the surface. A seamless mosaic of HyTES data will be acquired over the Los Angeles area at ~5m spatial resolution to undertake this study. This work will demonstrate an approach to understand the impact of urbanization on the properties of the Earth's surface.

Co Investigator (PI Simon Hook, JPL)

Internal Grants/Projects

- **JPL: Strategic RTD**

Title: *A Carbon Cycle Reanalysis for Improved Understanding, Monitoring, and Prediction of Carbon Climate Feedbacks*

Grant Number: 01STRS-R.25.342.027

POP: Oct 2024 – Sep 2025 (renewable for up to 3 years)

Award Amount and Effort: 150K Y1 / 250K Y2 / 250K Y3, 0.15 FTE

Objective: Develop a data constrained carbon-water cycle reanalysis to answer the following question: How accurately are models capturing carbon climate feedbacks under changing emissions

Initiative Lead: Joao Teixeira; **Carbon Task Lead:** Nicholas Parazoo

■ **JPL: Topical RTD**

Title: *Actionable Information for Urban GHG and Climate Mitigation*

Grant Number: 01STRT-R.25.023.102

POP: May 2025 – Sep 2025

Award Amount and Effort: 75K, 0.10 FTE

Objective: Develop maps of urban biodiversity and carbon cycling to answer the question: What is the resiliency of carbon and water exchange in diverse urban ecosystems to climate extremes?

Principal Investigator: Nicholas Parazoo

PEER REVIEWED PUBLICATIONS

In Review (6)

Parazoo, N.C., D. Carroll, et al. A scientific community vision for sustained earth observations of greenhouse gases to support local to global action, AGU Advances (Commentary), In Review

Carroll, D., **N.C. Parazoo**, et al., A unified greenhouse gas monitoring system toward better greenhouse gas monitoring and climate intervention, AGU Eos, In Review

Carroll, D. **N. C. Parazoo** et al., Observing system needs for understanding carbon-climate feedbacks, Environmental Research Letters (Perspective), In Review

Parazoo, N. C., D. Carroll, A scientific community review of carbon cycle science gaps and opportunities to better support earth system science and carbon management, Earth Science Reviews, In Review

Svoboda, M., O. Kira, Y. Sun, W. K. Smith, T. Magney, J. D. Wood, **N. C. Parazoo**, Monitoring the pulse of America's natural resources from the Orbiting Carbon Observatory Missions, Nature Perspectives (Commentary), Under Consideration

Parazoo, N. C., B. Fuchs. Solar Induced fluorescence as an application ready early warning indicator of flash drought, Geophysical Research Letters (Invited Commentary)

In Press (2)

Bilir, E., et al. Satellite-constrained reanalysis reveals CO₂ versus climate process compensation across the global land carbon sink, AGU Advances, In Press, 10.1029/2025AV001689

Wordon, M., T. Bilir, A. Bloom et al Combining observations and models: a review of the CARDAMOM framework for data-constrained terrestrial ecosystem modeling, Global Change Biology, In Press, 10.1111/gcb.70462

Published (97 citable)

2025 (3 citable)

Li, S., Yang, D., He, Y., Parazoo, N. C., & Liu, W. (2025). The biogeophysical impacts of land cover change on climate extremes in the Arctic and Boreal regions. *Environmental Research Letters*.

Muccio, D., Keppel-Aleks, G., & Parazoo, N. (2025). Contrasting temperature sensitivity of boreal forest productivity in North America and Eurasia. *Journal of Geophysical Research: Biogeosciences*, 130(6), e2024JG008634.

Doughty, R., Wimberly, M. C., Wanyama, D., Peiro, H., Parazoo, N., Crowell, S., & Cho, M. A. (2025). Seasonality and synchrony of photosynthesis in African forests inferred from spaceborne chlorophyll fluorescence and vegetation indices. *Biogeosciences*, 22(8), 1985-2004.

2024 (7 citable)

Kim, Y., Kimball, J. S., Parazoo, N., Xu, X., Colliander, A., Reichle, R. .. & Li, X (2024) Diagnosing spring onset across the North American Arctic-boreal region using complementary satellite environmental data records, *JGR-Biogeosciences*, 129(8), e2023JG007977.

Pierrat, Z., T. Magney, A. Maguire, L. Brissette, R. Doughty, D. Bowling, B. Logan, N. Parazoo, J. Stutz, Seasonal timing of fluorescence and photosynthetic yields at needle and canopy scales in evergreen needleleaf forests, *Ecology*, 105(10), e4402

Madani, N, N. C. Parazoo, M. Manizza, A. Chatterjee, D. Carroll, D. Menemenlis, V. le Fouest, A. Matsuaka, K. Luis, C. Serra-Pompei, C. Miller, 2024. A machine learning approach to produce a continuous solar-induced chlorophyll fluorescence over the Arctic Ocean, *JGR-Machine Learning and Computation*, 1(4), e2024JH000215.

Liu, Z, B. Rodgers, G. Keppel-Aleks et al (inc N Parazoo), 2024, Seasonal CO₂ amplitude in northern high latitudes, *Nature Reviews Earth & Environment*, 5, 802-817. <https://doi.org/10.1038/s43017-024-00600-7>

Joiner, J., Y Yoshida, L Guanter, L Lamsal, C. Li, Z Fasnacht, P Kohler, C Frankenberg, Y Sun, N Parazoo, Noise reduction for solar-induced fluorescence retrievals using machine learning and principal component analysis: simulations and applications to GOME-2 satellite retrievals, *Artificial Intelligence for the Earth Systems (AIES)*, <https://doi.org/10.1175/AIES-D-23-0085.1>

Parazoo, N., G. Keppel-Aleks, S. Sander, B. Byrne et al, More frequent spaceborne sampling of XCO₂ improves detectability of carbon cycle seasonal transitions in Arctic-Boreal Ecosystems, *Geophysical Research Letters*, <https://doi.org/10.1029/2023GL107158>

Parazoo, N. C., M. Osman, M. Pascolini-Campbell, B. Byrne (2024). Antecedent conditions mitigate carbon loss during flash drought events, *Geophysical Research Letters*, 51, e2024GL108310. <https://doi.org/10.1029/2024GL108310>

2023 (5 citable, 1 newsletter)

Levine, P., A. Bloom, K. Bowman J. T.Reager, J. R. Worden, J. Liu, N. C. Parazoo, V. Meyer, A. G. Konings, M. Longo (2023). Water stress dominates 21st-century land carbon uptake, *GBC*, 37 (12), e2023GB007702

Ma, S, A. A. Bloom, G. R. Quetin, J. D. Watts, Z. Donatella, E. S. Euskirchen, A. J. Norton, Y. Yin, P. A. Levine, R. K. Braghiere, **N. C. Parazoo**, J. R. Worden, D. S. Schimel, C. E. Miller. (2023) Resolving the carbon-climate feedback potential of high-latitude wetland CO₂ and CH₄ exchange, *Global Biogeochemical Cycles*, 37 (9), e2022GB007524

Au, J, A. Bloom, N. C. Parazoo, et al, Forest productivity recovery or collapse? Model-data integration insights on drought-induced tipping points, *Global Change Biology*, doi:10.1111/gcb.16867

Parazoo, N.C., A. Norton, J. Johnson. The need for SIF within Integrated Carbon-Water Cycle Assessments, *GEWEX Quarterly*, 33(2), p 5-7

Madani, N., Parazoo, N.C., Miller, C., Climate change is enforcing physiological changes in Arctic ecosystems, *Environmental Research Letters*, 18, 074027, <https://doi.org/10.1088/1748-9326/acde92>

Norton, A. J., A.A. Bloom, N. C. Parazoo, P. Levine, S.Ma, R. Braghieri, Smallman, T.L. (2023). Improved process representation of leaf phenology significantly shifts climate sensitivity of ecosystem carbon balance, *Biogeosciences*, 20 (12): 2455-2484.

2022 (14)

Pierrat, Z, J. Bortnik, B. Johnson, A. Barr, T. Jagney, D. Bowling, **N. Parazoo**, C. Frankenberg, U. Seibt, J. Stutz, Forests for Forests: Combining vegetation indices with solar-induced chlorophyll fluorescence in random forest models improves gross primary productivity prediction in the Boreal Forest, *Environmental Research Letters*, 17 (12), 125006, <http://doi.org/10.1088/1748-9326/aca5a0>

Byrne, B., J. Liu, Y. Yi, A. Chatterjee, S. Basu, R. Cheng, R. Doughty, F. Chevallier, K. W. Bowman, N. C. Parazoo, D. Crisp, X. Li, J. Xiao, X. Sitch, B. Guenet, F. Deng, M. S. Johnson, S. Philip, P. C. McGuire, C. E. Miller, 2022: Multi-year observations reveal a larger than expected autumn respiration signal across northeast Eurasia, *Biogeosciences*, 19, 4779-4799, <https://doi.org/10.5194/bg-19-4779-2022>, 2022.

Liu, Z, J. S. Kimball, A. P. Ballentayne, **N. C. Parazoo**, W. J. Wang, N. Madani, S. M. Natali, J. D. Watts, B. M. Rogers, A. Bastos, P. Ciais, K. Yu, A-M Virkkala, F. Chevallier, 2022: Permafrost regions contribute to an increasing net carbon sink in the northern high latitudes, *Nature Communications*, 13, 5626, <https://doi.org/10.1038/s41467-022-33293-x>.

Wen, J., J. B. Fisher, N. C. Parazoo, L. Hu, M. E. Litvak, Y. Sun. Resolve the clear-sky continuous diurnal cycle of high-resolution ECOSTRESS Evapotranspiration and Land Surface Temperature, *Water Research and Resources*, 58 (9), e2022WR032227.

Kuai, L., N. C. Parazoo, M. Shi, C. Miller, I. Baker, A. A. Bloom, K. Bowman, M. Lee, Z.-C.Zeng, J. Berry, R. Commane, S. Montzka, C. Sweeney, J. Miller, Y. Yung. Quantifying northern high latitude gross primary productivity (GPP) using carbonyl sulfide (OCS), *Global Biogeochemical Cycles*, 36 (9), e2021GB007216.

Stinecipher, J. R., Cameron-Smith, P., Kuai, L., Glatthor, N., Höpfner, M., Baker, I., ... Campbell, J. E. (2022). Remotely Sensed Carbonyl Sulfide Constrains Model Estimates of Amazon Primary Productivity. *Geophysical Research Letters*. <https://doi.org/10.1029/2021gl096802>

Doughty, R., T. Kurosu, **N. C. Parazoo**, P. Kohler, Y. Wang, Y. Sun, C. Frankenberg, Global GOSAT, OCO-2 and OCO-3 Solar Induced Chlorophyll Fluorescence Datasets, *Earth System Science Data*, 14(4), 1513-1529.

Yang, Y., A. Bloom, S. Ma, P. Levine, A. Norton, N. Parazoo, J. T. Reager, J. Worden, G. R. Quetin, L. Smallman, M. Williams, L. Xu, S. Saatchi, CARDAMOM-FluxVal Version 1.0: a FLUXNET-based validation system for CARDMOM carbon and water flux estimates, *Geosci. Model Dev*, 15(4), 1789-1802. <http://doi.org/10.5194/gmd-2021-190>

Li, R., D. Lombadozzi, M. Shi, C. Frankenberg, **N. Parazoo**, P. Kohler, X. Yang, Representation of leaf-to-canopy radiative transfer processes improves simulation of far-red solar-induced

chlorophyll fluorescence in the Community Land Model version 5, *Journal of Advances in Modeling Earth Systems*, 14(2), e2021MS002676.

Norton, A. J., P. J. Rayner, Y.-P. Wang, N. C. Parazoo, L. Baskaran, R. Doughty, K. Cawse-Nicholson, Hydrologic connectivity drives extremes and high variability in vegetation productivity across Australian arid and semi-arid ecosystems, *Remote Sensing of Environment*, 272, p. 112937, 2022. <https://doi.org/10.1016/j.rse.2022.112937>

Fisher, J.B., M. Sikka, G. L. Block, C. R. Schwalm, N. C. Parazoo et al, The Terrestrial Biosphere Model Farm, *Journal of Advances in Modeling Earth Systems*, 14(2): e2021MS002676, 1-16p, 2022.

Pierrat, Z, J. Stutz, T. Magney, N. C. Parazoo, K. Grossmann, D. Bowling, U. Seibt, B. Johnson, W. Helgason, A. Barr, J. Bortnik, A. Norton, A. Maguire, C. Frankenberg, Diurnal and seasonal dynamics of solar-induced chlorophyll fluorescence, vegetation indices, and gross primary productivity in the boreal forest, *JGR-Biogeosciences*, p. e2021JG006588, 2022. <https://doi.org/10.1029/2021JG006588>

Stettz, S. G., N. C. Parazoo, A. A. Bloom, P. D. Blanken, D. R. Bowling, S. P. Burns, C. Bacour, F. Maignan, B. Raczka, A. J. Norton, I. Baker, M. Williams, M. Shi, Y. Zhang, B. Qiu, Resolving temperature limitation on spring productivity in an evergreen conifer forest using a model-data fusion framework, *Biogeosciences*, 19, 541-558, 2022. <https://doi.org/10.5194/bg-19-541-2022>

Parazoo, N. C., R. W. Coleman, V. Yadav, E. N. Stavros, G. Hulley, L. Hutya, 2021, Diverse biosphere influence on carbon and heat in mixed urban Mediterranean landscape revealed by high resolution thermal and optical remote sensing, *Science of the Total Environment*, 806, P. 151335.

2021 (12)

Parazoo, N. C., K. Bowman, B. Baier, J. Liu, M. Lee, L. Kuai, Y. Shiga, I. Baker, M. Whelan, S. Feng, M. Krol, C. Sweeney, B. Runkle, E. Tajfar, K. J. Davis, Covariation of airborne biogenic tracers (CO₂, COS, and CO) supports stronger than expected growing season photosynthetic uptake in the southeast US, *Global Biogeochemical Cycles*, 35 (10), p.e2021GB006956. <https://doi.org/10.1029/2021GB006956>

Maguire, A. J., J. U. H. Eitel, T. S. Magney, C. Frankenberg, E. L. Orcutt, **N. C. Parazoo**, R. Pavlick, A. Pierrat, P. A. Townsend, 2021. Spatial covariation between solar-induced fluorescence and vegetation indices from Arctic-Boreal landscapes, *Environmental Research Letters*, 16(9), p. 095002.

Xiao, J., J. B. Fisher, H. Hashimoto, K. Ichii, **N. C. Parazoo**, Emerging satellite observations for studying diurnal cycles of ecosystem processes, *Nature Plants*, 2021. <https://doi.org/10.1038/s41477-021-00952-8>

Wu, D., J. C. Lin, H. F. Duarte, V. Yadav, **N. C. Parazoo**, T. Oda, E. A. Kort, A model for urban biogenic CO₂ fluxes: Solar-induced fluorescence for modeling urban biosphere fluxes (SMUrFv1), *Geophysical Model Development*, 14, 3633-3661, 2021. <https://doi.org/10.5194/gmd-14-3633-2021>.

Yadav, V., S. Ghosh, K. Mueller, A. Karion, G. Roest, S. Gourdji, I. Lopez-Coto, K. Gurney, K. Verhulst, **N. C. Parazoo**, J. Kim, M. Stock, E. DiGangi, S. Prinzivalli, C. Fain, R. Keeling, R. Weiss, R. Duren, J. Henderson, C. Miller, J. Whetstone, The impact of COVID-19 on CO₂

emissions in the Los Angeles and Washington DC/Baltimore metropolitan areas, *Geophysical Research Letters*, 48, e2021GL092744, 2021. <http://10.1029/2021GL092744>

Madani, N., **N.C. Parazoo**, J. S. Kimball, A. Chatterjee, J. D. Watts, S. Saatchi, Z. Liu, A. Endsley, T. Tagesson, B. M. Rogers, A. Xu, J. A. Wang, T. Magney, C. E Miller. The impacts of climate and wildfire on gross primary productivity in Alaska, *Journal of Geophysical Research Biogeoscience*, 126, e2020JG006078, 2021. <https://doi.org/10.1029/2020JG006078>.

Pierrat, Z., M. F. Nehemy, A. Roy, T. Magney, **N. Parazoo**, C. Laroque, C. Pappas, O. Sonnentag, K. Grossman, D. R. Bowling, U. Seibt, A. Ramirez, B. Johnson, W. Helgason, A. Barr, J. Stutz, 2021. Tower-based remote sensing reveals mechanisms behind two-phased spring transition in a mixed species boreal forest, *Journal of Geophysical Research: Biogeosciences*, 126, e2020JG006191. <https://doi.org/10.1029/2020JG006191>.

Famiglietti, Caroline A., T. L Smallman, P. A. Levine, S. Flack-Prain, G. R. Quetin, V. Meyer, **N. C. Parazoo**, S. G. Stettz, Y. Yang, D. Bonal, A. A. Bloom, M. Williams, and A. G. Konings: Optimal model complexity for terrestrial carbon cycle prediction, *Biogeosciences*, 18, 2727-2754, 2021. <https://doi.org/10.5194/bg-18-2727-2021>

He, W., W. Ju, F. Jiang, **N. C. Parazoo**, P. Gentine et al, Peak growing-season patterns of climate extremes-driven responses of gross primary production estimated by satellite and process based models over North America, *Agr. For. Met.*, V298-299, 15 March 2021, 108292

Worden, J., S. Saatchi, M. Keller A. Bloom, R. Fu, J. Liu, **N. C. Parazoo**, J. B. Fisher, H. Worden, Y. Yin, et al, Satellite observations of the Tropical Terrestrial Carbon Balance and Interactions with the Water Cycle During the 21st Century, *Reviews of Geophysics*, 59, e2020RG000711, <https://doi.org/10.1029/2020RG000711>.

Liu, J., Baskarran, L., Bowman, K., Schimel, D., Bloom, A. A., **Parazoo, N. C.**, Oda, T., Carroll, D., Menemenlis, D., Joiner, J., Commane, R., Daube, B., Gatti, L. V., McKain, K., Miller, J., Stephens, B. B., Sweeney, C., and Wofsy, S.: Carbon Monitoring System Flux Net Biosphere Exchange 2020 (CMS-Flux NBE 2020), *Earth Syst. Sci. Data*, 13, 299-330, 2021. <https://doi.org/10.5194/essd-13-299-2021>.

Jin, Y., R. F. Keeling, E. J. Morgan, E. Ray, **N. C. Parazoo**, and B. B. Stephens, A mass-weighted atmospheric isentropic coordinate for mapping chemical tracers and computing inventories, *Atmos. Chem. Phys.*, 21, 217-238, 2021. <https://doi.org/10.5194/acp-21-217-2021>.

2020 (17 citable, 1 chapter)

Bloom, A. A., K. W. Bowman, J. Liu, A. G. Konings, J. R. Worden, **N. C. Parazoo** et al, 2020: Lagged effects dominate the inter-annual variability of the 2010-2015 tropical carbon balance, *Biogeosciences*, 17, 6393-6422. <https://doi.org/10.5194/bg-17-6393-2020>

Coleman, R.W., N. Stavros, G. Hulley, **N. Parazoo**, 2020: Comparison of thermal infrared-derived maps of irrigated and non-irrigated vegetation in urban and non-urban areas of Southern California, *Remote Sensing*, 12 (24), p. 4102. Doi:10.3390/rs12244102.

Liu, J. L., P. Wennberg, **N. C. Parazoo**, Y. Yin, C. Frankenberg, 2020 Thermal fertilization of high-latitude northern forests, *AGU Advances*, 1, e2020AV000228. <https://doi.org/10.1029/2020AV000228>

Madani, N., **N. C. Parazoo**, J. S. Kimball, A. P. Ballantyne, S. Saatchi, P. I. Palmer, Z. Liu, T. Tagesson, A. Bloom, Recent amplified global gross primary productivity due to temperature

increase is offset by reduced productivity due to water constraint, AGU Advances, 2, e2020AV000180. <https://doi.org/10.1029/2020AV000180>.

Byrne, B., J. Liu, A. A. Bloom, K. W. Bowman, Z. Butterfield, T. F. Keenan, G. Keppel-Aleks, **N. C. Parazoo**, Y Yin (2020): Contrasting Regional Carbon Cycle Responses to Seasonal Climate Anomalies Across the East-West Divide of Temperate North America, Global Biogeochemical Cycles, 34, e2020GB006598, <https://doi.org/10.1029/2020GB006598>.

Whelan, M, L Anderegg, G. Badgley, J. Elliott Campbell, R. Commene, C. Frankenberg, T. W. Hilton, L. Kuai, **N. C. Parazoo**, Y. Shiga, Y. Wang, J. R. Worden, 2020: Two scientific communities striving for a common cause: innovations in carbon cycle science, BAMS, 101 (9): E1537-E1543. <https://doi.org/10.1175/BAMS-D-19-0306.1>

Byrne, B., J. Liu, M. Lee, I. Baker, K. W. Bowman, M. Kiel, J. S. Kimball, C. E. Miller, **N. C. Parazoo**, C. Petri, C. M. Roehl, M. K. Sha, K. Strong, V. A/ Velazco, P. O. Wennberg, and D. Wunch, 2020: Improved constraints on northern extratropical CO₂ fluxes obtained by combining surface-based and space-based atmospheric CO₂ measurements, JGR-Atmospheres, doi:10.1029/2019JD032029.

Joiner, J., Y. Yoshida, P. Kohler, C. Frankenberg, P. Campbell, C. van der Tol, P. Yang, **N. C. Parazoo**, L. Guanter, Y. Sun, 2020: Systematic orbital geometry-dependent variations in satellite solar-induced fluorescence (SIF) retrievals, Remote Sensing, 12 (15), 2346, <https://doi.org/10.3390/rs12152346>.

Coleman, R. W., N. Stavros, V. Yadav, **N. C. Parazoo**, 2020: A Simplified Framework for High-Resolution Urban Vegetation Classification with Optical Imagery in the Los Angeles Megacity, Remote Sensing, 12 (15), 2399, <https://doi.org/10.3390/rs12152399>.

Parazoo, N. C., T. Magney, I Baker, B Raczka, C Bacour, F Maignan, A Norton, Y Zhang, M Shi, N MacBean, D. R. Bowling, S. P. Burns, P. D. Blanken, J. Stutz, K Grossman, C Frankenberg, 2020: Wide Discrepancies in the Magnitude and Direction of Modelled SIF in Response to Light Conditions, Biogeosciences, 17 (13), 3733-3755, <https://doi.org/10.5194/bg-17-3733-2020>.

Jones, S., L. Rowland, P. Cox, D. Hemming, A. Wiltshire, K. Williams, **N. C. Parazoo**, J. Liu, A. C. L. da Costa, P. Meir, M. Mencuccini, A. Harper, 2020: The impact of a simple representation of non-structural carbohydrates on the simulated response of tropical forests to drought, Biogeosciences, 17, 3589-3612, <https://doi.org/10.5194/bg-17-3589-2020>

Zhang, Y., **N. C. Parazoo**, A. Park Williams, Zhao, P. Gentine, 2020: Large and projected strengthening moisture limitation on end-of-season photosynthesis, Proceedings of the National Academy of Sciences, 117, 17, 9216-9222.

Wen, J., P. Koehler, G. Duveiller, **N. C. Parazoo**, G. Hooker, L. Yu, C. Chang, Y. Sun, 2020: Generating a Long-Term Record of High-resolution Global Solar-Induced Chlorophyll Fluorescence (SIF) by Harmonizing Multiple Satellite Instruments: A Case Study for Fusing GOME-2 and SCIAMACHY, Remote Sensing of Environment, 239, 111644.

Madani, N., J. S. Kimball, **N. C. Parazoo**, A. P. Ballantyne, T. Tagesson, L. A. Jones, R. H. Reichle, P. I. Palmer, I. Velicogna, A. Anthony Bloom, S. Saatchi, Z. Liu, A. Geruo, 2019: Below-surface water mediates the response of African forests to reduced rainfall, Environmental Research Letters, 15(3), <https://doi.org/10.1088/1748-9326/ab724a>

Shi, M., **N. C. Parazoo**, S.-J. Jeong, L. Birch, P. Lawrence, E. S. Euskirchen, C. Miller, 2020: Exposure to Cold Temperature Affects the Phenology of Alaskan Deciduous Vegetation Types, *Environmental Research Letters*, 15, 2.

Smith, W., A. Fox, N. MacBean, D. Moore, **N. C. Parazoo**, 2020: Constraining estimates of terrestrial carbon uptake: new opportunities using long-term satellite observations and data assimilation, *New Phytologist*, 225 (1), 105-112, doi:10.1111/nph.16055.

Liu, Z., J. Kimball, **N. C. Parazoo**, A. Ballantyne, W. Wang, N. Madani, C. Pan, J. Watts, R. Reichle, et al, 2020: Increased high latitude photosynthetic carbon gain offset by respiration carbon loss during an anomalous warm winter to spring transition, *Global Change Biology*, <https://doi.org/10.1111/gcb.14863>

Kim, Y., Kimball, J. S., **Parazoo, N.**, & Kirchner, P. (2021). Diagnosing Environmental Controls on Vegetation Greening and Browning Trends Over Alaska and Northwest Canada Using Complementary Satellite Observations. In D. Yang & D. L. Kane (Eds.), *Arctic Hydrology, Permafrost and Ecosystems* (pp. 583–613). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-50930-9_20

2019 (7)

Labzovskii, L., S.-J. Jeong, **N.C. Parazoo**, Working towards confident spaceborne monitoring of carbon emissions from cities using Orbiting Carbon Observatory-2, 2019: *Remote Sens. Env.*, 233. <https://doi.org/10.1016/j.rse.2019.111359>

Schimel et al. inc **N. C. Parazoo**, 2019: Flux towers in the sky: global ecology from space, *New Phytologist*, 224 (2), 570-584.

Parazoo, N.C., C. Frankenberg, P. Kohler, J. Joiner, Y. Yoshida, T. Magney, Y. Sun, V. Yadav., Towards a harmonized long-term spaceborne record of far-red solar induced fluorescence, 2019: *JGR-Biogeosciences*, 124 (8), 2518-2539.

Magney, T. C., D. Bowling, B. Logan, K. Grossman, J. Stutz, P. Blanken, S. Burns, R. Cheng, M. Garcia, P. Kohler, S. Lopez, **N. Parazoo**, B. Raczka, D. Schimel, C. Frankenberg, 2019: Mechanistic evidence for tracking the precise seasonality of photosynthesis with remotely sensed solar induced fluorescence, *Proceedings of the National Academy of Sciences*, 116 (24), 11640-11645. <https://doi.org/10.1073/pnas.1900278116>

Konings, A. G., A. A. Bloom, J. Liu, **N. C. Parazoo**, D. S. Schimel, and K. W. Bowman, 2019: Global satellite-driven estimates of heterotrophic respiration, *Biogeosciences*, 16, 2269-2284, <https://doi.org/10.5194/bg-16-2269-2019>.

Cui, E. et al. inc **N. C. Parazoo**, 2019: Vegetation functional properties determine uncertainty of simulated ecosystem productivity: a traceability analysis in the East Asian monsoon region, *Global Biogeochemical Cycles*, 33 (6), 668-689. <https://doi.org/10.1029/2018GB005909>

Kolus, H., et al. inc **N.C. Parazoo**, 2019: Land carbon models underestimate the severity and duration of droughts impact on plant productivity, *Scientific Reports*, 9 (1), 2758.

2018 (6)

Liu, J., K. W. Bowman, D. Schimel, **N. C. Parazoo**, Z. Hiang, M. Lee, A. A. Bloom, D. Wunch, C. Frankenberg, Y. Sun, C. O'Dell, K. R. Gurney, D. Menemenlis, M. Girerach, D. Crisp, and Annmarie Eldering, 2017: Response to “Contrasting carbon cycle responses of the tropical continents to the 2015 El Nino”, *Science*, 362 (6418).

Liu, J., K. Bowman, **N. Parazoo**, A. A. Bloom, D. Wunch, Z. Jiang, K. Gurney, D. Schimel. 2018: Detecting drought impact on terrestrial biosphere carbon fluxes over continuous US with satellite observations, *Environ. Res. Lett.*, 13 (9), 095003

Parazoo, N. C., A. Arneeth, T. Pugh et al., 2018: Spring photosynthetic onset and net CO₂ uptake in northern terrestrial ecosystems triggered by landscape thawing, *Global Change Biology*, 24(8), 3416-3435 <https://doi.org/10.1111/gcb.14283>

Jeong, S.-J., A. Anthony Bloom, D. Schimel, C. Sweeney, **N. C. Parazoo**, D. Medvigy, G. Schaepman, and C. E. Miller, 2018: Accelerating rates of Arctic carbon cycling revealed by long-term atmospheric CO₂ measurements, *Science Advances*, 4(7), eaao1167, doi:10.1126/sciadv.aao1167

Graven, H., et al. and **N. C. Parazoo**, 2018: Assessing fossil fuel CO₂ emissions in California using atmospheric CO₂ observations and models, *Env. Res. Lett.*, 13, 065007.

Parazoo, N. C., C. D. Koven, D. M. Lawrence, V. Romanovsky, C.E. Miller, 2018: Detecting the permafrost carbon feedback: Talik formation and increased cold-season respiration as precursors to sink-to-source transitions: *The Cryosphere*, 12, 123-144, <https://doi.org/10.5194/tc-12-123-2018>.

2017 (9)

Liu, J., K. W. Bowman, D. Schimel, **N. C. Parazoo**, Z. Hiang, M. Lee, A. A. Bloom, D. Wunch, C. Frankenberg, Y. Sun, C. O'Dell, K. R. Gurney, D. Menemenlis, M. Gierach, D. Crisp, and Annmarie Eldering, 2017: Contrasting carbon cycle responses of the tropical continents to the 2015 El Nino: *Science*, 358 (6360), eaam5690, doi:10.1126/science.aam5690.

Bowman, K., J. Liu, A. Bloom, **N. C. Parazoo**, M. Lee, Z. Jiang, D. Menemenlis, M. Gierach, G. Collatz, K. Gurney, 2017: Global and Brazilian carbon response to El Nino Modoki 2011-2010, *Earth and Space Science*: 4, 637-660. <https://doi.org/10.1002/2016EA000204>.

Chew, C., S. Lowe, **N. Parazoo**, S. Esterhuizen, S. Oveisgharan, E. Podest, C. Zuffada, A. Freedman, 2017: SMAP radar receiver measures land surface freeze/thaw state through capture of forward-scattered L-band signals, *Remote Sensing Of Environment*, 198, 333-344.

Huntzinger, D. N., A. M. Michalak, C. Schwalm, P. Ciais, K. Schaefer, A. W. King, Y. Fang, K. Schaefer, Y. Wei, R. B. Cook, A. Jacobson, J. Fisher, D. Hayes, M. Huang, A. Ito, A. K. Jain, H. Lei, C. Lu, F. Maignan, J. Mao, **N. C. Parazoo**, S. Peng, B. Poulter, D. Ricciuto, X. Shi, H. Tian, W. Wang, N. Zeng, F. Zhao, 2017: Understanding the global land carbon sink: Beyond climate and CO₂ sensitivity, *Scientific Reports*, 7, 4764, doi:10.1038/s41598-017-03818-2.

Madani, N., J. Kimball, L. Jones, **N. C. Parazoo**, K. Guan, 2017: Global Analysis of Bioclimatic Controls on Ecosystem Productivity using Satellite Observations of Solar-Induced Chlorophyll Fluorescence, *Remote Sensing*, 9, 530, doi:10.3390/rs9060430.

Fang, Y., A. Michalak, C. Schwalm, D. Huntzinger, J. Berry, P. Ciais, S. Piao, B. Poulter, J. Fisher, R. Cook, D. Hayas, M. Huang, A. Ito, A. Jain, H. Lei, C. Lu, J. Mao, **N. Parazoo**, S. Peng, D. Ricciuto, X. Shi, B. Tao, H. Tian, W. Wang, Y. Wei, J. Yang, 2017: Global land carbon sink response to temperature and precipitation varies with ENSO phase, *Environ. Res. Lett.*, 12, 064007.

Commane, R., J. Lindaas, J. Benmergui, K. A. Luus, R. Y. W. Chang, S. M. Miller, J. M. Henderson, A. Karion, C. Sweeney, J. B. Miller, C. E. Miller, **N. C. Parazoo**, S. Veraverbeke, J.

Randerson, B. C. Daube, S. C. Wofsy, 2017: Carbon dioxide sources from Alaska driven by increasing early winter respiration from Arctic Tundra, *Proc Natl Acad Sci*, doi:10.1073/pnas.1618567114.

Fischer, M. L., **N. C. Parazoo**, K. Brophy, X. Cui, S. Jeong, J. Liu, R. Keeling, T. E. Taylor, K. Gurney, T. Oda, H. Graven, 2017: Simulated Estimation of California Fossil Fuel and Biosphere Carbon Dioxide Exchanges Combining In-situ Tower and Satellite Column Observations, *J. Geophys. Res. – Atmospheres*, 122 (6), 3653-3671.

Luus, K., R. Commane, **N. C. Parazoo**, J. S. Benmergui, S. E. Euskirchen, C. Frankenberg, J. Joiner, J. Lindaas, C. E. Miller, W. C. Oechel, D. Zona, S. Wofsy, and J. C. Lin, 2017: Tundra photosynthesis captured by satellite-observed solar-induced chlorophyll fluorescence, *Geophys. Res. Lett.*, DOI:10.1002/2016/GL070842.

2016 (5)

Barnes, E. A., **N. C. Parazoo**, C. Orbe, S. Denning, 2016: Isentropic transport and the seasonal cycle amplitude of CO₂, *J. Geophys. Res. Atmos.*, 121, doi:10.1002/2016JD025109.

Parazoo, N. C., C. Sweeney, R. Chang, S. Wofsy, R. Commane, J. Lindaas, C. Koven, D. Lawrence, C. Miller, 2016: Detecting Regional Patterns of Changing CO₂ Flux in Alaska, *Proc Natl Acad Sci*, 113, 28, 7733-7738.

Shao, J., J. Luo, G. Zhang, W. Yan, J. Li, B. Li, L. Dan, J. Fisher, Z. Gao, Y. He, D. Huntzinger, A. Jain, J. Mao, J. Meng, A. Michalak, **N. C. Parazoo**, C. Peng, B. Poulter, C. Schwalm, X. Shi, R. Sun, F. Tao, H. Tian, X. Wei, N. Zeng, Q. Zhu, W. Zhu, 2016: Uncertainty analysis of terrestrial net primary productivity and net biome productivity in China during 1901-2005, *J. Geophysical Research – Biogeosciences*, 10.1002/2015JG003062.

Deng, F., D. B. A. Jones, C. O'Dell, R. Nassar, **N. C. Parazoo**, 2016: Combining GOSAT XCO₂ observations over land and ocean to improve regional CO₂ flux estimates, *Journal of Geophysical Research – Atmospheres*, doi:10.1002/2015JD024157.

Ito, A., M. Inatomi, D. Huntzinger, C. Schwalm, A. M. Michalak, R. Cook, A. W. King, J. Mao, Y. Wei, W. Post, W. Wang, M. Arain, M. Huang, H. Lei, H. Tian, C. Lu, J. Yang, B. Tao, A. Jain, B. Poulter, S. Peng, P. Ciais, **N. C. Parazoo**, J. B. Fisher, K. Schaefer, C. Peng, N. Zeng, F. Zha, 2016: Decadal trends in seasonal-cycle amplitude of terrestrial CO₂ exchange resulting from the ensemble of terrestrial biosphere models, *Tellus B*, 68, 28968, doi:10.3402/tellusb.v68.28968

2015 (3)

J. Mao, W. Fu, X. Shi, D. Ricciuto, J. Fisher, R. Dickinson, Y. Wei, W. Shem, S. Piao, K. Wang, C. Schwalm, H. Tian, M. Mu, A. Arain, P. Ciais, R. Cook, J. Dai, D. Hayes, F. Hoffman, M. Huang, S. Huang, D. Huntzinger, A. Ito, A. Jain, A. King, J. Lei, C. Lu, A. Michalak, **N. Parazoo**, C. Peng, S. Peng, B. Poulter, K. Schaefer, E. Jafarov, P. Thornton, W. Wang, N. Zeng, Z. Zeng, F. Zhao, Q. Zhu, Z. Zhu, 2015: Disentangling climatic and anthropogenic controls on global terrestrial evapotranspiration trends, *Environ. Res. Lett.*, 10, 094008.

Anav, A., P. Friedlingstein, C. Beer, P. Ciais, A. Harper, C. Jones, G. Murray-Tortarolo, D. Papale, **N. C. Parazoo**, P. Peylin, S. Piao, S. Sitch, N. Viovy, A. Wiltshire, M. Zhao, 2015: Spatio-temporal patterns of terrestrial gross primary production: A review, *Review of Geophysics*, 53, doi:10.1002/2015RG000483.

Parazoo, N. C., E. Barnes, J. Worden, A. B. Harper, K. W. Bowman, C. Frankenberg, S. Wolf, M. Litvak, T. F. Keenan, 2015: Influence of ENSO and the NAO on Terrestrial Carbon Uptake in the Texas-northern Mexico Region, *Global Biogeochemical Cycles*, 29, doi:10.1002/2015GB005125.

2014 (1)

Parazoo, N. C., K. Bowman, J. B. Fisher, C. Frankenberg, D. B. Jones, A. Cescatti, O. Perez-Priego, G. Wohlfahrt, L. Montagnani, 2014: Terrestrial gross primary production inferred from satellite fluorescence and vegetation models, *Global Change Biology*, 20 (10), 3103-3121.

2013 (3)

Parazoo, N. C., K. Bowman, C. Frankenberg, J.-E. Lee, J. B. Fisher, J. Worden, D. Jones, et al., 2013: Interpreting seasonal changes in the carbon balance of southern Amazonia using measurements of XCO₂ and chlorophyll fluorescence from GOSAT, *Geophys. Res. Lett.*, 40, doi:10.1002/grl.50452

Wunch, D., P. O. Wennberg, J. Messerschmidt, **N. Parazoo**, G. C. Toon, N. M. Deutscher, G. Keppel-Aleks, C. M. Roehl, J. T. Randerson, T. Warneke, J. Notholt, 2013: The Covariation of Northern Hemisphere Summertime CO₂ with Surface Temperature at Boreal Latitudes, *Atmos. Chem. Phys.*, 13, 9447-9459.

Messerschmidt, J., **N. Parazoo**, N. M. Deutscher, C. Roehl, T. Warneke, P. O. Wennberg, and D. Wunch, 2013: Evaluation of seasonal atmosphere-biosphere exchange estimations with TCCON measurements, *Atmos. Chem. Phys.*, 13, 5103-5115, doi:10.5194/acp-13-5103-2013.

2008-2012 (7)

Parazoo, N. C., A. S. Denning, S. R. Kawa, S. Pawson, and R. Lokupitiya, 2012: CO₂ flux estimation errors associated with moist atmospheric processes, *Atmos. Chem. Phys.*, 12, 6405-6416.

Parazoo, N. C., A. S. Denning, J. Berry, D. Randall, S. Kawa, O. Pauluis, and S. C. Doney, 2011: Moist synoptic transport of CO₂ along the mid-latitude storm track, *Geophys. Res. Lett.*, 38, L09804, doi:10.1029/2011GL047238.

Schuh, A. E., A. S. Denning, K. D. Corbin, I. T. Baker, M. Uliasz, **N. Parazoo**, A. E. Andrews, D.E.J. Worthy, 2010: A regional high-resolution carbon flux inversion of North America for 2004, *Biogeosciences*, 7, 1625-1644.

Corbin, K. D., A. S. Denning, and **N. C. Parazoo**, 2009: Assessing temporal clear-sky errors in assimilation of satellite CO₂ retrievals using a global transport model, *Atmos. Chem. Phys.*, 9, 3043-3048.

Law, R. M, and others, 2008: TransCom model simulations of hourly atmospheric CO₂: Experimental overview and diurnal cycle results for 2002, *Global Biogeochem. Cycles*, 22, GB3009, doi:10.1029/2007GB003050.

Parazoo, N. C., A. S. Denning, R. Kawa, K. Corbin, R. Lokupitia, I. Baker, and D. Worthy, 2008: Mechanisms for synoptic transport of CO₂ in the midlatitudes and tropics, *Atmos. Chem. Phys.*, 8, 7239-7254.

Patra, P. K. inc. **N. C. Parazoo**, 2008: TransCom model simulations of hourly atmospheric CO₂: Analysis of synoptic-scale variations for the period 2002-2003, *Global Biogeochem. Cycles*, 22, GB4013, doi:10.1029/2007GB003081.

Newsletter

Parazoo, N.C., A. Norton, J. Johnson, 2023: The need for SIF within Integrated Carbon-Water Cycle Assessments, *GEWEX Quarterly*, 33 (2), 5-7.

Published Datasets

Joiner, J., Y. Yoshida, P. Koehler, C. Frankenberg, and N.C. Parazoo. 2023. L2 Daily Solar-Induced Fluorescence (SIF) from MetOp-A GOME-2, 2007-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2083>

Joiner, J., Y. Yoshida, P. Koehler, C. Frankenberg, and N.C. Parazoo. 2023. L2 Daily Solar-Induced Fluorescence (SIF) from MetOp-B GOME-2, 2013-2021. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2182>

Joiner, J., Y. Yoshida, P. Koehler, C. Frankenberg, and **N.C. Parazoo**. 2021. L2 Solar-Induced Fluorescence (SIF) from SCIAMACHY, 2003-2012. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1871>

Wen, J., P. Koehler, G. Duveiller, **N.C. Parazoo**, T. Magney, G. Hooker, L. Yu, C.Y. Chang, and **Y. Sun**. 2021. Global High-Resolution Estimates of SIF from Fused SCIAMACHY and GOME-2, 2002-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1864>

Joiner, J., Y. Yoshida, P. Koehler, C. Frankenberg, and **N.C. Parazoo**. 2019. L2 Daily Solar-Induced Fluorescence (SIF) from ERS-2 GOME, 1995-2003. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1758>

Madani, N., and N.C. Parazoo. 2020. Global Monthly GPP from an Improved Light Use Efficiency Model, 1982-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1789>

Teaching and Advising

Center for Multiscale Modeling of Atmospheric Processes (CMMAP) Summer Internship Mentor

■ Kyle Hemes (Summer 2010)

Undergraduate from Colorado College

Taught how to use vegetation models to examine environmental and climatic drivers of surface carbon exchange

AGU Poster Title: Vegetation Phenology as a Constraint on Global Surface Atmosphere Exchange

Currently: Research Associate in Carbon Forestry at Laos

■ **Lance Vanden Boogart** (Summer 2009)

Undergraduate from University of Wisconsin

Taught how to use atmospheric models to examine land-atmosphere tracer interactions

CMMAP Poster Title: Frontal Passage Effects on PCTM CO₂ Concentration in Continental North America

Currently: PhD Candidate in Atmospheric Science at Colorado State University

■ **Parker Kraus** (Summer 2008)

Undergraduate from Colorado College

Taught how to use vegetation and atmospheric models together with flux tower data to examine carbon and water cycles in Africa

Currently: PhD Candidate in Atmospheric Science at Colorado State University

Teachers Assistant

■ **Colorado State University, Introduction to Global Climate Change** (ATS 150, Fall 2010)

Taught several lectures, designed and graded homework assignments, collaborated with Little Shop of Physics in designing and demonstrating simple classroom physics experiments

■ **Colorado State University, Climatology** (ATS 606, Fall 2008)

Taught several lectures, designed and graded homework assignments, designed radiative-convective equilibrium class project