Brett M. Raczka

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Academic Interests

- Terrestrial carbon and water dynamics including response to climate change
- Terrestrial biosphere models (TBM) as a tool to diagnose/predict carbon and water dynamics
- Statistical analysis upon terrestrial biosphere model simulations to evaluate performance
- Sensitivity analysis as a tool to identify ways to quantify biosphere model predictive uncertainty
- Use of in-situ (e.g. stable carbon isotopes) and remotely-sensed (e.g. sun-induced fluorescence) observations to improve TBM performance within a data assimilation framework

Education

2014 Ph.D. Atmospheric Science, The Pennsylvania State University, with Ken Davis

2000 B.S. Chemical Engineering, University of Notre Dame, Magna Cum Laude

Previous Employment

2017-present	Research Assistant Professor, School of Biological Sciences, University of Utah
2014-2017	Post-Doctoral Scientist, School of Biological Sciences, University of Utah
2006-2014	Ph.D. Student, Pennsylvania State University, University Park, PA.
	-Investigation of long term land carbon sequestration sensitivity to parameterization, initial conditions and meteorology within the Ecosystem Demography Model
	-Member of North American Carbon Program Regional Synthesis Team that evaluated
	skill of regional terrestrial carbon models
2001-2006	Lead Engineer of Cobalt Chemical Department, Osram Sylvania, Towanda, PA.
	-Responsible for quality, equipment and cost savings measures related to production of cobalt hydroxide product within 3 shift, 7 days a week manufacturing operation
	 Organized and led weekly staff meetings involving staff scientists, engineers, department foreman, and department operators
	-Trained in Six Sigma statistical approach, implemented cost savings measures related to reduction in chemical/equipment usage, quality improvements
2000-2001	Engineering Associate Development Program, Osram Sylvania, Manchester, NH. -Accelerated management program designed to expose new engineers to broad view of company-wide operations

Academic Current/Past Projects

- 2015-present Using the Data Assimilation Research Testbed (DART) to ingest remotely sensed land surface observations (e.g. biomass, leaf area, snow, temp) to improve regional simulations of biomass and carbon exchange across the Western U.S.
- 2015-present Improving sun-induced fluorescence (SIF) representation within the Community Land Model (CLM5.0) using site-level measurements. Contributing to SIF model intercomparisons.
- 2014-2017 Developing and testing stable carbon isotope capability within the Community Land Model, part of the Community Earth System Model (CESM)
- 2014-2017 Quantifying the influence of carbon source regions (urban, forest, grassland) upon

seasonal variation of δ^{13} C land-atmosphere exchange of CO₂ with atmospheric observations

2010-2018: Investigating long term land carbon sequestration sensitivity to parameterization, initial conditions and meteorology within the Ecosystem Demography Model

Professional Lectures

- NASA Carbon Monitoring System Science Team Meeting, 'Carbon Monitoring System in 2019 Mountains (CMS-Mountains): Leveraging Satellite-based Solar-Induced Fluorescence to Understand Forest Drought and Mortality in the Western U.S.', Scripps Institute, La Jolla, CA.
- 2018 **Community Earth System Model Winter Meeting**, 'Simulating canopy-level solar induced fluorescence with CLM-SIF 4.5 at a sub-alpine conifer forest in the Colorado Rockies', National Center for Atmospheric Research, Boulder, CO.
- 2017 AGU Conference, 'Simulating canopy-level solar induced fluorescence with CLM-SIF 4.5 at a subalpine conifer forest in the Colorado Rockies' New Orleans, LA.
- 2017 Invited Lecture, DOE Environmental System Science Principal Investigator's Meeting, 'Using stable carbon isotopes of CO₂ to better characterize poorly understood terrestrial ecosystem processes'. Potomac, MD.
- 2016 AGU Conference, 'What drives the seasonal pattern in δ^{13} C in the net land atmosphere CO₂ exchange across the United States?' San Francisco, CA.
- 2015 Community Earth System Model Winter Meeting, 'An observational constraint on stomatal function in forests: evaluating coupled carbon and water vapor exchange with stable carbon isotopes in the Community Land Model (CLM 4.5)'. National Center for Atmospheric Research, Boulder, CO.
- 2013 NCAR Advanced Study Colloquium, Land-Ocean Carbon-Climate Interactions, 'Contribution of the Northern Hemisphere land sink to observed changes in seasonal amplitude of CO₂ fluxes: a model inter-comparison'. NCAR, Boulder, CO.
- 2011 North American Carbon Program Conference, 'Estimating the North American Carbon Balance Using Inter-Comparison Among Inversions, Regional Terrestrial Biogeochemistry Models, and Observational Data', New Orleans, LA.
- 2009 North American Carbon Program Conference, 'Site-level synthesis of modeled and measured carbon, water, and energy fluxes across North America: Evaluation of model and measurement uncertainty', San Diego, CA.
- 2009 AGU Conference, Talk, San Francisco, CA.

Professional Service and Activities

2019-present NASA Carbon Monitoring System Science Team Member 2019 Interviewed by KUCW Radio, Salt Lake City, UT on segment 'UnDisciplined' regarding solar-induced fluorescence research. Magney et al., (2019) PNAS manuscript. https://www.upr.org/post/undisciplined-paleontologist-and-atmospheric-scientist 2012-2019 Manuscript Reviews: JGR-Biogeosciences, Agricultural and Forest Meteorology, EGU-Biogeosciences, Atmospheric Chemistry and Physics, JAMES, Geophysical Research Letters, Remote Sensing, Nature Communications Undergraduate Research Mentor Development Program, University of Utah, Completed 2017 2015 Oral Session Chair, AGU Conference, 'Terrestrial Biome Fluxes and Biogeochemical Impacts of Forest and Disturbances: Measurements and Modeling from Minutes to Millennia'. San Francisco, CA.

2014 **Community Earth System Model Tutorial, NCAR**

2014	Stable Isotope Biogeochemistry & Ecology Course, University of Utah
2011-2014	Faculty Liaison to Graduate Academic Committee, Penn State
2009-2014	Earth & Mineral Science Academic Integrity Committee, Penn State
2012	PALEON Ecological Conference, UC-Berkeley
2012-2014	Teaching Assistant, Senior Meteorology Lab, Penn State
2012	Ecosystem Demography Model Workshop, Harvard University
2007-09	Tutor, Chi Epsilon Pi Honor Society, Penn State
2007	Chequamegon Ecosystem-Atmosphere Study Conference, Wisconsin.
2006	Teaching Assistant, Undergrad Thermodynamics, Penn State

Other Professional Presentations

- 2019 **AGU Conference**, Poster: 'Carbon Monitoring System in Mountains (CMS-Mountains): Development and Testing in the Western U.S.', San Francisco, CA.
- 2018 **AGU Conference**, Posters: 'Towards a Complex Terrain Carbon Monitoring System (CMS-Mountains): Development and Testing in the Western U.S.' and 'Sustained Non- Photochemical Quenching Shapes the Seasonal Pattern of Solar-Induced Fluorescence at a High-Elevation Evergreen Forest'. Washington, D.C.
- 2017 North American Carbon Program Conference, Poster, 'Vapor pressure deficit does not drive the seasonality of del13C of the net land-atmosphere CO2 exchange across the United States.' North Bethesda, MD.
- 2016 **DOE Environmental System Science Principal Investigator's Meeting**: Poster 'An observational constraint on stomatal function in forests: evaluating coupled carbon and water vapor exchange with carbon isotopes in the Community Land Model (CLM 4.5)', Potomac, MD.
- 2015 **DOE Environmental System Science Principal Investigator's Meeting**: Poster 'Multi-Scale Carbon Cycle Observations and Ecosystem Process Modeling at Niwot Ridge, Colorado.' Potomac, MD.
- 2015 North American Carbon Program Conference, Poster, 'Testing the Community Land Model (CLM 4.5) 13C isotope simulations against high resolution observations within a sub-alpine forest at Niwot Ridge, Colorado'. Washington, DC.
- 2013 North American Carbon Program Conference, Poster, 'Identifying sources of uncertainty and observational constraints to improve the simulation of long term carbon sequestration in Northern Wisconsin', Albuquerque, NM.
- 2010 AGU Conference, Poster, San Francisco, CA.

Grants and Awards

- 2019 Grant Co-writer: NASA Carbon Monitoring System (CMS): Continuing Prototype Product Development (ROSES) 2019: 'CMS-Mountains: Leveraging Satellite-based Solar-Induced Fluorescence to Understand Forest Drought and Mortality in the Western U.S.'
- 2019 Grant Co-Principal Investigator: National Science Foundation, Macrosystems Biology and NEON-Enabled Science, 'Seasonality of photosynthesis of temperate and boreal conifer forests across North America.'
- 2016 Grant Co-writer: NASA Research Opportunities in Space and Earth Sciences (ROSES) 2015 Carbon Monitoring System: 'Towards a Complex Terrain Carbon Monitoring System (CMS-Mountains): Development and Testing in the Western U.S.'
- 2012 Interface Exchange Travel Grant to University of Illinois
- 2006 Anne C. Wilson Graduate Fellowship, Pennsylvania State University

Professional Societies AND Affiliations

Ecological Society of America (ESA) American Geophysical Union (AGU) Chi Epsilon Pi (Meteorological Honor Society) Tau Beta Pi (Engineering Honor Society)

Academic Research Summary:

My research focuses upon the response of terrestrial carbon fluxes to climate change. Terrestrial biosphere models are an important tool to diagnose and predict the terrestrial carbon response. Model predictive uncertainty inhibits the implementation of carbon mitigation strategies. To address this need, I have been a member of the NACP Regional Synthesis Activity that has used flux tower, and biological observations to evaluate the skill, and recommend improvements for state of the art terrestrial biosphere models. I use sensitivity analyses of model simulations (Ecosystem Demography Model, ED2) as a tool to identify model improvements combined with observations that together can reduce model uncertainty. I currently use underutilized in-situ (e.g. stable carbon isotopes) and remotely sensed land surface (e.g. sun-induced fluorescence) observations to understand vegetation response to environmental conditions (e.g. drought stress). I leverage these observations within a data assimilation framework to improve modelled dynamics of water and carbon. This framework can be used to identify poorly represented areas of earth system processes and guide improvements to both model structure and parameterization, thereby improving the accuracy of climate projections.

Peer Reviewed Publications

- *Raczka, Brett,* H.F Duarte, A.M. Fox, T.M. Hoar, J.L. Anderson, J.C. Lin, D.R. Bowling. (in preparation-JAMES) Improving CLM5.0 Biomass and Carbon Exchange Simulations across the Western U.S. Using a Data Assimilation System.
- Duarte, H.F., *Raczka, Brett*, Bowling, D.R., Wang, A., Buotte, P.C., Lin, J.C. (in revision) How Can Biosphere Models Grow Enough Vegetation Biomass in the Mountains of the Western United States? Implications of Meteorological Forcing, Journal of Geophysical Research, Biogeosciences.
- Parazoo, N.C., Magney, T., Norton, A., *Raczka, Brett*, Bacour, C., Maignan, F., Baker, I., Zhang, Y., Qiu, B., Shi, M., MacBean, N., Bowling, D.R., Burns, S.P., Blanken, P.D., Stutz, J., Grossman, K., Frankenberg, C. (submitted-JGR Biogeosciences). Wide Discrepancies in the Magnitude and Direction of Modelled SIF in Response to Light Conditions.
- Raczka, Brett, A. Porcar-castell, T. Magney, J. Lee, P. Kohler, C. Frankenberg, K. Grossmann, B.A. Logan, J. Stutz, P.D. Blanken, S.P. Burns, H.F. Duarte, X. Yang, J.C. Lin, and D.R. Bowling. (2019). CLM Simulated Solar-Induced Fluorescence, Niwot Ridge, Colorado, USA, 1998-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1720
- Raczka, Brett, A. Porcar-Castell, T. Magney, J.E. Lee, P. Kohler, C. Frankenberg, K. Grossmann, B.A. Logan, J. Stutz, P.D. Blanken, S.P. Burns, H. Duarte, X. Yang, J.C. Lin, D.R. Bowling. (2019) Sustained Non-Photochemical Quenching Shapes the Seasonal Pattern of Solar-Induced Fluorescence at a High Elevation Evergreen Forest, Journal of Geophysical Research, Biogeosciences, https://doi.org//10.1029/2018JG004883

Magney, T.S., D.R. Bowling, B.A. Logan, K. Grossmann, J. Stutz, P. Blanken, S.P. Burns, R. Cheng, M.

Garcia, P, Kohler, S. Lopez, N. Parazoo, *Brett Raczka*, D. Schimel, C. Frankenberg. (2019) Mechanistic evidence for tracking the precise seasonality of photosynthesis with solar-induced fluorescence, Proceedings of the National Academy of Sciences. https://doi.org/10.1073/pnas.1900278116.

- *Raczka, Brett,* M. C. Dietze, S. P. Serbin, K. J. Davis. (2018) What Limits Predictive Certainty of Long-Term Carbon Uptake? Journal of Geophysical Research, Biogeosciences. https://doi.org/10.1029/2018JG004504.
- Christopher Still, Bharat Rastogi, What drives Carbon Isotope Fractionation by the Terrestrial Biosphere. (2017), Commentary highlighting **Raczka et al.**, (2017) JGR-Biogeosciences manuscript. https://doi.org/10.1002/2017JG004155
- **Raczka, Brett,** S. C. Biraud, J. R. Ehleringer, C. Lai, J. B. Miller, D. E. Pataki, S. Saleska, M. S. Torn, B. Vaughn, R. Wehr, D. R. Bowling. (2017). Does vapor pressure deficit drive the seasonality of δ^{13} C of the net land-atmosphere CO₂ exchange across the United States?, Journal of Geophysical Research, Biogeosciences, 122, 1969-1987. doi:10.1002/2017/JG003795
- Duarte, H. F., *Raczka, Brett*, Ricciuto, D. M., Lin, J. C., Koven, C. D., Thornton, P. E., Bowling, D. R., Lai, C.-T., Bible, K. J., and Ehleringer, J. R. (2017) Evaluating the Community Land Model (CLM4.5) at a coniferous forest site in northwestern United States using flux and carbon-isotope measurements, Biogeosciences, 14, 4315-4340, https://doi.org/10.5194/bg-14-4315-2017.
- Raczka, Brett, H. F. Duarte, C. D. Koven, D. Ricciuto, P. E. Thornton, J. C. Lin, and D. R. Bowling (2016), An observational constraint on stomatal function in forests: evaluating coupled carbon and water vapor exchange with carbon isotopes in the Community Land Model (CLM4.5), *Biogeosciences*, 13(18), 5183–5204, doi:10.5194/bg-13-5183-2016.
- McCormack, L. M., E. Crisfield, *Brett Raczka*, F. Schnekenburger, D. M. Eissenstat, E.
 H. Smithwick. Sensitivity of four ecological models to adjustments in fine root turnover rate. (2015) Ecological Modeling. 297:107-117. doi:10.1016/j.ecolmodel.2014.11.013
- Raczka, Brett, K. J. Davis, D. N. Huntzinger, R. Neilson, B. Poulter, A. Richardson, J. Xiao, I. Baker, P. Ciais, T. F. Keenan, B. Law, W. M. Post, D. Ricciuto, K. Schaefer, H. Tian, E. Tomelleri, H. Verbeeck, and N. Viovy. Evaluation of continental carbon cycle simulations with North American flux tower observations. (2013) Ecological Monographs http://dx.doi.org/10.1890/12-0893.1
- Richardson, A. D., R. S. Anderson, M. A. Arain, A. G. Barr, G. Bohrer, G. Chen, J. M. Chen, P. Ciais, K. J. Davis, A. R. Desai, M. C. Dietze, D. Dragoni, S. R. Garrity, C. M. Gough, R. Grant, D. Y. Hollinger, H. A. Margolis, H. McCaughey, M. Migliavacca, R. K. Monson, J. W. Munger, B. Poulter, *B. M. Raczka*, D. M. Ricciuto, A. K. Sahoo, K. Schaefer, H. Tian, R. Vargas, H. Verbeeck, J. Xiao, and Y. Xue. Terrestrial biosphere models need better representation of vegetation phenology: results from the North American Carbon Program Site Synthesis. (2012) Global Change Biology 18:566-584.
- Huntzinger D.N., W. Post, A. Michalak, Y. Wei, A. Jacobson, T.O. West, I. Baker, J. Chen, K. Davis, D.
 Hayes, F. Hoffman, A. Jain, S. Liu, D. McGuire, R. Neilson, *B. Raczka*, B. Poulter, H. Tian, P. Thornton,
 E. Tomelleri, N. Viovy, J. Xiao, N. Zeng, M. Zhao, and R. Cook. North American Carbon Project (NACP)
 Regional Interim Synthesis: Terrestrial Biospheric Model Intercomparison. (2012) Ecological
 Modelling 232:144-157. doi:10.1016/j.ecolmodel.2012.02.004

- Keenan, T.F., I. Baker, A. Barr, P. Ciais, K. Davis, M. Dietze, D. Dragoni, C. M. Gough, R. Grant, D. Hollinger, K. Hufkens, B. Poulter, H. McCaughey, *B. Raczka*, Y. Ryu, K. Schaefer, H. Tian, H. Verbeeck, M. Zhao and A. D. Richardson. Terrestrial biosphere model performance for inter-annual variability of land-atmosphere CO₂ exchange. (2012) Global Change Biology, doi: 10.1111/j.1365-2486.2012.02678.x
- Schaefer K., C. Schwalm, C. Williams, M.A. Arain, A. Barr, J. Chen, K.J. Davis, D. Dimitrov, T.W. Hilton, D.Y. Hollinger, E. Humphreys, B. Poulter, *B. M. Raczka*, A. D. Richardson, A. Sahoo, P. Thornton, R. Vargas, H. Verbeeck, R. Anderson, I. Baker, T. A. Black, P. Bolstad, J. Chen, P. Curtis, A. R. Desai, M. Dietze, D. Dragoni, C. Gough, R. F. Grant, L. Gu, A. Jain, C. Kucharik, B. Law, S. Liu, E. Lokipitiya, H. A. Margolis, R. Matamala, J. H. McCaughey, R. Monson, J. W. Munger, W. Oechel, C. Peng, D. T. Price, D. Ricciuto, W. J. Riley, N. Roulet, H. Tian, C. Tonitto, M. Torn, E. Weng, X. Zhou. A Model-Data Comparison of Gross Primary Productivity: Results from the North American Carbon Program Site Synthesis. (2012) Journal of Geophysical Research, Vol. 117, doi:10.1029/2012JG001960.