Center for Ecosystem Science & Society NORTHERN ARIZONA January-June 2016





Ecoss

22

communities Arctic warming carbon ecology trees soil fungi isotopes bacteria permafrost ecosystems warming fire forests streams nitrogen



Grants Received

\$3,878,128

\$334,522 Haubensak, Dijkstra, Grady, Gehring Joint Fire Sciences Program

Applied nucleation as a restoration strategy in degraded sagebrush habitat

(support) Hewitt, Temple-Beamish National Science Foundation/PolarTrec (Teachers and Researchers Exploring and Collaborating)

Arctic Scientist/Teacher Collaboration (K-12): "Deep roots: Plant and mycorrhizal acquisition of nitrogen from thawing permafrost"

\$2,474,771 Hungate, Dijkstra, B.Koch, Schwartz, Mack

U.S. Department of Energy, Office of Biological & Environmental Research: Systems Biology Enabled Research on the Roles of Microbial Communities in Carbon Cycle Processes

Scaling the microbial ecology of soil carbon

\$144,402 Hungate

\$66,033

National Institutes of Health/George Washington University

Microbial ecology of the nasal microbiome implications for Staphylococcus aureus colonization, carriage, and infection

\$272,867 G. Koch, Schwartz

National Science Foundation/ Early-concept Grants for Exploratory Research

Exploratory studies of metabolic water in plants and soil microorganisms

\$190,873 G. Koch, Ogle

National Science Foundation: Rapid Response Research

Leveraging the 2015-2016 El Niño to evaluate drought legacy effects on tree growth responses to rare wet events

\$394,660 Mack

National Science Foundation: Division of Environmental Biology

Shrub impacts on N inputs and turnover in the arctic, and their potential to feedback to vegetation and climate change

(support) Mauritz, Temple-Beamish National Science Foundation/PolarTrec (Teachers and Researchers Exploring and Collaborating)

Arctic Scientist/Teacher Collaboration (K-12): "Carbon balance in warming and drying tundra"

B. Koch

Arizona Game and Fish Department: Heritage Fund

Habitat evaluation to maximize success of spikedace and loach minnow repatriation





U.S. DEPARTMENT OF ENERGY









\$10,683,778

Dijkstra, van Groenigen, Schwartz, Hungate US Dept. of Energy/Environmental System Science \$599,604

Taxon-specific growth and death dynamics in response to temperature in intact soil microbial communities

Dijkstra, van Gestel, B. Koch, Schwartz, van Groenigen

National Science Foundation/Dimensions of Diversity \$1,984,865

Collaborative research: dimensions-communitywide and taxon-specific stress, growth and death in soil microbial communities in response to temperature and carbon availability

Dijkstra, Schwartz, Hungate

US Department of Agriculture/Integrated Research, Education, and Extension Competitive Grants Program-Organic Transitions \$499,730 C and N stress in soil microbial communities in organic farming systems

Dijkstra

US Dept. of Energy/Joint Genome Institute non-monetary match

Stress in Microbial Communities in Response to Changes in Carbon and Nitrogen Availability

Hungate, Ogle, Caporaso, Marks, Fofanov National Science Foundation/Research Traineeship

Program \$2,998,349

NRT-DESE: Research training in data-enabled microbial ecology (DEME)

Mack, HowardNASA\$30,000Effects of fire severity and spatial heterogeneity on
vegetation dynamics at the boreal-tundra ecotone
of interior Alaska

Mack, BoydNASA\$30,000Effects of climate change and insect outbreaks on
productivity and mortality of aspen in interior Alaska

Mack, Schuur

US Dept. of Defense / Strategic Environmental Research and Development Program \$274,269 Identifying indicators of state change in Alaskan boreal ecosystems: Testing previous hypotheses and conclusions with long-term data

Schuur

Univ. of Oklahoma/ Systems Biology Enabled Research on the Roles of Microbial Communities in Carbon Cycle Processes \$535,659

System-level predictive understanding of microbial feedbacks to experimental soil warming and moisture alterations

Schuur, Hungate, Mack, Kaufman, McKay National Science Foundation/ Major Research

Instrumentation \$2,832,134 MRI: Acquisition of a mini carbon dating system for understanding arctic carbon and climate (ACCLIMATE)

van Gestel, Hungate, Dijkstra

National Science Foundation/ Division of Polar Programs \$899,168 Antarctica as a model system for responses of

Antarctica as a model system for responses of terrestrial carbon balance to warming

Pre-proposals Prepared

10

MackDOD/SERDP1/7/2016Identifying indicators of state change in Alaskan borealecosystems: Testing previous hypotheses andconclusions with long-term data

Schädel, Schuur, NSF/DEB Hungate

1/25/2016

Climate forcing impacts from greenhouse gas release when permafrost undergoes environmental changes

Schuur	NSF/LTREB	1/25/2016
The Arctic carbon and climate observatory: Tundra		
ecosystem carboi	n balance and old carb	on loss as a
consequence of p	permafrost degradation	1

Marks Hungate, NSF/DEB 1/25/2016 Schwartz, B, Koch Litter quality and stream food webs: A new paradigm for understanding interactions between microbes and invertebrates

van Groenigen NSF/DEB 1/25/2016 The role of microbial turnover in regulating the soil carbon cycle

B. Koch, Marks NSF/DEB 1/25/2016 Geomorphic controls on freshwater food web energy flow in montane watersheds

Dijkstra NSF/DEB 1/25/2016 Stress in microbial communities



American Academy of Microbiology: **Bruce Hungate** elected Fellow

Ecological Society of America: **Michelle Mack** elected Fellow

Most Significant NAU Research/Scholarly Work: **Kees Jan van Groenigen**, for "Faster Decomposition Under Increased Atmospheric CO₂ Limits Soil Carbon Storage."

NAU 3-minute Research Presentation: **Elaine Pegoraro** awarded 2nd place, Graduate Student Government Poster Symposium.

Soil Science Society of America's Francis and Evelyn Clark Soil Biology Scholarship: **Rachel Rubin.**

Promoted to Assistant Research Professor: **Christina Schädel and Ben Koch**, February; effective August. Mack

NSF/DEB

1/25/2016

Decomposition and nutrient release in the saturated zone of thawing permafrost peatlands: Feedbacks between permafrost carbon loss and plant productivity

Dijkstra, Marks, NSF/EAGER 5/12/2016 Schwartz

Exploring transcription in bacterial communities: environment and evolution

B. Koch, Marks, NSF/EAGER 5/12/2016 Hungate, Schwartz

Quantifying the role of animal microbiomes in interspecific interactions



Student, Employee & Alumni News

Four Ecoss Alums Land Tenure-Track Faculty Jobs:

Ember Morrissey, PhD (Ecoss Postdoc 2013-2015): New position as Assistant Professor of Environmental Microbiology, Division of Plant and Soil Sciences, West Virginia University.

Theresa McHugh, PhD (NAU PhD, 2013; Ecoss Postdoc, 2013-2015): New position as Assistant Professor of Microbiology at Colorado Mesa University.

Joey Blankinship, PhD (NAU PhD, 2009) former Post-doctoral Fellow at NAU: New position as Assistant Professor of Microbial Biogeochemistry, Department of Soil, Water, and Environmental Sciences, University of Arizona.

Ben Duval, PhD (NAU PhD, 2010): New position as Assistant Professor of Ecology, Biology Department, New Mexico Tech.

Advanced to Candidacy: Rachel Rubin and Brianna Finley

Defended MS thesis: Emily Borodkin

Painting of veery (*Catharus fuscescens*) featured on American Society of Naturalists website as a "Featured Photograph": **Natasja van Gestel**



Schuur EAG, Druffel E, and Trumbore SE (eds.) (2016) Radiocarbon and Climate Change: Mechanisms, Applications, and Laboratory Techniques. Springer Verlag Publisher.



Bruce Hungate: University of New Hampshire, Invited Seminar Series, Ecosystem Ecology in a Changing World: *Big questions and innovative approaches: the microbial ecology of soil carbon* and *Climate change: how do we know?* April 2016.

Christina Schädel: Invited keynote talk, 8th Annual Meeting of the Permafrost Working Group of the German Society for Polar Sciences in Hamburg, Germany: *Carbon decomposability in permafrost*. January 2016.

Ted Schuur: Invited talk, Arctic Encounters, Seattle, WA: *Permafrost in a changing Arctic*. January 2016.

Ted Schuur: Invited talk, ARCUS Arctic Research Seminar Series, Washington, DC: *Regional and global implications of changing permafrost in a changing Arctic.* February 2016.

Gerardo Celis: Invited lecturer at University of Houston – Conservation Biology Course: *Implications* of climate change in the Arctic and results from Schuur lab group's research. March 2016.

Ted Schuur: Invited talk, Department of Energy Terrestrial Ecosystems Program All-Scientist Meeting, Washington, DC. *The response of permafrost carbon in an experimentally warmed tundra ecosystem*. April 2016. Jane Marks, Adam Siders and Rebecca Fritz: Oral and poster presentations given at the Society for Freshwater Science Annual Conference, Sacramento, CA. Subjects included Fossil Creek, leaf litter paradigm and qSIP in freshwater ecosystems. May 2016.

Christina Schädel: Session chair, International Conference on Permafrost, Potsdam, Germany. Session Title: "Climate Change and the Permafrost Carbon Feedback: Past, Present and Future." June 2016.

Christina Schädel and Ted Schuur: Organized the Permafrost Carbon Network 1.5 day workshop for synthesis leads and co-leads in Potsdam, Germany. June 2016.

Mauritz, M., Bracho, R., Celis, G., Natali, SM, Hutchings, J, Salmon, VG, Webb, EW, Schuur, EAG: Poster presented at the XI International Conference on Permafrost, Potsdam, Germany. *Tundra carbon dynamics in response to five seasons of experimental air warming and permafrost thaw*. June 2016.



Illustration used in presentation by Jane Marks at the Society for Freshwater Science showing the pre-restoration situation at Fossil Creek, where exotic species dominated the ecosystem. Illustration by Victor Leshyk.



Scientific Illustrations



Illustration from Schwartz et al. (2016) by Victor Leshyk: press release.



Illustration by Victor Leshyk: Restoration of Fossil Creek presentation for the Society for Freshwater Science Annual Meeting.



Illustration from Schädel et al. (2016) by Victor Leshyk: press release and social media. Illustration submitted as potential cover for *Nature Climate Change*.



Illustration from Compson et al. (2016) by Victor Leshyk: press release and social media.



Science Outreach

"Where Do Japanese Beetles Come From?" *Brain Food*, KNAU radio program, 4/7/2016

"We've got your number: Tracing the source of invasive Japanese beetles" NAU News, 3/9/2016; press release (via NAU Public Affairs), 3/9/2016; picked up by multiple science news sites and blogs.

"Biomass offsets little or none of permafrost carbon release" *NAU News*, 3/22/2016;

"New tool reveals role of ancestry in soil communities of bacteria" NAU News, 4/14/2016 Press Release (via NAU Public Affairs), 4/15/2016; picked up by many science news sites and blogs as well, both locally and internationally.

"Even for the fast-melting Arctic, 2016 is in 'uncharted territory" *Washington Post,* 5/16/16; Ted Schuur quoted in story.

Michelle Mack Elected as ESA Fellow, NAU News, 6/6/16

"Carbon Dioxide Biggest Player in Thawing Permafrost," NAU News, 6/13/16; Press release 6/13/16; picked up by many national science news sites including NSF and US Department of Energy websites.

"Do the leaves that fall into a stream affect the insects that fly out?" NAU News, 6/13/16; press release 6/13/16

"How Climate Change Could Make the Ground Collapse," by Anna North, 6/16/16; *New York Times* opinion page *Taking Note*.

Bruce Hungate elected Fellow of the American Academy of Microbiology, *NAU News*, 6/29/16

Microbes, nitrogen, and plant responses to rising atmospheric CO₂, press release, 6/30/16



Social Media

Ecoss Website: Over 11,000 page views and nearly 3,000 users



Ecoss FaceBook Page: Weekly posts reach 100-450 people





Science and Sentiment film: 180 views in one month





Public Outreach

In February, Ecoss held its first **Open House** on the third floor of the SLF Building. About 100 people attended: Bruce Hungate gave on overview of Ecoss (pictured below) and guests were able to read about Ecoss research during the poster session.

The Open House was held during the Prospective Graduate Student Retreat where students and faculty were able to interact, ask questions, and get to know each other. The result was that Ecoss recruited eight new students who have accepted graduate school offers for the fall (6 PhD and 2 MS).







Leupp Elementary School 4/7/2016 K-1st grade, 40 children: Jeff Propster and Rachel Rubin demonstrated how liquid nitrogen is both a tool for science and for making ice cream. Students were also given the opportunity to create soil paintings and tour the Biology Greenhouse.



3rd Annual Flagstaff Community STEMCelebration3/7/2016

2,000-3,000 students, 28 Flagstaff K-12 Schools: Adam Siders, Bri Finley and Becky Mau (pictured above) discussed the importance of soil invertebrates (worms), aquatic invertebrates, and mosses. Despite their small size, these organisms are important ecosystem engineers.



Fieldwork



In January, Paul Dijkstra, Becky Mau and other Ecoss researchers traveled to a resort near Tengchong, China, to sample the sediment in a variety of hot springs of various pH and temperatures. The sediment samples taken during this trip allow the study of growth rates of the bacteria and archaea living under these extreme conditions using quantitative Stable Isotope Probing (qSIP). This work is part of the Tengchong Partnerships in International Research and Education (PIRE) program, which conducts research in the largest geothermal area in China.



In March, the Mack Lab group made a trip to Kruger National Park in South Africa to survey the tree resprouting experiment (started in 2011). Savanna trees suffer frequent damage from large herbivores, and often the whole crown of the tree is knocked over and crushed. How fast and vigorously a damaged tree can resprout determines survival, growth, and reproduction – things that plant ecologists find fascinating. Resprouting is also important for maintaining forage for animals, firewood for humans, and for carbon storage in these ecosystems.



In April, Ecoss researchers Ted Schuur and other partners shoveled snow from experimental tundra warming plots just outside Denali National Park in Alaska. The snow fences are part of a long-term tundra warming experiment where the researchers create conditions that are expected to occur with climate changes in the Arctic (namely, warming of the deep soil and subsequent permafrost degradation). In late winter/early spring, the snow is removed from the warming plots so that spring comes at the same time as the control site tundra and no additional water/ snow enters the plots.



Published Papers

View all 2016 publications

- Abbott BW, Schuur EAG, Mack MC, Schädel C, et al. (2016) Biomass offsets little or none of permafrost carbon release from soils, streams, and wildfire: An expert assessment. *Environmental Research Letters*, (11) 3, 034014. Read
- Alexander HD, Mack MC (2016). A canopy shift in interior Alaskan boreal forests: Consequences for above-and below ground carbon and nitrogen pools during postfire Succession. *Ecosystems*, 19(1), 98-114. Read
- Bernal B, McKinley DC, Hungate BA, White PM, Mozdzer TJ, Megonigal JP (2016) Limits to soil carbon stability: Deep, ancient soil carbon decomposition stimulated by new labile organic inputs. *Soil Biology and Biochemistry*, 98: 85-94. **Read**
- Bracho R, Natali S, Pegoraro E, Crummer KG, Schädel C, Celis G, Hale L, Wu L, Yin H, Tiedje JM, Konstantinidis KT, Luo Y, Zhou J, Schuur EAG (2016) Temperature sensitivity of organic matter decomposition of permafrostregion soils during laboratory incubations. *Soil Biology and Biochemistry*, 97, 1-14. Read
- Butterfield BJ, Camhi AL, Rubin RL and Schwalm CR (2016) Tradeoffs and compatibilities among ecosystem services: biological, physical and economic drivers of multifunctionality. *Advances in Ecological Research*, 54: 207-243. **Read**
- Compson Z, Hungate BA, Whitham TG, Meneses N, Busby PE, Wojtowicz T, Ford AC, Adams KJ, and Marks J (2016) Plant genotype influences aquatic-terrestrial ecosystem linkages through timing and composition of insect emergence. *Ecosphere*, 7(5) DOI: 10.1002/ecs2.1331.Read
- Crews, T E,Blesh J, Culman SW, Hayes RC, Jensen ES, Mack MC, Peoples MB, Schipanski ME. (2016) Going where no grains have gone before: From early to mid-succession. *Agriculture, Ecosystems & Environment* 223: 223-238. **Read**
- Gehring CA, Hayer M, Flores-Rentería L, Krohn AF, Schwartz E, Dijkstra P (2016) Cheatgrass invasion alters the abundance and composition of dark septate fungal communities in sagebrush steppe. *Botany*, 94(6): 481-491. Read
- Grosse G, Goetz S, McGuire AD, Romanovsky VE, Schuur EAG (2016) Changing permafrost in a warming world and feedbacks to the Earth system. *Environmental Research Letters*, 11(4): 040201. Read

- Hewitt RE, Bennett AP, Breen AL, Hollingsworth TN, Taylor DL, Chapin FS, Rupp TS (2016) Getting to the root of the matter: Landscape implications of plant-fungal interactions for tree migration in Alaska. *Landscape Ecology*, 31: 895-911. Read
- Hewitt RE , Hollingsworth TN, Chapin III FS, and Taylor DL (2016) Fire-severity effects on plant–fungal interactions after a novel tundra wildfire disturbance: Implications for arctic shrub and tree migration. BMC Ecology 16(1). Read
- Hungate BA, Kearns DN, Ogle K, Caron M, Marks JC, Rogg HW (2016) Hydrogen isotopes as a sentinel of biological invasion by the Japanese beetle, *Popillia japonica* Newman). *Plos One*, DOI: 10.1371/journal.pone. 0149599. **Read**
- Hurteau MD, Liang S, Martin KL, North MP, Koch GW, Hungate BA (2016) Restoring forest structure and process stabilizes forest carbon in wildfire-prone south western ponderosa pine forests. *Ecological Applications*, 26(2): 382–391. **Read**
- Johnston ER, Rodríguez-R LM, Luo C, Yuan MM, Wu L, He Z, Schuur EA, Luo Y, Tiedje JM, Zhou J, Konstantinidis KT (2016) Metagenomics reveals pervasive bacterial populations and reduced community diversity across the Alaska tundra ecosystem. *Frontiers in Microbiology*, 7: 579. **Read**
- Kranabetter MJ, McLaughlan KK, Enders SK, Fraterrigo JM, Higuera PE, Morris JL, Rastetter EN, Barnes R, Buma B, Gavin DG, Gerhart LM, Gilson L, Hietz P, Mack MC, Mc-Neil B, Perakis S. (2016) A framework to assess biogeochemical response to ecosystem disturbance using nutrient partitioning ratios. *Ecosystems*, 19: 387-395. **Read**
- LeRoux X, Bouskill NJ, Niboyet A, Barthes L, Dijkstra P, Field CB, Hungate BA, Lerondelle C, Pommier T, Tang J, Terada A, Tourna M, Poly F (2016) Functional-type controls on responses of bacterial communities to global change. *Frontiers in Microbiology*, 7: 628. **Read**
- Luo Y, Ahlström A, Allison SD, Batjes NH, Brovkin V, Cavalhais N, Chappell A, Ciais P, Davidson EA, Finzi A, Georgiou K, Guenet B, Hararuk O, Harden JW, He Y, Hopkins F, Jiang L, Koven C, Jackson RB, Jones CD, Lara MJ, Liang J, McGuire AD, Parton W, Peng C, Randerson JT, Salazar A, Sierra CA, Smith MJ, Tian H, Todd-Brown KEO, Torn M, van Groenigen KJ, Wang YP, West TO, Wei Y, Wieder WR, Xia J, Xu X, Xu X, Zhou T (2016) Toward more realistic projections of soil carbon dynamics by Earth system models. *Global Biogeochemical Cycles*, 30(1): 40-56. **Read**
- McHugh TA and Schwartz, E (2016) A watering manipulation in a semiarid grassland induced changes in fungal but not bacterial community composition. *Pedobiologia*, 59(3): 121–127. **Read**

- Morrissey EM, Mau RL, Schwartz E, Caporaso JG, Dijkstra P, van Gestel N, Koch BJ, Liu CM, Hayer M, McHugh TA, Marks JC, Price LB, and Hungate BA (2016) Phylogenetic organization of bacterial activity. *The ISME Journal,* doi: 10.1038/ismej.2016.28. **Read**
- Salmon VG, Soucy P, Mauritz M, Celis G, Natali SM, Mack MC, Schuur EAG (2016) Nitrogen availability increases in a tundra ecosystem during five years of experimental permafrost thaw. *Global Change Biology*, 22 (5): 1927-1941. Read
- Schädel C, Bader MK-F, Schuur EAG, Biasi C, Bracho R, Capek P, De Baets S, Diáková K, Ernakovich J, Estop-Ara gones C, Graham DE, Hartley IP, Iversen CM, Kane E, Knoblauch C, Lupascu M, Martikainen PJ, Natali SM, Norby RJ, O'Donnell JA, Chowdhury TR, Šantrucková H, Shaver G, Sloan VL, Treat CC, Turetsky MR, Waldrop MP, Wickland KP (2016) Potential carbon emissions dominated by carbon dioxide from thawed permafrost soils. *Nature Climate Change* doi:10.1038/nclimate3054. **Read**
- Schwartz E, Hayer M, Hungate BA,Koch BJ, McHugh TA, Mercurio W, Morrissey EM, Soldanova K (2016) Stable isotope probing with 18O-water to investigate microbial growth and death in environmental samples. *Current Opinion in Biotechnology*, 41: 14–18. Read
- Selmants PC Adair KL, Creighton ML, Giardina CP, Schwartz E (2016) Increases in mean annual temperature do not alter soil bacterial community structure in tropical montane wet forests. *Ecosphere*, 7(4): e01296. Read
- Terrer C, Vicca S, Hungate BA, Phillips RP, Prentice IC Read (2016) Mycorrhizal association as a primary control of the CO2 fertilization effect. *Science*, 353 (6294): 72-74.
- van Gestel NC, Dhungana N, Tissue DT, Zak JC (2016) Seasonal microbial and nutrient responses during a 5-year reduction in the daily temperature range of soil in a Chihuahuan Desert ecosystem. *Oecologia*, 180:(1) 265-277. **Read**
- Webb EE, Schuur EAG, Natali SM, Oken KL, Bracho R, Krapek JP, Risk D, Nickerson NR (2016) Increased wintertime CO2 loss as a result of sustained tundra warming. Journal of Geophysical Research: *Biogeosciences*, 121(2): 249–265. Read
- Wymore AS, Liu CM, Hungate BA, Schwartz E, Price LB, Whitham TG, Marks JC (2016) The Influence of Time and Plant Species on the Composition of the Decomposing Bacterial Community in a Stream Ecosystem. *Microbial Ecology*, 71 (4): 825-834. Read
- Xue K, M Yuan M, J Shi Z, Qin Y, Deng Y, Cheng L, Wu L, He Z, Van Nostrand JD, Bracho R, Natali S, Schuur EAG, Luo C, Konstantinidis KT, Wang Q, Cole JR, Tiedje JM, Luo Y, Zhou J (2016) Tundra soil carbon is vulnerable to rapid microbial decomposition under climate warming. *Nature Climate Change*, doi:10.1038/nclimate2940. Read



- Buelow HN, Kooser AS, Van Horn DJ, Barrett JE, Gooseff MN, Schwartz E, Takacs-Vesbach CD (2016) Microbial community responses to increased water and organic matter in the arid soils of the McMurdo Dry Valleys, Antarctica. *Frontiers in Microbiology*.
- Christiansen, C. T., M. C. Mack, J. DeMarco, and P. Grogan (2016) Rapid foliar litter decomposition in tall deciduous shrub tundra. *Journal of Ecology*.
- Finger, R. A., M. R. Turetsky, E. S. Euskirchen, K. Kielland, R. W. Ruess, and M. C. Mack. (2016) Effects of permafrost thaw on nitrogen availability and plant-soil interactions in a boreal Alaskan lowland. *Journal of Ecology*.
- Hewitt RE, Hollingsworth TN, Chapin III FS, Taylor DL (2016) Fire-severity effects on plant-fungal interactions after a novel tundra wildfire disturbance: Implications for arctic shrub and tree migration. BMC Ecology. DOI: 10.1186/s12898-016-0075-y.
- Johnstone, J. F., C. D. Allen, J. F. Franklin, L. E Frelich, B. J. Harvey, P. E. Higuera, M. C. Mack, R. K. Meetenmeyer, M. R. Metz, G. L. W. Perry, T. Schoennagel, and M. G. Turner. (2016) Changing disturbance regimes, ecological memory, and forest resilience. *Frontiers in Ecology and the Environment*.
- Kwon, M.J., M. Heimann, O. Kolle, K.A. Luus, E.A.G.
 Schuur, N. Zimov, S.A. Zimov, and M. Gockede.
 (2016) Drainage reduces CO2 uptake and increases
 CO2 emission on a Siberian floodplain due to shifts in vegetation community and soil thermal characteristics. *Biogeosciences Discussions*.
- McGuire, DA, Schädel C, Schuur EAG, et al. (2016) Variability in the sensitivity among model simulations of permafrost and carbon dynamics in the permafrost region between 1960 and 2009: Modeling permafrost carbon dynamics. *Global Biogeochemical Cycles*.
- O'Connor MI, Gonzalez A, Byrnes JEK, Cardinale BJ, Duffy JE, Gamfeldt L, Griffin JN, Hooper, DU Hungat BA, Paquett A, Thompson PL, Dee LE, Matulich K (2016) A general biodiversity-functioning relationship is mediated by trophic level. *Oikos*.
- Olefeldt, D, Goswami S, Grosse G, Hayes D, Kuhry P, McGuire AD, Romanovsky VE, Sannel ABK Schuur EAG, Turetsky MR. Thermokarst terrain: circumpolar distribution and soil carbon vulnerability. *Nature Geosciences*.

Sack L, Ball MC, Brodersen C, Davis SD, Des Marais DL, Donavan LA, Givnish TJ, Hacke UG, Huxman T, Jansen S, Jacobsen AL, Johnson D, Koch GW, Maurel C, McCulloh CA, McDowell NG, McElrone A, Meinzer FC, Melcher PJ, North G, Pellegrini M, Pockman WT, Pratt RB, Sala A, Santiago LS, Savage JA, Scoffoni C, Sevanto S, Sperry J, Tyerman SD, Way D, and Holbrook NM (2016) Plant hydraulics as a central hub integrating plant and ecosystem function: meeting report for "Emerging Frontiers in Plant Hydraulics" (Washington, D.C., May 2015) *Plant Cell and Environment*.