

RICHARD J. NORBY

December 17, 2012

Address

Oak Ridge National Laboratory
One Bethel Valley Road
Building 2040, MS 6301
Oak Ridge, TN 37831-6301

Telephone

Tel.: (865) 576-5261
Fax: (865) 574-9501
E-mail: rjn@ornl.gov

Education

Ph.D., University of Wisconsin-Madison, Forestry and Botany, 1981
B.A., Carleton College, Chemistry, 1972

Positions

Environmental Sciences Division, Oak Ridge National Laboratory
ORNL Corporate Fellow, 2007 - present
Distinguished R&D Staff Member, 2001 - 2007
Senior Research Staff Member, 1996 - 2001
Research Staff Member, 1987-1996
Research Associate, 1985 -1987
University of Tennessee Research Associate, 1983-1985
U.S. DOE Postdoctoral Research Training Program, 1981-1983

University of Tennessee-Knoxville

Joint Professor, Bredesen Center for Interdisciplinary Research and Graduate Education,
2011- present
Adjunct Faculty, Department of Ecology & Evolutionary Biology, 1986-present
Research Associate, Graduate Program in Ecology, 1983-1985

University of Wisconsin-Madison

Research Assistant, Department of Forestry, 1978-1981
Research Assistant, Department of Botany, 1977-1978

Professional Activities

Environment Section Editor and Manager of U.S. office, *New Phytologist*, 1997-
Associate Editor, *Journal of Plant Ecology*, 2008 -
Editorial Board, *Ecological Applications*, 1998 – 2002
Co-chair, Research Priorities for Tropical Ecosystems Under Climate Change Workshop,
U.S. Department of Energy, Office of Science, Office of Biological and Environmental
Research, June, 2012.
Member, Science Steering Group for the North American Carbon Program, 2005 - 2008
Secretary, National Technical Advisory Committee, National Institute for Global
Environmental Change, 2002

Task Leader, Global Change and Terrestrial Ecosystems, Focus 1, 1997- 2003
Member, Scientific Steering Committee, Terrestrial Ecosystem Responses to Atmospheric and Climatic Change (NSF network activity), 2001- 2007
Member, Planning Committee and Science and Facility Writing Team, Terrestrial Ecosystem Research Facility (DOE), 2001
Panel member, NASA Carbon Cycle Science peer review panel, 2004
Panel member, National Institute for Global Environmental Change, southeastern region, 1997-1998
Organizer of New Phytologist Symposium, "Stoichiometric Flexibility in Terrestrial Ecosystems Under Global Change", Oracle, Arizona, September, 2011; New Phytologist Symposium, "Carbon Cycling in Tropical Ecosystems", Guangzhou, China, November, 2009; New Phytologist Symposium "Functional Genomics of Environmental Adaptation in *Populus*", Gatlinburg, Tennessee, October, 2004; TERACC workshop, "Interactions Between Increasing CO₂ and Temperature in Terrestrial Ecosystems", Lake Tahoe, California, April, 2003; GCTE/New Phytologist Symposium, "Fine Root Dynamics and Global Change: An Ecosystem Perspective", Townsend, Tennessee, October, 1999.
Contributing author, "Climate Change Impacts on Forests", In: Climate Change 1995. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 1996.
External Reviewer, EPRI/DOE Forest Response to CO₂ Research Program
External Reviewer, U.S. EPA Global Change Research Program
Consultant to the DOE/NSF/USDA Collaborative Research in Plant Biology Program Advisory Committee, 1992
Visiting Scientist, Estonian Academy of Sciences, Tartu, Estonia, U.S.S.R., 1989.
Rapporteur, SCOPE workshop, CO₂ and Climate Change, Washington, D.C., 1993.
Rapporteur, Interagency Workshop: Biological Response to Environmental Change, Woods Hole, Massachusetts, 1987
Rapporteur, CO₂ Research Conference: Carbon Dioxide, Science, and Consensus, Institute for Energy Analysis, Berkeley Springs, West Virginia, 1982.
Participant in environmental impact study of Columbia Generating Station, Portage, Wisconsin, 1979-1981.
Reviewer for *Acta Oecologica*, *American Journal of Botany*, *Annales des Sciences Forestières*, *Annals of Botany*; *Atmospheric Environment*; *Biogeochemistry*; *Canadian Journal of Forest Research*; *Ecological Applications*; *Ecology*; *Ecology Letters*; *Ecosystems*; *Environmental and Experimental Botany*; *Environmental Pollution*, *Forest Science*; *Functional Plant Biology*; *Global Biogeochemical Cycles*; *Global Change Biology*; *Global and Planetary Change*; *International Journal of Plant Science*; *Journal of Environmental Quality*; *Nature*; *Nature Climate Change*; *New Phytologist*; *Oecologia*; *Oikos*; *Plant and Soil*; *Plant, Cell and Environment*; *Plant Physiology*; *Proceedings of the National Academy of Sciences*; *Science*; *Soil Science Society of America Journal*; *Tree Physiology*; *Trees*; *Urban Atmosphere*; *Water, Air and Soil Pollution*; Academic Press; Oxford University Press; Springer-Verlag; International Geosphere-Biosphere Programme; National Science Foundation; U.S. Environmental Protection Agency; U.S. Forest Service; U.S. Department of Energy; U.S. Department of Agriculture; U.S. Agency for International Development; U.S.-Israel Binational Science Foundation; National Acid Deposition Assessment Program; National Institute for Global Environmental Change; U.K. National Environmental Research Council, Dutch National Research Council, Swiss National Science Foundation.

Outreach Activities

Organizer of class on global change, Oak Ridge Institute for Continued Learning, 2000
Treasurer, University of Tennessee Arboretum Society, 1996 – 1999
Lecturer, Traveling Lecture Program, Oak Ridge Institute for Science and Education, U.S.
Department of Energy, 1987- 1993

Research Activities

Ecosystem responses to atmospheric and climatic change
Effects of atmospheric CO₂ enrichment on tree growth and forest metabolism
Carbon and nitrogen cycling in forest ecosystems
Forest tree physiology and plant physiological ecology
Synthesis of experimental results for use in models

Membership in Professional Societies

American Association for the Advancement of Science
American Geophysical Union
Ecological Society of America

Awards and Honors

Outstanding Mentor Award, U. S. Department of Energy Office of Science, 2007
UT-Battelle Award for Outstanding Accomplishment in Science and Technology, 2004
Fellow, American Association for the Advancement of Science, 1995
Scientific Achievement Award, Environmental Sciences Division, Oak Ridge National
Laboratory, 1992
Society of Technical Communications, Award of Merit for Technical Publication, 1989 and
1998
E. B. Fred Fellow, University of Wisconsin-Madison, 1977
Westinghouse Science Talent Search semi-finalist, 1968
Sigma Xi
Xi Sigma Pi

Teaching Experience

Lectures as part of core curriculum in Ecology & Evolutionary Biology, University of
Tennessee-Knoxville, 2009
Organizer of class on global change, Oak Ridge Institute for Continued Learning, 2000
Lecturer, Traveling Lecture Program, Oak Ridge Institute for Science and Education, U.S.
Department of Energy, 1987- 1993

Student supervision

Postdoctoral advisees (current affiliation): Anthony Walker (ORNL), Victoria Sloan (ORNL),
Colleen M Iversen (ORNL), Jeffery M. Warren (ORNL), Aimee T. Classen (University
of Tennessee), Shiqiang Wan (Chinese Academy of Sciences), Tim J. Tschaplinski
(ORNL),
PhD. Dissertation advisee: Colleen M. Iversen, University of Tennessee
PhD Committees: Jessica Bryant (UTK), Emmi Felker-Quinn (UTK), Milena Holmgren
(UTK), Sue Natali (SUNY-StonyBrook), Elizabeth O'Neill (UTK), Johnna Sholtis

(Texas Tech Univ.), Katie Stuble (UTK), Lina Taneva (Univ. Illinois-Chicago), Rebecca Trueman (Univ. Illinois-Chicago)
MS committees: Cayenne Engle (UTK), Travis Belote (UTK)
Numerous summer undergraduate participants and post-B.S. interns at ORNL

Publications

2013

Franks PJ, Adams MA, Amthor JS, Barbour MM, Berry JA, Ellsworth DS, Farquhar GD, Ghannoum O, Lloyd J, McDowell N, Norby RJ, Tissue DT, von Caemmerer S. 2013. Sensitivity of plants to changing atmospheric CO₂ concentration: From the geological past to the next century. *New Phytologist* (in press).

2012

Battipaglia B, Saurer M, Cherubini P, Calfapietra C, McCarthy HR, Norby RJ, Cotrufo MF. 2012. Elevated CO₂ increases tree-level intrinsic water use efficiency: insights from carbon and oxygen isotope analyses in tree rings across three forest FACE sites. *New Phytologist* doi: 10.1111/nph.12044.

Iversen CM, Keller JK, Garten CT Jr., Norby RJ. 2012. Soil carbon and nitrogen cycling and storage throughout the soil profile in a sweetgum plantation after 11 years of CO₂-enrichment. *Global Change Biology* 18: 1684-1697.

Luo YQ, Randerson, Abramowitz G, Bacour C, Blyth E, Carvalhais N, Ciais P, Dalmonech D, Fisher JB, Fisher R, Friedlingstein P, Hibbard K, Hoffman F, Huntzinger D, Jones CD, Koven C, Lawrence D, Li DJ, Mahecha M, Niu SL, Norby R, Piao SL, Qi X, Peylin P, Prentice IC, Riley W, Reichstein M, Schwalm C, Wang YP, Xia JY, Zaehle S, Zhou XH. 2012. A framework for benchmarking land models. *Biogeosciences* 9: 3857-3874.

McMurtrie RE, Iversen CM, Dewar RC, Medlyn BE, Näsholm T, Pepper DA, Norby RJ. 2012. Plant root distributions and nitrogen uptake predicted by a hypothesis of optimal root foraging. *Ecology and Evolution* 2: 1235-1250.

Russell LM, Rasch PJ, Mace GM, Jackson RB, Shepherd J, Liss P, Leinen M, Schimel D, Vaughan NE, Janetos AC, Boyd PW, Norby RJ, Caldeira K, Merikanto J, Artaxo P, Melillo J, Morgan MG. 2012. Ecosystem Impacts of Geoengineering: A Review for Developing a Science Plan. *Ambio* 41: 350-369.

Warren JM, Iversen CM, Garten CT Jr, Norby RJ, Childs J, Brice D, Evans RM, Gu L, Thornton P, Weston DJ. 2012. Timing and magnitude of C partitioning through a young loblolly pine (*Pinus taeda* L.) stand using ¹³C labeling and shade treatments. *Tree Physiology* 32: 799-813.

Weston D, Hanson PJ, Norby RJ, Tuskan GA, Wullschleger SD. 2012. From systems biology to photosynthesis and whole-plant modeling: a conceptual model for integrating multi-scale networks. *Plant Signaling & Behavior* 7(2): 1-3.

Wicklein HF, Ollinger SV, Martin ME, Hollinger DY, Lepine LC, Day MC, Bartlett MK, Richardson AD, Norby RJ. 2012. Variation in foliar nitrogen and albedo in response to nitrogen fertilization and elevated CO₂. *Oecologia* 169: 915-925.

2011

Brosi GB, McCulley RL, Bush LP, Nelson JA, Classen AT, Norby RJ. 2011. Effects of multiple climate change factors on the tall fescue-fungal endophyte symbiosis: infection frequency and tissue chemistry. *New Phytologist* 189: 797-805.

Chen X, Post WM, Norby RJ, Classen AT. 2011. Modeling soil respiration and variations in source components using a multi-factor global climate change experiment. *Climatic Change* 107: 459-480.

Garten CT, Iversen CM, Norby RJ. 2011. Litterfall ¹⁵N abundance indicates declining soil nitrogen availability in a free-air CO₂-enrichment experiment. *Ecology* 92: 133-139.

Iversen CM, Hooker T, Classen AT, Norby RJ. 2011. Net mineralization of N at deeper soil depths as a potential mechanism for sustained forest production under elevated [CO₂]. *Global Change Biology* 17: 1130-1139.

Kardol P, Reynolds WN, Norby RJ, Classen AT. 2011. Climate change effects on soil microarthropod abundance and community structure. *Applied Soil Ecology* 47: 37-44.

Luo Y, Melillo JM, Niu S, Beier C, Clark J, Davidson E, Dukes J, Evans RD, Field CB, Czimczik C, Keller M, Kimball BA, Kueppers L, Norby RJ, Pelini S, Pendall E, Rastetter E, Six J, Smith M, Tjoelker MG, Torn MS. 2011. Coordinated approaches to quantify long-term ecosystem dynamics in response to global change. *Global Change Biology* 17: 843-854.

Norby RJ. 2011 Carbon cycling in tropical ecosystems. *New Phytologist* 189: 893-894.

Norby RJ, Zak DR. 2011. Ecological lessons from free-air CO₂ enrichment (FACE) experiments. *Annual Review of Ecology, Evolution, and Systematics* 42: 181-203.

Warren JM, Norby RJ, Wullschleger SD. 2011. Elevated CO₂ enhances leaf senescence during extreme drought in a temperate forest. *Tree Physiology* 31:117-130.

Warren, JM, Pötzelsberger E, Wullschleger SD, Thornton PE, Hasenauer H, Norby RJ. 2011. Ecohydrological impact of reduced stomatal conductance in forests exposed to elevated CO₂. *Ecohydrology* 4: 196-210.

2010

Amthor JS, Hanson PJ, Norby RJ, Wullschleger SD. 2010. A comment on “Appropriate experimental ecosystem warming methods by ecosystem, objective, and practicality” by Aronson and McNulty”. *Agricultural and Forest Meteorology* 150: 497-498.

Castro HF, Classen AT, Austin EE, Norby RJ, Schadt CW. 2010. Precipitation regime is the major driver of changes in soil microbial community structure over CO₂ and temperature in a

multifactorial climate change experiment. *Applied and Environmental Microbiology* 76: 999-1007.

Calfapietra C, Ainsworth EA, Beier C, De Angelis P, Ellsworth DS, Godbold DL, Hendrey GR, Hickler T, Hoosbeek MR, Karnosky DF, King J, Körner C, Leakey ADB, Lewin KF, Liberloo M, Long SP, Lukac M, Matyssek R, Miglietta F, Nagy J, Norby RJ, Oren R, Percy KE, Rogers A, Scarascia Mugnozza G, Stitt M, Taylor G, Ceulemans R. 2010. Challenges in elevated CO₂ experiments on forests. *Trends in Plant Science* 15: 5-10.

Classen AT, Norby RJ, Company CE, Sides KE, Weltzin JF. 2010. Climate change alters seedling emergence and establishment in an old-field ecosystem. *PLoS ONE* 5: e13476.

Kardol P, Company CE, Souza L, Norby RJ, Weltzin JF, Classen AT. 2010. Climate change effects on plant biomass alter dominance patterns and community evenness in an experimental old-field ecosystem. *Global Change Biology* 16: 2676-2687.

Norby RJ, Warren JM, Iversen CM, Medlyn BE, McMurtrie RE. 2010. CO₂ enhancement of forest productivity constrained by limited nitrogen availability. *Proceedings of the National Academy of Sciences* 107: 19368-19373.

Souza L, Belote RT, Kardol P, Weltzin JF, Norby RJ. 2010. CO₂ enrichment increased forest understory biomass and accelerates successional development of an understory community. *Journal of Plant Ecology* 3: 33-39.

2009

Engel EC, Weltzin JF, Norby RJ, Classen AT. 2009. Responses of an old-field plant community to interacting factors of elevated [CO₂], warming, and soil moisture. *Journal of Plant Ecology* 2: 1-11.

Franklin O, McMurtrie RE, Iversen CM, Crous KY, Finzi A, Tissue D, Ellsworth D, Oren R, Norby RJ. 2009. Forest fine-root production and nitrogen use under elevated CO₂: Contrasting responses in evergreen and deciduous trees explained by a common principle. *Global Change Biology* 15: 132-144.

Garten CT Jr., Classen AT, Norby RJ. 2009. Soil moisture surpasses elevated CO₂ and temperature in importance as a control on soil carbon dynamics in a multi-factor climate change experiment. *Plant and Soil* 319: 85-94.

Norby RJ. 2009. Introduction to a virtual special issue: probing the carbon cycle with ¹³C. *New Phytologist* 184: 1-3.

Villalpando SN, Williams RS, Norby RJ. 2009. Elevated air temperature alters an old-field insect community in a multifactor climate change experiment. *Global Change Biology* 15: 930-942.

2008

Ainsworth EA, Beier C, Calfapietra C, Ceulemans R, Durand-Tarfid M, Godbold DL, Hendrey GR, Hickler T, Kaduk J, Karnosky DF, Kimball BA, Körner C, Koornneef M, Lafarge T, Leakey ADB, Lewin KF, Long SP, Manderscheid R, McNeil DL, Mies TA, Miglietta F,

Morgan JA, Nagy J, Norby RJ, Norton RM, Percy KE, Rogers A, Soussana JF, Stitt M, Weigel HJ, White JW. 2008. Next generation of elevated [CO₂] experiments with crops: A critical investment for feeding the future world. *Plant, Cell and Environment* 31: 1317-1324.

Garten CT Jr., Classen AT, Norby RJ, Brice, DJ, Weltzin JF, Souza L. 2008. Role of N₂-fixation in constructed old-field communities under different regimes of [CO₂], temperature, and water availability. *Ecosystems* 11:125-137.

Iversen CM, Ledford J, Norby RJ. 2008. CO₂ enrichment increases carbon and nitrogen input from fine roots in a deciduous forest. *New Phytologist* 179: 837-847.

Iversen CM, Norby RJ. 2008. Nitrogen limitation in a sweetgum plantation: Implications for carbon allocation and storage. *Canadian Journal of Forest Research* 38:1021-1032.

McMurtrie RE, Norby RJ, Medlyn BE, Dewar RC, Pepper DA, Reich PB, Barton CVM. 2008. Why is plant-growth response to elevated CO₂ amplified when water is limiting but reduced when nitrogen is limiting? A growth-optimisation hypothesis. *Functional Plant Biology* 35: 521-534.

Natali SM, Sanudo-Wilhelmy SA, Norby RJ, Finzi AC, Lerdau MT. 2008. Increased mercury in forest soils under elevated carbon dioxide. *Oecologia* 158: 343-354.

2007

Dermody O, Weltzin JF, Engel EC, Allen P, Norby RJ. 2007. How do elevated [CO₂], warming, and reduced precipitation interact to affect soil moisture and LAI in an old field ecosystem? *Plant and Soil* 301: 255-266.

Finzi AC, Norby RJ, Calfapietra C, Gallet-Budynek A, Gielen B, Holmes WE, Hoosbeek MR, Iversen CM, Jackson RB, Kubiske ME, Ledford J, Liberloo M, Oren R, Polle A, Pritchard S, Zak DR, Schlesinger WH, Ceulemans R. 2007. Increases in nitrogen uptake rather than nitrogen-use efficiency support higher rates of temperate forest productivity under elevated CO₂. *Proceedings of the National Academy of Sciences* 104: 14014-14019.

Hyvönen R, Ågren GI, Linder S, Persson T, Cotrufo MF, Ekblad A, Freeman M, Grelle A, Janssens IA, Jarvis PG, Kellomäki S, Lindroth A, Loustau D, Lundmark T, Norby RJ, Oren R, Pilegaard K, Ryan MG, Sigurdsson BD, Strömberg M, van Oijen M, Wallin G. 2007. The likely impact of elevated [CO₂], nitrogen deposition, increased temperature, and management on carbon sequestration in temperate and boreal forest ecosystems. A literature review. *New Phytologist* 163: 463-480.

Körner C, Morgan J, Norby R. 2007. CO₂ fertilization When, where, how much? pp. 9-21 In Canadell JG, Pataki DE, Pitelka LF (eds) 'Terrestrial Ecosystems in a Changing World', Springer, Berlin.

Monson RK, Trahan N, Rosenstiel TN, Veres P, Moore D, Wilkinson M, Norby RJ, Volder A, Tjoelker MG, Briske DD, Karnosky DF, Fall R. 2007. Isoprene emission from terrestrial ecosystems in response to global change: minding the gap between models and observations.

Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences **365**: 1677-1695.

Norby RJ, Rustad LE, Dukes JS, Ojima DS, Parton WJ, Del Grosso SJ, McMurtrie RE, Pepper DA. 2007. Ecosystem Responses to Warming and Interacting Global Change Factors. pp. 23-36 In Canadell JG, Pataki DE, Pitelka LF (eds) 'Terrestrial Ecosystems in a Changing World', Springer, Berlin.

Norby R., Slater H. 2007. *New Phytologist* and the environment. *New Phytologist* 174: 1–3.

Wan S, Norby RJ, Ledford J, Weltzin JF. 2007. Responses of soil respiration to elevated CO₂, air warming, and changing soil water availability in an old-field grassland. 2007. *Global Change Biology* 13: 2411-2424.

2006

Norby RJ, Iversen CM. 2006. Nitrogen uptake, distribution, turnover, and efficiency of use in a CO₂-enriched sweetgum forest. *Ecology* 87:5-14.

Norby RJ, Wullschleger SD, Hanson PJ, Gunderson CA, Tschaplinski TJ, Jastrow JD. 2006. CO₂ enrichment of a deciduous forest: The Oak Ridge FACE Experiment. pp. 231-251 In: *Managed Ecosystems and CO₂: Case Studies, Processes, and Perspectives* (Nösberger J, Long SP, Norby RJ, Stitt M, Hendrey GR, Blum H, editors). *Ecological Studies*, Vol. 187. Springer, Berlin.

Nösberger J, Long SP, Norby RJ, Stitt M, Hendrey GR, Blum H (Eds.) 2006. *Managed Ecosystems and CO₂: Case Studies, Processes, and Perspectives*. *Ecological Studies*, Vol. 187. Springer, Berlin. 459 p.

2005

DeLucia EH, Moore DJ, Norby RJ. 2005. Contrasting responses of forest ecosystems to rising atmospheric CO₂: implications for the global C cycle. *Global Biogeochemical Cycles* 19: GB3006.

DeLucia EH, Moore DJ, Hamilton JG, Thomas RB, Springer CJ, Norby RJ. 2005. The changing role of forests in the global carbon cycle: responding to elevated carbon dioxide in the atmosphere. pp. 179-214 In: Lal R, Duxbury J, Steward BA Hansen DO, eds. *Climate Change and Global Food Security*, CRC Press.

Hanson PJ, Wullschleger SD, Norby RJ, Tschaplinski TJ, Gunderson CA. 2005. Importance of changing CO₂, temperature, precipitation, and ozone on carbon and water cycles of an upland oak forest: incorporating experimental results into model simulations. *Global Change Biology* 11: 1402-1423.

Jastrow JD, Miller RM, Matamala R, Norby RJ, Boutton TW, Rice CW, Owensby CE. 2005. Elevated atmospheric CO₂ increases soil carbon. *Global Change Biology* 11: 2057-2064.

Norby RJ, Joyce LA, Wullschleger SD. 2005. Modern and future forests in a changing atmosphere. pp. 394-414 In: Ehleringer JR, Cerling TE, Dearing MD, eds, *A History of Atmospheric CO₂ and Its Effects on Plants, Animals, and Ecosystems*. Springer, New York.

Norby RJ, DeLucia EH, Gielen B, Calfapietra C, Giardina CP, King JS, Ledford J, McCarthy HR, Moore DJP, Ceulemans R, De Angelis P, Finzi AC, Karnosky DF, Kubiske ME, Lukac M, Pregitzer KS, Scarascia-Mugnozza GE, Schlesinger WH, Oren R. 2005. Forest response to elevated CO₂ is conserved across a broad range of productivity. *Proceedings of the National Academy of Sciences* 102:18052-18056.

2004

Belote RT, Weltzin JF, Norby RJ. 2004. Differential invasive species responses to CO₂ enrichment in a forest understory community. *New Phytologist* 161: 827-835.

Harrison KG, Norby RJ, Post WM, Chapp EL. 2004. Soil C accumulation in a white oak CO₂-enrichment experiment via enhanced root production. *Earth Interactions* 8(14): 1-15.

Johnson DW, Cheng W, Joslin JD, Norby RJ, Edwards NT, Todd DE Jr. 2004. Effects of elevated CO₂ on nutrient cycling in a sweetgum plantation. *Biogeochemistry* 69:379-403.

King JS, Hanson PJ, Bernhardt E, DeAngelis P, Norby RJ, Pregitzer KS. 2004. A multi-year synthesis of soil respiration responses to elevated atmospheric CO₂ from four forest FACE experiments. *Global Change Biology* 10: 1027-1042.

Matamala R, González-Meler MA, Jastrow JD, Norby RJ, Schlesinger WH. 2004. Response to comment on "Impacts of fine root turnover on forest NPP and soil C sequestration potential". *Science* 304: 1745d.

Norby RJ. 2004. Forest responses to a future CO₂-enriched atmosphere. pp. 158-159 In: W. Steffen et al. (eds.) *Global Change and the Earth System: A Planet Under Pressure*. Springer, Berlin.

Norby RJ, Luo Y. 2004. Evaluating ecosystem responses to rising atmospheric CO₂ and global warming in a multi-factor world. *New Phytologist* 162:281-294.

Norby RJ, Ledford J, Reilly CD, Miller NE, O'Neill EG. 2004. Fine-root production dominates response of a deciduous forest to atmospheric CO₂ enrichment. *Proceedings of the National Academy of Sciences* 101: 9689-9693.

Sholtis JD, Gunderson CA, Norby RJ, Tissue DT. 2004. Persistent stimulation of photosynthesis by elevated CO₂ in a sweetgum (*Liquidambar styraciflua* L.) forest stand. *New Phytologist* 162: 343-354.

Wan S, Norby RJ, Pregitzer KS, Ledford J, O'Neill EG. 2004. CO₂ enrichment and warming of the atmosphere enhance both productivity and mortality of maple tree fine roots. *New Phytologist* 162: 437-446.

2003

BassiriRad H, Constable JVH, Lussenhop J, Kimball BA, Norby RJ, Oechel WC, Reich PB, Schlesinger WH, Zitzer S, Sehtiya HL, Silim S. 2003 Widespread foliage δ¹⁵N depletion under elevated CO₂: inferences for the nitrogen cycle. *Global Change Biology* 9: 1582-1590.

- George K, Norby RJ, Hamilton JG, DeLucia EH. 2003. Fine-root respiration in a loblolly pine and sweetgum forest growing in elevated CO₂. *New Phytologist* 160: 511-522.
- Marland G, Pielke RA Sr. , Apps M, Avissar R, Betts RA, Davis KJ, Frumhoff PC, Jackson ST, Joyce LA, Kauppi P, Katzenberger J, MacDicken KG, Neilson RP, Niles JO, Niyogi DS, Norby RJ, Pena N, Sampson N, Xue Y. 2003. The climatic impacts of land surface change and carbon management, and the implications for climate-change mitigation policy. *Climate Policy* 3:149-157.
- Matamala R, González-Meler MA, Jastrow JD, Norby RJ, Schlesinger WH. 2003. Impacts of fine root turnover on forest NPP and soil C sequestration potential. *Science* 302: 1385-1387.
- Norby RJ, Sholtis JD, Gunderson CA, Jawdy SS. 2003. Leaf dynamics of a deciduous forest canopy: no response to elevated CO₂. *Oecologia* 136:574-584.
- Norby RJ, Hartz-Rubin J, Verbrugge MJ. 2003. Phenological responses in maple to experimental atmospheric warming and CO₂ enrichment. *Global Change Biology* 9: 1792-1801.
- Sinsabaugh, RL, Saiya-Cork K, Long T, Osgood MP, Neher DA, Zak DR, Norby RJ. 2003. Soil microbial activity in a *Liquidambar* plantation unresponsive to CO₂-driven increases in primary productivity. *Applied Soil Ecology* 24: 263-271.
- Williams RS, Lincoln DE, Norby RJ. 2003. Development of gypsy moth larvae feeding on red maple saplings at elevated CO₂ and temperature. *Oecologia* 137:114-122.
- Zak DR, Holmes WE, Finzi AC, Norby RJ, and Schlesinger WH. 2003. Soil nitrogen cycling under elevated CO₂: A synthesis of forest FACE experiments. *Ecological Applications* 13: 1508-1514.

2002

- Edwards NT, Tschaplinski TJ, Norby RJ. 2002. Stem respiration increases in CO₂-enriched trees. *New Phytologist* 155: 239-248.
- Gunderson CA, Sholtis JD, Wullschlegler SD, Tissue DT, Hanson PJ, Norby RJ. 2002. Environmental and stomatal control of photosynthetic enhancement in the canopy of a sweetgum (*Liquidambar styraciflua* L.) plantation during three years of CO₂ enrichment. *Plant, Cell and Environment* 25: 379-393.
- Norby RJ, Hanson PJ, O'Neill EG, Tschaplinski TJ, Weltzin JF, Hansen RT, Cheng W, Wullschlegler SD, Gunderson CA, Edwards NT, Johnson DW. 2002. Net primary productivity of a CO₂-enriched deciduous forest and the implications for carbon storage. *Ecological Applications* 12:1261-1266
- Rustad LE, Norby RJ. 2002. Temperature Increase: Effects on Terrestrial Ecosystems. pp. 575-581, In: H. A. Mooney and J. G. Canadell (eds.), *The Earth System: Biological and Ecological Dimensions of Global Environmental Change*. Vol. 2 in *Encyclopedia of Global Environmental Change*. John Wiley and Sons, Chichester.

Wullschleger SD, Gunderson CA, Hanson PJ, Wilson KB, Norby RJ. 2002. Sensitivity of stomatal and canopy conductance to elevated CO₂ concentration BB interacting variables and perspectives of scale. *New Phytologist* 153: 485-496.

Wullschleger SD, Tschaplinski TJ, Norby RJ. 2002. Plant water relations at elevated CO₂ B implications for water-limited environments. *Plant, Cell and Environment* 25: 319-331

2001

Johnson, D. W., R. J. Norby, and B.A. Hungate. 2001. Effects of elevated CO₂ on nutrient cycling in forests. pp. 237-252 In: D. F. Karnosky, R. Ceulemans, G. E. Scarascia-Mugnozza, and J. L. Innes (eds.), *The Impact of Carbon Dioxide and Other Greenhouse Gases on Forest Ecosystems*. CABI, Wallingford, UK.

Karnosky, D. F., Gielen, B., Ceulemans, R., Schlesinger, W. H., Norby, R. J., Oksanen, E., Matussek, R. and Hendrey G. R. 2001. FACE systems for studying the impacts of greenhouse gases on forest ecosystems. pp. 297-324 In: D. F. Karnosky, R. Ceulemans, G. E. Scarascia-Mugnozza, and J. L. Innes (eds.), *The Impact of Carbon Dioxide and Other Greenhouse Gases on Forest Ecosystems*. CABI, Wallingford, UK

Norby, R. J., K. Ogle, P. S. Curtis, F.-W. Badeck, A. Huth, G. C. Hurtt, T. Kohyama, and J. Peñuelas. 2001. Aboveground growth and competition in forest gap models: An analysis for studies of climatic change. *Climatic Change* 51: 415-447.

Norby, R. J., D. E. Todd, J. Fults, and D. W. Johnson. 2001. Allometric determination of tree growth in a CO₂-enriched sweetgum stand. *New Phytologist* 150: 477-487.

Norby, R. J., K. Kobayashi, and B. A. Kimball. 2001. Rising CO₂ - future ecosystems. *New Phytologist* 150: 215-221.

Norby, R. J., M. F. Cotrufo, P. Ineson, E. G. O'Neill, and J. G. Canadell. 2001. Elevated CO₂, litter quality, and decomposition: A synthesis. *Oecologia* 127: 153-165.

Rustad L. E., Campbell J. L., Marion G. M., Norby R. J., Mitchell M. J., Hartley A. E., Cornelissen J. H. C., Gurevitch J., and GCTE-NEWS. 2001. A meta-analysis of the response of soil respiration, net nitrogen mineralization, and aboveground plant growth to experimental ecosystem warming. *Oecologia* 126:543-562.

Wullschleger S. D. and R. J. Norby. 2001. Sap velocity and canopy transpiration for a 12-year-old sweetgum stand exposed to free-air CO₂ enrichment. *New Phytologist* 150: 489-498.

2000

Canadell, J., Norby, R. J., Cotrufo, M. F., and Nösberger, J., editors. 2000. *Litter Quality and Decomposition Under Elevated Atmospheric CO₂*. Plant and Soil, vol. 224.

- Carter, G. A., R. Bahadur, and R. J. Norby. 2000. Effects of elevated atmospheric CO₂ and temperature on leaf optical properties in *Acer saccharum*. *Environmental and Experimental Botany* 43: 267-273.
- Gunderson, C. A., R. J. Norby, R. J., and S. D. Wullschleger. 2000. Acclimation of photosynthesis and respiration to simulated climatic warming in northern and southern populations of *Acer saccharum*: laboratory and field evidence. *Tree Physiology* 20: 87-96.
- Gunter, L. E., G. A. Tuskan, C. A. Gunderson, and R. J. Norby. 2000. Genetic variation and spatial structure in sugar maple (*Acer saccharum* Marsh.) and implications for predicted global-scale environmental change. *Global Change Biology* 6: 335-344.
- Norby, R.J. 2000. Atmospheric CO₂ and ecosystem feedback between carbon and nitrogen cycles: synthesis of an integrated experiment. *Ecological Applications* 10:1-2.
- Norby, R. J. and R. B. Jackson. 2000. Root dynamics and global change: seeking an ecosystem perspective. *New Phytologist* 147: 3-12.
- Norby, R. J., R. B. Jackson, and A. H. Fitter, editors. 2000. *Root Dynamics and Global Change: An Ecosystem Perspective*. New Phytologist Trust, Cambridge.
- Norby R.J., T. M. Long, J. S. Hartz-Rubin, and E. G. O'Neill. 2000. Nitrogen resorption in senescing tree leaves in a warmer, CO₂-enriched atmosphere. *Plant and Soil* 224: 15-29.
- Williams, R. S., R. J. Norby, and D. E. Lincoln. 2000. Effects of elevated CO₂ and temperature-grown red and sugar maple on gypsy moth performance. *Global Change Biology* 6: 685-695.

1999

- BassiriRad H., S. A. Prior, R. J. Norby, and H. H. Rogers. 1999. A field method of determining NH₄⁺ and NO₃⁻ uptake kinetics in intact roots: Effects of CO₂ enrichment on trees and crop species. *Plant and Soil* 217:195-204.
- Edwards, N.T. and R.J. Norby. 1999. Below-ground respiratory responses of sugar maple and red maple saplings to atmospheric CO₂ enrichment and elevated air temperature. *Plant and Soil* 206:85-97.
- Norby, R. J., S. D. Wullschleger, C. A. Gunderson, D. W. Johnson, and R. Ceulemans. 1999. Tree responses to rising CO₂: implications for the future forest. *Plant, Cell & Environment* 22: 683-714.
- Peterson, A. G., J. T. Ball, Y. Luo, C. B. Field, P. B. Reich, P.S. Curtis, K. L. Griffin, C. A. Gunderson, R. J. Norby, D. T. Tissue, M. Forstreuter, A. Rey, C. S. Vogel & CMEAL participants. 1999. The photosynthesis-leaf nitrogen relationship at ambient and elevated carbon dioxide: a meta-analysis. *Global Change Biology* 5:331-346.
- Peterson, A.G., Ball, J.T., Luo Y., Field C.B., Curtis P.S., Griffin K.L., Gunderson C.A., Norby, R.J., Tissue, D.T., Forstreuter M., Rey A., Vogel C.S. & CMEAL participants. 1999.

Quantifying the response of photosynthesis to changes in leaf nitrogen content and leaf mass per area in plants grown under atmospheric CO₂ enrichment. *Plant, Cell and Environment* 22: 1109-1119.

1998

Heilman, P. and R. J. Norby. 1998. Nutrient cycling in short rotation systems. *Biomass and Bioenergy* 14: 361-370.

Norby, R. J. 1998. Nitrogen deposition: A component of global change analyses. *New Phytologist* 139: 189-200.

Norby, R. J. and M. F. Cotrufo. 1998. Global change: a question of litter quality. *Nature* 396: 17-18.

Williams, R. S., D. E. Lincoln, and R. J. Norby. 1998. Leaf age effects of elevated CO₂-grown white oak leaves on spring-feeding lepidopterans. *Global Change Biology* 4:235-246.

1997

Norby, R. J. 1997. Carbon cycle: Inside the black box. *Nature* 388: 522-523.

Norby, R. J., N. T. Edwards, J. S. Riggs, C. H. Abner, S. D. Wullschleger, and C. A. Gunderson. 1997. Temperature-controlled open-top chambers for global change research. *Global Change Biology* 3:259-267.

Ringelberg, D. B., J. O. Stair, J. Almeida, R. J. Norby, E. G. O'Neill, and D. C. White. 1997. Consequences from rising atmospheric carbon dioxide levels for the belowground microbiota associated with white oak. *Journal of Environmental Quality* 26:495-503.

Wullschleger, S. D., R. J. Norby, J. C. Love, and C. Runck. 1997. Energetic cost of tissue construction in yellow-poplar and white oak trees exposed to long-term CO₂ enrichment. *Annals of Botany* 80: 289-297.

Wullschleger, S. D., R. J. Norby, and C. A. Gunderson. 1997. Forest trees and their response to atmospheric CO₂ enrichment: a compilation of results. pp. 79-100 In: L. H. Allen, Jr., M. B. Kirkham, D. M. Olszyk, and C. E. Whitman (eds.), *Advances in Carbon Dioxide Effects Research*. ASA Special Publication no. 61, American Society of Agronomy, Madison, WI.

1996

Norby, R. J. 1996. Oaks in a high CO₂ world. *Annales des Sciences Forestières* 53: 413-429.

Norby, R. J. 1996. Forest canopy productivity index. *Nature* 381:564

Norby, R. J., S. D. Wullschleger, and C. A. Gunderson. 1996. Tree responses to elevated CO₂ and the implications for forests. pp. 1-20 In: G. W. Koch and H. A. Mooney (eds.), *Carbon Dioxide and Terrestrial Ecosystems*. Academic Press, San Diego.

O'Neill, E. G. and R. J. Norby. 1996. Litter quality and decomposition rates of foliar litter produced under CO₂ enrichment. pp. 87-103 In: G. W. Koch and H. A. Mooney (eds.), Carbon Dioxide and Terrestrial Ecosystems. Academic Press, San Diego.

1995

Norby, R. J., E. G. O'Neill, and S. D. Wullschleger. 1995. Belowground responses to atmospheric carbon dioxide in forests. pp. 397-418, In: W. W. McFee and J. M. Kelly (eds.), Carbon Forms and Functions in Forest Soils. Soil Science Society of America, Madison, WI.

Norby, R. J., S. D. Wullschleger, C. A. Gunderson, and C. T. Nietch. 1995. Increased growth efficiency of *Quercus alba* trees in a CO₂-enriched atmosphere. New Phytologist 131: 91-97.

Tschaplinski, T. J., D. B. Stewart, P. J. Hanson, and R. J. Norby. 1995. Interactions between drought and elevated CO₂ on growth and gas exchange of seedlings of three deciduous tree species. New Phytologist 129:63-71.

Tschaplinski, T. J., D. B. Stewart, and R. J. Norby. 1995. Interactions between drought and elevated CO₂ on osmotic adjustment and solute concentrations of tree seedlings. New Phytologist 131:169-177.

Wullschleger, S. D., R. J. Norby, and P. J. Hanson. 1995. Growth and maintenance respiration in stems of *Quercus alba* L. after four years of carbon dioxide enrichment. Physiologia Plantarum 93: 47-54.

1994

Cooper, L. W. and R. J. Norby. 1994. Atmospheric CO₂ enrichment can increase the ¹⁸O content of leaf water and cellulose: paleoclimatic and ecophysiological implications. Climate Research 4:1-11.

Norby, R. J. 1994. Issues and perspectives for investigating root responses to elevated atmospheric carbon dioxide. Plant and Soil 165: 9-20.

van Miegroet, H., R. J. Norby, and T. J. Tschaplinski. 1994. Optimum nitrogen fertilization in a short-rotation sycamore plantation. Forest Ecology and Management 64:25-40.

1993

Gunderson, C. A., R. J. Norby, and S. D. Wullschleger. 1993. Foliar gas exchange responses of two deciduous hardwoods during three years of growth in elevated CO₂: No loss of photosynthetic enhancement. Plant, Cell, and Environment 16:797-807.

Tschaplinski, T. J., and R. J. Norby. 1993. Physiological indicators of nitrogen response in a short rotation sycamore plantation. II. Nitrogen metabolism. Canadian Journal of Botany 71: 841-847.

Tschaplinski, T. J., R. J. Norby, and S. D. Wullschleger. 1993. Responses of loblolly pine seedlings to elevated CO₂ and fluctuating water supply. Tree Physiology 13: 283-296.

1992

Norby, R. J., C. A. Gunderson, S. D. Wullschleger, E. G. O'Neill, and M. K. McCracken. 1992. Productivity and compensatory responses of yellow-poplar trees in elevated CO₂. *Nature* 357:322-324.

Tjoelker, M. G., S. B. McLaughlin, R. DiCosty, S. E. Lindberg, and R. J. Norby. 1992. Seasonal variation in nitrate reductase activity in needles of high-elevation red spruce trees. *Canadian Journal of Forest Research* 22:375-380.

Wullschleger, S. D., R. J. Norby, and D. L. Hendrix. 1992. Carbon exchange rates, chlorophyll content, and carbohydrate status of two forest tree species exposed to carbon dioxide enrichment. *Tree Physiology* 10:21-31.

Wullschleger, S. D., R. J. Norby, and C. A. Gunderson. 1992. Growth and maintenance respiration in leaves of *Liriodendron tulipifera* L. saplings exposed to long-term carbon dioxide enrichment in the field. *New Phytologist* 121: 515-523.

Wullschleger, S. D. and R. J. Norby. 1992. Respiratory cost of leaf growth and maintenance in white oak saplings exposed to atmospheric CO₂ enrichment. *Canadian Journal of Forest Research* 22: 1717-1721.

1991

McLaughlin, S. B., and R. J. Norby. 1991. Atmospheric pollution and terrestrial vegetation: Evidence of changes, linkages and significance to selection processes. pp. 61-101, In: G. E. Taylor, Jr., L. F. Pitelka, and M. T. Clegg (eds.), *Ecological Genetics and Air Pollution*. Springer-Verlag, New York.

Moldau, H., O. Kull, J. Sober, and R. J. Norby. 1991. Differential response of CO₂ uptake parameters of soil- and sand-grown *Phaseolus vulgaris* (L.) plants to absorbed ozone flux. *Environmental Pollution* 74:251-261.

Norby, R. J., and E. G. O'Neill. 1991. Leaf area compensation and nutrient interactions in CO₂-enriched yellow-poplar (*Liriodendron tulipifera* L.) seedlings. *New Phytologist* 117: 515-528.

O'Neill, E. G., R. V. O'Neill, and R. J. Norby. 1991. Hierarchy theory as a guide to mycorrhizal research on large-scale problems. *Environmental Pollution* 73:271-284.

Tschaplinski, T. J., D. W. Johnson, R. J. Norby, and D. E. Todd. 1991. Optimum nitrogen nutrition in short rotation sycamore plantations. *Soil Science Society of America Journal* 55:841-847.

Tschaplinski, T. J., and R. J. Norby. 1991. Physiological indicators of nitrogen response in short rotation sycamore plantations. I. CO₂ assimilation, photosynthetic pigments, and soluble carbohydrates. *Physiologia Plantarum* 82:117-126.

1989

Norby, R. J. 1989. Foliar nitrate reductase: a marker for assimilation of atmospheric nitrogen oxides. pp. 245-250 IN National Research Council, *Biologic Markers of Air Pollution Stress and Damage in Forests*. National Academy Press, Washington, D.C.

Norby, R. J. 1989. Direct responses of forest trees to rising atmospheric carbon dioxide. pp. 243-249 IN R. G. Noble, J. L. Martin, and K. F. Jensen (eds.), *Air Pollution Effects on Vegetation Including Forest Ecosystems*. Proceedings of the second US-USSR Symposium; Corvallis OR, Raleigh NC, and Gatlinburg TN, September 13-25, 1988. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Broomall, PA.

Norby, R. J., and E. G. O'Neill. 1989. Growth dynamics and water use of seedlings of *Quercus alba* L. in CO₂-enriched atmospheres. *New Phytologist* 111:491-500.

Norby, R.J., Y. Weerasuriya, and P.J. Hanson. 1989. Induction of nitrate reductase activity in red spruce needles by NO₂ and HNO₃ vapor. *Canadian Journal of Forest Research* 19:889-896.

Norby, R. J. and L. L. Sigal. 1989. Nitrogen fixation in the lichen *Lobaria pulmonaria* in elevated atmospheric carbon dioxide. *Oecologia* 79:566-568.

1988

McLaughlin, S.B., C.P. Andersen, P. J. Hanson, R. J. Norby, N. T. Edwards, and R. R. Tardiff. 1988. Interactive effects of natural and anthropogenic factors on growth and physiology of southern red spruce. pp. 381-388 IN G. Hertel (tech. coord.), Proceedings of the US/FRG Research Symposium: Effects of Atmospheric Pollutants on the Spruce-fir Forests of the Eastern United States and the Federal Republic of Germany; October 19-23, 1987, Burlington VT. Gen. Tech. Rep. NE-120. U.S. Department of Agric., For. Serv., Broomall, PA.

1987

Norby, R. J. 1987. Nodulation and nitrogenase activity in nitrogen-fixing woody plants stimulated by CO₂ enrichment of the atmosphere. *Physiologia Plantarum* 71:77-82.

Norby, R. J., E. G. O'Neill, W. G. Hood, and R. J. Luxmoore. 1987. Carbon allocation, root exudation, and mycorrhizal colonization of *Pinus echinata* seedlings grown under CO₂ enrichment. *Tree Physiology* 3:203-210.

O'Neill, E. G., R. J. Luxmoore, and R. J. Norby. 1987. Elevated atmospheric CO₂ effects on seedling growth, nutrient uptake, and rhizosphere bacterial populations of *Liriodendron tulipifera* L. *Plant and Soil* 104:3-11.

O'Neill, E. G., R. J. Luxmoore, and R. J. Norby. 1987. Increases in mycorrhizal colonization and seedling growth in *Pinus echinata* and *Quercus alba* in an enriched CO₂ atmosphere. *Canadian Journal of Forest Research* 17:878-883.

1986

Luxmoore, R. J., R. J. Norby, and E. G. O'Neill. 1986. Seedling tree responses to nutrient stress under atmospheric CO₂ enrichment. pp. 178-183 IN Proceedings, 18th IUFRO World Congress, Division II, Vol. I. IUFRO Secretariat, Vienna, Austria.

Norby, R. J., G. E. Taylor, Jr., S. B. McLaughlin, and C. A. Gunderson. 1986. Drought sensitivity of red spruce seedlings affected by precipitation chemistry. pp. 34-41 IN Proceedings, Ninth North American Forest Biology Workshop, Stillwater, Oklahoma.

Norby, R. J., B. K. Takemoto, J. W. Johnston, and D. S. Shriner. 1986. Acetylene reduction rate as a physiological indicator of the response of field-grown soybeans to simulated acid rain and ambient gaseous pollutants. *Environmental and Experimental Botany* 26:285-290.

Norby, R. J., E. G. O'Neill, and R. J. Luxmoore. 1986. Effects of atmospheric CO₂ enrichment on the growth and mineral nutrition of *Quercus alba* seedlings in nutrient-poor soil. *Plant Physiology* 82:83-89.

Norby, R. J., J. Pastor, and J. M. Melillo. 1986. Carbon-nitrogen interactions in CO₂enriched white oak: Physiological and long-term perspectives. *Tree Physiology* 2:233-241.

Taylor, G. E., Jr., R. J. Norby, S. B. McLaughlin, A. H. Johnson, and R. S. Turner. 1986. Carbon dioxide assimilation and growth of red spruce (*Picea rubens* Sarg.) seedlings in response to ozone, precipitation chemistry, and soil type. *Oecologia* 70:163-171.

1980-1985

Norby, R. J., D. D. Richter, and R. J. Luxmoore. 1985. Physiological processes in soybean inhibited by gaseous pollutants but not by acid rain. *New Phytologist* 100:79-85.

Taylor, G. E., Jr., and R. J. Norby. 1985. The significance of elevated levels of ozone on natural ecosystems of North America. pp. 152-175 IN S. D. Lee (ed.), International Specialty Conference on Evaluation of the Scientific Basis for Ozone/Oxidant Standards, Air Pollution Control Association, Pittsburgh, PA.

Norby, R. J., R. J. Luxmoore, E. G. O'Neill, and D. G. Weller. 1984. Plant responses to atmospheric CO₂ with emphasis on belowground processes. ORNL/TM-9426. Oak Ridge National Laboratory, Oak Ridge, TN.

Norby, R. J., and T. T. Kozlowski. 1983. Flooding and SO₂ stress interaction in *Betula papyrifera* and *B. nigra* seedlings. *Forest Science* 29:739-750.

Norby, R. J., and R. J. Luxmoore. 1983. Growth analysis of soybeans exposed to simulated acid rain and gaseous pollutants. *New Phytologist* 95:277-287.

Norby, R. J., and T. T. Kozlowski. 1982. The role of stomata in sensitivity of *Betula papyrifera* seedlings to SO₂ at different humidities. *Oecologia* 53:34-39.

Norby, R. J., and T. T. Kozlowski. 1981. Response of SO₂-fumigated *Pinus resinosa* seedlings to post-fumigation temperature. *Canadian Journal of Botany* 59:470-475.

Norby, R. J., and T. T. Kozlowski. 1981. Interaction of SO₂ concentration and post-fumigation temperature on growth of five species of woody plants. *Environmental Pollution Series A* 25:27-39.

Norby, R. J., and T. T. Kozlowski. 1981. Relative sensitivity of three species of woody plants to SO₂ at high or low exposure temperature. *Oecologia* 51:33-36.

Norby, R. J., and T. T. Kozlowski. 1980. Allelopathic potential of ground cover species on *Pinus resinosa*. *Plant and Soil* 57:363-374.

Invited(*) and contributed talks since 2005

*"Model synthesis of data from free-air CO₂ enrichment experiments" Annual meeting, American Geophysical Union, San Francisco, CA, December 2012.

- *“Carbon-nitrogen interactions in CO₂-enriched ecosystems: An experimentalist’s view on model-data integration” Distinguished Ecologist Lecture Series, Michigan Technological University, Houghton, Michigan, October 2012.
- **“Forest responses to elevated atmospheric CO₂: Lessons from FACE experiments” International Symposium on The Role of Ecological Institute, National Ecological Institute, Seoul, South Korea, September 2011.
- **“Carbon dynamics in an oldfield ecosystem: Was a multi-factor experiment the best approach for revealing responses to atmospheric and climatic change?” Annual meeting, Ecological Society of America, Austin, Texas, August 2011.
- **“Forest NPP in FACE experiments”, Workshop on Forest Sensitivity to CO₂, University of Sydney, Sydney, Australia, August, 2011.
- *“Forest responses to elevated CO₂: Lessons from a decades-long research program” keynote address at International Scientific Conference, “Functions and Services of Biodiversity”, University of Göttingen, Germany, June 2011
- * “Temperate Tree FACE Studies: Lessons from a decades-long research program” CO₂ Symposium, Smithsonian Tropical Research Institute, Panama City, Panama, March 2011.
- “Leaf and nitrogen distribution in sweetgum canopies after 12 years of CO₂ enrichment” Ecological Society of America annual meeting, Pittsburgh, PA, August 2010
- *“Where did the carbon go? The 12-year saga of the Oak Ridge FACE experiment” University of York, UK, March 2010
- *“Where did the carbon go? The 12-year saga of the Oak Ridge FACE experiment” University of Sheffield, UK, May 2010
- *“Long-term data from FACE experiments provide a benchmark for ecosystem response models” Ecological Society of America annual meeting, Albuquerque, NM, August 2009.
- *Nitrogen Limitation is Reducing the Enhancement of NPP by Elevated CO₂ in a Deciduous Forest. Annual meeting, American Geophysical Union, San Francisco, CA, December 2008.
- “Ten-year record of forest response to elevated CO₂ provides evidence for declining NPP and growth”. Ecological Society of America annual meeting Milwaukee, WI, August, 2008
- *“CO₂ fertilization and the global carbon cycle” DOE Global Change Education Program annual meeting, Knoxville, TN, June 2008
- *Will CO₂ fertilization of forests counteract global warming? Tennessee Tech University, Cookeville, TN, April 2008
- *“Single-factor and Multi-factor Experiments: Multiple Issues, Multiple Approaches” DOE conference, Exploring Science Needs for the Next Generation of Climatic Change and Elevated CO₂ Experiments in Terrestrial Ecosystems. Washington, DC, April 2008.
- *Will CO₂ fertilization of forests counteract global warming? Tennessee State University, Nashville, TN, February 2008
- *“Uncertainties: Ecosystem responses to climate change...and their feedbacks to the Carbon Cycle” ORNL symposium: Carbon Cycle, Biosequestration, and Ecosystem Response to Climate Change. Oak Ridge, TN, Jan 2008
- *“Open-Top Chambers for Investigating Ecological Responses to Atmospheric and Climatic Change” American Society of Agronomy annual meeting, New Orleans, LA, November 2007
- **“Net primary productivity and nitrogen uptake in forest FACE experiments” EcoFizz meeting, Sydney, Australia, Sept. 2007

- *"Will CO₂ fertilization counteract global warming?" Nature Conservancy Climate Change Science Conference, Portland OR, Sept. 2007
- *"Will CO₂ fertilization counteract global warming? Lessons from forest FACE experiments" University of Georgia, Athens, GA. Oct 2006
- "Nitrogen uptake and net primary productivity in four forest FACE experiments". Annual meeting, Ecological Society of America, Memphis, Tennessee, August, 2006.
- *"Global Change and Terrestrial Ecosystems: Do Trees Matter?" Oak Ridge Institute for Continued Learning, Oak Ridge TN, Feb. 2006
- *"Forest Responses to Elevated Atmospheric CO₂". Chinese Academy of Sciences and Peking University, Beijing, China, September 2005
- *"Forests in a CO₂-rich world: Old questions, new challenges". Keynote address, International Botanical Congress, Vienna, Austria, July 2005

Funded Proposals (as Principal Investigator)

- "Model-Data Synthesis of Terrestrial Responses to Elevated CO₂"; DOE; \$675,000, 2011-2013.
- "Partitioning in Trees and Soil"; DOE; \$775,000, 2010-2012.
- "Benchmarking Ecosystem Response Models with Experimental Data from Long-term CO₂ Enrichment Experiments"; NCEAS; \$84,450, 2008-2010.
- "Free-Air CO₂ enrichment of a Deciduous Forest"; DOE (TCP); \$1,100,000 per year; 1999-continuing.
- "Community and Ecosystem Response to Global Change: Interactive Effects of Atmospheric Carbon Dioxide, Surface Temperatures, and Soil Moisture "; DOE (PER); \$371,000 per year; 2002- continuing.
- "Forest FACE Synthesis Workshop"; TERACC; \$2500; 2005
- "Forest FACE Synthesis Workshop: U.S. Forest Service; \$10,000; 2002
- "Root Dynamics and Global Change Symposium "; New Phytologist Trust; \$30,000; 1999.
- "Free-Air Enrichment of a Closed-Canopy Deciduous Forest "; NSF (TECO); \$1,200,000; 1996-1999.
- "A Free-Air CO₂ Exposure Facility in a Deciduous Forest "; ORNL Director's R&D Fund; \$760,000; 1996-1997.
- "Temperature and CO₂ Interactions in Trees "; DOE (TCP); \$600,000 per year; 1995-1998.
- "Temperature Adjustments in Sugar Maple: Implications for Forest Succession in a Warmer Climate "; DOE (PER); \$195,000/year; 1994-1997.

- "Temperature-Controlled Open-Top Chambers for Global Change Research "; ORNL Exploratory Funds Program; \$102,000; 1992-1993.
- "Interactions Between Elevated CO₂ and Drought Stress in Tree Seedlings "; EPA; \$100,000; 1990.
- "Use of D/H and ¹⁸O/¹⁶O Variations in Plant Leaf Water to Monitor Biophysical Responses to Increased Concentrations of Atmospheric CO₂"; ORNL Exploratory Funds Program; \$76,000;1989.
- "Tree Responses to CO₂ Enrichment in the Field "; DOE (TCP); \$2,353,000; 1988-1994."Optimum Nitrogen Nutrition in Short-Rotation Sycamore Plantations "; DOE Biofuels Program; \$190,000 - \$325,000 per year; 1987-1992.