

ROSER MATAMALA

Terrestrial Ecology & Biogeochemistry

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Interests

I am an ecologist and biogeochemist who studies the carbon, water, and energy cycles and the changes occurring due to human factors, such as land-use and global climate changes at the ecosystem level. I am focused on understanding belowground systems—i.e. the interactions between plants, soil, and microbes. I study the contribution of root inputs to soil organic matter, mechanisms for soil organic matter stabilization/permanence and vulnerability to climate forcing factors in wetlands, grasslands, tundra, and forests. I use field chronosequences (space for time substitutions), manipulative climate change experiments, laboratory experiments, eddy covariance monitoring, spectroscopy, and stable isotope integrators. I am also developing soil sensors and wireless underground sensor networks to study soils.

Education

- University of Barcelona, Barcelona, Spain. Biological Sciences Ph.D. 1997
- University of Barcelona, Barcelona, Spain. Plant Biology M.S. 1993
- University of Barcelona, Barcelona, Spain. Biology B.S. 1991

Professional Positions

- **University of Chicago Consortium for Advanced Science & Engineering (CASE)**, IL.
2018-present, *Scholar*
- **Northwestern Argonne Institute of Science & Engineering (NAISE)**, IL
2015-present, *Institute Fellow*
- **Argonne National Laboratory**, Environmental Science Division, IL
2006-present, *Scientist*
2002-2005, *Assistant Scientist*
2000-2001, *Research Associate*
- **Duke University**, Botany Department, NC
1998-2000, *Research Associate*
- **Smithsonian Environmental Research Center (SERC)**, MD
1993-1997, *Plant Biologist*
- **Institut de Recerca i Tecnologia Agroalimentaries (IRTA)**, Barcelona, Spain
1991-1993, *Research Assistant*

Published Articles

John T. Lovell, Alice H. MacQueen, Sujan Mamidi, *et al.* 2021. Polyploidy and genomic introgressions facilitate climate adaptation and biomass yield in switchgrass. *Nature* 590, 438-444.

Mishra, U., G. Hugelius, E. Shelef, Y. Yang, J. Strauss, A. Lupachev, J. Harden, J. Jastrow, C.L. Ping, W. Riley, E. Schuur, R. Matamala, M. Siewert, L. Nave, C. Koven, M. Fuchs, J. Palmtag, P. Kuhry, C. Treat, S. Zubrzycki, F. Hoffman, B. Elberling, P. Camill, A. Veremeeva, and A. Orr. 2021. Spatial

- heterogeneity and environmental predictors of permafrost region soil organic carbon stocks. *Science Advances* 7:eaa5236. DOI:10.1126/sciadv.aaz5236.
- Ricketts, M.P., R. Matamala, J.D. Jastrow, D. Antonopoulos, J. Koval, C.L. Ping, C. Liang, and M.A. Gonzalez-Meler. 2020. The effects of warming and soil chemistry on bacterial community structure in Arctic tundra soils. *Soil Biology & Biochemistry* 148: 107882.
- Yu, G., Zare, A., Sheng, H., Matamala, R., Reyes-Cabrera, J., Fritschi, F., Juenger, T. 2020. Root identification in minirhizotron imagery with multiple instance learning. *Machine Vision and Application* 31:43.
- Xu, W., Yu, G., Zare, A., Zurweller, B., Rowland, D., Reyes-Cabrera, J., Fritschi, F.B., Matamala, R., Juenger, T.E. 2020. Overcoming Small Minirhizotron Datasets Using Transfer Learning. *Computer and Electronics in Agriculture* 175:105466.
- Berkelhammer, M., Alsip, B, Matamala, R., Cook, D, Whelan, M., Joo, E., Bernacchi, C., Miller, J., Meyers, T. 2020. Seasonal evolution of canopy stomatal conductance for a prairie and maize field in the midwestern US from continuous carbonyl sulfide fluxes. *Geophysical Research Letters*. 47: e2019GL085652.
- Wade, J., G. Maltais-Landry, D.E. Lucas, G. Bongiorno, T.M. Bowles, F.J. Calderón, S.W. Culman, R. Daughtridge, J.G. Ernakovich, S.J. Fonte, D. Giang, B.L. Herman, L. Guan, J.D. Jastrow, B.H.H. Loh, C. Kelly, M.E. Mann, R. Matamala, E.A. Miernick, B. Peterson, M.M. Pulleman, K.M. Scow, S.S. Snapp, V. Thomas, X.Tu, D. Wang, N.A. Jelinski, G.C. Liles, F.H. Barrios-Masias, M.L. Silveira, and A.J. Margenot. 2020. Assessing the sensitivity and repeatability of permanganate oxidizable carbon as a soil health metric: an interlab comparison. *Geoderma* 366:114235.
- Natali, S.M., Watts, J.D., Potter, S., *et al.*, 2019. Substantial winter CO₂ losses shift the Arctic to a carbon source under current and future climates. *Nature Climate Change*. 9:852-857.
- Matamala, R., Jastrow, J.D., Calderón, F.J., Liang, C., Fan, Z., Michaelson, G.J. and Ping. C.L. 2019. Predicting the decomposability of arctic tundra soil organic matter with mid infrared spectroscopy. *Soil Biology and Biochemistry* 129:1-12.
- Matamala, R., Calderón, F.J., Jastrow, J.D., Fan, Z., Hofmann, S.M., Michaelson, G.J., Mishra, U., and Ping, C.L. 2017. Influence of site and soil properties on the DRIFT spectra of northern cold-region soils. *Geoderma* 305:80-91. doi:10.1016/j.geoderma.2017.05.014.
- Mishra, U., B. Drewniak, J.D. Jastrow, R. Matamala, and U.W.A. Vitharana. 2017. Spatial representation of high latitude organic carbon and active-layer thickness in CMIP5 earth system models. *Geoderma* 300:55-63. doi:10.1016/j.geoderma.2016.04.017.
- Vitharana, U.W.A., U. Mishra, J.D. Jastrow, R. Matamala, and Z. Fan. 2017. Observational needs for estimating Alaskan soil carbon stocks under current and future climate. *Journal of Geophysical Research: Biogeosciences* 122:415-429. doi:10.1002/2016JG003421.
- Lokupitiya, E. , A.S. Denning, K. Schaefer, D. Ricciuto, R. Anderson, M.A. Arain, I. Baker, A.G. Barr, G. Chen, J.M. Chen, P. Ciais, D.R. Cook, M. Dietze, M. El Maayar, M. Fischer, R. Grant, D. Hollinger, C. Izaurralde, A. Jain, C. Kucharik, Z. Li, S. Liu, L. Li, R. Matamala, P. Peylin, D. Price, S.W. Running, A. Sahoo, M. Sprintsin, A.E. Suyker, H. Tian, C. Tonitto, M. Torn, Hans Verbeeck, S.B. Verma, Y. Xue. 2016. Carbon and energy fluxes in cropland ecosystems: a model- data comparison. *Biogeochemistry* doi:10.1007/s10533-016-0219-3.

- Yan, H., Wang, S., Billesbach, D., Oechel, W., Bohrer, G., Meyers, T., Martin, T.A., Matamala, R., Phillips, R.P., Rahman, F., Yu, Q., Shugart, H.H.Y. 2015. Improved global simulations of gross primary product based on a new definition of water stress factor and a separate treatment of C₃ and C₄ plants. *Ecological Modelling* 297:42-59.
- Wagle, P., X. Xiao, R.L. Scott, T.E. Kolb, D.R. Cook, N. Brunzell, D.D. Baldocchi, J. Basara, R. Matamala, Y. Zhou, and R. Bajgain. 2015. Biophysical controls on carbon and water vapor fluxes across a grassland climatic gradient in the United States. *Agricultural and Forest Meteorology* 214–215:293–305. doi:10.1016/j.agrformet.2015.08.265.
- Wagle, P., X. Xiao, M.S. Torn, D.R. Cook, R. Matamala, M.L. Fischer, C. Jin, J. Dong, and C. Biradar. 2014. Sensitivity of vegetation indices and gross primary production of tallgrass prairie to severe drought. *Remote Sensing of Environment* 152:1-14.
- Fan, Z, JD Jastrow, C Liang, R Matamala, and RM Miller. 2013. Priming effects in boreal black spruce forest soils: quantitative evaluation and sensitivity analysis. *PLoS One* 8: e77880.
- Mishra U, JD Jastrow, R Matamala, G Hugelius, CD Koven, JW Harden, CL Ping, GJ Michaelson, Z Fan, RM Miller, AD McGuire, C Tarnocai, P Kuhry, WJ Riley, K Schaefer, EAG Schuur, MT Jorgenson, and LD Hinzman. 2013. Empirical estimates to reduce modeling uncertainties of soil organic carbon in permafrost regions: a review of recent progress and remaining challenges. *Environmental Research Letters* 8:035020.
- Lynch, D.J., Matamala, R., Norby, R.J., Iversen, C., Gonzalez-Meler, M.A., 2013. Quantifying fine-root carbon sources and turnover using ¹³C tracer at the conclusion of a long-term FACE experiment. *New Phytologist* 199:420-430.
- Gilmanov, T., Baron, V., Hanan, N.P., Matamala, R., Prueger, J., Hatfield, J. 2013. CO₂ uptake and ecophysiological parameters of the grain crops in midcontinent North America: Estimates from flux tower measurements. *Agriculture, Ecosystems and Environment* 164:162-175.
- Gomez-Casanovas, N., Matamala, R., Cook, D.R., Gonzalez-Meler, M.A. 2012. Net ecosystem exchange affects the autotrophic and heterotrophic components of soil respiration at different time scales in prairie grasslands. *Global Change Biology* 18: 2532-45.
- Schaefer, K., Schwalm, C.R., Williams, C., et al. 2012. A model-data comparison of gross primary productivity: Results from the North American Carbon Program site synthesis. *Journal of Geophysical Research-Biogeosciences* 117. G03010 DOI: 10.1029/2012JG001960
- Garten, C.T., Brice, D.J., Castro, H.F. et al 2011. Response of "Alamo" switchgrass tissue chemistry and biomass to nitrogen fertilization in West Tennessee, USA. *Agriculture Ecosystems & Environment* 140: 289-297.
- Xiao, J., Zhuang, Q., Law, B.E., et al., 2011. Assessing net ecosystem carbon exchange of U.S. terrestrial ecosystems by integrating eddy covariance flux measurements and satellite observations. *Agricultural and Forest Meteorology* 151:60-69.
- Yi, C.X., Ricciuto, D. Li, R. et al., 2010. Climate controls of terrestrial carbon exchange across biomes and continents. *Environmental Research Letters*, 5: article number 034007.
- Schwalm, C.R., Williams, C.A., Schaefer, K. et al., 2010. A model-data intercomparison of CO₂ exchange across North America: Results from the North American Carbon Program site synthesis. *Journal of Geophysical Research-Biogeosciences* 115: Article number G00H05.

- Garten CT, Smith JL, Tyler DD et al., 2010. Intra-annual changes in biomass, carbon, and nitrogen dynamics at 4-year old switchgrass field trials in west Tennessee, USA. *Agriculture Ecosystems & Environment* 136:177-84.
- Xiao J, Zhuang Q, Law BD, et al. 2010. A Continuous measure of gross primary production for the conterminous United States derived from MODIS and AmeriFlux data. *Remote Sensing & Environment* 576-91.
- Xiao J, Zhuang Q, Baldocchi DD et al. 2008. Estimation of net ecosystem carbon exchange for the conterminous United States by combining MODIS and AmeriFlux data. *Agricultural and Forest Meteorology* 148:1827-47.
- Matamala R, Jastrow DJ, Miller RM, Garten CT. 2008. Temporal changes in the distribution of C and N stocks in a restored tallgrass prairie in the U.S. Midwest. *Ecological Applications* 18: 1470-88.
- Pritchard SG, Strand AE, McCormack ML, Davis MA, Finzi AC, Jackson RB, Matamala R, Rogers HH, Oren R. 2008. Fine root dynamics in a loblolly pine forest are influenced by Free-Air-CO₂-Enrichment (FACE): a six year minirhizotron study. *Global Change Biology* 14: 588-602.
- Allison VJ, Z Yermakov, RM Miller, JD Jastrow, R Matamala. 2007. Assessing soil microbial community composition across landscapes: Do surface soils reveal patterns? *Soil Science Society of America Journal* 71:730-734.
- Allison VJ, Z Yermakov, RM Miller, JD Jastrow, and RMatamala. 2007. Using landscape and depth gradients to decouple the impact of correlated environmental variables on soil microbial community composition. *Soil Biology and Biochemistry* 39:505-516.
- Finzi AC, Moore D, DeLucia EH, Lichter J, Kim HS, Matamala R, Jackson RB, McCarthy H, Oren R, Pippen JS, Schlesinger WH. 2006. Progressive Nitrogen Limitation of Ecosystem Processes under Elevated CO₂ in a Warm-Temperate Forest. *Ecology* 87: 15-25.
- Allison VJ, RM Miller, JD Jastrow, R Matamala, DR Zak. 2005. Changes in soil microbial community structure in a tallgrass prairie chronosequence. *Soil Science Society of America Journal* 69:1412-21.
- Jastrow JD, RM Miller, R Matamala, RJ Norby, TW Boutton, CW Rice, CE Owensby. 2005. Elevated atmospheric CO₂ increases soil carbon. *Global Change Biology* 11:2057-64.
- Matamala R, MA Gonzalez-Meler, JD Jastrow, R Norby, WH Schlesinger. 2003. Impacts of fine root turnover on forest NPP and soil C sequestration potential. *Science* 302: 1385-87.
- Pataki DE, DS Ellsworth, RD Evans, et al., 2003. Tracing changes in ecosystem function under elevated carbon dioxide conditions. *BioScience* 53: 805-18.
- Allen AS, Andrews JA, Finzi AC, Matamala R, Richter DR, Schlesinger WH. 2000. Effects of Free-Air CO₂ Enrichment (FACE) on belowground processes in a loblolly pine forest. *Ecological Applications* 10: 437-48.
- Andrews JA, Matamala R, Westover KM, Schlesinger WH. 2000. Temperature effect on the diversity of soil heterotrophs and the $\delta^{13}\text{C}$ of soil-respired CO₂. *Soil Biology and Biochemistry* 32: 699-706.
- Luo Y L, JA Andrews, L White, R Matamala, KVR Schafer, W H Schlesinger. 2000. Elevated CO₂ differentiates ecosystem carbon processes: A deconvolution analysis of Duke Forest FACE data. *Ecological Monographs* 71:357-76.

- Matamala R, Schlesinger WH. 2000. Effects of atmospheric CO₂ enrichment on fine root production and activity in an intact temperate forest ecosystem. *Global Change Biology* 6: 967-80.
- DeLucia, EH, Hamilton JG, Shawna LN, et al., 1999. Net primary production of a forest ecosystem with experimental CO₂ enrichment. *Science* 284: 1177-79.
- Andrews J A, Matamala R, Harrison K, Schlesinger WH. 1999. Separation of root from total soil respiration using ¹³C labeling during free-air CO₂ enrichment (FACE). *Soil Science Society of America Journal* 63: 1429-35.
- Matamala R, Drake BG. 1998. The influence of atmospheric CO₂ enrichment on plant-soil nitrogen interactions in a wetland plant community on the Chesapeake Bay. *Plant and Soil* 210: 93-101.
- Drake BG, Muehe M, Peresta G, González-Meler MA, Matamala R. 1996 Acclimation of photosynthesis, respiration and ecosystem carbon flux of a wetland on Chesapeake Bay, Maryland to elevated atmospheric CO₂ concentration. *Plant and Soil* 187: 111-8.
- Peñuelas J, R Matamala. 1993. Variations in the mineral-composition of herbarium plant-species collected during the last 3 centuries. *Journal of Experimental Botany*, 44: 1523-25.
- Peñuelas J, R Matamala. 1990. Changes in N and S leaf content, stomatal density and specific leaf area of 14 plant species during the last three centuries of CO₂ increase. *Journal of Experimental Botany* 41: 1119-24.

Book chapters

- Schlesinger WH, E S Bernhardt, EH DeLucia, et al., 2006. The Duke Forest FACE experiment: CO₂ enrichment of a loblolly pine forest. In ES 187, J Nosberger, SP Long, RJ Norby, M Stitt, GR Hendrey, and H Blum (eds.) *Managed Ecosystems and CO₂: Case Studies, Processes and Perspectives*, Springer-Verlag, New York. Pp. 197-212.
- Drake BG, Peresta G, Beugeling E, Matamala R. 1996. Long-term elevated CO₂ exposure in a Chesapeake Bay wetland: Ecosystem gas exchange, Primary production and tissue nitrogen. *Carbon Dioxide and Terrestrial Ecosystems*. Ed. Koch G W and Mooney H A pp. 197-214.

Reports

- Matamala, R., and D.B. Stover. 2013. Introduction to a Virtual Special Issue: modeling the hidden half – the root of our problem. *New Phytologist* 200:939-942.
- Hamada, Y., Graham, R., Matamala, R., 2013. Emerging Technological Needs for Terrestrial Biogeochemistry Measurements. *Eos, Transactions American Geophysical Union*, 94: 473.
- Matamala R, MA Gonzalez-Meler, JD Jastrow, R Norby, WH Schlesinger. 2004 Response to Comment on: Impacts of Fine Root Turnover on Forest NPP and Soil C Sequestration Potential. *Science* 304:1745.

Presentations (only invited are shown)

- Invited talk to French-American Innovation Days, virtual, 2021
- Invited talk to Fermilab Family Open House, virtual, 2021.
- Invited short talk at DOE-BER TES/SBR Joint Investigators Meeting, Potomac, MD, 2018.
- Invited seminar at Duke University Ecological seminar series, NC, 2018.
- Invited seminar to Biological Sciences Department seminar series, UI at Chicago, 2017.

- Keynote speaker at the Fundacao de Amparo a Pesquisa do Estado de Sao Paulo (FAPESP), Research Program on Global Climate Change (RPGCC), Sao Paulo, Brazil, 2014.
- Invited seminar at University Wisconsin-Madison seminar series, WI, 2014.
- Invited seminar at the Marine Biology Laboratory seminar series, Woods Hole, MA, 2013.
- Invited speaker at the 16th International Congress of Photosynthesis Research, St. Louis, 2013.
- Invited speaker at the AmeriFlux Annual Investigators Meeting, Washington D.C., 2009.
- Invited speaker at ESA Meeting Linking Roots and Soil session, Albuquerque, NM, 2009.
- Invited seminar at Colombia University seminar series, Colombia, 2007.
- Keynote speaker for the European COST E-38 Conference, Tartu, Estonia, 2005.
- Invited speaker, TCP DOE review in Boulder, Colorado, 2003.
- Invited seminar, Morton Arboretum seminar series, IL, 2002.
- Invited speaker for the Global Change Education Program, ANL, IL, 2002.
- Invited seminar at the University of Toledo seminar series, Toledo, OH, 2001.
- Invited seminar at University of Illinois Urbana-Champaign seminar series, Urbana, IL, 2000.

Numerous oral and poster presentations (+100) at the Ecological Society of America, Soil Science Society of America, American Geophysical Union and many others.

Workshop organizer

- Organized the “Linking Above and Belowground Processes” session at the Environmental System Science PI Meeting, Potomac, MD, 2019.
- Organization committee member of the “Sensor Needs for Terrestrial Biochemistry Measurements Workshop”, Argonne National Laboratory, 2013.
- Organized the “Scaling Root Processes: Global Impacts” Workshop for DOE-BER, Washington, D.C., 2012.
- Local organization committee member for the Soil Ecology Society Meeting, Lemont, IL, 2005.

Outreach

- Mentor to 20 undergraduate students through participation in many educational programs (Science Undergraduate Laboratory Internships). Committee member of 6 graduated students.
- Participation in activities and lectures organized to inspire young women to pursue careers in science at the Middle and High School level. Participation in “Science Careers in Search of Women” at Argonne National Laboratory.
- Participation in Databases and Network activities to foster interactions and collaborations across science disciplines and methodologies such as the North American Carbon Program, the AmeriFlux Network, Fluxnet, the International Soil Carbon Network, and the Permafrost Carbon Network.
- Member of the Ecological Society of America and the American Geophysical Union.

Media attention of research activities

- Nature News and Views. *Multiple genomes give switchgrass an advantage*. Written by Erik Sacks, Feb. 1, 2021. <https://www.nature.com/articles/d41586-021-00212-x>
- DRIFTing to Fast, Precise Data. BER Highlights. January, 2018. <https://www.energy.gov/science/ber/articles/drifting-fast-precise-data>
- The Challenge of Estimating Alaska's Soil Carbon Stocks. BER Highlights. Nov, 2017. <https://www.energy.gov/science/ber/articles/challenge-estimating-alaska-s-soil-carbon-stocks>
- *Multiple Argonne National Laboratory Highlights. Currently being featured in the Environmental Science Division website highlighting Arctic research work:* <http://www.evs.anl.gov/research-areas/highlights/drift-spectroscopy.cfm>
- *NERP study: Prairie buries greenhouse gas component*. Written by Siri Steiner, June 14, 2006 Fermilab Today, News: http://www.fnal.gov/pub/today/archive_2006/today06-06-14.html
- *New study of tree roots will alter carbon-sequestration models*. Written by Evelyn Brown, March 4, 2005.
- *CO₂ Research Gets to the Root of Things. Lifespan of plant roots may influence soils' abilities to absorb atmospheric carbon dioxide*. Written by Sean Canino, November 20, 2003. Duke University, News and Communications.
- *Faster tree growth may not stem global warming*. Written by Catherine Foster, November 21, 2003. Argonne News Release.
- *A forest's appetite for carbon*. Written by Daniel Kane, November 21, 2003. Science for kids.
- *Tree root study may unbalance greenhouse-gas accounting*. Written by Sarah Graham, November 21, 2003.