Mariah S. Carbone

Curriculum vitae

Education

Ph.D. (2007) Earth System Science, University of California, Irvine, California

B.A. (1999) Earth & Environmental Science, Cum Laude, Wesleyan University, Connecticut

Abroad (1998) at James Cook University, Townsville, Queensland, Australia

Research Positions

2017-present	**Associate Research Professor**, Center for Ecosystem Science and Society/Department of Biological Sciences, Northern Arizona University, Flagstaff
2013-16*	**Research Scientist/Adjunct Scientist**, Earth Systems Research Center, University of New Hampshire, Durham (*parental leave 100% of 2014, 50% of 2015-16, 100% January-July of 2017)
2011-12	**National Center for Ecological Analysis & Synthesis Postdoctoral Fellow**, Santa Barbara, California
2008-10	**NOAA Climate & Global Change Postdoctoral Fellow**, Department of Geography, University of California, Santa Barbara
2002-07	**Graduate Research Assistant**, Department of Earth System Science, University of California, Irvine
1999, 01-02	**Research Assistant**, Niwot Ridge LTER, Institute of Arctic & Alpine Research, University of Colorado, Boulder
2000	**Volunteer Research Assistant**, La Reserva Pacuare, Costa Rica
1997	**Undergraduate Research Assistant**, Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder

Publications (*denotes advisee undergraduate, PhD student, or postdoc)

Hessl A, AD Richardson, R Filwett, L Andreu-Hayles, M Walker; R Oelkers, A Robison, VO Leshyk, **MS Carbone** (2026) Tansley Review: Carbon uptake, storage, and allocation patterns contribute to blurring of annual 14C signals in tree rings. *New Phytologist.* https://doi.org/10.1111/nph.70868

*Teets A, **MS Carbone,** G Koch, T Kolb, K Morino, D Basler, T Rademacher, AD Richardson (2026) Opportunistic growth phenology and water-use of semiarid tree species of northern Arizona. *Tree Physiology*. https://doi.org/10.1093/treephys/tpag022.

*Peltier DMP, CD McIntire, N Robertson, RA Thompson, S Malone, J LeMoine, AD Richardson, **MS Carbone**, NG McDowell, HD Adams, WT Pockman, AM Trowbridge

(2026) Resin-based defenses in Pinus edulis are only reduced after long term drought. *Tree Physiology*. https://doi.org/10.1093/treephys/tpag004.

Almagro M *et al.* (2025) Vegetation type and climate determine temperature thresholds of soil respiration across drylands. *Soil Biology and Biochemistry*, 211. https://doi.org/10.1016/j.soilbio.2025.109984.

Berkelhammer M, F Zurek, G Page, CJ Still, **MS Carbone** *et al.* (2025) Canopy structure modulates the sensitivity of subalpine forest stands to interannual snowpack and precipitation variability. *Hydrol. Earth Syst. Sci.* https://doi.org/10.5194/hess-29-701-2025.

*Peltier DMP, **MS Carbone**, K Ogle, G Koch, AD Richardson (2024) Decades-old carbon reserves are widespread among tree species, constrained only by sapwood longevity. *New Phytologist.* https://doi.org/10.1111/nph.20310.

Carbone MS, AD Richardson, b barr, M Berkelhammer, CM Boot, *A Simonpietri, CJ Still (2023) Interannual precipitation controls on soil CO_2 fluxes in high elevation conifer and aspen forests. *Environmental Research Letters*, https://doi.org/10.1088/1748-9326/ad07b5.

*Peltier DMP, **MS Carbone**, M Enright, MC Marshall, AM Trowbridge, J LeMoine, G Koch, AD Richardson (2023) Old reserves and ancient buds fuel regrowth of coast redwood after catastrophic fire. *Nature Plants*, https://doi.org/10.1038/s41477-023-01581-z.

*Peltier DMP, **MS Carbone**, CD McIntire, N Robertson, RA Thompson, S Malone, J LeMoine, AD Richardson, NG McDowell, HD Adams, WT Pockman, AM Trowbridge (2023) Carbon starvation following a decade of experimental drought consumes old reserves in Pinus edulis. *New Phytologist,* https://doi.org/10.1111/nph.19119.

Carbone MS, T Ayers, C Ebert, S Munson, EAG Schuur, AD Richardson (2023) Atmospheric radiocarbon for the period 1910–2021 recorded by annual plants. *Radiocarbon, 65*(2), 357-374. Doi:10.1017/Rdc.2023.5.

*Peltier DMP, J Lemoine, C Ebert, X Xu, K Ogle, AD Richardson, **MS Carbone** (2023) An incubation method to determine the age of available nonstructural carbon in woody plant tissues, *Tree Physiology*, tpad015, https://doi.org/10.1093/treephys/tpad015.

Richardson AD, *GV Kong, *KM Taylor, JM Le Moine, MA Bowker, JJ Barber, D Basler, **MS Carbone**, M Hayer, GW Koch, MR Salvatore, AW Sonnemaker and DE Trilling (2022) Soil-atmosphere fluxes of CO_2, CH_4, and N_2O across an experimentally-grown, successional gradient of biocrust community types. *Frontiers in Microbiology,* 13:979825. Doi: 10.3389/fmicb.2022.979825

*Teets A, DJP Moore, R Alexander, PD Blanken, G Borher, SP Burns, **MS Carbone** *et al.* (2022). Coupling of tree growth and photosynthetic carbon uptake across six North American forests. Journal of Geophysical Research: *Biogeosciences*, 127, e2021JG006690. https://doi.org/10.1029/2021JG006690.

Bond-Lamberty B, DS Christianson, A Malhotra, SC Pennington, D Sihi, A AghaKouchak, H Anjileli, MA Arain, JJ Armesto, S Ashraf, M Ataka, D Baldocchi, AT Black, N Buchmann,

MS Carbone *et al.* (2020) COSORE: A community database for continuous soil respiration and other soil-atmosphere flux data. *Global Change Biology,* https://doi.org/10.1111/gcb.15353.

Hartman H, M Bahn, **MS Carbone**, AD Richardson (2020) Plant allocation in a changing world – challenges and progress. *New Phytologist,* https://doi.org/10.1111/nph.16757.

Furze M, B Huggett, D. Aubrecht, C Stolz, **MS Carbone**, AD Richardson (2020) Seasonal fluctuation of nonstructural carbohydrates reveals the metabolic availability of stemwood reserves in temperate trees with contrasting wood anatomy. *Tree Physiology,* https://doi.org/10.1093/treephys/tpaa080.

Berkelhammer M, CJ Still, F Ritter, M Winnick, L Anderson, R Carroll, **MS Carbone**, K Williams (2020) Persistence and plasticity in conifer water-use strategies. *JGR Biogeosciences, Doi:* 10.1029/2018JG004845.

Carbone MS, B Seyednasrollah, TT Rademacher, D Basler, J Le Moine, AD Richardson (2019) Flux Puppy – an open source software application and portable system design for low-cost manual measurements of CO_2 and H_2O fluxes. *Agricultural and Forest Meteorology,* https://doi.org/10.1016/j.agrformet.2019.04.012.

Hilman B, J Muhr, SE Trumbore, **MS Carbone** *et al.* (2019) Comparison of CO_2 and O_2 fluxes demonstrate retention of respired CO_2 in tree stems from a range of tree species. *Biogeosciences,* https://doi.org/10.5194/bg-16-177-2019.

Furze M, B Huggett, D Aubrecht, C Stolz, **MS Carbone**, AD Richardson (2018) Whole-tree nonstructural carbohydrate storage and seasonal dynamics in five temperate species. *New Phytologist,* Doi: 10.1111/nph.15462.

Carbone MS, AD Richardson, M Chen, EA Davidson, H Hughes, KE Savage, DY Hollinger (2016) Constrained partitioning of autotrophic and heterotrophic respiration reduces model uncertainties of forest ecosystem carbon fluxes but not stocks. *JGR Biogeosciences,* Doi: 10.1002/2016JG003386.

Richardson AD, **MS Carbone**, BA Huggett, ME Furze, CI Czimczik, JC Walker, X Xu, P Murakami, PG Schaberg (2015) Distribution and mixing of old and new nonstructural carbon in two temperate trees. *New Phytologist,* doi: 10.1111/nph.13273.

Dietze MC, A Sala, **MS Carbone**, CI Czimczik, JA Mantooth, AD Richardson, R Vargas (2014) Nonstructural carbon in woody plants. *Annual Review of Plant Biology,* 65: 667-687. Doi: 10.1146/annurev-arplant-050213-040054.

Czimczik CI, SE Trumbore, X Xu, **MS Carbone**, AD Richardson (2014) Extraction of Nonstructural Carbon and Cellulose from Wood for Radiocarbon Analysis. *Bioprotocol,* Doi: 10.21769/BioProtoc.1169.

Carbone MS, CI Czimczik, TF Keenan, P Murakami, N Pederson, PG Schaberg, X Xu, AD Richardson (2013) Age, allocation, and availability of nonstructural carbon in mature red maple trees. *New Phytologist*, 200, 1145-1155. Doi: 10.1111/nph.12448.

Richardson AD, **MS Carbone**, TF Keenan, CI Czimczik, DY Hollinger, P Murakami, PG Schaberg, X Xu (2013) Seasonal dynamics and age of stemwood nonstructural carbohydrates in temperate forest trees. *New Phytologist,* 197, 850–861. Doi: 10.1111/nph.12042.

Carbone MS, AP Williams, AM Ambrose, ES Bradley, CM Boot, TE Dawson, SM Schaeffer, JP Schimel, CJ Still (2013) Cloud shading and fog drip influence the metabolism of a coastal pine ecosystem. *Global Change Biology*, 19, 484–497. Doi: 10.1111/gcb.12054.

Carbone MS, CJ Still, AM Ambrose, TE Dawson, AP Williams, CM Boot, SM Schaeffer, JP Schimel (2011) Seasonal and episodic moisture controls on plant and microbial contributions to soil respiration. *Oecologia*, 167, 265-278. Doi:10.1007/s00442-011-1975-3.

Subke JA, **MS Carbone**, M Khomik, P Stoy, M Bahn (2012) Biotic interactions and biogeochemical processes in the soil environment. *Biogeosciences*, 9, 1823–1825. Doi:10.5194/bg-9-1823-2012.

Keenan TF, **MS Carbone**, M Reichstein, AD Richardson (2011) The model-data fusion pitfall: assuming certainty in an uncertain world. *Oecologia*, 167, 587-597. Doi: 10.1007/s00442-011-2106-x.

Marin-Spiotta E, OA Chadwick, M Kramer, **MS Carbone** (2011) Carbon delivery to deep mineral horizons in Hawaiian rainforest soils. *JGR Biogeosciences,* 116, G03011, doi:10.1029/2010JG001587.

Vargas R, **MS Carbone**, M Reichstein, DD Baldocchi (2011) Frontiers in soil respiration research: from measurements to model-data integration. *Biogeochemistry,*102,1-13, doi:10.1007/s10533-010-9462-1.

Bahn M, M Reichstein, EA Davidson, J Grünzweig, M Jung, **MS Carbone** *et al.* (2010) Soil respiration at mean annual temperature predicts annual total across vegetation types and biomes. *Biogeosciences*, 7, 2147-2157. Doi:10.5194/bg-7-2147-2010.

Carbone MS, GC Winston, SE Trumbore (2008) Soil respiration in perennial grass and shrub ecosystems: linking plant and microbial sources with environmental controls on seasonal and diel timescales. *JGR Biogeosciences,* 113, G02022. Doi:10.1029/2007JG000611.

Carbone MS & R Vargas (2008) Automated soil respiration measurements: new challenges, information, and opportunities. *New Phytologist,* 177, 295-297.

Carbone MS & SE Trumbore (2007) Contribution of new photosynthetic assimilates to respiration by perennial grasses and shrubs: residence times and allocation patterns. *New Phytologist,* 176, 124-135. Doi: 10.1111/j.1469-8137.2007.02153.x.

Carbone MS, CI Czimczik, KE McDuffee, SE Trumbore (2007) Allocation and residence time of photosynthetic products in a boreal forest using a low-level ^{14}C pulse-chase labeling technique. *Global Change Biology,* 13, 466-477. Doi: 10.1111/j.1365-2486.2006.01300.x.

Czimczik CI, **MS Carbone**, GC Winston, SE Trumbore (2006) Changing sources of soil respiration with time since fire in a boreal forest. *Global Change Biology,* 12, 957-971. Doi: 10.1111/j.1365-2486.2006.01107.x.

Czimczik CI, KK Treseder, **MS Carbone**, SE Trumbore (2005) Radiocarbon–a low impact tool to study nutrient transport by soil fungi under field conditions. *New Phytologist*, 166, 595-600. Doi: 10.1111/j.1469-8137.2005.01326.x.

Litaor MI, TR Seastedt, MD Walker, **MS Carbone**, A Townsend (2005) The biogeochemistry of phosphorus across an alpine topographic/snow gradient. *Geoderma,*124, 49-61. Doi: 10.1016/j.geoderma.2004.04.001.

Book Chapter

Schuur EAG, **MS Carbone**, CE Hicks Pries, F Hopkins, SM Natali. Radiocarbon in Terrestrial Systems in *Radiocarbon and Climate Change.* 10.1007/978-3-319-25643-6.

Datasets

Ballou K *et al.* (2025). *PhenoCam Dataset v3.0: Digital Camera Imagery from the PhenoCam Network, 2000-2023*(Version 3). ORNL Distributed Active Archive Center. https://doi.org/10.3334/ORNLDAAC/2364.

*Simonpietri A, **Carbone MS** (2023): Raw soil carbon dioxide, moisture, temperature and micrometeorological data in the East River Watershed, Colorado June 2021-October 2022. (DE-SC0021139). Ecohydrological controls on root and microbial respiration in the East River watershed of Colorado, ESS-DIVE repository. Dataset. doi:10.15485/1909712.

Varadharajan C *et al.* (2020 and 2023) Location Identifiers, Metadata, and Map for Field Measurements at the East River Watershed, Colorado, USA (Version 3.1), ESS-DIVE repository. Dataset. https://doi.org/10.15485/1660962.

Carbone MS (2019 and 2023). Depth profiles of soil CO_2 concentrations, soil temperature, and soil moisture (Rocky Mountain Biological Laboratory, Gothic, Colorado, 2011-2021). ESS-DIVE repository. Dataset. doi:10.6084/M9.FIGSHARE.7834406.V2 accessed via https://data.ess-dive.lbl.gov/datasets/doi:10.6084/M9.FIGSHARE.7834406.V2.

Grants

DOE EMSL-ARM FICUS: Dust and Regional Organic Aerosol Profiling for Land-Atmosphere Exchange and Transport for DUSTIEAIM ($0 total costs) 2025-26. **co-PI**

DOE EMSL MONet Winter Soil Sampling Award ($0 total costs) 2025**. PI**

NSF GEO/AGS Solar Terrestrial/Paleoclimate ($429,227 to NAU/$818,266 total costs) 2024-27 Collaborative Research: Resolving Uncertainty in Past 14C Spikes from Tree Rings. **PI**

DOE BER ESS ($999,383 total costs) 2023-26. Responses of plant and microbial respiration sources to changing cold season climate drivers in the East River watershed. **PI**

DOE BER ($855,000 to NAU/$950,000 total costs) 2023-26. Southwestern Mountains Climate Resilience Center. **co-PI**

NSF BIO DEB ($175,000 to NAU/$7,650,000 total costs) 2023-29. LTER: Long Term Ecological Research at the Hubbard Brook Experimental Forest. **co-PI**

NSF BIO DEB ($699,883 total costs) 2022-25. Interacting impacts of changes in mean and variance of water availability on vegetation phenology and productivity in dryland ecosystems. **co-PI**

DOE BER ESS ($52,400 total costs) 2021-22. Supplement to Ecohydrological controls on root and microbial respiration in the East River watershed of Colorado. **PI**

NSF BIO IOS ($199,912 total costs) 2020-22. RAPID: Resprouting and resilience: The role of nonstructural carbon reserves in fostering the longevity of coast redwood. **co-PI**

NSF BIO IOS ($93,915 to NAU/total costs $387,167) 2020-22. Collaborative Research: How to live on a (carbon and water) budget: Tree investment in chemical defenses across a gradient of physiological drought stress. **PI**

DOE BER SBR ($200,000 total costs) 2020-24. Ecohydrological controls on root and microbial respiration in the East River watershed of Colorado. **PI**

S-REAP NAU VPR Office ($24,979 total costs) 2020. Supercritical Fluid (SCF) Extraction System Speed SFE Prime. **co-PI**

REAP NAU VPR Office ($93,185 total costs) 2020. Isotope Ratio Infrared Spectrometer. **co-PI**

NSF BIO IOS ($197,752 total costs) 2019-22. RAPID: Leveraging an experimental drought on mature trees to study mechanisms of drought mortality and legacies with radiocarbon. **PI**

NSF GEO EAR ($486,652 total costs) 2019-23. MRI: Acquisition of equipment for an integrated gas analysis and labeling radiocarbon system with a focus on Arctic carbon and geochronology. **co-PI**

DOE SBIR ($0 to NAU/total costs $224,931) 2018-20**.** Optical Probe for Rapid In-Situ Survey of Soil Moisture and Carbon. **co-I**

NAU Office of the President (~$2,000,000 total costs) 2018. Acquisition of A Mini Carbon Dating System (MICADAS) for Environmental Sciences. **co-PI**

Rocky Mountain Biological Laboratory Research Grant ($1,400 total costs) 2011-13. Quantifying environmental and biological controls on soil CO_2 effluxes in East River valley forests. **PI**

William F. Milton Fund ($40,000 total costs) 2010. Nonstructural carbohydrate reserves in forest trees: How does tree size impact the capacity for resilience to stress factors? **co-I**

European Science Foundation ($0 total costs) 2009. Diurnal- to century-scale controls on soil respiratory fluxes: Towards a new generation of integrated experimental and modeling approaches. **co-I**

Kearney Foundation ($253,000 total costs) 2008-10. Fog drip drives summertime soil respiration in California's coastal conifer forests. **co-I, main writer.**

Fellowships

National Center for Ecological Analysis & Synthesis Postdoctoral Fellowship (2011-12)

NOAA Climate & Global Change Postdoctoral Fellowship (2008-10)

Kearney Foundation Graduate Fellowship (2004-06)

Jenkins Graduate Fellowship (2002-04) Dept. of Earth System Science, UC Irvine