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BIOS AND ABSTRACTS OF PRESENTERS
BIOS OF MODERATORS

ABU-OMAR, MAHDI

Abstract: *Center for Direct Catalytic Conversion of Biomass to Biofuels*
The Center for Direct Catalytic Conversion of Biomass to Biofuels (C3Bio) comprises a partnership between Purdue University, the National Renewable Energy Laboratory, the University of Tennessee, and the Argonne National Laboratory. The vision of the center is to develop technologies that maximize the energy and carbon efficiencies of biofuel production by the rational and synergistic design of both physical and chemical conversion processes and the biomass itself. Our research mission is to expand the product range beyond ethanol to alkanes and new energy-rich aromatic liquid fuels and other value-added products that retain the current liquid fuel infrastructure. The C3Bio collaborative effort is focused on fundamental processes of making and breaking covalent and other bonds in biological materials to afford control on the molecular scale. We have been investigating new ways to design lignocellulosic biomass tailored for its end-use in direct chemical catalytic pathways. C3Bio integrates advances in nanotechnology, chemical engineering, materials science, molecular biology and high-resolution instrumentation to relate the molecular and nanoscale properties of biomass materials to their macroscopic behavior in catalytic processing. Our scientific approach in developing new catalytic transformations, achieving an atomic-to-macromolecular scale understanding of catalysts interaction with lignocellulosic biomass, and engineering tailored biomass for highly efficient conversion to liquid fuels and value-added products will be discussed.

Bio: Mahdi Abu-Omar directs a research program aimed at developing metal catalysts for renewable energy and environmental applications. He also studies folding dynamics of metalloproteins relating to disease. He is the author or co-author of more than 70 original research papers published in peer-reviewed scientific journals. Prior to joining Purdue University in 2003, Dr. Abu-Omar spent one year as a National Institute of Health postdoctoral scholar in bioinorganic chemistry at Caltech before moving to UCLA as an Assistant Professor, where he launched his independent research career in transition-metal catalysis and 'green' chemistry. Dr. Abu-Omar has 10 years of experience in research and management. He mentored 19 Ph.D. students, 7 postdoctoral research associates, and 10 undergraduate students. In addition to being a professor of chemistry, Dr. Abu-Omar assumed in 2009 the post of associate director of the Center for Catalytic Conversion of Biomass to Biofuels (C3Bio), a DOE-funded Energy Frontiers Research Center. Dr. Abu-Omar is the recipient of several awards including the College of Engineering Team Excellence Award from Purdue University, a Faculty Early Career Development Award from the U.S. National Science Foundation, and a Beckman Young Investigator Award from the Beckman Foundation. In 2008, Dr. Abu-Omar was named University Faculty Scholar by Purdue University. Dr. Abu-Omar holds a B.S. degree (summa cum laude) in chemistry from Hampden-Sydney College, Virginia, and a Ph.D. in inorganic chemistry from Iowa State University.

BADER, DAVID

Abstract: *Global Climate Modeling and Prediction*
A transformational change in climate modeling took place as a result of the coordinated experiments executed for the Third Coupled Model Intercomparison Project (CMIP3). Much of Working Group I contribution to the IPCC

Fourth Assessment Report was based on these model runs, which were analyzed by thousands of researchers around the world. In this presentation, we will review the state-of-the-science in climate simulation and prediction as represented by the CMIP3 models. These models are, however, too inaccurate and incomplete to answer many of the questions raised about future climate change. We will summarize current directions in the development of the next generation of climate and Earth system models, with an eye towards the demands on models beyond that time frame.

Bio: David C. Bader received his PhD (Atmospheric Science) in 1985 from Colorado State University. Since June 2009, he has been Deputy Director of the Oak Ridge Climate Change Science Institute, where he oversees of ORNL's climate change research funded by the DOE Office of Science. From June, 2003 through June 2009, he was the Director, Program for Climate Model Diagnosis and Intercomparison at Lawrence Livermore National Laboratory, which coordinates major international climate model evaluation and intercomparison activities for the World Climate Research Programme. From October 2002 through September 2009, he was also Chief Scientist for the US Department of Energy's Climate Change Prediction Program. From 1990 to 2002, he developed and managed climate modeling and computational research programs for the Office of Science, US Department of Energy (DOE's) and was DOE's principal representative for climate research and climate modeling to interagency working groups and committees. He was the convening lead author of the U.S. Climate Change Science Program Synthesis and Assessment Report 3.1: *Climate Models: An Assessment of Strengths and Limitations*, published in 2008. In 2003, he was a lead author of the interagency US Climate Change Science Program Strategic Plan, Chapter 10: Modeling Strategy and in 2001 was chair of interagency Climate Change Research Initiative (CCRI) Working Group on Climate Modeling. He was the US Government review coordinator of the climate model evaluation chapters for Second and Third IPCC Working Group I Assessments.

BAO, JIE

Abstract: *Progress on Industrial Demonstration of Cellulose Ethanol and the Relevant Industrial Researches in China*—Currently China has launched at least four demonstration plants scaled from 3,000 t/a to 15,000 t/a fuel ethanol using agriculture residues such as corn stover or wheat straw as feedstock. All these demonstration projects were operated by the giant national or provincial energy producers, such as PetroChina, Sinopec, Cofco, and Tianguan corporations. The projects were partially supported by the Chinese government funding. Among the demonstration projects, two projects have put into operation trials and the other two are under constructions. All the demonstrations are expected to complete before the end of 2010, the last year of the 11th five-year planning of China. The major technical choices of these demonstration plants were introduced. The overall consideration of one project, the PetroChina demonstration plant, was introduced in details. The technical and economic feasibility assessment of the commercial production of lignocellulosic feedstocks are evaluated and the 50,000 t/a to 100,000 t/a scale of cellulose ethanol plants are expected to be established in the next Five-Year Planning period (2011-2015).

Bio: Jie Bao is the director of the Center for Biomass Energy Technology and Deputy Director of the State Key Laboratory of Bioengineering Reactor at East China University of Science and Technology (ECUST) in Shanghai. He received his Ph.D. in biochemical reaction engineering from Yamaguchi University in Japan. Bao also served as vice director and professor of the State Key Laboratory of bioreactor engineering at ECUST, senior resident associate in the biochemical engineering program at the University of California at Davis, postdoctoral scientist at the Department of Bioscience & Biotechnology at Okayama University, and conducted industrial research at the departments of chemical engineering and organic chemistry at the Qilu Petrochemical Research Institute of Sinopec in China. Bao's research interest is bioconversion of cellulosic biomass for biofuel production. He has published more than 30 journal articles in the field of biomass energy and biomanufacture in top international journals, such as *Biotechnology and Bioengineering* and *Biochemical Engineering Journal*.

BAUER, CARL

Abstract: *Energy Challenge and Technology R&D for Mitigation of CO_2 Emission*
Every energy source faces challenges. Traditional fuels are increasingly constrained by peaking production, mounting global demand, and instabilities in major energy producing regions. Deployment of renewable sources is limited by variability, high costs, distance from population centers, and access to compatible distribution grids.

Coal and natural gas face economic challenges in the projected costs to reduce greenhouse gas emissions. The sustainability of water supplies and the treatment and disposal of waste streams loom as environmental concerns, particularly for the major sources of base load electric power generation—coal, natural gas, and nuclear.

An increasingly complex energy economy with growing energy demand and a need to reduce greenhouse gas emissions needs a balanced perspective that considers all three dimensions—supply, economics, and environment—concurrently. Assured, affordable, and sustainable energy supplies will depend on a broad portfolio of proven, new, renewable, and alternative sources coupled with enhanced recovery technologies, greater fuel flexibility, and increased efficiency. Energy strategies and technologies are also increasingly sensitive to the water-energy nexus where water consumption for thermoelectric power is an emerging environmental issue.

Key among carbon abatement technologies is carbon capture and storage (CCS) for large point-source emitters, particularly fossil fuel power generation. While CCS technologies have evolved from proven industrial applications, continuing research is needed to lower the costs of carbon capture technologies, optimize infrastructure development, and demonstrate the widespread availability of storage reservoirs. Integrated solutions may further capitalize on synergies between bioenergy resources and CCS to enhance environmental sustainability, economic affordability, and supply security.

As two of the leading global economic powers, China and the United States also increasingly dominate energy use and share responsibility for the majority of the associated environmental impacts, particularly greenhouse gas emissions. Recognizing this, our two nations have embarked on an unprecedented level of technological collaboration involving all levels of government and with our leading research institutions, universities and corporations.

Bio: Carl Bauer is Director of the National Energy Technology Laboratory (NETL), a national laboratory owned and operated by the U.S. Department of Energy that serves as the lead field laboratory for the Department's Office of Fossil Energy. Mr. Bauer oversees the implementation of major science and technology development programs that advance energy options to fuel our economy, strengthen our security, and improve our environment. This includes carbon capture and storage for power generation and industry; advanced coal-fueled power generation and hydrogen production; environmental controls for existing coal-fired power plants; high-efficiency, low-impact oil and natural gas exploration, production, and processing; energy efficiency and renewable energy; energy system analyses of technologies, public benefits, and current trends.

Mr. Bauer has more than 30 years experience in technical and business management in both the public and private sectors. He was appointed NETL Director in August 2005 after serving as NETL Deputy Director, Director of NETL's Office of Coal and Environmental Systems, and Director of NETL's Office of Product Management for Environmental Management. Mr. Bauer received an M.S. in nuclear power engineering from the Naval Nuclear Power Postgraduate Program in 1972 and a B.S. in marine engineering/oceanography from the U.S. Naval Academy in 1971. In 2006, he was recognized as a Director of the Year by the Federal Laboratory Consortium for Technology Transfer.

BICKHAM, JOHN

Abstract: *Implications of Climate Change and Energy on the Conservation of Biodiversity*
There is a biodiversity crisis in which it is estimated that perhaps 2/3 of the world's species of plants and animals will go extinct by the end of this century. The causes of biodiversity loss are multi-factorial but since energy is a major driver of the economy, it is also a major driver of biodiversity loss including the following: impacts of extraction and transportation of fossil fuels; habitat loss related to fossil fuels and biofuels industries; environmental contamination; fossil fuel impacts on climate change. Climate change is anticipated to be the major driver of biodiversity loss by the middle of this century as entire ecosystems disappear. Extinctions will also result from the massive distributional changes as plants and animals strive to adapt to climatic shifts and complicated by the patchiness of suitable habitat disrupted by agriculture. The science of biodiversity is built around field of biological systematics which has a 250 year history. Despite this, we lack basic information about biodiversity such as an understanding of the number of species that exists on the planet. Even in relatively well understood groups, such as mammals, new species are still being discovered. Among all organisms, it is estimated that less than 10% of the world's biodiversity is known to science. As a result, there is an incomplete understanding of how to conserve biodiversity. In this presentation I will highlight some recent studies conducted at Purdue that shed light on the importance of habitat patches to migrating songbirds, a group highly vulnerable to climate

change and biofuels impacts, and on the use of genetics to reveal past climate change impacts on the biodiversity of Steller sea lions in the North Pacific.

Bio: John W. Bickham is Director of the Center for the Environment, which is part of the Global Sustainability at Purdue initiative in Discovery Park, and Professor of Forestry and Natural Resources at Purdue University. He received a B.S. and M.S. in Biology from the University of Dayton, and a Ph.D. in Zoology from Texas Tech University. Presently, Dr. Bickham conducts research on the conservation genetics of marine mammals (Steller sea lions and bowhead whales), the genetic effects of chemical contaminants on wildlife in Azerbaijan, and the molecular systematics of bats. He presently has grants and contracts from NSF, NOAA and the North Slope Borough of Alaska. Dr. Bickham has published more than 200 papers in peer-reviewed scientific journals and is co-author of the book "Bats of Jamaica." He serves on the Editorial Board of the journal *Ecotoxicology,* is past president of the Texas Society of Mammalogists and the Southwestern Association of Naturalists, and is a member of the U.S. delegation to the Scientific Committee of the International Whaling Commission.

BILELLO, DAN

Abstract: *Impact of Climate Change on Renewable Energy*
Climate change is expected to have noticeable effects across the globe: a rise in average temperatures in most regions, changes in precipitation amounts and seasonal patterns in many regions, changes in the intensity and pattern of extreme weather events, and sea level rise. Some of these effects have clear implications for energy production and use – including renewable energy. For instance, average warming can be expected to increase energy requirements for cooling and reduce energy requirements for warming. Changes in precipitation could affect prospects for hydropower, positively or negatively. Concerns about climate change impacts could change perceptions and valuations of energy technology alternatives, many of which are only partially understood or even identified. Any or all of these types of effects could have very real meaning for energy policies, decisions, and institutions, affecting discussions of courses of action and appropriate strategies for risk management. This presentation will outline and explore some of these critical questions and issues.

Bio: Dan Bilello manages partnership development for the National Renewable Energy Laboratory's (NREL) Strategic Energy Analysis Center. He works primarily on issues related to global climate change and renewable energy, including clean energy technology transfer, market-based approaches to reducing greenhouse gas emissions, and other policy analysis. Prior to joining NREL, Dan worked in both the private sector and the U.S. Government at the Department of State, the National Economic Council, and the Environmental Protection Agency during which he served on the U.S. delegation to the United Nations Framework Convention on Climate Change negotiations. Dan holds a Masters Degree in U.S. Foreign Policy and International Economics from the Johns Hopkins School of Advanced International Studies.

BROUDER, SYLVIE

Abstract: *Ecosystem Services of Existing and Candidate Bioenergy Cropping Systems: Critical Research Questions* (with J.J. Volenec, R. Turco, D.R. Smith (USDA-ARS), and G. Ejeta)
Current U.S. plans for energy security rely on converting large areas of cropland from food to biofuel production. Additionally, lands currently considered too marginal for intensive food production may be considered suitable for biofuel production; predominant cropping systems may shift to more varied arrays including novel species for which little agronomic and environmental data exist. U.S. agriculture has extensive experience with intensive corn production and much recent discussion on energy from plants has focused on simply repurposing the existing farming systems towards ethanol instead of or in addition to animal feed. Both the grain and the stover can be used in energy production, but removing the majority of the aboveground biomass from a farm field may negatively impact air, soil, and water quality. Herbaceous perennials including novel species such as *Miscanthus* imported from Europe and low-input native systems may offer key advantages over maize production. Farmers can use existing farm equipment and these systems are expected to require far fewer energy and financial inputs than annual row crops. However, at present, research on N and C cycling in these candidate biomass systems is fragmented and incomplete, a critical barrier to profitable and environmentally benign on-farm implementation of the U.S. biofuel agenda. In the crop production component of life cycle analyses (LCAs), nutrient (especially N) use efficiency (NUE) has been identified as a key advantage of herbaceous perennials when compared to corn.

Yet true comparative data on NUE and system N balance remain sparse and there are several critical N balance determinants that are easily overlooked when LCAs are developed and when crop improvement efforts are conceived. This presentation will focus on key unknowns in nutrient use and fertilizer management for candidate biofuel cropping systems, impacts on soil carbon and air and water quality and the potential for biotechnology solutions to improve nutrient use efficiency with a concomitant reduction in environmental impact.

Bio: Dr. Sylvie Brouder is a Professor of Agroecology in the Agronomy Department at Purdue University in West Lafayette, IN and Director of Purdue's Water Quality Field Station. She received her B.A. in Biology from Harvard University (1985) and her Ph. D. in Ecology from the Ecology Graduate Group at the University of California – Davis (1993). At Purdue, her area of specialization is crop mineral nutrition with an emphasis on rhizosphere ecology, crop ecology, water quality, and nutrient balances and losses in agro-ecosystems. She has expertise in analysis of large spatio-temporal datasets, application of mechanistic simulation models, and development/interpretation of soil and tissue diagnostics. Dr. Brouder has research experience in cotton, rice, corn, soybean, and alfalfa production systems. Her appointment is split between research, extension education and on-campus teaching.

Dr. Brouder's research interests include design/implementation of field and controlled environment experiments on nutrient budgets and plant-soil nutrient cycling processes. She has focused on nitrogen, carbon and potassium, evaluating agricultural systems and management practices with respect to their practicality, ecological viability and sustainability, including influences on surface/groundwater quality and greenhouse gas emissions from agricultural soils. Current research at the WQFS is an interdisciplinary, team effort to understand the production and environmental implications of the U.S. biofuel agenda. The goal of this project is to develop a cropping system level analysis of the potential for Miscanthus, switchgrass, sorghum-based, maize-based and low-input native prairie production systems to provide renewable fuel while protecting natural resources. Key project collaborators are Dr. J. Volenec (physiology), Dr. R. Turco (soil microbiology), Dr. D.R. Smith (soil processes) and Dr. G. Ejeta (crop breeding and genetics).

BROWN, PAUL

Abstract: *Omics: Potential New Tools for Understanding Global Climate Change Impacts*
The field of molecular biology continues to evolve and become more specialized, with each of the major events in DNA replication and eventual action now considered new or emerging scientific disciplines. The fields of proteomics and metabolomics are rapidly becoming useful tools for discovery, relying on linked analytical platforms that provide excellent accuracy and precision. Proteomics can be defined as the attempt to identify all proteins in a sample, while metabolomics can be defined as the identification of all metabolites weighing between 10 and 1000 daltons. Taken together, the combined use of these new disciplines has the potential of identifying up- and downregulation of protein expression patterns and the resulting changes in chemicals associated with the respective proteins. However, there is little standardization with the respective platforms and the fields continue their rapid advancement.

Proteomics began with traditional gel electrophoresis approaches, but has evolved to liquid chromatography (LC)-based platforms linked to (1) Matrix-Assisted Laser Desorption Ionization/Time-of-Flight (MALDI-TOF), or (2) Electrospray Ionization (ESI) approaches to identify mass of separated peptide fragments. There is little overlap (~30%) in identified peptides between MALDI-TOF and ESI ionization methods and it remains unclear which proteins can be identified by the two approaches. We are currently comparing the two approaches with a wide variety of biological samples including whole vertebrate embryos, algae, mixed assemblages of plankton (meta-proteomics), isolated bands of proteins from in vitro cell cultures, and cancer cells.

Metabolomics arose from gas (GC) and LC separation approaches, but the linkage to mass spectrometers (MS) provides a greater degree of precision than previous approaches. Nuclear magnetic resonance platforms are still used to some extent, but are generally not considered as precise as the GC- and LC-linked MS platforms. The tandem GC separation (GC x GC) linked to MALDI-TOF ionization approaches gained rapid acceptance, particularly as the National Institute of Standards and Technology (NIST) developed the mass library for identification of unknown metabolites. However, the GC platform requires chemical tagging of all metabolites and is a destructive analytical approach. The LC platform is not linked to the NIST library, but relies on developing databases offered by several non-profit sources. LC approaches do not require chemical tagging and are not destructive analytical approaches. Regardless of the analytical platform, metabolomic analyses require

extraction of chemical groups prior to separation and identification. We are currently exploring 3 separate extraction approaches (2:1 chloroform:methanol, 80:20 methanol:water and 20:80 methanol:water) with the two analytical platforms (GC and LC). Initial samples for comparison include soybean seeds, algae and zooplankton.

As we work through the analytical challenges, we are collecting samples and exploring our ability to more precisely address a question that has intrigued colleagues for many years; nutrient flows through food webs. Most of this work has been focused on C, N and to a lesser extent selected nutrients such as fatty acids. However, the micronutrients have not been considered. Some of the more intriguing questions include synthesis and movement of vitamin C (a highly labile water-soluble vitamin) through aquatic food webs, bioaccumulation of fat-soluble vitamins in polar food webs, and the overarching question, will critical nutrient flows be disrupted by changes in climate. Current and potential applications of proteomics and metabolomics will be addressed in this presentation.

Bio: Paul B. Brown received his B.S. from the University of Tennessee, where he majored in Fisheries and Aquatic Sciences. His first job after college was a few miles from the site of this conference, Melton Hill Lake, as an employee of the Tennessee Valley Authority and Tennessee Wildlife Resources Agency. However, his interest in research had been stimulated by a project conducted at the ORNL Environmental Sciences Laboratory. He returned to the University of Tennessee for a M.S. degree in nutrition followed by a Ph.D. in nutrition and biochemistry at Texas A&M University. He was employed by the Illinois Natural History Survey and University of Illinois from 1987 to 1989, then moved to Purdue University, Department of Forestry and Natural Resources, where he was promoted to Professor in 1997. He has served as Associate Editor of five peer-reviewed journals including the *British Journal of Nutrition*.

Dr. Brown's research program has been focused on nutritional sciences and aquatic organisms. He has published over 90 peer-reviewed papers utilizing 22 different species of fish and crustacean as model organisms. His research program began with a focus on environment and diet interactions (calcium and phosphorus metabolism), and more recently is moving toward nutrition and reproduction (n-3 fatty acids and methionine metabolism). Targeted aspects of amino acid metabolism, particularly methionine, remain a cornerstone in the research program. Current efforts are focused on (1) the role of methionine in hepatic metabolism of zebrafish and (2) the potential involvement of a nitrosylated GAPDH in apoptosis of liver cells in rainbow trout. Dr. Brown's lab is one of the few exploring use of proteomics, metabolomics and ionomics to pose new questions in the biological sciences.

Advances in analytical chemistry offer significant potential for understanding complex biological systems. Application of the –omics in the nutritional sciences is underway. Some of the early discoveries are new biological markers responsive to nutrient intake and unique metabolite profiles associated with important agricultural crops. The –omics also offer the possibility of addressing challenging questions on a much broader scale. One of the initial questions addressed is the potential for nutrient deficiencies in food webs impacted by human activities. Nutrient flows through food webs remains an important ecological consideration, but from a nutritional perspective, has been addressed only at the macro level. Analytical capabilities, particularly the –omics, offer the potential of new discoveries, and targeted studies of micronutrient flows through food webs.

CAI, JIA-NING

Bio: Jianing Cai is division director of the Department of International Cooperation of the Ministry of Science and Technology (MOST) in China. He coordinates the conference activities of Chinese affiliates of MOST, but also those of governmental international organizations like the Committee for Scientific and Technological Policy (CSTP), and the Organization of Economic Cooperation and Development (OECD). Dr. Cai also leads the efforts to take part in sessions and activities of four subsidiary working groups under the CSTP: Technology Innovation Policy (TIP), National Experts on Science and Technology Indicators (NESTI), Working Party on Biotechnology (WPB), and Global Science Forum (GSF). Prior to his joining MOST in 2002, Dr. Cai held posts in several Chinese governmental organizations such as the State Administration of Building Materials Industry and as the First Secretary of the Chinese Embassy in Hungary. Dr. Cai graduated from the Nanjing Chemistry University in Jiangsu Province and as a result of his achievements in the building materials and cement industries, he was awarded and holds the title of senior engineer.

CHANG, SHI-YAN

Abstract: *Trajectory and Policy of Biofuel Development in China*

Low carbon fuel solution is an important area to decarbonize China's transport sector and satisfy energy security. Since 1993, China has become a net petroleum importing country. Over 50% of Chinas oil consumption relies on importing from other countries in 2008. In this context the diversity of transport energy becomes more urgent than ever. China is the largest developing country in the world as well as a large agriculture country. Biofuel is one of the highest potential options for China. If properly regulated, biofuel can derive significant and extensive positive externalities or co-benefits. Although China actively exploits sustainable methods for biofuel development, a number of critical issues involved have not yet been well answered. For example, whether China has adequate available feedstock for scale-up development of liquid biofuel? What are the most appropriate biofuel technologies for China? What are the contributions of biofuels in improving oil supply security and mitigating CO2 emission in China? And what specific challenges in deployment of biofuel technologies in China? To address these problems, an integrated model with a bottom-up biomass evaluation approach and an energy system analysis modeling applied to assess the potential, implications, limitations, and enablers of large-scale production of biofuel in China by 2050. Typical biofuel feedstocks investigated and assessed includes: 1) non-plantation cellulosic feedstocks, including agriculture crop residues, forestry residues and municipal solid waste; 2) plantation resources, including energy crops (cassava, sweet sorghum, etc), oil bearing trees (Jatropha, etc) and woody biomass. The evaluation of techno-economic potential of biofuel feedstocks is based on the calculation of geographic potential and technical potential of these biofuel feedstocks. Furthermore, six scenarios were developed to assess how policy and technological advancement will affect biofuel development in China. The results show that both the "Moratorium" or "Deregulation" scenarios will derive undesired results, the "Sustainable development" maybe the best option.

Bio: Shi-Yan Chang is assistant professor at the Institute of Energy and Environmental Economics (3E) at Tsinghua University in Beijing. Chang holds a Ph.D. in Management Science and Engineering from the Beijing Institute of Technology. Her research interests are energy system analysis and automotive energy technology development roadmaps, especially as related to biofuels. She has published more than 10 journal articles on such topics as biofuel development potential and renewable energy development in China.

CHAUBEY, INDRAJEET

Abstract: *Impact of Biofuel Production on Hydrology and Water Quality in Midwest USA*

In recent years, high US gasoline prices and national security concerns have prompted a renewed interest in alternative fuel sources to meet increasing energy demands, particularly by the transportation sector. Policy signals from the current US administration now point towards sustainability of bioenergy production. As an example, EISA Section 204 will require federal agencies to report to Congress, in no later than 3 years, any environmental concerns associated with biofuel production using a set of science based indicators such as air quality, effects on hypoxia, pesticides, land productivity and soil quality, water use efficiency and water quality. However, the grand challenge to US ethanol production will be determining suitable, stable and efficient feedstocks for the production of ethanol in the United States. Feedstock selection will not be homogenous and will be based on regional availability and productivity. Addressing US biofuel production sustainability requires scientific assessment of regional feedstock production impacts on water quality and quantity including sediments, pesticides, and nutrient losses. These natural resource concerns should be carefully identified so that appropriate plans can be implemented to safeguard against or mitigate any potential adverse environmental consequences to natural resources.

The introduction of second generation biofuel feedstocks, such as, corn stover, switchgrass, miscanthus, and fast growing woody crops (e.g. hybrid poplar) for ethanol production have the potential to greatly impact erosion and nutrient losses in areas that are most vulnerable to such losses. The production of these biomass types may alter the hydrology and water balance of the region as well. While some feedstock production systems may have detrimental hydrologic and water quality impacts, others may be neutral relative to current cropping and land management systems, while others may actually improve water quality. Sustainability of these feedstock production systems may be constrained by availability of water and current land use activities.

At Purdue University, we are evaluating the impacts of bioenergy feedstock production on the environment, ecosystems and multi-regional agricultural water management. We are addressing the following questions (among

others): What are the unintended environmental consequences of increased corn production to meet biofuel demands? What are the environmental impacts of various second generation biofeedstock production systems to meet cellulosic ethanol demands? Would the management of cropping systems involving corn silage meet cellulosic ethanol demands with minimal environmental impact? What are the broad-scale water quality implications of energy crops, such as switchgrass, grown for bioenergy production on highly erodible soils? We are utilizing various models, such as Groundwater Loading Effects of Agricultural Management Systems – National Agricultural Pesticide Risk Assessment GLEAMS-NAPRA, and the Soil and Water Assessment Tool (SWAT) to evaluate the impacts of biofeedstock production on hydrology and water quality at various spatial (field to watershed and regional) and temporal (monthly, annual and decadal) scales. These simulations indicated that the regional impacts of the biofeedstock will be different depending upon soil, land use, and climatic conditions. We have quantified the long-term water quality impacts of projected cropping system shifts, associated with increased demands for grain-based biofeedstocks for ethanol production using the GLEMA-NAPRA model. The model simulated annual losses in runoff, percolation, erosion, nitrate-nitrogen, total phosphorus, atrazine (herbicide) and pyraclostrobin (foliar fungicide) to the edge-of-field and bottom-of-root-zone associated with continuous corn, corn-soybean and corn-corn-soybean cropping scenarios. The model results showed that agricultural management decisions involving a shift to continuous corn cropping would greatly impact percolation, erosion, nutrients and pesticides losses from agricultural fields and could potentially have greater impacts on runoff losses of those pollutants compared with the projected changes in crop rotations alone. Also, cropping systems influenced available soil residue, which would affect infiltration, surface runoff and percolation. Soil loss is an important component in understanding biofuel production impacts on the environment because persistent agrochemicals often attach to soil particles.

We are developing a web-based decision support tool for users to evaluate the water quality impacts using the NAPRA model. The decision support tool will allow users to change locations, land use, and/or management practices; run new simulations; and review results. Given this flexibility, users will be able to fine-tune their analyses and decisions. For example, users will be able to switch rotations and assess changes in hydrology, soil erosion, and nutrient and pesticide losses and then iteratively apply best management practices and assess impacts.

Bio: Dr. Indrajeet Chaubey is an Associate Professor of Ecohydrology in the Departments of Agricultural and Biological Engineering and Earth and Atmospheric Sciences at Purdue University. Prior to joining Purdue, Dr. Chaubey was a faculty member at the University of Arkansas.

Dr. Chaubey's teaching and research activities include ecohydrology and water quality with emphasis on watershed scale terrestrial and aquatic water quality processes. He has developed decision support tools using watershed models to evaluate performance of BMPs in reducing nonpoint source pollution. Dr. Chaubey has published more than 200 research articles, including 46 peer reviewed journal articles and more than 100 technical papers in various conferences, and has given 32 invited presentations at various regional, national, and international conferences. He has several active research projects funded by USEPA, USDA, and USGS, and NSF. He is a lead investigator on one of the 13 nationally funded projects to evaluate conservation effectiveness assessment program funded by USDA-CSREES. Currently, he is leading a national facilitation project funded by the USDA-CSREES to evaluate the hydrologic/water quality impacts of biofeedstock production in Midwest and southeast USA.

CIAIS, PHILIPPE

Abstract: *Modeling Climate Change Impacts on Terrestrial Carbon Cycle in East Asia during the Last Century*
We use three process-based models (Lund-Potsdam-Jena Dynamic Global Vegetation Model - LPJ-DGVM; ORganizing Carbon and Hydrology In Dynamic Ecosystems - ORCHIDEE; Sheffield model - SDGVM) to investigate the historical response of ecosystem Net Primary Productivity (NPP) and Net Ecosystem Productivity (NEP) over East Asia to climate change and rising atmospheric CO2. The results suggest that between1901 and 2002, the modeled NPP has significantly increased, by 8.5 Tg C yr-1 (a 20% growth) for ORCHIDEE, 6.3 Tg C yr-1 (a 16% growth) for SDGVM, and by 5.4 Tg C yr-1 (a 21% growth) for LPJ, respectively. At the continental scale, ORCHIDEE and SDGVM produce interannual variations in NPP that are more closely driven by temperature than by precipitation, while LPJ suggests that precipitation is the primary driver. In the relatively arid

mid-latitude region of East Asia, the variations in NPP remain however always more strongly correlated with precipitation than with temperature.

Bio: Philippe Ciais is a senior researcher at CEA (Commissariat à l'Energie Atomique) and deputy director of the LSCE (Climate and Environmental Sciences Laboratory). In the early 1990's, he confirmed the existence of a large sink of CO_2 in the North Hemisphere terrestrial vegetation using isotopic measurements. His research interests include the carbon cycle, global change and their interactions with society. Philippe Ciais authored or co-authored more than 150 articles in A-ranking scientific journals, including many in *Nature* and *Science*. Philippe Ciais is co-chair of Integrated Global Carbon Observations task in GEO, co-chair of the Global Carbon Project. He acted as a lead author of IPCC, and coordinated several European research projects. Since 2006, he is the coordinator of the preparatory phase of ICOS (Integrated Carbon Observation System), a European research infrastructure dedicated to monitoring the greenhouse budget of the continent and adjacent regions

DALE, VIRGINIA

Abstract: *The Land Use-Climate Change-Energy Nexus*

Changes to earth systems that are a result of human activities include land-use practices, climate modifications, and energy use. Together these three factors are major forces of global changes as induced by humans. Numerous studies have examined the causes and influences of these forces, but no analysis has considered the combined effects of these three factors or their interactions. This presentation undertakes such an analysis in order to identify major research issues within the land use-climate change –energy nexus that need to be addressed from the point of view of pattern and process.

Changes in the land cover of natural ecosystems are one of the ways that humans first caused broad-scale changes on the Earth. Agriculture activities were among these first changes, and cultivation allowed people to live in settlements, which instigated major changes in the pattern of land use as urban centers and transportation routes were established. Most land-use decisions are based on local economic, social, cultural, biophysical, political, and demographic forces within a spatial and temporal context. As a result, human occupation has both direct effects on the land it occupies and indirect downstream and downwind ecological effects on a regional scale. Furthermore, the anthropogenic modification of landscapes, characterized by introduction of linear features such as roads and transmission lines, can both provide access to new areas and disrupt ecological function of adjacent lands. Today, the ways in which people use the land can be cumulatively thought of as one of the key global changes on the earth. Collectively these land-use changes (especially historic deforestation) affect global atmospheric carbon dioxide (CO_2) concentration and thus global climate.

Climate change is a second major category of global change. Current scientific consensus is that global warming is unequivocally attributable to human activities and has broad-scale implications. The implications of global climate change vary over space with predictions of temperature and precipitation being place specific. In either case, effects on species and ecosystems are expected to include species shifts, risk of extinction, phenology changes, and damage from floods, storms and wildfires.

In addition to human-induced climate change and land-cover changes, implications of energy choices and use must be considered as a third major global change. As the developing world has become industrialized, less developed and developing countries accounted for 73% of the global GHG emissions growth in 2004. Yet energy sources and uses are still quite diverse. As global population increases and becomes more developed, there is still abundant use of wood and rising demand for energy from hydroelectric projects, wind, solar, waves, geothermal sources and bioenergy. Each type of energy use influences the environment throughout its life cycle including extraction from its source, the distance and means by which it travels from the source to the production center to the end use, production processes and secondary wastes, end uses, and final waste products. These supply chain processes are spatially distributed in different patterns across the landscape. Thus each type of energy extraction and use affects the Earth's surface in different ways. Decision makers are becoming aware that their choices of energy use are influenced by past land-use decisions and prevailing climate conditions and can, in turn, affect future land use and climate.

This analysis specifically explores how global changes in land use, climate and energy that are induced by humans when viewed from the perspective of process and pattern can offer insight into climate change and dynamic approaches to meet energy needs in light of changes to land-use activities. This presentation first reviews the interactions between climate change and land use. Then it explores in a pair-wise fashion the influences of

climate change, land-use change, and energy use. The analysis also discusses the complications and benefits of examining all three forces at once. Finally, it concludes with major research needs related to the interface between land use, climate change, and energy. This analysis shows that decision makers should use an integrated approach to consider the changes that can occur in climate, land use, and energy use, including their implications for the environment.

Bio: Dr. Virginia H. Dale is a Corporate Fellow in the Environmental Sciences Division at Oak Ridge National Laboratory (ORNL) and was selected as the 2006 Distinguished Scientist for the Laboratory. Her research focuses on understanding causes and effects of changes in the environment. She has authored more than 170 scientific papers and seven books and has served on national scientific advisory boards for five federal agencies. She is Director of ORNL's Center for Bioenergy Sustainability.

DAVISON, BRIAN

Abstract: *Challenges during Biofuel Deployment*

Bio: Dr. Brian Davison is the chief scientist for systems biology and biotechnology at the Oak Ridge National Laboratory (ORNL). Previously he was director of the Life Science Division at ORNL and director of the ORNL Bioprocessing Center. In the past 20 years at ORNL, Dr. Davison has worked on a variety of research and development projects in the use of bioprocessing. Dr. Davison earned his bachelor's degree in Chemical Engineering from the University of Rochester (New York, 1979), and his doctoral degree from the California Institute of Technology.

DRAKE, JOHN

Abstract: *A Scalable and Extensible Earth System Model for Climate Change Science*
Adaptation to impacts from global warming and mitigation strategies for climate change would be best planned based on predictive models of the earth system. A new level of predictive skill and an extension of physical climate models to include chemical interactions and ecological feedbacks is required to accomplish this goal. Though the ability of modelers to simulate many features of the general circulation and dynamics of climate has improved, there are still significant areas the need improvement and it is an outstanding question whether decadal prediction is even possible. Climate projections, such as those used for the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, indicate the relative importance of getting this right and the near term implications for providing decision makers with the best scientific information. In this talk, I will present the computational methods of making climate projections along with the new directions being pursued in the development of a more comprehensive earth system model. Examples, of the application of climate models using high end parallel computing platforms will be given.

Bio: Dr. John Drake is group leader of the Computational Earth Sciences Group in the Computer Sciences and Mathematics Division at Oak Ridge National Laboratory (ORNL). He received his Ph.D in Mathematics from the University of Tennessee in 1991.

Drake joined the Computer Sciences and Mathematics Division at ORNL in 1984 as part of the Mathematics Group. Previous research was on viscoelastic and fluid flows associated with gas centrifuges and he also served as site numerical methods consultant. His areas of expertise are mathematical methods, numerical simulation and fluid dynamics. Technical work encompasses fast algorithms for spectral evaluation, and general formulations of the semi-Lagrangian transport method for fluids problems relevant to climate modeling. He has worked extensively with the National Center for Computational Sciences, as a user of the Intel Hypercube, the Intel Paragon XPS150, the IBM Power4 and the Cray X1E and XT3/4/5. He has also acted as an advisor for the development of production parallel computing environments and high end computing on a number of NSF and DOE boards and panels.

He is an author on over 60 professional papers and 30 technical reports, and guest editor of special issues of Parallel Computing and International Journal of High Performance Computing and Applications.

Research Highlights—Dr. Drake has been at the lab for 30 years and since 1990 has lead the climate modeling efforts at ORNL. This started as an exploration of new algorithms for parallel computing research that could be applied to the simulation of climate on decadal to century time scales. The project that first implemented a full atmospheric general circulation model on distributed memory – message passing computers grew out of his work solving partial differential equations on the Intel Hybercube. Drake and his colleague Pat Worley created a parallel version of the Community Climate Model (CCM2) in 1993. The work is discussed in a special issue of Parallel Computing in 1995 for which Drake was a guest editor. A two dimensional domain decomposition and parallel spherical harmonic transform algorithms enabled some of the highest resolution climate simulation ever performed and pioneered the algorithms and methods that are in use today on what has become the dominant parallel computing architecture.

The collaborations that developed from this early parallel computing project have grown over the last decade into the largest DOE climate modeling project and a collaboration among six national laboratories and the National Center for Atmospheric Research. The Parallel Climate Model (PCM), Community Climate System Model (CCSM3), and the soon to be released CCSM4 are software products that have been directly associated with the projects Drake has lead for the DOE Climate Change Prediction Program over the last 17 years. The simulation results from these models have been used in numerous climate science studies including as part of the US contribution to the United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) that was released in 2007. Drake coordinated the ORNL supercomputer simulations that occupied more than a third of the NCCS computing resources in 2005. His current project is part of the development of Earth system models, a next generation of climate simulation that includes biogeochemical cycles and ecosystems coupled with the physical climate processes. The result of the project is a more comprehensive simulation of the earth's climate feedbacks with carbon in the atmosphere and a balancing of the carbon budget on a detailed regional basis. As a general tool promoting and enabling advanced climate research, the results of Drake's work and project management will be applied by other researchers in the next IPCC assessment and high-performance computing simulations of climate change.

FAN, JUN

Abstract: *Landscape Changes and Vegetation Restoration on the Loess Plateau, China* (with ***Quanjiu Wang*** and Mingan Shao)

The Loess Plateau in China has been seriously degraded by soil erosion due to wind and water for many centuries. The most serious soil erosion takes place in the coarse sand region because of the soil texture, topography and precipitation intensity where mean annual precipitation is around 400 mm compared to the typical loess soil region where precipitation is 20 percent higher (i.e., 500 mm). Vegetation restoration is suggested as a potentially effective method for soil and water conservation on this sloping landscape. Check dam is recognized as a significant method to reduce the gully erosion. Results demonstrate that grass reduces sediment and runoff significantly. However, more profitable crops, such as alfalfa, deplete deeper soil water reserves, eventually reducing yields and making it difficult to recharge the deeper soil moisture under the naturally low precipitation within this region. There is an urgent need to develop land use and land management practices that incorporate sustainable vegetation including trees that reduce soil erosion. Energy base development including coal mine and natural gas in this region provides both an opportunity and challenge to extract natural resources responsibly while planning and implementing soil and water resource restoration and management activities.

Bio: ***Jun Fan*** is associate professor at the Institute of Soil and Water Conservation of the Chinese Academy of Sciences in Yangling, China, where he was formerly an assistant professor and research associate and where he obtained his Ph.D. in soil science. Fan's research interests are soil physics and carbon cycling. He has published more than 30 articles on soil physics and plant nutrients in journals such as *Pedosphere*.

Quanjiu Wang is deputy director of the State Key Laboratory of Erosion and Dry-land Farming at the Institute of Soil and Water Conservation, Chinese Academy of Sciences. He holds a Ph.D in hydrology and water resources from the Xi'an University of Technology. Wang formerly served as a professor at Xian University and associate professor and director of Xian Institute of Water Resources. He also was a visiting scholar at Iowa State University. Wang's research interests are soil physics and hydrology, on which he has published more than 100 articles in journals such as *Water Resources Research, Soil Science*, and *Soil Science Society of America Journal*.

FILLEY, TIM

Abstract: *Molecular-isotope Approaches to Track Soil Organic Matter Dynamics*
Important insights into the dynamics of biogeochemical cycling of soil and litter have been made through the structural and isotopic characterization of their constituent plant-derived biopolymeric components. These investigations span spatiotemporally from micron to continental basin scale and from annual cropping cycles to the paleoclimate records. Recent work exploiting the natural isotope shifts in plant communities or applying enrichment labeling techniques has demonstrated how organic matter derived from biopolymers such as lignin, cutin, and suberin are decomposed, partitioned, stabilized or destabilized in nature. By far, most studies that combine compound-specific isotope analysis (CSIA) and molecular quantitation in terrestrial systems have focused upon lignin as it provides a relatively higher level of discrimination among botanical sources and is well suited to track input from natural and agroecosytems to soil and rivers. Indeed, the CSIA of lignin phenols in litter and soil particle fractions has helped to change the perception of lignin as a "refractory" biomolecule in mineral soil and focus attention on aliphatic and microbial macromolecules for long term soil organic matter stabilization. Building from this, greater research attention is being paid to aliphatic polyesters like suberin and cutin which, because of differences in chemical structure, have the capacity to help discriminate among foliar/shoot and root inputs to soils and their relative importance in soil organic matter accrual. This talk will highlight some of these important applications and developments. New research on the stabilization/destabilization of soil organic matter, as a result of changes to above and below ground productivity from an enhanced atmospheric CO_2 forest experiment, will also be discussed. Additionally, CSIA of lignin, cutin and suberin from invertebrate fecal pellets in forest soils will illustrate the potential role that these organisms play in the selective packaging and delivery of root and foliar tissue to soil particles and how they can contribute to accumulation patterns of plant organic matter observed in soil.

Bio: Dr. Timothy Filley is an Associate Professor of isotope geochemistry in the Department of Earth and Atmospheric Sciences (EAS), Purdue University. He also serves as the Associate Department Head for the EAS Graduate Program. He received his B.S. in Chemistry from Loyola University of Chicago, his Ph.D. in Geochemistry from the Department of Geosciences, The Pennsylvania State University, and he was a Carnegie Institution of Washington Postdoctoral Fellow from 1998-2000. Dr. Filley was elected national program chair for the Geochemistry Division of the American Chemical Society from 2006-2007. His expertise is in the area of ecosystem and environmental biogeochemistry. A central theme of his group's research is the response of terrestrial ecosystems to environmental change, such as land use and land cover change (agriculture and rangeland activity), hydrologic pulses (storm events), climate change (increased atmospheric CO_2), and invasive species (e.g. invasive invertebrate activity). He and his group track these impacts by observing the chemical (elemental and molecular) and stable isotopic transformations of plant and microbial biomolecules stored within litter, soil organic matter, and stream and river aquatic fractions. These studies comprise both field- and laboratory-scales, using a variety of spectroscopic and analytical techniques to investigate the fundamental controls on SOM stabilization, the fate of emerging pollutants, such as manufactured nanocarbon, in soils, the chemical mechanisms of plant tissue biodegradation in nature as well as in biofuels applications, and the multiple physical and chemical fates of terrestrial organic carbon as it is exported to rivers and lakes.

FU, YAO

Abstract: *Catalytic Conversion of Biomass-derived Carbohydrates to G-valerolactone without Using an External H2 Supply*
With diminishing fossil fuel reserves, great efforts are now being made worldwide to convert renewable biomass into fuels and value-added chemicals. Recently Horvath et al. demonstrated that the biomass-derived compound G-valerolactone (GVL) may be used as a liquid fuel, food additive, solvent, and organic intermediate in the synthesis of fine chemicals. Here we report a new route to convert various biomass-derived oxygenates (cellulose, starch, and sugars) to GVL without using any external H2 supply. We found that LA can be selectively reduced to GVL without over-reduced by-products by tuning the base and ligand in Ru-based catalytic systems. More importantly, this hydrogenation process can be accomplished by only using the formic acid produced from the original acidic dehydration step. The success of this new route not only improves the atom economy of the process, but also avoids the energy-costly step to separate LA from the aqueous solution mixture of LA and

formic acid. To our delight, the experiments show that the conversion of 1:1 LA/formic acid in ca. 50 wt% aqueous solution can be successfully achieved with a maximum yield of 90%.

A strikingly good performance of water insoluble PPh3 ligand in Ru-catalyzed hydrogenation in aqueous media is also observed. We suspect that CO_2 produced in formic acid decomposition may be a key factor. Indeed, when we intentionally add CO_2 to the direct hydrogenation system, a steady increase of yield is observed. The maximum yield (ca. 100%) is obtained when the pressure of CO_2 reaches 4 MPa whereas the yield is only 45% in the absence of CO_2. The study indicates that by using formic acid as a viable H2-storage system, Ru-catalyzed hydrogenation may become even more efficient due to the positive effect of CO_2.

Bio: Yao Fu is an associate professor in the Department of Chemistry at the University of Science and Technology (USTC). He holds a Ph.D. in organic chemistry from USTC. Fu's research interests include physical organic chemistry, green chemistry, and biomass conversion. Fu received the first prize in the Natural Science Award of Ministry of Education in 2007, the Outstanding New Faculty Award of USTC in 2006, the Outstanding Doctoral Thesis Award of Chinese Academic of Society in 2006, and the President Special Scholarship of Chinese Academic of Society in 2004.

FULKERSON, WILLIAM

Abstract: *A Framework for Managing Climate Change*

According to the Fourth Assessment Report of the IPCC greenhouse gases added to the atmosphere by human activities have been responsible for most of the global warming observed over the past 50 years. Thus, man is influencing the climate in non- trivial ways, which, if not managed, are estimated to be very costly by the end of the 21st century to humans and the environment. It is time to consider, therefore, how to manage anthropogenically forced climate change to the enhancement of human and ecological well-being. Only three strategies are available to accomplish the management: mitigation of emissions and removal from the atmosphere, adapting to negative impacts of climate change that can't be avoided and solar radiation management (geoengineering) to offset warming. This final strategy is controversial. Applying these strategies will be difficult and expensive. Because the cost of management is high major contributors to the problem, e.g. the United States, China and India, have been moving cautiously. The expense of management may be brought down by developing and adopting advanced energy and other technologies, but global public and private sector funding for RD&D has declined for the past two decades and is inadequate. Perhaps that trend is reversing, however. Finally, the application of solar radiation management to the Arctic to save summer sea ice seems a near term and limited application worth considering, and it deserves the attention of focused R&D to evaluate various approaches, assessment of possible unintended consequences, field experiments, determination of costs and development of a governance approach.

Bio: Bill Fulkerson's current interests include global sustainability issues with emphasis on energy and environmental technologies and policies. Since 1994 he has chaired the DOE Laboratory Energy R&D Working Group (LERDWG), an organization of energy R&D managers from 14 DOE labs including all the national labs concerned with energy R&D.

During 1999 and 2000 LERDWG helped the Under Secretary of Energy analyze the DOE energy R&D Portfolio with respect to its adequacy for making progress on DOE strategic goals related to the environment, the economy and national security. The results of these analyses were published and used extensively in preparing the DOE budget. More recently, LERDWG has assisted DOE in the planning of the National Climate Change Technology Initiative of the Bush Administration and with drafting a strategic plan for the Clean Energy Technology Export initiative.

Bill was a member of the Energy R&D Panel of the President's Committee of Advisors on Science and Technology, and he chaired the task force on fossil energy of the Panel. The report of the Panel is "Federal Energy Research and Development for the Challenges of the Twenty-First Century," (Nov. 1997). He also participated on the National Research Council report "Energy Research at DOE: Was it Worth it?" (National Academy Press 2001). He was a member of the Board on Energy and Environmental Systems of the National Academy of Sciences from 1996-2002.

Recently Bill has been involved with the Seminars on Global Emergencies held every year in Erice, Italy by the World Federation of Scientists. This has resulted in several papers on energy and terror published in the proceedings of the seminars.

Before joining ISSE, he was Associate Laboratory Director for Energy and Environmental Technologies at the Oak Ridge National Laboratory (ORNL). He retired from ORNL in December, l994 after 32 years of service.

Fulkerson was trained at Rice University where he received his B. A. in 1957 and his Ph. D. in Chemical Engineering in 1962. He is a member of Sigma Xi and a fellow of the American Association for the Advancement of Science.

GENTRY, RANDY

Bio: Dr. Randy Gentry is the Director of the Institute for a Secure and Sustainable Environment at the University of Tennessee, President of the University of Tennessee Research Foundation, and an Associate Professor in UT's Department of Civil and Environmental Engineering. Gentry, who earned his PhD in civil engineering from the University of Memphis, also directs the Southeastern Water Resources Institute, a multidisciplinary, multi-institutional research entity devoted to the study of science, technology, and public policy issues related to surface and ground water. Gentry's research focuses on the evaluation of groundwater hydrologic interfaces of highly localized systems as well as broad-scale watershed processes. Under Gentry's direction, ISSE's multidisciplinary research team is exploring the convergence of the carbon cycle and carbon sequestration, climate and natural systems response, and renewable bioenergy.

GOFORTH, REUBEN

Abstract: *Aquatic Ecosystem Responses to Land Use Changes Associated with Biofuel Crop Production*
Agriculture has played a significant role in human history and continues to be critical for providing food resources required by a large and growing world human population. However, this often comes at a high environmental cost, and a rich history of research has identified agricultural land uses as factors that alter and degrade aquatic ecosystems. Increasing demand for agriculturally-derived raw materials to support biofuels industries and both looming and realized environmental changes associated with global climate change are introducing additional challenges for maintaining resilient ecosystems that have both inherent and human resource values. Given the great imperilment of freshwater biota on a global scale and the need to mitigate large-scale ecosystem impacts resulting from cumulative effects of freshwater degradation, it is critical that we understand and plan for management contingencies that can facilitate the resilience of complex systems while at the same time fulfilling future food and energy demands.

Bio: Reuben Goforth is an aquatic ecologist with experience working with fish and invertebrates in small streams, large rivers, and the Laurentian Great Lakes. He has used a combination of manipulative field ecological studies and GIS analyses to observe and model responses of aquatic communities to patterns and changes in watershed (streams and rivers) and shoreline (Great Lakes nearshore areas) environmental properties over multiple spatial scales. Dr. Goforth has recently begun exploring the potential combined impacts of land use and climate change on aquatic ecosystem resilience. In particular, Dr. Goforth is considering the potential synergistic effects of land use changes to favor increased biofuel raw material production and climate change as emerging challenges for maintaining aquatic ecosystem resilience, and environmental sustainability.

GORE, JAY

Bio: Jay P. Gore is the Reilly University Chair Professor of Engineering and Director of the Energy Center at Purdue University. Jay received his B. E. from Pune University, India, and his M.S. and Ph.D. from the Pennsylvania State University. He served as a Research Fellow in Aerospace Engineering at the University of Michigan and as Assistant Professor at the University of Maryland prior to joining Purdue as an Associate Professor. Jay benefits from years of industrial work experience in: automobile engineering at TELCO in Pune, India; in nuclear engineering at Link Simulation Systems Division of the Singer Corporation in Silver Spring, MD; and in Gas Turbine Engines at Rolls Royce Corporation in Indianapolis, IN. Dr. Gore received early promotions to the rank of Professor of Mechanical Engineering and Chaired Professorship. Jay is a past Chairman of the Central States Section of the International Combustion Institute and the ASME K11 Committee on Heat Transfer. He has served as an Associate Editor of the ASME *Journal of Heat Transfer*. He was U.S. Editor of the

28th International Combustion Symposium. Dr. Gore is a Fellow of the ASME and has received the Best Paper in Heat Transfer Literature Award. He is a Fellow of the AIAA and serves as an Associate Editor of the AIAA Journal. He has received Best Paper in Heat Transfer Literature Award from the ASME. He has received the Presidential Young Investigator Award from the President of the USA. He has received Fellowships from the Japanese Ministry of Education and the U. S. Department of Energy. Jay's areas of research are energy, combustion, radiation heat transfer, biomedical engineering and diagnostics. He's authored/coauthored ~120 archival papers, 4 book chapters, 175 conference papers, and holds 3 patents. He has directed the work of 12 post-doctoral, 23 doctoral and 32 MS students.

GU, ALUN

Abstract: *Analysis of Embodied Energy and CO_2 Emissions in China's International Trade*
Recently, the international trade has been increasing continuously in China. The total value of import and export has reaches 2561.6 billion US$ in 2008, equal to 60% of GDP. With the development of economic globalization, on the one hand, the international trade has expanded the efficient frontier of our country's economic activities; on the other hand, the growth of international trade does not necessarily mean that the effective utilization of natural resources and the improvement of environment quality. China's export has got a strong growth and consumed a large number of energy resources in recent years. China's annual total energy consumption has not only met domestic general demand, but also served the production of export goods to meet the consumption needs of foreign areas.

Embodied energy of a product is the total energy consumption in the whole process from the product's raw material production to processing, manufacture, transport and so on. There is growing concern about the export embodied energy in China. What is the proportion of energy used in the production of export to China's total energy consumption? Whether there is a serious imbalance between the export goods embodied energy and import?

Using an input-output model and China input-output tables in 2002 and 2005, this paper has calculated the export embodied energy in 2002 and 2005, the export goods embodied energy and CO_2 emissions in 2006 and 2007. Through the comparison of methods and results in this paper and related papers in China and abroad, we found that the import and export processing trade had played a significant role in calculating the embodied energy and CO_2 emissions in China. And the results indicated that the export embodied energy has increased from 209 Mtce in 2002 to 528 Mtce in 2005 in China, its ratio to the total energy consumption increasing from 13.8% to 23.5%. Meantime, the import embodied energy assumes a growth trend in China. The net export embodied energy has reached 671 Mtce in 2007, accounting for 25.3% of total energy consumption.

Export is one of "three carriages" that stimulating economic growth. After deduction for its own value-added of processing products and intermediate inputs for domestic production in import, the export value-added resulting from domestic production accounts for 22.4% of GDP in 2005. Export energy consumption per unit added value is 1.16 tce/104 yuan, lower than the national GDP energy consumption intensity 1.23 tce/104 yuan, while higher than that per domestic unit industrial added value 2.07 tce/104 yuan. This indicates that export does not enlarge the energy consumption intensity in industrial sectors. But it has increased the ratio of the industrial sector.

Because China is a net exporter of embodied energy, and coal is primarily in the energy mix in China. The ratio of non-fossil energy, such as nuclear energy, renewable energy is low. CO_2 emissions factor per unit energy consumption is more than 30% higher than those of developed countries. Therefore, the difference of energy consumption CO_2 emissions between export and import is larger than the difference between embodied energy. In 2005, net export embodied energy accounts for 12% of domestic total energy consumption, and corresponding CO_2 emissions is 15% of the total emissions. In recent years, renewable energy and nuclear energy are developing rapidly in China. Energy structure is continuously optimized. CO_2 emissions factor per unit energy consumption is also keeping declining. In the future, along with the transformation of development model and the optimization of industrial structure, and with the increase of energy efficiency, optimization of energy structure, China 's net export embodied energy and CO_2 emissions will be gradually reduce.

Bio: Alun Gu is assistant professor at the Institute of Energy, Environment and Economy at Tsinghua University. She holds a Ph.D in management science and engineering from Tsinghua University School of Public Policy and Management. Gu's research interests include energy modeling, global climate change policy, and international trade. She has published more than 14 articles on energy, environment, and climate change in such journals as *Environmental Sciences, China Power and China Population*, and *Resource and Environment*.

HACK, JAMES

Bio: James J. Hack has been director of the National Center for Computational Sciences at ORNL since late 2007. An atmospheric scientist, Hack also leads ORNL's Climate Change Initiative. After receiving a PhD in atmospheric dynamics from Colorado State University in 1980, Hack became a research staff member at the IBM Thomas J. Watson Research Center, where he worked on the design and evaluation of high-performance computing architectures. In 1984 Hack moved to the National Center for Atmospheric Research, a National Science Foundation-sponsored center, where, as one of the principal developers of the NCAR global climate model, his roles included senior scientist, head of the Climate Modeling Section, and deputy director of the Climate and Global Dynamics Division.

HANSON, PAUL

Bio: Dr. Paul J. Hanson is a Distinguished Research and Development Staff Member and Group Leader of the Environmental Sciences Division of Oak Ridge National Laboratory. He has a B.A. degree in biology from St. Cloud State University, St. Cloud, Minnesota, in 1981, and both M.S. (1983) and Ph.D. (1986) degrees from the University of Minnesota, St. Paul in plant and forest tree physiology. Dr. Hanson's current research focuses on impacts of climatic change on the physiology, growth, and biogeochemical cycles of North American forest ecosystems. He has authored or co-authored over 100 journal articles and book chapters, and has co-edited (and authored) a book titled "North American Temperate Deciduous Forest Responses to Changing Precipitation Regimes." Dr. Hanson is an Editor of the journal *Global Change Biology*. Dr. Hanson received the 1995 Distinguished Scientific Achievement Award from the Environmental Sciences Division, Oak Ridge National Laboratory, and was elected a Fellow of the American Association for the Advancement of Science in 2008.

HE, QIANG

Abstract: *Toward Consolidated Bioprocessing for Bioethanol Production: Genomics Driven Optimization of Cellulolytic Co-cultures*
Two ethanolic fermentative Thermoanaerobacter strains were sequenced by JGI, as part of a large sequencing effort of ~20 related strains. A comparative genomic study with both transcriptional and flux analyses shows that one strain has special features that might enable more efficient co-cultures with cellulolytic partners. Guided by the genome-scale analyses, fermentation studies were carried out to verify the predictions. Indeed, the targeted co-cultures show much improved ethanol yields.

Bio: Dr. Qiang He obtained his PhD in environmental engineering from the University of Illinois at Urbana-Champaign. He was a post-doctoral researcher at ORNL-ESD for two years before he joined UT as an assistant professor in 2007. His research is focused on biological processes in water/wastewater treatment and renewable energy production.

HECHT, ALAN

Abstract: *Environmental Sustainability: A Theme of China-US Collaboration*

Bio: Dr. Hecht is Director for Sustainable Development, Office of Research and Development, at the U.S. Environmental Protection Agency (EPA). On detail to the White House, from 2001 to 2003 he was Associate Director for Sustainable Development at the Council on Environmental Quality (2002–2003), Director of International Environmental Affairs for the National Security Council (2001–2002), and White House coordinator for the 2002 World Summit on Sustainable Development. At EPA from 1989 to 2001, he served as the Deputy Assistant Administrator for International Activities and Acting Assistant Administrator for International Activities from 1992 to 1994. Before joining EPA, Dr. Hecht was Director of the National Climate Program at the National Oceanic and Atmospheric Administration (1981–1989) and Director of the Climate Dynamics Program at the National Science Foundation (1976–1981). Dr Hecht has a PhD in Geology from Case Western Reserve University.

HU, CHANG-WEI

Abstract: *Catalytic Conversion and Upgrading of Algae-based Biomass Components*

The shortage of resource for both the production of energy material and chemicals, and the huge amount of CO_2 emitted causing significant environmental effects, are among the challenging problems for our sustainable development. The establishment of new CO_2 cycle is thus necessary. Algae show promise for such a new CO_2 cycle. The present presentation will discuss some aspects of the catalytic conversion and upgrading of algae-based biomass component.

1. The cultivation of Nannochloropsis oculata, one kind of algae—The algae used in the present presentation, Nannochloropsis oculata, is cultivated in the laboratory with CO_2 flow.
2. The upgrading of the modeled extracted-oil from algae—The extracted-oil was upgraded by esterification using solid acids catalyst to obtain bio-diesel. CS-25%ZrSi solid acid catalyst was found effective under optimized conditions. The decarboxylation of modeled extracted-oil was carried to upgrade its quality using different kinds of catalysts.

3 One step production of bio-diesel directly from algae—A process combining the extraction of oil from algae and the esterification of oil was proposed. It was observed that this intensified process was effective to obtain bio-diesel with higher quality. The catalyst used and reaction conditions are optimized.

4 The catalytic pyrolysis of original algae and extracted-residue—The catalytic pyrolysis of original algae and the residue after extraction was carried out using ZSM-5 as the catalyst. Liquid with high concentration of aromatic compounds was obtained.

Bio: Chang-Wei Hu is Dean of the College of Chemistry at Sichuan University, where he formerly served as professor and associate head, associate professor, and assistant professor in the Department of Chemistry. He holds a Ph.D. in Chemistry from Sichuan University. Hu's research is in green chemistry and catalytic chemistry. He holds nine patents and has published more than 130 articles in green and organic chemistry in such journals as *JACS, J. Catal., Green Chem., AIChE. J., Ind. & Eng. Chem. Res., Appl. Catal., J. Phys. Chem., Organometallics, Chem. Phys. Lett.*, and *Catal. Lett.* He has received more than 10 awards by different organizations, including the Ministry of Education and the Government of Sichian Province.

HUANG, JIN-LOU

Abstract: *Urban Climate Change: A Comprehensive Ecological Analysis of the Thermo-effects of Major Chinese Cities*

Using 89 major Chinese cities which comprise the case study area, we computed the urban thermo-effect of summer in the 1990s and 2000s compared to that in the 1950s, using the database of highest monthly temperatures recorded by national weather stations from 1951 to 2007. We conducted a temporal-spatial analysis of the calculated urban thermo-effect, after which we carried out grey correlation degree analysis system core and coritivity computation of the 22 selected indicators that could affect the urban thermo-effect. These were performed in order to determine the main factors for comprehensive analysis of urban thermo-effect. Finally, we conducted multiple regression analysis between the computed urban thermo-effect and the main factors to create the comprehensive ecological model of the urban thermo-effect. The results indicate that the urban thermo-effect in the 2000s compared to that in the 1950s is stronger than that in the 1990s. Meanwhile, the respective maximum urban thermo-effects in the 2000s and in the 1990s compared to that in the 1950s are 1.97K and 1.50K, respectively. The strong positive urban thermo-effect occurred mainly in the northeastern Chinese cities during the 1990s, while it occurred in the northwestern cities and southeastern coastal cities during the 2000s. The six main factors of the urban thermo-effect are the total size, the Gross Domestic Product (GDP), the green area, and the population of the built-up area, as well as the gross of freight and annual electricity consumption. The multiple comprehensive ecological model of the urban thermo-effect is reliable because the residual error of the created model is smaller than 0.5K. The study discovers that the mitigation of urban temperature increase is possible with the adjustment of these controllable factors. Moreover, the findings could provide references to decisions made while carrying out urban planning and while implementing policies in the national and local scale. Our findings can also provide references to the urban planning and construction of other developing countries with high levels of urbanization and economic development.

Bio: Jin-lou Huang is assistant professor at the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. Additionally, he serves as executive director of the Ecopolis Planning and Engineering Department, International Council on Ecopolis Development and Commissary, Ecological Engineering Committee, Ecological Society of China. While obtaining his Ph.D. in urban ecology from the Chinese Academy of Sciences, he participated in the master's courses on sustainable development (natural resource management, governance and globalization) held by the Center of Transdisciplinary Environmental Research at Stockholm University in Sweden. Huang's research interests are ecosystem services oriented land use and management, ecological restoration, and ecological engineering He has published more than 15 papers in urban and human ecology and ecocity planning.

HUANG, YAO

Abstract: *Greenhouse Gas Emission and Terrestrial Carbon Sequestration in China*
With the rapid economic development, greenhouse gas emission in China has increased over the last decades. Meanwhile, terrestrial carbon sequestration has been promoted with the implementation of reforestation and afforestation, the improvement of agricultural management, and climate change. This presentation will review the greenhouse gas emission and terrestrial carbon sequestration in China. Uncertainties in the estimates of terrestrial carbon budget will be discussed.

Bio: With the rapid economic development, greenhouse gas emission in China has increased over the last decades. Meanwhile, terrestrial carbon sequestration has been promoted with the implementation of reforestation and afforestation, the improvement of agricultural management, and climate change. This presentation will review the greenhouse gas emission and terrestrial carbon sequestration in China. Uncertainties in the estimates of terrestrial carbon budget will be discussed.

JACKSON, SAMUEL

Abstract: *Tennessee's Bioenergy Program*
The University of Tennessee Biofuels Initiative (UTBI) is Tennessee's answer to the global challenge of securing sustainable, renewable, affordable energy while advancing the local economy and protecting the environment. The Biofuels Initiative is a farm-to-fuel business plan developed by State of Tennessee and UT Institute of Agriculture researchers. Tennessee has made an unparalleled commitment to lead the transition to an advanced biofuels economy with a commitment to support the development of a dedicated bioenergy crop supply chain and the construction of a 250,000 gallon per year demonstration cellulosic ethanol facility.

Working with private industrial partners UT aims to establish a dedicated energy crop (switchgrass) supply chain, demonstrate and improve the technologies used to create cellulosic ethanol, reduce the costs of production, and ultimately commercialize the technology across the state. Tennessee has the potential to produce over a billion gallons of ethanol each year, replacing 30 percent of the state's current petroleum consumption. This effort will serve as a model for commercialization for cellulosic biofuels and bioproducts. Multiple research programs involving dozens of faculty are underway in support of the biofuels program. Researchers with foci ranging from agronomics to biofuels conversion to bioproducts are leading the way.

One of the key elements of the integrated Biofuels Initiative is a demonstration-scale cellulosic ethanol biorefinery in East Tennessee, supplied by local biomass. For this endeavor, Genera Energy, LLC has been established. Genera Energy is a for-profit limited liability company formed in 2008 by the University of Tennessee Research Foundation as a vehicle to carry out the cellulosic biorefinery activities and capital projects of the UTBI. Genera Energy, is collaborating with DuPont Danisco Cellulosic Ethanol to construct a pilot-scale cellulosic ethanol biorefinery in the Niles Ferry Industrial Park in Vonore, Tennessee. The demonstration biorefinery is under construction and is to be completed by December 2009. When running at full capacity, the biorefinery will produce 250,000 gallons per year of cellulosic ethanol from switchgrass.

The Tennessee Biofuels Initiative takes a farm-centric approach to feedstock development, working with local farmers to develop a program that provides direct payments to farmers for switchgrass production as well as one-on-one technical assistance through UT Extension and wide-ranging research related to all aspects of the feedstock supply chain. In spring 2008, 723 acres on 16 farms located in six East Tennessee counties were enrolled in the incentive program and were planted to switchgrass. In 2009, an additional 1,901 acres on 34 farms

were planted into switchgrass. The UT Biofuels Initiative has the largest planting of switchgrass on private farms in the United States and expects to expand that acreage to more than 6,000 acres 2010.

The development of the cellulosic biofuels supply chain, from biomass to fuels and products, will have a significant impact on the energy future of the state and nation. These new systems, technologies, and products will provide increased economic opportunities for rural economies, increased energy security for the nation, and improved environmental impacts of energy production/utilization.

Bio: Samuel W. Jackson is a Research Assistant Professor with the University of Tennessee Agricultural Experiment Station, Office of Bioenergy Programs. He also serves as Vice President for Feedstock Operations of Genera Energy LLC, a subsidiary of the UT Research Foundation. Sam received his Bachelor of Science degree in Wildlife and Fisheries Science and his Master of Science in Forestry from the University of Tennessee. He earned a Doctor of Philosophy in Natural Resources in 2008.

Sam works with a variety of programs, including the UT Biofuels Initiative (http://www.UTbioenergy.org) and the Southeastern Sun Grant Center (http://sungrant.tennessee.edu). The Biofuels Initiative is a project that seeks to promote the development of cellulosic ethanol in Tennessee and the nation. The Southeastern Sun Grant Center is a federally funded program designed at facilitating research in biomass and bioenergy at Land-Grant universities around the Southeast. UT coordinates the program for the region. Sam is responsible for a variety of tasks in the Center, including coordination of the competitive grants programs.

With Genera Energy, Sam is responsible for developing all aspects of the feedstock program. Sam works directly with private landowners, UT Extension, and others to create a sustainable feedstock supply chain. Sam also works with developing alternative energy crop markets with the ultimate goal of attracting commercial investment in Tennessee.

Sam is a member of the Society of American Foresters and the Tennessee Forestry Association. Originally from West Virginia, Sam lives in Seymour, Tennessee with his wife Daphne and son Noah.

KELLER, MARTIN

Abstract: *DOE's BioEnergy Science Center*

The challenge of converting cellulosic biomass to sugars is the dominant obstacle to cost-effective production of biofuels. The BioEnergy Science Center (BESC), funded by the Department of Energy, will address this challenge with an unprecedented interdisciplinary effort focused on overcoming the recalcitrance of biomass. In addition to Oak Ridge National Laboratory (ORNL), the team consists of Dartmouth College, the University of Georgia, the Georgia Institute of Technology, the University of Tennessee, the National Renewable Energy Laboratory, the Samuel Roberts Noble Foundation, four industrial partners, and individual principal investigators from various institutes.

By combining engineered plant cell walls to reduce recalcitrance with new biocatalysts to improve deconstruction, BESC will revolutionize the processing of biomass. These breakthroughs will be achieved with a systems biology approach integrating from nanotechnology to large scale experiments and new high-throughput analytical and computational technologies to achieve (1) targeted modification of plant cell walls to reduce their recalcitrance (using *Populus* and switchgrass as high-impact bioenergy feedstocks), thereby decreasing or eliminating the need for costly chemical pretreatment; and (2) consolidated bioprocessing, which involves the use of a single microorganism or microbial consortium to overcome biomass recalcitrance through single-step conversion of biomass to biofuels.

This talk will provide an overview and update of ongoing research within BESC and will highlight significant breakthroughs in these areas.

Bio: Martin Keller was appointed to his current position as Associate Laboratory Director at Oak Ridge National Laboratory (ORNL), on July 1, 2009. As Associate Laboratory Director he is responsible for the Biological and Environmental Research programs at ORNL supported by the Department of Energy, Office of Science, as well as research programs supported by the Environmental Protection Agency and the National Institutes of Health. The scientific thrust of the directorate is to understand biological and environmental systems across multiple scales so that sustainable solutions to pressing societal challenges in energy, environment, and health can be developed. The directorate includes two research divisions (Biosciences and Environmental Sciences) and several research centers (BioEnergy Science Center, Center for Bioenergy Sustainability, Center for Molecular

Biophysics, and the Center for Structural Molecular Biology). Since July 2007 Martin also serves as the Director of the BioEnergy Science Center (BESC). The mission of BESC is to make revolutionary advances in understanding and overcoming the recalcitrance of biomass to conversion into sugars, making it feasible to displace imported petroleum with ethanol and other fuels. Before being named Associate Laboratory Director at ORNL, Martin served as the Director of the Biosciences Division, ORNL. He joined ORNL in July 2006.

Between 1996 and 2006 Martin held a series of research management positions within Diversa Corporation, a publicly-traded biotechnology company in San Diego. Martin joined Diversa Corporation in June 1994 as a consultant to build and develop the microbiology expertise within Diversa, before joining Diversa Corporation full time in 1996. Being among the first 20 researchers gave Martin the opportunity to participate from the shaping of a start-up biotechnology company to a publicly-traded company with a staff of approximately 380 people. As the Director for New Technology Development and High Throughput Screening, Martin was responsible for Small Molecule Discovery and High Throughput Screening (HTS), including microbiology, robotic high throughput screening, high throughput ELISA, HTS whole cell assays, flow cytometry, biopanning, Multiple Displacement Amplification development and ultra high throughput screening development using miniaturized bead technology. Martin received his Ph.D. in Microbiology from the University of Regensburg, Germany.

KING, ANTHONY

Abstract: *Ecosystem Modeling in the Context of Climate and Energy*
Ecosystems, complex networks of plants, animals and abiotic elements, are intimately linked to both climate and energy. Ecosystems are influenced by climate. At the same time, climate is influenced by ecosystems. Similarly, ecosystems both provide energy, and energy demand and production influence the distribution, structure, and viability of ecosystems. Utilizing feedbacks among these coupled climate, energy and ecological systems as a framework, these relationships and the modeling that reflects current understanding and practice are discussed. The days in which we could fruitfully consider climate only as a boundary condition on energy demand, treat energy production to satisfy this demand as a simple external forcing on climate, approach ecosystem management without considering how ecosystems might be impacted by future climate change, or how management of ecosystems might influence climate are behind us. Current and future challenges of ecosystem management, ecosystem science and ecosystem modeling require the consideration of ecosystems as one of the many nexi binding energy and climate in an integrated, holistic climate-energy system.

Bio: Anthony W. King is a Research Staff Member in the Environmental Sciences Division of Oak Ridge National Laboratory. Receiving a B.S. in Zoology from Arkansas State University in 1978, and an M.S. in Biology from Arkansas State University in 1981, he received his Ph.D. in Ecology from the University of Tennessee, Knoxville in 1986, joining the Environmental Sciences Division and Oak Ridge National Laboratory in 1987. Dr. King's research interests include the understanding and modeling of terrestrial ecosystems as part of the global Earth system, ecosystem and land-surface processes at landscape, regional, and global scales, climate-ecosystem feedbacks, carbon and water cycle modeling, land-use change, spatially structured population dynamics and modeling, theory of scale and system organization in ecology, model sensitivity and uncertainty analysis, and model evaluation. Most recently, Dr. King as been involved in scientific synthesis and assessment in support of decision making, the integration and modeling of coupled socio-eco-systems, and the assessment of climate impacts on these coupled systems.

KLINE, KEITH

Bio: Keith has contributed to the design, management and evaluation of international development programs since 1980. He has conducted environmental analyses and developed reports on issues ranging from sustainability of land-use to fuelwood markets, small hydro power, and cogeneration. Recent research has focused on the drivers of land-use change, sustainability indicators for agriculture and forestry, biomass resource assessments and biofuel feedstock potentials around the world. Keith helped plan, organize and document the results from the "Land Use Change and Bioenergy Workshop" in Tennessee (May 2009). That workshop focused on data, modeling and other issues contributing to uncertainty in land-use change calculations required for life-cycle assessment of bioenergy production pathways.

LI, SHENG-GONG

Abstract: *Spatio-temporary Variability of Carbon Cycles of China's Grasslands*
Grassland ecosystem is one of largest biomes in the world covering almost one third of the global land surface. They play critical roles in global carbon balance and offsetting the emission of green house gases from human activities. Whether they act as a sink or a source of atmospheric CO_2 depends upon a lot of environmental and biotic factors. Especially in arid and semi-arid environments, where grassland ecosystems are widely distributed, productivity of the grassland ecosystems is closely associated with seasonal and inter-annual variability of water availability.

China has a vast area of grasslands, covering over 40% of its land surface (3.93 million km2), and being mostly distributed on Inner Mongolia Plateau (temperate steppe) and Qinghai-Tibet Plateau (alpine meadow). The grasslands play very important roles in sustainable development for China's social-economy and environmental conservation. However, due to extensive and intensive anthropogenic activities such as over-exploitation, and the conversion from grassland to farmland, China's grasslands are subject to large-scale degradation over decades and thus their functioning as carbon sequestration potential is likely weakened. The degenerated grassland accounts for almost 1/3 of the total grassland area. Because most of the grassland ecosystems are located in the semi-arid and arid areas in China, drought or usually erratic precipitation becomes the dominant factor affecting plant growth and carbon balance of the grasslands.

This presentation will give an overview of carbon flux of grasslands in China from site measurements to network-based estimation. We want to address following issues: 1) whether China's grasslands act as a carbon sink or source with focus on their spatio-temporary variability or uncertainty in terms of net ecosystem CO_2 exchange? 2) What environmental and biotic factors driving this variability or uncertainty? 3) What is likely to be the trajectory of carbon cycle of the grassland under conditions of climate change and intensive anthropogenic activities? and 4) what carbon sequestration potential is likely achieved for offsetting gradually increased emissions of green house gases.

Bio: Sheng-Gong Li is deputy director of the Synthesis Center of Chinese Ecosystem Research Network and professor at the Institute of Geographical Science and Natural Resources Research, Chinese Academy of Sciences (CAS), Beijing. He has served as research professor at the Japan Science and Technology Agency, postdoctoral researcher at the Institute of Biology at the University of Utah, and associate research professor, assistant research professor, and research associate at Cold and Arid Regions Environmental and Engineering Research Institute, CAS. He holds a Ph.D in plant ecology from the University of Tsukuba in Japan. Li's research interest is biogeochemical cycles of terrestrial ecosystems. He has published more than 80 academic articles in grassland ecology and global climate change in international journals such as the *Journal of Geophysical Research*, *Journal of Hydrology*, *Agricultural and Forest Meteorology*, and *Global Change Biology*.

MACCRACKEN, MICHAEL

Abstract: *Achieving International Agreement and Climate Protection by Coordinated Mitigation of Short- and Long-Lived Greenhouse Gases*
As greenhouse gas emissions continue to increase, both warming and the commitment to future warming are increasing at a rate of ~0.2°C per decade. Projections are that the rate of warming will further increase if emissions controls are not put in place. Such warming and the associated changes in climate are likely to cause severe impacts to key societal and environmental support systems. Leaders of the largest nations have called for the increase in global average surface temperature to be no more than 2°C above its preindustrial value in order to avoid the most catastrophic consequences of climate change. This will require sharply reducing global greenhouse gas emissions by 2050 and reducing net emissions to near zero by 2100. With fossil fuels supplying over 80% of global energy needs, and with increasing use apparently inevitable in many developing nations in order to raise the standard-of-living, formulating an international agreement that will sufficiently limit the increase in global average temperature is quite problematic. Based on the present state of negotiations, it appears that neither developed nor developing nations ready to commit to a long-term agreement without commensurate action by all nations, in some cases not even taking notice of the very different situations and histories of emissions. An approach requiring comparable efforts by all nations has the potential to substantially limit warming, but there is no room for compromising by developed and developing nations. The comparable efforts require that: (1) developed nations reduce their emissions of both CO_2 and non-CO_2 greenhouse gases, demonstrating by 2050 that

a modern society can prosper without reliance on technologies that lead to net emissions of more than 20% of current levels (and less thereafter); and (2) developing nations act in the near-term to improve their carbon efficiency and halt deforestation while sharply limiting their non-CO_2 greenhouse gas emissions, and then later, as their per capita income rises to levels near those of developed nations, they also join in reducing their CO_2 emissions. Pursuing aggressive, near-term reductions in emissions of methane, black carbon (soot), and pollutants contributing to tropospheric ozone would also greatly improve the health and environmental well-being of the citizens of developing nations and, for a few decades, counterbalance the increase in warming influence from their ongoing CO_2 emissions. Such a two-phase approach by developing nations would not only recognize the equity imbalance created by very different per capita emissions, but also demonstrate their commitment to sharply limit global warming. Even with such actions, scrubbing of CO_2 from the atmosphere and intervening to reduce planetary absorption of solar radiation in at least some regions of the world may well be necessary to further limit warming, the thawing of permafrost, the melting of the Greenland and Antarctic ice sheets, and the loss of biodiversity.

Bio: Michael MacCracken has been Chief Scientist for Climate Change Programs with the Climate Institute in Washington DC since 2002; he was also elected to its Board of Directors in 2006. The Climate Institute is a non-partisan organization focused on: catalyzing innovative and practical solutions for climate change adaptation, mitigation, and climate stabilization; creating partnerships among policymakers, scientists, the public and environmental institutions at the local, national and international levels to address the climate challenge more effectively; contributing to and communicating the results of scientific research in an accurate and comprehensive manner; and providing objective and comprehensive information on climate change risks and potential responses.

Dr. MacCracken received his B.S. in Engineering degree from Princeton University in 1964 and his Ph.D. degree in Applied Science from the University of California Davis/Livermore in 1968. His dissertation used a 2-D climate model to evaluate the plausibility of several hypotheses of the causes of ice ages. Following his graduate work, he joined the Physics Department of the University of California's Lawrence Livermore National Laboratory (LLNL) as an atmospheric physicist. His research in the following 25 years included studies using numerical models of various causes of climate change (including study of the potential climatic effects of greenhouse gases, volcanic aerosols, land-cover change, and nuclear war) and of factors affecting air quality (including photochemical pollution in the San Francisco Bay Area and sulfate air pollution in the northeastern United States). At LLNL, he also served as division leader for atmospheric and geophysical sciences from 1987-1993 after serving as deputy division leader from 1974-1987.

From 1993-2002, Dr. MacCracken was on assignment from LLNL as senior global change scientist with the interagency Office of the U.S. Global Change Research Program (USGCRP) in Washington D.C., also serving as the Office's first executive director from 1993-1997. From 1997-2001, he served as executive director of the USGCRP's National Assessment Coordination Office, which coordinated the contributions of 20 regional assessment teams, 5 sectoral teams, and the National Assessment Synthesis Team (which was constituted as a federal advisory committee), which prepared the national climate impacts assessment report that was forwarded to the President and on to the Congress in late 2000. During this period with the Office of the USGCRP, Dr. MacCracken also coordinated the official U.S. Government reviews of several of the assessment reports prepared by the Intergovernmental Panel on Climate Change (IPCC), and he was a co-author/contributing author for various chapters in the IPCC assessments.

When Dr. MacCracken's assignment with the Office of the USGCRP concluded on September 30, 2002, he simultaneously retired from LLNL. In addition to volunteering with the Climate Institute, he served on the integration team for the Arctic Climate Impact Assessment from 2002-2004, contributing to the synthesis of findings presented in their 2004 assessment report. From 2003 to 2007 he served as president of the International Association of Meteorology and Atmospheric Sciences (IAMAS), members of which are national committees organized by the national academies of science of about 65 nations. As president of IAMAS, Dr. MacCracken also served on the executive committees of the International Union of Geodesy and Geophysics (IUGG) and he is continuing to serve on the Executive Committee of the Scientific Committee for Oceanic Research (SCOR). From 2004 to 2005, he served on a panel of the Scientific Committee on Problems in the Environment that prepared a report on what is known about the likelihood and consequences of an asteroid or comet impact, and from 2004-2007 on a scientific expert group convened by Sigma Xi and the UN Foundation at the request of the UN's Commission on Sustainable Development to suggest the best measures for mitigating and adapting to global climate change (see http://www.confrontingclimatechange.org).

His present research is focused on two approaches to helping limit global warming: (1) planning for comprehensive and coordinated reductions in emissions of CO_2, non-CO_2 greenhouse gases, and black carbon aerosols to create an effective and equitable framework for international agreement on a post-Kyoto approach to dealing with climate change; and (2) the potential application of geoengineering approaches to reduce planetary absorption of solar radiation, with particular interests in limiting Arctic warming, intensification of tropical cyclones, and sustaining the cooling offset of tropospheric aerosols as SO_2 emissions are reduced.

Dr. MacCracken is a fellow of the American Association for the Advancement of Science (AAAS), a member of the American Meteorological Society, the Oceanography Society, the American Geophysical Union and Sigma Xi, and serves as a member of the Board of Advisors of Scientists and Engineers for America. His affidavit relating to global climate change and impacts on particular regions was cited favorably by Justice Stevens in his opinion in the April 2007 decision by the US Supreme Court in the case of Massachusetts et al. versus EPA.

THOM MASON

Bio: Dr. Mason, who became Laboratory Director July 1, 2007, is an experimental condensed matter physicist whose primary research tool has been neutron scattering, supplemented by the use of X rays and transport and thermodynamic measurements.

Dr. Mason received a B.Sc. in physics from Dalhousie University in Halifax, Nova Scotia, in 1986 and a Ph.D. in physics from McMaster University in Hamilton, Ontario, in 1990. Following completion of his doctorate, he held a Natural Sciences and Engineering Research Council of Canada (NSERC) Postdoctoral Fellowship at AT&T Bell Laboratories in Murray Hill, New Jersey from 1990 to 1991. He then spent a year as a senior scientist at Risø National Laboratory in Denmark where, in addition to conducting ongoing physics research, he supported the user program and developed new instrumentation. From 1993 to 1998, he was an assistant and associate professor in the Department of Physics at the University of Toronto. He became director of the Experimental Facilities Division of the Spallation Neutron Source in 1998 and served in that capacity until being named Associate Laboratory Director for the Spallation Neutron Source in 2001. In October 2006, following the completion of the Spallation Neutron Source construction project, Dr. Mason was named Associate Laboratory Director for Neutron Sciences, leading a new directorate charged with delivering safe and productive scientific facilities for the study of structure and dynamics of materials.

Dr. Mason was an Alfred P. Sloan Research Fellow from 1997 to 1999. He has been an Associate of the Quantum Materials Program (formerly the Superconductivity Program) of the Canadian Institute for Advanced Research since 1993. He was elected a Fellow of the American Association for the Advancement of Science in 2001 and a Fellow of the American Physical Society in 2007. He has coauthored more than 100 publications in refereed journals, presented more than 50 invited talks at conferences, and served on a variety of advisory panels and review committees.

NIES, LARRY

Bio: Larry Nies is a professor in the School of Civil Engineering at Purdue University. His research interests include learning how to optimize the future capacities of our interdependent urban infrastructure systems and the molecular genetic characterization of the structure and function of microbial communities. Urban systems will play a pivotal role in future economic development and globalization and they must be must be robust, resilient, secure and sustainable. Dr. Nies is the leader of the "Megacities" initiative launched through the Discovery Park Center for the Environment at Purdue University. His teaching interests include the development of the first sustainable engineering course at Purdue University. More than 390 undergraduate students from Engineering, Science, Agriculture, Liberal Arts, Technology and Health Sciences have completed Engineering Environmental Sustainability.

OUYANG, ZHIYUN

Abstract: *Ecosystem Degradation and Restoration Study in China*

Bio: Zhi-Yun Ouyang is the deputy director and professor of the Research Center for Eco-environmental Sciences at the Chinese Academy of Sciences. He is also the director of the National Key Laboratory of Urban and Regional Ecology. He obtained his Ph.D. in Systems Ecology in Chinese Academy of Sciences in 1993. Ouyang's research interests include ecosystem services, ecosystem assessment and ecological planning, and biodiversity conservation. He has published more than 50 peer reviewed articles in ecosystem services and biodiversity conservation in international journals such as *Science, PNAS, Frontiers in Ecology and the Environment,* and *Global Change Biology*.

PALUMBO, TONY

Bio:

PARKER, JACK

Bio: Jack Parker is a research professor of Civil and Environmental Engineering with the Institute for a Secure and Sustainable Environment at the University of Tennessee. Previously, he served as a Distinguished Research Scientist at Oak Ridge National Laboratory, as founder and president of Environmental Systems & Technologies, Inc., and as a professor of Contaminant Hydrology at Virginia Tech. He has authored some 200 technical publications, mainly dealing with multiphase flow and transport modeling, inverse modeling, error analysis and various applications, and has presented numerous lectures, workshops and courses throughout the US and Europe.

PAUL, MELINDA

Abstract: *Springer: A Venue for Publishing US-China Joint Research*

Book publishing at Springer has transformed in the past two years with the addition of an online publication being released simultaneously with the hardcopy version of each title. E-books are easily located on search engines, thus making access to book content equal to that of online journals. This presentation will outline the publishing process, beginning with how to prepare a sound proposal. The steps of preparation, production, and an overview of sales and marketing functions will be detailed to give a full picture how a book is published and distributed by Springer.

Bio: Melinda (Lindy) Paul is a Senior Editor with Springer Science and Business Media. She has 10 years of experience publishing books and journals in the research areas associated with environmental Science. This publishing program includes the journals: *Ecotoxicology; Environmental Management; Environmental and Ecological Statistics; Urban Ecosystems; Archives of Environmental Contamination and Toxicology; The Bulletin of Environmental Contamination and Toxicology;* and *The Environmentalist.*

POST, MAC

Bio: Wilfred (Mac) Post has over 90 open literature publications in terrestrial ecosystem ecology. Particular emphasis is in the area of global terrestrial ecosystem carbon cycling and relationships of ecosystem dynamics to environmental, edaphic, and biological conditions. He is a recognized expert on soil carbon dynamics, nutrient relationships between soil and vegetation, and the impact of species composition on ecosystem processes. He has developed new approaches to representing the impact of land-use change, and climate change in terrestrial biogeochemistry models and also developed global data sets for the evaluation of global terrestrial biogeochemistry models. His current work now centers on developing data-assimilation methods to confront terrestrial ecosystem models with data from a variety of sources (atmospheric trace gas measurements, eddy-covariance networks, soil and biomass inventories) to estimate model parameters and initial conditions and to improve ecosystem models. He is a Senior Scientist at Oak Ridge National Laboratory in the Environmental Sciences Division.

RIALS, TIM

Abstract: *The Integrated Biorefinery: New Perspectives for Existing Biomass Industries*

Concerns over energy security have recently raised the profile of wood and related lignocellulosic materials as a potentially important source of alternative fuels, both liquid and solid. This creates the opportunity to consider new market outlets for residue generated from harvest operations and manufacturing processes. These additional markets also introduce the potential to more directly integrate bioenergy opportunities into current processing systems, as has been advocated for the pulp and paper industry in the "value prior to pulping" (VPP) concept. In VPP, a substantial portion of the hemicellulose component is extracted prior to the pulping process, generating a sugar stream for conversion to fuel, chemicals, or paper additive. Analogous prospects exist for wood composite manufacturing processes, such as that used for oriented strandboard. Recent work has demonstrated that panels prepared from hot water-extracted flakes exhibit significant improvements in many performance properties. For example, water absorption and thickness swell of panels was reduced by 52 percent and 38 percent, respectively. The effect of extraction conditions on physical and mechanical properties of the resulting composites, and the composition of the extract has been investigated. Details associated with the two process streams (i.e., wood flakes and sugars extract) will be discussed.

Bio: A native of McComb, Mississippi, Tim Rials received his undergraduate degree in Forestry from Mississippi State University in 1980. He then transferred to Virginia Tech where he earned both Masters (1983) and Ph.D. (1986) degrees from the Department of Wood Science and Technology. Tim joined the faculty at the University of California-Berkeley as assistant professor, conducting research on renewable materials. In 1988, he moved to Louisiana accepting a research scientist position with the USDA-Forest Service, Southern Research Station in Pineville, and later serving as Project Leader of the wood utilization research unit. Five years later he moved to The University of Tennessee, accepting the position of Professor in the Department of Forestry, Wildlife, and Fisheries, and Director of the Forest Products Center. At UT, Tim expanded his research into vibrational spectroscopy of wood and related materials while working to coordinate the Forest Products Center's overall research program and vision. In 2005, he assumed the role of director for the Southeast Sun Grant Center, effectively broadening the research effort to consider bioenergy, biofuels, and bioproducts. Dr. Rials was named director of Bioenergy Research in Spring 2007, and assigned to the newly created Office of Bioenergy Programs in the Institute of Agriculture. A fellow in the International Academy of Wood Science and member of the American Chemical Society, Tim continues working today to advance the efficient use of wood and lignocellulosic biomass.

SANSEVERINO, JOHN

Bio: Dr. Sanseverino is the Managing Director of the Center for Environmental Biotechnology (CEB) and a Research Associate Professor in the Department of Microbiology at the University of Tennessee. He has over 20 years experience in environmental microbiology and biotechnology. Dr. Sanseverino's past research has included the application of environmental molecular diagnostics to bioremediation in the subsurface and degradation of polynuclear aromatic hydrocarbons, polychlorinated biphenyls, and trichloroethylene. In recent years, he has been involved in the development of (i) bioluminescent yeast reporter systems for the detection of environmental endocrine disruptors, (ii) expression of bacterial luciferase in mammalian cells, and (iii) environmental genomics.

SAYLER, GARY

Bio: Dr. Sayler is the Beaman Distinguished Professor in the Department of Microbiology, Ecology and Evolutionary Biology at the University of Tennessee, Knoxville; director of the University of Tennessee-Oak Ridge National Laboratory Joint Institute for Biological Sciences; adjunct professor at Gwangju Institute for Science and Technology, South Korea; and Honorary Professor at East China University, Shanghai. He is the founding Director (1986) of the University of Tennessee Center for Environmental Biotechnology. His research interests include microbiology, toxicology, and molecular biology of biodegradation, of toxic pollutants such as PCB and PAH. He pioneered the development of environmental molecular diagnostics including the extraction and analysis of nucleic acids from the environment and wastes, environmental gene probe analysis, bioluminescent bioreporter/sensor technology, and conducted the first field release of a genetically-engineered microorganism for remediation process monitoring and control. Over his career, Dr. Sayler has built and directed programs of approximately $100 million in environmental research, edited five books, and contributed over 300 publications and 500 invited presentations. He holds 16 patents on environmental gene probing, genetic engineering for bioremediation, biosensor technology, and environmental gene expression. He received the NIEHS' Research Career Development Award (1980-1985); was named a Top 100 Innovator in Science by Science Digest (1985); received the American Society for Microbiology, Procter and Gamble Award for Environmental Microbiology (1994), the Distinguished Alumni Award of the University of Idaho (1995), the DOW Chemical Foundation SPHERE Award (1998-2000), as well as the Chancellor's Research Scholar Award and the Arts and Sciences Senior Researcher award from the University of Tennessee . He was elected to the American Academy of Microbiology in 1991. Dr. Sayler has served on numerous of councils and committees for the National Research Council, DOE, EPA, NIEHS, NSF, NASA, and WERF. He is currently a member of the

U.S. Environmental Protection Agency's Science Advisory Board, Chair of the Board of Scientific Counselors for EPA's Office of Research and Development, and is a member of the DOE/OS Biological and Environmental Research Advisory Committee. Dr. Sayler is a member of five professional societies and currently serves on five editorial boards and is associate editor of *Environmental Science and Technology*. Dr. Sayler has directed graduate research of approximately 50 doctoral and 15 master's students in microbiology, ecology and evolutionary biology and engineering.

SHAO, GUO-FAN

Abstract: *Roles of Forests in Offsetting CO_2 Emissions: China vs. US*
The US and China are the fourth and fifth largest forest countries on Earth. There are many bio-geographic similarities between the two countries as they are located in the same climate zones. While US forests are 1.4 times higher than China's total forest in total area, US forests are 2.7 times higher than China's forests in total carbon sequestration. Among many differences in forest policy and culture between US and China, forest productivities and wildfire activities show the highest contracts between the two countries. China needs to make more efforts to improve forest productivity but US need to work harder to prevent forest fires.

Bio: Guofan Shao received his Ph.D. in ecology from Chinese Academy of Sciences in 1989, and a post-doctoral education in ecological modeling from the University of Virginia, USA, between 1991 and 1993. He joined the faculty at Purdue University in 1997 and is now a Professor at the Department of Forestry and Natural Resources. He serves in editorial boards of five international journals. His research has focused on geospatial application in forest sustainability, and published over one hundred scientific papers and four books.

SHUGART, LEE

Abstract: *Master Plan for Huaibei's Bioenergy Development*
Huaibei, China is a coal mining city in the north of Anhui province with a population of 1.22 million situated in a 291 square miles of urban area that suffers the ecological pressures resulting from mining and pollution. The Huaibei Municipal Government is seriously considering ways to reinvigorate their economy and improve their environment and as part of their Eco-city Development Plan, a Bio-energy Initiative that incorporates a renewable energy industry is being evaluated.

It has been suggested that a Cooperative Project that incorporates the switchgrass-based biofuel model developed by UT be the interactive point for comparison, exchanges, lessons learned, and technical expertise for Huibei's Bio-energy Initiative. The goal of the proposed project will be to develop and demonstrate a comprehensive clean energy pilot model for Huaibei.

The first priority of the Cooperative Project will be to develop a science-based Master Plan for long-term bioenergy production in Huaibei. The purpose of the Master Plan is twofold. First, it will detail a scientifically sound roadmap for the successful construction of a biomass-based energy production system in Huaibei. Second, it will ensure that the roadmap assists Huaibei in its transition to a sustainable and clean energy economy. The Master Plan should be viewed as a vehicle for monitoring progress of the overall goals and objectives within the constraints of the economic (and other) parameters detailed in the roadmap, while continuously providing feedback information to accommodate the needs of the various partners. To be effective, it must address specific issues related to the sustainability of the Environment, the Economy, and the Society.

Bio: Dr. Shugart has a B.S. degree in Chemistry, a M.S. degree in Biochemistry and a PhD degree in Microbiology. He is president of LR Shugart & Associates, Inc., a consulting firm established in 1995 to provide the scientific community knowledge and expertise in genetic ecotoxicology, a rapidly developing discipline in the environmental sciences arena. His company has expanded its initial scope of operation and is currently structured to provide a thorough, comprehensive and scientifically defensible evaluation of a customer's activities and process as they relate to and either affect or are affected by the environment. Such evaluations can be used to identify risk and to suggest cost-effective solutions. The company provides supplemental expertise and assistance with technical, legal, and contractual issues

THORNTON, PETER

Abstract: *Coupled Climate-biogeochemistry Modeling: Carbon, Nutrients, and Land Cover Change*

Previous work has demonstrated the sensitivity of terrestrial net carbon exchange to disturbance history and land use patterns at the scale of individual sites or regions. Here we show the influence of land use and land cover dynamics over the historical period 1850-present on global-scale carbon, nutrient, water, and energy fluxes. We also explore the spatial and temporal details of interactions among land use and disturbance history, rising atmospheric carbon dioxide consentation, and increasing anthropogenic nitrogen deposition. Our simulations show that these interactions are significant, and that their importance grows over time, expressed as a fraction of the independent forcing terms. We conclude with an analysis of the influence of these interactions on the sign and magnitude of global climate-carbon cycle feedbacks.

Bio: Peter Thornton is a research scientist in the Environmental Sciences Division at Oak Ridge National Laboratory. He is a primary developer of the land biogeochemistry component of the Community Climate System Model, being used in the most recent IPCC assessment. He has nine years experience developing and applying land biogeochemistry models within the coupled climate system context. His earlier work focused on ecosystem model development and biometeorology. Thornton has his PhD from the School of Forestry, University of Montana, his M.A. in Plant Geography from Johns Hopkins University, and his B.A. in Biomedical Engineering, also from Johns Hopkins University.

UGARTE, DANIEL DE LA TORRE

Abstract: *Evaluating the Economic and Environmental Impacts on the Agricultural Sector as a Result of the Push toward Renewable Fuels* (with Burton C. English, James Larson, R. Jamey Menard, Chad Hellwinckel, and Tristram O. West)

The analysis shows that U.S. agriculture is capable to meet the energy goals outlined in this study solely through the increased use of corn-based ethanol at substantial environmental cost. In fact, substantial environmental impacts occur simply by meeting the expected production levels in current USDA 10-year baseline projections. Relaxing some of the assumptions built into this model will tend to reduce these impacts. A major one is the extent to which additional land is made available to meet the increased corn acreage and the extent to which cellulosic ethanol production becomes commercially viable within the next 10 years.

The model results suggest that many natural resource issues, such as soil quality, water quantity and quality, air quality, and wildlife habitat – will be exceedingly “at risk” given these increased agricultural production pressures. In that regard, USDA agencies involved in conservation efforts, such as the Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) should be aware that increased corn-based ethanol production could carry the following implications:

- More intensive corn production in the Midwest, particularly the western Corn Belt and eastern Nebraska although total corn acreage throughout the US increases.
- Soybeans leaving traditional corn-soybean rotations with substantial soybean acreage shifting out of the Corn Belt into the Southeast.
- Higher input use of both non-fertilizer chemicals and fertilizers.
- Higher soil erosion and sedimentation rates.
- Lower soil carbon sequestration rates and higher carbon emissions from crop production.
- Shifts in cotton acreage westward and wheat into the Southeast

Bio: Dr. Daniel De La Torre Ugarte is a professor of agricultural economics and associate director of the Agricultural Policy Analysis Center (APAC) at the University of Tennessee. He received a B.S. in economics from the Universidad del Pacifico (Lima, Peru) and a MS and PhD in agricultural economics in 1991 from Oklahoma State University.

Dr. De La Torre Ugarte has more than 15 years of experience in the areas of agricultural policy, international trade, and bioenergy. He helped established and developed APAC into a highly respected center that has developed working relationships with government agencies, national federal laboratories, other universities, non-government organizations (NGOs) in more than twenty countries.

His agricultural policy analysis worked has provided stake-holders with reliable analysis of issues affecting primarily the performance of the US agricultural sector, the issues researched range from alternative policy proposals for farm legislation to the analysis of the potential interaction between changing agricultural practices, carbon sequestration and climate change.

His work on bioenergy, has focused on the synergism between agricultural and energy policies, and how a bioenergy program based on agricultural feedstock could contribute to a national and international energy strategies to support farm and rural incomes in the US and abroad. The work done under this program has lead to the development of analytical capabilities that are unique in the country.

Dr. De La Torre Ugarte advanced APAC's regional and environmental policy analysis capabilities by (i) disaggregating the supply side of the POLYSYS model into 305 Agricultural Statistical Districts, and (ii) linking POLYSYS with natural resource data and physical process models to estimate environmental impacts. He worked on the development of the first stochastic multi-regional agricultural sector model for policy analysis and integrated into the POLYSYS system the modeling of bioenergy-dedicated crops and the use of cropland for short rotations woody crops.

VOLENEC, JEFFREY

Abstract: *Ecosystem Services of Existing and Candidate Bioenergy Cropping Systems: Critical Research Questions* (with S.M. Brouder, R. Turco, D.R. Smith(USDA-ARS), and G. Ejeta)
Current U.S. plans for energy security rely on converting large areas of cropland from food to biofuel production. Additionally, lands currently considered too marginal for intensive food production may be considered suitable for biofuel production; predominant cropping systems may shift to more varied arrays including novel species for which little agronomic and environmental data exist. U.S. agriculture has extensive experience with intensive corn production and much recent discussion on energy from plants has focused on simply repurposing the existing farming systems towards ethanol instead of or in addition to animal feed. Both the grain and the stover can be used in energy production, but removing the majority of the aboveground biomass from a farm field may negatively impact air, soil, and water quality. Herbaceous perennials including novel species such as *Miscanthus* imported from Europe and low-input native systems may offer key advantages over maize production. Farmers can use existing farm equipment and these systems are expected to require far fewer energy and financial inputs than annual row crops. However, at present, research on N and C cycling in these candidate biomass systems is fragmented and incomplete, a critical barrier to profitable and environmentally benign on-farm implementation of the U.S. biofuel agenda. In the crop production component of life cycle analyses (LCAs), nutrient (especially N) use efficiency (NUE) has been identified as a key advantage of herbaceous perennials when compared to corn. Yet true comparative data on NUE and system N balance remain sparse and there are several critical N balance determinants that are easily overlooked when LCAs are developed and when crop improvement efforts are conceived. This presentation will focus on key unknowns in nutrient use and fertilizer management for candidate biofuel cropping systems, impacts on soil carbon and air and water quality and the potential for biotechnology solutions to improve nutrient use efficiency with a concomitant reduction in environmental impact.

Bio: Dr. Volenec is professor of agronomy at Purdue University. His research focuses on the physiology and ecology of herbaceous plants used for forage and biomass. He teaches two courses: Crop Physiology and Ecology; and Forage Management. He has served as Editor of *Crop Science* and Editor-in-Chief of the Crop Science Society of America. He is a fellow of the American Society of Agronomy, Crop Science Society of America, and the American Association for the Advancement of Science. He holds a BS in agronomy/natural science from the University of Wisconsin-Madison, and graduate degrees from the University of Missouri-Columbia.

WANG, RU-SONG

Abstract: *Urban Ecological Restoration and Ecopolis Development in China (*Rusong Wang and Jinlou Huang)
China is experiencing rapid growth in urbanization and industrialization. By 2008, more than 45% of Chinese are living in towns and cities. The pace, depth, and magnitude of these changes, while bringing about benefits to local people, have exerted severe ecological stresses on both local human living conditions hand regional life support ecosystem. Urban sustainability can only be assured with a human ecological understanding of the complex interactions among environmental, economic, political, and social/cultural factors and with careful development and management grounded in ecological principles.

Based on ancient Chinese ecological thoughts and so-called social-economic-natural complex ecosystem approach, this presentation is to introduce the approaches and practices of urban ecological restoration and ecopolis development in China to meet the world's three biggest challenges of Global Climate Change, Regional Ecosystem Service deterioration, and Human Health Threatening.

The main contents of this presentation are: 1.Understanding urban eco-complexity: Social-Economic-Natural Complex Ecosystem approach; 2. Adaptive ecological restoration of resource exhausted cities and regions with case studies in Mentougou and Huaibei; 3. Five Facets of Adaptive Ecopolis development: eco-sanitation, eco-security, eco-industry, eco-landscape and eco-culture; 4. Planning with urban sustainability: Cases of Ecopolis development in China.

Adaptive urban ecological restoration is to restore and enhance comprehensive ecological order of the social-economic-natural complex ecosystem including the restoration of natural ecosystem service to enhance the city's function of cleaning, greening, vitalizing and beautification; vitalization of the industrial metabolism through vertical, horizontal, regional and social coulping to realize high efficiency and harmony with nature; and the renaissance of the cultural creativity and sustainability whilst improving the quality of citizens' lives and their social well-being.

A campaign of Ecopolis development has been undergoing in some Chinese cities and towns since 1980s. Ecopolis is a kind of administrative unit of human settlements having economically productive and ecologically efficient industry, systematically responsible and socially harmonious culture, and ecologically adaptive and functionally vivid landscape. Introduced here are two conjugate ecological planning cases in Huaibei and Beijing cities respectively, which is trying to balance and/or compromise the economic benefits and ecological service for the ecosystem development.

During the past decades, 40 experimental cities/counties towards sustainable development, 51 eco-agricultural county, more than 3000 Eco-villages, Eco-farms and eco-factories have been set up through both top-down and bottom-up channels. 484 eco demonstration zones have been set up by local government, among which 82 have been appraised and named by the State Environmental Protection Agency including prefecture and county level cities. While main lessons & challenges are also gained such as institutional barrier; behavioral bottleneck and technical malnutrition.

In recent years, the Dongtan ecocity planning in Chongming island of Shanghai, the Sino-Singapore ecocity planning in Tianjin, and a quite few other cases of ambitious ecocity planning in China show the public a dream of a sustainable city. To realize it, however, we need an adaptive process to local natural and human ecological condition, need to reshape our production mode, consumption behavior, development goal and life meaning, to reform the fragmented institution in legislation, organization, governance, decision making, planning and management, and to renovate the reductionism based and chain-linked technology.

Compared with foreign countries, China's ecocity development is rather top-down encouragement than bottom-up. Advantages of this way is that if the decision makers smart enough, the ecopolis plan will be strongly implemented, otherwise it will be just an oral promise or ideal utopian.

The functioning of an urban ecosystem depends on the service of the natural ecosystems and agricultural ecosystems in the region, as well as the health of urban life supporting infrastructure, especially the health of vegetation (which function as "lungs"), wetland ("kidneys"), the land surface and soil ("the skin"), wastes emission ("the mouth"), and the transportation network ("arteries"). Ecopolis development promotes the evolution from a traditional industrial civilization to an ecological civilization, through philosophical rethinking, institutional reform and technological renovation. Three so called ecopolis legs advocated by Chinese politicians are Circular Economy, Harmonious Society and Safe Ecology.

The functioning of urban ecosystems relies on the harmonious relationship between Mass, Matter, Man and Milieu in cities. The ecological engineering of eco-building, eco-mobility, renewable energy, eco-sanitation, life-cycle management, eco-civilization oriented capacity building and landscape restoration being innovated in ecopolis developments by scientists, technicians and practitioners all over world, are efficient instruments for adjusting these relationships. To build a living community resilient to climate change and to build a livable, workable, accessible, affordable and sustainable human habitat, the existing city should be further upgraded and integrated to meet ecopolis goals and the results should then be disseminated to all cities.

Bio: Rusong Wang is a professor at the Research Center for Eco-Environmental Sciences and the State Key Lab on Urban & Regional Ecology, Chinese Academy of Sciences, where he was the lab's founder and director. Wang received his Ph.D. in Urban Systems Ecology from the Chinese Academy of Sciences. Wang's research interests are urban sustainability methodology, especially the integrative planning and management approach of Social-Economic-Natural Complex Ecosystem (SENCE) for urban and human-dominated ecosystems. He has published more than 150 scientific papers and 16 books in this area. He has won 15 national awards in science and technology; was elected president of the Ecological Society of China (2004-2008); vice president of SCOPE/ICSU (2002-2008); vice president of the Society of Human Ecology (SHE) (1999-2004); vice president of the International Council on Ecopolis Development; Chair of the Committee of Eco-Environment, Chinese Association for Sustainable Development; and Board member of the International Association of Ecology (INTECOL) and International Ecological Engineering Society (IEES).

Additionally, Dr. Wang is a member of the Scientific Advisory Committee and the International Institute of Applied Systems Analysis (IIASA). He served as co-chair on the organization committee for the ECO-SUMMIT in Beijing. He was elected for two terms as the Delegate of the National People's Congress of China (2003-2012), Member of Beijing People's Political Consultation Conference (1998-2007), appointed as the Mayor's Counselor of Beijing City (2007-2012), and Scientific Advisor of the Ministry of Environment (2007-2010).

WANG, YAN-JIA

Abstract: C*hina's Efforts for Energy Efficiency in Industry*

This presentation reviews what happened in China during 2003-2005 and what has been done to improve energy efficiency in industry since China set up decreasing 20% of energy intensity target in 2006. Top 1000 enterprises action plan, new tariff subsidy policy, efficiency standards, and other policies for industry are explained. The presentation also provides personal thoughts on EE in China.

Bio: Yanjia Wang is an associate professor at Tsinghua University, where she obtained her M.S. in energy system analysis and B. S in Chemical Engineering. She also holds a certificate in energy planning from the Asia Institute of Technology. She was team leader at the Asia Pacific Energy Research Center in Japan, visiting scholar at Tulane University, and research fellow at the Asian Institute of Technology in Thailand. Wang's research interests are industrial energy efficiency and market solutions for environmental problems. Cooperating with others, she has published 14 books and more than ten journal articles in the field of energy in leading international journals, such as *Energy Policy*.

WILKERSON, ERIN AND CHRISTOPHER T. WRIGHT

Abstract: *Estimating Bioenergy Feedstock Costs from the Field to the Biorefinery*

Success of biomass conversion industries depends in part on their ability to produce fuels, power, and products from cellulosic biomass at costs that are competitive with non-renewable fossil fuels. Thus, the performance of biomass conversion facilities depends on a reliable and affordable year-round feedstock supply. Delivering the large volumes of feedstocks required for a commercial-scale biorefinery or power generation facility in a timely manner is costly due to the low bulk density of biomass and the large spatial distributions of biomass sources. Transporting and storing bulky, low-density material poses significant labor and infrastructure requirements. This is compounded with the challenges of seasonality, protecting soil quality, and preserving or even enhancing biomass conversion quality that can further increase the delivered costs of bioenergy feedstocks. This presentation will highlight the models and data sets developed at Oak Ridge National Laboratory and Idaho National Laboratory to estimate delivered feedstock costs. The entire feedstock supply chain from the field to the biorefinery will be considered. Critical findings of feedstock cost analyses that identify parameters in which advances in technology and logistics system designs can reduce feedstock costs while minimizing environmental impacts and preserving feedstock quality will also be presented.

Bios: Erin G. Wilkerson earned her B.S. in Agricultural Engineering from the University of Tennessee and her M.S. and Ph.D. from the University of Kentucky and the University of Florida, respectively. Her work focuses on bridging the gap between biomass resource assessment and biomass supply logistics. Erin recently completed an 8-month assignment at the U.S. Department of Energy Office of the Biomass Program in Washington, D.C. She is currently chair of the Energy Committee of the American Society of Agricultural and Biological Engineers. Erin is a research staff member of the Environmental Sciences Division of the Oak Ridge National Laboratory. She is a licensed professional agricultural engineer.

Christopher T. Wright earned his Ph.D., M.S., and B.S. in Mechanical Engineering from the University of Utah. His research has focused on applied fluid dynamics, thermal hydraulics, and two–phase flow. Chris has applied his expertise in fluid dynamics and solid mechanics to investigate flow separation processes in agricultural machinery and biomechanical properties of agricultural residues. Chris has authored or co–authored papers covering topics ranging from nuclear reactors to bioenergy in the areas of flow visualization techniques, computational fluid dynamics simulations, and biomechanical properties of agricultural crops. Dr. Wright is a Research Engineer in the Renewable Energy and Power Department at Idaho National Laboratory.

WULLSCHLEGER, STAN

Bio: Stan D. Wullschleger is a Distinguished R&D Staff Scientist and Leader for the Plant Systems Biology Group in the Environmental Sciences Division, Oak Ridge National Laboratory. His educational training is in tree biology and crop physiology. Stan has worked collaboratively to identify and model mechanisms by which trees, forests and ecosystems respond to global change. His research interests focus on stomatal physiology in trees, methods for estimating forest water use, the response of plants and ecosystems to drought, elevated CO2 concentration, and temperature, and understanding the genetic controls on carbon sequestration in plants and soils. He also more than 15 years experience in working with model bioenergy crops, including hybrid poplar and switchgrass. Stan has published extensively in the areas of plant physiology and global change biology, with over 100 research articles written to date. He currently serves as Manager for the Biological and Environmental Sciences Directorate (BESD) Laboratory Directed Research and Development (LDRD) Program where he manages the research portfolio in systems biology and the environment.

YU, GUI-RUI

Abstract: *Study on Carbon flux/storage in Terrestrial Ecosystems in China and its Impact Mechanism Based on Network Observation*

Carbon cycle in terrestrial ecosystem is the key process driving ecosystem change, and provides foundation for supporting ecosystem service. Global change has profound influence on ecosystem carbon cycle, and the latter will feedback to global change. Therefore, study on ecosystem carbon cycle is not only the frontier of ecological research at home and abroad, but also the demand of increasing terrestrial carbon sink, confronting global climate change, and reducing/restricting GHG emission as well. Funded by the Knowledge Innovation Program of the Chinese Academy of Sciences (CAS) (Study on Carbon Budget in Terrestrial and Marginal Sea Ecosystems of China),and the National Basic Research and Development Project (Carbon Cycle and Its Driving Mechanism in Chinese Terrestrial Ecosystems), the Chinese Terrestrial Ecosystem Flux Research Network (ChinaFLUX) was established in 2001. Up to now, ChinaFLUX includes 4 forest sites, 3 grassland sites, 1 cropland site with more than 60 site-years, and these eddy covariance sites present various climate and geographic types.

Relied on ChinaFLUX, we have conducted eddy covariance flux observation, and transect investigation on the carbon storage in soil and vegetation in China. Significant progresses have been made on the methodology and technique of eddy covariance flux measurement, on the responses of CO_2 and H_2O exchange between the terrestrial ecosystem and the atmosphere to environmental change, on the spatial pattern of carbon storage in soil and vegetation, and on flux modeling development. Results showed that the major forests on the North-South Transect of Eastern China (NSTEC) were all carbon sinks during 2003 to 2005, and the alpine meadows on the Tibet Plateau were also small carbon sinks. However, the reserved natural grassland, *Leymus chinensis* steppe in Inner Mongolia, was a carbon source. On a regional scale, temperature and precipitation are the primary climatic factors that determined the carbon balance in major terrestrial ecosystems in China. Moreover, synthesis analysis indicated responses of GPP and ET to meteorological factors differed at the different forest types, which led to the coupling and decoupling between GPP and ET.

As a national research network, ChinaFLUX has promoted the development of flux research in China. By combining flux network and terrestrial transect, ChinaFLUX will develop integrated research with multi-scale, multi-process, multi-subject observations, placing emphasis on the mechanism and coupling relationships between water, carbon and nitrogen cycles in terrestrial ecosystems. A new National Basic Research Development Project will be launched at the next year, which aims to frontier fields of scientific research, and seek important scientific breakthrough based on previous research bases and large national scientific platform. This project will make effective uses of research sites from ChinaFLUX, and conduct comprehensive observations of carbon - nitrogen - water fluxes, multi-factors controlling experiments, and coupling model of carbon - nitrogen - water.

Finally, several critical scientific issues will be addressed based on this project:
1) interannual variability of carbon, nitrogen and water fluxes in typical ecosystems and stoichiometric balance;
2) coupling mechanism of carbon, nitrogen and water cycles and environmental regulations;
3) development of integrated ecosystem model of carbon - nitrogen- water using multi-scale and source data;
4) spatio-temporal patterns of carbon sink and source in China and East Asian and regional responses to climate change.

Bio: Gui-Rui Yu is deputy director and professor of the Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS) in Beijing. He formerly served as an associate professor and assistant professor in both the Faculty of Horticulture at Chiba University in Japan, where he got his Ph.D. in environmental planning, and in the Department of Agronomy at Shenyang Agriculture University. His research interests are ecosystem management and observation of carbon and water fluxes in terrestrial ecosystem. He has published more than 100 international publications in plant eco-physiology, ecosystem management, and eddy covariance measurement.

YU, HAN-QING

Abstract: *Direct Electricity Recovery from Unpretreated* Canna indica *by an Air-cathode Microbial Fuel Cell Inoculated with Rumen Microorganisms* (with Guo-Long Zang and **Guo-Ping Sheng**)
Aquatic plants are widely used for phytoremediation. The effective disposal methods should be pursued for energy recovery and to avoid further environmental pollution problems. This study demonstrates that, using an air-cathode microbial fuel cell (MFC) inoculated with rumen microorganisms, electricity could be directly produced from canna indica, a lignocellulosic aquatic plant rich in cellulose, hemicellulose and lignin, without pre-treatment. The MFC produced a maximum power density of 360 mW/m2. The mechanisms of the canna indica degradation in the MFC were elucidated using X-ray photoelectron spectroscopy and X-ray diffraction techniques. It is observed that lignin is partially removed and more cellulose becomes exposed on the sample surface during the electricity generation in the MFC. Canna indica degradation in the MFC could be divided into three phases, and the electron transfer in this MFC is mainly completed through electron shuttling via self-produced mediators. This work provides a promising way for the utilization of lignocellulosic materials like aquatic plants for energy generation.

Bio: Han-Qing Yu is a professor of environmental engineering in the Department of Chemistry at the University of Science and Technology of China. He holds a Ph.D. in environmental engineering from Tongji University in Shanghai. Formerly, he served as a research assistant professor at the Centre for Environment, Engineering Res. at Hong Kong University. He was a Marie Curie postdoctoral fellow at the University of Newcastle in Tyne, U.K. Yu’s research interests are physicochemical and biological wastewater treatment, specifically microbial conversion of wastes for energy generation. He has more than 150 publications on wastewater treatment in leading international journals, including *Environmental Science & Technology*, *Water Research*, and *Biotechnology and Bioengineering*.
Guo-Ping Sheng is an associate professor in the Department of Chemistry at the University of Science and Technology of China, where he obtained his B.S in applied chemistry and Ph.D. in environmental engineering. He formerly served as a research associate at the University of Hong Kong and as a visiting scholar at Tohuku University. Sheng’s research interests are wastewater treatment, specifically the reuse of wastewater and the microbial fuel cell. He has published more than 30 articles in the field of environmental engineering and wastewater reuse in international journals, including *Environmental Science & Technology, Water Research*; *Biotechnology and Bioengineering*.

ZHANG, XI-LIANG

Abstract: *Technologies and Policies for the Transition to a Sustainable Energy System in China*
This paper introduces China’s energy dilemma in her modernization process. It explores the technological and policy options for the transition to a sustainable energy system in China. China has already taken intensive efforts to promote research, development, demonstration and commercialization of sustainable energy technologies over the past five year. The policy actions cover binding energy conservation and environmental pollution control targets, economic incentives for sustainable energy, and public R&D supports. In order to achieve the sustainable

energy system transformation eventually, however, China needs to take further actions such as strengthening R&D of radically innovative sustainable energy technologies and systems such as poly-generation, enhancing the domestic manufacturing capacity of sustainable energy technologies and systems, creating stronger economic incentives for research, development, demonstration and commercialization of sustainable energy technologies, and playing a leading role in international technology collaborations.

Bio: Dr. Zhang received his Ph.D. of Engineering at Tsinghua University in 1997. He is currently a full professor of energy systems analysis and executive director of Institute of Energy, Environment and Economy, Tsinghua University. Since April 2008 Prof. Zhang was also appointed as executive director of China Automotive Energy Research Center, Tsinghua University. Prof. Zhang has conducted research on sustainable energy technology innovation and diffusion, markets, policies, and futures for China. Prof. Zhang served as the chief scientist of the expert group for drafting the experts' version of China Renewable Energy Law during 2004 -2005, and the energy expert of the expert group for drafting China Circular Economy Law in 2007, both work were organized by Environmental Protection and Resource Conservation Committee of National People's Congress. Prof. Zhang is currently coordinating a research on integrated assessment of China's strategic energy technology pathways and policies for mitigating CO2 emission from an international perspective, which is a part of the National Global Environment Research Programme during the 11th Five-Year-Plan period (2006-2010). Prof. Zhang is also leading a five-year research program titled China Automotive Energy Outlook: technologies and policies. The research program is organized jointly by National Energy Administration and Ministry of Industry and Information Technology. Prof. Zhang was a lead author for Energy Supply of the *4th IPCC Assessment Report*, and shares Nobel Prize for the work on IPCC. He is an associate editor of *Energy for Sustainable Development*, and a member of editorial board of *Climate Policy*, *International Journal of Sustainable Engineering*, and *Frontiers of Energy and Power Engineering in China*. He is currently a co-guest editor of the Special Issue on China Renewable Energy of Energy Policy. Dr. Zhang has been the secretary general of the New Energy Committee of China Energy Research Society since January 2006.

ZHANG, YING

Abstract: *Selective Biomass Pyrolysis and Catalytic Bio-oil Upgrading*
Different catalysts were introduced to the biomass fast pyrolysis system. Concentrated products, such as furfural, levoglucosenone(LGO) and phenols, were obtained selectively. Except for organic chemicals, activated carbon could be produced simultaneously.

The crude bio-oil was upgraded in supercritical ethanol under hydrogen atmosphere by using multifunctional catalysts. This is a novel way to upgrade bio-oil with the combination of hydrotreating, esterification and cracking under supercritical conditions. The results indicated that the upgrading process performed effectively and the properties of upgraded bio-oil were improved significantly. After the upgrading process, trace amount of tar or coke, if there is any, was produced and most of the organic components were kept in the upgraded bio-oil. No phase separation was observed. The amount of aldehydes and ketones decreased evidently. Especially, aldehydes almost disappeared. Most of acids were converted into corresponding esters, and at same time many new kinds of esters were produced. The result of TGA and DTA indicated that macromolecular compounds were decomposed and much more volatile compounds were produced after the upgrading process. The pH value and heating value of upgraded bio-oil increased; meanwhile the kinematical viscosity and density of upgraded bio-oil decreased compared to those of crude bio-oil. Experimental results also confirmed that it is an effective way for hydrocracking pyrolysis lignin and producing high quality liquid fuel.

Bio: Ying Zhang is an associate professor in the Department of Chemistry at the University of Science and Technology in China. She holds a Ph.D. in chemical engineering from the University of Connecticut and an M.S. in biochemical engineering from the Chinese Academy of Sciences. Zhang's research interests include selective biomass pyrolysis and hydrothermal conversion, catalytic bio-oil upgrading, and novel catalyst development.

ZHAO, FU

Abstract: *Aspen Plus Process Simulation of Flexible Feedstock Thermochemical Ethanol Production* (with Nannan Kou)—Current US transportation sector mainly relies on liquid hydrocarbon derived from petroleum oil and about 60% of the petroleum oil consumed is from areas where supply may be disturbed by regional instability. This has led to serious concerns on global warming and energy security. To address these issues, numerous alternative energy carriers have been proposed. Among them, second generation biofuel is one of the most promising technologies. However, it may be worth to point out that the current technology development has been mainly efficiency (both economic and ecological) driven and the changes of the resources availability and other conditions could disturb the transportation fuel system based on these technologies away from its optimal state or even cause the collapse of the entire system. Resilience, which describes the capacity of an ecological system to maintain or recover basic functions relative to large or unforeseen changing conditions, damages or perturbations has been suggested as a way resolving problems with regard to unpredictability of complex systems, such as biofuel system. Gasification based thermo-chemical conversion can utilize a wide range of biomass wastes and residues and bring flexibility to both feedstock and production sides of a plant, thus presents an attractive technical route. In this paper, a flexible feedstock thermo-chemical ethanol production process is investigated. This research focuses mainly on the evaluation of the feasibility of the process through numerical simulation. An existing thermo-chemical ethanol production model developed by NREL has been updated to handle the cases when different biomass feedstock and feedstock combinations are used. It is found that the ethanol yield is positively proportional to the feedstock feeding rate, while the total conversion efficiency is negatively proportional to the feeding rate. To demonstrate a feedstock management strategy, a plant located near a major city with a population of 200,000 and above is considered and MSW, corn stover and wood chips are selected as potential feedstock. Simulation results indicate that with wood chips as the backup feedstock the plant can be operated under extreme conditions when corn stover availability is significantly reduced without major equipment modification. Based on simulation results, how the thermo-chemical ethanol production process address the four major metrics of resilience i.e. diversity, efficiency, adaptability and cohesion is discussed.

Bio: Dr. Zhao is an Assistant Professor in the School of Mechanical Engineering and the Division of Environmental and Ecological Engineering at Purdue University, and the director of the Sustainable Product Engineering Research and Education (SPERE) Laboratory. He received his BS (1993) and MS (1996) degree, both in Thermal Engineering, from Tsinghua University, China. From 1996 to 1999, he worked as a research engineer in the State Key Laboratory of Clean Coal Technology of China on in-furnace desulfurization during coal combustion and gasification of low quality coal and biomass for electricity generation. He received his second MS degree in Electrical Engineering-Systems (2001) and his PhD in Mechanical Engineering (2005) from the University of Michigan. Dr. Zhao's research lies in the intersection of mechanical engineering and environmental engineering with current focus on the gasification of heterogeneous biomass wastes and residues for sustainable liquid fuel production, environmental life cycle assessment of industrial processes including emerging biofuel production and renewable energy technologies, and sustainable product realization. He is member of ASME, ACS, and AEESP, and is currently leading the Life Cycle Engineering technical committee of the ASME's Manufacturing Engineering Division.

ZHAO, XIN-QUAN

Abstract: *Carbon Flux Associated with Management and Disturbance of Alpine Meadow on Tibetan Plateau* (Xin-Quan Zhao, Liang Zhao, Yin-Nian Li, Shi-Xiao Xu, and Hua-Kun Zhou)
Significant and potential degradation is increasing on the alpine meadow of the Tibetan Plateau. There is some acknowledgment that overgrazing by livestock has contributed to this degradation, but there is also a strong belief by local people that plateau pikas make a significant contribution to the problem. In the worst degradation stages the *Kobresia* turf cover is completely removed and open humic silt (black beach) is prone to deflation. A comprehensive plan for the ecological protection and construction of the Sanjiangyuan (The Headwaters of the Three Rivers) National Nature Reserve will invest about 7.5 billion Yuan (US$924.79 million) for this purpose by state. Fencing has been introduced to the plateau to help manage grazing pressure under situation of light pasture degradation. However, for worst degradation pasture, rehabilitation was necessary that permanent species (eg *Elymus nutans*, *Elymus sibircus*) or permanent +annual species (Oat) were used. However, while this may be an effective measure to improve winter fodder supply, is not applicable for the whole pastoral system, which is based on free range management. Reseeding indigenous grasses on fenced 'black beach' sites yielded a hay meadow with seven times higher productivity than open pastures. If grass seeds are artificially added, the ratio of palatable herbage above-ground productivity is much higher compared with fenced pastures without additional reseeding.

Carbon flux and carbon concentrations were measured by eddy-fluxes under different vegetations which included alpine meadow, degraded alpine meadow and permanent artificial pasture. NEE at these three sets ranged from -78 to -192 g C m-2yr-1 for undegraded alpine meadow, 25.4 and -49.4 g C m-2yr-1 for degraded and permanent species artificial pasture respectively. Disturbances such as over grazing caused pasture degradation are major factors controlling NEE on Sanjiangyuan region. NEE of this site appear to be net source on an annual basis. Managements, such as regenerating degraded pasture by planted permanent and permanent+annual species artificial pasture, which was carbon sink for atmosphere CO_2. Artificial pasture also could maintain more soil water content and harvest for hay production. Permanent and permanent+annual species artificial pasture have highest above-ground productivity but not for NEE. Under-ground biomass takes very important rule of net ecosystem carbon concentration. The results indicate that ecological protection, fodder and livestock production both will be benefited by human managements.

Bio: Xin-Quan Zhao is a senior research scientist of the Northwest Institute of Plateau Biology, Chinese Academy of Sciences in Xining, Qinghai, and holds a Ph.D. in animal nutrition from the Danish Institute of Animal Science and Northwest Plateau Institute of Biology, The Chinese Academy of Sciences. His research interests include climate change and pastoral land-use (different stocking rates) effects on ecosystem-mediated feedbacks to climate on the Tibetan plateau, sustainable production system of alpine meadow, and feed-lotting lambs on pastoral areas of the Tibetan plateau.

ZHOU, CHENG-HU

Bio: Chenhu Zhou is deputy director and professor of the Institute of Geographic Sciences and Natural Resource Research at the Chinese Academy of Sciences. He also is the director of State Key Lab of Resource and Environment Information Systems, the director of the Professional Committee of Hydrology of the Geographical Society of China and adjunct professor of Nanjing University, Shandong University of Science and Technology, and The Chinese University of Hong Kong. Zhou holds a Ph.D. from CAS in geography. His research interests are spatial data mining, geo-computation, application of remote sensing, and geographic information systems. Zhou has published more than 70 scientific papers in domestic and foreign publications and compiled about 10 memoirs and atlases.

ZHOU, SHENG

Abstract: *Carbon Market and CDM in China*

The presentation will first discuss the current status of Carbon Market and CDM in China, which includes the market share in the world, the potential of GHG emission reduction before 2012, and the gap between current status and the expected carbon market. Then the presentation will explore the reasons resulting in the gap, which will focus on the uncertainty of the CDM project development and the transaction cost on different type of CDM project. Finally, some disputation issues will be discussed, such as the additionality of CDM project, the eligibility criteria, the operable feasibility and the sustainable development. Some suggestions will be put forward to for the CDM rules improvement in the future.

Bio: Sheng Zhou is an associate professor at the Institute of Energy Environment and Economy at Tsinghua University in Beijing, where he earned a Ph.D. He also serves as an associate professor at the China Automotive Energy Research Center at Tsinghua University. Zhou's research interests are energy models and energy policy, climate change, and the carbon market. He has published more than ten articles in the fields of energy model and policy, climate change, and carbon market journals, such as *Renewable Energy*, *Environment Protection*, and *China Population Resource and Environment*.

ZHUANG, JIE – Workshop Coordinator

Bio: Dr. Jie (Joe) Zhuang is a research director for the Institute for a Secure and Sustainable Environment (ISSE) and a research associate professor in the Department of Biosystems Engineering and Soil Science at the University of Tennessee. He is also the coordinator of the China-U.S. Joint Research Center for Ecosystem and Environmental Change. Over the past two decades, Dr. Zhuang has worked on many challenging scientific research projects in the United States, Japan, and China. His research is focused on the fate and transport of contaminants (viruses, radionuclides, colloids, and munitions constituents) in the environment; soil carbon management; soil hydrology; and carbon-water-nitrogen fluxes of terrestrial ecosystems. He has published more than 40 research papers on high-profile international journals. Dr. Zhuang was a research fellow of Japan Society for Promotion of Science from 1998 to 2000. Currently, he is an editorial board member for three international journals, *Ecotoxicology*, *Environmental Management*, and *Pedosphere*. Dr. Zhuang also contributes a significant amount of his time to the China-U.S. Initiative launched by the University of Tennessee/Oak Ridge National Laboratory's Joint Institute of Biological Science and ISSE, with the aim of promoting U.S.-China collaborations in the areas of global environmental change, bioenergy sustainability, and international education.