CHINA • US

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**Joint
Research Center
for Ecosystem and
Environmental Change**

2013 China-US Annual Workshop

Environmental Health and Green Development

绿色合作伙伴计划

ecopartnerships.gov

**November 18-19, 2013
Gatlinburg, Tennessee, USA**

TABLE OF CONTENTS

INTRODUCTION

The China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC) (http://jrceec.utk.edu/) was established in 2006 to enhance collaboration among Chinese and US scientists in (1) ecosystem management and climate change, (2) environmental sustainability of bioenergy production, (3) water resources and quality, and (4) environmental technology. The center's partners include University of Tennessee (UT), Oak Ridge National Laboratory (ORNL), Purdue University, two research institutes of the Chinese Academy of Sciences (CAS)—Institute of Geographic Science and Natural Resources Research and Research Center for Eco-environmental Sciences—and the University of Science and Technology of China.

In May 2011, a JRCEEC-based new partnership, US-China Ecopartnership for Environmental Sustainability (USCEES), was approved by the US Department of State and the National Development and Reform Commission of China within the framework of annual dialogue of US-China Strategic and Economic Development. The overall mission of the USCEES (with a new member—CAS's Institute of Applied Ecology) was summarized by the US Secretary of State Hillary Clinton at the 2011 ceremony for the appointment of new Ecopartnership members.

> "This EcoPartnership program was founded to bring these groups together to share best practices, foster innovation, and encourage sustainable development. Already, the original group of seven eco-partners has generated results, and today, we are admitting six new groups of exciting and promising partners to the list. All of these collaborations have the potential to help us solve some of our most profound environmental challenges and, at the same time, create new jobs in both of our countries. I am confident that these new collaborations will yield innovative solutions, and I look forward to learning more about the results of your work. When it comes to the green economy, local partnerships can have a global impact."

Both JRCEEC and USCEES aim to promote bilateral collaboration to address the interconnected challenges of environmental sustainability, urbanization, rural prosperity, climate change, and food and energy security by leveraging and enhancing the capacity of member universities, research institutes, and industry through the promotion of research collaboration, academic exchange, student education, technology/business development, and policy enhancement. The partnership also accelerates information and technology exchange to generate more effective policy, technology and research solutions for sustainable development.

Sunday, November 17:

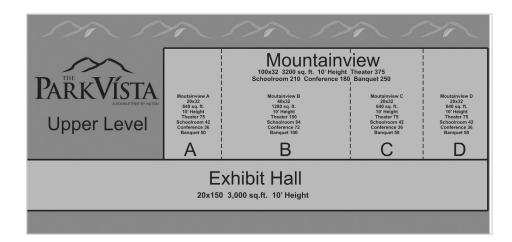- Reception 4:30-6:30pm in Firefly Lounge at Park Vista Hotel

Monday, November 18:

- Morning - Plenary session (Opening Ceremony and Keynote Addresses) in Mountainview AB
- Afternoon - Three breakout sessions:
  - Session 1: Biological Processes of Pollution and Remediation - Mountainview AB
  - Session 2: Agricultural Sustainability and Food Security - Mountainview C
  - Session 3: Environmental Conservation - Mountainview D

Tuesday, November 19:

- All day breakout sessions:
  - Session 1: Environmental Health and Waste Treatment - Mountainview AB
  - Session 2: Global Climate Change and Resources Utilization - Mountainview C
  - Session 3: Technology-Society Interactions - Mountainview D

Lunch on both days will be from 12:00-1:00pm in the Exhibit Hall

AGENDA

Sunday, November 17, 2013
Arrival and Evening Reception
4:30-6:30pm - Park Vista's Firefly Lounge

AGENDA - Monday, November 18, 2013

8:00-8:30	**Continental Breakfast - Exhibit Hall** (just outside meeting rooms)
8:30-12:00	**Opening Ceremony and Keynote Addresses** Location: Mountainview AB Moderator: **Chris Cox,** Chair of the Organizing Committee; Director, ISSE; Professor & Associate Head, Civil & Environmental Engineering; The University of Tennessee
8:30-8:35	Welcome by **Larry Arrington,** Chancellor, UT Institute of Agriculture
8:35-8:40	Welcome by **Gui-Bin Jiang,** Director, RCEES, CAS
8:40-8:45	Welcome by **Taylor Eighmy,** Vice-Chancellor, The University of Tennessee
8:45-8:50	Welcome by **Tony Palumbo,** Director, Biosciences Division, Oak Ridge National Laboratory
8:50-8:55	Welcome by **Sherry Wang,** Program Manager, Tennessee Department of Environment and Conservation
8:55-9:00	Partnership Introduction by **Timothy Filley,** Ecopartnership Director, Purdue University
9:00-9:05	Conference Introduction by **William Brown,** Dean for Research, UT Institute of Agriculture
9:05-9:15	Opening Address by **Gary Sayler,** Scientific Committee Chair, Director of JIBS, UT/ORNL
9:15-9:45	Group Photo and Break - Exhibit Hall
9:45-10:30	Keynote Address by **Thomas Wilbanks,** Oak Ridge National Laboratory Title: Policies and strategies for sustainable development
10:30-11:15	Keynote Address by **Cheng-Hu Zhou,** Chinese Academy of Sciences Title: Assessment of ecosystem rehabilitation compensation in China
11:15-12:00	Keynote Address by **Indrajeet Chaubey,** Purdue University Title: Ecohydrologic impacts of land use, land management, and climate change in the Midwest USA
12:00-13:00	Lunch – Exhibit Hall

AGENDA - Monday, November 18, 2013

13:00-17:15	**Session 1: Biological Processes of Pollution and Remediation** Place: Mountainview AB Chairs: **Alison Buchan,** The University of Tennessee **Guo-Ping Sheng,** University of Science and Technology of China
13:00-13:05	Chairs' Introduction
13:05-13:50	Keynote by **Frank Loeffler,** UT & ORNL Title: Reductive dechlorination: Where microbial ecology meets remediation practice
13:50-14:15	**Bin Zhao,** Chinese Academy of Sciences Title: Advances in understanding the mechanism of dioxin toxicity
14:15-14:40	**Terry Hazen,** The University of Tennessee Title: Microbial community structure predicts groundwater geochemistry at Oak Ridge contaminated and uncontaminated sites
14:40-15:10	Break - Exhibit Hall
Chairs	**Frank Loeffler,** The University of Tennessee **Min-Dong Bai,** Xiamen University
15:10-15:35	**Guo-Ping Sheng,** University of Science and Technology of China Title: A novel electrochemical membrane bioreactor as a potential net energy producer for sustainable wastewater treatment
15:35-16:00	**Alison Buchan,** The University of Tennessee Title: Metabolic response of a marine bacterium to phage infection provides insights into bacterial physiology and ocean biogeochemistry
16:00-16:25	**Xi-Juan Chen,** Chinese Academy of Sciences Title: Removal of personal care products in reed bed sludge treatment processes
16:25-16:50	**Jennifer Debruyn,** The University of Tennessee Title: Ecology of hypereutrophic Lake Taihu, China: Implications for nutrient management strategies
16:50-17:15	**Bao-Hua Gu,** Oak Ridge National Laboratory Title: Biogeochemical transformation of mercury as a global pollutant in the environment
17:45-20:00	Dinner at the Aquarium

AGENDA - Monday, November 18, 2013

13:00-17:15	**Session 2: Agricultural Sustainability and Food Security** Place: Mountainview C Chairs: **Dev Niyogi,** Purdue University **Yun-Sheng Li,** Chinese Academy of Science
13:00-13:05	Chairs' Introduction
13:05-13:50	Keynote by **Xu-Dong Zhang,** Chinese Academy of Sciences Title: Soil carbon and nitrogen cycling and control mechanisms in terrestrial ecosystems of China
13:50-14:15	**Shawn Campagna,** The University of Tennessee Title: Application of targeted metabolomics and chemical tools to understand metabolic function
14:15-14:40	**Sean Schaeffer,** The University of Tennessee Title: Soil carbon cycling and nitrogen retention under different conservation management practices in west Tennessee agroecosystems
14:40-15:10	Break - Exhibit Hall
Chairs	**Sean Schaeffer,** The University of Tennessee **Xu-Dong Zhang,** Chinese Academy of Sciences
15:10-15:35	**Jing-Kuan Wang,** Shenyang Agricultural University Title: Studies on cultivated soil quality and foodstuff productivity in black soil area in Northeastern China
15:35-16:00	**Dev Niyogi,** Purdue University Title: Towards climate ready agriculture and urban landscapes
16:00-16:25	**Yun-Sheng Li,** Chinese Academy of Sciences Title: No-till agricultural adoption in North China Plain
16:25-16:50	**Jian-Min Tao,** College of Horticulture, Nanjing Agricultural University Title: Protected culture of grape industry in China and its cultivation techniques
16:50-17:15	**Rachel Carnegie** and **Holly H. Wang,** Purdue University Title: Economic issues on Chinese food safety
17:45-20:00	Dinner at the Aquarium

AGENDA - Monday, November 18, 2013

13:00-17:15	**Session 3: Environmental Conservation** Place: Mountainview D Chairs: **Mark Radosevich,** The University of Tennessee **Cheng-Hu Zhou,** Chinese Academy of Sciences
13:00-13:05	Chairs' Introduction
13:05-13:50	Keynote **Shu-Zhong Gu,** Development Research Center, State Council of China Title: Background, aims, emphases, and progress of ecological civilization construction in China
13:50-14:15	**Timothy Filley,** Purdue University Title: Surface oxidation controls on decay pathways for condensed aromatic carbon in the terrestrial environment
14:15-14:40	**Paul Armsworth,** The University of Tennessee Title: Designing cost effective conservation payment programs
14:40-15:10	Break - Exhibit Hall
Chairs	**Paul Armsworth,** The University of Tennessee **Jing-Kuan Wang,** Shenyang Agricultural University
15:10-15:35	**Tim Ezzel** and **Catherine Wilt,** The University of Tennessee Title: Dark Skies, Bright Asset: Creative Economic Development Opportunities in Rural West Virginia
15:35-16:00	**Mark Radosevich,** The University of Tennessee Title: Effect of pyrolysis temperature on biochar mineralization, nitrification potential, and microbial community composition of biochar-amended soil
16:00-16:15	**Johanna Desprez,** Purdue University Title: Long-term sustainability of forest ecosystems in the eastern United States
16:15-16:40	**Charles Sims,** The University of Tennessee Title**:** How ecosystem service provision can increase forest mortality from insect outbreaks
16:40-17:05	**Xu-Xiang Zhang,** Nanjing University Title: Fates of antibiotic resistance genes and their correlations with bacterial communities in municipal sewage treatment plants revealed using high-throughput sequencing
17:05-17:20	**Tatiana Vishnivetskaya,** The University of Tennessee Title: Metagenomic and metaproteomic analyses of microbial communities in the Canadian high Arctic permafrost
17:45-20:00	Dinner at the Aquarium

AGENDA - Tuesday, November 19, 2013

8:00-8:30	Continental Breakfast - Exhibit Hall (outside meeting rooms)
8:30-17:00	**Session 1: Environmental Health and Waste Treatment** Place: Mountainview AB Chairs: **Chris Cox,** The University of Tennessee **Jian-Ming Xu,** Zhejiang University
8:30-8:35	Chairs' Introduction
8:35-9:20	Keynote by **Chuan-Yong Jing,** Chinese Academy of Sciences Title: Arsenic exposure, removal, and health implications in typical areas in China
9:20-9:45	**Jian-Ming Xu,** Zhejiang University Title: Human health risk assessment of heavy metals in soil-vegetable system
9:45-10:10	**Yuji Arai,** University of Illinois at Urban Champaign Title: Chemical transformation and toxicity of engineered nanoparticles in anaerobic soil environments
10:10-10:40	Break - Exhibit Hall
10:40-11:05	**Min-Dong Bai,** Xiamen University Title: Rapid treatment of ship's ballast water using OH radicals produced from strong ionization discharge based on IMO guidelines
11:05-11:30	**Qing-Jun Guo,** Chinese Academy of Sciences Title: Application of stable isotopes in environmental quality assessment and research on remediation technology
11:30-11:55	**Feng Yu,** Purdue University Title: **L-THIA-C: A practical model for planners to use in assessing and managing the impacts of land-use change on long-term runoff and non-point source pollution**
12:00-13:00	Lunch – Exhibit Hall
Chairs	**Steven Ripp,** The University of Tennessee **Bin Zhao,** Chinese Academy of Sciences
13:00-13:45	Keynote by **Jeremy Smith,** UT and Oak Ridge National Laboratory Title: Mercury: Toxication and detoxication
13:45-14:10	**Yang Mu,** University of Science and Technology of China Title: Mathematic modeling of ZVI-based anaerobic system
14:10-14:35	**Zhong-Hua Tong,** University of Science and Technology of China Title: Toxicity of imidazolium-based ionic liquids on *Caenorhabditis elegans*
14:35-15:10	Break- Exhibit Hall
15:10-16:10	Panel Meeting on **Systems Biology for Environmental Remediation** (open to all) **Panelists:** Terry Hazen, Gary Sayler, Gui-Bin Jiang, Jennifer Debruyn, Alison Buchan, Chris Cox, Jeremy Smith, Chuan-Yong Jing, Frank Loeffler, Mark Radosevich, Bin Zhao, Guo-Ping Sheng, Yang Mu, Xu-Xiang Zhang, Yuji Arai, Min-Dong Bai, Steven Ripp, Jian-Ming Xu, Qing-Jun Guo, Zhi-Tao Zhang
16:10-17:00	Closing Ceremony – **Plenary session in Mountainview AB** (see page 12)

AGENDA - Tuesday, November 19, 2013

8:00-8:30	Continental Breakfast - Exhibit Hall (outside meeting rooms)
8:30-17:00	**Session 2: Global Climate Change and Resources Utilization** Place: Mountainview C Chairs: **Timothy Filley,** Purdue University **Fei Lu,** Chinese Academy of Sciences
8:30-8:35	Chairs' Introduction
8:35-9:20	Keynote by **Bernard Engel,** Purdue University Title: Water resources decision support systems: Examination of successful systems and a look to the future
9:20-9:45	**Wei-Ping Chen,** Chinese Academy of Sciences Title: Reclaimed water: A safety irrigation water source?
9:45-10:10	**Ying-Kui Li,** The University of Tennessee Title: Permafrost-driven lake dynamics across the Tibetan Plateau in recent decades
10:10-10:40	Break - Exhibit Hall
10:40-11:05	**Melanie Mayes,** Oak Ridge National Laboratory Title: Incorporating microbial mechanisms into climate models
11:05-11:30	**Jennifer Jurado,** Broward County, Florida Title: The Southeast Florida Regional Climate Change Compact - A regional strategy for building climate resilience through policy, planning and action
11:30-11:55	**Lan-Fang Wu,** Chinese Academy of Sciences Title: CO_2 and N_2O emissions from cultivated soil with crop residues retention under different tillage in the North China Plain
12:00-13:00	Lunch – Exhibit Hall
Chairs	**Wei-Ping Chen,** Chinese Academy of Sciences **Melanie Mayes,** Oak Ridge National Laboratory
13:00-13:25	**Jiang-Yu Mao,** Chinese Academy of Sciences Title: Aerosol radiative effects in LASG/IAP model and projected change in East Asia
13:25-13:50	**Erik Zinser,** The University of Tennessee Title: Patterns of distribution of the numerically abundant photosynthetic bacterium *Prochlorococcus* in relation to temperature and other climate change variables
13:50-14:15	**Fei Lu,** Chinese Academy of Sciences Title: Greenhouse gas emissions from the Three Gorges Reservoir
14:15-14:40	**Yao-Ze Liu,** Purdue University Title: Evaluation of best management practices (BMPs) and low impact development (LID) practices with improved L-THIA-LID model
14:40-15:10	Break - Exhibit Hall
15:10-16:10	Panel Meeting on **Climate-Land Nexus and Modeling** (open to all) **Panelists**: Tim Filley, Wei-Ping Chen, Paul Armsworth, Sherry Wang, Cheng-Hu Zhou, Gui-Rui Yu, Bernard Engel, Erik Zinser, Ying-Kui Li, Melanie Mayes, Jing-Kuan Wang, Sean Schaeffer, Jiang-Yu Mao, Jennifer Jurado, Dev Niyogi, Charles Sims
16:10-17:00	Closing Ceremony –**Plenary session in Mountainview AB** (see page 12)

AGENDA - Tuesday, November 19, 2013

8:00-8:30	Continental Breakfast - Exhibit Hall (outside meeting rooms)
8:30-17:00	**Session 3: Technology-Society Interactions** Place: Mountainview D Chairs: **Virginia Dale,** Oak Ridge National Laboratory **Ren-Jie Dong,** China Agricultural University
8:30-8:35	Chairs' Introduction
8:35-9:20	Keynote by **Joe Francis,** Nebraska Department of Environment Title: A success story: Environmental decision making–Getting new technologies accepted
9:20-9:45	**Sherry Wang,** Tennessee Department of Environment and Conservation Title: An overview of Tennessee's eco-region based watershed management approach
9:45-10:10	**Virginia Dale,** Oak Ridge National Laboratory Title: Bioenergy sustainability: Research needs and deployment possibilities
10:10-10:40	Break – Exhibit Hall
10:40-11:05	**Ren-Jie Dong,** China Agricultural University Title: Dialectical relationship: Bioenergy importance for securities of energy vs. environment
11:05-11:30	**Liem Tran,** The University of Tennessee Title**:** Regional integrated environmental assessment in the US: Progress and challenges
11:30-11:55	**Ming Fan,** Procter and Gambles Title: Probabilistic environmental risk assessment for polycyclic musks in surface waters in two Chinese cities compared to the United States
12:00-13:00	Lunch – Exhibit Hall
Chairs	**Sherry Wang,** Tennessee Department of Environment & Conservation **Liem Tran,** The University of Tennessee
13:00-13:25	**Timothy Rials,** The University of Tennessee Title: Short-rotation woody crops as feedstock for alternative fuels
13:25-13:50	**Barry Bruce,** The University of Tennessee Title: Growing electricity: Strategies for improved biosolar energy conversion
13:50-14:15	**Philip Ye,** The University of Tennessee Title: Challenges and progress in the conversion of crude glycerol for high-value chemicals
14:15-14:40	**Shi-Rong Guo,** Nanjing Agricultural University Title: Analysis of general situation, characteristics, existing problems and development trend of protected horticulture in China
14:40-15:10	Break
15:10-16:10	Panel Meeting on **Biomass Production for Rural Sustainability** (open to all) **Panelists**: Virginia Dale, Ren-Jie Dong, Joe Francis, Shu-Zhong Gu, Tom Wilbanks, Indrajeet Chaubey, Xu-Dong Zhang, Tim Rials, Barry Bruce, Philip Ye, Liem Tran, Jie Zhuang, Shi-Rong Guo, Max Cheng, Tim Ezzell, Cat Wilt
16:10-17:00	Closing Ceremony –**Plenary session in Mountainview AB** (see page 12)

AGENDA - Tuesday, November 19, 2013

16:10-17:00	**Closing Ceremony -** Place: Mountainview AB Moderator: **Joe Zhuang**
	Conference Summary by **Gary Sayler,** Director of UT-ORNL JIBS
	Panel Meeting Summary by **Terry Hazen, Tim Filley,** and **Virginia Dale**
	Closing Remarks by **Gui-Bin Jiang,** Director of RCEES, CAS
	Announcement of the 2014 Annual Conference by **Chris Cox,** Director of ISSE, UT
17:00-19:00	Conference Ends; Dinner at Hotel in Garden View Room CD (downstairs)

AGENDA - Wednesday and Thursday , November 20-21, 2013

Certain individuals have requested post-Conference research activities, including Laboratory tour, Group Meetings, Academic Visits, and a Field Trip to the Everglades Wetland Site

Abstracts

Arranged Alphabetically by Presenters' Last Name

Yuji Arai

Department of Natural Resourecs and Environmental Sciences University of Illinois at Urbana-Champaign

Title: **Chemical transformation and toxicity of engineered nanoparticles in anaerobic soil environments**

ABSTRACT: Aquatic toxicity of engineered nanoparticles (ENPs) to various microorganisms has been extensively studied in the past decades. However, it is poorly understood that how the current toxicological data can be applied to the terrestrial system where ENPs and the reaction products are expected to retain in soils and sediments. To improve our understanding in the fate of ENPs in the environment, silver nanoparticles (15–60nm, uncoated, coated with 0.3% polyvinylpyrrolidone, or coated with 90% polyvinylpyrrolidone) and cerium oxide nanoparticles (uncoated 25-100 nm) were used as model ENPs because of soft and hard acidic characteristics of metals. Batch sorption and dissolution experiments were coupled with dynamic light scattering, zeta potential measurements, synchrotron based X-ray techniques to elucidate the chemical re- activity and transformation of ENPs in reduced soils. Denitrifying bacteria were chosen as a model bacteria community to assess the effects of ENPs in soils because of its critical role in sustaining nitrogen cycles. The impact of ENPs on denitrifi- cation kinetics will discussed along with the chemical reactivity and speciation of ENPs in reduced soils. The results of this study should highlight the importance of environmental media, soils, could potentially alter the biogeochemical behavior of ENPs in environment.

Paul Armsworth

The University of Tennessee

Title: **Designing cost effective conservation payment programs**

ABSTRACT: Incentive payment programs to private landowners provide a center-piece of conservation strategies in many parts of the world. We examine how payment programs can be designed to provide cost effective improvements in biodi- versity, using 44 extensive livestock farms in northern England as a case study and bird species as an indicator of biodiver- sity. We first estimate the "true" supply price to farmers of producing improvements in different biodiversity targets. We then derive the optimal (i.e. most cost effective) program design for each target. This provides a benchmark against which to compare the cost effectiveness of simpler, more readily implemented, payment programs.

Existing payment schemes appear cost ineffective and primarily act to subsidize farm profits. The optimal policy exploits variation in costs of producing biodiversity enhancements within and among farms. However such a policy would be pro- hibitively complex to administer. By comparing alternative, simpler policies to the optimal policy, we show that common simplifications in payment scheme design can result in 49-100% of promised biodiversity gains being given up. Moreover, we are able to identify which policy simplifications are most problematic. Spatially differentiating pricing for biodiversity improvements is critical to the success of such programs, a finding that is robust to idiosyncratic responses of different bio- diversity targets to management actions.

We also examine the scope two widely discussed policy alternatives, reverse auctions and allowing farmers to enter schemes as cooperatives, to enhance the cost effectiveness of incentive payment programs to deliver improvements in bio- diversity.

Min-Dong Bai[1,2],Zhi-tao Zhang[2], Na-hui Zhang[2], Yi-ping Tian[2], Xiang-ying Meng[2], and Cao Chen[2]

[1]Key Laboratory of Education Ministry for Coastal and Wetland Ecosystems, College of Environment and Ecology, Xiamen University
[2]Environmental Engineering Institute, Physics Department, Dalian Maritime University

Title: **Rapid treatment of ship's ballast water using •OH radicals produced from strong ionization discharge based on IMO guidelines**

ABSTRACT: The rapid treatment of ship's ballast water is achieved with hydroxyl radicals (•OH) generated from a strong ionization discharge combined with numbers of micro-streamer and micro-glow discharges. Production of •OH radicals and plasma reaction mechanisms are discussed, and a method for •OH radicals measurement in seawater is developed. A series of •OH treatment experiments for ship's ballast water were conducted based on the International Maritime Organiza- tion Guidelines. As a result, five species of algae from three different phyla and three types of bacteria were killed by •OH radicals in compliance with the D-2 ballast water discharge standard. Ship's ballast water could be rapidly treated onboard during ballast water discharge with only 6 s required. Meanwhile, the quality of ballast water with heavy pollution was greatly improved. The possible relevant chemicals (RCs) produced from the reactions between •OH radicals and natural organic matter were also analyzed. The concentrations of the measured RCs were within the World Health Organization

drinking water standard, indicating that ballast water after •OH treatment is safe to oceanic environments. Compared with the current methods, the •OH treatment of ship's ballast water developed herein is an effective technology for practical application in oceanic ships in the future.

Barry Bruce
The University of Tennessee

Title: **Growing electricity: Strategies for improved biosolar energy conversion**

ABSTRACT: Recent efforts have demonstrated the ability of photosynthetic complexes to be directly utilized for the production of hydrogen or electricity. In particular, Photosystem I has been shown to be a robust photoactive nanoparticle capable of generating both hydrogen and electricity in vitro. For the past 12 years we have been exploring various means to utilize both plant and cyanobacterial PSI preparations in these applied photosynthetic efforts. Despite our earlier proof-of-principal work in there is still considerable progress to be made to improve both the efficiency and spectral response of these devices. I will provide an update on our current efforts to improve the rates of electron transfer in and out of PSI, improve the electronic coupling of PSI with both organic and inorganic conductive material, and extend the spectral range of energy conversion. Specifically, we will explore electron transfer to P700+ from natural and non-natural donors, transfer of electrons to nano-catalysts and metal oxide semiconductors, and integration of phycobilisomes into light harvesting devices.

Alison Buchan
The University of Tennessee

Title: **Metabolic response of a marine bacterium to phage infection provides insights into bacterial physiology and ocean biogeochemistry**

ABSTRACT: It is well established that host cells provide metabolic resources for virus replication. However, the extent to which infection reshapes host metabolism at a global level and the effect of this alteration on the cellular material released following viral lysis is less understood. To address this knowledge gap, a targeted liquid chromatography-tandem mass spectrometry metabolomics approach was used to quantify global intracellular metabolite changes in cultures and extracellular lysate profiles of a phage-infected bacterium from the abundant marine Roseobacter lineage. Intracellular concentrations for 82 metabolites were measured at seven time points over the infection cycle. By the end of this period, 71% of the detected metabolites were significantly elevated in infected populations, and stable-isotope based flux measurements showed that these cells had elevated metabolic activity. Measurable extracellular metabolites were significantly altered by the presence of phage, including enrichments in select amino acids. Quantitative estimates of the total amount of carbon and nitrogen sequestered into particulate biomass indicate that phage infection redirects ~75% of nutrients into virions. These results indicate that virus-infected cells are physiologically distinct from their uninfected counterparts, which has implications for microbial community ecology and biogeochemistry.

Shawn Campagna
Chemistry Department, The University of Tennessee

Title: **Application of targeted metabolomics and chemical tools to understand metabolic function**

ABSTRACT: Our lab uses an interdisciplinary approach that relies heavily on liquid chromatography–mass spectrometry (LC–MS) based metabolomics to understand medicinally and environmentally relevant microbial processes. The primary analytical platform is an Orbitrap MS with an electrospray ionization source, and the methods employed attempt to measure the concentration (pool size) of ~1000s of analytically tractable, yet chemically diverse, water and lipid soluble metabolites from all kingdoms of life. These methods measure at least one metabolite from all known carbon and nitrogen utilization pathways, the activated methyl cycle, all amino acid and nucleotide biosynthesis pathways, as well as lipids with diverse head groups; and the average coverage for each major pathway is ~65%. The utility of these metabolomics methods can be enhanced by monitoring the incorporation of stable isotope-labeled nutrient sources, either ^{15}N or ^{13}C, into the metabolome using kinetic flux profiling techniques (KFP). When coupled, pool size determination and KFP can be used to determine both the amounts of metabolites within and relative rates of flux through many biochemical pathways *in vivo* and allow a global snapshot of cellular metabolism to be obtained from a single set of experiments. Several vignettes from our work studying bacterial cell-cell signaling (quorum sensing), microbial nutrient cycling by marine organisms, and novel biochemical pathways in yeast will be discussed to highlight the utility of applying these metabolomics tools to probe complex biological systems and to provide insight into the mechanisms that consortia of microogranisms utilize to cooperatively and/or competitively dictate resource utilization.

Rachel A. Carnegie and Holly H. Wang
Department of Agricultural Economics, Purdue University

Title: **Economic issues on Chinese food safety**

ABSTRACT: Alongside China's rapid economic growth, industrialization, and urbanization is an alarming deterioration of the eco-system in the form of polluted air, water, and soil. This pollution not only presents direct hazards to human health, but also indirect hazards via the contamination of food and agricultural production systems. Numerous recent food safety scandals, such as the 2008 melamine adulterated milk incident, have set off the alarm to consumers and severely undermined their confidence in Chinese produced foods both domestically and globally. Meanwhile, food produced in countries with higher food safety standards is favored. This study builds upon a body of work related to consumer and producer preferences for food safety, specifically for meat products, such as pork and duck that are available in urban restaurants and supermarkets.

Indrajeet Chaubey

Department of Earth, Atmospheric and Planetary Sciences and Department of Agricultural and Biological Engineering, Purdue University

Title: **Ecohydrologic impacts of land use, land management, and climate change in Midwest USA**

ABSTRACT: In recent years, land use changes associated with agricultural intensification to meet increased food, feed, and bioenergy demand has resulted in many unintended consequences, including accelerated soil erosion, losses of nutrients and pesticides to receiving waters, and habitat degradation. Further, these unintended consequences may be exacerbated by climate variability and change. Managing these ecosystems require that land use changes are managed such that food, feed, and energy crops are produced in environmentally sustainable and economically viable manner.

Our research group has been evaluating ecohydrologic impacts of land use and land management in agricultural and mixed use watersheds. Our research indicates that a global shift to continuous corn production would greatly impact hydrologic impacts by altering runoff and percolation. It will also increase losses of nitrogen, phosphorus and sediment to receiving waterbodies. If crop residue is also removed to serve as a bioenergy feedstrock, erosion and sediment losses will further increase due to loss of ground cover. In rainfed regions, no-till or reduce till practices cold mitigate erosion losses. If the crop residue is to be removed from corn-production fields, it should be done in areas with relatively flat topography (slope <2%). Further, our research indicates that producing perennial energy crops will slightly decrease surface runoff. However, infiltration and evapotranspiration losses could be relatively larger compared to grain crops due to longer growing season. Perennial crops, however, may have significant water quality benefits. Production of perennial crops will significantly reduce erosion, and losses of nitrogen and phosphorus compared to traditional agricultural crops. These dedicated energy crops are also very suited to be produced in marginal agricultural land where grain crop production may not be profitable. We have also evaluated impacts of various cropping systems on losses of green-house gases.

In this presentation, I will review some of the advances in quantifying impacts of land use and land management on ecohydrology, water quality, and green-house gas emissions. I will also discuss various strategies to optimize resource allocation and working with farmers to use optimization as an adaptive management strategy.

Wei-Ping Chen

State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences

Title: **Reclaimed water: A safety irrigation water source?**

ABSTRACT: Wastewater reclamation and reuse are recognized as key components of water resource management worldwide. An overwhelming majority of the reclaimed wastewater is used for irrigation. As irrigation water resource, reclaimed water can provide the soils with nutrients and organic matter, and thus promote sustainability. However, reclaimed water may be high in salts and containing heavy metals and emerging contaminants like PPCPs. The safety of reuse of such water for irrigation is doubted. Its impacts were depending on the quality of reclaimed water, irrigation rate, soil properties, and crop usage. By combining the field investigation and model simulation results, we systematically analyzed the ecological risk posed by reclaimed water irrigation regarding plant growth, groundwater quality and public health. Studies showed that salt and salt ions were the major risk sources of reclaimed water irrigation, spreading disease was another potential risk of using reclaimed water, and emerging pollutants was the hot topic in researches of ecological risk. Based on overseas experiences, risk control measures on reclaimed water irrigation in urban green space and farmland were proposed. Five recommendations were given to promote the safe use of reclaimed water irrigation including (1) strengthen long-term in situ monitoring, (2) promote the modeling studies, (3) build up the connections of reclaimed water quality, irrigation management and ecological risk, (4) evaluate the soil bearing capacity of reclaimed water irrigation, (5) and establish risk management system of reclaimed water reuse.

Xi-Juan Chen[1], Udo Pauly[2], Stefen Rehfus[2], and Kai Bester[3]

[1]Institute of Applied Ecology, Chinese Academy of Sciences
[2]Eko-plant, Neu-Eichenberg, Germany
[3]Department of Environmental Science, Aarhus University, Denmark

Title: **Removal of personal care products in reed bed sludge treatment processes**

ABSTRACT: Sludge reed beds have been used for dewatering (draining and evapotranspiration) and mineralisation of sludge in Europe since 1988. Although reed beds are considered as a low cost and low contamination method in reducing volume, breaking down organic matter and increasing the density of sludge, however weather this enhanced biological treatment is suitable for degradation of personal care products, is not fully elucidated. This project has pointed out the benefits of using the biological sludge treatment plant to reduce personal care products, and the capacity of plants to affect the treatment process.

The results showed that the reed bed sludge treatment technology is able to reduce persistent organic pollutant such as bis(2-ethylhexyl) phthalate (DEHP), 2,4,4´-trichloro-2´hydroxydiphenylether (triclosan), 1-(2,3,8,8-tetramethyl-1,2,3,4,5,6,7,8-octahydro-naphthalen-2-yl) ethan-1-one (OTNE), 1,3,4,6,7,8- hexahydro-4,6,6,7,8,8- hexamethylcyclopenta-(g)-2-benzopyran (HHCB) and 7-acetyl-1,1,3,4,4,6 hexamethyl-1,2,3,4 tetrahydronaphthalene (AHTN) significantly. HHCB and AHTN degraded faster in the top layer, while no significant differences were detected in degradation of OTNE, triclosan and DEHP in top and bottom layers, which indicates different regimes in the different layers and different degradation processes in the respective layers.

Considering half-lives of 300 to 900 days, this sludge reed bed can remove more than 90% of HHCB, AHTN, DEHP, triclosan and OTNE in its 10 years production cycle. If the sludge is to be used as fertilizer in agriculture the use of reed bed treatments can help considerably to decrease the contamination of sludge. An accounting of material flows in addition showed that only a small fraction (<1%) of the target substances was washed out (leached) with the effluent and the uptake of personal care products into the biomass of the macrophytes can also be neglected.

Virginia H. Dale

Oak Ridge National Laboratory

Title: **Bioenergy sustainability: Research needs and deployment possibilities**

ABSTRACT: Indicators are needed to assess both socioeconomic and environmental sustainability of bioenergy systems. Effective indicators can help to identify and quantify the sustainability attributes of bioenergy options. A team at Oak Ridge National Laboratory (ORNL) has selected key indicators of bioenergy sustainability and proposed how they are best used in particular contexts. The analysis addressed three goals: (1) choosing from the plethora of indicators proposed by many groups those that appear to be most useful to decision makers; (2) selecting measures of sustainability that are applicable across the entire bioenergy supply chain; and (3) identifying a minimum set of indicators that are practical, doable and incorporate key areas of interest to science. The proposed environmental and socioeconomic indicators represent a suite designed to reflect major sustainability considerations for bioenergy. McBride et al. (2011) identify major environmental categories of sustainability to be soil quality, water quality and quantity, greenhouse gases, biodiversity, air quality, and productivity and discussed 19 indicators that fit into those categories. Dale et al. (2013a) identify 16 socioeconomic indicators that fall into the categories of social well-being, energy security, trade, profitability, resource conservation, and social acceptability. Ten of those 16 socioeconomic indicators are proposed as a minimum list of practical measures of socioeconomic aspects of bioenergy sustainability. The utility of each indicator, methods for its measurement, and applications appropriate for the context of particular bioenergy systems are described along with future research needs. Together, this suite of indicators is hypothesized to reflect major enviroenmental and socioeconomic effects of the full supply chain for bioenergy, including feedstock production and logistics, conversion to biofuels, biofuel logistics and biofuel end uses. These indicators provide a basis to quantify and evaluate sustainability of bioenergy systems across many regions in which they are being deployed. For example, they have recenty be used to consider the sustainability implications of using Eucalyptus for bioenergy in the southeastern United States (Dale et al. 2013b).

The importance of interpreting these indicators of bioenergy sustainability in particular contexts is described in Efroymson et al. (2013). The context of an application strongly affects the choice, measurement and interpretation of sustainability indicators. Context considerations include the purpose of the analysis, the specific fuel production and distribution system, policy influences, stakeholders and their values, baseline attributes, available information, and spatial and temporal scales of interest (Efroymson et al. 2013). Knowing the context is essential for setting priorities for assessment, defining the purpose, setting the temporal and spatial boundaries for consideration, and determining practicality and utility of measures.

The ORNL team has also worked with agronmists to analyze how agricultural sustainability can consider the effects of farm activities on social, economic, and environmental conditions at local and regional scales (Dale et al. 2013c). Adoption

of more sustainable agricultural practices entails defining sustainability, developing easily measured indicators of sustainability, moving toward integrated agricultural systems, and offering incentives or imposing regulations to affect farmer behavior. Furthermore, our paper on "Communicating about bioenergy sustainability" addresses the challenges of communicating scientific information as a means to resolve controversies about bioenergy policies and misconceptions about opportunities (Dale et al. 2013d).

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Title: **Ecology of hypereutrophic Lake Taihu, China: implications for nutrient management strategies**

ABSTRACT: Anthropogenic nutrient over-enrichment (eutrophication) in freshwater ecosystems has promoted global proliferation of harmful blue-green algal (cyanobacterial) blooms (CyanoHABs). \These blooms foul waterways and water intakes, disrupt food webs, fuel hypoxia, and produce secondary metabolites that are toxic to water consumers and users; including zooplankton, fish, shellfish, cattle, domestic pets, and humans. Recent work has shown that this problem is exacerbated and complicated by climate change, specifically global warming, which favors CyanoHAB proliferation. CyanoHABs now threaten the use and sustainability of the world's largest lake ecosystems, including China's 3rd largest lake, Taihu, a previously pristine lake supplying the drinking water needs of ~8-12 million people and serving as a diverse fishery, tourism and as cultural center. In recent years, Taihu has experienced CyanoHABs so severe that human water use has had to be curtailed. The overarching goal of our interdisciplinary research is to understand the causes, abiotic influences and biotic interactions resulting in these massive blooms in order to inform remediation strategies. Implementation of nutrient management strategies can only be successful if they are ecologically-constrained i.e. selecting for desirable species (e.g., non-toxin producing genera). Our research group has applied molecular, toxicological, biogeochemical, and geohydrologic approaches to understand the Lake Taihu system. While excessive phosphorus (P) inputs are typically blamed for eutrophication in freshwater systems, our work revealed that excessive inputs of both P and nitrogen (N) stemming from rapidly increasing urbanization, industrialization and agricultural activities in the Taihu watershed are responsible for the proliferation and persistence of toxic CyanoHABs. Indeed, while P loading plays an important role in regulating phytoplankton biomass, our recent findings suggest that N loading in Taihu and other lakes controls phytoplankton community structure. Molecular data has revealed an even more nuanced story: not only does the amount of N matter, but also the speciation. Metagenomic analysis of Taihu reveals that inputs of organic N may be selecting for toxic cyanobacterial species. Ongoing research efforts are underway to continue to quantify and model the inputs and cycling of N, linking organismal genetics to biogeochemical cycles in the lake.

Johanna Desprez and Songlin Fei

Department of Forestry and Natural Resources, Purdue University

Title: **Long-term sustainability of forest ecosystems in the eastern United States**

ABSTRACT: North American forests provide a wide variety of vital ecosystem services, contributing an equivalent of 76% of North America's net carbon (C) uptake in recent years. The eastern forest removes more C from the atmosphere than any other comparable forest region in North America, and is a significant source of clean water to ecosystems in the eastern U.S. In this region, oak-hickory forests are the main C sink, holding over 7.4 billion metric tons above-ground biomass (30% of the eastern forest), but are declining substantially and being replaced by shade-tolerant species such as red maple. A large scale composition change will reduce the region's C storage capacity. In order to gain a comprehensive understanding of forest dynamics, we used Forest Inventory and Analysis (FIA) data to qualify changes in abundance of the ten most common genera during the period between the 1980s and 2000s across the eastern U.S. A decrease in abundance was observed for Carya, Pinus, Populus, Quercus and Betula genera, while an increase in abundance was observed for Acer, Fraxinus and Prunus genera. Ulmus and Nyssa did not have a uniform pattern at the genus level but had fluctuations in different geographic regions. Our results indicate an overall trend of forest mesophication in eastern U.S. Fire suppression, along with other major drivers such as land use change, invasive species, and climate change could be responsible for the observed shift. To ensure the sustainability of the eastern forest, management techniques need to be tailored towards local conditions.

Ren-Jie Dong

China Agricultural University

Title: **Dialectical relationship: Bioenergy importance for securities of energy vs. environment**

ABSTRACT: Bioenergy contributes to tackle energy challenges, especially in rural areas, helping guarantee rural urbanization in energy supply (clean gas and clean biomass stove for cooking, clean winter heating, or even clean drying in agricultural industries, etc.). However, at the national level, from industrial perspective, it is hard to say that bioenergy can compete with commercial energy, or even solar (renewable) or nuclear energy (large resources from the space, nuclear fusion technology commercialization, etc.). Bioenergy is from solar energy, then it would be better and more efficient to convert directly the solar energy into electricity, and to produce hydrogen or a synthetic liquid fuel by electricity. However, bioenergy technology is indispensable. Its contribution to environmental protection is growing. In addition to the treatment of organic waste, the bioenergy technology can even handle industrial waste. No matter what kind of energy development, energy demand has a rapid expansion to keep the people's living standards improvement. Any large-scale energy production and large-scale energy consumption with the corresponding industrial and agricultural production and rural life, will inevitably lead to a greater pollution. Bioenergy technology will be an eco-friendly way to protect the global environment.

Bernard A. Engel

Department of Agricultural and Biological Engineering (ABE), Purdue University

Title: **Water resources decision support systems: Examination of successful systems and a look to the future**

ABSTRACT: The management of industrial, agricultural and natural systems to meet societal needs while protecting water resources is an incredibly complex problem. The world's growing population places significant demands on industrial production, agricultural production, energy production, housing, water and our natural and environmental systems. The growth in information technologies, including the world wide web, provides opportunities to create decision support systems and tools to help meet the energy, food and other needs of a growing population while protecting our water resources.

Experiences with the creation of successful water resources decision support systems and tools, including web-based tools, will be described. These systems use databases, GIS, computer models, and optimization combined with web capabilities to address a range of water resources issues. The approaches to the development of these tools will be described as will the success of these tools in meeting needs of a range of stakeholders. Based on experiences in creating successful water resources decision support tools, trends in information technologies, and data availability, future opportunities to create tools to assist with the management and protection of our water resources while meeting the needs of a growing population will be explored.

Tim Ezzell and **Catherine Wilt**

The University of Tennessee

Title: **Dark Skies, Bright Asset: Creative Economic Development Opportunities in Rural West Virginia**

ABSTRACT: The Appalachian region of the United States is marked by tremendous natural beauty and environmental resources, yet the remoteness of many areas has limited opportunities for economic prosperity. This calls for creative think-

ing for new opportunities and solutions. One such opportunity has arisen in Calhoun County, West Virginia, where the lack of development has uncovered a unique asset—darkness. Amateur astronomy and stargazing is a serious hobby for many people, and Central West Virginia is accessible to many US population centers that are too bright for Night Sky enthusiasts. Researchers from the University of Tennessee are working with local citizens to explore the potential for an astronomy-based economic development initiative to cater to amateur astronomy enthusiasts and the area's dark skies. Yet planning for dark sky tourism must be done in a way that preserves the very darkness that is the local asset.

Ming Fan
Global Product Stewardship, The Procter and Gamble Company

Title: **Probabilistic environmental risk assessment for polycyclic musks in surface waters in two Chinese cities compared to the United States**

ABSTRACT: Environmental risk assessment methodologies for consumer product chemicals are well-established in most developed regions including the United States, Canada, and European Union. However, such methodologies are not yet fully developed for 'emerging economy' countries, such as China. The ultimate objective of this research is to develop an environmental risk assessment framework with primary focus on exposure methodology for China's specific conditions (i.e., physical setting, infrastructure, and consumers' habits and practice). The first phase presented here is a case study in two Chinese cities (Changzhou and Hefei) for two fragrance materials, the polycyclic musks (HHCB: 1,3,4,6,7,8-hexa-hydro-4,6,6,7,8,8-hexamethylcyclopenta-[gamma]-2-benzopyran, and AHTN: 7-acetyl-1,1,3,4,4,6-hexamethyl-1,2,3,4-tetrahydronaphthalene). Annual per capita usages of these materials were estimated from measured concentrations in Chinese wastewaters, found in the literatures. Other parameters incorporated into this assessment were population, sewage water flow, municipal wastewater treatment infrastructure (treatment type, capacity, population served, and discharge flow), and surface water flow network. The predicted ranges of 99.9 percentile concentrations in mixing zones downstream from wastewater treatment plants were 0.01-0.99 µg/L for HHCB and 0.01-0.23 µg/L for AHTN. These concentrations were significantly below the predicted no effect concentrations for pelagic freshwater organisms, i.e., 6.8 µg/L for HHCB and 3.5 µg/L for AHTN (European Union Risk Assessment Reports, 2008), comparable with the result from assessment previously conducted for United States. In addition, a summary of monitoring data in China (i.e., effluents from wastewater treatment plants in 4 major geographic regions: Beijing, Shanghai, Guangdong, and Xi'an) revealed that measured concentrations for these chemicals in effluents were consistently less than the predicted values (i.e., comparison on distributions and mean concentrations), which also demonstrates conservatism of the current assessment methodology. The results from this assessment indicate that levels of both compounds entering the environment in wastewater treatment plant effluents pose a minimal risk to receiving water aquatic communities.

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Title: **Surface oxidation controls on decay pathways for condensed aromatic carbon in the terrestrial environment**

ABSTRACT: The environmental fate of naturally produced or manufactured highly condensed aromatic carbon (HCAC), is controlled by the chemical and physical properties that makes HCAC susceptible to photochemical, aqueous and mineralogical, and microbial alteration processes. The relative importance of each of these decomposition drivers is, in part, determined by the mean residence time of that substance in an optimal zone of reactivity for that process and if the subsequent transformation makes it more or less susceptible to further decomposition or to sequestration. One of the significant barriers to microbial oxidation and metabolism of HCAC is the density and type of surficial hydrophilic functional groups permitting wetting, dissolution, and association of extracellular enzymes. Therefore, sequential decomposition processes that first oxidize the surface (such as photolysis) and then permit microbial oxidation and metabolism may be a significant mechanism for progressive loss of HCAC particles in soils. This talk will review recent studies that highlight the importance of such coupled processes and present new research using 13C-labeled black carbon and manufactured nanocarbon substrates in controlled soil and single culture experiments.

Joe Francis
Nebraska Department of Environmental Quality

Title: **A success story: Environmental decision making – Getting new technologies accepted**

ABSTRACT: Literally every person on the planet is affected by and has a role in dealing with environmental issues; everything from providing clean and safe drinking water to addressing legacy environmental contamination. If we are to provide our descendants with a healthy and sustainable place to live we must find a way to achieve success facing these critical issues. There is no question that the problems we face today are numerous and are more and more complex. Tremendous

strides have been made in confronting environmental issues, however, much remains to be done and our challenges are extensive.

As we face emerging environmental issues, and remediating existing environmental contamination, we cannot continue to rely only on the technologies that have been successful in the past. New and innovative technologies are needed – and acceptance of these new technologies can be an arduous process. The first step in the acceptance of new technologies is recognizing the barriers to their acceptance. These barriers will be discussed and two organizations that have been successful in overcoming the resistance to accepting new technologies will be examined. First, the Interstate Technology and Regulatory Council is an organization that is led by state regulatory environmental agencies and has been successful in facilitating the acceptance of new technologies. Second, the Strategic Environmental Research and Development Program have supported the development of technologies that reduce the environmental impact of the Department of Defense operations. Both of these organizations have had remarkable success in the adoption and use of new technologies.

The ITRC and SERDP have unique organizational characteristics and operational processes that could serve as models not only for environmental issues but for many of the challenges any organization faces. The characteristics of the organizations and the processes they rely on for success will be examined and explained.

Bao-Hua Gu

Environmental Sciences Division, Oak Ridge National Laboratory

Title: **Biogeochemical transformation of mercury as a global pollutant in the environment**

ABSTRACT: Redox transformation of mercury (Hg) critically controls the Hg speciation and subsequently its bioavailability and microbial uptake for production of neurotoxic methylmercury. However, mechanisms by which Hg and MeHg transform in anoxic water and sediments remain poorly understood. In this presentation, we describe recent discoveries of the multi-functional roles and mechanisms of both naturally dissolved organic matter and anaerobic bacteria in Hg reduction, oxidation, and complexation. We discuss a new mechanism of thiol-induced oxidative complexation of dissolved elemental mercury and how this porcess affect microbial community as a whole in methylmercury production under anoxic environments. Our research contributes to further understanding of the complex interactions and factors that lead to biological uptake and methylation of mercury.

Shu-Zhong Gu

Institute for Resources and Environmental Policies, Development Research Centre of State Council

Title: **Background, aims, emphases, and progress of ecological civilization construction in China**

ABSTRACT: This presentation will consist of a discussion of ecological civilization and ecological civilization construction (ECC). It will begin with a background introduction that includes China's economic development pattern, its industrialization and urbanization, its natural resource constraints, its environmental situation and public awareness, and China's dream of a beautiful nation. The aim of ECC is to build a beautiful China while also improving the environment and ecology, optimizing spatial structure, and alleviating the shortage of natural resources. The discussion will include the progress made at the central government level through pilot programs and related research, and the progress made by local governments and NGOs. Finally, the discussion will turn to factors that will determine the future success of ECC, such as awareness and acceptance by China's citizens, successful scientific evaluation, transformation in official appraisal and examination systems, and successful models of ECC.

Qing-Jun Guo

Center for Environmental Remediation, Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences

Title: **Application of stable isotopes in environmental quality assessment and research on remediation technology**

ABSTRACT: Rapid urbanization and fast economic growth in China are accompanied by increasing anthropogenic pressure to environment. The Beijing steel industry area and Fangshan smelter company and related pollution might serve as an example for how anthropogenic contributions have affected Beijing's environment. Differing ranges of sulfur, carbon, nitrogen isotopic composition, heavy metals of surface soil, several soil profiles, lake sediments, surface water, rain water, tab water from industrial area and from rural area of Beijing are utilized for characterizing sulfur, carbon, nitrogen, heavy metals and sources, identifying soil and water sulfur, nitrogen and carbon turnover and environmental quality assessment. Moreover, this study demonstrates that the combination of geochemical and multiple isotope diagnosis is a useful approach in order to assess environmental quality and to detect the sources of distinct pollutants in urban and countryside. Contaminated sites and farmland were remediated as well, and phytoremediation and some remediation technologies have been used and its mechanisms for contaminated environment have been discussed during the study.

Shi-Rong Guo

College of Horticulture, Nanjing Agricultural University

Title: **Analysis of general situation, characteristics, existing problems and development trend of protected horticulture in China**

ABSTRACT: Protected horticulture has developed rapidly in China, due to its progressiveness and high efficiency. In 2012, the cultivation area of protected horticulture was over 4 million hm2. It has played a huge role in supplying horticultural products and helping farmers to get rich. On the basis of briefing the development of protected horticulture, this paper reviews the development characteristics of protected horticulture in China, generalizes some typical experiences gained in the development process, analyzes the existing problems and deficiencies, discusses the development trend of protected horticulture in the future, and prospects the brilliant future of protected horticulture in China.

Terry C. Hazen

Governor's Chair Professor UTK/ORNL

Title: **Microbial community structure predicts groundwater geochemistry at Oak Ridge contaminated and uncontaminated sites**

ABSTRACT: The physical and geochemical nature of the groundwater environment is important towards understanding the taxonomic, genetic and functional diversity of the microbial communities. Within various groundwater environments, key geochemical transects may provide constraints on microbial activities and community composition. At the Department of Energy's Oak Ridge field research site, 243-acres of contaminated area is located within the Y-12 plant area of responsibility of the Oak Ridge Reservation. Here, over 800 groundwater wells each containing different geochemical properties are present. The goal of this study is to identify key geochemical transects where microbial communities and activities can be assessed. To maximize the geochemical diversity and to enhance the resolution of microbial-geochemical associations, 100 contaminated groundwater wells containing key geochemical features from were surveyed. Wells were selected using k-medians clustering to group 818 wells into 100 clusters by 14 geochemically similar measurements. Within each cluster, sites for sampling were chosen randomly or by accessibility to the well. For each well in situ groundwater parameters, including temperature, pH, dissolved oxygen, conductivity, and oxidation-reduction potential were measured. Additionally unfiltered and filtered groundwater samples were collected for geochemical and microbial analysis. Initial analysis of groundwater samples shows a pH and nitrate range of 2.9-10 and 0.09-14,000ppm, respectively, with the lowest nitrate concentrations corresponding to higher pH values (>7). The 100 well survey demonstrated the 16S rRNA analyses of community structure predicted pH, nitrate, dissolved oxygen in these wells.

Chuan-Yong Jing

Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences

Title: **Arsenic exposure, removal, and health implication in typical areas in China**

ABSTRACT: Arsenic exposure threatens human health. Shanxi and Inner Mongolia are two provinces with highest groundwater As concentrations and most reported endemic As cases in China. The As concentrations ranged from <1~1160 μg L-1 in the Datong Basin, Shanxi and <1~804 μg L-1 in the Hetao Basin, Inner Mongolia. High concentrations of As, Fe, and Mn occurred in the pe range -2 to -4. High percentages of water (77% of n=131 total samples), vegetables (92%, n=120), cereals (32%, n=25), urine (70%, n=99), nails (76%, n=176), and hair (62%, n=61) contained As higher than the acceptable levels. Dietary As contributed 92% of the average daily dose (ADD) when the water As concentration was less than 10 μg/L, for which 5 out of 30 examined participants were diagnosed with arsenicosis symptoms. The distinct positive correlation between ADD and As concentrations in urine, nails, and hair suggests different applicability for these biomarkers. Methylated As as the predominant urinary As species confirms that the ingested inorganic As is methylated and is excreted through urine. In situ micro-distribution and speciation analysis indicate that As is mainly associated with sulfur in nails and hair. Nails, rather than hair and urine, could be used as a proper biomarker for arsenicosis. High ADD from the environment and low excretion could result in As toxicity to humans. High arsenic in groundwater and industrial wastewater could be effectively removed using nano-TiO2 which resulted in a dramatic reduction in urinary As concentrations.

Jennifer Jurado

Natural Resources Planning and Management Division, Broward County, Florida, USA

Title: **The Southeast Florida Regional Climate Change Compact—A regional strategy for building climate resilience through policy, planning and action**

ABSTRACT: Southeast Florida is one of the most vulnerable regions in the United States to the impacts of climate change and sea level rise. Low land elevations, flat topography and a dense coastal population supported by a highly-permeable surficial aquifer make the region particularly at risk. Rising sea level has already begun to overwhelm local drainage systems, compounds coastal flooding during high tide events, and has accelerated saltwater intrusion into potable wellfields. Home to nearly 5.8 million residents and accounting for one-third the state's total gross domestic product (GDP), the implications for southeast Florida are significant. In recognizing these challenges, and the extensive planning efforts being duplicated across the region, in 2009 the counties of southeast Florida (Broward, Miami-Dade, Palm Beach, and Monroe) coordinated a Regional Climate Leadership Summit designed to highlight regional climate pressures and the benefits of collaboration. This led the four counties to establish the Southeast Florida Regional Climate Change Compact in 2010 with a commitment to work collaboratively on climate mitigation and adaptation strategies through policy coordination, development of unified planning tools, creation of a Regional Climate Action Plan (RCAP), and annual convening of regional Summits to assess progress and future direction.

A Compact Staff Steering Committee (SSC) was convened to coordinate the Compact's activities, and was later expanded to include municipal representatives. During a period of three years the SSC oversaw the development of specific Compact deliverables, including a unified sea level rise projection, sea level rise vulnerability assessments, a regional greenhouse gas emissions inventory and in 2012 the completion of the RCAP. Today regional efforts are focused on implementation of the RCAP which includes 110 recommendations across seven focal areas and is designed to integrate climate adaptation and mitigation strategies into existing decision-making systems and to implement the actions through existing local and regional agencies, processes and organizations. Other notable advancements celebrated by the Compact include a 2011 amendment to Florida law creating the Adaptation Action Area (AAA) designation for areas that are uniquely vulnerable to climate impacts, including sea level rise, to serve as a planning tool and means for prioritizing funding, and more than $1 million in grants to help advance RCAP implementation. By working regionally, Compact partners have been able to garner the attention and support of state and federal agency partners, resulting in additional technical and financial resources that have accelerated planning efforts. The Compact has been recognized as a national and international model for regional collaboration and has substantially enhanced the collective capacity of the region, all without additional governmental structure or staff resources.

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Title: **Permafrost-driven lake dynamics across the Tibetan Plateau in recent decades**

ABSTRACT: Detailed record of lake-extent changes in 1972-2010 derived using Landsat imagery and lake-level variations in 2003-2009 based on ICESat altimetry across the Tibetan Plateau revealed a pattern of dramatic lake changes after the late 1990s with a southwest-northeast transition from shrinkage, relatively stable, to rapid expansion. This changing pattern cannot be explained by the variations in precipitation/evaporation, but is more consistent with the pattern of permafrost degradation induced by continuous temperature increase. Lake expansion occurred and migrated northward in permafrost-dominated regions (the central and northern plateau) with the continuous temperature increase, whereas lake dynamics were mainly responding to precipitation/evaporation in isolated permafrost regions (the southern plateau). Glacier melting is not the dominated factor for the plateau-wide lake-changing pattern because even lake basins with limited glacier coverage in the northern plateau still experienced rapid expansion, whereas lakes in the southern plateau fed by fast retreating glaciers were relatively stable or shrinking. The space-time transition in lake dynamics across the plateau suggests that lake expansion is ephemeral and may not be able to sustain with continuously increase in temperature.

Patterns of distribution of the numerically abundant photosynthetic bacterium Prochlorococcus in relation to temperature and other climate change variables

Yun-Sheng Li

Institute of Geography and Natural Resources, Chinese Academy of Sciences

Title: **No-till agricultural adaption in North China Plain**

ABSTRACT: No-tillage agriculture has never been eventually valued in China. This is in part because of lack of mechanized agriculture, limited availability of no-tillage technology and some ideas related to Chinese traditional tillage culture. However, in some ways, China has a long history of no-tillage in the North China Plain (NCP) . This paper will review the current state of knowledge and application of no-tillage agriculture in China and how it compares to other more developed countries. The area of no-tillage maize in the NCP) is much greater than expected from the literature. Until 2010, no-tillage maize in the NCP occupied 10.4 million ha, which is 20.29% by area. No-tillage maize in the NCP is equivalent to one fifth

of the no-tillage agriculture area of South America and a quarter of that in North America. In the NCP this is one of largest no-till maize planted areas in the world, which is new finding by this research.

Yao-Ze Liu, Laurent M. Ahiablame, Vincent F. Bralts, and Bernard A. Engel
Department of Agricultural and Biological Engineering, Purdue University

Title: **Evaluation of best management practices (BMPs) and low impact development (LID) practices with improved L-THIA-LID model**

ABSTRACT: The Long-Term Hydrologic Impact Assessment-Low Impact Development (L-THIA-LID) model was developed as a quick and easy-to-use tool to evaluate the runoff and water quality impacts of land use changes and BMPs/LID practices resulting from past or proposed development. However, the representation of BMPs/LID practices in L-THIA-LID model needed to be enhanced. In this study, L-THIA-LID model was enhanced with additional practices and computational methods to represent BMPs and LID practices. The tool was used to evaluate the performance of BMPs and LID practices individually and in series with 30 years of daily rainfall data in four types of idealized watersheds (low density residential, high density residential, industrial, and commercial). Simulation results were compared with the results of other published studies. The data showed that reductions in runoff volume and pollutant loads after implementing BMPs and LID practices, both individually and in series, were consistent with the observed impacts of these practices.

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University of Tennessee and Oak Ridge National Laboratory (UT-ORNL) Joint Institute for Biological Sciences (JIBS) and Biosciences Division, Oak Ridge National Laboratory

Title: **Reductive dechlorination: Where microbial ecology meets remediation practice**

ABSTRACT: A diversity of microbes and pathways contribute to the detoxification of halogenated contaminants in soils, sediments and aquifers. Of particular interest to chlorinated contaminant degradation are organohalide-respiring *Bacteria,* including *Dehalococcoides mccartyi* strains (*Dhc*) and *Dehalogenimonas* spp. (*Dhgm*), which use halogenated priority pollutants (e.g., chlorinated solvents, PCBs) as electron acceptors for energy conservation. The key catalysts mediating organohalide respiration are reductive dehalogenases (RDases), which require a corrinoid co-factor. Remarkably, *Dhc* and *Dhgm* cannot synthesize corrinoids indicating that the microbial community must supply this essential co-factor. Co-culture experiments demonstrated that acetogens and methanogens produce copious amounts of corrinoid but do not support *Dhc* dechlorination activity. Dechlorination and *Dhc* growth in these co-cultures occurred after the addition of dimethylbenzimidazole (DMB), suggesting that cobalamin (i.e., a corrinoid with DMB as the lower ligand), or a modified cobalamin, is the functional co-factor of *Dhc* RDases involved in the reductive dechlorination of chlorinated ethenes. Unraveling the eco-physiology of specialized *Dhc* and *Dhgm* bacteria along with the identification of process-specific biomarkers offer opportunities to apply microbial remedies with enhanced efficacy. Several process-specific biomarker genes have been identified, and tools to quantify these gene/transcript abundances in environmental samples are being applied for site assessment and bioremediation monitoring. The integration of geochemical measurements, omics approaches and biomarker gene-centric, quantitative assessment tools will enable site-specific site management decisions and advance bioremediation from an empirical to a scientific practice with predictable outcomes.

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Title: **Greenhouse gas emissions from the Three Gorges Reservoir**

ABSTRACT: Methane (CH4), carbon dioxide (CO2) and nitrous oxide (N2O) are important greenhouse gases (GHGs) emitted from ecosystems. Recently, the amount and rates of GHG emissions from the Three Gorges Reservoir (TGR) have triggered broad concern in academic circles and among the public. In this study, the CH4, CO2 and N2O emissions from TGR water surfaces and drawdown areas along the mainstream of the Yangtze River were monitored from November 2009 to June 2011 with floating and static chambers and gas chromatography. The spatial and temporal pattern of the emissions was examined, and the influence of the environmental factors was further analyzed. Based on the observation data from our study and other researches on branches of the TGR, the total global warming potential(GWP) of the GHGs emission from the TGR was estimated to be 0.63 - 1.308 TgC-eqv•yr-1, which was only 2.6% - 5.4% of that of the GHG emission from thermo power plants when the same amount of electric power (84.7 billion kWh) was generated. Therefore, the TGR

hydropower plant provides a mitigation benefit of 22.73 - 23.41 TgC-eqv•yr-1. The GWP of N2O emission was as much as 45% - 70% of that of CH4 emission from the water surface, while in the drawdown area the GWP of N2O emission was even higher than CH4, indicating that N2O might also be an important GHG emitted from reservoirs.

Jiang-Yu Mao and Jiandong Li

LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences

Title: **Aerosol radiative effects in LASG/IAP model and projected change in East Asia**

ABSTRACT: This study briefly describes the aerosol radiative effects in the atmospheric general circulation model (AGCM) developed by LASG/IAP/CAS. Long-term aerosol dataset simulated from NCAR-Chem model are used as inputs to LASG AGCM, including major anthropogenic and natural aerosol species. The aerosol optical properties are evaluated and proved to be reasonable before they are included into the AGCM. Additionally, the empirical aerosol-cloud relationship is incorporated to consider aerosol indirect effects. Our results show that, compared to the pre-industrial era, the global mean direct radiative forcing (RF) at all-sky TOA and indirect cloud albedo effect (CAE) are calculated to be -0.27 and -0.67 W m-2 in 2000s, while a maximum atmospheric heating of 0.46 W m-2 mainly caused by black carbon absorption. These calculations are comparable to the recent publications, showing aerosol effects in our model are basically acceptable. Moreover, much larger RF values are found on the regional scales. For example, the strong surface dimming and atmospheric heating in East Asia, especially in Central and East China, can reach a maximum of 5.0 W m-2. According to future scenarios, the projected strong aerosol RF will likely stay until 2030s while the aerosol RF has peaked over Europe and North America in 1980s. Our study further indicate that the much larger RF values can be partly attributed to the unique climate characteristics over East Asia, where the high atmospheric moisture content helps to amplify the aerosol hygroscopic effect and resulting RF. The next more effects will be performed for explicit cloud microphysics and interactions between regional aerosol and clouds.

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Title: **Incorporating microbial mechanisms into climate models**

ABSTRACT: Contemporary models of soil organic carbon simulate C dynamics by determining pool sizes and turnover rates post hoc from long term agricultural experiments. This standard representation does not explicitly consider microbial activities, and the lack of quantification means that acclimation of the heterotrophic community and associated exo-enzyme activities to climate change and edaphic conditions are ignored. We created a mechanistic model of enzymatic degradation of measureable pools of soil organic C (OC), considering dormant microbial communities, dissolved and sorbed OC, and microbial biomass C. Inputs are separated into major categories of plant matter (cellulose, lignin) that are attacked by different major classes of microbial enzymes. The activities of extracellular enzymes are considered through the Michaelis-Menten equation, and the model is parameterized by steady-state and dynamic analyses using kinetic parameter values and pool estimates gleaned from an extensive literature search. Lab-scale sorption and incubation experiments using four different 14C labeled substrates (glucose, cellulose, lignin monomer, and fatty acid) and a global selection of soils are used to calibrate the model. Model sensitivity analysis identified microbial growth efficiency, enzyme production rate, and microbial maintenance rate as targets for current experimental endeavors. As growth efficiency decreases with temperature increases, lower CO2 fluxes are observed from the MEND model when compared to constant growth efficiency. We are linking the model into the Community Land Model (CLM4) to produce a validated, realistic, globally-relevant mechanistic microbial soil OC model in global climate and earth system models.

Yang Mu

University of Science and Technology of China

Title: **Mathematic modeling of ZVI-based anaerobic system**

ABSTRACT: Zero-valent iron (ZVI) is increasingly being added into anaerobic reactors to enhance the biological conversion of various less biodegradable pollutants (LBPs). Our study aimed to establish a new structure model based on the Anaerobic Digestion Model No. 1 (ADM1) to simulate such a ZVI-based anaerobic reactor. Three new processes, i.e., electron release from ZVI corrosion, H2 formation from ZVI corrosion, and transformation of LBPs, were integrated into ADM1. The established model was calibrated and tested using the experimental data from one published study, and validated using the data from another work. A good relationship between the predicted and measured results indicates that the proposed

model was appropriate to describe the performance of the ZVI-based anaerobic system. Our model could provide more precise strategies for the design, development, and application of anaerobic systems especially for treating various LBPs-containing wastewaters.

Dev Niyogi
Dept of Agronomy- Crops, Soils, and Environmental Sciences and Dept. of Earth &Atmospheric Sciences,
Purdue University

Title: **Towards Climate Ready Agriculture and Urban Landscapes**

ABSTRACT: Urbanization and agricultural intensification is dominantly underway as the human population continues to grow and migrate in a changing climate. This presentation will share experience and results from two projects currently underway at Purdue that deal with the issue of understanding the interactions of urban and agricultural landscapes on regional climate. The first deals with the assessment of climate-agricultural relations and how to develop useful and usable climatic information that can be adopted by the agronomic community. The second deals with the design and development of city layouts and their interactions with severe weather that can be used in designing storm and climate ready urban zones. The challanges in developing such studies and the opportunities to develop partnerships will be presented.

Mary-Jane Orr[1], Sylvie Brouder[1], Jeffrey Volenec[1], and Ronald Turco[1]
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Title: **Nitrogen (N) cycle dynamics in biomass production systems: Pathways for N loss mediated by soil biology**

ABSTRACT: Potential changes in crop production practices to accommodate the direct utilization of plant biomass for the production second-generation cellulosic biofuels has elevated concerns over possible unintended environmental effects. We hypothesized that the different cropping practices (e.g. plant selection, residue removal) would influence soil microbial community structure and functional capacity, altering pathways for system nitrogen (N) loss via leaching and greenhouse gas emissions. A comparative assessment of microbial community structure and the functional N cycling capacity between conventional Midwestern agricultural practices and bioenergy systems was carried out at the Purdue Water Quality Field Station (WQFS). Biomass production systems included no-till continuous corn with residue removed (Zea mays; CR), Miscanthus x giganteus (MS), mixed tallgrass prairie dominated by big bluestem (Andropogon gerardii; PR), dual-purpose sorghum (Sorghum bicolor; hybrid PU8168X; SG), and upland switchgrass (Panicum virgatum; c.v. Shawnee; SW). Shifts in N cycling pathways were estimated by soil assays of dehydrogenase (DH) and urease (UR) enzyme activity, net N mineralization (NM), acetylene reduction (AR), nitrification potential (NP) and denitrification potential (DP), and by profiling the diversity of functional genes essential for nitrogen fixation (nitrogenase, nifH), nitrification (ammonia monooxygenase, amoA), and denitrification (nitrite reductase, nirK) by PCR-denaturing gradient electrophoresis (PCR-DGGE). Findings indicate the N cycle was impacted by both plant selection and management, showing a distinct polarization in multivariate analysis of N enzymatic transformations and composite analysis of N functional gene diversity between the minimal management in the PR system and the high intensity practices of corn production. Over the study period SG, SW and MS developed unique N functional community structures and trended towards similarity with the PR system. We observed cropping system selection and subsequent best management practices are highly influential on critical microbial populations, potentially influencing long-term ecosystem function and sustainability.

Xiuli Dang[a,b], **Mark Radosevich**[b], Ying Wang[b], Nicole Labbé[c], Pyoungchung Kim[c], Yulong Zhang[a], Jie Zhuang[b], Timothy G. Rials[c,] and Amy Johnson[b]
[a]College of Land and Environment, Shenyang Agricultural University
[b]Department of Biosystems Engineering and Soil Science, The University of Tennessee
[c]Center for Renewable Carbon, The University of Tennessee

Title: **Effect of pyrolysis temperature on biochar mineralization, nitrification potential, and microbial community composition of biochar-amended soil**

ABSTRACT: Pyrolysis of biomass produces a co-product known as biochar. The incorporation of this material into the soil may act as an important long-term carbon (C) sink because its decomposition is slow. This study examined respiration, nitrification potential, and the abundance and expression of nitrification genes in biochar-amended soil. Shifts in microbial community composition were also examined. Oxidation of biochar-C to CO_2 was very slow and estimated at approximately 1.6×10^{-4} d-1 and 2.8×10^{-5} d-1 for switchgrass biochars pyrolized at 450 and 800°C, respectively, corresponding to a biochar decomposition of 5.8% and 1.0% of biochar-C per year. Biochar addition did not affect nitrification potential. Quantitative real-time PCR (qPCR) analysis indicated that biochar amendment slightly affected the abundance of ammonia monooxygenase genes (amoA) of ammonia-oxidizing bacteria (AOB) but had no effect on amoA genes of ammonia-oxidizing archaea (AOA). Ammonium sulfate addition significantly increased AOB amoA gene copies approximately

2-fold in the soils amended with biochar. The amoA gene frequency of AOA did not increase in response to ammonium sulfate addition. Nitrogen fertilization dramatically increased the expression level of amoA genes from AOB (up to 14 fold) but not those from AOA. The increase was more significant in soils lacking biochar amendment than in biochar-treated soils (14 versus 9 fold). Microbial community composition was unaltered by biochar addition. We conclude that biochar produced from switchgrass pyrolyzed at 800°C can sequester C in soil over a long time scale without negatively impacting nitrification.

T.G. Rials and J.F. McCord

Center for Renewable Carbon, The University of Tennessee

Title: Short-rotation woody crops as feedstock for alternative fuels

ABSTRACT:The Energy Independence and Security Act of 2007 mandates production of 36 billion gallons/year of bio-fuel, including 21 billion gallons/year of advanced cellulosic fuels by 2022. The U.S. Department of Agriculture projects that almost 50 percent of this supply will be provided by the southeastern United States, given its high biomass production capacity. Meeting this expectation will require a portfolio of crops designed to provide maximum yield on diverse sites and optimum performance in various technology platforms. One such energy crop system that meets these characteristics is short rotation woody crops (SRWC). This unique biomass production technology is a hybrid system that incorporates elements of current pine plantation management and conventional agricultural practices, relying on state-of-the-art genetic material and intensive management inputs to maximize yield over a relatively short production period. In an ongoing collaboration between the U.S. Department of Energy's BioEnergy Technologies Office and the Sun Grant Initiative, production potential for currently available genetic material has been assessed for willow and hybrid poplar through coordinated field trials distributed across the nation. This presentation will highlight the current potential yield baseline for these important energy crops; and, will introduce preliminary work to define biomass quality in terms of relevant performance characteristics (i.e., chemical composition, ultimate and proximate properties, etc.).

Sean M. Schaeffer

Department of Biosystems Engineering and Soil Science, The University of Tennessee

Title: **Soil carbon cycling and nitrogen retention under different conservation management practices in West Tennessee agroecosystems**

ABSTRACT: Nutrient exports from agroecosystems have severe health and ecological impacts including stream eutrophication and anoxia. Conservation agricultural practices such as reduced tillage, fertilizer application and planting winter cover crops can mitigate nitrogen (N) losses while also maintaining crop yields. Though we can model how these management practices affect crop yield and N export, we have little information on how they affect the mechanistic processes driving C and N transformations in soil. Previous research at long-term experimental plots in Tennessee shows reduced tillage changes soil structural characteristics such as aggregate and macropore formation and promotes the accumulation of soil organic matter. While this may lead to enhanced water infiltration and drainage, it also creates a more heterogeneous environment that enhances the structural and functional diversity of the microbial community. Soil microbial populations play a critical role in ecosystem N dynamics by controlling amounts of plant available N (NH4+ and NO3-) and acting as a reservoir of relatively labile N compared to soil organic matter. Our long term goal is to understand biogeochemical processes controlling fluxes of energy and nutrients in agroecosystems, and how these processes are altered by management practices. In this talk, we will describe a new project aimed at understanding the combined effects of conservation agricultural management practices on microbial N dynamics, and how they interact with conventional N fertilizer application to control the stability of soil organic matter. This new mechanistic understanding will be employed as a predictive tool to assess other control strategies to mitigate N movement out of agroecosystems.

Yun-Kun Wang, **Guo-Ping Sheng,** Wen-Wei Li, Han-Qing Yu

Department of Chemistry, University of Science & Technology of China

Title: **A novel electrochemical membrane bioreactor as a potential net energy producer for sustainable wastewater treatment**

ABSTRACT: One possible way to address both water and energy shortage issues, the two of major global challenges, is to recover energy and water resource from wastewater. Herein, we report a novel electrochemical membrane bioreactor (EMBR) without aeration for energy recovery and wastewater treatment. In this system, graphite felt served as the cathode, and non-woven cloth as the electrolyte separator. The treated water flew directly through the separator and cathode for filtration. With the help of the microorganisms in the biocatalysis and biodegradation process, net electricity could be recovered from a low-strength synthetic wastewater after estimating total energy consumption of this system. In the operation, wastewater was filtrated through the non-woven cloth, graphite felt in sequence, and high-quality clean water was obtained.

This unique configuration confers it several advantages for wastewater treatment: (1) Problems commonly encountered in air-cathode microbial fuel cells, such as fluid leakage through the cathode, pH gradient, and accumulation of inorganic salts deposits on the cathode, could be circumvented or overcome. The pH gradient was decreased attributed to a direct flow of the anolyte to the cathode side that effectively neutralized the alkalinity at the cathode. (2) Simultaneous oxygen reduction, nitrification and denitrification reactions occurred at the cathode without the need of aeration; (3) High quality effluent was obtained due to the filtration of the non-woven cloth and graphite felt cathode; and (4) Small sludge yield could be achieved. During the long-term operation of the EMBR, no excess sludge was discharged, except for few biomass draining with the effluent under low HRT conditions. The biomass rejection by the separator and the cathode increased the solid retention time in the anode chamber, which further decreased the sludge production yield. All these advantages suggest a promising future of the EMBR for sustainable wastewater treatment and energy recovery.

The results clearly demonstrate that, under the optimized operating conditions, it is possible that this novel EMBR system might become a net energy producer, rather than a consumer for clean water harvest from wastewater.

Charles Sims

The University of Tennessee

Title: **How ecosystem service provision can increase forest mortality from insect outbreaks**

Abstract: Climate change is believed to be the root cause of the unprecedented mountain pine beetle (MPB) outbreak currently underway in the western United States. While climate change is undoubtedly a factor, changes in public forest management have resulted in more host trees in MPB habitat. We employ a novel approach to separate the contribution of changing preferences for ecosystem services from the effects of fire suppression and climate change in the current MPB outbreak. Simulations illustrate how an increased emphasis on nontimber ecosystem services induced a shift from a climate-independent disturbance process (timber harvesting) to a climate dependent one (insect outbreaks).

Jeremy C. Smith

Governor's Chair, University of Tennessee; and Director: Center for Molecular Biophysics, Oak Ridge National Laboratory

Title: **Mercury: Toxification and detoxification**

ABSTRACT: The fate of mercury deposited in the environment depends on the molecular-level physical interactions and chemical reactions, mostly involving mercury interacting with water, various ligands, and proteins. Using the tools of molecular biophysics and computational chemistry we will examine the fundamental underpinnings of several environmentally-important mercury transformations. Mercury (II) preferentially binds to thiol groups; we will examine why this is the case (the traditional explanation fails here). We will also outline how chemical concepts guided our recent discovery of the bacterial genes responsible for producing toxic methylmercury in the environment [1]. Finally, mechanisms used by proteins to detoxify methylmercury mercury-resistant bacteria will be explored [2,3].
[1] Parks et al., *Science* 339 (6125) 1332-1335 (2013)
[2] Johs et al., *J. Mol. Biol.* 413(3):639-56 (2011); Guo et al J. Mol. Biol 398 555-68 (2010)
[3] Parks et al., *J. Am. Chem. Soc.* 131, 13278-13285 (2009)

Jian-Min Tao

College of Horticulture, Nanjing Agricultural University,

Title: **Protected culture of grape industry in China and its cultivation techniques**

ABSTRACT: Based on the 2011 data, grape production area in China is 596.9 hectors with a total yield of 9067.5 KT. The production is presented in all provinces and autonomous regions except Hong Kong and Macao. The research on protected culture of grape started in the 1970's, and became commercial in the 1990's. There are three main types based on the purposes with protection culture: promotion for early ripening, rain-prevention, and delaying ripening. Early-ripening promotion can be divided into three types, early, standard and general promotion. Rain-prevention culture for grape production is widely applied in the southern region with plentiful rainfall. Rain-prevention culture techniques greatly reduced disease incidences and enhanced fruit quality, is widely used across the country. Protected culture for delayed ripening is widely applied in regions of high elevation, cold climate with insufficient heat accumulation. Through plastic culture and heating with sunlight to increase effective accumulated temperature, ripening can be delayed to January or February with higher quality, price of grape is 3-5 times of that without plastic culture, are welcome by consumers.

There are many different structures for protected culture, primarily based on different cultivation models, geographic regions, costs, and management styles. The most popular ones are those inexpensive, cost-effective plastic houses using bamboo slices and wires for keeping rains away.

Techniques for fresh, high quality grape production are more advanced in the southern regions where industry started later than the traditional grape-growing regions in the north. Currently main technological system includes simple, standard trellis training, flower and fruit management, fruit bagging, and utilization of plant growth regulators.

Zhong-Hua Tong, Xuan Wu, Ling-Li Li, and Han-Qing Yu
Department of Chemistry, University of Science and Technology of China

Title: **Toxicity of imidazolium-based ionic liquids on *Caenorhabditis elegans***

ABSTRACT: By using *Caenorhabditis elegans* (*C. elegans*) as a model animal, our work is aimed to evaluate the toxicity of imidazolium-based bromide ionic liquids (ILs), and to elucidate the underlying mechanisms involved. Mortality, levels of reactive oxygen species (ROS), lipofuscin accumulation and expression of superoxide dismutase 3 in *C. elegans* were determined after exposed to ILs at sub-lethal concentrations for 12 h. A significant increase in the levels of these biomarkers was observed in accordance with the results of 12-h lethality assay. The addition of 0.5% dimethyl sulfoxide, which acts as a radical scavenger, remarkably rescued the lethality of *C. elegans* and significantly decreased the ROS level in *C. elegans*. Germline apoptosis induced by the ionic liquid was shown to be a more sensitive endpoint, with a dose- and time-dependent effect. The apoptosis occurs through a DNA damage response-, ERK- and JNK-pathway in *C. elegans* and is dependent on ABL-1 as well, while the p38 MAPK signaling pathway does not play an essential role.

Liem Tran
The University of Tennessee

Title: **Regional integrated environmental assessment in the US: Progress and challenges**

ABSTRACT: The U.S. Environmental Protections Agency's (U.S. EPA) Regional Vulnerability Assessment (ReVA) program has focused much of its research over the last ten years on developing and evaluating integration methods for spatial data. An initial strategic priority was to use existing data from monitoring programs, model results, and other spatial data. Because most of these data were not collected with an intention of integrating into a regional assessment of conditions and vulnerabilities, issues exist that may preclude the use of some methods or require some sort of data preparation. Additionally, to support multi-criteria decision-making, methods need to be able to address a series of assessment questions that provide insights into where environmental risks are a priority. This paper provides an overview of various spatial integration methods that can be applied towards regional assessment, along with preliminary results as to how sensitive each method is to data issues that will likely be encountered with the use of existing data. By exploring progresses and challenges of regional integrated environmental assessments in the US, the paper would provide useful examples for regional assessment in China to ensure sustainable development.

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Title: **Metagenomic and metaproteomic analyses of microbial communities in the Canadian high Arctic permafrost**

ABSTRACT: Permafrost or perennially frozen ground occupies about 24% of the exposed land surface in the Northern Hemisphere and can extend down to depths of more than 700 meters in northern Siberia and Canada. Most of the current permafrost was formed during or since the last ice age and includes ~1.7 x 1015 kg of carbon in the form of frozen organic matter. A global temperature increase will result in substantial thawing of near-surface permafrost, intensification of microbial decomposition of previously unavailable frozen organic carbon and escalation of carbon dioxide (CO_2) and methane (CH4) emissions. Release of large amounts of CO_2 and CH_4 into the atmosphere would further amplify warming and permafrost degradation symbolizing a significant potential positive feedback from terrestrial ecosystems to the atmosphere.

Comparative metagenomic and metaproteomic analyses of microbial ecosystems in low-carbon Arctic cryosols and upper permafrost layer were undertaken to understand the effect of temperature increase on the changes in community composition. Twenty, well-characterized, 1 meter long, intact cores consisting of active-layers and permafrost, collected from an ice-wedge polygon located near the McGill Arctic Research Station on Axel Heiberg Island, Nunavut, Canada were used in a long-term thawing experiment. The cores were thawed under saturated conditions (receiving artificial rain), under natural hydrological conditions with light input (drained cores) and with no light input (dark cores), and without thawing (control cores with permafrost maintained at 70 cm depth). Gas composition in the headspace (H_2, CH_4, CO, O_2, N_2, CO_2, and $\partial^{13}C$

of CO_2) and pore water chemistry (including dissolved gases) at 4 different depths were analyzed weekly. The cores were sub-sampled along 4 depths at 0, 1, 24 and 48 weeks for omics analyses. Shotgun metagenome libraries for samples before and after thawing were sequenced using 454 and Illumina platforms yielding >300 Gb of raw data. Taxonomic and functional characterization of the metagenomes indicated specific microbial community differences between the upper active layers and the lower permafrost layer. Potential CH_4 cycling pathways primarily consisted of CH_4 oxidizers in the upper layers with a paucity of methanogenic archaea in the lower layers. Other differences in carbon cycling pathways with depth included aromatic ring oxidation and CO_2 fixation potential in the uppermost layer, and carbon reduction pathways in the permafrost layer. Nitrogen-cycling pathways also differed by depth with nitrogen fixation occurring in the upper layers and nitrification in the permafrost. Metaproteome profiling of the selected samples revealed modest increases in protein recovery, indicating intensification of cellular activity of the microbial consortia upon thawing. Most of the expressed proteins belonged to the order Rhizobiales. The metagenomic sequences generated during the study are currently being co-assembled to generate a high quality database in order to understand the relationships between metabolic potential of microbial communities and ecosystem gradients.

Jing-Kuan Wang, et al.
Shenyang Agricultural University

Title: **Studies on cultivated soil quality and foodstuff productivity in black soil area in Northeastern China**

ABSTRACT: Black soil area in Northeastern China is the important base of producing foodstuff. Nearly 15% of the total foodstuff in China was produced here, with a commodity rate of over 60%. However, with the fast development of agriculture, the degradation of black soil was becoming serious in this area. The problems included: thinning of black topsoil by soil erosion, decreasing of soil fertility by irrational cultivation, fluctuation of foodstuff producing capacity by badly farmland infrastructure and unsuitable protection by law and regulation. Due to the decline of cultivated land, the quality of farmland should be determinant in foodstuff productivity. So it is very significance of carrying on the researches about the quality of cultivated land and capacity of producing foodstuff. The results obtained from the researches are as follows:

(1) The distribution patterns of soil fertility factors were significant in space in the black soil area. The contents of soil clay, organic matter, CEC, total N and P, available N, P and K, biomass C and N, and microelements were lower in the south and higher in the north area, whereas the pH was higher in the south and lower in the north, which means that the soils here tended to be acidification.

(2) The area where soil organic matter was declining was 87.82% in the total black soil areas. Over 40% of it in the north, soil organic matter was decreased to 20g/kg and over 55% of it in the south was lowered to 10g/kg, which means that manure has not been popularly applied here, although climate warming and soil reclamation in short period were the important factors.

(3) The integrated index of soil fertility quality trended to be lowering in past 20 years. According to the present results of evaluation, the area of the first grade decreased 20.16% comparably. The changes of integrated index were related with soil organic matter, available P and K, pH and total N. Since more P fertilizers were used in past 20 years, available P in soils was highly increased in this area, which leads to be relatively stable of the quality of soil fertility.

(4) The integrated productivities of foodstuff in the Northeastern black soil area included the capacities of resources' supply, essentials' input, techniques' support and calamities' resistance. The capacity of essentials input was one of the more important factors, the next was techniques' support, calamities' resistance and resources' supply in order.

(5) The potential of foodstuff productivity was great in the Northeastern black soil area. According to the present distributions of food products and technical efficiency, the total grain output should be increased through enlarging seeded area where new techniques were efficiently used and raising yield of crops planted with traditional techniques.

Sherry Wang
Division of Water Resources, Tennessee Department of Environment and Conservation

Title: **An overview of Tennessee's eco-region based watershed management approach**

ABSTRACT: Everyone lives in a watershed. A watershed is defined as the entire land area that ultimately drains into a particular watercourse. Tennessee refers to watersheds by their specific name as well as by a set of numbers. This set of numbers is called the watershed's Hydrologic Unit Code, or HUC. The HUC can range from 2 to 16 digits long, more digits indicating a smaller and smaller portion of the watershed is represented. Each watershed has an identifiable boundary that integrates its specific geologic, terrestrial, and aquatic features.

Water quality planning, monitoring, assessment and permitting activities in a watershed are organized in a cyclic sequence. Watershed approach promotes an integration of traditional regulatory (those addressing point source pollution) and non-regulatory (those addressing nonpoint sources of pollution) programs. This approach allows for close cooperation among

local citizen groups, local governments, other state and federal agencies. For example, when all permitted dischargers are considered together, agencies are better able to prioritize and apply comprehensive control measures to efficiently protect, maintain as well as restore water quality in a watershed. Successful implementation of an eco-region based watershed management strategy will ultimately provide clean and sustainable water resources for a healthy ecosystem.

Thomas Wilbanks

Oak Ridge National Laboratory

Title: **Policies and strategies for sustainable development**

ABSTRACT: Sustainable development embodies a commitment to both achieve continuing economic and social progress and at the same time to find a sustainable balance with a natural environment that is already under stress. Avoiding potentials of each goal while resolving tradeoffs between them is a formidable challenge to both research and action. After a brief overview of current perspectives on sustainable development, this presentation will use climate change as an example of a threat to sustainable development and report some emerging findings about what can be done now to move toward climate-resilient development pathways in our two countries and the world at large.

Catherine Wilt and Tim Ezzell

The University of Tennessee

Title: **Dark skies, bright asset: Creative economic development opportunities in rural West Virginia**

ABSTRACT: The Appalachian region of the United States is marked by tremendous natural beauty and environmental resources, yet the remoteness of many areas has limited opportunities for economic prosperity. This calls for creative thinking for new opportunities and solutions. One such opportunity has arisen in Calhoun County, West Virginia, where the lack of development has uncovered a unique asset—darkness. Amateur astronomy and stargazing is a serious hobby for many people, and Central West Virginia is accessible to many US population centers that are too bright for Night Sky enthusiasts. Researchers from the University of Tennessee are working with local citizens to explore the potential for an astronomy-based economic development initiative to cater to amateur astronomy enthusiasts and the area's dark skies. Yet planning for dark sky tourism must be done in a way that preserves the very darkness that is the local asset.

Lan-Fang Wu, Li Bin-Bin, and Qin Yue

Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

Title: **CO_2 and N_2O emissions from cultivated soil with crop residues retention under different tillage in the North China Plain**

ABSTRACT: The greenhouse gas emissions, mainly CO_2, N_2O and CH_4 from arable land farming systems are the most important source of greenhouse gases of the atmosphere. The processes of emission are strongly influenced by soil conditions, such as temperature, water content, available nitrogen and dissolved organic matter, those are further strongly influenced by farming practices, such as tillage, fertilizer, water, and crop residues retention and manure application. To elucidate relationship between soil respiration and SOM with crop residues retention under different tillage in the North China Plain., the experiment has been carried out at the Yucheng Experimental Station, which is located at middle of the Plain. The dominating wheat-corn double cropping system is conducted annually. The field trial with (+)/without (-) straw and stalk retention under conventional tillage (CT) and no-tillage (NT) was started in 2008. CO_2 and N_2O fluxes of soil surface have been measured since 2010. The gases were collected by using method of static chamber and determined by gas chromatography. Meanwhile, DOC and DON of 0-20cm soil were analyzed.

During corn growing season, the CO_2 emissions changed as corn growth, the fluctuation was likely related to rainfall. The amount of CO_2 emissions under CT was generally higher than under NT. However, the emission amount of CO_2 under CT with straw and stalk incorporation was significantly higher 205.3g/m2/y than without that, while the amount of CO_2 emission under NT with straw and stalk retention was markedly lower 174.8g/m2/y than without that. At the meantime, the changes of N_2O emission were a single peak curve; the peak of emission was resulted from N fertilizer addition. The amount of N_2O emission under NT was markedly greater than under CT. The amounts of N_2O under both CT and NT with straw and stalk incorporation (or retention) were obviously greater than without that, they were separately 595.4 mg/m2/y and 674.0mg/m2/y greater under CT and NT during one growth season. Both CO_2 and N_2O emissions during wheat growing season were similar to during corn growing season. Moreover, DOC and DON of soil were strongly related to the emissions.

CO_2 emission is produced by the respiration of soil microbes and roots in soil. Nitrification and de-nitrification by soil microbes are the dominant processes in the production of N_2O in soils. DOM (DOC and DON) is the essential substrate of microbe's activity, and crop residues are the major source of soil DOM. Therefore, how does residues-derived DOM medi-

ate transformation of organic C into CO_2 and reduction of nitrate into N_2O are being further studied on both quantity and composition.

Jian-Ming Xu and Xing-mei Liu

College of Environmental and Natural Resource Sciences, Zhejiang Provincial Key Laboratory of Subtropical Soil and Plant Nutrition, Zhejiang University

Title: **Human health risk assessment of heavy metals in soil-vegetable system**

ABSTRACT: In China, vegetable fields were located very near to the villages and conveniently close to the farmers. Unfortunately this means that the growing vegetables and soils are at high risk of contamination by local industrial pollution, since many small family-sized factories such as metal smelting and battery making businesses are located in villages due to the booming private economy. In this study, 268 vegetable samples which included rape, celery, cabbages, carrots, asparagus lettuces, cowpeas, tomatoes and cayenne pepper and their corresponding soils in three economically developed areas of Zhejiang Province, China were collected, and the concentrations of five heavy metals (Pb, Cd, Cr, Hg and As) in all the samples were determined. The health risk assessment methods developed by the United States Environmental Protection Agency (US EPA) were employed to explore the potential health hazards of heavy metals in soils growing vegetables. Results showed that heavy metal contaminations in investigated vegetables and corresponding soils were significant. Pollution levels varied with metals and vegetable types. The total non-cancer and cancer risk results indicated that the investigated arable fields near industrial and waste mining sites were unsuitable for growing leaf and root vegetables in view of the risk of elevated intakes of heavy metals adversely affecting food safety for local residents. Chromium and Pb were the primary heavy metals posing non-cancer risks while Cd caused the greatest cancer risk. It was concluded that more effective controls should be focused on Cd and Cr to reduce pollution in this study area.

X. Philip Ye

Biosystems Engineering and Soil Science, The University of Tennessee

Title: **Challenges and progress in the conversion of crude glycerol for high-value chemicals**

ABSTRACT: Glycerol glut as a consequence of rapid growth of biodiesel industry has attracted extensive research worldwide for the valorization of crude glycerol. Acrolein currently manufactured via the oxidation of petroleum-based propylene is one of those glycerol derivatives that hold an important status as intermediate for the production of many high-value chemicals such as acrylic acid, methionine, polyester resin, superabsorbent polymers, polyurethane, and acrylonitrile. However, the most promising technology of catalytic glycerol dehydration to produce acrolein faces two major obstacles for industrial application, namely direct use of crude glycerol and catalyst coking/deactivation. In the context of roles of reaction media, catalysis, reaction mechanisms and kinetics, product separation, and process efficiency, this presentation will focus on our progress in overcoming the two obstacles using non-thermal plasma and near-critical water technologies. Additionally, ongoing studies on downstream partial oxidation of acrolein to acrylic acid, and the simultaneous production of racemic lactic acid and propylene glycol from crude glycerol will be briefly discussed.

Feng Yu and Jon Harbor

Department of Earth, Atmospheric, and Planetary Sciences, Purdue University

Title: **L-THIA-C: A practical model for planners to use in assessing and managing the impacts of land-use change on long-term runoff and non-point source pollution**

ABSTRACT: As the impressive economic development, China is undergoing the most dramatic land use change in the world. Environmental sustainability becomes increasingly important to maintain the long-term development in the future and has already been recognized as the goal among Chinese scholars and decision makers. In practice, the implementation of this goal requires the relevant tools as the foundation of land use policies but such tools currently are rarely available in China. Long Term Hydrologic Impact Analysis (L-THIA), widely applied in the United States, is an easy-to-use assessment model that simulates the impacts of different decisions about land use change on water resources, in terms of long-term runoff and non-point source water pollution. We would like to introduce the successful experience of L-THIA to China and propose to develop a Chinese version of L-THIA (L-THIA-C) which matches the local data availability and land use scenarios. However, due to the different management contexts, usages for planners and the data surveying methods, we are looking for collaborators who would like to work with us on L-THIA-C. The first step is to demonstrate the development and implementation of L-THIA at a local scale using the minimum datasets; the next step is to understand the needs and expectation of Chinese planners, including decision makers, scholars, environmental managers and professional services. We aim to systematically bridge the gap between L-THIA-C and LTHIA and ultimately build a comprehensive version of L-THIA-C, which will become a useful tool for Chinese planners to accomplish the goal of environmental sustainability for the future generations.

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Title: **Soil carbon and nitrogen cycling and control mechanisms in terrestrial ecosystems of China**

ABSTRACT: Soil is a key resource for food and fiber production and soil quality determines ecosystem stability. Maintaining soil quality and enhancing soil functions has been given the highest priority in China's national agenda in terms of food security and sustainability. In order to address this need, we investigate biogeochemical cycling and operating mechanisms for soil carbon (C) and nitrogen (N). Our objectives are to reveal the transformation processes and microbial functions; and to understand the important roles and interactions of soil biota and aboveground plants in driving the processes of soil C and N cycling, turnover and sequestration in terrestrial ecosystem. In addition, the new technology development, such as the isotope-labeling based gas (liquid) chromatograghy/mass spectrometry (GC/MS and LC/MS) technology for differeciating the native and the newly immobilized microbial residues, was introduced for investigating bio-transformation or renewal of soil organic compound (microbial residues or metabolites) at molecular level. Our study significantly improved the understanding on the microbial process in soil C and N cycling.

Fuzheng Zhao, Jinbao Yin, **Xu-Xiang Zhang,** Kailong Huang, Zhu Wang, Yajun Chen, Mei Li
State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University

Title: **Fates of antibiotic resistance genes and their correlations with bacterial communities in municipal sewage treatment plants revealed by using high-throughput sequencing**

ABSTRACT: Antibiotics are widely used for human health protection and municipal sewage treatment plants (MSTPs) have been considered as important reservoirs for environmental antibiotic resistance genes (ARGs) and resistant bacteria, which can induce potential public health risks originated from the discharge of treated sewage into the environment. However, environmental fates of antibiotic resistance genes and their correlations with bacterial communities in MSTPs have been seldom characterized. In this study, we investigated abundance and diversity of ARGs and mobile genetic elements (MGEs) in influent wastewater, effluent wastewater and activated sludge of four MSTPs by using Illumina high-throughput sequencing and metagenomic analysis. Results revealed that a variety of ARGs and MGEs were prevalent in MSTPs. The abundance and types of the resistance genes were evidently decreased by activated sludge processes used in the MSTPs, which was also confirmed by quantitative real-time polymerase chain reaction assays used to quantify six selected tetracycline resistance genes. 454 Pyrosequencing of 16S rRNA gene was conducted to characterize bacterial communities in the MSTPs, demonstrating that some phyla including Firmicutes, Bacteroidetes and γ-proteobacteria had lower abundance in the treated sewage. Correlation analyses revealed that a group of core bacterial species carrying different MEGs might play important roles in environmental fates of the ARGs in MSTPs. This study may extend our knowledge about the abundance and diversity of ARGs in MSTPs and the correlations beween environmental ARGs and microbial communities.

Bin Zhao
State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center for Eco-environmental Sciences, Chinese Academy of Sciences

Title: **Advances in understanding the mechanism of dioxin toxicity**

ABSTRACT: Exposure to and bioaccumulation of dioxins and related POPs produce a wide variety of toxic and health effects, such as tumor promotion, teratogenicity, endocrine disruption. It took over a few decades for scientists to understand that most of the toxic effects of dioxin, if it's not all, were mediated by a receptor, aryl hydrocarbon receptor (AHR), a transcription factor belongs to bHLH/PAS superfamily, and its downstream signal transduction pathway. While recently, it has been observed that AHR plays important roles in normal physiological processes especially in immune balance, homeostasis and development. Particularly, discovery of multiple endogenous or dietary-derived ligands makes the molecular mechanisms of AHR signaling pathway more challenging and fascinating. More extensive research and better understanding of the physiological function of AHR will extend and enhance our understanding of broad-spectrum adverse health effects induced by dioxin and related POPs.

Cheng-Hu Zhou, Bao-lin Li, Ye-cheng Yuan, and Xi-zhang Gao
Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences

Title: **Assessment of ecosystem rehabilitation compensation in China**

ABSTRACT: Over the last decades, central and local governments have made great efforts to rehabilitate the natural eco-systems which have been seriously broken or being in danger with lots of investment. Several great planning have been put into action such as Tianbao Afforestation Program, Transfer of cultivated land into forest and grass. The implementation of these plans has improved the eco-environment situation at the regional level to some extent. Therefore it is vital to assess the eco-benefits of these investments. We develop a GIS-based method to make such an assessment by incorporating economic and ecological indexes such as coverage of the forest, air and water pollution et al. 450 counties have been selected as the sample for the assessment.

Erik Zinser

Department of Microbiology, The University of Tennessee

Title: **Patterns of distribution of the numerically abundant photosynthetic bacterium *Prochlorococcus* in relation to temperature and other climate change variables**

ABSTRACT: The cyanobacterium *Prochlorococcus* numerically dominates the marine phytoplankton community and accounts for almost half of all photosynthesis in the ocean. Genus-level and ecotype-level population structures of these photosynthetic organisms are becoming fairly well described, facilitating predictive modeling for climate change. Less well understood are the factors that constrain the latitudinal range for *Prochlorococcus,* and how seasonal dynamics impact this range. We will present results from multiple cruises spanning the latitudinal ranges of *Prochlorococcus* the Pacific and Atlantic Oceans. We will describe the "rule" where ecotype abundances correlate strongly with temperature, and identify the "exceptions" where other environmental factors appear to constrain the ecotype distributions. We will conclude with a discussion of how these results may help to predict *Prochlorococcus'* range as a consequence of climate change.

Poster Abstracts

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Title: **Genetic Cues for Cold Acclimation in Psychrotrophic Bacterium Pseudomonas fluorescens HK44**

ABSTRACT: Pseudomonas fluorescens HK44 is a psychrotrophic rhizosphere organism, capable of growing at temperatures ranging from 4°C to 32°C. Rhizospheric P. fluorescens often support plant growth and have been shown to help plants adapt and survive cold weather. While past studies have examined the cold shock mechanisms of cold tolerant organisms, there is an overall lack of knowledge of the mechanisms that allow psychrotolerant organisms to thrive at low temperatures. Here we look at P. fluorescens HK44 as a model organism to explore growth rates across temperatures, as well as mine the genome for genes that may serve in cold acclimation. There are seven potential cold shock genes that have been identified within the HK44 genome, of which six are considered genes for major cold shock proteins. The surrounding genes are being investigated to determine their potential role in cold acclimation. Transcriptomic analysis will target these key genes to determine if they have higher expression levels at low temperatures, providing insight into the mechanism(s) of cold acclimation in psychrotolerant organisms.

D. Alex Bevard, Amy Johnson, Neal Stewart, Jennifer M. DeBruyn
Title: **Downregulation of lignin content in switchgrass plants and its impact on the soil environment**

ABSTRACT: Lignin content is one of the major problems faced when trying to convert crop such as switchgrass into biofuel. One solution to this problem that is being explored is transgenically altering the desired crop to have a decreased lignin content. What is yet unknown is the effect of these genetic alterations on the environment where switchgrass is grown. Lignin content is one of the most important characteristics in determining the rate of plant residue decomposition, with any changes to the lignin levels potentially causing changes in soil processes. In this study we have examined field trials of switchgrass (Panicum virgatumis) in which caffeic acid O-methyltransferase (COMT), an enzyme directly involved in the biosynthesis of lignin, has been down-regulated. Two transgenic strains were grown along with their parent (unaltered) plants as controls in 30 randomized plots at the East Tennessee Research and Education Center. We hypothesized that there will be differences in soil chemistry between plots grown with transgenic compared to non-transgenic switchgrass. Composite soil samples were collected from the 0-15cm and 15-30cm from each plot throughout the growing season. Soil pH, total elemental composition, respiration rates and organic matter content were determined. Preliminary results indicate that there is no significant differences difference in soil chemistry between transgenic and nontransgenic plots. Thus we conclude that over the short term, these genetic modifications in switchgrass do not have a measurable impact on the soil chemistry.

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Title: **Survey of pharmaceutical and personal care products in the effluent of waste water treatment plants in Tennessee**

ABSTRACT: Chemicals, such as pharmaceuticals, hormones, and other organic contaminants, can enter the environment through wastewater. In an effort to determine whether chemicals were entering streams in the United States, the U.S. Geological Survey amassed water samples from 139 streams located throughout thirty states. Of these 139 streams, eighty percent were shown to be contaminated. To address this issue locally, in 2012, the Tennessee Department of Environment and Conservation and the Center for Environmental Biotechnology started working collectively on a survey of Pharmaceuticals and Personal Care Products (PPCPs) in the effluents from wastewater treatment facilities in all 95 counties of Tennessee. Analysis of this nature had never been done before in Tennessee, and little was known about the concentration of contaminants in the effluents before release back into nature. Chemical analysis indicated that each of the water samples collected in Tennessee contained from three to ten of the tested for PPCPs. The PPCPs that were found in all samples were

expected, for example caffeine, ibuprofen, and DEET. Yeast assays for the detection of hormonally active compounds were conducted on the samples as well. These assays were effective in showing that chemicals were present in the samples, but since the water was toxic to the yeast, the chemical analysis was much more effective in presenting hormone values. This study shows that monitoring is needed in TN waterways and indicates that we should be concerned about the long term effects of exposure in humans.

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Title: **Genetic engineering of a yeast-based bioluminescent bioreporter to detect dioxins**

ABSTRACT: Due to increasing concerns about exposure of humans and wildlife to harmful chemicals in the environment, many assays have been developed for their rapid detection. One set of chemicals that is beginning to receive more attention are those that interact with the human aryl hydrocarbon receptor system. Chemicals like dioxins and polycyclic aromatic hydrocarbons (PAHs) are known to be extremely toxic to humans, ultimately as mutagens and carcinogens; therefore, determining if they are present in the environment is of great importance. A bioluminescent yeast bioreporter was created for the detection of chemicals that interact with the human aryl hydrocarbon receptor response system. A yeast strain (from the American Type Culture Collection, ATCC) that contains the human aryl hydrocarbon receptor protein on its genome (*Saccharomyces cerevisiae* YCM3) was genetically engineered to produce bioluminescence in the presence of dioxins and any other aryl hydrocarbon mimics. Using PCR amplification and ligation of the aryl hydrocarbon response elements (XREs) from humans in between two promoters (GPD and ADH1) on an existing plasmid in CEB, plasmid pUTK422 was made and transformed, along with the existing pUTK404 (which contains the genes to produce the substrate for the bioluminescent reaction) into the yeast, creating the aryl hydrocarbon-sensing bioluminescent *Saccharomyces cerevisiae* BLYAHR.

Archana Chauhan[1,2,] Abby Smart[2,4], Jun Wang[2,4], Sagar Utturkar[3], Ashley Frank[4], Bi Meng[4], Jiang Liu[4], Daniel Williams[2], Tingting Xu[1,2], Melanie Eldridge[2], Andres Arreaza[2], Alexandra Rogers[2], Hector C. Gonzalez[5], Mitra Mazarei[6], Holly L. Baxter[6], Jennifer M. DeBruyn[7], Neal Stewart[6], Steve D. Brown[3], Lauren J. Hauser[3], Alice C. Layton[2] and Gary S. Sayler[1,2,4]
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Title: **Metagenomic and metatranscriptomics analysis of COMT-knockdown switchgrass rhizosphere microbiome**

ABSTRACT: Switchgrass (*Panicum virgatum L.*) is a perennial warm season forage grass indigenous to North America. Currently, switchgrass is planted extensively for bioenergy production and has also been genetically engineered to reduce the expression of the caffeic acid 3-O-methyltransferase (COMT) gene in the lignin biosynthetic pathway. The increased use of transgenic switchgrass plants to get enhanced ethanol yields with reduced processing costs is a promising method, but its wide-scale planting may carry risk of invasiveness and extinction of wild relative populations. Although some research is being carried out addressing some of these issues, little to no information is available on the effect of using genetically modified switchgrass on the microbial community structures, despite the important role played by microbes in maintaining soil health and biogeochemical cycles. Microbes in a community interact with each other as well as with the host plant, so it is very important to capture as much as diversity as possible. To do so requires the use of global analyses tools such as metagenomics, metatranscriptomics and metaproteomics, which allow simultaneous assessment and comparison of the microbial populations across all domains of life. Metagenomics reveals the functional potential of a microbiome whereas metatranscriptomics and metaproteomics provide a snapshot of the community wide gene expression and protein abundance. In our study, we carried out metagenomics and metatranscriptomics to analyze the rhizosphere microbiome of genetically modified versus wild- type COMT-knockdown switchgrass.

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Title: **Metagenomic analyses of microbial communities in canadian high arctic active layers and permafrost following long term thawing**

ABSTRACT: The extent to which thawing Arctic permafrost will significantly contribute to global warming as preserved, labile organic carbon becomes accessible to microbial degradation is poorly constrained. In an effort to understand the effect of thawing permafrost on the changes of microbial composition and active metabolic pathways in a low carbon Arctic cryosols a parallel- "omics" approach of metagenomics and metaproteomics was undertaken. Long-term thawing experiments were carried out on twenty, well-characterized, 1 meter long, intact cores consisting of active-layers and permafrost, collected from an ice-wedge polygon located near the McGill Arctic Research Station on Axel Heiberg Island, Nunavut, Canada. Experimental treatments included cores thawed under saturated conditions, under natural hydrological conditions, in the dark, and unthawed control cores. Gas composition in the headspace (H_2, CH_4, CO, O_2, N_2 and CO_2, and $\partial13C$ of CO_2) and aqueous chemistry (including dissolved gases) in pore water at 4 different depths were analyzed weekly. CH_4 production steadily decreased from a rate of 98 ± 20 nmol CH_4 m-2 hr-1 to 11 ± 22 nmol CH_4 m-2 hr-1, and CO_2 gradually increased to 0.85 ± 0.45 mmol CO_2 m-2 hr-1 at the end of thaw. Sediment sub-samples along 4 depths were also collected at 0, 0.25, 6 and 12 months' time points for metagenomic analyses. Shotgun metagenome libraries for samples before and after thawing were sequenced using 454 and Illumina platforms yielding >300 Gb of raw data. Taxonomic and functional characterization of the metagenomic sequences indicated specific microbial community gradients between the upper active layers and the lower permafrost layer. Potential CH_4 cycling pathways primarily consisted of methane oxidizers in the upper layers with a paucity of methanogenic archaea in the lower layers. In particular, a descending gradient was observed in the abundance of Type II methanotrophs from active layers to the permafrost. Other differences in carbon cycling pathways with depth included aromatic ring oxidation and CO_2 fixation potential in the uppermost layer, and carbon reduction pathways in the permafrost layer. Nitrogen-cycling pathways also differed by depth with nitrogen fixation occurring in the upper layers and nitrification in the permafrost. Ongoing analysis is currently being performed to determine what changes in microbial community structure or function, if any, have occurred as a function of time. A contiguous sequence of 4.2 kb spanning pMMO operon matching an uncultured atmospheric CH_4-oxidizing bacterium was obtained by exploiting metagenome data from multiple libraries for the uppermost active layer. Screening of metaproteomic libraries with translated proteins from this operon indicated the presence of low levels of both particulate and soluble methane monooxygenase. Metaproteome profiling of the samples also revealed slight increases in the cellular activity of the microbial consortia upon thawing. The combined metagenomic sequences generated from the study are currently being co-assembled to generate a high quality database for overlaying the metaproteomic data in order to understand the relationships between competing cycling pathways.

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Title: **Development of microbial community structure based databases for fecal and soil source identification in rural watersheds**

ABSTRACT: In Tennessee, agricultural practices are responsible for 43% of all water quality impairments which are generally reflected as elevated levels of fecal contamination (E. coli) and sediments. The main contributors of fecal contaminants in rural east Tennessee watersheds are poultry and cattle and are of concern because they carry bacterial pathogens, such as E. coli, Streptococcus, and Salmonella. Sediments can be introduced into the watershed via pasture and crop soil runoff, construction sites and bank erosion. Different Best Management Practices (BMPs) are used to reduce sediments and fecal contamination, so in order to maximize efficiency and minimize cost, the identity of the contaminants must first be determined. It is hypothesized that microbial communities associated with animal waste, soils and sediment will differ from each other and thus they can be identified by their bacterial ribosomal gene fingerprints (microbiome). In order to test this hypothesis and generate a database of source microbiomes for testing of water samples, Illumina based amplicon sequence analysis was used to profile the microbial communities in poultry litter, cattle manure, soils and sediments. Following sequencing, MG-RAST and STAMP analysis tools were used for sample clustering, comparative statistics and identification of unique taxa. Based on this analysis, Eubacteriaceae (15-20%) and Porphroymonacea (8.4-8.6%) were uniquely found in cattle, Cornyebacteriaceae (24.5%) and Brevibacteraceae (19.4%) were uniquely found in poultry litter and Norcardioidaceae (6.9%) and Intrasporangiaceae(4.2%) were most abundant in soil from cattle paths. These results show that microbiomes can be used to differentiate fecal and soil sources and they may also provide sequences needed to develop more specific quantitative PCR assays for source identification.

Chunyi Chen and Terry C. Hazen

Department of Civil and Environmental Engineering, University of Tennessee Knoxville

Title: **The response of microbial community structure to clay flocculation of algae**

ABSTRACT: One promising non-chemical strategy involves the treatment of harmful algal blooms (HABs) with flocculant clays (Kaolinite, Montmorillnite and Bentonite) which are modified by chitosan. Modified clays scavenge particles, including algal cells, from water column and carry them to bottom sediments. Flocculation Jar tests were carried out using *Microcystis aeruginosa* as the target algae in laboratory. Samples collected from supernatant and bottom sediments were sequenced by Illumina Miseq at a 2-250bp read length. Taxonomic analysis by Qiime showed that microbial community structure significantly changed after clay flocculation and slightly shifted in different clay flocculation processes. Supernatant and sediments were both dominant by *Proteobacteria, Bacteroidetes, Verrucomicrobia, Planctomycetes* and A*cidobacteria* phyla, and the abundance of *Nitrospirae, Chlorobi* and *Gemmatimonadetes* increased in bottom sediments. The results of this study provide a comprehensive view of microbial community structural within clay flocculation based techniques for algal sedimentation.

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Title: **Evaluation of a eukaryotic aldehyde decarbonylase for yeast-based biohydrocarbon production**

ABSTRACT: Recently, significant effort has been put forth to evaluate bacterial aldehyde decarbonylase enzymes as platforms for producing alkane/alkene biofuels from prokaryotic sources. These efforts have demonstrated that the function of these decarbonylases is dependent on the presence of unidentified endogenous reductase components, making them problematic for expression in alternative organisms such as yeast. This presents a significant detriment to their future use as biofuel production components, as yeast present several distinct advantages over bacterial species for use as biofuel production platforms. They are phage-resistant, can me modified to digest a wide variety of feedstocks, and already have a significant infrastructure in place for large scale growth and processing. In this work we evaluate the use of a eukaryotic homolog of the commonly utilized bacterial aldehyde decarbonylases to determine if it can be expressed in a genetically modified yeast strain to produce similar alkane/alkene products.

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Title: **The impacts of land spreading liquid manure on surface and subsurface waters**

ABSTRACT: For many waterways fecal contamination is a major source of impairment, with consequences for humans and aquatic ecosystems. While there are a variety of sources that can lead to fecal contamination, such as leaking septic tanks, runoff from agricultural land uses can be a major contributing factor. One issue in addressing the problem is trying to identify the potential source. Traditionally, the use of *E.coli* as a fecal indicator lacks the ability to differentiate between animal sources. The inability to pinpoint the source of contamination complicates efforts to address these problems, thus host specific Bacteroides and viruses can be used to identify the host species that generated the contamination. In this study, surface and groundwater samples were analyzed from March to August of 2013 at an active agricultural field site where land spreading of liquid manure on tile drained soil took place on May 29th to 31st, 2013. In addition to quantifying *E.coli*, a suite of fecal indicators, including Bacteroides, viruses, and nitrates, were used to better gauge the fecal contamination due to land spreading of liquid manure. Since all liquid manure used at the research site was generated by dairy cows, it was possible to look for only bovine specific Bacteroides and viruses. After the manure application *E.coli* and Bacteroides concentrations increased in many areas in as little as 24 hours but reverted to background levels in less than three weeks. Additional analysis will quantify the geographic spread of the fecal contamination at the site.

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Title: **Recent progress in the development of short-rotation woody crops as feedstock for alternative fuels**

ABSTRACT: As the demand for bioenergy and advanced biofuels increases, feedstock will need to be generated from a portfolio of sources, such as agricultural crops, managed forests, and residue streams from other industries. Providing op-

timal performance for a variety of conversion platforms, these dedicated biomass production systems will also need to address other important considerations, including: 1) enhanced ecological and environmental benefits, 2) improved economic performance, 3) flexibility in meeting landowner objectives, and 4) minimization of supply chain uncertainty and risk. Short-rotation woody crops (SRWC) represent one such system, and have a key role to play as a broad range of energy crops becomes available. SRWC offers several attractive characteristics that include low ash content, high energy density, and year-round availability for harvest. There remains a need for continued research leading to further improvements in genetics, management practices, and performance properties to enhance the genetic diversity, range of adaptability and overall economics of these systems. In an ongoing collaboration between the U.S. Department of Energy's Bioenergy Technologies Office and the Sun Grant Initiative, production potential for currently available genetic material has been assessed for willow and hybrid poplar through coordinated field trials. The ultimate goal of the program is to utilize genetic diversity for the production of faster growing, disease resistant genotypes to increase biomass yield. Additionally, the woody crops team is improving management systems, developing recommendations for region-specific variety selections, and improving economic and environmental models.

Focused on willow and hybrid poplar as model systems, the program established over 30 new field trials with advanced genetic material. Because of the time required for accurate yield assessment, more than 50 legacy trials have also been included in the program. This approach has provided new information on regional yield potential, while identifying elite genetic material for maximum performance in different regions across the country. This poster highlights progress in woody crops research and development, and discusses the implications of this feedstock production technology for the emerging advanced biofuels industry.

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Title: **Hydrocarbon degrading bacteria isolation and microbial response to oil in the warm oligotrophic deep eastern Mediterranean**

ABSTRACT: The oil spill happened in Gulf of Mexico in 2010 drives huge attention on the issue of oil contamination and microbial cleaning up in deep ocean. An extensive effort is taken to understand the co- relationship among geochemical characteristics, microbial community structure and oil degradation in many different deep basins. Eastern Mediterranean sea is considered as an oil-rich area with a big potential for oil production. It is deeper than Gulf of Mexico and considered as one of the most oligotrophic regions on Earth, in which the primary productivity is phosphorus limited. What's more, the bottom temperature and salinity level in this region are much higher than Gulf of Mexico and other deep basins. The average bottom temperature in the ocean is 4, but it is around 12 to 14 in Eastern Mediterranean Sea.

Very limited research is done on the oil degradation capacity and the response from microbial community to oil contamination in this area. With the increase of oil drilling platform number and spill, it becomes much more necessary to study the oil degradation potential and the response of natural microbial community to oil for a better locally applying bioremediation strategy. The on-ship perturbation was to test oil and dispersant influence to microbial community in short time period. The in-lab enrichment with mirorespirometer was study the effect in longer time period. oil, COREXIT 9500 and phosphate contributed to respiration. The natural microbial community from different sites can be grouped by depths. The community responded to the oil in less than 72 hours and there were big changes on the community structure especially on the number of Oceanspirillales.

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Title: **Use of nitrogen and oxygen isotope tracers to identify nitrate sources in the Yellow River, China**

ABSTRACT: Annual fixed nitrogen (N) production by humans is currently more than double the natural fixation rate, and its release into the environment is associated with a range of negative impacts, such as eutrophication and hypoxia and overall degradation of ecosystem service, as well as threatening drinking water supplies. The Yellow River, the second longest river in China, has suffered from a serious N pollution since the 1980s, and nitrate (NO_3^-) is one of the dominant N forms in the Yellow River. However, it is still unclear which NO_3^- sources are controlling the Yellow River's NO_3^- budget. In this study, triple nitrate isotopes ($\delta^{15}NNO_3$, $\delta^{18}ONO_3$ and $\Delta^{17}ONO_3$) were used for the first time to assess the sources

and sinks of NO3⁻ in the Yellow River. Results showed that the Δ17ONO3 of the surface water from the Yellow River basin ranged from 0‰ to 1.6‰ during two normal-water seasons. This suggested that unprocessed atmospheric NO3⁻ accounted for 0-7% of the total NO3⁻ of the Yellow River basin, and the sites with detectable atmospheric NO3⁻ mainly distributed within the high-rainfall zones in the middle and lower reaches of the Yellow River. The corrected δ15NNO3 and δ18ONO3 values with atmospheric imprints being removed indicated that the main terrestrial sources of NO3⁻ were urban/manure sewage and ammonium/urea-containing fertilizer, which made comparable contributions to the nitrate inventory in the middle and lower reaches. In addition, there was a significant positive relationship between δ15NNO3 and δ18ONO3 values of river water ($p < 0.01$) which may signal the presence of denitrification. This study has demonstrated the significant potential of the triple nitrate isotope method for assessing the nitrate sources and sinks in large rivers.

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Title: **Computational modeling of interactions between human estrogen receptor mutants and hormonally active compounds**

ABSTRACT: Human estrogen receptor alpha (hERα) is a key protein receptor responsible for sensing sex hormone estrogens and regulating downstream gene expressions through its transcriptional activity activated by the binding of natural hormones. Estrogen receptor involved pathways are critical for maintaining normal cellular and physiological function; malfunctioned estrogen receptor pathways are found to be the main contributor to breast cancer as well as other diseases including osteoporosis, abnormal development etc. Previous studies have demonstrated that hER can interact with and activated by many synthetic and naturally occurring chemicals aside from natural hormones, which are often referred as endocrine disruptive chemicals (EDCs). While most studies were focusing on the activity of EDCs with wild type hER, whether mutations occurring on hERα would cause varied binding of EDCs and altered transcriptional activity remains unknown. In this study, we used computational biology method to help predict potential change of binding affinity that could be caused by mutations on hER. Specifically, 3D models of hERα binding domain were mutated at 6 sites in silico. 20ns molecular dynamics (MD) simulation were performed for each mutant model on KRAKEN supercomputer at University of Tennessee. MD simulation trajectories were clustered based on the spatial coordinates of amino acid residues of the protein model. 10 representative snapshots sampled from clustering of MD trajectories were used in ligand-protein docking simulation to obtain binding affinity of candidate EDCs. In the future, mutations that suggest altered binding affinity in silico will be verified by wet-lab bioassay using genetically engineered bioluminescent yeast containing human estrogen receptor.

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Title: **Tillage, nitrogen, and cover crop effects on N-cycling bacteria under cotton production in West Tennessee**

ABSTRACT: Nitrogen (N) is the major limiting nutrient in many cropping systems worldwide. In many farming systems and especially in low input, subsistence systems, biological nitrogen fixation serves as the main N source. This study investigates the effect of different agronomic practices including tillage (no-till and tilled), cover crops, and N fertilization on the population sizes of N cycling bacteria (free living diazotrophs and ammonia oxidizing bacteria) at Jackson, Tennessee. The experiment is a split split-plot factorial with nitrogen as a whole plot, cover cropping as split plot and tillage as the split-split plot. Real time quantitative polymerase chain reaction (qPCR) will be used to determine the population sizes of these bacterial groups using their functional genes (nifH for diazotrophs and amoA for ammonia oxidizing bacteria) as a target for qPCR primers. Coupled to this objective will be the assessment of net nitrification rates determined through undisturbed soil cores and ion exchange resins to correlate it with the population dynamics of ammonia oxidizing bacteria. There will be four sampling times over the growing season: at planting, flowering, bolling and after harvest. Results from this study will serve as a basis for identifying which management practices promote the diversity and abundance of these beneficial and functional groups of bacteria as they play a vital role in the nutrients (nitrogen) cycling and availability.

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Title: **Factors contributing to chlorine decay and microbial presence in drinking water following stagnation in premise plumbing**

ABSTRACT: Premise plumbing is the part of the drinking water distribution system closest to the point of end use. Since premise plumbing is characterized with long residence time, elevated temperature, and reduced levels of disinfectant residue, drinking water in premise plumbing typically experiences elevated levels of microbial presence as compared to fin-

ished water exiting water treatment utilities, particularly under stagnation condition frequently encountered in premise plumbing. Thus, stagnant drinking water in premise plumbing may represent an important source of public health risk. Therefore, the objective of this study is to identify factors contributing to the deterioration of microbiological quality of stagnant drinking water in premise plumbing. Results from this study indicate that the service age of premise plumbing system is positively correlated to the concentration of microorganisms in stagnant drinking water. Another factor contributing to microbial contamination is the usage pattern, with systems experiencing lower levels of water consumption exhibiting greater microbial contamination than those having greater water usage patter, potential due to the prolonged periods of stagnation and subsequent greater disinfectant decay in systems with less water consumption. Since disinfectant residue is an important determinant of microbial contamination, the loss of free chlorine as the most common disinfectant residue was further examined. My results demonstrate that pipe material has significant impact on the decay rate of free chlorine, with copper pipe showing the greatest chlorine decay rate while PVC pipe showing the slowest. The deposits onto the pipe wall are able to reduce the rate of chlorine decay, likely forming a barrier between the pipe material and water which slows down the reaction between pipe wall and disinfectant. Moreover, pipe diameter and temperature has effects on chlorine decay, bigger diameter leads to the larger surface-to-volume ratio and then reduce chlorine decay rate, while elevated temperature could accelerate chlorine losing. These results provide important insights to the mechanisms of chlorine decay in premise plumbing and factors contribute to the deterioration of microbiological quality of drinking water in premise plumbing, which could facilitate the development of effective strategies for controlling water quality in premise plumbing and reducing public health risks from waterborne infectious diseases.

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Title: **Characterization and application of chemically weathered biochars produced by fast pyrolysis**

ABSTRACT: Adsorption of copper ion Cu(II) was investigated on switchgrass-derived biochars produced by fast pyrolysis at 450, 600 and 800 oC and the biochars treated with water and a pH3 solution to simulate weathering conditions. Acidified biochars had higher porosity and surface functionality, but lower cation exchange capacity than raw and water-treated biochars. Cu(II) adsorption kinetic study at pH 5.0 solution of raw biochar was followed the second-order model. Cu(II) adsorption capacity of biochars decreased with increasing pyrolysis temperature. Water-treated biochar produced at 450 oC had the highest adsorption capacity; whereas acidified biochar produced at 800 oC had the lowest adsorption capacity. Adsorption isotherm data of most biochars were fitted better to the Langmuir model than the Freundlich model. However, the adsorption isotherm data of the acidified biochars produced at 600 and 800 oC were better fitted to the Freundlich model. Cations (K+, Ca2+, Mg2+) release % in the process of Cu(II) adsorption isotherms was the highest in water-treated biochars, but the lowest in acidified biochar.

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Title: **Dominance of Methanosaeta populations at high acetate concentrations during unstable anaerobic digestion**

ABSTRACT: Anaerobic digestion is an ideal biological waste treatment process capable of simultaneous pollution mitigation and renewable energy recovery. Despite the apparent advantages of anaerobic digestion as compared to aerobic processes, the broader adoption of anaerobic digestion technology for waste treatment has been hindered by concerns of potential process instability resulting from the susceptibility of methanogenic microbial populations to changes in process conditions, such as fluctuations in the concentration of acetate, which is a key substrate for methanogenesis. Therefore, to enhance the process stability of anaerobic digestion, the objective of this study was to identify methanogenic populations that can potentially thrive at fluctuating concentrations of acetate.

Triplicate continuous anaerobic digesters fed with animal waste were established at 35°C. All digesters exhibited stable operation with consistent pH, methane yield, and acetate level prior to step-wise increases in substrate loading rate that eventually resulted in process disruption. 16S rRNA gene clone library and quantitative real time PCR assays were used to monitor the dynamics of various methanogenic populations in response to changes in process conditions. Chemical analyses indicate that acetate concentration remained constantly below 0.5 mM before spiking to ~40 mM as a result of substrate overloading. As expected, *Methanosaeta*-related populations, known to be competitive for acetate at low concentrations, were indeed the dominant methanogens at low acetate concentrations. However, *Methanosaeta* populations remained dominant even at higher acetate levels, outcompeting *Methanosarcina*-related methanogens known to be more competitive than *Methanosaeta* at high acetate conditions. Furthermore, analysis of enrichments developed with 20 mM acetate consistently resulted in *Methanosaeta* as the overwhelming majority.

Thus, the *Methanosaeta* populations dominating the methanogen community in this study appear to be more ecologically important than *Methanosarcina* throughout the acetate concentration range relevant to anaerobic digestion. Ongoing effort

is focused on the characterization of physiological features that may contribute to the surprising competitiveness of these *Methanosaeta* populations.

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Title: **Engineering autobioluminescent reporter cells for biomedical and environmental surveillance**

ABSTRACT: The use of bioluminescent and fluorescent imaging as an optical technique has increased steadily in recent years due to the continuous advancement of imaging hardware such as the IVIS series of imaging systems offered by PerkinElmer. Concurrent with these advances has been the introduction of new fluorescent imaging markers that significantly improve detection ability in living systems. However, despite these advances, relatively few new bioluminescent systems have been introduced, and none that have been capable of functioning without the exogenous application of a chemical substrate. To overcome this deficiency, we have pioneered an alternative approach that allows for the autonomous production of bioluminescent signal from human cells through expression of the bacterial luciferase (lux) gene cassette. The resulting autobioluminescent phenotype can be genetically programmed to continuously produce light, to trigger light production in response to cellular signals, or to inhibit light production in response to changes in cellular health. This expression system can either complement existing fluorescent and bioluminescent systems or, when used independently, can provide a simplified, more economical, and more informative approach for the acquisition of bioluminescent data, while utilizing existing detection hardware and protocols.

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Title: **Bacterial luciferase-based autobioluminescent human cell lines for detection of endocrine disrupting and oxidative stress-inducing compounds**

ABSTRACT: Substantial public health concerns exist over the potential endocrine disrupting capabilities of a wide variety of untested or under-tested natural and industrial chemicals. It is clear that the development of accurate, high-throughput, and inexpensive testing regimens will be key to mitigating public concern. Here we report on the development of a novel screening assay for estrogenic activity that utilizes an autonomously bioluminescent human cell line to provide direct bioavailability data. To construct this cell line, estrogen-responsive human breast carcinoma cells (T-47D) were genetically engineered to express the full bacterial bioluminescence gene cassette (luxCDABEfrp), generating an autonomously bioluminescent cell line (T-47D/Lux) capable of maintaining bioluminescent output independent of substrate addition. Bioluminescence emitted from T-47D/Lux cells was correlated tightly ($R2 > 0.99$) to the number of cells present in a population, permitting the use of light production dynamics as an indicator of cell proliferation. Additionally, the substrate-free nature of the lux system allowed for continuous, near real-time monitoring of the same cell population throughout exposure to the tested compounds. A significant change in bioluminescent production ($p < 0.05$) compared with unexposed control was observed 3 days after exposure to concentrations of 17β-estradiol (E2) as low as 1 pM. The EC50 for E2 in this assay was determined to be approximately 10 pM. These results are similar to those obtained using a traditional cell proliferation assay, but offer the advantage that data acquisition can be performed in a fully automated fashion since the need for sample destruction or substrate addition is removed, making it an ideal candidate for high-throughput analysis. We have also demonstrated bioluminescent emission in the human liver carcinoma HepG2 cell line, which is an ideal candidate for the detection of xenobiotics inducing oxidative stress due to its endogenous expression of the Nrf2 transcriptional factor. Ongoing efforts therefore include the coupling of Nrf2 transcriptional activation and bioluminescent expression to develop a target-specific bioluminescent HepG2 reporter cell line for high-throughput screening of oxidative stress-inducing compounds.

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Title: **Bioleaching of heavy metals from contaminated sediments by the Aspergillus niger strain SY1**

ABSTRACT: Bioleaching is a promising approach for the removal of heavy metals from low grade mine tailings, residues and soils. Using both one-step and two-step processes, both the bioleaching rate and overall change in heavy metals due bioleaching were measured to determine the overall bioleaching efficiency and change in toxicity of the sediment

after treatment. It was determined that the highest metal extraction efficiencies of Cd, Pb, Cu and Zn were 99.5%, 65.4 %, 71.9% and 76.4% in the two-step bioleaching process, which is more efficient than the one-step process. And that after said bioleaching, metals remaining in the sediment were mainly found in the stable fractions, and the toxicity of it has been reduced to a safe enough level for it to be used safely in landfill or used in land application. Aspergillus niger strain SY1 was a cost, environmental friend and efficient bioleacher of heavy metals.

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The University of Tennessee

Title: **Feature detection of peak data: Applications of deep machine learning and data mining**

ABSTRACT: There exists an overlapping need to mine large-scale multivariate data for unique patterns in both biological data and social network data. Both these data types can be represented as 'peaks' on a 2D line graph. This simple representation is the natural way of dealing with chromatography and mass spectrometry data, which typically produces complex peak patterns. Basic analysis techniques for these areas have been well-developed, but we seek to expand to more rigorous analyses using techniques from machine learning to determine which features of the data are most significant in a biological or social context. We have three distinct datasets that will be analyzed with basic and then more complex methods. The first two datasets are rooted in biology, with gas chromatography-mass spectrometry (GC-MS) data obtained for discovering new antimicrobials and Fourier transform infra-red (FTIR) and spectrofluorometry data for applications in renewable biofuels and global carbon cycling. The third dataset represents a social network, from which a unique "social fingerprint" of an individual could be derived. Despite the differences in the applications of these datasets, they all have similar 'peak' structures and require the same types of analyses, culminating in the extraction of significant features. Our interdisciplinary group seeks to mine three sets of peak data to identify significant portions of their feature space.

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