

## RESEARCH INTERESTS

Root and mycorrhizal ecology, ecosystem science, global change biology, forest ecology, biogeochemistry, plant physiology, landscape ecology, ecological modeling, soil ecology.

## EDUCATION

Pennsylvania State University	PhD	2012	Ecology and Biogeochemistry
College of Charleston	BS	2005	Biology

## APPOINTMENTS

- 2018-current    Research Scientist. Center for Tree Science, The Morton Arboretum, Lisle, IL.
- 2015-2018     Research Associate. Department of Plant and Microbial Biology, University of Minnesota, St. Paul, MN.
- 2013-2015     Postdoctoral Research Associate. Chinese Academy of Science, Institute of Geographical Sciences and Natural Resources Research, Beijing, China.
- 2007-2012     Graduate Research Assistant. The Pennsylvania State University, University Park, PA.
- 2005-2007     Research Technician. Department of Biology, College of Charleston, Charleston, SC. Located in the Nicholas School for the Environment, Duke University, Durham, NC.

## PUBLICATIONS

- Yang Y, **ML McCormack**, H Hui, WK Bao, FL Li. Linking fine-root architecture, vertical distribution and growth rate in temperate mountain shrubs. *Oikos*, (2022).
- Weigelt A, Mommer L, Andrzejak K, Iversen CM, Bergmann J, Bruelheide H, Fan Y, Freschet GT, Guerrero-Ramirez NR, Kattge J, Kuyper TW, Laughlin DC, Meier IC, van der Plas F, Poorter H, Roumet C, van Ruijven J, Sabatini FM, Semchenko M, Sweeney CJ, Valverde-Barrantes OJ, York LM, **ML McCormack**. An integrated framework of plant form and function: The belowground perspective. *New Phytologist* 232: 42-59 (2021).
- Iversen CM and **ML McCormack**. Filling gaps in our understanding of belowground plant traits across the world: an introduction to a Virtual Issue. *New Phytologist*, 231: 2097-2103 (2021).
- Zadworny M, J Mucha, A Bagniewska-Zadworna, R Ź, E Mąderek, D Danusevičius, J Oleksyn, TP Wyka, **ML McCormack**. Higher biomass partitioning to absorptive roots improves needle nutrition but does not alleviate stomatal limitation of northern Scots pine. *Global Change Biology*, 27: 3859-3869 (2021).
- Laughlin D, L Mommer, FM Sabatini, H Bruelheide, TW Kuyper, **ML McCormack**, J Bergmann, GT Freschet, N Guerrero-Ramirez, CM Iversen, J Kattge, IC Meier, H Poorter, C Roumet, M Semchenko, CJ Sweeney, OJ Valverde-Barrantes, F van der Plas, J van Ruijven, LM York, I Aubin, OR Burge, C Byun, R Čušterevska, J Dengler, E Forey, GR Guerin, B Herault, RB Jackson, DN Karger, J Lenoir, T Lysenko, P Meir, Ü Niinemets, WA Ozinga, J Penuelas, PB Reich, M Schmidt, F Schrodte, E Velázquez, A Weigelt. Root traits explain plant species distributions along climatic gradients yet challenge the nature of ecological trade-offs. *Nature Ecology & Evolution*, 5: 1123-1134 (2021).
- Wang J, C Defrenne, **ML McCormack**, L Yang, D Tian, Y Luo, E Hou, T Yan, Z Li, W Bu, Y Chen, S Niu. Fine-root functional trait responses to experimental warming: a global meta-analysis. *New Phytologist*, 230: 1856-1867 (2021).

- Hu H, FL Li, **ML McCormack**, L Huang, WK Bao. Functionally divergent growth, biomass allocation and root distribution of two xerophytic species in response to varying soil rock fragment content. *Plant and Soil*, 463: 265-277 (2021).
- Freschet G, L Pagès, CM Iversen, L Comas, B Rewald, C Roumet, J Klimešová, M Zadworny, H Poorter, J Postma, T Adams, A Bagniewska-Zadworna, A Bengough, E Blancaflor, I Brunner, J Cornelissen, E Garnier, A Gessler, S Hobbie, I Meier, L Mommer, C Picon-Cochard, L Rose, P Ryser, M Scherer-Lorenzen, N Soudzilovskaia, A Stokes, T Sun, O Valverde-Barrantes, M Weemstra, A Weigelt, N Wurzbürger, L York, S Batterman, M Gomes de Moraes, Š Janeček, H Lambers, V Salmon, N Tharayil, **ML McCormack**. A starting guide to root ecology: strengthening ecological concepts and standardizing root classification, sampling, processing and trait measurements. *New Phytologist*, 232: 973-1122 (2021).
- Freschet G, C Roumet, LH Comas, M Weemstra, AG Bengough, B Rewald, RD Bardgett, GB De Deyn, D Johnson, J Klimešová, M Lukac, **ML McCormack**, IC Meier, L Pagès, H Poorter, I Prieto, N Wurzbürger, M Zadworny, A Bagniewska-Zadworna, EB Blancaflor, I Brunner, A Gessler, SE Hobbie, CM Iversen, L Mommer, C Picon-Cochard, JA Postma, L Rose, P Ryser, M Scherer-Lorenzen, NA Soudzilovskaia, T Sun, OJ Valverde-Barrantes, A Weigelt, LM York, A Stokes. Root traits as drivers of plant and ecosystem functioning: current understanding, pitfalls and future research needs. *New Phytologist*, 232: 1123-1158 (2021).
- Guerrero-Ramirez N, L Mommer, GT Freschet, CM Iversen, **ML McCormack**, J Kattge, H Poorter, A van der Plas, J Bergmann, TW Kuyper, LM York, H Bruehlheide, DC Laughlin, IC Meier, C Roumet, M Semchenko, CJ Sweeney, J van Ruijven, OJ Valverde-Barrantes, I Aubin, JA Catford, P Manning, Adam Martin, R Milla, V Minden, J G Pausas, SW Smith, NA Soudzilovskaia, C Ammer, B Butterfield, JM Craine, JHC Cornelissen, F de Vries, T Hickler, ME Isaac, K Kramer, C König, E Lamb, B Medlyn, VG Onipchenko, Q Read, PB Reich, MC Rillig, L Sack, B Shipley, L Tedersoo, F Valladares, P van Bodegom, P Weigelt, J Wright, A Weigelt. Global Root Traits Database (GRooT). *Global Ecology and Biogeography*, 30: 25-37 (2021).
- McCormack ML\***, MA Kaproth\*, E Carlson\*, J Cavender-Bares, PG Kennedy. Fine-root morphology and architecture are interconnected among root orders but are unrelated to climate of origin across a diverse suite of oak species. *New Phytologist*, 228: 1824-1834 (2020).
- Li FL, **ML McCormack**, X Liu, H Hu, DF Feng, WK Bao. Vertical fine-root distributions in five subalpine forest types shifts with soil properties across environmental gradients. *Plant and Soil*, 456: 129-143 (2020).
- Bergmann J, A Weigelt, F van der Plas, DC Laughlin, TW Kuyper, N Guerrero-Ramirez, OJ Valverde-Barrantes, H Bruehlheide, GT Freschet, CM Iversen, J Kattge, **ML McCormack**, IC Meier, MC Rillig, C Roumet, M Semchenko, CJ Sweeney, J van Ruijven, LM York, L Mommer, The fungal collaboration gradient dominates the root economics space in plants, *Science Advances*, 6: eaba3756 (2020).
- Gallagher RV, DS Falster, B Maitner, R Salguero-Gómez, V Vandvik, WE Pearse, FD Schneider, J Kattge...**ML McCormack** (many authors). The Open Traits Network: Using Open Science principles to accelerate trait-based science across the Tree of Life. *Nature Ecology & Evolution*, 4: 294-303 (2020).
- McCormack ML**. Book Chapter: Patterns of Fine-Root Life Span and Fine-Root Turnover and Their Implications for Urban Trees. In: *The Landscape Below Ground: Proceedings on the Forth International Workshop on Tree Root Development in Urban Soils*. G Watson, E Gilman, J Miesbauer, J Morgenroth, B Scharenbroch (eds.). 4<sup>th</sup> Edition (2020).
- Kattge J, G Bönišch, S Díaz, S Lavorel, IC Prentice, P Leadley, S Tautenhahn, G Werner...**ML McCormack** with many coauthors...C Wirth. TRY plant trait database - enhanced coverage and open access. *Global Change Biology*, 26: 119-188 (2020).

- Addo-Danso S, C Defrenne, C Prescott, **ML McCormack**, I Ostonen, A Addo-Danso, E Foli, K Borden, I Marney. Fine-root morphological trait variation in tropical forest ecosystems: an evidence synthesis. *Plant Ecology*, 221: 1-13 (2020).
- McCormack ML** and CM Iversen. Physical and functional constraints on viable belowground acquisition strategies. *Frontiers in Plant Science*, 10: 1-12 (2019).
- Soudzilovskaia N, Peter M van Bodegom, C Terror, M van't Zelfde, I McCallum, **ML McCormack**, JB Fisher, M Brundrett, NC de Sá, L Tedersoo. Global mycorrhizal plants distribution linked to terrestrial carbon stocks. *Nature Communications*, 10: 5077 (2019).
- Defrenne CE, **ML McCormack**, SD Addo-Danso, SW Simard. Intraspecific fine-root trait-environment relationships across interior Douglas-fir forests of western Canada. *Plants*, 8: 199 (2019).
- See CR, **ML McCormack**, SE Hobbie, H Flores-Moreno, WL Silver, PG Kennedy. Global patterns in fine-root decomposition: climate, chemistry, mycorrhizal association and woodiness. *Ecology Letters*, 22:946-953 (2019).
- Li F, H Hu, **ML McCormack**, D Feng, X Liu, W Bao. A community-level economics spectrum of fine-roots driven by nutrient limitations in subalpine forests. *Journal of Ecology*, 107: 1238-1249 (2019).
- Dybzinski R, A Kelvakis, J McCabe, S Panock, K Anuchitlertchon, L Vasarhelyi, **ML McCormack**, GG McNickle, H Poorter, C Trinder, CE Farris. How are nitrogen availability, fine-root mass, and nitrogen uptake related empirically? Implications for models and theory. *Global Change Biology*, 25: 885-899 (2019).
- Caplan JS, SJ Meiners, H Flores-Moreno, **ML McCormack**. Fine-root traits are linked to species dynamics in a successional plant community. *Ecology*, 100: e02588 (2019).
- Li L, **ML McCormack**, F Chen, H Wang, Z Ma, D Guo. Different responses of absorptive roots and arbuscular mycorrhizal fungi to fertilization provide diverse nutrient acquisition strategies in Chinese fir. *Forest Ecology and Management*, 433: 64-72 (2019).
- Wang C, **ML McCormack**, D Guo, J Li. Global meta-analysis reveals different patterns of root tip adjustments by angiosperm and gymnosperm trees in response to environmental gradients. *Journal of Biogeography*, 46: 123-133 (2019).
- Mao Z, Y Wang, **ML McCormack**, N Rowe, X Deng, X Yang, S Xia, J Nespoulous, RC Sidle, D Guo, A Stokes. Mechanical properties of fine roots as a function of topology and anatomy. *Annals of Botany*, 122: 1103-1116 (2018).
- McCormack ML**, AS Powell, CM Iversen. Letter: The Fine-Root Ecology Database version 2 – better, bigger, and free. *Eos*, 99: (2018).
- Ma Z, D Guo, X Xu, M Lu, RD Bardgett, DM Eissenstat, **ML McCormack**, LO Hedin. Evolutionary history resolves global organization of root functional traits. *Nature*, 555: 94-97 (2018).
- Zhu K\*, **ML McCormack\***, RA Lankau, JF Egan, N Wurzbarger. Association of ectomycorrhizal trees with high carbon - to - nitrogen ratio soils across temperate forests is driven by smaller nitrogen not larger carbon stocks. *Journal of Ecology*, 106: 524-525 (2018).
- Mueller KE, DR LeCain, **ML McCormack**, DM Blumenthal, M Carlson, E Pendall. Root responses to climate change in a semiarid grassland: integrating biomass, length, and lifespan in a 5-year field experiment. *Journal of Ecology*, 106: 2176-2189 (2018).
- Erktan A\*, **ML McCormack\***, C Roumet\*, Editorial: Frontiers in root ecology: recent advances and future challenges. *Plant and Soil*, 424: 1-9 (2018).
- Li H, B Liu, **ML McCormack**, B Zhu, Z Ma, D Guo. Diverse belowground resource strategies underlie plant species coexistence and spatial distribution in three grasslands along a precipitation gradient. *New Phytologist*, 216: 1140-1150 (2017).

- Walker AP, **ML McCormack**, J Messier, I Myers-Smith, SD Wullschleger. *Meetings: Trait covariance: The functional warp of plant diversity? New Phytologist*, 216: 976-980 (2017).
- McCormack ML**, D Guo, CM Iversen, W Chen, DM Eissenstat, CW Fernandez, L Li, C Ma, Z Ma, H Poorter, PB Reich, M Zadworny, AE Zanne. Building a better foundation: Improved root-trait measurements to understand and model plant and ecosystem processes. *New Phytologist*, 215: 27-37 (2017).
- Freschet GT, OJ Valverde-Barrantes, CM Tucker, JM Craine, **ML McCormack**, C Blackwood, C Violle, KR Urban-Mead, A Bonis, LH Comas, M Dong, F Fort, D Guo, SE Hobbie, RJ, Holdaway, CM Iversen, SW Kembel, N Makita, VG Onipchenko, C Picon-Cochard, PB Reich, EG de la Riva, SW Smith, MG Tjoelker, DA Wardle, C Roumet. Climate, soil and plant functional types as drivers of global fine-root trait variation. *Journal of Ecology*, 105: 1182-1196 (2017).
- Iversen CM, **ML McCormack**, AS Powell, CB Blackwood, GT Freschet, J Kattge, C Roumet, DB Stover, NA Soudzilovskaia, OJ Valverde-Barrantes, PM van Bodegom, C Violle. A global Fine-Root Ecology Database to address belowground challenges in plant ecology. *New Phytologist*, 215: 15-26 (2017).
- McCormack ML**, CW Fernandez, H Brooks\*, SG Pritchard. Production dynamics of *Cenococcum geophilum* ectomycorrhizas in response to long-term elevated CO<sub>2</sub> and N fertilization. *Fungal Ecology*, 26: 11-19 (2017).
- Liu R, Z Huang, **ML McCormack**, X Zhou, X Wan, Z Yu, M Wang, L Zheng. Plasticity of fine-root functional traits in the litter layer in response to nitrogen addition in a *Mytilaria laosensis* plantation in subtropical China. *Plant and Soil*, 415: 317-330 (2017).
- Zadworny M, **ML McCormack**, R Żytkowiak, P Karolewski, J Mucha, J Oleksyn. Patterns of structural and defense investments in fine roots of Scots pine (*Pinus sylvestris* L.) across strong temperature and latitudinal gradient in Europe. *Global Change Biology*, 23: 1218-1231 (2017).
- Lin G, **ML McCormack**, C Ma, D Guo. Similar soil carbon sequestration potential but contrasting modes of nitrogen cycling between arbuscular mycorrhizal and ectomycorrhizal forests. *New Phytologist*, 213: 1440-1451 (2017).
- Wurzburger N, ENJ Brookshire, **ML McCormack**, RA Lankau. *Meetings: Mycorrhizal fungi as drivers and modulators of terrestrial ecosystem processes. New Phytologist*, 213: 996-999 (2017).
- Kou L, **ML McCormack**, W Chen, D Guo, H Wang, W Gao, H Yang, S Li. Ectomycorrhizal morphotype, nitrogen ion form and spatio-temporal variations in root distribution mediate nitrogen effects on lifespan of absorptive roots. *Plant and Soil*, 411: 261 (2017).
- Cheng L, DM Eissenstat, R Koide, J DeForest, **ML McCormack**, T Adams, W Chen, X Wei, L Li. Mycorrhizal fungi and roots are complementary in foraging within nutrient patches. *Ecology*, 97: 2815-2823 (2016).
- Zadworny M, **ML McCormack**, J Mucha, PB Reich, J Oleksyn. Scots pine fine roots adjust along a 2,000 km cold-climate gradient. *New Phytologist*, 212: 389-399 (2016).
- Radville L, **ML McCormack**, E Post, DM Eissenstat. Root phenology in a changing climate. *Journal of Experimental Botany*, 67: 3601-3603 (2016).
- Fernandez CW, JA Langley, S Chapman, **ML McCormack**, RT Koide. The decomposition dynamics of ectomycorrhizal fungal necromass. *Soil Biology and Biochemistry*, 93: 38-49 (2016).
- Sun K, Li L, **ML McCormack**, L Li, Z Ma, D Guo. Fast-cycling unit of root turnover in seven perennial herbaceous plants: implications for estimating root dynamics in herbaceous root systems. *Scientific Reports*, 6: 19698 (2016).
- McCormack ML**, CM Iversen, DM Eissenstat. Moving forward with fine-root definitions and research. *New Phytologist*, 212: 313 (2016).

- Li L, **ML McCormack**, C Ma, D Kong, Q Zhang, X Chen, Ü Niinemets, D Guo. Leaf-level modularity leads to independent leaf hydraulic and economics trait axes in topics. *Ecology Letters*, 18: 899-906 (2015).
- Lin G, **ML McCormack**, D Guo. A meta-analysis of arbuscular mycorrhizal fungi effects on plant competition and community structure. *Journal of Ecology*, 103: 1224-1232 (2015).
- McCormack ML**, IA Dickie, DM Eissenstat, TJ Fahey, CW Fernandez, D Guo, H-S Helmisaari, EA Hobbie, CM Iversen, RB Jackson, J Leppälammil-Kujansuu, RJ Norby, RP Phillips, KS Pregitzer, SG Pritchard, B Rewald, M Zadworny. Redefining fine roots improves understanding of belowground contributions to terrestrial biosphere processes. *New Phytologist*, 207: 505-518 (2015).
- Zadworny M, **ML McCormack**, K Rawlik, AM Jagodziński. Seasonal variation in root chemistry, but not root morphology, in roots of *Quercus robur* growing in different soil types. *Tree Physiology*, 35: 644-652 (2015).
- McCormack ML**, KP Gaines, MP Pastore\*, DM Eissenstat. Early season root production in relation to leaf production among six diverse temperate tree species. *Plant and Soil*, 389: 121-129 (2015).
- Meier IC, SG Pritchard, ER Brzostek, **ML McCormack**, RP Phillips. Rhizosphere and hyphosphere differ in their impacts on carbon and nitrogen cycling in forests exposed to elevated CO<sub>2</sub>. *New Phytologist*, 205: 1164-1174 (2015).
- McCormack ML**, E Crisfield, B Raczka, F Schnekenburger, DM Eissenstat, EAH Smithwick. Sensitivity of four ecological models to adjustments in fine root turnover rate. *Ecological Modelling*, 297: 107-117 (2015).
- Tian J, **ML McCormack**, J Wang, D Guo, Q Wang, X Zhang, E Blagodatskaya, Y Kuzyakov, G Yu. Linkages between the soil organic matter fractions and the microbial metabolic functional diversity within a broad-leaved Korean pine forest of the Changbai Mountains. *European Journal of Soil Biology*, 66: 57-64 (2015).
- McCormack ML**, E Lavelly, Z Ma. *Meetings: Fine root and mycorrhizal traits help explain ecosystem processes and responses to global change—2014 International Symposium on Critical Zone Biochemistry and Belowground Ecological Research*. *New Phytologist*, 204: 455-458 (2014).
- McCormack ML** and D Guo. *Review: Impacts of environmental factors on fine root lifespan*. *Frontiers in Plant Science*, 5: 205 (2014).
- Rosenfeld C, **ML McCormack**, CE Martinez. A novel approach to study composition of *in situ* produced root-derived dissolved organic matter. *Soil biology and Biochemistry*, 76: 1-4 (2014).
- Smithwick EAH, **ML McCormack**, G Sivandran, MS Lucash. Improving the representation of roots in terrestrial models. *Ecological Modelling*, 291: 193-204 (2014).
- Liao Y, **ML McCormack**, D Guo, H Wang, J Wu, J Tu, W Liu. Relation of fine root distribution to soil C in *Cunninghamia lanceolata* forest in subtropical China. *Plant and Soil*, 381: 225-234 (2014).
- McCormack ML**, TS Adams, EAH Smithwick, DM Eissenstat. Variability in root production, phenology, and turnover rate among 12 temperate tree species. *Ecology*, 95: 2224-2235 (2014).
- Pritchard SG, BN Taylor, ER Cooper, KV Biedler, AE Strand, **ML McCormack** S Zhang. Long-term dynamics of mycorrhizal root tips in a loblolly pine forest grown with free-air-CO<sub>2</sub>-enrichment and soil N fertilization for six years. *Global Change Biology*, 20: 1313-1326 (2014).
- Adams TS, **ML McCormack**, DM Eissenstat. Foraging strategies in trees of different root morphology: the role of root lifespan. *Tree Physiology*, 33: 940-948 (2013).
- Fernandez CW, **ML McCormack**, JM Hill, SG Pritchard, RT Koide. On the persistence of Cenococcum geophilum ectomycorrhizas and its implications for forest carbon and nutrient cycles. *Soil Biology and Biochemistry*, 65: 141-143 (2013).

- McCormack ML**, DM Eissenstat, AM Prasad, EAH Smithwick. Regional scale patterns of fine root lifespan and turnover under current and future climate. *Global Change Biology*, 19: 1697-1708 (2013).
- Eissenstat DM, **ML McCormack**, Q Du. Book Chapter: Global Change and Root Lifespan. In: *Plant roots: The Hidden Half*. A Eshel and T Beeckman (eds.). 4<sup>th</sup> Edition (2013).
- McCormack ML**, TS Adams, EAH Smithwick, DM Eissenstat. Predicting fine root lifespan from plant functional traits in temperate trees. *New Phytologist*, 195: 823-31 (2012).
- Polverigiani S, **ML McCormack**, CW Mueller, DM Eissenstat. Growth and physiology of olive pioneer and fibrous roots exposed to soil moisture deficits. *Tree Physiology*, 32: 1228-1237 (2011).
- McCormack ML** and CW Fernandez. *Meetings: Measuring and modeling roots, the rhizosphere, and microbial processes belowground*. *New Phytologist*, 192: 573-575 (2011).
- Drake JE, EH Delucia, A Gallet-Budynek, KS Hofmockel, ES Bernhardt, SA Billings, RB Jackson, J Lichter, **ML McCormack**, DJP Moore, R Oren, S Palmroth, RP Phillips, JS Phippen, SG Pritchard, KK Treseder, and AC Finzi. Nitrogen limitation of net primary production prevents soil carbon sequestration under elevated concentrations of atmospheric CO<sub>2</sub>. *Ecology Letters*, 14: 349-357 (2011).
- McCormack ML**, SG Pritchard, S Breland, MA Davis, SA Prior, GB Runion, RJ Mitchell, and HH Rogers. Soil fungi respond more strongly than fine roots to elevated CO<sub>2</sub> in a model regenerating longleaf pine-wiregrass ecosystem. *Ecosystems*, 13: 901-916 (2010).
- Pritchard SG, AE Strand, **ML McCormack**, MA Davis, and R Oren. Mycorrhizal and rhizomorph dynamics in a loblolly pine forest during five years of free-air-CO<sub>2</sub>-enrichment (FACE). *Global Change Biology*, 14: 1252-1265 (2008).
- Pritchard SG, AE Strand, **ML McCormack**, MA Davis, AC Finzi, RB Jackson, R Matamala, HH Rogers, and R Oren. Fine root dynamics in a loblolly pine forest are influenced by free-air-CO<sub>2</sub>-enrichment: a six-year-minirhizotron study. *Global Change Biology*, 14: 1-15 (2008).
- Strand AE, SG Pritchard, **ML McCormack**, MA Davis, and R Oren. Irreconcilable differences: fine root lifespans and soil carbon persistence. *Science*, 319: 456-458 (2008).

\*Authors contributed equally to this work.

\*Supervised undergraduate student

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## WORKSHOPS and ORGANIZED SESSIONS

- Erktan A, C Roumet, F Gerard, **McCormack ML**, Roots at the Heart of Belowground Ecology (organized session). International EcoSummit, Montpellier, France. August 2016.
- Wurzburger N, **ML McCormack**, J Brookshire. Mycorrhizal Fungi as Drivers and Modulators of Ecosystem Processes (organized session). Ecological Society of America, Fort Lauderdale, FL, USA. August 2016.
- McCormack ML** and DL Guo. International Symposium on Using Trait-based Approaches to Better Understand Ecosystem Ecology (Organized Meeting). Beijing, China, October 2015.
- McCormack ML** and DL Guo. International Symposium on Critical Zone Biochemistry and Belowground Ecological Research—森林联盟之关键带生物地化循环及地下生态学联网研究 2014 国际研讨会暨中国. (Organized Meeting). Beijing, China, May 2014.

Guo DL and **ML McCormack**. 森林联盟之关键带生物地化循环与地下生态学会议—Critical zone biogeochemical cycling and underground ecology (Organized Workshop). Beijing, China, November 2013.

**McCormack ML** and DM Eissenstat. Measuring and modeling roots, the rhizosphere and microbial processes belowground (organized session). Annual Meeting of the Ecological Society of America, Austin, TX, USA, August 2011.

## MEETING ABSTRACTS

Bin W, CM Iversen, **ML McCormack**, X Yang, DM Ricciuto. Taming root systems heterogeneity to reduce Earth System Model uncertainty (poster). American Geophysical Union, New Orleans, LA, USA, December 2021.

Xia M, **ML McCormack**, V Suseela, P Kennedy, N Tharayil. No Evidence that Arbuscular Mycorrhizal and Ectomycorrhizal Associations Induce Differential Effects on Carbon Quality Of Leaves and Fine Roots (poster). American Geophysical Union, New Orleans, LA, USA, December 2021.

Bergmann J, A Weigelt, CM Iversen, DC Laughlin, **ML McCormack**, OJ Valverde-Barrantes, F van der Plas, sROOT working group, L Mommer. The root economics space. British Ecological Society Conference, December 2020.

**McCormack ML**, M Lo, N Tran, CM Iversen, DM Ricciuto, D Lu. Species differences in fine-root production phenology: implications and model relevance (presentation). Ecological Society of America, Salt Lake City, UT, USA, August 2020.

Tran N, M Lo, MG Midgley, C Rollinson, R Dybzinski, **ML McCormack**. Linking fine-root traits in shallow soils to sap flow reductions in response to mild drought among 7 temperate tree species (presentation). Ecological Society of America, Salt Lake City, UT, USA, August 2020.

Liu Y, **ML McCormack**, K Ogle, AP Walker, CM Iversen. Understanding taxonomic, environmental, and mycorrhizal influences on fine-root trait variation using the global Fine-Root Ecology Database (FRED) (presentation). Ecological Society of America, Salt Lake City, UT, USA, August 2020.

Dybzinski R, MG Midgley, **ML McCormack**, C Rollinson, E Segal, A Nordgren R Mascarenhas. Plant community nitrogen uptake is independent of fine root mass in established forest (presentation). Ecological Society of America, Salt Lake City, UT, USA, August 2020.

Langguth JR\*, M Lo, N Tran, **ML McCormack**. Fine-root functional traits across the gymnosperm phylogeny (poster). Ecological Society of America, Salt Lake City, UT, USA, August 2020.

Rewald B, GT Freschet, C Roumet, A Stokes, M Weemstra, RD Bardgett, AG Bengough, LH Comas, GB De Deyn, D Johnson, J Klimešová, M Lukac, **ML McCormack**, IC Meier, L Pagès, H Poorter, I Prieto, N Wurzbürger, M Zadworny. Root traits as key proxies to unravel plant and ecosystem functioning: entities, trait selection and outlook (presentation). European Geophysical Union, Vienna, Austria, May 2020.

**McCormack ML**, MG Midgley, N Tran, M Lo, CM Iversen. Long-term observations of fine-root, stem, and leaf phenology across 13 diverse and model-relevant temperate tree species. American Geophysical Union, San Francisco, CA, USA, December 2019.

Liu Y, **ML McCormack**, K Ogle, AP Walker, CM Iversen. Controls on fine-root trait variation and implications for defining Root Functional Types. American Geophysical Union, San Francisco, CA, USA, December 2019.

Defrenne C, SW Simard, **ML McCormack**, WJ Roach, TJ Philpott, BJ Pickles, SD Addo-Danso, CM Iversen, J Childs, PJ Hanson. Fine root and mycorrhizal trait adjustments to the environment. American Geophysical Union, San Francisco, CA, USA, December 2019.

- Xia M, N Tharayil, P Kennedy, **ML McCormack**. Mycorrhizal colonization induces changes in the metabolomes of tree species depending on mycorrhizal species. Metabolomics Association of North America, Atlanta, GA, USA, November 2019.
- Liu Y, CM Iversen, **ML McCormack**, RJ Norby, K Ogle, AP Walker. Short- and long-term dynamics of leaf, wood, and fine-root production at the ORNL FACE site ([presentation](#)). Ecological Society of America, Louisville, KY, USA. August 2019.
- Midgley MG, **ML McCormack**, R Sims. The Morton Arboretum forestry plots: A classic experiment supports a vision for the future ([presentation](#)). Ecological Society of America, Louisville, KY, USA. August 2019.
- Li F, H Hu, **ML McCormack**, X Liu, D Feng, W Bao. Community-level economics spectrum of fine-roots driven by nutrient limitations in subalpine forests ([poster](#)). Ecological Society of America, Louisville, KY, USA. August 2019.
- See CR, **ML McCormack**, SE Hobbie, H Flores-Moreno, WL Siler, P Kennedy. Global patterns in fine-root decomposition: climate, chemistry, mycorrhizal association and woodiness ([presentation](#)). American Geophysical Union, Washington, DC, USA, December 2018.
- Malhotra A, RZ Abramoff, PJ Hanson, JW Harden, C Hicks Pries, RB Jackson, **ML McCormack**, RJ Norby, D Sihi, BN Sulman, PE Thornton, SJ Tumber-Davila, A Walker, Z Werbin, CM Iversen ([presentation](#)). The persistence of root carbon in soil: data and modeling gaps. American Geophysical Union, Washington, DC, USA, December 2018.
- McCormack ML**. Patterns and implications of root turnover in trees ([presentation](#)). The Landscape Below Ground, Lisle, IL, USA. October 2018.
- Defrenne CE, **ML McCormack**, SD Addo-Danso, SW Simard. Fine-root strategies along an environmental gradient in western Canada: Support for a multidimensional root trait ([presentation](#)). Ecological Society of America, New Orleans, LA, USA. August 2018.
- Iversen CM, PJ Hanson, A Malhotra, ML McCormack, RJ Norby, VG Salmon, SD Wullschlegel. Linking belowground plant traits with ecosystem processes: A multi-biome perspective ([presentation](#)). Ecological Society of America, New Orleans, LA, USA. August 2018.
- Hedin LO, M Lu, Z Ma, **ML McCormack**, RD Bardgett, DM Eissenstat, X Xu. The role of plant root strategies in resolving biome-scale biogeochemical cycles ([presentation](#)). Ecological Society of America, New Orleans, LA, USA. August 2018.
- Ma Z, D Guo, LO Hedin, RD Bardgett, DM Eissenstat, M Lu, **ML McCormack**, X Xu. Global root trait biogeography: Diversity, economics, mycorrhizal dependence, and physiological convergence. Ecological Society of America ([presentation](#)), New Orleans, LA, USA. August 2018.
- Defrenne CE, **ML McCormack**, SD Addo-Danso, SW Simard. Fine-root strategies along an environmental gradient in western Canada ([presentation](#)). International Society of Root Research, Yearim, Isreal. July 2018.
- McCormack ML**. Applying an ecosystem approach to manage urban trees belowground. International Symposium of the Management and Cultivation of the Urban Street Tree. 城市树木栽培和养护管理国际研讨会. Shanghai, China. April 2018.
- McCormack ML**, CM Iversen, H Flores-Moreno. Revisiting old assumptions and developing new paradigms informed by robust data and trait-based perspectives (invited presentation). Ecological Society of America, Portland, OR, USA. August 2017.
- Zhu K, **ML McCormack**, N Wurzburger, RA Lankau. Patterns in soil carbon and nitrogen relate to mycorrhizal and phylogenetic identity of forest trees across eastern North America (presentation). Ecological Society of America, Portland, OR, USA. August 2017.



- Iversen CM, **ML McCormack**, AS Powell. Harnessing a galaxy of root traits to address belowground challenges in plant ecology (presentation). Ecological Society of America, Portland, OR, USA. August 2017.
- McCormack ML**. Linking root traits to ecosystem processes: updating definitions and conceptual frameworks (invited presentation). 39<sup>th</sup> New Phytologist Symposium, Exeter, United Kingdom. June 2017.
- McCormack ML**, CM Iversen, DM Ricciuto, D Lu, H Flores-Moreno, AS Powell, JM Warren, AP Walker. A Growing And Global Fine-Root Trait Database: Current Coverage And Scientific Applications (poster). Department of Energy TES and SBR PI Meeting. April 2017.
- McCormack ML**, CM Iversen, DM Ricciuto, AS Powell, JM Warren, AP Walker, D Wang, Y Xu. How does a terrestrial biosphere model respond when confronted with observations from a global root trait database (poster)? International EcoSummit, Montpellier, France. August 2016.
- Zadworny M, **ML McCormack**, R Zytowski, P Karolewski, J Mucha, J Oleksyn. Intra-specific variation of Scots pine fine root adjustment along a large-scale climatic gradient (presentation). International EcoSummit, Montpellier, France. August 2016.
- McCormack ML**, RA Lankau, JF Egan, N Wurzbarger. Patterns in soil carbon and nitrogen relate to mycorrhizal and phylogenetic identity of forest trees across eastern North America (presentation). Ecological Society of America, Fort Lauderdale, FL, USA. August 2016.
- Iversen C, R Norby, J Childs, **ML McCormack**, A Walker, P Hanson, J Warren, V Sloan, P Sullivan, S Wullschlegler, AS Powell. Linking Belowground Plant Traits With Ecosystem Processes: A Multi-Biome Perspective (presentation). American Geophysical Union, San Francisco, CA, USA, December 2015.
- McCormack ML**. Are root and belowground traits ready for the big time? (invited presentation). DOE workshop on trait methods for representing ecosystem change. Rockville, MD, USA, November 2015.
- Iversen CM, **ML McCormack**, AS Powell, D Wang, Y Xu. The need for a global root trait database (presentation). DOE workshop on trait methods for representing ecosystem change. Rockville, MD, USA, November 2015.
- Iversen CM, **ML McCormack**, JM Warren, AP Walker, X Yang, D Wang. 2015. A path forward to improve the representation of fine roots in terrestrial biosphere models (presentation). 'Climate models revisited: the biogeochemical consequences of mycorrhizal dynamics' meeting. Amsterdam, Netherlands, Spring 2015.
- McCormack ML** and JF Egan. Associations with ectomycorrhizal fungi do not lead to greater soil carbon storage than arbuscular mycorrhizal fungi in temperate forests (presentation). Ecological Society of America, Baltimore, MD, USA, August 2015.
- McCormack ML**. Power to the people: Getting models and model modules into the hands of non-modelers (invited presentation). Ecological Society of America, Baltimore, MD, USA, August 2015.
- Iversen CM, **ML McCormack**, JM Warren, JL Trumbo, AS Powell, SD Wullschlegler. Fine roots in models: The answer to life, the universe, and everything (presentation). Ecological Society of America, Baltimore, MD, USA, August 2015.
- Trumbo JL, CM Iversen, AS Powell, **ML McCormack**, JM Warren. Engaging FRED (Fine-Root Ecology Database): Leveraging variation in root functional traits within and among plant functional

types to better understand and model above- and belowground ecosystem processes (poster). Ecological Society of America, Baltimore, MD, USA, August 2015.

**McCormack ML** and A Weigelt. Root turnover and decomposition in terrestrial ecosystems: what are we measuring and what does it mean (invited presentation and invited session convener). Rhizosphere4, Maastricht, Netherlands. June 2015.

**McCormack ML** and DL Guo. Estimates of forest fine root productivity based on functional classification of fine roots and root traits (Session B-198: Forests, Roots and Soil Carbon). International Union of Forest Research Organizations, Salt Lake City, UT, USA, October 2014.

**McCormack ML** and DL Guo. Linking fine root diversity to ecosystem processes in models and the real world: Allocation of NPP belowground and fine root phenology (invited presentation). Ecological Society of America, Sacramento, CA, USA, August 2014.

Eissenstat DM, **ML McCormack**, KP Gaines, TS Adams. Scaling root processes based on plant functional traits. American Geophysical Union, San Francisco, CA, USA. December 2013.

Cheng L, X Wei, T Adams, L Li, W Chen, **ML McCormack**, J Deforest, RT Koide, DM Eissenstat. Are roots and mycorrhizal fungi complementary in nutrient foraging of tree species (presentation)? Ecological Society of America, Minneapolis, MN, USA, August 2013.

**McCormack ML**, TS Adams, EAH Smithwick, DM Eissenstat. Fine root turnover: a story of root production and root phenology (presentation). American Geophysical Union, San Francisco, CA, USA, December 2012.

**McCormack ML**, E Crisfield, B Raczka, SG Pritchard, DM Eissenstat, EAH Smithwick. Fine root lifespan and turnover at ecosystem and landscape scales: sensitivity of four ecological models and new strategies for model incorporation (presentation). Ecological Society of America, Portland, OR, USA, August 2012.

**McCormack ML**, TS Adams, EAH Smithwick, DM Eissenstat. Predicting fine root lifespan from plant functional traits in temperate trees (presentation). Scaling Root Processes: Global Impacts Workshop. Arlington, VA, USA, March 2012.

Eissenstat DM, **ML McCormack**, Q Du. Root lifespan and global change (presentation). Scaling Root Processes: Global Impacts Workshop. Arlington, VA, USA, March 2012.

**McCormack ML**, TS Adams, EAH Smithwick, DM Eissenstat. Patterns of fine root turnover in temperate forests (presentation). Annual Meeting of the Ecological Society of America, Austin, TX, USA, August 2011.

Pritchard SG, AE Strand, BN Taylor, ER Cooper, **ML McCormack**, S Zhang. Effects of CO<sub>2</sub> and nitrogen enrichment on production, standing crop, and survivorship of mycorrhizal root tips in a loblolly pine FACE experiment over 12 years (poster). Annual Meeting of the Ecological Society of America, Austin, TX, USA, August 2011.

Pritchard SG, AE Strand, BN Taylor, ER Cooper, S Zhang, S Breland, **ML McCormack**. Production, standing crop, and survivorship of mycorrhizal root tips in a loblolly pine forest exposed to free-air-CO<sub>2</sub>-enrichment for a decade: Interactive effects of soil N availability (poster). International meeting on Ecology of Soil Microbes, Prague, Czech Republic, April 2011.

Strand AE, SG Pritchard, BN Taylor, ER Cooper, S Zhang, S Breland, **ML McCormack**. Influence of rhizomorph presence upon the persistence of temperate forest fine roots: summary of a 10 year

FACE study (presentation). International meeting on Ecology of Soil Microbes, Prague, Czech Republic, April 2011.

**McCormack ML**, DM Eissenstat, EAH Smithwick. Estimating current and future fine root turnover rates at landscape scales (poster). Annual Meeting of the Ecological Society of America, Pittsburgh, PA, USA, August 2010.

**McCormack ML**, EAH Smithwick, DM Eissenstat. Estimating current and future fine root turnover in Pennsylvania (presentation). Environmental Chemistry Student Symposium, University Park, PA, USA, March 2010.

**McCormack ML**, TS Adams, DM Eissenstat. Linking fine root lifespan with suites of plant species traits (presentation). Annual Meeting of the Ecological Society of America, Albuquerque, NM, USA, August 2009.

**McCormack ML**, SG Pritchard. Elevated CO<sub>2</sub> affects rhizomorph and ectomycorrhizal tip dynamics (presentation). Plant Biology Symposium: Plant-Soil Interactions in Future Climates, University Park, PA, USA, May 2009.

**McCormack ML**, TS Adams, DM Eissenstat. Predicting fine root lifespan: Is it possible and what's it good for? (presentation). Environmental Chemistry Student Symposium, University Park, PA, USA, March 2009.

Pritchard SG, **ML McCormack**, A Strand, MA Davis, S Breland, R Oren. Soil fungal dynamics in a loblolly pine forest exposed to elevated atmospheric carbon dioxide over a seven year period: interactions with soil N fertility (presentation). Annual Meeting of the Botanical Society of America, Vancouver British Columbia, Canada, July 2008.

Pritchard SG, AE Strand, **ML McCormack**, MA Davis, R Oren. Fine root dynamics in a loblolly pine forest exposed to FACE: an eight year minirhizotron study (presentation). 92<sup>nd</sup> Annual Meeting of the Ecological Society of America, San Jose, California, August 2007.

Pritchard SG, AE Strand, **ML McCormack**, MA Davis, R Oren. Effects of FACE on fine roots and soil fungi in a loblolly pine plantation (poster). North American Carbon Program Investigator's Meeting, Colorado Springs, Colorado, January 2007.

*\*Supervised undergraduate student*

## INVITED LECTURES AND SEMINARS

Invited Seminar. Arnold Arboretum and Department of Organismal and Evolutionary Biology, Harvard University. Linking belowground phenology to ecosystem processes in the real world and in models. March 2021.

Invited Seminar. Laboratoire des sciences du climat et de l'environnement, Institut Pierre Simon Laplace. Belowground phenology from empirical observations and links to leaves, wood, and models. February 2021.

Invited Seminar. Plant and Environmental Sciences Department, Clemson University. Belowground phenology: links to ecosystem processes and plant responses to changing climate. October 2020.

Invited Seminar. Chengdu Institute of Biology, Chinese Academy of Sciences. Defining belowground resource acquisition strategies. April 2018.

- Invited Seminar. Chengdu Institute of Biology, Chinese Academy of Sciences. Improving understanding of fine roots and fine root dynamics in perennial species: methods and definitions. April 2015.
- Invited Seminar. Earth Sciences Division of Lawrence Berkeley National Laboratory. Linking roots, the rhizosphere and soil science with aboveground ecosystem ecology—*RhizoNet*. August 2014.
- Invited Seminar. Ecology Research Group, Zhejiang University (浙江大学). Belowground ecology and links to ecosystem processes across an extensive research network. June 2014.
- Invited Seminar. Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, Chinese Academy of Sciences. Global relevance and universal problems measuring and modeling fine roots. November 2013.
- Guest Lecture. Root Ecology. The Pennsylvania State University, Department of Horticulture. *Controls and Constraints on Fine Root Lifespan*. October 2011.
- Guest Lecture. Concepts in Ecology. The Pennsylvania State University, IGDP in Ecology. *Global Change Ecology*. December 2009 and 2010.
- Guest Lecture. Plant EcoPhysiology. The Pennsylvania State University, Department of Horticulture/Plant Biology. *Growth, Carbon Allocation and Cost of Plant Tissues*. March 2009.
- Guest Lecture. Special Topics in Tree Research. Duke University, Nicholas School for the Environment. Durham, NC. *Methods and Study of Fine Roots*. March 2007.
- Guest Lecture. Introduction to Environmental Studies. College of Charleston, Charleston, SC. *Renewable Energy Technology, Policy, and Predictions*. October 2006.
- Invited Seminar. Alliance for Planet Earth, Earth Day Seminar Series. College of Charleston, Charleston, SC. *An Introduction to Wind and Solar Energy*. April 2005.
- Invited Seminar. Sierra Club, Charleston, SC. *Wind Energy*. April 2005.
- Environmental Studies Seminar Series. College of Charleston, Charleston, SC. *The Answer is blowing in the wind: A whirlwind tour of the world of wind energy*. February 2005.

## TEACHING

- 2008-2010 Teaching Assistant. Plant EcoPhysiology, Department of Horticulture, The Pennsylvania State University, University Park, PA.
- 2005 Teaching Assistant. Introductory Astronomy Lab, Department of Physics and Astronomy, College of Charleston, Charleston, SC.
- Additional Training: Active Learning in Life Sciences Classrooms Workshop with the Partnership for Undergraduate Life Science Education, University of Minnesota, January 2016.
- Course in College Teaching* through the Schreyer Institute for Teaching Excellence at Pennsylvania State University, Fall 2012.

## STUDENTS MENTORED

- Jessica Langguth, Undergraduate student, Ohio University, 2019-2021.
- Ashley Wrobel, Undergraduate Student, Hope College, 2020.
- Eva Carlson, Undergraduate Student, University of Minnesota, Plant Biology, 2017.
- Melissa Pastore, Undergraduate Student, The Pennsylvania State University, Biology, 2013. Completed Master's Degree at Villanova University. Currently pursuing PhD in Ecology at University of Minnesota.

Hope Brooks, Undergraduate Student, The Pennsylvania State University, Agroecology, 2015.  
Currently pursuing a PhD in Ecology and Evolution at the University of Pittsburgh.

Travis Haussener, Undergraduate Student, The Pennsylvania State University. Chemistry, 2009.  
Completed PhD in Chemistry at the University of Utah. Currently pursuing postdoctoral studies at University of Utah.

## GRANTS & FELLOWSHIPS

Elucidating the chemical plasticity of fine roots in response to soil heterogeneities and developing a robust parameter to forecast fine root decomposition. Co-PI, local PI at UMN. 2018-2020 (557,984 USD).

Linking topographic variation in belowground C processes with hydrological processes to improve Earth system models. Post-Doctoral Affiliate and Contributing Author. NASA ROSES. 2014-2016 (1,050,001 USD).

Postdoctoral Fellowship for Young International Scientists, Chinese Academy of Sciences. 2013-2015 (366,000 CNY).

China Postdoctoral Science Foundation (中国博士后科学基金) Research Fellowship. 2014-2015 (50,000 CNY).

Research Fellowship for Young International Scientists, National Natural Science Foundation of China, 2013-2014 (200,000 CNY).

Graduate Research Environmental Fellowship, Department of Energy. 2010-2013.

## SERVICE & PROFESSIONAL AFFILIATIONS

*Associate Editor:* Plant & Soil (2019-present)

*Guest Editor:* Oikos—Special Issue: Root ecology (2021-2022). Frontiers in Forests and Global Change, Special Issue: Root Dynamics-The Role of Nutrients, Water, and the Environment. Scheduled for release in late 2021. Plant & Soil, Special Issue S-71: Roots at the heart of belowground ecology. Volume 424, Issue 1-2, March 2018.

*Journal Review:* American Journal of Botany, Annals of Applied Biology, Annals of Botany, Annals of Forest Science, Arboriculture & Urban Forestry, Biogeosciences, Biologia Plantarum, Biology Letters, Canadian Journal of Forest Research, Ecological Research, Ecology, Ecology & Evolution, Ecology & Experimental Botany, Ecology Letters, Forest Ecology & Management, Forests, Functional Ecology, Global Change Biology, Geoderma, Journal of Ecology, Journal of Plant Ecology, Nature Plants, New Forests, New Phytologist, Oecologia, Plant & Soil, Plant Biology, Plant Cell & Environment, Plant Ecology, PLOS One, Soil Biology & Biochemistry, Proceedings of the Royal Society B, Restoration Ecology, Tree Physiology, Turkish Journal of Agriculture and Forestry, Urban Forestry and Urban Greening.

*Grant Review:* Panel: Department of Energy, Terrestrial Ecosystem Science Program. Ad hoc: DFG-German Research Foundation; National Science Foundation, Population and Community Ecology; Natural Sciences and Engineering Research Council of Canada, Discovery Program.

*Member:* Ecological Society of America, American Geophysical Union.