

BESD Newsletter
March 2011

Pubs and Products

Boggs, M. A., Minton, T., Lomasney, S., Islam, M. R., Dong, W., Gu, B., and N. A. Wall. 2011. Interactions of Tc(IV) with humic substances. *Environ. Sci. Technol.* 45: 2718-2724.

Dong, W., Bian, Y., Liang, L., and B. Gu. 2011. Binding constants of mercury and dissolved organic matter determined by a modified ion exchange technique. *Environ. Sci. Technol.* 45: 3576-3583.

Environmental Protection Agent (EPA) National Center for Environmental Assessment (NCEA) has published the report "Formulation for Human Health Risk Assessments of Pathogens in Land-applied Biosolids." EPA/600/R-08/035F. 2011. Co-authored by Rebecca Efroymson and Anthony Armstrong (ORNL), Audrey Ichida and Joy Lee (ICF International)
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=231964>

Feinberg, L., Foden, J., Barrett, T., Davenport, K. W., Bruce, D., Detter, C., Tapia, R., Han, C., Lapidus, A., Lucas, S., Cheng, J.-F., Pitluck, S., Woyke, T., Ivanova, N., Mikhailova, N., Land, M., Hauser, L., Argyros, D. A., Goodwin, L., Hogsett, D., and N. Caiazza. 2011. Complete Genome Sequence of the Cellulolytic Thermophile *Clostridium thermocellum* DSM1313. *J. Bacteriol.* Available online. DOI: 10.1128/JB.00322-11

Flores, G. E., Campbell, J. E., Kirshtein, J. D., Meneghin, J., Podar, M., Steinberg, J. I., Seewald, J. S., Tivey, M. K., Voytek, M. A., Yang, Z. K., and A.-L. Reysenbach. Microbial community structure of hydrothermal deposits from geochemically different vent fields along the Mid-Atlantic Ridge. *Environ. Microbiol.* Available online. DOI: 10.1111/j.1462-2920.2011.024

Graham, D. E. 2011. 2-Oxoacid metabolism in methanogenic CoM and CoB biosynthesis. In C. R. Amy and W. R. Stephen (Eds.), *Methods in Enzymology, Vol. 494, Methods in Methane Metabolism, Part A.* (Chapter 15, p. 301-326). Academic Press.

Hatab, N. A., Rouleau, C. M., Retterer, S. T., Eres, G., Hatzinger, P. B., and B. Gu. 2011. An integrated portable Raman sensor with nanofabricated gold bowtie array substrates for energetics detection. *Analyst* 136: 1697-1702.

Higashide, W., Li, Y., Yang, Y., and J. C. Liao. 2011. Metabolic Engineering of *Clostridium Cellulolyticum* for Isobutanol Production from Cellulose. *Appl. Environ. Microbiol.* Available online. DOI:10.1128/AEM.02454-10

Kline, K., Parish, E., Singh, N., Wullschleger, S., Preston, B., Keller, M., and L. R. Lynd. 2011. Collaborators welcome: Global Sustainable Bioenergy Project (GSB). GLP NEWS No. 7 (7-8). The article reviews recent collaborations among ORNL, PNL and others in research supporting the GSB. See <http://www.globallandproject.org/newsletter.shtml>

Luo, W., and B. Gu. 2011. Dissolution of uranium-bearing minerals and mobilization of uranium by organic ligands in a biologically reduced sediment. *Environ. Sci. Technol.* 45: 2994-2999.

McBride, A. C., Dale, V. H., Baskaran, L. M., Downing, M. E., Eaton, L. M., Efroymson, R. A., Garten, C. T., Jr., Kline, K. L., Jager, H. I., Mulholland, P. J., Parish, E. S., Schweitzer, P. E., and J. M. Storey. 2011. Indicators to support environmental sustainability of bioenergy systems. *Ecol. Indic.* Available online. DOI: 10.1016/j.ecolind.2011.01.010

Naimi, L. J., Sokhansanj, S., Womac, A. R., Bi, X., Lim, C. J., Igathinathane, C., Lau, A. K., Sowlati, T., Melin, S., Emami, M., and M. Afzal. 2011. Development of a population balance model to simulate fractionation of ground switchgrass. *Transactions of the ASABE* 54: 219-227.

Norby, R. J. 2011. Carbon cycling in tropical ecosystems. *New Phytol.* 189: 893-894.

Smith, S. J., van Aardenne, J., Klimont, Z., Andres, R. J., Volke, A., and S. Delgado Arias. 2011. Anthropogenic sulfur dioxide emissions: 1850-2005. *Atmos. Chem. Phys.* 11: 1101-1116.

Studer, M. H., DeMartini, J. D., Davis, M. F., Sykes, R. W., Davison, B., Keller, M., Tuskan, G. A., and C. E. Wyman. 2011. Lignin content in natural *Populus* variants affects sugar release. *P. Nat. Acad. Sci. USA* 108: 6300-6305.

Tumuluru, J. S., Kuang, X., Sokhansanj, S., Lim, C. J., Bi, T., and S. Melin. 2010. Development of laboratory studies on the off-gassing of wood pellets. *Can. Biosyst. Eng.* 52: 8.1-8.9.

Vishnivetskaya, T. A., Lucas, S., Copeland, A., Lapidus, A., del Rio, T. G., Dalin, E., Tice, H., Bruce, D. C., Goodwin, L. A., Pitluck, S., Saunders, E., Brettin, T., Detter, C., Han, C., Larimer, F., Land, M. L., Hauser, L. J., Kyrpides, N. C., Ovchinnikova, G., Kathariou, S., Ramaley, R. F., Rodrigues, D. F., Hendrix, C., Richardson, P., and J. M. Tiedje. 2011. Complete genome sequence of the thermophilic exiguobacterium sp. AT1b. *J. Bacteriol.* Available online. DOI:10.1128/JB.00303-11.

Watson, A., Dolislager, F., Hall, L., Raber, E., Hauschild, V., and A. Love. 2011b. Developing health-based pre-planning clearance goals for airport remediation following chemical terrorist attack: decision criteria for multipathway exposure routes. *Human Ecol. Risk Assess.* 17: 57-121.

Watson, A., Hall, L., Raber, E., Hauschild, V., Dolislager, F., Love, A., and M. L. Hanna. 2011a. Developing health-based pre-planning clearance goals for airport remediation following chemical terrorist attack: introduction and key assessment considerations. *Human Ecol. Risk Assess.* 17: 2-56.

Xu, X., Seal, K., Xu, X., Ivanov, I., Hsueh, C. H., Hatab, N. A., Gu, B., Zhang, Z., and J. Shen. 2011. High tunability of the SERS response with a metal-multiferroic composite. *Nano Lett.* 11: 1265-1269.

Notable Achievements

Vince Neary traveled to Boulder, CO, on February 28th - March 3rd for a meeting at the National Wind Center with partner labs to discuss marine and hydrokinetic (MHK) testing and measurement needs.

Shih-Chieh Kao and Mike Sale had a project coordination meeting with the Southeastern Power Administration on March 2nd in Elberton, GA, for the Secure Water Act Section 9505 Climate Change Impact Assessment report.

Rich Norby presented a poster at the 1st Integrated Network for Terrestrial Ecosystem Research on Feedbacks to the Atmosphere and Climate (INTERFACE) Workshop, Captiva Island, Florida on: "Benchmarking Ecosystem Response Models with Experimental Data from Long-term CO₂ Enrichment Experiments." Rich also participated in an International Geosphere-Biosphere Programme (IGBP) Ecosystem Impacts of Geoengineering Workshop, La Jolla, California, and he presented an invited lecture on "Temperate Tree FACE Studies: Lessons from a decades-long research program" at a symposium on "Responses of Tropical Vegetation to Elevated [CO₂]: What are the key questions and how best to address them experimentally?" at the Smithsonian Tropical Research Institute, Panama City, Panama.

Erin Webb hosted William Tong, Distinguished Professor of Chemistry and Biochemistry at San Diego State University during his visit to Oak Ridge National Laboratory (ORNL) on March 3rd. Dr. Tong presented a seminar "Multi-Photon Nonlinear Laser Spectroscopic Methods for Parts-Per-Quadrillion-Level Detection of Isotopes and Chem/Bio Agents" and met with research staff regarding potential collaborations.

ORNL Distributed Active Archive Center (DAAC) Chief Scientist, Bob Cook, participated in the DataONE Best Practices Workshop, March 3rd-4th, in Albuquerque, NM.

The Mercury Science Focus Area (SFA) team held an external scientific advisory committee (SAC) meeting at ORNL on March 3rd-4th. Both ORNL staff and university collaborators participated in the discussions. The team has received the report from the SAC, recognizing the contributions and impacts of this program in the mercury research field. Internal and external participants include: Beth Bailey, Craig Brandt, Scott Brooks, Steve Brown, Dwayne Elias, Cindy Gilmour, Andrew Graham, Baohua Gu, Hao-Bo Guo, Hong Guo, Feng He, Richard Hurt, Gary Jacobs, Alex Johs, David Kocman, Rich Landis, Liyuan Liang, Carrie Miller, Sue Miller, Bhoopesh Mishra, James Moberly, Tony Palumbo, Jerry Parks, Yun Qian, Demian Riccardi, Jeffra Schaefer, Liang Shi, Jeremy Smith, Anne Summers, Steve Tomanicek, Judy Wall, Qin Xu, and Wang Zheng.

On March 7th U.S. Secretary of Energy Steven Chu congratulated the BioEnergy Science Center (BESC) research team working on deriving isobutanol from cellulose (<http://www.energy.gov/news/10163.htm>). With former Biosciences Division (BSD) member Yunfeng Yang and current member Yongchao Li, the team developed a strain of *Clostridium cellulolyticum* that could generate isobutanol from cellulose in plants. Isobutanol can be used directly as fuel in car engines. The news was even cross-posted on the White House Blog (<http://www.whitehouse.gov/blog/2011/03/07/winning-biofuel-future>). Their paper, Metabolic Engineering of *Clostridium cellulolyticum* for isobutanol production from cellulose, was released in *Applied and Environmental Microbiology* online on March 4th (<http://aem.asm.org/cgi/reprint/AEM.02454-10v1>).

A Making Earth Science Data Records for Use in Research Environments (MEaSUREs) review occurred March 8th, and a joint ORNL DAAC and LP (Land Processes) DAAC User Working Group (UWG) Meeting occurred March 9th-10th in Annapolis, MD. ORNL DAAC participants included: ORNL DAAC Scientist, Bob Cook; DAAC Manager, Chris Lenhardt; Deputy DAAC Manager, Tammy Walker; DAAC Systems Engineer, Ben McMurry; and DAAC Lead Developer, Suresh SanthanaVannan.

Brennan Smith attended the Norwegian Water Resources and Energy Directorate Meeting in Oslo, Norway, on March 8th-10th.

On March 9th oral and written comments were provided by Keith Kline to the Council on Sustainable Biomass Production (CSBP) staff and Field Testing Task Force related to developing and implementing a two-tiered approach for Integrated Resource Management Plans (IRMP) as a strategy to move forward with an effective and successful voluntary standard. The first tier IRMP, at a fuel-shed scale, would be prepared by the biomass buyer/contractor to clarify and simplify requirements at the individual grower scale. ORNL also recommended more emphasis be placed on incentives for continuous improvement as a core principle in the Standard.

Also on March 9th Shahab Sokhansanj participated via teleconference in the planning committee for the Agricultural Equipment Technology Conference to be held in February 2012 in Louisville, KY. During this meeting the overall format of the 3-day meeting was established. Shahab Sokhansanj is responsible for the development of technical sessions on Bioenergy, the poster session, and a session for continuing professional development (CPD).

Robin Graham attended the Council for Chemical Research (CCR)/Department of Energy (DOE) High Performance Computing workshop, March 10th-11th in Rockville, MD. The workshop focused on optimizing the role of high performance computing in chemical research, and Robin participated in the Biomass/Bioenergy breakout session dealing with sustainable biomass supply: integration of life cycle assessment, macro-economic models and geospatial data.

Jeff Warren recently led a lecture for a University of Tennessee (UT) Tree Physiology class at the UT Arboretum that discussed current ORNL research into carbon partitioning in plants. The event included a visit to the nearby PiTS (Partitioning in Trees and Soils) research site, an ongoing effort that pairs ecologists, physiologists and modelers together to mechanistically assess carbon uptake, transport and release within an ecosystem.

On March 11th Shahab Sokhansanj participated in a teleconference with researchers from Texas A & M (Dr. Searcy, Huengjo An), the University of Arkansas (Dr. Popp, Jim Smart), and the University of British Columbia (Mahmoud Ebadian, Mahdi Mobini) to discuss the latest developments on the logistic modeling tool IBSAL. During this session examples of the application of a set of newly developed modules on “delays in harvest progress” due to precipitation (rainfall), drying, dry matter loss and recovery were presented.

On March 14th Keith Kline submitted comments, links and a list of references describing the drivers of global and regional land-use change to Stephen Kaffka for consideration by the California Air Resources Board (ARB) Low Carbon Fuel Standard (LCFS) Sustainability Work Group March 17th meeting in Sacramento, CA.

Erin Webb was an invited speaker at the Kentucky Statewide Energy Workshop on Energy Efficiency and Renewable Energy on March 14th in Louisville, KY. Her talk "Advancing the Biomass Supply Chain" highlighted ORNL research along the entire biomass supply system. In response to this presentation, a visit to ORNL was requested by representatives of the Kentucky Division of Renewable Energy and was planned for April 2011.

Jim Elkins provided images and information for hyperthermophilic, deep-branching archaea for the Sciences Museum in Barcelona, Spain. The images will be on permanent display in the “Archaea Room” which will be part of the *Planet Life* exhibition.

On March 14th and 30th ORNL provided additional information to CSBP staff and Task Force members on options for handling issues that vary with location such as invasive species and on the changes that likely be required if the CSBP wanted to be recognized as being in compliance with the provisions of the Roundtable on Sustainable Biofuels (RSB).

On March 15th Keith Kline, Gregg Marland, and Virginia Dale had a conference call with Brian Titus of the Canadian Forest Service, and Anne-Marie Chapman and Emil Laurin of Environment Canada. Topics discussed included Life Cycle Assessment (LCA) in forest systems – especially the spatial and temporal boundaries of these analyses and the temporal value of carbon. They also shared information about several ongoing projects in the two countries that focus on environmental indicators and optimization approaches to sustainable landscape designs. The group agreed to share information and to have another conference call in mid-April.

Also on March 15th Keith Kline and Virginia Dale conducted a conference call to share their knowledge, a white paper and ideas about biofuel issues in Brazil with Sheila Moynihan of DOE's Office of the Biomass Program to assist in developing a briefing package for the U.S. delegation visit to Brazil led by the President.

Glenn Cada was highlighted on the Knoxville News Sentinel Atomic City Underground blog by Frank Munger (<http://blogs.knoxnews.com/munger/2011/03/hydrokinetic-energy-and-the-en.html>) for his scheduled talk for the Friends of ORNL (FORNL). Glenn gave his talk, "Efforts to Ensure the Environmentally Sound Development of New Marine and Freshwater Hydrokinetic Energy Technology," on March 16th at the FORNL meeting in Oak Ridge, TN.

Also on March 16th ORNL contributed to formal comments on the proposed RSB calculation of a global average greenhouse gas emission value for the fossil fuel baseline to be used in their standard. The comments point out that the analysis omitted several sources of emissions and used U.S. values for venting and flaring which skew results toward a smaller value for fossil fuel emissions.

On March 24th Matt Langholtz participated in the conference call of the Climate Change Task Force of the CSBP. During the call the Task Force selected vendors to submit full proposals for the "Development of Bioenergy Greenhouse Gas Sustainability Standards" and discussed field-testing results and recommendations.

In May at the annual meeting, Pat Mulholland is slated to receive the 2011 Award of Excellence, their highest honor, from the North American Benthological Society (NABS).

Also on March 24th a five-person delegation from Novozymes visited the University of British Columbia (UBC) Clean Energy Research Center (CERC). Shahab Sokhansanj hosted the delegation and described the advanced biomass engineering experiments and logistics modeling. Novozymes and UBC scientists (Michael Smith Laboratory) are exploring potential areas of collaborative research on genomics (and related areas).

On Friday March 25th Steve Brown gave an invited seminar at Michigan Technical University sponsored by the Grain Processing Corporation 2010/2011 Lecture Series. Steve's seminar was entitled "Mutant alcohol dehydrogenase leads to improved ethanol tolerance in *Clostridium thermocellum*" and Steve was presenting as the Michigan Technological University Department of Chemical Engineering Distinguished Lecturer. To commemorate this event, Steve was

presented a plaque.

Jim Elkins gave an invited lecture at UT for the Elements of Synthetic Biology course on March 25th. The title of his talk was: Design and optimization of synthetic constructs for heterologous gene expression.

A Facebook page and a Twitter account have been set-up for the Center for BioEnergy Sustainability. These will help provide information to a larger group of people who are interested in bioenergy and sustainability.

<http://www.facebook.com/pages/Center-for-BioEnergy-Sustainability/198441580180476>.

Follow us on Twitter @ ORNL CBES.

Thanks to Stan Wullschleger, we have an update on the stats of the 2006 *Science* article (Tuskan, *et al.*), “The genome of the black cottonwood, *Populus trichocarpa* (Torr. & Gray)”:

- It has been cited 773 times.
- It is the 16th highest cited paper published in *Science* since 2006.
- If you search the ISI Web of Science using the key word Populus there have been 8,156 publications since 1955. The *Populus* genome paper is 1st in citations among that list.
- If you search the ISI Web of Science for "Oak Ridge Natl Lab" there have been 50,833 publications since 1955. The *Populus* genome paper is 21st in citations among that list.
- Among the 25 highest cited publications coming out of ORNL since 1955, and the Environmental Sciences Division (ESD) and BSD have contributed 6 of those (Bob O'Neill, Monica Turner, Michael Huston, Mac Post, Jerry Tuskan, and Lianhong Gu).

On March 28th a delegation of 3 persons from the Canadian Carbonization Research Association and Sunoco visited the UBC Clean Energy Research Center. Shahab Sokhansanj toured the delegation and described the advanced biomass engineering experiments and logistics modeling.

BSD's Poornima Sukumar and Udaya Kalluri, along with Hassina Bilheux and Sophie Voisin of the Neutron Scattering Science Division (NScD), and Lakeisha Walker of the Spallation Neutron Source (SNS), submitted a user proposal entitled "Defining role of auxin in wood formation and water uptake using neutron imaging" to the ORNL Neutron Sciences User Office (IPTS-4222) in August 2010. This proposal has been granted competitive beamtime following peer-review.

A map of the U.S. showing potential bioenergy feedstocks that was developed by ORNL will appear in the upcoming United States Department of Agriculture (USDA) report “Soil and Water Resources Conservation Act Appraisal Report” (per request of Dan Mullarkey). The map will appear in the paper to be published in June: Dale, V. H., Wright, L., Kline, K. L., Perlack, R., Graham, R. L., and M. Downing. In press. Interactions Between Bioenergy Feedstock Choices and Landscape Dynamics and Land Use. *Ecological Applications*.

Lynn Wright, Virginia Tolbert, and Allen McBride are organizing and preserving three decades' worth of material related to ORNL research in bioenergy feedstocks. Especially important are field data, institutional records, technical manuscripts, and subcontractor reports related to DOE's Bioenergy Feedstock Development Program between 1978 and 2002.

NASA conducted an annual project review of ORNL DAAC's Earth Science Data in Digital Object Repository Architecture (ESDORA) project on March 28th. ESDORA is lead by ORNL Developer Jerry Pan and ORNL DAAC Manager Chris Lenhardt, and is funded through the Advancing Collaborative Connections for Earth System Science (ACCESS) program. The project uses open source software including Fedora (digital object repository) and Drupal (content

management system) to preserve Earth Science content and promote metadata while semantically supporting the storage and distribution of diverse data sets.

Rebecca Nichols, 10th grade home-schooled daughter of Jeff Nichols, ESD, won two special awards in the regional Intel Science Fair Competition (sasef.com) held at UT on March 28th-31st. Her project, "Views of White-Nose Syndrome (WNS) in Bat Populations," was recognized by Science Applications International Corporation (SAIC) with an award for Environmental Excellence and received the Biology Teachers' Award. Both awards included \$75 and additional gifts. Her project was developing tools utilizing Google Earth for visualizing the results from a WNS disease dispersal model developed at UT. Her results have been included in a paper submitted to *Science*.

On March 29th an ORNL Press release, "Key plant traits yield more sugar for biofuels" highlighted work by a team at ORNL and others on lignin. The team, including Gerald Tuskan, Brian Davison and others, determined that variables other than the amount and makeup of lignin in the plant's cell wall appear to contribute to recalcitrance of a given sample. Read their *PNAS* paper, "Lignin content in natural *Populus* variants affects sugar release," online at <http://www.pnas.org/content/108/15/6300.full>.

On March 30th Gangsheng Wang and Keith Kline developed comments on the working draft of "Sustainability Criteria for Bioenergy" (International Standards Organization [ISO] 13065) for submission to the ISO Project Committee (PC)-248 in preparation for the May Committee meeting.

Shahab Sokhansanj is working on development of cellulose nano-fibers from energy crops for structural and biomedical applications along with Sudhagar Mani, Bharat Singh and Zhenwei Pan (University of Georgia).

Stan Wullschleger was invited to participate in the DOE Joint Genome Institute (JGI) Strategic planning meeting held in Asilomar, CA. Stan was asked to present on the topic of "Omics in the Arctic" with an emphasis on how JGI could contribute to plant and microbial genomics in support of carbon cycle science and climate models. David Graham, Dwayne Elias, David Weston, and Wellington Muchero helped prepare Stan for this presentation.

The proposal "On-Farm Biomass Processing: Towards an Integrated High Solids Transporting/Storing/Processing System" led by the University of Kentucky was selected for funding by the USDA as part of the Biomass Research and Development Initiative. Erin Webb of ORNL/ESD is a co-PI on the project and will be leading efforts to develop simulations of the feedstock supply chain for this unique project featuring high-density baling operations, single-pass cut and collection of herbaceous energy crops, pretreatment of biomass bales during storage, and on-farm processing of biomass to butanol and other advanced biofuels. Other collaborating institutions include: North Carolina State University, the University of Wisconsin, the USDA-Agricultural Research Service (ARS) Forage Animal Production Unit, and CNH America.

BESD New Arrivals

Susan Heinz reported to work in March, working as a Technical Project Leader with Chris Lenhardt in ESD's Environmental Data Science and Systems Group.

Haiyan Hu, a Ph.D. Candidate from the Chinese Academy of Science, arrived in March to work with Baohua Gu. She will be working on the Mercury SFA, focusing on the biogeochemical transformation of mercury.

Balaji Rao, a postdoctoral research associate, will be working with Baohua Gu on environmental transformation and fate of perchlorate and contaminant metals.

Qin Fen Zhang reported to work in March, working as a Mechanical Engineer with Brennan Smith in ESD's Energy-Water-Ecosystem Engineering Group.