FACING THE FUTURE

The FACTS II (Aspen FACE) Newsletter

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David F. Karnosky and Janet M. Pikkarainen, Editors

Aspen FACE is a highly successful project for global change research. Over 100 scientists and students contributing to the project have written over 100 scientific papers and Aspen FACE remains at the cutting edge of forestry and ecological research.

Principally supported by the U.S. Department of Energy's Office of Biological and Environmental Research, the Aspen FACE (Free Air CO_2 Enrichment) project is located on USFS property 10 miles west of Rhinelander, Wisconsin. Since 1998, the project has been examining the impacts of elevated atmospheric carbon dioxide (CO_2) and tropospheric ozone (O_3) on the structure and functioning of a northern forest ecosystem dominated by trembling aspen, North America's most widely distributed trees species. The Aspen FACE project became part of DOE's distributed facility in 2003. The Aspen FACE facility is run by Michigan Technological University with MTU's Dave Karnosky as Director. All major decisions at the Aspen FACE facility are made by the Steering Committee which includes Dave Karnosky, Kurt Pregitzer (MTU), Neil Nelson (U.S. Forest Service), Kevin Percy (Canadian Forest Service), and George Hendrey (Queens College). Dr. Mark Kubiske is an ex-officio member of the Steering Committee and he coordinates science at the site. ***Note****: Previous issues of the newsletter are available at the Aspen FACE web site http://aspenface.mtu.edu*

Future Plans for Aspen FACE Debated

University of Michigan Scientist, Dr. Don Zak (center), and Aspen Face Steering Committee members Dr. Mark Kubiske (USFS- far left), Dr. Kurt Pregitzer (Michigan Tech – 2nd from left), Dr. Neil Nelson (USFS – 2nd from right), and Dr. Kevin Percy (Canadian Forest Service – far right) joined Aspen FACE Director Dr. David Karnosky at the Aspen FACE site and the USFS Lab on June 13-14 to develop long-term plans and to identify a logical conclusion to the Aspen FACE experiment. The team outlined research needs remaining for the project and developed plans for another sample harvest in 2007. Plans were also discussed for another special scientific issue (Environmental Pollution) celebrating 10 years of Aspen FACE research. Scientists wishing to contribute to this Special Issue (likely to be developed in early 2008) should let Dave Karnosky know.

Drs. Kevin Percy, left, (Canadian Forest Service) and Neil Nelson (U.S. Forest Service) examine an elevated CO_2 ring.

Protocol Needs for Visitors at Aspen FACE

Now in our 9th year of operation at Aspen FACE, the staff of the Forestry Sciences Lab at Rhinelander is very pleased to continue to host numerous investigators from around the world. Each year we receive numerous requests for scaffold and safety

training, keys, supplies, equipment, laboratory space, lodging options, and other things. We do our best to accommodate everyone's needs. This is a reminder to please keep us apprised of your plans and your needs, particularly with regard to equipment and supplies. Our staff is very busy with their regular duties and spur-of-the-moment requests are often a considerable inconvenience. While we do share supplies with our close collaborators under formal agreements, we do not ordinarily provide supplies for any and all FACE research. Moreover, federal ordering policies and procedures, and our rural location are not always conducive to acquisition of supplies on short-order. Finally, our limited pool of equipment is in high demand by our own on-going work and by other Aspen FACE researchers. We may not always be able to fulfill supplies and equipment requests, particularly those that are made with short notice. Please plan ahead. (Submitted by Dr. Mark Kubiske [USFS]--Mark is the Aspen FACE Science Coordinator.)

Aspen FACE Protocol and Safety-2

A few reminders on Aspen FACE Protocol and Safety. First-time users of Aspen FACE and Aspen FACE veteran scientists who wish to start a new project are asked to visit the Aspen FACE web site to request the approval for their project at the site's protocol section. Users are requested to get the necessary paperwork to use the respirators in the O_3 rings. Also, we ask all investigators to remind their crews to get the necessary training to use the elevated walkways and to please stay on the walkways on the ground to minimize soil compaction and disruption of our belowground team's experiments which are often just at the soil surface. Thanks!

Recent Tours at Aspen FACE

Tours, led by Dr. Neil Nelson (USFS), assisted by Paula Marquardt, Ron Teclaw, Anita Foss, and Dr. Nic Saliendra (all USFS), were conducted for the Nicolet College Learning in Retirement Institute on June 7, and the Rhinelander Area YMCA Earth Service Corps on June 20. Participants in the latter tour are shown in the photo. (Submitted by Dr. Neil Nelson, USFS)

Aspen FACE Expansion Environmental Assessment Completed

The U.S. Forest Service has completed the Environmental Assessment (EA) on the planned modifications at the Aspen FACE site. This process is a requirement of the National Environmental Protection Act (NEPA). On May 14, 2006, Dr. Neil Nelson (USFS) issued a *Finding of No Significant Impact* based on the results of the Environmental Assessment. Those people and organizations that made substantive comments on the EA had until the close of business on June 28 to file appeals with the Acting Director of the North Central Research Station. The construction is currently planned for this autumn, pending the completion of the EA process. (Submitted by Dr. Neil Nelson, USFS)

N_{15} Study Roots Harvested at Aspen FACE

In a well coordinated effort between many Aspen FACE groups (Kurt Pregitzer's Lab – MTU; Mike Miller's Lab – Argonne National Lab; Don Zak's Lab – University of Michigan; Eric Lilleskov's Lab – USFS), Dr. Bill Holmes (top left photo) University of Michigan, recently led a crew of scientists and students harvesting roots for their tracer study focused on the N_{15} application in August, 2004. The soil cores will also be used for soil microorganism studies as well as studies of mycorrhizal associations and root biochemistry. Among the scientists involved were Angela Piket, left in bottom left photo (MTU), Susan Kiat and Zhanna Yermakov (right and left, respectively, in bottom right photo (Argonne National Lab), and MTU graduate student Carrie Andrew (right in bottom left photo). MTU undergraduate students involved in the harvest included Zach Wallace, Garrett Thrasher, Kate Tay, and April Gustafson.

New Ozone Flux Study Underway at Aspen FACE

Dr. Lisa Emberson (Stockholm Environment Institute at the University of York, UK) visited Aspen FACE on April 4-5, 2006 to examine the possibility of using Aspen FACE data to test O_3 flux-based metrics for estimating O_3 impacts on forest vegetation. Dr. Emberson has been actively involved in the movement towards a flux-based O_3 standard in Europe. Research is planned this summer in cooperation with Dave Karnosky (MTU), Neil Nelson (USFS), Mark Kubiske (USFS), and Markus Low, Rainer Matyssek, and Thorsten Grams (all of the Technical University of Munich, Germany). Markus Low and Thorsten Grams will visit Aspen FACE later this summer. The team believes the gas exchange characteristics from open-air studies, such as Aspen FACE, will be closer to those in real forests than those that have been generated from chambers.

Visiting Scientists at Aspen FACE

Drs. Kathryn Arano (West Virginia University) and Rico Gazal (Glenville State College) are spending the summer working with Dr. Mark Kubiske (USFS) on projects related to Aspen FACE. Kathryn, a forest economist, will be studying the economic implications of elevated CO_2 and O_3 on the growth and yield as well as wood quality of trembling aspen. This work could help forest managers understand the implications of global climate change on the forest products sector.

Rico, an ecophysiologist, is studying the variation in sources of water use by aspen trees under elevated CO_2 and O_3 treatments at Aspen FACE. Isotopic content of water taken up by the trees is a mixture of water from the various sources exploited by the trees. The comparison of isotopic composition in the trees and water sources (*i.e.* rain, soil and groundwater) can determine the actual sources of water transpired. Water from stem and soil samples will be extracted at the USFS Forest Science Lab in Rhinelander using the cryogenic vacuum distillation method.

Welcome Kathryn and Rico!

Passive Samplers are Supplied

Drs. Kevin Percy and Roger Cox (NRCAN Canadian Forest Service-Atlantic Forestry Centre) are again supplying Canoxy plate™ passive O_3 samplers to characterize spatial variability in O_3 doses across each O_3 and CO_2+O_3 ring at two heights (approximately 1 and 4 m) at four heights along the center pole. This is the fourth year for this activity which requires considerable coordination work by our Aspen FACE operators and a large volume of laboratory analyses by the CFS team. Thanks guys!

Scott Jacobson Returns to Aspen FACE

Scott Jacobson returned to Aspen FACE this spring as a site operator. Scott, who worked in a similar role from 1998 to 2000, replaced Jaak Sober who resigned this past winter to return to his native Estonia to take part in a humidity-FACE project. Scott, who graduated in 1992 from Bemidji State with a degree in geography, brings a host of practical skills to Aspen FACE. We look forward to his insights into logistical chores which often arise at Aspen FACE. Welcome back, Scott!

POPGENICS Team Meets in New York City

The POPGENICS Consortium, which is seeking to better understand the genomics of carbon sequestration, met in New York City on May 30 – June 1, 2006. Results from gene expression at Aspen FACE were summarized by University of Alabama-Huntsville Scientist Drs. Leland Cseke and Gopi Podila, while Dr. Alistair Rogers (Brookhaven National Lab) and Dr. David Karnosky (MTU) discussed biochemical and physiological responses of various aspen clones at Aspen FACE. Dr. Gail Taylor discussed genomes of elevated CO_2 studies from open-top chambers, POPFACE, and Aspen FACE. Dr. Ramesh Thakur discussed his work on transforming a number of poplar clones from Dr. Don Riemenschneider's (USFS) elite breeding program.

POPGENICS Scientists (L-R): Dave Karnosky (MTU), Gopi Podila (Univ. Alabama-Huntsville), Alistair Rogers (Brookhaven National Lab), Gail Taylor (Univ. Southampton, UK), Chung-Jui Tsai (MTU), Leland Cseke (Univ. Alabama-Huntsville), and Ramesh Thakur (MTU)

POPGENICS Team Participates in China Poplar Symposium

The POPGENICS Consortium, which is focusing on gene expression research to better understand the genetic control of carbon sequestration in poplars and which has conducted gene expression studies under elevated CO_2 at Aspen FACE, was featured in a symposium entitled "Poplars in a Changing World. Understanding Responses to Climate Change" at the Fourth International Poplar Symposium at the Nanjing Forestry University in Nanjing, China on June 5-7, 2006. Drs. Gail Taylor (University of Southampton), Dave Karnosky (Michigan Tech) and Xihuan Shen (Beijing Forestry University) organized the session. Dr. Taylor spoke on "Genetical Genomics and Poplar Response to a Changing Climate," while Dr. Karnosky spoke on "Global Change Impacts on Aspen Gene Expression: Genotypic Variability in Carbon Sequestration Potential." Other talks in the session were by Dr. Taylor's Ph.D. student, Matt Tallis, who discussed "Elevated CO_2 delays autumnal senescence in *Populus*." In another session, Dr. Chung-Jui Tsai (Michigan Tech) discussed "Functional Genomics of Carbon Allocation for Growth and Fitness in *Populus*."

Drs. Dave Karnosky, Chung-Jui Tsai, and Scott Harding (Michigan Tech) at the Fourth International Poplar Symposium.

Dr. Dave Karnosky (Michigan Tech) addresses the Symposium.

Dr. Gail Taylor (University of Southampton) addresses the topic of Genetical Genomics.

People at FACE

Janet Pikkarainen
Administrative Assistant
Michigan Technological University, Houghton, MI

Editor's Note: Janet Pikkarainen has served the Aspen FACE project diligently, professionally, and with tremendous dedication since April 10, 1995. She received an award acknowledging her superior effort to Aspen FACE during the Aspen FACE Annual Investigators' Meeting in Green Bay, Wisconsin on December 11, 2003.

Editor: How did you get involved in Aspen FACE?
Janet: I was hired by Dave Karnosky in April 1995. My introduction to Aspen FACE began on day one of my job (April 10) to type the very first Aspen FACE proposal to the TECO program due 4 days later (April 14). I felt like I was literally "in-the-woods" at that point with beginning a new job, new computer, new software and new terminology, etc. , but we finalized the proposal and it was funded – our first successful FACE grant! So, I actually was involved with Aspen FACE almost from its inception.

Editor: What have been your most rewarding experiences in working on Aspen FACE-related activities?
Janet: Prior to Aspen FACE, I assisted with the biomass harvest at the open-top chamber site in Alberta – I got a little glimpse of what was to come. I feel so fortunate to be involved in the growth of Aspen FACE from almost the ground up. Along with the daily duties, I also ordered equipment for the site and assisted in propagation of the aspen/birch/maple trees planted in the FACE rings, as well as field work for data collection, harvesting biomass, and scoring of insect, disease and ozone injury. Interacting with such a diverse group of Aspen FACE investigators and students has been one of the highlights of my position. My job never gets repetitious or boring – I'm always learning something new.

Editor: What are your toughest chores – besides keeping track of your globe-trotting boss?
Janet: Yes, that is one of my toughest chores – to keep Dave organized and to keep up with his many projects and travel – this makes my job interesting and challenging.

Editor: The book entitled "Air Pollution, Global Change and Forests in the new Millennium," published by Elsevier Press, that you, Dave, Dr. Kevin Percy and Carol Simpson (Canadian Forest Service) put together was well received in the literature. Would you tackle another one if the opportunity arose?
Janet: Certainly, I would welcome an opportunity to tackle another one! It was a bit of a tedious task and seemingly overwhelming when we started, but it was well worth the effort after seeing the published book. It was such a rewarding and tremendous learning experience working with the foreign writers and our editorial team.

Editor: Besides the FACE project, what has been most interesting component in your MTU position?
Janet: The most interesting experience has been the opportunity to interact with people from all parts of the world and to attend annual Internet Task Force meetings in four different countries (Costa Rica, Finland, Malaysia and China) while I was a IUFRO Division 7 web moderator and a member of the Internet Task Force which formulated policy and procedures for IUFRO's web site.
Editor: Keep up the great work, Janet!

Dan Baumann
Technician
U.S. Forest Service, Rhinelander, WI

Many of you have probably seen Dan and his mentor, Ron Teclaw, working in the FACE rings to maintain the large volume of instruments, sensors, and wires at the micrometeorological tower at the north end of the experiment.

Editors: How long have you worked on Aspen FACE?
Dan: I have worked on the Aspen FACE project for 4 years but I was out at the Harshaw Farm for a year before that working on the willows on another DOE-funded project.

Editors: What have your main roles been? In other words, what have you been doing at Aspen FACE?
Dan: Well, they have been varied to say the least. I help Ron maintain the micrometeorological tower and the micromet facilities *(i.e*. soil moisture probes, air and soil temperature, wind speed and direction, PAR, etc.) in each FACE ring. Also, I help maintain

the main micrometeorological tower on the site using the site's man-lift. More, recently, I have taken over a lot of the scaffold training sessions to help people get ready to use the elevated walkways.

Editors: What is your current position in the USFS? Where did you go to school? I take it you are in Neil's project.
Dan: I am a technician in Dr. Neil Nelson's project. I graduated from Iowa State University from their Forest Resource Management program in 2000.

Editors: How did you get involved in Aspen FACE?
Dan: Well, I was a bit lucky because just as the willow project I was working on finished, there was an opening with this project to work at Aspen FACE.

Dan Baumann demonstrates use of the safety harnesses and buddy climbing system.

Editors: What has been your biggest challenge in your Aspen FACE work?
Dan: By far, the biggest challenge is keeping the 1,400 instruments and sensors functioning so we can continue to record the some 2 million measurements per day that we make at Aspen FACE for the micrometeorological characterization of the site. Almost every day there is some trouble-shooting and repairs to be done – many from rodents who find our conduit attractive to munch on. We've tried all sorts of tricks to keep them away from these lines but nothing has really worked.

Editors: Dan, Ron Teclaw, Dr. John Nagy (Brookhaven National Lab) and, of course, Dr. Warren Heilman (USFS) do a fantastic job keeping our micromet system running. Thanks guys!

New Aspen FACE Grants

Richard L. Lindroth, University of Wisconsin. Impacts of elevated CO_2 and O_3 on insect-mediated ecosystem processes in a northern deciduous forest. $534,630. Supported by the US DOE-OBER. Congratulations, Rick!

Recent Aspen FACE Publications:

Bandeff, J.M., K.S. Pregitzer, W.M. Loya, W.E. Holmes, and D.R. Zak. 2006. Overstory community composition and elevated atmospheric CO_2 and O_3 modify understory biomass production and nitrogen acquisition. Plant and Soil 282:251-259.

Chapman, J.A., J.S. King, K.S. Pregitzer, and D.R. Zak. 2005. Effects of elevated CO_2 and tropospheric O_3 on tree fine root decomposition. Tree Physiology 25:1501-1510.

Chung, H., D.R. Zak, and E.A. Lilleskov. 2006. Fungal community composition and metabolism under elevated CO_2 and O_3. Oecologia 147:143-154.

Karnosky, D.F., J.M. Skelly, K.E. Percy, and A.H. Chappelka. 2006. Perspectives regarding 50 years of research on effects of tropospheric ozone air pollution on U.S. Forests. Environ. Pollut. (In Press)

Karnosky, D.F. and K.S. Pregitzer. 2006. Impacts of elevated CO_2 and O_3 on northern temperate forest ecosystems: Results from the Aspen FACE experiment. In: Nösberger, J., S.P. Long, R.J. Norby, M. Stitt, G.R. Hendrey, H. Blum, Eds. "Managed Ecosystems and CO_2: Case Studies, Processes and Perspectives." Ecological Studies, Springer-Verlag pp. 213-229.

King, J.S., M.E. Kubiske, K.S. Pregitzer, G.R. Hendrey, E.P. McDonald, C.P. Giardina, V.S. Quinn, and D.F. Karnosky. 2005. Tropospheric O_3 compromises net primary production in young stands of trembling aspen, paper birch and sugar maple in response to elevated atmospheric CO_2. New Phytologist 168:623-636.

King, J.S., K.S. Pregitzer, D.R. Zak, W.E. Holmes, K. Schmidt. 2005. Fine root chemistry and decomposition in model communities of north-temperate tree species show little response to elevated atmospheric CO_2 and varying soil resource availability. Oecologia 146:318-328.

Kubiske, M.E., V.S. Quinn, W.E. Heilman, E.P. McDonald, P.E. Marquardt, R.M. Teclaw, A.L. Friend, and D.F. Karnosky. 2006. Climatic variation mediates elevated CO_2 and O_3 effects on forest growth. Global Change Biology 12:1054-1068.

Liu, L., J.S. King, and C.P. Giardina. 2005. Effects of elevated atmospheric CO_2 and tropospheric O_3 on leaf litter production and chemistry in trembling aspen and paper birch ecosystems. Tree Physiology 15:1511-1522.

Mattson, W.J., R. Julkunen-Tiitto, and D.A. Herms. 2005. CO_2 enrichment and carbon partitioning to phenolics: do plant responses accord better with the protein competition of the growth-differentiation balance models? Oikos 111:337-347.

Muntifering, R.B., A.H. Chappelka, J.C. Lin, D.F. Karnosky, and G.L. Somers. 2006. Chemical composition and digestibility of *Trifolium* exposed to elevated ozone and carbon dioxide in a free-air (FACE) fumigation system. Functional Ecology 20:269-275.

Norby, R.J., E.H. DeLucia, B. Gielen, C. Calfapietra, C.P. Giardina, J.S. King, J. Ledford, H.R. McCarthy, D.J.P. Moore, R. Ceulemans, P. DeAngelis, A.C. Finzi, D.F. Karnosky, M.E. Kubiske, M. Lukac, K.S. Pregitzer, G.E. Scarascia-Mugnozza, R. Oren, W.H. Schlesinger. 2005. Forest response to elevated CO_2 is conserved across a broad range of productivity. Proc. Nat. Acad. Sci. 102:18052-18056.

Pregitzer, K., W. Loya, M. Kubiske, and D. Zak. 2006. Soil respiration in northern forests exposed to elevated atmospheric carbon dioxide and ozone. Oecologia 148:503-516.

Zak, D.R., C.B. Blackwood and M.P. Waldrop. 2006. A molecular down for biogeochemistry. Trends in Ecology and Evolution 21:288-295.