FACING THE FUTURE

The FACTS II (Aspen FACE) Newsletter

Volume 4, No. 1, June 2005

David F. Karnosky and Janet M. Pikkarainen, Editors

Aspen FACE Environmental Assessment

A team from Argonne National Laboratory, headed by John Krummel, Ed Pentecos, and Kirk LaGory, has been chosen to prepare the Environmental Assessment of the Aspen FACE's planned infrastructure expansion and resulting operation. As the first components of this Assessment, the USFS has established a web site http://www.ncrs.fs.fed.us/projects/face_ea/ as an information center on the assessment. Public comment on the expansion can be submitted on-line at the above web site or by mail to Rick Sindt, USFS, North Central Research Station, 1992 Folwell Ave., St. Paul, Minnesota 55108. An open house to discuss the expansion and to display the scientific findings of the project will be held at the Aspen FACE site on June 15.

Aspen FACE Renewal

The Aspen FACE User Facility has been renewed by the Office of Science (BER), U.S. Department of Energy's Program for Ecosystem Research for the time period from April 1, 2005 to March 31, 2008. The renewal proposal entitled "Impacts of elevated CO_2 and O_3, alone and in combination, on the structure and functioning of a northern forest ecosystem: Operating the Aspen FACE user facility" and written by Dave Karnosky (Michigan Tech), Kurt Pregitzer (Michigan Tech), Kevin Percy (Canadian Forest Service), Neil Nelson (USFS), George Hendrey (Queens College, NY), John Nagy (Brookhaven National Lab), Mark Kubiske USFS), Rick Lindroth (University of Wisconsin-Madison), and Don Zak (University of Michigan) was awarded $5,197,336.

Karnosky Receives Scientific Recognition

At the Aspen FACE Investigators meeting in Green Bay, Wisconsin in December 2004, the Aspen FACE Steering Committee presented Dr. David F. Karnosky, Project Director, a plaque acknowledging Dave's untiring and enthusiastic leadership of the Aspen FACE project. The plaque read "In recognition of his vision and leadership as Director of the Aspen FACE Project". Shown in the photo are Aspen FACE Steering Committee members (from left to right) Kurt Pregitzer (Michigan Tech), George Hendrey (Queens College, New York), Kevin Percy (Canadian Forest Service), Dave Karnosky (Michigan Tech), and Neil Nelson (USFS, NCRS).

At the same meeting, Neil Nelson (USFS) presented Dave Karnosky with a Certificate of Appreciation which reads "In recognition and appreciation for superior contributions to the success of the Aspen FACE project, North Central Research Station, USDA Forest Service, as Project Director, 1996 to present".

Dr. Karnosky also has been chosen to receive a "Scientific Achievement Award" from the International Union of Forestry Research Organizations (IUFRO). The award (5-8 are given out every 5 years) will be presented at IUFRO's World Congress in August, 2005 at Brisbane, Australia. The award includes a plaque and $1500 cash.

Cassian Town Board Visits Aspen FACE

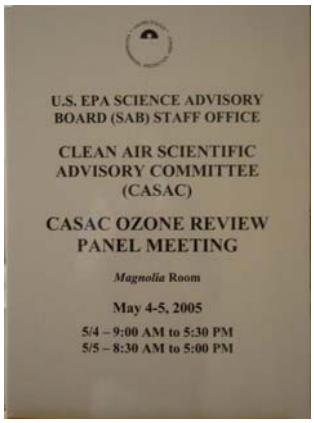
Cassian Town Board Supervisors Larry Hendrickson, Butch Black, Gail Winnie and Town Treasurer Denny Thompson visited the Aspen FACE facility on May 31, 2005, along with several local residents. Following a brief overview about Aspen FACE from Project Director Dave Karnosky, the Board was led on a tour of the north replicate by USFS scientists Neil Nelson and Mark Kubiske. The Board expressed the concern that Aspen FACE should be more involved with the town meetings (Richard Dickson used to regularly attend these meetings and kept the local people informed of Aspen FACE activities) to keep the neighboring land holders better informed.

Local Family Protests Aspen FACE Project

Local farmer John Herman and his mother have stepped up their campaign to shut down the Aspen FACE project. During this spring, the family set up some 7 signs on their property adjoining the Aspen FACE project. The family was unsuccessful in a crop damage claim to the USDA over an alleged loss of their potato crop planted along the Aspen FACE east fence line in 2003. Finally, the family has sought to convince local, state, and federal politicians of the alleged problem. For the record, the fence line monitoring data from all 8 years of Aspen FACE operation has shown absolutely no detectable O_3 drift off site. Furthermore, O_3-sensitive bioindicator plants along the fence lines (including black cherry, raspberry, milkweed, and clover) have also shown no visible symptoms. There is absolutely no danger that the Aspen FACE project poses to plants, forests, wildlife or humans off the USFS property.

Contractors Meet to Discuss Vertical Vent Pipe Extensions

George Hendrey (Queens College), Keith Lewin (BNL), Neil Nelson (USFS), Mark Kubiske (USFS), Dave Karnosky (Michigan Tech), Wendy Jones (Michigan Tech), and Jim Heikkinen (Michigan Tech) hosted a number of contractors at Aspen FACE on May 10, 2005 to discuss the options for extension of the vertical vent pipes and center monitoring pole. Richard Reitz (Wisconsin Public Service), who oversaw the original pole setting for our project, also attended. While visiting the Aspen FACE site, George Hendrey (R-left) and Keith Lewin (R-right) took the opportunity to inspect our site's infrastructure.



Karnosky's Continued Involvement in the Ozone Criteria Document

David Karnosky, Aspen FACE Director, recently attended the Clean Air Scientific Advisory Committee (CASAC) meeting at Raleigh, North Carolina on May 4-5, 2005. The purpose of the meeting was for CASAC to critique the draft of the Ozone Criteria Document, from which decisions on the adequacy of current federal air quality standard for O_3 is determined. A long-time consultant with the U.S. EPA, Dr. Karnosky was an author of two sections of the document.

Growing Finnish Connection

Dr. David F. Karnosky, Aspen FACE Director, served as the external opponent for Johanna Riikonen's Ph.D. thesis exam on November 15-22, 2004 at the University of Kuopio, Kuopio, Finland. Johanna's thesis dealt with the impacts of elevated CO_2 and O_3 on European birch trees growing in open-top chambers. Johanna (L-right) and her co-major professors Toini Holopainen, University of Kuopio (center), Elina Vapaavuori , Finnish Forest Research Institute (R- right), and Elina Oksanen, University of Joensuu (long-time Aspen FACE scientist), were later successful in garnering resources for Johanna to continue her work as post doctoral fellow. For this fellowship, Johanna will be conducting gas exchange measurements and birch biochemistry sampling at Aspen FACE in collaboration with Dave Karnosky and USFS scientists Neil Nelson and Mark Kubiske. This research will be used to augment ongoing birch transcriptomics (headed by Elina Vapaavuori).

Aspen FACE Well Represented at the 37th Air Pollution Workshop

Aspen FACE Director Dave Karnosky (right) was Program Co-Chair for the 37th Air Pollution Workshop in Banff, Alberta, Canada on April 25-28, 2005. Dave chaired a session on interacting stresses in which he made an overview presentation (with Kevin Percy and John King) about Aspen FACE research. He also made presentations on his Ozone Gradient Study (with Kevin Percy) and Gene Expression Research (with Gail Taylor and Gopi Podila). Also in the photo are local organizer Dr. Allan Legge (center) and David B. (Daver) Karnosky (left), MTU undergraduate. Daver was the Workshop's AV and computer specialist.

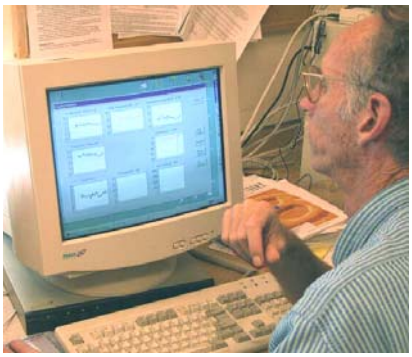
Also attending the Workshop and presenting Aspen FACE research were John King (Michigan Tech), Lingli Liu (John's graduate student), Kevin Percy (Canadian Forest Service), and David Weinstein (Boyce Thompson Institute).

Zak, Pregitzer Get Renewed DOE Support

Don Zak (University of Michigan) and Kurt Pregitzer (Michigan Tech) were recently renewed for their project entitled "Ecosystem response to elevated tropospheric carbon dioxide and ozone is regulated by plant-microbe interactions in soil". The award totals $1,725,271 over four years and it will support their work on understanding how the treatments and community types at FACE interact to control the biological interactions in the soil that are so important in regulating soil carbon and nitrogen cycling. The new award continues their productive collaboration that has been a cornerstone of the Aspen FACE project from the beginning. The project is supported by the Office of Science (BER), U.S. Department of Energy, Program for Ecosystem Research.

Wisconsin DNR Group Visits Aspen FACE

Drs. Neil Nelson (USFS) and Mark Kubiske (USFS) toured a group of Wisconsin Department of Natural Resources managers, headed by Neal Baudhuin (Air Management Program Supervisor for the Northern Region) and Lloyd Eagan (Director of the DNR Bureau of Air Management) on June 7, 2005. The WDNR continues to maintain our site's main control ozone monitor at our control building. Jim Trochta, Air Management Specialist with the WDNR, calibrates and maintains this monitor which is part of the EPA's Air News Network, a network to monitor O_3 across the U.S.



Aspen FACE Operations (Nagy's Corner)

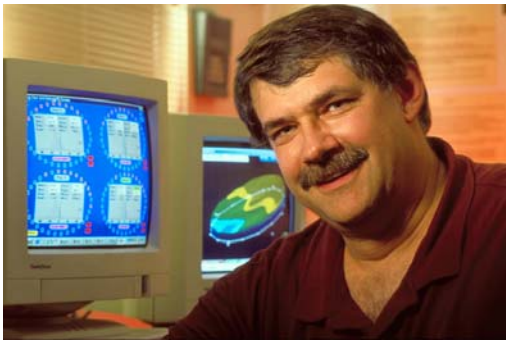
During the recent visit of the Cassian Town Board, some questions were raised that we asked our Aspen FACE atmospheric scientist Dr. John Nagy, Brookhaven National Lab.

Editors: Our present fence line monitor intakes are located about 5-6 feet above the ground. In our experiment, ozone is dispensed from 20 to 30 feet above the ground 200+ feet away from the monitor intakes. Would our monitoring be more accurate or effective if the monitor intakes were also 20 to 30 feet above the ground?

John: At the center of the ring, there is minimal exposure at ground level. Exposure 20-30 feet up will be high but still only 1.5-2 x background and not high enough to constitute either an acute or chronic hazard to plants and animals. As we proceed downwind, ground level [O_3] will increase reaching a maximum at some distance, then decrease. Elevated [O_3] at the release height will always decrease. The two will converge but how fast depends on conditions and height of mixing layer. I modeled the fence [O_3] at 2m and for all stability classes the maximum at ground level was inside the fence.

Editors: Is it possible for ozone generated at the aspen FACE experiment to be transported upward, then transported horizontally, and then deposited at ground level in toxic concentrations at some location off-site? Is it possible for ozone generated at the aspen FACE experiment to be transported off site as a toxic bubble of air, tracing a sine wave pattern as it propagates along, and causing harm to vegetation when it dips down to ground level?

John: The short answer to both questions is that it is not possible under unstable (in the scientific sense) conditions. Plumes that don't disperse do happen under very stable conditions -- there are some notorious smoke stack photos of this. However, we only release under unstable conditions -- day time, moderate or higher winds, and moderate or higher solar insolations. Blobs that meander around won't happen. There is also a feedback mechanism at work in our favor. The more stable conditions are, the less O_3 we generate to achieve the set point. This limits the maximum fence line concentration under any conditions. In summary, O_3 will disperse and not produce persisting plumes or blobs.



People at the Aspen FACE Project

Mark E. Kubiske, Plant Physiologist, USFS-NCRS, Rhinelander

Editors: You've been involved in Aspen FACE since the beginning. How did this come to be?

Mark: That was in 1995. I was a postdoc in Kurt Pregitzer's lab working on some open-top chamber experiments. Kurt and Dave Karnosky asked if I would like to help on a proposal to start a FACE experiment. Sounded like a good challenge. I think we started on the proposal a week before it was due and finished it around 8:00 a.m. the day it had to be shipped to DOE. We wrote in a lot of very good material from the other PIs, including Dave, Kurt, Don Zak, Rick Lindroth, Jud Isebrands, and Richard Dickson. After that first proposal to a joint program between DOE, NSF and NASA, I started working on procuring the equipment for the FACE infrastructure, started working on the experimental design, and worked with Jud Isebrands and Richard Dickson on getting the thing built. Richard put a lot of work into getting the experiment off the ground.

Editors: You have been involved in countless scientific projects, tours, interviews, and meetings over the years for Aspen FACE. What would you say has stood out as some of the highlights of your involvement in Aspen FACE?

Mark: Certainly pulling that all-nighter with Dave Karnosky the night before the original proposal was due will always be a highlight, at least in a twisted sort of way. My first graduate student Yu Takeuchi did her thesis work here looking at light, N, and photo-synthetic interactions in the canopies. The National Geographic film was very exciting to be a part of, as were the interviews with NPR, Voice of America radio, and some others. I was very pleased to give invited talks at the 2004 36th Air Pollution Workshop in Rhinelander, and at the Forest Service Global Change meeting in Oregon last November. What stands out most, by far, is the privilege I've enjoyed over the years to working with and learning from some truly exceptional individuals.

Editors: How does this Free-Air Enrichment Study compare to the previous open-top chamber study you were involved in at the University of Michigan Biological Station (UMBS)?

Mark: The UMBS experiments were extremely interesting because most of them involved interacting effects of CO_2 and soil fertility. But, the first experiment I conducted there looked at CO_2 and shade effects on tree species of differing shade tolerance. It was very gratifying to see that work get so much attention and play a big role in the experimental design of Aspen FACE. Another part of those experiments that carried over into Aspen FACE were a couple of the aspen clones that we used. The 8L and 42E clones in Aspen FACE come from the Outwash Plain near UMBS. We used those in the open-tops because they differ in timing of leaf drop. We thought there would be some interesting carbon gain questions there.

Working in the FACE project is quite a bit more logistically challenging. Of course, the kinds of questions we can address differ quite a bit from what we were able to accomplish with the open-top chambers. Despite all the limitations of that old technology, I

think we've found out that most of our findings from those experiments also hold true in Aspen FACE. It's always nice to see things work out the way we expect them to.

Editors: The local farmer (John Herman) continues to criticize the Aspen FACE project. What is your take on this situation?
Mark: Mr. Herman certainly has a right to his views, and he has a right to protest against something that his government is doing that he feels is wrong. He raised a good point regarding the road issue, and the North Central Station is cooperating with the town of Cassian, within legal constraints, to try and find some remedies. If the roads to the experiment are improved because of it, then it will be a benefit for the experiment as well as the residents. As for the ozone issue, we have presented the facts as they are. If he does not wish to acknowledge them, that is his right, too. I'm hopeful the Environmental Assessment will help convince Mr. Herman, as well as other residents of Harshaw, that we're not a threat to the people, crops, or native vegetation. I think the Open House will help them realize the benefits to society of this world-class experiment. It's something they should be proud to have here.

Editors: Over the years, Mark Kubiske has continued to show the utmost kindness, consideration, and respect for any and all Aspen FACE scientific users. Mark is never too busy to take the time to chat with or help organize items for graduate students, under-graduates, technical staff or senior scientists needing help at Aspen FACE. We at Aspen FACE are fortunate to have Mark as our Science Coordinator.

John S. King, Assistant Professor of Ecosystem Science, Michigan Tech

Editors: How did you get involved in Aspen FACE?
John: I did a post-doc with Kurt Pregitzer in which we put together a system of studies to examine pools and fluxes of the belowground carbon cycle as affected by the elevated CO_2 and O_3 treatments.

Editors: You've been uncannily successful in attracting USDA Competitive Grant support having received 2 awards in the past 4 years in an arena where less than 5% of projects are supported. What's your secret?
John: The Aspen FACE Project is such a well-conceived and implemented experiment that it is very well-suited to answering many of today's most pressing and difficult questions on the role of forest ecosystems in global environmental change. In fact it is the only experiment in the world where some of these questions can be answered at a scale that will provide information useful for making policy related to energy use, environmental protection, forestry, and the management of our natural resources. We've targeted a couple of these important questions and designed experiments to investigate them at Aspen FACE.

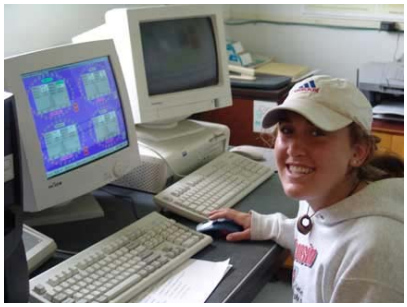
Editors: What is going on with your new water balance study at Aspen FACE?
John: This is a new project that we are setting up this field season. The goal of the project is to see how forests growing at CO_2 and O_3 pollutants loads predicted for the year 2050 will affect the cycling of water. This is important because at a regional scale, the way forests process water determines the amount and quality of water available for human use. We are installing equipment at Aspen FACE that will allow us to measure all of the inputs and outputs of the forest hydrologic cycle. We will then monitor forest water use for the next 3 years (or longer) to see if changes in forest growth and physiology in response to CO_2 and O_3 pollution will change the amount of water available for groundwater recharge.

Editors: We hear you are moving to North Carolina. What is the position? Will you still maintain your ties to Aspen FACE?
John: Yes, I recently accepted a position as assistant professor of tree physiology at North Carolina State University in Raleigh. I most definitely will remain active at Aspen FACE, working on existing projects and hopefully starting new ones. I've enjoyed our collaboration over the years and look forward to continuing work at Aspen FACE.

Editors: How does the Aspen FACE experiment compare to other projects you've been involved in?
John: Simply put, this is the most impressive experiment I've ever worked on. The incredible FACE technology and robust statistical design of the Aspen FACE Project make it possible for investigators to conduct the most sophisticated and meaningful research on forest ecology in response to some of today's most pressing environmental problems. The unflagging commitment and management of the project by Dave Karnosky and the Steering Committee have really provided a benefit to science and society. In terms of the kind of research I do, Aspen FACE is like a Hubble Telescope or Mars probe for astronomers, although at a fraction of the cost.

Editors: All of us at Michigan Tech will really miss John's upbeat personality and enthusiasm for research. Luckily, John will continue with us at Aspen FACE. Best of luck at North Carolina State!

Local Students in Prominent Roles at Aspen FACE



Student operators at the Aspen FACE site are Rhinelander natives, Susanna Ehlers (left) and Justin Bushong (right). Susanna is a 2003 graduate of Rhinelander High School and currently is a junior at the University of Wisconsin-Madison. Majoring in Geography and GIS (Geographic Information Systems). Susanna wants to go on to graduate school in this rapidly developing field. Justin, also a Rhinelander High School graduate and a local baseball player extraordinaire, is majoring in Natural Resources at the University of Wisconsin-Stevens Point. Susanna and Justin have quickly learned our computer-aided dispensing, monitoring, and record keeping systems for maintaining elevated CO_2 and O_3 in the 12 Aspen FACE treatment rings.

Local students, Eric Lorenzen (below L) and Anthony Rumsey (below R), are also playing key roles in Aspen FACE, assisting John King (Michigan Tech) and Mark Kubiske (USFS) on their new water balance study. Eric, a 2001 Rhinelander High School graduate, is pursuing a degree at Northern Michigan University in Physical Geography and GIS. This is his fourth year in working at Aspen FACE on various projects. Tony, a 2001 graduate of Tomahawk High School, went to UW-Lacrosse and graduated in 2005 with a B.S. in Biology. He will be pursuing an additional degree at Palmer College of Chiropractic in Davenport, Iowa.

Two additional students are assisting USFS scientists Neil Nelson and Mark Kubiske at Aspen FACE: Jason Tonne and Kyle McLaughlin. A Cassian Township resident, Jason Tonne recently graduated from UW-Oskhosh in Biology and will be pursuing a graduate degree in Biology there starting this fall. Kyle, a Rhinelander High School graduate, recently completed his second year at Nicolet College and he is transferring this fall to UW-Stevens Point to study in their Natural Resources Program.

Also returning to Aspen FACE for a second year as a general purpose maintenance man is Wisconsin resident and UW-Madison junior Jason Karnosky (right). Jason is working with Wendy Jones to maintain the roads and mow around the plots at the Aspen FACE experiment. Jason is majoring in history and is interested in political science of the European cold war. He also plans on going on to graduate school. When not working, Jason enjoys golf, having won his age class in the Rhinelander Country Club on several occasions.

Recent Aspen FACE Presentations

Kubiske, M.E. 2004. Seven years of Free-Air CO_2 and O_3 Enrichment at the Aspen FACE Experiment. USDA Forest Serivce Global Change Program All Scientists Workshop. Welches, OR

Kubiske, M.E., V.S. Quinn, P.E. Marquardt and D.F. Karnosky. 2004. Growth dynamics of tree communities exposed to elevated atmospheric CO_2 and O_3 in the Aspen FACE experiment. USDA Forest Service Global Change Program All Scientists Workshop, Welches, OR

Karnosky, D.F., C. Bernacchi, and A. Leakey. 2004. Ozone effects on forest and agricultural systems under a changing environment. International Micrometeorology Conference in Fukoka, Japan, September 8-13.

Karnosky, D.F. 2004. Research needs in global change: Questions arising from the Aspen FACE project. University of Kuopio, Kuopio, Finland, November 18.

Karnosky, D.F. 2005. Overview of Aspen FACE research. 18th Task Force Meeting of the UNECE ICP Vegetation, Almeria, Spain, February 1-4.

Giardina, C. 2005. The response of the belowground to global change. 3rd USDA Symposium on Greenhouse Gases and Carbon Sequestration in Agriculture& Forestry, Baltimore, Maryland, March 21-24.

Karnosky, D.F. 2005. Impacts of elevated CO_2 and O_3, alone and in combination, on the structure and functioning of a northern hardwood forest ecosystem: Operating the Aspen FACE User Facility. U.S. DOE PER Workshop, Flagstaff, Arizona, April 12-13.

Zak, D. and K. Pregitzer. 2005. Plant-microbe interactions at Aspen FACE. U.S. DOE PER Workshop, Flagstaff, Arizona, April 12-13.

Karnosky, D.F., K.E. Percy, and J.S. King. 2005. Overview of Aspen FACE research. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

Chappelka, A., R. Muntifering, J. Lin, and D.F. Karnosky. 2005. Chemical composition and nutritive quality of understory trifolium following long-term exposure to elevated ozone and carbon dioxide. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

King, J.S. 2005. The effects of elevated CO_2 and O_3 on root production, soil respiration and litter decomposition. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

Liu, L., J. King, C. Giardina. 2005. Effects of elevated atmospheric CO_2 and tropospheric O_3 on leaf litter production and chemistry in trembling aspen and paper birch communities. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

Percy, K., M. Nosal, M. Kubiske, W. Heilman, T. Dann, and D.F. Karnosky. 2005. Developing stand-level, standards-based ozone dose response functions for aspen and birch. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

Weinstein, D. 2005. Extrapolating experimental results of ozone injury to large regions. 37th Air Pollution Workshop, Banff, Alberta, Canada, April 26-28.

Karnosky, D. and C. Giardina. 2005. The effects of elevated CO_2 and O_3 on northern forest canopies. NCASI 2005 Regional Meeting. Green Bay, Wisconsin, May 25.

Aspen FACE New Publications

Journal Articles

Agrell, J., B.J. Kopper, E.P. McDonald and R.L. Lindroth. 2005. CO_2 and O_3 effects on host plant preferences of the forest tent caterpillar (*Malacosoma disstria*). Global Change Biology 11:588-599.

Gupta, P., S. Duplessis, H. White, D.F. Karnosky, F. Martin, and G.K. Podila. 2005. Gene expression patterns of trembling aspen trees following long-term exposure to interacting elevated CO_2 and tropospheric O_3. New Phytologist (In Press)

Karberg, N., K.S. Pregitzer, J.S. King, A.L. Friend, and J.R. Wood. 2005. Soil carbon dioxide partial pressure and dissolved inorganic carbonate chemistry under elevated carbon dioxide and ozone. Oecologia 142:296-306.

Karnosky, D.F. 2005. Ozone effects on forest ecosystems under a changing global environment. Journal of Agricultural Meteorology, 60(5):353-358.

Karnosky, D.F., K.S. Pregitzer, D.R. Zak, M.E. Kubiske, G.R. Hendrey, D. Weinstein, M. Nosal, and K.E. Percy. 2005. Scaling ozone responses of forest trees to the ecosystem level in a changing climate. Plant Cell and Environment (In Press).

Mankovska, B., K. Percy, and D. F. Karnosky. 2005. Impacts of greenhouse gases on epicuticular waxes of *Populus tremuloides* Michx.: Results from an open-air exposure and a natural O_3 gradient. Environmental Pollution (In Press)

Others

Giardina, C., M. Coleman, J. Hancock, J. King, E. Lilleskov, W. Loya, K. Pregitzer, M. Ryan, and C. Trettin. 2005. The effects of global change on belowground carbon allocation in forests. Chapter 7 in D. Binkley and O. Menyailo (eds), The impacts of global climate change on plant and soil interactions. NATO Science Series, Kluwer Academic Press (Invited paper).

Karnosky, D.F. and K.S. Pregitzer. 2005. Impacts of elevated CO_2 and O_3 on northern temperate forest ecosystems: Results from the Aspen FACE experiment. In (Nösberger, J. et al. Eds.) "Managed Ecosystems and CO_2: Case Studies, Processes and Perspectives". Ecological Studies, Springer-Verlag (In press).

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