

Dr. Sean M. R. Crowell

Voice/SMS: (405) 306-6820

Mail: 50 Sansharon Drive
Rochester, NY, 14617

Citizenship: USA

Email: seanmrcrowell@gmail.com

WWW: seancrowell.com

Professional Statement Dr. Sean Crowell employs instruments and models to improve scientific understanding the exchange of carbon between the land, ocean, and atmosphere. More specifically, he uses in situ and space-based observations in concert with atmospheric models and machine learning emulators to retrieve actionable scientific information from satellite remote sensing data in order to constrain surface fluxes, and additionally attributes those fluxes to different carbon cycle processes. He was formerly the Deputy Principal Investigator and Project Scientist for the Geostationary Carbon Observatory (GeoCarb) mission, a geostationary carbon gas imaging satellite. He is a member of the Orbiting Carbon Observatory-2/3 and ASCENDS science teams and works with international institutions on development of observations and models to improve our understanding of the carbon cycle.

Research Interests Remote Sensing of Trace Gases, Data Assimilation, Atmospheric Tracer Transport Modeling, Carbon Cycle Modeling, Carbon-Climate Feedbacks, Land-Atmosphere Interactions

Professional Experience **University of Rochester, Rochester, New York, USA**

Assistant Professor (January 2026 – Present)

- Build a research lab focused on remote sensing, the carbon cycle, and atmospheric modeling
- Teach courses related to research topics
- Mentor students and postdoctoral scholars
- Serve on University appointed committees

LumenUs Scientific, Oklahoma City, Oklahoma, USA

President and Chief Scientist (November 2022 – Present)

- Managing the GeoCarb Mission closeout on behalf of the University of Oklahoma and NASA: programmatic as well as technical performance testing and analysis
- Developing new mission concepts, instrument designs, and remote sensing algorithms in collaboration with commercial, university, and NASA partners
- Managing a team of data scientists, atmospheric scientists, and engineers to find significant applications in environmental science.

University of Oklahoma, Norman, Oklahoma, USA

Director, GeoCarb Science Mission Office (March 2020 – June 2023)

- Oversaw the preliminary development of the Science and Instrument Operations Centers
- Integrated GeoCarb research and development activities into the OU research and education portfolio by initiating strategic collaboration with the schools of Meteorology, Geography, Engineering, Data Science, and Physics.
- Developed and implemented the GeoCarb Mission Office strategic plan
- Managed the OU GeoCarb Science Mission Office staff and finances
- Managed the research enterprise for GeoCarb and related projects at OU

GeoCarb Deputy Principal Investigator & Project Scientist (December 2016 – June 2023)

- Implemented science vision for GeoCarb by prioritizing research and development activities to maximize science return during operations
- Regularly met with NASA center management and NASA headquarters to advocate for GeoCarb needs
- Negotiate scope changes with the instrument subcontractor as needs dictate
- Leadership of science segments: algorithm development, data processing, calibration and validation, applications
- Served as main interface between the engineering development and the science team - deploying resources to assess tradeoffs throughout instrument technical development
- Developed science requirements for the GeoCarb instrument and proper flowdown using instrument and science models
- Developed mission science related plans: Concept of Operations, Science Validation, Characterization and Calibration, Ground System Specification
- Analysis of calibration and characterization data and simulation of impacts on science objectives
- Supporting project management with assessing science impacts of project decisions
- Presentation of mission status to the scientific community at international meetings

Research Scientist/Senior Research Scientist (May 2015 – June 2023)

- Research using space-based and surface observations of CO₂ and CH₄ to infer emissions estimates and their uncertainties leading to published work in scientific journals
- Research supervision for undergraduate and graduate students and postdoctoral researchers
- Project management for grants, including coordinating researchers at four different institutions, to achieve project goals
- Promotion to Senior Research Scientist in 2022.

Postdoctoral Research Fellow (May 2012 - May 2015)

- Assessment of the utility of satellite observations in estimating carbon sources and sinks
- Aided in instrument design requirements definition for the ASCENDS instrument team
- Publication of results demonstrating the increased seasonal cycle information in active measurements at high latitudes

NOAA National Severe Storms Laboratory, Norman, Oklahoma, USA

National Research Council Postdoctoral Research Associate (Sept 2011 - May 2012)

- Assimilation of thermodynamic and dynamic boundary profiler retrievals into the Weather Research and Forecasting (WRF) model using variational methods
- Examination of the impact of these observations on forecasts of different types of severe weather events

Education University of Oklahoma, Norman, OK USA

- PhD, Mathematics, August 2011

Dissertation: Estimation of Near Surface Tornadic Wind Speeds

Advisor: Luther White

- M.S., Mathematics, August 2005

University of Science and Arts of Oklahoma, Chickasha, OK USA

- B.S., Mathematics, May 2003

- Publications**
- [1] Keely, W., Mauceri, S., Nelson, R., ..., **Crowell, S.**, et al. Uncertainty-Aware Machine Learning Bias Correction and Filtering for OCO-2 Part 2. *Earth and Space Science*, 12: 11, <https://doi.org/10.1029/2025EA004329>, 2025.
 - [2] Mauceri, S., Keely, W., ..., **Crowell, S.**, et al. Uncertainty-Aware Machine Learning Bias Correction and Filtering for OCO-2 Part 1. *Earth and Space Science*, 12: 11, <https://doi.org/10.1029/2025EA004329>, 2025.
 - [3] Jensen, M. P., Flynn, J., ..., **Crowell, S.**, et al. Studying Aerosol, Clouds, and Air Quality in the Coastal Urban Environment of Southeastern Texas. *Bull. Am. Met. Soc.*, <https://doi.org/10.1175/BAMS-D-23-0331.1>
 - [4] Wang, Q., **S. Crowell**, and P. K. Klein. NOAA-MP Parameter Optimization at Southern Great Plains Using Bayesian Optimization. *J. Geophys. Res. Atmos.*, 130: 13, <https://doi.org/10.1029/2024JD041793>.
 - [5] Somkuti, P., McGarragh, G., O'Dell, C., Di Noia, A., Vogel, L., **Crowell, S.**, Ott, L. E., and Bösch, H.: Surface reflectance biases in XCH₄ retrievals from the 2.3 μm band are enhanced in the presence of aerosols, *Atmos. Meas. Tech.*, 18, 4647–4663, <https://doi.org/10.5194/amt-18-4647-2025>, 2025.
 - [6] McGarragh, G. R., O'Dell, C. W., **Crowell, S. M. R.**, Somkuti, P., Burgh, E. B., and Moore III, B.: The GeoCarb greenhouse gas retrieval algorithm: simulations and

sensitivity to sources of uncertainty, *Atmos. Meas. Tech.*, 17, 1091–1121, <https://doi.org/10.5194/amt-17-1091-2024>, 2024.

- [7] Wimberly, M. C., Wanyama, D., Doughty, R., Peiro, H., and **Crowell, S.** (2024). Increasing fire activity in African tropical forests is associated with deforestation and climate change. *Geophysical Research Letters*, 51, e2023GL106240. <https://doi.org/10.1029/2023GL106240>
- [8] **Crowell, S.**, Haist, T., Tscherpel, M., Caron, J., Burgh, E., and Moore III, B.: Performance and polarization response of slit homogenizers for the GeoCarb mission, *Atmos. Meas. Tech.*, 16, 195–208, <https://doi.org/10.5194/amt-16-195-2023>, 2023.
- [9] Byrne, B., Baker, D. F., Basu, S., Bertolacci, M., ..., **Crowell, S.**, et al: National CO₂ budgets (2015–2020) inferred from atmospheric CO₂ observations in support of the global stocktake, *Earth Syst. Sci. Data*, 15, 963–1004, <https://doi.org/10.5194/essd-15-963-2023>, 2023.
- [10] Carlos Alberti, Frank Hase, Matthias Frey, Darko Dubravica, Thomas Blumenstock, Angelika Dehn, Paolo Castracane, Gregor Surawicz, Roland Harig, Bianca C Baier, ..., **Sean MR Crowell** et al. Improved calibration procedures for the EM27/Sun spectrometers of the Collaborative Carbon Column Observing Network (COCCON). *Atmospheric Measurement Techniques*, 15(8):2433–2463, 2022.
- [11] Li Zhang, Kenneth J Davis, Andrew E Schuh, Andrew R Jacobson, Sandip Pal, Yu Yan Cui, David Baker, **Sean Crowell**, Frederic Chevallier, Marine Remaud, et al. Multi-season evaluation of CO₂ weather in OCO-2 MIP models. *Journal of Geophysical Research: Atmospheres*, 127(2):e2021JD035457, 2022.
- [12] Yu Yan Cui, Li Zhang, Andrew R Jacobson, Matthew S Johnson, Sajeev Philip, David Baker, Frederic Chevallier, Andrew E Schuh, Junjie Liu, **Sean Crowell**, et al. Evaluating global atmospheric inversions of terrestrial net ecosystem exchange CO₂ over North America on seasonal and sub-continental scales. *Geophysical Research Letters*, page e2022GL100147, 2022.
- [13] Helene Peiro, **Sean Crowell**, Andrew Schuh, David F Baker, Chris O’Dell, Andrew R Jacobson, Frederic Chevallier, Junjie Liu, Annmarie Eldering, David Crisp, et al. Four years of global carbon cycle observed from the Orbiting Carbon Observatory 2 (OCO-2) Version 9 and in situ data and comparison to OCO-2 version 7. *Atmospheric Chemistry and Physics*, 22(2):1097–1130, 2022.
- [14] Peiro, H., **Crowell, S.**, and Moore III, B.: Optimizing 4 years of CO₂ biospheric fluxes from OCO-2 and in situ data in TM5: fire emissions from GFED and inferred from MOPITT CO data, *Atmos. Chem. Phys.*, 22, 15817–15849, <https://doi.org/10.5194/acp-22-15817-2022>, 2022.
- [15] Andrew E Schuh, Brendan Byrne, Andrew R Jacobson, **Sean MR Crowell**, Feng Deng, David F Baker, Matthew S Johnson, Sajeev Philip, and Brad Weir. On the role of atmospheric model transport uncertainty in estimating the Chinese land carbon sink. *Nature*, 603(7901):E13–E14, 2022.

- [16] Yuanwei Qin, Xiangming Xiao, Jean-Pierre Wigneron, Philippe Ciais, Josep G Canadell, Martin Brandt, Xiaojun Li, Lei Fan, Xiaocui Wu, Hao Tang, ..., **Sean Crowell** et al. Large loss and rapid recovery of vegetation cover and aboveground biomass over forest areas in Australia during 2019–2020. *Remote Sensing of Environment*, 278:113087, 2022.
- [17] Peter Somkuti, Christopher W O’Dell, **Sean Crowell**, Philipp Kohler, Gregory R McGarragh, Heather Q Cronk, and Eric B Burgh. Solar-induced chlorophyll fluorescence from the Geostationary Carbon Cycle Observatory (GeoCarb): An extensive simulation study. *Remote Sensing of Environment*, 263:112565, 2021.
- [18] Yuanwei Qin, Xiangming Xiao, Jean-Pierre Wigneron, Philippe Ciais, Martin Brandt, Lei Fan, Xiaojun Li, **Sean Crowell**, Xiaocui Wu, Russell Doughty, et al. Carbon loss from forest degradation exceeds that from deforestation in the Brazilian Amazon. *Nature Climate Change*, 11(5):442–448, 2021.
- [19] Yuanwei Qin, Xiangming Xiao, Jean-Pierre Wigneron, Philippe Ciais, Josep G Canadell, Martin Brandt, Xiaojun Li, Lei Fan, Xiaocui Wu, Hao Tang, ..., **Sean Crowell**, et al. Annual maps of forests in Australia from analyses of microwave and optical images with FAO forest definition. *Journal of Remote Sensing*, 2021.
- [20] Xiao-Ming Hu, Sharon M Gourdji, Kenneth J Davis, Qingyu Wang, Yao Zhang, Ming Xue, Sha Feng, Berrien Moore, and **Sean MR Crowell**. Implementation of improved parameterization of terrestrial flux in WRF-VPRM improves the simulation of nighttime CO₂ peaks and a daytime CO₂ band ahead of a cold front. *Journal of Geophysical Research: Atmospheres*, 126(10):e2020JD034362, 2021.
- [21] Xiao-Ming Hu, Jun Hu, Lan Gao, Changjie Cai, Yujun Jiang, Ming Xue, Tianliang Zhao, and **Sean MR Crowell**. Multisensor and multimodel monitoring and investigation of a wintertime air pollution event ahead of a cold front over eastern China. *Journal of Geophysical Research: Atmospheres*, 126(10):e2020JD033538, 2021.
- [22] Xiao-Ming Hu, **Sean Crowell**, Qingyu Wang, Yao Zhang, Kenneth J Davis, Ming Xue, Xiangming Xiao, Berrien Moore, Xiaocui Wu, Yonghoon Choi, et al. Dynamical downscaling of CO₂ in 2016 over the contiguous United States using WRF-VPRM, a weather-biosphere-online-coupled model. *Journal of Advances in Modeling Earth Systems*, 12(4):e2019MS001875, 2020.
- [23] Xiaolan Li, Xiao-Ming Hu, Changjie Cai, Qingyu Jia, Yao Zhang, Jingmiao Liu, Ming Xue, Jianming Xu, Rihong Wen, and **Sean MR Crowell**. Terrestrial CO₂ fluxes, concentrations, sources and budget in northeast China: Observational and modeling studies. *Journal of Geophysical Research: Atmospheres*, 125(6):e2019JD031686, 2020.
- [24] **Sean Crowell**, David Baker, Andrew Schuh, Sourish Basu, Andrew R Jacobson, Frederic Chevallier, Junjie Liu, Feng Deng, Liang Feng, Kathryn McKain, et al. The 2015–2016 carbon cycle as seen from OCO-2 and the global in situ network. *Atmospheric Chemistry and Physics*, 19(15):9797–9831, 2019.

- [25] Jeffrey Nivitanont, **Sean MR Crowell**, and Berrien Moore III. A scanning strategy optimized for signal-to-noise ratio for the Geostationary Carbon Cycle Observatory (GeoCarb) instrument. *Atmospheric Measurement Techniques*, 12(6):3317–3334, 2019.
- [26] Andrew E Schuh, Andrew R Jacobson, Sourish Basu, Brad Weir, David Baker, Kevin Bowman, Frederic Chevallier, **Sean Crowell**, Kenneth J Davis, Feng Deng, et al. Quantifying the impact of atmospheric transport uncertainty on CO₂ surface flux estimates. *Global Biogeochemical Cycles*, 33(4):484–500, 2019.
- [27] Zheng Shi, **Sean Crowell**, Yiqi Luo, and Berrien Moore. Model structures amplify uncertainty in predicted soil carbon responses to climate change. *Nature Communications*, 9(1):1–11, 2018.
- [28] **Sean MR Crowell**, S Randolph Kawa, Edward V Browell, Dorit M Hammerling, Berrien Moore, Kevin Schaefer, and Scott C Doney. On the ability of space-based passive and active remote sensing observations of CO₂ to detect flux perturbations to the carbon cycle. *Journal of Geophysical Research: Atmospheres*, 123(2):1460–1477, 2018.
- [29] S Randolph Kawa, James B Abshire, David F Baker, Edward V Browell, David Crisp, **Sean MR Crowell**, Jason J Hyon, Joseph C Jacob, Kenneth W Jucks, Bing Lin, et al. Active Sensing of CO₂ Emissions over Nights, Days, and Seasons (ASCENDS): Final report of the ASCENDS Ad Hoc Science Definition Team. Technical report, 2018.
- [30] Berrien Moore III, **Sean MR Crowell**, Peter J Rayner, Jack Kumer, Christopher W O’Dell, Denis O’Brien, Steven Utembe, Igor Polonsky, David Schimel, and James Lemen. The potential of the Geostationary Carbon Cycle Observatory (GeoCarb) to provide multi-scale constraints on the carbon cycle in the Americas. *Frontiers in Environmental Science*, 6:109, 2018.
- [31] Christopher W O’Dell, Annmarie Eldering, Paul O Wennberg, David Crisp, Michael R Gunson, Brendan Fisher, Christian Frankenberg, Matthias Kiel, Hannakaisa Lindqvist, Lukas Mandrake, et al. Improved retrievals of carbon dioxide from Orbiting Carbon Observatory-2 with the Version 8 ACOS algorithm. *Atmospheric Measurement Techniques*, 11(12):6539–6576, 2018.
- [32] **Sean Crowell**, Peter Rayner, Scott Zaccheo, Berrien Moore, III. Impacts of atmospheric state uncertainty on O₂ measurement requirements for the ASCENDS mission, *Atmos. Meas. Tech.*, 8, 2685–2697, <https://doi.org/10.5194/amt-8-2685-2015>, 2015.
- [33] Peter Rayner, Steven Utembe, and **Sean Crowell**. Constraining regional greenhouse gas emissions using geostationary concentration measurements: a theoretical study, *Atmos. Meas. Tech.*, 7, 3285–3293, <https://doi.org/10.5194/amt-7-3285-2014>, 2014.
- [34] **Sean Crowell**, Luther White, and Louis Wicker. Estimation of near surface wind speeds in strongly rotating flows. *Applied Mathematics and Computation*, 235, Pages 201–211, ISSN 0096-3003, <http://dx.doi.org/10.1016/j.amc.2014.01.01>, 2014.

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- Funding**
- 2024-2027: (PI) “Developing Modern Machine Learning Methods to Retrieve XCO₂ with associated Uncertainties from OCO-2 and OCO-3 Solar Absorption Spectra. NASA OCO-2/3 Science Team, Grant Number 80NSSC24K0763
 - 2021-2024: (Co-I) “Carbon Dynamics in Fragmented Tropical Forests of West Africa”, NASA Carbon Cycle Science, Grant Number 80NSSC21K1714
 - 2021-2024: (PI) “Assessing Drivers of Tropical Carbon Flux Variability across Spatial and Temporal Scales with Space-based Observations”, NASA OCO 2/3 Science Team, Grant Number 80NSSC21K1077
 - 2018-2021: (Co-I) “The OCO-2 Model Intercomparison Project.” NASA OCO-2/3 Science Team, Grant Number 80NSSC18K0896
 - 2017-2027: (Co-I) “The GeoCarb Mission.”, NASA Earth Venture Mission, Grant Number 80LARC17C0001
 - 2015-2018: (PI) “Improved Parameterization of Carbon Cycle Models Across Scales Using OCO-2 Measurements of XCO₂ and SIF.”, NASA Orbiting Carbon Observatory 2 Science Team Program, Grant Number NNX15AJ37G.

Professional Service *NASA Relevant Service:* OCO-2 Science Team, flux inversion group; ASCENDS Science Definition Team, community white paper co-author; CEOS Report on GHG Observations from Space; Sustained Observations Report for the North American Carbon Program

Conferences Organized : “Greenhouse Gas Emissions: Quantifying Uncertainties in Measurements and Models and Resultant Climate Impacts”, American Meteorological Society Annual Meeting, 2015-2026

Community Service *United Way of Oklahoma Volunteer*

Teaching programming to children through the Washington Elementary Coding Club

Oklahoma City YMCA Togetherhood Projects Committee Member.

Founder and past organizer of Science Cafe Norman.

Founder and past organizer of the OU SIAM Student Chapter Applied Math Seminar.

Author of Blog on Data Assimilation and Uncertainty in Atmospheric Sciences