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"Energy, Ecosystem, and Environmental Change"

ABSTRACTS AND BIOS OF PRESENTERS

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CATALOG

Keynote Addresses

Advances on the Carbon Cycle Research of China's Terrestrial Ecosystems

Li Sheng-Gong

Abstract: Process mechanisms of carbon storage and carbon cycle in earth system are the scientific foundation for analyzing the cause of climate change, forecasting the trend, and making mitigation and adaptation countermeasures, which have attracted great attention from the scientific community and international community. Since the late 1980s, Chinese scientists have carried out a great deal of research on the terrestrial ecosystem carbon cycle, and have made great progress in many fields. We review the history of the research on the terrestrial carbon cycle in China, summarize the results of the carbon storage in terrestrial ecosystems and its spatial patterns, evaluate the uncertainties of the research, and put forward important scientific issues which are needed to be addressed urgently. Most studies indicate that carbon storage of terrestrial ecosystems in China and its spatial pattern are controlled by temperature and precipitation. About 97.95–118.93 Pg carbon is stored in soil, forest and grassland in China. However, large uncertainty exists among the evaluation results with various methods. In the future we should focus on the integrated monitoring system of the dynamics of carbon storage and carbon sink, foresight studies on the coupling cycles of ecosystem C-N-H_2O and its regional regulation and control, quantitative assessment on the carbon budget and the potential of carbon sink of ecosystems in China, the evaluation of the economic benefit of various technologies for increasing carbon sink of typical ecosystems, and the measurable, reportable and verifiable scientific data and technical supports for establishing the policy framework of greenhouse gas management and carbon trading at national scale.

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*.

Funneling Photons: Two Parts Nature & One Part Material Science

Barry D. Bruce

Biochemistry, Cellular and Molecular Biology, Chemical and Biomolecular Engineering, & Microbiology Departments, SEERC-Sustainable Energy and Education Research Center, The University of Tennessee at Knoxville, TN 37996, USA

Abstract: Nature has developed remarkable means for harvesting solar energy to drive the process of photosynthesis. In part the remarkably high quantum efficiency associated with photosynthesis, has been enabled by the successful "division of labor" associated with this process. Specifically, in nature, organisms have evolved separate biomolecular structures that have become specialized to either capture photons and facilitate rapid energy transfer via exciton coupling of pigments or in a separate structure, known as a reaction center, to convert this photon/exciton into a charge separation. Both of these processes function with a quantum yield approaching unity. Through natural diversity the light harvesting process has adapted to capture a wide range of the visible solar energy. Although both the pigments and organization of these light-harvesting complexes demonstrate considerable diversity, the charge separation process is fundamentally conserved in reaction centers. Drawing on the remarkable efficiency, stability, and renewability of these biological complexes, we have begun to directly exploit their properties to 1) act as luminescent solar concentrators, 2) function as biophotovoltaic devices and 3) serve as a light driven catalyst for hydrogen production. I will report on the design and fabrication of these bio-hydrid devices. In addition, I will discuss future designs to further enhance their EQE towards the goal of a truly sustainable and environmentally benign new strategy for bioenergy production. This work has been supported by grants from the NSF Nanoscience Interdisciplinary Research Team Program, NSF IGERT, NSF Program in Sustainable Science., the Gibson Family Foundation, and UTK SEERC.

Bio: Dr. Barry D. Bruce is Professor in the Department of Biochemistry, Cellular and Molecular Biology. He is also an Adjunct Professor of Microbiology and Chemical and Biomolecular Engineering. He is a Founding Member and the Associate Director of the Sustainable Energy and Education Research Center (SEERC). Dr. Bruce has B.A.s in both chemistry and biology from the University of California at Santa Cruz and holds a MS in Biochemistry/Biophysics from the University of Massachusetts at Amherst. In 1990, he received his Ph.D. in Molecular Plant Biology from the University of California at Berkeley and joined the UT Knoxville faculty in 1994 after completing a National Science Foundation post-doctoral Fellowship in Plant Biology at the University of Wisconsin at Madison.

Professor Bruce's laboratory works on two aspects related to photosynthesis: 1) one group investigates how proteins are targeted and transported to chloroplasts in plant cells. This work is not only fundamental to how plants grow and perform essential processes such as photosynthesis, but has also led to discoveries that enable scientists to engineer plants with higher nutritional content and to grow edible vaccines to help fight the spread of disease. A second group in Dr. Bruce's lab is developing new methods to apply the process of photosynthesis towards new energy sources such as hydrogen and electricity. This work attracted the attention of Forbes Magazine which recently recognized Dr. Bruce's as one of the "Ten Revolutionaries that May Change the World." A prolific researcher, Dr. Bruce has produced a large and important body of work contributing to both of these research fields. His work has been reported in *The Plant Cell, Trends in Cell Biology, Plant Physiology, EMBO Reports, Molecular Biology of the Cell, J.*

Biological Chemistry, Nano Letters and *Biochemistry.*

Dr. Bruce teaches undergraduate and graduate courses in topics including Plant Physiology, Advanced Cell Biology, and Advanced Protein Chemistry and has been recognized several times for educational mentoring and outreach. Bruce's research is supported by grants from the National Science Foundation, USDA and DOE. He is currently the PI of a prestigious $1.7 million NIRT (Nanoscience Interdisciplinary Research Team) award from NSF to lead a team of researchers who are trying to harness the power of photosynthesis to generate electricity from solid-state solar panels. In 2008, he was a co-PI of a $3.1 million IGERT Award from NSF develop a graduate program in Sustainable Technology through Advanced Interdisciplinary Research (STAIR).

Dr. Bruce's work has been recognized on campus with awards and honors, as well as at the national and international levels. The Faculty Senate Research Council & Office of Research has twice awarded him the Scholarly Activity and Research Incentive Funds Award, and he won the Science Alliance Research Excellence Award three times. Bruce has been invited to give many national and international presentations. In 2007 he was invited to be one of the EMBO/FEBS Lecturers on The Molecular and Cellular Biology of Membranes held in Corsica, France.

Session 1: Microbial Ecology and Technology

Theme: Bioenergy Science and Technology

Hydrogen production from phenol a two-step biological process

Yu Han-Qing

Abstract: In this work, phenol was biologically converted to H_2 by combining anaerobic acidogenic bacteria and photosynthetic bacteria. The first step in this process was the conversion of phenol to benzoate by mixed anaerobic cultures, then benzoate was further fermented to H_2 by *Rhodopseudomonas palustris* in the second step. A high phenol concentration (800 mg/l) and addition of inhibitor were favorable for the benzoate accumulation. The phenol degradation and the benzoate formation in the anaerobic acidogenic reactor could be simulated by a mathematical model. The modified Gompertz model appeared to be useful for evaluating the ability of H_2 production from benzoate by *Rhodopseudomonas palustris*. The results show that the effluent from the acidogenic reactor for converting phenol into benzoate could be directly used as a sole carbon source for H_2 production by *Rhodopseudomonas palustris*. The maximum H_2 production rate was estimated to be 0.545 ml/h. The H_2 yield and light conversion efficiency were 0.58 and 2.08%, respectively. All these results suggest that aromatic compounds like phenol could be fermented to H_2 by such a two-step biological process.

Bio: Dr. Han-Qing Yu, Professor of Environmental Engineering, University of Science and Technology of China (USTC), Hefei, Anhui, China. hqyu@ustc.edu.cn

Research Area—Environmental Engineering

Novel Cellulolytic Microorganisms from Terrestrial Geothermal Springs

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Abstract: Terrestrial hot springs are known to support the growth of a wide range of thermophilic bacterial and archaeal species. Thermal features located within the Mud Volcano area of Yellowstone National Park, USA, were chosen for an in-depth compositional analysis of anaerobic, cellulolytic microbial communities. Novel isolates from several different bacterial genera including *Caldicellulosiruptor*, *Dictyoglomus*, and *Thermoanaerobacter* were recovered from enrichments on biomass substrates using a high-throughput single-cell isolation technique. A new species of *Caldicellulosirptor,* designated *C. obsidiansis,* displayed rapid growth on a wide range of polymeric carbohydrates at 80^{o}C and was chosen for further characterization. The complete genome sequence revealed several large open reading frames encoding multifunctional enzymes with glycoside hydrolase family 5, 9, 10, and 48 catalytic domains. Co-cultures with hydrogenotrophic bacteria were also established to evaluate cooperative growth on crystalline cellulose and xylan. Further characterization of these organisms will provide insights into their potential use in bioenergy production and other biotechnological applications.

Bio: James Elkins received his undergraduate degree from Montana State University in Microbiology and a M.Sc. working with microbial biofilms at the Center for Biofilm Engineering. He completed his Ph.D. in Microbiology at the Univ. of Regensburg, Germany, studying hyperthermophilic Archaea. He was a microbiologist at Diversa (Verenium) Corporation in San Diego, CA where he was involved in the discovery and cultivation of novel microorganisms as part of the Microbial Biodiversity group. He is currently a staff microbiologist at Oak Ridge National Laboratory in the Biosciences Division and is focused on the discovery and characterization of novel extremophiles for a variety of different applications.

Switchgrass Biotechnology and Modifications for Improved Bioenergy Feedstocks

David Mann
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Abstract: Switchgrass (Panicum virgatum L.) is a leading candidate feedstock for biofuels in the U.S. and is a crucial feedstock component of the BioEnergy Science Center (BESC). Improvements in biotechnology of switchgrass are important for screening potential cell wall biosynthesis genes, and genetic transformation of switchgrass is being performed by five laboratories in three institutions within BESC. Within our lab, goals and milestones have included improving tissue culture and transformation systems, isolating novel switchgrass

promoters, developing a new versatile vector set for monocot transformation, and altering lignin and cellulose biosynthesis within switchgrass. Additionally, switchgrass cell suspension cultures have been produced and characterized for mutant selection, mass propagation, and gene transfer experiments via protoplast isolation for cell wall trait assessment. In order to coordinate gene expression within the BESC switchgrass transformation labs and to facilitate more rapid screening of genes, we have developed a Gateway-compatible transformation vector set (termed "pANIC") for overexpression and RNAi-mediated knockdown for use in switchgrass and other monocot species. Overall, BESC has facilitated the coordination of scientific expertise and research in switchgrass biotechnology that would have been otherwise impossible by one investigator with funding under a traditional grant.

Bio: Dr. David Mann received his Ph.D. in Microbiology from the University of Tennessee in 2008 under the supervision of Gary Sayler. His work specialized in the development of novel methods for monitoring real-time single cell expression using RNAi-mediated silencing and nanotechnological approaches. His post-doctoral training occurred at the University of Tennessee Institute of Agriculture (UTIA) where he was involved in the advancement of biotechnological tools for switchgrass transformation. Currently, Dr. Mann is continuing this work as a research scientist in Neal Stewart's laboratory and has managed the bioenergy group within the lab as a part of the U.S. Department of Energy funded BioEnergy Science Center, which mainly focuses on developing improved systems for switchgrass tissue culture and transformation. The ultimate goal of this research is to produce next generation bioenergy feedstocks with enhanced properties including higher biomass yields and reduced recalcitrance for the biorefinery process.

Microbial communities assessed using a clone library analysis in a sulfide-fed microbial fuel cell

Tong Zhong-Hua
Abstract: Electricity generation can be coupled with sulfide oxidation in a microbial fuel cell (MFC). Various microbial communities have been shown to be involved in the process of sulfide oxidation. It is essential to elucidate the microbial communities and their roles in the process of sulfide conversion and electricity generation. In this work, an MFC was constructed to enrich a microbial consortium, which could harvest electricity from sulfide oxidation. Electrochemical analysis demonstrated that microbial catalysis was involved in electricity output. The anode-attached and planktonic communities could perform catalysis independently, and synergistic interactions occurred when the two communities worked together. The microbial community compositions were analyzed by 16S rRNA gene based clone library. The anode-attached and planktonic communities shared similar richness and diversity, while the LIBSHUFF analysis showed that the two community structures were significantly different. The exoelectrogenic bacteria were found both on the anode and in the solution. The sulfur-oxidizing bacteria were present in greater abundance on the anode than in the solution, while the sulfate-reducing bacteria preferably lived in the solution.

Bio: Zhong-Hua Tong obtained her PhD in soil and environmental science from Purdue University. After graduation, she joined the University of Science and Technology of China as an assistant professor in 2009. Her research is focused on the microbial processes in wastewater treatment and environmental toxicology.

Theme: Belowground Ecological Processes

Microbial Mediation of Carbon Cycle Feedbacks to Climate Warming

Zhou Jizhong
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Abstract: Understanding the mechanisms of biospheric feedbacks to climate change is critical to project future climate warming. Although microorganisms catalyze most of biosphere processes related to fluxes of greenhouse gases, little is known on the microbial role in regulating future climate change. Here, we show at least three lines of evidence, from integrated metagenomics analysis of soil from a long-term experimental warming site in the US Great Plains, for microbial mediation of carbon cycle feedback to climate warming. First, long-term experimental warming induced a decline in temperature sensitivity of heterotrophic soil respiration by 14.5% in comparison to that in control, largely attributable to functional adjustment in soil microbial communities. Second, warming significantly stimulated functional genes for labile carbon decomposition but did not affect genes for recalcitrant carbon decomposition although both labile and recalcitrant carbon input to soil increased under warming. Such differential impacts on microbial functional groups may promote long term stability of ecosystem carbon storage. Third, warming stimulated functional genes for nutrient cycling, possibly favoring plant growth and vegetation carbon uptake. Our results indicate that microorganisms critically regulated ecosystem carbon cycle feedback to climate warming, with important implications for the carbon-climate modeling.

Bio: Dr. Jizhong Zhou is a Presidential Professor in the Department of Botany and Microbiology and Director of the Institute for Environmental Genomics, University of Oklahoma, Norman, OK, an Adjunct Senior Scientist at Lawrence Berkeley National Laboratory, and Adjunct Professor at Tsinghua University, Beijing, China. Dr. Zhou received a B.S. in Plant Pathology and Entomology in 1981 and an M.S. in Insect Mathematical Ecology in 1984 from Hunan Agricultural University, China. He received a Ph.D. in Molecular Genetics and Cell Biology in 1993 from Washington State University. Before he came to the U.S. in 1989, he studied theoretical ecology and ecosystem modeling for three years at the Eco-Environmental Research Center, Chinese Academy of Sciences, Beijing, China. He worked at the Center for Microbial Ecology, Michigan State University, from 1993 to 1995 as a Postdoctoral Research Associate. Before moving to OU in 2005, he worked at Oak Ridge National Laboratory as a Staff Scientist, Senior Staff Scientist, and then Distinguished Staff Scientist for 10 years. His expertise is in molecular biology, microbial genomics, microbial ecology, molecular evolution, theoretical ecology, metagenomics, and genomic technologies, as well as array-based bioinformatics. He has pioneered the development of array-based genomic technologies for environmental studies. He has authored more than 250 publications, with H-index of 42, on microbial genomics, genomic technologies, molecular biology, molecular evolution, microbial ecology, bioremediation, bioenergy, global change, bioinformatics, systems biology, and theoretical ecology. One of his papers, published in 1996, is among the 20 most cited papers in the history of *Applied and Environmental Microbiology*.

Dr. Zhou has received numerous awards and honors, including a Presidential Early Career Award for Scientists and Engineers from the President of the United States in 2001, an Environmental Sciences Division Distinguished Scientific Achievement Award in 2001, a Federal Laboratory Consortium Award for Excellence in Technology Transfer in 2005, an R&D 100 Award in 2009, as well as an Alexander Hollaender Distinguished Postdoctoral Fellowship. He has been named an Overseas Changjiang Scholar by the Chinese Ministry of Education, an Outstanding Overseas Young Scientist by the Chinese National Science Foundation, an Outstanding Asian American in 2009, and Qianren (One Thousand Talent Program) Scholar in 2010. He has held guest professorships in several other top Chinese institutions and universities. In 2009, he was specially invited by the Chinese Government to attend the 60th Anniversary Ceremony as a member of the Overseas Delegation, which was received by the Chinese President, Premier, and other top leaders. He is an Editor for *Applied and Environmental Microbiology* and mBio, a new ASM integrative journal. He has served as a member of the Editorial Boards of two leading microbial ecology journals, *The ISME Journal* and *Environmental Microbiology*. He is an US Ambassador to the International Society of Microbial Ecology. He has chaired three International Conferences on Microbial Genomes and has served on numerous grant, fellowship, and award review panels for the Department of Energy, the National Science Foundation, the National Institutes of Health, the American Society for Microbiology, and the American Academy of Microbiology. He is a Fellow of the American Academy of Microbiology and a Fellow of the American Association for the Advancement of Science.

Soil Nitrogen Transformation: Agricultural and Environmental Significance

Zhang Xu-Dong
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Abstract: The transformation of carbon and nitrogen in soil is primarily a biological process, which is influenced and/or controlled by extraneous substrates. Hence, it is very important to understand whether and how the substrates are utilized and then immobilized by soil microorganisms during biological metabolism. As important constitutes of microbial cell wall, amino sugars are not only the storage pool for the immobilized carbon and nitrogen but also reliable microbial residue biomarkers of different populations due to their heterogeneous origins (fungi and bacteria). Among the identified amino sugars, muramic acid exclusively originates from bacteria, being a component of the peptidoglycan in bacterial cell wall. Glucosamine in soil is mainly in the form of chitin in fungal cell walls. Because amino sugars in soil mainly

contain dead microbial residues, theoretically they can reflect the changes in community structure of microorganisms. A better understanding of the production, stabilization, and turnover of amino sugars can be achieved by differentiating the newly synthesized microbial residues from the soil native portions. In this presentation, we will introduce a recently developed isotope-based gas chromatography-mass spectrometry method and some measured results. Our data show that the method offers a new opportunity to study the transformation dynamics of the 'new' and 'old' soil microbial residues.

Effects of temperature, glucose and inorganic nitrogen inputs on carbon and net nitrogen mineralization in a Tibetan alpine meadow soil

Song Ming-Hua
Abstract: High levels of available nitrogen (N) and carbon (C) have the potential to increase soil N and C mineralization. In nutrient-limited alpine meadow, nitrogen (N) mineralization is prioritized to soil microbial immobilization. Thus an increase in mineral N supply would be most likely immobilized by soil microbes due to nutrient shortage in alpine soil. In addition, low temperature in alpine meadow might be one of the primary factors limiting soil organic matter decomposition and therefore, C and N mineralization. We hypothesized that (i) with an external labile C or N supply alpine meadow soil will have a significantly higher C and N mineralization potential, and that temperature sensitivity of C mineralization will increase; (ii) net N mineralization is negatively correlated with CO_2 efflux for non-amended soil due to strong microbial immobilization, and the external labile N or C supply will shift the negative correlation to positive. To test the hypotheses an incubation experiment was conducted with two doses of N ($(NH_4)_2SO_4$) or C (glucose) supply at temperature of 5, 15 and 25 °C. Results showed external N supply had no significant effect on CO_2 emission. However, external C supply increased CO_2 emissions. Relationship between cumulative CO_2-C and additive C doses was linear at the three temperatures. Temperature coefficient (Q_{10}) ranged from 1.13 to 1.29. Significantly higher values were measured with C than with N addition and control treatment. Temperature dependence of C mineralization was well-represented by exponential functions. Under the control, CO_2 efflux rate was 425 g CO_2–C m^{-2} $year^{-1}$, comparable to the in situ measurement of 422 g CO_2–C m^{-2} $year^{-1}$. Our results also detected a negative correlation between CO_2 efflux and net N mineralization in non-amended soil. External N supply did not change the negative correlation. The external labile C supply shifted the linear correlation from negative to positive under low C addition dose. However, under high C dose no correlation was found. We demonstrated if N is disregarded, microbial decomposition is primarily limited by lack of labile C. The correlation of CO_2 respiration to net N mineralization strongly depend on soil labile C and C:N regardless of temperatures. It is predicted that labile C supply would further increase CO_2 efflux from the alpine meadow soil.

Bio: Song Minghua is a associate professor who comes from Institute of Geographic Sciences and Natural Resource Research, Chinese Academy of Sciences. She focuses on ecological processes of grassland, particularly on the interaction between plants and soil microbes and their resources, ranging from plant adaptation to low resource availability, to how plants influence soils and subsequently ecosystem function and biodiversity. Over the past six years her work has concentrated on the interaction among plants, as well as the influence that plants have on their nutrient environment. She visited University of British Columbia in Canada in 2009 as a visiting professor. Until now more than 30 papers have been published.

The effect of biochar on the paddy soil in Southern China

Wang Jing-Yuan
Abstract: To study the effect of biochar input paddy soil, biochar was added to cultivated field of Qianyanzhou ecological station, Southern China. We used 30 plots (3m×3m), in which we fertilized three plot replicates per treatment with control, biochar, straw, inorganic fertilizer, biochar plus inorganic fertilizer and biochar plus straw. The Biochar and straw were used as two levels ($3000kg\cdot ha^{-1}\cdot a^{-1}$and $6000kg\cdot ha^{-1}\cdot a^{-1}$). After one growing season, soil carbon increased in the plot with straw and Biochar, and pH of soil increased slightly with Biochar and straw. The plot with biochar plus inorganic fertilizer got highest yield. The yield of plot with Biochar was higher than that of control plot. Overall, our result shows that Biochar can enhance the soil carbon content; Biochar can also decrease the use of inorganic fertilizer.
Bio: Dr. Wang is an assistant researcher of Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences (CAS). He received his Ph.D. in biology from Wuhan University in 2006. He also served as postdoctoral scientist during 2006-2008 at Institute of botany, CAS. He has published several articles in the field of ecology.

Response of soil organic carbon to soil core transferring experiment from high- to low-elevation forest along natural altitudinal transect of old temperate volcanic forest soils

Zhang Xinyu
Abstract: Understanding soil carbon fractions and their responses to the global warming is important for improving soil carbon management of natural altitudinal forest ecosystem. In this study, the contents of soil total organic carbon (SOC), soil labile organic carbon (LOC), and microbial biomass carbon (MBC) in soil upper layers (0-20 cm) were measured along a natural altitudinal transect in the north slope of Changbai Mountain. Furthermore, the responses of soil organic carbon and $\delta^{13}C$ values to soil warming were conducted by relocating intact soil cores from high- to low-elevation forests for one year along a natural altitudinal transect in the northern slope of Changbai Mountain. As expected, the soil-core relocation caused significant increase in soil temperature but made no significant effect on soil moisture. The results showed that under natural conditions the contents of SOC and LOC were largest in *Betula ermanii* forest (altitude 1 996 m), moderate in Spruce-fir forest (altitude 1,350 m), and smallest in Korean pine mixed broad leaf tree forest (altitude 740 m). MBC contents in different forest ecosystems decreased in the order of *Betula ermanii* forest, Korean pine mixed broad leaf tree forest, and Spruce-fir forest. After one year incubation, soil relocation significantly decreased SOC contents, and $\delta^{13}C$ values whereas the contents of LOC, MBC, and the ratios of LOC to

SOC and MBC to SOC increased. Pearson correlation analysis demonstrates that SOC content was negatively related to soil temperature but positively related to soil moisture. After one-year simulated warming experiment, the $\delta^{13}C$ values in bulk soils were reduced by 0.45 ‰. Furthermore, a decrease of $\delta^{13}C$ values in the size fractions <63 μm was larger than in the size fractions 63-1000 μm. The results suggest that the older soil organic carbon associated with the fine particle size fraction may be significantly affected by climate warming.

Bio: Zhang Xinyu recieved her bachelor's degree, master's degree and PhD in soil science from the Shenyang Agricultural University and the Exeter University. She finished her two year post-doctorate research in State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. She works for Chinese Ecosystem Research Network (CERN) in the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences since 2006. Her scientific work involves global environmental change and soil carbon dynamics, water chemistry with special focus on land use change and its environmental effects on typical terrestrial ecosystems of China. She has published more than 25 papers in soil carbon, soil quality and water quality studies.
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Session 2: Ecosystem Cycles of Carbon and Nitrogen

Theme: Natural Ecosystem Processes

Mechanisms controlling soil organic matter dynamics in a forest under elevated CO_2

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Abstract: Much debate exists concerning the impact of elevated CO_2 driven increases in net primary productivity on soil organic carbon accrual. Recent studies have demonstrated that indeed surface forest soils (less than 5 cm) do exhibit C accrual in some forests under elevated CO_2. In contrast, findings also demonstrate that CO_2-driven increases in forest NPP may in fact promote microbial priming and result in a loss of soil in surface soils. We performed a molecular stable isotope study on the soils from a ten year old Aspen plantation in a free air CO_2 enrichment (FACE) experiment which has been interpreted as undergoing priming and loss of surface carbon to ascertain the mechanisms controlling soil organic matter dynamics in this system. Insights into the dynamics of biogeochemical cycling in the soil and litter were made through the structural and isotopic characterization of constituent plant-derived biopolymeric components derived from lignin, cutin, and suberin. Because the FACE system uses isotopically depleted CO_2 we could combine compound-specific isotope analysis (CSIA)

and molecular quantitation to track the cycling of specific molecular components derived from above and below ground input. We discuss these results in the context of the relative role of increased plant productivity and soil and litter invertebrates in controlling the distribution and chemistry of SOM.

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 CO2), 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.
Evolutionary Toxicology

Effects of climate change and plantation on carbon budget of coniferous forests in Poyang Lake Basin from 1981 to 2008

Wang Shao-Qiang
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Abstract: Forest is an important component in the research of carbon (C) cycles in which the processes are influenced by enrichment of atmospheric CO_2 concentration, higher air temperature and nitrogen (N) deposition in the context of global climate change. Because the area of subtropical plantations is larger than 50% of total planted forests in China, it is very important to calculate C sequestration potential in China's subtropical plantations. Meanwhile, the serious N deposition in southern China can also affect the forest C sequestration capacity. To analyze C-N-water cycles of coniferous plantations in Southern China will help us realize the affecting factors and limitation conditions of forest growth and C sequestration. This study makes use of a validated process-based model PnET-CN to simulate the coupling of water, C and N cycling and to analyze carbon budget of coniferous plantation in Poyang Lake Basin

($16.5 \times 10^4 km^2$) in southern China in responses to climate changes and land use changes.

This study indicates that the average annual NPP of coniferous forests is 611.6±160.4 $gCm^{-2}a^{-1}$ in Poyang Lake Basin (Jiangxi Province) from 1981 to 2008. Simulated annual NEP of coniferous forests is 309±89g gC $m^{-2}a^{-1}$, which is higher in northern Jiangxi Province indicating a stronger C sink compared to southern Jiangxi Province. The mean rate of mineralization, nitrification and nitrate leaching of needleleaf forests in Poyang Lake Basin is 6.3 ± 2g $m^{-2}a^{-1}$, 0.04 ± 0.01g $m^{-2}a^{-1}$ and 1 ± 0.2mg $m^{-2}a^{-1}$, respectively. Annual evapotranspiration is 846 ± 200mm, of which the maximum 1035 mm, 464 mm minimum. The spatial pattern of photosynthetic rate of coniferous forest ecosystem is significant different from evapotranspiration in Poyang Lake Basin. The area with the highest photosynthetic rate (1135-1237gC $m^{-2}a^{-1}$) also has the highest evapotranspiration rate (900mm a^{-1}). In conclusion, both annual NPP and NEP are significantly affected by annual temperature, while neither of annual NPP and NEP is significantly affected by precipitation, indicating that annual variation of temperature is a main factor determining C budget in Poyang Lake basin. Based on simulation, NEP increases with plantation areas, indicating that coniferous forests ecosystem played a C sink role in Poyang Lake Basin from 1981-2008.

Bio: Shaoqiang Wang is the director of the department of scientific planning and strategy, Institute of Geographic Sciences and Natural Resources Research. He obtained his Ph.D. in Geography and GIS in Chinaese Academy of Sciences in 2000. Shaoqiang's research fields focus on ecosystem ecology, terrestrial ecosystem carbon cycle and ecological modeling. He has authored more than 20 research papers in international journals such as *Global Change Biology*, *Global Geochemical Cycles* and *Tellus*.

Nitrogen cycling and ammonia oxidation microorganisms in terrestrial ecosystems as revealed by bio-molecular techniques

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Abstract: Metagenomic and cultivation studies have revealed the existence of ammonia-oxidizing archaeon (AOA) containing all three ammonia monooxygenase subunits (*amoA*, *amoB* and *amoC*). AOA were found dominating in *amoA* gene copy numbers over AOB in 12 European soils. We recently investigated the abundance and community structure of AOA in acidic and alkaline upland agricultural soils, nitrogen (N)-rich grassland soils and paddy soils, and found their different characteristics in different soils. There were higher copy numbers of AOA *amoA* gene than bacterial *amoA* gene in the acidic red soils with pH ranging from 3.7 to 6.0. There was a significant positive relationship between the AOA *amoA* gene copy numbers and the potential nitrification rates (PNR) in these acidic soils. The alkaline soils (pH 8.3 - 8.7) under different fertilization treatments showed no significant changes in archaeal *amoA* gene copy numbers and the AOA compositions, although the archaeal *amoA* gene copy numbers were significantly higher than those of AOB. There were significant positive correlation

between the bacterial *amoA* gene copy numbers and PNR, but no correlation between the archaeal *amoA* gene copy numbers and PNR. In the N-rich grassland soils, although AOA are present in large numbers in these soils, neither their abundance nor their activity increased with the application of an ammonia substrate, suggesting that their abundance was not related to the rate of nitrification. These results suggest that AOA are the numerically dominant ammonia oxidizers over AOB in most soils. They may actively involve in the nitrification of acidic soils, but not in the alkaline soils and N-rich neutral soils.

Bio: Ji-Zheng He is Professor of Soil Ecology in Research Centre for Eco-environmental Sciences, Chinese Academy of Sciences. He earned his PhD degree (Soil Chemistry) from Huazhong Agricultural University in 1992 and subsequently joined the University as a lecturer of soil environmental science. He was promoted to associate professor in 1994 and professor of Soil Science in 1997. Dr. He moved to Australia and joined Australian School of Environmental Science, Griffith University to study molecular microbiology in 2001 and received his PhD (Molecular Ecology) in 2004. He joined Research Centre of Eco-environmental Sciences, Chinese Academy of Sciences at Beijing in 2005 as Professor supported by Hundred-Talent Program of Chinese Academy of Sciences. Dr. He's research interests focus on the soil microbial ecology and biogeochemical cycles of carbon (C) and nitrogen (N) in soil ecosystems. His research employs advanced bio-molecular approaches and cutting-edge technology and attempts to understand the distribution and diversity of microbial communities in soils, the processes and mechanisms of microbes-mediated C and N cycles in soil ecosystems, and the formation and reactions of biogenic soil minerals. Dr. He has published more than 200 peer reviewed papers. He is editor/ editorial board member of Journal of Soils & Sediments and FEMS Microbiology Ecology.

Controls on the speed of spring: challenges for terrestrial carbon cycle models

Fu Yuling
Key Laboratory of Ecosystem Network Observation and Modelling, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences

Abstract: Warmer air temperatures are hypothesized to cause an earlier onset of photosynthetic activity in northern hemisphere ecosystems in spring (Menzel and Fabian, 1999; Cayan et al., 2001). However, little attention has been paid to the issue of how fast the growing season will proceed once it has started and what control this recovery speed. The underlying physiological mechanism determining the recovery rate of plant community photosynthesis in northern ecosystems are also not well understood (Tanja et al., 2003; Ensminger *et al*., 2004; Slot *et al*., 2005; Ensminger *et al*., 2008).

In our study, we evaluated the spring recovery rate of plant community photosynthesis capacity at canopy level across different ecosystems and biomes, and analyzed its relationship with meteorological variables. This study is based on a global collection of eddy covariance CO_2 flux observations—the FLUXNET LaThuile Database. We analyzed the

eddy-covariance-based GPP data measured at 65 sites located in temperate and boreal zones in northern hemisphere. We found that:

- Air temperature is the dominant factor that controls the spring recovery (both the timing and the recovery rate) of canopy photosynthesis in northern ecosystems.
- However, it is the increasing rate, rather than the absolute value, of daily mean air temperature (other than minimum, maximum air temperature or soil temperature) that determines the peak recovery rate of canopy photosynthetic capacity.
- The gross ecosystem productivity in late-half year affects the peak recovery rate of canopy photosynthetic capacity in the following spring, presumably through the influence of substrate supply for metabolism to support new shoot and leaf growth.
- Deciduous broad leaf forests and grasslands are more sensitive to temperature change in spring than evergreen needle leaf forests, probably due to the differences in the life history strategy between deciduous and evergreen leaves.

These findings suggest new requirements for climate models and point to new processes that should be represented in terrestrial carbon cycle models to improve future predictions of land carbon sinks and sources.

Bio: Yuling Fu is an associated professor at Institute of Geographical Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS). Dr. Fu received her B.S. from Peking University in China, where she majored in Environmental Sciences. Her interest in research had been stimulated during her graduate study at IGSNRR, CAS, where she received her PhD degree in 2006. Her research interest includes eddy covariance flux measurements, carbon and water cycles in grassland ecosystem and responses of ecosystem carbon flux to environmental changes. Recently, she has been focusing on the interaction between phenology change and terrestrial ecosystem carbon cycle.

Precipitation-use efficiency along a 4500-km grassland transect

Hu Zhongmin
Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

Abstract: With the data obtained through field surveys and long-term in situ observations, we investigated the spatiotemporal variations in precipitation use efficiency (PUE) along China Grassland Transect (CGT), a climate-related grassland transect covering the main temperate and alpine grassland types in China. Both aboveground net primary productivity and PUE generally decreased with the decreasing mean annual precipitation except a slight rise of PUE at the driest end of the transect. The maximum PUE showed none spatial gradient along the transect and varied greatly across sites, challenging the idea of a convergent maximum PUE proposed by previous reports. Vegetation cover, a factor regulating the fraction of precipitation for plant growth, was significantly correlated with the spatial variations in PUE, which probably is the main cause for the positive relationship between PUE and MAP. But leaf area index had no obvious impact on spatial PUE. At the site scale, there was no significant relationship between

annual precipitation or vegetation cover and PUE, implying distinct mechanisms controlling PUE at site scale and regional scale.
Based on results of this study and previous reports, we proposed a conceptual model describing the relationship between MAP and net primary productivity at regional or global scale with a logistic form function, which illustrated an increasing PUE with MAP in the arid regions, and it might be an improvement of the popular Miami model.

Bio: Hu Zhongmin is an assistant professor in Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (CAS). His research focuses on ecosystem carbon cycles and water cycles and their interaction in Chinese grasslands under the background of global climate change. Dr. Hu has published several peer-reviewed papers in reputable journals, e.g., Global Change Biology, Global Ecology and Biogeography, Agriculture and Forest Meteorology etc.

Effects of Cloudiness change on Net Ecosystem Exchange, Light Use Efficiency, and Water Use Efficiency in Typical Ecosystems of China

Zhang Mi
Abstract: As a weather element, clouds can affect CO_2 exchange between terrestrial ecosystems and the atmosphere by altering environmental conditions, such as solar radiation received on the ground surface, temperature and moisture. Based on the flux data measured at five typical ecosystems of China during June to August from 2003 to 2006, we analyzed the responses of net ecosystem exchange of carbon dioxide (NEE), light use efficiency (LUE, defined as NEE/ Photosynthetically active radiation (PAR)), and water use efficiency (WUE, defined as NEE/Evapotranspiration (ET)) to the changes in cloudiness. The five ecological sites included Changbaishan temperate mixed forest (CBS), Dinghushan subtropical evergreen broad-leaved forest (DHS), Xishuangbanna tropical rainforest (XSBN), Inner Mongolia semi-arid *L. chinensis* steppe (NMG), and Haibei alpine frigid *Potentilla fruticosa* shrub (HB). Our analyses show that cloudy sky conditions with cloud index (k_t) values ranging between 0.4 and 0.6 increased NEE, LUE, and WUE of the ecosystems at CBS, DHS, NMG and HB from June to August. The LUE of tropical rainforest at XSBN was higher under cloudy than under clear sky conditions, but NEE and WUE did not increase significantly from June to August. These different responses are attributable to the differences in canopy characteristic, light and water conditions of the five ecosystems. From June to August, the peaks of the k_t frequency distribution in temperate ecosystems (e.g., CBS, NMG, and HB) were larger than 0.5, while they were smaller than 0.4 in subtropical/tropical forest ecosystems (e.g., DHS and XSBN). These results suggest that the pattern of cloudiness during 2003 to 2006 in the five ecosystems was not the best condition for their net carbon uptake. This study highlights the importance of cloudiness factor in the prediction of net carbon absorption and water cycle in the Asia monsoon region under climate change.

Bio: I am PhD candidate of the Institute of Geographic Science and Natural Resource Research, Chinese Academy of Science, Beijing China. I received my B.A. in water and soil conservation from Northwest Agriculture and Forest University, Yangling, China in 2002 and my M.S. in Ecology from the Institute of Applied Ecology, Chinese Academy of Science, Shenyang, China in 2006. Currently, my research focuses on multi-temporal scales analysis of control of environmental and biotic factors of forest ecosystems carbon budget. I have published more than 5 articles in carbon cycle in such journals as Biogeosciences, Chinese Journal of Applied Ecology, Journal of Plant Ecology.

WUE and NUE trends and impacts of dominant species in the typical broadleaf forest ecosystems along NSTEC

Wenping Sheng

Abstract: Global change impacts on ecosystem key processes, such as water cycleing, carbon cycleing, and nitrogen cycleing, have been paid more attentions than ever before. The North-South transect of Eastern China (NSTEC), including almost all the main forest types in China, is an ideal testing field to investigate the process of water, carbon and nitrogen cycling of forests which are influenced by Asian monsoon. Foliage δ^{13}C and C/N of dominant species in broadleaf forests were analyzed, in order to investigate the water use efficiency (WUE) and nitrogen use efficiency (NUE) geographical distribution patterns and their relationship with environment factors along NSTEC. This study drew several conclusions: (1) the content of foliage organ C and N was in the range of 40.56 % to 50.55% and 1.59 % to 3.53%, respectively. The foliage δ^{13}C varied between -33.46‰ and -27.01‰; (2) WUE took a para-curve pattern from north to south, and its maximum appeared in the warm-temperate deciduous broadleaved forest in the middle part of NSTEC, while NUE showed a negative relationship with latitude form south to north; (3) stepwise regression analysis suggested that MAP was an independent contributing factor for WUE, while MAT was an independent contributing factor for NUE, nitrogen deposition and soil nutrient situation also had effects on vegetation NUE; (4) there was trade-off relationship between vegetation WUE and NUE, which was a balanced strategy of vegetation in resource utilization, and VPD played a key factor in the water and nitrogen using strategy.

Bio:Wenping Sheng, female, born in 1981, pH.D. Candidate supervised by Prof. Guirui Yu in Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, major in ecology ecosystem management, research interests in global change and its impacts to terrestrial ecosystem.

Assessment of Nitrate concentration in Groundwater on Typical Terrestrial Ecosystem of Chinese Ecosystem Research Network (CREN) during 2004-2009

XU Zhi-wei

Abstract: Nitrate pollution in groundwater has become a worldwide problem. In this paper, the

temporal and spatial variation of groundwater nitrate on Chinese Ecosystem Research Network(CREN) and its influencing factors were analyzed using the monitoring data of TN and nitrate-N in 31 ecosystems from 2004-2009. The results showed that: the mean concentration of nitrate-N varied as agro-ecosystem >oasis ecosystem>urban ecosystem > grass ecosystem > forest ecosystem. The average nitrate-N concentration of groundwater in Cele, Linze, Akesu, Ansai, Yucheng and Yanting stations were 4.18 mg L^{-1},10.8 mg L^{-1},4.82 mg L^{-1},30.74 mg L^{-1},2.73 mg L^{-1},7.04 mg L^{-1} respectively, and the highest values were 13.59 mg L^{-1},18.5 mg L^{-1},13.60 mg L^{-1},92.66 mg L^{-1},41.07 mg L^{-1},13.83 mg L^{-1}respectively. The average and highest nitrate-N concentration values were 8.05 mg L^{-1} and 22.65mg L^{-1} in urban ecosystem. According to the drinking water standard of nitrate-N provided by the World Health Organization(WHO), the nitrate-N concentration of all these stations exceeded 10 mg L^{-1} with different frequency, which the highest exceeding frequency of 84.6 % in Ansai station and 16.1%,50%,10%,7%,23.8% respectively in the Cele, Linze, Akesu, Yucheng and Yanting stations. The highest nitrate-N concentration of urban ecosystem groundwater was 22.65 mg L^{-1}, with exceeding frequency by 31.25%. The lowest value was in the forest ecosystem, which range from 0.02 mg L^{-1} to 1.04 mg L^{-1}. The phenomenon of nitrate-N pollution of groundwater mainly occurred in the agro-,oasis-and urban ecosystems. The nitrate-N in groundwater of desert and urban ecosystems was major nitrogen species, which accounted to more than 74% and 88 % total nitrogen respectively. Agro-, desert-, and grassland ecosystems had obvious spatial variation trends, with the higher values in the North China Plain, Northwest oasis and desert area, the lower values in southern agricultural area and the lowest values in northeast agricultural area. There were no obvious spatial variation trends in forest ecosystem. The groundwater nitrate-N concentration of agriculture-and urban ecosystem had obvious temporal variation. Generally, groundwater nitrate-N concentration came to the highest value in summer and winter, but no significantly temporal variation was found in the forest ecosystem.

Bio:Zhiwei Xu received her bachelor's degree from the Northeast Normal University, where she majored in Geographical Science from 2005-2009. Now she majors in wetland science for her master's degree in the same university. She is a visiting graduate student in the Institute of Geographic Sciences and Natural Resources Research, CAS. Her major research interest is wetland science and environmental geochemistry.

Theme: Managed Ecosystem Processes

Carbon Preservation in Subtropical Paddy Ecosystems

Wu Jinshui
Abstract: Carbon (C) preservation in subtropical paddy ecosystems was studied in 4 selected landscape units as representatives for the lowland (LL), low-hill (LH), high-hill (HH) and karst-mountain (KM) areas in subtropical China. The mean values for organic C content in paddy soils (0-20cm) in the landscape unit varied from 16.0 to 27.7 g kg^{-1}, which were remarkably larger than those for soils under arable cropping and orchard, and even under woodland except in the KM landscape unit. In the LH landscape unit, the mean organic C content in paddy soils increased by 1.67 times ($P<0.01$) in the period of 1979-2003. This increase was concordant with

the prolonged increase (since 1950s) in rice productivity in the region. It is concluded that paddy ecosystems in subtropical China had the ability to sequester organic C in amounts larger than those in other ecosystems. As these landscape units represent the real situations for paddy ecosystems under farmers' practices for rice production, data from this study confirm that the trend of continuing organic C sequestration in paddy soils occurred in subtropical China.

Bio: Professor, Key Laboratory of Agro-ecological Processes in Subtropical Regions, Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, China, E-mail jswu@isa.ac.cn

Low carbon city development in China: Challenges and Potentiality

Ouyang Zhiyun, Wang Xiaoke
Abstract: City is the biggest carbon source in the world, accounting for more than 70% of global carbon emission from fossil fuel combustion. In China, carbon dioxide emission per capita has reached 3.59 t/yr, about 7 times the emission per capita in rural areas. The carbon emissions from energy and household consumption were assessed as an example. So development of low carbon city will be one of the important paths to reduction of national carbon emission. In recent years, low carbon city have been recognized by China's people, governments and enterprises, and developed by alterations of energy structure, industrial structure and consumption behavior. Many cities, such as Shanghai, Beijing and Shenzhen have make proposals for developing low carbon city. The Shanghai Chengming eco-city and Sino-Singapore Tianjin eco-city have planned to develop low carbon technology for zero carbon emission. There are challenges China faces for low carbon city developments, such as lack of low carbon technology, financial supports, and governmental stimulations. Sciences and technologies supporting for low carbon should be prioritized. The technology of low carbon city planning, construction and managements should develop in priority.

Bio: Professor, State Key Lab of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085

Mitigation of N2O emission from upland soil by applying modified N fertilizer

Xu Hui
Abstract: Nitrous oxide (N_2O) fluxes from a maize field were monitored throughout the cultivation periods in Shenyang, northeast of China. The experimental field was divided into test plots and the effects of applying commercially available fertilizer additives containing inhibitors for urease and nitrification on N_2O flux and maize yield were examined. Nitrous oxide fluxes from the urea plots without additives showed significant increases after basal and topdress applications in both the years. The fertilizer induced emission factor for N_2O was calculated to be the range between 0.34% and 0.73%. In the cases of applying fertilizer additives, N_2O fluxes remained much lower than the cases without the additives. Addition of an additive containing a nitrification inhibitor, DCD, reduced the seasonal N_2O emission rates by

54% on average. While, application of another additive containing both nitrification inhibitor and urease inhibitor reduced by 44%. The application of additives resulted in no significant difference in the crop yields. This indicated that single application of urea together with the additives did not decrease the maize yield compared with the case of urea with split applications. The result suggests that application of tested fertilizer additives is a feasible option to mitigate N_2O emission from upland crop fields in northeast of China.
In addition, the plant *per se* was found to be an important source of N_2O. The δ value of $^{15/14}N_2O$ emitted from soybean was observed from -4‰ to 34‰ in the growing season. While the δ $^{15}N_2O$ emitted from soil was from -30‰ to -6‰. The significant difference between δ $^{15}N_2O$ from plant and soil indicated the different sources of the N_2O.

Bio: XU Hui is the Deputy director of Key Laboratory of Terrestrial Ecological Process, Chinese Academy of Sciences. He is mainly engaged in the research field of environmental microbiology and microbial ecology, emissions of greenhouse gases (N_2O and CH_4) from agro-ecosystems and the mitigation techniques.

He was the principle investigator of several projects financially supported by National Natural Science Foundation of China, such as "The bidirectional interrelation between microbial processes of CH_4 and N_2O emission/consumption in soils" and "The interrelation between N_2O and CH_4 emissions from forest ecosystem and its mechanism. He is the principle investigator of a key Project in the National Science & Technology Pillar Program "Study and demonstration on techniques for increasing carbon sequestration and decreasing nitrous oxide emission from upland soils".

In recent years, he is also engaged in the projects cooperated with pharmaceutical industry, such as “The novel microbial strains for Vitamin C fermentation with a higher efficiency” and “Asymmetric bio-transformation of fosfomycin”.

Assessment of the damage caused by the 2008 ice storm on subtropical forest in Jiangxi, China

Wang Hui-Min
Abstract: In early 2008, an unexpected ice storm hit the southern China, caused heavy damage to forest ecosystems, especially in subtropical region, such as in Jiangxi and Hunan provinces. The objective of this study is to evaluate the damage of subtropical forest resulted from the severe ice storm and to analyze the effect of terrain factors on the damage with remote sensing data in Jiangxi Province. Results indicated that the ice storm caused EVI abruptly decreased from 0.28 to 0.23. The damages of forest obviously affected by topography condition with the largest EVI losses occurred at higher elevations and deeper slope. The EVI loss was the least on the south slopes and gradually intensified to the southwest, northeast, northwest and north slopes. But the difference on EVI reduction between south and north slope showed a decreasing trend with the increasing elevation from 9 m to 1000 m, and tend to zero when elevations higher than 1000m. We found that the reduction on EVI by the ice storm is quite similar for mixed coniferous forest (0.037) and native hardwood forests (0.039), but is the highest for the pure coniferous forests (0.045). This result suggests that the artificial pure coniferous forests are

most vulnerable to the ice storm disturbance.

Bio: Dr. Huimin Wang is a professor and the leader of Qianyanzhou Ecological Station, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences. He achieved his Ph.D. from Toyama University (2000), Japan. Dr Wang's research interests are mainly on the carbon cycling of subtropical forest ecosystem at natural and disturbed (management and natural disaster) states.

Assessing the long-term environmental risk of trace elements in cropland soils

Chen Wei-Ping
Abstract: Trace elements such as As and Cd may be introduced into cropland soils by various anthropogenic activities. Accumulation of these potential toxic elements in the cropland soils is of great concern as they may be transferred via the food chain to consumers of the crop harvests. A generalized trace element mass balance model was developed to evaluate the long-term fate and transport of trace elements in cropland soils. Monte Carlo simulations were employed to assess the uncertainty associated with model predictions and sensitivity analyses were carried out to identify the key factors that affect the fate and transport of trace elements in the cropland soils. The model provides a basis for evaluating trace element accumulations in agricultural soils and plant transfer. Using California cropland as an example, we demonstrated that normal cropping practices do not have a significant effect on the total As content of the receiving soils, but over time Cd can accumulate in soil and therefore increases the risk of its transfer through the food chain. The simulation outcomes indicated that some of the existing fertilizer regulations are not strict enough to prevent significant accumulation of Cd in cropland soils. Sensitivity analyses show the solid-solution partitioning coefficient, and the plant uptake factors are primary factors that affect the fate and transport of As and Cd in cropland soils. The uncertainty associated with assessing the fate of trace elements in cropland soils is due to the high variability of model parameters.

Bio: Dr. Weiping Chen graduated from University of California, Riverside and was employed as a professor of Research Center for Eco-Environmental Sciences since 2009 through the 100 Talents Program of the Chinese Academy of Sciences. His researches mainly focus on evaluating the fates and transport of typical environmental pollutants in the soil-water-plant system and environmental risks associated with water reuse, soil trace element accumulation etc. Dr. Chen published more than 20 scientific papers in recent years and 2 book chapters. Dr. Chen developed three environmental models, STEM single layer and profile distribution model, and ENVIRON-GRO model. As a main author, Dr. Chen completed a technical bulletin on "Safe Application of Reclaimed Water Reuse in the Southwestern United States". The main research interests of Dr. Chen's group are to study the contamination mechanisms of main pollutant and their impacts on urban ecology system, and to develop dynamic prediction systems for urban water pollution and soil pollution and corresponding management practices to improve the regional environmental quality.

Nutrient Cycling Dynamics in Perennial Bioenergy Crops

Jennifer Burks, Jeffrey Volenec, and Sylvie Brouder
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Abstract: Partitioning of C and N within perennial bioenergy crop tissues throughout the growing season impacts yield and survival. Our objective was to quantify seasonal N accumulation and partitioning among organs of *Miscanthus* x. *giganteus*, switchgrass (*Panicum virgatum)*, and a big bluestem (*Andropogon gerardii*)-dominated prairie. *Miscanthus* and switchgrass plots received 56 kg ha^{-1} yr^{-1} of N while the prairie plots were unfertilized. Plants were sampled six times during the growing season and once in December. Plants were divided into roots, rhizomes, stem bases, and above-ground herbage, and were analyzed for yield and composition. In 2009 yield of the 2-yr-old *Miscanthus* stand in August (16.03 t ha^{-1}) was greater than that of the 3-yr-old switchgrass stand (8.96 t ha^{-1}) and the 28-yr-old prairie stand (3.47 t ha^{-1}). While *Miscanthus* produced the most above-ground growth, it produced the least amount of total below-ground tissue in August, yielding 2.93 kg m^{-3} compared to the prairie (9.6 kg m^{-3}) and the switchgrass (6.8 kg m^{-3}). These below-ground tissues of switchgrass and *Miscanthus* had similar sugar (128 & 127 mg g^{-1} dry wt.) and starch (335 & 320 mg g^{-1} dry wt.) concentrations. Below-ground prairie tissues contained 123 mg g^{-1} dry wt. sugar, but had low starch concentrations (185 mg g^{-1} dry wt.). Data from 2010 will be reported. Quantities and above-/below-ground allocation patterns of total C, starches, and sugars suggest a comparative advantage for *Miscanthus* as a bioenergy crop. However, more research is needed to understand spatio-temporal production aspects including stand-age and soil fertility.

Bio: Jennifer Burks is a 3rd year PhD student at Purdue University and is a member of the ESE (Ecological Sciences and Engineering) Program. She is housed in the department of Agronomy and works with Drs. Jeffrey Volenec and Sylvie Brouder on assessing seasonal nutrient cycling within perennial bioenergy crops, specifically *Miscanthus* x. *giganteus*, switchgrass (*Panicum virgatum)*, and big bluestem (*Andropogon gerardii*)-dominated prairie. Jennifer received her B.A. in Biology from Earlham College in 2008.

A study on the mechanism of mitigating methane and ingredient benefits of no-tillage in rice-duck complex system

Huang Huang
Abstract: Based on the mutualistic symbiosis relationship of rice and duck, jointed with no-tillage technique, the new no-tillage system of raising duck in paddyfield was formed. In order to provide the scientific and theoretic foundation for ecological assessment and popularization of the system, some experiments of methane emission, physical and chemical characteristic of soil, soil microbe, soil enzyme and rice growth characteristic were studied. The results were as follows:
1. The methane emission characteristic of no-tillage rice-duck complex system.

1.1 The methane emission dynamics of no-tillage rice-duck complex system
1.1.1 The daily variation dynamics of methane emission: the daily methane emission which reaches a climax in daytime was almost consistent with the change of air temperature. In the morning, the air temperature was lower so that the methane emission was lower. With the increase of the air temperature, the methane emission also increased gradually. At about 12:00～14：00, the emission reached a climax, and then declined. Till the dawn, it was the lowest. The dissolved oxygen in NCD(No-tillage Cast-transplanted with Duck treatment)system has increase greatly, compared with the NCND（No-tillage Cast-transplanted without Duck treatment ）and the CCND（Conventional-tillage Cast-transplanted without Duck treatment）, it increased 38.4%～44.7%, which was helpful to the methane oxidation.
1.1.2 The seasonal variation dynamics of methane emission: In wetlands system, during the late rice growth period, the emission was lower at early tillering stage. At fully tillering stage, it reached its summit, since then, with the rice growth, it reduced. After booting stage , the methane emission keeped lower.
The difference among the NCD, NCND and CCND was obvious, but it was not between the NCND and CCND. the average methane emission trend was: NCD＜NCND＜CCND. After raising ducks, at fully tillering stage, the methane emission from the NCD and the NCND was 23.6mg/m^2·h and 30.5mg/m^2·h respectively, which shows that raising ducks reduces 22.5% of total methane emission in the treatment of no-tillage-based paddyfield. After fully tillering stage, the difference between them declines gradually. The results showed that raising ducks in paddyfield mainly reduced the methane emission at fully tillering stage, which was usually the climax period of the emission.
1.2 Total methane emission from no-tillage-based rice-duck complex system during the rice whole growth period: the effect of raising ducks on methane emission climax period from paddy field was most obvious. Compared with the CCND and the NCND, the emission from per-square meter of the NCD reduced 4.723g and 2.333g respectively, with the reduced ratio of 40.5% and 25.2% respectively. The methane emission from the CCND during late rice whole growth period was higher than that one from the CCND and NCD.
1.3 The effect of soil redox characteristic on methane emission from no-tillage-based rice-duck complex system:
1.3.1 Soil redox characteristic of no-tillage-based rice-duck complex system: the redox potential of the NCD was higher than that of the NCND, but there was no law between the redox potential of the NCD and that of the CCND. The total reduction of the CCND was 4.11～12.34 and 3.26～7.02 as times as that of the NCND and the NCD respectively. The Fe^{2+} content of the CCND was obviously more than that of the NCD and the NCND. The reductive degree of the CCND was stronger than that of the NCD and the NCND.
1.3.2 The relationship between soil redox characteristic and methane emission in no-tillage-based rice-duck complex system: in no-tillage-based rice-duck complex system, there was obvious negative correlation between the redox potential and total reducer, active reducer, Fe^{2+}. There was also unobvious negative correlation between the redox potential and methane emission (correlative coefficient=-0.5232).
2 Soil physical and chemical characteristic of no-tillage-based rice-duck complex system
2.1 The change of soil physical characteristic of no-tillage-based rice-duck complex system
The study shows that: after one quarter of no-tillage and raising ducks, the dust capacity among

0～5cm dust reduced $0.013g/cm^3$;campared with the CCND, the soil non-capillary porosity of the NCD increases 3.13% among 0～5cm dust, and increases 1.05% among 5～15cm dust. It can be concluded that no-tillage protect the soil structure, avail gas improvement in soil and increase the air proportion in soil.

2.2 The change of soil chemical characteristic of no-tillage rice-duck complex system

Through the chemical analysis of no-tillage-based rice-duck system, it can be found that no-tillage and raising ducks was useful to the increase of organic carbon, full nitrogen, alkaline nitrogen, but had little effect on quick-resulted phosphor and kalium.

3 The soil microbe amounts and microbe biomass of no-tillage-based rice-duck complex system

3.2 Soil microbe floristic distributions of three paddyfield systems: three kinds of microbe amounts in section has an obvious distribution trend, which was the higher has the more. Especially among 0-5cm dust, each microbe amounts of the NCD was more than the same layer of the NCND and the CCND. Although the section distribution was that the upper was higher and the nether was lower, the amount of each microbe and total amount of all kinds of microbes are both greater than those of the same layer of the NCND and the CCND. The sequence was NCD＞NCND＞CCND.

3.3 The effect of different paddyfield systems on the amount of produced methane

3.3.1 The selection of culture medium: the produced methane from culture cuvettes with carbinol and acetic natrium as medium was both greater than that of blank. The produced methane from the NCD which has carbinol and acetic natrium as medium was 42.6 and 45.3 as times as that of blank respectively, thus the acetic natrium was selected as the growth medium for methane cultivation.

3.3.2 The amount change of methane bacterium at different stage of paddyfield systems: During the early period of rice growth, the soil methane bacterium was comparatively less. With the rice growth, the methane bacterium increases greatly. Compared with early tillering stage, it was evident that the soil methane bacterium increases at fully tillering stage, reaches its summit at booting stage and reduces afterwards. In the three systems, the methane bacterium amounts during the late period of rice growth are all greater than those of early period.

In the three systems, the methane bacterium was little different before raising ducks. After raising ducks, the methane bacterium in the NCD was terrifically less than that in NCND and CCND. At booting stage, it reduced two quantity levels. During the late period, it also reduced but less obvious than at ear bearing stage. Compared with the NCND and CCND, at the early stage, the methane bacterium in the NCND was less than that in the CCND, but at heading stageand mature stage, it was more than that.

3.4 Soil microbe biomass of no-tillage-based rice-duck complex system: biomass-C declines from the upper to nether according to soil layer. In the three systems, the microbe biomass sequence was : NCD＞NCND＞CCND.

Bio: Professor, Agronomy Department of Hunan Agricultural University, People'Road, Furong District, Changsha,Hunan Province of P.R.C 410128

Theme: Greenhouse Gas Emission and Land Use

Mitigating N-induced GHGs (N_2O and CO_2) Emission by Improving N Management in Chinese Croplands

Huang Yao

Abstract: It is well recognized that improving nitrogen use efficiency (NUE) can directly reduce nitrous oxide (N_2O) emission in cropland and indirectly reduce carbon dioxide (CO_2) release from nitrogen (N) production, while such a reduction has not been well quantified in China. We estimated the greenhouse gas (N_2O and CO_2) mitigation potential (MP) from Chinese cropland and its regional distribution by quantifying NUE and determining the amount of over-applied synthetic N under various scenarios of NUE. Our results indicated that synthetic N use efficiency was 31±11% for rice, 33±13% for wheat, 31±11% for maize, 29±15% for cotton, 31±13% for rapeseed, and 39±16% for soybean cultivation in the late 1990s, respectively. The area of NUE lower than 30% accounts for ~45% of the total area of these six crops. Improving NUE to 30%–50% could cut 3.4 to 7.7 million tons of synthetic N use per year, accounting for 18%–42% of the total used. As a result of this reduction, the direct N_2O emission from croplands together with CO_2 emission from the industrial production and transport of synthetic N could be reduced by 17%–39%, equivalent to 32 to 74Tg CO_2 per year. Mitigation in the Jiangsu, Henan, Shandong, Sichuan, Hubei, Anhui, and Hebei provinces should be given priority.

Bio: Dr Huang obtained his Ph. D. degree from Rice University, USA. He is a professor in the Institute of Atmospheric Physics, Chinese Academy of Sciences, an Adjunct Professor in Nanjing Agricultural University, and an Affiliate Professor in Auburn University, USA. Since 1997, his group has been focusing on the quantification, simulation and mitigation of CH_4, CO_2 and N_2O emissions from agricultural sector, particularly from croplands. Dr Huang is author or co-author of more than 150 papers, 40% of which was published in peer-reviewed international journals. He is now the chief committeeman of the Atmospheric Environment Committee, Chinese Meteorological Society, and the Editorial Board Member of two international journals (Agricultural and Forest Meteorology; Agriculture, Ecosystems & Environment). He was a reviewer of 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Greenhouse gas emissions and pelicans: Ecological accounting in bioenergy cropping systems

Sylvie M. Brouder and J.J. Volenec
Agronomy Department, Purdue University

Abstract: From a farmer perspective, annual grain systems have numerous desirable attributes for biomass production when compared to second generation, perennial crops such as switchgrass and *Miscanthus*. Equipment and management are familiar, revenues accrue in the

first year of production and the system maximizes both potential market diversity (grain, silage, stover, biomass…) and year-to-year flexibility in land use. Likewise, from an industrial perspective, annual sources will be important to synchronize feedstock availability with capacity at conversion facilities. Yet, both species and managements of common annual systems have been designed and optimized for production of food and feed while for candidate perennial bioenergy crops the systems remain poorly characterized. Switching to a fuel-production focus requires reassessment of optimization and efficiency metrics. With energy as a predominant input in intensive management, net energy balance must be positive but such an accounting entirely overlooks major resources that currently have no energy equivalency value. The purpose of this presentation is to review the current status of resource accounting in biomass feedstocks. Certainly, known biophysical limits to nutrient (especially N), water and radiation use efficiency have and will continue to constrain primary productivity. Over the past 70+ years, yields of widely grown commodities such as maize have increased dramatically due to a combination of genetic improvement and management intensification realized against increasing atmospheric CO_2 concentrations but the extent to which these yield increases are the product of increased system efficiencies is the subject of ongoing debate. Regardless, a bioenergy context for annual crop performance requires a higher standard for all efficiencies and an unprecedented exactness in resource accounting. Concomitantly, novel valuation systems with equivalencies for multiple ecosystem services must be developed (e.g. air versus water quality) and used to guide decision makers. This presentation will focus on efficiency interactions and tensions in past/current cropping systems and discuss potential and key limitations for efficiency improvements via management and/or crop improvement.

Bio: Dr. Sylvie Brouder is a Professor of Agronomy 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; at present, she also has an administrative appointment in Purdue's College of Agriculture to promote all Agroecology programming.

Dr. Brouder's research interests include design/implementation of field and controlled environment experiments on nutrient budgets and plant-soil nutrient cycling processes and the preservation, curation and repurposing of the datasets from these experiments. 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). The overarching goal of the WQFS research portfolio is to underpin quantitative approaches or ecological accounting frameworks that can inform the development of policy to promote agricultural sustainability through valuation of the non-provisioning ecosystem services.

Soil respiration and nitrous oxide emissions after the conversion of wheat cropland to apple orchard in Loess Plateau, China

Wang Xiao-Ke
Abstract: The contributions of land use change to greenhouse gases emission are significant in many parts of world. After 1970s, a mass conversion of cropland to apple orchard took place because of high economic benefit in Loess Plateau, China. However, it is less known what the influences on greenhouse gases emissions are caused. In this study, we simultaneously measurements of CO2 and N2O emissions from soil in both winter wheat cropland and apple orchard. The results showed that higher CO2 emission and lower N2O emissions in wheat cropland occurred as compared with apple orchard. The reason primarily is due to higher residue input into cropland soil and higher fertilizer applied in orchard soil. The implications of changes in soil CO2 and N2O emissions due to land use change are also discussed.

Bio: Xiaoke Wang is a researcher of the Research Center for Eco-Environmental Sciences, CAS. He received Ms in ecology and Ph.D in environmental sciences from the research Center for Eco-Environmental Sciences, CAS in 1991 and 1996, respectively. From graduate study, he has begun to investigate carbon and nitrogen cycles in terrestrial ecosystems in China. He has estimated the carbon-containing gases emission from forest fires, and estimated the carbon sequestrations by forests, croplands and grasslands in China. He also is interested in field experiments. He has monitored greenhouse gas emissions from various ecosystems, such as cropland, urban lawn, and wetland such as Wuliangsu Lake in arid region, lakes in Beijing urban area and Three Gorge Reservoir. He also investigated the effects of elevated ozone concentration on crops and trees in eastern China by open-top chamber methods. Recently, the carbon and nitrogen cycles in urban ecosystems have become his main focus.

Impacts of Ecosystem Services Change on Human Well-Being in the Loess Plateau.

Lin Zhen
Abstract: Changes in ecosystem services could impact all elements involved in human well-being in a direct or an indirect way, showing a non-linear relationship between each other. In the present work, we have examined the interaction between changes in ecosystem services and well-being of people in 4 villages in Guyuan City, located in Ningxia Hui Autonomous

Region, China. Data were collected by a questionnaire survey in conjunction with the participatory rural appraisal (PRA) method, spatial analysis method was applied to explore ecosystem changes of the region. Key ecosystem services related to human well-being in the study area were identified, i.e., food, fresh water, firewood and on-land work opportunity. Results indicate that on-land work opportunity and food supply function dropped significantly. Climate change and land use change caused by Grain for Green Policy were found to be two major affecting factors from the local farmers' view. From 1999 to 2009, the well-being increased from 31.5 to 48.6, still at a low level. Though the well-being did not exhibit remarkable differences between regions, some elements, such as income, production material supply satisfaction, resource accessibility and nutrient acquisition capacity, varied greatly over regions. Furthermore, differences between ecosystem services change and well-being were generally induced by provision of ecosystem services, income sources and transportation conditions. An increasing income was considered a key reason affecting well-beings. Decreases in agricultural materials supply satisfaction was thought of a constraint. With an increasing pressure from income improvement, farmers need more income sources like off-land work opportunities. This study provides a useful base for studying interactions between ecosystem sustainability and well-being improvement.

Bio: Prof. Dr. Lin Zhen is the deputy director of Department of Ecology and Bioenergy Resources in the Institute of Geographic Sciences and Natural Resources Research of Chinese Academy of Sciences. She holds a PhD in Natural Resources Management from the Asian Institute of Technology, a M.S from Dortmund University of Germany. Her fields of study include ecosystem change and payment for ecosystem services, impact assessment of land use and multifunctionality, and participatory natural resources management. In recent years, Dr Lin Zhen has focused very much on application and adoption of research results to decision making process in China. She is coordinating national and international research projects, and published articles in international peer reviewed journals. Dr Lin Zhen can be approached via: Tel/Fax: ++86-(10) 6488 8196 /6485 1844; Emails: zhenl@igsnrr.ac.cn, linlinzhen@yahoo.com

Teasing Apart the Influence of Past Land Use and Current Processes on the Controls of Soil Organic Matter Dynamics and Aggregation in Eastern Deciduous Forests, USA

Yini Ma[1,2], Timothy R. Filley[1,2]
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Abstract: The significant relationship of soil structure and soil organic matter stabilization has been realized recently. Our work seeks to identify how earthworm (EW) activity and past land use alters the relative importance of physical, chemical, and biochemical protection mechanisms controlling SOM stabilization in deciduous forests by changing the dynamics of soil particulate organic matter (POM) and aggregation. Within forests of the Smithsonian

Environmental Research Center (SERC) in coastal Maryland, USA, wood and litter amendment plots were established in high, low and no EW activity areas within forests of different stand age and land use history to study the controlling factor for litter-soil systems. Our previous work demonstrated that the plant biopolymer chemistry of both decayed litter and soil (0-5 cm) POM is driven by differences in EW activity and is responsible for the differences observed in lignin and root aliphatic matter accumulation in this system. Also, the stability of SOM reflected by the ^{13}C and ^{15}N natural abundance is influenced by both land use history and EW activity. In the present study we compare the stability and contribution to total SOM stabilization from different soil physical fractions to a depth of 15 cm among plots with 5 years of wood and litter amendment. We found the change of C/N proportion as well as δ13C values that shows a more significant physical or biochemical incorporation of amendments into both silt/clay and POM fraction within micro-aggregates, which is thought to be the most stable fraction of SOM, in higher EW activity sites. These results indicate the EW feeding habits and activity are the major control on the degree of mixing of surface litter and deep soil in all of research plots. This work will have important implications for understanding how soil invertebrates will have potential influence on SOM stabilization process under different land use pattern.

Bio: Yini Ma is a graduate student in Department of Earth and Atmospheric Science (EAS), Purdue University, USA. She received her B.S. from the Department of Environmental Science, Nanjing University, China. As a senior college student, Yini was funded by the "University Student Renovation Plan (USRP) in China for an independent project: "impact of antibiotics on the stability of soil organic carbon". In 2008, she joint Dr. Timothy Filley's group in Purdue University, working on a NSF funded project: Soil-Earthworm-Litter System Controls on the Stabilization of organic Matter in Eastern Deciduous Forests. Her research interests focus on soil organic matter cycling, soil-plant-microbial interaction and global climate change.

Greenhouse Gas Emissions from Forest Fires in China

Fu Chao
Abstract: Based on the emission factor method recommended by the 2006 guidelines of the Intergovernmental Panel on Climate Change (IPCC) and forest fire statistics of China, we estimated province-by-province annual GHG emissions from forest fires in China during 1990–2008. The study considers the burned areas of forestlands and shrublands, the fuel density by fuel component, and the combustion factor and emission factor by forest type. Specifically, the mean annual GHG emission was 8.606 Tg CO_2-eq. from forest fires in China during 1990–2008, showing a downward and then upward trend due mainly to the excessive GHG emissions in some years. During the period, the averaged annual emission density was 35.0 Mg CO_2-eq. ha^{-1} and fluctuated with the relative change in the areas of burned forests and burned shrubs. Our analysis indicates that GHG emissions from forest fires in China mainly came from the southern forest areas in the early 1990s, whereas the forests in Daxing'anling Mountains (located in northeastern Inner Mongolia and western Heilongjiang) made dominant contribution to the total emissions after 2002. The results suggest that ecosystem management could play an increasingly important role in mitigating GHG emissions from forest fires in most regions of

China particularly as extreme meteorological conditions (e.g., drought and dust storm) increase in China under climate change conditions. Long-term monitoring in various forest ecosystems should be strengthened to promote understanding of the relationship among forest fire occurrence, weather patterns, and human disturbance.

Bio: As a third-year PhD candidate at the Institute of Geographical Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), Fu is doing research focused on the estimation of Greenhouse gas (GHG) emission from Agriculture, Forestry and Other Land Use (AFOLU) in China.

Session 3: Renewable Energy and Emission Reduction

Theme: Energy Sustainability and Strategies

Renewable Energy Policy and its potentials for Emission Reduction in China

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Abstract: China and the United States are two largest countries of greenhouse gas (GHG) emission in the world and hence renewable energy is playing and will continue to play an important role in the future energy structure of both economies. This article aims to analyze the position and role, assess the resource availability, and discuss the geographic distribution, market scale and industry development, and policy options of biomass in China. The resource availability and geographical distribution of biomass have been assessed in terms of crop residues, dung, forest and wood biomass, city rubbish and wastewater. The position of biomass for power generation is just next to hydropower among renewable energy in China and the potential quantity of all biomass energy in 2004 is 3511Mtce, and the acquirable quantity is 460Mtce. The biomass energy plays critical role in rural regions of China. The geographical distribution and quantity of biomass resources depends mainly on the relationship between ecological zones and the climate conditions. Our estimate shows that the total quantity of crop residues, dung, forest and wood biomass, city rubbish, wastewater resources are 728Mt (million tons), 3926Mt, 2175Mt, 155Mt and 48240Mt, respectively. Crop residues come mainly from Henan, Shandong, Heilongjiang, Jilin and Sichuan provinces. All dung is mainly located in Henan, Shandong, Sichuan, Hebei and Hunan provinces. Forest and wood biomass are mainly produced in the provinces or autonomous regions of Tibet, Sichuan, Yunnan, Heilongjiang and Inner Mongolia, while most of city rubbish mainly comes from Guangdong, Shandong, Heilongjiang, Hubei and Jiangsu provinces. Most of wastewater are largely discharged from advanced provinces like Guangdong, Jiangsu, Zhejiang, Shandong and Henan. Moreover, biomass energy distribution varies from province to province in China. Based on the analysis of the market scale and industry development, the article argues that China's biomass energy industry is still at very early stage and that Feed-in Tariffs (FIT) might be the best policy option for China to

promote its development of biomass energy. Successful enforcement of FIT in China needs some policy combination of special capital subsidies, R&D funding, tax incentives and pricing.

Bio: Lei Shen, male, resource economist, graduated from China University of Geosciences in Wuhan in 1986 (Bsc.), China University of Geosciences in Beijing in 1989 (Msc.), University of Dundee in 2001 in UK (LLM), and Graduate School of CAS in 2005 (PhD). He also works in part-time as the Secretary General in China Society of Natural Resources (CNSR) and Deputy Director of Department of Natural Resources & Environmental Security (NRES) of IGSNRR, CAS. He is also member of Strategic Management Advisory Group (SMAG) at Communities and Small-scale Mining (CASM) in the World Bank, and Chairman of CASM China regional network (CASM-China), and a professor at Graduate University of CAS. His major research interests involve in the fields of energy and mineral economics and resource security, resource law and policy, evaluation of resource exploitation and regional development, sustainable development of resource-oriented cities and regions, and resource and environment management. He has published 11 articles in English in international journals of SSCI, SCI and EI like Resources Policy, Cities, Journal of Cleaner Production, Environmental Policy and Law, Natural Resource Forum, and over 100 articles in Chinese core journals. His three books had also been come out early.

The Global Sustainable Bioenergy Project: Reconciling Large-Scale Bioenergy Production with Social and Environmental Concerns

Lee Lynd[1], Carlos Enrique de Brito Cruz[2], Andre Faaij[3], John Sheehan[4], Jon Foley[4], Jose Goldemberg[5], Nathanael Greene[6], Mark Laser[1], Keith Kline[7,*], Patricia Osseweijer[8], Tom Richard[9], John Sheehan[4], August Temu[10], Emile van Zyl[11], Ramlan Abd. Aziz[12], Reinhold Mann[13].
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*Presenting author: Keith Kline on behalf of the GSB Project team

Abstract: Many organizations are uncertain about whether to look to bioenergy to play a prominent role in a renewable energy future, and if so, what policies are needed to ensure an appropriate, sustainable result. The Global Sustainable Bioenergy (GSB) project seeks to bring increasing clarity to this situation through a three-stage framework: (1) Workshops around the world to verify interest, develop scope, and identify participants; (2) Testing a working hypothesis that it is physically possible for bioenergy to sustainably meet a substantial fraction of future demand for energy services (> 25% of global mobility or equivalent) while also meeting social needs to feed humanity and provide ecological benefits (clean air, water, biodiversity and other environmental services); and (3) Analyze and recommend transition paths and policies in light of Stage (2) results, incorporating analysis of macroeconomic, environmental, ethical and

equity issues as well as local-scale effects on rural economies. This presentation will report on progress and the results to date in the GSB project as it completes stage (1), along with perspectives and selected analytical results related to potential bioenergy effects on global land use and landscapes. The conclusions and recommendations from five continental conventions will be shared and the current scope and strategic plans for Stage 2 discussed, inviting comments and participation.

Bio: For 22 years, Keith lived in developing nations and worked on programs to improve human welfare while conserving forests and biodiversity. Projects included community-based forestry concessions, protected area management, rehabilitation and reconstruction after natural disasters, and conflict resolution addressing issues ranging from land tenure and commercial agriculture to extractive industries in sensitive ecological areas. Since 1990, Keith has been affiliated with Oak Ridge National Laboratory. He holds degrees from the University of Michigan, School of Natural Resources and Framingham State College, Massachusetts. Keith's current research, supported by DOE, focuses on the drivers of land-use change, sustainability indicators for agriculture and forestry, and biofuel feedstock potentials around the world.

Integrated bioprocessing technology of lignocellulose for production of ethanol with significant energy saving and waste reduction

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Abstract: The massive water and steam are consumed in the production of cellulose ethanol, which correspondingly results in the significant increase of energy cost, waster water discharge and production cost as well. In this study, the process strategy under extremely low water usage and high solids loading of corn stover was investigated experimentally and computationally. The novel pretreatment technology with zero waste water discharge was developed; in which a unique biodetoxification method using a kerosene fungus strain Amorphotheca resinae ZN1 to degrade the lignocellulose derived inhibitors was applied. With high solids loading of pretreated corn stover, high ethanol titer was achieved in the simultaneous saccharification and fermentation process, and the scale-up principles were studied. Furthermore, the flowsheet simulation of the whole process was carried out with the Aspen plus based physical database, and the integrated process developed was tested in the biorefinery mini-plant. Finally, the core technologies were applied in the cellulose ethanol demonstration plant, which paved a way for the establishment of an energy saving and environment friendly technology of lignocellulose biotransformation with industry application potential.

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*

Innovations in Sustainability

Pankaj Sharma
Global Sustainability Initiative, Discovery Park and College of Technology (Courtesy); Bishan Nandy, Krannert School of Management, Purdue University, West Lafayette, IN 47907, USA

Abstract: The Global Sustainability Initiative (GSI) was founded in 2010 to help position Purdue as a leader in global sustainability scholarship. The current members of the GSI include the Energy Center, the Center for the Environment, the Purdue Climate Change Research Center, and the Purdue Water Community. The vision of Purdue University's GSI is to advance innovative solutions for the grand challenges of sustainability from a local to a global scale. The GSI promotes forward thinking on sustainability and engages and assists in the transition to a sustainable society by supporting sustainability research, practice, and education. The talk will provide examples of research projects in the areas of climate, energy, the environment, and water: (1) Center for Direct Catalytic Conversion of Biomass to Biofuel, (2) Modeling and Simulation of Photovoltaic Solar Cells, and (3) Solar Economy Integrated Graduate Education and Research Training. In addition, we will present a few examples of innovative research from Purdue University that will have a major impact in economy. These examples are: (1) Hestia Project to quantitatively characterize where, when, and how much carbon dioxide is emitted, (2) smart wind turbine blades to improve wind power, (3) hydrogen on demand from the Al/Ga alloy, (4) production of cellulosic ethanol using efficient yeast, (5) development of a hydrogen storage system for cars, and (6) biodiesel production from algae.

Bio: Pankaj Sharma holds a a master's degree in Solid State Physics and a Ph.D. in Physics. He also has an MBA from Purdue University and an Advanced Certificate in Applied Computer and Information Technology from the Rochester Institute of Technology. Dr. Sharma is Associate Director for Operations and International Affairs at Discovery Park, Purdue's $400 million home to the university's large-scale interdisciplinary research efforts. He also currently holds a courtesy Associate Professor appointment in Industrial Technology. Recently, Dr. Sharma was selected as a Fulbright New Century Scholar for 2009-2010. In addition, he is the Interim Managing Director of the Global Sustainability Initiative (climate, energy, environment, and water). Before coming to Purdue in 1993, Dr. Sharma worked as a researcher at the University of South Carolina, the University of Pennsylvania, and the University of Rochester. Prior to joining Discovery Park, Dr. Sharma was Associate Director of Purdue's Rare Isotope Measurement Laboratory. He worked on the application of accelerator mass spectrometry in geological and biomedical tracing. He is also an experimental nuclear physicist with expertise in applications of radioactivity in dating and tracing in geological and biological systems, and he has collaborated extensively with scientists from more than 10 countries and published over 90 research papers in national and international journals. His current interests include research administration and strategic planning of interdisciplinary research enterprises in nanotechnology, biosciences, entrepreneurship, healthcare engineering, cyber infrastructure, energy, environment, climate change, global competitiveness, and science and technology policy.

The Potentials of Next Generation Bio-jet Fuels: A Multi-Agent Life Cycle Assessment Approach

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Abstract: To reduce its carbon footprint, the aviation industry has been seriously considering jet fuels derived from bio-based feedstocks (i.e., bio-jet fuels). The particular focus is on bio-jet fuels from sources that do not compete with food production and water supply and that will not cause land use change. Life Cycle Analysis (LCA) provides a sound basis to evaluate the overall environmental impacts of bio-jet fuels. However, LCA does not cover the economic and social aspect of the system in question. It is usually assumed that all stakeholders involved in all the life cycle stages have common interests and thus are cooperative. In reality, stakeholders have conflicting interests. Leaving the motivations and interests of these stakeholders out of consideration might be acceptable for technology evaluation but seriously limits the application of LCA to support policy making.

This paper takes a multi-agent LCA approach that considers factors that drive agents' decisions using system of systems methodology. In particular, we look at the supply and demand chain of bio-jets involving farmers, bio-refineries, airlines and policymakers. The study addresses three issues: the potential of biojet fuels to reduce aviation life cycle emissions, the extent to which the potential will be actually achieved, and policies that can be designed to increase the chance of achieving the potentials. These issues are put in a context where the aviation industry needs to achieve carbon neutral operations by 2020 and a 50% reduction by 2050 compared to the 2005 level. Two kinds of feedstock are considered in the study: oil-containing feedstock and lignocellulosic biomass. The first kind includes camelina, jatropha, and algae whereas the second, corn stover, short rotation woody crops, forest residues, and switchgrass. By taking into account feedstock producers and bio-refineries profitability requirements, a more accurate and realistic estimate of the level of bio-jets supply can be developed. Preliminary analysis shows that camelina and algae appear as the most and least economic viable feedstock respectively. Subsidies, especially in the low oil price scenario are justified and would benefit all agents. But by and large bio-refineries would be the largest beneficiaries of bio-jet adoption. Bio-jet alone would not be sufficient to achieve emissions reduction target due to fuel standard constraint.

Sensitivity analysis suggests that the fraction of land allocated for bio-jet production turns out to be among most influential factor. However, it is found that a carbon cap and trade scheme is not sufficient to stimulate a substantial adoption of biojet fuels.

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 (SuPER) 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 desulfurization during coal combustion and gasification of low quality coal and biomass. 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 served as the co-chair (2006-2008) and chair (2008-2010) of the Life Cycle Engineering technical committee of the ASME's Manufacturing Engineering Division.

Implications of Bioenergy Crop Production on Water Quality

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Abstract: One of the grand challenges in meeting the US biofuel goal is supplying large quantities of lignocellulosic materials for the production of biofuels that are produced in an environmentally sustainable and economically viable manner. Feedstock selection will vary geographically based on regional adaptability, productivity, and reliability. Changes in land use and management practices related to biofeedstock production may have potential impacts on water quantity and quality, sediments, and pesticides and nutrient losses. We have initiated several projects to answer the following questions: 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 combining field data collection on crop production, crop management, and soil and water quality with process based mathematical modeling at field and watershed scales to answer these questions. Specifically, we are utilizing field data to parameterize and improve Groundwater Loading Effects of Agricultural Management Systems-National Agricultural Pesticide Risk Analysis (GLEAMS-NAPRA) and Soil and Water Assessment Tool (SWAT) models. The modified GLEAMS is being incorporated into the

web-based NAPRA to aid stakeholders in assessing pesticide, nutrient, erosion and hydrology based management decisions at field- and watershed-levels. The models are subsequently utilized in evaluating hydrologic and water quality impacts of alternative bioenergy crops. We are also evaluating various best management practices that can be utilized to minimize negative water quality impacts associated with bioenergy crop production. Through integration of SWAT and genetic algorithms, we have developed a method to optimize the placement of various energy crops and best management practices that will meet the objectives of crop productions goals while maximizing water quality benefits. This presentation will discuss how alternative management practices, including choice of bioenergy crop, their landscape positions and crop management practices will affect hydrology and water quality at field and watershed scales. Methods to optimize selection and placement of bioenergy to meet various objective functions will also be discussed.

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. He is also a faculty affiliate in the Division of Environmental and Ecological Engineering 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 54 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. Currently, he is leading a national facilitation project funded by the USDA-NIFA to evaluate the hydrologic/water quality impacts of biofeedstock production in Midwest and southeast USA.

Dr. Chaubey is a member of the American Society of Agricultural and Biological Engineers, American Water Resources Association, European Geosciences Union, Soil and Water Conservation Society, and Environmental Water Resources Institute. He serves on the editorial board of the Transactions of the American Society of Agricultural and Biological Engineering, and Applied Engineering in Agriculture. He has won numerous prestigious honors and awards recognizing his teaching and research contributions. He was recognized nationally as the outstanding researcher under the age of 40 by the American Society of Agricultural and Biological Engineers in 2007 through his selection for the New Holland Young Researcher Award. He received this prestigious award based on his record of innovative research and scholarly accomplishments in the area of water quality modeling and management.

Theme: Resources Utilization and Strategies

Agroecological Considerations When Growing Biomass

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Abstract: Current U.S. plans for energy security rely on the conversion of large agro-ecoregions from food crop production to the production of cellulosic biomass. However, concomitant with this emerging agenda are recent findings of increases in levels of both nitrogen (N) and phosphorus (P) in the Mississippi River. These nutrient materials originate in the Midwest U.S., but are discharging to the Gulf of Mexico creating an increasingly negative impact on this valuable water resource. The current plans for conversion to biofuel production will exacerbate the situation as many more acres could be put into intensive production using traditional management strategies. Indeed, Europe's progress toward a bio-economy has been abruptly slowed by concerns over the environmental impact of biofuel production, concerns that can be directly tracked to a general lack of unbiased information about these potential impacts. Long-term sustainable biofuels production while protecting and improving air, soil and water resources requires a concerted effort by the scientific community to gain knowledge regarding the comparative production potentials and environmental impacts of biofuel cropping systems. U.S. agriculture has extensive experience with intensive maize 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, sustainable, and environmentally benign on-farm implementation of the U.S. biofuel agenda. Likewise, understanding crop water balance and optimizing water use efficiency will be essential to renewable biofuel success as water is expected to be the single, most limiting factor that transcends the multiple agro-ecozones in which U.S. biofuel production will be pursued. While a win-win scenario is not a likely outcome of this shift in U.S. agricultural production, it is incumbent to understand the consequences and impacts of our decisions. The current dearth of knowledge for these choices is one of the most serious limitations for development of good policies aimed at moving towards energy security in the U.S.

Bio: Dr. Jeff Volenec is a professor in the Department of Agronomy at Purdue University. Volenec received his M.Sc. and Ph.D. degrees at the University of Missouri-Columbia in 1983 specializing in crop physiology where he studied leaf growth and development in grasses. He earned his B.Sc. in Agronomy/Natural Sciences at the University of Wisconsin-Madison. His appointment at Purdue encompasses all three areas of the Land Grant mission including teaching, research, and Extension. In addition, he served as Associate Head in the Agronomy Department from 1993 to 2009. Volenec's research focuses on the biochemistry, physiology and ecology of perennial plants used for forage and biomass. His teaching responsibilities have included upper-division courses in Crop Physiology and Ecology, and Forage Management. He is a five-time recipient of the Outstanding Teaching Award in the Department of Agronomy at Purdue University. Students also have twice selected him as Outstanding Counselor in the Department of Agronomy. He recently completed a six-year term as Chair of the Graduate Program in the Department of Agronomy, including leadership roles in administration of Graduate Education Programs in the College of Agriculture and in the Graduate Council of Purdue University. He has served as Editor of *Crop Science* and as Editor-in-Chief of the Crop Science Society of America. He is the recipient of Purdue University's Agricultural Research Award and the Young Crop Scientist Award from the Crop Science Society of America. He currently serves as a Non-Resident Fellow for the Noble Foundation. For his accomplishments, he has been elected Fellow of the American Association for the Advancement of Science, the American Society of Agronomy, and the Crop Science Society of America. He is currently Incoming President – elect of the Crop Science Society of America.

Establishing a Feedstock Supply Chain for Cellulosic Ethanol in Tennessee

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Abstract: Working with partners at Genera Energy LLC, the University of Tennessee's (UT) Biofuels Initiative is developing a farm-to-fuel business plan supported by the State of Tennessee, the UT Institute of Agriculture, and Oak Ridge National Laboratory 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 (950,000 liter) per year demonstration cellulosic ethanol facility, which is now operational with partners at Genera Energy and Dupont Danisco Cellulosic Ethanol.
UT and Genera are establishing a dedicated energy crop (switchgrass) supply chain, to demonstrate and improve the technologies used to create cellulosic ethanol, reduce the costs of production, and ultimately commercialize the technology across the state. We work with local farmers to develop switchgrass production and provide one-on-one technical assistance through UT Extension and wide-ranging research related to all aspects of the feedstock supply chain. This research focuses on improving efficiencies and reducing costs in harvesting, storing, transporting, and preprocessing switchgrass feedstock. Approximately 5,100 acres (2,064 hectares) of switchgrass have been planted under the Biofuels Initiative's incentive program. The program has one of the largest plantings of switchgrass on private farms in the United States. Genera is also currently constructing the Tennessee Biomass Innovation Park to

showcase processing, handling, storage, and conversion of a variety of cellulosic feedstocks. The development of the bioenergy feedstock supply chain, from biomass to fuels and products, will have a significant impact on the energy future of the state and nation. The scale of work ongoing in Tennessee has provided significant opportunity to conduct research and development on agronomic production of biomass, transportation and logistics, storage, preprocessing, and conversion of biomass to fuels and products. This work will provide a viable path to a sustainable, biomass-based future for rural economies and the nation.

Bio: Dr. Jackson holds a faculty position at the University of Tennessee, serving as a Research Assistant Professor in the University's Center for Renewable Carbon. In his faculty role, he is focused on the research, development, and commercialization of sustainable feedstock supply chains for the emerging bioenergy industry. He works with a variety of feedstocks including perennial grasses, short-rotation woody crops, forest materials, and other agricultural crops and residues. A significant focus of effort for Dr. Jackson has been the $70 million University of Tennessee Biofuels Initiative. The program, funded by the state of Tennessee, seeks to integrate the switchgrass feedstock supply chain with bioenergy and bioproducts industries in the state. The program has led to the establishment of nearly 5,100 acres (2,064 hectares) of switchgrass and the construction of a demonstration-scale biorefinery. He has also served with the Southeastern Sun Grant Center, part of a nationwide bioenergy research program funded by the US Departments of Transportation, Energy, and Agriculture. Dr. Jackson has helped coordinate a regional grant program that has provided nearly $5 million for bioenergy research across the southeast. Dr. Jackson currently leads a $2.3 million project focused on switchgrass production that was competitively funded by the US Departments of Energy (DOE) and Agriculture. He is also part of another $4.9 million US DOE research project focused on high-tonnage logistics for switchgrass biomass.

As Genera Energy Vice President for Feedstock Operations, Dr. Jackson has worked to develop feedstock supply chains for bioenergy and bioproducts in Tennessee and the region. He has worked with university faculty, legislators, and farmers to spur the development of switchgrass as a bioenergy feedstock through the state's Biofuels Initiative. Dr. Jackson works for sustainable, practical, and economical supply chain solutions.

Dr. Jackson received an undergraduate degree in Wildlife and Fisheries Science and his master's degree in forest ecology and management from the University of Tennessee. He earned his doctoral degree in Natural Resources from the University of Tennessee as well.

Understanding the Logistical Challenges of Supplying Biomass for Biopower Production - Purdue University-Zhejiang University Collaborative Research Effort

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Abstract: Over the last few years, there has been increased interest in the utilization of biomass for power production in China. This has spurred investment into the building of power plants powered by 100% biomass. On the contrary, the use of biomass for power in the U.S. is primarily as a co-fired fuel with coal. Whether biomass is the primary fuel or a secondary co-fired fuel, the challenges of sourcing, harvesting, transporting, preprocessing and feeding into the boiler remain a major bottleneck to its wide spread use as a fuel for power production. A major constraint is cost per ton at the plant-gate which is directly related to the cost of transportation. Therefore, biomass logistics needs to be improved to lower cost and grow the industry. With limited data available from an under-developed industry, event simulation provides an alternative to investigate the challenges of biomass delivery and how logistics can be improved. In this presentation, research on biomass logistics using event simulation studies will be presented. In particular, a comparison of the logistical challenges of supplying biomass for power in China and the U.S. will be highlighted using research from a collaborative study between Zhejiang University in Hangzhou, Zhejiang Province and Purdue University in West Lafayette, Indiana. This research collaboration, which is supported under China's *Program for Introducing Talents of Discipline to Universities*, abbreviated as the "*111 Project*" will also be briefly discussed as a model for US-China collaboration in energy and the environment.

Bio: Dr. Klein E. Ileleji is an Associate Professor and Extension Engineer in Agricultural and Biological Engineering at Purdue University. He holds a Ph.D. in Agricultural Engineering from the Slovak Agricultural University in Nitra, Slovakia. Prior to joining the faculty at Purdue in August 2004, he was a post-doc at Purdue and the University of Minnesota in 2001-2004 and 1999-2001, respectively. Dr. Ileleji's research focus and interest at Purdue University are in the areas of biomass feedstock systems engineering and powder technology. He teaches Biomass Feedstock Systems Engineering (ABE591K) and Electric Power and Controls (ASM420). Dr. Ileleji also leads the renewable energy extension effort at Purdue. He is a 16 year member of the American Society of Agricultural and Biological Engineers (ASABE) and a 5 year member of the Grain Elevators and Processing Society (GEAPS). He has been engaged in collaborative research with Zhejiang University State Key Lab for Clean Energy Utilization since 2007.

Forest resources for bioenergy in the Southeastern USA: examples of modeling to optimize bioenergy plants and to assess sustainability

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Abstract: Along with rising concerns resulted from the use of first-generation biomass and bioenergy production, the second generation biomass and bioenergy have received a great deal of attention. There have been regional, national and international policies to promote cellulosic

biofuel production. Forest biomass, such as standing trees, harvesting residues, mill residues or municipal waste, can be utilized to produce cellulosic biofuel. With the rising emphasis on cellulosic biofuel production, the role of forestry sector could be significant. However, the increasing demand for forest biomass as biofuel feedstock would raise wood prices and influence both agricultural and forest land use decision. The increased price would then result in forest mitigation and adaptation through adjustment in forest management, optimal rotation forest composition structure, and so on. Also, the utilization of forest biomass has the potential to compete with traditional forest products for forest resources, with agricultural sector for land, and with other biomass for bioenergy production. Therefore, the impacts of bioenergy development on forest resources and a sustainable way of utilizing forest biomass become my research questions. One step towards that is a spatial analysis to find optimal location and number of future bioenergy facilities in the Southeastern US, given a biofuel target. In this analysis a mixed integer programming model is used to minimize the total costs in the forest market. This model proposes an optimal forest biofuel production system when biofuel become economically feasible compared with fossil fuel. Furthermore, to assess forest sustainability in response to biofuel mandates, an integrated model is developed to disentangle the interactions among different types of biomass. Then it is used to project future biomass utilization and thereby forest inventory change over time. Thus it provides a more realistic estimation of forest resource sustainability in the presence of biofuel mandates. Therefore, this study has great implications on the economic and environmental impacts of bioenergy mandates, carbon tax, and also the emerging market of cellulosic biofuel and its various feedstocks.

Bio: Yun Wu is a PhD Candidate in Forest Economics at North Carolina State University, where she received her Master in Statistics. Currently, she works as a research associate at the Bioenergy Program in Oak Ridge National Laboratory. Her main interests are in quantitative analysis of bioenergy policy impacts on the economy of natural resource and also land use change regionally and nationally. Her past and current research experiences include 1) with Duke University and North Carolina State University in the US: forest biomass supply in the South for forest bioenergy production; 2) with Resources for the Future at Washington DC: cellulosic bioenergy development; 3) with Conservation International in China: the Climate, Community & Biodiversity Alliance Certification for CDM projects; 4) with International Institute for Applied Systems Analysis at Austria: spatial analysis of forest biorefineries in the US; 5) with Oak Ridge National Laboratory in the US: biofuel mandates impacts on forest sustainability.

Contribution 0f ecology environment through energy saving technology for tubular-furnace optimizations biomass energy value of exergy and anergie lost work

Liu De-Yuan
Abstract : Relation between reasonable utilization of energy and decrease in productioncost is impetus for social economy development more and more environment of the mian factors influencing.as we know ,use ofregenerated energy is an vituous circle,but utilize of MLCC and

economy threshold more other energy sources is a bottle-neck in the work of product quality inspection.power-saving technology for scientific and economical comprehensive treating applictions,the overall size advantage is a their tremendous contribution for ecological environment.

Bio: Dr.liu de yuan is senior engineer in automation of electric power systems from hunan university of technology.he graduations in 1986 from Hohai university ,his research interests are electrical energy and waste treatment and electricity,especially ascan comprehensive utilization.he have four patents.he has published more than 6 journal articles.

Optimization of straw utilization in China for greenhouse gas mitigation

Lu Fei

Abstract: As the largest developing country and one of the greatest contributors to the greenhouse gas (GHG) emissions from fossil fuel combustion, China is now facing the international pressure of GHG mitigation and the challenges of domestic economic and social sustainable development. It is therefore imperative for China to find feasible technical measures for GHG mitigation.

Since the 1980s, with the rise of crop yields, millions of tons of straw have been produced annually as an agricultural byproduct. In order to sow the next crop timely and save them the cost of handling, many farmers burn straw in the fields. This behavior leads to high risk of air pollution, fire and traffic accidents. The Chinese government makes great efforts to prohibit straw burning and optimize the utilization of straw, which may provide great opportunities for GHG mitigation.

Regardless of whether or not the straw is returned to the croplands or used as bioenergy, the huge amounts of carbon and nitrogen in the straw do not vanish, but in one way or another remain part of the global carbon and nitrogen cycles. Different treatments will result in widely varying levels of GHG emission, and some treatments may demonstrate GHG mitigation potentials when compared against present practices. So, the net mitigation potentials of straw return or use as bioenergy depend on the changes in the disposition of carbon and nitrogen, and the change in GHG emissions, sequestrations and mitigations among the different straw treatments.

In this presentation, a compound model was introduced which was constructed based on the carbon-nitrogen cycles and greenhouse gas mitigation and emission processes related to straw return, burning and bioenergy use, with the modification from a full greenhouse gas budget model “Straw Return and Burning Model” (SRBM, Lu et al., 2010). The model addressed the following five processes: (1) soil carbon sequestration, (2) fossil fuel and relative product substitution, (3) methane emission from rice paddies, (4) additional machine use for straw return, straw collection and transportation, and (5) emissions from straw burning, in the fields or in straw fired power plants. With GHG emissions and mitigation effects of the five processes converted into global warming potential, the net GHG mitigations of optimizations of straw utilization were estimated. Furthermore, the superiorities and risks of the three straw treatments were also discussed.

Bio: Fei Lu is an assistant research professor in State Key Laboratory of Urban and Regional

Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences (RCEES, CAS). Lu received B.Sc. (Environmental Sciences) at Collage of Environment, Peking University in 2002, and Ph. D. (Ecology) at RCEES, CAS in 2009. Lu's research interests include greenhouse gas emission, sequestration and mitigation, in agroecosystems, reservoirs and urban ecosystems.

Session 4: Environmental Change and Health

Theme: Environmental Contamination, Remediation, and Risk Assessment

Colloid transport and mobilization under transient unsaturated flow conditions

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Abstract: Knowledge of colloid transport and mobilization in natural and engineered systems is of primary importance for the assessment and prediction of the fate and migration of colloidal contaminants (such as viruses, pathogenic bacteria, protozoans, and colloid-/nano-sized industry materials) and toxic chemicals sorbed to mobile mineral colloids. Over the past several decades, considerable advances have been made towards understanding the processes and corresponding mechanisms governing colloid deposition and transport through laboratory investigations, field studies, and numerical modeling. It has been recognized that colloid transport and mobilization is a function of many factors, including the properties of colloids and porous media, solution chemistry, and flow conditions. The dominant mechanisms controlling colloid transport and remobilization in porous media have been attributed to electrostatic, capillary, and shear forces. Electrostatic forces are an important component of the total interaction energy between colloids and the porous medium and are impacted by factors influencing the electric double layer (EDL), such as solution ionic strength, ion composition, and pH. Capillary forces describe interactions between individual colloids or between colloids and surfaces wetted by fluid and are impacted by the degree of saturation, pore sizes, contact angles of both colloids and porous media, and surface tension. Shear force is the shear developed on the wetted area of the pore channel. It acts in the direction of flow and is impacted by the flow velocity, liquid density, and flow path tortuosity. Most previous colloid transport studies included only steady-state flow conditions, which do not effectively represent natural vadose zones, where transient flows (e.g., infiltration and drainage) tend to dominate. More recently, several studies have addressed transient transport of colloids by studying the influence of physical and chemical perturbations on colloid transport and mobilization. It has been found that colloids respond to changes in the distribution, configuration, and total area of air–water menisci. During the drainage process, colloids accumulate in the thin water films present at air–water–solid contacts. Although there are alternative arguments in the literature describing how air–water interfaces and/or air–water–solid interfaces affect colloid

retention and mobilization, it seems that changes in pore water saturation and the geometry of corner-water ducts in porous media can cause colloid remobilization. The transport of colloids under transient flow conditions (e.g., infiltration and drainage) is subject to the coupling of flow and chemical conditions. This is because, under certain conditions, capillary and shear forces create separation distances between colloids and pore walls beyond which the electric double layer (EDL) is ineffective in influencing the electrostatic component of the total interaction energies, thus reducing the importance of solution chemistry on colloid retention. This presentation will summarize our recent research progresses in the research of colloid retention, transport, and remobilization under transient unsaturated flow conditions.

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.

PAH-Degrading Mycobacteria: Distribution, Prevalence and Evolution

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Abstract: High molecular weight polycyclic aromatic hydrocarbons (HMW PAHs) are of concern due to documented health effects and environmental recalcitrance. Microbial biodegradation of HMW PAHs, such as pyrene and benzo[a]pyrene, has only been observed in a few genera, one of which is the fast-growing *Mycobacterium*. Using molecular approaches, we have demonstrated that PAH-degrading Mycobacteria have broad, cosmopolitan distribution in PAH-contaminated environments, implicating these organisms in natural attenuation of PAHs. The prevalence of HMW PAH-degrading organisms in these environments may have been enhanced through acquisition of degradation pathways via horizontal gene transfer: Isolation of pyrene-degrading organisms from disparate environments combined with a bioinformatic analysis of Mycobacterial genomes provides strong evidence for horizontal transfer of the genomic regions enriched in HMW PAH degradation genes.

Bio: Dr. Jennifer DeBruyn is a newly appointed Assistant Professor in the Department of Biosystems Engineering & Soil Science at the University of Tennessee. She pursues research in environmental microbiology, using molecular approaches to answer questions about the functional ecology of microorganisms to better their roles in contaminant biodegradation and nutrient cycling. During the course of her baccalaureate studies in biology at Queen's University in Kingston, Ontario, Canada, she worked aboard a limnology research ship investigating impacts of phosphorus on aquatic microbes in the Laurentian Great Lakes. In 2008, she earned her doctorate in Ecology & Evolutionary Biology at the University of Tennessee under the supervision of Professor Gary Sayler. Her dissertation work focused on PAH biodegradation, elucidating the role of Mycobacteria in contaminated sediments.

Arsenic remediation and remobilization in water treatment adsorbent

Jing Chuan-Yong
Abstract: Smelting and mining are major industrial processes that lead to anthropogenic heavy metal contamination of air, water and soil. Among various heavy metal contaminations, arsenic (As) from copper smelters has caused increasing public concern because of its high concentrations and apparent carcinogenicity. Developing innovative treatment technologies for As-containing metallurgical industry wastewater is currently of great urgency and high priority. The efficient removal and, more importantly, the recovery of As from the smelter wastewater present a challenge because of the ultra-high As concentrations at several grams per liter level and extremely low pH. A novel approach was investigated for the first time using TiO_2 for As adsorptive removal from wastewater, and subsequent spent adsorbent regeneration and As recovery using NaOH. Extended X-ray absorption fine structure spectroscopy results demonstrate that arsenite, as the only As species present in the raw water, does not form an aqueous complex with other metal ions. As in the waste solution after the TiO_2 regeneration process was recovered by thermo vaporization and subsequent precipitation of sodium arsenite. The redox transformation and mobility of arsenic in spent adsorbents under reducing conditions were studied, and the release of As from the spent adsorbent could be simulated using the charge distribution multi-site complexation model.

Bio: Dr. Chuanyong Jing is a professor at State Key Laboratory of Environmental Chemistry and Ecotoxicology in China. His research primarily focus on the areas of environmental molecular and interface science. Key areas of investigation include biogeochemical cycles of environmentally significant trace elements including arsenic, reactions at environmental interface, including adsorption, precipitation, and dissolution processes that affect the bioavailability of heavy metals and other contaminants, and characterization, fate and transport of heavy metals and persistent organic pollutants.

Robustness of *Archaeal* Populations in Anaerobic Co-Digestion of Dairy and Poultry Wastes

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Abstract: The application of anaerobic digestion remains economically unattractive for the treatment of dilute dairy waste. Poultry waste was characterized as an organic/nitrogen-rich substrate for anaerobic digestion. Supplementing dilute dairy waste with poultry waste for anaerobic co-digestion to increase organic loading rate by 50% resulted in improved biogas production. Elevated ammonia derived from poultry waste did not lead to process inhibition at the organic loadings tested, demonstrating the feasibility of the anaerobic co-digestion of dairy and poultry wastes for improved treatment efficiency. The stability of the anaerobic co-digestion process was linked to the robust archaeal microbial community, which remained mostly unchanged in community structure following increases in organic loading and ammonia levels. Surprisingly, Crenarchaeota archaeal populations, instead of the Euryarchaeota methanogens, dominated the archaeal communities in the anaerobic digesters. The ecological functions of these abundant non-methanogen archaeal populations in anaerobic digestion remain to be identified.

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 the Environmental Sciences Division of the Oak Ridge National Laboratory for two years before he joined the University of Tennessee as an assistant professor in 2007. His research is focused on biological processes in water/wastewater treatment and renewable energy production.

Preparation of Cationic Wheat Straw and its Application on Anionic Dye Removal

Yan Li-Feng
Abstract: Cationic wheat straw has been prepared for anionic dyes removal from aqueous solution. It includes two steps: pretreatment of straw to remove most lignin and the quaternization of the residual straw. Acetic acid pulping was used to remove lignin and the quaternization were carried out in an aqueous suspension. The dyes removal results revealed that the maximum adsorption of the cationic straw for dye AB92 could arrive 1072 g/kg. The effect of temperature, reaction time and the extents of the quaternization on the adsorption capacity were studied. The pseudo-second-order kinetic models were applied to describe the kinetic data and the rate constants were evaluated. The Freundlich and Langmuir adsorption models were used to describe the mechanism. The adsorption data indicated that the capacity of the adsorbents was depended obviously on the initial pH of dye solution and initial dye concentration.

Bio: Lifeng Yan is an Associate Professor in the Department of Chemical Physics at the University of Science and Technology of China (USTC). He holds a Ph.D. in Physical Chemistry from USTC. Yan's research interests include conversion of biomass, green chemistry, and polymeric chemistry and physics. He has published more than 70 articles and two books. Now he is the vice-director of the Anhui Provice Key Laboratory of Biomass Clean Energy.

Theme: Ecotoxicological Processes and Technology

Evolutionary Toxicology

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Abstract: Evolutionary Toxicology is the study of the effects of chemical pollutants on the genetics of natural populations. Research in Evolutionary Toxicology uses experimental designs familiar to the ecotoxicologist with matched reference and contaminated sites and the selection of sentinel species. It uses the methods of molecular genetics and population genetics, and is based on the theories and concepts of evolutionary biology and conservation genetics. Although it is a relatively young field, interest is rapidly growing among ecotoxicologists and more and more field studies and even controlled laboratory experiments are appearing in the literature. A number of population genetic impacts have been observed in organisms exposed to pollutants including selection at survivorship loci, loss of genetic diversity, altered patterns of gene flow which have been interpreted as evidence for ecological sinks, and increased mutation rates. It is concluded that population genetic impacts of pollution exposure are emergent effects that are not necessarily predictable from the mode of toxicity of the pollutant. Thus, to attribute an effect to a particular contaminant requires a careful experimental design which includes selection of appropriate reference sites, detailed chemistry analyses of environmental samples and tissues, and the use of appropriate biomarkers to establish exposure and effect. This paper describes the field of Evolutionary Toxicology and discusses relevant field studies and their findings.

Bio: John W. Bickham is Director of the Center for the Environment, which is part of the Global Sustainability 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, is co-author of the book *Bats of Jamaica* and co-editor of the book *Molecular Approaches in Natural Resource Conservation and Management.* 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 since 2002 has served as a member of the U.S. delegation to the Scientific Committee of the International Whaling Commission.

Microbial Genes and Communities Involved in Mercury Transformations

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Abstract: The industrial release of mercury (Hg) into the environment has resulted in widespread contamination globally, including at a number of Department of Energy (DOE) sites and several locations within Oak Ridge, TN in particular. At the Oak Ridge National Laboratory (ORNL), we conduct a multi-disciplinary program to gain a fundamental understanding of the mechanisms that govern mercury transformation and behavior in the environment in order to predict and mitigate their adverse impact. Over the next 5 to 10 year period, this program will address significant knowledge gaps regarding mercury transformation at the water-sediment interface that are characterized by steep chemical gradients. The principal research components in the SFA are: (1) Site Biogeochemical Processes and Microcosm Studies; (2) Fundamental Mechanisms and Transformations; (3) Microbial Transformations and Genetics; (4) Biomolecular Structure, Dynamics, and Simulation.

The fate of Hg varies, but typically results in either immobilized HgS or mobilized methylmercury (MeHg). When converted to MeHg by natural bacteria, it bioaccumulates in aquatic and terrestrial food webs, with significant deleterious impacts on human and ecosystem health. MeHg is primarily produced by sulfate-reducing bacteria (SRB) such as *Desulfovibrio* spp. and Fe(III)-reducing bacteria (IRB) such as *Geobacter* spp. Both can reduce various sulfur forms (eg. *G. sulfurreducens*) and play dual roles by methylating Hg while immobilizing it via S^{2-} generation and precipitation. Hence, they are important to the fate of Hg in subsurface systems, although the mechanism of MeHg formation in the environment is unknown. We have determined the genome sequence for *Desulfovibrio* ND132, a MeHg producing SRB and established a genetic system to elucidate the gene or genes responsible for methylating mercury. To better understand the ecological factors driving MeHg generation at the ORNL site, sixty sediment samples were collected from five contaminated sites over two years and analyzed for bacterial community composition and geochemistry, respectively. Community characterization via GS 454 FLX pyrosequencing resulted in 588,699 sequences targeting the 16S rDNA V4 region. The community was represented by 24 phyla and unclassified Bacteria including Proteobacteria (22.9-58.5%), Cyanobacteria (0.2-32.0%), Verrucomicrobia (3.4-31.0%), Acidobacteria (1.6-30.6%), Bacteroidetes (0.03-14.4%), Chloroflexi (0.3-6.3%), Firmicutes (0.03-5.2%), Planctomycetes (0.03-3.9%), Gemmatimonadetes (0.05-1.3%), WS3 (0.01-1.1%), OD1 (0.04-0.8%), Actinobacteria (0.01-0.8%), and TM7 (0.01-0.2%). A detailed analysis of Deltaproteobacteria, seasonal and geochemical variation was conducted, which indicated significant positive correlations between *Desulfobulbus* spp. and methyl mercury concentrations.

Bio: Steve Brown received his Bachelors of Science degree (Honors, First Class) and Ph.D. in

Microbiology from the University of Otago, New Zealand studying the *Mesorhizobium loti* symbiosis island. He completed a post-doctoral appointment under Prof. Jizhong Zhou at Oak Ridge National Laboratory and is now a staff scientist in the Biosciences Division. Dr. Brown applies his expertise in microbiology, transcriptomics and DNA sequencing to a wide range of projects for the U.S. Dept. of Energy that investigate microbial communities and the processes by which microorganisms transform materials and energy.

Sorption and Toxicity of Imidazolium-Based Ionic Liquids in the Absence and Presence of Dissolved Organic Matter

Liu Jing-Fu

Abstract: Ionic liquids (ILs) are a class of nonmolecular ionic solvents with low melting points, which has achieved widespread applications. Although ILs are considered as green solvents mainly due to their lack of vapour pressure, it is likely that ILs will be introduced into the environment through water. As experiments showed that ILs exhibited toxicities towards different levels of biological complexity as well as several environmental compartments, researchers are more and more concern the potential environmental impacts of these chemicals. Currently most toxicological studies focused on the effects of individual ILs, a few study considered the influence of the coexisted environmental matrix.

The objective of this present work is to study the toxicity of imidazolium-based ILs in the absence and presence of dissolved organic matter (DOM). It is expected that the interaction of imidazolium cations with DOM will reduce the freely dissolved concentration (C_{free}) of imidazolium. This in turn will reduce the toxicity of ILs, as it is generally believed that only the freely dissolved chemicals are bioavailable. To verify this, the C_{free} of the imidazolium cations of 1-butyl-3-methylimidazolium chloride ([C_4MIM]Cl) and 1-octyl-3- methylimidazolium chloride ([C_8MIM]Cl) were measured with negligible depletion hollow fiber-protected liquid-phase microextraction, and the influence of humic acid on the C_{free} and toxicity of imidazolium was tested. The toxicity was evaluated by testing the cytotoxicity using HepG2 cell line through MTT, the genotoxicity by SOS/umu, and acute toxicity with medaka. It was demonstrated that the presence of humic acid markedly reduced the C_{free}, cyclotoxicity, genetoxicity and acute toxicity of [C_4MIM] and [C_8MIM]. The reduction of toxicity of these two ILs in the presence of humic acid was discussed by linking with the reduction of the C_{free} of [C_4MIM] and [C_8MIM].

Bio: Jing-Fu Liu is a professor at the State Key Laboratory of Environmental Chemistry and Ecotoxicology and the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. He obtained his Ph.D. in environmental science from RCEES-CAS, and was a post-doctoral researcher at Lund University, Sweden. Liu's research interests involve the analytical methods, as well as the environmental fate and bioavailability of persistent toxic substances. He has more than 120 peer reviewed publications on environmental analysis and processes in leading international journals, including *Environmental Science & Technology*, *Analytical Chemistry*, and *Chemical Communications*. He received more than 10 awards by different organizations, including the the 100 Excellent Doctoral Dissertations of China in 2004, and Special Prize of Presidential Scholarship of CAS in 2002.

Application of omic's approaches to studying toxic algal blooms in large freshwater lakes

Steven W. Wilhelm
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Abstract: Eutrophication in freshwaters has led to a global proliferation of cyanobacteria which foul water intakes, disrupt foodwebs, fuel hypoxia and produce secondary metabolites that damage and/or are toxic to a variety of consumers. Of the problem causing freshwater organisms, *Microcystis* remains a major problem globally. As part of collaborative studies in China's Taihu (Lake Tai) and Lake Erie (of the Laurentian Great Lakes), we have developed and /or employed a series of biomolecular tools to address the question "What makes *Microcystis* bloom?". Statistical characterizations of metadata with PCR, qPCR and sequencing efforts have demonstrated that the environmental factors that lead to toxin production are often disconnected from those that lead to bloom formation, resulting in important caveats for ecosystem managers. Source tracking efforts of the co-occurring microbial community have further shed light on potential source(s) of nutrients that appear to drive blooms in these systems. Most recently shotgun and targeted metagenomics and shotgun metaproteomics are now providing insight into the metabolic pathways for both this organism and the co-occurring biota that are consistent with *Microcystis* proliferation, for the first time providing direct evidence as to the cause(s) of these events.

Bio: Steven Wilhelm is a Professor of Microbiology at the University of Tennessee with interests in aquatic microbial ecology. His research group couples classic oceanographic and limnetic tools with state-of-the-art biomolecular tools to tease apart the factors that shape and constrain microbial communities in both marine and freshwater systems. A native Canadian, he followed his doctoral work at the University of Western Ontario with postdoctoral research at the University of Texas and the University of British Columbia. His current interests revolve around the role(s) of viruses in aquatic biogeochemical cycles, the role of microbes in marine carbon cycling and the development of tools to study harmful algal blooms in marine and freshwater systems. Currently the Wilhelm group has active research projects in New Zealand, Canada, The United States and the People's Republic of China.

Mercury profiles in sediments of the Pearl River Estuary and the surrounding coastal area of South China

Shi Jian-Bo
Abstract: The biogeochemistry of mercury (Hg) in coastal and estuarial environments has been widely studied because of its high toxicity and biomagnification in aquatic system. However, the biogeochemical cycles of Hg in different estuaries are variable and complicated due to the

diverse Hg input, physical, chemical and hydrological conditions. The aim of this present work is to study the spatial and temporal variations of mercury in sediments of the Pearl River Estuary (PRE) and the surrounding coastal area (South China Sea). By using ^{210}Pb dating technique, the historic changes of concentrations and influxes of Hg in the last 100 years were investigated. The variations of Hg influxes in sediment cores were obviously correlated with the economic development and urbanization of the PRD region, especially in the last three decades.

Bio: Jian-bo Shi is an Associate Professor at the Research Center for Eco-Environmental Sciences (RCEES), Chinese Academy of Sciences. He obtained his Ph.D. in environmental science from RCEES in 2005, and was a post-doctoral researcher at Hong Kong Polytechnic University during 2005-2006. He was also a visiting scholar at Swiss Federal Institute of Aquatic Science and Technology (Eawag) in 2007 and at Hong Kong Baptist University in 2008-2009. His research interests have been focused on the biogeochemistry of mercury and speciation analysis of organometallic compounds.

Enhanced Toxicity of Acid-Functionalized Single-walled Carbon Nanotubes (SWCNTs) and Gene Expression Profiling in Murine Macrophages

Wan Bin

Abstract: Single-walled carbon nanotubes (SWCNTs) are being widely used in industrial and medical sectors and the increasing exposure of SWCNTs necessitate the studies of their potential environmental and health effects. Considerable efforts have been made to improve the dispersion of SWCNTs by chemical modifications. However, the toxicological effects of such modifications on SWCNTs are mostly unknown. This presentation will discuss the change of toxicity of SWCNT under acid functionalization and the potential toxic mechanism. Cytotoxicity and global gene expression analyses revealed that the enhanced toxicity may be due to the disruption of a few processes including ribosomal biogenesis, mitochondria respiration, inflammatory cytokines and chemokines, cell cycle/apoptosis inhibition, and proteasome pathway.

Bio: Dr. Bin Wan is a Research Associate Professor at the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. He received his Ph.D in Ecology and Evolutionary Biology from the University of Tennessee, Knoxville in 2004. He was a post-doctoral researcher at the department of Veterinary Medicine in UT before he joined RCEES in 2006. His research interests have been focused on the molecular toxicology and toxicogenomics.

Theme: Microbe-Environment Interactions

Heterotrophic bacteria protect the marine cyanobacterium, *Prochlorococcus*, from oxidative damage

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Abstract: In the open ocean, the numerically-dominant cyanobacterium *Prochlorococcus* accounts for approximately half of all photosynthesis. In the illuminated euphotic zone where *Prochlorococcus* grows, reactive oxygen species (ROS) are continuously generated via photochemical reactions with dissolved organic matter. Perhaps surprisingly, *Prochlorococcus* is especially sensitive to hydrogen peroxide (HOOH), as it lacks catalase and other protective mechanisms found in other aerobes. However, *Prochlorococcus* does not grow in the ocean as a pure culture, and we have observed in laboratory and field experiments that the co-existing heterotrophic bacteria are able to decrease the hydrogen peroxide concentration to levels that *Prochlorococcus* can tolerate. In return, *Prochlorococcus* provides the heterotrophs with fixed carbon. Through their active depletion of HOOH, heterotrophic bacteria protect the photosystems of *Prochlorococcus* from oxidative damage, and provide these cyanobacteria with a level of ROS protection that approaches their own.

Bio: Dr. Erik Zinser is an assistant professor of the Department of Microbiology at the University of Tennessee. The primary focus of his research group is to explore the relationships between physiology, ecology, and the forces of selection. He uses a combination of field ecology and laboratory experimentation to explore adaptation in natural microbial populations and in cultured representatives of those populations. His current interests are aimed at understanding how temperature and the presence of other microbes influences *Prochlorococcus* physiology and distribution in nature.

The Role of Pocket Plasticity in the ERα Modulation by Arg394

Zhang Ai-Qian
Abstract: Breast cancer is the most common malignant tumor among women, which accounts for 18% of all cancer deaths, and environmental contaminants leading to either estrogen deprivation or estrogen synthesis may exert a clear impact on breast cancer development. Moreover, the conformation adaptation of estrogen receptor alpha (ERα) helps to accommodate structure-diverse ligands due to pocket plasticity. However, data in molecular levels about such induced fit effects are still insufficient, and the role of amino acid arginine394 (Arg394) in conformation adaptation has not been well understand and determined. Herein, a flexible docking approach was used to characterize the molecular interaction of nine estradiol derivatives with ERα in the ligand-binding domain. Particular attention was focused on the role of side chain of Arg394. Closer inspection of the results of the present study suggested that Arg394 should be regarded as a considerable part of the flexible residues of active site. In addition, bioassays based on genetically modified yeast strains were used to validate the quality

of molecular simulation because of their rapidity and high sensitivity. The experimental findings about logarithm values of the median effective concentration value had a linear correlation with computational binding affinity from molecular docking, which described a pattern of interaction between estradiol derivatives and ER. Besides, 17α-ethylestradiol-3-cyclopentylether was reported to highly significantly correlate with the induced fit conformational change based upon proof-of-principle calculations on human ERα with the preservation of a strong salt bridge between glutamic acid 353 and Arg394. Our results identified a previously unknown structural plasticity of human ERα.

Bio: Prof. Dr. ZHANG AI-QIAN directs a research group focusing on theoretical environmental chemistry and environmental computational toxicology in State Key Laboratory of Environmental Chemistry and Ecotoxicity, Research Center of Eco-Environmental Sciences, Chinese Academy of Sciences. She obtained Ph.D. degree from Nanjing University in 1998. Prior to joining Research Center of Eco-Environmental Sciences in 2009, Prof. Zhang worked at School of the Environment, Nanjing University as a full professor, where she launched her independent research career in quantitative structure-activity relationship of organic pollutants. Specific research topics include establishment of prediction models, application of molecular simulation technique in exploring possible toxicity mechanism, and *in silico* target pre-screening.

Population dynamics of an ecologically important marine bacterial clade (Roseobacter) during an induced phytoplankton bloom

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Abstract: The Roseobacter clade is a broadly distributed and biogeochemically relevant group of heterotrophic marine bacteria. Roseobacter abundances tend to be highest in productive regions, such as coastal environments, where they can account for upwards of 30% of bacterioplankton communities. We have been able to delineate several subgroups within this clade that represent the most prevalent sequences in environmental inventories. However, as many of these clusters are poorly represented by cultured isolates, culture-independent investigations of specific subgroup abundances and distributions can facilitate our understanding of their ecological roles. To that end, we developed SYBR Green-based qPCR assays to monitor the relative abundances of specific subpopulations of roseobacters. These qPCR assays were applied to samples collected from a 14-day mesocosm experiment that induced a coccolithophorid algal bloom (Bergen, Norway). The relative abundance of some phylotypes was positively correlated with the abundance of specific phytoplankton (principally Emiliana huxleyi), while others showed a negative correlation. Pyrosequence data for the V3 region of bacterial 16S rRNA genes was highly congruent with that of the qPCR assays and provided relative abundance metrics for additional phylotypes that was subject to a multivariate analysis to obtain insight into the prevalence of phylotypes and specific environmental conditions.

Bio: Alison Buchan is an Assistant Professor of Microbiology at the University of Tennessee. She is also a faculty member of the Oak Ridge National Laboratory and UT Graduate Program in Genome Science and Technology as well as the UT Center for Environmental Biotechnology. She holds post-graduate degrees in Microbiology and Marine Sciences from the University of Georgia and was awarded a 2003 NSF Postdoctoral Fellowship in Microbial Biology to work with L. N. Ornston at Yale University to study the molecular basis of function in proteins involved in aromatic monomer catabolism in *Acinetobacter* sp. ADP1, a model bacterium for genetic engineering. Her current research focuses primarily on the ecology and physiology of marine *Roseobacter* bacteria. Dr. Buchan currently serves on the editorial boards for *Applied and Environmental Microbiology* and the new journal *Frontiers in Microbiology-Aquatic Microbiology.*

Reduction of Atmospheric PCDD/Fs during the Beijing 2008 Olympic Games

Li Ying-Ming
Abstract: A total of 120 air samples were collected using high-volume air samplers in summer of 2007-2010, to investigate current contamination levels and temporal variations of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) in the atmosphere of Beijing, and further to assess the effectiveness of emission control measures during the Beijing 2008 Olympic Games on reducing atmospheric PCDD/Fs. PCDD/Fs concentrations were typically in the range of 222-27124 fg m^{-3} (5.2-471 fg I-TEQ m^{-3}). PCDD/Fs showed a declining trend as function of time. During the Beijing Olympic Games, PCDD/Fs levels decreased to an average value of 63 fg I-TEQ m^{-3}, showing a ~70% reduction compared to the measurements in 2007 (average 240 fg I-TEQ m^{-3}). Also, for all urban sites, the PCDD/Fs and total suspended particulates (TSP) presented significantly lower concentrations during the Olympic Games period than those before the event ($P < 0.05$). However, PCDD/Fs levels increased after the Olympic Games, which could be due to the increased emissions from traffic vehicles and other industrial or anthropogenic activities rather than the meteorological effect. Atmospheric half-lives of PCDD/Fs were estimated to be 2.1-5.8 years by statistically aggressing PCDD/F concentrations as a function of time. From the results of this study, we conclude that the implementation of emission control measures including vehicle restrictions has contributed to the PCDD/Fs reductions in the atmosphere and to the improvement of the air quality during the Beijing 2008 Olympic Games.

Bio: Yingming Li is an assistant professor in the Research Center of Eco-environmental Sciences (RCEES), Chinese Academy of Sciences, Beijing, China. Li obtained his Ph.D. in Environmental Sciences from RCEES in 2008. His research interest is focused on the analysis and investigation on the environmental contamination of persistent organic pollutants (PCDD/Fs, PCBs and PBDEs), especially on their environmental distribution, partition and fate between multi environmental compartments; method development and regional application of passive air sampling technique to investigate sources and long range transportation of these persistent organic pollutants from contaminated region to urban, rural and remote areas. Dr. Li has published more than 10 papers in peer-reviewed scientific journals in the field of environmental sciences.

Assessment of the impact of Carboxylated and PEGylated single-walled nanotubes (SWNT) in an anaerobic environment

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Abstract: Nanomaterials show great potential for a variety of commercial applications that may benefit human health and the environment. Assessment of their environmental impacts is an emerging field of study necessary for development of ecologically responsible manufacture and disposal of these new materials. Carbon-based nanotubes are involved in new biomedical technologies for imaging and drug delivery because of their theoretical capability to penetrate cell membranes. They are challenging to work with in biological systems because of their low solubility; however, the addition of polar functional groups increases their dispersibility in aqueous environments. Their bioavailability is increased through such functionalization reactions. One example currently under investigation for such applications is SWNT functionalized with polyethylene glycol chains (SWNT- PEG). Carboxylated nanotubes (SWNT-COOH) are the base material for SWNT-PEG: the PEG is attached to these nanotubes via an ester bond. SWNT-COOH and SWNT-PEG are potentially bioavailable and bioreactive in the environment. It is important to study their impact on anaerobic microbial communities because the long-term environmental effects of nanotubes remain poorly understood. Nontoxic PEG polymer chains are already released to the environment through wastewater treatment in significant quantities and are rapidly degraded. We assessed microbial community function in response to SWNT-PEG and SWNT-COOH by monitoring methanogenesis in anaerobic digester sludge microcosms treated with up to 12,000 mg nanotube carbon per kg biomass (dw). Functional gene primers were used to detect the *mcrA* gene in treated samples and reference samples. Samples treated with SWNT-COOH showed a significant increase in gas formation. We assessed microbial community structure using PCR-DGGE and domain-level primers for Bacteria, Archaea, and Eukarya. Community shifts are observed over time in SWNT-COOH microcosms.

Bio: Leila Nyberg is a doctoral student in Civil/Environmental Engineering, and in the Ecological Sciences and Engineering Interdisciplinary Graduate Program at Purdue University. She completed her M.S. degree in the same program in May 2008. The title of her thesis is "Assessing the Impact of Nanomaterials on Anaerobic Microbial Communities". She completed her Bachelor of Science in Biology at Kansas State University in 2001. She serves as laboratory instructor for CE 352: Biological Principles of Environmental Engineering. She received the Nellie Munson Teaching Assistant Award in 2008, a Graduate Student Award for Outstanding Teaching in 2009, and the Magoon Award for Excellence in Teaching in 2010. She is also a 2009 and 2010 recipient of the Frederick N. Andrews Environmental Travel Grant. She has mentored six undergraduate students in research experience. Two were Purdue SURF program award winners, and three others presented posters at the Nanotechnology and the Environment Conference in 2008. She is also an education/outreach coordinator for the Scientific Salmon Monitoring Project, a collaborative effort between Purdue scientists and Native Alaskan villages to study health problems of salmon populations on which these villages depend for subsistence. She is also a 2010 EPA STAR Graduate Fellowship recipient.