

# **Mariah S. Carbone**

Curriculum vitae – training, publications, grants, fellowships

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## **Contact**

Center for Ecosystem Science and Society & Department of Biological Sciences  
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## **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**

**Associate Research Professor** (2025-present) Center for Ecosystem Science and Society/Department of Biological Sciences, Northern Arizona University, Flagstaff

**Assistant Research Professor** (2017-25) Center for Ecosystem Science and Society/Department of Biological Sciences, Northern Arizona University, Flagstaff

**Research Scientist** (2013-16\*) Earth Systems Research Center, University of New Hampshire, Durham \*parental leave 100% of 2014, 50% of 2015-16, 100% Jan-Jul 2017

**National Center for Ecological Analysis & Synthesis Postdoctoral Fellow** (2011-12) Santa Barbara, California

**NOAA Climate & Global Change Postdoctoral Fellow** (2008-10) Department of Geography, University of California, Santa Barbara

**Graduate Research Assistant** (2002-07) Department of Earth System Science, University of California, Irvine

**Research Assistant** (1999, 01-02) Niwot Ridge LTER, Institute of Arctic & Alpine Research, University of Colorado, Boulder

**Volunteer Research Assistant** (2000) La Reserva Pacuare, Costa Rica

**Undergraduate Research Assistant** (1997) Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder

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

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<sub>2</sub> 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<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O 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<sub>2</sub> and H<sub>2</sub>O 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<sub>2</sub> and O<sub>2</sub> fluxes demonstrate retention of respired CO<sub>2</sub> 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 <sup>14</sup>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.

### **Grants & Awards**

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<sub>2</sub> 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